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2017 ACCESSORIES AND EQUIPMENT

Bolted Exterior Body Panels and Closures - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Front Compartment Front Sight Shield Bolt	2.5 N.m (22 lb in)
Front Fender Bolt	9 N.m (80 lb in)
Front Side Door Check Link Bolt	22 N.m (16 lb ft)
Front Side Door Check Link Nut	9 N.m (80 lb in)
Front Side Door Hinge Bolt - Body Side	32 N.m (24 lb ft)
Front Side Door Lower Hinge Bolt	25 N.m (18 lb ft)
Front Side Door Upper Hinge Bolt	25 N.m (18 lb ft)
Headlamp Screw	2.5 N.m (22 lb in)
Hood Hinge Bolt	22 N.m (16 lb ft)
Hood Hinge Bracket Bolt	9 N.m (80 lb in)
Hood Hinge Nut	22 N.m (16 lb ft)
Hood Primary and Secondary Latch Bolt	9 N.m (80 lb in)
Hood Primary Latch Release Cable Handle Screw	2 N.m (18 lb in)
Liftgate Hinge Bolt	22 N.m (16 lb ft)
Liftgate Hinge Nut	43 N.m (32 lb ft)
Rear Side Door Check Link Bolt	22 N.m (16 lb ft)
Rear Side Door Check Link Nut	9 N.m (80 lb in)
Rear Side Door Hinge Bolt - Body Side	32 N.m (24 lb ft)
Rear Side Door Lower Hinge Bolt	25 N.m (18 lb ft)
Rear Side Door Upper Hinge Bolt	25 N.m (18 lb ft)

SCHEMATIC WIRING DIAGRAMS

HOOD LATCH WIRING SCHEMATICS

Hood Ajar Switch

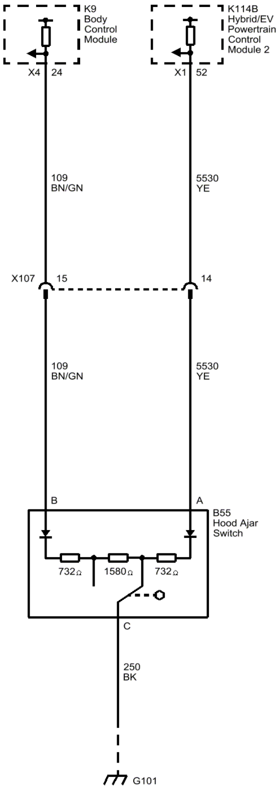

K9
Body
Control
Module
X4
24
K114B
Hybrid/EV
Powertrain
Control
Module 2
X1
52
109
BN/GN
5530
YE
X107
15
14
109
BN/GN
5530
YE
B
A
B55
Hood Ajar
Switch
732Ω
1580Ω
732Ω
C
250
BK
G101

Fig. 1: Hood Ajar Switch
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B3006: HOOD AJAR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3006 01

Hood Ajar Circuit Short to Battery

DTC B3006 02

Hood Ajar Circuit Short to Ground

DTC B3006 04

Hood Ajar Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3006 02	B3006 04	B3006 01	-
Ground	-	B3006 04	-	-

Circuit/System Description

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

Conditions for Running the DTC

The BCM continuously monitors for this DTC

Conditions for Setting the DTC

B3006 01

The BCM detects that the hood ajar switch signal circuit is shorted to battery.

B3006 02

The BCM detects that the hood ajar switch signal circuit is shorted to ground.

B3006 04

The BCM detects that the hood ajar switch signal circuit is open.

Action Taken When the DTC Sets

- The hood ajar switch input will be ignored as a content theft deterrent trigger.
- Remote vehicle start will be disabled.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Hood Ajar Switch parameter is Open when the hood is open and Closed when the hood is closed.
   - **If the parameter does not change**

  Refer to Circuit/System Testing.

- **If the parameter changes**

3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
        1. Ignition OFF
        2. Test for less than 2 Ω in the ground circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 11.5 V between the signal circuit terminal 1 and ground.
    - **If 11.5 V or less**
        1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
        2. Test for infinite resistance between the signal circuit and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If Infinite resistance.
        3. Test for less than 2 Ω in the signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K9 Body Control Module.
    - **If greater than 11.5 V**
5. Ignition OFF, disconnect the X4 and X7 harness connector at the K9 Body Control Module. Ignition ON.
6. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738 - 3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the CLOSED position.
    - **If not between 2738 - 3350 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 2738 - 3350 Ω**
3. Test for 658 - 806 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the CLOSED position.
    - **If not between 658 - 806 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 658 - 806 Ω**
4. Test for 2080 - 2545 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the CLOSED position.

- **If not between 2080 - 2545 Ω**

  Replace the B55 Hood Ajar Switch.

- **If between 2080 - 2545 Ω**

5. Test for 2738 - 3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the OPEN position.
   - **If not between 2738 - 3350 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 2738 - 3350 Ω**
6. Test for 2080 - 2545 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the OPEN position.
   - **If not between 2080 - 2545 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 2080 - 2545 Ω**
7. Test for 658 - 806 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the OPEN position.
   - **If not between 658 - 806 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 658 - 806 Ω**
8. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Hood Primary and Secondary Latch Replacement
- Control Module References for Body Control Module replacement, programming, and setup

DTC P257D-P257F: ENGINE HOOD SWITCH

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P257D

Engine Hood Switch Performance

DTC P257E

Engine Hood Switch Circuit Low Voltage

DTC P257F

Engine Hood Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hood Ajar Switch Signal 1	B3006 02	B3006 04	B3006 01	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hood Ajar Switch Signal 2	P257E	P257F	P257F	P257D
Ground	-	B3006 04, P257F	-	-

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 applies B+ to the hood ajar signal 2 circuit and monitors the voltage to determine the position of the hood. The hood ajar switch contains a multiplexed resistor. This resistor will vary the voltage seen by the Hybrid/EV Powertrain Control Module 2 by pulling down the applied voltage based on the position of the switch.

Conditions for Running the DTC

Propulsion system is active.

Conditions for Setting the DTC

P257D

The hood ajar switch signal voltage as measured by the Hybrid/EV Powertrain Control Module 2 is not within a valid voltage range.

P257E

The Hybrid/EV Powertrain Control Module 2 detects a short to ground in the hood ajar switch signal.

P257F

The Hybrid/EV Powertrain Control Module 2 detects a short to voltage or an open/high resistance in the hood ajar switch signal.

Action Taken When the DTC Sets

The engine will start and run whenever the vehicle is in Service Mode or the vehicle speed is less than 5 kph (3 mph).

Conditions for Clearing the DTC

DTCs P257D, P257E, and P257F are Type B DTCs.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hood Ajar Indicator Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Powertrain Control Module 2 Hood Position parameter is Open when the hood is OPEN and Closed when the hood is CLOSED..
    - **If the parameter does not change**

      Refer to Circuit/System Testing.

    - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to two minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify DTC P257F is set as current
    - **If DTC P257F is not set as current**
    1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the signal circuit terminal A and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If DTC P257F is set as current**
5. Install a 5 A fused jumper wire between the signal circuit terminal A and ground. Vehicle in Service Mode.
6. Verify DTC P257E is set as current.
    - **If DTC P257E is not set as current**
    1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If DTC P257E is set as current**
7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738 - 3350 Ω between the signal terminal A and the signal terminal B with the hood latch in the CLOSED position.

  - **If not between 2738 - 3350 Ω**

    Replace the B55 Hood Ajar Switch.

  - **If between 2738 - 3350 Ω**

3. Test for 658 - 806 Ω between the signal terminal A and the ground terminal C with the hood latch in the CLOSED position.
   - **If not between 658 - 806 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 658 - 806 Ω**

4. Test for 2080 - 2545 Ω between the signal terminal B and the ground terminal C with the hood latch in the CLOSED position.
   - **If not between 2080 - 2545 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 2080 - 2545 Ω**

5. Test for 2738 - 3350 Ω between the signal terminal A and the signal terminal B with the hood latch in the OPEN position.
   - **If not between 2738 - 3350 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 2738 - 3350 Ω**

6. Test for 2080 - 2545 Ω between the signal terminal A and the ground terminal C with the hood latch in the OPEN position.
   - **If not between 2080 - 2545 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 2080 - 2545 Ω**

7. Test for 658 - 806 Ω between the signal terminal B and the ground terminal C with the hood latch in the OPEN position.
   - **If not between 658 - 806 Ω**

     Replace the B55 Hood Ajar Switch.

   - **If between 658 - 806 Ω**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Hood Primary and Secondary Latch Replacement**
- **Control Module References** for Hybrid/EV Powertrain Control Module 2 replacement, programming, and setup

SYMPTOMS - BOLTED EXTERIOR BODY PANELS AND CLOSURES

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data links.

2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Hood Ajar Indicator Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Hood Ajar Indicator/Message Malfunction** in order to diagnose the symptom.

HOOD AJAR INDICATOR/MESSAGE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3006 01

Hood Ajar Circuit Short to Battery

DTC B3006 02

Hood Ajar Circuit Short to Ground

DTC B3006 04

Hood Ajar Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B3006 02	B3006 04	B3006 01	-
Ground	-	B3006 04	-	-

Circuit/System Description

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

Conditions for Running the DTC

The BCM continuously monitors for this DTC

Conditions for Setting the DTC

B3006 01

The BCM detects that the hood ajar switch signal circuit is shorted to battery.

B3006 02

The BCM detects that the hood ajar switch signal circuit is shorted to ground.

B3006 04

The BCM detects that the hood ajar switch signal circuit is open.

Action Taken When the DTC Sets

- The hood ajar switch input will be ignored as a content theft deterrent trigger.
- Remote vehicle start will be disabled.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Hood Ajar Switch parameter is Open when the hood is open and Closed when the hood is closed.
    - **If the parameter does not change**

      Refer to Circuit/System Testing.

    - **If the parameter changes**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B55 Hood Ajar Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF

    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 11.5 V between the signal circuit terminal 1 and ground.
    - **If 11.5 V or less**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If Infinite resistance.
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If greater than 11.5 V**
5. Ignition OFF, disconnect the X4 and X7 harness connector at the K9 Body Control Module. Ignition ON.
6. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
7. Test or replace the B55 Hood Ajar Switch.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B55 Hood Ajar Switch.
2. Test for 2738 - 3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the CLOSED position.
    - **If not between 2738 - 3350 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 2738 - 3350 Ω**
3. Test for 658 - 806 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the CLOSED position.
    - **If not between 658 - 806 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 658 - 806 Ω**
4. Test for 2080 - 2545 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the CLOSED position.
    - **If not between 2080 - 2545 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 2080 - 2545 Ω**
5. Test for 2738 - 3350 Ω between the signal terminal 1 and the signal terminal 2 with the hood latch in the OPEN position.
    - **If not between 2738 - 3350 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 2738 - 3350 Ω**

6. Test for 2080 - 2545 Ω between the signal terminal 2 and the ground terminal 3 with the hood latch in the OPEN position.
    - **If not between 2080 - 2545 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 2080 - 2545 Ω**
7. Test for 658 - 806 Ω between the signal terminal 1 and the ground terminal 3 with the hood latch in the OPEN position.
    - **If not between 658 - 806 Ω**

      Replace the B55 Hood Ajar Switch.

    - **If between 658 - 806 Ω**
8. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Hood Primary and Secondary Latch Replacement
- Control Module References for Body Control Module replacement, programming, and setup

REPAIR INSTRUCTIONS

HOOD PRIMARY LATCH RELEASE CABLE REPLACEMENT

Removal Procedure

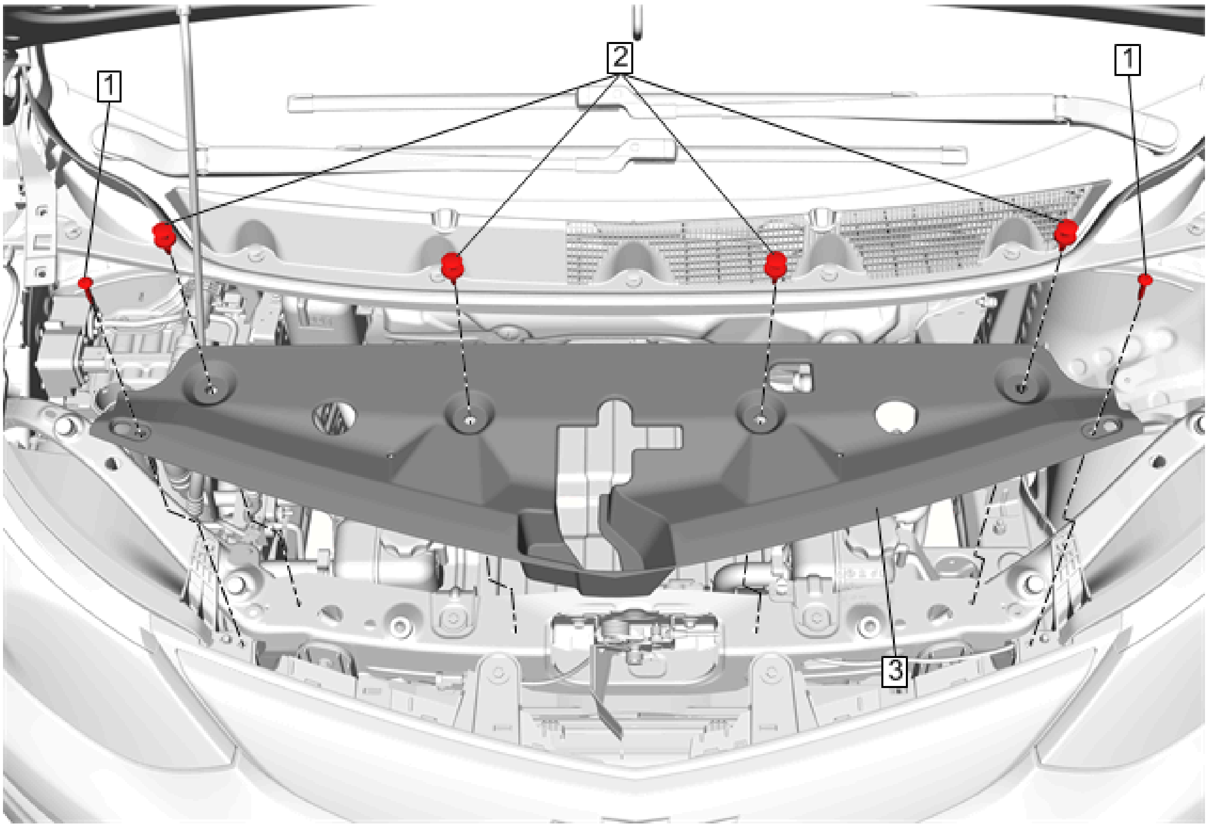


Fig. 2: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

1. Front Compartment Front Sight Shield - Remove - Front Compartment Front Sight Shield Replacement.

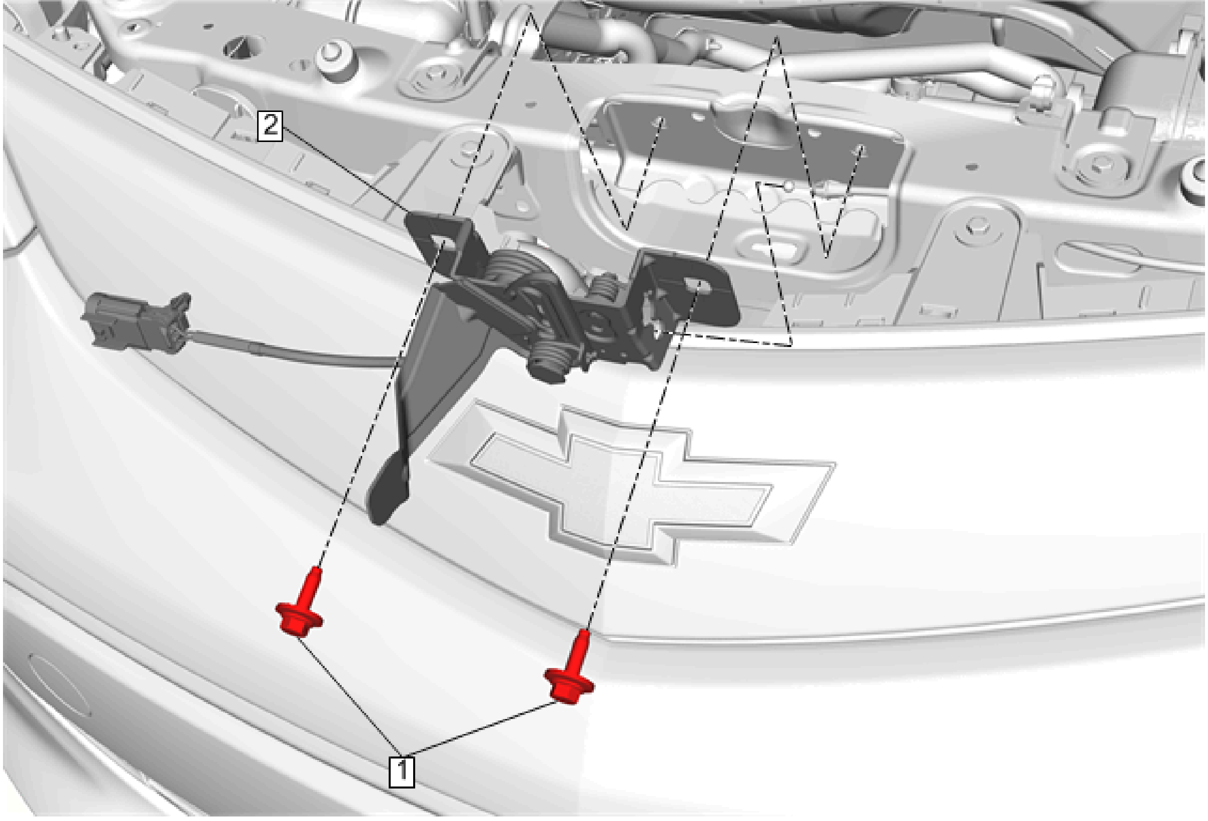


Fig. 3: Hood Primary and Secondary Latch
Courtesy of GENERAL MOTORS COMPANY

2. Hood Primary and Secondary Latch - Remove - **Hood Primary and Secondary Latch Replacement**

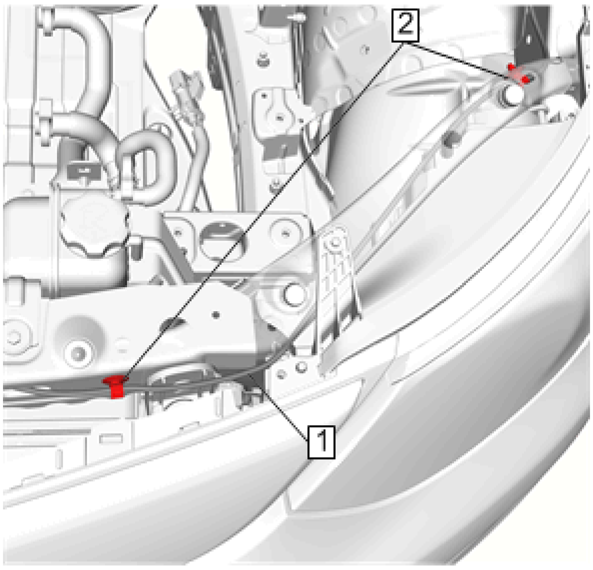


Fig. 4: Hood Primary Latch Release Cable
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the hood primary latch release cable (1) from the hood release cable retainers (2).

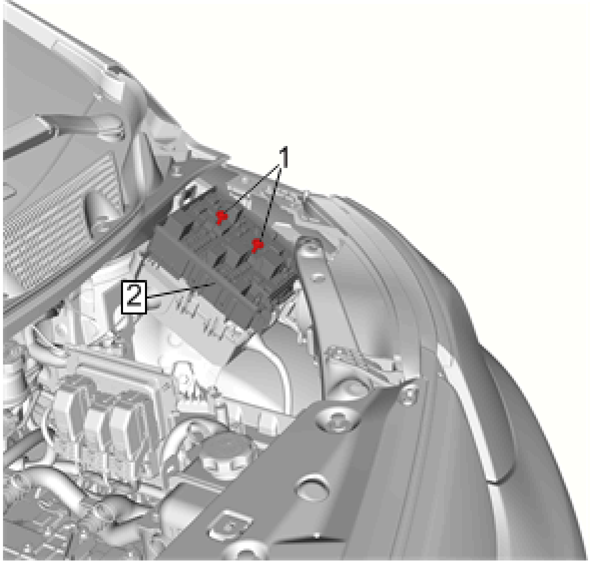


Fig. 5: Engine Wiring Harness Junction Block
Courtesy of GENERAL MOTORS COMPANY

4. Engine Wiring Harness Junction Block - Remove - **Engine Wiring Harness Junction Block Replacement**

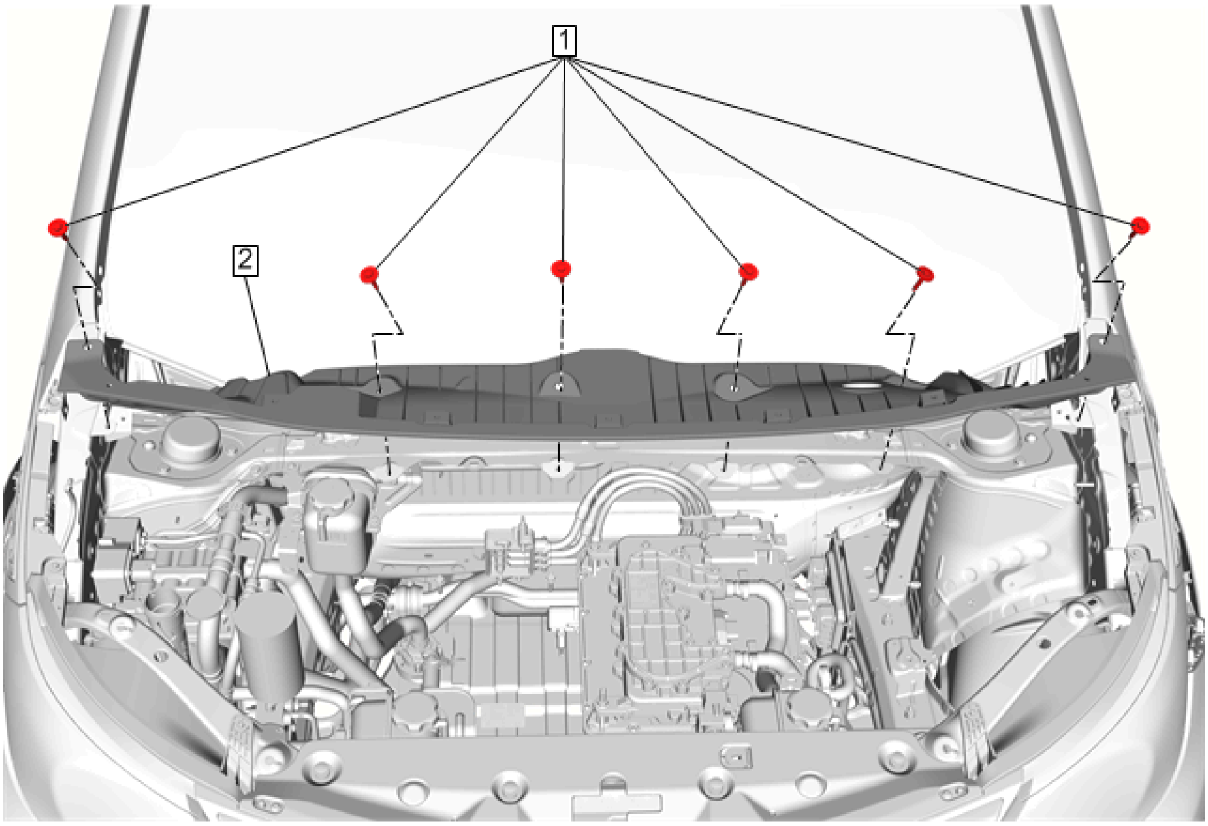


Fig. 6: Dash Panel Upper Extension Panel Extension
Courtesy of GENERAL MOTORS COMPANY

5. Dash Panel Upper Extension Panel Extension - Remove - **Dash Panel Upper Extension Panel Extension Replacement**

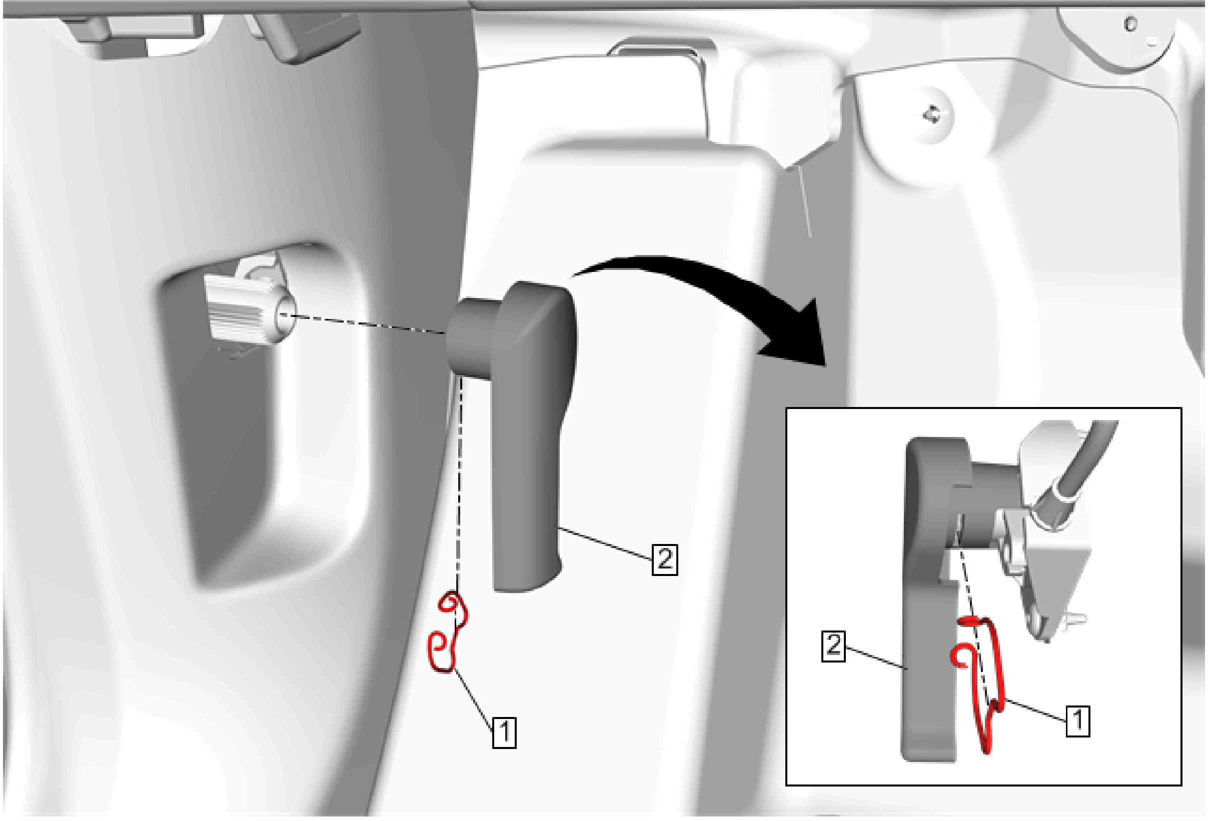


Fig. 7: Hood Primary Latch Release Cable Handle
Courtesy of GENERAL MOTORS COMPANY

6. Hood Primary Latch Release Cable Handle - Remove - **Hood Primary Latch Release Cable Handle Replacement**

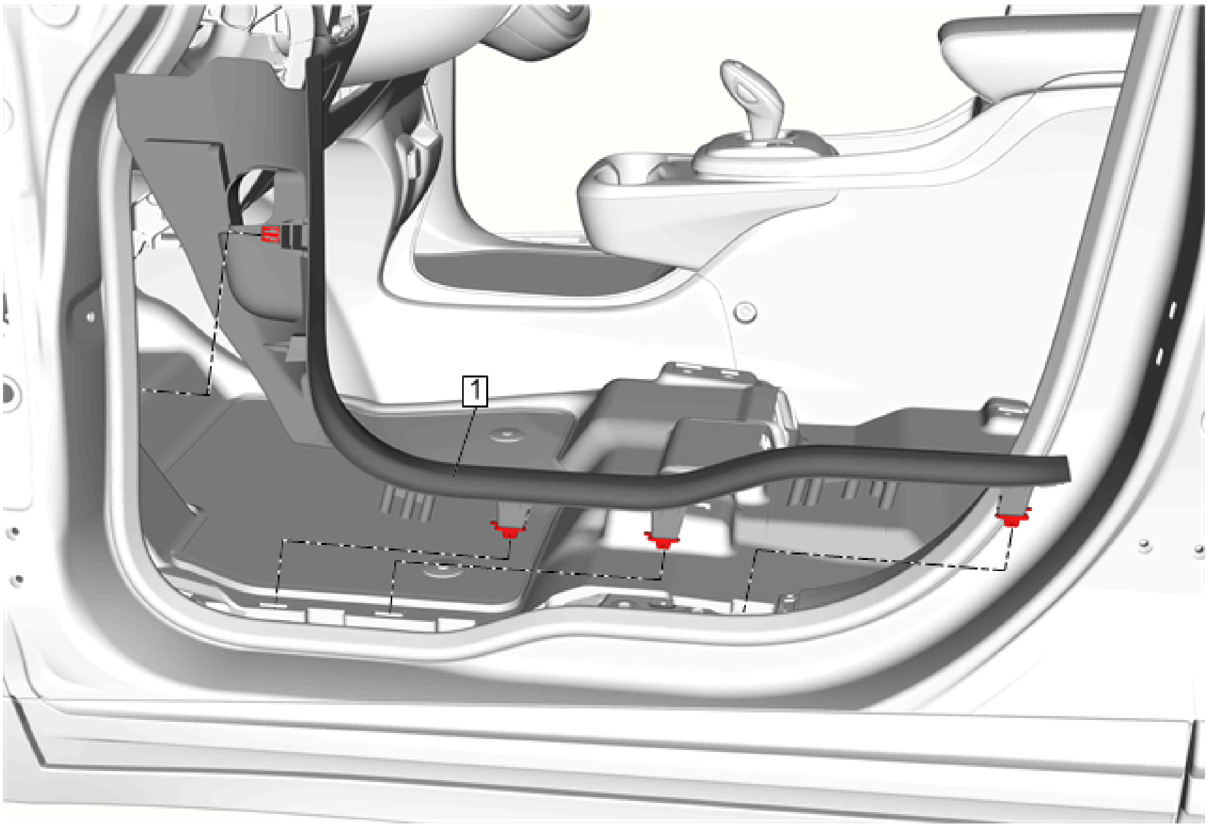
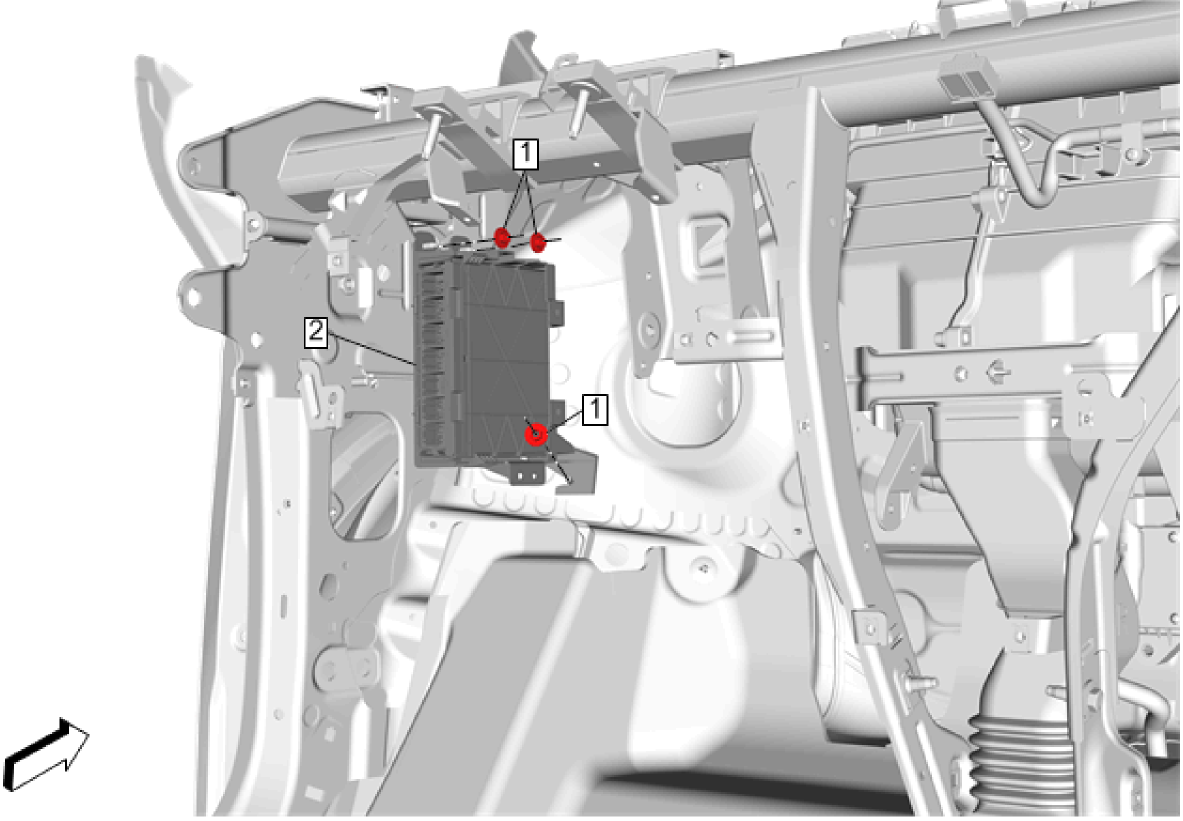


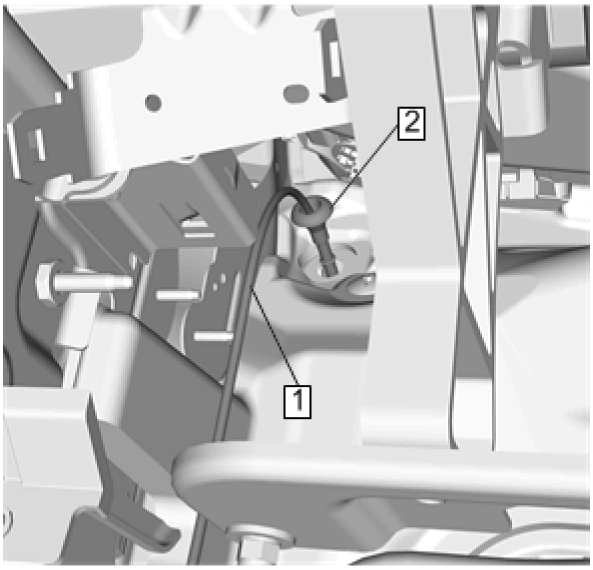
Fig. 8: Front Side Door Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

7. Front Side Door Sill Garnish Molding - Remove - **Front Side Door Sill Garnish Molding Replacement**



[Fig. 9: Body Control Module Bracket](#)
Courtesy of GENERAL MOTORS COMPANY

8. Body Control Module Bracket - Remove - [Body Control Module Bracket Replacement](#)



[Fig. 10: Hood Primary Latch Release Cable Grommet](#)
Courtesy of GENERAL MOTORS COMPANY

9. Remove hood primary latch release cable grommet (2) from the dash panel.

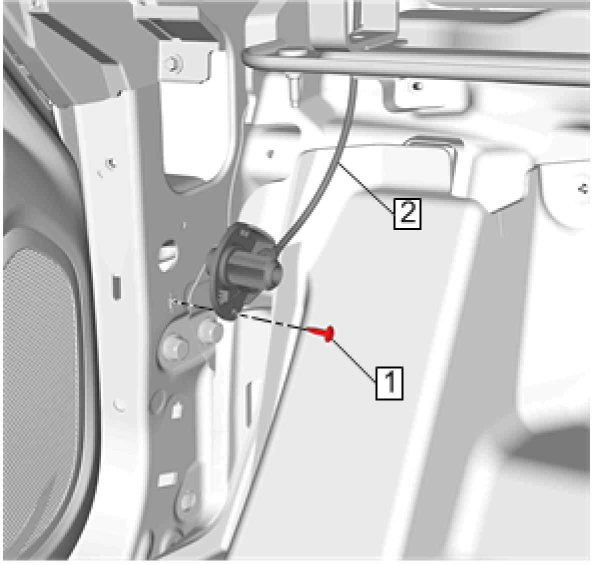


Fig. 11: Hood Primary Latch Release Cable Handle Screw
Courtesy of GENERAL MOTORS COMPANY

10. Remove the hood primary latch release cable handle screw (1) and remove the hood primary latch release cable (2) from the hinge pillar inner panel

Installation Procedure

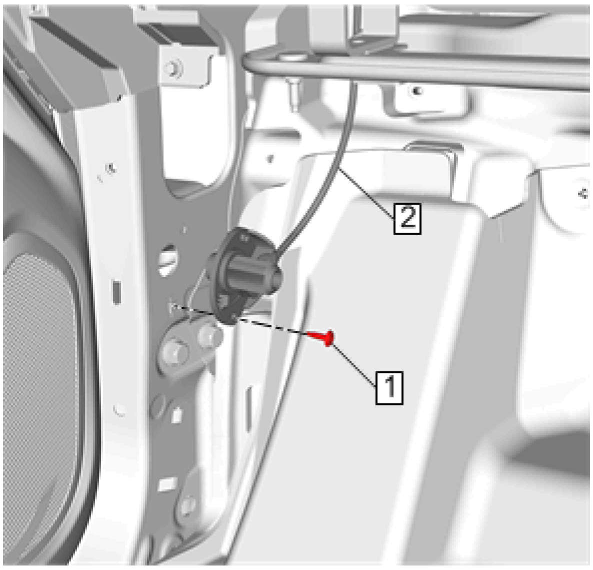


Fig. 12: Hood Primary Latch Release Cable Handle Screw
Courtesy of GENERAL MOTORS COMPANY

1. Position the hood primary latch release cable (2) to the hinge pillar inner panel. Install the hood primary latch release cable handle screw (1) and tighten to 2 N.m (18 lb in).

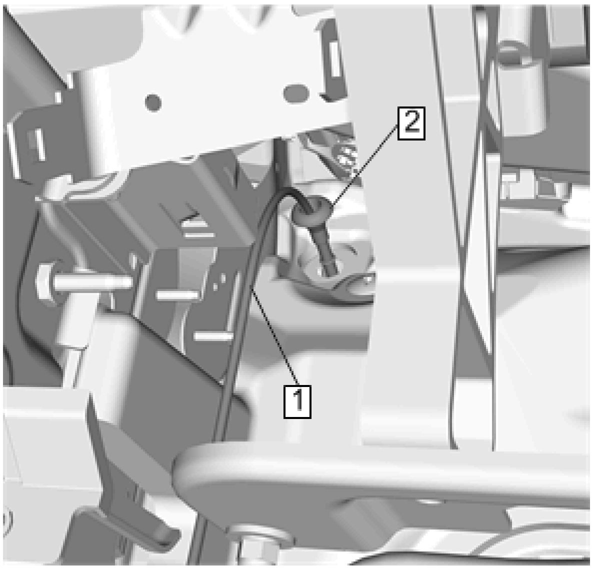


Fig. 13: Hood Primary Latch Release Cable Grommet
Courtesy of GENERAL MOTORS COMPANY

2. Install the hood primary latch release cable grommet to the dash.

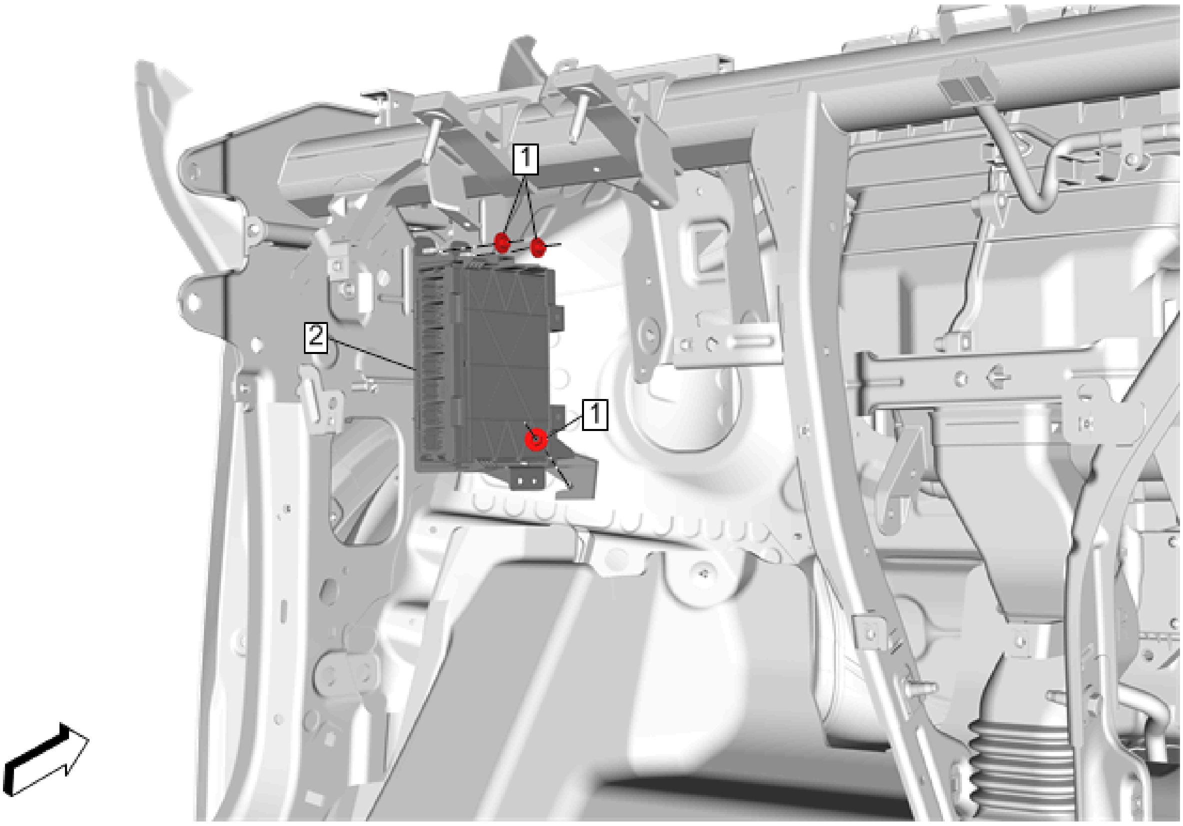


Fig. 14: Body Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Body Control Module Bracket - Install - **Body Control Module Bracket Replacement**

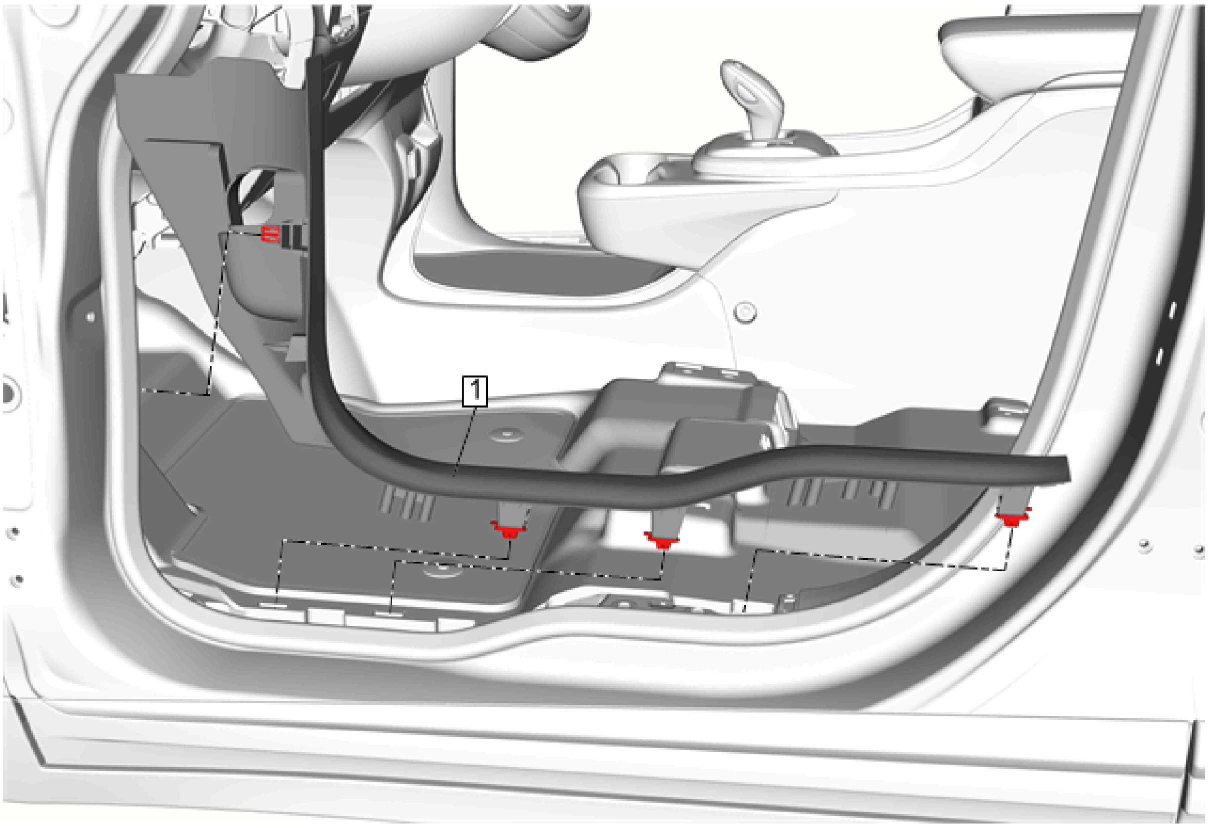


Fig. 15: Front Side Door Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

4. Front Side Door Sill Garnish Molding - Install - **Front Side Door Sill Garnish Molding Replacement**

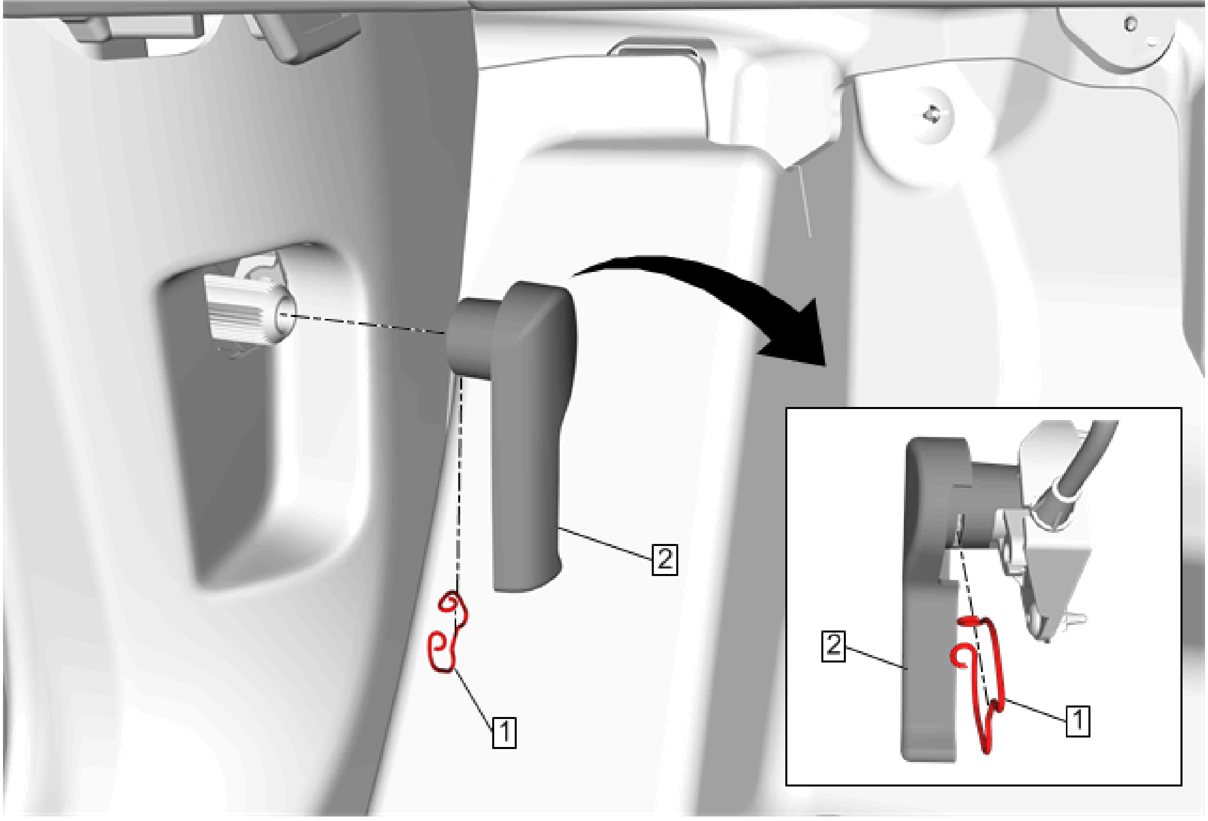


Fig. 16: Hood Primary Latch Release Cable Handle
Courtesy of GENERAL MOTORS COMPANY

5. Hood Primary Latch Release Cable Handle - Install - **Hood Primary Latch Release Cable Handle Replacement**

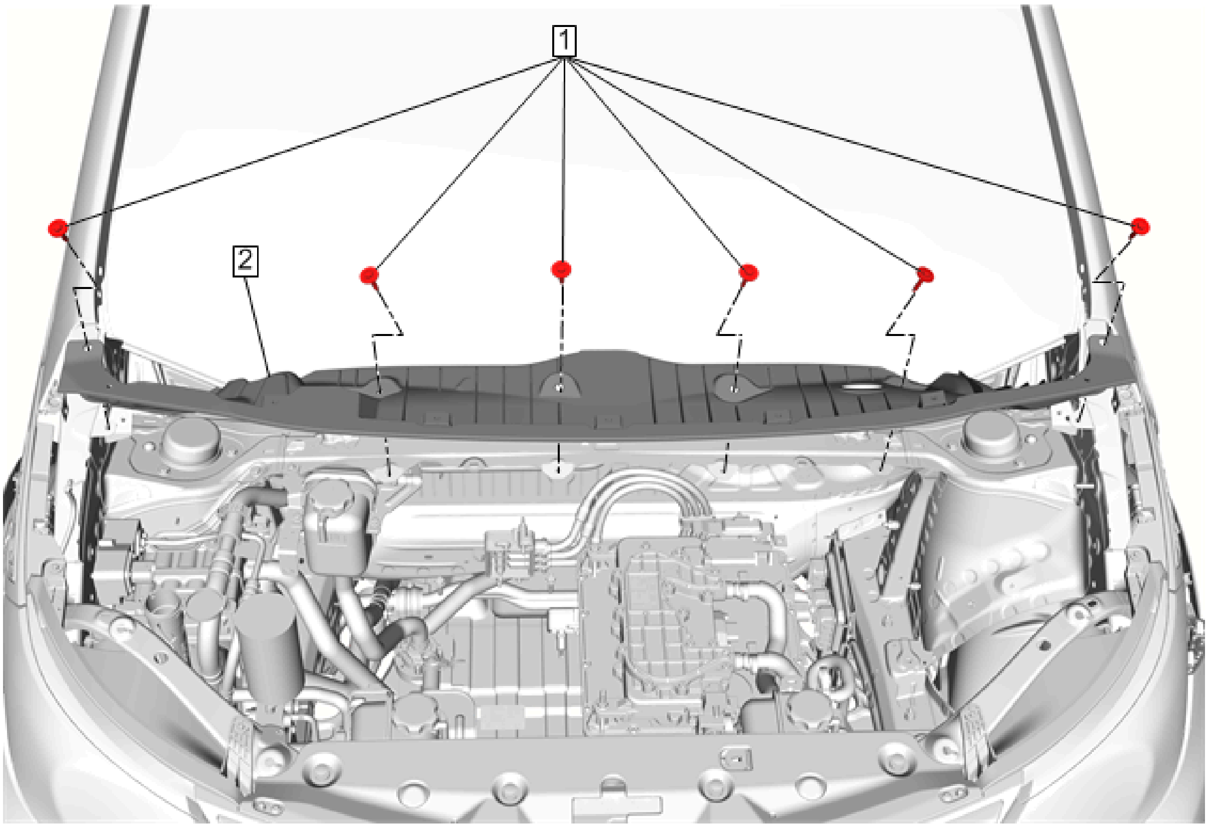


Fig. 17: Dash Panel Upper Extension Panel Extension
Courtesy of GENERAL MOTORS COMPANY

6. Dash Panel Upper Extension Panel Extension - Install - **Dash Panel Upper Extension Panel Extension Replacement**

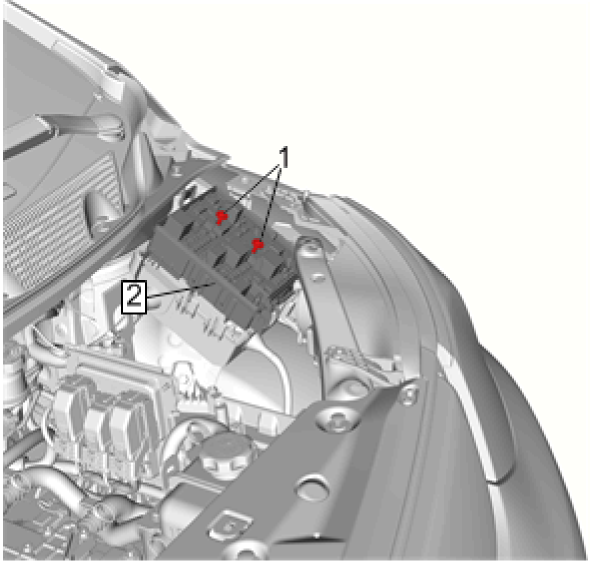


Fig. 18: Engine Wiring Harness Junction Block
Courtesy of GENERAL MOTORS COMPANY

7. Engine Wiring Harness Junction Block - Install - **Engine Wiring Harness Junction Block Replacement**

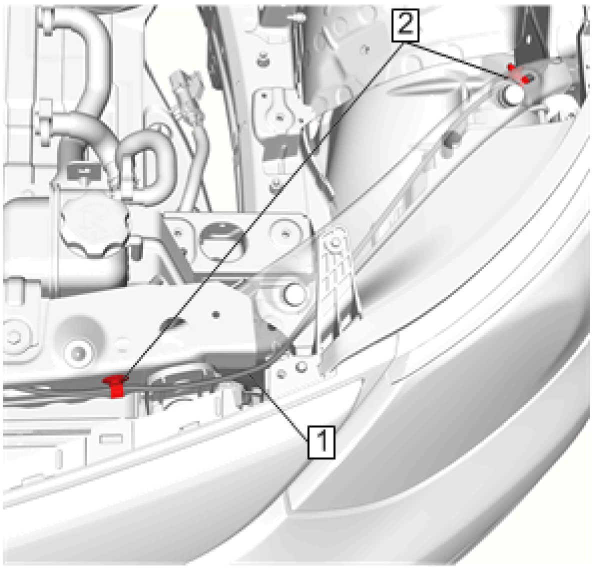


Fig. 19: Hood Primary Latch Release Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the hood primary latch release cable (1) to the hood release cable retainers (2).

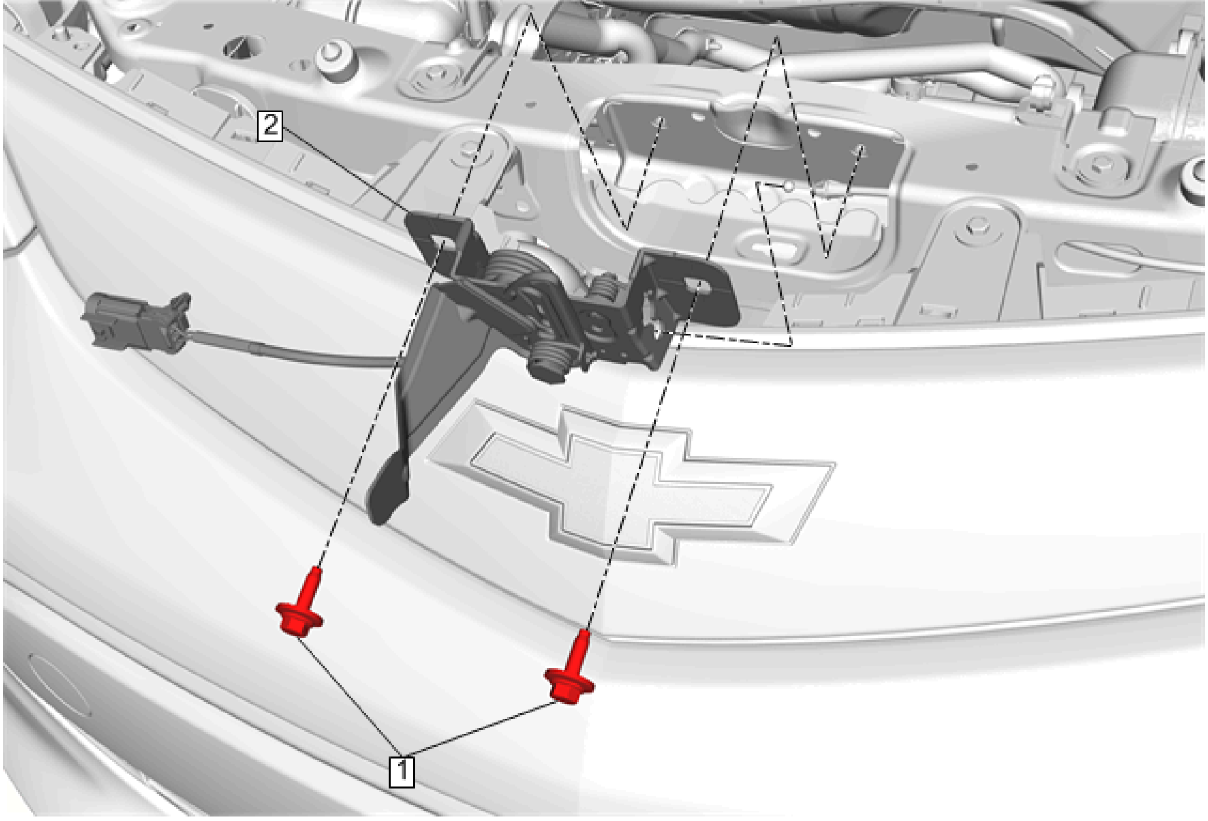


Fig. 20: Hood Primary and Secondary Latch
Courtesy of GENERAL MOTORS COMPANY

9. Hood Primary and Secondary Latch - Install - **Hood Primary and Secondary Latch Replacement**

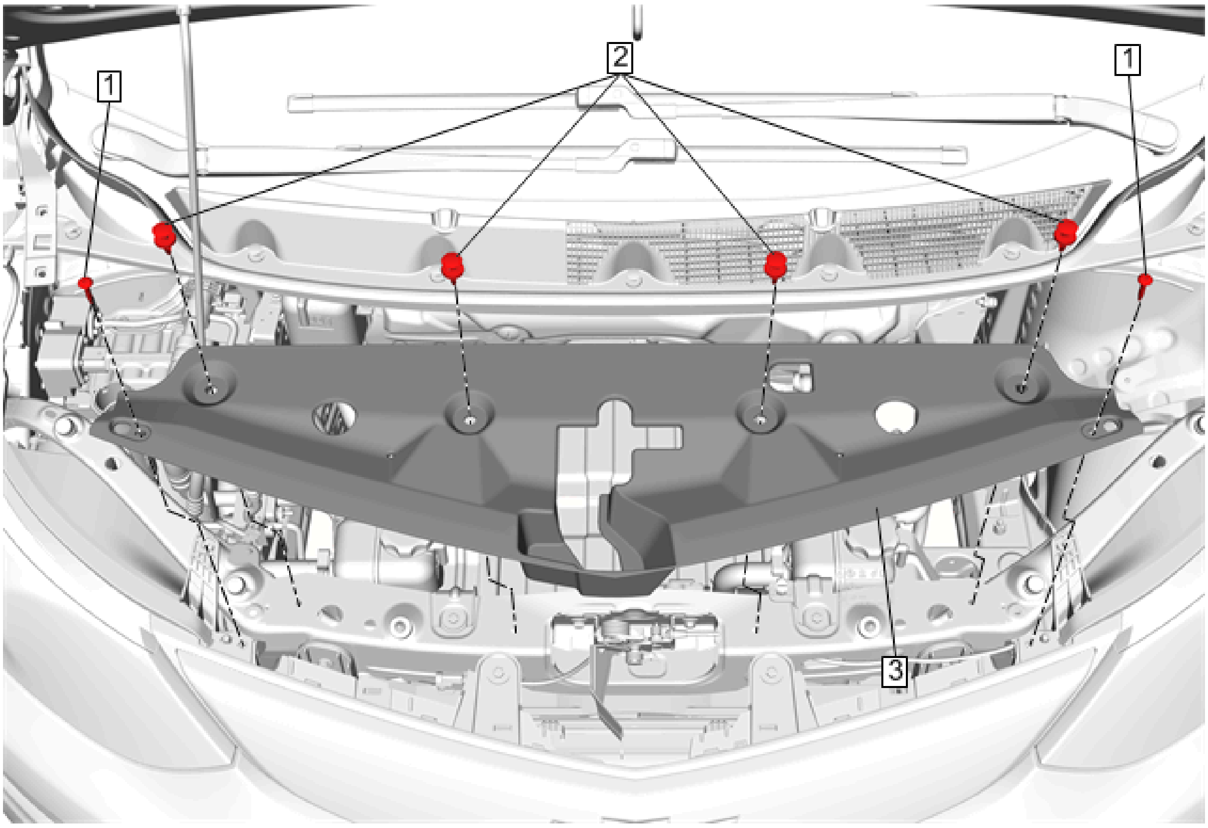


Fig. 21: Front Compartment Front Sight Shield (North America)
Courtesy of GENERAL MOTORS COMPANY

10. Front Compartment Front Sight Shield - Install - **Front Compartment Front Sight Shield Replacement**.

FRONT SIDE DOOR ADJUSTMENT

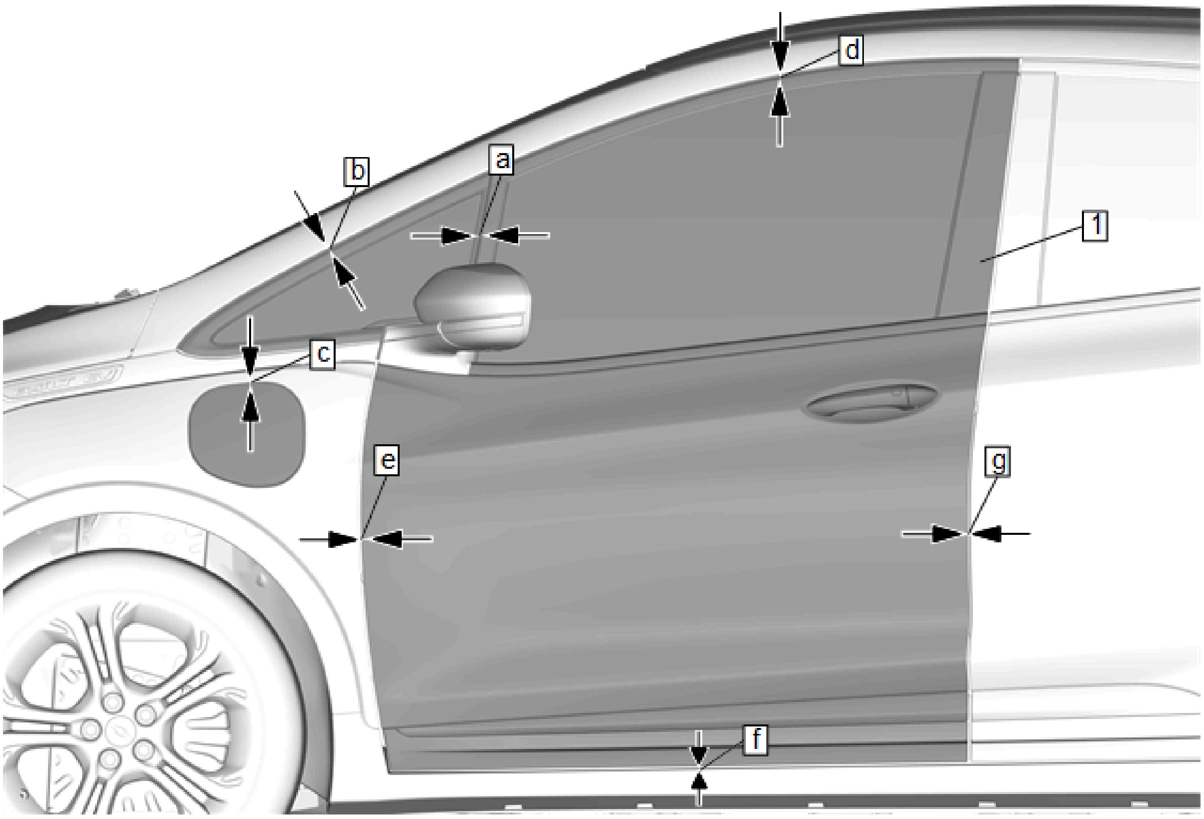


Fig. 22: Adjusting Front Side Door
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Wheelhouse Liner Replacement 2. Remove the front fender insulator.	

Callout	Component Name
1	Front Side Door **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Loosen the 4 front side door hinge bolts to adjust the front side door. 2. Adjust the front side door in order to obtain an even gap between the front side door and the body side, the rear door, the rocker panel, the fixed glass and the front fender. **Adjustment:** • Front side door to fixed glass molding (a) 5.0 mm Ã,Â± 1.25 mm (0.19 in Ã,Â± 0.05 in) • Fixed glass to body side (b) 5.0 mm Ã,Â± 1.0 mm (0.19 in Ã,Â± 0.04 in) • Fuel filler door to fender (c) 2.0 mm Ã,Â± 0.5 mm (0.08 in Ã,Â± 0.02 in) • Front side door to bodyside (d) 5.0 mm Ã,Â± 1.0 mm (0.19 in Ã,Â± 0.04 in) • Front side door to fender (e) 4.0 mm Ã,Â± 0.75 mm (0.16 in Ã,Â± 0.03 in) • Front side door to rocker panel (f) 5.5 mm Ã,Â± 1.5 mm (0.21 in Ã,Â± 0.06 in) • Front side door to rear side door (g) 4.0 mm Ã,Â± 0.75 mm (0.16 in Ã,Â± 0.03 in) **Tighten** 32 N.m (24 lb ft)

FRONT SIDE DOOR REPLACEMENT

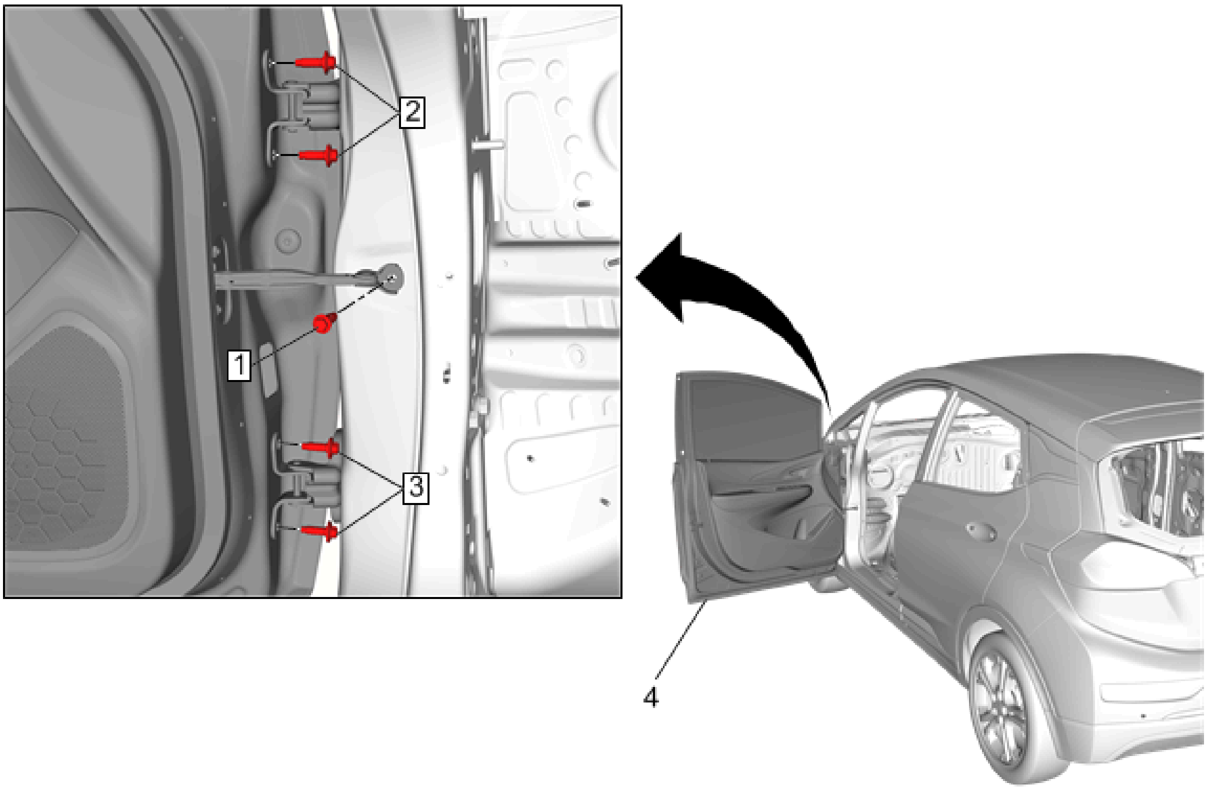


Fig. 23: Front Side Door

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Front Side Door Check Link Bolt **CAUTION:** Fastener Caution **Tighten** 22 N.m (16 lb ft)
2	Front Side Door Upper Hinge Bolt (Qty: 2) **Tighten** 25 N.m (18 lb ft)
3	Front Side Door Lower Hinge Bolt (Qty: 2) **Tighten** 25 N.m (18 lb ft) **Procedure** 1. Apply tape to the fender and door edges to protect the surfaces. 2. Support the door before removing the hinge bolts. 3. Disconnect the electrical connector. 4. Reposition the door away from the vehicle to gain access to the connector.
4	Front Side Door **Procedure** 1. Transfer all of the internal components. 2. Adjust the front side door as needed. Front Side Door Adjustment.

REAR SIDE DOOR ADJUSTMENT

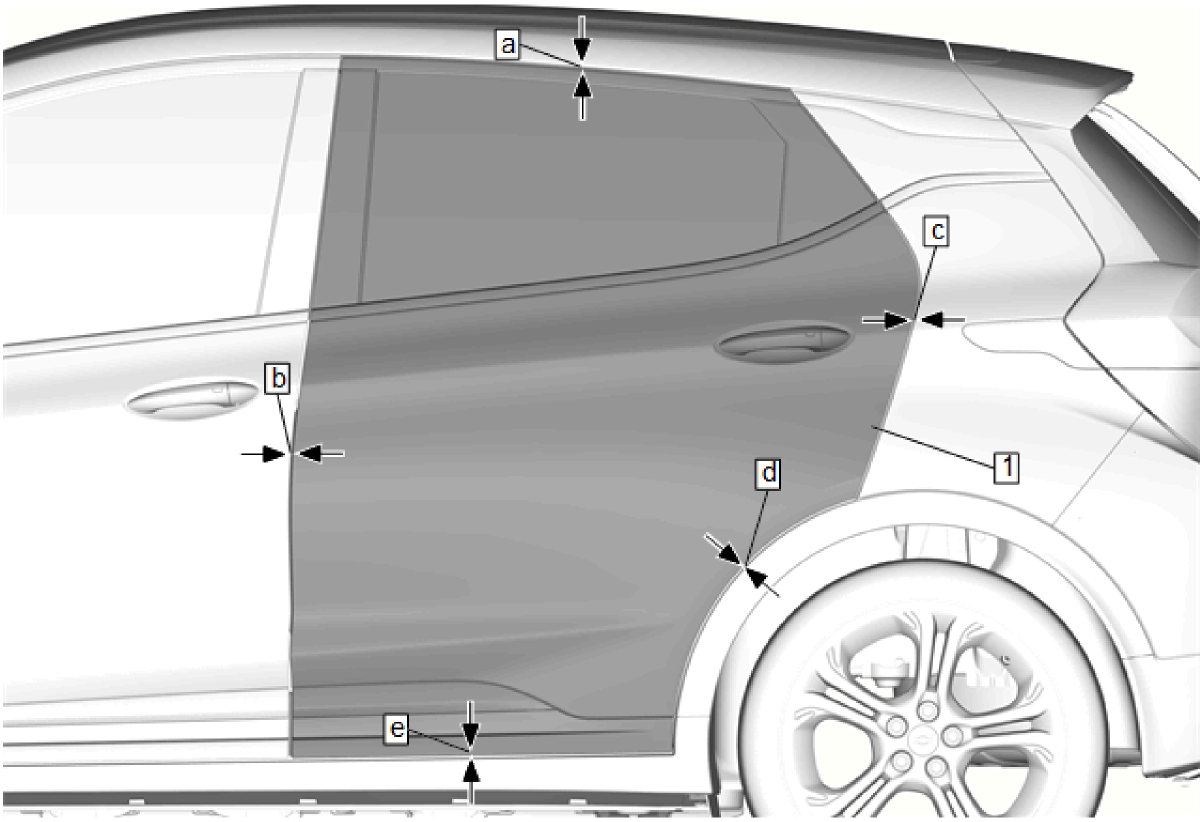


Fig. 24: Adjusting Rear Side Door
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Rear Side Door **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Loosen the 4 rear door hinge bolts to adjust the rear door. 2. Adjust the rear door in order to obtain an even gap between the rear door and the body side, the quarter outer panel, the wheelhouse molding, the rocker panel and the front side door. **Adjustment** • Rear side door to bodyside (a) 5.0 mm Ã,Â± 1.0 mm (0.19 in Ã,Â± 0.04 in) • Rear side door to front side door (b) 4.0 mm Ã,Â± 0.75 mm (0.16 in Ã,Â± 0.03 in) • Rear side door to quarter outer panel (c) 4.0 mm Ã,Â± 0.75 mm (0.16 in Ã,Â± 0.03 in) • Rear side door to wheelhouse molding (d) 4.5 mm Ã,Â± 1.0 mm (0.18 in Ã,Â± 0.04 in) • Rear side door to rocker panel (e) 5.5 mm Ã,Â± 1.5 mm (0.21 in Ã,Â± 0.06 in) **Tighten** 32 N.m (24 lb ft)

REAR SIDE DOOR REPLACEMENT

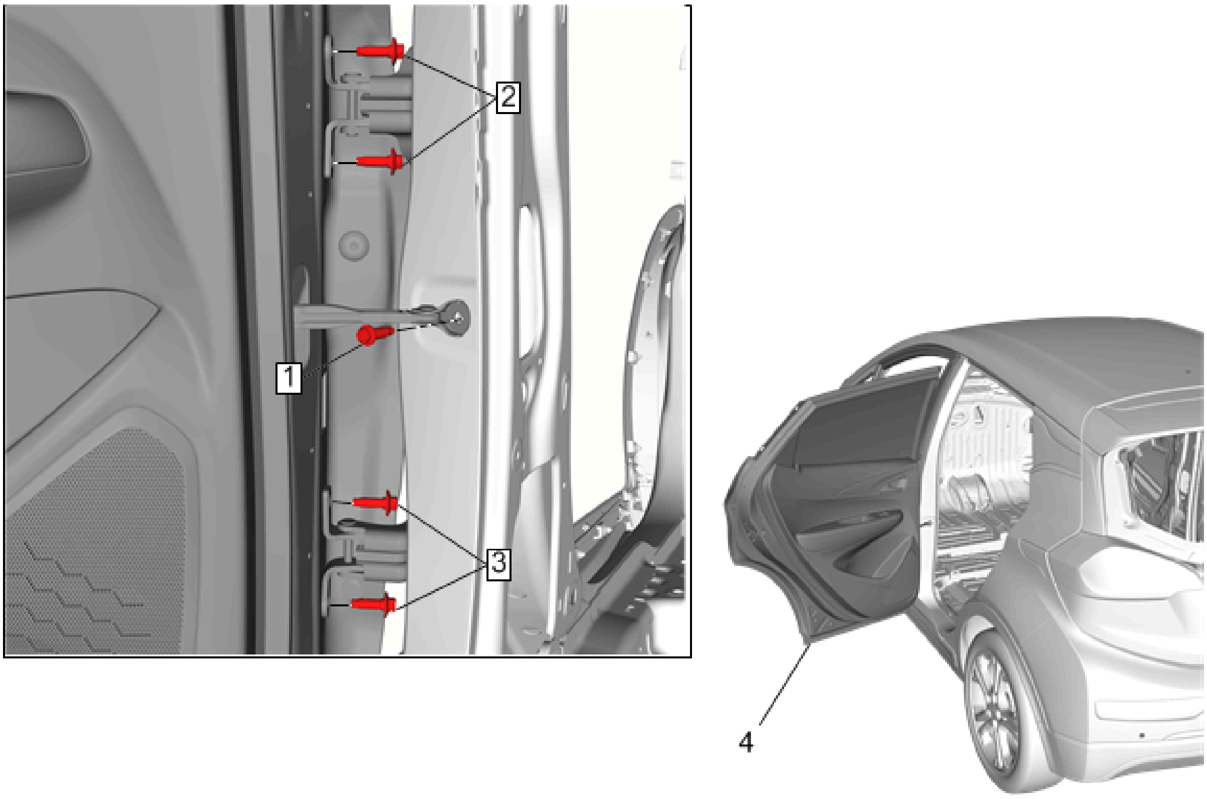


Fig. 25: Rear Side Door
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Rear Side Door Check Link Bolt **CAUTION:** Fastener Caution **Tighten** 22 N.m (16 lb ft)
2	Rear Side Door Upper Hinge Bolt (Qty: 2) **Tighten** 25 N.m (18 lb ft)
3	Rear Side Door Lower Hinge Bolt (Qty: 2) **Tighten** 25 N.m (18 lb ft) **Procedure** 1. Disconnect the electrical connector. 2. Support the door before removing the hinge bolts.
4	Rear Side Door **Procedure** 1. Transfer all of the internal components. 2. Adjust the rear side door as needed. **Rear Side Door Adjustment**

FRONT FENDER REPLACEMENT - LEFT SIDE

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

CAUTION: **When removing body panels, apply tape to corners of panel and adjacent**

surfaces to help prevent paint damage.

1. Disable the high voltage system. High Voltage Disabling

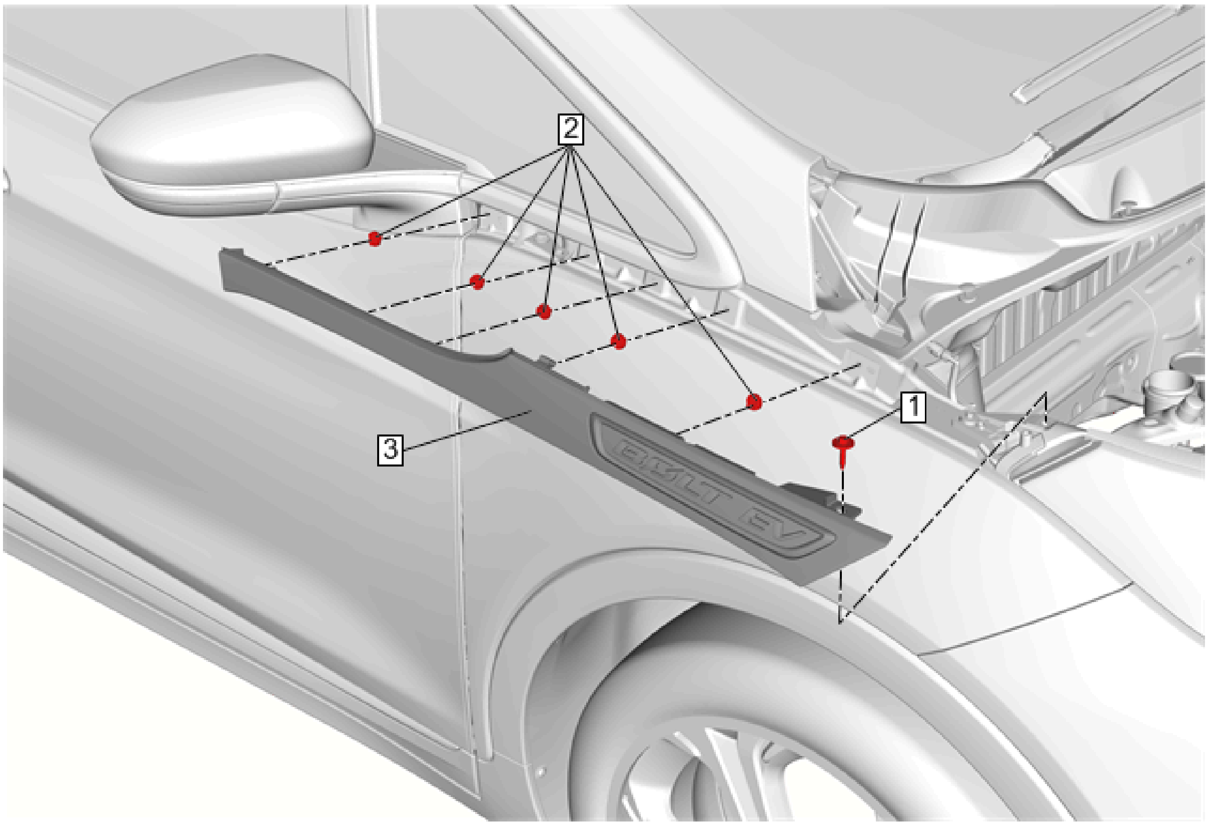


Fig. 26: Front Fender Upper Rear Molding
Courtesy of GENERAL MOTORS COMPANY

2. Front Fender Upper Rear Molding - Remove - Front Fender Upper Rear Molding Replacement

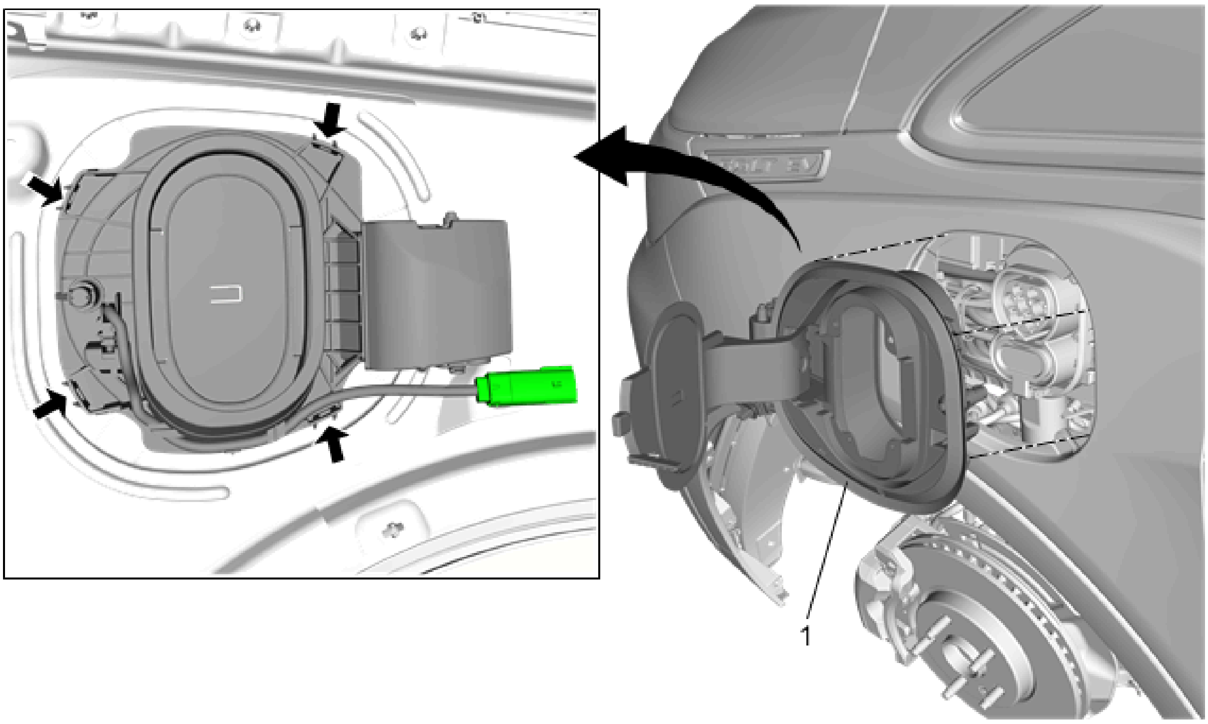


Fig. 27: Charge Port Housing
Courtesy of GENERAL MOTORS COMPANY

3. Charge Port Housing - Remove - Charge Port Housing Replacement (Except Dubai) Charge Port Housing Replacement (Dubai)

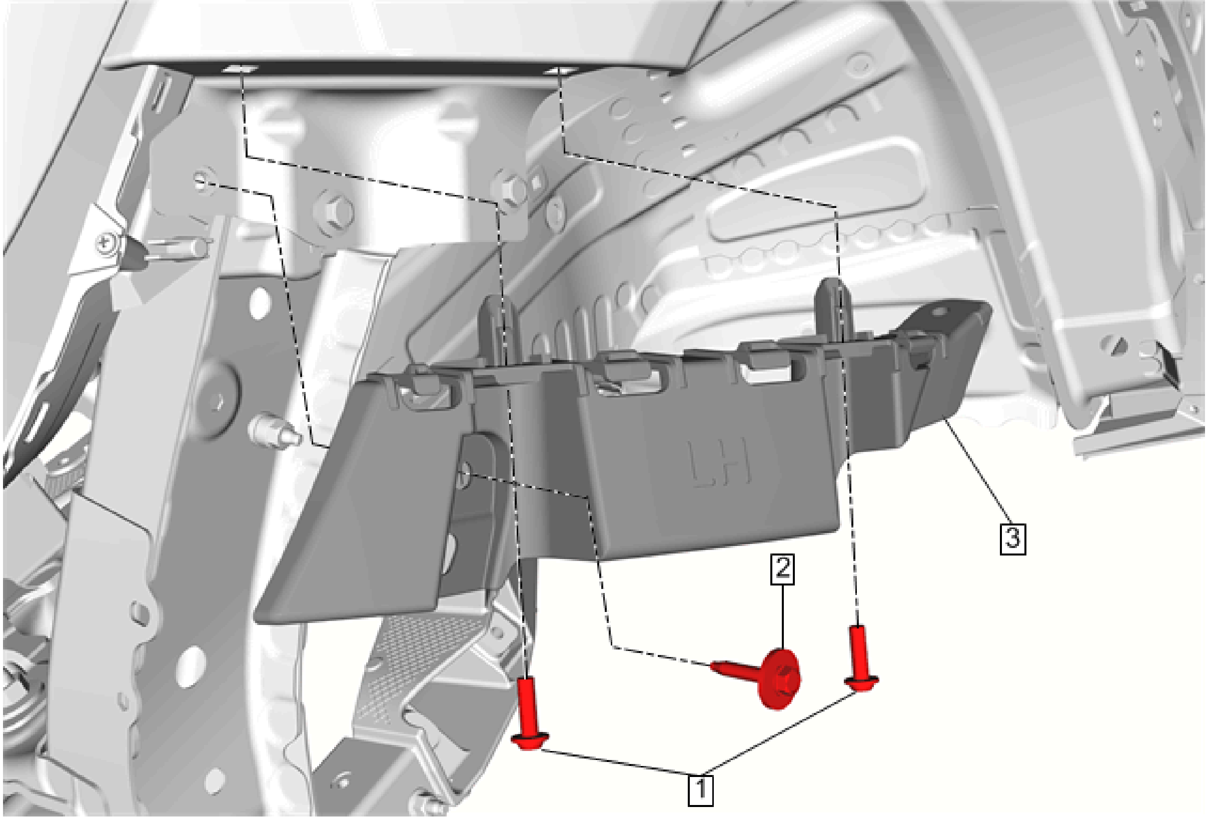


Fig. 28: Front Bumper Fascia Guide
Courtesy of GENERAL MOTORS COMPANY

4. Front Bumper Fascia Guide - Remove - **Front Bumper Fascia Guide Replacement**

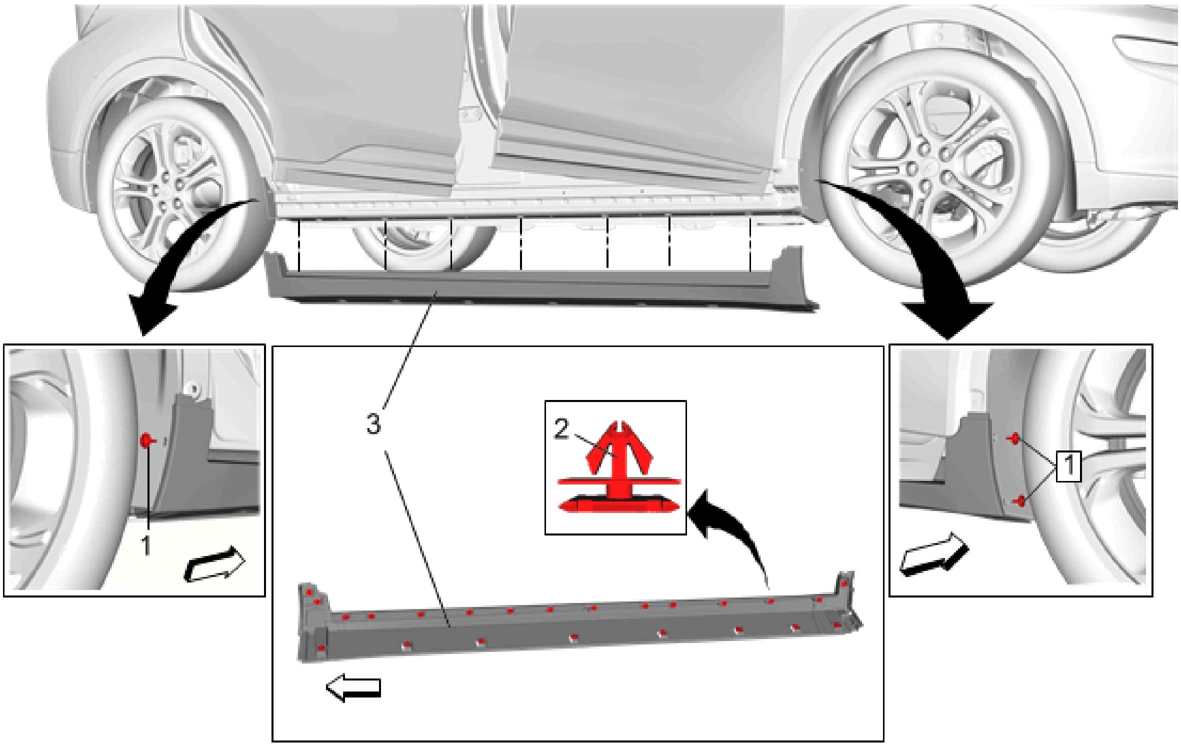


Fig. 29: Wheelhouse Liner Screw
Courtesy of GENERAL MOTORS COMPANY

5. Rocker Panel Molding - Remove - **Rocker Panel Molding Replacement**

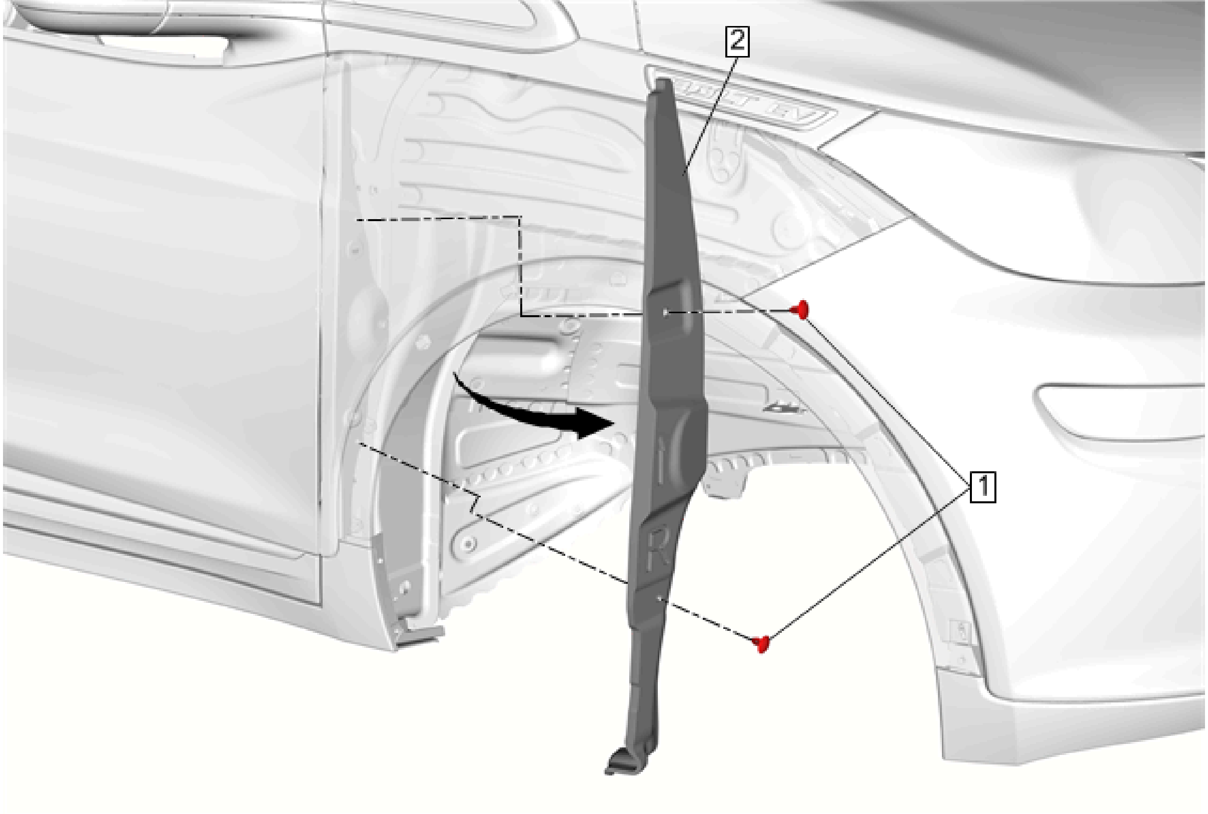


Fig. 30: Front Fender Insulator
Courtesy of GENERAL MOTORS COMPANY

6. Front Fender Insulator - Remove - **Front Fender Insulator Replacement**

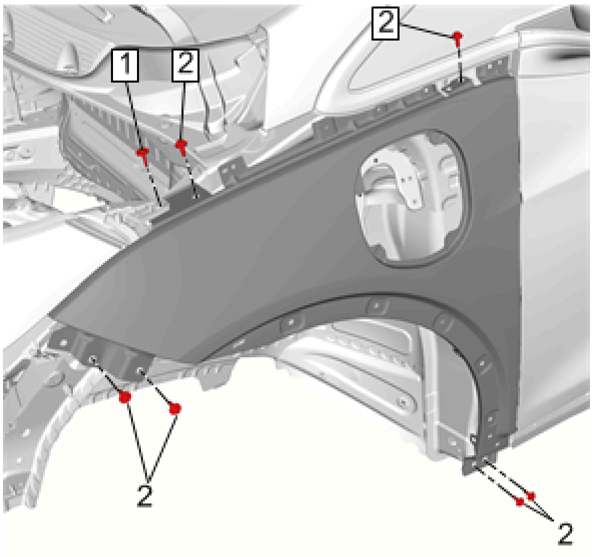


Fig. 31: Headlamp Screw
Courtesy of GENERAL MOTORS COMPANY

7. Headlamp Screw - Remove
8. Front Fender Bolt - Remove

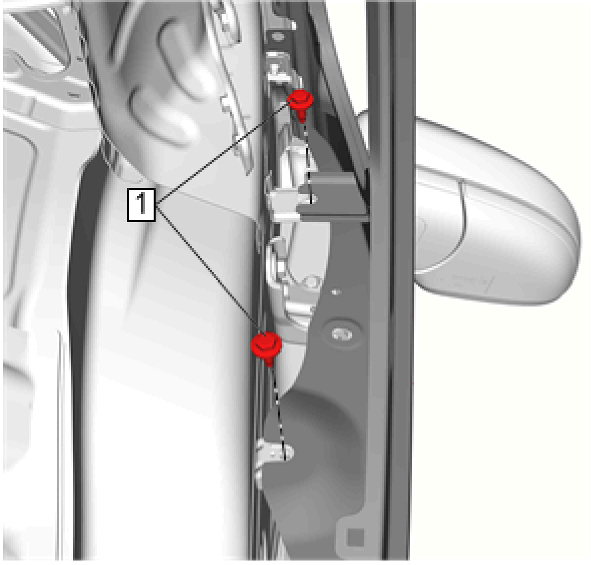


Fig. 32: Front Fender Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Front Fender Bolt - Remove

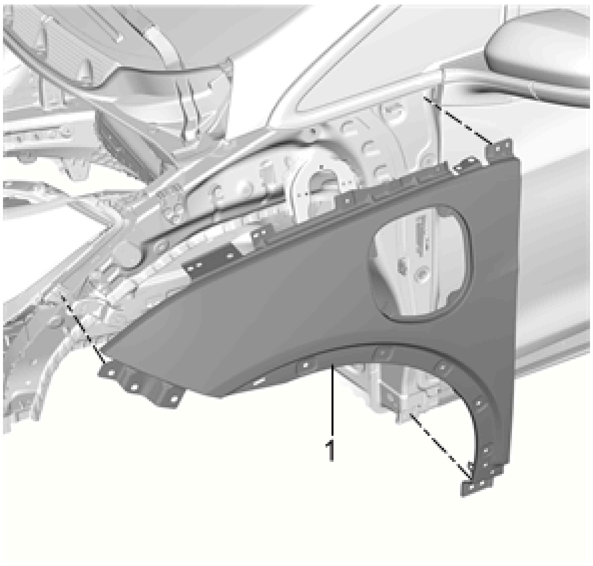


Fig. 33: Front Fender
Courtesy of GENERAL MOTORS COMPANY

10. Front Fender - Remove

Installation Procedure

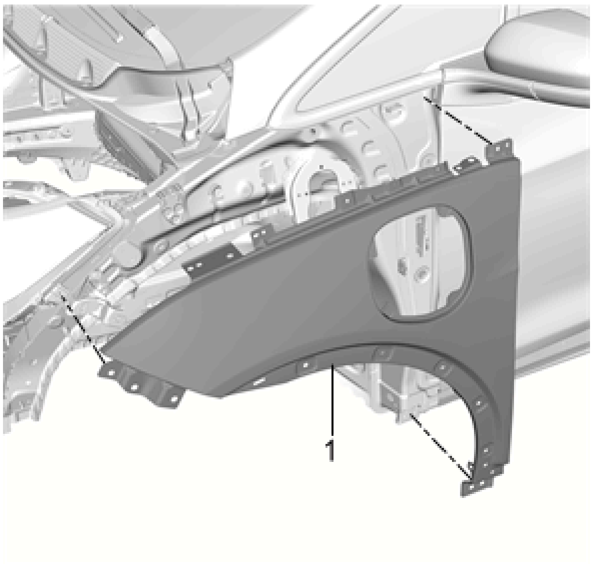


Fig. 34: Front Fender
Courtesy of GENERAL MOTORS COMPANY

1. Front Fender - Install

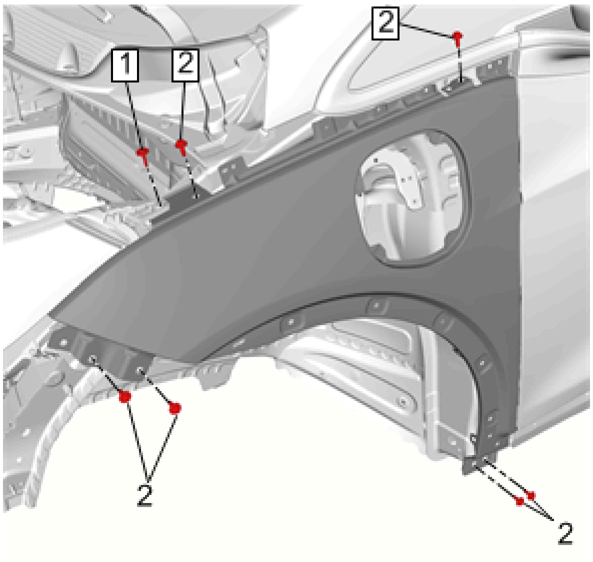


Fig. 35: Headlamp Screw
Courtesy of GENERAL MOTORS COMPANY

2. Headlamp Screw (1) - Install to 2.5 N.m (22 lb in)
3. Front Fender Bolt (2) Qty: 6) - Install to 9 N.m (80 lb in)

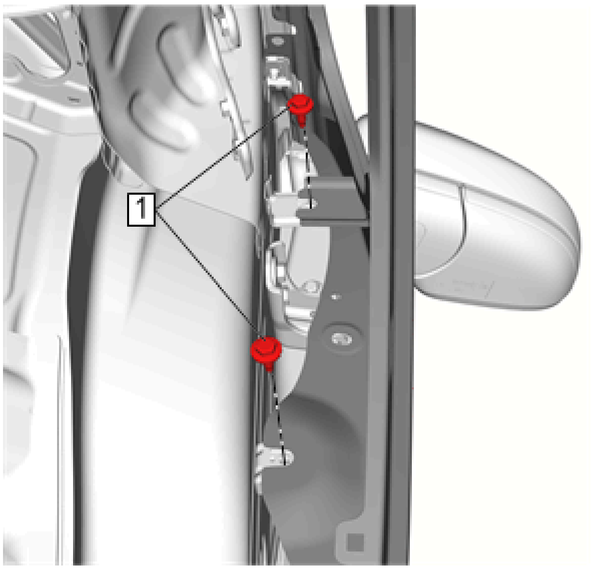


Fig. 36: Front Fender Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Front Fender Bolt (1) Qty: 2) - Install to 9 N.m (80 lb in)

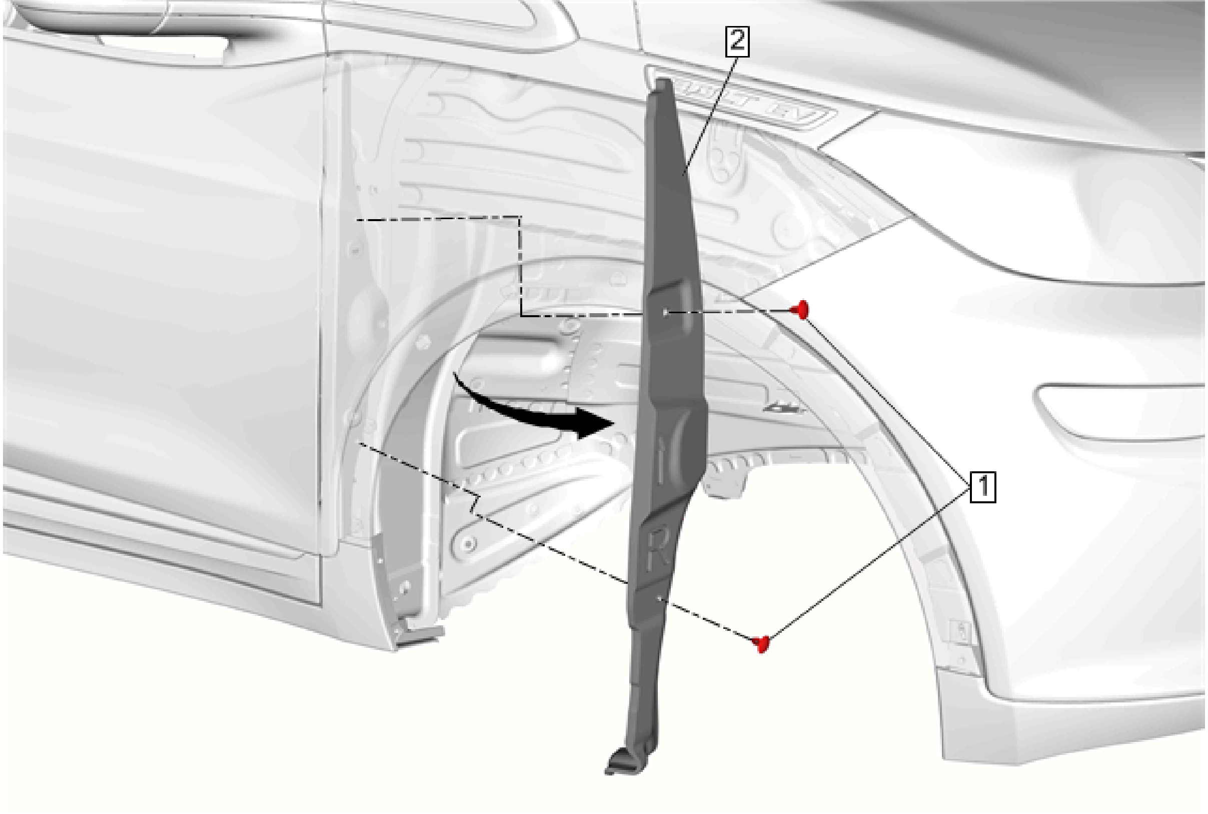


Fig. 37: Front Fender Insulator
Courtesy of GENERAL MOTORS COMPANY

5. Front Fender Insulator - Install - Front Fender Insulator Replacement

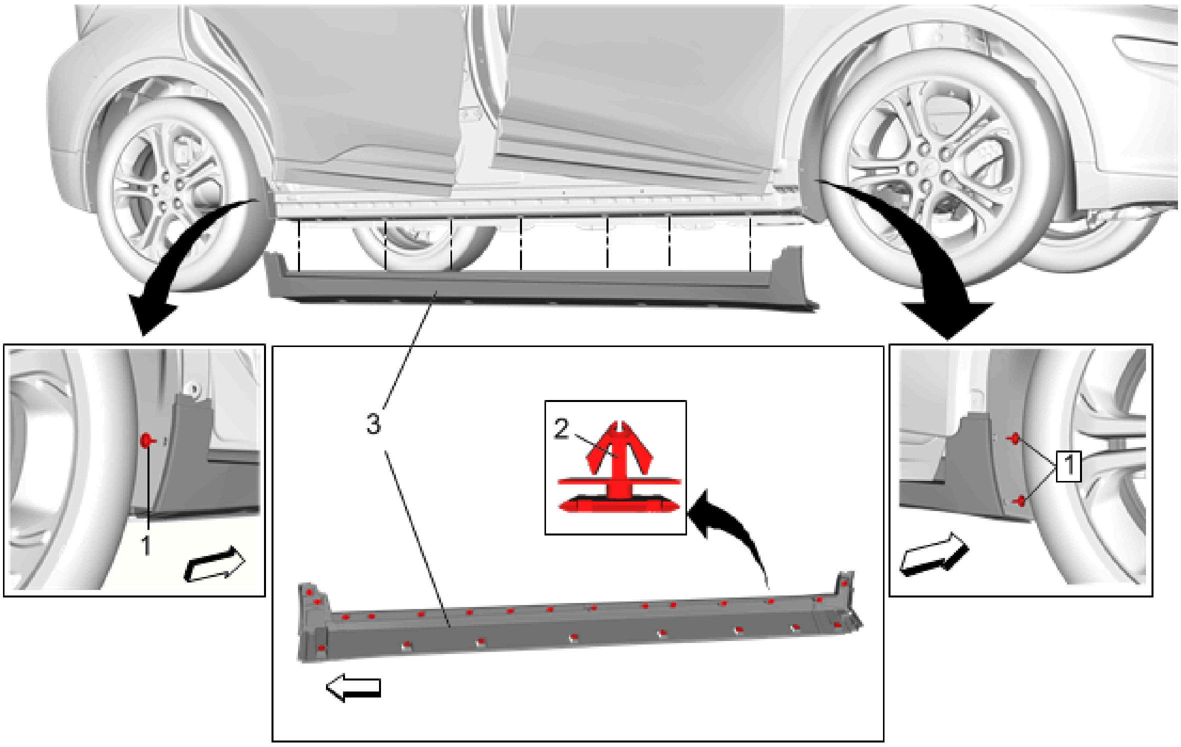


Fig. 38: Wheelhouse Liner Screw
Courtesy of GENERAL MOTORS COMPANY

6. Rocker Panel Molding - Install - Rocker Panel Molding Replacement

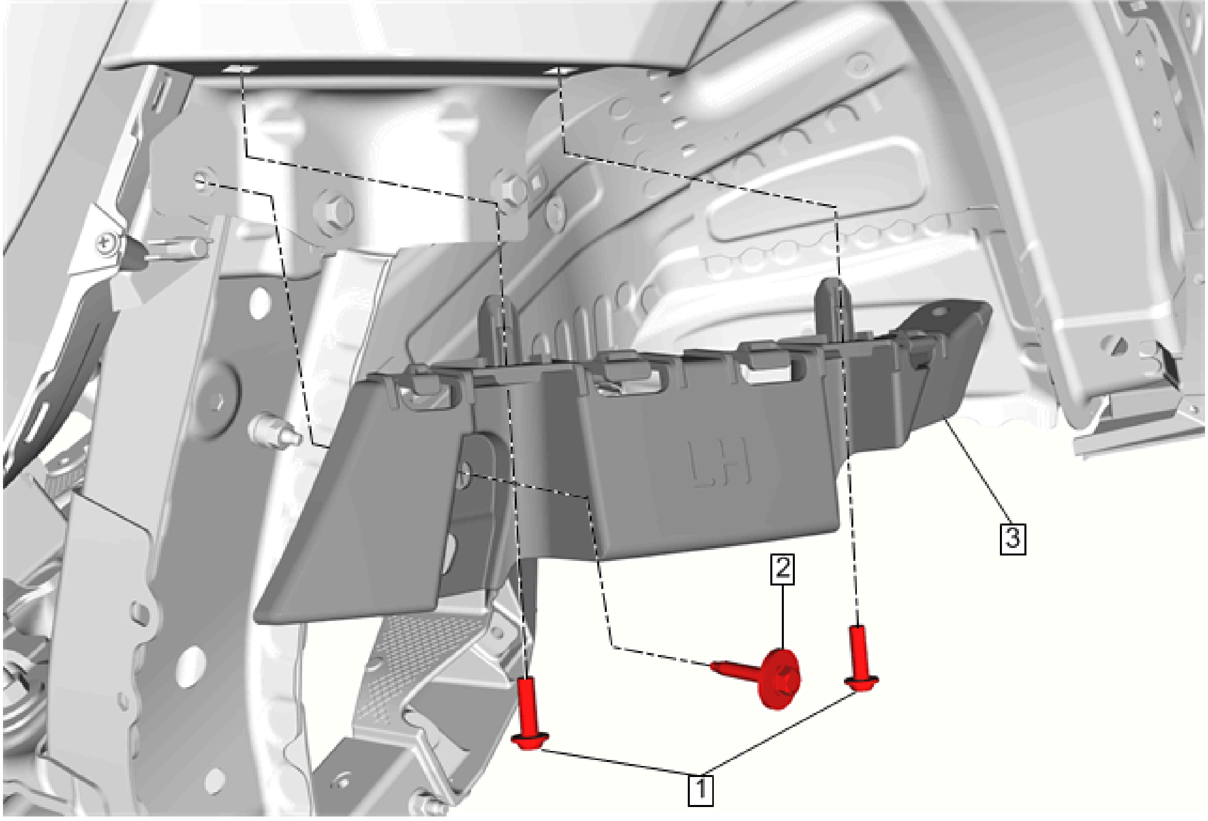


Fig. 39: Front Bumper Fascia Guide
Courtesy of GENERAL MOTORS COMPANY

7. Front Bumper Fascia Guide - Install - **Front Bumper Fascia Guide Replacement**

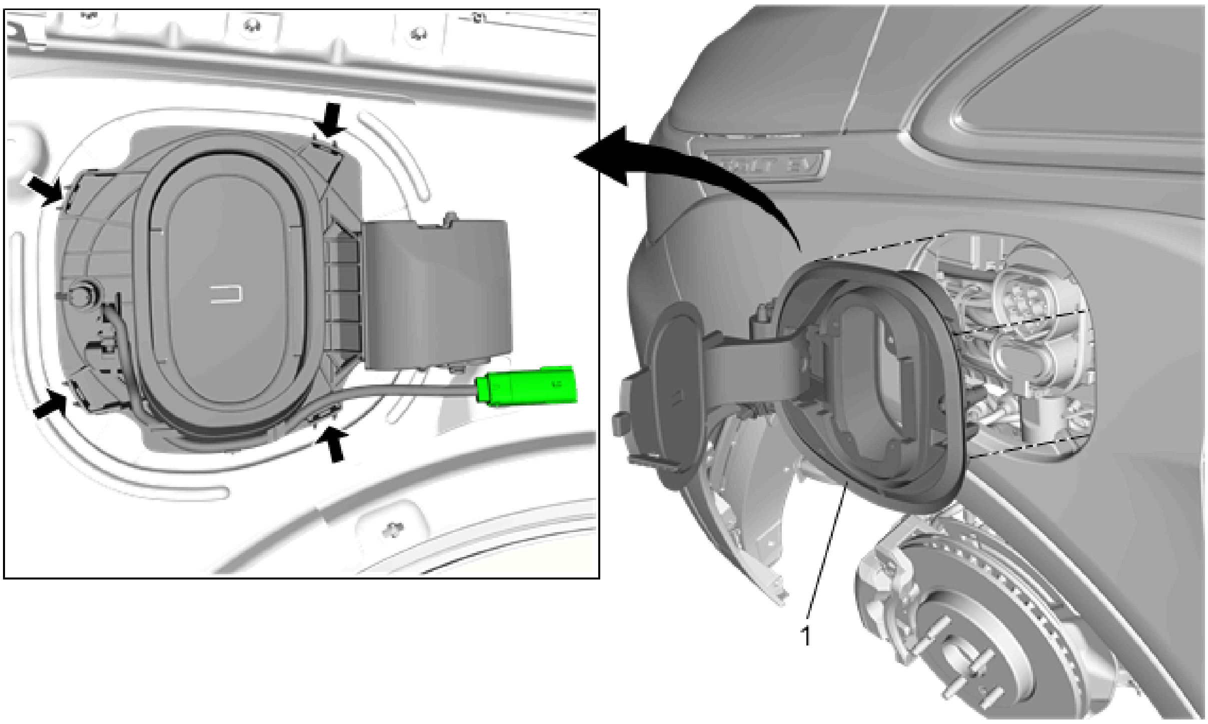


Fig. 40: Charge Port Housing
Courtesy of GENERAL MOTORS COMPANY

8. Charge Port Housing - Install - **Charge Port Housing Replacement (Except Dubai)** **Charge Port Housing Replacement (Dubai)**

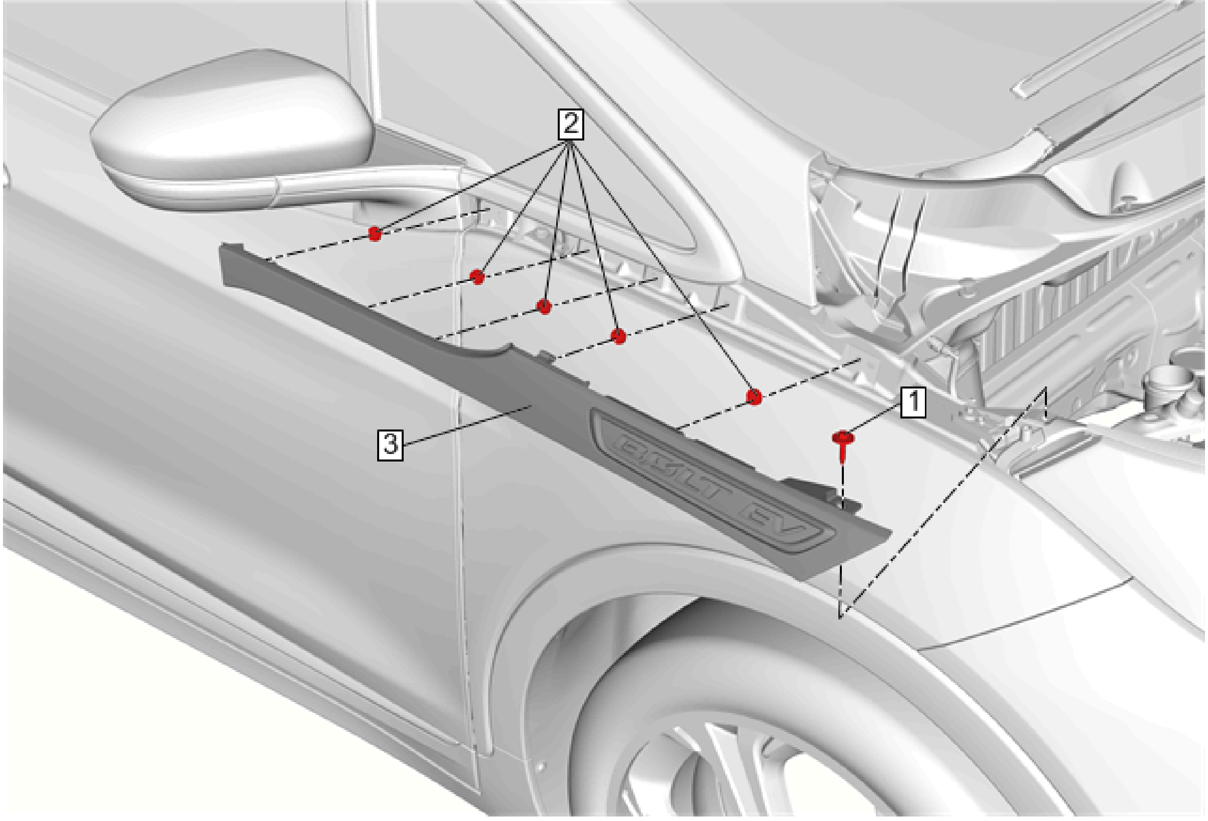


Fig. 41: Front Fender Upper Rear Molding
Courtesy of GENERAL MOTORS COMPANY

9. Front Fender Upper Rear Molding - Install - **Front Fender Upper Rear Molding Replacement**
10. Enable the high voltage system. **High Voltage Enabling**

FRONT FENDER REPLACEMENT - RIGHT SIDE

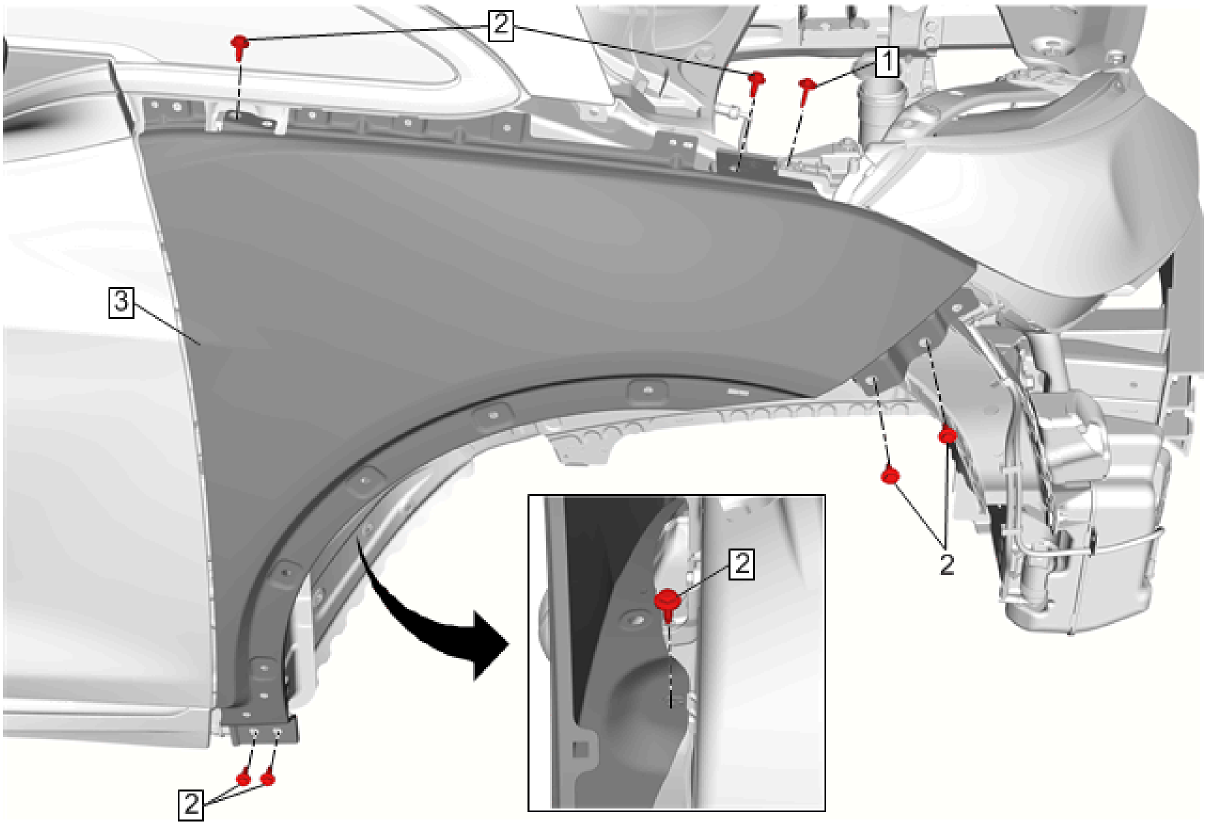


Fig. 42: Front Fender - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">CAUTION:
When removing body panels, apply tape to corners of panel and adjacent surfaces to help prevent paint damage.

Preliminary Procedures
1. Front Fender Upper Rear Molding Replacement
2. Front Bumper Fascia Guide Replacement
3. Rocker Panel Molding Replacement
4. Front Fender Insulator Replacement</td></tr>
<tr><td>1</td><td>Headlamp Screw
CAUTION:
Fastener Caution
Tighten
2.5 N.m (22 lb in)</td></tr>
<tr><td>2</td><td>Front Fender Bolt (Qty: 7)
Tighten
9 N.m (80 lb in)</td></tr>
<tr><td>3</td><td>Front Fender</td></tr>
</table>

LIFTGATE ADJUSTMENT

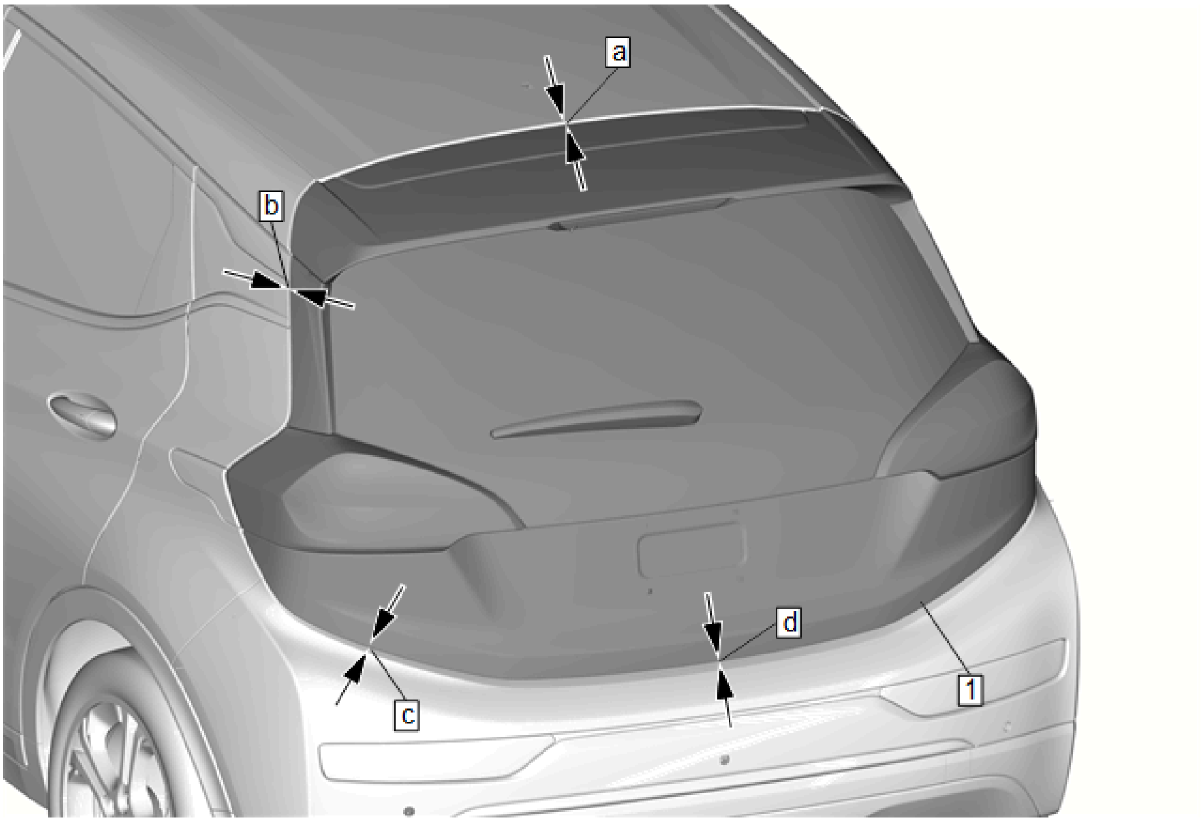


Fig. 43: Adjusting Liftgate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Liftgate **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Loosen the four liftgate hinge bolts to adjust the liftgate. 2. Adjust the liftgate in order to obtain an even gap between the liftgate and the roof, the quarter applique and the rear bumper fascia. **Adjustment** - Liftgate to roof (a) 5.5 mm Ã,Â± 1.0 mm (0.22 in Ã,Â± 0.04 in) - Quarter applique to body side (b) 4.5 mm Ã,Â± 1.2 mm (0.18 in Ã,Â± 0.05 in) - Liftgate to rear bumper fascia (c) 5.0 mm Ã,Â± 1.25 mm (0.19 in Ã,Â± 0.05 in) - Liftgate to rear bumper fascia (d) 5.5 mm Ã,Â± 1.25 mm (0.20 in Ã,Â± 0.05 in) **Tighten** 22 N.m (16 lb ft)

LIFTGATE REPLACEMENT

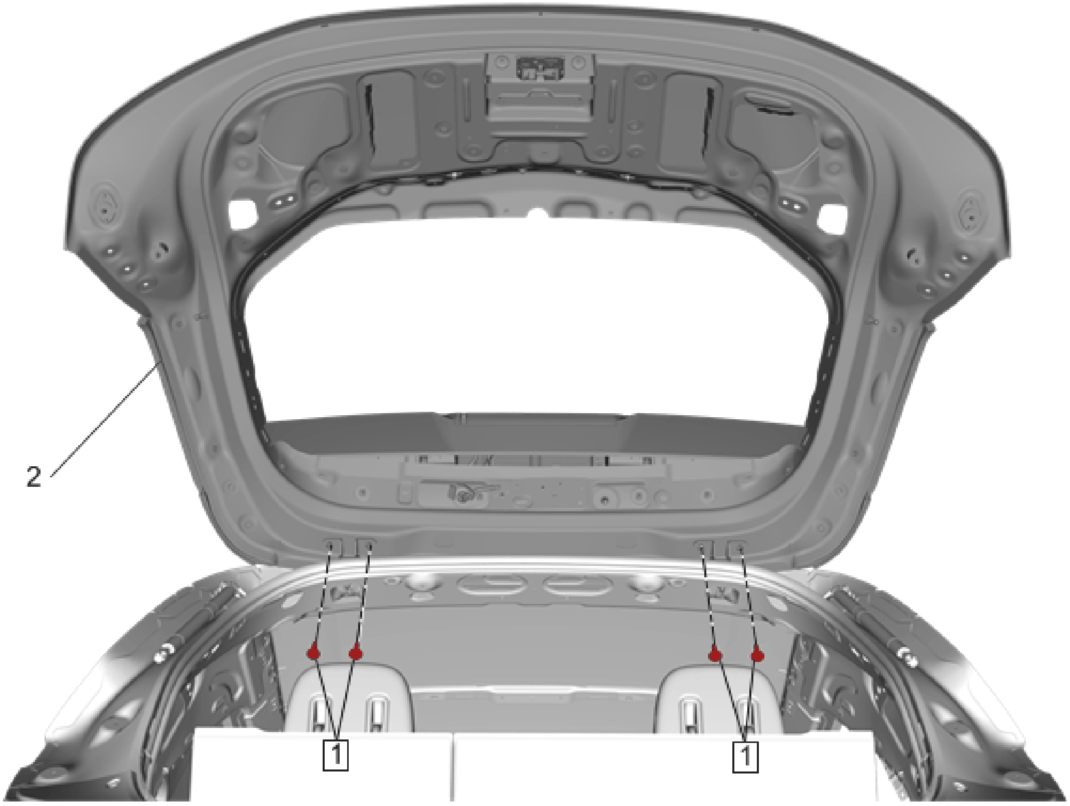


Fig. 44: Liftgate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: **When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.** **Preliminary Procedure** 1. Liftgate Upper Center Trim Finish Panel Replacement 2. Release the liftgate strut from the liftgate. Liftgate Strut Replacement
1	Liftgate Hinge Bolt **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Disconnect the electrical connector. 2. Pull the liftgate wiring grommet, the connectors, and the rear washer hose out of the body. 3. Mark the location of the liftgate hinges to the body with a grease pencil. **Tighten** 22 N.m (16 lb ft)
2	Liftgate **Procedure** 1. With the aid of an assistant, remove the liftgate. 2. Transfer components as necessary. 3. Adjust liftgate as needed. Liftgate Adjustment

FRONT SIDE DOOR WIRING HARNESS REPLACEMENT

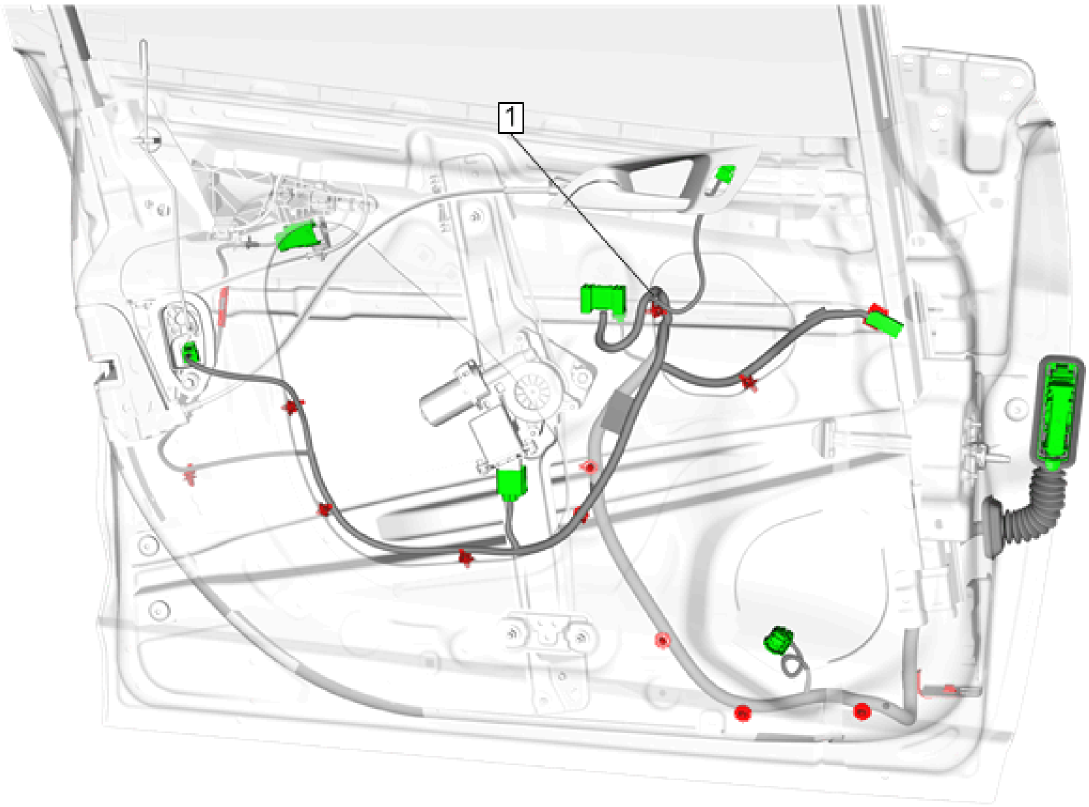


Fig. 45: Front Side Door Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Side Door Replacement 2. Front Side Door Trim Replacement 3. Front Side Door Water Deflector Replacement 4. Radio Front Side Door Speaker Replacement	
1	Front Side Door Wiring Harness **Procedure** Disconnect all electrical connectors and unclip harness.

LIFTGATE WIRING HARNESS REPLACEMENT

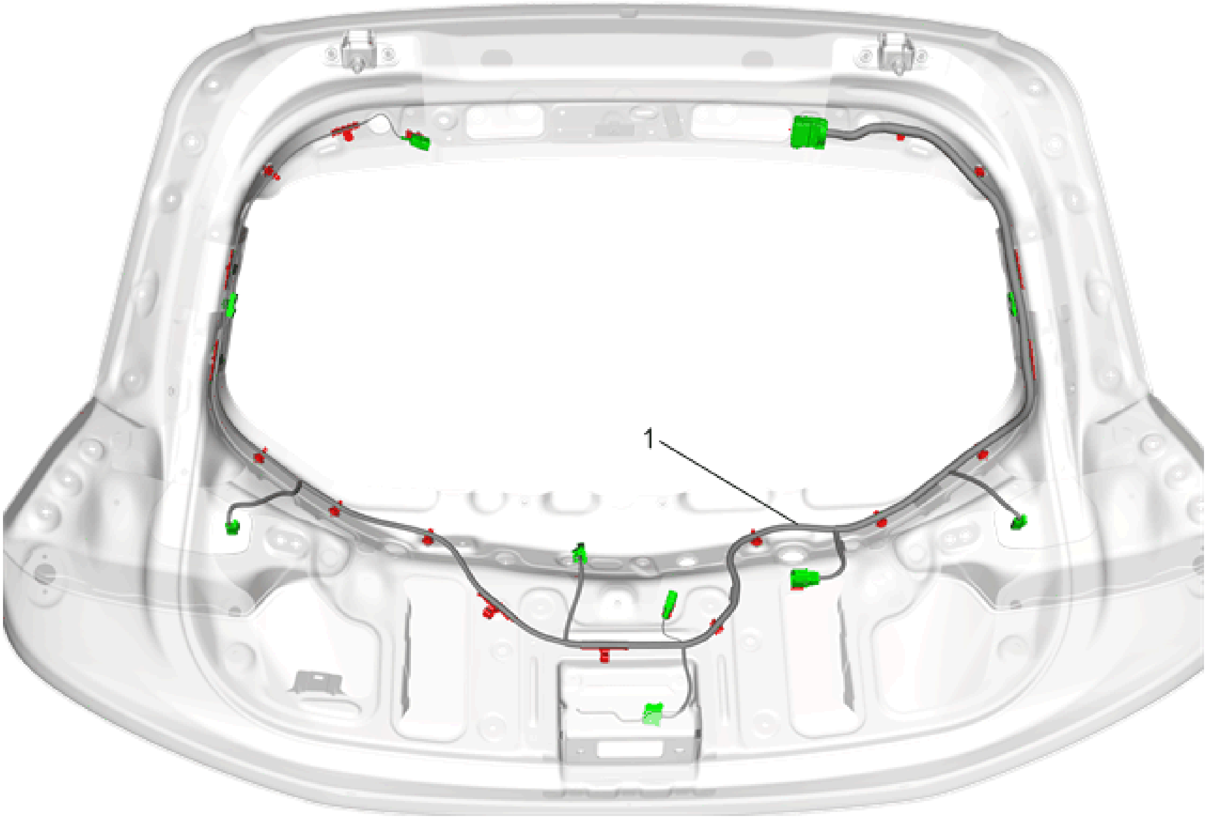


Fig. 46: Liftgate Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Liftgate Upper Side Trim Finish Panel Replacement 2. Liftgate Upper Center Trim Finish Panel Replacement 3. Liftgate Lower Trim Finish Panel Replacement	
1	Liftgate Wiring Harness **Procedure** Disconnect all electrical connectors.

LIFTGATE JUMPER WIRING HARNESS REPLACEMENT

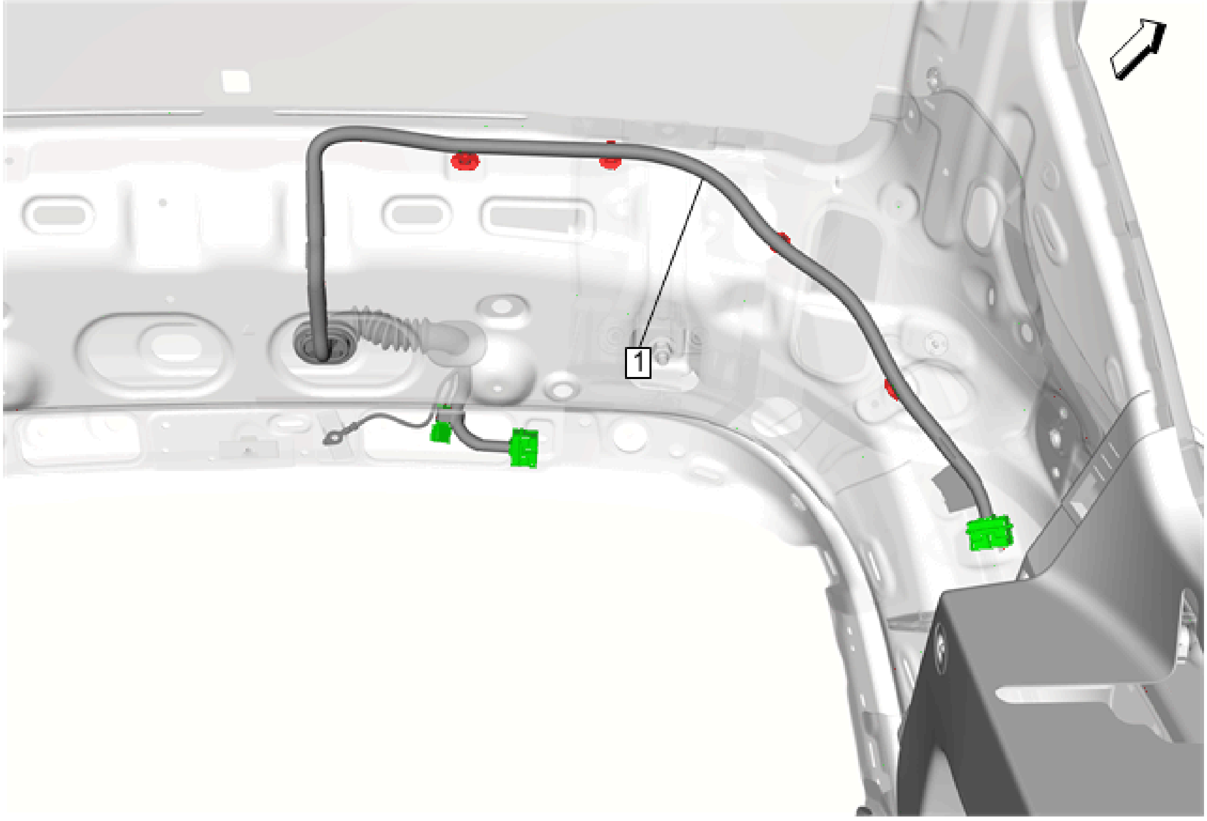


Fig. 47: Liftgate Jumper Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Liftgate Upper Center Trim Finish Panel Replacement 2. Lower the rear portion of headlining trim to gain access. Do not need to completely remove the headlining trim. Headlining Trim Panel Replacement	
1	Liftgate Jumper Wiring Harness **Procedure** Disconnect all electrical connectors.

REAR SIDE DOOR WIRING HARNESS REPLACEMENT

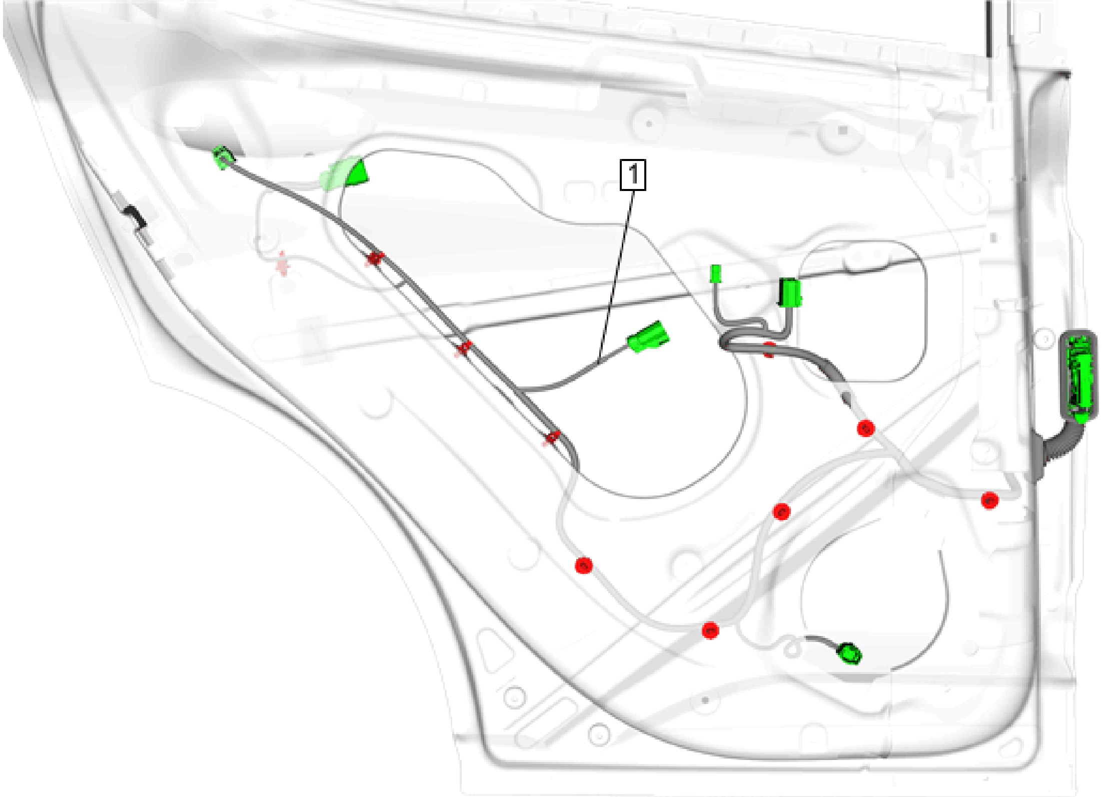


Fig. 48: Rear Side Door Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Rear Side Door Trim Replacement 2. Rear Side Door Water Deflector Replacement 3. Radio Rear Side Door Speaker Replacement	
1	Rear Side Door Wiring Harness **Procedure** Disconnect all electrical connectors and unclip harness.

HOOD PRIMARY LATCH RELEASE CABLE HANDLE REPLACEMENT

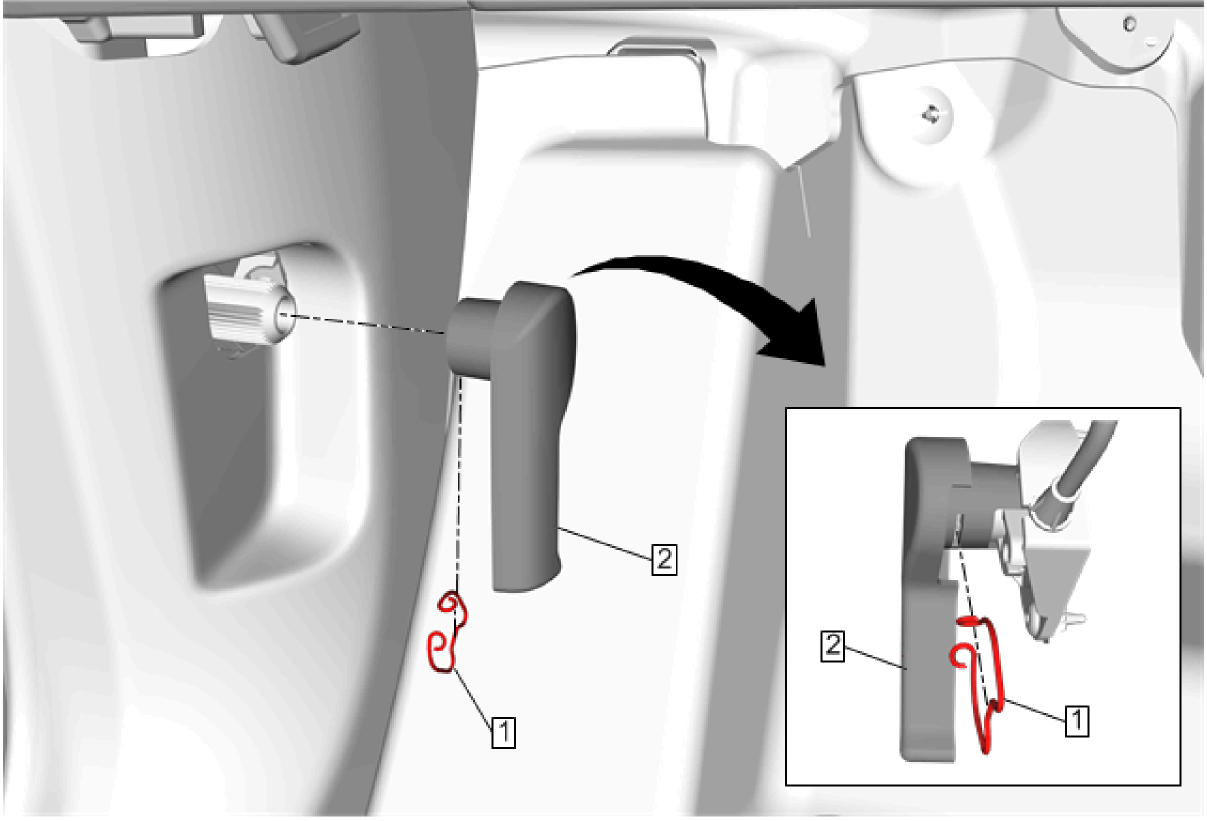


Fig. 49: Hood Primary Latch Release Cable Handle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hood Primary Latch Release Cable Handle Clip **Procedure** Pull down to remove the clip from the hood primary latch release cable handle.
2	Hood Primary Latch Release Cable Handle

FRONT SIDE DOOR UPPER HINGE AND LOWER HINGE REPLACEMENT

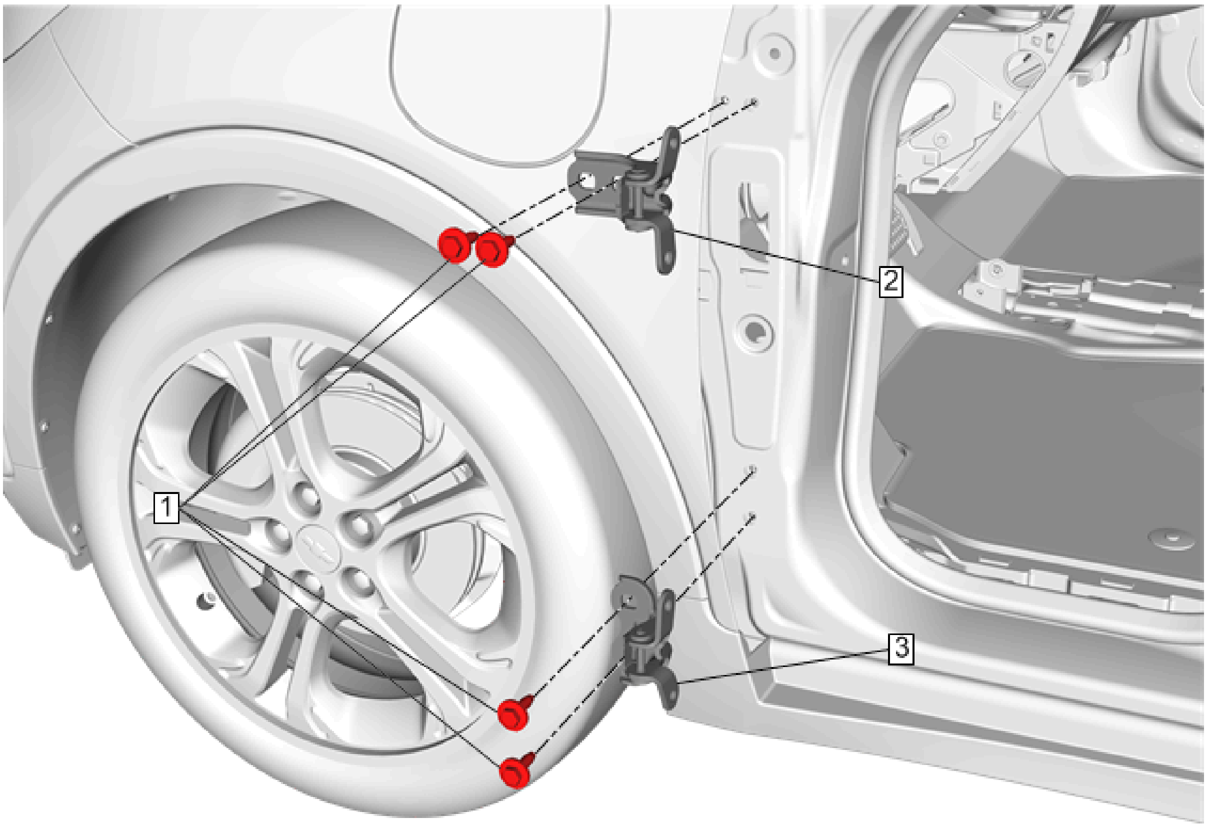


Fig. 50: Front Side Door Upper Hinge and Lower Hinge
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. **Front Side Door Replacement** 2. Mark the location of the old hinges.	
1	Front Side Door Hinge Bolt (Qty: 4) **CAUTION:** **Fastener Caution** **Tighten** 32 N.m (24 lb ft)
2	Front Side Door Upper Hinge
3	Front Side Door Lower Hinge **Procedure** Adjust the front side door as needed. **Front Side Door Adjustment**

HOOD HINGE REPLACEMENT

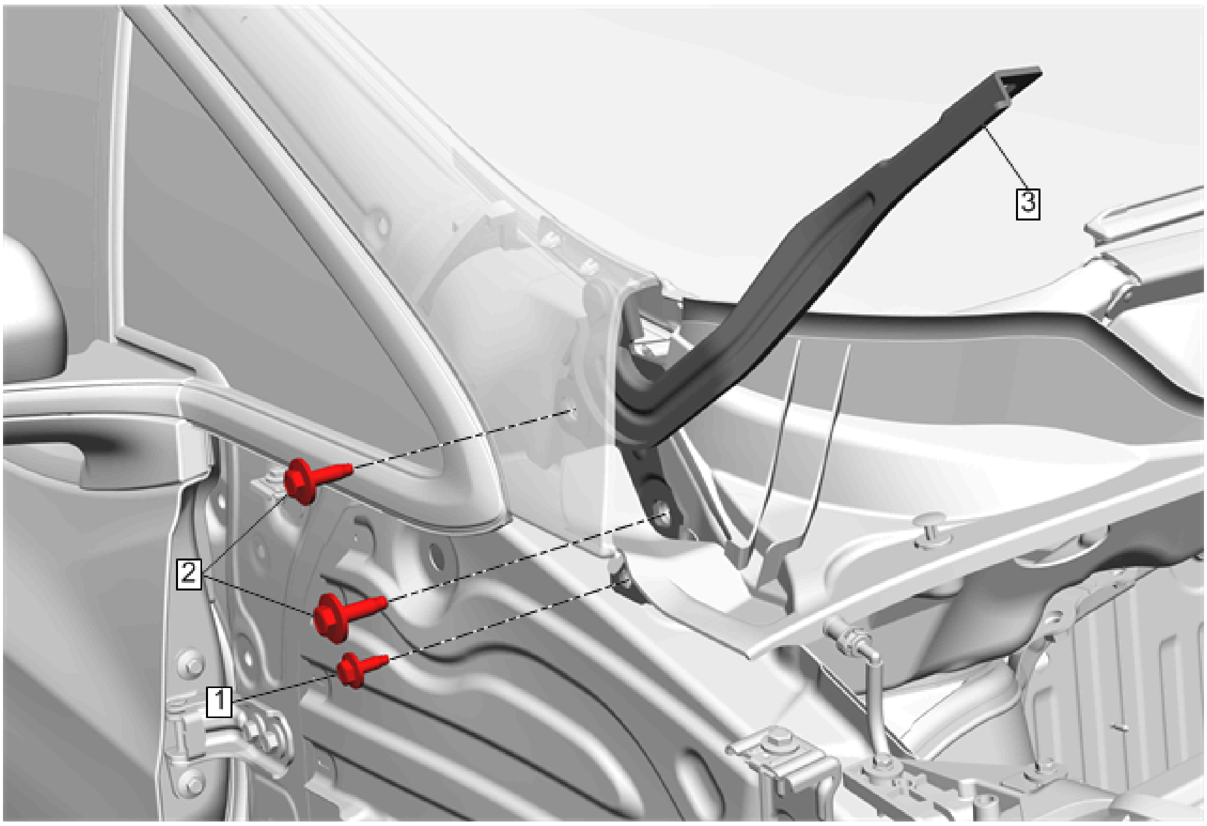


Fig. 51: Hood Hinge
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. **Hood Replacement** 2. **Front Fender Replacement - Left Side** 3. **Front Fender Replacement - Right Side**	

Callout	Component Name
1	Hood Hinge Bracket Bolt **CAUTION:** **Fastener Caution** **Tighten** 9 N.m (80 lb in)
2	Hood Hinge Bolt (Qty: 2) **Tighten** 22 N.m (16 lb ft)
3	Hood Hinge **Procedure** Adjust the hood and hinge if needed. **Hood Adjustment**

LIFTGATE HINGE REPLACEMENT

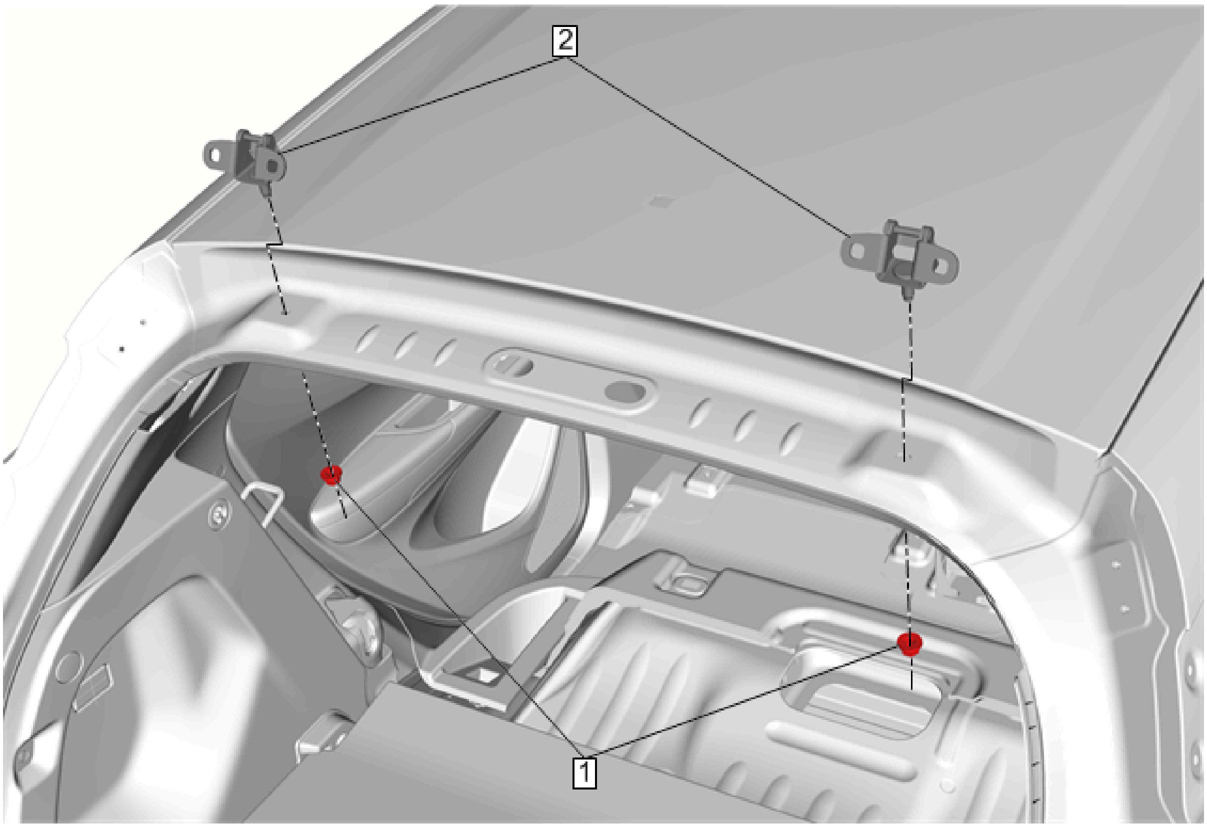


Fig. 52: Liftgate Hinge
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. **Liftgate Replacement** 2. Lower the rear headliner enough to access the liftgate hinge nuts. **Headlining Trim Panel Replacement** . 3. Use a grease pencil to mark the liftgate hinge position to the body prior to removal.	

Callout	Component Name
1	Liftgate Hinge Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 43 N.m (32 lb ft)
2	Liftgate Hinge

REAR SIDE DOOR UPPER HINGE AND LOWER HINGE REPLACEMENT

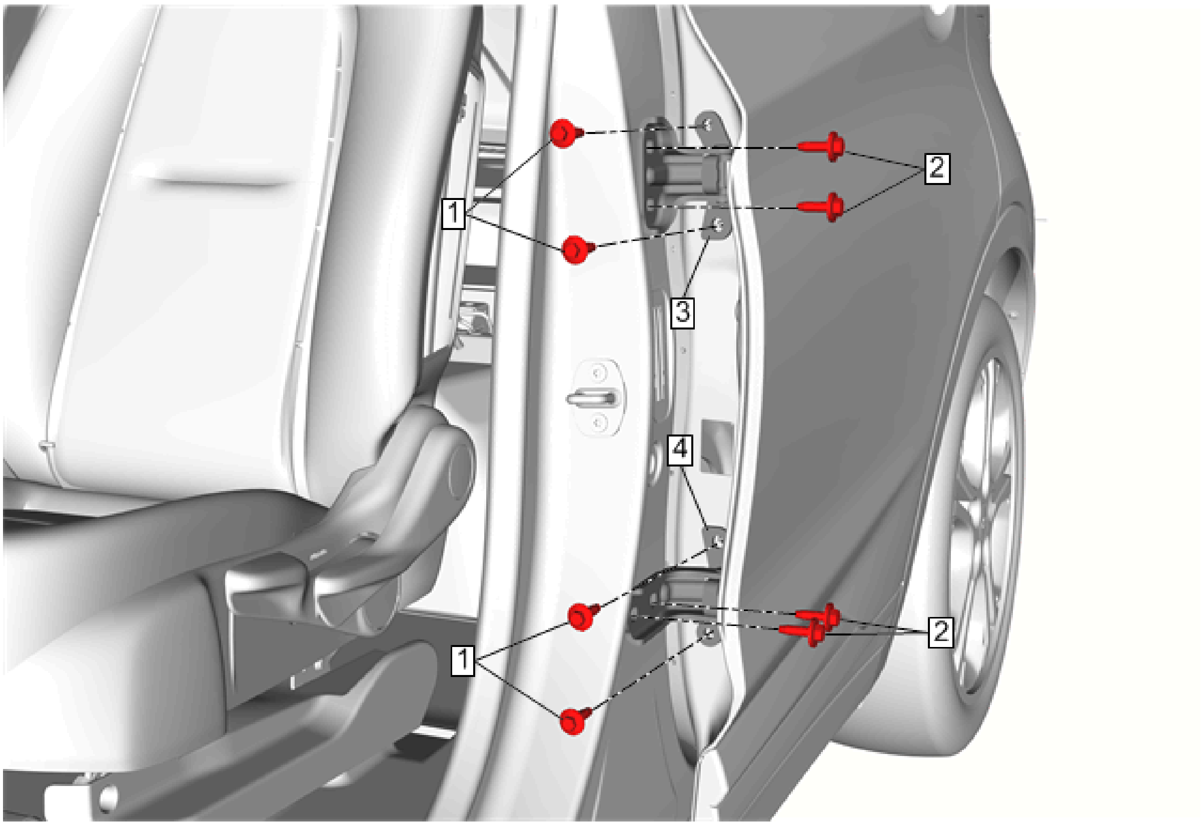


Fig. 53: Rear Side Door Upper Hinge and Lower Hinge
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Mark the location of the old hinges.	
1	Rear Side Door Hinge Bolt-Door Side (Qty: 4) **CAUTION:** **Fastener Caution** **Tighten** 25 N.m (18 lb ft)
2	Rear Side Door Hinge Bolt-Body Side (Qty: 4) **Tighten** 32 N.m (24 lb ft)
3	Rear Side Door Upper Hinge

Callout	Component Name
4	Rear Side Door Lower Hinge **Procedure** 1. Leave the rear door closed. And open the front door. 2. Replace one hinge at a time. 3. Adjust the rear side door as needed. **Rear Side Door Adjustment**

HOOD ADJUSTMENT

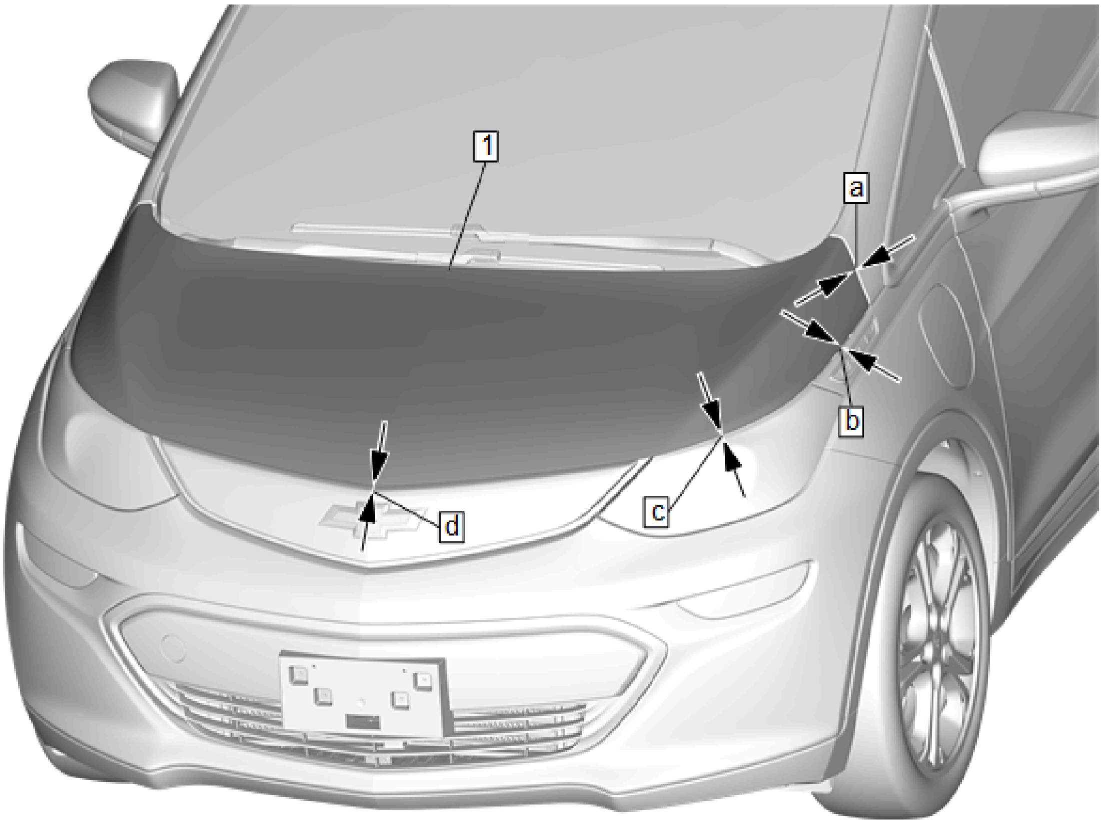


Fig. 54: Adjusting Hood
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Hood **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Loosen the four hood hinge bolt. 2. Adjust the hood in order to obtain an even gap on both sides between the hood and the A-pillar, the fender applique, the headlamp and the grille. **Adjustment** • Hood to A-pillar (a) 3.0 mm Ã,Â± 1.0 mm (0.12 in Ã,Â± 0.04 in) • Hood to fender applique (b) 3.0 mm Ã,Â± 0.75 mm (0.12 in Ã,Â± 0.03 in) • Hood to headlamp (c) 3.0 mm Ã,Â± 0.9 mm (0.12 in Ã,Â± 0.035 in) • Hood to grille (d) 6.0 mm Ã,Â± 1.0 mm (0.24 in Ã,Â± 0.04 in) **Tighten** 22 N.m (16 lb ft)

HOOD REPLACEMENT

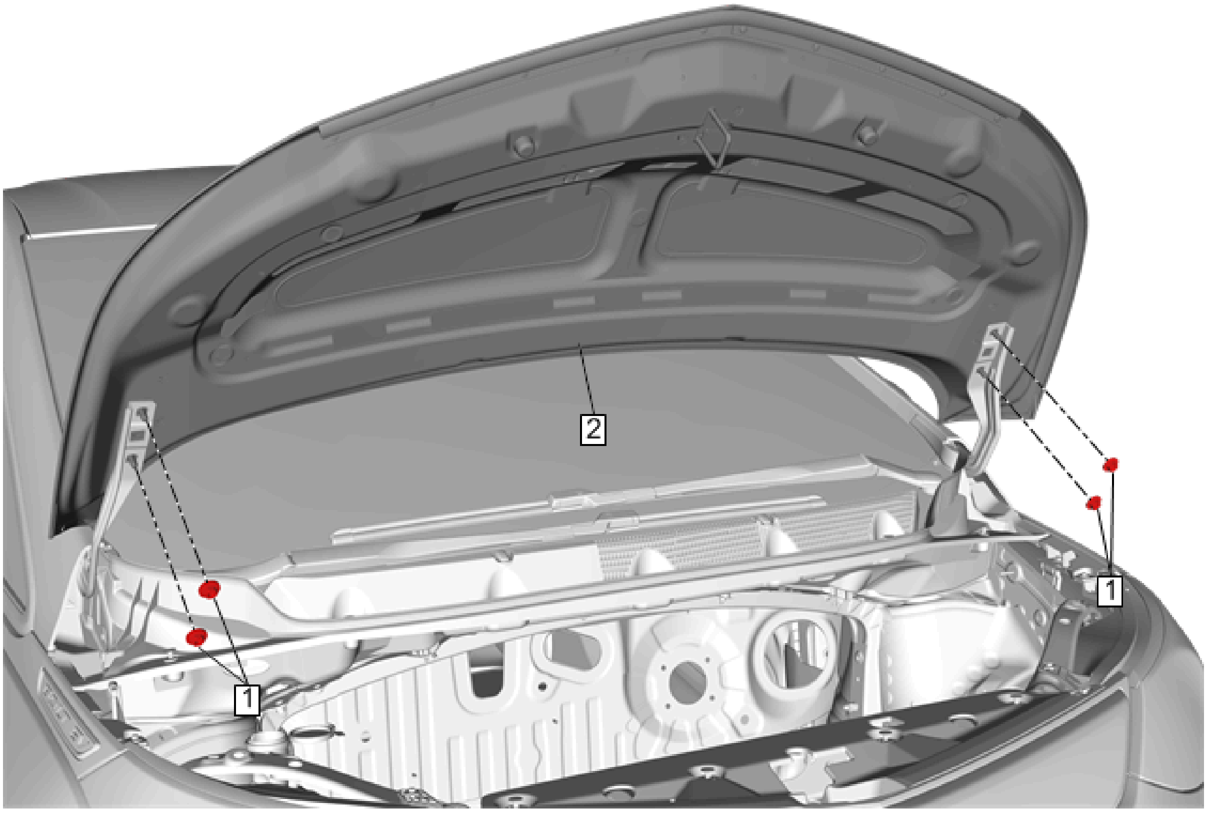


Fig. 55: Hood

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Hood Hinge Nut (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **Procedure** Mark the hinge to hood position with grease pencil. **Tighten** 22 N.m (16 lb ft)
2	Hood **WARNING:** **When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.** **Procedure** 1. Remove the hood with the aid of an assistant. 2. Transfer components as necessary. 3. Adjust hood as needed. **Hood Adjustment**

FRONT FENDER INSULATOR REPLACEMENT

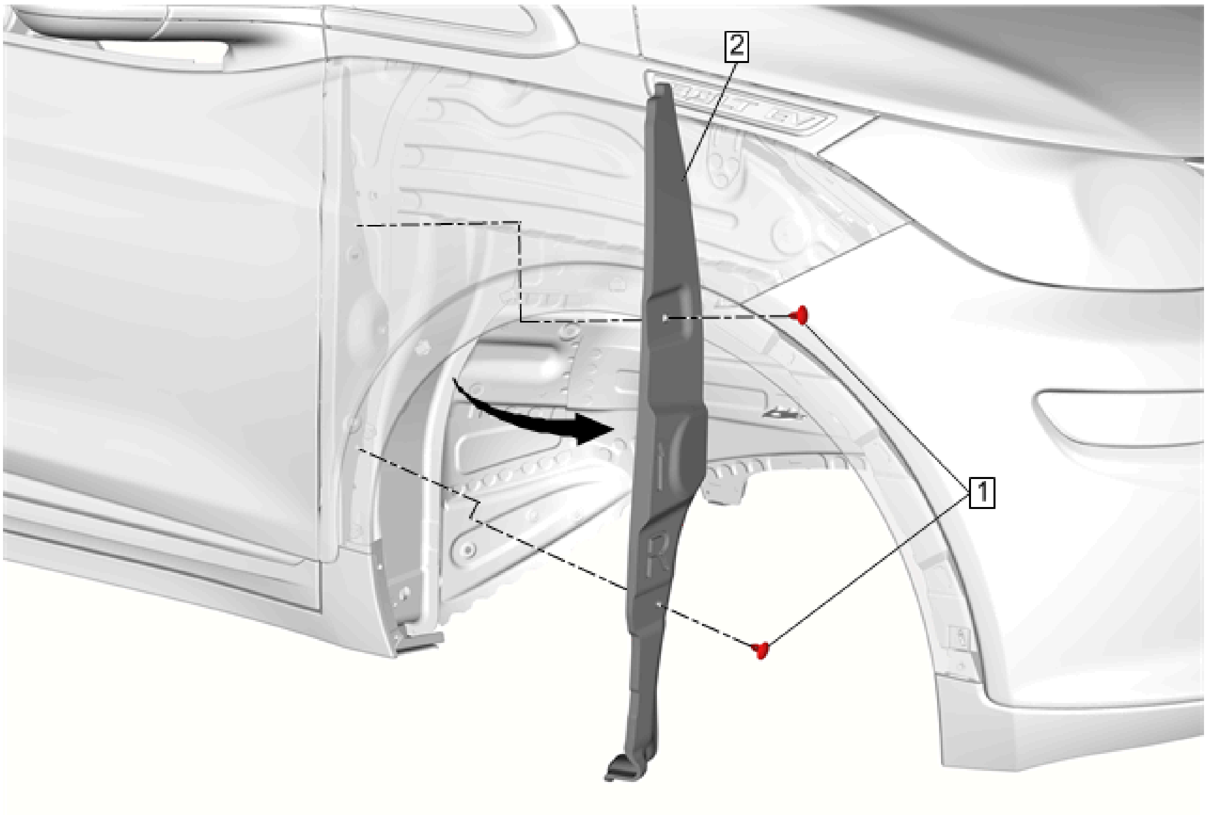


Fig. 56: Front Fender Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Wheelhouse Liner Replacement**	
1	Front Fender Insulator Retainer (Qty: 2)
2	Front Fender Insulator

HOOD INSULATOR REPLACEMENT

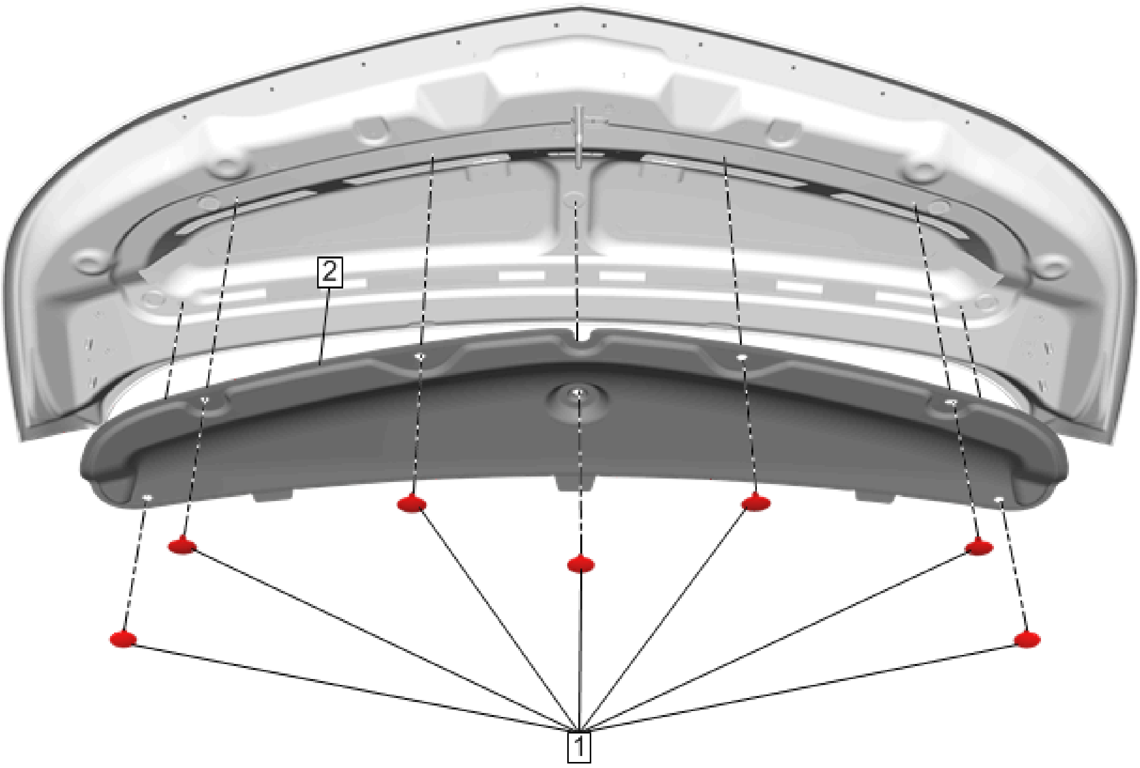


Fig. 57: Hood Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the hood.	
1	Hood Insulator Retainer (Qty: 7) **Procedure** Using a suitable flat-bladed tool, remove the hood insulator retainers.
2	Hood Insulator

HOOD PRIMARY AND SECONDARY LATCH REPLACEMENT

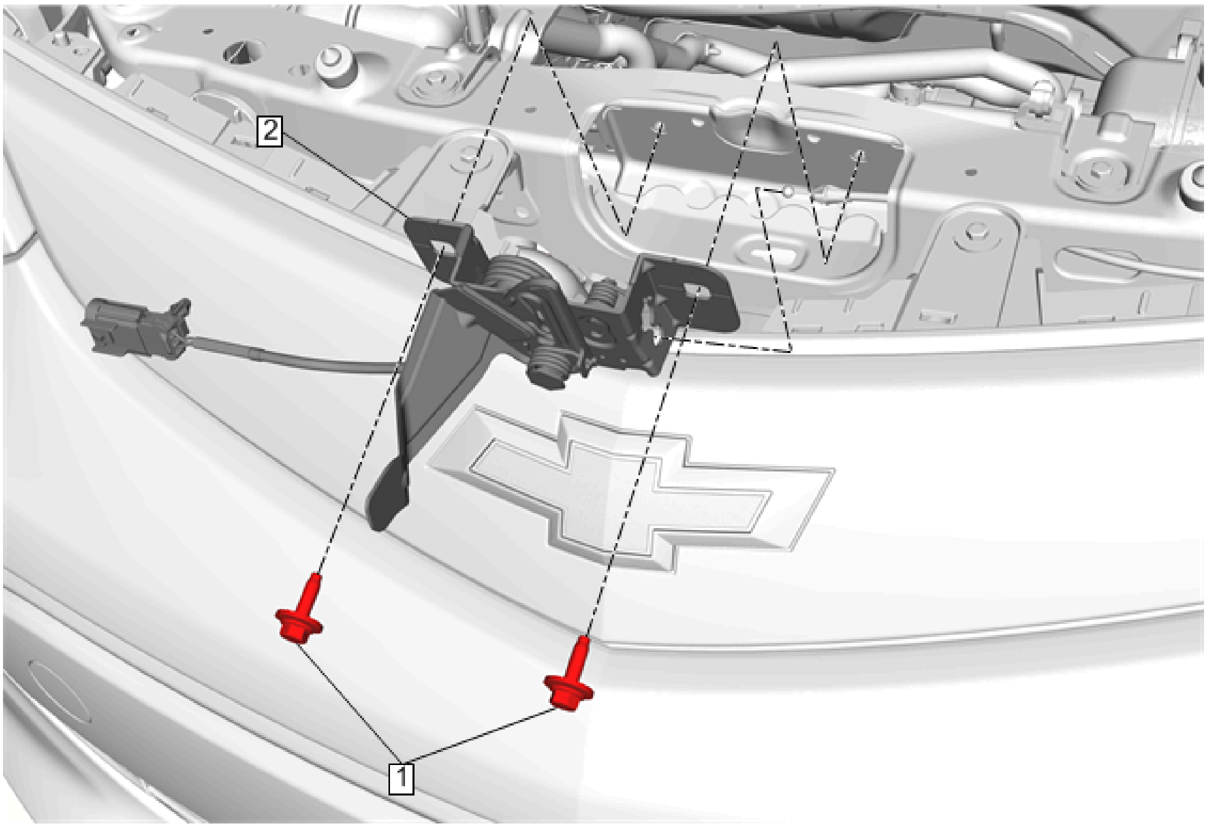


Fig. 58: Hood Primary and Secondary Latch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Front Compartment Front Sight Shield Replacement	
1	Hood Primary and Secondary Latch Bolt (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 9 N.m (80 lb in)
2	Hood Primary and Secondary Latch **Procedure** 1. Disconnect the release cable from the hood primary latch. 2. Unclip and disconnect the electrical connector.

FRONT SIDE DOOR CHECK LINK REPLACEMENT

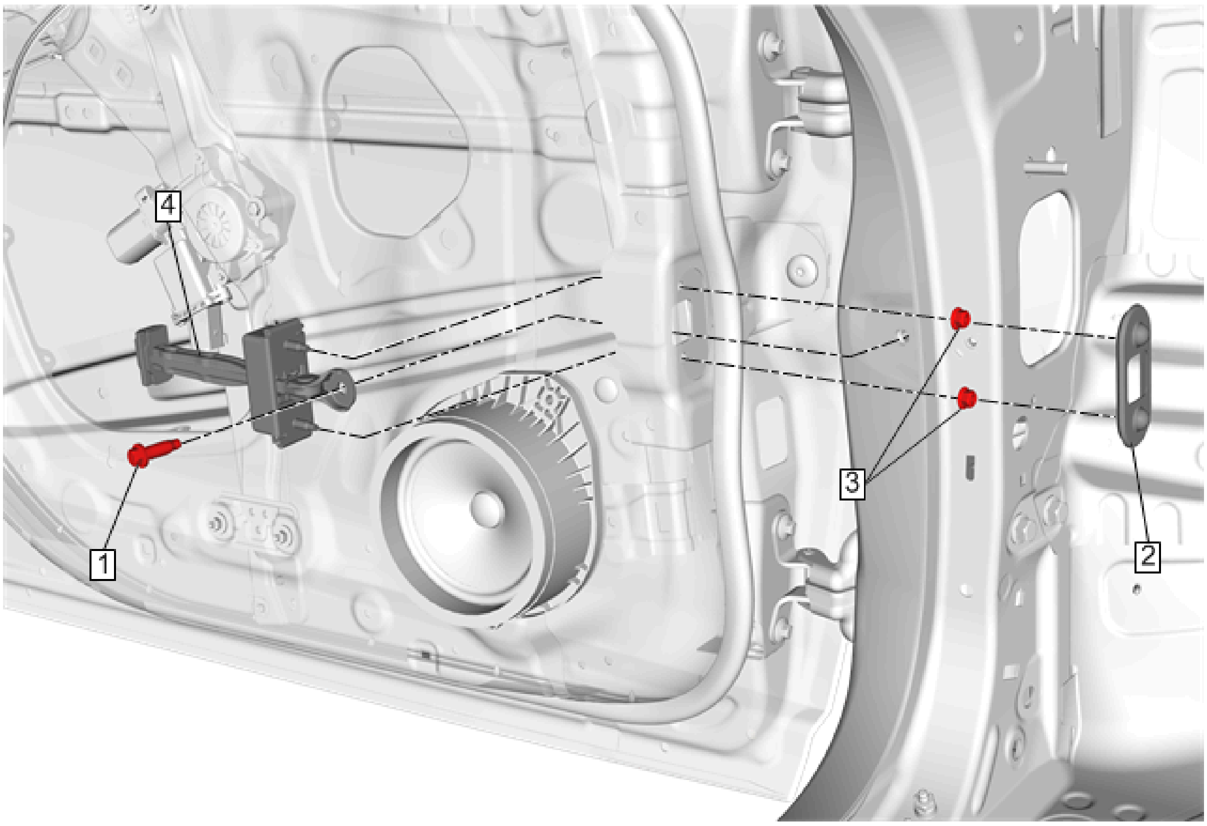


Fig. 59: Front Side Door Check Link
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Place the window in the full up position. 2. Front Side Door Trim Replacement 3. Front Side Door Water Deflector Replacement	

Callout	Component Name
1	Front Side Door Check Link Bolt **CAUTION:** **Fastener Caution** **Tighten** 22 N.m (16 lb ft)
2	Front Side Door Check Link Grommet
3	Front Side Door Check Link Nut (Qty: 2) **Tighten** 9 N.m (80 lb in)
4	Front Side Door Check Link

REAR SIDE DOOR CHECK LINK REPLACEMENT

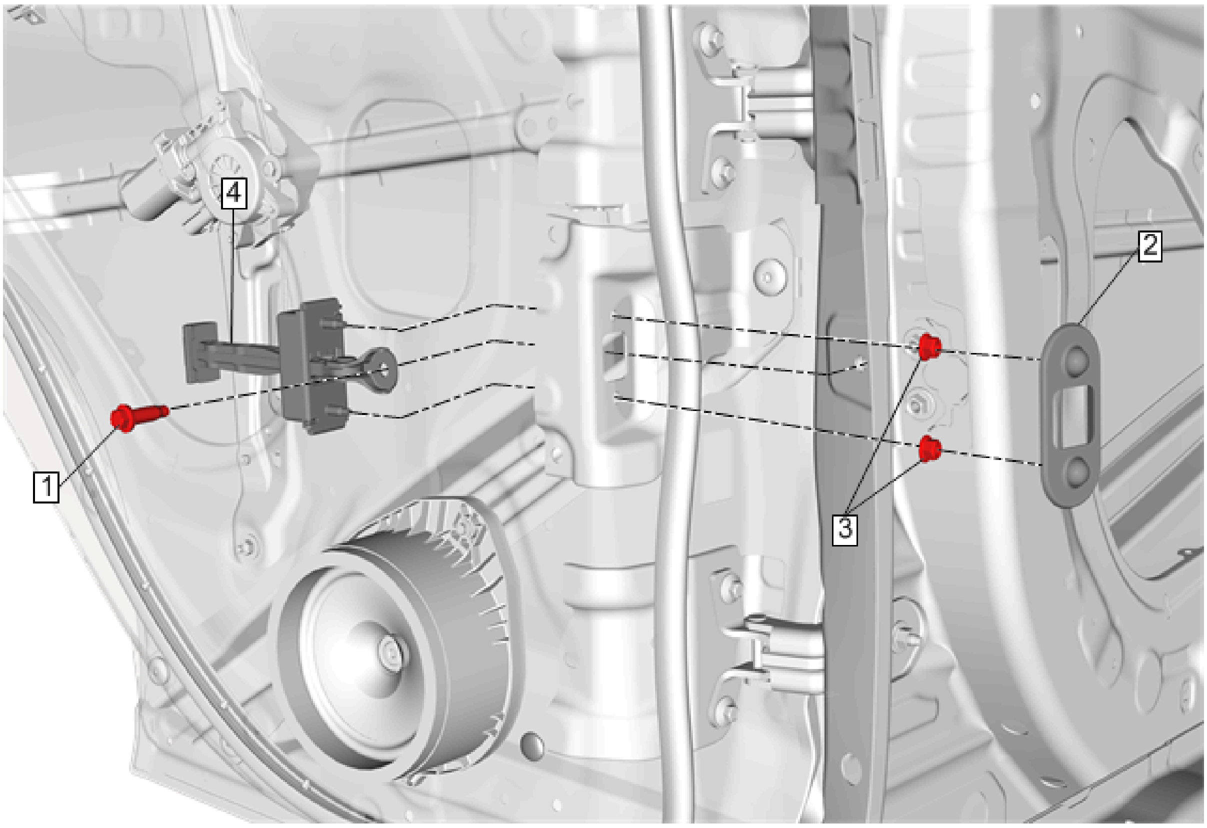


Fig. 60: Rear Side Door Check Link
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Place the window in the full up position. 2. Rear Side Door Trim Replacement 3. Rear Side Door Water Deflector Replacement	
1	Rear Side Door Check Link Bolt **CAUTION:** **Fastener Caution** **Tighten** 22 N.m (16 lb ft)
2	Rear Side Door Check Link Grommet

Callout	Component Name
3	Rear Side Door Check Link Nut (Qty: 2) **Tighten** 9 N.m (80 lb in)
4	Rear Side Door Check Link

HOOD HOLD-OPEN ROD REPLACEMENT

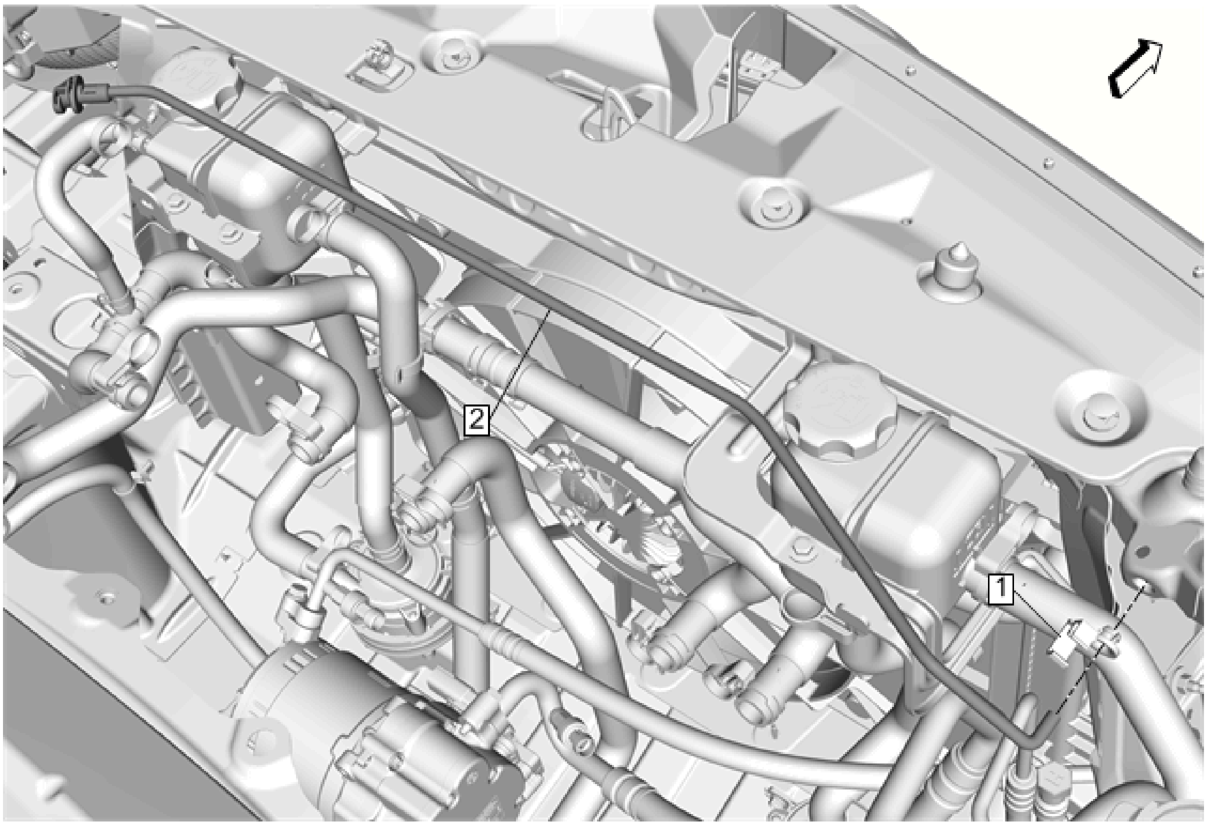


Fig. 61: Hood Hold-Open Rod
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hood Hold-Open Rod Pivot **WARNING:** **When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.** **Procedure** 1. Install an alternative hood support. 2. Release the retaining feature on the rod pivot.
2	Hood Hold-Open Rod **Procedure** Remove the rod from the vehicle.

HOOD HOLD-OPEN ROD PIVOT REPLACEMENT

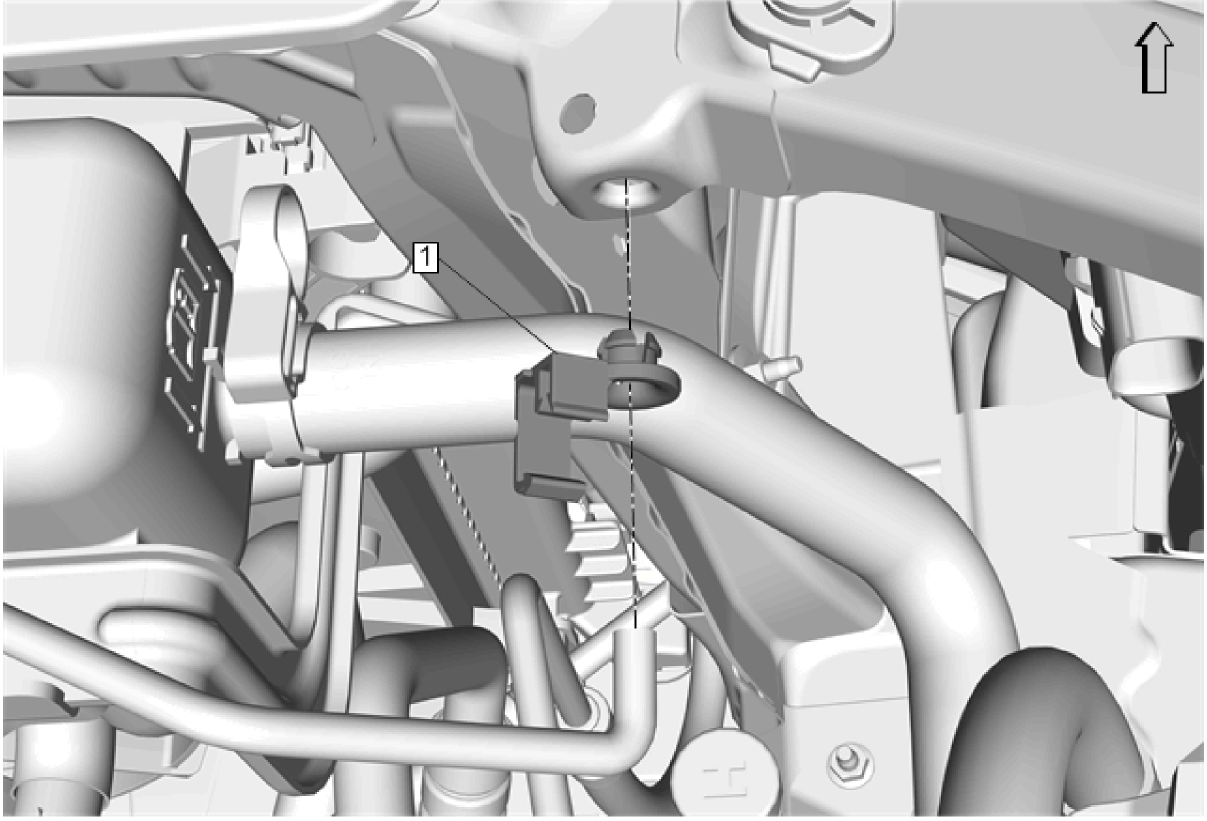


Fig. 62: Hood Hold-Open Rod Pivot
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Hood Hold-Open Rod Replacement	
1	Hood Hold-Open Rod Pivot **WARNING:** **When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.**

HOOD FRONT WEATHERSTRIP REPLACEMENT

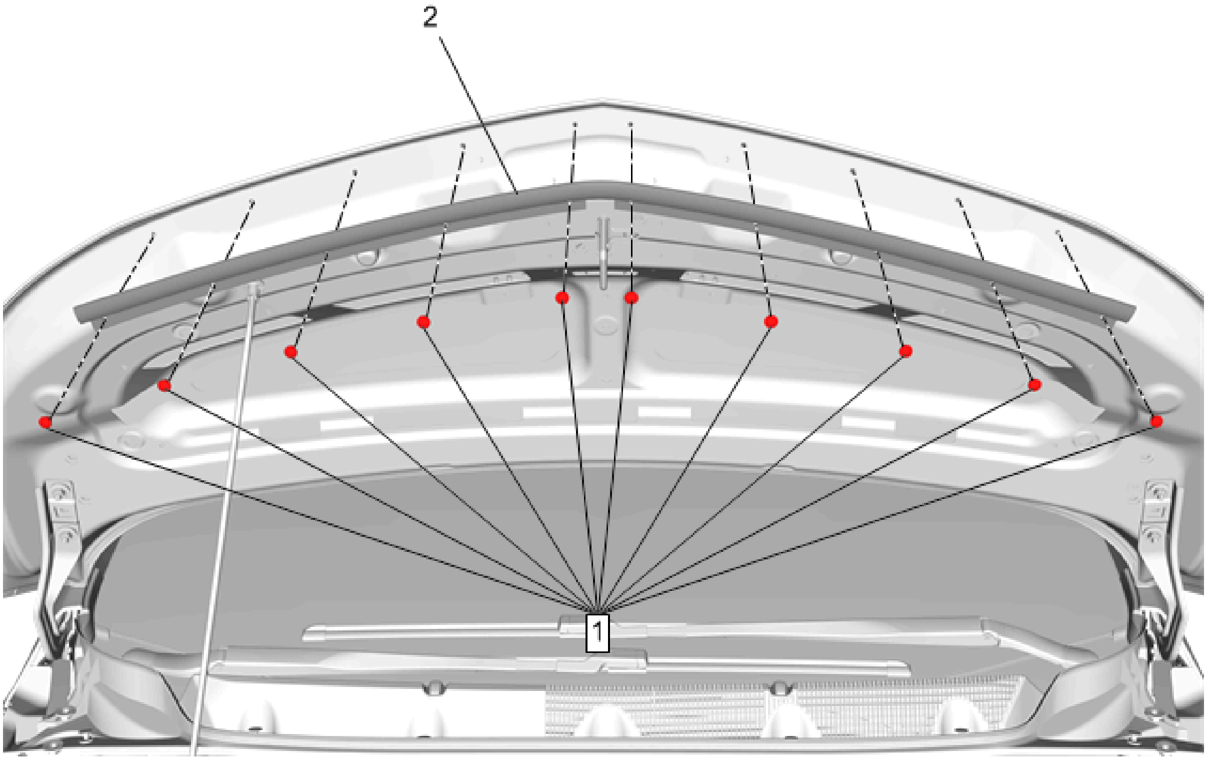


Fig. 63: Hood Front Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hood Front Weatherstrip Retainer
2	Hood Front Weatherstrip

FRONT COMPARTMENT FRONT SIGHT SHIELD REPLACEMENT

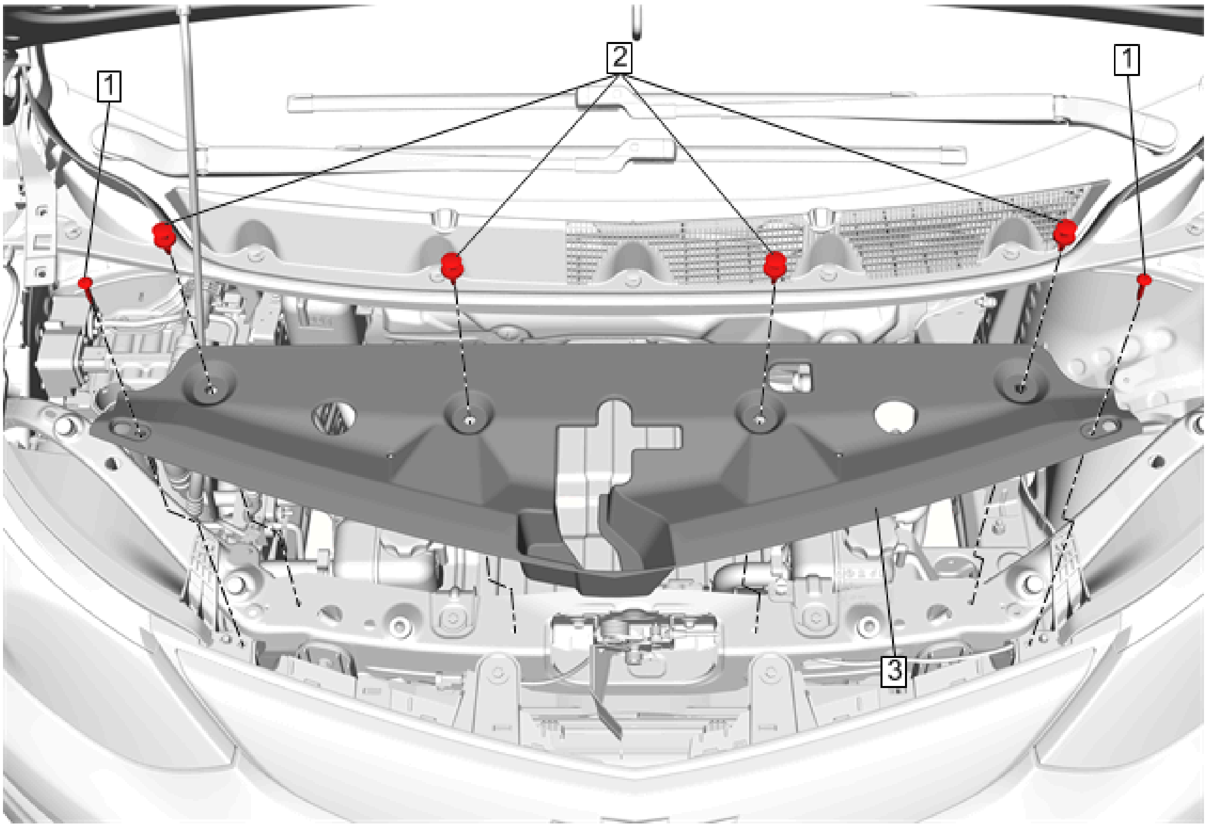


Fig. 64: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Front Compartment Front Sight Shield Bolt (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Front Compartment Front Sight Shield Retainer (Qty: 4)
3	Front Compartment Front Sight Shield **Procedure** Release the four integral retainers.

LIFTGATE STRUT REPLACEMENT

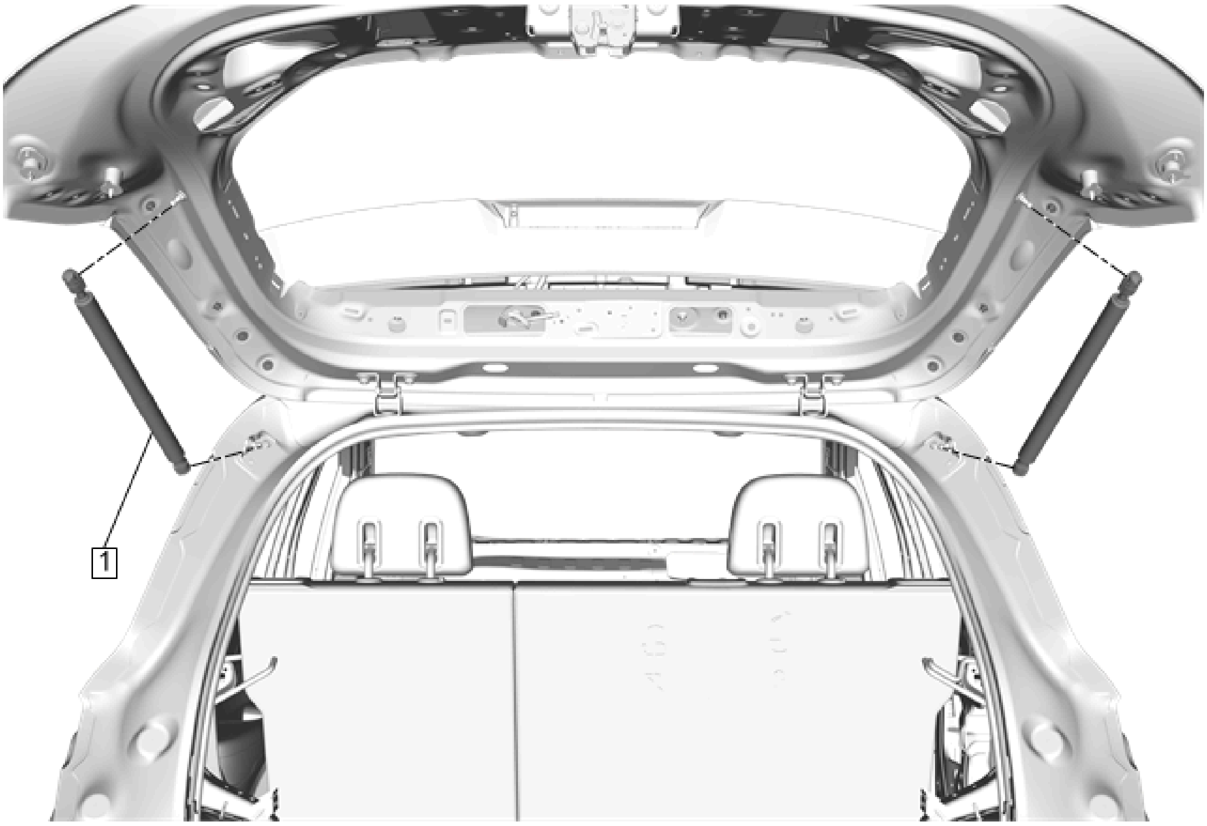


Fig. 65: Liftgate Strut
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Liftgate Strut **WARNING:** **When a lift gate hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.** **CAUTION:** **Apply pressure only at the end of the liftgate/hood assist rod that you are removing or attaching. Do NOT apply pressure to the middle of the rod because damage or bending will result.** **Procedure** 1. Release the locking tabs on the strut. 2. Ensure the clip is fully seated when the strut is reinstalled. If the clip cannot be fully seated, a new strut should be installed. 3. Ensure the strut shaft is pointing toward the roof structure.

FRONT SIDE DOOR WEATHERSTRIP REPLACEMENT - DOOR SIDE

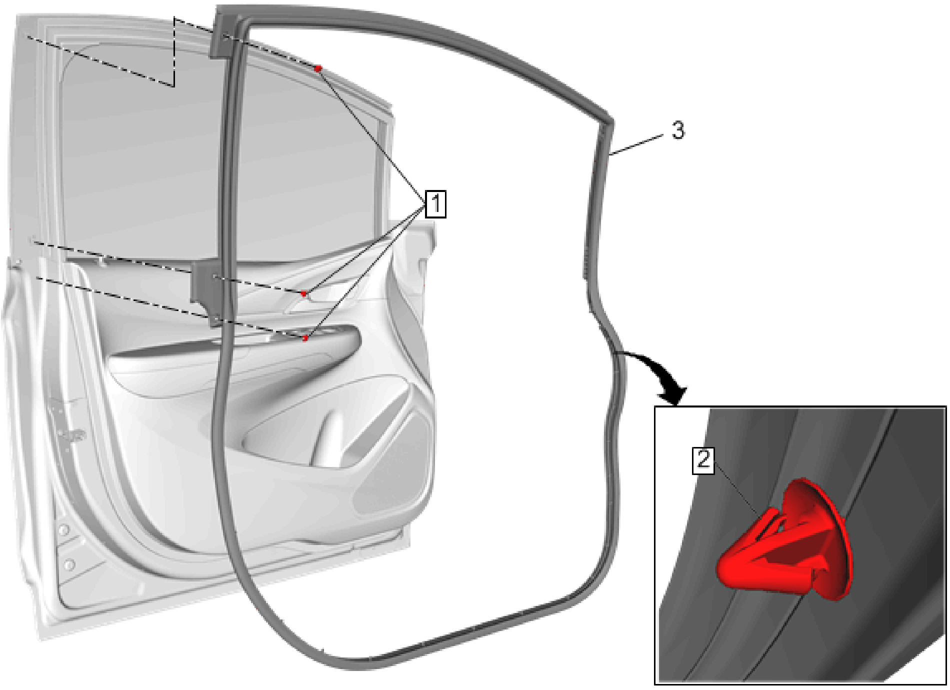


Fig. 66: Front Side Door Weatherstrip - Door Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Open the rear side door to the fully open position. 2. Remove the front side door check link bolt from the body side only. Front Side Door Check Link Replacement	
1	Front Side Door Weatherstrip Upper Retainer
2	Front Side Door Weatherstrip Retainer

Callout	Component Name
3	Front Side Door Weatherstrip - Door Side **Procedure** 1. Ensure that the weatherstrip is fully seated in the door frame retainer. 2. Verify proper door operation. **NOTE:** **Water test the door area after replacing the door weatherstrip to ensure no leaks.**

FRONT SIDE DOOR WEATHERSTRIP REPLACEMENT - BODY SIDE

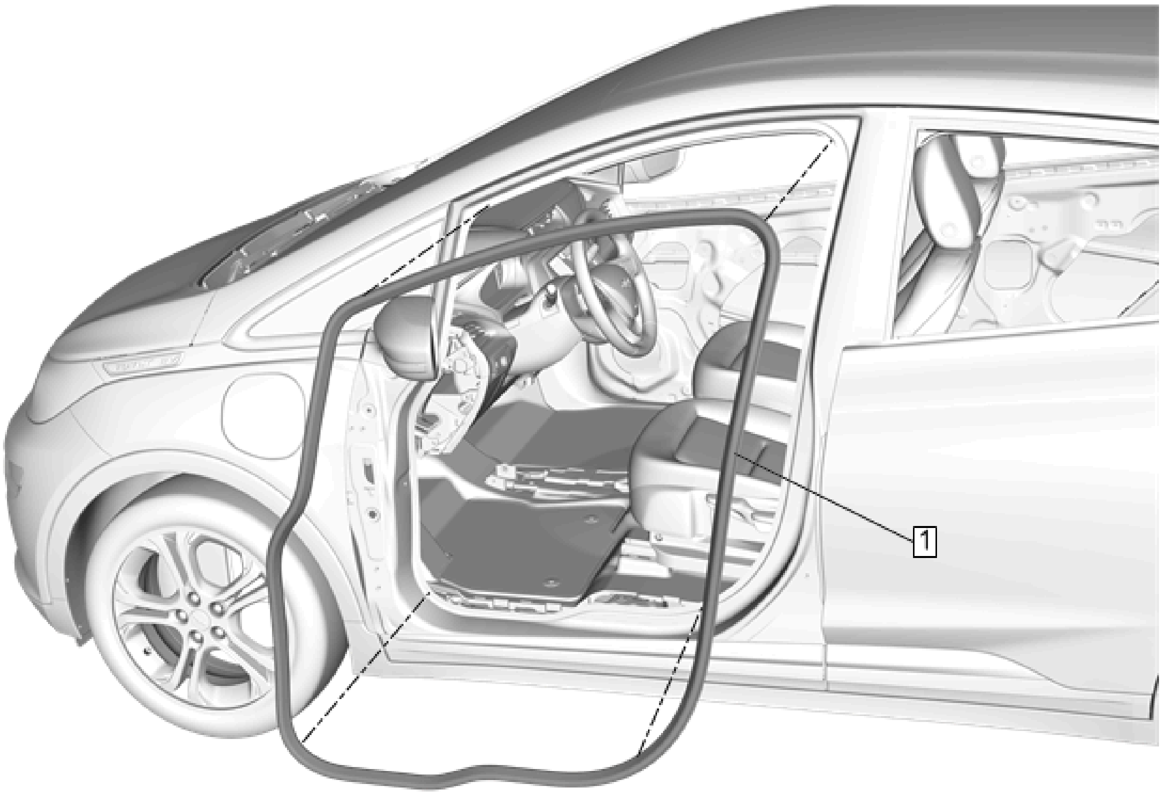


Fig. 67: Front Side Door Weatherstrip - Body Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Side Door Weatherstrip - Body Side **Procedure** 1. Ensure that the weatherstrip is fully seated on the flange. 2. Ensure that the weatherstrip is properly installed around the trim panel. 3. Verify proper door operation. **NOTE:** **Water test the door area after replacing the door weatherstrip to ensure no leaks.**

LIFTGATE WEATHERSTRIP REPLACEMENT

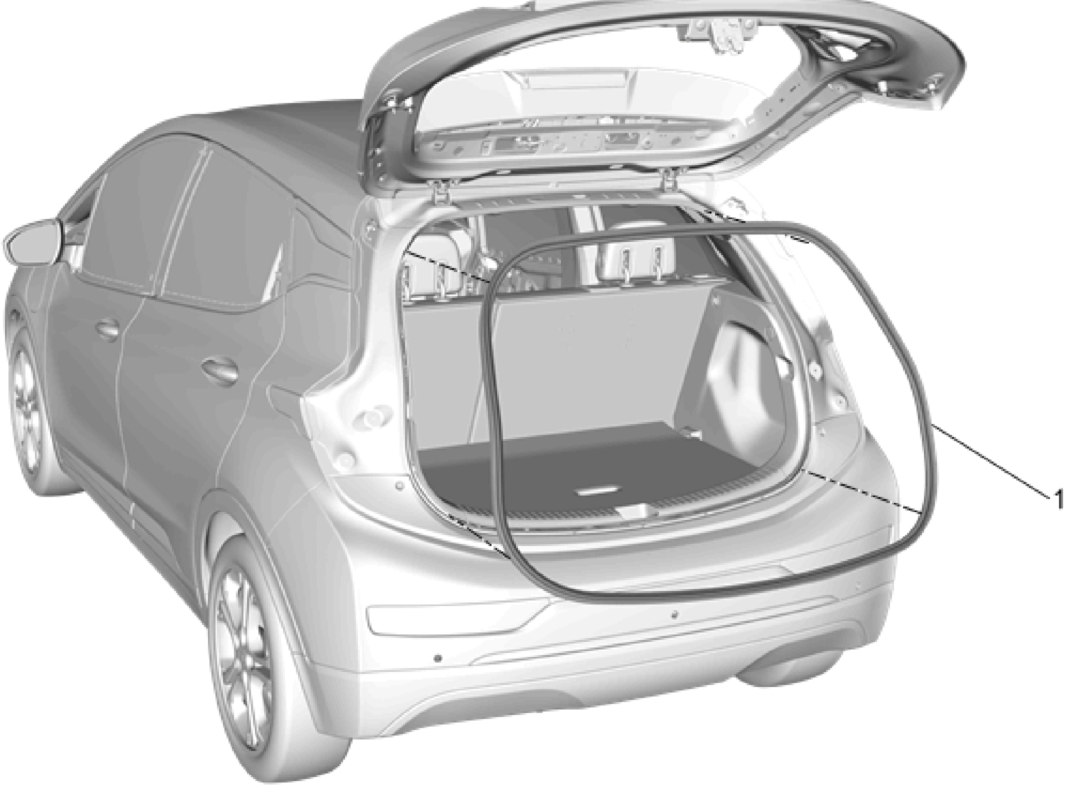


Fig. 68: Liftgate Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Liftgate Window Weatherstrip **Procedure** 1. Start at the upper corner of the liftgate opening and pull the weatherstrip away from the liftgate opening flange. 2. Position the weatherstrip in the upper corner of the liftgate opening. 3. Working downward along the edge, install the weatherstrip on the liftgate opening flange ensuring that the carrier is fully seated in the corners. 4. Using a rubber mallet, ensure that the weatherstrip is seated on the entire liftgate opening flange.

REAR SIDE DOOR WEATHERSTRIP REPLACEMENT - DOOR SIDE

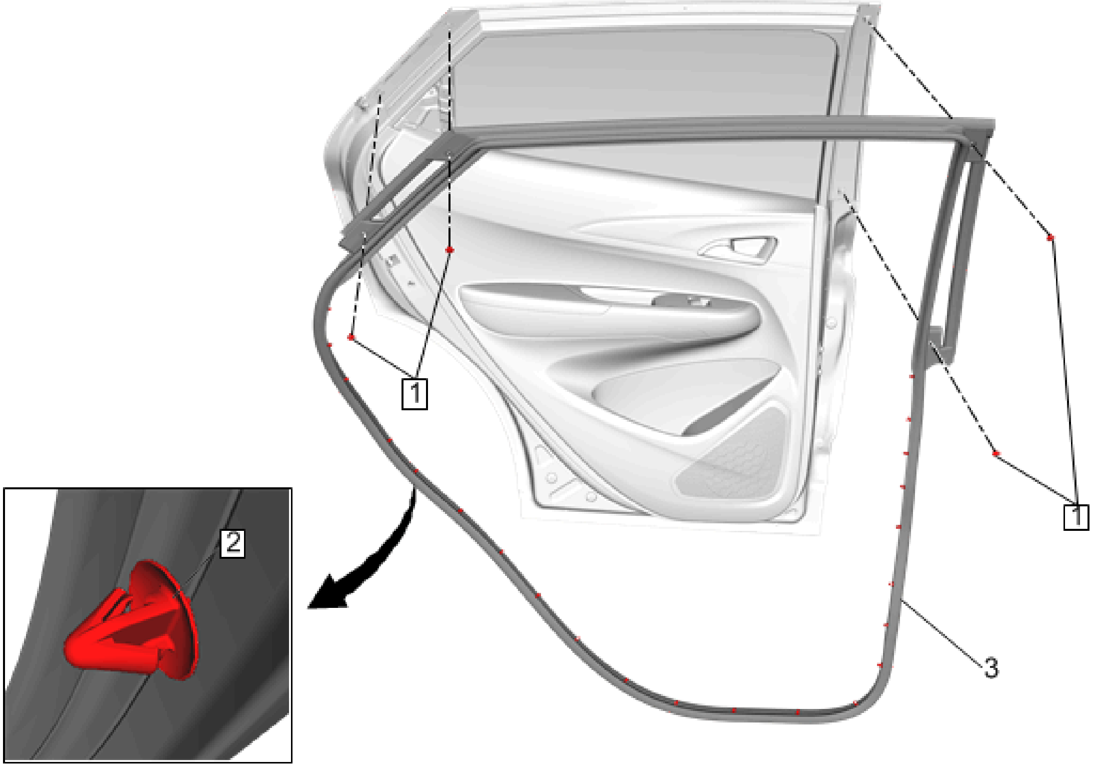


Fig. 69: Rear Side Door Weatherstrip - Door Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Open the rear side door to the fully open position. 2. Remove the rear side door check link bolt from the body side only. Rear Side Door Check Link Replacement	
1	Rear Side Door Weatherstrip Upper Retainer
2	Rear Side Door Weatherstrip Retainer
3	Rear Side Door Weatherstrip - Door Side **Procedure** 1. Ensure that the weatherstrip is fully seated in the door frame retainer. 2. Verify proper door operation. **NOTE:** **Water test the door area after replacing the door weatherstrip to ensure no leaks.**

REAR SIDE DOOR WEATHERSTRIP REPLACEMENT - BODY SIDE

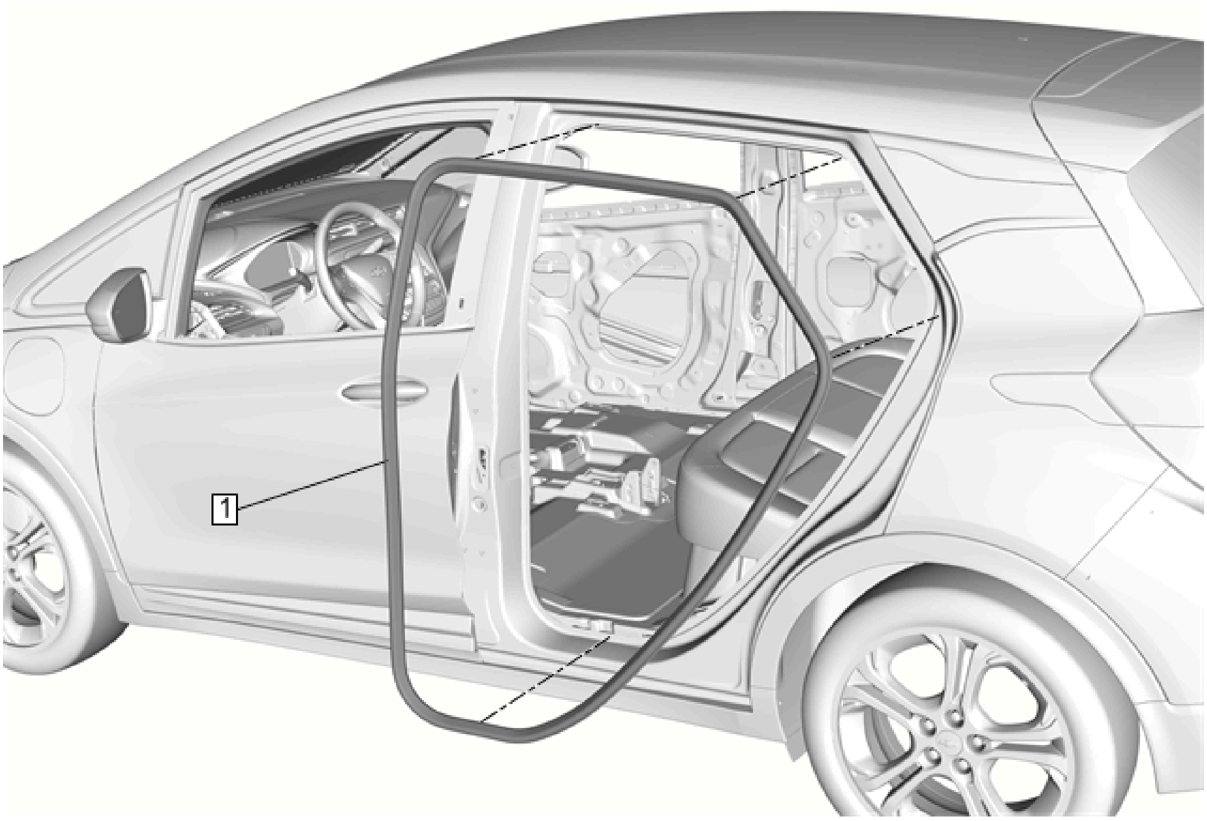


Fig. 70: Rear Side Door Weatherstrip - Body Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Side Door Weatherstrip - Body Side **Procedure** 1. Ensure that the weatherstrip is fully seated on the flange. 2. Ensure that the weatherstrip is properly installed around the trim panel. 3. Verify proper door operation. **NOTE:** **Water test the door area after replacing the door weatherstrip to ensure no leaks.**

DESCRIPTION AND OPERATION

HOOD AJAR INDICATOR DESCRIPTION AND OPERATION

Hood Ajar Switch

The body control module (BCM) applies B+ to the hood ajar signal circuit and monitors the voltage to determine the position of the hood. When the hood is closed, the switch is open and voltage remains high. When the hood is open, the switch is closed and the voltage is pulled low.

The BCM uses the hood ajar switch as a content theft deterrent alarm trigger.

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Bumpers and Fascias - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Front Bumper Energy Absorber Bolt	58 N.m (43 lb ft)
Front Bumper Fascia Guide Bolt	2.5 N.m (22 lb in)
Front Bumper Fascia Lower Bolt	2.5 N.m (22 lb in)
Front Bumper Fascia Lower Screw	2.5 N.m (22 lb in)
Front Bumper Fascia Lower Stiffener Bolt	17 N.m (13 lb ft)
Front Bumper Fascia Upper Bolt	6 N.m (53 lb in)
Front Bumper Fascia Wheel Opening Bolt	2.5 N.m (22 lb in)
Front Bumper Impact Bar Bolt	22 N.m (16 lb ft)
Front Bumper Lower Fascia Bolt	2.5 N.m (22 lb in)
Front Bumper Shutter Bolt	2.5 N.m (22 lb in)
Headlamp Bolt	2.5 N.m (22 lb in)
Radiator Air Lower Baffle Bolt	9 N.m (80 lb in)
Rear Bumper Fascia Bolt	2.5 N.m (22 lb in)
Rear Bumper Fascia Guide Bolt	2.5 N.m (22 lb in)
Rear Bumper Fascia Upper Bolt	2.5 N.m (22 lb in)
Rear Bumper Impact Bar Nut	58 N.m (43 lb ft)
Underbody Brace Reinforcement Bolt	58 N.m (43 lb ft)

SCHEMATIC WIRING DIAGRAMS

ACTIVE GRILLE AIR SHUTTER WIRING SCHEMATICS

Active Grille Air Shutter

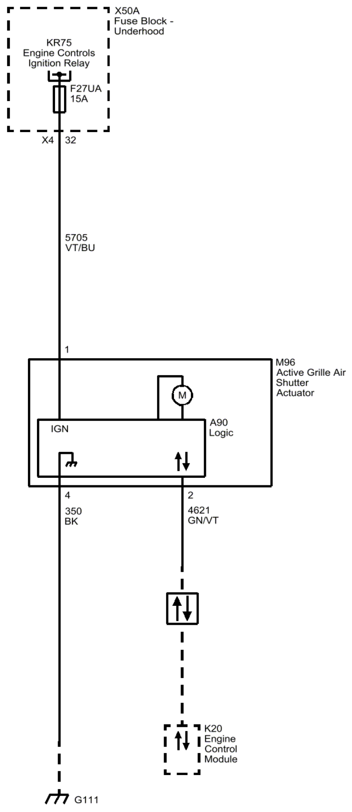

X50A Fuse Block - Underhood
KR75 Engine Controls Ignition Relay
F27UA 15A
X4
32
5705 VT/BU
1
M96 Active Grille Air Shutter Actuator
M
A90 Logic
IGN
4
350 BK
2
4621 GN/VT
K20 Engine Control Module
G111

Fig. 1: Active Grille Air Shutter
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P059F OR P151E: ACTIVE GRILLE AIR SHUTTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P059F

Active Grille Air Shutter 1 Performance

DTC P151E

Active Grille Air Shutter Actuator 1 Signal Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P059F, P151E	P059F, P151E	- -	- -
Local Interconnect Network Serial Data Bus	U1510	U1510	U1510	U1510
Ground	-	P059F, P151E	-	- -

Circuit/System Description

The active grille air shutter actuator closes louvers at the front bumper to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter actuator opens the louvers. The Local Interconnect Network (LIN) Serial Data Bus signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuator to operate. If the conditions for opening the louvers are reached the engine control module commands the active grille air shutter actuator to open the louvers.

Conditions for Running the DTC

- Ignition On/Vehicle in Service Mode.
- The battery voltage is greater than 10 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The DTC P059F will be set during a key cycle when the commanded louver position can not be achieved after 5 attempts are made to move the louver. The DTC will be stored as current for this key cycle but the malfunction indicator lamp (MIL) will not be illuminated. The malfunction indicator lamp will illuminate in the second key cycle after a failed movement attempt is made in each of two back to back key cycles.
- The DTC P151E will set if there is a serial data communication failure.

Action Taken When the DTC Sets

DTC P059F and P151E are type B DTCs.

Conditions for Clearing the DTC

DTC P059F and P151E are type B DTCs.

Reference Information

Schematic Reference

Active Grille Air Shutter Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Active Grille Air Shutter Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Verify DTC U1510 is not set.
   - **If DTC U1510 is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for further diagnosis.

   - **If DTC U1510 is not set**

3. Verify the active grille air shutter position parameter changes from 0% (fully closed) to 100% (fully open) when using the scan tool ECM Active Grille Air Shutter Position control function.
   - **If the louvers at the front bumper do not open and close**

     Refer to Circuit/System Testing.

   - **If the louvers at the front bumper open and close**
4. Verify none of the following conditions are present:
   - Snow or ice packed in the front fascia which prevents the louvers from moving.
   - Debris or foreign objects which prevent the louvers from moving.
   - **If any of the conditions are present**

     Clear any snow, ice or foreign objects from the front grille.

   - **If none of the conditions are present**
5. All OK

Circuit/System Testing

1. Ignition/Vehicle Off and all vehicle systems Off, disconnect the harness connector(s) at the active grille air shutter actuator(s). It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle Off.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition On/Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle Off.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse. Refer to **Power Mode Mismatch** .
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle Off.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   - **If the test lamp illuminates**
5. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.
   1. Test for infinite resistance between the LIN Serial Data Bus circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   2. Test for less than 2 Ω in the LIN Serial Data Bus circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω
   3. Test for less than 1 V between the LIN Serial Data Bus circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
6. Test or replace the M60A Active Grille Air Shutter 1 Motor Module.

7. Verify DTCs P059F, P151E or U1510 are not set while operating the vehicle under the conditions for setting the DTC.
    - **If the DTC is set**

      Replace the K20 Engine Control Module.

    - **If the DTC is not set**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup.

SYMPTOMS - ACTIVE GRILLE AIR SHUTTER

NOTE: The following steps must be completed before using the symptom tables:

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Active Grille Air Shutter Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Active Grille Air Shutter 1 Malfunction

ACTIVE GRILLE AIR SHUTTER 1 MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P059F

Active Grille Air Shutter 1 Performance

DTC P151E

Active Grille Air Shutter Actuator 1 Signal Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P059F, P151E	P059F, P151E	- -	- -
Local Interconnect Network Serial Data Bus	U1510	U1510	U1510	U1510
Ground	-	P059F, P151E	-	- -

Circuit/System Description

The active grille air shutter actuator closes louvers at the front bumper to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter actuator opens the louvers. The Local Interconnect Network (LIN) Serial Data Bus signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuator to operate. If the conditions for opening the louvers are reached the engine control module commands the active grille air shutter actuator to open the louvers.

Conditions for Running the DTC

- Ignition On/Vehicle in Service Mode.
- The battery voltage is greater than 10 V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

- The DTC P059F will be set during a key cycle when the commanded louver position can not be achieved after 5 attempts are made to move the louver. The DTC will be stored as current for this key cycle but the malfunction indicator lamp (MIL) will not be illuminated. The malfunction indicator lamp will illuminate in the second key cycle after a failed movement attempt is made in each of two back to back key cycles.
- The DTC P151E will set if there is a serial data communication failure.

Action Taken When the DTC Sets

DTC P059F and P151E are type B DTCs.

Conditions for Clearing the DTC

DTC P059F and P151E are type B DTCs.

Reference Information

Schematic Reference

Active Grille Air Shutter Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Active Grille Air Shutter Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Verify DTC U1510 is not set.
   - **If DTC U1510 is set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.

   - **If DTC U1510 is not set**
3. Verify the active grille air shutter position parameter changes from 0% (fully closed) to 100% (fully open) when using the scan tool ECM Active Grille Air Shutter Position control function.
   - **If the louvers at the front bumper do not open and close**

     Refer to Circuit/System Testing.

   - **If the louvers at the front bumper open and close**
4. Verify none of the following conditions are present:
   - Snow or ice packed in the front fascia which prevents the louvers from moving.
   - Debris or foreign objects which prevent the louvers from moving.
   - **If any of the conditions are present**

     Clear any snow, ice or foreign objects from the front grille.

   - **If none of the conditions are present**
5. All OK

Circuit/System Testing

1. Ignition/Vehicle Off and all vehicle systems Off, disconnect the harness connector(s) at the active grille air shutter actuator(s). It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle Off.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition On/Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle Off.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse. Refer to Power Mode Mismatch .
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle Off.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   - **If the test lamp illuminates**
5. Ignition/Vehicle Off, disconnect the harness connector at the K20 Engine Control Module.
   1. Test for infinite resistance between the LIN Serial Data Bus circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance

    2. Test for less than 2 Ω in the LIN Serial Data Bus circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω
    3. Test for less than 1 V between the LIN Serial Data Bus circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V

6. Test or replace the M60A Active Grille Air Shutter 1 Motor Module.
7. Verify DTCs P059F, P151E or U1510 are not set while operating the vehicle under the conditions for setting the DTC.
    - **If the DTC is set**

      Replace the K20 Engine Control Module.

    - **If the DTC is not set**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup.

REPAIR INSTRUCTIONS

FRONT BUMPER ENERGY ABSORBER REPLACEMENT (NORTH AMERICA)

Removal Procedure

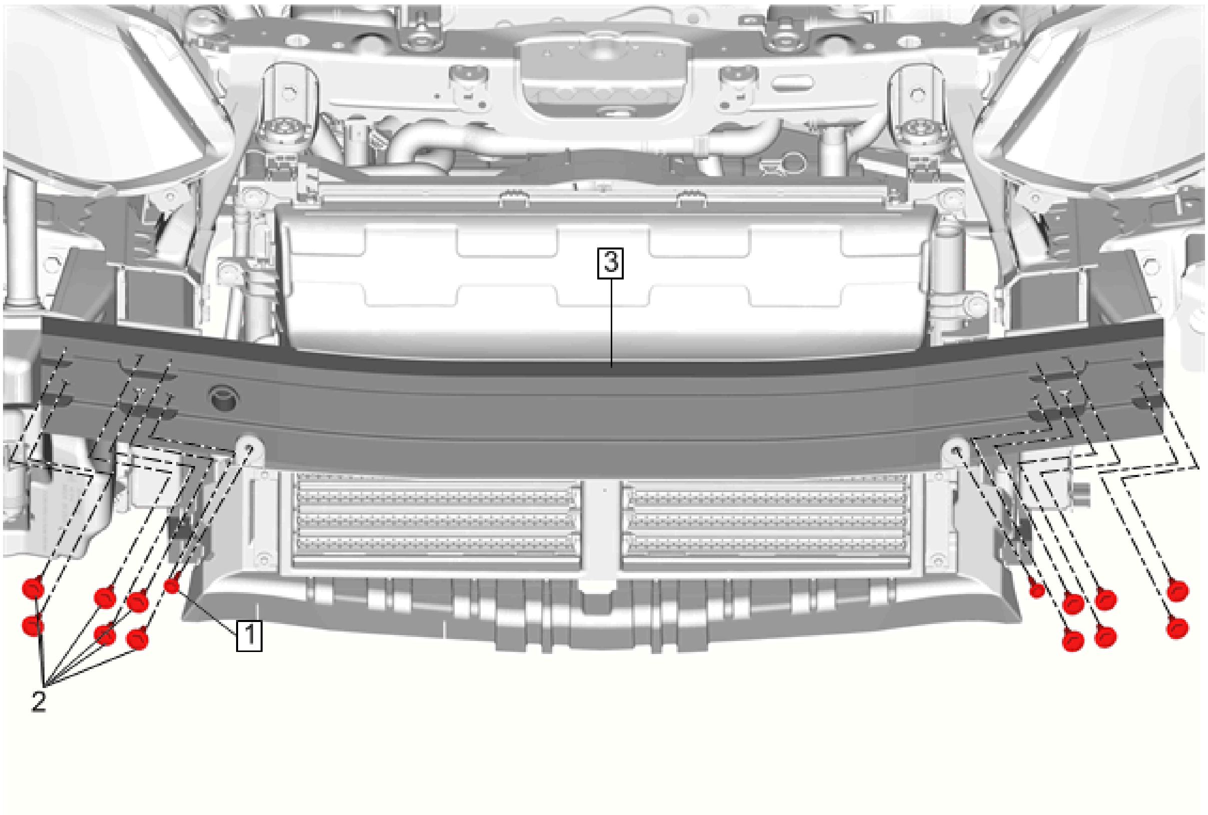


Fig. 2: Front Bumper Impact Bar (North America)
Courtesy of GENERAL MOTORS COMPANY

1. Front Bumper Impact Bar - Remove - **Front Bumper Impact Bar Replacement (North America)**

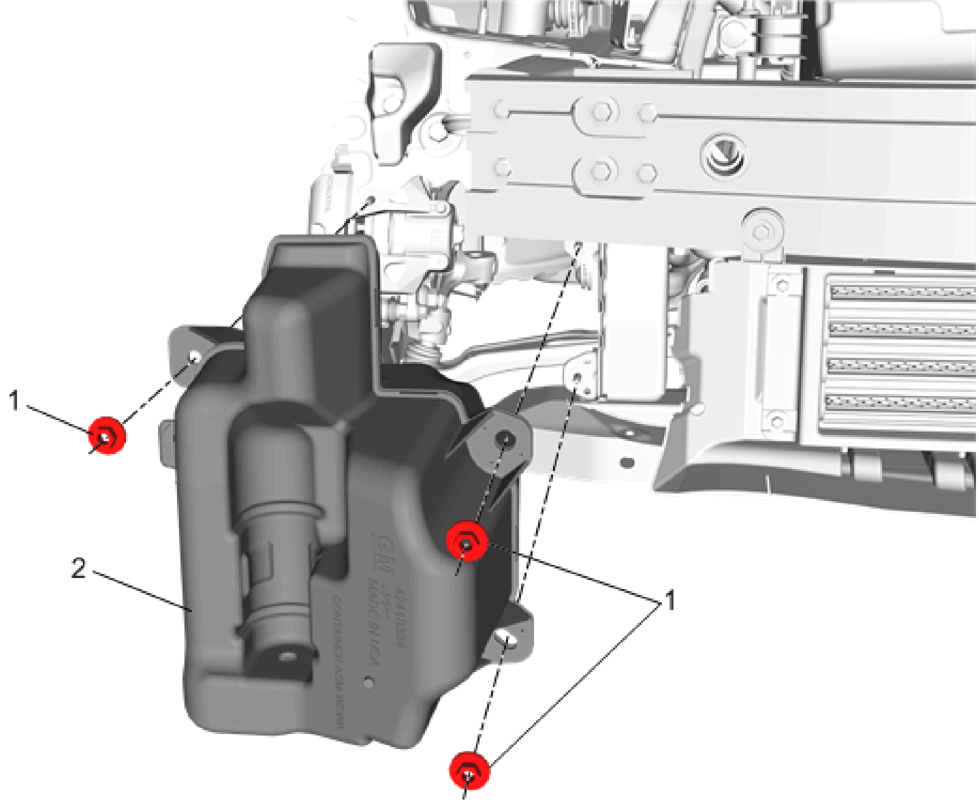


Fig. 3: Windshield Washer Solvent Container (North America)
Courtesy of GENERAL MOTORS COMPANY

2. Windshield Washer Solvent Container - Remove - **Windshield Washer Solvent Container Replacement**

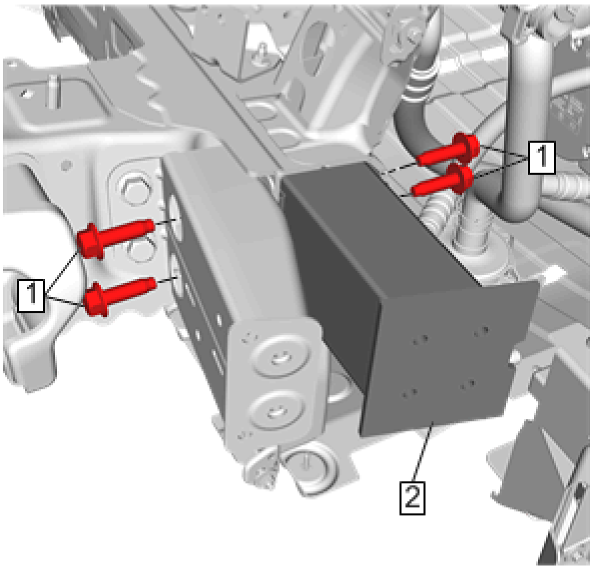


Fig. 4: Front Bumper Energy Absorber Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

3. Front Bumper Energy Absorber Bolt - Remove
4. Front Bumper Energy Absorber -Right Side - Remove

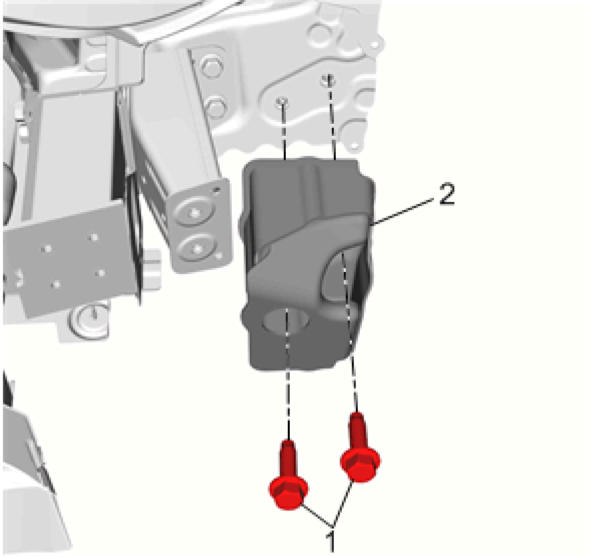


Fig. 5: Underbody Brace Reinforcement Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

5. Underbody Brace Reinforcement Bolt - Remove
6. Underbody Brace Reinforcement -Left Side - Remove

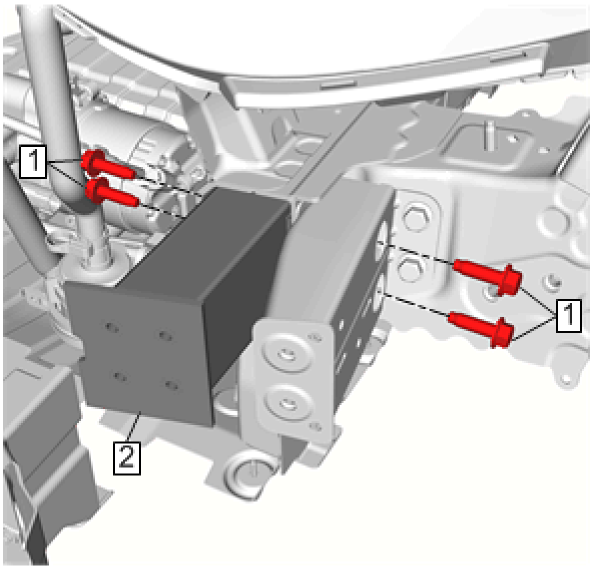


Fig. 6: Front Bumper Energy Absorber Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

7. Front Bumper Energy Absorber Bolt - Remove
8. Front Bumper Energy Absorber -Left Side - Remove

Installation Procedure

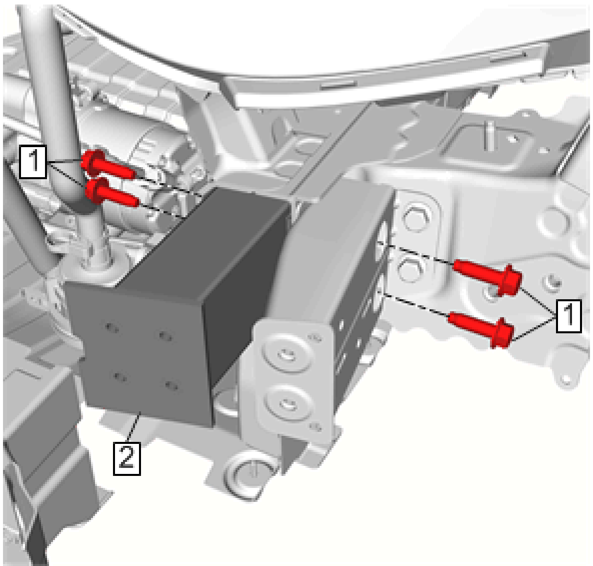


Fig. 7: Front Bumper Energy Absorber Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

1. Front Bumper Energy Absorber -Left Side - Install

CAUTION: Fastener Caution

2. Install the front bumper energy absorber bolt (1) and tighten to 58 N.m (43 lb ft)

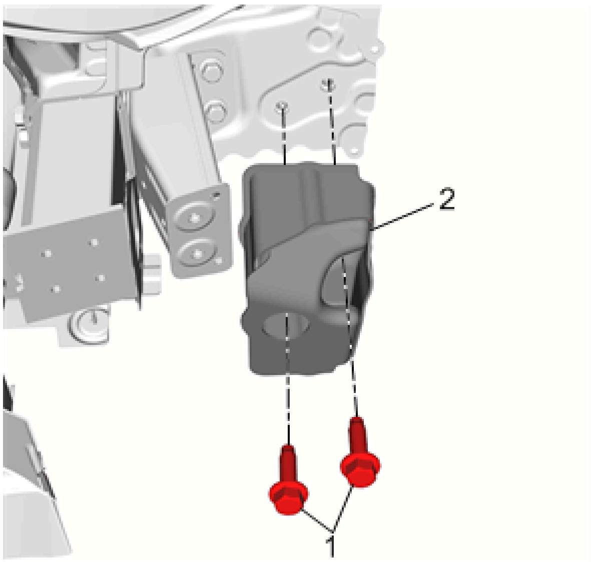


Fig. 8: Underbody Brace Reinforcement Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

3. Underbody Brace Reinforcement -Left Side - Install
4. Install the underbody brace reinforcement bolt (1) and tighten to 58 N.m (43 lb ft)

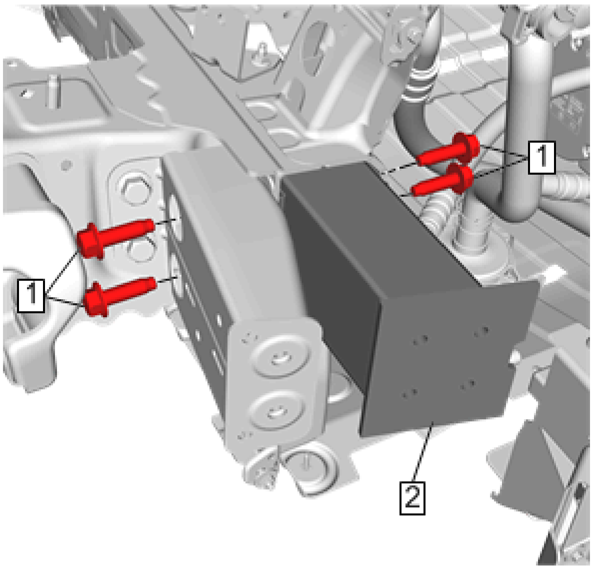


Fig. 9: Front Bumper Energy Absorber Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

5. Front Bumper Energy Absorber -Right Side - Install
6. Install the front bumper energy absorber bolt (1) and tighten to 58 N.m (43 lb ft)

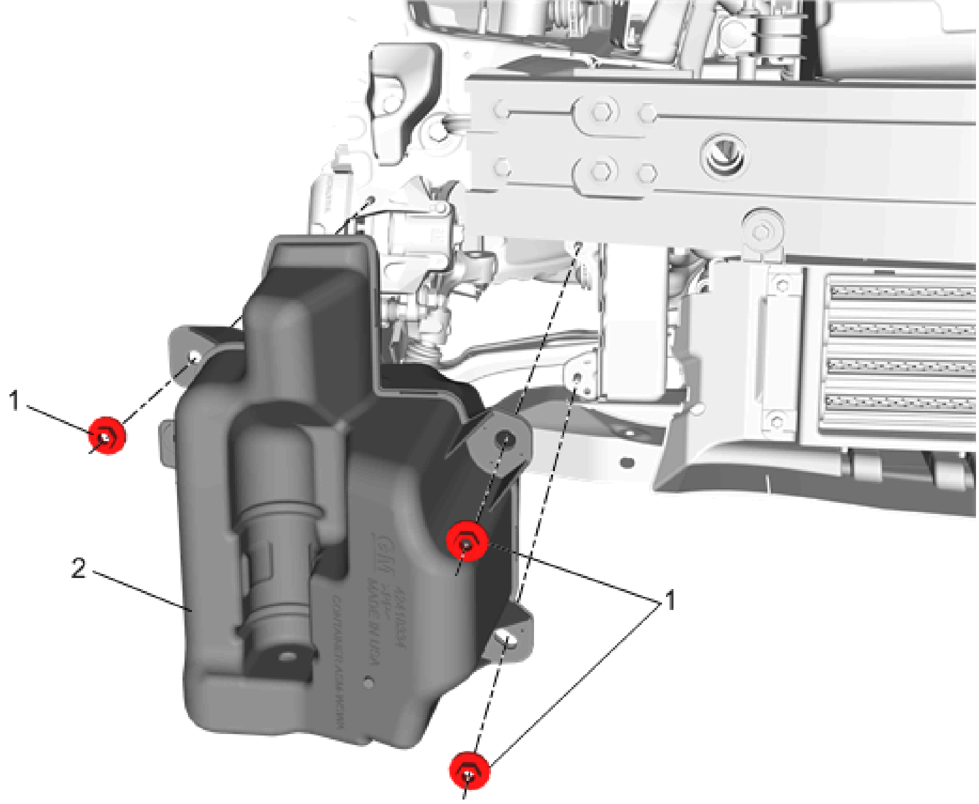


Fig. 10: Windshield Washer Solvent Container (North America)
Courtesy of GENERAL MOTORS COMPANY

7. Windshield Washer Solvent Container - Install - Windshield Washer Solvent Container Replacement

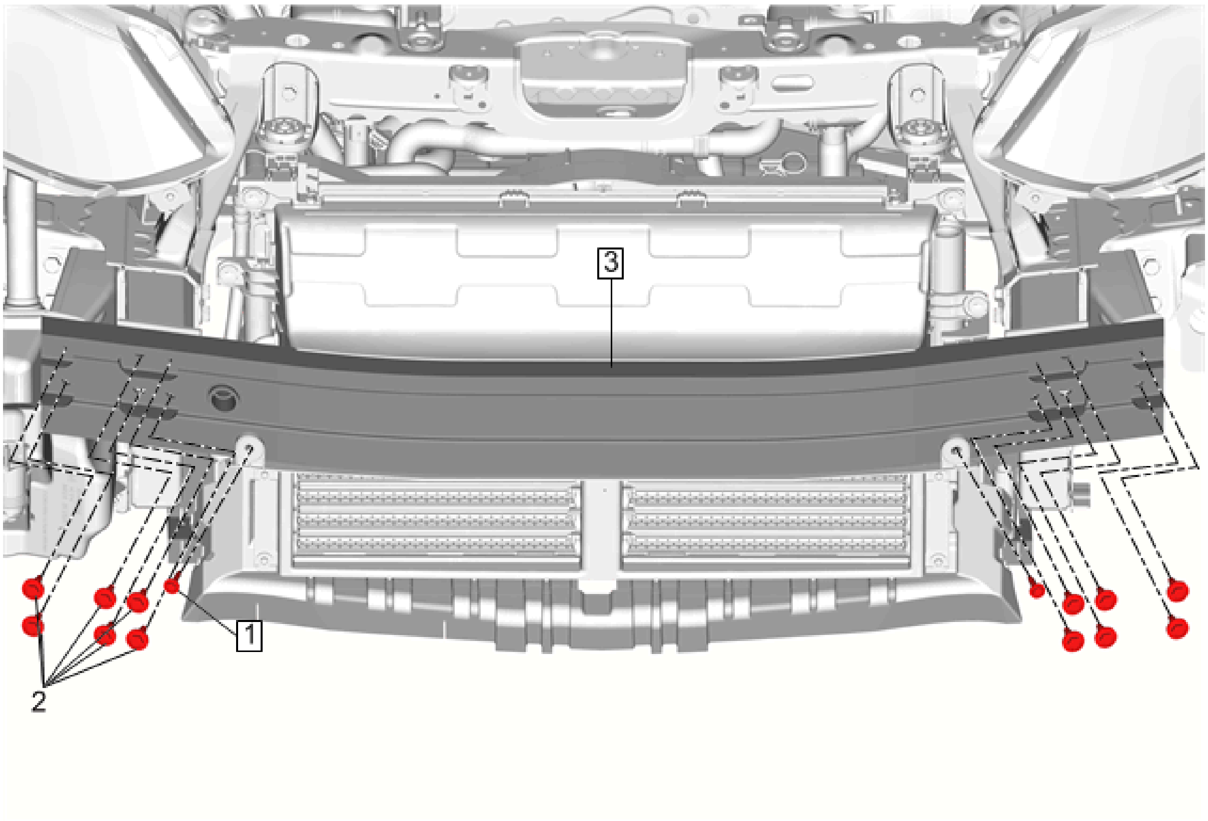


Fig. 11: Front Bumper Impact Bar (North America)
Courtesy of GENERAL MOTORS COMPANY

8. Front Bumper Impact Bar - Install - Front Bumper Impact Bar Replacement (North America)

FRONT BUMPER ENERGY ABSORBER REPLACEMENT (EUROPE, KOREA)

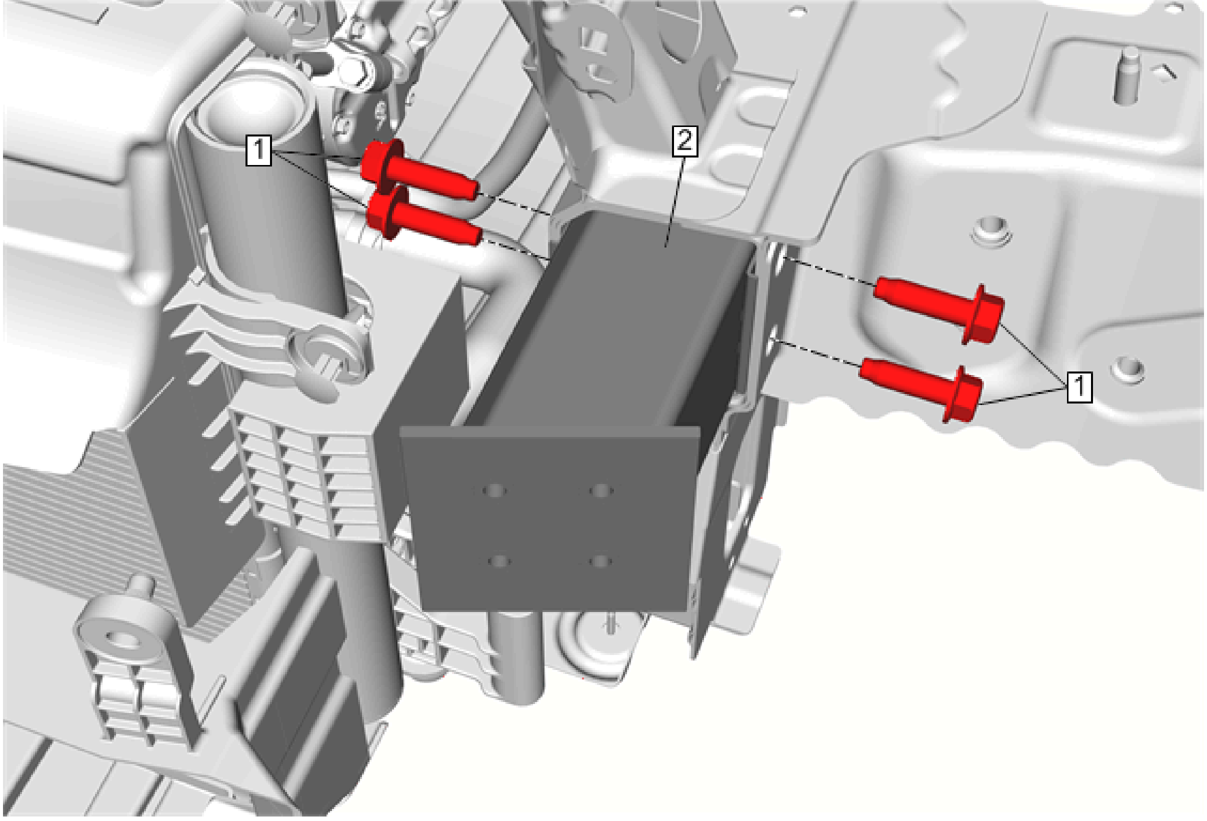


Fig. 12: Front Bumper Energy Absorber (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Impact Bar Replacement (Europe, Korea)	
1	Front Bumper Energy Absorber Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 58 N.m (43 lb ft)
2	Front Bumper Energy Absorber

FRONT BUMPER IMPACT ABSORBER REPLACEMENT (NORTH AMERICA)

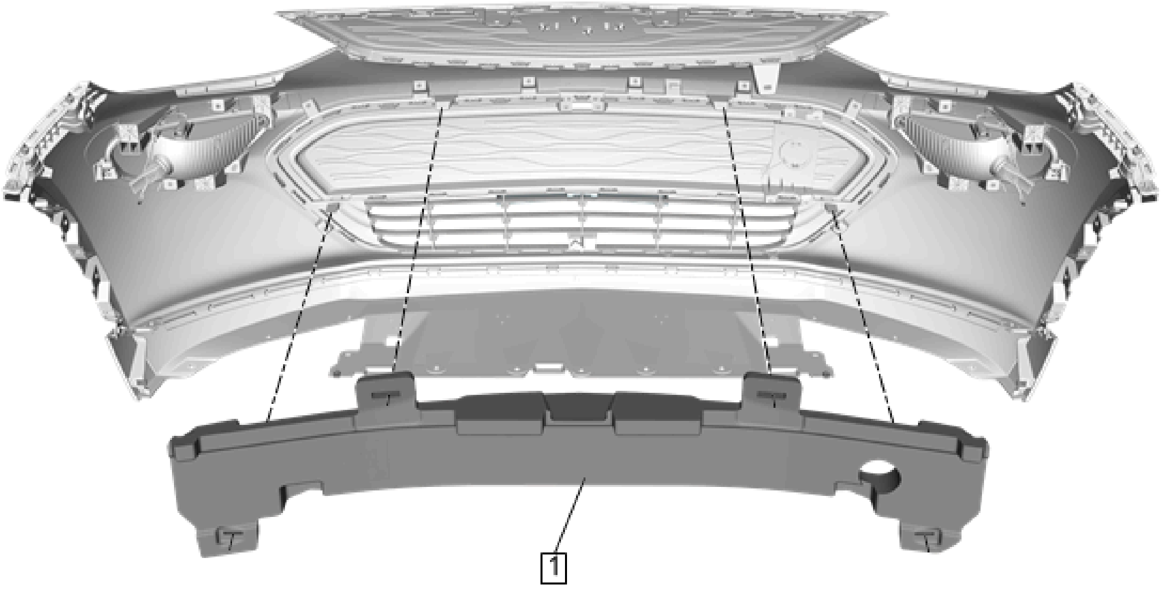


Fig. 13: Front Bumper Impact Absorber (North America)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Bumper Fascia Replacement (North America) 2. Retaining clips - Remove	
1	Front Bumper Impact Absorber **Procedure** Release the integral retainers.

FRONT BUMPER IMPACT ABSORBER REPLACEMENT (EUROPE, KOREA)

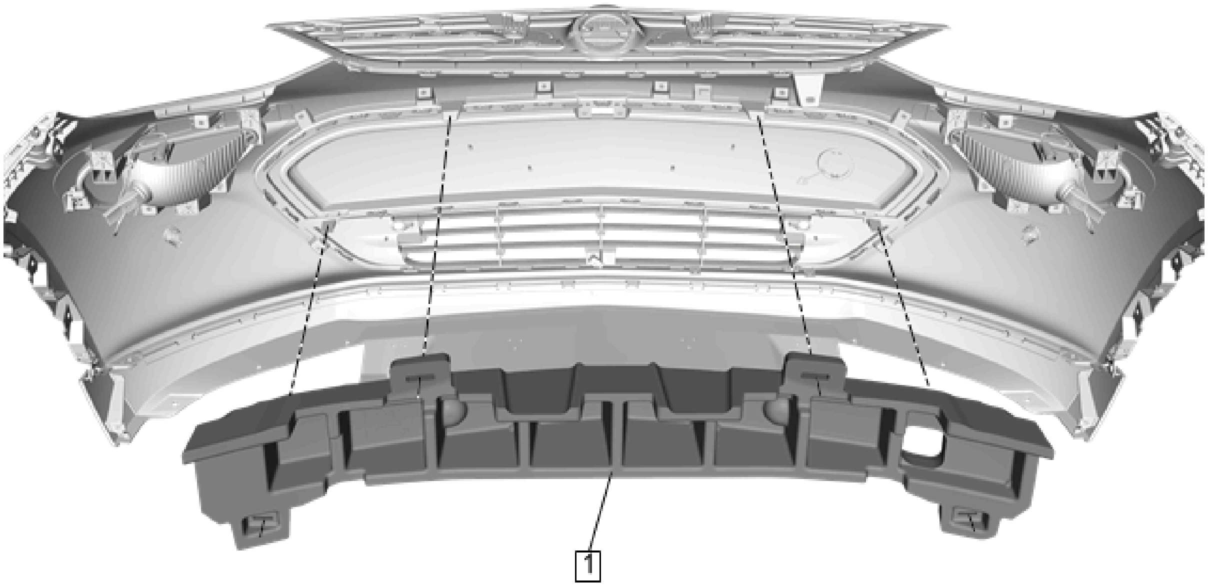


Fig. 14: Front Bumper Impact Absorber (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (Europe, Korea)	
1	Front Bumper Impact Absorber

FRONT BUMPER IMPACT BAR REPLACEMENT (EUROPE, KOREA)

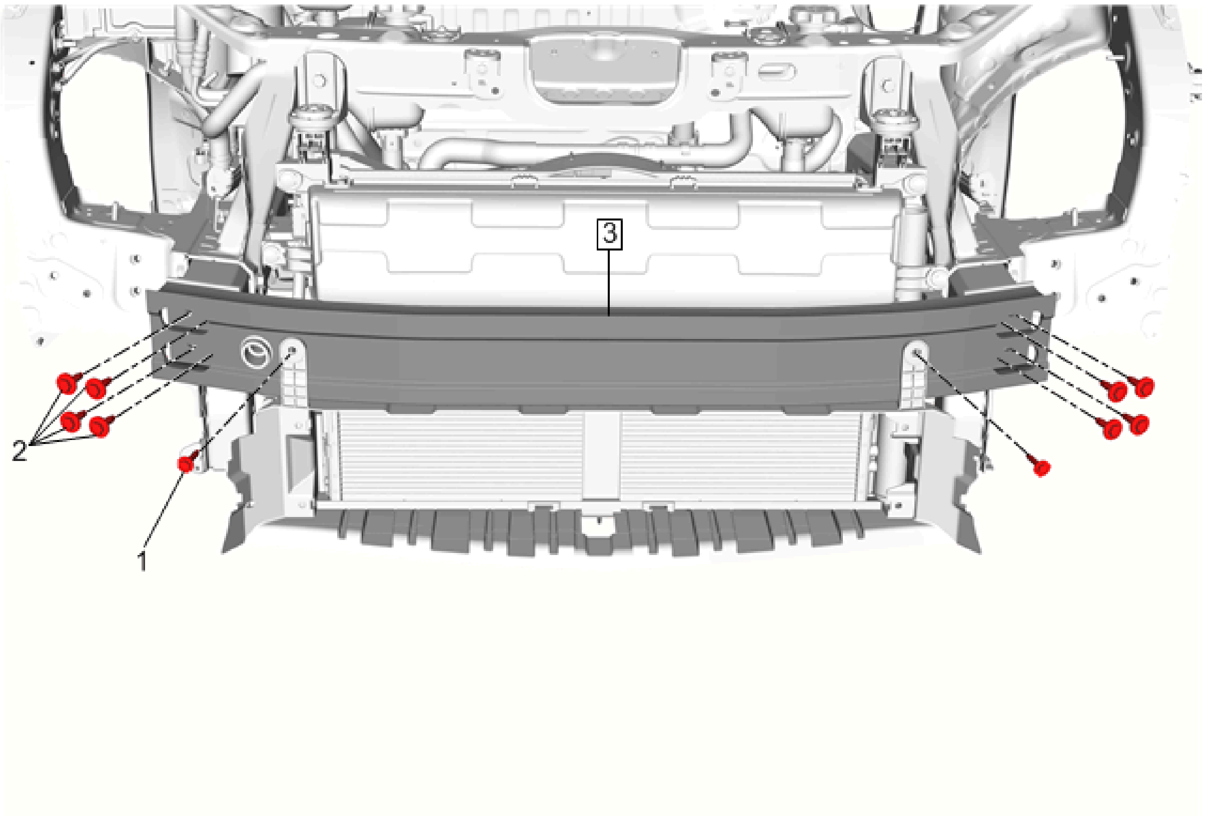


Fig. 15: Front Bumper Impact Bar (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (Europe, Korea)	
1	Radiator Air Lower Baffle Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Front Bumper Impact Bar Bolt **Tighten** 22 N.m (16 lb ft)
3	Front Bumper Impact Bar

FRONT BUMPER IMPACT BAR REPLACEMENT (NORTH AMERICA)

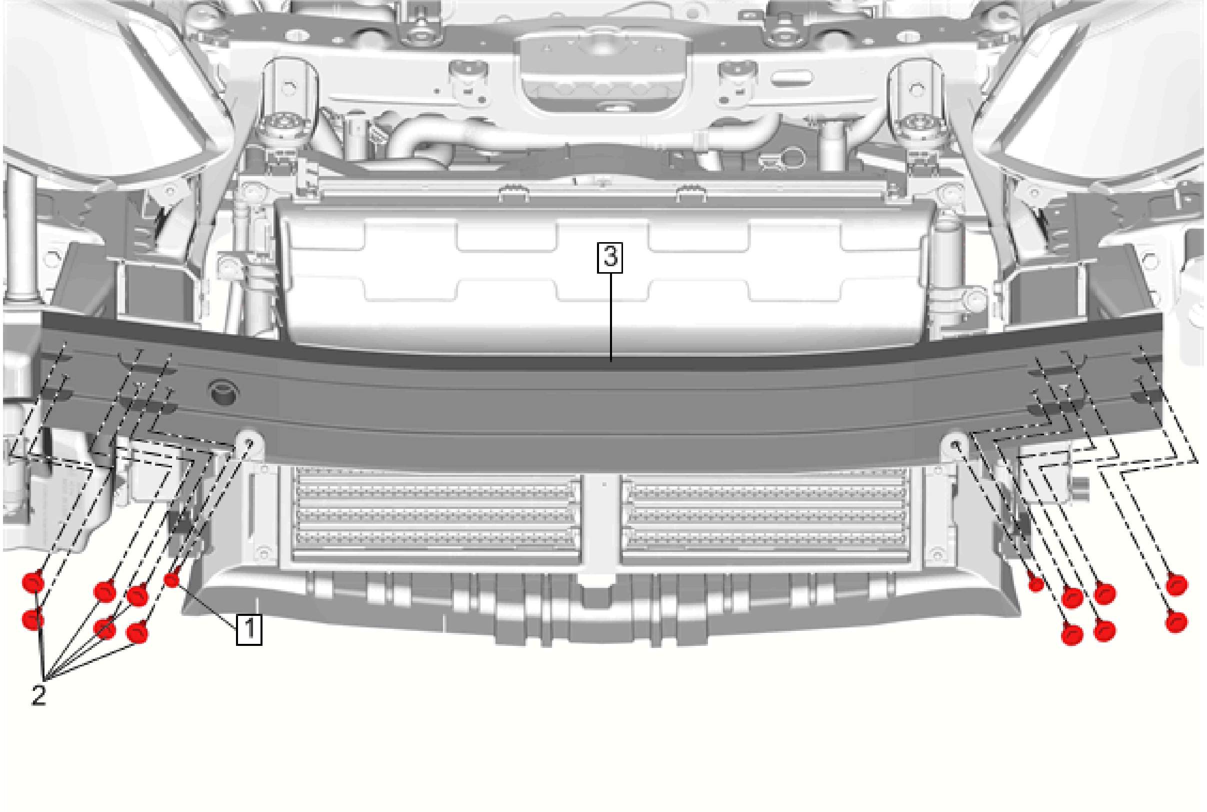


Fig. 16: Front Bumper Impact Bar (North America)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (North America)	
1	Radiator Air Lower Baffle Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Front Bumper Impact Bar Bolt **Tighten** 22 N.m (16 lb ft)
3	Front Bumper Impact Bar

FRONT BUMPER FASCIA REPLACEMENT (NORTH AMERICA)

Removal Procedure

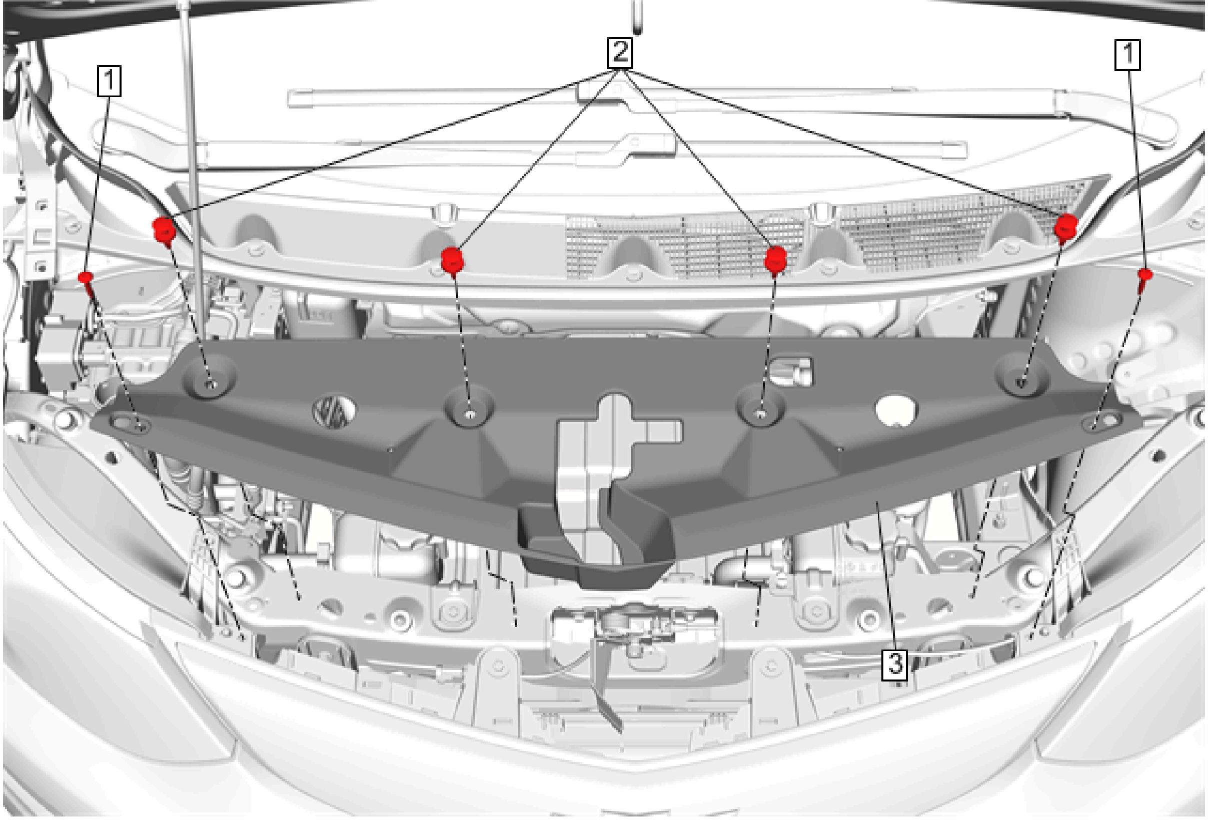


Fig. 17: Front Compartment Front Sight Shield (North America)
Courtesy of GENERAL MOTORS COMPANY

1. Front Compartment Front Sight Shield - Remove - **Front Compartment Front Sight Shield Replacement**

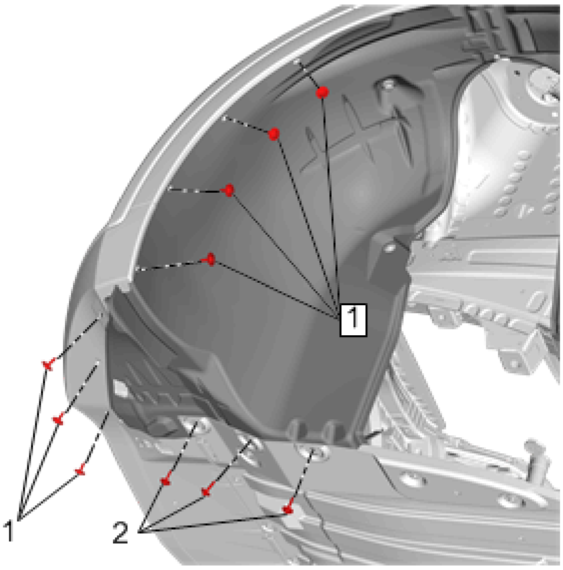


Fig. 18: Front Wheelhouse Liner Screw (North America)
Courtesy of GENERAL MOTORS COMPANY

2. Front Wheelhouse Liner Screw - Remove
3. Front Bumper Fascia Wheel Opening Screw - Remove - **Front Wheelhouse Liner Replacement**

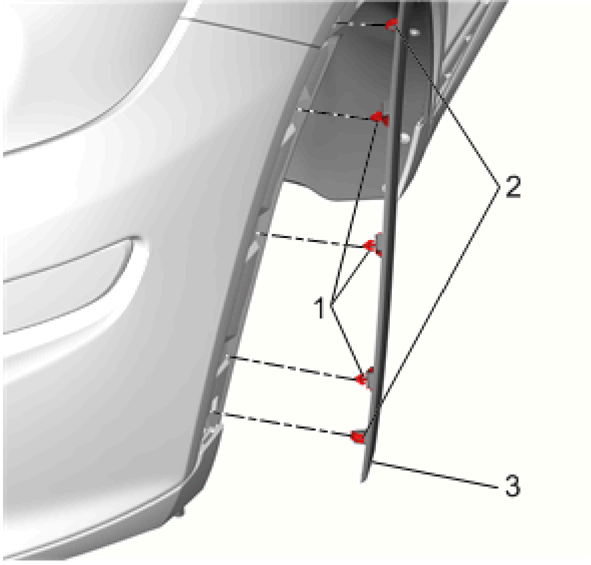


Fig. 19: Front Wheel Opening Molding Retainer (North America)
Courtesy of GENERAL MOTORS COMPANY

4. Front Wheel Opening Molding Retainer - Remove
5. Front Wheel Opening Molding Clip - Remove
6. Partially remove the front wheel opening molding (3). **Front Wheel Opening Molding Replacement**

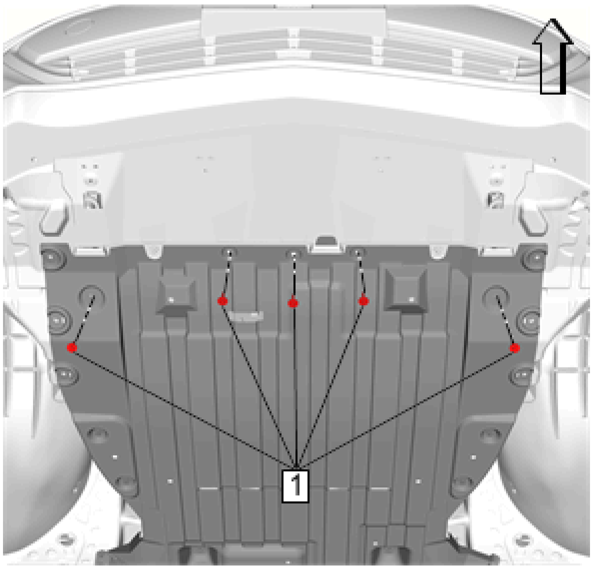


Fig. 20: Front Compartment Insulator Screw (North America)
Courtesy of GENERAL MOTORS COMPANY

7. Front Compartment Insulator Screw - Remove - **Front Compartment Air Deflector Replacement**

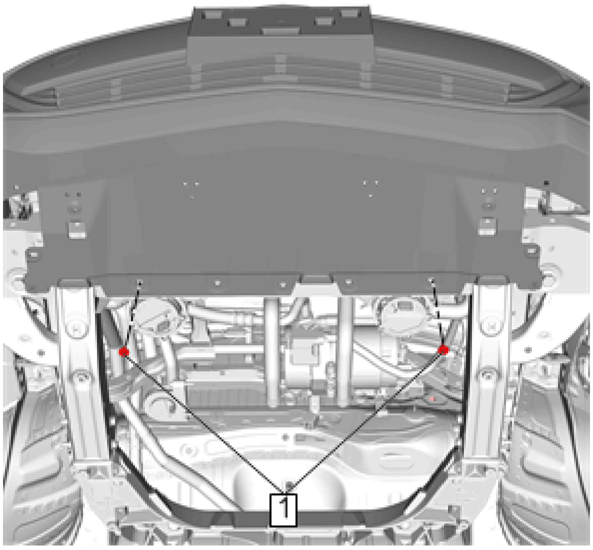


Fig. 21: Front Bumper Fascia Lower Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

8. Front Bumper Fascia Lower Bolt - Remove

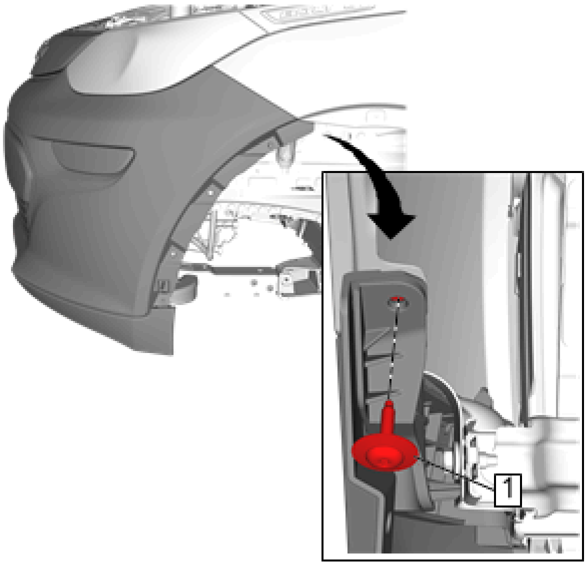


Fig. 22: Front Bumper Fascia Wheel Opening Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

9. Front Bumper Fascia Wheel Opening Bolt - Remove

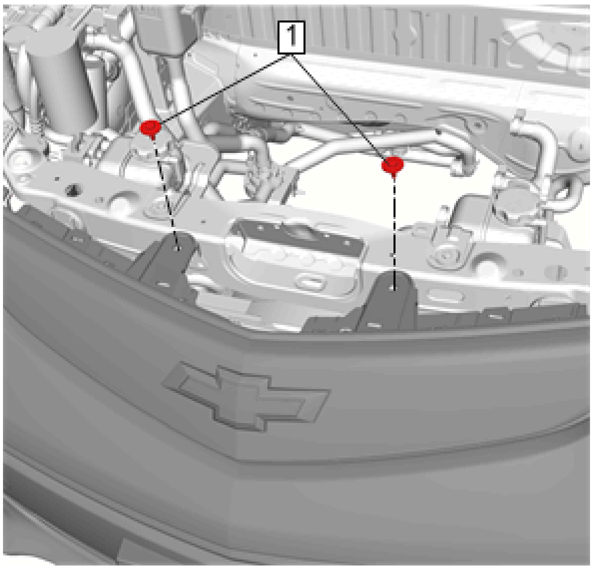


Fig. 23: Front Bumper Fascia Upper Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

10. Front Bumper Fascia Upper Bolt - Remove
11. Release the integral retainers at both fenders and headlamps.
12. Lift fascia off of headlamp retaining tabs, then Carefully pull the front bumper fascia outward to remove.
13. Disconnect all electrical connectors.

Installation Procedure

1. Transfer components as necessary.
2. Connect all electrical connectors.
3. Front Bumper Fascia - Install
4. Carefully push in the retaining tabs of the front bumper fascia into the front bumper fascia guides.

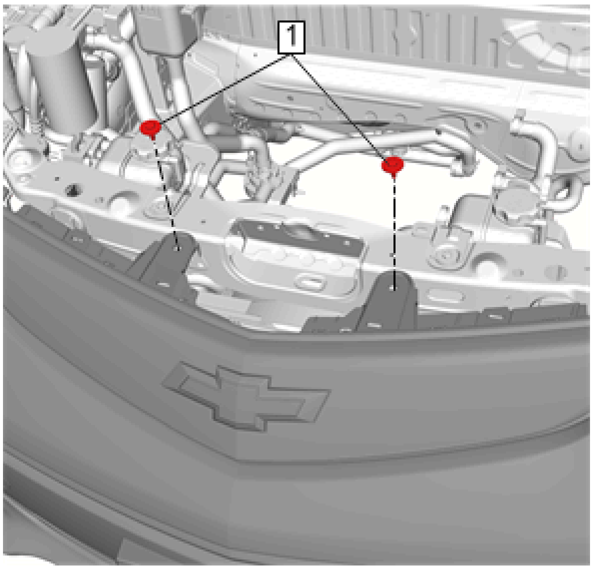


Fig. 24: Front Bumper Fascia Upper Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

5. Front Bumper Fascia Upper Bolt - Install and tighten to 6 N.m (53 lb in)

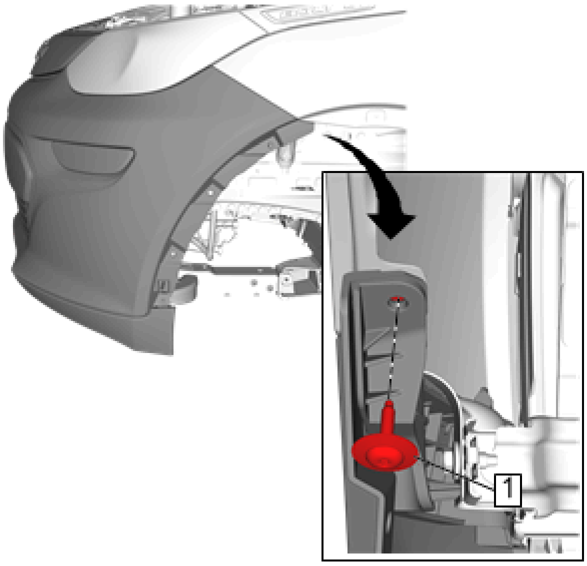


Fig. 25: Front Bumper Fascia Wheel Opening Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

6. Front Bumper Fascia Wheel Opening Bolt - Install and tighten to 2.5 N.m (22 lb in)

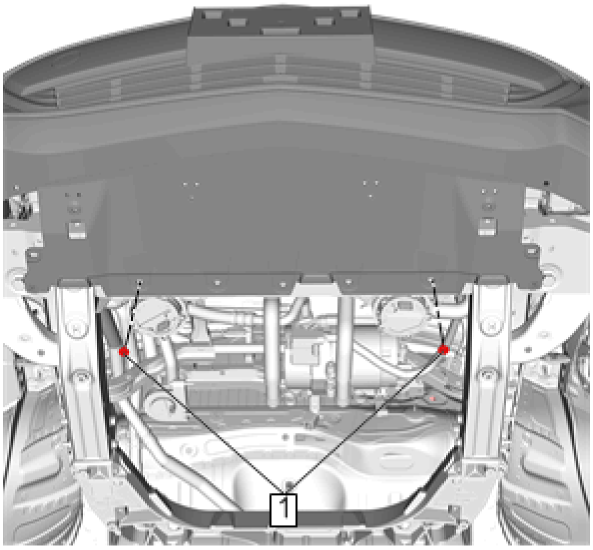


Fig. 26: Front Bumper Fascia Lower Bolt (North America)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

7. Front Bumper Fascia Lower Bolt - Install and tighten to 2.5 N.m (22 lb in)

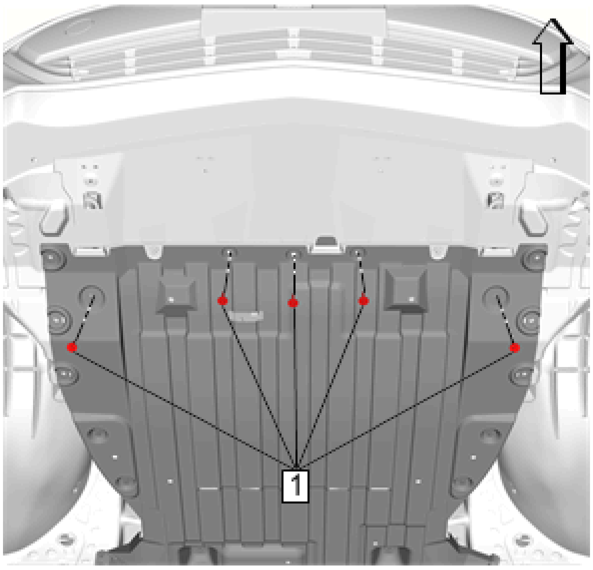


Fig. 27: Front Compartment Insulator Screw (North America)
Courtesy of GENERAL MOTORS COMPANY

8. Front Compartment Insulator Screw - Install - Front Compartment Air Deflector Replacement

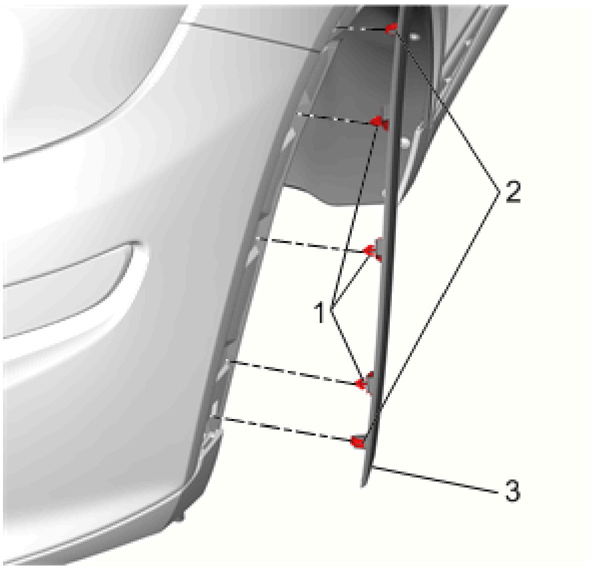


Fig. 28: Front Wheel Opening Molding Retainer (North America)
Courtesy of GENERAL MOTORS COMPANY

9. Front Wheel Opening Molding Retainer - Install
10. Front Wheel Opening Molding Clip - Install
11. Front Wheel Opening Molding - Install - **Front Wheel Opening Molding Replacement**

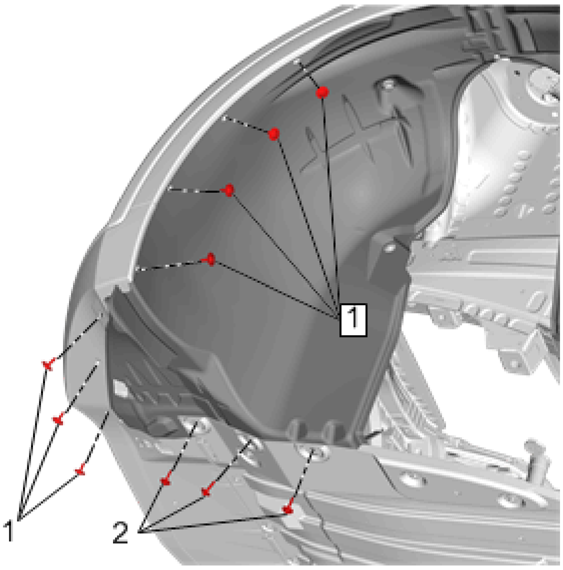


Fig. 29: Front Wheelhouse Liner Screw (North America)
Courtesy of GENERAL MOTORS COMPANY

12. Front Wheelhouse Liner Screw - Install
13. Front Bumper Fascia Wheel Opening Screw - Install - **Front Wheelhouse Liner Replacement**

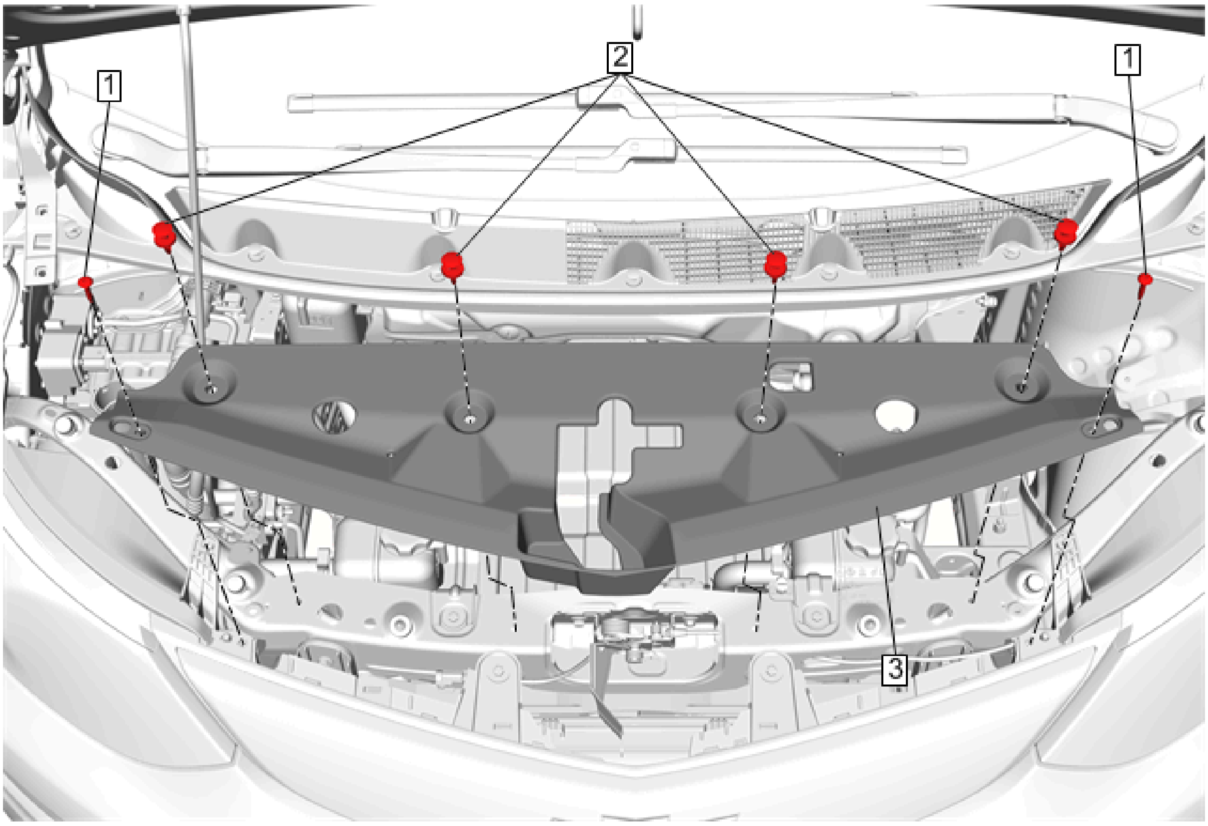


Fig. 30: Front Compartment Front Sight Shield (North America)
Courtesy of GENERAL MOTORS COMPANY

14. Front Compartment Front Sight Shield - Install - **Front Compartment Front Sight Shield Replacement**

FRONT BUMPER FASCIA REPLACEMENT (EUROPE, KOREA)

Removal Procedure

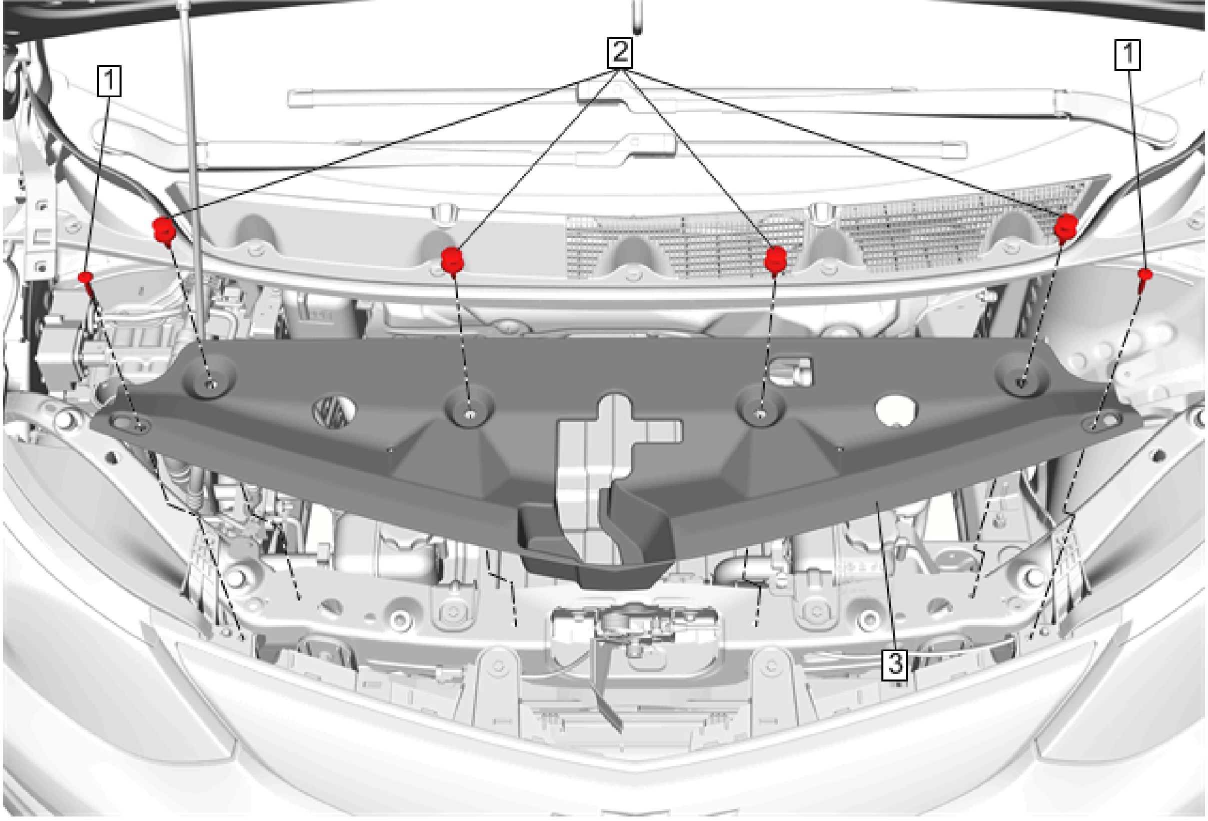


Fig. 31: Front Bumper Fascia (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

1. Front Compartment Front Sight Shield - Remove - **Front Compartment Front Sight Shield Replacement**

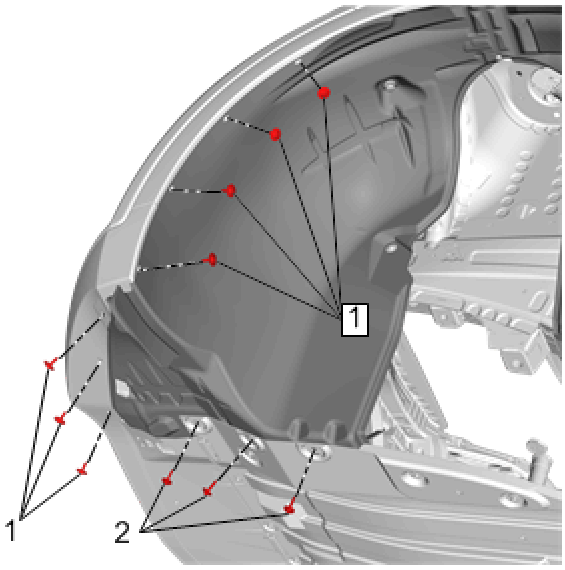


Fig. 32: Front Wheelhouse Liner Screw (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

2. Front Wheelhouse Liner Screw - Remove
3. Front Bumper Fascia Wheel Opening Screw - Remove - **Front Wheelhouse Liner Replacement**

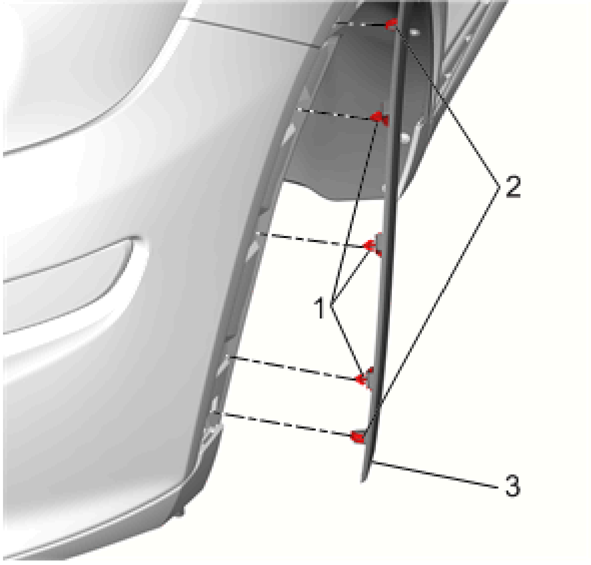


Fig. 33: Front Wheel Opening Molding Retainer (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

4. Front Wheel Opening Molding Retainer - Remove
5. Front Wheel Opening Molding Clip - Remove
6. Partially remove the front wheel opening molding (3). **Front Wheel Opening Molding Replacement**

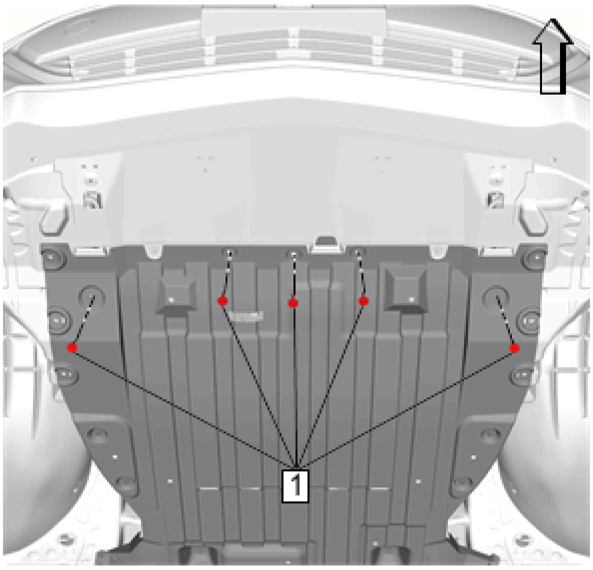


Fig. 34: Front Compartment Insulator Screw (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

7. Front Compartment Insulator Screw - Remove - **Front Compartment Air Deflector Replacement**

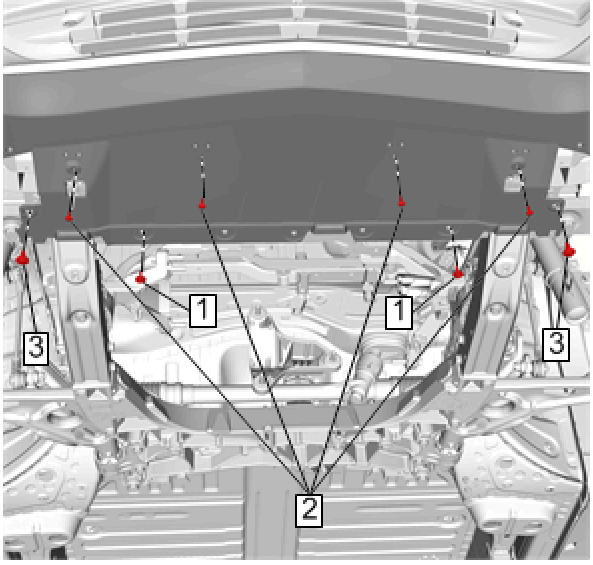


Fig. 35: Front Bumper Fascia Lower Bolt (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

8. Front Bumper Fascia Lower Bolt - Remove
9. Front Bumper Fascia Lower Screw - Remove
10. Front Bumper Fascia Lower Retainer - Remove

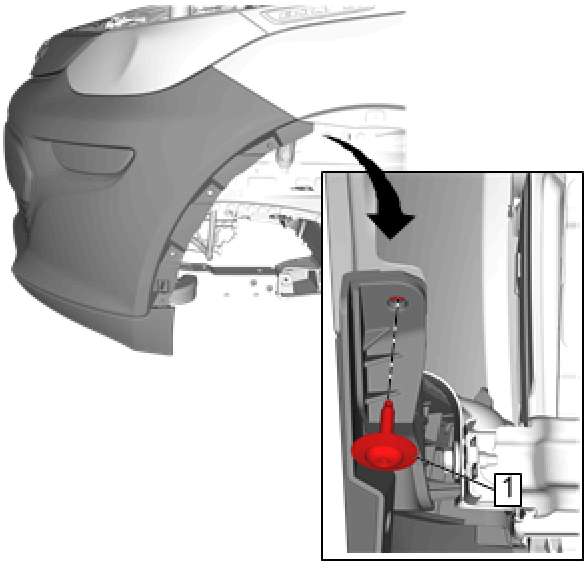


Fig. 36: Front Bumper Fascia Wheel Opening Bolt (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

11. Front Bumper Fascia Wheel Opening Bolt - Remove

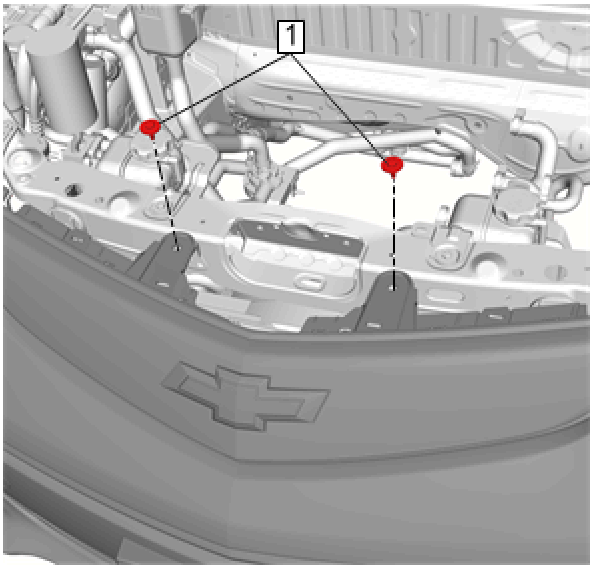


Fig. 37: Front Bumper Fascia Upper Bolt (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

12. Front Bumper Fascia Upper Bolt - Remove
13. Release the integral retainers at both fenders and headlamps.
14. Lift fascia off of headlamp retaining tabs, then Carefully pull the front bumper fascia outward to remove.
15. Disconnect all electrical connectors.

Installation Procedure

1. Transfer components as necessary.
2. Connect all electrical connectors.
3. Front Bumper Fascia - Install
4. Carefully push in the retaining tabs of the front bumper fascia into the front bumper fascia guides.

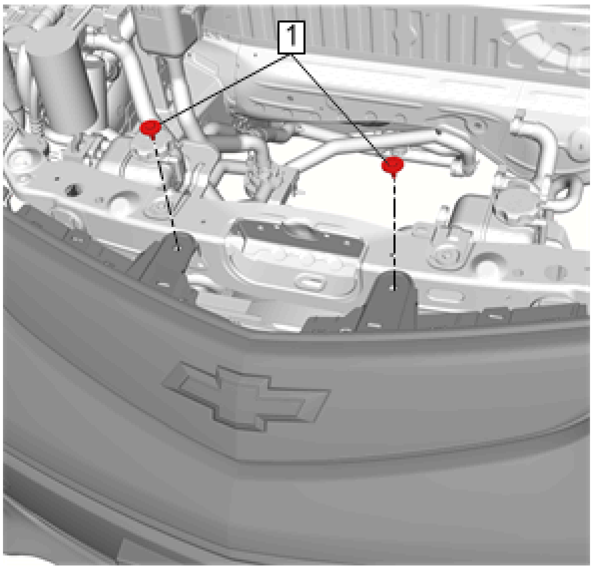


Fig. 38: Front Bumper Fascia Upper Bolt (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

5. Front Bumper Fascia Upper Bolt - Install and tighten to 6 N.m (53 lb in)

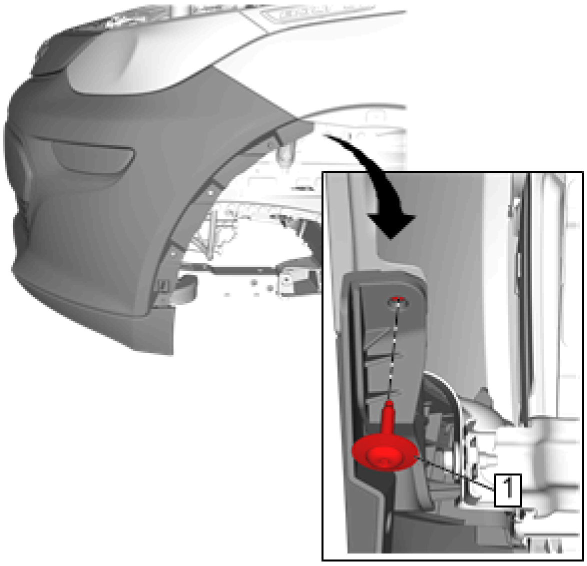


Fig. 39: Front Bumper Fascia Wheel Opening Bolt (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

6. Front Bumper Fascia Wheel Opening Bolt - Install and tighten to 2.5 N.m (22 lb in)

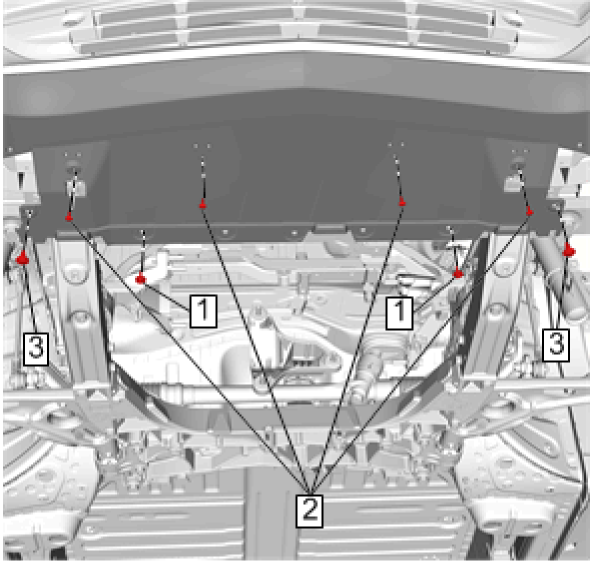


Fig. 40: Front Bumper Fascia Lower Bolt (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

7. Front Bumper Fascia Lower Bolt - Install and tighten to 2.5 N.m (22 lb in)
8. Front Bumper Fascia Lower Screw - Install and tighten to 2.5 N.m (22 lb in)
9. Front Bumper Fascia Lower Retainer - Install

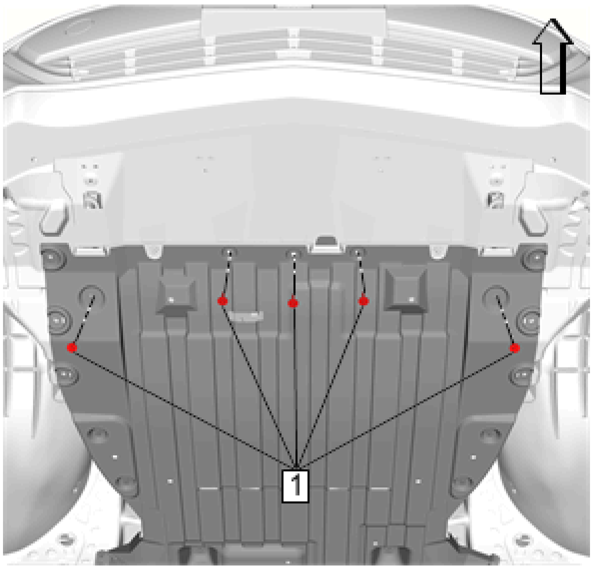


Fig. 41: Front Compartment Insulator Screw (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

10. Front Compartment Insulator Screw - Install - **Front Compartment Air Deflector Replacement**

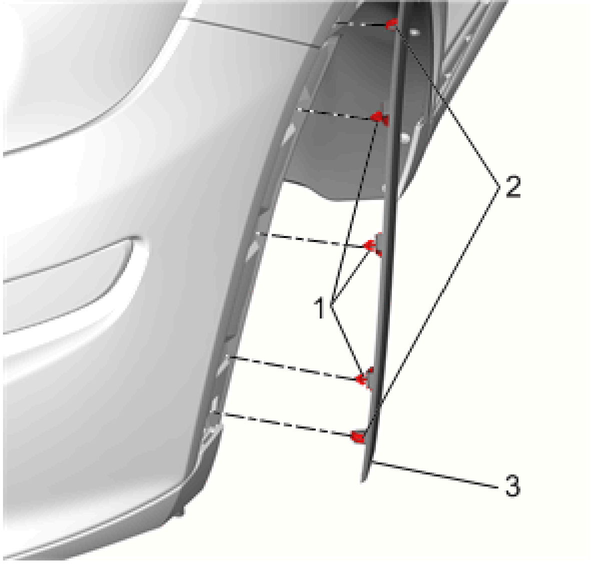


Fig. 42: Front Wheel Opening Molding Retainer (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

11. Front Wheel Opening Molding Retainer - Install
12. Front Wheel Opening Molding Clip - Install
13. Front Wheel Opening Molding - Install - **Front Wheel Opening Molding Replacement**

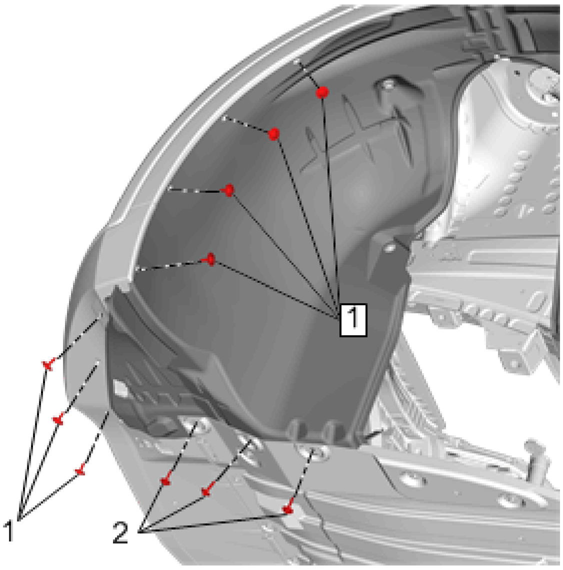


Fig. 43: Front Wheelhouse Liner Screw (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

14. Front Wheelhouse Liner Screw - Install
15. Front Bumper Fascia Wheel Opening Screw - Install - **Front Wheelhouse Liner Replacement**

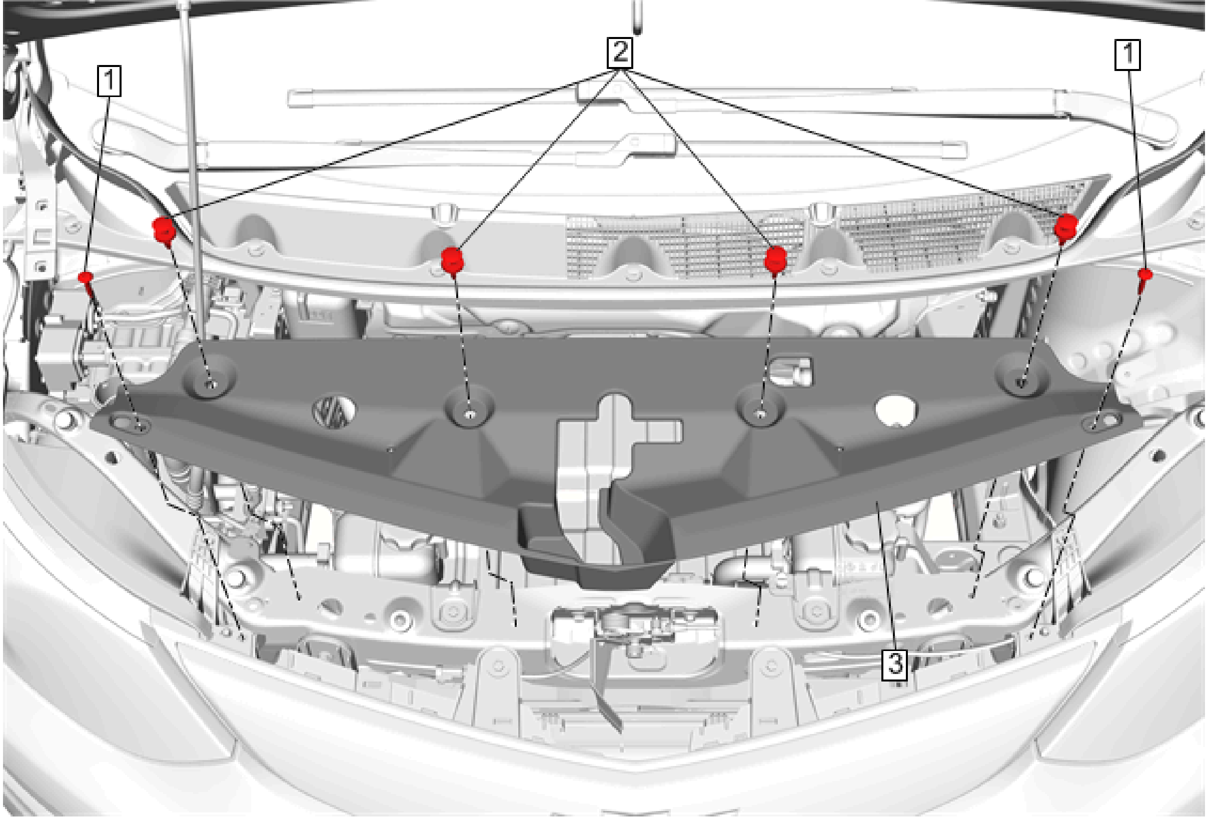


Fig. 44: Front Bumper Fascia (Europe, Korea)
Courtesy of GENERAL MOTORS COMPANY

16. Front Compartment Front Sight Shield - Install - **Front Compartment Front Sight Shield Replacement** .

FRONT BUMPER FASCIA GUIDE REPLACEMENT

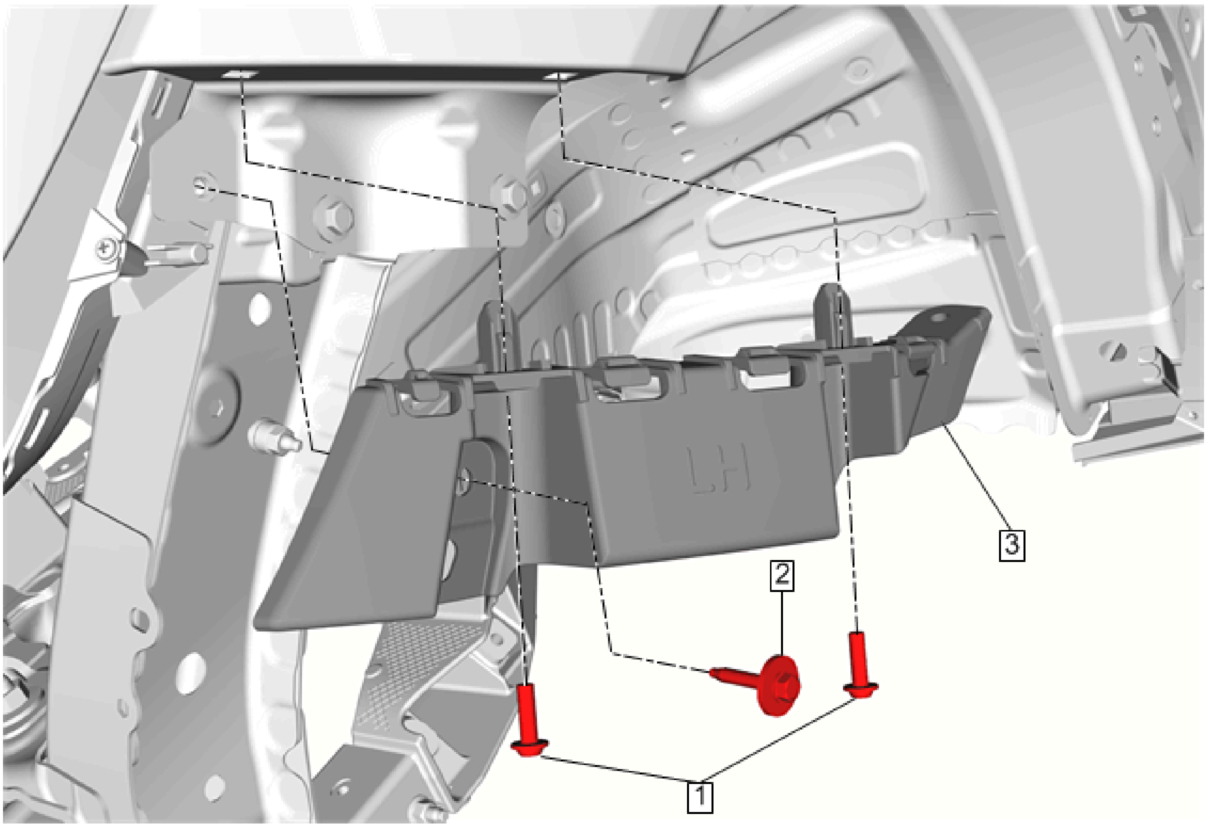


Fig. 45: Front Bumper Fascia Guide
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Bumper Fascia Replacement (North America)Front Bumper Fascia Replacement (Europe, Korea)**	

Callout	Component Name
1	Front Bumper Fascia Guide Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Headlamp Bolt **Tighten** 2.5 N.m (22 lb in)
3	Front Bumper Fascia Guide

FRONT BUMPER LOWER FASCIA REPLACEMENT

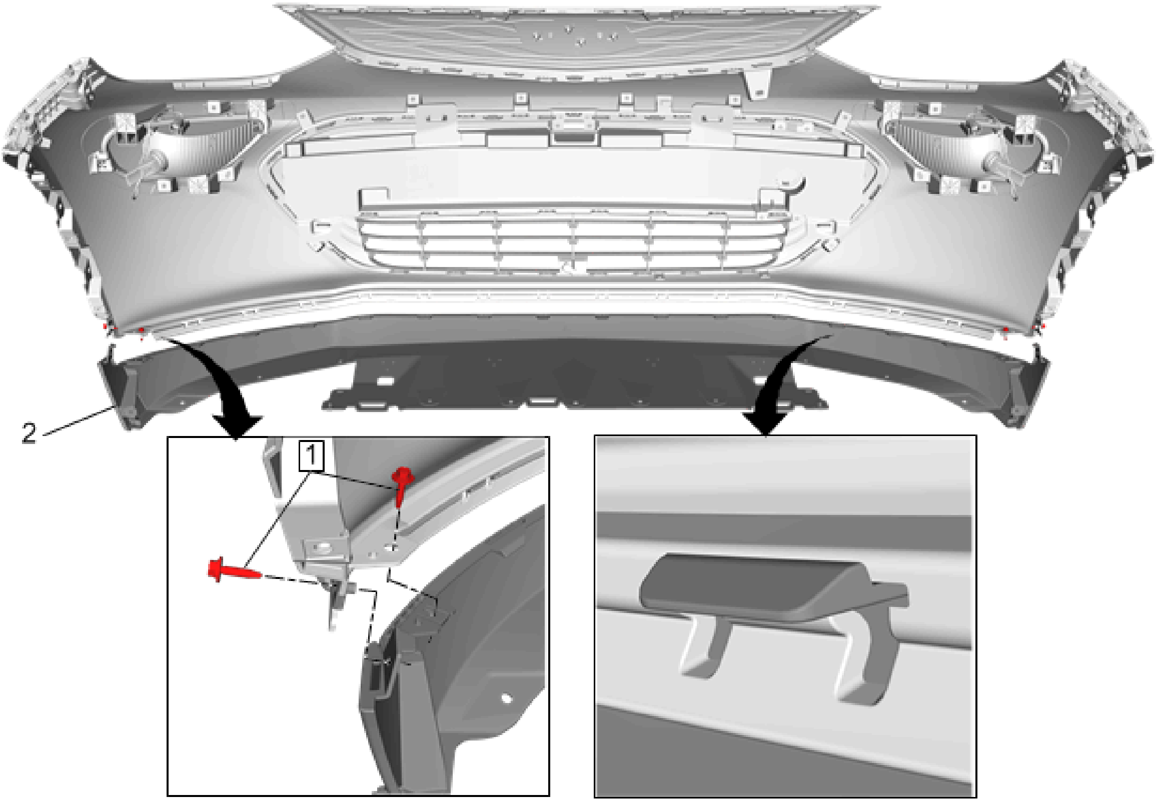


Fig. 46: Front Bumper Lower Fascia
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Bumper Fascia Replacement (North America)Front Bumper Fascia Replacement (Europe, Korea)**	
1	Front Bumper Lower Fascia Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
2	Front Bumper Lower Fascia **Procedure** Using an appropriate trim tool, release the 14 Integral retainers. **NOTE:** **Use care not to damage the front bumper lower fascia during removal.**

FRONT BUMPER UPPER FASCIA REPLACEMENT

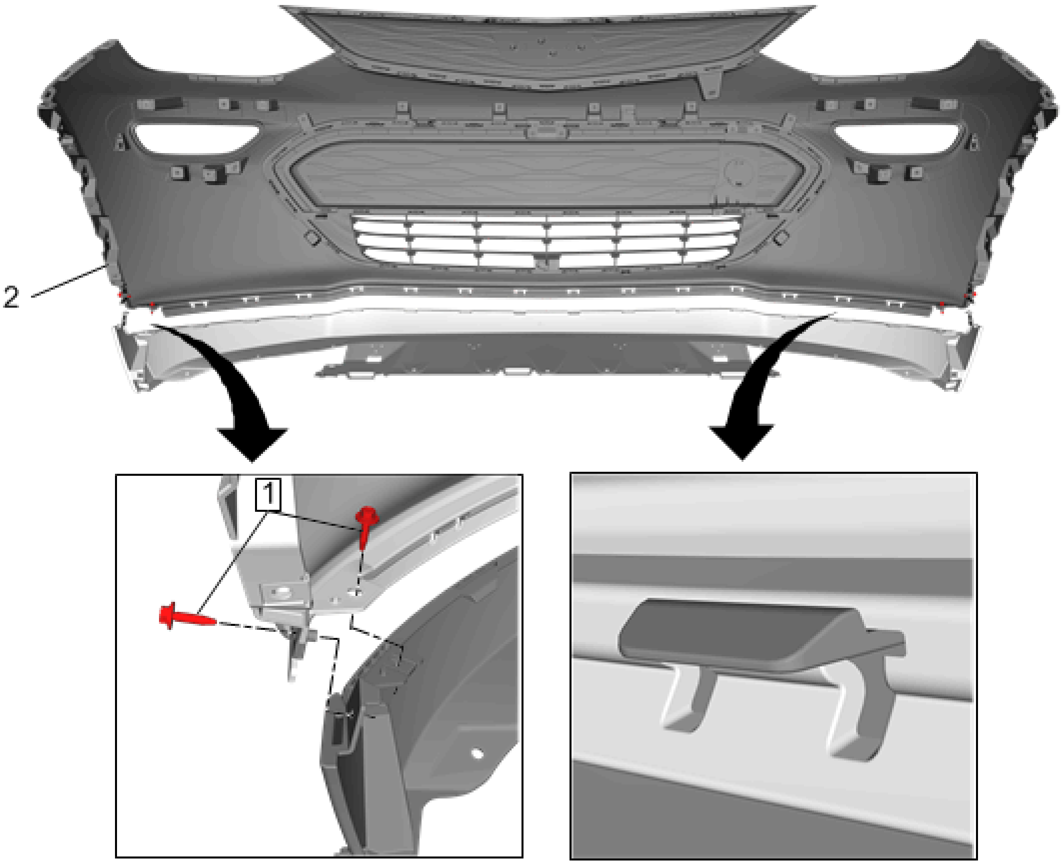


Fig. 47: Front Bumper Upper Fascia

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (North America)Front Bumper Fascia Replacement (Europe, Korea)	
1	Front Bumper Lower Fascia Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
2	Front Bumper Upper Fascia **Procedure** 1. Transfer components as necessary. 2. Using an appropriate trim tool, release the 14 integral retainers. **NOTE:** **Use care not to damage the front bumper lower fascia during removal.**

FRONT BUMPER SHUTTER REPLACEMENT

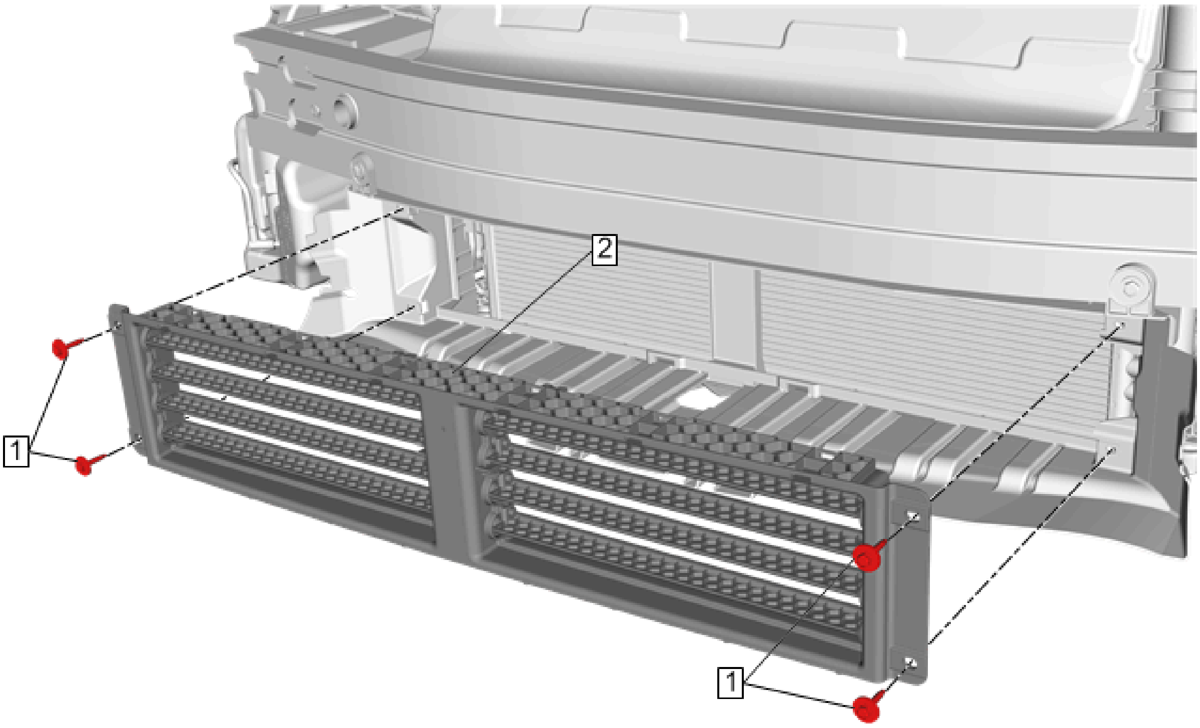


Fig. 48: Front Bumper Shutter
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (North America)Front Bumper Fascia Replacement (Europe, Korea)	
1	Front Bumper Shutter Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Bumper Shutter

FRONT BUMPER FASCIA LOWER STIFFENER REPLACEMENT

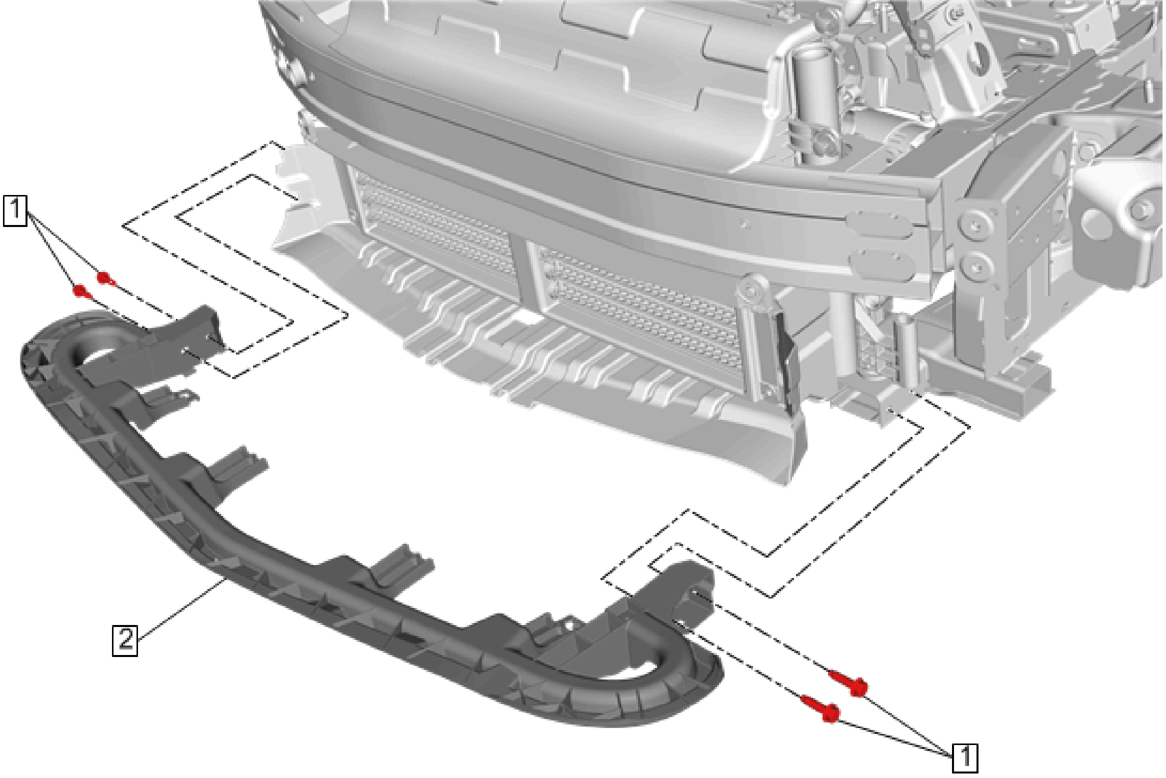


Fig. 49: Front Bumper Fascia Lower Stiffener
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (North America)Front Bumper Fascia Replacement (Europe, Korea)	
1	Front Bumper Fascia Lower Stiffener Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 17 N.m (13 lb ft)
2	Front Bumper Fascia Lower Stiffener

REAR BUMPER FASCIA MOLDING REPLACEMENT

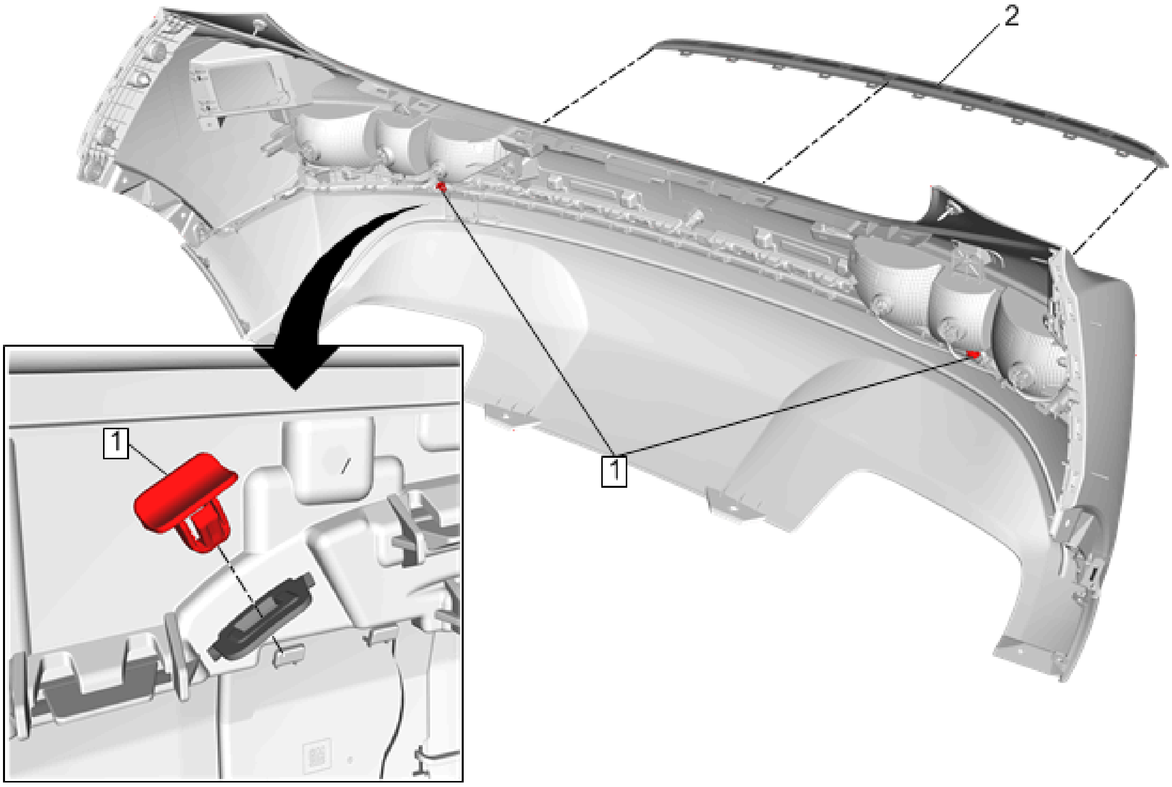


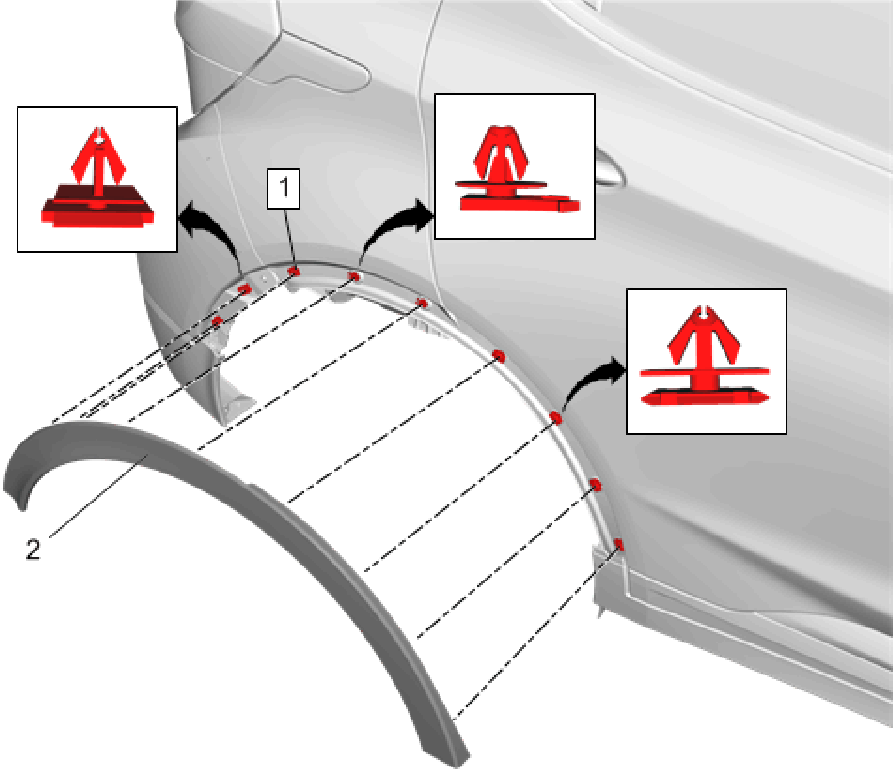
Fig. 50: Rear Bumper Fascia Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Bumper Fascia Replacement	
1	Rear Bumper Fascia Molding Clip
2	Rear Bumper Fascia Molding **Procedure** Carefully release the integral retainers using an appropriate flat bladed tool.

REAR BUMPER FASCIA REPLACEMENT

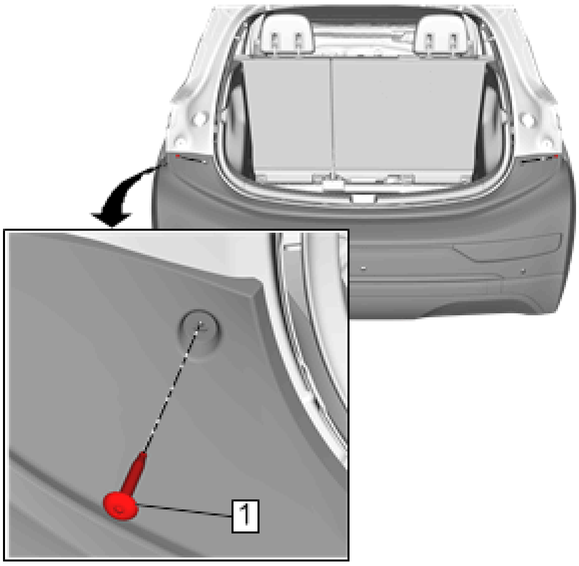
Removal Procedure

1. Raise and support the vehicle. Lifting and Jacking the Vehicle



[Fig. 51: Rear Wheel Opening Molding](#)
Courtesy of GENERAL MOTORS COMPANY

2. Rear Wheel Opening Molding - Remove - [Rear Wheel Opening Molding Replacement](#)



[Fig. 52: Rear Bumper Fascia Upper Bolt](#)
Courtesy of GENERAL MOTORS COMPANY

3. Rear Bumper Fascia Upper Bolt - Remove

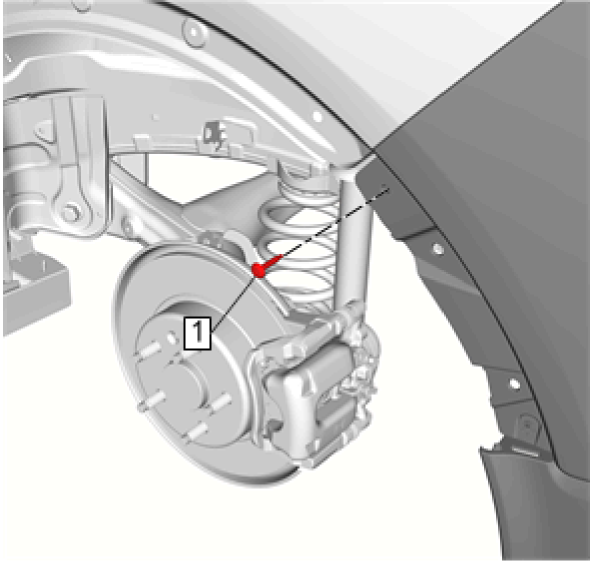


Fig. 53: Rear Bumper Fascia Guide Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Rear Bumper Fascia Guide Bolt - Remove

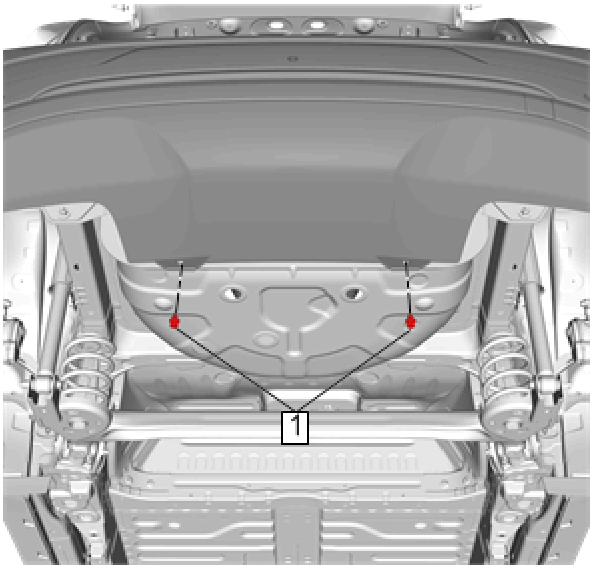


Fig. 54: Rear Bumper Fascia Lower Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Rear Bumper Fascia Lower Retainer - Remove

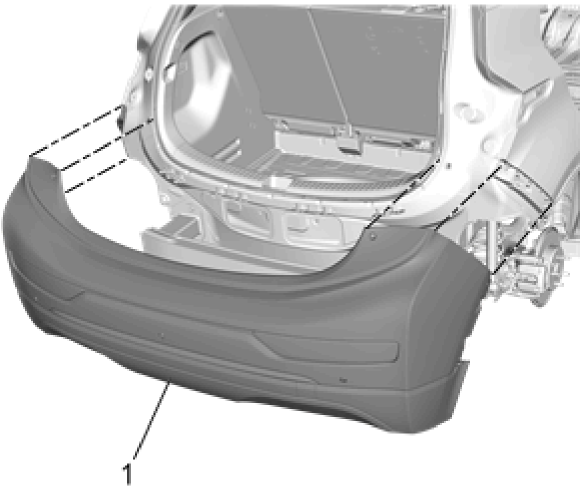


Fig. 55: Rear Fascia
Courtesy of GENERAL MOTORS COMPANY

6. Release the rear fascia from the fascia guides at the quarter panels by gently pulling the fascia outward.
7. Pull the rear bumper fascia carefully outwards.
8. Disconnect the electrical connector.

Installation Procedure

1. Transfer components as necessary.
2. Connect the electrical connector.

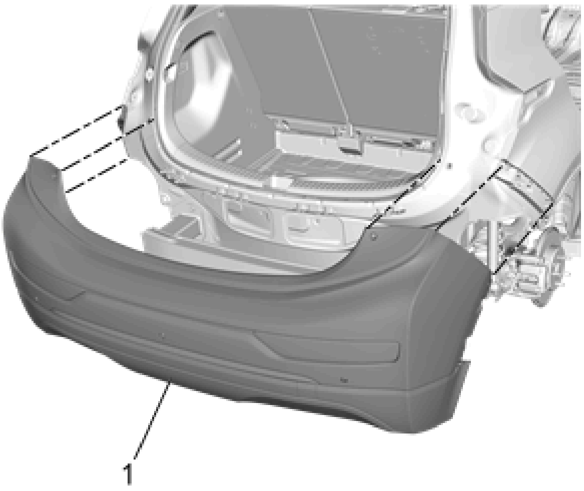


Fig. 56: Rear Fascia
Courtesy of GENERAL MOTORS COMPANY

3. Carefully push in the retaining tabs of the rear bumper fascia into the rear bumper fascia guides.

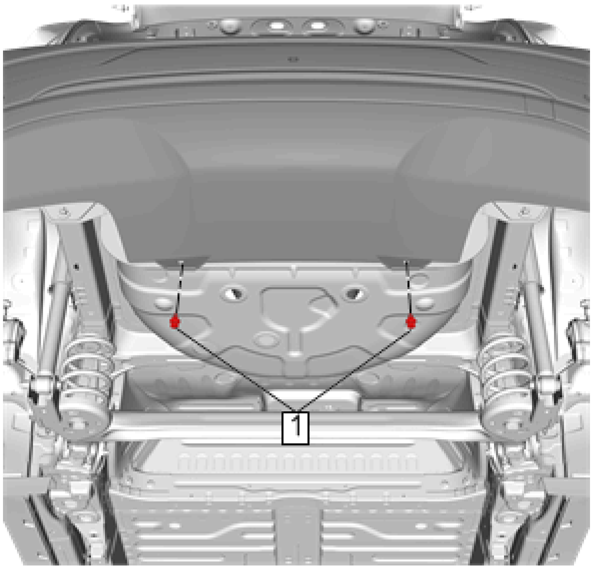


Fig. 57: Rear Bumper Fascia Lower Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Rear Bumper Fascia Lower Retainer - Install

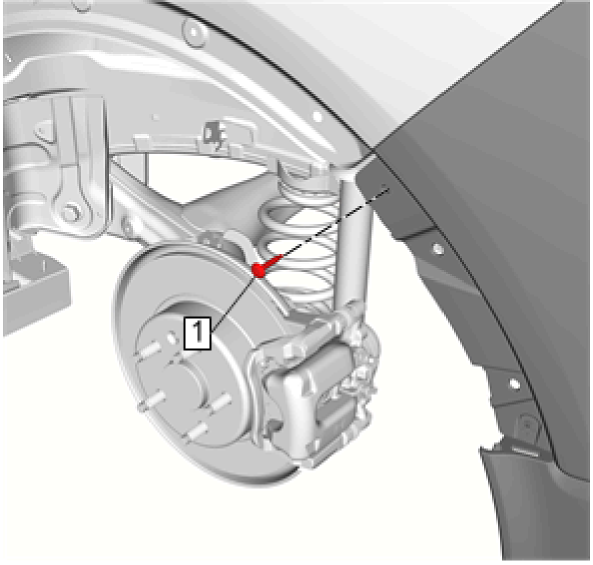


Fig. 58: Rear Bumper Fascia Guide Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution .

5. Rear Bumper Fascia Guide Bolt - Install and tighten to 2.5 N.m (22 lb in)

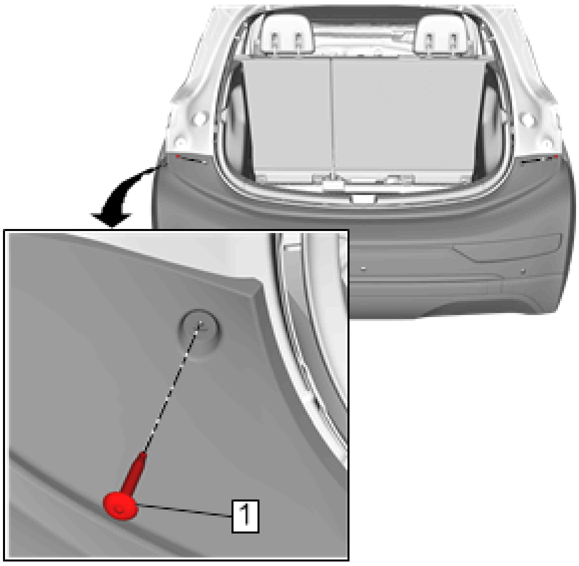


Fig. 59: Rear Bumper Fascia Upper Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Rear Bumper Fascia Upper Bolt - Install and tighten to 2.5 N.m (22 lb in)

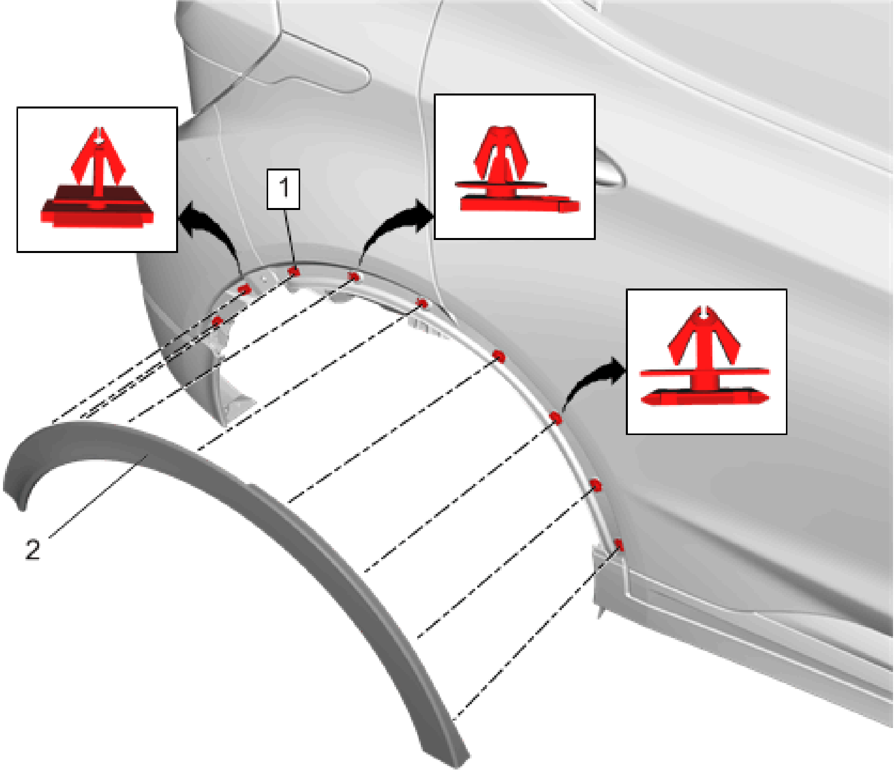


Fig. 60: Rear Wheel Opening Molding
Courtesy of GENERAL MOTORS COMPANY

7. Rear Wheel Opening Molding - Install - Rear Wheel Opening Molding Replacement
8. Remove the support and lower the vehicle. Lifting and Jacking the Vehicle

REAR BUMPER FASCIA GUIDE REPLACEMENT

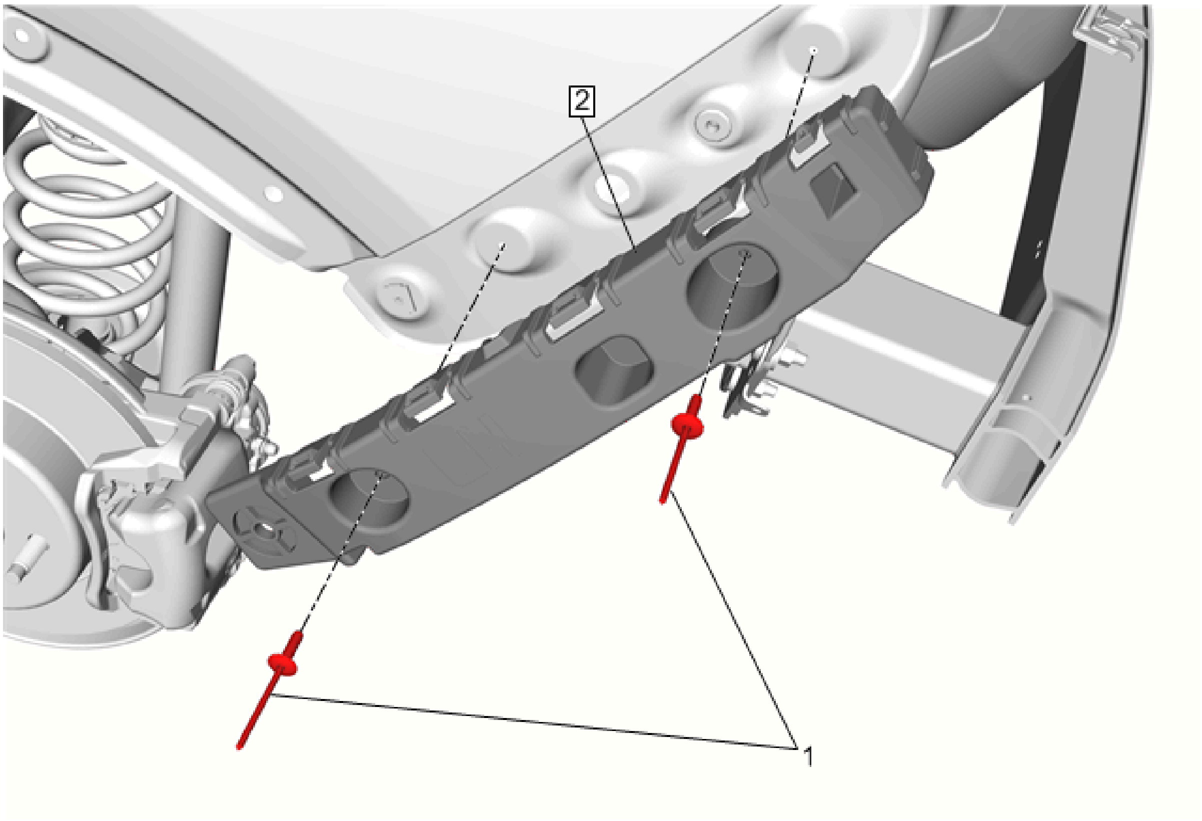


Fig. 61: Rear Bumper Fascia Guide
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Eye Protection Warning **Preliminary Procedure** Rear Bumper Fascia Replacement	
1	Rear Bumper Fascia Guide Rivet
2	Rear Bumper Fascia Guide

REAR BUMPER UPPER FASCIA REPLACEMENT

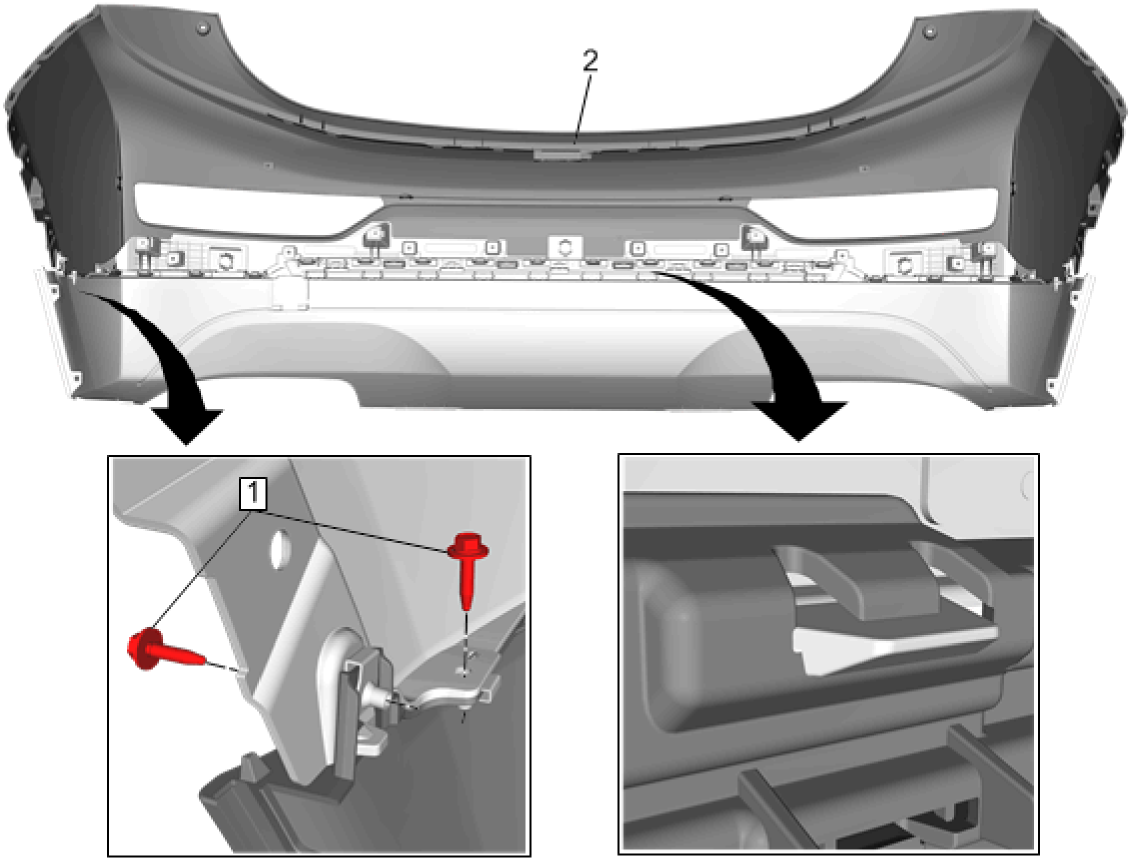


Fig. 62: Rear Bumper Upper Fascia
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Rear Bumper Fascia Replacement 2. Rear Fascia Lower Signal Lamp Replacement 3. Rear Bumper Fascia Molding Replacement 4. Rear Parking Assist Alarm Sensor Replacement	
1	Rear Bumper Fascia Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
2	Rear Bumper Upper Fascia **Procedure** 1. Disconnect and unclip the electrical harness as required. 2. Carefully release the integral retainers. 3. Transfer components as necessary. **NOTE:** **Use care not to damage the front bumper lower fascia during removal.**

REAR BUMPER LOWER FASCIA REPLACEMENT

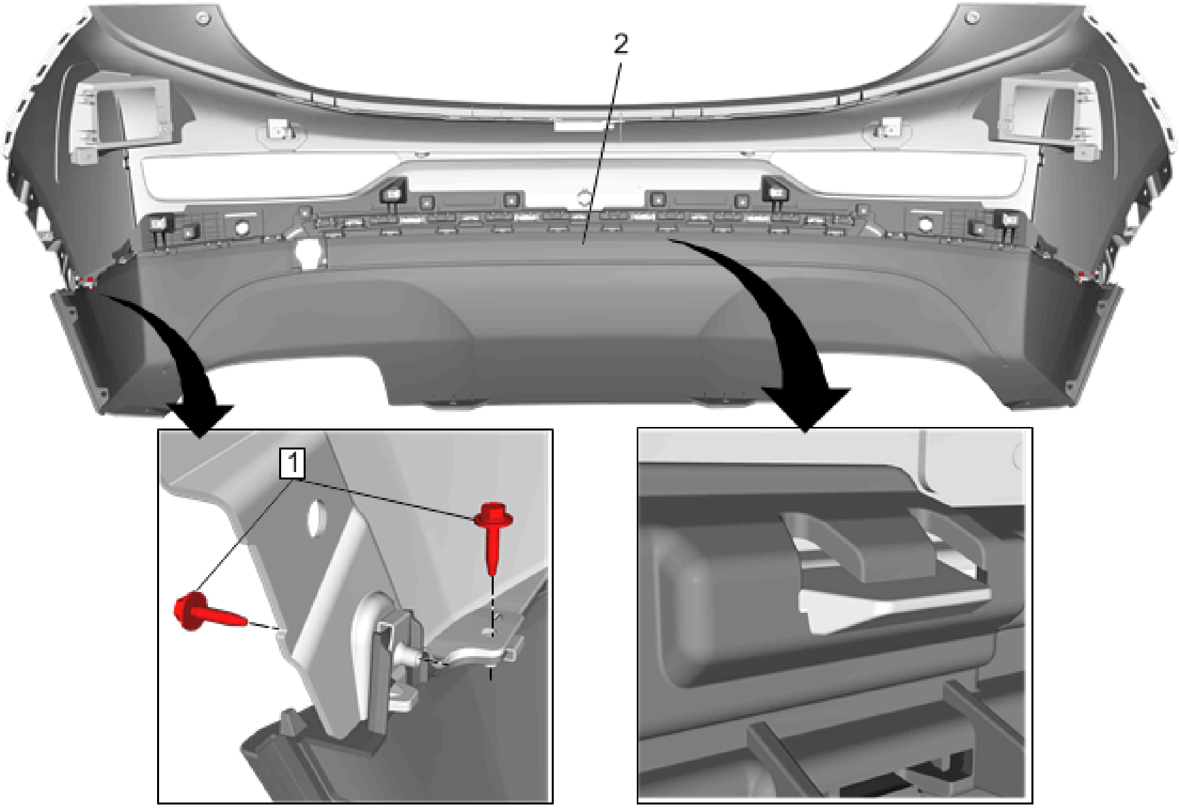


Fig. 63: Rear Bumper Lower Fascia
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Rear Bumper Fascia Replacement 2. Rear Fascia Lower Signal Lamp Replacement 3. Rear Bumper Fascia Molding Replacement 4. Rear Parking Assist Alarm Sensor Replacement	
1	Rear Bumper Fascia Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
2	Rear Bumper Lower Fascia **Procedure** 1. Disconnect and unclip the electrical harness as required. 2. Carefully release the integral retainers. 3. Transfer components as necessary. **NOTE:** **Use care not to damage the front bumper lower fascia during removal.**

REAR BUMPER IMPACT BAR REPLACEMENT

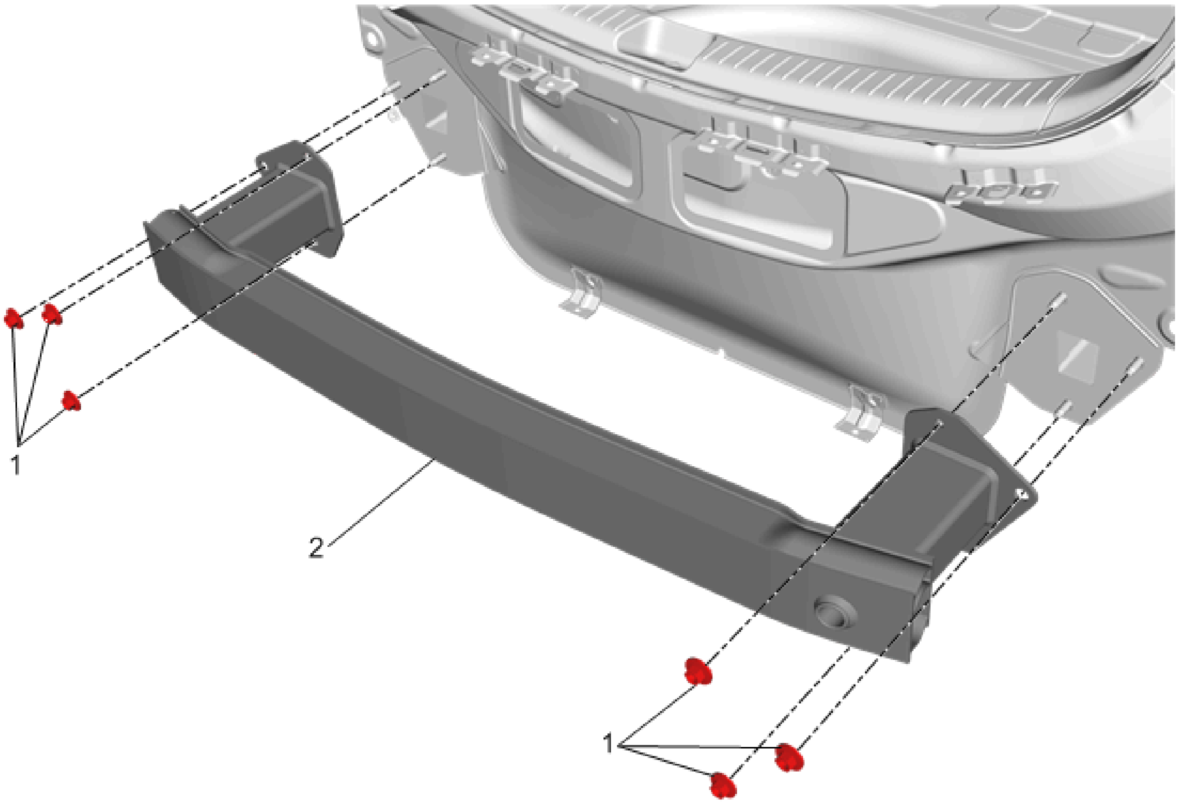


Fig. 64: Rear Bumper Impact Bar
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Bumper Fascia Replacement	
1	Rear Bumper Impact Bar Nut **CAUTION:** **Refer to Fastener Caution .** **Tighten** 58 N.m (43 lb ft)
2	Rear Bumper Impact Bar

DESCRIPTION AND OPERATION

ACTIVE GRILLE AIR SHUTTER DESCRIPTION AND OPERATION

The active grille air shutter system closes shutters in the front grille to enhance vehicle aerodynamics in driving situations where cooling and A/C loads are relatively low and high levels of front end airflow are not required. If high levels of airflow are required the active grille air shutter system will open one or both shutters. The control signal from the engine control module, ignition and ground circuits enable the active grille air shutter actuators to operate. If the conditions for opening the shutters are reached the engine control module commands the active grille air shutter actuators to open one or both shutters.

The dual active grille air shutter system consists of two aero shutter mechanisms located in the front grille for controlling the amount of air flowing through the grille. It includes three wires; ground, power and a Local Interconnect Network (LIN) Bus serial data circuit from the engine control module to the shutter actuator. The engine control module determines shutter state based on various vehicle conditions such as vehicle speed, coolant temperature, fan state, refrigerant system pressure, A/C compressor state and ambient temperature. The engine control module has the ability to command each shutter individually to the open or closed positions through communications on the LIN Bus.

The actuators are powered by an ignition circuit that is active when the key is in the RUN position. The vehicle may have to be driven for up to 13 minutes at speeds greater than 41 km/h (25 mph) before a shutter begins to move. If low ambient temperature is detected, the shutters will remain in the closed position.

Back To Article

2017 ACCESSORIES & EQUIPMENT

Cellular, Entertainment, and Navigation - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Communication Interface Module Battery Bolt	2.5 N.m (22 lb in)
Communication Interface Module Bracket Bolt	2.5 N.m (22 lb in)
Driver Information Display Bolt	2.5 N.m (22 lb in)
Ground Wire Bolt	9 N.m (80 lb in)
Ground Wire Nut	9 N.m (80 lb in)
High Frequency Antenna Fastener	9 N.m (80 lb in)
Radio Antenna Amplifier Bolt	9 N.m (80 lb in)
Radio Assembly Bolt	2.5 N.m (22 lb in)
Radio Control Switch Bolt - Spoke Lower Cover	1.5 N.m (13 lb in)
Radio Control Switch Bolt - Steering Wheel	2.5 N.m (22 lb in)
Radio Front Side Door Speaker Fastener	2.5 N.m (22 lb in)
Radio Function Switch Bolt	2.5 N.m (22 lb in)
Radio Rear Compartment Speaker Fastener	6 N.m (53 lb in)
Radio Rear Side Door Speaker Fastener	2.5 N.m (22 lb in)
Radio Speaker Amplifier Nut	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

RADIO/NAVIGATION SYSTEM WIRING SCHEMATICS

Radio Power, Ground, Data, Microphone and Controls

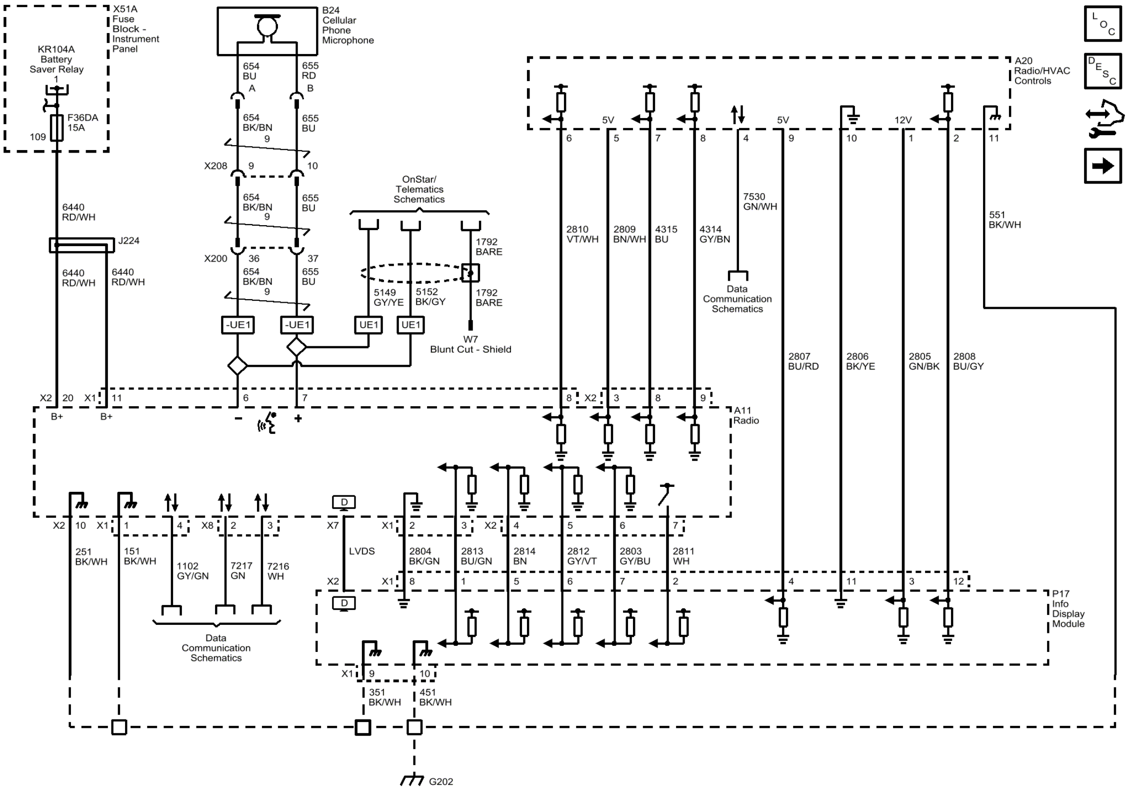

X51A Fuse Block - Instrument Panel
KR104A Battery Saver Relay
1
F36DA 15A
109
B24 Cellular Phone Microphone
654 BU A
655 RD B
654 BK/BN 9
655 BU
X208 9 10
654 BK/BN 9
655 BU
X200 36 37
654 BK/BN 9
655 BU
-UE1
-UE1
UE1
UE1
OnStar/ Telematics Schematics
5149 GY/YE
5152 BK/GY
1792 BARE
1792 BARE
W7 Blunt Cut - Shield
6440 RD/WH
J224
6440 RD/WH
6440 RD/WH
A20 Radio/HVAC Controls
5V 5V 12V
6 5 7 8 4 9 10 1 2 11
2810 VT/WH
2809 BN/WH
4315 BU
4314 GY/BN
7530 GN/WH
Data Communication Schematics
551 BK/WH
2807 BU/RD
2806 BK/YE
2805 GN/BK
2808 BU/GY
X2 20 X1 11 6 7 8 X2 3 8 9
B+ B+
A11 Radio
X2 10 X1 1 4 X8 2 3 X7 X1 2 3 X2 4 5 6 7
251 BK/WH
151 BK/WH
1102 GY/GN
7217 GN
7216 WH
Data Communication Schematics
LVDS
D
D
2804 BK/GN
2813 BU/GN
2814 BN
2812 GY/VT
2803 GY/BU
2811 WH
X2 X1 8 1 5 6 7 2 4 11 3 12
P17 Info Display Module
X1 9 10
351 BK/WH
451 BK/WH
G202

Fig. 1: Radio Power, Ground, Data, Microphone and Controls

Courtesy of GENERAL MOTORS COMPANY

Speakers (UQ3)

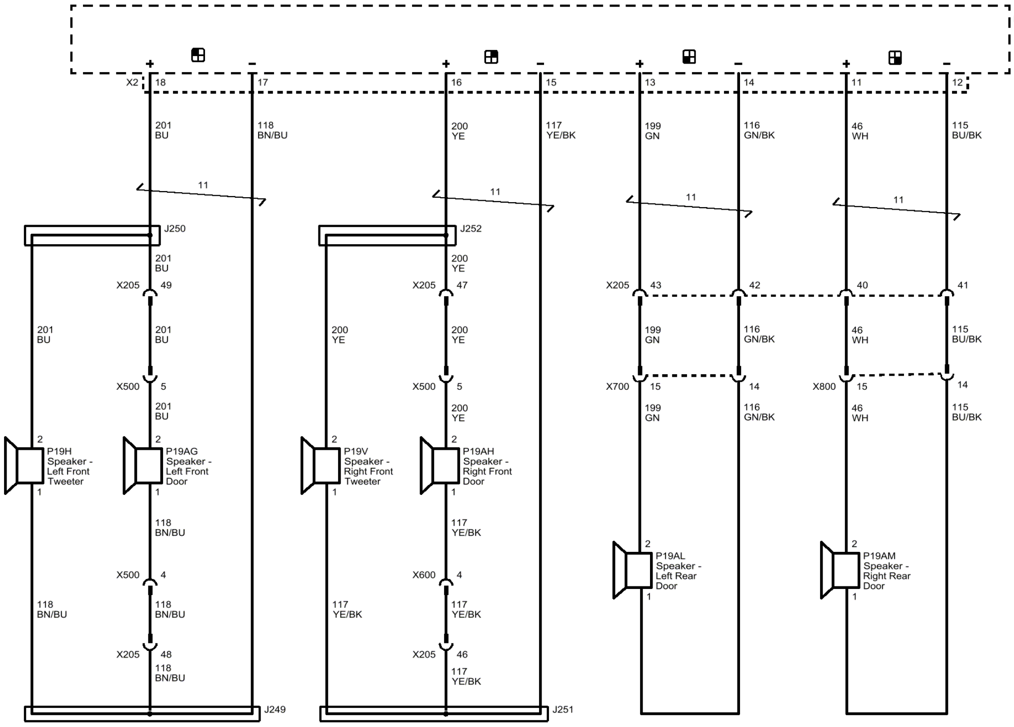

A11 Radio
X2 18 17 16 15 13 14 11 12
201 BU
118 BN/BU
200 YE
117 YE/BK
199 GN
116 GN/BK
46 WH
115 BU/BK
11
11
11
11
J250
J252
201 BU
200 YE
X205 49
X205 47
X205 43 42 40 41
201 BU
201 BU
200 YE
200 YE
199 GN
116 GN/BK
46 WH
115 BU/BK
X500 5
X500 5
X700 15 14
X800 15 14
201 BU
200 YE
199 GN
116 GN/BK
46 WH
115 BU/BK
2 P19H Speaker - Left Front Tweeter 1
2 P19AG Speaker - Left Front Door 1
2 P19V Speaker - Right Front Tweeter 1
2 P19AH Speaker - Right Front Door 1
118 BN/BU
117 YE/BK
X500 4
X600 4
2 P19AL Speaker - Left Rear Door 1
2 P19AM Speaker - Right Rear Door 1
118 BN/BU
118 BN/BU
117 YE/BK
117 YE/BK
X205 48
X205 46
118 BN/BU
117 YE/BK
J249
J251

Fig. 2: Speakers (UQ3)

Courtesy of GENERAL MOTORS COMPANY

Radio Speaker Outputs (UQA)

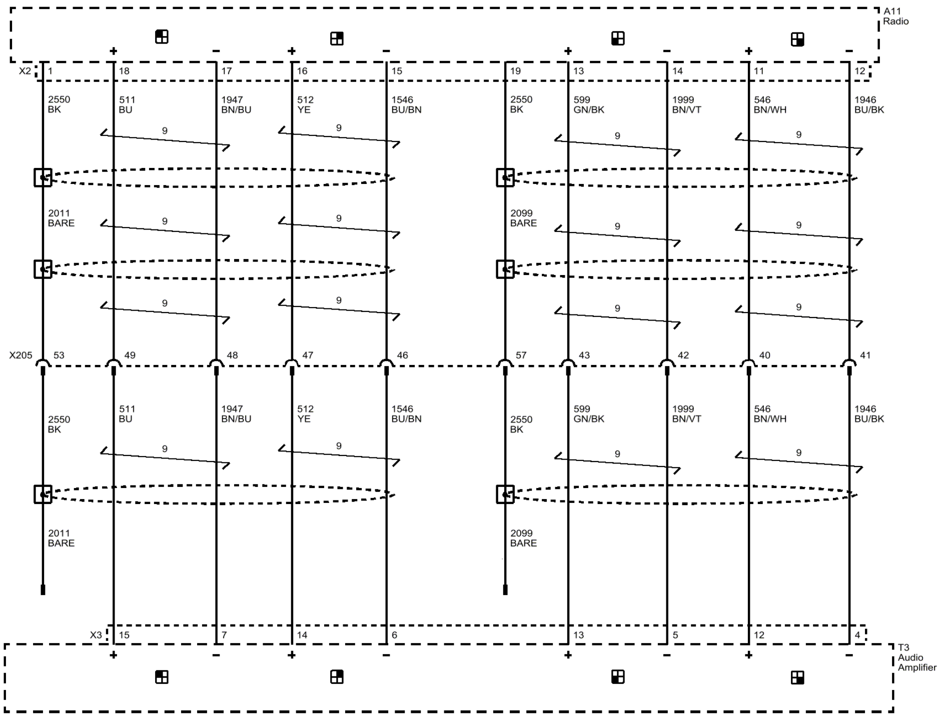

A11 Radio
X2
1
18
17
16
15
19
13
14
11
12
2550 BK
511 BU
1947 BN/BU
512 YE
1546 BU/BN
599 GN/BK
1999 BN/VT
546 BN/WH
1946 BU/BK
9
2011 BARE
2099 BARE
X205
53
49
48
47
46
57
43
42
40
41
X3
15
7
14
6
13
5
12
4
T3 Audio Amplifier

Fig. 3: Radio Speaker Outputs (UQA)
Courtesy of GENERAL MOTORS COMPANY

Speakers (UQA)

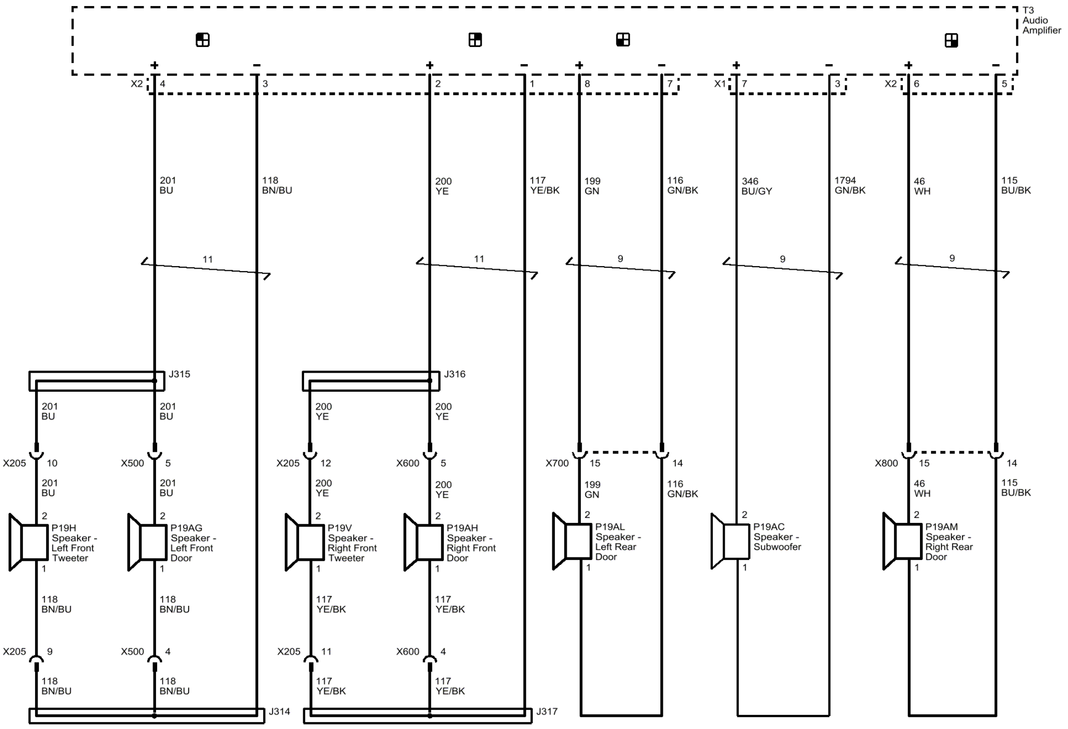

T3 Audio Amplifier
X2
4
3
2
1
8
7
X1
7
3
X2
6
5
201 BU
118 BN/BU
200 YE
117 YE/BK
199 GN
116 GN/BK
346 BU/GY
1794 GN/BK
46 WH
115 BU/BK
11
9
J315
J316
X205
10
X500
5
X205
12
X600
5
X700
15
14
X800
15
14
P19H Speaker - Left Front Tweeter
P19AG Speaker - Left Front Door
P19V Speaker - Right Front Tweeter
P19AH Speaker - Right Front Door
P19AL Speaker - Left Rear Door
P19AC Speaker - Subwoofer
P19AM Speaker - Right Rear Door
X205
9
X500
4
X205
11
X600
4
J314
J317

Fig. 4: Speakers (UQA)
Courtesy of GENERAL MOTORS COMPANY

Amplifier Power, Ground and Data (UQA)

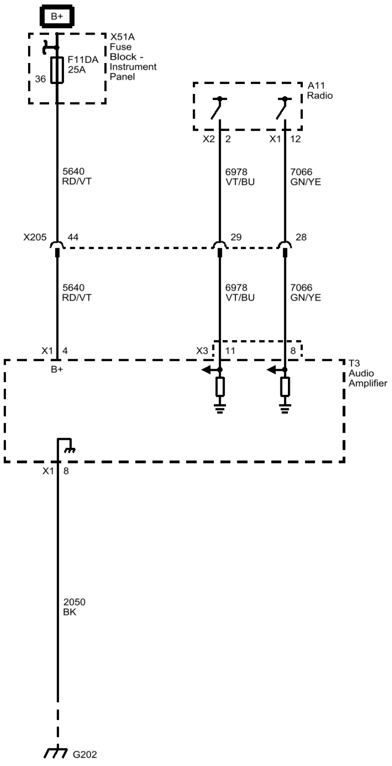

B+
X51A
Fuse
Block -
Instrument
Panel
F11DA
25A
36
A11
Radio
X2
2
X1
12
5640
RD/VT
6978
VT/BU
7066
GN/YE
X205
44
29
28
5640
RD/VT
6978
VT/BU
7066
GN/YE
X1
4
X3
11
8
T3
Audio
Amplifier
B+
X1
8
2050
BK
G202

Fig. 5: Amplifier Power, Ground and Data (UQA)
Courtesy of GENERAL MOTORS COMPANY

Antenna Signals (CV3/EF7/Z49)

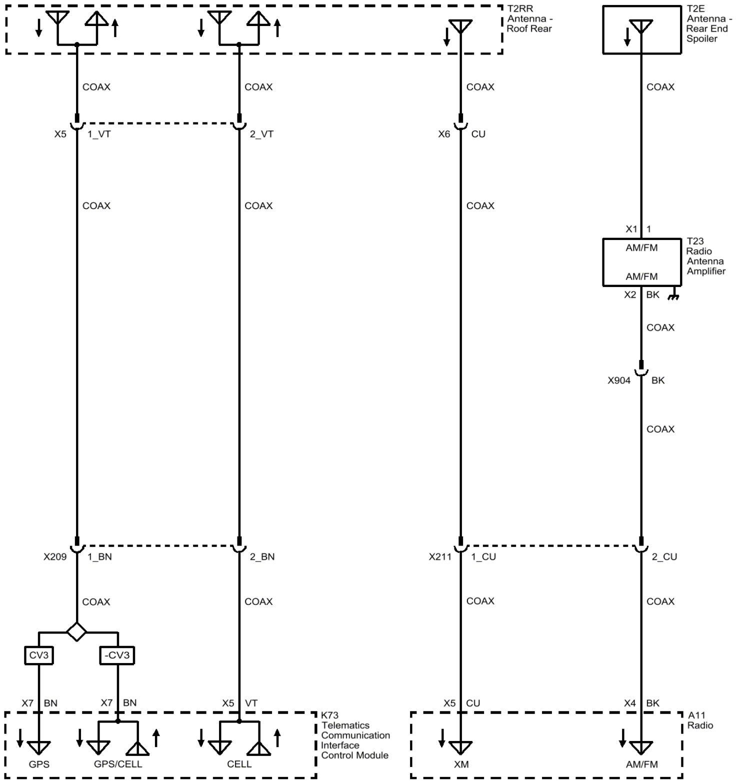

T2RR
Antenna -
Roof Rear
T2E
Antenna -
Rear End
Spoiler
COAX
COAX
COAX
COAX
X5
1_VT
2_VT
X6
CU
COAX
COAX
COAX
X1
1
AM/FM
AM/FM
T23
Radio
Antenna
Amplifier
X2
BK
COAX
X904
BK
COAX
X209
1_BN
2_BN
X211
1_CU
2_CU
COAX
COAX
COAX
COAX
CV3
-CV3
X7
BN
X7
BN
X5
VT
K73
Telematics
Communication
Interface
Control Module
X5
CU
X4
BK
A11
Radio
GPS
GPS/CELL
CELL
XM
AM/FM

Fig. 6: Antenna Signals (CV3/EF7/Z49)
Courtesy of GENERAL MOTORS COMPANY

Antenna Signals (MBM)

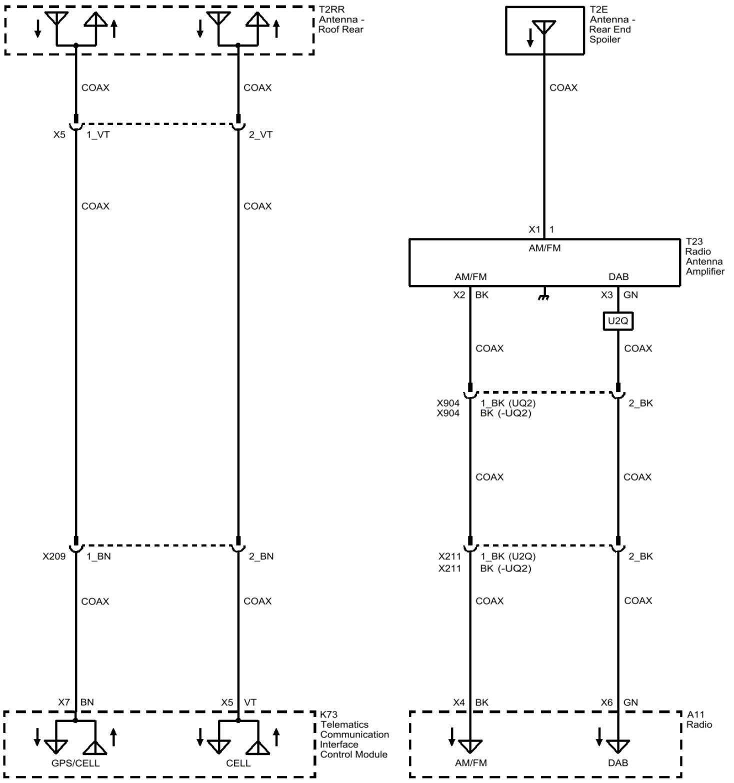

T2RR
Antenna - Roof Rear
T2E
Antenna - Rear End Spoiler
COAX
X5
1_VT
2_VT
X1
1
AM/FM
T23
Radio Antenna Amplifier
AM/FM
DAB
X2
BK
X3
GN
U2Q
X904
1_BK (UQ2)
X904
BK (-UQ2)
2_BK
X209
1_BN
2_BN
X211
1_BK (U2Q)
X211
BK (-UQ2)
X7
BN
VT
X4
X6
K73
Telematics Communication Interface Control Module
GPS/CELL
CELL
A11
Radio
AM/FM
DAB

Fig. 7: Antenna Signals (MBM)

Courtesy of GENERAL MOTORS COMPANY

Antenna Signals (CW1)

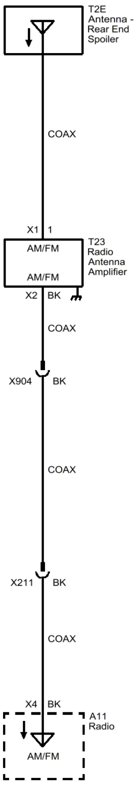

T2E
Antenna - Rear End Spoiler
COAX
X1
1
AM/FM
T23
Radio Antenna Amplifier
AM/FM
X2
BK
X904
BK
X211
BK
X4
BK
A11
Radio
AM/FM

Fig. 8: Antenna Signals (CW1)

Courtesy of GENERAL MOTORS COMPANY

Auxiliary Input

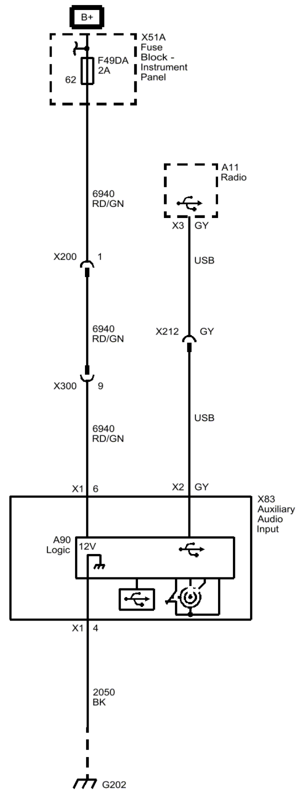

B+
X51A
Fuse
Block -
Instrument
Panel
F49DA
2A
62
6940
RD/GN
A11
Radio
X3
GY
USB
X200
1
6940
RD/GN
X212
GY
X300
9
USB
6940
RD/GN
X1
6
X2
GY
X83
Auxiliary
Audio
Input
A90
Logic
12V
X1
4
2050
BK
G202

Fig. 9: Auxiliary Input
Courtesy of GENERAL MOTORS COMPANY

ONSTAR/TELEMATICS WIRING SCHEMATICS

Power, Ground, Serial Data and Antennas (UE1)

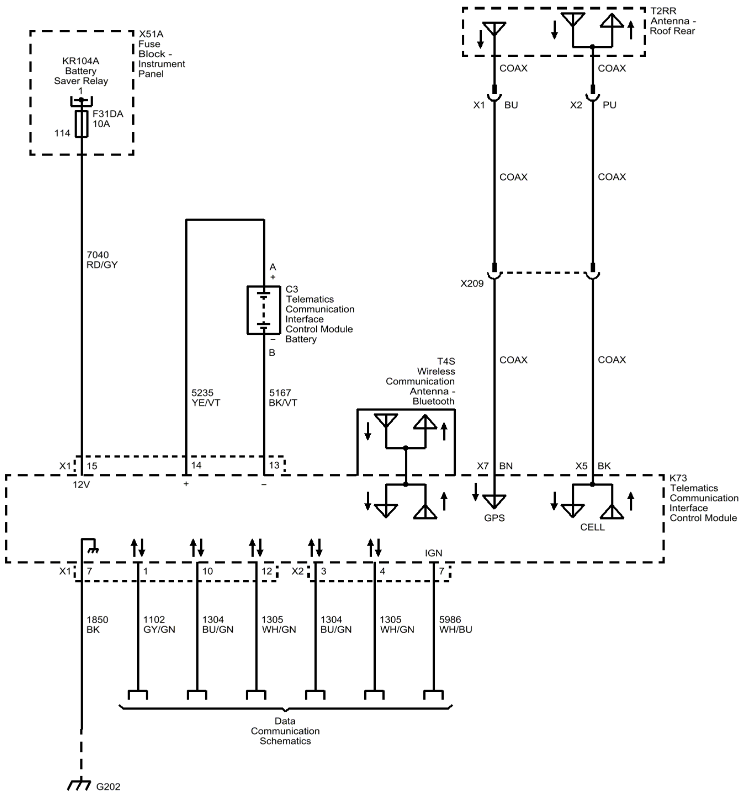

X51A
Fuse
Block -
Instrument
Panel
KR104A
Battery
Saver Relay
1
F31DA
10A
114
T2RR
Antenna -
Roof Rear
COAX
COAX
X1
BU
X2
PU
COAX
COAX
7040
RD/GY
A
+
C3
Telematics
Communication
Interface
Control Module
Battery
–
B
X209
COAX
COAX
T4S
Wireless
Communication
Antenna -
Bluetooth
5235
YE/VT
5167
BK/VT
X1
15
14
13
X7
BN
X5
BK
K73
Telematics
Communication
Interface
Control Module
12V
+
–
GPS
CELL
IGN
X1
7
1
10
12
X2
3
4
7
1850
BK
1102
GY/GN
1304
BU/GN
1305
WH/GN
1304
BU/GN
1305
WH/GN
5986
WH/BU
Data
Communication
Schematics
G202

Fig. 10: Power, Ground, Serial Data and Antennas (UE1)
Courtesy of GENERAL MOTORS COMPANY

Controls and Audio Signals (UE1)

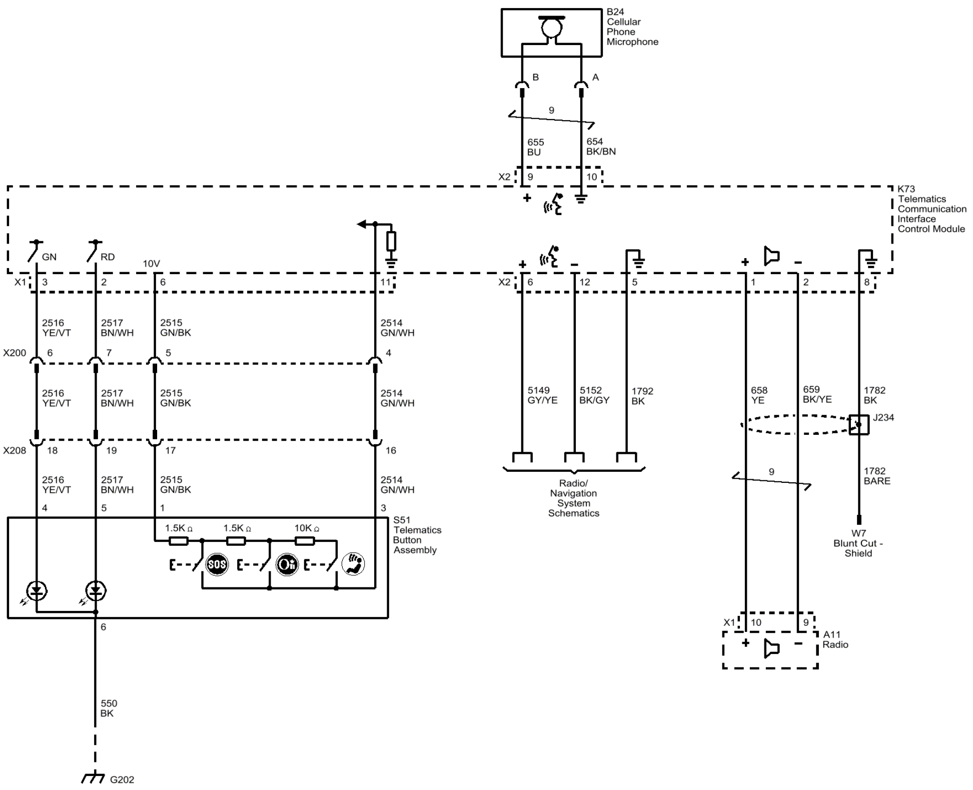

B24
Cellular
Phone
Microphone
B
A
9
655
BU
654
BK/BN
X2
9
10
K73
Telematics
Communication
Interface
Control Module
GN
RD
10V
X1
3
2
6
11
X2
6
12
5
1
2
8
2516
YE/VT
2517
BN/WH
2515
GN/BK
2514
GN/WH
X200
6
7
5
4
2516
YE/VT
2517
BN/WH
2515
GN/BK
2514
GN/WH
X208
18
19
17
16
2516
YE/VT
2517
BN/WH
2515
GN/BK
2514
GN/WH
4
5
1
3
S51
Telematics
Button
Assembly
1.5K Ω
1.5K Ω
10K Ω
SOS
6
550
BK
G202
5149
GY/YE
5152
BK/GY
1792
BK
Radio/
Navigation
System
Schematics
658
YE
659
BK/YE
1782
BK
J234
9
1782
BARE
W7
Blunt Cut -
Shield
X1
10
9
A11
Radio

Fig. 11: Controls and Audio Signals (UE1)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B123E: RADIO KEYPAD BUTTON SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC B123E

Radio Keypad Button Signal Circuit

Symptom Byte Information: Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal Terminal 6	B123E 02	B123E 01	B123E 01	-
Low Reference Terminal 10	-	B123E 01	-	-

Circuit/System Description

The radio controls communicate radio control inputs directly to the radio through a discrete circuit for volume up, volume down and power button. It also uses a series of resistors through a signal circuit when the home, seek up, seek down and phone buttons are pressed. After receiving the message the radio will perform the requested function. Messages communicated between the radio and the radio controls include the following:

- Button presses/knob rotations
- Commands for the state of indicators

- Controls back-lighting

Conditions for Running the DTC

- Vehicle in Service Mode/Ignition is ON or in the ACC position
- The system voltage is 9 - 16 V
- The infotainment system is ON
- The test is run once every 250 ms when the infotainment system is operating

Conditions for Setting the DTC

B123E 01

The radio detects an open/high resistance or short to voltage on the radio keypad button signal circuit

B123E 02

The radio detects a short to ground on the radio keypad button signal circuit

Actions Taken When the DTC Sets

Radio control buttons will be inoperative

Conditions for Clearing the DTC

The condition for setting the DTC is no longer detected for 250 ms.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition On/vehicle in Service Mode.
2. Verify that each button on the A20 Radio/HVAC Controls operates normally by pressing each button individually.
    - **If none of the buttons operate normally**

      Refer to Circuit/System Testing

    - **If some, but not all, of the buttons operate normally**

      Test or replace the A20 Radio/HVAC Controls

   - **If all of the buttons operate normally**
3. All OK

Circuit/System Testing

1. Ignition OFF/vehicle OFF and all vehicle systems OFF. Disconnect the harness connector at the A20 Radio/HVAC Controls. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 10 and ground.
   - **If 10 Ω of greater**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the P17 Info Display Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the P17 Info Display Module
   - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode.
4. Test for 2.5 - 3.5 V on the signal circuit terminal 6 and ground.
   - **If less than 2.5 V**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the A11 Radio.
   - **If greater than 3.5 V**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
   2. Ignition ON/vehicle in Service Mode, test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the A11 radio.
   - **If between 2.5 - 3.5 V**
5. Test or replace the A20 Radio/HVAC Controls

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- For control module replacement, programming, and setup refer to: **Control Module References**

DTC B124B: USB 1 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B124B

USB 1 Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B124B, 1, 6	1, 5	-	-
Auxiliary Audio Common Signal	-	8	-	-
Auxiliary Detection Signal	7	8	-	-
Left Auxiliary Audio Signal	2	2	2, 4	-
Right Auxiliary Audio Signal	3	3	3, 4	-
USB Cable	B124B	B124B	B124B	-
Ground	-	1	-	-

1. USB port Inoperative
2. No left side audio from device connected to AUX jack
3. No right side audio from device connected to AUX jack
4. Noticeable distortion may be present in affected audio channel
5. Fault may affect one or more components, dependant on fault location
6. Fault affects multiple components, dependant on vehicle equipment
7. Radio does not detect auxiliary device connection, AUX not available as input selection
8. AUX always available as an input selection, with or without auxiliary device connected

Circuit/System Description

The infotainment system has a auxiliary jack and USB receptacle assembly. The auxiliary jack and USB receptacle assembly receives fused battery voltage and ground from the harness to power the internal hub device as well as providing additional amperage to power USB devices. The internal hub device interfaces directly with the radio via a standard USB cable.

Auxiliary Audio Input Jack

When a portable audio playback device is connected to the 3.5 mm (1/8 in.) auxiliary audio input jack an internal switch opens the detection signal circuit. The radio detects the device and AUX becomes available as an audio source. Audio signals from the device are sent to the radio from the auxiliary input jack via the left, right, and common audio signal circuits.

USB Port

The USB receptacle interfaces directly with the radio via a standard USB cable. A Mini type USB connector is used to connect the cable at the radio and at the auxiliary jack and USB receptacle assembly. USB male to female connections are typically used for connecting USB cables together where an in-line connection is required. An in-line cable connection is typically found between the console and I/P harness.

The USB port allows connectivity to the infotainment system from portable media players or a USB storage device (memory stick/flash drive). When a device is connected to the USB port, the system detects the device and USB becomes available as an audio source. Once connected, the device can be controlled from the radio controls.

Not all portable media player devices or file types are compatible. Refer to the owner's manual for information on USB devices, control, and operation.

Conditions for Running the DTC

- Ignition is ON or in the ACC position/vehicle in Service Mode
- The system voltage is 9-16 V
- The infotainment system is ON
- The test is run once per second when the infotainment system is operating

Conditions for Setting the DTC

The radio detects an excessive current condition on the USB 5 V circuit.

Action Taken When the DTC Sets

The USB port is inoperative while the DTC is current.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

This DTC may be set due to the connection of an incompatible or faulty USB device.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-50334-20** Multi-Media Interface Tester (MIT)
- **EL-50334-50** USB Cable and Adapter Kit
- **EL-50334-14** Infotainment Test Cable

Circuit/System Verification

1. Verify DTC B124B is not set. Since occurrences of this DTC can be caused by an incompatible or faulty USB device, review with the customer the conditions under which their concern occurred.
   - **If DTC B124B is set.**

     Refer to Circuit/System testing.

   - **If DTC B124B is not set.**
2. Ignition ON/vehicle in Service Mode, infotainment system ON.
3. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
4. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.
   - **If audio is not heard from the test tool**

     Refer to Circuit/System Testing.

   - **If audio is heard from the test tool**
5. All OK.

Circuit/System Testing

1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the X83 Auxiliary Audio Input.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.

    - **If 10 Ω or greater**
    1. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Verify that a test lamp illuminates between the B+ circuit terminal 6 and ground.
    - **If the test lamp does not illuminate**
    1. Remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - **If the test lamp illuminates**
4. Verify the USB cable is properly connected at all components and any in-line connections, and there is no damage to the cable or connections.
    - **If connection problems or cable damage is noted.**

      Perform the appropriate repair or replacement to correct any issues.

    - **If no connection problems or cable damage is noted.**
5. Disconnect the vehicle USB cable at the A11 Radio and the X83 Auxiliary Audio Input.
6. Connect the EL-50334-14 Infotainment Test Cable and the EL-50334-2 Type-A Female to Mini-B Male Cable together. Connect the assembled test cable to the A11 Radio and the X83 Auxiliary Audio Input.
7. Ignition ON/vehicle in Service Mode, infotainment system ON.
8. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
9. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.
    - **If audio is not heard from the test tool**
    1. Replace the X83 Auxiliary Audio Input. Connect all harness connectors.
    2. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
    3. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.
        - If audio is not heard from the test tool, replace the A11 Radio.
        - If audio is heard from the test tool.
    4. All OK.
    - **If audio is heard from the test tool**
10. Replace the USB cable assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Audio Disc Player and USB Receptacle Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B124F: UNIVERSAL SERIAL BUS (USB) PROGRAMMING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B124F

Universal Serial Bus (USB) Programming

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Certain devices in the entertainment system must be programmed with specific software and other information to operate correctly. This DTC is the result of an unsuccessful USB programming event of the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved

Conditions for Running the DTC

Once upon each USB Programming Event.

Conditions for Setting the DTC

The programming event was incomplete, or completed with errors.

Action Taken When the DTC Sets

The entertainment system has limited or no functionality.

Conditions for Clearing the DTC

The programming event completes successfully.

Diagnostic Aids

DTC B124F could set if a programming attempt was made when the module already had the latest update available installed.

Circuit/System Verification

1. Ignition ON/vehicle in Service Mode.
2. Verify DTC B124F is not set.
   - **If DTC B124F is set**
   1. Program the device that set the DTC.
   2. Verify the DTC does not set.
      - If DTC is set, replace the device that set the DTC.
      - If the DTC is not set
   3. All OK.
   - **If DTC B124F is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for device replacement, programming, and setup.

DTC B125A: ANTENNA SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B125A 02

Antenna Signal Circuit Short to Ground

DTC B125A 04

Antenna Signal Circuit Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Antenna Coax	B125A 02	B125A 04	1	-
Antenna Module Ground	-	1	-	-
1. May exhibit possible AM/FM interference.				

Circuit/System Description

The antenna amplifier receives both AM and FM signals from the rear glass antenna. The radio antenna amplifier is enabled when the radio is turned on. The radio provides battery voltage to the antenna amplifier using the center conductor of the antenna coaxial cable. When a 12 V signal is seen by the amplifier on the center conductor of the antenna coax, both AM and FM signals are amplified.

Conditions for Running the DTC

- Ignition ON.
- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B125A 02

The radio detects a short to ground in the antenna signal circuit center conductor.

B125A 04

The radio detects an open in the antenna signal circuit center conductor.

Action Taken When the DTC Sets

Radio reception may be poor or not available.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clears after 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Poor AM and FM radio reception may be due to multiple influences, some of which may not be vehicle related. Areas which have high RF traffic or block the signal path may cause a degradation in radio reception. Radio reception may also be influenced by items within the vehicle, but not part of the radio system. Such examples are aftermarket electrical accessories or other items which may generate noise in the vehicle electrical system. Aftermarket window tinting, especially when there is a metallic in the film, may reduce radio reception.

AM reception is highly dependent on the antenna amplifier receiving battery voltage from the radio and being properly grounded. The antenna amplifier boosts both AM and FM reception. When the antenna amplifier does not receive power, AM stations may not be received and FM reception will be limited. If the amplifier is not properly grounded, excessive interference in the signal may occur, or reception may be limited.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the radio antenna coax cable from the A11 Radio and from the T23 Radio Antenna Amplifier.
2. Verify the antenna coax cable passes the coax cable component test. Refer to Component Testing.
    - **If the coax cable does not pass the test**

      Replace the antenna coax cable

    - **If the coax cable passes the test**
3. Connect the antenna coax cable to the A11 Radio. Ignition ON, A11 Radio ON.
4. Verify a test lamp illuminates between the antenna coax cable center terminal and ground at the T23 Radio Antenna Amplifier connector.
    - **If the test lamp does not illuminate**

      Replace the A11 Radio.

    - **If the test lamp illuminates**
5. Test or replace the T23 Radio Antenna Amplifier.

Component Testing

CAUTION: **Refer to Test Probe Caution .**

NOTE: **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.
    - **If 5 Ω or greater**

      Replace the coax cable

    - **If less than 5 Ω**
3. Test for less than 5 Ω between the coax cable outer shield end to end.
    - **If 5 Ω or greater**

      Replace the coax cable

    - **If less than 5 Ω**

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
    - **If less than infinite resistance**

      Replace the coax cable

    - **If infinite resistance**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Radio Antenna Amplifier Replacement**
- Refer to **Control Module References** for radio replacement, programming, and setup.

DTC B125C: SATELLITE ANTENNA CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B125C 01

Satellite Antenna Circuit Short to Battery

DTC B125C 02

Satellite Antenna Circuit Short to Ground

DTC B125C 04

Satellite Antenna Circuit Open

Circuit/System Description

The digital radio receiver, located inside the radio, receives digital radio information from the digital radio antenna located on the outside of the vehicle. The digital radio receiver is connected to the digital radio antenna via a shielded coax cable. The digital radio antenna contains an amplifier which is powered by the radio through the coax cable.

Conditions for Running the DTC

This DTC is run every 300 milliseconds.

Conditions for Setting the DTC

The radio detects a circuit fault in the digital radio antenna.

Action Taken When the DTC Sets

The radio displays No XM Signal or Check Antenna.

Conditions for Clearing the DTC

- A current DTC clears when the condition for setting the DTC is no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Diagnostic Aids

The digital radio antenna requires a clear line of sight to the sky to operate properly. Reception may be limited, intermittent, or unavailable inside structures.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools

EL-48028 Digital Radio Test Antenna

Circuit/System Verification

1. With the vehicle outside in an area with an unobstructed view of the southern sky, tune to XM.
2. Verify DTC B125C is not set as current and the No XM Signal message is not displayed on the radio.
   - **If DTC B125C is set as current or the No XM Signal message is displayed.**

     Refer to Circuit/System Testing.

   - **If DTC B125C is not set as current and the No XM Signal message is not displayed.**
3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the A11 Radio. Connect the **EL-48028** Digital Radio Test Antenna to the radio and place on the roof of the vehicle.
2. Ignition ON/Vehicle in Service Mode, radio tuned to XM channel 1.
3. Verify DTC B125C is not set as current and XM reception is improved.
   - **If DTC B125C is set as current or XM reception is not improved**

     Replace the A11 Radio.

   - **If DTC B125C is not set as current and XM reception is improved**
4. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the T2RR Antenna - Roof Rear.
5. Verify the digital radio antenna coax cable passes the coax cable component test. Refer to Component Testing.
   - **If the coax cable does not pass the test**

     Replace the antenna coax cable

   - **If the coax cable passes the test**
6. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: **Refer to Test Probe Caution .**

NOTE: **Before testing the coax cable, check the cable exterior for being pinched, cut,**

damaged, or having loose connections at the components, which can cause reception issues.

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF/Vehicle OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.
   - **If 5 Ω or greater**

     Replace the coax cable

   - **If less than 5 Ω**
3. Test for less than 5 Ω between the coax cable outer shield end to end.
   - **If 5 Ω or greater**

     Replace the coax cable

   - **If less than 5 Ω**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
   - **If less than infinite resistance**

     Replace the coax cable

   - **If infinite resistance**
5. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to High Frequency Antenna Replacement
- Refer to Control Module References for radio replacement, programming, and setup.

DTC B1265: SWITCHED 14 VOLT PERFORMANCE SHORT TO GROUND

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1265 02

Switched 14 Volt Performance Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Remote Enable	DTC B1265 02 *	1	2	-
* all components requiring remote enable inoperative 1. fault may affect one or more components, dependant on fault location and vehicle equipment 2. components will not power off with infotainment system				

Circuit/System Description

When the radio is on, a discrete 12 V signal is supplied on the entertainment remote enable circuit to the audio amplifier. This signal is used to control the power state of the component.

Conditions for Running the DTC

- The radio is ON.
- The system voltage is 9 - 16 V

Conditions for Setting the DTC

- The radio detects a short to ground on the entertainment remote enable circuit.
- The above condition is present for greater than 250 mS.

Action Taken When the DTC Sets

- The radio implements a current limiting mode and disables the output on the entertainment remote enable circuit.
- All components connected on the entertainment remote enable circuit will be inoperative.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- After the ignition has been OFF for a sufficient amount of time to allow the radio to enter a low power/sleep state, the radio will re-enable the output on the following ignition cycle and the DTC will become history.
- A history DTC clears after 50 malfunction-free ignition cycles.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the radio/infotainment systems.
- The radio's current limiting logic may not re-enable the output on the entertainment remote enable circuit until after the radio performs a full power - down. It may be necessary to wait 5 minutes between each test attempt with the key OFF and retained accessory power OFF.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, radio OFF, remove the radio B+ fuse.
2. Disconnect the X3 harness connector at the T3 Audio Amplifier.
3. Install the radio B+ fuse. Ignition ON, A11 Radio ON.

4. Verify that a test lamp illuminates between the control circuit terminal 8 and ground:
    - **If the test lamp does not illuminate.**
    1. Ignition OFF. Disconnect the X1 harness at the A11 Radio.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance.
    3. Test for less than 2 Ω in the control circuit end to end.
        - If greater than 2 Ω, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the A11 Radio.
    - **If the test lamp illuminates.**
5. Ignition OFF. Connect the X3 harness connector at the T3 Audio Amplifier.
6. Ignition ON, A11 Radio ON.
7. Verify that DTC B1265 is NOT set.
    - **If DTC B1265 is set.**

      Replace the T3 Audio Amplifier.

    - **If DTC B1265 is not set.**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for radio and amplifier replacement, programming, and setup

DTC B1271: THEFT PROTECTION ACTIVE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1271 00

Theft Protection Active

Circuit/System Description

When the radio is initially installed in the vehicle, the radio receives VIN information via serial data. The radio stores a portion of the VIN and compares this sequence to the VIN information received each time the radio powers on. The VIN in the radio is a single one-time learn.

The radio theft deterrent system is intended to disable or limit radio functionality if incorrect vehicle information is received by the radio. The radio disables functionality if the VIN information received by the radio does not match the VIN information that has been learned by the radio. This DTC is generated by the module when the Theft Protection is activated.

Conditions for Running the DTC

This DTC test runs when the radio changes from OFF to ON.

Conditions for Setting the DTC

The radio has learned a correct VIN sequence and the VIN information received via serial data does NOT match the learned VIN sequence.

Action Taken When the DTC Sets

The radio may be disabled or have limited functionality. The radio display will indicate that theft protection is active.

Conditions for Clearing the DTC

The radio receives the correct VIN information via serial data.

Diagnostic Aids

A possible cause of incorrect VIN info could be the radio was originally installed in another vehicle.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, radio ON.
2. Verify DTC B1271 is not set.
    - **If DTC B1271 is set**

      Replace the A11 Radio.

    - **If DTC B1271 is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for radio replacement, programming, and setup.

DTC B1277: CELLULAR PHONE MICROPHONE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1277 02

Cellular Phone Microphone Circuit Short to Ground

DTC B1277 04

Cellular Phone Microphone Circuit Open/High Resistance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B1277 02	B1277 04	B1277 04	-
Low Reference	B1277 02	B1277 04	B1277 04	-

Circuit/System Description

The radio provides the cellular phone microphone with a supplied voltage on the cellular phone microphone high signal circuit. When the microphone is in use, voice data from the user is sent back to the radio on the cellular microphone low signal circuit.

Conditions for Running the DTC

- The ignition must be in the RUN or ACC position/vehicle in Service Mode.
- The system voltage is at least 9.5 V and no more than 15.5 V.
- All the above conditions are present for greater than 10 s.

Conditions for Setting the DTC

B1277 02

The radio detects a short to ground in the cellular phone microphone high signal circuit for 10 s or greater.

B1277 04

The following conditions will set this DTC:

- The radio detects an open/high resistance in the cellular phone microphone high signal circuit for 10 s or greater.
- The radio detects an open/high resistance in the microphone low signal circuit for 10 s or greater.

Action Taken When the DTC Sets

- The radio will not receive a signal from the cellular phone microphone.
- Calls can be placed but the caller cannot be heard.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/vehicle OFF, disconnect the harness connector at the B24 Cellular Phone Microphone, ignition ON/vehicle in Service Mode.
2. Test for 9-11 V between the signal circuit terminal B and ground.
    - **If less than 9 V**
    1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the A11 Radio.
    - **If greater than 11 V**
    1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
    2. Ignition ON/vehicle in Service Mode, test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the A11 Radio.
    - **If between 9-11 V**
3. Test for less than 1 V between the low reference circuit terminal A and ground.
    - **If greater than 1 V**
    1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
    2. Ignition ON/vehicle in Service Mode, test for less than 1 V between the low reference circuit and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.
        - If less than 1 V, replace the A11 Radio
    - **If less than 1 V**
4. Test for greater than 9 V between the signal circuit terminal B and the low reference circuit terminal A.
    - **If less than 9 V**
    1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
    2. Test for infinite resistance between the low reference circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the A11 Radio.
    - **If greater than 9 V**
5. Test or replace the B24 Cellular Phone Microphone.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Mobile Telephone Microphone Replacement
- Refer to Control Module References for telematics communication interface control module replacement, programming and setup.

DTC B127E: FRONT VIDEO DISPLAY OUTPUT SIGNAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B127 00

Front Video Display Output Signal Malfunction

DTC B127 01

Front Video Display Output Signal Short to Battery

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Display LVDS Lock Signal	B127E 00	-	-	-
Radio Display LVDS Error Signal	B127E 00	-	-	-
LVDS cable	B127E 00	B127E 00	B127E 01	-

Circuit/System Description

The infotainment display and controls are separate components from the radio. The components are supplied battery voltage and ground from the vehicle harness. The radio communicates digital video data for on-screen display through a dedicated cable containing the LVDS data circuits.

If the radio detects the display is not responding to the output on the LVDS circuits, the radio sets the DTC.

Conditions for Running the DTC

- Ignition is ON or in the ACC position
- The system voltage is 9-16 V
- The infotainment system is ON
- The test is run once every 14 ms when the infotainment system is operating

Conditions for Setting the DTC

The radio detects the display is not responding to the output on the LVDS circuits.

Action Taken When the DTC Sets

- The radio sets this DTC
- No images are shown on the info display module

Conditions for Clearing the DTC

- The radio detects a properly synced digital video signal.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- EL-50334-2 Type A female to Mini B male USB Cable
- EL-50334-14 Infotainment Test Cable

Circuit/System Testing

1. Vehicle OFF/Ignition OFF, disconnect the X1 harness connector at the P17 Info Display Module
2. Test for infinite resistance between the signal circuits listed below and ground:
    - Radio display LVDS lock signal circuit terminal 5
    - Radio display LVDS error signal circuit terminal 6
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
3. Reconnect the X1 harness connector at the P17 Info Display Module.
4. Disconnect the LVDS interface cable from the P17 Info Display Module.
5. Connect the EL-50334-2 Type A female to Mini B male USB Cable to the P17 Info Display Module. Connect the EL-50334-14 Infotainment Test Cable to the adapter.
6. Disconnect the LVDS interface cable from the A11 Radio. Connect the EL-50334-14 Infotainment Test cable to the A11 Radio.
7. Ignition ON/Vehicle in Service Mode, infotainment system ON.
8. Verify DTC B127E is not set as current.
    - **If DTC B127E is set as current**
    1. Replace the P17 Info Display Module. Connect all harness connectors.
    2. Ignition ON, infotainment system ON.
    3. Verify DTC B127E is not set as current.
        - If DTC B127E is still set as current, replace the A11 Radio.
        - If DTC B127E is not set.
    4. All OK.
    - **If DTC B127E is not set as current.**
9. Replace the vehicle LVDS interface cable from the P17 Info Display Module to the A11 Radio.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Control Module References for replacement, programming, and setup.

DTC B1287: AMPLIFIER CONTROL SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1287 01

Amplifier Control Signal Circuit Short to Battery

DTC B1287 02

Amplifier Control Signal Circuit Short to Ground

DTC B1287 04

Amplifier Control Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Amplifier Control	B1287 02	B1287 04	B1287 01*	-
* No audio output.				

Circuit/System Description

The radio amplifier control circuit provides varying pulse width modulated (PWM) signals to control overall muting of the amplifier. The PWM signals are varying duty cycle percentages ranging from 0 - 100 percent. A low duty cycle unmutes all amplifier channels and a high duty cycle mutes all amplifier channels. The amplifier control circuit will measure less than 1 V when the mute function is OFF, and approximately 8 V when at full mute. The radio monitors the amp control circuit for faults.

Conditions for Running the DTC

- The radio is on.
- The system voltage is 9 - 16 V.
- The radio performs the test once during wakeup.

Conditions for Setting the DTC

The radio detects a fault on the amplifier control circuit 400 ms after radio activates the remote enable circuit.

Action Taken When the DTC Sets

Radio sets the DTC and continues to output correct state.

Conditions for Clearing the DTC

- The condition must no longer be present.
- A history DTC clears after 50 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **To prevent misdiagnosis, the door chime must be OFF during testing. Ensure the driver door latch is closed during testing.**

1. Ignition OFF/vehicle OFF, disconnect the X3 harness connector at the T3 Amplifier. Ignition ON/vehicle in Service Mode, A11 Radio ON, mute ON.
2. Test for 7.5 - 8.5 V between the control circuit terminal 11 and ground.
    - **If greater than 8.5 V**
    1. Ignition OFF/vehicle OFF, disconnect the X2 harness connector at the A11 Radio. Ignition ON/vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the A11 Radio.
    - **If less than 7.5 V**
    1. Ignition OFF/vehicle OFF, disconnect the X2 harness connector at the A11 Radio.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the A11 Radio.
    - **If between 7.5 - 8.5 V**
3. A11 Radio ON, mute OFF.
4. Test for less than 1 V between the control circuit terminal 11 and ground.
    - **If 1 V or greater**

      Replace the A11 Radio.

    - **If less than 1 V**
5. Test or replace the T3 Amplifier.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for radio and amplifier replacement, programming, and setup.

DTC B1446 OR B1447: BACKUP POWER SOURCE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1446

Replace Backup Power Source Below Minimum Threshold

DTC B1447

Backup Power Source Open Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Backup Battery B+	B1447 03	B1447 04	-	-
Backup Battery Low Reference	B1447 03	B1447 04	-	-

Circuit/System Description

The backup power source provides voltage to the telematics communication interface control module, to be able to successfully place a call in the event of a main battery disconnect during a collision event.

Conditions for Running the DTC

B1446 03

- Ignition On/Vehicle in Service Mode.
- System voltage is between 9.5 and 15.5 V.
- DTC B1447 is not set.

B1447 04

- Ignition On/Vehicle in Service Mode.
- System voltage is between 9.5 and 15.5 V.
- The above conditions are present for greater than 10 s.

Conditions for Setting the DTC

B1446 03

The telematics communication interface control module detects that the backup power source voltage has dropped below the minimum threshold value.

B1447 04

The telematics communication interface control module detects no voltage from the backup power source.

Action Taken When the DTC Sets

B1446 03

The OnStarÃ‚Â® status LED turns red.

B1447 04

- The OnStarÃ‚Â® status LED turns red.
- The telematics communication interface control module will be unable to place a call in the event of a main battery disconnect during a collision event.

Conditions for Clearing the DTC

- A current DTC B1446 will clear when the telematics communication interface control module detects the voltage of the backup power source is above the minimum threshold value.
- A current DTC B1447 will clear when the telematics communication interface control module detects voltage from the backup power source.
- A history DTC clears after 50 malfunction-free ignition cycles.

Diagnostic Aids

- Shorting the backup power source positive voltage circuit to the backup power source ground circuit or chassis ground will activate the internal circuit protection of the backup power source, rendering the backup power source inoperative.
- DTC B1447 may set if the K73 Telematics Communication Interface Control Module has been incorrectly disconnected or serviced. When disconnecting the K73 Telematics Communication Interface Control Module, disconnect the harness connector X1 at the K73 Telematics Communication Interface Control Module prior to disconnecting any other harness connectors. This will ensure the backup power source is preserved when voltage is removed from the K73 Telematics Communication Interface Control Module.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- **Testing for Intermittent Conditions and Poor Connections**
- **Circuit Testing**
- **Wiring Repairs**
- **Connector Repairs**

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for greater than 12.3 V between the B+ circuit terminal 14 and the low reference circuit terminal 13.
    - **If 12.3 V or less**
    1. Disconnect the C3 Telematics Communication Interface Control Module Battery.
    2. Test for infinite resistance between the circuits listed below and ground.
        - B+ circuit terminal 14
        - Low reference circuit terminal 13.
            - If less than infinite resistance, repair the short to ground in the circuit.
            - If infinite resistance.
    3. Test for less than 2 Ω in the circuits end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the C3 Telematics Communication Interface Control Module Battery.
    - **If greater than 12.3 V**
3. Replace the K73 Telematics Communication Interface Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Communication Interface Module Battery Replacement**
- Refer to **Control Module References** for telematics communication interface control module replacement, programming and setup.

DTC B2455: CELLULAR PHONE MICROPHONE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2455 02

Cellular Phone Microphone Circuit Short to Ground

DTC B2455 04

Cellular Phone Microphone Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone Signal	B2455 02	B2455 04	B2455 04	-
Microphone Low Signal	B2455 02	B2455 04	B2455 04	-

Circuit/System Description

The telematics communication interface control module provides the cellular phone microphone with a supplied voltage on the cellular phone microphone high signal circuit. When the microphone is in use, voice data from the user is sent back to the telematics communication interface control module on the microphone low signal circuit.

Conditions for Running the DTC

- The Vehicle must be ON or in Service Mode.
- The system voltage is at least 9.5 V and no more than 15.5 V.
- All the above conditions are present for greater than 10 s.

Conditions for Setting the DTC

B2455 02

The telematics communication interface control module detects a short to ground in the cellular phone microphone signal circuit for 10 s or greater.

B2455 04

The following conditions will set this DTC:

- The telematics communication interface control module detects an open/high resistance in the cellular phone microphone signal circuit for 10 s or greater.
- The telematics communication interface control module detects an open/high resistance in the low signal circuit for 10 s or greater.

Action Taken When the DTC Sets

- The OnStarÃ‚Â® status LED turns red.
- The telematics communication interface control module will not receive a signal from the cellular phone microphone.
- Calls can be placed but the caller cannot be heard.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the B24 cellular phone microphone, Ignition ON/Vehicle in Service Mode.
2. Test for 8.0-10.5 V between the signal circuit terminal B and ground.
   - **If less than 8.0 V**
   1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K73 telematics communication interface control module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the vehicle K73 Telematics Communication Interface Control Module.
   - **If greater than 10.5 V**
   1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K73 telematics communication interface control module, Ignition ON/Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
   - **If between 9.5-10.5 V**
3. Test for less than 1 V between the signal circuit terminal A and ground.
   - **If greater than 1 V**
   1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K73 telematics communication interface control module, Ignition ON/Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.
      - If less than 1 V, repair the K73 Telematics Communication Interface Control Module.
   - **If less than 1 V**
4. Test for greater than 8 V between the signal circuit terminal B and the signal circuit terminal A.
   - **If less than 8 V**
   1. Ignition OFF/Vehicle OFF, disconnect the connector X2 at the K73 telematics communication interface control module.

2. Test for infinite resistance between the low signal circuit and ground.
    - If less than infinite resistance, repair the short to ground in the circuit.
    - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the vehicle K73 Telematics Communication Interface Control Module.

- **If greater than 8 V**

5. Test or replace the B24 Cellular Phone Microphone.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Mobile Telephone Microphone Replacement**
- Refer to **Control Module References** for telematics communication interface control module replacement, programming and setup.

DTC B2462: GLOBAL POSITIONING SYSTEM (GPS) SIGNAL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2462 02

Global Positioning System (GPS) Signal Short to Ground

DTC B2462 04

Global Positioning System (GPS) Signal Open Circuit

Circuit/System Description

The Telematics Communication Interface Control Module receives information from the GPS antenna located on the outside of the vehicle. The GPS antenna is connected to the Telematics Communication Interface Control Module via a shielded coaxial cable. The telematics communication interface control module supplies 5 V through the coax cable to power the internal antenna amplifier.

Conditions for Running the DTC

- Ignition is in the RUN or ACC position.
- System voltage is between 9.5 V and 15.5 V.
- The above conditions are present for greater than 1 second.

Conditions for Setting the DTC

B2462 02

The Telematics Communication Interface Control Module detects a short to ground on the GPS antenna signal circuit.

B2462 04

The Telematics Communication Interface Control Module detects an open/high resistance on the GPS antenna signal circuit.

Action Taken When the DTC Sets

- The OnStarÃ‚Â® status LED turns red.

- The OnStarÃ,Â® Call Center cannot locate the vehicle.

Conditions for Clearing the DTC

- The K73 Telematics Communication Interface Control Module detects the presence of a GPS antenna.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903 GM OnStar Antenna Diagnostic Tool Kit

Circuit/System Testing

1. Ignition OFF/vehicle OFF, disconnect the GPS coax cable connector at the K73 Telematics Communication Interface Control Module.
2. Connect the **EL-49903-1** OnStar Test Antenna, Navn-Cell Comn to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON/vehicle in Service Mode.
3. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.
    - **If DTC B2462 is set or the advisor can not locate the vehicle**

      Replace the K73 Telematics Communication Interface Control Module.

    - **If DTC B2462 is not set or that the OnStar advisor can locate the vehicle.**
4. Ignition OFF/vehicle OFF, disconnect the **EL-49903-1** OnStar Test Antenna, Navn-Cell Comn from the K73 Telematics Communication Interface Control Module
5. Disconnect the GPS coax cable at the T2RR Antenna - Roof Rear.
6. Test the coax cable between the K73 Telematics Communication Interface Control Module and the T2RR Antenna - Roof Rear. Refer to component testing.
    - **If the coax cable does not pass the test**

      Replace the coax cable.

    - **If the coax cable passes the test**
7. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: Refer to Test Probe Caution

NOTE:

- **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**
- **To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.**

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between the coax cable center terminal end to end.
   - **If 5 Ω or greater**

     Replace the coax cable.

   - **If less than 5 Ω**
3. Test for greater than 5 Ω between the coax cable outer shield end to end.
   - **If 5 Ω or greater**

     Replace the coax cable.

   - **If less than 5 Ω**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
   - **If less than infinite resistance**

     Replace the coax cable.

   - **If infinite resistance**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Refer to High Frequency Antenna Replacement
- Refer to Control Module References for Telematics Communication Interface Control Module replacement, programming and setup.

DTC B2470: CELLULAR PHONE ANTENNA CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2470 02

Cellular Phone Antenna Circuit Malfunction Short to Ground

DTC B2470 04

Cellular Phone Antenna Circuit Malfunction Open Circuit

Circuit/System Description

The primary cellular phone antenna element is connected to the telematics communication interface control module (violet connector) via a shielded coaxial cable. Cellular communication takes place on both the primary cellular antenna signal circuit and the GPS/secondary cellular antenna signal circuit. This diagnostic only applies to the primary cellular antenna signal circuit. Internal to the antenna on the cellular antenna signal circuit resistance is used to apply a load, which the telematics communication interface control module uses to detect the presence of the antenna.

Conditions for Running the DTC

- Ignition in the RUN or ACC position.
- System voltage is between 9.5 V and 15.5 V.
- The above conditions are present for greater than 1 s.

Conditions for Setting the DTC

B2470 02

The telematics communication interface control module detects a short to ground on the primary cellular antenna signal circuit.

B2470 04

- The telematics communication interface control module detects an open or high resistance on the primary cellular antenna signal circuit.
- The above conditions are present for greater than 1 s.

Action Taken When the DTC Sets

The OnStarÃ‚Â® status LED turns red.

Conditions for Clearing the DTC

- The telematics communication interface control module detects the presence of a cellular antenna.
- A history DTC clears after 50 malfunction-free ignition cycles.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903-1 Test Antenna Navn-Cell Comn

Circuit/System Testing

NOTE:

- **The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.**
- **The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 min after turning the ignition ON for the GPS satellites to acquire vehicle signal.**

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the violet primary cellular coax cable connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Using the **EL-49903-1** Test Antenna Navn-Cell Comn connect the violet coax cable to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON/vehicle in Service Mode.
3. Verify the DTC does not set or a call can be completed to the OnStar Call Center while operating the vehicle within the conditions for running the DTC.
   - **If the DTC sets or a call can not be completed to the OnStar Call Center**

     Replace the K73 Telematics Communications Interface Control Module.

   - **If the DTC does not set or a call can be completed to the OnStar Call Center**
4. Ignition OFF/Vehicle OFF.
5. Disconnect the **EL-49903-1** Test Antenna Navn-Cell Comn from the K73 Telematics Communication Interface Control Module
6. Test the coax cable. Refer to Component Testing.
   - **If the coax cable does not pass the test**

     Replace the coax cable.

   - **If the coax cable passes the test**
7. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: **Refer to Test Probe Caution**

NOTE:

- **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**
- **To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.**

Coax Cable Test

1. Test for less than 5 Ω between the coax cable center terminal end to end.
   - **If 5 Ω or greater**

     Replace the coax cable.

   - **If less than 5 Ω**
2. Test for greater than 5 Ω between the coax cable outer shield end to end.
   - **If 5 Ω or greater**

     Replace the coax cable.

   - **If less than 5 Ω**
3. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
   - **If less than infinite resistance**

Replace the coax cable.

- **If infinite resistance**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

- Refer to **High Frequency Antenna Replacement**
- Refer to **Control Module References** for telematics communication interface control module replacement, setup, and programming

DTC B2476 OR B2482: CELLULAR PHONE SELECT SERVICE SWITCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2476 or B2482

Cellular Phone Select Service Switch

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	B2476 02	B2476 04	B2476 04	-
Signal	1	1	B2476 59	B2476 59, B2482 00
Ground	-	B2476 04	-	-
1. OnStarÃ‚Â® Buttons Inoperative				

Circuit/System Description

The OnStarÃ‚Â® button assembly consists of 3 buttons: Call/Answer, OnStarÃ‚Â® Call Center, and OnStarÃ‚Â® Emergency. The telematics communication interface control module supplies the OnStarÃ‚Â® button assembly with 10 V via the 10 V reference circuit. Each of the buttons, when pressed, completes the circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module over the keypad signal circuit. Depending upon the voltage range returned, the telematics communication interface control module is able to identify which button has been pressed.

Conditions for Running the DTC

- Ignition ON/vehicle in Service Mode.
- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B2476 02

The telematics communication interface control module detects a short to ground on the 10 V reference circuit

B2476 04

The telematics communication interface control module detects an open/high resistance on the keypad supply voltage circuit or the ground circuit.

B2482 and B2476 59

The telematics communication interface control module detects a valid signal on the keypad signal circuit for longer than 15 s. If one of the OnStarÃ‚Â® buttons is held or stuck for 15 s or greater, the telematics communication interface control module will set this DTC.

Action Taken When the DTC Sets

- The OnStarÃ‚Â® status LED turns red.
- No calls can be placed.
- The telematics communication interface control module will ignore all inputs from the OnStarÃ‚Â® button assembly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Contact the OnStarÃ‚Â® Call Center first before pressing the emergency button in order to notify them of the test.**

1. Ignition ON/vehicle in Service Mode.
2. Verify that each button of the S51 Telematics Button Assembly operates normally by pressing each button individually.
    - **If none of the buttons operate normally**

      Refer to Circuit/System testing

    - **If some, but not all, of the buttons operate normally**

      Test or replace the S51 Telematics Button Assembly

    - **If all of the buttons operate normally**
3. All OK.

Circuit/System Testing

1. Ignition OFF/vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S51 Telematics Button Assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
    - **If 10 Ω or greater**
    1. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode.
4. Test for 8.0 - 10.5 V between the 10 V reference circuit terminal 1 and the ground circuit terminal 6.
    - **If less than 8.0 V**
    1. Ignition OFF/vehicle OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module.
    2. Test for infinite resistance between the 10 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 10 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K73 Telematics Communication Interface Control Module.
    - **If greater than 10.5 V**
    1. Ignition OFF/vehicle OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module, ignition ON/vehicle in Service Mode.
    2. Test for less than 1 V between the 10 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
    - **If between 8.0 - 10.5 V**
5. Ignition OFF/vehicle OFF.
6. Test for 500 - 900 Ω between the signal circuit terminal 3 and the ground circuit terminal 6.
    - **If less than 500 Ω**
    1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.
    - **If greater than 900 Ω**
    1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON/vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF/vehicle OFF.
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K73 Telematics Communication Interface Control Module.
    - **If between 500 - 900 Ω**
7. Test or replace the S51 Telematics Button Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Communication Center Call Switch Replacement**

- Refer to Control Module References for telematics communication interface control module replacement, programming and setup

SYMPTOMS - CELLULAR COMMUNICATION

NOTE: The following steps must be completed before using the symptom table.

1. Perform the Diagnostic System Check - Vehicle before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to OnStar Description and Operation (UE3)OnStar Description and Operation (UE1).

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Radio/Audio System. Refer to Checking Aftermarket Accessories .
- Inspect for easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Bluetooth Malfunction
- No Global Positioning System (GPS) Reception
- OnStar Microphone Malfunction
- OnStar Audio Malfunction
- OnStar Button LED Malfunction
- OnStar Call Center Remote Function Requests Malfunction
- OnStar Button Malfunction
- Unable to Contact OnStar Call Center
- OnStar Voice Recognition Malfunction
- OnStar Steering Wheel Control Functions Malfunction

SYMPTOMS - ENTERTAINMENT

IMPORTANT: The following steps must be completed before using the symptom table.

1. Perform the Diagnostic System Check - Vehicle before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to Radio/Audio System Description and Operation.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Radio/Audio System. Refer to Checking Aftermarket Accessories .
- Inspect for easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Auxiliary Audio Input Malfunction**
- **Bluetooth Malfunction**
- **Digital Radio Poor or No Reception**
- **Radio Controls Malfunction**
- **Radio Information Display Malfunction**
- **Radio Poor Reception**
- **Speaker Malfunction (UQA)Speaker Malfunction (without UQA)**

AUXILIARY AUDIO INPUT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B124B

USB 1 Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B124B, 1, 6	1, 5	-	-
Auxiliary Audio Common Signal	-	8	-	-
Auxiliary Detection Signal	7	8	-	-
Left Auxiliary Audio Signal	2	2	2, 4	-
Right Auxiliary Audio Signal	3	3	3, 4	-
USB Cable	B124B	B124B	B124B	-
Ground	-	1	-	-
1. USB port Inoperative 2. No left side audio from device connected to AUX jack 3. No right side audio from device connected to AUX jack 4. Noticeable distortion may be present in affected audio channel 5. Fault may affect one or more components, dependant on fault location 6. Fault affects multiple components, dependant on vehicle equipment 7. Radio does not detect auxiliary device connection, AUX not available as input selection 8. AUX always available as an input selection, with or without auxiliary device connected				

Circuit/System Description

The infotainment system has a auxiliary jack and USB receptacle assembly. The auxiliary jack and USB receptacle assembly receives fused battery voltage and ground from the harness to power the internal hub device as well as providing additional amperage to power USB devices. The internal hub device interfaces directly with the radio via a standard USB cable.

Auxiliary Audio Input Jack

When a portable audio playback device is connected to the 3.5 mm (1/8 in.) auxiliary audio input jack an internal switch opens the detection signal circuit. The radio detects the device and AUX becomes available as an audio source. Audio signals from the device are sent to the radio from the auxiliary input jack via the left, right, and common audio signal circuits.

USB Port

The USB receptacle interfaces directly with the radio via a standard USB cable. A Mini type USB connector is used to connect the cable at the radio and at the auxiliary jack and USB receptacle assembly. USB male to female connections are typically used for connecting USB cables together where an in-line connection is required. An in-line cable connection is typically found between the console and I/P harness.

The USB port allows connectivity to the infotainment system from portable media players or a USB storage device (memory stick/flash drive). When a device is connected to the USB port, the system detects the device and USB becomes available as an audio source. Once connected, the device can be controlled from the radio controls.

Not all portable media player devices or file types are compatible. Refer to the owner's manual for information on USB devices, control, and operation.

Conditions for Running the DTC

- Ignition is ON or in the ACC position/vehicle in Service Mode
- The system voltage is 9-16 V
- The infotainment system is ON
- The test is run once per second when the infotainment system is operating

Conditions for Setting the DTC

The radio detects an excessive current condition on the USB 5 V circuit.

Action Taken When the DTC Sets

The USB port is inoperative while the DTC is current.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

This DTC may be set due to the connection of an incompatible or faulty USB device.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-50334-20** Multi-Media Interface Tester (MIT)
- **EL-50334-50** USB Cable and Adapter Kit
- **EL-50334-14** Infotainment Test Cable

Circuit/System Verification

1. Verify DTC B124B is not set. Since occurrences of this DTC can be caused by an incompatible or faulty USB device, review with the customer the conditions under which their concern occurred.
   - **If DTC B124B is set.**

     Refer to Circuit/System testing.

   - **If DTC B124B is not set.**
2. Ignition ON/vehicle in Service Mode, infotainment system ON.
3. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
4. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.
   - **If audio is not heard from the test tool**

     Refer to Circuit/System Testing.

   - **If audio is heard from the test tool**
5. All OK.

Circuit/System Testing

1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the X83 Auxiliary Audio Input.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Verify that a test lamp illuminates between the B+ circuit terminal 6 and ground.
   - **If the test lamp does not illuminate**
   1. Remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
   - **If the test lamp illuminates**
4. Verify the USB cable is properly connected at all components and any in-line connections, and there is no damage to the cable or connections.
   - **If connection problems or cable damage is noted.**

     Perform the appropriate repair or replacement to correct any issues.

   - **If no connection problems or cable damage is noted.**
5. Disconnect the vehicle USB cable at the A11 Radio and the X83 Auxiliary Audio Input.
6. Connect the EL-50334-14 Infotainment Test Cable and the EL-50334-2 Type-A Female to Mini-B Male Cable together. Connect the assembled test cable to the A11 Radio and the X83 Auxiliary Audio Input.
7. Ignition ON/vehicle in Service Mode, infotainment system ON.
8. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
9. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.

- **If audio is not heard from the test tool**
  1. Replace the X83 Auxiliary Audio Input. Connect all harness connectors.
  2. Connect the EL-50334-20 Multi-Media Interface Tester (MIT) to the X83 Auxiliary Audio Input USB port and select the USB test mode.
  3. Verify the audio from the EL-50334-20 Multi-Media Interface Tester (MIT) is heard through the infotainment system while operating the system to play audio from the test tool.
     - If audio is not heard from the test tool, replace the A11 Radio.
     - If audio is heard from the test tool.
  4. All OK.
- **If audio is heard from the test tool**

10. Replace the USB cable assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Audio Disc Player and USB Receptacle Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

BLUETOOTH MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

BluetoothÃ,Â® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The operating range of the signal is approximately 30 feet.

The available features and functions are determined by the type of device and the software within the devices being used. For a feature or function to operate, it must be supported in both devices.

The BluetoothÃ,Â® hardware is internal to the radio. The radio supports interfacing with cellular phones for hands-free features.

Refer to the vehicle owner manual, supplements, and the device manufacturer's information for information on devices, control, operation. and pairing instructions.

Diagnostic Aids

- Verify the mobile device is properly configured for the feature being used. Refer to the device manufacturer's information.
- Verify the function/feature that is being used is supported by the mobile device.
- The device must be paired to the radio to use the available BluetoothÃ,Â® feature(s). The pairing process must only be performed once for each device, unless that device's information is deleted.
- The system can store pairing information for multiple devices, but can only be actively connected to one at any given time.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-50334-20 Multi-Media Interface Tester (MIT)

For equivalent regional tools, refer to **Special ToolsSpecial Tools (MIT Tool Instructions)**.

Circuit/System Verification

1. Verify no DTCs are present.
    - **If any DTCs are present**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no DTCs are present**
2. Verify the A11 Radio calibrations are current.
    - **If the radio calibrations are not current**

      Reprogram the A11 Radio and re-evaluate the concern.

    - **If no update calibrations are available**

NOTE: **The MIT tool can be used to test either cellular phone or streaming audio functions. Refer to the tool instructions, and perform the appropriate test(s) related to the customers concern in the following steps.**

3. Ignition ON, infotainment system ON.
4. Verify the infotainment system successfully pairs with the MIT tool.
    - **If the infotainment system does not successfully pair with the MIT tool.**

      Replace the A11 Radio.

    - **If the infotainment system successfully pairs with the MIT tool.**
5. Verify the infotainment system successfully completes the desired feature test using the MIT tool.
    - **If the feature test is not successful**

      Replace the A11 Radio.

    - **If the feature test is successful**
6. All OK. Refer to Diagnostic Aids.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for radio replacement, programming, and setup

DIGITAL RADIO POOR OR NO RECEPTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B125C 01

Satellite Antenna Circuit Short to Battery

DTC B125C 02

Satellite Antenna Circuit Short to Ground

DTC B125C 04

Satellite Antenna Circuit Open

Circuit/System Description

The digital radio receiver, located inside the radio, receives digital radio information from the digital radio antenna located on the outside of the vehicle. The digital radio receiver is connected to the digital radio antenna via a shielded coax cable. The digital radio antenna contains an amplifier which is powered by the radio through the coax cable.

Conditions for Running the DTC

This DTC is run every 300 milliseconds.

Conditions for Setting the DTC

The radio detects a circuit fault in the digital radio antenna.

Action Taken When the DTC Sets

The radio displays No XM Signal or Check Antenna.

Conditions for Clearing the DTC

- A current DTC clears when the condition for setting the DTC is no longer present.
- A history DTC clears after 100 malfunction-free ignition cycles.

Diagnostic Aids

The digital radio antenna requires a clear line of sight to the sky to operate properly. Reception may be limited, intermittent, or unavailable inside structures.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Special Tools

EL-48028 Digital Radio Test Antenna

Circuit/System Verification

1. With the vehicle outside in an area with an unobstructed view of the southern sky, tune to XM.
2. Verify DTC B125C is not set as current and the No XM Signal message is not displayed on the radio.
    - **If DTC B125C is set as current or the No XM Signal message is displayed.**

      Refer to Circuit/System Testing.

    - **If DTC B125C is not set as current and the No XM Signal message is not displayed.**
3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the A11 Radio. Connect the **EL-48028** Digital Radio Test Antenna to the radio and place on the roof of the vehicle.
2. Ignition ON/Vehicle in Service Mode, radio tuned to XM channel 1.
3. Verify DTC B125C is not set as current and XM reception is improved.
    - **If DTC B125C is set as current or XM reception is not improved**

      Replace the A11 Radio.

    - **If DTC B125C is not set as current and XM reception is improved**
4. Ignition OFF/Vehicle OFF, disconnect the digital radio antenna coax cable from the T2RR Antenna - Roof Rear.
5. Verify the digital radio antenna coax cable passes the coax cable component test. Refer to Component Testing.
    - **If the coax cable does not pass the test**

      Replace the antenna coax cable

    - **If the coax cable passes the test**
6. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: **Refer to Test Probe Caution .**

NOTE: **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF/Vehicle OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.
    - **If 5 Ω or greater**

      Replace the coax cable

    - **If less than 5 Ω**
3. Test for less than 5 Ω between the coax cable outer shield end to end.

- **If 5 Ω or greater**

  Replace the coax cable

- **If less than 5 Ω**

4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
   - **If less than infinite resistance**

     Replace the coax cable

   - **If infinite resistance**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **High Frequency Antenna Replacement**
- Refer to **Control Module References** for radio replacement, programming, and setup.

ONSTAR MICROPHONE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Microphone High Signal Terminal 9	B2455 02	B2455 04	B2455 04	-
Microphone Low Signal Terminal 10	B2455 02	B2455 04	B2455 04	-
Cellular Telephone Voice Signal Terminal 6	2	1	2	-
Cellular Telephone Voice Low Signal Terminal 12	-	2	2	-
1. Voice Cannot be Heard by Telephone Conversation Partner 2. Customer Voice may be distorted for Telephone Conversation Partner				

Circuit/System Description

The telematics communication interface control module provides the Cellular Phone Microphone with a supplied voltage on the cellular phone microphone signal circuit. When the cellular phone microphone is in use, voice data from the user is sent back to the telematics communication interface control module on the signal circuit.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **It is necessary to have the vehicle in a quiet, open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.**

1. Vehicle in Service Mode.
2. Verify that DTC B2455 is not set.
   - **If DTC B2455 is set**

     Refer to DTC B2455.

   - **If DTC B2455 is not set**
3. Verify that a successful OnStar voice command can be made.
   - **If your voice can not be heard clearly**

     Refer to Circuit/System Testing - Microphone Malfunction.

   - **If your voice can be heard clearly**
4. Verify that your voice is heard clearly by the OnStar Call Center after completing a blue button press.
   - **If your voice can not be heard clearly**

     Refer to Circuit/System Testing - Cellular Telephone Voice Malfunction.

   - **If your voice can be heard clearly**
5. All OK.

Circuit/System Testing

Microphone Malfunction

1. Vehicle OFF, disconnect the harness connector at the B24 Cellular Phone Microphone, vehicle in Service Mode.
2. Test for 8.0-10.5 V between the signal circuit terminal B and ground.
   - **If less than 8.0 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the vehicle K73 Telematics Communication Interface Control Module.
   - **If greater than 10.5 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.

        - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
    - **If between 8.0-10.5 V**
3. Test for less than 1 V between the signal circuit terminal A and ground.
    - **If greater than 1 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.
        - If less than 1 V, repair the K73 Telematics Communication Interface Control Module.
    - **If less than 1 V**
4. Test for greater than 8 V between the signal circuit terminal B and the signal circuit terminal A.
    - **If less than 8 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the vehicle K73 Telematics Communication Interface Control Module.
    - **If greater than 9 V**
5. Test or replace the B24 Cellular Phone Microphone.

Cellular Telephone Voice Malfunction

1. Vehicle OFF and vehicle systems OFF, disconnect the X2 harness connector at the K73 Telematics Communication Interface Control Module and the X4 harness connector at the A11 Radio, vehicle in Service Mode.
2. Test for less than 1 V between the signal circuits listed below and ground.
    - K73 Telematics Communication Interface Control Module signal circuit Terminal 6
    - K73 Telematics Communication Interface Control Module signal circuit Terminal 12
    - **If greater than 1 V**

      Repair the short to voltage in the circuit.

    - **If less than 1 V**
3. Vehicle OFF.
4. Test for infinite resistance between the signal circuits listed below and ground.
    - K73 Telematics Communication Interface Control Module signal circuit Terminal 6
    - K73 Telematics Communication Interface Control Module signal circuit Terminal 12
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
5. Test for less than 2 Ω in the signal circuits listed below end to end.
    - K73 Telematics Communication Interface Control Module signal circuit Terminal 6
    - K73 Telematics Communication Interface Control Module signal circuit Terminal 12
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
6. Replace the K73 Telematics Communication Interface Control Module.
7. Verify that your voice is heard clearly by the OnStar Call Center after completing a blue button press.

- **If your voice can not be heard clearly**

  Replace the A11 Radio.

- **If your voice can be heard clearly**

8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

- Refer to **Mobile Telephone Microphone Replacement**
- Refer to **Control Module References** for telematics communication interface control module replacement, programming, and setup

ONSTAR AUDIO MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Audio Signal	1	1	1	-
Audio Common Signal	-	1	-	-
1. No or noisy OnStarÃ‚Â® audio				

Circuit/System Description

When an OnStarÃ‚Â® keypress is made, a serial data message is sent to the audio system to mute all radio functions and output OnStarÃ‚Â® originated audio. After the audio system is muted, the telematics communication interface control module transmits signals to the audio system on the audio signal and audio common circuits.

Reference Information

Schematic Reference

- **OnStar/Telematics Schematics**
- **Radio/Navigation System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/vehicle in Service Mode, radio ON.
2. Verify that audio is heard clearly through all speaker channels when tuning radio to a known good station.
    - **If audio is not heard clearly**

      Refer to **Speaker Malfunction (UQA)Speaker Malfunction (without UQA)**

    - **If audio is heard clearly**
3. Verify that the Connecting to OnStarÃ,Â® message is heard clearly through the audio system when the OnStarÃ,Â® blue button is pressed.
    - **If OnStar message is noisy or distorted**

      Refer to Circuit/System Testing

    - **If OnStar message is heard clearly**
4. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the A11 Radio and the X2 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON/vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit terminals listed below and ground:
    - K73 Telematics Communication Interface Control Module signal circuit terminal 1 X2
    - K73 Telematics Communication Interface Control Module signal circuit terminal 2 X2
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
3. Ignition OFF/Vehicle OFF.
4. Test for infinite resistance between the signal circuits listed below and ground:
    - K73 Telematics Communication Interface Control Module signal circuit terminal 1 X2
    - K73 Telematics Communication Interface Control Module signal circuit terminal 2 X2
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
5. Test for less than 2 Ω between the signal circuit terminals listed below:
    - K73 Telematics Communication Interface Control Module signal circuit terminal 1 X2 and the A11 Radio signal circuit terminal 10 X1
    - K73 Telematics Communication Interface Control Module signal circuit terminal 2 X2 and the A11 Radio signal circuit terminal 9 X1
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
6. Replace the K73 Telematics Communication Interface Control Module.
7. Verify that the Connecting to OnStarÃ,Â® message is heard clearly through the audio system when the OnStarÃ,Â® blue button is pressed.
    - **If audio is not heard clearly**

      Replace the A11 Radio.

    - **If audio is heard clearly**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for module replacement, programming, and setup.

NO GLOBAL POSITIONING SYSTEM (GPS) RECEPTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2462 02

Global Positioning System (GPS) Signal Short to Ground

DTC B2462 04

Global Positioning System (GPS) Signal Open Circuit

Circuit/System Description

The Telematics Communication Interface Control Module receives information from the GPS antenna located on the outside of the vehicle. The GPS antenna is connected to the Telematics Communication Interface Control Module via a shielded coaxial cable. The telematics communication interface control module supplies 5 V through the coax cable to power the internal antenna amplifier.

Conditions for Running the DTC

- Ignition is in the RUN or ACC position.
- System voltage is between 9.5 V and 15.5 V.
- The above conditions are present for greater than 1 second.

Conditions for Setting the DTC

B2462 02

The Telematics Communication Interface Control Module detects a short to ground on the GPS antenna signal circuit.

B2462 04

The Telematics Communication Interface Control Module detects an open/high resistance on the GPS antenna signal circuit.

Action Taken When the DTC Sets

- The OnStarÃ‚Â® status LED turns red.
- The OnStarÃ‚Â® Call Center cannot locate the vehicle.

Conditions for Clearing the DTC

- The K73 Telematics Communication Interface Control Module detects the presence of a GPS antenna.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903 GM OnStar Antenna Diagnostic Tool Kit

Circuit/System Testing

1. Ignition OFF/vehicle OFF, disconnect the GPS coax cable connector at the K73 Telematics Communication Interface Control Module.
2. Connect the **EL-49903-1** OnStar Test Antenna, Navn-Cell Comn to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON/vehicle in Service Mode.
3. Verify DTC B2462 is not set or that the OnStar advisor can locate the vehicle.
    - **If DTC B2462 is set or the advisor can not locate the vehicle**

      Replace the K73 Telematics Communication Interface Control Module.

    - **If DTC B2462 is not set or that the OnStar advisor can locate the vehicle.**
4. Ignition OFF/vehicle OFF, disconnect the **EL-49903-1** OnStar Test Antenna, Navn-Cell Comn from the K73 Telematics Communication Interface Control Module
5. Disconnect the GPS coax cable at the T2RR Antenna - Roof Rear.
6. Test the coax cable between the K73 Telematics Communication Interface Control Module and the T2RR Antenna - Roof Rear. Refer to component testing.
    - **If the coax cable does not pass the test**

      Replace the coax cable.

    - **If the coax cable passes the test**
7. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: Refer to **Test Probe Caution**

NOTE:

- **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**
- **To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.**

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between the coax cable center terminal end to end.
    - **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

3. Test for greater than 5 Ω between the coax cable outer shield end to end.
    - **If 5 Ω or greater**

      Replace the coax cable.

    - **If less than 5 Ω**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
    - **If less than infinite resistance**

      Replace the coax cable.

    - **If infinite resistance**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- Refer to **High Frequency Antenna Replacement**
- Refer to **Control Module References** for Telematics Communication Interface Control Module replacement, programming and setup.

ONSTAR BUTTON LED MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Terminal 4	1	1	2	-
Control Terminal 5	1	1	2	-
Ground	-	B2476 04	-	-
1. OnStarÃ,Â® Indicator Inoperative 2. Indicator Illuminated At All Times				

Circuit Description

The OnStarÃ,Â® status Indicators are located in the button assembly. The Green Indicator is illuminated when the system is ON and operating normally. When the Green Indicator is green and flashing, it is an indication that a call is in progress. When the Red Indicator is illuminated, a system malfunction is present. In the event there is a system malfunction and the OnStarÃ,Â® system is still able to make a call, the Indicator will flash red during the call. The OnStarÃ,Â® Indicators are controlled by the telematics communication interface control module via the keypad Green Indicator control circuit and the keypad Red Indicator control circuit.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **If the green LED is off with the ignition ON and the LED does not function when commanded with the scan tool, contact the OnStar Center to confirm the vehicle has a current subscription.**

1. Ignition ON/vehicle in Service Mode.
2. Verify no DTCs are set.
   - **If any DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle

   - **If no DTCs are set**
3. Verify that the Green Indicator turns ON and OFF when commanding the Green Indicator ON and OFF with a scan tool.
   - **If the Green Indicator does not turn ON and OFF**

     Refer to Circuit/System Testing - Green Indicator Test

   - **If the Green Indicator turns ON and OFF**
4. Verify that the Red Indicator turns ON and OFF when commanding the Red Indicator ON and OFF with a scan tool.
   - **If the Red Indicator does not turn ON and OFF**

     Refer to Circuit/System Testing - Red Indicator Test

   - **If the Red Indicator turns ON and OFF**
5. All OK.

Circuit/System Testing

Green Indicator Test

1. Ignition OFF/vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the S51 Telematics Button Assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode.
4. Test for less than 1 V between the control circuit terminal 4 and ground while commanding the Green Indicator OFF with a scan tool.
   - **If 1 V or greater**

   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON/vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
   - **If less than 1 V**
5. Test for greater than 8 V between the control circuit terminal 4 and ground while commanding the Green Indicator ON with a scan tool.
   - **If 8 V or less**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K73 Telematics Communication Interface Control Module.
   - **If greater than 8 V**
6. Test or replace the S51 Telematics Button Assembly.

Red Indicator Test

1. Ignition OFF/vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the S51 Telematics Button Assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode.
4. Test for less than 1 V between the control circuit terminal 5 and ground while commanding the Red Indicator OFF with a scan tool.
   - **If 1 V or greater**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON/vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
   - **If less than 1 V**
5. Test for greater than 8 V between the control circuit terminal 5 and ground while commanding the Red Indicator ON with a scan tool.
   - **If 8 V or less**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K73 Telematics Communication Interface Control Module.

- **If greater than 8 V**

6. Test or replace the S51 Telematics Button Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Communication Center Call Switch Replacement**
- Refer to **Control Module References** for telematics communication interface control module replacement, programming and setup.

ONSTAR CALL CENTER REMOTE FUNCTION REQUESTS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The telematics communication interface control module has the capability of commanding the horn, initiating door lock/unlock, or operating the exterior lamps using the serial data circuits. These functions are commanded by the OnStarÃ,Â® Call Center per a customer request.

Diagnostic Aids

The customer concern may have been due to a lack of cellular service in a given area, or a failure in the National Cellular Network infrastructure that has since been corrected.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **It is necessary to inform the OnStarÃ,Â® Call Center advisor that this call is for vehicle diagnostic purposes.**
- **It is necessary to have the vehicle in an open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.**

1. Vehicle in Service Mode.
2. Verify that the horn, lights, and the door locks on the vehicle operate properly.
    - **If an applicable vehicle system does not operate properly**

      Refer to Diagnostic System Check - Vehicle .

    - **If all applicable vehicle systems operate properly**
3. Verify that a call can be successfully placed to the OnStar Call Center by pressing the blue OnStar button.
    - **If unable to contact the OnStarÃ,Â® call center**

      Refer to Unable to Contact OnStar Call Center

    - **If able to contact the OnStar Call Center**
4. Verify with the OnStar advisor that all remote functions (door locks, lights, and horn) work.
    - **If the remote functions do not operate when requested**

      Replace the K73 telematics communication interface control module

    - **If the remote functions operate when requested**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for telematics communication interface control module replacement, programming and setup.

ONSTAR BUTTON MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2476 or B2482

Cellular Phone Select Service Switch

For symptom byte information refer to Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
10 V Reference	B2476 02	B2476 04	B2476 04	-
Signal	1	1	B2476 59	B2476 59, B2482 00
Ground	-	B2476 04	-	-
1. OnStarÃ,Â® Buttons Inoperative				

Circuit/System Description

The OnStarÃ,Â® button assembly consists of 3 buttons: Call/Answer, OnStarÃ,Â® Call Center, and OnStarÃ,Â® Emergency. The telematics communication interface control module supplies the OnStarÃ,Â® button assembly with 10 V via the 10 V reference circuit. Each of the buttons, when pressed, completes the circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module over the keypad signal circuit. Depending upon the voltage range returned, the telematics communication interface control module is able to identify which button has been pressed.

Conditions for Running the DTC

- Ignition ON/vehicle in Service Mode.
- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B2476 02

The telematics communication interface control module detects a short to ground on the 10 V reference circuit

B2476 04

The telematics communication interface control module detects an open/high resistance on the keypad supply voltage circuit or the ground circuit.

B2482 and B2476 59

The telematics communication interface control module detects a valid signal on the keypad signal circuit for longer than 15 s. If one of the OnStarÃ,Â® buttons is held or stuck for 15 s or greater, the telematics communication interface control module will set this DTC.

Action Taken When the DTC Sets

- The OnStarÃ,Â® status LED turns red.
- No calls can be placed.
- The telematics communication interface control module will ignore all inputs from the OnStarÃ,Â® button assembly.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Contact the OnStarÃ,Â® Call Center first before pressing the emergency button in order to notify them of the test.**

1. Ignition ON/vehicle in Service Mode.
2. Verify that each button of the S51 Telematics Button Assembly operates normally by pressing each button individually.
    - **If none of the buttons operate normally**

      Refer to Circuit/System testing

    - **If some, but not all, of the buttons operate normally**

      Test or replace the S51 Telematics Button Assembly

    - **If all of the buttons operate normally**
3. All OK.

Circuit/System Testing

1. Ignition OFF/vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S51 Telematics Button Assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
    - **If 10 Ω or greater**
    1. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode.
4. Test for 8.0 - 10.5 V between the 10 V reference circuit terminal 1 and the ground circuit terminal 6.
    - **If less than 8.0 V**
    1. Ignition OFF/vehicle OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module.
    2. Test for infinite resistance between the 10 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 10 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K73 Telematics Communication Interface Control Module.
    - **If greater than 10.5 V**
    1. Ignition OFF/vehicle OFF, disconnect the harness connector at the K73 Telematics Communication Interface Control Module, ignition ON/vehicle in Service Mode.
    2. Test for less than 1 V between the 10 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K73 Telematics Communication Interface Control Module.
    - **If between 8.0 - 10.5 V**
5. Ignition OFF/vehicle OFF.
6. Test for 500 - 900 Ω between the signal circuit terminal 3 and the ground circuit terminal 6.
    - **If less than 500 Ω**
    1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.
    - **If greater than 900 Ω**
    1. Disconnect the X1 harness connector at the K73 Telematics Communication Interface Control Module, ignition ON/vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.

        - If less than 1 V
    3. Ignition OFF/vehicle OFF.
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K73 Telematics Communication Interface Control Module.
  - **If between 500 - 900 Ω**
7. Test or replace the S51 Telematics Button Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Communication Center Call Switch Replacement**
- Refer to **Control Module References** for telematics communication interface control module replacement, programming and setup

ONSTAR STEERING WHEEL CONTROL FUNCTIONS MALFUNCTION

Some vehicles equipped with the OnStarÃ‚® system have the capability of accessing voice mailboxes and other automated phone systems by means of the steering wheel controls, while the OnStarÃ‚® Personal Calling feature is in use. If the "Talk" or "Mute" button (depending upon the vehicle) on the steering wheel controls is depressed during an OnStarÃ‚® Personal Calling call, the telematics communication interface control module receives the message on the serial data bus from either the radio or body control module. This message is interpreted as a request to turn any spoken numbers into dual tone multi-frequency tones to be delivered over the airwaves to the phone system the user is communicating with. Complete instructions for operation of these features can be found in the information provided to the customer with the OnStarÃ‚® system.

The steering wheel controls are a resistor network that consist of multiple momentary contact switches and a series of resistors. The switches and resistor network are arranged so that each switch has a different resistance value. When a switch is pressed, a voltage drop occurs in the resistor network, which produces a specific voltage value unique to the switch selected, to be interpreted by either the radio or BCM. In the event the OnStarÃ‚® steering wheel control functions are inoperative, technicians should refer to **Steering Wheel Controls Malfunction** , to begin diagnosis of the steering wheel control concern.

RADIO CONTROLS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal terminal 6	B123E 02, 1	B123E 01, 1	B123E 01, 1	-
Signal terminal 5	2	2	2	-
Signal terminal 7	3	3	3	-
signal terminal 8	3	3	3	-
Low Reference terminal 10	-	4	-	-
1. Home, Seek Up, Seek Down, and/or Phone button will not function 2. Power Button will not function 3. Unable to adjust volume 4. All Radio Control buttons may not function				

Circuit/System Description

The radio info display module, radio controls and radio are all separate components. The radio controls communicate radio control inputs directly to the radio through a discrete circuit for volume up, volume down and power ON button. It also uses a series of resistors through a single signal circuit when the home, seek up, seek down and phone buttons are pressed. After receiving the message the radio will perform the requested function. The info display module receives digital video data from the radio for on-screen display information through the LVDS (Low Voltage Differential Signal) cable. The radio communicates with the info display module over the radio display touch interrupt request signal for touch screen inputs.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B123E is not set.
    - **If DTC B123E is set.**
    - Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
    - **If DTC B123E is not set**
2. Ignition ON/vehicle in Service Mode, A11 Radio ON.
3. Verify that all radio controls operate and perform the correct function.
    - **If all or some of the radio controls are inoperative**

      Refer to Circuit/System Testing.

    - **If all radio controls operate and perform the correct function.**
4. All OK.

Circuit/System Testing

1. Ignition OFF/vehicle OFF, disconnect the harness connector at the A20 Radio/HVAC Controls.
2. Test for less than 10 Ω between the following low reference circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Disconnect the X1 harness connector at the P17 Info Display Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the P17 Info Display Module.
    - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode, test for 2.5 - 3.5 V between the following signal circuit terminals and ground:
    - Terminal 5 @ A20 Radio/HVAC Controls Harness
    - Terminal 6 @ A20 Radio/HVAC Controls Harness
    - Terminal 7@ A20 Radio/HVAC Controls Harness

- Terminal 8 @ A20 Radio/HVAC Controls Harness
- **If less than 2.5 V**

1. Ignition OFF/vehicle OFF, disconnect the X1 & X2 harness connectors at the A11 Radio.
2. Test for infinite resistance between the following signal circuits and ground:
    - Terminal 5 @ A20 Radio/HVAC Controls Harness
    - Terminal 6 @ A20 Radio/HVAC Controls Harness
    - Terminal 7@ A20 Radio/HVAC Controls Harness
    - Terminal 8 @ A20 Radio/HVAC Controls Harness
    - If less than infinite resistance repair the short to ground on the circuit.
    - If infinite resistance
3. Test for less than 2 Ω between the following test points:
    - Terminal 5 @ A20 Radio/HVAC Controls Harness & Terminal 3 X2 @ A11 Radio Harness
    - Terminal 6 @ A20 Radio/HVAC Controls Harness & Terminal 8 X1 @ A11 Radio Harness
    - Terminal 7 @ A20 Radio/HVAC Controls Harness & Terminal 8 X2 @ A11 Radio Harness
    - Terminal 8 @ A20 Radio/HVAC Controls Harness & Terminal 9 X2 @ A11 Radio Harness
    - If 2 Ω or greater repair the open/high resistance in the circuit.
    - If less than 2 Ω replace the A11 Radio.

- **If greater than 3.5 V**

1. Ignition OFF/vehicle OFF, disconnect the X1 & X2 harness connectors at the A11 Radio.
2. Test for less than 1 V between the following signal circuits and ground:
    - Terminal 5 @ A20 Radio/HVAC Controls Harness
    - Terminal 6 @ A20 Radio/HVAC Controls Harness
    - Terminal 7 @ A20 Radio/HVAC Controls Harness
    - Terminal 8 @ A20 Radio/HVAC Controls Harness
    - If greater than 1 V repair the short to voltage in the circuit.
    - If less than 1 V replace the A11 Radio.

- **If between 2.5 - 3.5 V**

4. Replace the A20 Radio/HVAC Controls

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for radio or radio control assembly replacement, programming, and setup.

RADIO INFORMATION DISPLAY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V reference 3 X1	1	-	-	-
Signal terminal 1 X1	1, 2	1, 2	-	-
Signal terminal 7 X1	2	2	2	-
Signal LVDS X2	B127E 00	B127E 00	B127E 00	-
Ground terminal 9 X1	-	1	-	-
Ground terminal 10 X1	-	1	-	-
1. Display blank 2. Touch screen does not function				

Circuit/System Description

The radio info display module, radio controls and radio are all separate components. The radio controls communicate radio control inputs directly to the radio through a discrete circuit for volume up, volume down and power ON button. It also uses a series of resistors through a single signal circuit when the home, seek up, seek down and phone buttons are pressed. After receiving the message the radio will perform the requested function. The info display module receives digital video data from the radio for on-screen display information through the LVDS (Low Voltage Differential Signal) cable. The radio communicates with the info display module over the radio display touch interrupt request signal for touch screen inputs.

Diagnostic Aids

Malfunctions may include a blank screen

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B127E is not set.
    - **If DTC B127E is set.**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If DTC B127E is not set.**
2. Ignition ON/vehicle in Service Mode, A11 Radio ON.
3. Verify the P17 Info Display Module turns on and information is shown on the display.
    - **If the P17 Info Display Module does not turn on, or information is not shown in the display.**

      Refer to Circuit/System Testing- Blank Screen

    - **If the P17 Info Display Module turns on and information is shown on the display.**
4. Verify the touch screen feature functions by touching a selection on the display.
    - **If the display does not respond to the touch screen selection**

      Refer to Circuit/System Testing- Touch Screen

    - **If the display responds to the touch screen selection**
5. All OK.

Circuit/System Testing

Blank Screen

1. Ignition OFF/vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector @ P17 Info Display Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the following signal ground circuit terminals and ground:
    - terminal 9
    - terminal 10
    - **If 10 Ω or greater**

    1. Test for less than 2 Ω in the signal ground circuits end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than, 2 Ω repair the open/high resistance in the ground connection.

    - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode.
4. Test for 5 V or greater between control circuit terminal 1 X1 and ground.
    - **If less than 5 V**

    1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
    2. Test for infinite resistance between the control circuit terminal 1 X1 @ P17 Info Display Module harness and ground.
        - If less than infinite resistance repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω between the test points: control circuit terminal 1 X1 @ P17 Info Display Module harness & terminal 3 X1 @ A11 Radio harness.
        - If 2 Ω or greater repair the open/high resistance in the circuit.
        - If less than 2 Ω replace the A11 Radio.

    - **If 5 V or greater**
5. Test for 4.7-5.3 V between the P17 Info Display Module harness terminal 3 X1 and ground.
    - **If less than 4.7 V**
6. Disconnect the harness connector at the A20 Radio/HVAC Controls.
    1. Test for infinite resistance between the P17 Info Display Module harness terminal 3 X1 and ground.
        - If less than infinite resistance repair the short to ground on the circuit.
        - If infinite resistance.
    2. Test for less than 2 Ω between the test points: voltage reference circuit terminal 3 X1 @ P17 Info Display Module harness & terminal 1 @ A20 Radio/HVAC Controls harness.
        - If 2 Ω or greater repair the open/high resistance in the circuit.
        - If less than 2 Ω
    3. Replace the A20 Radio/HVAC Controls.

    - **If greater than 5.3 V**
7. Disconnect the harness connector at the A20 Radio/HVAC Controls.
    1. Test for less than 1 V between terminal 3 X1 @ the P17 Info Display Module harness & ground.
        - If greater than 1 V repair the short to voltage in the circuit
        - If less than 1 V replace the A20 Radio/HVAC Controls

    - **If between 4.7-5.3 V**
8. Test or replace the P17 Info Display Module

Touch Screen

1. Ignition OFF/vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector @ P17 Info Display Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the following signal ground circuit terminals and ground:
    - terminal 9
    - terminal 10
    - **If 10 Ω or greater**

   1. Test for less than 2 Ω in the signal ground circuits end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/vehicle in Service Mode.
4. Test for 1.5 - 2 V between the signal circuit terminal 7 and ground.
   - **If less than 1.5 V**
   1. Ignition OFF/vehicle OFF, disconnect the X2 harness connector at the A11 radio.
   2. Test for infinite resistance between the signal circuit terminal 7 X1 @ the P17 Info Display Module harness and ground.
      - If less than infinite resistance repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω between the test points: signal circuit terminal 7 X1 @ P17 Info Display Module harness & terminal 6 X2 @ A11 Radio harness.
      - If 2 Ω or greater repair the open/high resistance in the circuit.
      - If less than 2 Ω replace the A11 Radio.
   - **If greater than 2 V**
   1. Ignition OFF/vehicle OFF, disconnect the X2 harness connector at the A11 Radio.
   2. Test for less than 1 V between the signal circuit signal circuit terminal 7 X1 @ the P17 Info Display Module harness and ground.
      - If greater than 1 V repair the short to voltage in the circuit.
      - If less than 1 V replace the A11 Radio.
   - **If between 1.5 - 2 V**
5. Replace the P17 Info Display Module

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control module replacement, programming, and setup.

RADIO POOR RECEPTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Radio Antenna Coax	B125A 02	B125A 04	1	-
Antenna Module Ground	-	1	-	-
1. May exhibit possible AM/FM interference.				

Circuit/System Description

The antenna amplifier receives both AM and FM signals from the antenna. The radio antenna amplifier is enabled when the radio is turned on. The radio provides battery voltage to the antenna amplifier using the center conductor of the antenna coaxial cable. When a 12 V signal is seen by the amplifier on the center conductor of the antenna coax, both AM and FM signals are amplified.

Diagnostic Aids

Poor AM and FM radio reception may be due to multiple influences, some of which may not be vehicle related. Areas which have high RF traffic or block the signal path may cause a degradation in radio reception. Radio reception may also be influenced by items within the vehicle, but not part of the radio system. Such examples are aftermarket electrical accessories or other items which may generate noise in the vehicle electrical system. Aftermarket window tinting, especially when there is a metallic in the film, may reduce radio reception.

AM reception is highly dependent on the antenna amplifier receiving battery voltage from the radio and being properly grounded. The antenna amplifier boosts both AM and FM reception. When the antenna amplifier does not receive power, AM stations may not be received and FM reception will be limited. If the amplifier is not properly grounded, excessive interference in the signal may occur, or reception may be limited.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the radio antenna coax cable from the A11 Radio and from the T23 Radio Antenna Amplifier.
2. Verify the antenna coax cable passes the coax cable component test. Refer to Component Testing.
    - **If the coax cable does not pass the test**

      Replace the antenna coax cable

    - **If the coax cable passes the test**
3. Connect the antenna coax cable to the A11 Radio. Ignition ON/Vehicle in Service Mode, A11 Radio ON.
4. Verify a test lamp illuminates between the antenna coax cable center terminal and ground at the T23 Radio Antenna Amplifier connector.
    - **If the test lamp does not illuminate**

      Replace the A11 Radio.

    - **If the test lamp illuminates**
5. Test or replace the T23 Radio Antenna Amplifier.
6. Verify radio reception has improved.
    - **If radio reception has not improved**

      Test or replace the T2E Antenna - Rear End Spoiler

    - **If radio reception has improved**
7. All OK

Component Testing

CAUTION: Refer to Test Probe Caution .

NOTE: **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**

To prevent false reading when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.

Coax Cable Test

1. Ignition OFF, disconnect the coax cable at both components.
2. Test for less than 5 Ω between coax cable center terminal end to end.
   - **If 5 Ω or greater**

     Replace the coax cable
   - **If less than 5 Ω**
3. Test for less than 5 Ω between the coax cable outer shield end to end.
   - **If 5 Ω or greater**

     Replace the coax cable
   - **If less than 5 Ω**
4. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
   - **If less than infinite resistance**

     Replace the coax cable
   - **If infinite resistance**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rear End Spoiler Replacement**
- Refer to **Radio Antenna Amplifier Replacement**
- Refer to **Control Module References** for radio replacement, programming, and setup.

SPEAKER REPLACEMENT REFERENCE

Component	Repair Instruction
Front Speakers	**Radio Front Side Door Speaker Replacement**
Front Tweeter Speakers	**Radio Windshield Side Garnish Molding Speaker Replacement**
Rear Speakers	**Radio Rear Side Door Speaker Replacement**
Rear Subwoofer	**Radio Rear Compartment Speaker Replacement**

SPEAKER MALFUNCTION (UQA)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Amplifier B+	1	1	-	-
LF Audio Signal	2	2	2, 3	2
LR Audio Signal	2	2	2, 3	2
RF Audio Signal	2	2	2, 3	2
RR Audio Signal	2	2	2, 3	2
Subwoofer Audio Signal	2	2	2, 3	2
Remote Enable Signal	1	1, 4	-	-
Amplifier Ground	-	1	-	-
1. Audio inoperative, no sound from all speakers. 2. No or reduced audio from speaker(s) on the affected audio circuit. 3. Noticeable audio distortion may be present. 4. Fault may affect one or more components, dependant on vehicle equipment.				

Circuit/System Description

Each of the audio output channel circuits (+) and (-), at the radio and audio amplifier have a DC bias voltage that is approximately one half of battery voltage. When using a DMM, each of the audio output channel circuits will measure approximately 6.5 V DC. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Diagnostic Aids

- Improper speaker mounting or loose trim may cause an audible buzz or distortion. Inspect the appropriate speaker and the surrounding interior trim for proper and secure mounting.

  The EL-50334-6 Audio System Diagnostic CD contains audio tracks that can be used to duplicate and isolate such concerns. Tracks 11 and 12 contain audio sweep tones for testing for speaker and grill rattles.

  If the speaker or surrounding interior trim is found to be loose or improperly secured, correctly secure the item.

- The test tones on the CD may be copied to a USB drive or other device to use during testing.
- When equipped with an amplifier, it is possible for some individual circuit faults to affect more than one speakers operation. Perform diagnostic tests in the sequence listed to avoid misdiagnosis.
- On the base 6 speaker system, the subwoofer is not used for reproducing audio. The subwoofer is used only for producing the cancellation tones for the active noise cancellation system.

  On the uplevel speaker system, the subwoofer is used for both reproducing audio and the active noise cancellation system tones.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-50334-50 USB Cable and Adapter Kit

Circuit/System Verification

1. Ignition ON/vehicle in Service Mode, A11 Radio ON, mute OFF.
2. Verify clear audio is heard from each speaker, adjusting fade and balance controls to test each speaker individually.
    - **If audio is inoperative from one or more speakers, or the audio emitted is not clear**

      Refer to Circuit/System Testing.

    - **If clear audio is heard from all speakers**
3. All OK.

Circuit/System Testing

NOTE: **In the following tests, audio signal frequencies (Hz) will be tested. To prevent misdiagnosis, the door chime must be OFF during testing. Ensure the driver door latch is closed during testing.**

1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the T3 Audio Amplifier.
2. Test for less than 10 Ω between the ground circuit terminal 8 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Verify that a test lamp illuminates between the B+ circuit terminal 4 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF/vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to Power Mode Mismatch .
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF/vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the T3 Audio Amplifier.
    - **If the test lamp illuminates**
4. Ignition OFF/vehicle OFF, disconnect the X3 harness connector at the T3 Audio Amplifier.

NOTE: **In the following tests, audio signal frequencies (Hz) will be tested. To prevent misdiagnosis, the door chime must be OFF during testing. Ensure the driver door latch is closed during testing.**

5. Verify a test lamp does not illuminate between the control circuit terminal 8 and ground.
    - **If the test lamp illuminates**

   1. Disconnect the X1 harness at the A11 Radio.
   2. Verify a test lamp does not illuminate between the control circuit and ground.
      - If the test lamp illuminates, repair the short to voltage on the circuit.
      - If the test lamp does not illuminate, replace the A11 Radio.
   - **If the test lamp does not illuminate**
6. Ignition ON/vehicle in Service Mode, A11 Radio ON.
7. Verify a test lamp illuminates between the control circuit terminal 8 and ground.
   - **If the test lamp does not illuminate**
   1. Ignition OFF/vehicle OFF. Disconnect the X1 harness at the A11 Radio.
   2. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the A11 Radio.
   - **If the test lamp illuminates**
8. Radio ON, mute ON.
9. Test for 7.5 - 8.5 V between the control circuit terminal 11 and ground.
   - **If greater than 8.5 V**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio. Ignition ON/vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the A11 Radio.
   - **If less than 7.5 V**
   1. Ignition OFF/vehicle OFF, disconnect the X1 harness connector at the A11 Radio.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the A11 Radio.
   - **If between 7.5 - 8.5 V**
10. Radio ON, mute OFF.
11. Test for less than 1 V between the control circuit terminal 11 and ground.
    - **If greater than 1 V**

      Replace the A11 Radio.

    - **If less than 1 V**
12. Test for 5 - 7 V between the signal circuit terminals listed below and ground:
    - Left front speaker signal (+) terminal 15
    - Left front speaker signal (-) terminal 7
    - Right front speaker signal (+) terminal 14
    - Right front speaker signal (-) terminal 6
    - Left rear speaker signal (+) terminal 13
    - Left rear speaker signal (-) terminal 5
    - Right rear speaker signal (+) terminal 12
    - Right rear speaker signal (-) terminal 4
    - **If less than 5 V**
    1. Ignition OFF/vehicle OFF, disconnect the X2 harness connector at the A11 Radio.
    2. Test for infinite resistance between the signal circuit and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.
   - If 2 Ω or greater, repair the open/high resistance in the circuit.
   - If less than 2 Ω, replace the A11 Radio.

- **If greater than 7 V**

1. Ignition OFF/vehicle OFF, disconnect the X2 harness connector at the A11 Radio. Ignition ON/vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit and ground.
   - If 1 V or greater, repair the short to voltage on the circuit.
   - If less than 1 V, replace the A11 Radio.

- **If between 5 - 7 V**

13. Play track number three (50 Hz bass test tone) from the **EL-50344-6** Audio Test CD.
14. Test for 49 - 51 Hz AC between the audio signal circuit terminals listed below and ground:
    - Left front speaker signal (+) terminal 15
    - Left front speaker signal (-) terminal 7
    - Right front speaker signal (+) terminal 14
    - Right front speaker signal (-) terminal 6
    - Left rear speaker signal (+) terminal 13
    - Left rear speaker signal (-) terminal 5
    - Right rear speaker signal (+) terminal 12
    - Right rear speaker signal (-) terminal 4
    - **If not between 49 - 51 Hz AC**

      Replace the A11 Radio.

    - **If between 49 - 51 Hz AC**
15. Ignition OFF/vehicle OFF, connect all harness connectors.
16. Disconnect the harness connector at the appropriate P19 Speaker. Ignition ON/vehicle in Service Mode, A11 Radio ON.
17. Test for 5 - 7 V between the appropriate P19 Speaker circuits listed below and ground:
    - Speaker signal (-) circuit terminal 1
    - Speaker signal (+) circuit terminal 2
    - **If less than 5 V**

    1. Ignition OFF/vehicle OFF, disconnect the X1 and X2 harness connector at the T3 Audio Amplifier.
    2. Test for infinite resistance between the signal circuit and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, replace the T3 Audio Amplifier.

    - **If greater than 7 V**

    1. Ignition OFF/vehicle OFF, disconnect the X1 and X2 harness connector at the T3 Audio Amplifier. Ignition ON/vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
       - If 1 V or greater, repair the short to voltage on the circuit.
       - If less than 1 V, replace the T3 Audio Amplifier.

    - **If between 5 - 7 V**
18. Mute OFF, play track number three (50 Hz bass test tone) from the test CD.
19. Test for 49 - 51 Hz AC between the appropriate P19 Speaker circuits listed below and ground:
    - Speaker signal (-) circuit terminal 1
    - Speaker signal (+) circuit terminal 2
    - **If not between 49 - 51 Hz AC**

Replace the T3 Audio Amplifier.

- **If between 49 - 51 Hz AC**

20. Test or replace the P19 Speaker.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Speaker Replacement Reference**
- Refer to **Control Module References** for amplifier or radio replacement, programming, and setup

SPEAKER MALFUNCTION (WITHOUT UQA)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Speaker Output Signal	1	1	1, 2	-
Right Front Speaker Output Signal	1	1	1, 2	-
Left Rear Speaker Output Signal	1	1	1, 2	-
Right Rear Speaker Output Signal	1	1	1, 2	-
1. No or reduced audio from speaker(s) on the affected audio circuit. 2. Noticeable audio distortion may be present.				

Circuit/System Description

Each of the audio output channel circuits (+) and (-), at the radio have a DC bias voltage that is approximately one half of battery voltage. When using a DMM, each of the audio output channel circuits will measure approximately 6.5 V DC. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Diagnostic Aids

- Improper speaker mounting or loose trim may cause an audible buzz or distortion. Inspect the appropriate speaker and the surrounding interior trim for proper and secure mounting.
- The EL-50334-6 Audio System Diagnostic CD contains audio tracks that can be used to duplicate and isolate such concerns. Tracks 11 and 12 contain audio sweep tones for testing for speaker and grill rattles.
- The test tones on the CD may be copied to a USB drive or other device to use during testing.
- If the speaker or surrounding interior trim is found to be loose or improperly secured, correctly secure the item.
- If equipped with an Active Noise Cancellation system that utilizes an ANC module, the module acts as a pass-through for the high level audio signals from the radio to the speakers.

Reference Information

Schematic Reference

Radio/Navigation System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Radio/Audio System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/vehicle in Service Mode, A11 Radio ON, mute OFF.
2. Verify clear audio is heard from each speaker, adjusting fade and balance controls to test each speaker individually.
   - **If audio is inoperative from one or more speakers, or the audio emitted is not clear.**

     Refer to Circuit/System Testing.

   - **If clear audio is heard from all speakers.**
3. All OK.

Circuit/System Testing

NOTE: **Some circuits supply audio signals to more than one speaker. It may be necessary to disconnect all speakers on the affected audio circuit when performing circuit tests.**

1. Ignition OFF/vehicle OFF, disconnect the harness connector at the appropriate P19 Speaker. Ignition ON, A11 Radio ON, mute OFF.
2. Test for 5 - 7 V between each audio signal circuit terminal 1 and terminal 2 and ground.
   - **If less than 5 V**
   1. Ignition OFF/vehicle OFF, disconnect the appropriate speaker harness connector at the A11 Radio.
   2. Test for infinite resistance between the signal circuits and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the A11 Radio.
   - **If greater than 7 V**
   1. Ignition OFF/vehicle OFF, disconnect the appropriate speaker harness connector at the A11 Radio. Ignition ON/vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the A11 Radio.
   - **If between 5 - 7 V**
3. Test or replace the P19 Speaker.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Speaker Replacement Reference**
- Refer to **Control Module References** for radio replacement, programming, and setup.

UNABLE TO CONTACT ONSTAR CALL CENTER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2470 02

Cellular Phone Antenna Circuit Malfunction Short to Ground

DTC B2470 04

Cellular Phone Antenna Circuit Malfunction Open Circuit

Circuit/System Description

The primary cellular phone antenna element is connected to the telematics communication interface control module (violet connector) via a shielded coaxial cable. Cellular communication takes place on both the primary cellular antenna signal circuit and the GPS/secondary cellular antenna signal circuit. This diagnostic only applies to the primary cellular antenna signal circuit. Internal to the antenna on the cellular antenna signal circuit resistance is used to apply a load, which the telematics communication interface control module uses to detect the presence of the antenna.

Conditions for Running the DTC

- Ignition in the RUN or ACC position.
- System voltage is between 9.5 V and 15.5 V.
- The above conditions are present for greater than 1 s.

Conditions for Setting the DTC

B2470 02

The telematics communication interface control module detects a short to ground on the primary cellular antenna signal circuit.

B2470 04

- The telematics communication interface control module detects an open or high resistance on the primary cellular antenna signal circuit.
- The above conditions are present for greater than 1 s.

Action Taken When the DTC Sets

The OnStarÃ‚Â® status LED turns red.

Conditions for Clearing the DTC

- The telematics communication interface control module detects the presence of a cellular antenna.
- A history DTC clears after 50 malfunction-free ignition cycles.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-49903-1 Test Antenna Navn-Cell Comn

Circuit/System Testing

NOTE:

- **The vehicle may be equipped with sectioned coax. Test each section and replace only the faulty section, not the entire length of coax.**
- **The following verification requires the vehicle to be outside with an unobstructed view of the southern sky. Allow 5 min after turning the ignition ON for the GPS satellites to acquire vehicle signal.**

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the violet primary cellular coax cable connector at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Using the **EL-49903-1** Test Antenna Navn-Cell Comn connect the violet coax cable to the K73 Telematics Communication Interface Control Module. Place the test antenna on the roof of the vehicle, ignition ON/vehicle in Service Mode.
3. Verify the DTC does not set or a call can be completed to the OnStar Call Center while operating the vehicle within the conditions for running the DTC.
    - **If the DTC sets or a call can not be completed to the OnStar Call Center**

      Replace the K73 Telematics Communications Interface Control Module.

    - **If the DTC does not set or a call can be completed to the OnStar Call Center**
4. Ignition OFF/Vehicle OFF.
5. Disconnect the **EL-49903-1** Test Antenna Navn-Cell Comn from the K73 Telematics Communication Interface Control Module
6. Test the coax cable. Refer to Component Testing.
    - **If the coax cable does not pass the test**

      Replace the coax cable.

    - **If the coax cable passes the test**
7. Test or replace the T2RR Antenna - Roof Rear.

Component Testing

CAUTION: **Refer to Test Probe Caution**

NOTE:

- **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause**

reception issues.
- **To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.**

Coax Cable Test

1. Test for less than 5 Ω between the coax cable center terminal end to end.
   - **If 5 Ω or greater**

     Replace the coax cable.
   - **If less than 5 Ω**
2. Test for greater than 5 Ω between the coax cable outer shield end to end.
   - **If 5 Ω or greater**

     Replace the coax cable.
   - **If less than 5 Ω**
3. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
   - **If less than infinite resistance**

     Replace the coax cable.
   - **If infinite resistance**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

- Refer to **High Frequency Antenna Replacement**
- Refer to **Control Module References** for telematics communication interface control module replacement, setup, and programming

ONSTAR VOICE RECOGNITION MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The telematics communication interface control module is capable of interpreting voice commands received over the cellular microphone circuits. Speech recognition allows the user to speak to one computer in the vehicle, and one reached over the cellular communication network. The module attempts to understand the users command, and responds by speaking back, or by taking the appropriate action, e.g. dialing the phone.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

OnStar Description and Operation (UE3)OnStar Description and Operation (UE1)

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

NOTE:

- **It is necessary to have the vehicle in an open outside area where a cellular call can be successfully placed and GPS data can be received from satellites.**
- **The vehicle should be located in a quiet area.**

1. Vehicle in Service Mode.
2. Verify that your voice is heard clearly by the OnStar Call center.
   - **If your voice can not be heard clearly**

     Refer to OnStar Microphone Malfunction

   - **If your voice can be heard clearly**
3. Verify that the system responds appropriately to all voice commands by pressing the voice command button and attempting to operate the system using multiple voice commands.
   - **If the OnStar system does not respond to any voice commands**

     Replace the K73 Telematics Communication Interface Control Module

   - **If the OnStar system responds to some, but not all voice commands**

     Refer to OnStar Description and Operation (UE3)OnStar Description and Operation (UE1) for tips on proper pronunciation

   - **If the OnStar system responds to all voice commands**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair procedure.

Refer to Control Module References for telematics communication interface control module replacement, programming and setup

REPAIR INSTRUCTIONS

MOBILE TELEPHONE MICROPHONE REPLACEMENT

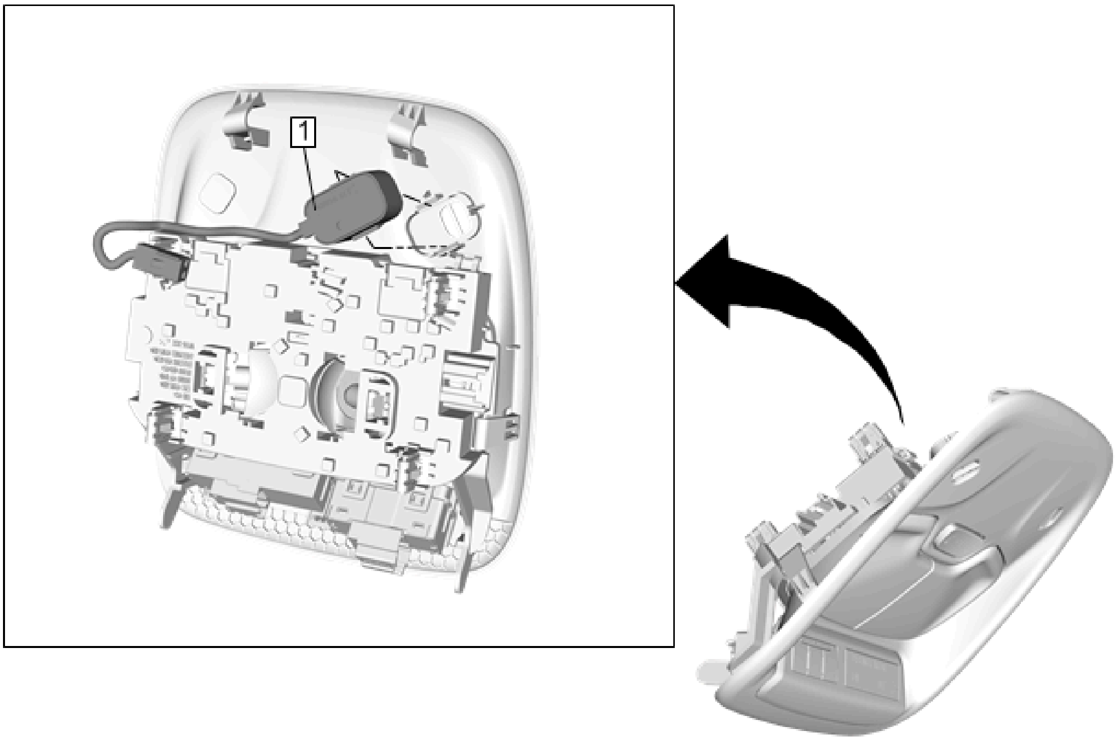


Fig. 12: Mobile Telephone Microphone
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Roof Console. Refer to Roof Console Replacement	
1	Mobile Telephone Microphone **Procedure** Release the retaining tabs.

COMMUNICATION CENTER CALL SWITCH REPLACEMENT

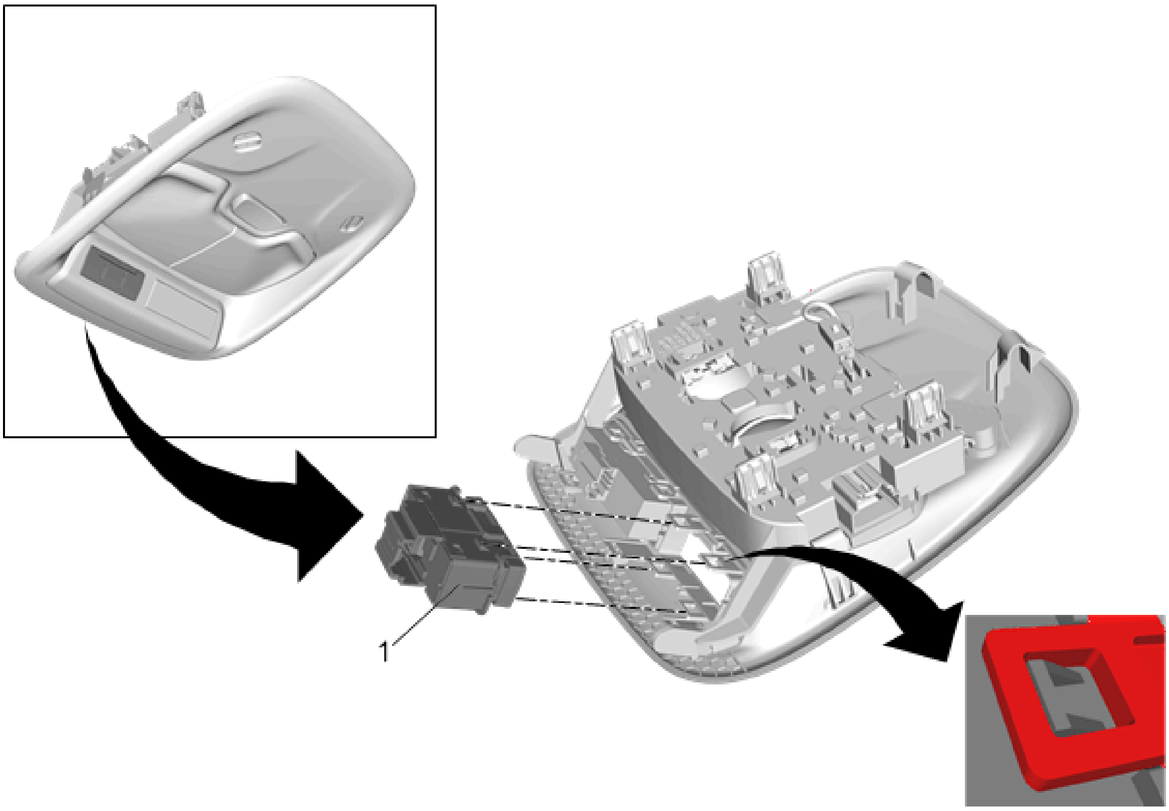


Fig. 13: Communication Center Call Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection 2. Remove Roof Console. Refer to Roof Console Replacement	
1	Communication Center Call Switch **Procedure** 1. Use a flat bladed plastic tool to remove. 2. Release tabs and remove the switch from the roof console. 3. Connect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection

COMMUNICATION INTERFACE MODULE REPLACEMENT

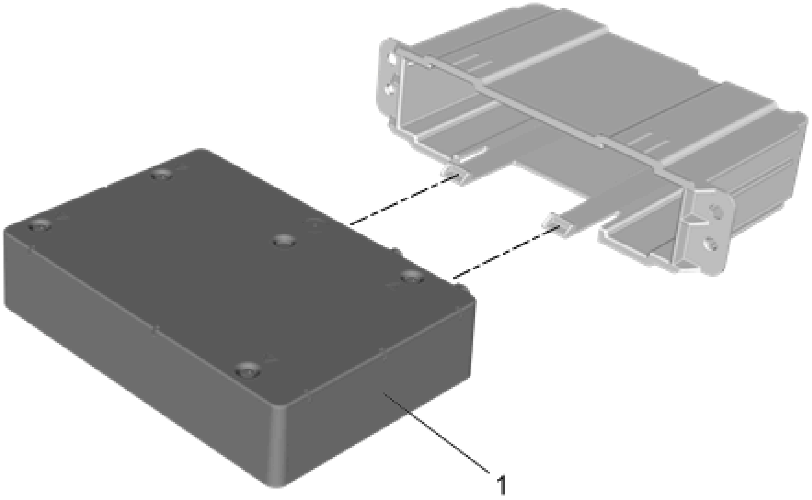


Fig. 14: Communication Interface Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Communication Interface Module Bracket. Refer to Communication Interface Module Bracket Replacement	
1	Communication Interface Module **Procedure** 1. Push the retaining tabs (Qty: 2) outward and slide the module upward. 2. Refer to Control Module References for programming and setup information, if required.

COMMUNICATION INTERFACE MODULE BATTERY REPLACEMENT

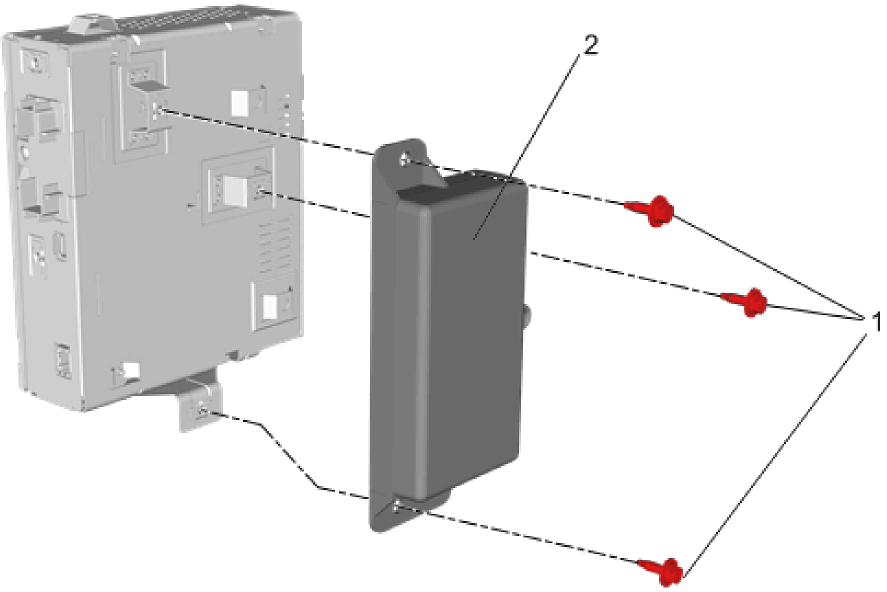


Fig. 15: Communication Interface Module Battery
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the radio. Refer to Radio Replacement	
1	Communication Interface Module Battery Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Communication Interface Module Battery

COMMUNICATION INTERFACE MODULE BRACKET REPLACEMENT

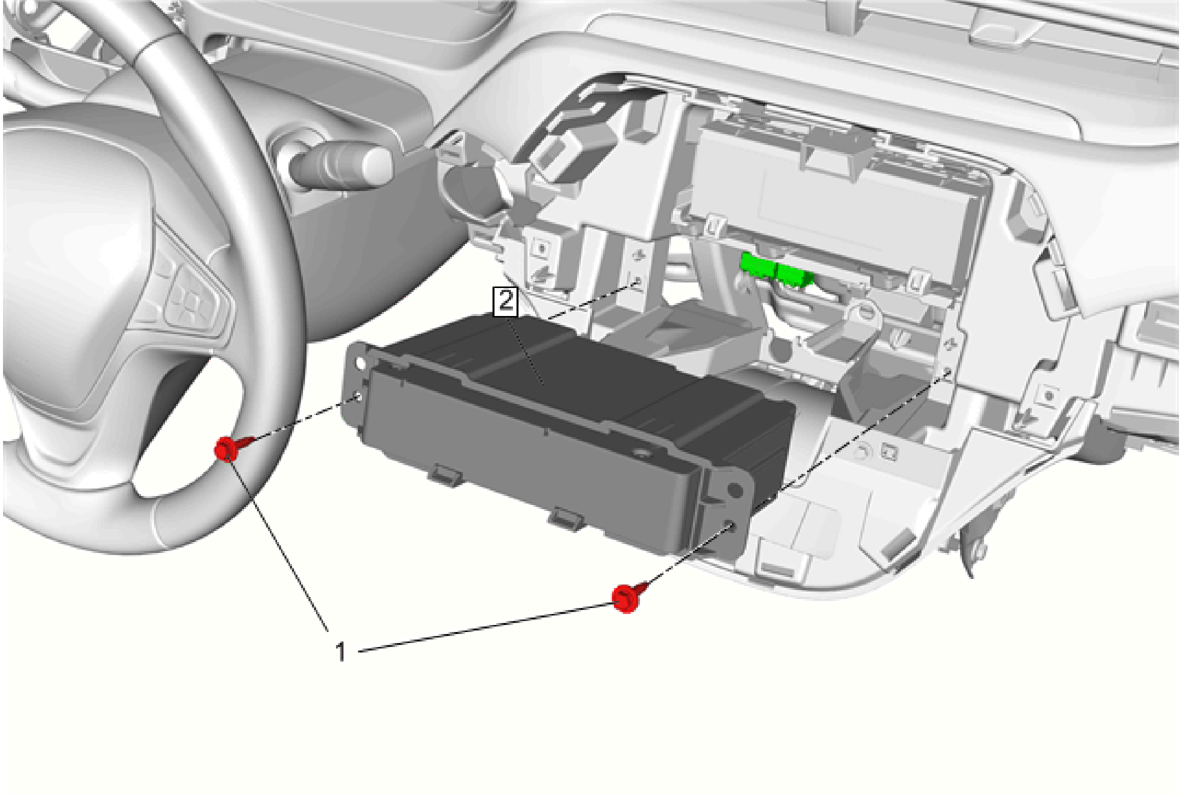


Fig. 16: Communication Interface Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Trim Plate. Refer to **Instrument Panel Trim Plate Replacement**	
1	Communication Interface Module Bracket Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Communication Interface Module Bracket **Procedure** 1. Disconnect all electrical connectors. 2. Transfer components as necessary.

RADIO REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to **Battery Negative Cable Disconnection and Connection**

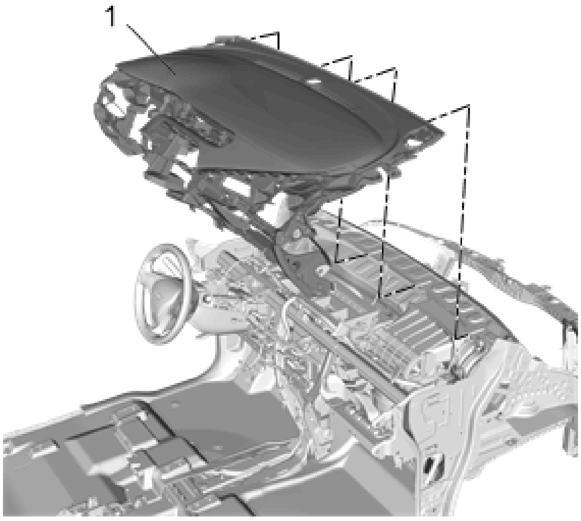


Fig. 17: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Remove Instrument Panel Assembly (1). Refer to **Instrument Panel Assembly Replacement**

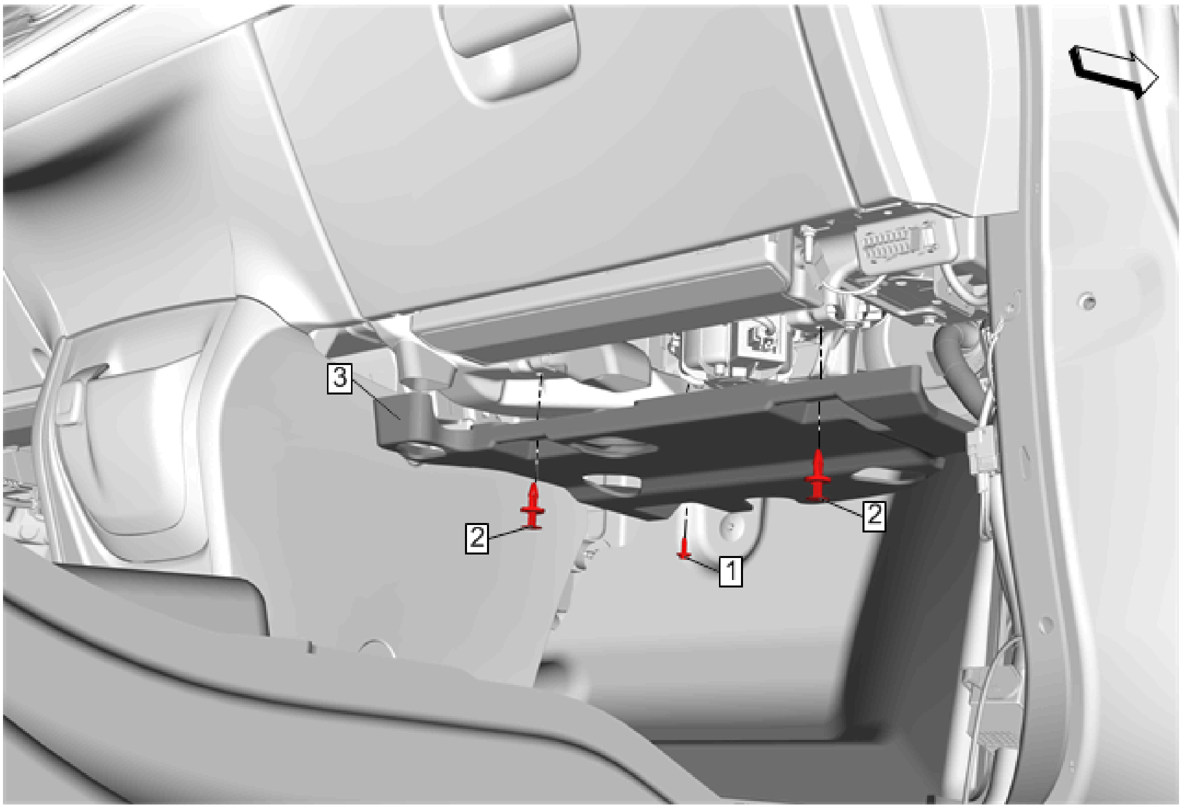


Fig. 18: Instrument Panel Lower Trim Panel Insulator
Courtesy of GENERAL MOTORS COMPANY

3. Remove Instrument Panel Lower Trim Panel Insulator (3). Refer to **Instrument Panel Lower Trim Panel Insulator Replacement**

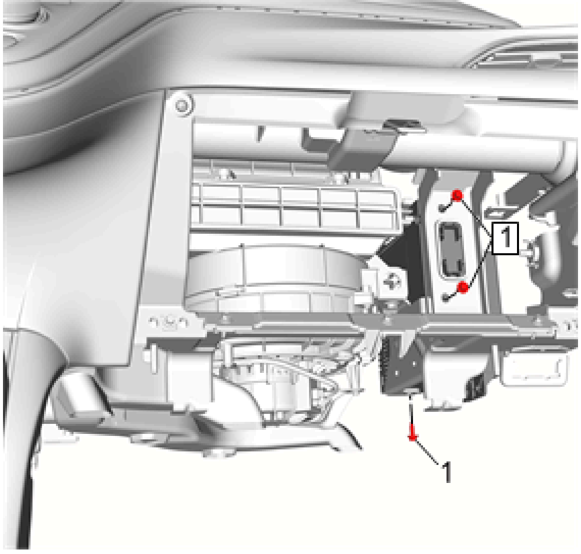


Fig. 19: Radio Assembly Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Radio Assembly Bolts (1)

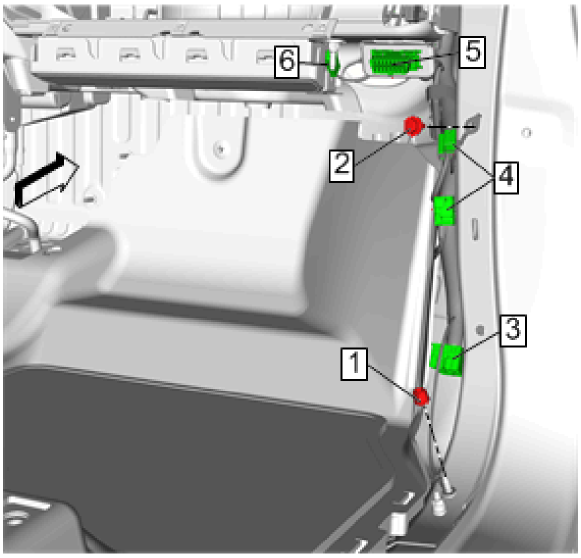


Fig. 20: Ground Nut, Bolt And Connectors
Courtesy of GENERAL MOTORS COMPANY

5. Remove the ground nut (1) and ground wire.
6. Remove the ground bolt (2) and ground wire.
7. Unclip and disconnect the I/P main harness connector (3).
8. Disconnect the coax antenna connectors (4).
9. Unclip the passenger side DLC connector (5).
10. Disconnect the passenger side airbag connector (6).

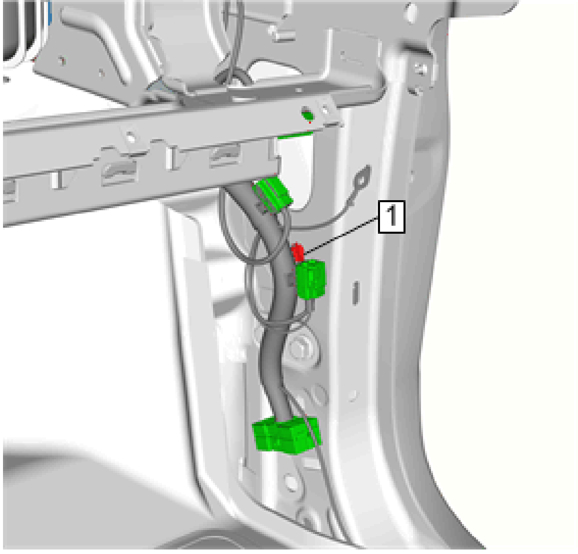


Fig. 21: Harness Retainer
Courtesy of GENERAL MOTORS COMPANY

11. Unclip the harness retainer (1).

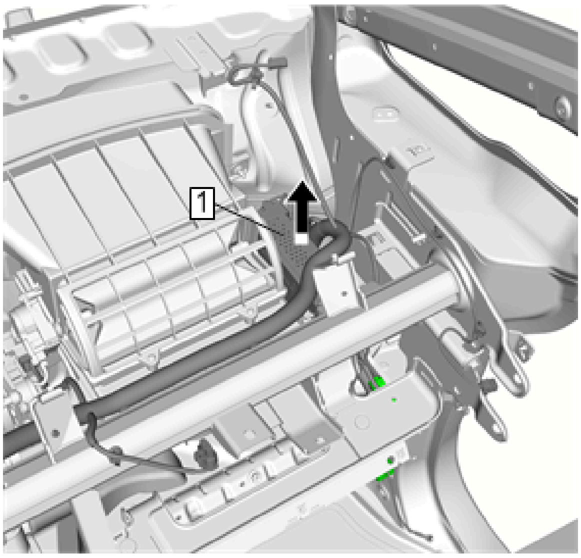


Fig. 22: Radio Module Assembly
Courtesy of GENERAL MOTORS COMPANY

12. Pull the radio assembly (1) upward with the harness.

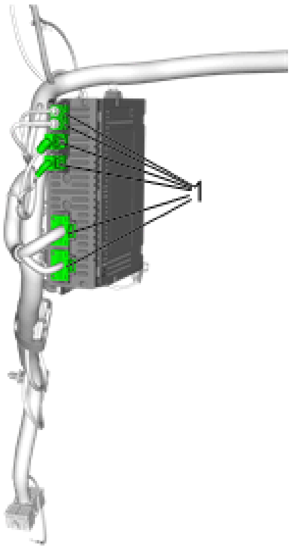


Fig. 23: Radio Assembly Connectors
Courtesy of GENERAL MOTORS COMPANY

13. Position the radio and harness assembly toward the interior of the vehicle.

14. Disconnect the electrical connectors (1).
15. Detach the wiring harness securing clips.
16. Remove the radio from the vehicle.

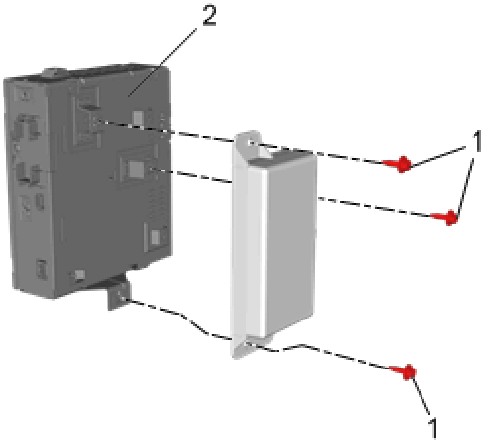


Fig. 24: Radio Assembly And Bolts
Courtesy of GENERAL MOTORS COMPANY

17. Remove Bolts (1)
18. Remove Communication Interface Module Battery @ Radio Assembly (2)

Installation Procedure

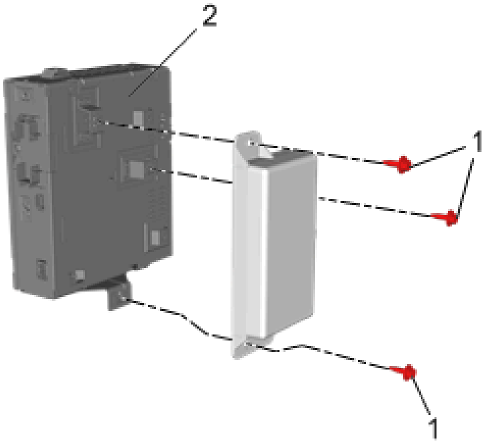
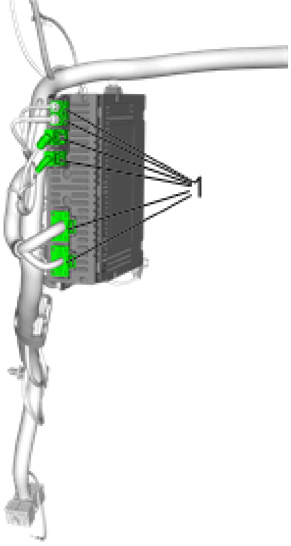


Fig. 25: Radio Assembly And Bolts
Courtesy of GENERAL MOTORS COMPANY

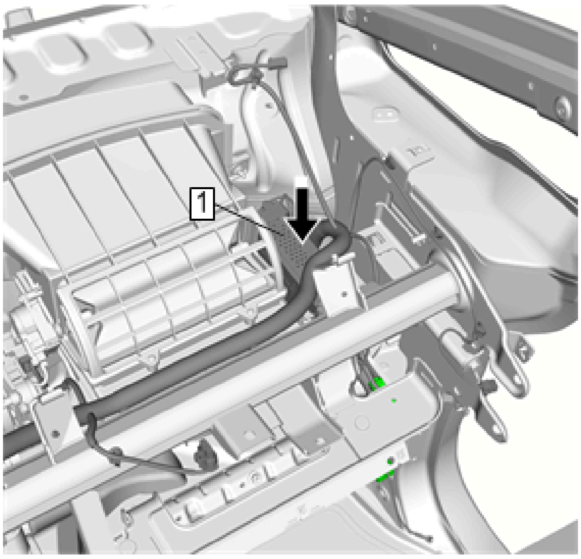
CAUTION: **Refer to Fastener Caution**

1. Install Communication Interface Module Battery @ Radio Assembly (2)
2. Install and tighten Radio Assembly Bolts (1) (Qty: 3) to 2.5 N.m (22 lb in)



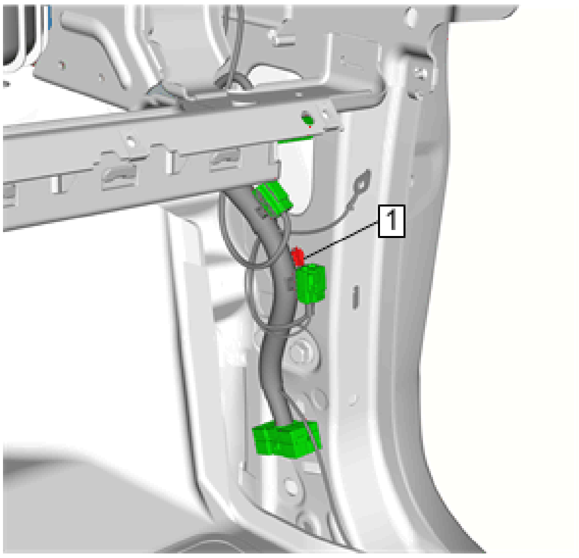
[Fig. 26: Radio Assembly Connectors](#)
Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connectors. (1)
4. Attach the wiring harness securing clips.



[Fig. 27: Radio Module Assembly](#)
Courtesy of GENERAL MOTORS COMPANY

5. Position the radio module (1) and harness assembly into the bracket.



[Fig. 28: Harness Retainer](#)
Courtesy of GENERAL MOTORS COMPANY

6. Clip the harness retainer (1).

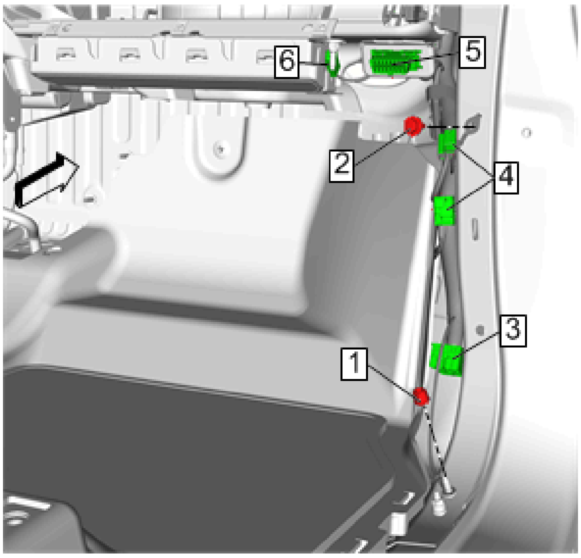


Fig. 29: Ground Nut, Bolt And Connectors
Courtesy of GENERAL MOTORS COMPANY

7. Install the ground nut (1) and ground wire. Tighten the fastener to 9 N.m (80 lb in).
8. Install the ground bolt (2) and ground wire. Tighten the fastener to 9 N.m (80 lb in).
9. Clip and Connect the I/P main harness connector (3).
10. Connect the coax antenna connectors (4).
11. Clip the passenger side DLC connector (5).
12. Connect the passenger side airbag connector (6).

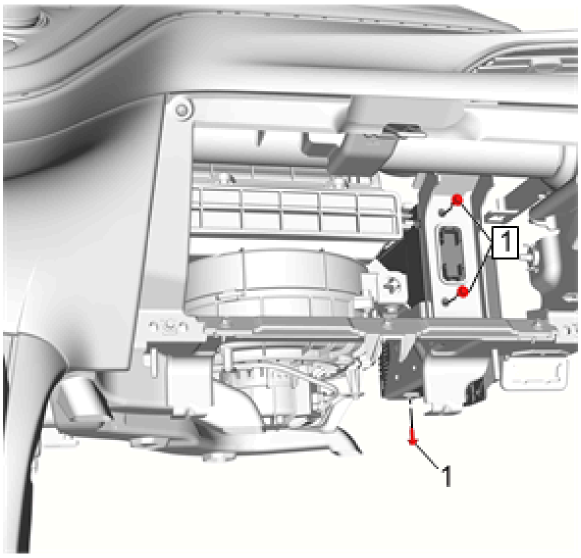


Fig. 30: Radio Assembly Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Install and tighten Radio Assembly Bolts (1) to 2.5 N.m (22 lb in)

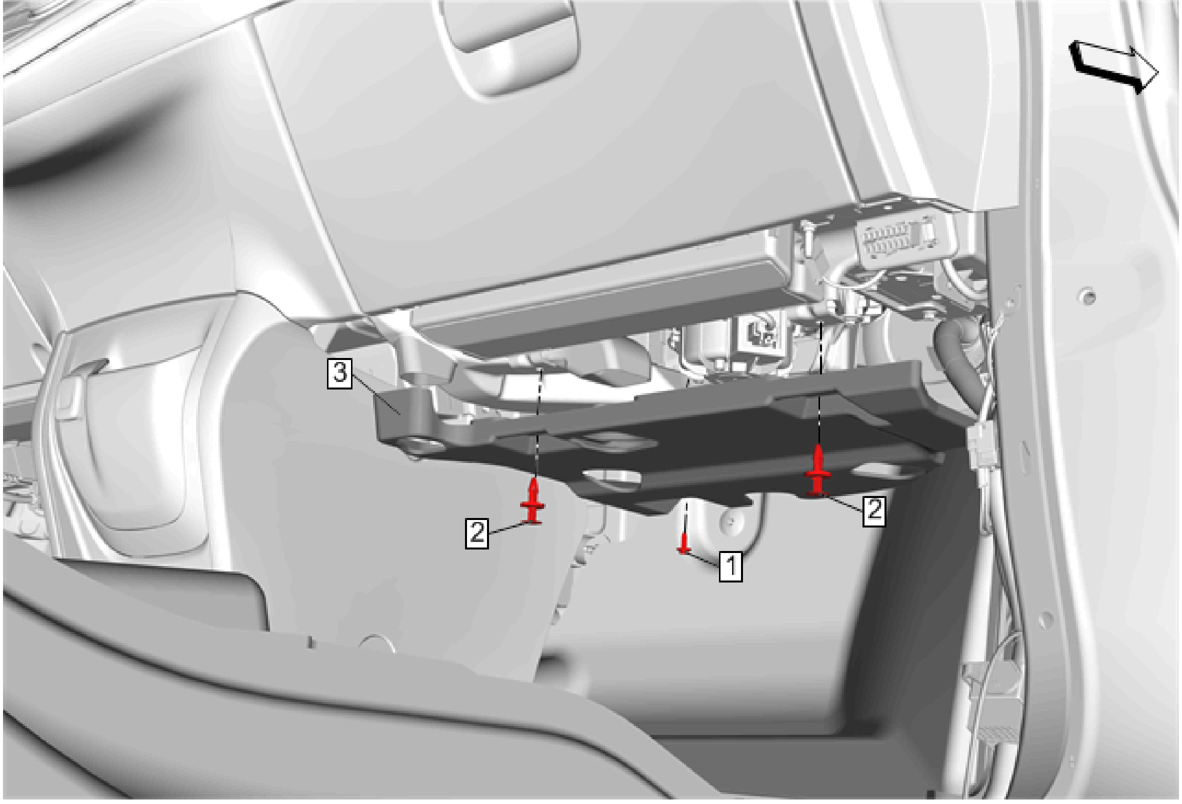


Fig. 31: Instrument Panel Lower Trim Panel Insulator
Courtesy of GENERAL MOTORS COMPANY

14. Install Instrument Panel Lower Trim Panel Insulator (3). Refer to **Instrument Panel Lower Trim Panel Insulator Replacement**

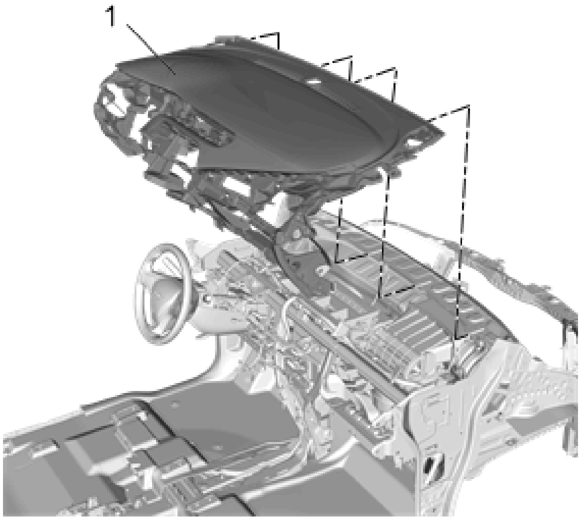
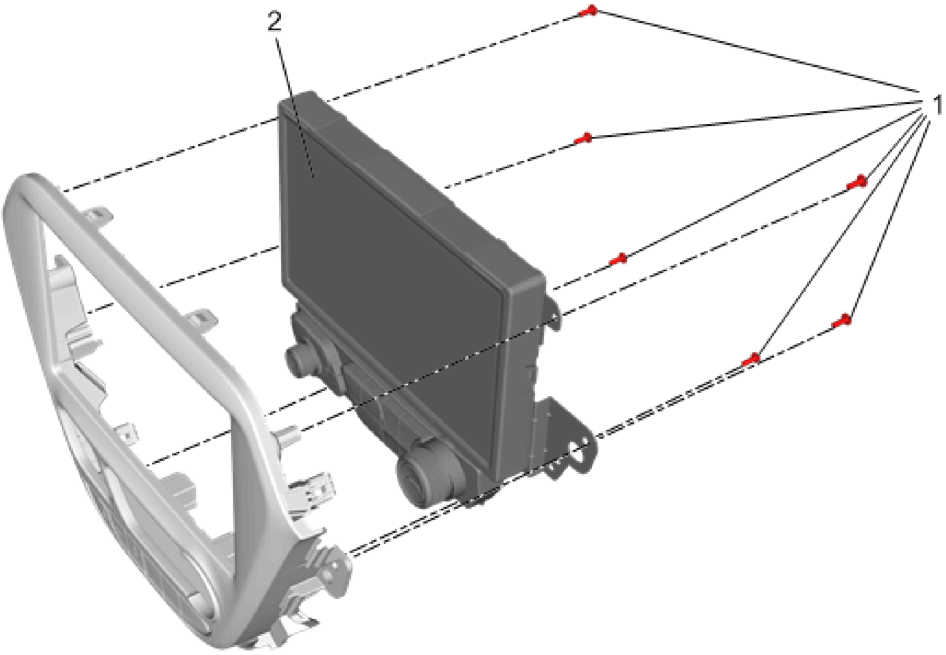


Fig. 32: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

15. Install Instrument Panel Assembly (1). Refer to **Instrument Panel Assembly Replacement**
16. Connect Battery Negative Cable. Refer to **Battery Negative Cable Disconnection and Connection**

DRIVER INFORMATION DISPLAY REPLACEMENT



[Fig. 33: Driver Information Display](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Trim Plate. Refer to **Instrument Panel Trim Plate Replacement**	
1	Driver Information Display Bolt (Qty: 6) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Driver Information Display **Procedure** 1. Transfer components as necessary. 2. Refer to **Control Module References** for programming and setup procedures, if required.

AUDIO DISC PLAYER AND USB RECEPTACLE REPLACEMENT

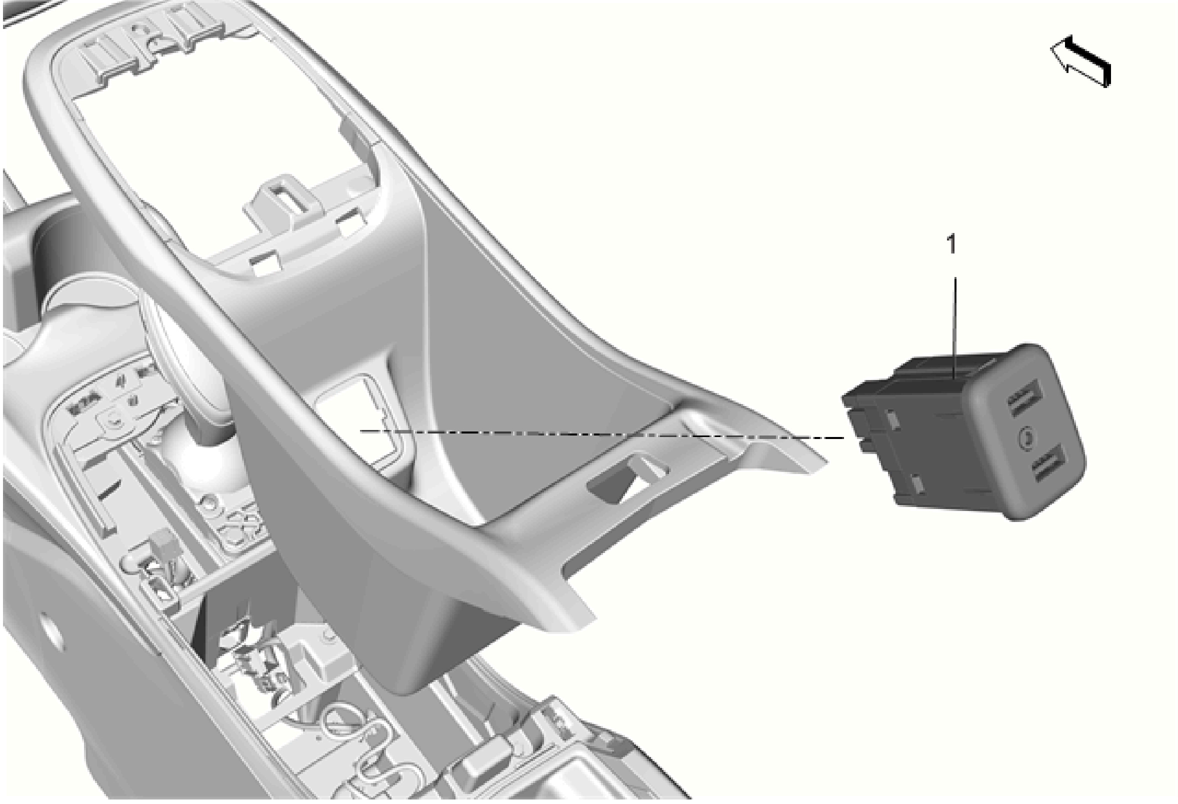


Fig. 34: Audio Disc Player and USB Receptacle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Floor Console Stowage Tray. Refer to Rear Floor Console Stowage Tray Replacement (without K4C) Rear Floor Console Stowage Tray Replacement (with K4C)	
1	Audio Disc Player and USB Receptacle **Procedure** Use a flat bladed plastic trim tool.

RADIO SPEAKER AMPLIFIER REPLACEMENT

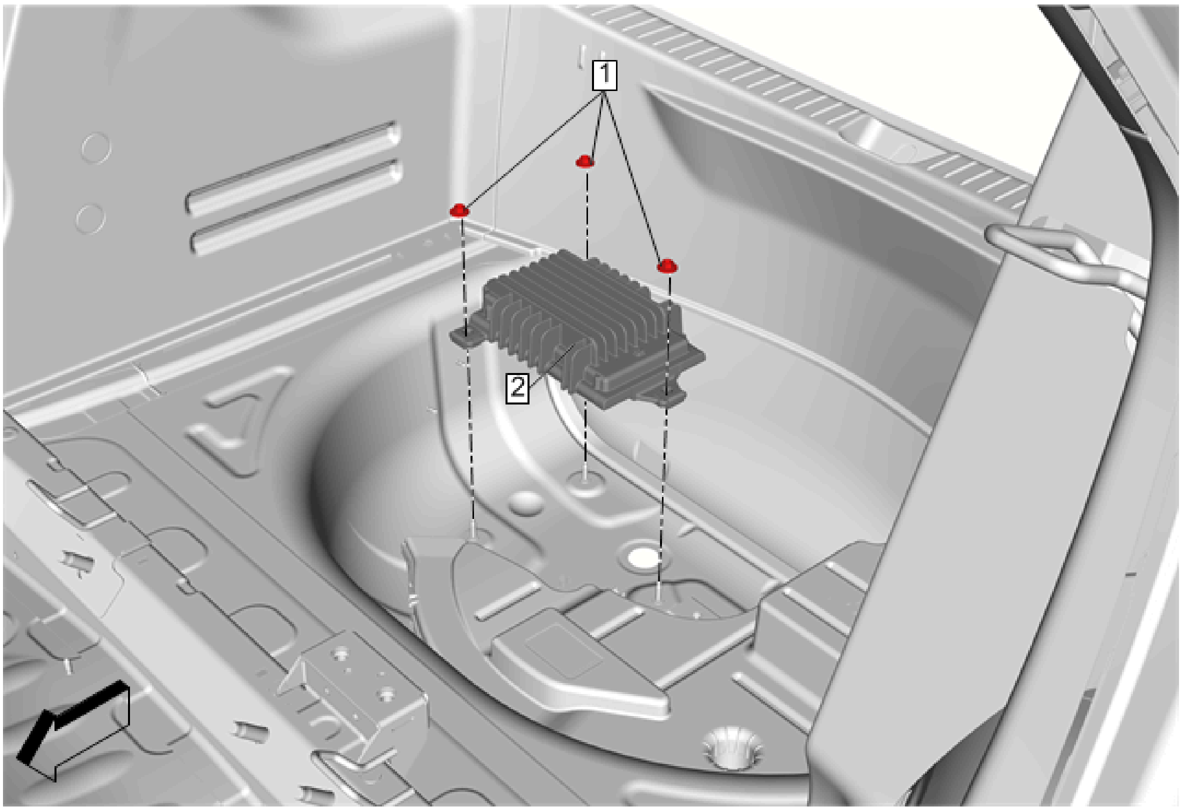


Fig. 35: Radio Speaker Amplifier
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Load Floor Trim Panel. Refer to **Load Floor Trim Panel Replacement**	
1	Radio Speaker Amplifier Nut (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Radio Speaker Amplifier **Procedure** 1. Disconnect all electrical connectors. 2. Refer to **Control Module References** for programming and setup information, if required.

RADIO ANTENNA AMPLIFIER REPLACEMENT

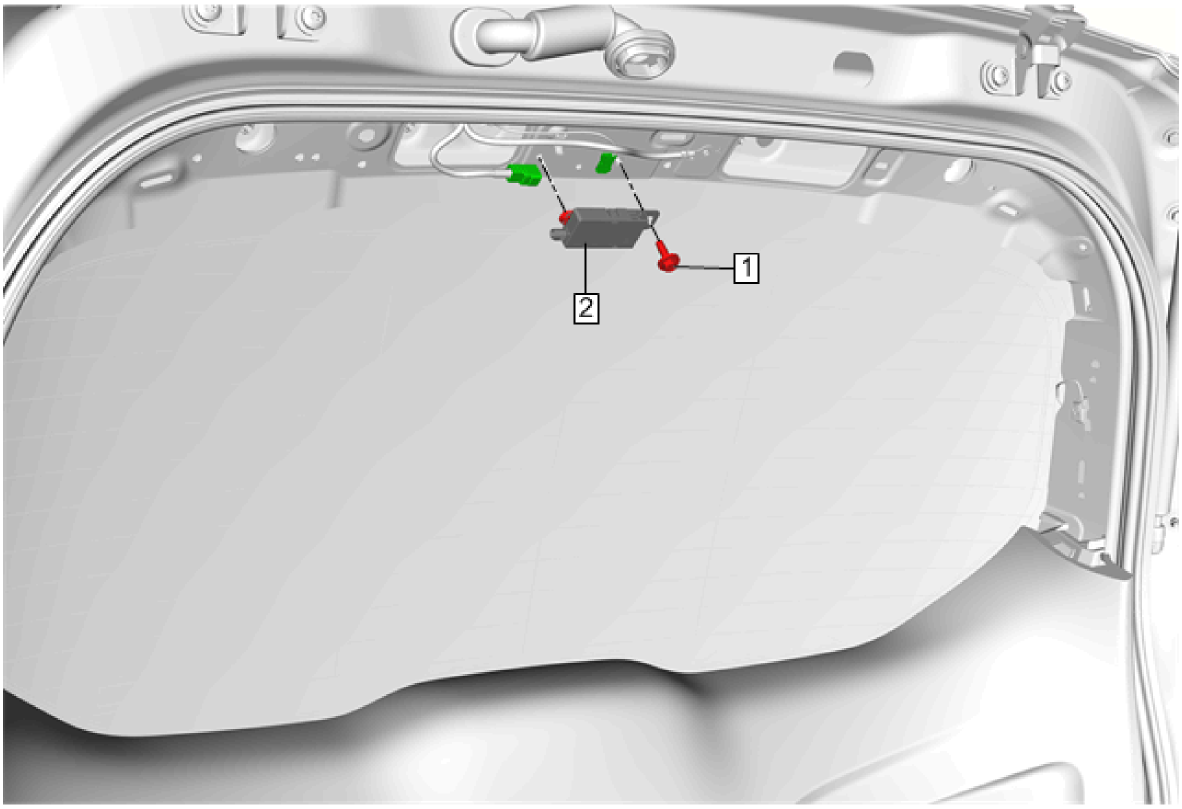


Fig. 36: Radio Antenna Amplifier
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Liftgate Upper Center Trim Finish Panel. Refer to **Liftgate Upper Center Trim Finish Panel Replacement**	
1	Radio Antenna Amplifier Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

Callout	Component Name
2	Radio Antenna Amplifier **Procedure** 1. Disconnect the electrical connectors. 2. Release the integral retainer using an appropriate trim tool.

ROOF ACCESSORY RADIO ANTENNA CABLE REPLACEMENT

Removal Procedure

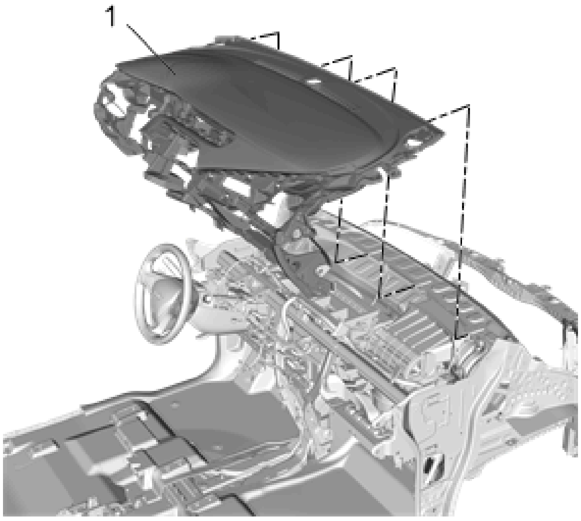


Fig. 37: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove Instrument Panel Assembly (1). Refer to Instrument Panel Assembly Replacement

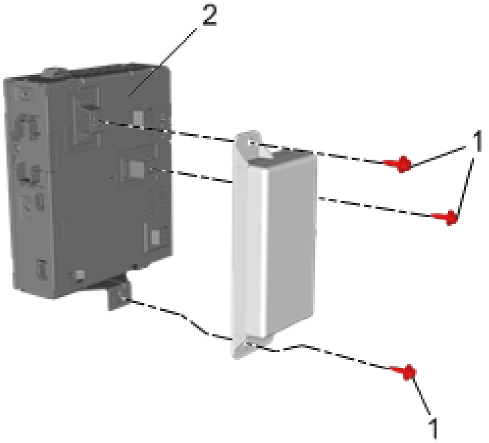


Fig. 38: Radio Assembly And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove Radio (2). Refer to Radio Replacement

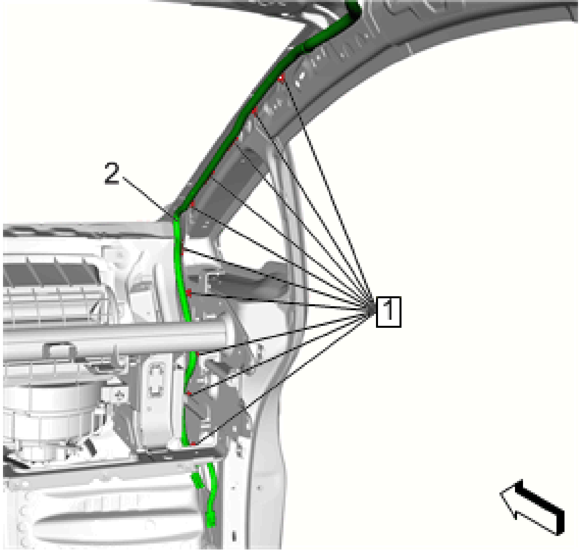


Fig. 39: Roof Accessory Radio Antenna Cable And Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

3. Detach the cable retaining clips (1) from the vehicle.
4. Remove the roof accessory radio antenna cable (2).

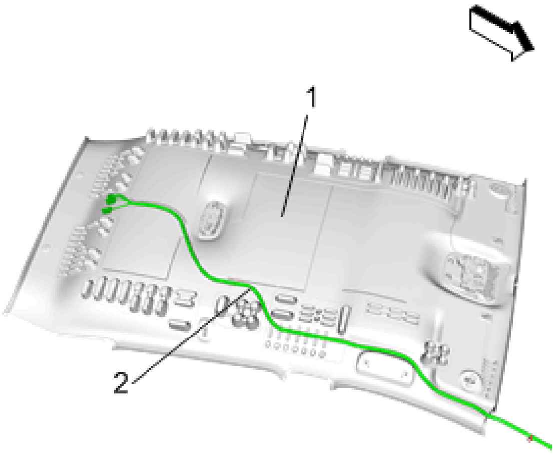


Fig. 40: Roof Accessory Radio Antenna Cable And Headlining Trim Panel
Courtesy of GENERAL MOTORS COMPANY

5. Lower Headlining Trim Panel (1). Refer to **Headlining Trim Panel Replacement**
6. Detach the antenna cable (2) from the headlining trim panel.

Installation Procedure

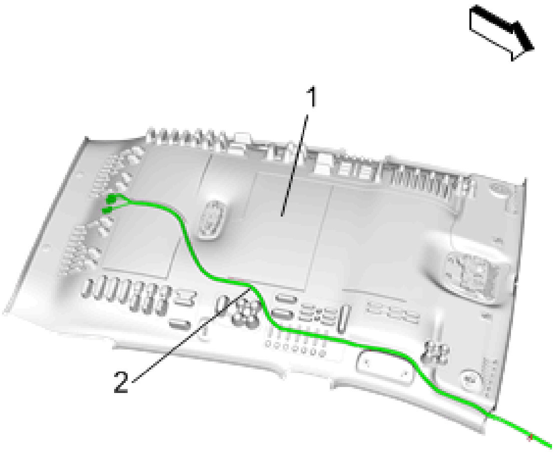


Fig. 41: Roof Accessory Radio Antenna Cable And Headlining Trim Panel
Courtesy of GENERAL MOTORS COMPANY

1. Attach the antenna cable (2) to the headlining trim panel using the glue.
2. Install Headlining Trim Panel (1). Refer to **Headlining Trim Panel Replacement**

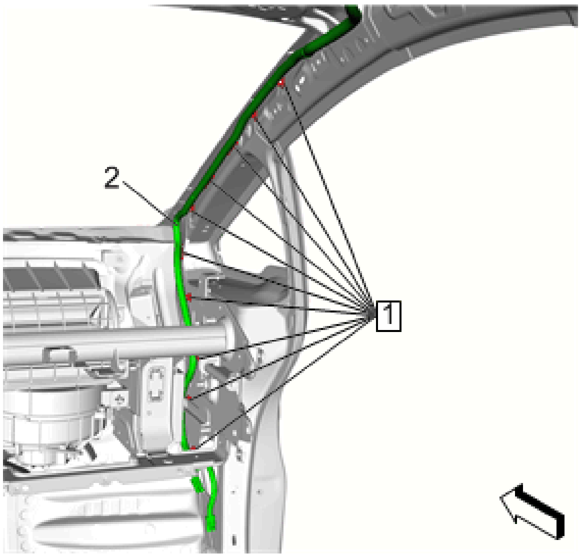


Fig. 42: Roof Accessory Radio Antenna Cable And Retaining Clips
Courtesy of GENERAL MOTORS COMPANY

3. Install the roof accessory radio antenna cable (2).
4. Attach the cable retaining clips (1) to the vehicle.

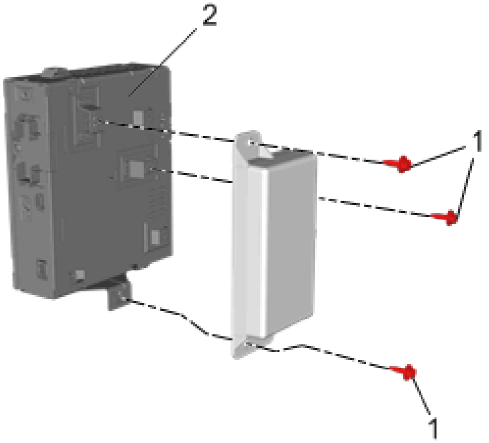
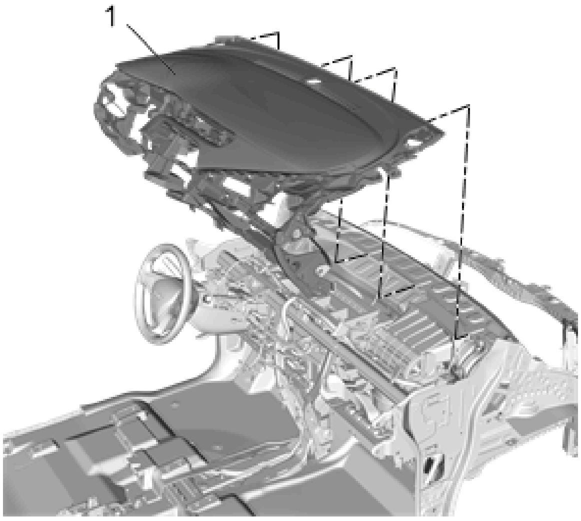


Fig. 43: Radio Assembly And Bolts
Courtesy of GENERAL MOTORS COMPANY

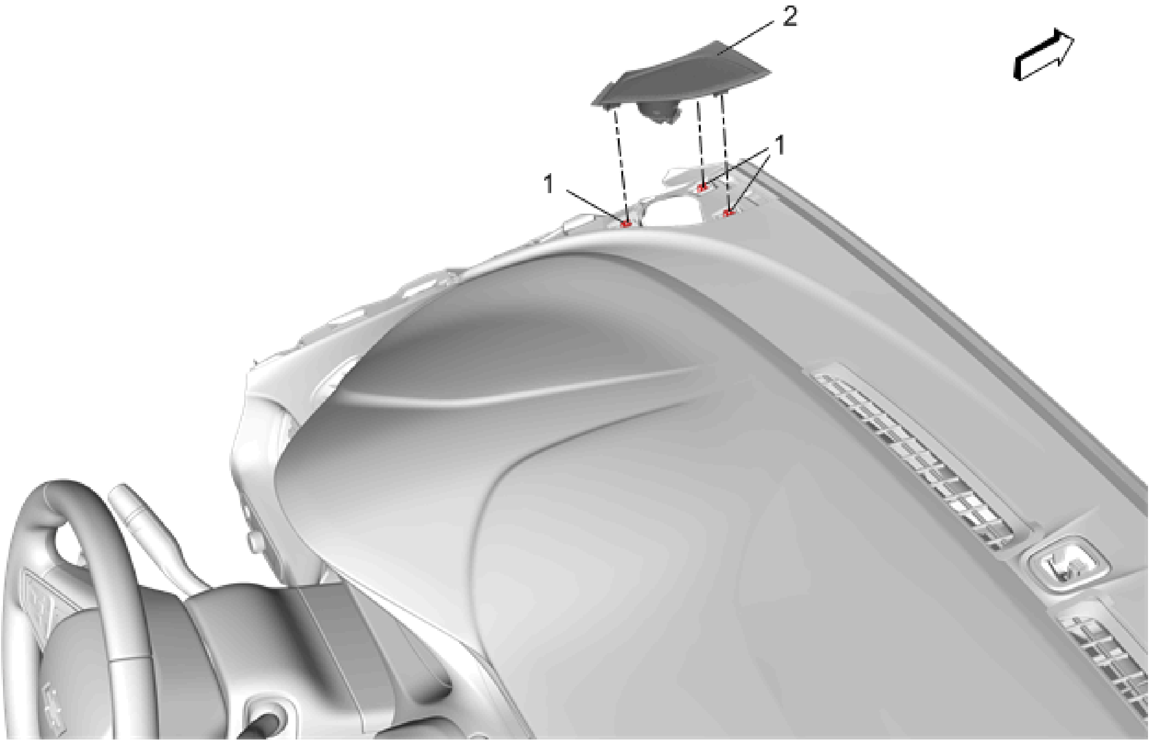
5. Install Radio (2). Refer to **Radio Replacement**



[Fig. 44: Instrument Panel Assembly](#)
Courtesy of GENERAL MOTORS COMPANY

6. Install Instrument Panel Assembly (1). Refer to [Instrument Panel Assembly Replacement](#)

RADIO FRONT SPEAKER GRILLE REPLACEMENT



[Fig. 45: Radio Front Speaker Grille](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Windshield Garnish Molding. Refer to [Windshield Garnish Molding Replacement](#)	
1	Radio Front Speaker Grille Clip (Qty: 3)
2	Radio Front Speaker Grille **Procedure** 1. Use a flat bladed plastic tool to remove. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

RADIO WINDSHIELD SIDE GARNISH MOLDING SPEAKER REPLACEMENT

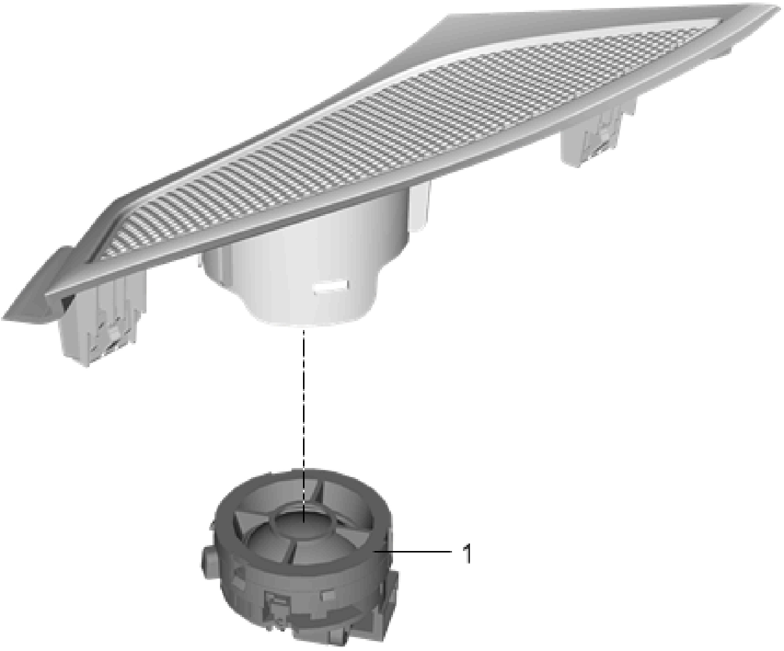


Fig. 46: Radio Windshield Side Garnish Molding Speaker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Radio Front Speaker Grille. Refer to **Radio Front Speaker Grille Replacement**	
1	Radio Windshield Side Garnish Molding Speaker **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the retaining tabs.

HIGH FREQUENCY ANTENNA REPLACEMENT

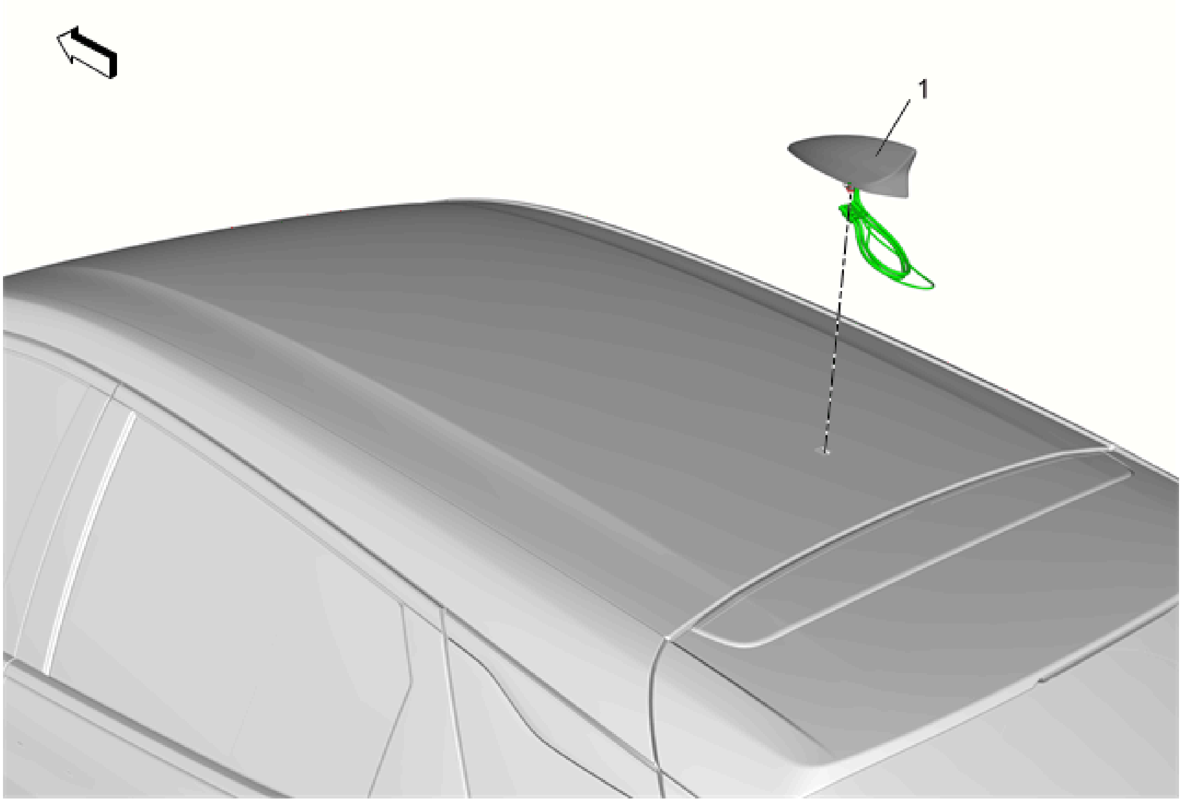


Fig. 47: High Frequency Antenna
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Lower the headlining trim panel. Refer to Headlining Trim Panel Replacement **NOTE:** **Only perform those steps that will lower the headlining trim panel enough to gain access to the part.**	
1	High Frequency Antenna **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Remove the bolt. 2. Disconnect the electrical connectors. 3. Disconnect the antenna cables. 4. Release the retaining features and feed the wiring and cable up through the hole in the roof panel. 5. Ensure that the antenna is straight while tightening. **Tighten** 9 N.m (80 lb in)

RADIO FRONT SIDE DOOR SPEAKER REPLACEMENT

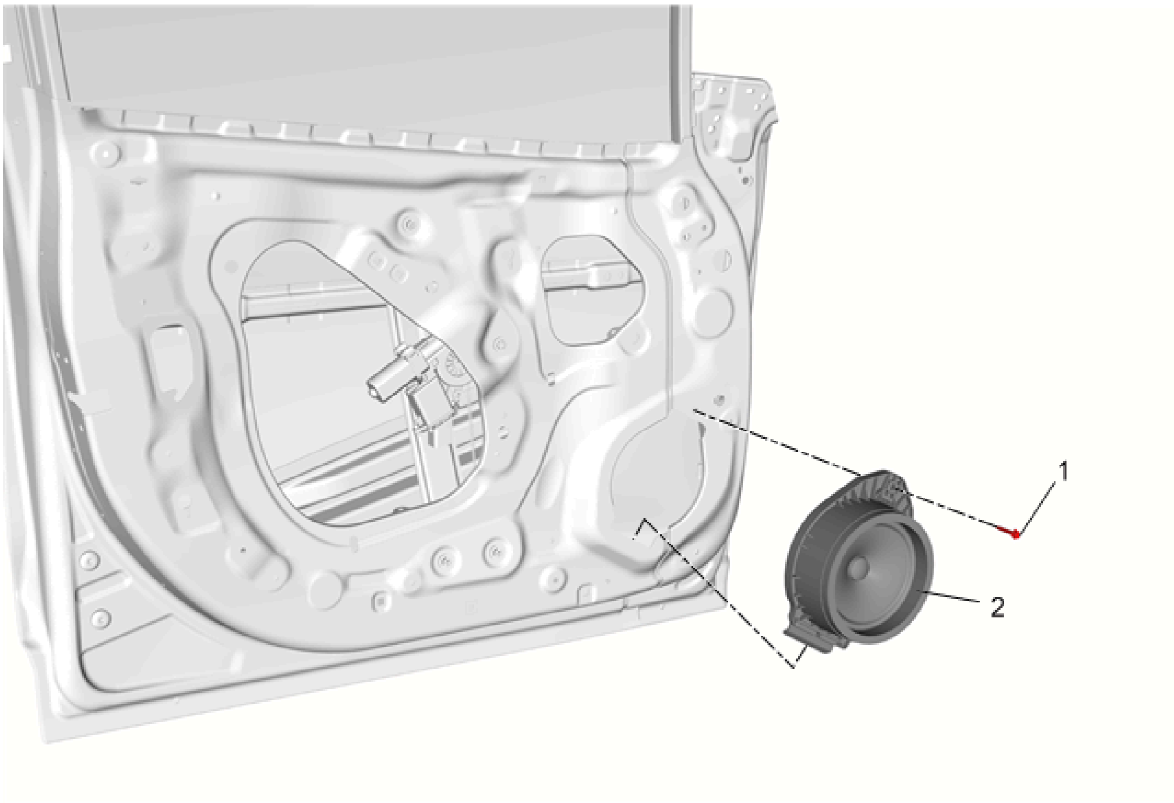


Fig. 48: Radio Front Side Door Speaker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Side Door Trim. Refer to Front Side Door Trim Replacement	

Callout	Component Name
1	Radio Front Side Door Speaker Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Radio Front Side Door Speaker **Procedure** 1. Disconnect the electrical connector. 2. Unclip and reposition the wiring harness.

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (LEFT SIDE LOWER)

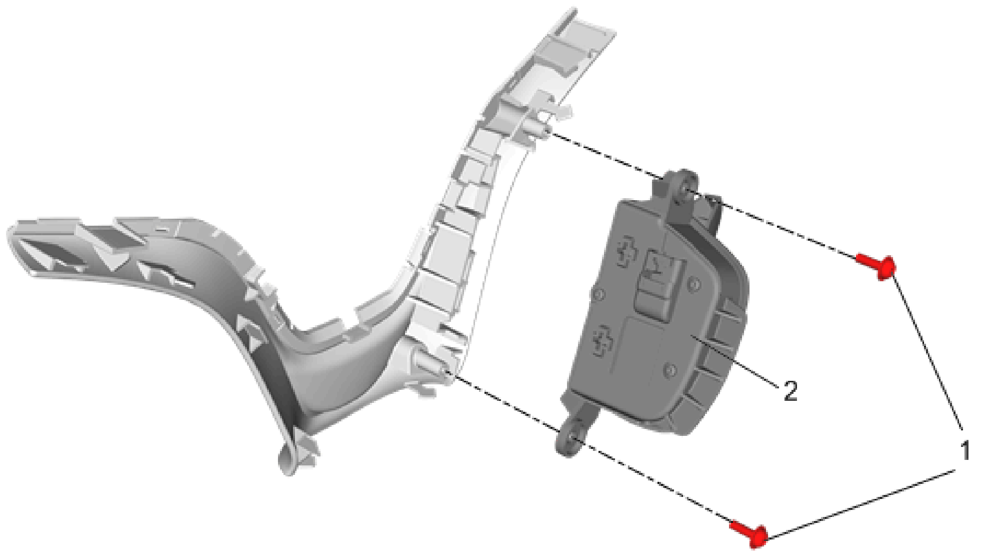


Fig. 49: Radio Control Switch - Steering Wheel (Left Side Lower)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement 2. Remove Steering Wheel Spoke Lower Cover. Refer to Steering Wheel Spoke Lower Cover Replacement	
1	Radio Control Switch Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 1.5 N.m (13 lb in)
2	Radio Control Switch

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (LEFT SIDE REAR)

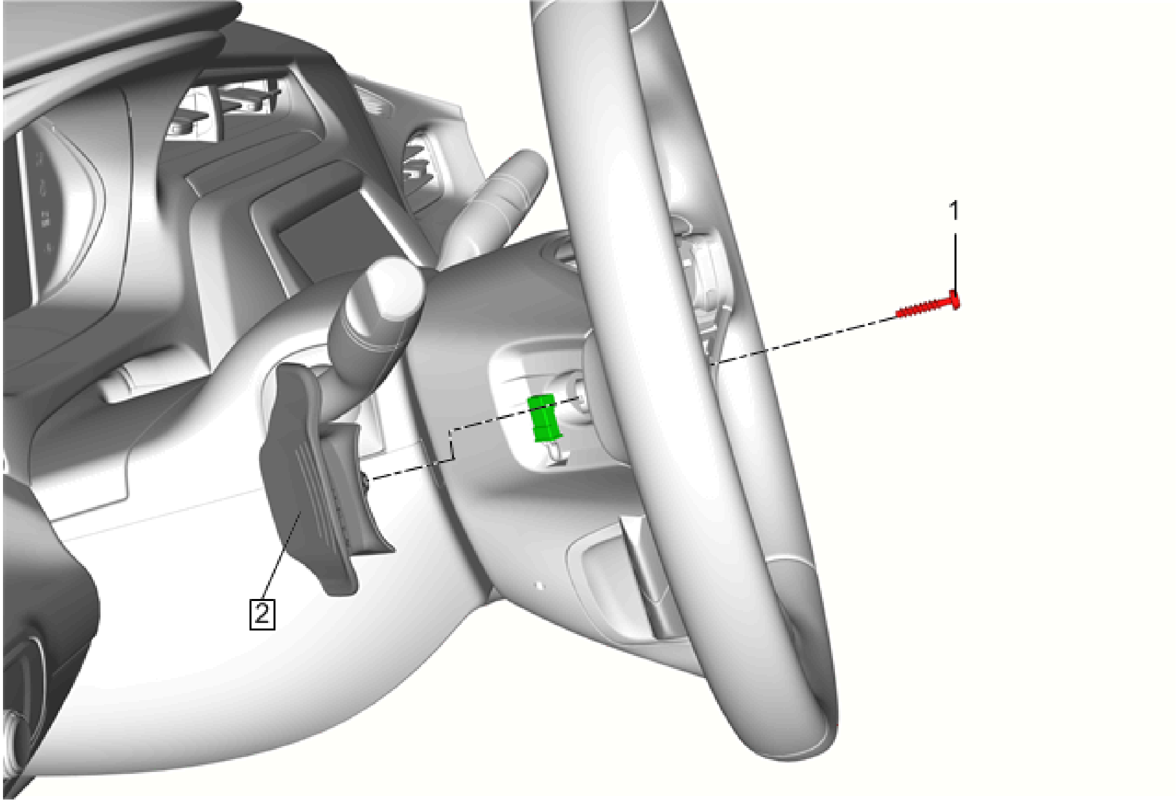


Fig. 50: Radio Control Switch - Steering Wheel (Left Side Rear)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement	
1	Radio Control Switch Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Radio Control Switch **Procedure** Disconnect the electrical connector.

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (RIGHT SIDE FRONT)

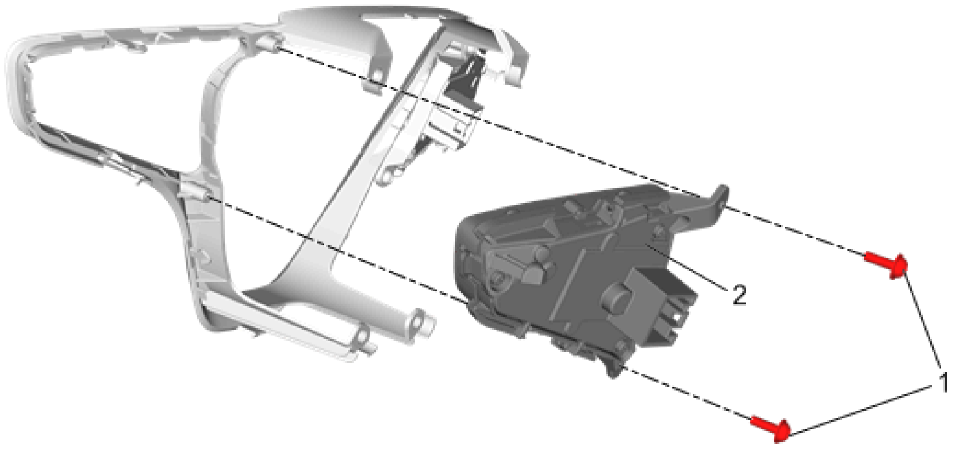


Fig. 51: Radio Control Switch - Steering Wheel (Right Side Front)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement	
1	Radio Control Switch Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 1.5 N.m (13 lb in)
2	Radio Control Switch **Procedure** Remove the radio control switch from the steering wheel spoke cover.

RADIO CONTROL SWITCH REPLACEMENT - STEERING WHEEL (RIGHT SIDE REAR)

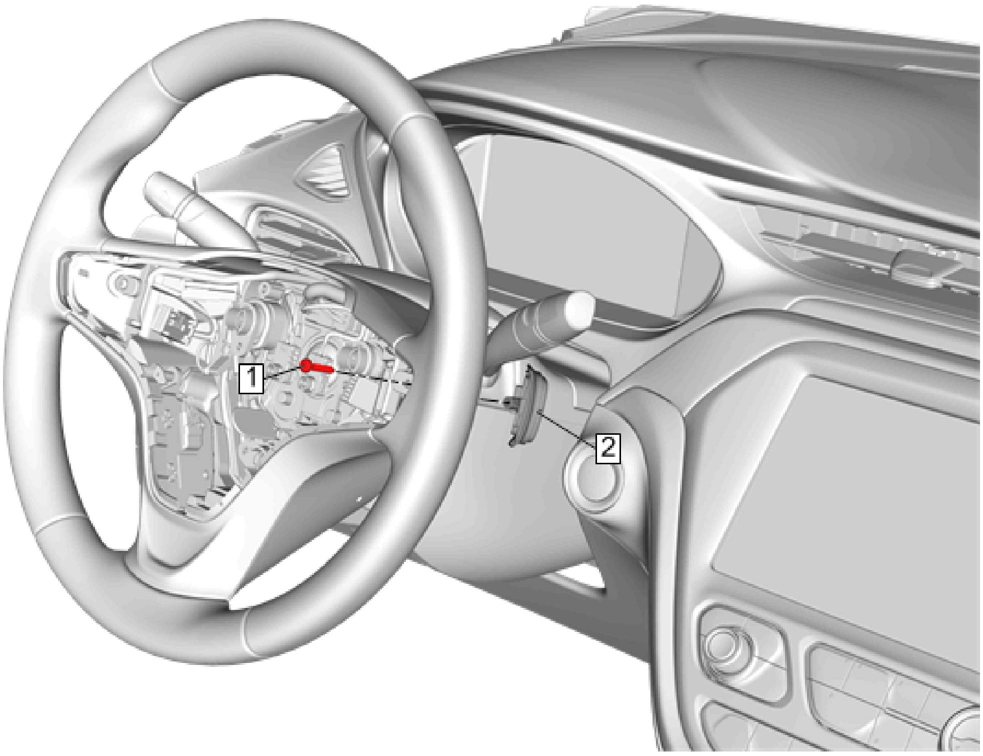


Fig. 52: Radio Control Switch - Steering Wheel (Right Side Rear)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Steering Wheel Spoke Cover. Refer to Steering Wheel Spoke Cover Replacement	
1	Radio Control Switch Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Radio Control Switch **Procedure** Disconnect the electrical connector.

RADIO REAR SIDE DOOR SPEAKER REPLACEMENT

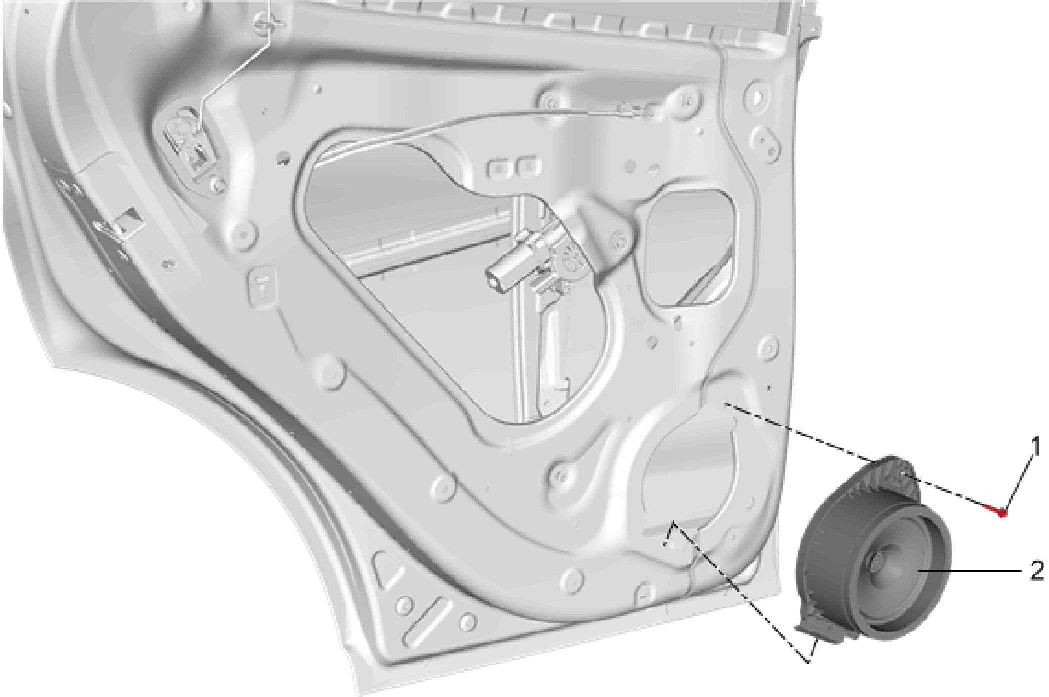


Fig. 53: Radio Rear Side Door Speaker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Side Door Trim. Refer to Rear Side Door Trim Replacement	
1	Radio Rear Side Door Speaker Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Radio Rear Side Door Speaker **Procedure** Disconnect the electrical connector.

RADIO REAR COMPARTMENT SPEAKER REPLACEMENT

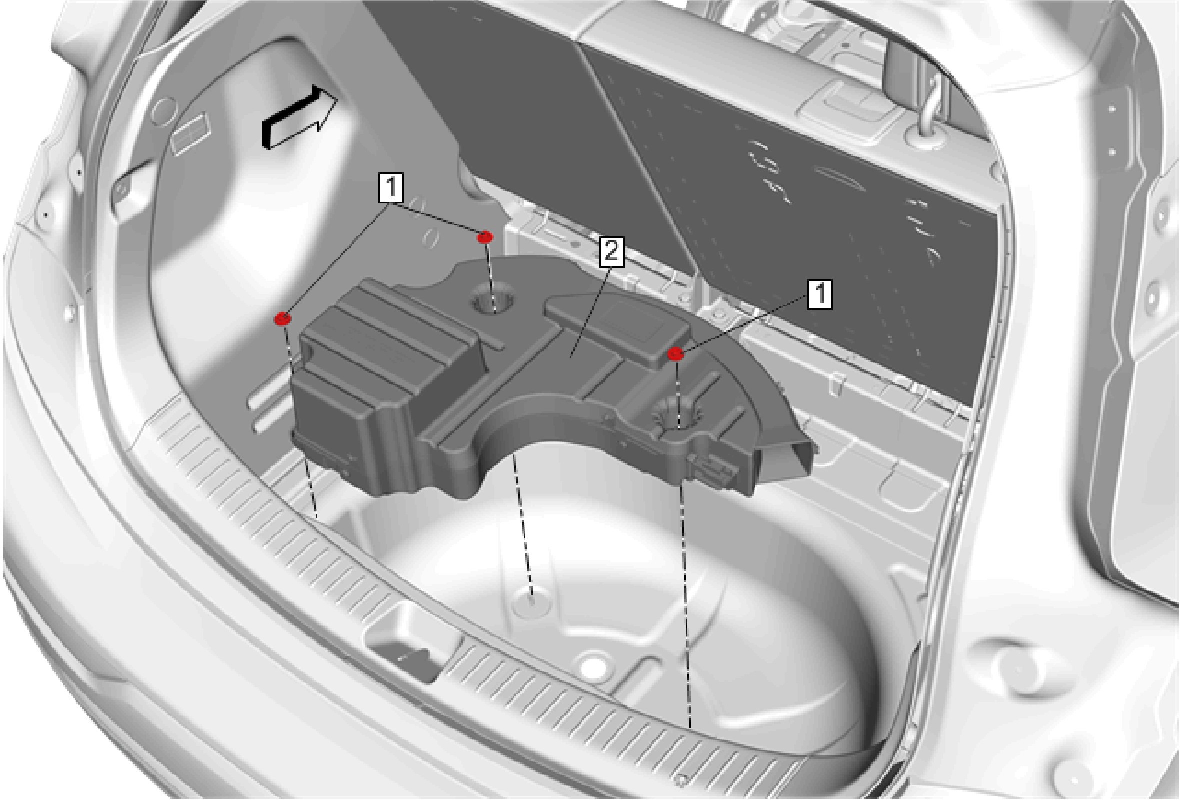


Fig. 54: Radio Rear Compartment Speaker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Load Floor Trim Panel. Refer to Load Floor Trim Panel Replacement	
1	Radio Rear Compartment Speaker Fastener (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 6 N.m (53 lb in)
2	Radio Rear Compartment Speaker **Procedure** 1. Unclip the wiring harness. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

INSTRUMENT PANEL CENTER ACCESSORY FUNCTION SWITCH REPLACEMENT

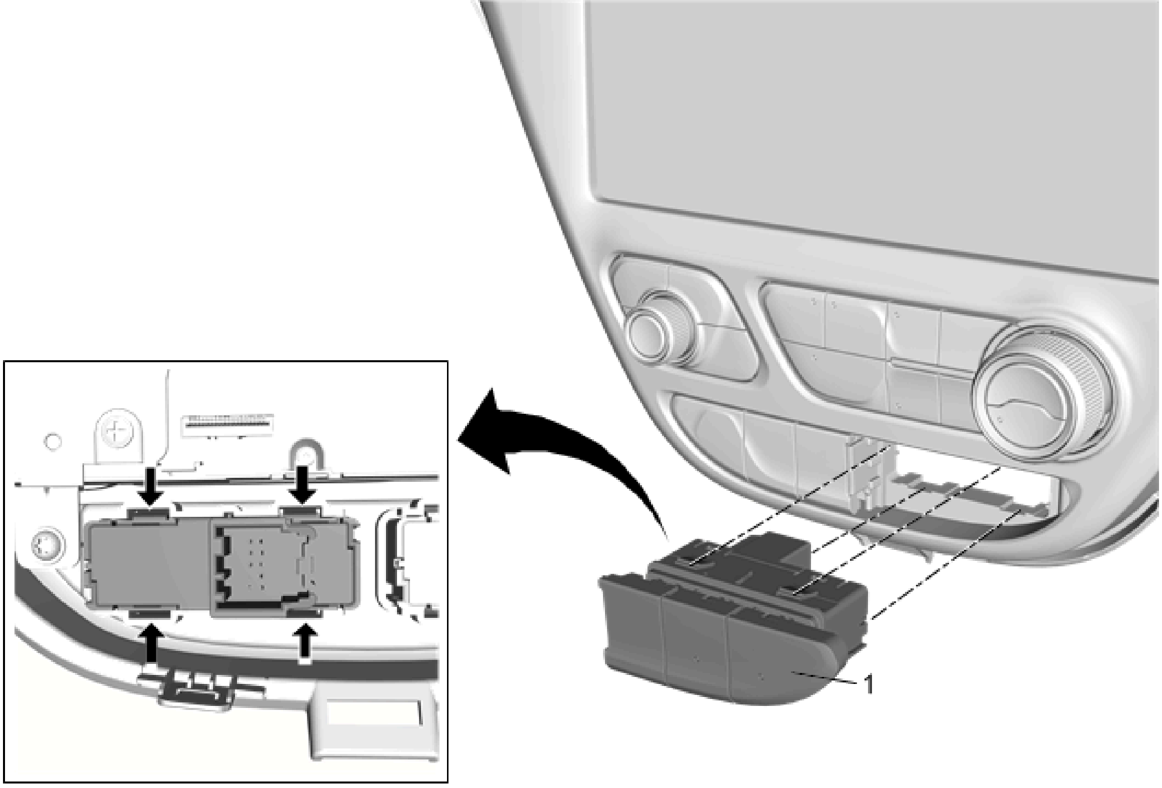


Fig. 55: Instrument Panel Center Accessory Function Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Instrument Panel Trim Plate. Refer to **Instrument Panel Trim Plate Replacement**	
1	Instrument Panel Center Accessory Function Switch **Procedure** Release the tabs and remove the switch.

DESCRIPTION AND OPERATION

ONSTAR DESCRIPTION AND OPERATION (UE3)

This OnStarÃ‚Â® system consists of the following components:

- Telematics communication interface control module
- OnStarÃ‚Â® three button assembly
- Microphone
- Cellular antenna
- Navigation antenna
- Back up battery (If equipped)

This system also interfaces with the factory installed vehicle audio system.

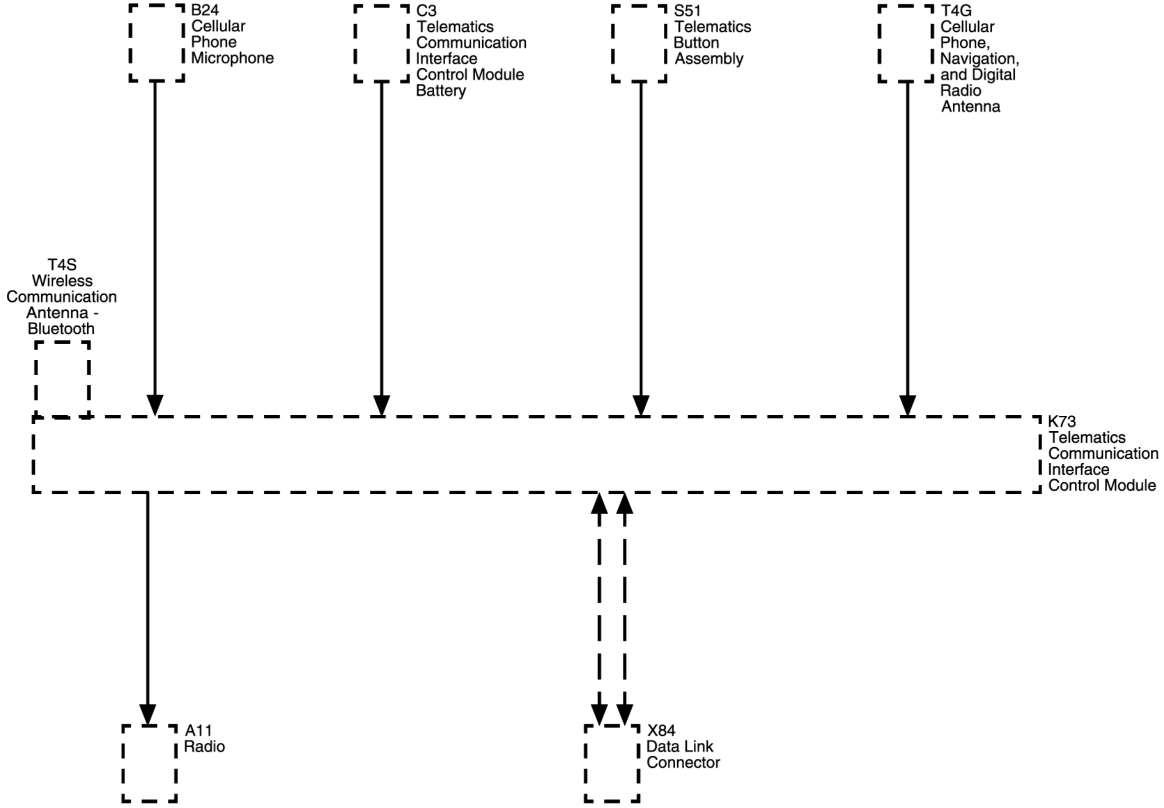

B24
Cellular
Phone
Microphone
C3
Telematics
Communication
Interface
Control Module
Battery
S51
Telematics
Button
Assembly
T4G
Cellular
Phone,
Navigation,
and Digital
Radio
Antenna
T4S
Wireless
Communication
Antenna -
Bluetooth
K73
Telematics
Communication
Interface
Control Module
A11
Radio
X84
Data Link
Connector

Fig. 56: OnStar System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
B24	B24 Cellular Phone Microphone
C3	C3 Telematics Communication Interface Control Module Battery
S51	S51 Telematics Button Assembly
T4G	T4G Cellular Phone, Navigation, and Digital Radio Antenna
T4S	T4S Wireless Communication Antenna - Bluetooth
K73	K73 Telematics Communication Interface Control Module
A11	A11 Radio
X84	X84 Data Link Connector

Telematics Communication Interface Control Module

The telematics communication interface control module is a cellular device that allows the user to communicate data and voice signals over the national cellular network. Power is provided by a dedicated, fused B+ circuit. Ground is provided through the vehicle wiring harness attached to the module. The ignition state is determined by the telematics communication interface control module through serial data messaging.

Dedicated circuits are used to connect the telematics communication interface control module to a microphone, the button assembly, and to command the status LED. The telematics communication interface control module communicates with the rest of the vehicle over the serial data bus.

The module houses 2 technology systems, one to process GPS data, and another for cellular information. The cellular system connects the OnStarÃ,Â® system to the cellular carrier's communication system by interacting with the national cellular infrastructure. The module sends and receives all cellular communications over the cellular antenna and cellular antenna coax. GPS satellites orbiting earth are constantly transmitting signals of their current location. The OnStarÃ,Â® system uses the GPS signals to provide location on demand.

The module also has the capability of activating the horn, initiating door lock/unlock, or activating the exterior lamps using the serial data circuits. These functions can be commanded by the OnStarÃ,Â® Call Center per a customer request.

OnStarÃ,Â® Three Button Assembly

The OnStarÃ,Â® button assembly may be part of the rearview mirror, or a separate, stand alone unit. The button assembly is comprised of 3 buttons and a status LED. The buttons are defined as follows:

- The answer/end call button, which is black with a white phone icon, allows the user to answer and end calls or initiate speech recognition.
- The blue OnStarÃ,Â® call center button, which displays the OnStarÃ,Â® logo, allows the user to connect to the OnStarÃ,Â® call center.
- The emergency button, which displays a white cross with a red background, sends a high priority emergency call to the OnStarÃ,Â® call center when pressed.

The telematics communication interface control module supplies 10 volts to the OnStarÃ,Â® button assembly on the keypad supply voltage circuit. When pressed, each button completes a circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module on the keypad signal circuit. Depending upon the voltage range returned the telematics communication interface control module is able to identify which button has been pressed.

The OnStarÃ,Â® status LED is located with the button assembly. The LED is green when the system is ON and operating normally. When the status LED is green and flashing, it is an indication that a call is in progress. When the LED is red, this indicates a system malfunction is present. In the event there is a system malfunction and the OnStarÃ,Â® system is still able to make a call, the LED will flash red during the call.

If the LED does not illuminate, this may indicate that the customers OnStarÃ,Â® subscription is not active or has expired. Push the blue OnStar button to connect to an advisor who can then verify the account status.

Each LED is controlled by the telematics communication interface control module over dedicated LED signal circuits. Ground for the LED is provided by the wiring harness attached to the button assembly.

Secondary OnStarÃ,Â® Controls

Some vehicles may have an additional button that when pushed can engage the OnStarÃ,Â® system. The button may be a symbol of a face with sound waves, or may say MUTE, or be a symbol of a radio speaker with a slash through it.

By engaging the OnStarÃ,Â® system with this feature, the user can interact with the system by use of voice commands. A complete list of these commands is supplied in the information provided to the customer. If the information is not available for reference, at any command prompt the user can say "HELP" and the telematics communication interface control module will return an audible list of available commands.

OnStarÃ,Â® Microphone

The OnStarÃ,Â®, or cellular microphone, can be a part of the rearview mirror assembly, or on some vehicle lines, a separate, stand alone unit. In either case, the telematics communication interface control module supplies approximately 10 volts to the microphone on the cellular microphone signal circuit, and voice data from the user is sent back to the telematics communication interface control module over the same circuit. A cellular microphone low reference circuit or a drain wire provides a ground for the microphone.

Cellular and GPS Antennas

This vehicle will be equipped with one of the following types of antennas:

- A combination cellular and navigation antenna, which brings the functions of both into a single part
- A cellular, GPS, and digital radio receiver antenna, which also incorporates the functionality of the digital radio receiver satellite antenna (XM).
- A cellular, GPS, and digital radio receiver antenna, which also incorporates the AM/FM antenna.

The cellular antenna is the component that allows the OnStarÃ,Â® system to send and receive data over airwaves by means of cellular technology. The antenna is connected at the base to a coax cable that plugs directly into the telematics communication interface control module.

The GPS antenna is used to collect the signals of the orbiting GPS satellites. Within the antenna is housed a low noise amplifier that allows for a more broad and precise reception of this data. The antenna is connected at the base to a coax cable that plugs directly into the telematics communication interface control module. The cable also provides a path for DC current for powering the antenna.

The OnStarÃ,Â® Call Center also has the capability of communicating with the vehicle during an OnStarÃ,Â® call to retrieve the latest GPS location and transmit it to the OnStarÃ,Â® Call Center. A history location of the last recorded position of the vehicle is stored in the module and marked as aged, for as long as the module power is not removed. Actual GPS location may take up to 10 minutes to register in the event of a loss of power.

OnStarÃ‚Â® RemoteLink

OnStarÃ‚Â® RemoteLink is a mobile app to link mobile devices to a vehicle for limited diagnostics and feature controls. After downloading the app and registering the device, vehicle owners with an eligible vehicle can use their mobile devices to access real-time data from their vehicle and perform specific commands remotely.

All communication between the app and the vehicle is powered by OnStar'sÃ‚Â® advanced connected vehicle technology. An active OnStarÃ‚Â® account as well as a valid OnStarÃ‚Â® username and password are required to use the app. The remote commands must be enabled by logging into the user's OnStarÃ‚Â® account prior to using the app.

Vehicle Control Features

- Lock/Unlock doors
- Start vehicle remotely
- Activate your Horn & Lights
- Contact an OnStar Advisor, Roadside Assistance or your Preferred Dealer

Available Vehicle Data:

- Real-time fuel information, including fuel range, fuel remaining, and lifetime MPG
- Lifetime mileage
- Remaining oil life
- Current tire pressure information
- OnStarÃ‚Â® account information

Compass Heading

The telematics communication interface module has a compass feature to calculate vehicle direction which is displayed via the instrument panel cluster or designated display. The compass heading is determined by dead reckoning until the GPS 3d fix is established. The dead reckoning is accomplished by using the yaw rate sensors and wheel ticks to determine heading changes from a GPS known heading. The GPS 3d fix heading is determined by the deferential of two locations.

Back-up Battery (If Equipped)

IMPORTANT:	Do not disconnect the main vehicle battery or remove the OnStarÃ‚Â® fuse with the ignition key in any position other than OFF. Disconnecting power to the OnStarÃ‚Â® module in any way while the ignition is ON or with retained accessory power activated may cause activation of the OnStarÃ‚Â® Back-Up Battery. This action is per design as the back-up battery is designed to provide power to the telematics communication interface control module so an emergency notification call can be made after an event where the main battery is disabled. Once the Back-Up Battery is activated it will stay on until the power is restored back to the telematics communication interface control module. The telematics communication interface control module naturally chooses the main supply voltage as it's default supply, but if the main supply is removed or lost for any reason the OnStarÃ‚Â® module will use the Back-Up Battery as a power supply as long as the default supply can not be detected. The back-up battery is not rechargeable and once discharged below 9.5 volts the back-up battery must be replaced.

Certain OnStarÃ‚Â® equipped vehicles may also be equipped with a back-up battery. The back-up battery is a non-rechargeable, lithium battery intended to provide an auxiliary power source for the telematics communication interface control module in the event where power from the main vehicle battery is lost.

The back-up battery is intended to have a limited life span of approximately 4 years and is designed to maintain an open circuit voltage between 16 V and 9 V throughout this period. This allows the battery to power the basic functions of the telematics communication interface control module for least one 200 second (5 minute) call at the end of the 4 year span, should the main vehicle battery be lost. In the case of a vehicle losing vehicle battery power, OnStar will switch over to the backup battery based on an internal algorithm. It will look for an air-bag deploy, or near-deploy, messages from the SDM. If there are no messages the OnStar module will stay wake for a few minutes longer and monitor the buttons in the mirror. If not pressed, the modules will power down and shut off completely.

The back-up battery is connected to the telematics communication interface control module through the back-up battery positive voltage circuit and back-up battery ground circuit and is protected from a short circuit by means of an internal fuse. In the event the back-up battery, battery positive voltage circuit is shorted to the back-up battery ground circuit or chassis ground, the fuse will open and render the back-up battery permanently inoperable. The status of the back-up battery and its associated wiring is monitored by the telematics communication interface control module.

Audio System Interface

When the OnStarÃ,Â® requires audio output, a serial data message is sent to the audio system to mute all radio functions and transmit OnStarÃ,Â® originated audio. The OnStarÃ,Â® audio is transmitted to the vehicle audio system by a dedicated signal circuit and a low reference circuit.

The audio system will mute and an audible ring will be heard though the speakers if the vehicle receives a call with the radio ON.

On some vehicles, the HVAC blower speed may be reduced when the OnStarÃ,Â® system is active to aid in reducing interior noise. When the system is no longer active, the blower speed will return to its previous setting.

OnStarÃ,Â® Sleep Cycle

The OnStarÃ,Â® system uses a unique sleep cycle to allow the system to receive cellular calls while the ignition is in the OFF position and retained accessory power mode has ended. This cycle enables the telematics communication interface control module to perform remote functions, such as door unlock, as commanded over the air by the OnStarÃ,Â® Call Center, and to continue to maintain an acceptable level of battery electrical drain.

The OnStarÃ,Â® system uses 4 states of readiness, depending upon the type of cellular market the vehicle is in when the ignition is put into the OFF state:

- High power
- Low power
- Sleep
- Digital standby

The high power state is in effect whenever the ignition is in the ON or RUN position, or retained accessory power is enabled, and the OnStarÃ,Â® system is sending or receiving calls or when the system is performing a remote function.

The low power state is in effect when the OnStarÃ,Â® system is idle with the ignition in the ON or RUN position, or with retained accessory power enabled.

The sleep state is entered after the vehicle has been shut off and the retained accessory power has timed out while in an analog cellular area. At a predetermined time recorded within the telematics communication interface control module, the system re-enters the low power state to listen for a call from the OnStarÃ,Â® Call Center for 1 minute. After this interval, the system will again return to the sleep state for 9 minutes. If a call is sent during the 1 minute interval, the OnStarÃ,Â® system will receive the call and immediately go into the high power mode to perform any requested functions. If no call is received during the 1 minute interval, the system will go back into the sleep mode for another 9 minutes. This process will continue for up to 48 hours, after which the OnStarÃ,Â® system will turn off until the ignition is turned to the ON or RUN position.

The digital standby power state is entered after the vehicle has been shut off and the retained accessory power has timed out while in a digital cellular area. When in digital standby mode, the OnStarÃ,Â® module is able to perform all remote functions as commanded by an OnStarÃ,Â® advisor at any time, for a continuous 120 hours. After 120 hours, the OnStarÃ,Â® module will go into sleep mode until a wake up signal from the vehicle is seen by the telematics communication interface control module. If the OnStar module loses the digital cellular signal it will revert to analog mode and follow the standard sleep state (9 minutes OFF, 1 minute standby) based on the time of the GPS signals, this will continue until a digital cellular signal is again received.

If the OnStarÃ,Â® system loses battery power while the system is in a standby or sleep mode, the system will remain OFF until battery power is restored and the ignition is turned to the ON or RUN position.

Features

OnStarÃ,Â® Personal Calling

The hands free, OnStarÃ,Â® personal calling cellular phone feature is an additional feature of the OnStarÃ,Â® system. This feature is embedded within the telematics communication interface control module; however it must be activated by an OnStarÃ,Â® advisor. OnStarÃ,Â® personal calling operates similar to most hand held cellular phones in that the availability for its usage is based on minutes or units. The customer must have a current OnStarÃ,Â® subscription, as this feature cannot be utilized without it. To use OnStarÃ,Â® personal calling, the customer must also purchase units (minutes) as outlined in the owners guide provided with the OnStarÃ,Â® system. Units begin to deplete, 1 unit is equal to 1 minute, as the customer makes outbound phone calls, answers inbound phone calls, or while connected to the OnStarÃ,Â® virtual advisor. In addition, units may also have an expiration date, depending upon the type of units purchased.

Customers have the ability to store telephone numbers within the module, referenced by a nametag for the convenience of frequently dialed numbers. After storing a nametag, the user can dial this number by initiating the OnStarÃ,Â® personal calling feature, speaking the word "call," and repeating the nametag assigned.

Turn by Turn Navigation

Turn by Turn Navigation allows the driver to contact OnStarÃ,Â® to obtain directions for driving from a current location to a desired location. The Turn by Turn Navigation system stores your planned route and continually checks your position along that route, when you deviate from the planned route, the system will recognize this and prompt the driver with verbal prompts for how to proceed. The driver then responds verbally to direct the system to continue the current routing or to recalculate the route because of a missed turn.

Advisor Record Feature

The Advisor Record Feature allows the user to store any information given during a call with an OnStarÃ,Â® Advisor. Recording is activated by pressing the blue OnStar button during a call; pressing the button a second time stops the recording. The stored information can be played back by pressing the phone button on the three button assembly and using the voice command "Advisor Playback".

Deactivated OnStarÃ,Â® Accounts

In the event a customer has not renewed their OnStarÃ,Â® account after expiration or the account was never activated, OnStarÃ,Â® will make a discrete cellular call to the vehicle to deactivate the OnStarÃ,Â® system. Before taking this action, customers are notified that the OnStarÃ,Â® system in their vehicle will be deactivated unless they elect to renew the account. After the OnStarÃ,Â® account has been deactivated, customers will experience the following:

- The OnStarÃ,Â® status LED will not illuminate.
- The OnStarÃ,Â® system will NOT attempt to connect to the OnStarÃ,Â® Call Center in the event of a collision or if the vehicle's front air bags deploy for any other reason.
- An emergency button press will play a demo message indicating the service has been deactivated.
- An OnStarÃ,Â® Call Center button press will connect the customer with a dedicated sales team who can sell an OnStarÃ,Â® subscription and reactivate the vehicle. Depending on the type of OnStarÃ,Â® hardware in the vehicle, the customer may first hear a demonstration message stating there is no current OnStarÃ,Â® subscription for the vehicle, and directing the customer what to do to activate services.
- OnStarÃ,Â® personal calling will not be available, as this feature requires the customer to have a current OnStarÃ,Â® account. Attempts to use this feature may result in cellular connection failure messages and the inability to connect to the number dialed.

Certain vehicles that have never had an active OnStarÃ,Â® account, or that have been deactivated, may be unable to establish a connection with the OnStarÃ,Â® Call Center. When normal published diagnostic procedures do not indicate a possible cause for the no connect concern, the vehicle may have been deactivated. For deactivated vehicles, a no connect response should be considered normal operation. Further diagnosis and subsequent repair is only necessary should the customer elect to become an active OnStarÃ,Â® subscriber or renew the account subscription.

OnStarÃ,Â® Cellular, GPS, and Diagnostic Limitations

The proper operation of the OnStarÃ,Â® System is dependent on several elements outside the components integrated into the vehicle. These include the National Cellular Network Infrastructure, the cellular telephone carriers within the network, and the GPS.

The cellular operation of the OnStarÃ,Â® system may be inhibited by factors such as the users range from an analog or digital cellular tower, the state of the cellular carrier's equipment, and the location where the call is placed.

Making an OnStarÃ‚Â® key press in areas that lack sufficient cellular coverage or have a temporary equipment failure will result in either the inability of a call to complete with a data transfer or the complete inability to connect to the OnStarÃ‚Â® Call Center. The OnStarÃ‚Â® system may also experience connection issues if the identification numbers for the module, station identification number, electronic serial number or manufacturers electronic ID, are not recognized by the cellular carriers local signal receiving towers.

The satellites that orbit earth providing the OnStar system with GPS data have almost no failures associated with them. In the event of a no GPS concern, the failure will likely lie with the inability of the system to gain GPS signals because of its location, i.e. in a parking structure, hardware failure, or being mistaken with an OnStarÃ‚Â® call which has reached the Call Center without vehicle data.

During diagnostic testing of the OnStarÃ‚Â® system, the technician should ensure the vehicle is located in an area that has a clear unobstructed view of the open sky, and preferably, an area where analog or digital cellular calls have been successfully placed. These areas can be found by successfully making an OnStarÃ‚Â® keypress in a known good OnStarÃ‚Â® equipped vehicle and confirming success with the OnStarÃ‚Â® Call Center advisor. Such places can be used as a permanent reference for future OnStarÃ‚Â® testing.

Mobile Identification Number and Mobile Directory Number

The telematics communication interface control module utilizes 2 numbers for cellular device identification, call routing and connection, a mobile identification number and a mobile directory number. The mobile identification number represents the number used by the cellular carrier for call routing purposes while the mobile directory number represents the number dialed to reach the cellular device.

Operation of the OnStarÃ‚Â® Speech Recognition Systems

OnStarÃ‚Â® users communicate with 2 speech recognition systems. Speech recognition allows the user to speak to one computer in the vehicle, and one reached over a phone line. The computer tries to understand the users command, and responds by speaking back, or by taking the appropriate action, e.g. dialing the phone.

- Personal Calling uses a speech recognition system that resides in the vehicle. When the user presses the phone button, the system states, Ready, and listens for the user's command. The user can speak commands to control the hands-free phone.
- Virtual advisor is a remote speech recognition system that the caller can access by making a phone call. The user connects to virtual advisor by requesting it during personal calling use. The user is then transferred to the virtual advisor server and talks to it via a cellular connection.

The OnStarÃ‚Â® speech recognition systems use speech technology that is designed to understand a wide range of American English speakers. Although there is no one right way to speak English, the system will work best when users try to modify their pronunciation should they encounter difficulty. Users who do not obtain good results are advised to try the tips and workarounds found in this section.

General Tips for Better Speech Recognition

Concern	Tip for Better Result
Noise	Noise may confuse the speech recognition system. You usually get better performance from the system in quieter conditions: • The HVAC fan creates noise. Turn it down or OFF for better speech system performance. • Driving at high speeds creates louder road noise and wind noise. You may get better results at lower speeds. • An open window or an open sunroof allows more noise to enter the vehicle. Close all windows for better results. • Noisy rainstorms can also reduce performance. • If passengers are talking while you use the speech system, it may be confused by their speech. You will get better results if all occupants of the vehicle are quiet while the system is listening for commands.

Concern	Tip for Better Result
When to Speak	In Personal Calling, the system is only listening after it prompts you to speak with a beep. • When the system prompts you to speak, you have about 5 seconds to respond. If the system does not hear a response, it will prompt you again, or cancel the transaction. • If you begin to speak too soon, try pausing for a half second before speaking after the beep. • In the Virtual Advisor, the system is always listening for commands, even while it is speaking.
How to Speak	Speak forcefully, and clearly. • The noisier the environment, the louder you need to speak. If you are in the driver seat, speak facing the front of the car. If you are a passenger, speak facing the rearview mirror. • Speak calmly, and naturally. The system may sometimes fail your repeated attempts to give a command. If your speech is distorted by shouting or frustration, this may cause more errors. • People with high-pitched voices may have better results by speaking in a deeper, lower-pitched voice. However, do not lower the volume of the voice. • Avoid speaking with a rising intonation, like asking a question. Use a flat or falling intonation, like giving an answer.
What to Say	Personal Calling: One-word commands • The Personal Calling system listens for only one word at a time. There are some exceptions, 2-word phrases that are spoken and understood as a single word, e.g. "virtual advisor", "voice feedback", and "my number". You can enter phone numbers only one digit at a time, and the system repeats each digit as it hears it. • Say "Help" at the Ready prompt to hear the list of Personal Calling commands. • Virtual Advisor can understand sentences with more than one word. It also expects to hear a 4-digit number all at once when it asks for your PIN. • Say, "What are my choices?" to hear a list of commands that the Virtual Advisor understands.
Entering a phone number	• If you have trouble getting numbers correctly into the system, store your frequently-called number in the directory, so the system will remember them. After you have stored a number with a nametag, then you simply say "call" and the nametag in order to call the number. • If the system cannot understand your numbers, ask another person to help you enter your frequently-called numbers. This person can speak the numbers, then you can speak the nametag.
Storing or dialing a number	When you have finished speaking your phone number, you do not need to say "store" or "dial" to indicate that you are done. If you pause and say nothing, the system will ask you if you want to store or dial. Say "yes".

Concern	Tip for Better Result
Creating nametags	• Short nametags that are similar may be easily confused by the system. You may get better recognition of your nametags if you make them longer, for example "George Washington" without pause, instead of "George" only. • If you want to use nametags while driving, it is best to store the nametag with some vehicle noise in the background. If you are in park while you are storing nametags, you can turn the fan on low or open windows in order to create some background noise.
Virtual Advisor 4-digit PIN	Say the 4 digits in a natural way, without pausing between digits.
Interrupting	• When the Virtual Advisor is speaking, you can interrupt it with another command. The first word in your command helps to get its attention. • If the Virtual Advisor has trouble understanding your commands when you interrupt, try speaking the first word loudly and clearly, then pause for an instant, then continue with the rest of the command. For example: "Get... my weather" or "Lookup... a quote for General Motors".

ONSTAR DESCRIPTION AND OPERATION (UE1)

This OnStarÃ,Â® system consists of the following components:

- Telematics communication interface control module
- OnStarÃ,Â® three button assembly
- Microphone
- Cellular antenna
- Navigation antenna
- BluetoothÃ,Â® antenna (If equipped)
- Back up battery (If equipped)
- WiFi Hotspot (If equipped)
- TTY (Teletypewriter)

This system also interfaces with the factory installed vehicle audio system.

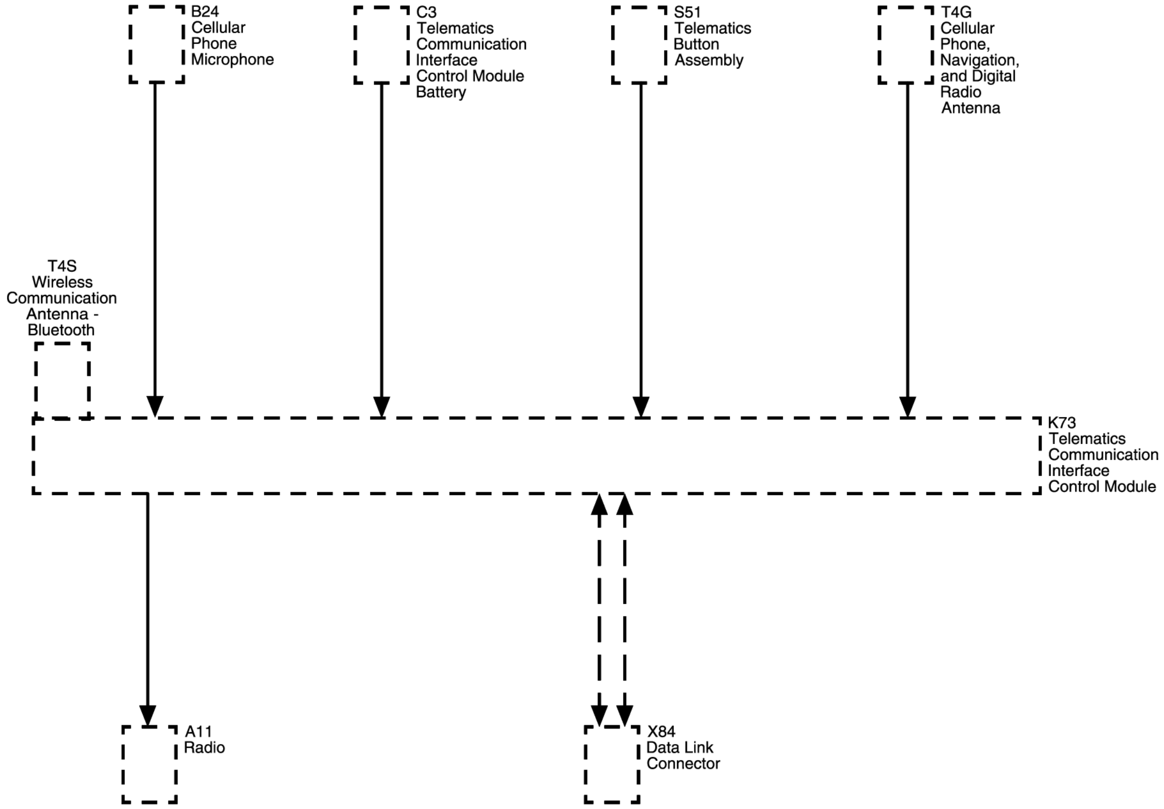

B24 Cellular Phone Microphone
C3 Telematics Communication Interface Control Module Battery
S51 Telematics Button Assembly
T4G Cellular Phone, Navigation, and Digital Radio Antenna
T4S Wireless Communication Antenna - Bluetooth
K73 Telematics Communication Interface Control Module
A11 Radio
X84 Data Link Connector

Fig. 57: OnStar System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
B24	B24 Cellular Phone Microphone
C3	C3 Telematics Communication Interface Control Module Battery
S51	S51 Telematics Button Assembly
T4G	T4G Cellular Phone, Navigation, and Digital Radio Antenna
T4S	T4S Wireless Communication Antenna - Bluetooth
K73	K73 Telematics Communication Interface Control Module
A11	A11 Radio
X84	X84 Data Link Connector

Telematics Communication Interface Control Module

The OnStar Generation 10 system uses Global System for Mobile Communication (GSM) to communicate data and voice signals over the national cellular network. The module may also have the ability to act as a Wireless Local Area Network (WLAN) Wi-Fi hotspot similar to a home wireless router. The module houses an internal WLAN antenna enabling hotspot connectivity and streaming high speed media to the entertainment system. The module also may enable Teletypewriter (TTY) and be capable of Bluetooth communication utilizing an internal antenna. The module is capable of up to 4G LTE speeds and houses 2 technology systems, one to process Global Positioning System (GPS) data, and another for cellular information. The module sends and receives all cellular communications over two cellular antennas and cellular antenna coax cables.

The OnStar Gen 10 system has two antenna inputs, a primary cellular signal and a combined GPS/secondary cellular signal. The OnStarÃ‚Â® system uses the United States Global Positioning System (GPS) signals to provide location on demand. GPS is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near Earth where there is an unobstructed line of sight to four or more GPS satellites.

The module also has the capability of activating certain features such as, the horn, remote starting, initiating door lock/unlock, or activating the exterior lamps using the serial data circuits. These functions can be commanded by the OnStarÃ‚Â® Call Center per a customer request or mobile device app depending on vehicle and customer subscription.

Dedicated circuits are used to connect the telematics communication interface control module to a microphone, the button assembly, radio, and if equipped the Back Up Battery (BUB). The telematics communication interface control module communicates with the rest of the vehicle over the serial data bus.

Power is provided by a dedicated, fused B+ circuit. Ground is provided through the vehicle wiring harness attached to the module. The power mode state is determined by the telematics communication interface control module through serial data messaging.

OnStarÃ‚Â® Three Button Assembly

- The OnStarÃ‚Â® button assembly may be part of the rearview mirror, or a separate, stand alone unit. The button assembly is comprised of 3 buttons or 3 capacitive touch buttons and status LED's or an error indicator. The buttons are defined as follows:
  - The answer/end button, which is black with a white phone icon or a white driver figure seated with voice signals near its face, allows the user to answer and end calls or initiate speech recognition.
  - The blue OnStarÃ‚Â® call center button, which displays the OnStarÃ‚Â® logo, allows the user to connect to the OnStarÃ‚Â® call center.
  - The emergency button, which displays white letters "SOS" with red background, sends a high priority emergency call to the OnStarÃ‚Â® call center when pressed.

If the LED does not illuminate, this may indicate that the customers OnStarÃ‚Â® subscription is not active or has expired. Push the blue OnStar button to connect to an advisor who can then verify the account status.

The telematics communication interface control module supplies 10 volts to the OnStarÃ‚Â® button assembly on the keypad supply voltage circuit. When pressed, each button completes a circuit across a resistor allowing a specific voltage to be returned to the telematics communication interface control module on the keypad signal circuit.

Depending upon the voltage range returned the telematics communication interface control module is able to identify which button has been pressed.

The OnStarÃ,Â® status LED or error indicator is located near the buttons. The LED is green when the system is ON and operating normally. When any indicator is illuminated and flashing, it is an indication that a call is in progress. When the LED is red, this indicates a system malfunction is present. In the event there is a system malfunction and the OnStarÃ,Â® system is still able to make a call, the LED will flash red during the call.

Each LED or error indicator is controlled by either the telematics communication interface control module over dedicated LED signal circuits or by low speed GM LAN serial data depending on the inside rearview mirror option. Ground for the LED is provided by the wiring harness attached to the button assembly.

Secondary OnStarÃ,Â® Controls

Some vehicles may have an additional button that when pushed can engage the OnStarÃ,Â® system. The button may be a symbol of a face with sound waves, or may say MUTE, or be a symbol of a radio speaker with a slash through it.

By engaging the OnStarÃ,Â® system with this feature, the user can interact with the system by use of voice commands. A complete list of these commands is supplied in the information provided to the customer. If the information is not available for reference, at any command prompt the user can say "HELP" and the telematics communication interface control module will return an audible list of available commands.

OnStarÃ,Â® Microphone

The cellular microphone can be part of the rearview mirror assembly, or a stand-alone unit in the headliner or roof console. In either case, the telematics communication interface control module supplies approximately 10V to the microphone on the cellular microphone signal circuit. The microphone modifies the 10V depending on the volume and voice being detected. A cellular microphone low reference circuit or a drain wire provides a ground for the microphone. The microphone signal circuits pass through the telematics communication interface control module to support entertainment voice recognition.

Cellular and GPS Antennas

The combination antenna will have any of the following antenna elements when equipped with OnStar:

- Primary cellular element
- Secondary cellular element
- GPS element
- Digital radio element
- AM/FM element

The Gen 10 OnStarÃ,Â® system uses 2 cellular antenna elements to send and receive cellular data, the primary cellular element and the secondary cellular element. The primary cellular signal is carried by a coax cable that connects the antenna directly to the telematics communication interface control module. Details of the secondary cellular signal are further described below.

The GPS antenna element is used to collect the signals of the orbiting GPS satellites. Within the antenna is housed a low noise amplifier that allows for a more broad and precise reception of this data. Also housed within the antenna is circuitry to combine the GPS signal and the secondary cellular signal. Without navigation, the combination GPS/secondary cellular signal is carried by a coax cable that connects directly to the telematics communication interface control module. The cable also provides a path for DC current for powering the antenna. With navigation, the combination GPS/secondary cellular signal is carried by a coax cable that connects to the navigation signal splitter. The splitter supplies the GPS signal to the navigation/entertainment system and the GPS/cellular signal to the telematics communication interface control module.

The digital radio element collects digital radio signals from two satellites and where necessary terrestrial repeaters. The digital radio signal is carried by a coax cable and connected to the digital radio receiver. Refer to Radio/Audio System Description and Operation for further details.

The radio signal is sent from a broadcast station and is then received by the AM/FM radio antenna element. The AM/FM radio signal is carried by a coax cable and is connected to the radio. Refer to Radio/Audio System Description and Operation for further details.

OnStarÃ,Â® RemoteLink

OnStarÃ,Â® RemoteLink is a mobile app to link mobile devices to a vehicle for limited diagnostics and feature controls. After downloading the app and registering the device, vehicle owners with an eligible vehicle can use their mobile devices to access real-time data from their vehicle and perform specific commands remotely.

All communication between the app and the vehicle is powered by OnStar'sÃ,Â® advanced connected vehicle technology. An active OnStarÃ,Â® account as well as a valid OnStarÃ,Â® username and password are required to use the app. The remote commands must be enabled by logging into the user's OnStarÃ,Â® account prior to using the app. Refer to the owners manual for available vehicle data and control features.

Compass Heading

The telematics communication interface module has a compass feature to calculate vehicle direction which is displayed via the instrument panel cluster or designated display. The compass heading is determined by dead reckoning until the GPS 3d fix is established. The dead reckoning is accomplished by using the yaw rate sensors and wheel ticks to determine heading changes from a GPS known heading. The GPS 3d fix heading is determined by the deferential of two locations. If "CAL" is displayed on the Instrument Panel Cluster or designated display refer to the owners manual for steps to calibrate the compass.

BluetoothÃ,Â® (If Equipped)

BluetoothÃ,Â® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. Only vehicles with steering wheel controls will have BluetoothÃ,Â® functionality. In order to utilize the vehicle's BluetoothÃ,Â® system, a BluetoothÃ,Â® equipped cellular phone is required.

The BluetoothÃ,Â® antenna is internal to the telematics communication interface control module, radio or human machine interface module and is used to send and receive signals from a BluetoothÃ,Â® enabled cellular phone. The available features and functions are determined by the software within the device being used and the telematics communication interface control module. The operating range of the signal from the vehicle is approximately 30 feet. Note that the operating range is dependent upon the cellular phone being used and battery level of the phone.

With BluetoothÃ,Â® technology customers can experience hands-free calling as their BluetoothÃ,Â® capable cellular phones are wirelessly connected to the vehicle. It will allow customers to place and receive calls using the steering wheel controls and voice recognition. The vehicle audio system will allow you to listen to your call through the vehicle speakers and adjust volume through steering wheel or radio controls.

Not all BluetoothÃ,Â® cellular phones are guaranteed to work with the vehicle's BluetoothÃ,Â® system. Based on the cellular phone's service provider and the manufacturer's implementation of BluetoothÃ,Â®, not all phones support all available BluetoothÃ,Â® functionality. BluetoothÃ,Â® enabled cellular phones will be tested for vehicle compatibility and a feature compatibility list will be provided via the GM BluetoothÃ,Â® website: http://www.gm.com/vc/bluetooth/

BluetoothÃ,Â® Features Supported

The following is a list of features supported by the BluetoothÃ,Â® system. Note that not all devices will support all of the listed functions.

- Automatic reconnection - highest priority phone will automatically be connected to vehicle when vehicle ignition is on
- Hands-free dialing- via digits, redial, name tags (phone number saved to a nametag via voice recognition)
- Answering a call
- Ending a call
- Mute a Call
- Rejecting a call - ignore an incoming call
- Call Waiting
- Three-way Calling - initiated from hands-free system
- Send Number During a Call - this is used when calling a menu-driven phone system
- Transfer a Call - transfer call from vehicle to cellular phone and visa versa
- Voice Pass-Thru - allow access to the voice recognition commands on the cellular phone

Pairing a BluetoothÃ‚® Cellular Phone to the Vehicle

In order to use hands-free calling, the cellular phone must be paired to the vehicle. Up to five devices can be paired to the vehicle at one time, but only one can be connected at any given time. To pair a phone, the customer must know how to operate the BluetoothÃ‚® functionality of their phone. The pairing process must only be done one time for each phone, unless that phone's information is deleted. The system will always generate a password and will provide that password if the device you are pairing does not support Secure Simple Pairing (SSP). If the device being paired does support SSP the system will not provide the password and automatically pair the device. For safety reasons, the pairing process is disabled while the vehicle is moving.

Once the BluetoothÃ‚® cellular phone has been paired with vehicle, it will automatically connect to the vehicle when the ignition is on and the device is on. When more than one paired phone is in the vehicle, the phone with the highest priority will be connected. If the cellular phone is in use while getting into the vehicle, the phone can be switched to hands-free mode with the press of a button. In addition, a call in progress can be transferred from the vehicle hands-free mode to the phone to continue the call as the customer exits the vehicle.

Complete pairing instructions are provided in the Vehicle Owners Manual.

Back-up Battery (If Equipped)

NOTE: **Do not disconnect the main vehicle battery or remove the OnStarÃ‚® fuse with the ignition key in any position other than OFF. Disconnecting power to the OnStarÃ‚® module in any way while the ignition is ON or with retained accessory power activated may cause activation of the OnStarÃ‚® Back-Up Battery. This action is per design as the back-up battery is designed to provide power to the telematics communication interface control module so an emergency notification call can be made after an event where the main battery is disabled. Once the Back-Up Battery is activated it will stay on until the power is restored back to the telematics communication interface control module. The telematics communication interface control module naturally chooses the main supply voltage as it's default supply, but if the main supply is removed or lost for any reason the OnStarÃ‚® module will use the Back-Up Battery as a power supply as long as the default supply can not be detected. The back-up battery is not rechargeable and once discharged below 9.5 volts the back-up battery must be replaced.**

Certain OnStarÃ‚® equipped vehicles may also be equipped with a back-up battery. The back-up battery is a non-rechargeable, lithium battery intended to provide an auxiliary power source for the telematics communication interface control module in the event where power from the main vehicle battery is lost.

The back-up battery is intended to have a limited life span of approximately 4 years and is designed to maintain an open circuit voltage between 16 V and 9 V throughout this period. This allows the battery to power the basic functions of the telematics communication interface control module for least one 200 second (5 minute) call at the end of the 4 year span, should the main vehicle battery be lost. In the case of a vehicle losing vehicle battery power, OnStar will switch over to the backup battery based on an internal algorithm. It will look for an air-bag deploy, or near-deploy, messages from the SDM. If there are no messages the OnStar module will stay wake for a few minutes longer and monitor the buttons in the mirror. If not pressed, the modules will power down and shut off completely.

The back-up battery is connected to the telematics communication interface control module through the back-up battery positive voltage circuit and back-up battery ground circuit and is protected from a short circuit by means of an internal fuse. In the event the back-up battery, battery positive voltage circuit is shorted to the back-up battery ground circuit or chassis ground, the fuse will open and render the back-up battery permanently inoperable. The status of the back-up battery and its associated wiring is monitored by the telematics communication interface control module.

WiFi Hotspot

The telematics communication interface control module acts as a Wireless Local Area Network (WLAN) WiFi hotspot router and uses direct 4G LTE connectivity to the internet. It has the ability to connect up to 7 devices at one time. A data plan is required and when purchased, a security default password is established. There are several ways to change the SSID or password, by placing a call to the OnStar Call Center, by using the Gen 10 mobile app or through the scan tool.

The system utilizes a secure autoconnect feature between the telematics communication interface control module and the radio/HMI. No user interaction is required, it is always available and ready to connect to a dedicated in car device. The ignition must be in Run, Accessory or RAP for WiFi to operate.

Audio System Interface

When the OnStarÃ,Â® requires audio output, a serial data message is sent to the audio system to mute all radio functions and transmit OnStarÃ,Â® originated audio. The OnStarÃ,Â® audio is transmitted to the vehicle audio system by a dedicated signal circuit and a low reference circuit.

The audio system will mute and an audible ring will be heard though the speakers if the vehicle receives a call with the radio ON.

On some vehicles, the HVAC blower speed may be reduced when the OnStarÃ,Â® system is active to aid in reducing interior noise. When the system is no longer active, the blower speed will return to its previous setting.

OnStarÃ,Â® Sleep Cycle

The OnStarÃ,Â® system uses a unique sleep cycle to allow the system to receive cellular calls while the ignition is in the OFF position and retained accessory power mode has ended. This cycle enables the telematics communication interface control module to perform remote functions, such as door unlock, as commanded over the air by the OnStarÃ,Â® Call Center, and to continue to maintain an acceptable level of battery electrical drain.

The OnStarÃ,Â® system uses 4 states of readiness, depending upon the type of cellular market the vehicle is in when the ignition is put into the OFF state:

- High power
- Low power
- Sleep
- Digital standby

The high power state is in effect whenever the ignition is in the ON or RUN position, or retained accessory power is enabled, and the OnStarÃ,Â® system is sending or receiving calls or when the system is performing a remote function.

The low power state is in effect when the OnStarÃ,Â® system is idle with the ignition in the ON or RUN position, or with retained accessory power enabled.

The sleep state is entered after the vehicle has been shut off and the retained accessory power has timed out while in an analog cellular area. At a predetermined time recorded within the telematics communication interface control module, the system re-enters the low power state to listen for a call from the OnStarÃ,Â® Call Center for 1 minute. After this interval, the system will again return to the sleep state for 9 minutes. If a call is sent during the 1 minute interval, the OnStarÃ,Â® system will receive the call and immediately go into the high power mode to perform any requested functions. If no call is received during the 1 minute interval, the system will go back into the sleep mode for another 9 minutes. This process will continue for up to 48 hours, after which the OnStarÃ,Â® system will turn off until the ignition is turned to the ON or RUN position.

The digital standby power state is entered after the vehicle has been shut off and the retained accessory power has timed out while in a digital cellular area. When in digital standby mode, the OnStarÃ,Â® module is able to perform all remote functions as commanded by an OnStarÃ,Â® advisor at any time, for a continuous 120 hours. After 120 hours, the OnStarÃ,Â® module will go into sleep mode until a wake up signal from the vehicle is seen by the telematics communication interface control module. If the OnStar module loses the digital cellular signal it will revert to analog mode and follow the standard sleep state (9 minutes OFF, 1 minute standby) based on the time of the GPS signals, this will continue until a digital cellular signal is again received.

If the OnStarÃ,Â® system loses battery power while the system is in a standby or sleep mode, the system will remain OFF until battery power is restored and the ignition is turned to the ON or RUN position.

Features

OnStarÃ,Â® Personal Calling

The hands free, OnStarÃ,Â® personal calling cellular phone feature is an additional feature of the OnStarÃ,Â® system. This feature is embedded within the telematics communication interface control module; however it must be activated by an OnStarÃ,Â® advisor. OnStarÃ,Â® personal calling operates similar to most hand held cellular phones in that the availability for its usage is based on minutes or units. The customer must have a current

OnStarÃ,Â® subscription, as this feature cannot be utilized without it. To use OnStarÃ,Â® personal calling, the customer must also purchase units (minutes) as outlined in the owners guide provided with the OnStarÃ,Â® system. Units begin to deplete, 1 unit is equal to 1 minute, as the customer makes outbound phone calls, answers inbound phone calls, or while connected to the OnStarÃ,Â® virtual advisor. In addition, units may also have an expiration date, depending upon the type of units purchased.

Customers have the ability to store telephone numbers within the module, referenced by a nametag for the convenience of frequently dialed numbers. After storing a nametag, the user can dial this number by initiating the OnStarÃ,Â® personal calling feature, speaking the word "call," and repeating the nametag assigned.

Turn by Turn Navigation

Turn by Turn Navigation allows the driver to contact OnStarÃ,Â® to obtain directions for driving from a current location to a desired location. The Turn by Turn Navigation system stores your planned route and continually checks your position along that route, when you deviate from the planned route, the system will recognize this and prompt the driver with verbal prompts for how to proceed. The driver then responds verbally to direct the system to continue the current routing or to recalculate the route because of a missed turn.

Advisor Record Feature

The Advisor Record Feature allows the user to store any information given during a call with an OnStarÃ,Â® Advisor. Recording is activated by pressing the blue OnStar button during a call; pressing the button a second time stops the recording. The stored information can be played back by pressing the phone button on the three button assembly and using the voice command "Advisor Playback".

Teletypewriter (TTY) Users

OnStar has the ability to communicate to deaf, hard-of-hearing, or speech-impaired customers while in the vehicle. The available dealer-installed TTY system can provide in-vehicle access to all of the OnStar services, except Virtual Advisor and OnStar Turn-by-Turn Navigation.

Deactivated OnStarÃ,Â® Accounts

In the event a customer has not renewed their OnStarÃ,Â® account after expiration or the account was never activated, OnStarÃ,Â® will make a discrete cellular call to the vehicle to deactivate the OnStarÃ,Â® system. Before taking this action, customers are notified that the OnStarÃ,Â® system in their vehicle will be deactivated unless they elect to renew the account. After the OnStarÃ,Â® account has been deactivated, customers will experience the following:

- The OnStarÃ,Â® status LED will not illuminate.
- The OnStarÃ,Â® system will NOT attempt to connect to the OnStarÃ,Â® Call Center in the event of a collision or if the vehicle's front air bags deploy for any other reason.
- An emergency button press will play a demo message indicating the service has been deactivated.
- An OnStarÃ,Â® Call Center button press will connect the customer with a dedicated sales team who can sell an OnStarÃ,Â® subscription and reactivate the vehicle. Depending on the type of OnStarÃ,Â® hardware in the vehicle, the customer may first hear a demonstration message stating there is no current OnStarÃ,Â® subscription for the vehicle, and directing the customer what to do to activate services.
- OnStarÃ,Â® personal calling will not be available, as this feature requires the customer to have a current OnStarÃ,Â® account. Attempts to use this feature may result in cellular connection failure messages and the inability to connect to the number dialed.

Certain vehicles that have never had an active OnStarÃ,Â® account, or that have been deactivated, may be unable to establish a connection with the OnStarÃ,Â® Call Center. When normal published diagnostic procedures do not indicate a possible cause for the no connect concern, the vehicle may have been deactivated. For deactivated vehicles, a no connect response should be considered normal operation. Further diagnosis and subsequent repair is only necessary should the customer elect to become an active OnStarÃ,Â® subscriber or renew the account subscription.

OnStarÃ,Â® Cellular, GPS, and Diagnostic Limitations

The proper operation of the OnStarÃ,Â® System is dependent on several elements outside the components integrated into the vehicle. These include the National Cellular Network Infrastructure, the cellular telephone carriers within the network, and the GPS.

The cellular operation of the OnStarÃ‚Â® system may be inhibited by factors such as the users range from an analog or digital cellular tower, the state of the cellular carrier's equipment, and the location where the call is placed. Making an OnStarÃ‚Â® key press in areas that lack sufficient cellular coverage or have a temporary equipment failure will result in either the inability of a call to complete with a data transfer or the complete inability to connect to the OnStarÃ‚Â® Call Center. The OnStarÃ‚Â® system may also experience connection issues if the identification numbers for the module, station identification number, electronic serial number or manufacturers electronic ID, are not recognized by the cellular carriers local signal receiving towers.

The satellites that orbit earth providing the OnStar system with GPS data have almost no failures associated with them. In the event of a no GPS concern, the failure will likely lie with the inability of the system to gain GPS signals because of its location, i.e. in a parking structure, hardware failure, or being mistaken with an OnStarÃ‚Â® call which has reached the Call Center without vehicle data.

During diagnostic testing of the OnStarÃ‚Â® system, the technician should ensure the vehicle is located in an area that has a clear unobstructed view of the open sky, and preferably, an area where analog or digital cellular calls have been successfully placed. These areas can be found by successfully making an OnStarÃ‚Â® keypress in a known good OnStarÃ‚Â® equipped vehicle and confirming success with the OnStarÃ‚Â® Call Center advisor. Such places can be used as a permanent reference for future OnStarÃ‚Â® testing.

Mobile Identification Number and Mobile Directory Number

The telematics communication interface control module utilizes 2 numbers for cellular device identification, call routing and connection, a mobile identification number and a mobile directory number. The mobile identification number represents the number used by the cellular carrier for call routing purposes while the mobile directory number represents the number dialed to reach the cellular device.

Operation of the OnStarÃ‚Â® Speech Recognition Systems

OnStarÃ‚Â® users communicate with 2 speech recognition systems. Speech recognition allows the user to speak to one computer in the vehicle, and one reached over a phone line. The computer tries to understand the users command, and responds by speaking back, or by taking the appropriate action, e.g. dialing the phone.

- Personal Calling uses a speech recognition system that resides in the vehicle. When the user presses the phone button, the system states, Ready, and listens for the user's command. The user can speak commands to control the hands-free phone.
- Virtual advisor is a remote speech recognition system that the caller can access by making a phone call. The user connects to virtual advisor by requesting it during personal calling use. The user is then transferred to the virtual advisor server and talks to it via a cellular connection.

The OnStarÃ‚Â® speech recognition systems use speech technology that is designed to understand a wide range of American English speakers. Although there is no one right way to speak English, the system will work best when users try to modify their pronunciation should they encounter difficulty. Users who do not obtain good results are advised to try the tips and workarounds found in the Infotainment System Manual or the Owners Manual.

RADIO/AUDIO SYSTEM DESCRIPTION AND OPERATION

Each item in the list below represents topics covered in detail below.

- Radio Circuit Operation
- Information Display and Controls
- Antenna System
- Radio Reception
- Speaker Operation
- Audio Amplifier (If equipped)
- Theft Deterrent
- BluetoothÃ‚Â® (if equipped)
- Auxiliary Audio Input Jack (If equipped)
- USB Port (If equipped)
- OnStarÃ‚Â®
- Steering Wheel Controls (If equipped)
- SCV (Speed Compensated Volume)

- FOTA (Firmware Over The Air)

Radio Circuit Operation

Radio Power

The radio is supplied power by a fused B+ circuit. The radio does not use a discrete ignition feed circuit for power moding. The power mode master provides the system power mode to the radio via serial data messages. The power mode master determines the system power mode by processing power mode information from ignition switch inputs. Serial data power modes supported by the radio are OFF, ACCESSORY, RUN, and CRANK REQUEST.

Radio Retained Accessory Power

The radio retained accessory power system is controlled by serial data. The activation/termination is the same as relay operation (see Retained Accessory Power Description and Operation) with one exception; the only door switch that will turn off the radio during retained accessory power is the driver door open switch.

Radio Grounds

The vehicle harness provides a ground for the radio circuits. The radio may also be case grounded.

Radio Data Link Communication

The radio communicates with other modules via serial data.

Radio Audio Outputs

Each of the audio output channel circuits (+) and (-), at the radio have a DC bias voltage that is approximately one half of battery voltage. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Information Display and Controls

The info display module and radio controls can be separate components from the radio or combined with the radio into one assembly.

When the info display module and radio controls are separate the radio controls communicate radio control inputs directly to the radio through discrete circuits for volume up, volume down and power ON button. It also uses a series of resistors through a single signal circuit when the home, seek up, seek down and phone buttons are pressed. After receiving the message the radio will perform the requested function. The info display module receives digital video data from the radio for on-screen display information through the LVDS (Low Voltage Differential Signal) cable. The radio communicates with the info display module over the radio display touch interrupt request signal for touch screen inputs.

Antenna System

Multi-Band Antenna (if equipped)

The multi-band antenna is located on the roof of the vehicle. This type of antenna may be used with the AM/FM radio, cellular and GPS signals. Keep this antenna clear of snow and ice build up for clear reception. If the vehicle has a sunroof, the performance of the system may be affected if the sunroof is open. Loading items onto the roof of the vehicle can interfere with the performance of the system, ensure the multi-band antenna is not obstructed.

Active Antenna (if equipped)

The active antenna system uses an integral antenna applied as an applique to the rear glass. The antenna module receives both AM and FM signals from the rear glass antenna. The antenna is part of the rear window and looks similar to the defogger grid. One antenna receives AM signals while the other antenna receives FM signals. Any damage to the antenna requires replacing the glass.

The radio antenna module is enabled when the radio is turned on. The radio provides battery voltage to the antenna module using the center conductor of the antenna coaxial cable. When a 12 V signal is seen by the module on the center conductor of the antenna coax, both AM and FM signals are amplified.

Radio Reception

AM/FM Radio Signal

The radio signal is sent from a broadcast station and is then received by an antenna. The strength of the signal received depends on the following:

- The power output (wattage) of the broadcasting station
- The location of the vehicle (or receiver) relative to the broadcast tower.
- Height of the broadcast antenna
- Height of the receiving antenna
- Obstacles between the tower and the receiver
- Atmospheric conditions
- What band (AM or FM) the station is broadcasting
- Type of antenna and the ground plane

Radio Data System (RDS)

The RDS feature is available only on FM stations that broadcast RDS information. This system relies upon receiving specific information from these stations and only works when the information is available. While the radio is tuned to an FM-RDS station, the station name or call letters display. RDS data is carried in what is known as a "subcarrier". A subcarrier is a frequency that the FM broadcaster is authorized to use to send data that is not audible in the main audio program.

RDS functions will only work with FM broadcast stations that are broadcasting RDS data. Not all FM Broadcast stations broadcast RDS data or offer all of the RDS services.

The information displayed is dependent upon the information broadcast by the particular station. The information may vary greatly between stations. RDS functions may not work properly when reception is weak, reception is of poor quality, or RDS is not implemented properly by the FM Broadcaster. In some cases, a radio station broadcasting incorrect information may cause the RDS features of the radio to appear to work improperly.

With RDS, the radio can do the following:

- Display text information such as: station identification, type of programming, and general information (artist and song title, station messages, call in phone numbers, etc.).
- Seek to stations broadcasting the selected type of programming
- Receive announcements concerning local and national emergencies
- Receive alert warnings of local or national emergencies. When an alert announcement comes on the current radio station, ALERT! displays. You will hear the announcement, even if the volume is low or if an auxiliary device is playing. If an auxiliary device is playing, play stops during the announcement. Alert announcements cannot be turned off. ALERT! is not affected by tests of the emergency broadcast system. This feature is not supported by all RDS stations.

Digital Radio Receiver (If equipped)

The vehicle may have one of two digital radio options, satellite transmitted (XM-Sirius) or terrestrial Digital Audio Broadcast (DAB) depending on geographical area.

XM-Sirius

The XM satellite receiver is integrated into the radio. XM satellite radio provides digital radio reception. The XM signal is broadcast from two satellites and, where necessary, terrestrial repeaters. The high power satellites allow the antenna to receive the XM signal even when foliage and other partial obstructions block the antennas view of the satellite. Terrestrial repeaters are used in dense urban areas. These repeaters will receive the satellite signal and re-broadcast them at much higher power levels in order to ensure reception in areas with densely packed tall buildings. A service fee is required in order to receive the XM service.

Digital Audio Broadcast (DAB)

The DAB receiver is integrated into the radio. DAB radio provides digital radio reception. The DAB signal is broadcast from terrestrial transmitters. Services available can include: main radio stations, additional stations (news, sports, etc..) and data services (digital images, video and other data). The availability of services is dependent upon broadcasters in the area. The strength of the DAB signal depends on the following:

- The power output (wattage) of the broadcasting station
- Location of the vehicle (or receiver) relative to the broadcast tower
- Height of the broadcast antenna
- Height of the receiving antenna
- Obstacles between the tower and the receiver
- Type of antenna and the ground plane

Speaker Operation

Speakers turn electrical energy into mechanical energy to move air, using a permanent magnet and an electromagnet. The electromagnet is energized when the radio or amplifier (if equipped) delivers current to the voice coil on the speaker. The voice coil will form a north and south pole that will cause the voice coil and the speaker cone to move in relation to the permanent magnet. The current delivered to the speaker is rapidly changing alternating current (A/C). This causes the speaker cone to move in two directions producing sound.

Audio Amplifier (If equipped)

Amplifier Interface

A fused battery voltage circuit provides the main amplifier power. A switched 12 V output from the radio is used to control the power - state of the amplifier. To respond quickly to audio input and control signals, the amplifier is ON in all vehicle power modes except OFF and CRANK Request. The internal amplifier bridges are fully powered and unmuted when the amplifier receives the switched 12 V input.

Amplifier Operation

The purpose of the amplifier is to increase the power of a voltage or current signal. The output signal of an amplifier may consist of the same frequencies as the input signal or it may consist of only a portion of the frequencies as in the case of a subwoofer or midrange speaker. The radio creates a low level stereo audio output signal, which is sent at the user-defined volume level to the audio amplifier. The audio amplifier amplifies the signal and sends it to the appropriate speakers. Each of the audio output channel circuits (+) and (-), from the amplifier have a DC bias voltage that is approximately one half of battery voltage. The audio being played on the system is produced by a varying AC voltage that is centered around the DC bias voltage on the same circuit. The AC voltage is what causes the speaker cone to move and produce sound. The frequency (Hz) of the AC voltage signal is directly related to the frequency of the input (audio source playing) to the audio system. Both the DC bias voltage and the AC voltage signals are needed for the audio system to properly produce sound.

Theft Deterrent

The radio theft deterrent system is intended to disable or limit radio functionality if incorrect vehicle information is received by the radio. The radio disables functionality if the VIN information received by the radio does not match the VIN information that has been learned by the radio. The radio receives this information via serial data. A possible cause of incorrect VIN info could be the radio was originally installed in another vehicle.

The radio has the following theft operating modes as part of the theft deterrent system:

- Normal Mode: The radio has learned a correct VIN sequence and the VIN information received via serial data matches the learned VIN sequence. In this mode the radio has full functionality.
- No VIN Mode: The radio has not received or learned a correct VIN sequence. In this mode the radio has limited functionality.
- Theft Detected Mode: The radio has learned a correct VIN sequence and the VIN information received via serial data does NOT match the learned VIN sequence. In this mode the radio may be disabled or have limited functionality. The radio display will indicate that theft protection is active.

BluetoothÃ‚® (If Equipped)

BluetoothÃ‚® wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. Only vehicles with steering wheel controls will have BluetoothÃ‚® functionality. In order to utilize the vehicle's BluetoothÃ‚® system, a BluetoothÃ‚® equipped cellular phone is required.

The BluetoothÃ‚Â® antenna is internal to the telematics communication interface control module, radio or human machine interface module and is used to send and receive signals from a BluetoothÃ‚Â® enabled cellular phone. The available features and functions are determined by the software within the device being used and the telematics communication interface control module. The operating range of the signal from the vehicle is approximately 30 feet. Note that the operating range is dependent upon the cellular phone being used and battery level of the phone.

With BluetoothÃ‚Â® technology customers can experience hands-free calling as their BluetoothÃ‚Â® capable cellular phones are wirelessly connected to the vehicle. It will allow customers to place and receive calls using the steering wheel controls and voice recognition. The vehicle audio system will allow you to listen to your call through the vehicle speakers and adjust volume through steering wheel or radio controls.

Not all BluetoothÃ‚Â® cellular phones are guaranteed to work with the vehicle's BluetoothÃ‚Â® system. Based on the cellular phone's service provider and the manufacturer's implementation of BluetoothÃ‚Â®, not all phones support all available BluetoothÃ‚Â® functionality. BluetoothÃ‚Â® enabled cellular phones will be tested for vehicle compatibility and a feature compatibility list will be provided via the GM BluetoothÃ‚Â® website: http://www.gm.com/vc/bluetooth/

BluetoothÃ‚Â® Features Supported

The following is a list of features supported by the BluetoothÃ‚Â® system. Note that not all devices will support all of the listed functions.

- Automatic reconnection - highest priority phone will automatically be connected to vehicle when vehicle ignition is on
- Hands-free dialing- via digits, redial, name tags (phone number saved to a nametag via voice recognition)
- Answering a call
- Ending a call
- Mute a Call
- Rejecting a call - ignore an incoming call
- Call Waiting
- Three-way Calling - initiated from hands-free system
- Send Number During a Call - this is used when calling a menu-driven phone system
- Transfer a Call - transfer call from vehicle to cellular phone and visa versa
- Voice Pass-Thru - allow access to the voice recognition commands on the cellular phone

Auxiliary Audio Input Jack (If equipped)

The infotainment system may have a 3.5 mm (1/8 in.) auxiliary audio input jack located in the center console or on the radio faceplate. The auxiliary audio input jack interfaces directly with the radio. When a portable audio playback device is connected to the auxiliary jack, an internal switch detects the connection and the radio will switch to AUX as the audio source. Audio signals from the device are sent to the radio from the auxiliary jack via the left, right, and common audio signal circuits.

- When a device is first connected to the 3.5 mm (1/8 in.) input jack the infotainment system automatically switches to that device. If an auxiliary device has already been connected, press the Media or AUX button to select the device.
- Playback of an audio device that is connected to the 3.5 mm jack can only be controlled using the controls on the device.
- The volume control on the device may need to be adjusted to ensure sufficient playback volume through the infotainment system.

USB Port (If Equipped)

The infotainment system may have a USB connector located in the center console. The USB connector interfaces directly with the radio. The USB connector supports both USB standards 1.1 and 2.0.

USB Supported Devices:

- USB Flash Sticks (Thumb Drives)
- Portable USB Hard Drives
- Portable Digital Media Players (iPODÃ‚Â®, ZUNEÃ‚Â®, etc)

Depending on the USB device, some devices may not be recognized, or some features/functions may not be able to be controlled with the radio controls. USB HUB devices are not supported.

Refer to the owner's manual for information on USB devices, control, and operation.

OnStarÃ‚Â® (If equipped)

When OnStar is activated, a serial data message is sent to the radio that activates a software program. When the software begins its process, the fade goes to the front, Bass and Treble are set to the mid range, the outputs are mono, and the audio source is OnStar. OnStar takes priority over any other audio source. All of these actions are preset values stored in the radio.

Steering Wheel Controls (If equipped)

Some audio functions are available using the steering wheel controls. The steering wheel controls duplicate the function of the primary controls available on the radio.

For additional information on steering wheel controls, refer to Steering Wheel Controls Description and Operation.

Speed Compensated Volume

With Speed Compensated Volume the audio system will adjust automatically to make up for road and wind noise as you drive, by increasing the volume as vehicle speed increases. To use speed compensated volume, set the volume to the desired level, then select either Low, Medium, or High. To turn SCV off select the Off screen button.

Firmware Over The Air

The Firmware Over The Air feature was designed to reflash software remotely. Remote reflash is an in-vehicle feature that enables the installation of a software package to update the infotainment system without requiring service test equipment to be physically connected to the vehicle. Remote reflash will utilize a long range or short range connection from the host module to a remote IT system.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

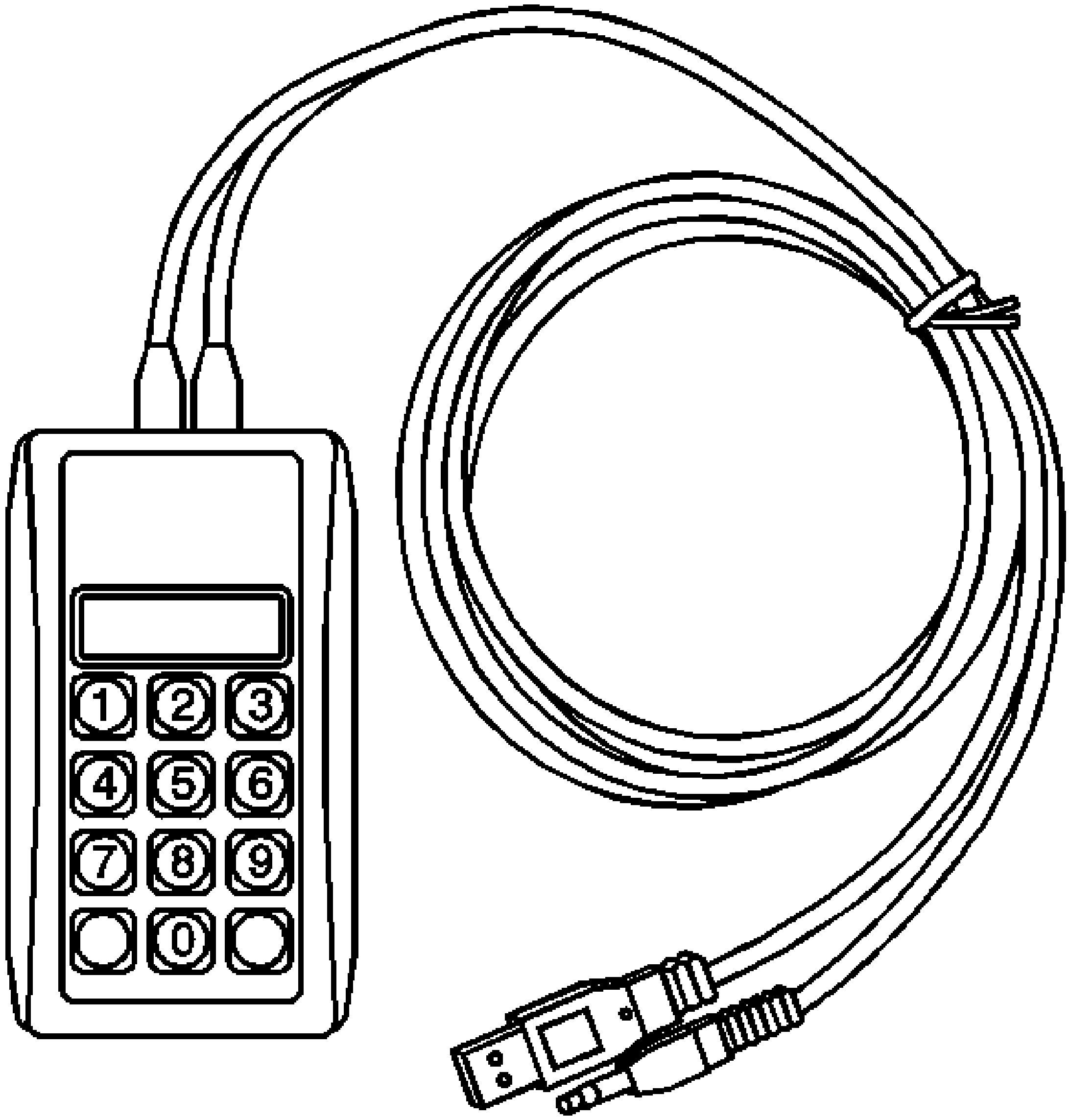
Illustration	Tool Number/Description
 1 2 3 4 5 6 7 8 9 0	EL-50334-20 Multi-Media Interface Tester (MIT)

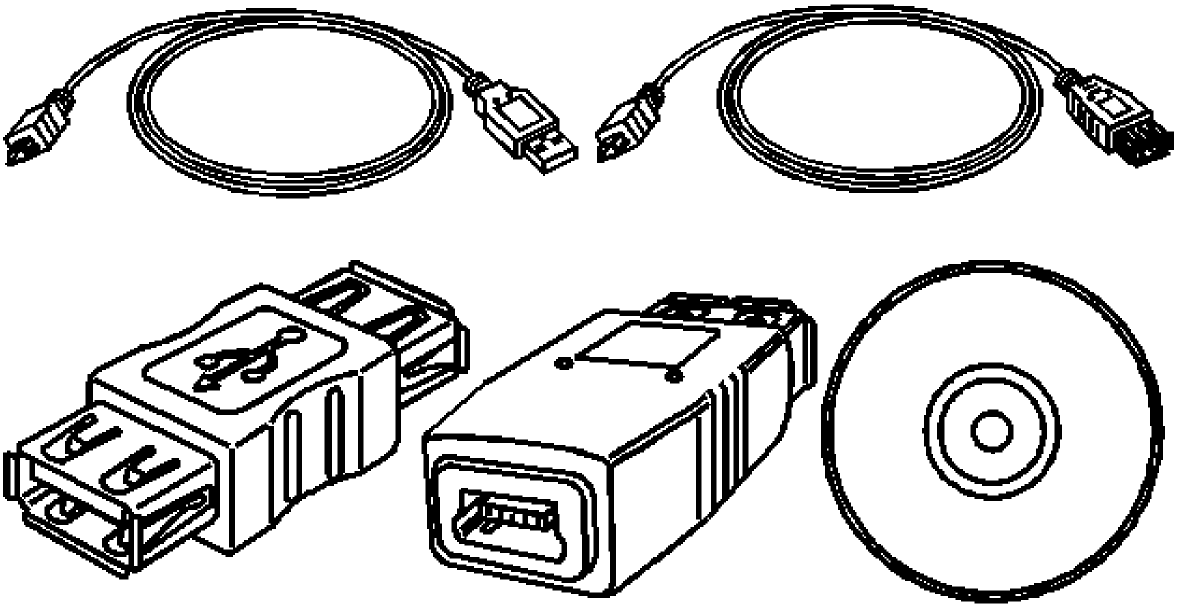
Illustration	Tool Number/Description
	EL-50334-50 USB Cable and Adapter Kit

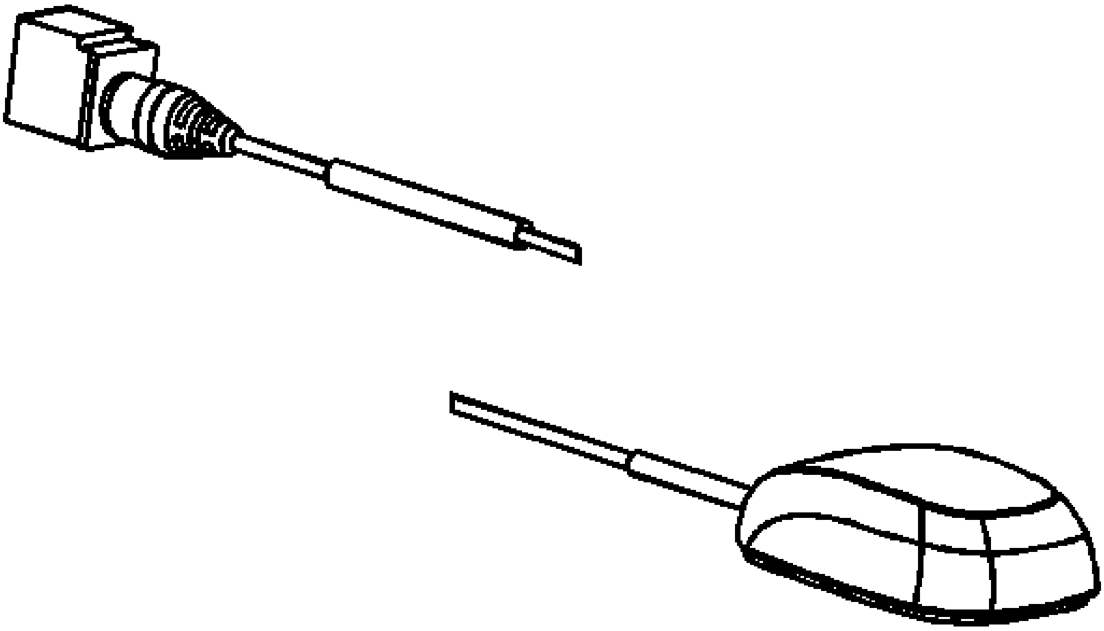
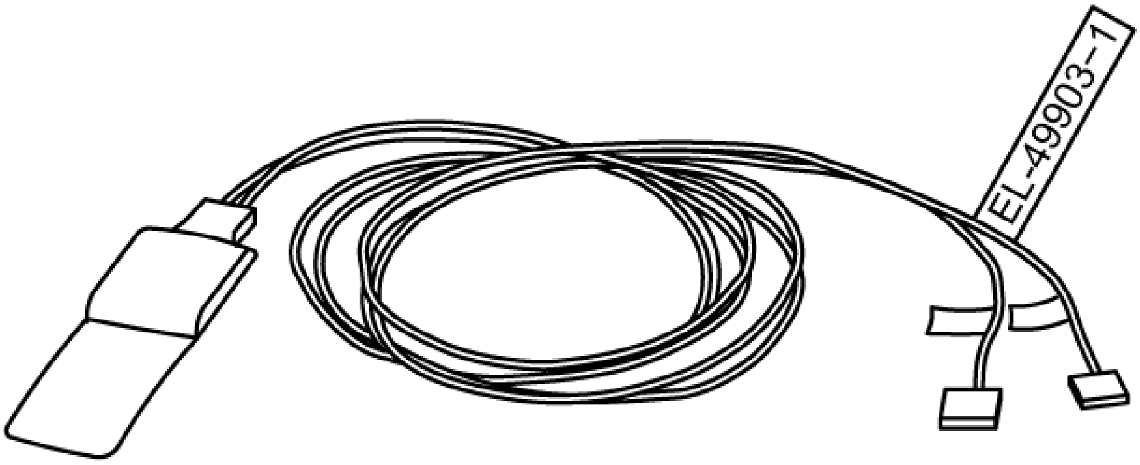
Illustration	Tool Number/Description
	EL-48028 Digital Radio Test Antenna

Illustration	Tool Number/Description
 	EL-49903-1 Test Antenna, Navn-Cell Comn

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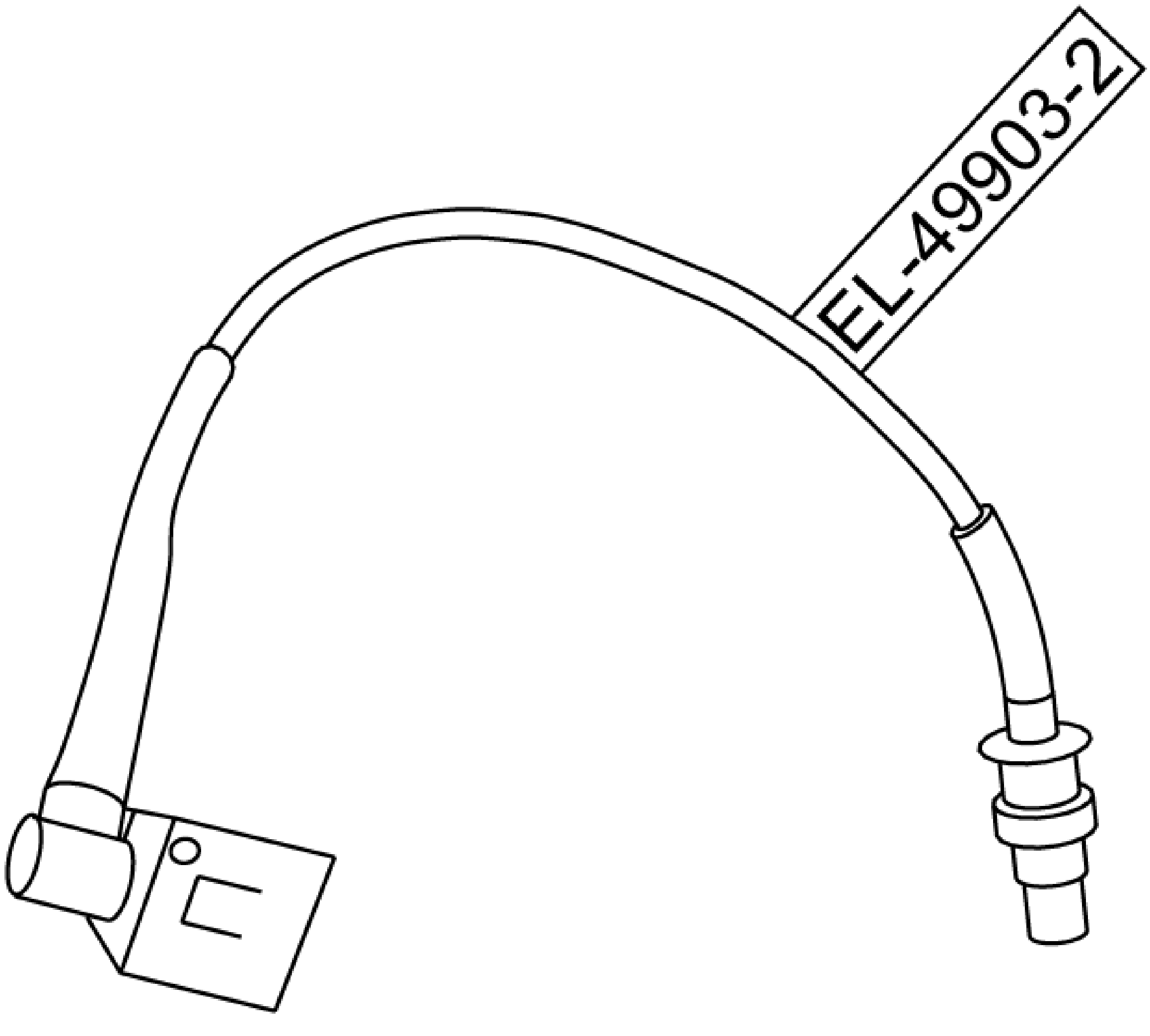
<tr><td>
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Adapter Cable-UHF RT Angle</td></tr>
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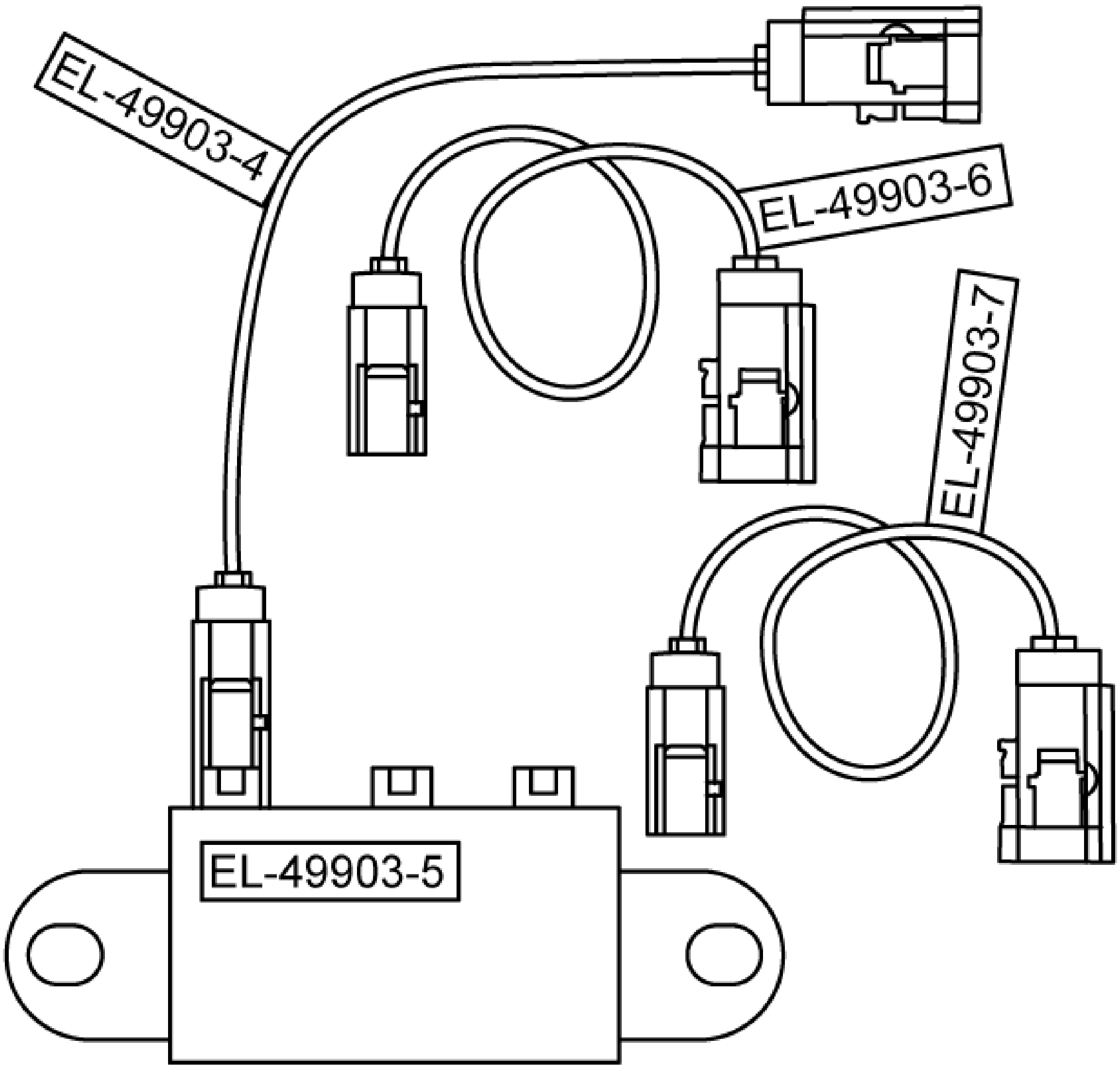
 EL-49903-4 EL-49903-6 EL-49903-7 EL-49903-5	EL-49903-3A Combiner Kit, Test Antenna

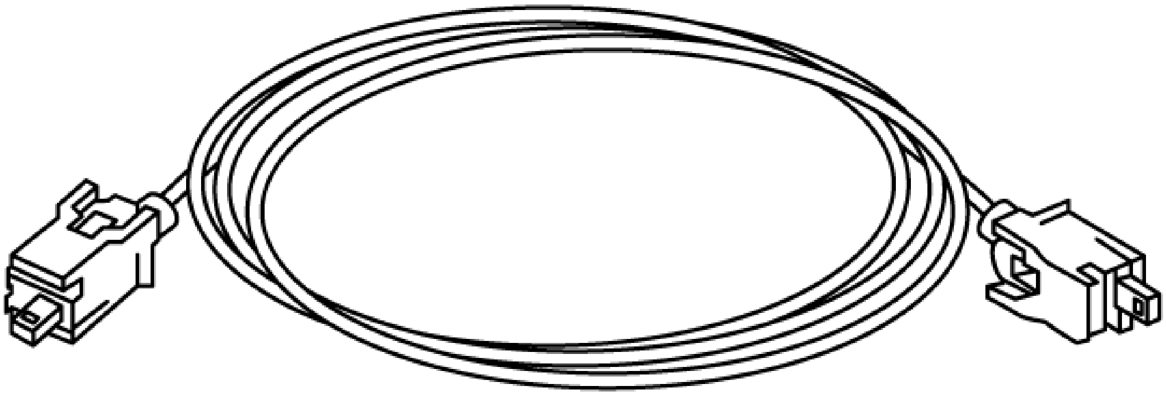
Illustration	Tool Number/Description
	EL-50334-12 Infotainment Test Cable - RSE

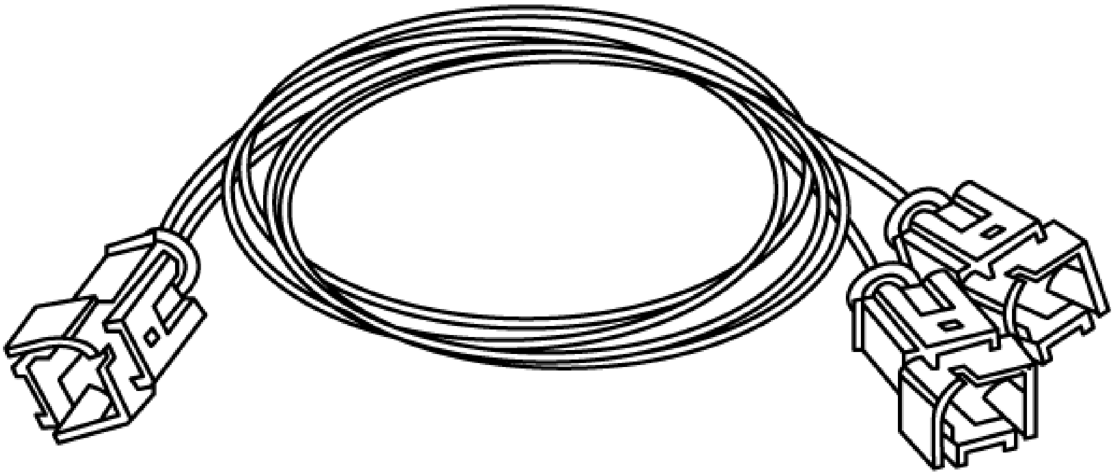
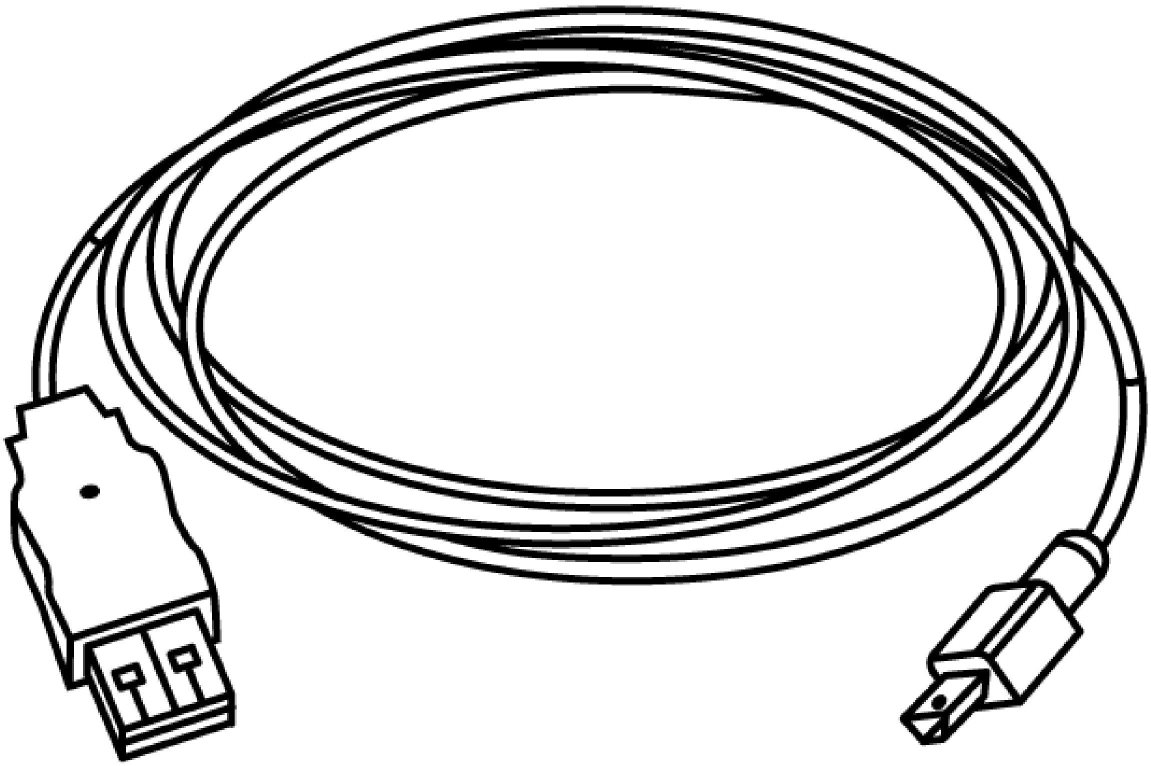
Illustration	Tool Number/Description
	EL-50334-13 Infotainment Test Cable - RSE Splitter

Illustration	Tool Number/Description
	EL-50334-14 Infotainment Test Cable

SPECIAL TOOLS (MIT TOOL INSTRUCTIONS)

Bluetooth Pairing for Vehicles with Radio RPO: UF7

Either reset the pin code on the radio to 0000, or go under Device Info on the radio and see what the pin code is (to enter it later on the MIT).

1. Turn the BT discoverable ON in the radio Bluetooth settings.
2. Press Pair Device on radio (DO NOT PRESS SEARCH BLUETOOTH DEVICES ON THE RADIO).
3. Press the Pair button on the MIT.
4. When the three LED lights begin flashing on the MIT, enter the pin code (either 0000 if you reset it to that or what the radio pin code was).
5. MIT will then automatically connect with the radio and should show "MIT Connected" message.

   Make test call and the audio streaming test.

Holden Radio Bluetooth Pairing Instructions

1. Using the radio controls, place the radio into "Discoverable Mode".
2. Place the MIT into Bluetooth mode by pressing TEST SELECTOR until the Bluetooth LED is illuminated.
3. With the MIT in Bluetooth mode Press and Release the #1 button (the Bluetooth LED will begin to slowly blink).
4. Now Press and release the PAIR/CALL button on the MIT (the Bluetooth LED will begin to blink a little faster).
5. On the radio Enter the PASSKEY when prompted: (press "0000" then Press "OK").

6. The MIT and radio will PAIR and CONNECT (the Bluetooth LED will be Fast Flashing).
7. Use as regular MIT at this point.

For All Other Radios

Testing the Bluetooth Function

1. Verify connection of the MIT to the USB port.
2. Press and release the TEST SELECTOR button until the Bluetooth LED illuminates.
3. Disable all other Bluetooth devices present in the vehicle (ie. cell phones, laptops, etc.).

Standard Bluetooth Pairing/Bonding

1. Use the vehicle controls to place the radio into Bluetooth Pairing mode. The vehicle will prompt you with a security code.
2. Press and release the PAIR/CALL button. The Bluetooth LED will blink slowly while preparing to have a security code entered.
3. Wait for the all three LEDs to blink confirming it is ready to have the security code entered.
4. Enter the code with the MIT keypad and hit ENTER.
5. The Bluetooth LED will blink slowly while pairing/bonding and move to a quick flash once paired/bonded.

   The vehicle should confirm pairing/bonding is complete.

Streaming Audio

1. Confirm pairing/bonding is complete - the Bluetooth LED will be in a quick flash mode.
2. On some radios the MIT automatically begins streaming audio via A2DP. The audio playback will confirm that the Bluetooth connection using streaming and the audio is working correctly.
3. On other radios you will need to select Bluetooth Audio from the Source menu to verify Audio Streaming.
4. Audio playback confirms that the Bluetooth connection using Streaming Audio is working correctly.
5. Placing a test call will temporarily stop the streaming audio function, but upon disconnection of that test call, the streaming audio from the MIT will resume.

To Place a Test Call

1. Confirm pairing/bonding is complete - the Bluetooth LED will be in a quick flash mode. If the vehicle is equipped with streaming audio, and the radio is set to play a Bluetooth audio file, the streaming audio playback will be audible.
2. Press and release PAIR/CALL button to place a test call. Streaming audio will be temporarily turned off.
3. Use the vehicle controls to answer the call.

   NOTE: **If the call is not answered within several rings, the MIT's audio files will not transmit, even though an active call is occurring.**

4. Audio playback confirms that the Bluetooth connectivity is working correctly.

   NOTE: **The MIT will remain paired/bonded when the call is ended by the vehicle. To re-test the call function, place the MIT in Bluetooth mode and press and release the Pair button to reconnect. When testing is completed, delete MIT from the audio system before returning the vehicle to the customer.**

5. Use the vehicle controls to end the call. If applicable, streaming audio will resume.

Testing the AUX/Line-In Function

1. Verify connection of the MIT as stated above.
2. Press and release the TEST SELECTOR button until the MIT AUX LED illuminates.
3. Use the vehicle controls to put the audio system into Audio (Line-In) mode.
4. Audio playback confirms that the audio input is working correctly.

Testing the USB Function

1. Verify connection of the MIT as stated above.
2. Press and release the TEST SELECTOR button until the MIT USB LED illuminates.
3. Use the vehicle controls to put the audio system into USB mode.

NOTE: **Volume levels may vary dependent upon vehicle audio system.**

4. Audio playback confirms that the USB is working correctly.

Troubleshooting Guide

If the MIT unit is still not working properly after following the below troubleshooting, the unit is malfunctioning and should be repaired or replaced.

Unit not Working

- Verify the MIT is powered on correctly as indicated by the green Power LED.
- If Power LED is not illuminated, verify USB power source is working properly.
- If USB power adapter is being used to power the MIT, check and, if necessary, replace the fuse in adapter.

Problem with Aux/Line-In Test

- Verify Aux/Line-In test cable is inserted properly into the vehicle audio input jack. Verify the MIT is in Aux/Line-In mode as indicated by the red AUX LED.
- Verify the vehicle audio system is in Auxiliary or Line-in mode. Verify the vehicle audio system volume is turned up and not in mute mode.

Problem with USB Test

- Verify MIT is in USB mode as indicated by the red USB LED. Verify the vehicle audio system is in USB mode.
- Verify the vehicle audio system volume is turned up and not in mute mode.

Problem with Bluetooth Pairing

- Delete previous devices stored in the device list of the radio and the pair the MIT.
- Remove USB cable, and then reconnect to reset the MIT. Carefully follow the bonding instructions for the correct Passkey procedure.

Problem with Bluetooth Test Call Audio

- Verify the MIT is paired with the vehicle. This is indicated by the quick flashing Bluetooth LED.
- Audio system should have indicated the MIT is bonded.

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Steering Wheel Spoke Cover Fastener	1.5 N.m (13 lb in)

SCHEMATIC WIRING DIAGRAMS

CRUISE CONTROL WIRING SCHEMATICS

Cruise Control (K33)

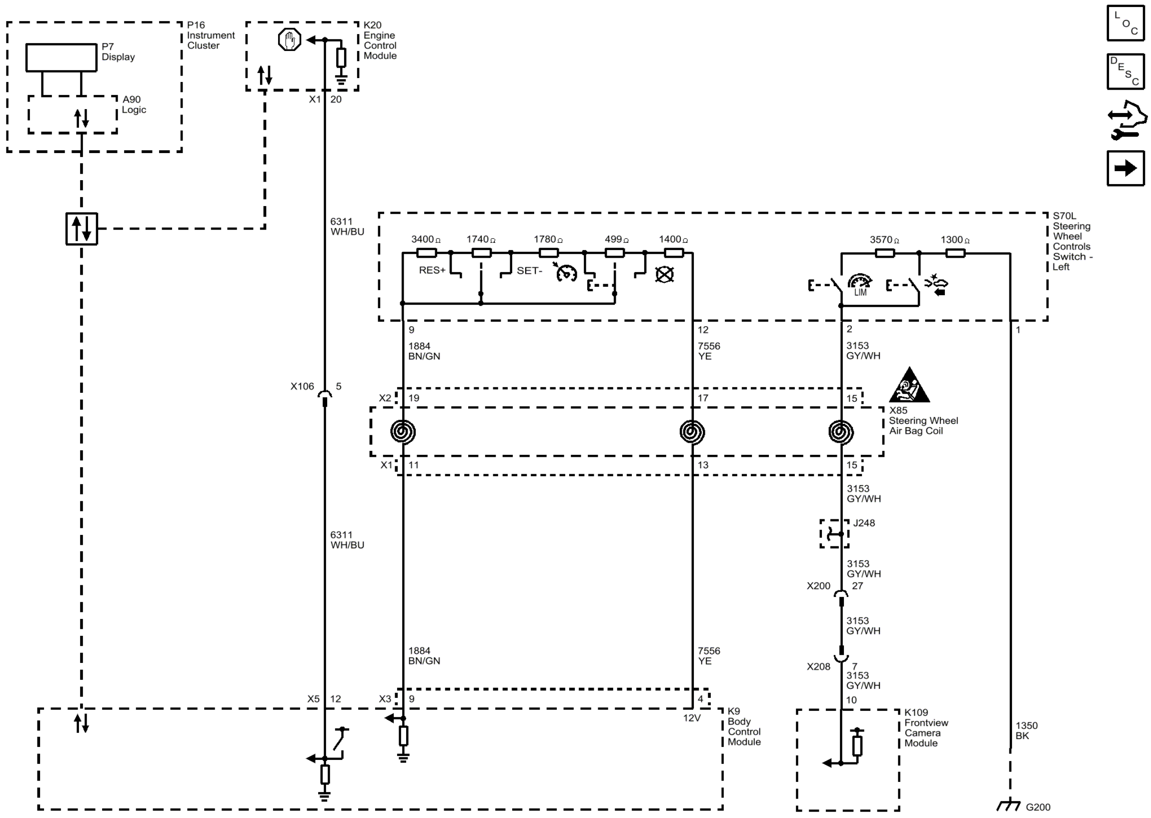
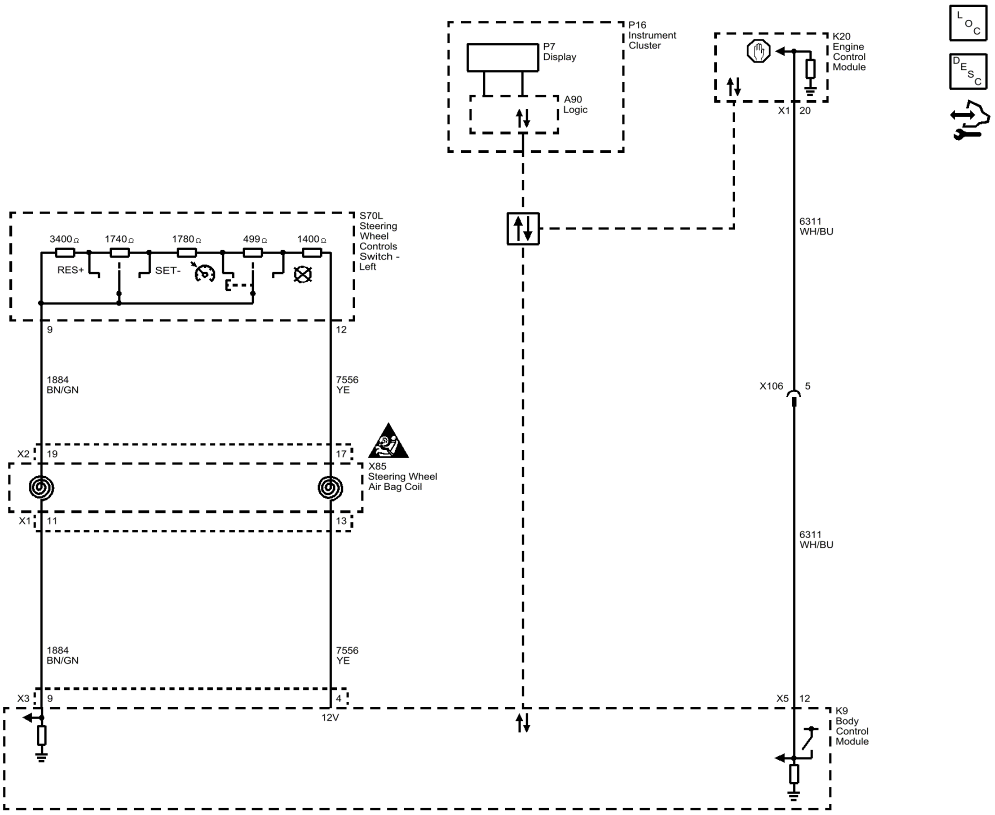

P16
Instrument
Cluster
P7
Display
A90
Logic
K20
Engine
Control
Module
X1
20
6311
WH/BU
X106
5
S70L
Steering
Wheel
Controls
Switch -
Left
3400Ω
1740Ω
1780Ω
499Ω
1400Ω
RES+
SET-
3570Ω
1300Ω
LIM
9
1884
BN/GN
12
7556
YE
2
3153
GY/WH
1
X2
19
17
15
X85
Steering Wheel
Air Bag Coil
X1
11
13
15
J248
X200
27
X208
7
10
X5
12
X3
9
4
12V
K9
Body
Control
Module
K109
Frontview
Camera
Module
1350
BK
G200
LOC
DESC

Fig. 1: Cruise Control (K33)
Courtesy of GENERAL MOTORS COMPANY

Cruise Control (K34)


P16
Instrument
Cluster
P7
Display
A90
Logic
K20
Engine
Control
Module
X1
20
LOC
DESC
S70L
Steering
Wheel
Controls
Switch -
Left
3400Ω
1740Ω
1780Ω
499Ω
1400Ω
RES+
SET-
9
12
1884
BN/GN
7556
YE
6311
WH/BU
X106
5
X2
19
17
X85
Steering Wheel
Air Bag Coil
X1
11
13
6311
WH/BU
1884
BN/GN
7556
YE
X3
9
4
12V
X5
12
K9
Body
Control
Module

[Fig. 2: Cruise Control (K34)](#)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0572 OR P0573: BRAKE SWITCH CIRCUIT 1 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC P0572

Brake Switch Circuit 1 Low Voltage

DTC P0573

Brake Switch Circuit 1 High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cruise Control Brake Pedal Signal Circuit	C0297, P0572	P0572	P0573	P0703

Circuit/System Description

For an overview of the component/system, refer to: Cruise Control Description and Operation

Conditions for Running the DTC

- Ignition/Vehicle = On
- Vehicle Speed. = Greater than 40 km/h (25 MPH)
- Cruise Control = On

Frequency the DTC runs = Continuously - After the running conditions are met - For greater than 5 s

Conditions for Setting the DTC

DTC P0572

Brake Pedal Position Circuit Signal - Open/Short to Ground

DTC P0573

Brake Pedal Position Circuit Signal - Short to Voltage

Actions Taken When the DTC Sets

- Cruise Control System Status = Disabled
- DTCs listed in the DTC Descriptor Category = Type C DTC

Conditions for Clearing the DTC

DTCs listed in the DTC Descriptor Category = Type C DTC

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the component works as specified: Brake Pedal Position Sensor
   - **If a related DTC is set**

     Refer to: **Diagnostic Trouble Code (DTC) List - Vehicle**

   - **If a related DTC is not set**
3. Verify that no DTC listed in the DTC Descriptor Category is set.
   - **If a related DTC is set**

     Refer to Circuit/System Testing.

- **If a related DTC is not set**

4. All OK.

Circuit/System Testing

1. Use the schematics to identify the items listed below:
    - Brake Pedal Position Sensor Signal at K20 Engine Control Module
2. Ignition/Vehicle & All vehicle systems - Off
3. Disconnect the component: K20 Engine Control Module
4. Ignition - On / Vehicle - In Service Mode
5. Connect a test lamp between the test points: Brake Pedal Position Sensor Signal & Ground
6. Slowly press and release the brake pedal.

    Verify the test lamp turns On and Off.

    - **If the test lamp is always Off**

    1. Ignition/Vehicle & All vehicle systems - Off
    2. Disconnect the component: K9 Body Control Module
    3. {If equipped} Disconnect all components on the circuit: Brake Pedal Position Sensor Signal
    4. Test for infinite resistance between the test points: Signal circuit terminal 12 at K9 Body Control Module X5 & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance
    5. Test for less than 2 ohms between the test points: Signal circuit terminal 12 at K9 Body Control Module X5 & The other end of the circuit
        - If 2 ohms or greater - Repair the open/high resistance in the circuit.
        - If less than 2 ohms - Replace the component: K9 Body Control Module

    - **If the test lamp is always On**

    1. Ignition/Vehicle & All vehicle systems - Off
    2. Disconnect the component: K9 Body Control Module
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Signal circuit terminal 12 at K9 Body Control Module X5 & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V - Replace the component: K9 Body Control Module

    - **If the test lamp turns On and Off**

7. Replace the component: K20 Engine Control Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P0575: CRUISE CONTROL SWITCH SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0575

Cruise Control Switch Signal Message Counter Incorrect

Circuit/System Description

When a cruise control function switch is activated, the body control module (BCM) detects a predetermined voltage. The BCM sends a serial data message to the engine control module (ECM) indicating the function that has been requested.

Conditions for Running the DTC

- Vehicle ON.
- The vehicle speed is greater than 40 km/h (25 MPH) and the cruise control is engaged.

Conditions for Setting the DTC

- The ECM receives an invalid cruise control switch status serial data message from the BCM.
- This diagnostic runs continuously.

Actions Taken When the DTC Sets

DTC P0575 is a type C DTC.

Conditions for Clearing the DTC

DTC P0575 is a type C DTC.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that no DTCs are set, except DTC P0575.
    - **If any other DTC is set, except DTC P0575**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If only DTC P0575 is set**

3. Replace the K9 Body Control Module.
4. Verify DTC P0575 does not set when operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC sets**

      Replace the K20 Engine Control Module.

    - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or ECM programming, replacement, and setup

DTC P0703: BRAKE SWITCH SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0703

Brake Switch Signal Message Counter Incorrect

Circuit/System Description

The body control module (BCM) monitors the brake pedal position sensor. When the brake pedal is applied, the BCM detects a predetermined voltage signal. The BCM sends a serial data message to the engine control module (ECM) indicating the status of the stop lamps.

Conditions for Running the DTC

Vehicle ON.

Conditions for Setting the DTC

- The ECM receives an invalid brake pedal status serial data message from the BCM.
- This diagnostic runs continuously.

Actions Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that no DTCs are set, except DTC P0703.
   - **If any other DTC is set, except DTC P0703**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If only DTC P0703 is set**
3. Replace the K9 Body Control Module.
4. Verify DTC P0703 does not set when operating the vehicle within the conditions for running the DTC.
   - **If the DTC sets**

     Replace the K20 Engine Control Module.

   - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or ECM programming, replacement, and setup

DTC P158A: CRUISE CONTROL CALIBRATION INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P158A

Cruise Control Calibration Incorrect

Circuit/System Description

The type of cruise control system the vehicle has is programmed into the body control module and the engine control module. If this information is not the same in both modules DTC P158A will set.

Conditions for Running the DTC

This diagnostic runs continuously.

Conditions for Setting the DTC

The type of cruise control system programmed into the body control module does not match what is programmed into the engine control module.

Actions Taken When the DTC Sets

DTC P158A is a Type C DTC.

Conditions for Clearing the DTC

DTC P158A is a Type C DTC.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that no DTCs are set, except DTC P158A.
    - **If any other DTC is set, except DTC P158A**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If only DTC P158A is set**
2. Reprogram the K9 Body Control Module and the K20 Engine Control Module one after the other. Do not place the Ignition On/Vehicle in Service Mode between each programming event.
3. Verify DTC P158A does not set when operating the vehicle within the conditions for running the DTC.
    - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming, and setup.

SYMPTOMS - CRUISE CONTROL

NOTE: The following steps must be completed before using the symptom tables.

1. Before using the symptom diagnostic table, perform the **Diagnostic System Check - Vehicle** in order to verify the following conditions:
    - There are no DTCs set.
    - The module can communicate via the serial data.
2. Review the system operation in order to understand the system functions. Refer to **Cruise Control Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the Cruise Control System. Refer to **Checking Aftermarket Accessories** .
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
- **Cruise Control Indicator Malfunction**

CRUISE CONTROL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster illuminates the cruise control engaged indicator based on serial data messages received from the engine control module (ECM). The indicator is commanded ON when the cruise control system is controlling vehicle speed, and turned OFF with the system disengaged.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the cruise control indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
   - **If the indicator does not turn ON and OFF**

     Replace the P16 Instrument Cluster.

   - **If the indicator turns ON and OFF**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for instrument cluster replacement, programming and setup

CRUISE CONTROL MALFUNCTION - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, OR P162C

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B3794

Cruise Control Function Request Circuit

DTC P0564

Cruise Control Multifunction Switch Circuit

DTC P0565

Cruise Control Switch Circuit

DTC P0567

Cruise Control Resume Switch Circuit

DTC P0568

Cruise Control Set Switch Circuit

DTC P056C

Cruise Control Cancel Switch Circuit

DTC P0580

Cruise Control Multifunction Switch Circuit Low Voltage

DTC P0581

Cruise Control Multifunction Switch Circuit High Voltage

DTC P155A

Cruise Control Switch State Undetermined

DTC P155B

Cruise Control Set/Coast Switch 2 Circuit

DTC P155C

Cruise Control Resume/Acceleration Switch 2 Circuit

DTC P162C

Vehicle Speed Limiting/Warning Switch Circuit

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Signal	1	P0564	B3794 08, P0567, P0568	B3794 61, P0564
1. Cruise Control Malfunction				

Circuit/System Description

The cruise control switch is an input to the body control module (BCM). The BCM monitors the cruise control on/off, set/coast, resume/accelerate and cancel switches via the cruise control switch signal circuit in order to detect when the driver has requested to perform a cruise control function. The BCM detects a specific voltage signal on the cruise control switch signal circuit when a switch is applied. The engine control module (ECM) receives the requested cruise control switch function from the BCM via a serial data message.

Conditions for Running the DTC

- The cruise control switch is ON.
- Ignition On/Vehicle in Service Mode

Conditions for Setting the DTC

B3794 08

The BCM detects an invalid voltage signal on the cruise control switch signal circuit for 1 s.

B3794 61

Stuck switch for either Resume/Accel or Set/Coast button for 60 s.

P0564, P0565, P0567, P0568, P056C

- The BCM detects an invalid voltage signal on the cruise control switch signal circuit for greater than 2 s and sends a serial data message to the ECM. The ECM sets these DTCs when the message is received.
- The ECM runs this diagnostic continuously.

P0580, P0581

- The ECM detects an invalid voltage signal on the cruise control switch signal circuit.
- The above condition is present for greater than 2 s.
- The ECM runs this diagnostic continuously.

P155A

The ECM is unable to determine the state of the cruise control switch.

P162C

The ECM is unable to determine the state of the vehicle speed limiting switch.

Actions Taken When the DTC Sets

B3794

- The malfunction indicator lamp (MIL) will not illuminate.
- The cruise control system is disabled.

P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A, P162C

DTCs P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A and P162C are type C DTCs

Conditions for Clearing the DTC

B3794

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A, P162C

DTCs P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A and P162C are type C DTCs.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Cruise Control Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.

2. Verify that the stop lamps operate properly and that no B22 Brake Pedal Position Sensor related DTCs are set.
    - **If brake pedal position sensor related DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If no brake pedal position sensor related DTCs are set**
3. Verify the scan tool K9 Body Control Module Cruise Control Switch Status parameter changes between Off and On, Resume and Set when switching between each position on the cruise control switch.
    - **If the parameter does not change**

      Refer to Circuit/System Testing.

    - **If the parameter changes**
4. Verify that no conditions that may inhibit cruise control operation are present. Refer to the K20 Engine Control Module scan tool data list Cruise Control Inhibit Reason parameter. Refer to the **Cruise Control Description and Operation** for a list of inhibit reasons.
    - **If the cruise control system has a reason why it is inhibited**

      Repair the condition that is causing the inhibit reason.

    - **If the cruise control system does not have any reasons why it may be inhibited**
5. Verify that no cruise control related DTCs are set.
    - **If any cruise control related DTCs are set**

      Refer to Circuit/System Testing.

    - **If no cruise control related DTCs are set**
6. All OK.

Circuit/System Testing

NOTE:

- **An open ignition circuit or fuse before the control module will cause communication DTCs or power mode mismatch DTCs to set against or in the control module. This failure mode will be diagnosed in the no communications diagnostic procedure or power mode mismatch.**
- **This test assumes the ignition circuit has a module driver that will open under a high current condition before the fuse opens.**
- **The module driver can open under normal conditions such as battery run down protection or a retained accessory power mode.**
- **The ignition circuit referred to below is the 12 V reference/lighting control switch reference/voltage supply circuit from the K9 Body Control Module to the S70L Steering Wheel Controls Switch-Left.**
- **The signal circuit referred to below is the cruise control set/coast/resume/accelerate switch signal from the S70L Steering Wheel Controls Switch-Left to the K9 Body Control Module.**

1. Ignition /Vehicle Off, disconnect the harness connector at the S70L Steering Wheel Controls Switch-Left, Ignition On/Vehicle in Service Mode.
2. Verify a test lamp illuminates between the ignition circuit and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module.
    2. Test for greater than 100 Ω between the ignition circuit and ground.
        - If 100 Ω or less, repair the short to ground on the circuit.
        - If greater than 100 Ω

    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the K9 Body Control Module.
    - **If the test lamp illuminates**
3. Verify the scan tool K9 Body Control Module Cruise Control Switch Status parameter is Open/Short to Ground or Undetermined State.
    - **If not Open/Short to Ground or Undetermined State**
    1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module, Ignition/Vehicle On.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If Open/Short to Ground or Undetermined State**
4. Install a 3 A fused jumper wire between the signal circuit and the ignition circuit.
5. Verify the scan tool K9 Body Control Module Cruise Control Switch Status parameter is Short to Battery or Undetermined State.
    - **If not Short to Battery or Undetermined State**
    1. Ignition/Vehicle Off, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Short to Battery or Undetermined State**
6. Test or replace the S70L Steering Wheel Controls Switch-Left.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup.

REPAIR INSTRUCTIONS

CRUISE CONTROL SWITCH REPLACEMENT

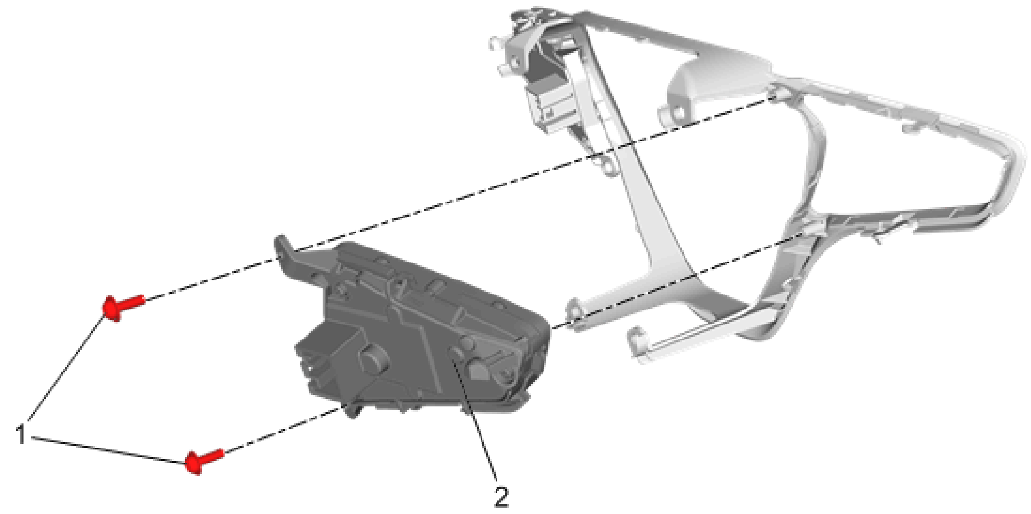


Fig. 3: Cruise Control Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Wheel Spoke Cover Replacement	
1	Steering Wheel Spoke Cover Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 1.5 N.m (13 lb in)
2	Cruise Control Switch **Procedure** Remove the cruise control switch from the steering wheel spoke cover.

DESCRIPTION AND OPERATION

CRUISE CONTROL DESCRIPTION AND OPERATION

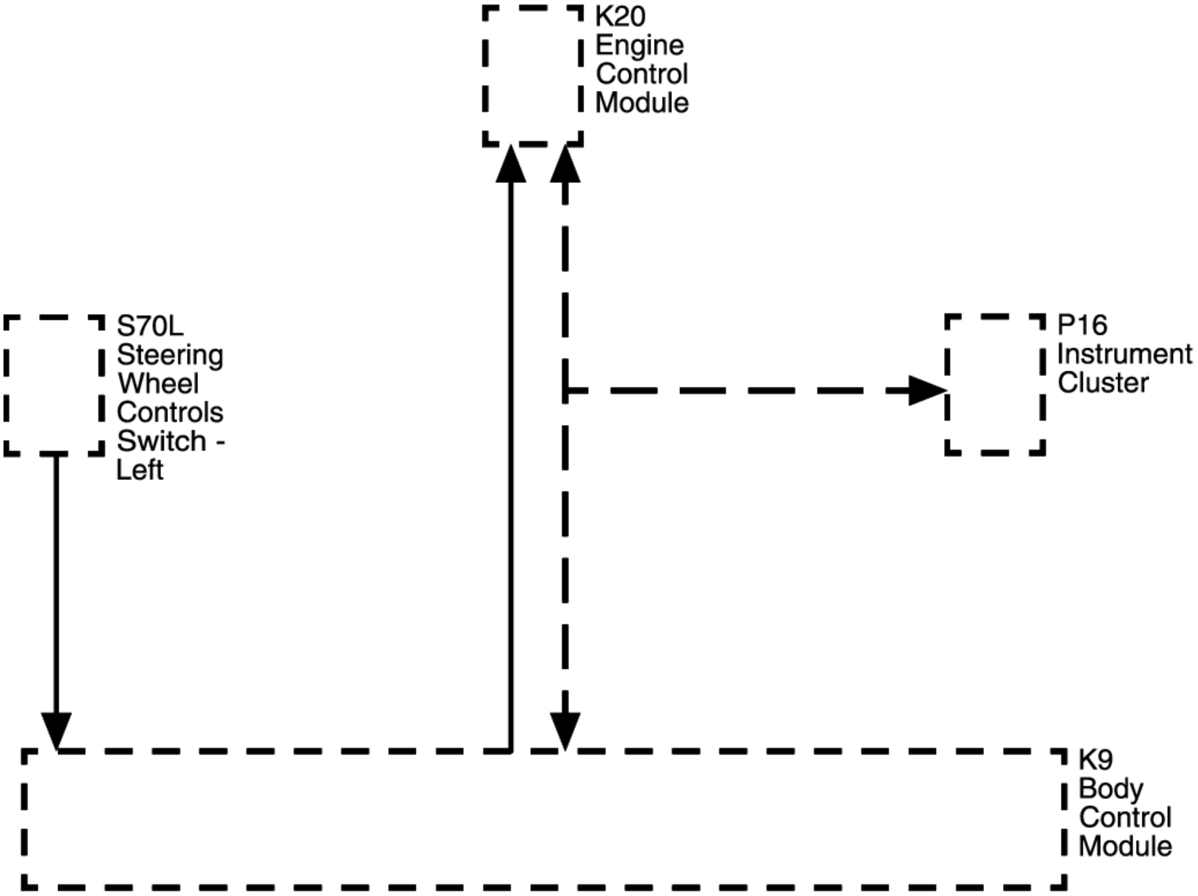

K20 Engine Control Module
S70L Steering Wheel Controls Switch - Left
P16 Instrument Cluster
K9 Body Control Module

Fig. 4: Cruise Control System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K20	K20 Engine Control Module
S70L	S70L Steering Wheel Controls Switch - Left
P16	P16 Instrument Cluster
K9	K9 Body Control Module

Cruise control is a speed control system that maintains a desired vehicle speed under normal driving conditions at speeds above 40 km/h (25 mph). Steep grades may cause variations in the selected vehicle speeds.

The following are the main components of the Cruise Control System:

- The accelerator pedal
- The brake pedal position (BPP) sensor
- The body control module (BCM)
- The cruise on/off switch
- The cruise control cancel switch
- The + RES switch (equivalent to resume/accelerate switch)
- The - SET switch (equivalent to set/coast switch)
- The engine control module (ECM)
- The throttle actuator control (TAC) motor (gasoline engines only)
- The vehicle speed sensor

The body control module (BCM) monitors the signal circuit of the cruise control switches, which are located on the steering wheel. The BCM relays the cruise control switch status to the engine control module (ECM) via the serial data circuit. The ECM uses the status of the cruise control switch to determine when to capture and maintain the vehicle speed. The ECM monitors the vehicle speed signal circuit in order to determine the desired vehicle speed.

Voltage is supplied to the cruise control switch via the steering wheel control switch reference voltage circuit supplied by the BCM. The cruise control function switches are arranged in a resistive ladder design, with each cruise control function switch having a different resistance value. The BCM detects a specific voltage value that is associated with the cruise control function switch being activated. The BCM sends a serial data message to the ECM indicating that the on/off switch is active. Similarly, when the normally open + RES switch or the normally open - SET switch are pressed, the switch closes and the BCM detects the predetermined voltage signal on the cruise control resume/accel and set/coast switch signal circuit. The BCM sends a serial data message to the ECM indicating that the + RES switch or the - SET switch is active.

Cruise Control Engaged

The Cruise Control System will engage and adjust vehicle speeds, based on the activation of the following cruise control switches, which are located on the steering wheel:

- On/Off
- + RES
- - SET

To engage the Cruise Control System, ensure that the vehicle speed is above 40.2 km/h (25 mph), turn the cruise On/Off switch ON and momentarily press the - SET switch. The ECM will engage the Cruise Control System and record the vehicle speed. The ECM sends a serial data message to the instrument panel cluster (IPC) in order to illuminate the Cruise Engaged indicator in the IPC. Refer to the vehicle owner's manual for the location and operation of the cruise control On/Off indicators and driver information center (DIC) messages.

Pressing the accelerator pedal while the Cruise Control System is engaged, allows the driver to override the Cruise Control System in order to accelerate the vehicle beyond the current set vehicle speed. When the accelerator pedal is released, the vehicle will decelerate and resume the current set vehicle speed.

The driver can also override the current set vehicle speed via the - SET switch and the + RES switch. When the Cruise Control System is engaged, pressing and holding the - SET switch will allow the vehicle to decelerate from the current set vehicle speed without deactivating the Cruise Control System. When the - SET switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing the - SET switch will allow the vehicle to decelerate at a vehicle specific calibratable increment, commonly 1 km/h or 1 mph, each time that the - SET is momentarily pressed, with a minimum vehicle speed of 38 km/h (24 mph). Refer to the vehicle Owner's Manual for more information.

Pressing and holding the + RES switch, when the Cruise Control System is engaged, will allow the vehicle to accelerate to a greater vehicle speed than the current set vehicle speed. When the + RES switch is released, the ECM will record the vehicle speed and maintain the vehicle speed as the new set vehicle speed. When the Cruise Control System is engaged, momentarily pressing the + RES switch will allow the vehicle to accelerate at a vehicle specific calibratable increment, commonly 1 km/h or 1 mph, each time that the + RES switch is momentarily pressed. Momentarily activating the + RES switch will recall the previous vehicle speed, after the cruise control system has been disengaged by pressing the brake pedal, or CANCEL switch. Refer to the vehicle Owner's Manual for more information.

Cruise Control Disengaged

The engine control module (ECM) disengages the cruise control operation based on the signals from the following switches:

- The brake pedal position (BPP) sensor
- The On/Off switch
- The cruise control cancel switch

The Cruise Control System will disengage when the brake pedal is applied. The body control module (BCM) monitors the BPP sensor via the BPP sensor signal circuit as the voltage signal increases while the pedal is further applied. The ECM monitors the BPP signal through a discrete input and a serial data message signal from the BCM indicating the brake status. When either signal indicates the brake pedal is applied, the ECM will disengage the cruise control system.

The Cruise Control System will also disengage when the cruise control on/off switch is switched OFF, or the cruise control cancel switch is activated. The body control module (BCM) determines when the cruise control cancel switch is activated. When the normally open cancel switch is closed, the BCM detects the predetermined voltage signal on the cruise control function switch circuit. The vehicle speed stored in the memory of the engine control module will be erased when the cruise control On/Off switch is turned OFF, or the ignition switch is turned OFF. The BCM sends a serial data message to the ECM in order to disengage the cruise control system. When the Cruise Control System has been disengaged, the ECM sends a serial message to the instrument panel cluster (IPC) in order to turn OFF the Cruise Engaged indicator.

Every time the Cruise Control System is disengaged, the ECM will keep track of the reason for system disengagement. The last 8 disengagement reasons will be recorded within the ECM memory. The scan tool will display the last 8 Cruise Disengage History parameters, in which one out of approximately 50 possible reasons will be displayed in each of these 8 parameters. For the disengagement reason to be displayed within the scan tool parameter the Cruise Control System is active and disengagement is requested.

When engagement of the system is requested but an engagement inhibit is present, the most recent inhibit reason is recorded in the ECM history. The scan tool will display the most recent inhibit reason, in which one out of approximately 50 possible reasons will be displayed.

Cruise Control Inhibited

The engine control module (ECM) inhibits the cruise control operation when any of the following conditions exist:

- The ECM has not detected a brake pedal activation from the body control module (BCM) this ignition cycle.
- A Cruise Control System DTC has been set.
- The vehicle speed is less than 38.6 km/h (24 mph).
- The vehicle speed is too high.
- The vehicle is in PARK, REVERSE, NEUTRAL, or 1st gear.
- The engine RPM is low.
- The engine RPM is high.
- The system voltage is not between 9 volts and 16 volts.
- The Antilock Brake System (ABS)/Traction Control System (TCS) is active for more than a calibratable time (typically 0.3 to 0.7 seconds).

Cruise Control Inhibit Reasons

This is a general list of inhibit reasons. Not every inhibit reason is applicable to all vehicles. Refer to the scan tool inhibit reason list for the last 8 reasons that have been recorded during the current ignition cycle.

Scan Tool Name	Description	Long Description
Acceleration Rate too High	High acceleration	The vehicle acceleration rate is too high.
Acceleration Time	Rate limiting fault	Cruise torque request rate limiting active too long.
Adaptive Cruise Control Configuration Incorrect	Adaptive cruise control option mismatch	The cruise control type (adaptive cruise or conventional cruise) is mismatched between the engine control module (ECM) and the body control module (BCM).
Antilock Braking System Active	Antilock Braking System Active	The antilock braking system was active. Only reported on enhanced cruise control vehicles.

Scan Tool Name	Description	Long Description
Automatic Braking Engine Torque Request Signal Communication Malfunction	Automatic braking engine torque request signal communication malfunction	An engine control module to electronic brake control module (EBCM) serial data fault is active or communication has been lost between the modules.
Automatic Braking Malfunction	Brake system malfunction	The electronic brake control module has detected a failure that does not allow automatic braking to be performed.
Axle Torque Serial Communication Malfunction	Axle Torque Serial Communication Malfunction	The adaptive cruise control is being inhibited by the ECM because a serial data signal timeout error has occurred with the hybrid max/min torque signals.
Battery Voltage Too High	Voltage above high voltage threshold	The ignition voltage is too high at the engine control module (typically 18 volts).
Battery Voltage Too Low	Voltage below low voltage threshold	The ignition voltage is low at the engine control module (typically 9 volts).
Brake Pedal Applied	Brake pedal apply	The brake pedal was applied.
Brake Pedal Not Initialized	Brake before cruise	The brake pedal has not been seen as applied prior to driver request to engage cruise with set switch. A brake pedal apply must be seen before allowing cruise engagement during each key cycle. On a vehicle equipped with a manual transmission, a clutch pedal apply may satisfy the brake pedal apply criteria.
Brake Pedal Position Malfunction	Brake pedal position signal invalid	A brake pedal apply circuit fault has been detected.
Brake Pedal Position Signal Malfunction	DTC P0703 is active or maximum time elapsed without receiving a valid Brake Pedal Position signal.	A serial data fault is active or communication has been lost with the module sending the brake pedal apply state.
Brake Pedal Pressure Detected	Brake pedal driver applied pressure detected	A brake pedal apply has been detected based on brake pedal pressure as measured by the electronic brake control module.
Brake Pedal Released Position Not Learned	Brake apply sensor home position not learned	The brake pedal position sensor released position is not learned.
Brake System Malfunction	Adaptive cruise control automatic braking failed	Adaptive cruise control automatic braking inoperative.
Calculated Torque	Calculated engine torque	The engine torque calculation is incorrect.
Clutch Pedal Applied	Clutch switch active	The clutch pedal was applied.
Coast Below Minimum Speed	Coast below low speed inhibit	The Set/Coast switch was depressed and the vehicle slowed below the minimum cruise control operating speed.
Coast Mode	Coast disengage	Cruise control is in coast mode with the Set/Coast switch depressed and is requesting no throttle.
Control Function Active	DLC override	A scan tool is plugged into the Data Link Connector (DLC) connector.

Scan Tool Name	Description	Long Description
Control Module Memory Malfunction	Memory failure	A control module memory failure has been detected.
Control Module Processor Malfunction	Processor integrity fault (random access memory corruption)	An engine control module software error has occurred.
Crawl Mode Active	Crawl Mode Active	Crawl mode is active and inhibiting cruise control.
Cruise Control Cancel Switch Active	Cancel switch active	The cruise control cancel switch was depressed.
Cruise Control Software Malfunction	Sequence of completion checks	A cruise control software execution error has occurred.
Cruise Control Switch Inactive	On/Off switch in Off state	The cruise control On/Off switch is turned off.
Cruise Control Switch Invalid	Analog cruise switch input out of range	The cruise control switch voltage signal is in an invalid range.
Cruise Control Switch Serial Communication Malfunction	Serial data fault (cruise switch serial communication fault)	The cruise control switch serial data fault is active or communication has been lost with the module sending cruise control switch states.
Deceleration Rate Too High	High deceleration	The vehicle deceleration rate is too high.
Diagnostic Trouble Code (DTC) Set	Malfunction in PCM/ECM (DTC active)	A DTC is active or in history that inhibits cruise control operation.
Distance Sensing Cruise Control Brake Pedal Applied	Distance Sensing Cruise Control Brake Pedal Applied	Adaptive cruise control is being inhibited by the ECM because a brake pedal apply has occurred.
Distance Sensing Cruise Control Cancel Switch Active	Distance Sensing Cruise Control Cancel Switch Active	Adaptive cruise control is being inhibited by the ECM because the driver applied the cancel switch.
Distance Sensing Cruise Control Data	Serial data fault for adaptive cruise control throttle control and brake control signals sent by the distance sensing cruise control module	A distance sensing cruise control module serial data fault is active or communication has been lost between the distance sensing cruise control module and the engine control module.
Distance Sensing Cruise Control Inhibit	Distance sensing cruise control inhibited	The distance sensing cruise control system is inhibited.
Distance Sensing Cruise Control Invalid Engage	Distance Sensing Cruise Control Invalid Engage	Adaptive cruise control is being inhibited by the ECM because an invalid sequence of cruise control applies, brake pedal applies, or an invalid speed range has been detected.
Distance Sensing Cruise Control Off	Distance Sensing Cruise Control Off	Adaptive cruise control is being inhibited by the ECM because the driver has turned off the cruise on/off switch.
Distance Sensing Cruise Control Reduced Engine Power	Distance Sensing Cruise Control Reduced Engine Power	Adaptive cruise control is being inhibited by the ECM due to a fault resulting in "Reduced Engine Power".
Driven Wheel Speed Higher Than Non Driven Wheel Speed	Driven wheel speed greater (wheel slip detection)	The driven wheel speed is greater than the non driven wheel speed (slip detection).
Engine Control Module	PCM/ECM inhibit (RAM corruption)	Engine control module internal communication error.

Scan Tool Name	**Description**	**Long Description**
Engine Control Module (ECM) Reset	ECM running reset	An engine control module running reset has occurred.
Engine Overspeed Protection Active	Injectors disabled (engine overspeed fuel cut-off active)	Engine RPM limiter active with fuel cut off active.
Engine Overtemperature Protection Active	Engine metal overtemp active	The engine is over temperature. The engine is overheated.
Engine Run Time	Engine run time not elapsed	The engine has not been running long enough, typically five seconds.
Engine Speed	Engine speed too low or too high	The engine RPM is too low (near stall) or too high (near engine RPM fuel shutoff).
Excessive Accelerator Position Override	Pedal greater than cruise (override)	The driver has overridden cruise control set speed with accelerator pedal for greater than an allowable time.
1st Gear	First Gear	Transmission is engaged in 1st gear.
Gear Change without Applied Clutch Pedal	Manual transmission out of gear with no clutch pedal apply	Manual transmission shifted to Neutral without clutch pedal being applied.
Hill Descent Control Active	Hill Descent Control System Active	The hill descent control system has gone active.
Hill Descent Control Serial Communication Malfunction	Hill Descent Control Serial Communication Malfunction	An electronic brake control module serial data fault is active or communication has been lost between the EBCM and ECM.
Hybrid/EV System	Hybrid Cruise Disengage	Cruise control is inhibited on hybrid applications when "Regen on Demand" is requested by the driver via the tap-up/tap-down paddles.
Illegal Mode	Illegal cruise mode	The cruise control mode is incorrect based on switch states.
Lane Center Control Serial Data Error	Lane Center Control Serial Communication Malfunction	Adaptive cruise control is being inhibited by the ECM because a serial data error has been detected on a vehicle with Lane Center Control.
Non Driven Wheel Speed Higher Than Drive Wheel Speed	Non-driven wheel speed greater	The non driven wheel speed is greater than the driven wheel speed.
None	None	This disengagement reason may be displayed after a dead battery repair or module replacement.
Park Brake Applied	Park brake switch signal active	The parking brake is applied.
Power Take-Off Active	Power Take Off active	The Power Take Off (PTO) system is active.
Rear Axle in Low Range	Rear axle in low	The rear axle is in low range.
Set/Coast and Resume/Accelerate Switches Active Simultaneously	SET and RESUME switches simultaneously active	The Set/Coast and Resume/Accelerate switches were pressed simultaneously.
Set/Coast Switch Active With Vehicle Speed Higher Than Set Point	Over schedule tap-down	The Set/Coast switch is selected, vehicle speed is above set speed and does not decrease. May be due to traveling down hill.

Scan Tool Name	Description	Long Description
Speed Limiting/Warning System On	Speed limiter/warning On/Off switch turned on	Driver has turned on the Speed Limiter/Warning on/off switch. Cruise is disabled/inhibited and cruise on/off switch will be set to Off.
Throttle Actuator Control System	Electronic throttle control prevents cruise operation	The electronic throttle control system has detected a failure in the throttle control hardware.
Traction Control Active	Traction control active	The traction control system was active.
Traction Control System Malfunction	Traction Control System Malfunction	A fault is present in the traction control system.
Traction Control System Off	Traction Control System Off	The traction control system has been turned off by the driver.
Transfer Case in 4WD Low Range	Transfer case in 4WD Low	The transfer case is in low range.
Transmission Gear Ratio Malfunction	Transmission gear fault	A transmission DTC is active or in history, that inhibits cruise control operation.
Transmission Not in Forward Gear	Transmission in neutral, reverse or park	The transmission gear selector is not in a forward gear.
Vehicle Overspeed Protection Active	MPH limited fuel (vehicle overspeed fuel cut-off active)	The vehicle overspeed protection is active with fuel cut off active.
Vehicle Speed Higher Than Set Point	Over schedule	Vehicle speed has exceeded driver selected set speed by more than an allowable amount. This may occur while driving down a significant grade or driver overriding cruise while performing a passing maneuver.
Vehicle Speed Lower Than Set Point	Under schedule	The vehicle speed is below cruise control set speed by more than an allowable amount.
Vehicle Speed Too High	Vehicle speed exceeds high speed threshold	Vehicle speed has exceeded maximum cruise operating speed.
Vehicle Speed Too Low	Vehicle speed drops below low speed threshold	Vehicle speed dropped below the cruise control minimum operating speed. May be due to hilly terrain and low vehicle speed. Manual transmission gear selection and engine torque may contribute to this disengagement reason.
Vehicle Stability System Active	Vehicle stability control active	The vehicle stability control system was active.
Vehicle Stability System Malfunction	Vehicle Stability System Malfunction	A fault has been detected in the vehicle stability control system.
Vehicle Stability System Off	Vehicle Stability System Off	The vehicle stability control system has been turned off by the driver.

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Data Communications - Description and Operation - Bolt EV

DESCRIPTION AND OPERATION

BODY CONTROL SYSTEM DESCRIPTION AND OPERATION

The body control system consists of the body control module (BCM), communications, and various input and outputs. Some inputs, outputs and messages require other modules to interact with the BCM. The BCM also has discrete input and output terminals to control the vehicle's body functions. The BCM is wired to the high speed GMLAN serial data bus, low speed GMLAN serial data bus and Multiple LIN buses and acts as a gateway between them.

Power Mode Master

This vehicle body control module (BCM) functions as the power mode master (PMM). The ignition switch is a low current switch with multiple discrete ignition switch signals to the PMM for determining the power mode that will be sent over the serial data circuits to the other modules that need this information; the PMM will activate relays and other direct outputs of the PMM as needed. Refer to **Power Mode Description and Operation** for a complete description of power mode functions.

Gateway

The body control module (BCM) in this vehicle functions as a gateway or translator. The purpose of the gateway is to translate serial data messages between the GMLAN high speed bus and the GMLAN low speed bus for communication between the various modules. The gateway will interact with each network according to that network's transmission protocol.

All communication between the BCM and a scan tool is on the high speed GMLAN serial data circuits. A lost communication DTC typically is set in modules other than the module with a communication failure.

Body Control

The various body control module (BCM) input and output circuits are illustrated in the corresponding functional areas on the BCM electrical schematics. Refer to the **Body Control System Schematics** for more detailed information.

DATA LINK COMMUNICATIONS DESCRIPTION AND OPERATION

NOTE: **This is an overview of different serial data buses used by GM devices to communicate with each others. Use Data Communication Schematics to find out which serial data buses are configured for a specific vehicle.**

Circuit Description

There are many components in a vehicle that rely on information from other sources, transmit information to other sources, or both. Serial data communication networks provide a reliable, cost effective, way for various components of the vehicle to "talk" to one another and share information.

GM uses a number of different communication buses to insure the timely and efficient exchange of information between devices. When compared to each other, some of these buses are different in nature as far as speed, signal characteristics, and behavior. An example of this is the High Speed GMLAN and Low Speed GMLAN buses.

On the other hand, when other buses are compared to each other they have similar characteristics and simply operate in parallel. In this case they are used to group together components which have high interaction. Examples are the High Speed GMLAN, Powertrain Expansion, and Chassis Expansion buses. This allows them to communicate with each other on a bus with reduced message congestion insuring faster and the more timely exchange of information than if all vehicle devices were on a single bus.

The majority of information that exists within a given network generally stays local; however some information will have to be shared on other networks. Control modules designated as Gateway's perform the function of transferring information between the various buses. A Gateway module is connected to at least 2 buses and will interact with each network according to its message strategy and transmission models.

GMLAN provides the capability for a receiving device to monitor message transmissions from other devices in order to determine if messages of interest are not being received. The primary purpose is to allow reasonable default values to be substituted for the information no longer being received. Additionally, a device may set a Diagnostic Trouble Code to indicate that the device it is expecting information from is no longer communicating.

High Speed GMLAN Circuit Description

A High Speed GMLAN Bus is used where data needs to be exchanged at a high enough rate to minimize the delay between the occurrence of a change in sensor value and the reception of this information by a control device using the information to adjust vehicle system performance.

The High Speed GMLAN serial data network consists of two twisted wires. One signal circuit is identified as GMLAN-High and the other signal circuit is identified as GMLAN-Low. At each end of the data bus there is a 120 Ω termination resistor between the GMLAN-High and GMLAN-Low circuits.

Data symbols (1's and 0's) are transmitted sequentially at a rate of 500 Kbit/s. The data to be transmitted over the bus is represented by the voltage difference between the GMLAN-High signal voltage and the GMLAN-Low signal voltage.

When the two wire bus is at rest the GMLAN-High and GMLAN-Low signal circuits are not being driven and this represents a logic "1". In this state both signal circuits are at the same voltage of 2.5 V. The differential voltage is approximately 0 V.

When a logic "0" is to be transmitted, the GMLAN-High signal circuit is driven higher to about 3.5 V and the GMLAN-Low circuit is driven lower to about 1.5 V. The differential voltage becomes approximately 2.0 (+/- 0.5) V.

Chassis High Speed GMLAN Circuit Description

The GMLAN Chassis Expansion Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for chassis components. This implementation splits message congestion between two parallel buses helping to insure timely message transmission and reception. Sometimes communication is required between the Chassis Expansion Bus and the primary High Speed GMLAN Bus. This is accomplished by using the K17 Electronic Brake Control Module (EBCM) as the Gateway module. Since the High Speed GMLAN Chassis Expansion Bus and primary High Speed GMLAN Bus operate in the same manner, the diagnostics for each are similar.

Powertrain High Speed GMLAN Circuit Description

The GMLAN Powertrain Expansion Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for Hybrid powertrain components or Diesel powertrain components in some cases. The bus is optional based upon feature content. Sometimes communication is required between the Powertrain Expansion Bus and the primary High Speed GMLAN Bus. This is accomplished by using the K20 Engine Control Module (ECM) as the Gateway module. Since the High Speed GMLAN Powertrain Expansion Bus and the primary High Speed GMLAN Bus operate in the same manner, the diagnostics for each are similar.

All diagnostic information is available only through the primary high speed GMLAN bus.

High Voltage Energy Management High Speed GMLAN Circuit Description

The GMLAN High Voltage Energy Management Bus is basically a copy of the High Speed GMLAN Bus except that its use is reserved for Hybrid charging components of an electric vehicle. Sometimes communication is required between the Low Speed GMLAN Bus and the High Voltage Energy

Management Bus. This is accomplished by using the K114B Hybrid Powertrain Control Module 2 as the Gateway module. Since the High Speed GMLAN High Voltage Energy Management Bus and primary High Speed GMLAN Bus operate in the same manner, the diagnostics for each are similar.

All diagnostic information is available only through the primary high speed GMLAN bus.

Gateway Isolated High Speed GMLAN Circuit Description

NOTE: **Continuity check cannot be performed between the X84 Data Link Connector (or control modules on the primary High Speed GMLAN Bus) and control modules on the Gateway Isolated High Speed GMLAN Bus.**

The Gateway Isolated High Speed GMLAN Bus is an extension of the primary High Speed GMLAN Bus except it is separated from the primary High Speed GMLAN Bus by the K56 Serial Data Gateway Module for cybersecurity protection. The K56 Serial Data Gateway Module verifies data messages being transmitted from the control modules on the Gateway Isolated High Speed GMLAN Bus back to the primary High Speed GMLAN Bus are good with valid transmitter messages. This bus does not terminate to the X84 Data Link Connector.

The Gateway Isolated High Speed GMLAN Bus consists of two twisted wires. One signal circuit is identified as GMLAN-High and the other signal circuit is identified as GMLAN-Low. At each end of the data bus there is a 120 Ω termination resistor between the GMLAN-High and GMLAN-Low circuits.

Gateway Expansion High Speed GMLAN Circuit Description

NOTE: **Continuity check cannot be performed between the X84 Data Link Connector (or control modules on the primary High Speed GMLAN Bus) and control modules on the Gateway Expansion High Speed GMLAN Bus.**

The Gateway Expansion High Speed GMLAN Bus is not cybersecurity protected and does not terminate at the X84 Data Link Connector. This expansion bus is created to alleviate the throughput on the primary High Speed GMLAN Bus.

The Gateway Expansion High Speed GMLAN Bus consists of two twisted wires. One signal circuit is identified as GMLAN-High and the other signal circuit is identified as GMLAN-Low. At each end of the data bus there is a 120 Ω termination resistor between the GMLAN-High and GMLAN-Low circuits.

Ethernet Circuit Description

At the core of the infotainment system is the Radio Ethernet Audio Video Bridging switch which communicates directly to each contributing Infotainment module terminator. The Ethernet harness consists of twisted pair wires from point to point. Each device on the Ethernet infotainment system sends/receives data at 100 Mbit/s to/from a specified port at the Radio. The Radio/Ethernet will also be used to program USB software update files to the devices connected to the Ethernet ports.

The Radio is the Ethernet master. The Radio communicates with other devices and systems in the vehicle via GMLAN and LIN. Diagnostic Trouble Codes will be read on GMLAN to diagnose Ethernet, LIN and system faults. GMLAN will also be used for programming calibrations.

Low Speed GMLAN Circuit Description

Low Speed GMLAN Bus is used in applications where a high data rate is not required which allows for the use of less complex components. It is typically used for operator controlled functions where the response time requirements are slower than those required for dynamic vehicle control.

The Low Speed GMLAN Serial Data Network consists of a single wire, ground referenced bus with high side voltage drive. During on road vehicle operation data symbols (1's and 0's) are transmitted sequentially at the normal rate of 33.3 Kbit/s. For component programming only, a special high speed data mode of 83.3 Kbit/s may be used.

Unlike the high speed dual wire networks, the single wire low speed network does not use terminating resistors at either end of the network.

The data symbols to be transmitted over the bus are represented by different voltage signals on the bus. When the Low Speed GMLAN Bus is at rest and is not being driven, there is a low signal voltage of approximately 0.2 V. This represents a logic "1". When a logic "0" is to be transmitted, the signal voltage is driven higher to around 4.0 V or higher.

Gateway Isolated Low Speed GMLAN Circuit Description

NOTE: **Continuity check cannot be performed between the X84 Data Link Connector (or control modules on the primary Low Speed GMLAN Bus) and control modules on the Gateway Isolated Low Speed GMLAN Bus.**

The Gateway Isolated Low Speed GMLAN Bus is an extension of the primary Low Speed GMLAN Bus except it is separated from the primary Low Speed GMLAN Bus by the K56 Serial Data Gateway Module for cybersecurity protection. The K56 Serial Data Gateway Module verifies data messages being transmitted from the control modules on the Gateway Isolated Low Speed GMLAN Bus back to the primary Low Speed GMLAN Bus are good with valid transmitter messages. This bus does not terminate to the X84 Data Link Connector.

Local Interconnect Network (LIN) Circuit Description

The Local Interconnect Network (LIN) Bus consists of a single wire with a transmission rate of 10.417 Kbit/s. This bus is used to exchange information between a master control module and other smart devices which provide supporting functionality. This type of configuration does not require the capacity or speed of either a High Speed GMLAN Bus or Low Speed GMLAN Bus and is thus relatively simpler.

The data symbols (1's and 0's) to be transmitted are represented by different voltage levels on the communication bus. When the LIN Bus is at rest and is not being driven, the signal is in a high voltage state of approximately Vbatt. This represents a logic "1". When a logic "0" is to be transmitted, the signal voltage is driven low to about ground (0.0 V).

Communication Enable Circuit Description

Devices on High Speed GMLAN Bus enable or disable communication based on the voltage level of the communication enable circuit. When the circuit voltage is high (around 12 V), communications are enabled. When the circuit is low, communications are disabled.

Data Link Connector (DLC)

The X84 Data Link Connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Terminal 1: Low speed GMLAN communications terminal
- Terminal 2: Class 2 communications terminal
- Terminal 3: Object high speed GMLAN serial bus (+) terminal
- Terminal 4: Scan tool power ground terminal
- Terminal 5: Common signal ground terminal
- Terminal 6: High speed GMLAN serial data bus (+) terminal
- Terminal 7: Keyword communications terminal
- Terminal 11: Object high speed GMLAN serial bus (-) terminal
- Terminal 12: Chassis high speed GMLAN serial bus (+) terminal
- Terminal 13: Chassis high speed GMLAN serial bus (-) terminal
- Terminal 14: High speed GMLAN serial data bus (-) terminal
- Terminal 16: Scan tool power, battery positive voltage terminal

Auxiliary Data Connector

The X84B Auxiliary Data Connector is a standardized 16-cavity connector. The pinouts for this X84B Auxiliary Data Connector are as follows:

- Terminal 3: High Voltage Energy Management high speed GMLAN serial bus (+) terminal

- Terminal 4: Scan tool power ground terminal
- Terminal 5: Common signal ground terminal
- Terminal 8: Ground terminal for Auxiliary Data Connector identification
- Terminal 11: High Voltage Energy Management high speed GMLAN serial bus (-) terminal
- Terminal 12: Powertrain high speed GMLAN serial bus (+) terminal
- Terminal 13: Powertrain high speed GMLAN serial bus (-) terminal
- Terminal 16: Scan tool power, battery positive voltage terminal

Serial Data Reference

The scan tool communicates over the various buses on the vehicle. When a scan tool is installed on a vehicle, the scan tool will try to communicate with every device that could be optioned into the vehicle. If an option is not installed on the vehicle, the scan tool will display No Comm (or Not Connected) for that optional device. In order to avert misdiagnoses of No Communication with a specific device, refer to **Data Link References** for a list of devices and the buses they communicate with. Use schematics and specific vehicle build RPO codes to determine optional devices.

SERIAL DATA GATEWAY MODULE DESCRIPTION AND OPERATION

The K56 Serial Data Gateway Module is used to handle communications between multiple GMLAN busses and functions as a gateway to isolate the secure networks from the unsecured networks. It was created to mitigate bus loading to support cyber security and new active/advanced safety features like Limited Ability Autonomous Driving and Enhanced Collision Avoidance (if equipped). The K56 Serial Data Gateway Module is used as a frame-to-frame gateway for all functional messages.

Depending on the vehicle contents, the K56 Serial Data Gateway Module is gating between primary High Speed GMLAN Bus, Gateway Expansion High Speed GMLAN Bus, Gateway Isolated High Speed GMLAN Bus, and Chassis High Speed GMLAN Bus. The K56 Serial Data Gateway Module is also gating between primary Low Speed GMLAN Bus and Gateway Isolated Low Speed GMLAN Bus.

Communication between the K56 Serial Data Gateway Module and a scan tool is done through the primary High Speed GMLAN Bus.

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DIAGNOSTIC INFORMATION AND PROCEDURES

CONTROL MODULE U CODE LIST

This list includes all Data Communications related U-code DTCs in alphanumeric order with descriptors for all devices. Not all DTCs listed will be applicable to all vehicles.

For symptom byte information, refer to Symptom Byte List .

DTC	DTC Descriptor
U0001	High Speed CAN Bus Malfunction
U0002	High Speed CAN Bus
U0009	High Speed CAN Bus [-] Shorted to Bus [+]
U0020	Low Speed CAN Bus
U0028	MOST Bus
U0029	MOST Bus Performance
U0073	Control Module Communication Bus A Off
	Control Module Communication High Speed CAN Bus Off
U0074	Control Module Communication Bus B Off
	Control Module Communication Powertrain Expansion CAN Bus Off
U0075	Control Module Communication Object Detection CAN Bus Off
U0076	Control Module Communication Powertrain Sensor CAN Bus Off
U0077	Control Module Communication Chassis Expansion CAN Bus Off
U0078	Control Module Communication Low Speed CAN Bus Off
U007A	Control Module Communication High Voltage Energy Management CAN Bus Off
U007B	Control Module Communication High Speed Extension CAN Bus Off
U007C	Control Module Communication High Speed Extension CAN Bus 2 Off
U007D	Control Module Communication Low Speed Extension CAN Bus Off
U007E	Control Module Communication FlexRay 1A Bus Off
U007F	Control Module Communication FlexRay 1B Bus Off
U0100	Lost Communication With Engine Control Module
U0101	Lost Communication With Transmission Control Module
U0102	Lost Communication with Transfer Case Control Module
U0103	Lost Communication with Shift Lever Module
U0104	Lost Communication With Cruise Control Module
U0105	Lost Communication with Fuel Injector Control Module
U0106	Lost Communication with Glow Plug Control Module
U0109	Lost Communication with Fuel Pump Control Module *(2013 and prior)*
	Lost Communication with Chassis Control Module *(2014 and beyond)*
U010C	Lost Communication with Turbocharger Boost Control Module
U010E	Lost Communication with Reductant Sensor Module
U010F	Lost Communication with Air Conditioning Control Module
U0111	Lost Communication with Battery Energy Control Module
U0112	Lost Communication with Battery Energy Control Module
U0114	Lost Communication with Four Wheel Drive Clutch Control Module
U0115	Lost Communication with Engine Control Module B
U0117	Lost Communication With Power Take-Off Control Module

DTC	DTC Descriptor
U0121	Lost Communication With Electronic Brake Control Module
U0122	Lost Communication With Vehicle Stability Control Module
U0123	Lost Communication with Yaw Rate Sensor Module
U0125	Lost Communication With Multi-Axis Acceleration Sensor Module
U0126	Lost Communication With Steering Wheel Angle Sensor Module
U0128	Lost Communication With Park Brake Control Module
U0129	Lost Communication with Brake System Control Module
U012A	Lost Communication With Chassis Control Module
U0130	Lost Communication With Power Steering Control Module
U0131	Lost Communication With Power Steering Control Module
U0132	Lost Communication With Suspension Control Module
U0133	Lost Communication With Air Suspension Control Module
U0134	Lost Communication with Power Steering Control Module - Rear
U0136	Lost Communication With Differential Control Module - Rear
U0137	Lost Communication with Trailer Brake Control Module
U0139	Lost Communication With Suspension Control Module 2
U0140	Lost Communication With Body Control Module
U0146	Lost Communication with Serial Data Gateway Module
U0151	Lost Communication With Inflatable Restraint Sensing and Diagnostic Module
U0154	Lost Communication with Passenger Presence Module
U0155	Lost Communication With Instrument Cluster
U0158	Lost Communication With Head-Up Display
U0159	Lost Communication With Parking Assist Control Module
U0160	Lost Communication With Chime Alarm Control Module
U0164	Lost Communication with HVAC Control Module
U0166	Lost Communication with Auxiliary Heater Control Module
U0167	Lost Communication with Immobilizer Control Module
U0168	Lost Communication With Keyless Entry Control Module
U016B	Lost Communication with Electric A/C Compressor Control Module
U0170	Lost Communication with Passenger Presence Detection Sensor Module
U017E	Lost Communication with Seat Belt Retractor Motor Module
U0181	Lost Communication with Automatic Headlamp Leveling Control Module
U0182	Lost Communication With Lighting Control Module - Front
U0184	Lost Communication With Radio
U0186	Lost Communication With Speaker Amplifier Module
U0196	Lost Communication With Rear Audio Control Module
U0191	Lost Communication With Television
U0193	Lost Communication With Digital Radio Receiver Control Module
U0197	Lost Communication With Telephone Control Module
U0198	Lost Communication with Telematics Communication Interface Control Module
U019E	Lost Communication With Transmission Range Control Module
U01A0	Lost Communication with Hybrid/EV Battery Interface Control Module 1
U01A1	Lost Communication with Hybrid/EV Battery Interface Control Module 2
U01A2	Lost Communication with Hybrid/EV Battery Interface Control Module 3
U01A3	Lost Communication with Hybrid/EV Battery Interface Control Module 4
U01A4	Lost Communication with Hybrid/EV Battery Interface Control Module 5
U01A5	Lost Communication with Hybrid/EV Battery Interface Control Module 6
U01A6	Lost Communication with Hybrid/EV Battery Interface Control Module 7
U01A7	Lost Communication with Hybrid/EV Battery Interface Control Module 8
U01B0	Lost Communication with Battery Monitor Module

DTC	DTC Descriptor
U01B4	Lost Communication with Brake System Control Module 2
U0201	Lost Communication with Passenger Door Switch Panel Control Module
U0203	Lost Communication With Left Rear Door Switch Panel Control Module
U0204	Lost Communication With Right Rear Door Switch Panel Control Module
U0207	Lost Communication With Moveable Roof Control Module
U0208	Lost Communication with Seat Memory Control Module
U0209	Lost Communication With Front Seat Heating Control Module
U0210	Lost Communication With Rear Seat Heating Control Module
U0230	Lost Communication With Liftgate Control Module
U0231	Lost Communication with Rain Sensor Module
U0232	Lost Communication with Side Object Detection Control Module - Left
U0233	Lost Communication with Side Object Detection Control Module - Right
U0236	Lost Communication With Steering Column Lock Module
U0237	Lost Communication With Multimedia Player Interface Module
U023A	Lost Communication With Vehicle Direction Camera Control Module *(without UGN)*
	Lost Communication With Active Safety Control Module 1 *(with UGN)*
U023B	Lost Communication with Active Safety Control Module 2
U023C	Lost Communication with Night Vision Camera Control Module
U0241	Lost Communication With Left Headlamp High Beam Control Module
U0242	Lost Communication With Right Headlamp High Beam Control Module
U0248	Lost Communication with Remote Accessory Module
U0249	Lost Communication with Rear Seat Entertainment Control Module
U0250	Lost Communication with Impact Classification System Module
U0252	Lost Communication With Trailer Interface Control Module
U0253	Lost Communication with Accessory Protocol Interface Module
U0254	Lost Communication With Remote Start Module
U0255	Lost Communication With Info Display Module
U0256	Lost Communication With Infotainment Faceplate Control Module
U0257	Lost Communication With Info Display Module/Infotainment Faceplate Control Module
U0259	Lost Communication with Special Purpose Vehicle Control Module
U025B	Lost Communication with Special Purpose Vehicle Control Module "C"
U025C	Lost Communication with Special Purpose Vehicle Control Module "D"
U0264	Lost Communication With Camera Module - Rear
U0265	Lost Communication with Left Front Short Range Radar Sensor Module
U0266	Lost Communication with Night Vision Camera
U0268	Lost Communication with Right Front Short Range Radar Sensor Module
U0269	Lost Communication with Front Long Range Object Sensor
U026A	Lost Communication with Frontview Camera Module
U026B	Lost Communication with Rear Short Range Object Sensor
	Lost Communication with Left Rear Short Range Radar Sensor Module
U026C	Lost Communication with Right Rear Short Range Radar Sensor Module
U026D	Lost Communication with Rear Middle Short Range Radar Sensor Module
U0284	Lost Communication with Active Grille Air Shutter 1 Motor Module
U0285	Lost Communication with Active Grille Air Shutter 2 Motor Module
U0293	Lost Communication with Hybrid/EV Powertrain Control Module
U0298	Lost Communication with DC/DC Converter Control Module
U029D	Lost Communication with NOx Sensor 1 Module
U029E	Lost Communication with NOx Sensor 2 Module
U02A3	Lost Communication With Particulate Matter Sensor Module
U0301	Software Incompatibility with Engine Control Module

DTC	DTC Descriptor
U0302	Software Incompatibility with Transmission Control Module
U0305	Software Incompatibility With Cruise Control Module
U0315	Software Incompatibility with Electronic Brake Control Module
U031C	Software Incompatibility With Brake System Control Module 2
U0401	Invalid Data Received From Engine Control Module
U0402	Invalid Data Received From Transmission Control Module
U0403	Invalid Data Received From Transfer Case Control Module
U0405	Invalid Data Received From Cruise Control Module
U0414	Invalid Data Received From Four Wheel Drive Clutch Control Module
U0415	Invalid Data Received From Electronic Brake Control Module
U0416	Invalid Data Received From Vehicle Dynamics Control Module
U0417	Invalid Data Received From Park Brake Control Module
U0418	Invalid Data Received From Brake System Control Module
U0420	Invalid Data Received From Power Steering Control Module
U0421	Invalid Data Received From Suspension Control Module
U0422	Invalid Data Received From Body Control Module
U0423	Invalid Data Received From Instrument Cluster
U0424	Invalid Data Received From HVAC Control Module
U0428	Invalid Data Received From Steering Wheel Angle Sensor Module
U042B	Invalid Data Received From Chassis Control Module
U0431	Invalid Data Received From Body Control Module "A"
U0432	Invalid Data Received From Multi-axis Acceleration Sensor Module
U0437	Invalid Data Received From Differential Control Module - Rear
U0438	Invalid Data Received From Trailer Brake Control Module
U0447	Invalid Data Received from Central Gateway Module
U0452	Invalid Data Received From Inflatable Restraint Sensing and Diagnostic Module
U045A	Invalid Data Received From Parking Assist Control Module "A"
U0465	Invalid Data Received From Power Take-Off Control Module
U0499	Invalid Data Received From Telematics Communication Interface Control Module
U0513	Invalid Data Received From Yaw Rate Sensor Module
U053B	Invalid Data Received From Active Safety Control Module 1
U053C	Invalid Data Received From Active Safety Control Module 2
U056B	Invalid Data Received From Frontview Camera Module
U0594	Invalid Data Received From Hybrid/EV Powertrain Control Module
U063E	Lost Communication with Exhaust Heat Exchanger Exhaust Bypass Valve
U0656	Lost Communication with Turbocharger Boost Control Position Sensor
U0657	Lost Communication with Turbocharger/Supercharger Bypass Valve "A" Position Sensor
U1032	Lost Communication with Vehicle Dynamic Sensor 1
U1033	Lost Communication with Vehicle Dynamic Sensor 2
U1067	Lost Communication with Digital Map Control Module
U1069	Lost Communication with Driver Monitoring System Control Module
U106A	Lost Communication with Multifunction Energy Storage Capacitor Control Module
U106B	Lost Communication with Multifunction Battery Isolator Control Module
U1112	Lost Communication with Left Headlamp Leveling Device
U1113	Lost Communication with Right Headlamp Leveling Device
U1114	Lost Communication with Left Headlamp Vertical Motor
U1115	Lost Communication with Right Headlamp Vertical Motor
U1343	Chassis Control Module LIN Bus 1

DTC	DTC Descriptor
U1345	Engine Control Module LIN Bus 1
U1347	Engine Control Module LIN Bus 3
U1359	Lost Communication with Transmission Range Indicator
U135A	Lost Communication with Shift to Park Range Actuator
U135B	Lost Communication with Sunload Sensor
U135C	Lost Communication with Start-Stop Capacitor Control Module
U135D	Lost Communication with Transmission Control Module on Chassis Control Module LIN Bus 2
U135E	Lost Communication with Transmission Control Module on Engine Control Module LIN Bus 1
U1501	LIN Bus
U1502	LIN Bus
U1505	LIN Bus
U1509	LIN Bus
	A26 HVAC Controls / P17 Info Display Module Lost Communication with K33 HVAC Control Module on LIN Bus
U150E	LIN Bus
	A22 Radio Controls / P17 Info Display Module Lost Communication with A11 Radio on LIN Bus
U150F	LIN Bus
	A22 Radio Controls / P17 Info Display Module Lost Communication with K74 Human Machine Interface Control Module on LIN Bus
	K161 Vehicle Performance Data Recorder Lost Communication with K74 Human Machine Interface Control Module on LIN Bus
U1510	A11 Radio Lost Communication with A20 Radio/HVAC Control / P17 Info Display Module on LIN Bus
	K9 Body Control Module Lost Communication with B67 Ultrasonic Intrusion Sensor / B165 Content Theft Deterrent Sensor Module on LIN Bus
	K20 Engine Control Module Lost Communication with M96 Active Grille Air Shutter Actuator / M60A Active Grille Air Shutter 1 Motor Module on LIN Bus
	K33 HVAC Control Module Lost Communication with A26 HVAC Controls / A20 Radio/HVAC Controls / P17 Info Display Module on LIN Bus
	K33 HVAC Control Module Lost Communication with A34 HVAC Controls - Auxiliary on LIN Bus
	K39 Liftgate Control Module Lost Communication with K171 Hands-Free Liftgate Sensor Control Module / S45A Liftgate Control Switch - Exterior on LIN Bus
	P16 Instrument Cluster Lost Communication with S70D Steering Wheel Controls Switch - Right Upper / S70R Steering Wheel Controls Switch - Right on LIN Bus
U1511	K20 Engine Control Module Lost Communication with M60B Active Grille Air Shutter 2 Motor Module on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
	K40 Seat Memory Control Module Lost Communication with K99 Steering Column Position Control Module on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342A UHF Low Energy Remote Control Access Sensor Transceiver 1 on LIN Bus
U1512	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K124B Active Safety Control Module 2 Lost Communication with K187 Steering Column Friction Control Module on LIN Bus

DTC	DTC Descriptor
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342B UHF Low Energy Remote Control Access Sensor Transceiver 2 on LIN Bus
U1513	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342C UHF Low Energy Remote Control Access Sensor Transceiver 3 on LIN Bus
U1514	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K33 HVAC Control Module Lost Communication with A34 HVAC Controls - Auxiliary on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342D UHF Low Energy Remote Control Access Sensor Transceiver 4 on LIN Bus
U1515	K9 Body Control Module Lost Communication with M75 Windshield Wiper Motor / M75L Windshield Wiper Motor Module - Left on LIN Bus
	K183 UHF Short Range Low Energy Remote Control Access Transceiver Lost Communication with B342E UHF Low Energy Remote Control Access Sensor Transceiver 5 on LIN Bus
U1516	K9 Body Control Module Lost Communication with B110 Battery Sensor Module on LIN Bus
U1517	K9 Body Control Module Lost Communication with K62 Sunroof Sunshade Motor Module on LIN Bus
U1518	P16 Instrument Cluster Lost Communication with K78 Head-Up Display Module / P29 Head-Up Display on LIN Bus
U1519	K40 Seat Memory Control Module Lost Communication with S52 Outside Rearview Mirror Switch on LIN Bus
	K40 Seat Memory Control Module Lost Communication with K96 Mirror Control Module / K96D Mirror Control Module - Driver / K96L Mirror Control Module - Left on LIN Bus
U151A	K9 Body Control Module Lost Communication with B117 Rain Sensor / B177 Rain/Ambient Light Sensor Module / B200 Rain Sensor Module on LIN Bus
U151B	K9 Body Control Module Lost Communication with K61 Sunroof Control Module on LIN Bus
	K40 Seat Memory Control Module Lost Communication with S79P Window Switch - Passenger on LIN Bus
U151C	K33 HVAC Control Module Lost Communication with A34 HVAC Controls - Auxiliary / K33A HVAC Control Module - Auxiliary on LIN Bus
U151F	A11 Radio Lost Communication with A20 Radio/HVAC Controls / A22 Radio Controls / P17 Info Display Module on LIN Bus
U1520	K9 Body Control Module Lost Communication with P4 Security Siren / P25 Power Sounder Content Theft Deterrent Alarm Module on LIN Bus
	K33 HVAC Control Module Lost Communication with M6CR Air Temperature Door Actuator - Center Console Right Auxiliary on LIN Bus
	K40D Seat Memory Control Module - Driver Lost Communication with K134D Seat Bolster Memory Control Module - Driver on LIN Bus
	K40P Seat Memory Control Module - Passenger Lost Communication with K134P Seat Bolster Memory Control Module - Passenger on LIN Bus
U1521	K9 Body Control Module Lost Communication with S48E Multifunction Switch - Center Console on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
U1522	K9 Body Control Module Lost Communication with K65 Tire Pressure Indicator Module / B178 Tire Pressure Sensor Locator Module on LIN Bus

DTC	DTC Descriptor
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K33 HVAC Control Module Lost Communication with M6UR Air Temperature Door Actuator - Right Upper Auxiliary on LIN Bus
U1523	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13L Headlamp - Left on LIN Bus
U1524	K9 Body Control Module Lost Communication with K29 Seat Heating Control Module / K29F Seat Heating Control Module - Front on LIN Bus
	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13R Headlamp - Right on LIN Bus
	K33 HVAC Control Module Lost Communication with K10 Coolant Heater Control Module on LIN Bus
U1525	K33 HVAC Control Module Lost Communication with K10 Coolant Heater Control Module on LIN Bus
U1526	K9 Body Control Module Lost Communication with K29R Seat Heating Control Module - Rear on LIN Bus
U1528	K33 HVAC Control Module Lost Communication with M37B Mode Door Actuator - Auxiliary on LIN Bus
	K40D Seat Memory Control Module - Driver Lost Communication with S64D Seat Adjuster Switch - Driver on LIN Bus
	K40P Seat Memory Control Module - Passenger Lost Communication with S64P Seat Adjuster Switch - Passenger on LIN Bus
U152A	K33 HVAC Control Module Lost Communication with M6UL Air Temperature Door Actuator - Left Upper Auxiliary on LIN Bus
U152B	K33 HVAC Control Module Lost Communication with K32 Steering Wheel Heating Control Module on LIN Bus
U152C	K9 Body Control Module Lost Communication with K18 Compass Module on LIN Bus
U152D	K9 Body Control Module Lost Communication with P2 Transmission Shift Lever Position Indicator on LIN Bus
	K33 HVAC Control Module Lost Communication with V1 Air Ionizer on LIN Bus
U1530	K9 Body Control Module Lost Communication with M35P Window Motor Module - Passenger / M74P Window Motor - Passenger on LIN Bus
U1531	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13LA Headlamp Assembly - Left on LIN Bus
U1532	K26 Headlamp Control Module / K28 Headlamp Leveling Control Module Lost Communication with E13RA Headlamp Assembly - Right on LIN Bus
U1534	K9 Body Control Module Lost Communication with M74D Window Motor - Driver on LIN Bus
U1538	K9 Body Control Module Lost Communication with S79D Window Switch - Driver / S146 Window/Outside Rearview Mirror Switch - Driver on LIN Bus
U153A	K9 Body Control Module Lost Communication with S79P Window Switch - Passenger on LIN Bus
U1540	K9 Body Control Module Lost Communication with M74RR Window Motor - Right Rear on LIN Bus
U1544	K9 Body Control Module Lost Communication with M74LR Window Motor - Left Rear on LIN Bus
U1548	K9 Body Control Module Lost Communication with S79LR Window Switch - Left Rear on LIN Bus
U1549	K9 Body Control Module Lost Communication with M45 Rear Wiper Motor on LIN Bus
U154A	K9 Body Control Module Lost Communication with S79RR Window Switch - Right Rear on LIN Bus
U154B	K9 Body Control Module Lost Communication with K49 Rear Seat Control Module on LIN Bus

DTC	DTC Descriptor
U1550	K9 Body Control Module Lost Communication with S31D Seat Heating and Cooling Switch - Driver on LIN Bus
U1551	K9 Body Control Module Lost Communication with K33 HVAC Control Module on LIN Bus
U1555	K9 Body Control Module Lost Communication with S100LR Seat Heating/Venting/Cooling Switch - Left Rear on LIN Bus
U1556	K38 Chassis Control Module Lost Communication with K133 Trailer Brake Power Control Module on LIN Bus
U1558	K9 Body Control Module Lost Communication with S31P Seat Heating and Cooling Switch - Passenger on LIN Bus
U1559	K9 Body Control Module Lost Communication with K183 Short Range Remote Control Transceiver on LIN Bus
U155D	K9 Body Control Module Lost Communication with S100RR Seat Heating/Venting/Cooling Switch - Right Rear on LIN Bus
U156D	K38 Chassis Control Module Lost Communication with S3 Transmission Shift Lever on LIN Bus
U15E1	A11 Radio Lost Communication with A26 HVAC Controls / P17 Info Display Module on LIN Bus
U15F0	K74 Human Machine Interface Control Module Lost Communication with P17 Info Display Module on LIN Bus
	A11 Radio Lost Communication with A20 Radio/HVAC Controls / A22 Radio Controls / P17 Info Display Module on LIN Bus
U15F1	K74 Human Machine Interface Control Module Lost Communication with K188 Human Machine Interface Control Module Bypass Module on LIN Bus
U15F3	K74 Human Machine Interface Control Module Lost Communication with K31 Navigation Control Module on LIN Bus
U1653	Chassis Systems High Speed Communication Enable Circuit
U1725	Left Headlamp High Beam Control Module Lost Communication with Left Headlamp Low Beam Control Module
U1726	Right Headlamp High Beam Control Module Lost Communication with Right Headlamp Low Beam Control Module
U1727	Right Headlamp High Beam Control Module Lost Communication with Right Headlamp Leveling Actuator
U1728	Left Headlamp High Beam Control Module Lost Communication with Left Headlamp Leveling Actuator
U1729	Right High Beam Control Module Lost Communication with Right Headlamp Horizontal Motor
U172A	Left High Beam Control Module Lost Communication with Left Headlamp Horizontal Motor
U1793	14V Power Module Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion Communication Bus
U1795	14V Power Module Powertrain Expansion Communication Bus Off
U179A	Lost Communication with Hybrid/EV Powertrain Control Module 2
U179C	Lost Communication with One or More Hybrid/EV Battery Interface Control Modules
U179D	Lost Communication with Brake System Control Module 2 on Chassis Expansion Bus
U1803	Lost Communication with Hybrid/EV Powertrain Control Module 2
U1804	Lost Communication with Inside Rearview Mirror Control Module
U1806	Battery Energy Control Module High Voltage Energy Management CAN Bus Off
U1807	Battery Charger Control Module High Voltage Energy Management CAN Bus Off
U180A	Electric A/C Compressor Control Module High Speed CAN Bus Off
U180B	Battery Energy Control Module High Speed CAN Bus Off

DTC	DTC Descriptor
U180C	Battery Charger Control Module High Speed CAN Bus Off
U180D	Electronic Brake Control Module Chassis Expansion CAN Bus Off
U1811	Battery Energy Control Module Powertrain Expansion CAN Bus Off
U1814	Powertrain Wake-Up Communication Circuit
U1815	Lost Communication with Drive Motor Control Module 1 on Bus B
U1816	Lost Communication with Drive Motor Control Module B on Bus B
U1817	Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion CAN Bus
U1818	Lost Communication with Engine Control Module on Powertrain Expansion Communication Bus
U1821	Lost Communication with 14V Power Module on Powertrain Expansion Communication Bus
U1826	Lost Communication with Multi-Axis Acceleration Sensor Module on Powertrain Expansion CAN Bus
U1827	Lost Communication with Steering Angle Sensor Module on Powertrain Expansion CAN Bus
U182A	Hybrid/EV Powertrain Control Module Lost Communication with Battery Energy Control Module on Powertrain Expansion CAN Bus
U182D	Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U182E	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U182F	Drive Motor Control Module 2 Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U1831	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module on Powertrain Expansion CAN Bus
U1833	Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
U1838	Lost Communication with Battery Charger Control Module on High Voltage Energy Management CAN Bus
U1839	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Engine Control Module
U183A	Lost Communication with Telematics Communication Interface Control Module on High Speed CAN Bus
U183B	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Transmission Control Module
U183C	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on Powertrain Expansion Communication Bus
U183E	Lost Communication with Telematics Communication Interface Control Module on Low Speed CAN Bus
U1844	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module on Bus B
U1845	Drive Motor Control Module 1 Lost Communication with Hybrid/EV Powertrain Control Module
U1846	Drive Motor Control Module 2 Lost Communication with Hybrid/EV Powertrain Control Module
U1847	Drive Motor Control Module 1 Lost Communication with Battery Energy Control Module on Powertrain Expansion CAN Bus
U1849	Drive Motor Control Module 1 Lost Communication with Transmission Control Module
U184A	Lost Communication with Body Control Module on Low Speed CAN Bus
U184B	Lost Communication with Remote Heater and Air Conditioning Control Module on Low Speed CAN Bus
U184C	Lost Communication with Instrument Cluster on Low Speed CAN Bus

DTC	DTC Descriptor
U184D	Lost Communication with Radio on Low Speed CAN Bus
U184E	Lost Communication with Inflatable Restraint Sensing and Diagnostic Module on Low Speed CAN Bus
U184F	Electric A/C Compressor Control Module Lost Communication with Engine Control Module
U1850	Drive Motor Control Module 2 Lost Communication with Transmission Control Module
U1858	Electronic Brake Control Module Lost Communication with Hybrid/EV Powertrain Control Module on Chassis Expansion CAN Bus
U185A	Lost Communication with Battery Energy Control Module on High Voltage Energy Management CAN Bus
U185B	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
U185C	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
U185D	Fuel Injector Control Module Lost Communication with Engine Control Module
U185E	Fuel Injector Control Module Lost Communication with Body Control Module
U1860	Electric A/C Compressor Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U1861	Battery Charger Control Module Lost Communication with Engine Control Module
U186A	Electronic Brake Control Module Lost Communication with Engine Control Module
U186B	Electronic Brake Control Module Lost Communication with Transmission Control Module
U1875	Drive Motor Control Module 1 Lost Communication with Battery Energy Control Module
U1876	Drive Motor Control Module 1 Lost Communication with Engine Control Module
U1879	Drive Motor Control Module 2 Lost Communication with Engine Control Module
U1885	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U1886	Battery Energy Control Module Lost Communication with Engine Control Module
U1888	Hybrid/EV Powertrain Control Module Lost Communication with Battery Energy Control Module
U18A1	Lost Communication with Coolant Temperature Control Module on High Voltage Energy Management CAN Bus
U18A2	Lost Communication with Fuel Pump Driver Control Module
U18A3	Lost Communication with Human Machine Interface Control Module
U18A4	Lost Communication with Hybrid/EV Battery DC Charging Communications Gateway Module on High Voltage Energy Management CAN Bus
U18A5	Lost Communication with Fuel Injector Control Module on Powertrain Expansion CAN Bus
U18A6	Lost Communication with Right Object Detection Control Module on Dedicated Bus 1
U18A7	Lost Communication with Power Supply Transformer on Powertrain Expansion CAN Bus
U18A9	Lost Communication With Transmission Range Control Module on Chassis Expansion CAN Bus

DTC	DTC Descriptor
U18AA	Transmission Range Control Module Lost Communication with Engine Control Module
U18AB	Transmission Range Control Module Lost Communication with Chassis Control Module on High Speed CAN Bus
U18AC	Transmission Range Control Module Lost Communication with Chassis Control Module on Chassis Expansion CAN Bus
U18AD	Transmission Range Control Module Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
U18AE	Lost Communication with Infotainment Control Touchpad on Dedicated Bus 1
U18AF	Lost Communications With Telematics Communications Interface Control Module on Ethernet Bus
U18B0	Lost Communications With Instrument Cluster on Ethernet Bus
U18B1	Lost Communications With Audio Amplifier on Ethernet Bus
U18B2	Lost Communication with Rear Audio Control Module on Ethernet Bus
U18B3	Lost Communications With Navigation Control Module on Ethernet Bus
U18B4	Lost Communication with Radio on Ethernet Bus
U18B5	Lost Communication With Hybrid Powertrain Control Module on Chassis Expansion CAN Bus
U18B6	Lost Communication with Active Safety Control Module 1 on Chassis Expansion CAN Bus
U18B7	Lost Communication with Active Safety Control Module 2 on Chassis Expansion CAN Bus
U18B8	Lost Communication with Body Control Module on High Speed CAN Bus
U18B9	Primary High Speed CAN Bus Subnet Configuration List
U18BA	Lost Communication with Power Steering Control Module on High Speed CAN Bus
U18BB	Lost Communication with Power Steering Control Module on Chassis Expansion CAN Bus
U18BF	Secondary High Speed CAN Bus Subnet Configuration List
U18C0	Lost Communication with Suspension Control Module on High Speed CAN Bus
U18C1	Lost Communication with Suspension Control Module on Chassis Expansion CAN Bus
U18C2	Lost Communication with Frontview Camera Module on Flexray Bus
U18C3	Lost Communication with Video Processing Control Module on High Speed CAN Bus
U18C4	Lost Communication with Video Processing Control Module on Low Speed CAN Bus
U18C5	Lost Communication with Electronic Brake Control Module on High Speed CAN Bus
U18CA	Lost Communication with Active Safety Control Module 1 on Flexray Bus
U18CB	Lost Communication with Active Safety Control Module 2 on Flexray Bus
U18CC	Transmission Range Control Module Lost Communication with ECM on Powertrain Expansion Bus
U18CF	Lost Communication with Active Safety Control Module 1 on High Speed CAN Bus
U18D0	Lost Communication with Active Safety Control Module 2 on High Speed CAN Bus
U18D1	Lost Communication with Transmission Range Control Module on Powertrain Expansion CAN Bus
U18D2	Lost Communication with Transmission Range Selector Control Module on Powertrain Sensor CAN Bus
U18D3	Lost Communication with Transmission Range Selector Control Module on Powertrain Expansion CAN Bus

DTC	DTC Descriptor
U1900	Lost Communication With Speech to Text Interface Module
U1901	Lost Communication with Infotainment Multifunction Switch Module
U2098	MOST Communication Enable Circuit
U2099	High Speed Communication Enable Circuit
U209E	Object Detection Control Module High Speed Communication Enable Circuit 1
U209F	Object Detection Control Module High Speed Communication Enable Circuit 2
U2100	CAN Bus Communication
U2101	CAN Bus Maximum List of Control Modules
U2103	Fewer Controllers On Bus Than Programmed
U2105	Lost Communication with Engine Control Module
U2106	Lost Communication with Transmission Control Module
U2107	Lost Communication with Body Control Module
U2108	Lost Communication with Electronic Brake Control Module
U2125	Lost Communication with Telematic Unit
U2127	Lost Communication with Front HVAC Control Module
U2139	Lost Communication with Column Integration Module
U2144	Lost Communication with Distance Sensing Cruise Control Module
U216A	Lost Communication with Front Object Detection Control Module
U216B	Lost Communication with Rear Object Detection Control Module
U2176	Lost Communication with Power Take-Off Control Module
U2178	Lost Communication With Trailer Interface Control Module
U2400	Fuel Injector Control Module High Speed CAN Bus Off
U2401	Battery Energy Control Module Dedicated Bus 1 Off
U2409	Transmission Range Control Module High Speed CAN Bus Off
U240A	Transmission Range Control Module Chassis Expansion CAN Bus Off
U240B	Radio Dedicated Bus Off
U240D	Transmission Range Selector Control Module Powertrain Expansion CAN Bus Off
U240E	Transmission Range Selector Control Module Powertrain Sensor CAN Bus Off
U240F	Transmission Range Control Module Lost Communication with EBCM on High Speed CAN Bus
U2410	Transmission Range Control Module Lost Communication with BCM on High Speed CAN Bus
U2411	Transmission Range Control Module Powertrain Expansion CAN Bus Off
U2412	Reductant Control Module Powertrain Sensor Bus Off
U2501	Invalid Data Received From Hybrid/EV Powertrain Control Module 2
U2502	Invalid Data Received From Electronic Brake Control Module on Chassis Expansion CAN Bus
U2503	Invalid Data Received From Object Detection Control Module
U2504	Invalid Data Received From Trailer Brake Driver Control Module
U2505	Invalid Data Received from Human Machine Interface Control Module on MOST Bus
U2506	Invalid Data Received From Dual Battery Control Module
U2507	Invalid Data Received from Instrument Cluster on MOST Bus
U2508	Invalid Data Received from Audio Amplifier on MOST Bus
U250B	Invalid Data Received from Active Safety Control Module 1 on Chassis Expansion CAN Bus
U250C	Invalid Data Received from Active Safety Control Module 2 on Chassis Expansion CAN Bus

DTC	DTC Descriptor
U250D	Invalid Data Received from Transmission Control Module on Chassis Control Module LIN Bus 2
U250E	Invalid Data Received from Vehicle Dynamic Sensor 1
U250F	Invalid Data Received from Vehicle Dynamic Sensor 2
U2510	Invalid Data Received from Multifunction Energy Storage Capacitor Control Module
U2511	Invalid Data Received from Digital Map Control Module
U2512	Invalid Data Received from Video Processing Control Module
U2513	Invalid Data Received from Driver Monitoring System Control Module
U2520	Invalid Data Received from Active Safety Control Module 1 on High Speed CAN Bus
U2602	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2603	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 1
U2604	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 2
U2605	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 3
U2606	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 4
U2608	Electric A/C Compressor Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2609	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2611	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module
U2612	Battery Charger Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2613	Drive Motor 1 Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2614	Drive Motor 2 Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2615	Auxiliary Transmission Fluid Pump Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
U2616	Fuel Pump Driver Control Module Lost Communication with ECM
U2617	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 5
U2618	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 6
U2619	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 7
U2620	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 8
U2621	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 9
U2622	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 10
U2623	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 11
U2624	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 12
U2625	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 13

DTC	DTC Descriptor
U2626	Reductant Control Module Lost Communication With Engine Control Module on Powertrain Sensor CAN Bus
U2627	Reductant Control Module Lost Communication with Reductant Level Sensor
U2628	Reductant Control Module Lost Communication with Reductant Concentration Sensor
U2629	Reductant Control Module Lost Communication with Reductant Tank Temperature Sensor 1
U2630	Reductant Control Module Lost Communication with Reductant Tank Temperature Sensor 2
U2631	Reductant Control Module Lost Communication with Reductant Pressure Sensor
U3000	Control Module
U3001	Control Module Improper Shutdown Performance
U3012	Control Module Improper Wake-up Perfomance

DTC B1000: ELECTRONIC CONTROL UNIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1000

Electronic Control Unit

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B1000 is not set.
   - **If DTC B1000 is set**

     Replace the device that set the DTC.

   - **If DTC B1000 is not set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC B1001: OPTION CONFIGURATION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B1001

Option Configuration

For symptom byte information, refer to Symptom Byte List .

Circuit/System Description

Some devices must be configured with serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set DTC B1001. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B1001 is not set.
    - **If DTC B1001 is set**
    1. Program the device that set the DTC.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the device that set the DTC.
        - If the DTC does not set
    3. All OK.
    - **If DTC B1001 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC B1016: VEHICLE IDENTIFICATION NUMBER INFORMATION NOT PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1016

Vehicle Identification Number Information Not Programmed

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The device performs a self test and vehicle identification number (VIN) verification. This DTC indicates that a VIN is not programmed or that the device has an internal fault. The internal fault detection is handled inside the device, no external circuits are involved.

Conditions for Running the DTC

The only requirements are voltage and ground.

Conditions for Setting the DTC

The device has detected that the VIN is not programmed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 50 fault-free ignition cycles.
- The DTC can be cleared using a scan tool.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B1016 is not set.
   - **If DTC B1016 is set**
   1. Program the device that set the DTC.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the device that set the DTC.
      - If the DTC does not set
   3. All OK.
   - **If DTC B1016 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC B101D: ELECTRONIC CONTROL UNIT HARDWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B101D

Electronic Control Unit Hardware

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

- The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.
- The keyless entry control module will set this DTC with symptom byte 39 when the keyless entry control module antenna is activated.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- Do not replace a device based only on DTC B101D being set in history with the exception of the following devices:
  - K36 Inflatable Restraint Sensing and Diagnostic Module
  - K85 Passenger Presence Module
- If DTC B101D is set as current, replace the appropriate device.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B101D is not set.
   - **If DTC B101D is set with symptom byte 43**
   1. Program the device that set the DTC.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the device that set the DTC.
      - If the DTC does not set
   3. All OK.
   - **If DTC B101D is set with any symptom byte, except symptom byte 43**

     Replace the device that set the DTC.

   - **If DTC B101D is not set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC B101E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B101E

Electronic Control Unit Software

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set DTC B101E. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify DTC B101E is not set.
    - **If DTC B101E is set**
    1. Program the device that set the DTC.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the device that set the DTC.
        - If the DTC does not set
    3. All OK.
    - **If DTC B101E is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC C056D: ELECTRONIC CONTROL UNIT HARDWARE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C056D

Electronic Control Unit Hardware

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC C056D is not set.
    - **If DTC C056D is set in a device that can be programmed**
    1. Program the device that set the DTC.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the device that set the DTC.
        - If the DTC does not set
    3. All OK.
    - **If DTC C056D is set in a device that cannot be programmed**

      Replace the device that set the DTC.

    - **If DTC C056D is not set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC C056E

- Electronic Control Unit Software

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set DTC C056E. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

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- **Circuit Testing**
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- **Wiring Repairs**

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC C056E is not set.
   - **If DTC C056E is set**
   1. Program the device that set the DTC.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the device that set the DTC.
      - If the DTC does not set
   3. All OK.
   - **If DTC C056E is not set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, OR P262B: CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0605

Control Module Programming Read Only Memory Performance

DTC P0606

Control Module Processor Performance

DTC P0607

Control Module Performance

DTC P060A

Control Module Monitoring Processor Performance

DTC P060B

Control Module Analog to Digital Converter Performance

DTC P060C

Control Module Main Processor Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P16E9

Control Module Serial Peripheral Interface Bus 2

DTC P16EA

Control Module Serial Peripheral Interface Bus 3

DTC P16EB

Control Module Serial Peripheral Interface Bus 4

DTC P16EC

Control Module Serial Peripheral Interface Bus 5

DTC P16ED

Control Module Serial Peripheral Interface Bus 6

DTC P16EE

Control Module Serial Peripheral Interface Bus 7

DTC P16EF

Control Module Serial Peripheral Interface Bus 8

DTC P16F0

Control Module Serial Peripheral Interface Bus 1

DTC P262B

Control Module Power Off Timer Performance

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the device. This diagnostic also addresses if the device is not programmed. The device monitors its ability to read and write to the memory. It also monitors a timing function. No external circuits are involved.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The device detects an internal malfunction or incomplete programming.

Action Taken When the DTC Sets

- DTCs P0601 - P0607, P060A - P060C, and P16E9 - P16F0 are Type A DTCs.
- DTC P062F is a Type C DTCs.
- DTC P262B is a Type B DTC.
- The high voltage contactor relays may open.

Conditions for Clearing the DTC

- DTCs P0601 - P0607, P060A - P060C, and P16E9 - P16F0 are Type A DTCs.
- DTC P062F is a Type C DTCs.
- DTC P262B is a Type B DTC.

Diagnostic Aids

- The DTC P0606 may set in Hybrid/EV Powertrain Control Module 2 due to other faults. Do not replace the Hybrid/EV Powertrain Control Module 2 until other DTCs are diagnosed first.
- The DTC P0606 can falsely set in Hybrid/EV Powertrain Control Module 2 when the 12 V battery has been disconnected/re-connected or if the 12 V battery has been overcharged (over 18 V). In this case, do the following. If this DTC becomes history, use scan tool to clear this DTC. No further action is required:
  - Vehicle OFF and all vehicle systems off. It may take up to 2 minutes for all vehicle systems to power down.
  - Vehicle ON, verify that DTC P0606 is in history and contactors close. (If DTC P0606 remains current and contactors do not close, repeat the above step again).
  - Use scan tool to clear the DTC to turn off the malfunction indicator lamp (MIL).
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

NOTE: **The DTC P0606 can falsely set in K114B Hybrid/EV Powertrain Control Module 2 when disconnecting the 12 V battery. See Diagnostic Aids section for more information.**

1. Vehicle in Service Mode.
2. Verify DTC P0606 is not set.
   - **If DTC P0606 is set with other DTCs set**

     Diagnose all other DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If DTC P0606 is set without other DTCs set**

     Replace the device that set the DTC.

   - **If DTC P0606 is not set**

3. Verify DTC P0602 is not set.
    - **If DTC P0602 is set**
    1. Program the device that set the DTC.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the device that set the DTC.
        - If the DTC does not set
    3. All OK.
    - **If DTC P0602 is not set**
4. Verify DTC P0601, P0603, P0604, P0605, P0607, P060A, P060B, P060C, P062F, P16E9, P16EA, P16EB, P16EC, P16ED, P16EE, P16EF, P16F0, or P262B is not set.
    - **If any of the DTCs are set**

      Replace the device that set the DTC.

    - **If none of the DTCs are set**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P06E4 : CONTROL MODULE WAKE-UP CIRCUIT PERFORMANCE (HYBRID/EV POWERTRAIN CONTROL MODULE 2)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P06E4

Control Module Wake-Up Circuit Performance

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wake Up Serial Data 2	P06E4, U0100-U02FF*	U0100-U02FF	U0100-U02FF	-
* Vehicle will not start.				

Circuit/System Description

The accessory wake up serial data 2 circuit is energized by the K114B Hybrid/EV Powertrain Control Module 2 to immediately activate other devices connected to this circuit when the K9 Body Control Module signals the K114B Hybrid/EV Powertrain Control Module 2 that serial data is required.

Depending on the option content, devices that may receive the wake up signal are as follows:

- K1 14 V Power Module
- T18 Battery Charger
- K16 Battery Energy Control Module

- K17 Electronic Brake Control Module
- G1 A/C Compressor
- K71 Transmission Control Module / T12 Automatic Transmission Assembly
- K20 Engine Control Module
- K114A Hybrid/EV Powertrain Control Module 1 / T6 Power Inverter Module

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.
- The K114B Hybrid/EV Powertrain Control Module 2 attempts to wake up the devices connected to its control module output wake up circuit.
- Circuit check runs continuously.

Conditions for Setting the DTC

- The K114B Hybrid/EV Powertrain Control Module 2 detects a fault in the control module output wake up circuit.
- A circuit fault exists for greater than 6 s.

Action Taken When the DTC Sets

- The DTC P06E4 is a type A DTC.
- The devices is never signaled. Therefore, the specific subsystems will not function.
- The vehicle will not start while the circuit is shorted to ground.
- The malfunction indicator lamp (MIL) will illuminate, along with several DIC messages.

Conditions for Clearing the DTC

- The DTC P06E4 is a type A DTC.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

Short to ground will also set multiple no communication codes for high speed GMLAN devices.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B097B, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1451, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
   - **If none of the DTCs are set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematic to determine which devices are on the K114B Hybrid/EV Powertrain Control Module 2 terminal 43 X2 accessory wake up serial data 2 circuit. Use the connector end view to identify the B+, ignition, and accessory wake up serial data 2 circuit terminals for each of those devices.**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Vehicle in Service Mode.
3. Verify that a test lamp illuminates between the accessory wake up serial data circuit terminal 67 X2 and ground.

- **If the test lamp does not illuminate**
1. Vehicle OFF and all vehicle systems OFF, remove the test lamp, disconnect the X4 harness connector at the K9 Body Control Module.
2. Test for greater than 100 Ω between the K114B Hybrid/EV Powertrain Control Module 2 wake up circuit terminal 67 X2 and ground.
    - If 100 Ω or less, repair the short to ground in the accessory wake up serial data circuit.
    - If greater than 100 Ω
3. Test for less than 2 Ω between the K114B Hybrid/EV Powertrain Control Module 2 wake up circuit terminal 67 X2 and the K9 Body Control Module wake up circuit terminal 22 X4.
    - If 2 Ω or greater, repair the open/high resistance in the accessory wake up serial data circuit.
    - If less than 2 Ω
4. Replace the K9 Body Control Module.

- **If the test lamp illuminates**

4. Vehicle OFF, remove the test lamp, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
5. Test for greater than 100 Ω, but less than infinite resistance, between the accessory wake up serial data 2 circuit terminal 43 X2 and ground.
    - **If 100 Ω or less**

      Refer to Testing the Accessory Wake Up Serial Data 2 Circuits for a Short to Ground.

    - **If infinite resistance**

      Test for an open/high resistance in the accessory wake up serial data 2 circuit.

    - **If greater than 100 Ω and less than infinite resistance**
6. Vehicle in Service Mode.
7. Verify that a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
8. Vehicle in Service Mode.
9. Verify that a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**

10. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Testing the Accessory Wake Up Serial Data 2 Circuits for a Short to Ground

1. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to **High Voltage Disabling** .
2. Reconnect the 12 V battery.
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at an easily accessible device that shares the K114B Hybrid/EV Powertrain Control Module 2 terminal 43 X2 accessory wake up serial data 2 circuit. It may take up to 2 min for all vehicle systems to power down.
4. Test for less than 100 Ω between the K114B Hybrid/EV Powertrain Control Module 2 accessory wake up serial data 2 circuit terminal 43 X2 and ground.
    - **If 100 Ω or greater**

      Replace the device that was just disconnected.

    - **If less than 100 Ω**
5. Repeat step 3 until all devices on the K114B Hybrid/EV Powertrain Control Module 2 accessory wake up serial data 2 circuit terminal 43 X2 have been disconnected.
6. Repair the short to ground on the accessory wake up serial data 2 circuit.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup.

DTC P0A1F, P1A01, P1A05, OR P1A06: BATTERY ENERGY CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0A1F

Battery Energy Control Module Performance

DTC P1A01

Battery Energy Control Module Long Term Memory Performance

DTC P1A05

Battery Energy Control Module Random Access Memory

DTC P1A06

Battery Energy Control Module Read Only Memory

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The Battery Energy Control Module will diagnose its own systems and determine when a fault condition is present. Diagnostics and system status is communicated from the Battery Energy Control Module to the Hybrid/EV Powertrain Control Module 2 through serial data. The Hybrid/EV Powertrain Control Module 2 is the host controller for diagnostic trouble code (DTC) information.

This diagnostic applies to internal microprocessor integrity conditions within the Battery Energy Control Module. This fault is internal to the Battery Energy Control Module and no external circuits are involved.

Conditions for Running the DTC

- The Battery Energy Control Module is awake and communicating.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The Battery Energy Control Module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0A1F, P1A01, P1A05, and P1A06 are type A DTCs.
- Vehicle goes to reduced battery power mode. After vehicle is turned off, vehicle will not return to propulsion active mode.

Conditions for Clearing the DTC

DTCs P0A1F, P1A01, P1A05, and P1A06 are type A DTCs.

Diagnostic Aids

If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing**

any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.

   NOTE: **If the power is interrupted at exactly the time the K16 Battery Energy Control Module is writing to its memory, it may set a false P1A01 DTC.**

2. Verify that DTC P1A01 is not set.
   - **If DTC P1A01 is set**
   1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.
   2. Vehicle in Service Mode.
   3. Verify that the DTC does not set.
      - If the DTC sets, replace the K16 Battery Energy Control Module.
      - If the DTC does not set
   4. All OK.
   - **If DTC P1A01 is not set**
3. Verify that DTC P0A1F, P1A05, or P1A06 is not set.
   - **If any of the DTCs are set**

     Replace the K16 Battery Energy Control Module.

   - **If none of the DTCs are set**
4. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC P16B7: ELECTRIC A/C COMPRESSOR CONTROL MODULE WAKE-UP CIRCUIT PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P16B7

Electric A/C Compressor Control Module Wake-Up Circuit Performance

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wake Up Serial Data 2	P16B7, U016B*	U016B*	U016B*	-
* Other DTCs may set with this fault				

Circuit/System Description

The accessory wake up serial data 2 circuit is energized by the K114B Hybrid/EV Powertrain Control Module 2 to immediately activate the G1 A/C Compressor connected to this circuit when the body control module signals the K114B Hybrid/EV Powertrain Control Module 2 that serial data is required.

Conditions for Running the DTC

- The system voltage is greater than 10.25 V.
- The G1 A/C Compressor is awake.
- Vehicle ON.
- The G1 A/C Compressor receives serial data message from K114B Hybrid/EV Powertrain Control Module 2 and "Propulsion System Active" is TRUE for 500 ms continuously.

Conditions for Setting the DTC

The G1 A/C Compressor detects a fault in the wake up circuit.

Action Taken When the DTC Sets

DTC P16B7 is a type B DTC.

Conditions for Clearing the DTC

DTC P16B7 is a type B DTC.

Diagnostic Aids

Short to ground may set multiple no communication codes for high speed GMLAN devices.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

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Electrical Information Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P06E4 is not set.
   - **If DTC P06E4 is set**

     Refer to **DTC P06E4 (Hybrid/EV Powertrain Control Module 2)**.

   - **If DTC P06E4 is not set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's accessory wake up serial data 2 circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X1 harness connector at the G1 A/C Compressor. It may take up to 2 min for all vehicle systems to power down.
2. Vehicle in Service Mode.
3. Verify that a test lamp illuminates between the accessory wake up serial data 2 circuit terminal 2 X1 and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF and all vehicle systems OFF, remove the test lamp, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 Ω between the G1 A/C Compressor wake up circuit terminal 2 X1 and the K114B Hybrid/EV Powertrain Control Module 2 wake up circuit terminal 43 X2.
      - If 2 Ω or greater, repair the open/high resistance in the accessory wake up serial data 2 circuit.
      - If less than 2 Ω
   3. Vehicle in Service Mode.
   4. Verify that a test lamp illuminates between the K114B Hybrid/EV Powertrain Control Module 2 accessory wake up serial data circuit terminal 67 X2 and ground.
      - If the test lamp does not illuminate, test the accessory wake up serial data circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K9 Body Control Module.
      - If the test lamp illuminates
   5. Replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
4. Test or replace the G1 A/C Compressor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P16B8-P16BA: ELECTRIC A/C COMPRESSOR CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P16B8

Electric A/C Compressor Control Module Random Access Memory Performance

DTC P16B9

Electric A/C Compressor Control Module Read Only Memory Performance

DTC P16BA

Electric A/C Compressor Control Module Long Term Memory Performance

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The A/C Compressor will diagnose its own systems and determine when a fault condition is present. This diagnostic applies to internal microprocessor integrity conditions within the A/C compressor. This fault is internal to the A/C compressor and no external circuits are involved.

Conditions for Running the DTC

- System voltage is greater than 10.25 V.
- The device is awake and communicating.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

DTCs P16B8, P16B9, and P16BA are type A DTCs.

Conditions for Clearing the DTC

- DTCs P16B8, P16B9, and P16BA are type A DTCs.
- After the vehicle has been OFF for a sufficient amount of time to allow the devices to enter a sleep mode, the devices will re-enable the output on the following ignition cycle and the DTC will become history.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P16B8, P16B9, or P16BA is not set.
    - **If any of the DTCs are set**

      Replace the G1 A/C Compressor.

    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, OR P3042: HYBRID/EV BATTERY INTERFACE CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1E8E

Hybrid/EV Battery Interface Control Module 1 Performance

DTC P1E8F

Hybrid/EV Battery Interface Control Module 1 Random Access Memory Performance

DTC P1E90

Hybrid/EV Battery Interface Control Module 1 Read Only Memory Performance

DTC P1E91

Hybrid/EV Battery Interface Control Module 1 Long Term Memory Performance

DTC P1E94

Hybrid/EV Battery Interface Control Module 2 Performance

DTC P1E95

Hybrid/EV Battery Interface Control Module 2 Random Access Memory Performance

DTC P1E96

Hybrid/EV Battery Interface Control Module 2 Read Only Memory Performance

DTC P1E97

Hybrid/EV Battery Interface Control Module 2 Long Term Memory Performance

DTC P1E9A

Hybrid/EV Battery Interface Control Module 3 Performance

DTC P1E9B

Hybrid/EV Battery Interface Control Module 3 Random Access Memory Performance

DTC P1E9C

Hybrid/EV Battery Interface Control Module 3 Read Only Memory Performance

DTC P1E9D

Hybrid/EV Battery Interface Control Module 3 Long Term Memory Performance

DTC P1EA0

Hybrid/EV Battery Interface Control Module 4 Performance

DTC P1EA1

Hybrid/EV Battery Interface Control Module 4 Random Access Memory Performance

DTC P1EA2

Hybrid/EV Battery Interface Control Module 4 Read Only Memory Performance

DTC P1EA3

Hybrid/EV Battery Interface Control Module 4 Long Term Memory Performance

DTC P1F06

Hybrid/EV Battery Interface Control Module 1 Processor Performance

DTC P1F07

Hybrid/EV Battery Interface Control Module 2 Processor Performance

DTC P1F08

Hybrid/EV Battery Interface Control Module 3 Processor Performance

DTC P1F09

Hybrid/EV Battery Interface Control Module 4 Processor Performance

DTC P1FAC

Hybrid/EV Battery Interface Control Module 5 Read Only Memory Performance

DTC P1FAD

Hybrid/EV Battery Interface Control Module 7 Read Only Memory Performance

DTC P1FAE

Hybrid/EV Battery Interface Control Module 8 Read Only Memory Performance

DTC P1FAF

Hybrid/EV Battery Interface Control Module 9 Read Only Memory Performance

DTC P1FB0

Hybrid/EV Battery Interface Control Module 10 Read Only Memory Performance

DTC P1FB1

Hybrid/EV Battery Interface Control Module 5 Random Access Memory Performance

DTC P1FB2

Hybrid/EV Battery Interface Control Module 6 Random Access Memory Performance

DTC P1FB3

Hybrid/EV Battery Interface Control Module 7 Random Access Memory Performance

DTC P1FB4

Hybrid/EV Battery Interface Control Module 8 Random Access Memory Performance

DTC P1FB5

Hybrid/EV Battery Interface Control Module 9 Random Access Memory Performance

DTC P1FB6

Hybrid/EV Battery Interface Control Module 10 Random Access Memory Performance

DTC P1FB7

Hybrid/EV Battery Interface Control Module 5 Long Term Memory Performance

DTC P1FB8

Hybrid/EV Battery Interface Control Module 6 Long Term Memory Performance

DTC P1FB9

Hybrid/EV Battery Interface Control Module 7 Long Term Memory Performance

DTC P1FBA

Hybrid/EV Battery Interface Control Module 8 Long Term Memory Performance

DTC P1FBB

Hybrid/EV Battery Interface Control Module 9 Long Term Memory Performance

DTC P1FBC

Hybrid/EV Battery Interface Control Module 10 Long Term Memory Performance

DTC P1FBD

Hybrid/EV Battery Interface Control Module 5 Performance

DTC P1FBE

Hybrid/EV Battery Interface Control Module 6 Performance

DTC P1FBF

Hybrid/EV Battery Interface Control Module 7 Performance

DTC P1FC0

Hybrid/EV Battery Interface Control Module 8 Performance

DTC P1FC1

Hybrid/EV Battery Interface Control Module 9 Performance

DTC P1FC2

Hybrid/EV Battery Interface Control Module 10 Performance

DTC P1FCF

Hybrid/EV Battery Interface Control Module 5 Processor Performance

DTC P1FD0

Hybrid/EV Battery Interface Control Module 6 Processor Performance

DTC P1FD1

Hybrid/EV Battery Interface Control Module 7 Processor Performance

DTC P1FD2

Hybrid/EV Battery Interface Control Module 8 Processor Performance

DTC P1FD3

Hybrid/EV Battery Interface Control Module 9 Processor Performance

DTC P1FD4

Hybrid/EV Battery Interface Control Module 10 Processor Performance

DTC P1FF3

Hybrid/EV Battery Interface Control Module 6 Read Only Memory Performance

DTC P3031

Hybrid/EV Battery Interface Control Module 11 Read Only Memory

DTC P3032

Hybrid/EV Battery Interface Control Module 11 Random Access Memory

DTC P3033

Hybrid/EV Battery Interface Control Module 11 Long Term Memory Performance

DTC P3034

Hybrid/EV Battery Interface Control Module 11 Performance

DTC P3037

Hybrid/EV Battery Interface Control Module 11 Processor Performance

DTC P303C

Hybrid/EV Battery Interface Control Module 12 Read Only Memory

DTC P303D

Hybrid/EV Battery Interface Control Module 12 Random Access Memory

DTC P303E

Hybrid/EV Battery Interface Control Module 12 Long Term Memory Performance

DTC P303F

Hybrid/EV Battery Interface Control Module 12 Performance

DTC P3042

Hybrid/EV Battery Interface Control Module 12 Processor Performance

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The Hybrid/EV Battery Interface Control Modules will diagnose their own systems and determine when a fault condition is present. This diagnostic applies to internal microprocessor integrity conditions within the Hybrid/EV Battery Interface Control Modules. This fault is internal to the Hybrid/EV Battery Interface Control Modules and no external circuits are involved.

Conditions for Running the DTC

- The device is awake.
- The system voltage is at least 9 V.
- DTC U2603 - U2606 or U2617 - U2624 is not set.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

DTCs P1E8E - P1E91, P1E94 - P1E97, P1E9A - P1E9D, P1EA0 - P1EA3, P1F06 - P1F09, P1FAC - P1FC2, P1FCF - P1FD4, P1FF3, P3031 - P3034, P3037, P303C - P303F, and P3042 are type A DTCs.

Conditions for Clearing the DTC

DTCs P1E8E - P1E91, P1E94 - P1E97, P1E9A - P1E9D, P1EA0 - P1EA3, P1F06 - P1F09, P1FAC - P1FC2, P1FCF - P1FD4, P1FF3, P3031 - P3034, P3037, P303C - P303F, and P3042 are type A DTCs.

Diagnostic Aids

- The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify that DTC P1E8E - P1E91, P1E94 - P1E97, P1E9A - P1E9D, P1EA0 - P1EA3, P1F06 - P1F09, P1FAC - P1FC2, P1FCF - P1FD4, P1FF3, P3031 - P3034, P3037, P303C - P303F, or P3042 is not set.
   - **If any of the DTCs are set**

     Replace the K16 Battery Energy Control Module.

   - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P1EB1: HYBRID/EV BATTERY INTERFACE CONTROL MODULE SOFTWARE INCOMPATIBLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EB1

Hybrid/EV Battery Interface Control Module Software Incompatible

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

This is the software incompatibility issue between the Hybrid/EV Battery Interface Control Modules and the Battery Energy Control Module. No external circuits are involved.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.
- DTC U2401, U2603, U2604, U2605, or U2606 is not set.

Conditions for Setting the DTC

- Any one of the Hybrid/EV Battery Interface Control Module software revision does not match.
- Battery Energy Control Module software and Hybrid/EV Battery Interface Control Module software are incompatible.

Action Taken When the DTC Sets

- Slave data that are incompatible with the Battery Energy Control Module software is set to Invalid, 0 V and -40Ã‚Â°C (-40Ã‚Â°F).
- DTC P1EB1 is a type A DTC.

Conditions for Clearing the DTC

DTC P1EB1 is a type A DTC.

Diagnostic Aids

If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify DTC P1EB1 is not set.
   - **If DTC P1EB1 is set**
   1. Program the K16 Battery Energy Control Module.
   2. Verify the DTC does not set.
      - If the DTC sets without other DTCs set, replace the K16 Battery Energy Control Module.

        - If the DTC sets along with any of the DTCs P1EB2, P1EB3, P1EB4, or P1EB5 set, refer to **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**.
        - If the DTC does not set
            3. All OK.
    - **If DTC P1EB1 is not set**
        3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, OR P303B: HYBRID/EV BATTERY INTERFACE CONTROL MODULE NOT PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1EB2

Hybrid/EV Battery Interface Control Module 1 Not Programmed

DTC P1EB3

Hybrid/EV Battery Interface Control Module 2 Not Programmed

DTC P1EB4

Hybrid/EV Battery Interface Control Module 3 Not Programmed

DTC P1EB5

Hybrid/EV Battery Interface Control Module 4 Not Programmed

DTC P1FA6

Hybrid/EV Battery Interface Control Module 5 Not Programmed

DTC P1FA7

Hybrid/EV Battery Interface Control Module 6 Not Programmed

DTC P1FA8

Hybrid/EV Battery Interface Control Module 7 Not Programmed

DTC P1FA9

Hybrid/EV Battery Interface Control Module 8 Not Programmed

DTC P1FAA

Hybrid/EV Battery Interface Control Module 9 Not Programmed

DTC P1FAB

Hybrid/EV Battery Interface Control Module 10 Not Programmed

DTC P3030

Hybrid/EV Battery Interface Control Module 11 Not Programmed

DTC P303B

Hybrid/EV Battery Interface Control Module 12 Not Programmed

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When the Battery Energy Control Module is flash programmed, the Hybrid/EV Battery Interface Control Module operating software and calibrations are provided to the Battery Energy Control Module. The Hybrid/EV Battery Interface Control Module software and calibrations are then loaded to each of the Hybrid/EV Battery Interface Control Modules from the Battery Energy Control Module. This operation is automatic and requires no operator action. At this point, if any of the Hybrid/EV Battery Interface Control Modules are not programmed correctly, the appropriate DTC is set. This fault is internal to the Hybrid/EV Battery Interface Control Modules and no external circuits are involved.

Conditions for Running the DTC

- The Battery Energy Control Module is awake and communicating.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The Hybrid/EV Battery Interface Control Module is not programmed correctly.

Action Taken When the DTC Sets

DTCs P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, and P303B are type A DTCs.

Conditions for Clearing the DTC

- The Hybrid/EV Battery Interface Control Module is programmed correctly.
- DTCs P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, and P303B are type A DTCs.

Diagnostic Aids

The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool References

Control Module References for scan tool information

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify DTC P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, or P303B is not set.
   - **If any of the DTCs are set**
   1. Program the K16 Battery Energy Control Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K16 Battery Energy Control Module.
      - If the DTC does not set
   3. All OK.
   - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC P1EB9: HIGH VOLTAGE ENERGY MANAGEMENT COMMUNICATION BUS ENABLE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1EB9

High Voltage Energy Management Communication Bus Enable Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy Management Communication Enable	P1EB9, U0100-U02FF*	U0100-U02FF	U0100-U02FF	-
* Vehicle will not start.				

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 activates the high voltage energy management communication enable circuit when the vehicle is on. This circuit wakes up the devices for high voltage energy bus communication.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The Hybrid/EV Powertrain Control Module 2 detects a fault in the high voltage energy management communication enable circuit.

Action Taken When the DTC Sets

DTC P1EB9 is a type A DTC.

Conditions for Clearing the DTC

DTC P1EB9 is a type A DTC.

Diagnostic Aids

Short to ground will also set multiple no communication codes for devices on high voltage energy serial data bus.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematics to determine which devices are on the K114B Hybrid/EV Powertrain Control Module 2 terminal 65 X2 high voltage energy management communication enable circuit. Use the connector end views to identify the B+, ignition, and high voltage energy management communication enable circuit terminals for each of those devices.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for greater than 100 Ω, but less than infinite resistance, between the high voltage energy management communication enable circuit terminal 65 X2 and ground.
   - **If 100 Ω or less**

Refer to Testing the High Voltage Energy Management Communication Enable Circuits for a Short to Ground.

- **If infinite resistance**

  Test for an open/high resistance in the high voltage energy management communication enable circuit.

- **If greater than 100 Ω and less than infinite resistance**

3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
5. Verify that a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
6. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Testing the High Voltage Energy Management Communication Enable Circuits for a Short to Ground

1. Perform the High Voltage Disabling procedure. Refer to **High Voltage Disabling** .
2. Reconnect the 12 V battery.
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connector at an easily accessible device that shares the K114B Hybrid/EV Powertrain Control Module 2 terminal 65 X2 high voltage energy management communication enable circuit. It may take up to 2 min for all vehicle systems to power down.
4. Test for less than 100 Ω between the K114B Hybrid/EV Powertrain Control Module 2 high voltage energy management communication enable circuit terminal 65 X2 and ground.
   - **If 100 Ω or greater**

     Replace the device that was just disconnected.

   - **If less than 100 Ω**
5. Repeat step 3 until all devices on the K114B Hybrid/EV Powertrain Control Module 2 high voltage energy management communication enable circuit terminal 65 X2 have been

disconnected.

6. Repair the short to ground on the high voltage energy management communication enable circuit.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup.

DTC P1EC1 OR P1EC2: BATTERY ENERGY CONTROL MODULE HIGH VOLTAGE ENERGY MANAGEMENT COMMUNICATION BUS ENABLE CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1EC1

Battery Energy Control Module High Voltage Energy Management Communication Bus Enable Circuit Low Voltage

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy Management Communication Enable	P1EC1	P1EC1	-	-

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 activates the high voltage energy management communication enable circuit when the vehicle is on. The high voltage energy management communication enable circuit wakes up the Battery Energy Control Module for serial data communication.

The Battery Energy Control Module compares the high voltage energy management communication enable hardwire signal with a Hybrid/EV Powertrain Control Module 2 serial data message indicating that the high voltage energy management communication enable signal is active. If the high voltage energy management communication enable hardwire signal is low when the serial data message indicates it should be high, then DTC P1EC1 is set.

Conditions for Running the DTC

- The device is awake and communicating.
- The system voltage is at least 9 V.
- DTCs U2602, U180B, P1A0C, or P1A07 is not set.

Conditions for Setting the DTC

P1EC1

The ignition voltage on the high voltage energy management communication enable circuit is less than 5 V.

Action Taken When the DTC Sets

DTCs P1EC1 and P1EC2 are type A DTCs.

Conditions for Clearing the DTC

P1EC1

The ignition voltage on the high voltage energy management communication enable circuit is at least 5 V for 10 s.

DTCs P1EC1 and P1EC2 are type A DTCs.

Diagnostic Aids

Short to ground will also set multiple no communication codes for devices on high voltage management serial data bus.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX
- INLINE HARNESS CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-52014** Low Voltage Test Harness

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P1EB9 or U185B is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematics and connector end views to identify the devices' high voltage energy management communication enable circuit terminals.**

1. Vehicle OFF, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
2. Vehicle in Service Mode.
3. Verify that a test lamp illuminates between the high voltage energy management communication enable circuit terminal 11 X357 and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the high voltage energy management communication enable circuit terminal 11 X357 at the A4 Hybrid/EV Battery Pack and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the high voltage energy management communication enable circuit end to end between the A4 Hybrid/EV Battery Pack terminal 11 X357 and the K114B Hybrid/EV Powertrain Control Module 2 terminal 65 X2.
      - If greater than 2 Ω, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
4. Vehicle OFF, connect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
5. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to **High Voltage Disabling** .
6. Reconnect the 12 V battery.
7. Vehicle OFF, connect the EL-52014 low voltage test harness.
8. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
9. Vehicle in Service Mode.
10. Verify that a test lamp illuminates between the high voltage energy management communication enable circuit terminal 10 X8 at K16 Battery Energy Control Module and ground.

- **If the test lamp does not illuminate**

  Repair the open/high resistance in the circuit.

- **If the test lamp illuminates**

11. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U0020: LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC U0020

Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Devices connected to the GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have programmed information about what messages are needed to be exchanged on the serial data circuits. The messages are also supervised and some periodic messages are used by the receiver device as an availability indication of the transmitter device.

Conditions for Running the DTCs

- Supply voltage to the devices is in the normal operating range.
- The vehicle power mode requires serial data communication to occur.
- The DTC U2100 does not have a current status.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTCs Sets

The device uses a default value for the missing parameter.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Circuit/System Verification

Diagnosis of this DTC is accomplished via the symptom or an additional DTC. Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device** , or **Diagnostic Trouble Code (DTC) List - Vehicle** .

DTC U0073 OR U2100: CONTROL MODULE COMMUNICATION BUS A OFF, CAN BUS COMMUNICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC U0073

Control Module Communication Bus A Off

DTC U2100

CAN Bus Communication

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The serial data circuits are used to communicate information between the devices. The serial data circuits also connect directly to the data link connector (DLC).

Conditions for Running the DTCs

- Supply voltage to the devices is in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits more than 3 times in 5 s.

Action Taken When the DTCs Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- In the transmission control module, DTC U0073 will cause the transmission to go into default gears.
- In the engine control module and transmission control module, DTC U0073 will cause the malfunction indicator lamp (MIL) to illuminate.
- If equipped with eAssist, DTC U0073 in the hybrid powertrain control module is a type B DTC and will cause the malfunction indicator lamp to illuminate and result in the engine operating in conventional engine mode and will maintain 14 V module operation.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- The engine control module or transmission control module turns OFF the MIL after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- If equipped with eAssist, the hybrid powertrain control module turns off the MIL after the diagnostic runs and does not fail during subsequent ignition cycles. Normal operation will resume 5 s after subsequent ignition cycle.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Circuit/System Verification

1. Refer to **Data Link References** to determine which serial data communication system is used for a specific device.
2. This DTC may not be retrieved with a current status. Diagnosis is accomplished using the symptom. Refer to **Symptoms - Data Communications** .

DTC U0074: CONTROL MODULE COMMUNICATION POWERTRAIN EXPANSION CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U0074

Control Module Communication Powertrain Expansion CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Powertrain High Speed GMLAN Serial Data (+)	U0074	U0074, U0100-U02FF*	U0074	-
Powertrain High Speed GMLAN Serial Data (-)	U0074	U0074, U0100-U02FF*	U0074	-
Ground (auxiliary data connector terminal 5)	-	U0074	-	-
* An open in only one powertrain high speed GMLAN serial data circuit may allow degraded communication between the devices.				

Circuit/System Description

The serial data is transmitted on two twisted wires that allow speeds up to 500 Kb/s. The twisted pair is terminated with two 120 Ω resistors, one is internal to the engine control module (ECM) and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the powertrain high speed GMLAN bus during normal vehicle operation. The powertrain high speed GMLAN is a differential bus. The powertrain high speed GMLAN serial data bus (+) and powertrain high speed GMLAN serial data (-) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the powertrain high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the powertrain high speed GMLAN serial data bus (-) circuit. If serial data is lost, devices will set a no communication code against the non-communicating device. Note that a loss of serial data DTC does not represent a failure of the device that set it.

The powertrain high speed GMLAN serial data circuits connect directly to the auxiliary data connector. The scan tool does not communicate with powertrain high speed GMLAN bus.

Conditions for Running the DTC

- Supply voltage to the devices are in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the powertrain high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The MIL and battery indicators will illuminate, along with several DIC messages.
- DTC U0074 is a type A DTC.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.
- DTC U0074 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- The engine will not start when there is a total malfunction of the powertrain high speed GMLAN serial data bus.
- Use **Data Link References** to determine which devices connect to the powertrain high speed GMLAN serial data bus.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify two or more devices are not communicating on the powertrain high speed GMLAN serial data circuit. Refer to **Data Link References** to determine how many devices should be communicating on the bus.
    - **If only one device is not communicating**

      Refer to Circuit/System Testing - Testing the Device Circuits.

    - **If two or more devices are not communicating**
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the scan tool from the X84 data link connector. The following tests will be done at the X84B auxiliary data connector. It may take up to 2 minutes for all vehicle systems to power down.
4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. Test for less than 4.5 V between the serial data circuits listed below and ground.
    - Terminal 12
    - Terminal 13
    - **If 4.5 V or greater**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

    - **If less than 4.5 V**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for greater than 100 Ω between the serial data circuits listed below and ground.
    - Terminal 12
    - Terminal 13
    - **If 100 Ω or less**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

    - **If greater than 100 Ω**
9. Test for 50 - 70 Ω between the serial data circuit terminals 12 and 13.
    - **If less than 35 Ω**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

    - **If between 35 - 50 Ω**

      There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 Ω but less than infinite**

  Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

  Repair the open/high resistance in the circuit between the X84B auxiliary data connector and the first splice/device in the serial data circuit.

- **If between 50 - 70 Ω**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: **Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.**

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- **Powertrain high speed GMLAN devices the vehicle is equipped with**
- **Powertrain high speed GMLAN serial data circuit terminating resistors**
- **Device locations on the powertrain high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and powertrain high speed GMLAN serial data circuit terminals**

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at an easily accessible device, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
   1. Vehicle OFF.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the device that was disconnected.
   - **If any serial data circuit is greater than 4.5 V**
3. Vehicle OFF, disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
   1. Vehicle OFF.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.

    - If less than 10 Ω, replace the device that was disconnected.
  - **If any serial data circuit is greater than 4.5 V**
5. Repeat step 3 until one of the following conditions are isolated:
   - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
   - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 100 Ω or greater**

     Replace the device that was disconnected.

   - **If any serial data circuit is less than 100 Ω**
4. Disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
   - **If both serial data circuits are 100 Ω or greater**

     Replace the device that was disconnected.

   - **If any serial data circuit is less than 100 Ω**
6. Repeat step 4 until one of the following conditions are isolated:
   - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
   - A short to ground on the serial data circuit between a device and a terminating resistor.
   - A short to ground on the serial data circuit between the X84B auxiliary data connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
   - **If each pair of serial data circuits is 110 Ω or greater**

     Replace the device that was disconnected.

   - **If any pair of serial data circuits is less than 110 Ω**
4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
   - **If each pair of serial data circuits is 110 Ω or greater**

     Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

7. Repeat step 4 until one of the following conditions are isolated:
    - Serial data circuits shorted together between two devices or splice packs, if equipped.
    - Serial data circuits shorted together between a device and a terminating resistor.
    - Serial data circuits shorted together between the X84B auxiliary data connector and the first device or splice pack.
    - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuit is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the powertrain high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
7. Repeat step 4 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Vehicle in Service Mode
5. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF.
2. Test for infinite resistance between the B+ circuit and ground.
   - If less than infinite resistance, repair the short to ground on the circuit.
   - If infinite resistance, replace the disconnected device.

- **If the test lamp illuminates**

6. Vehicle in Service Mode.
7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
8. Vehicle in Service Mode
9. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the control module that controls the ignition circuit.
   - **If the test lamp illuminates**
10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
11. Test for less than 130 Ω between each pair of powertrain high speed GMLAN serial data circuits at the device connector that was just disconnected.
    - **If any pair of serial data circuits is greater than 130 Ω**

      Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.

    - **If each pair of serial data circuits is 130 Ω or less**
12. Replace the device that was disconnected.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U0077: CONTROL MODULE COMMUNICATION CHASSIS EXPANSION CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U0077

Control Module Communication Chassis Expansion CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Chassis High Speed GMLAN Serial Data (+)	U0077	U0077, U0100 - U02FF*	U0077	-
Chassis High Speed GMLAN Serial Data (-)	U0077	U0077, U0100 - U02FF*	U0077	-
Ground (DLC, terminal 5)	-	1	-	-
* An open in only one chassis high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the Data Link Connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. 1. No communication with any chassis high speed GMLAN device.				

Circuit/System Description

The GMLAN high speed chassis expansion bus functions the same as the GMLAN high speed bus, and the two buses operate in parallel. The expansion chassis bus was added to reduce message congestion on the primary high speed bus. Since the GMLAN high speed chassis bus and primary GMLAN high speed bus operate in the same manner, the diagnostics for each are the same.

The chassis high speed GMLAN serial data circuits also connect directly to the Data Link Connector (DLC).

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the chassis high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.
- DTC U0077 is a type A DTC.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.

- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.
- DTC U0077 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify two or more devices are not communicating on the chassis high speed GMLAN serial data circuit. Refer to **Data Link References** to determine how many devices should be communicating on the bus.
    - **If only one device is not communicating**

      Refer to Circuit/System Testing - Testing the Device Circuits.
    - **If two or more devices are not communicating**
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.
4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. Test for less than 4.5 V between the serial data circuits listed below and ground.
    - Terminal 12
    - Terminal 13
    - **If 4.5 V or greater**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.
    - **If less than 4.5 V**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
8. Test for greater than 100 Ω between the serial data circuits listed below and ground.
    - Terminal 12
    - Terminal 13
    - **If 100 Ω or less**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.
    - **If greater than 100 Ω**
9. Test for 50 - 70 Ω between the serial data circuit terminals 12 and 13.
    - **If less than 35 Ω**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.
    - **If between 35 - 50 Ω**

      There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 Ω but less than infinite**

  Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

  Repair the open/high resistance in the circuit between the X84 Data Link Connector and the first splice/device in the serial data circuit.

- **If between 50 - 70 Ω**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: **Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.**

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- **Chassis high speed GMLAN devices the vehicle is equipped with**
- **Chassis high speed GMLAN serial data circuit terminating resistors**
- **Device locations on the chassis high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and chassis high speed GMLAN serial data circuit terminals**

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
   1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the device that was disconnected.
   - **If any serial data circuit is greater than 4.5 V**
3. Vehicle OFF, disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
   1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the device that was disconnected.
   - **If any serial data circuit is greater than 4.5 V**

5. Repeat step 3 until one of the following conditions are isolated:
    - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
    - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
    - **If each serial data circuit is 100 Ω or greater**

      Replace the device that was disconnected.

    - **If any serial data circuit is less than 100 Ω**
4. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
    - **If both serial data circuits are 100 Ω or greater**

      Replace the device that was disconnected.

    - **If any serial data circuit is less than 100 Ω**
6. Repeat step 4 until one of the following conditions are isolated:
    - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
    - A short to ground on the serial data circuit between a device and a terminating resistor.
    - A short to ground on the serial data circuit between the X84 Data Link Connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 110 Ω or greater**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is less than 110 Ω**
4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 110 Ω or greater**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is less than 110 Ω**
7. Repeat step 4 until one of the following conditions are isolated:

- Serial data circuits shorted together between two devices or splice packs, if equipped.
- Serial data circuits shorted together between a device and a terminating resistor.
- Serial data circuits shorted together between the X84 Data Link Connector and the first device or splice pack.
- A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuit is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the chassis high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
7. Repeat step 4 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Vehicle in Service Mode
5. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**
1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the disconnected device.
- **If the test lamp illuminates**

6. Vehicle in Service Mode.
7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
8. Vehicle in Service Mode
9. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the control module that controls the ignition circuit.
    - **If the test lamp illuminates**
10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
11. Test for less than 130 Ω between each pair of chassis high speed GMLAN serial data circuits at the device connector that was just disconnected.
    - **If any pair of serial data circuits is greater than 130 Ω**

      Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.

    - **If each pair of serial data circuits is 130 Ω or less**
12. Replace the device that was disconnected.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U0078: CONTROL MODULE COMMUNICATION LOW SPEED CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U0078

Control Module Communication Low Speed CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The low speed GMLAN serial data bus is used to communicate information between the devices. The serial data is transmitted over a single wire to the appropriate devices. The low speed GMLAN serial data circuits also connect directly to the data link connector (DLC).

Conditions for Running the DTC

- Supply voltage to the devices are in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits more than 3 times in 5 seconds.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0078 is not set.
    - **If DTC U0078 is set**

      Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device** .

    - **If DTC U0078 is not set**
3. All OK

DTC U007A: CONTROL MODULE COMMUNICATION HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U007A

Control Module Communication High Voltage Energy Management CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A*	U007A*	U007A*	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A*	U007A*	U007A*	-
Ground (auxiliary data connector terminal 5)	-	U007A*	-	-
* Other DTCs may be set with this fault.				

Circuit/System Description

Devices connected to the high voltage energy management high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices when the vehicle is on. The high voltage energy management high speed GMLAN serial data bus uses a terminating resistor that is in parallel with the high voltage energy management high speed GMLAN (+) and (-) circuits.

The high voltage energy management high speed GMLAN serial data circuits connect directly to the auxiliary data connector. The scan tool does not communicate with high voltage energy management high speed GMLAN bus.

Conditions for Running the DTC

- Supply voltage to the devices are in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the high voltage energy management high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- The engine may not start when there is a total malfunction of the high voltage energy management high speed GMLAN serial data bus.
- Use **Data Link References** to determine which devices connect to the high voltage energy management high speed GMLAN serial data bus.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**

- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.**

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- **High voltage energy management high speed GMLAN devices the vehicle is equipped with**
- **High voltage energy management high speed GMLAN serial data circuit terminating resistors**
- **Device locations on the high voltage energy management high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and high voltage energy management high speed GMLAN serial data circuit terminals**

1. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to High Voltage Disabling .
2. Reconnect the 12 V battery after performing the high voltage disabling procedure.
3. Vehicle in Service Mode.
4. Verify two or more devices are not communicating on the high voltage energy management high speed GMLAN serial data circuit. Refer to Data Link References to determine how many devices should be communicating on the bus.
   - **If only one device is not communicating**

     Refer to Testing the Device Circuits.

   - **If two or more devices are not communicating**
5. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84B Auxiliary Data Connector. It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
7. Vehicle in Service Mode.
8. Test for less than 4.5 V between the serial data circuits listed below and ground.
    - Terminal 3
    - Terminal 11
    - **If 4.5 V or greater**

      Refer to Testing the Serial Data Circuits for a Short to Voltage.

    - **If less than 4.5 V**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
10. Test for greater than 100 Ω between the serial data circuits listed below and ground.
    - Terminal 3
    - Terminal 11
    - **If 100 Ω or less**

      Refer to Testing the Serial Data Circuits for a Short to Ground.

    - **If greater than 100 Ω**
11. Test for 50 - 70 Ω between the serial data circuit terminals 3 and 11.
    - **If less than 35 Ω**

      Refer to Testing the Serial Data Circuits for a Short between the Circuits.

    - **If between 35 - 50 Ω**

      There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Testing the Serial Data Circuits for a Short between the Circuits.

    - **If greater than 70 Ω but less than infinite**

      Refer to Testing the Serial Data Circuits for an Open/High Resistance.

    - **If infinite resistance**

      Repair the open/high resistance in the circuit between the X84B Auxiliary Data Connector and the first splice/device in the serial data circuit.

    - **If between 50 - 70 Ω**
12. Refer to Testing the Device Circuits.

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at an easily accessible device, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
    - **If each serial data circuit is 4.5 V or less**
    1. Vehicle OFF.
    2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
        - If 10 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 10 Ω, replace the device that was disconnected.

- **If any serial data circuit is greater than 4.5 V**

3. Vehicle OFF, disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
     1. Vehicle OFF.
     2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
        - If 10 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 10 Ω, replace the device that was disconnected.
   - **If any serial data circuit is greater than 4.5 V**
5. Repeat step 3 until one of the following conditions are isolated:
   - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
   - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 100 Ω or greater**

     Replace the device that was disconnected.

   - **If any serial data circuit is less than 100 Ω**
4. Disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
   - **If both serial data circuits are 100 Ω or greater**

     Replace the device that was disconnected.

   - **If any serial data circuit is less than 100 Ω**
6. Repeat step 4 until one of the following conditions are isolated:
   - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
   - A short to ground on the serial data circuit between a device and a terminating resistor.
   - A short to ground on the serial data circuit between the X84B auxiliary data connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
   - **If each pair of serial data circuits is 110 Ω or greater**

     Replace the device that was disconnected.

- **If any pair of serial data circuits is less than 110 Ω**

4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 110 Ω or greater**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is less than 110 Ω**
7. Repeat step 4 until one of the following conditions are isolated:
    - Serial data circuits shorted together between two devices or splice packs, if equipped.
    - Serial data circuits shorted together between a device and a terminating resistor.
    - Serial data circuits shorted together between the X84B auxiliary data connector and the first device or splice pack.
    - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuit is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high voltage energy management high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
7. Repeat step 4 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.

   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Vehicle in Service Mode
5. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
6. Vehicle in Service Mode.
7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
8. Vehicle in Service Mode
9. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the control module that controls the ignition circuit.
   - **If the test lamp illuminates**
10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
11. Test for less than 130 Ω between each pair of high voltage energy management high speed GMLAN serial data circuits at the device connector that was just disconnected.
    - **If any pair of serial data circuits is greater than 130 Ω**

Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.

- **If each pair of serial data circuits is 130 Ω or less**

12. Replace the device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U007B: CONTROL MODULE COMMUNICATION HIGH SPEED EXTENSION CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U007B 00

Control Module Communication High Speed Extension CAN Bus Off

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Gateway Expansion High Speed GMLAN Serial Data (+) or High Speed GMLAN Serial Data (+) (8)	U007B	U007B	U007B	-
Gateway Expansion High Speed GMLAN Serial Data (-) or High Speed GMLAN Serial Data (-) (8)	U007B	U007B	U007B	-

Circuit/System Description

The devices connected to the gateway expansion high speed GMLAN serial data circuits (circuit numbers 3935 & 3936) monitor for serial data communications during normal vehicle operation. The K56 Serial Data Gateway Module acts as the gateway module between devices on primary high speed GMLAN bus and devices on gateway expansion high speed GMLAN bus. The gateway expansion high speed GMLAN serial data bus uses terminating resistors that are in parallel with the gateway expansion high speed GMLAN (+) and (-) circuits.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.

- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Each device may need to be disconnected to isolate a circuit fault. Use the schematic to identify the following:**

- **Gateway expansion high speed GMLAN devices and terminating resistors the vehicle is equipped with**
- **Device locations on the gateway expansion high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and gateway expansion high speed GMLAN serial data circuit terminals**

Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate

failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at an easily accessible device that is not communicating. Refer to **Data Link References** to determine which devices are on the gateway expansion high speed GMLAN bus.
2. Ignition ON/Vehicle In Service Mode.
3. Test for less than 4.5 V between each gateway expansion high speed GMLAN serial data circuit at the device that was just disconnected and ground.
    - **If 4.5 V or greater**

      Refer to Testing the Serial Data Circuits for a Short to Voltage.

    - **If less than 4.5 V**
4. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
5. Test for greater than 100 Ω between each gateway expansion high speed GMLAN serial data circuit at the device that was just disconnected and ground.
    - **If 100 Ω or less**

      Refer to Testing the Serial Data Circuits for a Short to Ground.

    - **If greater than 100 Ω**
6. Test for 110 - 130 Ω between each pair of the gateway expansion high speed GMLAN serial data circuits at the device that was just disconnected:
    - **If less than 110 Ω**

      Refer to Testing the Serial Data Circuits for a Short between the Circuits.

    - **If greater than 130 Ω**

      Refer to Testing the Serial Data Circuits for an Open/High Resistance.

    - **If between 110 - 130 Ω**
7. Refer to Testing the Device Circuits.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON/Vehicle In Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
    - **If each serial data circuit is 4.5 V or less**
    1. Ignition/Vehicle OFF.
    2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
        - If 10 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 10 Ω, replace the device that was disconnected.
    - **If any serial data circuit is greater than 4.5 V**
3. Repeat step 1 until one of the following conditions are isolated:
    - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
    - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
    - **If each serial data circuit is 100 Ω or greater**

      Replace the device that was disconnected.

    - **If any serial data circuit is less than 100 Ω**
4. Repeat step 1 until one of the following conditions are isolated:
    - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
    - A short to ground on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
4. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 110 Ω or greater**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is less than 110 Ω**
5. Repeat step 2 until one of the following conditions are isolated:
    - Serial data circuits shorted together between two devices or splice packs, if equipped.
    - Serial data circuits shorted together between a device and a terminating resistor.
    - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
4. Test for less than 130 Ω between each pair of the serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
5. Repeat step 2 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
4. Ignition ON/Vehicle In Service Mode.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
   - **If the test lamp does not illuminate**
   1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the control module that controls the ignition circuit.
   - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K56 Serial Data Gateway

Module. It may take up to 2 min for all vehicle systems to power down.

8. Test for less than 2 Ω in each of the gateway expansion high speed GMLAN serial data circuits end to end between the non communicating device and the K56 Serial Data Gateway Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Test for less than 2 Ω in each of the primary high speed GMLAN serial data circuits (circuit numbers 2500 & 2501) end to end between the K56 Serial Data Gateway Module and the appropriate X84 Data Link Connector (DLC) terminals listed below.
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 6
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 14
    - **If 2 Ω or greater**

      Repair the open/high resistance in the high speed GMLAN serial data circuit.

    - **If less than 2 Ω**
10. Replace the non communicating device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U007C: CONTROL MODULE COMMUNICATION HIGH SPEED EXTENSION CAN BUS 2 OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U007C 00

Control Module Communication High Speed Extension CAN Bus 2 Off

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Gateway Isolated High Speed GMLAN Serial Data (+) or High Speed GMLAN Serial Data (+) (9)	U007C	U007C	U007C	-
Gateway Isolated High Speed GMLAN Serial Data (-) or High Speed GMLAN Serial Data (-) (9)	U007C	U007C	U007C	-

Circuit/System Description

The devices connected to the gateway isolated high speed GMLAN serial data circuits (circuit numbers 1304 & 1305) monitor for serial data communications during normal vehicle operation. The K56 Serial Data Gateway Module acts as the gateway module between devices on primary high speed GMLAN bus and devices on gateway isolated high speed GMLAN bus. The gateway isolated high speed GMLAN serial data bus uses terminating resistors that are in parallel with the gateway isolated high speed GMLAN (+) and (-) circuits.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Each device may need to be disconnected to isolate a circuit fault. Use the schematic to identify the following:**

- **Gateway isolated high speed GMLAN devices and terminating resistors the vehicle is equipped with**
- **Device locations on the gateway isolated high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and gateway isolated high speed GMLAN serial data circuit terminals**

Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at an easily accessible device that is not communicating. Refer to Data Link References to determine which devices are on the gateway isolated high speed GMLAN bus.
2. Ignition ON/Vehicle In Service Mode.
3. Test for less than 4.5 V between each gateway isolated high speed GMLAN serial data circuit at the device that was just disconnected and ground.
   - **If 4.5 V or greater**

     Refer to Testing the Serial Data Circuits for a Short to Voltage.
   - **If less than 4.5 V**
4. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
5. Test for greater than 100 Ω between each gateway isolated high speed GMLAN serial data circuit at the device that was just disconnected and ground.
   - **If 100 Ω or less**

     Refer to Testing the Serial Data Circuits for a Short to Ground.
   - **If greater than 100 Ω**
6. Test for 110 - 130 Ω between each pair of the gateway isolated high speed GMLAN serial data circuits at the device that was just disconnected:
   - **If less than 110 Ω**

     Refer to Testing the Serial Data Circuits for a Short between the Circuits.
   - **If greater than 130 Ω**

     Refer to Testing the Serial Data Circuits for an Open/High Resistance.
   - **If between 110 - 130 Ω**
7. Refer to Testing the Device Circuits.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON/Vehicle In Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**

   1. Ignition/Vehicle OFF.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the device that was disconnected.
   - **If any serial data circuit is greater than 4.5 V**
3. Repeat step 1 until one of the following conditions are isolated:
   - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
   - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 100 Ω or greater**

     Replace the device that was disconnected.

   - **If any serial data circuit is less than 100 Ω**
4. Repeat step 1 until one of the following conditions are isolated:
   - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
   - A short to ground on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
4. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
   - **If each pair of serial data circuits is 110 Ω or greater**

     Replace the device that was disconnected.

   - **If any pair of serial data circuits is less than 110 Ω**
5. Repeat step 2 until one of the following conditions are isolated:
   - Serial data circuits shorted together between two devices or splice packs, if equipped.
   - Serial data circuits shorted together between a device and a terminating resistor.
   - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
4. Test for less than 130 Ω between each pair of the serial data circuits at the device connector that was just disconnected.
   - **If each pair of serial data circuits is 130 Ω or less**

Replace the device that was disconnected.

- **If any pair of serial data circuits is greater than 130 Ω**

5. Repeat step 2 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.
    - **If 10 Ω or greater**
    1. Ignition/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
4. Ignition ON/Vehicle In Service Mode.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
    - **If the test lamp does not illuminate**

    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the control module that controls the ignition circuit.
  - **If the test lamp illuminates**

7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K56 Serial Data Gateway Module. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 2 Ω in each of the gateway isolated high speed GMLAN serial data circuits end to end between the non communicating device and the K56 Serial Data Gateway Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Test for less than 2 Ω in each of the primary high speed GMLAN serial data circuits (circuit numbers 2500 & 2501) end to end between the K56 Serial Data Gateway Module and the appropriate X84 Data Link Connector (DLC) terminals listed below.
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 6
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 14
    - **If 2 Ω or greater**

      Repair the open/high resistance in the primary high speed GMLAN serial data circuit.

    - **If less than 2 Ω**
10. Replace the non communicating device that was disconnected.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U007D: CONTROL MODULE COMMUNICATION LOW SPEED EXTENSION CAN BUS OFF

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U007D 00

Control Module Communication Low Speed Extension CAN Bus Off

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Gateway Isolated Low Speed GMLAN Serial Data or Low Speed GMLAN Serial Data #2 (Circuit #1102)	U007D	U0100-U02FF	U007D	-

Circuit/System Description

The gateway isolated low speed GMLAN serial data bus is used to communicate information between the devices. The serial data is transmitted over a single wire (circuit number 1102) to the appropriate devices. The K56 Serial Data Gateway Module acts as the gateway module between devices on low speed GMLAN bus and devices on gateway isolated low speed GMLAN bus.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Attempt to communicate with all devices on the gateway isolated low speed GMLAN serial data circuit. Refer to **Data Link References** to determine which devices are on the gateway isolated low speed GMLAN bus.
4. Verify that all gateway isolated low speed GMLAN devices are communicating.
    - **If only one device is not communicating**

      Refer to Circuit/System Testing - Testing the Device Circuits.

    - **If all devices are not communicating, except the K56 Serial Data Gateway Module**

      Refer to Circuit/System Testing.

    - **If two or more devices are not communicating but not all, except the K56 Serial Data Gateway Module**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

    - **If all devices are communicating**
5. All OK.

Circuit/System Testing

NOTE: **Use the schematic to identify the following:**

- **Gateway isolated low speed GMLAN devices the vehicle is equipped with**
- **Device and splice pack locations on the gateway isolated low speed GMLAN serial data circuit**
- **The gateway isolated low speed GMLAN serial data circuit terminals for each device or splice pack**

1. Ignition/Vehicle OFF, disconnect the harness connectors at the K56 Serial Data Gateway Module, ignition ON/Vehicle In Service Mode.
2. Test for less than 4.5 V between each gateway isolated low speed GMLAN serial data circuit at the K56 Serial Data Gateway Module and ground.
    - **If any serial data circuit is greater than 4.5 V**

      Refer to Testing the Serial Data Circuits for a Short to Voltage.

    - **If all serial data circuits are less than 4.5 V**
3. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
4. Test for greater than 100 Ω between each gateway isolated low speed GMLAN serial data circuit at the K56 Serial Data Gateway Module and ground.
    - **If any serial data circuit is 100 Ω or less**

      Refer to Testing the Serial Data Circuits for a Short to Ground.

    - **If all serial data circuits are greater than 100 Ω**

5. Test for less than 2 Ω in the primary low speed GMLAN serial data circuit (circuit number 5060) end to end between the K56 Serial Data Gateway Module and X84 Data Link Connector terminal 1.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the low speed GMLAN serial data circuit.

    - **If less than 2 Ω**
6. If equipped, inspect all gateway isolated low speed GMLAN splice packs for damage.
7. Repair the open/high resistance in the gateway isolated low speed GMLAN serial data circuit between the K56 Serial Data Gateway Module and the closest splice (or the closest gateway isolated low speed GMLAN device).

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition/Vehicle OFF.
    - For vehicles equipped with splice packs, disconnect the appropriate harness connectors at all gateway isolated low speed GMLAN serial data splice packs.
    - For vehicles equipped with sonic splices, cut the appropriate harness at a gateway isolated low speed GMLAN serial data splice closest to the K56 Serial Data Gateway Module, at least 40 mm (1.57 in) from the splice. Do not cut the wires right at the splice because these wires need to be repaired after the test is done.
2. Ignition ON/Vehicle In Service Mode.
3. Test for less than 4.5 V between each gateway isolated low speed GMLAN serial data circuit at a splice pack (or splice) and ground.
    - **If any serial data circuit is 4.5 V or greater**
    1. Ignition/Vehicle OFF, reconnect (or repair) all serial data circuits at the tested splice pack (or splice) except the failed serial data circuit, ignition ON/Vehicle In Service Mode.
    2. Verify the gateway isolated low speed GMLAN devices that are still not communicating to identify the failed serial data circuit.
    3. Ignition/Vehicle OFF, disconnect all devices on the failed serial data circuit, ignition ON/Vehicle In Service Mode.
    4. Test for less than 1 V between each section of the failed serial data circuit and ground.
        - If 1 V or greater, repair the short to voltage in the serial data circuit.
        - If less than 1 V
    5. Ignition/Vehicle OFF, reconnect (or repair) the failed serial data circuit to the splice pack (or splice) and connect the first device on the failed serial data circuit, ignition ON/Vehicle In Service Mode.
    6. Verify the scan tool communicates or not with the gateway isolated low speed GMLAN serial data circuit.
        - If the scan tool does not communicate, replace the device that was just connected.
        - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.6.
        - If the scan tool communicates and there are no more devices to connect
    7. All OK.
    - **If each serial data circuit is less than 4.5 V**
4. Inspect all gateway isolated low speed GMLAN splice packs (or splices) for damage.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
    - For vehicles equipped with splice packs, disconnect the appropriate harness connectors at all gateway isolated low speed GMLAN serial data splice packs.
    - For vehicles equipped with sonic splices, cut the appropriate harness at a gateway isolated low speed GMLAN serial data splice closest to the K56 Serial Data Gateway Module, at

least 40 mm (1.57 in) from the splice. Do not cut the wires right at the splice because these wires need to be repaired after the test is done.

2. Test for greater than 100 Ω between each gateway isolated low speed GMLAN serial data circuit at a splice pack (or splice) and ground.
   - **If any serial data circuit is 100 Ω or less**
   1. Reconnect (or repair) all serial data circuits at the tested splice pack (or splice) except the failed serial data circuit, ignition ON/Vehicle In Service Mode.
   2. Verify the gateway isolated low speed GMLAN devices that are still not communicating to identify the failed serial data circuit.
   3. Ignition/Vehicle OFF, disconnect all devices on the failed serial data circuit.
   4. Test for infinite resistance between each section of the failed serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground in the serial data circuit.
      - If infinite resistance
   5. Reconnect (or repair) the failed serial data circuit to the splice pack (or splice) and connect the first device on the failed serial data circuit, ignition ON/Vehicle In Service Mode.
   6. Verify the scan tool communicates or not with the gateway isolated low speed GMLAN serial data circuit.
      - If the scan tool does not communicate, replace the device that was just connected.
      - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 2.6.
      - If the scan tool communicates and there are no more devices to connect
   7. All OK.
   - **If each serial data circuit is greater than 100 Ω**
3. Inspect all gateway isolated low speed GMLAN splice packs (or splices) for damage.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors at the gateway isolated low speed GMLAN device that is not communicating and closest to the K56 Serial Data Gateway Module.
3. Disconnect the harness connectors at the K56 Serial Data Gateway Module.
4. Test for less than 2 Ω in the gateway isolated low speed GMLAN serial data circuit (circuit number 1102) end to end between the non-communicating device and the K56 Serial Data Gateway Module.
   - **If 2 Ω or greater**

     Repair the open/high resistance in the serial data circuit.

   - **If less than 2 Ω**
5. Test for less than 2 Ω in the primary low speed GMLAN serial data circuit (circuit number 5060) end to end between the K56 Serial Data Gateway Module and the X84 Data Link Connector terminal 1.
   - **If 2 Ω or greater**

     Repair the open/high resistance in the serial data circuit.

   - **If less than 2 Ω**
6. Replace the non-communicating device that was disconnected.

Testing the Device Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the gateway isolated low speed GMLAN device that is not communicating. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.
    - **If 10 Ω or greater**
    1. Ignition/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
4. Ignition ON/Vehicle In Service Mode.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the control module that controls the ignition circuit.
    - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K56 Serial Data Gateway Module. It may take up to 2 min for all vehicle systems to power down.

8. Test for less than 2 Ω in each of the gateway isolated low speed GMLAN serial data circuits end to end between the non communicating device and the K56 Serial Data Gateway Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.
    - **If less than 2 Ω**
9. Test for less than 2 Ω in the primary low speed GMLAN serial data circuit (circuit number 5060) end to end between the K56 Serial Data Gateway Module and X84 Data Link Connector terminal 1.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the low speed GMLAN serial data circuit.
    - **If less than 2 Ω**
10. Replace the non communicating device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U0100-U02FF: LOST COMMUNICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to **Control Module U Code List**.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0100-U02FF	U0100-U02FF	-	-
Ignition	U0100 - U02FF, U1814, U2099, P06E4, P1EB9	U0100-U02FF	-	-
Low Speed GMLAN Serial Data	U0078, 1	U0100-U02FF	U0078, 1	-
High Speed GMLAN Serial Data (+)	U0073, 2	U0100-U02FF	U0073, 2	-
High Speed GMLAN Serial Data (-)	U0073, 2	U0100-U02FF	U0073, 2	-
Chassis High Speed GMLAN Serial Data (+)	U0077	U0077, U0100-U02FF	U0077	-
Chassis High Speed GMLAN Serial Data (-)	U0077	U0077, U0100-U02FF	U0077	-
Powertrain High Speed GMLAN Serial Data (+)	U0074	U0074, U0100-U02FF	U0074	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Powertrain High Speed GMLAN Serial Data (-)	U0074	U0074, U0100-U02FF	U0074	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A	U007A, U0100-U02FF	U007A	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A	U007A, U0100-U02FF	U007A	-
Ground	-	U0100-U02FF	-	-
1. Scan Tool Does Not Communicate With Most Low Speed GMLAN Device 2. Scan Tool Does Not Communicate With Most High Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC) on the driver side, the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). The Auxiliary Data Connector on the passenger side is used for expansion buses. When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non-communicating device. The DTC is unique to the device which is not communicating and one or more devices may set the same exact code. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- Specific subsystems will not function.
- DTC U0100 in the Transmission Control Module will cause the transmission to go into default gears.
- Both DTC U0100 in the Transmission Control Module and DTC U0101 in the Engine Control Module will cause the malfunction indicator lamp (MIL) to illuminate.

Conditions for Clearing the DTC

- The Engine Control Module or Transmission Control Module turns OFF the MIL after 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with either the low or high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- Use **Data Link References** to determine what serial data communications the device uses.
- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- Some intermittent communication concerns may be caused by fretting corrosion on the serial data circuit terminals. Inspect all connectors at the device that set the communication DTC, the device that the communication DTC was set against, and any inline harness connectors between the two devices. Do not replace a device based only on fretting corrosion. Refer to bulletin 09-06-03-004 for assistance with the diagnosis and repair of this condition, if applicable.
- This diagnostic can be used for any device that is not communicating, regardless of the type of serial data circuit it is connected to, providing the vehicle is equipped with the device.
- This diagnostic procedure can be used to diagnose the common no communication DTCs: U0100, U0101, U0102, U0103, U0104, U0105, U0106, U0109, U010E, U010F, U0111, U0112, U0115, U0117, U0121, U0122, U0123, U0125, U0126, U0128, U0129, U012A, U0130, U0131, U0132, U0133, U0136, U0137, U0139, U0140, U0146, U0151, U0155, U0158, U0159, U0160, U0164, U0166, U0167, U0168, U016B, U0170, U0181, U0182, U0184, U0186, U0191, U0193, U0196, U0197, U0198, U0201, U0203, U0204, U0207, U0208, U0209, U0210, U0230, U0232, U0233, U0236, U0237, U023A, U0248, U0249, U0250, U0252, U0254, U025B, U0264, U0265, U0268, U0269, U026A, U026B, U0293, U029D, U029E, U02A3, and other DTCs within U0100 - U02FF range.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, U007B, U007C, U007D, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If none of the DTCs are set**
3. Verify that the K56 Serial Data Gateway Module is communicating.
   - **If the K56 Serial Data Gateway Module is not communicating**

     Refer to Circuit/System Testing to diagnose the K56 Serial Data Gateway Module first.

   - **If the K56 Serial Data Gateway Module is communicating**
4. Determine the device that is not communicating. Refer to Control Module U Code List.
5. Refer to Data Link References to determine which data communication bus the non communicating device is on.
   - **If the device is on Gateway Expansion High Speed GMLAN bus**

     Refer to Scan Tool Does Not Communicate with Gateway Expansion High Speed GMLAN Device to diagnose that device.

   - **If the device is on Gateway Isolated High Speed GMLAN bus**

     Refer to Scan Tool Does Not Communicate with Gateway Isolated High Speed GMLAN Device to diagnose that device.

   - **If the device is on Gateway Isolated Low Speed GMLAN bus**

     Refer to Scan Tool Does Not Communicate with Gateway Isolated Low Speed GMLAN Device to diagnose that device.

   - **If the device is not on Gateway Expansion High Speed GMLAN bus, Gateway Isolated High Speed GMLAN bus, and Gateway Isolated Low Speed GMLAN bus**
6. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must**

be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wakeup serial data, serial data communication enable, accessory wakeup serial data 2, high voltage energy management communication enable, and serial data circuit terminals.**

1. Using the High Voltage Device Chart below, verify that the non-communicating device is not a high voltage device. If the device is a high voltage device, perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to **High Voltage Disabling** .
2. If high voltage disabling is required, reconnect the 12 V battery after performing the high voltage disabling procedure.
3. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect all the harness connectors at the device that is not communicating. It may take up to 2 min for all vehicle systems to power down.
4. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
5. Ignition ON/Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
7. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**

NOTE: **Accessory wakeup serial data, serial data communication enable, accessory wakeup serial data 2, and high voltage energy management communication enable circuits are ignition circuits controlled by another control module.**

8. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the control module that controls the ignition circuit.
    - **If the test lamp illuminates**
9. Test for less than 4.5 V between each GMLAN serial data circuit terminal and ground.
    - **If 4.5 V or greater between a low speed GMLAN serial data circuit and ground**

      Refer to Scan Tool Does Not Communicate with Low Speed GMLAN Device to test for a short to voltage.

    - **If 4.5 V or greater between a high speed GMLAN serial data circuit and ground**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to voltage.

    - **If less than 4.5 V**
10. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
11. Test for greater than 100 Ω between each GMLAN serial data circuit terminal and ground.
    - **If 100 Ω or less between a low speed GMLAN serial data circuit and ground**

      Refer to Scan Tool Does Not Communicate with Low Speed GMLAN Device to test for a short to ground.

    - **If 100 Ω or less between a high speed GMLAN serial data circuit and ground**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to ground.

    - **If greater than 100 Ω**
12. Test for less than 2 Ω in each of the serial data circuits end to end between the device harness connector and the appropriate X84 Data Link Connector terminals listed below:
    - X84 DLC low speed GMLAN serial data circuit terminal 1
    - X84 DLC high speed GMLAN serial data circuit terminal 6 or 14

- X84 DLC object high speed GMLAN serial data circuit terminal 3 or 11
- X84 DLC chassis high speed GMLAN serial data circuit terminal 12 or 13
- **If 2 Ω or greater**

  Repair the open/high resistance in the serial data circuit between the non communicating device and the device setting the DTC or a serial data splice pack.

- **If less than 2 Ω**

NOTE: **The following test step is only applicable to a high speed GMLAN device with 2 pairs of serial data circuits or a high speed GMLAN device with an internal terminating resistor.**

13. Test for 110 - 130 Ω between each pair of high speed GMLAN serial data circuits.
    - **If less than 110 Ω**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to ground or a short between the serial data circuits.

    - **If greater than 130 Ω**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for an open/high resistance in the serial data circuit.

    - **If between 110 - 130 Ω**
14. Replace the device that is not communicating.

High Voltage Device Chart

Device	Voltage System	Data Link Type
K16 Battery Energy Control Module (BECM)	300 V 12 V	• High Voltage Energy Management High Speed GMLAN • High Speed GMLAN • BECM Dedicated Bus

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U0300-U0336: SOFTWARE INCOMPATIBILITY

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

Refer to Control Module U Code List.

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that device may set the appropriate communication DTCs. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U0300-U0336 is not set.
    - **If DTC U0300-U0336 is set**
    1. Program the device specified by the DTC descriptor.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the device specified by the DTC descriptor.
        - If the DTC does not set
    3. All OK.
    - **If DTC U0300-U0336 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U0400-U05FF: INVALID DATA RECEIVED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

Refer to **Control Module U Code List**.

Circuit/System Description

Some devices are constantly receiving information from other devices through serial data communication network. The invalid data code will be set when a receiving device detects a discrepancy in information it receives from another device causing its integrity to be questioned. The symptom byte listed in the DTC Descriptor is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Engine running for 10 seconds.
2. Vehicle in Service Mode.
3. Verify DTC U0400-U05FF is not set.
    - **If DTC U0400-U05FF is set along with other DTCs set**

Diagnose all other DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC U0400-U05FF is set without other DTCs set**

1. Program the device specified by the DTC descriptor.
2. Verify the DTC does not set.
    - If the DTC sets, replace the appropriate device.
    - If the DTC does not set
3. All OK.

- **If DTC U0400-U05FF is not set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U1026: LOST COMMUNICATION WITH TRANSFER CASE CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC U1026

Lost Communication with Transfer Case Control Module

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0102, U1026	U0102, U1026	-	-
Ignition	U0102, U1026	U0102, U1026	-	-
Accessory WakeUp Serial Data	U1814, U2099, U0102, U1026	U0102, U1026	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U0102, U1026*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U0102, U1026*	U0073*	-
Ground	-	U0102, U1026	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC U0073, U0074, U0075, U0076, U0077, U0078, U2100, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wakeup serial data, and serial data circuit terminals.**

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K69 Transfer Case Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K69 Transfer Case Control Module.
    - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K69 Transfer Case Control Module.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Ignition OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
7. Test for less than 4.5 V between each high speed GMLAN serial data circuit terminal and ground.
    - **If 4.5 V or greater**

Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device** to test for a short to voltage.

- **If less than 4.5 V**

8. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
9. Test for greater than 100 Ω between each high speed GMLAN serial data circuit terminal and ground.
    - **If 100 Ω or less**

      Refer to **Scan Tool Does Not Communicate with High Speed GMLAN Device** to test for a short to ground.

    - **If greater than 100 Ω**
10. Disconnect the harness connectors at the device setting the DTC.
11. Test for less than 2 Ω in each serial data circuits end to end between the K69 Transfer Case Control Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
12. Replace the K69 Transfer Case Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1340-U135F: CHASSIS/ENGINE CONTROL MODULE, LOST COMMUNICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to **Control Module U Code List**.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1340-U135F	U1340-U135F	-	-
Ignition	U1340-U135F	U1340-U135F	-	-
LIN Serial Data	U1340-U135F	U1340-U135F	U1340-U135F	-
Ground	-	U1340-U135F	-	-

Circuit/System Description

The Local Interconnect Network (LIN) Bus consists of a single wire with a transmission rate of 10.417 Kbit/s. The serial data is transmitted over a LIN circuit between a master control module and other LIN devices within a particular subsystem. If serial data communication is lost between any of the LIN devices on the LIN bus network, the master control module will set a no communication code against the non-communicating LIN device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- An open in the LIN bus serial data circuit between the splice pack and a LIN device will only affect that specific LIN device. This type of failure will set a loss of communication DTC for each LIN device affected and the other LIN devices will still communicate.
- This diagnostic procedure can be used to diagnose the common LIN DTCs: U1340, U1341, U1342, U1343, U1344, U1345, U1346, U1347, U1348, U1349, U134A, U134B, U134C, U134D, U134E, U134F, U1350, U1351, U1352, U1353, U1354, U1355, U1356, U1357, U1358, U1359, U135A, U135B, U135C, U135D, U135E, and U135F.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Determine the LIN device that is not communicating. Refer to **Control Module U Code List**.
2. Vehicle in Service Mode.
3. Verify that DTC B1325, B1330, B1370, B1380, B1424, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
4. Verify that DTC U0100 - U02FF is not set.
    - **If any of the DTCs are set**

      Refer to **DTC U0100-U02FF**.

    - **If none of the DTCs are set**
5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics to determine the master control module and all LIN devices on the same LIN serial data circuit. Use the connector end views to identify the B+, ignition, ground, and LIN serial data circuit terminals for each of those devices.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connector at a LIN device that is not communicating.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the B+ circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the B+ circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the disconnected LIN device.

- **If the test lamp illuminates**

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**

1. Vehicle OFF, remove the test lamp.
2. Test for less than 2 Ω in the ignition circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Vehicle OFF, remove the test lamp.
2. Test for infinite resistance between the ignition circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the disconnected LIN device.

- **If the test lamp illuminates**

6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
2. Test for infinite resistance between the ignition circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

NOTE: **For accurate voltage reading, disconnect the battery charger prior to performing the following test step.**

7. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.

- **If less than 2 V**

1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.
2. Test for infinite resistance between the serial data circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
3. Test for less than 2 Ω in the serial data circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω
4. Reconnect the control module that set the DTC, Vehicle in Service Mode.
5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.

        - If less than 2 V, replace the control module setting the DTC.
        - If greater than 2 V, replace the LIN device that causes a current DTC to set when connected.
    - **If greater than 12 V**
    1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.
    2. Vehicle in Service Mode.
    3. Test for less than 1 V between the serial data circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    4. Vehicle OFF, reconnect the control module that set the DTC, Vehicle in Service Mode.
    5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.
        - If greater than 12 V, replace the control module setting the DTC.
        - If less than 12 V, replace the LIN device that causes a current DTC to set when connected.
    - **If between 2 - 12 V**

8. Replace the disconnected LIN device.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1500-U15FF: LIN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to **Control Module U Code List**.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1500-U15BF	U1500-U15BF	-	-
Ignition	U1500-U15BF	U1500-U15BF	-	-
LIN Serial Data	U1500-U15BF	U1500-U15BF	U1500-U15BF	-
Ground	-	U1500-U15BF	-	-

Circuit/System Description

The serial data is transmitted over a Local Interconnect Network (LIN) single wire network circuit bus between a master control module and other LIN devices within a particular subsystem. If serial data communication is lost between any of the LIN devices on the LIN bus network, a no communication code against the non-communicating LIN device will be set. A master control module is the one that reports the non communication code. A loss of serial data communications DTC does not represent a failure of the master control module that set it.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication will be available between the master control module and the scan tool if there is a loss of communications with any of the other LIN devices on the LIN bus network.
- Some devices may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the device.
- Some intermittent communication concerns may be caused by fretting corrosion on the serial data circuit terminals. Inspect all connectors at the device that set the communication DTC, the device that the communication DTC was set against, and any inline harness connectors between the two devices. Do not replace a device based only on fretting corrosion. Refer to bulletin 09-06-03-004 for assistance with the diagnosis and repair of this condition, if applicable.
- An open in the LIN bus serial data circuit between the splice pack and a LIN device will only affect that specific LIN device. This type of failure will set a loss of communication DTC for each LIN device affected and the other LIN devices will still communicate.
- This diagnostic procedure can be used to diagnose the common LIN DTCs: U1500, U1501, U1502, U1503, U1504, U1505, U1506, U1507, U1508, U1509, U150E, U150F, U1510, U1511, U1512, U1513, U1514, U1515, U1516, U1517, U1518, U1519, U151A, U151B, U151C, U1520, U1521, U1522, U1523, U1524, U1526, U1528, U152C, U152D, U1530, U1531, U1532, U1534, U1538, U153A, U1540, U1544, U1548, U1549, U154A, U154B, U1550, U1556, U1558, U15E1, U15E3, U15F0, and other DTCs within the U1500 - U15FF range.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **Use the schematics to determine the master control module and all LIN devices on the same LIN serial data circuit. Use the connector end view to identify the B+, ignition, ground, and LIN serial data circuit terminals for each of those devices.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connector at a LIN device that is not communicating.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between each B+ circuit terminal and ground, if equipped.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected LIN device.
    - **If the test lamp illuminates**
5. Verify a test lamp illuminates between each ignition circuit terminal and ground, if equipped.
    - **If the test lamp does not illuminate and the circuit fuse is good**

   1. Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected LIN device.
   - **If the test lamp illuminates**

6. Verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground, if equipped.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the control module that controls the ignition circuit.
   - **If the test lamp illuminates**

NOTE: **For accurate voltage reading, disconnect the battery charger prior to performing the following test step.**

7. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.
   - **If less than 2 V**
   1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.
   2. Test for infinite resistance between the serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the serial data circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω
   4. Reconnect the control module that set the DTC, Vehicle in Service Mode.
   5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.
      - If less than 2 V, replace the control module setting the DTC.
      - If greater than 2 V, replace the LIN device that causes a current DTC to set when connected.
   - **If greater than 12 V**
   1. Vehicle OFF, disconnect the harness connector at the control module setting the DTC and all LIN devices that share the same LIN serial data circuit.
   2. Vehicle in Service Mode.
   3. Test for less than 1 V between the serial data circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   4. Vehicle OFF, reconnect the control module that set the DTC, Vehicle in Service Mode.
   5. Test for 2 - 12 V between the LIN serial data circuit terminal and ground.
      - If greater than 12 V, replace the control module setting the DTC.

        - If less than 12 V, replace the LIN device that causes a current DTC to set when connected.
    - **If between 2 - 12 V**

8. Replace the disconnected LIN device.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U1653: CHASSIS SYSTEMS HIGH SPEED COMMUNICATION ENABLE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U1653

Chassis Systems High Speed Communication Enable Circuit

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Serial Data Communication Enable	U2099	U0100-U02FF, U1653	1	-
Chassis High Speed GMLAN Serial Data (+) or High Speed GMLAN Serial Data (+) (2)	U0077	U0100-U02FF, U1653	U0077	-
Chassis High Speed GMLAN Serial Data (-) or High Speed GMLAN Serial Data (-) (2)	U0077	U0100-U02FF, U1653	U0077	-
1. Battery drain condition may occur.				

Circuit/System Description

The Body Control Module (BCM) activates the ignition circuit, when the vehicle power mode is in ACCESSORY mode or Ignition ON/Vehicle In Service mode. The ignition circuit wakes up the devices for serial data bus communication.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the chassis high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The devices use a default value for the missing parameters until the next ignition cycle.

- The device(s) is never signaled. Therefore, the specific subsystem(s) will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073 - U007F, U2100, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematic and the connector end view to identify the device's serial data communication enable circuit and chassis high speed GMLAN serial data circuit terminals.**

1. Ignition/Vehicle OFF, disconnect the harness connectors at the device setting this DTC, ignition ON/Vehicle In Service Mode.
2. Verify a test lamp illuminates between the serial data communication enable circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the serial data communication enable circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance
    3. Test for less than 2 Ω in the serial data communication enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
3. Test for less than 4.5 V between each chassis high speed GMLAN serial data circuit terminal and ground.
    - **If 4.5 V or greater**

      Refer to DTC U0077 to test for a short to voltage.

    - **If less than 4.5 V**
4. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
5. Test for greater than 100 Ω between each chassis high speed GMLAN serial data circuit terminal and ground.
    - **If 100 Ω or less**

      Refer to DTC U0077 to test for a short to ground.

    - **If greater than 100 Ω**
6. Test for less than 2 Ω in each of the chassis high speed GMLAN serial data circuits end to end between the harness connector at the device setting this DTC and the appropriate X84 Data Link Connector terminals listed below.
    - Chassis high speed GMLAN serial data circuit terminal 12
    - Chassis high speed GMLAN serial data circuit terminal 13
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
7. Replace the device setting this DTC.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U179A: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U179A

Lost Communication with Hybrid Powertrain Control Module 2

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U179A	U179A	-	-
Ignition	U179A	U179A	-	-
Accessory Wakeup Serial Data	U1814	U179A	-	-
Low Speed GMLAN Serial Data	1	U179A	1	-
High Speed GMLAN Serial Data (+)	2	U179A, U0073	2	-
High Speed GMLAN Serial Data (-)	2	U179A, U0073	2	-
Powertrain High Speed GMLAN Serial Data (+)	U0074	U179A, U0074	U0074	-
Powertrain High Speed GMLAN Serial Data (-)	U0074	U179A, U0074	U0074	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A	U179A, U007A	U007A	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A	U179A, U007A	U007A	-
Ground	-	U179A	-	-
1. Scan Tool Does Not Communicate With Low Speed GMLAN Device 2. Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

DTC U179A is a type A DTC.

Conditions for Clearing the DTC

DTC U179A is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
    - **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U179D: LOST COMMUNICATION WITH BRAKE SYSTEM CONTROL MODULE 2 ON CHASSIS EXPANSION BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U179D

Lost Communication with Brake System Control Module 2 on Chassis Expansion Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U179D	U179D	-	-
Ignition	U179D	U179D	-	-
Accessory Wake Up Serial Data 2	P06E4, U179D	U179D	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U179D, U0077*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U179D, U0077*	U0077*	-
Ground	-	U179D	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- A driver information center message and/or a warning indicator may be displayed.
- The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**

- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K177 Brake Booster Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Ignition/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**

    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K177 Brake Booster Control Module.
    - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K177 Brake Booster Control Module.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 2 Ω in each Chassis high speed GMLAN serial data circuits end to end between the K177 Brake Booster Control Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Replace the K177 Brake Booster Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U1803: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U1803

Lost Communication with Hybrid Powertrain Control Module 2

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1803	U1803	-	-
Ignition	U1803	U1803	-	-
Accessory Wakeup Serial Data	U1814	U1803	-	-
Low Speed GMLAN Serial Data	1	U1803	1	-
High Speed GMLAN Serial Data (+)	2	U1803, U0073	2	-
High Speed GMLAN Serial Data (-)	2	U1803, U0073	2	-
Powertrain High Speed GMLAN Serial Data (+)	U0074	U1803, U0074	U0074	-
Powertrain High Speed GMLAN Serial Data (-)	U0074	U1803, U0074	U0074	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A	U1803, U007A	U007A	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A	U1803, U007A	U007A	-
Ground	-	U1803	-	-
1. Scan Tool Does Not Communicate With Low Speed GMLAN Device 2. Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.

    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1806: BATTERY ENERGY CONTROL MODULE HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U1806

Battery Energy Control Module High Voltage Energy Management CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The high voltage energy management high speed GMLAN serial data circuits are serial data buses used to communicate information between the Hybrid Powertrain Control Module 2, the Battery Energy Control Module, and the Battery Charger. If this serial data system is inoperative the devices will not communicate with each other on this bus, but they still communicate with the scan tool through high speed GMLAN bus.

The scan tool does not communicate with devices through the high voltage energy management high speed GMLAN bus. The high voltage energy high speed GMLAN serial data circuits connect directly to the auxiliary data connector and do not connect with the scan tool.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits for more than 1.4 seconds without success.

Action Taken When the DTC Sets

The DTC U1806 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1806 is a type B DTC.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U1806 is not set.
    - **If DTC U1806 is set**

      Refer to **DTC U007A**.

    - **If DTC U1806 is not set**
3. All OK

DTC U180B: BATTERY ENERGY CONTROL MODULE HIGH SPEED CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U180B

Battery Energy Control Module High Speed CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The high speed GMLAN serial data circuits are serial data buses used to communicate information between the devices. The high speed GMLAN serial data circuits connect directly to the data link connector (DLC) for programming purposes.

This diagnostic is used to check the high speed GMLAN communication bus status.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the serial data circuits for more than 1.4 seconds without success.

Action Taken When the DTC Sets

The DTC U180B is a type B DTC.

Conditions for Clearing the DTC

The DTC U180B is a type B DTC.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U180B is not set.
   - **If DTC U180B is set**

     Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device .
   - **If DTC U180B is not set**
3. All OK

DTC U1814: POWERTRAIN WAKE-UP COMMUNICATION CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U1814

Powertrain Wake-Up Communication Circuit

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U1814 02*	U0100-U02FF	-	-
* Vehicle will not start.				

Circuit/System Description

The body control module activates the ignition circuit, when the ignition key is in ACC, ON or START. The ignition circuit wakes up the devices for serial data bus communication.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The body control module senses a short to ground on the ignition circuit.

Action Taken When the DTC Sets

- The output command is turned off while the malfunction is present.

- The devices use a default value for the missing parameters until the next ignition cycle.
- The device(s) is never signaled. Therefore, the specific subsystem(s) will not function.
- The vehicle will not start while the circuit is shorted to ground.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **Use the schematics to determine which devices are on the K9 body control module's ignition circuit terminal 22 X4. Use the connector end view to identify the ignition circuit terminal for each of those devices.**

1. Vehicle OFF, disconnect the harness connector at an easily accessible device that shares the K9 body control module's ignition circuit terminal 22 X4. Vehicle in Service Mode.
2. Verify that the DTC U1814 remains current.
   - **If the DTC becomes history**

     Replace the device that was just disconnected.

   - **If the DTC remains current**
3. With the prior devices disconnected, repeat steps 1 and 2 for each device on the ignition circuit except the K9 body control module.
4. Vehicle OFF, disconnect the X4 harness connector at the K9 body control module.
5. Test for infinite resistance between the ignition circuit terminal 22 X4 at the K9 body control module and ground.
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**

6. Replace the K9 body control module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1817: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE ON POWERTRAIN EXPANSION CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U1817

Lost Communication with Hybrid Powertrain Control Module on Powertrain Expansion CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1817	U1817	-	-
Ignition	U1817	U1817	-	-
Accessory Wake Up Serial Data 2	P06E4, U1817*	U1817*	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U0074, U1817*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U0074, U1817*	U0074*	-
Ground	-	U1817*	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the powertrain high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

The Motor Control Modules and the Hybrid Powertrain Control Module 1 are all internal to the Power Inverter Module. All circuits to the Hybrid Powertrain Control Module 1 are also internal to the Power Inverter Module and replaced as a single component.

Communication diagnostics for the serial data, including device power and ground as well as the wakeup circuits for Motor Control Modules and the Hybrid Powertrain Control Module 1 are all diagnosed from external sources only to the Power Inverter Module connector because any circuit fault condition within the Power Inverter Module will cause a complete replacement.

Conditions for Running the DTC

- The system voltage is more than 10 V.

- The vehicle power mode master requires serial data communication to occur from this specific device.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

DTC U1817 is a type A DTC.

Conditions for Clearing the DTC

DTC U1817 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0293 is not set.
   - **If DTC U0293 is set**

     Refer to DTC U0100-U02FF.

   - **If DTC U0293 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If none of the DTCs are set**
4. Verify that DTCs U1818, U1821, and U182D are not set.
   - **If all of the DTCs are set together**

     Refer to DTC U0074.

   - **If all of the DTCs are not set together**
5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the X1 and X2 harness connectors at the T6 Power Inverter Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the T6 Power Inverter Module case and ground.
   - **If 10 Ω or greater**

     Check the ground connection and ground strap for the open/high resistance.

   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the T6 Power Inverter Module.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the T6 Power Inverter Module.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
10. Test for less than 2 Ω in each of the powertrain high speed GMLAN serial data circuits end to end between the T6 Power Inverter Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

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DIAGNOSTIC INFORMATION AND PROCEDURES

DTC U1818: LOST COMMUNICATION WITH ENGINE CONTROL MODULE ON POWERTRAIN EXPANSION COMMUNICATION BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U1818

Lost Communication with Engine Control Module on Powertrain Expansion Communication Bus

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1818	U1818	-	-
Ignition	U1818	U1818	-	-
Accessory Wake Up Serial Data 2	P06E4*	U1818	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U1818, U0074*	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U1818, U0074*	U0074*	-
Ground	-	U1818	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

- The system voltage is at least 10 V.
- The vehicle power mode master requires serial data communication to occur from this specific device.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

DTC U1818 is a type A DTC.

Conditions for Clearing the DTC

DTC U1818 is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0100 is not set.
    - **If DTC U0100 is set**

      Refer to **DTC U0100-U02FF** .

    - **If DTC U0100 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
4. Verify that DTCs U1817, U1821, and U182D are not set.
    - **If all of the DTCs are set together**

      Refer to **DTC U0074** .

    - **If all of the DTCs are not set together**
5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K20 Engine Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance, replace the K20 Engine Control Module.
    - **If the test lamp illuminates**

5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
10. Test for less than 2 Ω in each of the powertrain high speed GMLAN serial data circuits end to end between the K20 Engine Control Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the K20 Engine Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U182D: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2 ON POWERTRAIN EXPANSION COMMUNICATION BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U182D

Lost Communication with Hybrid Powertrain Control Module 2 on Powertrain Expansion Communication Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U182D	U182D	-	-
Ignition	U182D	U182D	-	-
Accessory Wake Up Serial Data	U1814	U182D	-	-
Powertrain High Speed GMLAN Serial Data (+)	U0074*	U182D, U0074	U0074*	-
Powertrain High Speed GMLAN Serial Data (-)	U0074*	U182D, U0074	U0074*	-
Ground	-	U182D	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is at least 11 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received for 10 seconds.

Action Taken When the DTC Sets

The DTC U182D is a type B DTC.

Conditions for Clearing the DTC

The DTC U182D is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Verify that DTCs U1817, U1818, and U1821 are not set.
    - **If all of the DTCs are set together**

      Refer to DTC U0074 .

    - **If all of the DTCs are not set together**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.

8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
10. Test for less than 2 Ω in each powertrain high speed GMLAN serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U1833: LOST COMMUNICATION WITH ELECTRONIC BRAKE CONTROL MODULE ON CHASSIS EXPANSION CAN BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U1833

Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0121, U0129, U1833	U0121, U0129, U1833	-	-
Ignition	U0121, U0129, U1833	U0121, U0129, U1833	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wake Up Serial Data 2	P06E4, U0121, U0129, U1833	U0121, U0129, U1833	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U0121, U0129, U1833, U0077*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U0121, U0129, U1833, U0077*	U0077*	-
Ground	-	U0121, U0129, U1833	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is at least 10 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- A driver information center message and/or a warning indicator may be displayed.
- The DTC U1833 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1833 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.

- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0121 or U0129 is not set.
    - **If any of the DTCs are set**

      Refer to **DTC U0100-U02FF** .
    - **If none of the DTCs are set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
    - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K17 Electronic Brake Control Module.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K17 Electronic Brake Control Module.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**

9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 2 Ω in each Chassis high speed GMLAN serial data circuits end to end between the K17 Electronic Brake Control Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U183E: LOST COMMUNICATION WITH TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U183E

Lost Communication with Telematics Communication Interface Control Module on Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U183E	U183E	-	-
Ignition	U183E	U183E	-	-
Serial Data Communication Enable	U1814, U2099	U183E	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U183E	U0078*	-
Ground	-	U183E	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the Data Link Connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0198 is not set.
   - **If DTC U0198 is set**

     Refer to **DTC U0100-U02FF** .

   - **If DTC U0198 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, serial data communication enable, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K73 Telematics Communication Interface Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K73 Telematics Communication Interface Control Module.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the serial data communication enable circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the serial data communication enable circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the serial data communication enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K73 Telematics Communication Interface Control Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the K73 Telematics Communication Interface Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U184A: LOST COMMUNICATION WITH BODY CONTROL MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U184A

Lost Communication with Body Control Module on Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184A	U184A	-	-
Ignition	U184A	U184A	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U184A	U0078*	-
Ground	-	U184A	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are

transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0140 is not set.
    - **If DTC U0140 is set**

Refer to DTC U0100-U02FF .

- **If DTC U0140 is not set**

3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K9 Body Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp illuminates**

7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K9 Body Control Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U184B: LOST COMMUNICATION WITH REMOTE HEATER AND AIR CONDITIONING CONTROL MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U184B

Lost Communication with Remote Heater and Air Conditioning Control Module on Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U0164, U184B	U0164, U184B	-	-
Ignition	U0164, U184B	U0164, U184B	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U0164, U184B	U0078*	-
Ground	-	U0164, U184B	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0164 is not set.
   - **If DTC U0164 is set**

     Refer to **DTC U0100-U02FF** .

   - **If DTC U0164 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K33 HVAC Control Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**
  1. Vehicle OFF.
  2. Test for infinite resistance between the B+ circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance, replace the K33 HVAC Control Module.
- **If the test lamp illuminates**

5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
     1. Vehicle OFF.
     2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K33 HVAC Control Module.
   - **If the test lamp illuminates**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K33 HVAC Control Module and the device setting the DTC.
   - **If 2 Ω or greater**

     Repair the open/high resistance in the serial data circuit.

   - **If less than 2 Ω**
9. Replace the K33 HVAC Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U184C: LOST COMMUNICATION WITH INSTRUMENT CLUSTER ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U184C

Lost Communication with Instrument Cluster on Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184C	U184C	-	-
Ignition	U184C	U184C	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U184C	U0078*	-
Ground	-	U184C	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.

- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

Data Link Communications Description and Operation

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0155 is not set.
    - **If DTC U0155 is set**

      Refer to **DTC U0100-U02FF** .

    - **If DTC U0155 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the P16 Instrument Cluster. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the P16 Instrument Cluster.
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the P16 Instrument Cluster.
    - **If the test lamp illuminates**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the P16 Instrument Cluster and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U184D: LOST COMMUNICATION WITH RADIO ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U184D

Lost Communication with Radio on Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184D	U184D	-	-
Ignition	U184D	U184D	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U184D	U0078*	-
Ground	-	U184D	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

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- **Circuit Testing**
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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

2. Verify that DTC U0184 is not set.
   - **If DTC U0184 is set**

     Refer to DTC U0100-U02FF .
   - **If DTC U0184 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
   - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the A11 Radio. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the A11 Radio.
   - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the A11 Radio.
    - **If the test lamp illuminates**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the A11 Radio and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Replace the A11 Radio.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U184E: LOST COMMUNICATION WITH INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE ON LOW SPEED CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U184E

Lost Communication with Inflatable Restraint Sensing and Diagnostic Module on Low Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U184E	U184E	-	-
Ignition	U184E	U184E	-	-
Low Speed GMLAN Serial Data	U0078*	U0078, U184E	U0078*	-
Ground	-	U184E	-	-
* Scan Tool Does Not Communicate With Low Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTCs). When the vehicle is ON, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0151 is not set.
    - **If DTC U0151 is set**

      Refer to DTC U0100-U02FF .
    - **If DTC U0151 is not set**
3. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
    - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: Use the schematics and connector end views to identify the device's ground, B+, ignition, and serial data circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K36 Inflatable Restraint Sensing and Diagnostic Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

    - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
  - **If the test lamp does not illuminate and the circuit fuse is open**
  1. Vehicle OFF.
  2. Test for infinite resistance between the B+ circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
  - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If the test lamp illuminates**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for less than 2 Ω in the low speed GMLAN serial data circuits end to end between the K36 Inflatable Restraint Sensing and Diagnostic Module and the device setting the DTC.
   - **If 2 Ω or greater**

     Repair the open/high resistance in the serial data circuit.

   - **If less than 2 Ω**
9. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U185A: LOST COMMUNICATION WITH BATTERY ENERGY CONTROL MODULE ON HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U185A

Lost Communication with Battery Energy Control Module on High Voltage Energy Management CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U185A*	U185A	-	-
Ignition	U185A*	U185A	-	-
High Voltage Fault Signal	U185A	U185A	-	-
Accessory Wake Up Serial Data 2	P06E4, U185A*	U185A*	-	-
High Voltage Energy Management Communication Enable	P1EB9, U185A*	U185A*	-	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A*	U007A, U185A*	U007A*	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A*	U007A, U185A*	U007A*	-
Ground	-	U185A*	-	-
* Multiple DTCs may be set and multiple symptoms including a no start condition may occur.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is more than 10 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received for more than 500 ms.

Action Taken When the DTC Sets

DTC U185A is a type A DTC.

Conditions for Clearing the DTC

DTC U185A is a type A DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.

    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Hybrid/EV Energy Storage Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-52014** Low Voltage Test Harness

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0111 is not set.
    - **If DTC U0111 is set**

      Refer to **DTC U0100-U02FF** .

- **If DTC U0111 is not set**

3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
   - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, high voltage energy management communication enable, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**

   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K16 Battery Energy Control Module.
   - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K16 Battery Energy Control Module.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
7. If equipped, verify a test lamp illuminates between the high voltage energy management communication enable circuit terminal and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the high voltage energy management communication enable circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the high voltage energy management communication enable circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
8. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the

harness connectors at the device setting the DTC.

9. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
10. Vehicle OFF, reconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack.
11. Perform the High Voltage Disabling procedure before proceeding with this diagnostic. Refer to **High Voltage Disabling** .
12. Reconnect the 12 V battery.
13. Vehicle OFF, connect the EL-52014 low voltage test harness.
14. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
15. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 10 Ω**
16. Vehicle in Service Mode.
17. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate**

      Repair the short to ground or the open/high resistance in the circuit.

    - **If the test lamp illuminates**
18. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate**

      Repair the short to ground or the open/high resistance in the circuit.

    - **If the test lamp illuminates**
19. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
    - **If the test lamp does not illuminate**

      Repair the short to ground or the open/high resistance in the circuit.

    - **If the test lamp illuminates**
20. If equipped, verify a test lamp illuminates between the high voltage energy management communication enable circuit terminal and ground.
    - **If the test lamp does not illuminate**

      Repair the short to ground or the open/high resistance in the circuit.

    - **If the test lamp illuminates**
21. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
22. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the K16 Battery Energy Control Module and the A4 Hybrid/EV Battery Pack.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

23. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U185B: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV POWERTRAIN CONTROL MODULE 2 ON HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U185B

Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U185B	U185B	-	-
Ignition	U185B	U185B	-	-
Accessory Wake Up Serial Data	U1814	U185B	-	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	U007A*	U007A, U185B	U007A*	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	U007A*	U007A, U185B	U007A*	-
Ground	-	U185B	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

This diagnostic is used to check the loss of communication with the Hybrid/EV Powertrain Control Module 2 on high voltage energy management high speed GMLAN bus. The Battery Energy Control Module supervises a periodic serial data message to check the communication status of the Hybrid/EV Powertrain Control Module 2. If this message is not received within 1 s, this DTC is set.

Conditions for Running the DTC

- The device is awake and communicating.

- The system voltage is at least 9 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received within 1 s.

Action Taken When the DTC Sets

- No Cell Balancing function. However, cell balancing switch diagnostics still run.
- DTC U185B is a type B DTC.

Conditions for Clearing the DTC

DTC U185B is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0078, U007A, U1814, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data**

circuit terminals.

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the

X357 harness connector at the A4 Hybrid/EV Battery Pack.

8. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the A4 Hybrid/EV Battery Pack.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.
    - **If less than 2 Ω**
9. Vehicle OFF, disable the high voltage system. Refer to **High Voltage Disabling** .
10. Reconnect the 12 V battery.
11. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
12. Test for less than 2 Ω in each high voltage energy management high speed GMLAN serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the K16 Battery Energy Control Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.
    - **If less than 2 Ω**
13. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1860: ELECTRIC A/C COMPRESSOR CONTROL MODULE LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U1860

Electric A/C Compressor Control Module Lost Communication with Hybrid Powertrain Control Module 2

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1860	U1860	-	-
Ignition	U1860	U1860	-	-
Accessory Wake Up Serial Data	U1814	U1860	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U1860	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U1860	U0073*	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ground	-	U1860	-	-
* Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is greater than 10.25 V.

Conditions for Setting the DTC

The A/C Compressor is not able to receive the serial data message from the Hybrid Powertrain Control Module 2 for 3 seconds.

Action Taken When the DTC Sets

The DTC U1860 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1860 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.

- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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Data Link Communications Description and Operation

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0078, U007A, U1814, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.

4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
   2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the X1 harness connector at the G1 A/C Compressor. It may take up to 2 minutes for all vehicle systems to power down.
10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the G1 A/C Compressor.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U1885: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV POWERTRAIN CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U1885

Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1885*	U1885	-	-
Ignition	U1885*	U1885*	-	-
Accessory Wake Up Serial Data 2	P06E4, U1885*	U1885*	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U1885*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U1885*	U0073*	-
Ground	-	U1885*	-	-
* Other DTCs may set with this fault and multiple symptoms including a no start condition may occur.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

This diagnostic is used to check the loss of communication with Hybrid/EV Powertrain Control Module 1 on high speed GMLAN bus. The Battery Energy Control Module supervises a periodic serial data message to check the communication status of the Hybrid/EV Powertrain Control Module 1. If this message is not received within 3 s, then this DTC is set.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.
- The DTC U180B is not set.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received within 3 s.

Action Taken When the DTC Sets

The DTC U1885 is a type B DTC.

Conditions for Clearing the DTC

The DTC U1885 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0293 is not set.
   - **If DTC U0293 is set**

     Refer to DTC U0100-U02FF .

   - **If DTC U0293 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X1 harness connector at the T6 Power Inverter Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal (or T6 Power Inverter Module case) and ground.
    - **If 10 Ω or greater**

      Check the ground connection and ground strap for the open/high resistance.

    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the T6 Power Inverter Module.
    - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the T6 Power Inverter Module.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack. It may take up to 2 min for all vehicle systems to power down.

8. Test for less than 2 Ω in each high speed GMLAN serial data circuits end to end between the T6 Power Inverter Module and the A4 Hybrid/EV Battery Pack.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Vehicle OFF, disable the high voltage system. Refer to **High Voltage Disabling** .
10. Reconnect the 12 V battery.
11. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X8 harness connector at the K16 Battery Energy Control Module. It may take up to 2 min for all vehicle systems to power down.
12. Test for less than 2 Ω in each high speed GMLAN serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the K16 Battery Energy Control Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
13. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U18A4: LOST COMMUNICATION WITH HYBRID/EV BATTERY DC CHARGING COMMUNICATIONS GATEWAY MODULE ON HIGH VOLTAGE ENERGY MANAGEMENT CAN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U18A4

Lost Communication with Hybrid/EV Battery DC Charging Communications Gateway Module on High Voltage Energy Management CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18A4*	U18A4	-	-
Ignition	U18A4*	U18A4	-	-
Serial Data Communication Enable	U2099, U18A4*	U18A4*	-	-
High Voltage Energy Management Communication Enable	P1EB9, U18A4*	U18A4*	-	-
High Voltage Energy Management Serial Data (+)	U007A*	U007A, U18A4*	U007A*	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Voltage Energy Management Serial Data (-)	U007A*	U007A, U18A4*	U007A*	-
Ground	-	U18A4*	-	-
* Multiple DTCs may be set and multiple symptoms including a no start condition may occur.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

- The system voltage is more than 10.2 V.
- The High Voltage Energy Management bus communication is enabled for more than 2 s.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received for more than 500 ms.

Action Taken When the DTC Sets

DTC U18A4 is a type B DTC.

Conditions for Clearing the DTC

DTC U18A4 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.

- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Hybrid/EV Energy Storage Schematics**
- **Control Module References**

Connector End View Reference

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Data Link Communications Description and Operation

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, serial data communication enable, high voltage energy management communication enable, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the low voltage harness connectors at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between each ground circuit terminal and ground.

- **If 10 Ω or greater**
  1. Vehicle OFF.
  2. Test for less than 2 Ω in the ground circuit end to end.
     - If 2 Ω or greater, repair the open/high resistance in the circuit.
     - If less than 2 Ω, repair the open/high resistance in the ground connection.
- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
     1. Vehicle OFF.
     2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the T24 Battery Charger - DC.
   - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
     1. Vehicle OFF.
     2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the T24 Battery Charger - DC.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the serial data communication enable circuit terminal and ground.
   - **If the test lamp does not illuminate**
     1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
     2. Test for infinite resistance between the serial data communication enable circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
     3. Test for less than 2 Ω in the serial data communication enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
7. If equipped, verify a test lamp illuminates between the high voltage energy management communication enable circuit terminal and ground.
   - **If the test lamp does not illuminate**
     1. Vehicle OFF, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
     2. Test for infinite resistance between the high voltage energy management communication enable circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the high voltage energy management communication enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**

8. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the device setting the DTC.
9. Test for less than 2 Ω in each high voltage energy management serial data circuits end to end between the T24 Battery Charger - DC and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
10. Replace the T24 Battery Charger - DC.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U18A6: LOST COMMUNICATION WITH RIGHT OBJECT DETECTION CONTROL MODULE ON DEDICATED BUS 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U18A6

Lost Communication with Right Object Detection Control Module on Dedicated Bus 1

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18A6	U18A6	-	-
Communication Enable	U18A6	U18A6	-	-
Serial Data (+)	U18A6	U18A6	U18A6	-
Serial Data (-)	U18A6	U18A6	U18A6	-
Ground	-	U18A6	-	-

Circuit/System Description

The side object sensor modules use radar to determine the presence of objects nearby. The left side object sensor is the master that communicates on serial data. There is a private communication network between the left and right sensors. The scan tool can communicate only with the left sensor. Side blind zone alert is active when the vehicle is out of park or the parking brake is off on manual transmission vehicles. If a vehicle is detected in the side blind zone, the warning symbols will illuminate on the appropriate side. The warning symbols will vary brightness based on the ambient light conditions. When an object is detected in the left side blind zone, the side object sensor module sends a message to the right sensor through serial data. The right sensor then supplies voltage to illuminate the visual indicator on the left side outside rear view mirror. When an object is detected in the right side blind zone, the right side object sensor will supply a voltage to illuminate the visual indicator on the right side outside rear view mirror.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 40, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC U0073, U0075, U0078, U007B, U007C, U007D, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, and serial data circuit terminals.**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connector at the B218R Side Object Sensor Module - Right. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle In Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the B218R Side Object Sensor Module - Right.
   - **If the test lamp illuminates**
5. If equipped, test for at least 6 V between the communication enable circuit terminal and ground.
   - **If less than 6 V**
   1. Ignition/Vehicle OFF, disconnect the harness connectors at the B218L Side Object Sensor Module - Left.
   2. Test for infinite resistance between the communication enable circuit terminal and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the communication enable circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the B218L Side Object Sensor Module - Left.
   - **If 6 V or greater**
6. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connector at the B218L Side Object Sensor Module - Left. It may take up to 10 min for all vehicle systems to power down.
7. Test for less than 1 V between each serial data circuits and ground.
   - **If 1 V or greater**

     Repair the short to voltage in the serial data circuit.

   - **If less than 1 V**
8. Test for infinite resistance between each serial data circuits and ground.
   - **If less than infinite resistance**

     Repair the short to ground in the serial data circuit.

   - **If infinite resistance**

9. Test for infinite resistance between 2 serial data circuits.
    - **If less than infinite resistance**

      Repair the short together between the serial data circuits.

    - **If infinite resistance**
10. Test for less than 2 Ω in each of the serial data circuits end to end between the B218L Side Object Sensor Module - Left and the B218R Side Object Sensor Module - Right.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**

NOTE: **Prior to replacing a module, visually inspect wiring connections to both Side Object Sensor Modules for contamination, deformation, terminal fretting corrosion, terminal tension, and chafing.**

11. Replace the B218R Side Object Sensor Module - Right.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U18A9: LOST COMMUNICATION WITH TRANSMISSION RANGE CONTROL MODULE ON CHASSIS EXPANSION CAN BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U18A9

Lost Communication With Transmission Range Control Module on Chassis Expansion CAN Bus

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18A9	U18A9	-	-
Ignition	U18A9	U18A9	-	-
Accessory Wakeup Serial Data	U1814, U2099	U18A9	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U0077, U18A9*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U0077, U18A9*	U0077*	-
Ground	-	U18A9	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC U0073, U0074, U0077, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wakeup serial data, and serial data circuit terminals.**

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K173 Transmission Range Control Module.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K173 Transmission Range Control Module.
   - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K173 Transmission Range Control Module.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
   - **If the test lamp does not illuminate**
   1. Ignition OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module.
   2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
7. Test for less than 4.5 V between each chassis high speed GMLAN serial data circuit terminal and ground.
   - **If 4.5 V or greater**

     Refer to DTC U0077 to test for a short to voltage.

   - **If less than 4.5 V**
8. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
9. Test for greater than 100 Ω between each chassis high speed GMLAN serial data circuit terminal and ground.
   - **If 100 Ω or less**

     Refer to DTC U0077 to test for a short to ground.

   - **If greater than 100 Ω**
10. Disconnect the harness connectors at the device setting the DTC.
11. Test for less than 2 Ω in each chassis high speed GMLAN serial data circuits end to end between the K173 Transmission Range Control Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

12. Replace the K173 Transmission Range Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U18AA: TRANSMISSION RANGE CONTROL MODULE LOST COMMUNICATION WITH ENGINE CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U18AA

Transmission Range Control Module Lost Communication with Engine Control Module

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18AA	U18AA	-	-
Ignition	U18AA	U18AA	-	-
Accessory Wakeup Serial Data	U1814, U2099	U18AA	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U18AA*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U18AA*	U0073*	-
Ground	-	U18AA	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Data Link Communications Description and Operation

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wakeup serial data, and serial data circuit terminals.**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K20 Engine Control Module.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle In Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K20 Engine Control Module.
   - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.

    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K20 Engine Control Module.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
7. Test for less than 4.5 V between each high speed GMLAN serial data circuit terminal and ground.
    - **If 4.5 V or greater**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to voltage.

    - **If less than 4.5 V**
8. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
9. Test for greater than 100 Ω between each high speed GMLAN serial data circuit terminal and ground.
    - **If 100 Ω or less**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to ground.

    - **If greater than 100 Ω**
10. Disconnect the harness connectors at the K173 Transmission Range Control Module.
11. Test for less than 2 Ω in each high speed GMLAN serial data circuits end to end between the K20 Engine Control Module and the K173 Transmission Range Control Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
12. Replace the K20 Engine Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U18AB: TRANSMISSION RANGE CONTROL MODULE LOST COMMUNICATION WITH CHASSIS CONTROL MODULE ON HIGH SPEED CAN BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U18AB

Transmission Range Control Module Lost Communication with Chassis Control Module on High Speed CAN Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18AB	U18AB	-	-
Ignition	U18AB	U18AB	-	-
Accessory Wakeup Serial Data	U1814, U2099	U18AB	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U18AB*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U18AB*	U0073*	-
Ground	-	U18AB	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.

    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wakeup serial data, and serial data circuit terminals.**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K38 Chassis Control Module.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Ignition/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle In Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K38 Chassis Control Module.
    - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K38 Chassis Control Module.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

    - If less than 2 Ω, replace the K9 Body Control Module.
  - **If the test lamp illuminates**

7. Test for less than 4.5 V between each high speed GMLAN serial data circuit terminal and ground.
   - **If 4.5 V or greater**

     Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to voltage.

   - **If less than 4.5 V**
8. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
9. Test for greater than 100 Ω between each high speed GMLAN serial data circuit terminal and ground.
   - **If 100 Ω or less**

     Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to ground.

   - **If greater than 100 Ω**
10. Disconnect the harness connectors at the K173 Transmission Range Control Module.
11. Test for less than 2 Ω in each high speed GMLAN serial data circuits end to end between the K38 Chassis Control Module and the K173 Transmission Range Control Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
12. Replace the K38 Chassis Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U18AC: TRANSMISSION RANGE CONTROL MODULE LOST COMMUNICATION WITH CHASSIS CONTROL MODULE ON CHASSIS EXPANSION CAN BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U18AC

Transmission Range Control Module Lost Communication with Chassis Control Module on Chassis Expansion CAN Bus

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18AC	U18AC	-	-
Ignition	U18AC	U18AC	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Wakeup Serial Data	U1814, U2099	U18AC	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U0077, U18AC*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U0077, U18AC*	U0077*	-
Ground	-	U18AC	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.

- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Data Link Communications Description and Operation

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC U0073, U0074, U0077, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wakeup serial data, and serial data circuit terminals.**

1. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K38 Chassis Control Module.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, repair the open/high resistance in the ground connection.
- **If less than 10 Ω**

3. Ignition ON.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K38 Chassis Control Module.
   - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K38 Chassis Control Module.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
   - **If the test lamp does not illuminate**
   1. Ignition OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module.
   2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
7. Test for less than 4.5 V between each chassis high speed GMLAN serial data circuit terminal and ground.
   - **If 4.5 V or greater**

     Refer to DTC U0077 to test for a short to voltage.

   - **If less than 4.5 V**
8. Ignition OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
9. Test for greater than 100 Ω between each chassis high speed GMLAN serial data circuit terminal and ground.

- **If 100 Ω or less**

  Refer to DTC U0077 to test for a short to ground.

- **If greater than 100 Ω**

10. Disconnect the harness connectors at the K173 Transmission Range Control Module.
11. Test for less than 2 Ω in each chassis high speed GMLAN serial data circuits end to end between the K38 Chassis Control Module and the K173 Transmission Range Control Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
12. Replace the K38 Chassis Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U18AD: TRANSMISSION RANGE CONTROL MODULE LOST COMMUNICATION WITH ELECTRONIC BRAKE CONTROL MODULE ON CHASSIS EXPANSION CAN BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U18AD

Transmission Range Control Module Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18AD	U18AD	-	-
Ignition	U18AD	U18AD	-	-
Serial Data Communication Enable	U1814, U2099	U18AD	-	-
Chassis High Speed GMLAN Serial Data (+)	U0077*	U0077, U18AD*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U0077, U18AD*	U0077*	-
Ground	-	U18AD	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, serial data communication enable, and serial data circuit terminals.**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the harness connectors at the K17 Electronic Brake Control Module.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Ignition/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle In Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance, replace the K17 Electronic Brake Control Module.
    - **If the test lamp illuminates**

5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K17 Electronic Brake Control Module.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the serial data communication enable circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the serial data communication enable circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the serial data communication enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
7. Test for less than 4.5 V between each chassis high speed GMLAN serial data circuit terminal and ground.
    - **If 4.5 V or greater**

      Refer to DTC U0077 to test for a short to voltage.

    - **If less than 4.5 V**
8. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
9. Test for greater than 100 Ω between each chassis high speed GMLAN serial data circuit terminal and ground.
    - **If 100 Ω or less**

      Refer to DTC U0077 to test for a short to ground.

    - **If greater than 100 Ω**
10. Disconnect the harness connectors at the K173 Transmission Range Control Module.
11. Test for less than 2 Ω in each chassis high speed GMLAN serial data circuits end to end between the K17 Electronic Brake Control Module and the K173 Transmission Range Control Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
12. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U18AF-U18B4: LOST COMMUNICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U18AF

Lost Communications With Telematics Communications Interface Control Module on Ethernet Bus

DTC U18B0

Lost Communications With Instrument Cluster on Ethernet Bus

DTC U18B1

Lost Communications With Audio Amplifier on Ethernet Bus

DTC U18B2

Lost Communication with Rear Audio Control Module on Ethernet Bus

DTC U18B3

Lost Communications With Navigation Control Module on Ethernet Bus

DTC U18B4

Lost Communication with Radio on Ethernet Bus

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18AF - U18B4	U18AF - U18B4	-	-
Ignition	U18AF - U18B4	U18AF - U18B4	-	-
Ethernet Serial Data (+)	U18AF - U18B4	U18AF - U18B4	U18AF - U18B4	-
Ethernet Serial Data (-)	U18AF - U18B4	U18AF - U18B4	U18AF - U18B4	-
Ground	-	U18AF - U18B4	-	-

Circuit/System Description

At the core of the infotainment system is the Radio Ethernet Audio Video Bridging switch which communicates directly to each contributing Infotainment control module terminator. The Ethernet harness consists of twisted pair wires from point to point. Each control module on the Ethernet infotainment system sends/receives data at 100 Mbit/s to/from a specified port at the Radio. The Radio

Ethernet will also be used to program USB software update files to the control modules connected to the Ethernet ports.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0078, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the control module's ground, B+, ignition, and serial data circuit terminals.**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the control module specified by the DTC descriptor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Ignition/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle In Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the control module specified by the DTC descriptor.
    - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the control module specified by the DTC descriptor.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the control module that controls the ignition circuit.
    - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, disconnect the harness connectors at the device setting the DTC.
8. Ignition ON/Vehicle In Service Mode.

9. Test for less than 4.5 V between each Ethernet serial data circuit terminal and ground.
    - **If 4.5 V or greater**

      Repair the short to voltage in the serial data circuit.

    - **If less than 4.5 V**
10. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
11. Test for infinite resistance between each Ethernet serial data circuit terminal and ground.
    - **If less than infinite resistance**

      Repair the short to ground in the serial data circuit.

    - **If infinite resistance**
12. Test for infinite resistance between each pair of Ethernet serial data circuit terminals.
    - **If less than infinite resistance**

      Repair the short together in the serial data circuits.

    - **If infinite resistance**
13. Test for less than 2 Ω in each Ethernet serial data circuit end to end.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
14. Replace the control module specified by the DTC descriptor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U18B5: LOST COMMUNICATION WITH HYBRID POWERTRAIN CONTROL MODULE ON CHASSIS EXPANSION CAN BUS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U18B5

Lost Communication With Hybrid Powertrain Control Module on Chassis Expansion CAN Bus

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U18B5	U18B5	-	-
Ignition	U18B5	U18B5	-	-
Accessory Wake Up Serial Data 2	P06E4, U1817*	U18B5	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Chassis High Speed GMLAN Serial Data (+)	U0077*	U0077, U18B5*	U0077*	-
Chassis High Speed GMLAN Serial Data (-)	U0077*	U0077, U18B5*	U0077*	-
Ground	-	U18B5	-	-
* Other DTCs may set with this fault.				

Circuit/System Description

Devices connected to the Chassis high speed GMLAN serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

The Motor Control Modules and the Hybrid Powertrain Control Module 1 are all internal to the Power Inverter Module. Communication diagnostics for the serial data, including device power and ground as well as the wakeup circuits for Motor Control Modules and the Hybrid Powertrain Control Module 1 are all diagnosed from external sources only to the Power Inverter Module connector because any circuit fault condition within the Power Inverter Module will cause a complete replacement.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

The device is never signaled. Therefore, the specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.

- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC U0293 is not set.
    - **If DTC U0293 is set**

      Refer to **DTC U0100-U02FF** .

    - **If DTC U0293 is not set**
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.**

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X1 and X2 harness connectors at the T6 Power Inverter Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal (or module case) and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the ground circuit or ground strap.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the T6 Power Inverter Module.
   - **If the test lamp illuminates**
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the T6 Power Inverter Module.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between the accessory wakeup serial data 2 circuit terminal and ground.
   - **If the test lamp does not illuminate**
   1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the accessory wakeup serial data 2 circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the accessory wakeup serial data 2 circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

    - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the device setting the DTC. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 2 Ω in each of the Chassis high speed GMLAN serial data circuits end to end between the T6 Power Inverter Module and the device setting the DTC.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U18B9-U18BF: PRIMARY/SECONDARY HIGH SPEED CAN BUS SUBNET CONFIGURATION LIST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U18B9

Primary High Speed CAN Bus Subnet Configuration List

DTC U18BF

Secondary High Speed CAN Bus Subnet Configuration List

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The devices on the high speed GMLAN serial data bus and the chassis high speed GMLAN serial data bus must be programmed with software that specifically identifies the correct type and quantity of devices on the bus based on RPO configuration. If a device was not properly configured after installation, the appropriate U Code may be set for that device. No external circuit diagnosis is involved.

Conditions for Running the DTC

- Voltage supplied to the device is in the normal operating voltage range.
- The vehicle power mode requires serial data communication to occur.

Conditions for Setting the DTC

- The device is not configured properly.
- The device recognises a programming error.
- CAN-Bus configuration is invalid

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.

- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U18B9-U18BF is not set.
    - **If DTC U18B9-U18BF is set along with other DTCs set**

      Diagnose all other DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If DTC U18B9-U18BF is set without other DTCs set**
    1. Program the device that set the DTC.
    2. Vehicle OFF, remove the scan tool, open and close the driver door. Wait 60 seconds. Vehicle in Service Mode.
    3. Verify the DTC does not set.
        - If the DTC sets, replace the appropriate device.
        - If the DTC does not set
    4. All OK.
    - **If DTC U0400-U05FF is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U2099: HIGH SPEED COMMUNICATION ENABLE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U2099

High Speed Communication Enable Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	U2099 02*	U0100-U02FF	U0100-U02FF	-
* Vehicle will not start.				

Circuit/System Description

The body control module activates the ignition circuit, when the ignition key is in ACC, ON or START. The ignition circuit wakes up the devices for serial data bus communication.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode master requires serial data communication to occur.

Conditions for Setting the DTC

The body control module senses a short to ground on the ignition circuit.

Action Taken When the DTC Sets

- The output command is turned off while the malfunction is present.
- The devices use a default value for the missing parameters until the next ignition cycle.
- The device(s) is never signaled. Therefore, the specific subsystem(s) will not function.
- The vehicle will not start while the circuit is shorted to ground.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **Use the schematics to determine which devices are on the K9 body control module's ignition circuit terminal 23 X4. Use the connector end view to identify the ignition circuit terminal for each of those devices.**

1. Vehicle OFF, disconnect the harness connector at an easily accessible device that shares the K9 body control module's ignition circuit terminal 23 X4. Vehicle in Service Mode.
2. Verify that the DTC U2099 remains current.
    - **If the DTC becomes history**

      Replace the device that was just disconnected.
    - **If the DTC remains current**
3. With the prior devices disconnected, repeat steps 1 and 2 for each device on the ignition circuit except the K9 body control module.
4. Vehicle OFF, disconnect the X4 harness connector at the K9 body control module.
5. Test for infinite resistance between the ignition circuit terminal 23 X4 at the K9 body control module and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.
    - **If infinite resistance**
6. Replace the K9 body control module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U2160-U2231: LOST COMMUNICATION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

For device DTC descriptors, refer to Control Module U Code List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U2160 - U2231	U2160 - U2231	-	-
Ignition	U2160 - U2231, U1814, U2099	U2160 - U2231	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Object High Speed GMLAN Serial Data (+)	U0075	U2160 - U2231	U0075	-
Object High Speed GMLAN Serial Data (-)	U0075	U2160 - U2231	U0075	-
Chassis High Speed GMLAN Serial Data (+)	U0077	U2160 - U2231	U0077	-
Chassis High Speed GMLAN Serial Data (-)	U0077	U2160 - U2231	U0077	-
High Speed GMLAN Serial Data (+)	U0073, 2	U2160 - U2231	U0073, 2	-
High Speed GMLAN Serial Data (-)	U0073, 2	U2160 - U2231	U0073, 2	-
Low Speed GMLAN Serial Data	U0078, 1	U2160 - U2231	U0078, 1	-
Ground	-	U2160 - U2231	-	-
1. Scan tool does not communicate with most low speed GMLAN device 2. Scan tool does not communicate with most high speed GMLAN device				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored code.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.

  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.
- This diagnostic procedure can be used to diagnose the common no communication DTCs: U216A, U216B, and other DTCs within U2160 - U2231 range.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Determine the device that is not communicating. Refer to **Control Module U Code List** .
2. Vehicle in Service Mode.
3. Verify that DTC U0073, U0074, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
4. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data 2, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect all the harness connectors at the device that is not communicating.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the control module that controls the ignition circuit.
- **If the test lamp illuminates**

NOTE: **This test step is only applicable to a low speed GMLAN device.**

9. Test for less than 4.5 V between each low speed GMLAN serial data circuit terminal and ground.
    - **If 4.5 V or greater**

      Refer to Scan Tool Does Not Communicate with Low Speed GMLAN Device to test for a short to voltage in the serial data circuit.

    - **If less than 4.5 V**
10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
11. Test for less than 2 Ω in each of the serial data circuits end to end between the device harness connector and the appropriate X84 Data Link Connector terminals listed below.
    - Low speed GMLAN serial data circuit terminal 1
    - High speed GMLAN serial data circuit terminal 6 or 14
    - Chassis high speed GMLAN serial data circuit terminal 12 or 13
    - Object high speed GMLAN serial data circuit terminal 3 or 11
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit between the non communicating device and the device setting the DTC or a serial data splice pack.

    - **If less than 2 Ω**

NOTE: **The following test step is only applicable to a high speed GMLAN device with 2 pairs of serial data circuits or a high speed GMLAN device with an internal terminating resistor.**

12. Test for 110 - 130 Ω between each pair of high speed GMLAN serial data circuits.
    - **If less than 110 Ω**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for a short to ground or a short between the serial data circuits.

    - **If greater than 130 Ω**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device to test for an open/high resistance in the serial data circuit.

    - **If between 110 - 130 Ω**
13. Replace the device that is not communicating.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

DTC U2401: BATTERY ENERGY CONTROL MODULE DEDICATED BUS 1 OFF

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U2401

Battery Energy Control Module Dedicated Bus 1 Off

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The Battery Energy Control Module dedicated bus is a communication bus used to communicate between the Battery Energy Control Module and the Hybrid/EV Battery Interface Control Modules inside the Hybrid/EV Battery Pack assembly. The Battery Energy Control Module dedicated bus does not communicate with the scan tool.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The device setting the DTC has received too many transmit errors on the Battery Energy Control Module dedicated serial data circuits.

Action Taken When the DTC Sets

DTC U2401 is a type A DTC.

Conditions for Clearing the DTC

- DTC U2401 is a type A DTC.
- No bus off status.

Diagnostic Aids

The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Hybrid/EV Energy Storage Schematics**
- **Control Module References**

Connector End View Reference

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify each scan tool Hybrid/EV Battery 1 - 96 parameters are between 3.45 - 4.05 V and all readings are within 0.03 V of each other.
   - **If not between 3.45 - 4.05 V or not within 0.03 V of each other**

     Refer to DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B .
   - **If between 3.45 - 4.05 V and within 0.03 V of each other**
3. Verify that DTC U2401 is not set.
   - **If the DTC is set**

     Replace the K16 Battery Energy Control Module.
   - **If the DTC is not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC U2409: TRANSMISSION RANGE CONTROL MODULE HIGH SPEED CAN BUS OFF

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U2409

Transmission Range Control Module High Speed CAN Bus Off

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Speed GMLAN Serial Data (+)	U0073, U2409*	U0073, U2409*	U0073, U2409*	-
High Speed GMLAN Serial Data (-)	U0073, U2409*	U0073, U2409*	U0073, U2409*	-
* Other DTCs may set with this fault.				

Circuit/System Description

The high speed GMLAN serial data circuits are serial data buses used to communicate information between the devices. The high speed GMLAN serial data circuits also connect directly to the X84 Data Link Connector (DLC) for programming purposes. If this serial data system is inoperative, some devices may still be able to communicate with the scan tool due to other serial data systems but not with each other.

Conditions for Running the DTC

- Supply voltage to the devices are in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**

- Control Module References

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify DTC U2409 is not set.
    - **If DTC U2409 is set**

      Refer to Scan Tool Does Not Communicate with High Speed GMLAN Device.

    - **If DTC U2409 is not set**
3. All OK

DTC U240A: TRANSMISSION RANGE CONTROL MODULE CHASSIS EXPANSION CAN BUS OFF

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC U240A

Transmission Range Control Module Chassis Expansion CAN Bus Off

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Chassis High Speed GMLAN Serial Data (+)	U0077, U240A*	U0077, U240A*	U0077, U240A*	-
Chassis High Speed GMLAN Serial Data (-)	U0077, U240A*	U0077, U240A*	U0077, U240A*	-
* Other DTCs may set with this fault.				

Circuit/System Description

The chassis high speed GMLAN serial data circuits are serial data buses used to communicate information between the devices. The chassis high speed GMLAN serial data circuits also connect directly to the X84 Data Link Connector (DLC) for programming purposes. If this serial data system is inoperative, the devices will still communicate with the scan tool due to other serial data systems but not with each other.

Conditions for Running the DTC

- Supply voltage to the devices are in the normal operating range.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

The device setting the DTC has attempted to establish communications on the chassis high speed GMLAN serial data circuits more than 3 times.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify DTC U240A is not set.
    - **If DTC U240A is set**

      Refer to DTC U0077 .

- **If DTC U240A is not set**

3. All OK

DTC U2500-U25FF: INVALID DATA RECEIVED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

Refer to **Control Module U Code List** .

Circuit/System Description

Some devices are constantly receiving information from other devices through serial data communication network. The invalid data code will be set when a receiving device detects a discrepancy in information it receives from another device causing its integrity to be questioned. The symptom byte listed in the DTC Descriptor is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **An invalid data DTC is normally set along with another DTC or symptom. Diagnose other DTCs and/or symptoms before replacing any device.**

1. Engine running for 10 s.
2. Ignition ON, engine OFF, verify DTC U2500-U25FF is not set.
   - **If DTC U2500-U25FF is set along with other DTCs set**

     Diagnose all other DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
   - **If DTC U2500-U25FF is set without other DTCs set**
   1. Program the device specified by the DTC descriptor.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the appropriate device.
      - If the DTC does not set
   3. All OK.
   - **If DTC U2500-U25FF is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U2602: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV POWERTRAIN CONTROL MODULE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U2602

Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U2602	U2602	-	-
Ignition	U2602	U2602	-	-
Accessory Wake Up Serial Data	U1814	U2602	-	-
High Speed GMLAN Serial Data (+)	U0073*	U0073, U2602*	U0073*	-
High Speed GMLAN Serial Data (-)	U0073*	U0073, U2602*	U0073*	-
Ground	-	U2602	-	-
* Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

This diagnostic is used to check the loss of communication with the Hybrid/EV Powertrain Control Module 2 on high speed GMLAN bus. The Battery Energy Control Module supervises a periodic serial data message to check the communication status of the Hybrid/EV Powertrain Control Module 2. If this message is not received within 400 ms, the Battery Energy Control Module increases its fail count. When this fail count is over X Cal Value (7) during Y Cal Value (10 samples), the diagnostic status of this code is set to Failed and transmitted over high voltage energy high speed GMLAN bus to the Hybrid/EV Powertrain Control Module 2.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 9 V.
- The DTC U180B is not set.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received within 400 ms.

Action Taken When the DTC Sets

The DTC U2602 is a type B DTC.

Conditions for Clearing the DTC

The DTC U2602 is a type B DTC.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
    - A device on the data communication circuit was disconnected while the communication circuit is awake.
    - Power to one or more devices was interrupted during diagnosis.
    - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
    - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
    - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U code.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.

- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0078, U007A, U1814, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
7. Vehicle in Service Mode.
8. If equipped, verify a test lamp illuminates between the accessory wakeup serial data circuit terminal and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
    2. Test for infinite resistance between the accessory wakeup serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the accessory wakeup serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
9. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X357 and X358 harness connectors at the A4 Hybrid/EV Battery Pack. It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 2 Ω in each serial data circuits end to end between the K114B Hybrid/EV Powertrain Control Module 2 and the A4 Hybrid/EV Battery Pack.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Vehicle OFF, disable the high voltage system. Refer to **High Voltage Disabling** .
12. Reconnect the 12 V battery.
13. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the X8 harness connector at the K16 Battery Energy Control Module. It may take up to 2 min for all vehicle systems to power down.
14. Test for less than 2 Ω in each serial data circuits end to end between the A4 Hybrid/EV Battery Pack and the K16 Battery Energy Control Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
15. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DTC U2603-U2606 OR U2617-U2624: BATTERY ENERGY CONTROL MODULE LOST COMMUNICATION WITH HYBRID/EV BATTERY INTERFACE CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U2603

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 1

DTC U2604

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 2

DTC U2605

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 3

DTC U2606

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 4

DTC U2617

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 5

DTC U2618

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 6

DTC U2619

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 7

DTC U2620

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 8

DTC U2621

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 9

DTC U2622

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 10

DTC U2623

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 11

DTC U2624

Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module 12

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

Devices connected to the serial data circuits monitor for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the devices. The devices have prerecorded information about what messages are needed to be exchanged on the serial data circuits, for each virtual network. The messages are supervised and also, some periodic messages are used by the receiver device as an availability indication of the transmitter device. Each message contains the identification number of the transmitter device.

The scan tool does not communicate the Hybrid/EV Battery Interface Control Modules 1 - 12 on Battery Energy Control Module dedicated bus.

Conditions for Running the DTC

- The device is awake and communicating.
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

There is no temperature report message from Hybrid/EV Battery Interface Control Modules 1 - 12 to Battery Energy Control Module within 4 s.

Action Taken When the DTC Sets

The DTC U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, and U2624 are type A DTCs.

Conditions for Clearing the DTC

The DTC U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, and U2624 are type A DTCs.

Diagnostic Aids

The Hybrid/EV Battery Interface Control Modules 1 - 12 are all internal to the Battery Energy Control Module.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Hybrid/EV Energy Storage Schematics**
- **Control Module References**

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify that DTC U2401 is not set.
   - **If the DTC is set**

     Refer to DTC U2401.

   - **If the DTC is not set**
3. Verify each scan tool Hybrid/EV Battery 1 - 96 parameters are between 3.45 - 4.05 V and all readings are within 0.03 V of each other.
   - **If not between 3.45 - 4.05 V or not within 0.03 V of each other**

     Refer to DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B .

   - **If between 3.45 - 4.05 V and within 0.03 V of each other**
4. Verify that DTC U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, or U2624 is not set.
   - **If any of the DTCs are set**

     Replace the K16 Battery Energy Control Module.

   - **If none of the DTCs are set**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC U3000: CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U3000

Control Module

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U3000 is not set.
    - **If DTC U3000 is set with symptom byte 43, 47, or 4B**
    1. Program the device that set the DTC.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the device that set the DTC.
        - If the DTC does not set
    3. All OK.
    - **If DTC U3000 is set with any symptom byte, except 43, 47, or 4B**

      Replace the device that set the DTC.

    - **If DTC U3000 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

DTC U3012: CONTROL MODULE IMPROPER WAKE-UP PERFOMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC U3012

Control Module Improper Wake-up Perfomance

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U3012 is not set.
   - **If DTC U3012 is set**

     Replace the device that set the DTC.

   - **If DTC U3012 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for device replacement, programming and setup

SYMPTOMS - DATA COMMUNICATIONS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
   - There are no Diagnostic Trouble Codes (DTC) set.
   - The devices can communicate via the serial data links.

2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Data Link Communications Description and Operation** .

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Scan Tool Does Not Power Up**
- **Scan Tool Does Not Communicate with High Speed GMLAN Device**
- **Scan Tool Does Not Communicate with Low Speed GMLAN Device**
- **Scan Tool Does Not Communicate with Gateway Expansion High Speed GMLAN Device**
- **Scan Tool Does Not Communicate with Gateway Isolated High Speed GMLAN Device**
- **Scan Tool Does Not Communicate with Gateway Isolated Low Speed GMLAN Device**

SCAN TOOL DOES NOT POWER UP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Data Link Connector B+	1	1	-	-
Data Link Connector Ground	-	1	-	-
1. Scan Tool Does Not Power Up				

Circuit/System Description

The data link connector (DLC) is a standardized 16 cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Scan tool B+ voltage at terminal 16
- Scan tool ground at terminal 4
- Common ground at terminal 5

Diagnostic Aids

- The scan tool will power up with the vehicle OFF. Some devices however, will not communicate unless the vehicle is ON and the power mode master device sends the appropriate power mode message.
- If the B+ circuit, ground circuits, and connections of the data link connector are functioning properly, the malfunction must be due to the scan tool.

Reference Information

Schematic Reference

- Data Communication Schematics
- Control Module References

Connector End View Reference

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 2 Ω between each of the X84 data link connector ground circuit terminals listed below and ground.
    - Ground circuit terminal 4
    - Ground circuit terminal 5
    - **If 2 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 2 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 16 at the X84 data link connector and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
    - **If the test lamp illuminates**
5. Refer to the scan tool user guide.

SCAN TOOL DOES NOT COMMUNICATE WITH GATEWAY EXPANSION HIGH SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Gateway Expansion High Speed GMLAN Serial Data (+) or High Speed GMLAN Serial Data (+) (8)	U007B	U007B	U007B	-
Gateway Expansion High Speed GMLAN Serial Data (-) or High Speed GMLAN Serial Data (-) (8)	U007B	U007B	U007B	-

Circuit/System Description

The devices connected to the gateway expansion high speed GMLAN serial data circuits (circuit numbers 3935 & 3936) monitor for serial data communications during normal vehicle operation. The K56 Serial Data Gateway Module acts as the gateway module between devices on primary high speed GMLAN bus and devices on gateway expansion high speed GMLAN bus. The gateway expansion high speed GMLAN serial data bus uses terminating resistors that are in parallel with the gateway expansion high speed GMLAN (+) and (-) circuits.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

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Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Attempt to communicate with all devices on the gateway expansion high speed GMLAN serial data circuits. Refer to **Data Link References** to determine which devices are on the gateway expansion high speed GMLAN bus.
4. Verify which devices are communicating on the gateway expansion high speed GMLAN serial data circuits.
    - **If only one device is not communicating**

      Refer to Circuit/System Testing - Testing the Device Circuits.

    - **If one or more devices are communicating but not all, except the K56 Serial Data Gateway Module**

      Refer to Circuit/System Testing - Testing the Serial Data Circuit for an Open/High Resistance.

    - **If none of the devices are communicating, except the K56 Serial Data Gateway Module**
5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Each device may need to be disconnected to isolate a circuit fault. Use the schematic to identify the following:**

- **Gateway expansion high speed GMLAN devices and terminating resistors the vehicle is equipped with**
- **Device locations on the gateway expansion high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and gateway expansion high speed GMLAN serial data circuit terminals**

Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at an easily accessible device that is not communicating. Refer to Data Link References to determine which devices are on the gateway expansion high speed GMLAN bus.
2. Ignition ON/Vehicle In Service Mode.
3. Test for less than 4.5 V between each gateway expansion high speed GMLAN serial data circuit at the device that was just disconnected and ground.
    - **If 4.5 V or greater**

      Refer to Testing the Serial Data Circuits for a Short to Voltage.

    - **If less than 4.5 V**
4. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
5. Test for greater than 100 Ω between each gateway expansion high speed GMLAN serial data circuit at the device that was just disconnected and ground.
    - **If 100 Ω or less**

      Refer to Testing the Serial Data Circuits for a Short to Ground.

    - **If greater than 100 Ω**
6. Test for 110 - 130 Ω between each pair of the gateway expansion high speed GMLAN serial data circuits at the device that was just disconnected:
    - **If less than 110 Ω**

      Refer to Testing the Serial Data Circuits for a Short between the Circuits.

    - **If greater than 130 Ω**

      Refer to Testing the Serial Data Circuits for an Open/High Resistance.

    - **If between 110 - 130 Ω**
7. Refer to Testing the Device Circuits.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON/Vehicle In Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
    - **If each serial data circuit is 4.5 V or less**
    1. Ignition/Vehicle OFF.
    2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
        - If 10 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 10 Ω, replace the device that was disconnected.
    - **If any serial data circuit is greater than 4.5 V**
3. Repeat step 1 until one of the following conditions are isolated:
    - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
    - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.

3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
    - **If each serial data circuit is 100 Ω or greater**

      Replace the device that was disconnected.

    - **If any serial data circuit is less than 100 Ω**
4. Repeat step 1 until one of the following conditions are isolated:
    - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
    - A short to ground on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
4. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 110 Ω or greater**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is less than 110 Ω**
5. Repeat step 2 until one of the following conditions are isolated:
    - Serial data circuits shorted together between two devices or splice packs, if equipped.
    - Serial data circuits shorted together between a device and a terminating resistor.
    - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway expansion high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
4. Test for less than 130 Ω between each pair of the serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
5. Repeat step 2 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.

   - **If 10 Ω or greater**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
4. Ignition ON/Vehicle In Service Mode.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
   - **If the test lamp does not illuminate**
   1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the control module that controls the ignition circuit.
   - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K56 Serial Data Gateway Module. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 2 Ω in each of the gateway expansion high speed GMLAN serial data circuits end to end between the non communicating device and the K56 Serial Data Gateway Module.
   - **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

9. Test for less than 2 Ω in each of the primary high speed GMLAN serial data circuits (circuit numbers 2500 & 2501) end to end between the K56 Serial Data Gateway Module and the appropriate X84 Data Link Connector (DLC) terminals listed below.
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 6
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 14
    - **If 2 Ω or greater**

      Repair the open/high resistance in the high speed GMLAN serial data circuit.

    - **If less than 2 Ω**
10. Replace the non communicating device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

SCAN TOOL DOES NOT COMMUNICATE WITH GATEWAY ISOLATED HIGH SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Gateway Isolated High Speed GMLAN Serial Data (+) or High Speed GMLAN Serial Data (+) (9)	U007C	U007C	U007C	-
Gateway Isolated High Speed GMLAN Serial Data (-) or High Speed GMLAN Serial Data (-) (9)	U007C	U007C	U007C	-

Circuit/System Description

The devices connected to the gateway isolated high speed GMLAN serial data circuits (circuit numbers 1304 & 1305) monitor for serial data communications during normal vehicle operation. The K56 Serial Data Gateway Module acts as the gateway module between devices on primary high speed GMLAN bus and devices on gateway isolated high speed GMLAN bus. The gateway isolated high speed GMLAN serial data bus uses terminating resistors that are in parallel with the gateway isolated high speed GMLAN (+) and (-) circuits.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Attempt to communicate with all devices on the gateway isolated high speed GMLAN serial data circuits. Refer to **Data Link References** to determine which devices are on the gateway isolated high speed GMLAN bus.
4. Verify which devices are communicating on the gateway isolated high speed GMLAN serial data circuits.
   - **If only one device is not communicating**

     Refer to Circuit/System Testing - Testing the Device Circuits.

- **If one or more devices are communicating but not all, except the K56 Serial Data Gateway Module**

  Refer to Circuit/System Testing - Testing the Serial Data Circuit for an Open/High Resistance.

- **If none of the devices are communicating, except the K56 Serial Data Gateway Module**

5. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Each device may need to be disconnected to isolate a circuit fault. Use the schematic to identify the following:**

- **Gateway isolated high speed GMLAN devices and terminating resistors the vehicle is equipped with**
- **Device locations on the gateway isolated high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and gateway isolated high speed GMLAN serial data circuit terminals**

Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at an easily accessible device that is not communicating. Refer to Data Link References to determine which devices are on the gateway isolated high speed GMLAN bus.
2. Ignition ON/Vehicle In Service Mode.
3. Test for less than 4.5 V between each gateway isolated high speed GMLAN serial data circuit at the device that was just disconnected and ground.
   - **If 4.5 V or greater**

     Refer to Testing the Serial Data Circuits for a Short to Voltage.

   - **If less than 4.5 V**
4. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
5. Test for greater than 100 Ω between each gateway isolated high speed GMLAN serial data circuit at the device that was just disconnected and ground.
   - **If 100 Ω or less**

     Refer to Testing the Serial Data Circuits for a Short to Ground.

   - **If greater than 100 Ω**
6. Test for 110 - 130 Ω between each pair of the gateway isolated high speed GMLAN serial data circuits at the device that was just disconnected:
   - **If less than 110 Ω**

     Refer to Testing the Serial Data Circuits for a Short between the Circuits.

   - **If greater than 130 Ω**

     Refer to Testing the Serial Data Circuits for an Open/High Resistance.

   - **If between 110 - 130 Ω**
7. Refer to Testing the Device Circuits.

Testing the Serial Data Circuits for a Short to Voltage

1. Ignition/Vehicle OFF, disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, ignition ON/Vehicle In Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
   1. Ignition/Vehicle OFF.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the device that was disconnected.
   - **If any serial data circuit is greater than 4.5 V**
3. Repeat step 1 until one of the following conditions are isolated:
   - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
   - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 100 Ω or greater**

     Replace the device that was disconnected.

   - **If any serial data circuit is less than 100 Ω**
4. Repeat step 1 until one of the following conditions are isolated:
   - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
   - A short to ground on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short between the Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
4. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
   - **If each pair of serial data circuits is 110 Ω or greater**

     Replace the device that was disconnected.

   - **If any pair of serial data circuits is less than 110 Ω**
5. Repeat step 2 until one of the following conditions are isolated:
   - Serial data circuits shorted together between two devices or splice packs, if equipped.
   - Serial data circuits shorted together between a device and a terminating resistor.
   - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Connect the harness connectors at the device that was previously disconnected.
3. Disconnect the harness connectors with the gateway isolated high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
4. Test for less than 130 Ω between each pair of the serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
5. Repeat step 2 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.
    - **If 10 Ω or greater**
        1. Ignition/Vehicle OFF.
        2. Test for less than 2 Ω in the ground circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
        1. Ignition/Vehicle OFF, remove the test lamp.
        2. Test for less than 2 Ω in the B+ circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
        1. Ignition/Vehicle OFF, remove the test lamp.
        2. Test for infinite resistance between the B+ circuit and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
4. Ignition ON/Vehicle In Service Mode.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
        1. Ignition/Vehicle OFF, remove the test lamp.
        2. Test for less than 2 Ω in the ignition circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**

    1. Ignition/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
    - **If the test lamp does not illuminate**
    1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the control module that controls the ignition circuit.
    - **If the test lamp illuminates**
7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K56 Serial Data Gateway Module. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 2 Ω in each of the gateway isolated high speed GMLAN serial data circuits end to end between the non communicating device and the K56 Serial Data Gateway Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Test for less than 2 Ω in each of the primary high speed GMLAN serial data circuits (circuit numbers 2500 & 2501) end to end between the K56 Serial Data Gateway Module and the appropriate X84 Data Link Connector (DLC) terminals listed below.
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 6
    - X84 Data Link Connector high speed GMLAN serial data circuit terminal 14
    - **If 2 Ω or greater**

      Repair the open/high resistance in the primary high speed GMLAN serial data circuit.

    - **If less than 2 Ω**
10. Replace the non communicating device that was disconnected.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

SCAN TOOL DOES NOT COMMUNICATE WITH GATEWAY ISOLATED LOW SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Gateway Isolated Low Speed GMLAN Serial Data or Low Speed GMLAN Serial Data #2 (Circuit #1102)	U007D	U0100-U02FF	U007D	-

Circuit/System Description

The gateway isolated low speed GMLAN serial data bus is used to communicate information between the devices. The serial data is transmitted over a single wire (circuit number 1102) to the appropriate devices. The K56 Serial Data Gateway Module acts as the gateway module between devices on low speed GMLAN bus and devices on gateway isolated low speed GMLAN bus.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The vehicle power mode requires serial data communications.

Conditions for Setting the DTC

A supervised periodic message that includes the transmitter device availability has not been received.

Action Taken When the DTC Sets

- The device suspends all message transmission.
- The device uses default values for all parameters received on the serial data circuits.
- The device inhibits the setting of all other communication DTCs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Data Communication Schematics**
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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle In Service Mode.
2. Verify that DTC U0073, U0074, U0075, U0077, U0078, U007A, P06E4, P1EB9, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Verify that the K56 Serial Data Gateway Module is communicating.
    - **If the K56 Serial Data Gateway Module is not communicating**

      Refer to **DTC U0100-U02FF** to diagnose the K56 Serial Data Gateway Module.

    - **If the K56 Serial Data Gateway Module is communicating**
4. Attempt to communicate with all devices on the gateway isolated low speed GMLAN serial data circuit. Refer to **Data Link References** to determine which devices are on the gateway isolated low speed GMLAN bus.
5. Verify which devices are communicating on the gateway isolated low speed GMLAN serial data circuit.
    - **If only one device is not communicating**

      Refer to Circuit/System Testing - Testing the Device Circuits.

    - **If one or more devices are communicating but not all, except the K56 Serial Data Gateway Module**

      Refer to Circuit/System Testing - Testing the Serial Data Circuit for an Open/High Resistance.

    - **If none of the devices are communicating, except the K56 Serial Data Gateway Module**
6. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematic to identify the following:**

- **Gateway Isolated low speed GMLAN devices the vehicle is equipped with**
- **Device and splice pack locations on the gateway isolated low speed GMLAN serial data circuit**
- **The gateway isolated low speed GMLAN serial data circuit terminals for each device or splice pack**

1. Ignition/Vehicle OFF, disconnect the appropriate harness connectors at all gateway isolated low speed GMLAN serial data splice packs, ignition ON/Vehicle In Service Mode.
2. Test for less than 4.5 V between each gateway isolated low speed GMLAN serial data circuit at a splice pack and ground.
    - **If any serial data circuit is greater than 4.5 V**
    1. Ignition/Vehicle OFF, disconnect all devices on the failed serial data circuit, ignition ON/Vehicle In Service Mode.
    2. Test for less than 1 V between each section of the failed serial data circuit and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.
        - If less than 1 V
    3. Connect the splice pack and connect the first device on the failed serial data circuit, ignition ON/Vehicle In Service Mode.

   4. Verify the scan tool communicates or not with the gateway isolated low speed GMLAN serial data circuit.
      - If the scan tool does not communicate, replace the device that was just connected.
      - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 2.4.
      - If the scan tool communicates and there are no more devices to connect
   5. All OK.
   - **If all serial data circuits are less than 4.5 V**
3. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the appropriate harness connectors at all gateway isolated low speed GMLAN serial data splice packs. It may take up to 2 min for all vehicle systems to power down.
4. Test for greater than 100 Ω between each gateway isolated low speed GMLAN serial data circuit at a splice pack and ground.
   - **If any serial data circuit is 100 Ω or less**
   1. Disconnect all devices on the failed serial data circuit.
   2. Test for infinite resistance between each section of the failed serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance
   3. Connect the splice pack and connect the first device on the failed serial data circuit, ignition ON/Vehicle In Service Mode.
   4. Verify the scan tool communicates or not with the gateway isolated low speed GMLAN serial data circuit.
      - If the scan tool does not communicate, replace the device that was just connected.
      - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 4.4.
      - If the scan tool communicates and there are no more devices to connect
   5. All OK.
   - **If all serial data circuits are greater than 100 Ω**
5. Inspect all gateway isolated low speed GMLAN splice packs for damage.

Testing the Serial Data Circuit for an Open/High Resistance

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
2. Disconnect the harness connectors at the gateway isolated low speed GMLAN device that is not communicating and closest to the K56 Serial Data Gateway Module.
3. Disconnect the harness connectors at the K56 Serial Data Gateway Module.
4. Test for less than 2 Ω in the gateway isolated low speed GMLAN serial data circuit (circuit number 1102) end to end between the non-communicating device and the K56 Serial Data Gateway Module.
   - **If 2 Ω or greater**

     Repair the open/high resistance in the serial data circuit.

   - **If less than 2 Ω**
5. Test for less than 2 Ω in the primary low speed GMLAN serial data circuit (circuit number 5060) end to end between the K56 Serial Data Gateway Module and the X84 Data Link Connector terminal 1.
   - **If 2 Ω or greater**

     Repair the open/high resistance in the serial data circuit.

   - **If less than 2 Ω**
6. Replace the non-communicating device that was disconnected.

Testing the Device Circuits

1. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the Gateway isolated low speed GMLAN device that is not communicating. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal at the device that was just disconnected and ground.
   - **If 10 Ω or greater**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
4. Ignition ON/Vehicle In Service Mode.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the disconnected device.
   - **If the test lamp illuminates**
6. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
   - **If the test lamp does not illuminate**
   1. Ignition/Vehicle OFF, remove the test lamp, disconnect the harness connectors at the control module that controls the ignition circuit.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the control module that controls the ignition circuit.

- **If the test lamp illuminates**

7. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from vehicle. Disconnect the harness connectors at the K56 Serial Data Gateway Module. It may take up to 2 min for all vehicle systems to power down.
8. Test for less than 2 Ω in each of the gateway isolated low speed GMLAN serial data circuits end to end between the non communicating device and the K56 Serial Data Gateway Module.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
9. Test for less than 2 Ω in the primary low speed GMLAN serial data circuit (circuit number 5060) end to end between the K56 Serial Data Gateway Module and X84 Data Link Connector terminal 1.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the low speed GMLAN serial data circuit.

    - **If less than 2 Ω**
10. Replace the non communicating device that was disconnected.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

SCAN TOOL DOES NOT COMMUNICATE WITH HIGH SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Speed GMLAN Serial Data (+)	1	U0100 - U02FF*	1	-
High Speed GMLAN Serial Data (-)	1	U0100 - U02FF*	1	-
Ground (DLC, terminal 5)	-	1	-	-
* No communications with one or more high speed GMLAN devices. An open in only one high speed GMLAN serial data circuit may allow degraded communication between the devices. An open between the data link connector (DLC) and the first splice/device will only affect the communication with the scan tool. The devices will still communicate. 1. No communication with any high speed GMLAN device				

Circuit/System Description

The serial data is transmitted on two twisted wires that allow speeds up to 500 Kb/s. The twisted pair is terminated with two 120 Ω resistors, one is internal to the engine control module (ECM) and the other can be a separate resistor in a connector assembly or in another device. The resistors are used as the load for the High Speed GMLAN bus during normal vehicle operation. The high speed GMLAN is a differential bus. The high speed GMLAN serial data bus (+) and high speed GMLAN serial data (-) are driven to opposite extremes from a rest or idle level of approximately 2.5 V. Driving the lines to their extremes, adds 1 V to the high speed GMLAN serial data bus (+) circuit and subtracts 1 V from the high speed GMLAN serial data bus (-) circuit. If serial data is lost, devices will set a no communication code against the non-communicating device. Note that a loss of serial data DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between some devices and the scan tool with the high speed GMLAN serial data system inoperative. This condition is due to those devices using multiple serial data communication systems.
- An open in the DLC ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine will not start when there is a total malfunction of the high speed GMLAN serial data bus.
- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no low speed GMLAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio module (see bulletins). Some customers may comment of one or more of the following concerns:
  - Vehicle will not crank
  - Vehicle cranks but will not start
  - Vehicle stability enhancement system warning lights and messages
  - PRNDL gear indicator position errors

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify two or more devices are not communicating on the high speed GMLAN serial data circuit. Refer to Data Link References to determine how many devices should be communicating on the bus.
    - **If only one device is not communicating**

      Refer to Circuit/System Testing - Testing the Device Circuits.

    - **If two or more devices are not communicating**
3. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. Disconnect the scan tool from the X84 data link connector. The following tests will be done at the X84 data link connector. It may take up to 2 minutes for all vehicle systems to power down.
4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. Test for less than 4.5 V between the serial data circuits listed below and ground.
    - Terminal 6
    - Terminal 14
    - **If 4.5 V or greater**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

    - **If less than 4.5 V**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
8. Test for greater than 100 Ω between the serial data circuits listed below and ground.
    - Terminal 6
    - Terminal 14
    - **If 100 Ω or less**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

    - **If greater than 100 Ω**
9. Test for 50 - 70 Ω between the serial data circuit terminals 6 and 14.
    - **If less than 35 Ω**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

    - **If between 35 - 50 Ω**

There may be a third terminating resistor between the serial data circuits. This can happen if the incorrect device is installed. Some devices are available with and without the terminating resistors installed to reduce the need of terminating resistors in the wiring harness. Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short between the Circuits.

- **If greater than 70 Ω but less than infinite**

  Refer to Circuit/System Testing - Testing the Serial Data Circuits for an Open/High Resistance.

- **If infinite resistance**

  Repair the open/high resistance in the circuit between the X84 data link connector and the first splice/device in the serial data circuit.

- **If between 50 - 70 Ω**

10. Refer to Circuit/System Testing - Testing the Device Circuits.

Circuit/System Testing

NOTE: **Some devices with an internal terminating resistor have a loop in the harness that connects the internal terminating resistor to the serial data circuit. When wired this way, test these loop circuits for the appropriate failure mode short to voltage, short to ground, or open/high resistance prior to replacing the device for each of the following tests.**

Each device may need to be disconnected to isolate a circuit fault. Use the schematics and connector end views to identify the following:

- **High speed GMLAN devices the vehicle is equipped with**
- **High speed GMLAN serial data circuit terminating resistors**
- **Device locations on the high speed GMLAN serial data circuits**
- **Each device's ground, B+, ignition, and high speed GMLAN serial data circuit terminals**

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device, Vehicle in Service Mode.
2. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
   1. Vehicle OFF.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the device that was disconnected.
   - **If any serial data circuit is greater than 4.5 V**
3. Vehicle OFF, disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to voltage, Vehicle in Service Mode.
4. Test for greater than 4.5 V between each serial data circuit at the device connector that was just disconnected and ground.
   - **If each serial data circuit is 4.5 V or less**
   1. Vehicle OFF.
   2. Test for less than 10 Ω between each of the device's ground circuit terminals and ground.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the device that was disconnected.

- **If any serial data circuit is greater than 4.5 V**

5. Repeat step 3 until one of the following conditions are isolated:
    - A short to voltage on the serial data circuit between two devices or splice packs, if equipped.
    - A short to voltage on the serial data circuit between a device and a terminating resistor.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device.
3. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
    - **If each serial data circuit is 100 Ω or greater**

      Replace the device that was disconnected.

    - **If any serial data circuit is less than 100 Ω**
4. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted to ground.
5. Test for greater than 100 Ω between each serial data circuit at the device connector that was just disconnected and ground.
    - **If both serial data circuits are 100 Ω or greater**

      Replace the device that was disconnected.

    - **If any serial data circuit is less than 100 Ω**
6. Repeat step 4 until one of the following conditions are isolated:
    - A short to ground on the serial data circuit between two devices or splice packs, if equipped.
    - A short to ground on the serial data circuit between a device and a terminating resistor.
    - A short to ground on the serial data circuit between the X84 data link connector and the first device or splice pack.

Testing the Serial Data Circuits for a Short between the Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 110 Ω or greater**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is less than 110 Ω**
4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit shorted together.
6. Test for greater than 110 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 110 Ω or greater**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is less than 110 Ω**

7. Repeat step 4 until one of the following conditions are isolated:
    - Serial data circuits shorted together between two devices or splice packs, if equipped.
    - Serial data circuits shorted together between a device and a terminating resistor.
    - Serial data circuits shorted together between the X84 data link connector and the first device or splice pack.
    - A shorted terminating resistor.

Testing the Serial Data Circuits for an Open/High Resistance

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors with the high speed GMLAN serial data circuits at an easily accessible device that is not communicating.
3. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
4. Connect the harness connectors at the device that was disconnected.
5. Disconnect the harness connectors with the high speed GMLAN serial data circuits at another device, in the direction of the circuit with the open/high resistance.
6. Test for less than 130 Ω between each pair of serial data circuits at the device connector that was just disconnected.
    - **If each pair of serial data circuits is 130 Ω or less**

      Replace the device that was disconnected.

    - **If any pair of serial data circuits is greater than 130 Ω**
7. Repeat step 4 until one of the following conditions are isolated:
    - An open/high resistance on the serial data circuit between two devices or splice packs, if equipped.
    - An open/high resistance on the serial data circuit between a device and a terminating resistor.
    - An open/high resistance terminating resistor.

Testing the Device Circuits

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the harness connectors at an easily accessible device that is not communicating.
3. Test for less than 10 Ω between each ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Vehicle in Service Mode
5. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
6. Vehicle in Service Mode.
7. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which has a fuse in the circuit, and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the disconnected device.
    - **If the test lamp illuminates**
8. Vehicle in Service Mode
9. If equipped, verify a test lamp illuminates between each ignition circuit terminal, which is controlled by a control module, and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connectors at the control module that controls the ignition circuit.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the control module that controls the ignition circuit.
    - **If the test lamp illuminates**
10. Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 meters (9.8 feet) away from vehicle. It may take up to 2 minutes for all vehicle systems to power down.
11. Test for less than 130 Ω between each pair of high speed GMLAN serial data circuits at the device connector that was just disconnected.
    - **If any pair of serial data circuits is greater than 130 Ω**

      Repair the open/high resistance in the serial data circuits between the disconnected device and the circuit splice in the serial data circuits.

    - **If each pair of serial data circuits is 130 Ω or less**
12. Replace the device that was disconnected.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Serial Data Circuit Wiring Repairs
- Control Module References for device replacement, programming and setup

SCAN TOOL DOES NOT COMMUNICATE WITH LOW SPEED GMLAN DEVICE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Speed GMLAN Serial Data	1	U0100-U02FF*	1	-
Ground (DLC, terminal 5)	-	1*	-	-
* An open between the Data Link Connector (DLC) and the first splice pack/device will only affect the communication with the scan tool. 1. No communication with any low speed GMLAN device				

Circuit/System Description

The serial data is transmitted over a single wire to the appropriate devices. The transmission speed for GMLAN low speed is up to 83.33 Kbit/s. Under normal vehicle operating conditions, the speed of the bus is 33.33 Kbit/s. The devices toggle the serial data circuit between 0 - 5 V during normal communications. To wake the devices connected to the low speed GMLAN serial data circuit, a voltage wake up pulse of 10 V is sent out. If serial data is lost, devices will set a no communication code against the non-communicating device. A loss of serial data communications DTC does not represent a failure of the device that set it.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U code present. However, there is no associated "current" or "active" status. Loss of communication U codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms. Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:
  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss of communication U code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- Do not replace a device reporting a U code. The U code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with the low speed GMLAN serial data system inoperative. This condition is due to the device using both the high and low speed GMLAN systems.
- An open in the low speed GMLAN serial data circuit between the splice pack and a device will only affect that specific device. This type of failure will set a loss of communication DTC for each device affected, and the other devices will still communicate.
- An open in the Data Link Connector ground circuit terminal 5 will allow the scan tool to operate but not communicate with the vehicle.
- The engine may not start when there is a total malfunction of the low speed GMLAN serial data circuit.

- Technicians may find various Local Area Network (LAN) communication Diagnostic Trouble Codes (DTC) and no low speed LAN communications with the scan tool.
- These conditions may be caused by the installation of an aftermarket navigation radio device (see bulletins). Some customers may comment of one or more of the following concerns:
  - Vehicle will not crank
  - Vehicle cranks but will not start
  - Vehicle stability enhancement system warning lights and messages
  - PRNDL gear indicator position errors

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

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Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Use the schematic to identify the following:**

- **Devices the vehicle is equipped with**
- **Device and splice pack locations on the low speed GMLAN serial data circuit**
- **The low speed GMLAN serial data circuit terminals for each device or splice pack**

1. Attempt to communicate with all devices on the low speed GMLAN serial data circuit. Refer to **Data Link References**.
2. Verify which devices are communicating on the low speed GMLAN serial data circuit.
   - **If only one device is not communicating**

     Diagnose that device only. Refer to **DTC U0100-U02FF** .

   - **If one or more devices are communicating but not all**

     Refer to Circuit/System Testing - Testing the Serial Data Circuit for an Open/High Resistance.

   - **If none of the devices are communicating**

3. Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the scan tool from the X84 Data Link Connector. The following tests will be done at the X84 Data Link Connector.
4. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. Test for less than 4.5 V between the serial data circuit terminal 1 and ground.
    - **If 4.5 V or greater**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Voltage.

    - **If less than 4.5 V**
7. Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down.
8. Test for greater than 100 Ω between the serial data circuit terminal 1 and ground.
    - **If 100 Ω or less**

      Refer to Circuit/System Testing - Testing the Serial Data Circuits for a Short to Ground.

    - **If greater than 100 Ω**
9. Disconnect the appropriate harness connector at the first splice pack closest in the circuit to the X84 Data Link Connector.
10. Test for less than 2 Ω between the X84 Data Link Connector's serial data circuit terminal 1 and the splice pack harness connector's serial data input terminal.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
11. Replace the splice pack.

Circuit/System Testing

Testing the Serial Data Circuits for a Short to Voltage

1. Vehicle OFF, disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs, Vehicle in Service Mode.
2. Test for less than 4.5 V between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.
    - **If 4.5 V or greater**

      Repair the short to voltage on the serial data circuit.

    - **If less than 4.5 V**
3. Test for less than 4.5 V between each low speed GMLAN serial data circuit at a splice pack and ground.
    - **If any serial data circuit is greater than 4.5 V**
    1. Vehicle OFF, disconnect all devices on the failed serial data circuit, Vehicle in Service Mode.
    2. Test for less than 1 V between each section of the failed serial data circuit and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.

        - If less than 1 V
    3. Vehicle OFF, connect the splice pack and connect the first device on the failed serial data circuit, Vehicle in Service Mode.
    4. Verify the scan tool communicates or not with the low speed GMLAN serial data circuit.
        - If the scan tool does not communicate, replace the device that was just connected.
        - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.4.
        - If the scan tool communicates and there are no more devices to connect
    5. All OK.
    - **If all serial data circuits are less than 4.5 V**
4. All OK.

Testing the Serial Data Circuits for a Short to Ground

1. Vehicle OFF, all access doors closed, all vehicle systems OFF, all keys at least 3 m (9.8 ft) away from vehicle. It may take up to 2 min for all vehicle systems to power down. Disconnect the appropriate harness connectors at all low speed GMLAN serial data splice packs.
2. Test for infinite resistance between the serial data circuit terminal 1 at the X84 Data Link Connector and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the serial data circuit.

    - **If infinite resistance**
3. Test for greater than 100 Ω between each low speed GMLAN serial data circuit at a splice pack and ground.
    - **If any serial data circuit is 100 Ω or less**
    1. Disconnect all devices on the failed serial data circuit.
    2. Test for infinite resistance between each section of the failed serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance
    3. Connect the splice pack and connect the first device on the failed serial data circuit, Vehicle in Service Mode.
    4. Verify the scan tool communicates or not with the low speed GMLAN serial data circuit.
        - If the scan tool does not communicate, replace the device that was just connected.
        - If the scan tool communicates and there are more devices to connect, connect the next device and repeat step 3.4.
        - If the scan tool communicates and there are no more devices to connect
    5. All OK.
    - **If all serial data circuits are greater than 100 Ω**
4. All OK.

Testing the Serial Data Circuit for an Open/High Resistance

1. Vehicle OFF and all vehicle systems OFF, disconnect the splice pack containing the devices that are not communicating on the low speed GMLAN serial data circuit.
2. Test for less than 2 Ω between the X84 Data Link Connector terminal 1 and the disconnected splice pack.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the serial data circuit.

    - **If less than 2 Ω**
3. Disconnect all devices on the failed serial data circuit.
4. Test for less than 2 Ω between each section of the failed serial data circuit end to end.

- **If 2 Ω or greater**

  Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

5. Connect the splice pack and connect the first device on the failed serial data circuit, Vehicle in Service Mode.
6. Verify if the device communicates or not with the scan tool.
   - **If the device does not communicates**

     Replace the device.

   - **If the device communicates and there are more devices to connect**

     Connect the next device on the failed serial data circuit and repeat step 6.

   - **If all devices are connected and communicating**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Serial Data Circuit Wiring Repairs**
- **Control Module References** for device replacement, programming and setup

DATA LINK REFERENCES

This table identifies which serial data link that a particular module uses for in-vehicle data transmission. Some modules may use more than one data link to communicate. Some modules may have multiple communication circuits passing through them without actively communicating on that data link. This table is used to assist in correcting a communication malfunction. For the description and operation of these serial data communication circuits refer to **Data Link Communications Description and Operation** .

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
A11	Radio	• Gateway Isolated Low Speed GMLAN • Ethernet Bus	• **DTC U007D** • **DTC U18AF-U18B4**
A26	HVAC Controls	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
B174W	Frontview Camera - Windshield	• High Speed GMLAN • Low Speed GMLAN	• **Scan Tool Does Not Communicate with High Speed GMLAN Device** • **Scan Tool Does Not Communicate with Low Speed GMLAN Device**
B200	Rain Sensor Module	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
B218L	Side Object Sensor Module - Left	Low Speed GMLAN	**Scan Tool Does Not Communicate with Low Speed GMLAN Device**

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
B305	Ambient Light/Sunload Sensor and Battery State Of Charge Indicator	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
G1	A/C Compressor	High Speed GMLAN	**Scan Tool Does Not Communicate with High Speed GMLAN Device**
K9	Body Control Module	- High Speed GMLAN - Low Speed GMLAN - Local Interconnect Network (LIN)	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **Scan Tool Does Not Communicate with Low Speed GMLAN Device** - **DTC U1500-U15FF**
K10	Coolant Heater Control Module	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
K16	Battery Energy Control Module	- High Speed GMLAN - High Voltage Management Expansion Bus - BECM Dedicated Bus	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U007A** - **DTC U2401**
K17	Electronic Brake Control Module	- High Speed GMLAN - Chassis Expansion Bus	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U0077**
K20	Engine Control Module	- High Speed GMLAN - Powertrain Expansion Bus - Local Interconnect Network (LIN)	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U0074** - **DTC U1500-U15FF**
K29F	Seat Heating Control Module - Front	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
K29R	Seat Heating Control Module - Rear	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
K33	HVAC Control Module	- Low Speed GMLAN - Local Interconnect Network (LIN)	- **Scan Tool Does Not Communicate with Low Speed GMLAN Device** - **DTC U1500-U15FF**

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
K36	Inflatable Restraint Sensing and Diagnostic Module	• Low Speed GMLAN • Chassis Expansion Bus	• Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U0077
K38	Chassis Control Module	• High Speed GMLAN • Chassis Expansion Bus • Local Interconnect Network (LIN)	• Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U0077 • DTC U1500-U15FF
K43	Power Steering Control Module	• High Speed GMLAN • Chassis Expansion Bus	• Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U0077
K56	Serial Data Gateway Module	• High Speed GMLAN • Gateway Isolated High Speed GMLAN • Low Speed GMLAN • Gateway Isolated Low Speed GMLAN	• Scan Tool Does Not Communicate with High Speed GMLAN Device • DTC U007C • Scan Tool Does Not Communicate with Low Speed GMLAN Device • DTC U007D
K60	Steering Column Lock Module	Low Speed GMLAN	Scan Tool Does Not Communicate with Low Speed GMLAN Device
K73	Telematics Communication Interface Control Module	• Gateway Isolated High Speed GMLAN • Gateway Isolated Low Speed GMLAN	• DTC U007C • DTC U007D
K84	Keyless Entry Control Module	Low Speed GMLAN	Scan Tool Does Not Communicate with Low Speed GMLAN Device
K85	Passenger Presence Module	Low Speed GMLAN	Scan Tool Does Not Communicate with Low Speed GMLAN Device
K101	Trailer Interface Control Module	Low Speed GMLAN	Scan Tool Does Not Communicate with Low Speed GMLAN Device

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
K114A / T6	Hybrid/EV Powertrain Control Module 1 / Power Inverter Module	- High Speed GMLAN - Chassis Expansion Bus - Powertrain Expansion Bus	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U0077** - **DTC U0074**
K114B	Hybrid/EV Powertrain Control Module 2	- Low Speed GMLAN - High Speed GMLAN - Powertrain Expansion Bus - High Voltage Management Expansion Bus	- **Scan Tool Does Not Communicate with Low Speed GMLAN Device** - **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U0074** - **DTC U007A**
K132	Pedestrian Alert Sound Control Module	High Speed GMLAN	**Scan Tool Does Not Communicate with High Speed GMLAN Device**
K157	Video Processing Control Module	Gateway Isolated Low Speed GMLAN	**DTC U007D**
K173	Transmission Range Control Module	- High Speed GMLAN - Chassis Expansion Bus - Local Interconnect Network (LIN)	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U0077** - **DTC U1500-U15FF**
K177	Brake Booster Control Module	- High Speed GMLAN - Chassis Expansion Bus	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U0077**
K182	Parking Assist Control Module	- Low Speed GMLAN - Chassis Expansion Bus	- **Scan Tool Does Not Communicate with Low Speed GMLAN Device** - **DTC U0077**
K183	Short Range Remote Control Transceiver	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
K190	Power Line Communication Module	- High Speed GMLAN - High Voltage Management Expansion Bus	- **Scan Tool Does Not Communicate with High Speed GMLAN Device** - **DTC U007A**

Code	Device	Data Link Type	Diagnostic Procedure
Schematic Reference: Data Communication Schematics			
M74D	Window Motor - Driver	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
M75L	Windshield Wiper Motor Module - Left	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
M96	Active Grille Air Shutter Actuator	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
P2	Transmission Shift Lever Position Indicator	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
P16	Instrument Cluster	• Gateway Isolated Low Speed GMLAN • Ethernet Bus • Local Interconnect Network (LIN)	• **DTC U007D** • **DTC U18AF-U18B4** • **DTC U1500-U15FF**
P17	Info Display Module	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
S70R	Steering Wheel Controls Switch - Right	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
S79LR	Window Switch - Left Rear	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
S79P	Window Switch - Passenger	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
S79RR	Window Switch - Right Rear	Local Interconnect Network (LIN)	**DTC U1500-U15FF**
S146	Window/Outside Rearview Mirror Switch - Driver	Local Interconnect Network (LIN)	**DTC U1500-U15FF**

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REPAIR INSTRUCTIONS

BODY CONTROL MODULE REPLACEMENT

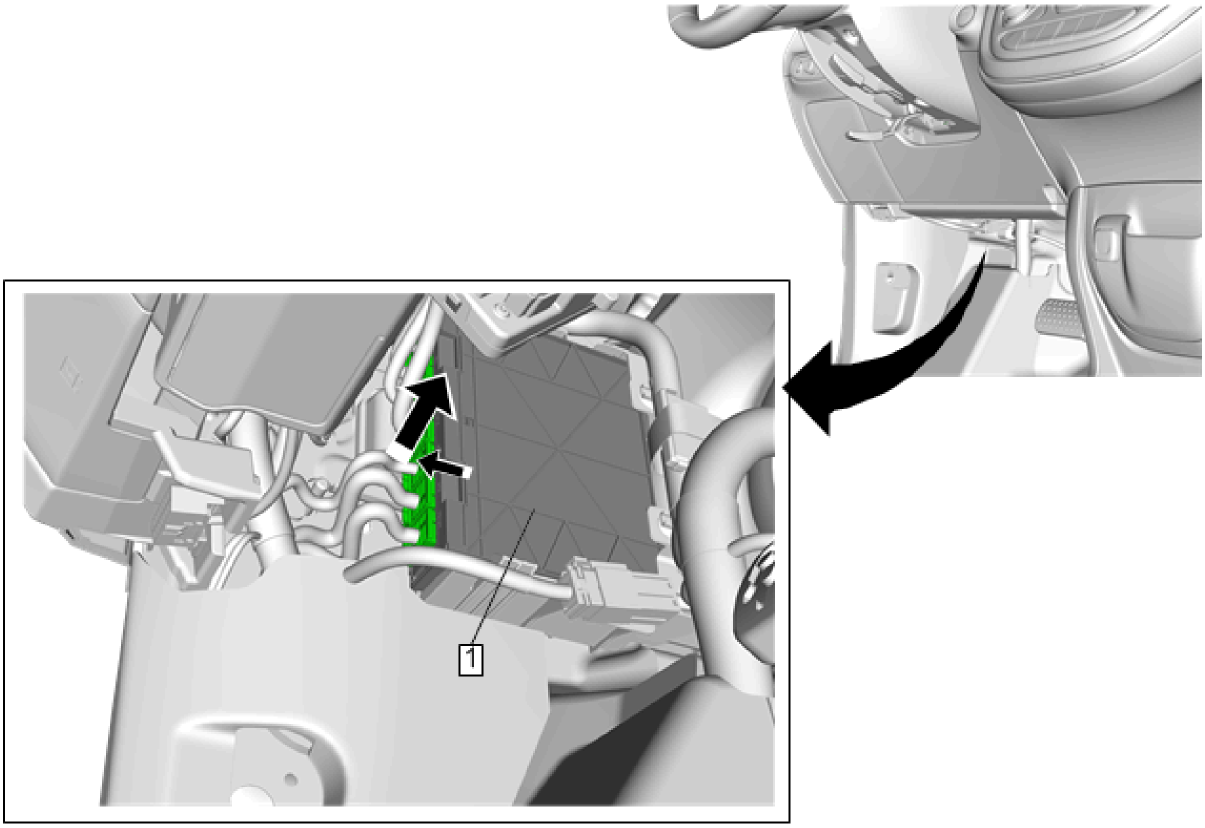

Fig. 1: Body Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Body Control Module **Procedure** 1. While pushing the retaining tab, slightly slide the module rearward. 2. Push the (Qty: 2) retaining tabs and pull the module out from its bracket. 3. Disconnect the electrical connectors. 4. Refer to Control Module References for programming and set up information, if required.

BODY CONTROL MODULE BRACKET REPLACEMENT

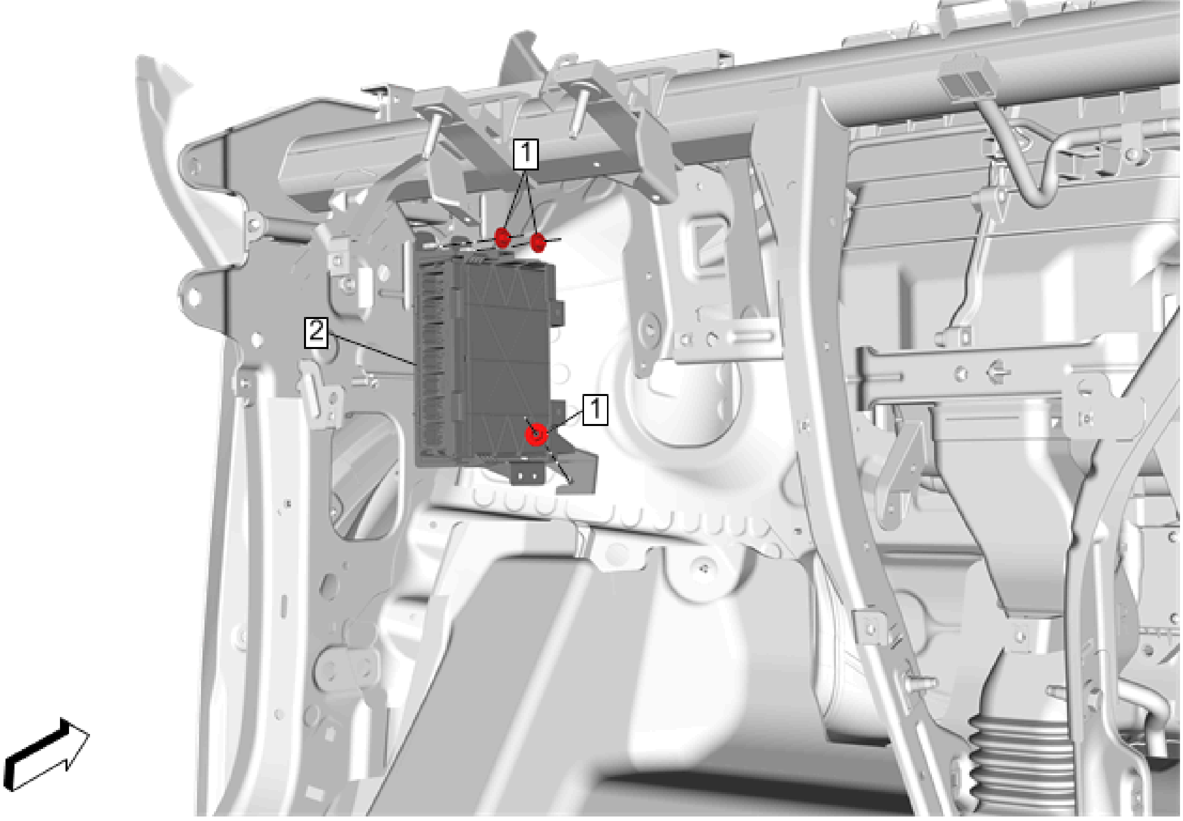

Fig. 2: Body Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection** 2. **Steering Column Replacement**	
1	Body Control Module Bracket Nut **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Body Control Module Bracket **Procedure** 1. Unclip the body harness from the bracket. 2. Transfer components as necessary. 3. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

HYBRID POWERTRAIN CONTROL MODULE 2 REPLACEMENT

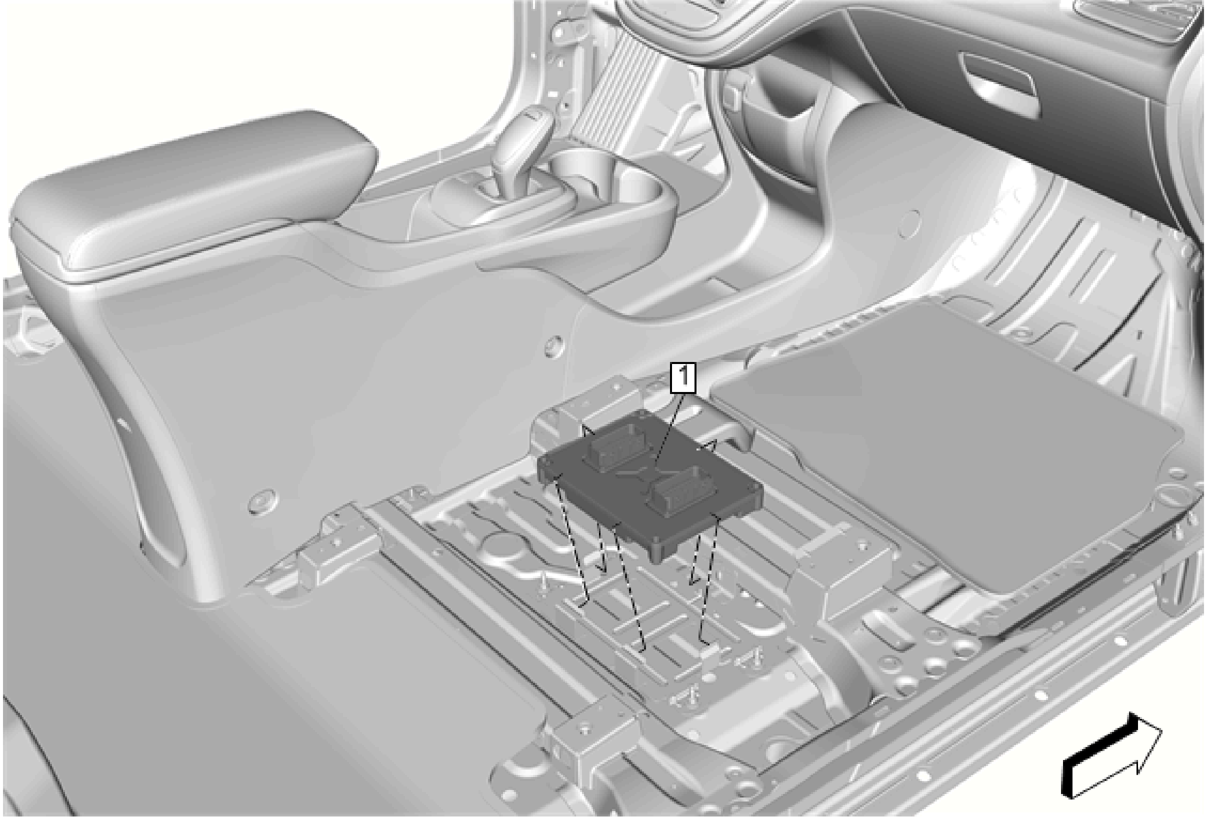

Fig. 3: Hybrid Powertrain Control Module 2
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures **WARNING:** **Refer to Battery Disconnect Warning .** 1. Disconnect the battery negative cable. 2. Move the passenger seat fully backward. 3. Raise the seat fully upward.	
1	Hybrid Powertrain Control Module 2 **Procedure** 1. To access the module, open up the floor carpet along the cut line. 2. Disconnect the electrical connectors. 3. Release tabs on bracket to remove module. 4. For programming and set up, refer to Control Module References . 5. Fully charge the Hybrid Battery following all programming.

SERIAL DATA GATEWAY MODULE REPLACEMENT

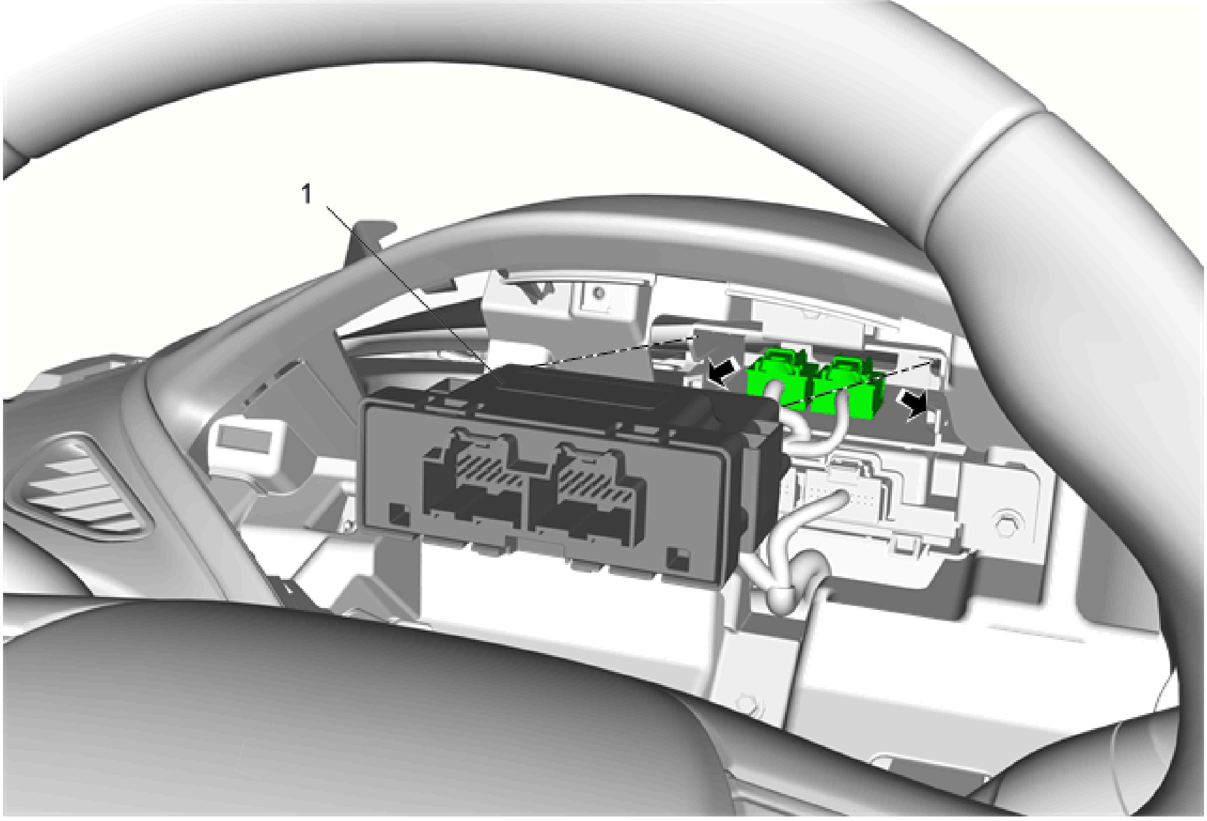

Fig. 4: Serial Data Gateway Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Cluster Replacement	
1	Serial Data Gateway Module **Procedure** 1. Disconnect the electrical connectors. 2. Release the retaining tab. 3. Perform the necessary programming and setup procedure:Control Module References

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SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

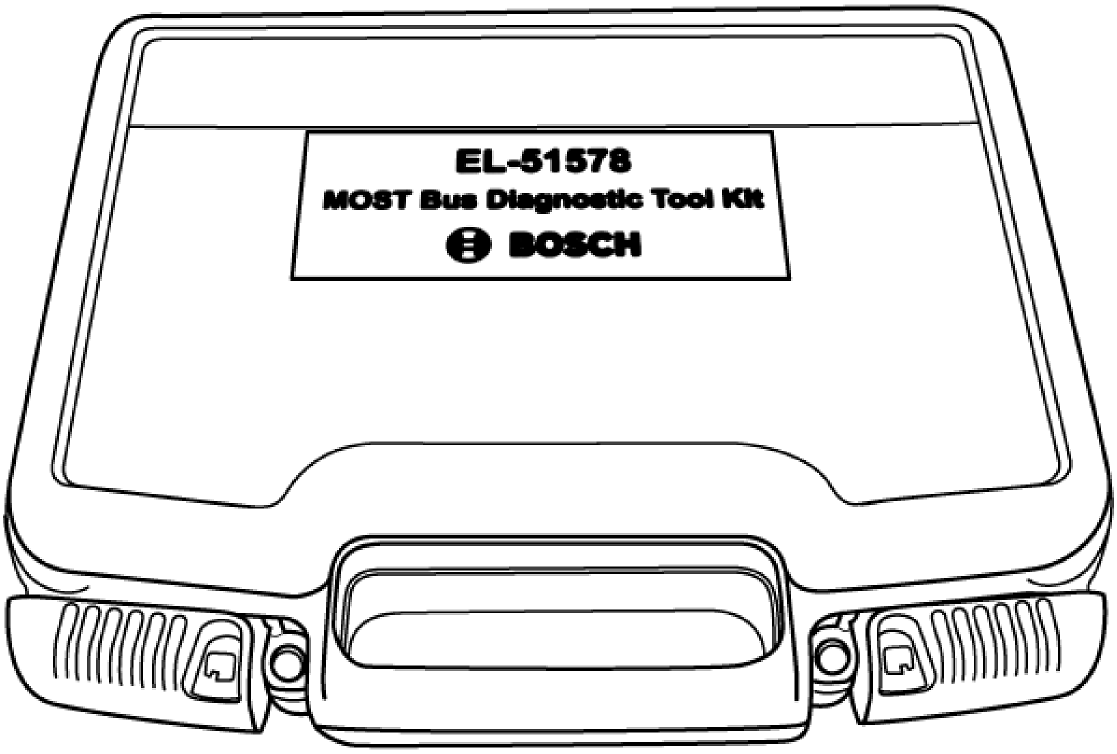
Illustration	Tool Number/Description
 EL-51578 MOST Bus Diagnostic Tool Kit BOSCH	EL - 51578 MOST Bus Diagnostic Tool Kit

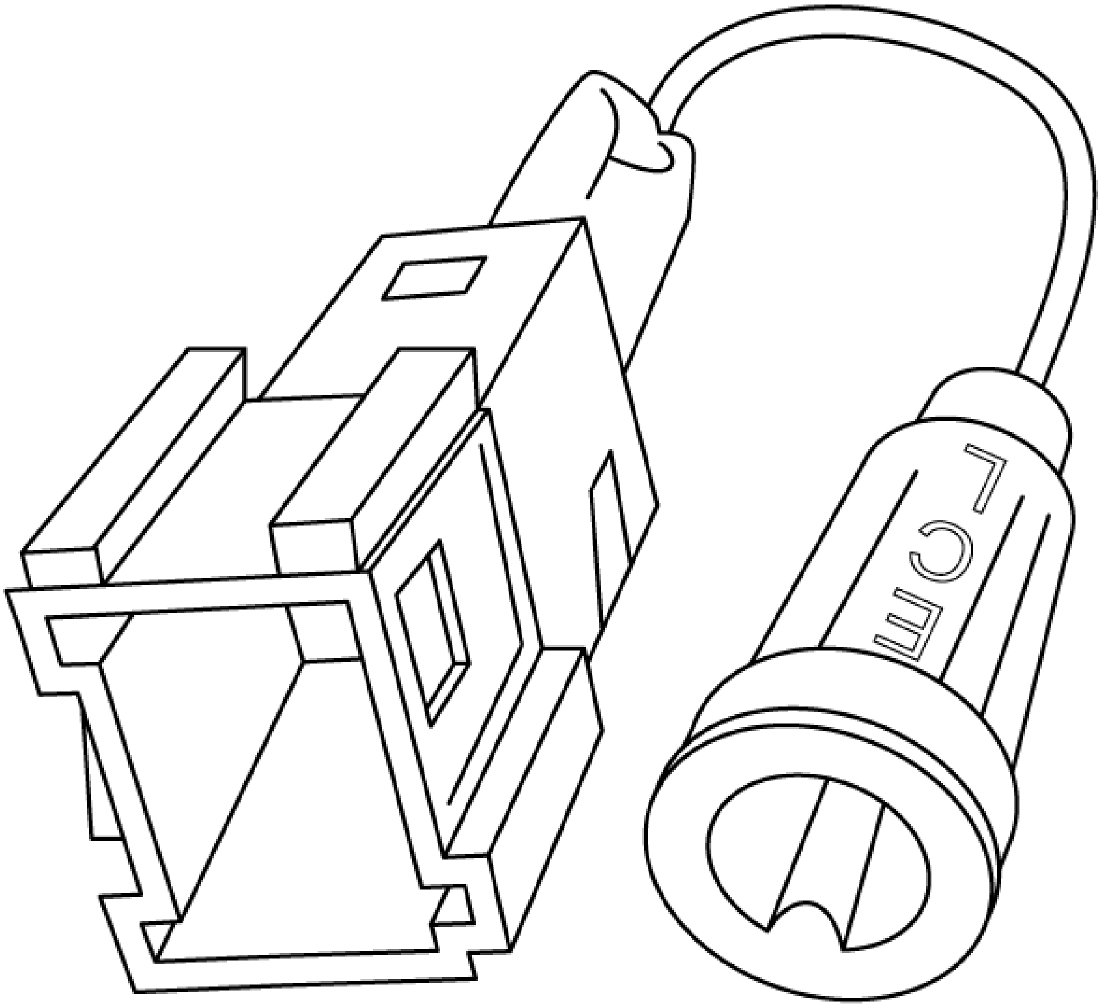
Illustration	Tool Number/Description
	EL - 51578 - 1 8 - Pin Black Connector Touch Pad

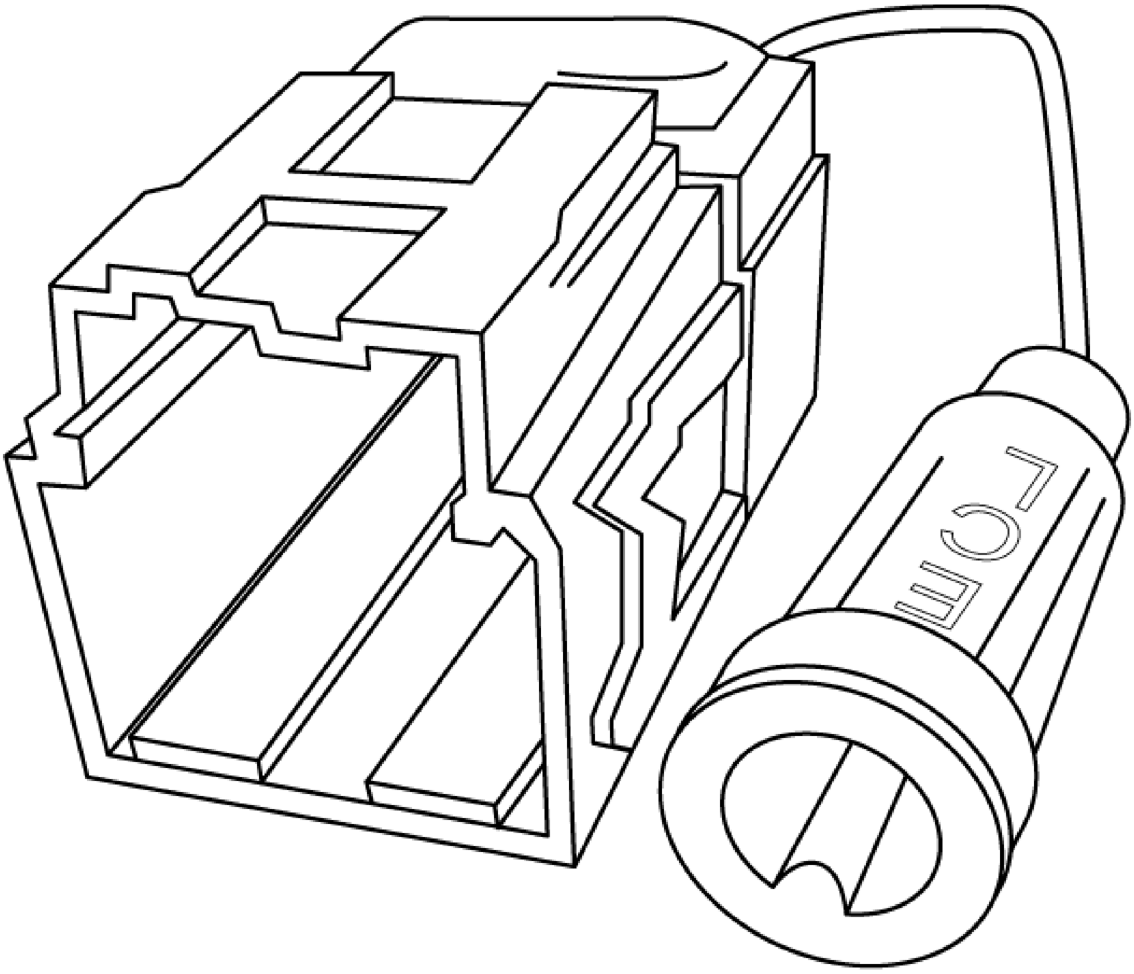
Illustration	Tool Number/Description
	EL - 51578 - 2 12 - Pin Gray Header HMI Control

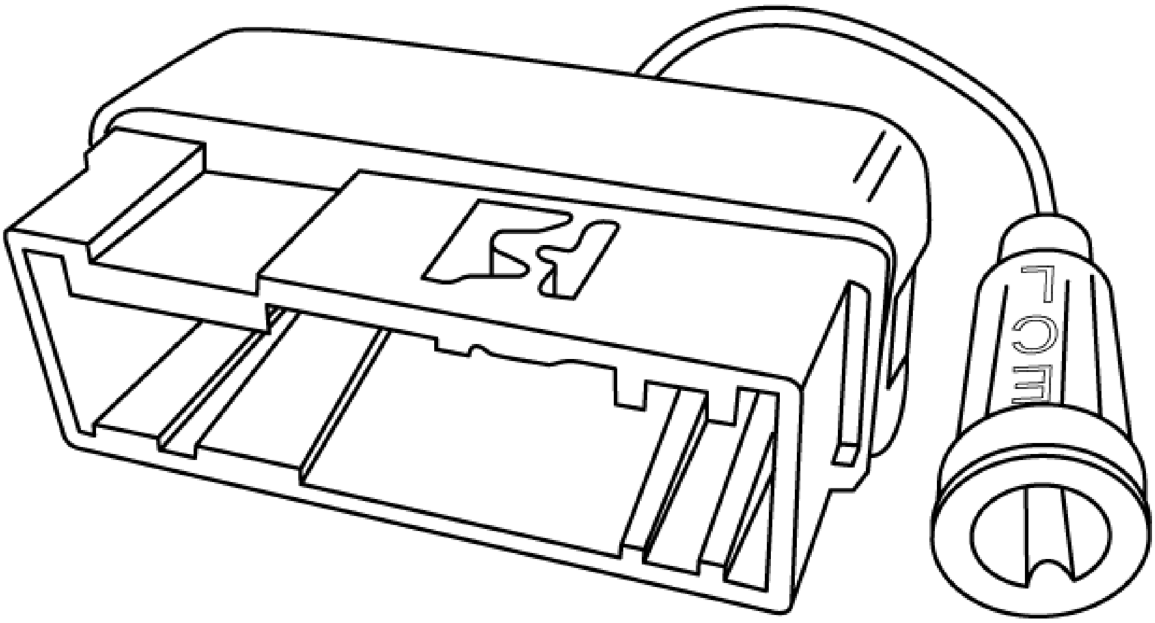
Illustration	Tool Number/Description
	EL - 51578 - 3 32 - Pin Gray Header IPC

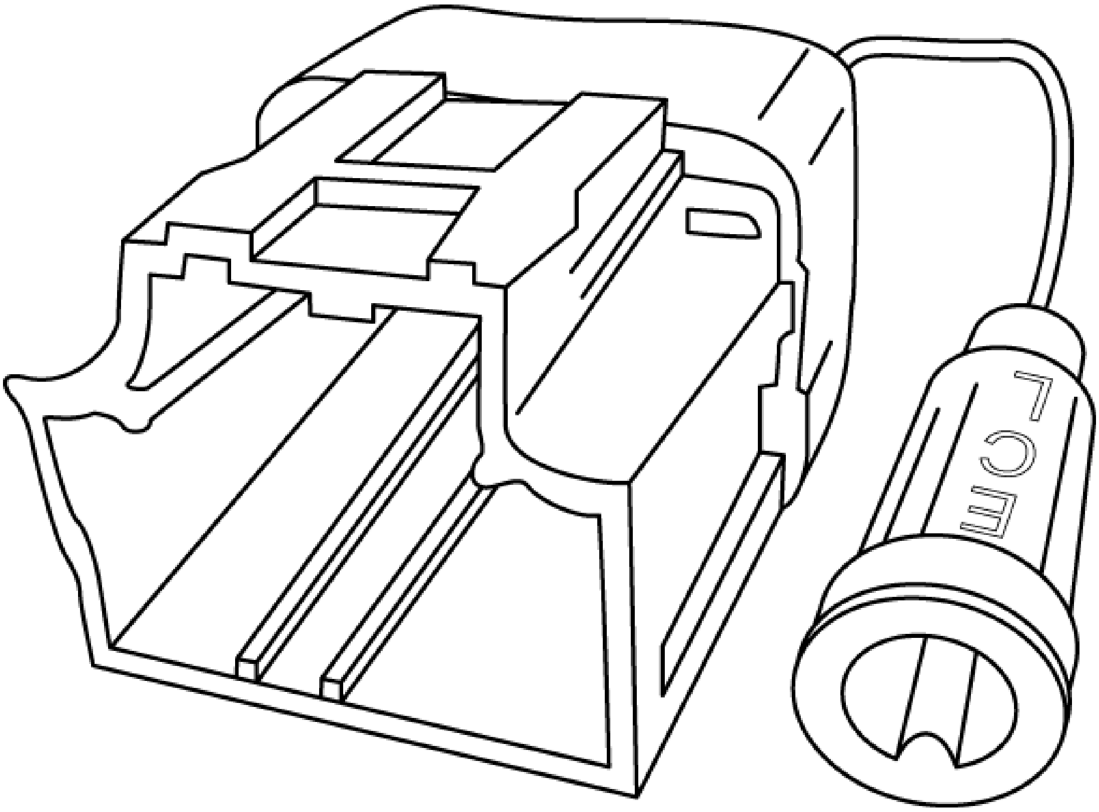
Illustration	Tool Number/Description
	EL - 51578 - 4 16 - Pin Brown Header AMP

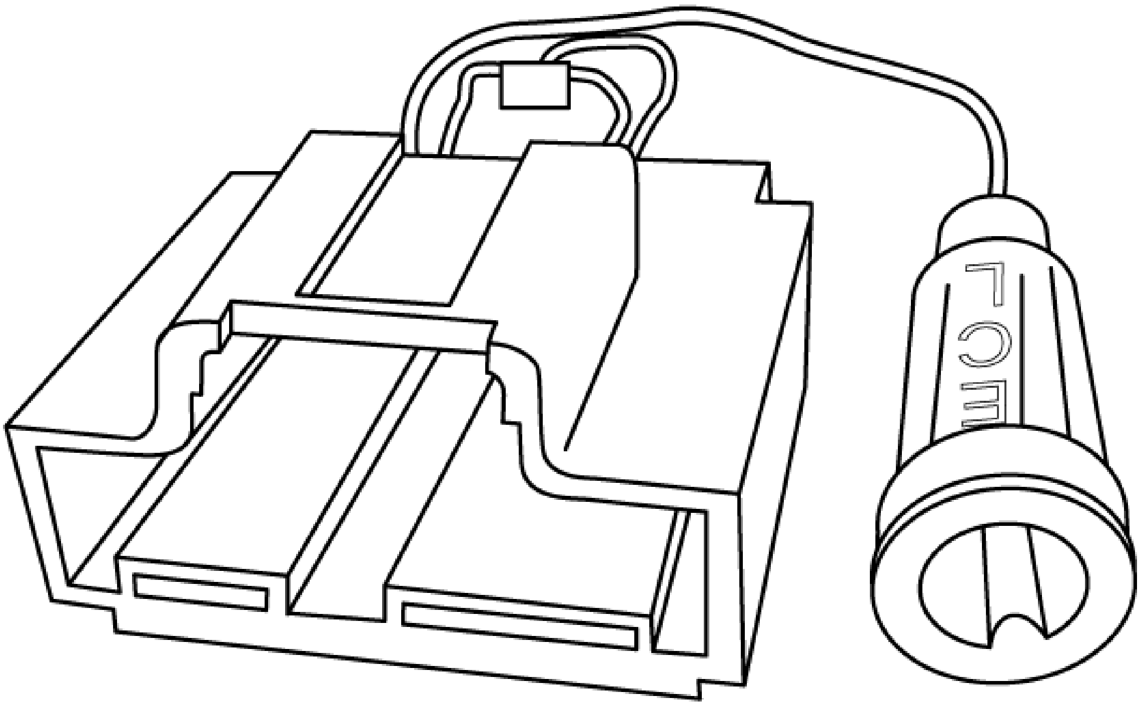
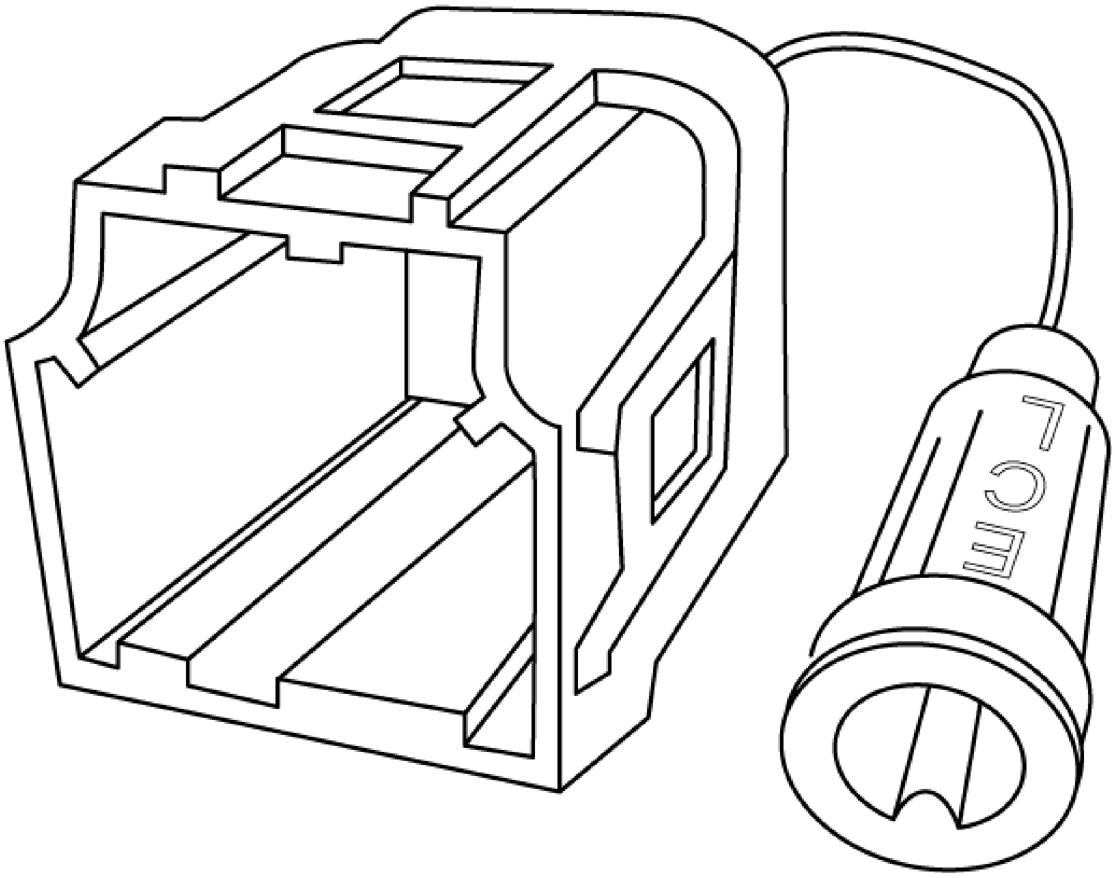
Illustration	Tool Number/Description
	EL - 51578 - 5 10 - Pin Black Connector CD

Illustration	Tool Number/Description
	EL - 51578 - 6 12 - Pin Black Header DVD

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2017 ACCESSORIES AND EQUIPMENT

Data Communications - Specifications - Fastener Specifications - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Body Control Module Bracket Nut	9 N.m (80 lb in)

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Instrument Cluster Bolt	2.5 N.m (22 lb in)

AMBIENT AIR TEMPERATURE SENSOR RESISTANCE

Temperature		Ambient Air Temp Sensor	Ambient Air Temp Sensor (Min)	Ambient Air Temp Sensor (Max)
Â°C	**Â°F**	**(kΩ)**	**(kΩ)**	**(kΩ)**
-40	-40	169.4	158.46	181.19
-30	-22	88.74	83.39	94.47
-20	-4	48.58	47.19	50.02
-10	14	27.67	26.93	28.44
0	32	16.33	15.92	16.75
10	50	9.95	9.71	10.19
20	68	6.24	6.1	6.38
30	86	4.02	3.94	4.11
40	104	2.66	2.61	2.71
50	122	1.8	1.73	1.87
60	140	1.24	1.2	1.29

SCHEMATIC WIRING DIAGRAMS

INSTRUMENT CLUSTER WIRING SCHEMATICS

Power, Ground, Serial Data, and Subsystem References

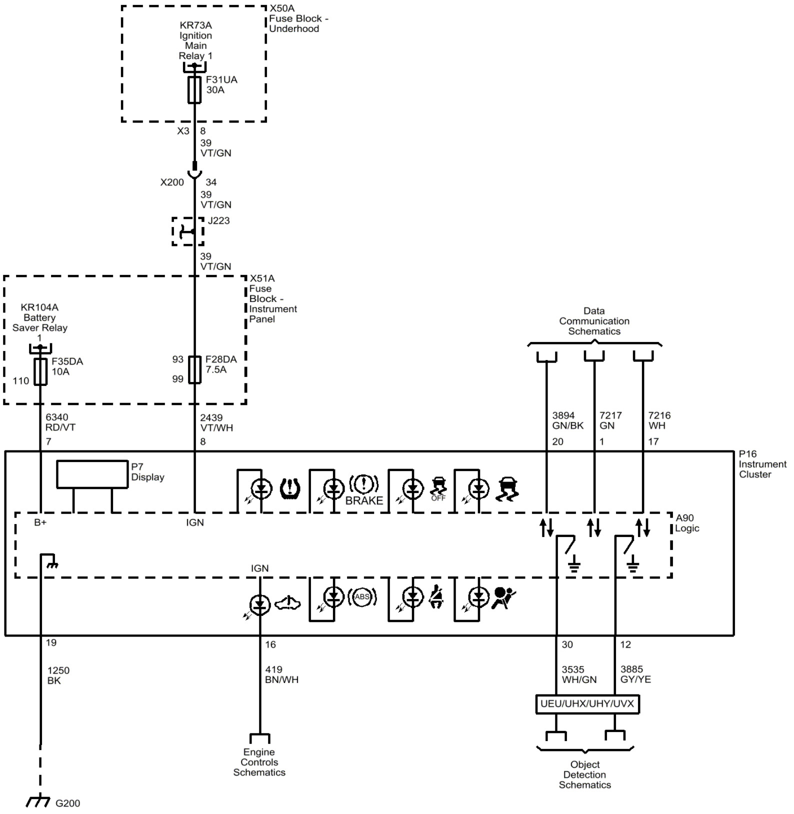

X50A
Fuse Block - Underhood
KR73A
Ignition
Main
Relay 1
F31UA
30A
X3
8
39
VT/GN
X200
34
39
VT/GN
J223
39
VT/GN
X51A
Fuse
Block -
Instrument
Panel
KR104A
Battery
Saver Relay
1
F35DA
10A
110
93
F28DA
7.5A
99
Data
Communication
Schematics
6340
RD/VT
7
2439
VT/WH
8
3894
GN/BK
20
7217
GN
1
7216
WH
17
P16
Instrument
Cluster
P7
Display
BRAKE
OFF
B+
IGN
A90
Logic
IGN
ABS
19
16
30
12
1250
BK
419
BN/WH
3535
WH/GN
3885
GY/YE
UEU/UHX/UHY/UVX
Engine
Controls
Schematics
Object
Detection
Schematics
G200

Fig. 1: Power, Ground, Serial Data, and Subsystem References

Courtesy of GENERAL MOTORS COMPANY

Driver Information Center

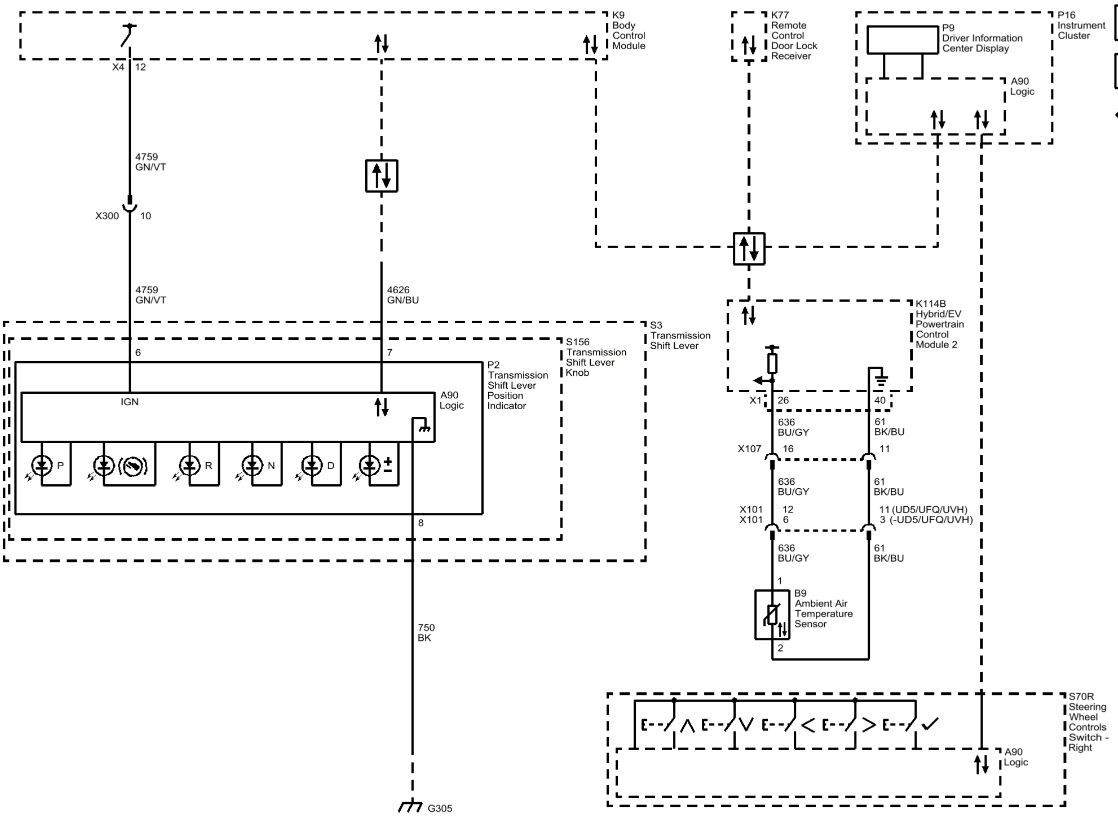
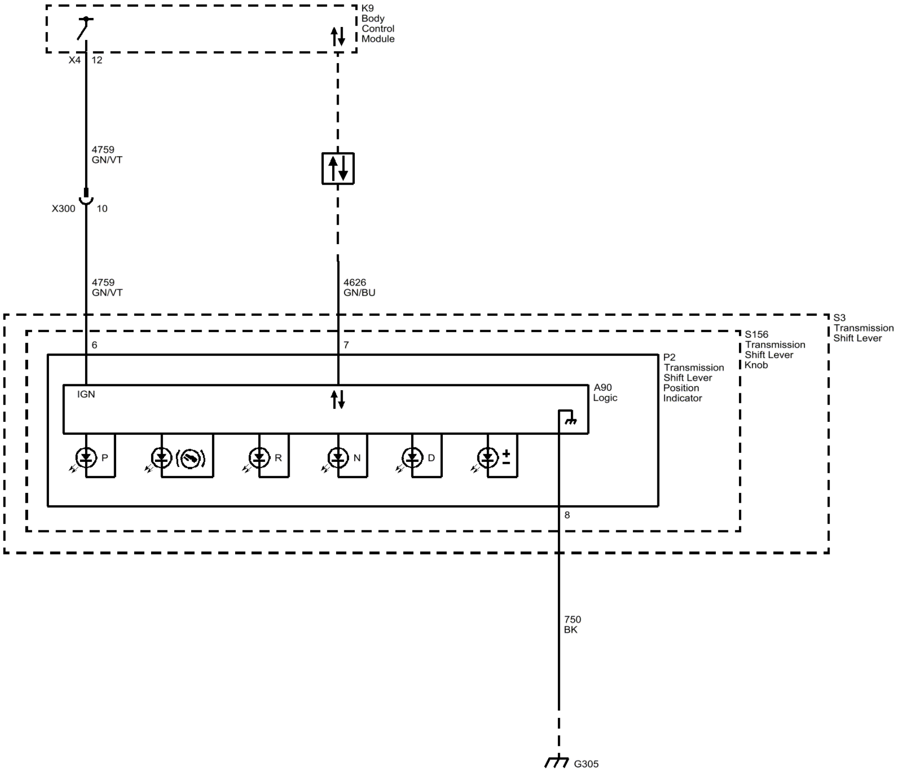

K9
Body
Control
Module
X4
12
4759
GN/VT
X300
10
4759
GN/VT
4626
GN/BU
K77
Remote
Control
Door Lock
Receiver
P9
Driver Information
Center Display
P16
Instrument
Cluster
A90
Logic
K114B
Hybrid/EV
Powertrain
Control
Module 2
S3
Transmission
Shift Lever
S156
Transmission
Shift Lever
Knob
P2
Transmission
Shift Lever
Position
Indicator
6
7
IGN
A90
Logic
P
R
N
D
±
8
750
BK
G305
X1
26
40
636
BU/GY
61
BK/BU
X107
16
11
636
BU/GY
61
BK/BU
X101
X101
12
6
11 (UD5/UFQ/UVH)
3 (-UD5/UFQ/UVH)
636
BU/GY
61
BK/BU
1
B9
Ambient Air
Temperature
Sensor
2
S70R
Steering
Wheel
Controls
Switch -
Right
A90
Logic

Fig. 2: Driver Information Center

Courtesy of GENERAL MOTORS COMPANY

DRIVER INFORMATION SYSTEM WIRING SCHEMATICS

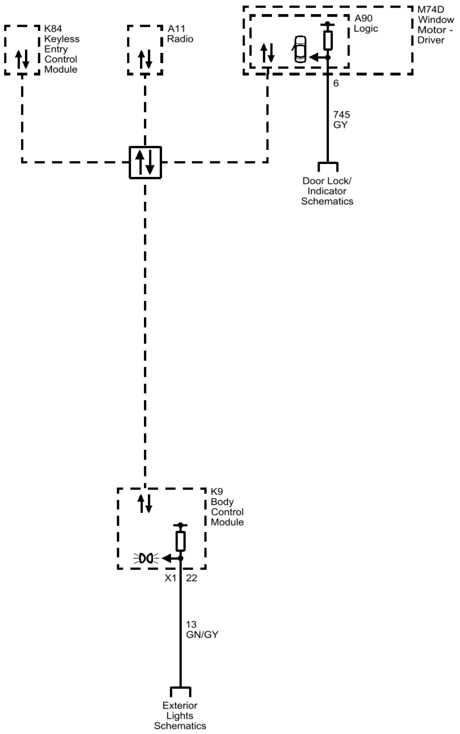
Shift Lever Position Indicator


K9
Body
Control
Module
X4
12
4759
GN/VT
X300
10
4759
GN/VT
4626
GN/BU
S3
Transmission
Shift Lever
S156
Transmission
Shift Lever
Knob
P2
Transmission
Shift Lever
Position
Indicator
6
7
IGN
A90
Logic
P
R
N
D
8
750
BK
G305

[Fig. 3: Shift Lever Position Indicator]
Courtesy of GENERAL MOTORS COMPANY

AUDIBLE WARNINGS WIRING SCHEMATICS

Audible Warnings


K84
Keyless
Entry
Control
Module
A11
Radio
A90
Logic
M74D
Window
Motor -
Driver
6
745
GY
Door Lock/
Indicator
Schematics
K9
Body
Control
Module
X1
22
13
GN/GY
Exterior
Lights
Schematics

[Fig. 4: Audible Warnings]
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0550: ODOMETER CIRCUIT GENERAL MEMORY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B0550 32

Odometer Circuit General Memory Malfunction

Circuit/System Description

The instrument cluster is equipped with odometers that indicate the distance traveled by the vehicle. One type of odometer is the season odometer where the traveled distance can not be reset by the driver. This information is also stored in the body control module (BCM). In addition to storing the season odometer value for the vehicle, the instrument cluster and the BCM store the VIN. Software checks are performed to ensure these modules, and their stored season odometer information, can not be moved or transferred between different vehicles.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The BCM has detected an internal memory malfunction.

Action Taken When the DTC Sets

DTC B0550 32 is stored in the BCM memory.

Conditions for Clearing the DTC

The BCM no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Driver Information Center (DIC) Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B0550 32 is not set.
    - **If DTC B0550 32 is set**
    1. Program the K9 Body Control Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K9 Body Control Module
        - If the DTC does not set
    3. All OK.
    - **If DTC B0550 32 is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM replacement, programming and setup

DTC B071F: TRANSMISSION RANGE INDICATOR INTERNAL MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B071F 39

Transmission Range Indicator Internal Malfunction

Circuit/System Description

The transmission shift lever position indicator is located on the center console and indicates the current transmission shift lever position. The transmission shift lever position indicator receives power and ground and is controlled by the body control module (BCM) via serial data.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The BCM has detected an internal malfunction in the transmission shift lever position indicator.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

The DTC will become history if the BCM no longer detects a malfunction.

Reference Information

Schematic Reference

Driver Information System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Indicator/Warning Message Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC B071F 39 is not set.
    - **If the DTC is set**

      Replace the P2 Transmission Shift Lever Position Indicator.

    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Displays and Gauges Component Replacement Reference

DTC P0071-P0074: AMBIENT AIR TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0072	P0073	P0073	P0071, P0074

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	P0073	-	P0071, P0074

Circuit/System Description

The ambient air temperature sensor is located behind the grille. The Hybrid/EV Powertrain Control Module 2 monitors the ambient air temperature sensor utilizing a low reference circuit and signal circuit. The Hybrid/EV Powertrain Control Module 2 monitors the voltage drop across the sensor, which is inversely proportional to temperature. When the ambient air temperature is cold, the resistance of the sensor is high. When the ambient air temperature is warm, the resistance of the sensor is low. The Hybrid/EV Powertrain Control Module 2 converts the voltage value to a temperature value. The Hybrid/EV Powertrain Control Module 2 also sends the temperature value to other control modules via serial data.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

During the first 20 s of run time after the 1 hour soaking period, the difference between the outside air temperature and the A/C High Pressure Switch Signal is greater than 30Â°C (86Â°F).

P0072

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is more than 60Â°C (140Â°F).

P0073

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is less than -40Â°C (-40Â°F).

P0074

The Hybrid/EV Powertrain Control Module 2 detects an unrealistic signal variance.

Action Taken When the DTC Sets

- DTC P0071 - P0074 are type B DTCs.

Conditions for Clearing the DTC

The DTC will become history if the ECM no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Powertrain Control Module 2 Ambient Air Temperature parameter is between -40Â°C (-40Â°F) and + 60Â°C (+140Â°F) and changes with air temperature changes.
   - **If not between -40Â°C (-40Â°F) and +60Â°C (+140Â°F) or changes with air temperature changes**

     Refer to Circuit/System Testing.

   - **If between -40Â°C (-40Â°F) and +60Â°C (+140Â°F) and changes with air temperature changes**
3. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is less than -39Â°C (-38Â°F).
   - **If -39Â°C (-38Â°F) or greater**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the signal circuit terminal A (or 1) and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than -39Â°C (-38Â°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal A (or 1) and the low reference circuit terminal B (or 2).
6. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is 57Â°C (+135Â°F) or greater.
   - **If less than 57Â°C (+135Â°F)**

    1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If 57Â°C (135Â°F) or greater**

7. Test or replace the B9 Ambient Air Temperature Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ambient Air Temperature Sensor Replacement**
- **Control Module References** for control module replacement, programming and setup

DISPLAYS AND GAUGES COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
B9 Ambient Air Temperature Sensor	**Ambient Air Temperature Sensor Replacement**
P2 Transmission Shift Lever Position Indicator	**Transmission Electronic Control Replacement**
S16 Driver Information Center Switch	**Turn Signal Switch Replacement**

SYMPTOMS - DISPLAYS AND GAUGES

NOTE: **The following steps must be completed before using the symptom diagnostic tables.**

1. Before using the symptom diagnostic tables, perform the **Diagnostic System Check - Vehicle** .
2. Review the system operation in order to understand the system functions. Refer to the following description and operations:
    - **Instrument Cluster Description and Operation**
    - **Indicator/Warning Message Description and Operation**
    - **Driver Information Center (DIC) Description and Operation**
    - **Audible Warnings Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the instrument panel cluster or the audible warning systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.
- Inspect for the proper fluid levels.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Gauges and Odometer

- **Instrument Cluster Display Malfunction**
- **Speedometer and/or Odometer Malfunction**

Audible Warnings

Chime Malfunction

CHIME MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The radio generates the audible warnings. The instrument cluster, the body control module (BCM), the inflatable restraint sensing and diagnostic module (SDM) or the object alarm module request audible warnings via Low Speed CAN-Bus signals.

Reference Information

Schematic Reference

Audible Warnings Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Audible Warnings Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Before performing this diagnostics, make sure no indicators are illuminated after the instrument cluster performs a lamp test. If any indicators are illuminated after the bulb test, perform the indicator diagnostics before this diagnostics.**

1. Vehicle in Service Mode.
2. Verify all the radio speakers operate by adjust the radio balance and fade to each speaker.
    - **If any speaker does not operate properly**

      Refer to **Speaker Malfunction (UQA)** **Speaker Malfunction (without UQA)** .

    - **If the speakers operate properly**
3. Verify the scan tool Driver Seat Belt Status and Passenger Seat Belt Status parameters are Buckled when both front seat belts are buckled.

- **If not Buckled**

  Refer to **Seat Belt Indicator Malfunction - Driver** .

- **If buckled**

4. Verify the scan tool Headlamp On Switch parameter is Inactive when the headlamps are OFF.
   - **If not Inactive**

     Refer to **Headlamps Malfunction** .

   - **If Inactive**
5. Verify the scan tool Park Lamps Switch parameter is Inactive when the park lamp switch is OFF.
   - **If not Inactive**

     Refer to **Park, License, and/or Tail Lamps Malfunction (MBM)** **Park, License, and/or Tail Lamps Malfunction (MAH/MBC/MAW/MCX)** .

   - **If Inactive**
6. Verify the scan tool Left Turn Signal Switch and Right Turn Signal Switch parameters are Inactive while the turn signal switch is OFF.
   - **If not Inactive**

     Refer to **Turn Signal Lamps and/or Indicators Malfunction** .

   - **If Inactive**
7. Verify the scan tool Park Brake Switch parameter is Inactive when the park brake is OFF.
   - **If not Inactive**

     Refer to **Park Brake System Diagnosis** .

   - **If Inactive**
8. Verify that all scan tool parameters listed below are Inactive when all the doors are closed.
   - Driver Door Ajar Switch
   - Passenger Door Ajar Switch
   - Left Rear Door Ajar Switch
   - Right Rear Door Ajar Switch
   - **If not Inactive**

     Refer to **Door Ajar Indicator Malfunction** .

   - **If Inactive**
9. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for BCM or Radio replacement, programming and setup

INSTRUMENT CLUSTER DISPLAY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster is a multifunction module that provides the vehicle operator with information using an interactive LCD display. Because the instrument cluster is an LCD display, driver information center elements are located in various zones of the display, depending on how the display l is configured. The instrument cluster displays vehicle information based on the information received via seral data from other modules.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify all indicators illuminate when performing the Instrument Cluster All Indicators test with the scan tool.
    - **If all indicators do no illuminate**

      Replace the P16 Instrument Cluster.

    - **If all indicators illuminate**
3. Verify Instrument Cluster dimming changes from 0 - 100% when performing the Instrument Cluster Dimming test with the scan tool.
    - **If Instrument Cluster dimming does not change properly**

      Replace the P16 Instrument Cluster.

    - **If Instrument Cluster dimming changes properly**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup

OUTSIDE AIR TEMPERATURE DISPLAY MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0071

Ambient Air Temperature Sensor Performance

DTC P0072

Ambient Air Temperature Sensor Circuit Low Voltage

DTC P0073

Ambient Air Temperature Sensor Circuit High Voltage

DTC P0074

Ambient Air Temperature Sensor Circuit Intermittent

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0072	P0073	P0073	P0071, P0074
Low Reference	-	P0073	-	P0071, P0074

Circuit/System Description

The ambient air temperature sensor is located behind the grille. The Hybrid/EV Powertrain Control Module 2 monitors the ambient air temperature sensor utilizing a low reference circuit and signal circuit. The Hybrid/EV Powertrain Control Module 2 monitors the voltage drop across the sensor, which is inversely proportional to temperature. When the ambient air temperature is cold, the resistance of the sensor is high. When the ambient air temperature is warm, the resistance of the sensor is low. The Hybrid/EV Powertrain Control Module 2 converts the voltage value to a temperature value. The Hybrid/EV Powertrain Control Module 2 also sends the temperature value to other control modules via serial data.

Conditions for Running the DTC

- Ignition ON/Vehicle in Service Mode
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0071

During the first 20 s of run time after the 1 hour soaking period, the difference between the outside air temperature and the A/C High Pressure Switch Signal is greater than 30Â°C (86Â°F).

P0072

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is more than 60Â°C (140Â°F).

P0073

The Hybrid/EV Powertrain Control Module 2 detects the sensor signal is less than -40Â°C (-40Â°F).

P0074

The Hybrid/EV Powertrain Control Module 2 detects an unrealistic signal variance.

Action Taken When the DTC Sets

- DTC P0071 - P0074 are type B DTCs.

Conditions for Clearing the DTC

The DTC will become history if the ECM no longer detects a malfunction.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Powertrain Control Module 2 Ambient Air Temperature parameter is between -40Â°C (-40Â°F) and + 60Â°C (+140Â°F) and changes with air temperature changes.
    - **If not between -40Â°C (-40Â°F) and +60Â°C (+140Â°F) or changes with air temperature changes**

      Refer to Circuit/System Testing.

    - **If between -40Â°C (-40Â°F) and +60Â°C (+140Â°F) and changes with air temperature changes**
3. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B9 Ambient Air Temperature Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal B (or 2) and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2 Ω in the low reference circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is less than -39Â°C (-38Â°F).
    - **If -39Â°C (-38Â°F) or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the signal circuit terminal A (or 1) and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than -39Â°C (-38Â°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal A (or 1) and the low reference circuit terminal B (or 2).
6. Verify the Hybrid/EV Powertrain Control Module 2 scan tool Ambient Air Temperature parameter is 57Â°C (+135Â°F) or greater.
    - **If less than 57Â°C (+135Â°F)**
    1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 57Â°C (135Â°F) or greater**
7. Test or replace the B9 Ambient Air Temperature Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ambient Air Temperature Sensor Replacement**
- **Control Module References** for control module replacement, programming and setup

SPEEDOMETER AND/OR ODOMETER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster displays the engine coolant temperature, fuel level, vehicle speed and the engine speed based on the information from the engine control module (ECM). The ECM sends information via serial data to the body control module (BCM). The BCM then sends the information via serial data to the instrument cluster to display the engine coolant temperature, fuel level, the engine speed, the vehicle speed and the distance travelled, either in kilometers or miles, based on the vehicle requirements. The instrument cluster will display dashes when its VIN does not match the VIN received from the BCM.

Diagnostic Aids

If the VIN mismatch is corrected the odometer will once again be displayed in the instrument cluster. If the vehicle is driven for a calibrated distance with a VIN mismatch, it will cause the instrument cluster odometer to enter into an error mode and lock itself. When this occurs the dashes will remain on the display even after correcting the VIN mismatch. The vehicle odometer status data display on the scan tool can be used to identify a locked odometer. The only way to unlock the instrument cluster (clear the dashes from the display) is to perform an SPS programming event. Failure to follow the diagnostic and programming procedures may result in either an improper odometer value or a module replacement.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Instrument Cluster Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify all gauge segments illuminate when performing the Driver Information Center Segments test with the scan tool.
    - **If any gauge segments do not illuminate**

      Replace the P16 instrument cluster

    - **If all gauge segments illuminate**
3. Drive the vehicle.
4. Verify the displayed Instrument Cluster speedometer value matches the vehicle speed parameter on the scan tool.
    - **If the values do not match**

      Replace the P16 Instrument Cluster.

    - **If the values match**
5. Verify the odometer display and the displayed distance counts up while driving the vehicle.
    - **If the odometer displays only "----" (dashes)**

      Refer to Circuit/System Testing.

    - **If the odometer display does not count up**

      Replace the P16 Instrument Cluster.

    - **If speedometer sweeps and displays the correct value, and the odometer display counts up**

6. All OK.

Circuit/System Testing

NOTE:

- **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**
- **If there are multiple modules not original to the vehicle and are not new correctly configured service parts, SPS may not be able to proper read or recover the vehicle odometer value. Follow government rules and documentation (including vehicle identification) regarding inaccurate/unknown odometer values.**

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes) odometer is still unlocked

1. Verify the scan tool Odometer Status parameter is Unlocked.
   - **If the reading is Locked**

     Refer to correcting VIN mismatch - odometer locked.

   - **If the reading is Unlocked**
2. Verify the scan tool BCM VIN parameter matches the vehicle's VIN placard.
   - **If the VIN does not match**

     Reprogram the BCM, then proceed to Step 3.

   - **If the VIN matches**
3. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.
   - **If the VIN does not match**

     Reprogram the instrument cluster. Then proceed with step 4.

   - **If the VIN matches**
4. Vehicle in Service Mode.
5. Verify the instrument cluster is displaying the correct value.
   - **If the instrument cluster is still displaying "----" (dashes)**

     Replace the P16 Instrument Cluster.

   - **If the instrument cluster displays the correct value**
6. All OK.

Correcting VIN mismatch: Instrument Cluster is Showing "----" (Dashes) odometer is locked

1. Verify the scan tool Odometer Status parameter is Locked.
   - **If the reading is Unlocked**

     Refer to Correcting VIN mismatch - odometer unlocked.

   - **If the reading is Locked**
2. Verify the scan tool Instrument Cluster VIN parameter matches the vehicle's VIN placard.
   - **If the VIN does not match**

     Reprogram the Instrument Cluster. Then proceed with step 3.

   - **If the VIN matches**
3. Perform the BCM setup procedure in SPS.
4. Vehicle in Service Mode.

5. Verify the instrument cluster is displaying the correct value.
    - **If the instrument cluster is still displaying "----" (dashes)**

      Replace the P16 Instrument Cluster.

    - **If instrument cluster is displaying the correct value**
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for control module replacement, programming and setup

REPAIR INSTRUCTIONS

AMBIENT AIR TEMPERATURE SENSOR REPLACEMENT

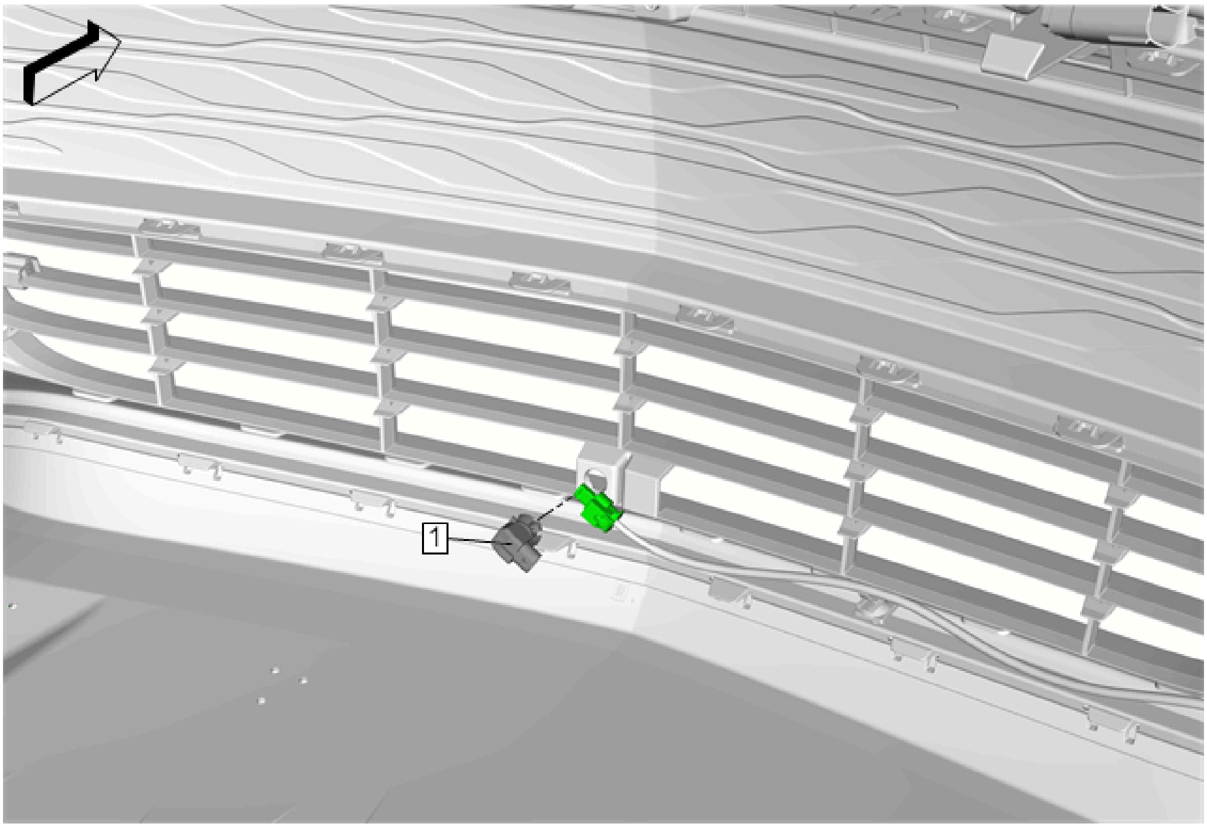


Fig. 5: Ambient Air Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)	
1	Ambient Air Temperature Gauge Sensor **Procedure** 1. Disconnect the electrical connectors. 2. Unlock the retaining tabs.

INSTRUMENT CLUSTER REPLACEMENT

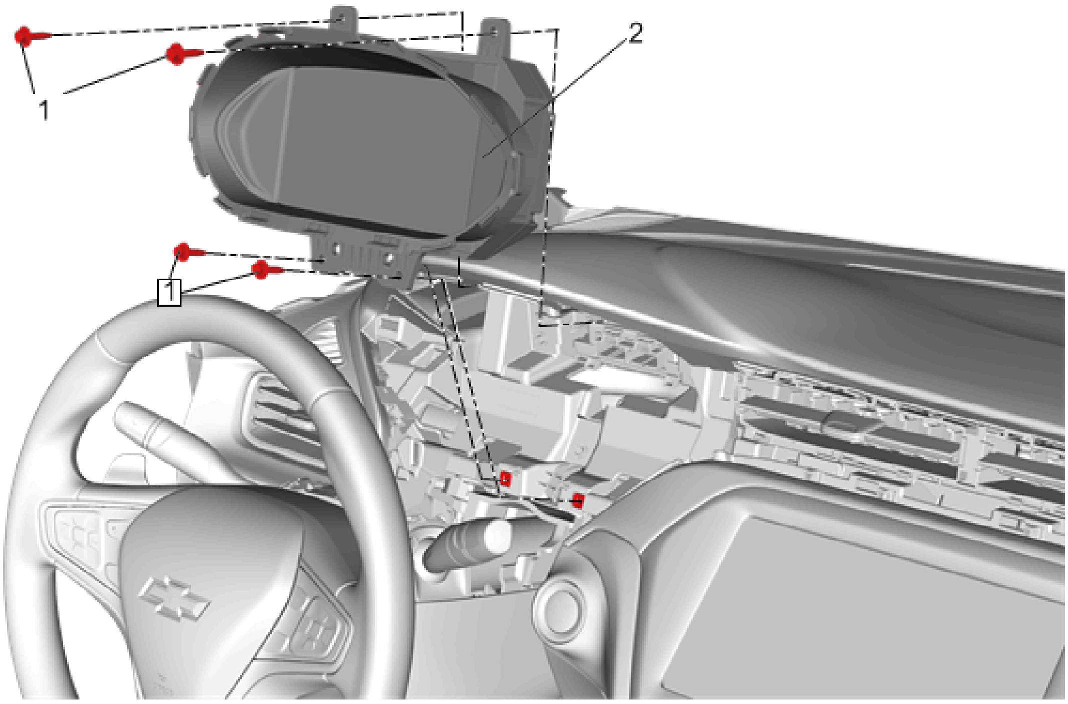


Fig. 6: Instrument Cluster
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Column Upper Trim Cover Replacement	
1	Instrument Cluster Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Instrument Cluster **Procedure** 1. Disconnect the electrical connector. 2. Refer to Control Module References for programming and set up information, if required.

DESCRIPTION AND OPERATION

AUDIBLE WARNINGS DESCRIPTION AND OPERATION

The audible warnings alert the driver of a system concern or a critical vehicle condition. The radio generates the audible warnings through the speakers. The radio receives audible warning requests via the serial data circuit. If the radio receives multiple audible warning requests, the warning with the highest priority sounds first. On vehicles without a radio, a chime module generates the audible warnings and receives audible warning requests via the serial data circuit. Either the radio or the chime module is the chime producer. The following lists the audible warning sounds:

1. Single pulse gong
2. Multiple pulse gong
3. Single pulse beep

4. Multiple pulse beep
5. Click
6. Clack

Auto Stop Mode

The chime producer activates when the vehicle comes to a stop and the driver or passenger door is opened as requested by the body control module.

Fasten Safety Belt Warning

The chime producer activates the fasten safety belt audible warning as requested by the body control module (BCM). The BCM sends a serial data message to the chime producer indicating the chime as a multiple gong. The fasten safety belt warning sounds and the fasten safety belt indicator illuminates when the following occurs:

- The ignition switch transitions to ON.
- The inflatable restraint sensing and diagnostic module (SDM) detects that the drivers seat belt is not buckled and the signal is low. The SDM sends a serial data message to the BCM indicating the seat belt status. The instrument cluster receives a serial data message from the BCM indicating the driver seat belt status.

If the seat belt is buckled when the ignition is turned ON, the chime does not sound. If the seat belt is buckled while the chime is sounding, the chime stops. If the seat belt is unbuckled after the initial transition to ON, the chime does not sound.

Lights On Warning

The chime producer activates the lights on warning as requested by the BCM. The BCM sends a serial data message to the chime producer indicating the chime as a multiple gong. The lights on warning sounds when the following occurs:

- The ignition is OFF.
- The BCM determines that the driver door is open and the signal circuit is low.
- The BCM determines that the headlamp switch is in the park or head position.

Brake Warning

The chime producer activates the brake audible warning as requested by multiple control modules. The BCM, electronic brake control module or the parking brake control module sends a serial data message to the chime producer indicating the chime as a multiple gong. The brake warning sounds and the BRAKE indicator illuminates when the following occurs:

- The ignition is ON.
- The vehicle speed is greater than 8 km/h (4.9 mph). The instrument cluster receives a serial data message from the engine control module (ECM) indicating the vehicle speed.
- The BCM determines that the parking brake is engaged and the signal circuit is low.
- The brake fluid is low.

Door Ajar Warning

The chime producer activates the door ajar audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer indicating the chime frequency of a medium rate and continuous duration. The door ajar warning sounds and the appropriate door ajar indicator illuminates in the driver information center when the following occurs:

- The BCM determines that a door (driver door, passenger door, left rear door, right rear door) is open and the signal circuit is low. The instrument cluster also receives a serial data message from the BCM indicating the door ajar status.
- The vehicle is not in PARK. The BCM receives a serial data message from the ECM/BCM indicating the gear position.

Object Detection

The chime producer activates the object detection audible warning as requested by the object alarm module. When an object is within the measuring range of the sensor, the ultrasonic pulse is reflected and is received by the sending or a neighboring sensor. The sensor converts this signal into a voltage signal and sends this signal to the object alarm module. The object alarm module evaluates the received sensor signals. As soon as an object is within the measuring range, the object alarm module sends a message via CAN-Bus to the chime producer in order to give out the acoustic distance signal. The measuring range is between 30 - 120 cm (11.81 - 47.24 in). From a distance of 120 cm (47.24 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 30 cm (11.81 in), the sound becomes continuous.

Additional Warnings

The following warnings have an associated instrument cluster indicator or driver information center message:

- Turn Signal Indicators - The chime producer activates the audible warning as requested by the BCM. The chime produces two different chimes, one when the turn signal turns off and another when the turn signal turns on.
- Vehicle Overspeed Message - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Fuel Level Low Message - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Oil Pressure Indicator - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Park Assist Fault Clean Rear Bumper Message - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.
- Tire Pressure Low Indicator - The chime producer activates the audible warning as requested by the BCM. The BCM sends a serial data message to the chime producer.

Refer to **Indicator/Warning Message Description and Operation**.

DRIVER INFORMATION CENTER (DIC) DESCRIPTION AND OPERATION

The Driver Information Center display is in the instrument cluster. The Driver Information Center displays information about the vehicle. It also displays warning messages if a system problem is detected. For more information on Indicators and Warning messages, refer to **Indicator/Warning Message Description and Operation**.

There are 3 switch functions for the driver information center:

- CONFIG: Press to select either the Simple or Enhanced instrument cluster configuration display.
- BACK: Press to return to the previous screen, exit a screen, or return to the main menu. Press BACK to minimize the DIC menu display.
- SELECT: Press the center of the knob to select the highlighted item. Turn the knob to scroll through the menu items.

Menu

Turn the SELECT knob to scroll through the possible menus. Press the center of the SELECT knob when a menu is highlighted to enter that menu. The possible Driver Information Center menu's are:

- Trip A
- Trip B
- Tire Pressure
- Vehicle Messages
- Units
- Tutorial Mode

Trip A and Trip B

The trip displays show fuel used and distance traveled since the last trip reset.

Reset the trip data by pressing and holding the SELECT button when either Trip A or Trip B is displayed.

Outside Air Temperature

The outside air temperature can be accessed through the driver information center Trip/Fuel switch function. The driver information center shows the outside air temperature as a damped value. The time and rate of the temperature update is based on an algorithm in the instrument cluster. Factors such as last temperature reading, current temperature reading, length of time the vehicle was off, current vehicle speed, and the distance driven effect when the displayed temperature is updated. To get the vehicle to display the most accurate temperature faster, drive the vehicle. Constant moving traffic will update the display to the correct temperature more quickly than stop and go traffic.

Tire Pressure

The display will show a vehicle with the approximate pressures of all four tires. Tire pressure is displayed in either kilopascal (kPa) or in pounds per square inch (psi).

If a low or high tire pressure is detected, a message is displayed advising to check the tire pressure in the specified tire.

Vehicle Messages

Turn the SELECT knob to scroll through any active warning messages. Press SELECT to review the messages.

Units

Turn the SELECT knob to change the unit display to METRIC or US when the display is active. Press SELECT to confirm the setting. This will change the displays on the cluster and DIC to either metric or English (US) measurements.

Tutorial Mode

Select this menu item to view a screen that explains some of the unique features of the cluster.

Language

The driver information center is capable of displaying in different languages, corresponding to the radio language settings. The instrument cluster receives a GMLAN message with language information from the radio. This message is only sent one time, after a new language is selected. To set the language, see the owners manual.

INDICATOR/WARNING MESSAGE DESCRIPTION AND OPERATION

Indicator LIGHT ON

Refer to the owner's manual for the descriptions and explanations of all indicator lights.

For diagnosis and repair information related to an indicator light, refer to the System Diagnosis and the Description of Operation that the message relates to.

Message Displayed

Refer to the owner's manual for descriptions and explanations of all messages displayed.

For diagnosis and repair information related to a displayed message, refer to the System Diagnosis and the Description of Operation that the message relates to.

Transmission Shift Lever Position Indicator

The Transmission Shift Lever Position Indicator (if equipped) is located on the center console and indicates the current transmission shift lever position. The Transmission Shift Lever Position Indicator receives power and ground and is controlled by the Body Control Module (BCM) via serial data. The Transmission Control Module determines transmission shift lever position based on signals from the Transmission Internal Mode Switch and sends the shift lever position information to the BCM via serial data.

INSTRUMENT CLUSTER DESCRIPTION AND OPERATION

Displays Test

The instrument cluster displays a preview of information that includes electric range, charging, odometer, and battery status. This happens when the driver door is first opened, and following the welcome animation before starting the vehicle.

A CHARGING OVERRIDE/INTERRUPTION OCCURRED message may display on the lower left of the screen to indicate that a charging override or interruption has occurred due to:

- Override of charging settings by vehicle owner via OnStar.
- Unintended interruption of AC power at the vehicle's charge port.
- Interruption of charging by the utility company via OnStar as authorized by vehicle owner.

Refer to the owners manual for a complete list of vehicle charging status screen messages.

Indicators and Warning Messages

Refer to **Indicator/Warning Message Description and Operation**.

Battery and Driver Efficiency Gauges

Refer to the owner's manual for descriptions and explanations of Battery and Driver Efficiency Gauges.

Speedometer

The instrument cluster displays the vehicle speed based on the information from the ECM. The ECM sends the vehicle speed information via a High Speed CAN-Bus signal to the BCM. The BCM then sends the vehicle speed information via a Low Speed CAN-Bus signal to the instrument cluster in order to display the vehicle speed, either in kilometers or miles, based on the vehicle requirements. The speedometer defaults to 0 km/h (0 MPH) if:

- The BCM detects a loss of serial data communications with the ECM.
- The instrument cluster detects a loss of serial data communications with the BCM.

Odometer

The instrument cluster displays the vehicle odometer in the driver information center. The ECM send a distance rolling count message on GMLAN to the body control module (BCM). The BCM uses this information to calculate the vehicle odometer. This odometer value is then sent to the instrument cluster on GMLAN. The instrument cluster does not calculate the odometer. The odometer displays miles or kilometers as selected in the Units menu.

The odometer value is stored in multiple modules. The instrument cluster is a secondary storage module for the odometer, while the BCM is the primary storage and accumulator.

In addition to storing the odometer value for the vehicle, the instrument cluster and the BCM store the VIN. Software checks are performed to ensure these modules, and their stored odometer information, can not be move or transferred between different vehicles.

If the VINs do not match, the instrument cluster will go into an error mode and display "----" (dashes). If the VIN mismatch exists over a calibrated distance, the instrument cluster will "lock" the odometer display and only show dashes, even if the VIN mismatch is subsequently correct. The only way to clear or "unlock" the instrument cluster is to perform a BCM programming event using SPS.

Compass

The vehicle may have a compass display on the Driver Information Center. The compass receives its heading and other information from the Global Positioning System (GPS) antenna. If applicable, the GPS antenna is located with the telematics communication interface control module.

Driver Information Center Display

In the lower middle of the instrument cluster, an additional display is installed. Its task is to give additional information, such as an odometer or error codes. This part of the instrument cluster is available in 4 different variants, mostly depending on the assembled configuration. For further information refer to **Driver Information Center (DIC) Description and Operation**.

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Body Side Upper Rear Applique Nut	4.7 N.m (42 lb in)
Front Fender Upper Rear Molding Bolt	2.5 N.m (22 lb in)
Front License Plate Bracket Fastener	2.5 N.m (22 lb in)
Front Side Door Molding Insert Fastener	2.5 N.m (22 lb in)
Rear Closure Center Applique Nut	4.7 N.m (42 lb in)
Rear End Spoiler Bolt	5 N.m (44 lb in)
Rear End Spoiler Nut	5 N.m (44 lb in)
Rear Side Door Molding Insert Fastener	2.5 N.m (22 lb in)
Rear Side Door Window Frame Front Applique Fastener	2.5 N.m (22 lb in)
Wheelhouse Liner Screw	2.5 N.m (22 lb in)

REPAIR INSTRUCTIONS

FRONT FENDER EMBLEM/NAMEPLATE REPLACEMENT

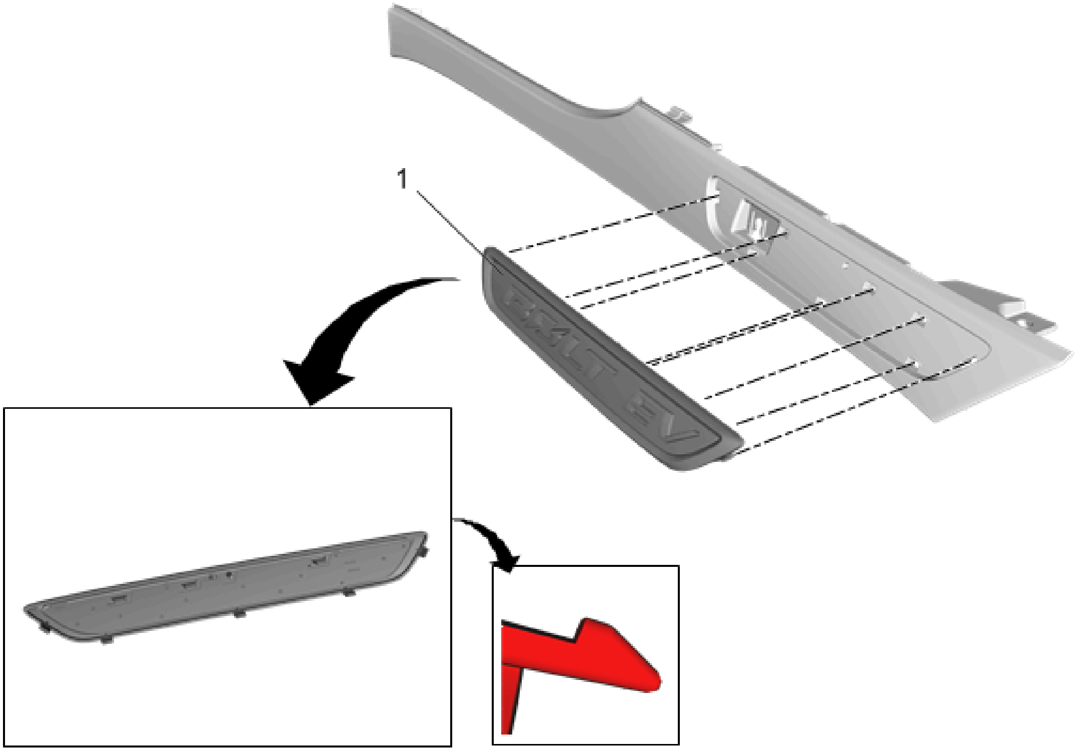


Fig. 1: Front Fender Emblem/Nameplate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Fender Upper Rear Molding Replacement	
1	Front Fender Emblem/Nameplate **CAUTION:** **Use a plastic, flat-bladed tool to prevent paint damage when removing an emblem/name plate.** **CAUTION:** **Anytime the emblem/nameplate is removed from the vehicle, it MUST BE REPLACED. The locking tabs that secure the emblem/nameplate to the vehicle WILL BE DAMAGED when the emblem name/plate is removed, and under no circumstances may the emblem/nameplate be re-used.** **Procedure** 1. Using a suitable flat bladed tool release the eight locking tabs and pull the emblem from the molding. 2. The part and surface should be 21Â°C (70Â°F) prior to installation. The vehicle should remain 21Â°C (70Â°F) for one hour after assembly to allow adhesive to develop sufficient bond strength. 3. Use a heat gun or equivalent to remove the liftgate emblem. Use a plastic flat bladed tool to assist in removal. 4. Clean any remaining residue with a 50/50 mixture by volume of isopropyl alcohol and clean drinkable water. Wipe surface dry with a clean lint-free towel. 5. When removing protective liners from the adhesive tape, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. 6. Using the palm of the hand, wet out the liftgate emblem to ensure full adhesion is made.

LIFTGATE EMBLEM/NAMEPLATE REPLACEMENT (EMBLEM)

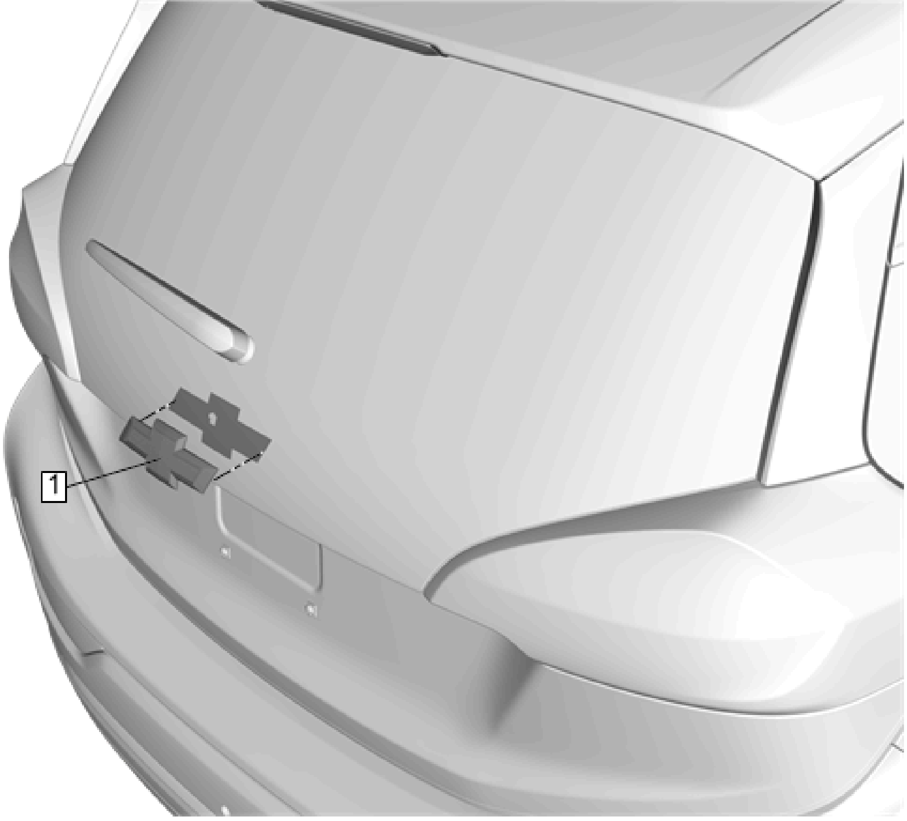


Fig. 2: Liftgate Emblem/Nameplate (Emblem)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Liftgate Emblem/Nameplate **CAUTION:** **Refer to Exterior Trim Emblem Removal Caution .** **Procedure** 1. The part and surface should be 21Â°C (70Â°F) prior to installation. The vehicle should remain 21Â°C (70Â°F) for one hour after assembly to allow adhesive to develop sufficient bond strength. 2. Use a commercial type Heat Gun or equivalent to remove the old nameplate. 3. Clean all adhesive from the liftgate panel and wipe the surface dry with a clean lint-free towel prior to installing the new nameplate. 4. Close the liftgate prior to installing the new nameplate. 5. When removing protective liners from the adhesive tape, be careful not to touch tape with hands and do not allow tape to come in contact with dirt or any foreign matter prior to adhesion. 6. Position and adhere the nameplate to the liftgate. 7. Using the palm of the hand, wet out the nameplate on the liftgate panel to ensure full adhesion of the nameplate is made.

LIFTGATE EMBLEM/NAMEPLATE REPLACEMENT (NAMEPLATE)

Removal Procedure

CAUTION: **Refer to Exterior Trim Emblem Removal Caution .**

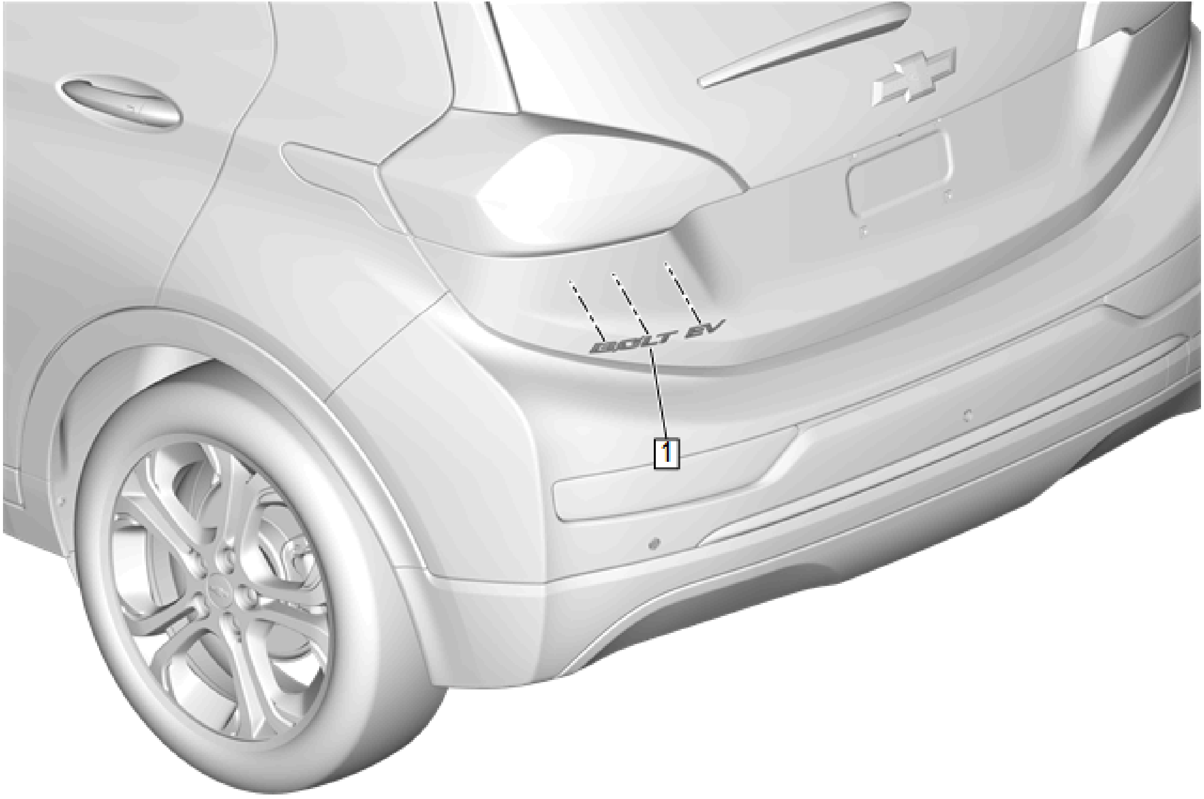


Fig. 3: Liftgate Emblem/Nameplate (Nameplate)
Courtesy of GENERAL MOTORS COMPANY

1. Perform the following steps to remove the liftgate nameplate lettering (1):
    1. Completely clean and dry the area that contains the nameplate lettering.
    2. To aid in installation, outline each individual letter with painter's tape or another suitable method. The lettering pieces may be individual or attached to each other.
    3. Use a commercial type Heat Gun or equivalent to remove the old nameplate lettering.
    4. Using a clean, lint-free towel, wipe the surface dry prior to installing the new nameplate lettering.

Installation Procedure

1. The part and surface should be 21Â°C (70Â°F) prior to installation. The vehicle should remain at 21Â°C (70Â°F) for a minimum of one hour after assembly to allow the adhesive to develop sufficient bond strength.

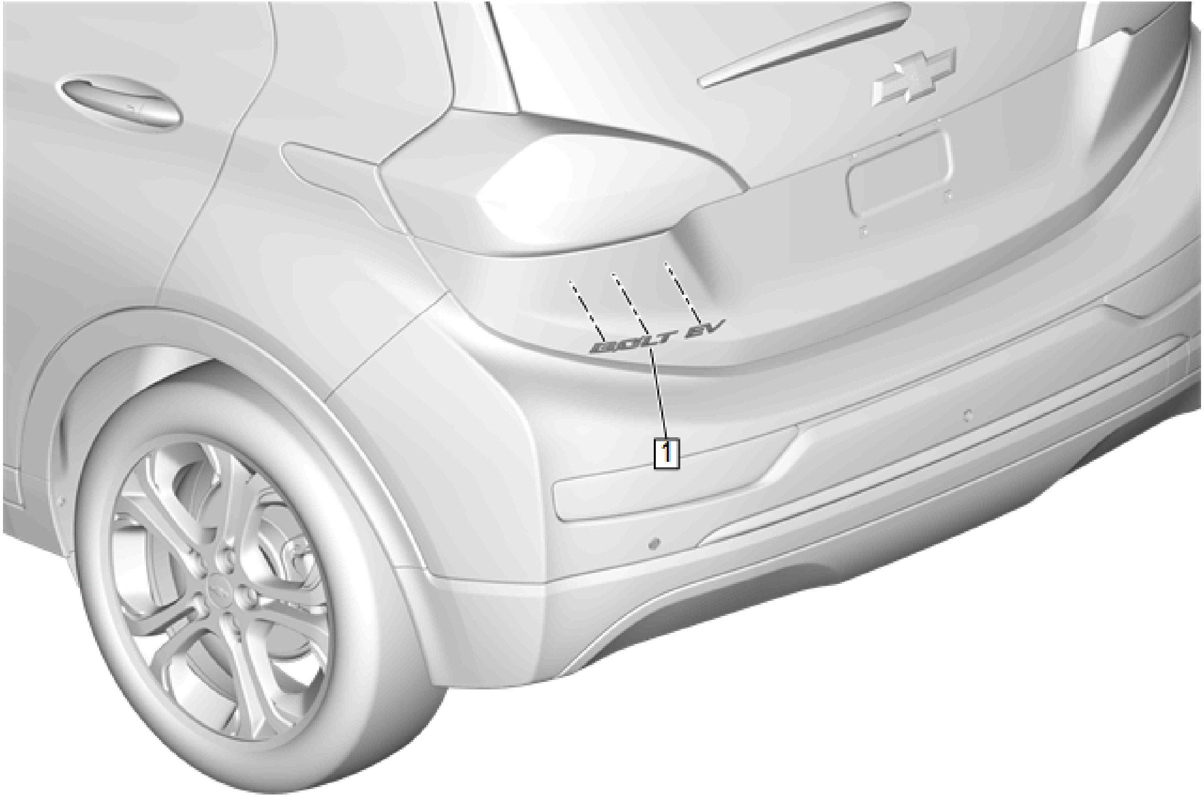


Fig. 4: Liftgate Emblem/Nameplate (Nameplate)
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When removing the protective liners from the adhesive tape, be careful not to touch the tape and do not allow the tape to come in contact with any dirt or foreign matter.**

2. Perform the following steps to install the liftgate nameplate lettering (1):
    1. Close the liftgate prior to installing the new nameplate lettering.
    2. Remove the protective liner from the adhesive tape of the first nameplate letter and align it to the location marked previously.
    3. Apply the aligned letter and use the palm of the hand to ensure full adhesion has been made.
    4. Repeat the same steps with each letter additional letter.

BODY SIDE UPPER REAR APPLIQUE REPLACEMENT

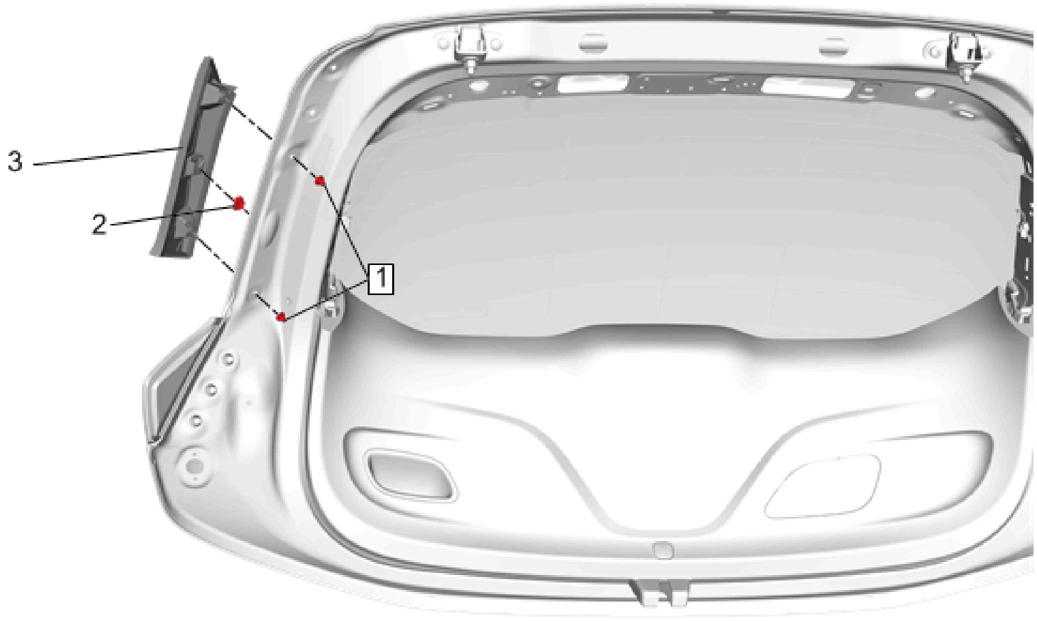


Fig. 5: Body Side Upper Rear Applique
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear End Spoiler Replacement	
1	Body Side Upper Rear Applique Nut **CAUTION:** Fastener Caution **Tighten** 4.7 N.m (42 lb in)
2	Body Side Upper Rear Applique Retainer
3	Body Side Upper Rear Applique **Procedure** 1. Gently pull up the applique. 2. Replace damaged retainers as needed.

FRONT SIDE DOOR WINDOW FRAME REAR APPLIQUE REPLACEMENT

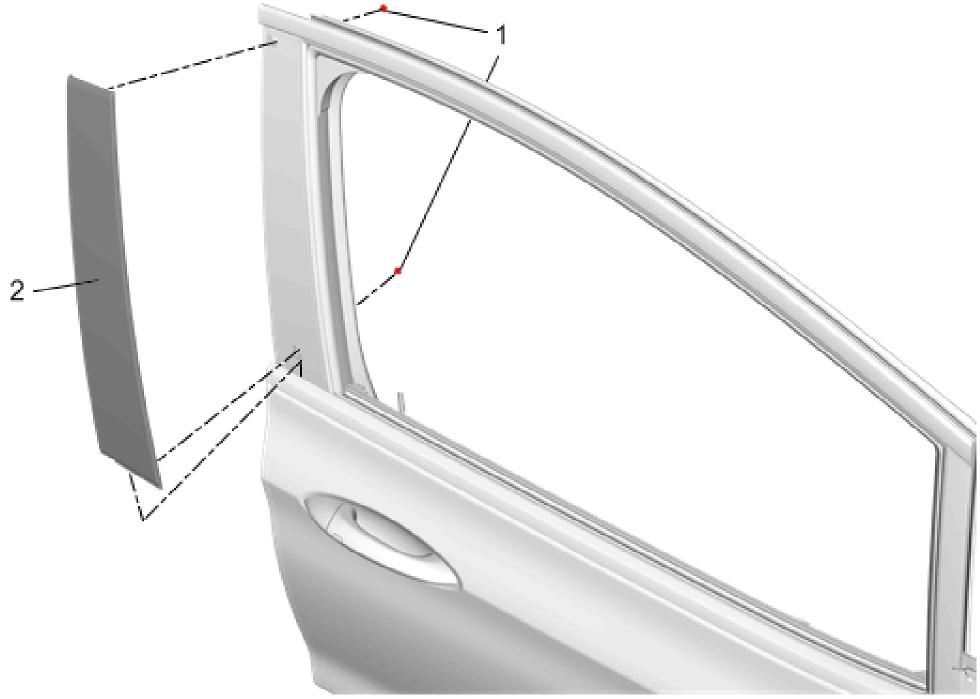


Fig. 6: Front Side Door Window Frame Rear Applique
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Side Door Weatherstrip Replacement - Door Side** **NOTE:** **It is not necessary to completely remove the weatherstrip. Reposition the rear edge of the front side door weatherstrip.**	
1	Front Side Door Weatherstrip Upper Retainer
2	Front Side Door Window Frame Rear Applique 1. Use a solution of 50/50 isopropyl alcohol and water to clean the adhesive surface. 2. Peel the protective film from the foam tape and install the rear applique to the vehicle.

REAR CLOSURE CENTER APPLIQUE REPLACEMENT

Removal Procedure

1. Open and support the rear liftgate.
2. Liftgate Lower Trim Finish Panel - Remove - **Liftgate Lower Trim Finish Panel Replacement**

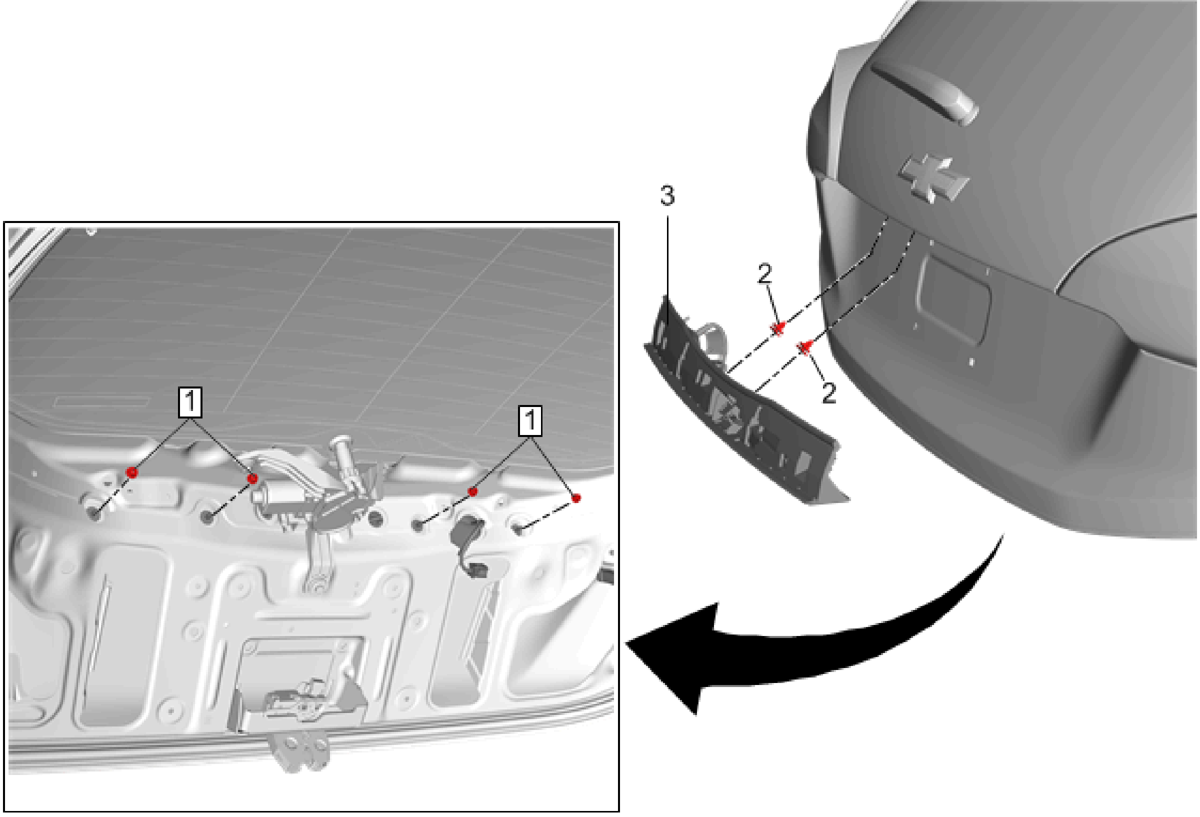


Fig. 7: Rear Closure Center Applique
Courtesy of GENERAL MOTORS COMPANY

3. Rear Closure Center Applique Nut (1) - Remove
4. Disconnect the electrical connectors.
5. Disconnect the backup camera washer hose.
6. Disengage the electrical grommets from the liftgate outer panel.
7. With a trim type release tool, disengage the two retainers (2) on the rear closure center applique.
8. Remove the rear closure center applique (3).
9. Replace any broken retainers.
10. Transfer parts as necessary.

Installation Procedure

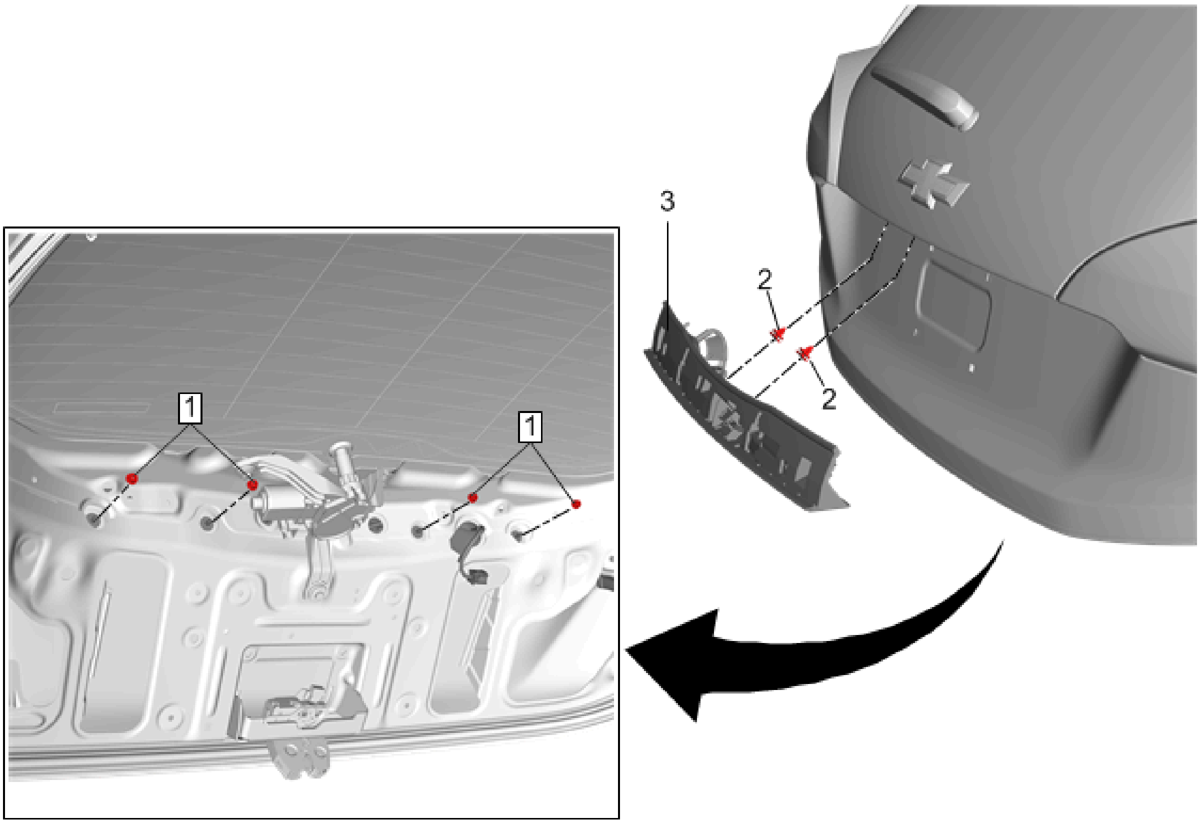


Fig. 8: Rear Closure Center Applique
Courtesy of GENERAL MOTORS COMPANY

1. Install the rear closure center applique (3).
2. Engage the electrical grommets to the liftgate outer panel.
3. Connect the backup camera washer hose.
4. Connect the electrical connectors.

CAUTION: **Refer to Fastener Caution .**

5. Rear Closure Center Applique Nut (1) - Install to 4.7 N.m (42 lb in)
6. Liftgate Lower Trim Finish Panel - Install - Liftgate Lower Trim Finish Panel Replacement
7. Close the rear liftgate.

REAR SIDE DOOR WINDOW FRAME FRONT APPLIQUE REPLACEMENT

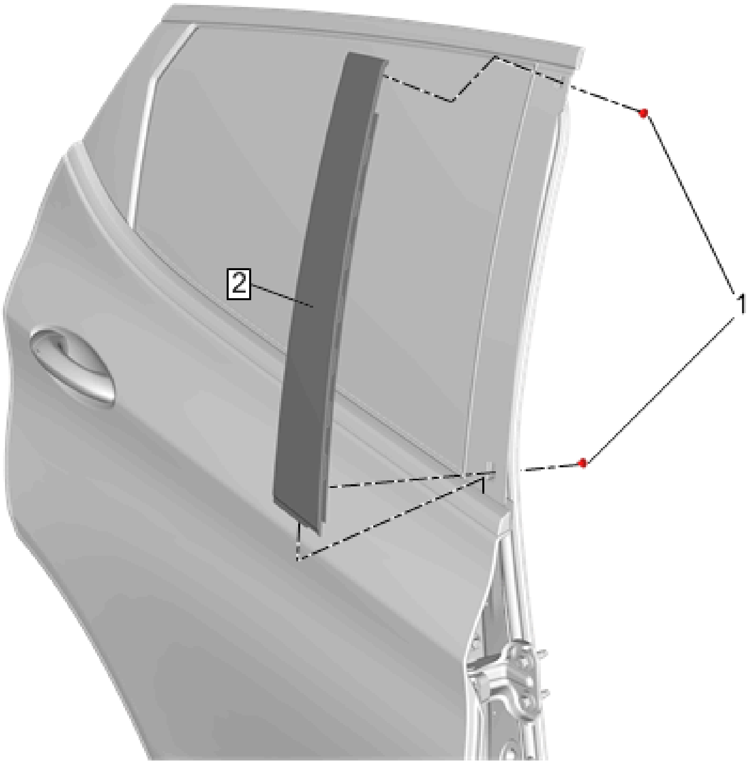


Fig. 9: Rear Side Door Window Frame Front Applique
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Side Door Weatherstrip Replacement - Door Side **NOTE:** **It is not necessary to completely remove the weatherstrip. Reposition the front edge of the rear side door weatherstrip.**	
1	Rear Side Door Weatherstrip Upper Retainer
2	Rear Side Door Window Frame Front Applique 1. Use a solution of 50/50 isopropyl alcohol and water to clean the adhesive surface. 2. Peel the protective film from the foam tape and install the rear applique to the vehicle.

REAR SIDE DOOR WINDOW FRAME REAR APPLIQUE REPLACEMENT

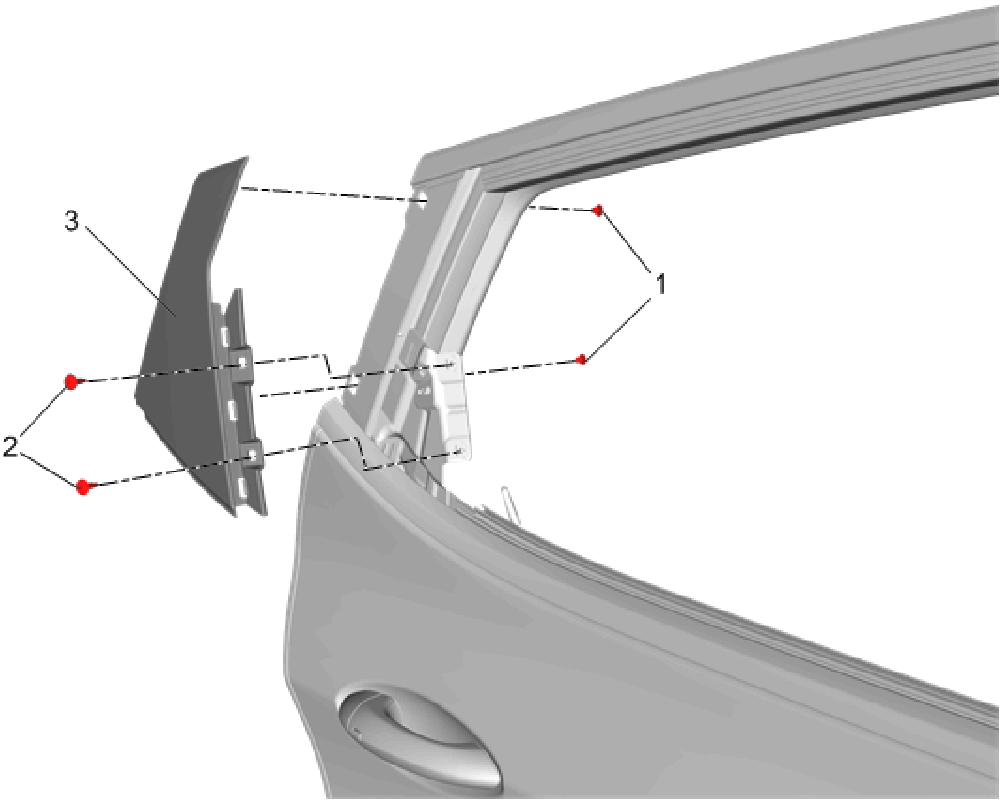


Fig. 10: Rear Side Door Window Frame Rear Applique
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Rear Side Door Weatherstrip Replacement - Door Side 2. Rear Side Door Window Weatherstrip Replacement **NOTE:** **It is not necessary to completely remove the weatherstrip. Reposition the weatherstrips to access the fasteners.**	
1	Rear Side Door Weatherstrip Upper Retainer
2	Rear Side Door Window Frame Front Applique Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
3	Rear Side Door Window Frame Front Applique 1. Use a solution of 50/50 isopropyl alcohol and water to clean the adhesive surface. 2. Peel the protective film from the foam tape and install the rear applique to the vehicle.

FRONT LICENSE PLATE BRACKET REPLACEMENT

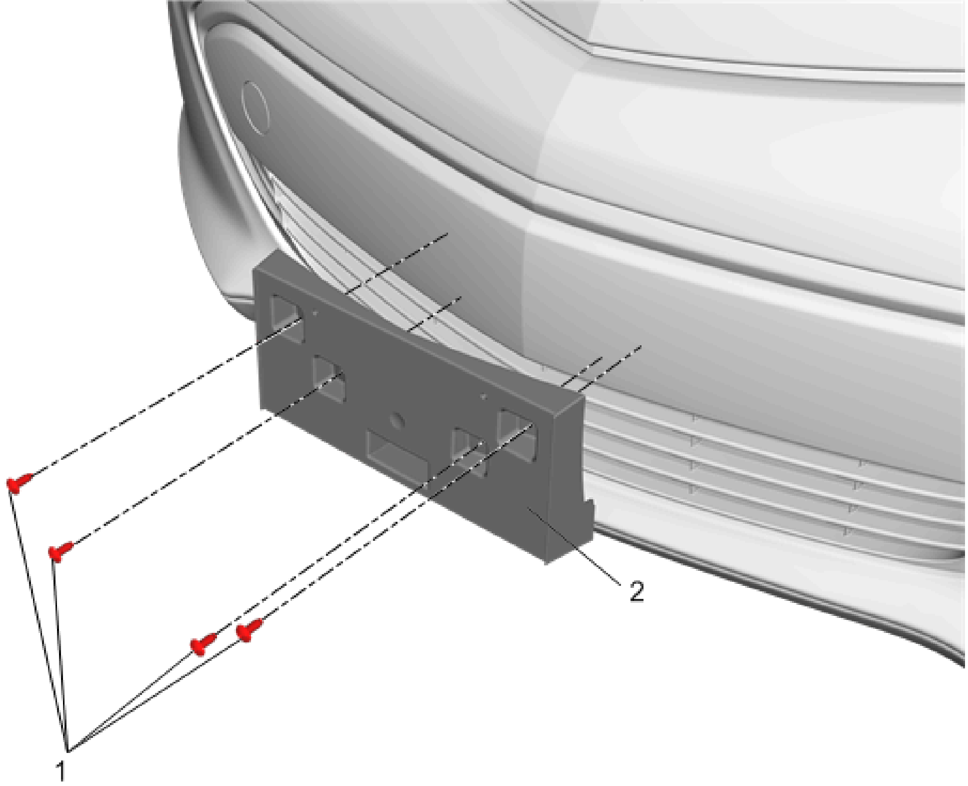


Fig. 11: Front License Plate Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front License Plate Bracket Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front License Plate Bracket

FRONT BUMPER FASCIA TOW EYE ACCESS HOLE COVER REPLACEMENT

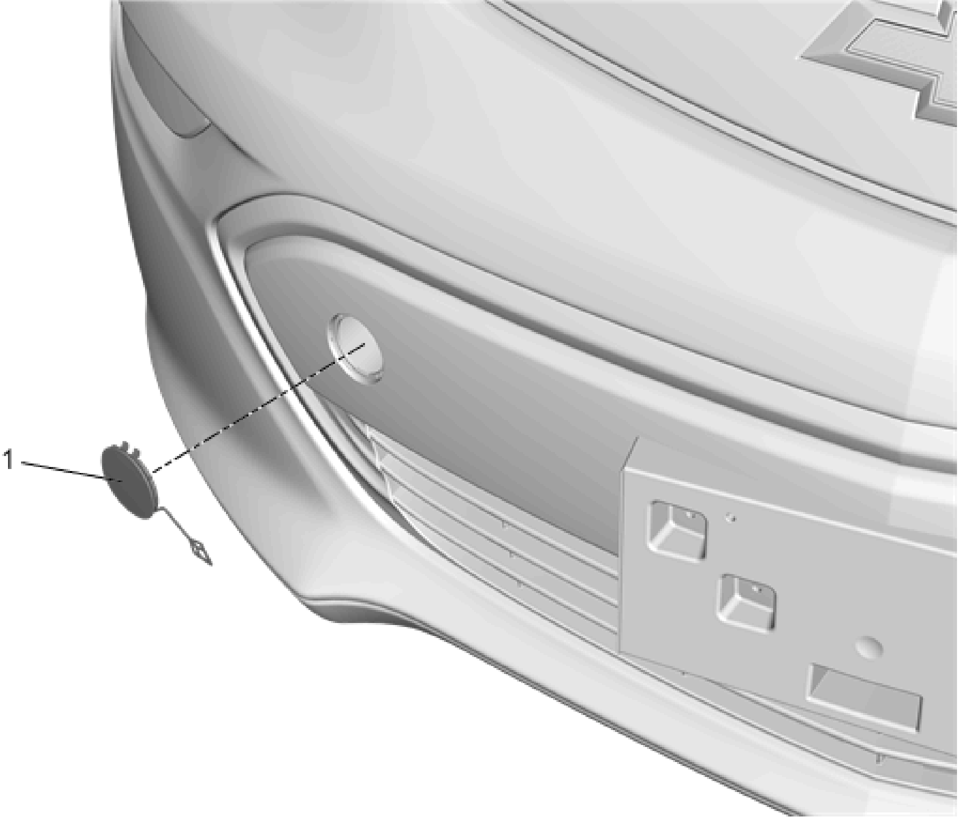


Fig. 12: Front Bumper Fascia Tow Eye Access Hole Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Bumper Fascia Front Tow Eye Access Hole Cover **Procedures** 1. Using a small flat-bladed tool, release the cover from the front bumper fascia. 2. Using needle nose pliers, release the hook from the square in the front fascia and remove.

FRONT BUMPER FASCIA EMBLEM/NAMEPLATE REPLACEMENT

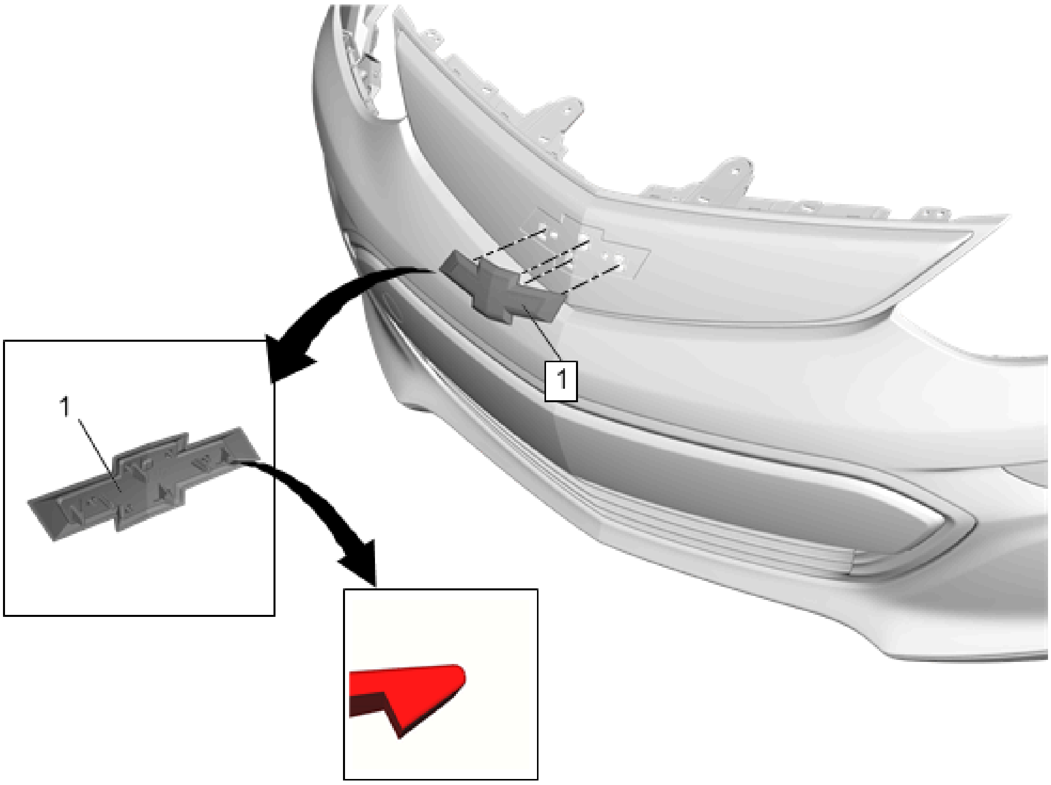


Fig. 13: Front Bumper Fascia Emblem/Nameplate
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">CAUTION:
To avoid paint damage, protect the area surrounding the part which you are removing or installing.
Preliminary Procedure Front Compartment Front Sight Shield Replacement</td></tr>
<tr><td>1</td><td>Radiator Grille Emblem/Nameplate
Procedure
Using a suitable flat bladed tool, release the four locking tabs from the rear side of the front upper grille and pull radiator grille emblem from the front upper grille.
NOTE:
Use care when releasing the tabs, to not contact the grille. Ensure that the tabs are properly engaged upon installation.</td></tr>
</table>

FRONT WHEEL OPENING MOLDING REPLACEMENT

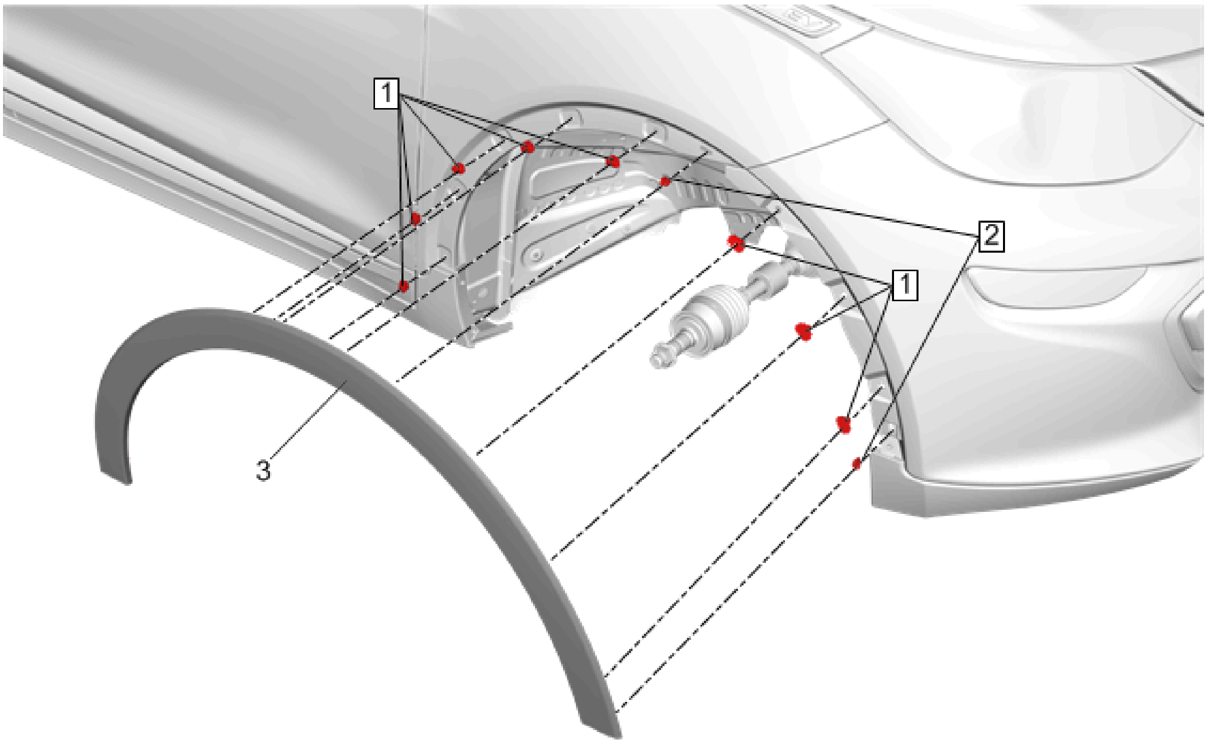


Fig. 14: Front Wheel Opening Molding
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
Remove the front wheelhouse liner. Front Wheelhouse Liner Replacement</td></tr>
<tr><td>1</td><td>Front Wheel Opening Molding Retainer</td></tr>
<tr><td>2</td><td>Front Wheel Opening Molding Clip</td></tr>
</table>

Callout	Component Name
3	Front Wheel Opening Molding **Procedure** 1. Apply two layers of masking tape around the edge of the front wheel opening molding to prevent any paint surface damage. 2. Carefully remove the clips that attached the molding to the bumper from the inside of the front wheelhouse using pliers. 3. Work from the front fender area to the bumper area.

FRONT UPPER GRILLE REPLACEMENT

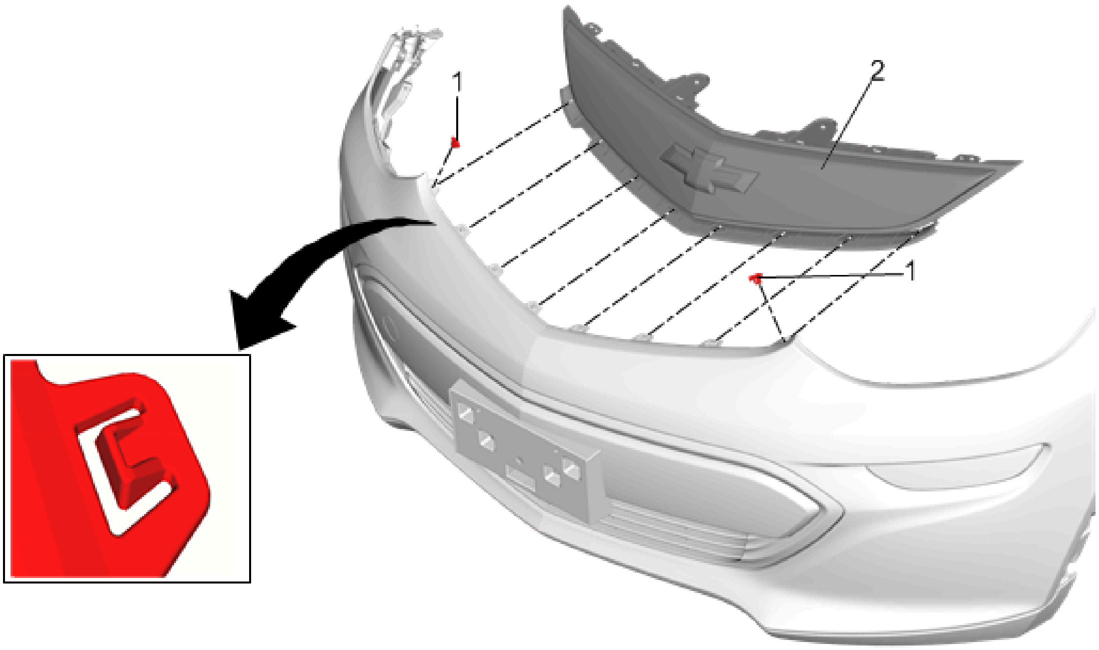


Fig. 15: Front Upper Grille
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)**	
1	Front Bumper Impact Bar Binding Band Clip
2	Front Upper Grille **Procedure** 1. Unclip the electrical connector from the grille. 2. Release the front upper grille from the front bumper fascia grille tabs. 3. Pull the front upper grille from the backside of the front bumper fascia. 4. Transfer components as necessary.

FRONT LOWER GRILLE REPLACEMENT

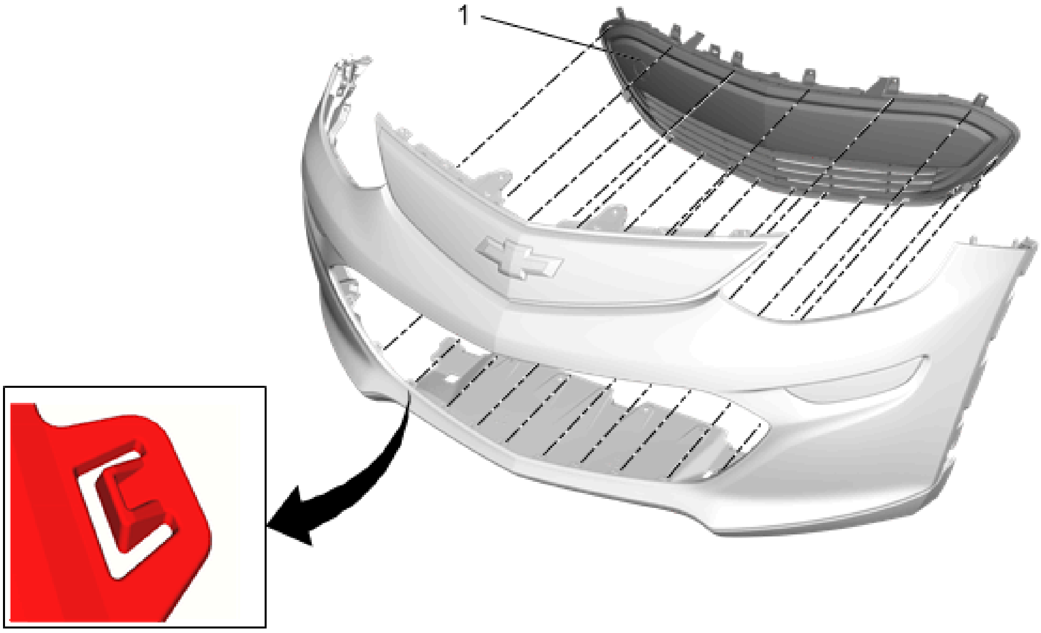


Fig. 16: Front Lower Grille
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea) 2. Front Bumper Impact Absorber Replacement (North America) Front Bumper Impact Absorber Replacement (Europe, Korea) 3. Ambient Air Temperature Sensor Replacement 4. Front View Driver Information Camera Replacement 5. Reposition the electrical wiring harness around the front lower grille.	
1	Front Lower Grille **Procedure** 1. Release the front lower grille from the front bumper fascia grille retainers and grille tabs. 2. Pull the front lower grille from the backside of the front bumper fascia. 3. Remove the front license plate bracket as necessary. Front License Plate Bracket Replacement

BODY SIDE REAR MOLDING REPLACEMENT

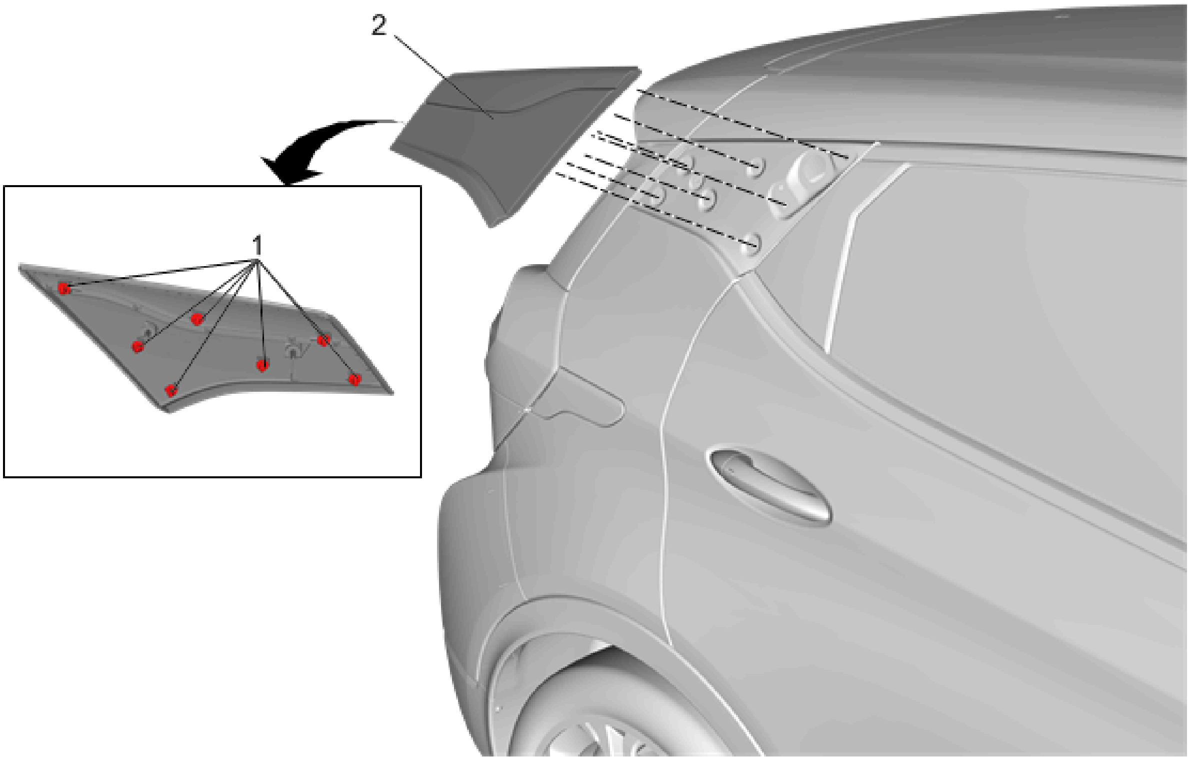


Fig. 17: Body Side Rear Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the rear side door and the liftgate	
1	Body Side Rear Molding Retainer
2	Body Side Rear Molding **Procedure** 1. Apply two layers of masking tape around the top edge of the body side rear molding to prevent any paint surface damage. 2. Starting at the front top corner, use a flat bladed plastic tool to release the front side door lower molding retainers. 3. Replace the body side rear molding retainers as needed.

FRONT SIDE DOOR MOLDING INSERT REPLACEMENT

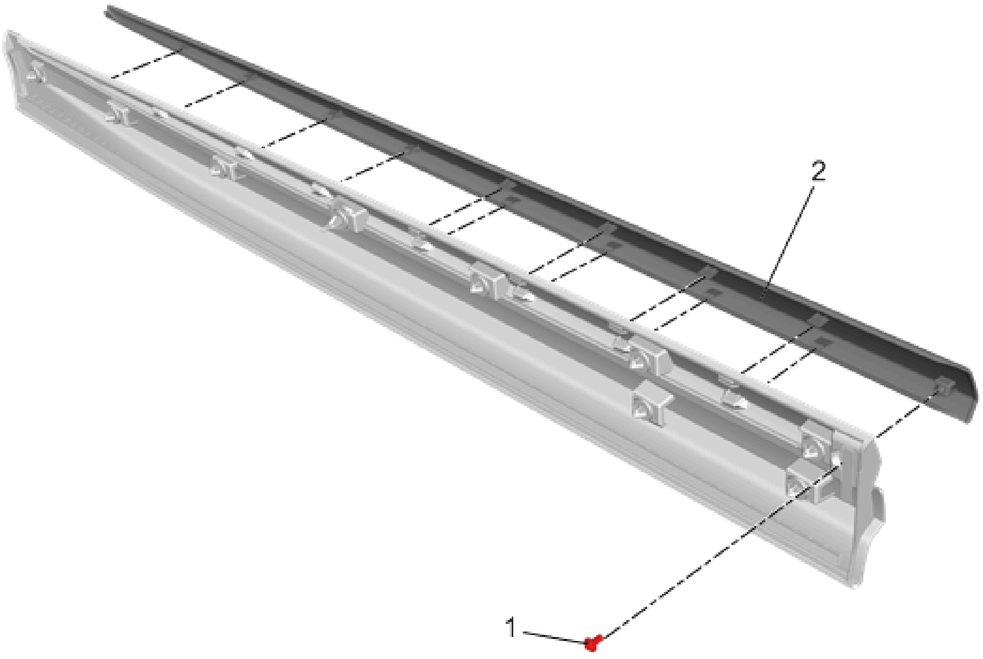


Fig. 18: Front Side Door Molding Insert
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Side Door Lower Molding Replacement	
1	Front Side Door Molding Insert Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Side Door Molding Insert

FRONT SIDE DOOR LOWER MOLDING REPLACEMENT

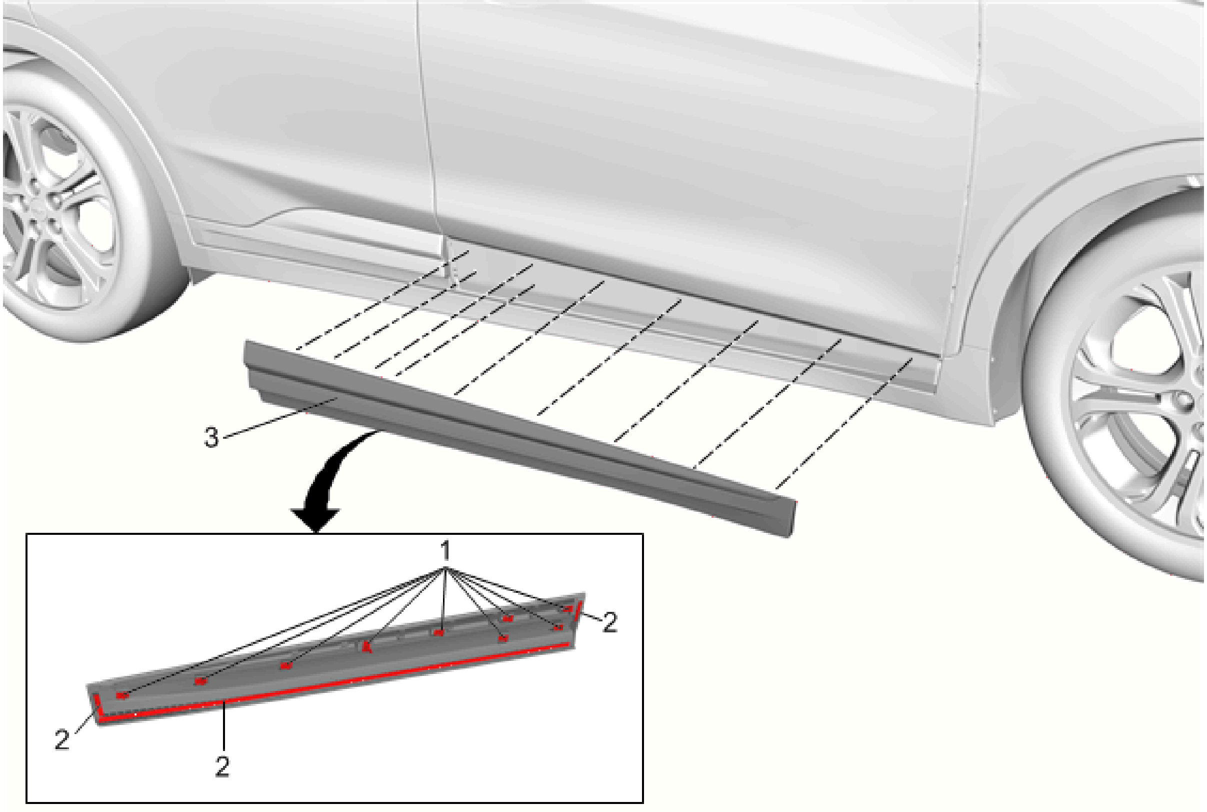


Fig. 19: Front Side Door Lower Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Side Door Lower Molding Retainer
2	Front Side Door Lower Molding Double Adhesive Tape
3	Front Side Door Lower Molding **Procedure** 1. Apply two layers of masking tape around the top edge of the front side door lower molding to prevent any paint surface damage. 2. Starting at the front top corner using a suitable flat bladed plastic tool release the nine front side door lower molding retainers. 3. Replace the front side door lower molding retainers as needed. 4. Using a 50/50 mixture of isopropyl alcohol and clean drinkable water and a clean towel, remove the left over adhesive residue from the masking tape.

FRONT FENDER UPPER REAR MOLDING REPLACEMENT

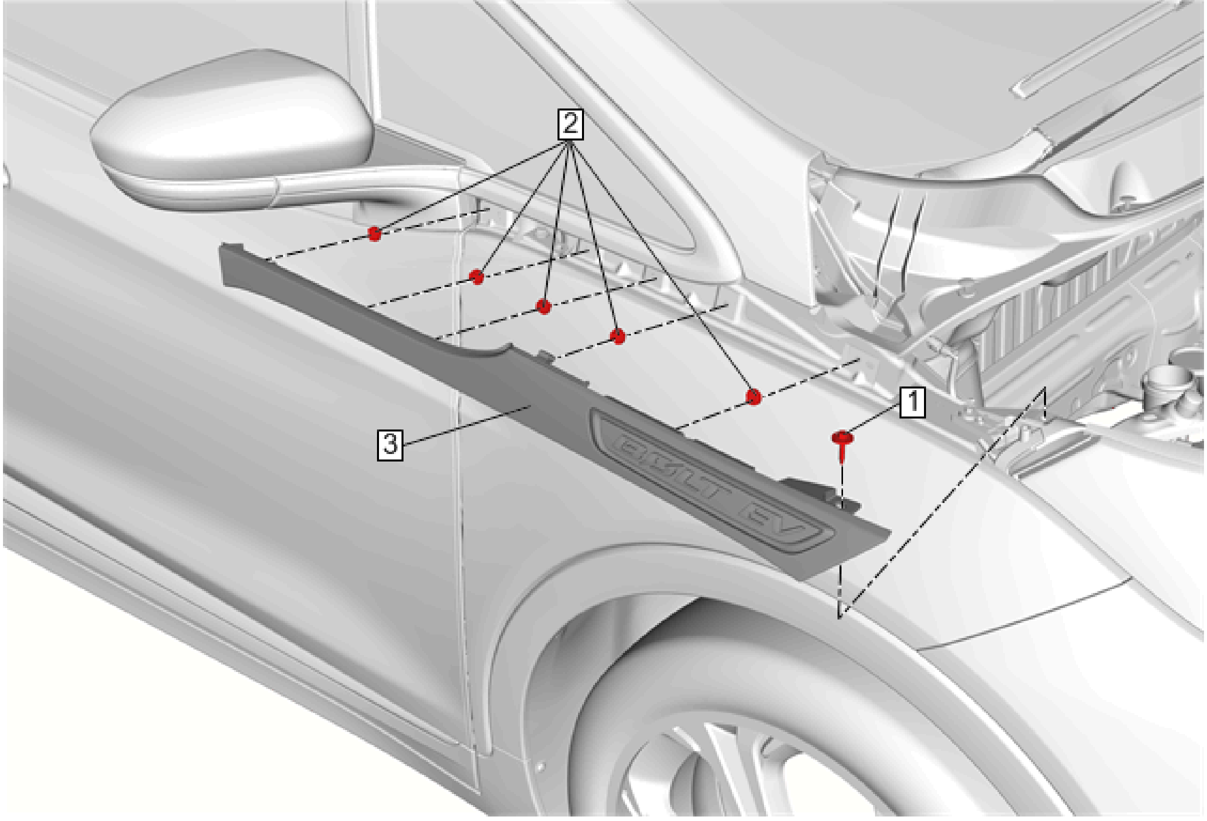


Fig. 20: Front Fender Upper Rear Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Open the hood.	
1	Front Fender Upper Rear Molding Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Fender Upper Rear Molding Retainer **Procedure** Using the appropriate tool, release the five molding retainers.
3	Front Fender Upper Rear Molding **Procedure** Transfer components as necessary. **NOTE:** **Transferring the emblem/nameplate is not possible, the emblem/nameplate will be damaged if it is removed from the molding.**

REAR SIDE DOOR MOLDING INSERT REPLACEMENT

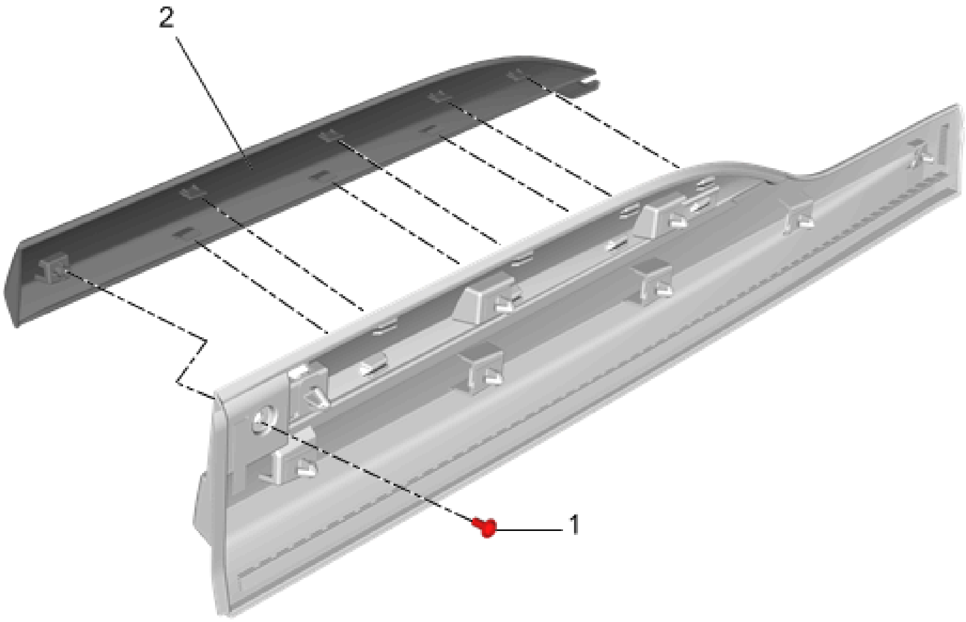


Fig. 21: Rear Side Door Molding Insert
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Side Door Lower Molding Replacement	
1	Rear Side Door Molding Insert Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Rear Side Door Molding Insert

REAR SIDE DOOR LOWER MOLDING REPLACEMENT

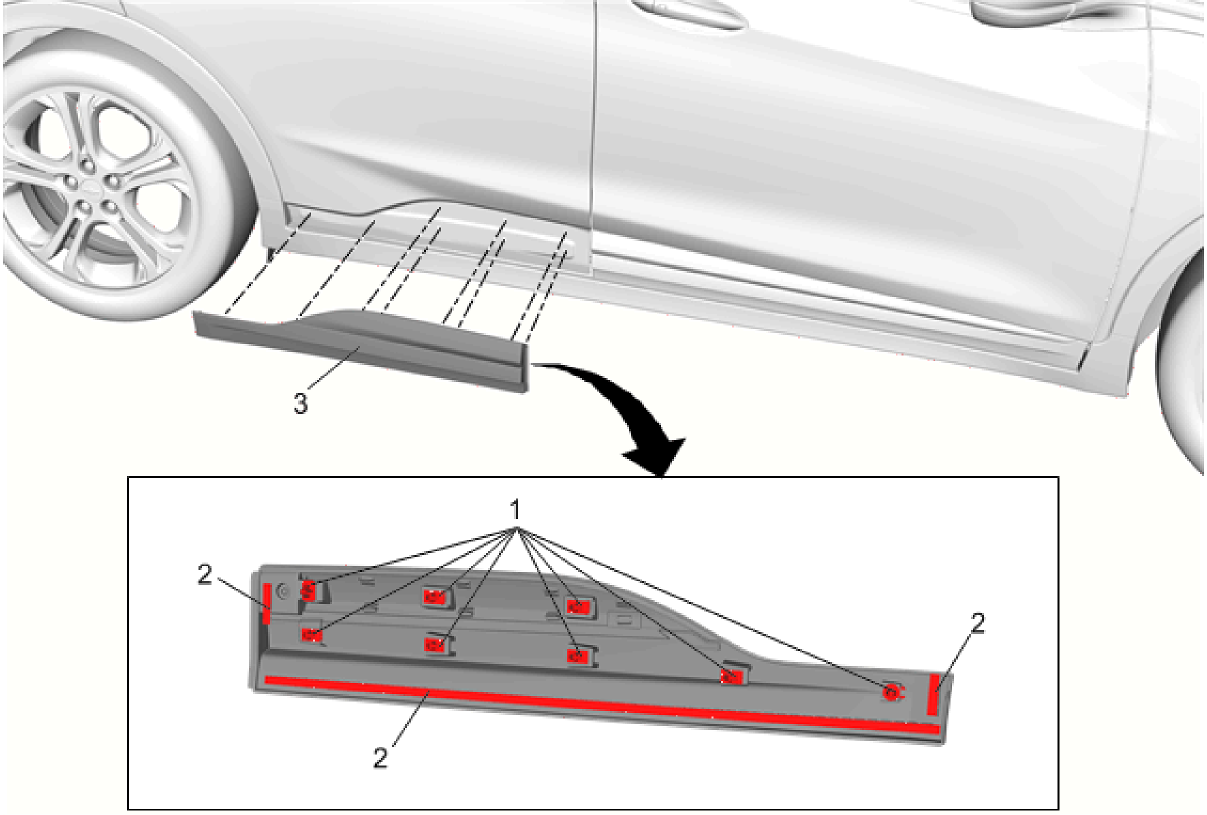


Fig. 22: Rear Side Door Lower Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Side Door Lower Molding Retainer
2	Rear Side Door Lower Molding Double Adhesive Tape
3	Rear Side Door Lower Molding **Procedure** 1. Apply two layers of masking tape around the top edge of the rear side door lower molding to prevent any paint surface damage. 2. Starting at the front top corner, use a flat bladed plastic tool release the rear side door lower molding retainers. 3. Replace the rear side door lower molding retainers as needed. 4. Using a 50/50 mixture of isopropyl alcohol and clean drinkable water and a clean towel, remove the left over adhesive residue from the masking tape.

REAR WHEEL OPENING MOLDING REPLACEMENT

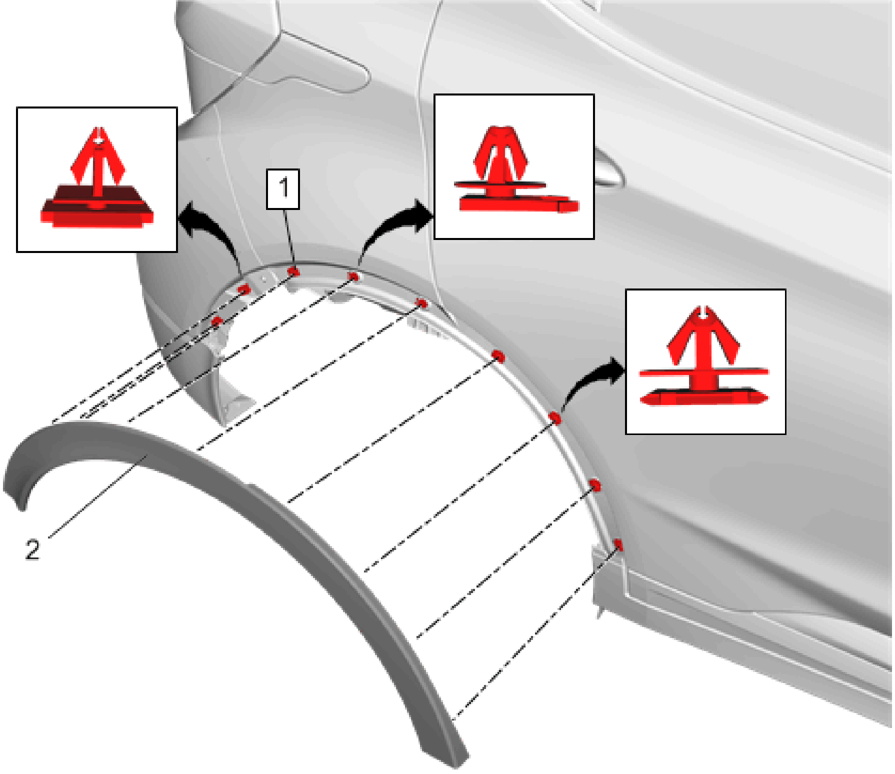


Fig. 23: Rear Wheel Opening Molding
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
1. Open the rear side door.
2. Rear Wheelhouse Liner Replacement</td></tr>
<tr><td>1</td><td>Rear Wheel Opening Molding Retainer</td></tr>
<tr><td>2</td><td>Rear Wheel Opening Molding
Procedure
1. Apply two layers of masking tape around the edge of the rear wheel opening molding to prevent any paint surface damage.
2. Using a trim type release tool, working from the inside fender flange area, disengage the seven retainers from the body side outer panel and then the two retainers from the rear bumper fascia.
3. Pull the rear wheel opening molding upward to slide the tab on the wheel opening molding out of the rear fascia.
4. Replace the rear wheel opening molding retainers as needed.
5. Using a 50/50 mixture of isopropyl alcohol and clean drinkable water and a clean towel, remove the left over adhesive residue from the masking tape.
NOTE:
After removing the molding it is mandatory to wax the retainer holes outside and from the inner wheelhouse to help prevent corrosion.</td></tr>
</table>

ROCKER PANEL MOLDING REPLACEMENT

Removal Procedure

1. Open both side doors in order to remove the rocker panel front molding assembly.
2. Partly remove and reposition the front wheel opening molding. Front Wheel Opening Molding Replacement

3. Partly remove and reposition the rear wheel opening molding. **Rear Wheel Opening Molding Replacement**

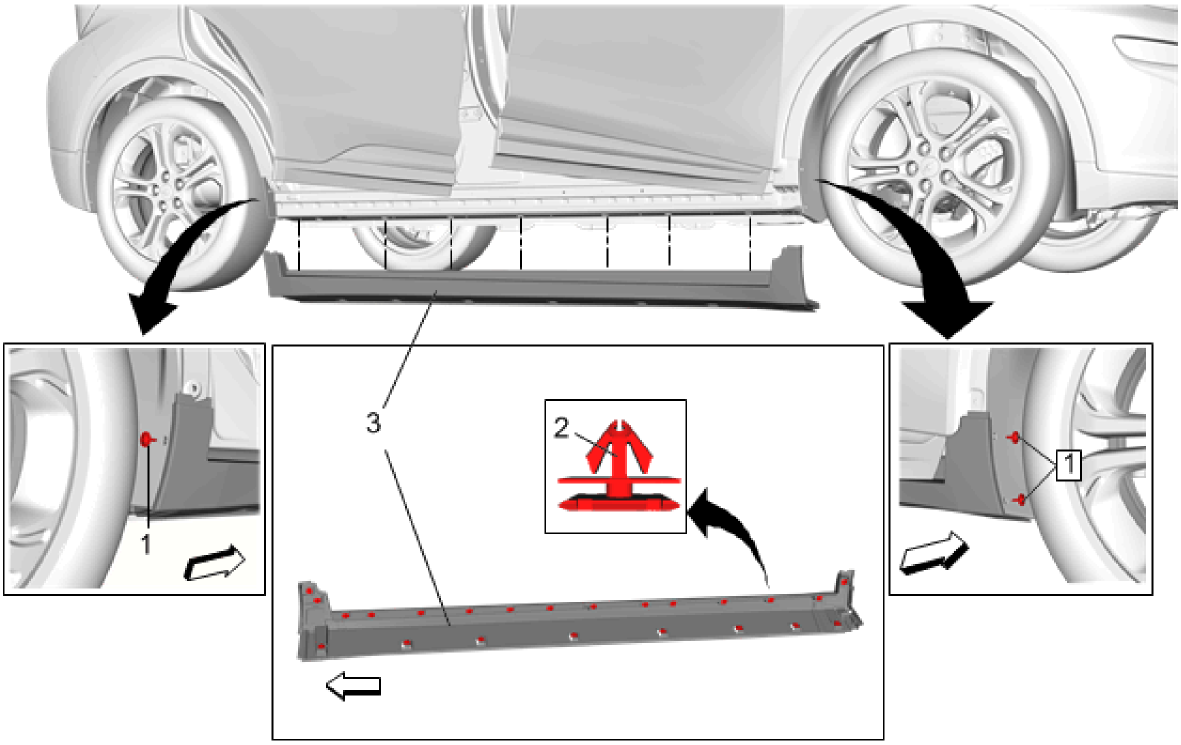


Fig. 24: Wheelhouse Liner Screw
Courtesy of GENERAL MOTORS COMPANY

4. Wheelhouse Liner Screw - Remove
5. Apply masking tape to the painted surfaces.
6. Release the fifteen side retainers.
7. Release the front lower retainer.
8. Pull the upper portion of the molding (3) away and slide the rocker molding (3) rearward to release the lower retainer form the molding (3).
9. Release the seven remaining lower rocker molding retainers from the body.

Installation Procedure

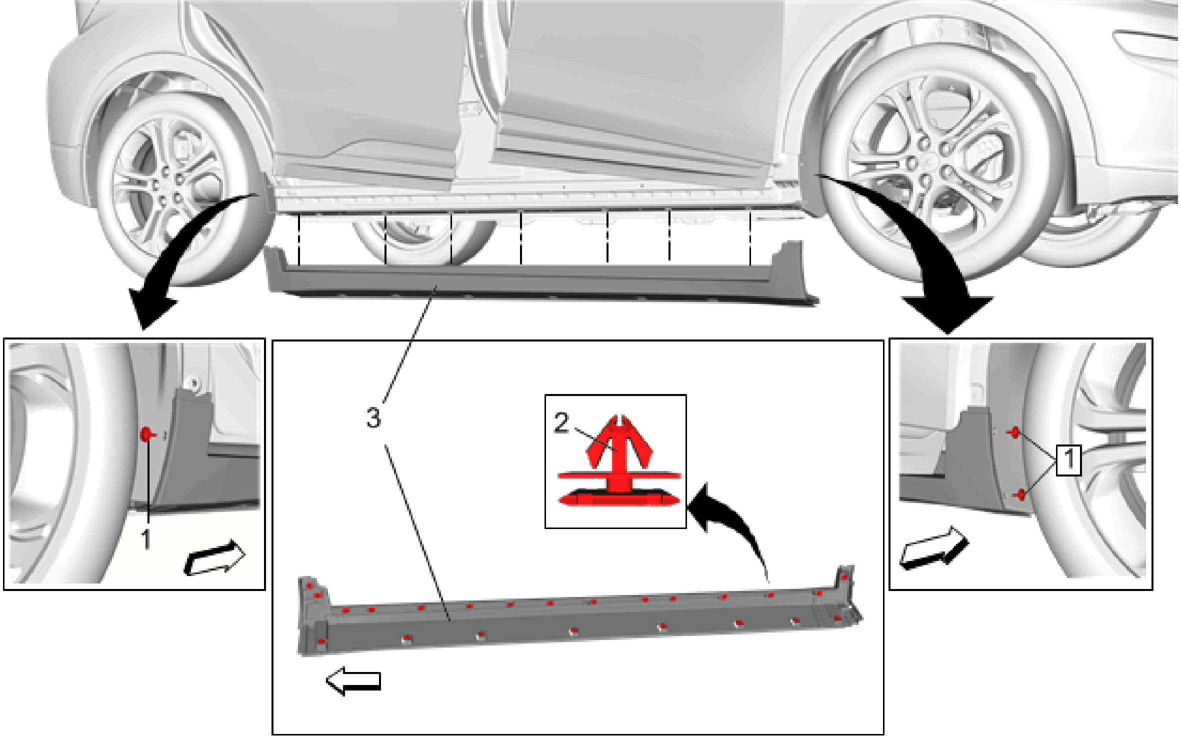


Fig. 25: Wheelhouse Liner Screw
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

1. Install new retainers as required.
2. Install the molding (3) to the vehicle and engage all retainers (2).
3. Remove the masking tape.
4. Wheelhouse Liner Screw (1) - Install to 2.5 N.m (22 lb in)
5. Install the rear wheel opening molding. **Rear Wheel Opening Molding Replacement**
6. Install the front wheel opening molding. **Front Wheel Opening Molding Replacement**
7. Close side doors.

REAR END SPOILER REPLACEMENT

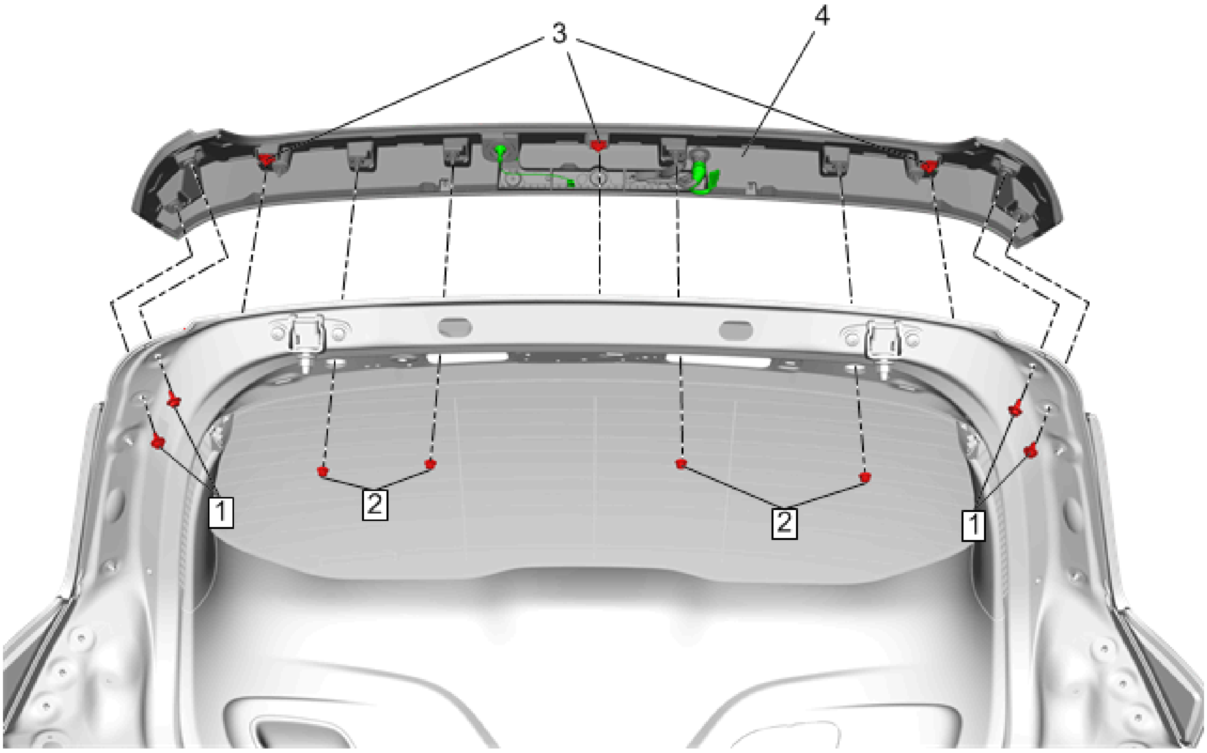


Fig. 26: Rear End Spoiler
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Liftgate Upper Center Trim Finish Panel Replacement	
1	Rear End Spoiler Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 5 N.m (44 lb in)
2	Rear End Spoiler Nut **Tighten** 5 N.m (44 lb in)
3	Rear End Spoiler Retainer **Procedure** Using the appropriate tool, release the rear end spoiler retainers.
4	Rear End Spoiler **Procedure** 1. Disconnect the electrical connector. 2. Disconnect the rear window washer hose from the rear window washer nozzle. 3. Transfer components as necessary.

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Front Side Door Window Belt Reveal Molding Screw	1.5 N.m (13 lb in)
Front Side Door Window Channel Retainer Bolt	9 N.m (80 lb in)
Front Side Door Window Regulator Bolt	11 N.m (97 lb in)
Front Side Door Window Regulator Nut	11 N.m (97 lb in)
Rear Side Door Window Belt Reveal Molding Screw	1.5 N.m (13 lb in)
Rear Side Door Window Channel Rear Retainer Bolt	9 N.m (80 lb in)
Rear Side Door Window Regulator Bolt	11 N.m (97 lb in)
Rear Side Door Window Regulator Nut	11 N.m (97 lb in)

SCHEMATIC WIRING DIAGRAMS

MOVEABLE WINDOW WIRING SCHEMATICS

Driver Door

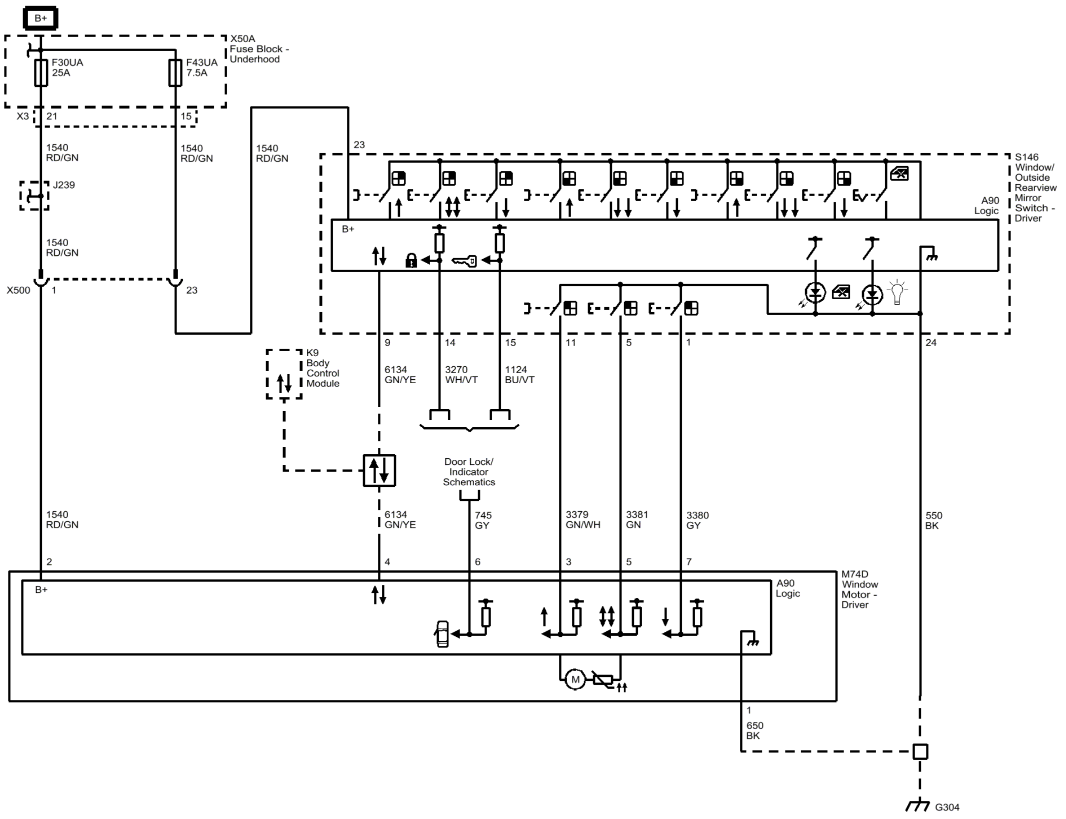

B+
X50A
Fuse Block -
Underhood
F30UA
25A
F43UA
7.5A
X3
21
15
1540
RD/GN
1540
RD/GN
1540
RD/GN
J239
1540
RD/GN
X500
1
23
23
S146
Window/
Outside
Rearview
Mirror
Switch -
Driver
A90
Logic
B+
9
14
15
11
5
1
24
K9
Body
Control
Module
6134
GN/YE
3270
WH/VT
1124
BU/VT
Door Lock/
Indicator
Schematics
1540
RD/GN
6134
GN/YE
745
GY
3379
GN/WH
3381
GN
3380
GY
550
BK
2
4
6
3
5
7
M74D
Window
Motor -
Driver
A90
Logic
B+
M
1
650
BK
G304

Fig. 1: Driver Door

Courtesy of GENERAL MOTORS COMPANY

Passenger Door

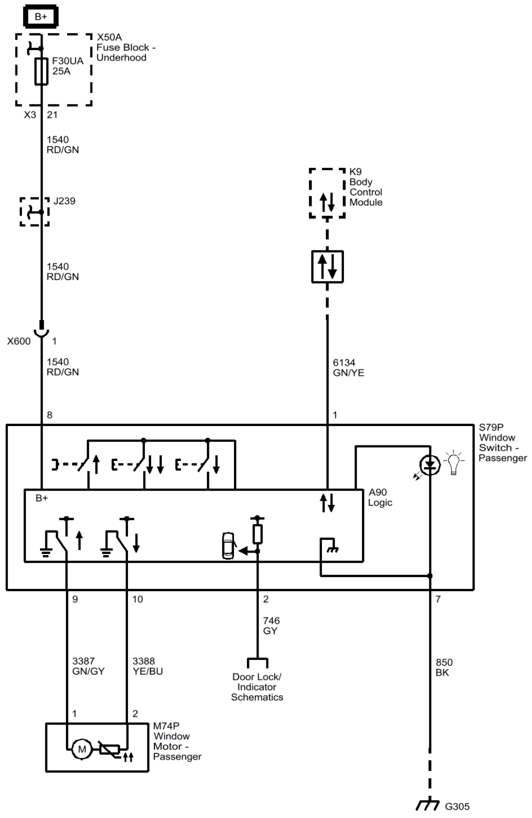

B+
X50A
Fuse Block -
Underhood
F30UA
25A
X3
21
1540
RD/GN
J239
1540
RD/GN
X600
1
1540
RD/GN
K9
Body
Control
Module
6134
GN/YE
8
1
S79P
Window
Switch -
Passenger
B+
A90
Logic
9
10
2
7
3387
GN/GY
3388
YE/BU
746
GY
Door Lock/
Indicator
Schematics
850
BK
1
2
M
M74P
Window
Motor -
Passenger
G305

Fig. 2: Passenger Door

Courtesy of GENERAL MOTORS COMPANY

Rear Doors

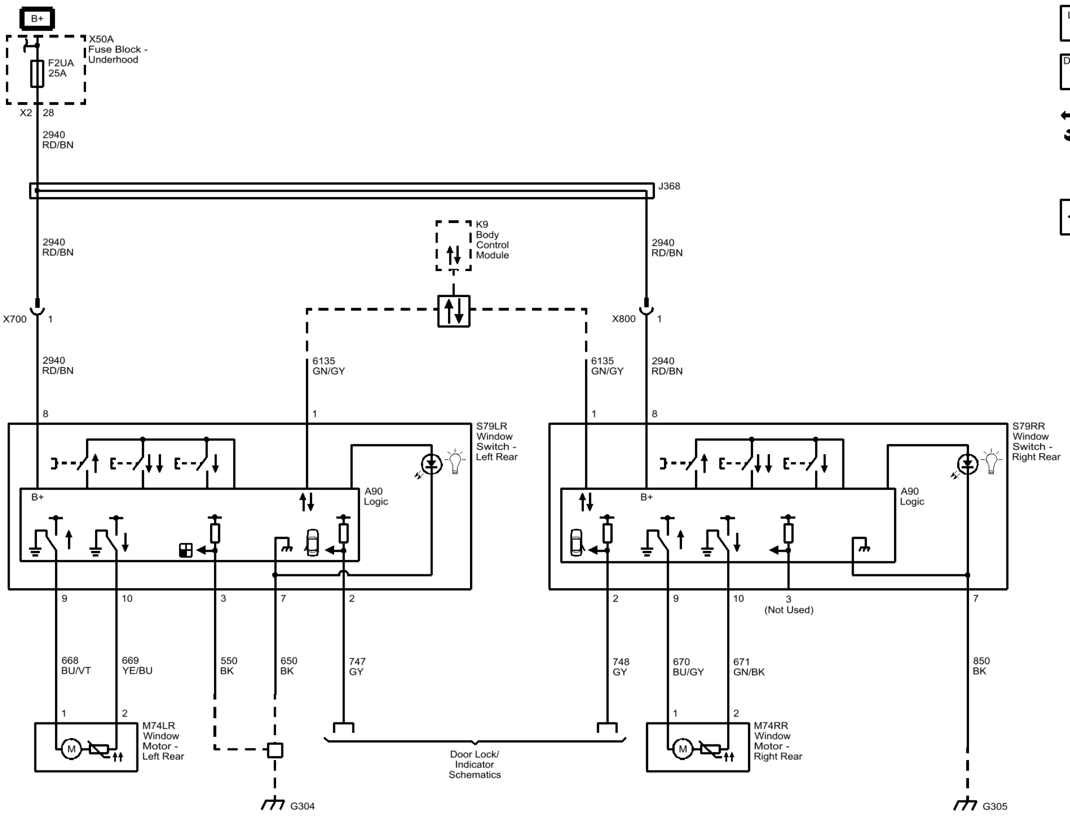

B+
X50A
Fuse Block -
Underhood
F2UA
25A
X2
28
2940
RD/BN
J368
2940
RD/BN
K9
Body
Control
Module
2940
RD/BN
X700
1
X800
1
2940
RD/BN
6135
GN/GY
6135
GN/GY
2940
RD/BN
8
1
S79LR
Window
Switch -
Left Rear
B+
A90
Logic
1
8
S79RR
Window
Switch -
Right Rear
B+
A90
Logic
9
10
3
7
2
2
9
10
3
(Not Used)
7
668
BU/VT
669
YE/BU
550
BK
650
BK
747
GY
748
GY
670
BU/GY
671
GN/BK
850
BK
1
2
M
M74LR
Window
Motor -
Left Rear
Door Lock/
Indicator
Schematics
1
2
M
M74RR
Window
Motor -
Right Rear
G304
G305

Fig. 3: Rear Doors
Courtesy of GENERAL MOTORS COMPANY

DEFOGGER WIRING SCHEMATICS

Rear Window Defogger

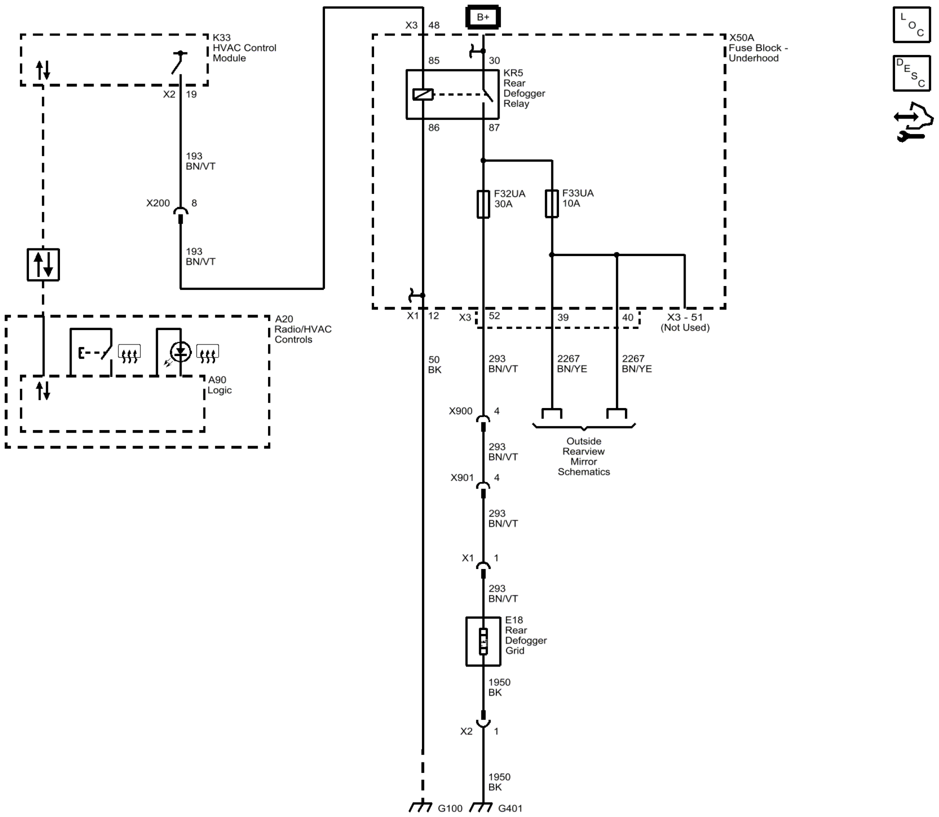

K33
HVAC Control
Module
X2 19
193
BN/VT
X200 8
193
BN/VT
X3 48
B+
X50A
Fuse Block -
Underhood
85 30
KR5
Rear
Defogger
Relay
86 87
F32UA
30A
F33UA
10A
X1 12
X3 52
39
40
X3 - 51
(Not Used)
A20
Radio/HVAC
Controls
A90
Logic
50
BK
293
BN/VT
2267
BN/YE
2267
BN/YE
X900 4
Outside
Rearview
Mirror
Schematics
X901 4
X1 1
E18
Rear
Defogger
Grid
1950
BK
X2 1
G100
G401
LOC
DESC

Fig. 4: Rear Window Defogger
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0283: REAR DEFOGGER CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC B0283

Rear Defogger Circuit

Symptom Byte Information: Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Relay Coil	B0283 02	B0283 05	B0283 05	-
Ground - Relay Coil	-	B0283 05	-	-

Circuit/System Description

For an overview of the component/system, refer to: **Rear Window Defogger Description and Operation**

Circuit	Description
B+ - Relay Switch	Supplied from a fuse.
E18 Rear Defogger GridControl - Component	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to 12 V to activate the component.
E18 Rear Defogger GridGround - Component	Chassis Ground
Ground - Relay Coil	Chassis Ground

Component	Description
KR5 Rear Defogger Relay	A relay is a switch that is actuated by a solenoid.
E18 Rear Defogger Grid	Window defoggers are parallel resistive conductors in or on the glass that heat up when electric power is applied.
K33 HVAC Control Module	The control module controls a series of actuators to ensure optimal heating, ventilation and air conditioning of the passenger compartment. The control module does this by reading values from a variety of sensors and interprets the data and adjusts the actuators accordingly.
A26 HVAC Controls	This device is the user interface to control the HVAC system. Some buttons and indicators are hardwired, some functions use serial data communication.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

- B0283 02 Control Circuit = Short to Ground
- B0283 05 Control Circuit = OpenorShort to Battery

Actions Taken When the DTC Sets

- B0283 02E18 Rear Defogger Grid = Disabled
- B0283 05E18 Rear Defogger Grid = DisabledorAlways On

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Perform the scan tool control function: Rear Defogger - On and Off

   Verify the component turns On and Off: E18 Rear Defogger Grid

   - **If the component does not turn On and Off**

     Refer to: Circuit/System Testing

   - **If the component turns On and Off**
3. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Remove the component: KR5 Rear Defogger Relay
3. Test for less than 10 Ω between the test points: Ground circuit terminal 86 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 86 & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Connect a test lamp between the test points: Control circuit terminal 85 & Ground circuit terminal 86
5. Ignition - On / Vehicle - In Service Mode
6. Perform the scan tool control function: Rear Defogger - On and Off

   Verify the test lamp turns On and Off.

   - **If the test lamp is always Off**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Disconnect the electrical connector: K33 HVAC Control Module
   3. Test for infinite resistance between the test points: Control circuit terminal 85 at Relay Socket & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance
   4. Test for less than 2 Ω between the test points: Control circuit terminal 85 at Relay Socket & Terminal 19 X2 at Control module harness
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Replace the component: K33 HVAC Control Module

    - **If the test lamp is always On**

    1. Ignition/Vehicle - Off & Remove - Test lamp
    2. Disconnect the electrical connector: K33 HVAC Control Module
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Control circuit terminal 85 at Relay Socket & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V - Replace the component: K33 HVAC Control Module

    - **If the test lamp turns On and Off**

7. Test or replace the component: KR5 Rear Defogger Relay

Component Testing

Relay Test

1. Ignition/Vehicle - Off
2. Remove the component: KR5 Rear Defogger Relay
3. Test for 70 to 110 Ω between the test points: Component terminal 85 & Component terminal 86
    - **If not between 70 and 110 Ω**

      Replace the component: KR5 Rear Defogger Relay

    - **If between 70 and 110 Ω**
4. Test for infinite resistance between the test points:
    - Component terminal 30 & 85
    - Component terminal 30 & 86
    - Component terminal 30 & 87
    - Component terminal 85 & 87
    - **If less than infinite resistance**

      Replace the component: KR5 Rear Defogger Relay

    - **If infinite resistance**
5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & 12 V

   Connect a jumper wire between the test points: Component terminal 85 & Ground

6. Test for less than 2 Ω between the test points: Component terminal 30 & Component terminal 87
    - **If 2 Ω or greater**

      Replace the component: KR5 Rear Defogger Relay

    - **If less than 2 Ω**
7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- For control module replacement, programming, and setup refer to: Control Module References

DTC B316B, B317A, B318A, OR B319A: WINDOW SWITCH

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B316B

Driver Window Switch

DTC B317A

Passenger Window Switch

DTC B318A

Left Rear Window Switch

DTC B319A

Right Rear Window Switch

For symptom byte information refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Window Switch Down Signal	B316B 02	1	1	-
Driver Window Switch Up Signal	B316B 02	2	2	-
Driver Window Switch Express Signal	B316B 02	3	3	-
1. Driver window switch down function inoperative 2. Driver window switch up function inoperative 3. Driver window switch express function inoperative				

Circuit/System Description

The driver window motor supplies 12 V signal circuits to the driver window switch, when a window switch has been activated, a switch closes providing a ground to the appropriate signal circuit causing the voltage to drop to 0 V. The driver window motor will detect the voltage drop in the signal circuit and will command the window to move in the desired direction.

The driver window/outside rearview mirror switch also contains control switches for the passenger, left rear and right rear window functions. When a window switch is pressed, a serial data message is sent to the body control module. The body control module examines the request and checks for messages from other power window motors that may prohibit window movement. If no prohibitive messages have been received, the body control module will send a serial data message to the appropriate passenger or rear window switch which will perform the command as requested.

Conditions for Running the DTC

Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B316B 00

The body control module has detected a control switch on the driver window/outside rearview mirror switch has been active for greater than 60 seconds.

B316B 02

The driver window motor has detected the driver window/outside rearview mirror switch is active for greater than 60 seconds.

B316B 39

The driver window motor has detected an internal failure within the driver window/outside rearview mirror switch.

B317A 02

The body control module has detected the passenger window switch is active for greater than 60 seconds.

B317A 39

The body control module has detected an internal failure within the passenger window switch.

B318A 02

The body control module has detected the left rear window switch is active for greater than 60 seconds.

B318A 39

The body control module has detected an internal failure within the left rear window switch.

B319A 02

The body control module has detected the right rear window switch is active for greater than 60 seconds.

B319A 39

The body control module has detected an internal failure within the right rear window switch.

Action Taken When the DTC Sets

The affected power window will malfunction.

Conditions for Clearing the DTC

B316B 00, B316B 02, B317A 02, B318A 02, B319A 02

- The DTC will be current for as long as the fault is present.
- The DTC will change from current to history when the fault is no longer present.
- A history DTC will clear after 100 consecutive ignition cycles if the condition for the malfunction is no longer present.

B316B 39, B317A 39, B318A 39, B319A 39

If the DTC is current, the affected window switch must be replaced before the DTC can be cleared.

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Windows Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool parameters listed below change when pressing and pulling the passenger and rear window control switches on the S146 Window/Outside Rearview Mirror Switch-Driver:
    - Left Rear Main Control Down Switch - Inactive and Active
    - Left Rear Main Control Express Switch - Inactive and Active
    - Left Rear Main Control Up Switch - Inactive and Active
    - Right Rear Main Control Down Switch - Inactive and Active
    - Right Rear Main Control Express Switch - Inactive and Active
    - Right Rear Main Control Up Switch - Inactive and Active
    - Front Passenger Main Control Down Switch - Inactive and Active
    - Front Passenger Main Control Express Switch - Inactive and Active
    - Front Passenger Main Control Up Switch - Inactive and Active
    - **If any parameter does not change**

      Replace the S146 Window/Outside Rearview Mirror Switch-Driver.

    - **If the parameters change**
3. Verify the scan tool parameters listed below change when pressing and pulling the S79P Window Switch-Passenger, the S79LR Window Switch-Left Rear and the S79RR Window Switch-Right Rear.
    - Passenger Window Switch at Door - Inactive, Up, Down, Express Down
    - Left Rear Window Switch at Door - Inactive, Up, Down, Express Down
    - Right Rear Window Switch at Door - Inactive, Up, Down, Express Down
    - **If any parameter does not change**

      Test or replace the appropriate passenger or rear S79 Window Switch

    - **If all the parameters change**
4. Verify the scan tool parameters listed below change when pressing and pulling the driver window control switch on the S146 Window/Outside Rearview Mirror Switch-Driver:
    - Driver Window Main Control Down Switch - Inactive and Active
    - Driver Window Main Control Up Switch - Inactive and Active
    - Driver Window Main Control Express Down Switch - Inactive and Active
    - Driver Window Main Control Express Up Switch - Inactive and Active
    - **If any parameter does not change**

      Refer to Circuit/System Testing.

    - **If all the parameters change**
5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch-Driver. It may take up to 2 minutes for all vehicle systems

to power down.

2. Test for less than 10 Ω between the ground circuit terminal 24 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 23 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the S146 Window/Outside Rearview Mirror Switch-Driver.
    - **If the test lamp illuminates**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 24.

NOTE: **Leaving the 3 A fused jumper wire connected between the signal circuit and ground for greater than 60 sec will cause the scan tool Driver Window Main Control Down Switch parameter to change from Active to Inactive**

6. Verify the scan tool Driver Window Main Control Down Switch parameter is Active
    - **If not Active**
    1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the M74D Window Motor-Driver, Vehicle in Service Mode.
    2. Test for infinite resistance between the S146 Window/Outside Rearview Mirror Switch-Driver signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 1 V between the S146 Window/Outside Rearview Mirror Switch-Driver signal circuit terminal 1 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the M74D Window Motor-Driver.
    - **If Active**
7. Install a 3 A fused jumper wire between the signal circuit terminal 11 and the ground circuit terminal 24.

NOTE: **Leaving the 3 A fused jumper wire connected between the signal circuit and ground for greater than 60 sec will cause the scan tool Driver Window Main Control Up Switch parameter to change from Active to Inactive**

8. Verify the scan tool Driver Window Main Control Up Switch parameter is Active
    - **If not Active**
    1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the M74D Window Motor-Driver, Vehicle in Service Mode.
    2. Test for infinite resistance between the S146 Window/Outside Rearview Mirror Switch-Driver signal circuit terminal 11 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 1 V between the S146 Window/Outside Rearview Mirror Switch-Driver signal circuit 11 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the M74D Window Motor-Driver.
    - **If Active**
9. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 24.

NOTE: **Leaving the 3 A fused jumper wire connected between the signal circuit and ground for greater than 60 sec will cause the scan tool Driver Window Main Control Express Switch parameter to change from Active to Inactive**

10. Verify the scan tool Driver Window Main Control Express Switch parameter is Active
    - **If not Active**
    1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the M74D Window Motor-Driver, Vehicle in Service Mode.
    2. Test for infinite resistance between the S146 Window/Outside Rearview Mirror Switch-Driver signal circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 1 V between the S146 Window/Outside Rearview Mirror Switch-Driver signal circuit 5 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the M74D Window Motor-Driver.
    - **If Active**
11. Test or replace the S146 Window/Outside Rearview Mirror Switch-Driver.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Front Side Door Window Switch Replacement
- Front Side Door Window Control Switch Replacement
- Rear Side Door Window Switch Replacement
- Front Side Door Window Regulator Replacement
- Rear Side Door Window Regulator Replacement

DTC B3205: DRIVER WINDOW MOTOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3205

Driver Window Motor Circuit

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When a window switch is pressed on the driver window switch, a serial data message is sent to the body control module (BCM). The BCM examines the request and checks for messages from other power window motors prohibiting the window movement. If no prohibitive messages have been received, the BCM will send a serial data message to the passenger window motor or to the appropriate rear window switch which will perform the command as requested.

Conditions for Running the DTC

- The ignition switch is in the ON position.
- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B3205 00

The BCM has detected that the compatibility code stored in the driver window motor does not match the compatibility code stored in the BCM.

B3205 39

An internal malfunction has been detected by the BCM in the driver window motor while commanding the window UP or DOWN.

B3205 42

The BCM will automatically attempt to download the calibration program into the driver window motor (As will occur when the window motor has been replaced), if the first calibration program fails to load, the BCM will attempt to download the calibration program a second time. If this download fails, the BCM will set DTC.

B3205 4B

The BCM detects that the driver window motor is "not normalized" which will occur under the following conditions:

- When the battery has been disconnected
- When the battery has been replaced
- When the door wiring harness has been disconnected
- When the window motor has been disconnected.

Action Taken When the DTC Sets

B3205 00, B3205 39, B3205 42

The driver motor will be inoperative.

B3205 4B

The driver motor will not perform the express up or express down functions and the driver information center will display Open, then Close Driver Window.

Conditions for Clearing the DTC

B3205 00

Installing a compatible window motor for that specific make and model vehicle.

B3205 39

The window motor must be replaced before the DTC can be cleared.

B3205 42

The window motor must be replaced before the DTC can be cleared.

B3205 4B

The window motor must be normalized before the DTC can be cleared.

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Windows Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON
2. Verify the driver window functions while commanding the Driver Window Motor Up and Down with a scan tool.
    - **If the Up and Down functions do not work**

      Replace the M74D Window Motor - Driver.

    - **If the UP and DOWN functions works**
3. Verify the driver window performs the Express Up and Express Down functions with the S79D Window Switch-Driver.
    - **If the driver window does not Express Up and Express Down**

      Normalize the M74D Window Motor - Driver, refer to **Window Motor Programming - Express Function**.

  - **If the driver window performs the Express Up and Express Down functions**

4. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Ignition ON
6. Verify the driver window performs the Express Up and Express Down functions with the S79D Window Switch-Driver.
   - **If the driver window does not Express Up and Express Down**

     Replace the M74D Window Motor - Driver

   - **If the driver window performs the Express Up and Express Down functions**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Front Side Door Window Regulator Replacement

SYMPTOMS - FIXED AND MOVEABLE WINDOWS

Important Preliminary Checks Before Starting:

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the power window system operation or rear window defogger system operation in order to familiarize yourself with the system functions. Refer to the following:
   - **Rear Window Defogger Description and Operation**
   - **Power Windows Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the rear window defogger. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

NOTE:

- **Inspect for proper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Ensure that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone signal may cause the condition. Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .**
- **The problem may or may not turn ON the SERVICE VEHICLE SOON indicator or store a DTC. Do not use the symptom tables to diagnose intermittent conditions. The malfunction must be present in order to locate the problem.**

Poor electrical connections or wiring cause most intermittent conditions. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body

- An improperly formed or damaged terminal
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.
- Poor terminal to wire connection requires removing the terminal from the connector body in order to perform the check.

Use a scan tool in order to help detect intermittent conditions. The scan tool has several features that can be used to locate an intermittent condition. The snapshot feature can capture and store data parameters within the scan tool when the malfunction occurs. This information can then be reviewed in order to see what caused the malfunction.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Rear Window Defogger Malfunction**
- **Power Windows Malfunction**

REAR WINDOW DEFOGGER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay B+	1	1	-	-
Relay Control	B0283 02	B0283 05	B0283 05	-
Rear Defogger Grid Control	1	1	2	-
Relay Ground	-	B0283 05	-	-
Rear Defogger Grid Ground	-	1	-	-
1. Rear Defogger Inoperative 2. Rear Defogger Always ON				

Circuit/System Description

When the HVAC control module receives a rear window defog request from the HVAC controls, the HVAC control module will supply voltage to the relay coil. Battery positive voltage is supplied at all times to the relay switched input and the relay coil is always grounded. This allows battery positive voltage from the relay switched input to flow through the switch contacts and out the relay switched output to the rear window defogger grid.

Diagnostic Aids

Rear window defogger indicator will still function when the switch is pressed but any of the following conditions may cause the rear window defogger not to function:

- Ambient temperature at the HVAC control module must be less than 10Ã‚Â°C (50Ã‚Â°F).
- System voltage is out of range.
- A DTC is set that disables rear window defogger functionality.

Reference Information

Schematic Reference

Defogger Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Window Defogger Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool Rear Defogger Switch parameter changes between On and Off when pressing the rear window defogger switch.
    - **If the parameter does not change between On and Off**

      Replace the A26 HVAC Controls.

    - **If the parameter changes between On and Off**
3. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.
    - **If the E18 Rear Defogger Grid does not turn ON and OFF**

      Refer to Circuit/System Testing

    - **If the E18 Rear Defogger Grid turns ON and OFF**
4. Verify the rear window defogger indicator turns ON and OFF when pressing the rear window defogger switch.
    - **If the indicator does not turn ON and OFF**

      Replace the A26 HVAC Controls.

    - **If the indicator turns ON and OFF**
5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR5 Rear Defogger Relay. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 86 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

    - **If the test lamp does not illuminate**
    - Replace the X50A Fuse Block-Underhood
    - **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 85 and the ground circuit terminal 86.
6. Verify the test lamp turns ON and OFF pressing the rear window defogger switch.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K33 HVAC Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K33 HVAC Control Module.
    - **If the test lamp turns ON and OFF**
7. Verify that a test lamp does not illuminate between the control circuit terminal 87 and ground.
    - **If the test lamp illuminates**

      Repair the short to voltage on the control circuit

    - **If the test lamp does not illuminate**
8. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the E18 Rear Defogger Grid. It may take up to 2 minutes for all vehicle systems to power down.
9. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
10. Connect the X2 harness connector at the E18 Rear Defogger Grid.
11. Vehicle in Service Mode, connect a 30 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
12. Verify the E18 Rear Defogger Grid is activated.
    - **If the E18 Rear Defogger Grid does not activate**
    1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the E18 Rear Defogger Grid.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the E18 Rear Defogger Grid.
    - **If the E18 Rear Defogger Grid activates**
13. Test or replace the KR5 Rear Defogger Relay.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the KR5 Rear Defogger Relay.
2. Test for 60-180 Ω between terminals 85 and 86.
   - **If less than 60 Ω or greater than 180 Ω**

     Replace the KR5 Rear Defogger Relay.

   - **If between 60-180 Ω**
3. Test for infinite resistance between the terminals listed below:
   - 30 and 86
   - 30 and 87
   - 30 and 85
   - 85 and 87
   - **If less than infinite resistance**

     Replace the KR5 Rear Defogger Relay.

   - **If infinite resistance**
4. Install a 3 A fused jumper wire between relay terminal 86 and 12 V. Install a jumper wire between relay terminal 85 and ground.
5. Test for less than 2 Ω between terminals 30 and 87.
   - **If 2 Ω or greater**

     Replace the KR5 Rear Defogger Relay.

   - **If less than 2 Ω**
6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Window Replacement**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for HVAC control module and HVAC controls replacement, programming and setup

POWER WINDOWS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - S146 Window/Outside Rearview Mirror Switch - Driver	U1538 00	U1538 00	-	-
B+ - S146 Window/Outside Rearview Mirror Switch - Driver	U1534 00	U1534 00	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - S79P Window Switch - Passenger	U153A 00	U153A 00	-	-
B+ - S79RR Window Switch - Right Rear	U1534 00, U154A 00	U154A 00	-	-
B+ - S79LR Window Switch - Left Rear	U1534 00, U154A 00	U1534 00	-	-
Serial Data - S146 Window/Outside Rearview Mirror Switch - Driver	U1534 00, U1538 00, U153A 00	U1538 00	U1538 00	-
Serial Data - M74D Window Motor - Driver	U1534 00, U1538 00, U153A 00	U1534 00	U1534 00	-
Serial Data - S79P Window Switch - Passenger	U1534 00, U1538 00, U153A 00	U153A 00	U153A 00	-
Serial Data - S79LR Window Switch - Left Rear	U1534 00, U154A 00	U1534 00	U1534 00	-
Serial Data - S79RR Window Switch - Right Rear	U1534 00, U154A 00	U154A 00	U154A 00	-
Power Window Master Switch Left Front Down Signal	B316B 02	1	1	B316B 39
Power Window Switch Driver Express Signal	1	1	1	B316B 39
Power Window Master Switch Left Front Up Signal	B316B 02	1	1	B316B 39
Control - M74P Window Motor - Passenger	2	2	2	-
Control - M74LR Window Motor - Left Rear	3	3	3	-
Control - M74RR Window Motor - Right Rear	4	4	4	-
Ground - S146 Window/Outside Rearview Mirror Switch - Driver	-	U1538 00	-	-
Ground - M74D Window Motor - Driver	-	U1534 00	-	-
Ground - S79P Window Switch - Passenger	-	U153A 00	-	-
Ground - S79LR Window Switch - Left Rear	-	U1534 00	-	-
Ground - S79RR Window Switch - Right Rear	-	U154A 00	-	-

1. M74D Window Motor - Driver = Inoperative
2. M74P Window Motor - Passenger = Inoperative
3. M74LR Window Motor - Left Rear = Inoperative
4. M74RR Window Motor - Right Rear = Inoperative

Circuit/System Description

For an overview of the component/system, refer to: Power Windows Description and Operation

Circuit	Description
B+ - M74D Window Motor - Driver	Supplied from a fuse.
B+ - M74P Window Motor - Passenger	Supplied from a fuse.

Circuit	Description
B+ - S79LR Window Switch - Left Rear	Supplied from a fuse.
B+ - S79RR Window Switch - Right Rear	Supplied from a fuse.
Power Window Switch Driver Down Signal	The output circuit is switched to ground to activate the component.
Power Window Switch Driver Express Signal	The output circuit is switched to ground to activate the component.
Power Window Switch Driver Up Signal	The output circuit is switched to ground to activate the component.
Power Window Motor Passenger Down Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Passenger Up Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Left Rear Up Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Left Rear Down Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Right Rear Up Control	The output circuit is switched from ground to 12 V to activate the component.
Power Window Motor Right Rear Down Control	The output circuit is switched from ground to 12 V to activate the component.
Ground	Chassis Ground

Component	Description
S146 Window/Outside Rearview Mirror Switch - Driver	The S146 sends a serial data message to the K9 indicating the M74 function that has been requested.
M74D Window Motor - Driver	• Power Window Control • The control module and the DC motor are one assembly.
S79P Window Switch - Passenger	The switch has a normally open contact.
M74P Window Motor - Passenger	An electric DC motor.
S79LR Window Switch - Left Rear	The switch has a normally open contact.
M74LR Window Motor - Left Rear	An electric DC motor.
S79RR Window Switch - Right Rear	The switch has a normally open contact.
M74RR Window Motor - Right Rear	An electric DC motor.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Diagnostic Aids

M74D Window Motor - Driver - Window Express Up System Not Initialized

- Battery - Disconnected/Replaced
- Front Side Door Wiring Harness - Disconnected
- M74 Window Motor - Disconnected

M74D Window Motor - Driver - Normalized - **Window Motor Programming - Express Function**

Reference Information

Schematic Reference

Moveable Window Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Perform the scan tool control function: Driver Window Motor - Up & Down

   Verify the component operates in both directions: M74D Window Motor - Driver

   - **If not the specified state**

     Refer to: Circuit/System Testing - Test 1

   - **If the specified state**
3. Operate the component: Driver Left Front Window Switch - Pressed & Pulled

   Verify the component works as specified: M74D Window Motor - Driver = Up/Express Up /Down/Express Down

   - **If not the specified state**

     Refer to: Circuit/System Testing - Test 2

   - **If the specified state**
4. S146 Window/Outside Rearview Mirror Switch - Driver - Not Pressed

   Verify the scan tool parameter:

   - Left Rear Window Main Control Down Switch = Inactive
   - Left Rear Window Main Control Express Switch = Inactive
   - Left Rear Window Main Control Up Switch = Inactive
   - Right Rear Window Main Control Down Switch = Inactive
   - Right Rear Window Main Control Express Switch = Inactive
   - Right Rear Window Main Control Up Switch = Inactive
   - Front Passenger Window Main Control Down Switch = Inactive
   - Front Passenger Window Main Control Express Switch = Inactive
   - Front Passenger Window Main Control Up Switch = Inactive
   - **If not the specified state**

     Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

   - **If the specified state**
5. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver-Left Rear Window Switch - Pressed & Pulled

Verify the scan tool parameter:

- Left Rear Window Main Control Down Switch = Active
- Left Rear Window Main Control Express Switch = Active
- Left Rear Window Main Control Up Switch = Active
- **If not the specified state**

  Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

- **If the specified state**

6. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver-Right Rear Window Switch - Pressed & Pulled

   Verify the scan tool parameter:

   - Right Rear Window Main Control Down Switch = Active
   - Right Rear Window Main Control Express Switch = Active
   - Right Rear Window Main Control Up Switch = Active
   - **If not the specified state**

     Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

   - **If the specified state**

7. Operate the component: S146 Window/Outside Rearview Mirror Switch - Driver-Right Front Window Switch - Pressed & Pulled

   Verify the scan tool parameter:

   - Front Passenger Window Main Control Down Switch = Active
   - Front Passenger Window Main Control Express Switch = Active
   - Front Passenger Window Main Control Up Switch = Active
   - **If not the specified state**

     Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

   - **If the specified state**

8. Perform the scan tool control function: Passenger Window Motor - Up & Down

   Verify the component works as specified: M74P Window Motor - Passenger = Up & Down

   - **If not the specified state**

     Refer to: Circuit/System Testing - Test 3

   - **If the specified state**

9. Perform the scan tool control function: Left Rear Window Motor - Up & Down

   Verify the component works as specified: M74LR Window Motor - Left Rear = Up & Down

   - **If not the specified state**

     Refer to: Circuit/System Testing - Test 3

   - **If the specified state**

10. Perform the scan tool control function: Right Rear Window Motor - Up & Down

    Verify the component works as specified: M74RR Window Motor - Right Rear = Up & Down

    - **If not the specified state**

Refer to: Circuit/System Testing - Test 3

- **If the specified state**

11. All OK.

Circuit/System Testing

Test 1

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: M74D Window Motor - Driver
3. Test for less than 10 Ω between the test points: Ground circuit terminal 1 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 1 at Component harness & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 2 & Ground
   - **If the test lamp does not turn On and the circuit fuse is OK**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Test for less than 2 Ω between the test points: M74D Window Motor - DriverB+ circuit terminal 2 at Output terminal at F28UA Fuse
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not turn On and the circuit fuse is open**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Test for infinite resistance between the test points: B+ circuit terminal 2 & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: M74D Window Motor - Driver
   - **If the test lamp turns On**
6. Test or replace the component: M74D Window Motor - Driver

Test 2

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: S146 Window/Outside Rearview Mirror Switch - Driver
3. Test for less than 10 Ω between the test points: Ground circuit terminal 24 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 24 at Component harness & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.

   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 23 & Ground
   - **If the test lamp does not turn On and the circuit fuse is OK**
     1. Ignition/Vehicle - Off & Remove - Test lamp
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not turn On and the circuit fuse is open**
     1. Ignition/Vehicle - Off & Remove - Test lamp
     2. Test for infinite resistance between the test points: B+ circuit terminal 23 & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component: S146 Window/Outside Rearview Mirror Switch - Driver
   - **If the test lamp turns On**
6. Verify the scan tool parameter: Driver Window Main Control Down Switch = Inactive
   - **If not the specified state**
     1. Ignition/Vehicle - Off
     2. Disconnect the electrical connector: M74D Window Motor - Driver
     3. Test for infinite resistance between the test points: Signal circuit terminal 1 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component: M74D Window Motor - Driver
   - **If the specified state**
7. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 24

   Verify the scan tool parameter: Driver Window Main Control Down Switch = Active

   - **If not the specified state**
     1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
     2. Disconnect the electrical connector: M74D Window Motor - Driver
     3. Ignition - On / Vehicle - In Service Mode
     4. Test for less than 1 V between the test points: Signal circuit terminal 1 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
     5. Ignition/Vehicle - Off
     6. Test for less than 2 Ω between the test points: Signal circuit terminal 1 at Component harness & Terminal 7 at M74D Window Motor - Driver
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: M74D Window Motor - Driver
   - **If the specified state**
8. Verify the scan tool parameter: Driver Window Main Control Up Switch = Inactive
   - **If not the specified state**
     1. Ignition/Vehicle - Off
     2. Disconnect the electrical connector: M74D Window Motor - Driver
     3. Test for infinite resistance between the test points: Signal circuit terminal 11 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component: M74D Window Motor - Driver
   - **If the specified state**

9. Momentarily connect a 3 A fused jumper wire between the test points: Signal circuit terminal 11 & Ground circuit terminal 24

   Verify the scan tool parameter: Driver Window Main Control Up Switch = Active

   - **If not the specified state**
   1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
   2. Disconnect the electrical connector: M74D Window Motor - Driver
   3. Ignition - On / Vehicle - In Service Mode
   4. Test for less than 1 V between the test points: Signal circuit terminal 11 at Component harness & Ground
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V
   5. Ignition/Vehicle - Off
   6. Test for less than 2 Ω between the test points: Signal circuit terminal 11 at Component harness & Terminal 3 at M74D Window Motor - Driver
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Replace the component: M74D Window Motor - Driver
   - **If the specified state**
10. Test for greater than 10 V between the test points: Signal circuit terminal 5 at Component harness & Ground
   - **If 10 V or less**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: M74D Window Motor - Driver
   3. Test for infinite resistance between the test points: Signal circuit terminal 5 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If less than infinite resistance
   1. Ignition/Vehicle - Off
   2. Test for less than 2 Ω between the test points: Signal circuit terminal 11 at Component harness & Signal circuit terminal 3 at M74D Window Motor - Driver
   - If 2 Ω or greater - Repair the open/high resistance in the circuit.
   - If less than 2 Ω - Replace the component: M74D Window Motor - Driver
   - **If the specified state**
11. Test or replace the component: S146 Window/Outside Rearview Mirror Switch - Driver

Test 3

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: S79P Window Switch - Passenger/S79LR Window Switch - Left Rear/S79RR Window Switch - Right Rear
3. Test for less than 10 Ω between the test points: Ground circuit terminal 7 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 7 at Component harness & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**

4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 8 & Ground
   - **If the test lamp does not turn On and the circuit fuse is OK**
   1. Ignition/Vehicle - Off & Remove - Test lamp
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not turn On and the circuit fuse is open**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Test for infinite resistance between the test points: B+ circuit terminal 8 & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: S79 Window Switch
   - **If the test lamp turns On**
6. Ignition/Vehicle - Off
7. Connect the electrical connector. S79 Window Switch
8. Disconnect the electrical connector: M74 Window Motor
9. Connect a test lamp between the test points: Control circuit terminal 1 & Control circuit terminal 2
10. Ignition - On / Vehicle - In Service Mode
11. Perform the scan tool control function: Window Motor

    Verify the test lamp state:

    Window Motor - Stop = Test lamp Off

    Window Motor - Up = Test lamp On

    Window Motor - Down = Test lamp On

   - **If not the specified state**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Disconnect the electrical connector: S79 Window Switch
   3. Ignition - On / Vehicle - In Service Mode
   4. Test for less than 1 V between the test points:
      - Control circuit terminal 1 at Component harness & Ground
      - Control circuit terminal 2 at Component harness & Ground
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V
   5. Ignition/Vehicle - Off
   6. Test for infinite resistance between the test points:
      - Control circuit terminal 1 at Component harness & Ground
      - Control circuit terminal 2 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance
   7. Test for less than 2 Ω between the test points:
      - Control circuit terminal 1 at Component harness & Control circuit terminal 10 at S79 Window Switch
      - Control circuit terminal 2 at Component harness & Control circuit terminal 9 at S79 Window Switch
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: S79 Window Switch
   - **If the specified state**
12. Test or replace the component: M74 Window Motor

Component Testing

M74P Window Motor - Passenger/M74LR Window Motor - Left Rear/M74RR Window Motor - Right Rear

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector:
    - M74P Window Motor - Passenger
    - M74LR Window Motor - Left Rear
    - M74RR Window Motor - Right Rear
3. Connect a 25 A fused jumper wire between the test points: Control terminal 1 & B+

    CAUTION: **Complete the testing as quickly as possible in order to prevent overheating and damaging the component.**

4. Momentarily connect a jumper wire between the test points: Control terminal 2 & Ground

    Reverse the jumper wires 2 times between the terminals.

    Verify the component works as specified: M74 Window Motor = Up & Down

    - **If not the specified state**

        Replace the component:

    - M74P Window Motor - Passenger
    - M74LR Window Motor - Left Rear
    - M74RR Window Motor - Right Rear
    - **If the specified state**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

- Front Side Door Window Switch Replacement
- Front Side Door Window Control Switch Replacement
- Rear Side Door Window Switch Replacement
- Front Side Door Window Regulator Replacement
- Rear Side Door Window Regulator Replacement

REPAIR INSTRUCTIONS

WINDSHIELD REPLACEMENT

Special Tools

- **BO-24402-A** Glass Sealant Remover (Cold Knife).
- **BO-39032** Stationary Glass Removal Tool, or equivalent in order to remove the window.
- Use a urethane adhesive systems which meet GM Specification GM 3651G

Equivalent regional tools: Special Tools

Removal Procedure

NOTE: **Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and the interior trim.**

1. Open the hood.
2. Battery Negative Cable - Disconnect - **Battery Negative Cable Disconnection and Connection**

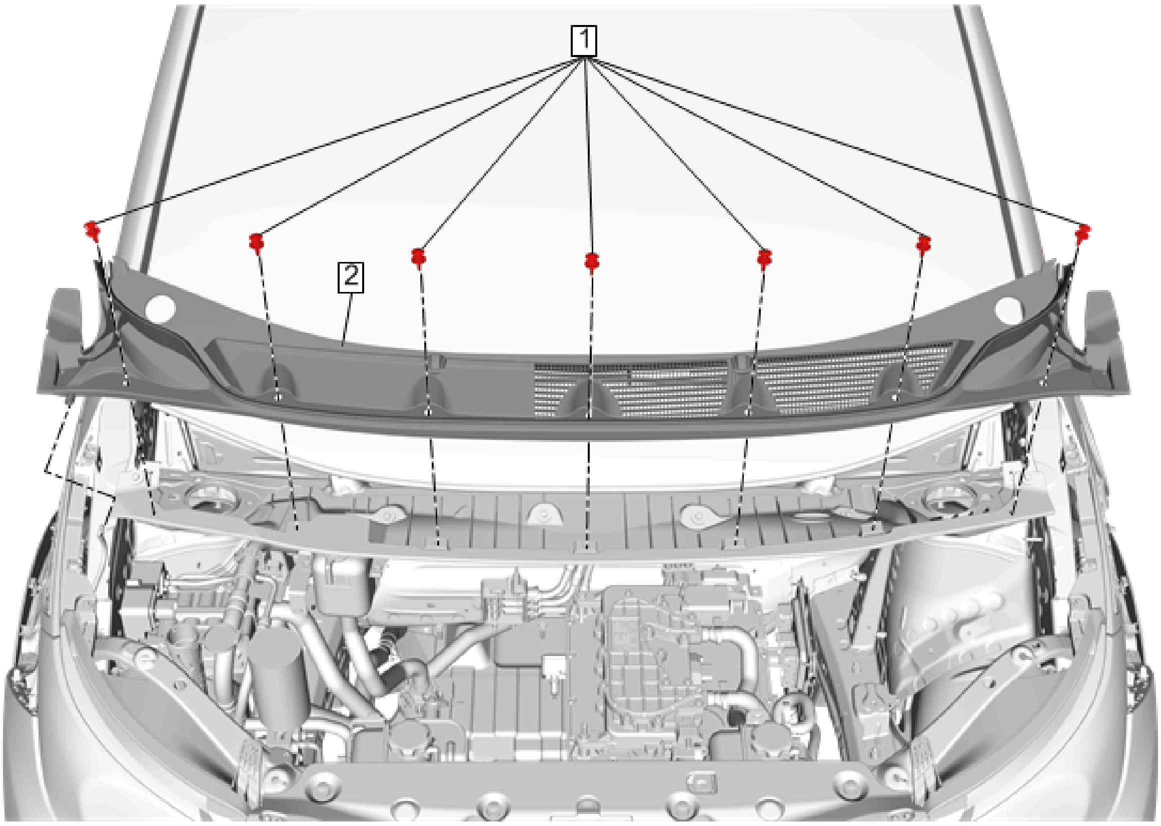


Fig. 5: Air Inlet Grille Panel
Courtesy of GENERAL MOTORS COMPANY

3. Air Inlet Grille Panel - Remove - **Air Inlet Grille Panel Replacement**

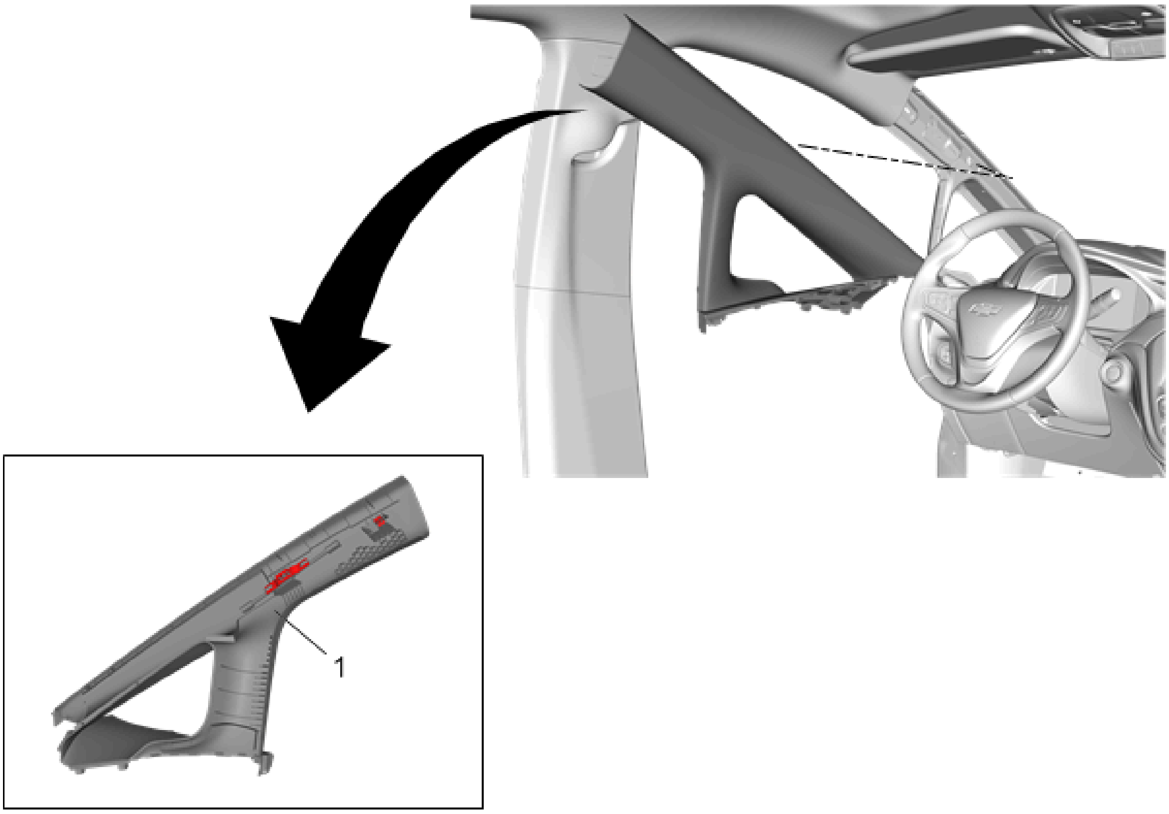


Fig. 6: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

4. Windshield Garnish Molding - Remove - **Windshield Garnish Molding Replacement**

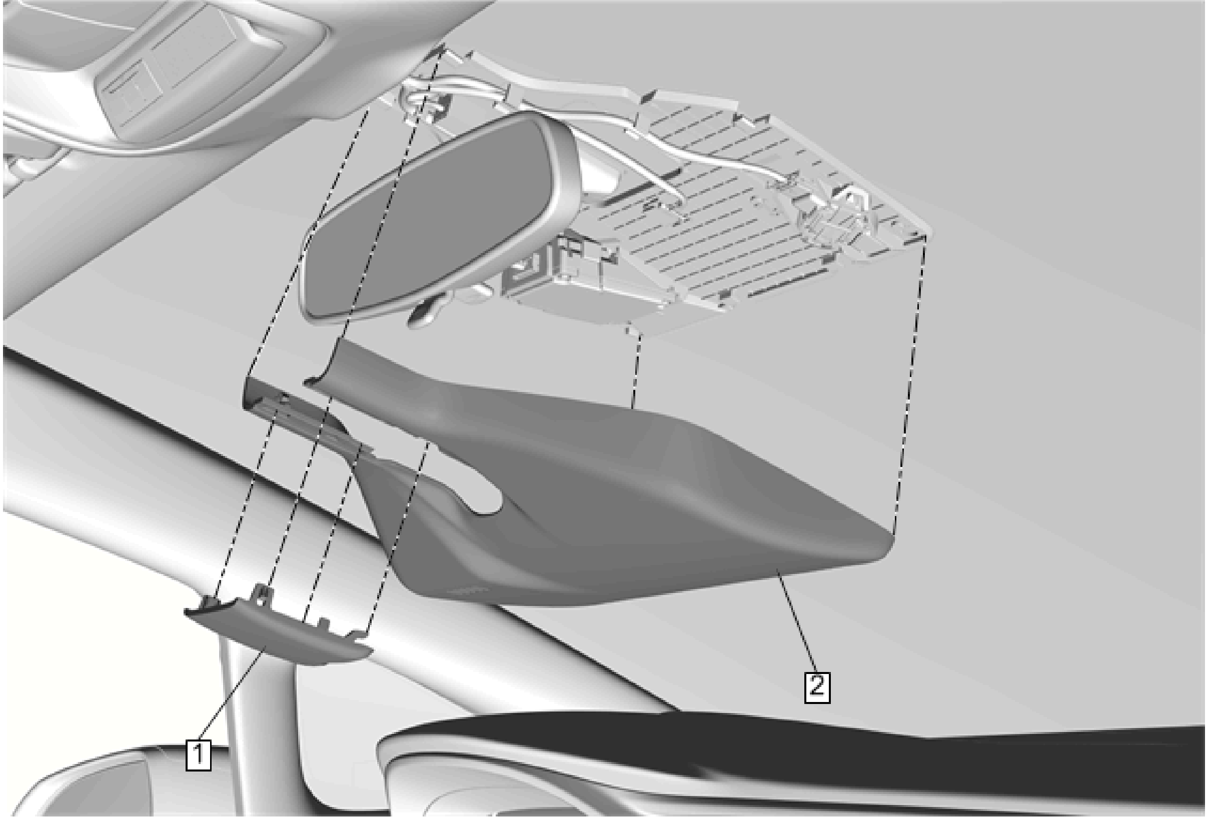


Fig. 7: Windshield Multifunction Sensor Mount Bracket Cover
Courtesy of GENERAL MOTORS COMPANY

5. Windshield Multifunction Sensor Mount Bracket Cover - Remove - Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera) Windshield Multifunction Sensor Mount Bracket Cover Replacement (without Front View Camera)

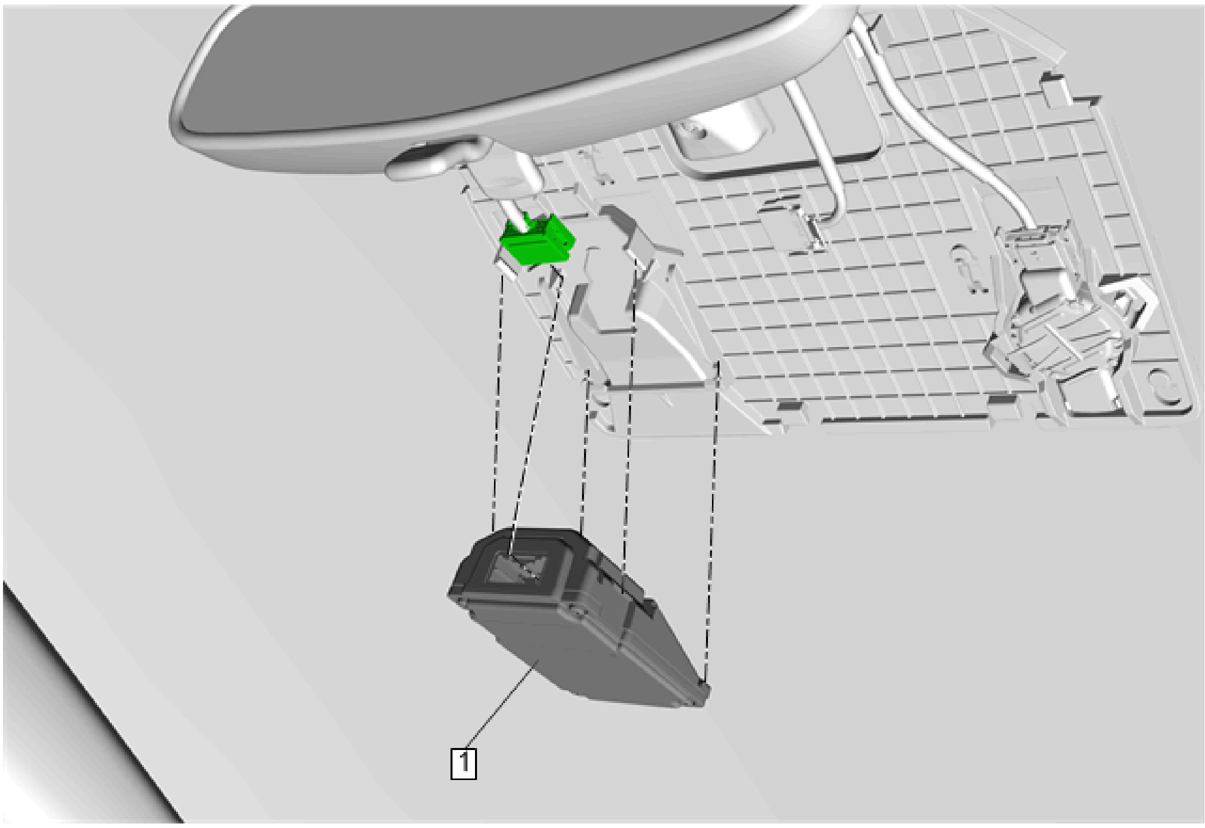


Fig. 8: Front View Camera
Courtesy of GENERAL MOTORS COMPANY

6. { If equipped } Front View Camera - Remove - Front View Camera Replacement

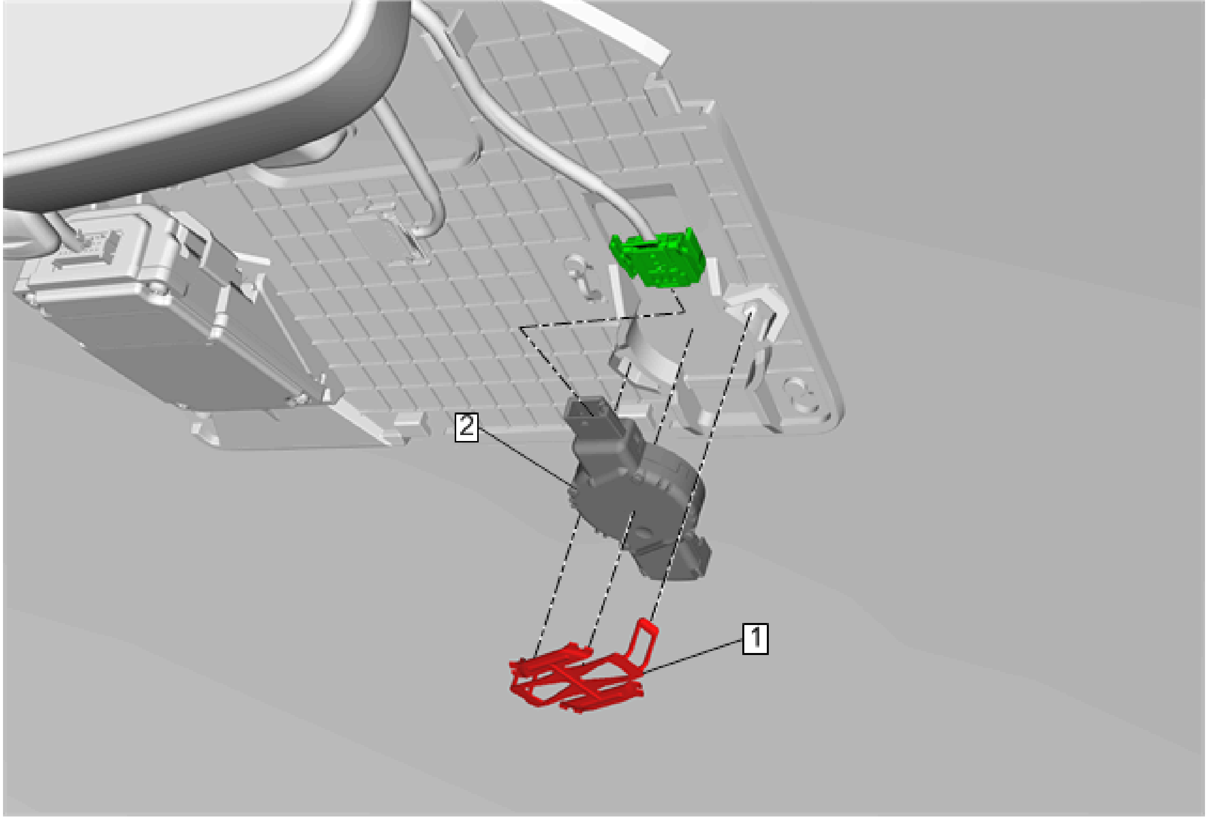


Fig. 9: Inside Air Moisture and Windshield Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

7. { If equipped } Inside Air Moisture and Windshield Temperature Sensor - Remove - **Inside Air Moisture and Windshield Temperature Sensor Replacement (With Front View Camera)** **Inside Air Moisture and Windshield Temperature Sensor Replacement (Without Front View Camera)**

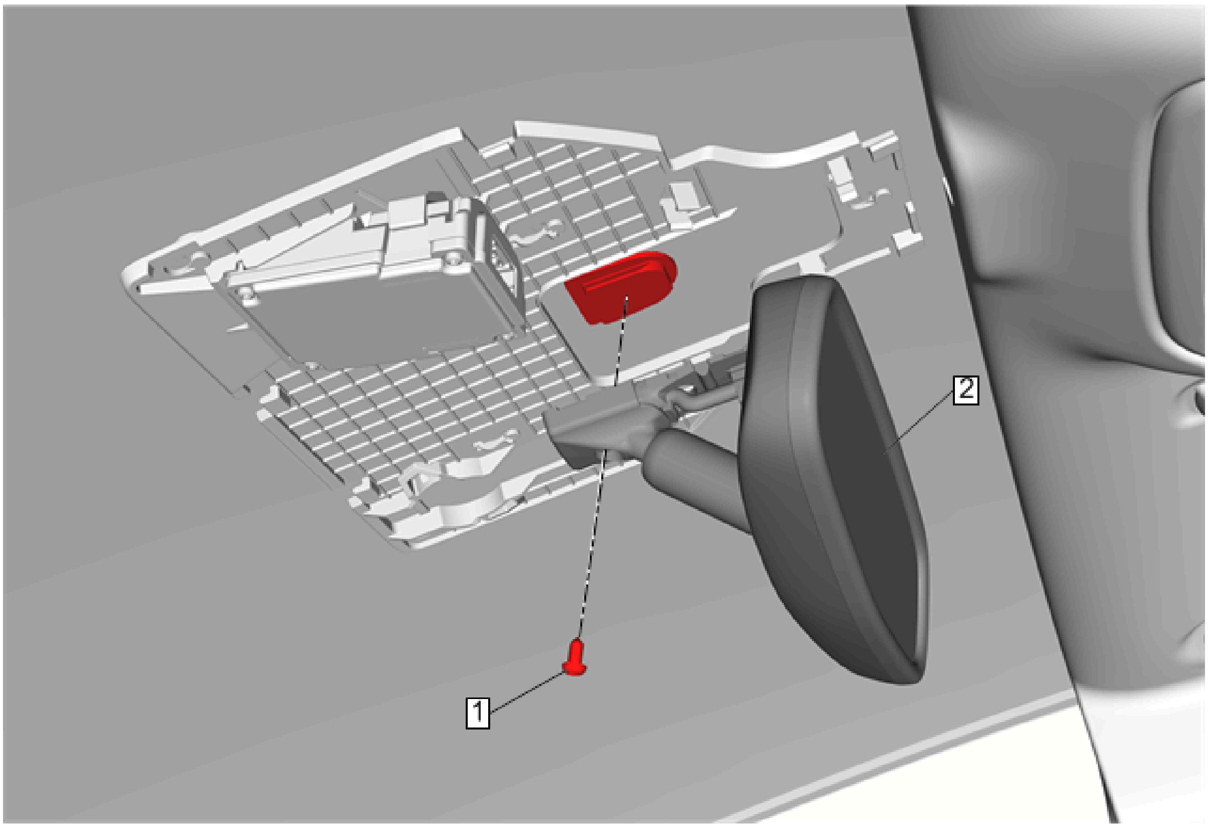


Fig. 10: Inside Rearview Mirror
Courtesy of GENERAL MOTORS COMPANY

8. Inside Rearview Mirror - Remove - **Inside Rearview Mirror Replacement**

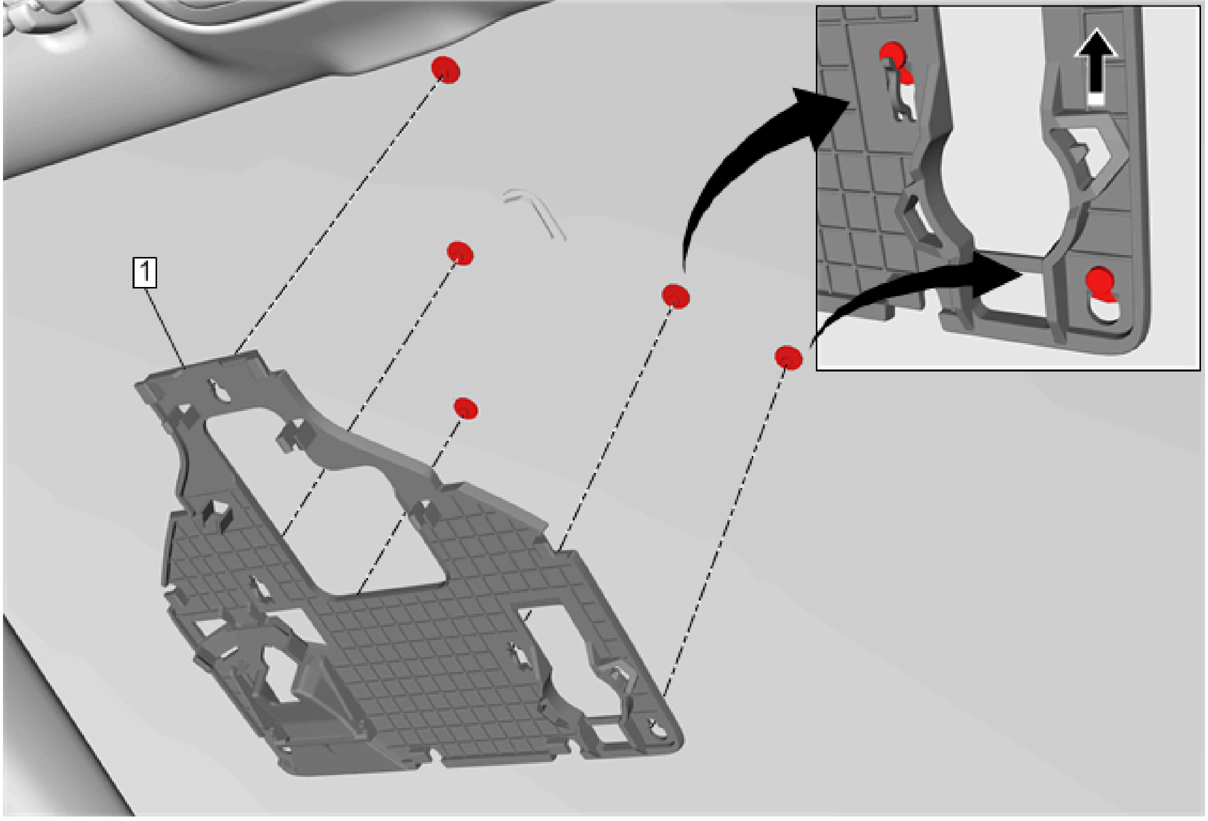


Fig. 11: Multifunction Relay Module Bracket (With Front View Camera)
Courtesy of GENERAL MOTORS COMPANY

9. Multifunction Relay Module Bracket - Remove - **Multifunction Relay Module Bracket Replacement (with Front View Camera)** **Multifunction Relay Module Bracket Replacement (without Front View Camera)**

WARNING: **If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.**

10. Cover to protect the following parts from broken glass:
    - Upper Dash Pad
    - The defroster outlets and A/C outlets
    - The seats and carpeting
11. Remove the lower windshield supports from the cowl panel, if equipped.

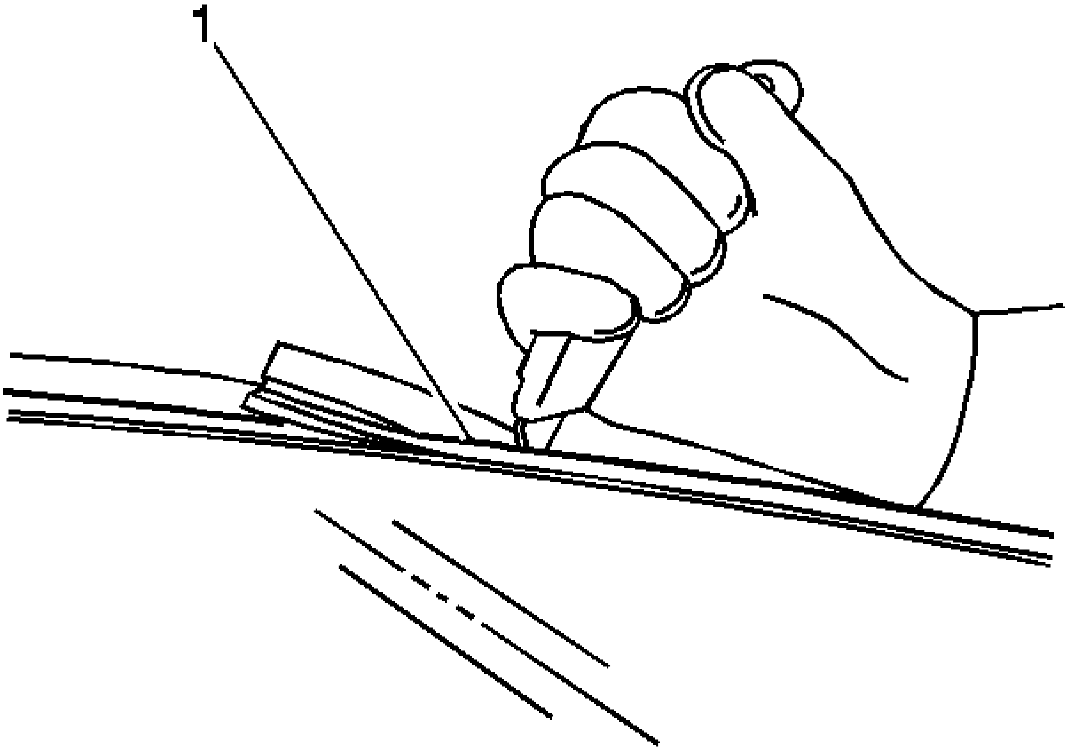


Fig. 12: Using Utility Knife To Remove Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

WARNING: **When working with any type of glass or sheet metal with exposed or rough edges, wear approved safety glasses and gloves in order to reduce the chance of personal injury.**

12. Using the appropriate tool, carefully cut around the lace (1), start in the center working from side to side of the window to access the urethane adhesive bead, if equipped.

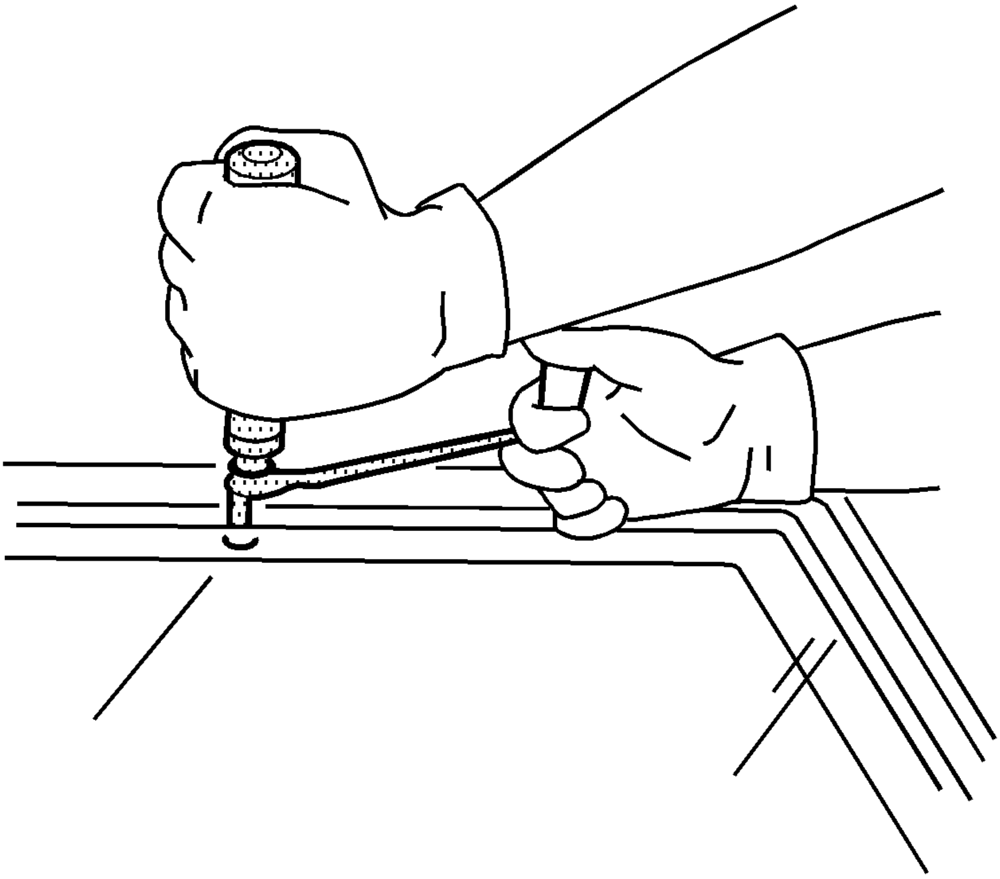


Fig. 13: Separating Urethane Adhesive From Window
Courtesy of GENERAL MOTORS COMPANY

NOTE: Keep the cutting edge of the tool against the window.

13. This will allow the urethane adhesive to be separated from the windshield.
    - Leave a base of urethane on the pinchweld flange.
    - The only suitable lubrication is clear water.
    - **BO-24402-A** Glass Sealant Remover (Cold Knife).
    - **BO-39032** Stationary Glass Removal Tool, or equivalent in order to remove the window.

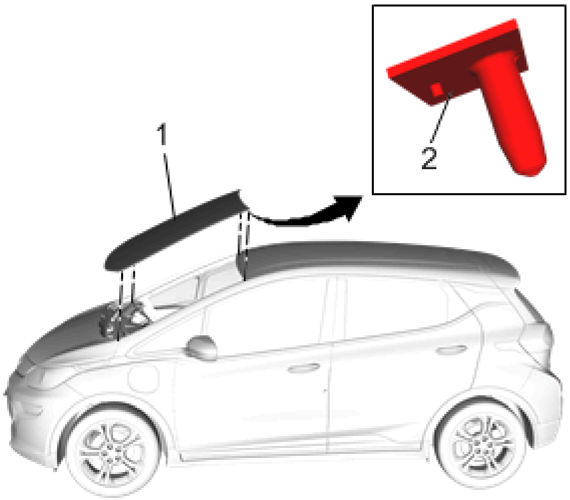


Fig. 14: Windshield And Locating Pin
Courtesy of GENERAL MOTORS COMPANY

14. With the aid of an assistant, remove the windshield and locating pin from the vehicle.

Installation Procedure

1. Windshield - Install - Adhesive Installation of Windshields

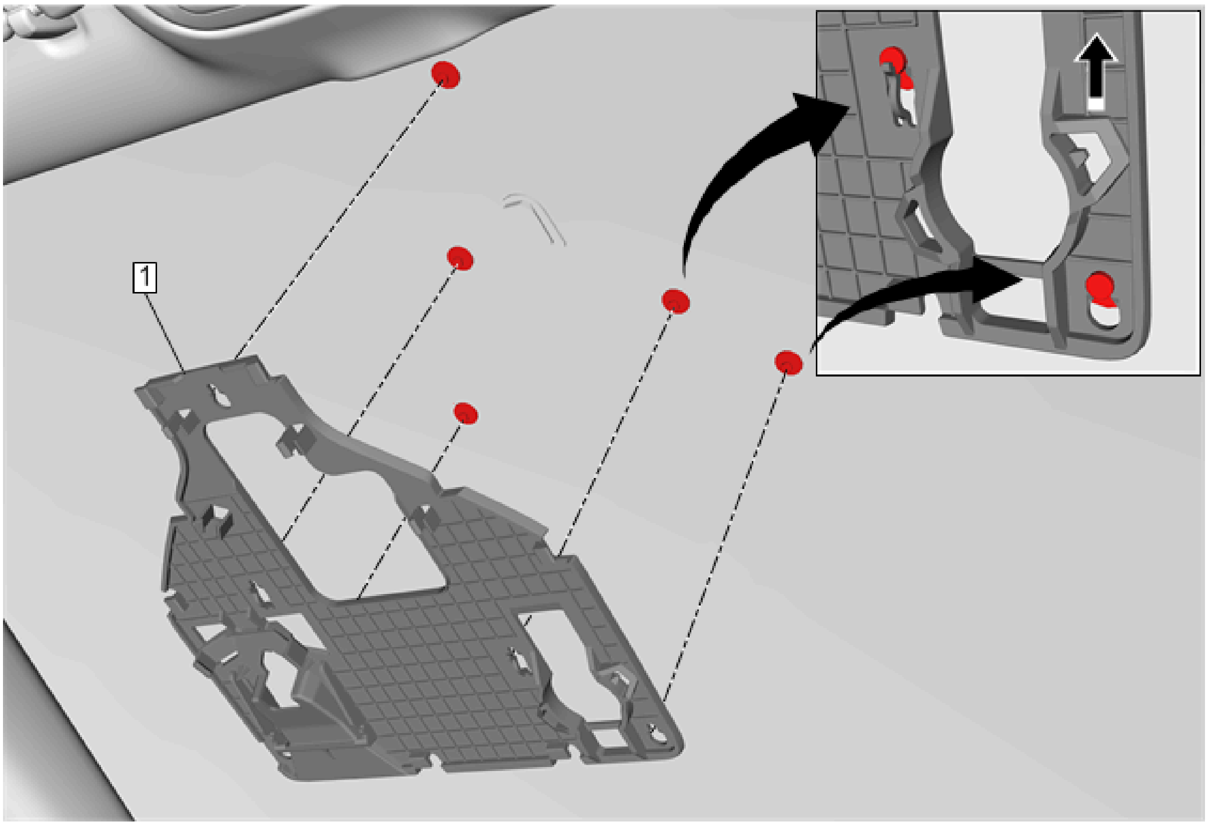


Fig. 15: Multifunction Relay Module Bracket (With Front View Camera)
Courtesy of GENERAL MOTORS COMPANY

2. Multifunction Relay Module Bracket - Install - Multifunction Relay Module Bracket Replacement (with Front View Camera) Multifunction Relay Module Bracket Replacement (without Front View Camera)

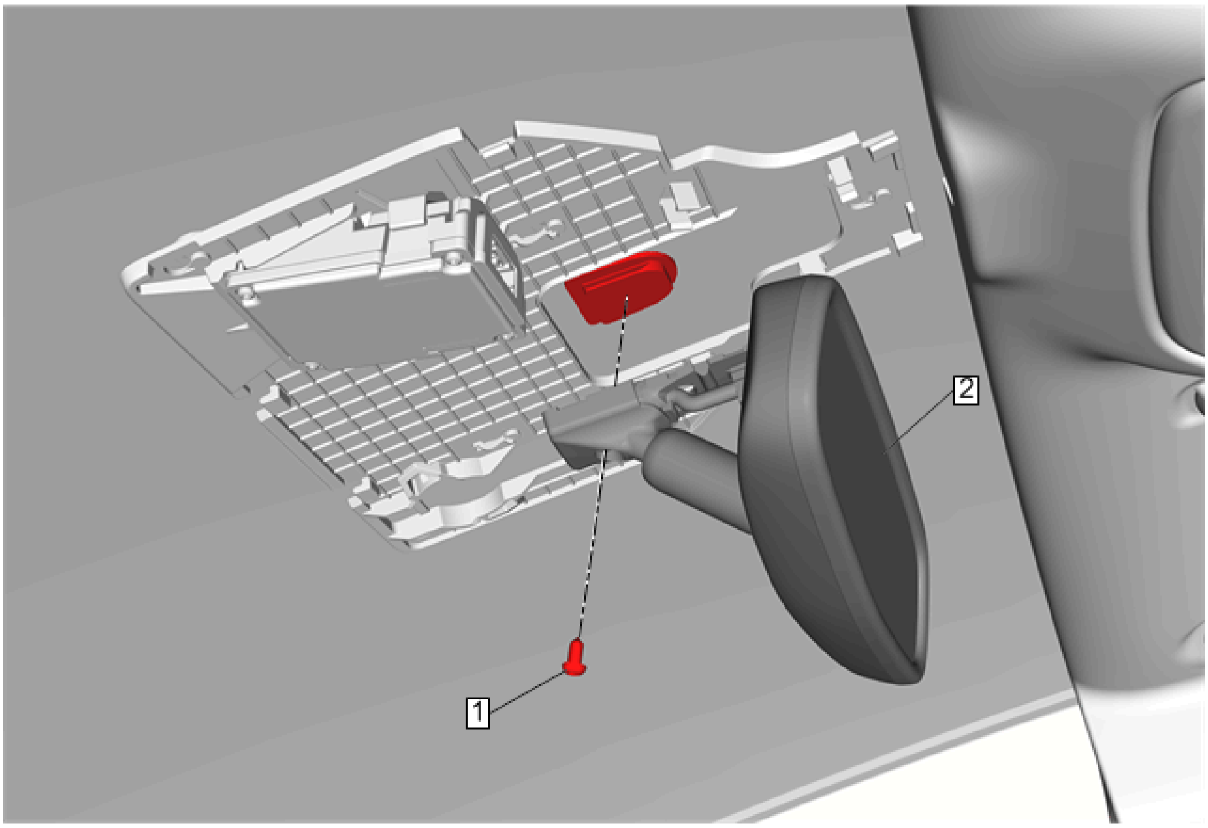


Fig. 16: Inside Rearview Mirror
Courtesy of GENERAL MOTORS COMPANY

3. Inside Rearview Mirror - Install - Inside Rearview Mirror Replacement

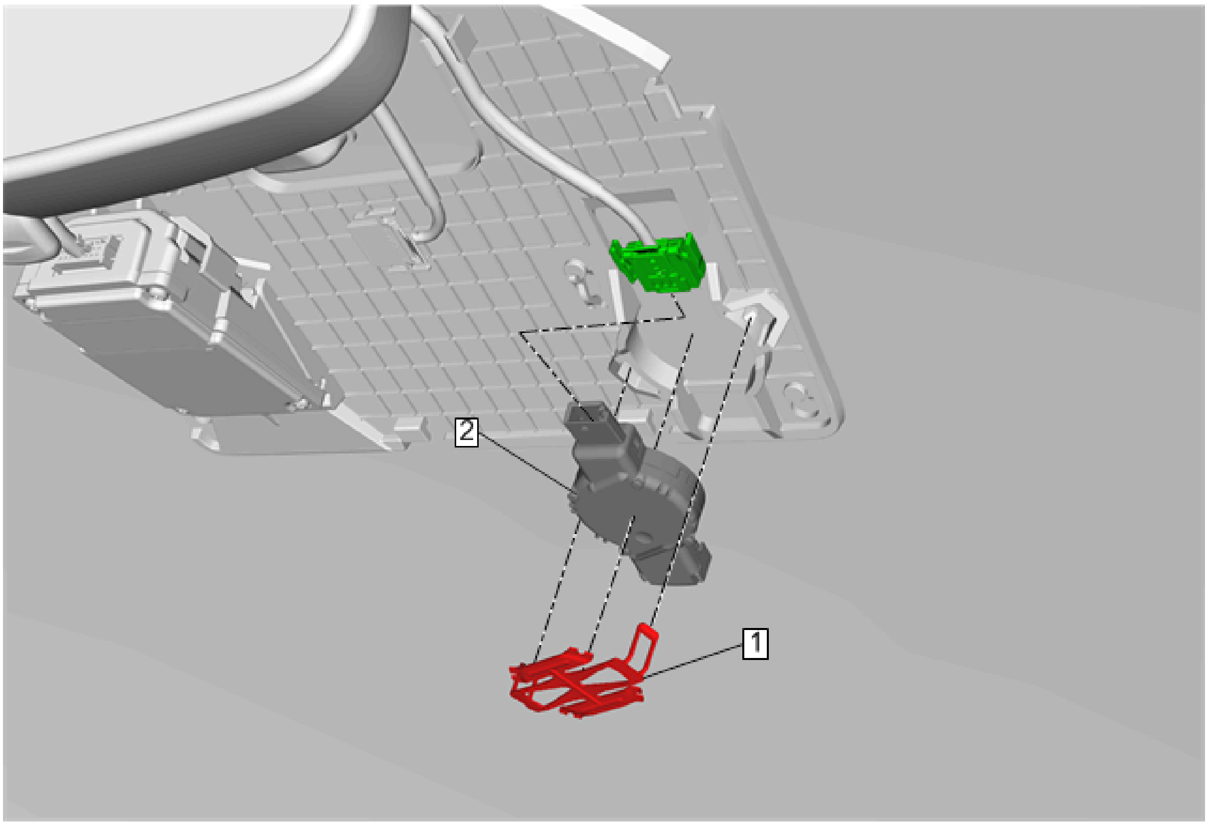


Fig. 17: Windshield Outside Moisture/Ambient Light and Humidity Sensor
Courtesy of GENERAL MOTORS COMPANY

4. Windshield Outside Moisture/Ambient Light and Humidity Sensor - Install - Inside Air Moisture and Windshield Temperature Sensor Replacement (With Front View Camera) Inside Air Moisture and Windshield Temperature Sensor Replacement (Without Front View Camera)

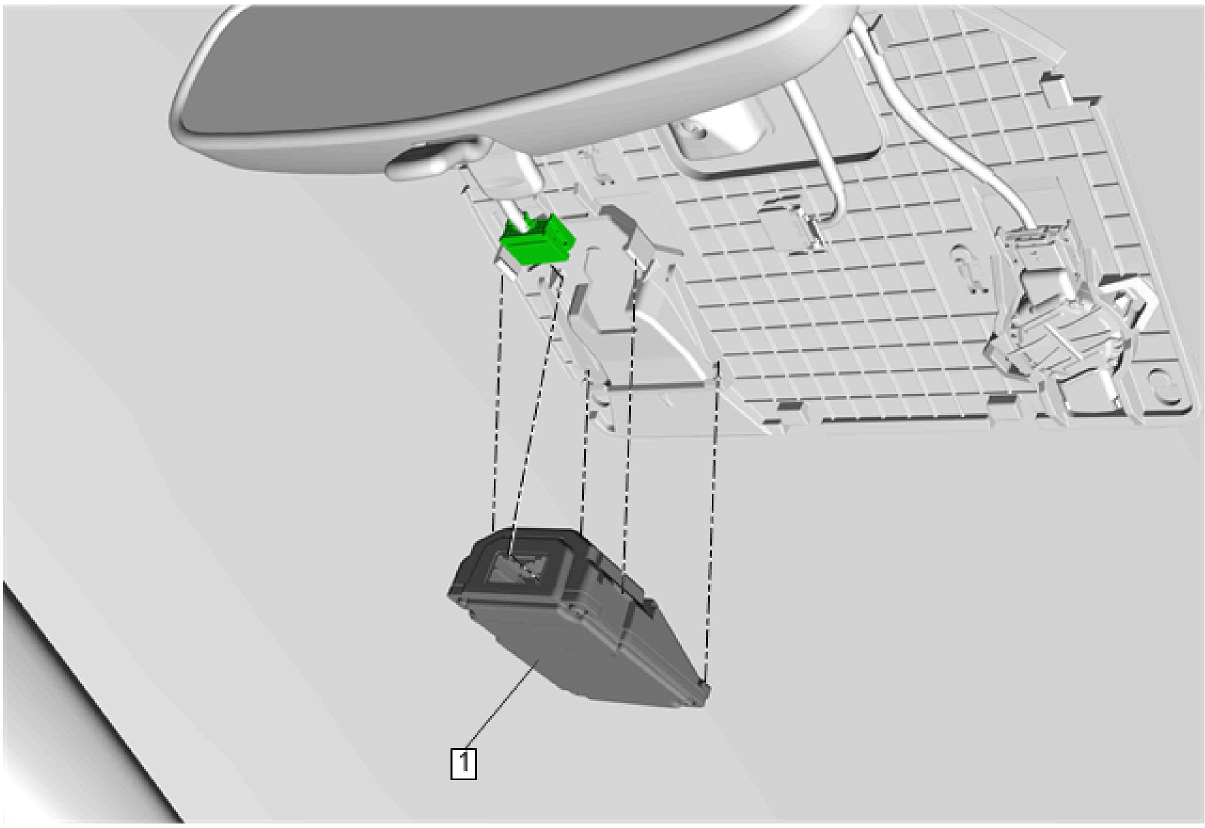


Fig. 18: Front View Camera
Courtesy of GENERAL MOTORS COMPANY

5. { If equipped } Front View Camera - Install - Front View Camera Replacement

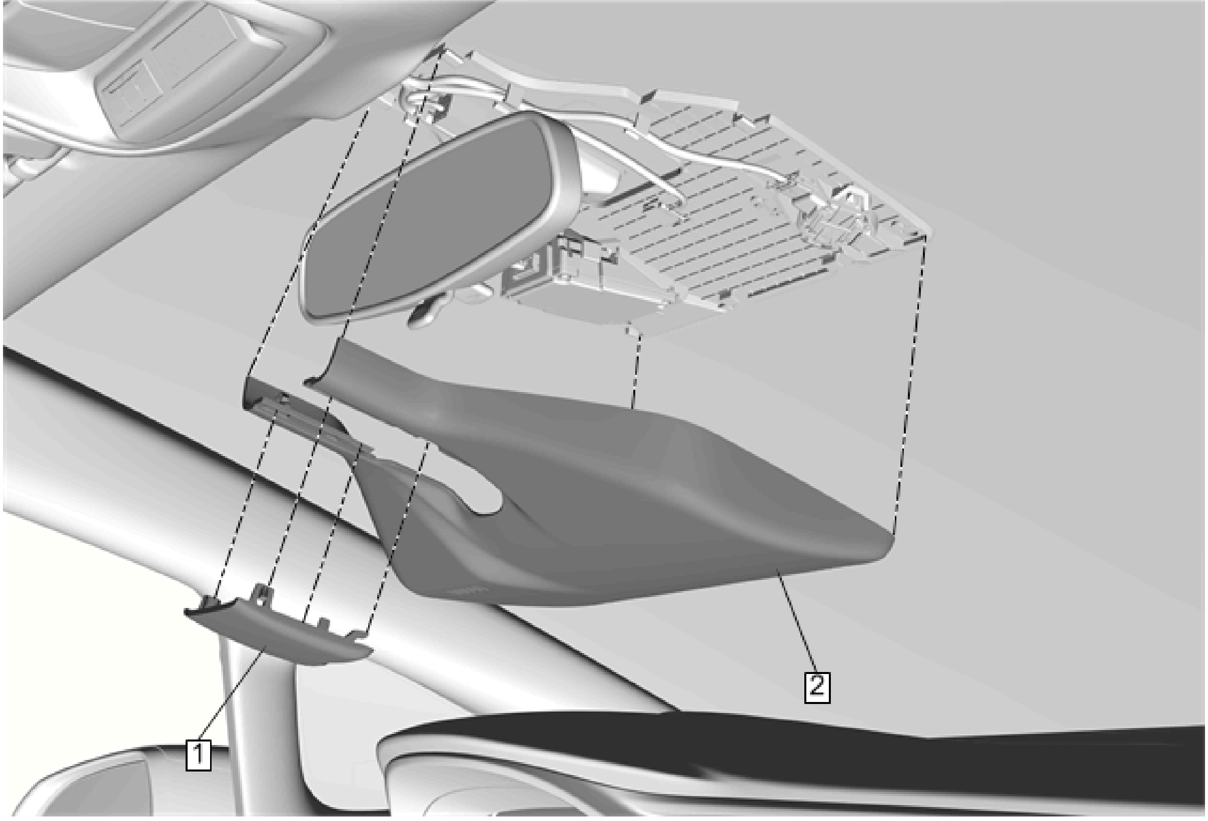


Fig. 19: Windshield Multifunction Sensor Mount Bracket Cover
Courtesy of GENERAL MOTORS COMPANY

6. Windshield Multifunction Sensor Mount Bracket Cover - Install - Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera) Windshield Multifunction Sensor Mount Bracket Cover Replacement (without Front View Camera)

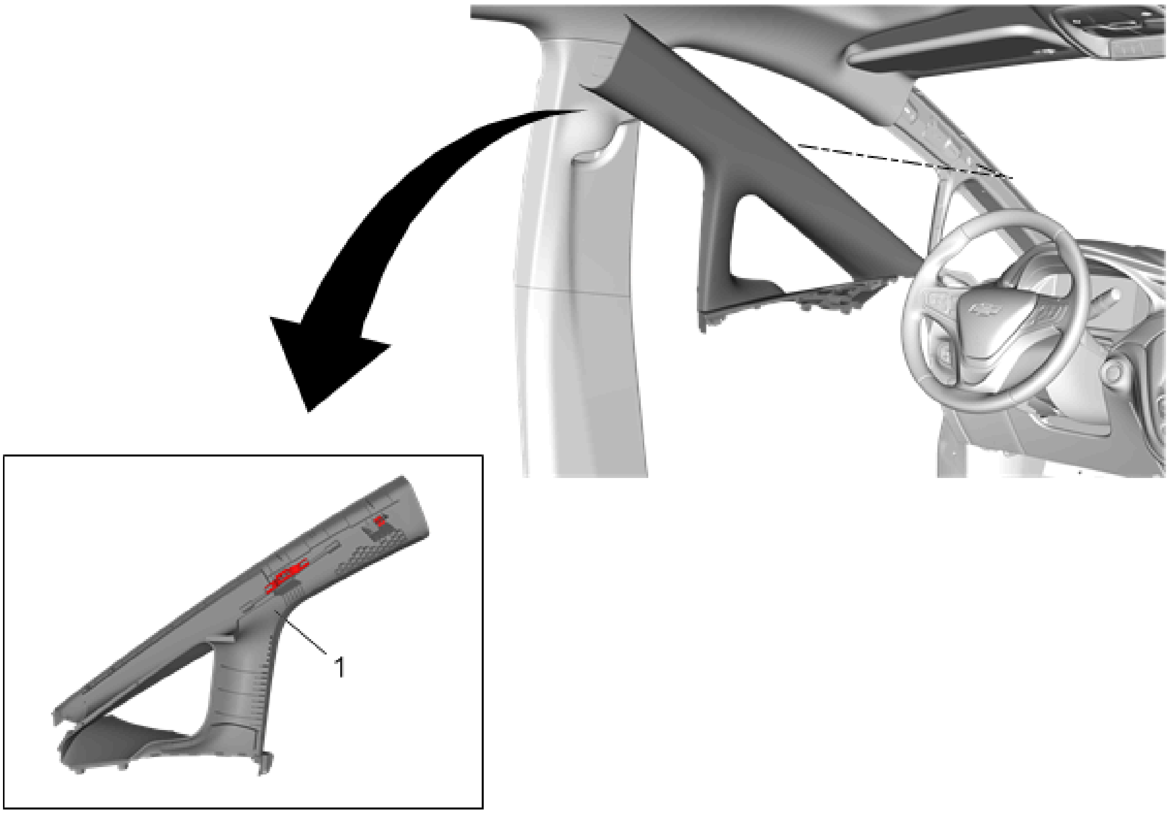


Fig. 20: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

7. Windshield Garnish Molding - Install - Windshield Garnish Molding Replacement

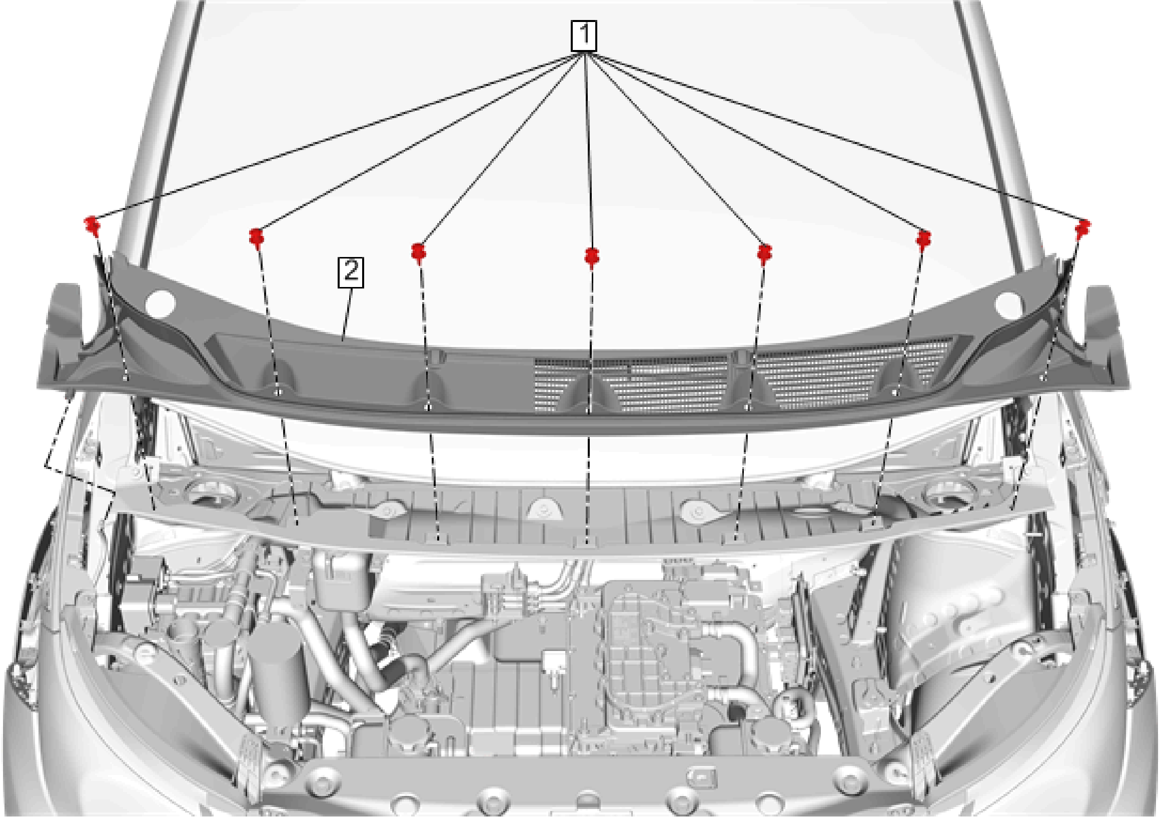


Fig. 21: Air Inlet Grille Panel
Courtesy of GENERAL MOTORS COMPANY

8. Air Inlet Grille Panel - Install - **Air Inlet Grille Panel Replacement** .
9. Battery Negative Cable - Connect - **Battery Negative Cable Disconnection and Connection**
10. Close the hood.
11. Remove the double layer of masking tape around the perimeter of the painted surfaces.

FRONT SIDE DOOR WINDOW REPLACEMENT

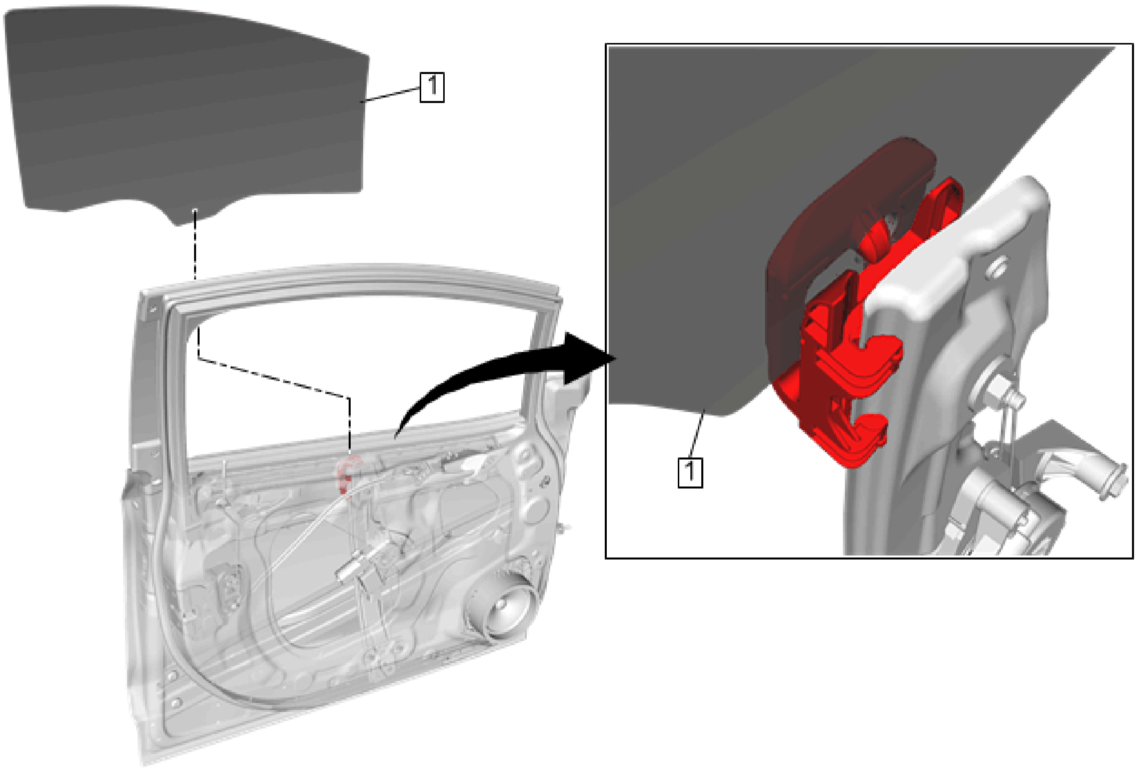


Fig. 22: Front Side Door Window
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING: Glass and Sheet Metal Handling Warning
Preliminary Procedures
1. Position the window approximately half way down in the door
2. Front Side Door Window Channel Retainer Replacement
3. Front Side Door Window Belt Reveal Molding Replacement</td></tr>
<tr><td>1</td><td>Front Side Door Window
Procedure
1. Front Side Door Window at Front Side Door Window Regulator - Remove
2. Rotate the front side door window as necessary to remove it from the front side door.</td></tr>
</table>

REAR SIDE DOOR WINDOW REPLACEMENT

Removal Procedure

WARNING: Glass and Sheet Metal Handling Warning

1. Position the window approximately half way down in the door.

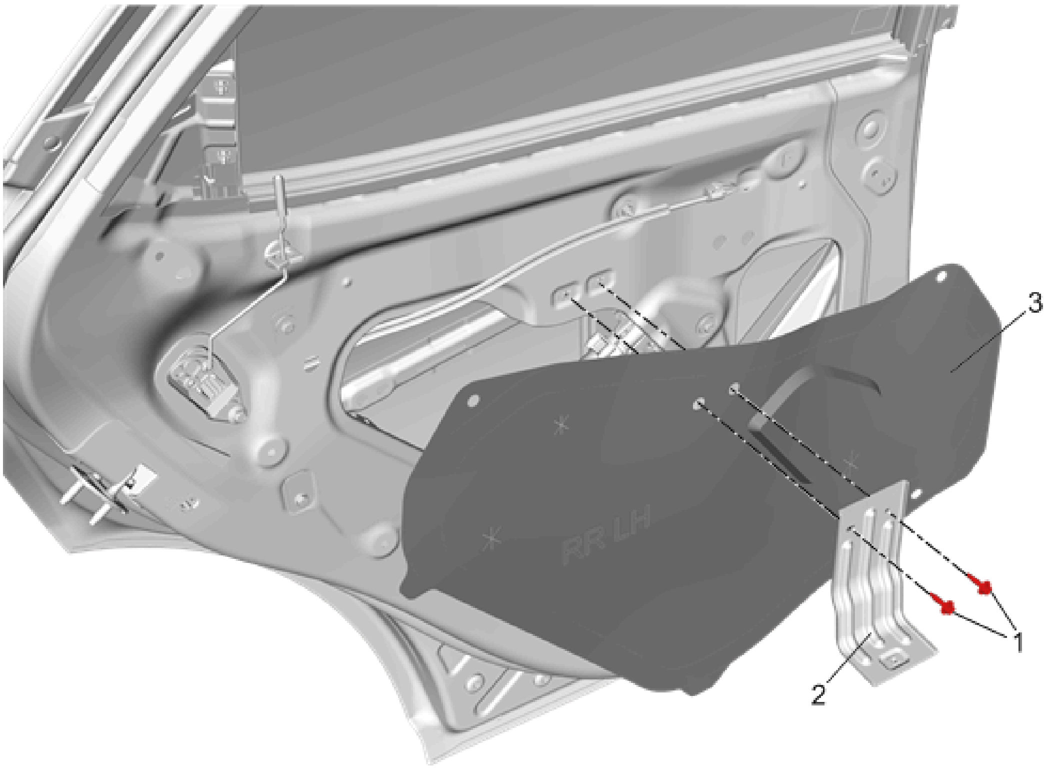


Fig. 23: Rear Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

2. Rear Side Door Water Deflector - Remove - Rear Side Door Water Deflector Replacement

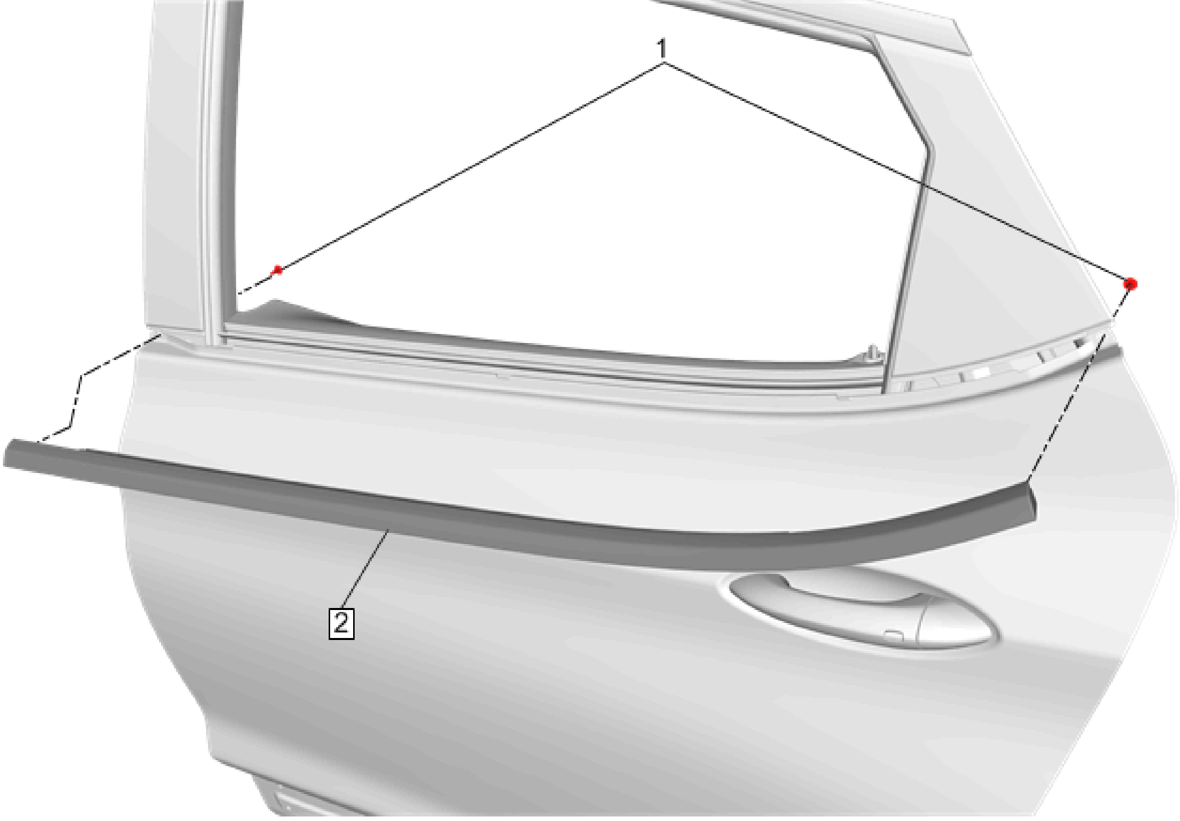


Fig. 24: Rear Side Door Window Belt Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

3. Rear Side Door Window Belt Reveal Molding - Remove - Rear Side Door Window Belt Reveal Molding Replacement

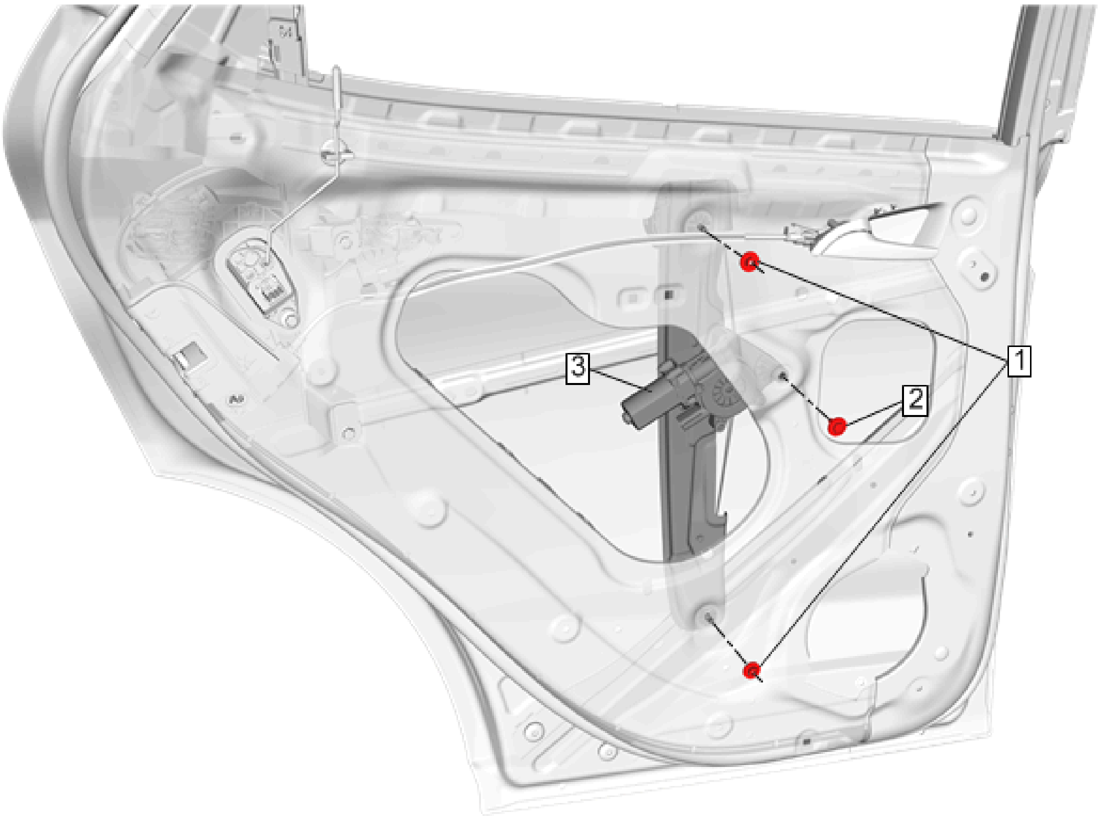


Fig. 25: Rear Side Door Window Regulator
Courtesy of GENERAL MOTORS COMPANY

4. Rear Side Door Window Regulator - Remove - Rear Side Door Window Regulator Replacement

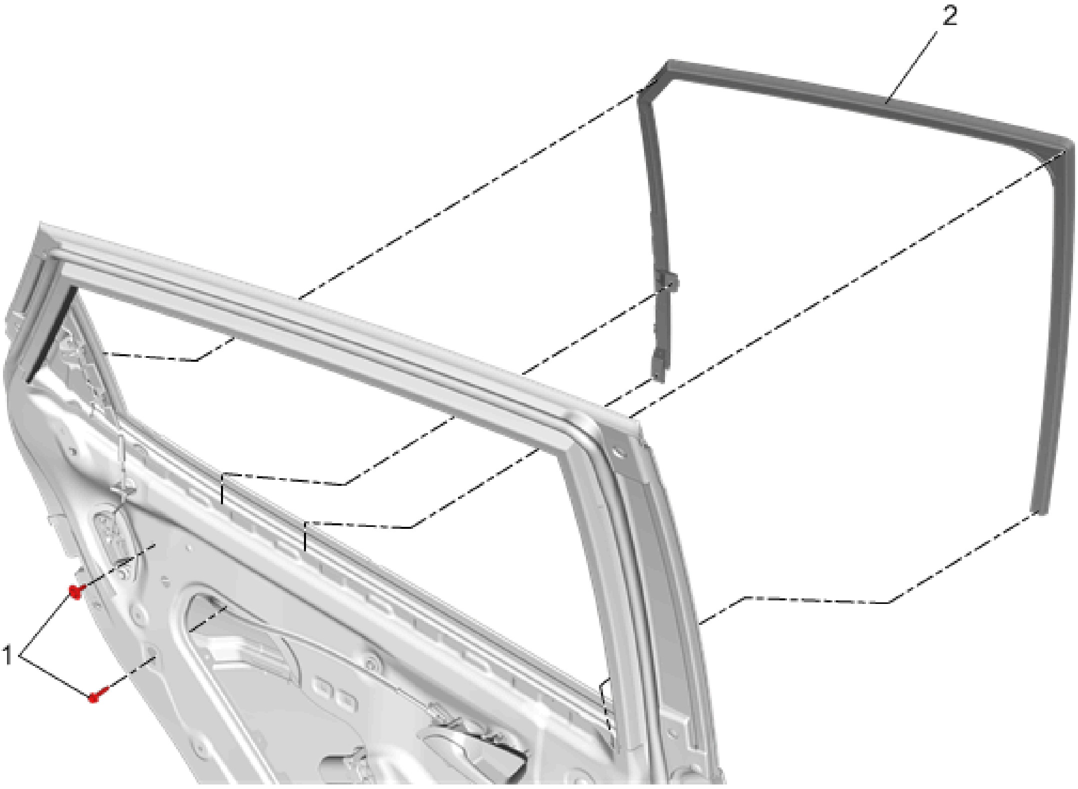


Fig. 26: Rear Side Door Window Channel Rear Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the rear side door window channel rear retainer bolts and reposition the channel. Rear Side Door Window Weatherstrip Replacement

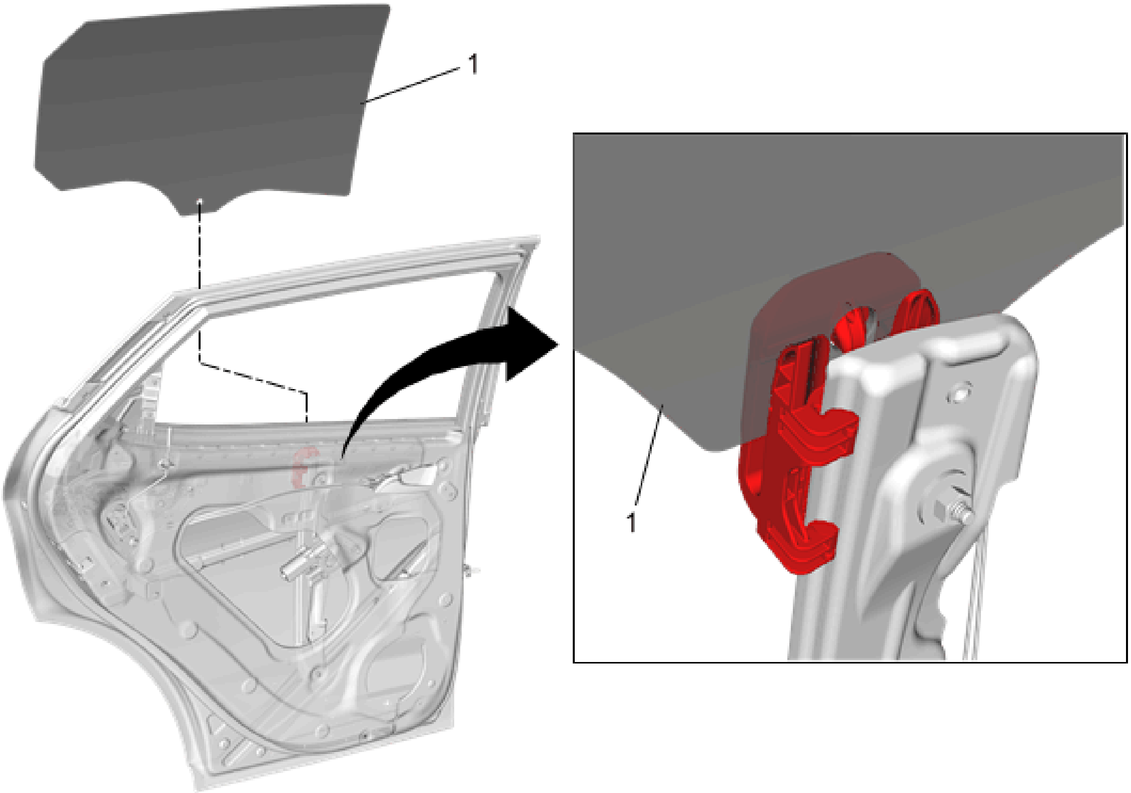


Fig. 27: Rear Side Door Window
Courtesy of GENERAL MOTORS COMPANY

6. Rotate the rear side door window as necessary to remove it from the rear side door.

Installation Procedure

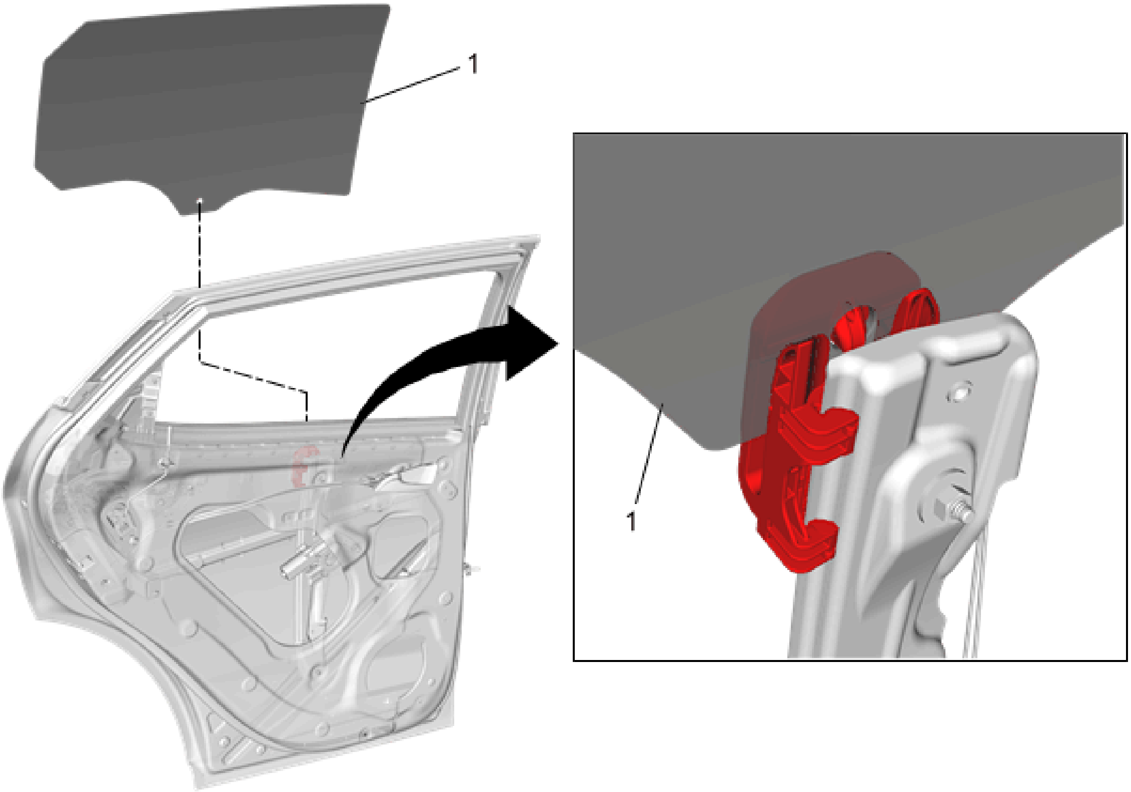


Fig. 28: Rear Side Door Window
Courtesy of GENERAL MOTORS COMPANY

1. Insert the rear side door window to the rear side door.

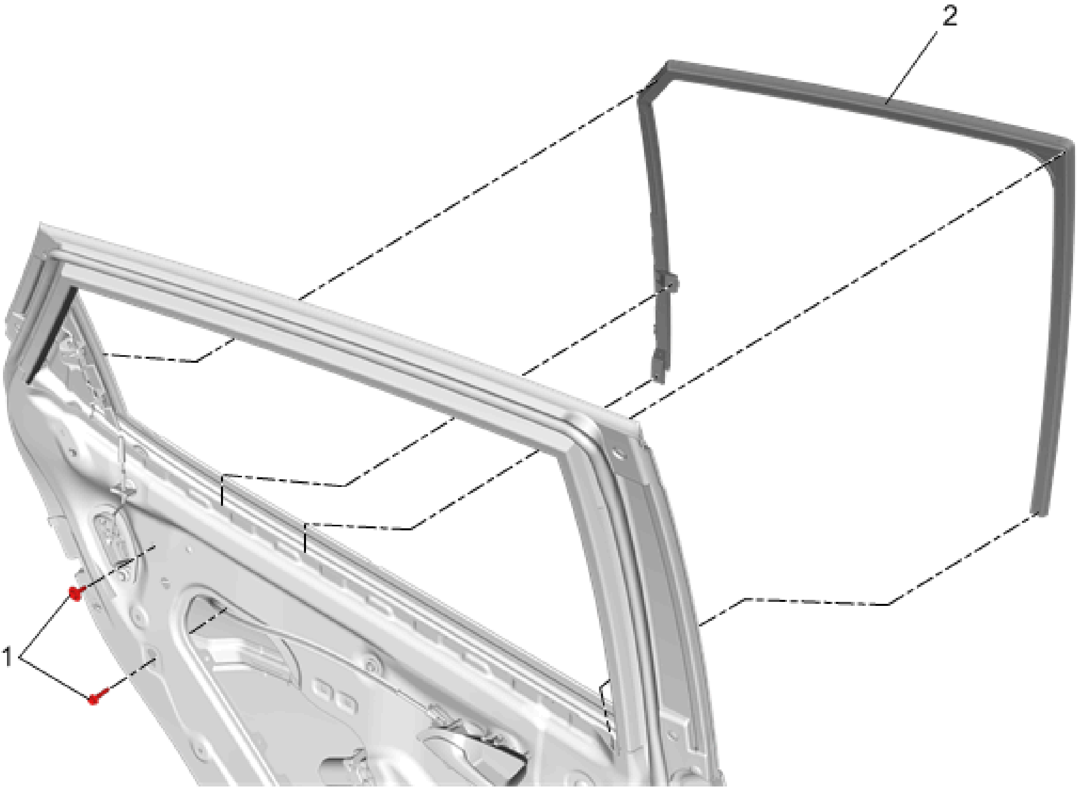


Fig. 29: Rear Side Door Window Channel Rear Retainer Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Position the channel and Install the rear side door window channel rear retainer bolts. Rear Side Door Window Weatherstrip Replacement

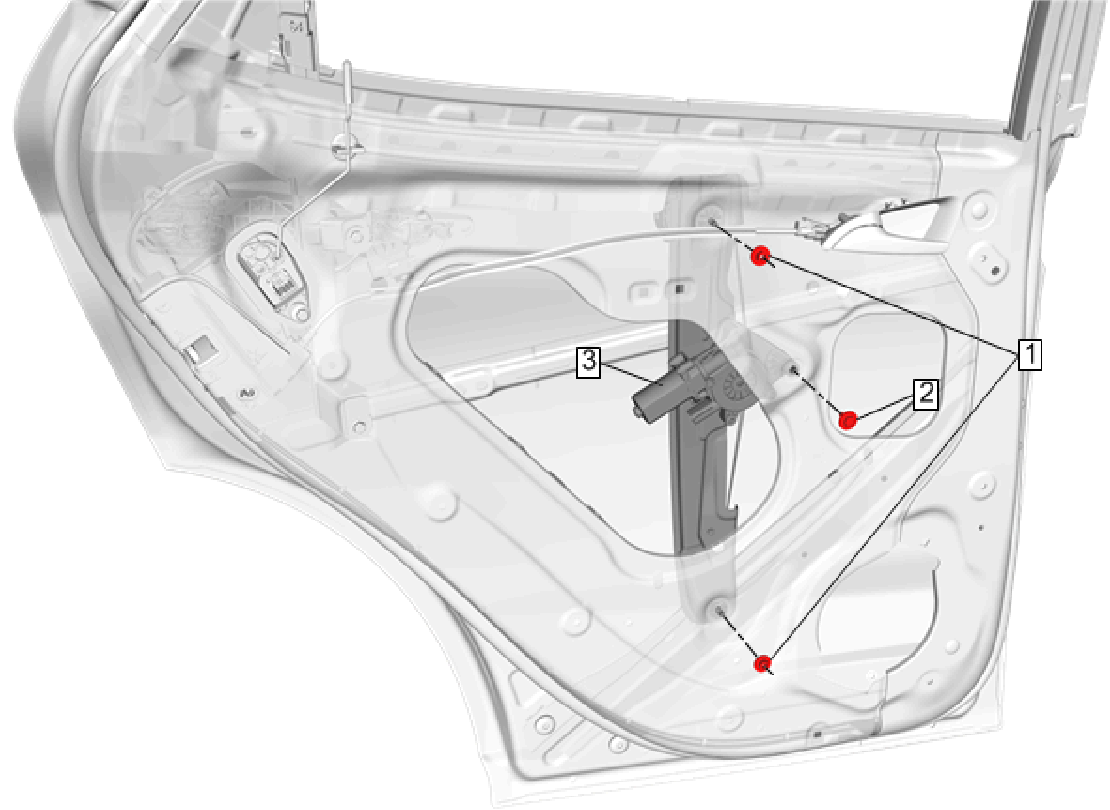


Fig. 30: Rear Side Door Window Regulator
Courtesy of GENERAL MOTORS COMPANY

3. Rear Side Door Window Regulator - Install - **Rear Side Door Window Regulator Replacement**

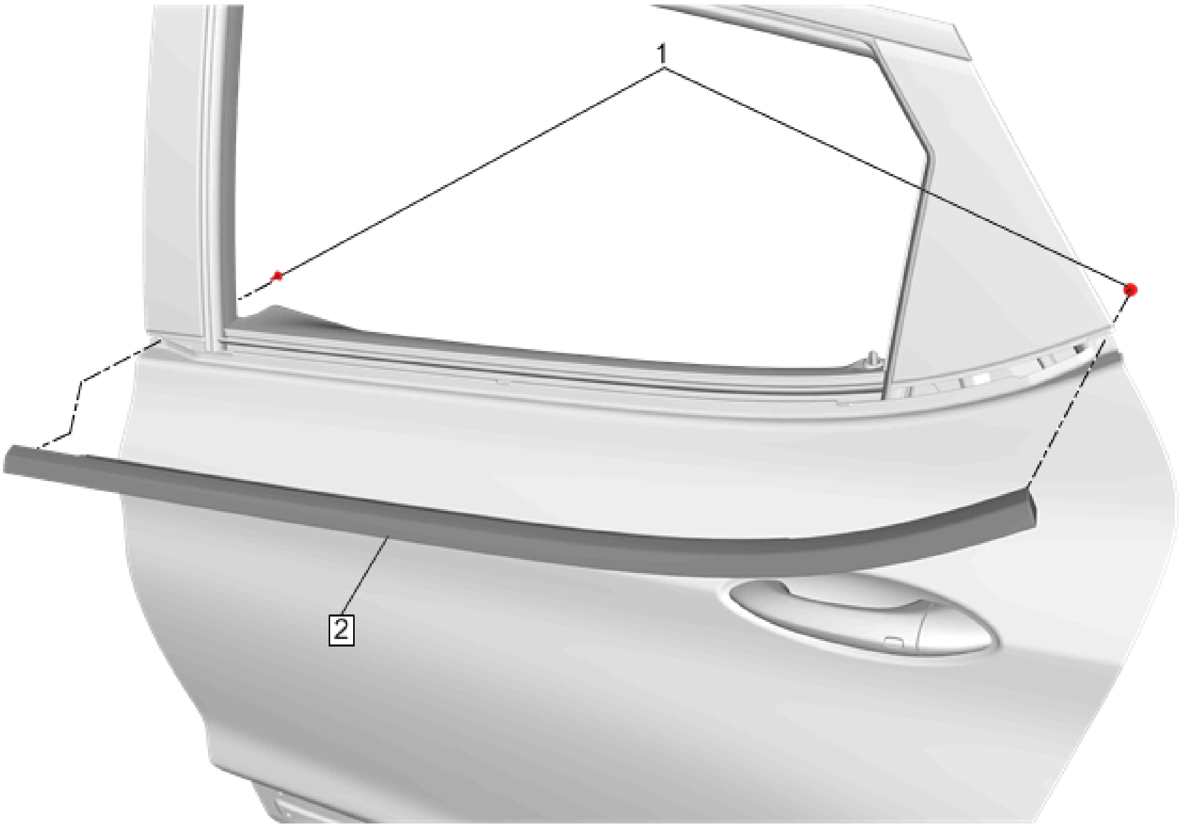


Fig. 31: Rear Side Door Window Belt Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

4. Rear Side Door Window Belt Reveal Molding - Install - **Rear Side Door Window Belt Reveal Molding Replacement**

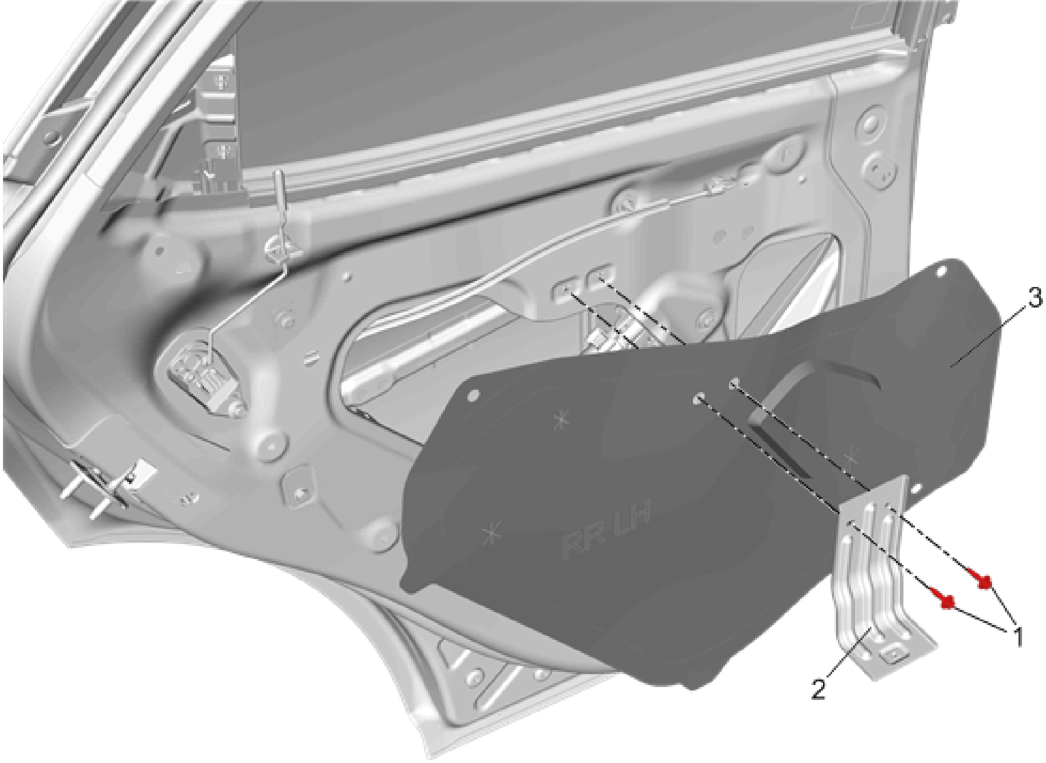


Fig. 32: Rear Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

5. Rear Side Door Water Deflector - Install - Rear Side Door Water Deflector Replacement
6. Inspect the door window for proper operation before installing the door trim.

REAR WINDOW REPLACEMENT

Special Tools

- **BO-24402-A** Glass Sealant Remover (Cold Knife).
- **BO-39032** Stationary Glass Removal Tool, or equivalent in order to remove the window.
- Use a urethane adhesive systems which meet GM Specification GM 3651G

Special Tools

Removal Procedure

WARNING: **If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.**

NOTE: **Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and inner trim.**

1. Rear Compartment Lid - Open
2. Battery Negative Cable - Disconnect - Battery Negative Cable Disconnection and Connection

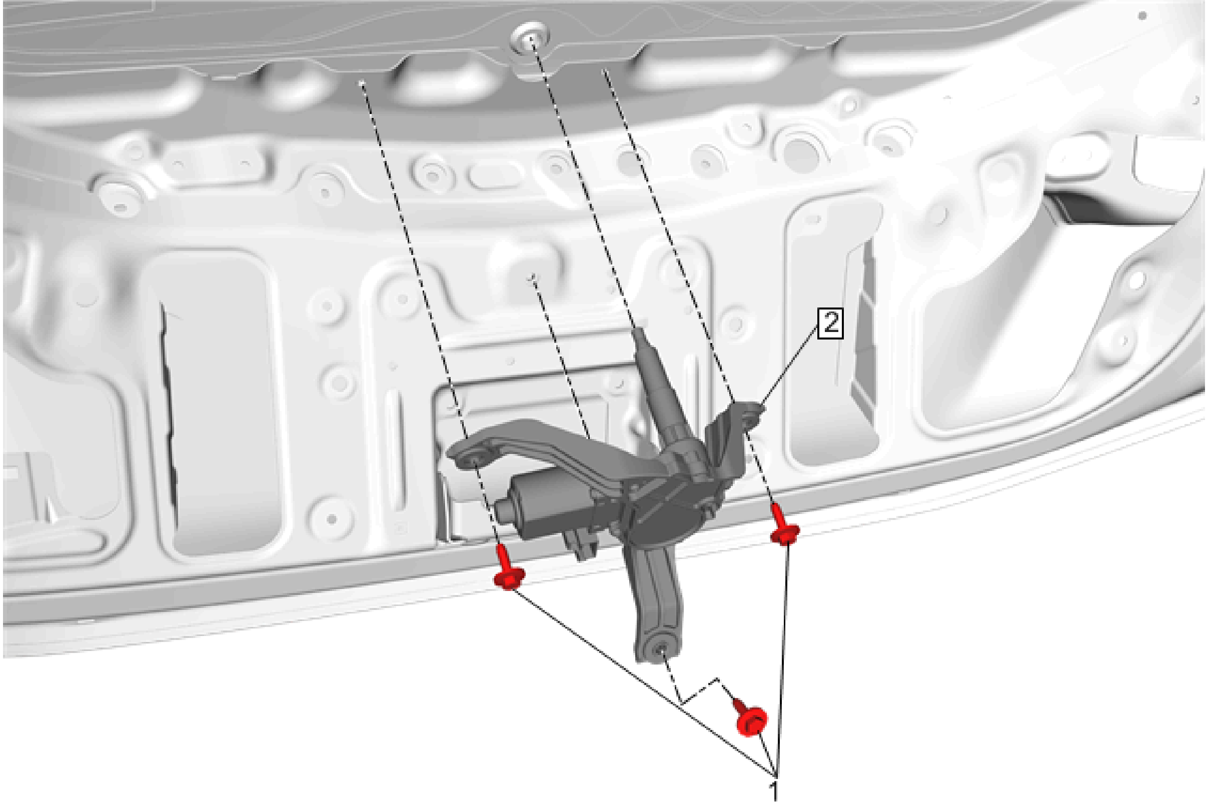


Fig. 33: Rear Window Wiper Motor
Courtesy of GENERAL MOTORS COMPANY

3. Rear Window Wiper Motor - Remove - Rear Window Wiper Motor Replacement

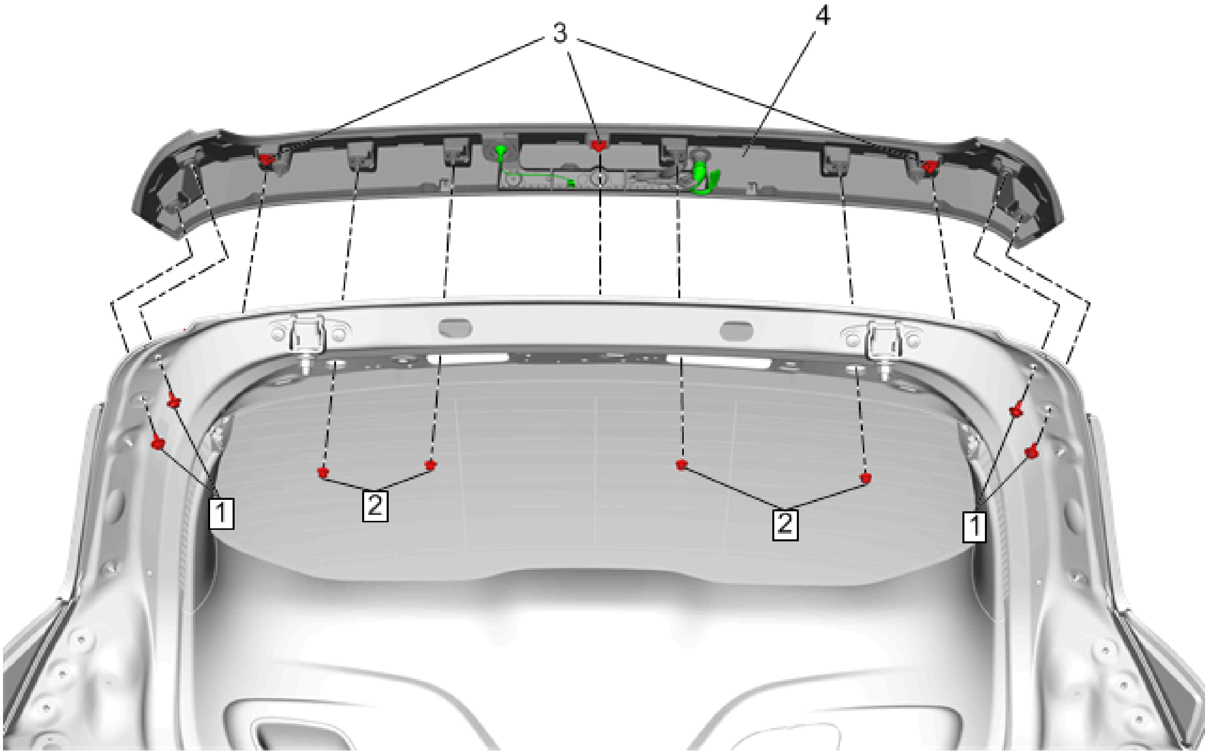


Fig. 34: Rear End Spoiler
Courtesy of GENERAL MOTORS COMPANY

4. Rear End Spoiler - Remove - Rear End Spoiler Replacement

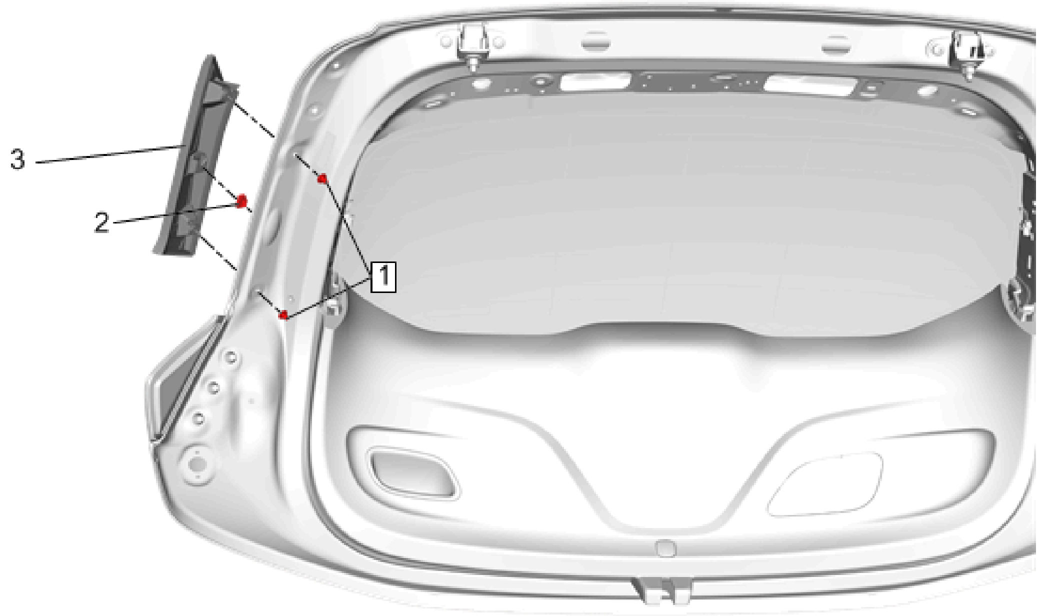


Fig. 35: Body Side Upper Rear Applique
Courtesy of GENERAL MOTORS COMPANY

5. Body Side Upper Rear Applique - Remove - **Body Side Upper Rear Applique Replacement**

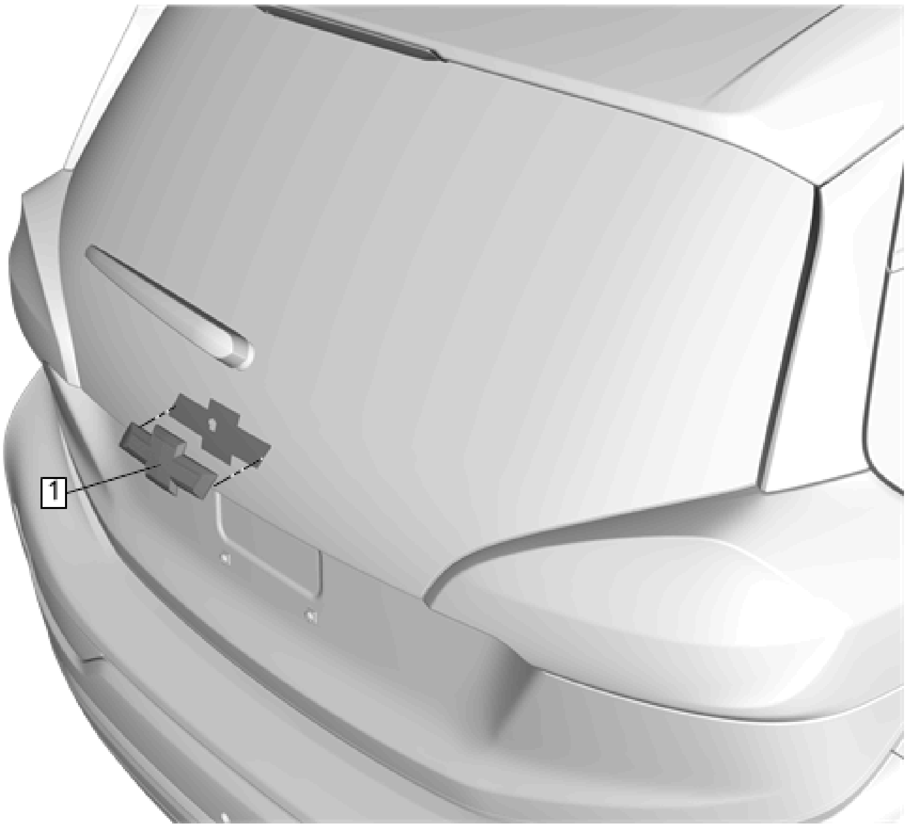


Fig. 36: Liftgate Emblem/Nameplate (Emblem)
Courtesy of GENERAL MOTORS COMPANY

6. Liftgate Emblem/Nameplate - Remove -

   Liftgate Emblem/Nameplate Replacement (Emblem) **Liftgate Emblem/Nameplate Replacement (Nameplate)**

7. Disconnect the rear window grid electrical connectors.

WARNING: **If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.**

8. Cover to protect the following parts from broken glass:
    - Seats and carpeting

WARNING: **Refer to Glass and Sheet Metal Handling Warning .**

9. Using the appropriate tool, carefully cut around the lace, start in the center working from side to side of the window to access the urethane adhesive bead, if equipped.

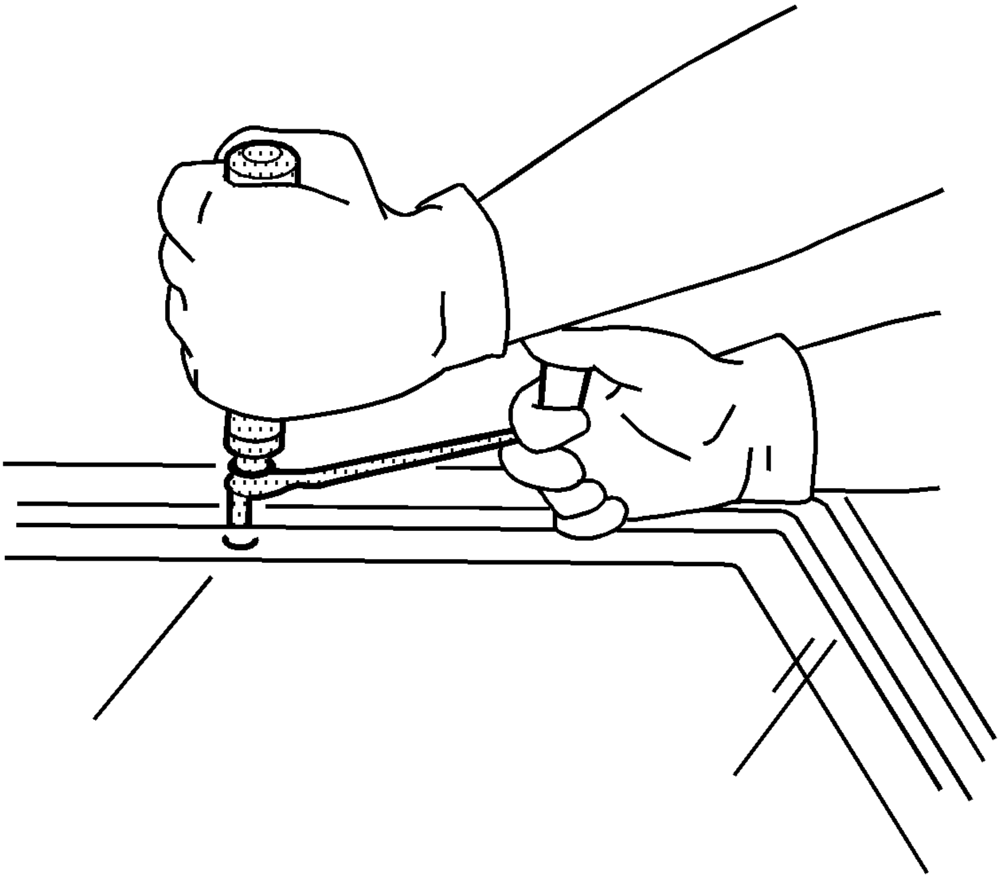
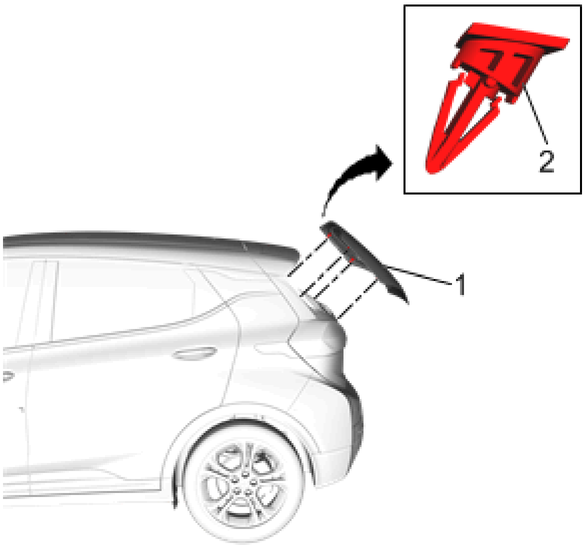


Fig. 37: Separating Urethane Adhesive From Window
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Keep the cutting edge of the tool against the window.**

10. This will allow the urethane adhesive to be separated from the window.
    - Leave a base of urethane on the pinchweld flange.
    - The only suitable lubrication is clear water.
    - **BO-24402-A** Glass Sealant Remover (Cold Knife).
    - **BO-39032** Stationary Glass Removal Tool, or equivalent in order to remove the window.



[Fig. 38: Rear Window And Locating Pin](#)
Courtesy of GENERAL MOTORS COMPANY

11. With the aid of an assistant lift the rear window (1) and locating pin (2) from vehicle.

Installation Procedure

1. Rear Window - Install - **Adhesive Installation of Rear Windows**
2. Connect the rear window grid electrical connectors.

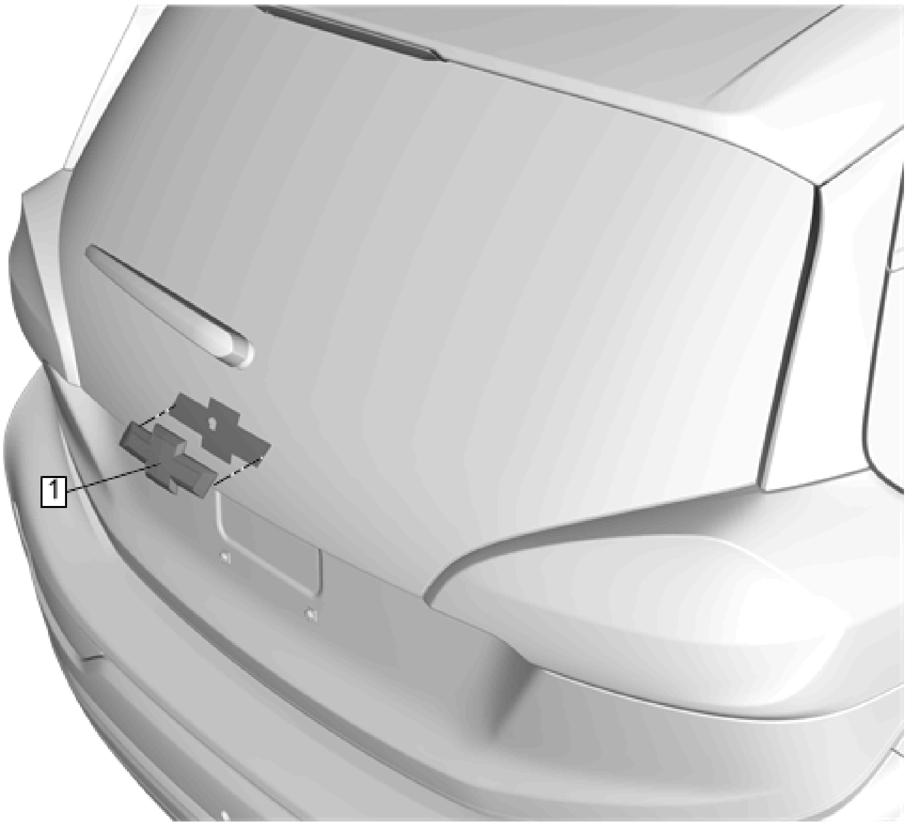


Fig. 39: Liftgate Emblem/Nameplate (Emblem)
Courtesy of GENERAL MOTORS COMPANY

3. Liftgate Emblem/Nameplate - Install -

Liftgate Emblem/Nameplate Replacement (Emblem) Liftgate Emblem/Nameplate Replacement (Nameplate)

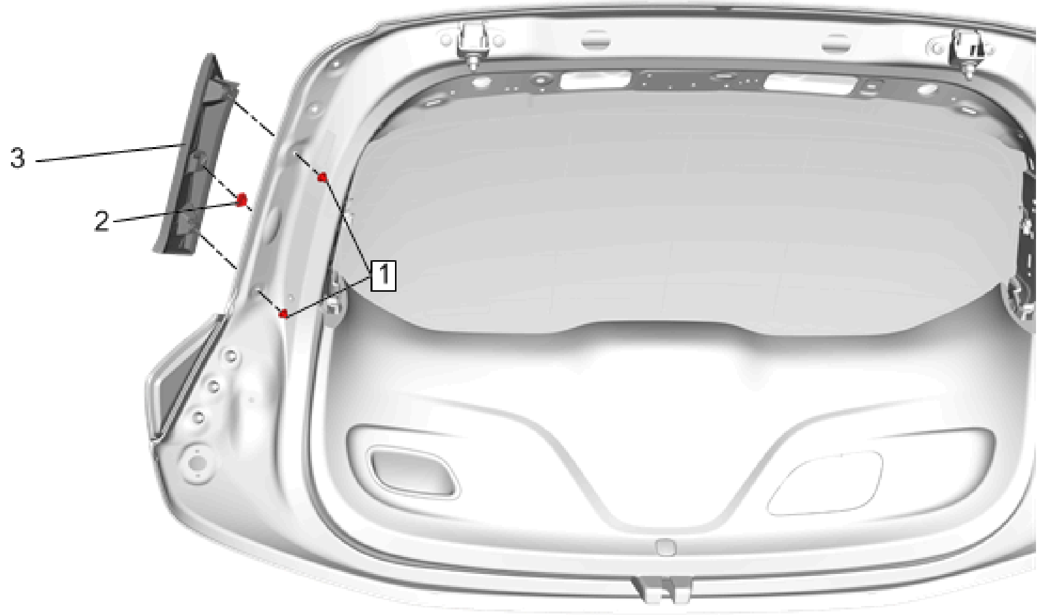


Fig. 40: Body Side Upper Rear Applique
Courtesy of GENERAL MOTORS COMPANY

4. Body Side Upper Rear Applique - Install - Body Side Upper Rear Applique Replacement

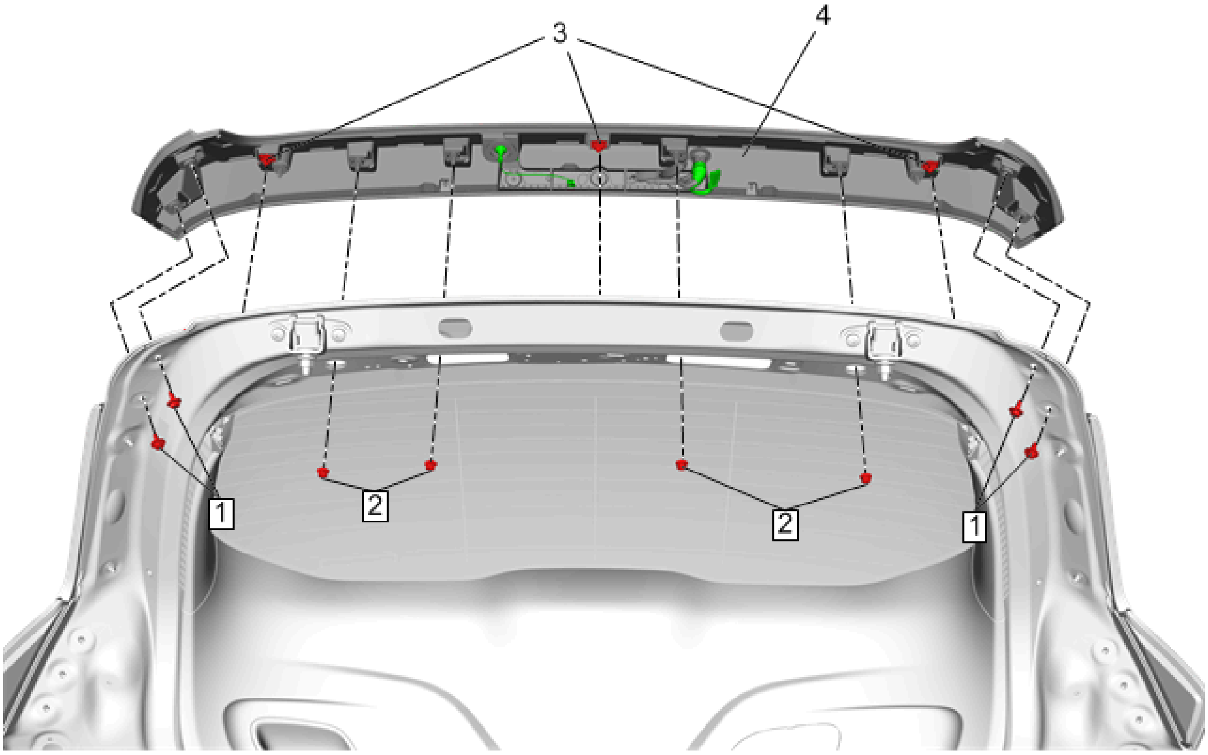


Fig. 41: Rear End Spoiler
Courtesy of GENERAL MOTORS COMPANY

5. Rear End Spoiler - Install - Rear End Spoiler Replacement

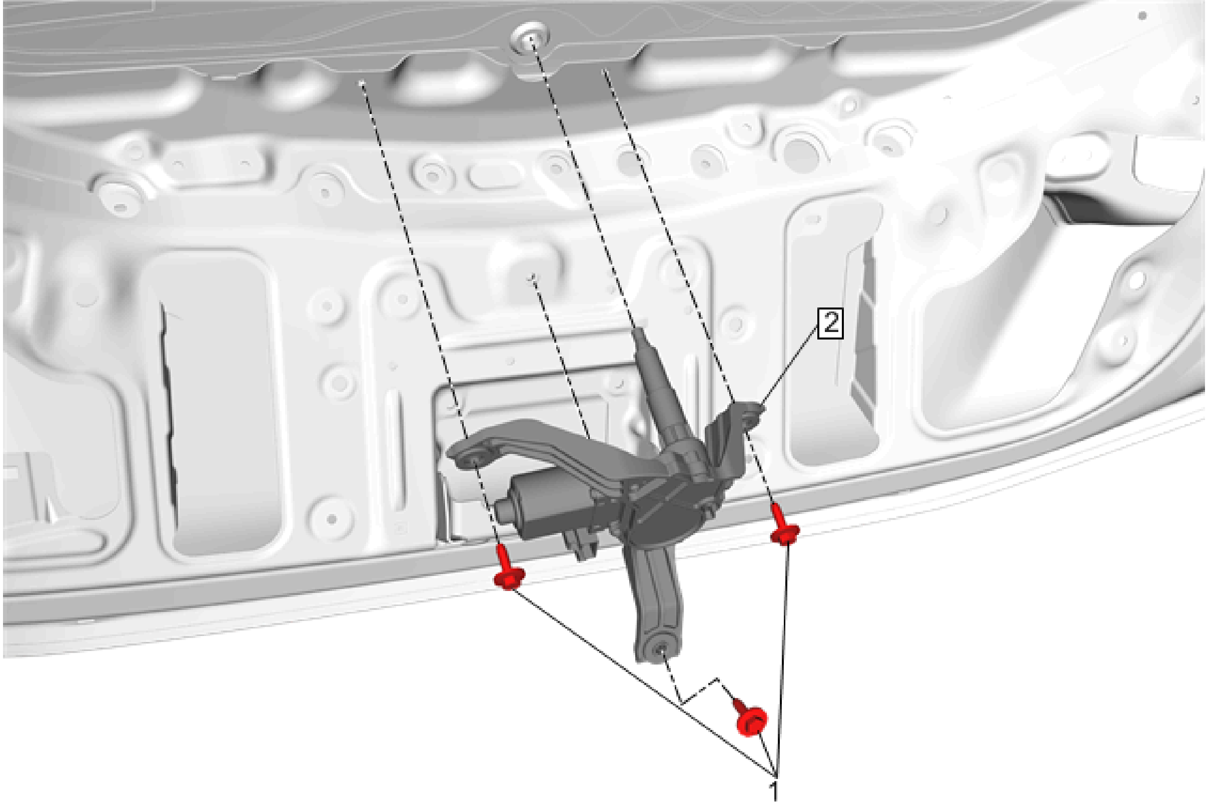


Fig. 42: Rear Window Wiper Motor
Courtesy of GENERAL MOTORS COMPANY

6. Rear Window Wiper Motor - Install - **Rear Window Wiper Motor Replacement**
7. Battery Negative Cable - Connect - **Battery Negative Cable Disconnection and Connection**
8. Rear compartment lid - Close
9. Double layer of masking tape around the perimeter of the painted surfaces and the interior trim - Remove

WINDSHIELD PILLAR STATIONARY WINDOW REPLACEMENT

Special Tools

- **BO-24402-A** Glass Sealant Remover (Cold Knife).
- **BO-39032** Stationary Glass Removal Tool, or equivalent in order to remove the window.
- Use a urethane adhesive systems which meet GM Specification GM 3651G

Special Tools

Removal Procedure

WARNING: **If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.**

NOTE: **Before cutting out a stationary window, apply a double layer of masking tape around the perimeter of the painted surfaces and inner trim of the window.**

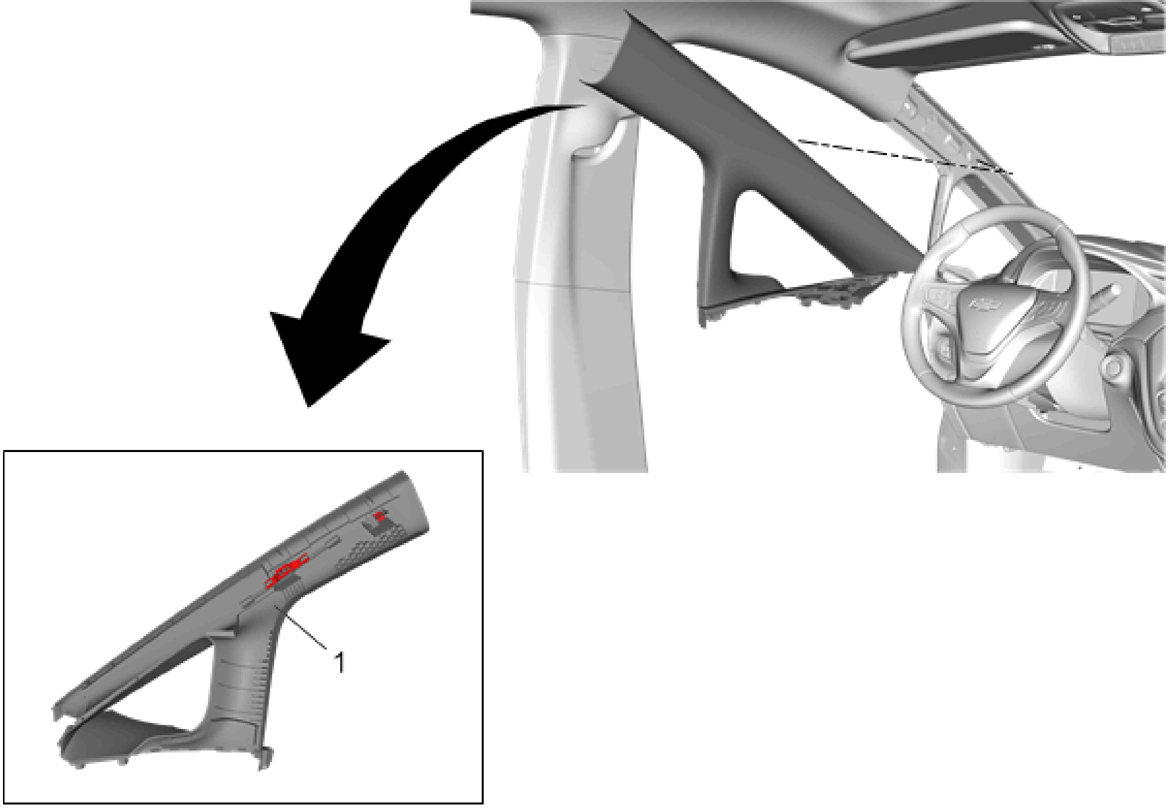


Fig. 43: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

1. Windshield Garnish Molding - Remove - Windshield Garnish Molding Replacement

WARNING: **If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.**

2. Cover to protect the following parts from broken glass:
    - Upper dash pad
    - Defroster outlets and A/C outlets
    - Seats and carpeting

WARNING: **Refer to Glass and Sheet Metal Handling Warning .**

NOTE: **Keep the cutting edge of the tool against the window. Do this from inside the vehicle to protect the outer painted surface.**

3. Carefully cut around the inside of the quarter modular window to expose the urethane adhesive bead.

    Use care not to damage the retainers. If the retainer get damaged it will be necessary to use mask tape to tape it in place while curing.

4. Keep the cutting edge of the tool against the inside of the window.

    This will allow the urethane adhesive to be separated from the window.

    - Leave a base of urethane on the pinch-weld flange.
    - The only suitable lubrication is clear water.
    - **BO-24402-A** Glass Sealant Remover (Cold Knife).
    - **BO-39032** Stationary Glass Removal Tool, or equivalent in order to remove the window.

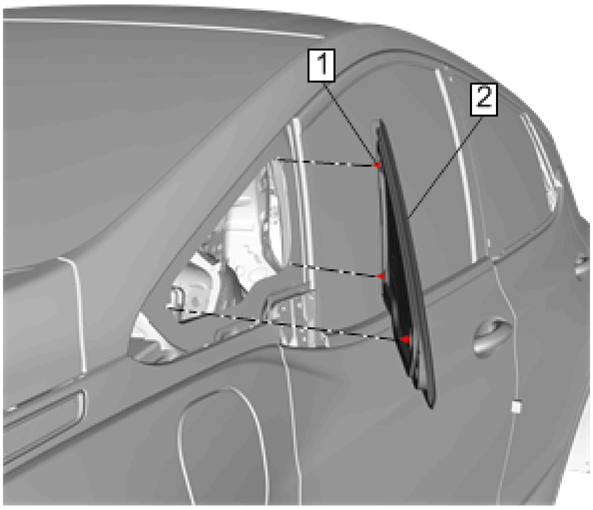


Fig. 44: Stationary Window
Courtesy of GENERAL MOTORS COMPANY

- Remove the stationary window (2) from the pinch-weld flange.

Installation Procedure

1. Windshield Pillar Stationary Window - Install - Adhesive Installation of Stationary Windows

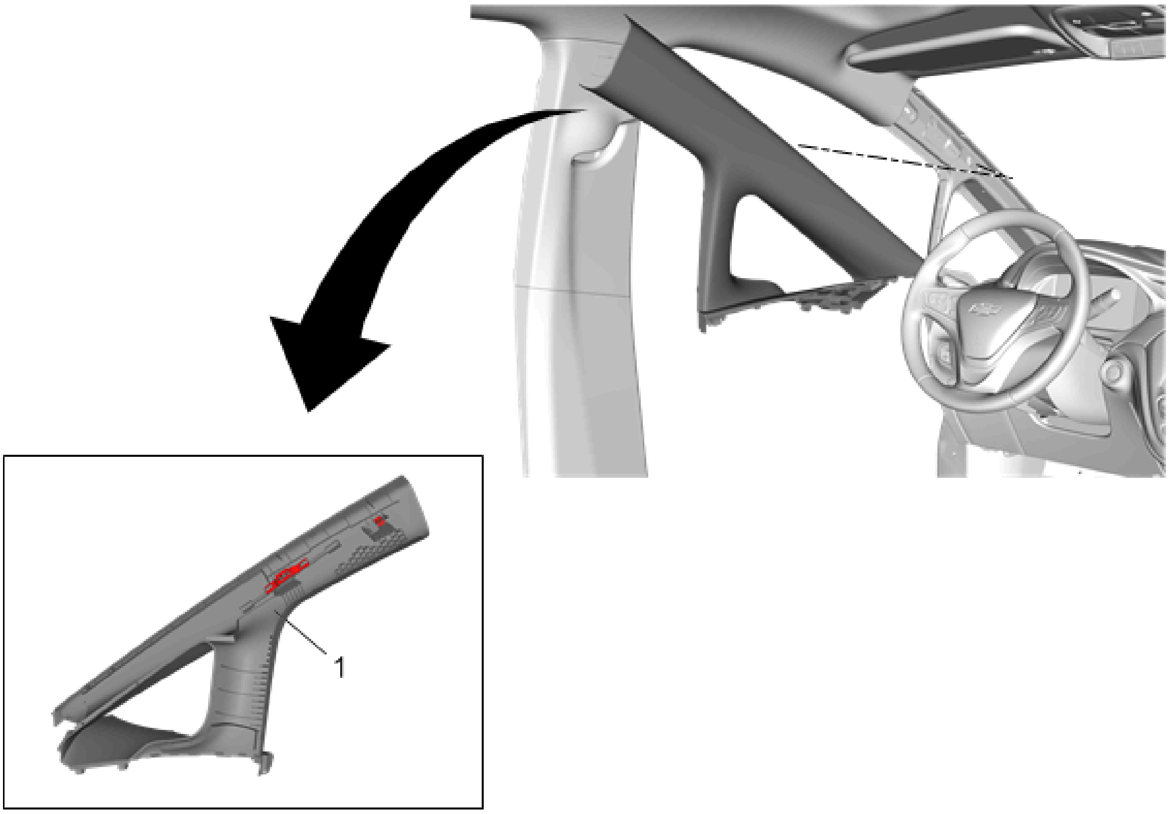


Fig. 45: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

2. Windshield Garnish Molding - Remove - Windshield Garnish Molding Replacement
3. Masking tape around the perimeter of the painted surfaces and the interior trim - Remove

FRONT SIDE DOOR WINDOW CONTROL SWITCH REPLACEMENT

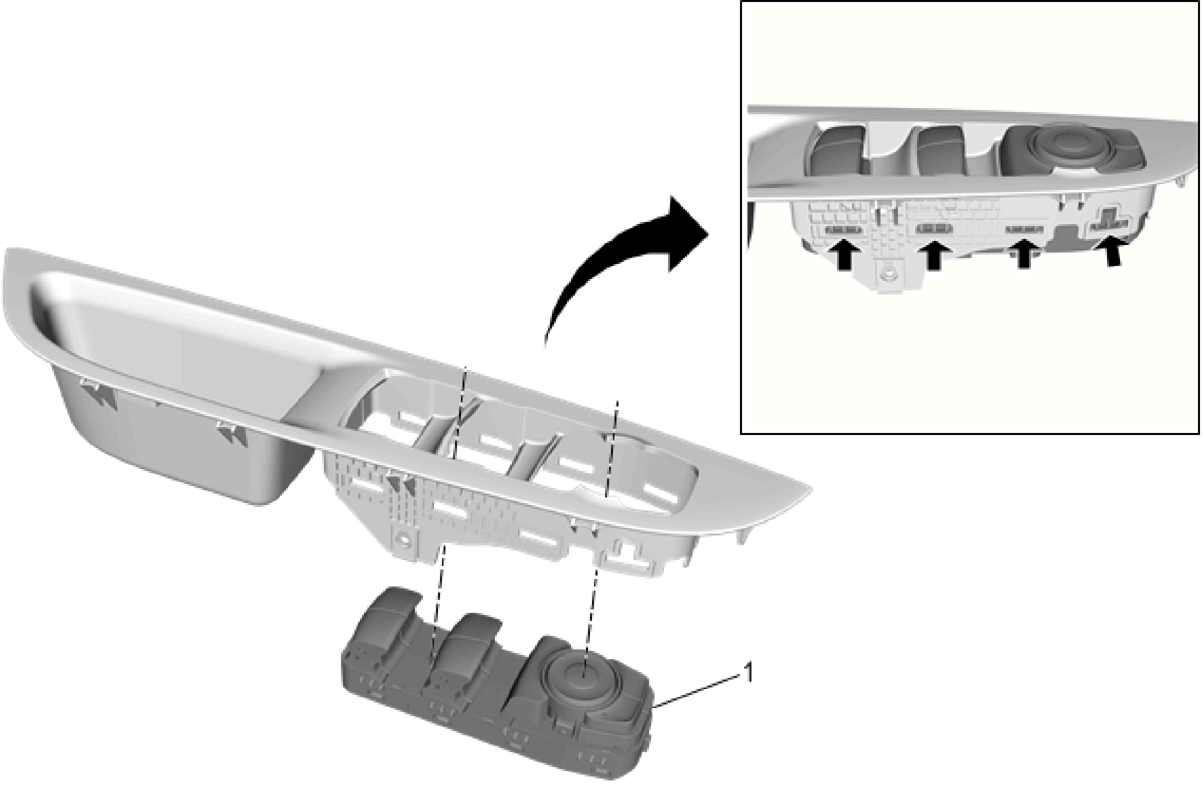


Fig. 46: Front Side Door Window Control Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Side Door Armrest Switch Mount Plate Replacement**	
1	Front Side Door Window Control Switch **Procedure** 1. Remove the J-nut from the mount plate. 2. Release the switch from the switch mount plate by depressing the tabs along each side of the switch.

FRONT SIDE DOOR WINDOW SWITCH REPLACEMENT

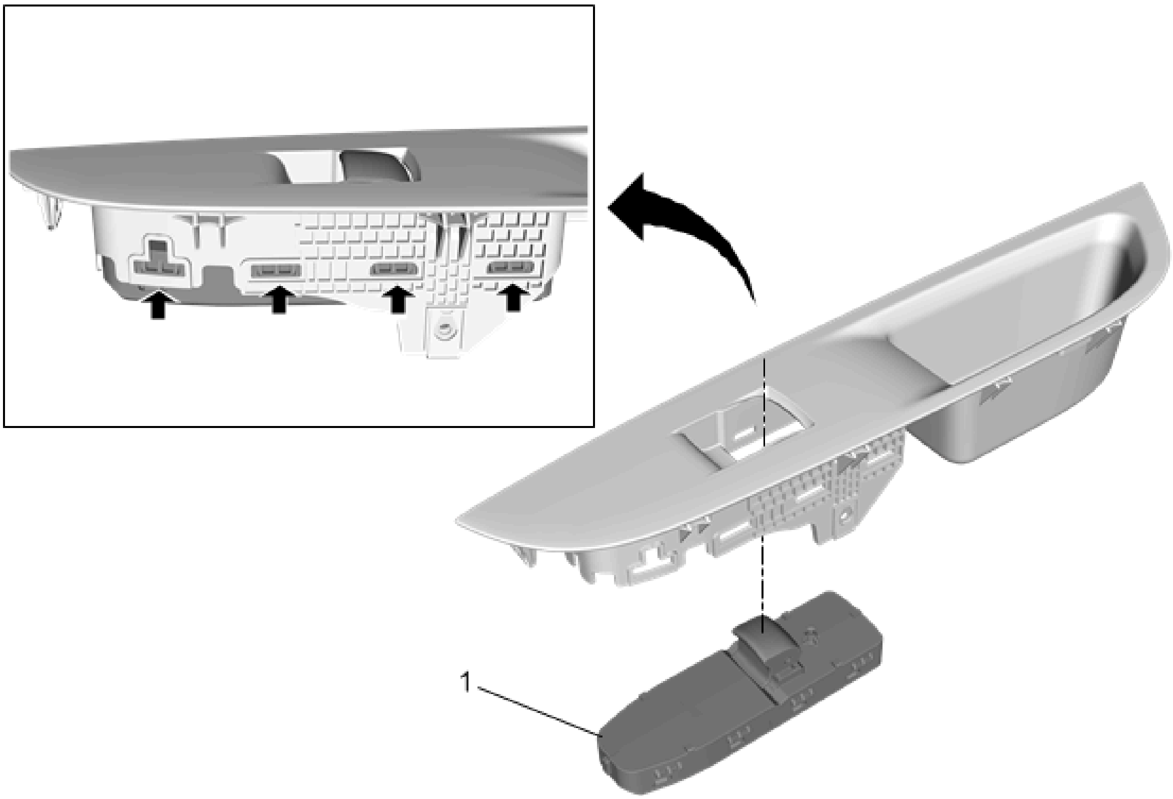


Fig. 47: Front Side Door Window Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Side Door Armrest Switch Mount Plate Replacement	
1	Front Side Door Window Switch **Procedure** 1. Remove the J-nut from the mount plate. 2. Release the switch assembly from the switch mount plate by depressing the tabs along each side of the switch.

REAR SIDE DOOR WINDOW SWITCH REPLACEMENT

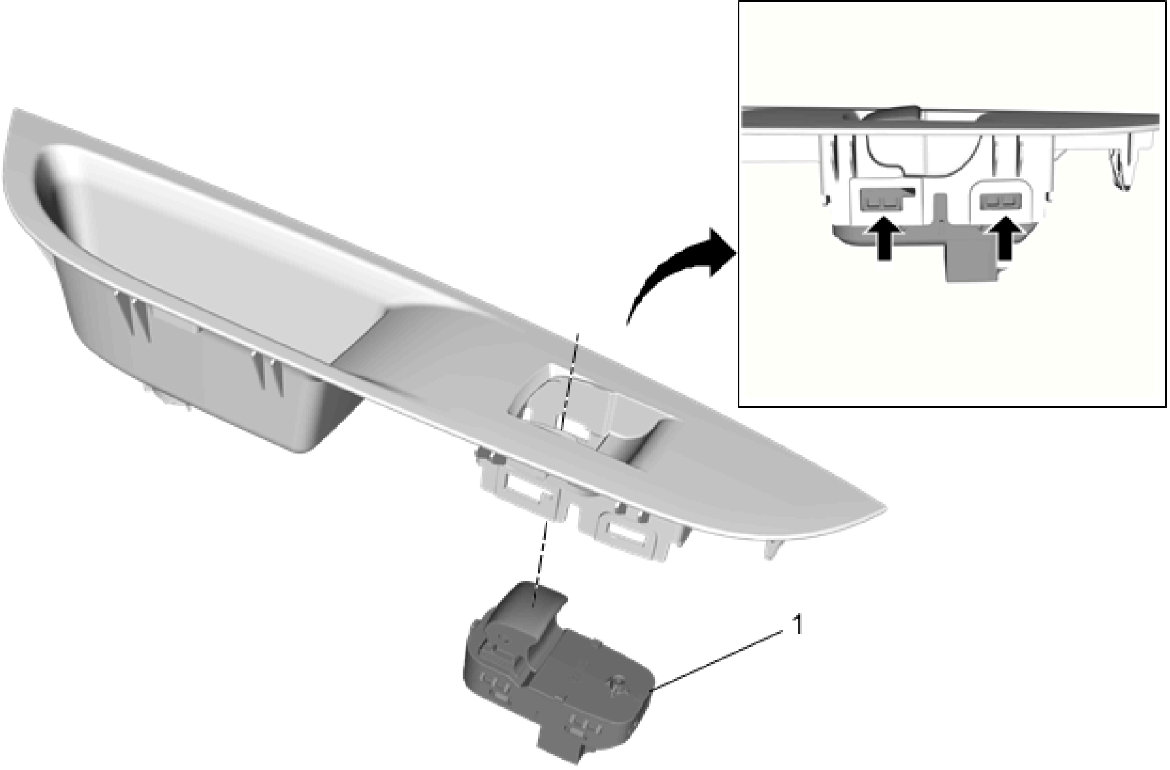


Fig. 48: Rear Side Door Window Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Side Door Armrest Switch Mount Plate Replacement	
1	Rear Side Door Window Switch **Procedure** Release the switch assembly from the switch mount plate by depressing the tabs along each side of the switch.

FRONT SIDE DOOR WINDOW REGULATOR REPLACEMENT

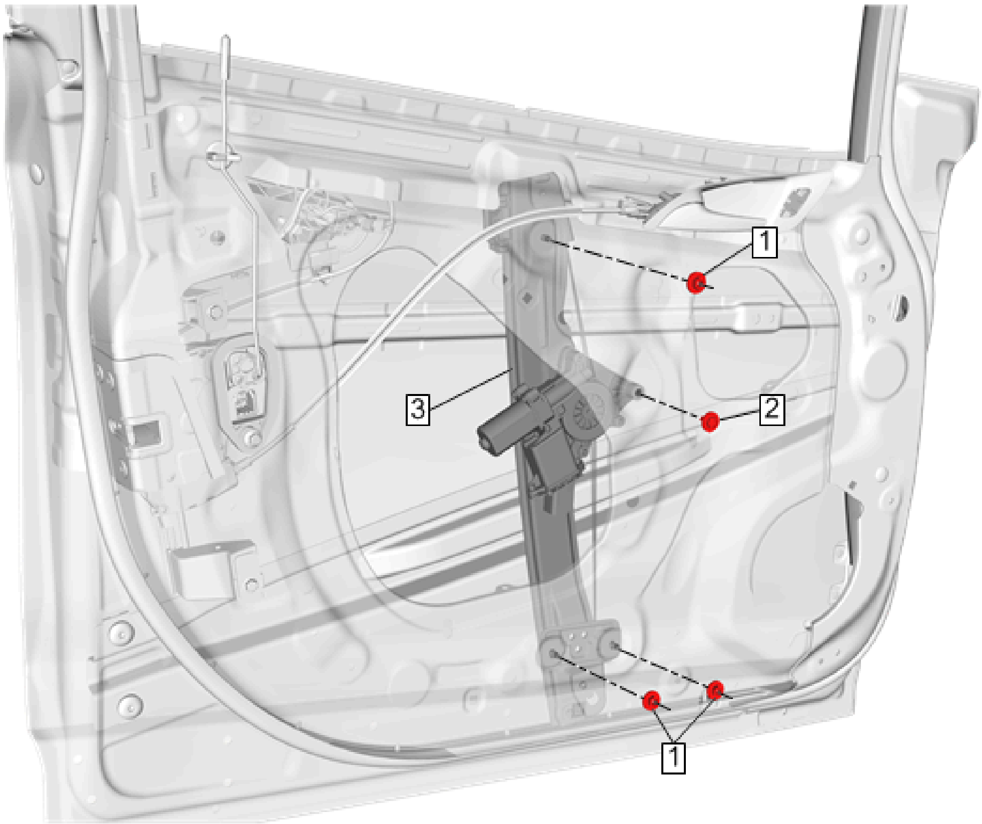


Fig. 49: Front Side Door Window Regulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Glass and Sheet Metal Handling Warning **Preliminary Procedures** 1. Disconnect the window from the regulator. Front Side Door Window Replacement 2. Manually raise the window and tape in position.	
1	Front Side Door Window Regulator Nut (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 11 N.m (97 lb in)
2	Front Side Door Window Regulator Bolt **Tighten** 11 N.m (97 lb in)
3	Front Side Door Window Regulator **Procedure** 1. Disconnect the electrical connector. 2. Inspect the door window for proper operation before installing the door trim panel. 3. Perform the window regulator motor program relearn. Window Motor Programming - Express Function

WINDOW MOTOR PROGRAMMING - EXPRESS FUNCTION

Window Motor Normalized Procedure

A window motor that has not been normalized will no longer perform the express up and express down functions, this may occur during the following conditions:

- When a window motor has been disconnected
- When a door harness has been disconnected
- When the battery has been disconnected or replaced

NOTE: **When DTC B3205 4B & 3210 4B are set, the following warnings will be displayed on the driver information center:**

Open, then Close Driver Window

Open, then Close Passenger Window

These warnings will clear once the windows have been "Normalized" and the respective DTC will clear.

To normalize the window motor, follow these steps:

NOTE: **The doors must be completely closed prior to normalizing the windows, a door that is open or ajar may cause the power window to function abnormally or to become inoperative while performing the**

normalizing procedure. If this occurs, verify that the door is completely closed then repeat the normalizing procedure.

1. Vehicle in Service Mode.
2. Starting with the window completely UP, press and hold the power window switch until the window is fully open and continue holding the switch down for approximately 5 seconds after the window is completely open.
3. Pull the power window switch up until the window is fully closed and continue holding the switch up for approximately 5 seconds after the window is completely closed.

The window should now be normalized and the window should perform the express up and express down functions.

Window Motor Relearn Procedure

A relearn procedure may need to be performed for any Local Interconnect Network (LIN) window motor for the following conditions:

- When the window glass is out of alignment
- When the window glass has been replaced
- When the door has been replaced
- When the window regulator has been replaced

NOTE: **Prior to performing the relearn procedure the vehicle must have all 4 wheels properly inflated and mounted, the vehicle must be sitting on a level surface and all doors must be completely closed.**

To relearn the window motor, follow these steps:

1. Vehicle in Service Mode.
2. With a scan tool, select Module Diagnosis, Body Control Module, Configuration/Reset Functions and then select the appropriate Clear Window Learn Values for the window motor requiring the relearn procedure.
3. After the learn procedure, exit the scan tool learn procedure completely, the power window cannot be normalized and will not function until you exit the program.
4. Starting with the window completely UP, press and hold the power window switch until the window is fully open and continue holding the switch down for approximately 5 seconds after the window is completely open.
5. Pull the power window switch up until the window is fully closed and continue holding the switch up for approximately 5 seconds after the window is completely closed.

The window is now reprogrammed.

REAR SIDE DOOR WINDOW REGULATOR REPLACEMENT

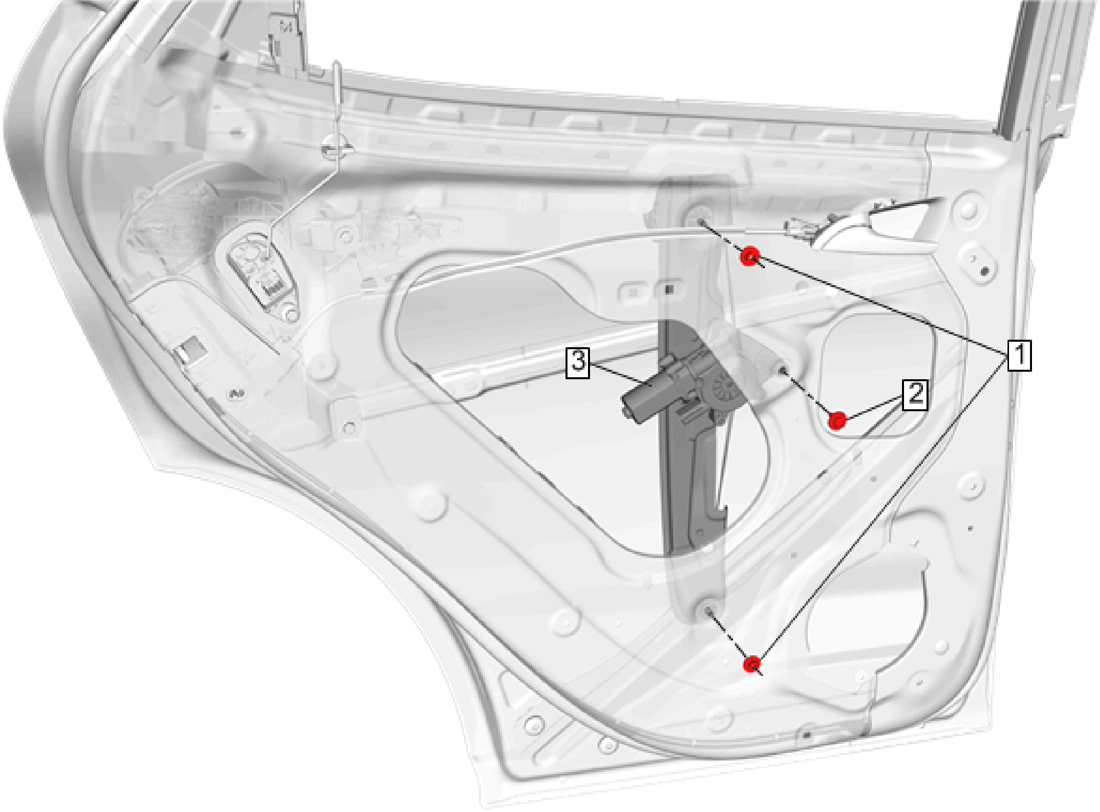


Fig. 50: Rear Side Door Window Regulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Glass and Sheet Metal Handling Warning **Preliminary Procedures** 1. Disconnect the window from the regulator. Rear Side Door Window Replacement 2. Tape the window in the full up position.	
1	Rear Side Door Window Regulator Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 11 N.m (97 lb in)
2	Rear Side Door Window Regulator Bolt **Tighten** 11 N.m (97 lb in)
3	Rear Side Door Window Regulator **Procedure** 1. Disconnect the electrical connector. 2. Inspect the door window for proper operation before installing the door trim panel. 3. Perform the window regulator motor program relearn. Window Motor Programming - Express Function

FRONT SIDE DOOR WINDOW CHANNEL RETAINER REPLACEMENT

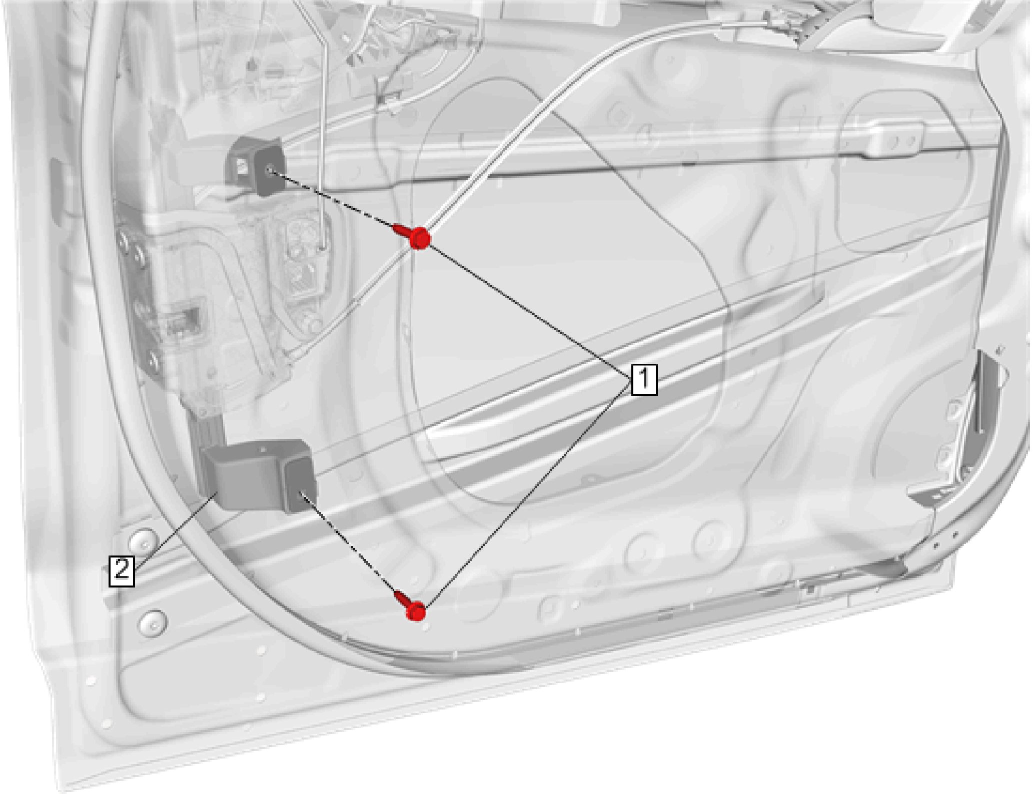


Fig. 51: Front Side Door Window Channel Retainer
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Glass and Sheet Metal Handling Warning **WARNING:** **Disconnect the power window switch when working inside the door. When operated, the Express Up/Down Feature allows the door window to move very quickly, without stopping, which could cause personal injury.** **Preliminary Procedures** 1. Front Side Door Trim Replacement 2. Front Side Door Water Deflector Replacement	
1	Front Side Door Window Channel Retainer Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Front Side Door Window Channel Retainer **Procedure** Unclip the electrical harness from the window channel retainer.

FRONT SIDE DOOR WINDOW INNER SEALING STRIP REPLACEMENT

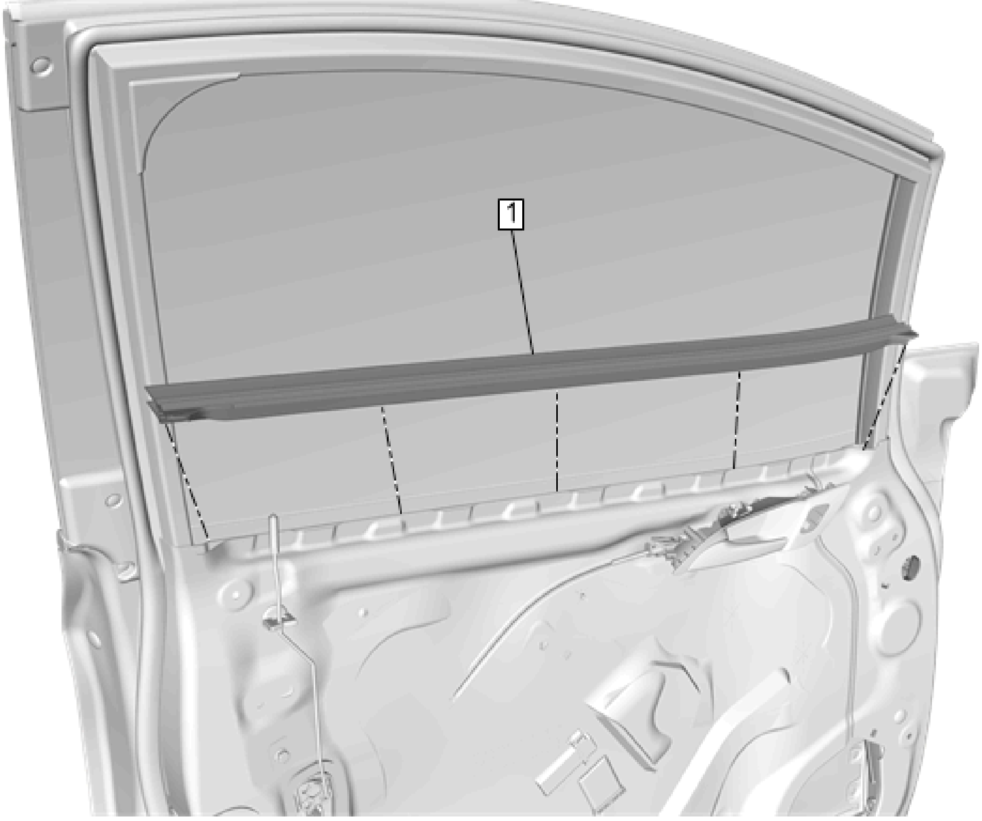


Fig. 52: Front Side Door Window Inner Sealing Strip
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Front Side Door Trim Replacement	
1	Front Side Door Window Inner Sealing Strip **NOTE:** **The sealing strip will come off with the door trim panel. It will need to be removed from the trim panel. Trim panel clips should be installed back to the door and then install the sealing strip.**

REAR SIDE DOOR WINDOW UPPER REVEAL MOLDING REPLACEMENT

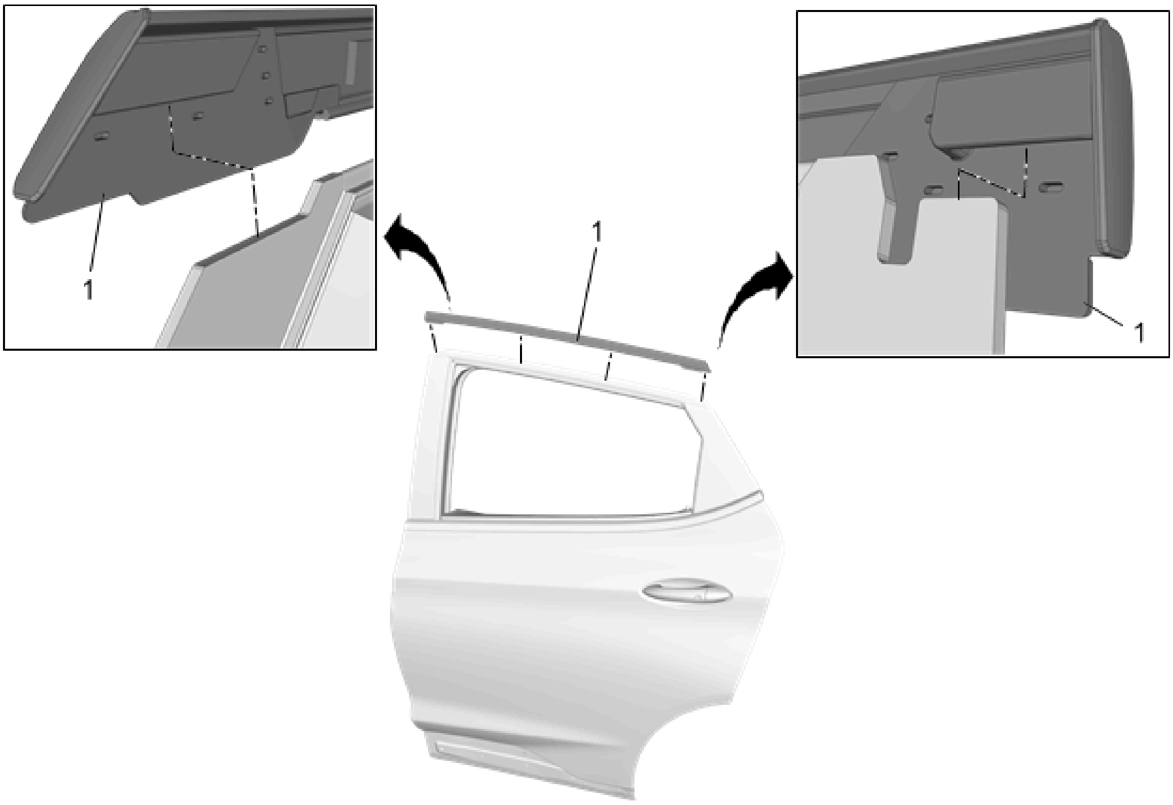


Fig. 53: Rear Side Door Window Upper Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Reposition the upper portion of the door side weatherstrip. Rear Side Door Weatherstrip Replacement - Door Side	
1	Rear Side Door Window Upper Reveal Molding **Procedure** Using the appropriate tool, release the upper reveal molding starting at the rear of the rear door.

REAR SIDE DOOR WINDOW BELT REVEAL MOLDING REPLACEMENT

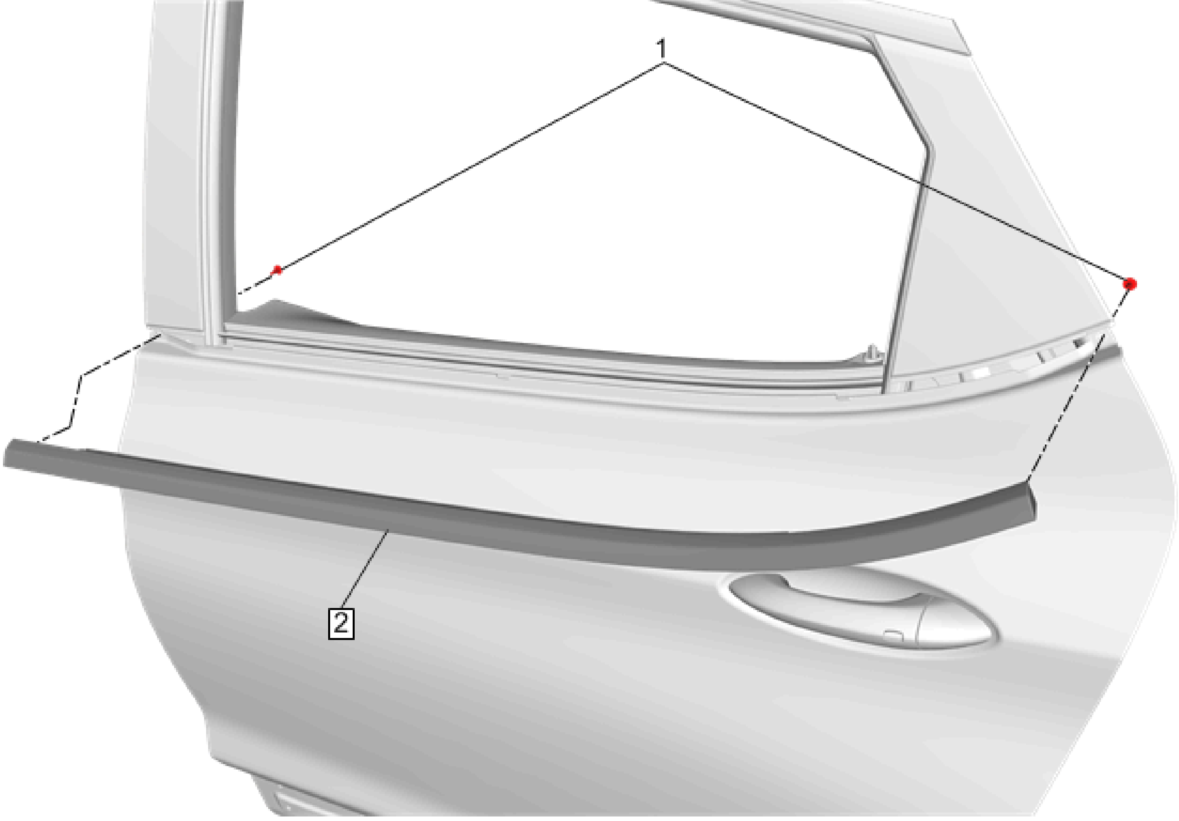


Fig. 54: Rear Side Door Window Belt Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Release the rear side door weatherstrip to access the screw. **Rear Side Door Weatherstrip Replacement - Door Side**	
1	Rear Side Door Window Belt Reveal Molding Screw (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 1.5 N.m (13 lb in)
2	Rear Side Door Window Belt Reveal Molding

FRONT SIDE DOOR WINDOW BELT REVEAL MOLDING REPLACEMENT

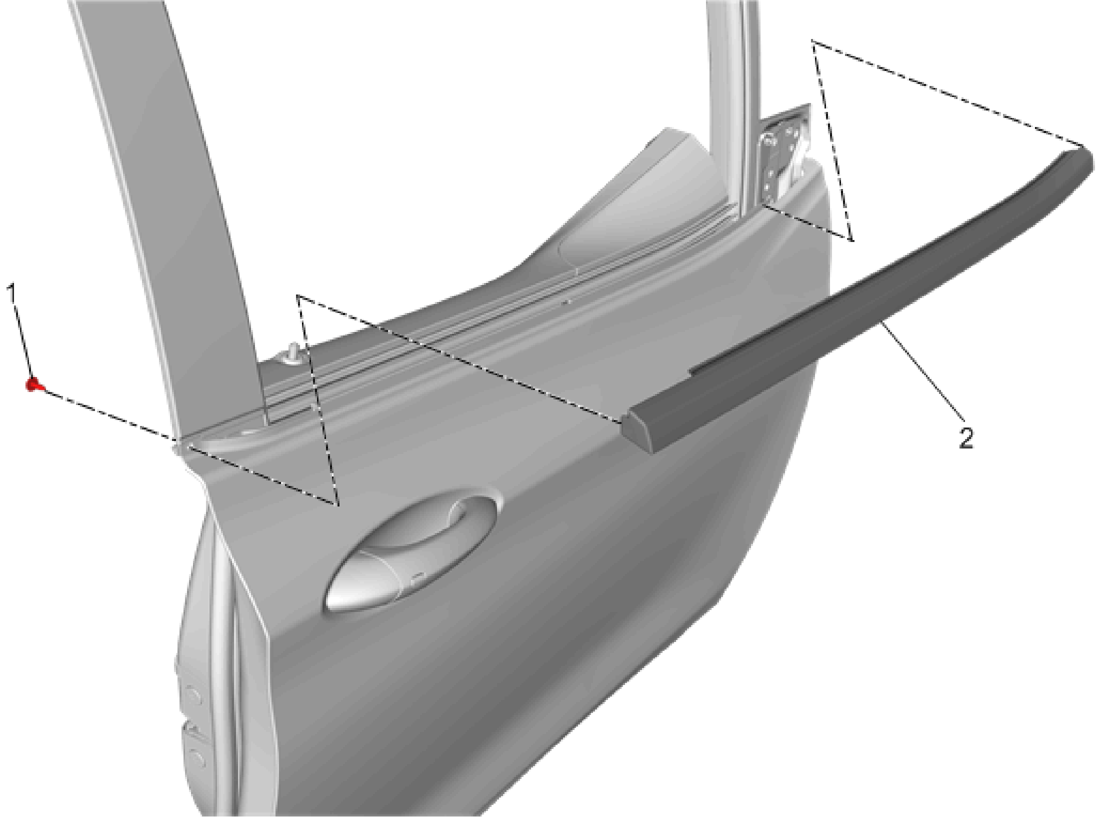


Fig. 55: Front Side Door Window Belt Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Release the front side door weatherstrip to access the screw. **Front Side Door Weatherstrip Replacement - Door Side** 2. Remove the mirror fasteners, reposition and support the mirror. **Outside Rearview Mirror Replacement**	
1	Front Side Door Window Belt Reveal Molding Screw **CAUTION:** **Refer to Fastener Caution .** **Tighten** 1.5 N.m (13 lb in)
2	Front Side Door Window Belt Reveal Molding

FRONT SIDE DOOR WINDOW UPPER REVEAL MOLDING REPLACEMENT

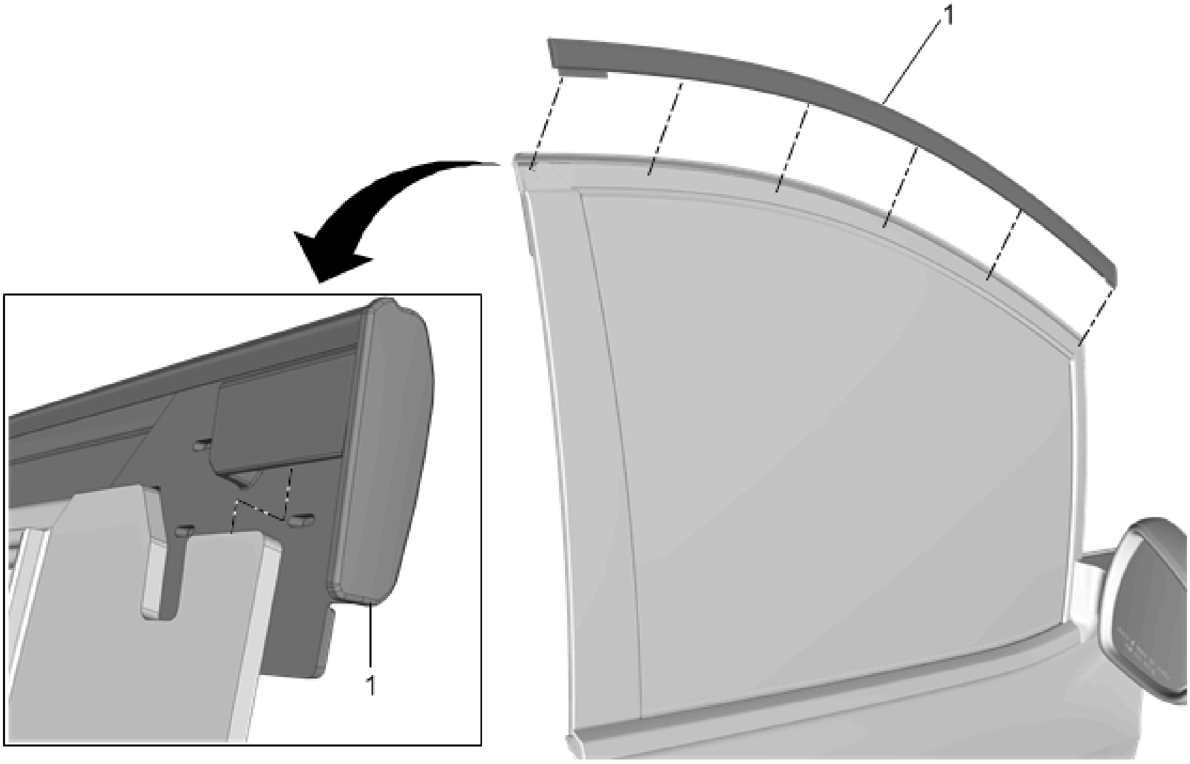


Fig. 56: Front Side Door Window Upper Reveal Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Reposition the upper portion of the door side weatherstrip. Front Side Door Weatherstrip Replacement - Door Side	
1	Front Side Door Window Upper Reveal Molding **Procedure** Using the appropriate tool, release the upper reveal molding.

REAR SIDE DOOR WINDOW INNER SEALING STRIP REPLACEMENT

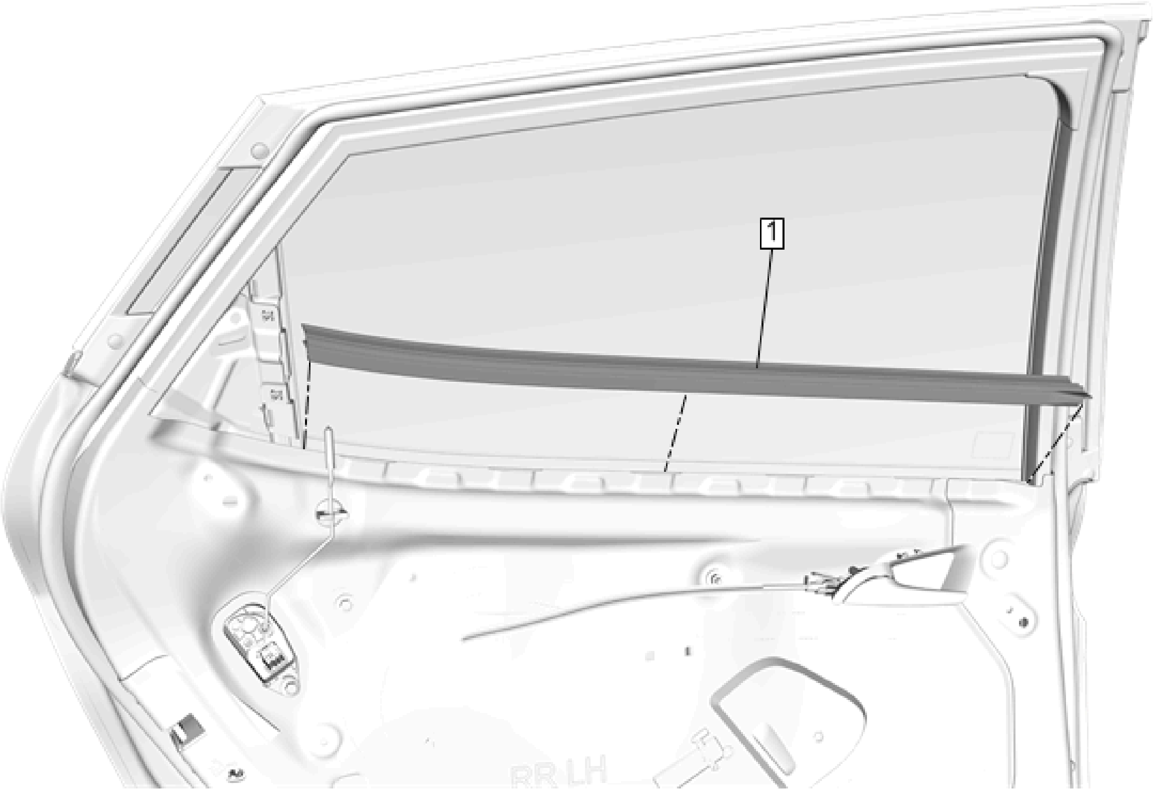


Fig. 57: Rear Side Door Window Inner Sealing Strip
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Side Door Trim Replacement	
1	Rear Side Door Window Inner Sealing Strip **NOTE:** **The sealing strip will come off with the door trim panel. It will need to be removed from the trim panel. The trim panel clips will need to be installed back into the door and then install the sealing strip.**

FRONT SIDE DOOR WINDOW WEATHERSTRIP REPLACEMENT

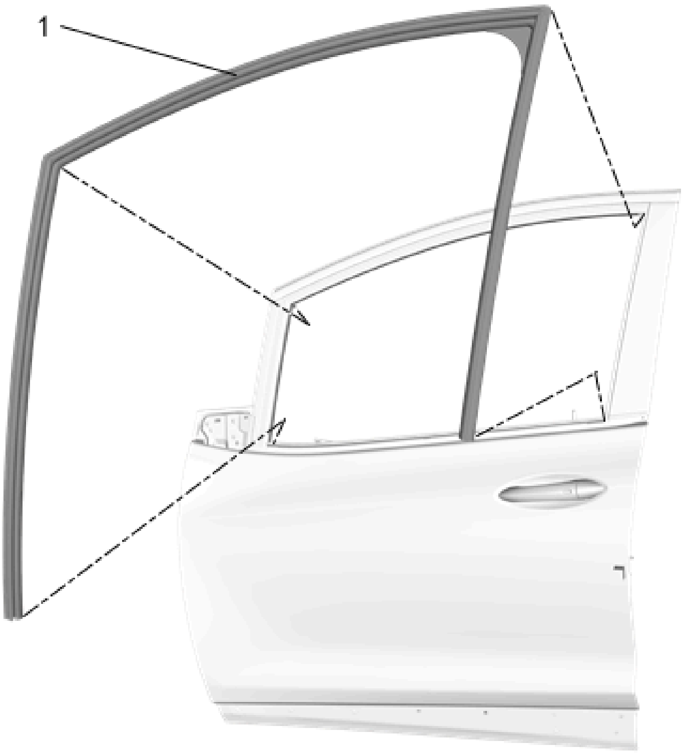


Fig. 58: Front Side Door Window Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Side Door Window Replacement 2. Front Side Door Window Inner Sealing Strip Replacement 3. Radio Front Side Door Speaker Replacement	
1	Front Side Door Window Weatherstrip **Procedure** 1. Grasp both upper corners of the window weatherstrip, pull downward releasing the window weatherstrip from the door frame. 2. Insert the weatherstrip downward in the front and rear channel until fully seated. 3. Inspect the door window for proper operation before installing the door trim panel.

REAR SIDE DOOR WINDOW WEATHERSTRIP REPLACEMENT

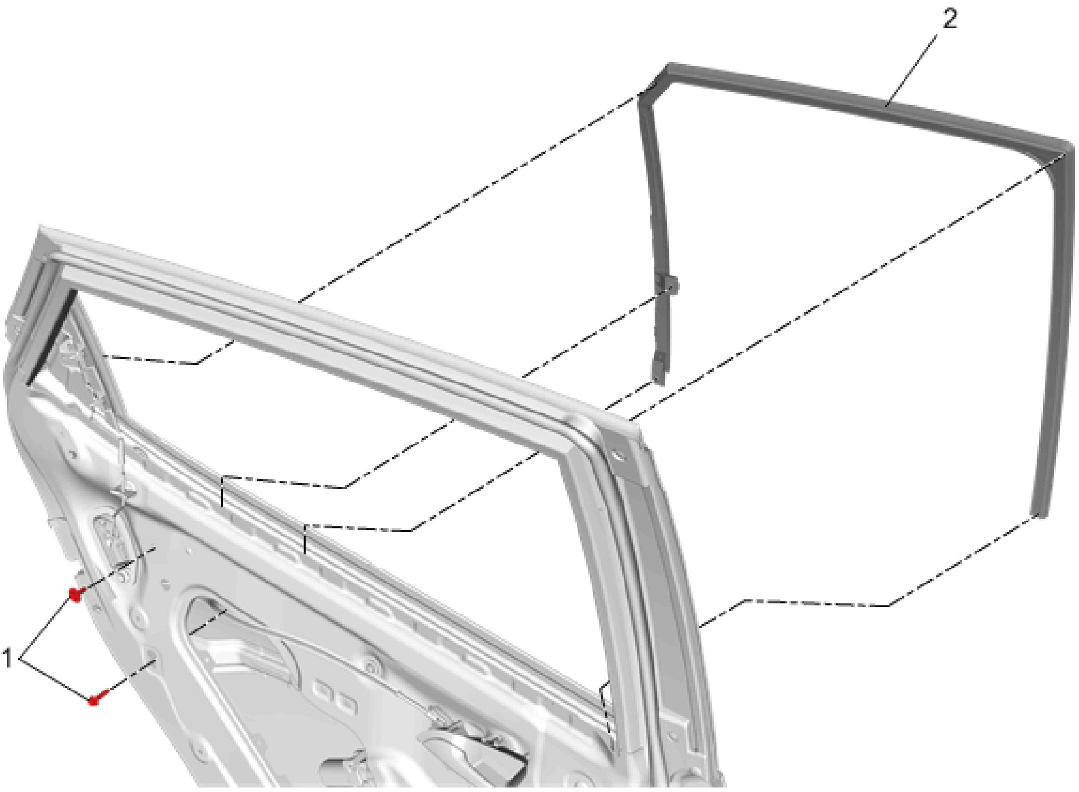


Fig. 59: Rear Side Door Window Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Rear Side Door Window Replacement 2. Rear Side Door Window Inner Sealing Strip Replacement	
1	Rear Side Door Window Channel Rear Retainer Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Rear Side Door Window Weatherstrip **Procedure** 1. Grasp both upper corners of the window weatherstrip, pull downward releasing the window weatherstrip from the door frame. 2. Unclip electrical harness from the rear channel. 3. Insert the weatherstrip downward in the front and rear channel until fully seated. 4. Inspect the door window for proper operation before installing the door trim panel.

ADHESIVE INSTALLATION OF STATIONARY WINDOWS

WARNING: **Refer to Glass and Sheet Metal Handling Warning .**

1. Use a urethane adhesive systems which meet GM Specification GM 3651G

2. Remove all mounds or loose pieces of urethane adhesive from the pinchweld area.
3. If the original window is being reused, remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinchweld flange by using a clean utility knife or razor blade scraper.
4. Inspect for any of the following problems in order to help prevent future breakage of the window:
    - The flange of the window opening
    - High weld
    - Solder spots
    - Hardened sealer
    - Any other obstruction or irregularity in the pinchweld flange

NOTE: **If corrosion of the pinch-weld flange is present or if sheet metal repairs or replacements are required, the pinch-weld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15Ã,Â®, DuPont 2610Ã,Â®, Sherwin-Williams PSE 4600 and NP70Ã,Â® and Martin-Semour 5120 and 5130Ã,Â® PPG DP90LF SPIES/HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDOX 11158/13320 - 14653/14980 products are approved for this application.**

5. After repairing the opening as indicated, perform the following steps:
6. Use an abrasive pad if necessary to remove mold release buildup from the encapsulated window. Use a dampened lint free cloth to remove any debris remaining on the window.

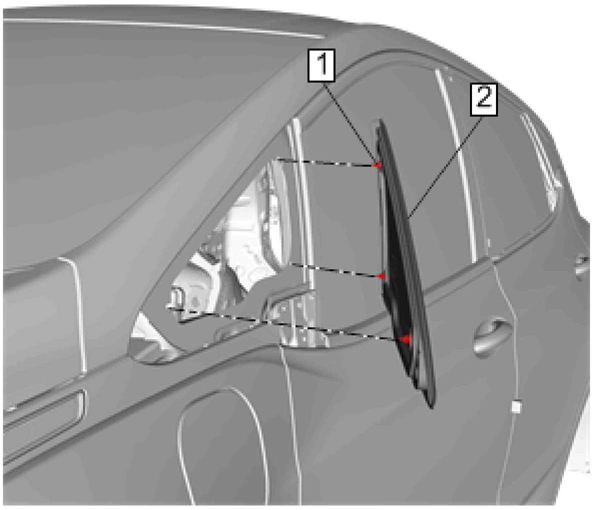


Fig. 60: Stationary Window
Courtesy of GENERAL MOTORS COMPANY

7. Ensure that the window locator pins (1) are positioned to the pinch-weld flange.
8. Dry fit the window (2) to the opening in order to determine the correct position.
9. Use masking tape to mark the locations of the window in the opening.
10. Cut the masking in the center and remove the window from the opening.
11. Verify all primers and urethane adhesive are within expiration dates.

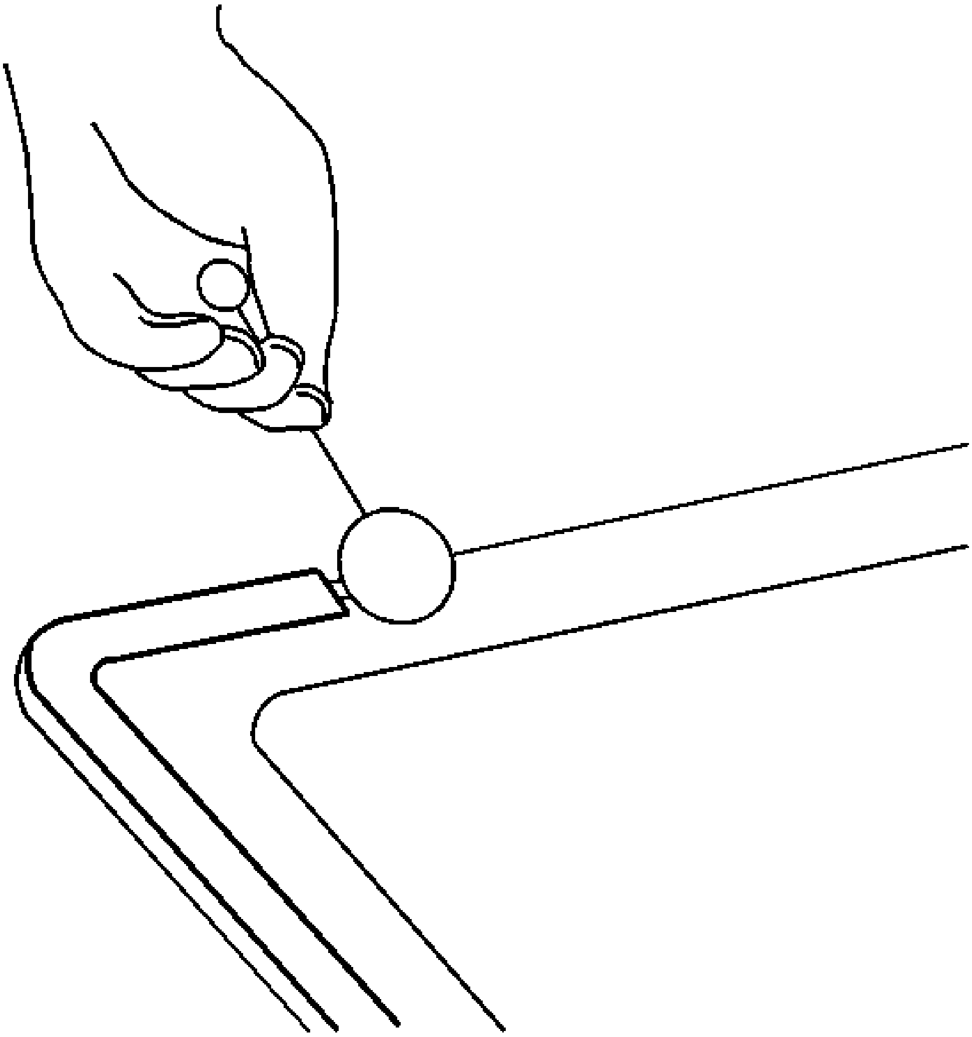


Fig. 61: Applying Glass Prep
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.**

NOTE: **Do not apply the black primer to the existing bead of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.**

12. Shake the primer clear for at least 1 minute.
13. Use a new dauber in order to apply the primer to the surface of the encapsulated window.
14. Allow the primer to dry for approximately 6 minutes.

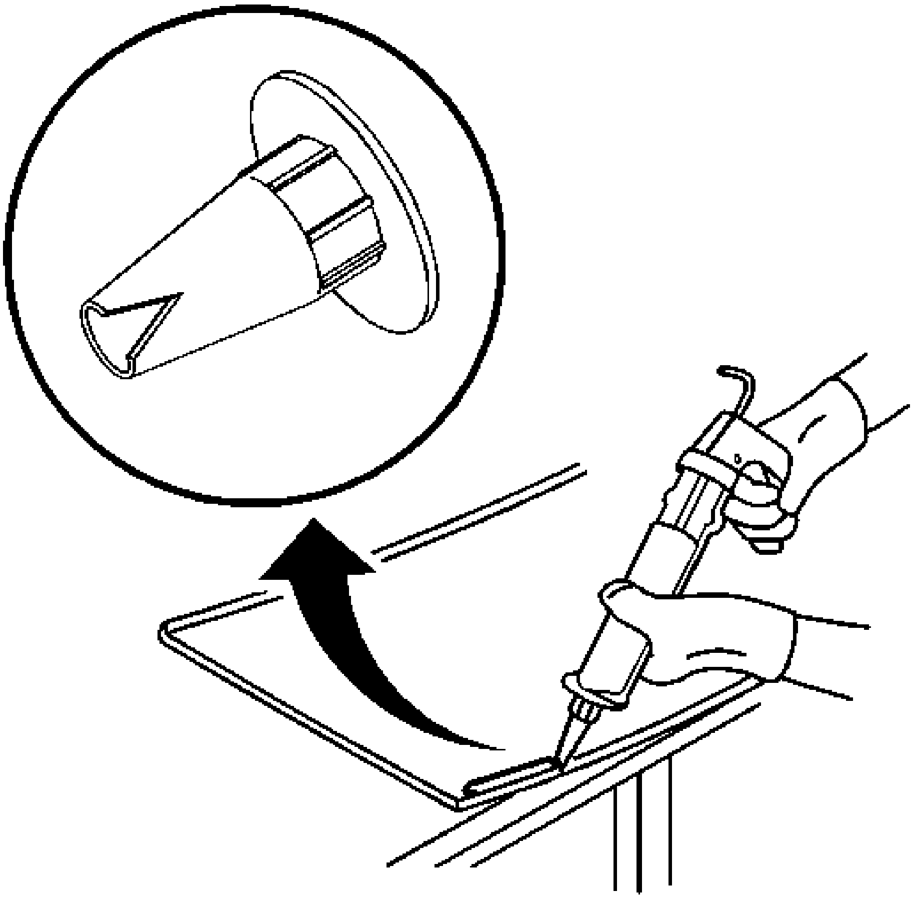


Fig. 62: Modified Applicator Nozzle
Courtesy of GENERAL MOTORS COMPANY

15. Cut the applicator nozzle in order to provide a bead of 8 mm (0. 31 in) wide, 12 mm (0. 50 in) high.

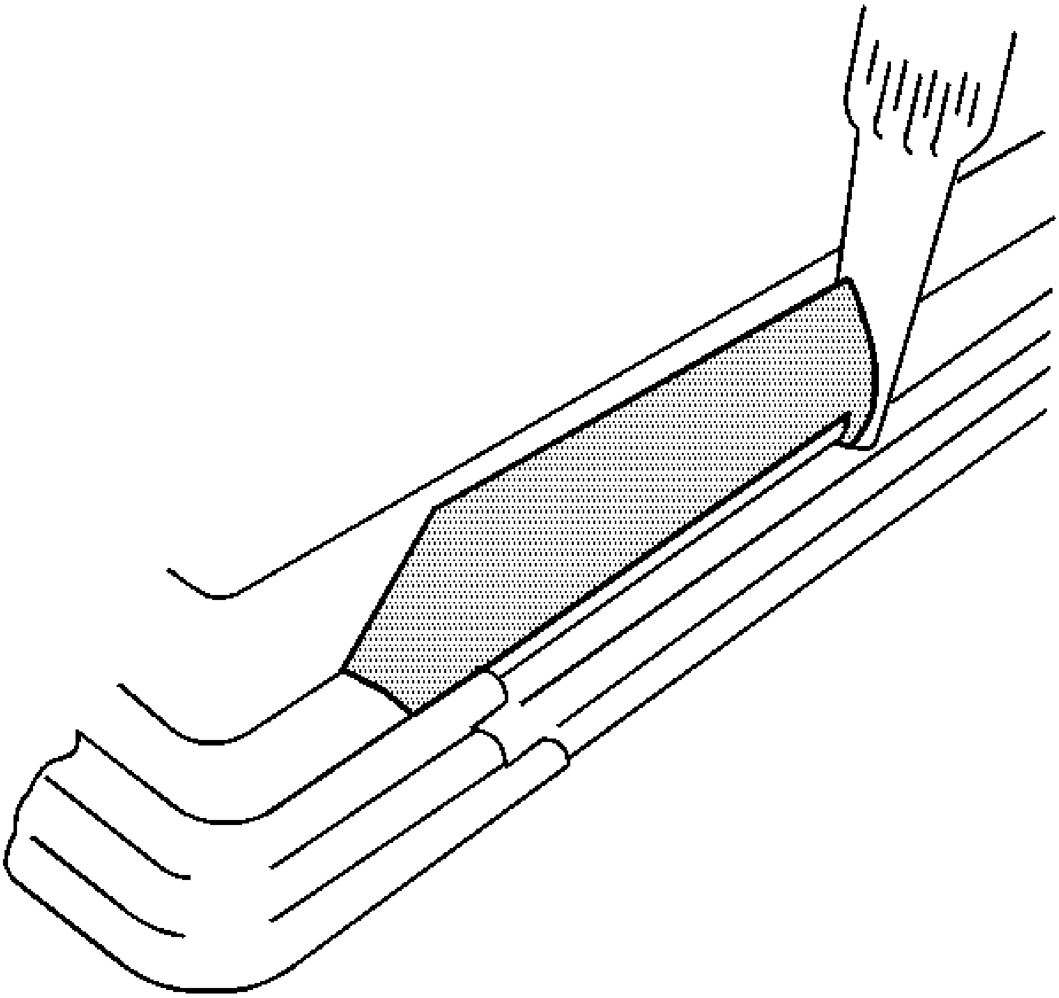


Fig. 63: Applying Continuous Bead Of Urethane Adhesive
Courtesy of GENERAL MOTORS COMPANY

16. Use a cartridge-type caulking gun in order to apply a smooth, continuous bead of urethane adhesive.
17. Use the edge of the inside encapsulated window track as a guide for the nozzle in order to apply the urethane adhesive.
18. Place the window in the opening.
19. Align the masking tape lines on the window and the body.
20. Press firmly around the entire periphery of the window in order to wet-out the urethane bead.
21. Tape the window to the body in order to minimize movement until the urethane adhesive cures.
22. Clean any excess urethane adhesive from the body.

NOTE: **Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.**

23. Use a soft spray of warm water in order to immediately water test the window.
24. Inspect the window for leaks.
25. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
26. Retest the window for leaks.

WARNING: **Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.**

- **For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21Ã‚Â°C (70Ã‚Â°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.**

- **For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.**

Do NOT physically disturb the repair area until after these minimum times have elapsed.

27. Maintain the following conditions in order to properly cure the urethane adhesive:
    - Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
    - Do not drive the vehicle until the urethane adhesive is cured. Refer to the above curing times.
    - Do not use compressed air in order to dry the urethane adhesive.
28. Complete the window installation.

ADHESIVE INSTALLATION OF WINDSHIELDS

WARNING: **Refer to Glass and Sheet Metal Handling Warning .**

1. Use a urethane adhesive systems which meet GM Specification GM 3651G.
2. Remove all mounds or loose pieces of urethane adhesive from the pinchweld area.
3. If the original window is being reused, remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinchweld flange by using a clean utility knife or razor blade scraper.
4. Inspect for any of the following problems in order to help prevent future breakage of the window:
    - The flange of the window opening
    - High weld
    - Solder spots
    - Hardened sealer
    - Any other obstruction or irregularity in the pinchweld flange

NOTE: **If corrosion of the pinch-weld flange is present or if sheet metal repairs or replacements are required, the pinch-weld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15Ã‚Â®, DuPont 2610Ã‚Â®, Sherwin-Williams PSE 4600 and NP70Ã‚Â® and Martin-Semour 5120 and 5130Ã‚Â® PPG DP90LF SPIES/ HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDOX 11158/13320 - 14653/14980 products are approved for this application.**

5. After repairing the opening as indicated, perform the following steps:
    1. Remove all traces of broken glass from the outer cowl panel, seats, floor and defroster ducts.
    2. Clean around the edge of the inside surface of the window with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.
6. Verify all primers and urethane adhesive are within expiration dates.

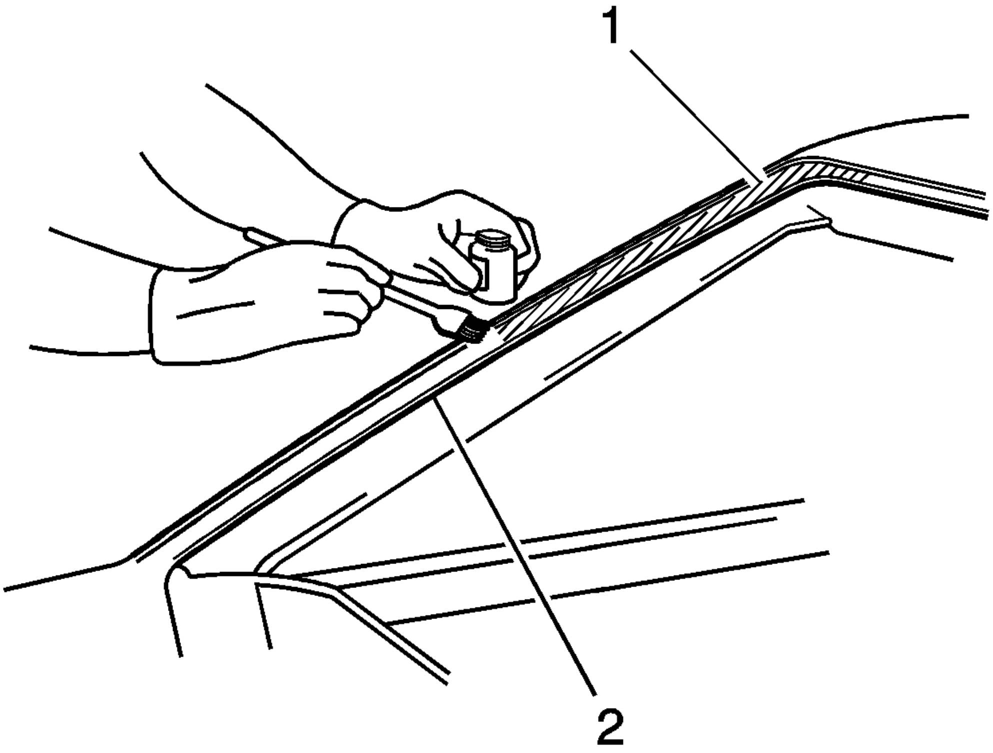


Fig. 64: Applying Pinch-Weld Primer
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.**

NOTE: **Do not apply the black primer to the existing bead of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.**

7. Shake the pinch-weld primer for at least 1 minute.
8. Use a new dauber in order to apply the primer to the surface of the pinch-weld flange (1).
9. Allow the pinch-weld primer to dry for approximately 10 minutes.

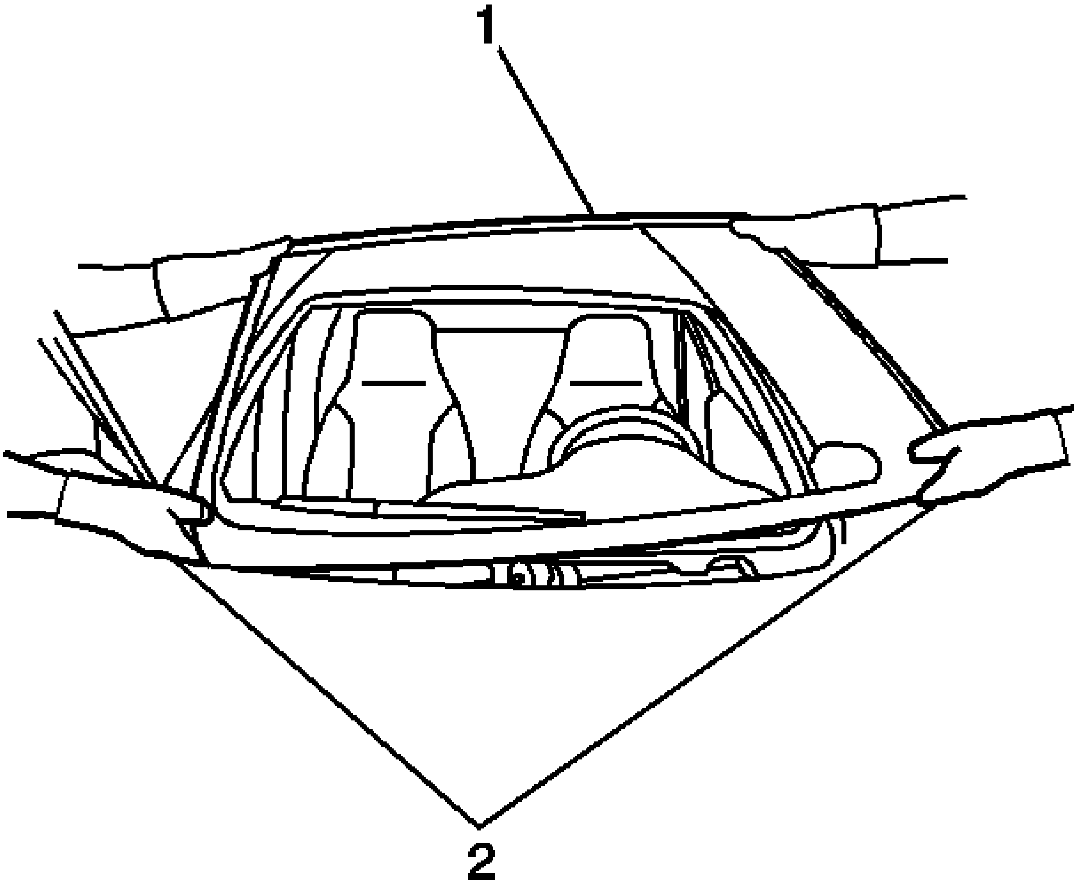


Fig. 65: Removing/Installing Windshield
Courtesy of GENERAL MOTORS COMPANY

10. With the an assistant, dry fit the window (1) to the opening in order to determine the correct position.

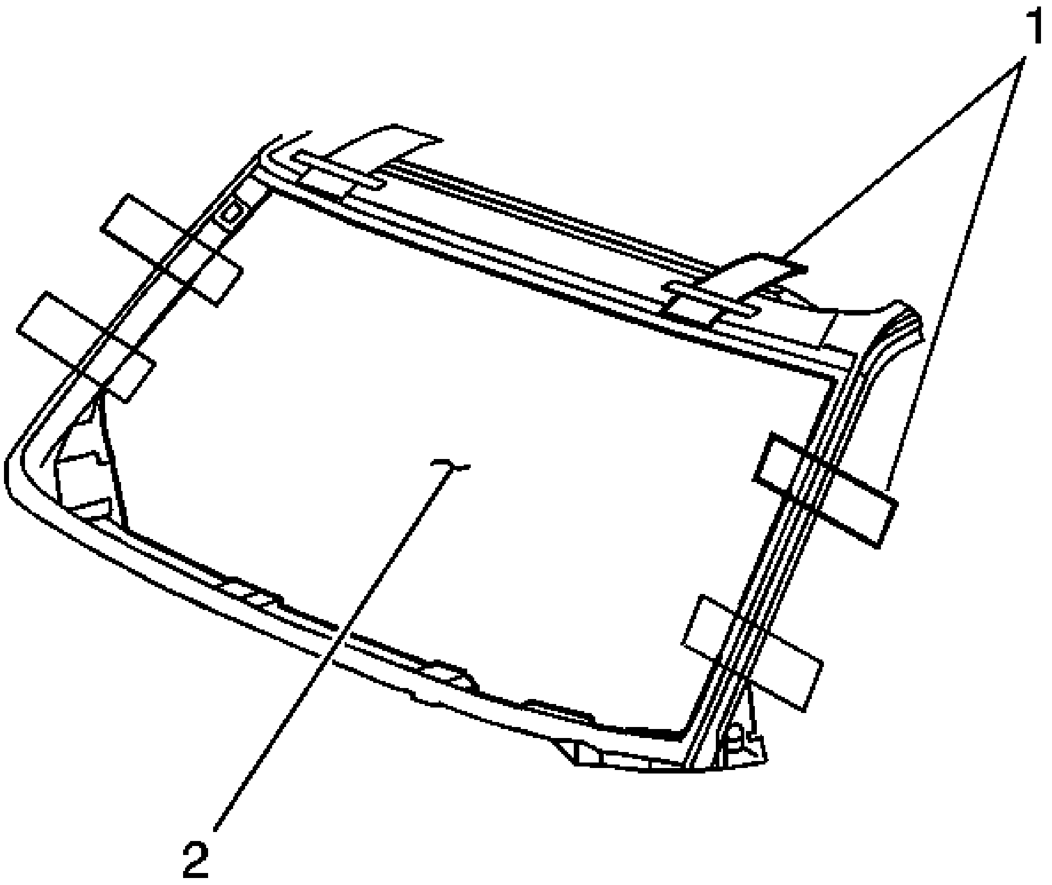


Fig. 66: Aligning Tape Lines On Window To Body
Courtesy of GENERAL MOTORS COMPANY

11. Use masking tape in order to mark the locations (1) of the window (2) in the opening.
12. Cut the masking tape in the center and remove the window from the opening.

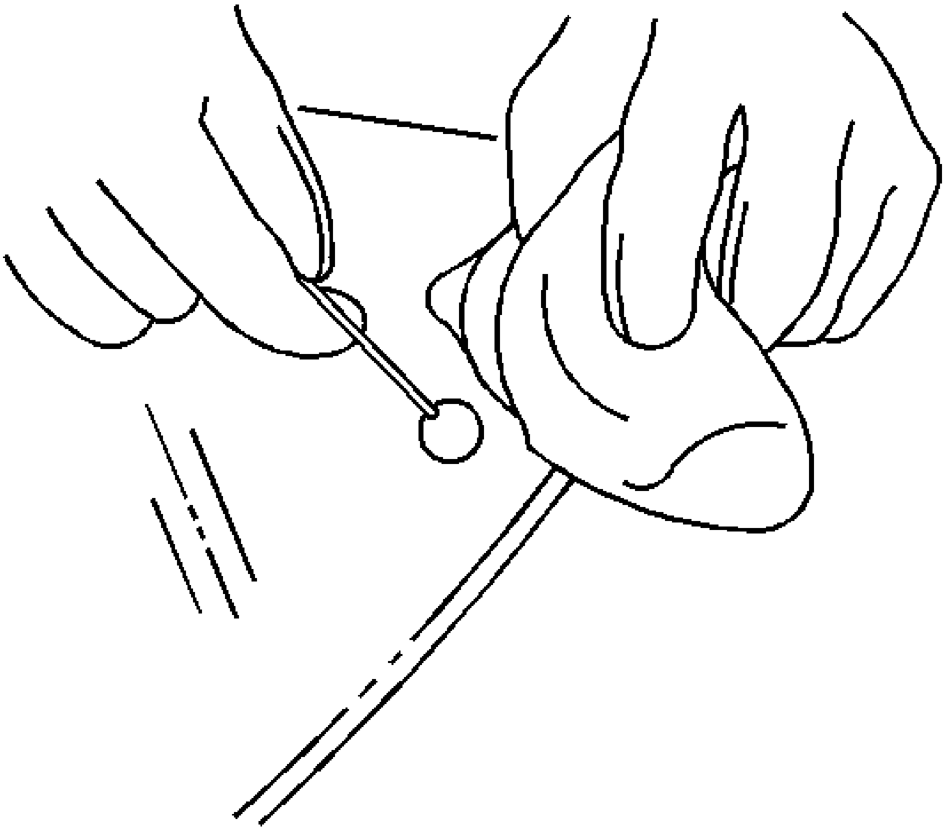


Fig. 67: Applying Glass Prep
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use care when applying glass prep clear on the window. This primer dries almost instantly, and may stain the viewing area of the window if not applied evenly.**

13. Use a new dauber in order to apply glass prep clear to the area approximately 10 - 16 mm (3/8 - 5/8 in) around the entire perimeter of the window inner surface.

    Immediately wipe the glass primed area using a clean, lint-free cloth.

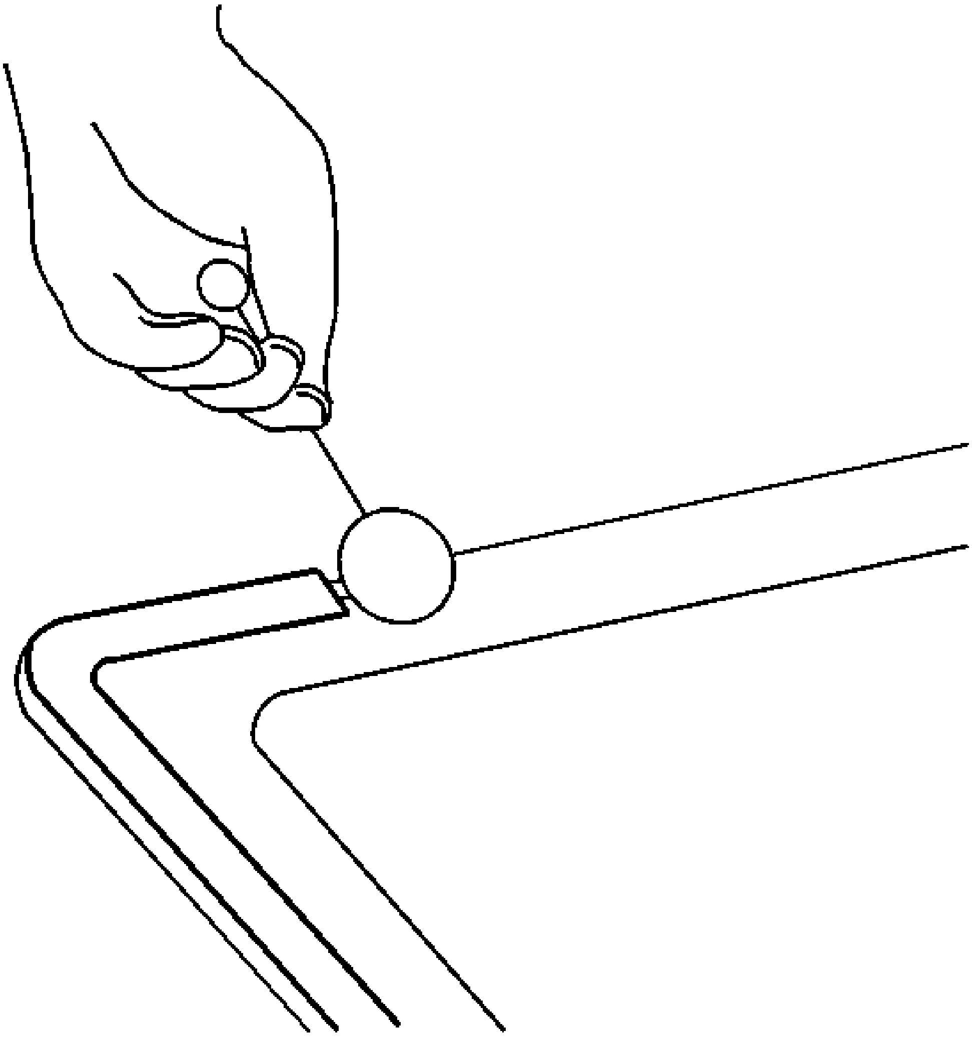


Fig. 68: Applying Glass Prep
Courtesy of GENERAL MOTORS COMPANY

14. Apply a second coat of the glass prep clear to the same area of the glass.

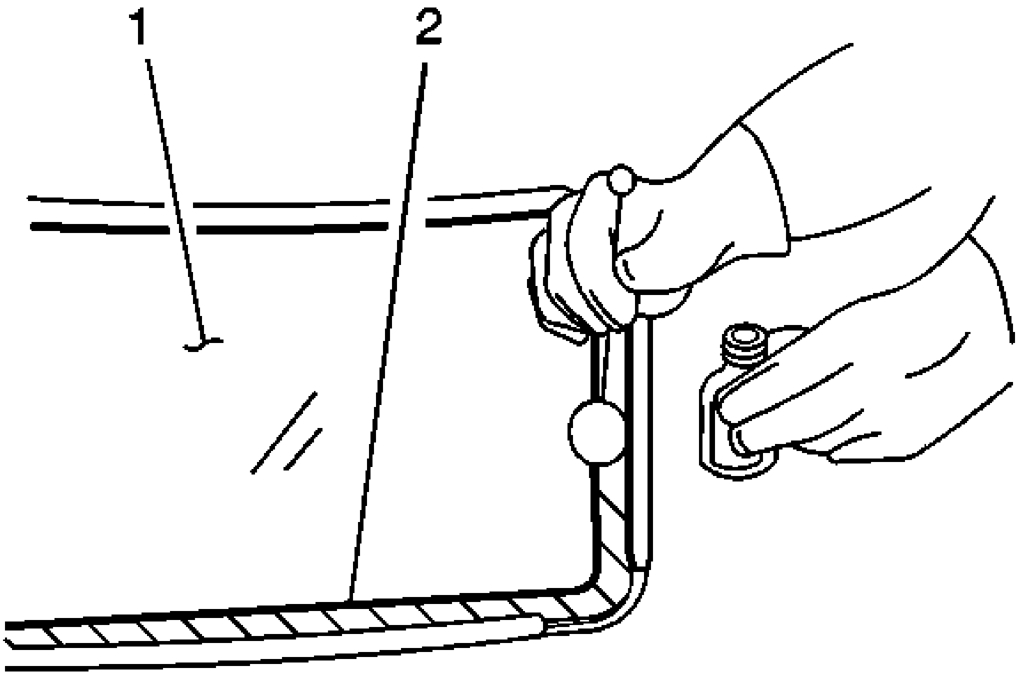


Fig. 69: Applying Glass Primer
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The glass primer black is effective up to 8 hours after applying it to the glass. The primed surface of the glass must be kept clean.**

15. Shake the glass primer black for at least 1 minute.
16. Use a new dauber in order to apply the glass primer black to the same areas (2) that glass prep clear was applied.
17. Allow the glass primer to dry for approximately 10 minutes.

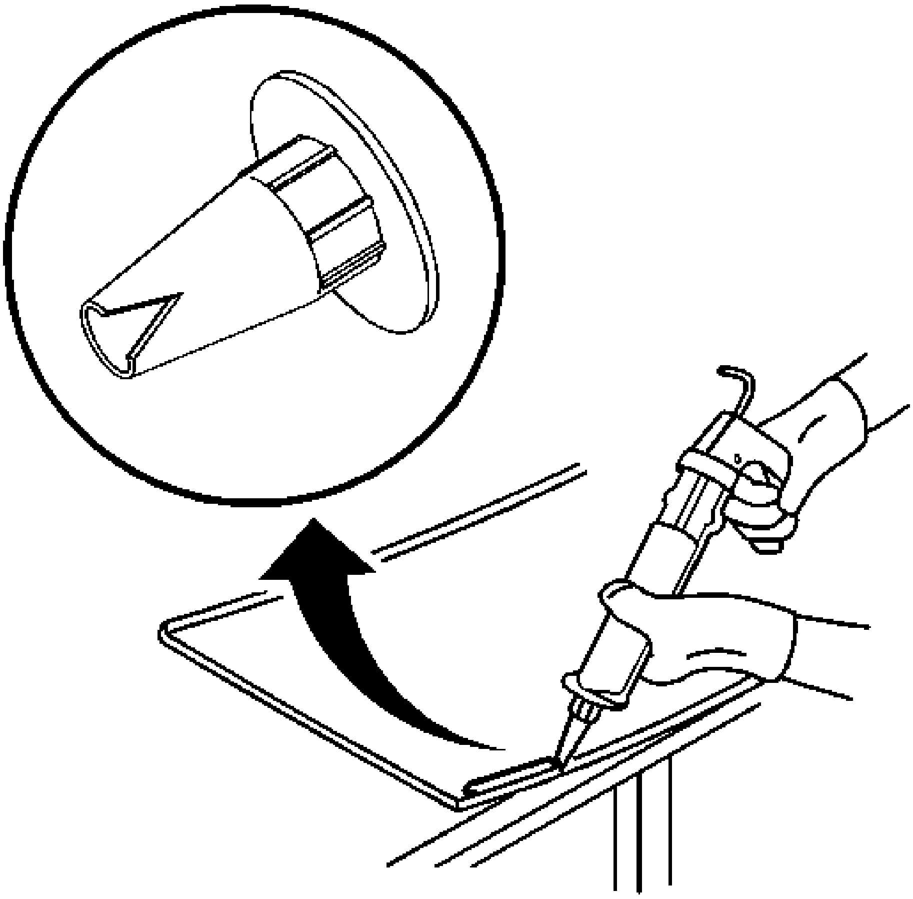


Fig. 70: Modified Applicator Nozzle
Courtesy of GENERAL MOTORS COMPANY

18. Cut the applicator nozzle in order to provide a bead of 12. 7 mm (1/2 in) wide and 12. 7 mm (1/2 in) high.

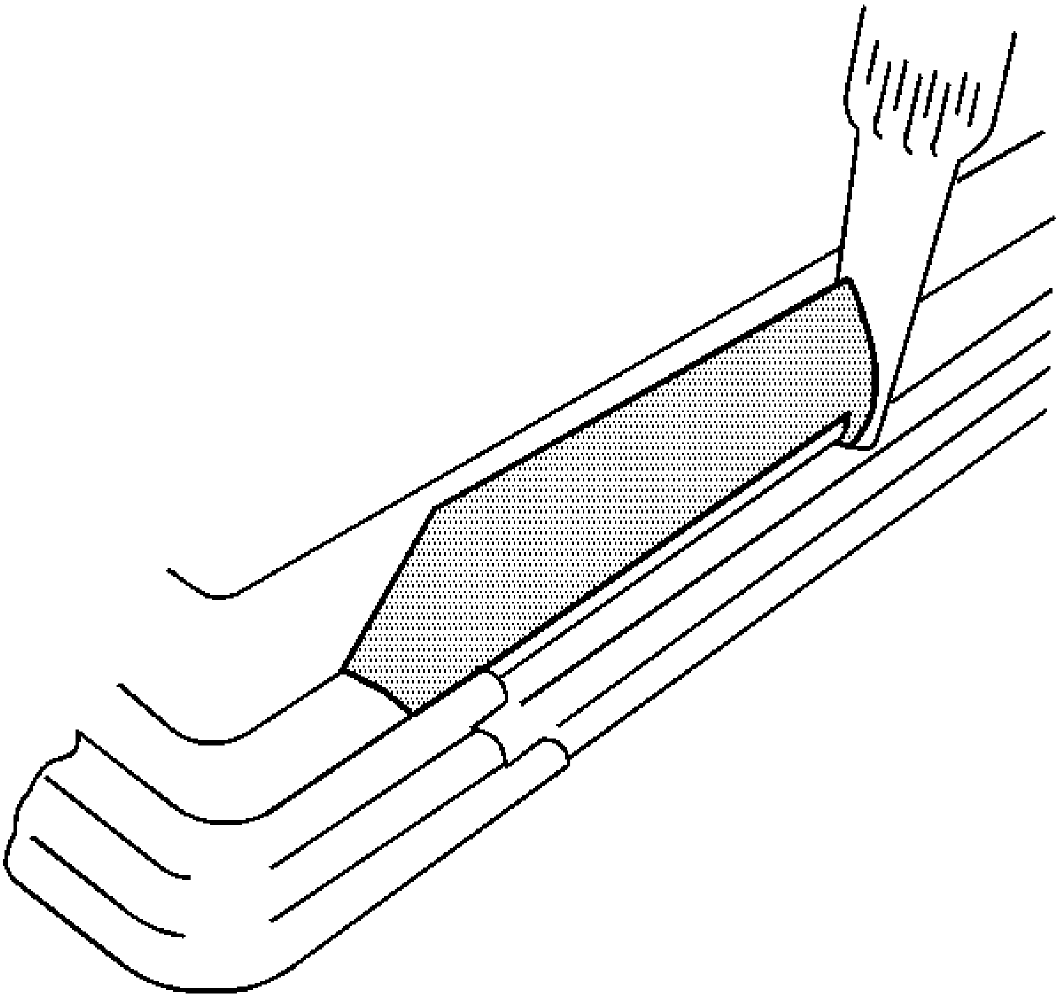


Fig. 71: Applying Continuous Bead Of Urethane Adhesive
Courtesy of GENERAL MOTORS COMPANY

19. Use a cartridge-type caulking gun in order to apply a smooth, continuous bead of urethane adhesive.

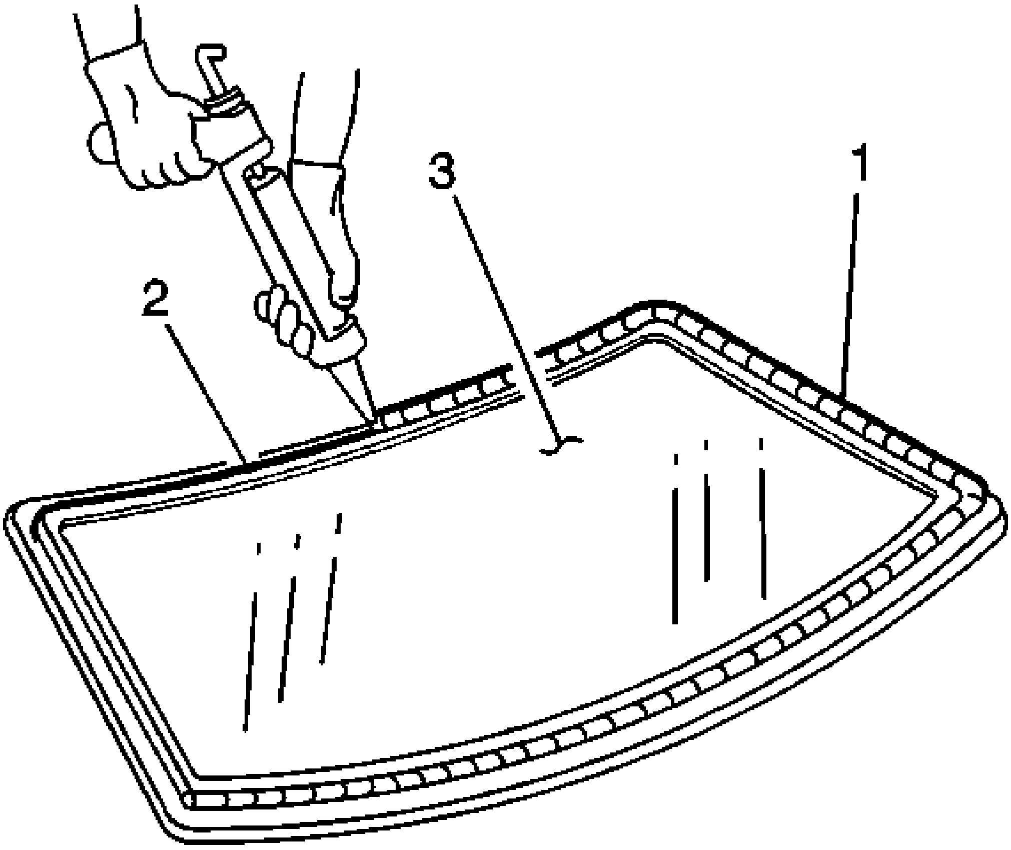


Fig. 72: Applying Urethane Adhesive To Inner Surface Of Window
Courtesy of GENERAL MOTORS COMPANY

20. Use the edge of the window as a guide for the nozzle in order to apply the urethane adhesive (1) to the inner surface of the window (3).

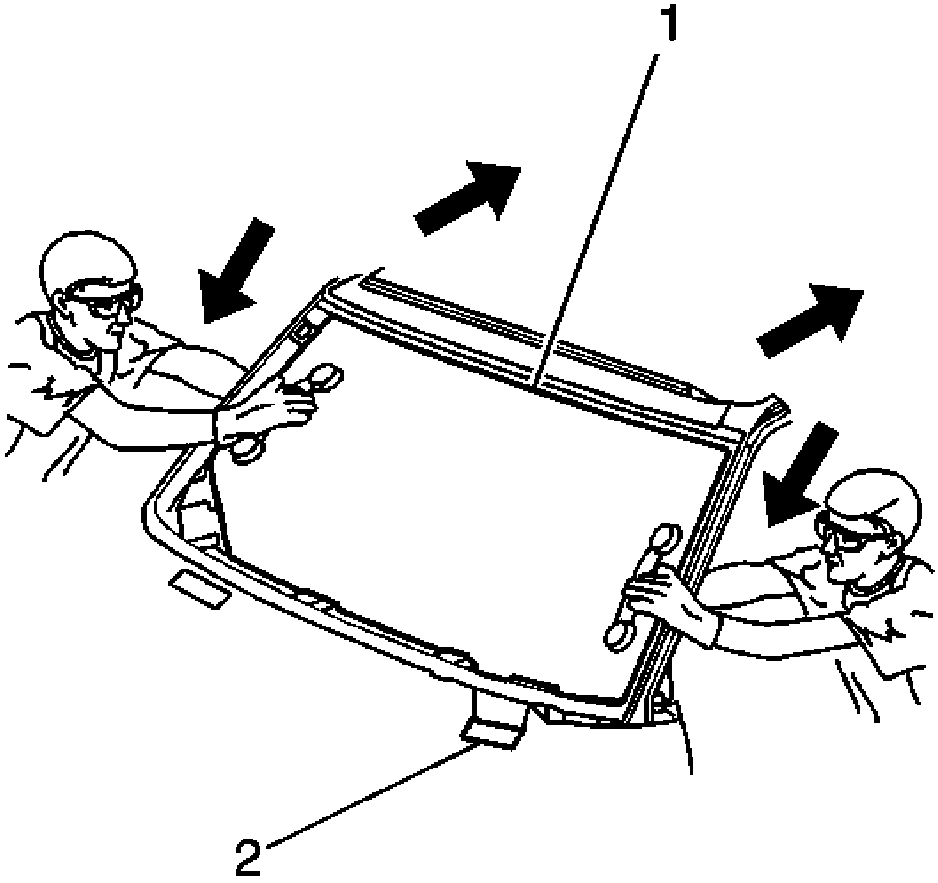


Fig. 73: Installing Windshield
Courtesy of GENERAL MOTORS COMPANY

21. With an assistant, installing the windshield (1) to the locator pins to the slots located in each corner of the upper pinch-weld flange.

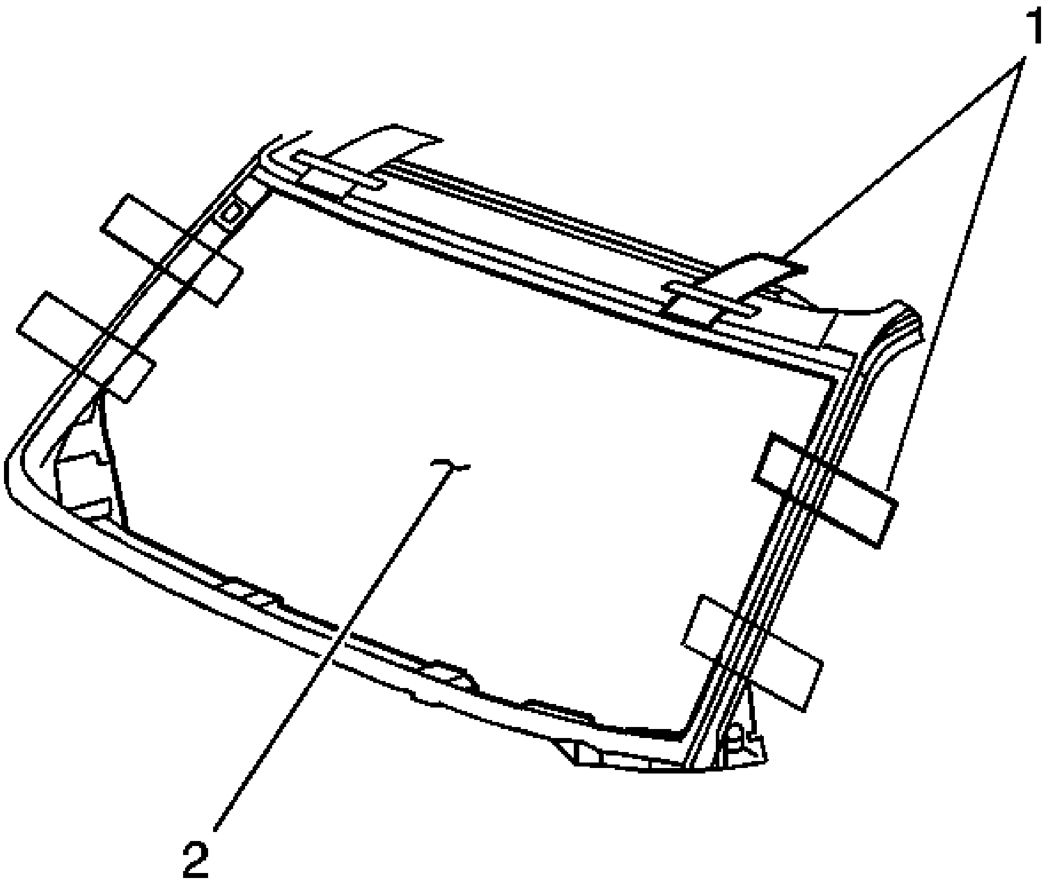


Fig. 74: Aligning Tape Lines On Window To Body
Courtesy of GENERAL MOTORS COMPANY

22. Align the masking tape (1) lines on the window (2) and the body.

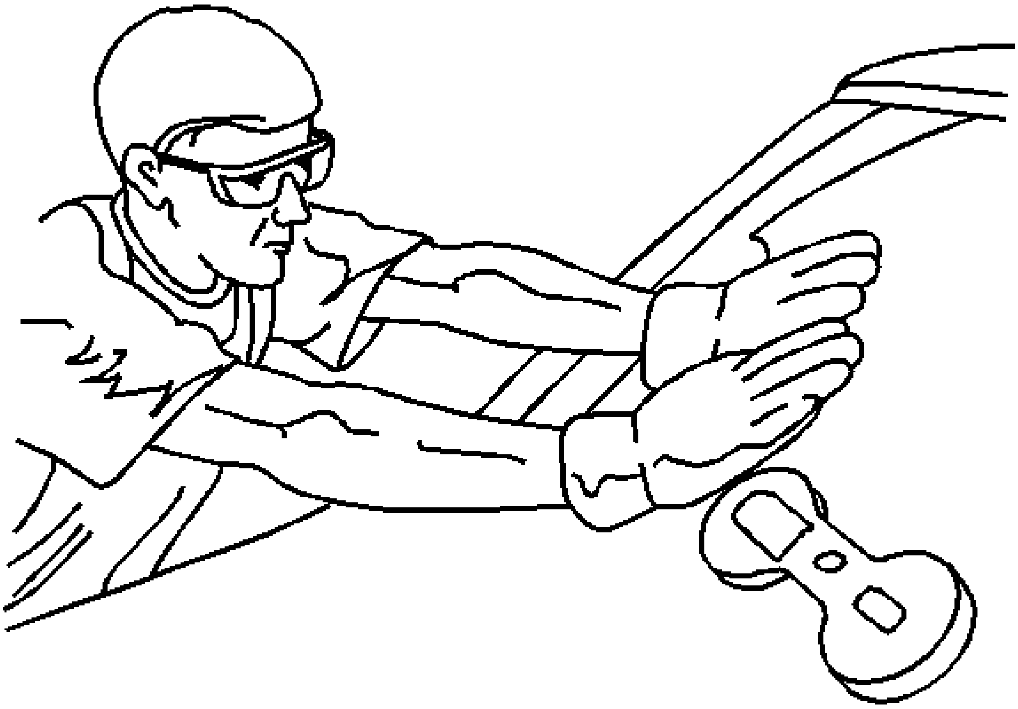


Fig. 75: Pressing Window Into Place
Courtesy of GENERAL MOTORS COMPANY

23. Press the window firmly into place, 1 mm (0. 039 in) below surface.
24. Tape the window to the body in order to minimize movement until the urethane adhesive cures.

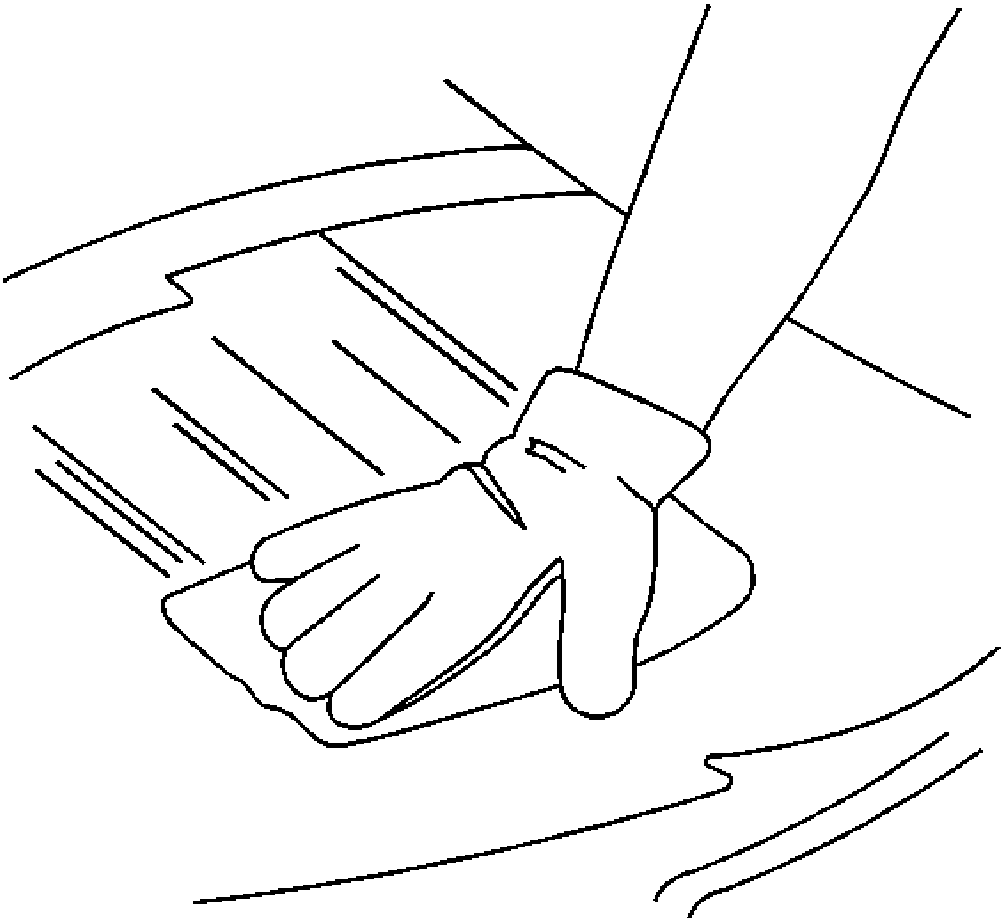


Fig. 76: Cleaning Excess Urethane Adhesive From Body
Courtesy of GENERAL MOTORS COMPANY

25. Clean any excess urethane adhesive from the body.

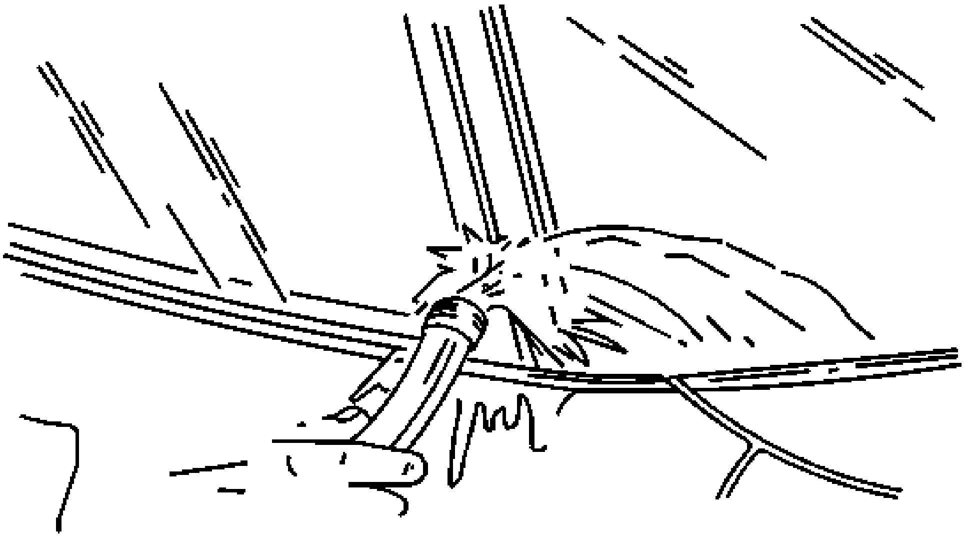


Fig. 77: Performing Water Hose Test
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.**

26. Use a soft spray of warm water in order to immediately water test the window.
27. Inspect the window for leaks.
28. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
29. Retest the window for leaks.

WARNING: **Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.**

- **For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21Ã‚Â°C (70Ã‚Â°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.**
- **For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.**

Do NOT physically disturb the repair area until after these minimum times have elapsed.

30. Maintain the following conditions in order to properly cure the urethane adhesive:
    - Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
    - Do not drive the vehicle until the urethane adhesive is cured. Refer to the above curing times.

- Do not use compressed air in order to dry the urethane adhesive.

31. Complete the window installation.

ADHESIVE INSTALLATION OF REAR WINDOWS

WARNING: **Refer to Glass and Sheet Metal Handling Warning .**

1. Use a urethane adhesive systems which meet GM Specification GM 3651G.
2. Remove all mounds or loose pieces of urethane adhesive from the pinchweld area.
3. If the original window is being reused, remove all but approximately 2 mm (3/64 in) of the existing bead of urethane adhesive from the pinchweld flange by using a clean utility knife or razor blade scraper.
4. Inspect for any of the following problems in order to help prevent future breakage of the window:
    - The flange of the window opening
    - High weld
    - Solder spots
    - Hardened sealer
    - Any other obstruction or irregularity in the pinchweld flange

NOTE: **If corrosion of the pinch-weld flange is present or if sheet metal repairs or replacements are required, the pinch-weld flange must be refinished in order to restore the bonding area strength. If paint repairs are required, mask the flange bonding area prior to applying the color coat in order to provide a clean primer only surface. Materials such as BASF DE15Ã‚Â®, DuPont 2610Ã‚Â®, Sherwin-Williams PSE 4600 and NP70Ã‚Â® and Martin-Semour 5120 and 5130Ã‚Â® PPG DP90LF SPIES/HECKER 3688/8590 - 3688/5150 - 4070/5090 STANDOX 11158/13320 - 14653/14980 products are approved for this application.**

5. After repairing the opening as indicated, perform the following steps:
    1. Remove all traces of broken glass from the outer cowl panel, seats, floor and defroster ducts.
    2. Clean around the edge of the inside surface of the window with a 50/50 mixture of isopropyl alcohol and water by volume on a dampened lint free cloth.
6. Verify all primers and urethane adhesive are within expiration dates.

WARNING: **Failure to prep the area prior to the application of primer may cause insufficient bonding of urethane adhesive. Insufficient bonding of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.**

NOTE: **Do not apply the black #3 primer to the existing bead (1) of the urethane adhesive on the pinch-weld flange. Apply the primer only to nicks, scratches or the primed surfaces.**

7. Shake the pinch-weld primer black #3 for at least 1 minute.
8. Use a new dauber in order to apply the primer to the surface of the pinch-weld flange (1).
9. Allow the pinch-weld primer to dry for approximately 10 minutes.

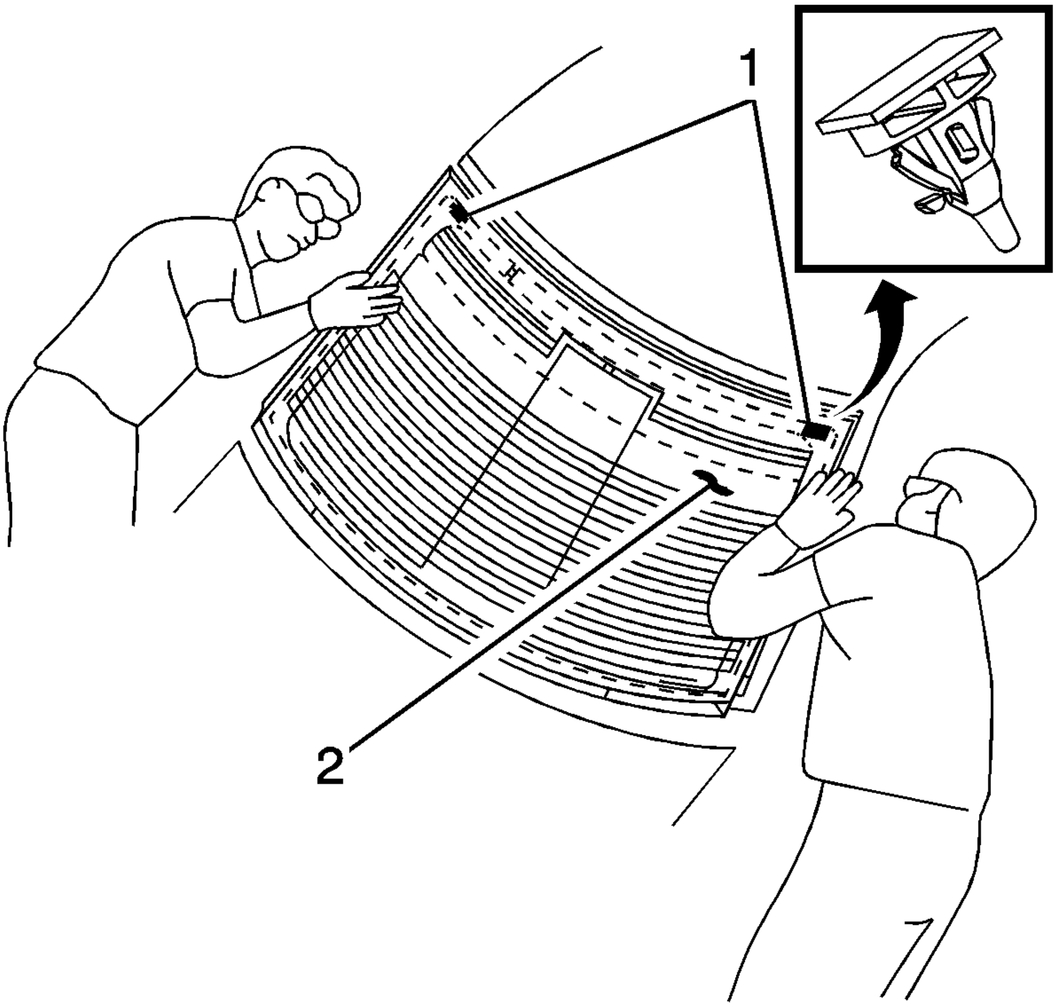


Fig. 78: Installing Rear Window
Courtesy of GENERAL MOTORS COMPANY

10. With the aid of an assistant, dry fit the window (1) to the opening in order to determine the correct position.
11. Ensure the window locator pins are positioned into the locator slots in the pinch-weld flange.
12. Use masking tape to mark the locations of the window in the opening.
13. Cut the masking in the center and remove the window from the opening.

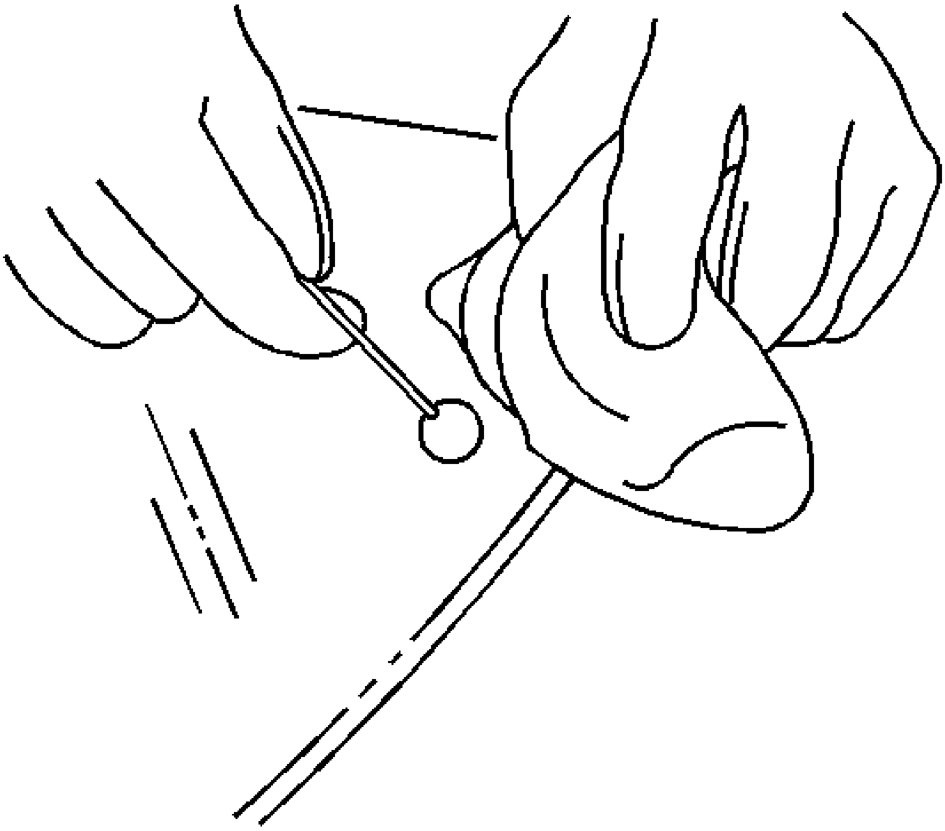


Fig. 79: Applying Glass Prep
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use care when applying glass prep clear on the window. This primer dries almost instantly, and may stain the viewing area of the window if not applied evenly.**

14. Use a new dauber in order to apply glass prep clear to the area approximately 18 mm (0. 71 in) around the entire perimeter of the window inner surface.

    Immediately wipe the glass primed area using a clean, lint-free cloth.

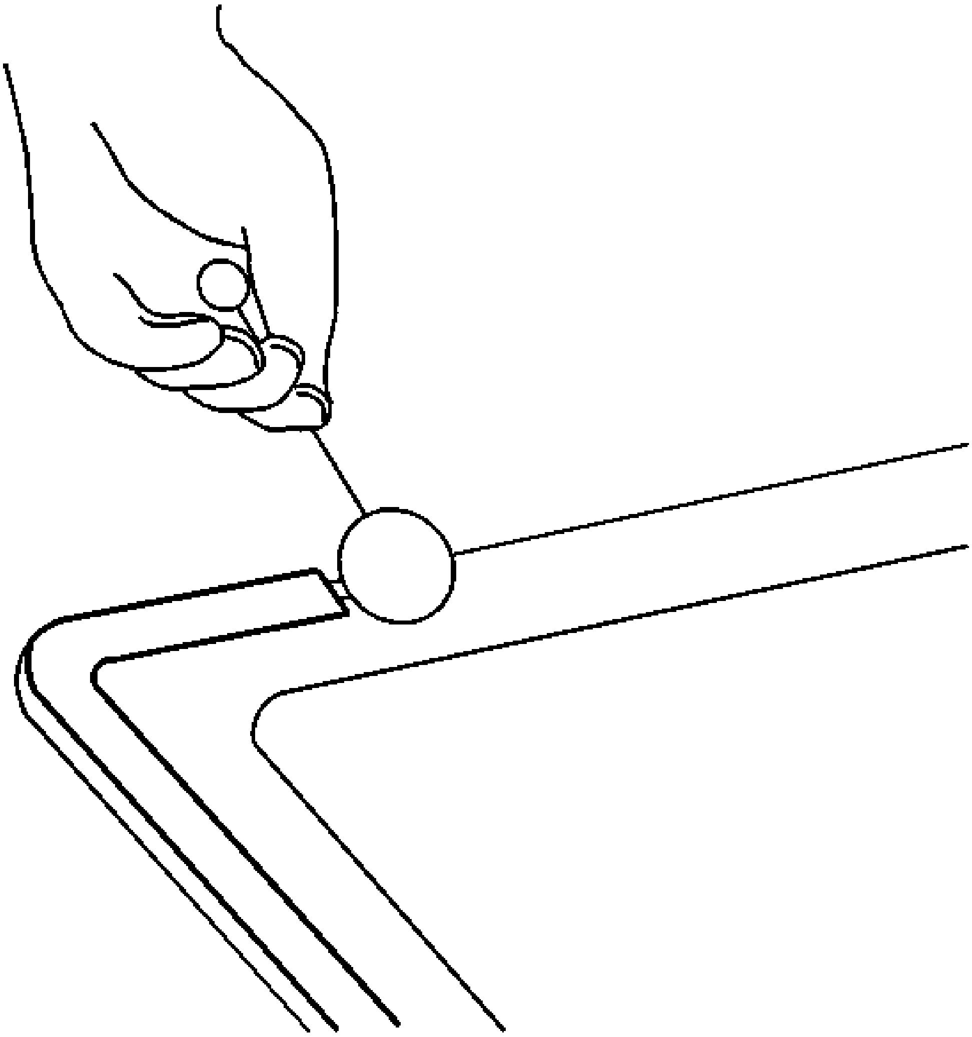


Fig. 80: Applying Glass Prep
Courtesy of GENERAL MOTORS COMPANY

15. Apply a second coat of the glass prep clear to the same area of the glass.

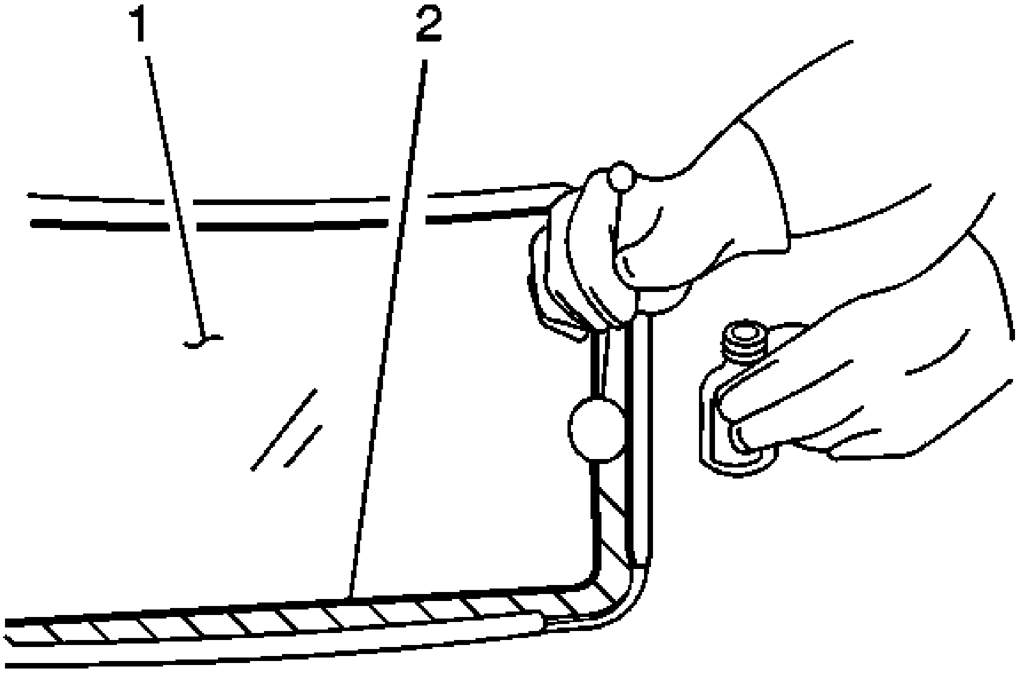


Fig. 81: Applying Glass Primer
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The glass primer black is effective up to 8 hours after applying it to the glass. The primed surface of the glass must be kept clean.**

16. Shake the glass primer black for at least 1 minute.
17. Use a new dauber in order to apply the glass primer black to the same areas (2) that glass prep clear was applied.
18. Allow the glass primer to dry for approximately 10 minutes.

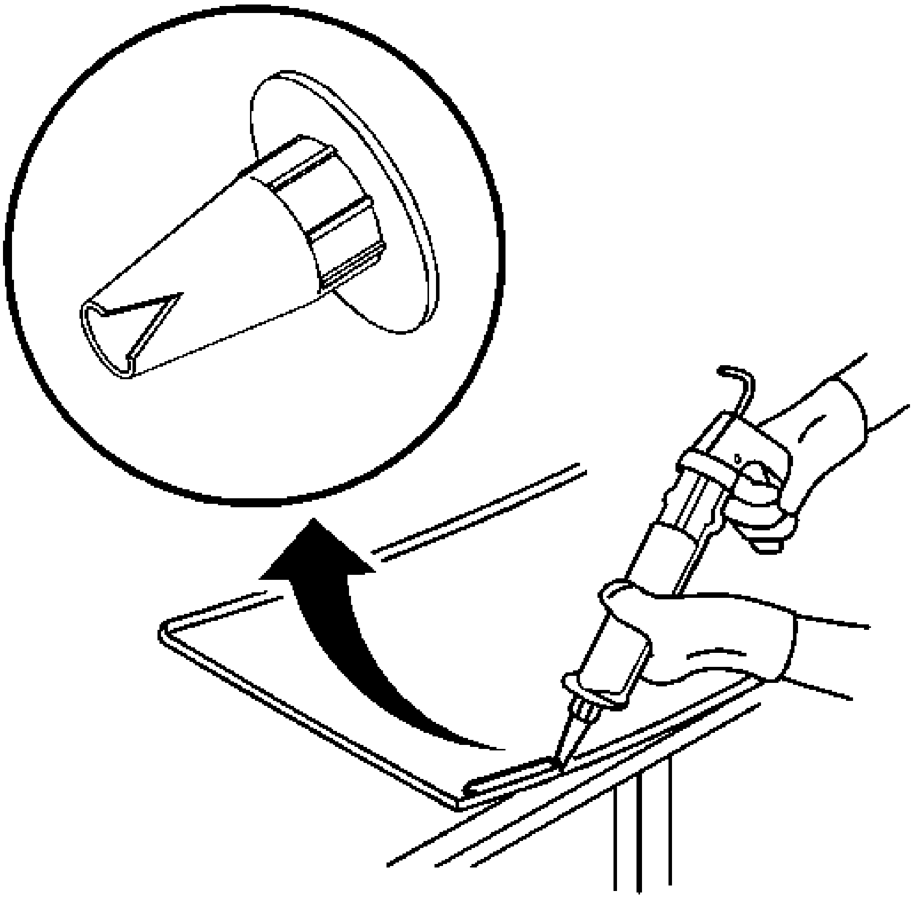


Fig. 82: Modified Applicator Nozzle
Courtesy of GENERAL MOTORS COMPANY

19. Cut the applicator nozzle in order to provide a bead of 12. 7 mm (1/2 in) wide and 12. 7 mm (1/2 in) high.

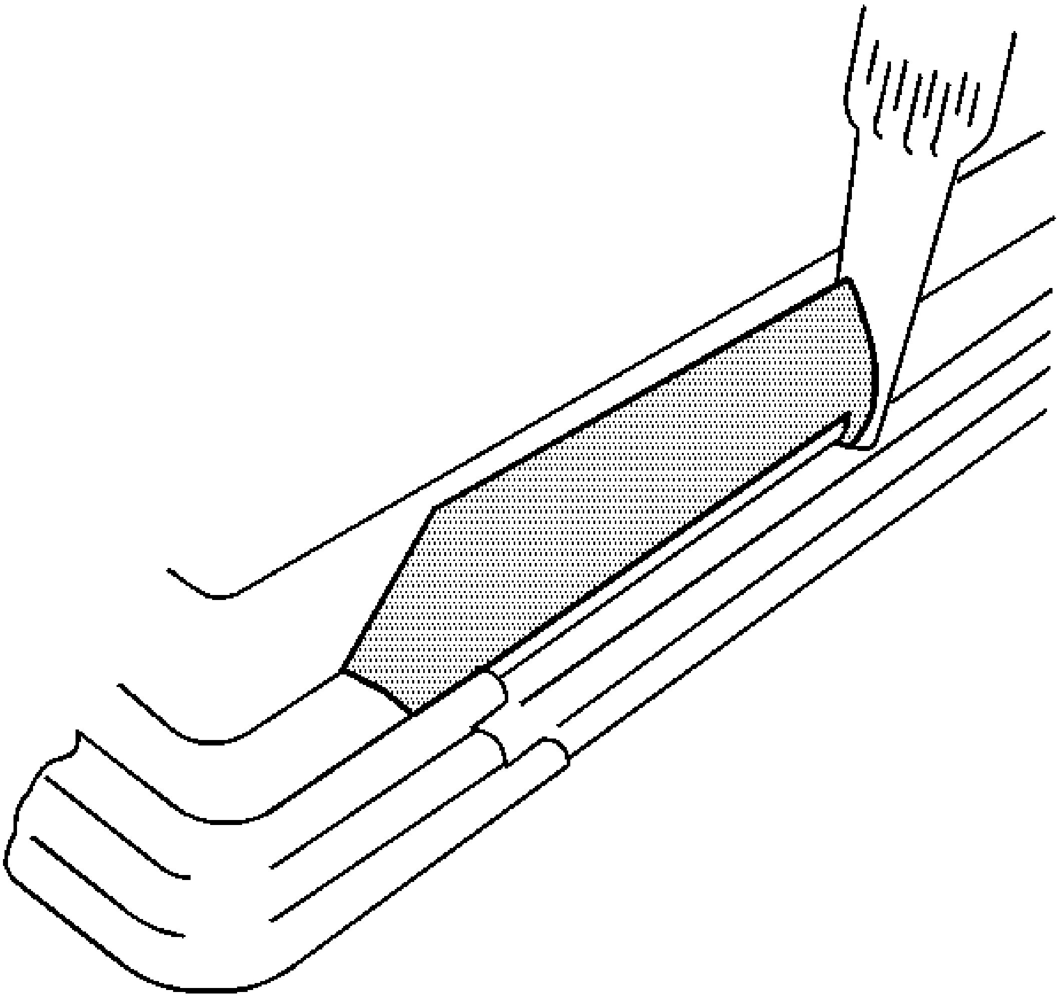


Fig. 83: Applying Continuous Bead Of Urethane Adhesive
Courtesy of GENERAL MOTORS COMPANY

20. Use a cartridge-type caulking gun in order to apply a smooth, continuous bead of urethane adhesive.

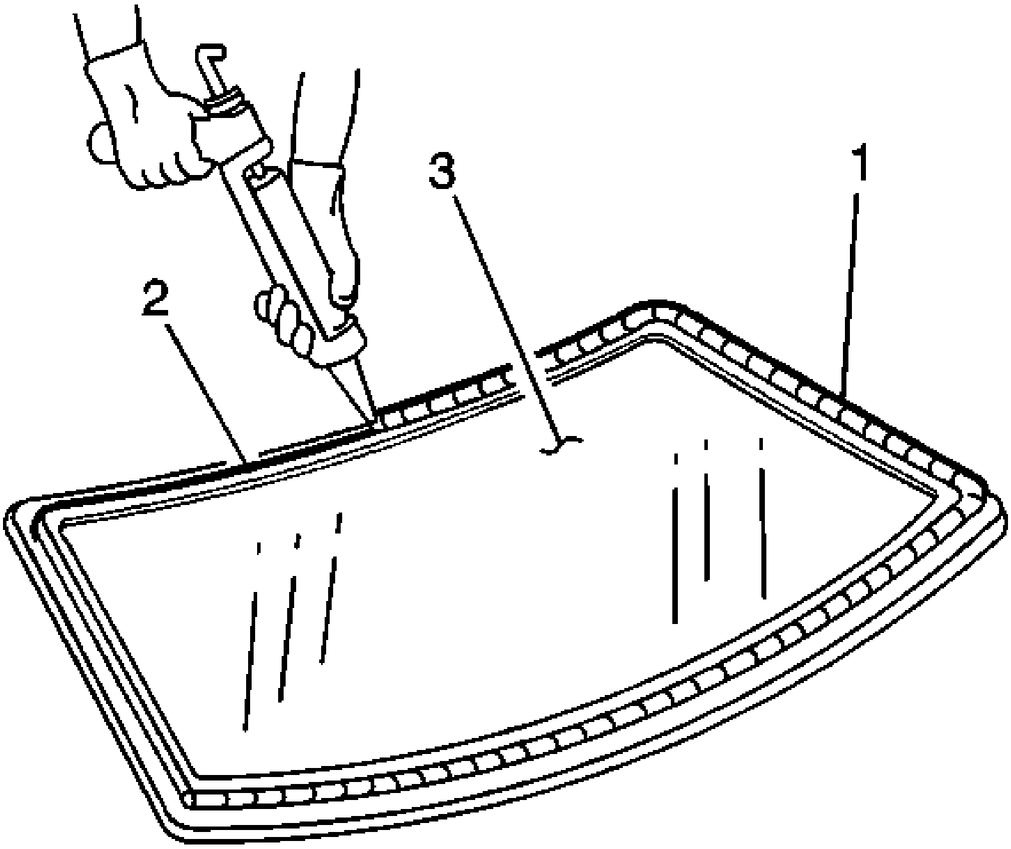


Fig. 84: Applying Urethane Adhesive To Inner Surface Of Window
Courtesy of GENERAL MOTORS COMPANY

21. Use the edge of the window as a guide for the nozzle in order to apply the urethane adhesive (1) to the inner surface of the window (3).
22. With the aid of an assistant, place the window in the opening.
23. Align the masking tape lines on the window and the body.

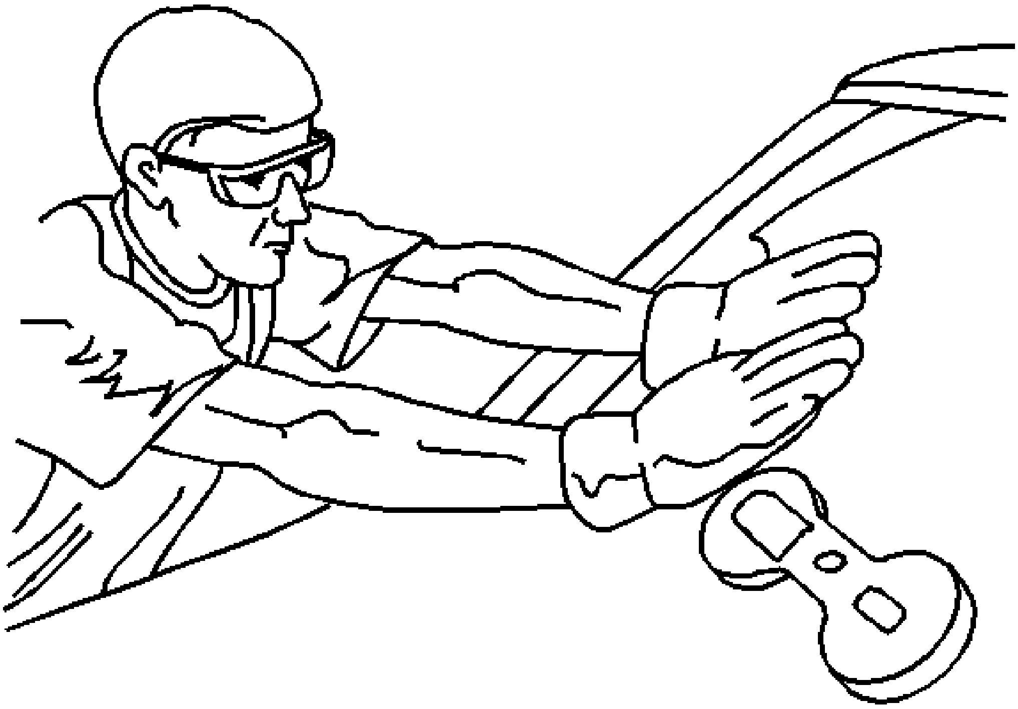


Fig. 85: Pressing Window Into Place
Courtesy of GENERAL MOTORS COMPANY

NOTE: **To prevent damage to the window due to objects impacting an exposed edge, upon installation, the window must rest 1 mm (0. 040 in) below the surface of the sheet metal.**

24. Press firmly around the entire periphery of the window in order to wet-out the urethane bead.
25. Tape the window to the body in order to minimize movement until the urethane adhesive cures.

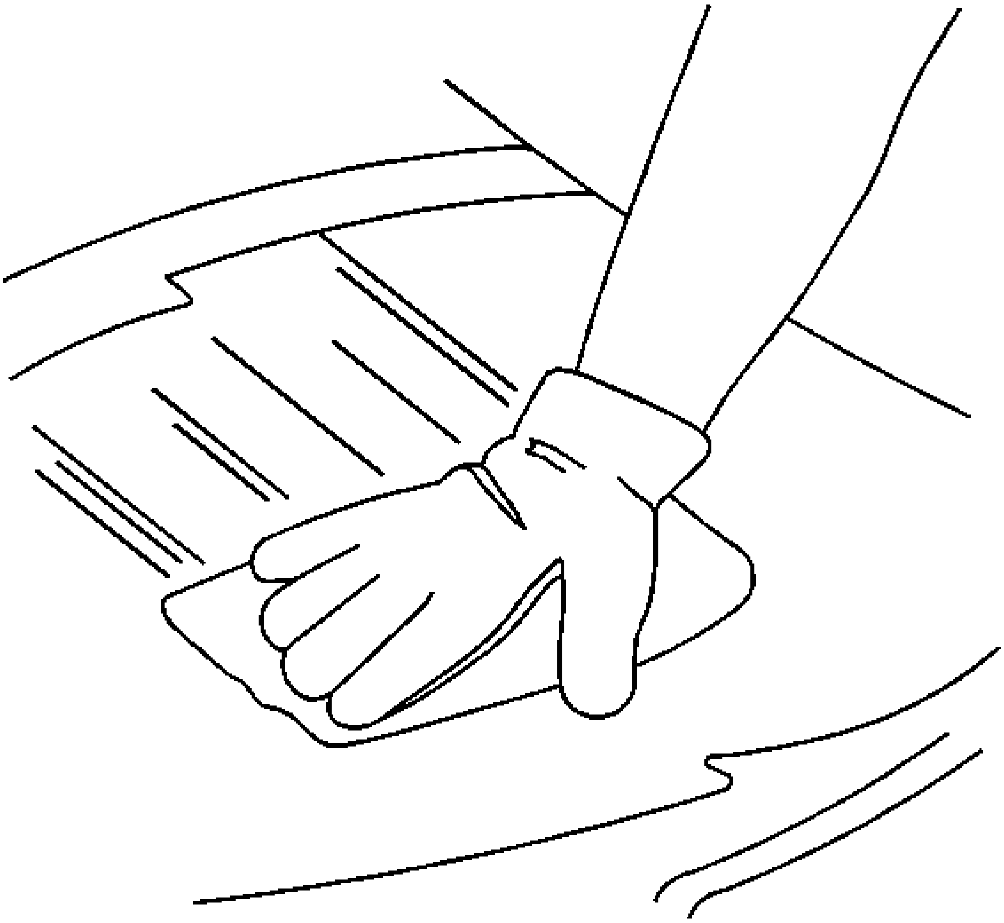


Fig. 86: Cleaning Excess Urethane Adhesive From Body
Courtesy of GENERAL MOTORS COMPANY

26. Clean any excess urethane adhesive from the body.

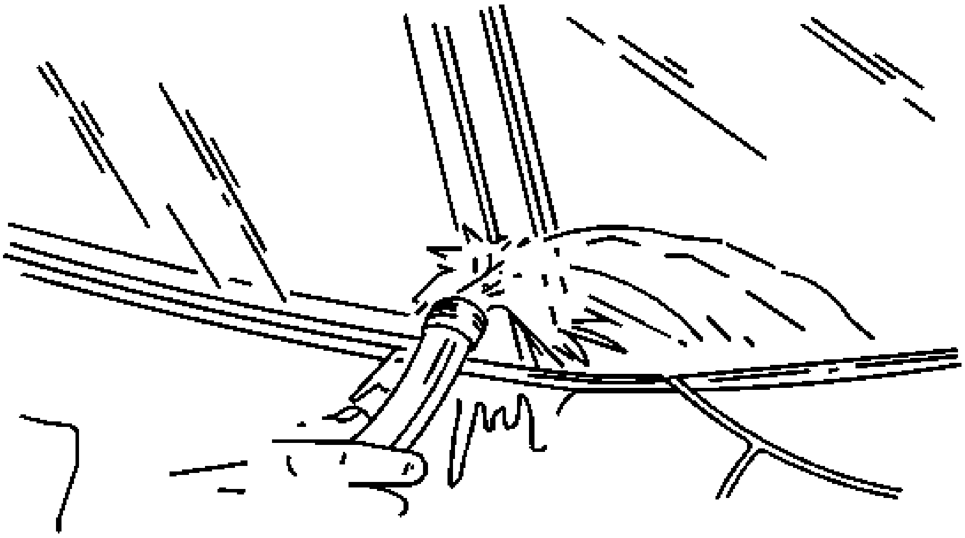


Fig. 87: Performing Water Hose Test
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not direct a hard stream of high pressure water to the freshly applied urethane adhesive.**

27. Use a soft spray of warm water in order to immediately water test the window.
28. Inspect the window for leaks.
29. If any leaks are found, use a plastic paddle in order to apply extra urethane adhesive at the leak point.
30. Retest the window for leaks.

WARNING: **Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.**

- **For the moisture-curing type of urethane adhesive, allow a minimum of 6 hours at 21Ã,Â°C (70Ã,Â°F) or greater and with at least 30 percent relative humidity. Allow at least 24 hours for the complete curing of the urethane adhesive.**
- **For the chemical-curing type of urethane adhesive, allow a minimum of 1 hour.**

Do NOT physically disturb the repair area until after these minimum times have elapsed.

31. Maintain the following conditions in order to properly cure the urethane adhesive:
    - Partially lower a door window in order to prevent pressure buildups when closing doors before the urethane adhesive cures.
    - Do not drive the vehicle until the urethane adhesive is cured. Refer to the above curing times.

- Do not use compressed air in order to dry the urethane adhesive.

32. Complete the window installation.

DESCRIPTION AND OPERATION

POWER WINDOWS DESCRIPTION AND OPERATION

Power Windows System Components

The power window system consists of the following components:

- Driver window/outside rearview mirror switch
- Passenger window switch
- Left rear window switch
- Right rear window switch
- Right rear door latch
- Left rear door latch
- Window motors in each of the doors
- 25A Fuse
- Body control module (BCM)

Driver Express Up and Express Down Power Window Motor

The driver door contains a window motor is smart motor that will detect excessive resistance while performing the express up function and automatically reverse direction to prevent injury to any occupants that may become trapped between the closing window and the door frame. The automatic reverse safety feature can be overridden by pulling and holding the window switch.

The logic circuit within the window motor monitors the up, down and express signal circuits which are normally equal to B+ voltage. When a switch is used on the driver window/outside rearview mirror switch, the contacts close causing a voltage drop within the appropriate signal circuit. The driver window motor will detect the voltage drop and will command the window to move in the direction requested.

Passenger, Left Rear and Right Rear Express Down Window Motors

For the passenger, right rear and left rear doors, when their window switch is pressed in the down position, battery positive voltage is applied to their respective window motor control circuit and ground to the other window motor control circuit causing that window to open. When the individual window switch is pulled in the up position, voltage and ground is applied to the window motor in the opposite direction causing that window to close. The return path to ground is supplied through the inactive control circuit being normally grounded through the window switch.

Each passenger and rear window switch communicates to the BCM by a serial data circuit. When the driver wishes to control the passenger, left rear or right rear window, the driver will use the appropriate switch on the driver window/outside rearview mirror switch. When this switch is used, a serial data message is sent to the BCM requesting a window motor command, the BCM will then send a serial data message to the appropriate door window switch which will then command that window to move in the direction requested.

Lockout Switch Feature

The driver window/outside rearview mirror switch contains a window lockout switch, when the driver presses the window lockout switch, a serial data message is sent to the BCM which will send a disable command to the rear window switches, the rear window switches will then ignore all functions when a passenger uses the rear window switch. The rear window motor commands will still function normally when the driver uses the appropriate switches on the driver window/outside rearview mirror switch.

REAR WINDOW DEFOGGER DESCRIPTION AND OPERATION

Rear Window Defogger System Components

The rear window defogger system consists of the following components:

- HVAC Control Module
- HVAC Controls Switch Assembly
- Rear Defogger Relay
- Rear Defogger Grid
- Driver Outside Rearview Mirror
- Passenger Outside Rearview Mirror
- 40A Fuse

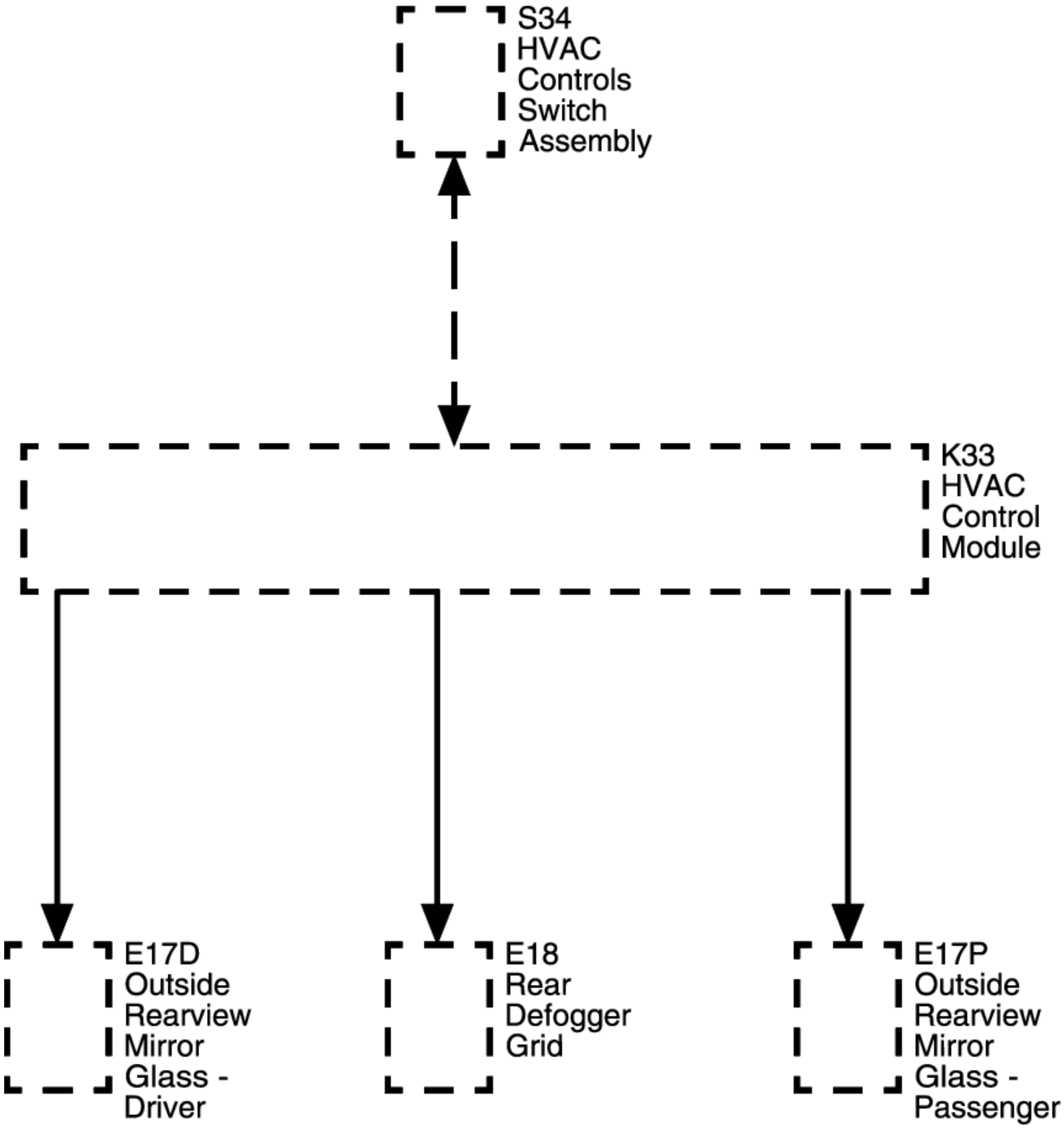

S34
HVAC
Controls
Switch
Assembly
K33
HVAC
Control
Module
E17D
Outside
Rearview
Mirror
Glass -
Driver
E18
Rear
Defogger
Grid
E17P
Outside
Rearview
Mirror
Glass -
Passenger

Fig. 88: S34-K33-X50A Defogger Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S34	S34 HVAC Controls Switch Assembly
E17D	E17D Outside Rearview Mirror Glass - Driver
E18	E18 Rear Defogger Grid
E17P	E17P Outside Rearview Mirror Glass - Passenger
K33	K33 HVAC Control Module

Rear Window Defogger Operation

The rear defog control system utilizes a single zone backlight design, driven with a single relay configuration. Additionally, up to two outside rear view mirrors can be heated if required. A switch for the customer to control the system is provided within the HVAC controls switch assembly. Also included in the HVAC controls switch assembly is an indicator to inform the customer with the current state of the system. The system is only operational when the vehicle is ON/RUN.

Pressing the heated rear window switch causes the HVAC controls switch assembly to send a serial data message to the HVAC control module requesting rear window defog operation. The HVAC control module upon receipt of the serial data message will provide voltage to the coil side of the rear defogger relay, this will energize the relay causing the relay switch contacts to close allowing B+ voltage to flow through the rear defogger grid control circuit to the rear defogger grid.

When the rear heated rear window switch is pressed and the vehicle is ON/RUN, the rear window defogger grid will activate and will turn off automatically depending upon the vehicle speed (refer to owner's manual for rear window defogger operation cycles)

Heated Mirrors

The heated mirrors are also controlled through the rear defogger relay. Whenever the rear window defogger is turned on battery voltage is supplied to the mirror heater elements through the left and right mirror heater element control circuits.

STATIONARY WINDOW DESCRIPTION

Most stationary windows, specifically windshields, are retained to the body with adhesive which adheres the window to the body, increasing structural integrity. The reinstallation of the windows with adhesive requires complete replacement of the adhesive bead, and is known as the full cut method. All stationary windows must use a adhesive systems which meet GM Specification GMW-15672.

URETHANE ADHESIVE DESCRIPTION

For replacement of any adhesive-installed window, use the full cut method only.

Use an adhesive that is approved by GM, Specification GMW-15672.

Use these materials based on specific manufacturer. Do NOT intermix primers or adhesives from one manufacturer to another.

Always follow the system manufacturers instructions for application, handling, and curing.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

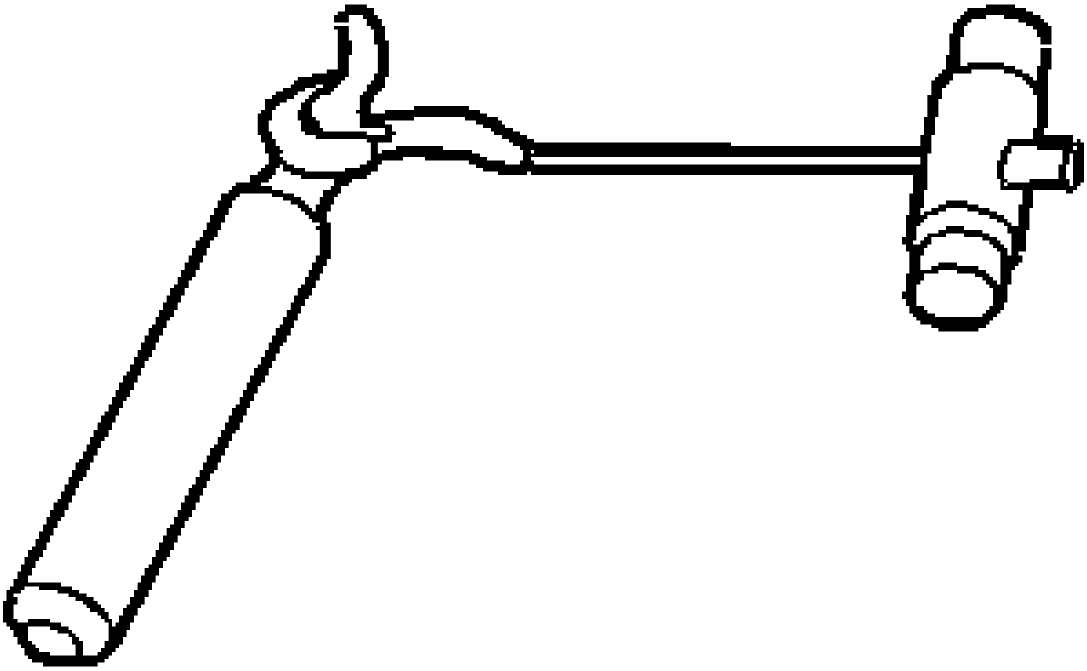
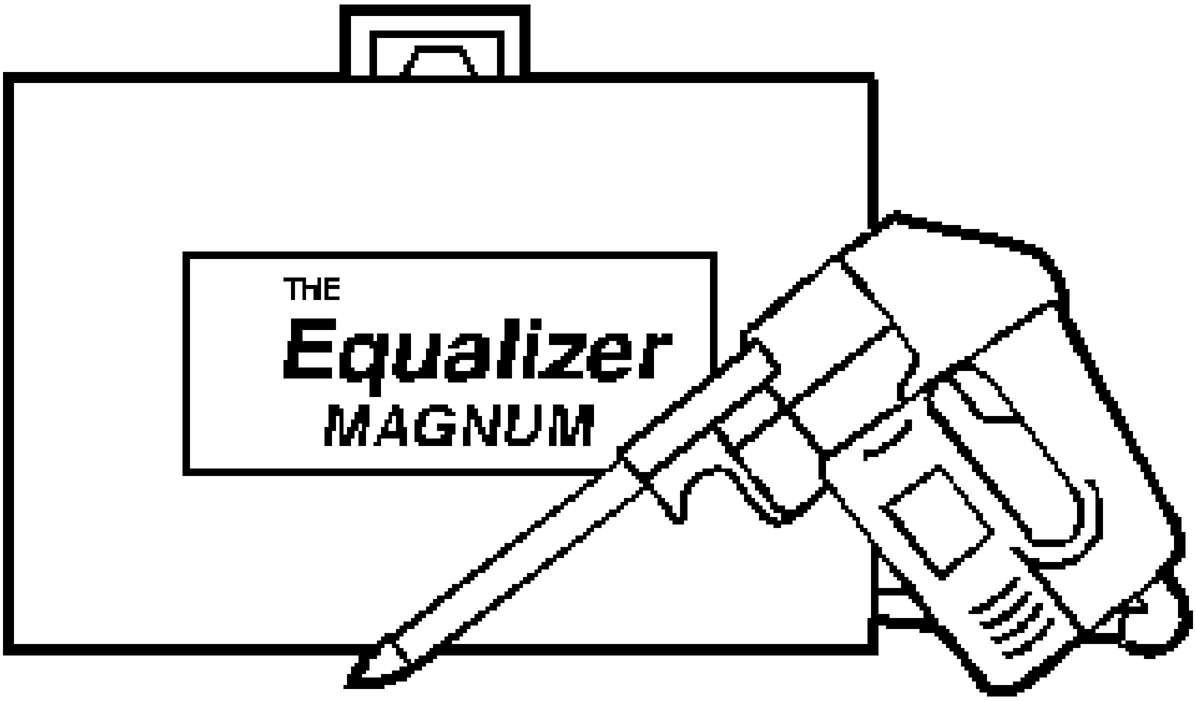
Illustration	Tool Number/ Description
	BO-24402-A J-24402-A Glass Sealant Cold Knife Remover
	BO-39032 J-39032 Stationary Glass Removal Tool

Illustration	Tool Number/ Description
 THE Equalizer MAGNUM	

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Floor Coverings and Headlinings - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Coat Hook Bolt	6 N.m (53 lb in)
Driver Footrest Bolt	6 N.m (53 lb in)
Driver Footrest Nut	9 N.m (80 lb in)
Ground Nut	9 N.m (80 lb in)
Instrument Panel Tie Bar Brace Bolt	22 N.m (16 lb ft)
Roof Rail Assist Handle Bolt	6 N.m (53 lb in)
Sunshade Fastener	2.5 N.m (22 lb in)
Sunshade Support Screw	2.5 N.m (22 lb in)

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number
GM Vehicle Care Odor Eliminator	Fluids	Refer to Electronic Parts Catalog.

REPAIR INSTRUCTIONS

ELIMINATING UNWANTED ODORS IN VEHICLES

GM Vehicle Care Odor Eliminator, Refer to Adhesives, Fluids, Lubricants, and Sealers, may control or eliminate odors in the interior and luggage compartment areas of GM vehicles. This non-toxic, biodegradable, odorless product has been shown to greatly reduce or remove the following types of odor:

- Objectionable smells of mold and mildew resulting from vehicle water leaks
- Customer created odors, such as smoke

You may safely use GM Vehicle Care Odor Eliminator on fabrics, vinyl, leather, carpet, and sound deadening materials. You may also induce this product into HVAC modules and instrument panel ducts for the control of non-bacterial related odors.

NOTE: **This product leaves no residual scent and should not be used as an air freshener.**

This product may result in the permanent elimination of an odor and may be preferable to customers whose allergies make them sensitive to perfumes. This product may effectively remove odors when directly contacting the odor source. In cases such as water leaks, use this product with diagnostic procedures to first eliminate the primary cause of the odor. Then use further applications on the residual odor to permanently correct the vehicle condition.

How to Use this Product

- Spray GM Vehicle Care Odor Eliminator directly or as an additive with carpet shampoo in steam cleaners.
- Do not use on any interior surface that plain water would deteriorate, because this product will have the same effect. Also avoid letting this product come into contact with vinegar or any acidic substance. Acid-based products will hamper the effectiveness of GM Vehicle Care Odor Eliminator.
- Complete eight page treatment sheets are enclosed within each case of GM Vehicle Care Odor Eliminator. These treatment instructions range from simple vehicle odor elimination to full step by step procedures for odor removal from water leaks.
- Instructions and cautions are printed on the bottle, but additional help is available. If you encounter a persistent or recurring odor, you may call to obtain additional information and usage suggestions.

FLOOR CARPET DRYING

If the carpet or the pad or insulator is wet, use the following criteria for drying or for replacing the components:

- For a 1-piece carpet assembly bonded to a cotton or a fiber padding, replace the entire assembly.
- For a 2-piece carpet assembly with a cotton or a fiber padding, replace the padding only. While the carpet is out of the vehicle, dry the carpet using the method described below.
- For a 1-piece carpet assembly bonded to a foam padding or attached to a synthetic padding, dry the carpet using the method described below.
- For a 2-piece carpet assembly with a synthetic padding, dry the assembly using the method described below.

Drying Method

1. If you observe puddles of liquid on the carpet face, use a wet vacuum to remove the excess moisture.
2. Blot the face of the carpet with a towel in order to absorb as much moisture as possible.
3. Point a fan at the affected area and air dry the carpet.

FLOOR PANEL CARPET REPLACEMENT

Removal Procedure

1. Battery Negative Cable - Disconnect - **Battery Negative Cable Disconnection and Connection**
2. Remove the driver and passenger seat. **Driver or Passenger Seat Removal and Installation**
3. Remove the rear seat cushion. **Rear Seat Cushion Removal and Installation**

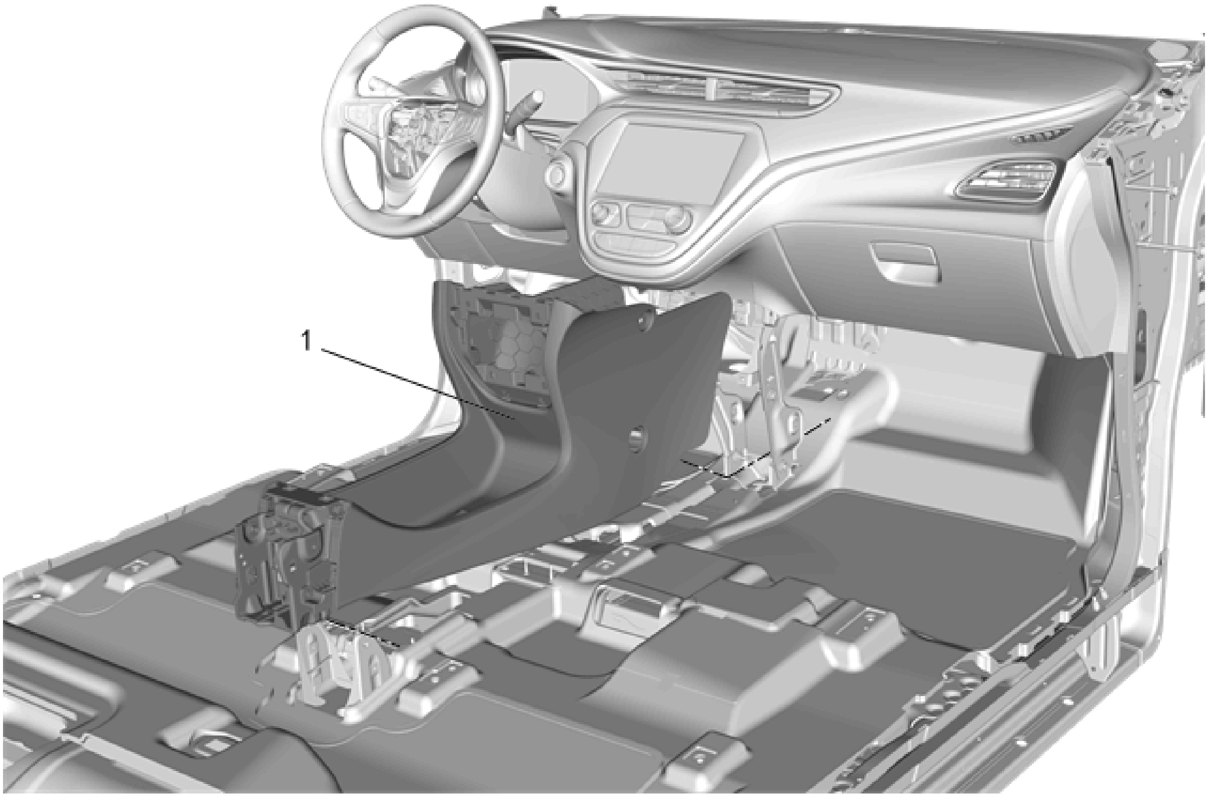


Fig. 1: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

4. Front Floor Console - Remove - **Front Floor Console Replacement**
5. Front Side Door Sill Garnish Molding - Remove - **Front Side Door Sill Garnish Molding Replacement**
6. Rear Side Door Sill Garnish Molding - Remove - **Rear Side Door Sill Garnish Molding Replacement**
7. Center Pillar Lower Trim Panel - Remove - **Center Pillar Lower Trim Panel Replacement**

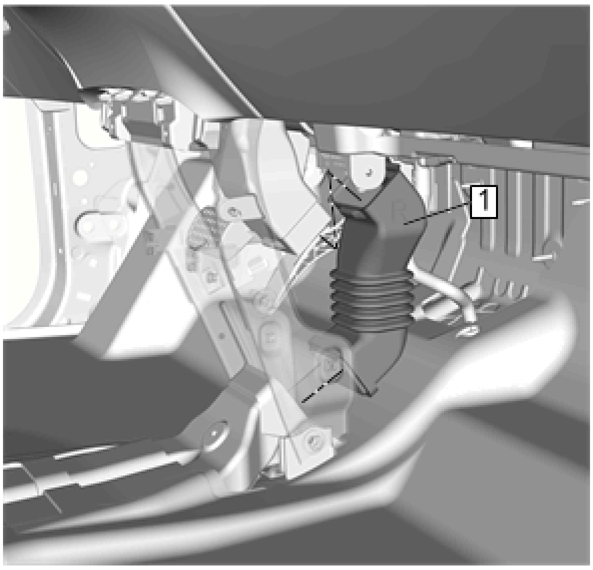


Fig. 2: Floor Front Air Outlet Duct Adapter
Courtesy of GENERAL MOTORS COMPANY

8. Floor Front Air Outlet Duct Adapter - Remove - **Floor Front Air Outlet Duct Replacement**

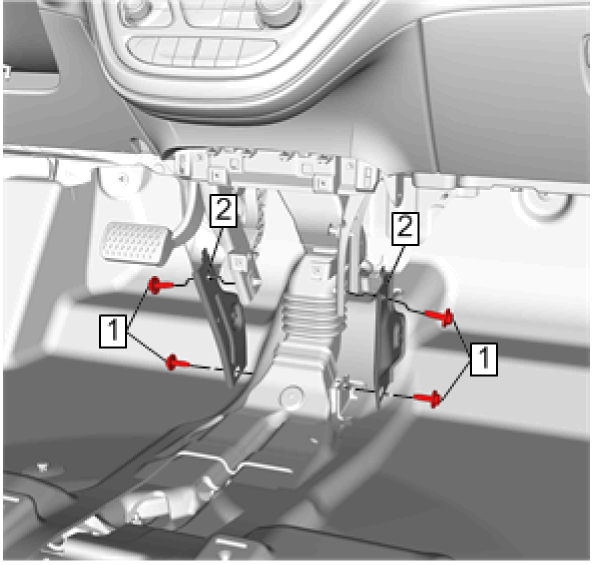


Fig. 3: Instrument Panel Tie Bar Brace Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Instrument Panel Tie Bar Brace Bolt - Remove
10. Instrument Panel Tie Bar Brace - Remove

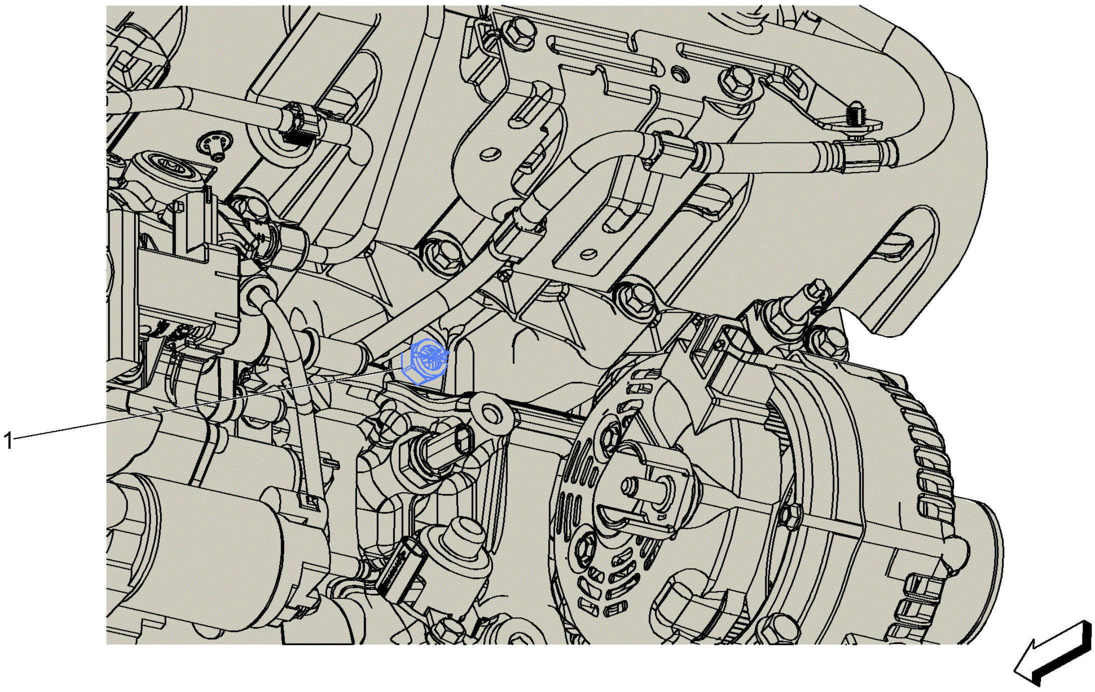


Fig. 4: Ground Nut
Courtesy of GENERAL MOTORS COMPANY

11. Remove the ground nut (1).
12. Disconnect the instrument panel electrical wiring harness connector (2) from the airbag sensing and diagnostic module.
13. Reposition the instrument panel electrical wiring harness.

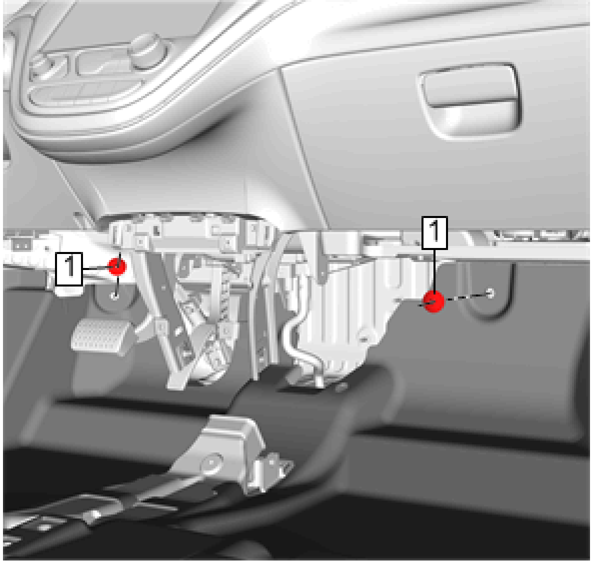


Fig. 5: Dash Panel Inner Insulator Retainer
Courtesy of GENERAL MOTORS COMPANY

14. Dash Panel Inner Insulator Retainer - Remove

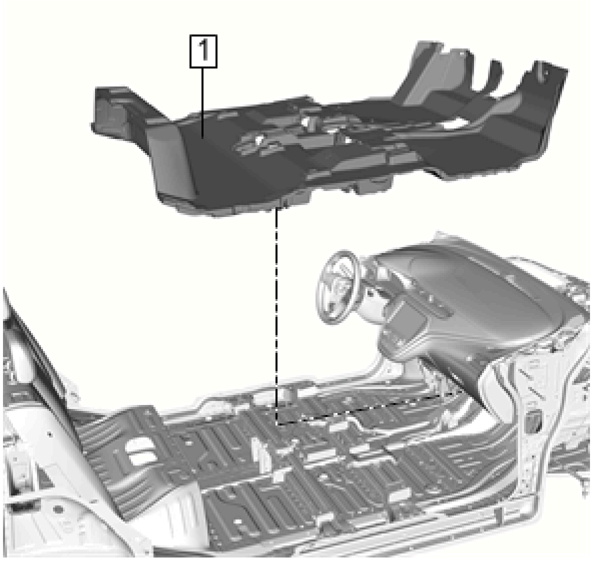


Fig. 6: Floor Panel Carpet
Courtesy of GENERAL MOTORS COMPANY

15. Floor Panel Carpet - Remove

Installation Procedure

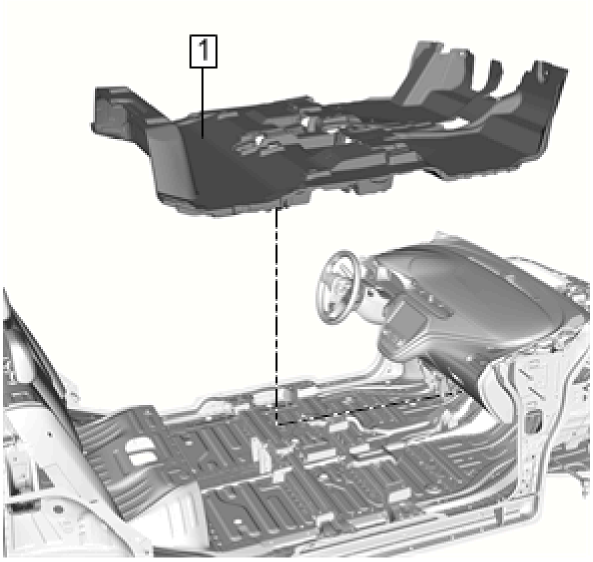


Fig. 7: Floor Panel Carpet
Courtesy of GENERAL MOTORS COMPANY

1. Floor Panel Carpet - Install

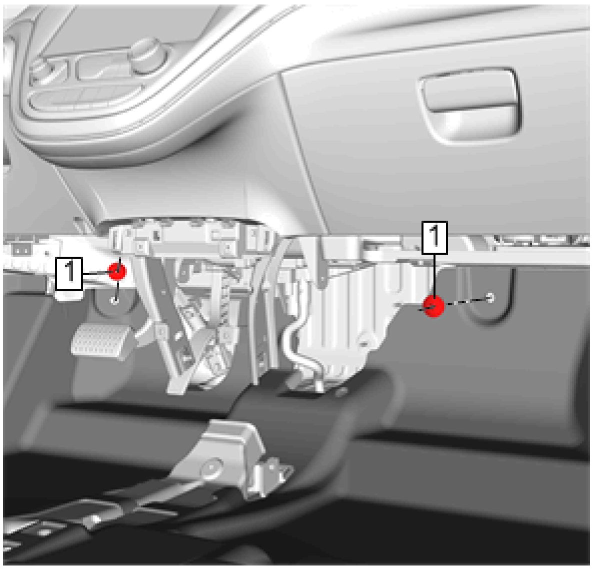


Fig. 8: Dash Panel Inner Insulator Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Dash Panel Inner Insulator Retainer - Install

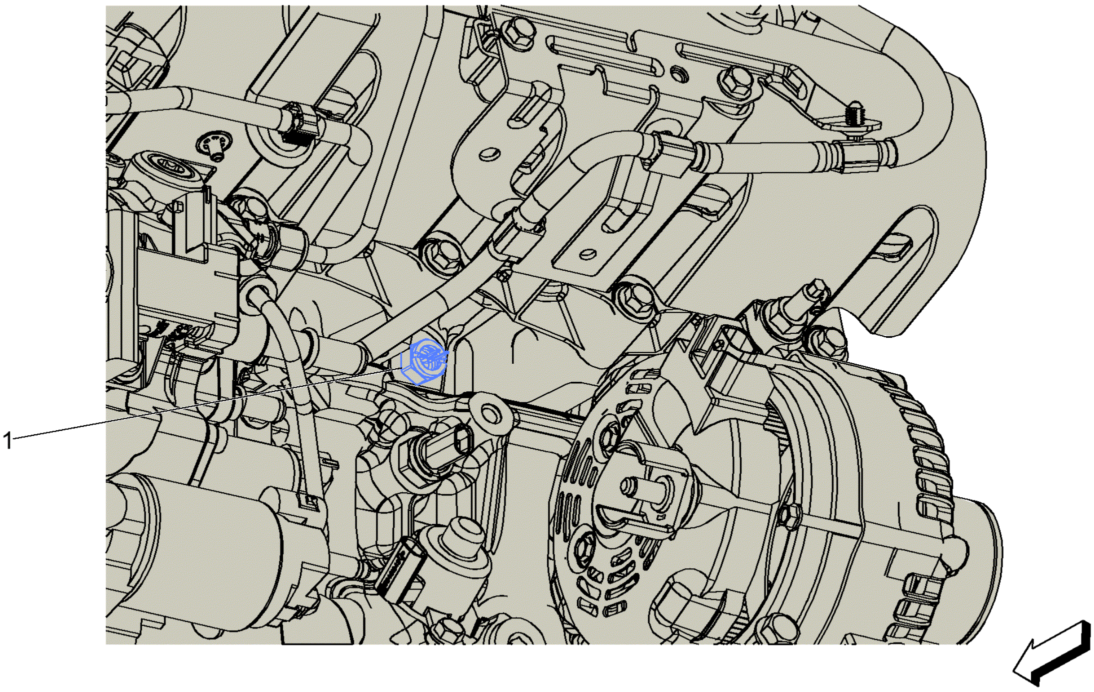


Fig. 9: Ground Nut
Courtesy of GENERAL MOTORS COMPANY

3. Install and tighten the ground nut (1) to 9 N.m (80 lb ft).
4. Connect the instrument panel electrical wiring harness connector (2) to the airbag sensing and diagnostic module.

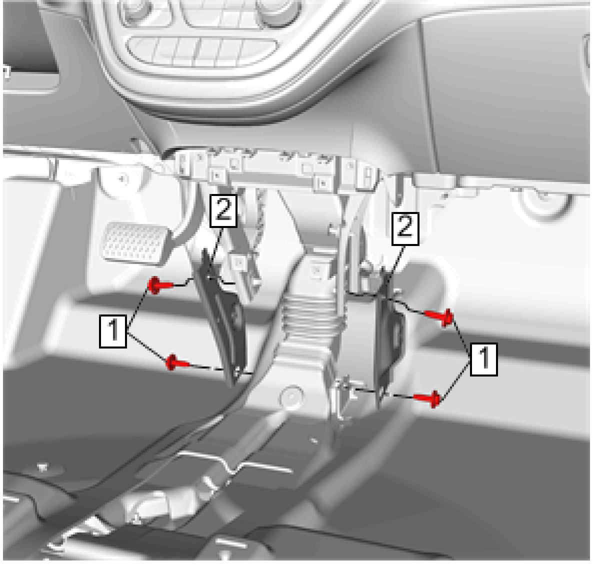


Fig. 10: Instrument Panel Tie Bar Brace Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

5. Instrument Panel Tie Bar Brace - Install
6. Instrument Panel Tie Bar Brace Bolt - Install and tighten to 22 N.m (16 lb ft)

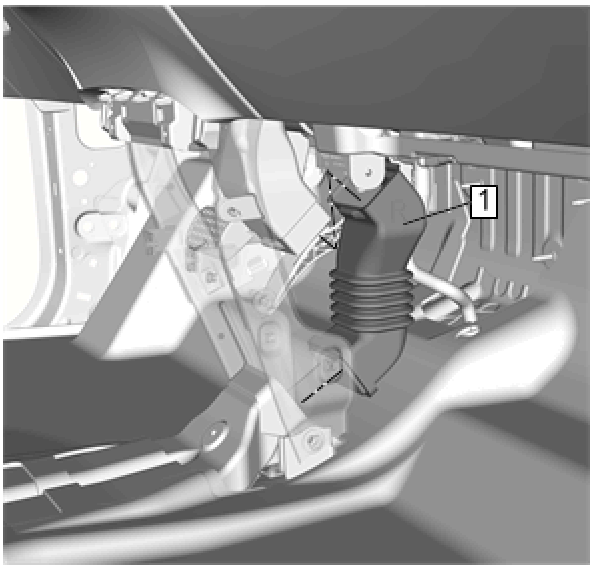


Fig. 11: Floor Front Air Outlet Duct Adapter
Courtesy of GENERAL MOTORS COMPANY

7. Floor Front Air Outlet Duct Adapter - Install - **Floor Front Air Outlet Duct Replacement**
8. Center Pillar Lower Trim Panel - Install - **Center Pillar Lower Trim Panel Replacement**
9. Rear Side Door Sill Garnish Molding - Install - **Rear Side Door Sill Garnish Molding Replacement**
10. Front Side Door Sill Garnish Molding - Install - **Front Side Door Sill Garnish Molding Replacement**

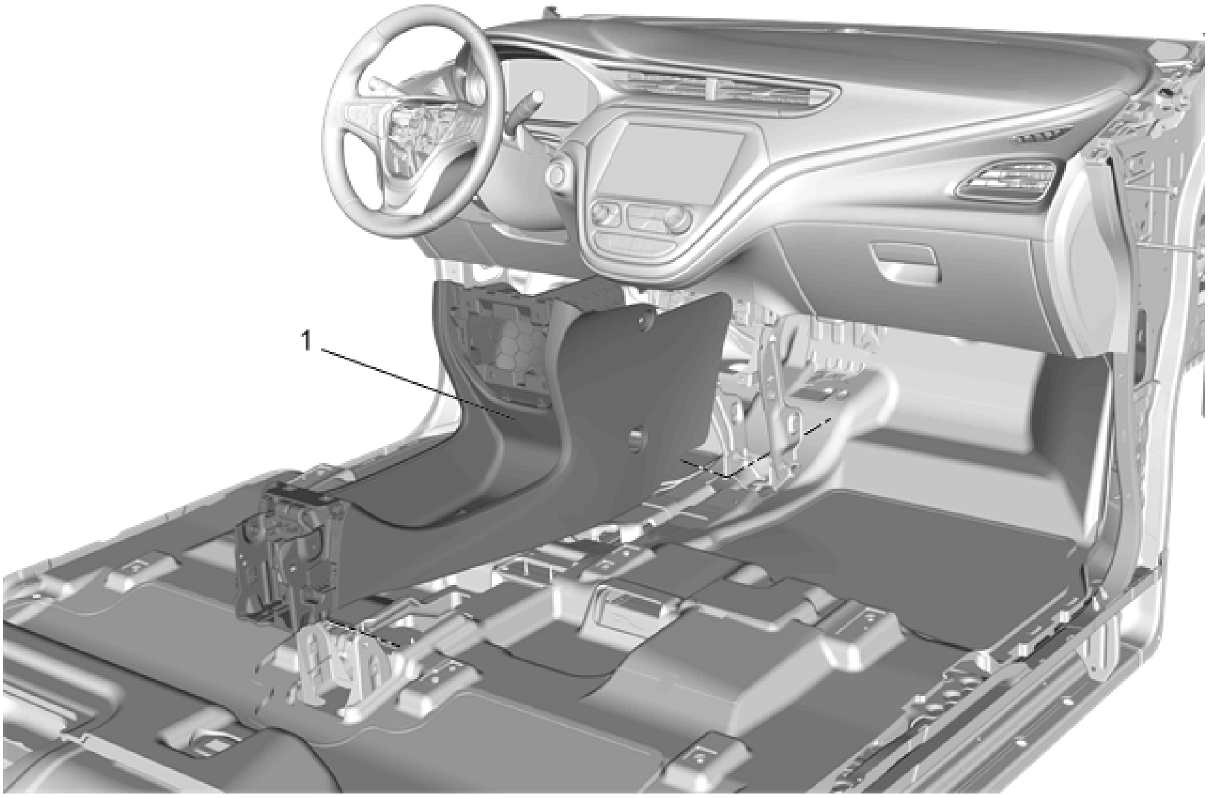


Fig. 12: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

11. Front Floor Console - Install - **Front Floor Console Replacement**
12. Install the rear seat cushion. **Rear Seat Cushion Removal and Installation**
13. Install the driver and passenger seat. **Driver or Passenger Seat Removal and Installation**
14. Battery Negative Cable - Connect - **Battery Negative Cable Disconnection and Connection**

FLOOR CARPET AUXILIARY MAT RETAINER REPLACEMENT

Removal Procedure

WARNING: **Wear safety glasses in order to avoid eye damage.**

1. Front Side Door Sill Garnish Molding - Remove - **Front Side Door Sill Garnish Molding Replacement**
2. Reposition the floor panel carpet as needed to access retainers. **Floor Panel Carpet Replacement**

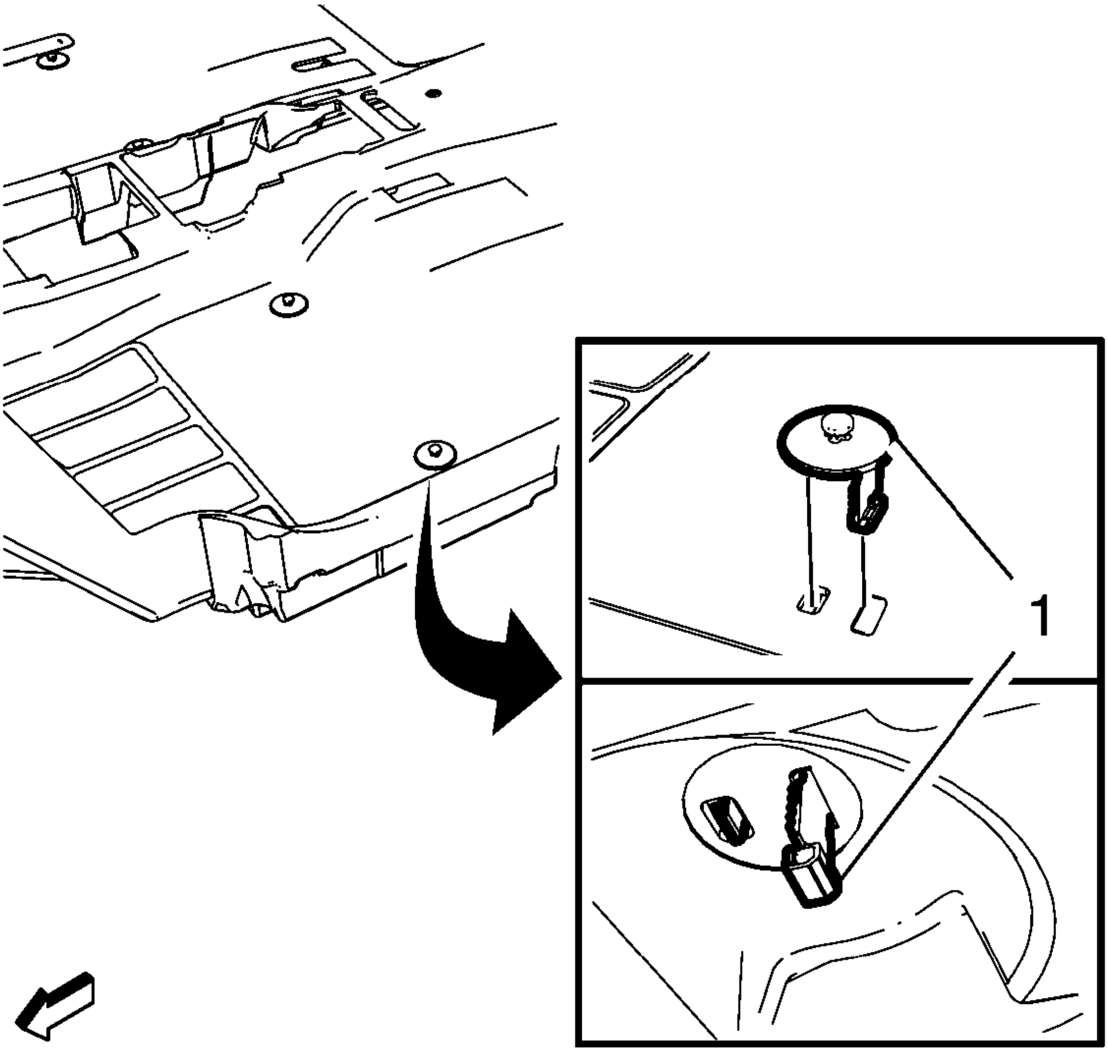


Fig. 13: Floor Panel Carpet Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Disengage the floor carpet auxiliary mat retainer (1) on the rear side of the floor panel carpet.
4. Remove the floor carpet auxiliary mat retainer (1) upwards.

Installation Procedure

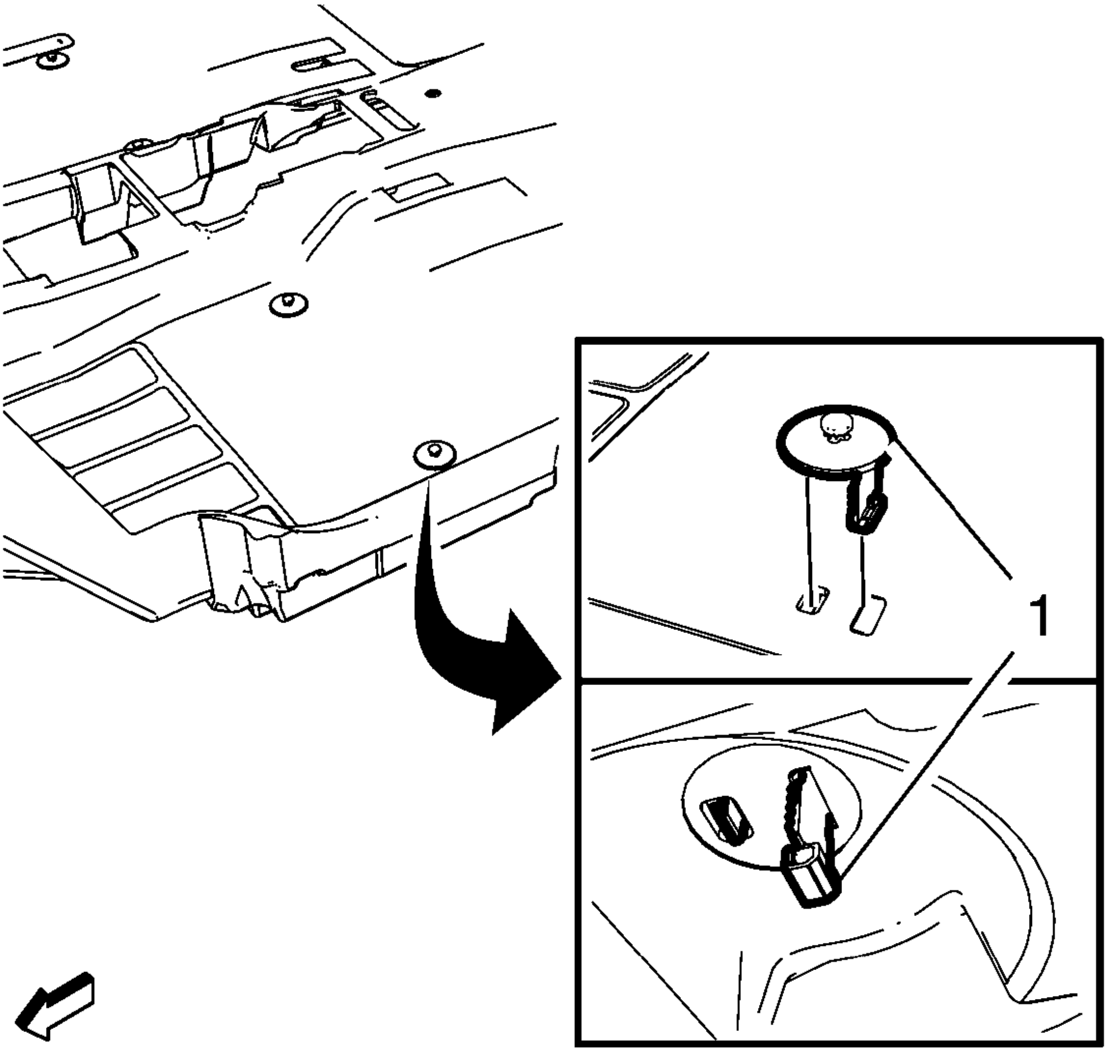


Fig. 14: Floor Panel Carpet Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Align the floor carpet auxiliary mat retainer (1) to the cutout in the carpet.
2. Engage the floor carpet auxiliary mat retainer (1) on the rear side of the floor panel carpet.
3. Reposition the floor panel carpet as needed. **Floor Panel Carpet Replacement**
4. Front Side Door Sill Garnish Molding - Install - **Front Side Door Sill Garnish Molding Replacement**

DRIVER FOOTREST REPLACEMENT

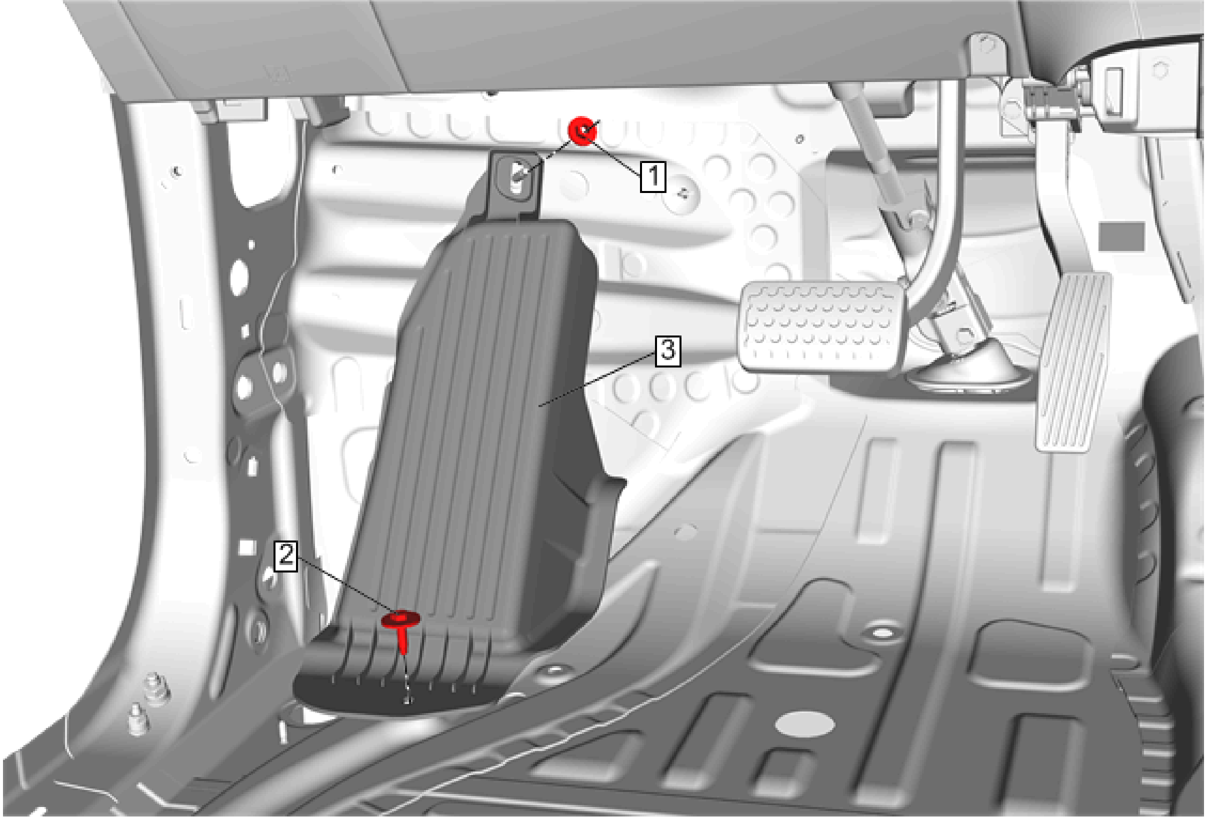


Fig. 15: Driver Footrest
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Reposition the driver side portion of the floor carpet. Floor Panel Carpet Replacement	
1	Driver Footrest Nut **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Driver Footrest Bolt **Tighten** 6 N.m (53 lb in)
3	Driver Footrest

HEADLINING TRIM PANEL REPLACEMENT

Removal Procedure

WARNING: **Do not attempt to repair or alter the head impact energy-absorbing material glued to the headliner or to the garnish trims. If the material is damaged, replace the headliner and/or the garnish trim. Failure to do so could result in personal injury.**

CAUTION: **If a vehicle is equipped with a head curtain inflator module ensure that the inflator module and tether are undamaged. If tether or curtain airbag are damaged in any way, they must be replaced.**

CAUTION: **Use care when working around the head curtain inflator module. Sharp tools may puncture the curtain airbag. If the head curtain inflator module is damaged in any way, it must be replaced.**

NOTE: **If removing the right side harness from the vehicle that goes to the**

radio, then the headliner, I/P, and radio must be removed. If removing left side harness from vehicle, only I/P needs to be removed. If only just removing the headliner, then the harnesses can be removed from the headliner and left to hang.

1. Disable the SIR system. SIR Disabling and Enabling

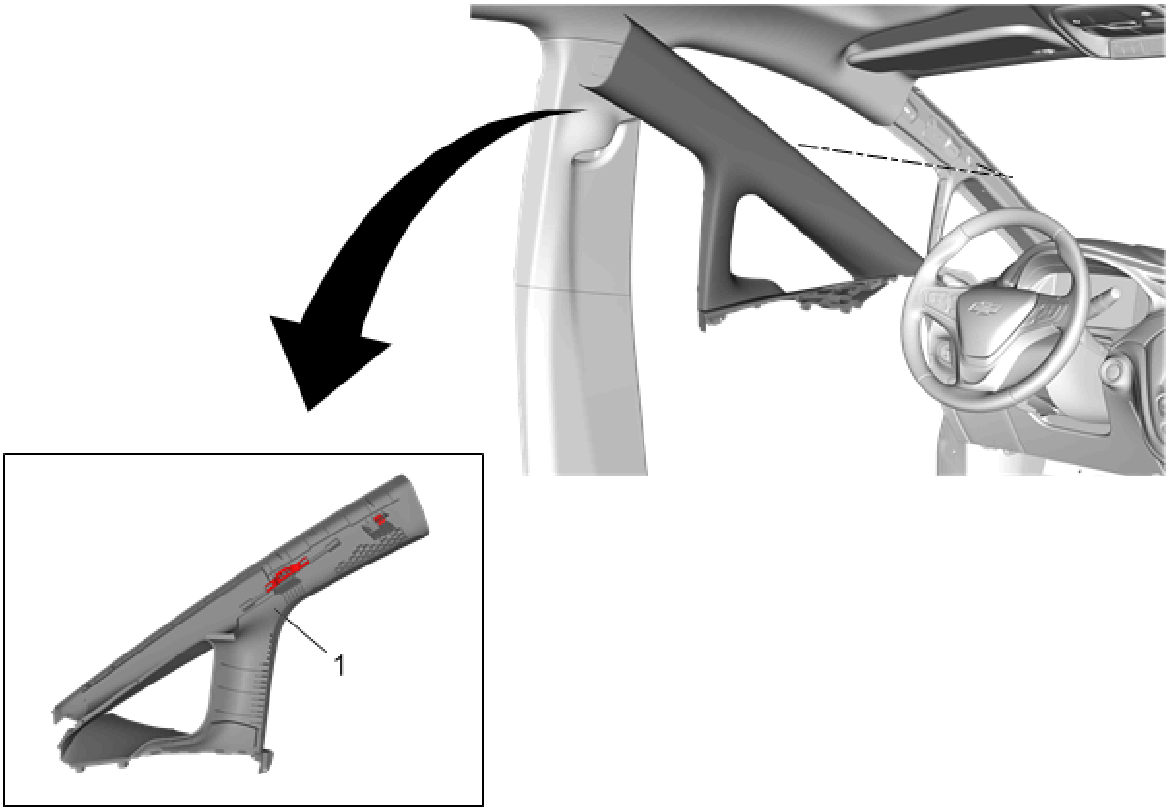


Fig. 16: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

2. Windshield Garnish Molding - Remove - Windshield Garnish Molding Replacement

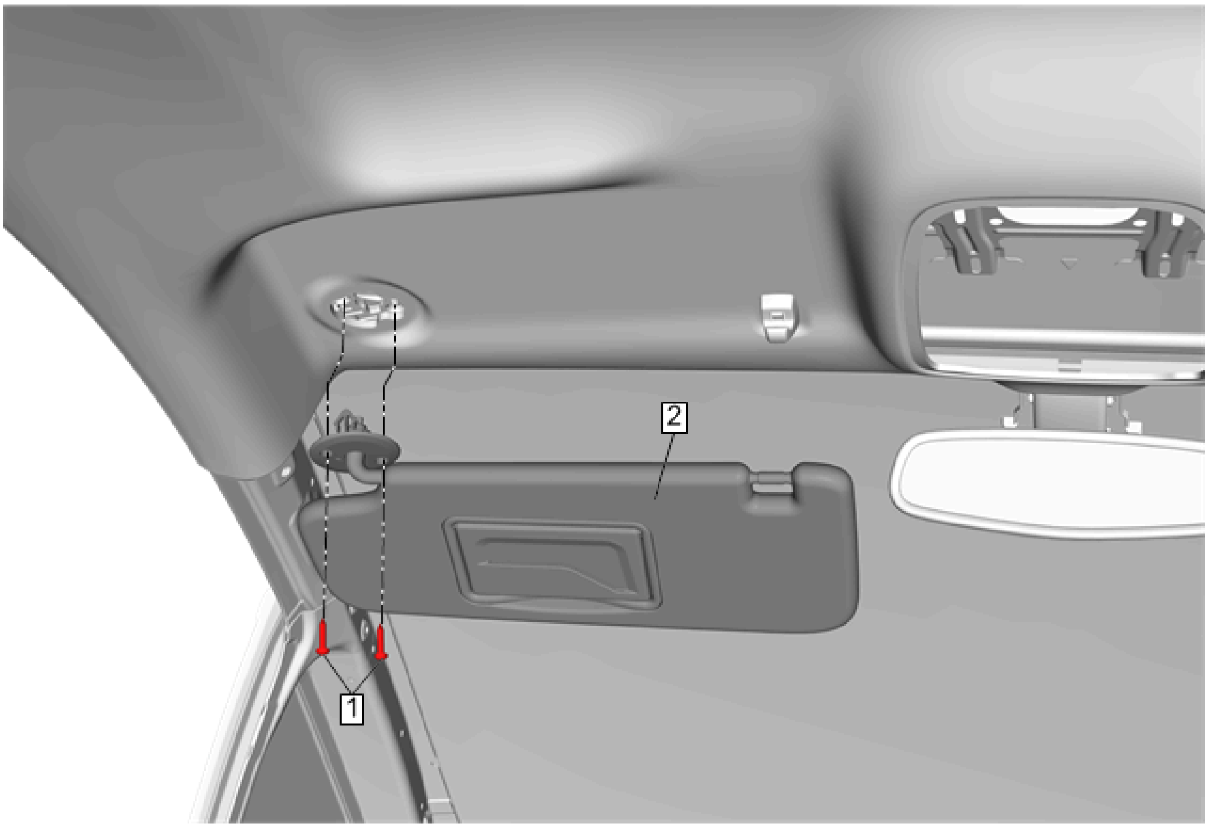


Fig. 17: Sunshade
Courtesy of GENERAL MOTORS COMPANY

3. Sunshade - Remove - Sunshade Replacement

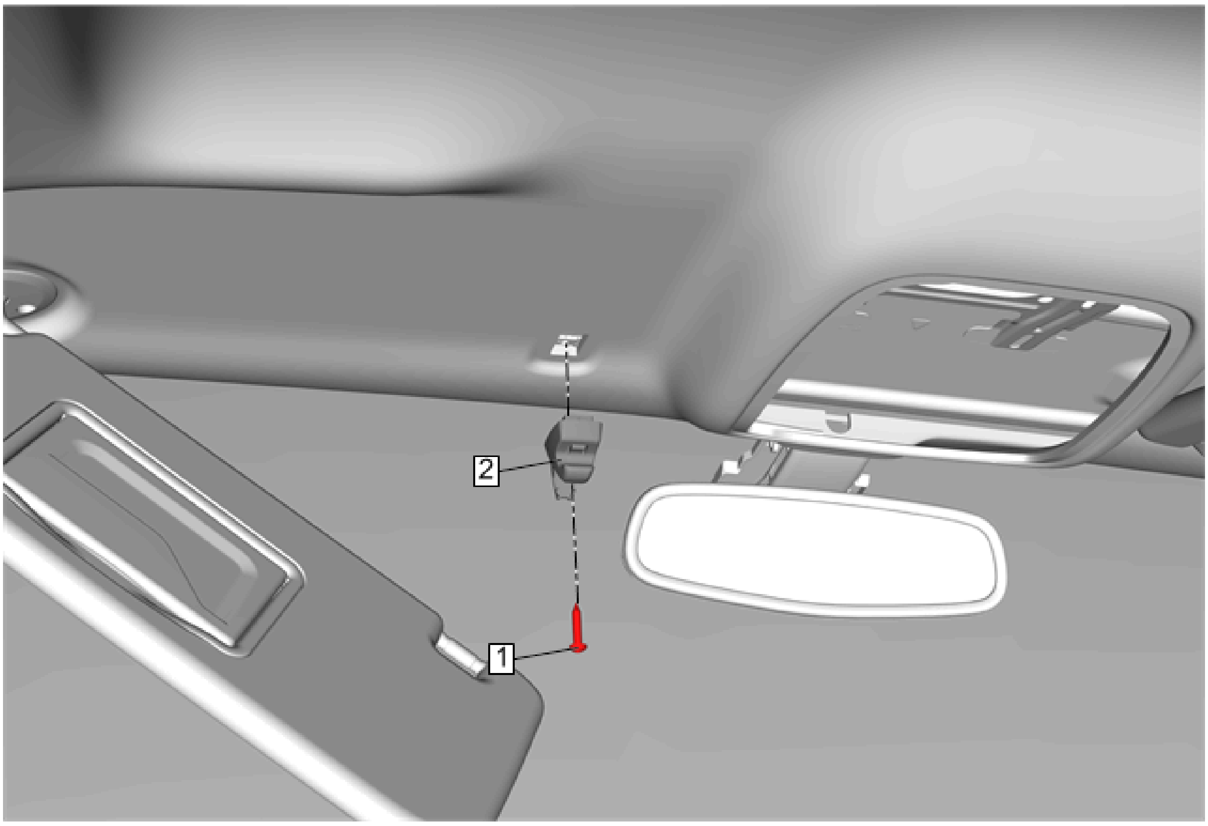


Fig. 18: Sunshade Support
Courtesy of GENERAL MOTORS COMPANY

4. Sunshade Support - Remove - Sunshade Support Replacement

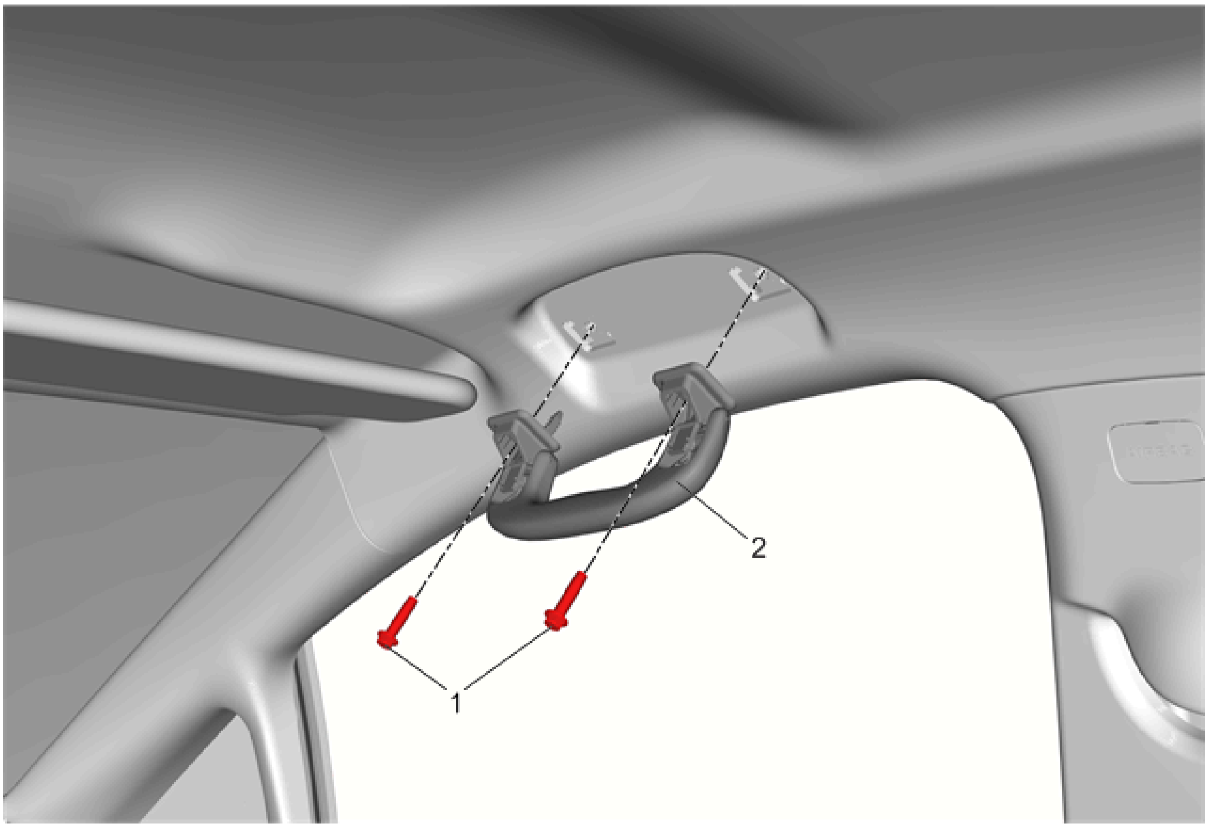


Fig. 19: Roof Rail Assist Handle
Courtesy of GENERAL MOTORS COMPANY

5. Roof Rail Assist Handle - Remove - Roof Rail Assist Handle Replacement

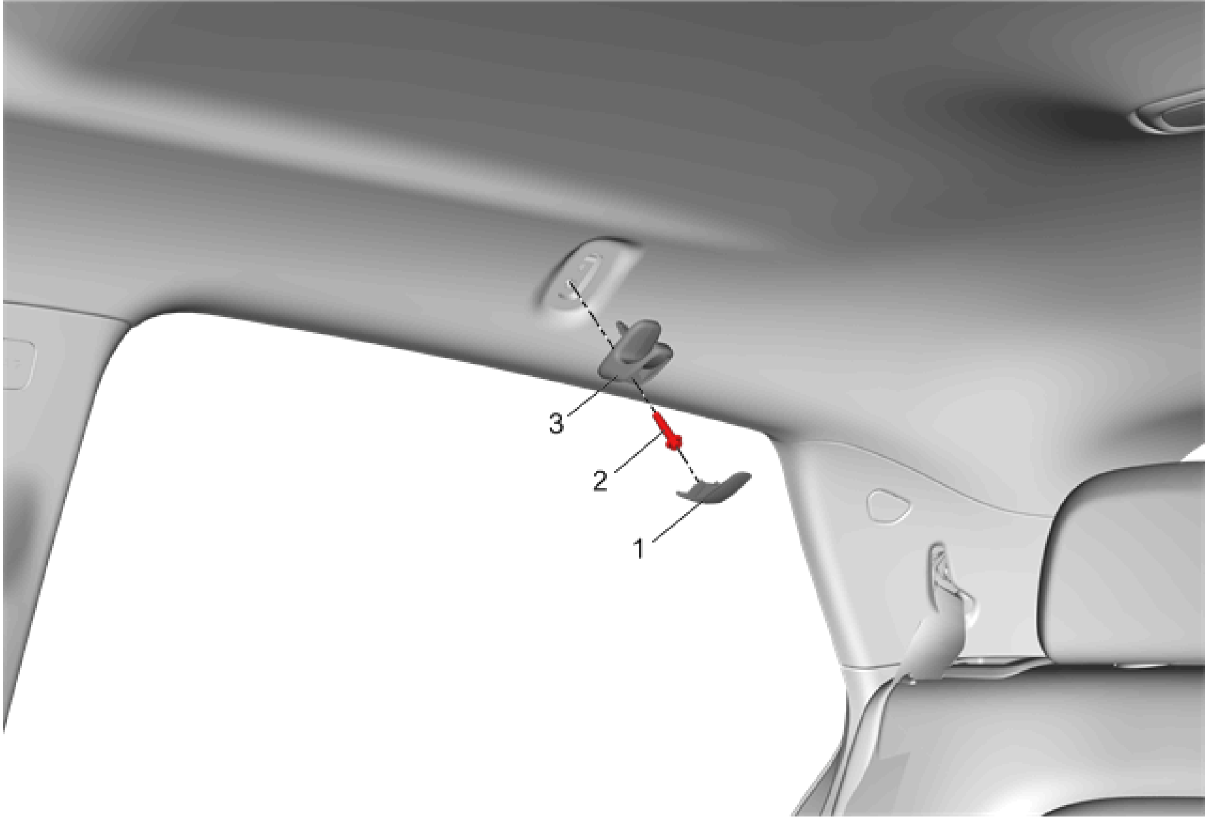


Fig. 20: Coat Hook
Courtesy of GENERAL MOTORS COMPANY

6. Coat Hook - Remove - Coat Hook Replacement

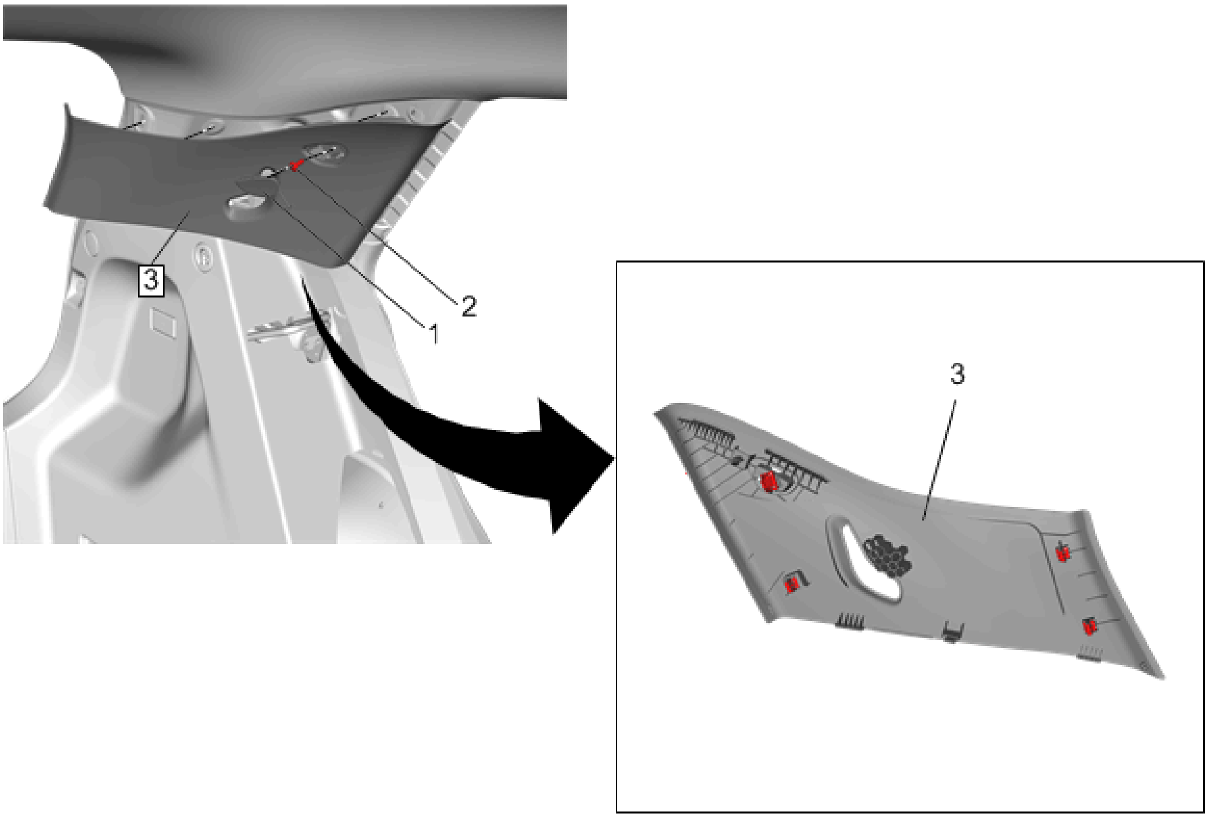


Fig. 21: Body Lock Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

7. Body Lock Pillar Upper Trim Panel - Reposition - Body Lock Pillar Upper Trim Panel Replacement

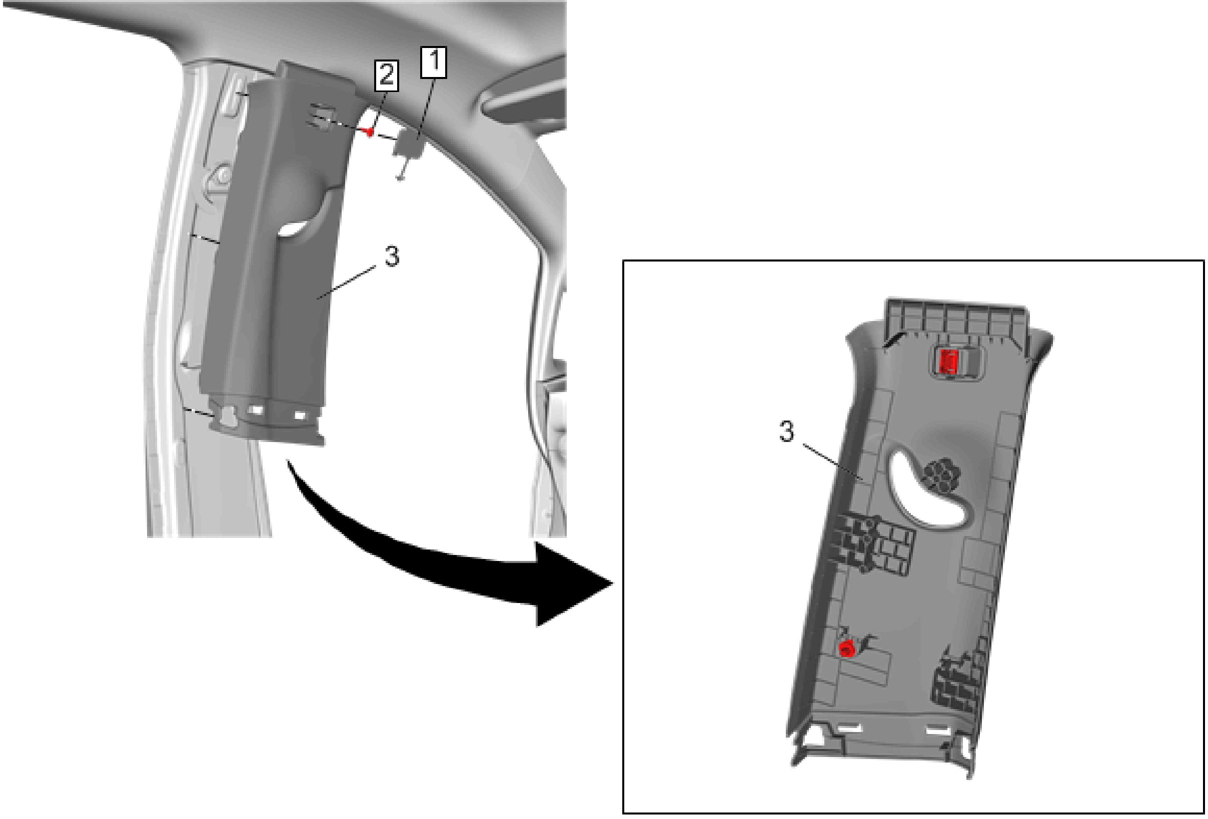


Fig. 22: Center Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

8. Center Pillar Upper Trim Panel - Reposition - Center Pillar Upper Trim Panel Replacement

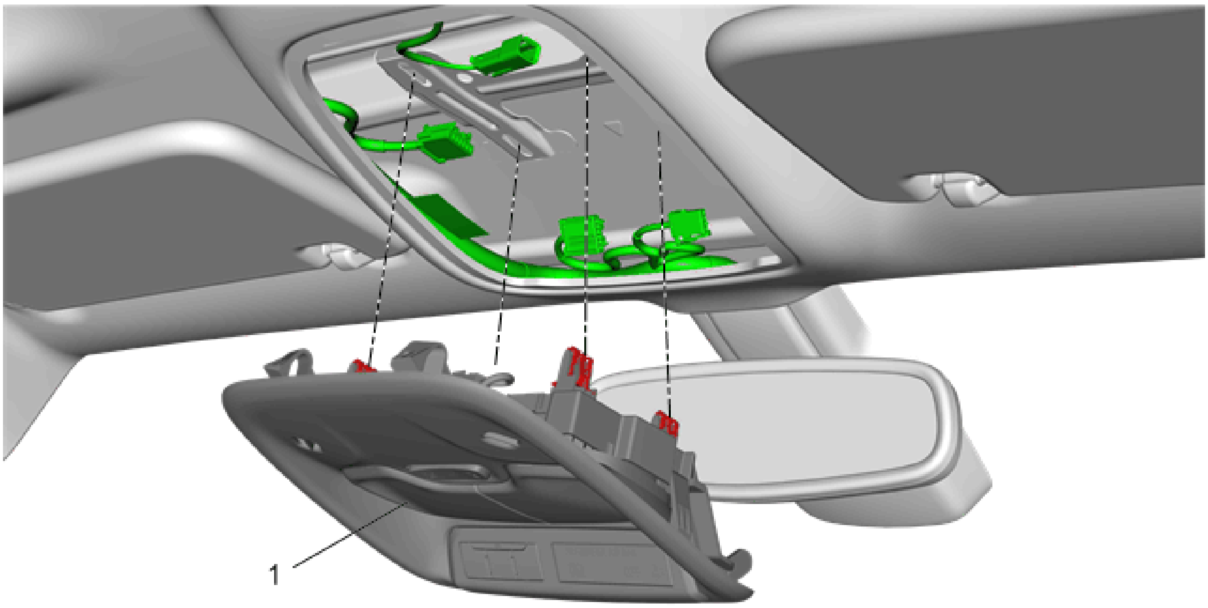


Fig. 23: Roof Console
Courtesy of GENERAL MOTORS COMPANY

9. Roof Console - Remove - Roof Console Replacement

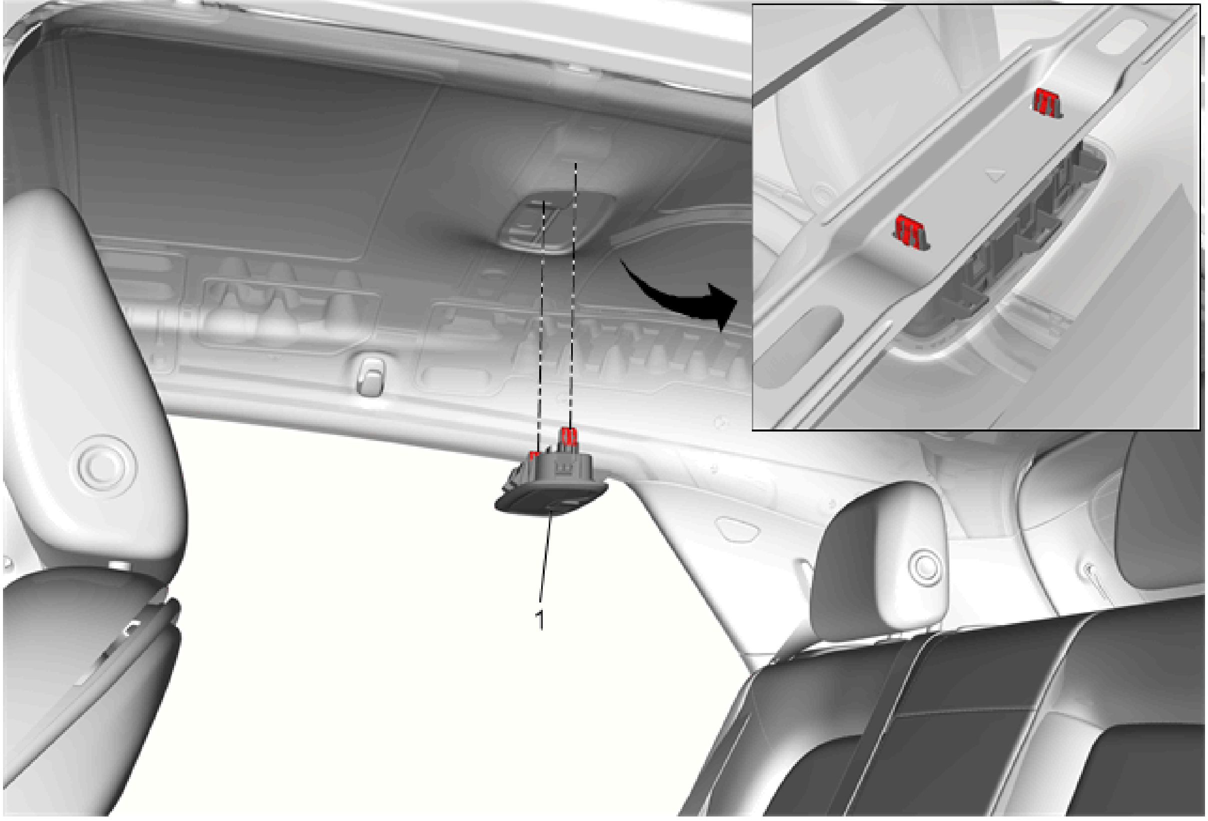


Fig. 24: Center Courtesy Lamp
Courtesy of GENERAL MOTORS COMPANY

10. Center Courtesy Lamp - Remove - **Center Courtesy Lamp Replacement**

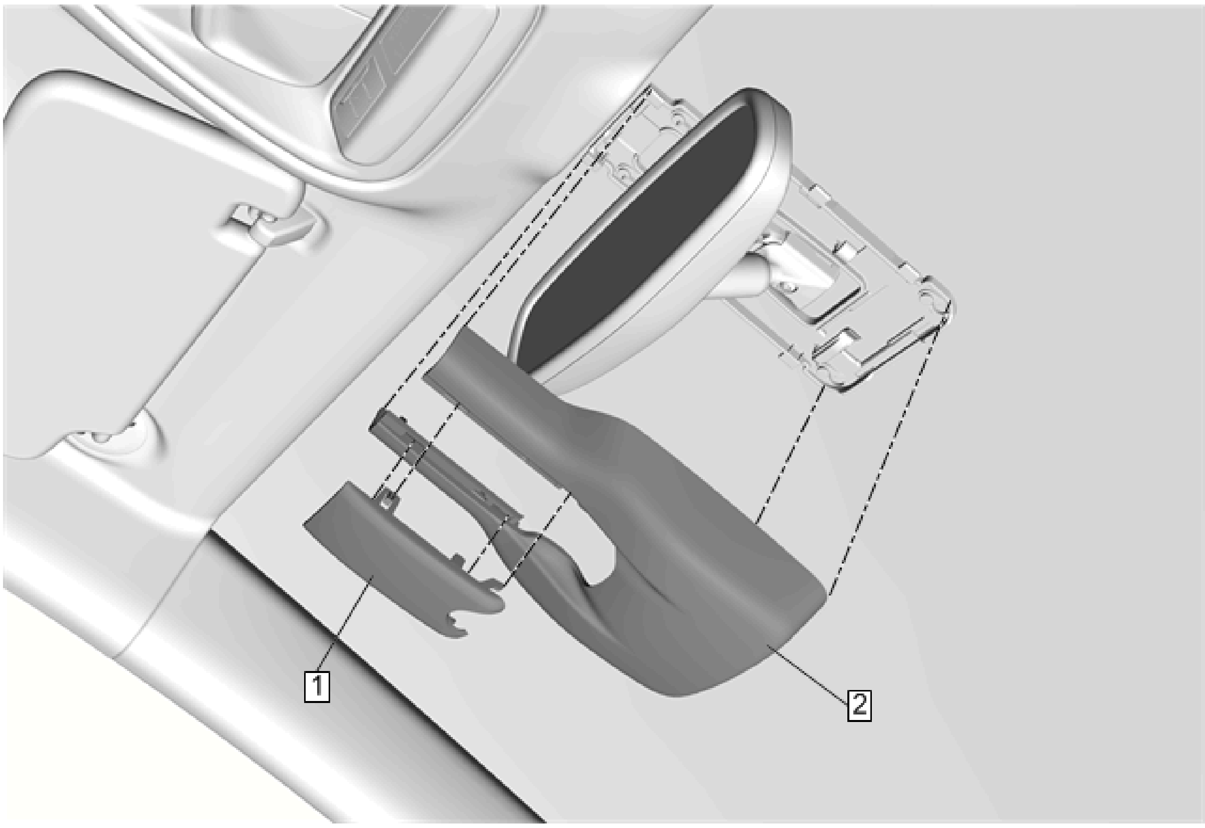


Fig. 25: Windshield Multifunction Sensor Mount Bracket Cover
Courtesy of GENERAL MOTORS COMPANY

11. Windshield Multifunction Sensor Mount Bracket Cover - Remove - **Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera)** **Windshield Multifunction Sensor Mount Bracket Cover Replacement (without Front View Camera)**
12. Fold down the rear seat backs.
13. Move the driver and passenger seats fully forward and recline.

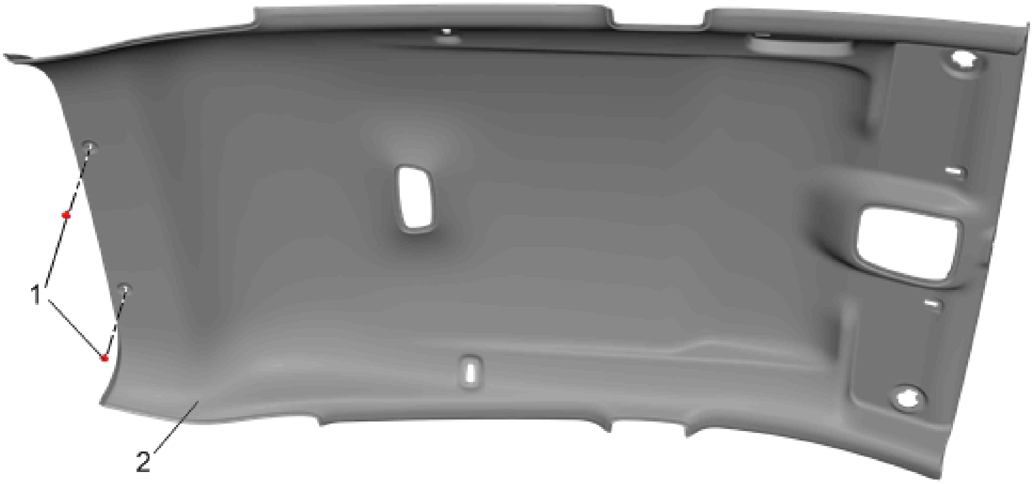


Fig. 26: Headliner Trim Panel Retainers
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Prior to removal, note the routing of the wire harness to aid in reassembly and to ensure proper installation.**

14. Remove the headliner trim panel retainers (1).
15. Release the headliner from the door weatherstrip and lower.
16. Disconnect the electrical connectors.
17. Note the location of the harness and remove the harness from the headliner. **Headliner Harness Replacement**
18. With the aid of an assistant, remove the headliner trim panel assembly (2) from the vehicle through the liftgate opening.
19. Transfer components as necessary.
20. If transferring or replacing the wiring harness. **Headliner Harness Replacement**

Installation Procedure

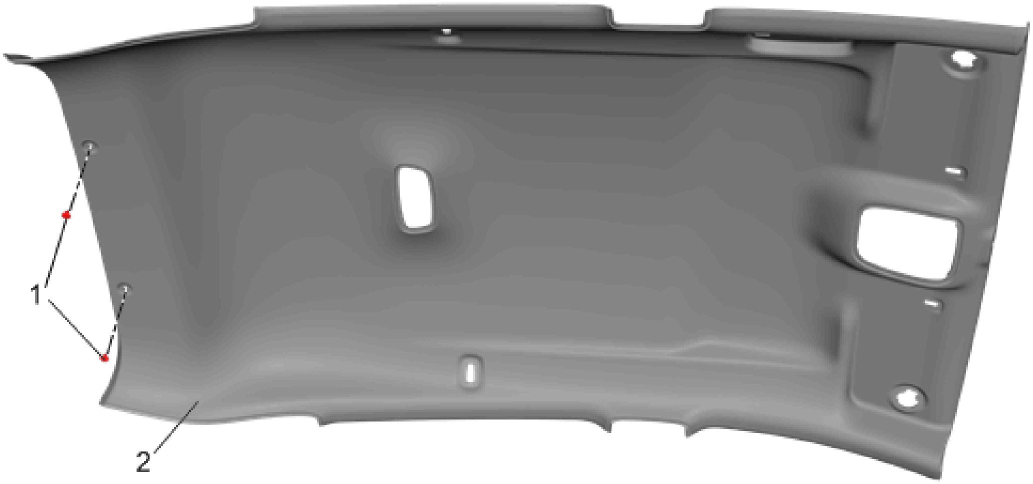


Fig. 27: Headliner Trim Panel Retainers
Courtesy of GENERAL MOTORS COMPANY

1. With the aid of an assistant, position the headliner trim panel assembly (2) into the vehicle through the liftgate opening.
2. Install the harnesses to the headliner.
3. Connect the electrical connectors.
4. Tape any unused connectors to the headlining with a high adhesive tape.
5. Raise the headliner into position and install around weatherstrips.
6. Install the headliner trim panel retainers (1).

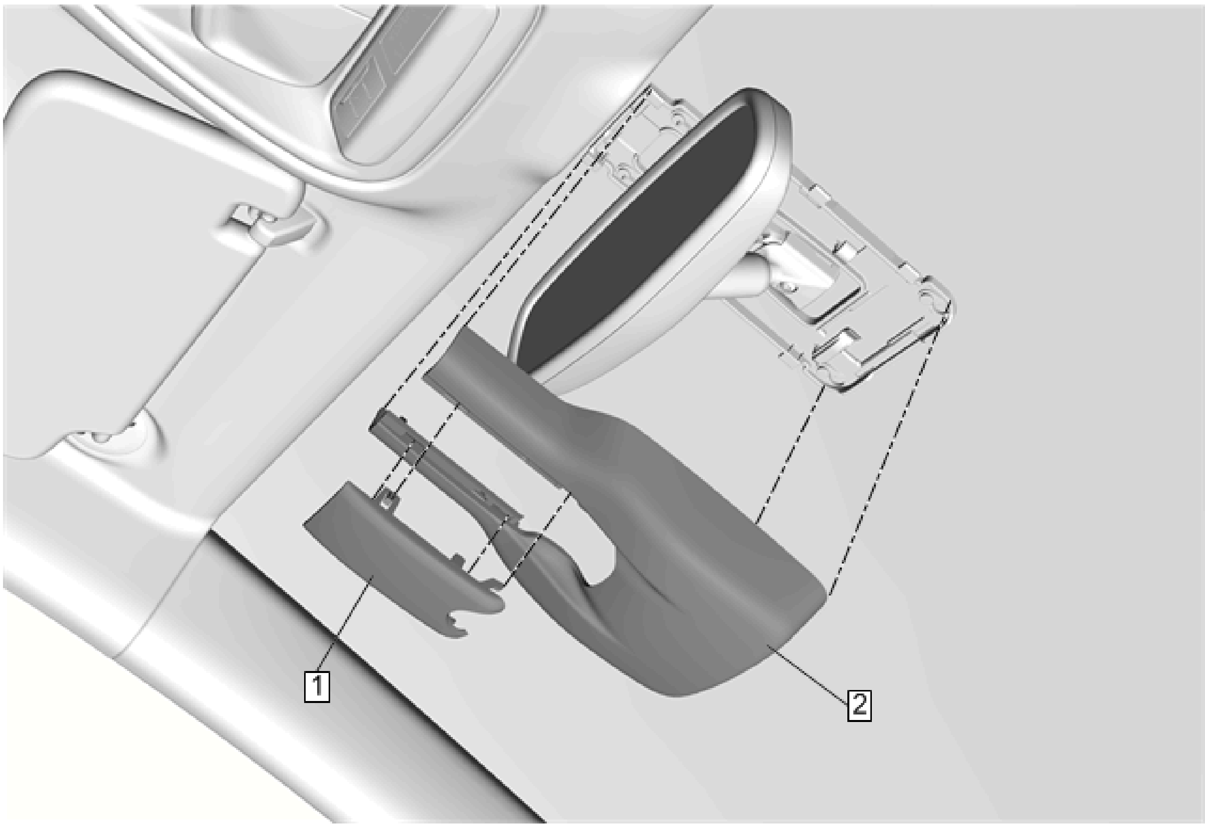


Fig. 28: Windshield Multifunction Sensor Mount Bracket Cover
Courtesy of GENERAL MOTORS COMPANY

7. Windshield Multifunction Sensor Mount Bracket Cover - Install - Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera) Windshield Multifunction Sensor Mount Bracket Cover Replacement (without Front View Camera)

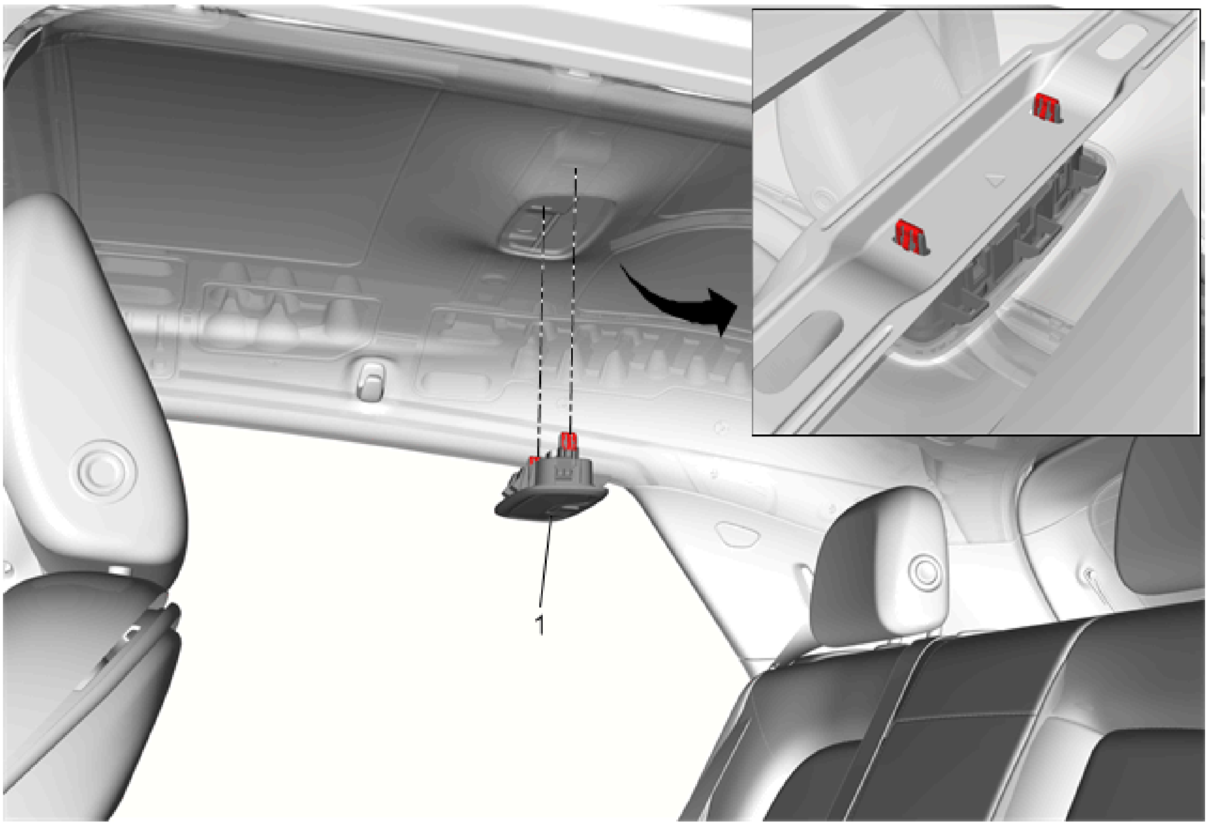


Fig. 29: Center Courtesy Lamp
Courtesy of GENERAL MOTORS COMPANY

8. Center Courtesy Lamp - Install Center Courtesy Lamp Replacement

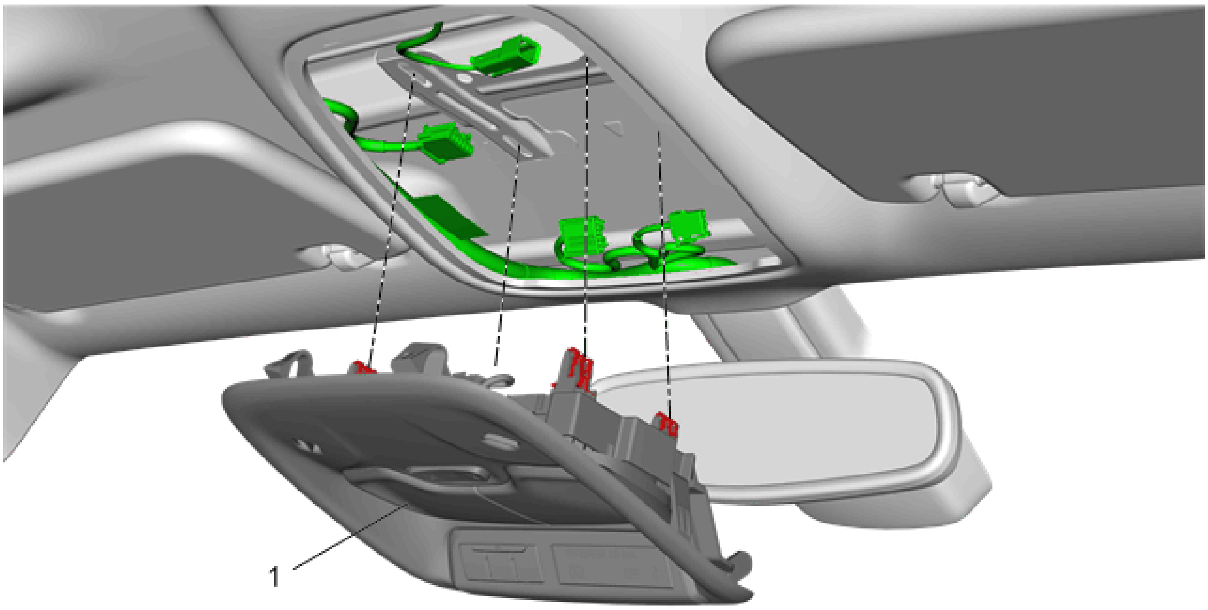


Fig. 30: Roof Console
Courtesy of GENERAL MOTORS COMPANY

9. Roof Console - Install - Roof Console Replacement

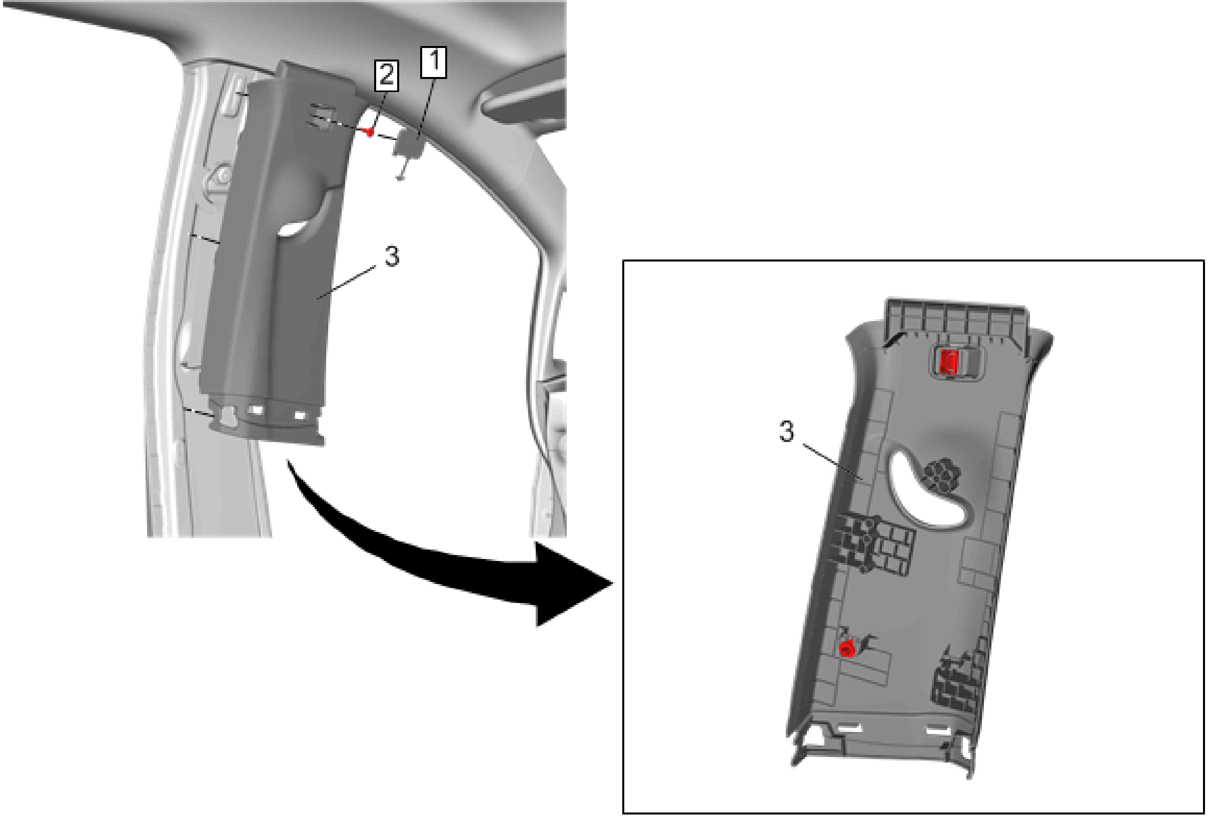


Fig. 31: Center Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

10. Center Pillar Upper Trim Panel - Install - Center Pillar Upper Trim Panel Replacement

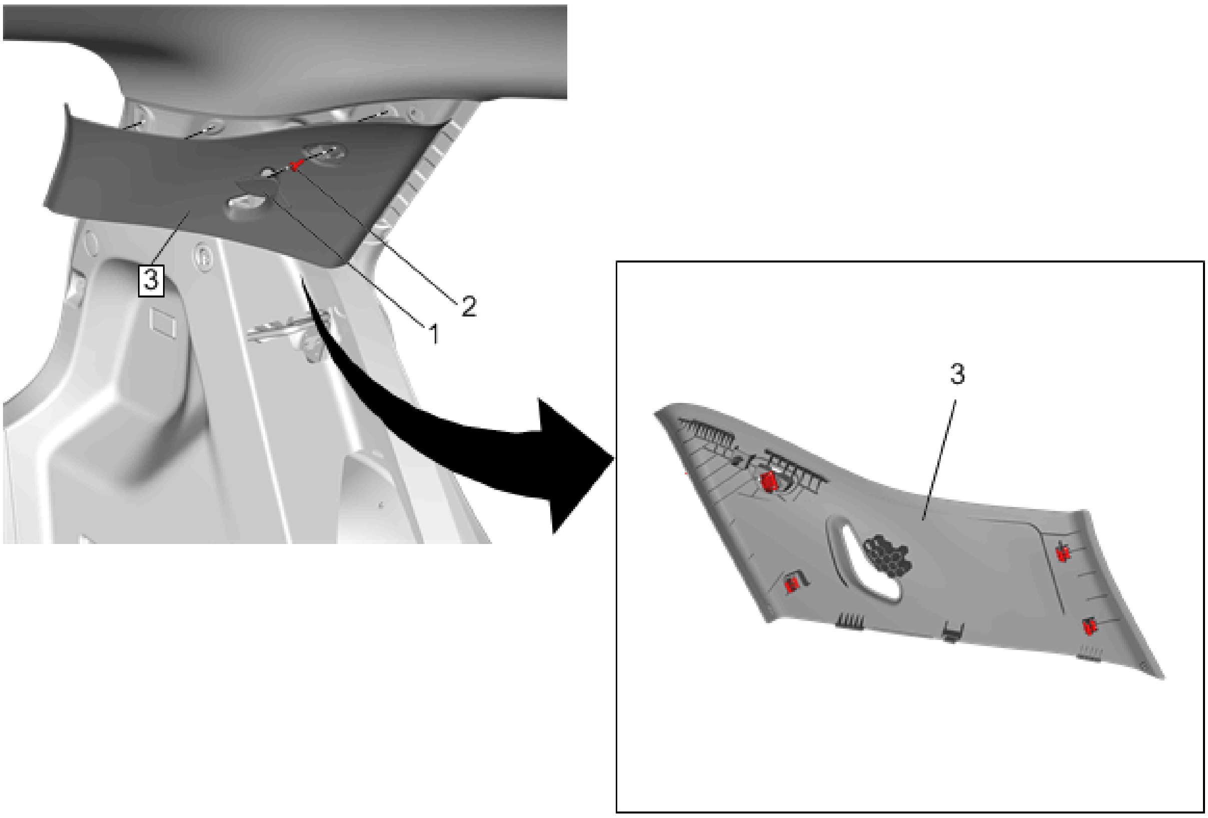


Fig. 32: Body Lock Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

11. Body Lock Pillar Upper Trim Panel - Install - Body Lock Pillar Upper Trim Panel Replacement

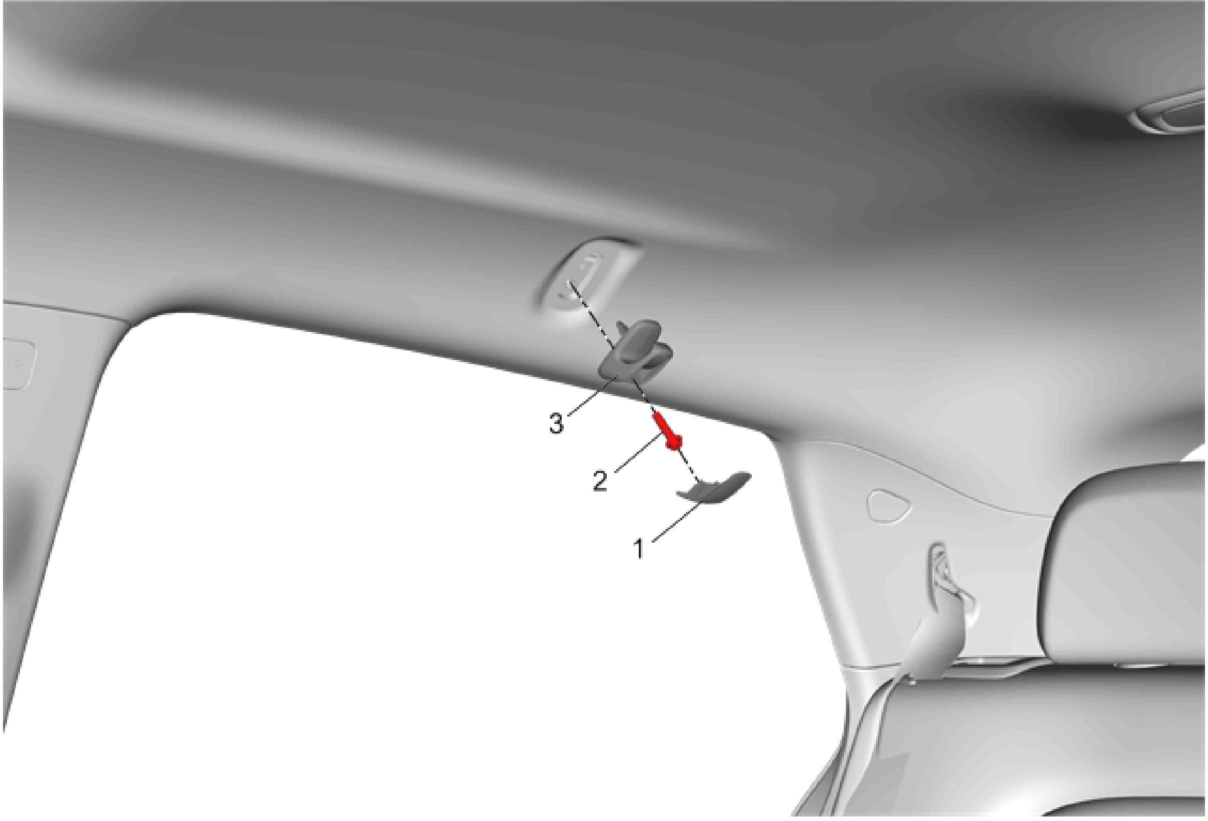


Fig. 33: Coat Hook
Courtesy of GENERAL MOTORS COMPANY

12. Coat Hook - Install - Coat Hook Replacement

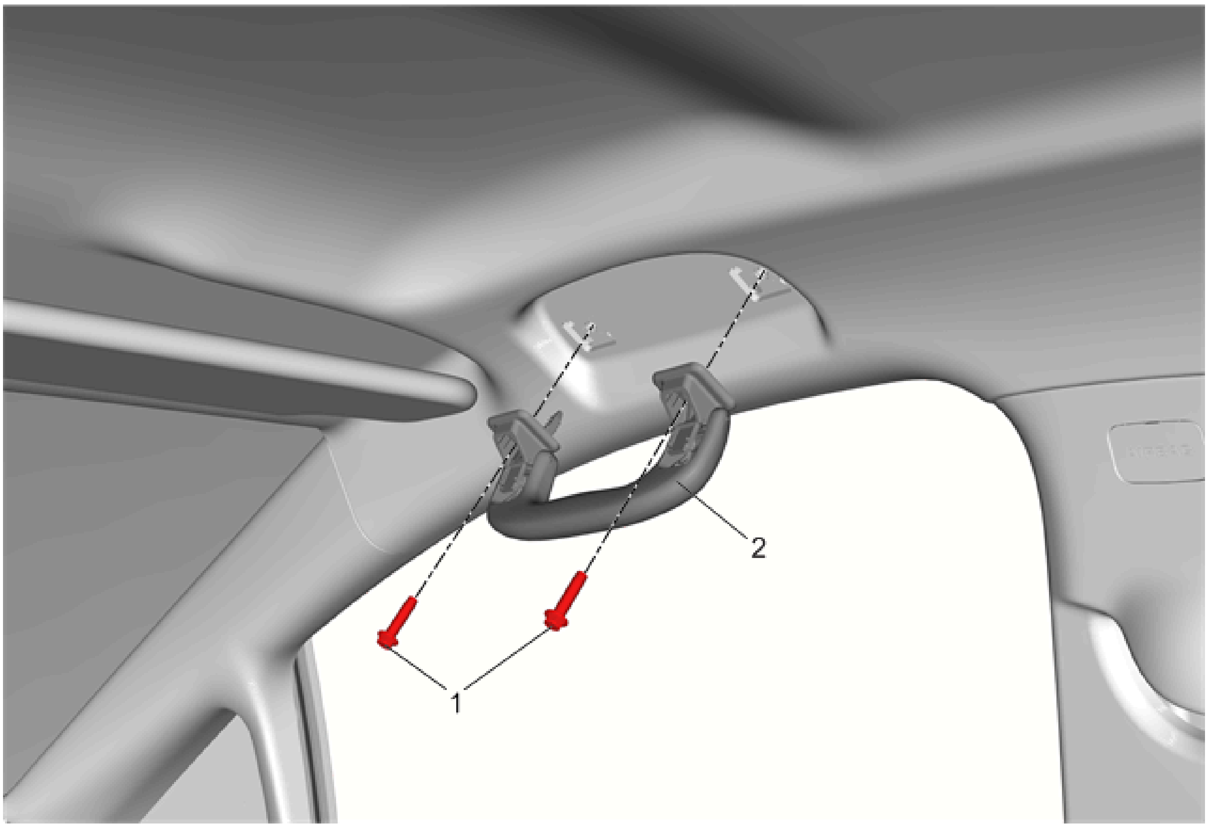


Fig. 34: Roof Rail Assist Handle
Courtesy of GENERAL MOTORS COMPANY

13. Roof Rail Assist Handle - Install - Roof Rail Assist Handle Replacement

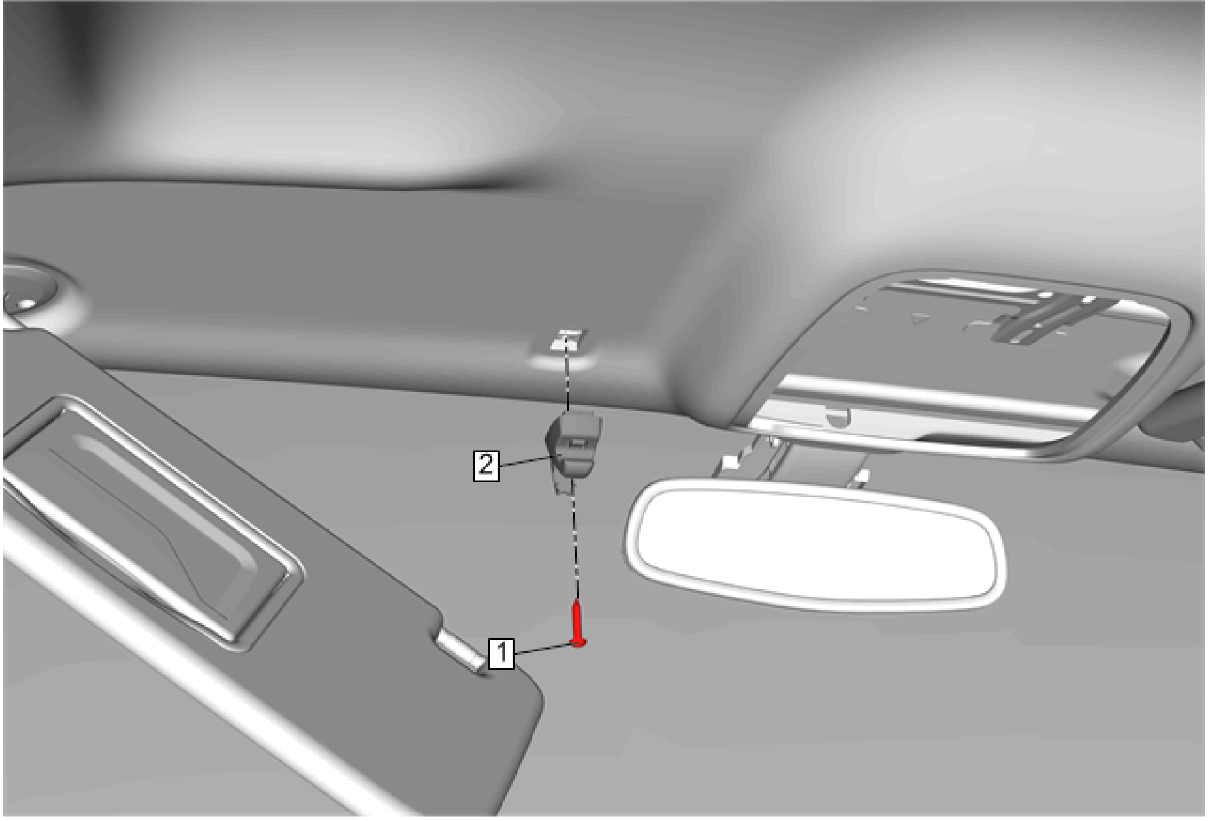


Fig. 35: Sunshade Support
Courtesy of GENERAL MOTORS COMPANY

14. Sunshade Support - Install - Sunshade Support Replacement

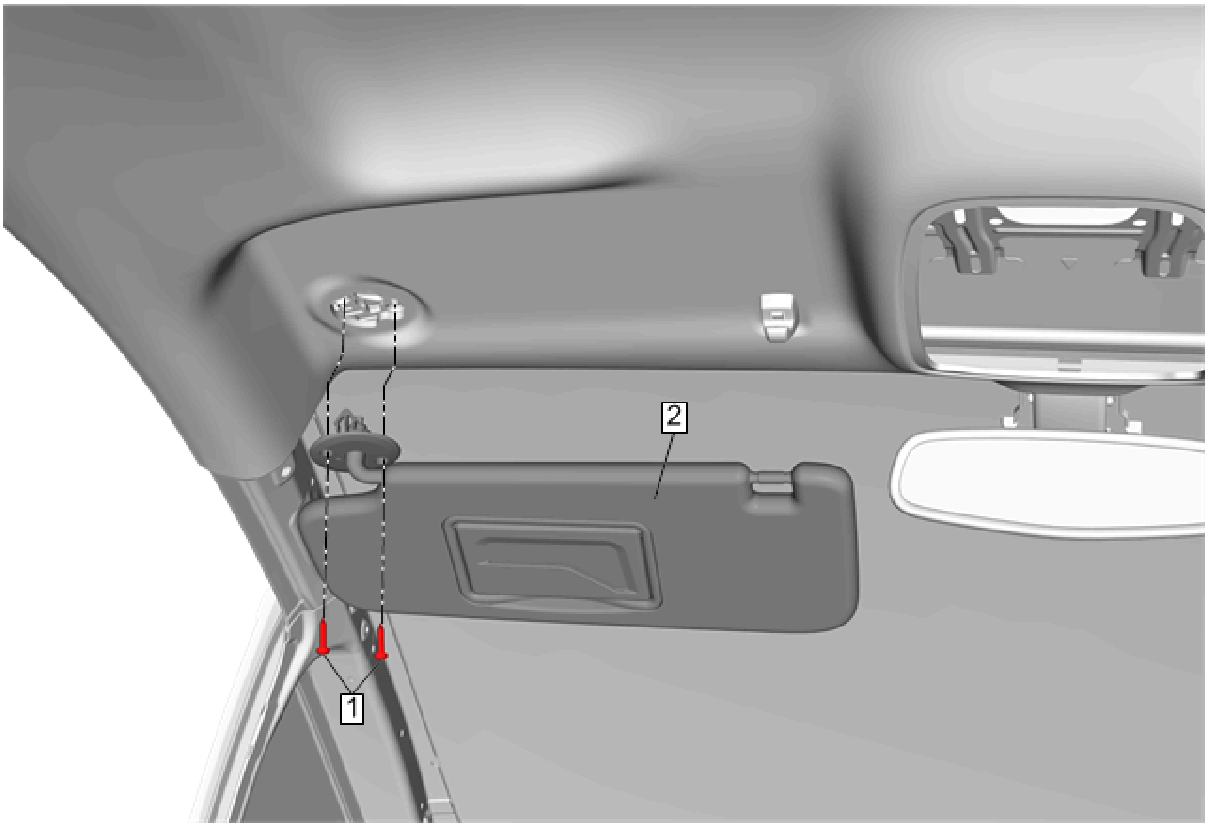


Fig. 36: Sunshade
Courtesy of GENERAL MOTORS COMPANY

15. Sunshade - Install - Sunshade Replacement

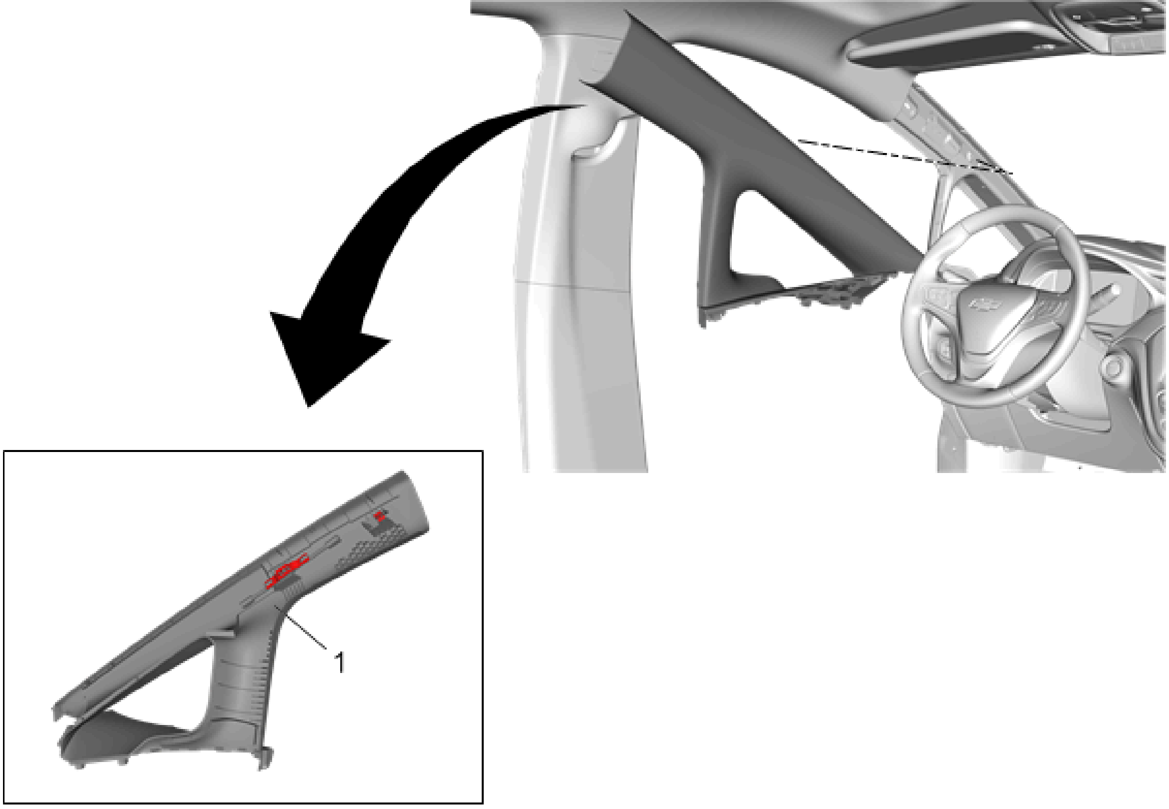


Fig. 37: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

16. Windshield Garnish Molding - Install - **Windshield Garnish Molding Replacement**
17. Enable the SIR System. **SIR Disabling and Enabling**

HEADLINER HARNESS REPLACEMENT

Removal Procedure

1. For the left side harness, remove the instrument panel. **Instrument Panel Assembly Replacement**
2. For the right side harness, remove the instrument panel and radio. **Instrument Panel Assembly Replacement** , **Radio Replacement**
3. Remove the headlining trim panel. Refer to **Headlining Trim Panel Replacement**.
4. Take note of the wiring harness locations and measure the harness lead length prior to removing. Mark harness routing locations on new headliner prior to harness removal.

NOTE: **Use a camera to take pictures and use a pencil to mark the new headliner.**

5. Use fiber or plastic trim tool to assist in removing the wiring harness from the headliner, taking care not to damage the harness.
6. Remove excess glue and material from the wiring harness and re-tape areas where the tape was removed or damaged.

Installation Procedure

1. Lay the wiring harness on the new headliner assembly to confirm correct routing and ensure harness leads are proper length for mating connections prior to gluing.

WARNING: **Do not change the wiring harness routing locations. Correct harness routing is critical for air bag deployment. Possible personal injury or vehicle damage could result if the harness routing is changed.**

NOTE: **When installing a new headliner harness, tape any unused connector to the headliner with a high adhesive tape.**

2. Use hot melt adhesive to install the wiring harness. Apply insulator tape over glued locations to prevent squeaks and rattles as needed.
3. Install the headlining trim panel. Refer to **Headlining Trim Panel Replacement**.
4. For the left side harness, install the instrument panel. **Instrument Panel Assembly Replacement**
5. For the right side harness, install the instrument panel and radio. **Instrument Panel Assembly Replacement** , **Radio Replacement**

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Frame and Underbody - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Battery Negative Cable Ground Bolt	22 N.m (16 lb ft)
Battery Positive and Negative Cable Bracket Bolt	9 N.m (80 lb in)
Battery Positive and Negative Cable Bracket Nut	9 N.m (80 lb in)
Drivetrain and Front Suspension Cradle Front Bolt	
- First Pass:	160 N.m (118 lb ft)
- Final Pass:	60 - 75 Degrees
Drivetrain and Front Suspension Cradle Intermediate Bolt	
- First Pass:	160 N.m (118 lb ft)
- Final Pass:	60 - 75 Degrees
Drivetrain and Front Suspension Cradle Nut	58 N.m (43 lb ft)
Drivetrain and Front Suspension Cradle Rear Bolt	
- First Pass:	160 N.m (118 lb ft)
- Final Pass:	60 - 75 Degrees
Drivetrain and Front Suspension Crossmember Center Bolt	58 N.m (43 lb ft)
Front Bumper Fascia Wheel Opening Screw	2.5 N.m (22 lb in)
Front Compartment Insulator Bolt	9 N.m (80 lb in)
Front Compartment Insulator Screw	2.5 N.m (22 lb in)
Front Tire Front Air Deflector Fastener	2.5 N.m (22 lb in)
Front Wheelhouse Liner Screw	2.5 N.m (22 lb in)
Power Electric Carrier Frame Bolt (Front Mounting)	160 N.m (118 lb ft)
Power Electric Carrier Frame Bolt (Rear Mounting)	58 N.m (43 lb ft)
Rear Tire Front Air Deflector Fastener	2.5 N.m (22 lb in)
Rear Wheelhouse Liner Screw	2.5 N.m (22 lb in)

REPAIR INSTRUCTIONS

POWER ELECTRIC CARRIER FRAME REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Battery Tray - Remove - Battery Tray Replacement

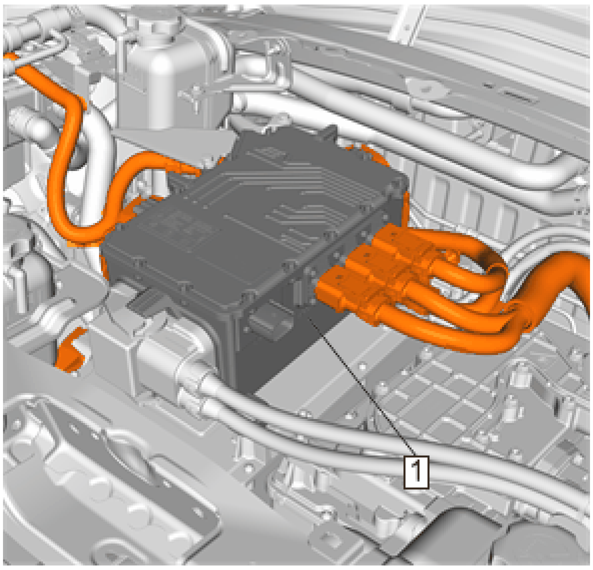


Fig. 1: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

3. Generator Battery Control Wiring Junction Block - Remove - High Voltage Battery Control Wiring Junction Block Replacement (With quick charge) High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)

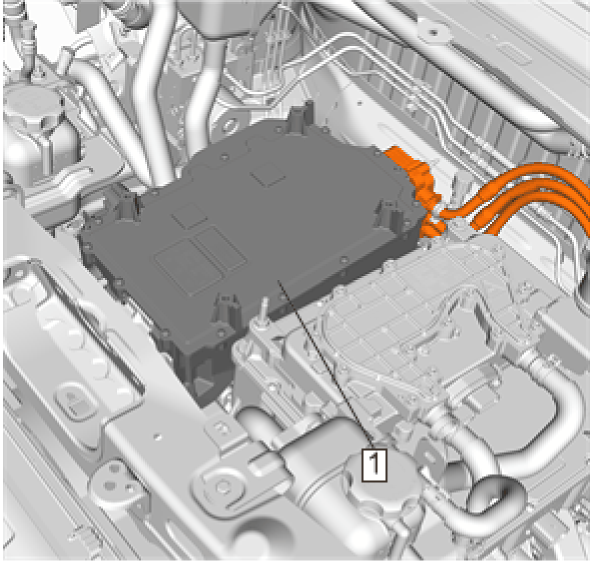


Fig. 2: Drive Motor Power Inverter Module
Courtesy of GENERAL MOTORS COMPANY

4. Drive Motor Power Inverter Module - Remove - **Drive Motor Power Inverter Module Replacement**

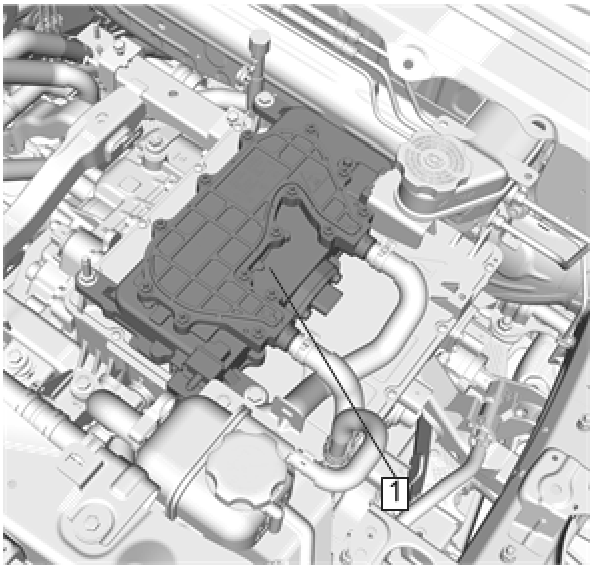


Fig. 3: Accessary DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

5. Accessary DC Power Control Module - Remove - **Accessory DC Power Control Module Replacement**

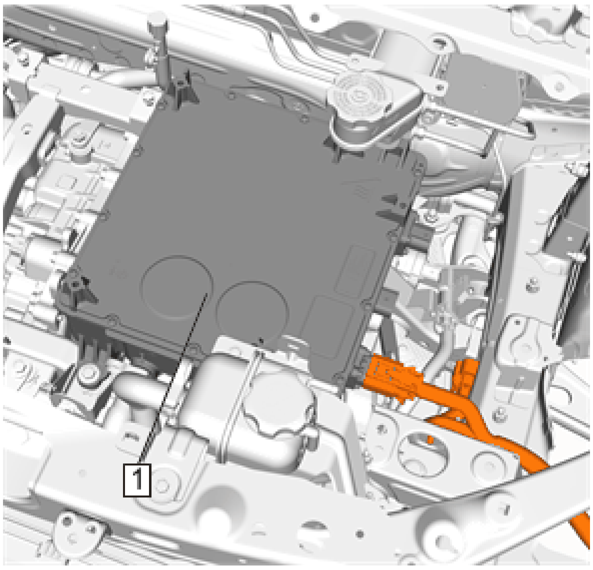


Fig. 4: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

6. Drive Motor Battery Charger - Remove - **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**

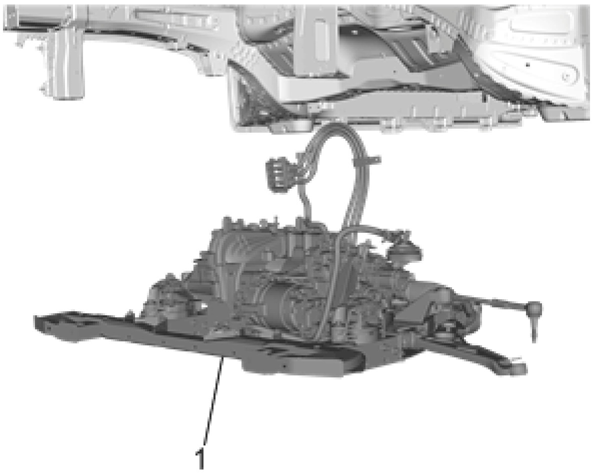


Fig. 5: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - **Drivetrain and Front Suspension Frame Removal and Installation**
   1. Remove the drive motor battery coolant pump instead of supporting the drive motor battery coolant pump to the power electric carrier frame with a wire during the removal process of the drive unit and drivetrain and front suspension frame assembly.
   2. Remove the heater coolant pump instead of supporting the heater coolant pump to the power electric carrier frame with a wire during the removal process of the drive unit and drivetrain and front suspension frame assembly.
8. Auxiliary Battery Negative Cable-Chassis Structure to Front Compartment Side Rail - Remove - **Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 2nd Cable)** **Auxiliary Battery Negative Cable Replacement (Chassis Structure to Front Compartment Side Rail)** **Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 1st Cable)**
9. Auxiliary Battery Negative Cable-Drive Unit to Chassis Structure - Remove - **Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 2nd Cable)** **Auxiliary Battery Negative Cable Replacement (Chassis Structure to Front Compartment Side Rail)** **Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 1st Cable)**

NOTE: **Mark the routes of the wiring harness and their locations.**

10. Remove the wiring harness connectors, retainers and ground from the power electric carrier frame.

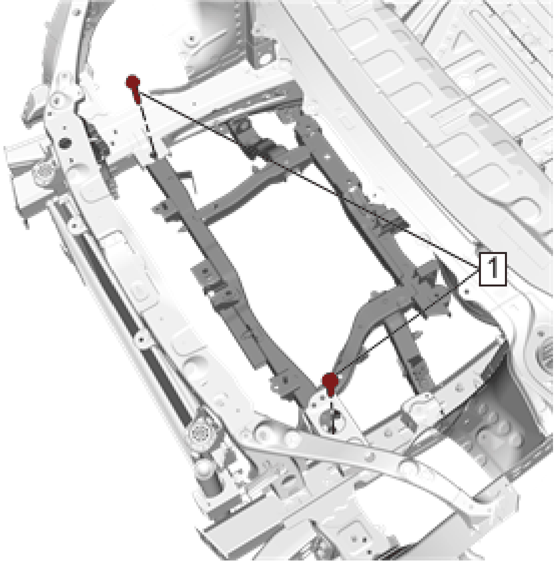


Fig. 6: Power Electric Carrier Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Power Electric Carrier Frame Bolt at Body Lower Structure - Remove

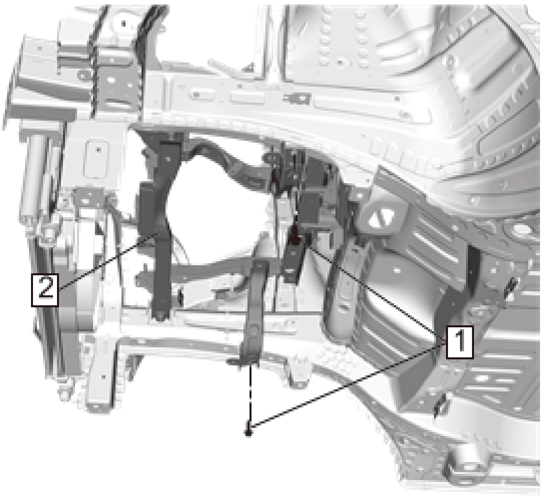


Fig. 7: Power Electric Carrier Frame Bolt at Body Lower Structure
Courtesy of GENERAL MOTORS COMPANY

12. Power Electric Carrier Frame Bolt at Body Lower Structure - Remove
13. With the aid of an assistant, remove the power electric carrier frame (2) from the vehicle

Installation Procedure

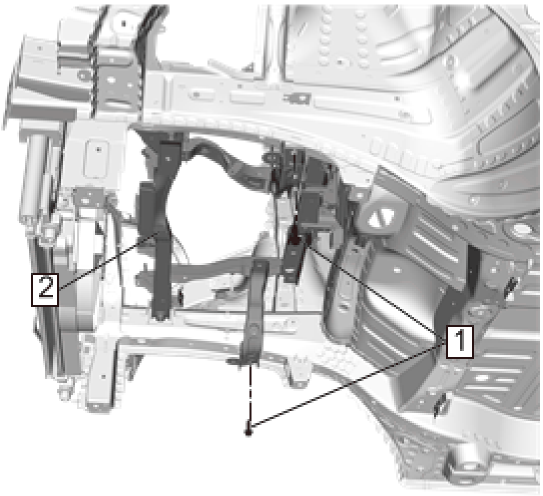


Fig. 8: Power Electric Carrier Frame Bolt at Body Lower Structure
Courtesy of GENERAL MOTORS COMPANY

1. With the aid of an assistant, install the power electric carrier frame (2) to the vehicle

CAUTION: Fastener Caution

2. Power Electric Carrier Frame Bolt at Body Lower Structure - Install and tighten to 58 N.m (43 lb ft)

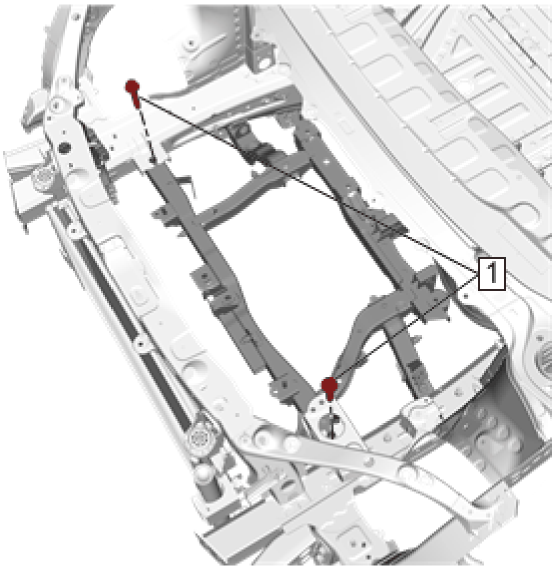


Fig. 9: Power Electric Carrier Frame Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Power Electric Carrier Frame Bolt at Body Lower Structure - Install and tighten to 160 N.m (118 lb ft)
4. Install the wiring harness connectors, retainers and ground to the power electric carrier frame in the proper locations.
5. Auxiliary Battery Negative Cable-Drive Unit to Chassis Structure - Install - Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 2nd Cable) Auxiliary Battery Negative Cable Replacement (Chassis Structure to Front Compartment Side Rail) Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 1st Cable)
6. Auxiliary Battery Negative Cable-Chassis Structure to Front Compartment Side Rail - Install - Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 2nd Cable) Auxiliary Battery Negative Cable Replacement (Chassis Structure to Front Compartment Side Rail) Auxiliary Battery Negative Cable Replacement (DU to Chassis Structure, 1st Cable)

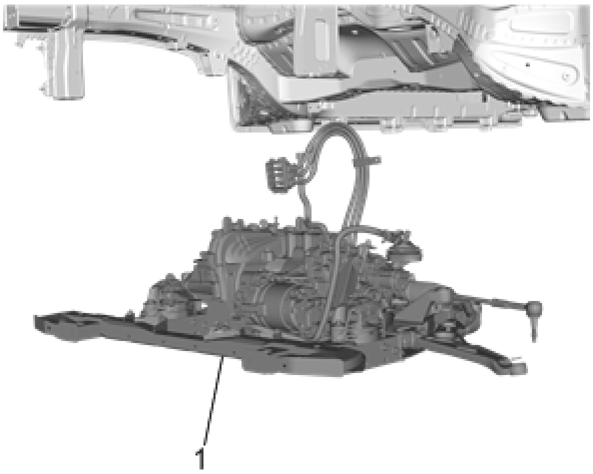


Fig. 10: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Install - **Drivetrain and Front Suspension Frame Removal and Installation**
    1. Drive Motor Battery Coolant Pump - Install - **Drive Motor Battery Coolant Pump Replacement (RESS Pump)** **Drive Motor Battery Coolant Pump Replacement (PE Pump)**
    2. Heater Coolant Pump - Install -

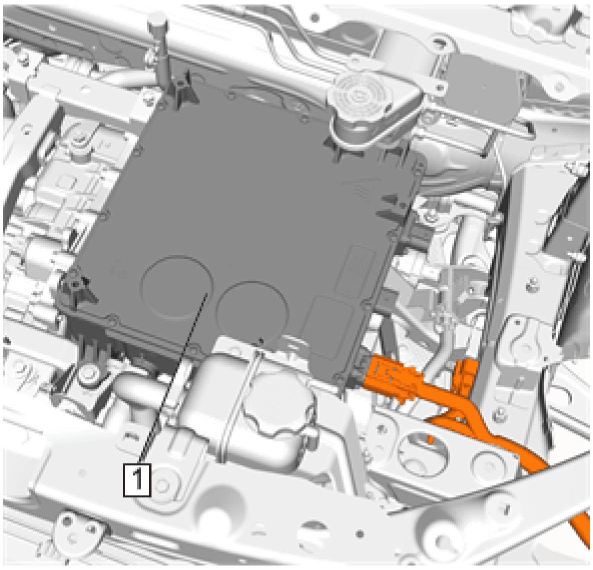


Fig. 11: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Battery Charger - Install - **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**

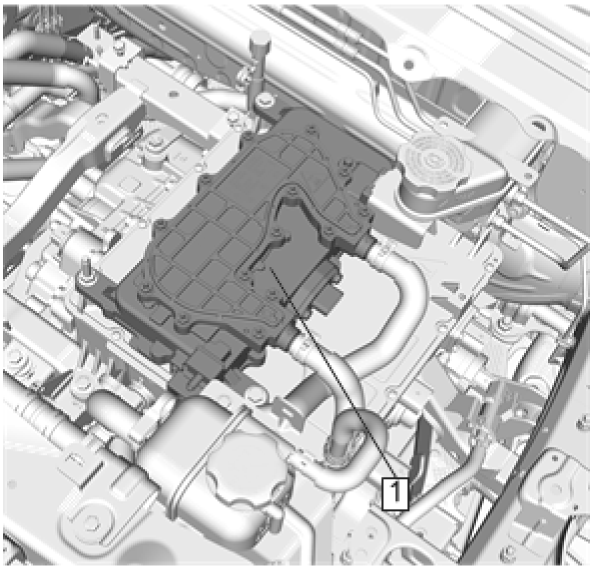


Fig. 12: Accessary DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

9. Accessary DC Power Control Module - Install - **Accessory DC Power Control Module Replacement**

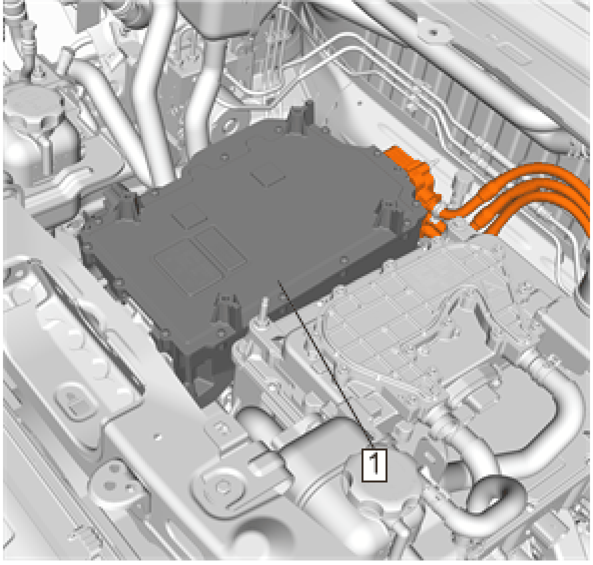


Fig. 13: Drive Motor Power Inverter Module
Courtesy of GENERAL MOTORS COMPANY

10. Drive Motor Power Inverter Module - Install - **Drive Motor Power Inverter Module Replacement**

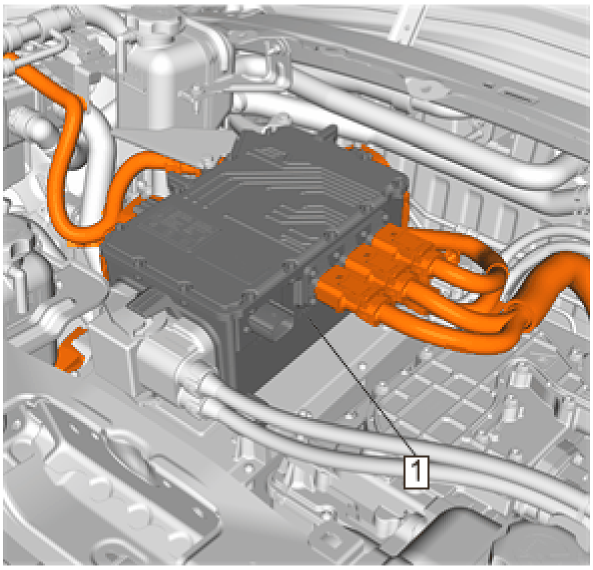


Fig. 14: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

11. Generator Battery Control Wiring Junction Block - Install - **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)** **High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)**
12. Battery Tray - Install - **Battery Tray Replacement**
13. Enable the high voltage system. **High Voltage Enabling**

FRONT COMPARTMENT AIR DEFLECTOR REPLACEMENT

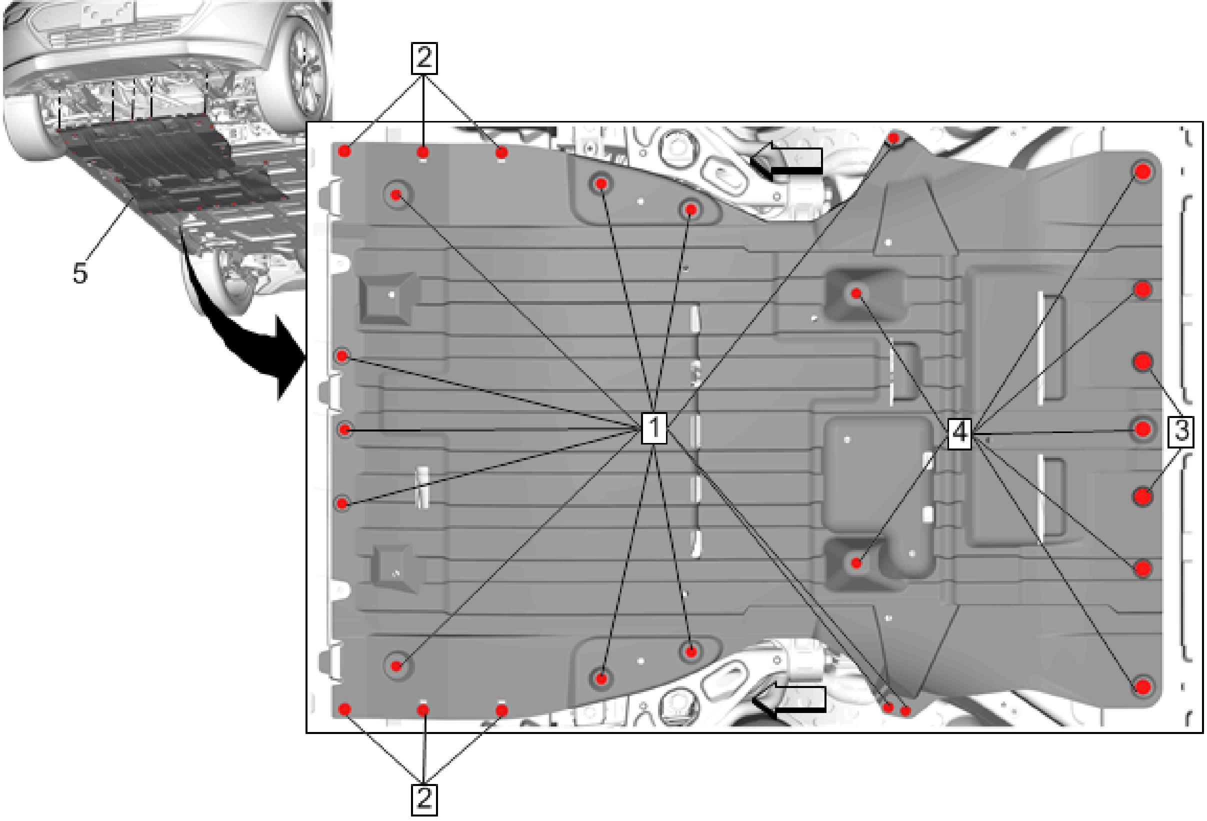


Fig. 15: Front Compartment Air Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Lifting and Jacking the Vehicle	
1	Front Compartment Insulator Screw (Qty: 12) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Bumper Fascia Wheel Opening Screw (Qty: 6) **Tighten** 2.5 N.m (22 lb in)
3	Front Compartment Insulator Retainer (Qty: 2)
4	Front Compartment Insulator Bolt (Qty: 7) **Tighten** 9 N.m (80 lb in)
5	Front Compartment Air Deflector

DRIVETRAIN AND FRONT SUSPENSION CROSSMEMBER EXTENSION REPLACEMENT

Removal Procedure

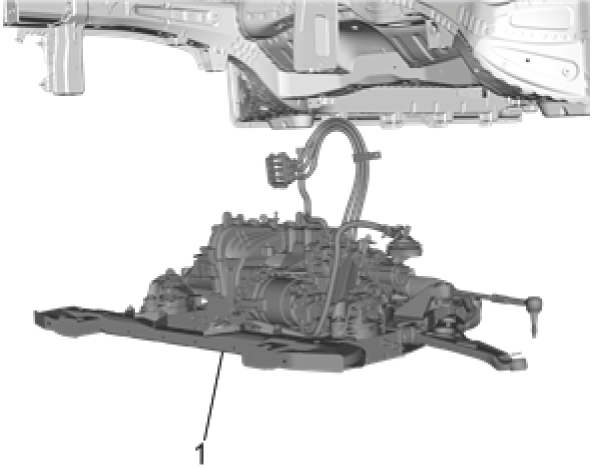


Fig. 16: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - **Drivetrain and Front Suspension Frame Removal and Installation**
2. Automatic Transmission - Remove - **Transmission Replacement**

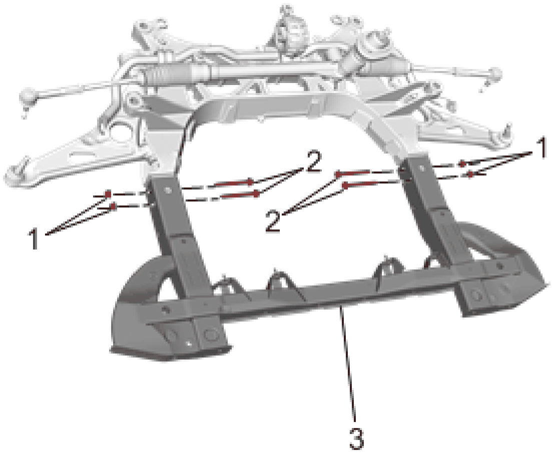


Fig. 17: Drivetrain and Front Suspension Cradle Nut
Courtesy of GENERAL MOTORS COMPANY

3. Drivetrain and Front Suspension Cradle Nut (1) (Qty: 4) - Remove
4. Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2) (Qty: 4) - Remove
5. Drivetrain and Front Suspension Crossmember Extension (3) at Drivetrain and Front Suspension Crossmember - Remove

Installation Procedure

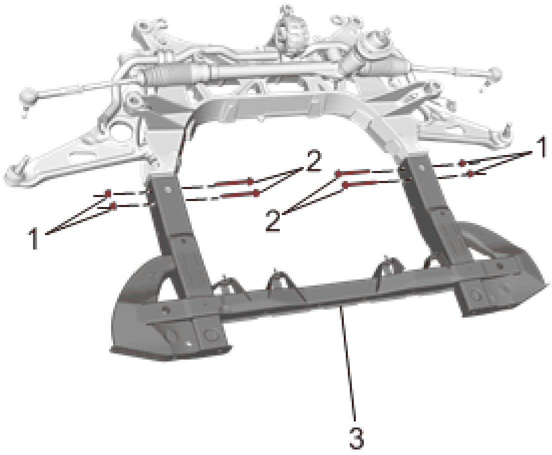


Fig. 18: Drivetrain and Front Suspension Cradle Nut
Courtesy of GENERAL MOTORS COMPANY

1. Drivetrain and Front Suspension Crossmember Extension (3) at Drivetrain and Front Suspension Crossmember - Install
2. Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2) (Qty: 4) - Install

CAUTION: **Fastener Caution**

3. Drivetrain and Front Suspension Cradle Nut (1) (Qty: 4) - Install and tighten to 58 N.m (43 lb ft)
4. Automatic Transmission - Install - **Transmission Replacement**

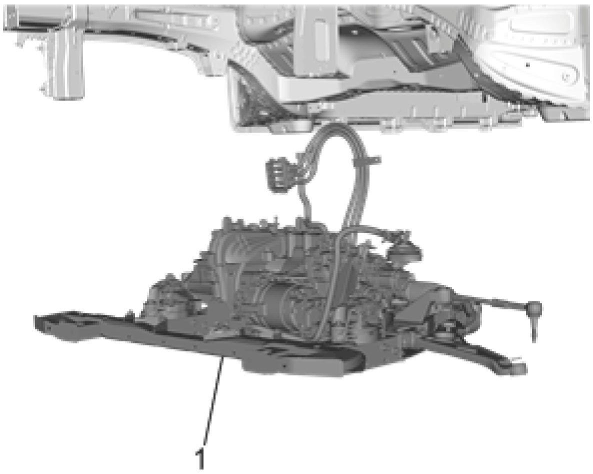


Fig. 19: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

5. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1) - Install - **Drivetrain and Front Suspension Frame Removal and Installation**

DRIVETRAIN AND FRONT SUSPENSION FRAME FRONT CROSSMEMBER REPLACEMENT

Removal Procedure

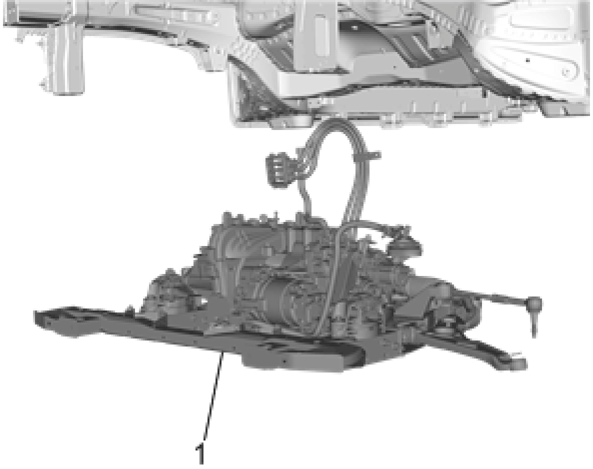


Fig. 20: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - **Drivetrain and Front Suspension Frame Removal and Installation**
2. Automatic Transmission - Remove - **Transmission Replacement**

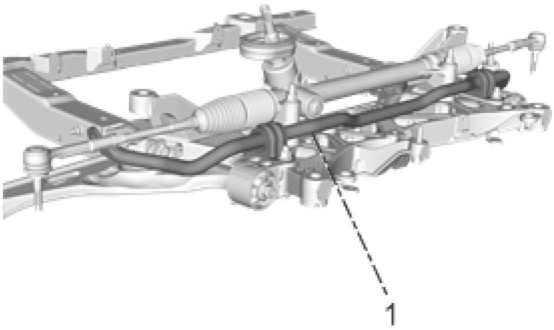


Fig. 21: Front Stabilizer Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Front Stabilizer Shaft - Remove - **Stabilizer Shaft Replacement**

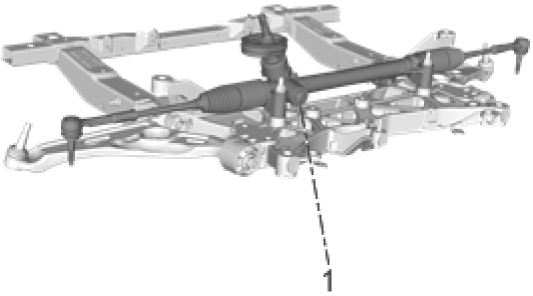


Fig. 22: Rack and Pinion Steering Gear
Courtesy of GENERAL MOTORS COMPANY

4. Rack and Pinion Steering Gear - Remove - **Steering Gear Replacement**

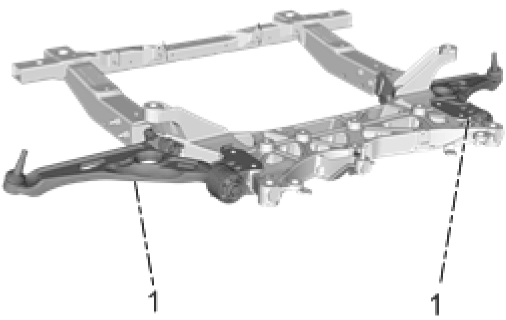


Fig. 23: Front Lower Control Arm
Courtesy of GENERAL MOTORS COMPANY

5. Front Lower Control Arm - Remove - **Lower Control Arm Replacement**

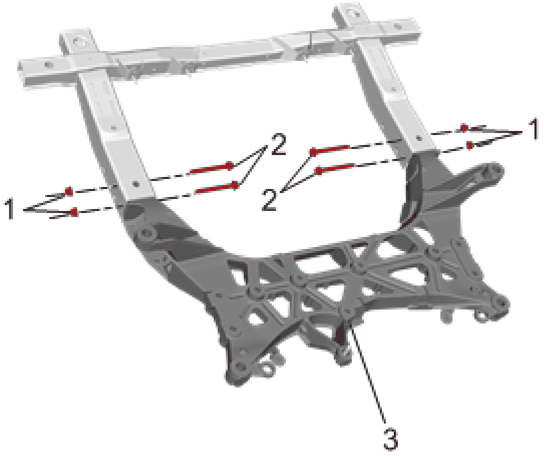


Fig. 24: Drivetrain and Front Suspension Cradle Nut
Courtesy of GENERAL MOTORS COMPANY

6. Drivetrain and Front Suspension Cradle Nut (1) (Qty: 4) - Remove
7. Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2) (Qty: 4) - Remove
8. Drivetrain and Front Suspension Crossmember (3) at Drivetrain and Front Suspension Crossmember Extension - Remove

Installation Procedure

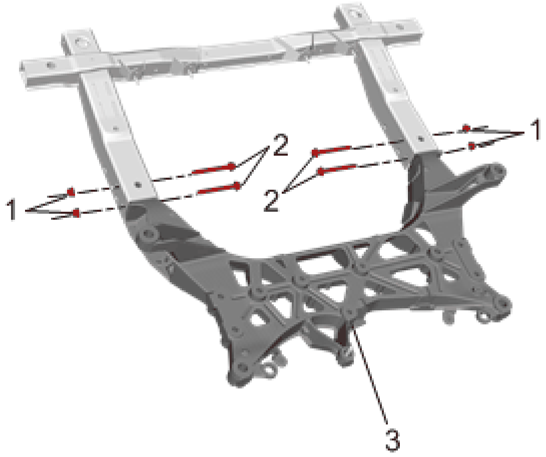


Fig. 25: Drivetrain and Front Suspension Cradle Nut
Courtesy of GENERAL MOTORS COMPANY

1. Drivetrain and Front Suspension Crossmember (3) at Drivetrain and Front Suspension Crossmember Extension - Install
2. Drivetrain and Front Suspension Crossmember Extension Rear Bolt (2) (Qty: 4) - Install

CAUTION: Fastener Caution

3. Drivetrain and Front Suspension Cradle Nut (1) (Qty: 4) - Install and tighten to 58 N.m (43 lb ft)

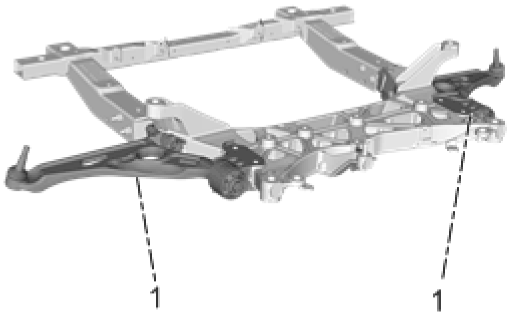


Fig. 26: Front Lower Control Arm
Courtesy of GENERAL MOTORS COMPANY

4. Front Lower Control Arm - Install - Lower Control Arm Replacement

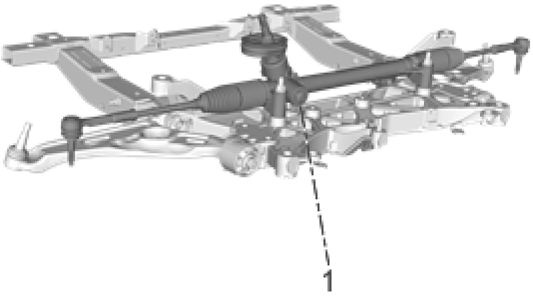


Fig. 27: Rack and Pinion Steering Gear
Courtesy of GENERAL MOTORS COMPANY

5. Rack and Pinion Steering Gear - Install - Steering Gear Replacement

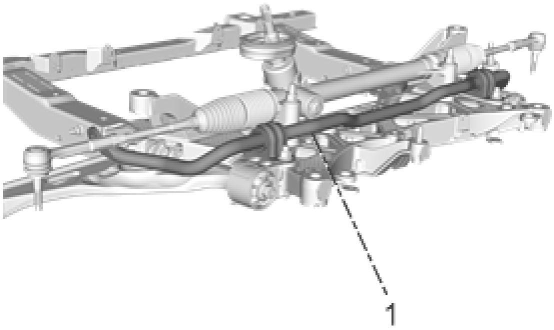


Fig. 28: Front Stabilizer Shaft
Courtesy of GENERAL MOTORS COMPANY

6. Front Stabilizer Shaft - Install - Stabilizer Shaft Replacement
7. Automatic Transmission - Install - Transmission Replacement

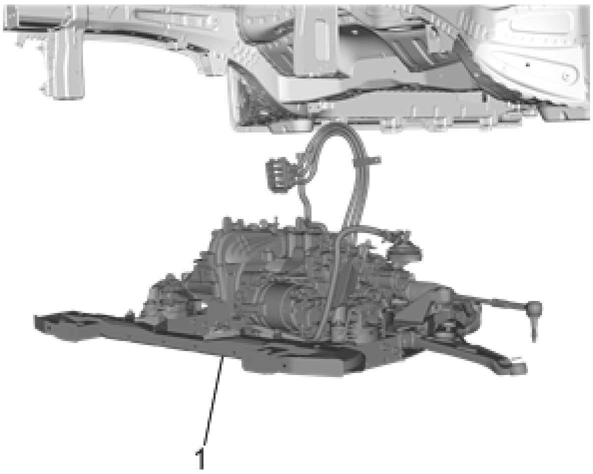


Fig. 29: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Install - Drivetrain and Front Suspension Frame Removal and Installation

DRIVETRAIN AND FRONT SUSPENSION FRAME REMOVAL AND INSTALLATION

Special Tools

- **CH-51034** Cradle Alignment Guide Pins

Equivalent regional tools: Special Tools

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Turn the steering wheel to the straight ahead position and lock it in place.

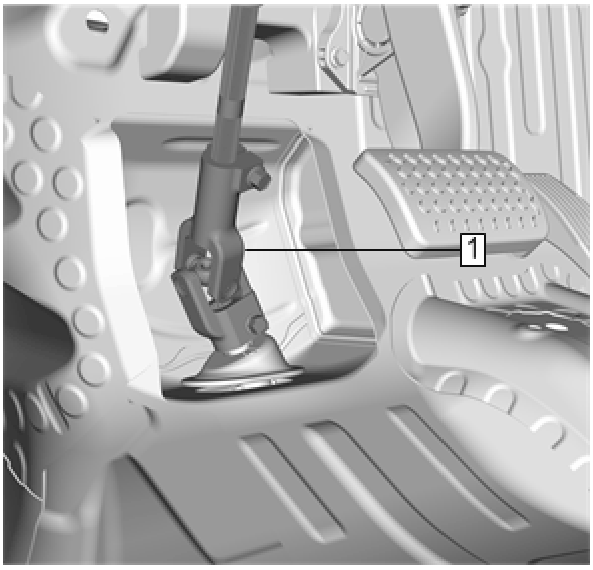


Fig. 30: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the intermediate steering shaft (1) from the steering gear. Intermediate Steering Shaft Replacement
4. Recover the refrigerant. Refrigerant Recovery and Recharging
5. Dash Panel Upper Extension Panel Extension - Remove - Dash Panel Upper Extension Panel Extension Replacement

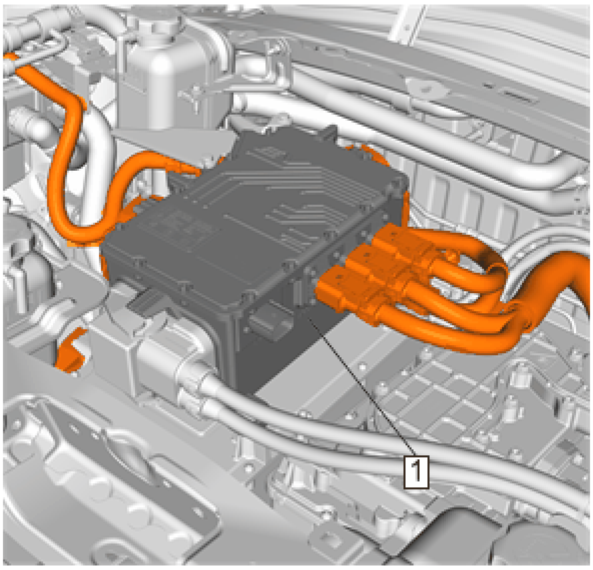


Fig. 31: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

6. Generator Battery Control Wiring Junction Block - Remove - High Voltage Battery Control Wiring Junction Block Replacement (With quick charge) High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)

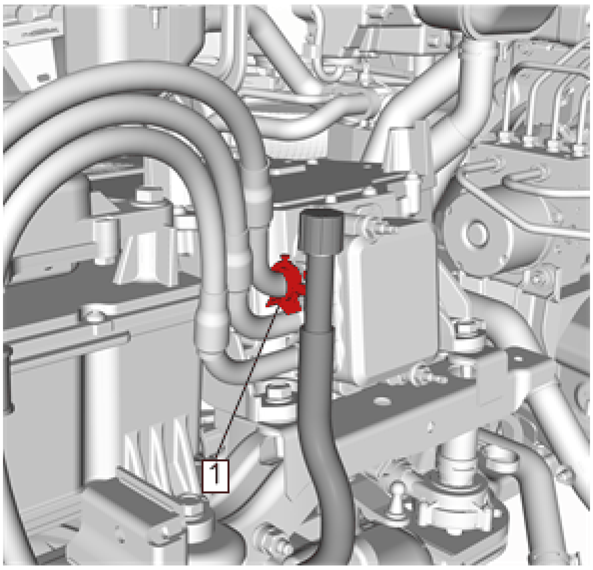


Fig. 32: Transmission Vent Pipe Clip at Drive Motor Power Inverter Module 3 Phase Cable
Courtesy of GENERAL MOTORS COMPANY

7. Transmission Vent Pipe Clip at Drive Motor Power Inverter Module 3 Phase Cable - Unclip

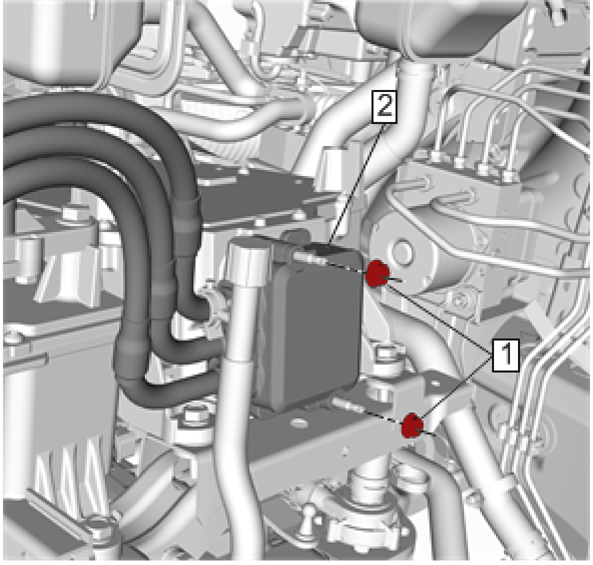


Fig. 33: Drive Motor Power Inverter Module 3 Phase Cable Cover Nut
Courtesy of GENERAL MOTORS COMPANY

8. Drive Motor Power Inverter Module 3 Phase Cable Cover Nut - Remove
9. Drive Motor Power Inverter Module 3 Phase Cable at Drive Motor Power Inverter Module - Disconnect

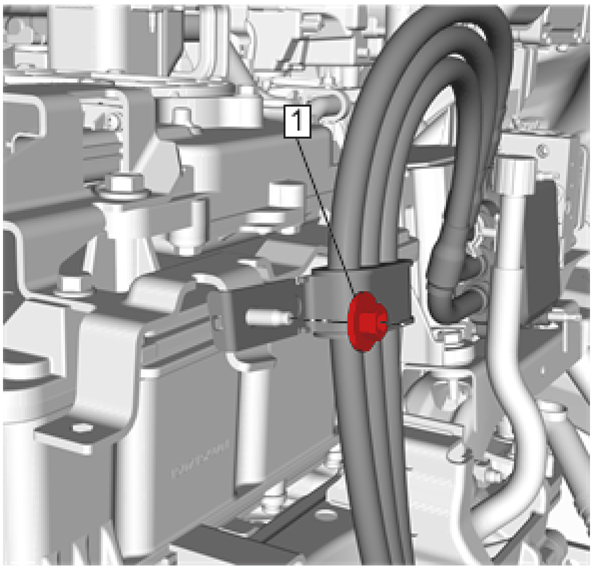


Fig. 34: Drive Motor Power Inverter Module Cable Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

10. Drive Motor Power Inverter Module Cable Bracket Nut at Accessary DC Power Control Module High Voltage Connector Protector - Remove

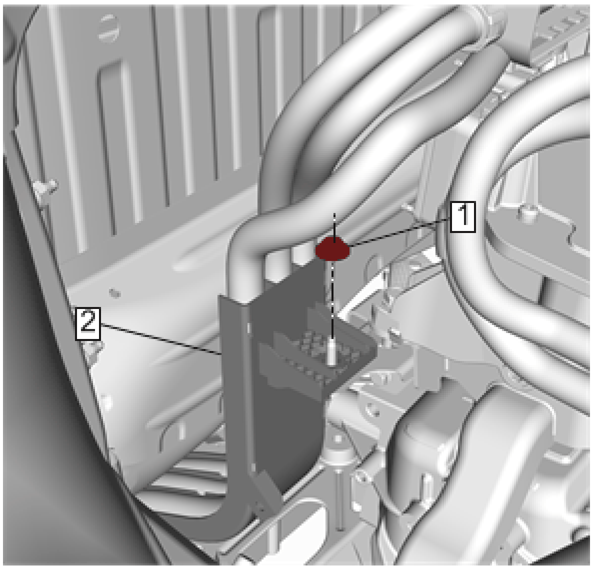


Fig. 35: Battery Positive and Negative Cable Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

11. Battery Positive and Negative Cable Bracket Nut - Remove
12. Battery Cable Protector at Power Electric Carrier Frame Stud Bolt - Remove
13. Battery Tray - Remove - Battery Tray Replacement

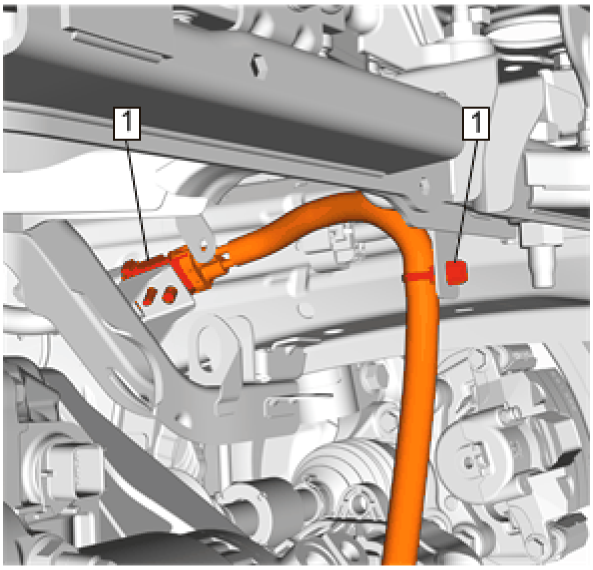


Fig. 36: Air Conditioning Compressor High Voltage Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

14. Air Conditioning Compressor High Voltage Cable Retainer at Power Electric Carrier Frame - Unclip

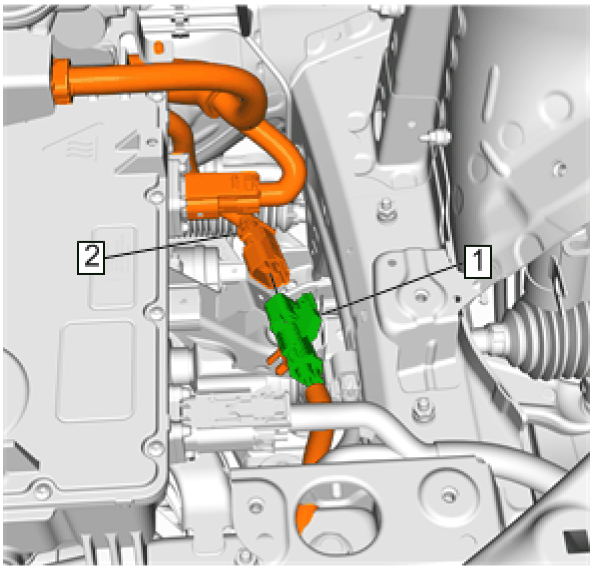


Fig. 37: Air Conditioning Compressor High Voltage Cable Connector
Courtesy of GENERAL MOTORS COMPANY

15. Air Conditioning Compressor High Voltage Cable Connector at High Voltage Battery Cable - Disconnect
16. Remove the front tire and wheel assemblies. Tire and Wheel Removal and Installation
17. Front Compartment Air Deflector - Remove - Front Compartment Air Deflector Replacement
18. Front Wheelhouse Liner - Remove - Front Wheelhouse Liner Replacement
19. Front Bumper Fascia - Remove - Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)
20. Radiator Air Lower Baffle - Remove - Radiator Air Lower Baffle and Deflector Replacement
21. Drain the drive motor generator power inverter module cooling system. Drive Motor Generator Power Inverter Module Cooling System Draining and Filling

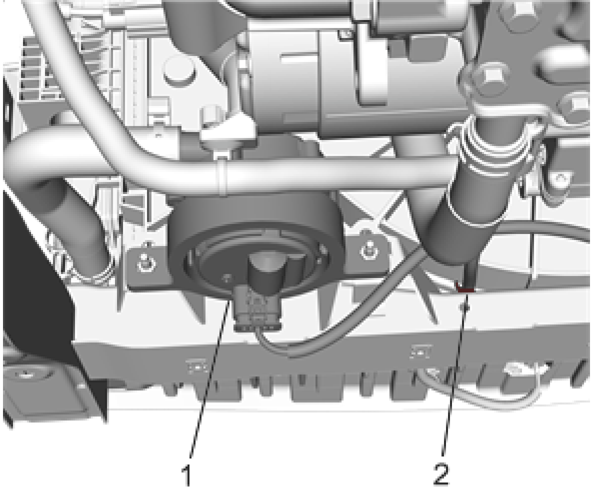


Fig. 38: Drive Motor Generator Control Module Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

22. Drive Motor Generator Control Module Coolant Pump - Remove - **Drive Motor Battery Coolant Pump Replacement (RESS Pump)** **Drive Motor Battery Coolant Pump Replacement (PE Pump)**
23. Engine Wiring Harness Retainer at Drivetrain and Front Suspension Crossmember Extension - Unclip

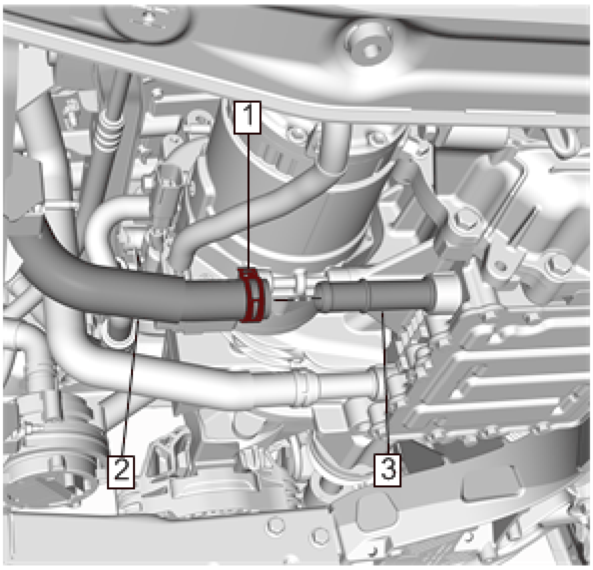


Fig. 39: Clamp at Drive Motor Stator Cooling Tube
Courtesy of GENERAL MOTORS COMPANY

24. Clamp at Drive Motor Stator Cooling Tube - Loosen
25. Generator Control Module Coolant Tank Hose at Drive Motor Stator Cooling Tube - Disconnect

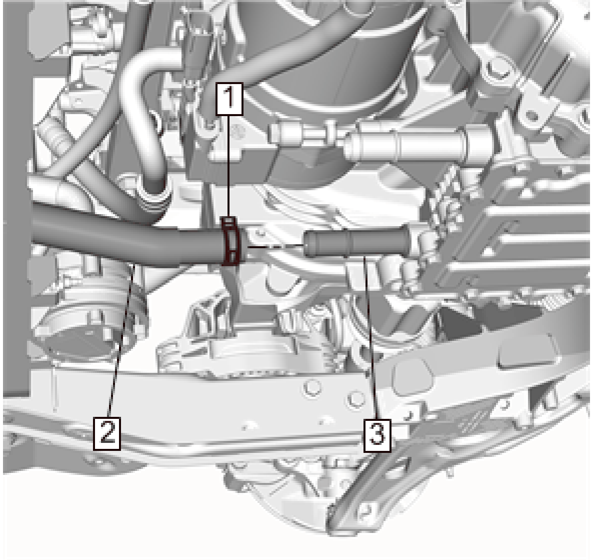


Fig. 40: Clamp at Drive Motor Stator Cooling Tube
Courtesy of GENERAL MOTORS COMPANY

26. Clamp at Drive Motor Stator Cooling Tube - Loosen
27. Drive Motor Power Inverter Module Cooling Inlet Hose at Drive Motor Stator Cooling Tube - Disconnect

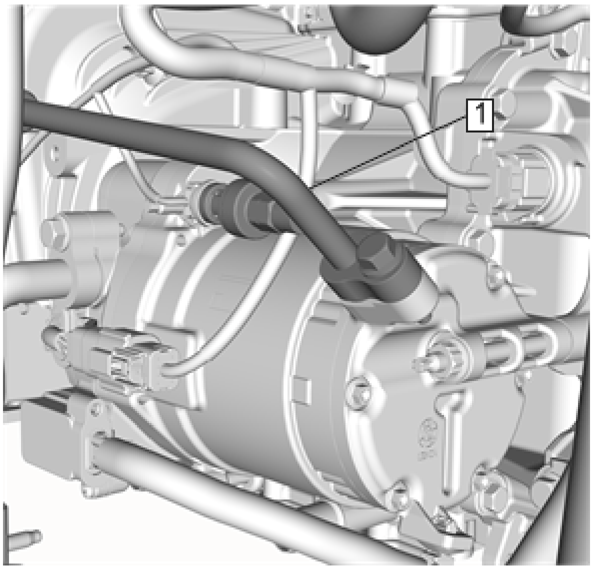


Fig. 41: Air Conditioning Condenser Hose at Air Conditioning Compressor
Courtesy of GENERAL MOTORS COMPANY

28. Air Conditioning Condenser Hose at Air Conditioning Compressor - Disconnect - **Air Conditioning Condenser Hose Replacement**

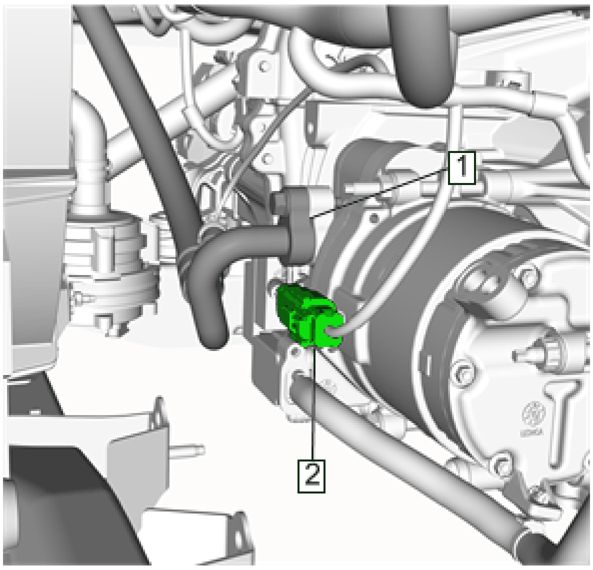


Fig. 42: Air Conditioning Compressor Hose at Air Conditioning Compressor
Courtesy of GENERAL MOTORS COMPANY

29. Air Conditioning Compressor Hose at Air Conditioning Compressor - Disconnect - **Air Conditioning Compressor Hose Replacement**
30. Electrical Connector at Air Conditioning Compressor - Disconnect

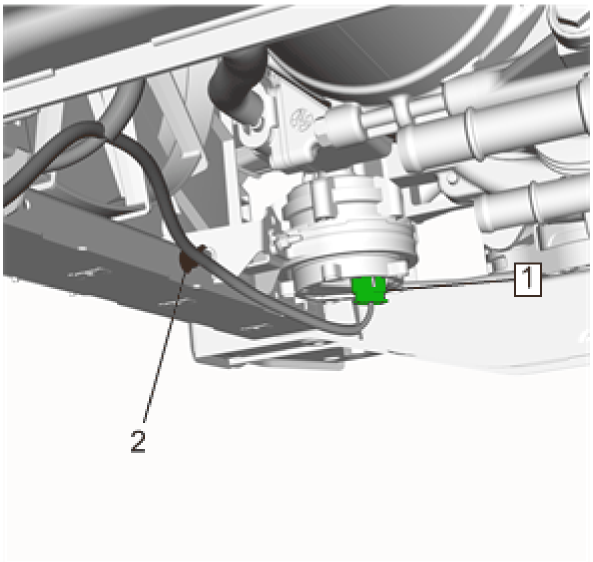


Fig. 43: Electrical Connector at Drive Motor Battery Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

31. Electrical Connector at Drive Motor Battery Coolant Pump - Disconnect
32. Engine Wiring Harness Clip at Drivetrain and Front Suspension Crossmember Extension - Unclip

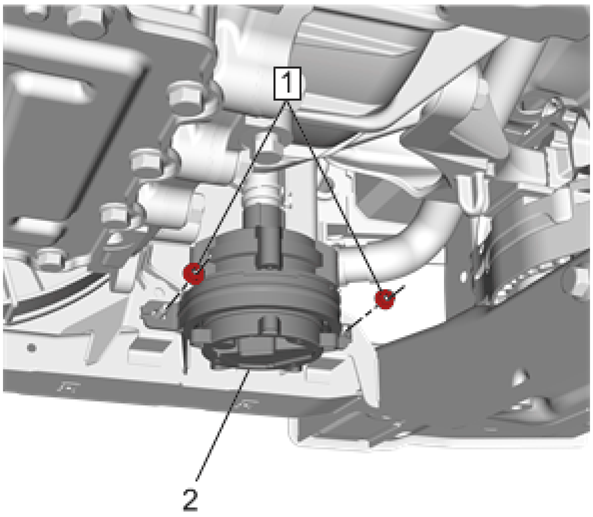


Fig. 44: Drive Motor Battery Coolant Pump Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do NOT disconnect the coolant hose.**

33. Drive Motor Battery Coolant Pump Nut - Remove
34. Support the drive motor battery coolant pump (2) to the power electric carrier frame with a wire.
35. Disconnect both of the steering gear tie rod ends from the steering knuckle. **Steering Linkage Outer Tie Rod Replacement**
36. Remove both of the stabilizer shaft links. **Stabilizer Shaft Link Replacement**
37. Disconnect both of the control arm ball joints from the steering knuckles. **Lower Control Arm Replacement**
38. Remove both of the front wheel drive shaft. **Front Wheel Drive Shaft Replacement**

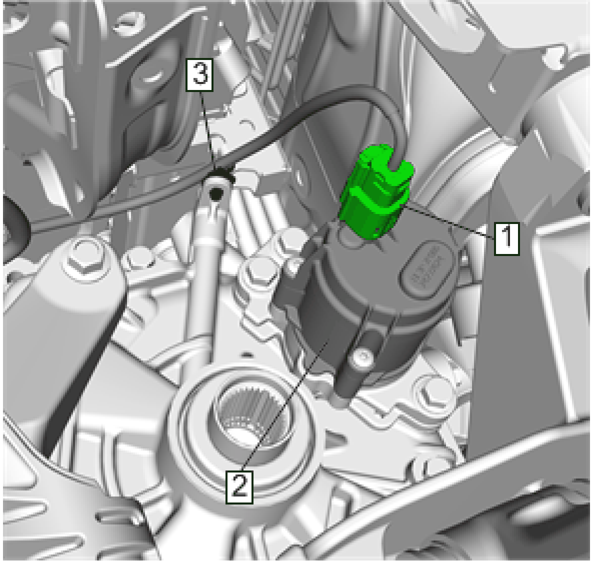


Fig. 45: Electrical Connector at Automatic Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

39. Electrical Connector at Automatic Transmission Fluid Pump - Disconnect
40. Engine Wiring Harness Retainer at Drive Motor Housing Assembly - Unclip

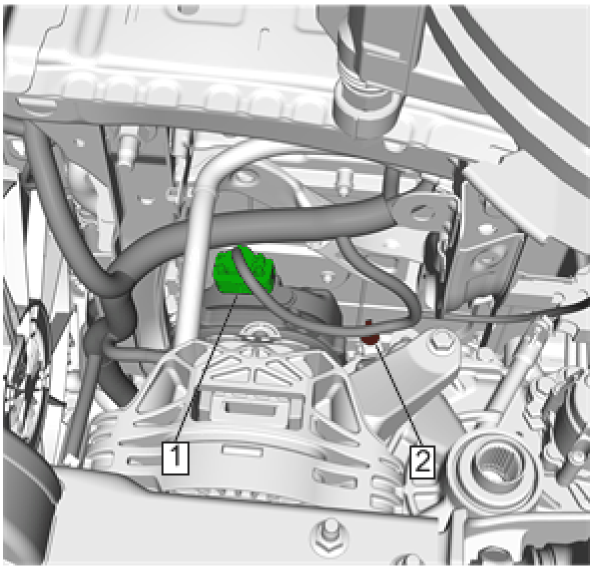


Fig. 46: Electrical Connector at Automatic Transmission Range Select Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

41. Electrical Connector at Automatic Transmission Range Select Actuator Hardware Module - Disconnect
42. Engine Wiring Harness Retainer at Drive Motor Housing Assembly - Unclip

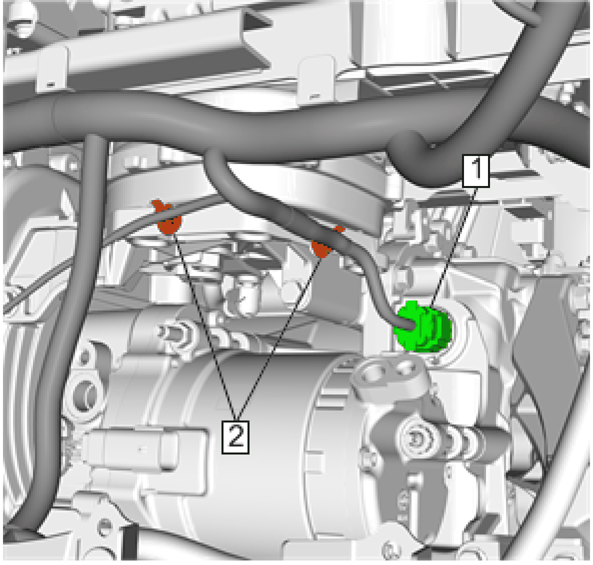


Fig. 47: Electrical Connector at Automatic Transmission
Courtesy of GENERAL MOTORS COMPANY

43. Electrical Connector at Automatic Transmission - Disconnect
44. Engine Wiring Harness Retainer at Automatic Transmission Range Select Actuator Hardware Module - Unclip

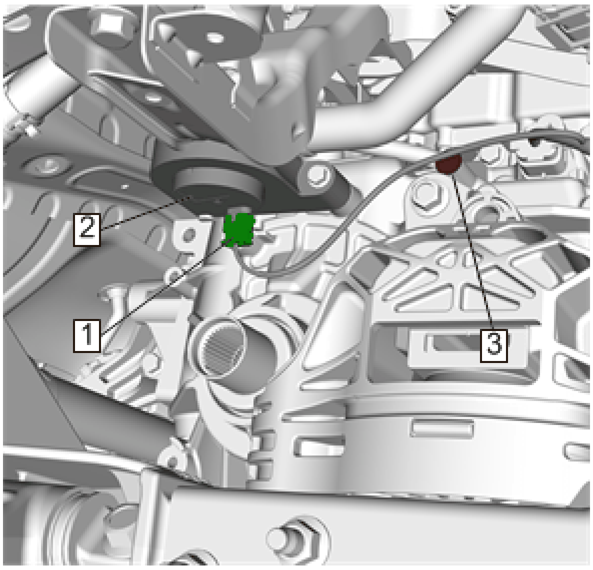


Fig. 48: Electrical Connector at Heater Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

45. Electrical Connector at Heater Coolant Pump - Disconnect
46. Engine Wiring Harness Retainer at Automatic Transmission Case - Unclip

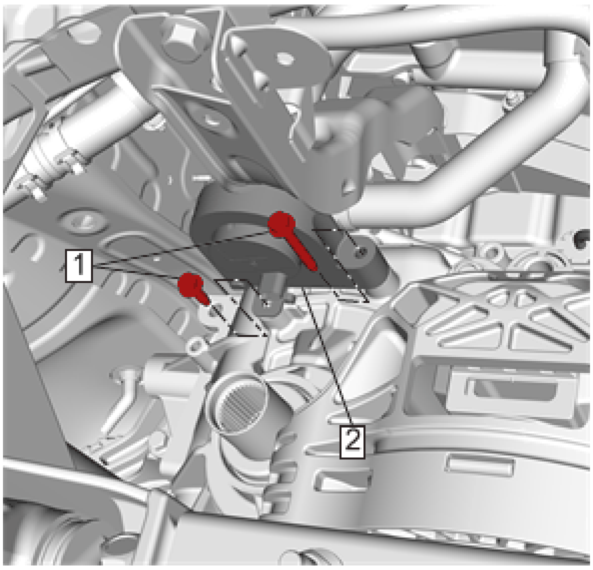


Fig. 49: Heater Coolant Pump Bolt at Automatic Transmission
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do NOT disconnect the coolant hose.**

47. Heater Coolant Pump Bolt at Automatic Transmission - Remove
48. Support the heater coolant pump (2) to the power electric carrier frame with a wire.

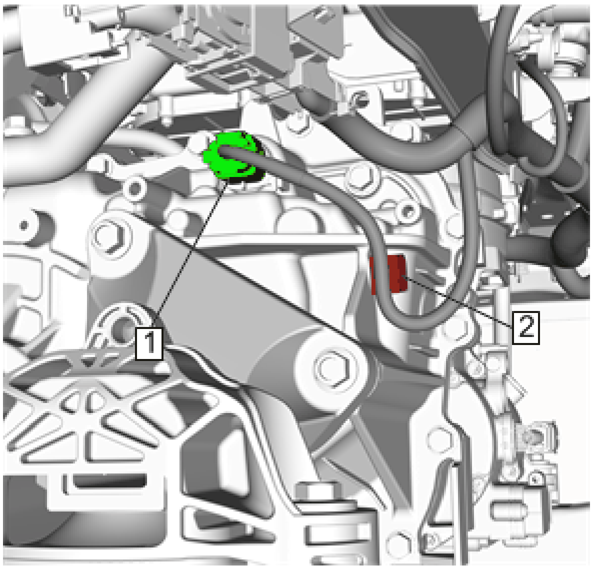


Fig. 50: Electrical Connector at Automatic Transmission Shift Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

49. Electrical Connector at Automatic Transmission Shift Shaft Position Switch - Disconnect
50. Engine Wiring Harness Retainer at Automatic Transmission Case - Unclip

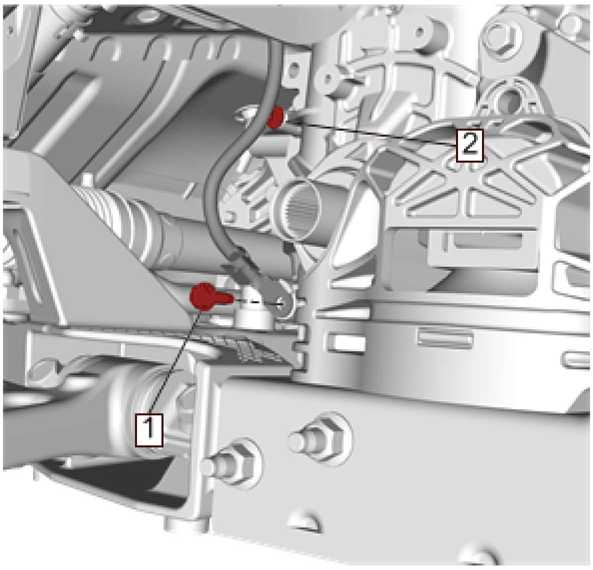


Fig. 51: Battery Negative Cable Ground Bolt at Automatic Transmission Case
Courtesy of GENERAL MOTORS COMPANY

51. Battery Negative Cable Ground Bolt at Automatic Transmission Case - Remove
52. Battery Negative Cable Retainer at Automatic Transmission Case - Unclip

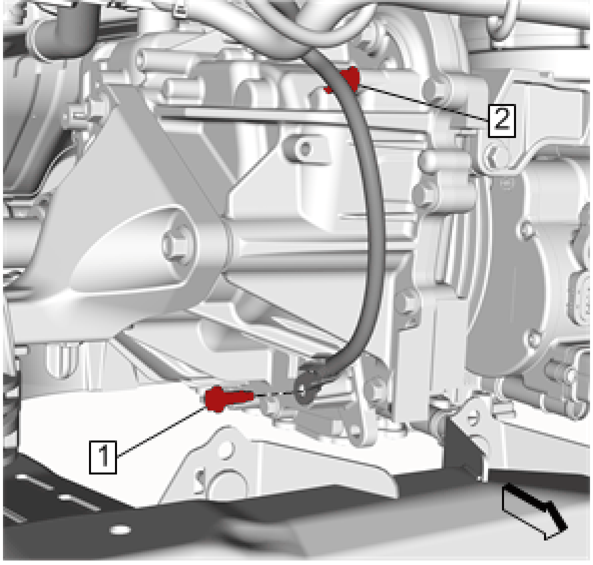


Fig. 52: Battery Negative Cable Ground Bolt at Automatic Transmission Case
Courtesy of GENERAL MOTORS COMPANY

53. Battery Negative Cable Ground Bolt at Automatic Transmission Case - Remove
54. Battery Negative Cable Retainer at Automatic Transmission Case - Unclip

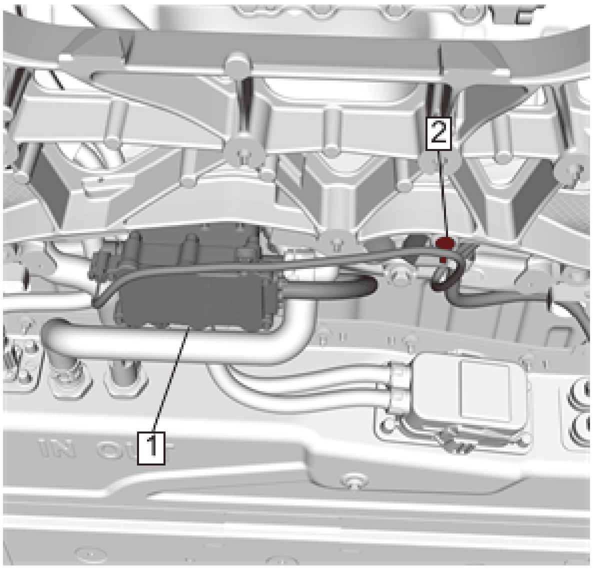


Fig. 53: High Voltage Battery Heater at Vehicle
Courtesy of GENERAL MOTORS COMPANY

55. High Voltage Battery Heater at Vehicle - Remove - High Voltage Battery Heater Replacement
56. Wiring Harness Retainer at Drivetrain and Front Suspension Frame - Unclip
57. Secure the condenser, radiator and fan module to the upper body structure with a suitable strap.

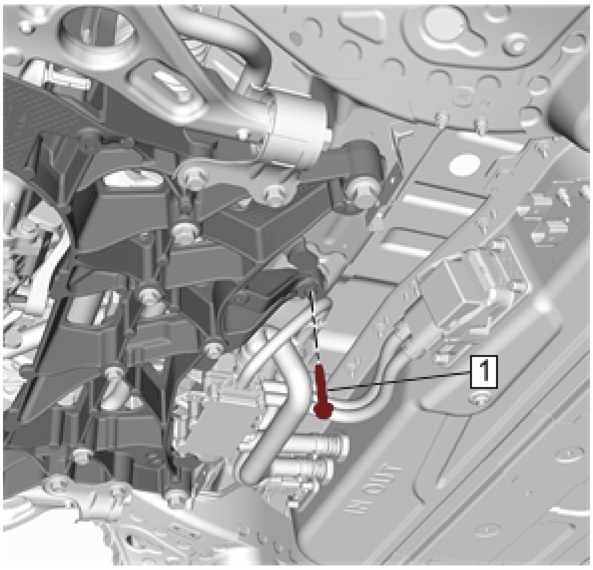


Fig. 54: Drivetrain and Front Suspension Crossmember Center Bolt
Courtesy of GENERAL MOTORS COMPANY

58. Drivetrain and Front Suspension Crossmember Center Bolt - Remove

NOTE: **Blocks of wood can be used on the table to level the powertrain during the removal.**

59. Position a powertrain support table under the powertrain assembly.
60. With the table positioned, fully raise the table to contact with the powertrain assembly.

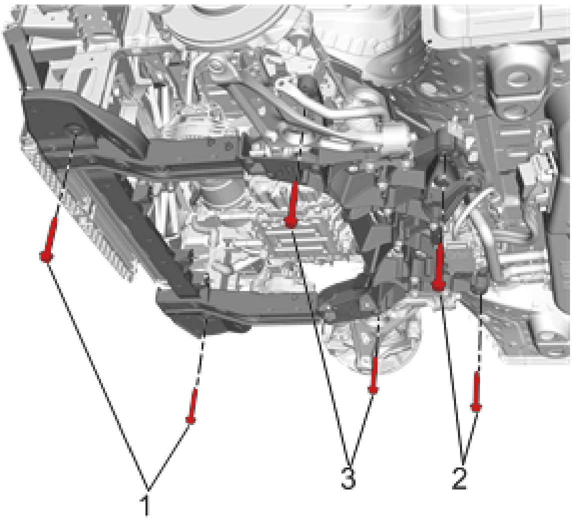


Fig. 55: Drivetrain and Front Suspension Cradle Front Bolt
Courtesy of GENERAL MOTORS COMPANY

61. Drivetrain and Front Suspension Cradle Front Bolt (1) (Qty: 2) - Remove
62. Drivetrain and Front Suspension Cradle Rear Bolt (2) (Qty: 2) - Remove
63. Drivetrain and Front Suspension Cradle Intermediate Bolt (3) (Qty: 2) - Remove

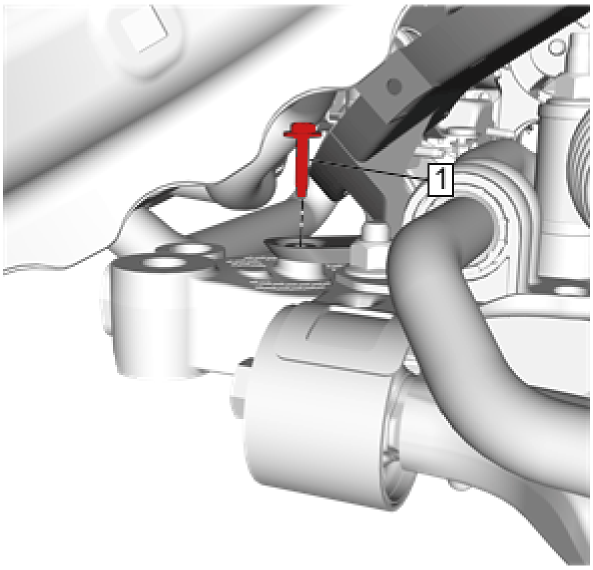


Fig. 56: Battery Positive and Negative Cable Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Ensure that the harnesses and hoses are clear, and do not become stuck on anything as the front suspension frame assembly is being lowered.**

64. Partially lower the powertrain support table to get an access to the battery positive and negative cable bracket bolt.
65. Battery Positive and Negative Cable Bracket Bolt (1) - Remove

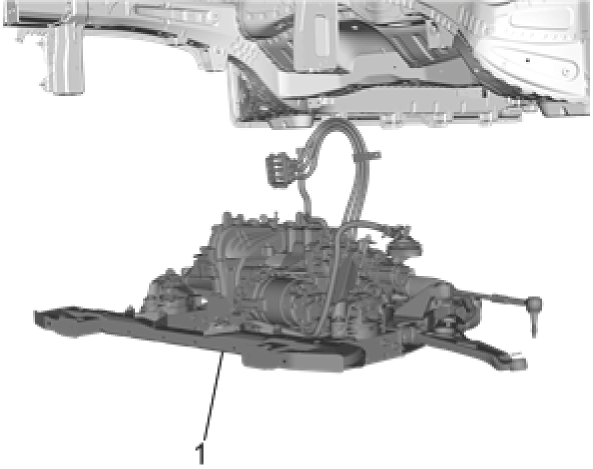


Fig. 57: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

66. Carefully lower the powertrain support table and raise the vehicle on the hoist to separate the automatic transmission and drivetrain and front suspension frame assembly (1) from the vehicle.
67. Remove the automatic transmission as necessary. **Transmission Replacement**

Installation Procedure

1. Install the automatic transmission as necessary. **Transmission Replacement**

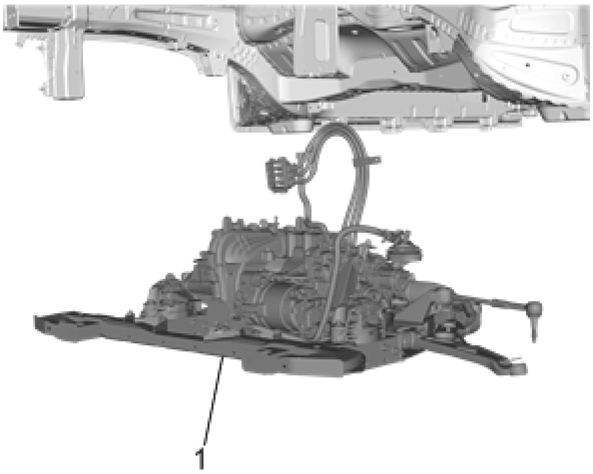


Fig. 58: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Carefully raise the powertrain support table and lower the vehicle on the hoist to install the automatic transmission and drivetrain and front suspension frame assembly (1) to the vehicle.

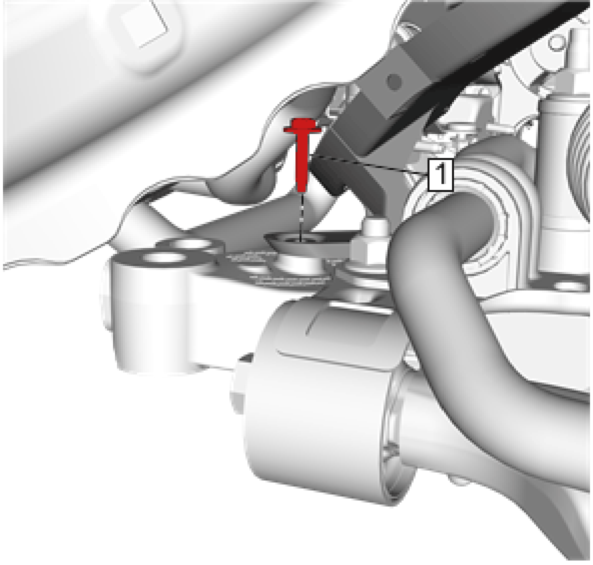


Fig. 59: Battery Positive and Negative Cable Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Battery Positive and Negative Cable Bracket Bolt (1) - Install and tighten to 9 N.m (80 lb in)

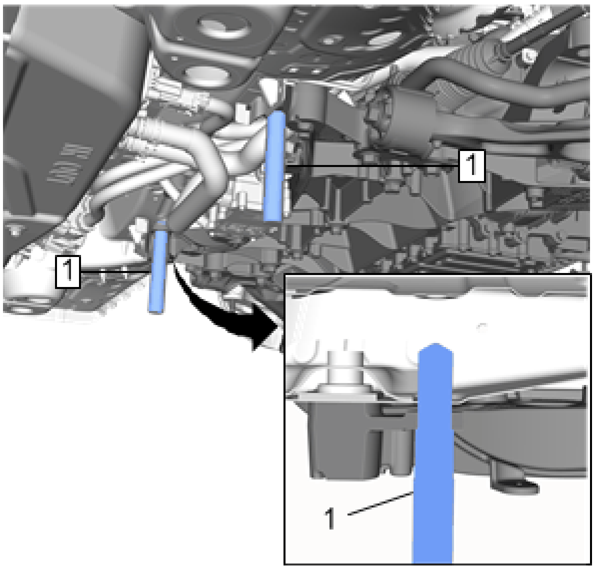


Fig. 60: Special Tool Cradle Alignment Guide Pins
Courtesy of GENERAL MOTORS COMPANY

4. Using the CH-51034 Cradle Alignment Guide Pins (1), have an assistant vertically insert and hold the pins through the front suspension cradle and floor panel.

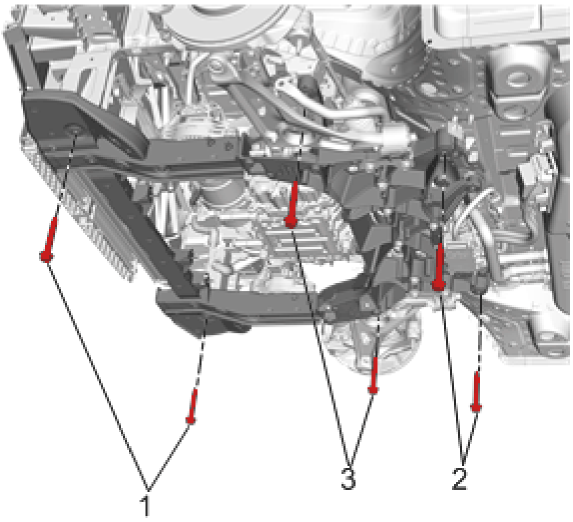


Fig. 61: Drivetrain and Front Suspension Cradle Front Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Drivetrain and Front Suspension Cradle Intermediate Bolt (3) (Qty: 2) - Install and tighten
    1. First Pass: 160 N.m (118 lb ft)
    2. Final Pass: 60 - 75 Degrees
6. Drivetrain and Front Suspension Cradle Rear Bolt (2) (Qty: 2) - Install and tighten
    1. First Pass: 160 N.m (118 lb ft)
    2. Final Pass: 60 - 75 Degrees
7. Drivetrain and Front Suspension Cradle Front Bolt (1) (Qty: 2) - Install and tighten
    1. First Pass: 160 N.m (118 lb ft)
    2. Final Pass: 60 - 75 Degrees
8. Remove the powertrain support table.

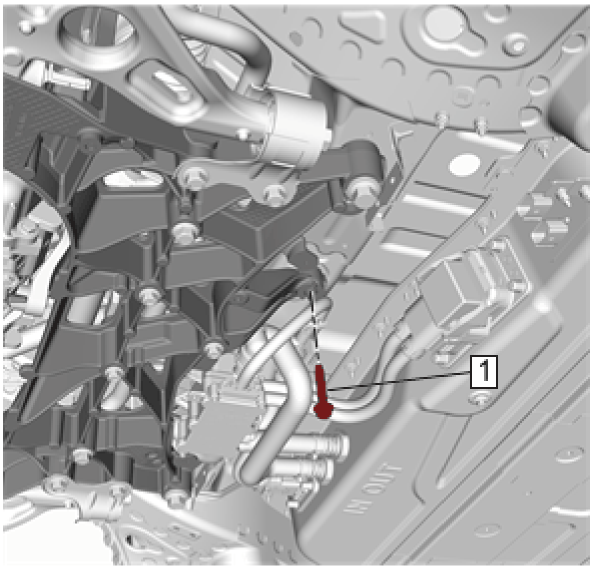


Fig. 62: Drivetrain and Front Suspension Crossmember Center Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Drivetrain and Front Suspension Crossmember Center Bolt (1) - Install and tighten to 58 N.m (43 lb ft)
10. Remove the strap which secures the condenser, radiator and fan module from the upper body structure.

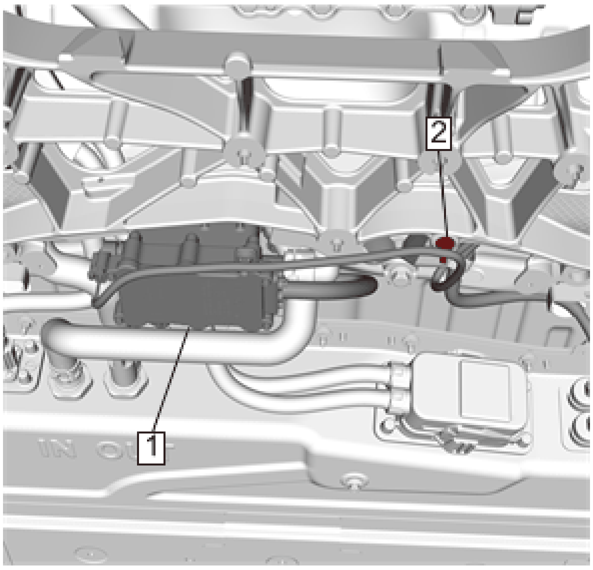


Fig. 63: High Voltage Battery Heater at Vehicle
Courtesy of GENERAL MOTORS COMPANY

11. Wiring Harness Retainer (2) at Drivetrain and Front Suspension Frame - Install

12. High Voltage Battery Heater (1) at Vehicle - Install - High Voltage Battery Heater Replacement
13. Retainer (1) at Front Compartment Side Rail - Install

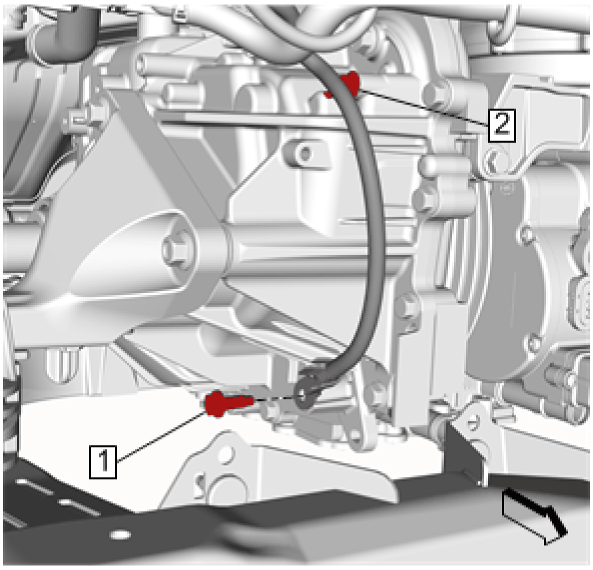


Fig. 64: Battery Negative Cable Ground Bolt at Automatic Transmission Case
Courtesy of GENERAL MOTORS COMPANY

14. Battery Negative Cable Retainer (2) at Automatic Transmission Case - Install
15. Battery Negative Cable Ground Bolt (1) at Automatic Transmission Case - Install and tighten to 22 N.m (16 lb ft)

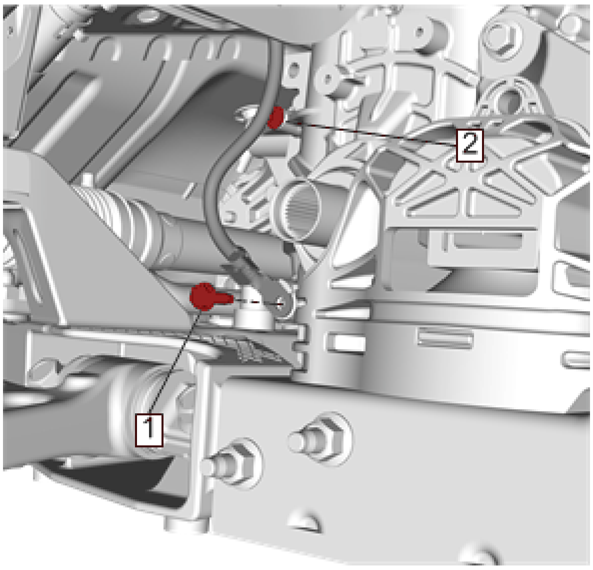


Fig. 65: Battery Negative Cable Ground Bolt at Automatic Transmission Case
Courtesy of GENERAL MOTORS COMPANY

16. Battery Negative Cable Retainer (2) at Automatic Transmission Case - Install
17. Battery Negative Cable Ground Bolt (1) at Automatic Transmission Case - Install and tighten to 22 N.m (16 lb ft)

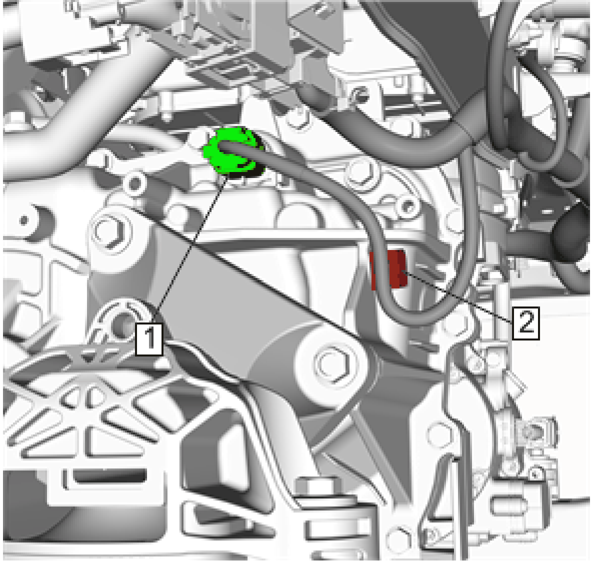


Fig. 66: Electrical Connector at Automatic Transmission Shift Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

18. Engine Wiring Harness Retainer (2) at Automatic Transmission Case - Install
19. Electrical Connector (1) at Automatic Transmission Shift Shaft Position Switch - Connect

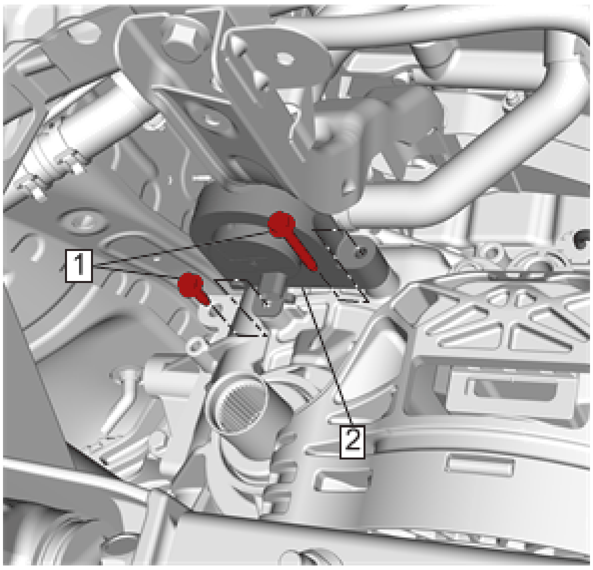


Fig. 67: Heater Coolant Pump Bolt at Automatic Transmission
Courtesy of GENERAL MOTORS COMPANY

20. Remove the support wire supporting the heater coolant pump (2) to the power electric carrier frame.
21. Heater Coolant Pump Bolt (1) (Qty: 2) at Automatic Transmission - Install - Heater Coolant Pump Replacement

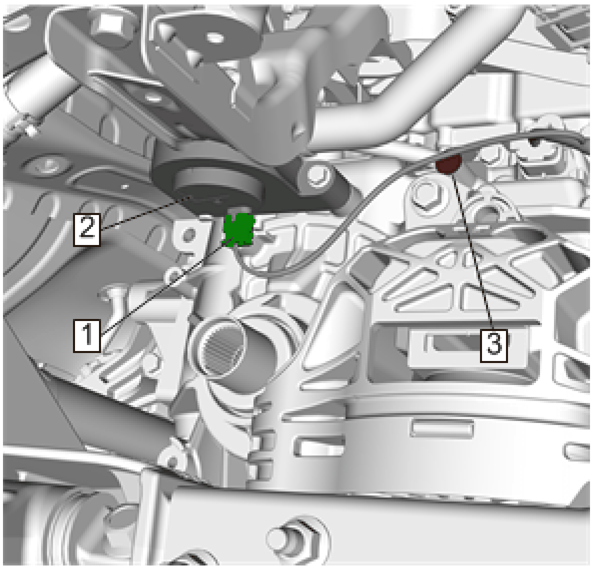


Fig. 68: Electrical Connector at Heater Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

22. Engine Wiring Harness Retainer (3) at Automatic Transmission Case - Install
23. Electrical Connector (1) at Heater Coolant Pump (2) - Connect

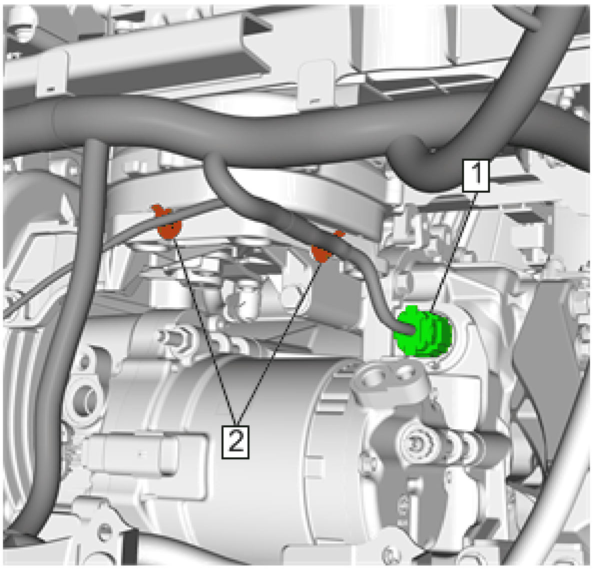


Fig. 69: Electrical Connector at Automatic Transmission
Courtesy of GENERAL MOTORS COMPANY

24. Engine Wiring Harness Retainer (2) (Qty: 2) at Automatic Transmission Range Select Actuator Hardware Module - Install
25. Electrical Connector (1) at Automatic Transmission - Connect

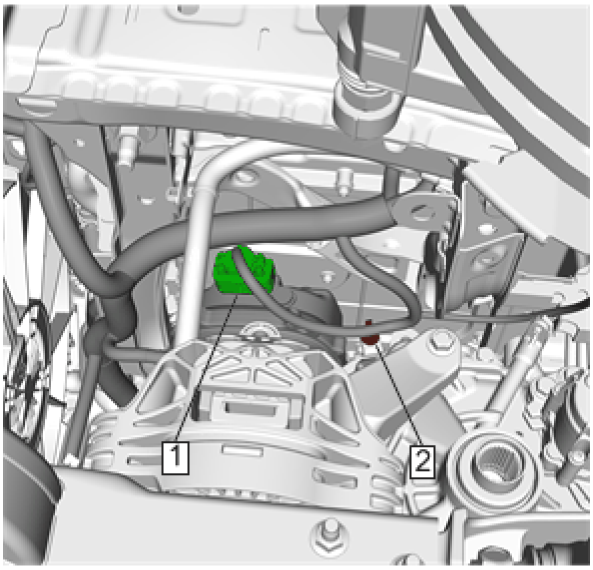


Fig. 70: Electrical Connector at Automatic Transmission Range Select Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

26. Engine Wiring Harness Retainer (2) at Drive Motor Housing Assembly - Install
27. Electrical Connector (1) at Automatic Transmission Range Select Actuator Hardware Module - Connect

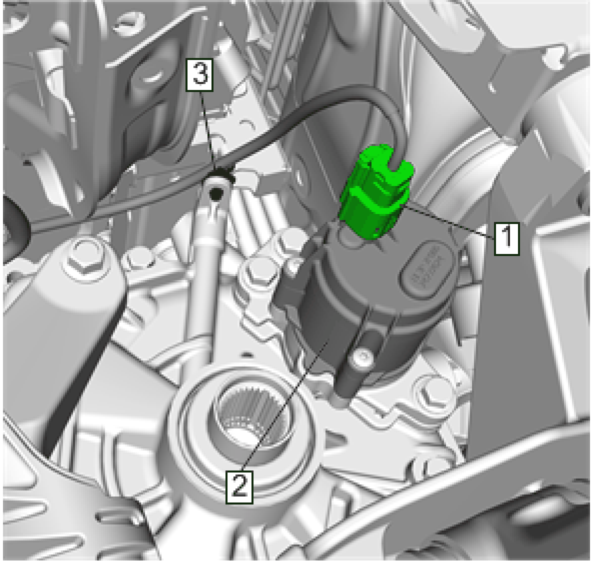


Fig. 71: Electrical Connector at Automatic Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

28. Engine Wiring Harness Retainer (3) at Drive Motor Housing Assembly - Install
29. Electrical Connector (1) at Automatic Transmission Fluid Pump (2) - Connect
30. Install both of the front wheel drive shaft. **Front Wheel Drive Shaft Replacement**
31. Connect both of the control arm ball joints to the steering knuckles. **Lower Control Arm Replacement**
32. Install both of the stabilizer shaft links. **Stabilizer Shaft Link Replacement**
33. Connect both of the steering gear tie rod ends to the steering knuckle. **Steering Linkage Outer Tie Rod Replacement**

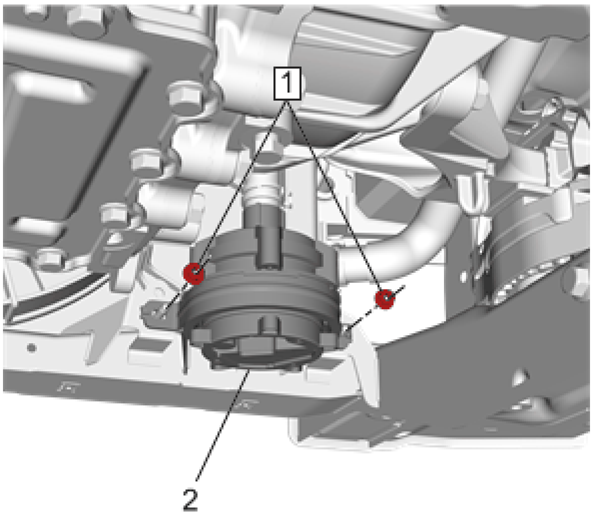


Fig. 72: Drive Motor Battery Coolant Pump Nut
Courtesy of GENERAL MOTORS COMPANY

34. Remove the support wire supporting the drive motor battery coolant pump (2) to the power electric carrier frame.
35. Drive Motor Battery Coolant Pump Nut (1) (Qty: 2) - Install - **Drive Motor Battery Coolant Pump Replacement (RESS Pump)** **Drive Motor Battery Coolant Pump Replacement (PE Pump)**

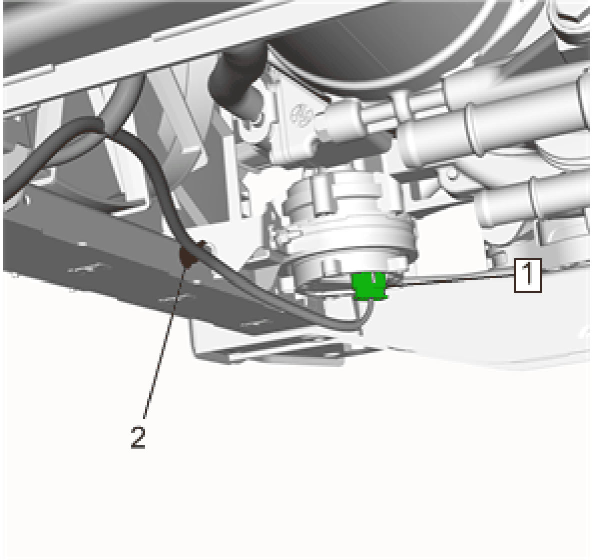


Fig. 73: Electrical Connector at Drive Motor Battery Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

36. Engine Wiring Harness Retainer (2) at Drivetrain and Front Suspension Crossmember Extension - Install
37. Electrical Connector (1) at Drive Motor Battery Coolant Pump - Connect

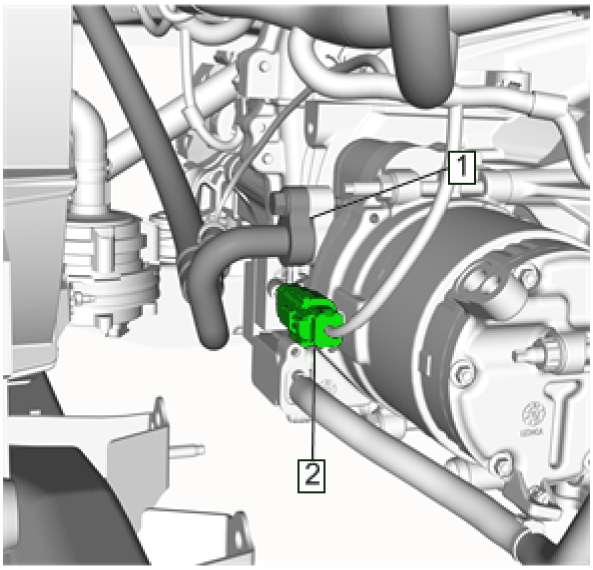


Fig. 74: Air Conditioning Compressor Hose at Air Conditioning Compressor
Courtesy of GENERAL MOTORS COMPANY

38. Electrical Connector (2) at Air Conditioning Compressor - Connect
39. Air Conditioning Compressor Hose (1) at Air Conditioning Compressor - Connect - **Air Conditioning Compressor Hose Replacement**

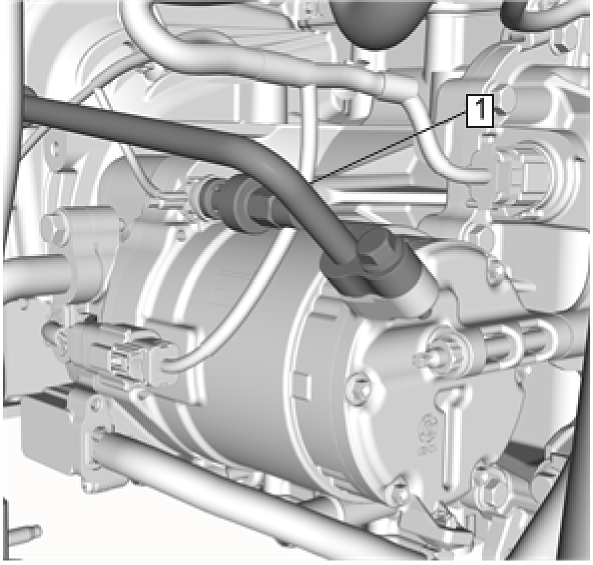


Fig. 75: Air Conditioning Condenser Hose at Air Conditioning Compressor
Courtesy of GENERAL MOTORS COMPANY

40. Air Conditioning Condenser Hose (1) at Air Conditioning Compressor - Connect - Air Conditioning Condenser Hose Replacement

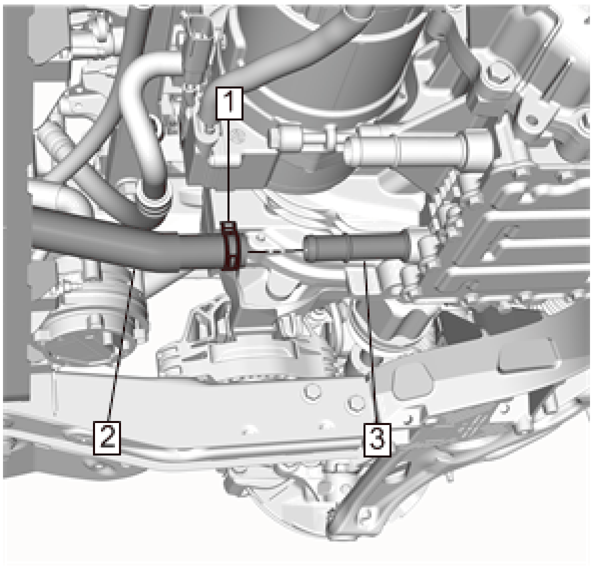


Fig. 76: Clamp at Drive Motor Stator Cooling Tube
Courtesy of GENERAL MOTORS COMPANY

41. Drive Motor Power Inverter Module Cooling Inlet Hose (2) at Drive Motor Stator Cooling Tube (3) - Connect
42. Clamp (1) at Drive Motor Stator Cooling Tube (3) - Install

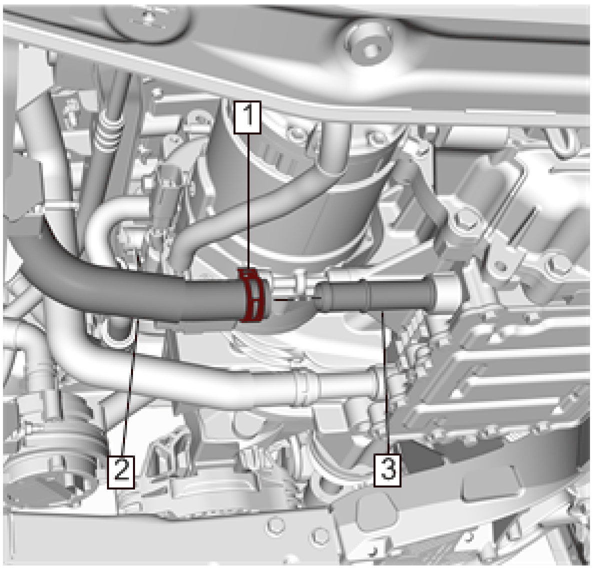


Fig. 77: Clamp at Drive Motor Stator Cooling Tube
Courtesy of GENERAL MOTORS COMPANY

43. Generator Control Module Coolant Tank Hose (2) at Drive Motor Stator Cooling Tube (3) - Connect
44. Clamp (1) at Drive Motor Stator Cooling Tube (3) - Install

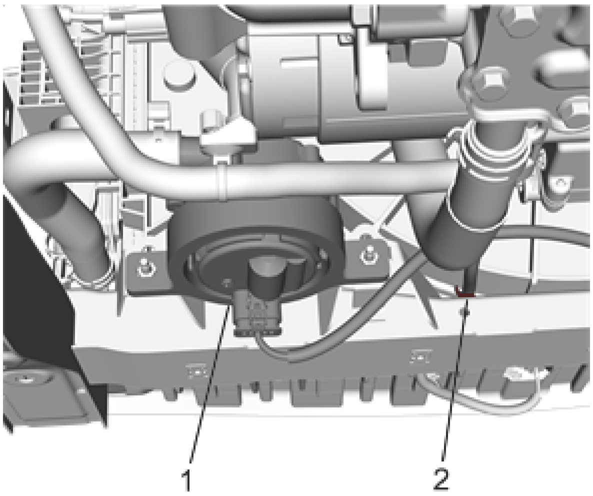


Fig. 78: Drive Motor Generator Control Module Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

45. Engine Wiring Harness Retainer (2) at Drivetrain and Front Suspension Crossmember Extension - Install
46. Drive Motor Generator Control Module Coolant Pump (1) - Install - **Drive Motor Battery Coolant Pump Replacement (RESS Pump)** **Drive Motor Battery Coolant Pump Replacement (PE Pump)**
47. Radiator Air Lower Baffle - Install - **Radiator Air Lower Baffle and Deflector Replacement**
48. Front Bumper Fascia - Install - **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**
49. Front Wheelhouse Liner - Install - **Front Wheelhouse Liner Replacement**
50. Front Compartment Air Deflector - Install - **Front Compartment Air Deflector Replacement**
51. Install the front tire and wheel assemblies. **Tire and Wheel Removal and Installation**

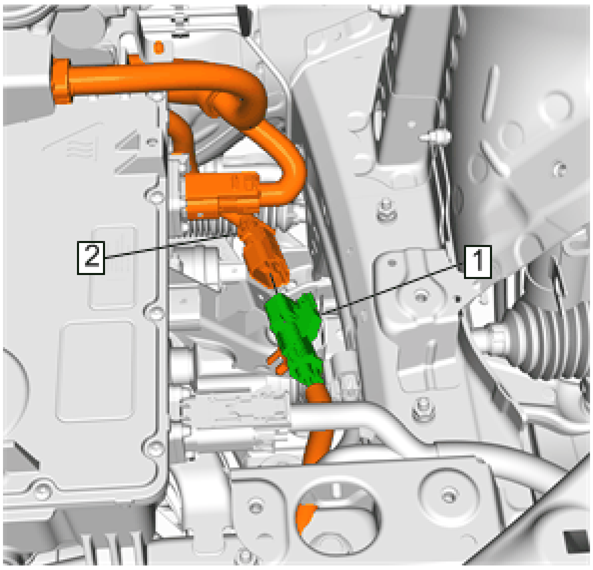


Fig. 79: Air Conditioning Compressor High Voltage Cable Connector
Courtesy of GENERAL MOTORS COMPANY

52. Air Conditioning Compressor High Voltage Cable Connector (1) at High Voltage Battery Cable - Connect

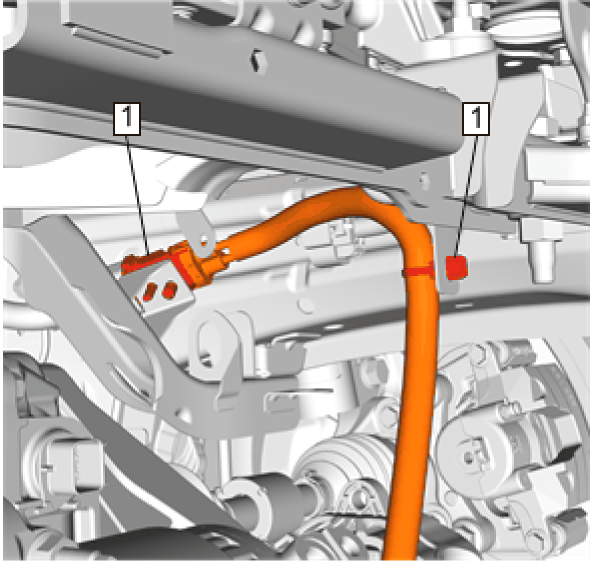


Fig. 80: Air Conditioning Compressor High Voltage Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

53. Air Conditioning Compressor High Voltage Cable Retainer (1) (Qty: 2) at Power Electric Carrier Frame - Install
54. Battery Tray - Install - **Battery Tray Replacement**

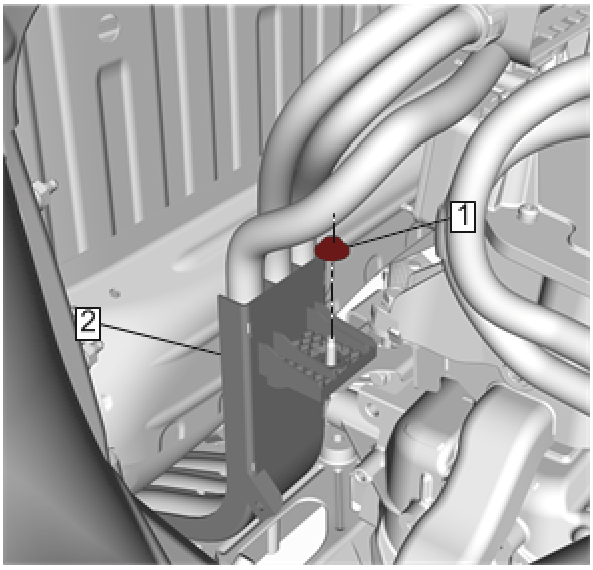


Fig. 81: Battery Positive and Negative Cable Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

55. Battery Cable Protector (2) at Power Electric Carrier Frame Stud Bolt - Install
56. Battery Positive and Negative Cable Bracket Nut (1) - Install and tighten to 9 N.m (80 lb in)

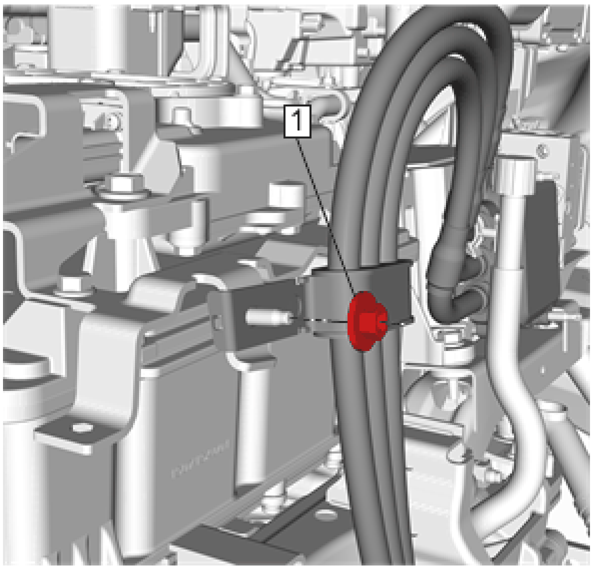


Fig. 82: Drive Motor Power Inverter Module Cable Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

57. Drive Motor Power Inverter Module Cable Bracket Nut (1) at Accessary DC Power Control Module High Voltage Connector Protector - Install and tighten - **Drive Motor Power Inverter Module 3 Phase Cable Replacement**

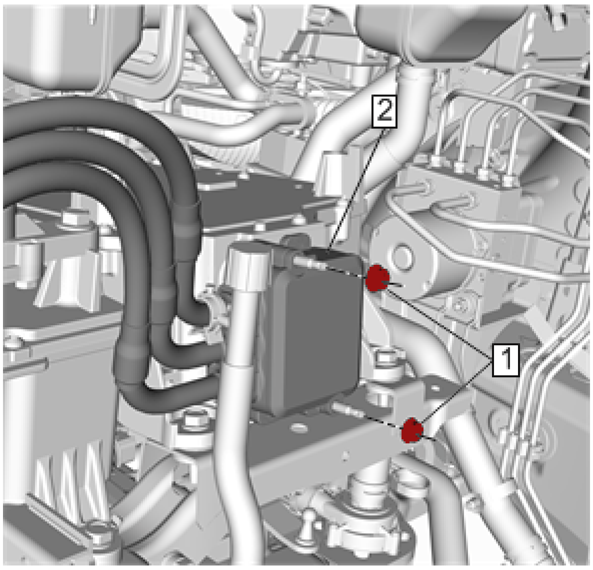


Fig. 83: Drive Motor Power Inverter Module 3 Phase Cable Cover Nut
Courtesy of GENERAL MOTORS COMPANY

58. Drive Motor Power Inverter Module 3 Phase Cable (2) at Drive Motor Power Inverter Module - Connect
59. Drive Motor Power Inverter Module 3 Phase Cable Cover Nut (1) (Qty: 2) - Install and tighten - **Drive Motor Power Inverter Module 3 Phase Cable Replacement**

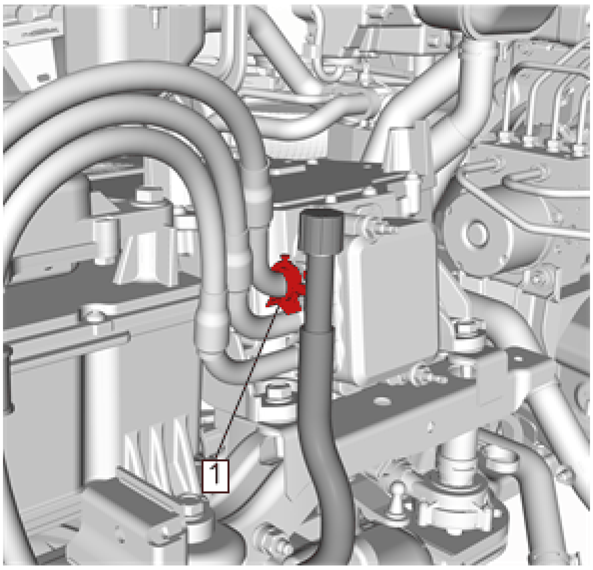


Fig. 84: Transmission Vent Pipe Clip at Drive Motor Power Inverter Module 3 Phase Cable
Courtesy of GENERAL MOTORS COMPANY

60. Transmission Vent Pipe Clip (1) at Drive Motor Power Inverter Module 3 Phase Cable - Install

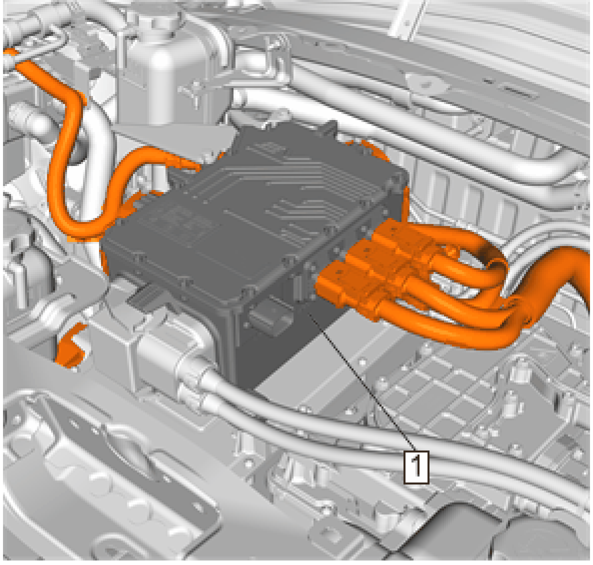


Fig. 85: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

61. Generator Battery Control Wiring Junction Block (1) - Install - **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)** **High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)**
62. Dash Panel Upper Extension Panel Extension - Install - **Dash Panel Upper Extension Panel Extension Replacement**

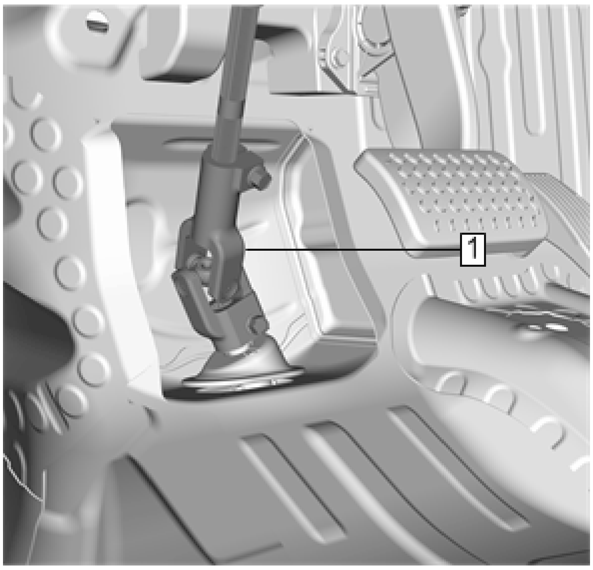


Fig. 86: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

63. Connect the intermediate steering shaft (1) to the steering gear. **Intermediate Steering Shaft Replacement**
64. Fill the drive motor generator power inverter module cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
65. Recharge the refrigerant. **Refrigerant Recovery and Recharging**
66. Enable the high voltage system. **High Voltage Enabling**
67. Center the steering angle sensor. **Steering Wheel Angle Sensor Centering**
68. Measure the wheel alignment. **Wheel Alignment Measurement**

FRONT WHEELHOUSE LINER REPLACEMENT

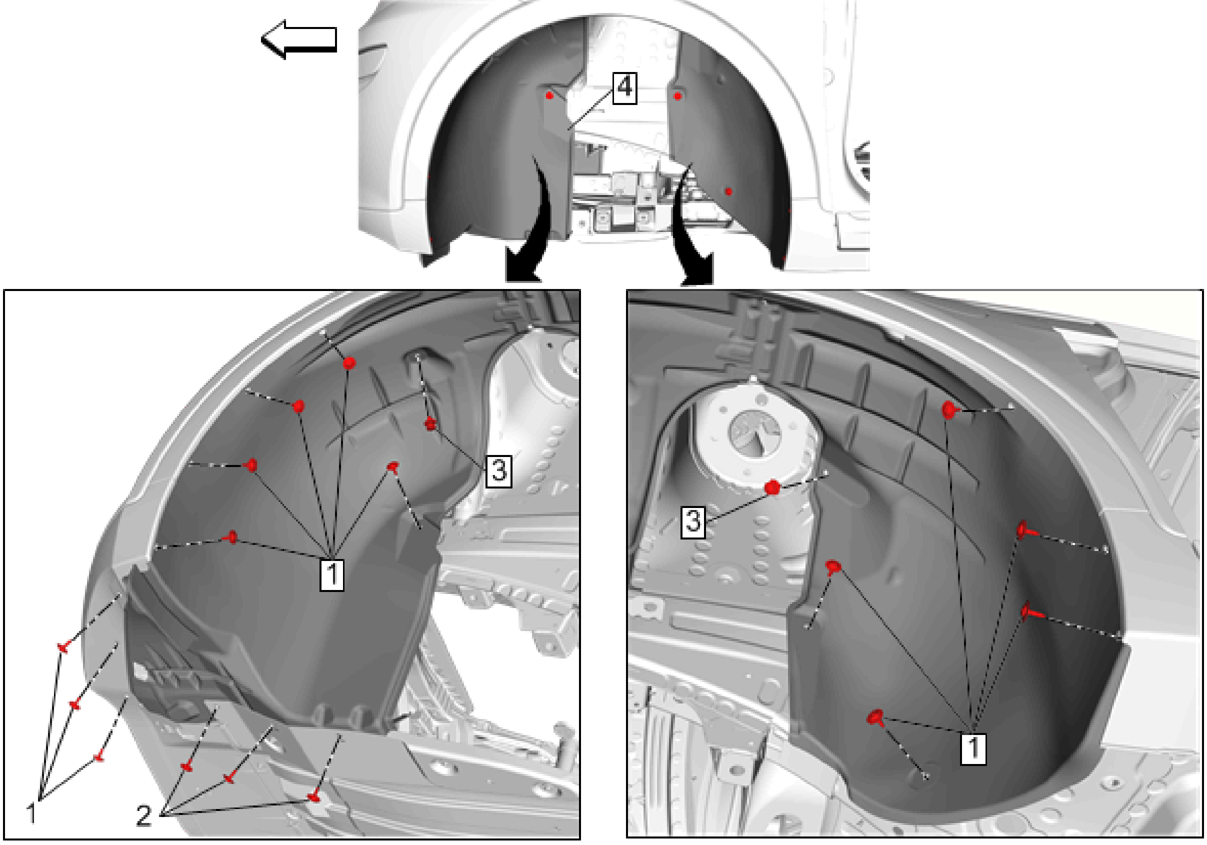


Fig. 87: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Tire and Wheel Removal and Installation	
1	Front Wheelhouse Liner Screw (Qty: 13) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Bumper Fascia Wheel Opening Screw (Qty: 3) **Tighten** 2.5 N.m (22 lb in)
3	Front Wheelhouse Liner Retainer (Qty: 2)
4	Front Wheelhouse Liner

REAR WHEELHOUSE LINER REPLACEMENT

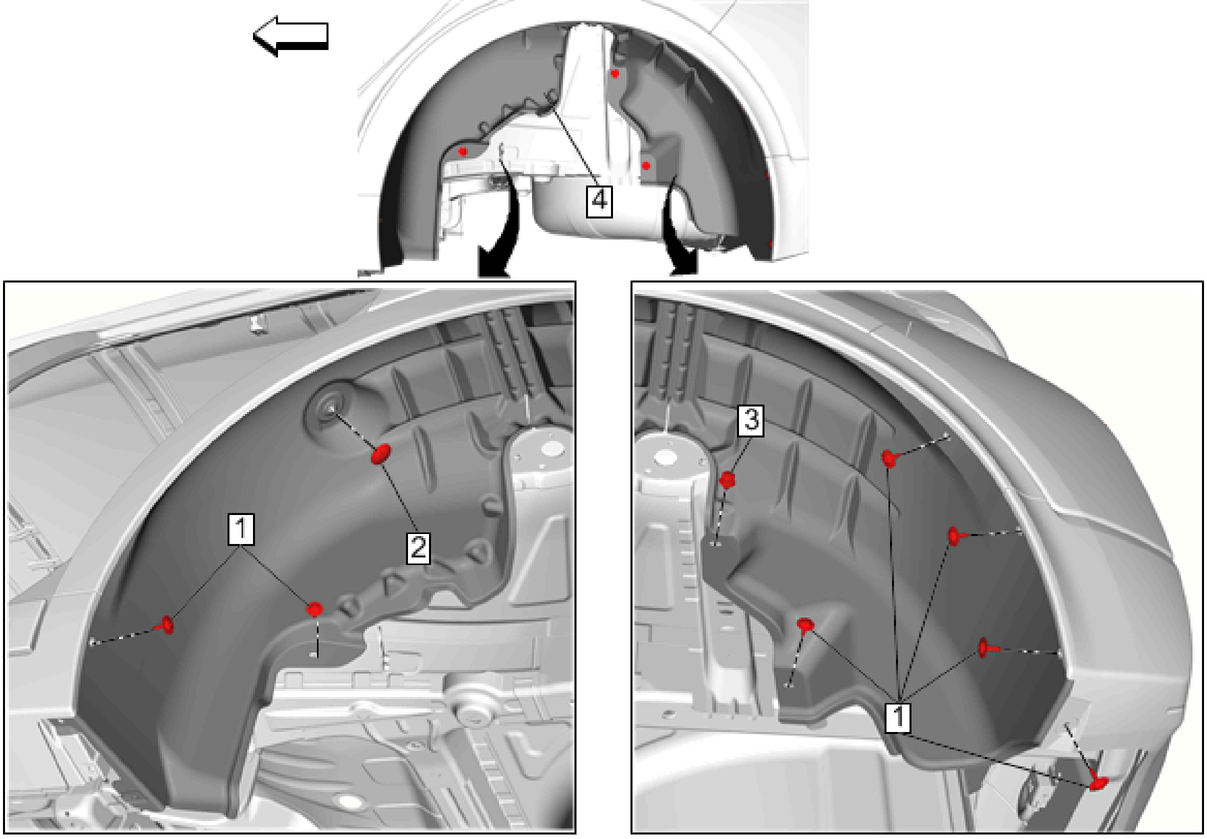


Fig. 88: Rear Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Tire and Wheel Removal and Installation 2. Rear Tire Front Air Deflector Replacement	
1	Rear Wheelhouse Liner Screw (Qty: 7) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Rear Wheelhouse Liner Retainer
3	Rear Wheelhouse Liner Push-Pin
4	Rear Wheelhouse Liner

FRONT TIRE FRONT AIR DEFLECTOR REPLACEMENT

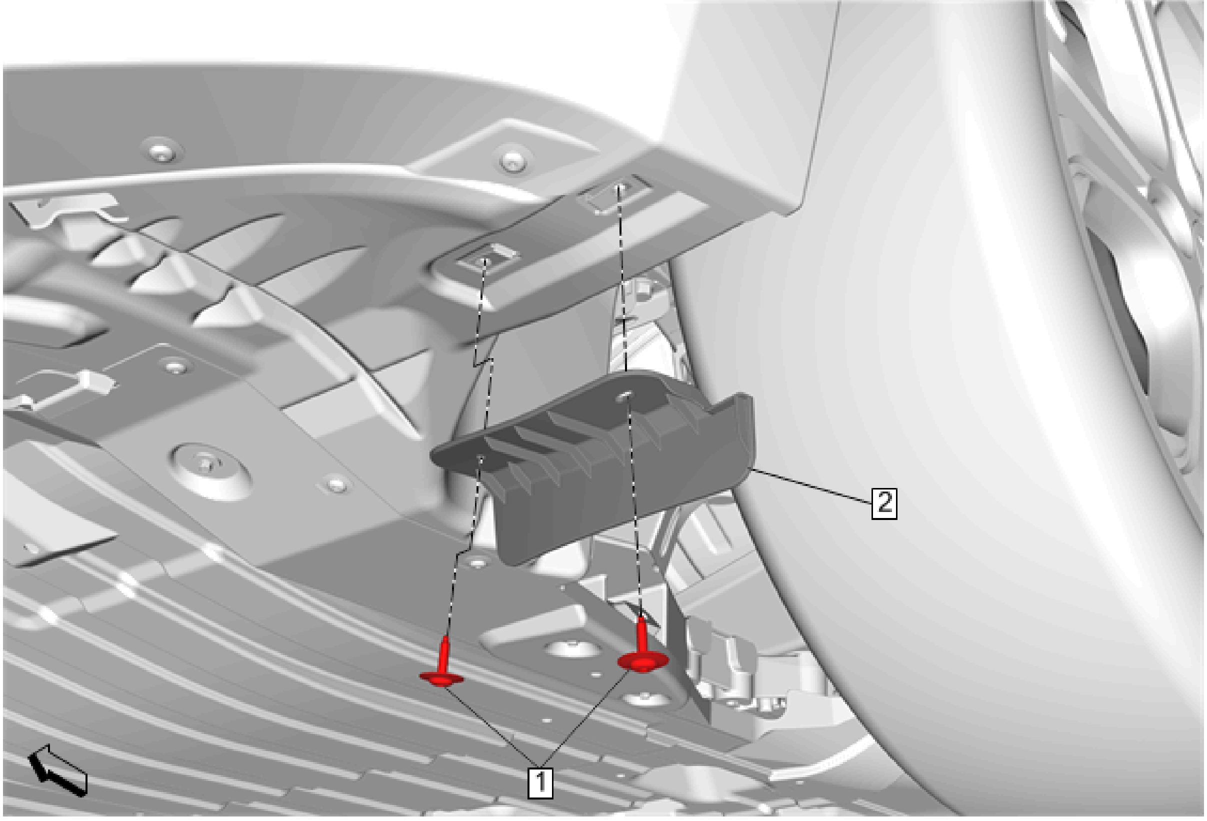


Fig. 89: Front Tire Front Air Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Tire Front Air Deflector Fastener (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Tire Front Air Deflector

REAR TIRE FRONT AIR DEFLECTOR REPLACEMENT

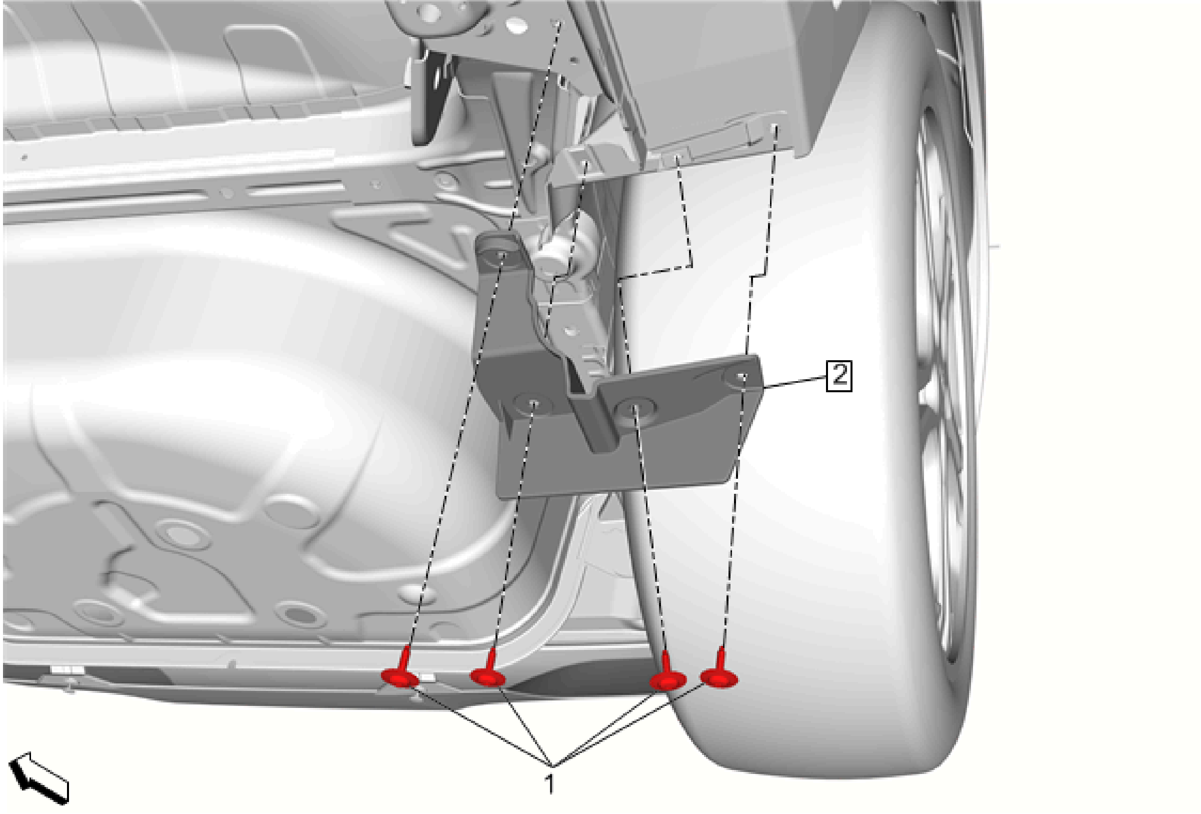


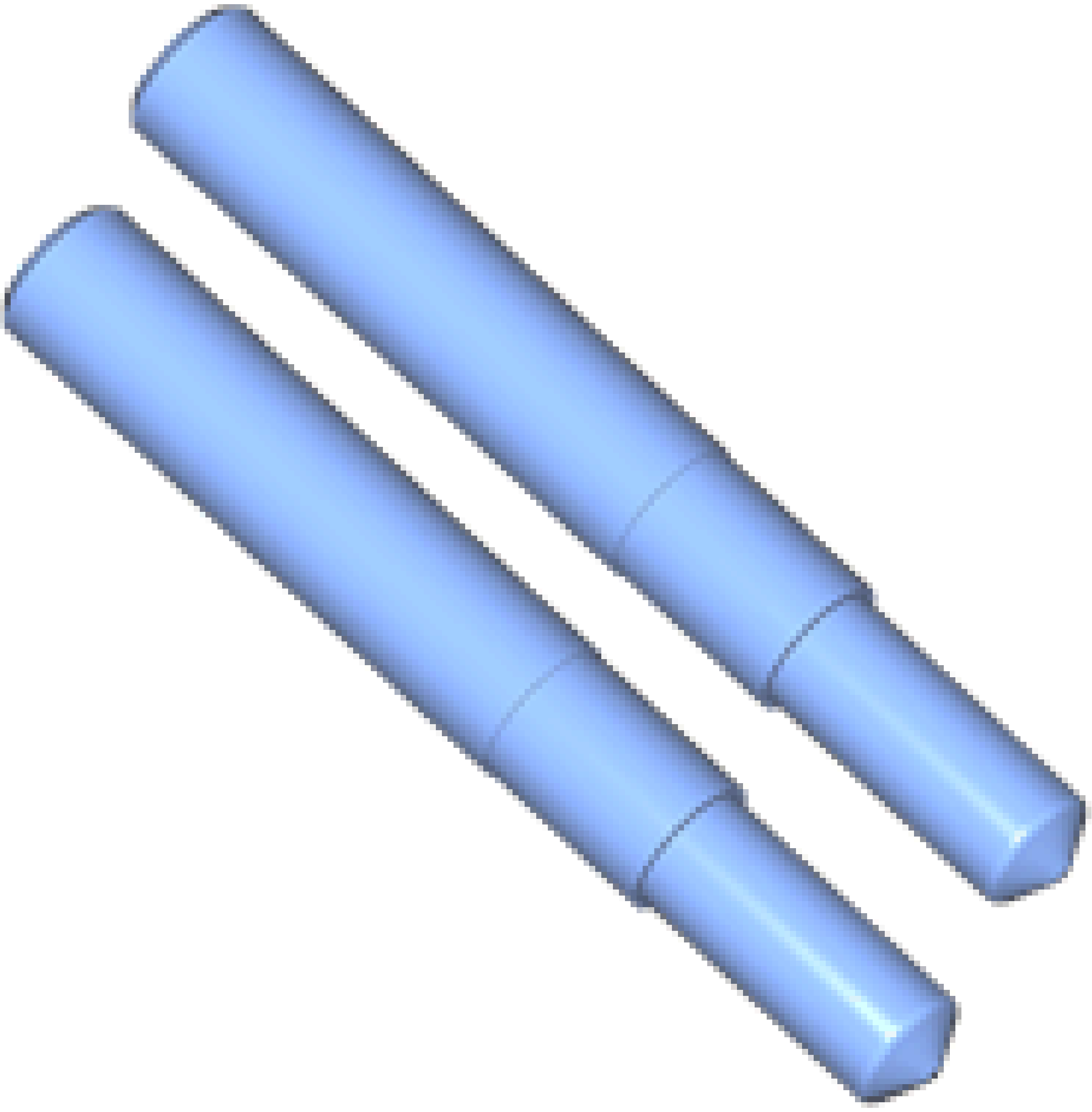
Fig. 90: Rear Tire Front Air Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Rear Tire Front Air Deflector Fastener (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Rear Tire Front Air Deflector **Procedure** Lower the vehicle. Lifting and Jacking the Vehicle

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number / Description

Illustration	Tool Number / Description
	CH-51034 Cradle Alignment Guide Pins

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Horns and Pedestrian Alerts - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Horn Nut	22 N.m (16 lb ft)
Pedestrian Sound Alert Module Bracket Nut	9 N.m (80 lb in)
Pedestrian Sound Alert Speaker Bracket Nut	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

HORN WIRING SCHEMATICS

Horn

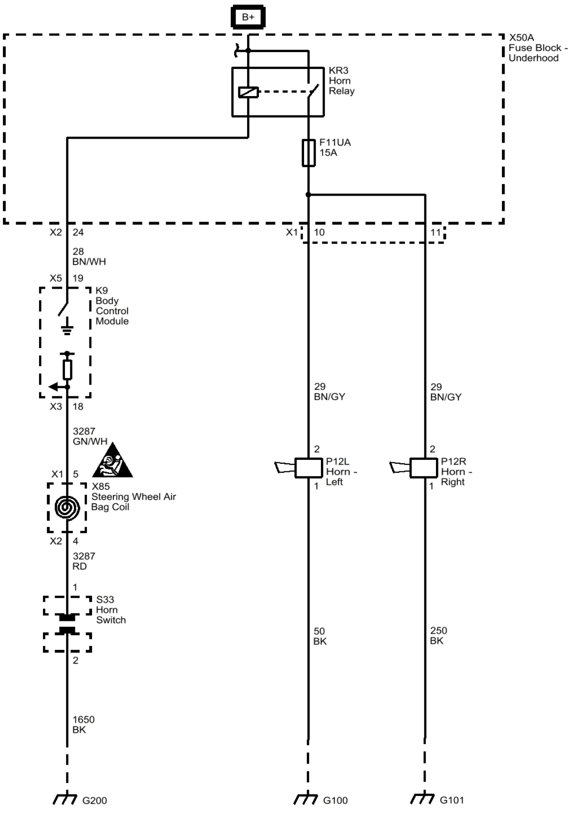

B+
X50A
Fuse Block -
Underhood
KR3
Horn
Relay
F11UA
15A
X2
24
X1
10
11
28
BN/WH
X5
19
K9
Body
Control
Module
X3
18
3287
GN/WH
X1
5
X85
Steering Wheel Air
Bag Coil
X2
4
3287
RD
1
S33
Horn
Switch
2
1650
BK
G200
29
BN/GY
2
P12L
Horn -
Left
1
50
BK
G100
29
BN/GY
2
P12R
Horn -
Right
1
250
BK
G101

Fig. 1: Horn
Courtesy of GENERAL MOTORS COMPANY

Pedestrian Alert

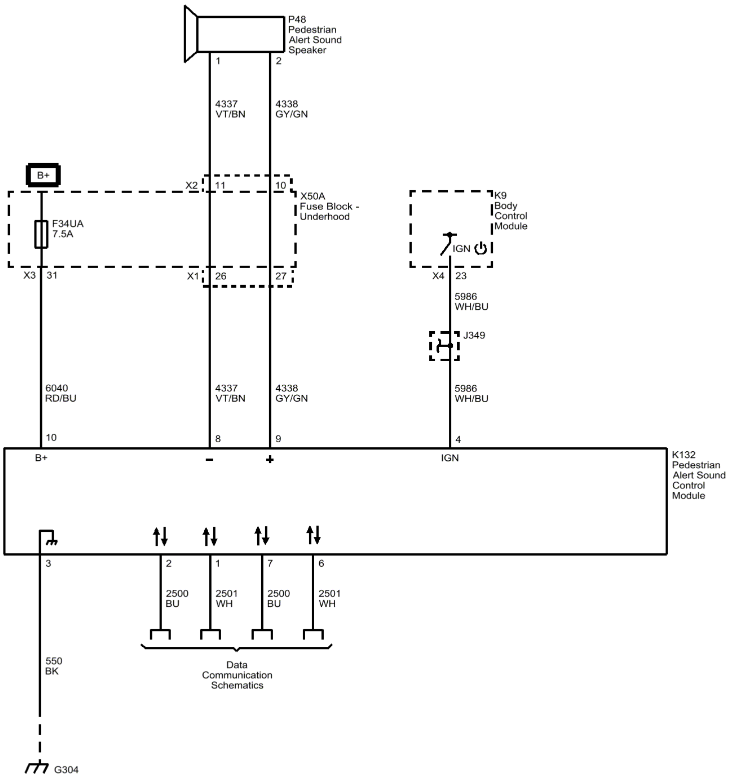

P48
Pedestrian
Alert Sound
Speaker
1
2
4337
VT/BN
4338
GY/GN
B+
X2
11
10
X50A
Fuse Block -
Underhood
F34UA
7.5A
X3
31
X1
26
27
K9
Body
Control
Module
IGN
X4
23
5986
WH/BU
J349
5986
WH/BU
6040
RD/BU
4337
VT/BN
4338
GY/GN
10
8
9
4
B+
-
+
IGN
K132
Pedestrian
Alert Sound
Control
Module
3
2
1
7
6
2500
BU
2501
WH
2500
BU
2501
WH
550
BK
Data
Communication
Schematics
G304

Fig. 2: Pedestrian Alert
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B010E: PEDESTRIAN FRIENDLY ALERT AUDIO OUTPUT CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC B010E

Pedestrian Friendly Alert Audio Output Circuit

Symptom Byte Information: Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Pedestrian Friendly Alert Speaker Control (-)	1	B010E 04	1	B010E 1B
Pedestrian Friendly Alert Speaker Control (+)	1	B010E 04	1	B010E 1B
1. P48 Pedestrian Alert Sound Speaker = Inoperative				

Circuit/System Description

For an overview of the component/system, refer to: **Pedestrian Alert Description and Operation**

Circuit	Description
Pedestrian Friendly Alert Speaker Control (-)	The output circuit is switched to 6 V to activate the component.
Pedestrian Friendly Alert Speaker Control (+)	The output circuit is switched to 6 V to activate the component.

Component	Description
P48 Pedestrian Alert Sound Speaker	Each of the speaker output [+] and [-] circuits has a DC bias voltage that is approximately one half of the battery voltage. When using a DMM, each of the circuits will measure approximately 6 V DC to ground. The audio being played is produced by a varying AC voltage that is centered around the DC bias voltage. The AC voltage causes the speaker cone to move and produce sound.
K132 Pedestrian Alert Sound Control Module	The control module K132 controls a speaker to emit an audible tone at low vehicle speeds to notify pedestrians of an approaching vehicle.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode & Transmission in Drive

Conditions for Setting the DTC

- B010E 1B - Control Circuit = Signal Cross Coupled
- B010E 04 - Control Circuit = Open/High Resistance

Actions Taken When the DTC Sets

Pedestrian Alert Sound System = Inoperative

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
2. Verify the component is activated: P48 Pedestrian Alert Sound Speaker
    - **If the component does not produce a sound**

      Refer to: Circuit/System Testing

    - **If the component produces a sound**
3. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: P48 Pedestrian Alert Sound Speaker
3. Test for less than 10 Ω between the test points: Low Reference terminal 1 & Ground
    - **If 10 Ω or greater**
    1. Disconnect the electrical connector: K132 Pedestrian Alert Sound Control Module
    2. Test for less than 2 Ω between the test points: Low Reference terminal 1 at Component harness & Terminal 8 at Control module harness
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: K132 Pedestrian Alert Sound Control Module
    - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
5. Test for 5 to 7 V between the test points: Control circuit terminal 2 & Ground
    - **If less than 5 V**
    1. Ignition/Vehicle - Off
    2. Disconnect the electrical connector: K132 Pedestrian Alert Sound Control Module
    3. Test for infinite resistance between the test points: Control circuit terminal 2 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance
    4. Test for less than 2 Ω between the test points: Control circuit terminal 2 at Component harness & Terminal 9 at Control module harness
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: K132 Pedestrian Alert Sound Control Module
    - **If greater than 7 V**
    1. Ignition/Vehicle - Off
    2. Disconnect the electrical connector: K132 Pedestrian Alert Sound Control Module
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Control circuit terminal 2 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V - Replace the component: K132 Pedestrian Alert Sound Control Module
    - **If between 5 and 7 V**
6. Test or replace the component: P48 Pedestrian Alert Sound Speaker

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Pedestrian Sound Alert Speaker Replacement**
- For control module replacement, programming, and setup refer to: **Control Module References**

DTC B274E OR B274F: LOW HORN OUTPUT SHORT TO BATTERY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B274E 01

Low Horn Output Short to Battery

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	2	1	B274E 01	-
1. Horns Inoperative 2. Horns Always ON				

Circuit/System Description

The body control module controls the horn relay by providing a ground to the control circuit of the horn relay coil energizing the relay. When the horn relay is energized, the horn relay contacts close applying voltage through the horn fuse and the horn control circuit to the horns.

Conditions for Running the DTC

The DTC can only set only when the output is actively being requested by the body control module.

Conditions for Setting the DTC

The body control module detects a short to voltage in the horn relay circuit.

Action Taken When the DTC Sets

The horns will be inoperative.

Conditions for Clearing the DTC

- The DTC clears when the fault is no longer detected.
- The current DTC will become history when the request for the output is removed.
- The history DTC will clear after 50 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Horns System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the P12 Horn turns ON and OFF when commanding the Horn Relay On and Off with a scan tool.
    - **If the P12 Horn is always ON or always OFF**

      Refer to Circuit/System Testing.
    - **If the P12 Horn turns ON and OFF**
3. All OK.

Circuit/System Testing

1. Vehicle OFF.
2. Disconnect the X5 harness connector at the K9 Body Control Module, Vehicle in Service Mode.
3. Verify the P12 Horn is not activated.
    - **If the P12 Horn is activated**
    1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block-Underhood.
    2. Test for infinite resistance between the K9 Body Control Module control circuit terminal 19 X5 and ground.
        - If less than Infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, test or replace the X50A Fuse Block-Underhood.
    - **If the P12 Horn is not activated**
4. Connect a 3 A fused jumper wire between the control circuit terminal 19 and ground.
5. Verify the P12 Horn activates.
    - **If the P12 Horn does not activate**
    1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block-Underhood, Vehicle in Service Mode.
    2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 19 X5 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the X50A Fuse Block-Underhood.
    - **If the P12 Horn activates**
6. Replace the K9 Body Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for body control module replacement, programming and setup

SYMPTOMS - HORNS

Important Preliminary Checks Before Starting:

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the horn operation or pedestrian alert sound system operation in order to familiarize yourself with the system functions. Refer to the following:
    - **Horns System Description and Operation**
    - **Pedestrian Alert Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the rear window defogger. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

NOTE:

- **Inspect for proper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Ensure that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone signal may cause the condition. Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .**
- **The problem may or may not turn ON the SERVICE VEHICLE SOON indicator or store a DTC. Do not use the symptom tables to diagnose intermittent conditions. The malfunction must be present in order to locate the problem.**

Poor electrical connections or wiring cause most intermittent conditions. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body
- An improperly formed or damaged terminal
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.
- Poor terminal to wire connection requires removing the terminal from the connector body in order to perform the check.

Use a scan tool in order to help detect intermittent conditions. The scan tool has several features that can be used to locate an intermittent condition. The snapshot feature can capture and store data parameters within the scan tool when the malfunction occurs. This information can then be reviewed in order to see what caused the malfunction.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Horns Malfunction**
- **Pedestrian Alert System Malfunction**

HORNS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - Relay Coil	2, 4	2, 4	-	-
B+ - Relay Switch	2, 4	2, 4	-	-
Signal - S33 Horn Switch	2, 4	5	-	-
Control - P12 Horn	2, 4	2, 4	1, 3	-
Control - Relay Coil	2, 4	2, 4	B274E 01	-
Ground - S33 Horn Switch	-	5	-	-
Ground - P12L Horn - Left	-	2	-	-
Ground - P12R Horn - Right	-	4	-	-

1. P12L Horn - Left = Always On
2. P12L Horn - Left = Inoperative
3. P12R Horn - Right = Always On
4. P12R Horn - Right = Inoperative
5. S33 Horn Switch = Inoperative

Circuit/System Description

For an overview of the component/system, refer to: **Horns System Description and Operation**

Circuit	Description
B+ - Relay Coil	Supplied from a fuse.
B+ - Relay Switch	Supplied from a fuse.
Signal - S33 Horn Switch	The control module input circuit has an internal resistance connected to 12 V.
Control - P12 Horn	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to ground to activate the component.
Ground - S33 Horn Switch	Chassis Ground
Ground - P12 Horn	Chassis Ground

Component	Description
P12 Horn	The horn has an electromagnet which pulls a diaphragm inwards and simultaneously opens a contact which interrupts the current through the magnet. When the diaphragm springs back, the contact is closed and the cycle starts over. The vibration of the diaphragm produces the sound.
S33 Horn Switch	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.
X50A Fuse Block - Underhood	The fuse block houses various fuses and relays.

Diagnostic Aids

Rotate the steering wheel while pressing the horn pad to identify intermittent and poor connections within the steering column.

If the horn produces only a weak noise, inspect the following:

- Debris or water in the horn.
- Incorrect MountingRefer to: **Fastener Specifications**.
- Debris on the component.
- Vehicle components that vibrate while the horn is sounding.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify the scan tool parameter: Horn Switch = Inactive
    - **If not the specified state**

      Refer to: Circuit/System Testing - Test 1

    - **If the specified state**
2. Operate the component: S33 Horn Switch - Pressed

   Verify the scan tool parameter: Horn Switch = Active

    - **If not the specified state**

      Refer to: Circuit/System Testing - Test 1

    - **If the specified state**
3. Perform the scan tool control function: Horn Relay Command - On and Off

   Verify the component turns On and Off: P12L Horn - Left & P12R Horn - Right & The horn should emit a clear and even tone.

    - **If none of the components operate**

      Refer to: Circuit/System Testing - Test 2

    - **P12 Horn - InoperativeorIf an abnormal noise is present**

  - Refer to: Circuit/System Testing - Test 3
  - **If the component turns On and Off & If no abnormal noise is present**
4. All OK.

Circuit/System Testing

Test 1

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle Off and all vehicle systems Off.
2. Disconnect the electrical connector: S33 Horn Switch
3. Test for less than 10 Ω between the test points: Ground circuit terminal 2 & Ground
   - **If 10 Ω or greater**
   1. Disconnect the ground connection: G200
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 2 at Component harness & Terminal G200
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition On/Vehicle in Service Mode.
5. Verify the scan tool parameter: Horn Switch = Inactive
   - **If not the specified state**
   1. Ignition/Vehicle Off.
   2. Disconnect the electrical connector: X3 at K9 Body Control Module
   3. Test for infinite resistance between the test points: Signal circuit terminal 1 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: K9 Body Control Module
   - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 2
7. Verify the scan tool parameter: Horn Switch = Active
   - **If not the specified state**
   1. Ignition/Vehicle Off.Remove - Jumper Wire
   2. Disconnect the electrical connector: X3 at K9 Body Control Module
   3. Ignition On/Vehicle in Service Mode.
   4. Test for less than 1 V between the test points: Signal circuit terminal 1 at Component harness & Ground
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V
   5. Ignition/Vehicle Off.
   6. Test for less than 2 Ω between the test points: Signal circuit terminal 1 at Component harness & Terminal 18 X3 at Control module harness
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Replace the component: K9 Body Control Module
   - **If the specified state**
8. Test or replace the component: S33 Horn Switch

Test 2

1. Ignition/Vehicle Off.
2. Disconnect the electrical connector: X1X50A Fuse Block - Underhood
3. Ignition - On / Vehicle - In Service Mode
4. Momentarily connect a 20 A fused jumper wire between the test points:
    - Control circuit terminal 10 X1 & B+
    - Control circuit terminal 11 X1 & B+
5. Verify the component turns On and Off when connecting and disconnecting the jumper wire: P12L Horn - Left & P12R Horn - Right
    - **If the component does not turn On and Off**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: P12L Horn - Left & P12R Horn - Right
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points:
        - Control circuit terminal 10 X1 at Component harness & Ground
        - Control circuit terminal 11 X1 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
    5. Ignition/Vehicle - Off
    6. Test for infinite resistance between the test points:
        - Control circuit terminal 10 X1 at Component harness & Ground
        - Control circuit terminal 11 X1 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance
    7. Test for less than 2 Ω between the test points:
        - Control circuit terminal 2 at Component harness & Control circuit terminal 10 X1 at Fuse Block Harness
        - Control circuit terminal 2 at Component harness & Control circuit terminal 11 X1 at Fuse Block Harness
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Test or replace the component: P12L Horn - Left & P12R Horn - Right
    - **If the component turns On and Off**
6. Connect the electrical connector: X1 at X50A Fuse Block - Underhood
7. Disconnect the electrical connector: X5 at K9 Body Control Module
8. Ignition - On / Vehicle - In Service Mode
9. Momentarily connect a 3 A fused jumper wire between the test points: Control circuit terminal 19 X5 & B+

    Verify the component turns On and Off when connecting and disconnecting the jumper wire: P12L Horn - Left & P12R Horn - Right

    - **If the component does not turn On and Off**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: X2 at X50A Fuse Block - Underhood
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Control circuit terminal 19 X5 at Control module harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
    5. Ignition/Vehicle - Off

6. Test for infinite resistance between the test points: Control circuit terminal 19 X5 at Control module harness & Ground
    - If less than infinite resistance - Repair the short to ground on the circuit.
    - If infinite resistance
7. Test for less than 2 Ω between the test points: Control circuit terminal 19 X5 at Control module harness & Terminal 24 X2 at Fuse Block Harness
    - If 2 Ω or greater - Repair the open/high resistance in the circuit.
    - If less than 2 Ω - Test or replace the component: X50A Fuse Block - Underhood
- **If the component turns On and Off**

10. Replace the component: K9 Body Control Module

Test 3

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: P12L Horn - LeftorP12R Horn - Right
3. Test for less than 1 Ω between the test points: Ground circuit terminal 1 & Ground
    - **If 1 Ω or greater**
    1. Disconnect the ground connection: G100/G101
    2. Test for less than 1 Ω between the test points:
        - Ground circuit terminal 1 & Terminal G100
        - Ground circuit terminal 1 & Terminal G101
        - If 1 Ω or greater - Repair the open/high resistance in the circuit.
    - **If less than 1 Ω**
4. Disconnect the electrical connector: X1 at X50A Fuse Block - Underhood
5. Test for less than 1 Ω between the test points:
    - Control circuit terminal 2 at Component harness & Control circuit terminal 10 X1 at Fuse Block Harness
    - Control circuit terminal 2 at Component harness & Control circuit terminal 11 X1 at Fuse Block Harness
    - If 1 Ω or greater - Repair the open/high resistance in the circuit.
    - **If less than 1 Ω**
6. Test or replace the component: P12 Horn

Component Testing

P12 Horn

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: P12L Horn - LeftorP12R Horn - Right
3. Connect a jumper wire between the test points: Ground terminal 1 & Ground
4. Momentarily connect a 15 A fused jumper wire between the test points: Control terminal 2 & 12 V

    Verify the component turns On and Off when connecting and disconnecting the jumper wire: P12 Horn

    - **If the component does not turn On and Off**

      Replace the component: P12 Horn

    - **If the component turns On and Off**

5. All OK.

S33 Horn Switch

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: at S33 Horn Switch
3. Test for infinite resistance between the test points: Signal circuit terminal 1 & Ground circuit terminal 2 - Switch Not Pressed
    - **If less than infinite resistance**

      Replace the component: S33 Horn Switch

    - **If infinite resistance**
4. Test for less than 3 Ω between the test points: Signal circuit terminal 1 & Ground circuit terminal 2 - Switch - Pressed
    - **If 3 Ω or greater**

      Replace the component: S33 Horn Switch

    - **If less than 3 Ω**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Horn Replacement (High Note)Horn Replacement (Low Note)**
- **Steering Wheel Airbag Replacement**
- **Engine Wiring Harness Junction Block Replacement**
- For control module replacement, programming, and setup refer to: **Control Module References**

PEDESTRIAN ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - K132 Pedestrian Alert Sound Control Module	1	1	-	-
High Speed GMLAN Serial Data (-) 8 - Terminal 1	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00	P0AC4 00, P25A2 00, P25C9 00, U179A 00, U0293 00
High Speed GMLAN Serial Data (+) 8 - Terminal 2	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Serial Data Communication Enable - Terminal 4	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00
High Speed GMLAN Serial Data (-) 8 - Terminal 6	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00
High Speed GMLAN Serial Data (+) 8 - Terminal 7	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00	U216A 00, U026A 00, U0131 00, U0151 00, C114C 08, U023A 00, U0422 00
Pedestrian Friendly Alert Speaker Control (-)	1	B010E 04	1	B010E 1B
Pedestrian Friendly Alert Speaker Control (+)	1	B010E 04	1	B010E 1B
Ground - K132 Pedestrian Alert Sound Control Module	-	1	-	-

1. P48 Pedestrian Alert Sound Speaker = Inoperative

Circuit/System Description

For an overview of the component/system, refer to: **Pedestrian Alert Description and Operation**

Circuit	Description
B+ - K132 Pedestrian Alert Sound Control Module	Supplied from a fuse.
Ground - K132 Pedestrian Alert Sound Control Module	Chassis Ground
Pedestrian Friendly Alert Speaker Control (-)	The output circuit is switched to 6 V to activate the component.
Pedestrian Friendly Alert Speaker Control (+)	The output circuit is switched to 6 V to activate the component.

Component	Description
P48 Pedestrian Alert Sound Speaker	Each of the speaker output [+] and [-] circuits has a DC bias voltage that is approximately one half of the battery voltage. When using a DMM, each of the circuits will measure approximately 6 V DC to ground. The audio being played is produced by a varying AC voltage that is centered around the DC bias voltage. The AC voltage causes the speaker cone to move and produce sound.
K132 Pedestrian Alert Sound Control Module	The control module K132 controls a speaker to emit an audible tone at low vehicle speeds to notify pedestrians of an approaching vehicle.

Reference Information

Schematic Reference

Horn Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
2. Verify the component is activated: P48 Pedestrian Alert Sound Speaker
    - **If the component does not produce a sound**

      Refer to: Circuit/System Testing

    - **If the component produces a sound**
3. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: K132 Pedestrian Alert Sound Control Module
3. Test for less than 10 Ω between the test points: Ground circuit terminal 3 & Ground
    - **If 10 Ω or greater**
    1. Disconnect the ground connection: G302
    2. Test for less than 2 Ω between the test points: Ground circuit terminal 3 & Terminal G302
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 10 & Ground
    - **If the test lamp does not turn On and the circuit fuse is OK**
    1. Ignition/Vehicle - Off & Remove - Test lamp
    2. Test for less than 2 Ω between the test points: B+ circuit terminal 10 & Output terminal at F9UA Fuse
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Verify the fuse is OK and there is voltage at the fuse.

   - **If the test lamp does not turn On and the circuit fuse is open**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Test for infinite resistance between the test points: B+ circuit terminal 10 & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: K132 Pedestrian Alert Sound Control Module
   - **If the test lamp turns On**

6. Ignition/Vehicle - Off
7. Connect the electrical connector: K132 Pedestrian Alert Sound Control Module
8. Disconnect the electrical connector: P48 Pedestrian Alert Sound Speaker
9. Test for less than 10 Ω between the test points: Low Reference terminal 2 & Ground
   - **If 10 Ω or greater**
   1. Disconnect the electrical connector: K132 Pedestrian Alert Sound Control Module
   2. Test for less than 2 Ω between the test points: Low Reference terminal 2 at Component harness & Terminal 8 at Control module harness
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Replace the component: K132 Pedestrian Alert Sound Control Module
   - **If less than 10 Ω**
10. Ignition - On / Vehicle - In Service Mode & Transmission in Drive
11. Test for 5 to 7 V between the test points: Control circuit terminal 1 & Ground
   - **If less than 5 V**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: K132 Pedestrian Alert Sound Control Module
   3. Test for infinite resistance between the test points: Control circuit terminal 1 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance
   4. Test for less than 2 Ω between the test points: Control circuit terminal 1 at Component harness & Terminal 9 at Control module harness
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Replace the component: K132 Pedestrian Alert Sound Control Module
   - **If greater than 7 V**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: K132 Pedestrian Alert Sound Control Module
   3. Ignition - On / Vehicle - In Service Mode
   4. Test for less than 1 V between the test points: Control circuit terminal 1 at Component harness & Ground
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V - Replace the component: K132 Pedestrian Alert Sound Control Module
   - **If between 5 and 7 V**
12. Test or replace the component: P48 Pedestrian Alert Sound Speaker

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Pedestrian Sound Alert Speaker Replacement**
- For control module replacement, programming, and setup refer to: **Control Module References**

REPAIR INSTRUCTIONS

HORN REPLACEMENT (HIGH NOTE)

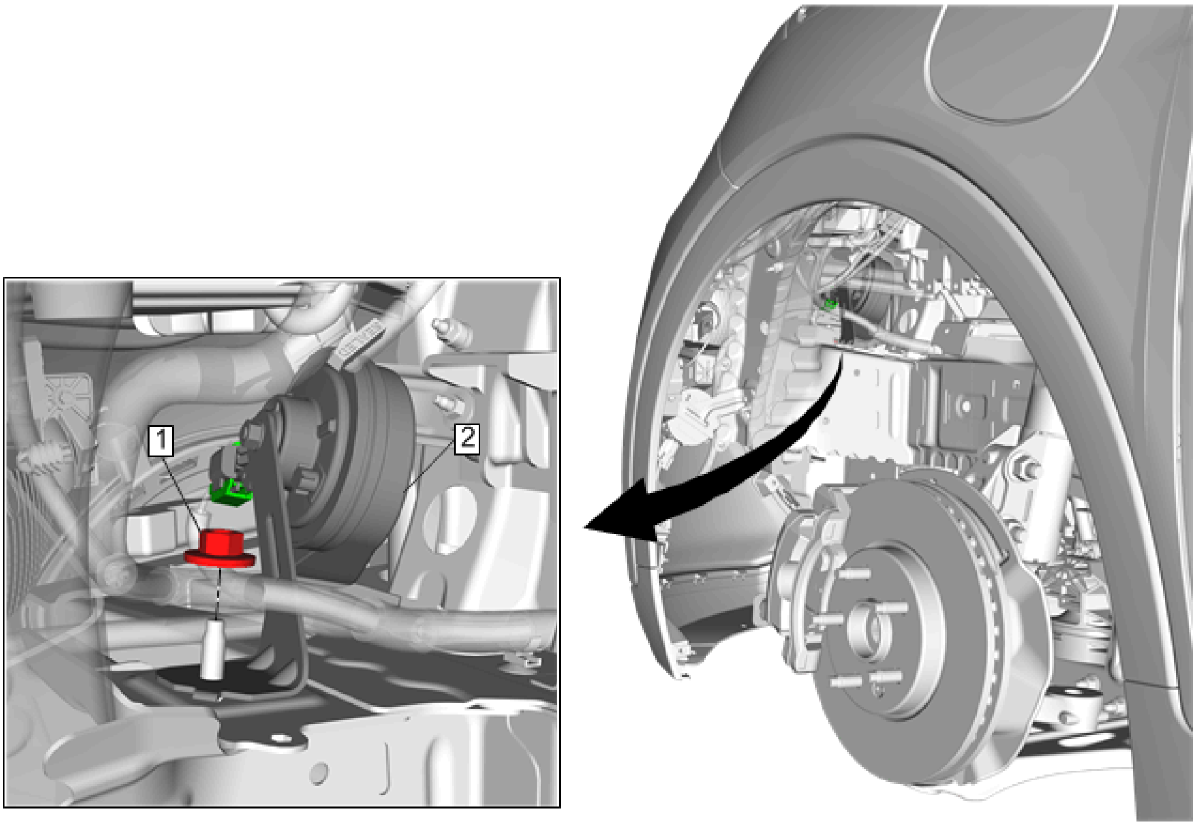


Fig. 3: Horn (High Note)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Wheelhouse Liner-Left Side - Remove - Front Wheelhouse Liner Replacement	
1	Horn Nut **CAUTION:** Fastener Caution **Tighten** 22 N.m (16 lb ft)
2	Horn - High Note **Procedure** Disconnect the electrical connector.

HORN REPLACEMENT (LOW NOTE)

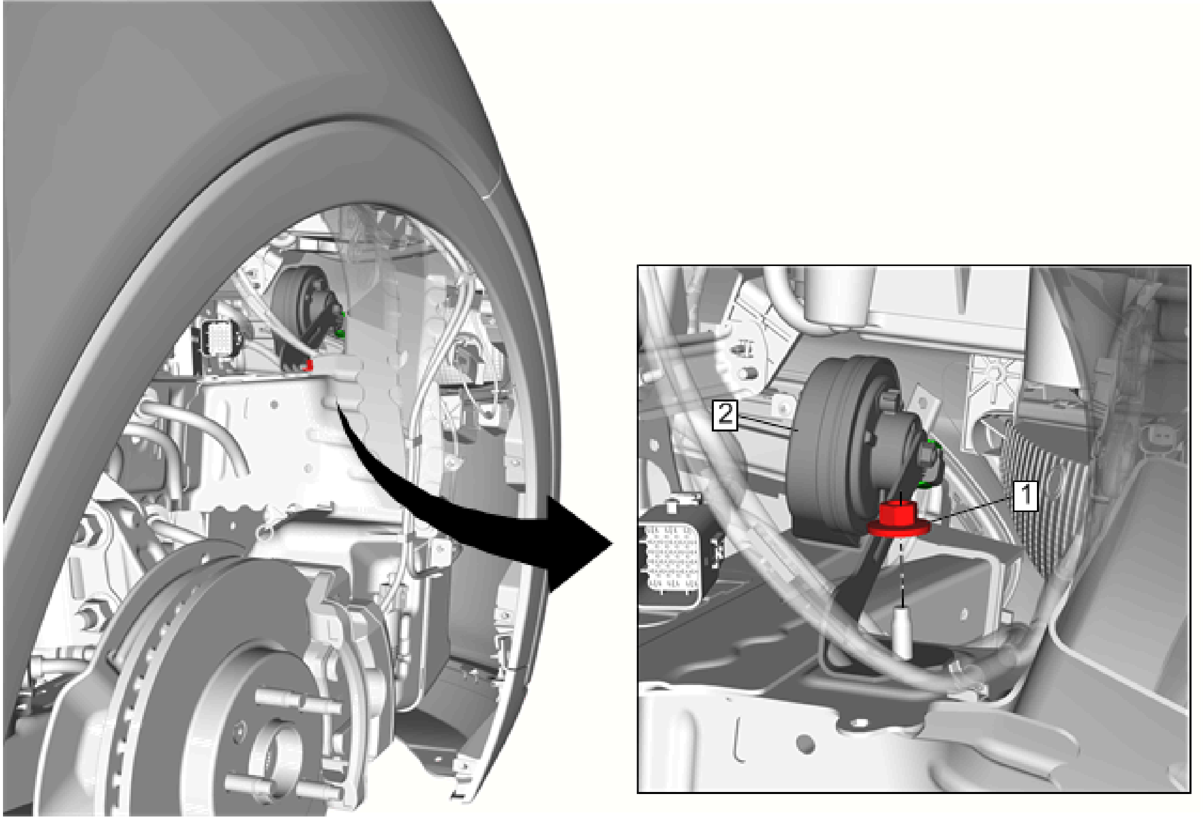


Fig. 4: Horn (Low Note)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Wheelhouse Liner-Right Side - Remove - **Front Wheelhouse Liner Replacement**	
1	Horn Nut **CAUTION:** **Fastener Caution** **Tighten** 22 N.m (16 lb ft)
2	Horn - Low Note **Procedure** Disconnect the electrical connector.

PEDESTRIAN SOUND ALERT MODULE REPLACEMENT

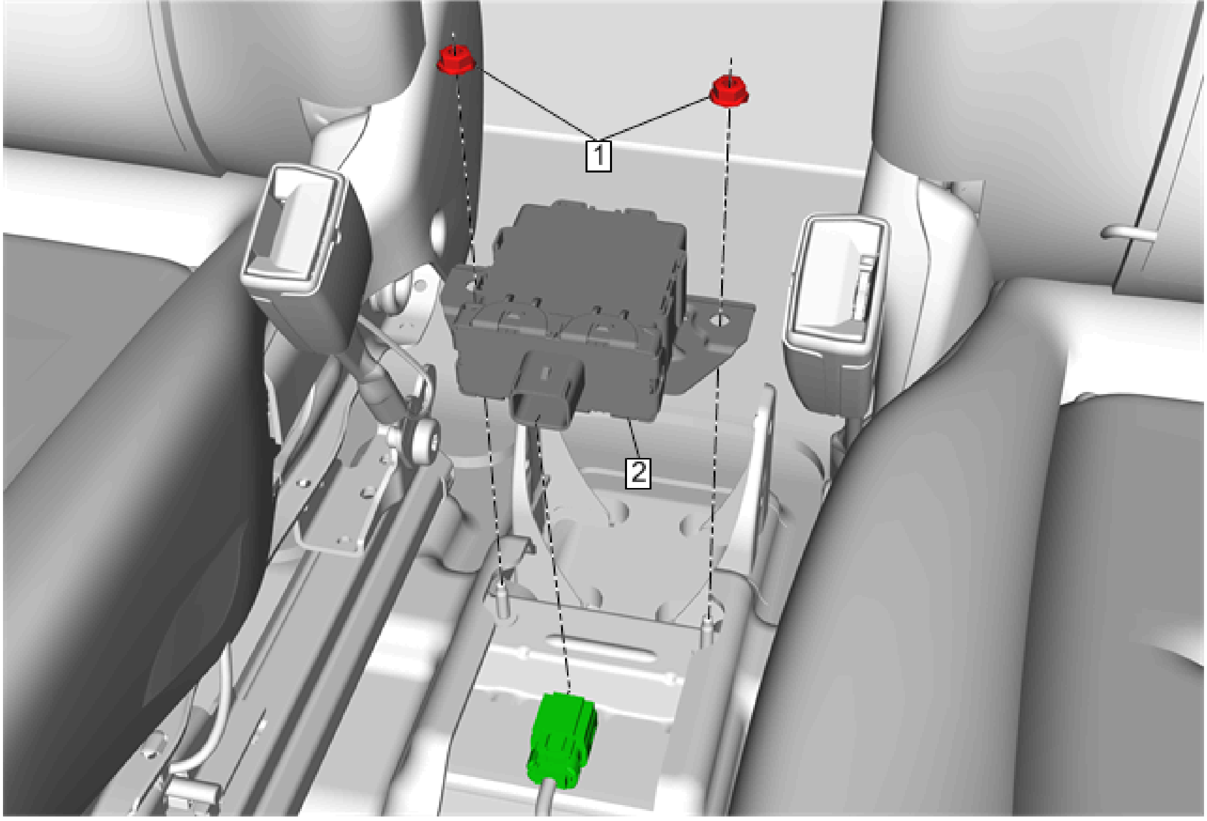


Fig. 5: Pedestrian Sound Alert Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Floor Console Replacement	
1	Pedestrian Sound Alert Module Bracket Nut (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 9 N.m (80 lb in)
2	Pedestrian Sound Alert Module **Procedure** 1. Disconnect the electrical connector. 2. Perform all necessary programming and setup procedures for the control module: Control Module References

PEDESTRIAN SOUND ALERT SPEAKER REPLACEMENT

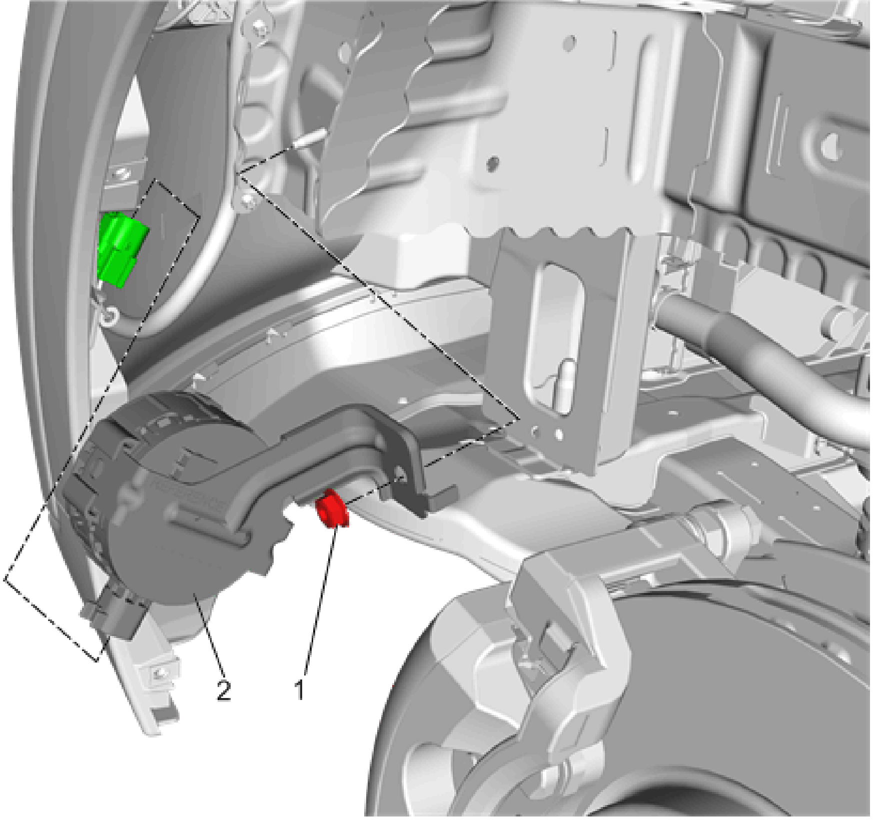


Fig. 6: Pedestrian Sound Alert Speaker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Wheelhouse Liner Replacement	
1	Pedestrian Sound Alert Speaker Bracket nut **CAUTION:** Fastener Caution **Tighten** 9 N.m (80 lb in)
2	Pedestrian Sound Alert Speaker **Procedure** Disconnect the electrical connector.

DESCRIPTION AND OPERATION

HORNS SYSTEM DESCRIPTION AND OPERATION

System Description

The horn system consists of the following components:

- HORN fuse
- Underhood fuse block (contains PCB horn relay)
- Horn switch
- Horn-low note
- Horn-high note
- Body control module (BCM)

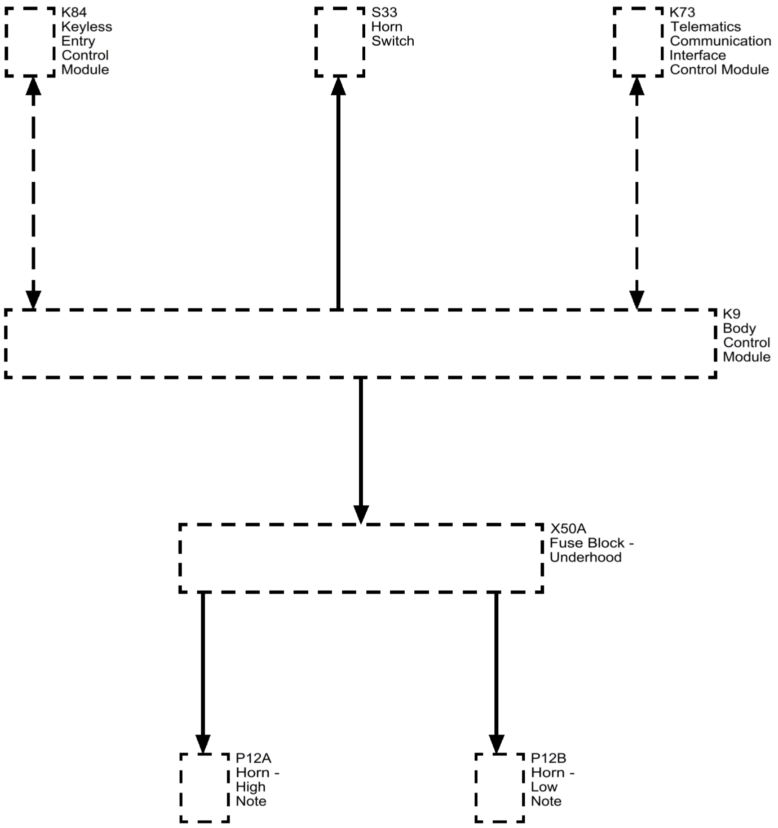

K84
Keyless
Entry
Control
Module
S33
Horn
Switch
K73
Telematics
Communication
Interface
Control Module
K9
Body
Control
Module
X50A
Fuse Block -
Underhood
P12A
Horn -
High
Note
P12B
Horn -
Low
Note

Fig. 7: Horns System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K84	K84 Keyless Entry Control Module
S33	S33 Horn Switch
K73	K73 Telematics Communication Interface Control Module
K9	K9 Body Control Module
X50A	X50A Fuse Block - Underhood
P12A	P12A Horn - High Note
P12B	P12B Horn - Low Note

System Operation

The vehicle horn system is activated under the following conditions:

- When the horn switch is depressed
- The BCM commands the horns ON under any of the following conditions:
  - When the content theft deterrent system detects a vehicle intrusion - For further information refer to **Theft Systems Description and Operation** .
  - When the panic button is depressed on the remote control door lock transmitter - For further information refer to **Keyless Entry System Description and Operation** .
  - When the keyless entry system is used to lock the vehicle, a horn chirp may sound to notify the driver that the vehicle has been locked. The notification feature may be enabled or disabled through personalization. For further information refer to **Keyless Entry System Description and Operation** .
  - When the OnStarÃ‚Â® system is used to sound the horns if equipped - For further information, refer to **OnStar Description and Operation (UE3)** **OnStar Description and**

Operation (UE1) .

Circuit Operation

Battery positive voltage is applied at all times to the horn relay coil and the horn relay switch. Pressing either of the horn switches applies ground to the horn relay control circuit. The BCM may also apply ground to the horn relay control circuit as described above. When the horn relay control circuit is grounded, the horn relay is energized and battery positive voltage is applied to the horns through the horn control circuit. The horns sound as long as ground is applied to the horn relay control circuit.

PEDESTRIAN ALERT DESCRIPTION AND OPERATION

Electric vehicles present a situation for visually impaired pedestrians who cannot hear an approaching electric vehicle, the pedestrian alert module creates sounds from a dedicated speaker to alert a visually impaired pedestrian, in a non-startling manner.

Operation of the Pedestrian Alert

- Emit sound from 0 to 12 MPH (20 KM/H)
- Fade in and out control for the sound ON and OFF
- Change the pitch of the sound dependent of vehicle speed

Back To Article

SCHEMATIC WIRING DIAGRAMS

IMMOBILIZER WIRING SCHEMATICS

Immobilizer

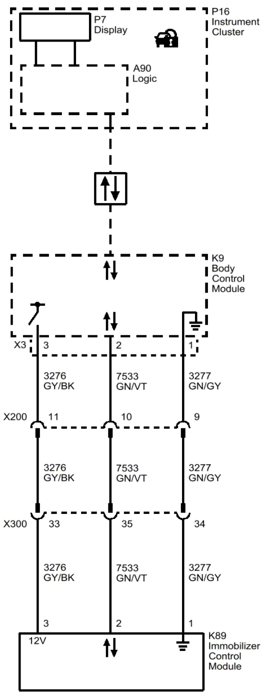

P7
Display
P16
Instrument
Cluster
A90
Logic
K9
Body
Control
Module
X3
3
2
1
3276
GY/BK
7533
GN/VT
3277
GN/GY
X200
11
10
9
3276
GY/BK
7533
GN/VT
3277
GN/GY
X300
33
35
34
3276
GY/BK
7533
GN/VT
3277
GN/GY
3
2
1
12V
K89
Immobilizer
Control
Module

Fig. 1: Immobilizer
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B2955: SECURITY SENSOR DATA CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B2955 00

Security Sensor Data Circuit Malfunction

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B2955 00	B2955 00	-	-
Serial Data	B2955 00	B2955 00	B2955 00	B2955 00
Low Reference	-	B2955 00	-	-

Circuit/System Description

When a keyless entry transmitter is inserted into the transmitter pocket/slot and the ignition mode switch is pressed, the transponder embedded in the transmitter is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

The BCM detects a circuit fault on the immobilizer antenna circuits.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the condition for setting the DTC are no longer present.
- A history DTC will be cleared after 100 malfunction-free power mode cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the K89 Immobilizer Control Module. It may take up to 2 min for all vehicle systems to power down.

2. Verify a test lamp illuminates between the low reference circuit terminal 1 and B+.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
3. Vehicle in Service Mode.

NOTE: **In some instances, the K9 Body Control Module may only apply voltage for 3 s immediately after the ignition mode switch is pressed. It may be necessary to monitor the DMM while pressing the ignition mode switch to observe the voltage.**

4. Test for greater than 9 V between the ignition circuit terminal 3 and ground.
    - **If 9 V or less**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If greater than 9 V**
5. Vehicle in Service Mode.
6. Test for 12 - 13 V between the serial data circuit terminal 2 and ground.
    - **If less than 12 V**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If greater than 13 V**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If within 12 - 13 V**
7. Replace the K89 Immobilizer Control Module.
8. Verify DTC B2955 is not set.
    - **If DTC B2955 is set**

      Replace the K9 Body Control Module.

    - **If DTC B2955 is not set or is set as history**
9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for body control module or immobilizer control module replacement, programming, and setup

DTC B302A: MOBILE TELEPHONE COMMUNICATIONS INTERFACE REQUESTED IMMOBILIZATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B302A

Mobile Telephone Communications Interface Requested Immobilization

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

As part of the vehicle telematics enhanced services, a request may be sent to the body control module (BCM) to disable vehicle starting. If a valid message is received by the BCM requesting that starting be disabled, the start enable message will not be sent to the engine control module (ECM).

Conditions for Running the DTC

The BCM continuously monitors for this DTC.

Conditions for Setting the DTC

A start disable message has been received from the telematics module.

Action Taken When the DTC Sets

Vehicle starting will be suspended and the security indicator will be illuminated.

Conditions for Clearing the DTC

- A current DTC will clear when the telematics start disable request is no longer received.
- A history DTC will clear after 100 ignition cycles in which the telematic start disable request is not seen.

Diagnostic Aids

- DTC B302A is only an indicator that a start disable request has been received from the vehicle telematics system and does not indicate a fault in the immobilizer or telematics system.
- To remove the start disable request, the vehicle account must be updated with the OnStar stolen vehicle team. This will require that a law enforcement agency or the customer contact OnStar to indicate that the vehicle has been successfully and safely recovered.
- If the OnStar system has been disabled or damage during a theft attempt, the system will not be able to communicate and the start disable request will not be removed. OnStar must be functioning properly for the start disable request to be removed.

Reference Information

Schematic Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the OnStar system is not damaged and is operating properly, with no DTCs set.
    - **If the OnStar system is damaged, inoperative, or any OnStar DTCs are set**

      These concerns must be corrected before the start disable can be removed.

    - **If the OnStar system is not damaged and is operating properly**
2. Press the blue OnStar button and ask the advisor to be transferred to the stolen vehicle team to verify the vehicle account has been updated.
3. Verify that OnStar is aware the vehicle has been recovered and that the vehicle account has been updated.
    - **If OnStar has not been notified that the vehicle has been recovered**

      Contact the customer and advise them that for security purposes, they must contact OnStar and the law enforcement agency to update the vehicle account.

    - **If the account has been properly updated**
4. Once the vehicle account has been updated and the start disable request has been removed, DTC B302A will transition to a history DTC. Clear the history DTC.

DTC B3031: SECURITY CONTROLLER IN LEARN MODE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3031

Security Controller In Learn Mode

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When learning a coded key, the body control module (BCM) is placed in learn mode. DTC B3031 will set automatically as an indicator that the system is in learn mode and not as a fault indicator. On some model year vehicles the instructions for adding keys includes the direction to always use two learned keys. This DTC will set if that direction is not followed. If only one learned key is available then Replacing Keys must be performed. Once the coded key is learned, learn mode will be exited and the DTC cleared. If the BCM does not exit learn mode, DTC B3031 will remain current and indicate a fault.

The instrument cluster security indicator will illuminate and the driver information center will display a message.

Conditions for Running the DTC

The immobilizer system is the learn coded keys state.

Conditions for Setting the DTC

The DTC will set any time the BCM enters the learn coded keys state.

Action Taken When the DTC Sets

The security indicator will illuminate. The driver information center will display a message.

Conditions for Clearing the DTC

- A current DTC B3031 will be cleared upon the successful exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify all available keys are correct for the vehicle. This can be accomplished by comparing the part number that is laser etched on the key to the part number listed in the parts catalog.

   NOTE: **On some model year vehicles two learned keys are required to add additional keys. If only one learned key is used, this DTC will set. If only one learned key is available then Replacing Keys must be performed.**

   - **If a key is not correct**

     Replace the key

   - **If all keys are correct**
2. Verify the scan tool Immobilizer data displays two or more keys learned to the vehicle.
   - **If not**

Add one additional key

- **If two or more keys are learned to the vehicle**

3. Perform the Replacing Keys procedure. Refer to **Key with Integrated Transmitter Programming**.
4. Verify the K9 Body Control Module learns the vehicle key and exits the learn coded key state. The scan tool Master Keys Learned parameter should increment to 1.
    - **If the K9 Body Control Module does not exit the learn coded key state after the programming attempt**

      Replace the K9 Body Control Module

    - **If the K9 Body Control Module exits the learn coded key state after the programming attempt**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for body control module replacement, programming, and setup.

DTC B3055: NO TRANSPONDER MODULATION OR NO TRANSPONDER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3055

No Transponder Modulation or No Transponder

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

The BCM is unable to measure the key transponder value.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator will illuminate. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a valid transponder value from the key.

- A history DTC will be cleared after 100 malfunction-free power mode cycles.

Diagnostic Aids

- Because DTC B3055 may be caused by a malfunctioning vehicle key, it is necessary to have all available keys at the time of diagnosis. A possible scenario would be a customer leaving the vehicle with a spare key during the service visit, but the key which they use everyday, not the spare key, is the cause of the DTC. Not having all available keys in this instance would result in the customer concern not being duplicate or a misdiagnosis.
- Ensure that the immobilizer control module is properly installed and fully seated. An audible and/or tactile click will indicate that the immobilizer control module is fully seated. To ensure proper transponder communication, the key must be in a specific location in relation to the immobilizer control module. If the immobilizer control module is not fully seated, transponder communication may not occur and DTC B3055 will set.

Reference Information

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B1370, B1380, or B1441 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Verify all available keys are correct for the vehicle.
    - **If a key is not correct**

      Replace the key

    - **If all keys are correct**
4. Remove the battery from each of the available vehicle keys.
5. Verify that DTC B3055 does not set while attempting to start the vehicle which each available key. To start the vehicle with the key battery removed, the key must be placed in the key slot.
    - **If DTC B3055 sets when attempting to start the vehicle with only one of the available keys**

Replace the appropriate key.

- **If DTC B3055 sets when attempting to start the vehicle with all of the available keys**

  Replace the K89 Immobilizer Control Module.

- **If DTC B3055 does not set**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for immobilizer control module replacement, programming, and setup

DTC B305C: IMMOBILIZER TRANSPONDER OF WRONG TYPE PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B305C

Immobilizer Transponder of Wrong Type Programmed

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When a vehicle key/keyless entry transmitter is inserted into the key slot/transmitter pocket and the vehicle on/off switch is pressed, the transponder embedded in the key/transmitter is energized by the immobilizer antenna exciter coil. The transponder transmits a signal to the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is correct, the BCM will send the prerelease password via the serial data circuit to the engine control module (ECM). If the learned key code does not match or a transponder value is not received, the BCM will send the start disable password to the ECM.

Conditions for Running the DTC

- Battery voltage is greater than 9 volts
- Transponder authentication has occurred

Conditions for Setting the DTC

- The programed transponder type does not match the equipped system on the vehicle.
- A transponder used for vehicles without BTM and/or ATH/ATS has been programmed to a vehicle with BTM and/or ATH/ATS.
- A transponder used for vehicles with BTM and/or ATH/ATS has been programmed to a vehicle without BTM and/or ATH/ATS.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a programed transponder type that matches the equipped system on the vehicle.
- A history DTC will be cleared after 100 malfunction-free power mode cycles.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Using each vehicle key, attempt to put the vehicle in Service Mode.
2. Verify DTC B305C does not set after each attempt to put the vehicle in Service Mode.
    - **If the DTC sets**

      Replace the appropriate key or keyless entry transmitter.

    - **If the DTC does not set**
3. All OK.

DTC B3060: UNPROGRAMMED TRANSPONDER IDENTIFICATION CODE RECEIVED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3060

Unprogrammed Transponder Identification Code Received

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

The transponder value measured by the BCM is incorrect or not learned to the vehicle.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. The driver information center will display a service message.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a valid transponder value from the key.
- A history DTC will be cleared after 100 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

Reference Information

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Vehicle Key Relearn procedure. Refer to **Key with Integrated Transmitter Programming**.
2. Verify the scan tool Key Part Number parameter reads a Key Part Number when turning the vehicle ON with each key.
    - **If a Key Part Number is not read**

      Replace the appropriate key.

    - **If a Key Part Number is read with each key**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Key with Integrated Transmitter Programming

DTC B389A: ENVIRONMENT IDENTIFICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B389A

Environment Identification

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The Instrument Cluster, Electronic Brake Control Module, HVAC Control Module, Inflatable Restraint Sensing and Diagnostic Module, engine control module (ECM), and Steering Column Lock Module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

An incorrect immobilizer identifier was broadcast by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the BCM broadcasts a correct immobilizer identifier.

Diagnostic Aids

If BCM programming is not completed after BCM replacement, the immobilizer identifier will not be learned. If DTC B389A sets immediately after the replacement and programming of a BCM, perform the programming procedure again.

Reference Information

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B389A did not set immediately following the replacement and programming of the K9 Body Control Module.
   - **If the DTC set immediately after the replacement and programming of the K9 Body Control Module**

     The immobilizer learn procedure was not properly completed. Perform the BCM immobilizer learn using the body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to Immobilizer System Component Programming.

   - **If the DTC did not set immediately after the replacement and programming of the K9 Body Control Module**
2. Verify DTC B3902 is not set in any of the control modules listed below:
   - K20 Engine Control Module
   - K36 Inflatable Restraint Sensing and Diagnostic Module
   - K17 Electronic Brake Control Module
   - K33 HVAC Control Module
   - P16 Instrument Cluster
   - K60 Steering Column Lock Module (if equipped)
   - **If DTC B3902 is set in any of the modules**

     Refer to DTC B3902.

   - **If DTC B3902 is not set in any of the modules**
3. Perform the K9 Body Control Module immobilizer learn using body control module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to Immobilizer System Component Programming.
4. Verify DTC B389A does not set after programming.
   - **If the DTC sets after programming**

     Replace the K9 Body Control Module.

   - **If the DTC does not set after programming**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for body control module replacement, programming, and setup.

DTC B3902: INCORRECT IMMOBILIZER IDENTIFIER RECEIVED

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B3902

Incorrect Immobilizer Identifier Received

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module (ECM), and steering column lock module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The control module's environment identifier does not match the environment identifier stored by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set DTC B3902.

   NOTE: **When performing the following step, Immobilizer System Component Programming, the module may also need to be reset by using the SPS function Prepare For Removal.**

2. Perform the Immobilizer System Component Programming **Immobilizer System Component Programming**.
3. Verify DTC B3902 does not set after programming.
   - **If the DTC sets after programming**

     Replace the control module that set the DTC.

   - **If the DTC does not set after programming**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module, or steering column lock module replacement, programming, and setup.

DTC B3924-B3928: INCORRECT ENVIRONMENTAL IDENTIFIER RECEIVED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3924

Incorrect Environmental Identifier Received From Inflatable Restraint Sensing and Diagnostic Module

DTC B3925

Incorrect Environmental Identifier Received From HVAC Control Module

DTC B3926

Incorrect Environmental Identifier Received From Instrument Cluster

DTC B3927

Incorrect Environmental Identifier Received From Electronic Brake Control Module

DTC B3928

Incorrect Environmental Identifier Received From Telematics Communication Interface Control Module

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping of control modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, and telematics communication interface control module each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The control module's environment identifier does not match the environment identifier stored by the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set the DTC.
2. Verify the DTC does not set after programming.
    - **If the DTC sets after programming**

      Replace the control module that set the DTC.

    - **If the DTC does not set after programming**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, or telematics communication interface control module replacement, programming, and setup.

DTC B3935: TRANSPONDER AUTHENTICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3935

Transponder Authentication

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils surrounding the key slot. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

- Vehicle is ON or in Service Mode.
- A valid transponder value has been read.

Conditions for Setting the DTC

- The transponder value is valid and matches the value stored in the BCM memory.
- The transponder calculation of the challenge from the BCM does not match the BCM calculation.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator will illuminate. The driver information center will display a service message.

Conditions for Clearing the DTC

- A current DTC will be cleared when a valid transponder value has been read and authenticated.
- A history DTC will be cleared after 100 malfunction-free power mode cycles.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Replace the suspected inoperative or malfunctioning key.
2. Verify DTC B3935 is not set as current.
    - **If the DTC is set as current**

      Replace the K9 Body Control Module.

    - **If the DTC is set as history**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for body control module replacement, programming, and setup

DTC B3976: UNCONFIGURED TRANSPONDER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3976

Unconfigured Transponder

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When a vehicle key is inserted into the key slot and the vehicle on/off switch is pressed, the transponder embedded in the head of the key is energized by the exciter coils surrounding the key slot. The energized transponder transmits a signal that contains its unique value, which is received by the body control module (BCM). The BCM then compares this value to a value stored in memory. If the value is not correct, the BCM disables engine start.

Conditions for Running the DTC

- Vehicle is ON or in Service Mode.
- The BCM is in the learn coded key state.

Conditions for Setting the DTC

The BCM has determined the current key is not configured as a proper vehicle key.

Action Taken When the DTC Sets

- Vehicle starting will be disabled.
- The security indicator in the instrument cluster will be illuminated. A service message will be displayed in the driver information center.

Conditions for Clearing the DTC

- A current DTC will be cleared when the BCM detects a properly configured vehicle key.
- A history DTC will be cleared after 100 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the engine starts with each available key.
    - **If the engine does not start with a key**

      Replace the key.

    - **If the engine starts with all keys**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC B3984: DEVICE 1 ENVIRONMENT IDENTIFIER NOT PROGRAMMABLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3984

Device 1 Environment Identifier Not Programmable

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When certain modules are programmed and configured during installation, the module learns a specific environment identifier which is unique to the vehicle. The environment identifier is used to prevent the swapping modules between vehicles. The body control module (BCM) is the keeper of the environment identifier. The instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module (ECM), and steering column lock module (if equipped) each learn the environment identifier during their configuration process. During vehicle operation, the BCM sends the immobilizer identifier as a challenge and each module responds to the challenge by sending the environment identifier back to the BCM. If the BCM sends an incorrect immobilizer identifier or a specific number of incorrect environment identifiers are received, vehicle starting is disabled.

Conditions for Running the DTC

Ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

An incorrect environment identifier is programmed or no environment identifier is programmed.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

A current DTC will be cleared when the module learns a correct environment identifier.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the Programming and Setup procedure for the control module that set DTC B3984.
2. Verify DTC B3984 does not set after programming.
    - **If the DTC sets after programming**

      Replace the control module that set the DTC.

- **If the DTC does not set after programming**

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for instrument cluster, electronic brake control module, HVAC control module, inflatable restraint sensing and diagnostic module, engine control module, and steering column lock module replacement, programming, and setup.

DTC P0513: IMMOBILIZER KEY INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC P0513

Immobilizer Key Incorrect

Circuit/System Description

The body control module (BCM) sends the pre - release information to the hybrid/EV powertrain control module 1 via the serial data circuit. The hybrid/EV powertrain control module 1 then sends a challenge to the BCM. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. The engine control module (ECM) also monitors this challenge and calculates it's own result. If the calculated response from the BCM equals the calculation performed by the hybrid/EV powertrain control module 1 and ECM, the hybrid/EV powertrain control module 1 and ECM will allow vehicle propulsion.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

Hybrid/EV Powertrain Control Module 1

The calculated response from the BCM does not equal the calculation performed by the hybrid/EV powertrain control module 1.

Engine Control Module

The calculated response from the BCM does not equal the calculation performed by the ECM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

- A current DTC P0513 will be cleared when a valid calculation is received.
- A history DTC will be cleared after 40 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

Diagnostic Aids

The key referenced in the DTC descriptor does not refer to the vehicle key. In this case, key is referring to the challenge response.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
    - **If any immobilizer DTCs are set in the K9 Body Control Module**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K9 Body Control Module immobilizer learn using the Body Control Module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to **Immobilizer System Component Programming**.
3. Verify the K9 Body Control Module successfully completes the learn procedure and DTC P0513 is not set.
    - **If the K9 Body Control Module does not successfully learn or DTC P0513 is set**

      Perform the appropriate immobilizer learn using the IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.

    - **If the K9 Body Control Module successfully completes the learn and DTC P0513 is not set**
4. All OK

DTC P0633: IMMOBILIZER KEY NOT PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P0633

Immobilizer Key Not Programmed

Circuit/System Description

When learning the immobilizer data, as well as the challenge and response sequence, the engine control module (ECM) is placed in learn mode. DTC P0633 will set automatically as an indicator that the system is in learn mode and not as a fault indicator. Once the immobilizer data and challenge/response are learned, learn mode will be exited when the engine is successfully started. If the ECM does not exit learn mode, DTC P0633 will remain current and indicate a fault.

Conditions for Running the DTC

The ECM is in learn mode.

Conditions for Setting the DTC

DTC P0633 will set any time the ECM enters learn mode.

Action Taken When the DTC Sets

The security indicator in the instrument cluster will illuminate.

Conditions for Clearing the DTC

- A current DTC will be cleared upon a successful engine start after exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **DTC P0633 will clear upon a successful engine start. Any malfunction that will cause a no-start condition will prevent DTC P0633 from clearing. Prior to diagnosing DTC P0633, ensure that all power moding and engine control systems are operating properly and all conditions that may cause a no-start have been corrected. Do not replace the K20 Engine Control Module. Replacing the K20 Engine Control Module will not correct the no-start condition.**

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
   - **If any immobilizer DTCs are set in the K9 Body Control Module**

        Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no immobilizer DTCs are set in the K9 Body Control Module**

2. Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.
3. Verify the engine starts after the K20 Engine Control Module completes the learn procedure.
    - **If the engine does not start**

      An undiagnosed no-start condition exists. Refer to the appropriate subsection and diagnostic to correct the no-start condition.

    - **If the engine starts**
4. All OK.

DTC P162B: REMOTE VEHICLE SPEED LIMITING SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P162B

Remote Vehicle Speed Limiting Signal Message Counter Incorrect

Circuit/System Description

When a remote slow-down request is sent from OnStar, the vehicle communication interface control module sends a serial data message to the engine control module (ECM) indicating that reduced vehicle speed has been requested. Once the request is active, the ECM begins reducing engine torque to match the requested vehicle speed and the REDUCED ENGINE POWER message is displayed.

Conditions for Running the DTC

- The engine run time is greater than 5 s
- A remote slow-down request is sent from OnStar

Conditions for Setting the DTC

- The VIN embedded in the slow-down request does not match the VIN stored in the ECM.
- The rolling code counter embedded in the slow-down request does not increment for ten consecutive messages.

Action Taken When the DTC Sets

- ECM ignores all reduced vehicle speed request messages from the vehicle communication interface module.
- The ECM stores DTC P162B in history.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear after 40 malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Remote Vehicle Speed Limiting Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the vehicle is equipped with OnStar (RPO UE1) and DTC P162B is set
    - **If the vehicle is not equipped with OnStar (RPO UE1) and DTC P162B is set**

      Replace the ECM.

    - **If the vehicle is equipped with OnStar (RPO UE1) and DTC P162B is set**
2. Perform the Remote Vehicle Speed Limiting Reset procedure with the scan tool.
3. Verify DTC P162B is not set.
    - **If DTC P162B is set**
    1. Reprogram the ECM. Refer to **Control Module References** .
    2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
        - If the DTC sets, replace the ECM. If the DTC continues to set after ECM replacement, replace the vehicle communication interface module.
        - If the DTC does not set
    3. All OK.
    - **If DTC P162B is not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for telematics communication interface control module or engine control module replacement, programming, and setup

DTC P1631: IMMOBILIZER FUEL ENABLE SIGNAL NOT CORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1631

Immobilizer Fuel Enable Signal Not Correct

Circuit/System Description

The body control module (BCM) sends the pre - release information to the hybrid/EV powertrain control module 1 via the serial data circuit. The hybrid/EV powertrain control module 1 then sends a challenge to the BCM. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. The engine control module (ECM) also monitors this challenge and calculates it's own result. If the calculated response from the BCM equals the calculation performed by the hybrid/EV powertrain control module 1 and ECM, the hybrid/EV powertrain control module 1 and ECM will allow vehicle propulsion.

Conditions for Running the DTC

Vehicle is ON or in Service Mode.

Conditions for Setting the DTC

Hybrid/EV Powertrain Control Module 1

The hybrid/EV powertrain control module 1 receives incorrect immobilizer data from the BCM.

Engine Control Module

The ECM receives incorrect immobilizer data from the BCM.

Action Taken When the DTC Sets

- The security indicator in the instrument cluster will illuminate.
- Vehicle starting will be disabled.

Conditions for Clearing the DTC

- A current DTC P1631 will be cleared when correct immobilizer data is received.
- A history DTC will be cleared after 40 malfunction-free power mode cycles or when a scan tool is used to clear DTCs.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
    - **If any immobilizer DTCs are set in the K9 Body Control Module**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no immobilizer DTCs are set in the K9 Body Control Module**

2. Perform the K9 Body Control Module immobilizer learn using the Body Control Module IMMO Function with Existing Transponder or Remote Key in SPS. Refer to **Immobilizer System Component Programming**.
3. Verify the K9 Body Control Module successfully completes the learn procedure and DTC P1631 is not set.
    - **If the K9 Body Control Module does not successfully learn or DTC P1631 is set**

      Perform the appropriate immobilizer learn using the IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.

    - **If the K9 Body Control Module successfully completes the learn and DTC P1631 is not set**
4. All OK

DTC P1649: IMMOBILIZER SECURITY CODE NOT PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1649

Immobilizer Security Code Not Programmed

Circuit/System Description

When learning the security code, as well as the challenge and response sequence, the engine control module (ECM) is placed in learn mode. Once the security code and challenge/response are learned, learn mode will be exited when the engine is successfully started.

Conditions for Running the DTC

The ECM is in learn mode.

Conditions for Setting the DTC

The ECM has not learned a security code.

Action Taken When the DTC Sets

The security indicator in the instrument cluster will illuminate.

Conditions for Clearing the DTC

- A current DTC will be cleared upon a successful engine start after exit of learn mode.
- A history DTC will be cleared after 100 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Immobilizer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Immobilizer Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify there are no immobilizer DTCs set in the K9 Body Control Module.
    - **If any immobilizer DTCs are set in the K9 Body Control Module**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no immobilizer DTCs are set in the K9 Body Control Module**
2. Perform the K20 Engine Control Module immobilizer learn using the engine control module IMMO Learn in SPS. Refer to **Immobilizer System Component Programming**.
3. Verify the engine starts after the K20 Engine Control Module completes the learn procedure.
    - **If the engine does not start**

      Replace the K20 Engine Control Module.

    - **If the engine starts**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for engine control module replacement, programming, and setup.

SYMPTOMS - IMMOBILIZER

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Immobilizer Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **OnStar Stolen Vehicle Slowdown Active** to diagnose the symptom.

ONSTAR STOLEN VEHICLE SLOWDOWN ACTIVE

Diagnostic Instructions

NOTE: **This procedure is not used in Brazil.**

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

When a remote slow-down request is sent from OnStar, the Telematics Communication Interface Control Module sends a serial data message to the engine control module (ECM) indicating that reduced vehicle speed has been requested. Once the request is active, the ECM begins reducing engine torque to match requested vehicle speed and the REDUCED ENGINE POWER message is displayed.

Reference Information

Schematic Reference

OnStar/Telematics Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Remote Vehicle Speed Limiting Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the vehicle is not in the OnStar initiated Stolen Vehicle Slowdown mode. This can be accomplished by verifying the scan tool Telematics Enhanced Service Immobilization parameter is No.
    - **If the scan tool Telematics Enhanced Service Immobilization parameter is Yes**
    1. Perform the Remote Vehicle Speed Limiting Reset procedure with the scan tool.
    2. Press the blue OnStar button and inform the advisor that you need to be transferred to the stolen vehicle team to update the vehicle account.
    - **If the scan tool BCM Telematics Enhanced Service Immobilization parameter is No**
2. All OK.

REPAIR INSTRUCTIONS

IMMOBILIZER SYSTEM COMPONENT PROGRAMMING

This procedure will learn the immobilizer function and require greater than 15 minutes to complete. If the battery voltage is low, charge the battery before proceeding with the learn. If the body control module (BCM) or engine control module (ECM) have been replaced, they must be programmed before performing this learn procedure.

Depending on the immobilizer function being learned or the component replaced, different learn functions are required to be performed. These learn functions are as follows:

Function name on SPS tool:	Function description:	When the function should be used:	Notes:
Body Control Module IMMO Function with Existing Transponder or Remote Key	The BCM will relearn the immobilizer passwords and data while reusing the existing vehicle keys	The BCM has been replaced and the existing vehicle keys are being reused or a diagnostic has instructed to perform the learn	-
Body Control Module IMMO Function with New Transponder or Remote Key	The BCM will relearn the immobilizer passwords and data while using new vehicle keys	The BCM has been replaced and new vehicle keys are being reused	-
Engine Control Module IMMO Learn	The ECM will relearn the immobilizer passwords and data	The ECM has been replaced or a diagnostic has instructed to perform the learn	-
Engine Control Module and Body Control Module IMMO Learn	The ECM and BCM will learn new immobilizer passwords and data	Both the ECM and BCM have been replaced (this selection will REQUIRE new vehicle keys be used)	Because both the ECM and BCM have been replaced and are learning new immobilizer passwords and data, all vehicle keys must also be replaced
Program Transponder or Remote Key (Add)	A new vehicle key will learn the immobilizer passwords and data	A new vehicle key is being added (does not affect other vehicle keys)	This function may not be available in all sales regions
Program Transponder or Remote Key (Delete)	All existing vehicle keys will be invalidated and any desired keys are relearned	All vehicle keys are desired to be invalidated and certain keys relearned or a diagnostic has instructed to perform the learn	This procedure may be used if a customer has had their keys lost or stolen and wishes to invalidate the keys, making them unable to start the vehicle

1. Connect a scan tool to the vehicle and access SPS.
2. Vehicle in Service Mode, engine OFF.
3. Ensure that all power consuming devices are turned OFF on the vehicle.
4. Select SPS application and follow the on-screen instructions.
5. Select Reprogram ECU.
6. Select IMMO Immobilizer Learn - Setup.
7. Select the appropriate programming function based on the component that was replaced or is being programmed. Refer to the table at the top of this document for assistance in choosing the correct programming function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the vehicle to Service Mode. Make sure the vehicle**

is actually in the Service Mode before continuing on the SPS terminal. If the vehicle is not in the Service Mode, the learn procedure will fail.

- **The key pocket is located in the center console under the small tray. The key must be placed with the buttons facing down.**

8. Follow the on-screen instructions.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

9. After programming all keys "Programming Complete" is displayed.
10. Press and hold the vehicle ON/OFF switch for 15 seconds.
11. Press the lock and unlock button on each transmitter that was programmed. This will awaken each transmitter and allow passive and active keyless entry functions to be established.
12. With a scan tool, clear any DTCs.
13. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the transmitter and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Unable to Complete Programming

When attempting to program immobilizer components, various conditions may prevent the programming operation from completing. These conditions may be caused by normal system operation, a system malfunction, or an external influence. Common symptoms of a incomplete programming is receiving an error message during the attempt or having the SPS application become unresponsive.

- DTCs are set in the body control module (BCM)

  The immobilizer system is a function of the BCM software. If immobilizer DTCs are set in the BCM, such as DTC B2955, a fault has been identified in the immobilizer system. If this is not corrected before attempting to program components, the programming may not complete. Correct all immobilizer DTCs before attempting to program any immobilizer components.

- The key has been programmed to another vehicle or is not the correct type for the vehicle

  A key can only be programmed to a single vehicle. Once a key is programming to a vehicle, it is paired for the life of the key. The key can be learned to the same vehicle again and again, but it is not able to be programmed to a different vehicle.

  Many vehicle are available with both a base keyless entry system and an optional passive entry system. These keys typically look identical but cannot be substituted for one another. To verify the key is correct, compare the part number that is etched on the key to the part number identified in the parts catalog. The key should be correct for the system installed in the vehicle.

- The theft deterrent module is not properly secured or the key is not properly positioned in the pocket/slot.

  A theft deterrent module that is not fully seated or is otherwise not properly secured may prevent a coupling between the transponder located in the key and the theft deterrent module. Being out of place by as little as 1 mm may prevent programming from completing. Make sure the theft deterrent module is properly installed and fully seated in it's clip.

  The key shank must be fully extended so that the entire key shank fits into the programming slot.

  To determine if the theft deterrent module is properly secured, remove the battery from the key and place the key into the pocket/slot. Attempt to change the vehicle mode by pressing the vehicle ON/OFF switch. The vehicle should change modes. If the NO REMOTE DETECTED message is displayed on the DIC, the theft deterrent module may not be properly secured.

- External interference is interrupting the programming operation

  External RF interference and EMI may interrupt the low frequency coupling between the key and theft deterrent module. This interference may come from many different locations. Devices plugged into the vehicle power outlets such as cell phone chargers, laptop computers, GPS devices, etc. may cause interference. Vehicle location may also cause interference. Locations near airports and military installations may causer interference. Remove all customer installed devices and, if necessary, move the vehicle if interference is suspected.

KEY WITH INTEGRATED TRANSMITTER PROGRAMMING

Keys can be programmed in various ways using the procedures outlined below. Using the Replacing Keys procedures will first erase all the known keys from the vehicle. Any existing keys and any new keys will then be programmed. This procedure should be used any time a key is required to be unlearned or erased from a vehicle. If a new key is being learned to a vehicle to replace a damaged, inoperative, or stolen key, the Replacing Keys procedure must be used. This ensures that the old key cannot be used to access or start the vehicle after programming.

The Adding Keys procedure does not erase any keys prior to programming. The procedure will simply program the key into the next available slot. The Adding Keys procedure should only be used when adding an additional key to the vehicle. The Adding Keys procedure should never be used to program a key to a vehicle that is having a key replaced, regardless of the cause for the replacement.

Replacing Keys (Without SPS)

NOTE:

- **This procedure will unlearn all previously learned keys. All keys that are to be programmed must be with the vehicle.**
- **This procedure will take approximately 30 minutes to complete.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **This procedure may be used with or without existing learned keys being present. If existing keys are present, keep the keys away from the vicinity of the vehicle. Failure to keep learned keys away from the vehicle will result in the learn changing to the Adding Keys procedure.**
- **The keys to be learned must duplicate the mechanical cut of the current key.**

1. Insert the mechanical key of the new key into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The Driver Information Center (DIC) will display Remote Learn Pending, Please Wait.
2. After ten minutes, the DIC will display Press Engine Start Button To Learn. Press the vehicle ON/OFF switch. The DIC will again display Remote Learn Pending, Please Wait.
3. Repeat Step 2 two additional times, for a total of thirty minutes. All previously known keys have now been unlearned. Remaining keys can be relearned during the next steps. The DIC display will now display Ready For Remote # 1.

   NOTE: **The key pocket is located in the center console under the small tray. The key must be placed with the buttons facing down.**

4. Place the new key into the key pocket.

   NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

5. Press the vehicle ON/OFF switch. When the key is learned the DIC will indicate that it is ready to program the next key.
6. Remove the key from the key pocket and press the unlock button. To program additional keys, repeat Steps 4 through 6.
7. When all additional keys are programmed, press and hold the vehicle ON/OFF switch for 5 seconds to exit programming mode.

Replacing Keys (With SPS)

NOTE:

- **This procedure will unlearn all previously learned keys. All keys that are to be programmed must be with the vehicle.**
- **This procedure may be used with or without existing learned keys being present.**
- **This procedure will take more than 15 minutes to complete.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Delete) function.

   NOTE:

   - **At multiple times during the learn procedure, SPS will instruct you to turn the vehicle to Service Mode. Make sure the vehicle is actually in the Service Mode before continuing on the SPS terminal. If the vehcile is not in the Service Mode, the learn procedure will fail.**
   - **The key pocket is located in the center console under the small tray. The key must be placed with the buttons facing down.**

7. Follow the on-screen instructions.

   NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

8. After programming all keys, Programming Complete, is displayed.
9. Press and hold the vehicle ON/OFF switch for 15 seconds.
10. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow passive and active keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Adding Keys (Without SPS)

NOTE:

- **To initiate, this procedure requires that 2 learned keys be available.**

- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure adds keys only. The procedure does not erase previously learned keys.**
- **The keys to be learned must duplicate the mechanical cut of the current key.**

1. Place the recognized keys in the vehicle cupholder.
2. Insert the mechanical key of the new key into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The Driver Information Center (DIC) will display Ready For Remote #2, 3, 4 or 5.

NOTE: **The key pocket is located in the center console under the small tray. The key must be placed with the buttons facing down.**

3. Place the new key into the key pocket.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

4. Press and hold the vehicle ON/OFF switch for two seconds. When the key is programmed, the DIC will show that it is ready to program the next key.
5. Remove the key from the key slot and press the unlock button. To program additional keys, repeat Steps 3 through 5.
6. When all additional keys are programmed, press and hold the vehicle ON/OFF switch for 10 seconds to exit programming mode.

Adding Keys (With SPS)

NOTE:

- **This procedure may be used with or without existing learned keys being present.**
- **This procedure will take more than 15 minutes to complete.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Add) function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the vehicle to Service Mode. Make sure the vehicle is actually in the Service Mode before continuing on the SPS terminal. If the vehcile is not in the Service Mode, the learn procedure will fail.**
- **The key pocket is located in the center console under the small tray. The key must be placed with the buttons facing down.**

7. Follow the on-screen instructions.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

8. After programming all keys, Programming Complete, is displayed.
9. Press and hold the vehicle ON/OFF switch for 15 seconds.
10. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow passive and active keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Unable to Complete Programming

When attempting to program immobilizer components, various conditions may prevent the programming operation from completing. These conditions may be caused by normal system operation, a system malfunction, or an external influence. Common symptoms of a incomplete programming is receiving an error message during the attempt or having the SPS application become unresponsive.

- DTCs are set in the body control module (BCM)

  The immobilizer system is a function of the BCM software. If immobilizer DTCs are set in the BCM, such as DTC B2955, a fault has been identified in the immobilizer system. If this is not corrected before attempting to program components, the programming may not complete. Correct all immobilizer DTCs before attempting to program any immobilizer components.

- The key has been programmed to another vehicle or is not the correct type for the vehicle

  A key can only be programmed to a single vehicle. Once a key is programming to a vehicle, it is paired for the life of the key. The key can be learned to the same vehicle again and again, but it is not able to be programmed to a different vehicle.

  Many vehicle are available with both a base keyless entry system and an optional passive entry system. These keys typically look identical but cannot be substituted for one another. To verify the key is correct, compare the part number that is etched on the key to the part number identified in the parts catalog. The key should be correct for the system installed in the vehicle.

- The theft deterrent module is not properly secured or the key is not properly positioned in the pocket/slot.

  A theft deterrent module that is not fully seated or is otherwise not properly secured may prevent a coupling between the transponder located in the key and the theft deterrent module. Being out of place by as little as 1 mm may prevent programming from completing. Make sure the theft deterrent module is properly installed and fully seated in it's clip.

  The key shank must be fully extended so that the entire key shank fits into the programming slot.

  To determine if the theft deterrent module is properly secured, remove the battery from the key and place the key into the pocket/slot. Attempt to change the vehicle mode by pressing the vehicle ON/OFF switch. The vehicle should change modes. If the NO REMOTE DETECTED message is displayed on the DIC, the theft deterrent module may not be properly secured.

- External interference is interrupting the programming operation

  External RF interference and EMI may interrupt the low frequency coupling between the key and theft deterrent module. This interference may come from many different locations. Devices plugged into the vehicle power outlets such as cell phone chargers, laptop computers, GPS devices, etc. may cause interference. Vehicle location may also cause interference. Locations near airports and military installations may causer interference. Remove all customer installed devices and, if necessary, move the vehicle if interference is suspected.

DESCRIPTION AND OPERATION

IMMOBILIZER DESCRIPTION AND OPERATION

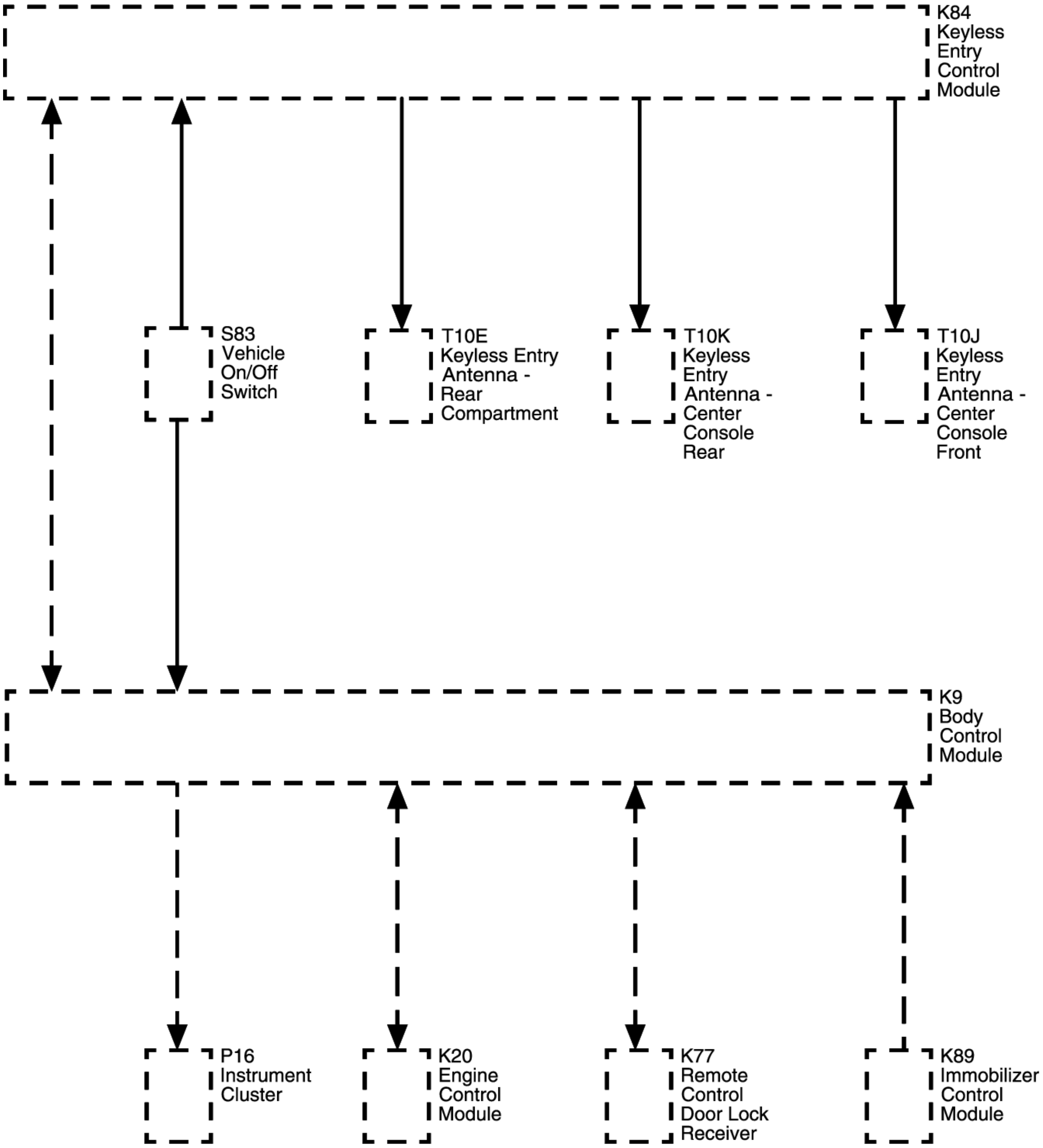

K84 Keyless Entry Control Module
S83 Vehicle On/Off Switch
T10E Keyless Entry Antenna - Rear Compartment
T10K Keyless Entry Antenna - Center Console Rear
T10J Keyless Entry Antenna - Center Console Front
K9 Body Control Module
P16 Instrument Cluster
K20 Engine Control Module
K77 Remote Control Door Lock Receiver
K89 Immobilizer Control Module

Fig. 2: Immobilizer System Diagram
Courtesy of GENERAL MOTORS COMPANY

The immobilizer system functions are provided by the keyless entry control module, remote control door lock receiver, body control module (BCM), hybrid/EV powertrain control module 1, and engine control module (ECM), as well as any modules which store and report the environment identifier. The keyless start system use low frequency antennas in three different locations on the vehicle to determine the location of the transmitter. Multiple antenna are used to ensure complete coverage of the vehicle interior and rear compartment.

When the vehicle ON/OFF switch is pressed, the low frequency antennas emit a challenge to the keyless entry transmitter. The transmitter receives this challenge and emits it's response as an RF message. The transmitter transmits a signal that contains its unique value, which is received by the BCM through the remote control door lock receiver. The BCM then compares this value to a value stored in memory. The BCM also monitors various modules to determine if the stored environment identifiers match.

If both the environment identifier and the value received from the transponder match, the BCM will send the prerelease password via serial data to the hybrid/EV powertrain control module 1. If the encrypted code's unique value is incorrect or the environment identifier does not match, the BCM will send the fuel disable message to the hybrid/EV powertrain control module 1.

When the hybrid/EV powertrain control module 1 receives the BCM prerelease password, the hybrid/EV powertrain control module 1 will challenge the password. The hybrid/EV powertrain control module 1 sends this challenge to the BCM via serial data. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. Additionally, the ECM will also monitor this challenge and calculate it's own response. If the BCM calculated response to the challenge equals the calculation performed by the hybrid/EV powertrain control module 1 and ECM, the hybrid/EV powertrain control module 1 and ECM will allow vehicle propulsion.

If RF communication is interrupted, a "No Remote Detected" message will be displayed on the DIC. In these cases, the extended transmitter key blade can be placed in the transmitter slot located in the upper instrument panel storage compartment, under the rubber mat. The immobilizer antenna coil is located directly beneath the transmitter slot. Placing the transmitter in the pocket will create a low powered coupling between the transmitter and immobilizer antenna, allowing communications to occur and enabling vehicle starting.

The components of the theft system are as follows:

- BCM
- Hybrid/EV powertrain control module 1
- ECM
- Immobilizer antenna
- Ignition key or keyless entry transmitter
- Security indicator
- Various modules which store and report the environment identifier

Body Control Module (BCM)

The immobilizer system is an integral part of the BCM and is controlled internally within the BCM. The BCM can learn up to 8 keys (transponder values).

The BCM uses the following inputs:

- Environment identifier exchange with various modules
- Encrypted code from the vehicle key, received by the immobilizer antenna

The BCM uses the following outputs:

- Prerelease password communication with ECM
- Challenge/response with ECM

When the vehicle ON/OFF switch is pressed, the low frequency antennas emit a challenge to the keyless entry transmitter. The transmitter receives this challenge and emits it's response as an RF message. The transmitter transmits a signal that contains its unique value, which is received by the BCM through the remote control door lock receiver. The BCM then compares this value to a value stored in memory. The BCM then performs one of the following functions:

- If the encrypted code value matches the values stored in the BCM memory, the BCM will send the prerelease password to the ECM via serial data.
- If the encrypted code unique value does not match the value stored in the BCM, the BCM will send the start disable message to the ECM via serial data.
- If the BCM is unable to measure the ignition key encrypted code value, the BCM will not send any messages to the ECM.

Hybrid/EV Powertrain Control Module 1

When the hybrid/EV powertrain control module 1 receives the BCM prerelease password, the hybrid/EV powertrain control module 1 will challenge the password. The hybrid/EV powertrain control module 1 sends this challenge to the BCM via the serial data circuit. Both the hybrid/EV powertrain control module 1 and BCM perform a calculation on this challenge. If the calculated response from the BCM equals the calculation performed by the hybrid/EV powertrain control module 1, the hybrid/EV powertrain control module 1 will allow vehicle propulsion.

The hybrid/EV powertrain control module 1 will disable vehicle propulsion if any of the following immobilization conditions occur:

- The prerelease password is invalid.
- The start disable password is sent by the BCM.
- No passwords are received. There is no communication with the BCM.
- The BCM calculated response to the challenge does not equal the calculation performed by the hybrid/EV powertrain control module 1.

Engine Control Module (ECM)

The ECM functions in the immobilizer system as a type of slave device. It does not general the password challenge, but it does monitor the challenge and response messages between the BCM and hybrid/EV powertrain control module 1. The ECM will calculate it's own result to the challenge. If the ECM response does not equal the BCM response, the ECM may also disable vehicle propulsion. To allow vehicle propulsion, the response from the BCM, ECM, and hybrid/EV powertrain control module 1 must all match.

The ECM will disable vehicle propulsion if any of the following immobilization conditions occur:

- The start disable password is sent by the BCM.
- No passwords are received. There is no communication with the BCM or hybrid/EV powertrain control module 1.
- The BCM calculated response to the challenge does not equal the calculation performed by the ECM.

Immobilizer Antenna

The immobilizer antenna contains an immobilizer coil. The coil passively powers the transponder located in the ignition key when the key is in the transmitter slot. When powered, the key transmits its unique value to the immobilizer antenna, which is then relayed to the BCM via a LIN serial data circuit. The immobilizer antenna also receives B+ and ground from the BCM.

The immobilizer antenna is used to:

1. Learn keys
2. To start vehicle with or without RF interference
3. To start vehicle when key battery is dead

Keyless Entry Transmitter

Each keyless entry transmitter contains a transponder with a unique encrypted value. The transponder's encrypted value is fixed and unable to be changed. The immobilizer system uses the transponder value to determine if a valid transmitter is being used to start the vehicle.

Environment Identifier

Various modules throughout the vehicle learn a specific environment identifier during the module programming process. The environment identifier is learned by each individual module and matches the environment identifier stored in the BCM. Prior to starting after a battery disconnect, each of the modules which store a environment identifier will compare their identifier to that of the identifier stored in the BCM. If all the identifiers match, the engine starting process will continue. If the environment identifiers do not match, engine starting will be disabled.

Security Indicator

The BCM will command the instrument panel cluster to illuminate the security indicator when the vehicle is in Service Mode to indicate a fault has occurred within the immobilizer system and when the engine starting is disabled.

REMOTE VEHICLE SPEED LIMITING DESCRIPTION AND OPERATION

Certain vehicles equipped with OnStarÃ,Â® now have an additional feature that allows for remote limiting of the vehicle's speed. This OnStarÃ,Â® feature is called Stolen Vehicle Slow-Down and is now part of the OnStarÃ,Â® Stolen Vehicle Assistance service. This feature, when used in conjunction with local law enforcement and strict guidelines at the OnStarÃ,Â® Call Center, will slow the vehicle by interacting with the engine control system.

When the engine control system receives a valid request from the OnStarÃ,Â® telematics communications interface module, it will enter into a reduced engine power/vehicle speed limiting mode, which will decelerate the vehicle. Once the request is active the engine control module begins reducing engine torque to match requested vehicle speed and a REDUCED ENGINE POWER indication is displayed. No DTCs will be set during this process.

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Armrest Hinge Reinforcement Assembly Bolt	3 N.m (27 lb in)
Armrest Hinge Reinforcement Assembly Screw	2 N.m (18 lb in)
Diagnostic Link Connector Bolt	2.5 N.m (22 lb in)
Front Floor Console Armrest Hinge Bolt	4.5 N.m (40 lb in)
Front Floor Console Armrest Hinge Screw	2.5 N.m (22 lb in)
Front Floor Console Bolt	3 N.m (27 lb in)
Front Floor Console Cup Holder Bolt	3 N.m (27 lb in)
Front Floor Console Cup Holder Trim Plate Bolt	3 N.m (27 lb in)
Front Floor Console Cup Holder Trim Plate Screw	2.5 N.m (22 lb in)
Front Floor Console Nut	5 N.m (44 lb in)
Heater and Air Conditioning Evaporator and Blower Module Bolt	5 N.m (44 lb in)
Instrument Panel Airbag Bolt	10 N.m (89 lb in)
Instrument Panel Bolt	2.5 N.m (22 lb in)
Instrument Panel Compartment Center Upper Bracket Bolt	10 N.m (89 lb in)
Instrument Panel Knee Bolster Bolt	2.5 N.m (22 lb in)
Instrument Panel Lower Trim Panel Bolt	1.5 N.m (13 lb in)
Instrument Panel Tie Bar Brace Bolt	22 N.m (16 lb ft)
Instrument Panel Tie Bar Reinforcement Bolt	22 N.m (16 lb ft)
Instrument Panel Tie Bar Side Bolt	22 N.m (16 lb ft)
Instrument Panel Tie Bar Upper Bolt	22 N.m (16 lb ft)
Rear Console Side Panel Bolt	3 N.m (27 lb in)
Rear Floor Console Bolt	9 N.m (80 lb in)
Rear Floor Console Stowage Tray Bolt	3 N.m (27 lb in)

REPAIR INSTRUCTIONS

INSTRUMENT PANEL LOWER TRIM PANEL INSULATOR REPLACEMENT

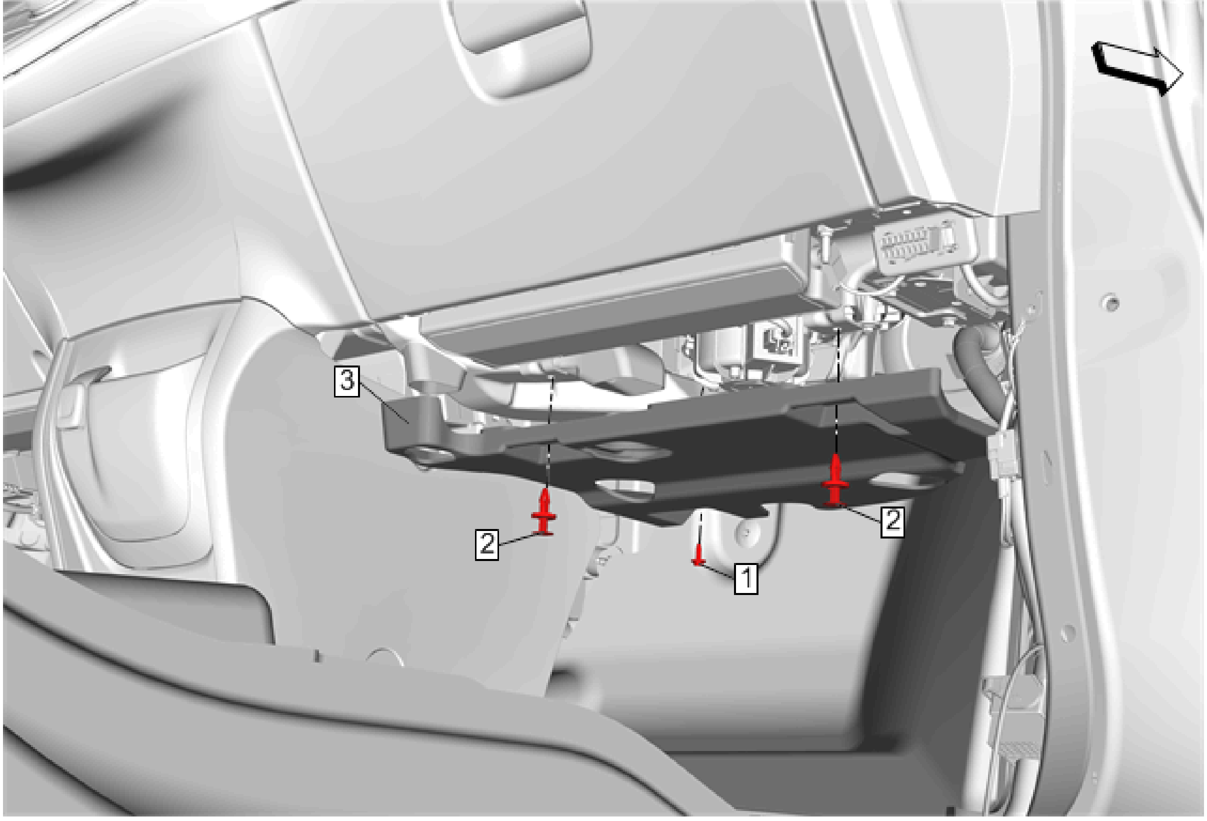


Fig. 1: Instrument Panel Lower Trim Panel Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Refer to SIR Warning .** **Preliminary Procedure** Disable the SIR system. SIR Disabling and Enabling	
1	Instrument Panel Lower Trim Panel Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 1.5 N.m (13 lb in)
2	Instrument Panel Lower Insulator Retainer (Qty: 2) **Procedure** Use a flat bladed plastic tool to remove the push-in retainers.
3	Instrument Panel Lower Trim Panel Insulator **Procedure** Enable the SIR system. SIR Disabling and Enabling

INSTRUMENT PANEL KNEE BOLSTER REPLACEMENT

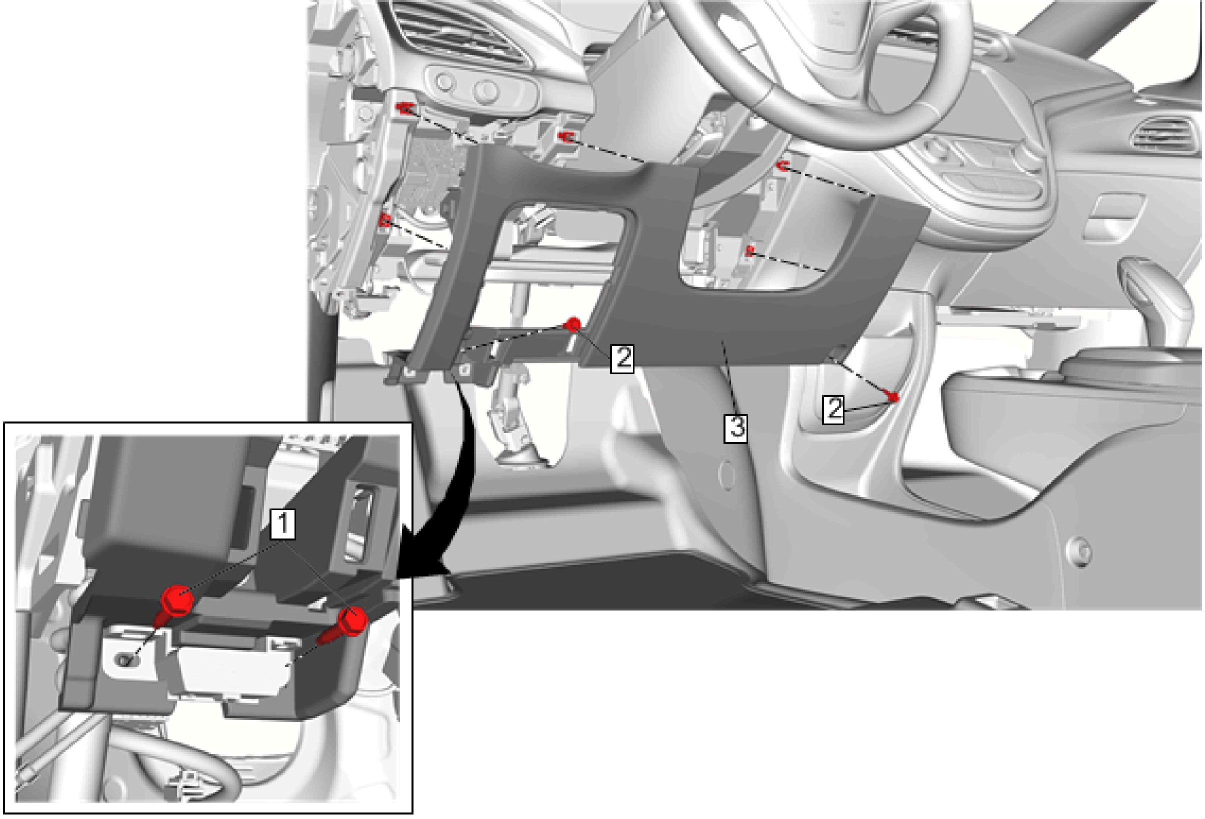


Fig. 2: Instrument Panel Knee Bolster
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Instrument Panel Outer Trim Cover Replacement 2. Instrument Panel Fuse Block Access Hole Cover Replacement	
1	Diagnostic Link Connector Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Instrument Panel Knee Bolster Bolt (Qty: 2) **Tighten** 2.5 N.m (22 lb in)
3	Instrument Panel Knee Bolster **Procedure** Use a flat bladed plastic trim tool.

INSTRUMENT PANEL TRIM PLATE REPLACEMENT

Removal Procedure

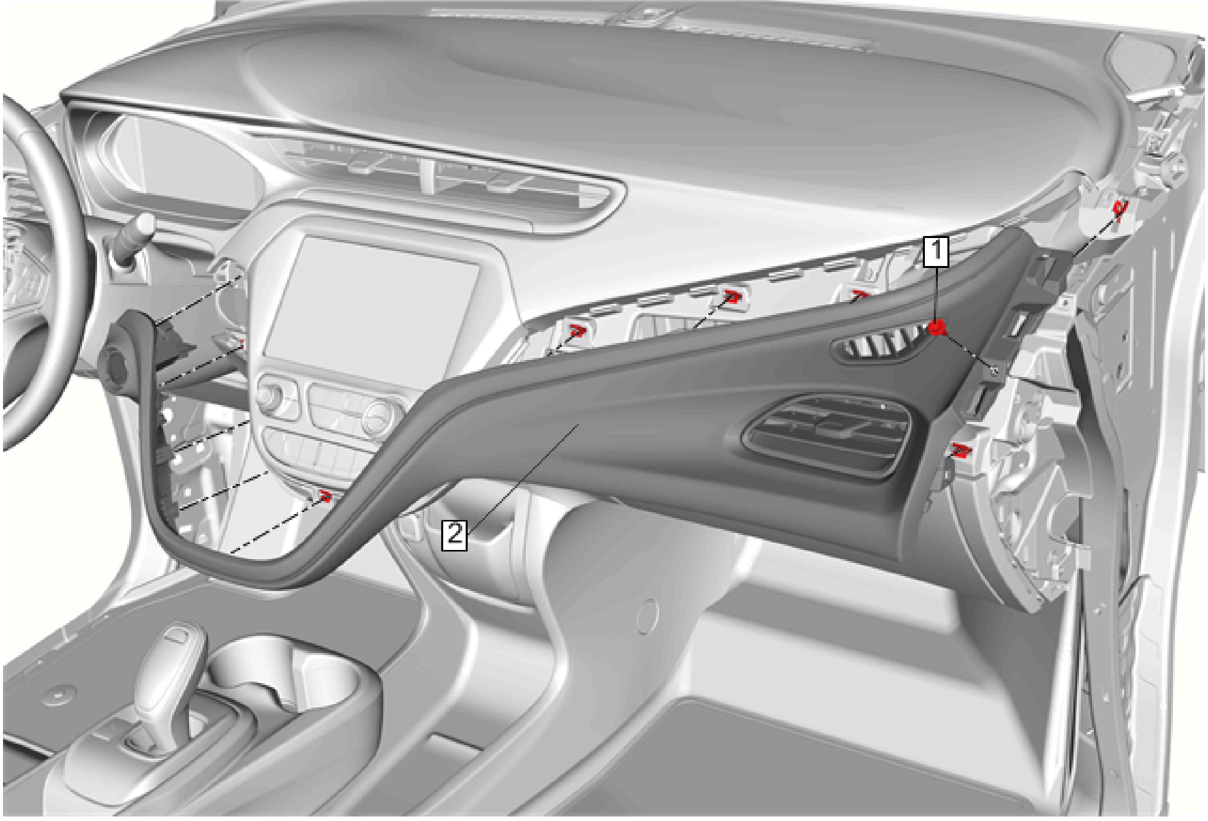


Fig. 3: Instrument Panel Trim Pad - Right Side
Courtesy of GENERAL MOTORS COMPANY

1. Instrument Panel Trim Pad - Right Side - Remove - **Instrument Panel Trim Pad Replacement - Right Side**

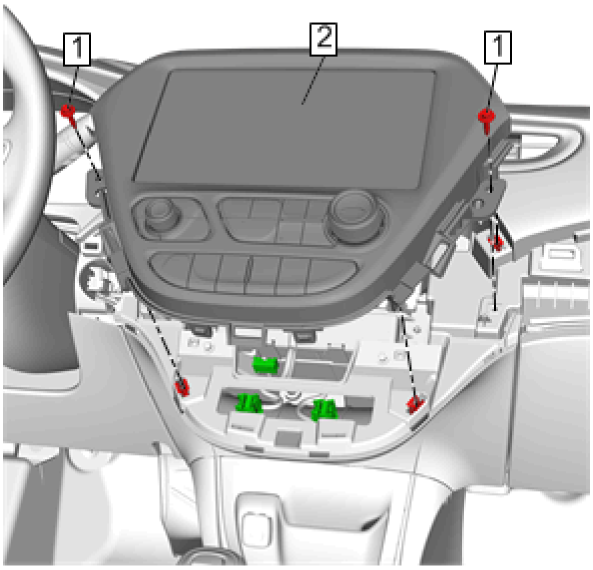


Fig. 4: Instrument Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Instrument Panel Bolt (1) - Remove
3. Instrument Panel Trim Plate Assembly (2) at Instrument Panel - Remove
4. Disconnect the electrical connectors.

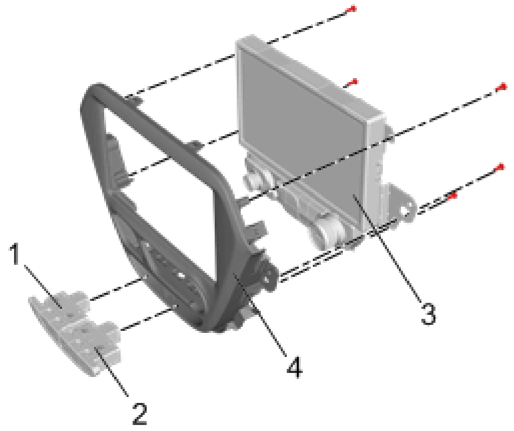


Fig. 5: Hazard Warning Switch at Instrument Panel Trim Plate
Courtesy of GENERAL MOTORS COMPANY

5. Hazard Warning Switch (1) at Instrument Panel Trim Plate - Remove - **Hazard Warning Switch Replacement**
6. Instrument Panel Center Accessory Function Switch (2) at Instrument Panel Trim Plate - Remove - **Instrument Panel Center Accessory Function Switch Replacement**
7. Driver Information Display (3) at Instrument Panel Trim Plate - Remove - **Driver Information Display Replacement**

Installation Procedure

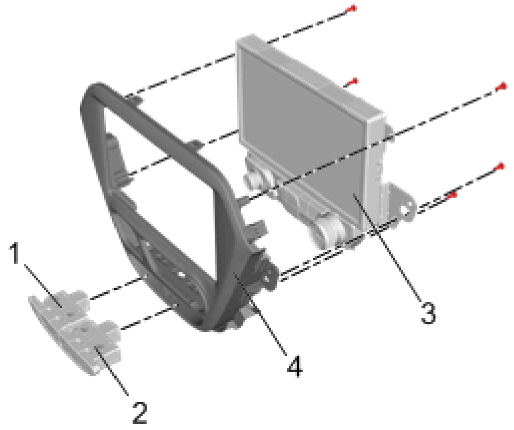


Fig. 6: Hazard Warning Switch at Instrument Panel Trim Plate
Courtesy of GENERAL MOTORS COMPANY

1. Driver Information Display (3) at Instrument Panel Trim Plate - Install - **Driver Information Display Replacement**
2. Instrument Panel Center Accessory Function Switch (2) at Instrument Panel Trim Plate - Install - **Instrument Panel Center Accessory Function Switch Replacement**
3. Hazard Warning Switch (1) at Instrument Panel Trim Plate - Install - **Hazard Warning Switch Replacement**

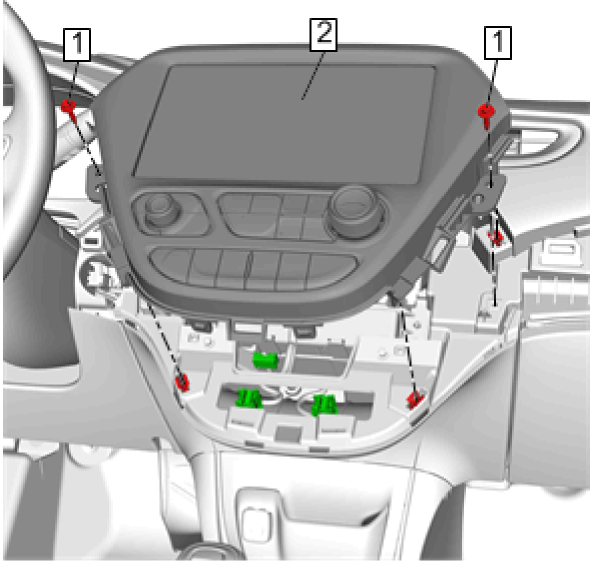


Fig. 7: Instrument Panel Trim Plate With Driver Information Display
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

4. Connect the electrical connectors.
5. Instrument Panel Trim Plate Assembly (2) at Instrument Panel - Install
6. Instrument Panel Bolt (Qty: 2) - Install and tighten to 2.5 N.m (22 lb in)

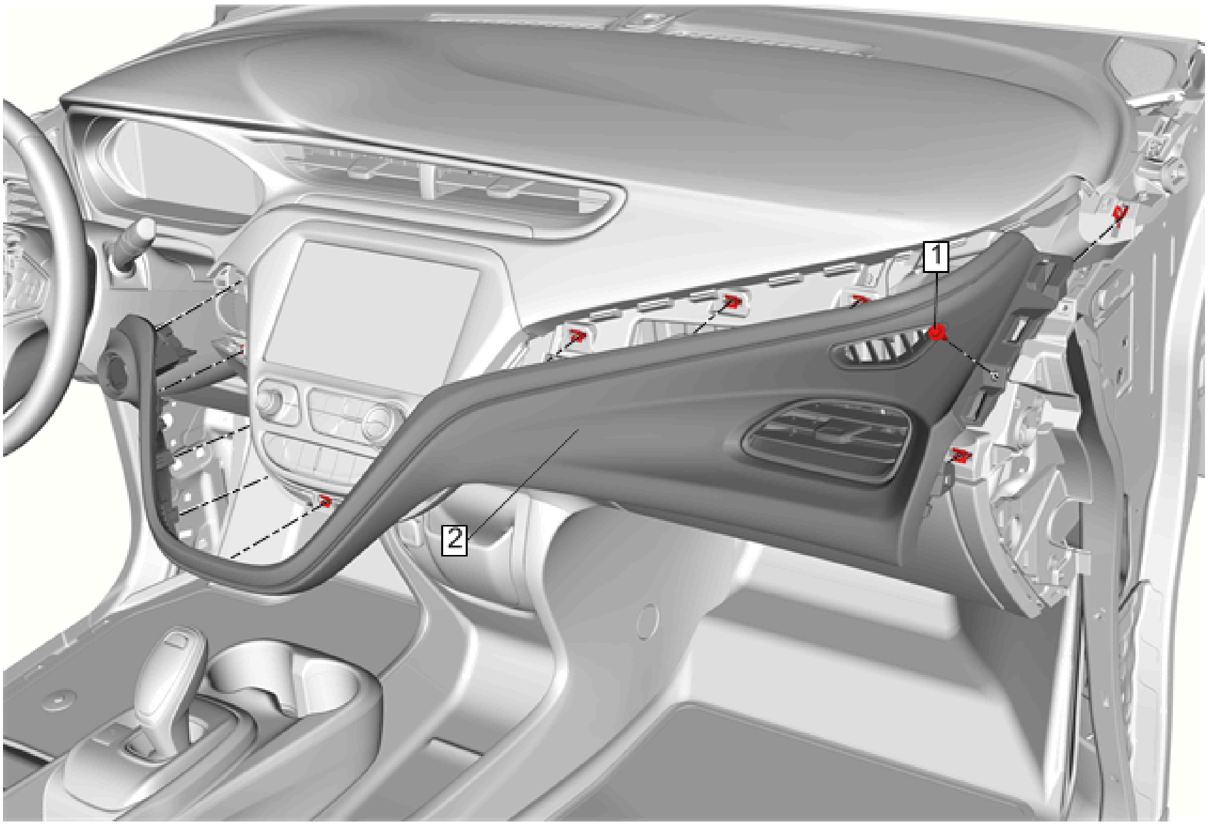


Fig. 8: Instrument Panel Trim Pad - Right Side
Courtesy of GENERAL MOTORS COMPANY

7. Instrument Panel Trim Pad - Right Side - Install - Instrument Panel Trim Pad Replacement - Right Side

FORWARD COLLISION ALERT DISPLAY BEZEL REPLACEMENT

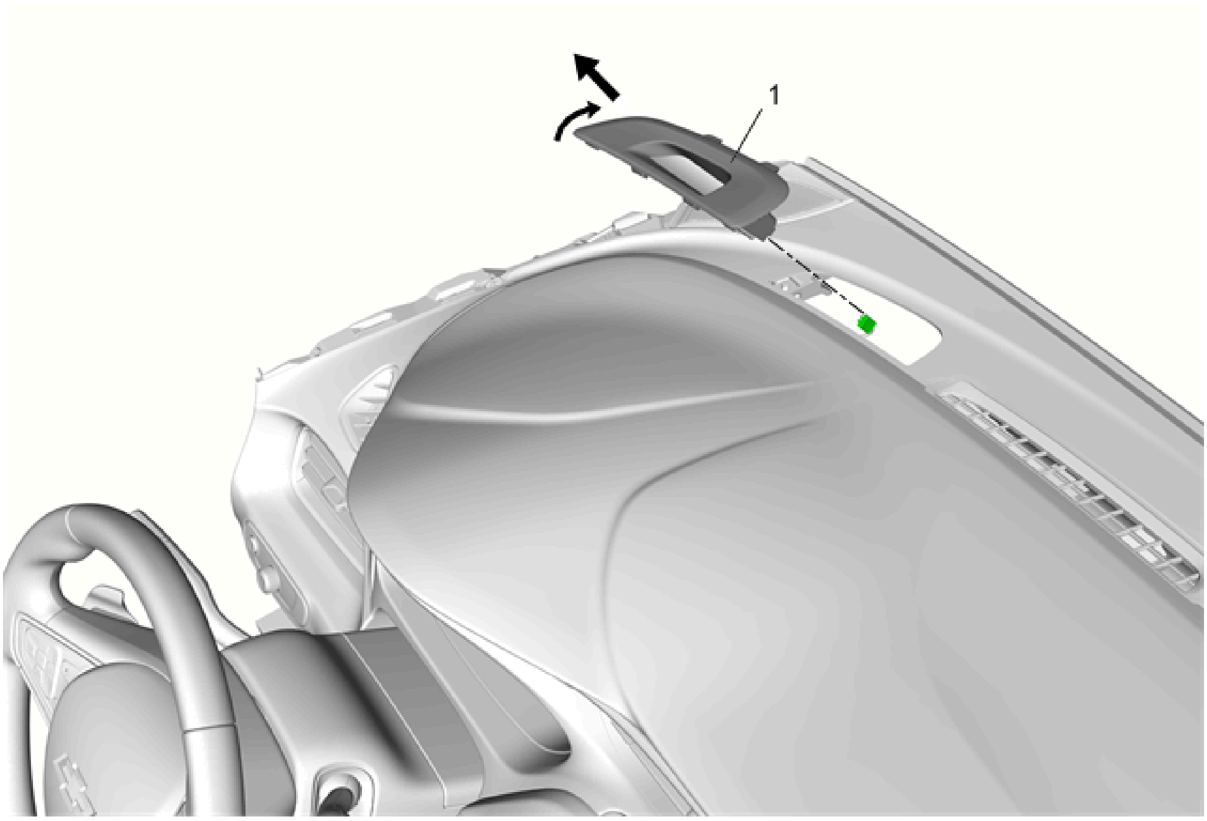


Fig. 9: Forward Collision Alert Display Bezel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Forward Collision Alert Display Bezel **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs. 3. Disconnect the electrical connector. 4. Remove the forward collision alert display. **Forward Collision Alert Display Replacement**

INSTRUMENT PANEL FUSE BLOCK ACCESS HOLE COVER REPLACEMENT

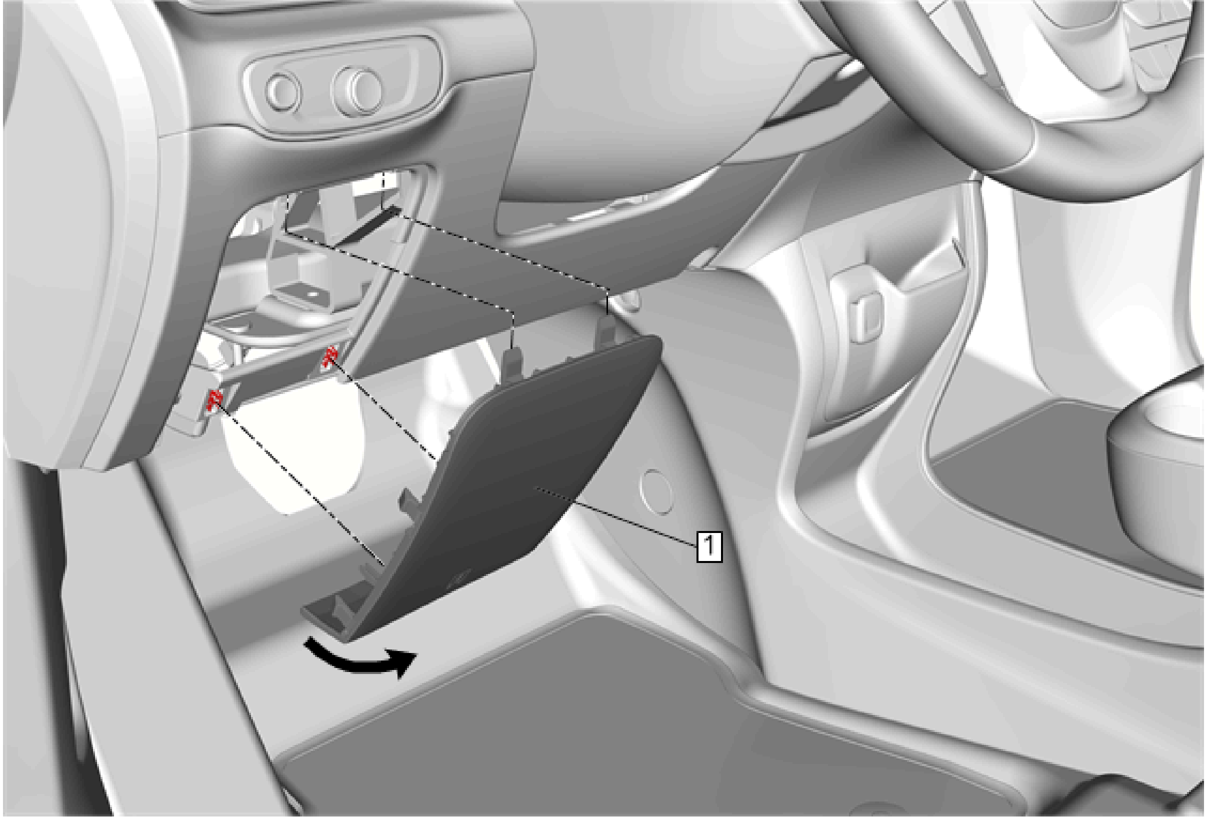


Fig. 10: Instrument Panel Fuse Block Access Hole Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Instrument Panel Fuse Block Access Hole Cover **Procedure** Grasp the lower edge of the fuse block cover and pull outward disengaging the retainers securing the fuse block cover to the instrument panel knee bolster.

INSTRUMENT PANEL OUTER TRIM COVER REPLACEMENT

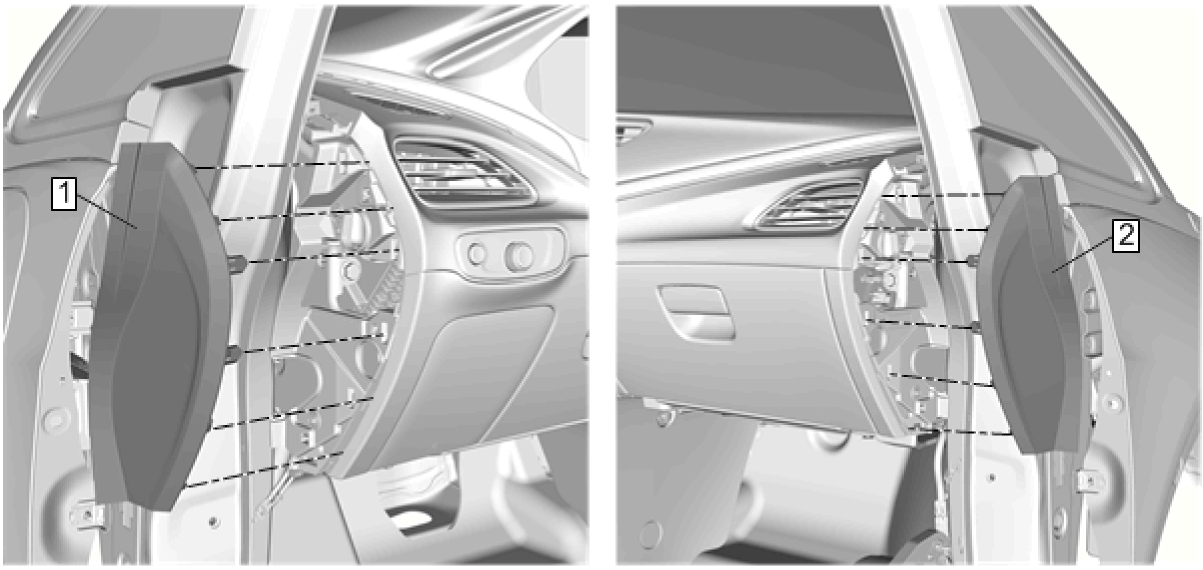


Fig. 11: Instrument Panel Outer Trim Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Instrument Panel Outer Trim Cover - Left **Procedure** Use a flat bladed plastic trim tool.
2	Instrument Panel Outer Trim Cover - Right **Procedure** Use a flat bladed plastic trim tool.

INSTRUMENT PANEL LOWER TRIM PANEL REPLACEMENT

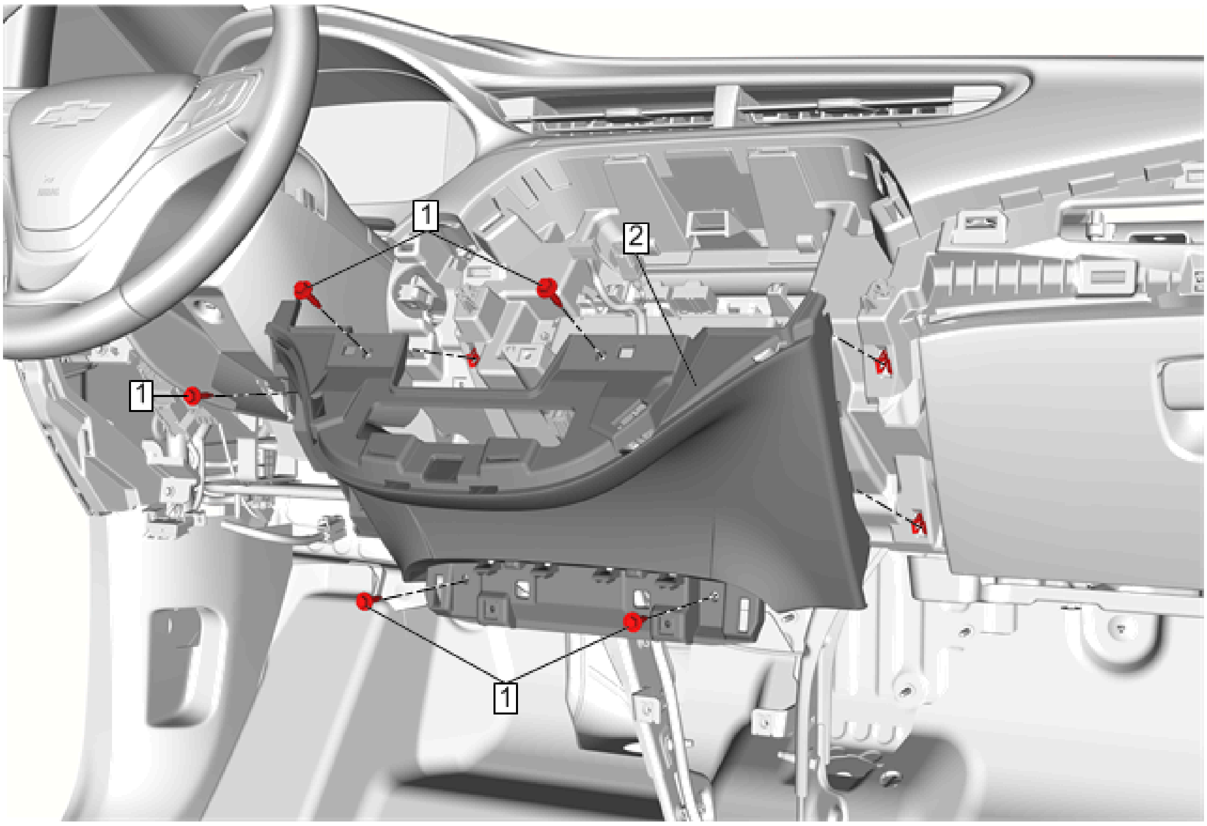


Fig. 12: Instrument Panel Lower Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Floor Console Replacement 2. Instrument Panel Trim Pad Replacement - Right Side 3. Instrument Panel Trim Plate Replacement 4. Instrument Panel Knee Bolster Replacement	
1	Instrument Panel Bolt (Qty: 5) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Instrument Panel Lower Trim Panel **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs.

INSTRUMENT PANEL COMPARTMENT REPLACEMENT

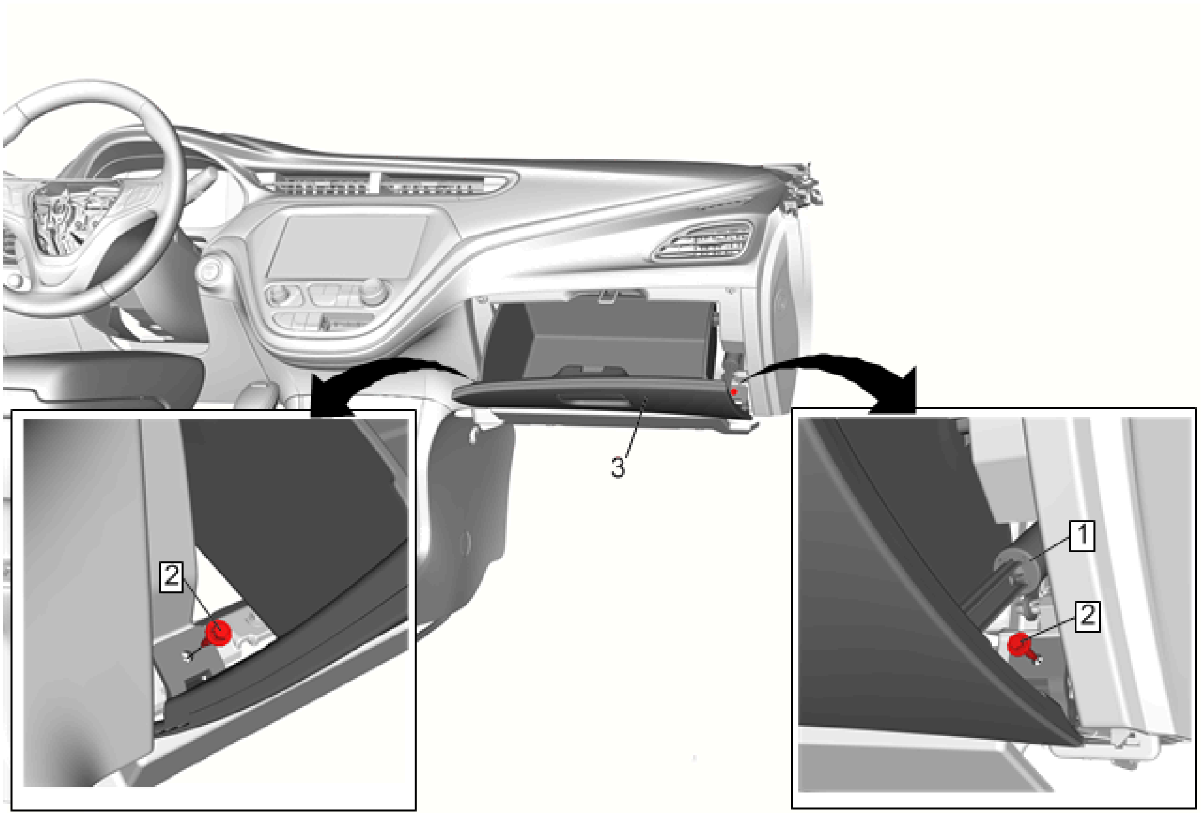


Fig. 13: Instrument Panel Compartment
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Instrument Panel Compartment Door Dampener **Procedure** 1. Open the IP compartment door. 2. Release the door dampener from the IP compartment. 3. Squeeze the sides of the instrument panel compartment allowing the compartment to open past the stops.
2	Instrument Panel Compartment Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
3	Instrument Panel Compartment

INSTRUMENT PANEL TRIM PAD REPLACEMENT - LEFT SIDE

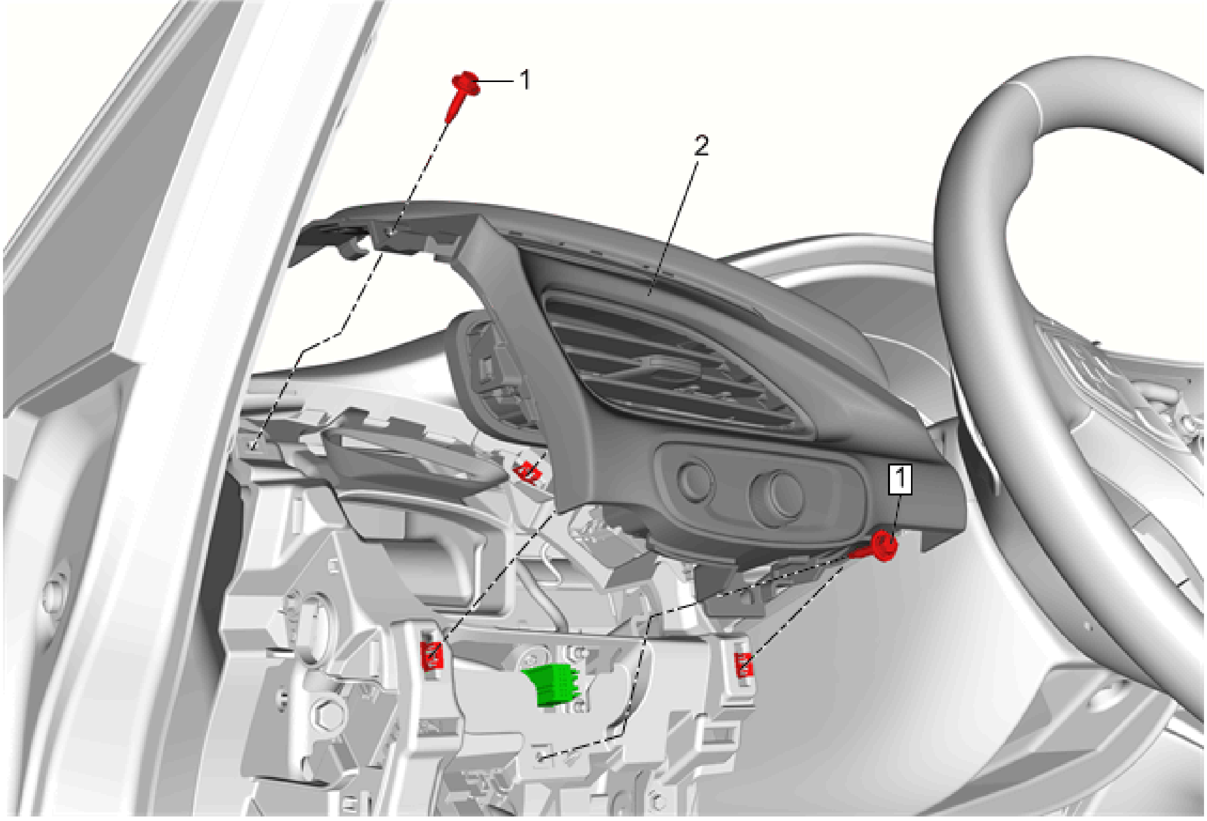


Fig. 14: Instrument Panel Trim Pad - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Instrument Panel Outer Trim Cover Replacement 2. Windshield Garnish Molding Replacement 3. Instrument Panel Knee Bolster Replacement	
1	Instrument Panel Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Instrument Panel Trim Pad - Left Side **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs. 3. Disconnect the electrical connectors. 4. Remove the headlamp switch. Headlamp Switch Replacement 5. Remove the instrument panel outer air outlet - left side. Instrument Panel Outer Air Outlet Replacement - Left Side 6. Remove the side window defogger outlet grille. Side Window Defogger Outlet Grille Replacement - Left Side

INSTRUMENT PANEL TRIM PAD REPLACEMENT - RIGHT SIDE

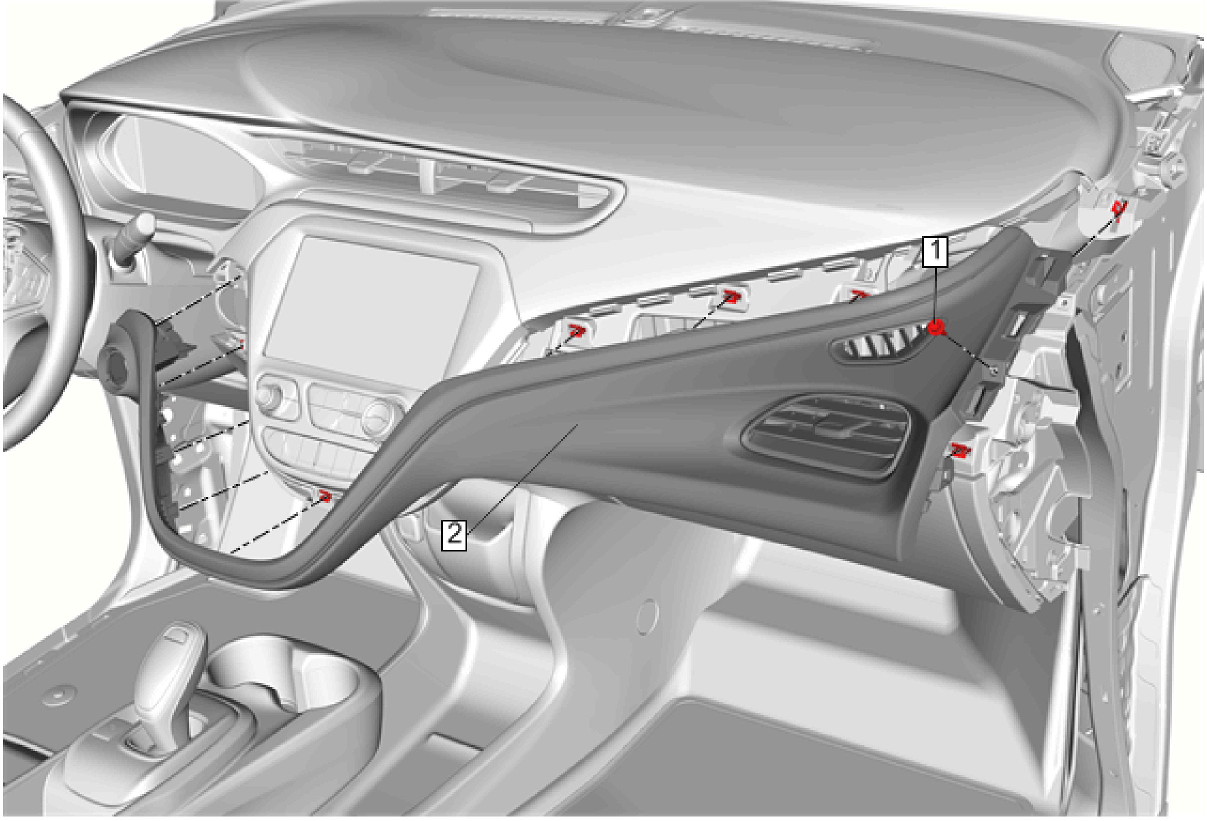


Fig. 15: Instrument Panel Trim Pad - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. On/Off Vehicle Switch Replacement 2. Instrument Panel Outer Trim Cover Replacement 3. Windshield Garnish Molding Replacement	
1	Instrument Panel Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Instrument Panel Trim Pad - Right Side **Procedure** 1. Using a flat bladed plastic trim tool, release the plastic retaining tabs. 2. Disconnect the electrical connector. 3. Remove the instrument panel outer air outlet. Instrument Panel Outer Air Outlet Replacement - Right Side 4. Remove the side window defogger outlet grille. Side Window Defogger Outlet Grille Replacement - Right Side

INSTRUMENT PANEL ASSEMBLY REPLACEMENT

Removal Procedure

1. Disable the SIR system. SIR Disabling and Enabling

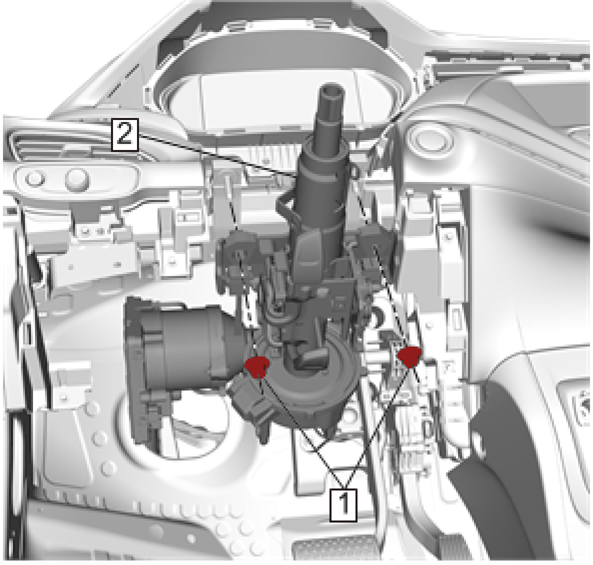


Fig. 16: Steering Column
Courtesy of GENERAL MOTORS COMPANY

2. Steering Column - Remove - **Steering Column Replacement**

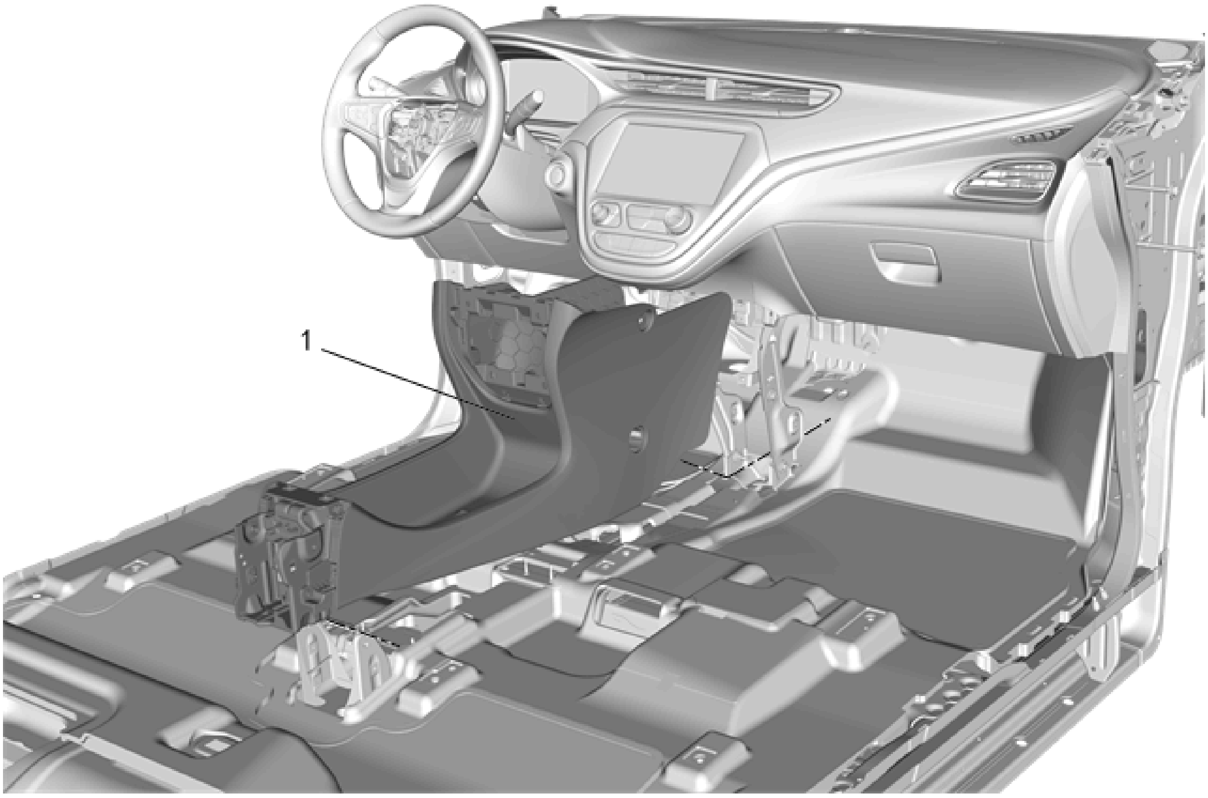


Fig. 17: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

3. Front Floor Console - Remove - **Front Floor Console Replacement**

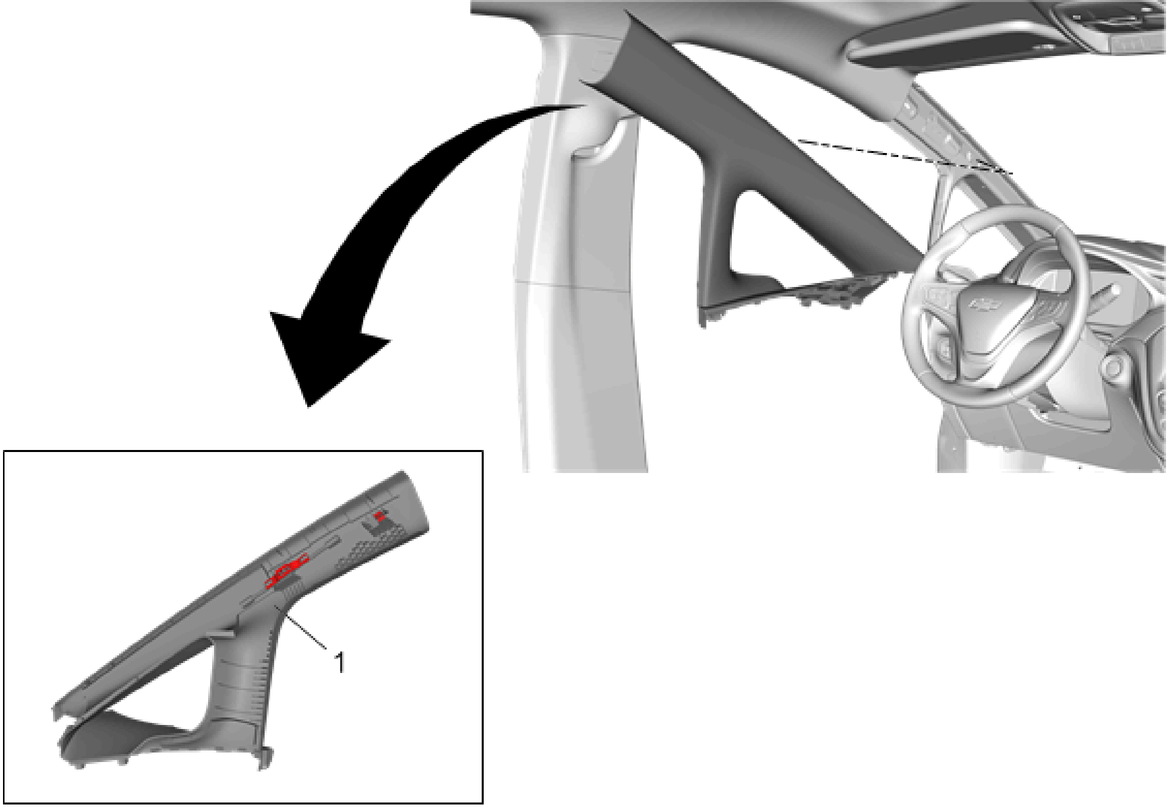


Fig. 18: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

4. Windshield Garnish Molding - Remove - Windshield Garnish Molding Replacement

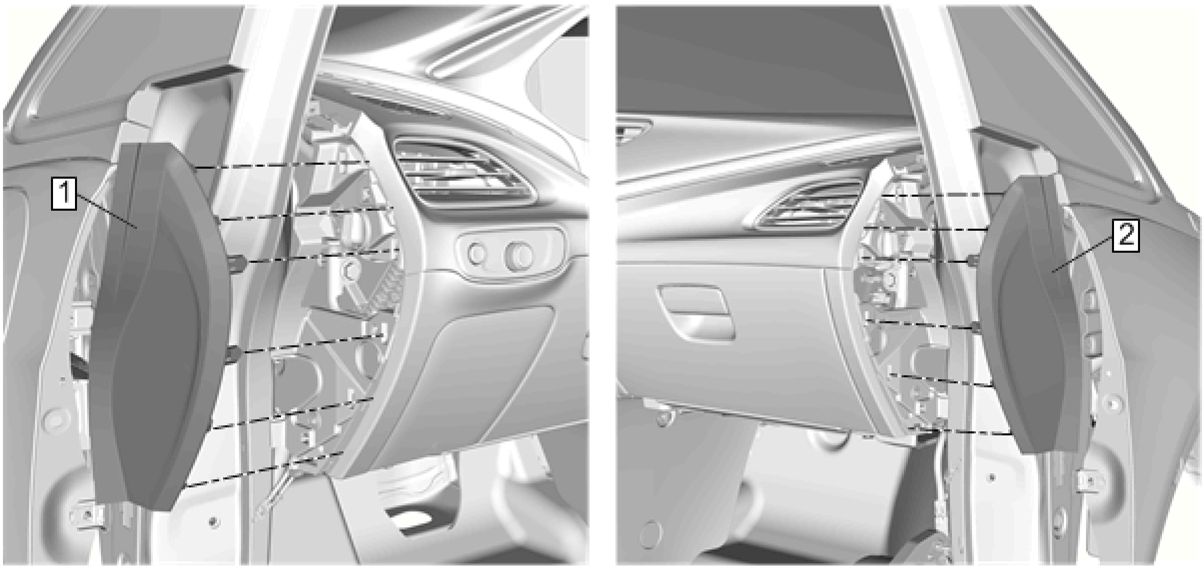


Fig. 19: Instrument Panel Outer Trim Cover - Right
Courtesy of GENERAL MOTORS COMPANY

5. Instrument Panel Outer Trim Cover - Right - Remove - Instrument Panel Outer Trim Cover Replacement

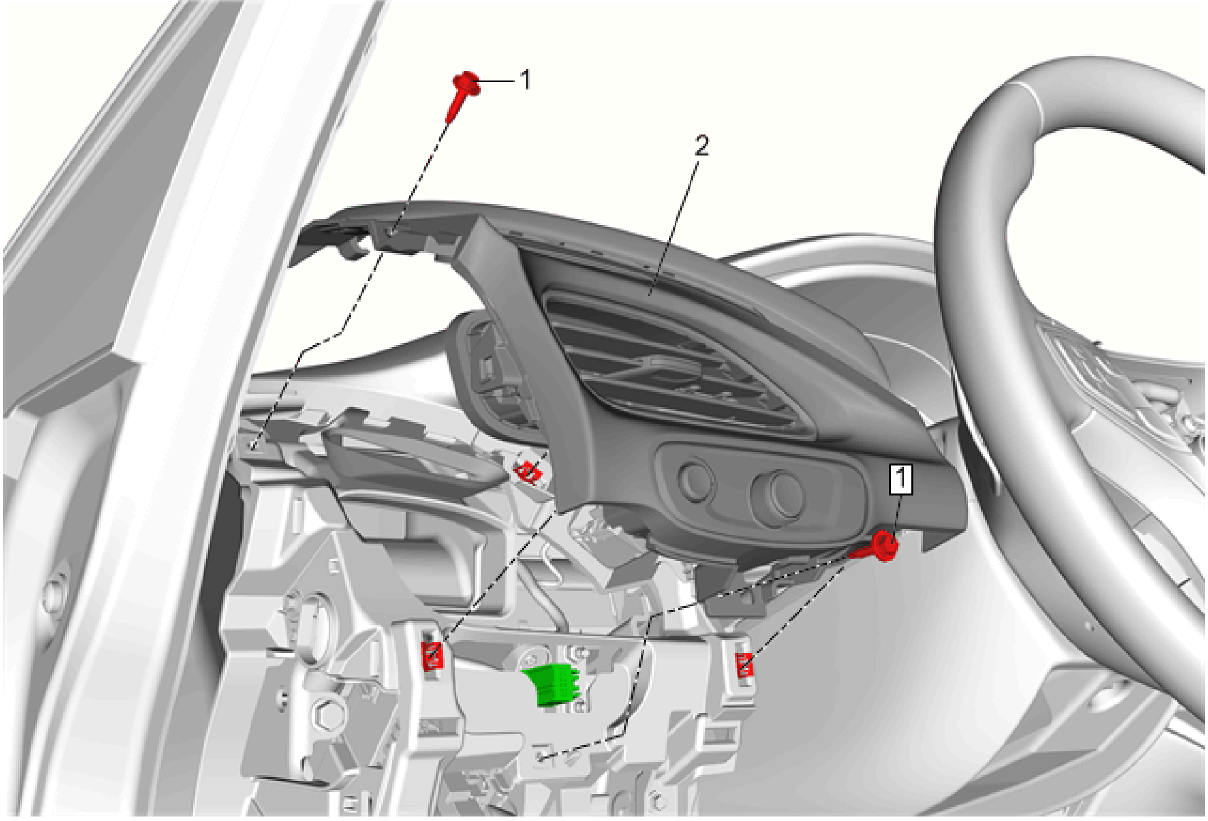


Fig. 20: Instrument Panel Trim Pad - Left Side
Courtesy of GENERAL MOTORS COMPANY

6. Instrument Panel Trim Pad - Left Side - Remove - **Instrument Panel Trim Pad Replacement - Left Side**

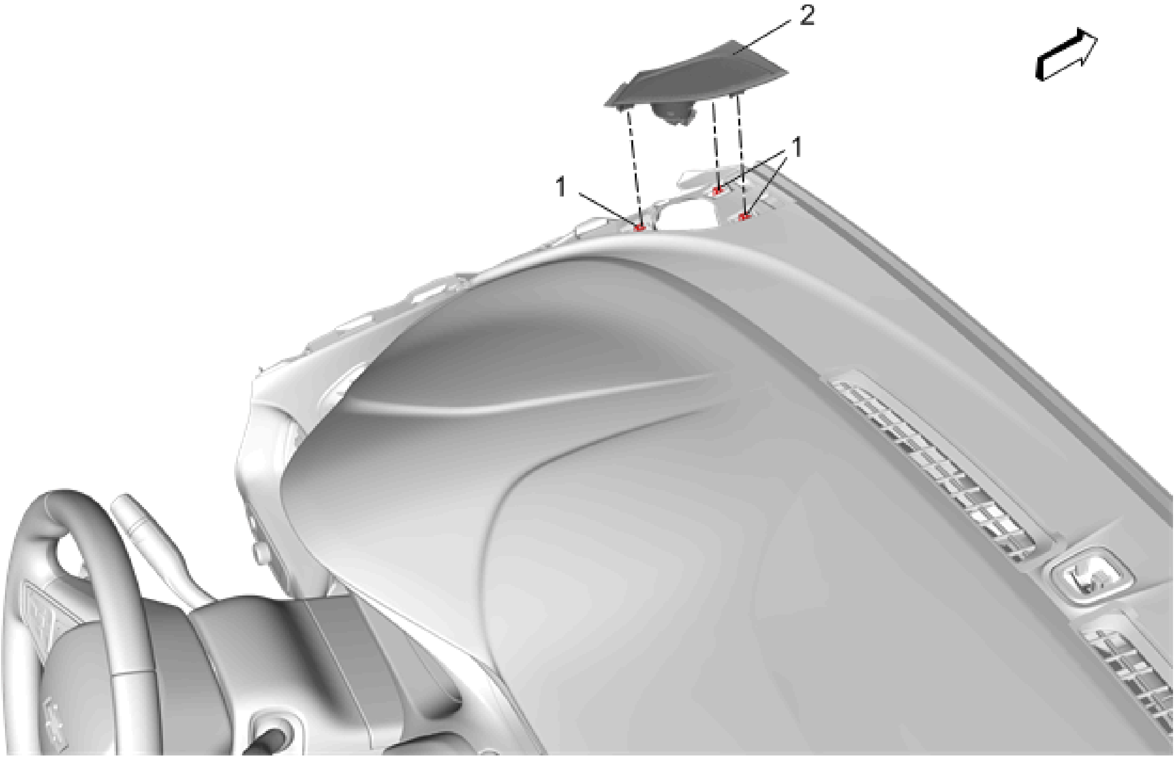


Fig. 21: Radio Front Speaker Grille
Courtesy of GENERAL MOTORS COMPANY

7. Radio Front Speaker Grille - Remove - **Radio Front Speaker Grille Replacement**

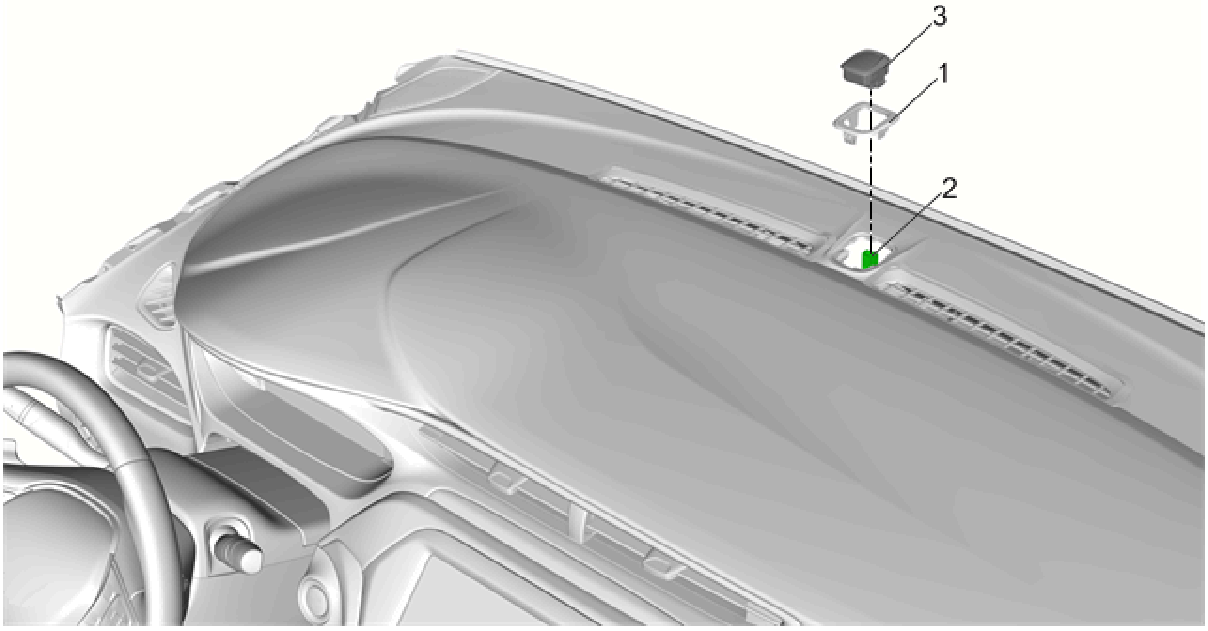


Fig. 22: Sun Load, Ambient Light, and Charge Indicator Sensor
Courtesy of GENERAL MOTORS COMPANY

8. Sun Load, Ambient Light, and Charge Indicator Sensor - Remove - **Sun Load, Ambient Light, and Charge Indicator Sensor Replacement**

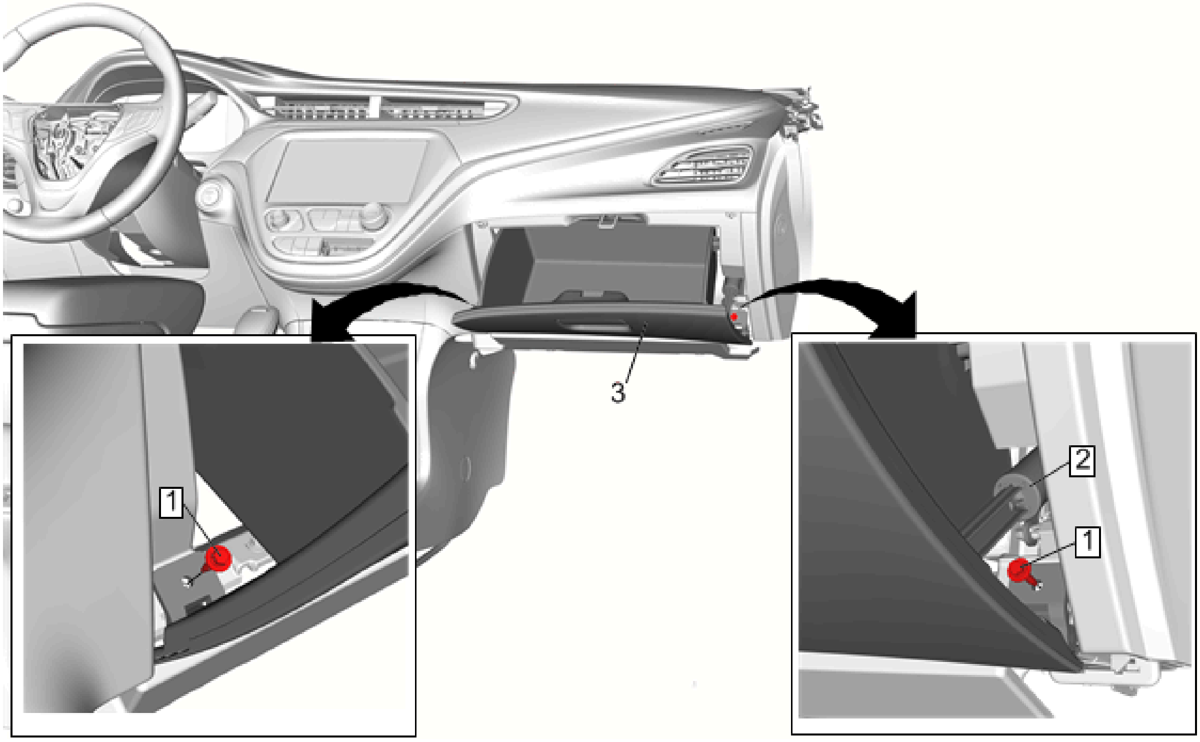


Fig. 23: Instrument Panel Compartment
Courtesy of GENERAL MOTORS COMPANY

9. Instrument Panel Compartment - Remove - **Instrument Panel Compartment Replacement**

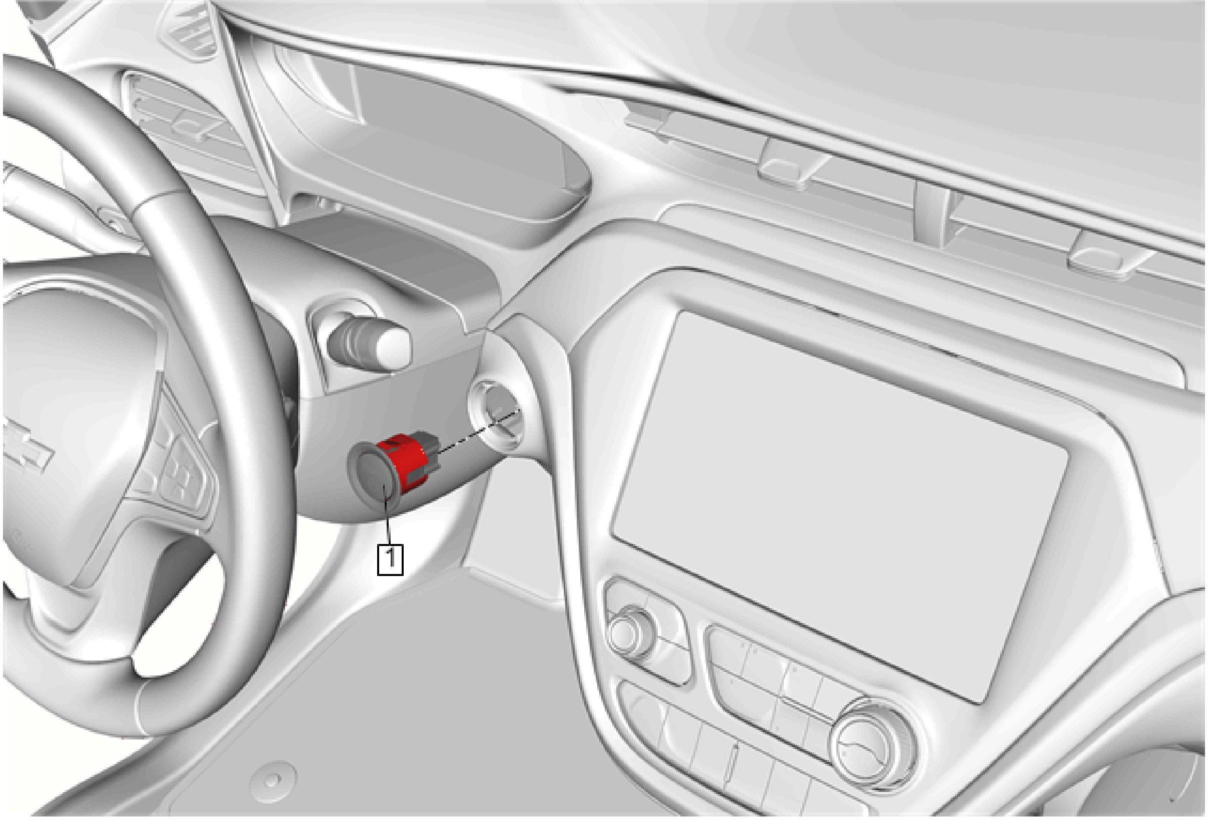


Fig. 24: On/Off Vehicle Switch
Courtesy of GENERAL MOTORS COMPANY

10. On/Off Vehicle Switch - Remove - On/Off Vehicle Switch Replacement

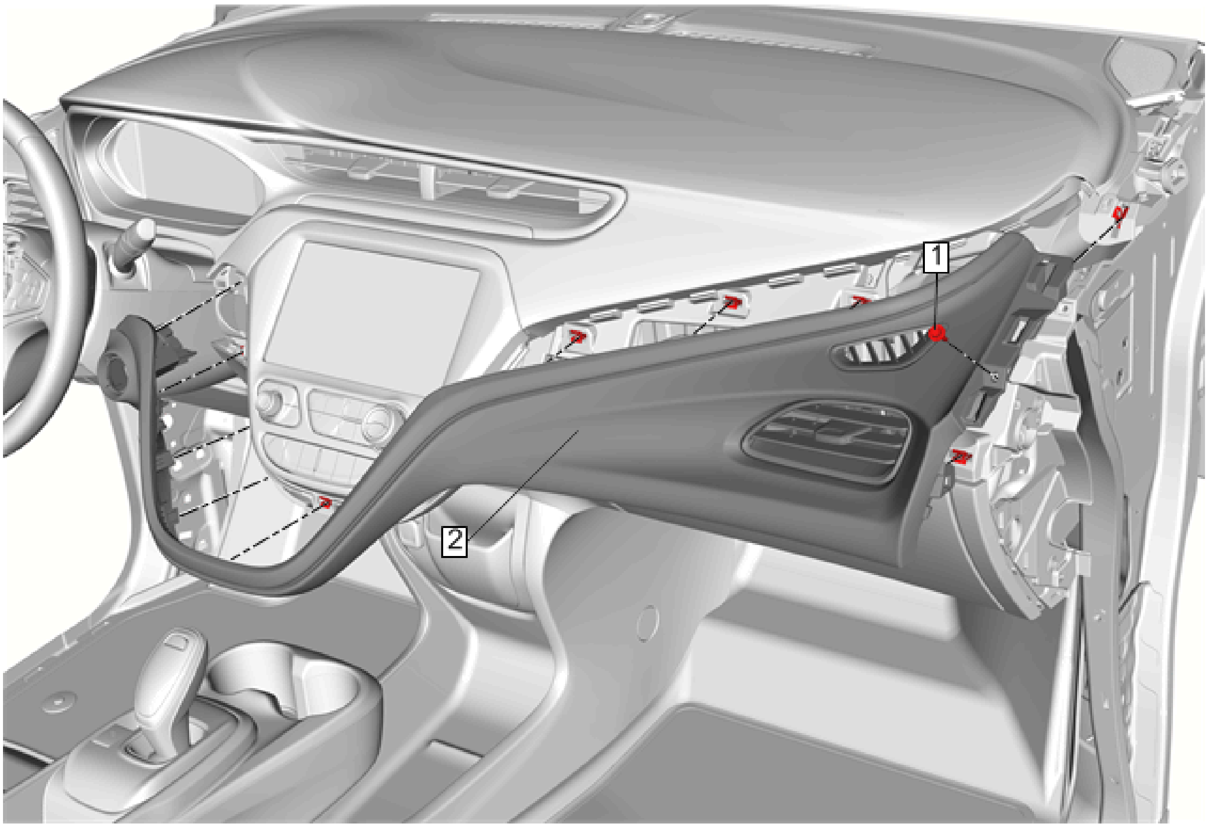
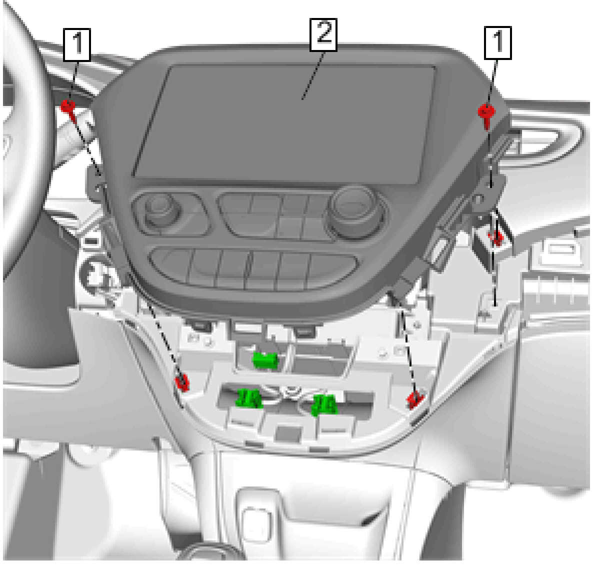


Fig. 25: Instrument Panel Trim Pad - Right Side
Courtesy of GENERAL MOTORS COMPANY

11. Instrument Panel Trim Pad - Right Side - Remove - Instrument Panel Trim Pad Replacement - Right Side



[Fig. 26: Instrument Panel Trim Plate With Driver Information Display](#)
Courtesy of GENERAL MOTORS COMPANY

12. Remove the instrument panel trim plate (2) with Driver Information Display, Hazard Warning Switch and Instrument Panel Center Accessory Function Switch. **Instrument Panel Trim Plate Replacement**

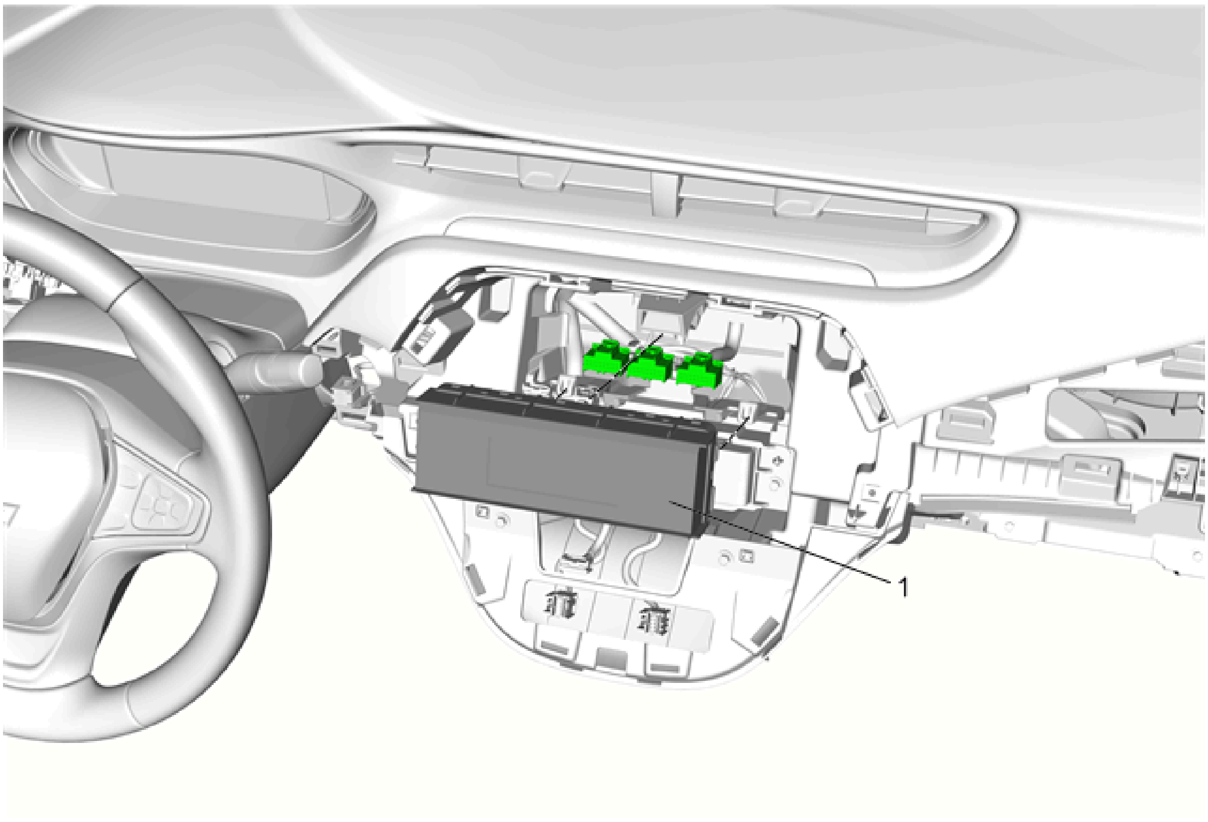


Fig. 27: Heater and Air Conditioning Remote Control
Courtesy of GENERAL MOTORS COMPANY

13. Heater and Air Conditioning Remote Control - Remove - **Heater and Air Conditioning Remote Control Replacement**

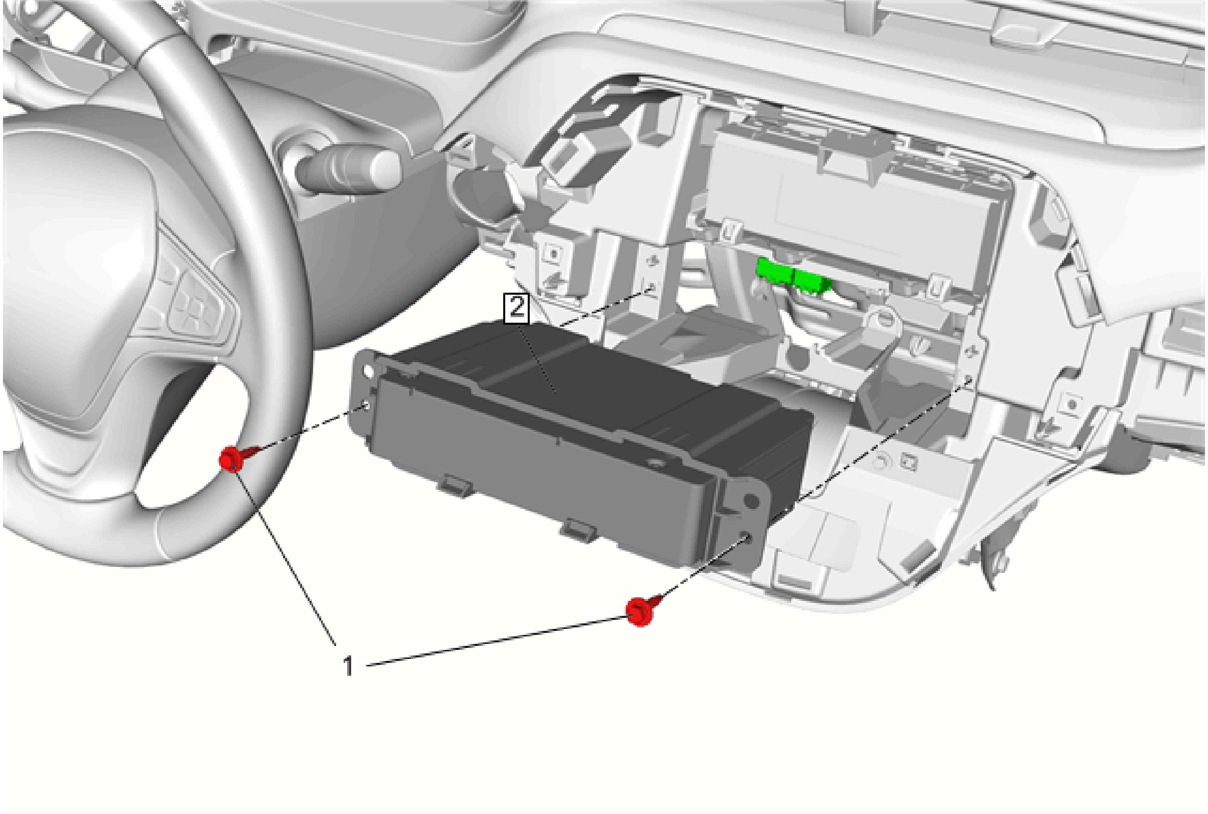


Fig. 28: Communication Interface Module Bracket
Courtesy of GENERAL MOTORS COMPANY

14. Communication Interface Module Bracket - Remove - **Communication Interface Module Bracket Replacement**

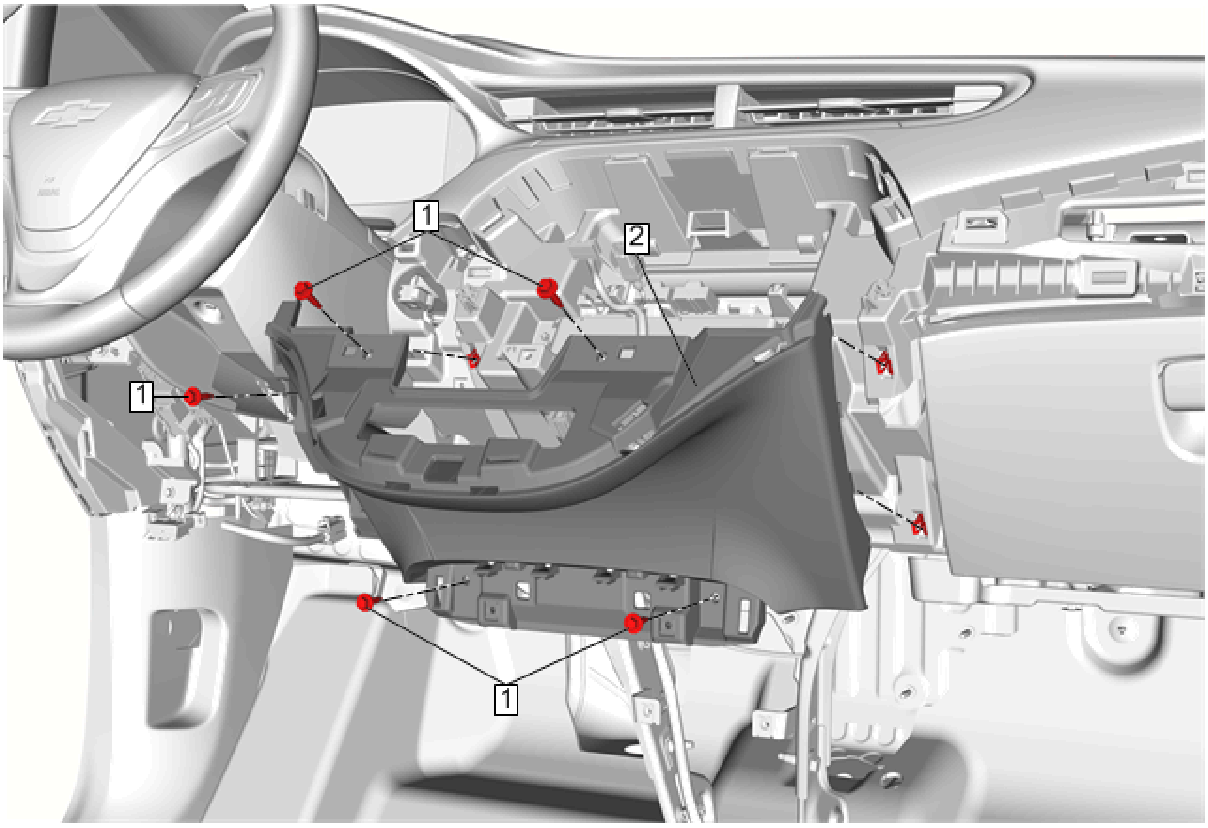


Fig. 29: Instrument Panel Lower Trim Panel
Courtesy of GENERAL MOTORS COMPANY

15. Instrument Panel Lower Trim Panel - Remove - **Instrument Panel Lower Trim Panel Replacement**

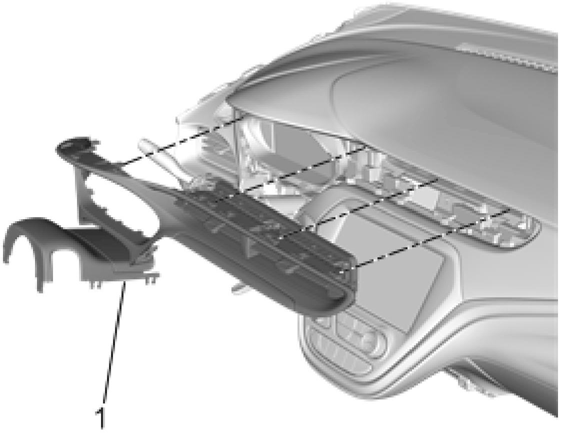


Fig. 30: Instrument Panel Steering Column Upper Trim Cover
Courtesy of GENERAL MOTORS COMPANY

16. Instrument Panel Steering Column Upper Trim Cover - Remove - **Steering Column Upper Trim Cover Replacement**

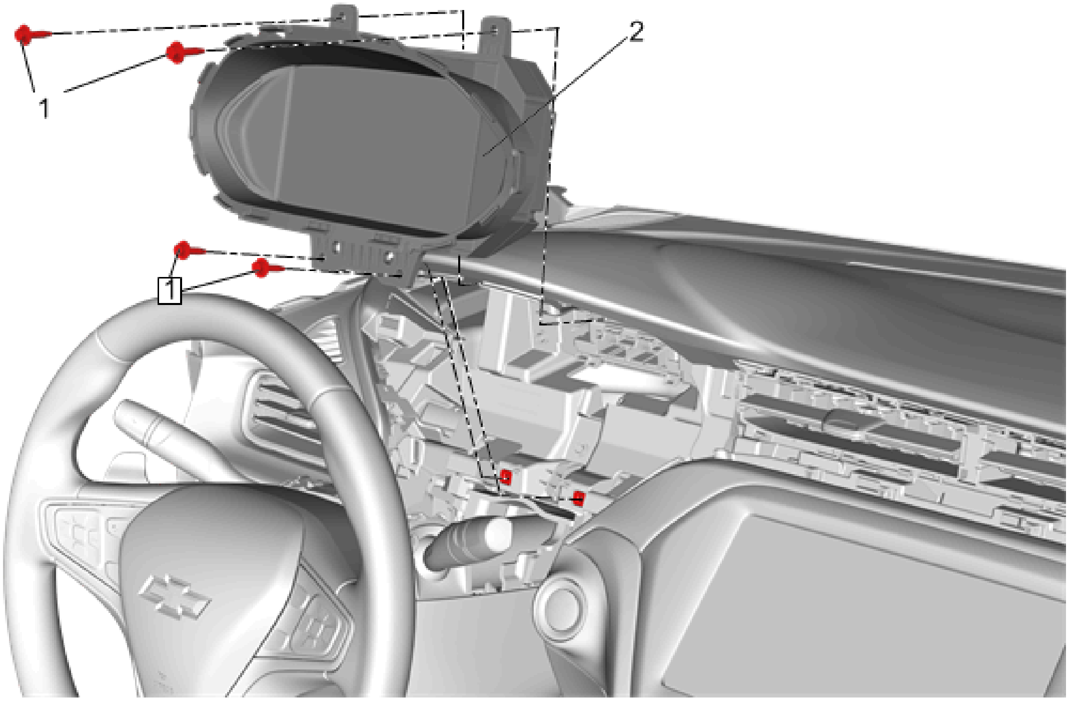


Fig. 31: Instrument Cluster
Courtesy of GENERAL MOTORS COMPANY

17. Instrument Cluster - Remove - **Instrument Cluster Replacement**

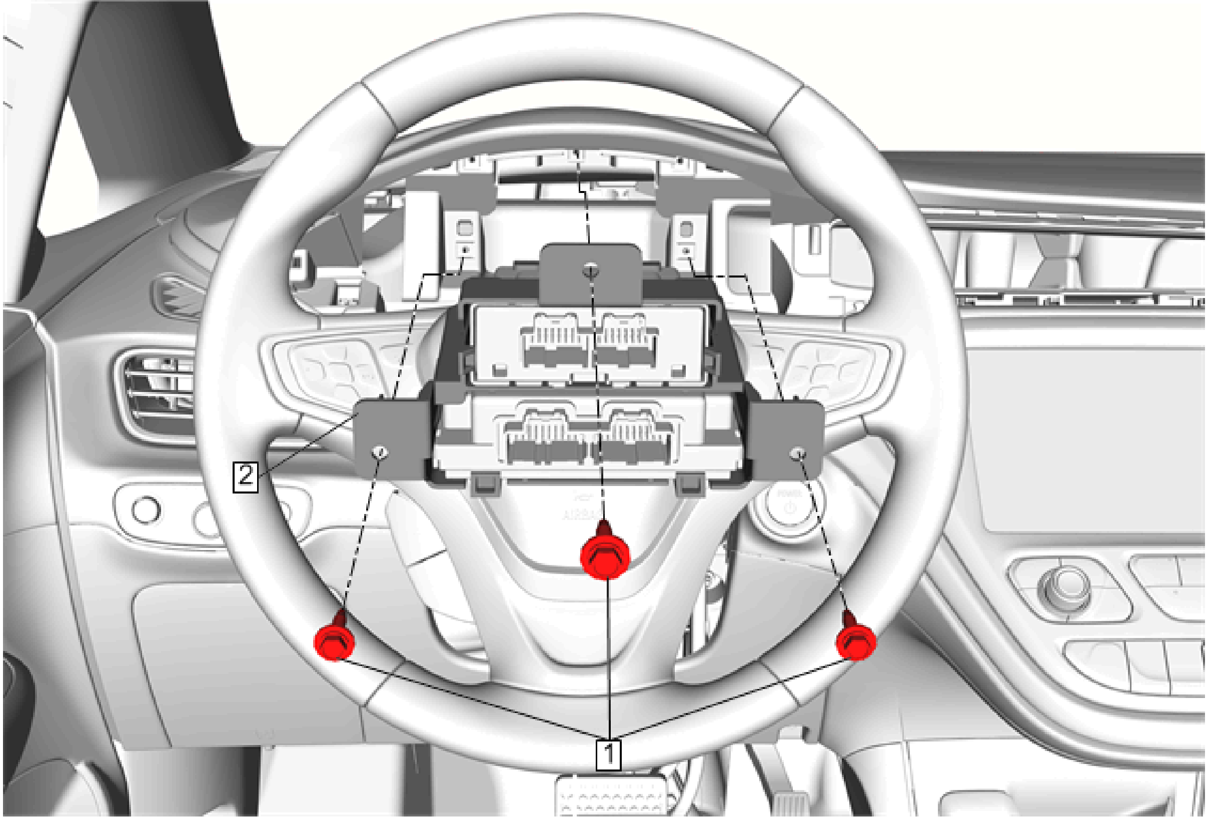


Fig. 32: Keyless Entry Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

18. Keyless Entry Control Module Bracket - Remove - **Keyless Entry Control Module Bracket Replacement**

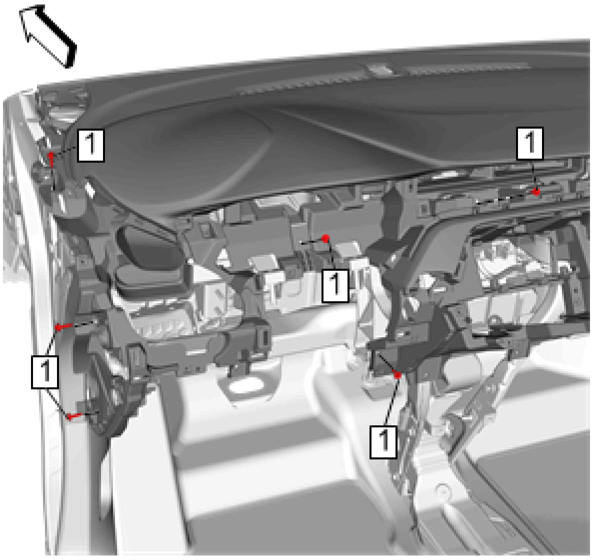


Fig. 33: Instrument Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

19. Instrument Panel Bolt - Remove

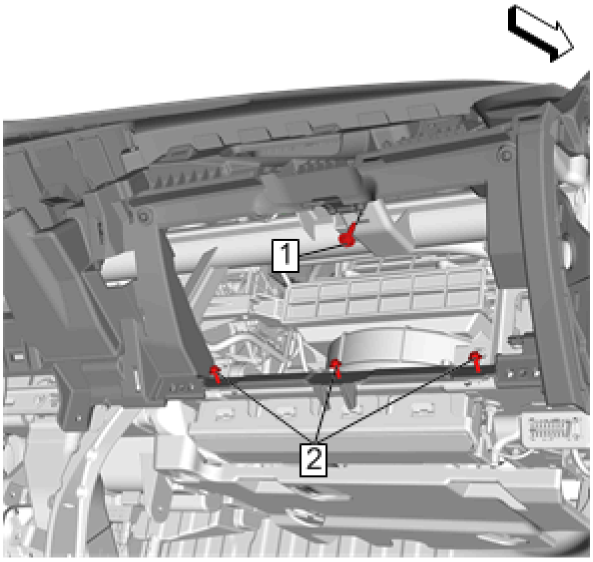


Fig. 34: Instrument Panel Compartment Center Upper Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

20. Instrument Panel Compartment Center Upper Bracket Bolt - Remove
21. Instrument Panel Bolt - Remove

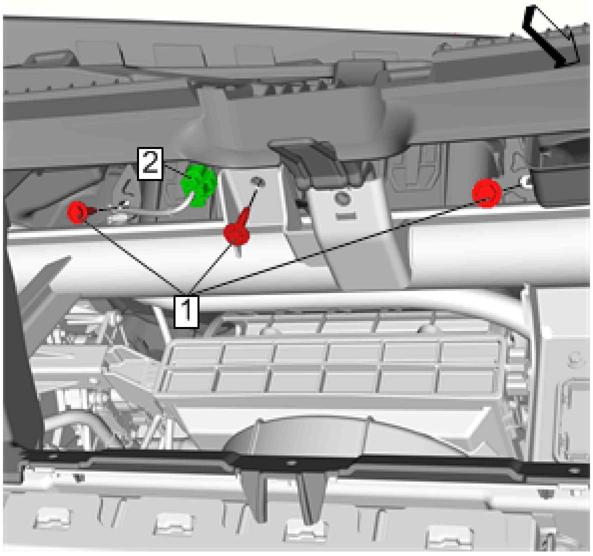
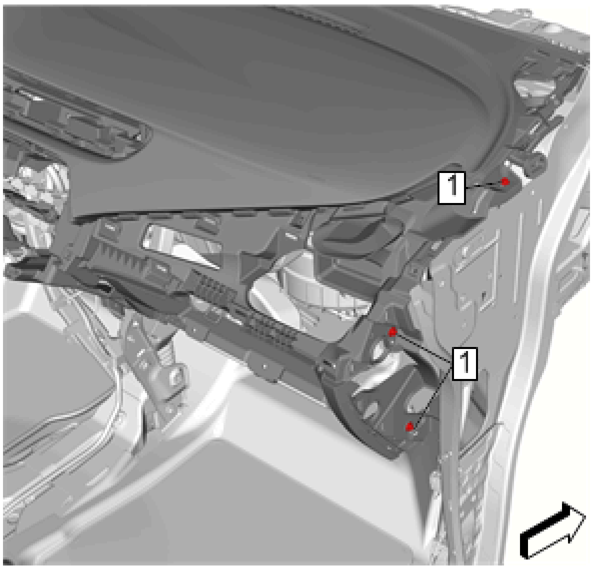


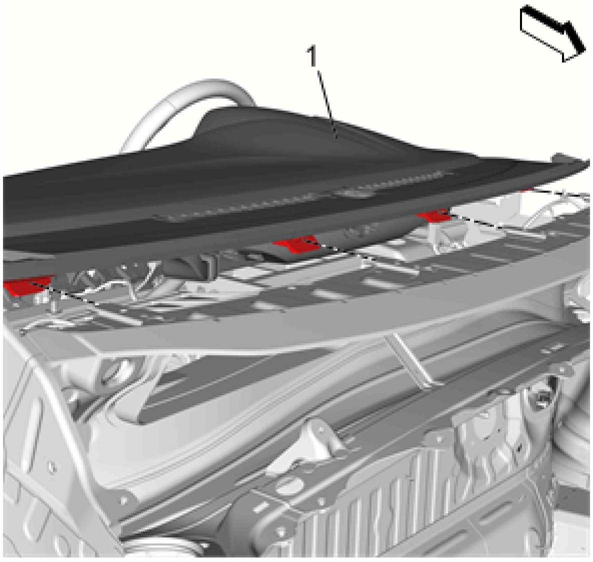
Fig. 35: Instrument Panel Airbag Bolt
Courtesy of GENERAL MOTORS COMPANY

22. Instrument Panel Airbag Bolt - Remove
23. Disconnect the instrument panel airbag electrical connector.



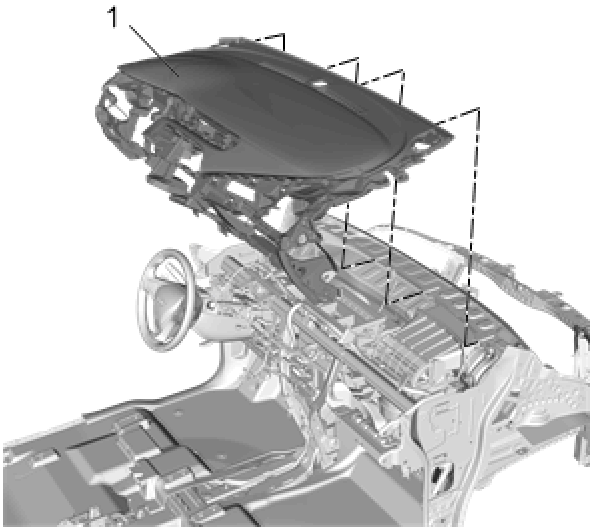
[Fig. 36: Instrument Panel Bolt]
Courtesy of GENERAL MOTORS COMPANY

24. Instrument Panel Bolt - Remove



[Fig. 37: Instrument Panel Assembly]
Courtesy of GENERAL MOTORS COMPANY

25. Slide the instrument panel assembly (1) rearward.



[Fig. 38: Instrument Panel Assembly]
Courtesy of GENERAL MOTORS COMPANY

26. Note the location and routing of the instrument panel wiring harness prior to removal to ensure proper installation.
27. Disconnect the wiring harness from the instrument panel carrier.
28. With the aid of an assistant, remove the instrument panel carrier assembly (1) from the vehicle.
29. Transfer components as necessary.

Installation Procedure

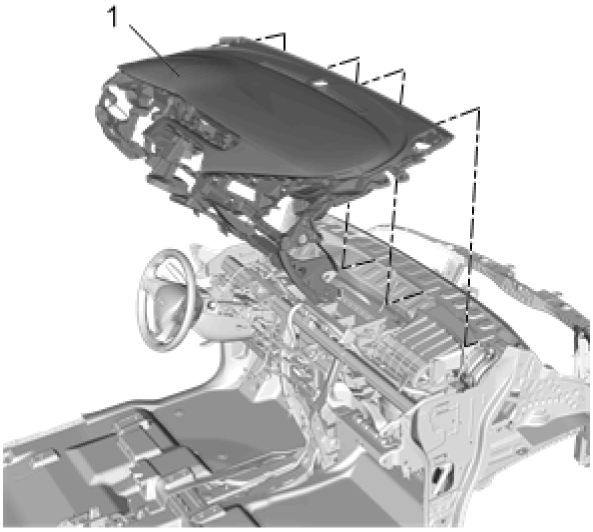


Fig. 39: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

1. With the aid of an assistant, position the instrument carrier (1) in the vehicle.
2. Reposition the instrument panel wiring harness into the vehicle position as was noted in the removal and connect the fasteners securing the instrument panel wiring harness to the instrument carrier.

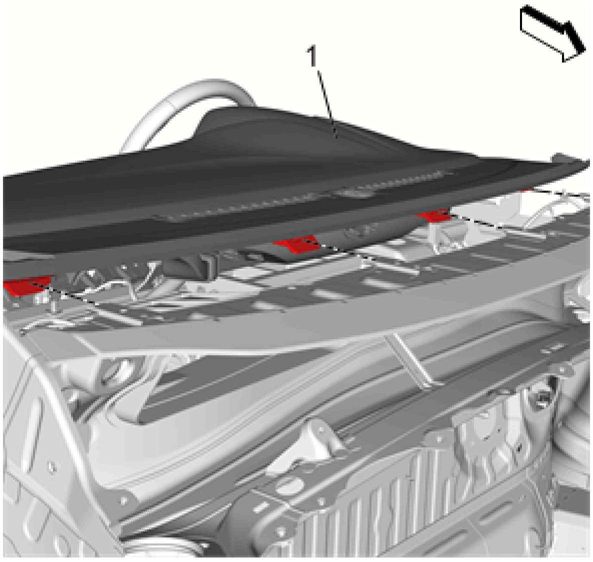


Fig. 40: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Slide the instrument panel assembly (1) forward.

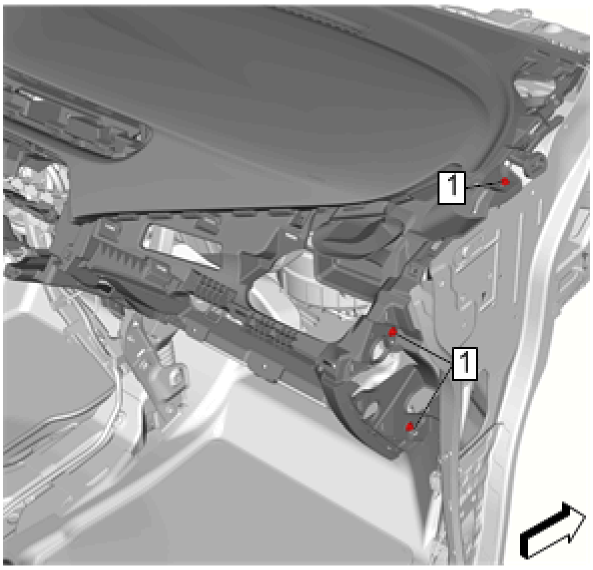


Fig. 41: Instrument Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

4. Instrument Panel Bolt - Install and tighten to 2.5 N.m (22 lb in)

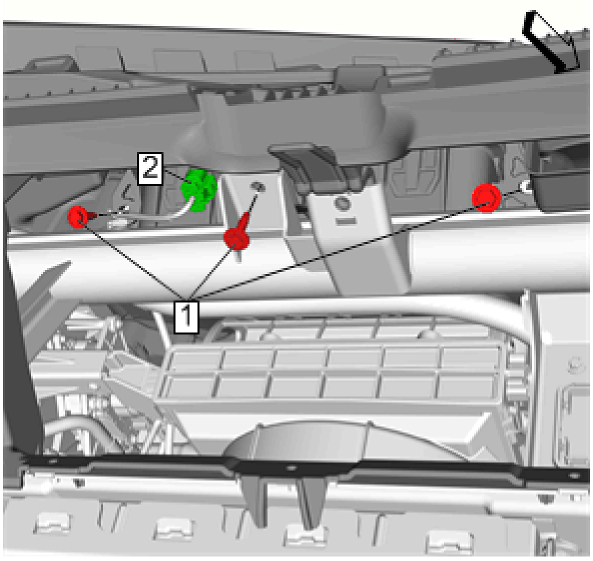


Fig. 42: Instrument Panel Airbag Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Instrument Panel Airbag Bolt - Install and tighten to 10 N.m (89 lb in)
6. Connect the instrument panel airbag electrical connector (2).

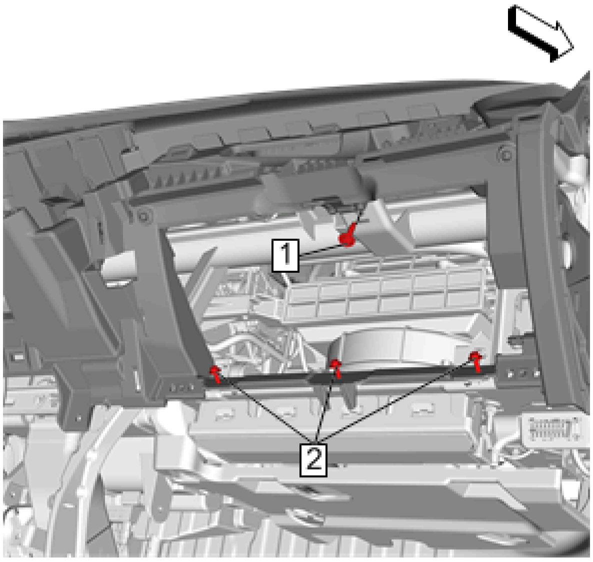


Fig. 43: Instrument Panel Compartment Center Upper Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Instrument Panel Bolt (2) - Install and tighten to 2.5 N.m (22 lb in)
8. Instrument Panel Compartment Center Upper Bracket Bolt (1) - Install and tighten to 10 N.m (89 lb in)

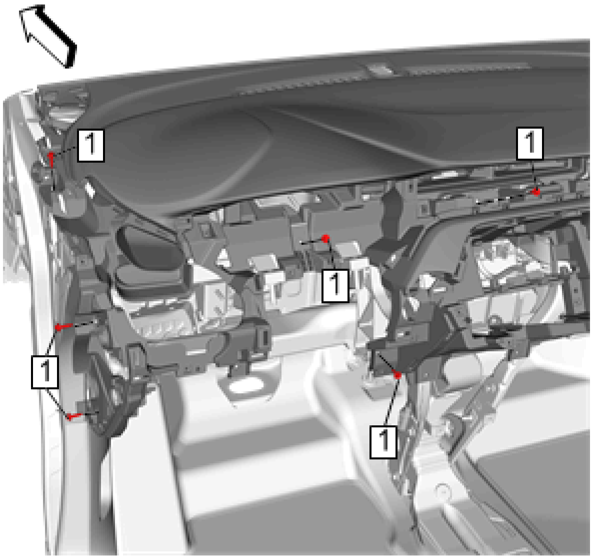


Fig. 44: Instrument Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Instrument Panel Bolt - Install and tighten to 2.5 N.m (22 lb in)

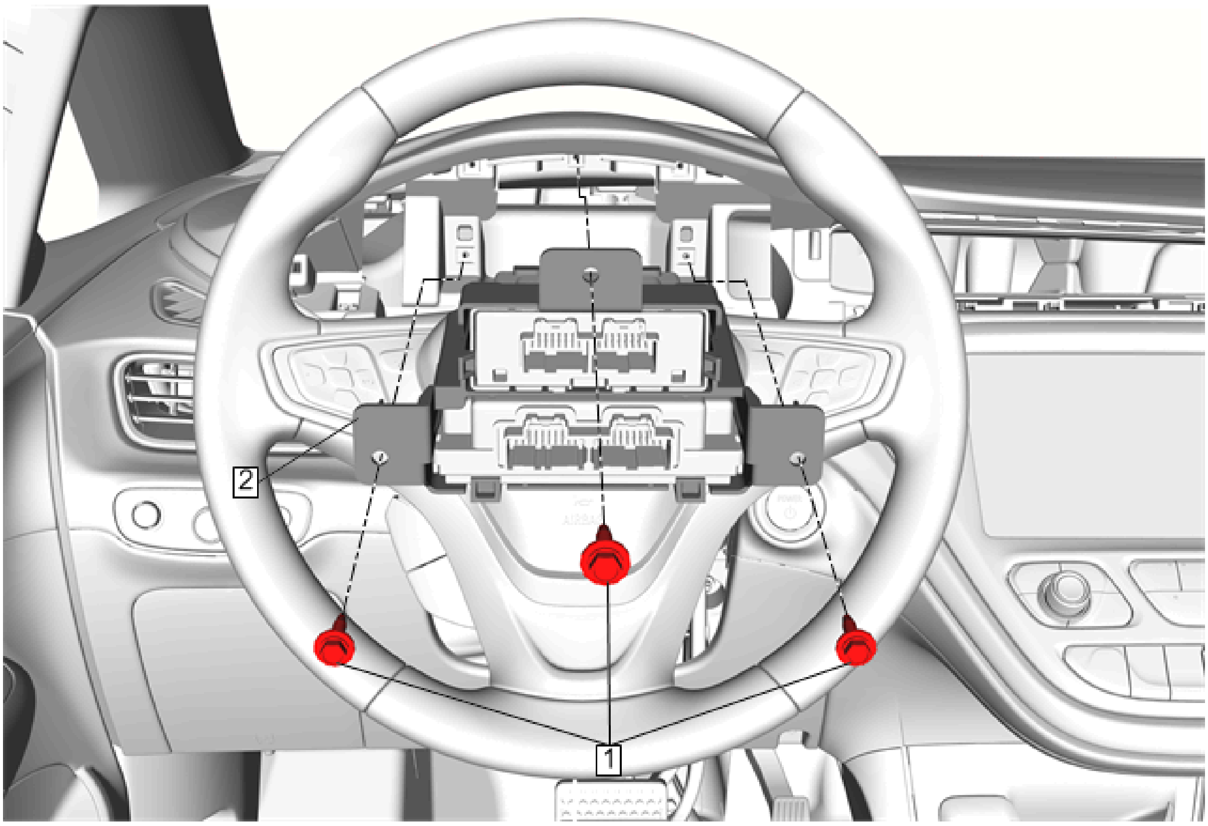


Fig. 45: Keyless Entry Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

10. Keyless Entry Control Module Bracket (2) - Install - Keyless Entry Control Module Bracket Replacement

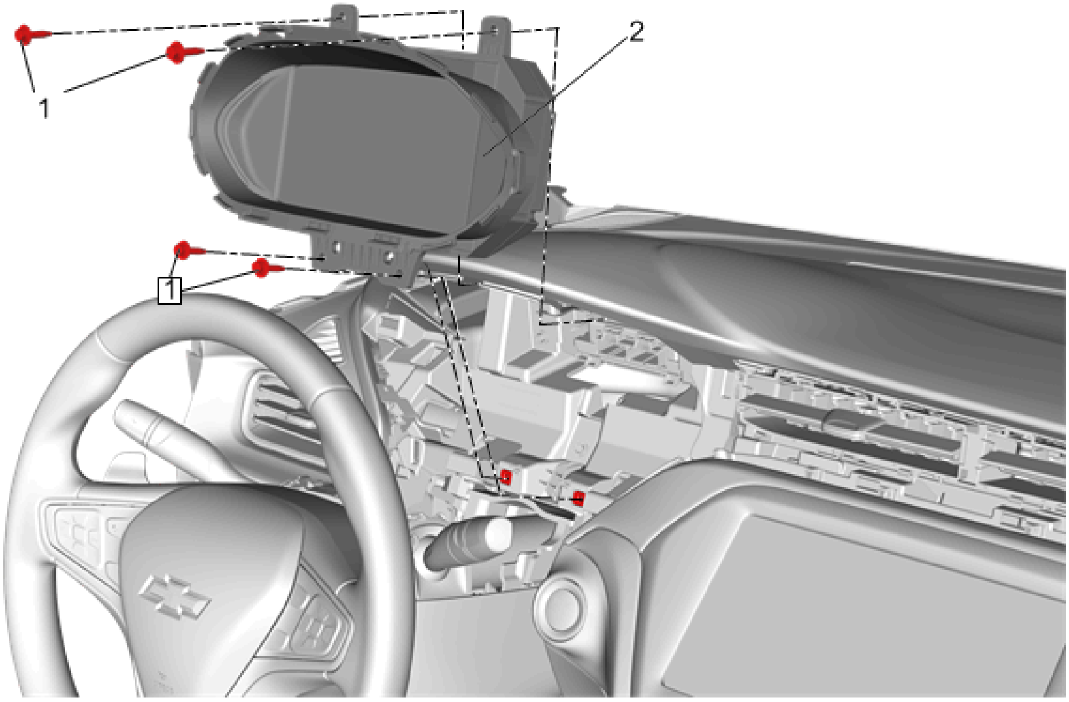


Fig. 46: Instrument Cluster
Courtesy of GENERAL MOTORS COMPANY

11. Instrument Cluster (2) - Install - Instrument Cluster Replacement

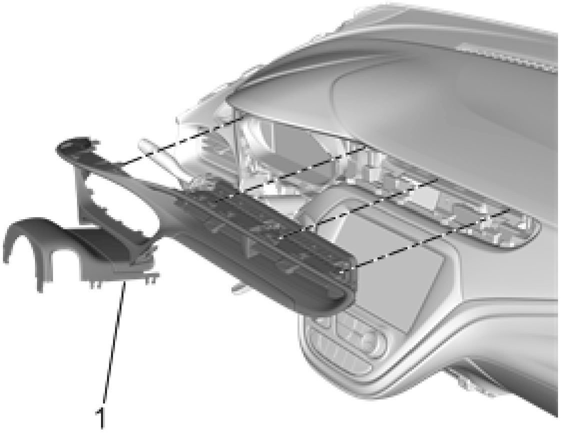


Fig. 47: Instrument Panel Steering Column Upper Trim Cover
Courtesy of GENERAL MOTORS COMPANY

12. Instrument Panel Steering Column Upper Trim Cover (1) - Install - Steering Column Upper Trim Cover Replacement

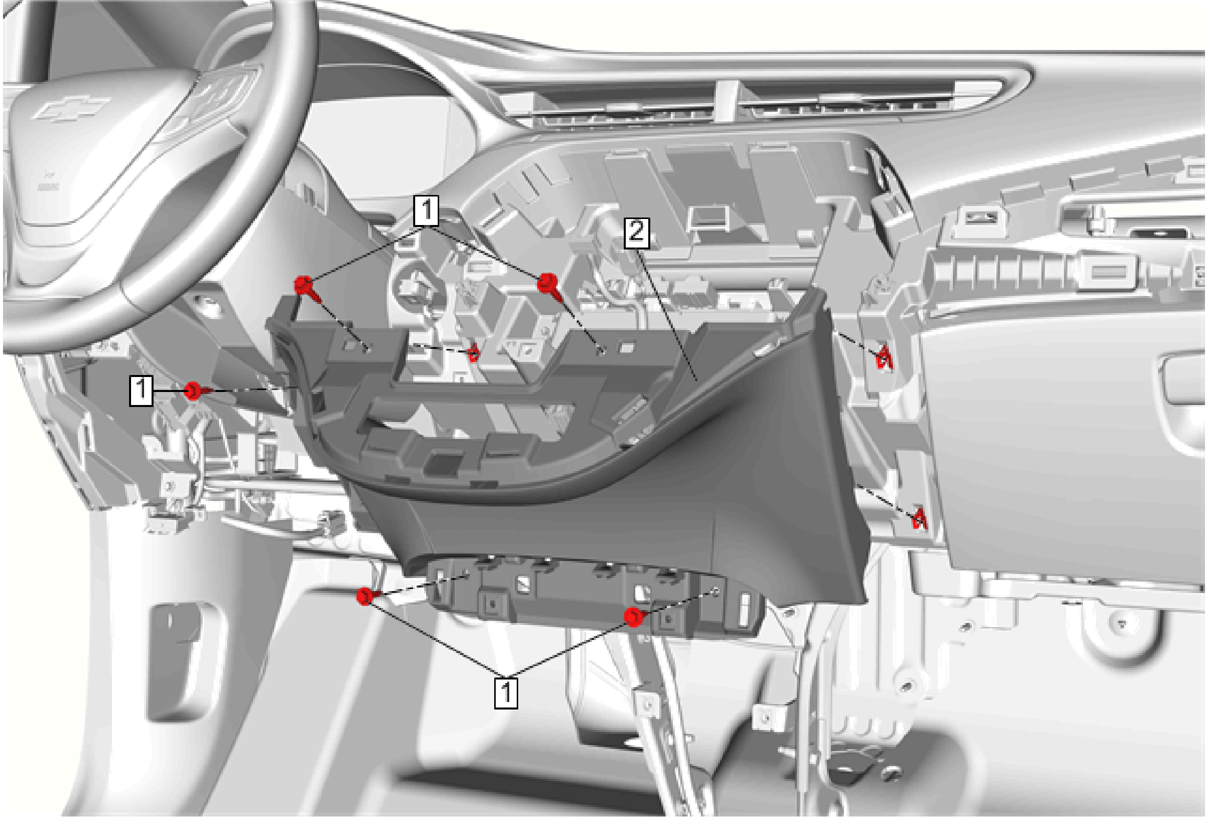


Fig. 48: Instrument Panel Lower Trim Panel
Courtesy of GENERAL MOTORS COMPANY

13. Instrument Panel Lower Trim Panel (2) - Install - Instrument Panel Lower Trim Panel Replacement

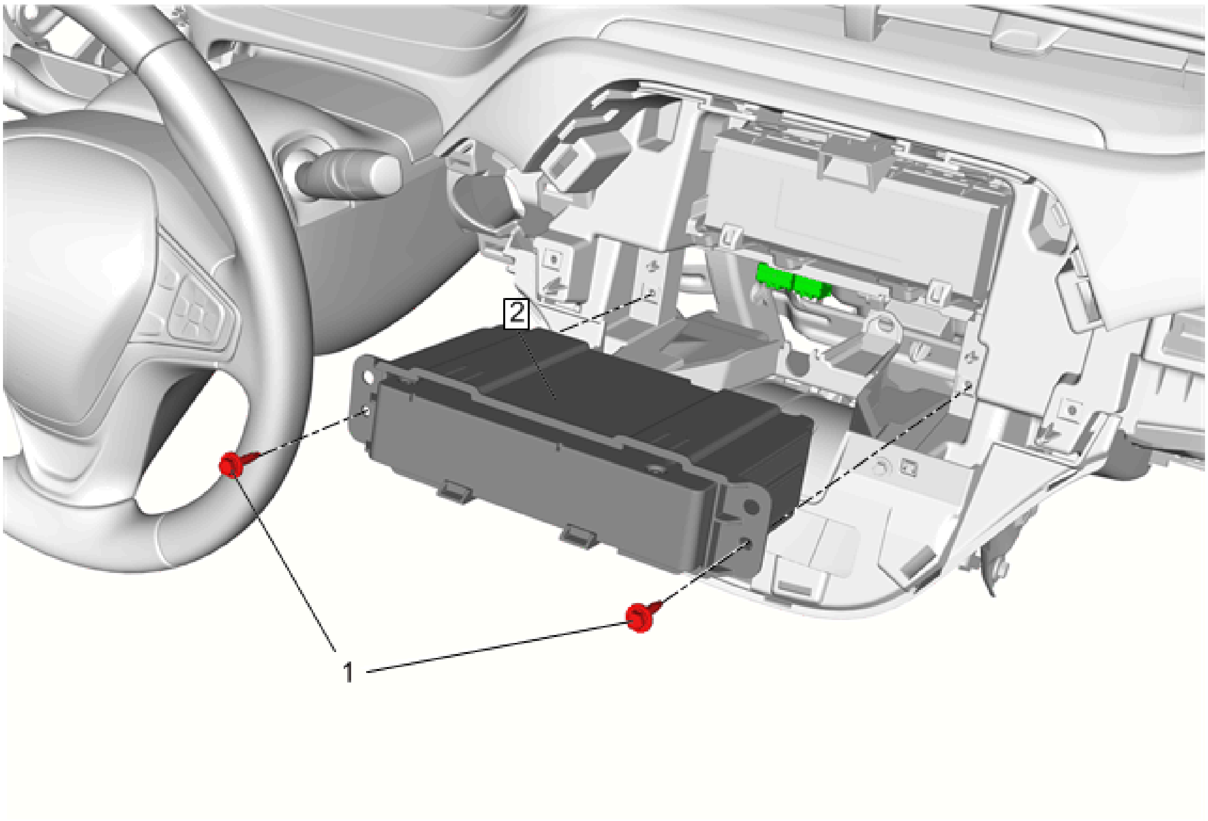


Fig. 49: Communication Interface Module Bracket
Courtesy of GENERAL MOTORS COMPANY

14. Communication Interface Module Bracket - Install - Communication Interface Module Bracket Replacement

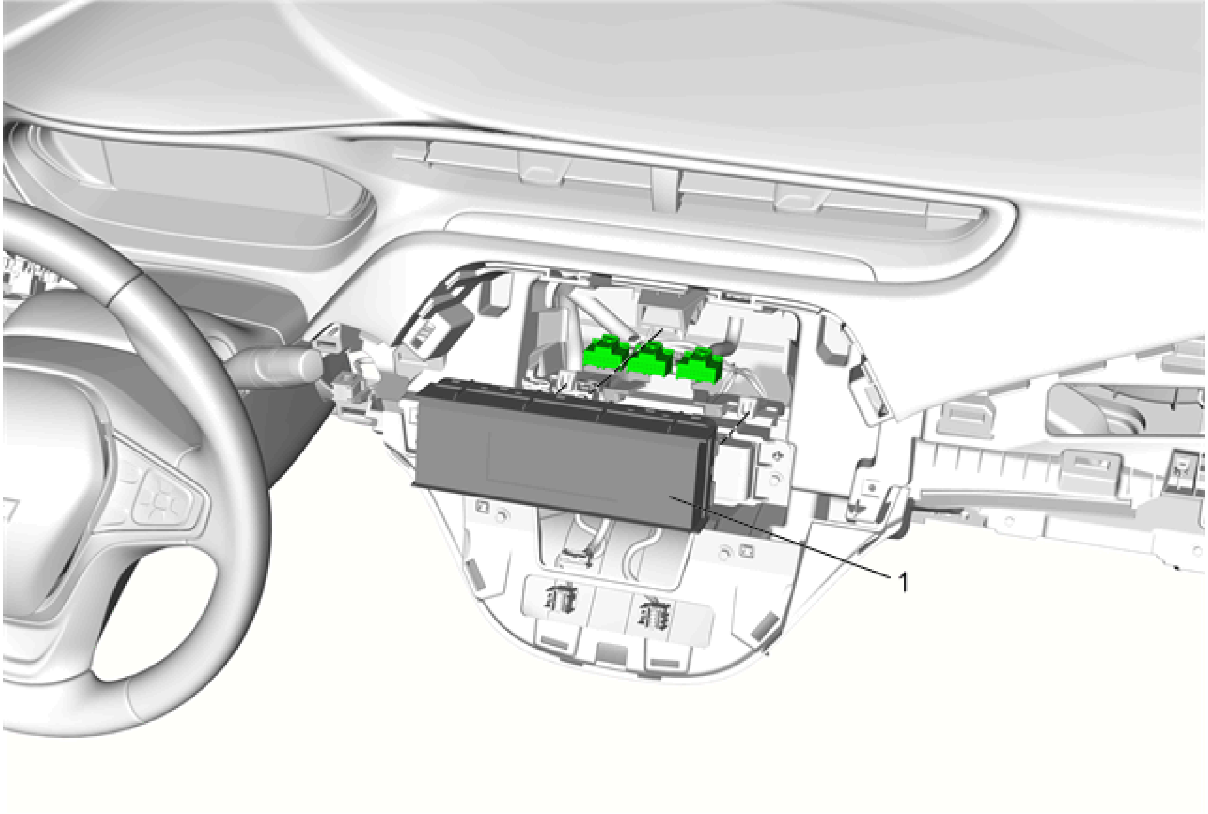


Fig. 50: Heater and Air Conditioning Remote Control
Courtesy of GENERAL MOTORS COMPANY

15. Heater and Air Conditioning Remote Control - Install - **Heater and Air Conditioning Remote Control Replacement**

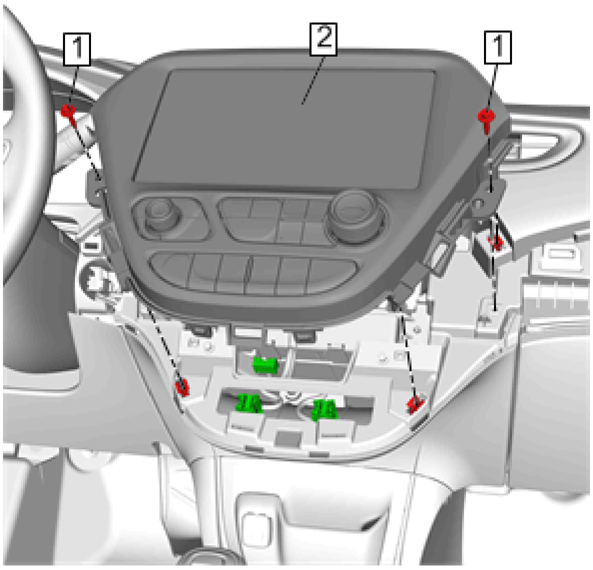


Fig. 51: Instrument Panel Trim Plate With Driver Information Display
Courtesy of GENERAL MOTORS COMPANY

16. Instrument Panel Trim Plate - Install - **Instrument Panel Trim Plate Replacement**

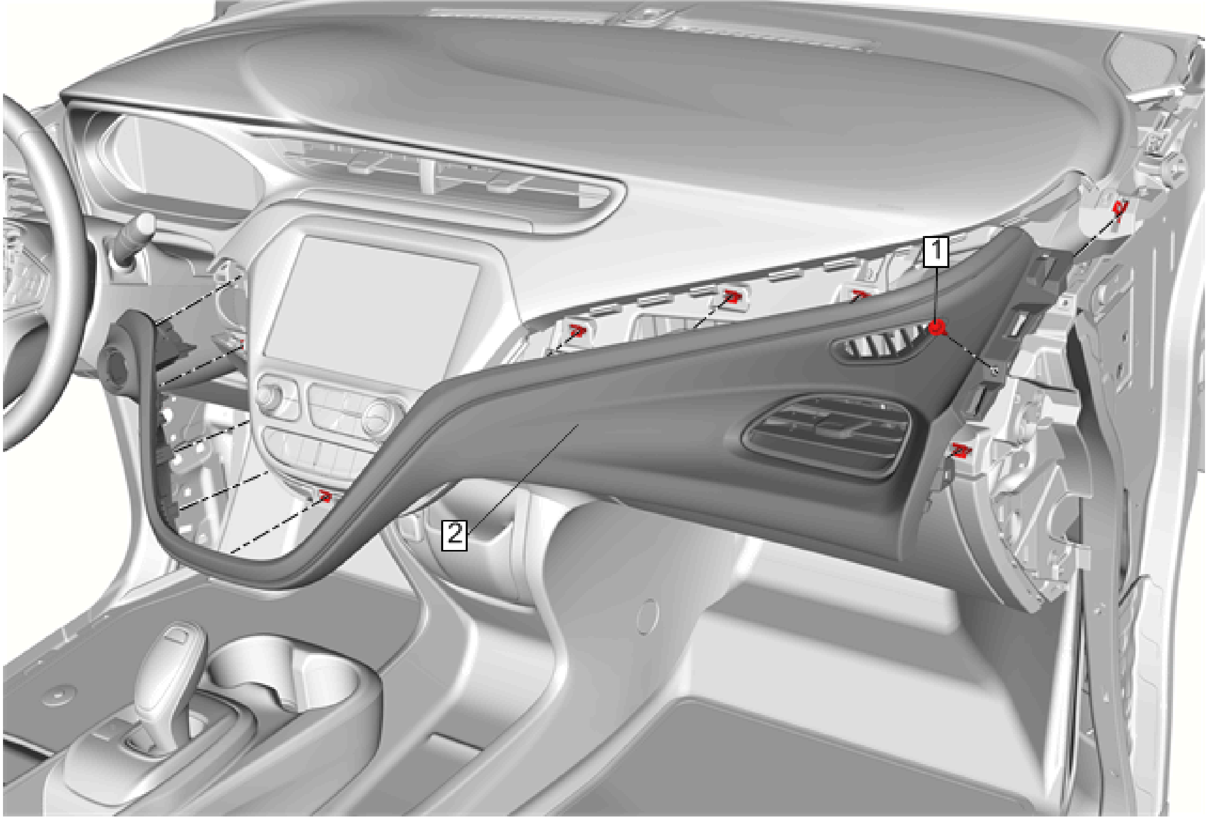


Fig. 52: Instrument Panel Trim Pad - Right Side
Courtesy of GENERAL MOTORS COMPANY

17. Instrument Panel Trim Pad - Right Side - Install - **Instrument Panel Trim Pad Replacement - Right Side**

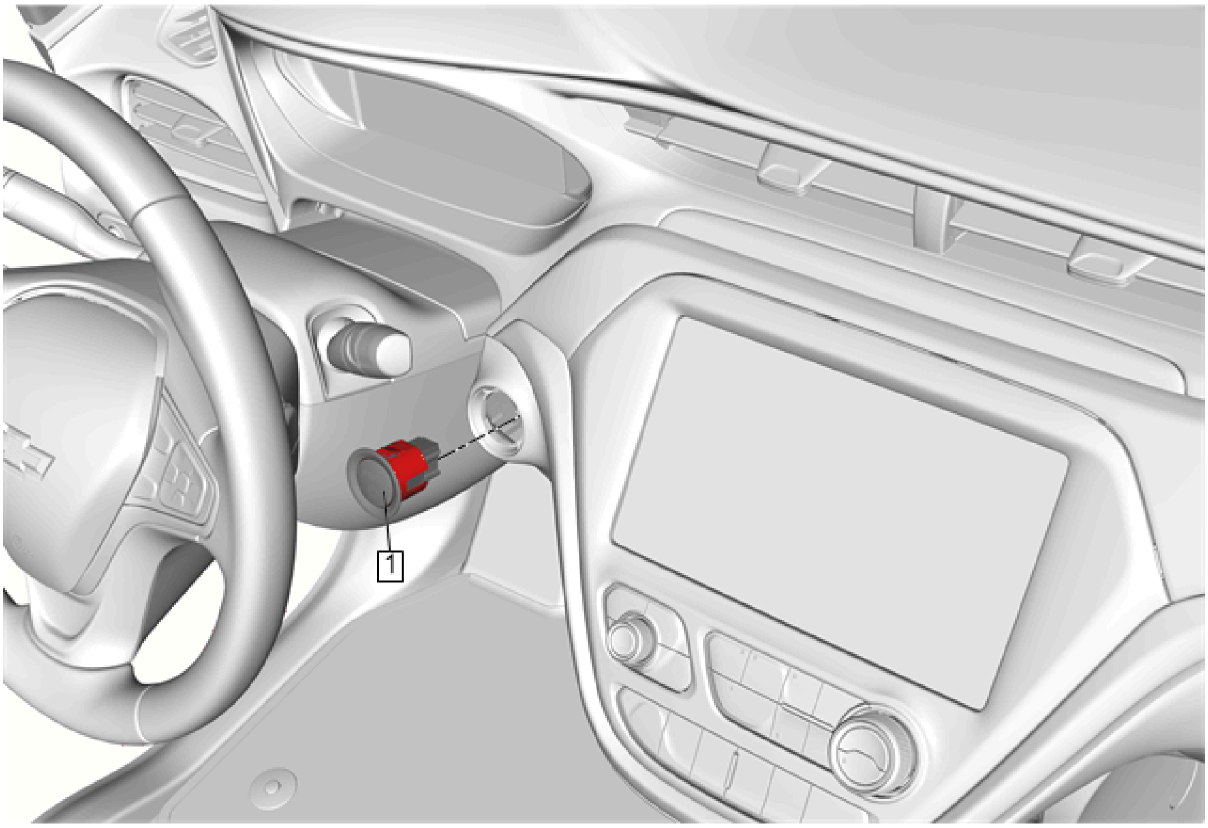


Fig. 53: On/Off Vehicle Switch
Courtesy of GENERAL MOTORS COMPANY

18. On/Off Vehicle Switch - Install - **On/Off Vehicle Switch Replacement**

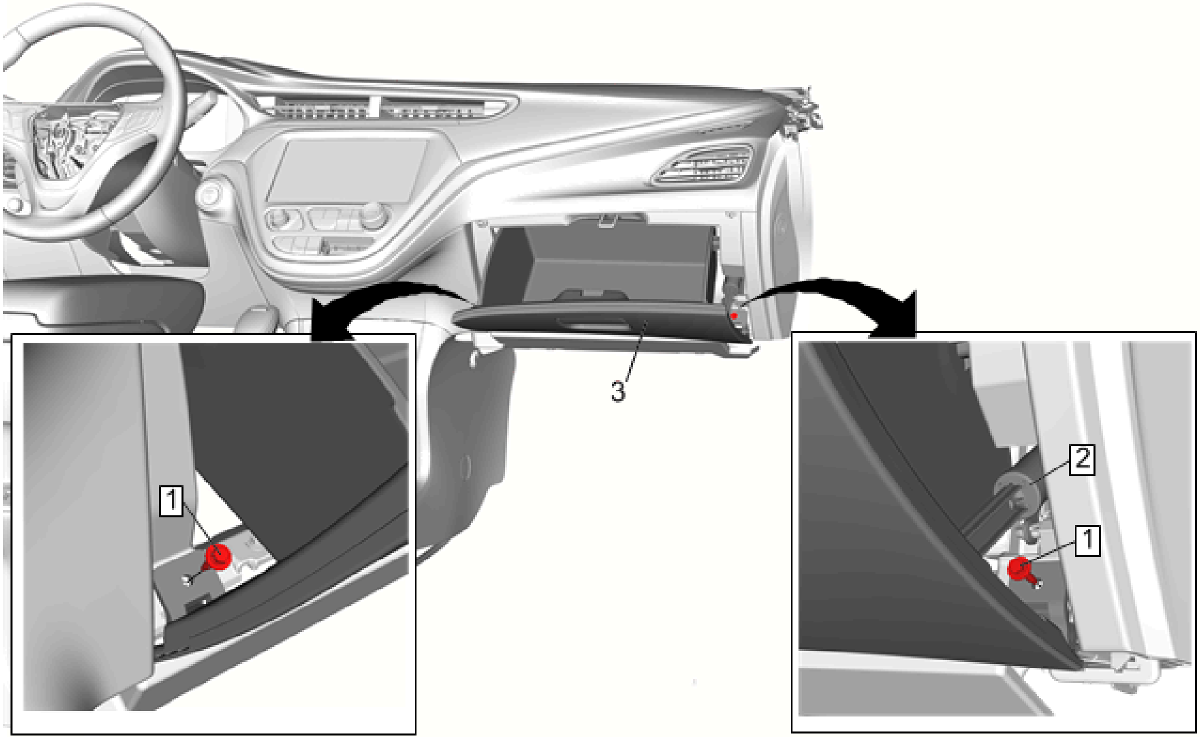


Fig. 54: Instrument Panel Compartment
Courtesy of GENERAL MOTORS COMPANY

19. Instrument Panel Compartment - Install - **Instrument Panel Compartment Replacement**

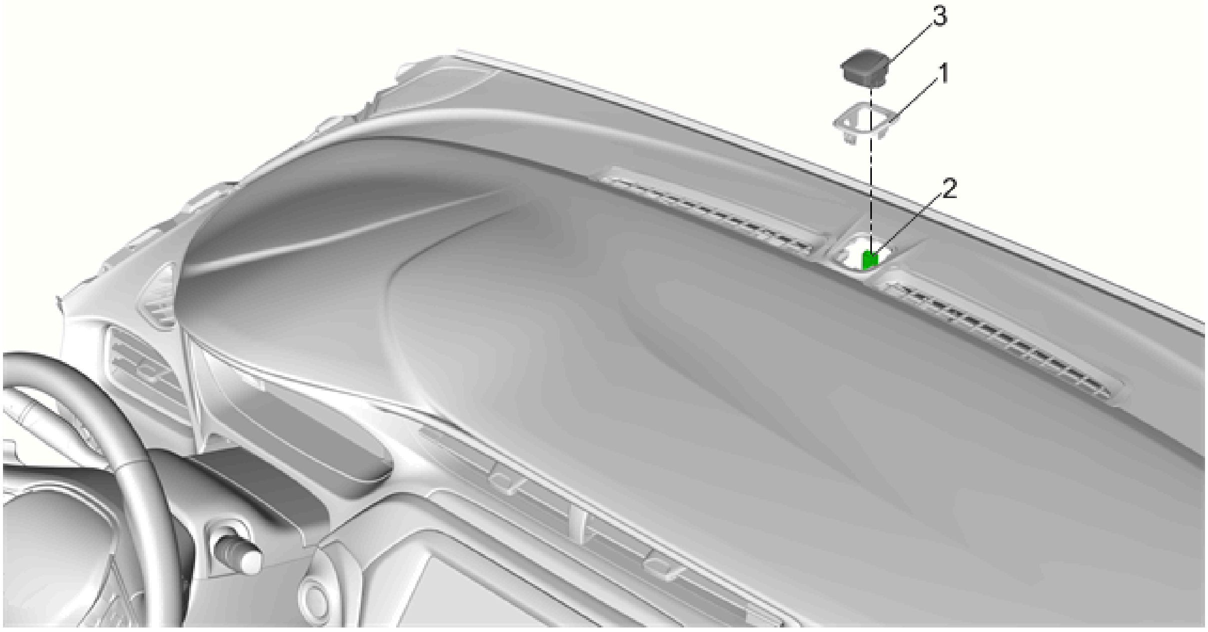


Fig. 55: Sun Load, Ambient Light, and Charge Indicator Sensor
Courtesy of GENERAL MOTORS COMPANY

20. Sun Load, Ambient Light, and Charge Indicator Sensor - Install - **Sun Load, Ambient Light, and Charge Indicator Sensor Replacement**

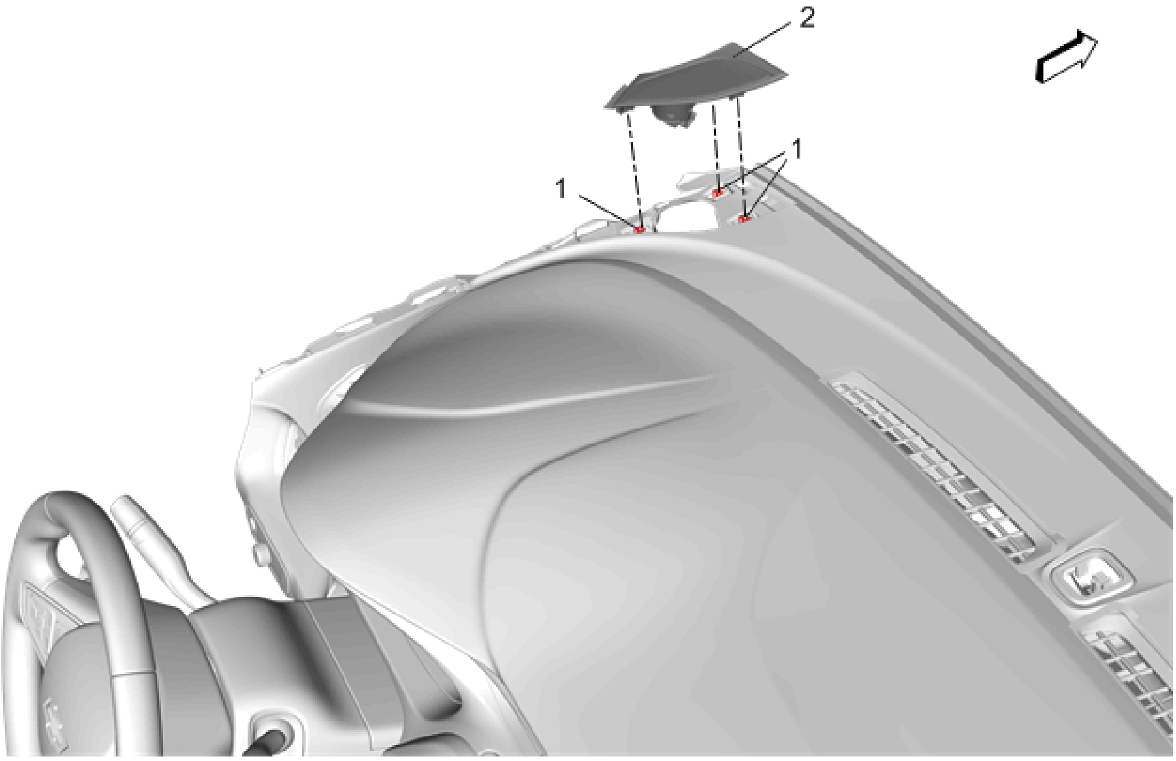


Fig. 56: Radio Front Speaker Grille
Courtesy of GENERAL MOTORS COMPANY

21. Radio Front Speaker Grille - Install - **Radio Front Speaker Grille Replacement**

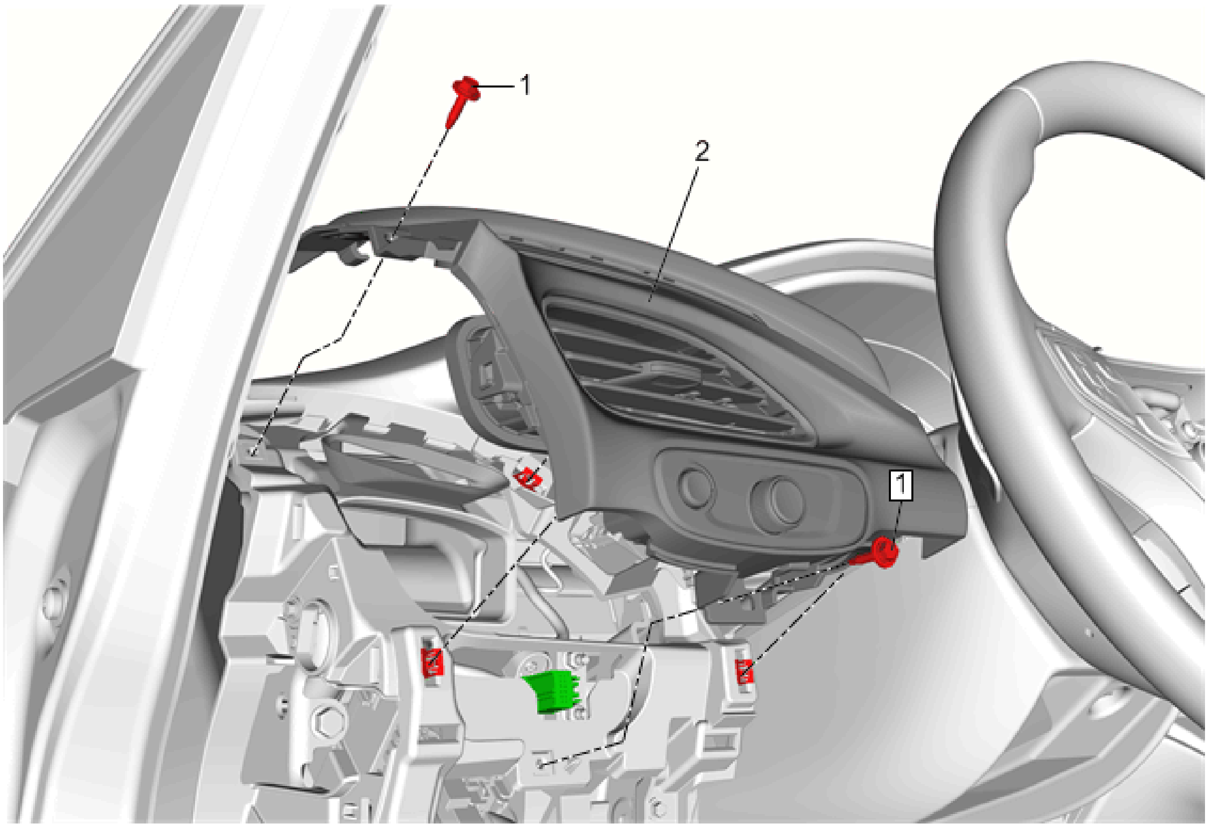


Fig. 57: Instrument Panel Trim Pad - Left Side
Courtesy of GENERAL MOTORS COMPANY

22. Instrument Panel Trim Pad - Left Side - Install - **Instrument Panel Trim Pad Replacement - Left Side**

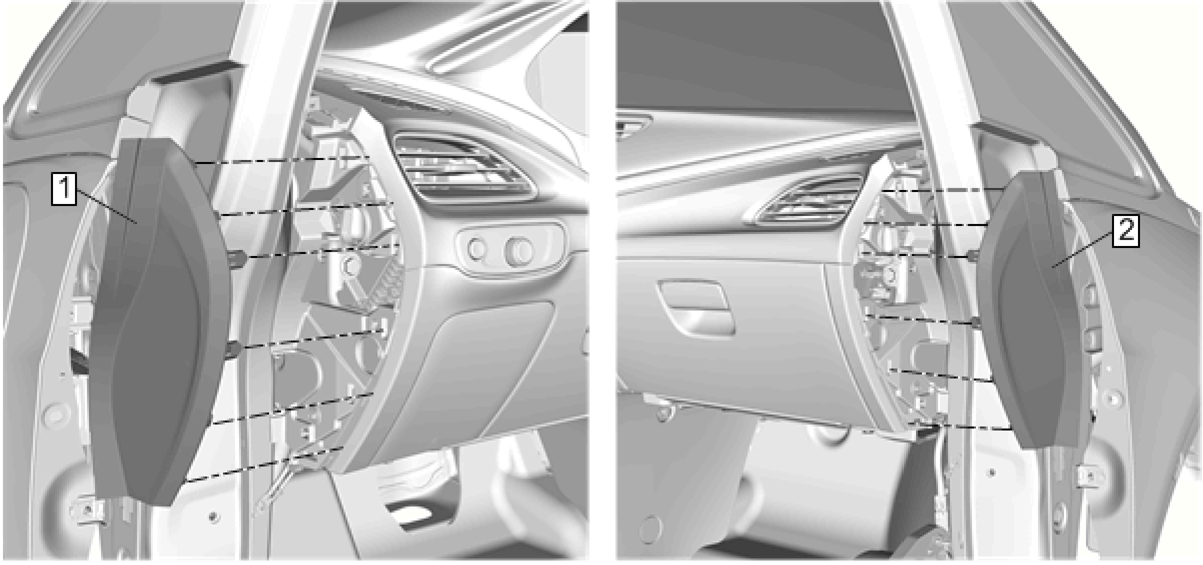


Fig. 58: Instrument Panel Outer Trim Cover - Right
Courtesy of GENERAL MOTORS COMPANY

23. Instrument Panel Outer Trim Cover - Right - Install - **Instrument Panel Outer Trim Cover Replacement**

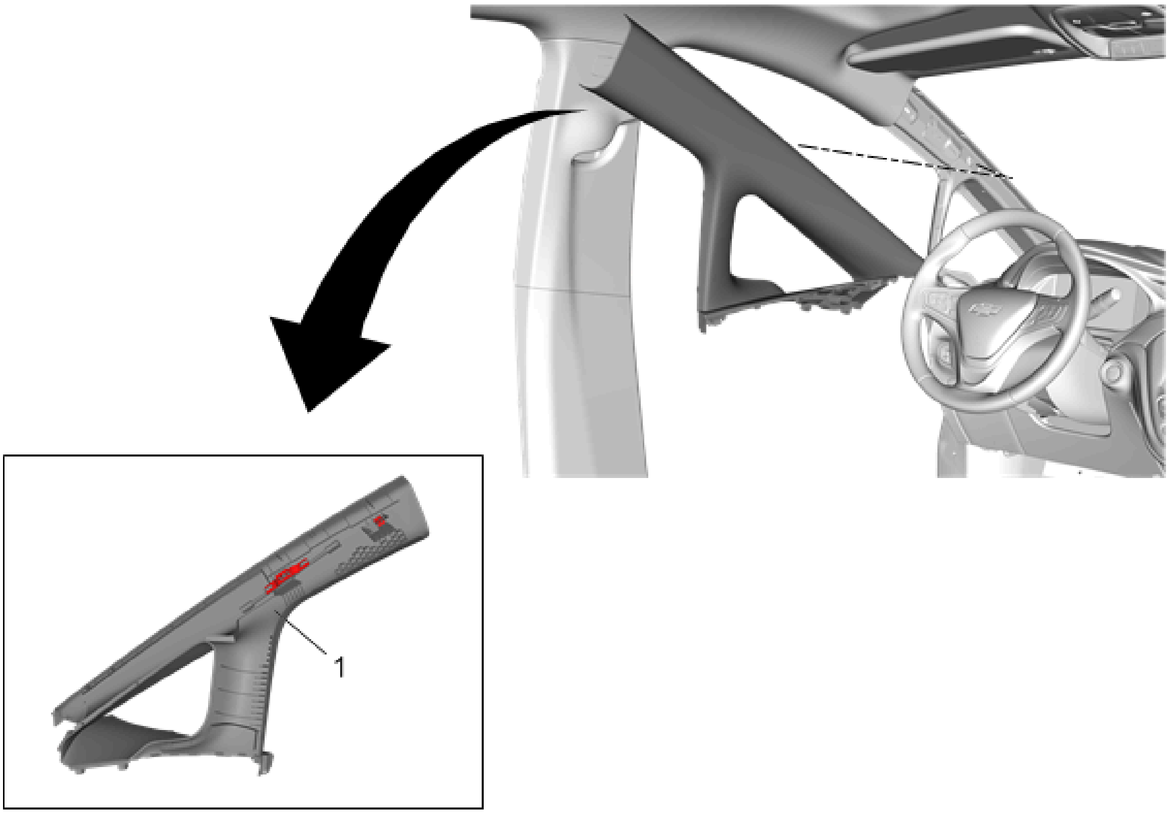


Fig. 59: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

24. Windshield Garnish Molding - Install - **Windshield Garnish Molding Replacement**

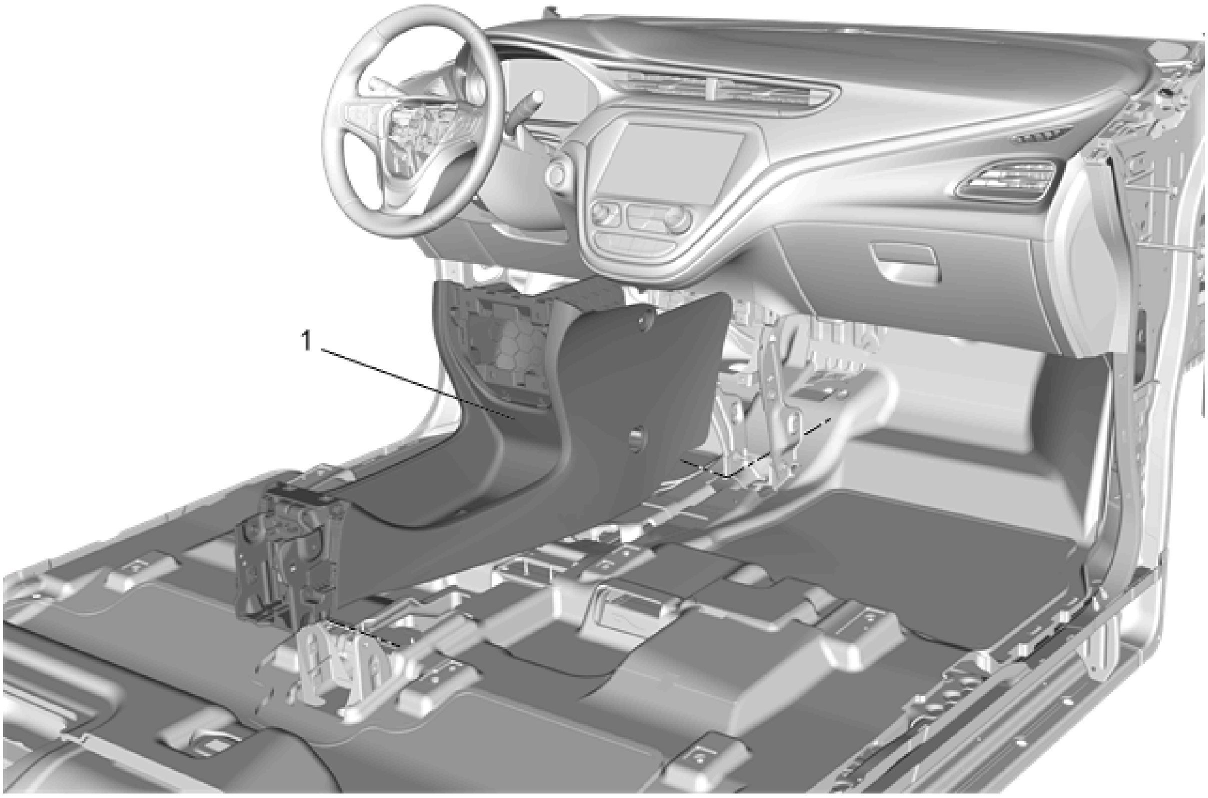


Fig. 60: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

25. Front Floor Console - Install - **Front Floor Console Replacement**

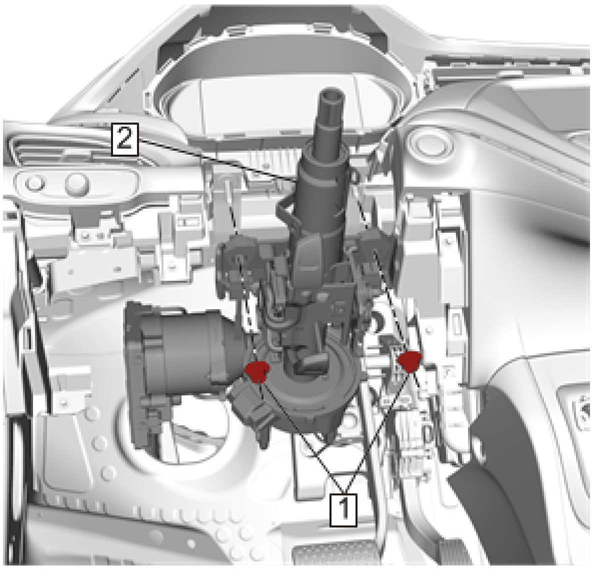


Fig. 61: Steering Column
Courtesy of GENERAL MOTORS COMPANY

26. Steering Column - Install - **Steering Column Replacement**
27. Enable the SIR System. **SIR Disabling and Enabling**

INSTRUMENT PANEL TIE BAR REPLACEMENT

Removal Procedure

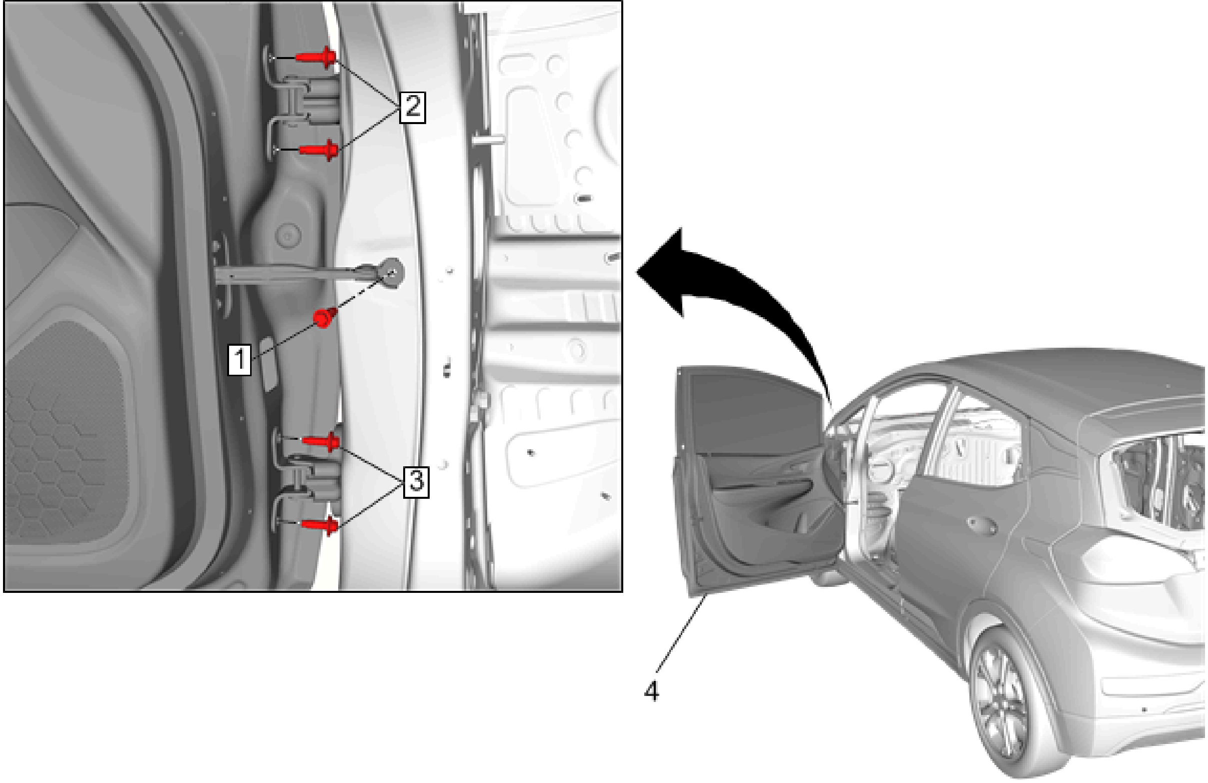


Fig. 62: Front Side Door
Courtesy of GENERAL MOTORS COMPANY

1. Front Side Door - Remove - **Front Side Door Replacement**

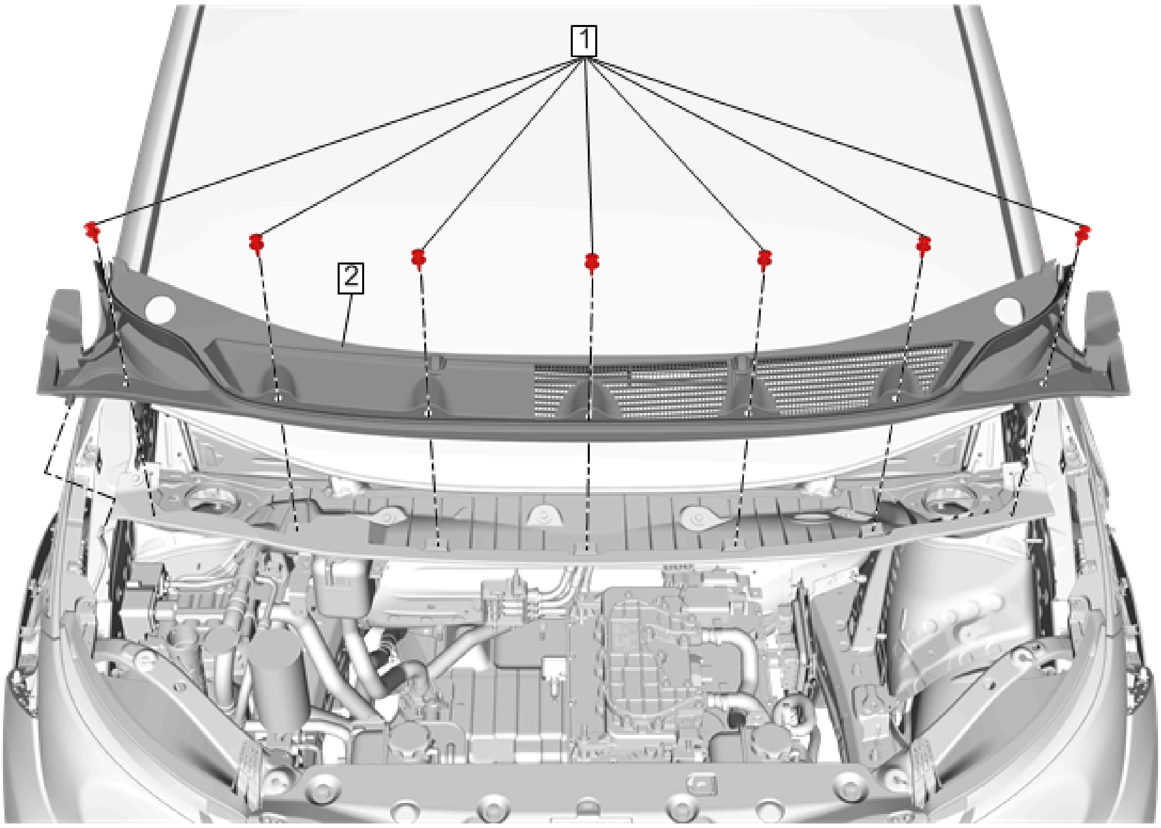


Fig. 63: Air Inlet Grille Panel
Courtesy of GENERAL MOTORS COMPANY

2. Air Inlet Grille Panel - Remove - **Air Inlet Grille Panel Replacement**

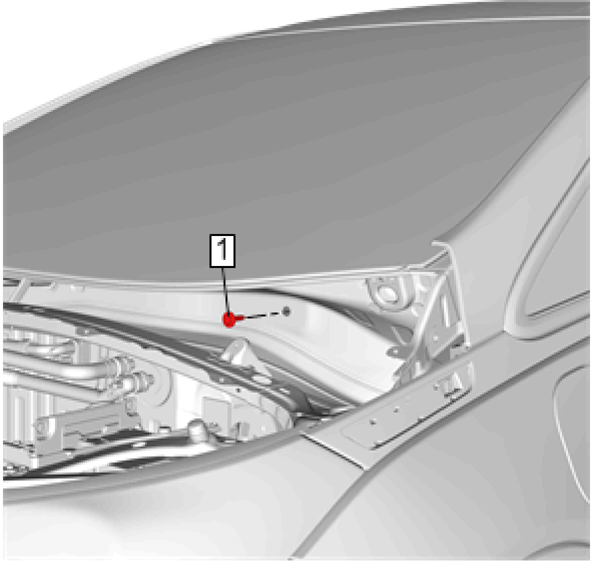


Fig. 64: Instrument Panel Upper Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Instrument Panel Upper Bolt - Remove

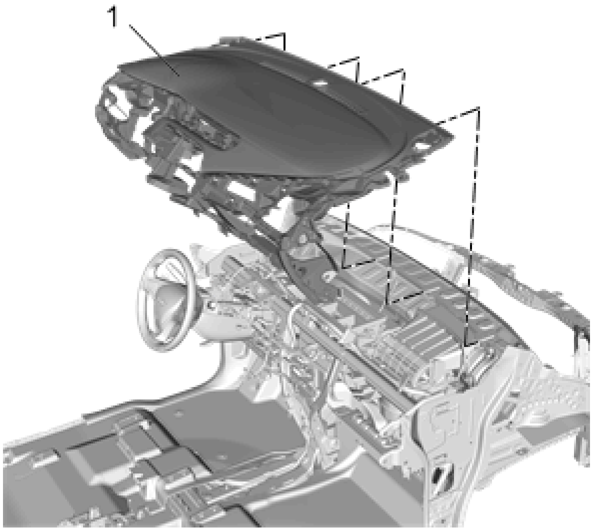


Fig. 65: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Instrument Panel Assembly - Remove - **Instrument Panel Assembly Replacement**

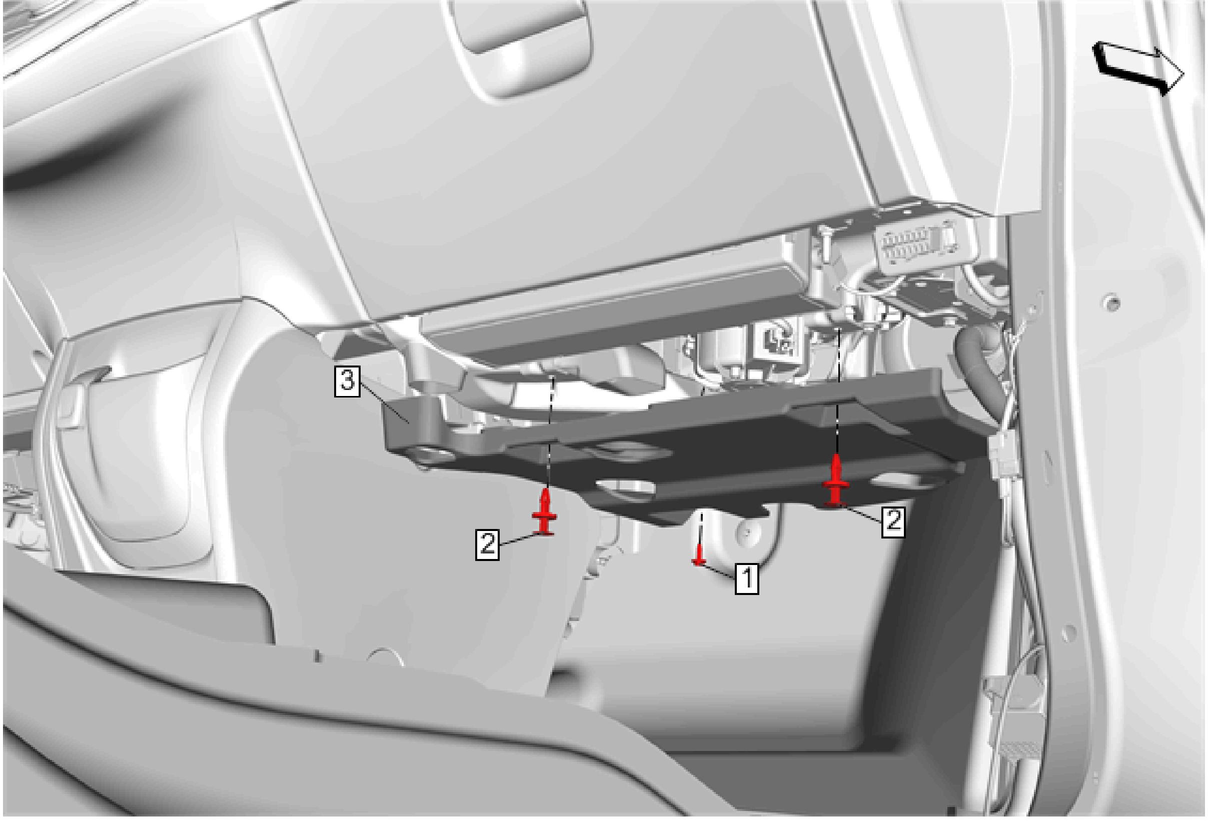


Fig. 66: Instrument Panel Lower Trim Panel Insulator
Courtesy of GENERAL MOTORS COMPANY

5. Instrument Panel Lower Trim Panel Insulator - Remove - **Instrument Panel Lower Trim Panel Insulator Replacement**

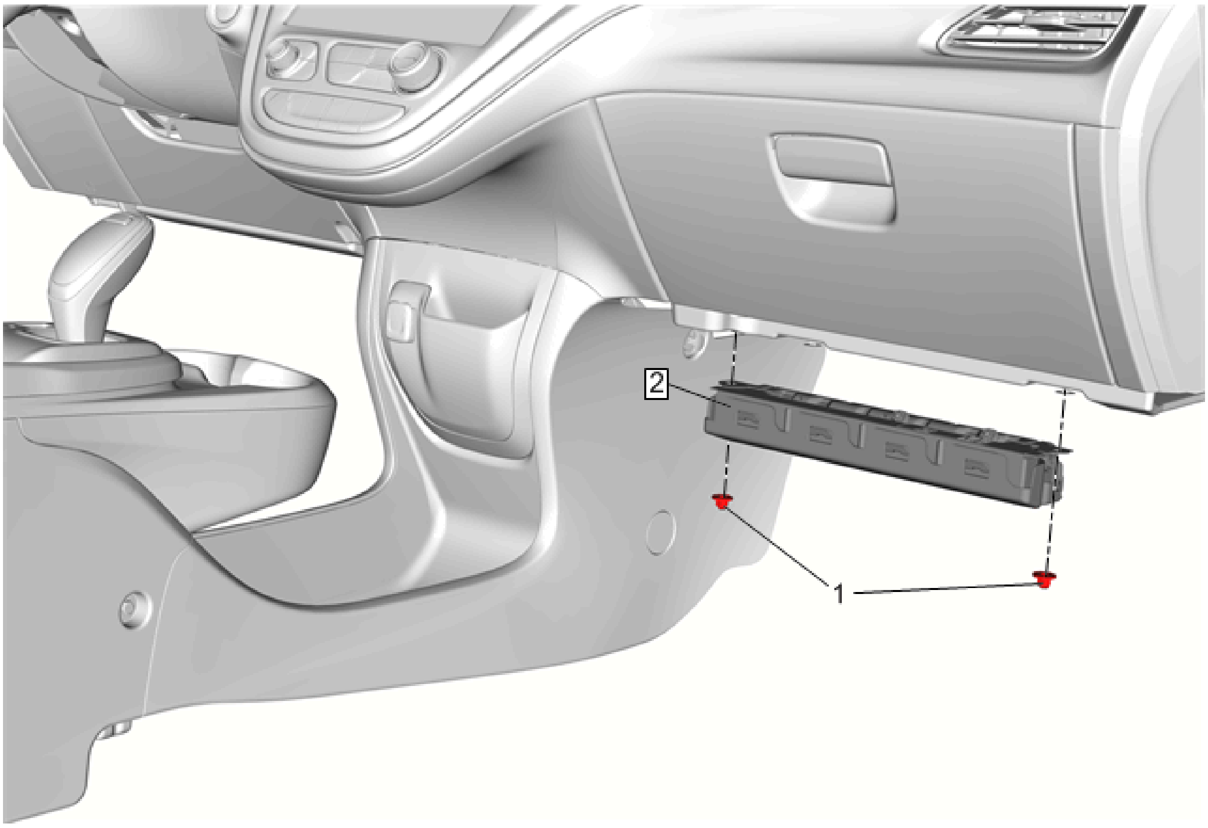


Fig. 67: Instrument Panel Lower Airbag - Passenger Side
Courtesy of GENERAL MOTORS COMPANY

6. Instrument Panel Lower Airbag - Passenger Side - Remove - **Instrument Panel Lower Airbag Replacement - Passenger Side**

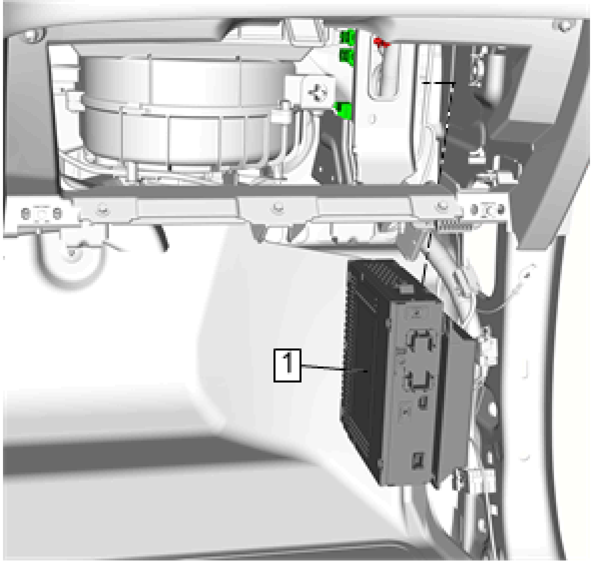


Fig. 68: Radio
Courtesy of GENERAL MOTORS COMPANY

7. Radio - Remove **Radio Replacement**

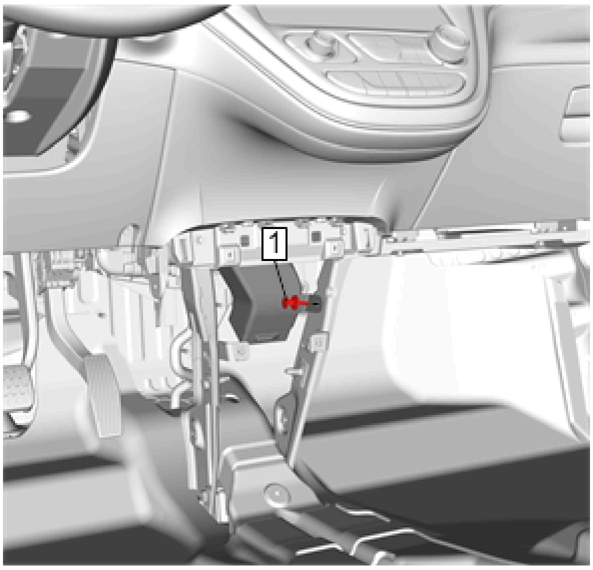


Fig. 69: Floor Front Air Outlet Duct Push Pin
Courtesy of GENERAL MOTORS COMPANY

8. Floor Front Air Outlet Duct Push Pin (1) - Remove - **Floor Front Air Outlet Duct Replacement**

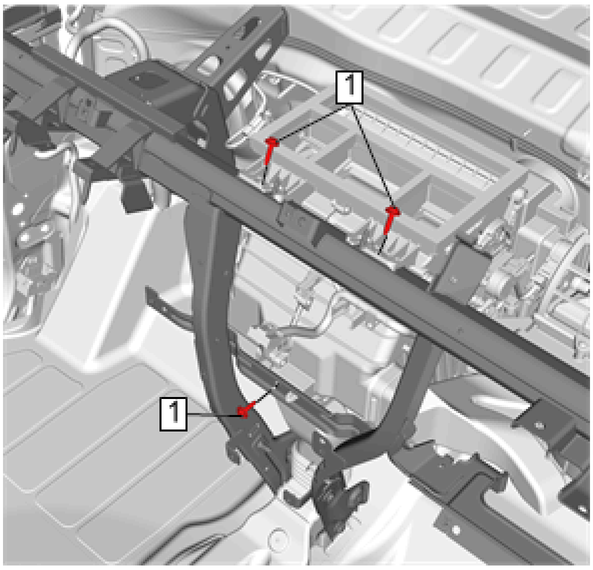


Fig. 70: Heater and Air Conditioning Evaporator Module Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Heater and Air Conditioning Evaporator Module Bolt - Remove

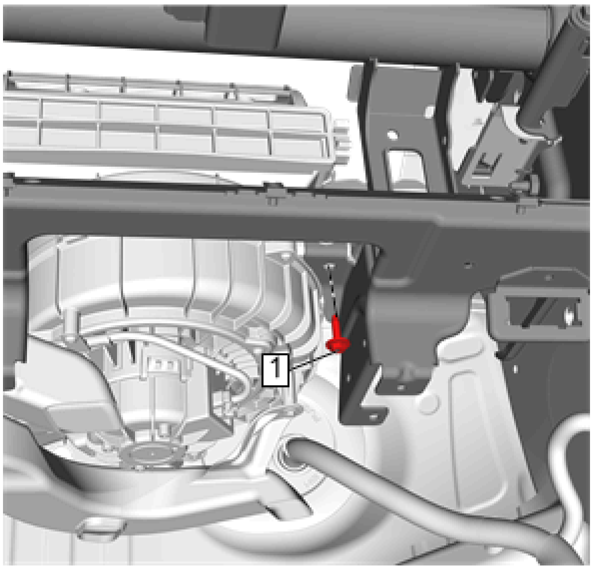


Fig. 71: Heater and Air Conditioning Evaporator and Blower Module Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Heater and Air Conditioning Evaporator and Blower Module Bolt - Remove

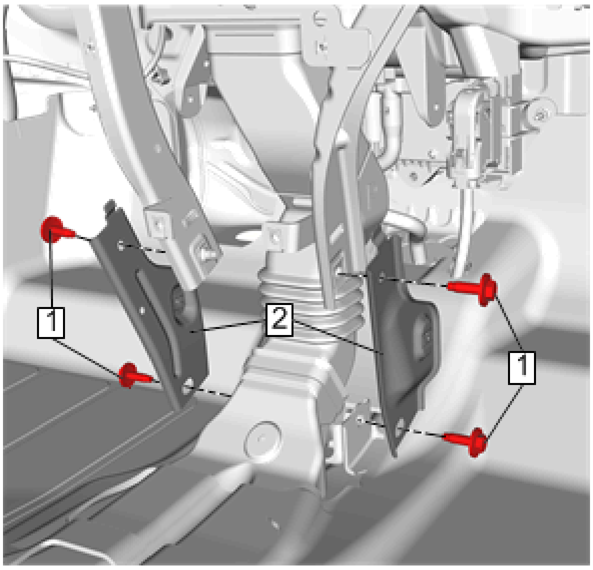


Fig. 72: Instrument Panel Tie Bar Brace Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Unclip the harness from the left brace.
12. Instrument Panel Tie Bar Brace Bolt - Remove
13. Instrument Panel Tie Bar Brace - Remove

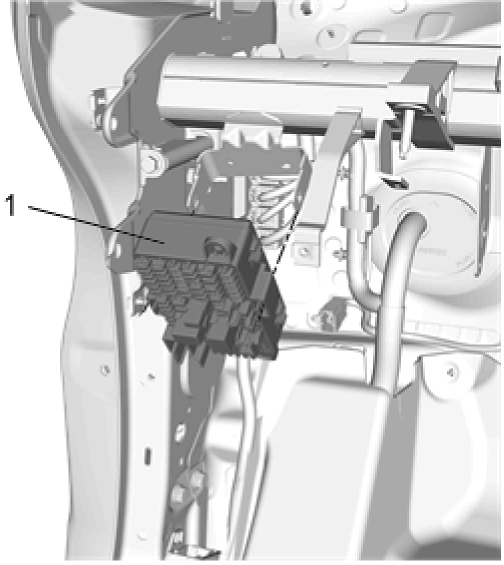


Fig. 73: Instrument Panel Wiring Harness Junction Block
Courtesy of GENERAL MOTORS COMPANY

14. Use a suitable tool to release the Instrument Panel Wiring Harness Junction Block (1) from the Instrument Panel Tie Bar and position out of the way.
15. Unclip the head lamp switch harness from the block.

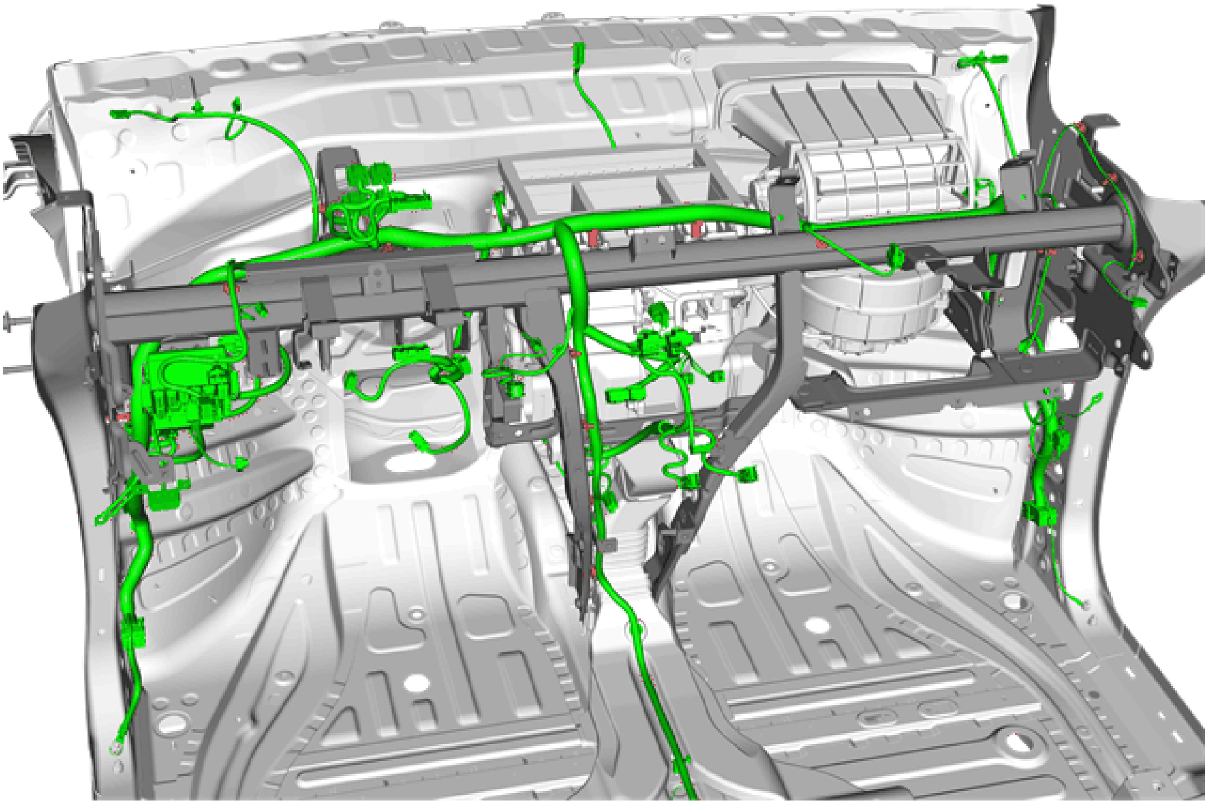


Fig. 74: Instrument Panel Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

16. Note the location and routing of the instrument panel wiring harness prior to removal to ensure proper installation.
17. Detach the I/P wiring harness retaining clips from the Instrument Panel Tie Bar.

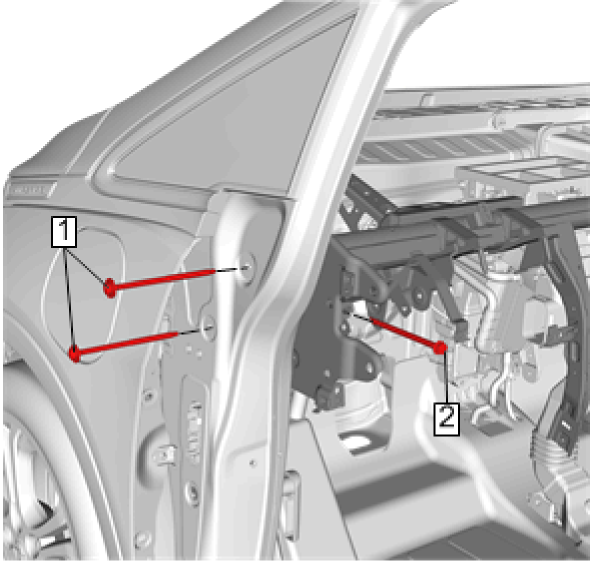


Fig. 75: Instrument Panel Tie Bar Bolt - Right Side
Courtesy of GENERAL MOTORS COMPANY

18. Instrument Panel Tie Bar Bolt - Remove
19. Instrument Panel Tie Bar Reinforcement Bolt - Remove

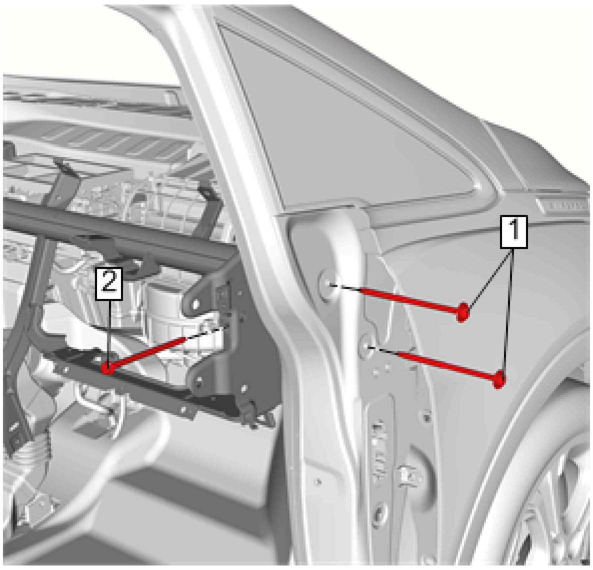


Fig. 76: Instrument Panel Tie Bar Bolt - Left Side
Courtesy of GENERAL MOTORS COMPANY

20. Instrument Panel Tie Bar Bolt - Remove
21. Instrument Panel Tie Bar Reinforcement Bolt - Remove

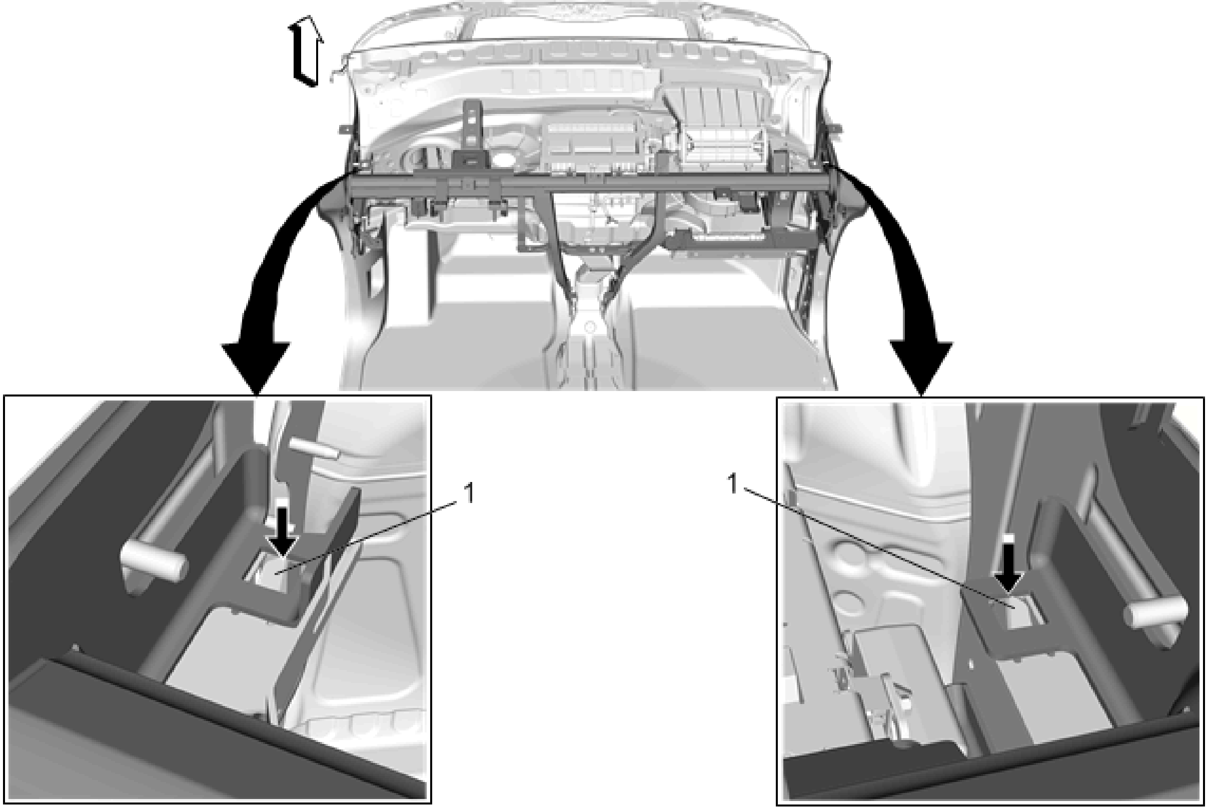


Fig. 77: Body Bracket Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

22. Bend the locking tabs (1) down on the body bracket at the pillars.

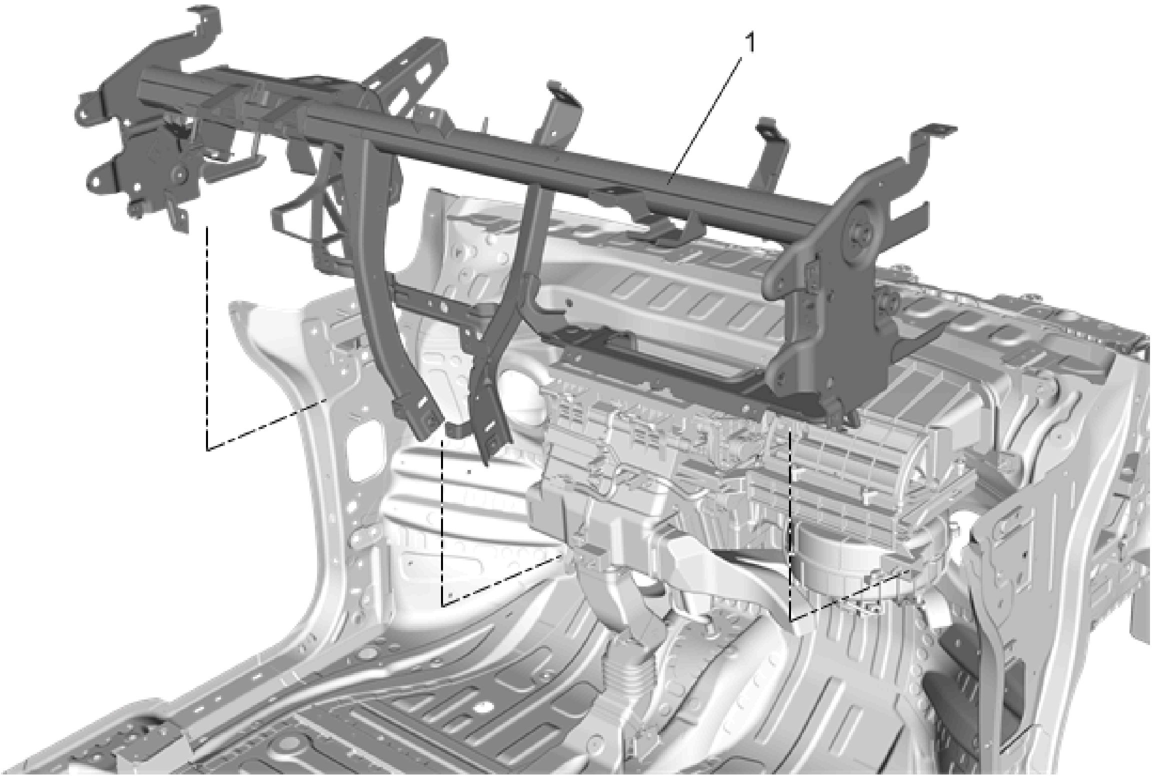
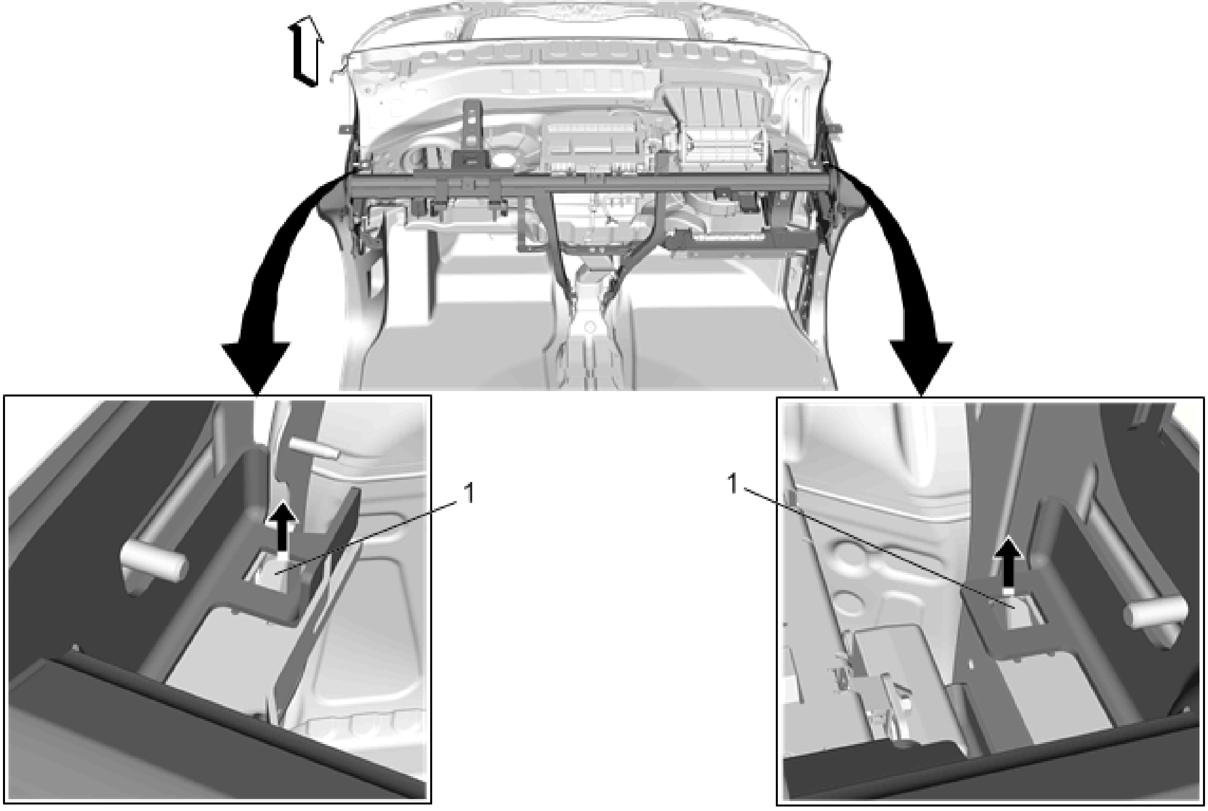


Fig. 78: Instrument Panel Tie Bar Assembly
Courtesy of GENERAL MOTORS COMPANY

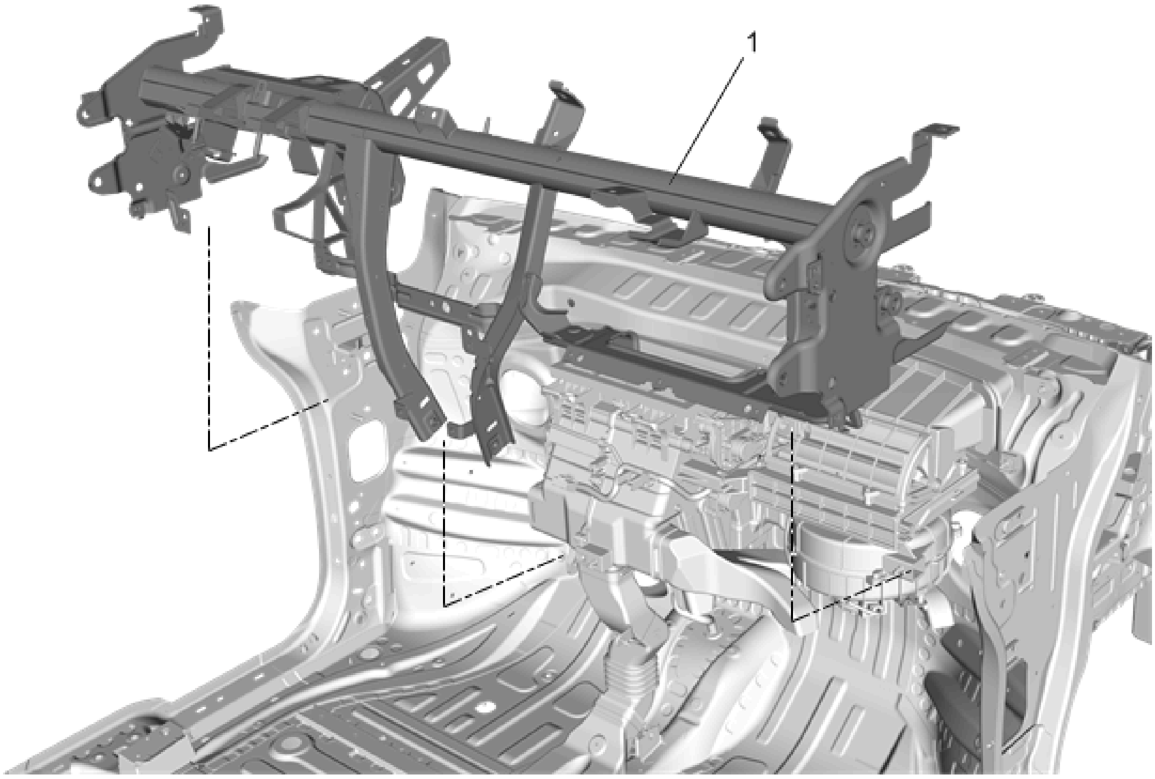
23. Support the HVAC module in order to prevent damage.
24. With the aid of an assistant, remove the instrument panel tie bar assembly from the vehicle.

Installation Procedure



[Fig. 79: Assembly Line Locking Tabs](#)
Courtesy of GENERAL MOTORS COMPANY

1. Bend the assembly line locking tabs (1) back into position.



[Fig. 80: Instrument Panel Tie Bar Assembly](#)
Courtesy of GENERAL MOTORS COMPANY

2. With the aid of an assistant, position the instrument panel tie bar assembly into the vehicle.
3. Remove the HVAC module temporary support.
4. Install the instrument panel wiring harness assembly to the position noted in the removal procedure.

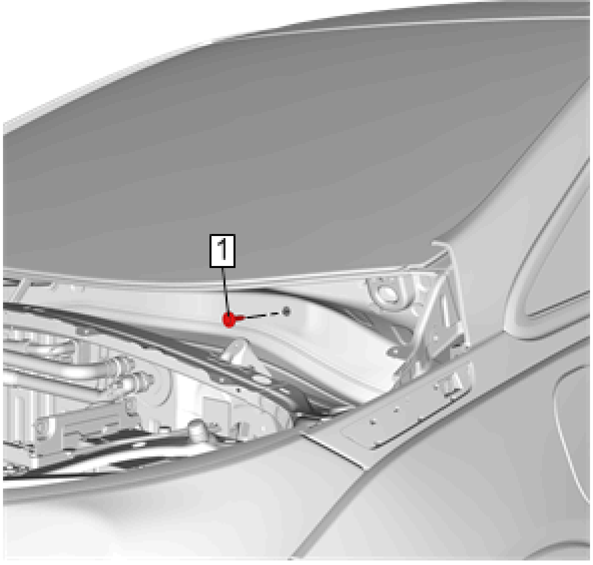


Fig. 81: Instrument Panel Upper Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Instrument Panel Upper Bolt - Install and tighten to 22 N.m (16 lb ft)

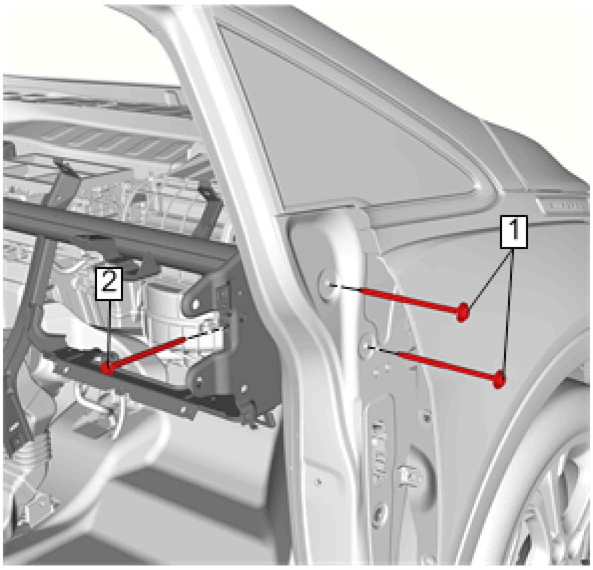


Fig. 82: Instrument Panel Tie Bar Bolt - Left Side
Courtesy of GENERAL MOTORS COMPANY

6. Instrument Panel Bolt (1) - Install and tighten to 22 N.m (16 lb ft)
7. Instrument Panel Tie Bar Reinforcement Bolt (2) - Install and tighten to 22 N.m (16 lb ft)

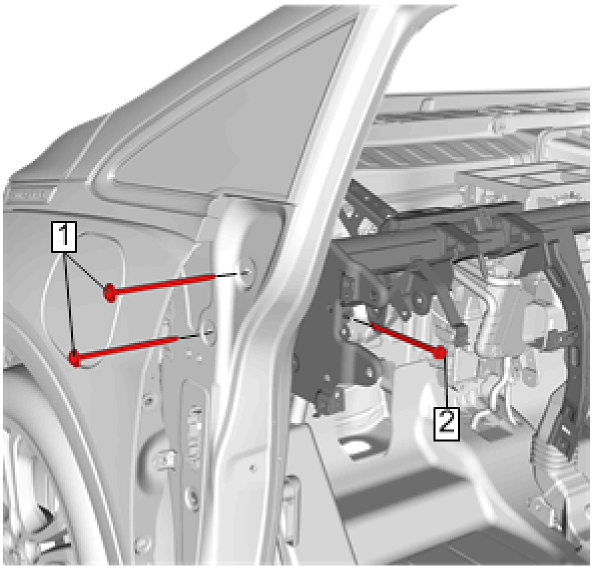


Fig. 83: Instrument Panel Tie Bar Bolt - Right Side
Courtesy of GENERAL MOTORS COMPANY

8. Instrument Panel Bolt (1) - Install and tighten to 22 N.m (16 lb ft)
9. Instrument Panel Tie Bar Reinforcement Bolt (2) - Install and tighten to 22 N.m (16 lb ft)

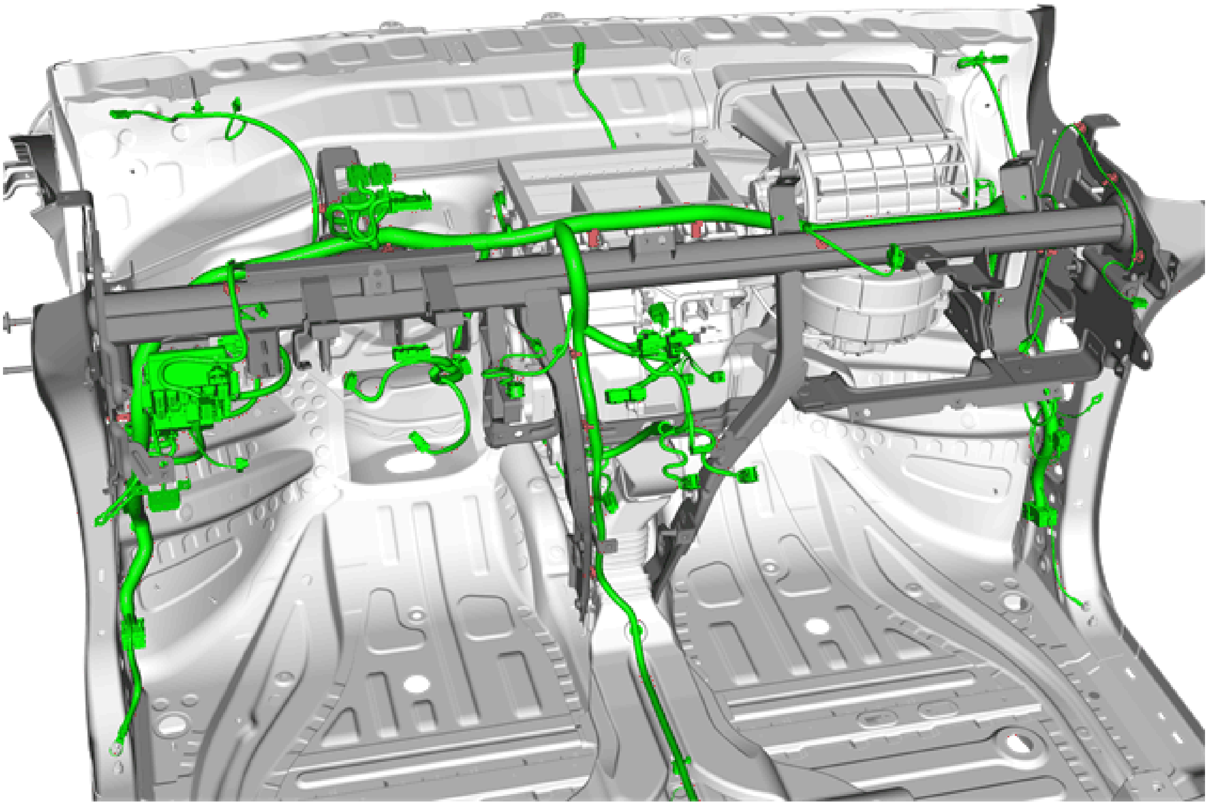


Fig. 84: Instrument Panel Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

10. Attach the I/P wiring harness retaining clips to the Instrument Panel Tie Bar and connect all necessary electrical connectors.

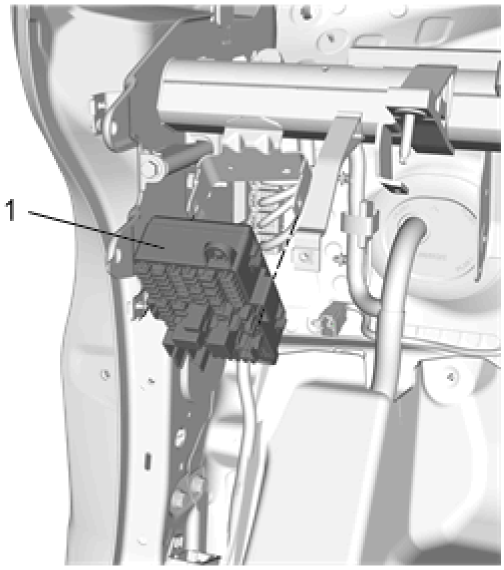


Fig. 85: Instrument Panel Wiring Harness Junction Block
Courtesy of GENERAL MOTORS COMPANY

11. Install the Instrument Panel Wiring Harness Junction Block (1) to the Instrument Panel Tie Bar and clip the head lamp harness to the block.

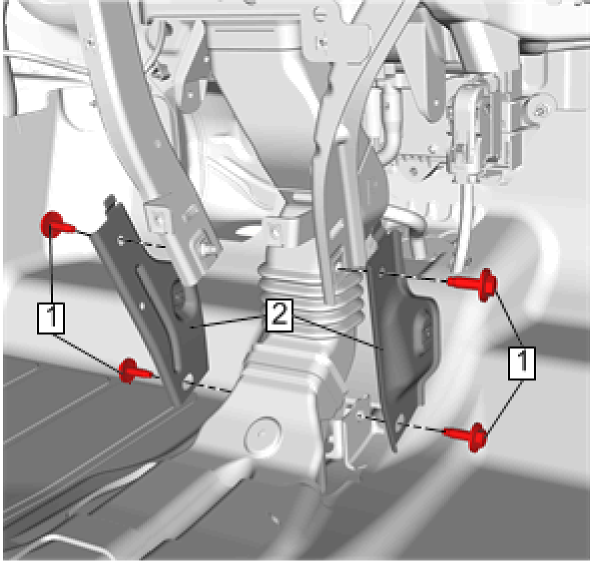


Fig. 86: Instrument Panel Tie Bar Brace Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Instrument Panel Tie Bar Brace (2) - Install
13. Instrument Panel Tie Bar Brace Bolt (1) - 22 N.m (16 lb ft)
14. Clip the electrical harness to the brace.

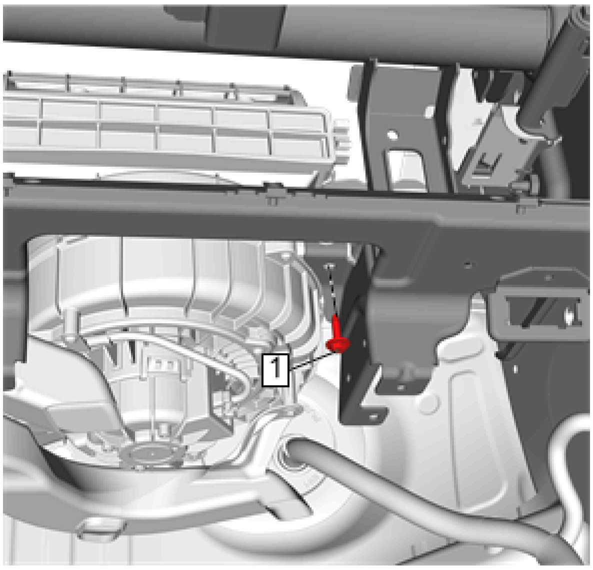


Fig. 87: Heater and Air Conditioning Evaporator and Blower Module Bolt
Courtesy of GENERAL MOTORS COMPANY

15. Heater and Air Conditioning Evaporator and Blower Module Bolt - Install and tighten to 5 N.m (44 lb in)

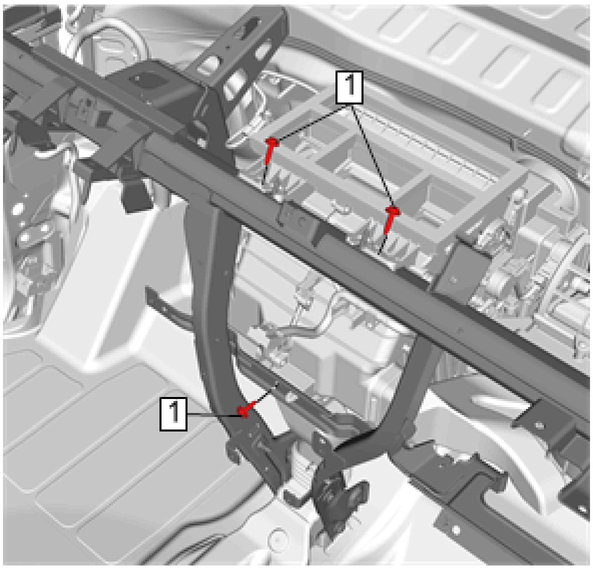


Fig. 88: Heater and Air Conditioning Evaporator Module Bolt
Courtesy of GENERAL MOTORS COMPANY

16. Heater and Air Conditioning Evaporator and Blower Module Bolt - Install and tighten to 5 N.m (44 lb in)

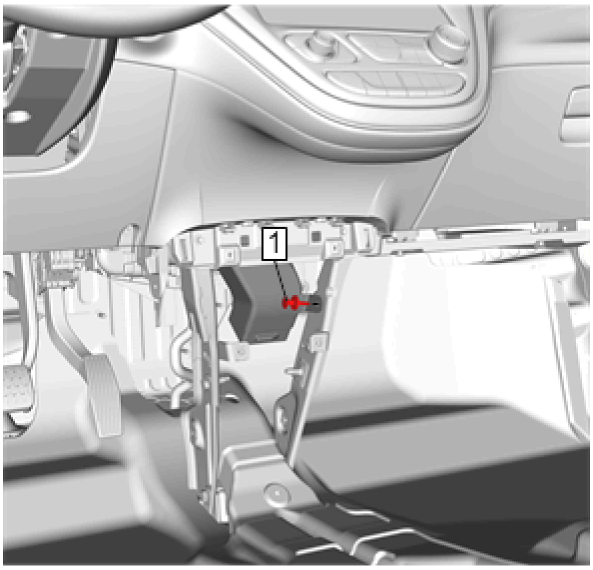


Fig. 89: Floor Front Air Outlet Duct Push Pin
Courtesy of GENERAL MOTORS COMPANY

17. Floor Front Air Outlet Duct Push Pin (1) - Install - Floor Front Air Outlet Duct Replacement

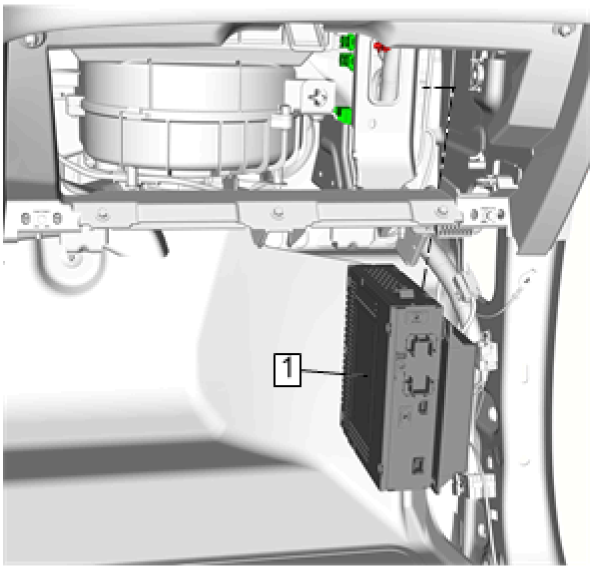


Fig. 90: Radio
Courtesy of GENERAL MOTORS COMPANY

18. Radio - Install - Radio Replacement

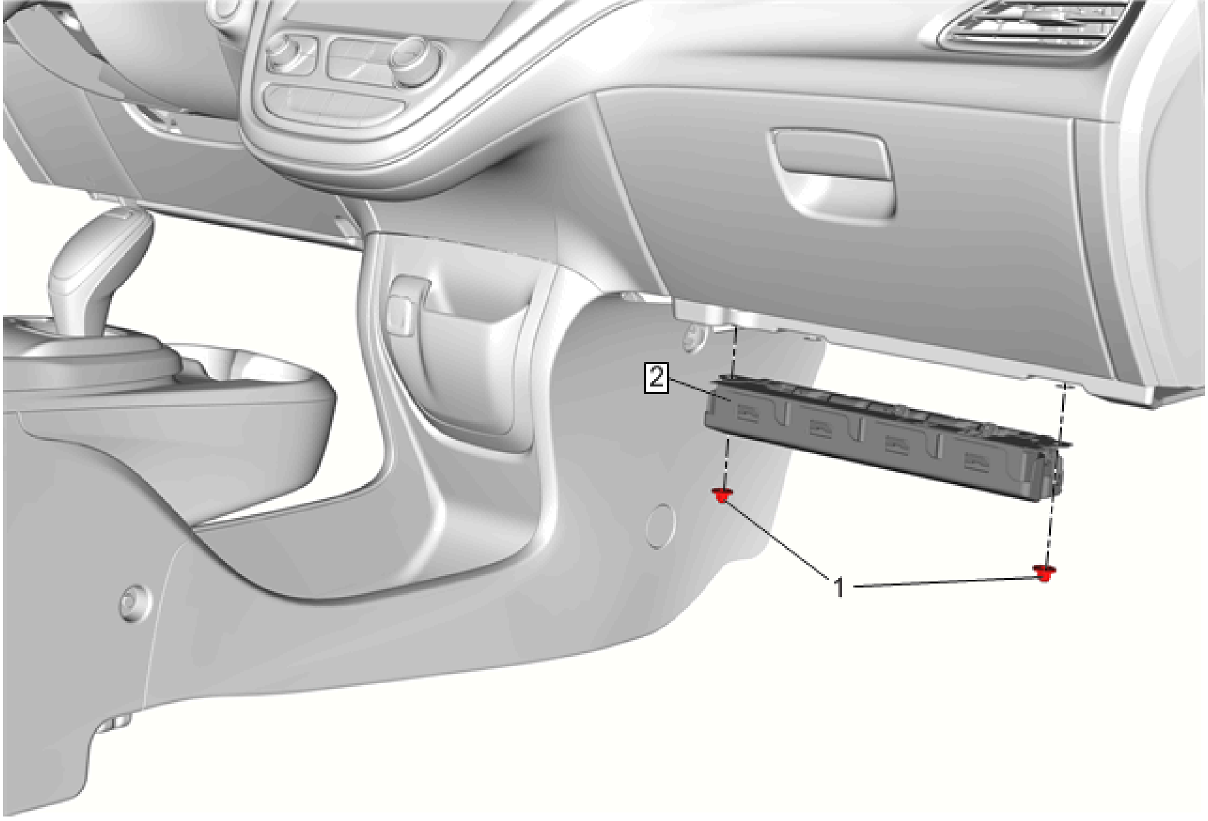


Fig. 91: Instrument Panel Lower Airbag - Passenger Side
Courtesy of GENERAL MOTORS COMPANY

19. Instrument Panel Lower Airbag - Passenger Side - Install - **Instrument Panel Lower Airbag Replacement - Passenger Side**

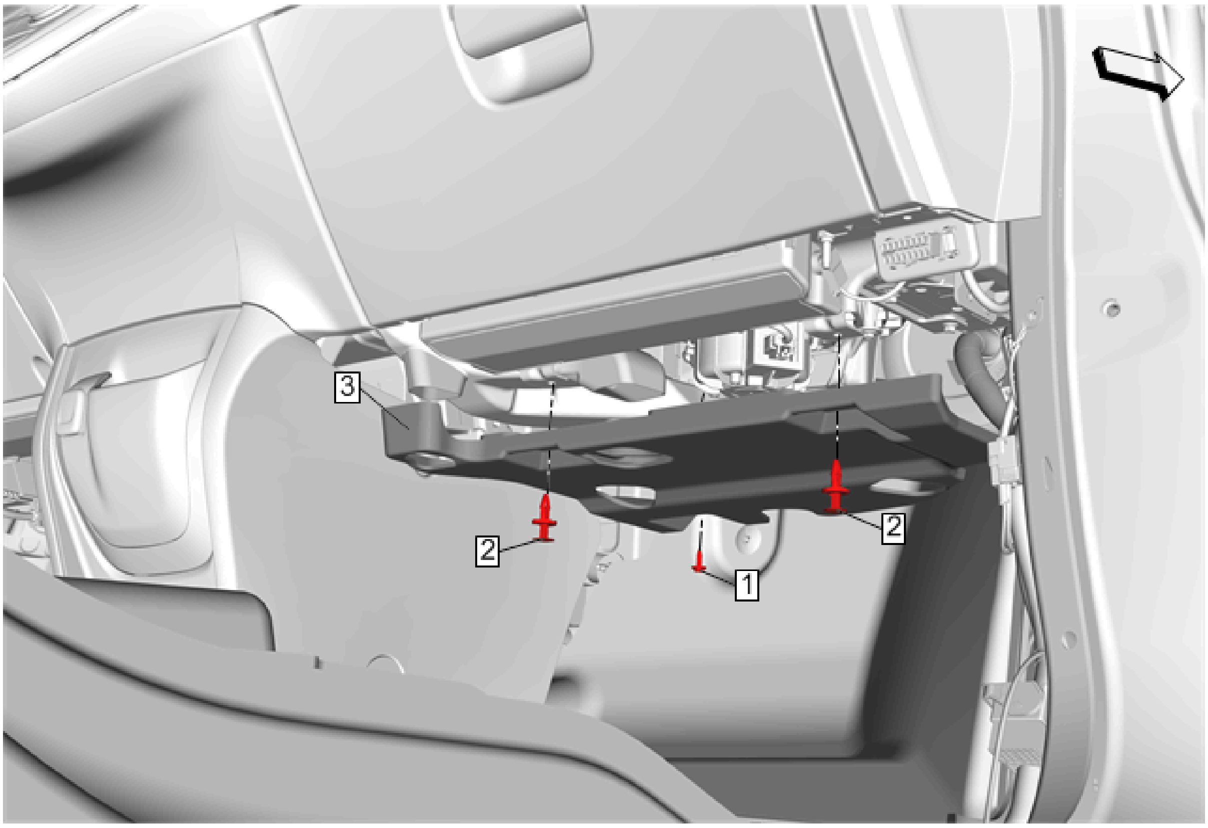


Fig. 92: Instrument Panel Lower Trim Panel Insulator
Courtesy of GENERAL MOTORS COMPANY

20. Instrument Panel Lower Trim Panel Insulator - Install - **Instrument Panel Lower Trim Panel Insulator Replacement**

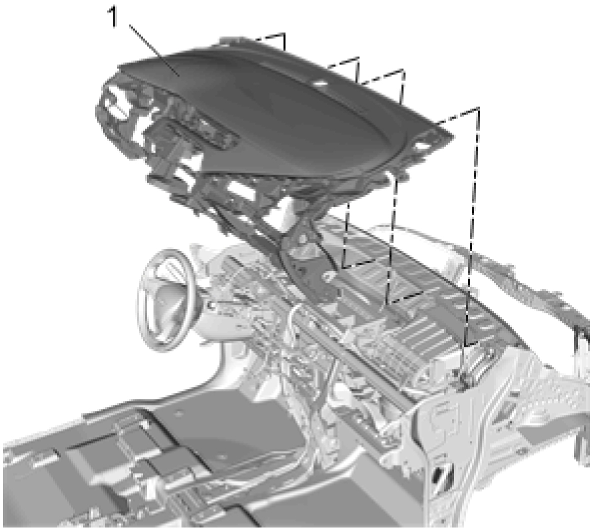


Fig. 93: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

21. Instrument Panel Assembly - Install - Instrument Panel Assembly Replacement

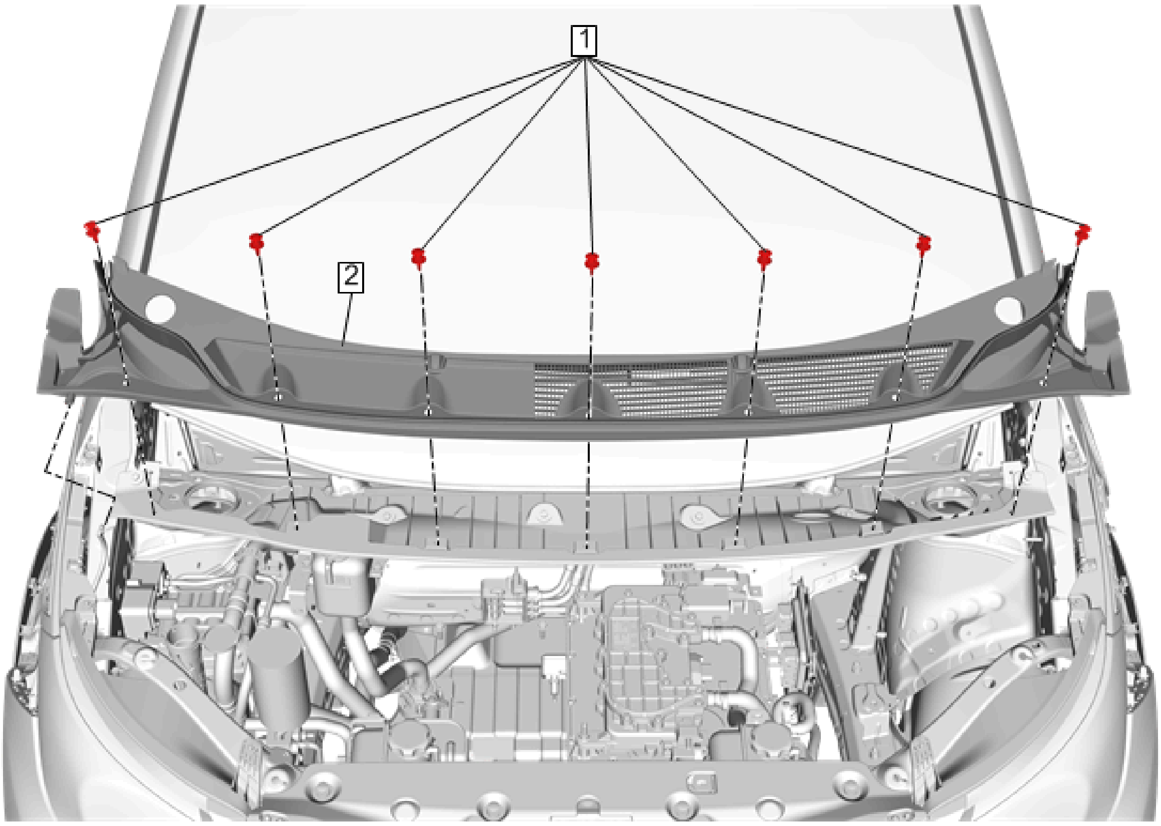


Fig. 94: Air Inlet Grille Panel
Courtesy of GENERAL MOTORS COMPANY

22. Air Inlet Grille Panel - Install - Air Inlet Grille Panel Replacement

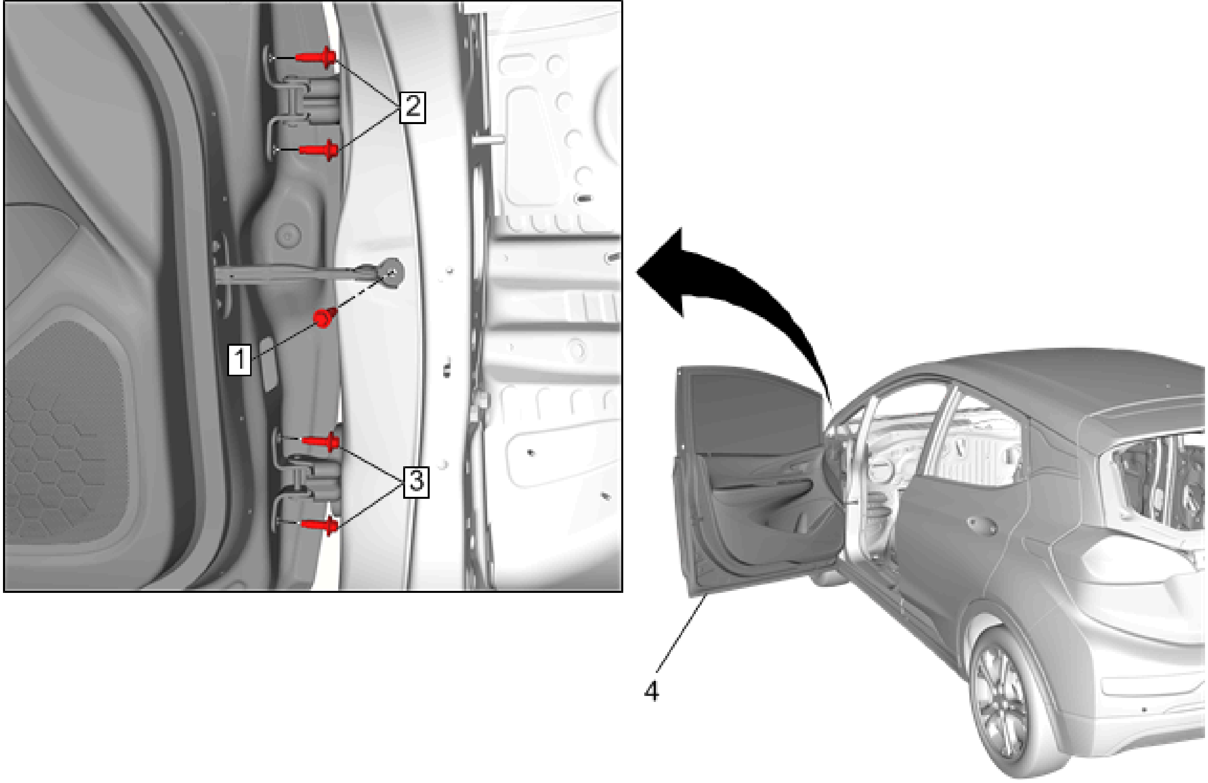


Fig. 95: Front Side Door
Courtesy of GENERAL MOTORS COMPANY

23. Front Side Door - Install - Front Side Door Replacement

FRONT FLOOR CONSOLE COMPARTMENT DIVIDER REPLACEMENT

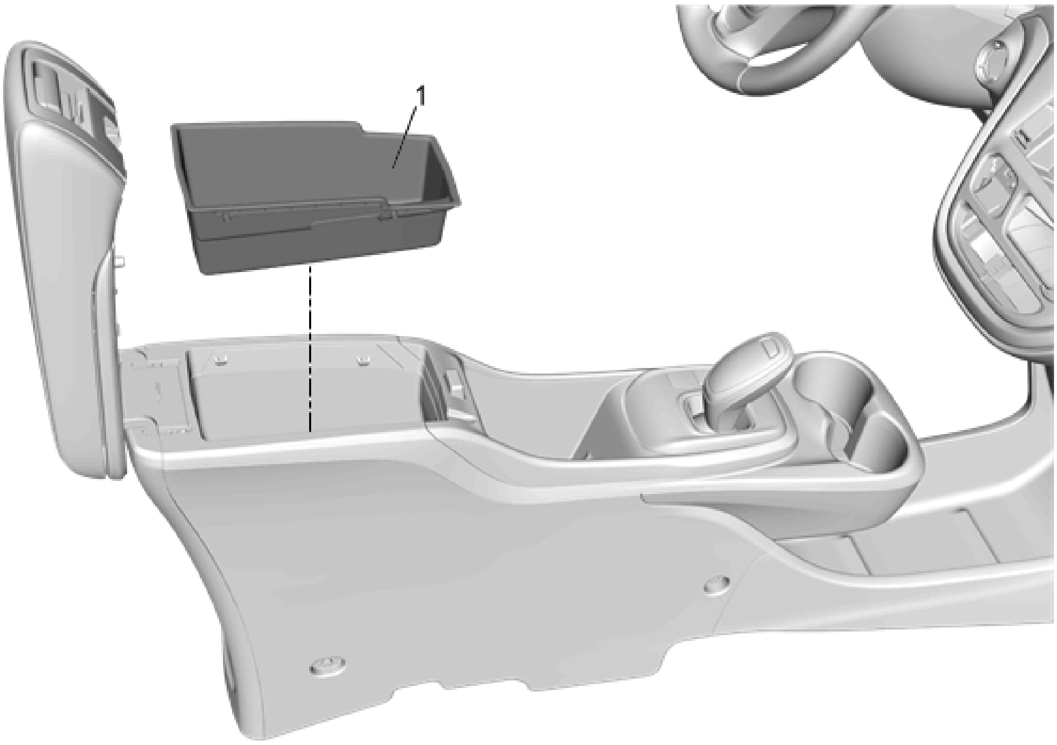
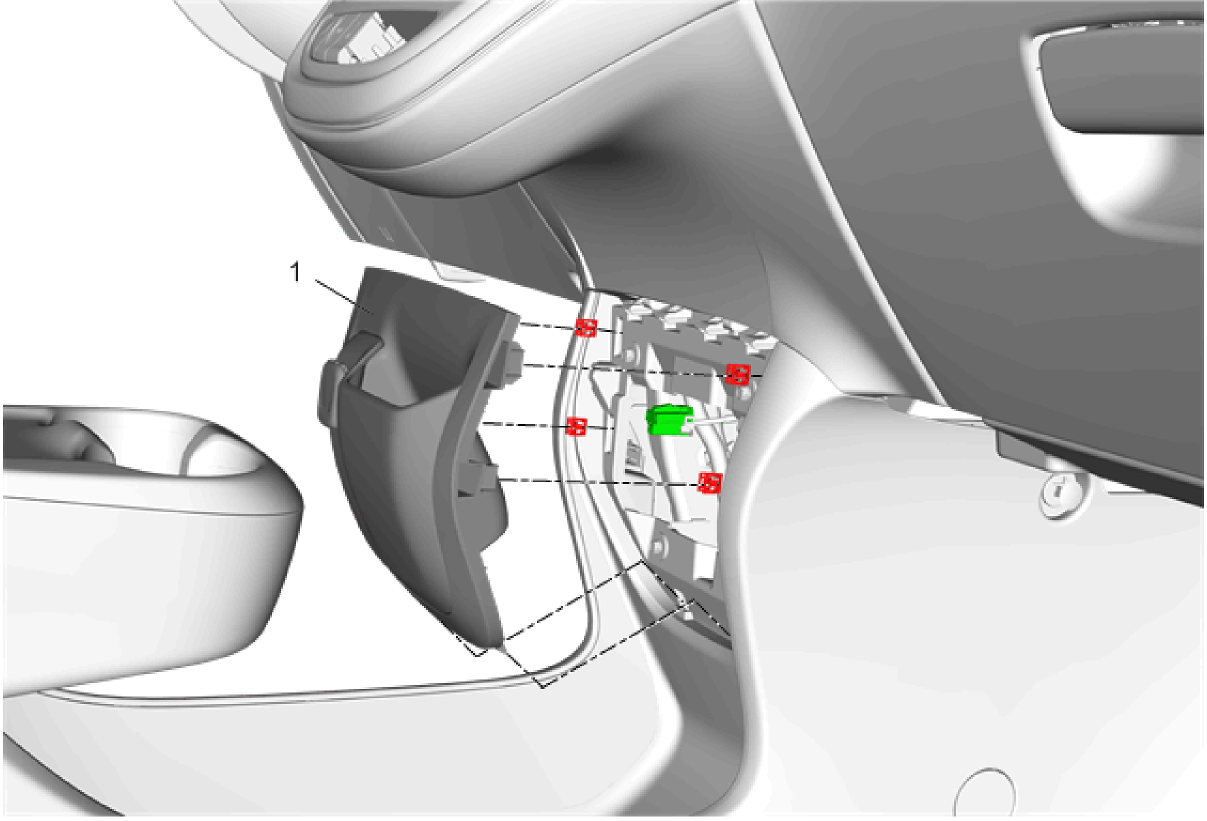


Fig. 96: Front Floor Console Compartment Divider
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Compartment Divider

FRONT FLOOR CONSOLE COMPARTMENT TRIM PLATE REPLACEMENT

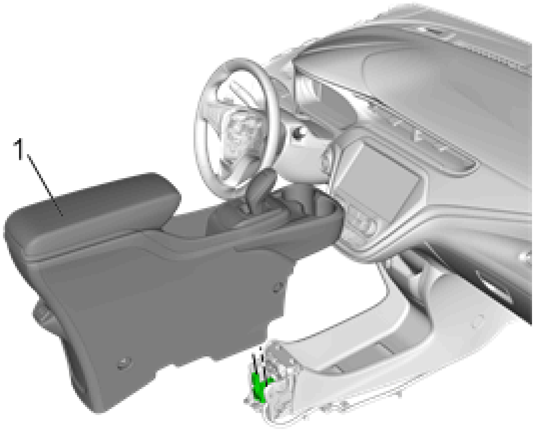


[Fig. 97: Front Floor Console Compartment Trim Plate](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Compartment Trim Plate **Procedure** 1. Use a flat bladed plastic trim tool. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

FRONT FLOOR CONSOLE CUP HOLDER REPLACEMENT

Removal Procedure



[Fig. 98: Rear Floor Console](#)
Courtesy of GENERAL MOTORS COMPANY

1. Rear Floor Console - Remove - [Rear Floor Console Replacement](#)

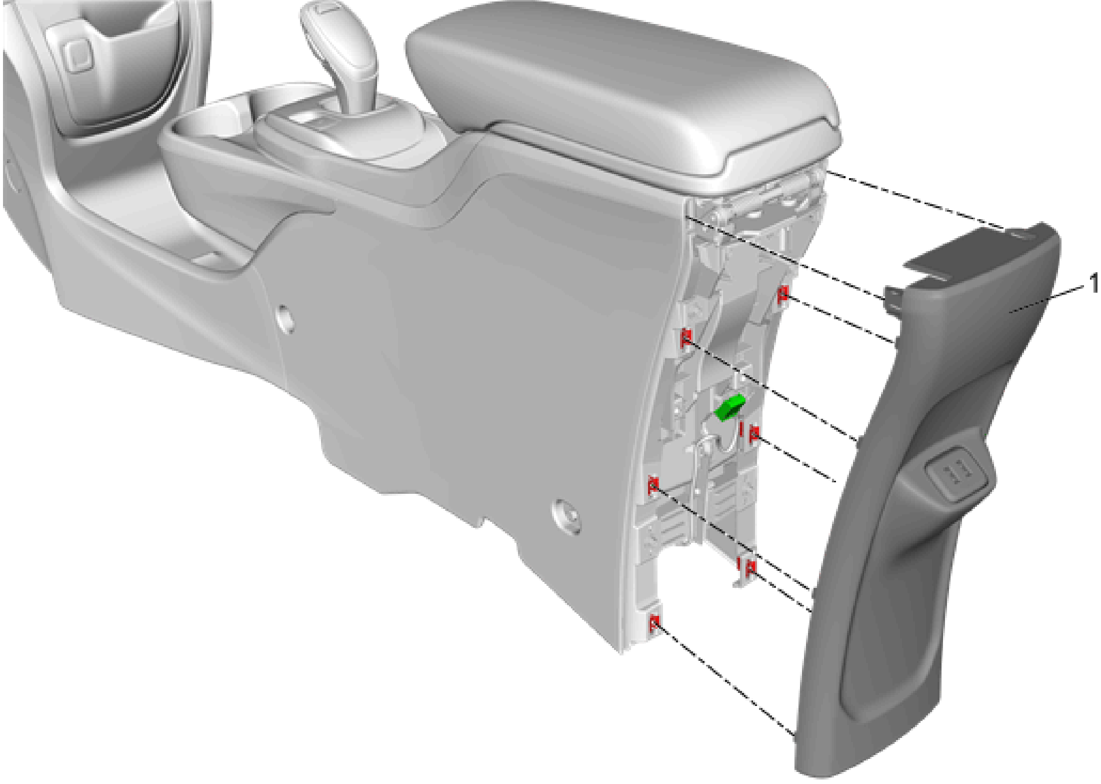


Fig. 99: Front Floor Console Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

2. Front Floor Console Rear Trim Panel - Remove - Front Floor Console Rear Trim Panel Replacement

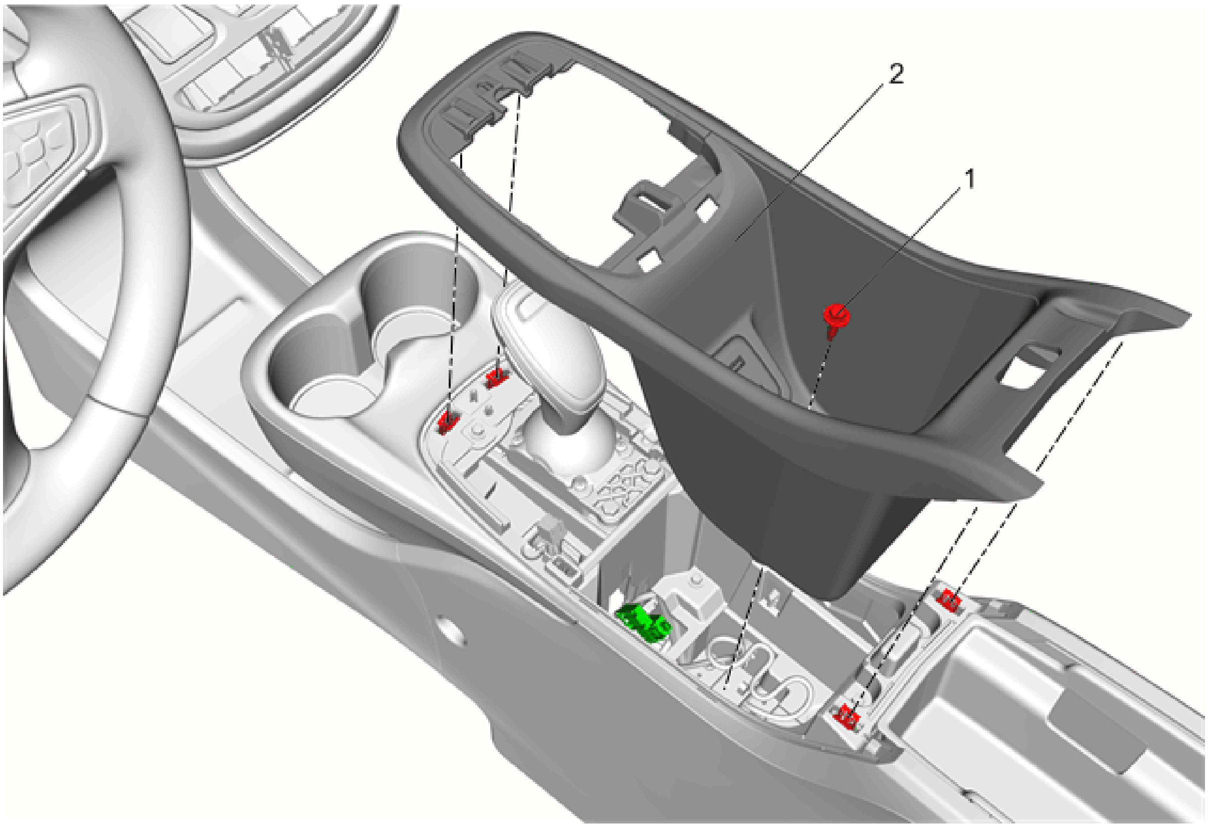


Fig. 100: Rear Floor Console Stowage Tray
Courtesy of GENERAL MOTORS COMPANY

3. Rear Floor Console Stowage Tray - Remove - Rear Floor Console Stowage Tray Replacement (without K4C)Rear Floor Console Stowage Tray Replacement (with K4C)

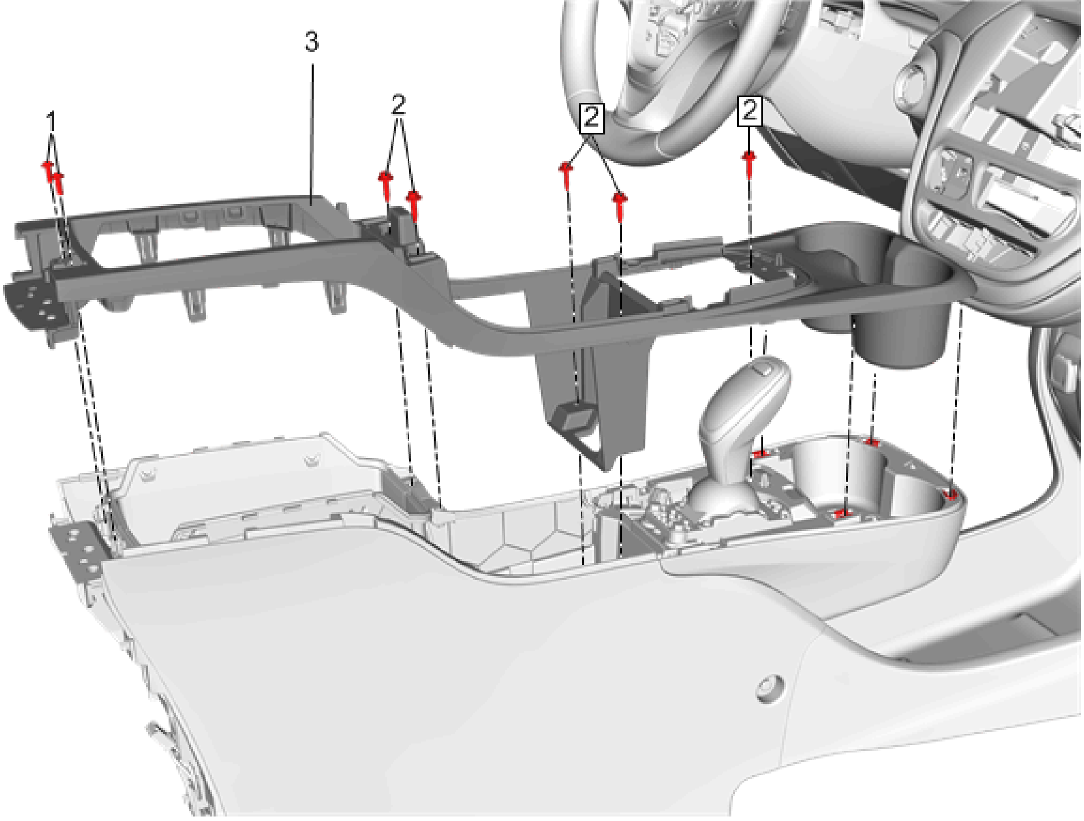


Fig. 101: Front Floor Console Cup Holder Trim Plate
Courtesy of GENERAL MOTORS COMPANY

4. Front Floor Console Cup Holder Trim Plate - Remove - Front Floor Console Cup Holder Trim Plate Replacement

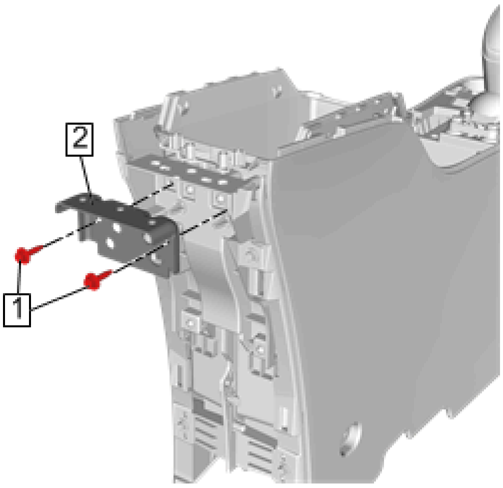


Fig. 102: Armrest Hinge Reinforce Assembly-No. 1 Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Armrest Hinge Reinforce Assembly-No. 1, Bolt - Remove
6. Armrest Hinge Reinforce Assembly-No. 1 - Remove

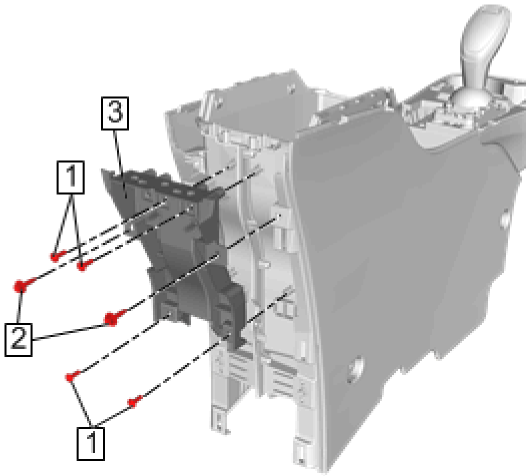


Fig. 103: Armrest Hinge Reinforce Assembly-No. 2 Screw
Courtesy of GENERAL MOTORS COMPANY

7. Armrest Hinge Reinforce Assembly-No. 2, Screw - Remove
8. Armrest Hinge Reinforce Assembly-No. 2, Bolt - Remove
9. Armrest Hinge Reinforce Assembly-No. 2 - Remove

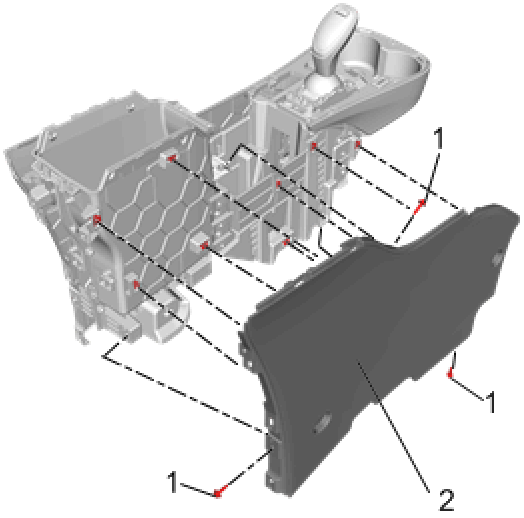
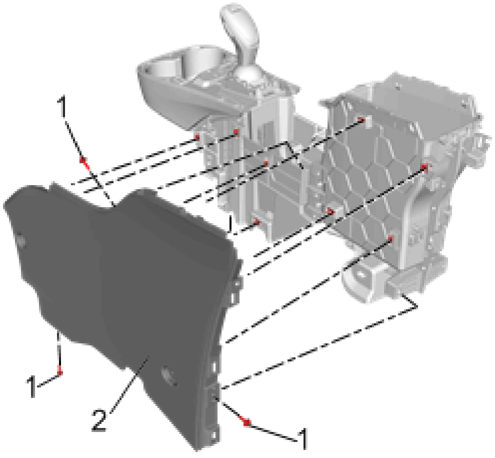


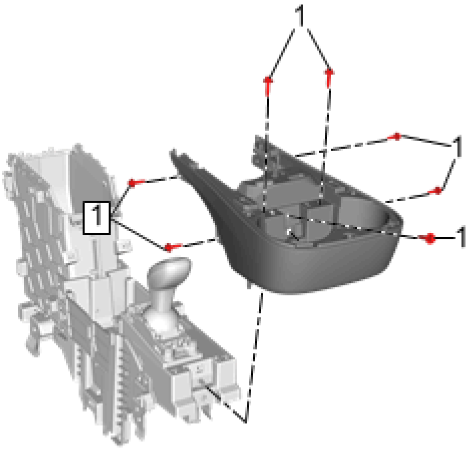
Fig. 104: Rear Console Side Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Rear Console Side Panel Bolt - Remove
11. Rear Console Side Panel-Right - Remove



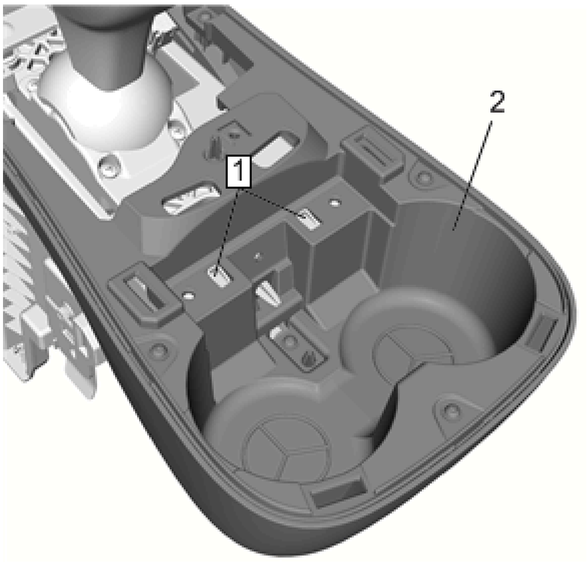
[Fig. 105: Rear Console Side Panel Bolt]
Courtesy of GENERAL MOTORS COMPANY

12. Rear Console Side Panel Bolt - Remove
13. Rear Console Side Panel-Left - Remove



[Fig. 106: Front Floor Console Cup Holder Bolt]
Courtesy of GENERAL MOTORS COMPANY

14. Front Floor Console Cup Holder Bolt - Remove



[Fig. 107: Front Floor Console Cup Holder]
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Integral retainers will most likely be damaged when cup holder is removed, but damage dose not matter since fasteners secure the cup holder.**

15. Release the two integral retainers (1) and pull the cup holder (2) forward to release it.
16. Front Floor Console Cup Holder - Remove

Installation Procedure

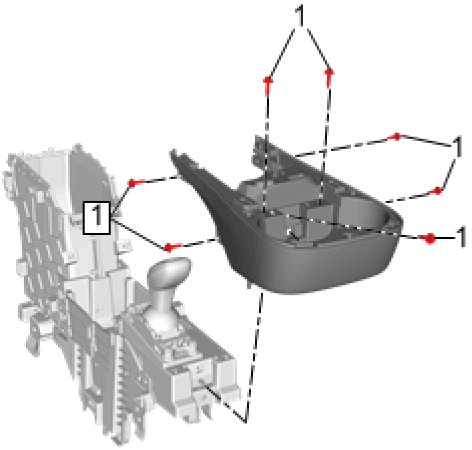


Fig. 108: Front Floor Console Cup Holder Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

1. Front Floor Console Cup Holder - Install
2. Front Floor Console Cup Holder Bolt Install and tighten to 3 N.m (27 lb in)

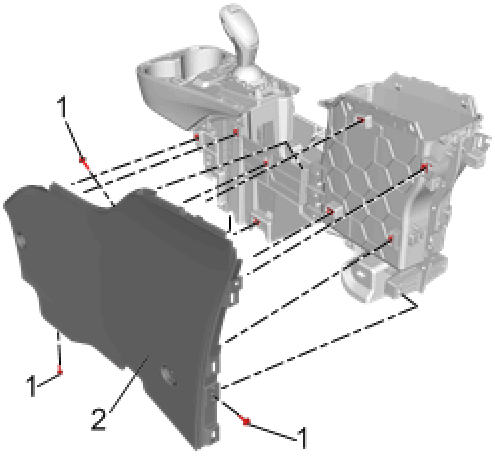


Fig. 109: Rear Console Side Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Rear Console Side Panel (2) -Left - Install
4. Rear Console Side Panel Bolt (1) Install and tighten to 3 N.m (27 lb in)

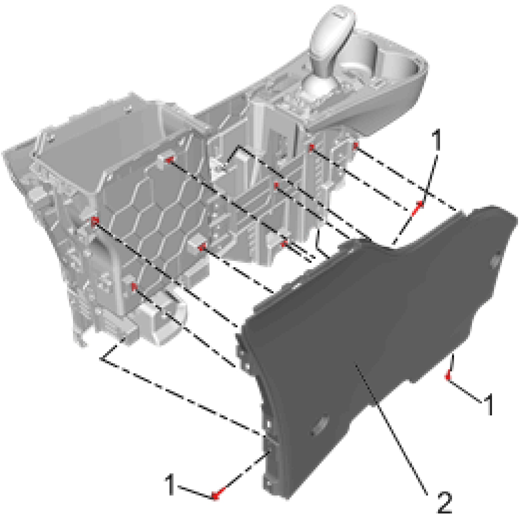


Fig. 110: Rear Console Side Panel Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Rear Console Side Panel (2) -Right - Install
6. Rear Console Side Panel Bolt (1) Install and tighten to 3 N.m (27 lb in)

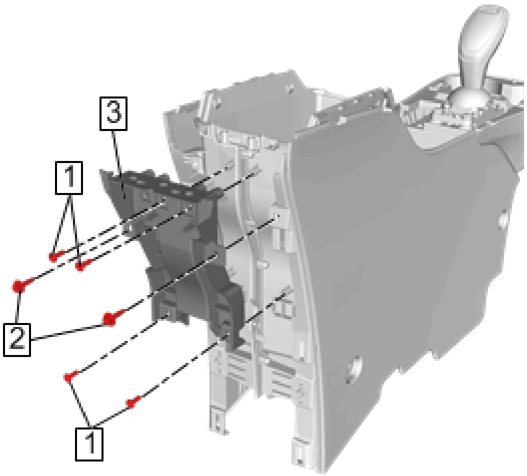


Fig. 111: Armrest Hinge Reinforce Assembly-No. 2 Screw
Courtesy of GENERAL MOTORS COMPANY

7. Armrest Hinge Reinforce Assembly-No. 2 (3) - Install
8. Armrest Hinge Reinforce Assembly-No. 2, Bolt (2) Install and tighten to 3 N.m (27 lb in)
9. Armrest Hinge Reinforce Assembly-No. 2, Screw (1) Install and tighten to 2 N.m (18 lb in)

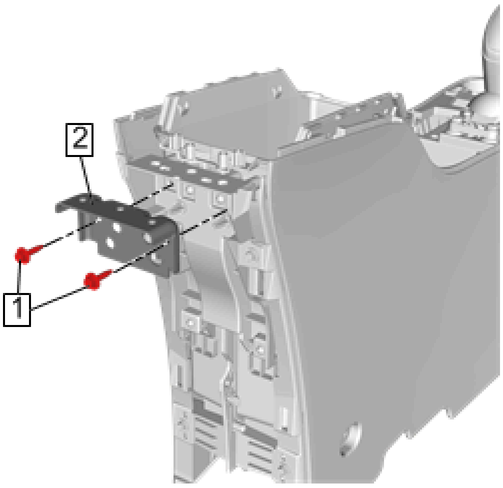


Fig. 112: Armrest Hinge Reinforce Assembly-No. 1 Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Armrest Hinge Reinforce Assembly-No. 1 - Install
11. Armrest Hinge Reinforce Assembly-No. 1, Bolt - Install and tighten to 3 N.m (27 lb in)

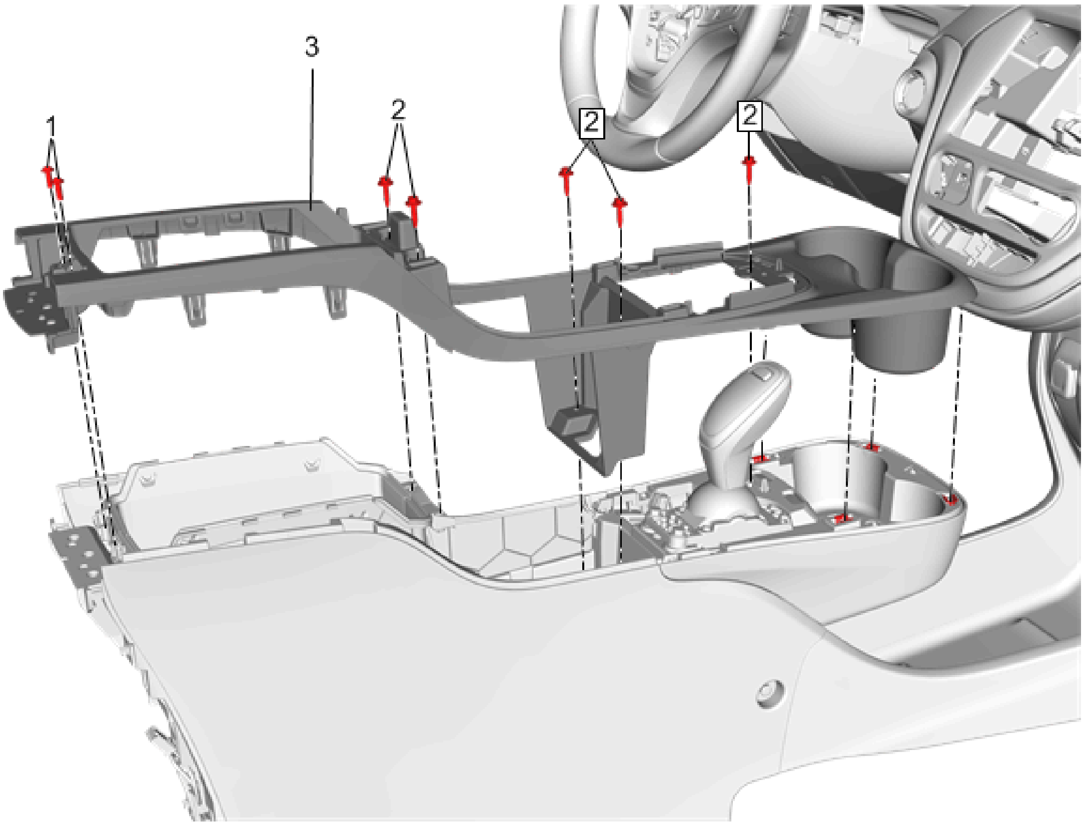


Fig. 113: Front Floor Console Cup Holder Trim Plate
Courtesy of GENERAL MOTORS COMPANY

12. Front Floor Console Cup Holder Trim Plate (3) - Install - Front Floor Console Cup Holder Trim Plate Replacement

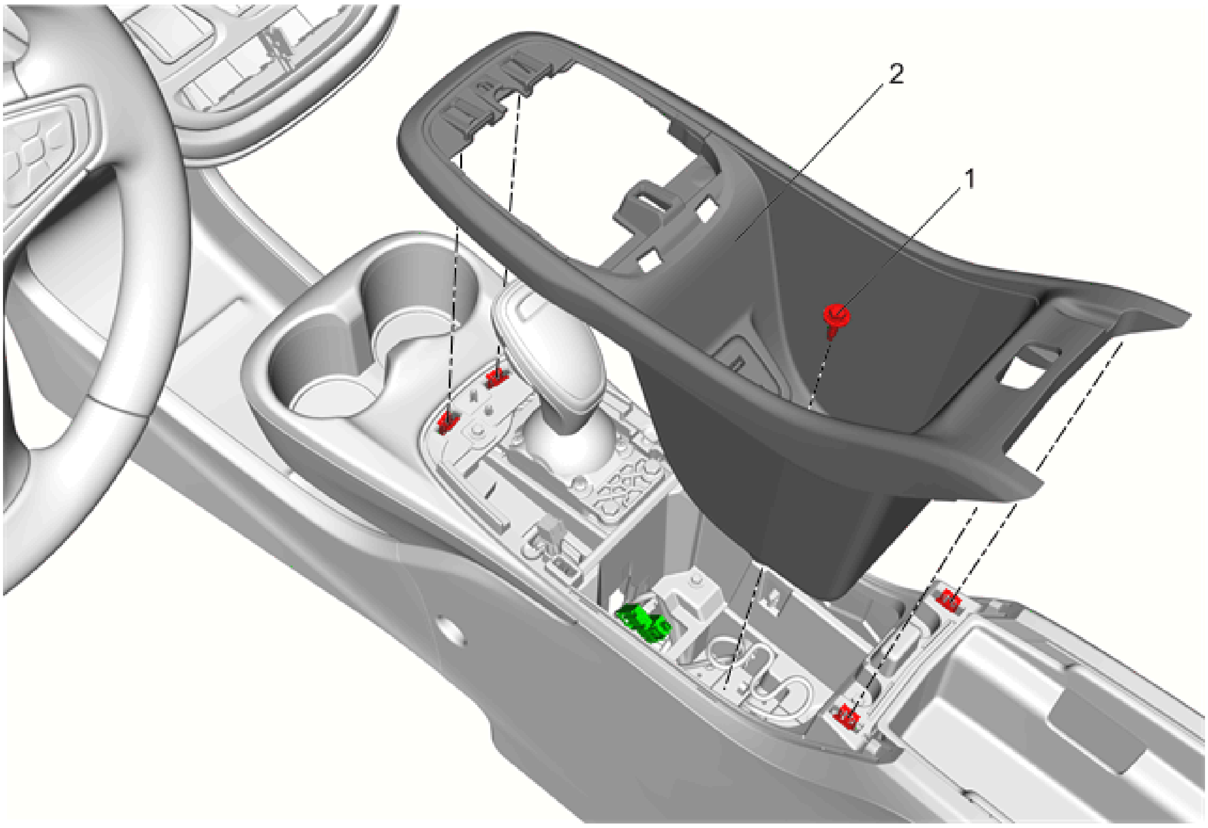


Fig. 114: Rear Floor Console Stowage Tray
Courtesy of GENERAL MOTORS COMPANY

13. Rear Floor Console Stowage Tray (2) - Install - **Rear Floor Console Stowage Tray Replacement (without K4C)Rear Floor Console Stowage Tray Replacement (with K4C)**

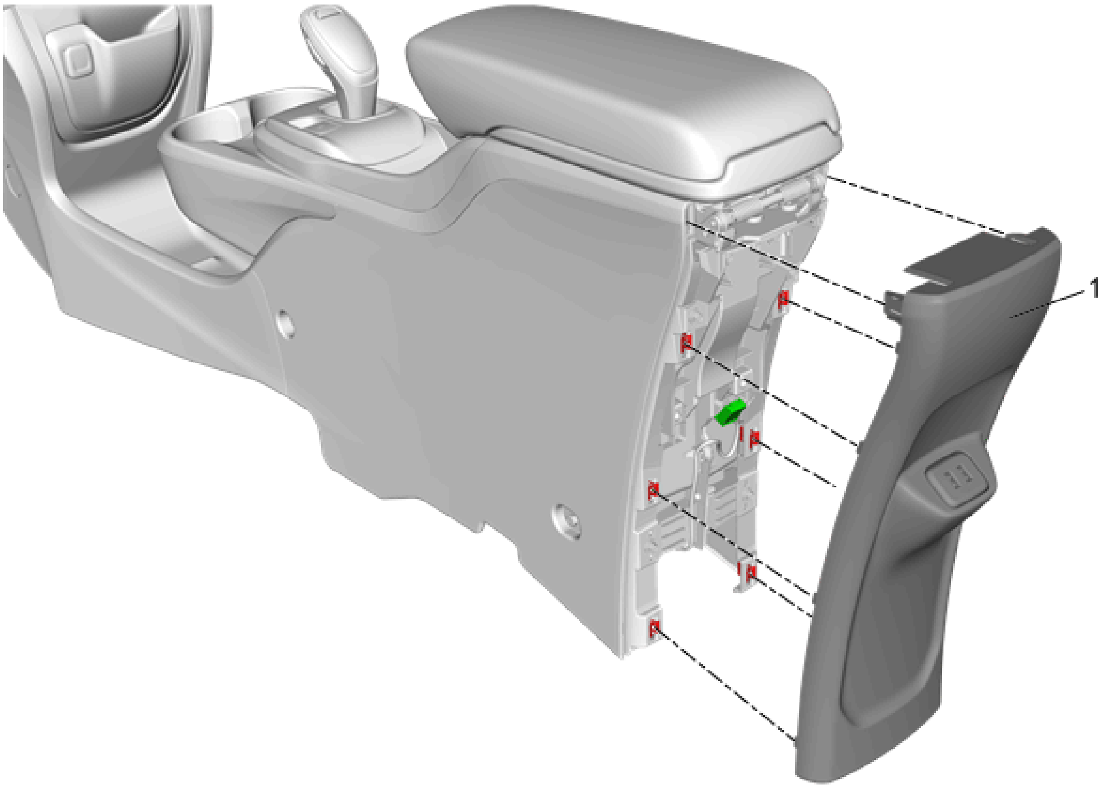


Fig. 115: Front Floor Console Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

14. Front Floor Console Rear Trim Panel - Install - **Front Floor Console Rear Trim Panel Replacement**

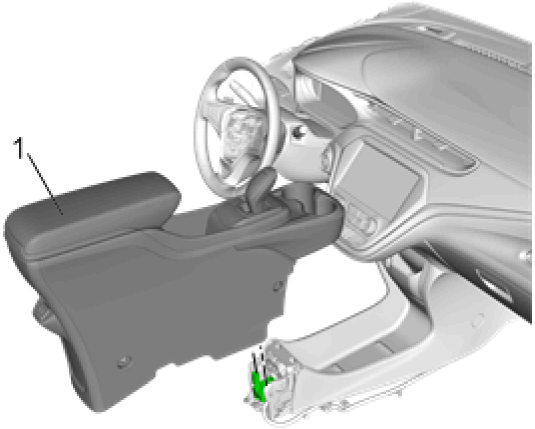


Fig. 116: Rear Floor Console
Courtesy of GENERAL MOTORS COMPANY

15. Rear Floor Console - Install - **Rear Floor Console Replacement**

FRONT FLOOR CONSOLE REAR STOWAGE LINER REPLACEMENT (WITHOUT K4C)

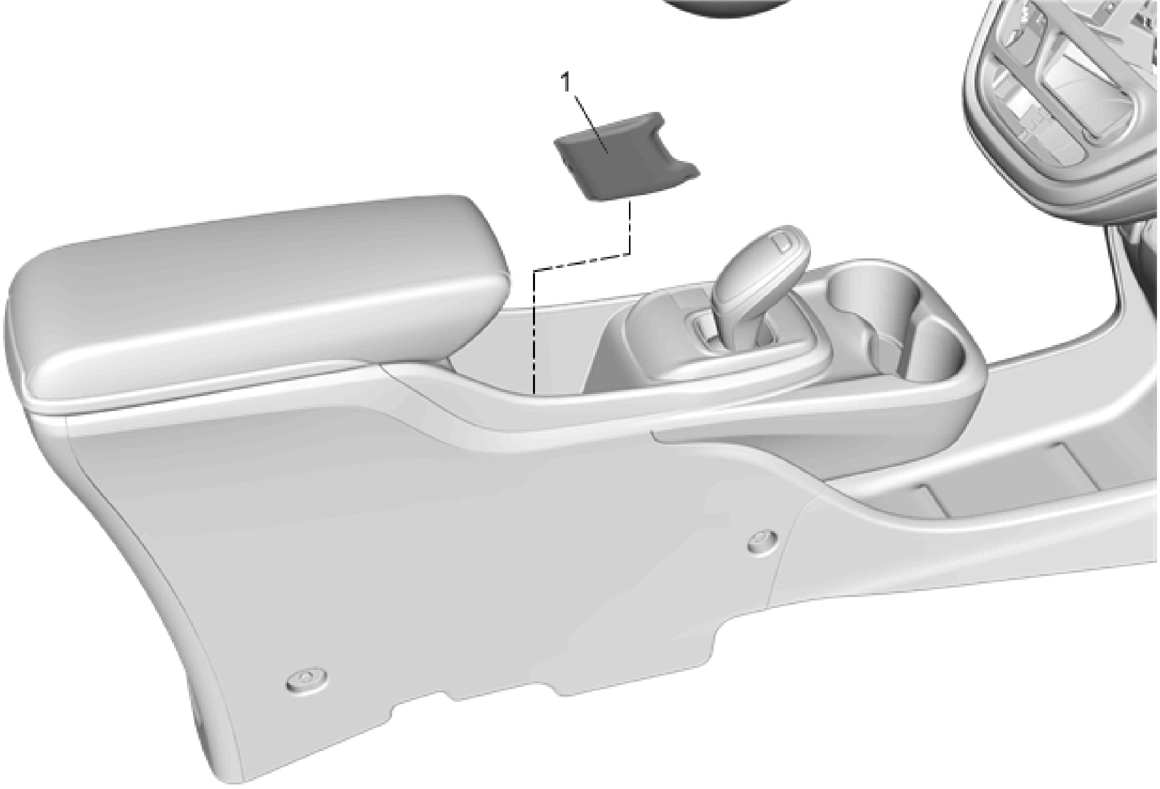


Fig. 117: Front Floor Console Rear Stowage Liner (without K4C)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Rear Stowage Liner

FRONT FLOOR CONSOLE REAR STOWAGE LINER REPLACEMENT (WITH K4C)

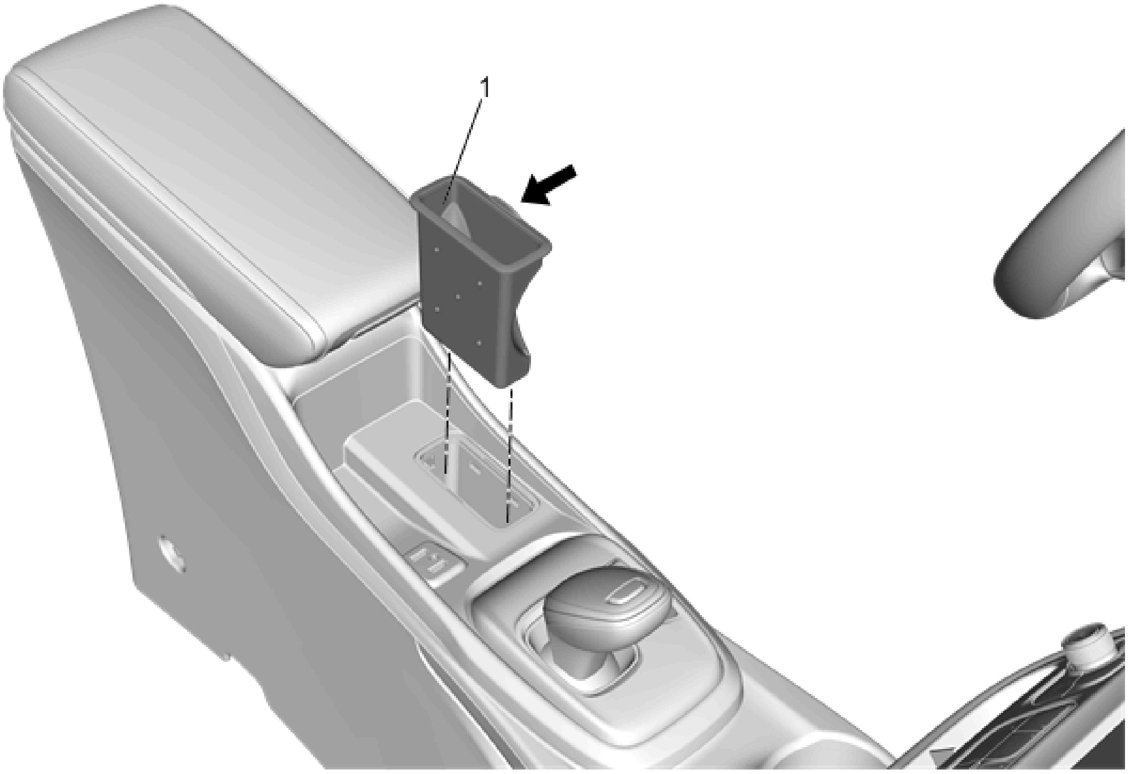


Fig. 118: Front Floor Console Rear Stowage Liner (with K4C)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Front Floor Console Rear Stowage Liner **Procedure** Push the upper left side of the stowage liner and slide it upward.

FRONT FLOOR CONSOLE COMPARTMENT LINER REPLACEMENT

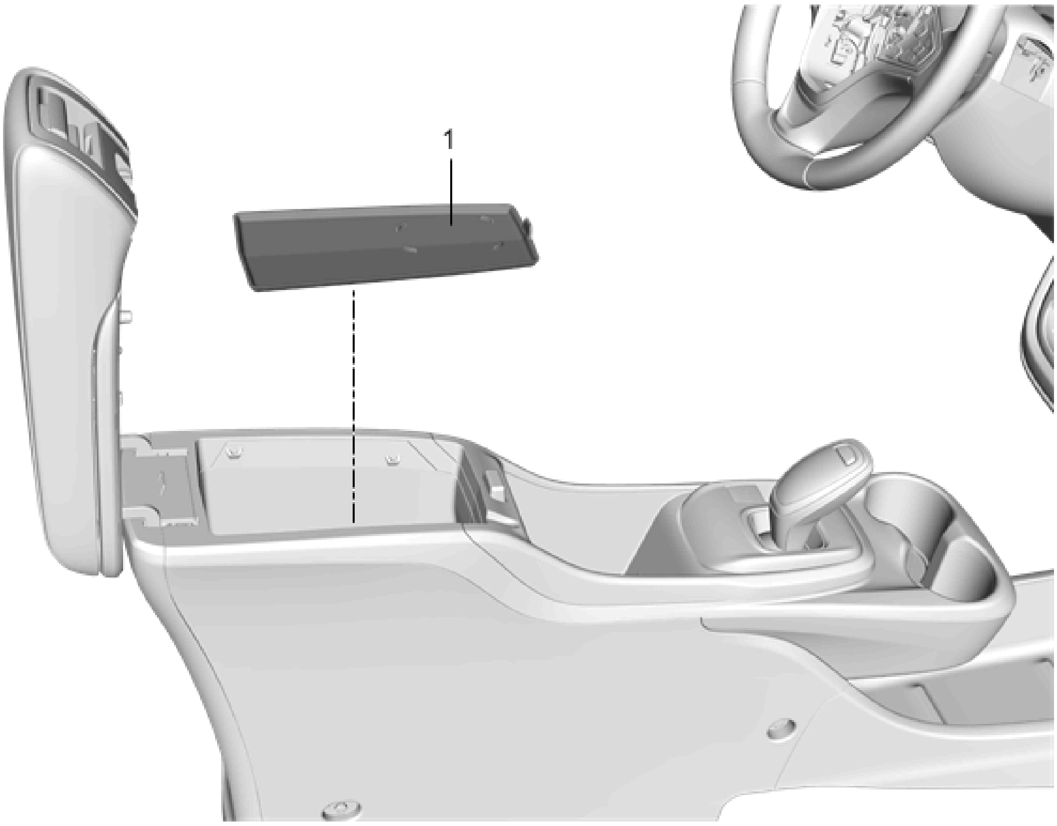


Fig. 119: Front Floor Console Compartment Liner
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Compartment Divider Replacement	
1	Front Floor Console Compartment Liner

FRONT FLOOR CONSOLE REAR TRIM PANEL REPLACEMENT

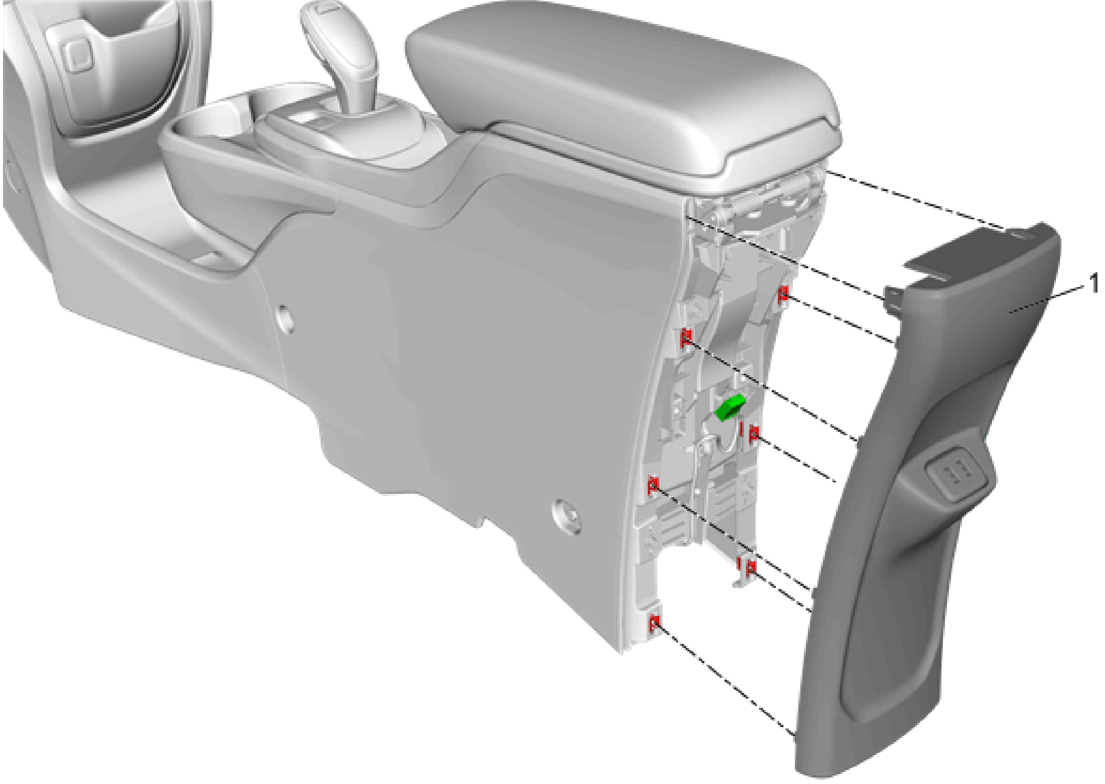


Fig. 120: Front Floor Console Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Floor Console Rear Trim Panel **Procedure** 1. Use a flat bladed plastic trim tool. 2. Disconnect the electrical connector, if equipped. 3. Transfer components as necessary, USB if equipped.

FRONT FLOOR CONSOLE CUP HOLDER TRIM PLATE REPLACEMENT

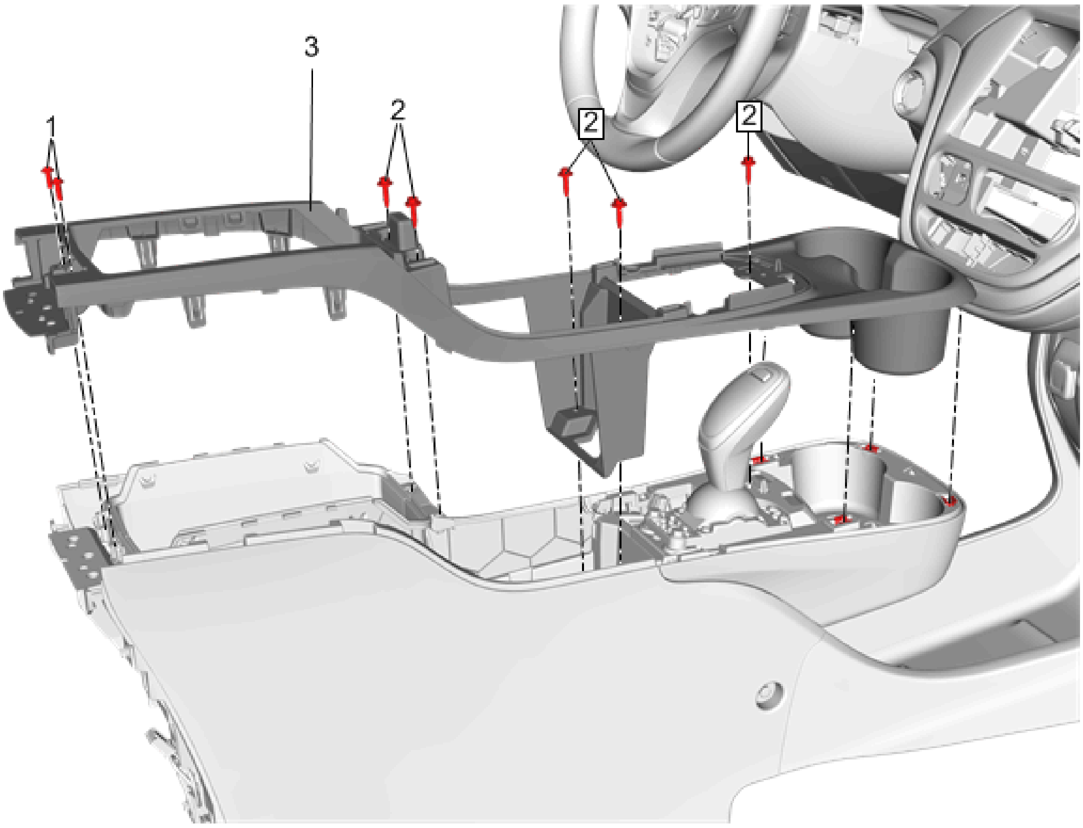


Fig. 121: Front Floor Console Cup Holder Trim Plate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Floor Console Armrest Replacement 2. Front Floor Console Trim Plate Replacement 3. Rear Floor Console Stowage Tray Replacement (without K4C)Rear Floor Console Stowage Tray Replacement (with K4C)	
1	Front Floor Console Cup Holder Trim Plate Screw (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Floor Console Cup Holder Trim Plate Bolt (Qty: 5) **Tighten** 3 N.m (27 lb in)
3	Front Floor Console Cup Holder Trim Plate **Procedure** Use a plastic trim tool if necessary.

FRONT FLOOR CONSOLE REPLACEMENT

Removal Procedure

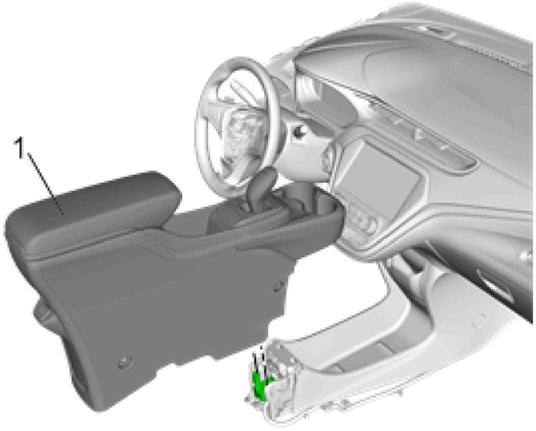


Fig. 122: Rear Floor Console
Courtesy of GENERAL MOTORS COMPANY

1. Rear Floor Console - Remove - Rear Floor Console Replacement

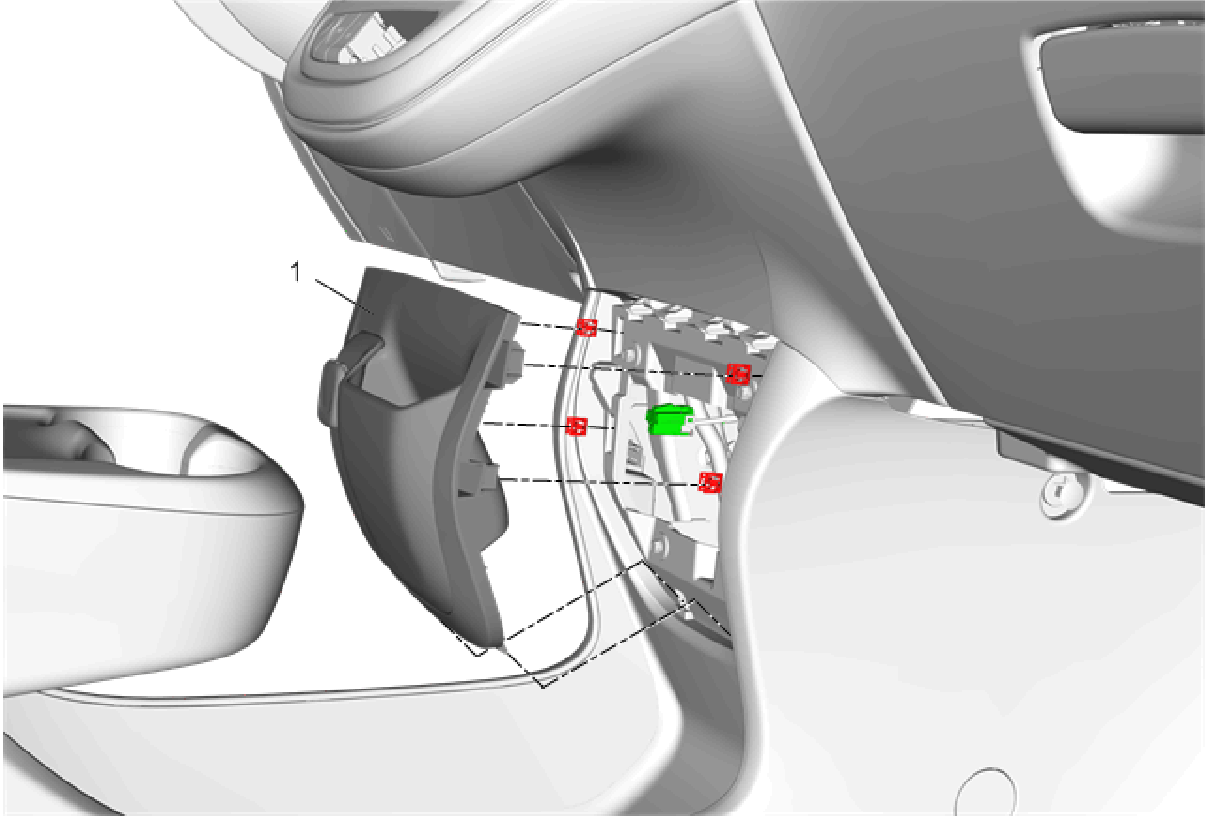


Fig. 123: Front Floor Console Compartment Trim Plate
Courtesy of GENERAL MOTORS COMPANY

2. Front Floor Console Compartment Trim Plate - Remove - Front Floor Console Compartment Trim Plate Replacement

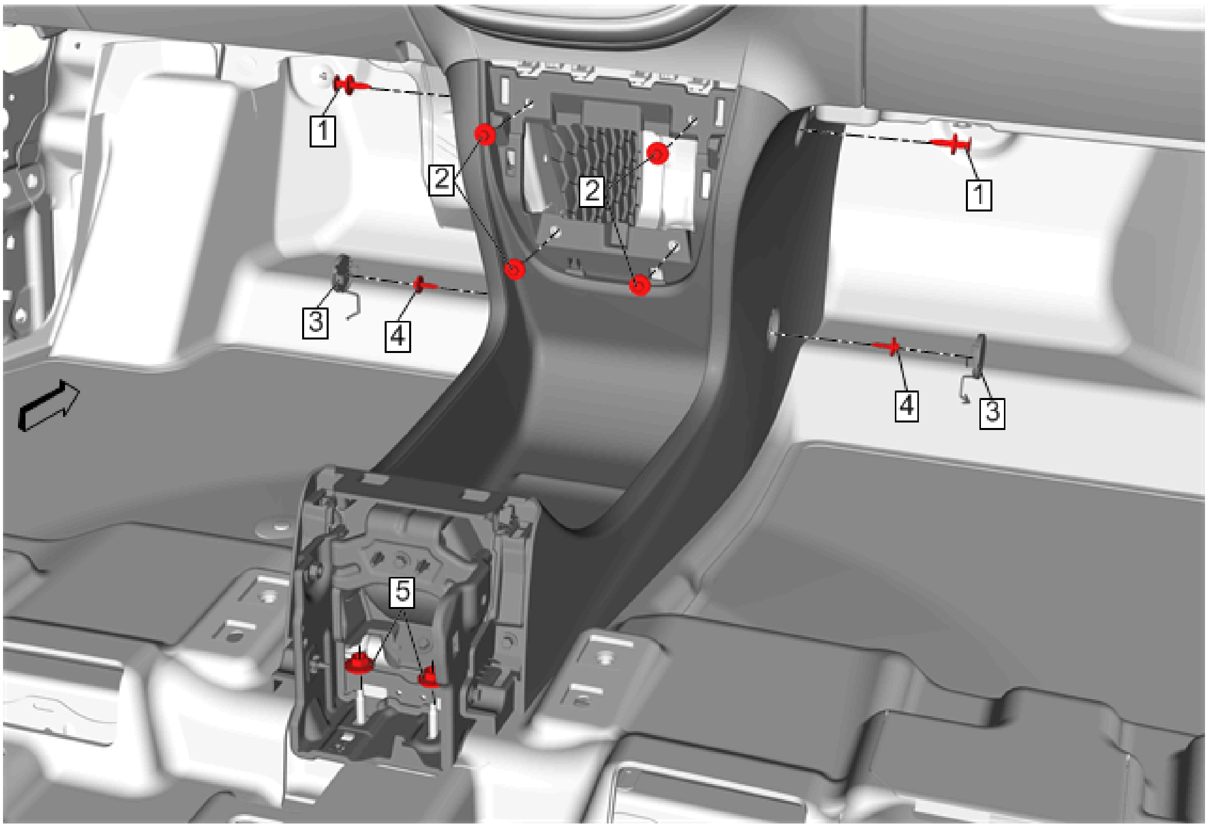


Fig. 124: Front Floor Console Clip, Bolt, Cap, Nut
Courtesy of GENERAL MOTORS COMPANY

3. Clip (1) (Qty: 2) - Remove
4. Front Floor Console Bolt (2) (Qty: 4) - Remove
5. Front Floor Console Cap (3) (Qty: 2) - Remove
6. Front Floor Console Bolt (4) (Qty: 2) - Remove
7. Front Floor Console Nut (5) (Qty: 2) - Remove

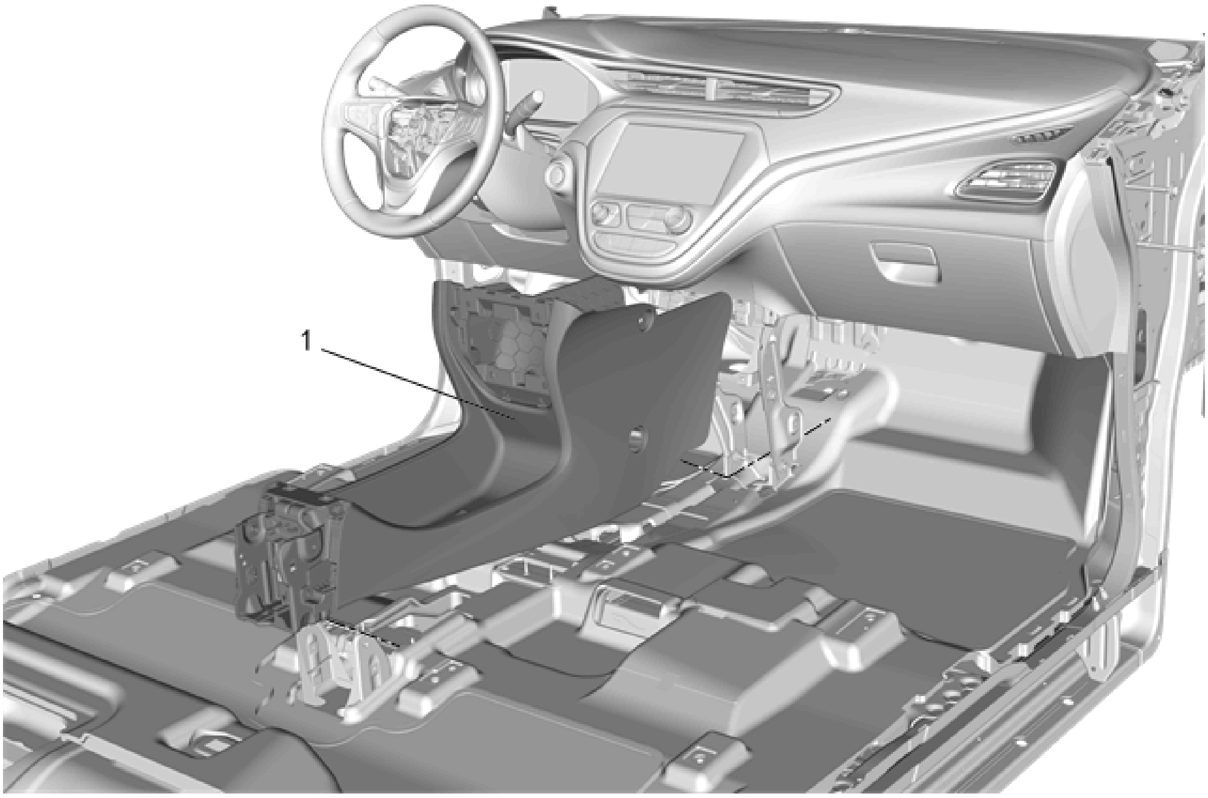


Fig. 125: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the wiring harness.
9. Front Floor Console (1) - Remove
10. Transfer components as necessary.

Installation Procedure

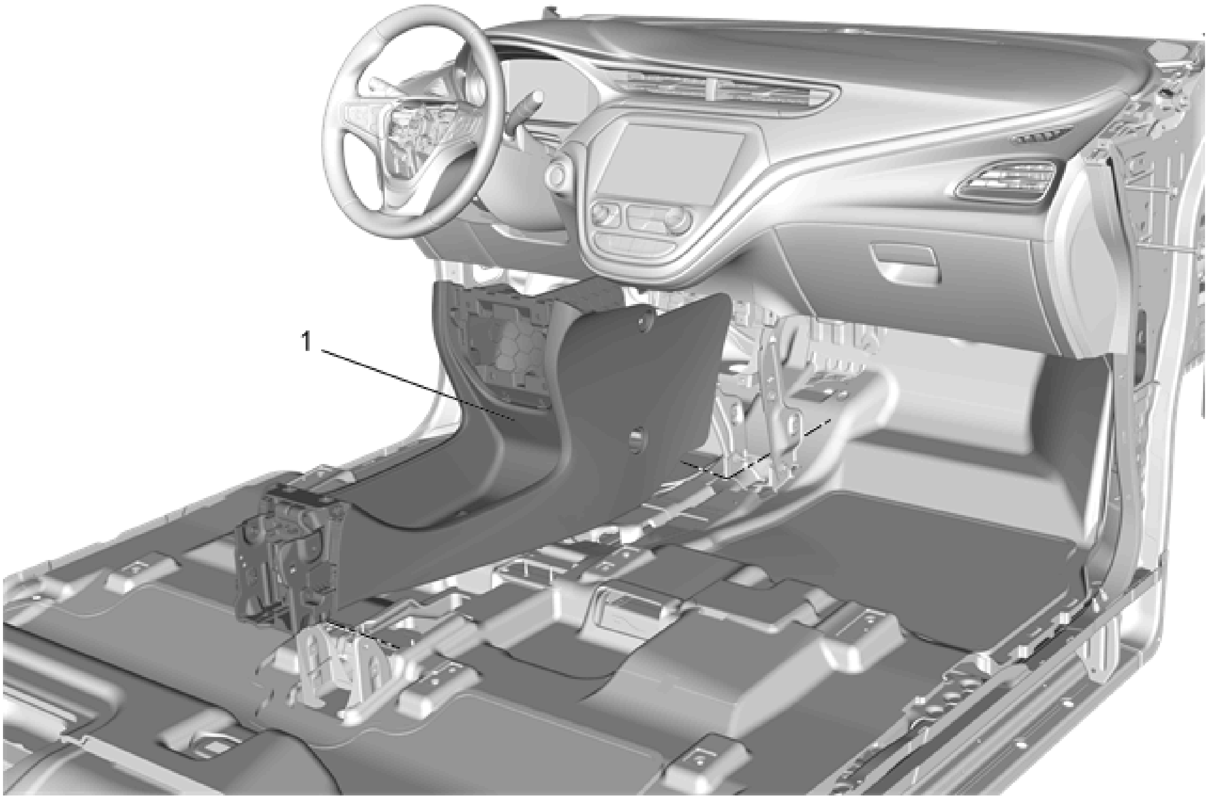
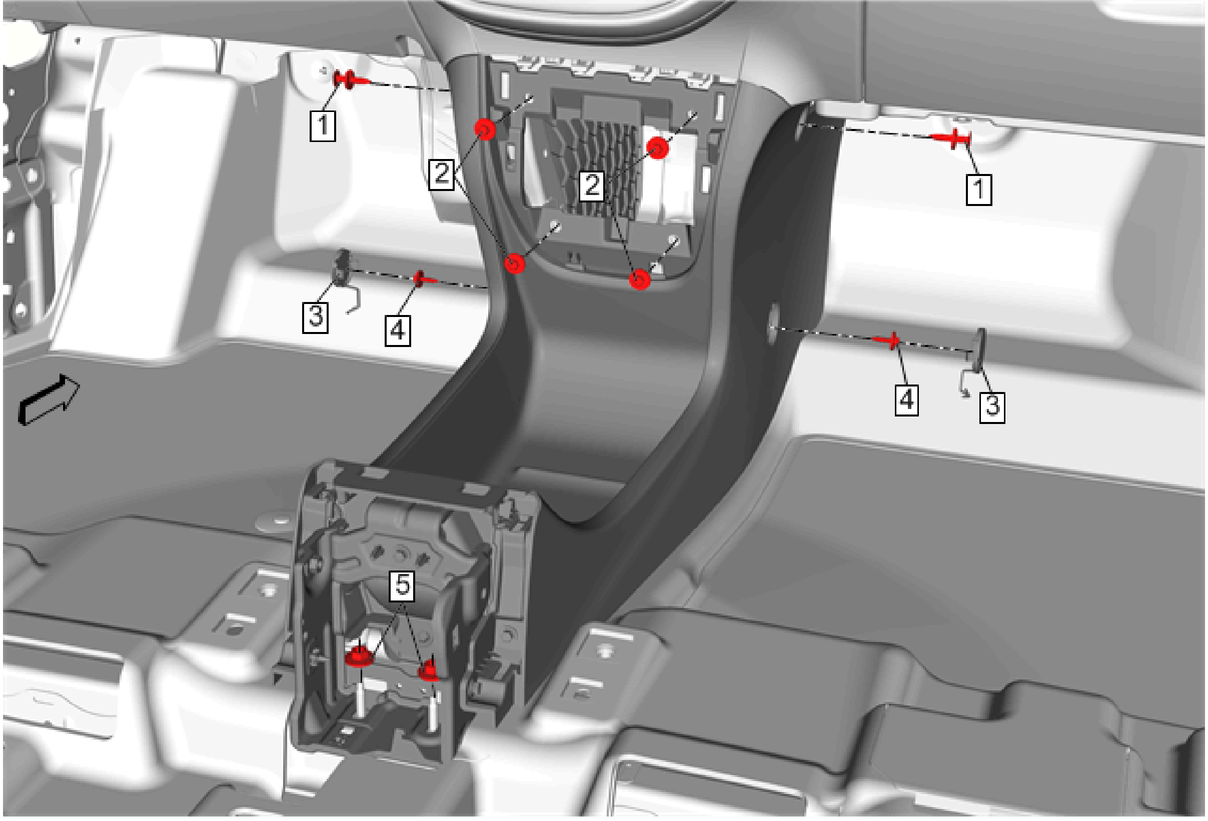


Fig. 126: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

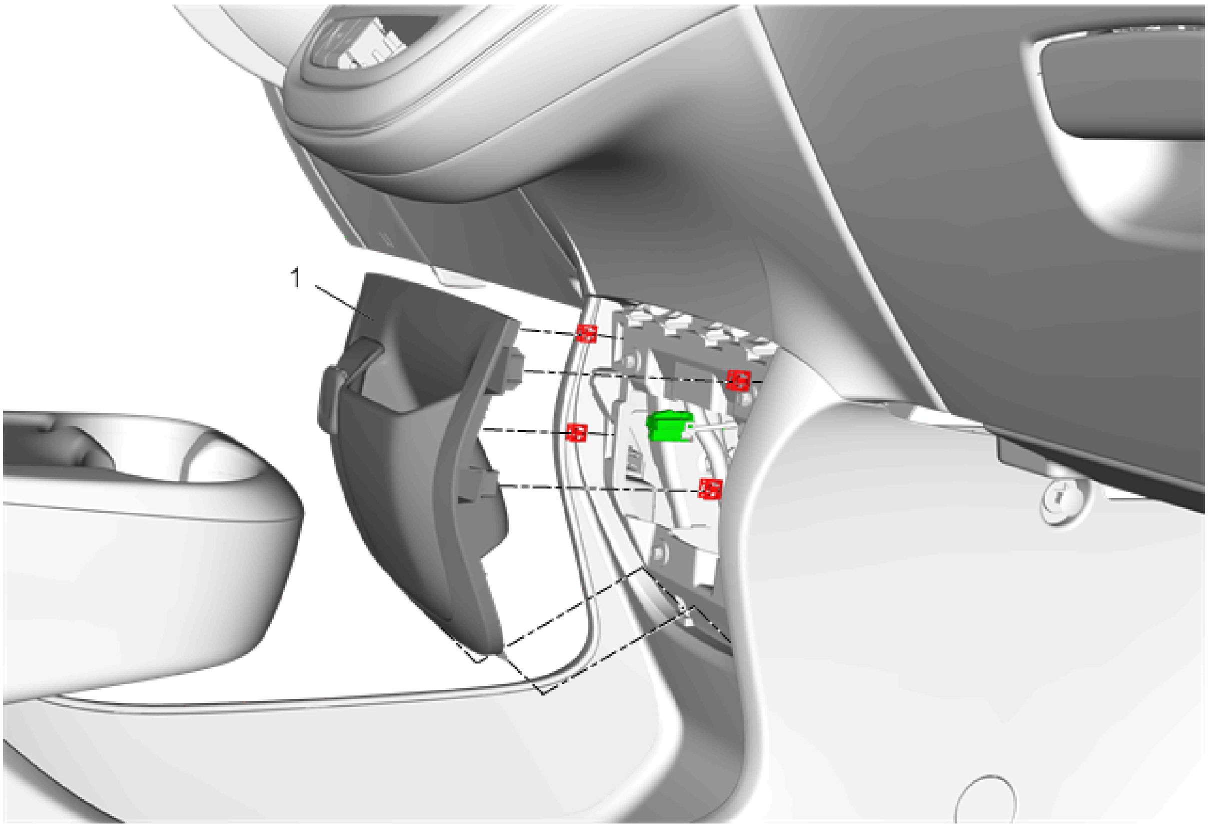
1. Front Floor Console - Install
2. Connect the wiring harness.



[Fig. 127: Front Floor Console Clip, Bolt, Cap, Nut](#)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

3. Front Floor Console Nut (5) (Qty: 2) - Install and tighten to 5 N.m (44 lb in)
4. Front Floor Console Bolt (4) (Qty: 2) - Install and tighten to 3 N.m (27 lb in)
5. Front Floor Console Cap (3) (Qty: 2) - Install
6. Front Floor Console Bolt (2) (Qty: 4) - Install and tighten to 3 N.m (27 lb in)
7. Clip (1) (Qty: 2) - Install



[Fig. 128: Front Floor Console Compartment Trim Plate](#)
Courtesy of GENERAL MOTORS COMPANY

8. Front Floor Console Compartment Trim Plate - Install - Front Floor Console Compartment Trim Plate Replacement

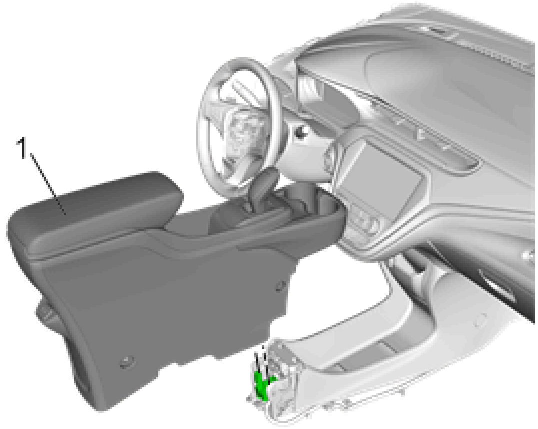


Fig. 129: Rear Floor Console
Courtesy of GENERAL MOTORS COMPANY

9. Rear Floor Console - Install - Rear Floor Console Replacement

REAR FLOOR CONSOLE REPLACEMENT

Removal Procedure

1. Reposition the seats to access the console bolts.

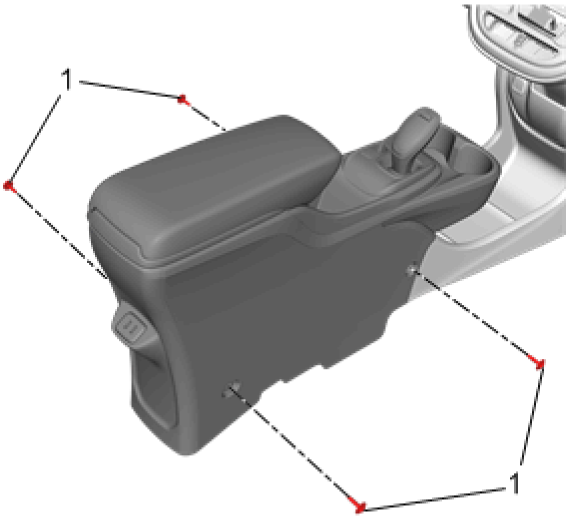


Fig. 130: Rear Floor Console Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Rear Floor Console Bolt (1) - Remove

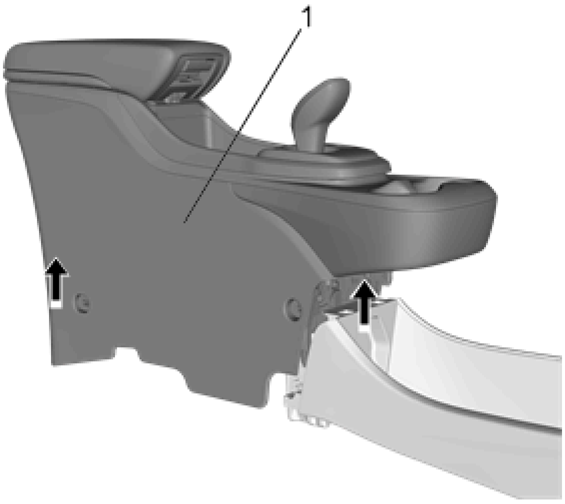


Fig. 131: Rear Floor Console
Courtesy of GENERAL MOTORS COMPANY

3. Gently and slightly lift the rear floor console (1).

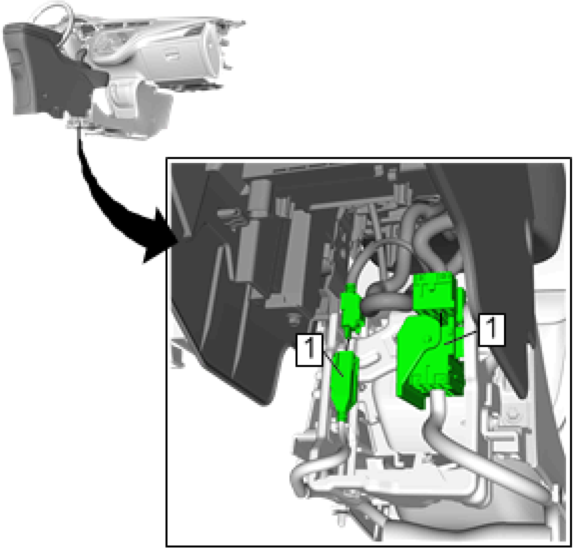


Fig. 132: Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connectors (1).

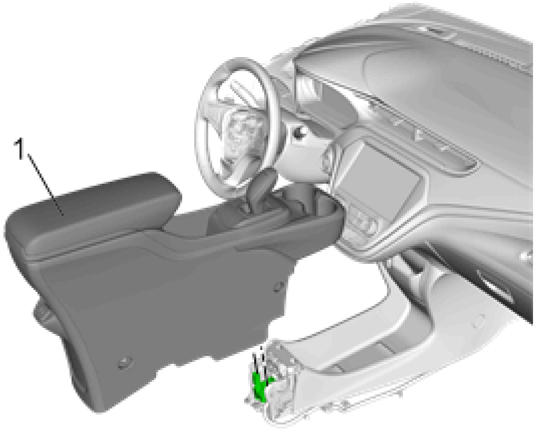


Fig. 133: Rear Floor Console
Courtesy of GENERAL MOTORS COMPANY

5. Rear Floor Console (1) - Remove

Installation Procedure

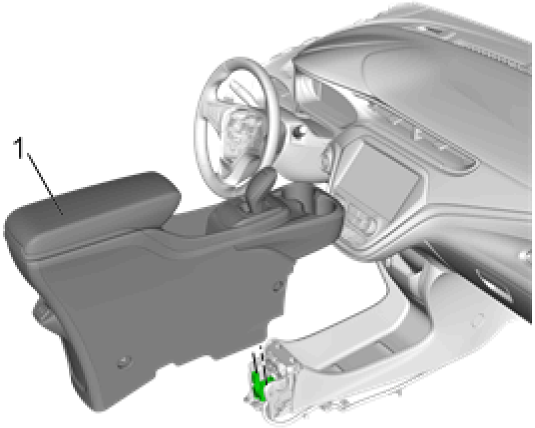


Fig. 134: Rear Floor Console
Courtesy of GENERAL MOTORS COMPANY

1. Rear Floor Console (1) - Install

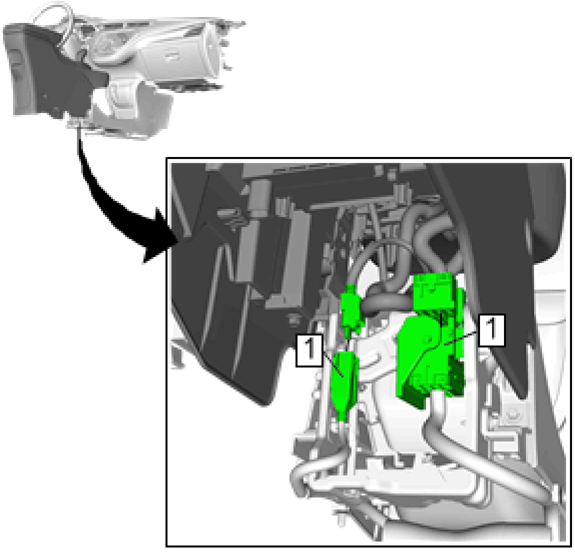


Fig. 135: Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

2. Connect the electrical connector (1).

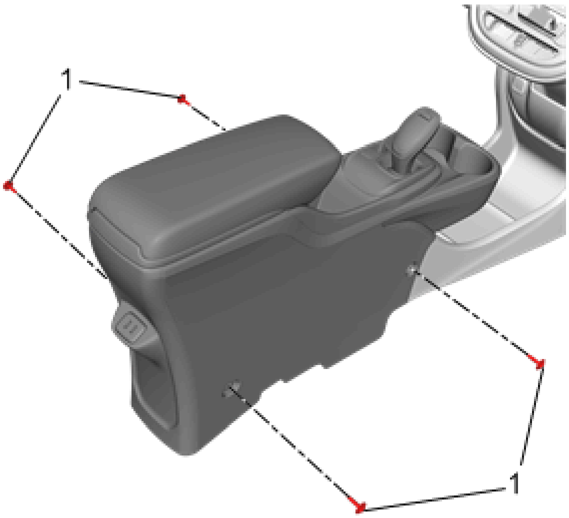


Fig. 136: Rear Floor Console Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Rear Floor Console Bolt (1) - Install and tighten to 9 N.m (80 lb in)

REAR FLOOR CONSOLE STOWAGE TRAY REPLACEMENT (WITHOUT K4C)

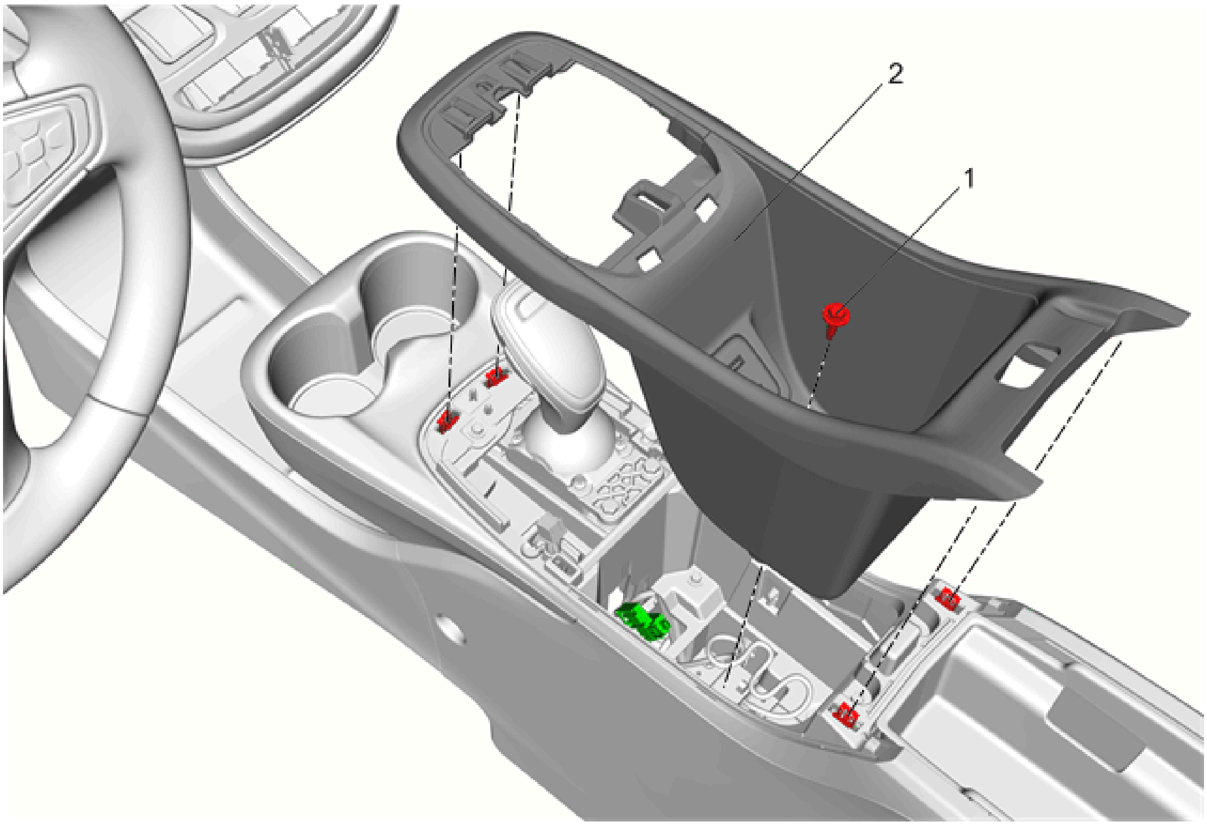


Fig. 137: Rear Floor Console Stowage Tray (without K4C)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Front Floor Console Trim Plate Replacement 2. Front Floor Console Rear Stowage Liner Replacement (without K4C)	
1	Rear Floor Console Stowage Tray Bolt **CAUTION:** Fastener Caution **Tighten** 3 N.m (27 lb in)
2	Rear Floor Console Stowage Tray **Procedure** 1. Use a plastic trim tool if necessary. 2. Disconnect the electrical connectors. 3. Transfer components as necessary.

REAR FLOOR CONSOLE STOWAGE TRAY REPLACEMENT (WITH K4C)

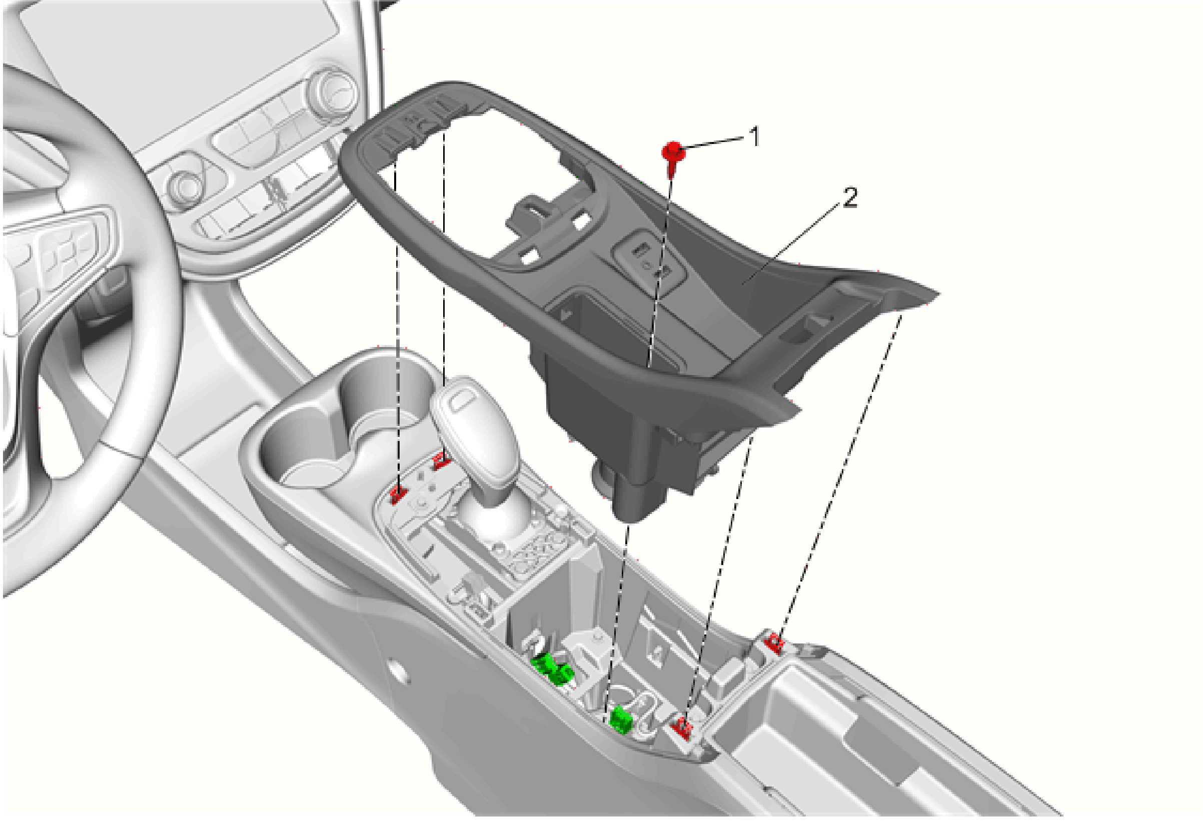


Fig. 138: Rear Floor Console Stowage Tray (with K4C)
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
1. Front Floor Console Trim Plate Replacement
2. Front Floor Console Rear Stowage Liner Replacement (with K4C)</td></tr>
<tr><td>1</td><td>Rear Floor Console Stowage Tray Bolt
CAUTION:
Fastener Caution
Tighten
3 N.m (27 lb in)</td></tr>
<tr><td>2</td><td>Rear Floor Console Stowage Tray
Procedure
1. Use a plastic trim tool if necessary.
2. Disconnect the electrical connectors.
3. Transfer components as necessary.</td></tr>
</table>

FRONT FLOOR CONSOLE ARMREST REPLACEMENT

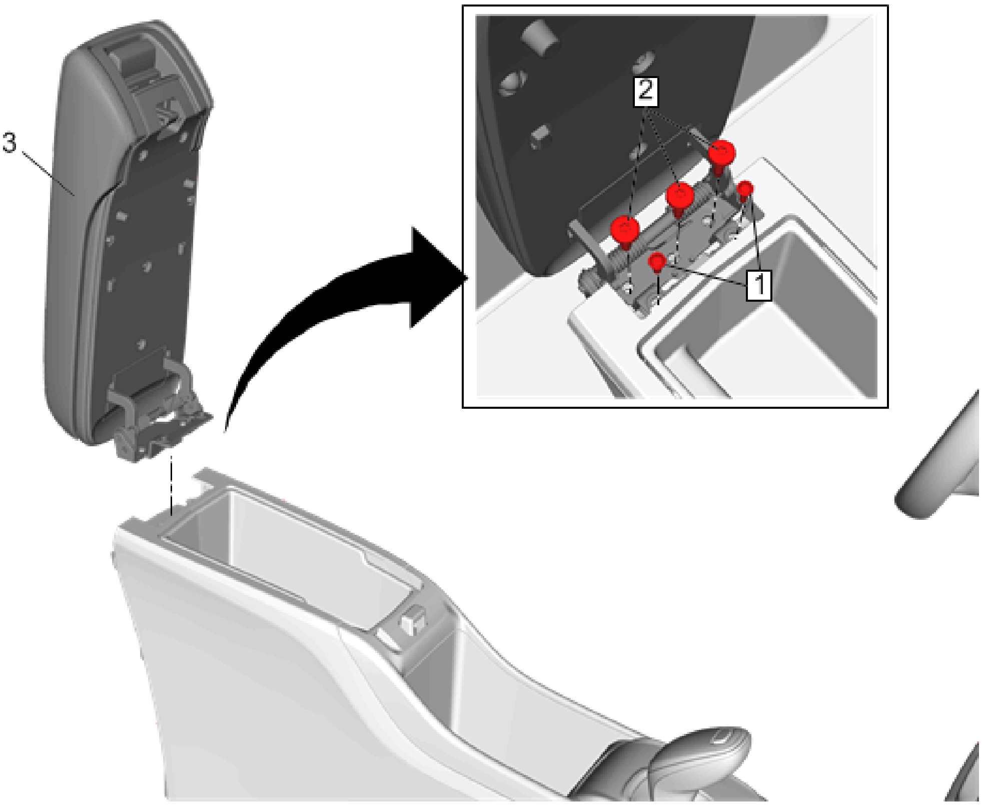


Fig. 139: Front Floor Console Armrest
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Rear Trim Panel Replacement	
1	Front Floor Console Armrest Hinge Screw (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Floor Console Armrest Hinge Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 4.5 N.m (40 lb in)
3	Front Floor Console Armrest Assembly

FRONT FLOOR CONSOLE TRIM PLATE REPLACEMENT

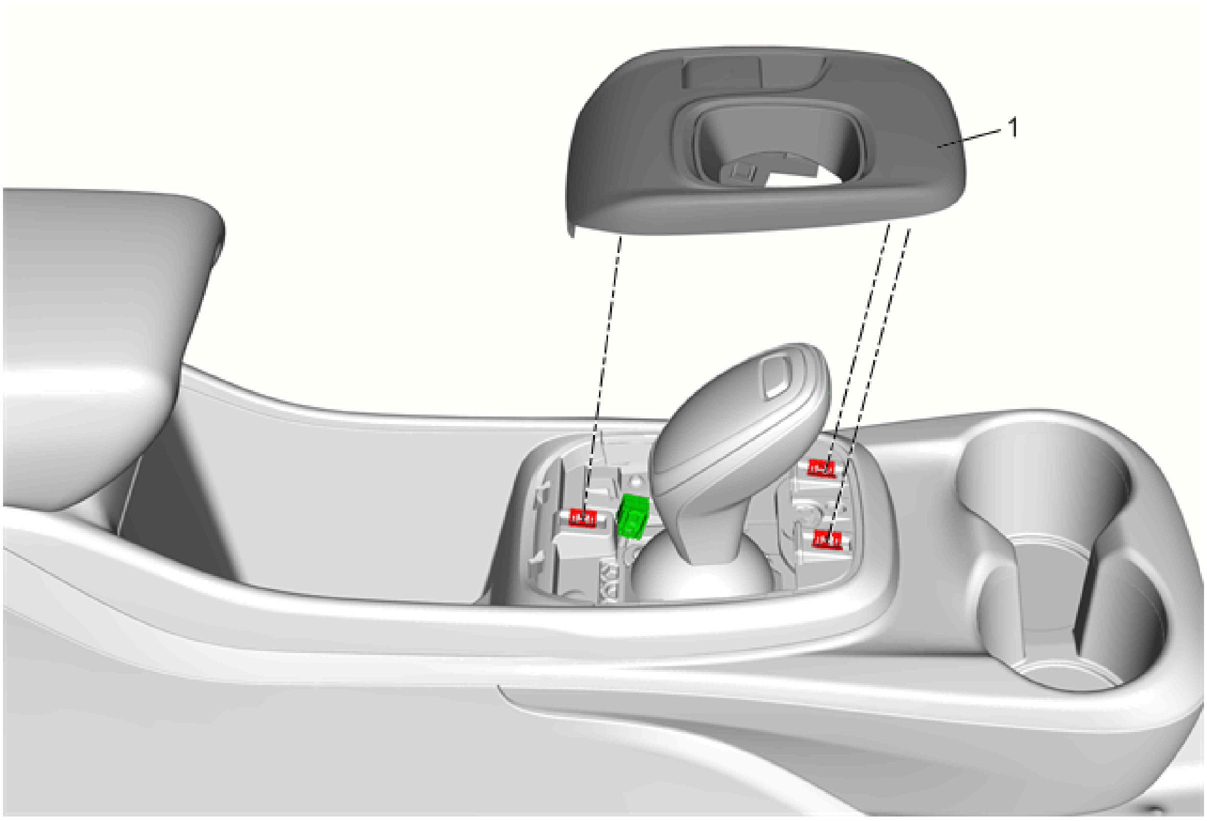


Fig. 140: Front Floor Console Trim Plate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Transmission Control Lever Knob Replacement	
1	Front Floor Console Trim Plate **Procedure** 1. Use a flat bladed plastic trim tool. 2. Disconnect the electrical connector. 3. Transfer components as necessary.

ROOF CONSOLE REPLACEMENT

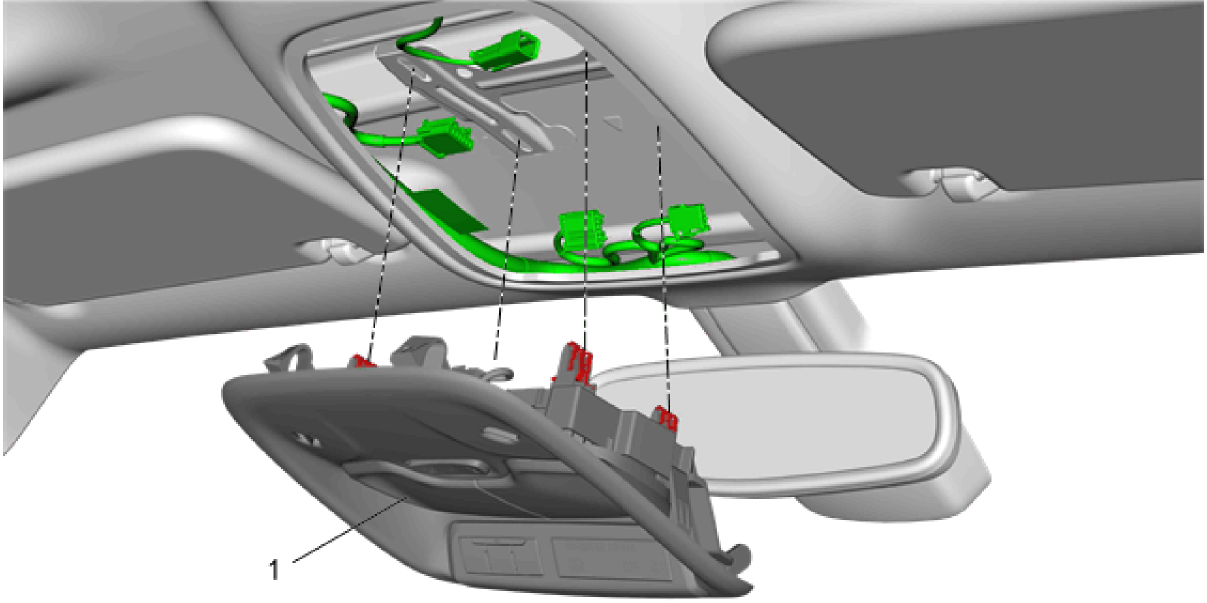


Fig. 141: Roof Console
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**	
1	Roof Console **NOTE:** **The retainers are stronger than the console assembly. During removal, the console may separate, and if this happens, the roof console will need to be reassembled.** **Procedure** 1. Grasp the roof console on both sides and pull down to disengage the clips. 2. Disconnect all electrical connectors. 3. Transfer components as necessary. 4. Reassemble the roof console if it becomes separated upon removal. 5. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Luggage Shade Pivot

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Body Lock Pillar Upper Trim Panel Bolt	3 N.m (27 lb in)
Center Pillar Upper Garnish Molding Bolt	3 N.m (27 lb in)
Coat Hook Bolt	6 N.m (53 lb in)
Front Side Door Armrest Bracket Bolt	2.5 N.m (22 lb in)
Front Side Door Armrest Pull Cup Fastener	2.5 N.m (22 lb in)
Front Side Door Armrest Switch Mount Plate Fastener	2.5 N.m (22 lb in)
Front Side Door Inside Handle Fastener	2.5 N.m (22 lb in)
Liftgate Inside Pull Handle Fastener	1.8 N.m (16 lb in)
Load Floor Stowage Compartment Cover Support Bolt	5 N.m (44 lb in)
Rear Side Door Armrest Bracket Bolt	2.5 N.m (22 lb in)
Rear Side Door Armrest Pull Cup Fastener	2.5 N.m (22 lb in)
Rear Side Door Inside Handle Fastener	2.5 N.m (22 lb in)
Roof Rail Assist Handle Fastener	6 N.m (53 lb in)
Spare Wheel Stowage Bolt	3.5 N.m (31 lb in)
Sunshade Fastener	2.5 N.m (22 lb in)
Sunshade Support Screw	2.5 N.m (22 lb in)

REPAIR INSTRUCTIONS

FRONT SIDE DOOR ARMREST SWITCH MOUNT PLATE REPLACEMENT

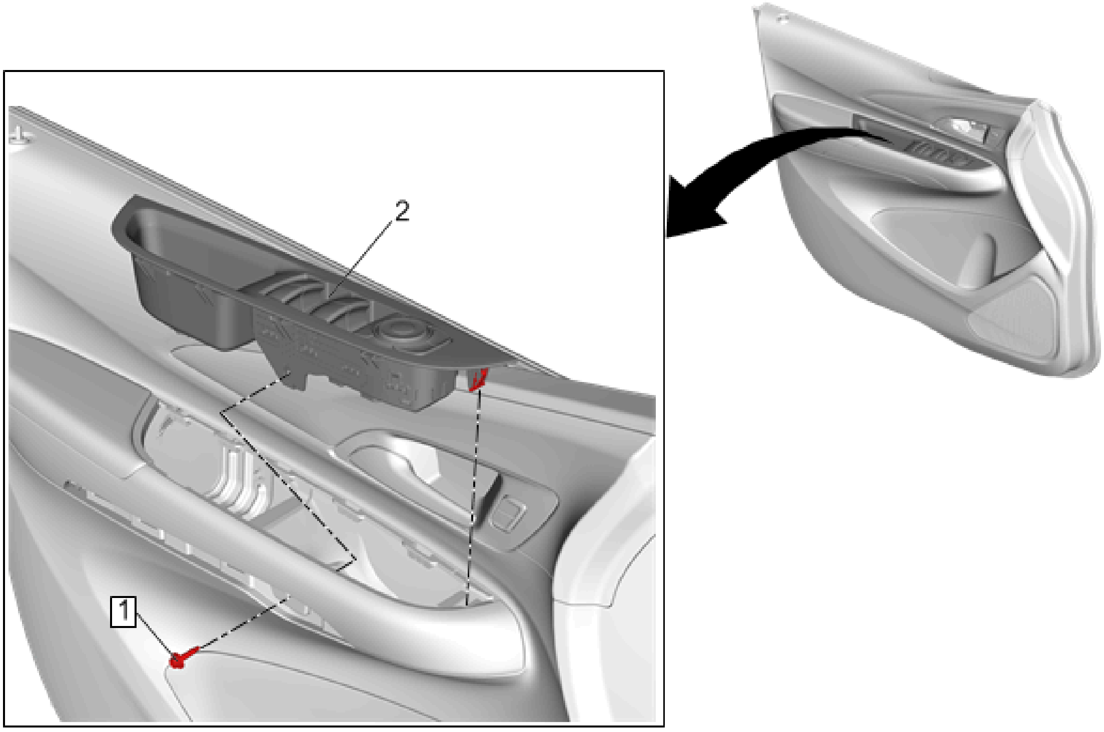


Fig. 1: Front Side Door Armrest Switch Mount Plate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Side Door Trim Panel Applique Replacement 2. Front Side Door Trim Replacement	
1	Front Side Door Armrest Switch Mount Plate Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Side Door Armrest Switch Mount Plate **Procedure** 1. Remove the cloth sound deadening material from the trim. 2. Release the integral retainers from the inside of the door trim. Lift up and outward. 3. Transfer parts as necessary.

FRONT SIDE DOOR UPPER TRIM PANEL REPLACEMENT

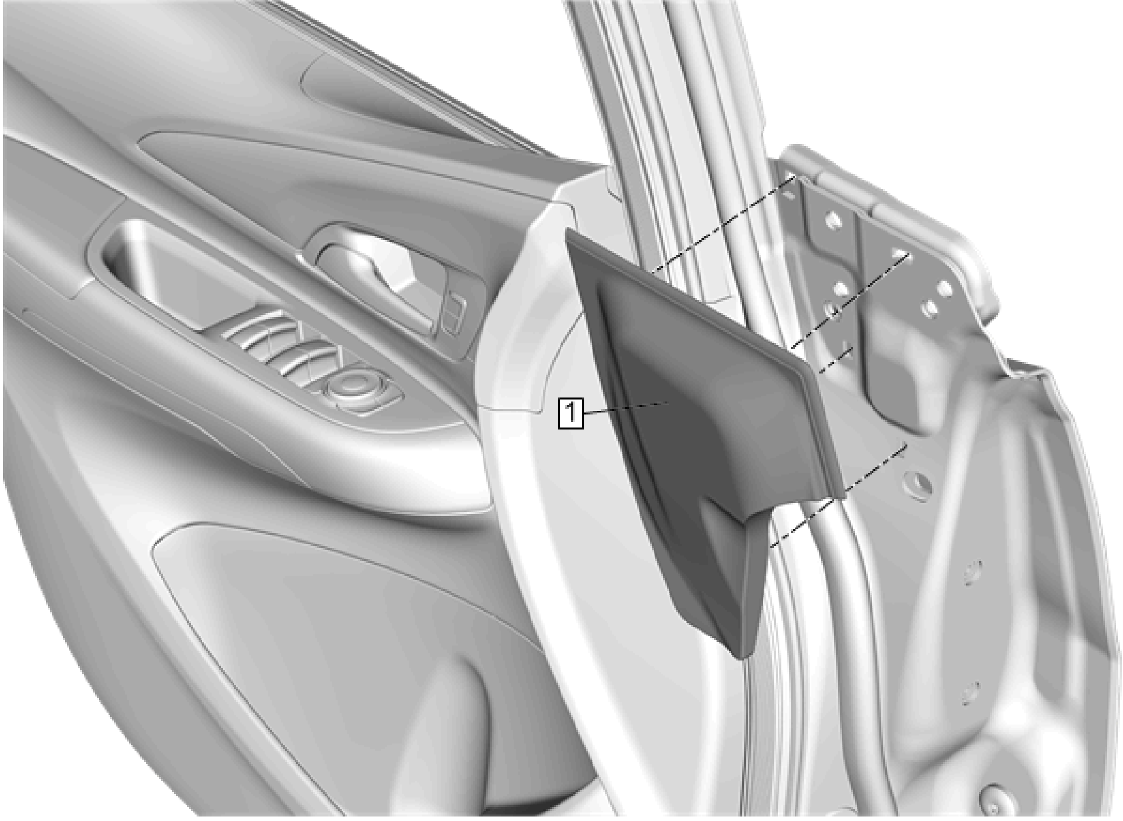


Fig. 2: Front Side Door Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Side Door Upper Trim Panel **Procedure** Pull the door upper trim panel away from the front side door.

FRONT SIDE DOOR TRIM REPLACEMENT

Removal Procedure

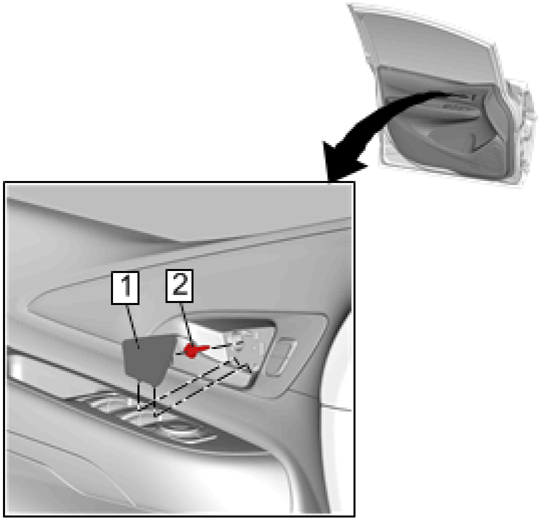


Fig. 3: Front Side Door Inside Handle Fastener Finish Cap
Courtesy of GENERAL MOTORS COMPANY

1. Remove the front side door inside handle fastener finish cap (1).
2. Remove the front side door inside handle fastener (2).

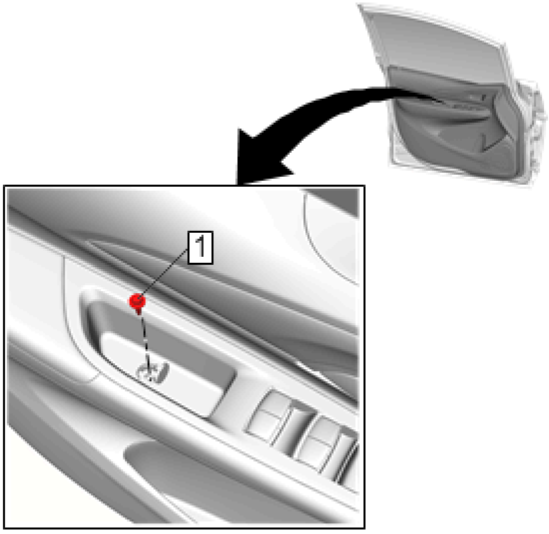


Fig. 4: Front Side Door Armrest Pull Cup Bolt Cap
Courtesy of GENERAL MOTORS COMPANY

3. Use a flat bladed plastic trim tool to release the front side door armrest pull cup bolt cap.
4. Remove the front side door armrest pull cup fastener (1).

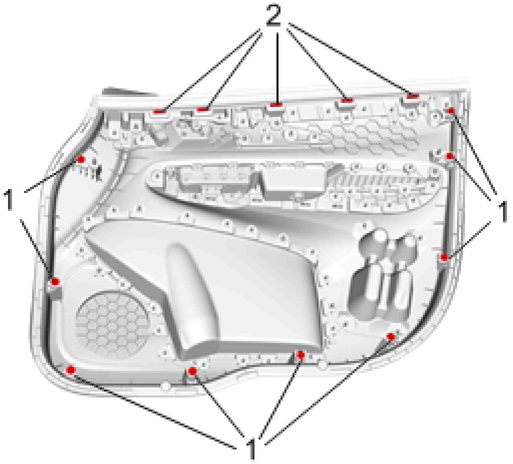


Fig. 5: Door Trim Panel Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Use a appropriate plastic trim tool loosen the retainer (1) (Qty: 9) along the bottom of the door trim panel.
6. When the panel is sufficiently loosened, grasp with both hands and lift up and release the belt line clip (2) (Qty: 5) with the belt molding.
7. Disconnect the door lock retainer cable from the door trim panel and the inside handle.
8. Disconnect the electrical connector.

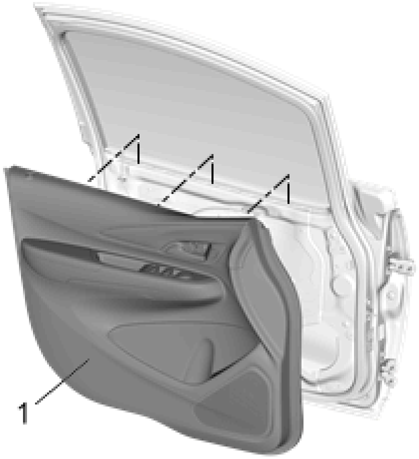


Fig. 6: Front Side Door Trim
Courtesy of GENERAL MOTORS COMPANY

9. Remove the front side door trim (1).
10. Place the door trim panel on a clean flat surface.
11. Release the belt molding and belt line clips from the door trim panel.

Installation Procedure

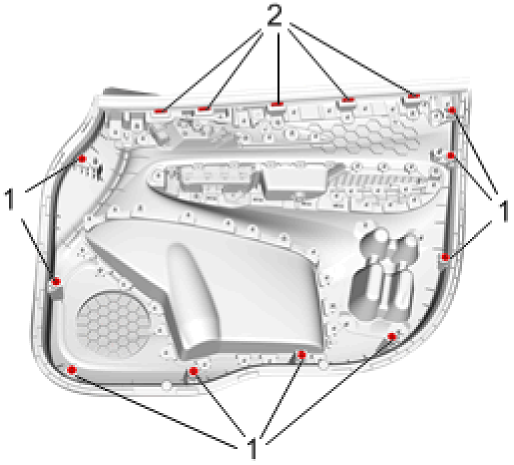


Fig. 7: Door Trim Panel Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Make sure the belt line clip (2) (Qty: 5) are replaced with new clips before re-attaching the door trim, even if they weren't damaged.
2. Install the belt molding to the front side door trim assembly.
3. The retainer (1) (Qty: 9) that are destroyed during removal must be replaced with new retainers to properly reattach the door trim.

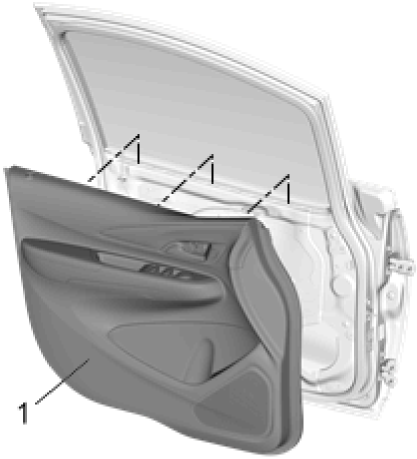


Fig. 8: Front Side Door Trim
Courtesy of GENERAL MOTORS COMPANY

4. Connect the electrical connector.
5. Connect the door lock retainer cable to the door trim panel and the inside handle.
6. Install the front side door trim (1)

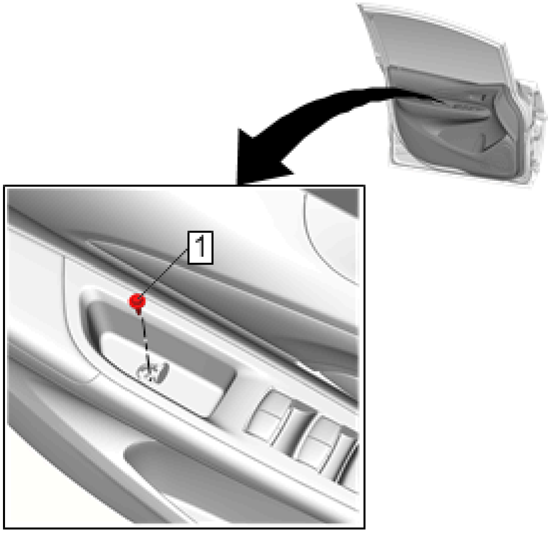


Fig. 9: Front Side Door Armrest Pull Cup Bolt Cap
Courtesy of GENERAL MOTORS COMPANY

7. Front Side Door Armrest Pull Cup Fastener (1) - Install and tighten to 2.5 N.m (22 lb in)
8. Install the front side door armrest pull cup fastener cap.

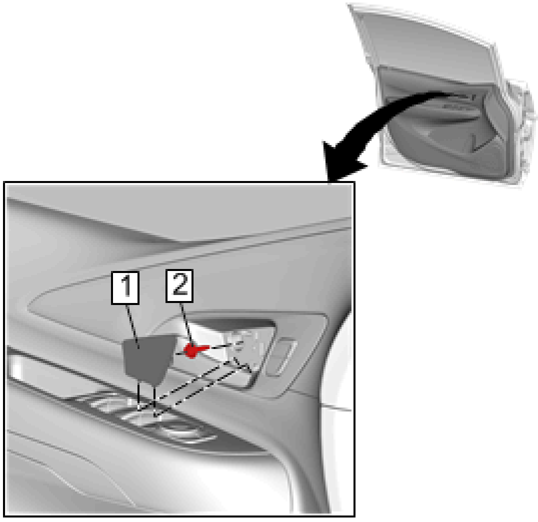


Fig. 10: Front Side Door Inside Handle Fastener Finish Cap
Courtesy of GENERAL MOTORS COMPANY

9. Front Side Door Inside Handle Fastener (2) - Install and tighten to 2.5 N.m (22 lb in)
10. Install the front side door inside handle fastener finish cap (1).

FRONT SIDE DOOR TRIM PANEL APPLIQUE REPLACEMENT

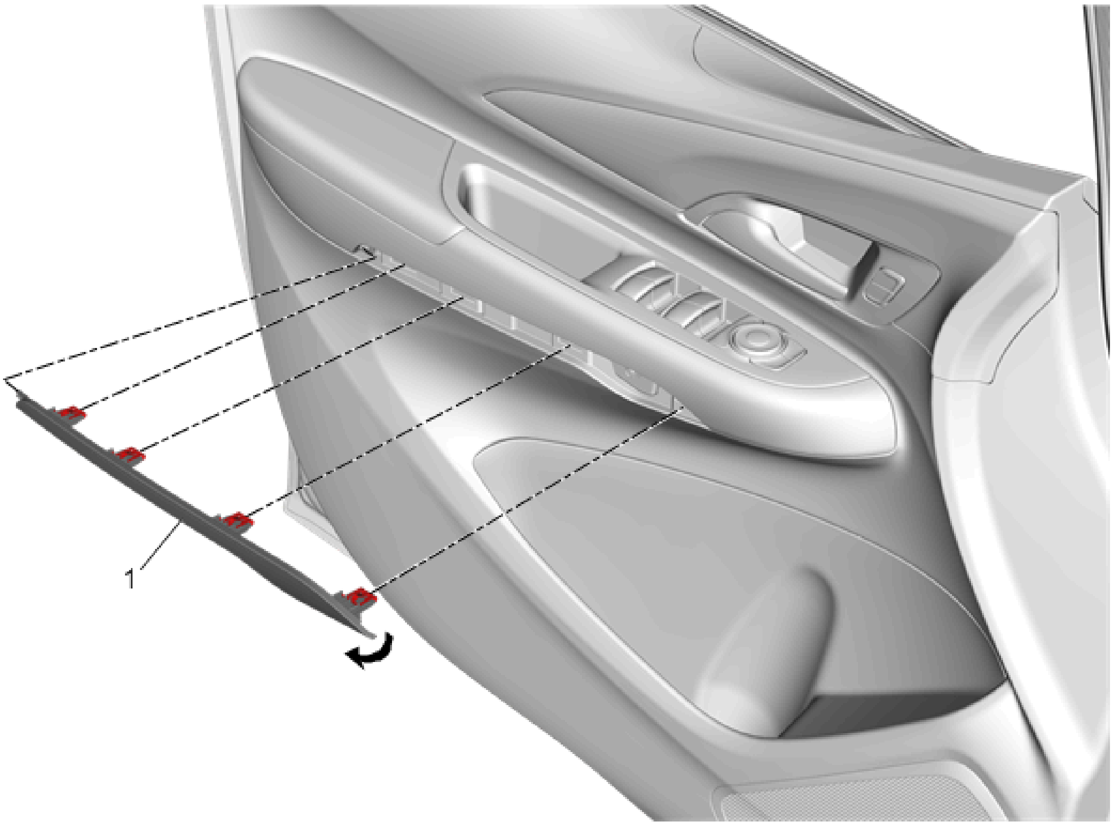


Fig. 11: Front Side Door Trim Panel Applique
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Side Door Trim Panel Applique **Procedure** 1. Using a flat-bladed plastic trim tool, gently lift the front side door trim panel applique from the door trim panel, starting from the forward edge. 2. Pull the rear edge of the front side door trim panel applique forward to disengage from the door trim panel.

REAR SIDE DOOR UPPER REAR TRIM PANEL REPLACEMENT

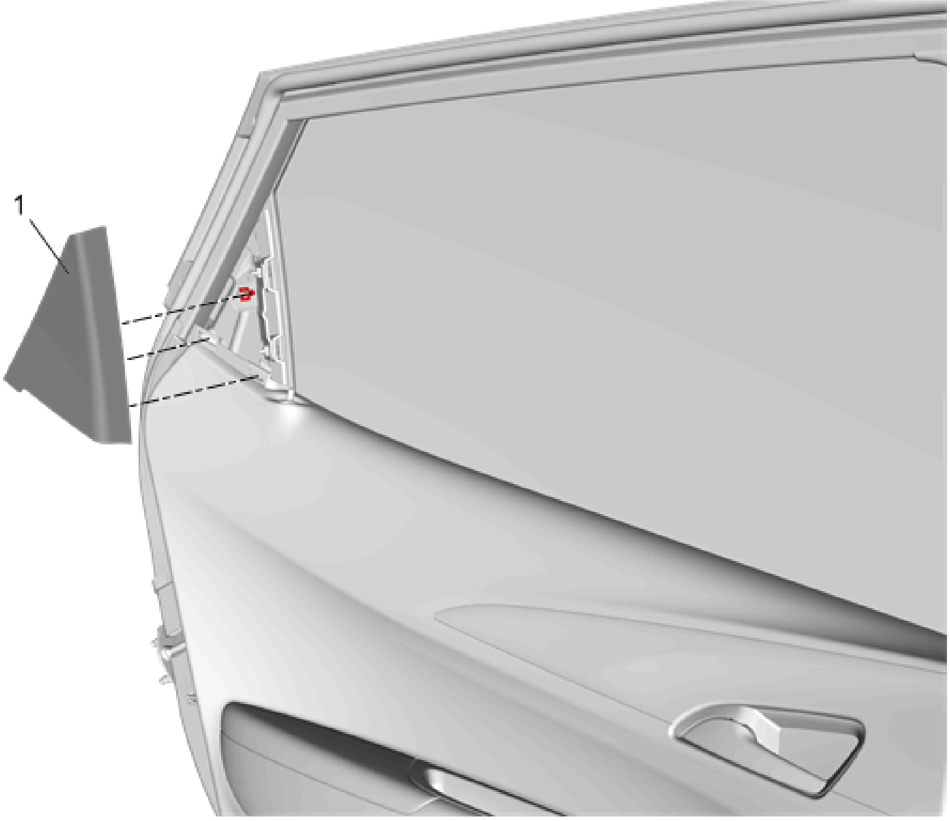


Fig. 12: Rear Side Door Upper Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Side Door Upper Rear Trim Panel **Procedure** Pull the door upper rear trim panel away from the rear side door.

FRONT SIDE DOOR WATER DEFLECTOR REPLACEMENT

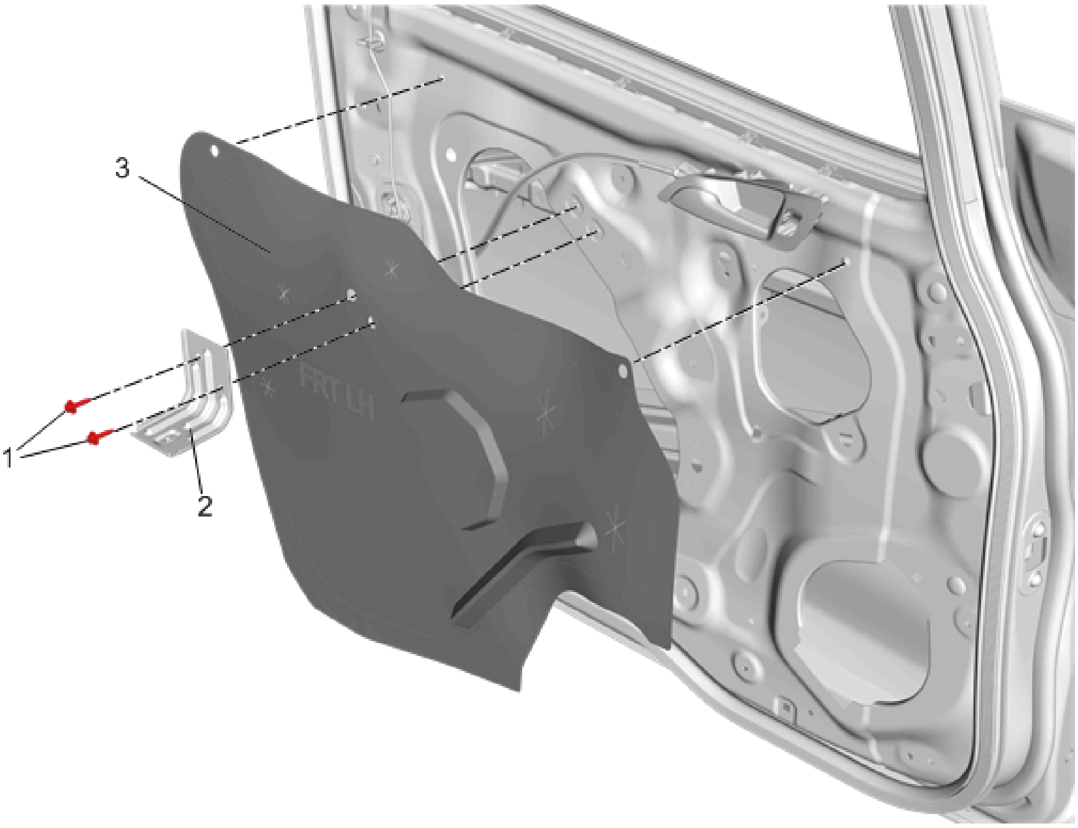


Fig. 13: Front Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure Remove the front side door trim panel. Front Side Door Trim Replacement	
1	Front Side Door Armrest Bracket Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Front Side Door Armrest Bracket
3	Front Side Door Water Deflector **Procedure** Disconnect, unclip and guide the electrical connectors and door lock cable through the water deflector while removing it from the door. **NOTE:** **Make sure that the front side door water deflector is leakproof.**

REAR SIDE DOOR WATER DEFLECTOR REPLACEMENT

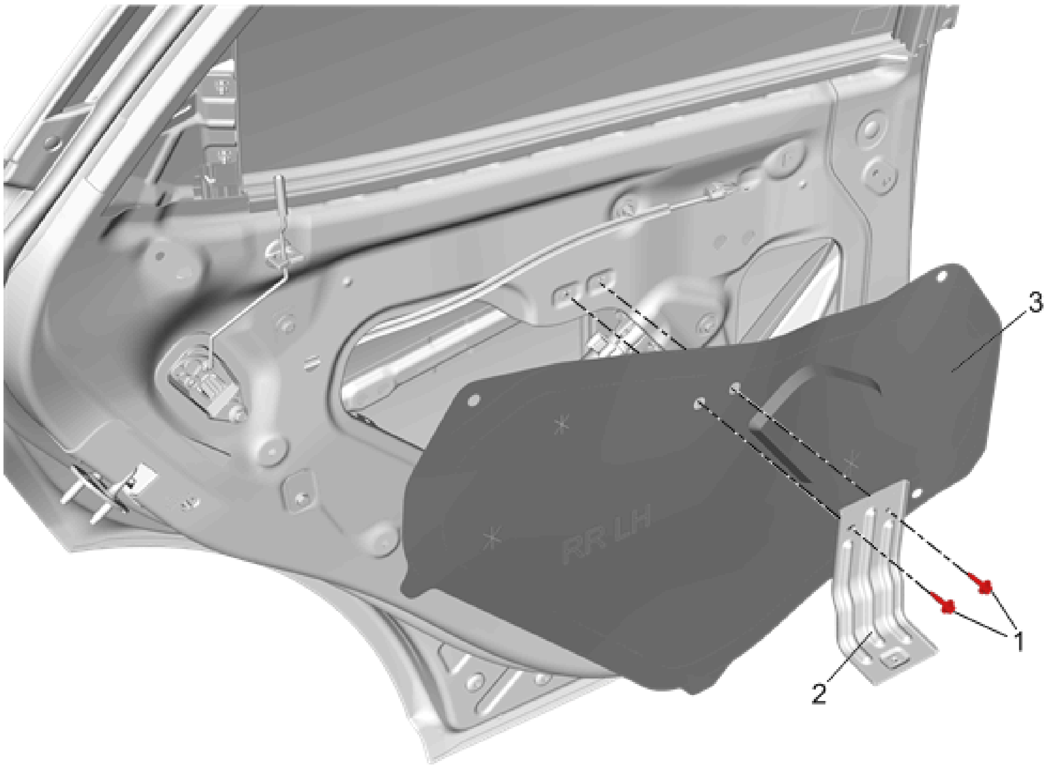


Fig. 14: Rear Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the rear side door trim panel. Rear Side Door Trim Replacement	

Callout	Component Name
1	Rear Side Door Armrest Bracket Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Rear Side Door Armrest Bracket
3	Rear Side Door Water Deflector **Procedure** Disconnect, unclip and guide the electrical connectors and door lock cable through the water deflector while removing it from the door. **NOTE:** **Secure that the rear side door water deflector is leakproof.**

REAR SIDE DOOR ARMREST SWITCH MOUNT PLATE REPLACEMENT

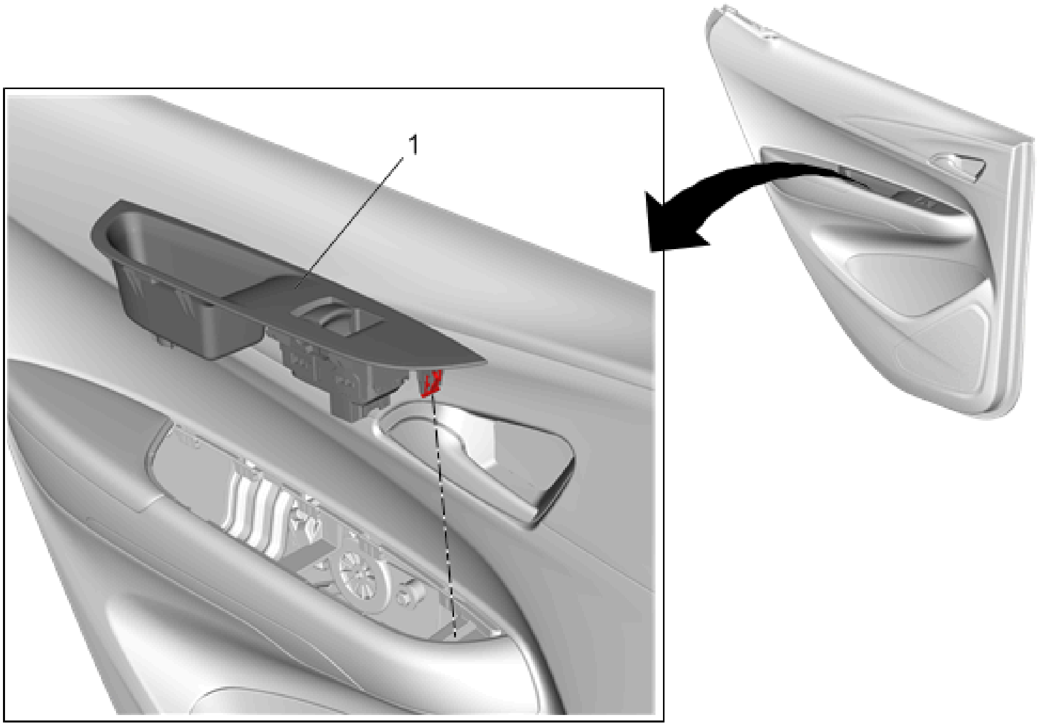


Fig. 15: Rear Side Door Armrest Switch Mount Plate
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Side Door Trim Replacement	
1	Rear Side Door Armrest Switch Mount Plate **Procedure** 1. Remove the cloth sound deadening material from the trim panel. 2. Release the integral retainers from the inside of the door trim. Lift up and outward. 3. Transfer components as necessary.

FRONT SIDE DOOR SILL GARNISH MOLDING REPLACEMENT

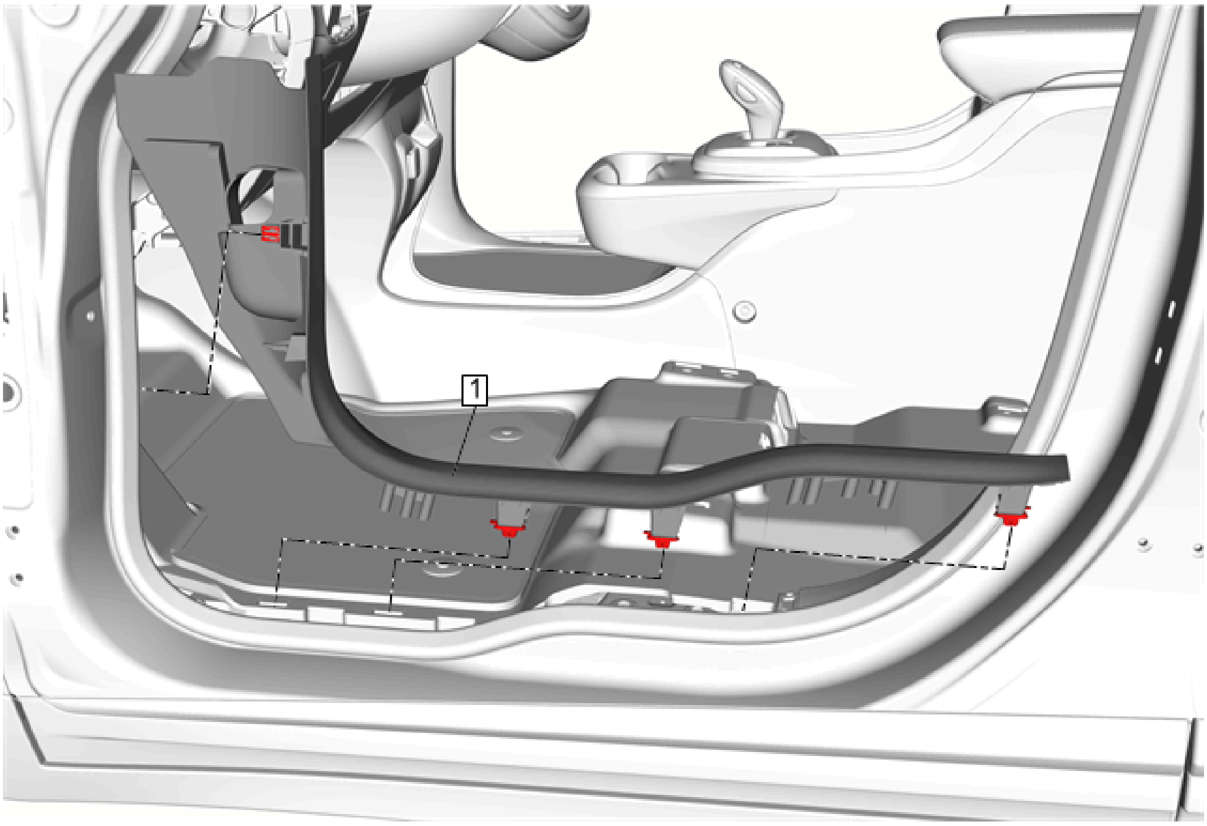


Fig. 16: Front Side Door Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. **Instrument Panel Outer Trim Cover Replacement** 2. When replacing the driver side front side door sill garnish molding, remove the hood primary latch release cable handle. **Hood Primary Latch Release Cable Handle Replacement**	
1	Front Side Door Sill Garnish Molding **Procedure** 1. Starting at the rear of the garnish molding, pull upward at the B-Pillar joint to disengage garnish molding. 2. Work your way forward disengaging all of the garnish molding clips then pull rearward to disengage the clip on the forward vertical wall. 3. Reposition the door weatherstrip as needed. 4. Replace the retainers as required.

REAR SIDE DOOR SILL GARNISH MOLDING REPLACEMENT

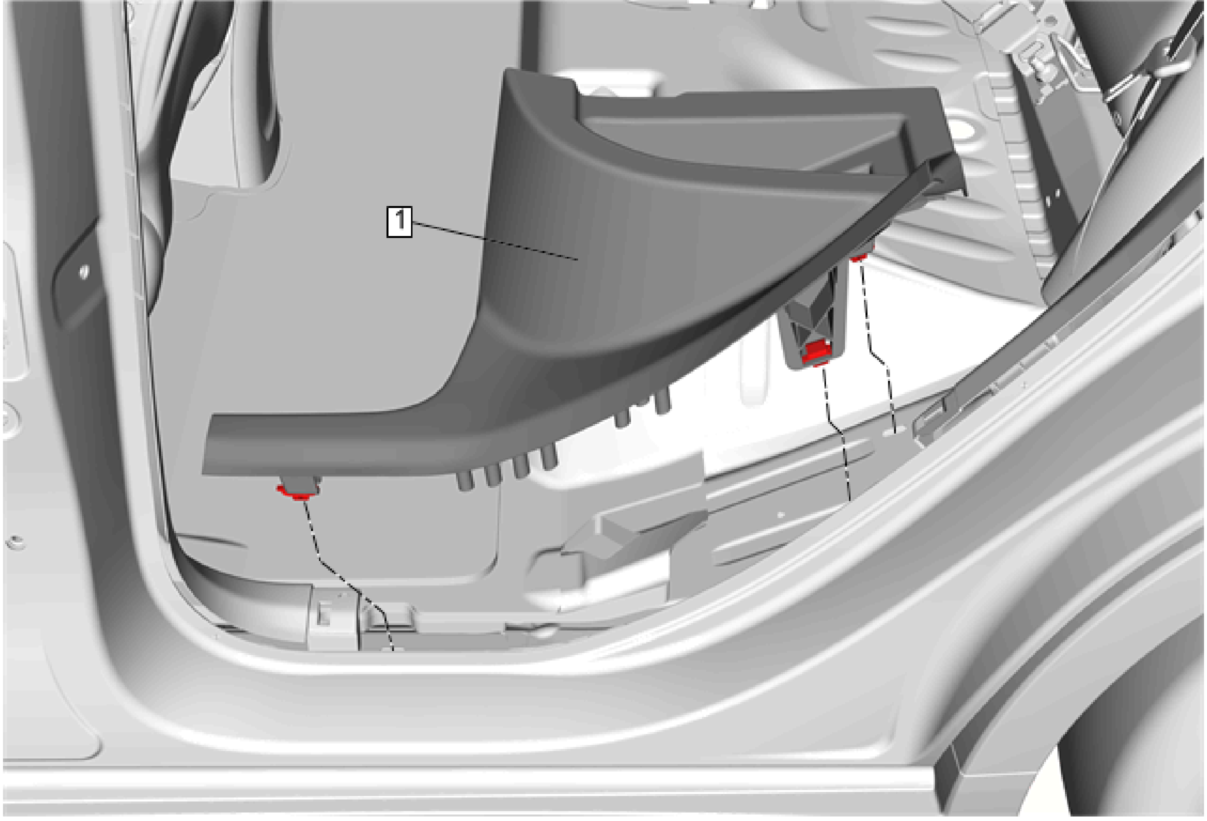


Fig. 17: Rear Side Door Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Cushion Removal and Installation	
1	Rear Side Door Sill Garnish Molding **Procedure** 1. Starting at the front of the sill garnish molding, pull upward at the B-Pillar joint to disengage sill garnish molding. 2. Work your way rearward disengaging all of the garnish molding clips then pull forward to disengage from the C-Pillar lower. 3. Replace the retainers as required.

ROOF RAIL ASSIST HANDLE REPLACEMENT

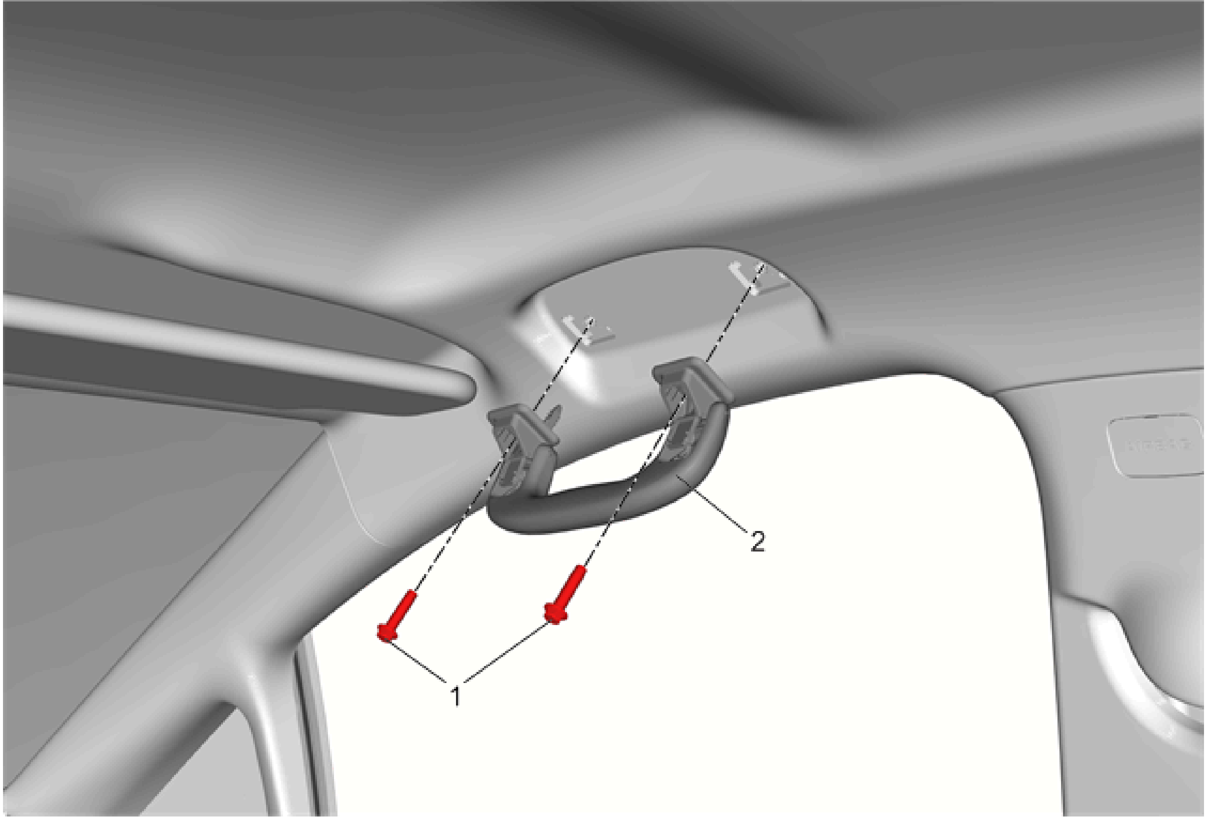


Fig. 18: Roof Rail Assist Handle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Roof Rail Assist Handle Fastener **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Fold the roof rail assist handle downward and hold. 2. Use a small flat-bladed tool to open the roof rail assist handle covers to access the bolt. **Tighten** 6 N.m (53 lb in)
2	Roof Rail Assist Handle

COAT HOOK REPLACEMENT

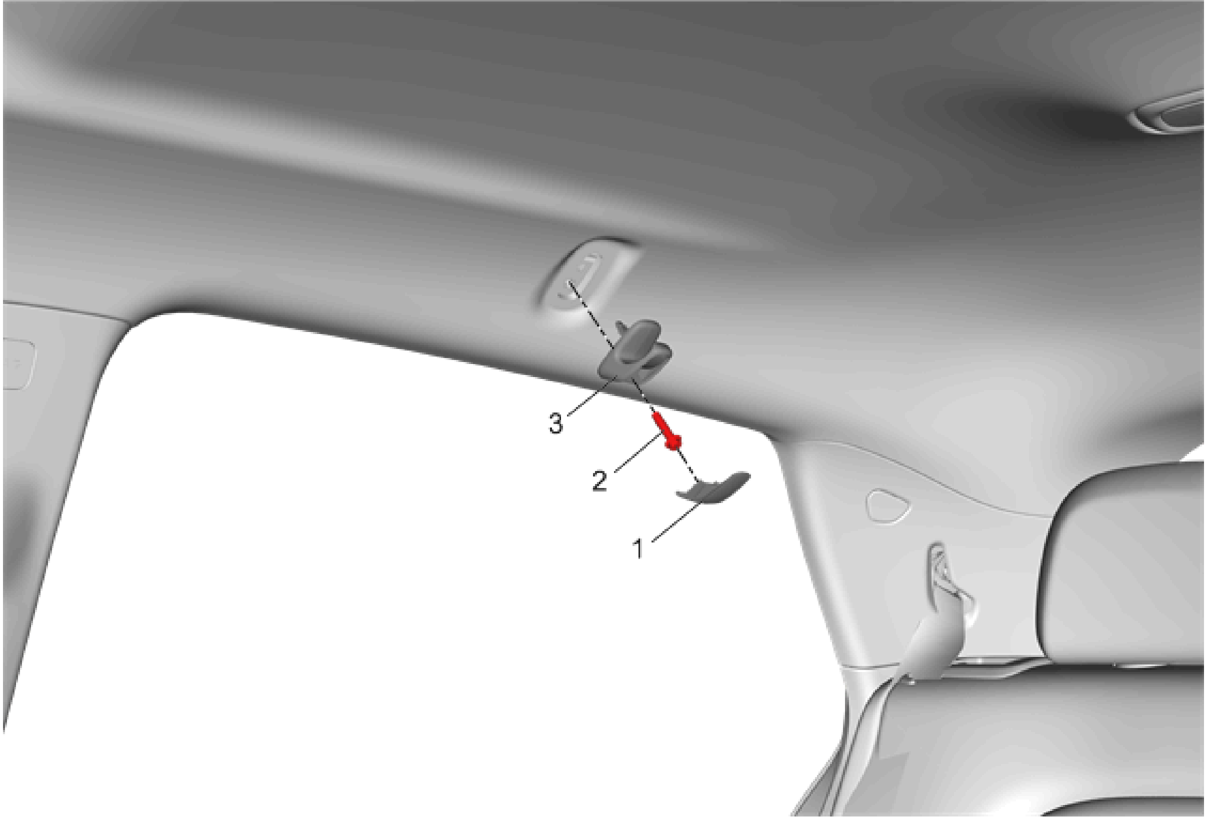


Fig. 19: Coat Hook
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Coat Hook Cover
2	Coat Hook Bolt **CAUTION:** **Refer to Fastener Caution .** **Procedure** Use a small flat-bladed tool to open the coat hook cover for access to the bolt. **Tighten** 6 N.m (53 lb in)
3	Coat Hook

SUNSHADE REPLACEMENT

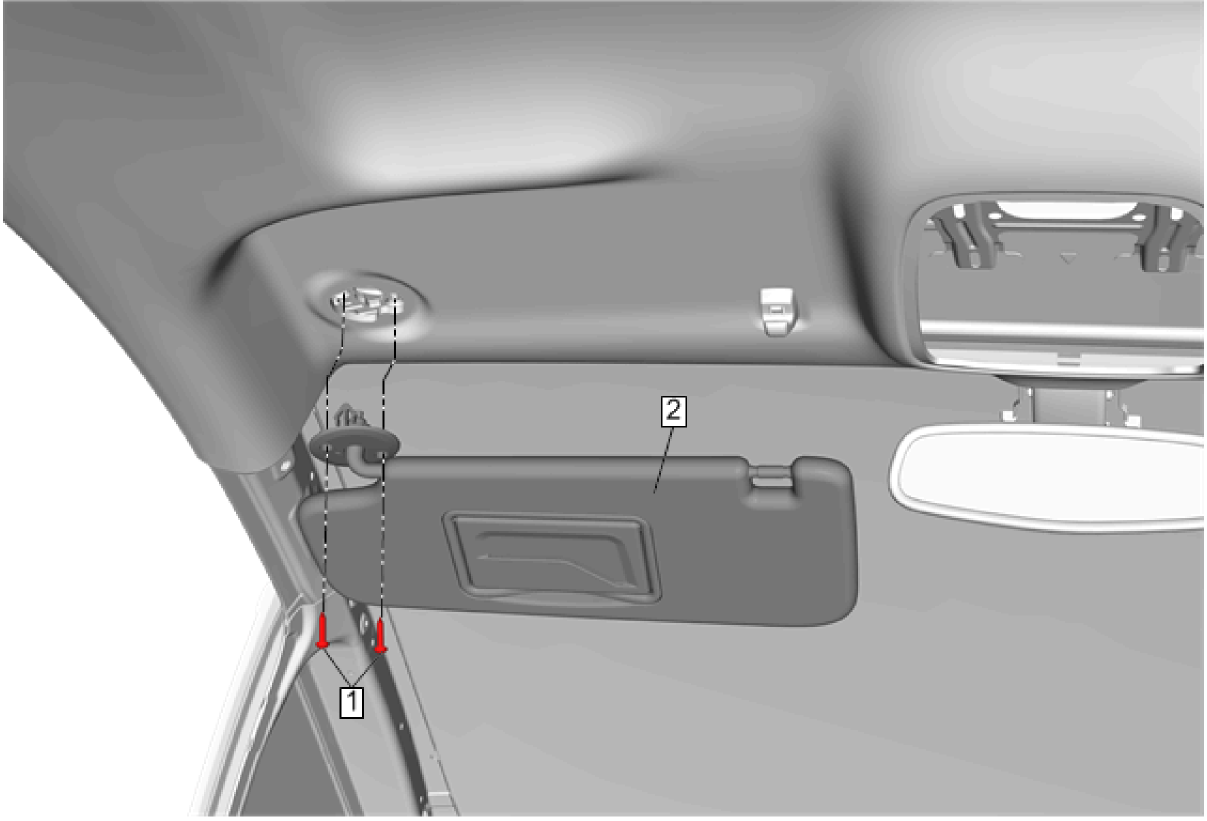


Fig. 20: Sunshade
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Sunshade Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Sunshade **Procedure** 1. Lower the front portion of the headliner to access the sunshade electrical connector and sunshade retainer. **Headlining Trim Panel Replacement** 2. Squeeze the tabs at the base of the sunshade assembly to detach it from the roof panel and allow the headliner with the sunshade attached to be lowered. 3. Release the retainer attaching the sunshade to the headliner assembly.

SUNSHADE SUPPORT REPLACEMENT

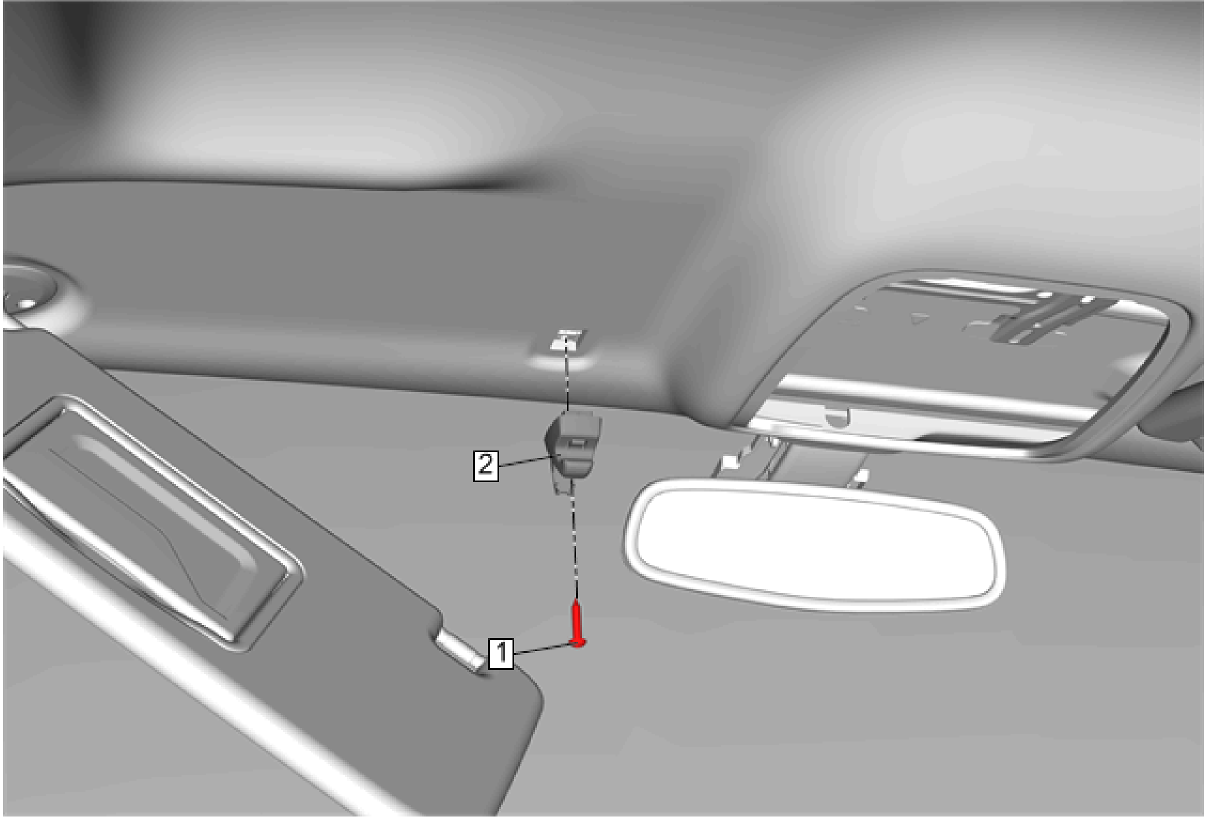


Fig. 21: Sunshade Support
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Sunshade Support Screw **CAUTION:** **Refer to Fastener Caution .** **Procedure** Open the sunshade support screw access cover with a appropriate tool. **Tighten** 2.5 N.m (22 lb in)
2	Sunshade Support **Procedure** Unclip the sunshade from the support and reposition.

WINDSHIELD GARNISH MOLDING REPLACEMENT

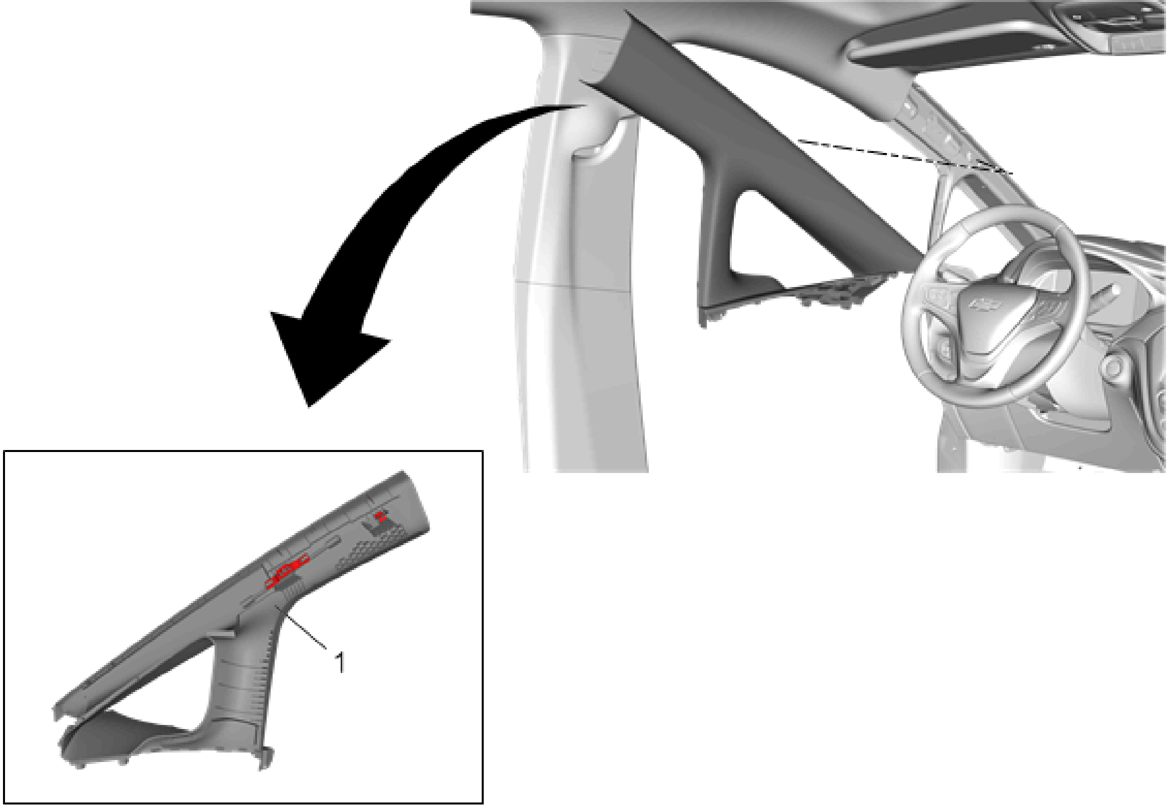


Fig. 22: Windshield Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: **If a vehicle is equipped with a head curtain inflator module ensure that the inflator module and tether are undamaged. If tether or curtain airbag are damaged in any way, they must be replaced.** **CAUTION:** **Use care when working around the head curtain inflator module. Sharp tools may puncture the curtain airbag. If the head curtain inflator module is damaged in any way, it must be replaced.** **Preliminary Procedure** Disable the SIR system. SIR Disabling and Enabling	
1	Windshield Garnish Molding **Procedure** 1. Pull the top of the A-Pillar inward to disengage the upper clip. 2. Carefully remove the tether from the garnish molding. 3. Pull upward to disengage from the instrument panel. 4. The tether clip at the center portion of the garnish molding MUST be replaced every time the windshield garnish molding is removed. 5. Enable the SIR system. SIR Disabling and Enabling

CENTER PILLAR UPPER TRIM PANEL REPLACEMENT

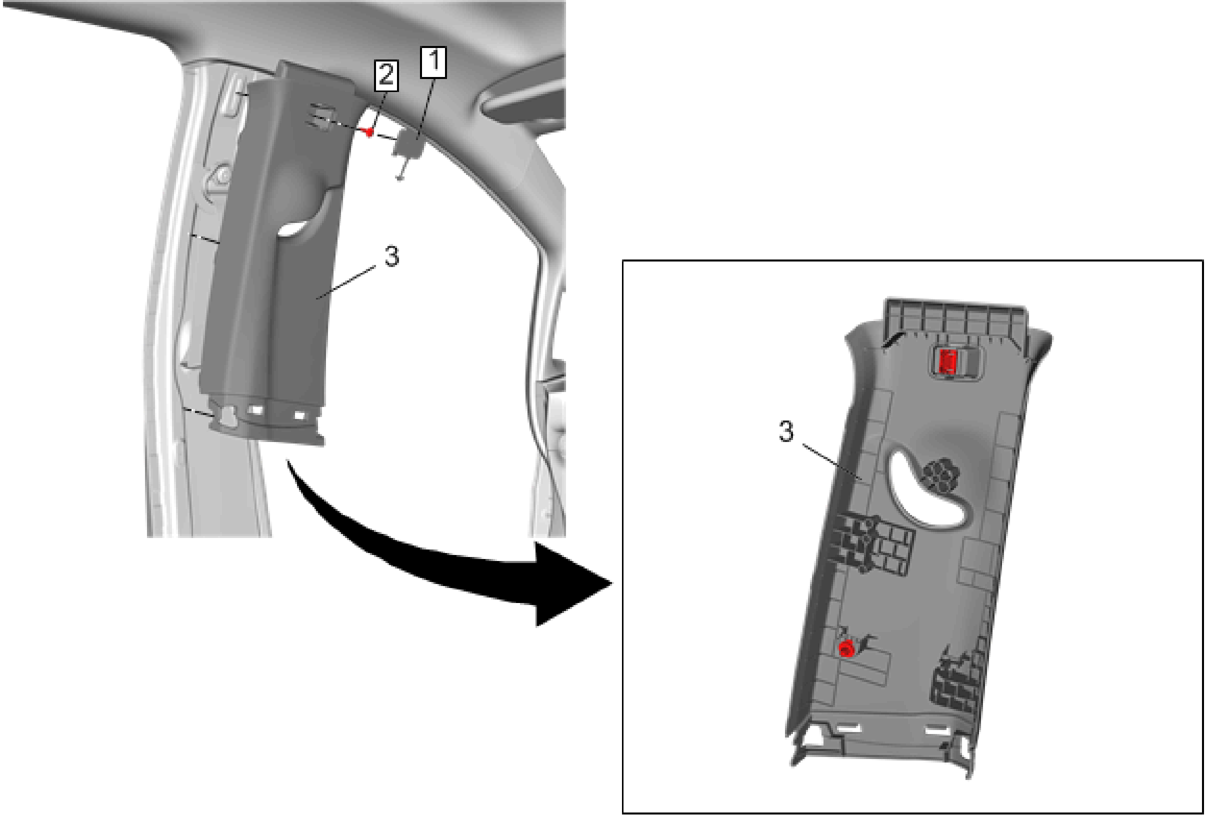


Fig. 23: Center Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disable the SIR system. SIR Disabling and Enabling 2. Center Pillar Lower Trim Panel Replacement 3. Remove the front seat belt anchor bolt. Front Seat Belt Anchor Plate Tensioner Replacement	
1	Center Pillar Upper Trim Panel Bolt Cap
2	Center Pillar Upper Garnish Molding Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 3 N.m (27 lb in)
3	Center Pillar Upper Trim Panel **Procedure** 1. Pull the trim panel toward the inside of the vehicle to disengage the retainers and to clear the front seat tensioner assembly. 2. When replacing the center pillar upper trim panel, feed the seat belt through the panel. 3. Ensure the seat belt webbing does not become trapped during installation. 4. Enable the SIR system. SIR Disabling and Enabling

CENTER PILLAR LOWER TRIM PANEL REPLACEMENT

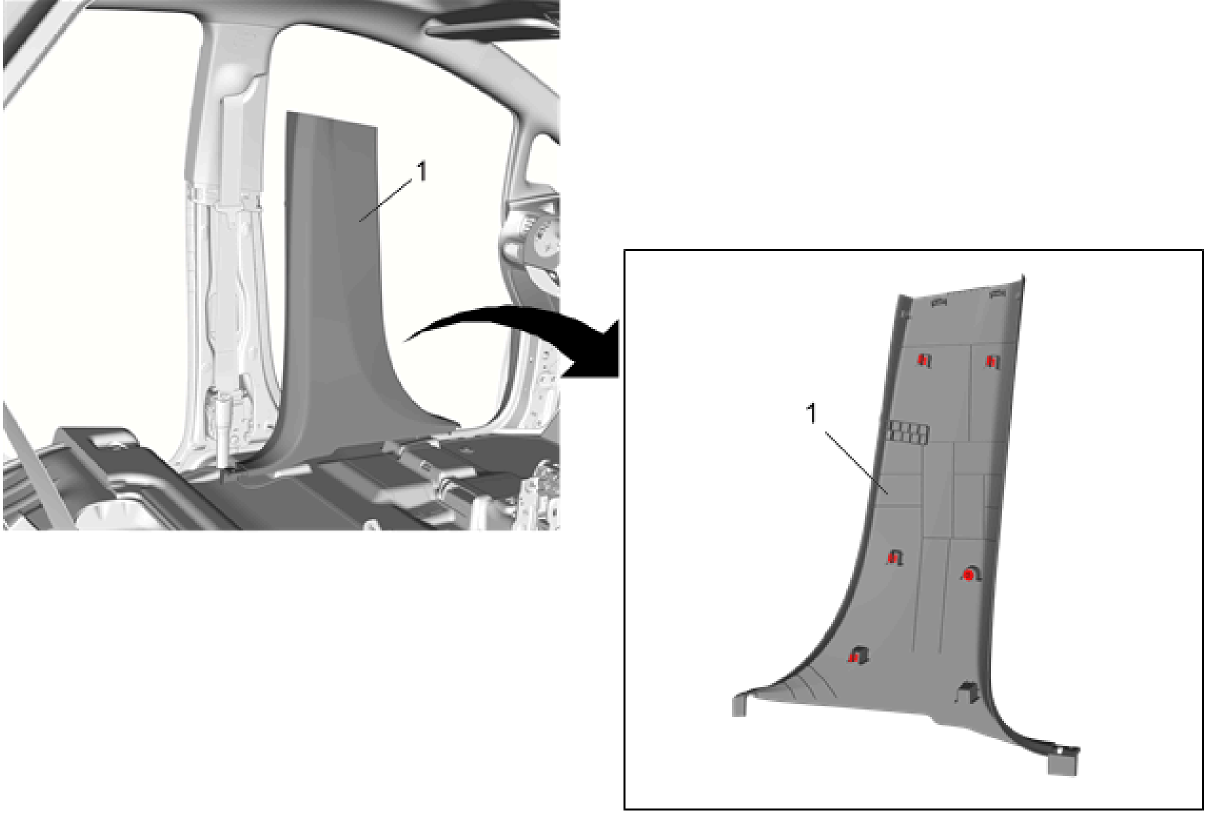


Fig. 24: Center Pillar Lower Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Side Door Sill Garnish Molding Replacement 2. Rear Side Door Sill Garnish Molding Replacement 3. Move the seat to the full forward position.	
1	Center Pillar Lower Trim Panel Assembly **Procedure** Pull the center pillar lower trim panel inward and upward to disengage the retainers.

BODY LOCK PILLAR UPPER TRIM PANEL REPLACEMENT

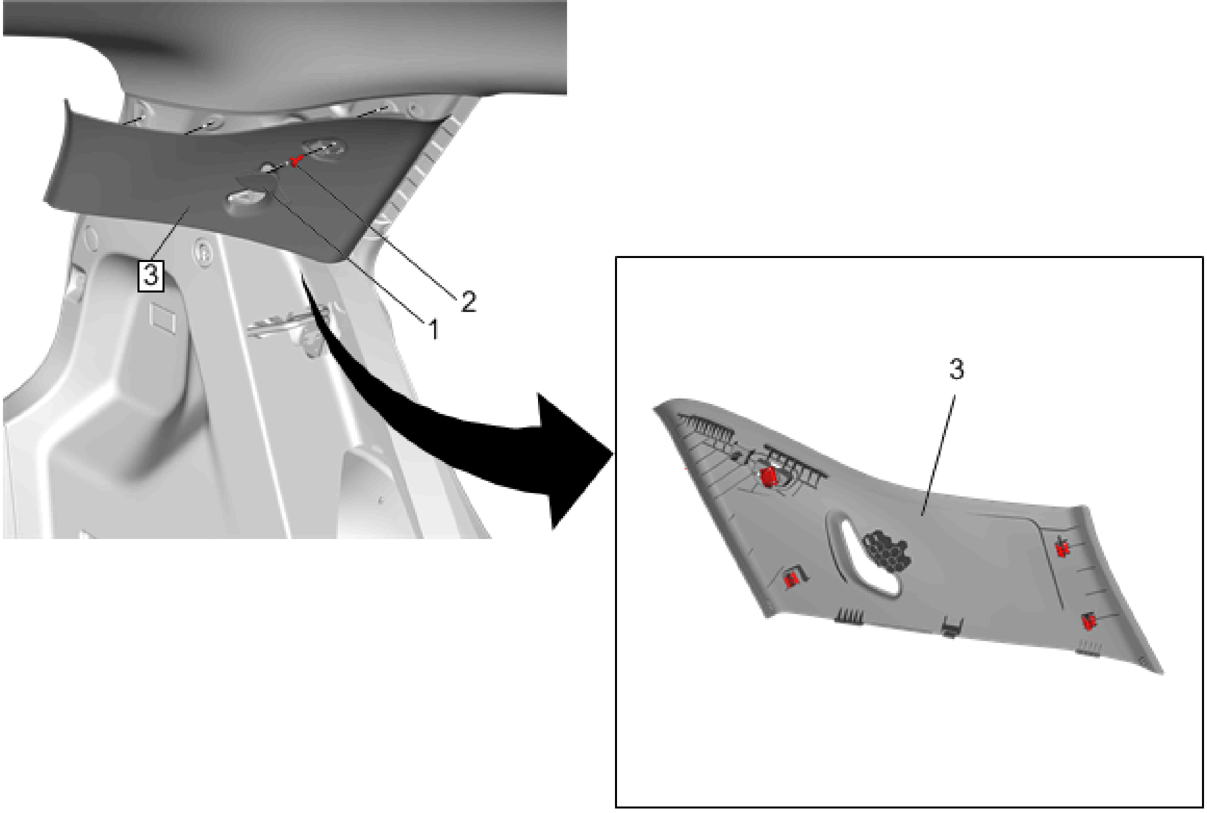


Fig. 25: Body Lock Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Disable the SIR system. SIR Disabling and Enabling 2. Remove the rear seat belt retractor bolt on the bottom of the body. Rear Seat Belt Retractor Replacement	
1	Body Lock Pillar Upper Trim Panel Bolt Cap
2	Body Lock Pillar Upper Trim Panel Bolt **CAUTION:** Fastener Caution **Tighten** 3 N.m (27 lb in)
3	Body Lock Pillar Upper Trim Panel **Procedure** 1. Use a flat bladed plastic trim tool. 2. Grasp and gently pull up on the body lock pillar upper trim panel. 3. Enable the SIR system. SIR Disabling and Enabling

QUARTER LOWER REAR TRIM PANEL REPLACEMENT

Removal Procedure

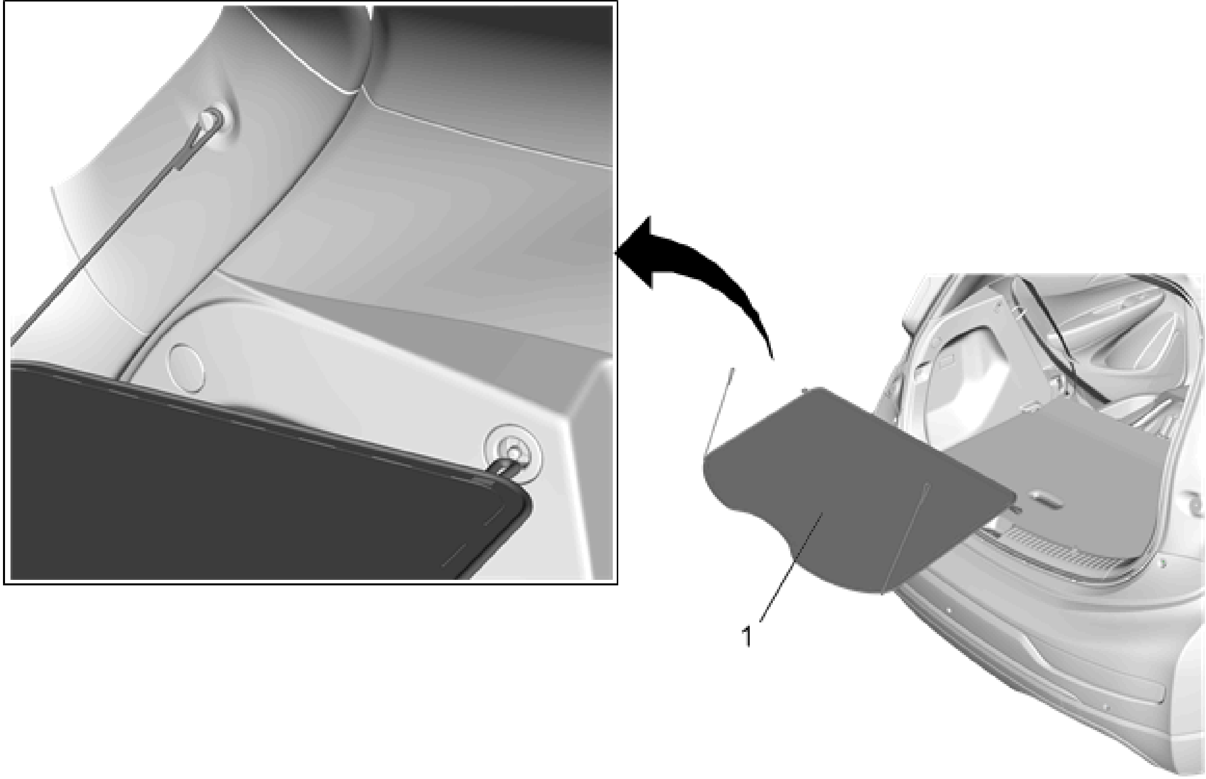


Fig. 26: Luggage Shade
Courtesy of GENERAL MOTORS COMPANY

1. Remove the luggage shade for either side. **Luggage Shade Replacement**

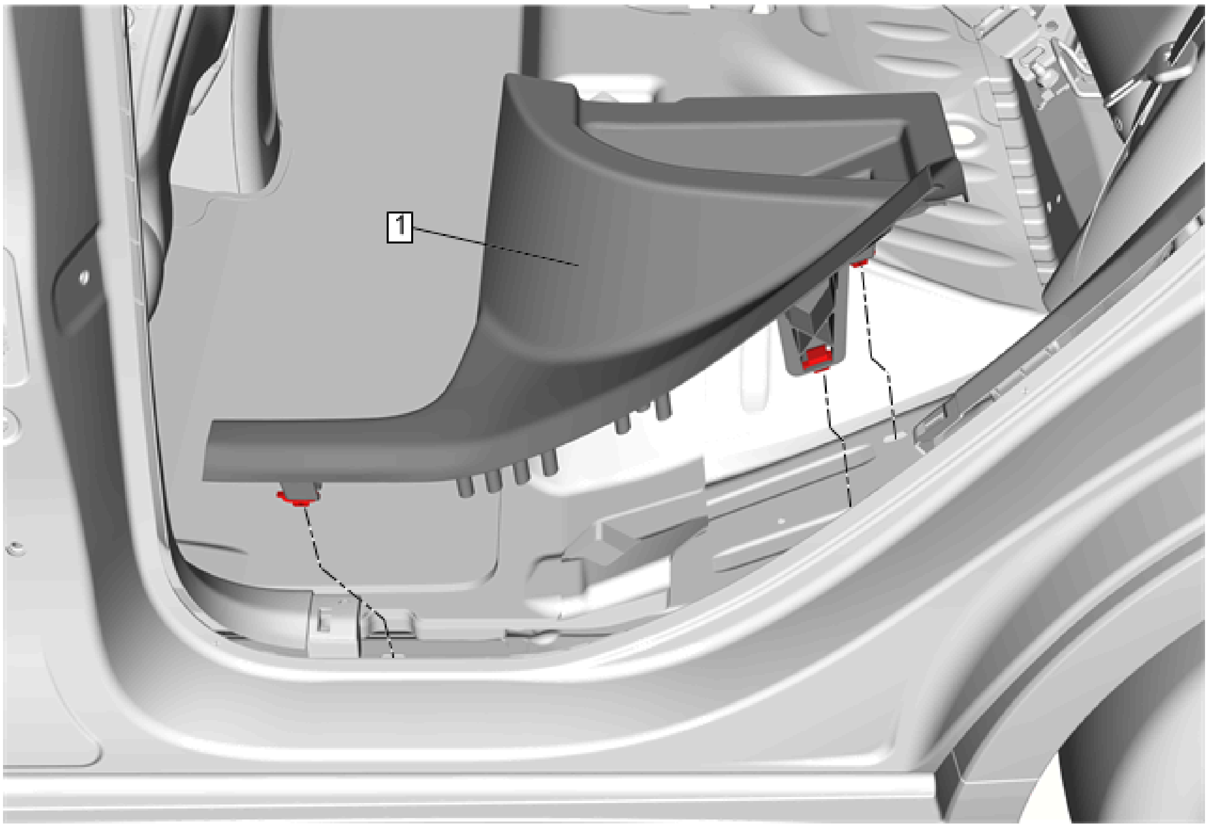


Fig. 27: Rear Side Door Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

2. Remove the rear side door sill garnish molding from side being worked on. **Rear Side Door Sill Garnish Molding Replacement**

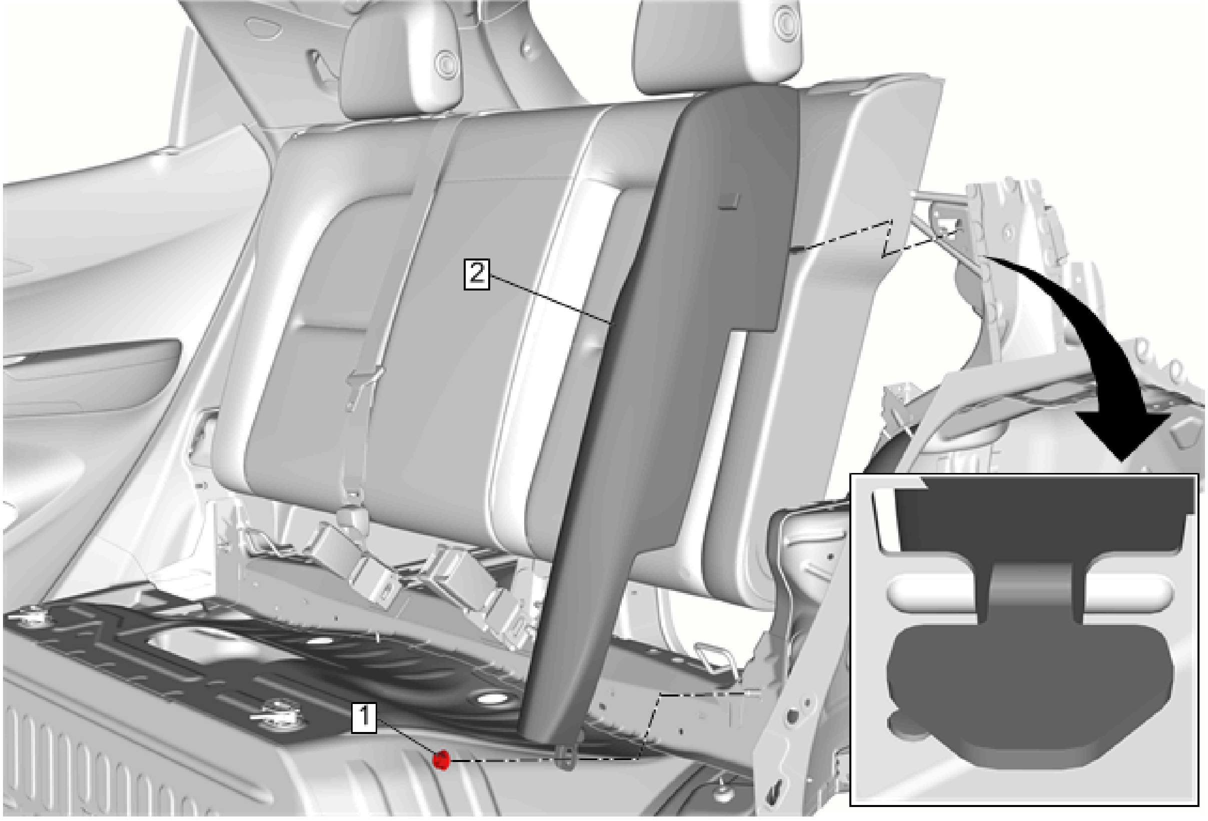


Fig. 28: Rear Seat Back Bolster
Courtesy of GENERAL MOTORS COMPANY

3. Remove the rear seat back bolster from side being worked on. **Rear Seat Back Bolster Replacement**

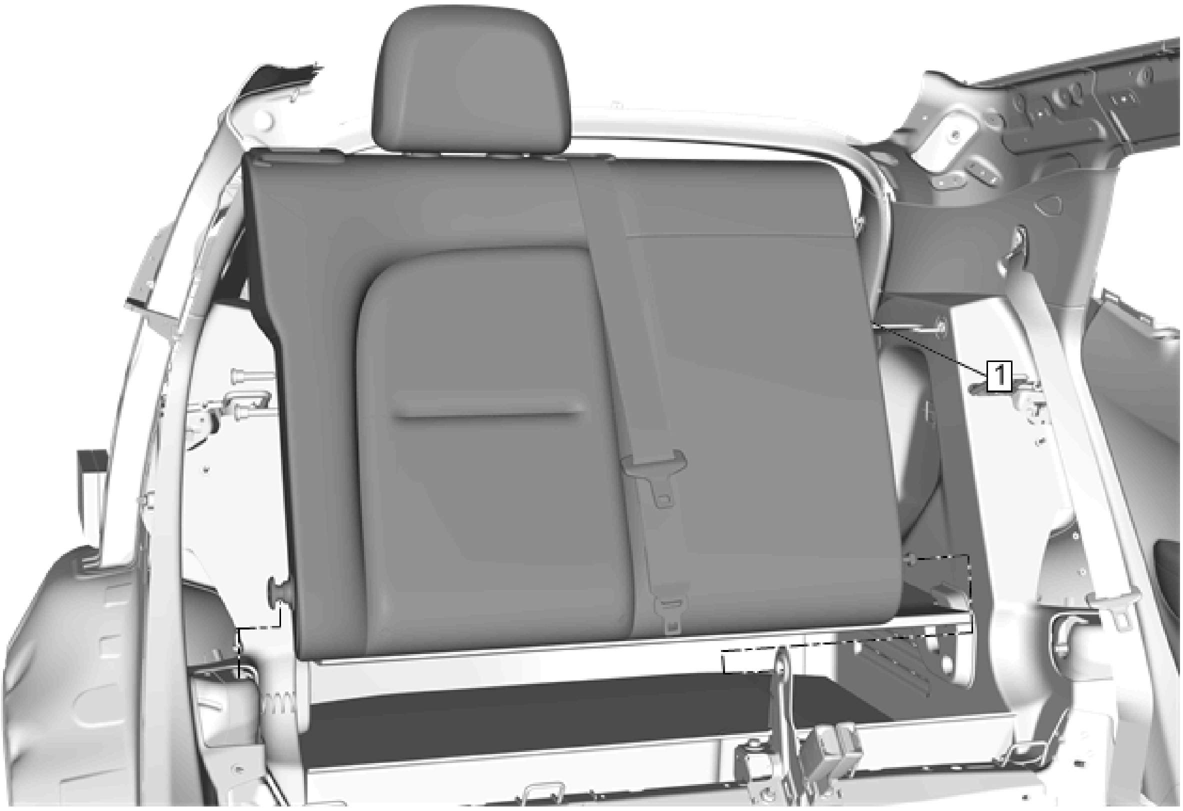


Fig. 29: Rear Seat Back Cushion
Courtesy of GENERAL MOTORS COMPANY

4. Remove 40% rear seat back cushion for left, 60% for right. **Rear Seat Back Cushion Removal and Installation (40%)** **Rear Seat Back Cushion Removal and Installation (60%)**

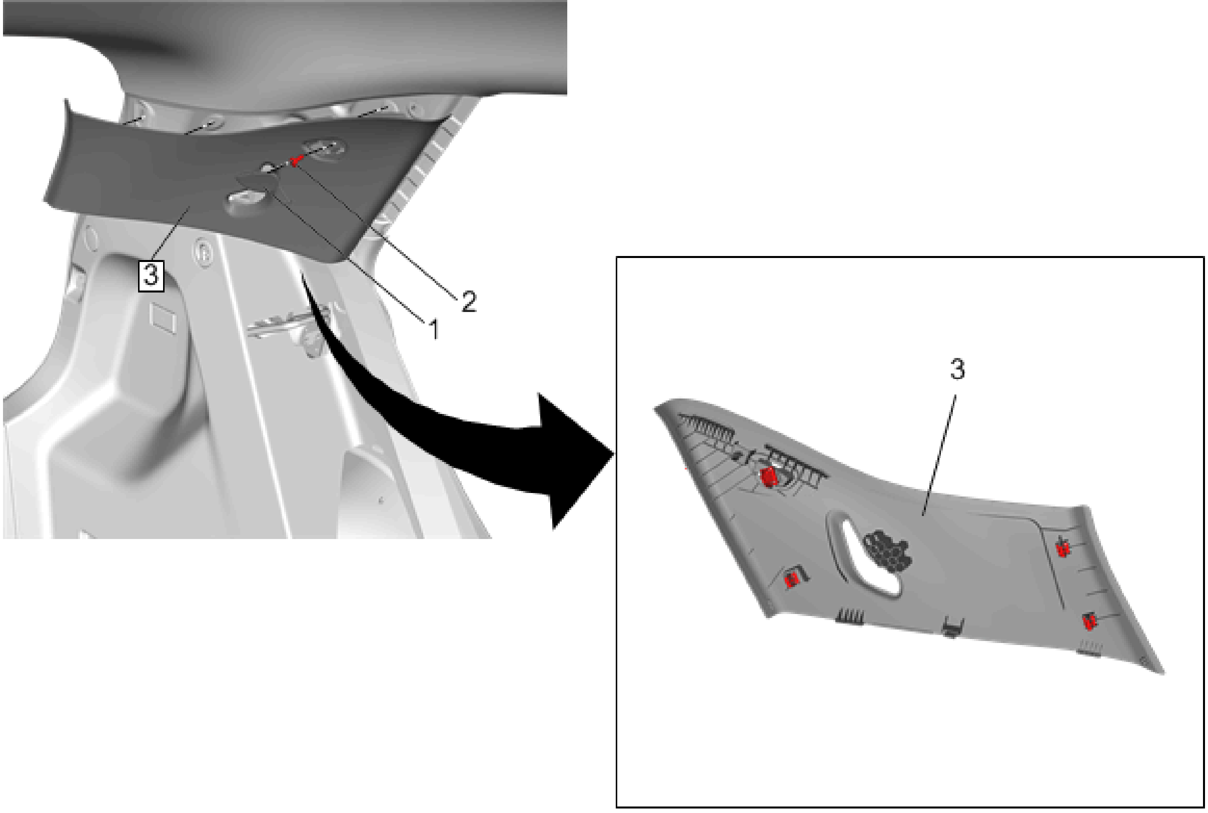


Fig. 30: Body Lock Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

5. Reposition the body lock pillar upper trim panel from side being worked on. **Body Lock Pillar Upper Trim Panel Replacement**

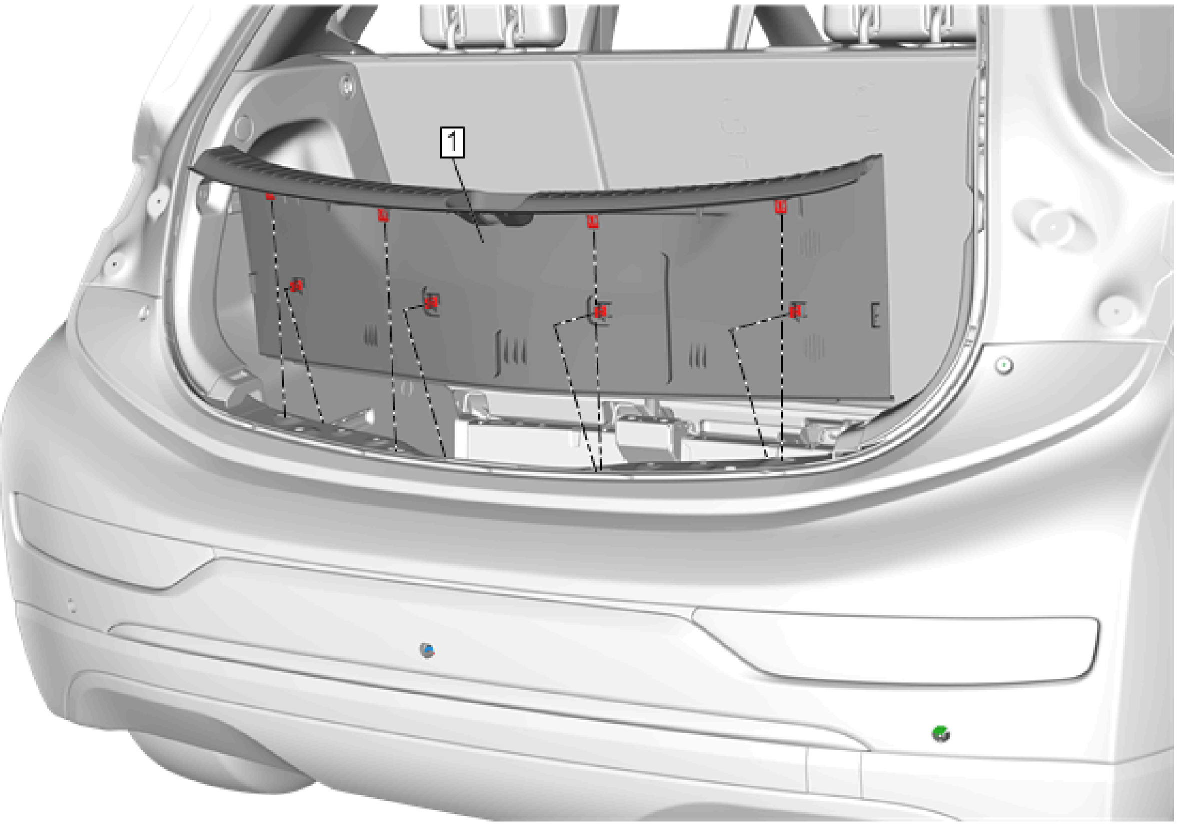
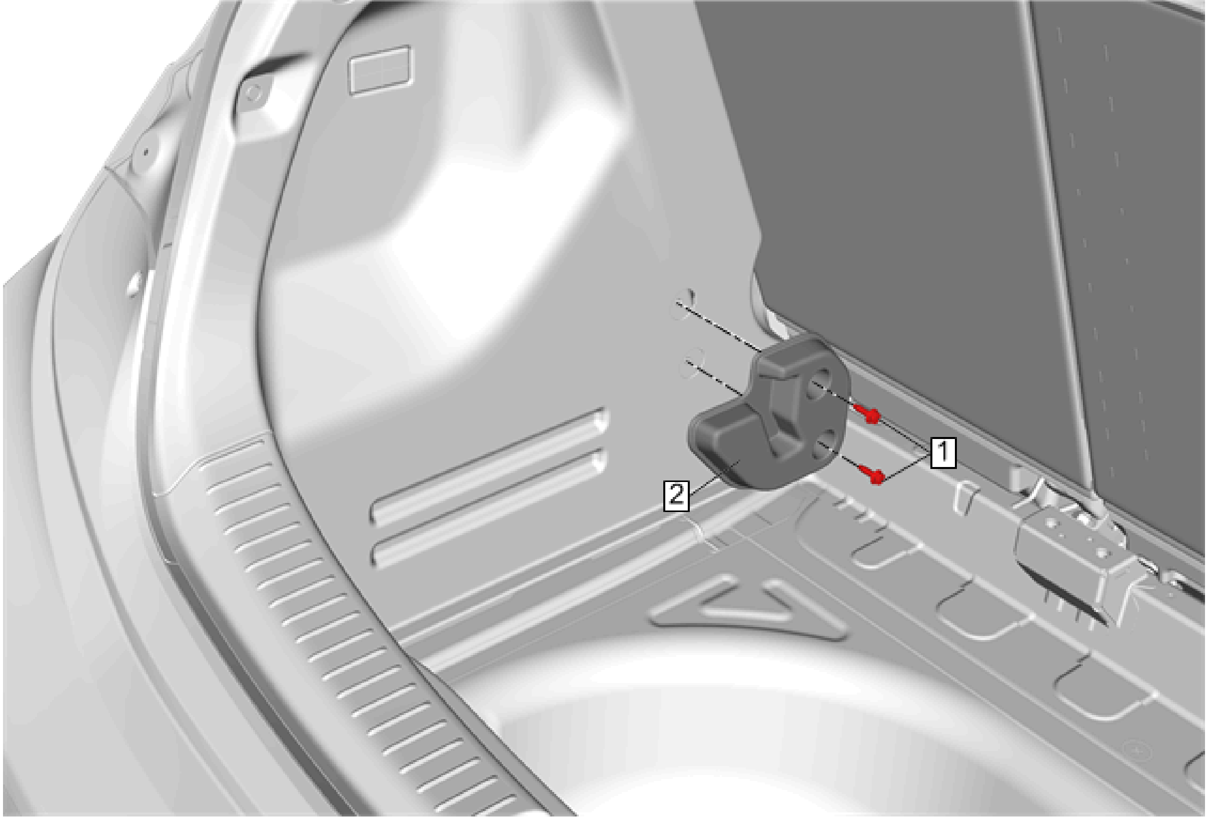


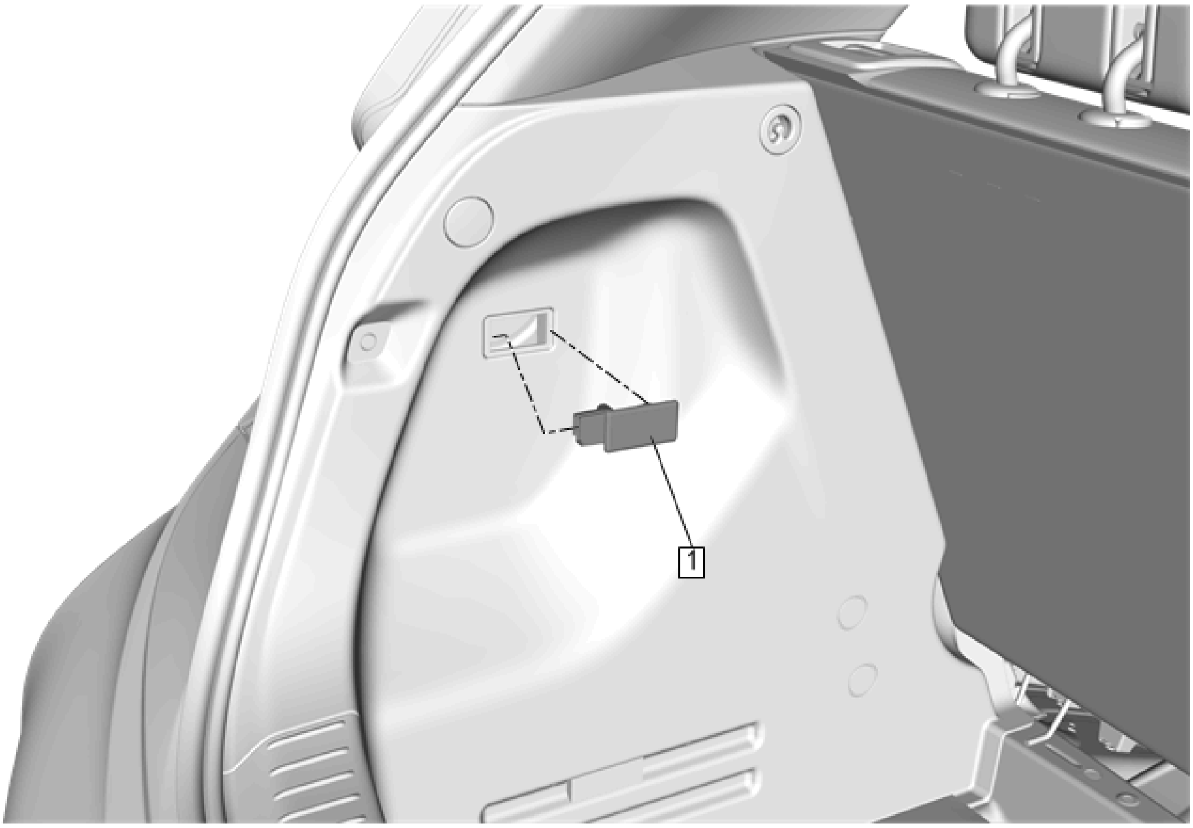
Fig. 31: Lift Gate Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

6. Remove the lift gate sill garnish molding. **Liftgate Sill Garnish Molding Replacement**



[Fig. 32: Oad Floor Stowage Compartment Cover Support](#)
Courtesy of GENERAL MOTORS COMPANY

7. Remove the load floor stowage compartment cover support from side being worked on. [Load Floor Stowage Compartment Cover Support Replacement](#)



[Fig. 33: Cargo Center Courtesy Lamp On Left Side](#)
Courtesy of GENERAL MOTORS COMPANY

8. Remove the cargo center courtesy lamp on left side panel only. [Cargo Center Courtesy Lamp Replacement](#)

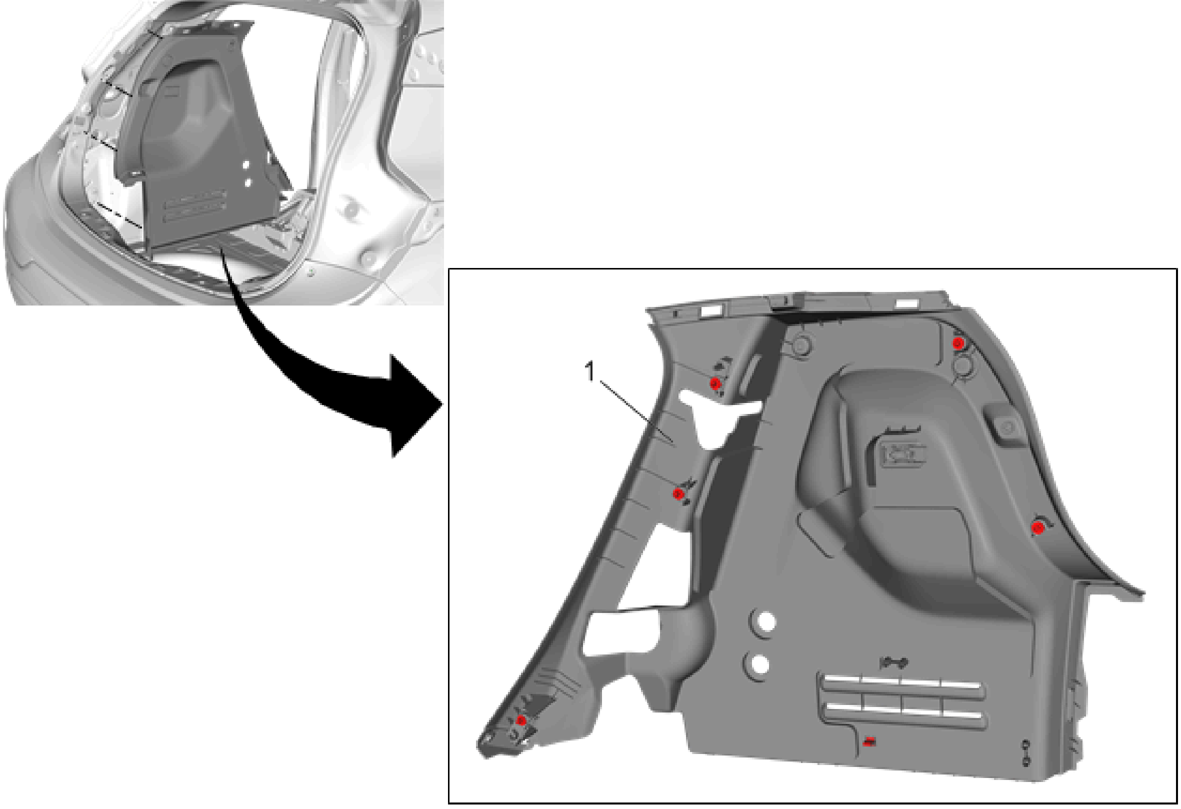


Fig. 34: Quarter Lower Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

9. Use a flat-bladed plastic trim tool to release the quarter lower rear trim panel.
10. Quarter Lower Rear Trim Panel - Remove

Installation Procedure

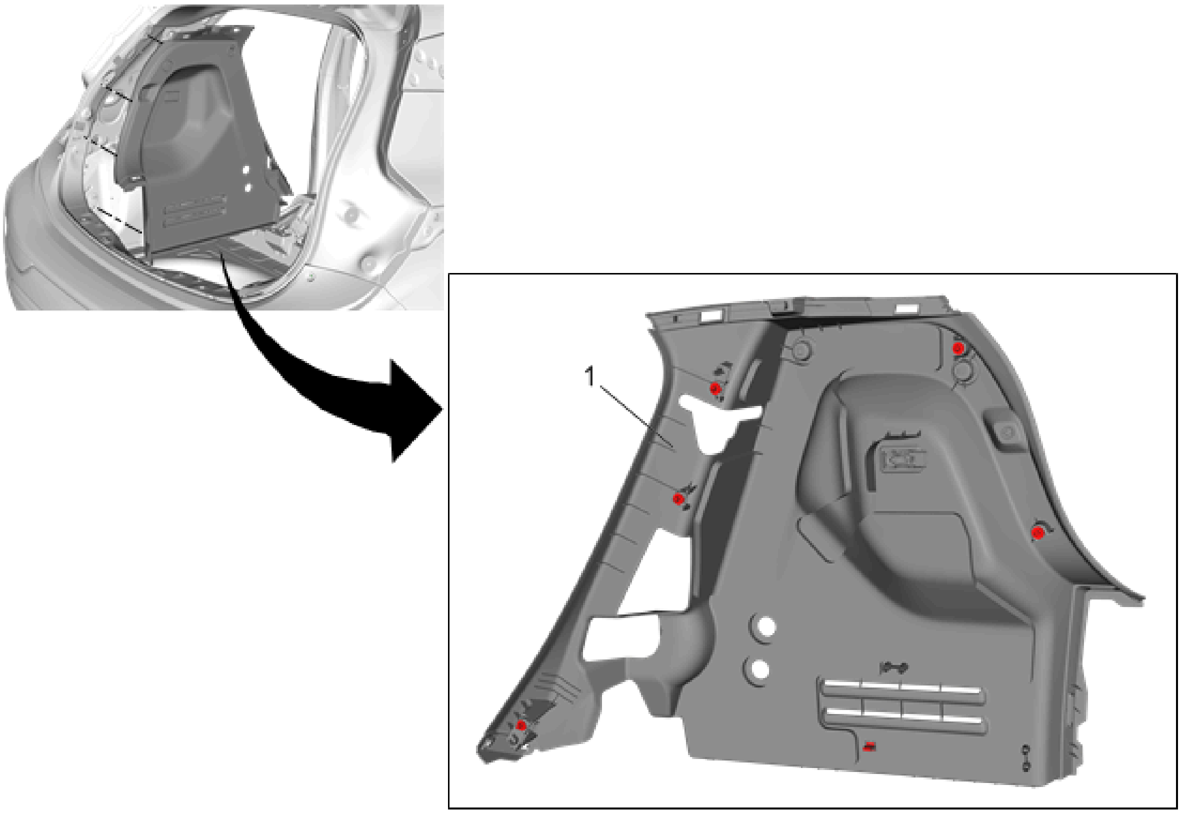


Fig. 35: Quarter Lower Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

1. Quarter Lower Rear Trim Panel - Install

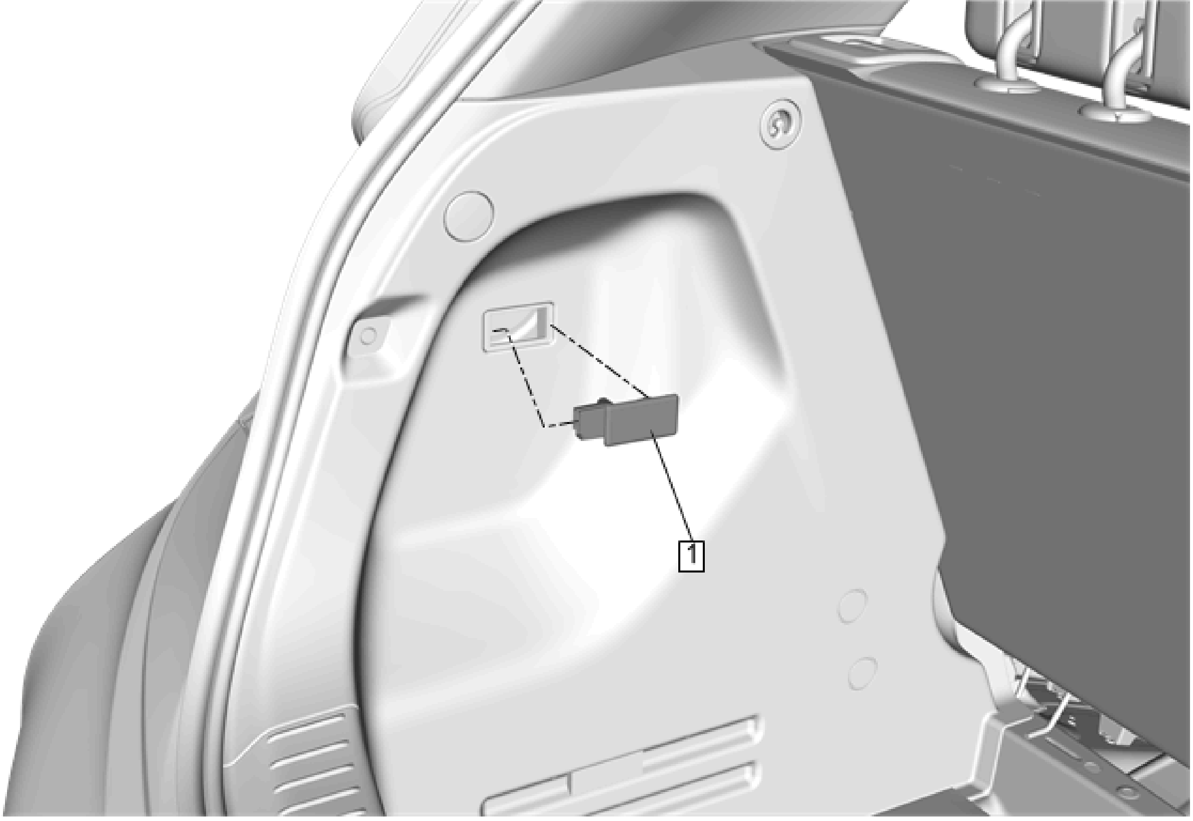


Fig. 36: Cargo Center Courtesy Lamp On Left Side
Courtesy of GENERAL MOTORS COMPANY

2. Install the cargo center courtesy lamp. **Cargo Center Courtesy Lamp Replacement**

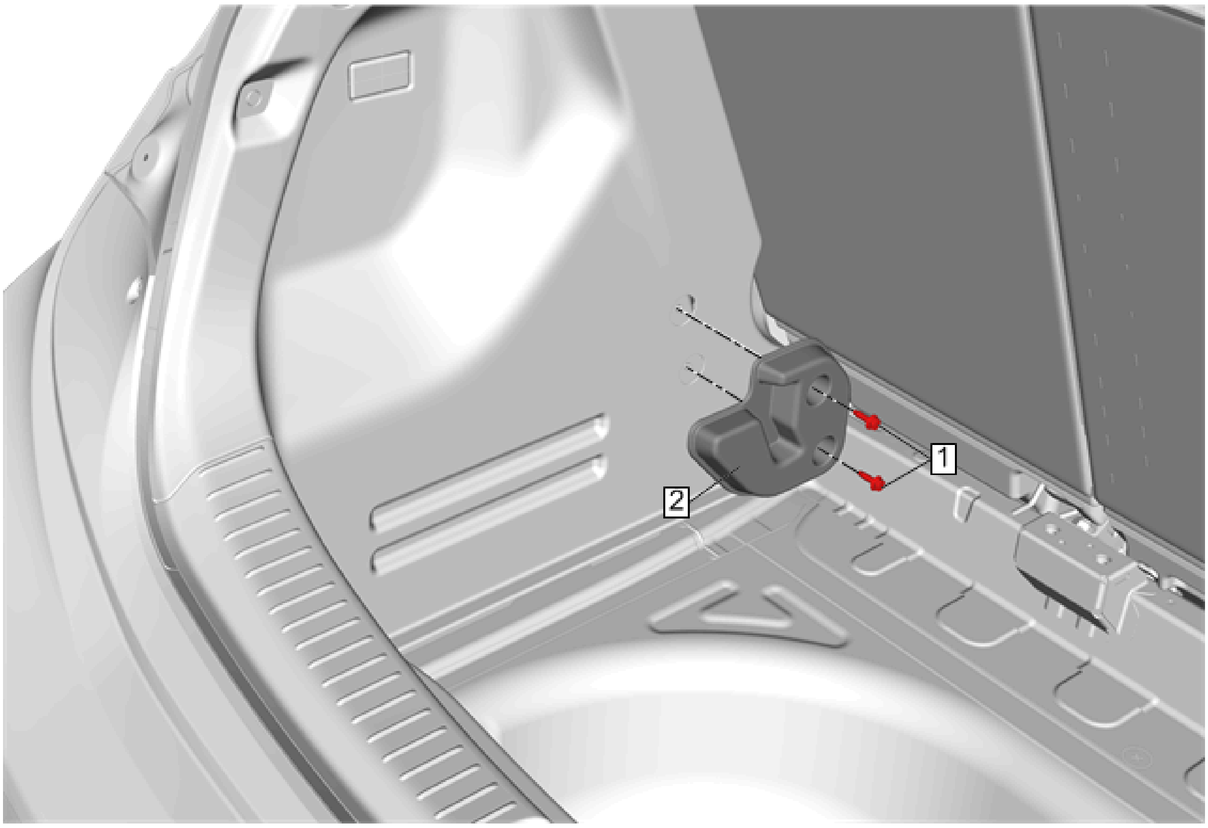


Fig. 37: Oad Floor Stowage Compartment Cover Support
Courtesy of GENERAL MOTORS COMPANY

3. Install the load floor stowage compartment cover support. **Load Floor Stowage Compartment Cover Support Replacement**

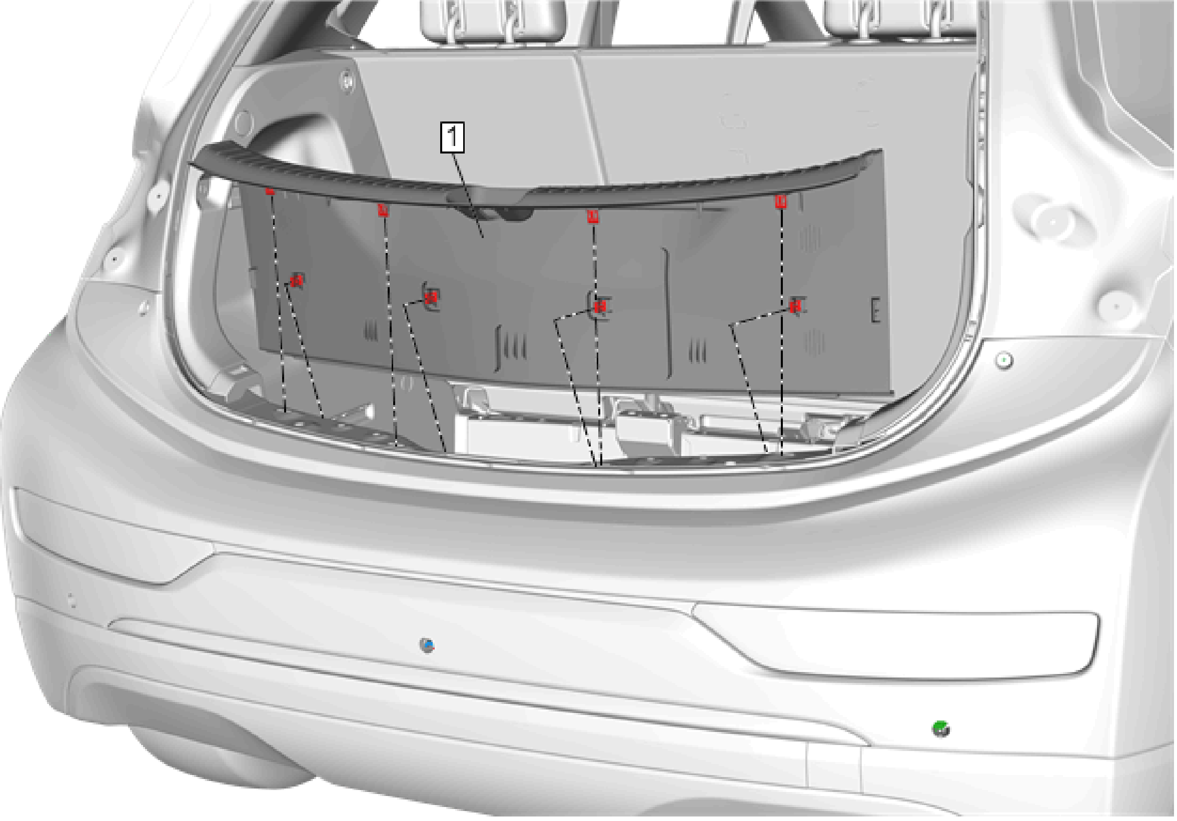


Fig. 38: Lift Gate Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

4. Install the lift gate sill garnish molding. Liftgate Sill Garnish Molding Replacement

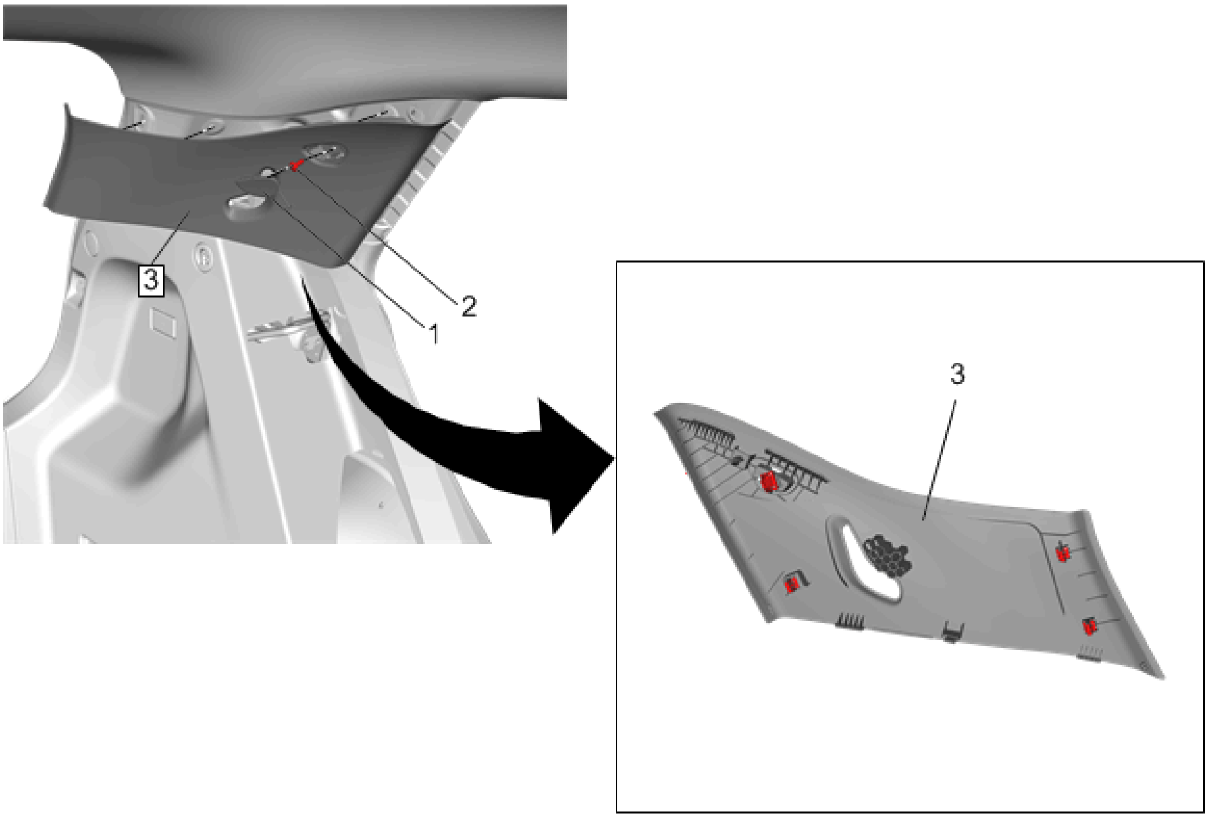


Fig. 39: Body Lock Pillar Upper Trim Panel
Courtesy of GENERAL MOTORS COMPANY

5. Install the body lock pillar upper trim panel. Body Lock Pillar Upper Trim Panel Replacement

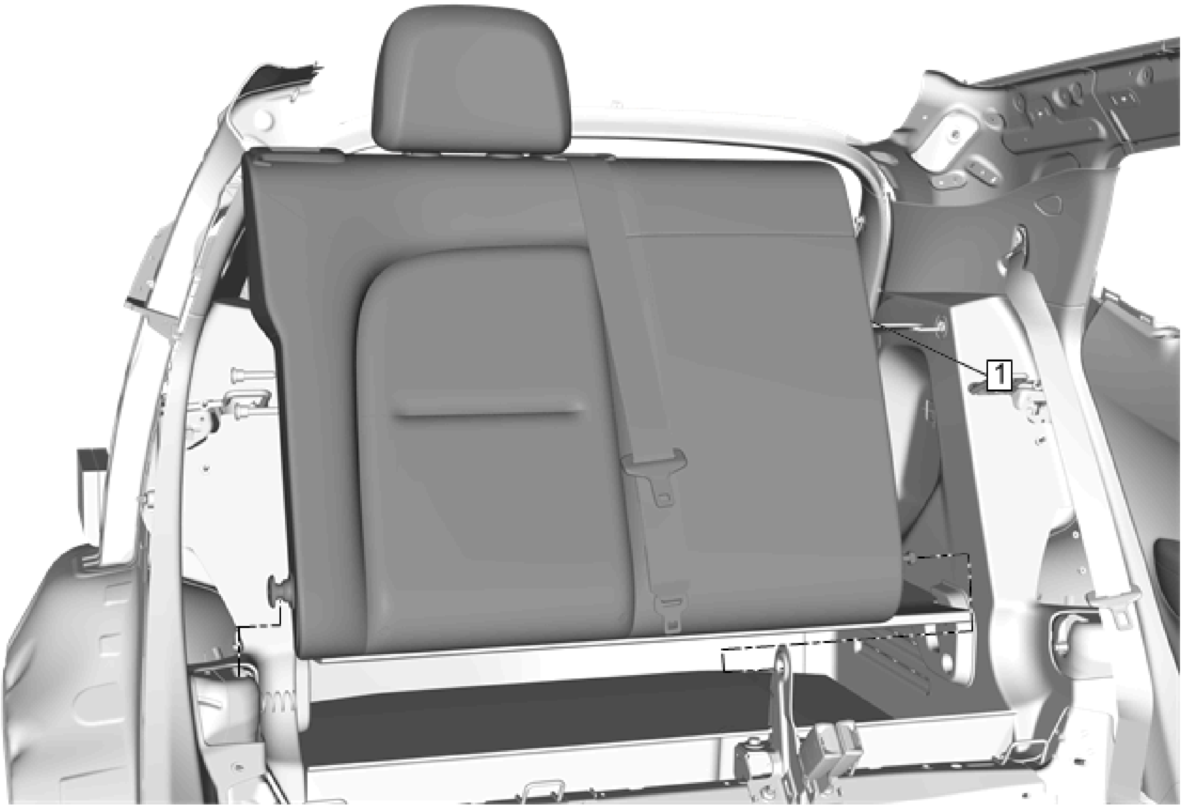


Fig. 40: Rear Seat Back Cushion
Courtesy of GENERAL MOTORS COMPANY

6. Install the rear seat back cushion. Rear Seat Back Cushion Removal and Installation (40%) Rear Seat Back Cushion Removal and Installation (60%)

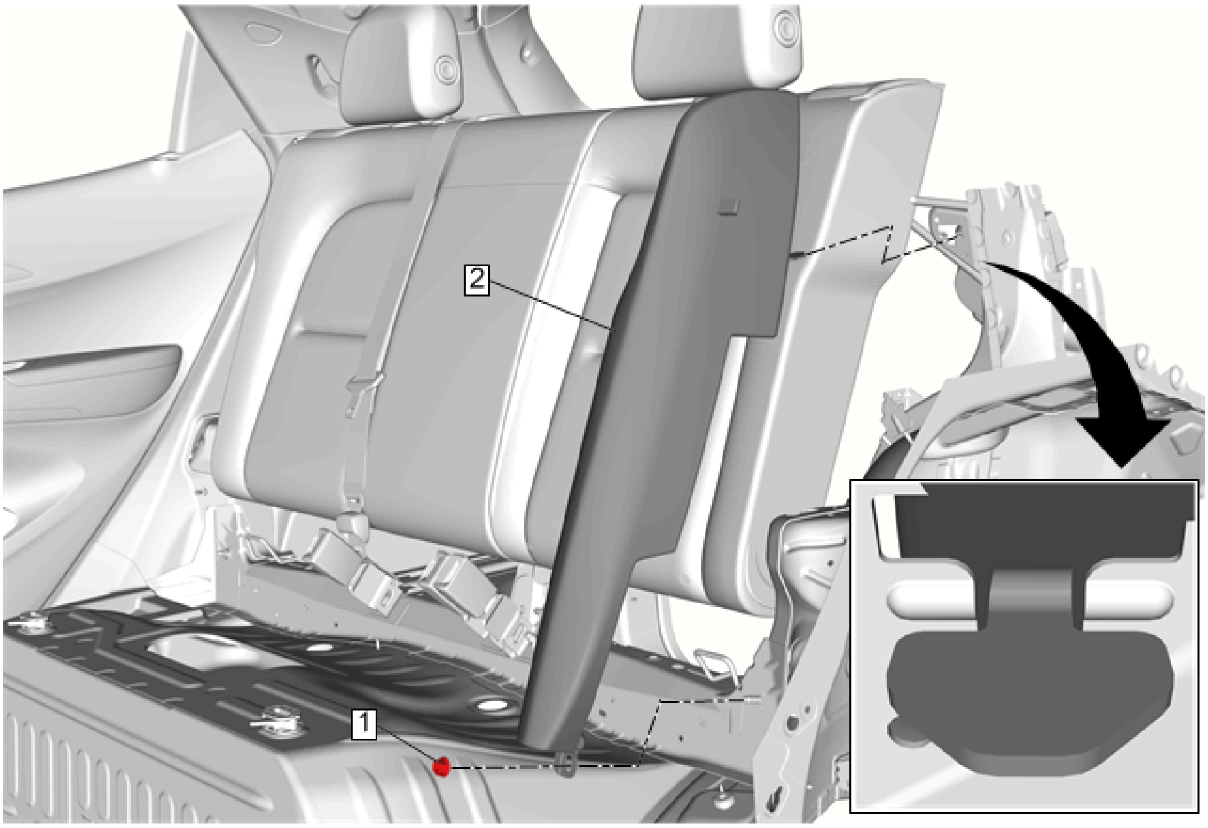


Fig. 41: Rear Seat Back Bolster
Courtesy of GENERAL MOTORS COMPANY

7. Install the rear seat back bolster. Rear Seat Back Bolster Replacement

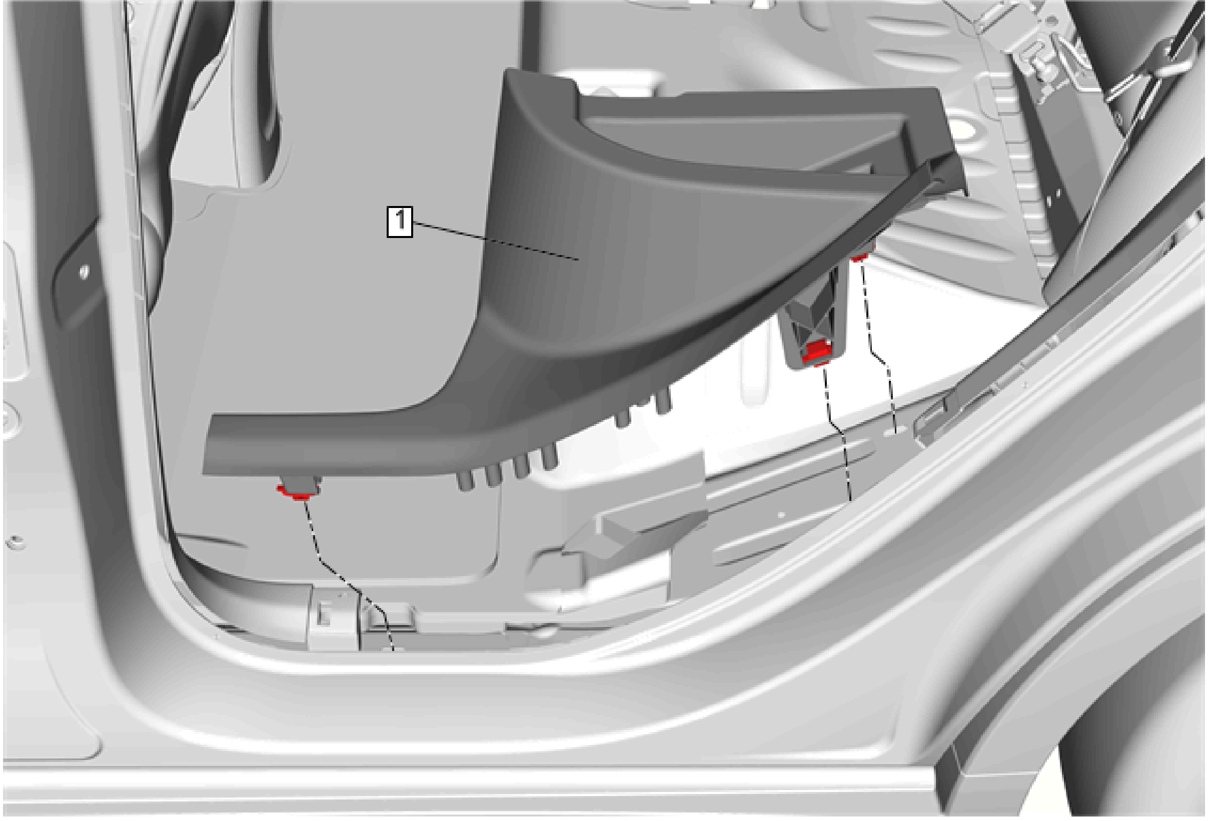


Fig. 42: Rear Side Door Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

8. Install the rear side door sill garnish molding. Rear Side Door Sill Garnish Molding Replacement

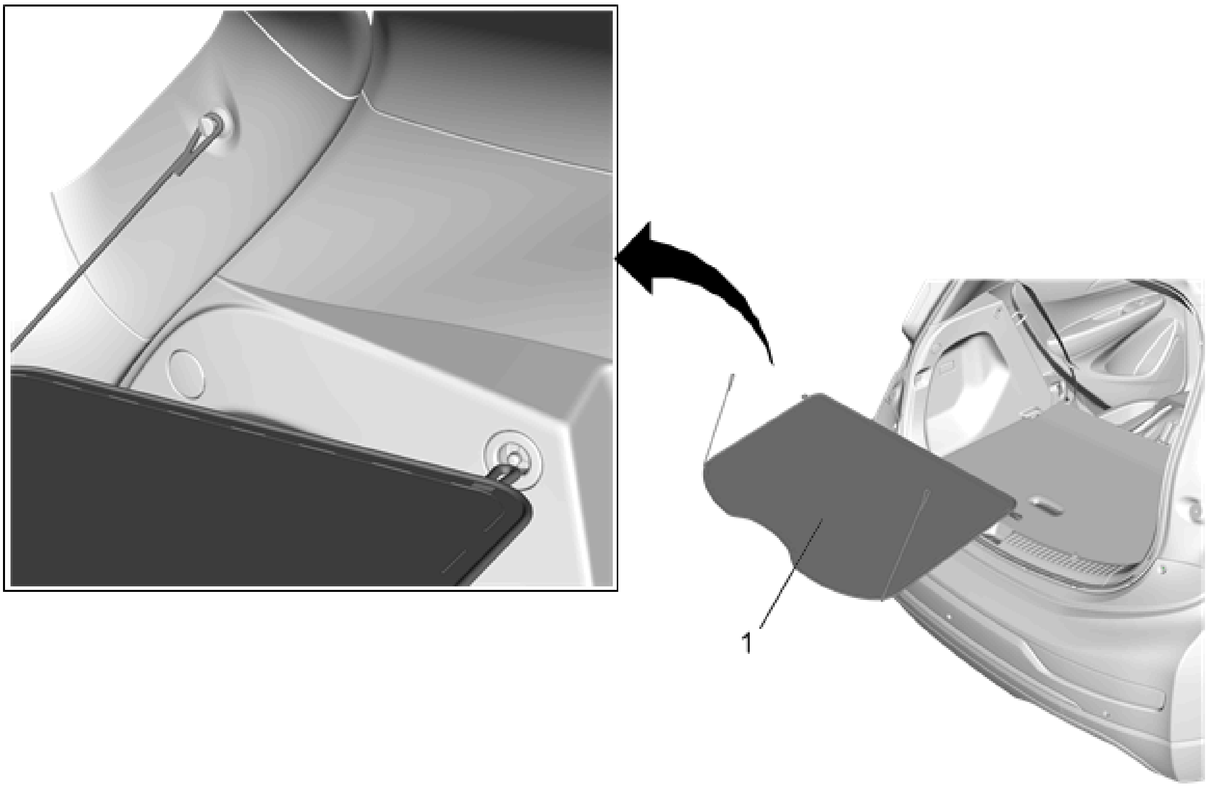


Fig. 43: Luggage Shade
Courtesy of GENERAL MOTORS COMPANY

9. Install the luggage shade. Luggage Shade Replacement

TOOL STOWAGE COMPARTMENT REPLACEMENT

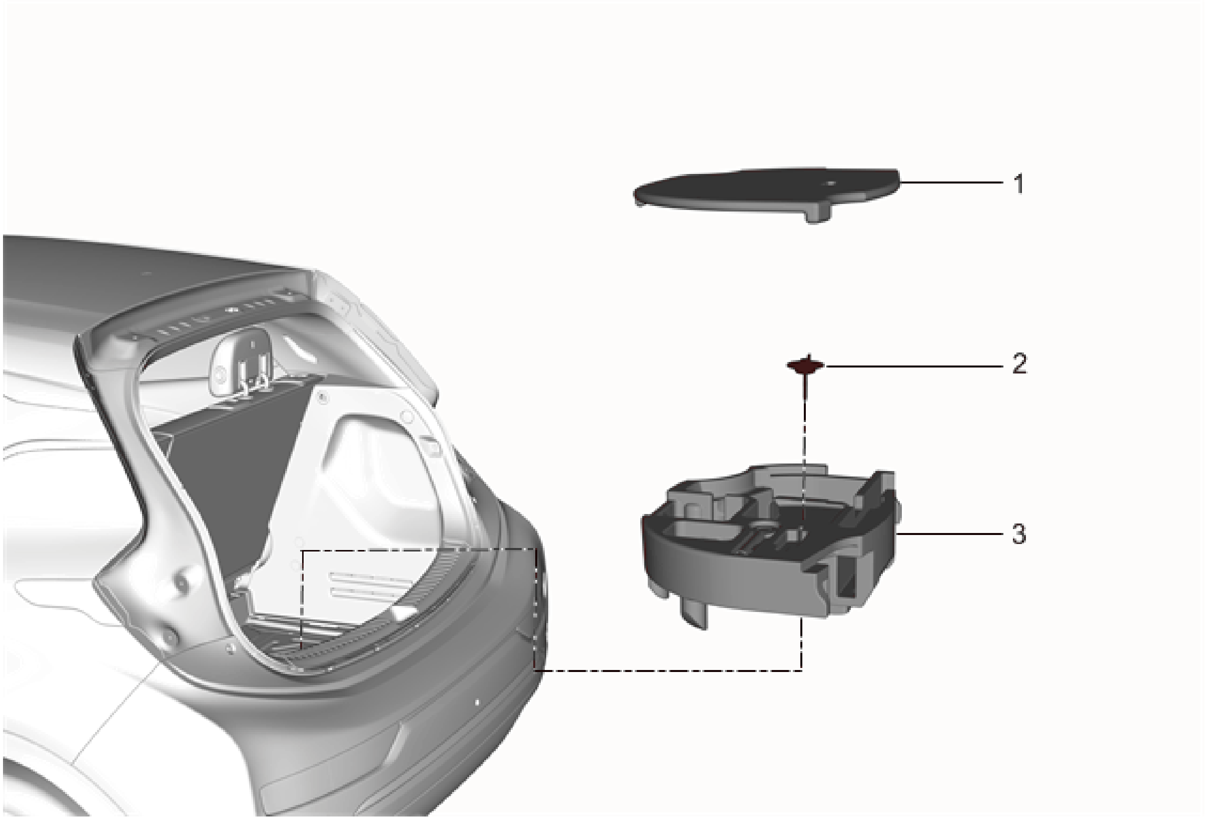


Fig. 44: Tool Stowage Compartment
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Rear Compartment Stowage Shelf Replacement 2. Load Floor Trim Panel Replacement	
1	Tool Stowage Compartment Cover
2	Spare Wheel Stowage Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 3.5 N.m (31 lb in)
3	Tool Stowage Compartment **Procedure** Transfer components as necessary.

REAR COMPARTMENT STOWAGE SHELF REPLACEMENT

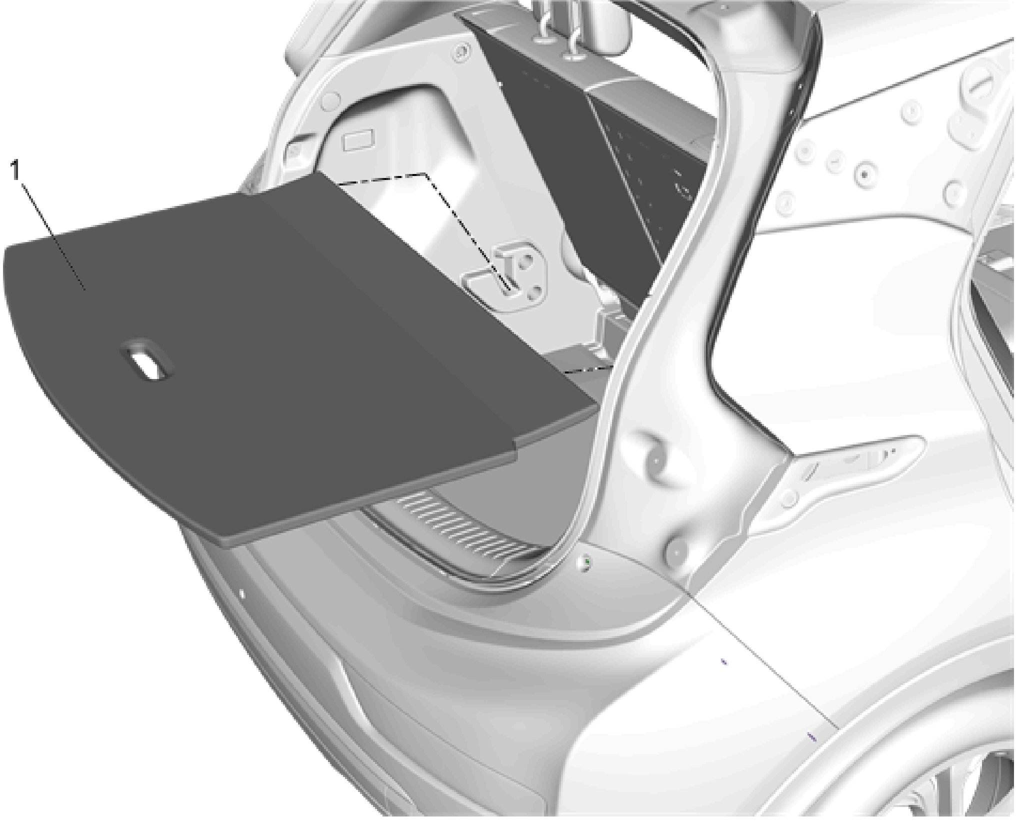


Fig. 45: Rear Compartment Stowage Shelf
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Compartment Stowage Shelf

LOAD FLOOR STOWAGE COMPARTMENT COVER SUPPORT REPLACEMENT

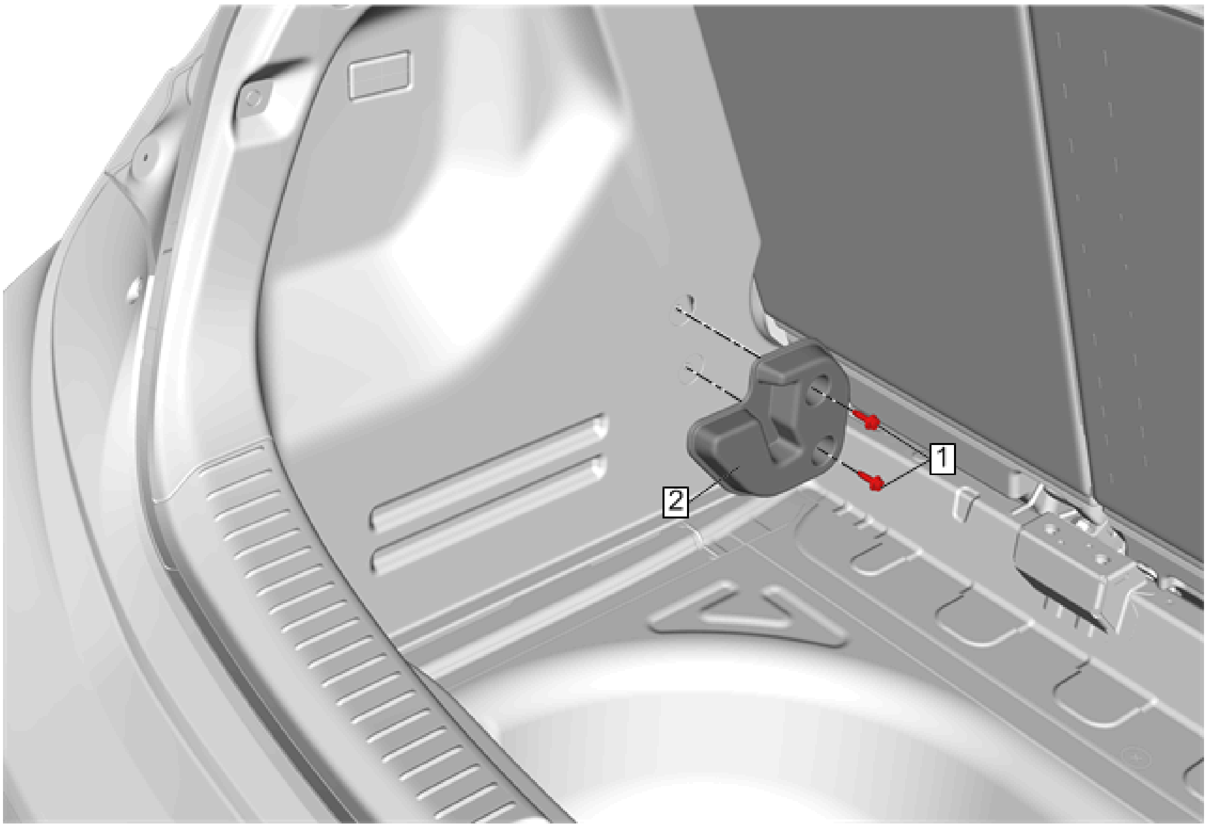


Fig. 46: Load Floor Stowage Compartment Cover Support
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the rear compartment stowage shelf. Rear Compartment Stowage Shelf Replacement	

Callout	Component Name
1	Load Floor Stowage Compartment Cover Support Bolt **CAUTION:** Fastener Caution **Tighten** 5 N.m (44 lb in)
2	Load Floor Stowage Compartment Cover Support

LOAD FLOOR TRIM PANEL REPLACEMENT

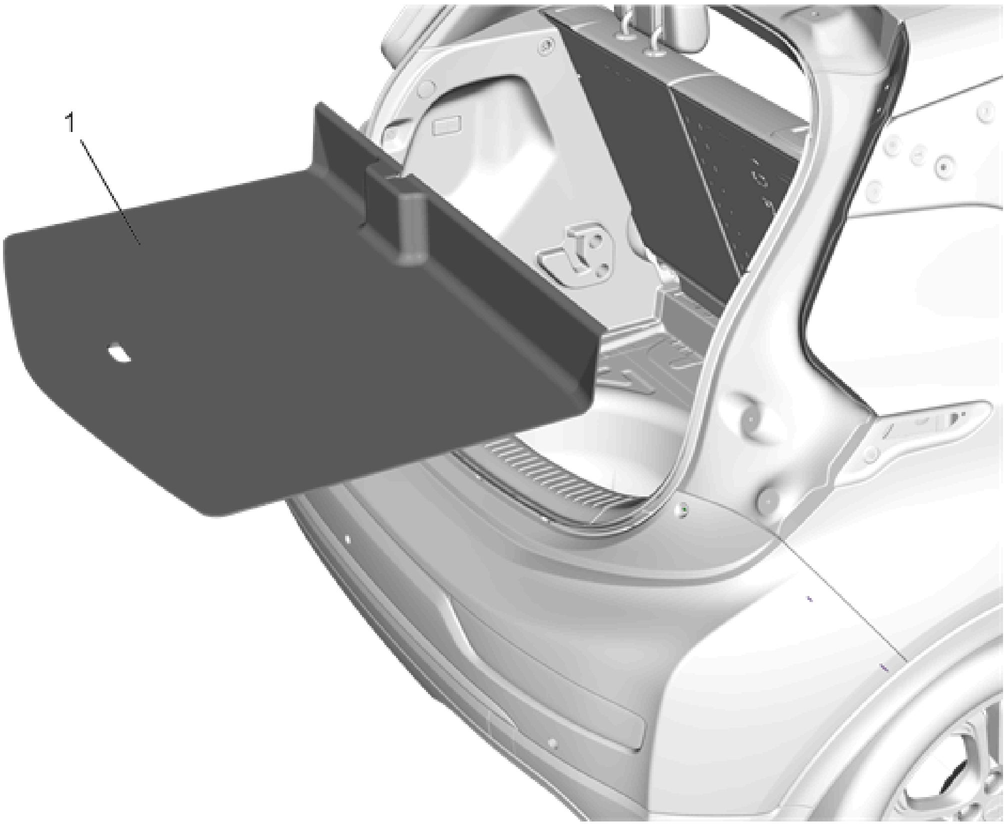


Fig. 47: Load Floor Trim Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Compartment Stowage Shelf Replacement	
1	Load Floor Trim Panel

REAR SIDE DOOR TRIM REPLACEMENT

Removal Procedure

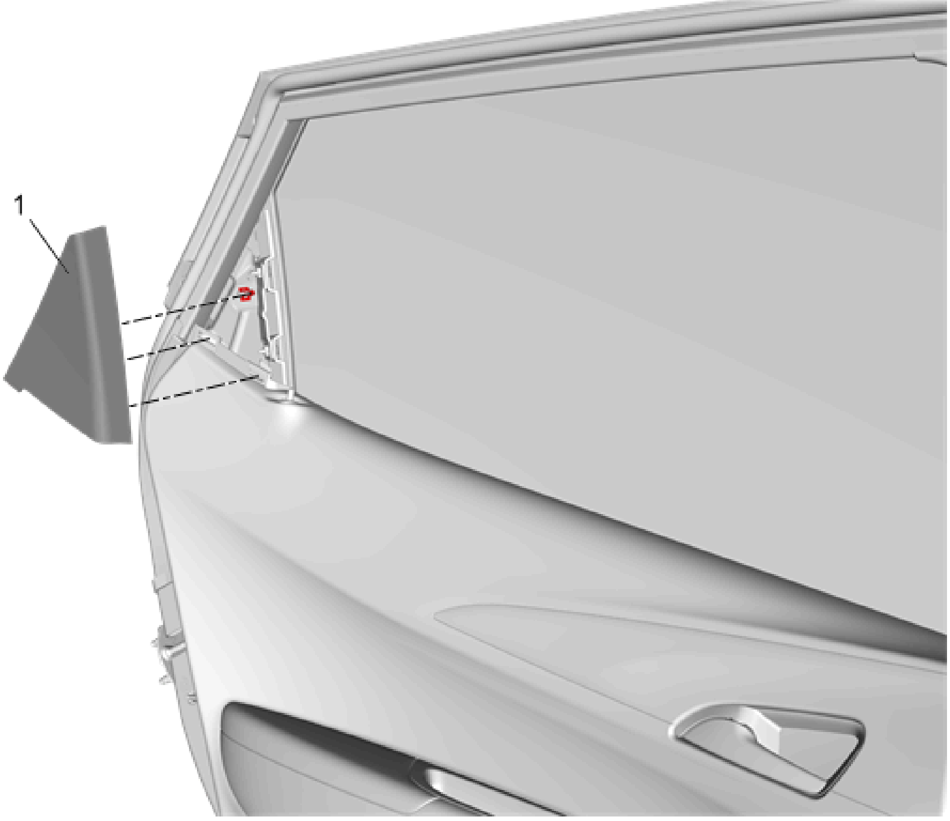


Fig. 48: Rear Side Door Upper Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

1. Remove the rear side door upper rear trim panel. **Rear Side Door Upper Rear Trim Panel Replacement**

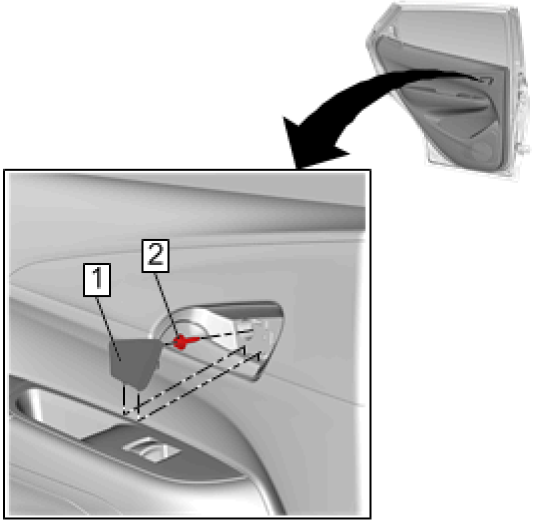


Fig. 49: Rear Side Door Inside Handle Fastener Finish Cap
Courtesy of GENERAL MOTORS COMPANY

2. Remove the rear side door inside handle fastener finish cap (1).
3. Remove the rear side door inside handle fastener (2).

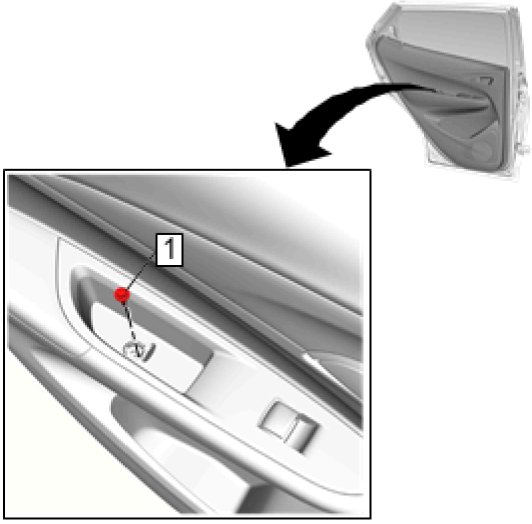


Fig. 50: Rear Side Door Armrest Pull Cup Fastener Cap
Courtesy of GENERAL MOTORS COMPANY

4. Use a flat bladed plastic trim tool to release the rear side door armrest pull cup fastener cap.
5. Remove the rear side door armrest pull cup fastener (1).

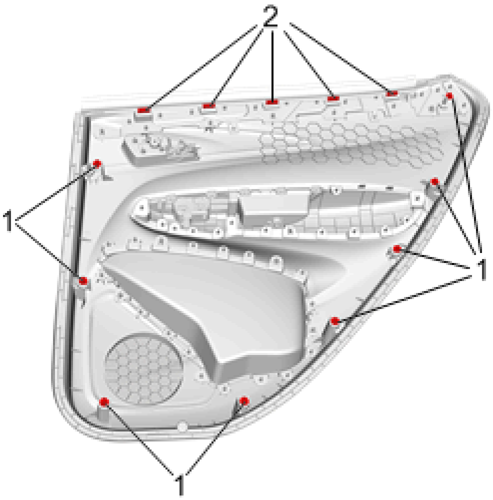


Fig. 51: Door Trim Panel Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Use a appropriate plastic trim tool loosen the retainer (1) (Qty: 8) along the bottom of the door trim panel.
7. When the panel is sufficiently loosened, grasp with both hands and lift up and release the belt line clip (2) (Qty: 5) with the belt molding.
8. Disconnect the door lock retainer cable from the door trim panel and the inside handle.
9. Disconnect the electrical connector.

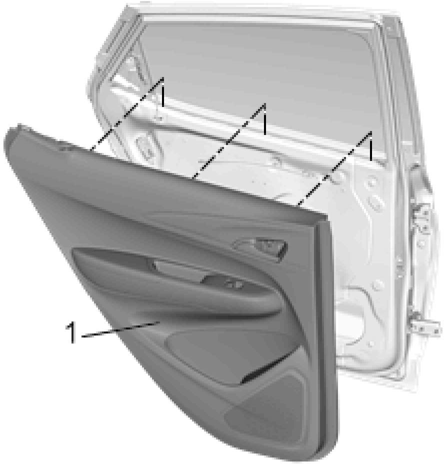


Fig. 52: Rear Side Door Trim
Courtesy of GENERAL MOTORS COMPANY

10. Remove the rear side door trim (1).
11. Place the door trim panel on a clean flat surface.
12. Release the belt molding and belt line clips from the door trim panel.

Installation Procedure

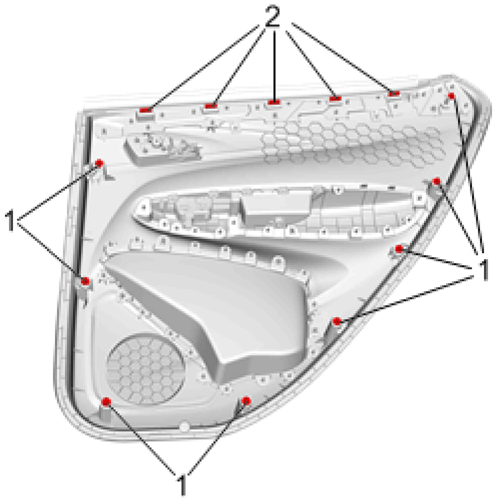


Fig. 53: Door Trim Panel Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Make sure the belt line clip (2) (Qty: 5) are replaced with new clips before re-attaching the door trim, even if they weren't damaged.
2. Install the belt molding to the rear side door trim assembly.
3. The retainer (1) (Qty: 8) that are destroyed during removal must be replaced with new retainers to properly reattach the door trim.

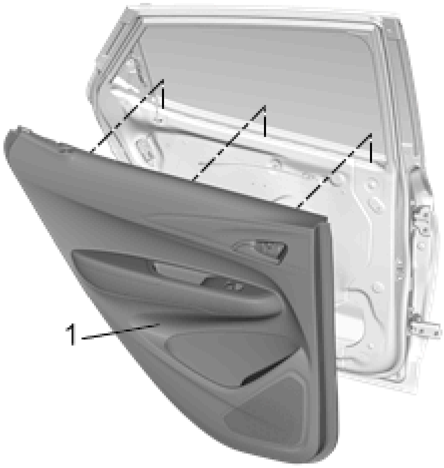


Fig. 54: Rear Side Door Trim
Courtesy of GENERAL MOTORS COMPANY

4. Connect the electrical connector.
5. Connect the door lock retainer cable to the door trim panel and the inside handle.
6. Install the rear side door trim (1)

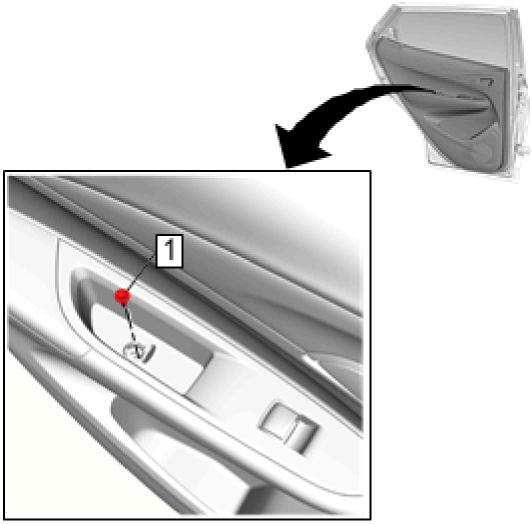


Fig. 55: Rear Side Door Armrest Pull Cup Fastener Cap
Courtesy of GENERAL MOTORS COMPANY

7. Rear Side Door Armrest Pull Cup Fastener (1) - Install and tighten to 2.5 N.m (22 lb in)
8. Install the rear side door armrest pull cup fastener cap.

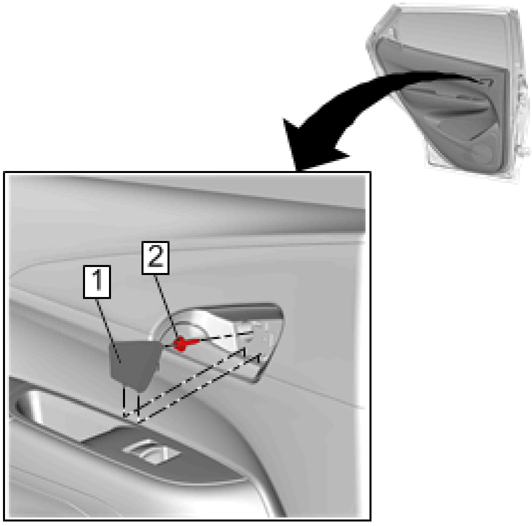


Fig. 56: Rear Side Door Inside Handle Fastener Finish Cap
Courtesy of GENERAL MOTORS COMPANY

9. Rear Side Door Inside Handle Fastener (2) - Install and tighten to 2.5 N.m (22 lb in)
10. Install the rear side door inside handle fastener finish cap (1).

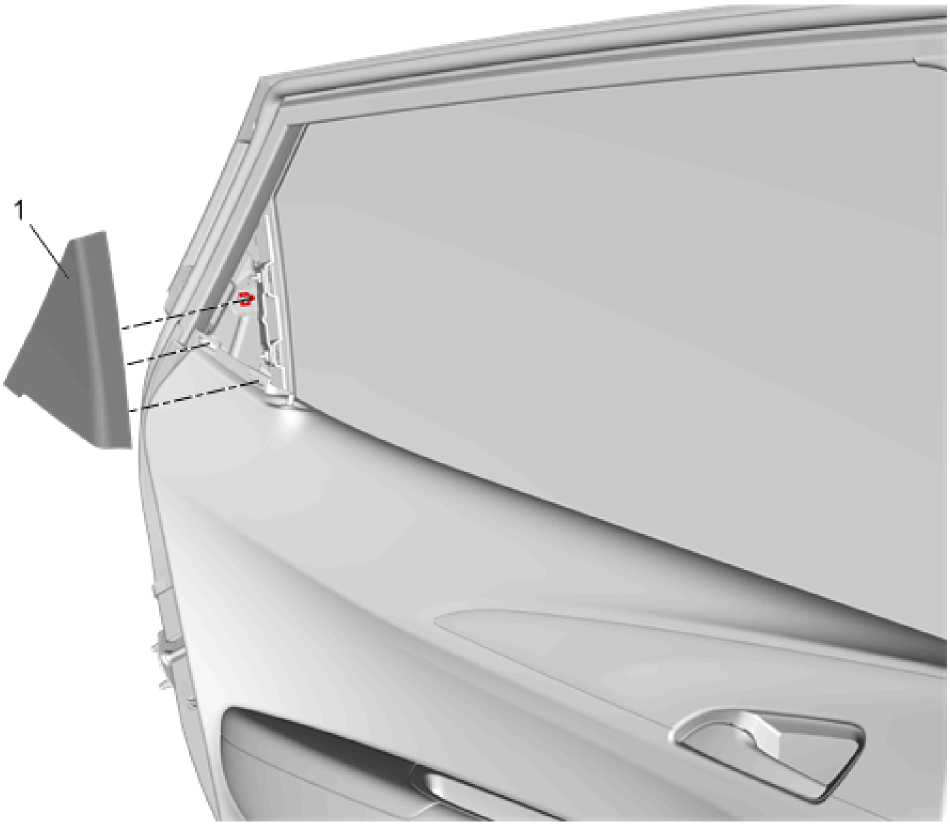


Fig. 57: Rear Side Door Upper Rear Trim Panel
Courtesy of GENERAL MOTORS COMPANY

11. Install the rear side door upper rear trim panel. Rear Side Door Upper Rear Trim Panel Replacement

LUGGAGE SHADE REPLACEMENT

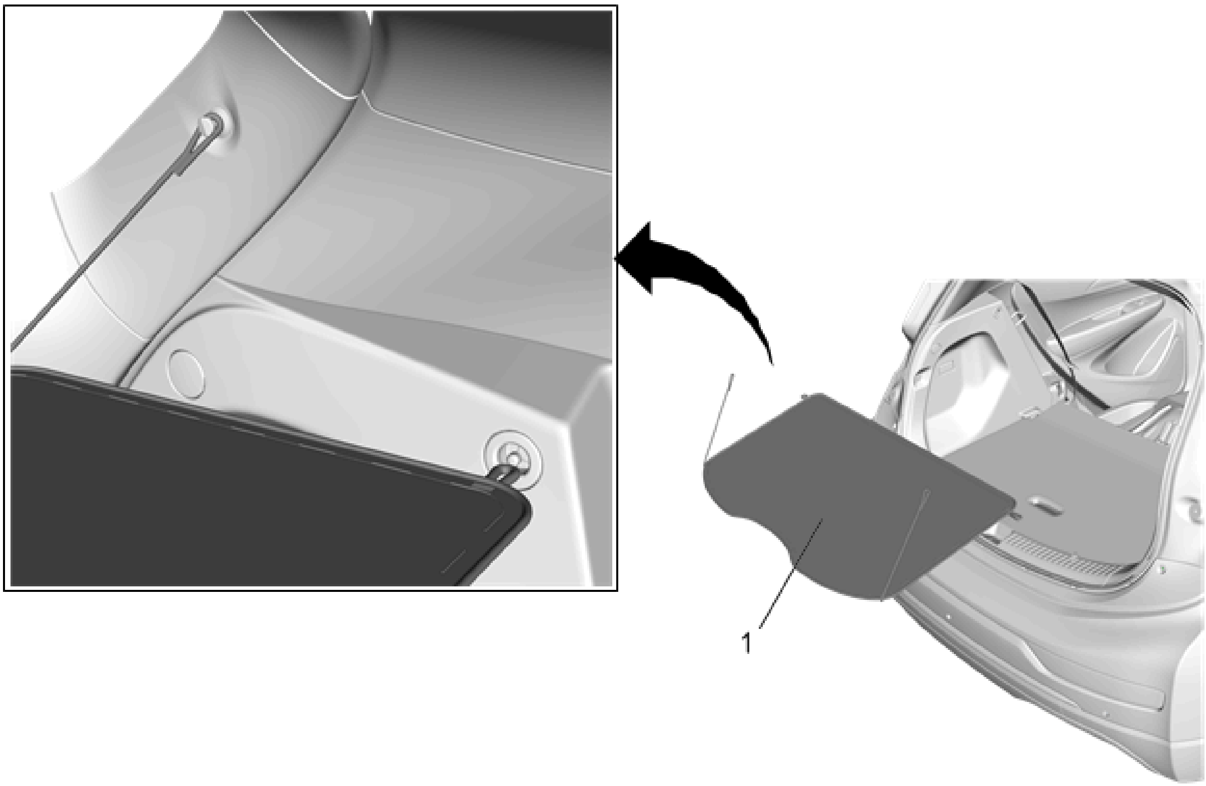


Fig. 58: Luggage Shade
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Luggage Shade **Procedure** Release the luggage shade straps from the cargo screen retainers.

LUGGAGE SHADE PIVOT REPLACEMENT

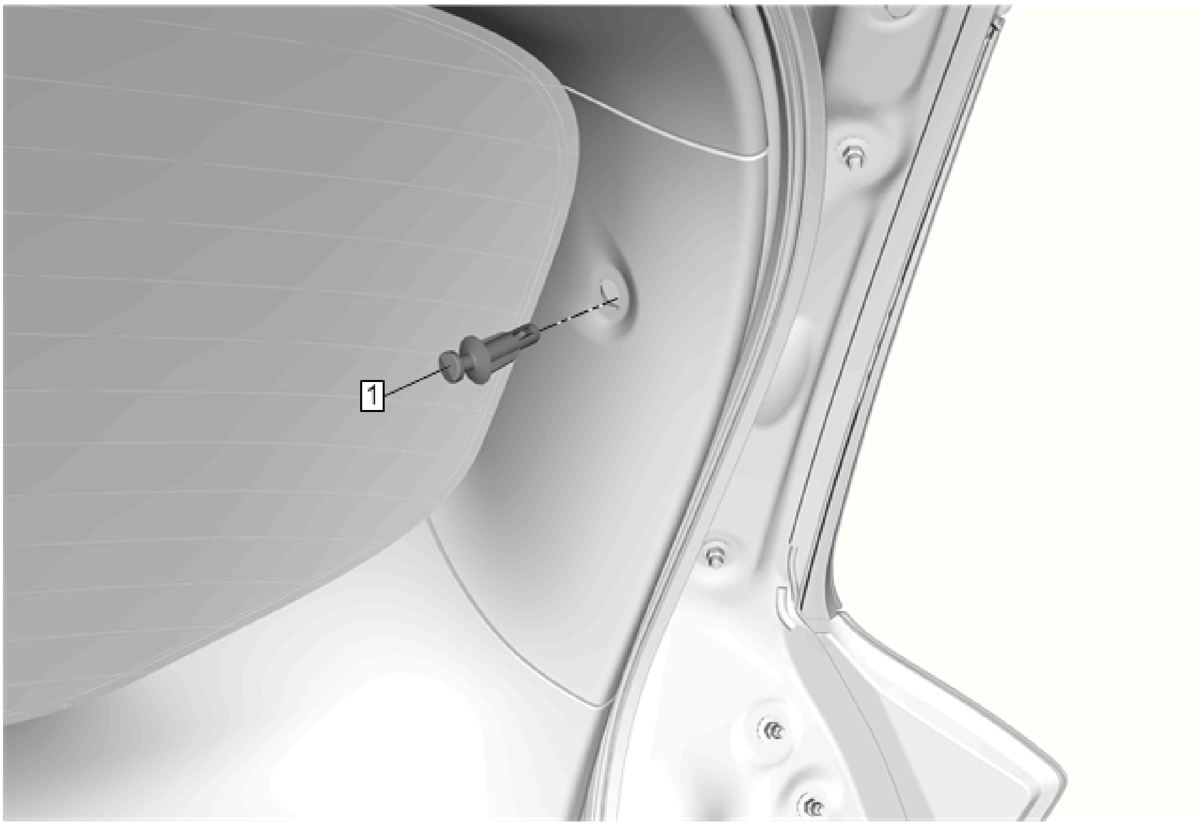


Fig. 59: Luggage Shade Pivot
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Luggage Shade Pivot **Procedure** Release the luggage shade strap. **NOTE:** **The luggage shade pivots are a one-time use component and will break upon removal.**

LIFTGATE SILL GARNISH MOLDING REPLACEMENT

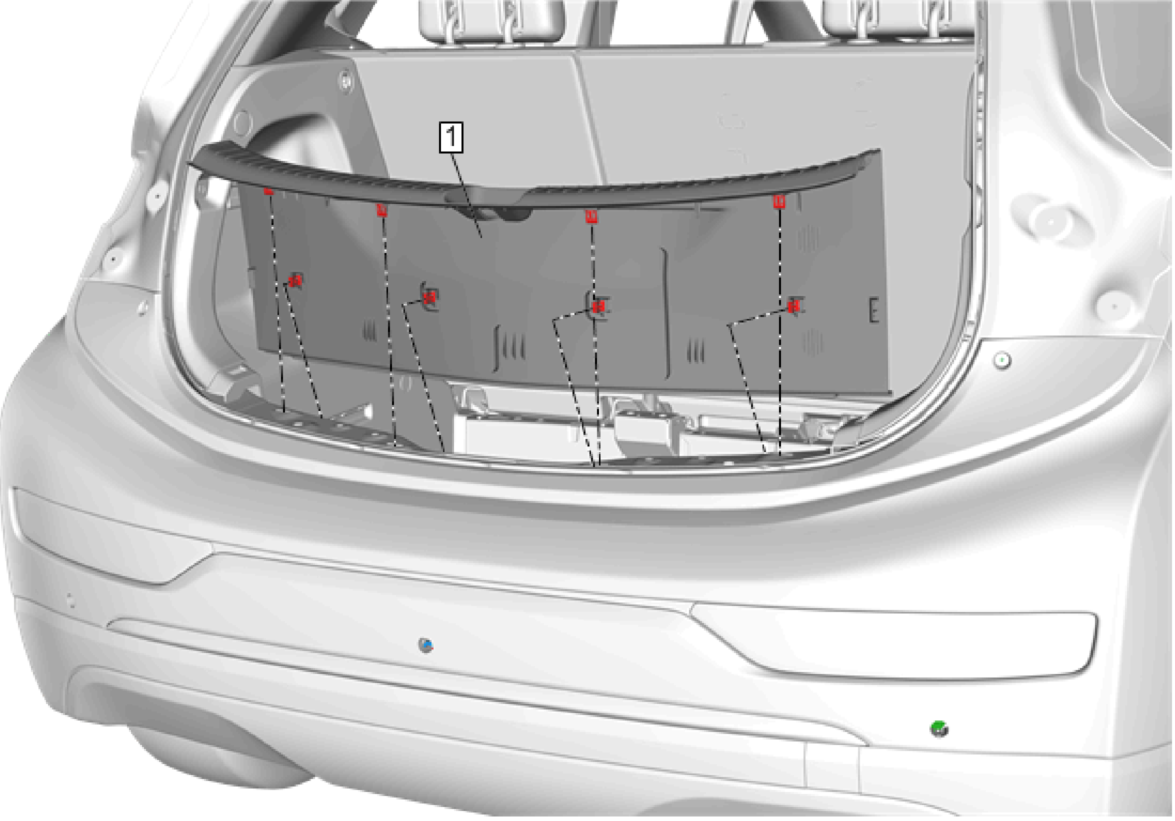


Fig. 60: Liftgate Sill Garnish Molding
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Rear Compartment Stowage Shelf Replacement 2. Load Floor Trim Panel Replacement	
1	Liftgate Sill Garnish Molding **Procedure** Grasp and gently pull inward on the bottom of the panel to release the lower retainers and then up on the rear end trim finish panel in order to release the integral retaining clips.

LIFTGATE UPPER CENTER TRIM FINISH PANEL REPLACEMENT

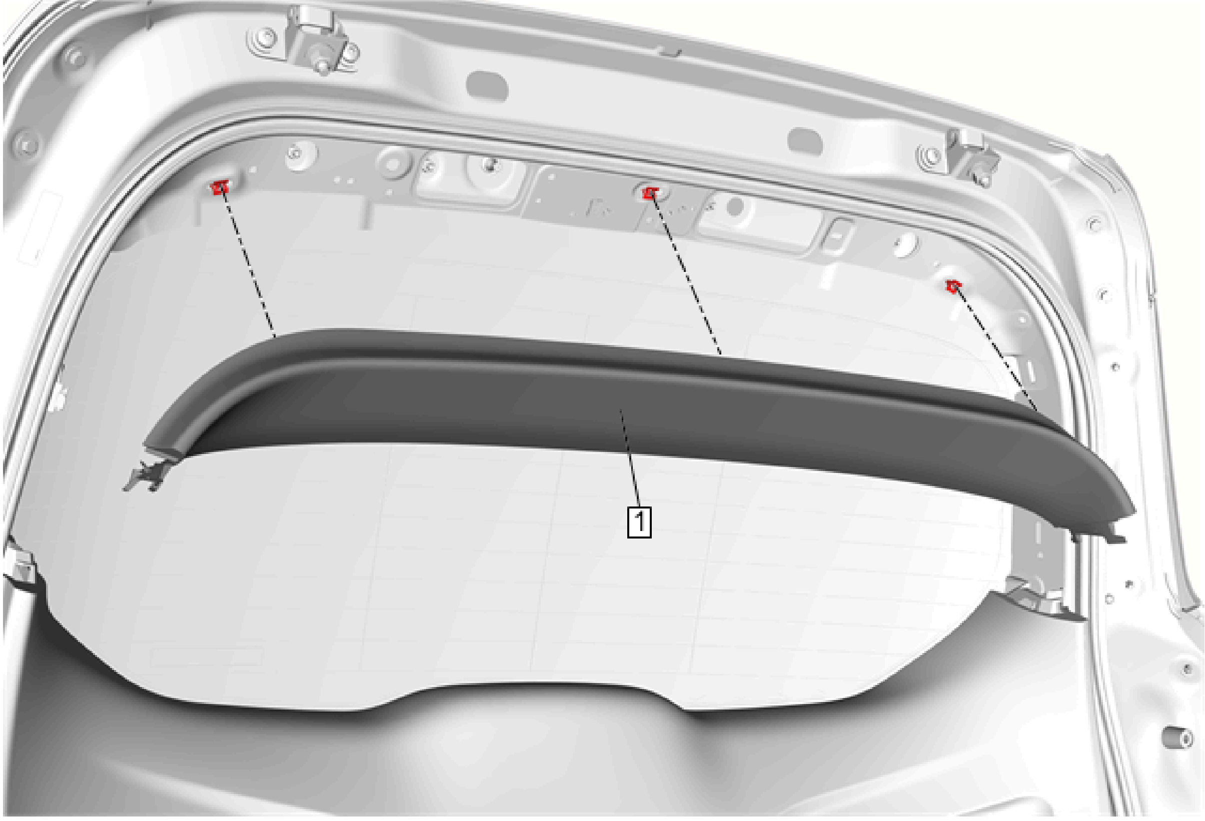


Fig. 61: Liftgate Upper Center Trim Finish Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Liftgate Upper Side Trim Finish Panel Replacement	
1	Liftgate Upper Center Trim Finish Panel

LIFTGATE UPPER SIDE TRIM FINISH PANEL REPLACEMENT

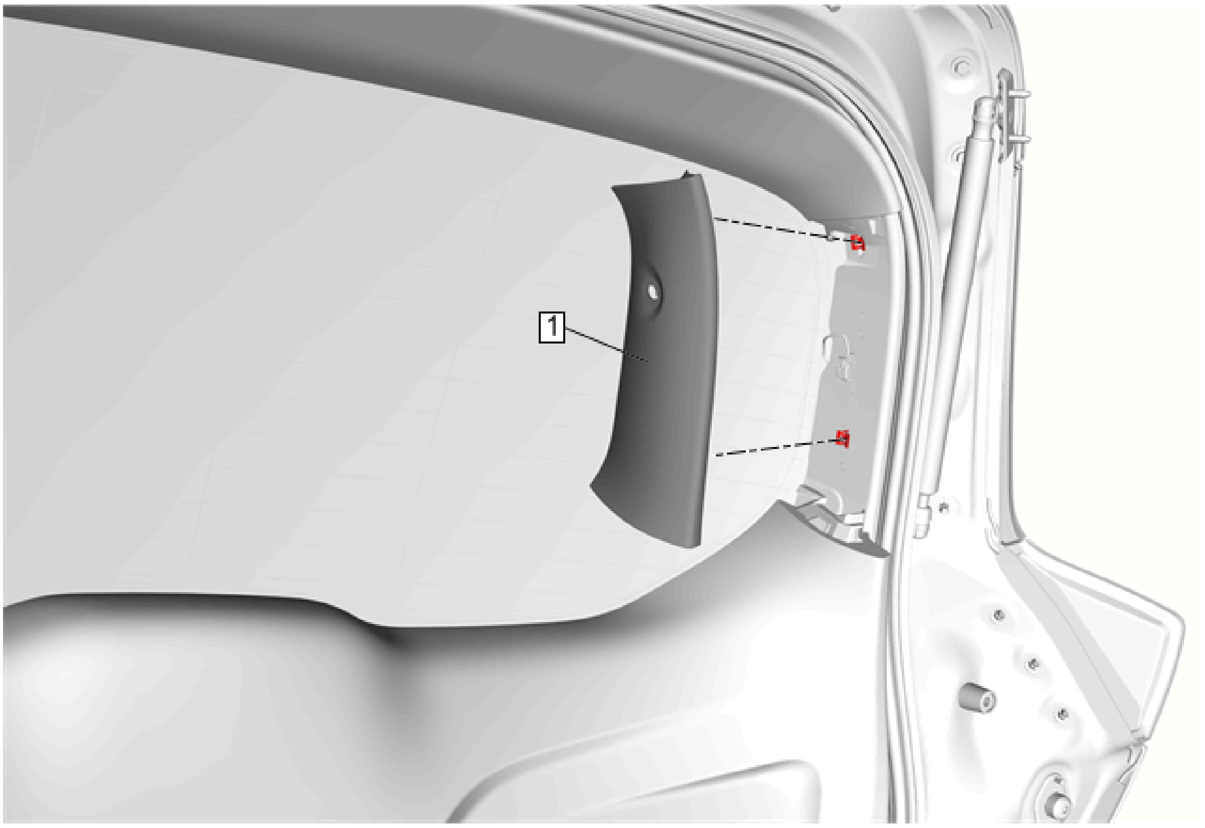


Fig. 62: Liftgate Upper Side Trim Finish Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure Remove the luggage shade pivot. Luggage Shade Pivot Replacement	
1	Liftgate Upper Side Trim Finish Panel

LIFTGATE LOWER TRIM FINISH PANEL REPLACEMENT

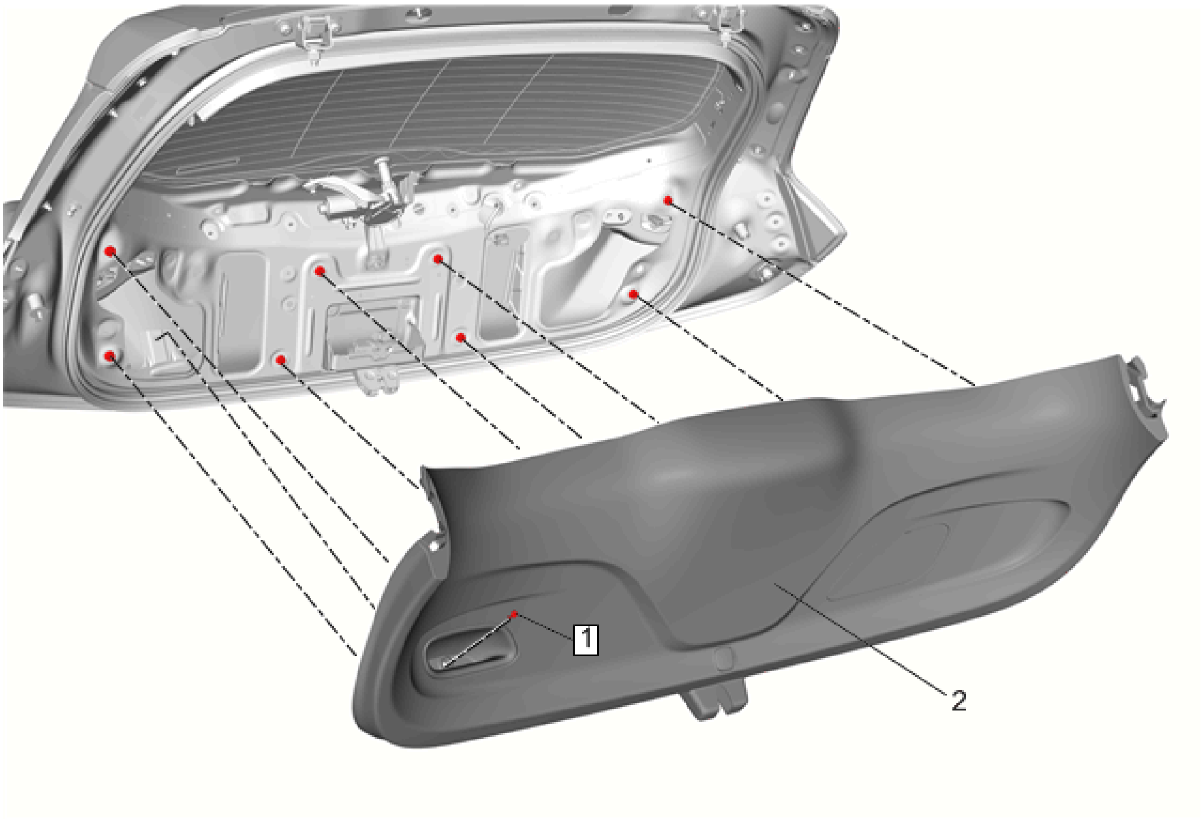


Fig. 63: Liftgate Lower Trim Finish Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the liftgate upper side trim finish panel. Liftgate Upper Side Trim Finish Panel Replacement.	
1	Liftgate Inside Pull Handle Fastener **CAUTION:** Fastener Caution **Tighten** 1.8 N.m (16 lb in)
2	Liftgate Lower Trim Finish Panel **Procedure** 1. Use a trim panel removal tool to aid in the removal of the trim panel from the liftgate assembly. 2. Start at the top clip on the right-hand side of liftgate lower trim finish panel.

BODY PRESSURE RELIEF VALVE REPLACEMENT

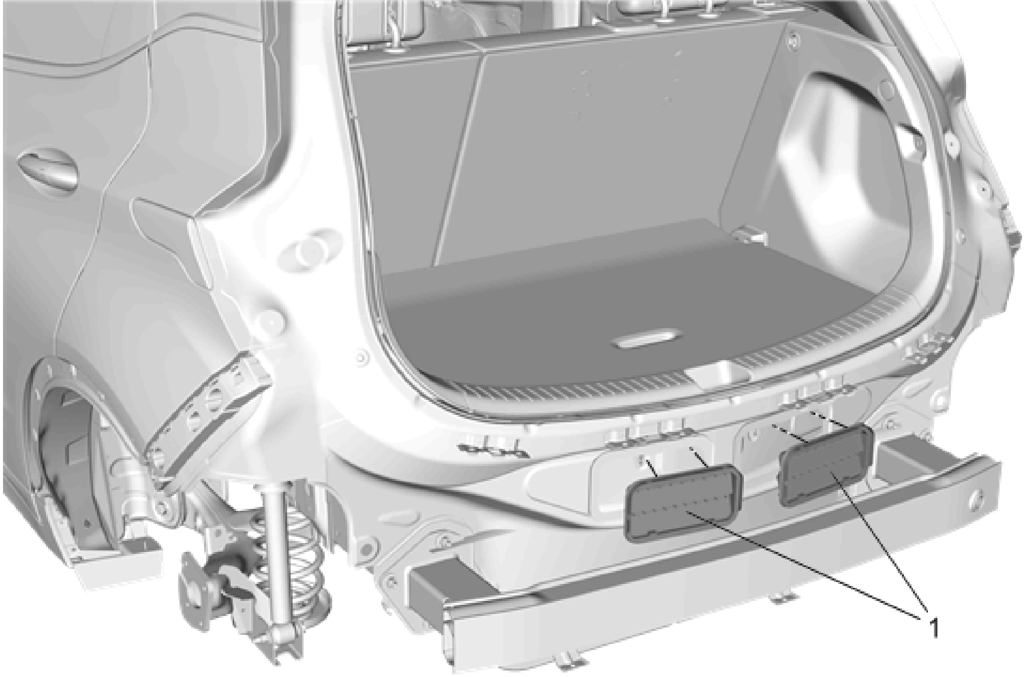


Fig. 64: Body Pressure Relief Valve
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Rear Bumper Fascia Replacement	
1	Body Pressure Relief Valve **Procedure** Using the appropriate flat blade tool, release the tabs attaching the valves to the rear end panel to remove the body pressure relief valve.

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2017 ACCESSORIES AND EQUIPMENT

Lighting - Description and Operation - Bolt EV

DESCRIPTION AND OPERATION

EXTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Exterior Lamps

The exterior lighting system consist of the following lamps if equipped:

- Automatic high beam assist
- Backup lamps
- Daytime running lamps
- Rear fog lamps
- Hazard warning lamps
- Headlamps
- Manual headlamp leveling
- Park, tail, license, and side marker lamps
- Stop lamps
- Turn signal lamps

Low Beam Headlamps

The headlamps may be turned ON in 3 different ways:

- When the headlamp switch is placed in the ON position, for normal operation
- When the headlamp switch is placed in the AUTO position, for automatic lamp control
- When the headlamp switch is placed in the AUTO position, with the windshield wipers ON in daylight conditions, after a 6 s delay

The BCM will also command the low beam headlamps ON during daylight conditions when the following conditions are met:

- Headlamp switch in the AUTO position
- Windshield wipers ON
- Vehicle in any gear but PARK

The body control module (BCM) monitors three signal circuits from the headlamp switch. When the headlamp switch is in the AUTO position, all three signal circuits are open. When placed in the AUTO position, the BCM monitors inputs from the ambient light sensor to determine if headlamps are required or if daytime running lamps will be activated based on outside lighting conditions. When the headlamp switch is placed in the OFF position, the headlamp switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the headlamp switch in the PARK position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is placed in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds to the inputs by illuminating the park lamps and headlamps. When the low beam headlamps are requested, the BCM responds by applying ground to the low beam relay control circuit which energizes the low beam relay. With the low beam relay energized, the switch contacts close allowing battery voltage to flow through the left and right low beam fuses to the low beam control circuits and onto the left and right low beam headlamps.

When the BCM commands the low beam headlamps ON, the operator will notice the interior backlighting for the instrument cluster and the various other switches dim to the level of brightness selected by the instrument panel dimmer switch.

High Beam Headlamps

When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the left and right high beam fuses to the high beam control circuits and onto the left and right high beam solenoid actuators within the headlamp assemblies. Once the high beam solenoid actuators are active, the solenoid shutters open in each headlamp assembly exposing the remaining portion of the headlamp that was covered by the shutters illuminating the high beams at full intensity.

Automatic High Beam Assist

The automatic high beam assist system operates the high beam headlamps ON and OFF automatically when the system is activated and certain conditions are met. The automatic high beam assist system consists of a front camera module that detects light and is able to identify approaching vehicles on an even, straight road at a distance of greater than 0.4 km (0.25 mi). The front camera module analyzes light color, intensity, and movement. The automatic high beam assist system will turn OFF the high beam headlamps when approaching vehicle headlamps or preceding vehicle taillights are detected by the front camera module. Automatic high beam assist can be deactivated when the headlamp dimmer switch is moved from the neutral position to the high beam or flash to pass positions. Automatic high beam assist can be reactivated by operating the high beam select switch from the neutral position to the high beam position twice within 2 s.

Automatic High Beam Assist System Activation

- Vehicle ON
- Turn signal/multifunction switch placed in the AUTO position
- Turn signal/multifunction switch high beam dimmer switch must be in the neutral position
- Press the Auto High Beam ON/OFF switch located on the turn signal/multifunction switch
- Outside lighting conditions must be dark
- Vehicle speed greater than 25 MPH (40 km/h)

Automatic High Beam Assist System Operation

The following are conditions that the automatic high beam assist system will turn the high beam headlamps off during operation:

- The system detects approaching traffic headlamps
- The system detects preceding traffic tail lamps
- Ambient light level too high due to towns or twilight situations
- The vehicle's speed drops below 13 MPH (22 km/h)
- Delay

NOTE: **Automatic high beam assist may not operate properly if any of the following conditions exist:**

- Approaching and preceding vehicles lamps are undetectable due to dirt, snow, road spray, smoke, fog, or any other airborne conditions.
- The front camera module is covered with ice, dirt, snow, haze, or is obstructed.
- The vehicle is being driven on winding or hilly road conditions which would make any on coming vehicle headlamps undetectable by the automatic high beam assist system.

Automatic High Beam Assist System Deactivation

- Manually operating the turn signal/multifunction switch high beam dimmer switch from neutral to high beam position
- Press the Auto High Beam ON/OFF switch located on the turn signal/multifunction switch

Automatic High Beam Assist System Indicator

The status of the automatic high beam assist system is shown by a green indicator located on the instrument panel cluster. When automatic high beam assist is active, the indicator will be illuminated continuously. If the operator deactivates the automatic high beam assist system, the indicator will turn off.

Manual Headlamp Leveling

Each headlamp assembly contains a headlamp leveling actuator that is controlled by the headlamp leveling switch. The headlamp leveling switch is supplied with ignition voltage and contains a resistor ladder with 4 positions for adjusting the headlamps up or down. When the headlamp leveling switch is activated to the desired position, voltage from the B+ ignition circuit is pulled down through the resistor ladder and the voltage is applied to the left and right headlamp leveling actuators via the headlamp leveling control module. The headlamp leveling actuators are supplied with B+ and ground. When the headlamp leveling switch is activated, the left and right headlamp leveling actuators respond by moving the headlamps to the desired position.

Daytime Running Lamps

The daytime running lamps will illuminate continuously when the following conditions are met:

- The vehicle mode switch is in the RUN or CRANK position
- The shift lever is out of the PARK position for vehicles equipped with automatic transmissions or the parking brake is released for vehicles with manual transmissions
- The low and high beam headlamps are OFF

The ambient light sensor (T83) or rain sensor module (CE1) is used to monitor outside lighting conditions. The BCM monitors the ambient light sensor or rain sensor module via serial data to determine if outside lighting conditions are correct for either daytime running lights or automatic lamp control when the headlamp switch is in the AUTO position. In daylight conditions the BCM will command the designated daytime running lights ON. During low light conditions the BCM will command the low beam headlamps ON. Any function or condition that turns on the headlamps will cancel daytime running lights operation.

Rear Fog Lamps

When the rear fog lamp switch is placed in the ON position, battery voltage is applied from the BCM to the rear fog lamps. Ground for the rear fog lamps is applied at all times.

The BCM will send a message via GMLAN serial data to the instrument panel cluster to enable the rear fog lamp indicator.

Flash to Pass

When the low beam headlamps are on and the turn signal/multi-function switch is momentarily placed in the flash to pass position, ground is applied to the turn signal/multi-function switch. The turn signal/multifunction switch applies ground to the BCM through the flash to pass switch signal circuit. The BCM then applies ground to the high beam relay control circuit. This energizes the high beam relay, closing the switch side contacts of the high beam relay, applying battery voltage to the left and right high beam fuses. Battery voltage is applied from the high beam fuses through the high beam voltage supply circuit to the high beam headlamp assemblies. This causes the high beam headlamps to illuminate at full brightness momentarily or until the flash to pass switch is released.

Hazard Lamps

The hazard flashers may be activated in any power mode. The hazard switch signal circuit is momentarily grounded when the hazard switch is pressed. The body control module (BCM) responds to the hazard switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard switch is activated, the BCM sends a serial data message to the instrument panel cluster requesting both turn signal indicators to be cycled ON and OFF.

The instrument panel dimmer switch controls the brightness of the interior backlighting components. When the instrument panel dimmer switch is placed in a desired brightness position, the body control module (BCM) receives a signal from the instrument panel dimmer switch and responds by applying a pulse width modulated (PWM) voltage to the hazard switch light emitting diode (LED) backlighting control circuit illuminating the LED to the desired level of brightness.

Park, Tail, License, and Side Marker Lamps

The park lamps, tail lamps, license plate lamps, and side marker lamps are turned ON when the headlamp switch is placed in the PARK LIGHT or LOW BEAM position or anytime the headlights are requested. When the BCM receives a request from the headlamp switch to turn ON the park lamps the BCM will apply battery voltage to the left and right park lamp, side marker lamp, and license plate lamp control circuits illuminating the left and right park lamps, side marker lamps, and license plate lamps.

When the trailer lighting control module receives a request from the headlamp switch to turn ON the park lamps the trailer lighting control module will apply battery voltage to the left and right tail/stop lamp control circuits illuminating the left and right tail/stop lamps.

Stop Lamps

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the center high mounted stop lamp control circuit illuminating the center high mounted stop lamp.

When the brakes have been applied the trailer lighting control module will apply battery voltage to the left and right tail/stop lamp and auxiliary tail/stop lamp control circuits. The left and right tail/stop lamps will illuminate when the liftgate is in the CLOSED position and the left and right auxiliary tail/stop lamps will illuminate when the liftgate is in the OPEN position.

Regen on Demand allows increased deceleration by pressing and holding the steering wheel paddle. It works in D (Drive) and L (Low). The accelerator pedal can be used to manage deceleration while using Regen on Demand. Cruise control will turn off and the brake lamps may come on when this feature is activated.

Turn Signal Lamps

Ground is applied at all times to the turn signal/multi-function switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the Service Mode or ON position. When the turn signal/multi-function switch is placed in either the TURN RIGHT or TURN LEFT position, ground is applied to the BCM through either the right turn or left turn signal switch signal circuit. The BCM then applies a pulsating voltage to the front and rear turn signal lamps through their respective voltage supply circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Backup Lamps

With the vehicle ON and the transmission in the REVERSE position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the REVERSE position. The BCM applies battery voltage to the backup lamps control circuit illuminating the backup lamps. Once the driver moves the gear selector out of the REVERSE position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamps control circuit. The vehicle must be ON for the backup lamps to operate.

Battery Run Down Protection/Inadvertent Power

To provide battery run down protection, the exterior lamps will be deactivated automatically under certain conditions. The BCM monitors the state of the headlamp switch. If the park or headlamp switch is ON when the vehicle mode switch is placed in either the CRANK or RUN position and then placed in the OFF position, the BCM initiates a 10 min timer. At the end of the 10 min, the BCM will turn off the control power output to the park lamp controls as well as the headlamp relay coils, deactivating the exterior lamps. This feature will be cancelled if any power mode other than OFF becomes active. The BCM will disable battery run down protection if any of the following conditions exist. The park or headlamp switch is placed in the ON to OFF position, and back to the ON position during battery run down protection. The BCM determined that the park or headlamp switch was not active when the vehicle mode switch was turned OFF.

INTERIOR LIGHTING SYSTEMS DESCRIPTION AND OPERATION

Interior Lamps

The interior lamps consist of 2 groups. The first group includes lamps that may not be dimmed.

- Dome lamps
- Courtesy lamps
- Reading lamps
- Rear compartment courtesy lamp

Dome Lamps

The dome lamp switch contains 3 positions: DOOR, OFF, and ON. The ON position provides a ground for continuous operation and the dome lamps will remain illuminated until the switch is placed in either the DOOR or OFF position. When in the DOOR position, the dome lamp operation is controlled by the body control module (BCM). When any door is opened, the door ajar switch contacts close and the BCM receives a door-open input. The BCM illuminates the dome lamp when any door is opened or a door lock/unlock request is activated with the key fob. After all doors have been closed, the dome lamp will remain illuminated approximately 3 s after the last door closes. When the driver places the dome lamp switch in the OFF position, the dome lamps will be disabled. In the event that the dome lamps were to remain illuminated for more than 10 min with the ignition switch in the OFF position, the BCM will deactivate the dome lamp control circuit to prevent total battery discharge. The dome lamps will turn OFF using the theater dimming feature when controlled by the BCM.

Reading Lamps

The inadvertent power supply voltage circuit from the BCM provides battery positive voltage to each reading lamp. When a reading lamp switch is activated, the switch contacts close providing a path to ground and the reading lamp illuminates. If the operator inadvertently leaves a reading lamp ON, the BCM will turn all interior lamps OFF after 10 min has passed since any switch activation has been detected by the BCM.

Rear Compartment Courtesy Lamp

When the rear compartment is opened, the rear compartment lid latch opens providing a rear compartment open input signal to the BCM. The BCM responds by applying battery voltage to the rear compartment courtesy lamp control circuit illuminating the rear compartment courtesy lamp.

Courtesy/Illuminated Entry Lamps

The following lamps may be manually turned ON by placing the interior lamp switch in the ON position, or by opening a door while the switch is in the AUTOMATIC LIGHT position.

- The dome lamp
- The liftgate lamps
- Courtesy lamps

The courtesy lamp supply voltage circuit of the body control module (BCM) supplies battery positive voltage to the dome lamp, the liftgate lamps and courtesy lamps. When any door is opened, the door jamb switch contacts close providing a door open input to the BCM. The BCM then provides a B+ to the interior lamps with the switch in the AUTO position. The interior lamps receive a ground when the switch is in the ON position.

NOTE: **If the liftgate is opened after all the modules go to sleep, the dome light will not come on. The liftgate ajar switch input to the BCM will not wake up the BCM once it has gone to sleep, so the dome light will not come on. Once the BCM gets an input to wake it up, from remote keyless entry or a door handle, the dome light will turn on when the liftgate is opened.**

If the driver inadvertently leaves any interior lamp ON, the BCM will turn it OFF after a 20 min time-out.

The courtesy lamps will turn OFF immediately if the vehicle ON/OFF switch is turned to the ON position or approximately 20 s after all doors are closed.

Keyless Entry Interior Illumination

When the BCM receives a door unlock command from the remote keyless entry transmitter, the BCM will flash the park lamps several times, illuminate the courtesy and park lamps, and illuminate the low beam headlamps at low intensity. The lamps will remain on until the vehicle ON/OFF switch is turned from the OFF position, a keyless entry transmitter door lock command is received, or after an approximate 20 s delay.

Interior Lamps Dimming

The second group includes lamps which may dim. This group may use a combination of vacuum fluorescent illumination, LEDs and incandescent lamps.

- Accent lamp - left instrument panel
- Accent lamp - right instrument panel
- Headlamp switch
- Multifunction switch 1 - instrument panel
- Multifunction switch 2 - instrument panel
- Door lock switch - driver
- Door lock switch - passenger
- The instrument panel cluster
- Park brake control switch
- Seat heating switch - left rear
- Seat heating switch - right rear
- Power window switches
- Various switches

When the vehicle ON/OFF switch is turned to the ON position, the vacuum fluorescent display, radio, turns ON at maximum brightness. When the park lamps are ON, all incandescent back lighting turn ON at the dimming level indicated by the instrument panel dimmer switch. At the same time all fluorescent display displays dim to match the indicated dimming level. When the headlamp switch is placed in the PARK position, the park lamp supply voltage circuit provides an input to the BCM. The BCM then supplies voltage to the instrument panel dimmer switch through the dimming control circuit. The setting of the instrument panel dimmer switch determines the amount of voltage that the instrument panel dimmer switch supplies to the BCM through the instrument panel dimming lamps low reference circuit. The BCM then sends a PWM voltage to all the interior lamps. All the fluorescent display and incandescent back lighting lamps are provided a specific voltage and are then grounded. When the headlight switch is turned to the park lamp or headlamp position, all incandescent back lighting turn ON at the dimming level indicated by the instrument panel dimmer switch. When the instrument panel dimmer switch is moved from MIN to MAX, all fluorescent display displays, as well as all incandescent back lighting respond from minimum intensity to maximum brightness in response to the instrument panel dimmer switch.

Inadvertent Power

The BCM used in this vehicle controls the lighting system through circuits that enable the interior lamps. The BCM opens these enabling circuits shortly after the vehicle ON/OFF switch is turned OFF with no lamp switch activity. If the vehicle ON/OFF switch is turned to any position other than OFF, or if a lamp switch is activated during this period, the timer will reset itself.

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2017 ACCESSORIES & EQUIPMENT

Lighting - Diagnostic Information and Procedures - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B1395: CONTROL MODULE VOLTAGE REFERENCE OUTPUT CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1395 03

Control Module Voltage Reference Output Circuit Low Voltage

DTC B1395 07

Control Module Voltage Reference Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch B+	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Signal	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Low Reference	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B1395 03

- The BCM detects a short to ground in the instrument panel dimmer switch B+ reference circuit.

- The BCM detects a short to ground in the instrument panel dimmer switch signal circuit.

DTC B1395 07

- The BCM detects a short to voltage in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to voltage in the instrument panel dimmer switch signal circuit.

Actions Taken When the DTC Sets

All interior backlighting defaults to FULL bright.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S30 Headlamp Switch, vehicle in Service Mode.
2. Test for B+ between the B+ circuit terminal 12 and ground.
    - **If less than B+**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If B+**
3. Test for B+ between the B+ circuit terminal 12 and the low reference circuit terminal 7.
    - **If less than B+**

   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the low reference circuit terminal 7 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If B+**

4. Verify a test lamp does not illuminate between the B+ circuit terminal 12 and the signal circuit terminal 11.
   - **If the test lamp illuminates**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp does not illuminate**
5. Test for B+ between the B+ circuit terminal 12 and the signal circuit terminal 11.
   - **If less than B+**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 11 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If B+**
6. Test or replace the S30 Headlamp Switch.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Headlamp Switch Replacement
- Refer to Control Module References for BCM replacement, programming and setup

DTC B1480: BATTERY RUNDOWN PROTECTION CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1480 02

Battery Rundown Protection Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Courtesy Lamps Control - Terminal 2 X7	B1480 02	1	1	-
Dome/Reading Lamps - Overhead Console Ground	-	1, 2	-	-
Dome/Reading Lamps - Rear Ground	-	1, 2	-	-
1. Courtesy Lamps Malfunction 2. Dome Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the front and rear reading lamps via the courtesy lamp control circuit. The front and rear reading lamps are controlled by individual switches that are activated by the operator when additional cabin lighting is required. In the event that any of these courtesy lamps were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the courtesy lamp control circuit.

Actions Taken When the DTC Sets

The BCM will disable the circuit and the front and rear reading lamps will be inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

The Inadvertent Load scan tool command operates when the front and rear dome lamp switches are in the ON position.

Reference Information

Schematic Reference

Interior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connectors at the components listed below.
    - E37D Dome/Reading Lamps - Overhead Console
    - E37R Dome/Reading Lamps - Rear
2. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E37D Dome/Reading Lamps - Overhead Console terminal 2
    - E37R Dome/Reading Lamps - Rear terminal 1
3. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
4. Test or replace the appropriate courtesy lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Roof Console Replacement**
- Refer to **Center Courtesy Lamp Replacement**
- Refer to **Rear Seat Position Center Courtesy Lamp Bulb Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2540: REAR FOG LAMPS CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2540 02

Rear Fog Lamps Control Circuit Short to Ground

DTC B2540 04

Rear Fog Lamps Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Fog Lamp Control	B2540 02	B2540 04	1	-
Rear Fog Lamp Ground	-	1	-	-
1. Rear Fog Lamp Malfunction				

Circuit/System Description

The rear fog lamp switch signal circuit is grounded momentarily by pressing the rear fog lamp switch. The body control module (BCM) responds to the rear fog lamp request by applying voltage to the rear fog lamp control circuit which illuminates the rear fog lamp.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Rear fog lamp ON.

Conditions for Setting the DTC

DTC B2540 02

The BCM detects a short to ground in the rear fog lamp control circuit.

DTC B2540 04

The BCM detects an open/high resistance in the rear fog lamp control circuit.

Actions Taken When the DTC Sets

The rear fog lamp will not operate when the park lamps are ON and the rear fog lamp switch is active.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the X410 harness connector at the E5EA Tail Lamp - Auxiliary Left.
2. Test for less than 5 Ω between the ground circuit terminal 6 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Connect a test lamp between the control circuit terminal 4 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Rear Fog Lamp(s) Relay ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E29R Fog Lamp - Rear.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog)** **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2545: BACKUP LAMPS CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2545 01

Backup Lamps Circuit Short to Battery

DTC B2545 02

Backup Lamps Circuit Short to Ground

DTC B2545 04

Backup Lamps Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Backup Lamp Control	B2545 02	1	1	-
Backup Lamp Ground	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

With the vehicle ON and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamp control circuit illuminating the backup lamp. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamp control circuit. The vehicle must be ON for the backup lamps to operate.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Vehicle ON.
- Transmission placed in REVERSE gear.

Conditions for Setting the DTC

DTC B2545 01 and B2545 04

The BCM detects an open/high resistance in the backup lamp control circuit.

DTC B2545 02

The BCM detects a short to ground in the backup lamp control circuit.

Actions Taken When the DTC Sets

The backup lamp will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E5 Backup Lamp, vehicle in Service Mode.
2. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E5 Backup Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog)** **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2570: TRUNK LAMP CONTROL CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2570 02

Trunk Lamp Control Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Compartment Courtesy Lamp Control	B2570 02	1	1	-
Rear Compartment Courtesy Lamp Ground	-	1	-	-
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the rear compartment courtesy lamp through the rear compartment courtesy lamp control circuit. When the BCM receives a rear liftgate open input from the rear compartment lid latch, the BCM applies battery voltage to the rear compartment courtesy lamp control circuit illuminating the rear compartment courtesy lamp. In the event that the rear compartment courtesy lamp were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position, the BCM will deactivate the rear compartment courtesy lamp control circuit to prevent total battery discharge.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Liftgate OPEN.

Conditions for Setting the DTC

The BCM detects a short to ground in the rear compartment courtesy lamp control circuit.

Actions Taken When the DTC Sets

The rear compartment courtesy lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E8S Rear Compartment Courtesy Lamp. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E8S Rear Compartment Courtesy Lamp.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Cargo Center Courtesy Lamp Bulb Replacement
- Refer to Control Module References for BCM replacement, programming, and setup

DTC B257A: HEADLAMP SWITCH INPUT SIGNALS CORRELATION MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B257A 00

Headlamp Switch Input Signals Correlation Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
Headlamp Switch Headlamps OFF Signal	B257A 00	1	1	-
Headlamp Switch Headlamps ON Signal	B257A 00	1	1	-
Headlamp Switch Ground	-	1	-	-
1. Headlamps Malfunction 2. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors three signal circuits from the headlamp switch. When the headlamp switch is in the AUTO position, the three signal circuits are open and the BCM relies on the ambient light sensor input to turn the headlamps and daytime running lamps (DRLs) ON and OFF. When the headlamp switch is placed in the OFF position, the headlamp switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the headlamp switch in the PARK LAMPS position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

- The BCM detects an open/high resistance in the headlamp switch park lamps ON signal circuit.
- The BCM detects a short to ground in the headlamp switch headlamps ON signal circuit.
- The BCM detects a short to ground in the headlamp switch headlamps OFF signal circuit.

Actions Taken When the DTC Sets

- When DTC B257A 00 is present on the headlamp switch headlamps OFF signal circuit, the low beam and high beam headlamps are inoperative.
- When DTC B257A 00 is present on the headlamp switch headlamps ON signal circuit, the low beam headlamps are always ON in the PARK position and the park lamps are always ON in all positions.
- When DTC B257A 00 is present on the headlamp switch park lamps ON signal circuit, the high beam and low beam headlamps are inoperative in the PARK and HEAD positions.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- **Headlights/Daytime Running Lights (DRL) Schematics**
- **Exterior Lights Schematics**

Connector End View Reference

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Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 8 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Automatic Headlamps Disable Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 3 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 8.
6. Verify the scan tool Automatic Headlamps Disable Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 3 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.

   - **If Active**

7. Verify the scan tool Park Lamps Switch parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
8. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 8.
9. Verify the scan tool Park Lamps Switch parameter is Active.
   - **If not Active**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 5 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
10. Verify the scan tool Headlamps On Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
11. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 8.
12. Verify the scan tool Headlamps On Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 1 and ground.
       - If 1 V or greater, repair the short to voltage on the circuit.
       - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
13. Test or replace the S30 Headlamp Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Switch Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2580: HEADLAMP HIGH BEAM CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2580 01

Headlamp High Beam Control Circuit Short to Battery

DTC B2580 02

Headlamp High Beam Control Circuit Short to Ground

DTC B2580 04

Headlamp High Beam Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp High Beam Relay Control	1	1	B2580 01	-
High Beam Headlamp - Left Control	1	1	1	-
High Beam Headlamp - Right Control	1	1	1	-
Headlamp - Left Ground	-	1	-	-
Headlamp - Right Ground	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with two signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the left and right high beam fuses to the high beam control circuits and on to the left and right high beam solenoid actuators within the headlamp assemblies. Once the high beam solenoid actuators are active, the solenoid shutters open in each headlamp assembly exposing the remaining portion of the headlamp that was covered by the shutters illuminating the high beams at full intensity.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- High beam headlamps ON.

Conditions for Setting the DTC

DTC B2580 01

The BCM detects a short to voltage in the headlamp high beam relay control circuit.

DTC B2580 02 and B2580 04

The BCM detects a short to ground or an open/high resistance in the headlamp high beam relay control circuit.

Actions Taken When the DTC Sets

- For an open/high resistance fault, the high beam headlamps and flash to pass function are inoperative. The high beam indicator on the instrument cluster operates normally.
- For a short to ground fault, the high beam headlamps and high beam indicator on the instrument cluster are always ON with the headlamp switch in the AUTO or HEAD positions.
- For a short to voltage fault, the high beam headlamps and flash to pass function are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for B+ between the control circuit terminal 18 and ground.
    - **If less than B+**
    1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the control circuit terminal and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the X50A Fuse Block - Underhood.
    - **If B+**
3. Vehicle OFF, connect a 3 A fused jumper between the control circuit terminal 18 and ground, vehicle in Service Mode, low beams ON.
4. Verify the high beam headlamps illuminate.

    - **If the high beam headlamps do not illuminate**
        1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
        2. Test for less than 1 V between the control circuit terminal 18 and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V, replace the X50A Fuse Block - Underhood.
    - **If the high beam headlamps illuminate**

5. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Battery Distribution Fuse Block Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2585 OR B3867: LEFT/RIGHT PARK LAMPS CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2585 01

Left Park Lamps Control Circuit Short to Battery

DTC B2585 02

Left Park Lamps Control Circuit Short to Ground

DTC B2585 04

Left Park Lamps Control Circuit Open

DTC B3867 01

Right Park Lamp Control Circuit Short to Battery

DTC B3867 02

Right Park Lamp Control Circuit Short to Ground

DTC B3867 04

Right Park Lamp Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Lamps Control - Left	B2585 02	1	1	-
Park Lamps Control - Right	B3867 02	1	1	-
Park Lamp Ground - Left Front	-	1	-	-
Park Lamp Ground - Right Front	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Side Marker Lamp Ground - Left Front	-	1	-	-
Side Marker Lamp Ground - Right Front	-	1	-	-
Side Marker Lamp Ground - Left Rear	-	1	-	-
Side Marker Lamp Ground - Right Rear	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the headlamp switch is placed in the HEAD or PARK position, ground is applied to the park lamps ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps control circuit illuminating the park and side marker lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B2585 02

The BCM detects a short to ground in the left front park lamp control circuit.

DTC B3867 02

The BCM detects a short to ground in the right front park lamp control circuit.

Actions Taken When the DTC Sets

DTC B2585 02

The left front park lamp and left front and rear side marker lamps are inoperative.

DTC B3867 02

The right front park lamp and right front and rear side marker lamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B2585

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate park lamp listed below.
    - E13LA Headlamp Assembly - Left
    - E2LR Side Marker Lamp - Left Rear
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
    - E13LA Headlamp Assembly - Left terminal 8
    - E2LR Side Marker Lamp - Left Rear terminal 2
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E13LA Headlamp Assembly - Left terminal 4
    - E13LA Headlamp Assembly - Left terminal 7 (-TR6)
    - E2LR Side Marker Lamp - Left Rear terminal 1
4. Verify the test lamp turns ON and OFF when commanding the Left Park Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate left park lamp.

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1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate park lamp listed below.
    - E13RA Headlamp Assembly - Right
    - E2RR Side Marker Lamp - Right Rear
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
    - E13RA Headlamp Assembly - Right terminal 8
    - E2RR Side Marker Lamp - Right Rear terminal 2
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E13RA Headlamp Assembly - Right terminal 4
    - E13RA Headlamp Assembly - Right terminal 7 (-TR6)
    - E2RR Side Marker Lamp - Right Rear terminal 1
4. Verify the test lamp turns ON and OFF when commanding the Right Park Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate right park lamp.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Headlamp Replacement
- Refer to Rear Side Marker Lamp Replacement
- Refer to Control Module References for BCM replacement, programming, and setup

DTC B258A: LOW BEAM CONTROL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B258A 01

Low Beam Control Circuit Short to Battery

DTC B258A 02

Low Beam Control Circuit Short to Ground

DTC B258A 04

Low Beam Control Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Low Beam Relay Control	B258A 02	B258A 04	B258A 01	-
Headlamp Low Beam Control - Left	1	1	1	-
Headlamp Low Beam Control - Right	1	1	1	-
Headlamp Assembly Ground - Left	-	1	-	-
Headlamp Assembly Ground - Right	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

The headlamp low beam relay is supplied with battery voltage at all times. When the headlamp switch is in the ON position ground is applied to the body control module (BCM) through the low beam signal circuit. The BCM responds to the low beam request by applying ground to the low beam relay control circuit which energizes the headlamp low beam relay. With the low beam relay energized, the switch contacts close allowing battery voltage to flow through the low beam fuses to the low beam headlamps illuminating the low beam headlamps.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Low beam headlamps ON.

Conditions for Setting the DTC

DTC B2580 01

The BCM detects a short to voltage in the headlamp low beam relay control circuit.

DTC B2580 02

The BCM detects a short to ground in the headlamp low beam relay control circuit.

DTC B2580 04

The BCM detects an open/high resistance in the headlamp low beam control circuit.

Actions Taken When the DTC Sets

- The left and right low beam headlamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, remove the KR49 Headlamp Low Beam Relay.
2. Connect a test lamp between the control circuit terminal 86 and B+, vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF when commanding the Low Beam Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit terminal and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
4. Test or replace the KR49 Headlamp Low Beam Relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**

- Refer to Control Module References for BCM, replacement, programming, and setup

DTC B2600 OR B2605: LEFT/RIGHT DAYTIME RUNNING LAMPS CONTROL CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2600 02

Left Daytime Running Lamps Control Circuit Short to Ground

DTC B2605 02

Right Daytime Running Lamps Control Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Daytime Running Lamp Control - Left	B2600 02	1	1	-
Daytime Running Lamp Control - Right	B2605 02	1	1	-
Headlamp Assembly Ground - Left	-	1	-	-
Headlamp Assembly Ground - Right	-	1	-	-
1. Daytime Running Lamps Malfunction				

Circuit/System Description

The ambient light/sunload sensor is used to monitor outside lighting conditions. The ambient light/sunload sensor provides a serial data message to the body control module (BCM) based on outside lighting conditions to determine if outside lighting conditions are correct for either daytime running lamps or automatic lamp control when the headlamp switch is in the AUTO position. In daylight conditions the BCM will command the designated daytime running lamps ON. During low light conditions the BCM will command the low beam headlamps ON. Any function or condition that turns on the headlamps will cancel daytime running lamps operation.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B2600 02

The BCM detects a short to ground in the left daytime running lamp control circuit.

DTC B2605 02

The BCM detects a short to ground in the right daytime running lamp control circuit.

Actions Taken When the DTC Sets

DTC B2600 02

The left daytime running lamp is inoperative.

DTC B2605 02

The right daytime running lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

The daytime running lamps will only operate in daylight conditions with the vehicle ON and in any transmission gear except PARK.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below.
    - X110 - left daytime running lamp
    - X120 - right daytime running lamp
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
    - Terminal 5 (-TR6)
    - Terminal 7 (TR6)
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Dedicated Daytime Running Lamp ON and OFF with a scan tool.

    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E13 Headlamp Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2610: PASSENGER COMPARTMENT DIMMING 1 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2610 01

Passenger Compartment Dimming 1 Circuit Short to Battery

DTC B2610 02

Passenger Compartment Dimming 1 Circuit Short to Ground

DTC B2610 04

Passenger Compartment Dimming 1 Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
LED Backlight Dimming Control Terminal 8 X2	B2610 02	1	1	-
LED Backlight Dimming Control Terminal 9 X7	B2610 02	1	1	-
Door Lock Switch - Driver Ground	-	1	-	-
Door Lock Switch - Passenger Ground	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch Ground	-	1	-	-
Multifunction Switch 1 - Instrument Panel Ground	-	1	-	-
Multifunction Switch 2 - Instrument Panel Ground	-	1	-	-
Park Brake Control Switch Ground	-	1	-	-
Seat Heating Switch - Left Rear Ground	-	1	-	-
Seat Heating Switch - Right Rear Ground	-	1	-	-
Steering Wheel Controls Switch - Radio Presets Ground	-	1	-	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The headlamp switch is used to increase and decrease the brightness of the interior backlighting components. The headlamp switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides a B+, low reference, and signal circuits to the headlamp switch. When the headlamp switch is placed in the desired position, the dimmed voltage setting is applied from the headlamp switch through the headlamp switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

DTC B2610 01

The BCM detects a short to battery in the LED backlight dimming control circuit terminal 8 X2 or the LED backlight dimming control circuit terminal 9 X7.

DTC B2610 02

The BCM detects a short to ground in the LED backlight dimming control circuit terminal 8 X2 or the LED backlight dimming control circuit terminal 9 X7.

DTC B2610 04

The BCM detects an open/high resistance in the LED backlight dimming control circuit terminal 8 X2 or the LED backlight dimming control circuit terminal 9 X7.

Actions Taken When the DTC Sets

The BCM will disable the LED backlight dimming control circuits.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **Each component with backlighting may need to be disconnected to isolate a short to voltage or short to ground. Use the schematics to identify the following:**

- **Backlighting components the vehicle is equipped with**
- **Each component's control and ground circuit terminals**
- **Component locations on the backlighting control circuit**

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the appropriate ground circuit terminal and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Connect a test lamp between the appropriate control circuit terminal and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
        - X2 terminal 8
        - X7 terminal 9
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.

- **If the test lamp is always ON**
  1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode
     - X2 terminal 8
     - X7 terminal 9
  2. Test for less than 1 V between the control circuit terminal and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V, replace the K9 Body Control Module.
- **If the test lamp turns ON and OFF**

5. Test or replace the component with inoperative backlighting.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Parking Brake Actuator Switch Replacement
- Refer to Headlamp Switch Replacement
- Refer to Door Lock Switch Replacement
- Refer to Rear Seat Heater Switch Replacement
- Refer to Radio Control Switch Replacement - Steering Wheel (Left Side Lower) Radio Control Switch Replacement - Steering Wheel (Left Side Rear) Radio Control Switch Replacement - Steering Wheel (Right Side Front) Radio Control Switch Replacement - Steering Wheel (Right Side Rear)
- Refer to Hazard Warning Switch Replacement
- Refer to Control Module References for BCM replacement, programming, and setup

DTC B2615: PASSENGER COMPARTMENT DIMMING 2 CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2615 02

Passenger Compartment Dimming 2 Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F8DA (BCM 2) Fuse B+	B2615 02	B2615 02	-	-
Dome Lamps Control - Terminal 1 X7	B2615 02	1	1	-
Dome/Reading Lamps - Overhead Console Ground	-	1	-	-
Dome/Reading Lamps - Rear Ground	-	1	-	-
1. Dome Lamps Malfunction				

Circuit/System Description

The dome lamp switch has 3 positions: DOOR, OFF, and ON. The ON position provides a ground for continuous operation and the dome lamps will remain illuminated until the switch is placed in either the DOOR or OFF position. When in the DOOR position, the dome lamps operation is controlled by the body control module (BCM). When any door is opened, the door ajar switch contacts close and the BCM receives a door-open input. The BCM illuminates the dome lamps when any door is opened or a door lock/unlock request is activated with the key fob. After all doors have been closed, the dome lamps will remain illuminated approximately 3 s after the last door closes. When the driver places the dome lamp switch in the OFF position, the dome lamps will be disabled. In the event that the dome lamps were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the dome lamps control circuit to prevent total battery discharge.

Conditions for Running the DTC

Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

- The BCM detects a short to ground or an open/high resistance in the F8DA (BCM 2) fuse B+ circuit.
- The BCM detects a short to ground in the dome lamps control circuit.

Actions Taken When the DTC Sets

The front and middle dome lamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- **Interior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

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Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Test for less than 2 Ω in the B+ circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**

1. Test for infinite resistance between the B+ circuit and ground.
   - If less than infinite resistance, repair the short to ground on the circuit.
   - If infinite resistance, replace the K9 Body Control Module

- **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the inoperative E37 Dome/Reading Lamp. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit terminals listed below and ground.
   - E37D Dome/Reading Lamps - Overhead Console terminal 4
   - E37R Dome/Reading Lamps - Rear terminal 3
   - **If 5 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuits end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 5 Ω**
6. Connect a test lamp between the control circuit terminals listed below and ground, vehicle in Service Mode.
   - E37D Dome/Reading Lamps - Overhead Console terminal 3
   - E37R Dome/Reading Lamps - Rear terminal 4
7. Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
8. Test or replace the inoperative E37 Dome/Reading Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Roof Console Replacement**
- Refer to **Center Courtesy Lamp Replacement**
- Refer to **Rear Seat Position Center Courtesy Lamp Bulb Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B2625: DISPLAY DIMMING PULSE WIDTH MODULATION OUTPUT CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B2625 02

Display Dimming Pulse Width Modulation Output Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Switch Indicator LED Backlight Control Terminal 5 X1	B2625 02	1	1	-
Lane Departure Warning Switch Control	1	1	1	-
Parking Assist Control Switch Control	1	1	1	-
Seat Heating Switch - Left Rear Control	1	1	1	-
Seat Heating Switch - Right Rear Control	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the amber switch indicators through the amber LED indicator control circuit. When the appropriate switch has been activated, the BCM applies a pulse width modulated voltage through the amber LED indicator control circuit illuminating the rear seat heating switches, park assist control switch, and lane departure warning switch amber LEDs.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the switch indicator LED backlight dimming control circuit terminal 5 X1.

Actions Taken When the DTC Sets

The switch indicator LED backlight dimming control circuit terminal 5 X1 driver is shut down.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

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Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connectors at the components listed below.
    - S32LR Seat Heating Switch - Left Rear
    - S32RR Seat Heating Switch - Right Rear
    - S48D Multifunction Switch 2 - Instrument Panel

NOTE: **The test lamp in the following step will illuminate at LOW intensity. This is normal circuit operation and does not indicate a circuit malfunction.**

2. Vehicle in Service Mode, verify a test lamp illuminates between each control circuit terminal 6 and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
3. Verify a test lamp does not illuminate at FULL intensity between each control circuit terminal 6 and ground.
    - **If the test lamp illuminates at FULL intensity**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp does not illuminate at FULL intensity**
4. Test or replace the component with the inoperative switch indicator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rear Seat Heater Switch Replacement**

- Refer to **Instrument Panel Center Accessory Function Switch Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B3588: REAR FOG LAMP SWITCH CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3588 00

Rear Fog Lamp Switch Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Fog Lamp Switch Signal	B3588 00	1	1	-
Rear Fog Lamp Control	B2540 02	B2540 04	1	-
Rear Fog Lamp Ground	-	1	-	-
Headlamp Switch Ground	-	1	-	-
1. Rear Fog Lamp Malfunction				

Circuit/System Description

The rear fog lamp switch signal circuit is grounded momentarily by pressing the rear fog lamp switch. The body control module (BCM) responds to the rear fog lamp request by applying voltage to the rear fog lamp control circuit which illuminates the rear fog lamp.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the headlamp switch rear fog lamp signal circuit.

Actions Taken When the DTC Sets

The rear fog lamp indicator on the instrument cluster is always ON.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 8 and ground.
   - **If 15 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 15 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Rear Fog Lamp Switch parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 6 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
6. Verify the scan tool Rear Fog Lamp Switch parameter is Active.
   - **If not Active**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 6 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
7. Test or replace the S30 Headlamp Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Switch Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B3596: HAZARD LAMPS REQUEST CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3596 00

Hazard Lamps Request Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Hazard Warning Switch Signal	B3596 00	1	1	-
Multifunction Switch 1 - Instrument Panel Ground	-	1	-	-
1. Hazard Lamps Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Hazard lamps ON.

Conditions for Setting the DTC

The hazard warning switch input is Active for longer than 60 s.

Actions Taken When the DTC Sets

The hazard lamps are inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S48C Multifunction Switch 1 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
6. Verify the scan tool Hazard Lamps Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 1 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the S48C Multifunction Switch 1 - Instrument Panel.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Hazard Warning Switch Replacement
- Refer to Control Module References for BCM replacement, programming, and setup

DTC B3600: PASSENGER COMPARTMENT DIMMING REQUEST SIGNAL CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3600 03

Passenger Compartment Dimming Request Signal Circuit Low Voltage

DTC B3600 07

Passenger Compartment Dimming Request Signal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Switch B+	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Signal	B1395 03, B3600 03	B3600 03	B1395 07, B3600 07	-
Headlamp Switch Low Reference	1	1	1	-
1. Interior Backlighting Malfunction				

Circuit/System Description

The instrument panel dimmer switch is used to increase and decrease the brightness of the interior backlighting components. The instrument panel dimmer switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal circuits to the instrument panel dimmer switch. When the instrument panel dimmer switch is placed in the desired position, the dimmed voltage setting is applied from the instrument panel dimmer switch through the instrument panel dimmer switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Park lamps ON.

Conditions for Setting the DTC

DTC B3600 03

- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to ground or an open/high resistance in the instrument panel dimmer switch signal circuit.

DTC B3600 07

- The BCM detects a short to voltage in the instrument panel dimmer switch B+ reference circuit.
- The BCM detects a short to voltage in the instrument panel dimmer switch signal circuit.

Actions Taken When the DTC Sets

All interior backlighting defaults to FULL bright.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Interior Lights Dimming Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S30 Headlamp Switch, vehicle in Service Mode.
2. Test for B+ between the B+ circuit terminal 12 and ground.
    - **If less than B+**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If B+**
3. Test for B+ between the B+ circuit terminal 12 and the low reference circuit terminal 7.
    - **If less than B+**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the low reference circuit terminal 7 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If B+**
4. Verify a test lamp does not illuminate between the B+ circuit terminal 12 and the signal circuit terminal 11.

- **If the test lamp illuminates**
  1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
  2. Test for infinite resistance between the signal circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance, replace the K9 Body Control Module.
- **If the test lamp does not illuminate**

5. Test for B+ between the B+ circuit terminal 12 and the signal circuit terminal 11.
   - **If less than B+**
     1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
     2. Test for less than 1 V between the signal circuit terminal 11 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
     3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If B+**
6. Test or replace the S30 Headlamp Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Switch Replacement**
- Refer to **Control Module References** for BCM replacement, programming and setup

DTC B3650: HIGH BEAM REQUEST SIGNAL CIRCUIT PERFORMANCE - SIGNAL INVALID

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3650 08

High Beam Request Signal Circuit Performance - Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	1	1	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors three signal circuits from the turn signal/multifunction switch. When the turn signal/multifunction switch is in the AUTO position, the three signal circuits are open and the BCM relies on the ambient light sensor input to turn the headlamps and daytime running lamps (DRLs) ON and OFF. When the turn signal/multifunction switch is placed in the OFF position, the turn signal/multifunction switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the turn signal/multifunction switch in the PARK LAMPS position, the turn signal/multifunction switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the turn signal/multifunction switch is in the HEADLAMP position, both the turn signal/multifunction switch park lamps ON signal circuit and the turn signal/multifunction switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/multifunction switch high beam signal circuit.

Actions Taken When the DTC Sets

The high beam headlamps will not operate.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Verify the scan tool High Beam Select Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 7 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the ground circuit terminal 3.
6. Verify the scan tool High Beam Select Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 7 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Turn Signal Switch Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B3806: HIGH BEAM AND HEADLAMP FLASH SELECT CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3806 00

High Beam and Headlamp Flash Select Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	1	1	-
Turn Signal/Multifunction Switch Ground	-	1	-	-
1. Headlamps Malfunction				

Circuit/System Description

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the body control module (BCM) through the flash to pass signal circuit. The BCM responds to the flash to pass request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the high beam fuses to the high beam control circuits illuminating the high beam headlamps. The high beam headlamps will only illuminate for as long at the flash to pass switch is activated.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the turn signal/multifunction switch flash to pass signal circuit.

Actions Taken When the DTC Sets

The high beam lamps and the high beam indicator on the instrument panel cluster are always ON with the headlamp switch in the HEAD position.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Headlamps Flash Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 6 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 3.
6. Verify the scan tool Headlamps Flash Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 6 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the S78 Turn Signal/Multifunction Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Turn Signal Switch Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B3881 OR B3882: LEFT/RIGHT TAIL LAMP CIRCUIT (MBM)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3881 02

Left Tail Lamp Circuit Short to Ground

DTC B3881 04

Left Tail Lamp Circuit Open

DTC B3882 02

Right Tail Lamp Circuit Short to Ground

DTC B3882 04

Right Tail Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Tail Lamp Control	B3881 02	B3881 04	-	-
Right Tail Lamp Control	B3882 02	B3882 04	-	-
Left Tail/Stop Lamp Ground	-	1	-	-
Right Tail/Stop Lamp Ground	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the headlamp switch is placed in either the park or low beam position, ground is applied from the park lamp signal circuit to the body control module (BCM). The BCM sends this message to the trailer lighting control module. The trailer lighting control module responds by applying battery voltage to the left and right tail lamp control circuits, illuminating the left and right tail lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Tail lamps ON.

Conditions for Setting the DTC

DTC B3881 02

The trailer lighting control module detects a short to ground in the left tail lamp control circuit.

DTC B3881 04

The trailer lighting control module detects an open in the left tail lamp control circuit.

DTC B3882 02

The trailer lighting control module detects a short to ground in the right tail lamp control circuit.

DTC B3882 04

The trailer lighting control module detects an open in the right tail lamp control circuit.

Actions Taken When the DTC Sets

The appropriate tail lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the ignition is cycled.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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Description and Operation

Exterior Lighting Systems Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3881

1. Vehicle OFF, exterior lamps OFF, disconnect the X910 harness connector at the E42L Tail Lamp Assembly - Left.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Left Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E42L Tail Lamp Assembly - Left.

DTC B3882

1. Vehicle OFF, exterior lamps OFF, disconnect the X920 harness connector at the E42R Tail Lamp Assembly - Right.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

    - If less than 2 Ω, repair the open/high resistance in the ground connection.
  - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Right Rear Stop/Park Lamp ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the E42R Tail Lamp Assembly - Right.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Tail Lamp Control Module Replacement
- Refer to Rear Combination Lamp Replacement
- Refer to Control Module References for trailer lighting control module replacement, programming, and setup

DTC B3881 OR B3882: LEFT/RIGHT TAIL LAMP CIRCUIT (MAH/MBC/MAW/MCX)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3881 02

Left Tail Lamp Circuit Short to Ground

DTC B3881 04

Left Tail Lamp Circuit Open

DTC B3882 02

Right Tail Lamp Circuit Short to Ground

DTC B3882 04

Right Tail Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Tail Lamp Control	B3881 02	B3881 04	-	-
Right Tail Lamp Control	B3882 02	B3882 04	-	-
Left Tail/Stop Lamp Ground	-	1	-	-
Right Tail/Stop Lamp Ground	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the headlamp switch is placed in either the park or low beam position, ground is applied from the park lamp signal circuit to the body control module (BCM). The BCM sends this message to the trailer interface control module. The trailer interface control module responds by applying battery voltage to the left and right tail lamp control circuits, illuminating the left and right tail lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Tail lamps ON.

Conditions for Setting the DTC

DTC B3881 02

The trailer interface control module detects a short to ground in the left tail lamp control circuit.

DTC B3881 04

The trailer interface control module detects an open in the left tail lamp control circuit.

DTC B3882 02

The trailer interface control module detects a short to ground in the right tail lamp control circuit.

DTC B3882 04

The trailer interface control module detects an open in the right tail lamp control circuit.

Actions Taken When the DTC Sets

The appropriate tail lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the ignition is cycled.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3881

1. Vehicle OFF, exterior lamps OFF, disconnect the X910 harness connector at the E42L Tail Lamp Assembly - Left.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Left Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E42L Tail Lamp Assembly - Left.

DTC B3882

1. Vehicle OFF, exterior lamps OFF, disconnect the X920 harness connector at the E42R Tail Lamp Assembly - Right.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**

3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Right Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E42R Tail Lamp Assembly - Right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Rear Combination Lamp Replacement**
- Refer to **Control Module References** for trailer interface control module replacement, programming, and setup

DTC B3883: LICENSE PLATE LAMP CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3883 01

License Plate Lamp Circuit Short to Battery

DTC B3883 02

License Plate Lamp Circuit Short to Ground

DTC B3883 04

License Plate Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
License Plate Lamp Control	B3883 02	B3883 01, B3883 04	B3883 01	-
License Plate Lamp - Right Ground	-	1	-	-
License Plate Lamp - Left Ground	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction				

Circuit/System Description

When the turn signal/multifunction switch is placed in the HEAD or PARK position, ground is applied to the park lamp switch ON signal circuit to the body control module (BCM). The BCM responds by applying voltage to the park lamps and license lamps control circuits illuminating the park and license lamps.

Conditions for Running the DTC

DTC B3883 01

Turn signal/multifunction switch in OFF position.

DTC B3883 02 and B3883 04

Turn signal/multifunction switch in AUTO, PARK or ON positions.

Conditions for Setting the DTC

DTC B3883 01

The BCM detects a short to voltage in the license plate lamp control circuit.

DTC B3883 02

The BCM detects a short to ground in the license plate lamp control circuit.

DTC B3883 04

The BCM detects an open/high resistance in the license plate lamp control circuit.

Actions Taken When the DTC Sets

DTC B3883 01

License plate lamps always ON.

DTC B3883 02 and B3883 04

License plate lamps inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, remove both E7 License Plate Lamp bulbs.
2. Test for less than 5 Ω between each ground circuit terminal 2 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Connect a test lamp between the E7L License Plate Lamp - Left control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Vehicle OFF.
6. Connect a test lamp between the E7R License Plate Lamp - Right control circuit terminal 1 and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.

    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
  3. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
- **If the test lamp turns ON and OFF**

8. Test or replace the E7 License Plate Lamp bulb.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rear License Plate Lamp Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B3884: CENTER HIGH MOUNTED STOP LAMP CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3884 01

Center High Mounted Stop Lamp Circuit Short to Battery

DTC B3884 02

Center High Mounted Stop Lamp Circuit Short to Ground

DTC B3884 04

Center High Mounted Stop Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Center High Mounted Stop Lamp Control	B3884 02	1	1	-
Center High Mounted Stop Lamp Ground	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp control circuit illuminating the left and right stop lamps and the center high mounted stop lamp.

Conditions for Running the DTC

- Battery voltage must be between 9-16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC B3884 01

The BCM detects a short to voltage in the center high mounted stop lamp control circuit.

DTC B3884 02

The BCM detects a short to ground in the center high mounted stop lamp control circuit.

DTC B3884 04

The BCM detects an open/high resistance in the center high mounted stop lamp control circuit.

Actions Taken When the DTC Sets

DTC B3884 01

Center high mounted stop lamp always ON.

DTC B3884 02 and B3884 04

Center high mounted stop lamp inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Center Stop Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E6 Center High Mounted Stop Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **High Mount Stop Lamp Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC B388B OR B388C: AUXILIARY LEFT/RIGHT TAIL AND STOP LAMP CIRCUIT (MBM)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B388B 02

Auxiliary Left Tail and Stop Lamp Circuit Short to Ground

DTC B388B 04

Auxiliary Left Tail and Stop Lamp Circuit Open

DTC B388C 02

Auxiliary Right Tail and Stop Lamp Circuit Short to Ground

DTC B388C 04

Auxiliary Right Tail and Stop Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Auxiliary Left Tail/Stop Lamp Control	B388B 02	B388B 04	-	-
Auxiliary Right Tail/Stop Lamp Control	B388C 02	B388C 04	-	-
Auxiliary Left Tail/Stop Lamp Ground	-	1	-	-
Auxiliary Right Tail/Stop Lamp Ground	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor provides an analog voltage signal to the BCM. The BCM sends this message to the trailer lighting control module. The trailer lighting control module responds by applying battery voltage to the left and right stop lamp control circuits, illuminating the left and right stop lamps. When the liftgate is in the CLOSED position, the trailer lighting control module will illuminate the left and right stop lamps. When the liftgate is in the OPEN position, the trailer lighting control module will illuminate the left and right auxiliary stop lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brake pedal applied.
- Liftgate OPEN.

Conditions for Setting the DTC

DTC B388B 02

The trailer lighting control module detects a short to ground in the left auxiliary tail/stop lamp control circuit.

DTC B388B 04

The trailer lighting control module detects an open in the left auxiliary tail/stop lamp control circuit.

DTC B388C 02

The trailer lighting control module detects a short to ground in the right auxiliary tail/stop lamp control circuit.

DTC B388C 04

The trailer lighting control module detects an open in the right auxiliary tail/stop lamp control circuit.

Actions Taken When the DTC Sets

The appropriate auxiliary tail/stop lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the ignition is cycled.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B388B

1. Vehicle OFF, exterior lamps OFF, disconnect the X410 harness connector at the E51L Tail Lamp Assembly - Auxiliary Left.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the E5LC Tail/Stop Lamp - Auxiliary Left.

DTC B388C

1. Vehicle OFF, exterior lamps OFF, disconnect the X420 harness connector at the E51R Tail Lamp Assembly - Auxiliary Right.

2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E5RC Tail/Stop Lamp - Auxiliary Right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog) Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Control Module References** for trailer lighting control module replacement, programming, and setup

DTC B388B OR B388C: AUXILIARY LEFT/RIGHT TAIL AND STOP LAMP CIRCUIT (MAH/MBC/MAW/MCX)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B388B 02

Auxiliary Left Tail and Stop Lamp Circuit Short to Ground

DTC B388B 04

Auxiliary Left Tail and Stop Lamp Circuit Open

DTC B388C 02

Auxiliary Right Tail and Stop Lamp Circuit Short to Ground

DTC B388C 04

Auxiliary Right Tail and Stop Lamp Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Auxiliary Left Tail/Stop Lamp Control	B388B 02	B388B 04	-	-
Auxiliary Right Tail/Stop Lamp Control	B388C 02	B388C 04	-	-
Auxiliary Left Tail/Stop Lamp Ground	-	1	-	-
Auxiliary Right Tail/Stop Lamp Ground	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor provides an analog voltage signal to the BCM. The BCM sends this message to the trailer interface control module. The trailer interface control module responds by applying battery voltage to the left and right stop lamp control circuits, illuminating the left and right stop lamps. When the liftgate is in the CLOSED position, the trailer interface control module will illuminate the left and right stop lamps. When the liftgate is in the OPEN position, the trailer interface control module will illuminate the left and right auxiliary stop lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brake pedal applied.
- Liftgate OPEN.

Conditions for Setting the DTC

DTC B388B 02

The trailer interface control module detects a short to ground in the left auxiliary tail/stop lamp control circuit.

DTC B388B 04

The trailer interface control module detects an open in the left auxiliary tail/stop lamp control circuit.

DTC B388C 02

The trailer interface control module detects a short to ground in the right auxiliary tail/stop lamp control circuit.

DTC B388C 04

The trailer interface control module detects an open in the right auxiliary tail/stop lamp control circuit.

Actions Taken When the DTC Sets

The appropriate auxiliary tail/stop lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists and the ignition is cycled.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B388B

1. Vehicle OFF, exterior lamps OFF, disconnect the X410 harness connector at the E51L Tail Lamp Assembly - Auxiliary Left.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
    - **If the test lamp is always ON**

    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E5LC Tail/Stop Lamp - Auxiliary Left.

DTC B388C

1. Vehicle OFF, exterior lamps OFF, disconnect the X420 harness connector at the E51R Tail Lamp Assembly - Auxiliary Right.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E5RC Tail/Stop Lamp - Auxiliary Right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog)** **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Control Module References** for trailer interface control module replacement, programming, and setup

DTC B3890 OR B3891: TRAILER BACKUP/FOG LAMPS CIRCUIT SHORT TO GROUND (MBM)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3890 02

Trailer Backup Lamps Circuit Short to Ground

DTC B3891 02

Trailer Fog Lamps Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Stop Lamp Control	B3890 02	B3890 04	1	-
Right Stop Lamp Control	B3891 02	B3891 04	1	-
Tail Lamp Assembly - Left Ground	-	1	-	-
Tail Lamp Assembly - Right Ground	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor provides an analog voltage signal to the BCM. The BCM sends this message to the trailer lighting control module. The trailer lighting control module responds by applying battery voltage to the left and right stop lamp control circuits, illuminating the left and right stop lamps. When the liftgate is in the CLOSED position, the trailer lighting control module will illuminate the left and right stop lamps. When the liftgate is in the OPEN position, the trailer lighting control module will illuminate the left and right auxiliary stop lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brake pedal applied.
- Liftgate CLOSED.

Conditions for Setting the DTC

DTC B3890 02

The trailer lighting control module detects a short to ground in the left stop lamp control circuit.

DTC B3890 04

The trailer lighting control module detects an open/high resistance in the left stop lamp control circuit.

DTC B3891 02

The trailer lighting control module detects a short to ground in the right stop lamp control circuit.

DTC B3891 04

The trailer lighting control module detects an open/high resistance in the right stop lamp control circuit.

Actions Taken When the DTC Sets

The appropriate tail/stop lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3890

1. Vehicle OFF, exterior lamps OFF, disconnect the X910 harness connector at the E42L Tail Lamp Assembly - Left.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp is always ON**

    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E42L Tail Lamp Assembly - Left.

DTC B3891

1. Vehicle OFF, exterior lamps OFF, disconnect the X920 harness connector at the E42R Tail Lamp Assembly - Right.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E42R Tail Lamp Assembly - Right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Rear Combination Lamp Replacement**
- Refer to **Control Module References** for trailer lighting control module replacement, programming, and setup

DTC B3890 OR B3891: TRAILER BACKUP/FOG LAMPS CIRCUIT SHORT TO GROUND (MAH/MBC/MAW/MCX)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3890 02

Trailer Backup Lamps Circuit Short to Ground

DTC B3891 02

Trailer Fog Lamps Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Stop Lamp Control	B3890 02	B3890 04	1	-
Right Stop Lamp Control	B3891 02	B3891 04	1	-
Tail Lamp Assembly - Left Ground	-	1	-	-
Tail Lamp Assembly - Right Ground	-	1	-	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position sensor provides an analog voltage signal to the BCM. The BCM sends this message to the trailer interface control module. The trailer interface control module responds by applying battery voltage to the left and right stop lamp control circuits, illuminating the left and right stop lamps. When the liftgate is in the CLOSED position, the trailer interface control module will illuminate the left and right stop lamps. When the liftgate is in the OPEN position, the trailer interface control module will illuminate the left and right auxiliary stop lamps.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brake pedal applied.
- Liftgate CLOSED.

Conditions for Setting the DTC

DTC B3890 02

The trailer interface control module detects a short to ground in the left stop lamp control circuit.

DTC B3890 04

The trailer interface control module detects an open/high resistance in the left stop lamp control circuit.

DTC B3891 02

The trailer interface control module detects a short to ground in the right stop lamp control circuit.

DTC B3891 04

The trailer interface control module detects an open/high resistance in the right stop lamp control circuit.

Actions Taken When the DTC Sets

The appropriate tail/stop lamp is inoperative.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3890

1. Vehicle OFF, exterior lamps OFF, disconnect the X910 harness connector at the E42L Tail Lamp Assembly - Left.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
   - **If the test lamp is always ON**

    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E42L Tail Lamp Assembly - Left.

DTC B3891

1. Vehicle OFF, exterior lamps OFF, disconnect the X920 harness connector at the E42R Tail Lamp Assembly - Right.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E42R Tail Lamp Assembly - Right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Rear Combination Lamp Replacement**
- Refer to **Control Module References** for trailer interface control module replacement, programming, and setup

DTC B3948 OR B3949: LEFT/RIGHT FRONT TURN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3948 01

Left Front Turn Signal Circuit Short to Battery

DTC B3948 02

Left Front Turn Signal Circuit Short to Ground

DTC B3948 04

Left Front Turn Signal Circuit Open

DTC B3949 01

Right Front Turn Signal Circuit Short to Battery

DTC B3949 02

Right Front Turn Signal Circuit Short to Ground

DTC B3949 04

Right Front Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F7DA (BCM 3) Fuse B+	B3949 01, B3949 04	B3949 01, B3949 04	-	-
F43DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	-	-
Turn Signal Control - Left Front	B3948 01, B3948 02	B3948 01, B3948 04	B3948 01	-
Turn Signal Control - Right Front	B3949 01, B3949 02	B3949 01, B3949 04	B3949 01	-
Outside Rearview Mirror - Driver Ground	-	1	-	-
Outside Rearview Mirror - Passenger Ground	-	1	-	-
Turn Signal Lamp - Left Front Ground	-	1	-	-
Turn Signal Lamp - Right Front Ground	-	1	-	-
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the SERVICE MODE or ON positions. When the turn signal/multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the

BCM, a serial data message is sent to the instrument panel requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B3948 01

The BCM detects a short to voltage in the left front turn signal control circuit.

DTC B3948 01 and B3948 04

- The BCM detects a short to ground or an open/high resistance in the F43DA (BCM 7) fuse B+ circuit.
- The BCM detects an open/high resistance in the left front turn signal control circuit.

DTC B3948 02

The BCM detects a short to ground in the left front turn signal control circuit.

DTC B3949 01

The BCM detects a short to voltage in the left front turn signal control circuit.

DTC B3949 01 and B3949 04

- The BCM detects a short to ground or an open/high resistance in the F7DA (BCM 3) fuse B+ circuit.
- The BCM detects an open/high resistance in the right front turn signal control circuit.

DTC B3949 02

The BCM detects a short to ground in the right front turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3948

- The left front turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Left Front Turn Indicator Failure".

DTC B3949

- The right front turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Right Front Turn Indicator Failure".

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- Exterior Lights Schematics
- Body Control System Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3948

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Exterior lamps OFF, disconnect the harness connector at the appropriate left front turn signal listed below.
   - E4LF Turn Signal Lamp - Left Front
   - A9A Outside Rearview Mirror - Driver
5. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4LF Turn Signal Lamp - Left Front terminal 2
   - A9A Outside Rearview Mirror - Driver terminal 5
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E4LF Turn Signal Lamp - Left Front terminal 1

   - A9A Outside Rearview Mirror - Driver terminal 6

7. Verify the test lamp turns ON and OFF when commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
8. Test or replace the appropriate left front turn signal lamp.

DTC B3949

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Exterior lamps OFF, disconnect the harness connector at the appropriate right front turn signal listed below.
   - E4RF Turn Signal Lamp - Right Front
   - A9B Outside Rearview Mirror - Passenger
5. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4RF Turn Signal Lamp - Right Front terminal 2
   - A9B Outside Rearview Mirror - Passenger terminal 5
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E4RF Turn Signal Lamp - Right Front terminal 1
    - A9B Outside Rearview Mirror - Passenger terminal 6
7. Verify the test lamp turns ON and OFF when commanding the Right Front Turn Signal Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
8. Test or replace the E4RF Turn Signal Lamp - Right Front.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Front Turn Signal Lamp Bulb Replacement**
- Refer to **Outside Rearview Mirror Turn Signal Lamp Replacement**
- Refer to **Control Module References** for BCM replacement, programming and setup

DTC B3950 OR B3951: LEFT/RIGHT REAR TURN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3950 01

Left Rear Turn Signal Circuit Short to Battery

DTC B3950 02

Left Rear Turn Signal Circuit Short to Ground

DTC B3950 04

Left Rear Turn Signal Circuit Open

DTC B3951 01

Right Rear Turn Signal Circuit Short to Battery

DTC B3951 02

Right Rear Turn Signal Circuit Short to Ground

DTC B3951 04

Right Rear Turn Signal Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 4) Fuse B+	B3950 01, B3950 04	B3950 01, B3950 04	-	-
F43DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	-	-
Turn Signal - Left Rear Control	B3950 01, B3950 02	B3950 01, B3950 04	B3950 01	-
Turn Signal - Right Rear Control	B3951 01, B3951 02	B3951 01, B3951 04	B3951 01	-
Turn Signal Lamp - Left Rear Ground	-	1	-	-
Turn Signal Lamp - Right Rear Ground	-	1	-	-
1. Turn Signal Lamps and/or Indicators Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the vehicle ON/OFF switch in the SERVICE MODE or ON positions. When the turn signal/multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument panel requesting the respective turn signal indicator be pulsed ON and OFF.

Conditions for Running the DTC

Battery voltage must be between 9-16 V.

Conditions for Setting the DTC

DTC B3950 01

The BCM detects a short to voltage in the left rear turn signal control circuit.

DTC B3950 01 and B3950 04

- The BCM detects a short to ground or an open/high resistance in the F6DA (BCM 4) fuse B+ circuit.
- The BCM detects an open/high resistance in the left rear turn signal control circuit.

DTC B3950 02

The BCM detects a short to ground in the left rear turn signal control circuit.

DTC B3951 01

The BCM detects a short to voltage in the right rear turn signal control circuit.

DTC B3951 01 and B3951 04

- The BCM detects a short to ground or an open/high resistance in the F43DA (BCM 7) fuse B+ circuit.
- The BCM detects an open/high resistance in the right rear turn signal control circuit.

DTC B3951 02

The BCM detects a short to ground in the right rear turn signal control circuit.

Actions Taken When the DTC Sets

DTC B3950

- The left rear turn signal is inoperative.
- The left turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Left Rear Turn Indicator Failure".

DTC B3951

- The right rear turn signal is inoperative.
- The right turn signal indicator on the instrument cluster flashes rapidly.
- The driver information center displays "Right Rear Turn Indicator Failure".

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC B3950

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**

   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**

3. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E4LR Turn Signal Lamp - Left Rear.
5. Test for less than 10 Ω between the ground circuit at the socket terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Left Rear Turn Signal Lamp ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
8. Test or replace the E4LR Turn Signal Lamp - Left Rear.

DTC B3951

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E4RR Turn Signal Lamp - Right Rear.
5. Test for less than 10 Ω between the ground circuit at the socket terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Right Rear Turn Signal Lamp ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
8. Test or replace the E4RR Turn Signal Lamp - Right Rear.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog) Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)
- Refer to Rear Fascia Lower Signal Lamp Replacement
- Refer to Control Module References for BCM replacement, programming and setup

DTC C0277 OR C0890: BRAKE PEDAL POSITION SENSOR CIRCUIT/CONTROL MODULE VOLTAGE REFERENCE OUTPUT 3 CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC C0277 06

Brake Pedal Position Sensor Circuit Low Voltage/Open

DTC C0277 07

Brake Pedal Position Sensor Circuit High Voltage

DTC C0277 09

Brake Pedal Position Sensor Circuit Too Fast Transitions

DTC C0277 4B

Brake Pedal Position Sensor Circuit Calibration Not Learned

DTC C0890 03

Control Module Voltage Reference Output 3 Circuit Low Voltage

DTC C0890 07

Control Module Voltage Reference Output 3 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, U0422 71	C0277 06, U0422 71	C0890 07, U0422 71	-
Brake Pedal Position Sensor Signal	C0277 06, U0422 71	C0277 06, U0422 71	C0277 07, C0890 07, U0422 71	C0277 09
Brake Pedal Position Sensor Low Reference	-	C0277 07, U0422 71	1	-
1. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the left and right stop lamp control circuits as well as the center high mounted stop lamp (CHMSL) control circuit illuminating the left and right stop lamps and the CHMSL.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

DTC C0277 06

- The BCM detects a short to ground or an open/high resistance in the BPP sensor 5 V reference circuit.
- The BCM detects a short to ground or an open/high resistance in the BPP sensor signal circuit.

DTC C0277 07

- The BCM detects an open/high resistance in the BPP sensor low reference circuit.
- The BCM detects a short to voltage in the BPP sensor signal circuit.

DTC C0277 09

The BCM detects the BPP sensor signal is changing faster than possible under normal operating conditions.

DTC C0277 4B

The DTC will set when the BPP sensor home position is not learned.

DTC C0890 03

- The BCM detects a short to ground in the BPP sensor 5 V reference circuit.

DTC C0890 07

- The BCM detects a short to voltage in the BPP sensor 5 V reference circuit.
- The BCM detects a short to voltage in the BPP sensor signal circuit.

Actions Taken When the DTC Sets

DTC C0277 06 or C0890 03

- The vehicle will not start with a short to ground or an open/high resistance on the BPPS 5 V reference circuit or the BPPS signal circuit.

DTC C0277 07 or C0890 07

The vehicle will not start with a short to voltage on the BPPS 5 V reference circuit or the BPPS signal circuit.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- For DTC C0277 4B a successful brake pedal position sensor calibration has been performed.
- A history DTC will clear once 50 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.
- A DTC will not clear the current status until the next ignition cycle.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

DTC C0277 06, C0277 07, C0890 03, and C0890 07

1. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.
2. Test for B+ between the low reference circuit terminal 2 and B+.
   - **If less than B+**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If B+**
3. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 5 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If greater than 5.2 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If between 4.8 - 5.2 V**
4. Verify the scan tool Brake Pedal Applied parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 3 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the 5-volt reference circuit terminal 1 and the signal circuit terminal 3.
6. Verify the scan tool Brake Pedal Applied parameter is Active.
   - **If not Active**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the B22 Brake Pedal Position Sensor.

DTC C0277 4B

1. Verify DTC C0277 4B is not set.
    - **If DTC C0277 4B is set**
    1. Vehicle in Service Mode.
    2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to **Brake Pedal Position Sensor Calibration** .
    3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.
        - If the DTC resets, replace the B22 Brake Pedal Position Sensor.
        - If the DTC does not reset
    4. All OK.
    - **If DTC C0277 4B is not set**
2. All OK.

DTC C0277 09

1. Verify DTC C0277 09 is not set.
    - **If DTC C0277 09 is set**
    1. Replace the B22 Brake Pedal Position Sensor.
    2. Perform the BPP sensor recalibration procedure for the K9 Body Control Module. Refer to **Brake Pedal Position Sensor Calibration** .
    3. Verify the DTC does not reset while operating the vehicle under the conditions for running the DTC.
        - If the DTC resets, replace the K9 Body Control Module.
        - If the DTC does not reset
    4. All OK.
    - **If DTC C0277 09 is not set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Brake Pedal Position Sensor Calibration**
- Refer to **Brake Pedal Position Sensor Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DTC C0297: BRAKE APPLIED OUTPUT CIRCUIT SHORT TO GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0297 02

Brake Applied Output Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Brake Applied Signal	C0297 02	1	1	-
1. Cruise Control Malfunction				

Circuit/System Description

The brake pedal position sensor is used to sense the action of the driver application of the brake pedal. The brake pedal position sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5 V reference voltage to the brake pedal position sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the right and left stop lamp control circuits, engine control module (ECM), and center high mounted stop lamp control circuit.

Conditions for Running the DTC

- Battery voltage must be between 9 - 16 V.
- Brakes APPLIED.

Conditions for Setting the DTC

The BCM detects a short to ground or an open/high resistance on the brake applied signal circuit.

Actions Taken When the DTC Sets

The cruise control system is disabled.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free vehicle ON/OFF switch cycles have occurred.

Diagnostic Aids

Verify that the brake pedal position sensor is properly calibrated.

Reference Information

Schematic Reference

Cruise Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Connect a test lamp between the signal circuit terminal 20 and ground, ignition ON.
3. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
4. Replace the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Brake Pedal Position Sensor Calibration**
- Refer to **Control Module References** for BCM or ECM replacement, programming, and setup

SYMPTOMS - LIGHTING

NOTE: **The following steps must be completed before using a symptom table.**

- Perform the **Diagnostic System Check - Vehicle** before using a symptom table in order to verify that all of the following conditions are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
- Review the system description and operation in order to familiarize yourself with the system functions. Refer to the following:
    - **Exterior Lighting Systems Description and Operation**
    - **Interior Lighting Systems Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the lighting system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Thoroughly inspect the wiring and connectors. An incomplete inspection of the wiring and connectors may result in misdiagnosis causing part replacement with the reappearance of the malfunction. If an intermittent malfunction exists, refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Backup Lamps Malfunction**
- **Courtesy Lamps Malfunction**
- **Daytime Running Lamps Malfunction**
- **Dome Lamps Malfunction**
- **Rear Fog Lamps Malfunction**
- **Hazard Lamps Malfunction**
- **Headlamps Malfunction**
- **Headlamp Leveling Malfunction**
- **Interior Backlighting Malfunction**
- **Park, License, and/or Tail Lamps Malfunction (MBM)Park, License, and/or Tail Lamps Malfunction (MAH/MBC/MAW/MCX)**
- **Rear Compartment Lamp Malfunction**
- **Stop Lamps Malfunction (MBM)Stop Lamps Malfunction (MAH/MBC/MAW/MCX)**
- **Turn Signal Lamps and/or Indicators Malfunction**

BACKUP LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F17DA (BCM 6) Fuse B+	1	1	-	-
Backup Lamp Control	B2545 02	1	1	-
Backup Lamp Ground	-	1	-	-
1. Backup Lamps Malfunction				

Circuit/System Description

With the vehicle ON and the transmission in the reverse position, the transmission control module (TCM) sends a serial data message to the body control module (BCM). The message indicates that the gear selector is in the reverse position. The BCM applies battery voltage to the backup lamp control circuit illuminating the backup lamp. Once the driver moves the gear selector out of the reverse position, a message is sent by the TCM via serial data requesting the BCM to remove battery voltage from the backup lamp control circuit. The vehicle must be ON for the backup lamps to operate.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E5 Backup Lamp.
5. Test for less than 5 Ω between the ground circuit at the socket terminal and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
6. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Backup Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**

        1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
        2. Test for less than 1 V between the control circuit terminal and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**

8. Test or replace the E5 Backup Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog) Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Control Module References** for BCM replacement, programming, and setup

COURTESY LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F17DA (BCM 6) Fuse B+	1	1	-	-
Courtesy Lamps Control - Terminal 2 X7	B1480 02	1	1	-
Dome/Reading Lamps - Overhead Console Ground	-	1	-	-
Dome/Reading Lamps - Rear Ground	-	1	-	-
1. Courtesy Lamps Malfunction				

Circuit/System Description

The body control module (BCM) supplies battery voltage to the front and rear reading lamps via the courtesy lamp control circuit. The front and rear reading lamps are controlled by individual switches that are activated by the operator when additional cabin lighting is required. In the event that any of these courtesy lamps were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the courtesy lamp control circuit to prevent total battery discharge.

Diagnostic Aids

The Inadvertent Load scan tool command operates when the front and rear dome lamp switches are in the ON position.

Reference Information

Schematic Reference

- **Interior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module
    - **If the test lamp illuminates**
3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connectors at the inoperative component listed below. It may take up to 2 min for all vehicle systems to power down.
    - E37D Dome/Reading Lamps - Overhead Console
    - E37R Dome/Reading Lamps - Rear
5. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
    - E37D Dome/Reading Lamps - Overhead Console terminal 4
    - E37R Dome/Reading Lamps - Rear terminal 3
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E37D Dome/Reading Lamps - Overhead Console terminal 2
    - E37R Dome/Reading Lamps - Rear terminal 1
7. Verify the test lamp turns ON and OFF when commanding the Inadvertent Load ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.

    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**

8. Test or replace the appropriate courtesy lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Roof Console Replacement**
- Refer to **Center Courtesy Lamp Replacement**
- Refer to **Rear Seat Position Center Courtesy Lamp Bulb Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DAYTIME RUNNING LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Daytime Running Lamp Control - Left	B2600 02	1	1	-
Daytime Running Lamp Control - Right	B2605 02	1	1	-
Headlamp Assembly Ground - Left	-	1	-	-
Headlamp Assembly Ground - Right	-	1	-	-
1. Daytime Running Lamps Malfunction				

Circuit/System Description

The ambient light/sunload sensor is used to monitor outside lighting conditions. The ambient light/sunload sensor provides a serial data message to the body control module (BCM) based on outside lighting conditions to determine if outside lighting conditions are correct for either daytime running lamps or automatic lamp control when the headlamp switch is in the AUTO position. In daylight conditions the BCM will command the designated daytime running lamps ON. During low light conditions the BCM will command the low beam headlamps ON. Any function or condition that turns on the headlamps will cancel daytime running lamps operation.

Diagnostic Aids

The daytime running lamps will only operate in daylight conditions with the vehicle ON and in any transmission gear except PARK.

Reference Information

Schematic Reference

- Headlights/Daytime Running Lights (DRL) Schematics
- Body Control System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lights Schematics

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the left daytime running lamp turns ON and OFF when commanding the Left Dedicated Daytime Running Lamp ON and OFF with a scan tool.
    - **If the left daytime running lamp does not turn ON and OFF**

      Refer to Daytime Running Lamp Malfunction.

    - **If the left daytime running lamp turns ON and OFF**
3. Verify the right daytime running lamp turns ON and OFF when commanding the Right Dedicated Daytime Running Lamp ON and OFF with a scan tool.
    - **If the right daytime running lamp does not turn ON and OFF**

      Refer to Daytime Running Lamp Malfunction.

    - **If the right daytime running lamp turns ON and OFF**
4. Refer to DTC U1340-U135F .

Circuit/System Testing

Daytime Running Lamp Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below.
    - X110 - left daytime running lamp
    - X120 - right daytime running lamp
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
    - Terminal 5 (-TR6)
    - Terminal 7 (TR6)
    - **If 10 Ω or greater**
    1. Vehicle OFF.

        2. Test for less than 2 Ω in the ground circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, repair the open/high resistance in the ground connection.
        - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Dedicated Daytime Running Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E13 Headlamp Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

DOME LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Dome Lamps Control - Terminal 1 X7	B2615 02	1	1	-
Dome Lamp Switch Cancel Signal	2	2	2	-
Dome Lamp Switch ON Signal	2	2	2	-
Dome/Reading Lamps Ground - Overhead Console	-	1, 2	-	-
Dome/Reading Lamps Ground - Rear	-	1	-	-
1. Dome Lamps Malfunction 2. Dome Lamp Switch Malfunction				

Circuit/System Description

The dome lamp switch has 3 positions: DOOR, OFF, and ON. The ON position provides a ground for continuous operation and the dome lamps will remain illuminated until the switch is placed in either the DOOR or OFF position. When in the DOOR position, the dome lamps operation is controlled by the body control module (BCM). When any door is opened, the door ajar switch contacts close and the BCM receives a door-open input. The BCM illuminates the dome lamps when any door is opened or a door lock/unlock request is activated with the key fob. After all doors have been closed, the dome lamps will remain illuminated approximately 3 s after the last door closes. When the driver places the dome lamp switch in the OFF position, the dome lamps will be disabled. In the event that the dome lamps were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position and no doors opened, the BCM will deactivate the dome lamps control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

Interior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Door Ajar Sw. parameter changes between Active and Inactive while opening and closing each vehicle door.
   - **If the parameter does not change**

     Refer to **Door Ajar Indicator Malfunction** .
   - **If the parameter changes**
3. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter changes between Door, On, and Cancel while placing the dome lamp switch in the Door, On, and Cancel positions.
   - **If the parameter does not change**

     Refer to Dome Lamp Switch Malfunction.
   - **If the parameter changes**
4. Verify the dome lamps turn ON and OFF while commanding the Courtesy Lamps ON and OFF with a scan tool.
   - **If the dome lamps do not turn ON and OFF**

     Refer to Dome Lamp Malfunction.
   - **If the dome lamps turn ON and OFF**

5. All OK.

Circuit/System Testing

Dome Lamp Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the E37D Dome/Reading Lamps - Overhead Console. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.
   - **If 5 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter is Door.
   - **If Cancel**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 6 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If On**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Door**
5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and the ground circuit terminal 4.
6. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter is Cancel.
   - **If not Cancel**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 6 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Cancel**
7. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 4.
8. Verify the scan tool Interior/Courtesy Lighting Master Switch parameter is On.
   - **If not On**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 5 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V

   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If On**
9. Test or replace the E37D Dome/Reading Lamps - Overhead Console.

Dome Lamps Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the inoperative component listed below. It may take up to 2 min for all vehicle systems to power down.
   - E37D Dome/Reading Lamps - Overhead Console
   - E37R Dome/Reading Lamps - Rear
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - E37D Dome/Reading Lamps - Overhead Console terminal 4
   - E37R Dome/Reading Lamps - Rear terminal 3
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuits end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E37D Dome/Reading Lamps - Overhead Console terminal 3
   - E37R Dome/Reading Lamps - Rear terminal 4
4. Verify the test lamp turns ON and OFF when commanding the Courtesy Lamps ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the inoperative E37 Dome/Reading Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Roof Console Replacement**
- Refer to **Center Courtesy Lamp Replacement**
- Refer to **Rear Seat Position Center Courtesy Lamp Bulb Replacement**

- Refer to Control Module References for BCM replacement, programming, and setup

REAR FOG LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Rear Fog Lamp Switch Signal	B3588 00	2	2	-
Rear Fog Lamps Control	B2540 02	B2540 04	1	-
Rear Fog Lamp Ground	-	1	-	-
Headlamp Switch Ground	-	2	-	-
1. Rear Fog Lamp Malfunction 2. Rear Fog Lamp Switch Malfunction				

Circuit/System Description

The rear fog lamp switch signal circuit is grounded momentarily by pressing the rear fog lamp switch. The body control module (BCM) responds to the rear fog lamp request by applying voltage to the rear fog lamp control circuit which illuminates the rear fog lamp.

Reference Information

Schematic Reference

Fog Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, headlamps ON.
2. Verify the scan tool Rear Fog Lamps Switch parameter changes between Active and Inactive while commanding the rear fog lamp ON and OFF with the rear fog lamp switch.
   - **If the parameter does not change**

     Refer to Rear Fog Lamp Switch Malfunction.

  - **If the parameter changes**
3. Verify the rear fog lamp turns ON and OFF when commanding the Rear Fog Lamp(s) Relay ON and OFF with a scan tool.
   - **If the rear fog lamp does not turn ON and OFF**

     Refer to Rear Fog Lamp Malfunction.

   - **If the rear fog lamp turns ON and OFF**
4. Verify the rear fog lamp indicator on the instrument cluster turns ON and OFF while commanding the rear fog lamp ON and OFF with the rear fog lamp switch.
   - **If the rear fog lamp indicator does not turn ON and OFF**

     Refer to Rear Fog Lamp Indicator Malfunction.

   - **If the rear fog lamp indicator turns ON and OFF**
5. All OK.

Circuit/System Testing

Rear Fog Lamp Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the ground circuit terminal 8 and ground.
   - **If 15 Ω or greater**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 15 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Rear Fog Lamp Switch parameter is Inactive.
   - **If not Inactive**
     1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
     2. Test for infinite resistance between the signal circuit terminal 6 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
6. Verify the scan tool Rear Fog Lamp Switch parameter is Active.
   - **If not Active**
     1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
     2. Test for less than 1 V between the signal circuit terminal 6 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
     3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
7. Test or replace the S30 Headlamp Switch.

Rear Fog Lamp Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the X410 harness connector at the E5EA Tail Lamp - Auxiliary Left.
2. Test for less than 5 Ω between the ground circuit terminal 6 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Connect a test lamp between the control circuit terminal 4 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the Rear Fog Lamp(s) Relay ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E5EA Tail Lamp - Auxiliary Left.

Rear Fog Lamp Indicator Malfunction

1. Vehicle in Service Mode.
2. Verify the rear fog lamp indicator turns ON and OFF when commanding the Instrument Cluster All Indicators Test ON and OFF with a scan tool.
    - **If the rear fog lamp indicator is always OFF or remains ON**

      Replace the P16 Instrument Cluster.

    - **If the rear fog lamp indicator turns ON and OFF**
3. Replace the K9 Body Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Headlamp Switch Replacement
- Refer to Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog) Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)
- Refer to Control Module References for BCM and instrument cluster replacement, programming, and setup

HAZARD LAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F9DA (BCM 1) Fuse B+	B1325 03, U156D 00	B1325 03, U156D 00	-	-
Hazard Warning Switch Signal	B3596 00	1	1	-
Hazard Warning Switch LED Backlighting Control	2	2	2	-
Multifunction Switch 1 - Instrument Panel Ground	-	1	-	-
1. Hazard Lamps Malfunction 2. Hazard Warning Switch Backlighting Malfunction				

Circuit/System Description

The hazard flashers may be activated in any power mode. The hazard warning switch signal circuit is momentarily grounded when the hazard warning switch is pressed. The body control module (BCM) responds to the hazard warning switch signal input by supplying battery voltage to all four turn signal lamps in an ON and OFF duty cycle. When the hazard warning switch is activated, the BCM sends a serial data message to the instrument cluster requesting both turn signal indicators to be cycled ON and OFF.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hazard Lamps Switch parameter changes between Active and Inactive while commanding the hazard lamps ON and OFF with the hazard warning switch.
   - **If the parameter does not change**

     Refer to Hazard Warning Switch Malfunction.

    - **If the parameter changes**

3. Verify all left and right turn signal lamps turn ON and OFF while commanding the hazard lamps ON and OFF with the hazard warning switch.
    - **If all turn signal lamps do not turn ON and OFF**

      Refer to **Turn Signal Lamps and/or Indicators Malfunction**

    - **If all turn signal lamps turn ON and OFF**
4. Verify the hazard lamps switch backlighting turns ON and OFF while commanding the hazard lamps ON and OFF with the hazard warning switch.
    - **If the hazard warning switch backlighting does not turn ON and OFF**

      Refer to Hazard Warning Switch Backlighting Malfunction.

    - **If the hazard warning switch backlighting turns ON and OFF**
5. All OK.

Circuit/System Testing

Hazard Warning Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S48C Multifunction Switch 1 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Hazard Lamps Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground terminal 10.
6. Verify the scan tool Hazard Lamps Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 1 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the S48C Multifunction Switch 1 - Instrument Panel.

Hazard Warning Switch Backlighting Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module
    - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S48C Multifunction Switch 1 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
6. Vehicle in Service Mode, test for B+ between the control circuit terminal 4 and ground.
    - **If less than B+**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If B+**
7. Verify a test lamp does not illuminate between control circuit terminal 4 and ground.
    - **If the test lamp illuminates**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp does not illuminate**
8. Test or replace the S48C Multifunction Switch 1 - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Hazard Warning Switch Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

HEADLAMPS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp High Beam Relay Control	2	2	B2580 01	-
Headlamp Low Beam Relay Control	B258A 02	B258A 04	B258A 01	-
High Beam Headlamp Control - Left	2	2	2	-
High Beam Headlamp Control - Right	2	2	2	-
Low Beam Headlamp Control - Left	1	1	1	-
Low Beam Headlamp Control - Right	1	1	1	-
Headlamp Switch Headlamps OFF Signal	B257A 00	4	4	-
Headlamp Switch Headlamps ON Signal	B257A 00	4	4	-
Turn Signal/Multifunction Switch Flash To Pass Signal	B3806 00	3	3	-
Turn Signal/Multifunction Switch High Beam Signal	B3650 08	3	3	-
Turn Signal/Multifunction Switch Auto High Beam Select Signal (TQ5)	5	5	5	-
Headlamp Assembly Ground - Left	-	1, 2	-	-
Headlamp Assembly Ground - Right	-	1, 2	-	-
Headlamp Switch Ground	-	4	-	-
Turn Signal/Multifunction Switch Ground	-	3	-	-
1. Headlamps Malfunction - Low Beam 2. Headlamps Malfunction - High Beam 3. Turn Signal/Multifunction Switch Malfunction 4. Headlamp Switch Malfunction 5. Automatic High Beam Select Switch Malfunction				

Circuit/System Description

For headlamp operation, the body control module (BCM) monitors 3 signal circuits from the headlamp switch. When the headlamp switch is in the AUTO position, the 3 signal circuits are open and the BCM relies on the ambient light sensor input to turn the headlamps and daytime running lamps (DRLs) ON and OFF. When the headlamp switch is placed in the OFF position, the headlamp switch headlamps OFF signal circuit is grounded, indicating to the BCM that the exterior lamps should be turned OFF. With the headlamp switch in the PARK LAMPS position, the headlamp switch park lamps ON signal circuit is grounded, indicating that the park lamps have been requested. When the headlamp switch is in the HEADLAMP position, both the headlamp switch park lamps ON signal circuit and the headlamp switch headlamps ON signal circuit are grounded. The BCM responds by commanding the park lamps and headlamps ON.

The high beam and flash to pass functions are contained within the turn signal/multifunction switch. The BCM provides the turn signal/multifunction switch with 2 signal circuits, the high beam signal circuit and the flash to pass signal circuit. When the low beam headlamps are ON and the turn signal/multifunction switch is placed in the high beam position, ground is applied to the BCM through the high beam signal circuit. The BCM responds to the high beam request by applying ground to the high beam relay control circuit which energizes the high beam relay. With the high beam relay energized, the switch contacts close allowing battery voltage to flow through the left and right high beam fuses to the high beam control circuits and on to the left and right high beam solenoid actuators within the headlamp assemblies. Once the high beam solenoid actuators are active, the solenoid shutters open in each headlamp assembly exposing the remaining portion of the headlamp that was covered by the shutters illuminating the high beams at full intensity.

When the turn signal/multifunction switch is momentarily placed in the flash to pass position, ground is applied to the BCM through the flash to pass signal circuit. The BCM responds by applying ground to the high beam relay control circuit which energizes the high beam relay illuminating the high beams for a brief moment or until the flash to pass switch is released.

The automatic high beam assist system operates the high beam headlamps ON and OFF automatically when the system is activated and certain conditions are met. The automatic high beam assist system consists of a front camera module that detects light and is able to identify approaching vehicles on an even, straight road at a distance of greater than 0.4 km (0.25 mi). The front camera module analyzes light color, intensity, and movement. The automatic high beam assist system will turn OFF the high beam headlamps when approaching vehicle headlamps or preceding vehicle taillights are detected by the front camera module. Automatic high beam assist can be deactivated when the headlamp dimmer switch is moved from the neutral position to the high beam or flash to pass positions. Automatic high beam assist can be reactivated by operating the high beam select switch from the neutral position to the high beam position twice within 2 s.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

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Exterior Lighting Systems Description and Operation

Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Headlamps On Switch parameter changes between Active and Inactive while commanding the headlamps ON and OFF with the turn signal/multifunction switch.
   - **If the parameter does not change**

     Refer to Headlamp Switch Malfunction.

   - **If the parameter changes**

3. Verify the scan tool Automatic Headlamps Disable Switch parameter changes between Active and Inactive while commanding the automatic lamp control ON and OFF with the headlamp switch.
   - **If the parameter does not change**

     Refer to Headlamp Switch Malfunction.

   - **If the parameter changes**
4. Verify the scan tool Headlamps Flash Switch parameter changes between Active and Inactive while commanding the flash to pass ON and OFF with the headlamp switch.
   - **If the parameter does not change**

     Refer to Turn Signal/Multifunction Switch Malfunction.

   - **If the parameter changes**
5. Verify the scan tool High Beam Select Switch parameter changes between Active and Inactive while commanding the high beams ON and OFF with the turn signal/multifunction switch.
   - **If the parameter does not change**

     Refer to Turn Signal/Multifunction Switch Malfunction.

   - **If the parameter changes**
6. Verify the low beam headlamps turn ON and OFF when commanding the Low Beam Lamps ON and OFF with a scan tool.
   - **If the low beam headlamps do not turn ON and OFF**

     Refer to Headlamps Malfunction - Low Beam.

   - **If the low beam headlamps turn ON and OFF**
7. Low beam headlamps ON, verify the high beams turn ON and OFF when commanding the High Beams ON and OFF with a scan tool.
   - **If the high beams do not turn ON and OFF**

     Refer to Headlamps Malfunction - High Beam.

   - **If the high beams turn ON and OFF**
8. Verify the high beam indicator on the instrument cluster turns ON and OFF while commanding the All Indicators Test ON and OFF with a scan tool.
   - **If the high beam indicator does not turn ON and OFF**

     Refer to High Beam Indicator Malfunction.

   - **If the high beam indicator turns ON and OFF**
9. (TQ5 only) Verify the scan tool Auto High Beam Select Switch parameter changes between Active and Inactive while commanding the auto high beams ON and OFF with the turn signal/multifunction switch.
   - **If the parameter does not change**

     Refer to Automatic High Beam Select Switch Malfunction.

   - **If the parameter changes**
10. All OK.

Circuit/System Testing

Headlamp Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 8 and ground.

   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Automatic Headlamps Disable Switch parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 3 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.
6. Verify the scan tool Automatic Headlamps Disable Switch parameter is Active.
   - **If not Active**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 3 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
7. Verify the scan tool Headlamps On Switch parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
8. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
9. Verify the scan tool Headlamps On Switch parameter is Active.
   - **If not Active**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 1 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
10. Test or replace the S30 Headlamp Switch.

Turn Signal/Multifunction Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool High Beam Select Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 7 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
6. Verify the scan tool High Beam Select Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 7 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Verify the scan tool Headlamps Flash Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 6 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
8. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
9. Verify the scan tool Headlamps Flash Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 6 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Automatic High Beam Select Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Auto High Beam Select Switch parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 4 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 4 and ground.
6. Verify the scan tool Auto High Beam Select Switch parameter is Active.
   - **If not Active**
   1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 4 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
7. Test or replace the S78 Turn Signal/Multifunction Switch.

Headlamps Malfunction - Low Beam

1. Vehicle OFF, disconnect the KR49 Headlamp Low Beam Relay, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
   - **If the test lamp does not illuminate**

     Replace the X50A Fuse Block - Underhood.

   - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 85 and ground.
   - **If the test lamp does not illuminate**

     Replace the X50A Fuse Block - Underhood.

   - **If the test lamp illuminates**
4. Connect a test lamp between the control circuit terminal 86 and B+, ignition ON.
5. Verify the test lamp turns ON and OFF when commanding the Low Beam Lamps ON and OFF with a scan tool.

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the control circuit terminal 13 and ground.
   - If 1 V or greater, repair the short to voltage on the circuit.
   - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
   - If 2 Ω or greater, repair the open/high resistance in the circuit.
   - If less than 2 Ω, replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit terminal 13 and ground.
   - If less than infinite resistance, repair the short to ground on the circuit.
   - If infinite resistance, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

6. Vehicle OFF, exterior lamps OFF, connect the KR49 Headlamp Low Beam Relay.
7. Disconnect the appropriate E4 Headlamp - Low Beam.
8. Test for less than 10 Ω between the ground circuit at the socket terminal and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
9. Connect a test lamp between the control circuit at the socket terminal and ground, vehicle in Service Mode.
10. Verify the test lamp turns ON and OFF when commanding the Low Beam Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the control circuit and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood, ignition ON.
    2. Test for less than 1 V between the control circuit terminal and ground.
       - If 1 V or greater, repair the short to voltage on the circuit.
       - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
11. Test or replace the E4 Headlamp - Low Beam.

Headlamps Malfunction - High Beam

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Test for B+ between the control circuit terminal 18 and ground.

   - **If less than B+**
   1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
   2. Test for infinite resistance between the control circuit terminal and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the X50A Fuse Block - Underhood.
   - **If B+**
3. Vehicle OFF, connect a 3 A fused jumper between the control circuit terminal 18 and ground.
4. Remove the left high beam fuse at the X50A Fuse Block - Underhood, vehicle in Service Mode.
5. Verify a test lamp illuminates between the left high beam fuse B+ switch control terminal and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal 18 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the X50A Fuse Block - Underhood.
   - **If the test lamp illuminates**
6. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
7. Install the left high beam fuse at the X50A Fuse Block - Underhood.
8. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below.
   - X110 - left high beam headlamp
   - X120 - right high beam headlamp
9. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - Terminal 6 (-TR6)
   - Terminal 8 (TR6)
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
10. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
11. Verify the test lamp turns ON and OFF when commanding the High Beams ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the control circuit and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, replace the X50A Fuse Block - Underhood.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.

        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the X50A Fuse Block - Underhood.
    - **If the test lamp turns ON and OFF**

12. Test or replace the E13 Headlamp Assembly.

High Beam Indicator Malfunction

1. Vehicle in Service Mode.
2. Verify the high beam indicator turns ON and OFF when commanding the Instrument Cluster All Indicators Test ON and OFF with a scan tool.
    - **If the high beam indicator is always OFF or remains ON**

      Replace the P16 Instrument Cluster.

    - **If the high beam indicator turns ON and OFF**
3. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Replacement**
- Refer to **Headlamp Switch Replacement**
- Refer to **Turn Signal Switch Replacement**
- Refer to **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- Refer to **Battery Distribution Fuse Block Replacement**
- Refer to **Control Module References** for BCM and Instrument Cluster replacement, programming, and setup

HEADLAMP LEVELING MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Headlamp Leveling Actuator - Left B+	1	1	-	-
Headlamp Leveling Actuator - Right B+	1	1	-	-
Headlamp Leveling Switch B+	1	1	-	-
Headlamp Leveling Control	1	1	1	-
Headlamp Leveling Actuator - Left Ground	-	1	-	-
Headlamp Leveling Actuator - Right Ground	-	1	-	-
Driver Information Center Switch Ground	-	1	-	-
1. Headlamp Leveling Malfunction				

Circuit/System Description

Each headlamp assembly contains a headlamp leveling actuator that is controlled by the headlamp leveling switch. The headlamp leveling switch is supplied with ignition voltage and ground and contains a resistor ladder with 4 positions for adjusting the headlamps up or down. When the headlamp leveling switch is activated to the desired position, voltage from the B+ ignition circuit is pulled down through the resistor ladder and the voltage is applied to the left and right headlamp leveling actuators via the headlamp leveling control circuits. The headlamp leveling actuators are supplied with B+ and ground. When the headlamp leveling switch is activated, the left and right headlamp leveling actuators respond by moving the headlamps to the desired position.

Diagnostic Aids

For testing purposes, the vehicle battery must be fully charged.

Reference Information

Schematic Reference

Headlights/Daytime Running Lights (DRL) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below. It may take up to 2 min for all vehicle systems to power down.
    - X110 - left headlamp
    - X120 - right headlamp
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance

    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to **Power Mode Mismatch** .
    - **If the test lamp illuminates**
5. Vehicle OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the ground circuit terminal 8 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
7. Vehicle in Service Mode.
8. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the X3 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the X50A Fuse Block - Underhood.
    - **If the test lamp illuminates**
9. Vehicle OFF, connect the harness connector at the S30 Headlamp Switch.
10. Vehicle in Service Mode, exterior lights OFF.
11. Test the voltage between the control circuit terminal 11 and ground for each headlamp leveling switch position listed below.
    - Headlamp leveling switch position 0 - 10 V - 11 V
    - Headlamp leveling switch position 1 - 8.5 V - 9.9 V
    - Headlamp leveling switch position 2 - 8 V - 9 V
    - Headlamp leveling switch position 3 - 6 V - 7 V
    - **If less than the specified voltage range for each headlamp leveling switch position**
    1. Vehicle OFF, disconnect the harness connector at the S30 Headlamp Switch.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S30 Headlamp Switch.
    - **If greater than the specified voltage range for each headlamp leveling switch position**
    1. Vehicle OFF, disconnect the harness connector at the S30 Headlamp Switch, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the S30 Headlamp Switch.
    - **If within the specified voltage range for each headlamp leveling switch position**
12. Test or replace the appropriate E13 Headlamp Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Replacement**
- Refer to **Headlamp Switch Replacement**

INTERIOR BACKLIGHTING MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F17DA (BCM 6) Fuse B+	3	3	-	-
Headlamp Switch B+	B1395 03, B3600 03	B3600 03	1	-
Headlamp Switch Signal	B1395 03, B3600 03	B3600 03	1	-
LED Backlight Dimming Control Terminal 8 X2	B2610 02	2	2	-
LED Backlight Dimming Control Terminal 9 X7	B2610 02	2	2	-
Switch Indicator Amber LED Backlight Dimming Control Terminal 5 X1	B2625 02	3	3	-
Headlamp Switch Low Reference	1	1	1	-
Door Lock Switch - Driver Ground	-	2	-	-
Door Lock Switch - Passenger Ground	-	2	-	-
Headlamp Switch Ground	-	2	-	-
Multifunction Switch 1 - Instrument Panel Ground	-	2	-	-
Multifunction Switch 2 - Instrument Panel Ground	-	2	-	-
Park Brake Control Switch Ground	-	2	-	-
Seat Heating Switch - Left Rear Ground	-	2	-	-
Seat Heating Switch - Right Rear Ground	-	2	-	-
Steering Wheel Controls Switch - Radio Presets Ground	-	2	-	-
1. Dimmer Switch Malfunction 2. Interior Backlighting Malfunction 3. Switch Indicator Amber LED Backlighting Malfunction				

Circuit/System Description

The headlamp switch is used to increase and decrease the brightness of the interior backlighting components. The headlamp switch provides a voltage signal to the body control module (BCM) that will increase as the brightness of the lights are increased and decrease as the brightness of the lights are decreased. The BCM provides B+, low reference, and signal, circuits to the headlamp switch. When the headlamp switch is placed in the desired position, the dimmed voltage setting is applied from the headlamp switch through the headlamp switch signal circuit to the BCM. The BCM interprets the signal and applies a pulse width modulated (PWM) voltage through the LED dimming control circuits illuminating the interior backlighting to the requested level of brightness.

Reference Information

Schematic Reference

- **Interior Lights Dimming Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, park lamps ON.
2. Verify the scan tool LED Backlight Dimming Command parameter changes between a high percentage to a low percentage while operating the dimmer switch from high to low.
    - **If the parameter does not change**

      Refer to Dimmer Switch Malfunction.

    - **If the parameter changes**
3. Verify the backlighting components turn ON and OFF while commanding the LED Backlight Dimming ON and OFF with a scan tool.
    - **If the backlighting components do not turn ON and OFF**

      Refer to Interior Backlighting Malfunction.

    - **If the backlighting components turn ON and OFF**
4. Vehicle ON, verify the switch indicator amber LED's for the components listed below illuminate when the appropriate switch is commanded ON and OFF.
    - S32LR Seat Heating Switch - Left Rear
    - S32RR Seat Heating Switch - Right Rear
    - S48D Multifunction Switch 2 - Instrument Panel Park Assist Switch
    - S48D Multifunction Switch 2 - Instrument Panel Lane Departure Warning Switch
    - **If the switch indicator amber LED's do not illuminate**

      Refer to Switch Indicator Amber LED Backlighting Malfunction.

    - **If the switch indicator amber LED's illuminate**
5. All OK.

Circuit/System Testing

Dimmer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S30 Headlamp Switch, vehicle in Service Mode.
2. Test for B+ between the B+ circuit terminal 12 and ground.
   - **If less than B+**
     1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
     2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
     3. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If B+**
3. Test for B+ between the B+ circuit terminal 12 and the low reference circuit terminal 7.
   - **If less than B+**
     1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
     2. Test for less than 1 V between the low reference circuit terminal 7 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
     3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If B+**
4. Verify a test lamp does not illuminate between the B+ circuit terminal 12 and the signal circuit terminal 11.
   - **If the test lamp illuminates**
     1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
     2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp does not illuminate**
5. Test for B+ between the B+ circuit terminal 12 and the signal circuit terminal 11.
   - **If less than B+**
     1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
     2. Test for less than 1 V between the signal circuit terminal 11 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
     3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If B+**
6. Test or replace the S30 Headlamp Switch.

Interior Backlighting Malfunction

NOTE: **Each component with backlighting may need to be disconnected to**

isolate a short to voltage or short to ground. Use the schematics to identify the following:

- **Backlighting components the vehicle is equipped with**
- **Each component's control and ground circuit terminals**
- **Component locations on the backlighting control circuit**

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the component with inoperative backlighting. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the appropriate ground circuit terminal and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the appropriate control circuit terminal and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the LED Backlight Dimming ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
        - X2 terminal 8
        - X7 terminal 9
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode
        - X2 terminal 8
        - X7 terminal 9
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the component with inoperative backlighting.

Switch Indicator Amber LED Backlighting Malfunction

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.

- **If the test lamp does not illuminate and the circuit fuse is open**
  1. Test for infinite resistance between the B+ circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance, replace the K9 Body Control Module
- **If the test lamp illuminates**

3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, disconnect the harness connectors at the components listed below.
   - S32LR Seat Heating Switch - Left Rear
   - S32RR Seat Heating Switch - Right Rear
   - S48D Multifunction Switch 2 - Instrument Panel

NOTE: **The test lamp in the following step will illuminate at LOW intensity. This is normal circuit operation and does not indicate a circuit malfunction.**

5. Vehicle in Service Mode, verify a test lamp illuminates between each control circuit terminal 6 and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
6. Verify a test lamp does not illuminate at FULL intensity between each control circuit terminal 6 and ground.
   - **If the test lamp illuminates at FULL intensity**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp does not illuminate at FULL intensity**
7. Test or replace the component with the inoperative switch indicator.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Parking Brake Actuator Switch Replacement
- Refer to Headlamp Switch Replacement
- Refer to Door Lock Switch Replacement
- Refer to Rear Seat Heater Switch Replacement
- Refer to Radio Control Switch Replacement - Steering Wheel (Left Side Lower) Radio Control Switch Replacement - Steering Wheel (Left Side Rear) Radio Control Switch Replacement - Steering Wheel (Right Side Front) Radio Control Switch Replacement - Steering Wheel (Right Side Rear)
- Refer to Hazard Warning Switch Replacement
- Refer to Instrument Panel Center Accessory Function Switch Replacement
- Refer to Control Module References for BCM replacement, programming and setup

PARK, LICENSE, AND/OR TAIL LAMPS MALFUNCTION (MBM)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 4) Fuse B+	B3950 01, B3950 04	B3950 01, B3950 04	-	-
F7DA (BCM 3) Fuse B+	B3949 01, B3949 04	B3949 01, B3949 04	-	-
F9DA (BCM 1) Fuse B+	B1325 03, U156D 00	B1325 03, U156D 00	-	-
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-
Left Tail Lamp Control	B3881 02	B3881 04	4	-
Right Tail Lamp Control	B3882 02	B3882 04	4	-
License Plate Lamp Control	B3883 02	3	3	-
Park Lamps Control - Left	B2585 02	1	1	-
Park Lamps Control - Right	B3867 02	1	1	-
Headlamp Switch Ground	-	2	-	-
Left Tail Lamp Ground	-	4	-	-
Right Tail Lamp Ground	-	4	-	-
License Plate Lamp Ground - Left	-	3	-	-
License Plate Lamp Ground - Right	-	3	-	-
Park Lamp Ground - Left Front	-	1	-	-
Park Lamp Ground - Right Front	-	1	-	-
Side Marker Lamp Ground - Left Front	-	1	-	-
Side Marker Lamp Ground - Right Front	-	1	-	-
Side Marker Lamp Ground - Left Rear	-	1	-	-
Side Marker Lamp Ground - Right Rear	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction 2. Park Lamp Switch Malfunction 3. License Plate Lamps Malfunction 4. Tail Lamps Malfunction				

Circuit/System Description

The park lamps, tail lamps, license plate lamps, and side marker lamps are turned ON when the headlamp switch is placed in the PARK LIGHT or LOW BEAM position or anytime the headlights are requested. When the BCM receives a request from the headlamp switch to turn ON the park lamps the BCM will apply battery voltage to the left and right park lamp, side marker lamp, and license plate lamp control circuits illuminating the left and right park lamps, side marker lamps, and license plate lamps.

When the trailer lighting control module receives a request from the headlamp switch to turn ON the park lamps the trailer lighting control module will apply battery voltage to the left and right tail/stop lamp and auxiliary tail/stop lamp control circuits illuminating the left and right tail/stop lamps and auxiliary tail/stop lamps.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Park Lamp Switch parameter changes between Active and Inactive while commanding the park lamps ON and OFF with the headlamp switch.
    - **If the parameter does not change**

      Refer to Park Lamp Switch Malfunction.

    - **If the parameter changes**
3. Verify the left front park lamp and left front and rear side marker lamps turn ON and OFF when commanding the Left Park Lamps ON and OFF with a scan tool.
    - **If the left front park lamps do not turn ON and OFF**

      Refer to Park Lamps Malfunction.

    - **If the left front park lamps turn ON and OFF**
4. Verify the right front park lamp and right front and rear side marker lamps turn ON and OFF when commanding the Right Park Lamps ON and OFF with a scan tool.
    - **If the right front park lamps do not turn ON and OFF**

      Refer to Park Lamps Malfunction.

    - **If the right front park lamps turn ON and OFF**
5. Verify the left tail/stop lamp on the vehicle turns ON and OFF when commanding the Left Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the left tail/stop lamp does not turn ON and OFF**

      Refer to Tail Lamps Malfunction.

    - **If the left tail/stop lamp turns ON and OFF**

6. Verify the right tail/stop lamp on the vehicle turns ON and OFF when commanding the Right Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the right tail/stop lamp does not turn ON and OFF**

      Refer to Tail Lamps Malfunction.

    - **If the right tail/stop lamp turns ON and OFF**
7. Verify the license plate lamps turn ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
    - **If the license plate lamps do not turn ON and OFF**

      Refer to License Plate Lamps Malfunction.

    - **If the license plate lamps turn ON and OFF**
8. All OK.

Circuit/System Testing

Park Lamp Switch Malfunction

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 8 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 8.
6. Verify the scan tool Park Lamps Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 5 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the S30 Headlamp Switch.

Park Lamps Malfunction

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
4. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
5. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
6. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module
    - **If the test lamp illuminates**
7. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
8. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the inoperative park lamp.
9. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
    - E4LA Headlamp Assembly - Left terminal 8
    - E4RA Headlamp Assembly - Right terminal 8
    - E2LR Side Marker Lamp - Left Rear terminal 2
    - E2RR Side Marker Lamp - Right Rear terminal 2
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.

  - If 2 Ω or greater, repair the open/high resistance in the circuit.
  - If less than 2 Ω, repair the open/high resistance in the ground connection.
- **If less than 10 Ω**

10. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E4LA Headlamp Assembly - Left terminal 4
    - E4RA Headlamp Assembly - Right terminal 4
    - E4LA Headlamp Assembly - Left terminal 7 (-TR6)
    - E4RA Headlamp Assembly - Right terminal 7 (-TR6)
    - E2LR Side Marker Lamp - Left Rear terminal 1
    - E2RR Side Marker Lamp - Right Rear terminal 1
11. Verify the test lamp turns ON and OFF when commanding the appropriate Park Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
12. Test or replace the appropriate park lamp.

Tail Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below at the appropriate E42 Tail Lamp Assembly.
    - X910 - left tail lamp assembly
    - X920 - right tail lamp assembly
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E42 Tail Lamp Assembly.

License Plate Lamps Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove both E7 License Plate Lamp bulbs.
5. Test for less than 10 Ω between each ground circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
6. Connect a test lamp between the E7L License Plate Lamp - Left control circuit terminal 1 and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.

   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
8. Connect a test lamp between the E7R License Plate Lamp - Right control circuit terminal 1 and ground, vehicle in Service Mode.
9. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
10. Test or replace the appropriate E7 License Plate Lamp bulb.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Headlamp Replacement
- Refer to Rear License Plate Lamp Bulb Replacement
- Refer to Rear Side Marker Lamp Replacement
- Refer to Headlamp Switch Replacement
- Refer to Tail Lamp Control Module Replacement
- Refer to Rear Combination Lamp Replacement
- Refer to Control Module References for BCM and trailer lighting control module replacement, programming, and setup

PARK, LICENSE, AND/OR TAIL LAMPS MALFUNCTION (MAH/MBC/MAW/MCX)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F6DA (BCM 4) Fuse B+	B3950 01, B3950 04	B3950 01, B3950 04	-	-
F7DA (BCM 3) Fuse B+	B3949 01, B3949 04	B3949 01, B3949 04	-	-
F9DA (BCM 1) Fuse B+	B1325 03, U156D 00	B1325 03, U156D 00	-	-
Headlamp Switch Park Lamps ON Signal	2	B257A 00	2	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Tail Lamp Control	B3881 02	B3881 04	4	-
Right Tail Lamp Control	B3882 02	B3882 04	4	-
License Plate Lamp Control	B3883 02	3	3	-
Park Lamps Control - Left	B2585 02	1	1	-
Park Lamps Control - Right	B3867 02	1	1	-
Headlamp Switch Ground	-	2	-	-
Left Tail Lamp Ground	-	4	-	-
Right Tail Lamp Ground	-	4	-	-
License Plate Lamp Ground - Left	-	3	-	-
License Plate Lamp Ground - Right	-	3	-	-
Park Lamp Ground - Left Front	-	1	-	-
Park Lamp Ground - Right Front	-	1	-	-
Side Marker Lamp Ground - Left Front	-	1	-	-
Side Marker Lamp Ground - Right Front	-	1	-	-
Side Marker Lamp Ground - Left Rear	-	1	-	-
Side Marker Lamp Ground - Right Rear	-	1	-	-
1. Park, License, and/or Tail Lamps Malfunction 2. Park Lamp Switch Malfunction 3. License Plate Lamps Malfunction 4. Tail Lamps Malfunction				

Circuit/System Description

The park lamps, tail lamps, license plate lamps, and side marker lamps are turned ON when the headlamp switch is placed in the PARK LIGHT or LOW BEAM position or anytime the headlights are requested. When the BCM receives a request from the headlamp switch to turn ON the park lamps the BCM will apply battery voltage to the left and right park lamp, side marker lamp, and license plate lamp control circuits illuminating the left and right park lamps, side marker lamps, and license plate lamps.

When the trailer interface control module receives a request from the headlamp switch to turn ON the park lamps the trailer interface control module will apply battery voltage to the left and right tail/stop lamp and auxiliary tail/stop lamp control circuits illuminating the left and right tail/stop lamps and auxiliary tail/stop lamps.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Park Lamp Switch parameter changes between Active and Inactive while commanding the park lamps ON and OFF with the headlamp switch.
    - **If the parameter does not change**

      Refer to Park Lamp Switch Malfunction.

    - **If the parameter changes**
3. Verify the left front park lamp and left front and rear side marker lamps turn ON and OFF when commanding the Left Park Lamps ON and OFF with a scan tool.
    - **If the left front park lamps do not turn ON and OFF**

      Refer to Park Lamps Malfunction.

    - **If the left front park lamps turn ON and OFF**
4. Verify the right front park lamp and right front and rear side marker lamps turn ON and OFF when commanding the Right Park Lamps ON and OFF with a scan tool.
    - **If the right front park lamps do not turn ON and OFF**

      Refer to Park Lamps Malfunction.

    - **If the right front park lamps turn ON and OFF**
5. Verify the left tail/stop lamp on the vehicle turns ON and OFF when commanding the Left Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the left tail/stop lamp does not turn ON and OFF**

      Refer to Tail Lamps Malfunction.

    - **If the left tail/stop lamp turns ON and OFF**
6. Verify the right tail/stop lamp on the vehicle turns ON and OFF when commanding the Right Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the right tail/stop lamp does not turn ON and OFF**

      Refer to Tail Lamps Malfunction.

    - **If the right tail/stop lamp turns ON and OFF**
7. Verify the license plate lamps turn ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
    - **If the license plate lamps do not turn ON and OFF**

      Refer to License Plate Lamps Malfunction.

    - **If the license plate lamps turn ON and OFF**
8. All OK.

Circuit/System Testing

Park Lamp Switch Malfunction

1. Vehicle OFF, all doors closed, all accessories OFF, disconnect the harness connector at the S30 Headlamp Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 8 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Park Lamps Switch parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 8.
6. Verify the scan tool Park Lamps Switch parameter is Active.
   - **If not Active**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 5 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
7. Test or replace the S30 Headlamp Switch.

Park Lamps Malfunction

1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
3. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**

    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
4. Vehicle OFF, connect the X1 harness connector at the K9 Body Control Module.
5. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
6. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module
    - **If the test lamp illuminates**
7. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
8. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the inoperative park lamp.
9. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
    - E4LA Headlamp Assembly - Left terminal 8
    - E4RA Headlamp Assembly - Right terminal 8
    - E2LR Side Marker Lamp - Left Rear terminal 2
    - E2RR Side Marker Lamp - Right Rear terminal 2
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
10. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E4LA Headlamp Assembly - Left terminal 4
    - E4RA Headlamp Assembly - Right terminal 4
    - E4LA Headlamp Assembly - Left terminal 7 (-TR6)
    - E4RA Headlamp Assembly - Right terminal 7 (-TR6)
    - E2LR Side Marker Lamp - Left Rear terminal 1
    - E2RR Side Marker Lamp - Right Rear terminal 1
11. Verify the test lamp turns ON and OFF when commanding the appropriate Park Lamps ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**

12. Test or replace the appropriate park lamp.

Tail Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below at the appropriate E42 Tail Lamp Assembly.
    - X910 - left tail lamp assembly
    - X920 - right tail lamp assembly
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Rear Stop/Park Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E42 Tail Lamp Assembly.

License Plate Lamps Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.

2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, remove both E7 License Plate Lamp bulbs.
5. Test for less than 10 Ω between each ground circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
6. Connect a test lamp between the E7L License Plate Lamp - Left control circuit terminal 1 and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
8. Connect a test lamp between the E7R License Plate Lamp - Right control circuit terminal 1 and ground, vehicle in Service Mode.
9. Verify the test lamp turns ON and OFF when commanding the License Plate Lamps ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**

10. Test or replace the appropriate E7 License Plate Lamp bulb.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Headlamp Replacement**
- Refer to **Rear License Plate Lamp Bulb Replacement**
- Refer to **Rear Side Marker Lamp Replacement**
- Refer to **Headlamp Switch Replacement**
- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Rear Combination Lamp Replacement**
- Refer to **Control Module References** for BCM and trailer interface control module replacement, programming, and setup

REAR COMPARTMENT LAMP MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F43DA (BCM 7) Fuse B+	B3948 01, B3948 04, B3951 01, B3951 04	B3948 01, B3948 04, B3951 01, B3951 04	-	-
Rear Compartment Courtesy Lamp Control	B2570 02	1	1	-
Rear Compartment Courtesy Lamp Ground	-	1	-	-
1. Rear Compartment Lamp Malfunction				

Circuit/System Description

The body control module (BCM) applies battery voltage to the cargo lamp through the cargo lamp control circuit. When the BCM receives a rear liftgate open input from the rear compartment lid latch, the BCM applies battery voltage to the cargo lamp control circuit illuminating the cargo lamp. In the event that the cargo lamp were to remain illuminated for more than 10 min with the vehicle ON/OFF switch in the OFF position, the BCM will deactivate the cargo lamp control circuit to prevent total battery discharge.

Reference Information

Schematic Reference

- **Interior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Interior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module
   - **If the test lamp illuminates**
3. Vehicle OFF, connect the X5 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E8S Rear Compartment Courtesy Lamp. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
   - **If 5 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 5 Ω**
6. Connect a test lamp between the control circuit terminal 1 and ground, vehicle in Service Mode.
7. Verify the test lamp turns ON and OFF when commanding the Cargo Lamp ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X7 harness connector at the K9 Body Control Module, vehicle in Service Mode.

        2. Test for less than 1 V between the control circuit terminal and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**

8. Test or replace the E8S Rear Compartment Courtesy Lamp.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cargo Center Courtesy Lamp Bulb Replacement**
- Refer to **Control Module References** for BCM replacement, programming, and setup

STOP LAMPS MALFUNCTION (MBM)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F9DA (BCM 1) Fuse B+	1	1	-	-
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, U0422 71	C0277 06, U0422 71	C0890 07, U0422 71	-
Brake Pedal Position Sensor Signal	C0277 06, U0422 71	C0277 06, U0422 71	C0277 07, C0890 07, U0422 71	C0277 09
Auxiliary Left Tail/Stop Lamp Control	B388B 02	B388B 04	3	-
Auxiliary Right Tail/Stop Lamp Control	B388C 02	B388C 04	3	-
Center High Mounted Stop Lamp Control	B3884 02	1	1	-
Left Stop Lamp Control	B3890 02	B3890 04	4	-
Right Stop Lamp Control	B3891 02	B3891 04	4	-
Brake Pedal Position Sensor Low Reference	-	C0277 07, U0422 71	2	-
Auxiliary Left Tail/Stop Lamp Ground	-	3	-	-
Auxiliary Right Tail/Stop Lamp Ground	-	3	-	-
Center High Mounted Stop Lamp Ground	-	1	-	-
Tail Lamp Assembly - Left Ground	-	4	-	-
Tail Lamp Assembly - Right Ground	-	4	-	-
1. Center High Mounted Stop Lamp Malfunction 2. Brake Pedal Position Sensor Malfunction 3. Auxiliary Stop Lamps Malfunction 4. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the center high mounted stop lamp control circuit illuminating the center high mounted stop lamp.

For stop lamp operation, the trailer lighting control module receives an input from the center high mount stop lamp control circuit. When the brakes are applied on the vehicle, the trailer lighting control module receives the brake applied input from the center high mount stop lamp control circuit. The trailer lighting control module responds by applying voltage to the trailer stop lamp control circuit illuminating the trailer stop lamps. The trailer lighting control module also receives a serial data message from the BCM indicating that the vehicle brakes have been applied. When the liftgate is in the OPEN position, the trailer lighting control module will illuminate the left and right auxiliary stop lamps. When the liftgate is in the CLOSED position, the trailer lighting control module will illuminate the left and right stop lamps.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Brake Pedal Applied parameter changes between Active and Inactive while pressing and releasing the brake pedal.
    - **If the parameter does not change**

      Refer to Brake Pedal Position Sensor Malfunction.

    - **If the parameter changes**
3. Verify the center high mounted stop lamp turns ON and OFF when commanding the Center Stop Lamp ON and OFF with a scan tool.
    - **If the center high mounted stop does not turn ON and OFF**

      Refer to Center High Mount Stop Lamp Malfunction.

    - **If the center high mounted stop turns ON and OFF**
4. Verify the left and right tail/stop lamps turn ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.

- **If the left and right tail/stop lamps do not turn ON and OFF**

  Refer to Stop Lamps Malfunction.

- **If the left and right tail/stop lamps turn ON and OFF**

5. Verify the left and right auxiliary tail/stop lamps turn ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
   - **If the left and right auxiliary tail/stop lamps do not turn ON and OFF**

     Refer to Auxiliary Stop Lamps Malfunction.

   - **If the left and right auxiliary tail/stop lamps turn ON and OFF**
6. All OK.

Circuit/System Testing

Brake Pedal Position Sensor Malfunction

1. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.
2. Test for less than 1 V between the low reference circuit terminal 2 and ground.
   - **If 1 V or greater**
   1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the low reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If less than 1 V**
3. Test or replace the B22 Brake Pedal Position Sensor.

Center High Mount Stop Lamp Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp.
5. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**

6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E6 Center High Mounted Stop Lamp terminal 1
    - K68 Trailer Lighting Control Module terminal 14 X1
7. Verify the test lamp turns ON and OFF when commanding the Center Stop Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
8. Test or replace the E6 Center High Mounted Stop Lamp.

Auxiliary Stop Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below at the appropriate E51 Tail Lamp Assembly - Auxiliary.
    - X410 - left auxiliary tail lamp assembly
    - X420 - right auxiliary tail lamp assembly
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.

   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E5 Tail/Stop Lamp - Auxiliary.

Stop Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below at the appropriate E42 Tail Lamp Assembly.
   - X910 - left tail lamp assembly
   - X920 - right tail lamp assembly
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X1 harness connector at the K68 Trailer Lighting Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K68 Trailer Lighting Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E42 Tail Lamp Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **High Mount Stop Lamp Replacement**
- Refer to **Brake Pedal Position Sensor Replacement**
- Refer to **Brake Pedal Position Sensor Calibration**
- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog) Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Rear Combination Lamp Replacement**

- Refer to **Control Module References** for BCM and trailer lighting control module replacement, programming, and setup

STOP LAMPS MALFUNCTION (MAH/MBC/MAW/MCX)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
F9DA (BCM 1) Fuse B+	1	1	-	-
Brake Pedal Position Sensor 5 V Reference	C0277 06, C0890 03, U0422 71	C0277 06, U0422 71	C0890 07, U0422 71	-
Brake Pedal Position Sensor Signal	C0277 06, U0422 71	C0277 06, U0422 71	C0277 07, C0890 07, U0422 71	C0277 09
Auxiliary Left Tail/Stop Lamp Control	B388B 02	B388B 04	3	-
Auxiliary Right Tail/Stop Lamp Control	B388C 02	B388C 04	3	-
Center High Mounted Stop Lamp Control	B3884 02	1	1	-
Left Stop Lamp Control	B3890 02	B3890 04	4	-
Right Stop Lamp Control	B3891 02	B3891 04	4	-
Brake Pedal Position Sensor Low Reference	-	C0277 07, U0422 71	2	-
Auxiliary Left Tail/Stop Lamp Ground	-	3	-	-
Auxiliary Right Tail/Stop Lamp Ground	-	3	-	-
Center High Mounted Stop Lamp Ground	-	1	-	-
Tail Lamp Assembly - Left Ground	-	4	-	-
Tail Lamp Assembly - Right Ground	-	4	-	-
1. Center High Mounted Stop Lamp Malfunction 2. Brake Pedal Position Sensor Malfunction 3. Auxiliary Stop Lamps Malfunction 4. Stop Lamps Malfunction				

Circuit/System Description

The brake pedal position (BPP) sensor is used to sense the action of the driver application of the brake pedal. The BPP sensor provides an analog voltage signal that will increase as the brake pedal is applied. The body control module (BCM) provides a low reference signal and a 5-volt reference voltage to the BPP sensor. When the variable signal reaches a voltage threshold indicating the brakes have been applied, the BCM will apply battery voltage to the center high mounted stop lamp control circuit illuminating the center high mounted stop lamp.

For stop lamp operation, the trailer interface control module receives an input from the center high mount stop lamp control circuit. When the brakes are applied on the vehicle, the trailer interface control module receives the brake applied input from the center high mount stop lamp control circuit. The trailer interface control module responds by applying voltage to the trailer stop lamp control circuit illuminating the trailer stop lamps. The trailer interface control module also receives a serial data message from the BCM indicating that the vehicle brakes have been applied. When the liftgate is in the OPEN position, the trailer interface control module will illuminate the left and right auxiliary stop lamps. When the liftgate is in the CLOSED position, the trailer interface control module will illuminate the left and right stop lamps.

Reference Information

Schematic Reference

- **Exterior Lights Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Brake Pedal Applied parameter changes between Active and Inactive while pressing and releasing the brake pedal.
    - **If the parameter does not change**

      Refer to Brake Pedal Position Sensor Malfunction.

    - **If the parameter changes**
3. Verify the center high mounted stop lamp turns ON and OFF when commanding the Center Stop Lamp ON and OFF with a scan tool.
    - **If the center high mounted stop does not turn ON and OFF**

      Refer to Center High Mount Stop Lamp Malfunction.

    - **If the center high mounted stop turns ON and OFF**
4. Verify the left and right tail/stop lamps turn ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.
    - **If the left and right tail/stop lamps do not turn ON and OFF**

      Refer to Stop Lamps Malfunction.

    - **If the left and right tail/stop lamps turn ON and OFF**
5. Verify the left and right auxiliary tail/stop lamps turn ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
    - **If the left and right auxiliary tail/stop lamps do not turn ON and OFF**

      Refer to Auxiliary Stop Lamps Malfunction.

- **If the left and right auxiliary tail/stop lamps turn ON and OFF**

6. All OK.

Circuit/System Testing

Brake Pedal Position Sensor Malfunction

1. Vehicle OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor, vehicle in Service Mode.
2. Test for less than 1 V between the low reference circuit terminal 2 and ground.
    - **If 1 V or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the low reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If less than 1 V**
3. Test or replace the B22 Brake Pedal Position Sensor.

Center High Mount Stop Lamp Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
3. Vehicle OFF, connect the X2 harness connector at the K9 Body Control Module.
4. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the E6 Center High Mounted Stop Lamp.
5. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
6. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
    - E6 Center High Mounted Stop Lamp terminal 1
    - K101 Trailer Interface Control Module terminal 14 X1
7. Verify the test lamp turns ON and OFF when commanding the Center Stop Lamp ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
8. Test or replace the E6 Center High Mounted Stop Lamp.

Auxiliary Stop Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below at the appropriate E51 Tail Lamp Assembly - Auxiliary.
    - X410 - left auxiliary tail lamp assembly
    - X420 - right auxiliary tail lamp assembly
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 2 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate OPEN.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K101 Trailer Interface Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E5 Tail/Stop Lamp - Auxiliary.

Stop Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the appropriate harness connector listed below at the appropriate E42 Tail Lamp Assembly.
    - X910 - left tail lamp assembly

- X920 - right tail lamp assembly

2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 3 and ground, vehicle in Service Mode.
4. Verify the test lamp turns ON and OFF while pressing and releasing the brake pedal, liftgate CLOSED.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K101 Trailer Interface Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the X1 harness connector at the K101 Trailer Interface Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K101 Trailer Interface Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate E42 Tail Lamp Assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **High Mount Stop Lamp Replacement**
- Refer to **Brake Pedal Position Sensor Replacement**
- Refer to **Brake Pedal Position Sensor Calibration**
- Refer to **Tail Lamp Control Module Replacement**
- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog)** **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Rear Combination Lamp Replacement**
- Refer to **Control Module References** for BCM and trailer interface control module replacement, programming, and setup

TURN SIGNAL LAMPS AND/OR INDICATORS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Turn Signal Switch Signal - Left	2	2	2	-
Turn Signal Switch Signal - Right	2	2	2	-
Turn Signal Control - Left Front	B3948 01, B3948 02	B3948 01, B3948 04	B3948 01	-
Turn Signal Control - Right Front	B3949 01, B3949 02	B3949 01, B3949 04	B3949 01	-
Turn Signal Control - Left Rear	B3950 01, B3950 02	B3950 01, B3950 04	B3950 01	-
Turn Signal Control - Right Rear	B3951 01, B3951 02	B3951 01, B3951 04	B3951 01	-
Outside Rearview Mirror Ground - Driver	-	1	-	-
Outside Rearview Mirror Ground - Passenger	-	1	-	-
Turn Signal Lamp Ground - Left Front	-	1	-	-
Turn Signal Lamp Ground - Right Front	-	1	-	-
Turn Signal Lamp Ground - Left Rear	-	1	-	-
Turn Signal Lamp Ground - Right Rear	-	1	-	-
Turn Signal/Multifunction Switch Ground	-	2	-	-
1. Turn Signal Lamps and/or Indicators Malfunction 2. Turn Signal/Multifunction Switch Malfunction				

Circuit/System Description

Ground is applied at all times to the turn signal/multifunction switch. The turn signal lamps may only be activated with the vehicle mode switch in the SERVICE MODE or ON positions. When the turn signal/multifunction switch is placed in either the turn right or turn left position, ground is applied to the body control module (BCM) through either the right turn or left turn signal switch signal circuit. The BCM responds to the turn signal switch input by applying a pulsating voltage to the front and rear turn signal lamps through their respective control circuits. When a turn signal request is received by the BCM, a serial data message is sent to the instrument cluster requesting the respective turn signal indicator be pulsed ON and OFF.

Diagnostic Aids

The tail lamp outage detection circuits are low current B+ circuits that will not illuminate a test lamp.

Reference Information

Schematic Reference

Exterior Lights Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Exterior Lighting Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Right Turn Signal Switch and Left Turn Signal Switch parameters change between Active and Inactive while cycling the turn signal switch between the right and left positions.
    - **If the parameters do not change**

      Refer to Turn Signal/Multifunction Switch Malfunction.

    - **If the parameters change**
3. Verify the left front turn signal lamp and turn signal repeater lamp turn ON and OFF while commanding the Left Front Turn Signal Lamp ON and OFF with a scan tool.
    - **If the left front turn signal lamp does not turn ON and OFF**

      Refer to Turn Signal Lamps Malfunction.

    - **If the left front turn signal lamp turns ON and OFF**
4. Verify the right front turn signal lamp and turn signal repeater lamp turn ON and OFF while commanding the Right Front Turn Signal Lamp ON and OFF with a scan tool.
    - **If the right front turn signal lamp does not turn ON and OFF**

      Refer to Turn Signal Lamps Malfunction.

    - **If the right front turn signal lamp turns ON and OFF**
5. Verify the left rear turn signal lamp turns ON and OFF while commanding the Left Rear Turn Signal Lamp ON and OFF with a scan tool.
    - **If the left rear turn signal lamp does not turn ON and OFF**

      Refer to Turn Signal Lamps Malfunction.

    - **If the left rear turn signal lamp turns ON and OFF**
6. Verify the right rear turn signal lamp turns ON and OFF while commanding the Right Rear Turn Signal Lamp ON and OFF with a scan tool.
    - **If the right rear turn signal lamp does not turn ON and OFF**

      Refer to Turn Signal Lamps Malfunction.

    - **If the right rear turn signal lamp turns ON and OFF**
7. Verify the left and right turn signal indicators turn ON and OFF while commanding the Instrument Cluster Gauge Sweep Test ON and OFF with a scan tool.
    - **If the left or right turn signal indictors do not turn ON and OFF**

      Refer to Turn Signal Indicators Malfunction.

    - **If the left and right turn signal indictors turn ON and OFF**
8. All OK.

Circuit/System Testing

Turn Signal/Multifunction Switch Malfunction

1. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, disconnect the harness connector at the S78 Turn Signal/Multifunction Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Left Turn Signal Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 3.
6. Verify the scan tool Left Turn Signal Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 1 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Verify the scan tool Right Turn Signal Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
8. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.
9. Verify the scan tool Right Turn Signal Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.

   - **If Active**

10. Test or replace the S78 Turn Signal/Multifunction Switch.

Turn Signal Lamps Malfunction

1. Vehicle OFF, exterior lamps OFF, disconnect the harness connector at the appropriate turn signal lamp.
2. Test for less than 10 Ω between the appropriate ground circuit terminal listed below and ground.
   - E4LF Turn Signal Lamp - Left Front terminal 2
   - E4RF Turn Signal Lamp - Right Front terminal 2
   - A9A Outside Rearview Mirror - Driver terminal 5
   - A9B Outside Rearview Mirror - Passenger terminal 5
   - E4LR Turn Signal Lamp - Left Rear socket terminal
   - E4RR Turn Signal Lamp - Right Rear socket terminal
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect a test lamp between the appropriate control circuit terminal listed below and ground, vehicle in Service Mode.
   - E4LF Turn Signal Lamp - Left Front terminal 1
   - E4RF Turn Signal Lamp - Right Front terminal 1
   - A9A Outside Rearview Mirror - Driver terminal 6
   - A9B Outside Rearview Mirror - Passenger terminal 6
   - E4LR Turn Signal Lamp - Left Rear socket terminal
   - E4RR Turn Signal Lamp - Right Rear socket terminal
4. Verify the test lamp turns ON and OFF when commanding the appropriate Turn Signal Lamp ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module.
      - X5 left turn signals
      - X4 right turn signals
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the appropriate harness connector listed below at the K9 Body Control Module, vehicle in Service Mode.
      - X5 left turn signals
      - X4 right turn signals
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
5. Test or replace the appropriate turn signal lamp.

Turn Signal Indicators Malfunction

1. Vehicle in Service Mode.
2. Verify the left and right turn signal indicators turn ON and OFF while commanding the Instrument Cluster Gauge Sweep Test ON and OFF with a scan tool.
   - **If the left or right turn signal indictors are always OFF or remain ON**

     Replace the P16 Instrument Cluster.

   - **If the left and right turn signal indictors turn ON and OFF**
3. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Front Turn Signal Lamp Bulb Replacement**
- Refer to **Outside Rearview Mirror Turn Signal Lamp Replacement**
- Refer to **Rear Fascia Lower Signal Lamp Replacement**
- Refer to **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea with Rear Fog)** **Stop and Turn Signal Lamp Bulb Replacement (Europe, Korea, North America with Back-up Bulb)**
- Refer to **Turn Signal Switch Replacement**
- Refer to **Control Module References** for BCM or Instrument Cluster replacement, programming and setup

Back To Article

REPAIR INSTRUCTIONS

TURN SIGNAL SWITCH REPLACEMENT

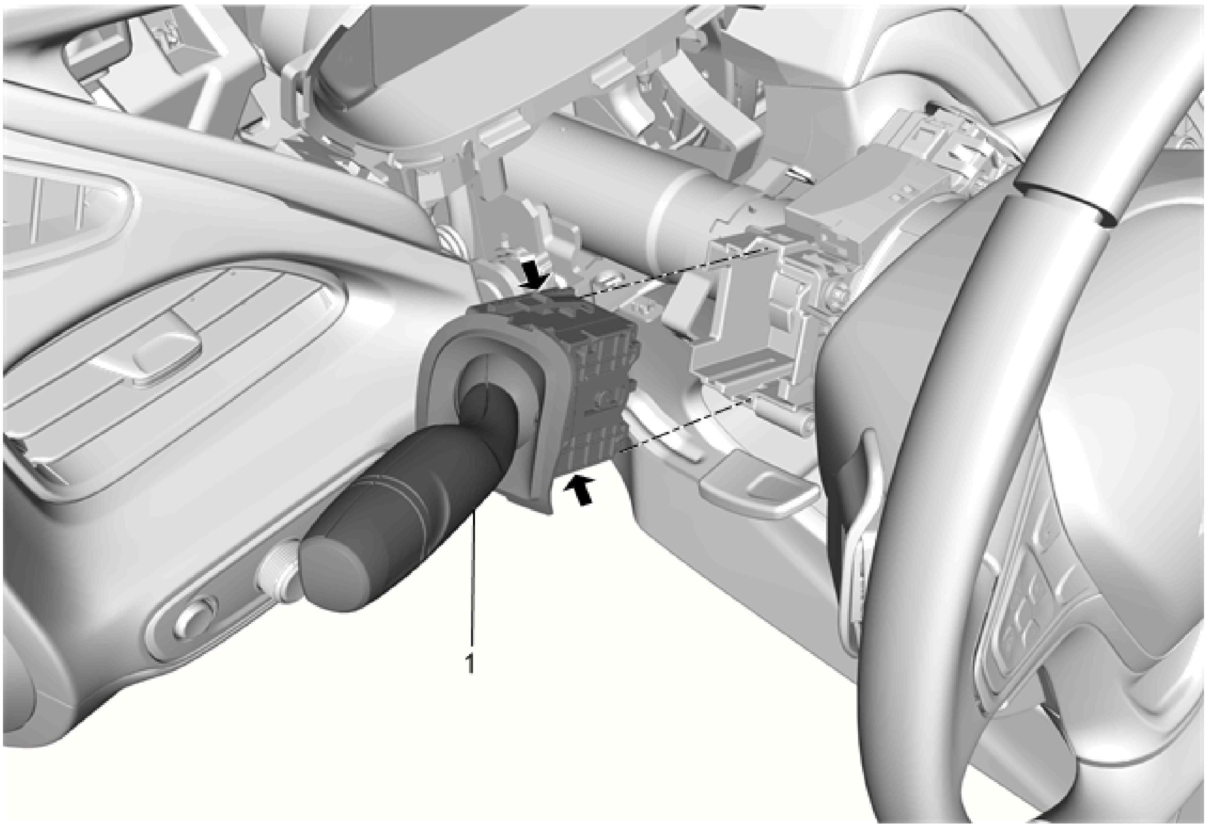


Fig. 1: Turn Signal Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Column Lower Trim Cover Replacement	
1	Turn Signal Switch **Procedure** 1. Release the retaining tabs and remove the turn signal switch from the switch bracket. 2. Disconnect the electrical connector.

BRAKE PEDAL POSITION SENSOR CALIBRATION

Calibration Criteria

NOTE: **Do not apply the brake pedal during the brake pedal position sensor calibration procedure. Any movement of the brake pedal during this procedure will cause the calibration procedure to fail. If this occurs, the brake pedal position sensor calibration must be repeated.**

Brake pedal position sensor calibration must be performed after the brake pedal position sensor, body control module (BCM), engine control module (ECM), or hybrid powertrain control module have been serviced. The calibration procedure will set the brake pedal position sensor home value. This value is used by the BCM and ECM/HPCM to determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via serial data.

Calibration Procedure

1. Apply the parking brake.
2. Vehicle in Service Mode, place the transmission in the PARK position for automatic transmission or NEUTRAL position for manual transmission.
3. Install a scan tool.
4. Clear all DTCs before proceeding.
5. Navigate to the Configuration/Reset Functions menu of the BCM.
6. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.

BRAKE PEDAL POSITION SENSOR REPLACEMENT

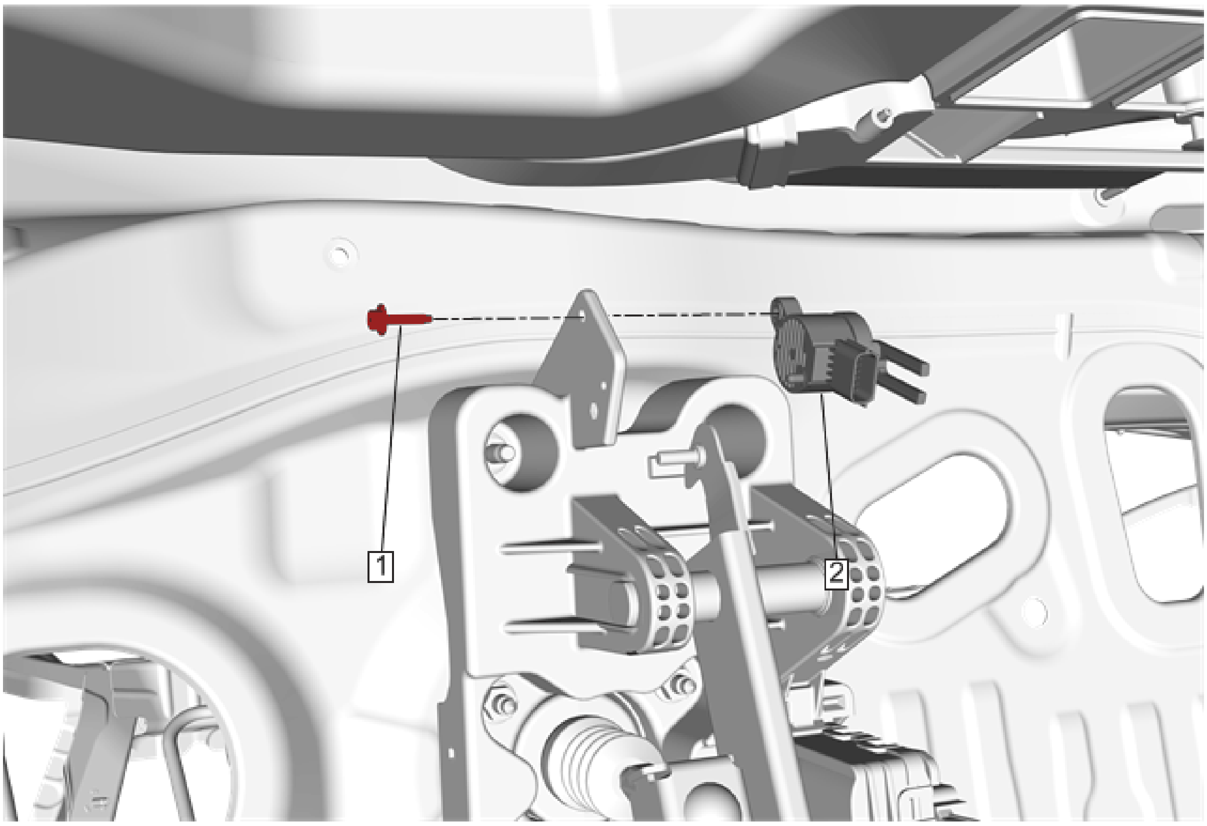


Fig. 2: Brake Pedal Position Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Column Replacement	
1	Brake Pedal Position Sensor Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
3	Brake Pedal Position Sensor **Procedure** 1. Disconnect the electrical connector. 2. Calibrate the brake pedal position sensor. Brake Pedal Position Sensor Calibration

HEADLAMP SWITCH REPLACEMENT

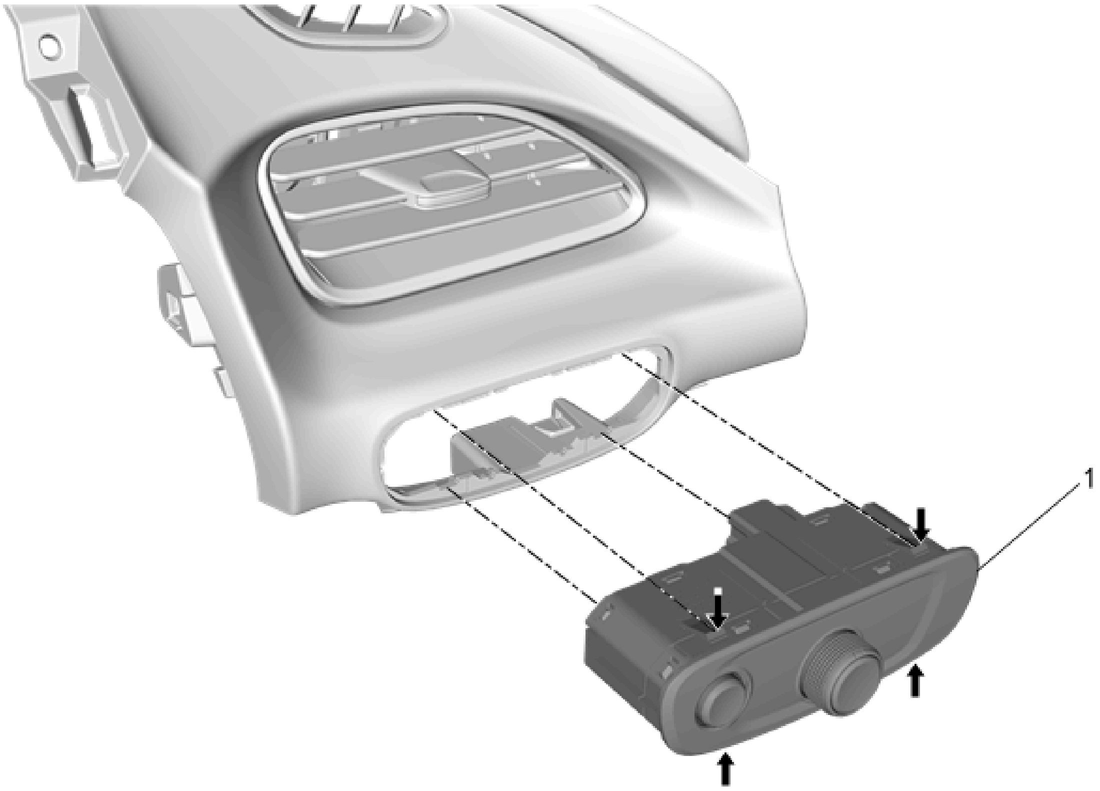


Fig. 3: Headlamp Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Trim Pad Replacement - Left Side	
1	Headlamp Switch **Procedure** Release the tabs and remove the switch.

HAZARD WARNING SWITCH REPLACEMENT

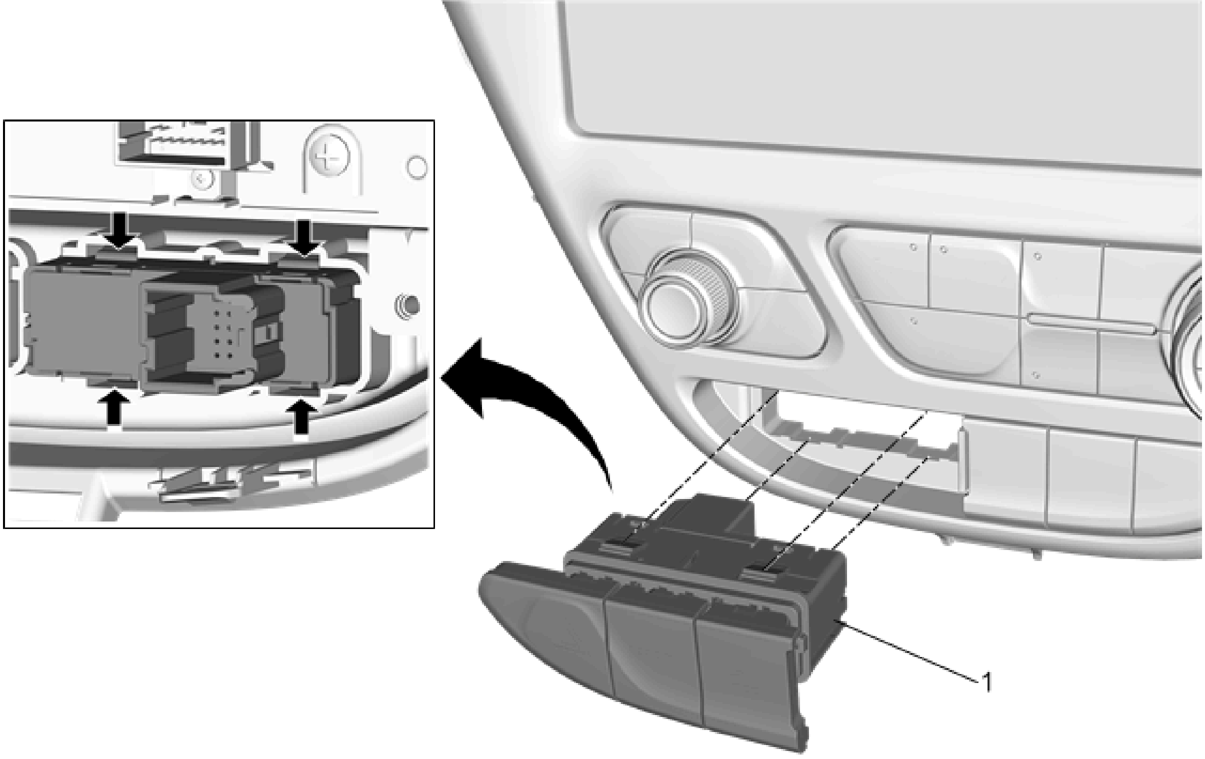


Fig. 4: Hazard Warning Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Trim Plate Replacement	
1	Hazard Warning Switch **Procedure** Release the tabs and remove the switch.

CENTER COURTESY LAMP REPLACEMENT

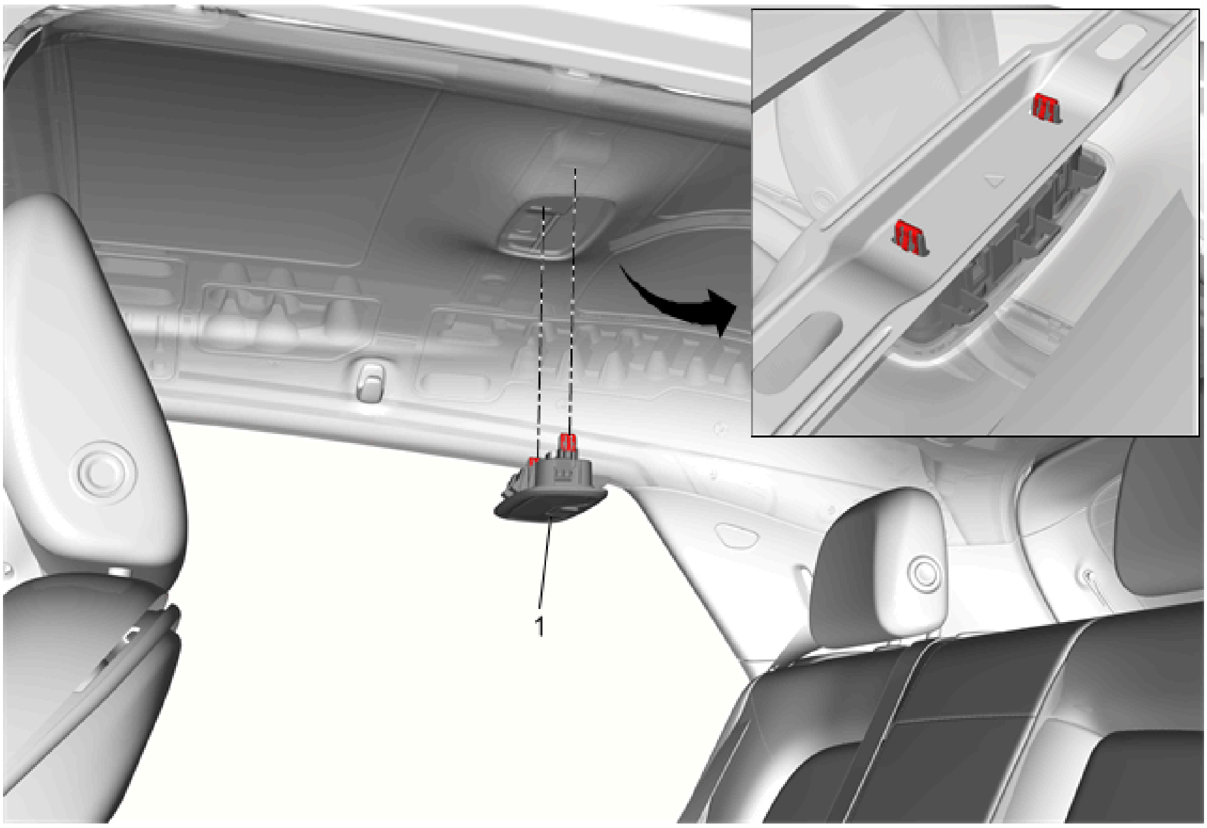


Fig. 5: Center Courtesy Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Center Courtesy Lamp **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release enough of the courtesy lamp wiring harness from headliner to allow slack for installation. 3. Wrap the exposed harness with foam tape to preventing rattling. 4. Disconnect the electrical connector.

REAR SEAT POSITION CENTER COURTESY LAMP BULB REPLACEMENT

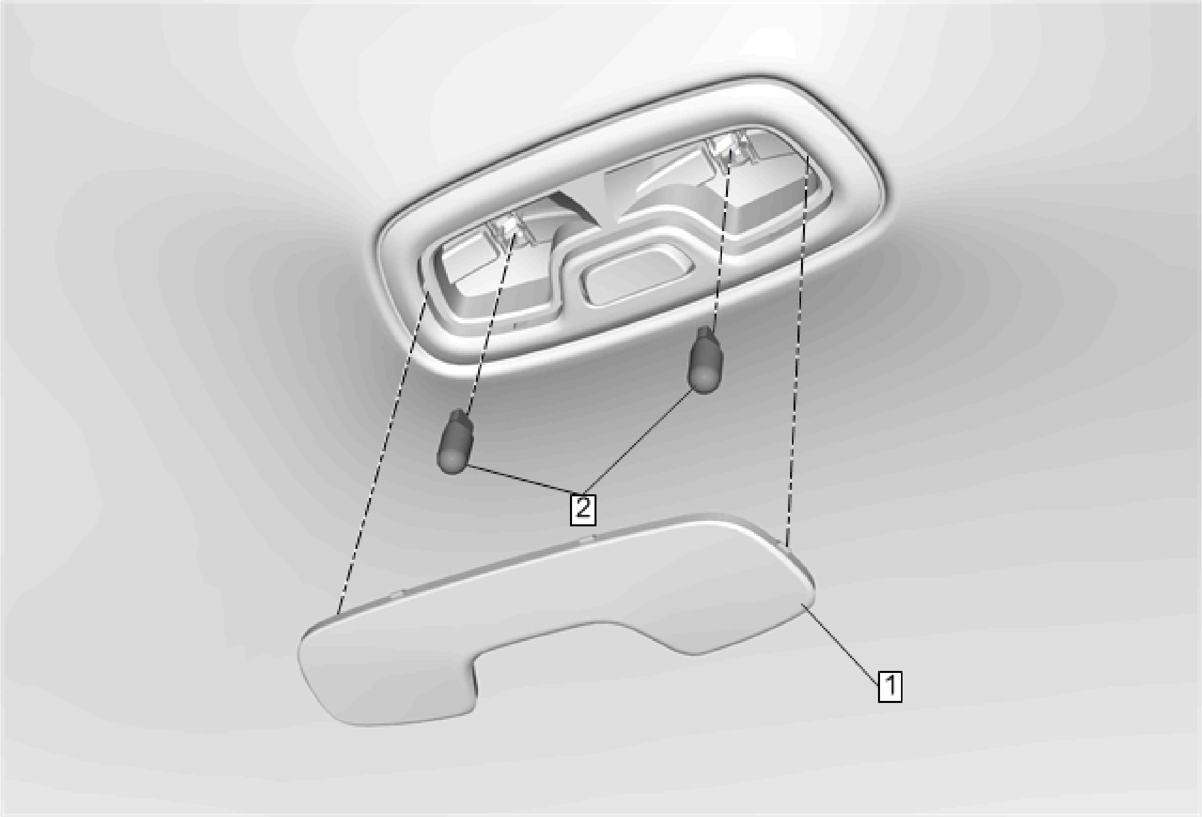


Fig. 6: Rear Seat Position Center Courtesy Lamp Bulb
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Center Courtesy Lamp Lens **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs.
2	Rear Seat Position Center Courtesy Lamp Bulb

OUTSIDE REARVIEW MIRROR TURN SIGNAL LAMP REPLACEMENT

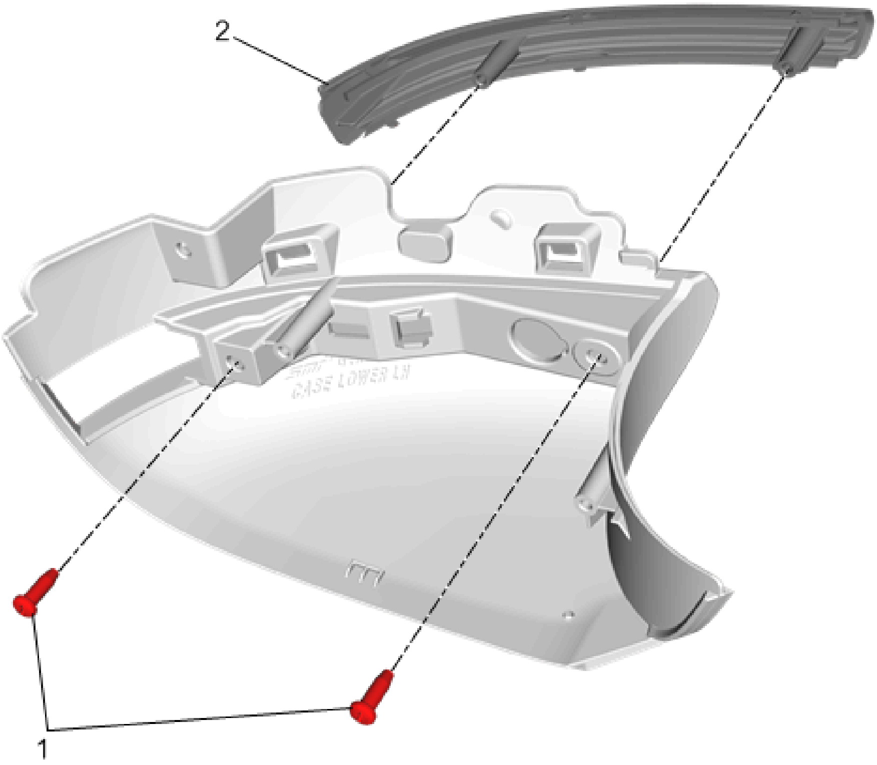


Fig. 7: Outside Rearview Mirror Turn Signal Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Outside Rearview Mirror Housing Lower Cover Replacement	
1	Outside Rearview Mirror Turn Signal Lamp Screw **CAUTION:** Fastener Caution **Tighten** 0.8 N.m (7 lb in)
2	Outside Rearview Mirror Turn Signal Lamp

HEADLAMP REPLACEMENT

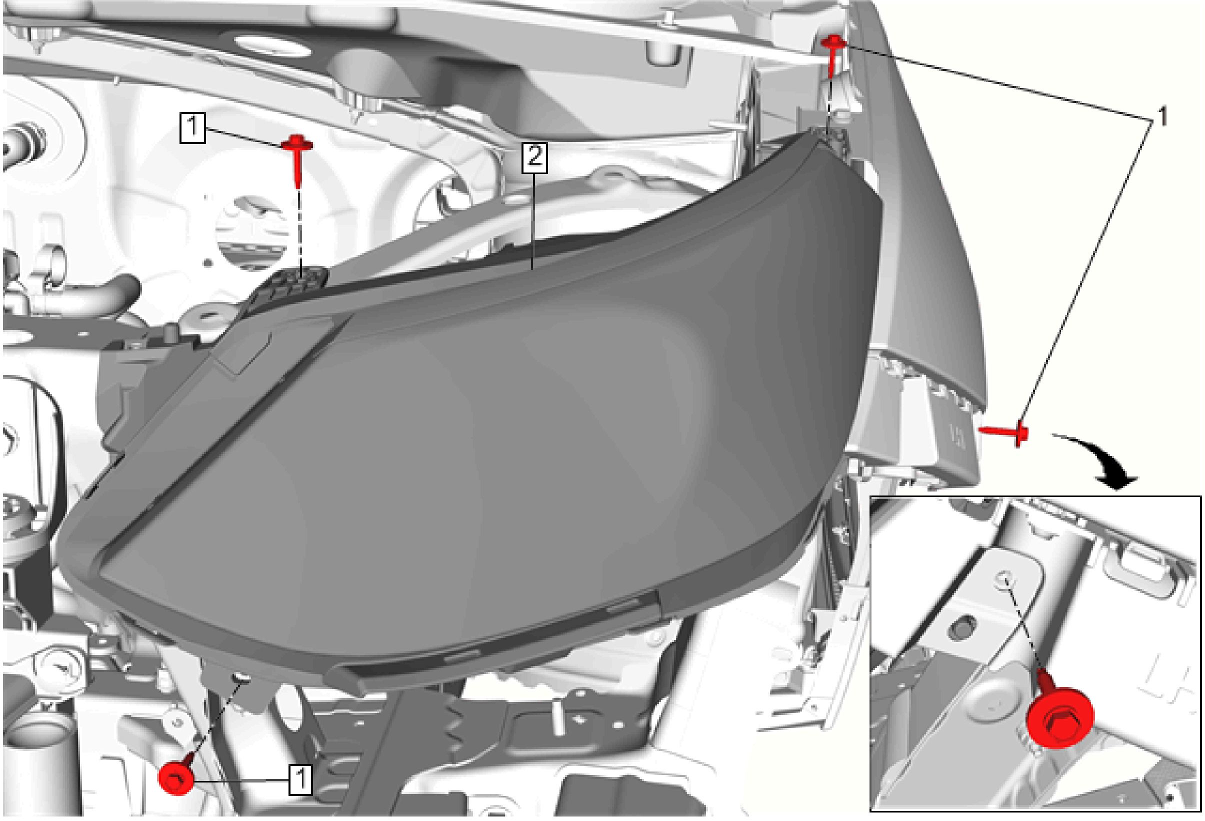


Fig. 8: Headlamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea) 2. Front Fender Upper Rear Molding Bolt - Remove - Front Fender Upper Rear Molding Replacement	
1	Headlamp Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Headlamp **Procedure** 1. Remove the fastener shared by the front fender upper rear molding. 2. Disconnect the electrical connector. 3. Perform the headlamp aiming procedure. Headlamp Aiming (Europe, Korea)Headlamp Aiming (North America)

HEADLAMP BALLAST REPLACEMENT

Removal Procedure

WARNING: **The high intensity discharge system produces high voltage and current. In order to reduce the risk of severe shocks and burns, the battery negative cable must be disconnected any time service work is being performed on or around the high intensity discharge system.**

WARNING: **The high intensity discharge system produces high voltage and current. To reduce the risk of severe shocks and burns:**

- **Never open the high intensity discharge system ballast or the arc tube assembly starter.**
- **Never probe between the high intensity discharge system ballast output connector and the arc tube assembly.**

1. Remove the headlamp. Headlamp Replacement

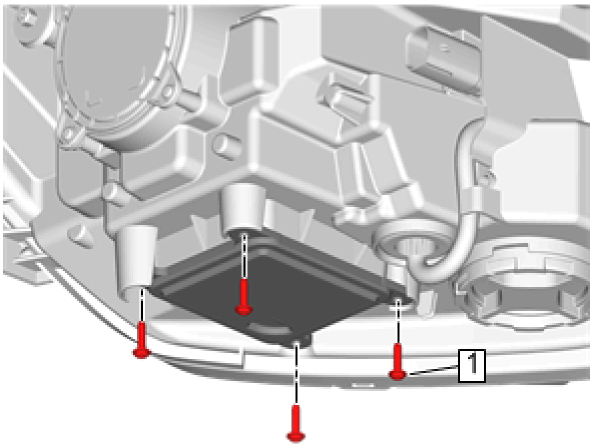


Fig. 9: Headlamp Ballast Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Remove the headlamp ballast fasteners (1).

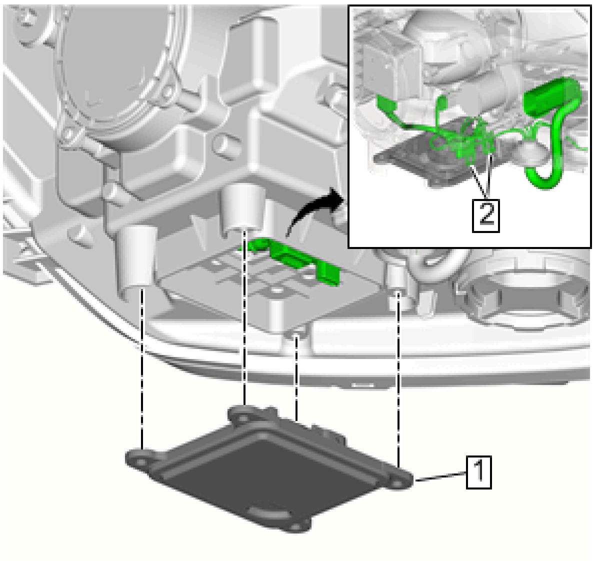


Fig. 10: Headlamp Ballast
Courtesy of GENERAL MOTORS COMPANY

3. Remove the headlamp ballast (1).
4. Disconnect the electrical connectors (2).

Installation Procedure

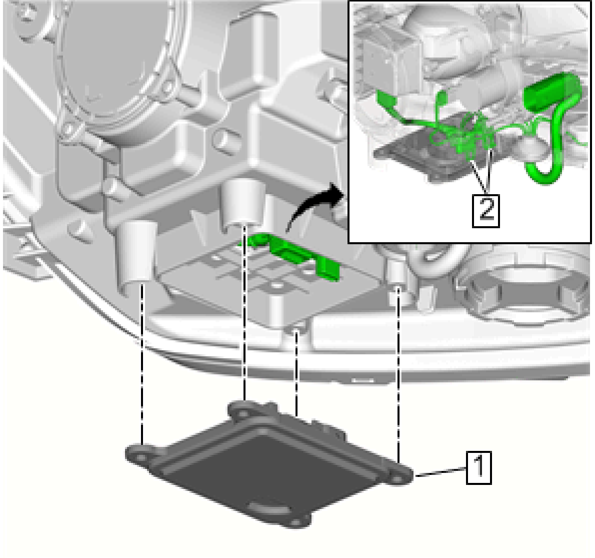


Fig. 11: Headlamp Ballast
Courtesy of GENERAL MOTORS COMPANY

1. Connect the electrical connectors (2).
2. Install the headlamp ballast (1).

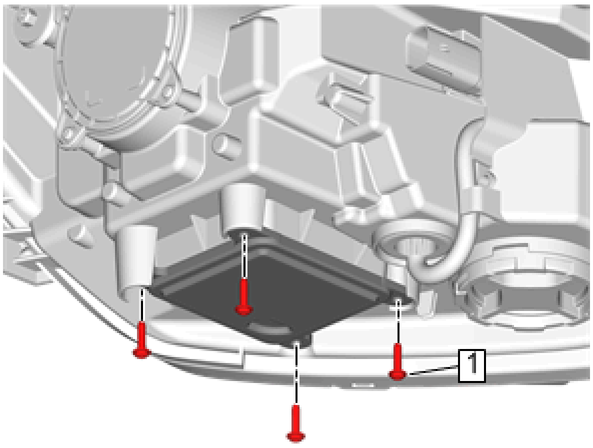


Fig. 12: Headlamp Ballast Fasteners
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install the headlamp ballast fasteners (1) and tighten to 2.5 N.m (22 lb in).
4. Install the headlamp. **Headlamp Replacement**

HEADLAMP BULB REPLACEMENT

Removal Procedure

WARNING: **The high intensity discharge system produces high voltage and current. In order to reduce the risk of severe shocks and burns, the battery negative cable must be disconnected any time service work is being performed on or around the high intensity discharge system.**

WARNING: **The high intensity discharge system produces high voltage and current. To reduce the risk of severe shocks and burns:**

- **Never open the high intensity discharge system ballast or the arc tube assembly starter.**

- **Never probe between the high intensity discharge system ballast output connector and the arc tube assembly.**

1. Remove the headlamp. **Headlamp Replacement**

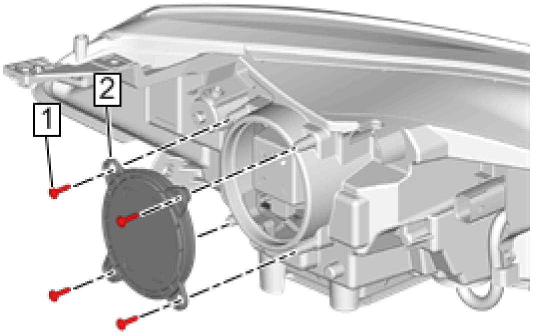


Fig. 13: Headlamp Bulb Access Cover Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Remove the headlamp bulb access cover fasteners (1).
3. Remove the headlamp bulb access cover (2).

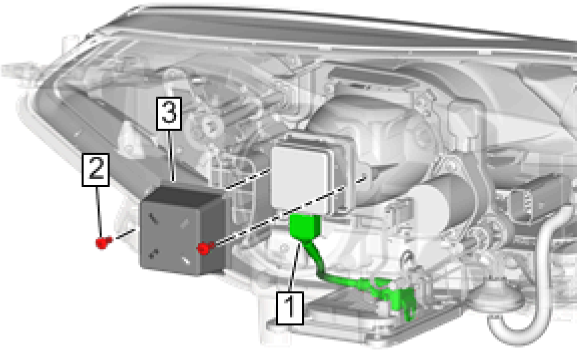
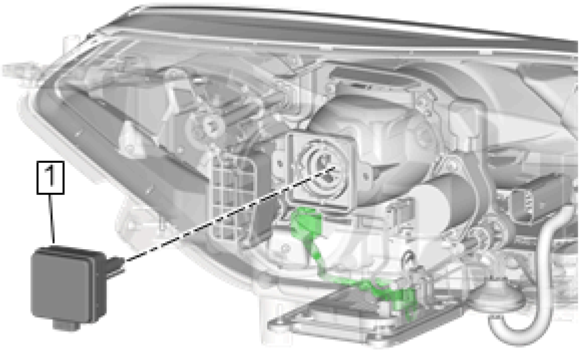


Fig. 14: Headlamp Bulb Retaining Cover Fasteners
Courtesy of GENERAL MOTORS COMPANY

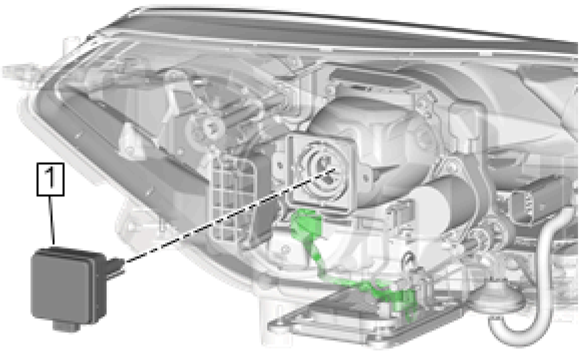
4. Disconnect the electrical connector (1).
5. Remove the headlamp bulb retaining cover fasteners (2).
6. Remove the headlamp bulb retaining cover (3).



[Fig. 15: Headlamp Bulb]
Courtesy of GENERAL MOTORS COMPANY

7. Remove the headlamp bulb (1).

Installation Procedure



[Fig. 16: Headlamp Bulb]
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The outer ring of the assembly contains alignment keys to ensure the correct orientation.**

1. Install the headlamp bulb (1).

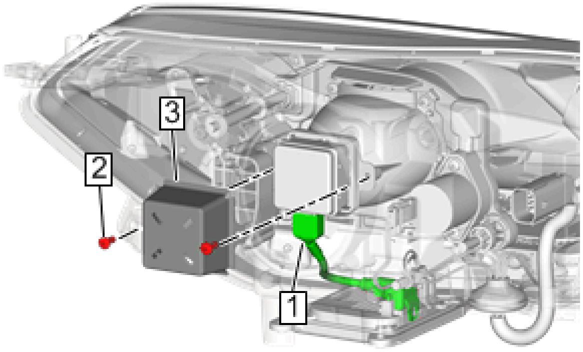


Fig. 17: Headlamp Bulb Retaining Cover Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Install the headlamp bulb retaining cover (3).

CAUTION: **Refer to Fastener Caution .**

3. Install the headlamp bulb retaining cover fasteners (2) and tighten to 2.5 N.m (22 lb in).
4. Connect the electrical connector (1).

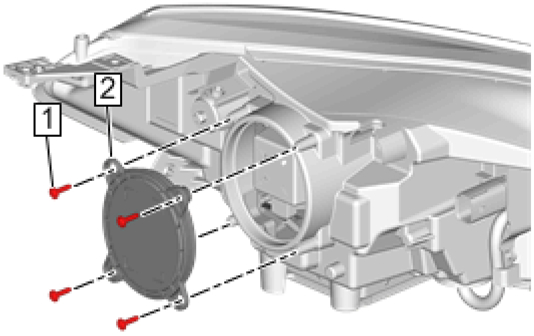


Fig. 18: Headlamp Bulb Access Cover Fasteners
Courtesy of GENERAL MOTORS COMPANY

5. Install the headlamp bulb access cover (2).
6. Install the headlamp bulb access cover fasteners (1) and tighten to 2.5 N.m (22 lb in).
7. Install the headlamp. **Headlamp Replacement**

HEADLAMP AIMING (EUROPE, KOREA)

General

Directive 76/756 EEC and ECE-Regulation 48 cover checking and aiming of headlamps on vehicle. Correct aiming of headlamps of vehicles should enable optimal road illumination by the low beam-, with minimal glare to oncoming traffic. For this purpose the inclination of the light beam in relation to the road surface and the angle of the beam to the vertical longitudinal plane running through the vehicle centre must comply with the requirements laid down in the ECE regulation and EEC directive.

Glaring of the low beam is considered eliminated if the intensity of the illumination at a distance of 25 m (82 ft) from each individual headlamp on the plane perpendicular to the road and at the height of the headlamp as well as above, is not greater than 1 lux. This requirement is generally satisfied if the headlamp aiming is carried out according to these aiming guidelines.

For the nondazzling high beam (Intelilux) special attention must be turned to the correct lateral alignment of the headlamps (low beam).

If a non-railed adjustment device will be used, the lateral orientation of the adjustment device has to be checked separately in front of each single headlamp.

The measurement of adjustment for the basic headlamp aiming is displayed in % on the headlamp housing.

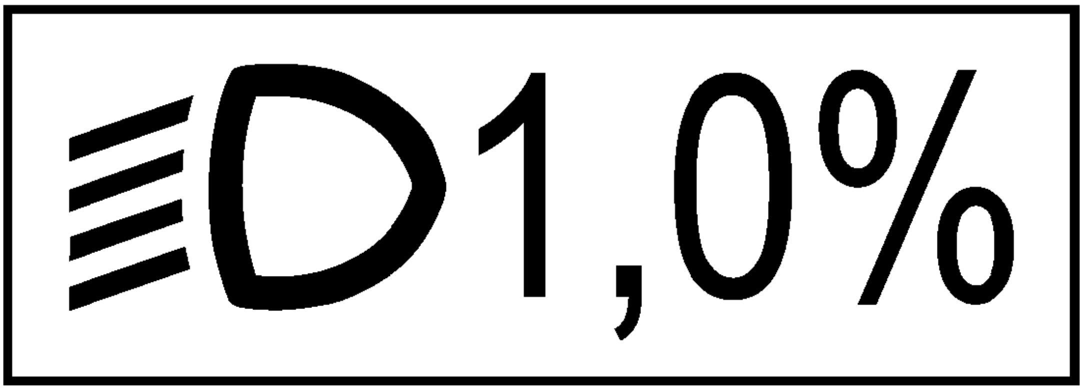


Fig. 19: Headlamp Aiming
Courtesy of GENERAL MOTORS COMPANY

Example: Label for a headlamp inclination of 1.0% for the low beam on the headlamp.

Reference 1.0 percent corresponds to the adjustment dimension of the headlamp with reference to the inclination of the light beam. The inclination at a distance of 10 m (33 ft) from vehicle headlamp is therefore 10 cm (4 in). The inclination of the low beam headlamp is indicated by its light/dark boundary (cut-off line).

Depending on the specific inner design of the headlamps, the movement of the lightbeam on the measurement screen is not exactly vertical or horizontal during the aiming on the aiming screws. This is caused by the technical solution of the suspension of the reflectors in the headlamp housing. After aiming of one axis the aiming of the other axis should be rechecked. For instance the vertical aiming could be changed a bit after the aiming of the horizontal axis. Therefore the vertical axis must be checked and if necessary aimed again after the aiming of the horizontal axis.

If a headlamp shows a significant deviation from the correct aiming for both horizontal and vertical direction the aiming operation must be performed step by step for the two directions. This means that in such a case the aiming of horizontal and vertical direction must be done alternately in small steps. Not more than one turn of an aiming screw shall be performed at once. After one turn change to the other aiming screw. Repeat this procedure until the headlamp is correctly aimed.

Headlamp Beam Setter / Inspection Station

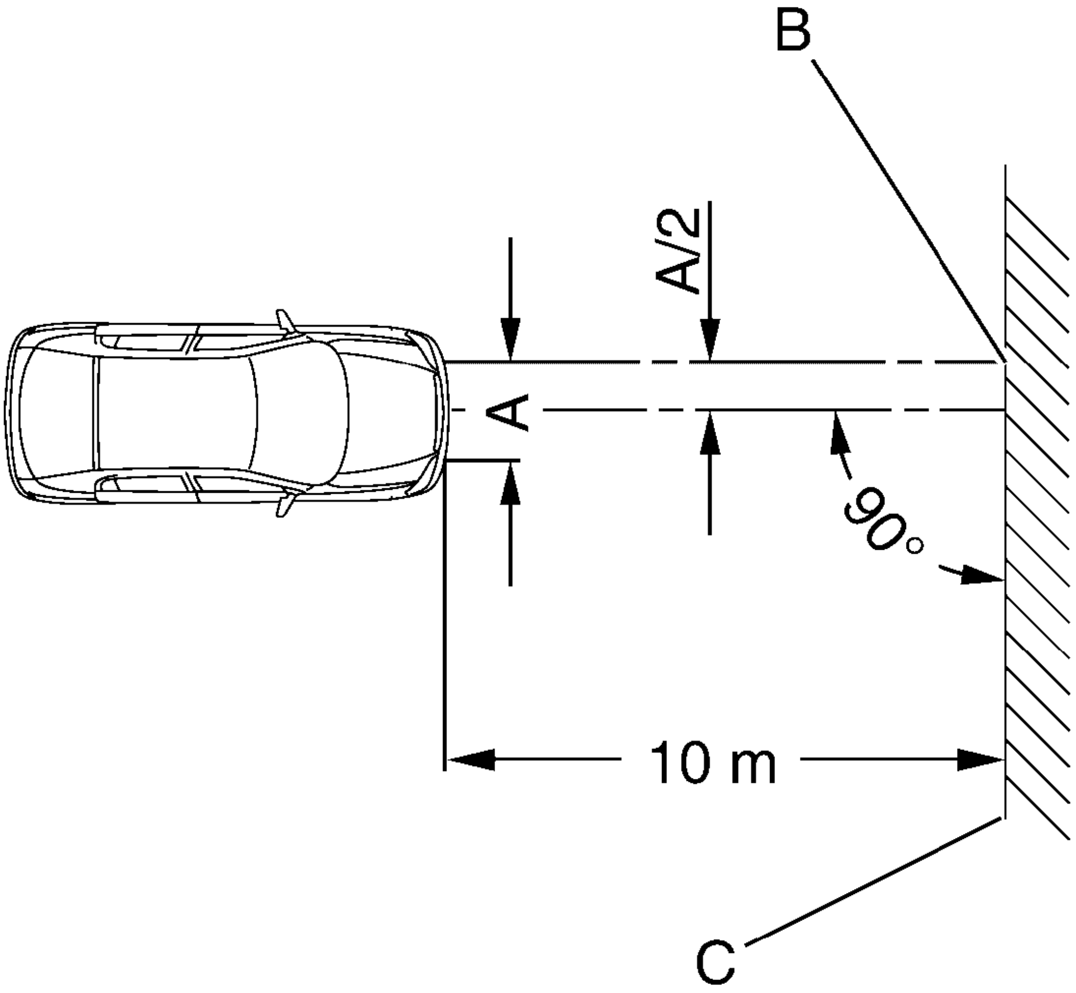


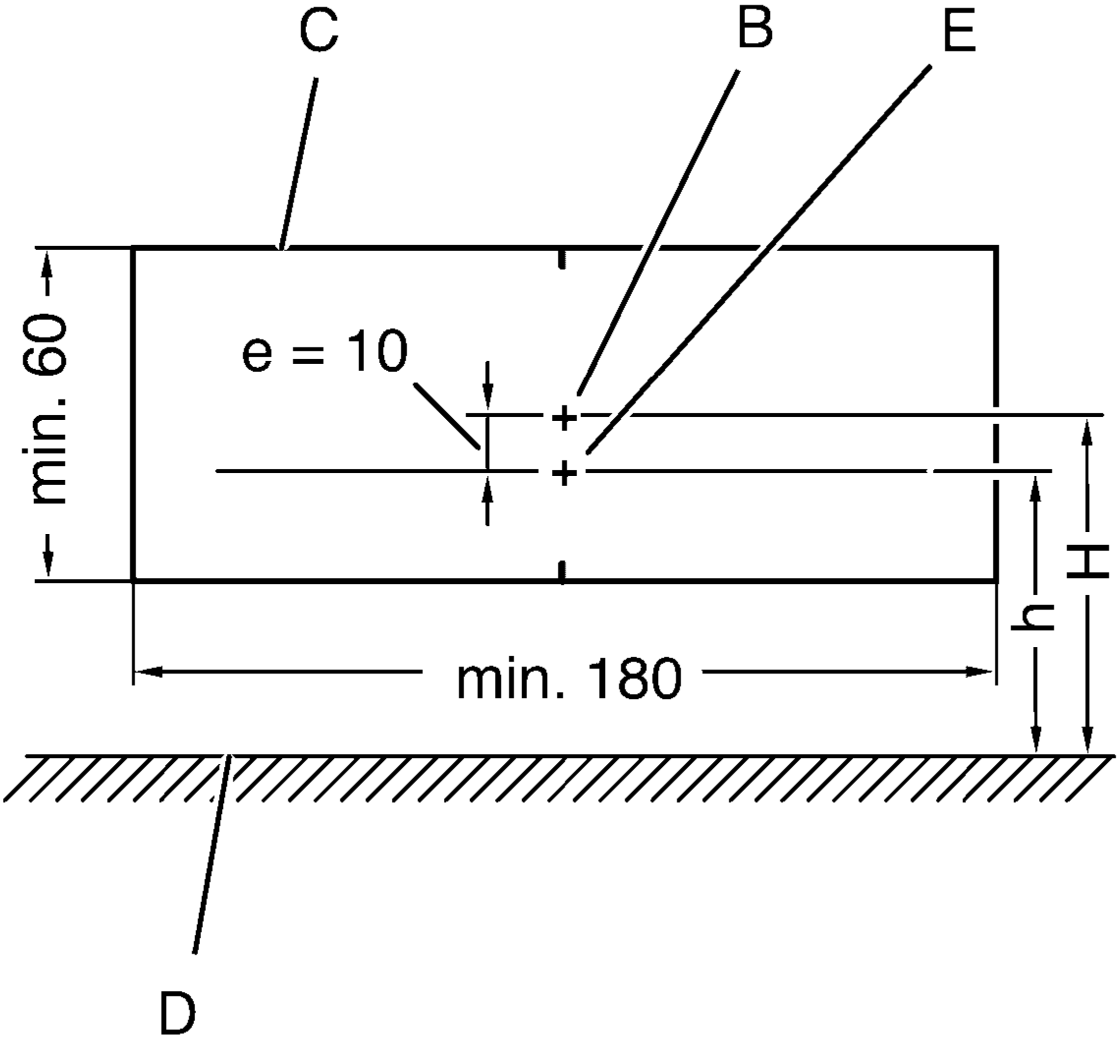
Fig. 20: Aiming Guideline
Courtesy of GENERAL MOTORS COMPANY

Abbreviations used:

A = Horizontal distance between headlamp centres

B = Central marking

C = Test surface



[Fig. 21: Aiming Guideline](#)
Courtesy of GENERAL MOTORS COMPANY

C = Test surface

D = Road surface

E = Break point (kink of cut-off line)

e = Aiming dimension in cm, e = H - h (aiming dimension, low beam headlamps usually at 1.0 percent, e = 10 cm (4 in), front fog lamps 2.0 percent, e = 20 cm (8 in), high beam headlamps (if separately amiable) at 0 percent, e = 0 cm (0 in).

H = Height of centre of headlamp over road surface

h = Height of light/dark boundary line (cut-off line) of low beam above road surface

The headlamp aiming is performed according to the specifications, as shown in the illustrations, using an adjuster. When using a headlamp adjuster, set up the height and position of the adjuster according to the instructions in the operation manual. Ensure that the vehicle tire surface that is in contact with the road and the surface for setting up the adjuster are at the same level and parallel with each another.

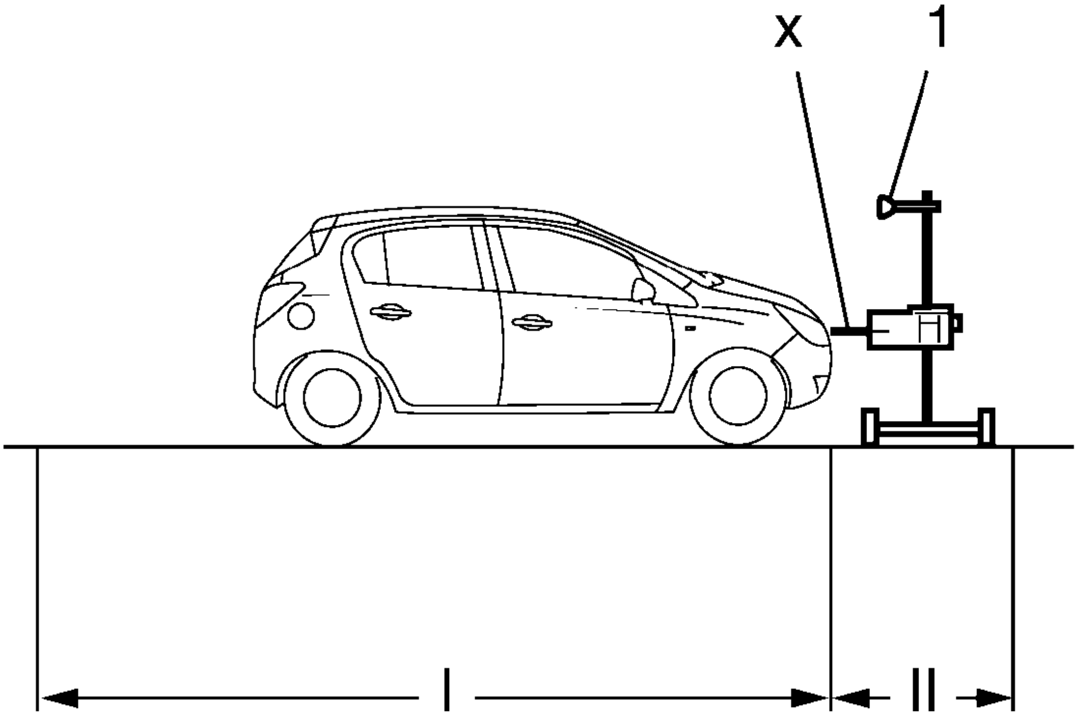


Fig. 22: Marking Of Control Mirror
Courtesy of GENERAL MOTORS COMPANY

X = Center of adjuster lens (see arrow mark on adjuster housing) must be aligned on the same level as the low beam headlamp and must be parallel to the ground.

1 = Use marking of the control mirror (1) to align the adjuster system in the correct angle to the vehicle, based on the information shown in the owner operating instructions.

The distance between the adjuster lens and the headlamp must be max. 0, 9 meters (refer to operation instructions of the adjuster system)

The surface on which the measuring instrument (adjuster system) and the vehicle stand must be flat. See follow table.

I difference utility space from vehicle	
longitudinal direction	**lateral direction**
Â± 3 mm / m	Â± 0 mm / 1 m
Â± 5 mm / 2m	Â± 0 mm / 2 m
Â± 7 mm /3 m	Â± 0 mm / 3 m
Â± 9 mm / 4 m	Â± 0 mm / 4 m
Â± 10 mm / 6 m	Â± 0 mm / 6 m
Â± 11 mm / 8 m	Â± 0 mm / 8 m

II difference utility space from vehicle	
longitudinal direction	**lateral direction**
Â± 1 mm / 1 m	Â± 1 mm / 1 m

Vehicle tires must have specified air pressure. Blackened bulbs must be replaced before adjusting.

The adjustment is performed at vehicle curb weight plus one person or 75 kg (165 lb) on the driver's seat. (Curb weight = weight of vehicle ready for use with 90% filled fuel tank plus the weight of all equipment carried during use, e.g. spare wheel, tools, jack, first aid kit, emergency warning triangle, etc.).

Light Pattern / Scheme of Headlamps

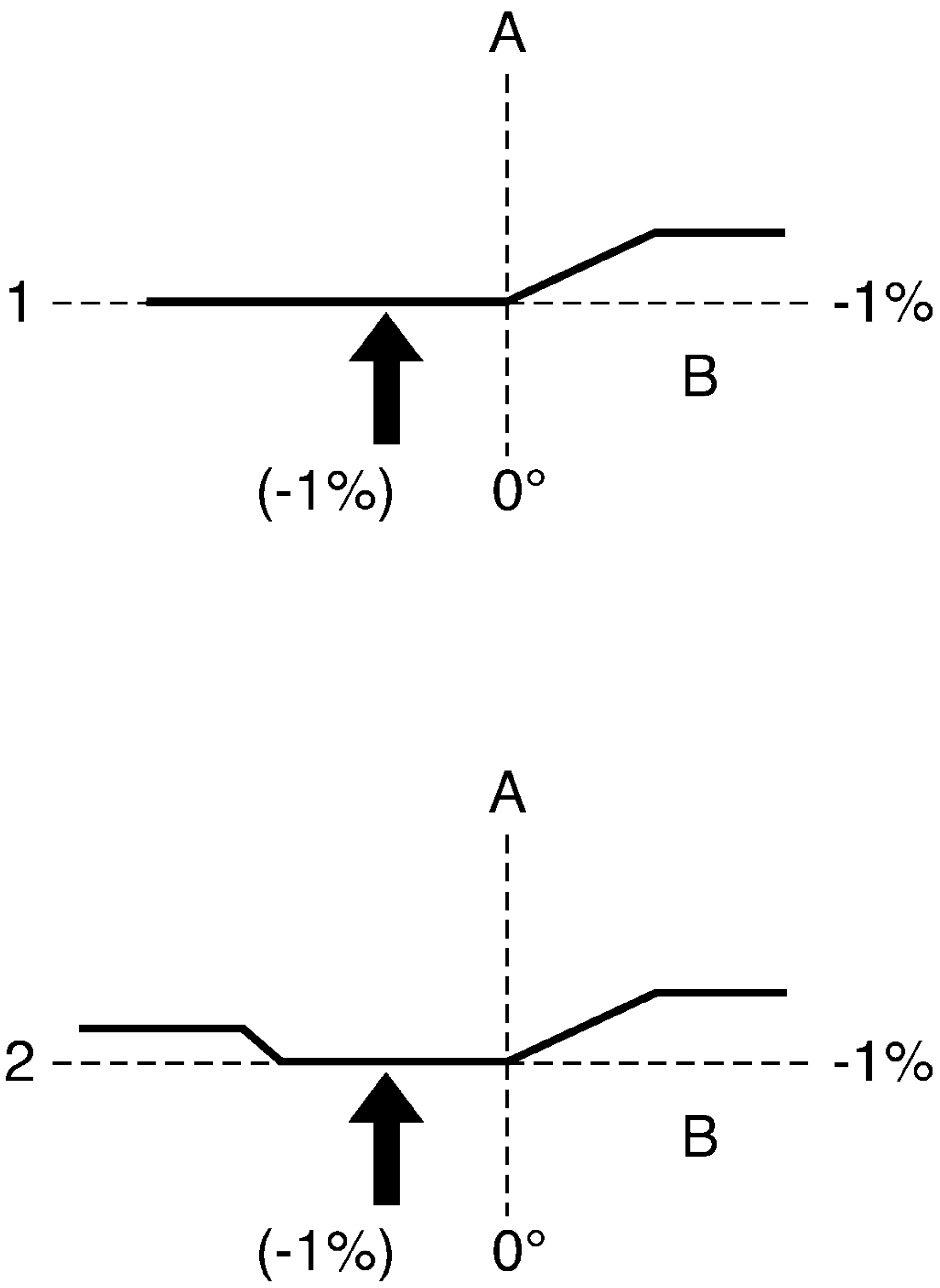


Fig. 23: Light Pattern / Scheme of Headlamp
Courtesy of GENERAL MOTORS COMPANY

A = Kink of cut-off line for the left/right setting

B = Horizontal area of the cut-off line for up/down setting

1 and 2 = Depending on the headlamp setup the outer sections will be straight or increasing.

Headlamp Aiming

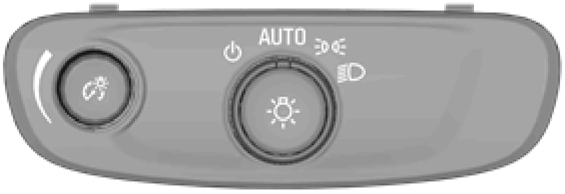


Fig. 24: Headlamp Switch
Courtesy of GENERAL MOTORS COMPANY

The headlamp switch must be turned on manual low beam if equipped, the manual headlamp range adjustment has to be in the zero position.

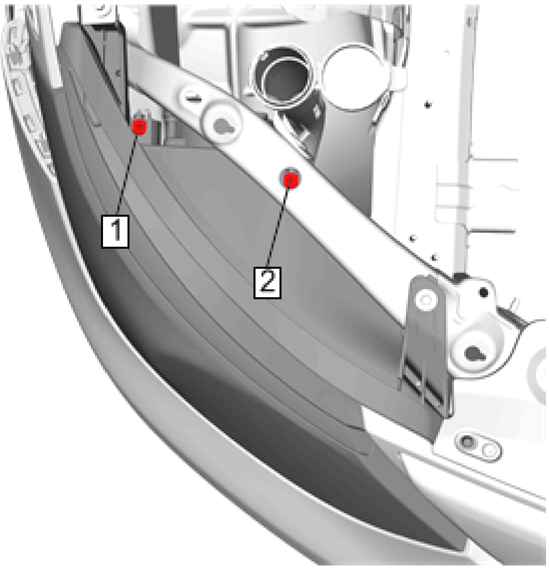


Fig. 25: Headlamp Screw
Courtesy of GENERAL MOTORS COMPANY

Halogen Headlamp

- (1) Aiming screw for vertical adjustment
- (2) Aiming screw for horizontal adjustment

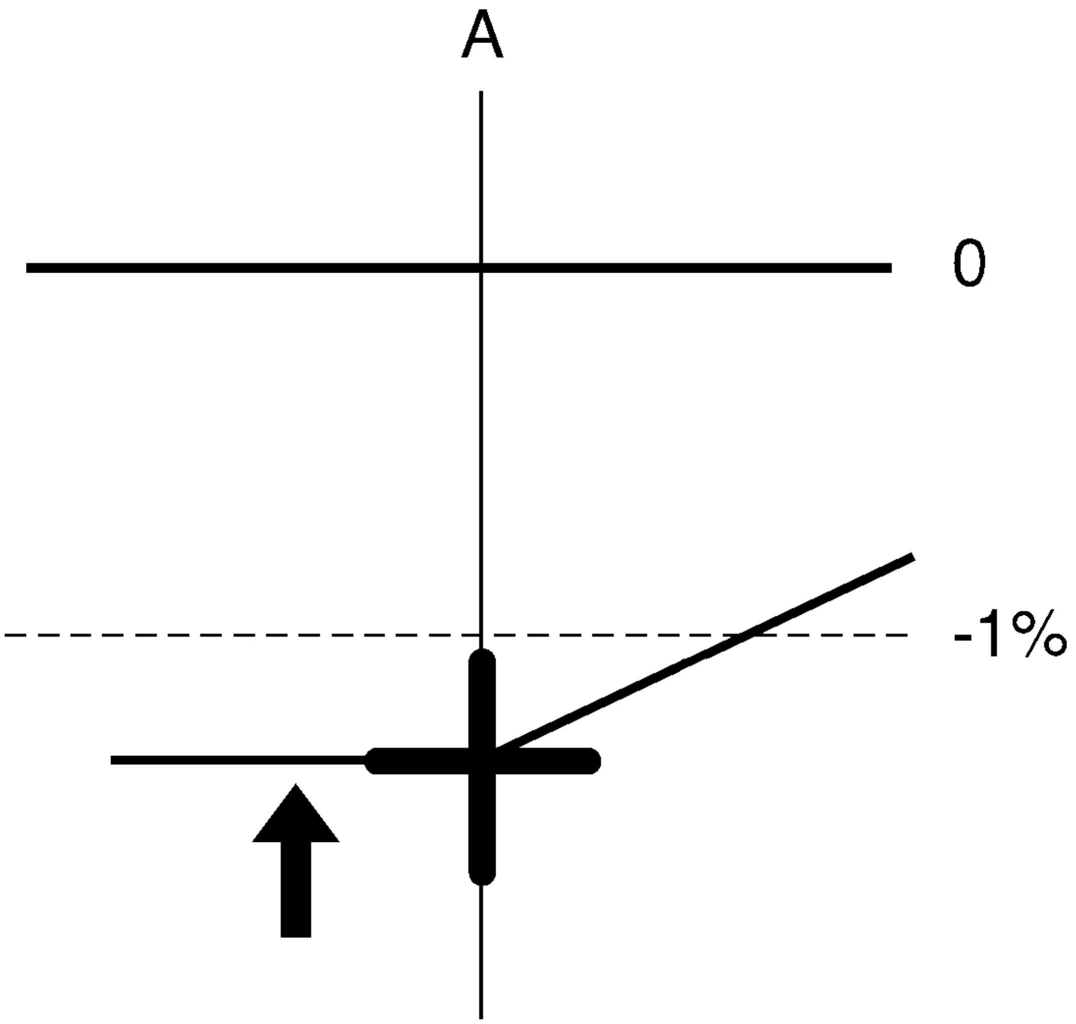


Fig. 26: Headlamp Adjustment Grid
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Guide and adjust the headlamps always from below to the horizontal area of the separation line**

For the vertical adjustment (adjustment of the height), the separation line has to be on the left side of the adjustment cross parallel to the horizontal adjustment line (1).

NOTE: **At first perform the vertical (1) and then the lateral adjustment. Check the vertical adjustment again after the lateral adjustment.**

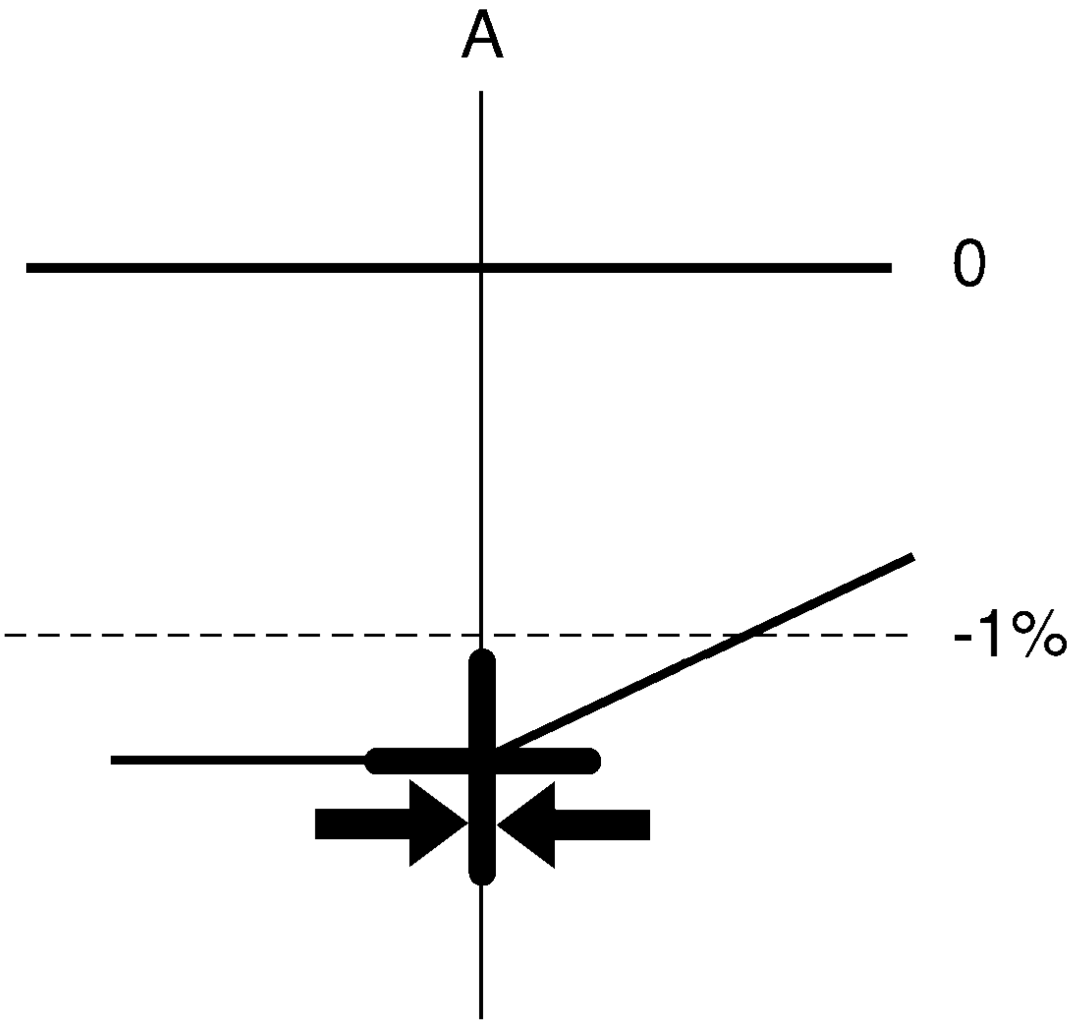


Fig. 27: Vertical Separation Line
Courtesy of GENERAL MOTORS COMPANY

To assure the correct lateral adjustment the horizontal increase (inflection point) must lay on the vertical separation line A (0 degree).

NOTE: **This description is valid for right hand traffic. For left hand traffic the light pattern of left and right side is mirrored.**

HEADLAMP AIMING (NORTH AMERICA)

Visual Aiming Preparation Procedure

NOTE: **Some state and local laws specify requirements for headlamp aim. Comply with all of these laws when performing any headlamp aiming operations.**

Headlamp aim should be checked:

- When a new headlamp capsule is installed.
- If service or repairs to the front end area have, or may have, disturbed the headlamps or their mounting.

The aiming screen should meet the following criteria:

- The area will consist of a level surface large enough to allow for a vehicle and an additional 7.62 m (25 ft) measured from face of lamps to the front of the aiming screen.
- The screen will be 1.52 m (5 ft) high x 3.66 m (12 ft) wide with a matte white surface well shaded from extraneous light, and properly adjusted to the floor on which the vehicle stands. Provisions

should be made to align the aiming screen parallel with the vehicle.

- The screen shall be provided with a fixed vertical centerline, two laterally adjustable vertical tapes, and one vertically adjustable horizontal tape.
- If a regular commercial aiming screen is not available, the screen may consist of a vertical wall having a clear uninterrupted area approximately 1.83 m (6 ft) high and 3.66 m (12 ft) wide. The surface should be finished with a washable non-gloss white paint.

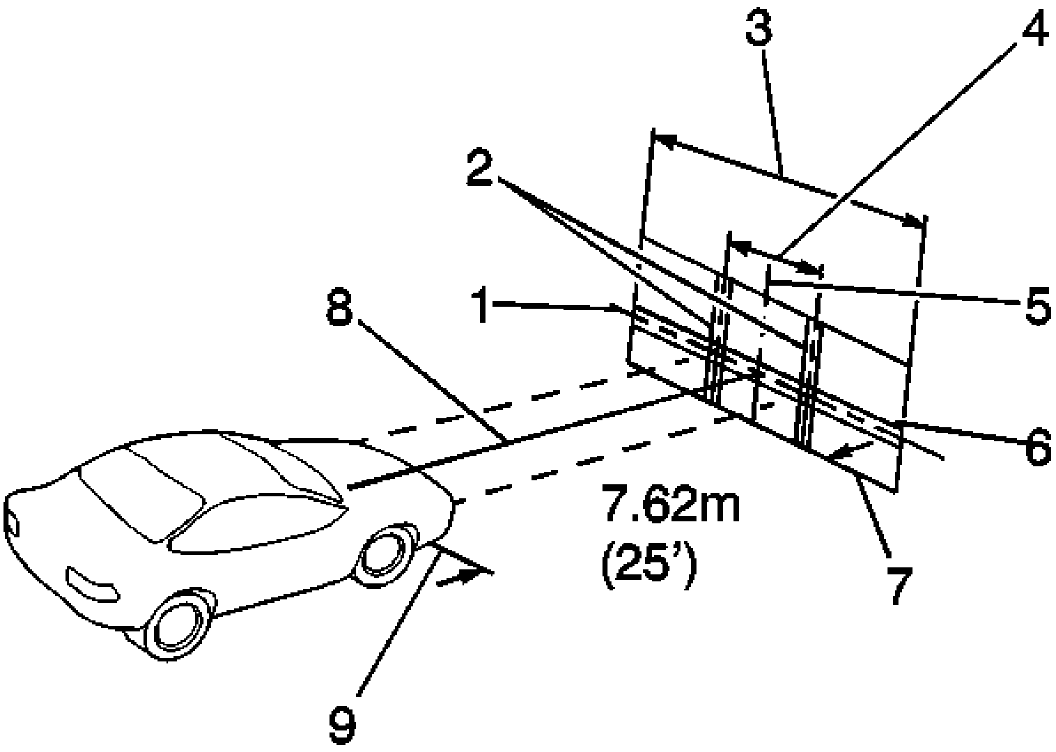


Fig. 28: Headlamp Aiming/Adjustment Procedure
Courtesy of GENERAL MOTORS COMPANY

- After the aiming screen has been set up in a permanent location, paint a reference line on the floor directly under the lens of the lamps to indicate the proper location of the headlamps when they are being aimed:
  - Distance between headlamps (1)
  - Center line of screen (2)
  - Adjustable vertical pointer (3)
  - Adjustable horizontal tape (4)
  - Diagram of light screen (5)
  - Vertical center line ahead of right headlamp pointer position (6)
  - 7.62 m (25 ft) (7)
  - Car axis (8)
  - Adjustable vertical pointer
  - Horizontal center line of lamps
  - Vertical center line ahead of left headlamp

Prior to aiming the headlamps, the following steps must be taken:

1. Remove any snow, ice or mud from the vehicle.
2. Stop all other work on the vehicle.
3. If any service has been performed on the vehicle, make sure that all of the components are back in their original place.
4. The vehicle must be on a level surface.

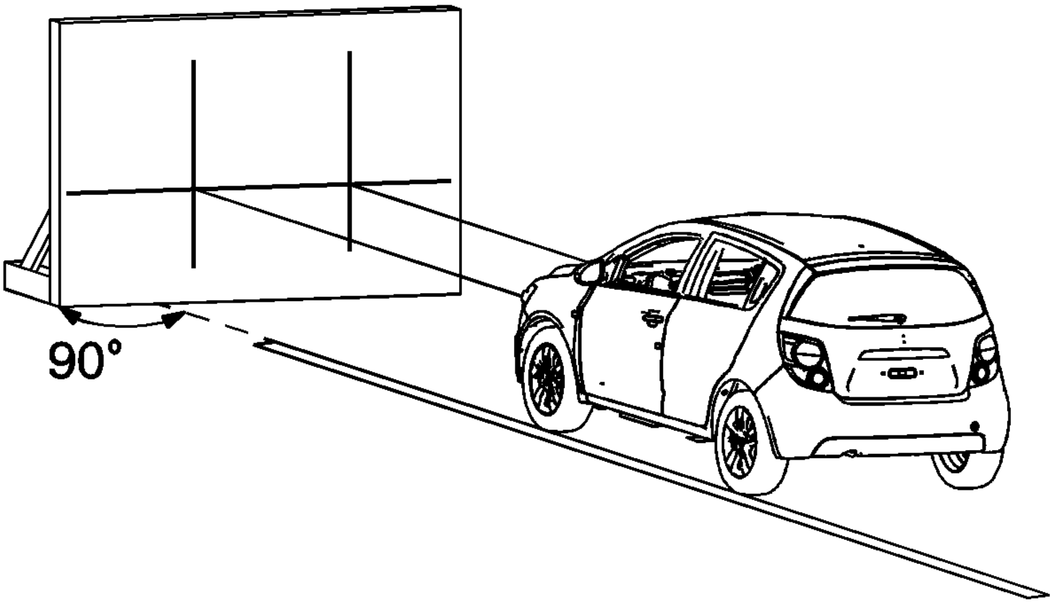


Fig. 29: Headlamp Aiming
Courtesy of GENERAL MOTORS COMPANY

5. The vehicle left tires must be aligned with the reference line extending from the screen with the headlamps aligned with the reference line.
6. Do not load any cargo in the vehicle.
7. The vehicle must contain approximately 75 kg (165 lb) on the driver seat.
8. Inflate the tires to the proper pressure.
9. Simulate the vehicle loads if the intended use of the vehicle is for hauling heavy loads or towing a trailer.
10. Rock the vehicle in order to stabilize the suspension.
11. Turn on the headlamps to low beam and observe the left and the top edges of the high intensity zone on the screen. The edges of the high intensity zone should fall within the specifications.

Headlamp Aiming Procedure

1. Open the hood.

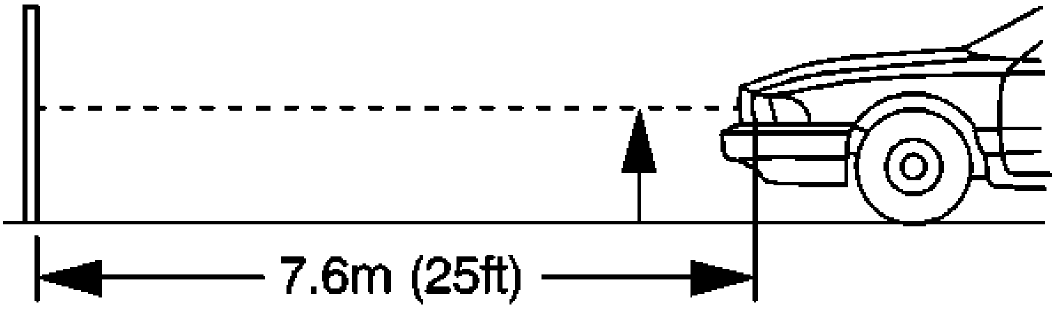


Fig. 30: Measuring Distance Between Headlamps Face & Aiming Screen
Courtesy of GENERAL MOTORS COMPANY

2. Measure from the floor to the center of the headlamp bulb. Some headlamps have an aim dot marked on the headlamp lens.
3. At the screen, measure from the floor and place the horizontal tape at the measured distance.
4. Measure from the reference line on the floor to the left headlamp bulb centerline.
5. At the screen, measure from the reference line and place the vertical tape at the measured distance.
6. Measure from the reference line on the floor to the right headlamp bulb centerline.
7. At the screen, measure from the reference line and place the vertical tape at the measured distance.

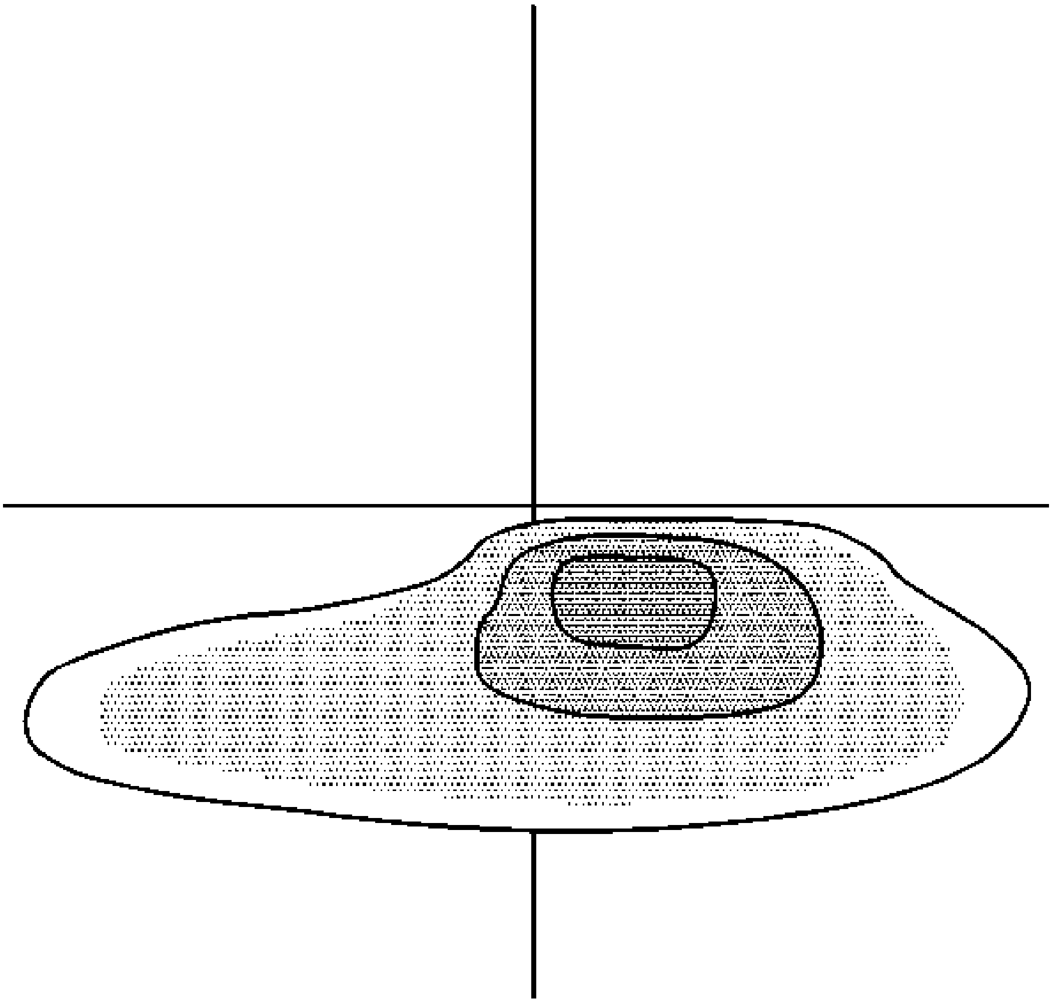


Fig. 31: Right Side Low Beam Proper Screen Positioning
Courtesy of GENERAL MOTORS COMPANY

NOTE: **DO NOT cover the headlamp. This may cause excessive heat build up.**

8. Turn ON the low beam headlamps. Block the light from projecting onto the screen from the passenger side headlamp.

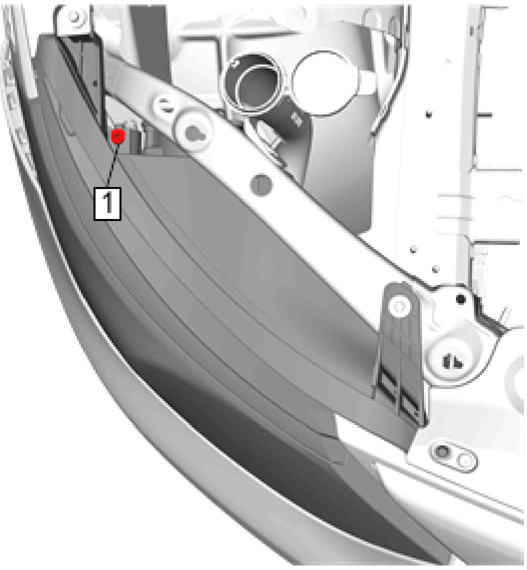


Fig. 32: Vertical Aim Screw
Courtesy of GENERAL MOTORS COMPANY

9. Adjust the vertical aim screw (1) of the headlamps to the specifications required by the state and the local authorities, or as shown in step number 8.
10. Repeat the aiming procedure for the passenger side headlamp while blocking the light from projecting onto the screen from the driver side headlamp.
11. Turn the headlamps OFF.
12. Close the hood.

FRONT TURN SIGNAL LAMP REPLACEMENT

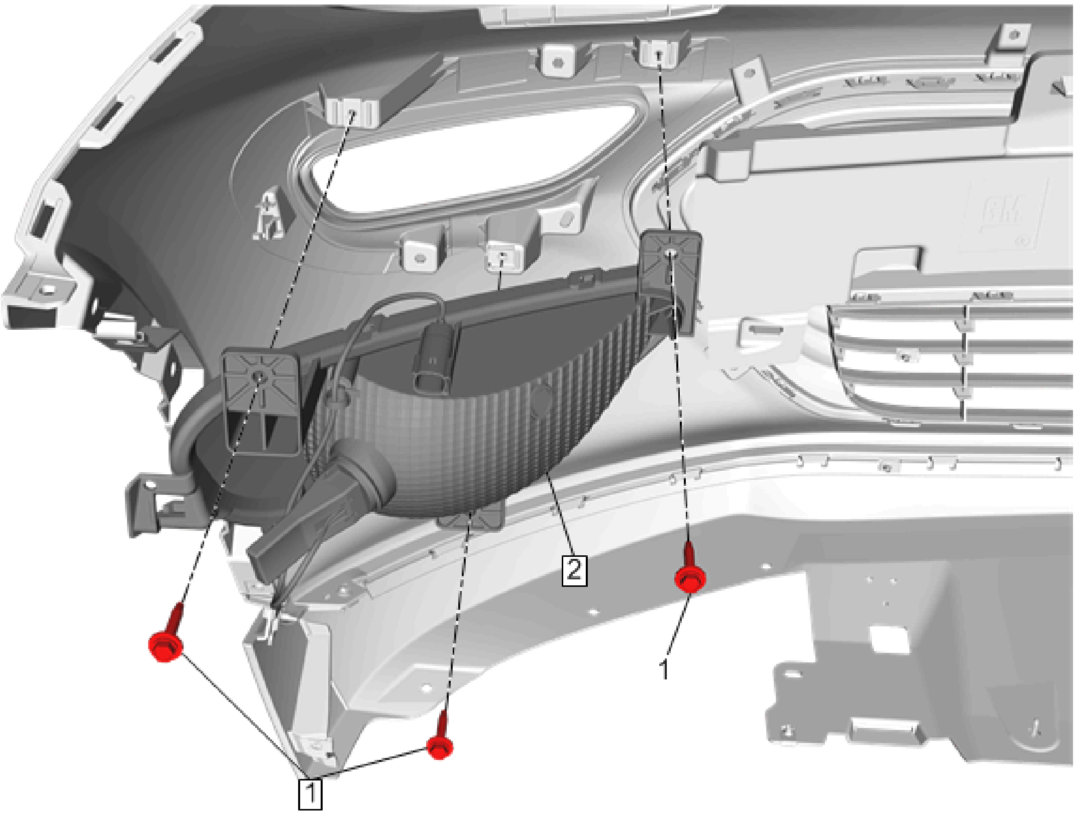


Fig. 33: Front Turn Signal Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)	
1	Front Turn Signal Lamp Bolt **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Front Turn Signal Lamp **Procedure** Disconnect the electrical connector.

REAR SIDE MARKER LAMP REPLACEMENT

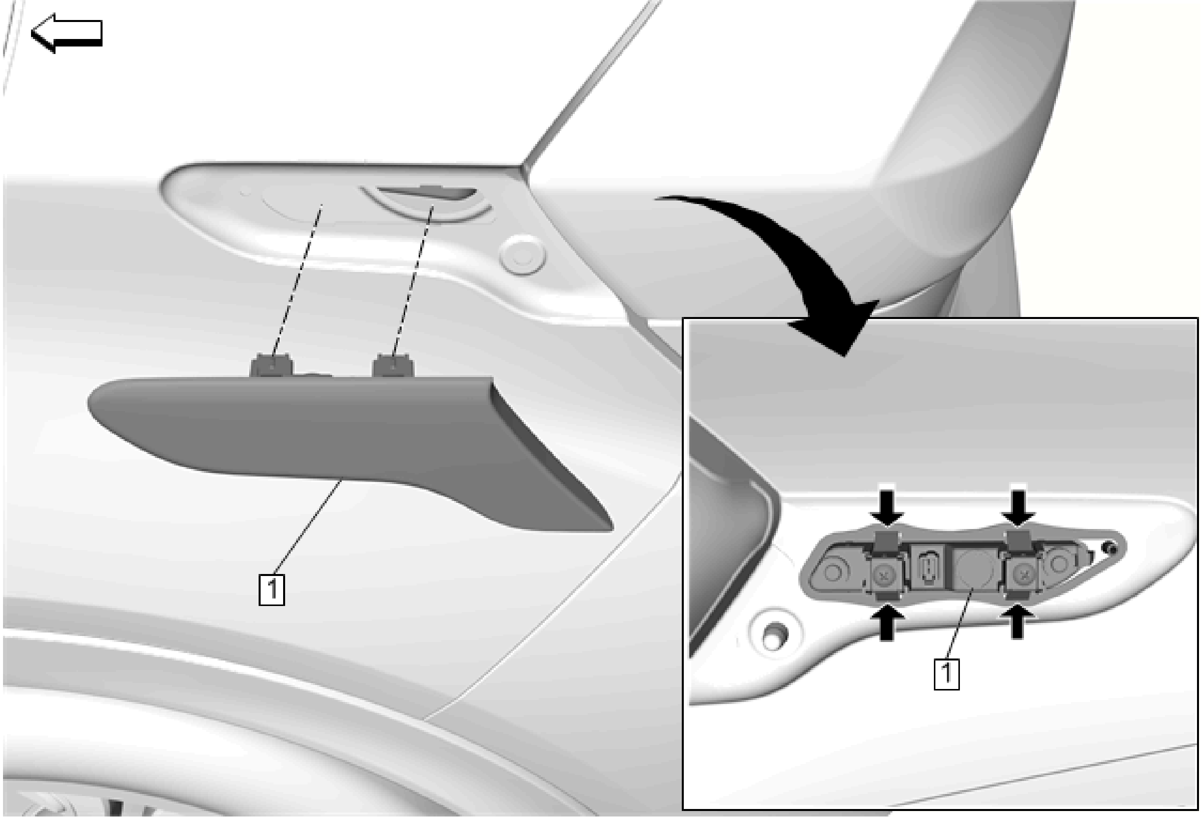


Fig. 34: Rear Side Marker Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	**CAUTION:** **To avoid paint damage, protect the area surrounding the part which you are removing or installing.** **CAUTION:** **Be very careful and gentle when using the plastic trim tool to remove the rear side marker lamp. The rear side marker lamp is very brittle and will be damaged if one is not careful with the plastic trim tool. If the rear side marker lamp is damaged it must be replaced.** Rear Side Marker Lamp**Procedure** Using a plastic trim tool, remove the side marker lamp from the body.

FRONT TURN SIGNAL LAMP BULB REPLACEMENT

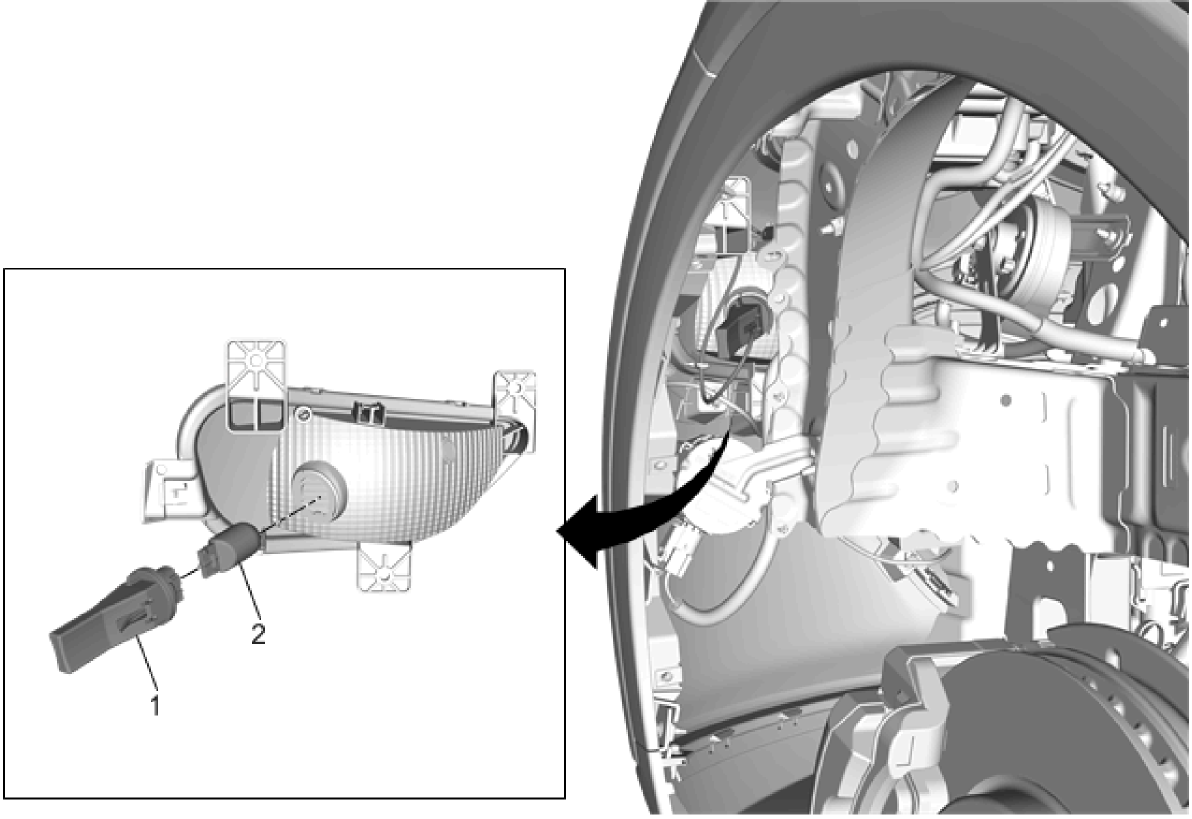
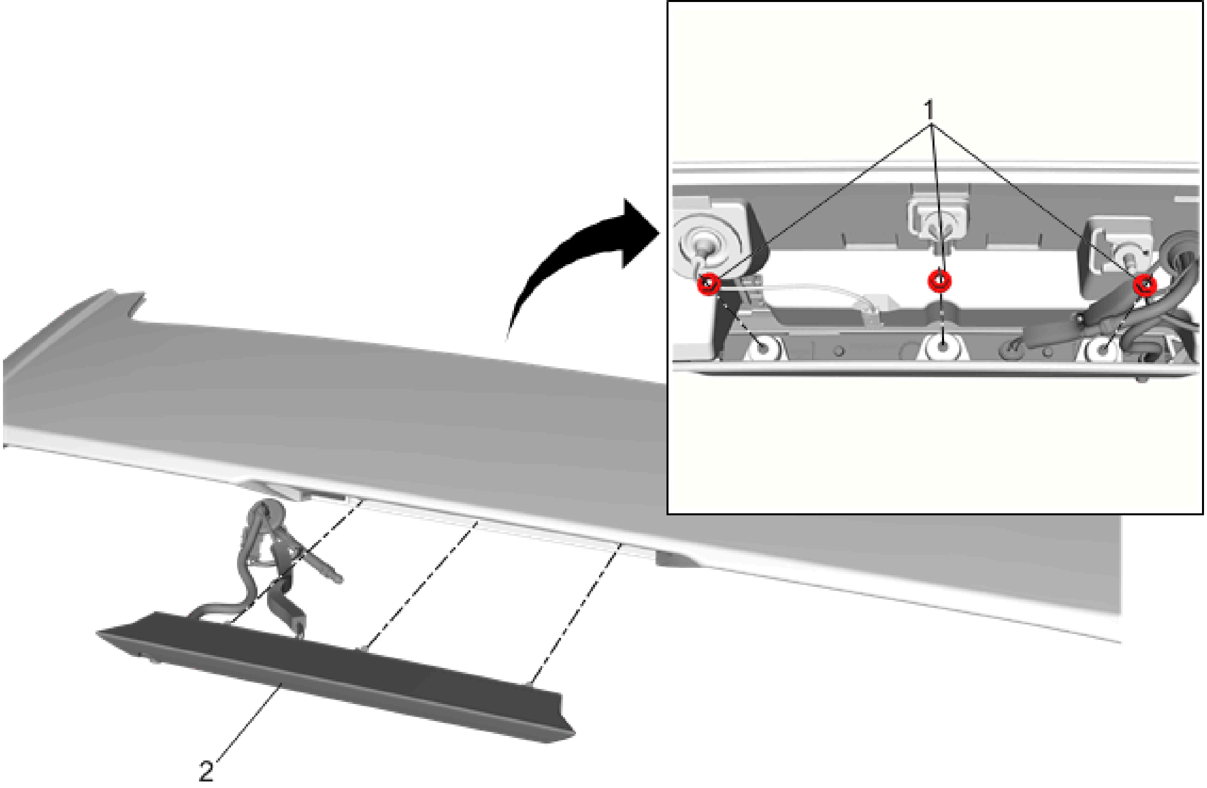


Fig. 35: Front Turn Signal Lamp Bulb

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Halogen Bulb Warning** **Preliminary Procedure Front Wheelhouse Liner Replacement**	
1	Front Turn Signal Lamp Bulb Socket **Procedure** Rotate the bulb socket counterclockwise to remove it from the lamp housing.
2	Front Turn Signal Lamp Bulb **Procedure** Pull the bulb straight from the lamp socket.

HIGH MOUNT STOP LAMP REPLACEMENT



[Fig. 36: High Mount Stop Lamp](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure [Rear End Spoiler Replacement](#)	
1	High Mount Stop Lamp Nut **CAUTION:** [Fastener Caution](#) **Tighten** 6 N.m (53 lb in)
2	High Mount Stop Lamp **Procedure** Disconnect the washer hose from rear washer nozzle. Route the hose and harness through the spoiler.

CARGO CENTER COURTESY LAMP REPLACEMENT

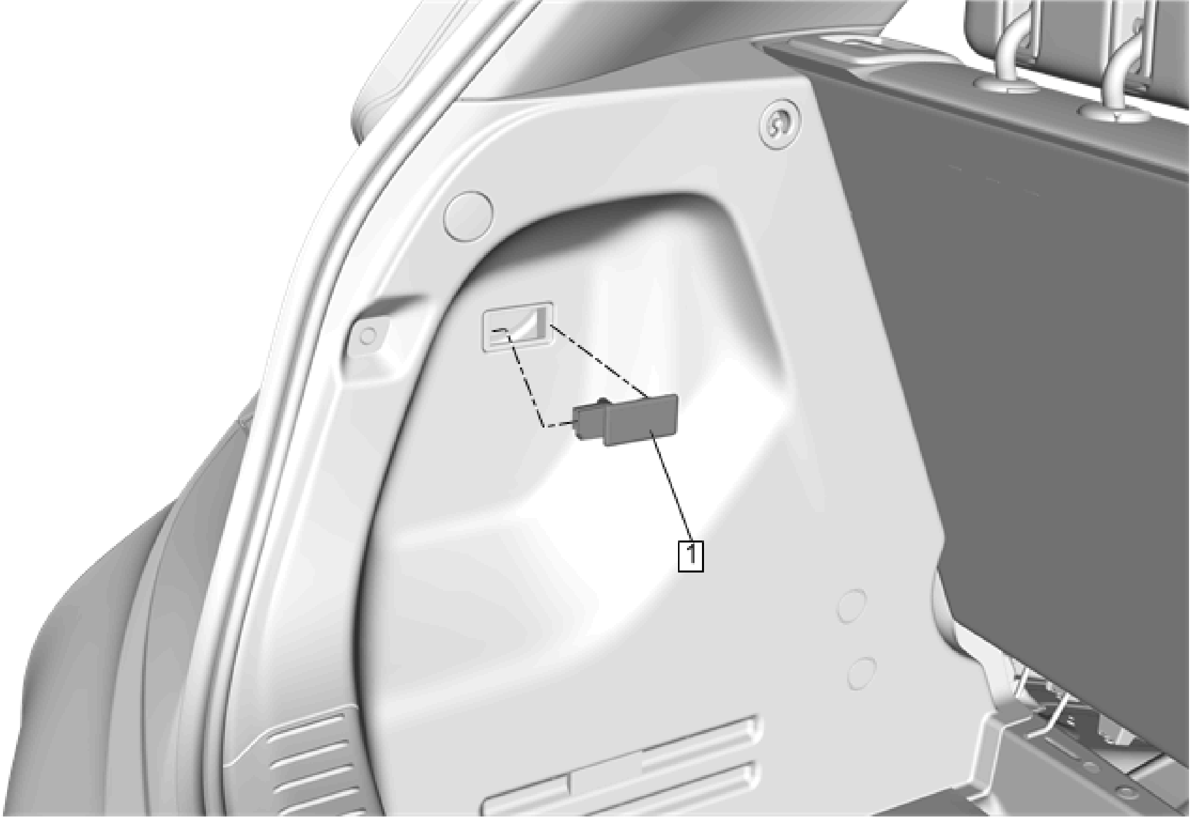


Fig. 37: Cargo Center Courtesy Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Cargo Center Courtesy Lamp **Procedure** 1. Use a plastic flat bladed trim tool in order to release the lamp assembly. 2. Disconnect the electrical connector.

CARGO CENTER COURTESY LAMP BULB REPLACEMENT

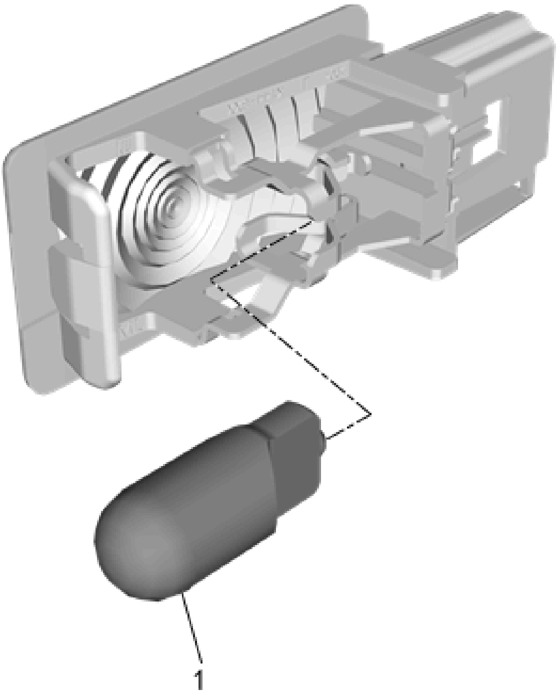


Fig. 38: Cargo Center Courtesy Lamp Bulb
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Cargo Center Courtesy Lamp Replacement	
1	Cargo Center Courtesy Lamp Bulb

REAR LICENSE PLATE LAMP REPLACEMENT

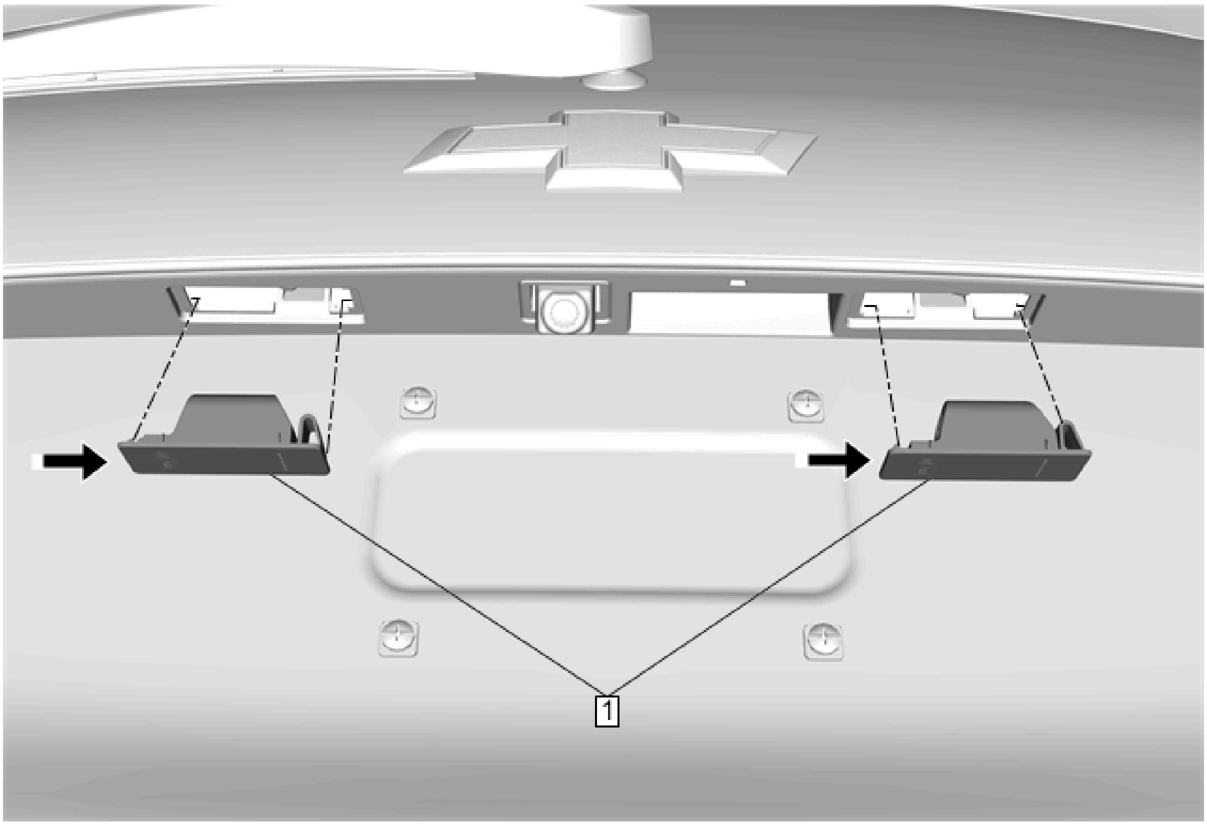


Fig. 39: Rear License Plate Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear License Plate Lamp **Procedure** 1. Using a plastic trim tool, from the left side, gently pry the lamp to the right, then downward to release and remove. 2. Remove the sockets from the lamps by twisting counterclockwise.

REAR LICENSE PLATE LAMP BULB REPLACEMENT

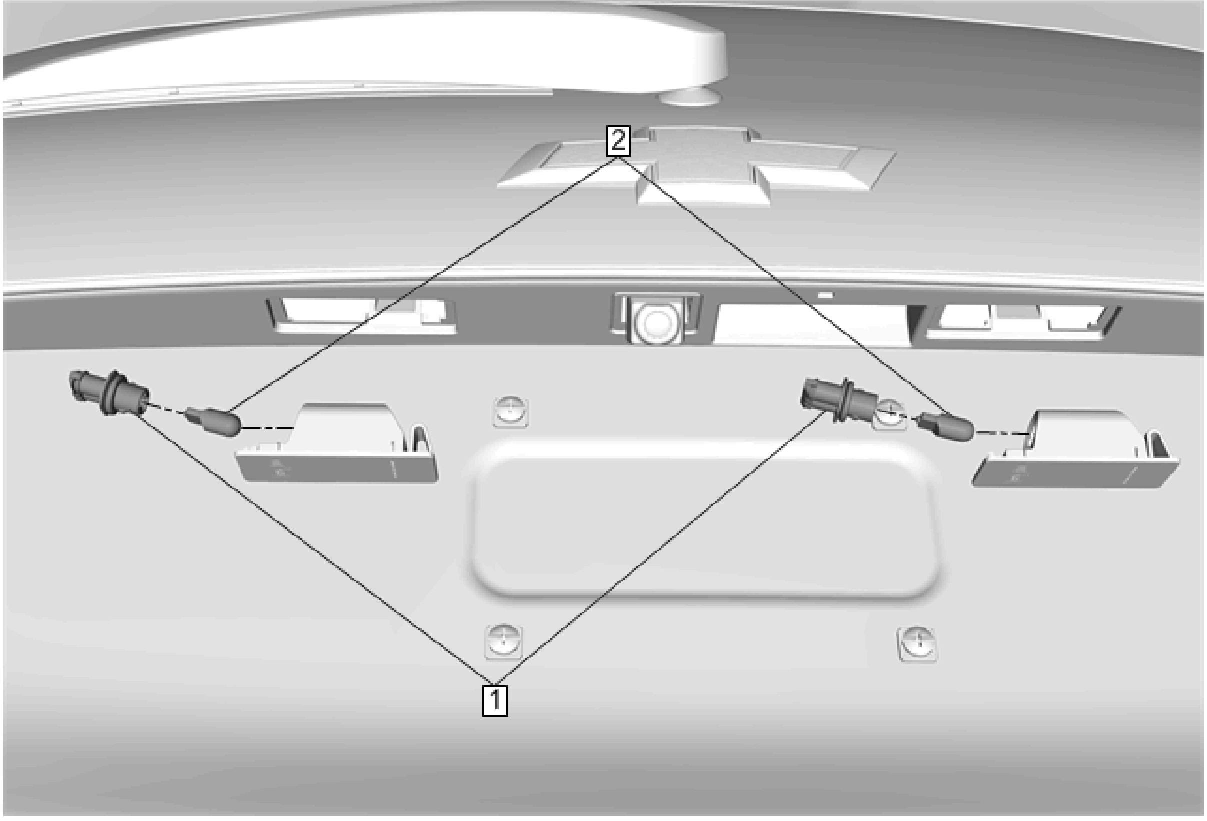


Fig. 40: Rear License Plate Lamp Bulb
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear License Plate Lamp Replacement	
1	License Plate Lamp Socket **Procedure** Rotate the bulb socket counterclockwise to remove it from the lamp housing.
2	Rear License Plate Lamp Bulb **Procedure** Pull the bulb straight from the lamp socket.

REAR LICENSE PLATE LAMP WIRING HARNESS REPLACEMENT

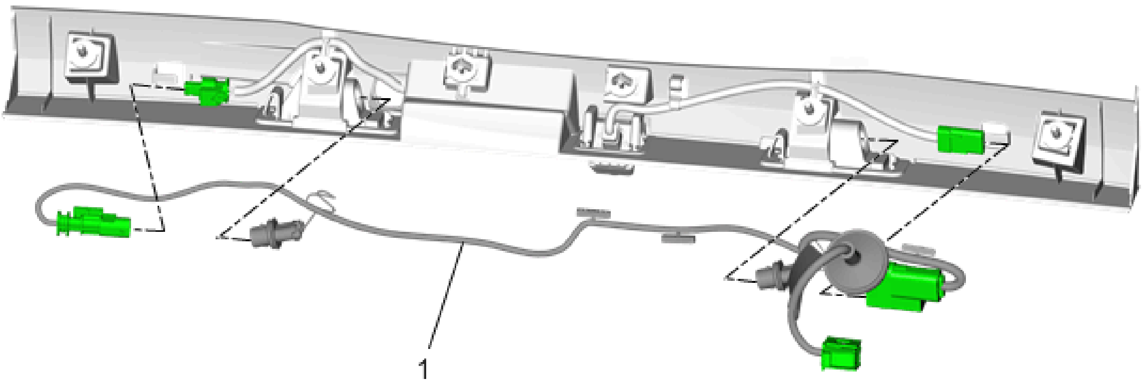


Fig. 41: Rear License Plate Lamp Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Closure Center Applique Replacement	
1	Rear License Plate Lamp Wiring Harness **Procedure** 1. Disconnect the electrical connector. 2. Transfer components as necessary.

REAR COMBINATION LAMP REPLACEMENT

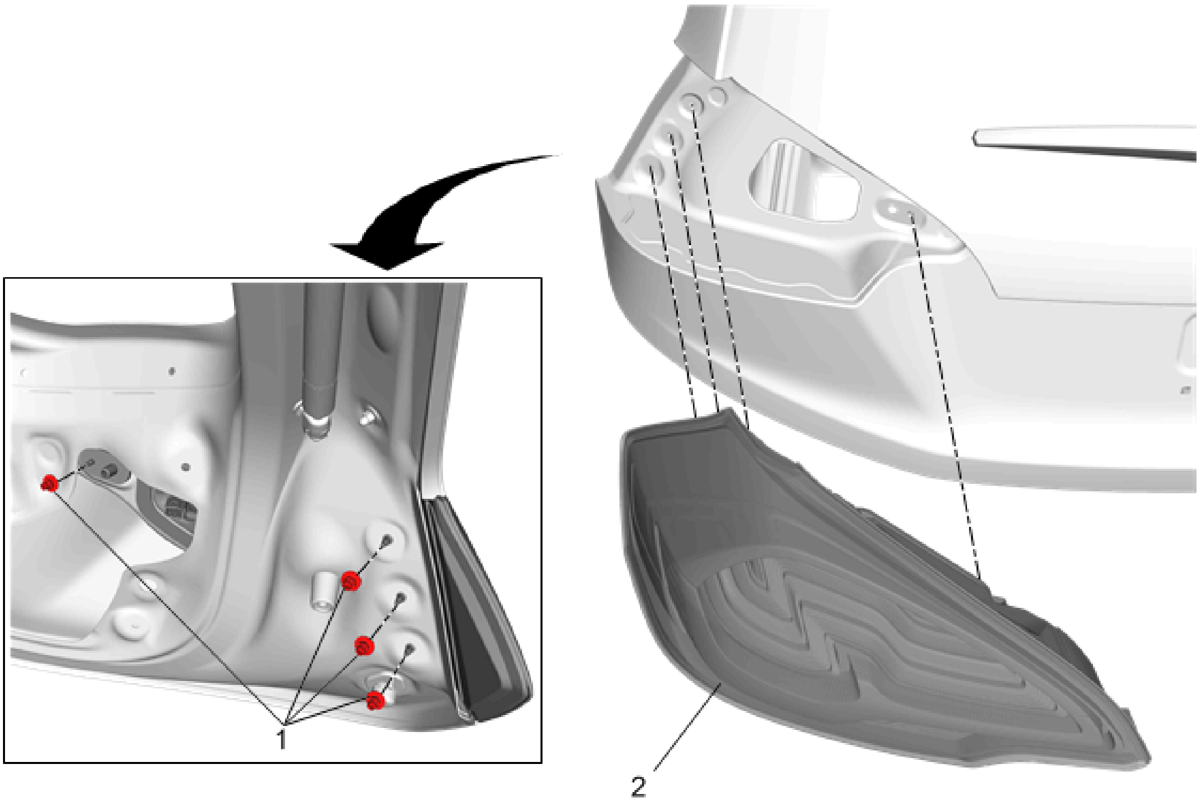


Fig. 42: Rear Combination Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Liftgate Lower Trim Finish Panel Replacement	
1	Rear Combination Lamp Nut **CAUTION:** **Refer to Fastener Caution .** **Procedure** Remove the lamp stud cover / cap **Tighten** 4.7 N.m (42 lb in)

Callout	Component Name
2	Rear Combination Lamp **Procedure** 1. Disconnect the electrical connector. 2. Release the integral retainers by pulling the lamp outward.

STOP AND TURN SIGNAL LAMP BULB REPLACEMENT (EUROPE, KOREA WITH REAR FOG)

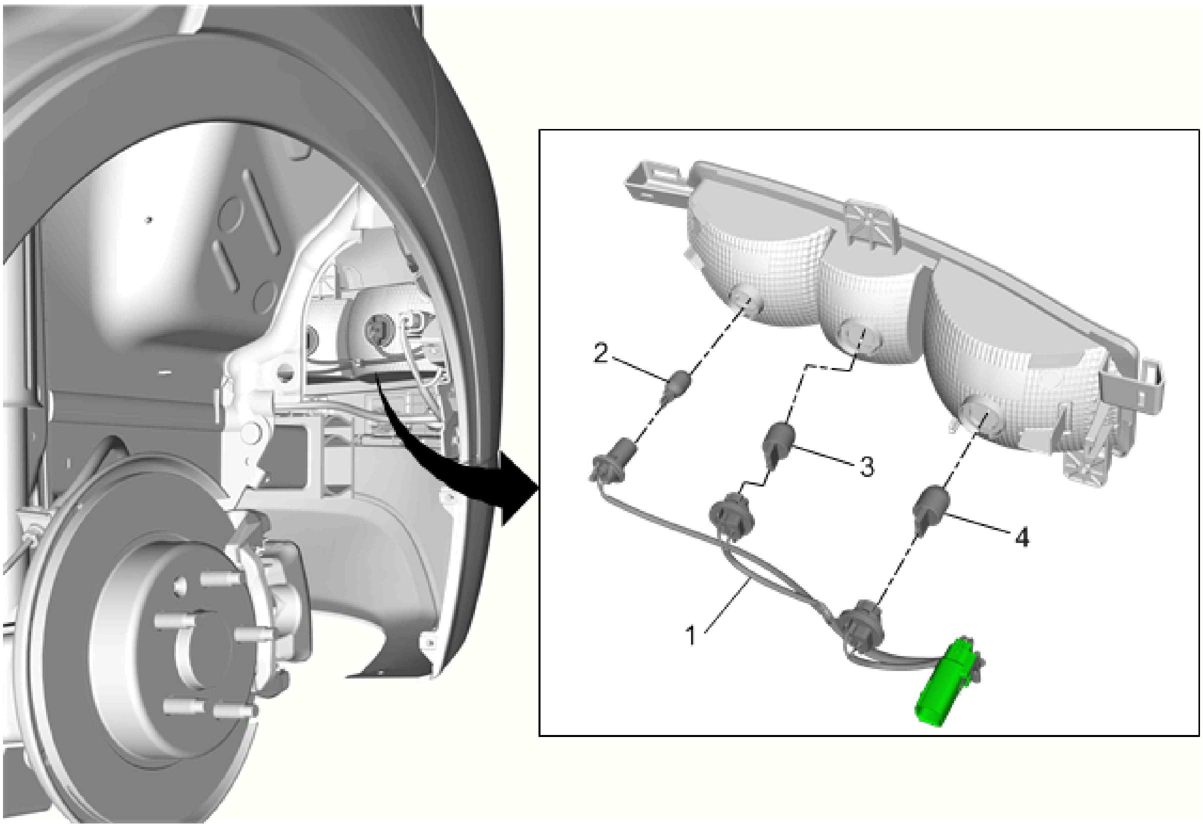


Fig. 43: Stop and Turn Signal Lamp Bulb (Europe, Korea with Rear Fog)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Halogen Bulb Warning** **Preliminary Procedure** Raise and support the vehicle. **Lifting and Jacking the Vehicle**	
1	Stop and Turn Signal Lamp Bulb Socket **Procedure** Rotate the bulb socket counterclockwise to remove it from the lamp housing.
2	Rear Fog Bulb **Procedure** Pull the bulb straight from the lamp socket.
3	Turn Signal Bulb **Procedure** Pull the bulb straight from the lamp socket.
4	Tail and Stop Bulb **Procedure** 1. Pull the bulb straight from the lamp socket. 2. Lower the vehicle. **Lifting and Jacking the Vehicle**

STOP AND TURN SIGNAL LAMP BULB REPLACEMENT (EUROPE, KOREA, NORTH AMERICA WITH BACK-UP BULB)

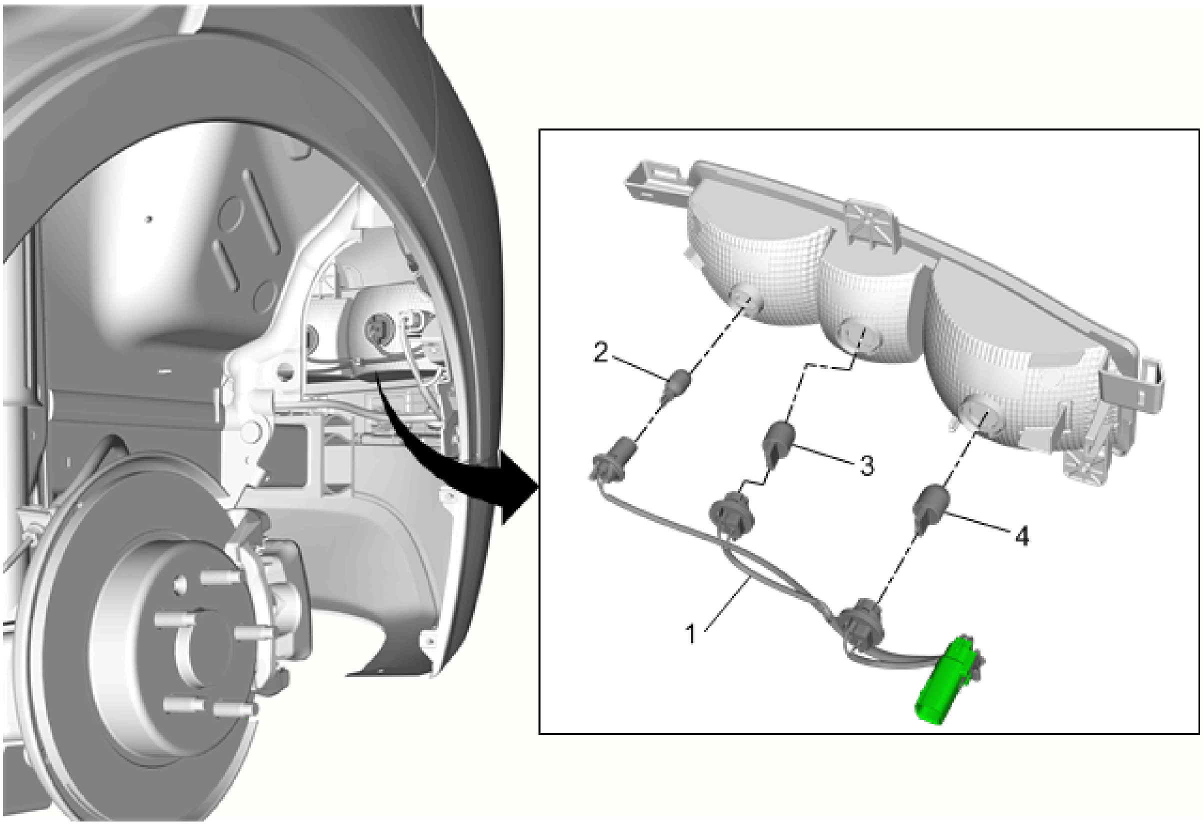


Fig. 44: Stop and Turn Signal Lamp Bulb (Europe, Korea, North America with Back-up Bulb)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Halogen Bulb Warning **Preliminary Procedure** Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Stop and Turn Signal Lamp Bulb Socket **Procedure** Rotate the bulb socket counterclockwise to remove it from the lamp housing.
2	Back Up Bulb **Procedure** Pull the bulb straight from the lamp socket.
3	Turn Signal Bulb **Procedure** Pull the bulb straight from the lamp socket.
4	Tail and Stop Bulb **Procedure** 1. Pull the bulb straight from the lamp socket. 2. Lower the vehicle. Lifting and Jacking the Vehicle

REAR FASCIA LOWER SIGNAL LAMP REPLACEMENT

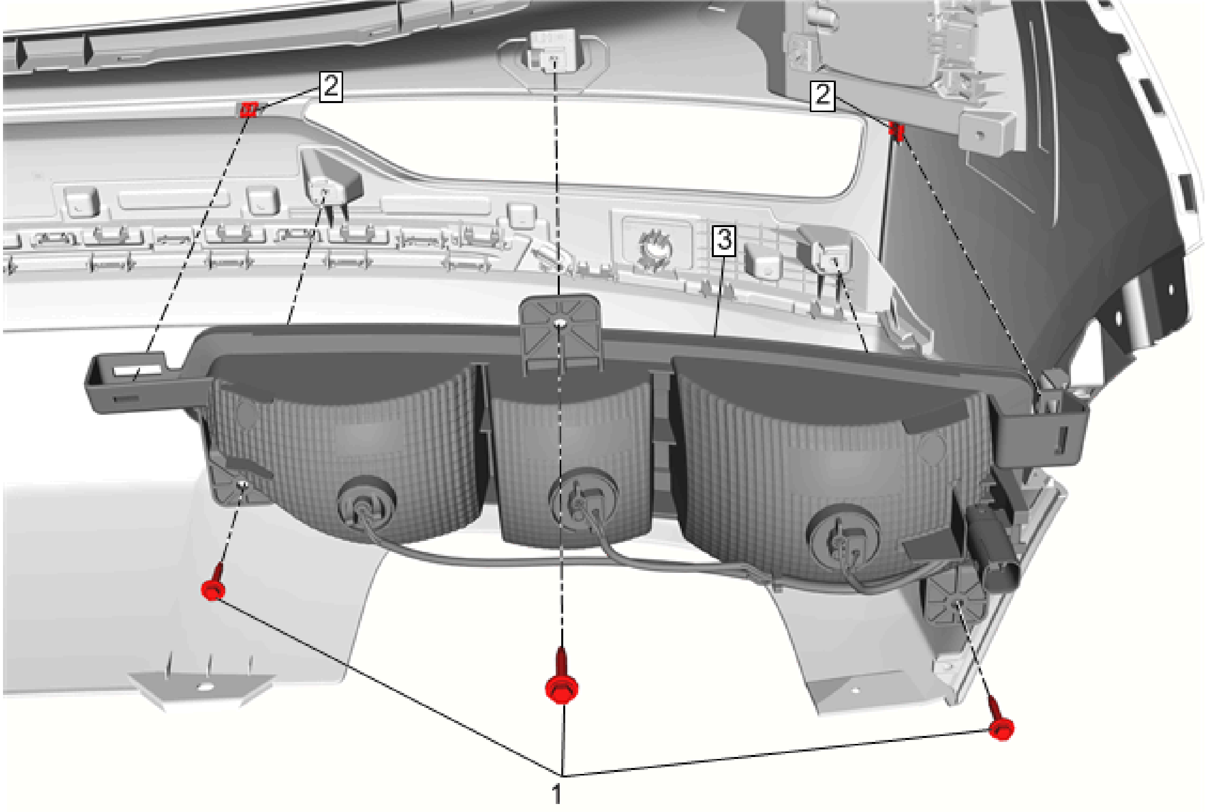


Fig. 45: Rear Fascia Lower Signal Lamp
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Bumper Fascia Replacement	
1	Rear Fascia Lower Signal Lamp Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Rear Fascia Lower Signal Lamp Clip
3	Rear Fascia Lower Signal Lamp **Procedure** 1. Disconnect the electrical connector. 2. Transfer components as necessary.

TAIL LAMP CONTROL MODULE REPLACEMENT

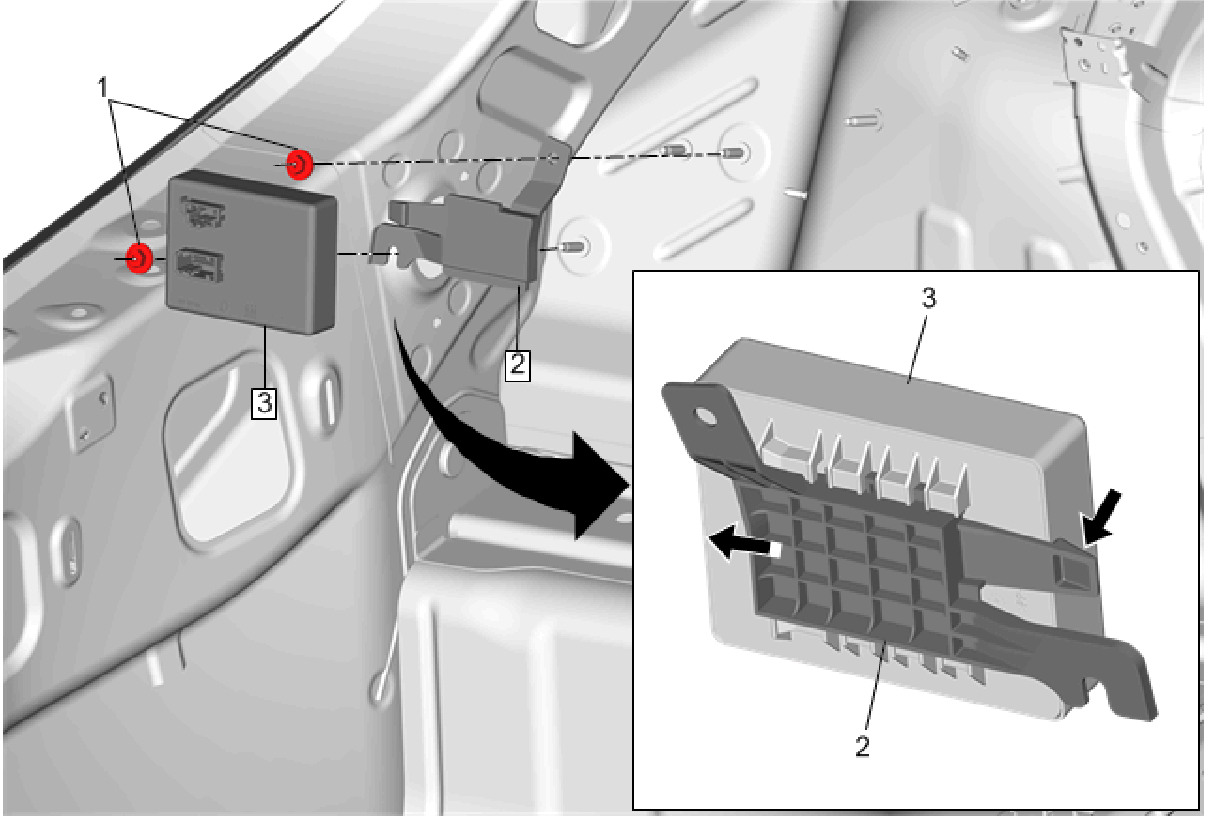


Fig. 46: Tail Lamp Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Quarter Lower Rear Trim Panel-Left Side - Remove - Quarter Lower Rear Trim Panel Replacement	
1	Tail Lamp Control Module Nut **CAUTION:** Fastener Caution **Tighten** 8 N.m (71 lb in)
2	Tail Lamp Control Module Bracket **Procedure** Slide the module bracket and remove it from the module.
3	Tail Lamp Control Module **Procedure** 1. Disconnect the electrical connector. 2. Perform the necessary programming and setup procedure:Control Module References

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Lighting - Schematic Wiring Diagrams - Bolt EV

SCHEMATIC WIRING DIAGRAMS

HEADLIGHTS/DAYTIME RUNNING LIGHTS (DRL) WIRING SCHEMATICS

Controls and Indicators

LOC
DESC

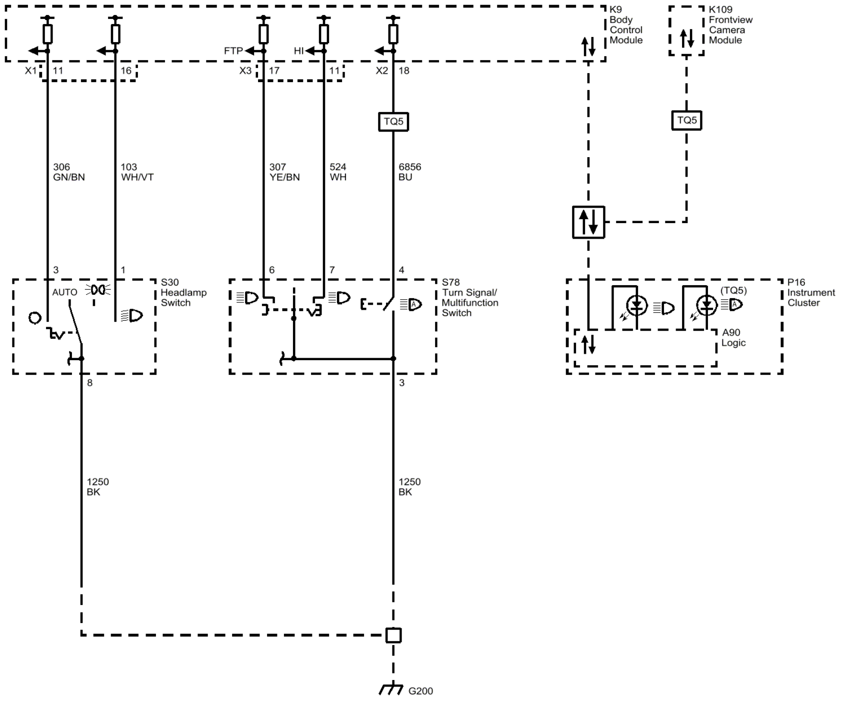

K9
Body
Control
Module
K109
Frontview
Camera
Module
FTP
HI
X1
11
16
X3
17
11
X2
18
TQ5
TQ5
306
GN/BN
103
WH/VT
307
YE/BN
524
WH
6856
BU
3
1
S30
Headlamp
Switch
AUTO
6
7
4
S78
Turn Signal/
Multifunction
Switch
P16
Instrument
Cluster
(TQ5)
A90
Logic
8
3
1250
BK
1250
BK
G200

Fig. 1: Controls and Indicators

Courtesy of GENERAL MOTORS COMPANY

Headlamps and Daytime Running Lamps

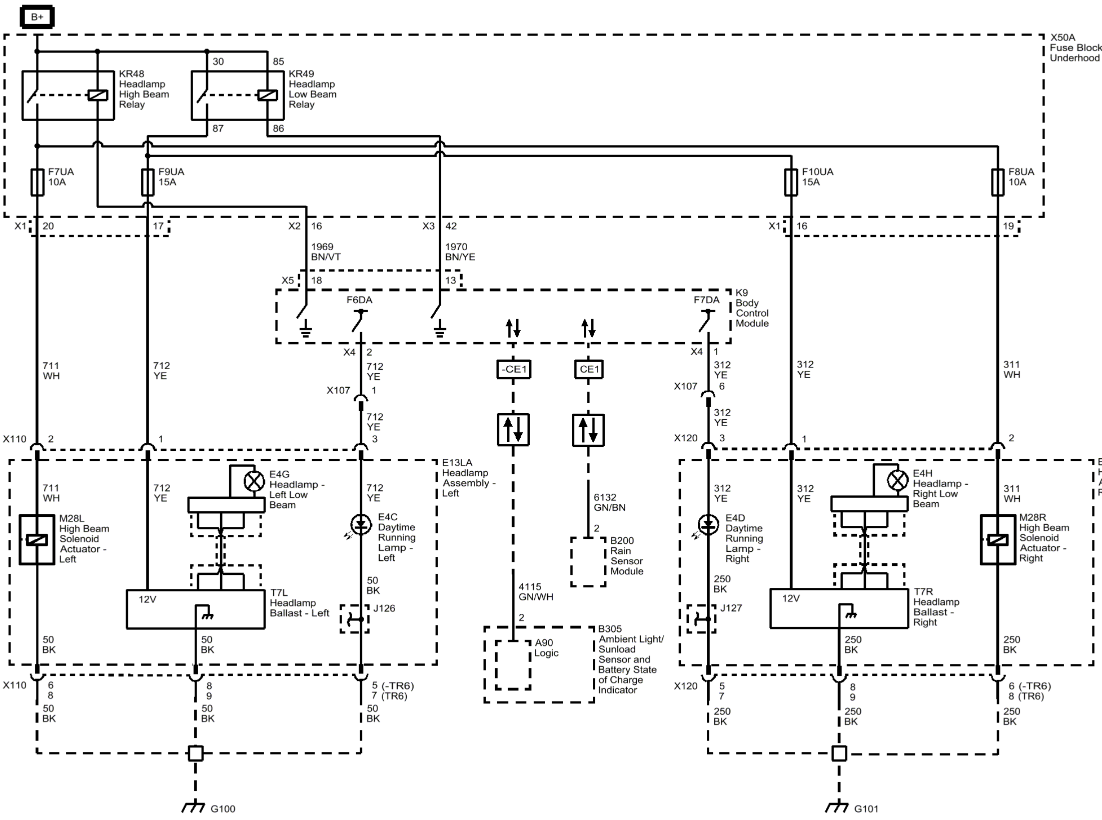

B+
X50A
Fuse Block -
Underhood
KR48
Headlamp
High Beam
Relay
30
85
KR49
Headlamp
Low Beam
Relay
87
86
F7UA
10A
F9UA
15A
F10UA
15A
F8UA
10A
X1
20
17
X2
16
X3
42
X1
16
19
1969
BN/VT
1970
BN/YE
X5
18
13
F6DA
F7DA
K9
Body
Control
Module
X4
2
X4
1
711
WH
712
YE
712
YE
-CE1
CE1
312
YE
312
YE
311
WH
X107
1
X107
6
712
YE
3
312
YE
3
X110
2
1
X120
1
2
E13LA
Headlamp
Assembly -
Left
E13RA
Headlamp
Assembly -
Right
711
WH
712
YE
E4G
Headlamp -
Left Low
Beam
712
YE
E4H
Headlamp -
Right Low
Beam
M28L
High Beam
Solenoid
Actuator -
Left
E4C
Daytime
Running
Lamp -
Left
6132
GN/BN
2
B200
Rain
Sensor
Module
E4D
Daytime
Running
Lamp -
Right
M28R
High Beam
Solenoid
Actuator -
Right
50
BK
12V
T7L
Headlamp
Ballast - Left
J126
4115
GN/WH
2
A90
Logic
B305
Ambient Light/
Sunload
Sensor and
Battery State
of Charge
Indicator
250
BK
J127
12V
T7R
Headlamp
Ballast -
Right
50
BK
50
BK
250
BK
250
BK
X110
6
8
8
9
5 (-TR6)
7 (TR6)
X120
5
7
8
9
6 (-TR6)
8 (TR6)
50
BK
50
BK
50
BK
250
BK
250
BK
250
BK
G100
G101

Fig. 2: Headlamps and Daytime Running Lamps

Courtesy of GENERAL MOTORS COMPANY

Manual Headlamp Leveling (TR6)

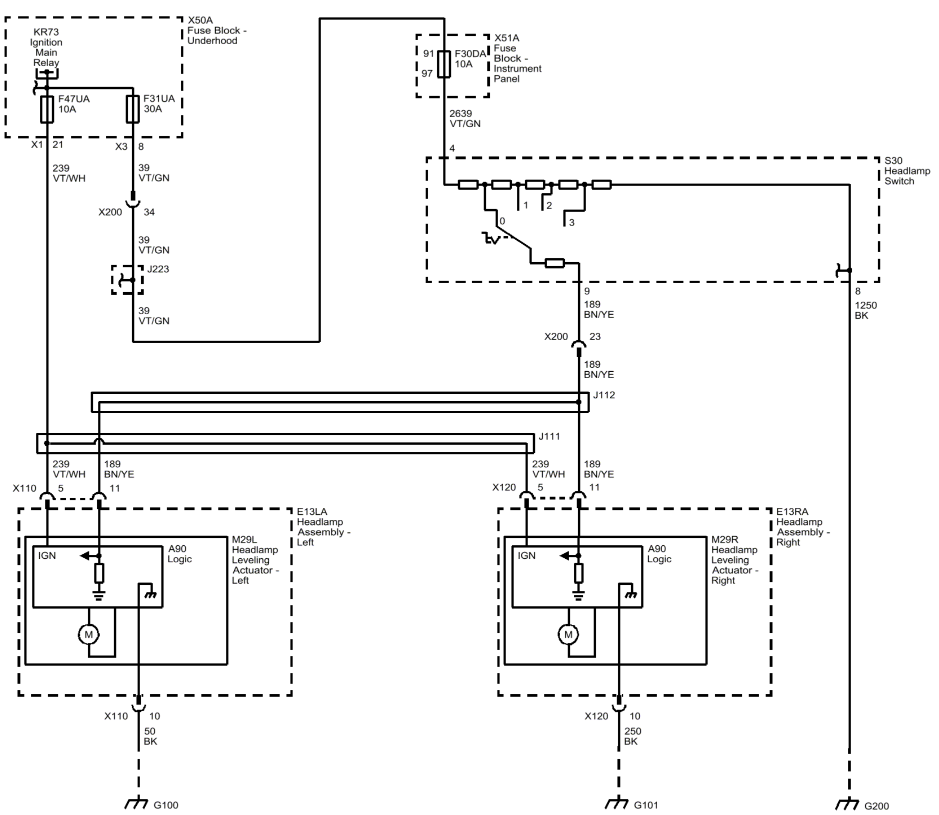

KR73
Ignition
Main
Relay
X50A
Fuse Block -
Underhood
F47UA
10A
F31UA
30A
X1
21
X3
8
91
97
F30DA
10A
X51A
Fuse
Block -
Instrument
Panel
2639
VT/GN
4
S30
Headlamp
Switch
1
2
0
3
239
VT/WH
39
VT/GN
X200
34
39
VT/GN
J223
39
VT/GN
9
189
BN/YE
8
1250
BK
X200
23
189
BN/YE
J112
J111
239
VT/WH
189
BN/YE
X110
5
11
239
VT/WH
189
BN/YE
X120
5
11
E13LA
Headlamp
Assembly -
Left
E13RA
Headlamp
Assembly -
Right
IGN
A90
Logic
M29L
Headlamp
Leveling
Actuator -
Left
IGN
A90
Logic
M29R
Headlamp
Leveling
Actuator -
Right
M
M
X110
10
50
BK
X120
10
250
BK
G100
G101
G200

Fig. 3: Manual Headlamp Leveling (TR6)

Courtesy of GENERAL MOTORS COMPANY

FOG LIGHTS WIRING SCHEMATICS

Rear Fog Light (VD1)

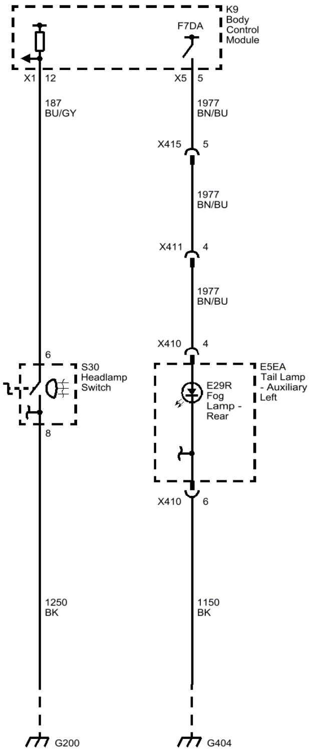

K9
Body
Control
Module
F7DA
X1
12
X5
5
187
BU/GY
1977
BN/BU
X415
5
1977
BN/BU
X411
4
1977
BN/BU
X410
4
6
S30
Headlamp
Switch
8
E5EA
Tail Lamp
- Auxiliary
Left
E29R
Fog
Lamp -
Rear
X410
6
1250
BK
1150
BK
G200
G404

Fig. 4: Rear Fog Light (VD1)

Courtesy of GENERAL MOTORS COMPANY

EXTERIOR LIGHTS WIRING SCHEMATICS

Controls and Indicators

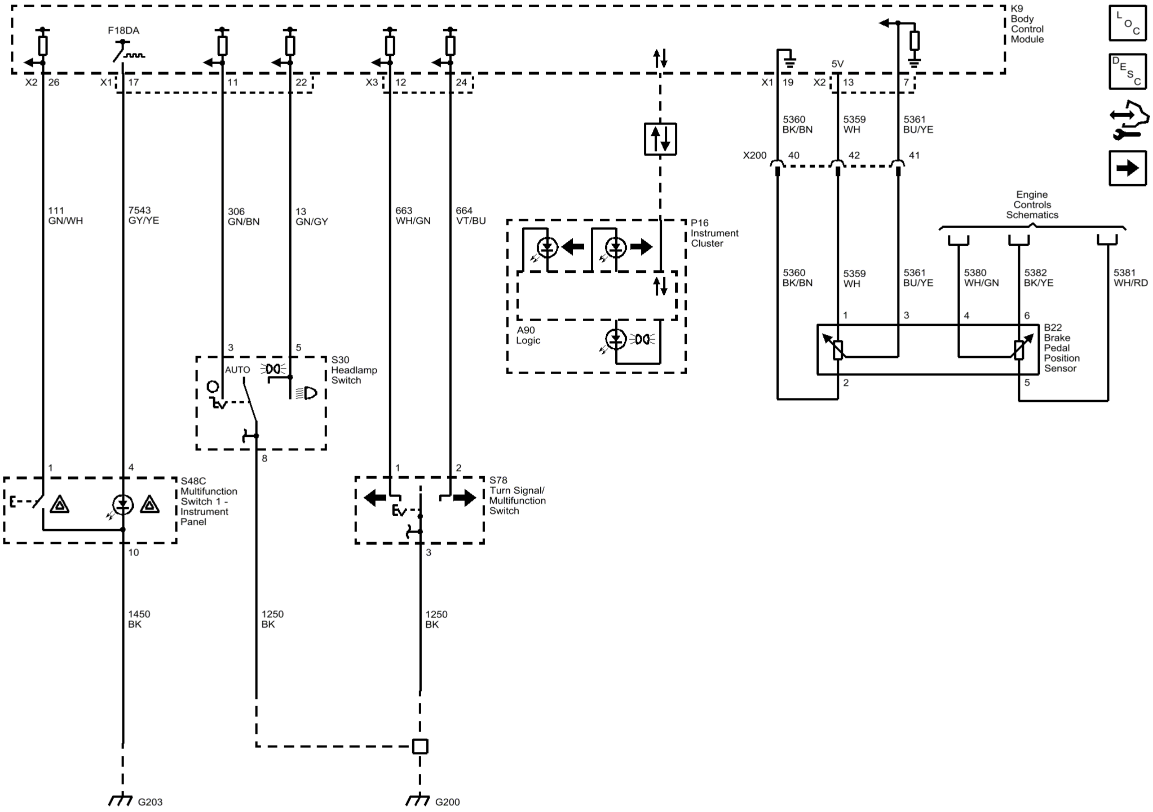

K9
Body
Control
Module
F18DA
X2
26
X1
17
11
22
X3
12
24
X1
19
X2
5V
13
7
X200
40
42
41
111
GN/WH
7543
GY/YE
306
GN/BN
13
GN/GY
663
WH/GN
664
VT/BU
5360
BK/BN
5359
WH
5361
BU/YE
P16
Instrument
Cluster
A90
Logic
Engine
Controls
Schematics
5360
BK/BN
5359
WH
5361
BU/YE
5380
WH/GN
5382
BK/YE
5381
WH/RD
1
3
4
6
B22
Brake
Pedal
Position
Sensor
2
5
3
5
AUTO
S30
Headlamp
Switch
8
1
4
S48C
Multifunction
Switch 1 -
Instrument
Panel
10
1
2
S78
Turn Signal/
Multifunction
Switch
3
1450
BK
1250
BK
1250
BK
G203
G200

Fig. 5: Controls and Indicators

Courtesy of GENERAL MOTORS COMPANY

Park/Position Lamps

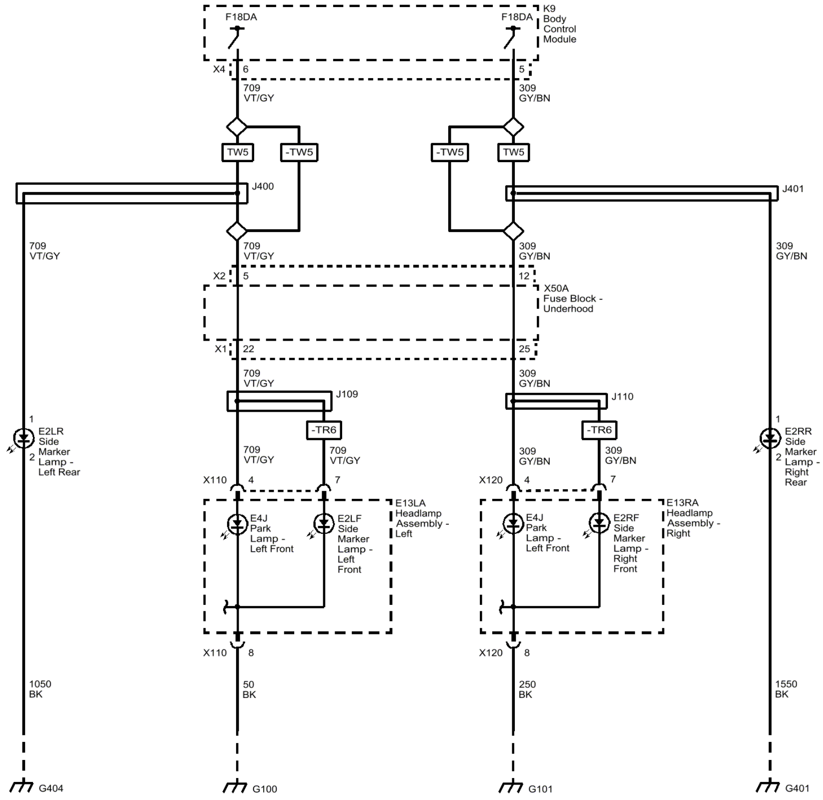

F18DA
F18DA
K9 Body Control Module
X4
6
5
709 VT/GY
309 GY/BN
TW5
-TW5
-TW5
TW5
J400
J401
709 VT/GY
709 VT/GY
309 GY/BN
309 GY/BN
X2
5
12
X50A Fuse Block - Underhood
X1
22
25
709 VT/GY
309 GY/BN
J109
J110
-TR6
-TR6
1
E2LR Side Marker Lamp - Left Rear
2
709 VT/GY
709 VT/GY
309 GY/BN
309 GY/BN
1
E2RR Side Marker Lamp - Right Rear
2
X110
4
7
X120
4
7
E13LA Headlamp Assembly - Left
E13RA Headlamp Assembly - Right
E4J Park Lamp - Left Front
E2LF Side Marker Lamp - Left Front
E4J Park Lamp - Left Front
E2RF Side Marker Lamp - Right Front
X110
8
X120
8
1050 BK
50 BK
250 BK
1550 BK
G404
G100
G101
G401

Fig. 6: Park/Position Lamps

Courtesy of GENERAL MOTORS COMPANY

Front Turn Signal and Repeater Lamps

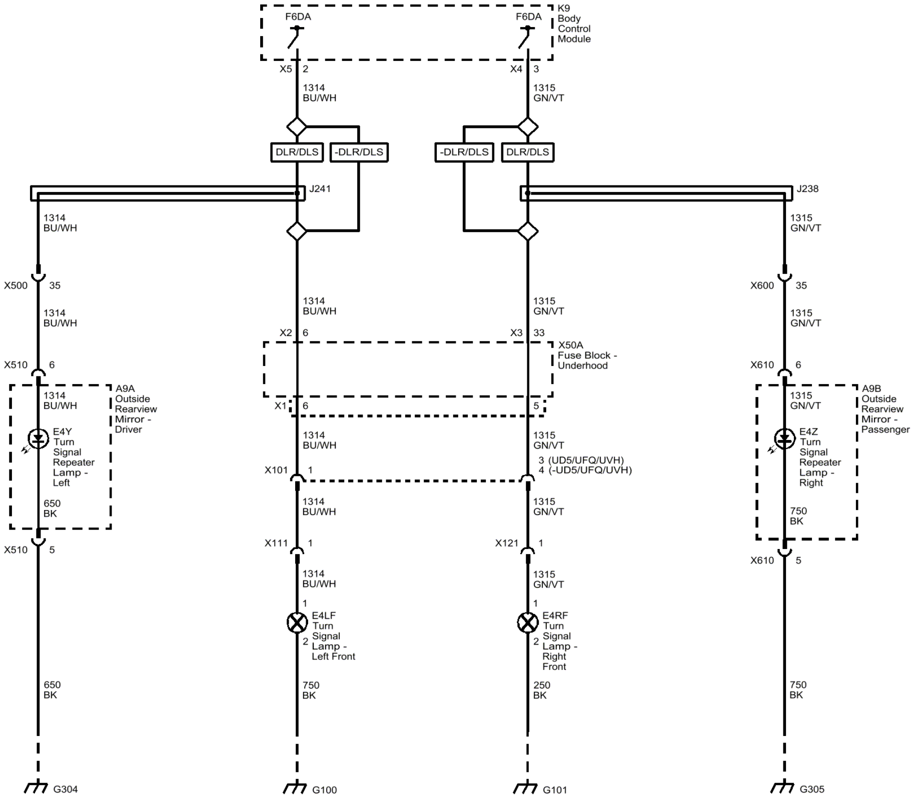
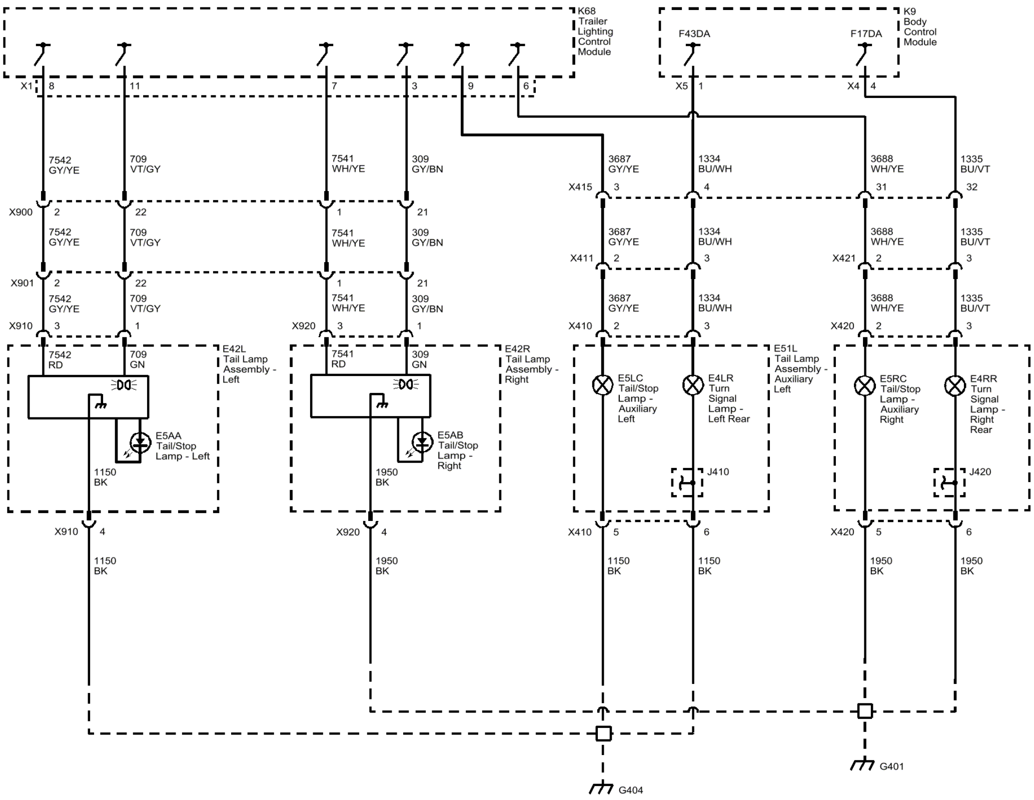

F6DA
F6DA
K9 Body Control Module
X5
2
X4
3
1314 BU/WH
1315 GN/VT
DLR/DLS
-DLR/DLS
-DLR/DLS
DLR/DLS
J241
J238
1314 BU/WH
1315 GN/VT
X500
35
X600
35
1314 BU/WH
1315 GN/VT
1314 BU/WH
1315 GN/VT
X2
6
X3
33
X50A Fuse Block - Underhood
X510
6
X610
6
1314 BU/WH
A9A Outside Rearview Mirror - Driver
1315 GN/VT
A9B Outside Rearview Mirror - Passenger
E4Y Turn Signal Repeater Lamp - Left
E4Z Turn Signal Repeater Lamp - Right
X1
6
5
1314 BU/WH
1315 GN/VT
3 (UD5/UFQ/UVH)
4 (-UD5/UFQ/UVH)
X101
1
650 BK
750 BK
1314 BU/WH
1315 GN/VT
X510
5
X610
5
X111
1
X121
1
1314 BU/WH
1315 GN/VT
1
E4LF Turn Signal Lamp - Left Front
2
1
E4RF Turn Signal Lamp - Right Front
2
650 BK
750 BK
250 BK
750 BK
G304
G100
G101
G305

Fig. 7: Front Turn Signal and Repeater Lamps

Courtesy of GENERAL MOTORS COMPANY

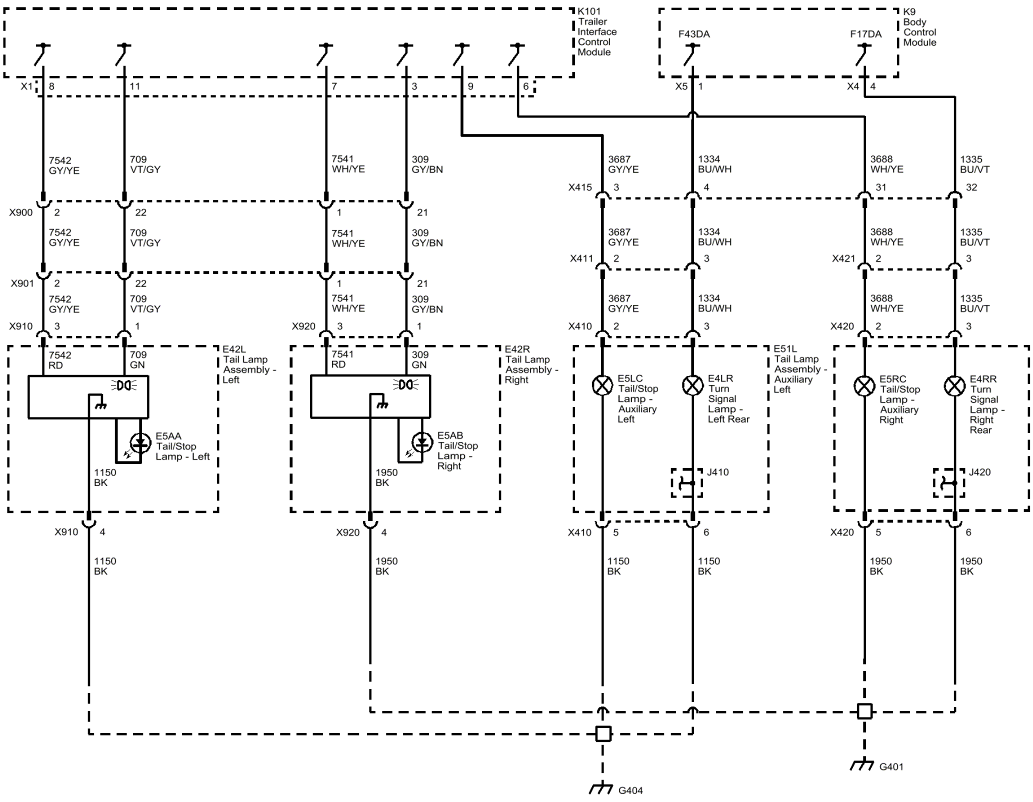
Tail, Stop, and Rear Turn Signal Lamps (MBM)



K68
Trailer
Lighting
Control
Module
K9
Body
Control
Module
F43DA
F17DA
X1
8
11
7
3
9
6
X5
1
X4
4
7542
GY/YE
709
VT/GY
7541
WH/YE
309
GY/BN
3687
GY/YE
1334
BU/WH
3688
WH/YE
1335
BU/VT
X900
2
22
1
21
X415
3
4
31
32
X901
X411
X421
X910
3
1
X920
X410
2
X420
7542
RD
709
GN
7541
RD
309
GN
E42L
Tail Lamp
Assembly -
Left
E42R
Tail Lamp
Assembly -
Right
E51L
Tail Lamp
Assembly -
Auxiliary
Left
E51R
Tail Lamp
Assembly -
Auxiliary
Right
E5AA
Tail/Stop
Lamp - Left
E5AB
Tail/Stop
Lamp -
Right
E5LC
Tail/Stop
Lamp -
Auxiliary
Left
E4LR
Turn
Signal
Lamp -
Left Rear
E5RC
Tail/Stop
Lamp -
Auxiliary
Right
E4RR
Turn
Signal
Lamp -
Right
Rear
J410
J420
1150
BK
1950
BK
X910
4
X920
4
X410
5
6
X420
5
6
G404
G401

Fig. 8: Tail, Stop, and Rear Turn Signal Lamps (MBM)
Courtesy of GENERAL MOTORS COMPANY

Tail, Stop, and Rear Turn Signal Lamps (MAH/MBC/MAW/MCX)



K101
Trailer
Interface
Control
Module
K9
Body
Control
Module
F43DA
F17DA
X1
8
11
7
3
9
6
X5
1
X4
4
7542
GY/YE
709
VT/GY
7541
WH/YE
309
GY/BN
3687
GY/YE
1334
BU/WH
3688
WH/YE
1335
BU/VT
X900
2
22
1
21
X415
3
4
31
32
X901
X411
X421
X910
3
1
X920
X410
2
X420
7542
RD
709
GN
7541
RD
309
GN
E42L
Tail Lamp
Assembly -
Left
E42R
Tail Lamp
Assembly -
Right
E51L
Tail Lamp
Assembly -
Auxiliary
Left
E51R
Tail Lamp
Assembly -
Auxiliary
Right
E5AA
Tail/Stop
Lamp - Left
E5AB
Tail/Stop
Lamp -
Right
E5LC
Tail/Stop
Lamp -
Auxiliary
Left
E4LR
Turn
Signal
Lamp -
Left Rear
E5RC
Tail/Stop
Lamp -
Auxiliary
Right
E4RR
Turn
Signal
Lamp -
Right
Rear
J410
J420
1150
BK
1950
BK
X910
4
X920
4
X410
5
6
X420
5
6
G404
G401

Fig. 9: Tail, Stop, and Rear Turn Signal Lamps (MAH/MBC/MAW/MCX)
Courtesy of GENERAL MOTORS COMPANY

Backup, Center Stop, and License Lamps (MBM)

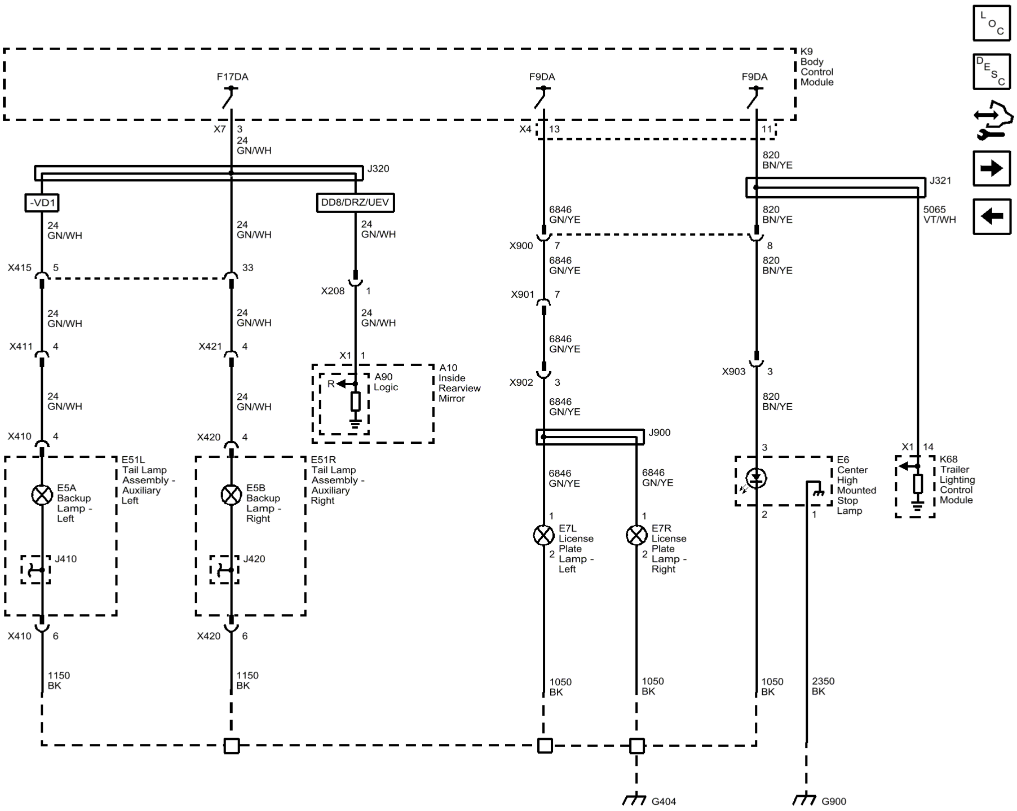

K9
Body
Control
Module
F17DA
F9DA
F9DA
X7
3
24
GN/WH
X4
13
11
820
BN/YE
J320
J321
-VD1
DD8/DRZ/UEV
24
GN/WH
5065
VT/WH
6846
GN/YE
X900
7
8
X415
5
33
X208
1
X901
X411
4
X421
X1
A90
Logic
R
A10
Inside
Rearview
Mirror
X902
3
X903
X410
X420
J900
E51L
Tail Lamp
Assembly -
Auxiliary
Left
E5A
Backup
Lamp -
Left
J410
E51R
Tail Lamp
Assembly -
Auxiliary
Right
E5B
Backup
Lamp -
Right
J420
E7L
License
Plate
Lamp -
Left
E7R
License
Plate
Lamp -
Right
E6
Center
High
Mounted
Stop
Lamp
14
K68
Trailer
Lighting
Control
Module
6
1150
BK
1050
BK
2350
BK
2
G404
G900

Fig. 10: Backup, Center Stop, and License Lamps (MBM)
Courtesy of GENERAL MOTORS COMPANY

Backup, Center Stop, and License Lamps (MAH/MBC/MAW/MCX)

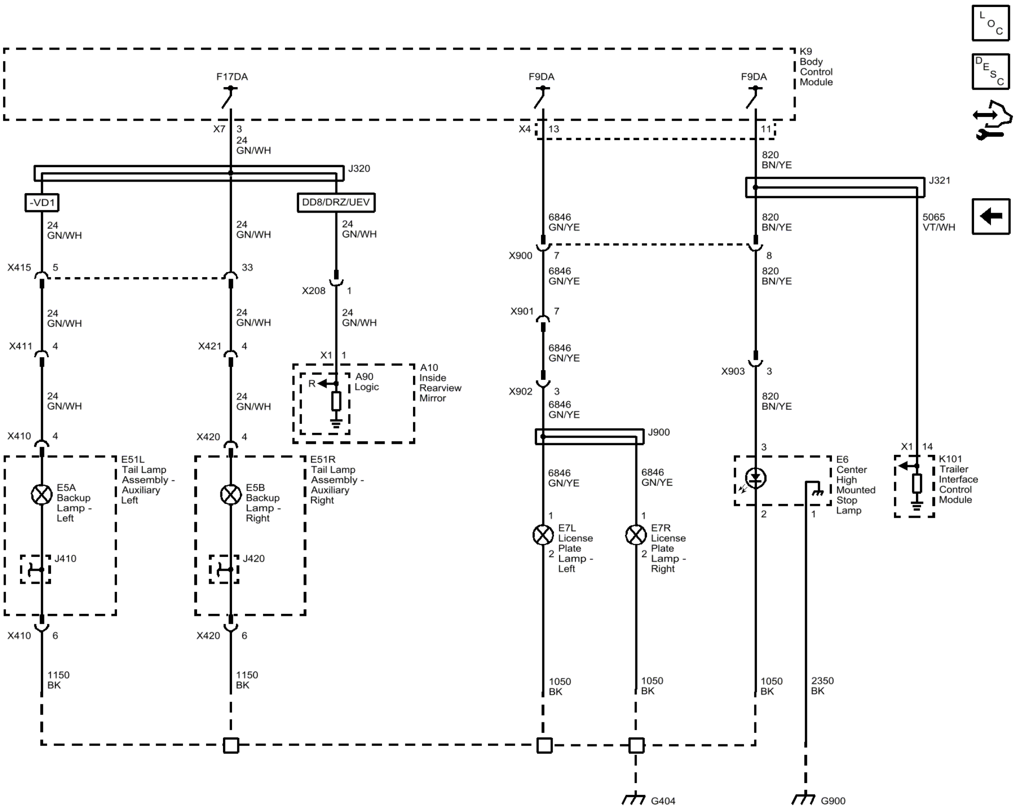

K9
Body
Control
Module
F17DA
F9DA
F9DA
X7
3
24
GN/WH
X4
13
11
820
BN/YE
J320
J321
-VD1
DD8/DRZ/UEV
24
GN/WH
5065
VT/WH
6846
GN/YE
X900
7
8
X415
5
33
X208
1
X901
X411
4
X421
X1
A90
Logic
R
A10
Inside
Rearview
Mirror
X902
3
X903
X410
X420
J900
E51L
Tail Lamp
Assembly -
Auxiliary
Left
E5A
Backup
Lamp -
Left
J410
E51R
Tail Lamp
Assembly -
Auxiliary
Right
E5B
Backup
Lamp -
Right
J420
E7L
License
Plate
Lamp -
Left
E7R
License
Plate
Lamp -
Right
E6
Center
High
Mounted
Stop
Lamp
14
K101
Trailer
Interface
Control
Module
6
1150
BK
1050
BK
2350
BK
2
G404
G900

Fig. 11: Backup, Center Stop, and License Lamps (MAH/MBC/MAW/MCX)
Courtesy of GENERAL MOTORS COMPANY

INTERIOR LIGHTS WIRING SCHEMATICS

Controls

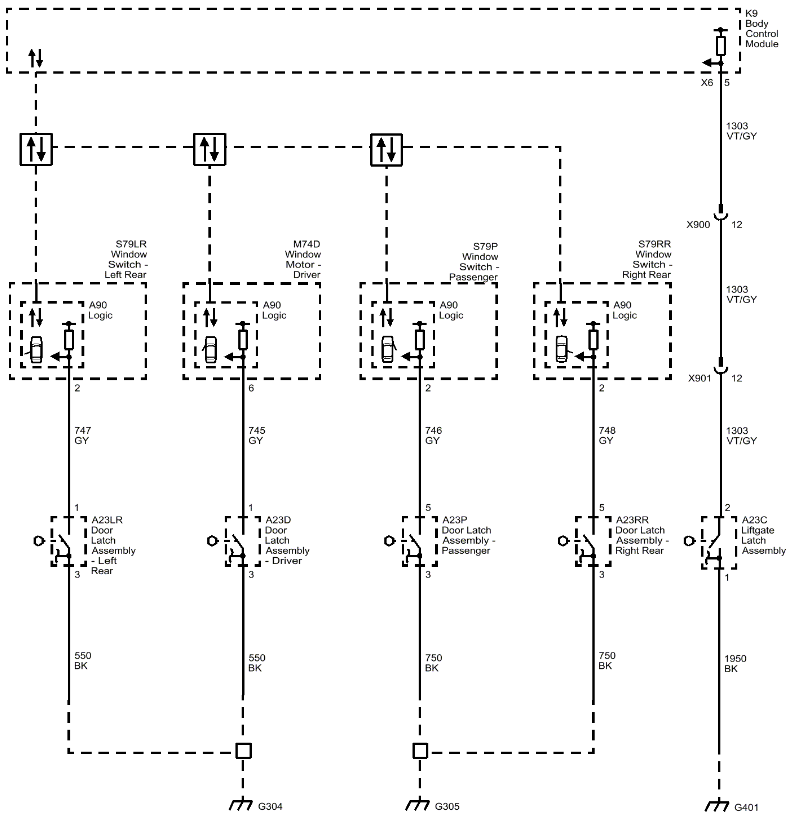

K9 Body Control Module
X6
5
1303 VT/GY
X900
12
1303 VT/GY
X901
12
1303 VT/GY
S79LR Window Switch - Left Rear
M74D Window Motor - Driver
S79P Window Switch - Passenger
S79RR Window Switch - Right Rear
A90 Logic
A90 Logic
A90 Logic
A90 Logic
2
6
2
2
747 GY
745 GY
746 GY
748 GY
1
1
5
5
2
A23LR Door Latch Assembly - Left Rear
A23D Door Latch Assembly - Driver
A23P Door Latch Assembly - Passenger
A23RR Door Latch Assembly - Right Rear
A23C Liftgate Latch Assembly
3
3
3
3
1
550 BK
550 BK
750 BK
750 BK
1950 BK
G304
G305
G401

Fig. 12: Controls

Courtesy of GENERAL MOTORS COMPANY

Dome and Courtesy Lamps

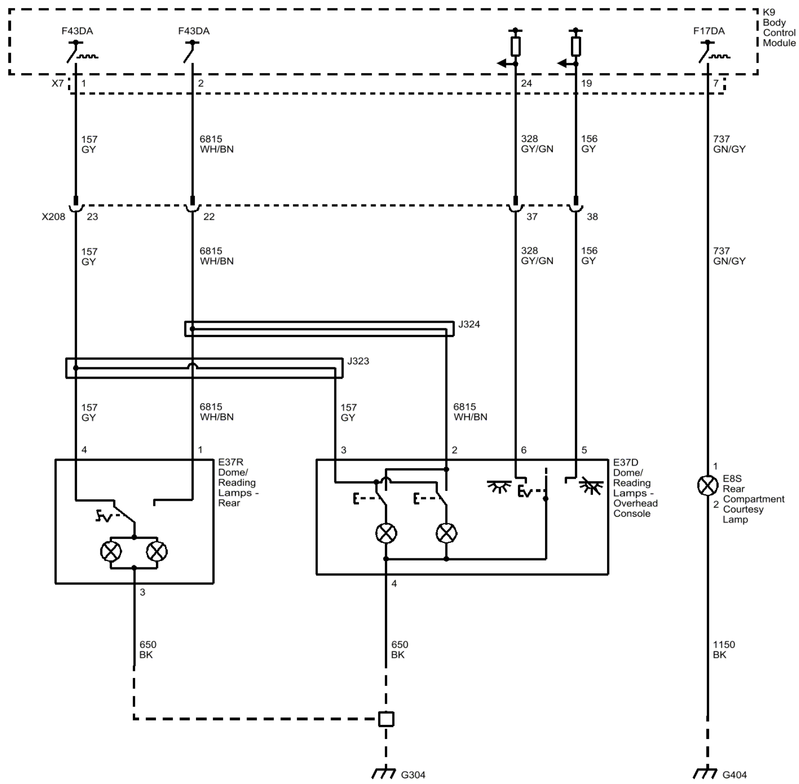

K9 Body Control Module
F43DA
F43DA
F17DA
X7
1
2
24
19
7
157 GY
6815 WH/BN
328 GY/GN
156 GY
737 GN/GY
X208
23
22
37
38
157 GY
6815 WH/BN
328 GY/GN
156 GY
737 GN/GY
J324
J323
157 GY
6815 WH/BN
157 GY
6815 WH/BN
4
1
3
2
6
5
1
E37R Dome/ Reading Lamps - Rear
E37D Dome/ Reading Lamps - Overhead Console
E8S Rear Compartment Courtesy Lamp
2
3
4
650 BK
650 BK
1150 BK
G304
G404

Fig. 13: Dome and Courtesy Lamps

Courtesy of GENERAL MOTORS COMPANY

Accent Lamp - Instrument Panel (C9J)

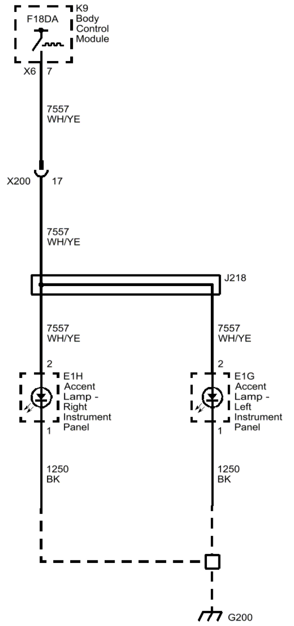

F18DA
K9
Body
Control
Module
X6
7
7557
WH/YE
X200
17
7557
WH/YE
J218
7557
WH/YE
7557
WH/YE
2
E1H
Accent
Lamp -
Right
Instrument
Panel
1
2
E1G
Accent
Lamp -
Left
Instrument
Panel
1
1250
BK
1250
BK
G200

Fig. 14: Accent Lamp - Instrument Panel (C9J)

Courtesy of GENERAL MOTORS COMPANY

INTERIOR LIGHTS DIMMING WIRING SCHEMATICS

Controls and Instrument Panel Lamps

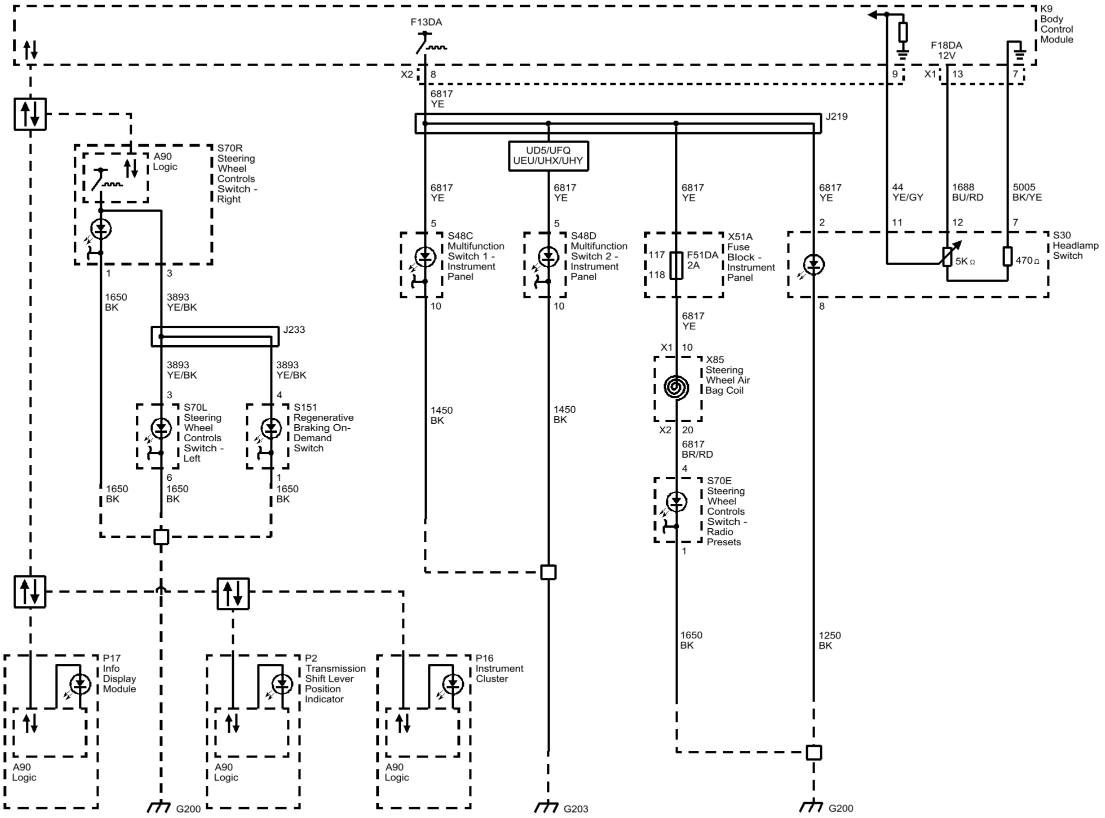

F13DA
X2
8
6817
YE
J219
K9
Body
Control
Module
F18DA
12V
9
X1
13
7
A90
Logic
S70R
Steering
Wheel
Controls
Switch -
Right
1
3
1650
BK
3893
YE/BK
J233
3893
YE/BK
3893
YE/BK
3
S70L
Steering
Wheel
Controls
Switch -
Left
6
1650
BK
4
S151
Regenerative
Braking On-
Demand
Switch
1
1650
BK
1650
BK
UD5/UFQ
UEU/UHX/UHY
6817
YE
6817
YE
6817
YE
6817
YE
5
S48C
Multifunction
Switch 1 -
Instrument
Panel
10
5
S48D
Multifunction
Switch 2 -
Instrument
Panel
10
117
118
F51DA
2A
X51A
Fuse
Block -
Instrument
Panel
2
8
44
YE/GY
11
1688
BU/RD
12
5005
BK/YE
7
5K Ω
470 Ω
S30
Headlamp
Switch
1450
BK
1450
BK
6817
YE
X1
10
X85
Steering
Wheel Air
Bag Coil
X2
20
6817
BR/RD
4
S70E
Steering
Wheel
Controls
Switch -
Radio
Presets
1
1650
BK
1250
BK
P17
Info
Display
Module
A90
Logic
P2
Transmission
Shift Lever
Position
Indicator
A90
Logic
P16
Instrument
Cluster
A90
Logic
G200
G203
G200

Fig. 15: Controls and Instrument Panel Lamps

Courtesy of GENERAL MOTORS COMPANY

Doors, Seats and Center Console

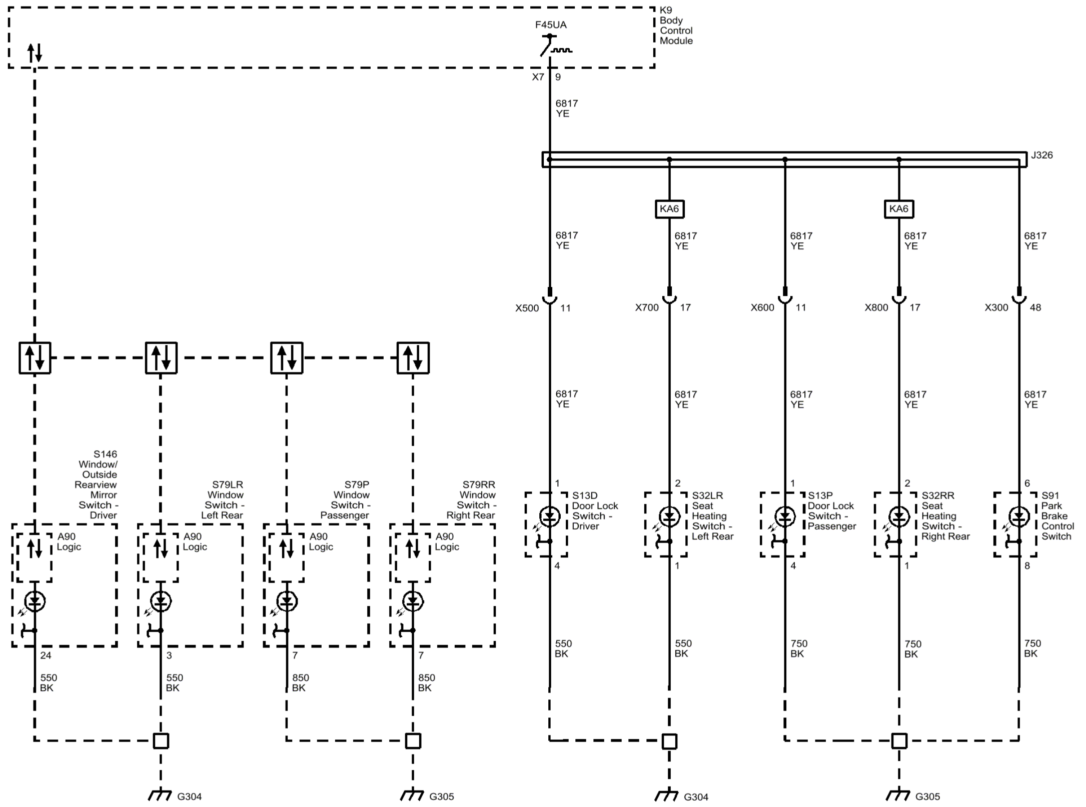

K9 Body Control Module
F45UA
X7 9
6817 YE
J326
KA6
KA6
X500 11
X700 17
X600 11
X800 17
X300 48
S146 Window/ Outside Rearview Mirror Switch - Driver
S79LR Window Switch - Left Rear
S79P Window Switch - Passenger
S79RR Window Switch - Right Rear
A90 Logic
S13D Door Lock Switch - Driver
S32LR Seat Heating Switch - Left Rear
S13P Door Lock Switch - Passenger
S32RR Seat Heating Switch - Right Rear
S91 Park Brake Control Switch
24 550 BK
3 550 BK
7 850 BK
7 850 BK
550 BK
550 BK
750 BK
750 BK
750 BK
G304
G305
G304
G305

Fig. 16: Doors, Seats and Center Console

Courtesy of GENERAL MOTORS COMPANY

Indicator Lamps

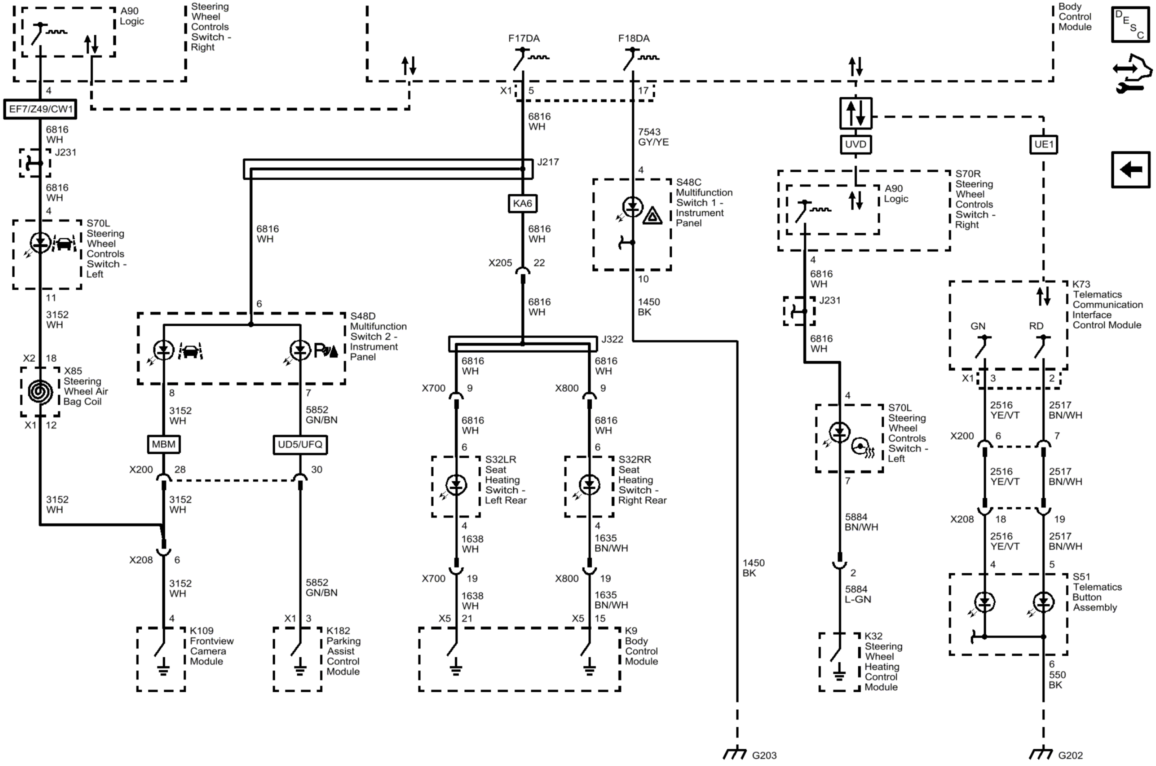

S70R Steering Wheel Controls Switch - Right
A90 Logic
EF7/Z49/CW1
6816 WH
J231
S70L Steering Wheel Controls Switch - Left
3152 WH
X2 18
X85 Steering Wheel Air Bag Coil
X1 12
K9 Body Control Module
F17DA
F18DA
X1 5
17
7543 GY/YE
J217
KA6
6816 WH
X205 22
S48C Multifunction Switch 1 - Instrument Panel
1450 BK
S48D Multifunction Switch 2 - Instrument Panel
MBM
UD5/UFQ
X200 28
30
5852 GN/BN
X208 6
K109 Frontview Camera Module
X1 3
K182 Parking Assist Control Module
J322
X700 9
X800 9
S32LR Seat Heating Switch - Left Rear
S32RR Seat Heating Switch - Right Rear
1638 WH
1635 BN/WH
X700 19
X800 19
X5 21
X5 15
K9 Body Control Module
UVD
UE1
S70R Steering Wheel Controls Switch - Right
A90 Logic
J231
S70L Steering Wheel Controls Switch - Left
5884 BN/WH
5884 L-GN
K32 Steering Wheel Heating Control Module
K73 Telematics Communication Interface Control Module
GN
RD
X1 3 2
2516 YE/VT
2517 BN/WH
X200 6 7
X208 18 19
S51 Telematics Button Assembly
6 550 BK
G203
G202

Fig. 17: Indicator Lamps

Courtesy of GENERAL MOTORS COMPANY

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2017 ACCESSORIES AND EQUIPMENT

Lighting - Specifications - Fastener Specifications - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Brake Pedal Position Sensor Bolt	2.5 N.m (22 lb in)
Front Turn Signal Lamp Bolt	2.5 N.m (22 lb in)
Headlamp Ballast Fastener	2.5 N.m (22 lb in)
Headlamp Bolt	2.5 N.m (22 lb in)
Headlamp Bulb Access Cover Fastener	2.5 N.m (22 lb in)
Headlamp Bulb Retaining Cover Fastener	2.5 N.m (22 lb in)
High Mount Stop Lamp Nut	6 N.m (53 lb in)
Outside Rearview Mirror Turn Signal Lamp Screw	0.8 N.m (7 lb in)
Rear Combination Lamp Nut	4.7 N.m (42 lb in)
Rear Fascia Lower Signal Lamp Bolt	2.5 N.m (22 lb in)
Tail Lamp Control Module Nut	8 N.m (71 lb in)

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2017 ACCESSORIES AND EQUIPMENT

Luggage Rack and Roof Trim - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Luggage Carrier Nut	9 N.m (80 lb in)

REPAIR INSTRUCTIONS

LUGGAGE CARRIER REPLACEMENT

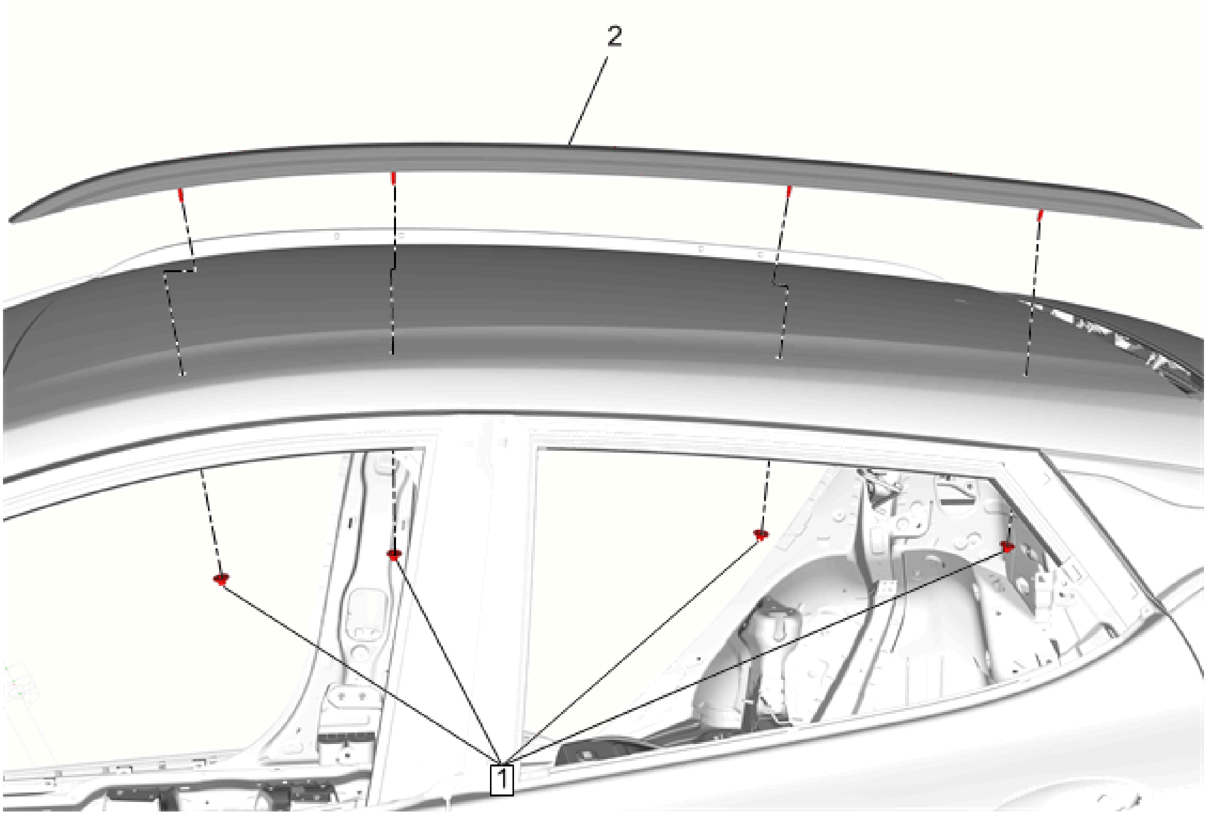

Fig. 1: Luggage Carrier
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure It is only necessary to lower the headliner. Only do those steps in headliner replacement that will lower the headliner enough to gain access to the part. Headlining Trim Panel Replacement	

Callout	Component Name
1	Luggage Carrier Nut **CAUTION:** Fastener Caution **Tighten** 9 N.m (80 lb in)
2	Luggage Carrier Side Rail

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2017 ACCESSORIES AND EQUIPMENT

Mirrors - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

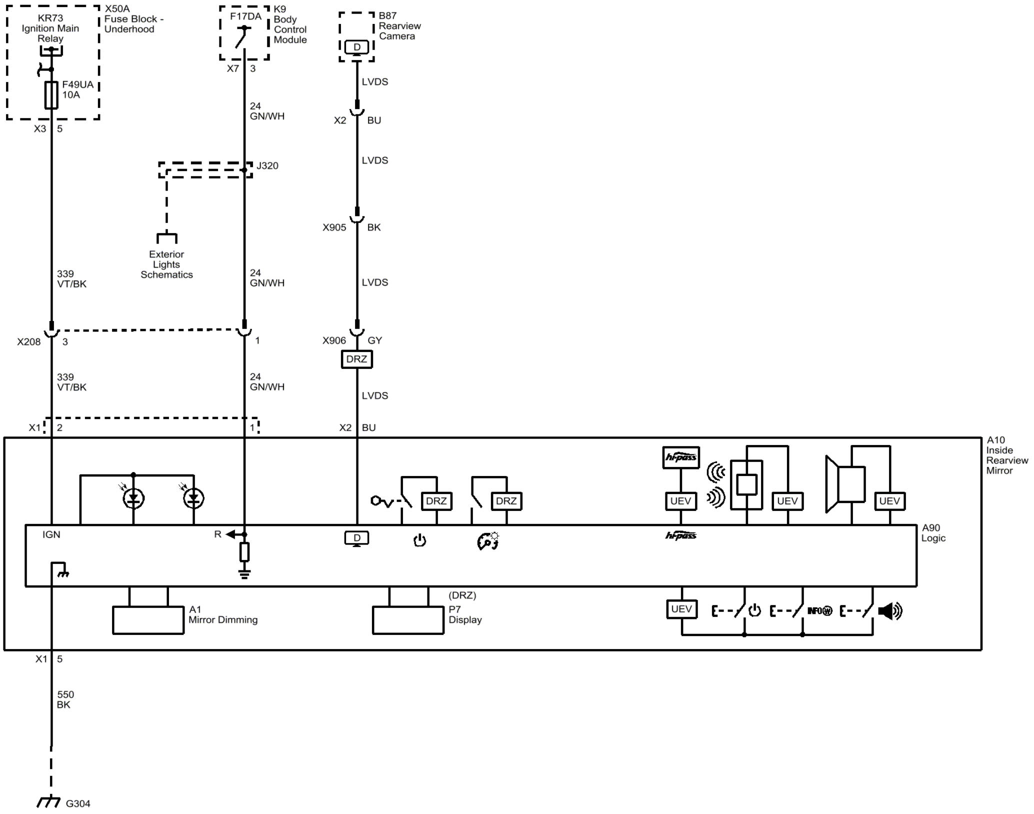
Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Inside Rearview Mirror Fastener	1.8 N.m (16 lb in)
Outside Rearview Mirror Applique Screw	0.8 N.m (7 lb in)
Outside Rearview Mirror Fastener	9 N.m (80 lb in)
Outside Rearview Mirror Housing Cover Bezel Screw	0.8 N.m (7 lb in)
Outside Rearview Mirror Housing Lower Cover Screw	0.5 N.m (4 lb in)
Outside Rearview Mirror Inner Actuator Fastener	1 N.m (9 lb in)

SCHEMATIC WIRING DIAGRAMS

INSIDE REARVIEW MIRROR WIRING SCHEMATICS

Inside Rearview Mirror



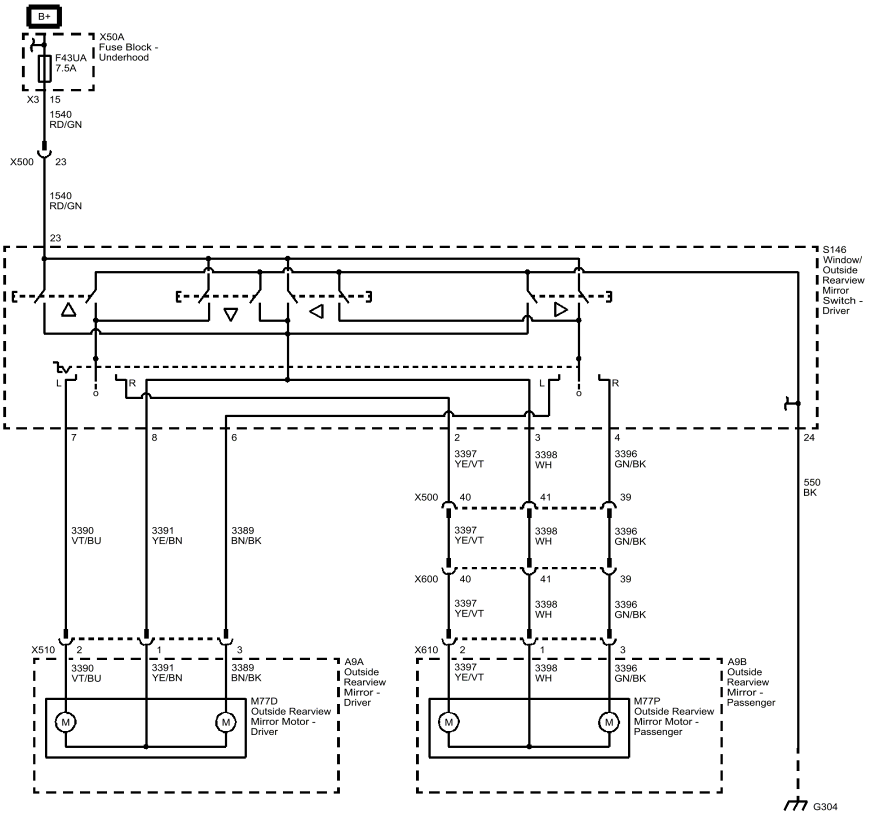
KR73
Ignition Main
Relay
X50A
Fuse Block -
Underhood
F49UA
10A
X3
5
F17DA
K9
Body
Control
Module
X7
3
B87
Rearview
Camera
D
LVDS
24
GN/WH
X2
BU
J320
X905
BK
Exterior
Lights
Schematics
339
VT/BK
X208
1
X906
GY
DRZ
X1
2
A10
Inside
Rearview
Mirror
IGN
R
UEV
A90
Logic
A1
Mirror Dimming
(DRZ)
P7
Display
INFO
550
BK
G304

Fig. 1: Inside Rearview Mirror

Courtesy of GENERAL MOTORS COMPANY

OUTSIDE REARVIEW MIRROR WIRING SCHEMATICS

Outside Rearview Mirrors

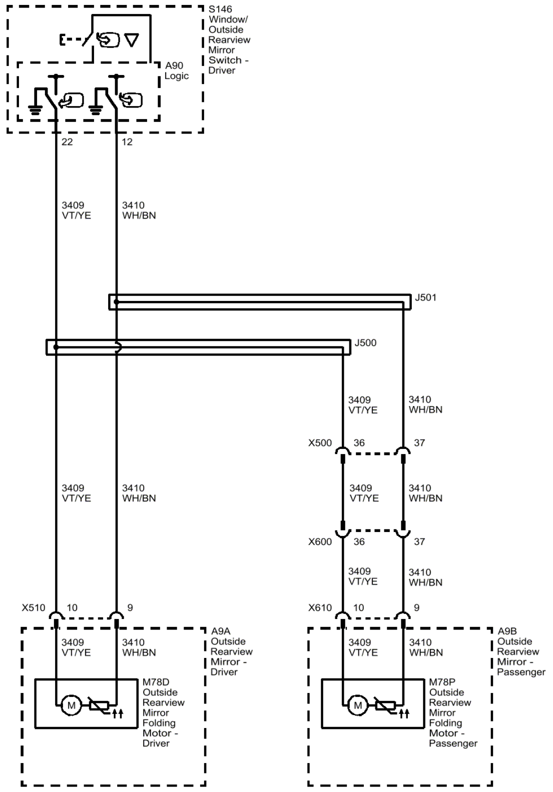


B+
X50A
Fuse Block - Underhood
F43UA
7.5A
X3
15
1540
RD/GN
X500
23
1540
RD/GN
23
S146
Window/ Outside Rearview Mirror Switch - Driver
L
R
L
R
7
8
6
2
3
4
24
3397
YE/VT
3398
WH
3396
GN/BK
550
BK
X500
40
41
39
3390
VT/BU
3391
YE/BN
3389
BN/BK
3397
YE/VT
3398
WH
3396
GN/BK
X600
40
41
39
3397
YE/VT
3398
WH
3396
GN/BK
X510
2
1
3
3390
VT/BU
3391
YE/BN
3389
BN/BK
A9A
Outside Rearview Mirror - Driver
M77D
Outside Rearview Mirror Motor - Driver
M
M
X610
2
1
3
3397
YE/VT
3398
WH
3396
GN/BK
A9B
Outside Rearview Mirror - Passenger
M77P
Outside Rearview Mirror Motor - Passenger
M
M
G304

Fig. 2: Outside Rearview Mirrors

Courtesy of GENERAL MOTORS COMPANY

Folding (DLR)



S146
Window/ Outside Rearview Mirror Switch - Driver
A90
Logic
22
12
3409
VT/YE
3410
WH/BN
J501
J500
3409
VT/YE
3410
WH/BN
X500
36
37
3409
VT/YE
3410
WH/BN
3409
VT/YE
3410
WH/BN
X600
36
37
3409
VT/YE
3410
WH/BN
X510
10
9
X610
10
9
3409
VT/YE
3410
WH/BN
A9A
Outside Rearview Mirror - Driver
M78D
Outside Rearview Mirror Folding Motor - Driver
M
3409
VT/YE
3410
WH/BN
A9B
Outside Rearview Mirror - Passenger
M78P
Outside Rearview Mirror Folding Motor - Passenger
M

Fig. 3: Folding (DLR)

Courtesy of GENERAL MOTORS COMPANY

Heating

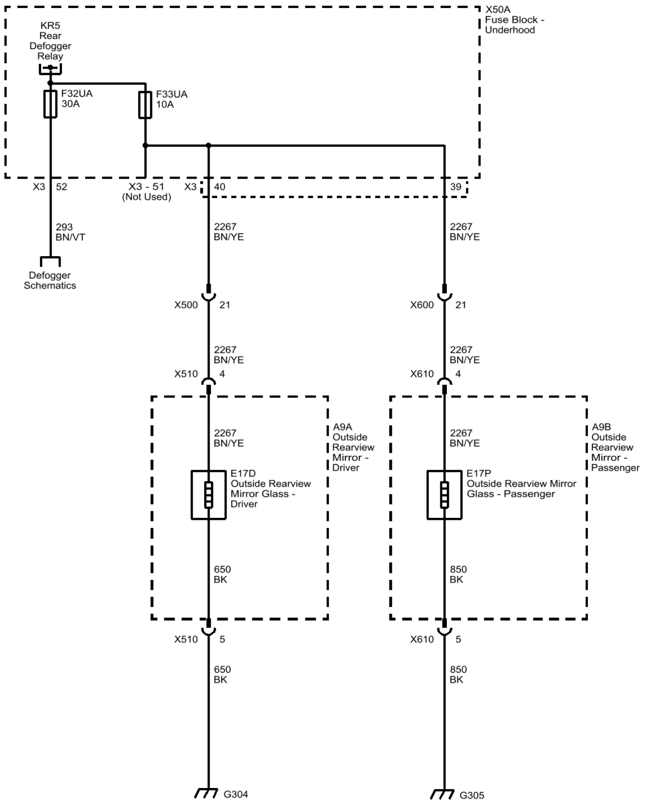

X50A
Fuse Block - Underhood
KR5
Rear Defogger Relay
F32UA
30A
F33UA
10A
X3
52
X3 - 51
(Not Used)
X3
40
39
293
BN/VT
Defogger Schematics
2267
BN/YE
2267
BN/YE
X500
21
X600
21
2267
BN/YE
2267
BN/YE
X510
4
X610
4
2267
BN/YE
A9A
Outside Rearview Mirror - Driver
E17D
Outside Rearview Mirror Glass - Driver
2267
BN/YE
A9B
Outside Rearview Mirror - Passenger
E17P
Outside Rearview Mirror Glass - Passenger
650
BK
850
BK
X510
5
X610
5
650
BK
850
BK
G304
G305

Fig. 4: Heating
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B154A OR B154B: MIRROR INTERNAL MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B154A 39

Driver Mirror Internal Malfunction

DTC B154B 39

Passenger Mirror Internal Malfunction

Circuit/System Description

The outside mirror switch and passenger window switch are on a serial data circuit with the memory seat module as the master. The mirror select and directional control switches are inputs to the memory seat module through the serial data circuit. When the memory seat module receives switch inputs from the outside mirror switch, mirror output commands are sent to the appropriate switch through the serial data circuit. The outside mirror switch and passenger window switch control the left and right outside rear view mirrors through bi-directional motor control circuits. The motor control circuits are floating while in an inactive state and the switches will apply power and ground to the control circuits as necessary to move the mirror in the commanded direction.

Mirror position is determined by both horizontal and vertical position sensors in each of the power mirrors. The outside mirror switch and passenger window switch supply a 5 V reference, low reference, and horizontal and vertical position signal circuits to these sensors. The signal circuits are referenced from 5 V by the switches and the signal circuit voltage levels represent the mirror positions. The mirror positions are sent to the memory seat module through the serial data circuit where they are stored for memory mirror operation. When the memory seat module receives a memory recall command, the memory seat module will send the go to position commands to the outside mirror switch and passenger window switch. The switches will then drive the appropriate mirror motors to the commanded position sensor settings.

Conditions for Running the DTC

Battery voltage must be between 9 - 16 V.

Conditions for Setting the DTC

B154A 39

An internal malfunction has been detected by the outside rearview mirror switch while commanding the driver outside rearview mirror UP, DOWN, LEFT or RIGHT.

B154B 39

An internal malfunction has been detected by the passenger window switch while commanding the passenger outside rearview mirror UP, DOWN, LEFT or RIGHT.

Action Taken When the DTC Sets

The affected outside rearview mirror will be inoperative.

Conditions for Clearing the DTC

B154A 39

The driver outside rearview mirror must be replaced before the DTC can be cleared.

B154B 39

The passenger outside rearview mirror must be replaced before the DTC can be cleared.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.

2. Verify the A9A Outside Rearview Mirror - Driver moves when commanding the Driver Mirror Horizontal Movement Right/Left and Driver Mirror Vertical Movement Up/Down with a scan tool.
    - **If the A9A Outside Rearview Mirror - Driver does not move RIGHT or LEFT or UP or DOWN**

      Replace the M77D Outside Rearview Mirror Motor - Driver.

    - **If the A9A Outside Rearview Mirror-Driver moves RIGHT, LEFT, UP and DOWN**
3. Verify the A9B Outside Rearview Mirror-Passenger moves when commanding the Passenger Mirror Horizontal Movement Right/Left and Passenger Mirror Vertical Movement Up/Down with a scan tool.
    - **If the A9B Outside Rearview Mirror-Passenger does not move RIGHT or LEFT or UP or DOWN**

      Replace the M77P Outside Rearview Mirror Motor - Passenger.

    - **If the A9B Outside Rearview Mirror-Passenger moves RIGHT, LEFT, UP and DOWN**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Outside Rearview Mirror Inner Actuator Replacement.

SYMPTOMS - MIRRORS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Outside Mirror Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Heated Mirrors Malfunction**
- **Power Mirror Malfunction**
- **Power Mirror Folding Malfunction (With A45)Power Mirror Folding Malfunction (Without A45)**
- **Automatic Day-Night Mirrors Malfunction**
- **Power Mirror Tilt Inoperative in Reverse**
- **Rearview Camera Full Display Mirror Malfunction**

HEATED MIRRORS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Heated Mirror Element Control	2	1	3	-
Driver Outside Rearview Mirror Ground	-	1	-	-
Right Heated Mirror Element Control	2	1	3	-
Passenger Outside Rearview Mirror Ground	-	1	-	-
1. Single Heated Mirror Inoperative 2. Both Heated Mirrors Inoperative 3. Heated Mirrors Always On				

Circuit/System Description

The rear defogger relay supplies voltage to the outside rearview mirror heater elements based on the current state of the rear window defogger. The relay supplies B+ through the driver/passenger mirror heating element control circuit when a request is seen.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode..
2. Verify the E18 Rear Defogger Grid turns ON and OFF when commanding the Rear Defogger On and Off with a scan tool.
    - **If the E18 Rear Defogger Grid does not turn ON or OFF**

    Refer to Rear Window Defogger Malfunction .

  - **If the E18 Rear Defogger Grid turns ON and OFF**

3. Verify the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger become warm when commanding the Rear Defogger On with a scan tool.
   - **If the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger do not become warm**

     Refer to Circuit/System Testing.

   - **If the E17D Outside Rearview Mirror Glass-Driver and the E17P Outside Rearview Mirror Glass-Passenger become warm**
4. All OK.

Circuit/System Testing

Single Outside Mirror Defogger Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the appropriate X510 or X610 inline harness connector at the A9 Outside Rearview Mirror. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode, connect a test lamp between the control circuit terminal 4 and the ground circuit terminal 5.
4. Verify the test lamp turns ON when commanding the Rear Defogger On with a scan tool.
   - **If the test lamp is always OFF**
   1. Ignition OFF, remove the test lamp, disconnect the X1 harness connector at the X50A Fuse Block - Underhood.
   2. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the E17 Outside Rearview Mirror Glass.
   - **If the test lamp turns ON**
5. Test or replace the E17 Outside Rearview Mirror Glass.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Outside Rearview Mirror Glass Replacement
- Engine Wiring Harness Junction Block Replacement

AUTOMATIC DAY-NIGHT MIRRORS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach
- Diagnostic Procedure Instructions provides an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Backup Lamp Control	B2545 02	1	1	-
Ground	-	1	-	-
1. Inside Electrochromic Mirror Malfunction				

Circuit/System Description

The inside rearview mirror uses 2 photocell sensors. One sensor is the rear light sensor, located on the face side of the mirror, facing the rear of the vehicle. The rear light sensor is used to determine light conditions present at the mirror face. The other sensor is the front light sensor, located on the backside of the mirror, facing the front of the vehicle. The front light sensor is used to determine the exterior light conditions at the front of the vehicle. With a low exterior light condition detected by the front light sensor and a high light condition from the rear light sensor, the inside rearview mirror will automatically darken the face of the inside rearview mirror.

With the gear selector lever in the REVERSE position and the engine running, backup lamp control voltage is supplied as an input to the inside rearview mirror. The mirror monitors this input to disable the automatic day-night feature. This allows the driver to see objects in the mirror clearly when backing up, regardless of the rear light sensor status.

Reference Information

Schematic Reference

- Inside Rearview Mirror Schematics
- Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic Day-Night Mirror Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Cover the windshield with a blanket or other suitable item.
3. Verify the A10 Inside Rearview Mirror face dims when shining a bright light into the rear light sensor
    - **If the A10 Inside Rearview Mirror does not dim**

      Refer to Circuit/System Testing - Inside Review Mirror Dimming Inoperative

    - **If the A10 Inside Rearview Mirror dims**
4. Verify the A10 Inside Rearview Mirror face transitions from dim to bright while commanding the Backup Lamps Active and Inactive with a scan tool.

   - **If the A10 Inside Rearview Mirror does not transition between dim and bright.**

     Refer to Circuit/System Testing - Day-Night Disable Malfunction

   - **If the A10 Inside Rearview Mirror transitions between bright and dim states**
5. All OK.

Circuit/System Testing

Inside Review Mirror Dimming Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A10 Inside Rearview Mirror. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
   - If 2 Ω or greater, repair the open/high resistance in the circuit.
   - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 2 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, refer to **Power Mode Mismatch** .
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the A10 Inside Rearview Mirror.
   - **If the test lamp illuminates**
5. Replace the A10 Inside Rearview Mirror.

Day-Night Disable Malfunction

1. Ignition OFF, disconnect the harness connector at the A10 Inside Rearview Mirror.
2. Connect a test lamp between the control circuit terminal 1 and ground
3. Ignition ON, verify the test lamp turns ON and OFF while commanding the Backup Lamps Active and Inactive with a scan tool.
   - **If the test lamp is always ON**
   1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, refer to **Backup Lamps Malfunction** .
   - **If the test lamp is always OFFN**
   1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, ignition ON.

2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, refer to Backup Lamps Malfunction
    - **If the test lamp turns ON and OFF**
4. Replace the A10 Inside Rearview Mirror.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair

Inside Rearview Mirror Replacement

POWER MIRROR FOLDING MALFUNCTION (WITH A45)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Folding Mirror Motor Fold Control	1	1	-	-
Folding Mirror Motor Unfold Control	1	1	-	-
1. Power Folding Mirror Inoperative				

Circuit/System Description

The outside rearview mirror switch contains resistors which will reduce the signal voltage from the mirror control module, the mirror memory control module is programmed to move the driver outside mirror in a direction depending upon the voltage received from the outside rearview mirror switch. The outside rearview mirror switch has a 3 position rocker switch which corresponds to the driver outside rearview mirror select, no mirror select and passenger outside mirror selected. When the switch is in the no mirror select position and the mirror position switch is held in the DOWN position, mirror control module will command the driver outside mirror to fold or unfold and send a serial data message to the memory seat control module to send a fold or unfold command to the passenger window switch which will command the passenger outside rearview mirror to fold or unfold. The mirror control module and passenger window switch control the fold/unfold motors through bi-directional control circuits.

Diagnostic Aids

Power folding mirrors only operate when the mirror selector switch is in the no mirror select position.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Mirror Select Switch parameter changes from None to Left and Right when cycling the S146 Window/Outside Rearview Mirror Switch - Driver..
    - **If the parameter does not change**

      Refer to Power Mirror Malfunction.

    - **If the parameter changes**
3. Verify the scan tool Mirror Direction Switch parameter changes from Inactive to Up, Down, Right and Left when cycling the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the parameter does not change**

      Refer to Power Mirror Malfunction.

    - **If the parameter changes**
4. Verify the A9A Outside Rearview Mirror-Driver FOLD and UNFOLD when commanding the Driver Mirror Fold Motor to Fold and Unfold with a scan tool.
    - **If the A9A Outside Rearview Mirror-Driver does not FOLD and UNFOLD**

      Refer to Circuit/System Testing - Driver Outside Mirror Folding Command Malfunction.

    - **If the A9A Outside Rearview Mirror-Driver does FOLD and UNFOLD**
5. Verify the A9B Outside Rearview Mirror-Passenger FOLD and UNFOLD when commanding the Passenger Mirror Fold Motor to Fold and Unfold with a scan tool.
    - **If the A9B Outside Rearview Mirror-Passenger does not FOLD and UNFOLD**

      Refer to Circuit/System Testing - Passenger Outside Mirror Folding Command Malfunction.

    - **If the A9B Outside Rearview Mirror-Passenger does FOLD and UNFOLD**
6. All OK.

Circuit/System Testing

Driver Outside Mirror Folding Command Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the X510 inline harness connector at the A9A Outside Rearview Mirror-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the control circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If less than 10 Ω**

3. Test for less than 10 Ω between the control circuit terminal 9 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If less than 10 Ω**
4. Connect a test lamp between control circuit terminal 10 and control circuit terminal 9, ignition ON.
5. Verify the test lamp turns ON when commanding the FOLD and UNFOLD states with a scan tool.
    - **If the test lamp remains OFF during either of the commands**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for infinite resistance between each control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp turns ON during each of the commands**
6. Test or replace the A9A Outside Rearview Mirror-Driver.

Passenger Outside Mirror Folding Command Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the X610 inline harness connector at the A9B Outside Rearview Mirror-Passenger. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the control circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the X2 harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If less than 10 Ω**
3. Test for less than 10 Ω between the control circuit terminal 9 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the X2 harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If less than 10 Ω**
4. Connect a test lamp between control circuit terminal 10 and control circuit terminal 9, ignition ON.
5. Verify the test lamp turns ON when commanding the FOLD and UNFOLD states with a scan tool.
    - **If the test lamp remains OFF during either of the commands**
    1. Ignition OFF, remove the test lamp, disconnect the X2 harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for infinite resistance between each control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the S146 Window/Outside Rearview Mirror Switch - Driver.

- **If the test lamp turns ON during each of the commands**

6. Test or replace the A9B Outside Rearview Mirror-Passenger.

Component Testing

Outside Rearview Mirror

1. Ignition OFF, disconnect the harness connector at the appropriate A9 Outside Rearview Mirror.
2. Install a 10 A fused jumper wire between one of the control terminals and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the A9 Outside Rearview Mirror should perform the FOLD and UNFOLD functions.
    - **If the function does not perform the FOLD and UNFOLD functions**

      Replace the A9 Outside Rearview Mirror.

    - **If the function performs the FOLD and UNFOLD functions**
3. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Outside Rearview Mirror Replacement
- Front Side Door Window Control Switch Replacement
- Control Module References for the left mirror control module replacement, programming and setup

POWER MIRROR FOLDING MALFUNCTION (WITHOUT A45)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Folding Mirror Motor Fold Control	1	1	-	-
Folding Mirror Motor Unfold Control	1	1	-	-
1. Power Folding Mirror Inoperative				

Circuit/System Description

The outside mirror switch controls the power fold/unfold functions of the outside rearview mirrors. The folding mirror motors are controlled by using bi-directional motor controls through the folding mirror motor fold control circuit and the folding mirror motor unfold control circuit.

Diagnostic Aids

Power folding mirrors only operate when the mirror selector switch is in the no mirror select position.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Verify the outside folding mirrors is fully extended or fully retracted, refer to **Power Folding Mirrors Resetting Procedure**.
2. Ignition ON.
3. Verify the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger FOLD and UNFOLD with the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the A9A Outside Rearview Mirror-Driver or the A9B Outside Rearview Mirror-Passenger do not FOLD or UNFOLD**

      Refer to Circuit/System Testing

    - **If the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger FOLD and UNFOLD**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the inline harness connector at the appropriate A9 Outside Rearview Mirror. Ignition ON
2. Connect a test lamp between the control circuit terminal 9 and control circuit terminal 10.
3. Verify the test lamp turns ON when commanding the FOLD and UNFOLD states with the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp remains OFF during either of the commands**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for infinite resistance between each control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp is always ON**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver, ignition ON.
    2. Test for less than 1 V between each control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver
    - **If the test lamp turns ON during each of the commands**
4. Test or replace the A9 Outside Rearview Mirror.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Window Control Switch Replacement**
- **Outside Rearview Mirror Replacement**

POWER MIRROR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Outside Rearview Mirror Switch B+	1	1	-	-
Driver Mirror Motor Horizontal Control	1	2	2	-
Driver Mirror Motor Vertical Control	1	2	2	-
Passenger Mirror Motor Horizontal Control	1	3	3	-
Passenger Mirror Motor Vertical Control	1	3	3	-
Outside Rearview Mirror Switch Ground	-	1	-	-
1. Both Outside Power Mirrors Inoperative 2. Driver Outside Power Mirror Malfunction 3. Passenger Outside Power Mirror Malfunction				

Circuit/System Description

The outside rearview mirror switch controls the outside rearview mirrors based on the position of the mirror selector switch and which movement position is selected. The outside rearview mirror switch has four positions: up, down, left, and right. B+ is applied to the switch from the power mirror fuse and when a movement position switch is selected, voltage is sent to the commanded mirror via a mirror control circuit. The opposite mirror control circuit acts as a ground circuit for the bi-directional mirror motor. Ground is the applied through the switch.

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

1. Verify the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT with the S146 Window/Outside Rearview Mirror Switch - Driver.
   - **If both outside mirror glasses do not move**

     Refer to Circuit/System Testing - Both Outside Rearview Mirrors Inoperative.

   - **If the driver outside mirror glass does not move UP, DOWN, LEFT or RIGHT**

     Refer to Circuit/System Testing - Driver Outside Mirror Movement Malfunction.

   - **If the passenger outside mirror glass does not move UP, DOWN, LEFT or RIGHT**

     Refer to Circuit/System Testing - Passenger Outside Mirror Movement Malfunction.

   - **If the mirror glass of the A9A Outside Rearview Mirror-Driver and the A9B Outside Rearview Mirror-Passenger move UP, DOWN, LEFT and RIGHT**
2. All OK.

Circuit/System Testing

Both Outside Rearview Mirrors Inoperative

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 24 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 23 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for infinite resistance between each of the control circuit terminals listed below and ground:
      - Control circuit terminal 2
      - Control circuit terminal 3
      - Control circuit terminal 4
      - Control circuit terminal 6
      - Control circuit terminal 7

        - Control circuit terminal 8
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the appropriate M77 Outside Rearview Mirror Motor.
    - **If the test lamp illuminates**
4. Test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.

Driver Outside Mirror Movement Malfunction

1. Ignition OFF, disconnect the X501 inline harness connector at the A9A Outside Rearview Mirror-Driver. Ignition ON
2. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2.
3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp remains OFF during either of the commands**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for infinite resistance between each control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp is always ON**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver, ignition ON.
    2. Test for less than 1 V between each control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp turns ON during each of the commands**
4. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 3.
5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp remains OFF during either of the commands**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for infinite resistance between each control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp is always ON**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver, ignition ON.
    2. Test for less than 1 V between each control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp turns ON during each of the commands**

6. Test or replace the M77D Outside Rearview Mirror Motor-Driver.

Passenger Outside Mirror Movement Malfunction

1. Ignition OFF, disconnect the X601 inline harness connector at the A9B Outside Rearview Mirror-Passenger. Ignition ON
2. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 2.
3. Verify the test lamp turns ON when commanding the UP and DOWN states with the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp remains OFF during either of the commands**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for infinite resistance between each control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp is always ON**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver, ignition ON.
    2. Test for less than 1 V between each control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp turns ON during each of the commands**
4. Connect a test lamp between the control circuit terminal 1 and control circuit terminal 3.
5. Verify the test lamp turns ON when commanding the LEFT and RIGHT states with the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp remains OFF during either of the commands**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver.
    2. Test for infinite resistance between each control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp is always ON**
    1. Ignition OFF, remove the test lamp, disconnect the harness connector at the S146 Window/Outside Rearview Mirror Switch - Driver, ignition ON.
    2. Test for less than 1 V between each control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, test or replace the S146 Window/Outside Rearview Mirror Switch - Driver.
    - **If the test lamp turns ON during each of the commands**
6. Test or replace the M77P Outside Rearview Mirror Motor-Passenger.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Window Control Switch Replacement**
- **Outside Rearview Mirror Inner Actuator Replacement**

POWER MIRROR TILT INOPERATIVE IN REVERSE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

Mirror position is determined by both horizontal and vertical position sensors in each of the power mirrors. The mirror control module and passenger window switch supply a 5 V reference, low reference, and horizontal and vertical position signal circuits to these sensors. The signal circuits are referenced from 5 V by the switches and the signal circuit voltage levels represent the mirror positions. The mirror positions are sent to the memory seat module through the serial data circuit where they are stored for memory mirror operation. When the memory seat module receives a park tilt mirror in reverse command, the memory seat module will send the tilt down command to the mirror control module and the passenger window switch. The mirror control module and the passenger window switch will then drive the appropriate mirror motors to the commanded position.

Diagnostic Aids

The Park Tilt Mirror in Reverse is a feature in the Personalization Menu of the audio system controls that allows the operator to program the driver and/or passenger outside rearview mirrors to tilt downward when the vehicle is shifted into R (reverse). Verify that this feature has been correctly programmed into the system before performing extensive diagnostics

Reference Information

Schematic Reference

Outside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Outside Mirror Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the A9A Outside Rearview Mirror - Driver moves when commanding the Driver Mirror Horizontal Movement Right/Left and Driver Mirror Vertical Movement Up/Down with a scan tool.
    - **If the A9A Outside Rearview Mirror - Driver does not move RIGHT or LEFT or UP or DOWN**

Refer to Power Mirror Malfunction.

- **If the A9A Outside Rearview Mirror - Driver moves RIGHT, LEFT, UP and DOWN**

3. Verify the A9B Outside Rearview Mirror-Passenger moves when commanding the Passenger Mirror Horizontal Movement Right/Left and Passenger Mirror Vertical Movement Up/Down with a scan tool.
    - **If the A9B Outside Rearview Mirror-Passenger does not move RIGHT or LEFT or UP or DOWN**

      Refer to Power Mirror Malfunction.

    - **If the A9B Outside Rearview Mirror-Passenger moves RIGHT, LEFT, UP and DOWN**
4. All OK.

Circuit/System Testing

1. Ignition ON/Vehicle in Service Mode, shift the vehicle in REVERSE.
2. Verify that the appropriate A9 Outside Rearview Mirror moves DOWN.
    - **If the A9 Outside Rearview Mirror does not move DOWN**

      Replace the K40 Seat Memory Control Module

    - **If the A9 Outside Rearview Mirror does move DOWN**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for the seat memory control module replacement, programming and setup

REARVIEW CAMERA FULL DISPLAY MIRROR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach
- Diagnostic Procedure Instructions provides an overview of each diagnostic category

Circuit/System Description

If equipped, full display mirror (FDM) provides a wider field of view than normally seen from the inside rearview mirror to assist when driving and changing lanes. When the tab under the inside rearview mirror is pulled rearward, a view of the area behind the vehicle displays on the mirror.

Reference Information

Schematic Reference

Inside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic Day-Night Mirror Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify there is no debris on the B87 Rearview Camera lens, and the lens is not damaged or the rearview camera is not out of alignment.
    - **If debris is found on the lens, or the lens is damaged, or the rearview camera is out of alignment**

      Clean the lens. If the lens, replace as necessary, or adjust the mirror.

    - **If there is no debris on the lens, or the lens is not damaged, or the rearview camera is not out of alignment**
2. All OK.

Circuit/System Testing

1. Ignition OFF/vehicle OFF, disconnect the coax cable connector at the B87 Rearview Camera.
2. Ignition On, test for 7 - 10 V between the center conductor of the coax cable and the coax cable ground shield wires.
    - **If the value within the range of 7 - 10 V**

      Replace the B87 Rearview Camera.

    - **If the value outside range of 7 - 10 V**
3. Disconnect the A10 Inside Rearview Mirror, and check the coaxal cable resistance
    - **If the value is more than 5 Ω**

      Replace the coax cable.

    - **If the value is less than 5 Ω**
4. Test or replace the A10 Inside Rearview Mirror.

Component Testing

CAUTION: **Refer to Test Probe Caution**

NOTE:

- **Before testing the coax cable, check the cable exterior for being pinched, cut, damaged, or having loose connections at the components, which can cause reception issues.**
- **To prevent false readings when testing the center coax terminals, use care not to ground the test probe on the outer housing/shield.**

Coax Cable Test

1. Test for less than 5 Ω between the coax cable center terminal end to end.
    - **If 5 Ω or greater**

      Replace the coax cable.

    - **If less than 5 Ω**
2. Test for greater than 5 Ω between the coax cable outer shield end to end.
    - **If 5 Ω or greater**

Replace the coax cable.

- **If less than 5 Ω**

3. Test for infinite resistance between the coax cable center terminal and the coax cable outer shield.
   - **If less than infinite resistance**

     Replace the coax cable.

   - **If infinite resistance**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

- **Rearview Driver Information Camera Replacement**
- **Inside Rearview Mirror Replacement**
- **Control Module References** for human machine interface control module replacement, programming, and setup.

REPAIR INSTRUCTIONS

OUTSIDE REARVIEW MIRROR APPLIQUE REPLACEMENT

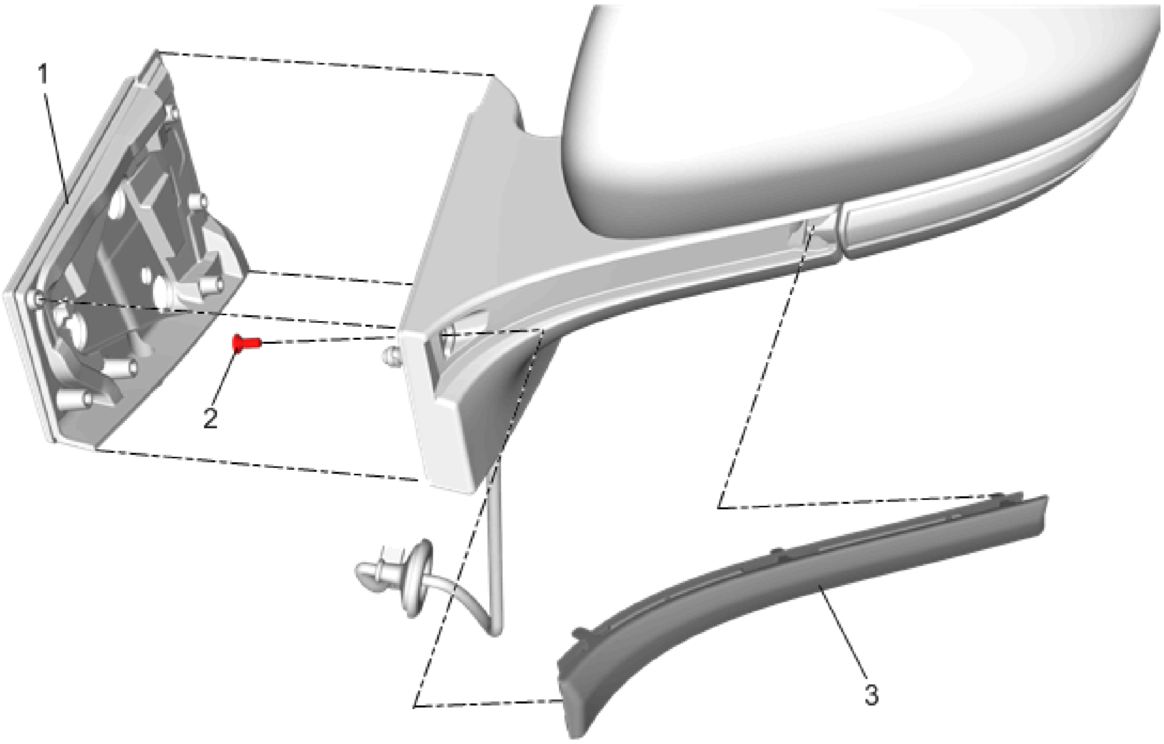


Fig. 5: Outside Rearview Mirror Applique
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Outside Rearview Mirror Replacement**	
1	Outside Rearview Mirror Gasket

Callout	Component Name
2	Outside Rearview Mirror Applique Screw **CAUTION:** Fastener Caution **Tighten** 0.8 N.m (7 lb in)
3	Outside Rearview Mirror Applique

OUTSIDE REARVIEW MIRROR REPLACEMENT

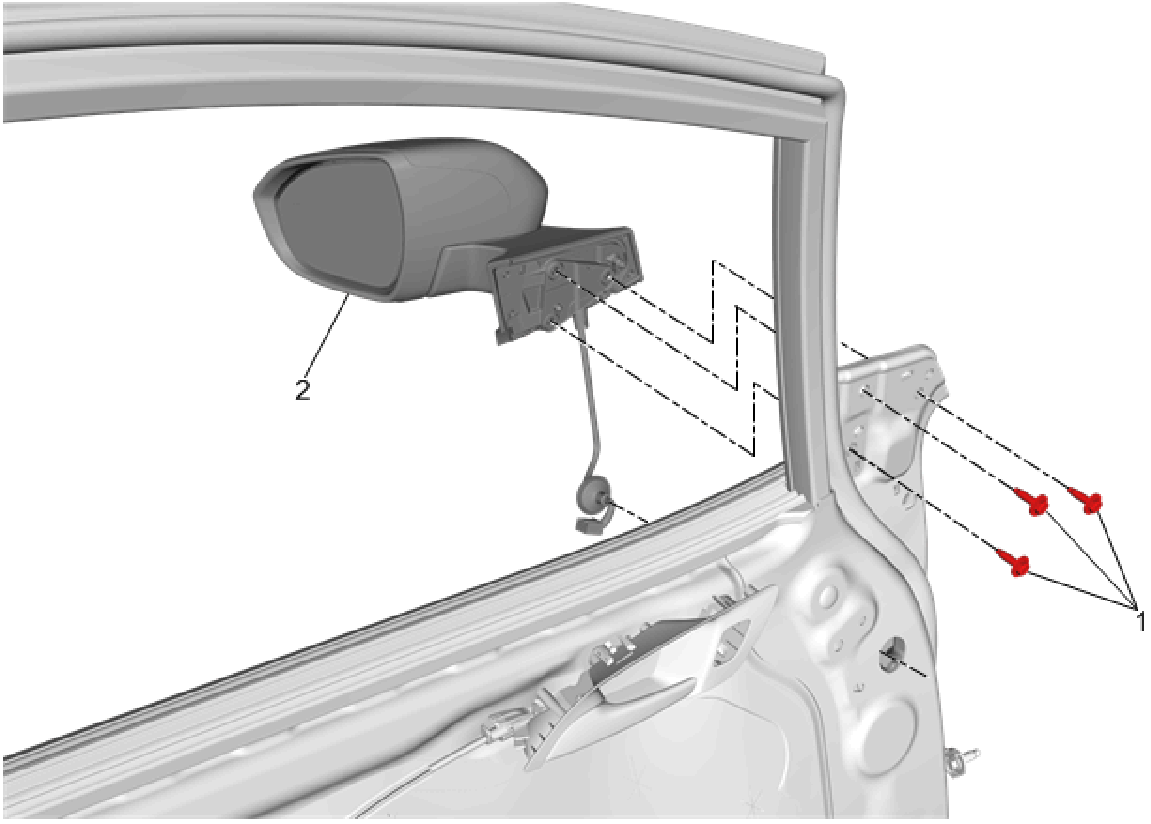


Fig. 6: Outside Rearview Mirror
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Side Door Trim Replacement 2. Front Side Door Upper Trim Panel Replacement	
1	Outside Rearview Mirror Fastener (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

Callout	Component Name
2	Outside Rearview Mirror **Procedure** 1. Disconnect the electrical connector. 2. Release the mirror harness grommet and route the harness through the doors while removing the mirror.

OUTSIDE REARVIEW MIRROR HOUSING LOWER COVER REPLACEMENT

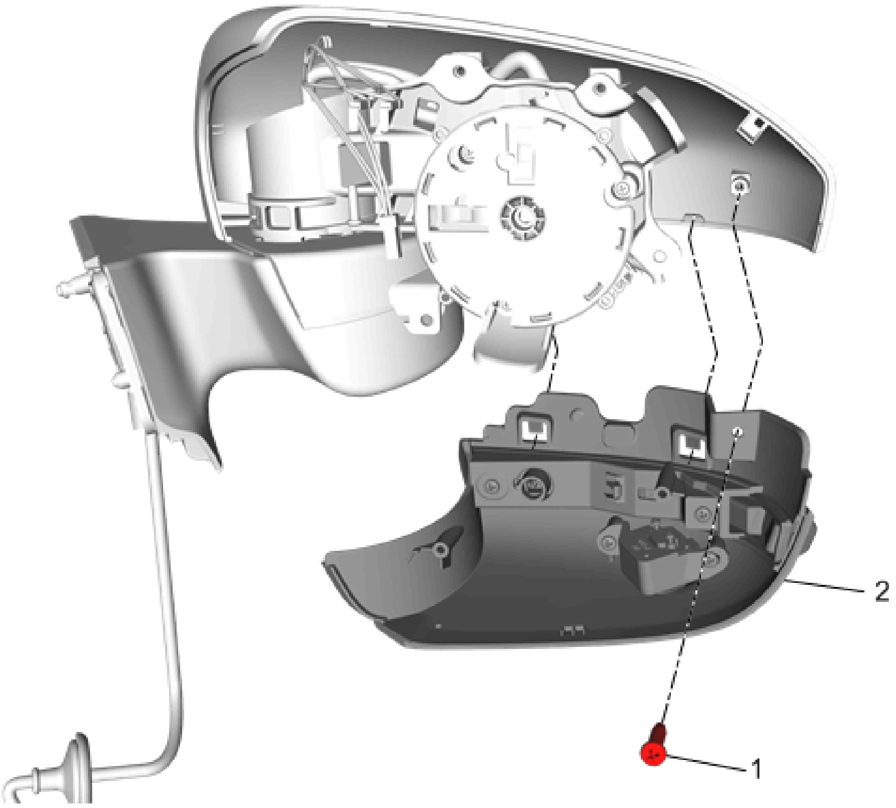


Fig. 7: Outside Rearview Mirror Housing Lower Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Outside Rearview Mirror Housing Bezel Replacement	
1	Outside Rearview Mirror Housing Lower Cover Screw **CAUTION:** Fastener Caution **Tighten** 0.5 N.m (4 lb in)
2	Outside Rearview Mirror Housing Lower Cover **Procedure** 1. Disconnect the turn signal lamp electrical connector. 2. Outside Rearview Mirror Turn Signal Lamp - Remove - Outside Rearview Mirror Turn Signal Lamp Replacement 3. {If equipped} Side View Driver Information Camera - Remove - Side View Driver Information Camera Replacement

OUTSIDE REARVIEW MIRROR HOUSING BEZEL REPLACEMENT

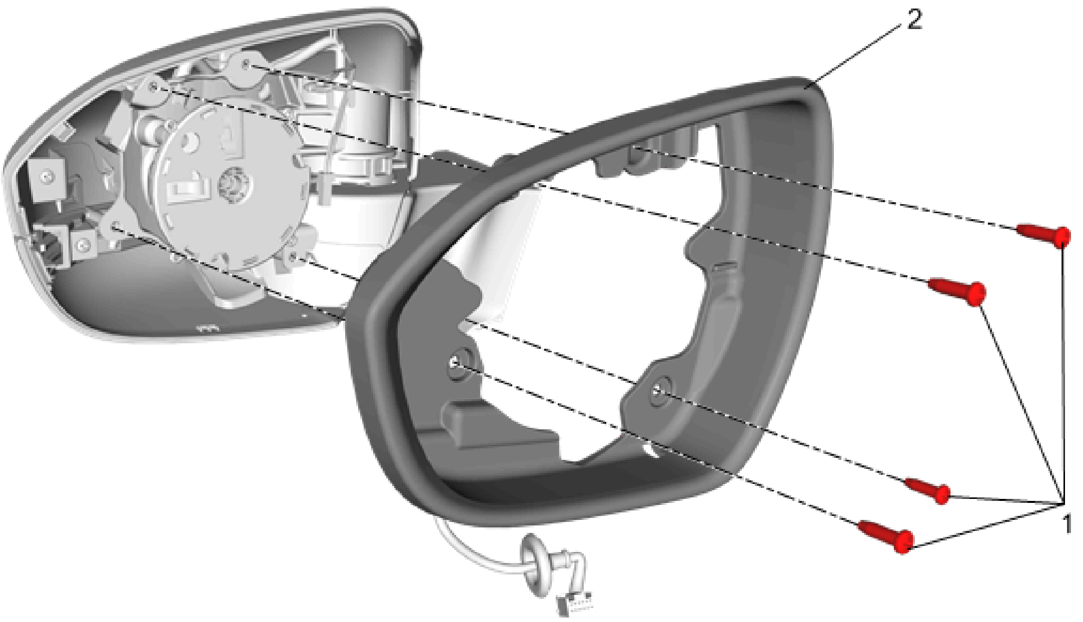


Fig. 8: Outside Rearview Mirror Housing Bezel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Outside Rearview Mirror Glass Replacement	
1	Outside Rearview Mirror Housing Cover Bezel Screw **CAUTION:** Fastener Caution **Tighten** 0.8 N.m (7 lb in)
2	Outside Rearview Mirror Housing Bezel

POWER FOLDING MIRRORS RESETTING PROCEDURE

Initialization Procedure

Reset the power folding mirrors in the following scenarios:

- The mirrors are accidentally obstructed while folding.
- They are accidentally manually folded/unfolded.
- The mirrors will not stay in the unfolded position.
- The mirrors vibrate at normal driving speeds.

Until the motor assembly has been initialized, the express open and close switch inputs and manual open inputs are disregarded. During the process of initialization, anti-pinch detection is not active.

Resetting the Power Folding Mirrors:

Fold and unfold the mirrors one time using the mirror folding control to reset them to their normal position. A popping noise may be heard during the resetting of the power folding mirrors. This sound is normal after a manual folding operation.

OUTSIDE REARVIEW MIRROR INNER ACTUATOR REPLACEMENT

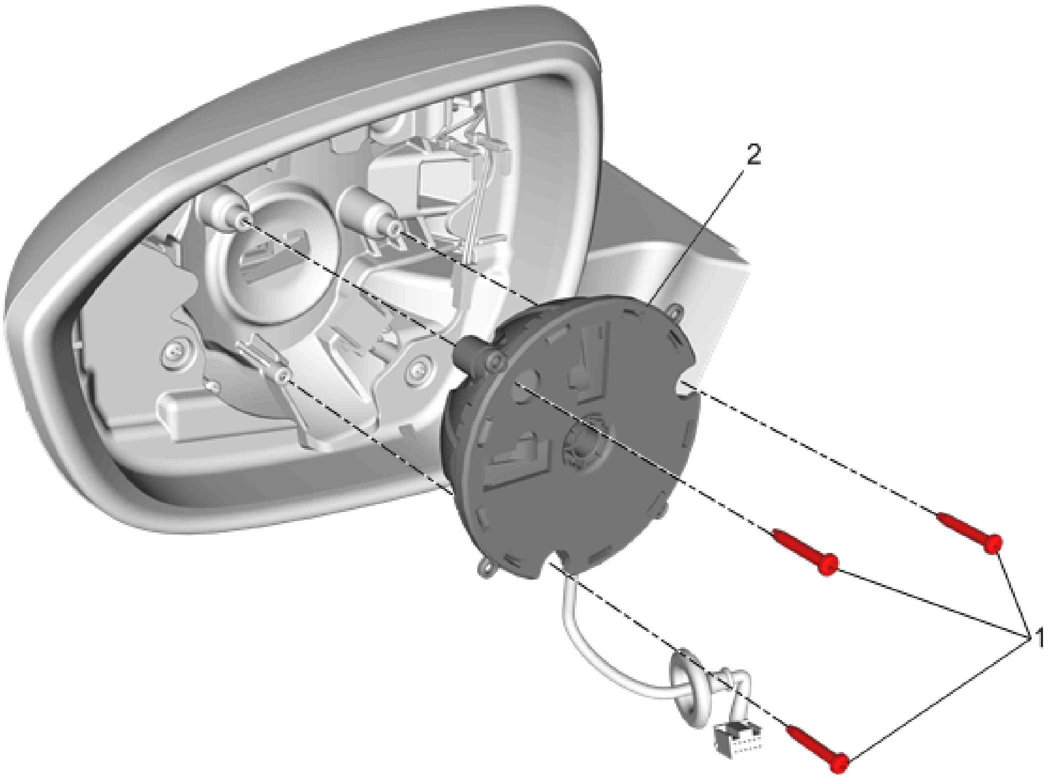


Fig. 9: Outside Rearview Mirror Inner Actuator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Outside Rearview Mirror Glass Replacement	
1	Outside Rearview Mirror Inner Actuator Fastener **CAUTION:** Fastener Caution **Tighten** 1 N.m (9 lb in)
2	Outside Rearview Mirror Inner Actuator **Procedure** Disconnect the electrical connector.

OUTSIDE REARVIEW MIRROR GLASS REPLACEMENT

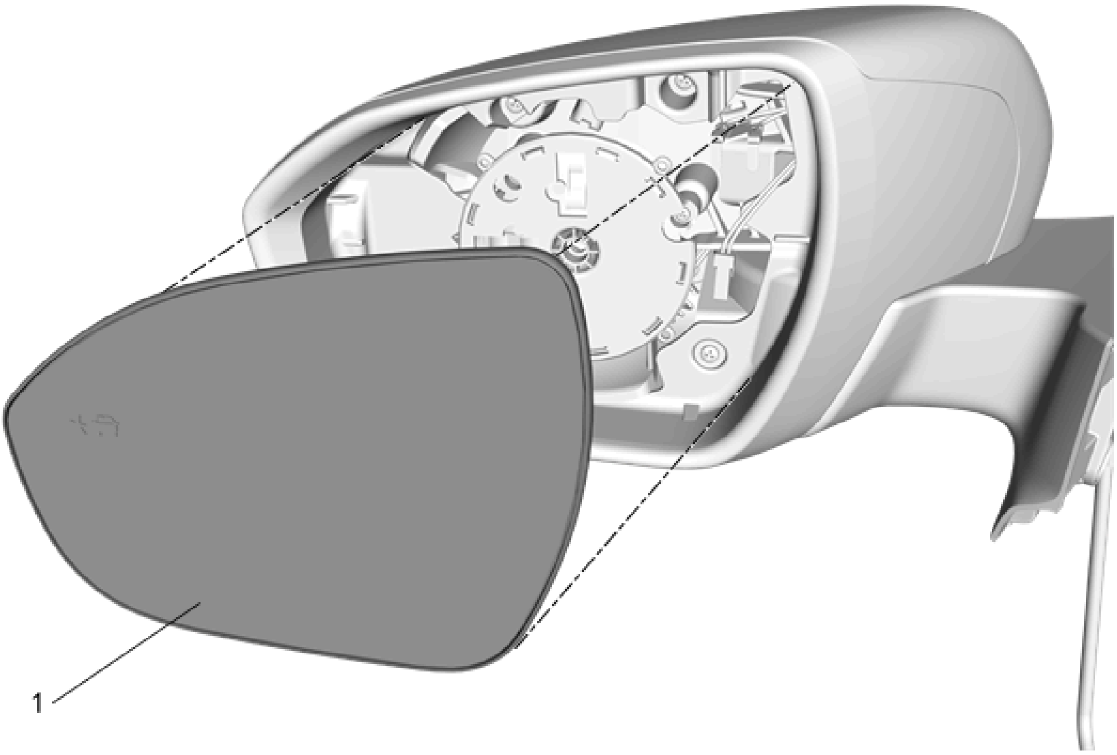


Fig. 10: Outside Rearview Mirror Glass
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Outside Rearview Mirror Glass **WARNING:** **Glass and Sheet Metal Handling Warning** **Procedure** 1. Push inward on the top of the mirror glass exposing a gap. Using a hook type tool, release the long retainer tabs that are accessible while pulling outward on the glass, once long retainer tabs are released, the glass will separate from the actuator. 2. Note the connector location for installation. 3. Disconnect the electrical connector. **NOTE:** **Wear gloves to prevent potentially damaging the new glass during installation. For installation, align the tabs on mirror with the actuator. Apply firm pressure across the surface until the mirror is locked in place.**

INSIDE REARVIEW MIRROR REPLACEMENT

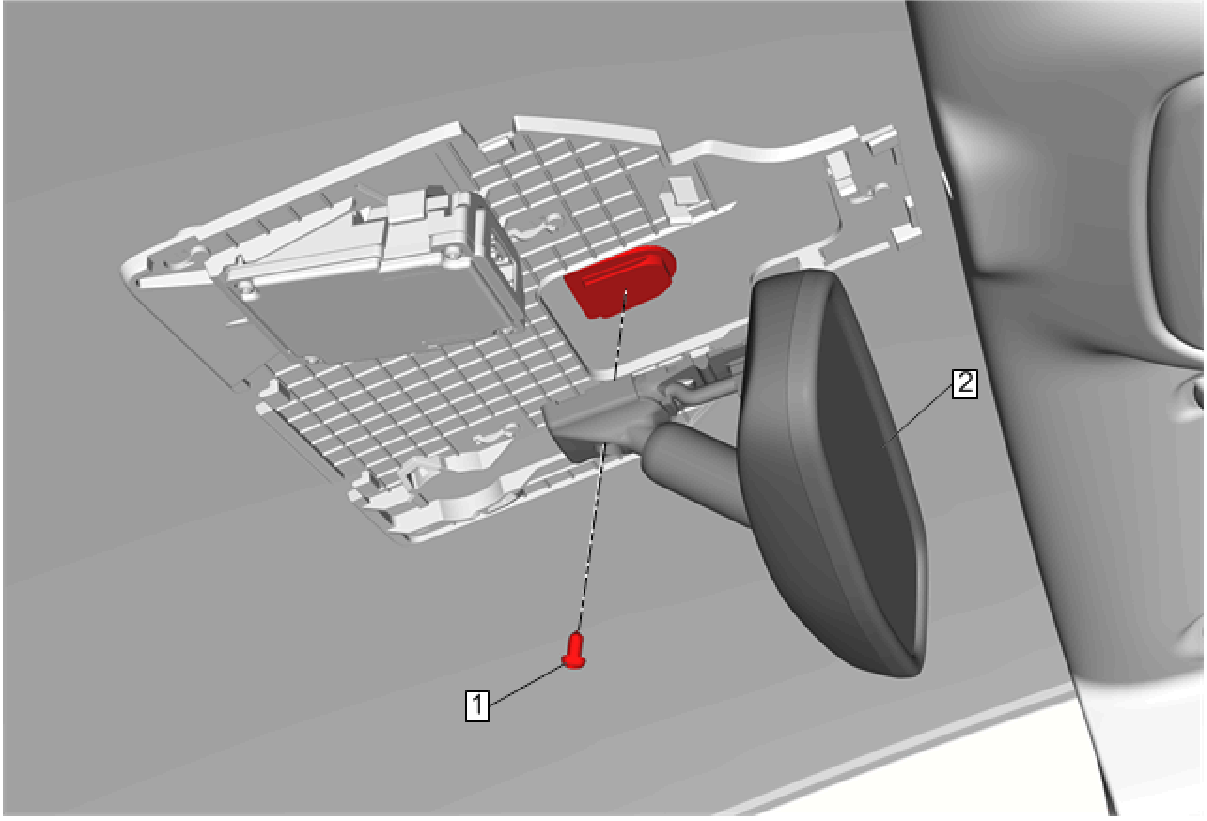


Fig. 11: Inside Rearview Mirror
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera) Windshield Multifunction Sensor Mount Bracket Cover Replacement (without Front View Camera)	
1	Inside Rearview Mirror Fastener **CAUTION:** **Refer to Fastener Caution .** **Tighten** 1.8 N.m (16 lb in)
2	Inside Rearview Mirror **Procedure** Disconnect the electrical connector.

DESCRIPTION AND OPERATION

AUTOMATIC DAY-NIGHT MIRROR DESCRIPTION AND OPERATION

Inside Rearview Mirror with the Automatic Day-Night Feature System Operation

The inside rearview mirror uses 2 photocell sensors. One sensor is the headlight sensor, located on the face side of the mirror. The headlight sensor is used to determine light conditions present at the mirror face. The other sensor is the ambient light sensor, located on the rear of the mirror or windshield side. The ambient light sensor is used to determine the exterior light conditions. With a low exterior light condition detected, and a high light condition from behind the car, at the headlight sensor, the inside rearview mirror will automatically darken the face of the mirror.

In the daytime, the mirror is in a normal state because of the high exterior light condition that is indicated by the ambient light sensor. With the gear selector lever in the REVERSE position and the Ignition ON/Vehicle in Service Mode, backup lamp supply voltage is supplied as an input to the inside rearview mirror. The mirror monitors this input to disable the automatic day-night feature. This allows the driver to see objects in the mirror clearly when backing up, even during the night.

Driver Outside Rearview Mirror with Automatic Day-Night System Operation (If Equipped)

The automatic day-night feature of the driver outside rearview mirror is controlled by the inside rearview mirror. The inside rearview mirror supplies control and low reference to the driver outside rearview mirror. At night, with the automatic day-night feature enabled, the driver outside rearview mirror will automatically darken with the inside rearview mirror to reduce glare from headlamps behind the vehicle.

Inside Rearview Camera Full Display Mirror System Operation

The inside rearview camera full display mirror is connected to the outside rearview camera via a shielded coaxial cable. When the tab under the inside rearview mirror is pulled rearward, a view of the area behind the vehicle displays on the mirror. Adjust the rearview mirror for a clear view of the area behind the vehicle before turning on full display mirror. Use the button on the back of the mirror to adjust the brightness of the display. Make sure the light sensor is not covered when adjusting the brightness.

The inside rearview camera full display mirror may not work properly or display a clear image if:

- It is dark.
- The sun or the beam of headlamps are shining directly into the camera lens.
- Ice, snow, mud, or anything else builds up on the camera lens. Clean the lens, rinse it with water, and wipe it with a soft cloth.

When the mirror detects that the camera is not sending a valid video signal, it "blue screens" with a "no video" decal for 3 seconds, then reverts back to the mirror. Meanwhile, if a blue screen keeps on displaying instead of the camera view, take the vehicle to your dealer for service.

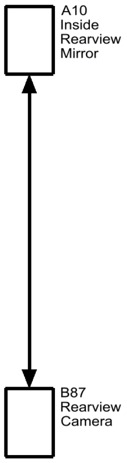


Fig. 12: Rearview Camera Full Display Mirror Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
A10	A10 Inside Rearview Mirror
B87	B87 Rearview Camera

OUTSIDE MIRROR DESCRIPTION AND OPERATION

Power Mirror System Components

The power mirror system consists of the following components:

- Outside rearview mirror switch
- Mirror selector switch
- Driver outside rearview mirror
- Passenger outside rearview mirror

Each of the outside rearview mirror contains two motors. The vertical motor operates the mirror in the up and down directions, and the horizontal motor operates the mirror in the left and right directions.

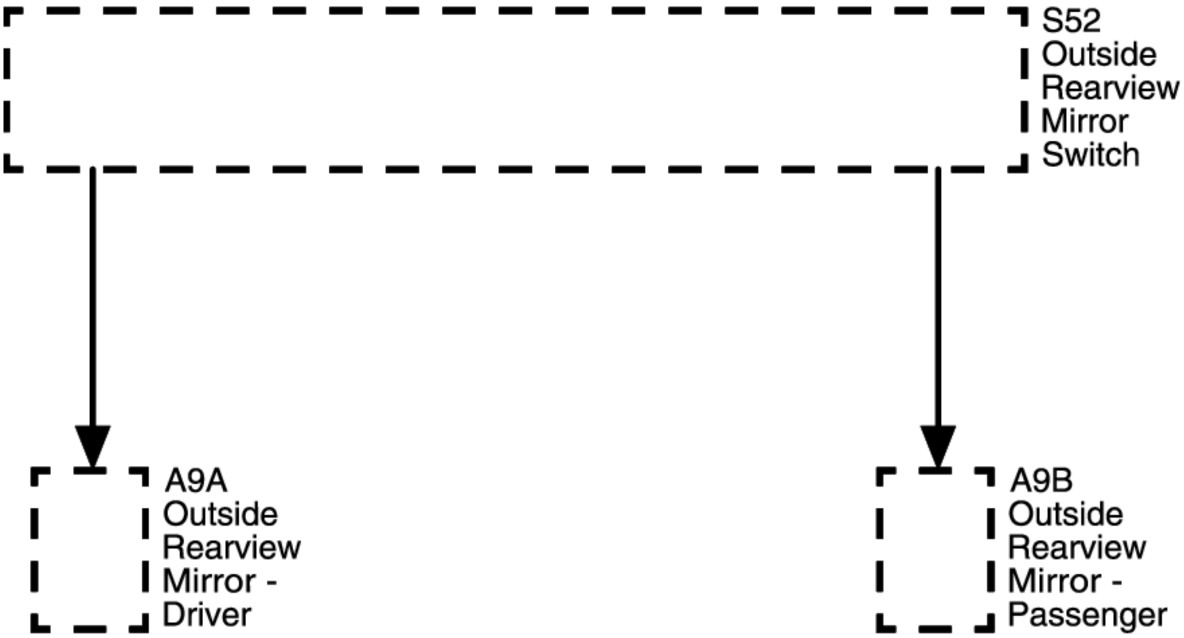


Fig. 13: Power Mirror System Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S52	S52 Outside Rearview Mirror Switch
A9A	A9A Outside Rearview Mirror - Driver
A9B	A9B Outside Rearview Mirror - Passenger

Power Mirror System Controls

The outside rearview mirror switch is a four position directional switch: Up, Down, Left and Right.

The mirror select switch is a three position switch: left, neutral/fold, and right.

Power Mirror System Operation

The outside rearview mirror switch receives battery voltage from the underhood fuse block The power mirror switch also receives a constant ground.

The four positions of the direction switch have dual switch contacts. Each of the contacts are connected to opposing sides of the appropriate power mirror motors through the selector switch. The selector switch completes these circuits depending on the position of the selector switch, L or R.

If the selector switch is placed in the L position and the up switch is pressed, battery voltage will be supplied to the left outside rearview mirror vertical motor through the left mirror motor vertical control circuit and ground through the left mirror motor common control circuit. If the down switch is pressed, battery voltage will be supplied to the left outside rearview mirror vertical motor through the left mirror motor common control circuit and ground through the left mirror motor vertical control circuit.

The remainder of the mirror functions operate in the same manner as described above. Placing the power mirror switch in opposing positions, left/right or up/down, will reverse the polarity to the mirror motor, reversing the direction of movement.

Heated Mirrors (If Equipped)

The heated mirrors are controlled through the rear defog relay. Whenever the rear window defogger is turned on battery voltage is supplied to the mirror heater elements through the left and right mirror heater element control circuits.

Back To Article

2017 ACCESSORIES & EQUIPMENT

Object Detection and Pedestrian Protection - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

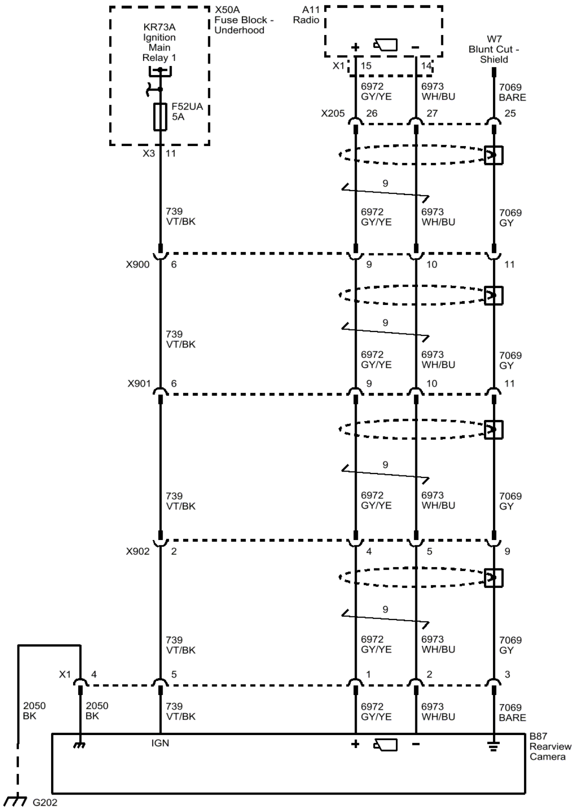
Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Forward Collision Alert Display Bolt	2.5 N.m (22 lb in)
Front View Driver Information Camera Fastener	2.5 N.m (22 lb in)
Outside Rearview Mirror Housing Lower Cover Screw	0.5 N.m (4 lb in)
Parking Assist Control Module Nut	5 N.m (44 lb in)
Side Object Sensing Alert Module Bolt	2.5 N.m (22 lb in)
Side View Driver Information Camera Screw	0.8 N.m (7 lb in)
Video Processing Module Nut	8 N.m (71 lb in)

SCHEMATIC WIRING DIAGRAMS

OBJECT DETECTION WIRING SCHEMATICS

Rearview Camera (UVC)



X50A
Fuse Block - Underhood
KR73A Ignition Main Relay 1
F52UA 5A
X3
11
A11
Radio
+
-
X1
15
14
W7
Blunt Cut - Shield
6972 GY/YE
6973 WH/BU
7069 BARE
X205
26
27
25
9
739 VT/BK
6972 GY/YE
6973 WH/BU
7069 GY
X900
6
9
10
11
739 VT/BK
X901
6
9
10
11
X902
2
4
5
9
X1
4
5
1
2
3
2050 BK
2050 BK
739 VT/BK
6972 GY/YE
6973 WH/BU
7069 BARE
IGN
B87
Rearview Camera
G202

Fig. 1: Rearview Camera (UVC)

Courtesy of GENERAL MOTORS COMPANY

Rear Cross Traffic Alert (UFG) and Side Object Detection (UKC)

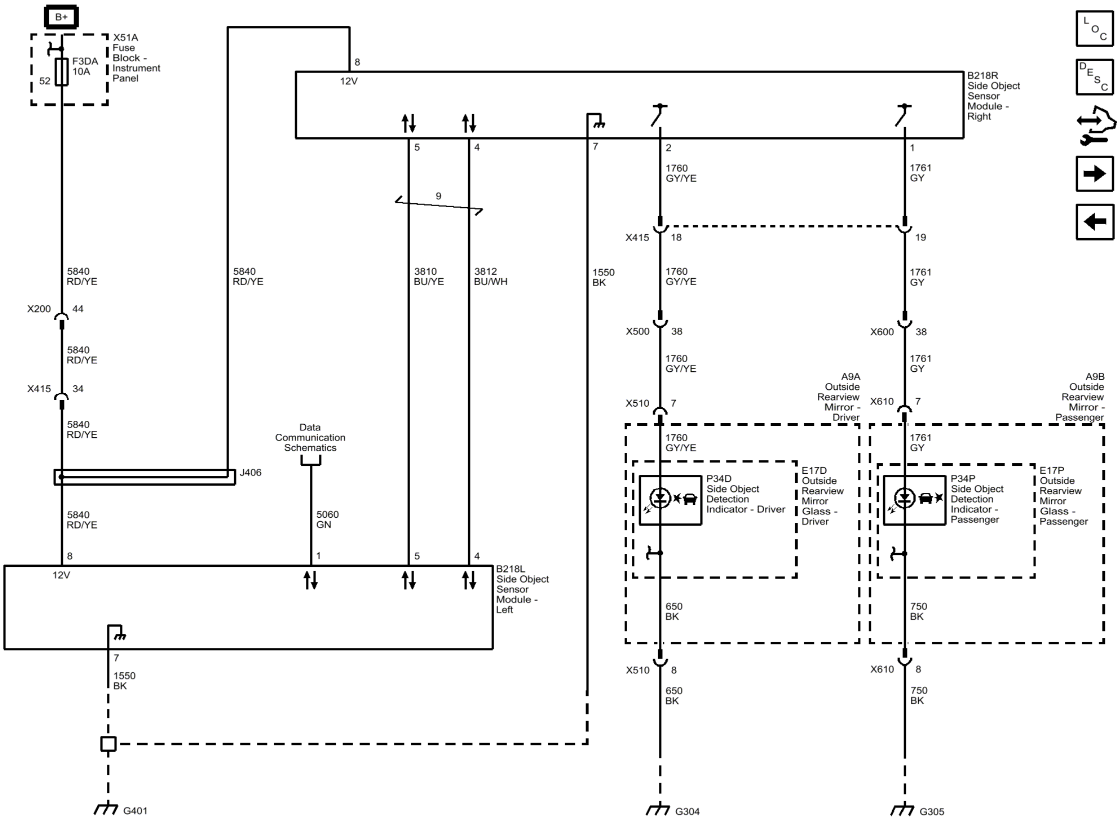

B+
X51A Fuse Block - Instrument Panel
F3DA 10A
52
8
12V
B218R Side Object Sensor Module - Right
5
4
7
2
1
9
1760 GY/YE
1761 GY
X415 18
19
5840 RD/YE
3810 BU/YE
3812 BU/WH
1550 BK
X200 44
X500 38
X600 38
X415 34
A9A Outside Rearview Mirror - Driver
A9B Outside Rearview Mirror - Passenger
X510 7
X610 7
Data Communication Schematics
J406
P34D Side Object Detection Indicator - Driver
E17D Outside Rearview Mirror Glass - Driver
P34P Side Object Detection Indicator - Passenger
E17P Outside Rearview Mirror Glass - Passenger
5060 GN
B218L Side Object Sensor Module - Left
650 BK
750 BK
X510 8
X610 8
G401
G304
G305
LOC
DESC

Fig. 2: Rear Cross Traffic Alert (UFG) and Side Object Detection (UKC)
Courtesy of GENERAL MOTORS COMPANY

Lane Keep Assist (UHX) and Forward Collision Alert (UEU) with (EF7/Z49/CW1)

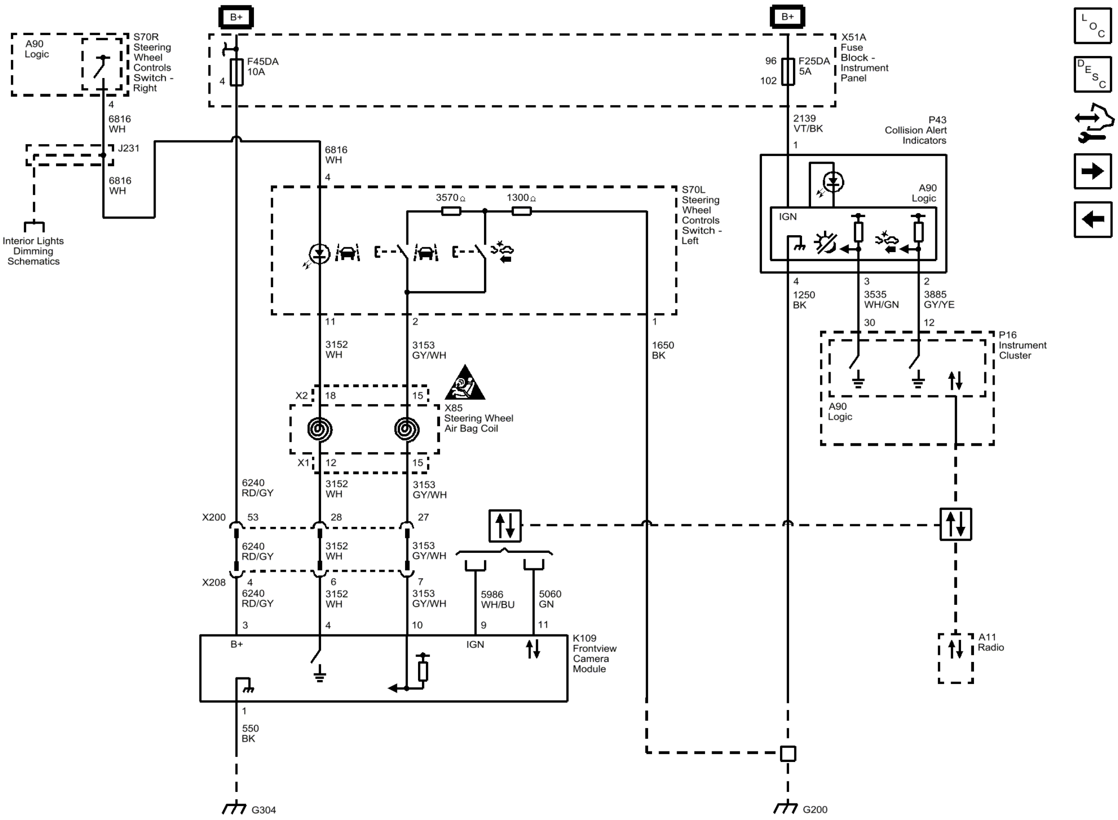

A90 Logic
S70R Steering Wheel Controls Switch - Right
B+
F45DA 10A
4
X51A Fuse Block - Instrument Panel
96
102
F25DA 5A
6816 WH
J231
Interior Lights Dimming Schematics
2139 VT/BK
P43 Collision Alert Indicators
A90 Logic
IGN
3570Ω
1300Ω
S70L Steering Wheel Controls Switch - Left
11
2
1
1250 BK
3535 WH/GN
3885 GY/YE
30
12
P16 Instrument Cluster
A90 Logic
3152 WH
3153 GY/WH
1650 BK
X2 18
15
X85 Steering Wheel Air Bag Coil
X1 12
15
6240 RD/GY
X200 53
28
27
X208 4
6
7
5986 WH/BU
5060 GN
3
4
10
9
11
B+
IGN
K109 Frontview Camera Module
A11 Radio
550 BK
G304
G200
LOC
DESC

Fig. 3: Lane Keep Assist (UHX) and Forward Collision Alert (UEU) with (EF7/Z49/CW1)
Courtesy of GENERAL MOTORS COMPANY

Lane Keep Assist (UHX) and Forward Collision Alert (UEU) with (MBM)

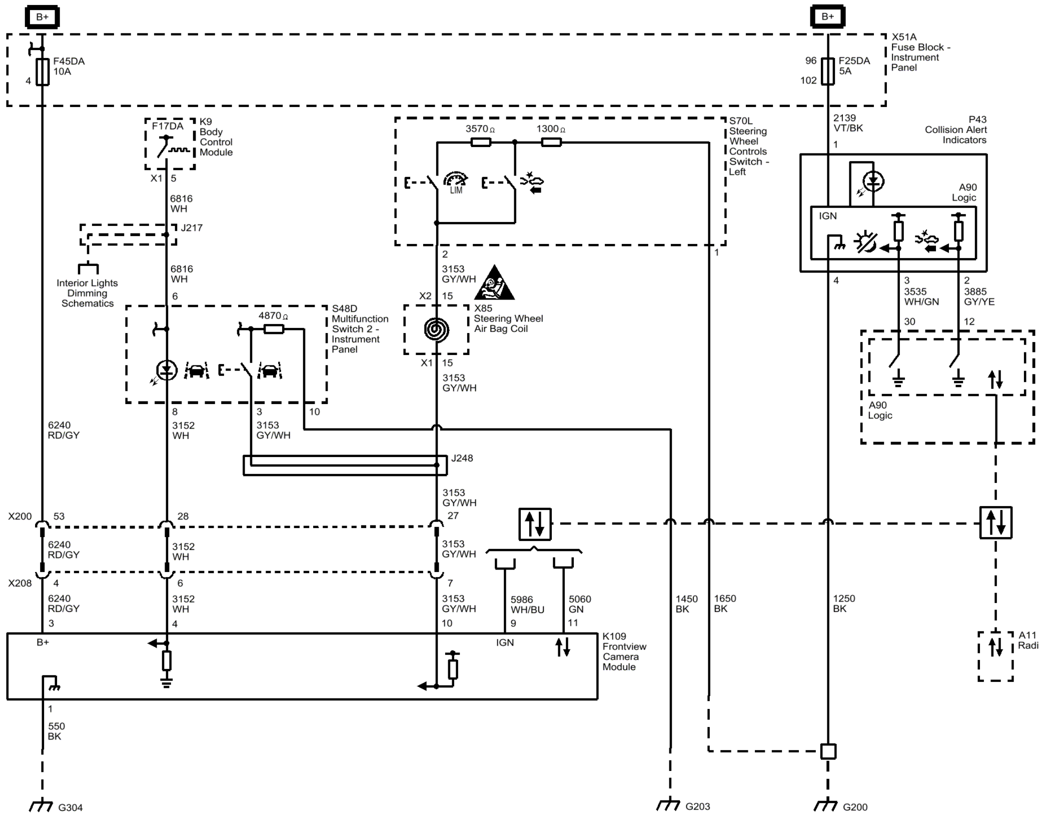

B+
F45DA
10A
4
B+
96
F25DA
5A
102
X51A
Fuse Block - Instrument Panel
F17DA
K9
Body Control Module
X1
5
6816
WH
J217
Interior Lights Dimming Schematics
6816
WH
6
3570Ω
1300Ω
S70L
Steering Wheel Controls Switch - Left
LIM
2139
VT/BK
1
P43
Collision Alert Indicators
A90
Logic
IGN
2
3153
GY/WH
X2
15
X85
Steering Wheel Air Bag Coil
X1
15
3153
GY/WH
4870Ω
S48D
Multifunction Switch 2 - Instrument Panel
8
3152
WH
3
3153
GY/WH
10
1
4
3
3535
WH/GN
2
3885
GY/YE
30
12
P16
Instrument Cluster
A90
Logic
6240
RD/GY
J248
3153
GY/WH
X200
53
28
27
6240
RD/GY
3152
WH
3153
GY/WH
X208
4
6
7
6240
RD/GY
3152
WH
3153
GY/WH
5986
WH/BU
5060
GN
1450
BK
1650
BK
1250
BK
3
4
10
9
11
A11
Radio
B+
IGN
K109
Frontview Camera Module
1
550
BK
G304
G203
G200

Fig. 4: Lane Keep Assist (UHX) and Forward Collision Alert (UEU) with (MBM)

Courtesy of GENERAL MOTORS COMPANY

Park Assist - Power, Ground, Serial Data and Control (UD5, UD7 or UFQ)

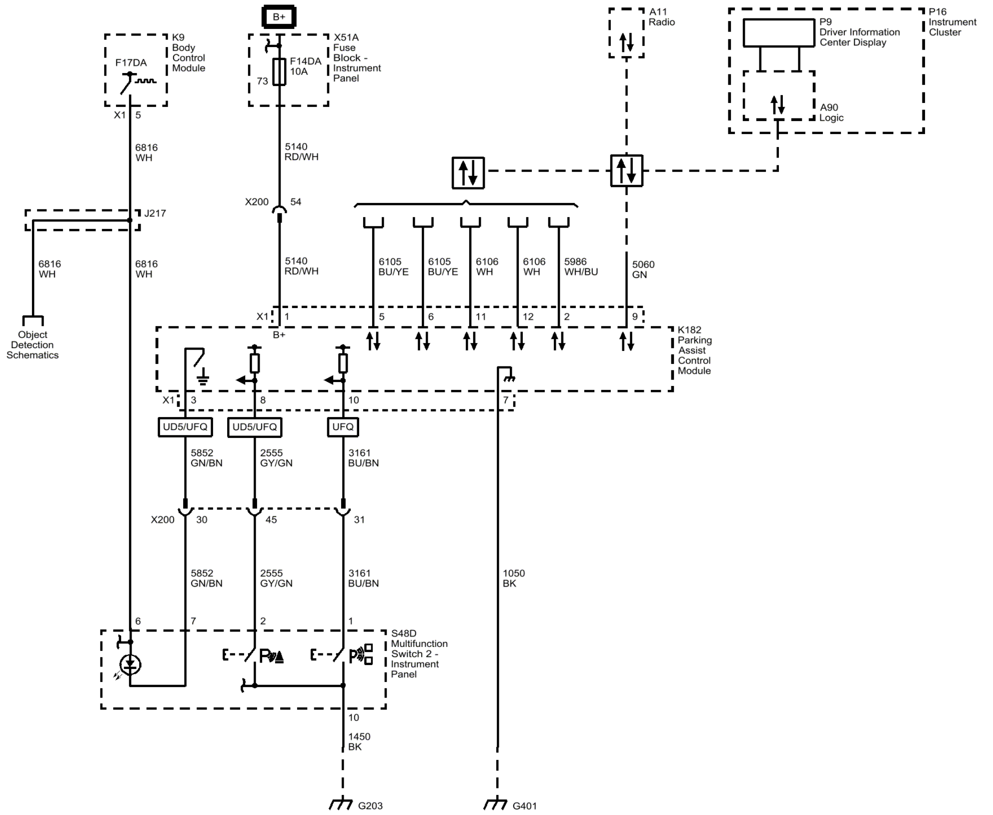

K9
Body Control Module
F17DA
X1
5
B+
X51A
Fuse Block - Instrument Panel
F14DA
10A
73
A11
Radio
P9
Driver Information Center Display
P16
Instrument Cluster
A90
Logic
6816
WH
5140
RD/WH
J217
X200
54
6816
WH
6816
WH
Object Detection Schematics
5140
RD/WH
6105
BU/YE
6105
BU/YE
6106
WH
6106
WH
5986
WH/BU
5060
GN
X1
1
B+
5
6
11
12
2
9
K182
Parking Assist Control Module
X1
3
8
10
7
UD5/UFQ
UD5/UFQ
UFQ
5852
GN/BN
2555
GY/GN
3161
BU/BN
X200
30
45
31
5852
GN/BN
2555
GY/GN
3161
BU/BN
1050
BK
6
7
2
1
S48D
Multifunction Switch 2 - Instrument Panel
10
1450
BK
G203
G401

Fig. 5: Park Assist - Power, Ground, Serial Data and Control (UD5, UD7 or UFQ)

Courtesy of GENERAL MOTORS COMPANY

Park Assist - Rear Sensors (UD5, UD7 and UFQ)

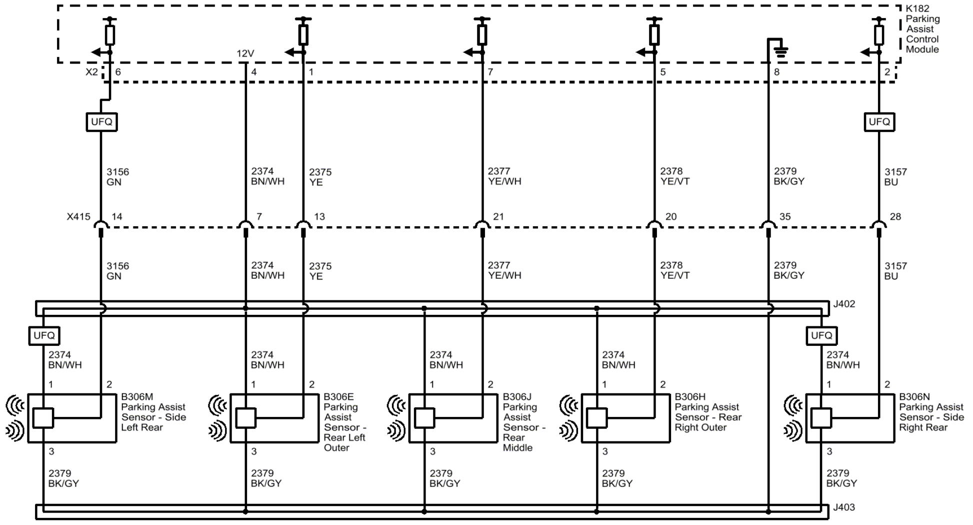

K182 Parking Assist Control Module
12V
X2
6
4
1
7
5
8
2
UFQ
UFQ
3156 GN
2374 BN/WH
2375 YE
2377 YE/WH
2378 YE/VT
2379 BK/GY
3157 BU
X415
14
7
13
21
20
35
28
3156 GN
2374 BN/WH
2375 YE
2377 YE/WH
2378 YE/VT
2379 BK/GY
3157 BU
J402
UFQ
2374 BN/WH
1
2
B306M Parking Assist Sensor - Side Left Rear
3
2379 BK/GY
2374 BN/WH
1
2
B306E Parking Assist Sensor - Rear Left Outer
3
2379 BK/GY
2374 BN/WH
1
2
B306J Parking Assist Sensor - Rear Middle
3
2379 BK/GY
2374 BN/WH
1
2
B306H Parking Assist Sensor - Rear Right Outer
3
2379 BK/GY
UFQ
2374 BN/WH
1
2
B306N Parking Assist Sensor - Side Right Rear
3
2379 BK/GY
J403

Fig. 6: Park Assist - Rear Sensors (UD5, UD7 and UFQ)
Courtesy of GENERAL MOTORS COMPANY

Park Assist - Front Sensors (UD5 and UFQ)

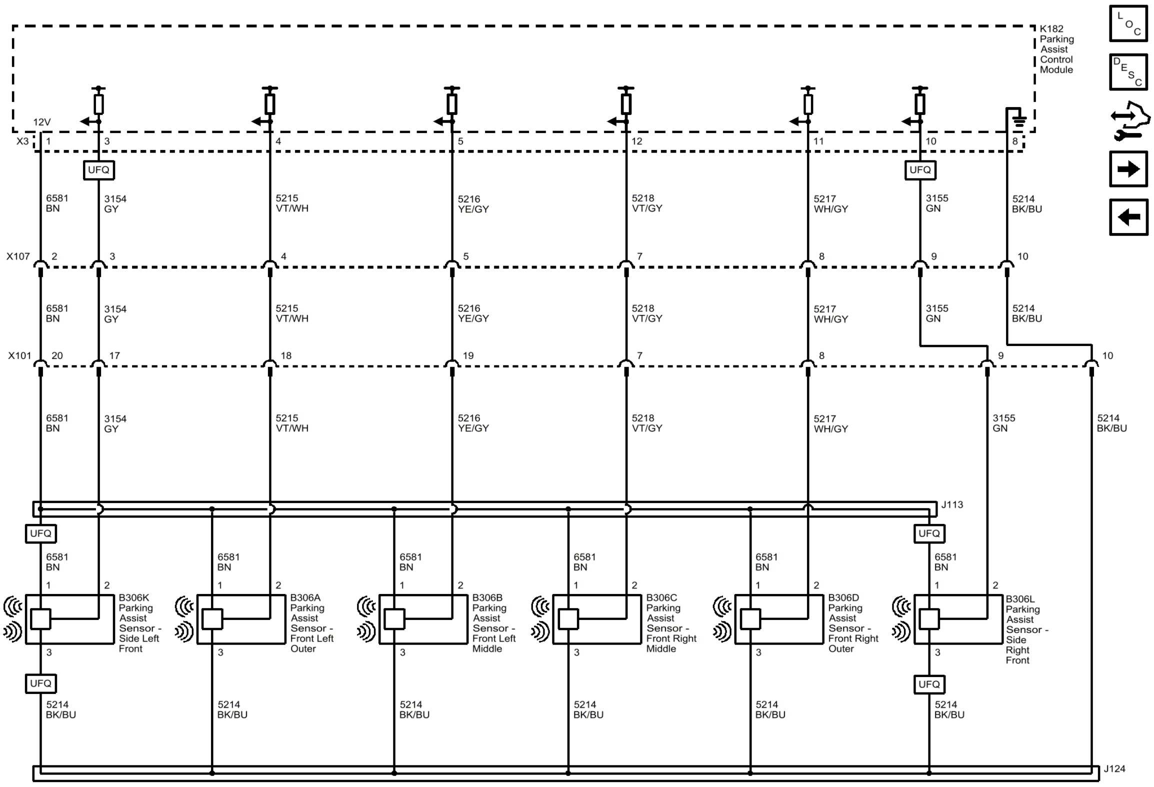

K182 Parking Assist Control Module
12V
X3
1
3
4
5
12
11
10
8
UFQ
UFQ
6581 BN
3154 GY
5215 VT/WH
5216 YE/GY
5218 VT/GY
5217 WH/GY
3155 GN
5214 BK/BU
X107
2
3
4
5
7
8
9
10
6581 BN
3154 GY
5215 VT/WH
5216 YE/GY
5218 VT/GY
5217 WH/GY
3155 GN
5214 BK/BU
X101
20
17
18
19
7
8
9
10
6581 BN
3154 GY
5215 VT/WH
5216 YE/GY
5218 VT/GY
5217 WH/GY
3155 GN
5214 BK/BU
J113
UFQ
6581 BN
1
2
B306K Parking Assist Sensor - Side Left Front
3
UFQ
5214 BK/BU
6581 BN
1
2
B306A Parking Assist Sensor - Front Left Outer
3
5214 BK/BU
6581 BN
1
2
B306B Parking Assist Sensor - Front Left Middle
3
5214 BK/BU
6581 BN
1
2
B306C Parking Assist Sensor - Front Right Middle
3
5214 BK/BU
6581 BN
1
2
B306D Parking Assist Sensor - Front Right Outer
3
5214 BK/BU
UFQ
6581 BN
1
2
B306L Parking Assist Sensor - Side Right Front
3
UFQ
5214 BK/BU
J124

Fig. 7: Park Assist - Front Sensors (UD5 and UFQ)
Courtesy of GENERAL MOTORS COMPANY

360 Degree Vision - Power, Ground, Serial Data, and Camera Signals (UVH)

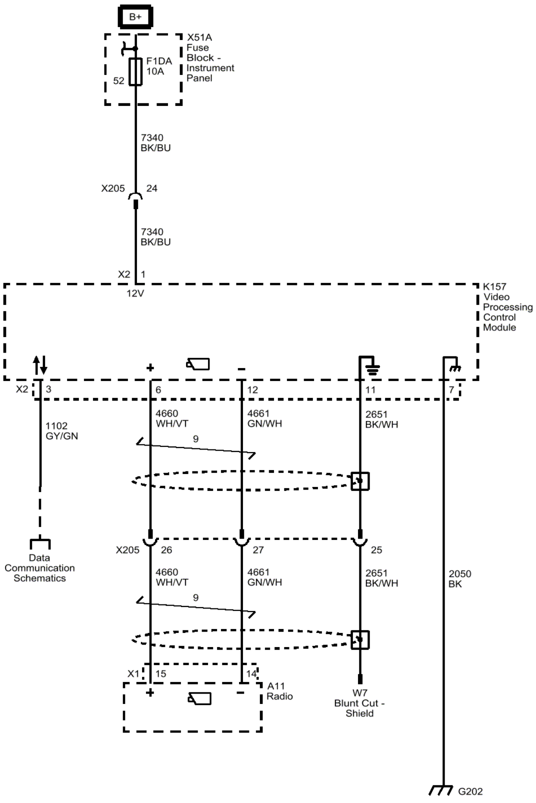

B+
X51A Fuse Block - Instrument Panel
F1DA 10A
52
7340 BK/BU
X205 24
7340 BK/BU
X2 1
12V
K157 Video Processing Control Module
X2 3
6
12
11
7
1102 GY/GN
4660 WH/VT
4661 GN/WH
2651 BK/WH
9
Data Communication Schematics
X205 26
27
25
4660 WH/VT
4661 GN/WH
2651 BK/WH
2050 BK
9
X1 15
14
A11 Radio
W7 Blunt Cut - Shield
G202

Fig. 8: 360 Degree Vision - Power, Ground, Serial Data, and Camera Signals (UVH)

Courtesy of GENERAL MOTORS COMPANY

360 Degree Vision - Front and Rear Cameras (UVH)

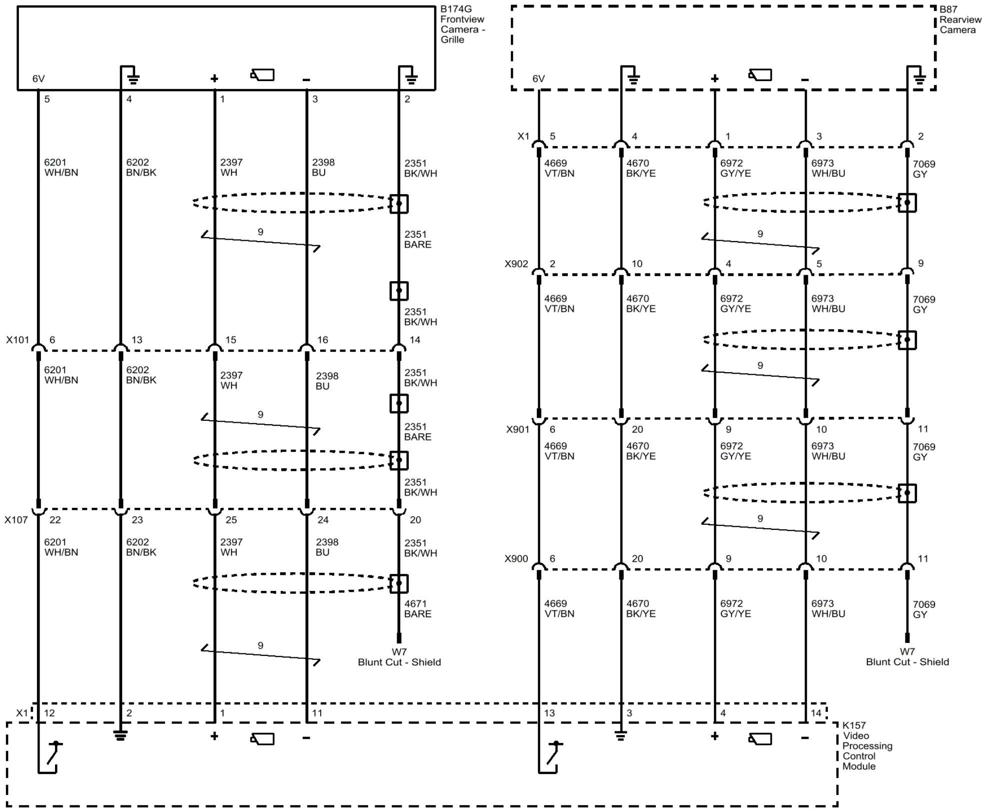

B174G Frontview Camera - Grille
6V
5
4
1
3
2
6201 WH/BN
6202 BN/BK
2397 WH
2398 BU
2351 BK/WH
9
2351 BARE
2351 BK/WH
X101 6
13
15
16
14
6201 WH/BN
6202 BN/BK
2397 WH
2398 BU
2351 BK/WH
9
2351 BARE
2351 BK/WH
X107 22
23
25
24
20
6201 WH/BN
6202 BN/BK
2397 WH
2398 BU
2351 BK/WH
4671 BARE
9
W7 Blunt Cut - Shield
B87 Rearview Camera
6V
X1 5
4
1
3
2
4669 VT/BN
4670 BK/YE
6972 GY/YE
6973 WH/BU
7069 GY
9
X902 2
10
4
5
9
4669 VT/BN
4670 BK/YE
6972 GY/YE
6973 WH/BU
7069 GY
9
X901 6
20
9
10
11
4669 VT/BN
4670 BK/YE
6972 GY/YE
6973 WH/BU
7069 GY
9
X900 6
20
9
10
11
4669 VT/BN
4670 BK/YE
6972 GY/YE
6973 WH/BU
7069 GY
W7 Blunt Cut - Shield
X1 12
2
1
11
13
3
4
14
K157 Video Processing Control Module

Fig. 9: 360 Degree Vision - Front and Rear Cameras (UVH)

Courtesy of GENERAL MOTORS COMPANY

360 Degree Vision - Side Vision Cameras (UVH)

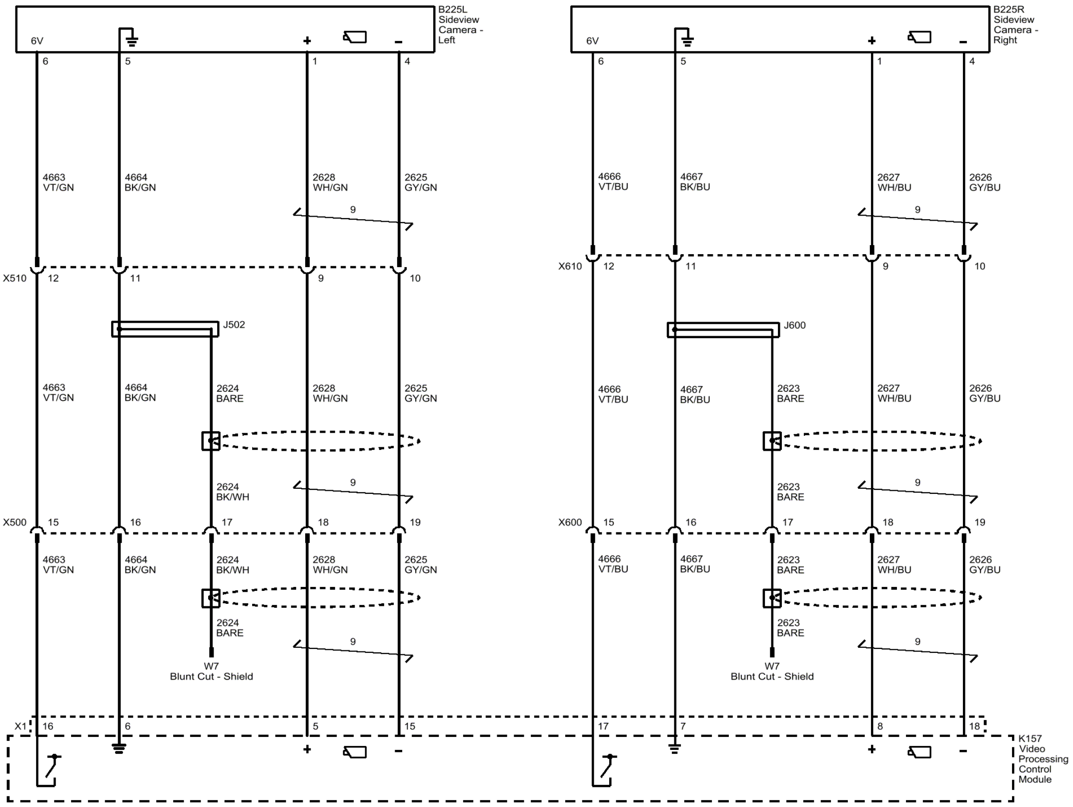

B225L
Sideview
Camera -
Left
6V
+
-
6
5
1
4
4663
VT/GN
4664
BK/GN
2628
WH/GN
2625
GY/GN
9
X510
12
11
9
10
J502
2624
BARE
2624
BK/WH
X500
15
16
17
18
19
W7
Blunt Cut - Shield
X1
16
6
5
15
B225R
Sideview
Camera -
Right
4666
VT/BU
4667
BK/BU
2627
WH/BU
2626
GY/BU
X610
J600
2623
BARE
X600
17
7
8
18
K157
Video
Processing
Control
Module

Fig. 10: 360 Degree Vision - Side Vision Cameras (UVH)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B094C: RIGHT SIDE OBJECT DETECTION CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B094C

Right Side Object Detection Control Module

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Indicator Control - Left	B094C 39	1	2	-
Indicator Control - Right	B094C 39	3	4	-
Ground - Left	-	1	-	-
Ground - Right	-	3	-	-

1. Left side blind spot indicator inoperative
2. Left side blind spot indicator always on
3. Right side blind spot indicator inoperative
4. Right side blind spot indicator always on

Circuit/System Description

The side object sensor module - left communicates on a private communication data bus with the side object sensor module - right. The side object sensor module - left is the master and is responsible for communicating with other control modules on the vehicle, as well as setting DTCs for both side object sensor modules.

The side object sensor module - right is responsible for illuminating the left and right side blind spot indicators. The indicators are located on each outside rearview mirror glass. The indicators each receive ground at all times and are controlled by side object sensor module - right though a discrete control circuit. When a vehicle is located in the vehicle's blind spot or is in an adjacent lane, approaching the side of the vehicle, the side object sensor module - right will illuminate the indicator by applying voltage to the appropriate control circuit. If the driver turns on a turn signal, indicating an intention to change lanes, the side object sensor module - right will flash the indicator as an additional warning.

Conditions for Running the DTC

Vehicle in Service Mode.

Conditions for Setting the DTC

The side object sensor module - right has detected an internal malfunction or a malfunction with one of the indicator control circuits.

Action Taken When the DTC Sets

- The side object sensor system is disabled.
- A service message may be displayed on the driver information center.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 40, without a repeat of the malfunction.

Diagnostic Aids

- The side object sensor module - left and side object sensor module - right are different parts and cannot be swapped from side to side.
- This DTC may be stored as a history DTC without affecting the operation of the side object sensor module - right. Do not replace side object sensor module - right based only on DTC B094C being set in history.
- The side object sensor module - right communicates on a private communication data bus with the side object sensor module - left. If programming is needed for module replacement, you must program the side object sensor module - left, which will then program the side object sensor module - right.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Side Blind Zone Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that both side blind spot indicators turn ON and OFF when commanding the Object Detection Alert Indicators On and Off with a scan tool.
   - **If both indicators do not turn ON and OFF**

     Replace the B218R Side Object Sensor Module - Right.

   - **If one indicator does not turn ON and OFF**

     Refer to Circuit/System Testing.

   - **If both indicators turn ON and OFF**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the appropriate X510 (Left) or X610 (Right) inline harness connector. It may take up to 2 mins for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 8 and ground.
   - **If 2 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the ground circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 2 Ω**
3. Vehicle in Service Mode.
4. Test for less than 1 V between the control circuit terminal 7 and ground.
   - **If 1 V or greater**
   1. Vehicle OFF, disconnect the harness connector at the B218R Side Object Sensor Module - Right.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 2 Ω, replace the B218R Side Object Sensor Module - Right.
   - **If less than 1 V**
5. Command the Object Detection Alert Indicators On with a scan tool.
6. Test for greater than 3 V between the control circuit terminal 7 and ground.
   - **If 3 V or less**
   1. Vehicle OFF, disconnect the harness connector at the B218R Side Object Sensor Module - Right.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance
   3. Vehicle OFF.
   4. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the B218R Side Object Sensor Module - Right.

- **If greater than 3 V**

7. Replace the appropriate E17 Outside Rearview Mirror Glass.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Outside Rearview Mirror Glass Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B094D OR B094E: LEFT/RIGHT SIDE OBJECT DETECTION INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B094D

Left Side Object Detection Indicator Circuit

DTC B094E

Right Side Object Detection Indicator Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Left Indicator	B094D 02	B094D 04	B094D 01	-
Ground - Left Indicator	-	B094D 04	-	-
Control - Right Indicator	B094E 02	B094E 04	B094E 01	-
Ground - Right Indicator	-	B094E 04	-	-

Circuit/System Description

The side blind zone alert system sensors are located on the side of the rear fascia and detect and report objects on either side of the vehicle, within a specified blind spot area. The system alerts the presence of objects in the blind spot with a visual indicator on each outside rearview mirror. When the system detects a vehicle in the side blind zone while driving forward, an amber warning symbol will light up in the appropriate outside mirror. This indicates that it may be unsafe to change lanes. If the driver then activates the turn signal, the amber warning symbol will begin flashing and an audible alert will sound to give an extra warning not to change lanes.

Each indicator receives a constant ground and is controlled by the Side Object Sensor Module - Left and/or Right by applying voltage to the control circuit. When voltage is applied on the control circuit, the indicator will illuminate.

Conditions for Running the DTC

- Engine running.
- The side blind zone alert system is active.

Conditions for Setting the DTC

B094D 01

The Side Object Sensor Module has detected a short to voltage on the left indicator control circuit.

B094D 02

The Side Object Sensor Module has detected a short to ground on the left indicator control circuit.

B094D 04

The Side Object Sensor Module has detected an open in the left indicator control circuit.

B094E 01

The Side Object Sensor Module has detected a short to voltage on the right indicator control circuit.

B094E 02

The Side Object Sensor Module has detected a short to ground on the right indicator control circuit.

B094D 04

The Side Object Sensor Module has detected an open in the right indicator control circuit.

Action Taken When the DTC Sets

- The side blind zone alert system is disabled.
- A service message may be displayed on the driver information center.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Side Blind Zone Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the side blind zone alert indicators located in each outside rearview mirror briefly turn ON and OFF during the system self test immediately after the vehicle is turned ON.
    - **If either indicator does not briefly turn ON and OFF**

      Refer to Circuit/System Testing

    - **If both indicators briefly turn ON and OFF**

3. All OK.

Circuit/System Testing

NOTE: Make sure to use a high impedance test lamp like special tool EL-35616-210.

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate E17 Outside Rearview Mirror Glass. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON, connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2.
4. Verify the test lamp turns ON and OFF when commanding the appropriate Object Detection Indicator On and Off with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the harness connector at the appropriate B218 Side Object Sensor Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the B218 Side Object Sensor Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the harness connector at the B218 Side Object Sensor Module, vehicle ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the B218 Side Object Sensor Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the E17 Outside Rearview Mirror Glass.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Outside Rearview Mirror Glass Replacement
- Refer to Control Module References for parking assist control module replacement, programming and setup

DTC B0954, B0955, B0956, OR B0957: PARKING ASSIST FRONT SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B0954

Parking Assist Front Sensor Left Corner Circuit

DTC B0955

Parking Assist Front Sensor Left Middle Circuit

DTC B0956

Parking Assist Front Sensor Right Middle Circuit

DTC B0957

Parking Assist Front Sensor Right Corner Circuit

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	B1405 02	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 03	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 07	-
Left Front Object Sensor Signal	B0954 06	B0954 06	B0954 01	B0954 08, B0954 21
Left Middle Front Object Sensor Signal	B0955 06	B0955 06	B0955 01	B0955 08, B0955 21
Right Middle Front Object Sensor Signal	B0956 06	B0956 06	B0956 01	B0956 08, B0956 21
Right Front Object Sensor Signal	B0957 06	B0957 06	B0957 01	B0957 08, B0957 21
Low Reference	-	B0954 01, B0955 01, B0956 01, B0957 01, B0958 01, B0959 01, B0960 01, B0961 01	-	-

Circuit/System Description

The object sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The parking assist control module supplies 9 V to the object sensors via the 9 V reference circuit and provides ground via the low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received through the signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Vehicle ON
- The park assist is activated. The activation takes place through putting in the reverse gear or through operating the park assist switch.

Conditions for Setting the DTC

B0954 01, B0955 01, B0956 01, or B0957 01

The parking assist control module has detected the voltage at the sensor circuit is greater than 11.5 V or the object sensor is not grounded.

B0954 06, B0955 06, B0956 06, or B0957 06

The parking assist control module has detected the voltage at the sensor circuit is less than 0.5 V.

B0954 08, B0955 08, B0956 08, or B0957 08

The parking assist control module has received an invalid signal.

B0954 21, B0955 21, B0956 21, or B0957 21

The object sensor determines no change in the position of an object while the vehicle is in motion.

B0954 3A, B0955 3A, B0956 3A, or B0957 3A

The parking assist control module determines the wrong sensor type is installed.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC B1405 is not set.
    - **If the DTC is set**

Refer to DTC B1405

- **If the DTC is not set**

3. Verify that DTC B0954 01, B0955 01, B0956 01, B0957 01 B0954 21, B0955 21, B0956 21 or B0957 21 is not set.
   - **If the DTC is set**
   1. Verify the B78 Front Object Sensors are not contaminated with snow, mud, dirt, slush, or ice.
      - If contaminated, clean sensor.
      - If there is no contamination
   2. Refer to Circuit/System Testing.
   - **If the DTC is not set**
4. Verify that DTC B0954 3A, B0955 3A, B0956 3A or B0957 3A is not set.
   - **If the DTC is set**

     Replace the B78 Front Object Sensor with the correct sensor type.

   - **If the DTC is not set**
5. Vehicle ON, transmission in REVERSE.
6. Verify the scan tool Parking Assist System Status parameter displays Enabled.
   - **If the Parking Assist System displays Disabled**

     Refer to Circuit/System Testing.

   - **If the Parking Assist System displays Enabled**
7. All OK.

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, disconnect the harness at the appropriate B78 Front Object Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the harness connector X3 at the K182 Parking Assist Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω replace the K182 Parking Assist Control Module.
   - **If less than 10 Ω**
3. Vehicle ON.
4. Test for 7.5 - 10.5 V between the 9 V reference circuit terminal 1 and ground.
   - **If less than 7.5 V**
   1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
   2. Test for infinite resistance between the 9 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 9 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K182 Parking Assist Control Module.
   - **If greater than 10.5 V**
   1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
   2. Test for less than 1 V between the 9 V reference circuit and ground.

        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K182 Parking Assist Control Module.
    - **If between 7.5 - 10.5 V**
5. Test for 7.5 - 9.5 V between the signal circuit terminal 2 and ground.
    - **If less than 7.5 V**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If greater than 9.5 V**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K182 Parking Assist Control Module.
    - **If between 7.5 - 9.5 V**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Advanced Parking Assist Alarm Sensor Replacement (Front)Advanced Parking Assist Alarm Sensor Replacement (Rear)**
- Refer to **Control Module References** for parking assist control module replacement, programming and setup

DTC B095D OR B095E: PARKING ASSIST REAR SENSOR LEFT/RIGHT SIDE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B095D

Parking Assist Rear Sensor Left Side Circuit

DTC B095E

Parking Assist Rear Sensor Right Side Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	B1405 02, B1405 03	B095D 06, B095E 06	B1405 07	-
Left Rear Supplemental Object Sensor Signal	B095D 02, B095D 06	B095D 06	B095D 01	B095D 08, B095D 21

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Right Rear Supplemental Object Sensor Signal	B095E 02, B095E 06	B095E 06	B095E 01	B095E 08, B095E 21
Low Reference	-	B095D 01, B095D 06, B095E 01, B095E 06	-	-

Circuit/System Description

The parking assist sensors are 3-wire ultrasonic sensors that are used to determine the distance between the vehicle and an object on the side of the vehicle, in the vehicle's blind spot. The parking assist control module supplies 12 V to the parking assist sensors via the 12 V reference circuit and provides ground via the low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received through the signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Vehicle ON.
- The side blind spot system (if equipped) or parking assist system is activated.

Conditions for Setting the DTC

B095D 01, B095E 01

The parking assist control module has determined the sensor signal voltage is too high.

B095D 06, B095E 06

The parking assist control module has determined the sensor signal voltage is too low.

B095D 08, B095E 08

The parking assist control module has received an invalid signal.

B095D 21, B095E 21

The parking assist control module has determined no change in the position of an object while the vehicle is in motion.

B095D 3A, B095E 3A

The parking assist control module has determined the wrong sensor type is installed.

Action Taken When the DTC Sets

- The side blind spot system (if equipped) is disabled.
- The parking assist system is disabled.
- The driver information center may display a service message.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

For symptom byte 21, the parking assist control module only runs the diagnostic when the vehicle is driven greater than 40 km/h (25 MPH). When diagnosing symptom byte 21, the vehicle must be driven greater than 40 km/h (25 MPH) after a repair to verify the concern has been corrected.

The following is a list of reasons this symptom byte 21 might have set:

- One or more of the sensors may be blocked by snow, mud, ice, or debris. This condition may occur after going through a car wash in cold weather.
- One or more of the sensors may be scratched or the paint maybe chipped.
- Excessive paint thickness on a sensor may cause an excessive sensor ring time. When replacing or refinishing a sensor, do not apply an excessive amount of paint or clear coat.
- The silicone insulator (ring) surrounding sensor maybe missing, cut, or twisted.
- The sensor may be improperly installed and not fully seated, or the sensor may be misaligned due to a tight wiring harness.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC B1405 is not set.
    - **If the DTC is set**

      Refer to **DTC B1405**

    - **If the DTC is not set**
3. Verify DTC B095D 01, B095E 01, B095D 21, or B095E 21 is not set.
    - **If any of the DTCs are set**
    1. Verify none of the B306 Parking Assist Sensors - Rear are contaminated with snow, mud, dirt, slush, or ice.
        - If contaminated, clean the B306 Parking Assist Sensors - Rear.
        - If there is no contamination.
    2. Refer to Circuit/System Testing.
    - **If none of the DTCs are set**
4. Verify that DTC B095D 3A or B095E 3A is not set.
    - **If any of the DTCs are set**

      Replace the appropriate B306 Parking Assist Sensor - Rear with the correct sensor type.

    - **If none of the DTCs are set**
5. Vehicle ON.

6. Verify the scan tool Parking Assist System Status parameter is Enabled.
    - **If the Parking Assist System Status parameter is Disabled**

      Refer to Circuit/System Testing.

    - **If the Parking Assist System Status parameter is Enabled**
7. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness at the appropriate B306 Parking Assist Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 15 Ω between the low reference circuit terminal 3 and ground.
    - **If 15 Ω or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω replace the K182 Parking Assist Control Module.
    - **If less than 15 Ω**
3. Vehicle ON.
4. Test for greater than 9.7 V between the 12 V reference circuit terminal 1 and ground.
    - **If less than 9.7 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the 12 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 9 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If greater than 9.7 V**
5. Test for 4 - 12.0 V between the signal circuit terminal 2 and ground.
    - **If less than 4 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If greater than 12 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K182 Parking Assist Control Module, vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K182 Parking Assist Control Module.
    - **If between 4 - 12.0 V**
6. Test or replace the B306 Parking Assist Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rear Parking Assist Alarm Sensor Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B0958, B0959, B0960, OR B0961: PARKING ASSIST REAR SENSOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B0958

Parking Assist Rear Sensor Left Corner Circuit

DTC B0960

Parking Assist Rear Sensor Middle Circuit

DTC B0961

Parking Assist Rear Sensor Right Corner Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
12 V Reference	B1405 02	B0958 06, B0959 06, B0960 06, B0961 06	-	-
Parking Assist Rear Sensor Left Corner Signal	B0958 02, B0958 06	B0958 06	B0958 01	B0958 08, B0958 22
Parking Assist Rear Sensor Middle Signal	B0960 06	B0960 06	B0960 01	B0960 08, B0960 22
Parking Assist Rear Sensor Right Corner Signal	B0961 06	B0961 06	B0961 01	B0961 08, B0961 22
Low Reference	-	B0958 01, B0959 01, B0960 01, B0961 01	-	-

Circuit/System Description

The parking assist sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The parking assist control module supplies 12 V to the object sensors via the 12 V reference circuit and provides ground via the low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received through the signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Vehicle ON
- The parking assist is activated. The activation takes place through putting in the reverse gear or through operating the park assist switch.

Conditions for Setting the DTC

B0958 01, B0960 01, or B0961 01

The parking assist control module has detected the voltage at the sensor circuit is shorted to voltage or the object sensor is not grounded.

B0958 02, B0960 02, or B0961 02

The parking assist control module has detected the voltage at the sensor is shorted to ground.

B0958 04, B0960 04, or B0961 04

The parking assist control module has detected the voltage at the sensor is too high.

B0958 08, B0960 08, or B0961 08

The parking assist control module has received an invalid signal.

B0958 18, B0960 18, or B0961 18

The parking assist control module has detected the voltage at the sensor has a low signal amplitude.

B0958 22, B0960 22, or B0961 22

The parking assist control module determines the sensor has too short of a low time.

B0958 3A, B0960 3A, or B0961 3A

The parking assist control module determines the wrong sensor type is installed.

B0958 3B, B0960 3A, or B0961 3B

The parking assist control module determines the sensor failed a self test.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC B1405 is not set.
   - **If the DTC is set**

     Refer to DTC B1405

   - **If the DTC is not set**
3. Verify that DTC B0958 01, B0960 01 or B0961 01 is not set.
   - **If the DTC is set**

     Check the appropriate B306 Parking Assist Sensor for contamination with mud. If no contamination is diagnosed, refer to Circuit/System Testing.

   - **If the DTC is not set**
4. Verify that DTC B0958 22, B0960 22 or B0961 22 is not set.
   - **If the DTC is set**

     Check the appropriate B306 Parking Assist Sensor for contamination with mud, ice or snow. If no contamination is diagnosed, replace the sensor.

   - **If the DTC is not set**
5. Verify that DTC B0958 3A, B0958 3B, B0960 3A B0960 3B B0961 3A or B0961 3B is not set.
   - **If the DTC is set**

     Replace the appropriate B306 Parking Assist Sensor with a sensor of the correct sensor type.

   - **If the DTC is not set**
6. Vehicle ON, transmission in REVERSE, verify the scan tool Parking Assist System Status parameter displays Enabled.
   - **If the Parking Assist System displays Disabled**

     Refer to Circuit/System Testing.

   - **If the Parking Assist System displays Enabled**
7. All OK.

Circuit/System Testing

1. Vehicle OFF for 1 min, scan tool must be disconnected for steps 1 and 2 to allow module to power down. Disconnect the harness connector at the affected rear object sensor.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the harness connector X2 at the K182 Parking Assist Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω replace the K182 Parking Assist Control Module.
   - **If less than 10 Ω**
3. Vehicle ON.

4. Test for at least 9.7 V between the 12 V reference circuit terminal 1 and ground.
    - **If less than 9.7 V**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the 12 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 12 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If 9.7 V or greater**
5. Test for 4 - 12 V between the signal circuit terminal 3 and ground.
    - **If less than 4 V**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If greater than 12 V**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K182 Parking Assist Control Module.
    - **If between 4 - 12 V**
6. Vehicle OFF, connect all of the B306 Parking Assist Sensors.
7. Vehicle ON.
8. Verify that DTC B0958, B0960, or B0961 is not set.
    - **If the DTC is set**

      Replace the appropriate B306 Parking Assist Sensor

    - **If the DTC is not set**
9. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair

- Refer to Rear Parking Assist Alarm Sensor Replacement
- Refer to Control Module References for control module replacement, programming and setup.

DTC B0967 OR B0968: PARKING ASSIST ON/OFF SWITCH CIRCUIT/PARKING ASSIST ON/OFF SWITCH INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0967

Parking Assist On/Off Switch Circuit

DTC B0968

Parking Assist On/Off Switch Indicator Circuit

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Parking Assist Switch Signal	B0967 02, 1	1	1	-
Parking Assist Switch Indicator Illumination	B0968 06, 2	B0968 06, 2	2	-
Parking Assist Switch Indicator Control	B0968 06, 2	B0968 06, 2	B0968 01,	-
Parking Assist Switch Ground	-	1	-	-
1. Parking Assist Switch Malfunction 2. Parking Assist Indicator Malfunction				

Circuit/System Description

The parking assist can be activated/deactivated by pressing the parking assist switch. By engaging the reverse gear the parking assist can also be activated. By subsequently pressing the parking assist switch the parking assist can be disabled again.

The indicator in the parking assist switch shows the status of the parking assist. If the lamp is ON, the parking assist is activated.

Conditions for Running the DTC

- Vehicle ON
- The parking assist is activated. The activation takes place by putting in the reverse gear or by pressing the parking assist switch.

Conditions for Setting the DTC

B0967 02

The parking assist control module has detected a short to ground.

B0968 01

The parking assist control module has detected a short to battery.

B0968 06

The parking assist control module has detected a short to ground or open.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC B0967 02 is not set.
    - **If the DTC is set**

      Refer to Parking Assist Switch Malfunction.

    - **If the DTC is not set**
3. Verify that B0968 01 or B0968 06 is not set.
    - **If the DTC is set**

      Refer to Parking Assist Switch Indicator Malfunction.

    - **If the DTC is not set**
4. Activate and deactivate the parking assist switch and verify the scan tool Park Assist Switch parameter changes between Active and Inactive.
    - **If the Parking Assist Switch parameter does not change between Active and Inactive**

      Refer to Circuit/System Testing.

    - **If the Parking Assist Switch parameter changes between Active and Inactive**
5. All OK.

Circuit/System Testing

Parking Assist Indicator Malfunction

1. Vehicle OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for 1.6 - 3.6 V between the control circuit terminal 6 and ground.
    - **If less than 1.6 V**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to **Interior Backlighting Malfunction** .

  - **If greater than 3.6 V**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
       - If 1 V or greater, repair the short to voltage on the circuit.
       - If less than 1 V, refer to **Interior Backlighting Malfunction** .
  - **If between 1.6 - 3.6 V**
3. Connect a test lamp between the control circuit terminal 7 and signal circuit terminal 6.
4. Verify the test lamp turns On and Off when commanding the Parking Assist Switch On and Off with a scan tool.
   - **If the test lamp is always OFF**
     1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
     2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit
        - If less than 1 V
     3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K182 Parking Assist Control Module.
   - **If the test lamp is always ON**
     1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
     2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance, replace the K182 Parking Assist Control Module.
   - **If the test lamp turns ON and OFF**
5. All OK.

Parking Assist Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
   - **If 10 Ω or greater**
     1. Ignition OFF.
     2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Park Assist Switch parameter is Inactive.
   - **If not Inactive**
     1. Ignition OFF, disconnect the harness connector X1 at the K182 Parking Assist Control Module.
     2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K182 Parking Assist Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.
6. Verify the scan tool Park Assist Switch parameter is Active.
   - **If not Active**

1. Ignition OFF, disconnect the harness connector X1 at the K182 Parking Assist Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K182 Parking Assist Control Module.

- **If Active**

7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair

- Refer to **Instrument Panel Center Accessory Function Switch Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup.

DTC B096B: PARKING ASSIST SWITCH PARALLEL PARKING CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B096B

Parking Assist Switch Parallel Parking Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Parallel Park Assist Switch Signal	B096B 02	1	-	-
Parallel Parking Assist Switch Ground	-	1	-	-
1. Parallel Parking Assist Switch Malfunction				

Circuit/System Description

The parallel parking assist can be activated/deactivated by pressing the parallel parking assist switch.

Conditions for Running the DTC

- Vehicle ON
- The parallel parking assist is activated. The activation takes place through pressing the parallel parking assist switch.

Conditions for Setting the DTC

The parking assist control module has detected a short to ground.

Action Taken When the DTC Sets

- The parallel parking assist is disabled.

- An indicator in the driver information center shows the parking assistance is not available.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the ground circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the scan tool Advanced Parking Assist Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K182 Parking Assist Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
6. Verify the scan tool Advanced Parking Assist Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, vehicle ON.

        2. Test for less than 1 V between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 1 and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V.
        3. Test for less than 2 Ω in the signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If Active**

7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Instrument Panel Center Accessory Function Switch Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup.

DTC B096C OR B096D: PARKING ASSIST SIDE SENSOR LEFT/RIGHT FRONT CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B096C

Parking Assist Side Sensor Left Front Circuit

DTC B096D

Parking Assist Side Sensor Right Front Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	B1405 02	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06, B1405 03	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06, B1405 07	-
Left Side Object Sensor Signal	B096C 06	B096C 06	B096C 01	B096C 08, B096C 21
Right Side Object Sensor Signal	B096D 06	B096D 06	B096D 01	B096D 08, B096D 21

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B096C 06, B096D 06	-	-

Circuit/System Description

The object sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The parking assist control module supplies 9 V to the object sensors via the 9 V reference circuit and provides ground via the low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received though the signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Vehicle in Service Mode
- The parallel parking assist is activated. The activation takes place through operating the parallel parking assist switch.

Conditions for Setting the DTC

B096C 01 or B096D 01

The parking assist control module has detected the voltage at the sensor circuit is too high.

B096C 06 or B096D 06

The parking assist control module has detected the voltage at the sensor circuit is too low.

B096C 08 or B096D 08

The parking assist control module has received an invalid signal.

B096C 21 or B096D 21

The object sensor determines no change in the position of an object while the vehicle is in motion.

B096C 3A or B096D 3A

The parking assist control module determines the wrong sensor type is installed.

Action Taken When the DTC Sets

- The parallel parking assist is disabled.
- An indicator in the driver information center shows the parking assistance is not available.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC B1405 is not present.
    - **If the DTC is set**

      Refer to **DTC B1405**

    - **If the DTC does not set**
3. Verify that DTC B096C 01 or B096D 01 is not present.
    - **If the DTC is set**

      Check the appropriate sensor for contamination with mud, ice or snow. If no contamination is diagnosed, refer to Circuit/System Testing.

    - **If the DTC does not set**
4. Verify that DTC B096C 3A or B096D 3A is not present.
    - **If the DTC is set**

      Replace the appropriate sensor with a sensor by correct sensor type.

    - **If the DTC does not set**
5. Verify that DTC B096C 21 or B096D 21 is not present.
    - **If the DTC is set**

      Check the appropriate sensor for contamination with mud, ice or snow. If no contamination is diagnosed, replace the appropriate sensor.

    - **If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Vehicle OFF for 30 s, disconnect the harness connector at the appropriate B94 Side Object Sensor - Front. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.

    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K182 Parking Assist Control Module.
  - **If less than 10 Ω**
3. Vehicle in Service Mode, engine running.
4. Test for 7.5 - 10.5 V between the 9 V reference circuit terminal 1 and ground.
  - **If less than 7.5 V**
  1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
  2. Test for infinite resistance between the 9 V reference circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance
  3. Test for less than 2 Ω in the 9 V reference circuit end to end.
     - If 2 Ω or greater, repair the open/high resistance in the circuit.
     - If less than 2 Ω, replace the K182 Parking Assist Control Module.
  - **If greater than 10.5 V**
  1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle in Service Mode.
  2. Test for less than 1 V between the 9 V reference circuit and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V, replace the K182 Parking Assist Control Module.
  - **If between 7.5 - 10.5 V**
5. Test for 7.5 - 9.5 V between the signal circuit terminal 2 and ground.
  - **If less than 7.5 V**
  1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
  2. Test for infinite resistance between the signal circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance
  3. Test for less than 2 Ω in the signal circuit end to end.
     - If 2 Ω or greater, repair the open/high resistance in the circuit.
     - If less than 2 Ω, replace the K182 Parking Assist Control Module.
  - **If greater than 9.5 V**
  1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle in Service Mode.
  2. Test for less than 1 V between the signal circuit and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V, replace the K182 Parking Assist Control Module
  - **If between 11.5 - 13.5 V**
6. Test or replace the appropriate B94 Side Object Sensor - Front.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Advanced Parking Assist Alarm Sensor Replacement (Front)Advanced Parking Assist Alarm Sensor Replacement (Rear)
- Refer to Control Module References for control module replacement, programming and setup.

DTC B0987: VEHICLE DIRECTION CAMERA INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0987 01

Vehicle Direction Camera Indicator Circuit Short to Battery

DTC B0987 06

Vehicle Direction Camera Indicator Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lane Departure Warning Switch Indicator Ignition	B0987 06	B0987 06	-	-
Lane Departure Warning Switch Indicator Control	B0987 06	B0987 06	B0987 01	-

Circuit/System Description

The lane departure warning is enabled and disabled through a switch located in the left steering wheel controls switch. When enabled, the frontview camera module will illuminate the indicator located in the switch.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The frontview camera module has detected a short to battery or open/high resistance in the control circuit.

Action Taken When the DTC Sets

- Lane departure warning is disabled.
- SERVICE FRONT CAMERA is displayed on the driver information center.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B356A is not set.
   - **If the DTC is set**

     Refer to **DTC B356A**.

   - **If the DTC is not set**
3. Verify the lane departure warning indicator turns ON and OFF while pressing and releasing the lane departure warning switch.
   - **If the indicator does not turn ON and OFF**

     Refer to Circuit/System Testing.

   - **If the indictor turns ON and OFF**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left, ignition ON.

NOTE: **Verify interior lighting dimming is turned all the way up.**

2. Test for 6.2 - 12.0 V between the dimming control circuit terminal 4 and ground.
   - **If less than 6.2 V**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, refer to **Interior Backlighting Malfunction** .
   - **If greater than 12.0 V**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, refer to **Interior Backlighting Malfunction** .
   - **If between 6.2 - 12.0 V**
3. Connect a test lamp between the control circuit terminal 5 and B+.
4. Verify the test lamp turns ON and OFF when commanding the Lane Departure Warning Indicator parameter ON and OFF with a scan tool.
   - **If the test lamp is always OFF**
   1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module, ignition ON.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Ignition OFF.

4. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K109 Frontview Camera Module.
- **If the test lamp is always ON**
1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module.
2. Test for infinite resistance between the control circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K109 Frontview Camera Module.
- **If the test lamp turns ON and OFF**

5. Test or replace the S70L Steering Wheel Controls Switch - Left.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cruise Control Switch Replacement** - Steering Wheel Controls Switch - Left replacement.
- Refer to **Control Module References** for control module replacement, programming and setup.

DTC B1008: CALIBRATION DATA NOT PROGRAMMED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1008

Calibration Data Not Programmed

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

When the ignition is turned ON, the frontview camera module performs a self-test to verify if a critical malfunction exists within the system. During the power-up mode, the frontview camera module checks for a valid calibration data set.

Conditions for Running the DTC

- DTC B1325 is not set
- Ignition voltage is between 9 - 16 volts

Conditions for Setting the DTC

- A valid calibration is not detected upon module power - up.
- The frontview camera module has been replaced and programmed, but not calibrated.

Action Taken When the DTC Sets

- Lane departure and forward collision alert system is disabled.
- The instrument panel cluster to display SERVICE FRONT CAMERA or SERVICE LANE DEPARTURE WARNING message in the driver information center and a chime will sound.
- All functions handled by the frontview camera module are inoperative

Conditions for Clearing

- The DTC will transition to history when the fault is no longer present.

- A history DTC will clear after 50 malfunction - free ignition cycles.

Diagnostic Aids

- This DTC will be set as current while performing calibration, and will remain set as current until calibration can be completed
- The frontview camera will not calibrate if not properly installed or mounted.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Do not diagnose this DTC if set in history**

1. Ignition ON.
2. Verify that DTC B101E 42 is not set.
    - **If DTC is set**

      Perform the **Front View Camera Module Programming and Setup** procedure.

    - **If the DTC is not set**
3. Perform the **Vehicle Yaw Sensor Learn** procedure.
4. Verify that DTC B1008 is not set.
    - **If DTC is set**
    1. Calibrate the front camera module. Refer to **Front View Camera Module Learn**.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the B174W Frontview Camera - Windshield.
        - If the DTC does not set
    3. All OK.
    - **If the DTC is not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B1011: SYSTEM DISABLED INFORMATION STORED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1011

System Disabled Information Stored

Circuit/System Description

The front view camera module permanently monitors the serial data bus for error messages. When a malfunction is detected by the front view camera module, the system will be disabled and an error message will be stored in the front view camera module disable history buffer which is used to store information about the front camera features that are disabled.

Conditions for Running the DTC

- Ignition ON
- Front view camera enabled

Conditions for Setting the DTC

The front view camera module detects a malfunction.

Action Taken When the DTC Sets

- The front view camera module is disabled.
- The front view camera module disable history buffer stores information why the system was disabled.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

The front view camera module disable history buffers are used to store information about the front view camera module features that are disabled. The Buffers will only update if the disable condition changes.

Example: If the data received from the steering wheel angle sensor is Invalid across many ignition cycles then it will only appear in 1 history buffer and not all history buffers. If this condition is the current reason why the front view camera module is disabled then it will be set in front view camera module disable history buffer 1. If a new reason occurs, such as vehicle speed validity is invalid, then the invalid steering wheel angle sensor fault will shift into disable history buffer 2 and vehicle speed validity invalid will be in disable history buffer 1. Since there are only 4 disable history buffers, the invalid steering wheel angle sensor will age out if 4 other disable reasons occur since the last invalid steering wheel angle sensor event occurred. Front view camera module disable history buffer 1 contains the current reason that one of the front view camera module features is disabled.

The front view camera module disable history buffers can display the following values:

- Lane Departure Warning Indicator Malfunction
- Lane Departure Warning Switch Malfunction
- Camera Obstructed
- Accelerator Pedal Position Out of Range
- Driven Wheel Speed Signal Invalid
- Non-Driven Wheel Speed Signal Invalid

- Brake Pedal Moderate Travel Signal Invalid
- Brake Pedal Initial Travel Position Achieved
- Lost Communication with Steering Wheel Angle Sensor Module
- Invalid Data Received From Steering Wheel Angle Sensor Module
- Forward Collision Alert Switch Malfunction
- Clutch Pedal Position (CPP) Sensor Performance
- Clutch Pedal Position (CPP) Sensor Performance
- Transmission Gear Engaged
- Acceleration Sensor Longitudinal Signal
- Invalid Data Received From Yaw Rate Sensor Module
- Power Mode Controlled by Backup Device
- System Power Mode
- Overvoltage
- Undervoltage
- Undefined

Reference Information

Schematic Reference

Object Detection Schematics

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Forward Collision Alert Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no DTC is set.
    - If a DTC is present, diagnose this first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
2. Verify the scan tool Vehicle Direction Camera System parameter is NORMAL.
    - If not the specified value, refer to **Lane Departure Warning System Malfunction**, and **Forward Collision Alert System Malfunction**.
3. Verify the scan tool Vehicle Direction Camera Calibration Status parameter is CALIBRATED.
    - If not the specified value, calibrate the K109 Frontview Camera Module. Refer to **Front View Camera Module Learn**.

Circuit/System Testing

NOTE: **Perform the Circuit/System Verification before proceeding with the Circuit/System Testing.**

1. Verify the scan tool Front View Camera Module Disable History displays no current malfunction. Refer to Diagnostic Aids.
    - If a current malfunction is displayed, diagnose the system that sets the malfunction.
2. If no malfunction is displayed in the Front View Camera Module Disable History, refer to **Lane Departure Warning System Malfunction**, and **Forward Collision Alert System Malfunction**.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for front view camera module programming and setup

DTC B1015: VEHICLE IDENTIFICATION NUMBER INFORMATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B1015

Vehicle Identification Number Information

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

When the ignition is turned ON, the advanced parking assist control module and the frontview camera module receive the vehicle identification number (VIN) from the body control module (BCM). The modules will compare the VIN received to the VIN stored in memory.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

The stored VIN does not match the received VIN.

Action Taken When the DTC Sets

- The parking assist system or the lane departure warning system is disabled.
- The driver information center may display a system service message.

Conditions for Clearing the DTC

The stored VIN matches the VIN stored in the body control module.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B1015 is not set.
    - **If the DTC is set**
    1. Program the control module that set the DTC.
    2. Verify that DTC B1015 is not set.
        - If the DTC is set, replace the control module that set the DTC.
        - If the DTC is not set
    3. All OK
    - **If the DTC is not set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair

Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B101D: ELECTRONIC CONTROL UNIT HARDWARE (DTC SET IN K109 FRONTVIEW CAMERA MODULE)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B101D

Electronic Control Unit Hardware

DTC B101D 3C

Electronic Control Unit Hardware Performance Internal Communications Failure

For symptom byte information, refer to **Symptom Byte List**

Circuit/System Description

The internal fault detection is handled inside the device. The symptom byte information is for engineering reference only. No external circuit diagnosis is involved.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

B101D

The frontview camera module has detected an internal malfunction

B101D 3C

The frontview camera module has detected a software malfunction

Action Taken When the DTC Sets

- Lane departure warning is disabled
- SERVICE LANE DEPARTURE SYSTEM is displayed on the DIC.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B101D symptom byte 3C is not set as current.
    - **If DTC B101D symptom byte 3C is set as current**

      Reprogram the K109 Frontview Camera Module

    - **If DTC B101D symptom byte 3C is not set as current**
2. Verify that DTC B101D is not set as current.
    - **If DTC B101D is set as current**

      Replace the K109 Frontview Camera Module

    - **If DTC B101D is not set as current**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for control module replacement, setup, and programming

DTC B127B: REARVIEW CAMERA INPUT SIGNAL CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

B127B 08

Rearview Camera Input Signal Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	B127B 2B	-	-
Camera Module signal +	1	B127B 2B	1	-
Camera Module signal -	3	B127B 2B	1	-
Ground	-	B127B 2B	-	-
Shield	3	3	3	-
1. Rear Vision Camera Malfunction 2. Rear Vision Camera image always displayed 3. Poor Quality Image				

Circuit/System Description

When the vehicle is placed in reverse with the engine running, a video signal is sent from the rearview camera to the Radio. If the Radio does not see a signal from the camera it will set B127B 2B and display "Service Rear Vision System". The rearview camera is powered with ignition voltage and does not have a reverse signal circuit.

Conditions for Running the DTC

The vehicle must be in reverse with the engine running.

Conditions for Setting the DTC

B127B 08

Signal from the rearview camera not received by the Radio for 2.5 s.

Action Taken When the DTC Sets

- The Radio commands the driver information center to display "Service Rear Vision System".
- The Radio stores the DTC in memory.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 40 malfunction-free ignition cycles have occurred.

Diagnostic Aids

A poor video image can be caused by ice, snow, and mud buildup on the lens of the rearview camera. Also, extreme lighting conditions can affect performance, such as operating in the dark or with bright sunlight shining on the camera. Extreme high or low temperatures can also affect the image quality. An open in the shield of the video signal circuit can also cause a distorted screen.

Terminal fretting or incorrectly seated connectors can cause a poor image displayed condition. Check the circuit terminals for fretting or incorrectly seated connector. If the condition is intermittent or cannot be duplicated, disconnect the connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance condition due to terminal fretting corrosion.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Rear Vision Camera Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Vehicle ON.
2. Verify that DTC B2545 is not set.
    - **If the DTC is set**

      Refer to **DTC B2545** .

    - **If the DTC is not set**
3. Verify the rearview camera has no debris on the lens and that the bezel and bezel seal are not damaged.
    - **If debris is found on the lens**

      Clean the lens. If the lens, bezel, or bezel seal are damaged, replace as necessary.

    - **If no debris on the lens**
4. Vehicle ON, transmission in R.
5. Verify the backup lamps are illuminated.
    - **If the backup lamps are not illuminated**

      Refer to **Backup Lamps Malfunction** .

    - **If the backup lamps are illuminated**
6. Verify a clear rear vision image is displayed on the P17 Info Display Module.
    - **If a clear image is not displayed**

      Refer to Circuit/System Testing.

- **If a clear image is displayed**

7. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the B87 Rearview Camera. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse. Refer to **Power Mode Mismatch** .
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the B87 Rearview Camera.
    - **If the test lamp illuminates**
5. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio, vehicle ON.
6. Test for less than 1 V between the signal circuit terminal listed below and ground:
    - B87 Rearview Camera signal (+) circuit terminal 15
    - B87 Rearview Camera signal (-) circuit terminal 14
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
7. Test for infinite resistance between the signal circuit terminal listed below and ground:
    - B87 Rearview Camera signal (+) circuit terminal 15
    - B87 Rearview Camera signal (-) circuit terminal 14
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
8. Test for less than 2 Ω in the signal (+) circuit end to end.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**

9. Test for less than 2 Ω in the signal (-) circuit end to end.
    - **If 2 Ω or greater**

      Test the signal circuit for an open/high resistance.

    - **If less than 2 Ω**
10. Replace the B87 Rearview Camera.
11. Vehicle ON, transmission in R,
12. Verify a clear rear vision image is displayed on the P17 Info Display Module.
    - **If a clear rear vision image is not displayed**

      Replace the A11 Radio.

    - **If a clear rear vision image is displayed**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rearview Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup.

DTC B1405: CONTROL MODULE VOLTAGE REFERENCE OUTPUT 2 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B1405 02

Control Module Voltage Reference Output 2 Circuit Short to Ground

DTC B1405 03

Control Module Voltage Reference Output 2 Circuit Low Voltage

DTC B1405 07

Control Module Voltage Reference Output 2 Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	B1405 02	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 03	B0954 06, B0955 06, B0956 06, B0957 06, B0958 06, B0959 06, B0960 06, B0961 06, B1405 07	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	B0954 01, B0955 01, B0956 01, B0957 01, B0958 01, B0959 01, B0960 01, B0961 01	-	-

Circuit/System Description

The object sensors are 3-wire sensors that are used to determine the distance between the vehicle and an object of interest. The parking assist control module supplies 9 V to the object sensors via the object sensor supply voltage circuit and provides ground via the object sensor low reference circuit. The parking assist control module triggers the sensors in a sequential loop. After each sensor transmits, the parking assist control module uses the sensor echo received through the object sensor signal circuit to calculate the distance and position of an object.

Conditions for Running the DTC

- Ignition ON
- Transmission in REVERSE

Conditions for Setting the DTC

B1405 02

The parking assist control module has detected the object sensor supply voltage circuit is shorted to ground.

B1405 03

The parking assist control module has detected the object sensor supply voltage circuit is low.

B1405 07

The parking assist control module has detected the object sensor supply voltage circuit is high.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the X2 and X3 harness connectors at the K41 Front and Rear Parking Assist Control Module.
2. Test for infinite resistance between the 12 V reference circuit terminal 4 X2 and ground.
    - **If less than infinite resistance**
    1. Ignition OFF, disconnect the harness connector at each of the B78 Rear Object Sensors.
    2. Test for infinite resistance between the 12 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If less than 2 Ω, replace the appropriate B78 Rear Object Sensor.
    - **If infinite resistance**
3. Test for infinite resistance between the 12 V reference circuit terminal 1 X3 and ground.
    - **If less than infinite resistance**
    1. Ignition OFF, disconnect the harness connector at each of the B78 Front Object Sensors.
    2. Test for infinite resistance between the 12 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If less than 2 Ω, replace the appropriate B78 Front Object Sensor.
    - **If infinite resistance**
4. Ignition ON.
5. Test for less than 1 V between the 12 V reference circuit terminal 4 X2 and ground.
    - **If greater than 1 V**
    1. Ignition OFF, disconnect the harness connector at each of the B78 Rear Object Sensors.
    2. Test for less than 1 V between the 12 V reference circuit and ground.
        - If greater than 1 V, repair the short to voltage on the circuit.
        - If less than 1 V, replace the appropriate B78 Front Object Sensor.
    - **If less than 1 V**
6. Test for less than 1 V between the 12 V reference circuit terminal 1 X3 and ground.
    - **If greater than 1 V**
    1. Ignition OFF, disconnect the harness connector at each of the B78 Front Object Sensors.
    2. Test for less than 1 V between the 12 V reference circuit and ground.
        - If greater than 1 V, repair the short to voltage on the circuit.
        - If less than 1 V, replace the appropriate B78 Front Object Sensor.
    - **If less than 1 V**
7. Connect the X2 and X3 harness connector at the K41 Front and Rear Parking Assist Control Module, ignition ON.
8. Verify DTC B1405 is not set.
    - **If DTC B1405 is set**
    1. Ignition OFF, disconnect the harness connector at each of the B78 Object Sensors.
    2. Verify DTC B1405 is not set.
        - If DTC B1405 is set

Replace the K41 Front and Rear Parking Assist Control Module.

- If DTC B1405 is not set.

3. Verify the DTC B1405 does not set while connecting the harness connector at each B78 Object Sensor, one at a time.

- If DTC B1405 does set

  Replace the B78 Object Sensor that was connected immediately before DTC B1405.

- If DTC B1405 does not set.

9. All OK.

- **If DTC B1405 is not set.**

10. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rear Parking Assist Alarm Sensor Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup

DTC B356A: VEHICLE DIRECTION WARNING SWITCH CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B356A

Vehicle Direction Warning Switch Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lane Departure Warning Switch Signal	B356A 02	1	B356A 05	-
Lane Departure Warning Switch Ground	-	1	-	-
1. Lane Departure Warning Malfunction				

Circuit/System Description

The lane departure warning system is controlled by the Frontview Camera - Windshield mounted on the windshield. Lane departure warning is enabled and disabled through a switch located on the steering wheel. When enabled, the Frontview Camera - Windshield or Active Safety Control Module will illuminate the indicator located in the switch.

When the system is operating and can detect the lane markings, the Frontview Camera - Windshield will request via serial data communications that the instrument panel cluster illuminate the green lane departure ready - to - assist indicator. If the Frontview Camera - Windshield detects that the vehicle has crossed a lane marking without the turn signal being used, the module will request that the instrument cluster flash the yellow lane departure warning indicator. An audible warning may also sound three times or the haptic seat (if equipped) may pulse when the yellow Instrument Cluster indicator is flashing. The driver can select between audible or haptic alerts in the vehicle personalization menu. See the Owner's Manual for more detailed information on vehicle personalization.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

DTC B356A 02

The Frontview Camera Module has detected a short to ground for more than 10 s.

DTC B356A 05

The Frontview Camera Module has detected a short to voltage or an open/high resistance for more than 10 s.

Action Taken When the DTC Sets

- Lane departure warning is disabled.
- Service Lane Departure is displayed on the driver information center.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Manually pressing the lane departure warning switch for an extended length of time will cause this DTC to set.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Lane Departure Warning Switch Status parameter changes between Open and Closed while cycling the lane departure warning switch.
    - **If the parameter does not change**

    Refer to Circuit/System Testing.

    - **If the parameter changes**

3. All OK.

Circuit/System Testing - Without MBM

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Vehicle Direction Warning Switch Status parameter is Open.
    - **If not Open**
    1. Ignition OFF, disconnect the harness connector at the B174W Frontview Camera - Windshield.
    2. Test for infinite resistance between the S70L Steering Wheel Controls Switch - Left signal circuit terminal 2 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the B174W Frontview Camera - Windshield.
    - **If Open**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.
6. Verify within 10 s the scan tool Vehicle Direction Warning Switch Status parameter is Closed.
    - **If not Closed**
    1. Ignition OFF, disconnect harness connector at the B174W Frontview Camera - Windshield. Ignition ON.
    2. Test for less than 1 V between the S70L Steering Wheel Controls Switch - Left signal circuit terminal 2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the B174W Frontview Camera - Windshield.
    - **If Closed**
7. Test or replace the S70L Steering Wheel Controls Switch - Left.

Circuit/System Testing - with MBM

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.

4. Verify the scan tool Vehicle Direction Warning Switch Status parameter is Open.
    - **If not Open**
    1. Ignition OFF, disconnect the harness connector at the B174W Frontview Camera - Windshield.
    2. Test for infinite resistance between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 3 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the B174W Frontview Camera - Windshield.
    - **If Open**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.
6. Verify within 10 s the scan tool Vehicle Direction Warning Switch Status parameter is Closed.
    - **If not Closed**
    1. Ignition OFF, disconnect harness connector at the B174W Frontview Camera - Windshield. Ignition ON.
    2. Test for less than 1 V between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 3 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the B174W Frontview Camera - Windshield.
    - **If Closed**
7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cruise Control Switch Replacement**
- Refer to **Instrument Panel Center Accessory Function Switch Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B390D: FRONTVIEW CAMERA MODULE INCORRECT MOUNTING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B390D 66

Frontview Camera Module Incorrect Mounting

Circuit/System Description

The frontview camera module has determined that it is not properly mounted.

Conditions for Running the DTC

Vehicle operating on the road.

Conditions for Setting the DTC

The frontview camera module was unable to see the road ahead.

Action Taken When the DTC Sets

- The frontview camera module is disabled.
- The Active Safety System is disabled.
- Service Driver Assist is displayed on the driver information center and/or heads up display.

Conditions for Clearing the DTC

The frontview camera module is successfully aligned.

Diagnostic Aids

- The frontview camera module needs to be securely mounted. Verify it is secured properly in it's mount.
- The frontview camera module needs to have a clear field of vision to the road ahead. Check for anything that can impair the camera's vision.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify there are no DTCs set, except for DTC B101E 4B in the B233B Radar Sensor Module - Long Rage or K109 Frontview Camera Module.
   - **If other DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If no other DTCs are set**

NOTE: **Before conducting alignment, verify that the K109 Frontview Camera Module will not have difficulty seeing the lines on the road. If the view of the K109 Frontview Camera Module is blocked with mud, dirt, snow, ice, or slush, if the windshield is damaged, or if weather limits visibility, such as while driving in fog, rain, or snow conditions, the calibration procedure may not be able to be completed.**

3. Perform the calibration procedure. Refer to **Front View Camera Module Learn**.

4. Verify DTC B390D 66 is not set
    - **If DTC B390D 66 is set**

      Replace and calibrate the K109 Frontview Camera Module.

    - **If DTC B390D 66 is not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for frontview camera module replacement, programming, and setup.

DTC B390F: FRONTVIEW CAMERA

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B390F 08

Frontview Camera Performance - Signal Invalid

DTC B390F 66

Frontview Camera Wrong Mounting Position

DTC B390F 4B

Frontview Camera Calibration Not Learned

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B390F 08, B399A 02	B390F 08, 1	B399A 01	-
Video Signal +	1, 2	1	1, 2	-
Video Signal -	1, 2	1	1, 2	-
Low Reference	-	B390F 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B390F 08

The frontview camera video circuit is open, shorted to voltage, or shorted to ground.

B390F 66

The frontview camera is incorrectly mounted.

B390F 4B

The camera calibration is not learned.

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the Surround Vision Camera System.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Surround Vision Camera Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B390F 4B is not set.
   - **If the DTC is set**
   1. Program the K157 Video Processing Control Module.
   2. Verify DTC B390F 4B is not set after programming.
      - If the DTC sets after programming, replace the B174G Frontview Camera - Grille.
      - If the DTC does not set
   3. All OK.
   - **If both DTCs are not set**
3. Verify DTC B390F 66 is not set.
   - **If the DTC is set**

Remove the B174G Frontview Camera - Grille and reinstall

- **If the DTC is not set**

4. Verify DTC B390F 08 is not set.
   - **If DTC is set**

     Refer to Circuit/System Testing

   - **If DTC is not set**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the B174G Frontview Camera - Grille harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K157 Video Processing Control Module.
   - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 5 and ground.
   - **If less than 4.8 V**
   1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
   2. Test for infinite resistance between the 6 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 6 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K157 Video Processing Control Module.
   - **If greater than 7.2 V**
   1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.
   2. Test for less than 1 V between the 6 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K157 Video Processing Control Module.
   - **If between 4.8 - 7.2 V**
5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:
   - Vision Signal + signal circuit terminal 1
   - Vision Signal - signal circuit terminal 3
   - **If 10 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K157 Video Processing Control Module.
   - **If less than 10 V**

7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 3
    - **If less than 100 Ω**
    1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
    2. Test for infinite between the signal circuit and ground.
        - If less than infinite resistance, repair the short to voltage on the circuit.
        - If infinite resistance, replace the K157 Video Processing Control Module.
    - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
    - B174G Frontview Camera - Grille video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 1 X1
    - B174G Frontview Camera - Grille video signal (-) circuit terminal 3 and the K157 Video Processing Control Module video signal (-) circuit terminal 11 X1
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B174G Frontview Camera - Grille.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B390F is not set.
    - **If DTC B390F is set**

      Replace the B174G Frontview Camera - Grille.

    - **If DTC B390F is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Front View Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B395A: REARVIEW CAMERA

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B395A 08

Rearview Camera Performance - Signal Invalid

DTC B395A 66

Rearview Camera Wrong Mounting Position

DTC B395A 4B

Rearview Camera Calibration Not Learned

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B395A 02, B399B 08	B395A 08, 1	B399B 08	-
Video Signal +	1, 2	B395A 08, 1	1, 2	-
Video Signal -	1, 2	1	1, 2	-
Low Reference	-	B395A 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B395A 08

The rearview camera video circuit is open, shorted to voltage, or shorted to ground.

B395A 66

The rearview camera is incorrectly mounted.

B395A 4B

The camera calibration is not learned.

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the camera and that cameras portion of the display.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Surround Vision Camera Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B395A 4B is not set.
    - **If the DTC is set**
    1. Program the K157 Video Processing Control Module.
    2. Verify DTC B395A 4B is not set after programming.
        - If the DTC sets after programming, replace the B87 Rearview Camera.
        - If the DTC does not set
    3. All OK.
    - **If the DTC is not set**
3. Verify DTC B395A 66 is not set.
    - **If the DTC is set**

      Remove the B87 Rearview Camera and reinstall

    - **If the DTC is not set**
4. Verify DTC B395A 08 is not set.
    - **If DTC is set**

      Refer to Circuit/System Testing

    - **If DTC is not set**
5. Vehicle ON, transmission in R, verify a clear image is displayed on the P17 Info Display Module.
    - **If a clear image is not displayed**

      Refer to Circuit/System Testing

    - **If a clear image is displayed**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the B87 Rearview Camera harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 5 and ground.
    - **If less than 4.8 V**

    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for infinite resistance between the 6 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 6 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If greater than 7.2 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If between 4.8 - 7.2 V**
5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 3
    - **If 10 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If less than 10 V**
7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 3
    - **If less than 100 Ω**
    1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
    2. Test for infinite between the signal circuit and ground.
        - If less than infinite resistance, repair the short to voltage on the circuit.
        - If infinite resistance, replace the K157 Video Processing Control Module.
    - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
    - B87 Rearview Camera video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 4 X1
    - B87 Rearview Camera video signal (+) circuit terminal 3 and the K157 Video Processing Control Module video signal (+) circuit terminal 14 X1
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B87 Rearview Camera.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B395A is not set.
    - **If DTC B395A is set**

Replace the B87 Rearview Camera.

- **If DTC B395A is not set**

13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rearview Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B395B: SIDEVIEW CAMERA - LEFT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B395B 08

Sideview Camera - Left Performance - Signal Invalid

DTC B395B 66

Sideview Camera - Left Wrong Mounting Position

DTC B395B 4B

Sideview Camera - Left Calibration Not Learned

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B395B 08, B399C 02	B395B 08, 1	B399C 01	-
Video Signal +	1, 2	B395B 08, 1	1, 2	-
Video Signal -	1, 2	1	1, 2	-
Low Reference	-	B395B 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B395B 08

The sideview camera - left video circuit is open, shorted to voltage, or shorted to ground.

B395B 66

The sideview camera - left is incorrectly mounted.

B395B 4B

The sideview camera - left is not learned.

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the camera and that cameras portion of the display.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Description and Operation

Surround Vision Camera Description and Operation

Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B395B 4B is not set.
    - **If the DTC is set**
    1. Program the K157 Video Processing Control Module.
    2. Verify DTC B395B 4B is not set after programming.
        - If the DTC sets after programming, replace the B225L Sideview Camera - Left.
        - If the DTC does not set
    3. All OK.
    - **If the DTC is not set**
3. Verify DTC B395B 66 is not set.
    - **If the DTC is set**

      Remove the B225L Sideview Camera - Left and reinstall

- **If the DTC is not set**

4. Verify DTC B395B 08 is not set.
    - **If DTC is set**

      Refer to Circuit/System Testing

    - **If DTC is not set**
5. Vehicle ON, transmission in R, verify a clear image is displayed on the P17 Info Display Module.
    - **If a clear image is not displayed**

      Refer to Circuit/System Testing

    - **If a clear image is displayed**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the B225L Sideview Camera - Left harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 6 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for infinite resistance between the 6 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 6 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If greater than 7.2 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the 6 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If between 4.8 - 7.2 V**
5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 4
    - **If 10 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.

        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If less than 10 V**
7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 4
    - **If less than 100 Ω**
    1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
    2. Test for infinite between the signal circuit and ground.
        - If less than infinite resistance, repair the short to voltage on the circuit.
        - If infinite resistance, replace the K157 Video Processing Control Module.
    - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
    - B225L Sideview Camera - Left video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 5 X1
    - B225L Sideview Camera - Left video signal (+) circuit terminal 4 and the K157 Video Processing Control Module video signal (+) circuit terminal 15 X1
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B225L Sideview Camera - Left.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B395B is not set.
    - **If DTC B395B is set**

      Replace the B225L Sideview Camera - Left.

    - **If DTC B395B is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Side View Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B395C: SIDEVIEW CAMERA - RIGHT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B395C 08

Sideview Camera - Right Performance - Signal Invalid

DTC B395C 66

Sideview Camera - Right Wrong Mounting Position

DTC B395C 4B

Sideview Camera - Right Calibration Not Learned

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B395C 08, B399D 02	B395C 08, 1	B399D 01	-
Video Signal +	1, 2	B395C 08, 1	1, 2	-
Video Signal -	B395C 08, 1	1	1, 2	-
Low Reference	-	B395C 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B395C 08

The sideview camera - right video circuit is open, shorted to voltage, or shorted to ground.

B395C 66

The sideview camera - right is incorrectly mounted.

B395C 4B

The sideview camera - right is not learned.

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the camera and that cameras portion of the display.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Surround Vision Camera Description and Operation

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B395C 4B is not set.
    - **If the DTC is set**
    1. Program the K157 Video Processing Control Module.
    2. Verify DTC B395C 4B is not set after programming.
        - If the DTC sets after programming, replace the B225R Sideview Camera - Right.
        - If the DTC does not set
    3. All OK.
    - **If the DTC is not set**
3. Verify DTC B395C 66 is not set.
    - **If the DTC is set**

      Remove the B225R Sideview Camera - Right and reinstall

    - **If the DTC is not set**
4. Verify DTC B395C 08 is not set.
    - **If DTC is set**

      Refer to Circuit/System Testing

    - **If DTC is not set**
5. Vehicle ON, transmission in R, verify a clear image is displayed on the P17 Info Display Module.
    - **If a clear image is not displayed**

      Refer to Circuit/System Testing

    - **If a clear image is displayed**
6. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the B225R Sideview Camera - Right harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If less than 10 Ω**

3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 6 and ground.
   - **If less than 4.8 V**
   1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
   2. Test for infinite resistance between the 6 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 6 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K157 Video Processing Control Module.
   - **If greater than 7.2 V**
   1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.
   2. Test for less than 1 V between the 6 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K157 Video Processing Control Module.
   - **If between 4.8 - 7.2 V**
5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:
   - Vision Signal + signal circuit terminal 1
   - Vision Signal - signal circuit terminal 4
   - **If 10 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K157 Video Processing Control Module.
   - **If less than 10 V**
7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
   - Vision Signal + signal circuit terminal 1
   - Vision Signal - signal circuit terminal 4
   - **If less than 100 Ω**
   1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
   2. Test for infinite between the signal circuit and ground.
      - If less than infinite resistance, repair the short to voltage on the circuit.
      - If infinite resistance, replace the K157 Video Processing Control Module.
   - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
   - B225R Sideview Camera - Right video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 8 X1
   - B225R Sideview Camera - Right video signal (+) circuit terminal 4 and the K157 Video Processing Control Module video signal (+) circuit terminal 18 X1
   - **If 2 Ω or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B225R Sideview Camera - Right.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.

12. Verify DTC B395C is not set.
    - **If DTC B395C is set**

      Replace the B225R Sideview Camera - Right.

    - **If DTC B395C is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Side View Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B399A: FRONTVIEW CAMERA SUPPLY CIRCUIT SHORT TO BATTERY/GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B399A 01

Frontview Camera Supply Circuit Short to Battery

DTC B399A 02

Frontview Camera Supply Circuit Short to Ground

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B390F 08, B399A 02	B390F 08, 1	B399A 01	-
Video Signal +	1, 2	1	1, 2	-
Video Signal -	1, 2	1	1, 2	-
Low Reference	-	B390F 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B399A 01

The frontview camera 6 V reference circuit is shorted to voltage

B399A 02

The frontview camera 6 V reference circuit is shorted to ground

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the camera and that cameras portion of the display.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

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Surround Vision Camera Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the B174G Frontview Camera - Grille harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 5 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for infinite resistance between the 6 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the 6 V reference circuit end to end.
   - If 2 Ω or greater, repair the open/high resistance in the circuit.
   - If less than 2 Ω, replace the K157 Video Processing Control Module.

- **If greater than 7.2 V**

1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.
2. Test for less than 1 V between the 6 V reference circuit and ground.
   - If 1 V or greater, repair the short to voltage on the circuit.
   - If less than 1 V, replace the K157 Video Processing Control Module.

- **If between 4.8 - 7.2 V**

5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:
   - Vision Signal + signal circuit terminal 1
   - Vision Signal - signal circuit terminal 3
   - **If 10 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K157 Video Processing Control Module.
   - **If less than 10 V**
7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
   - Vision Signal + signal circuit terminal 1
   - Vision Signal - signal circuit terminal 3
   - **If less than 100 Ω**
   1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
   2. Test for infinite between the signal circuit and ground.
      - If less than infinite resistance, repair the short to voltage on the circuit.
      - If infinite resistance, replace the K157 Video Processing Control Module.
   - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
   - B174G Frontview Camera - Grille video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 1 X1
   - B174G Frontview Camera - Grille video signal (+) circuit terminal 3 and the K157 Video Processing Control Module video signal (+) circuit terminal 11 X1
   - **If 2 Ω or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B174G Frontview Camera - Grille.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B399A is not set.
    - **If DTC B399A is set**

      Replace the B174G Frontview Camera - Grille.

    - **If DTC B399A is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Front View Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B399B: REARVIEW CAMERA SUPPLY CIRCUIT SHORT TO BATTERY/GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B399B 01

Rearview Camera Supply Circuit Short to Battery

DTC B399B 02

Rearview Camera Supply Circuit Short to Ground

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B395A 02, B399B 08	B395A 08, 1	B399B 08	-
Video Signal +	1, 2	B395A 08, 1	1, 2	-
Video Signal -	1, 2	1	1, 2	-
Low Reference	-	B395A 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B399B 01

The rearview camera 6 V reference circuit is shorted to voltage

B399B 02

The rearview camera 6 V reference circuit is shorted to ground

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the camera and that cameras portion of the display.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

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Surround Vision Camera Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the B87 Rearview Camera harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 5 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for infinite resistance between the 6 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 6 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If greater than 7.2 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.

        2. Test for less than 1 V between the 6 V reference circuit and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If between 4.8 - 7.2 V**
5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 3
    - **If 10 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If less than 10 V**
7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 3
    - **If less than 100 Ω**
    1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
    2. Test for infinite between the signal circuit and ground.
        - If less than infinite resistance, repair the short to voltage on the circuit.
        - If infinite resistance, replace the K157 Video Processing Control Module.
    - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
    - B87 Rearview Camera video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 4 X1
    - B87 Rearview Camera video signal (+) circuit terminal 3 and the K157 Video Processing Control Module video signal (+) circuit terminal 14 X1
    - **If 2 Ω or greater**

        Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B87 Rearview Camera.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B399B is not set.
    - **If DTC B399B is set**

        Replace the B87 Rearview Camera.

    - **If DTC B399B is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rearview Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B399C: SIDEVIEW CAMERA - LEFT SUPPLY CIRCUIT SHORT TO BATTERY/GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B399C 01

Sideview Camera - Left Supply Circuit Short to Battery

DTC B399C 02

Sideview Camera - Left Supply Circuit Short to Ground

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B395B 08, B399C 02	B395B 08, 1	B399C 01	-
Video Signal +	1, 2	B395B 08, 1	1, 2	-
Video Signal -	1, 2	1	1, 2	-
Low Reference	-	B395B 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B399C 01

The sideview camera - left 6 V reference circuit is shorted to voltage

B399C 02

The sideview camera - left 6 V reference circuit is shorted to ground

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the camera and that cameras portion of the display.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the B225L Sideview Camera - Left harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 6 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for infinite resistance between the 6 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 6 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If greater than 7.2 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the 6 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If between 4.8 - 7.2 V**
5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:

   - Vision Signal + signal circuit terminal 1
   - Vision Signal - signal circuit terminal 4
   - **If 10 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K157 Video Processing Control Module.
   - **If less than 10 V**
7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
   - Vision Signal + signal circuit terminal 1
   - Vision Signal - signal circuit terminal 4
   - **If less than 100 Ω**
   1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
   2. Test for infinite between the signal circuit and ground.
      - If less than infinite resistance, repair the short to voltage on the circuit.
      - If infinite resistance, replace the K157 Video Processing Control Module.
   - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
   - B225L Sideview Camera - Left video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 5 X1
   - B225L Sideview Camera - Left video signal (+) circuit terminal 4 and the K157 Video Processing Control Module video signal (+) circuit terminal 15 X1
   - **If 2 Ω or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B225L Sideview Camera - Left.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B399C is not set.
   - **If DTC B399C is set**

     Replace the B225L Sideview Camera - Left.

   - **If DTC B399C is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Side View Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC B399D: SIDEVIEW CAMERA - RIGHT SUPPLY CIRCUIT SHORT TO BATTERY/GROUND

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B399D 01

Sideview Camera - Right Supply Circuit Short to Battery

DTC B399D 02

Sideview Camera - Right Supply Circuit Short to Ground

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
6 V Reference	B395C 08, B399D 02	B395C 08, 1	B399D 01	-
Video Signal +	1, 2	B395C 08, 1	1, 2	-
Video Signal -	B395C 08, 1	1	1, 2	-
Low Reference	-	B395C 08, 1	-	-
1. Camera inoperative 2. Poor image quality displayed from camera				

Circuit/System Description

The video processing control module performs fault detection on itself and the cameras attached to it.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B399D 01

The sideview camera - right 6 V reference circuit is shorted to voltage

B399D 02

The sideview camera - right 6 V reference circuit is shorted to ground

Action Taken When the DTC Sets

- The Video Processing Control Module requests the instrument cluster to display "Service Surround Vision Camera".
- The Video Processing Control Module will disable the camera and that cameras portion of the display.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the control module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the B225R Sideview Camera - Right harness connector. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4.8 - 7.2 V between the 6 V reference circuit terminal 6 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module.
    2. Test for infinite resistance between the 6 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 6 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K157 Video Processing Control Module.
    - **If greater than 7.2 V**
    1. Ignition OFF, disconnect the harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the 6 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If between 4.8 - 7.2 V**
5. Ignition ON.
6. Test for less than 10 V between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 4
    - **If 10 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K157 Video Processing Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.

        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K157 Video Processing Control Module.
    - **If less than 10 V**

7. Ignition OFF.
8. Test for greater than 100 Ω between the signal circuit terminals listed below and ground:
    - Vision Signal + signal circuit terminal 1
    - Vision Signal - signal circuit terminal 4
    - **If less than 100 Ω**
    1. Disconnect the X1 harness connector at the K157 Video Processing Control Module.
    2. Test for infinite between the signal circuit and ground.
        - If less than infinite resistance, repair the short to voltage on the circuit.
        - If infinite resistance, replace the K157 Video Processing Control Module.
    - **If greater than 100 Ω**
9. Test for less than 2 Ω between the video signal circuit terminals listed below:
    - B225R Sideview Camera - Right video signal (+) circuit terminal 1 and the K157 Video Processing Control Module video signal (+) circuit terminal 8 X1
    - B225R Sideview Camera - Right video signal (+) circuit terminal 4 and the K157 Video Processing Control Module video signal (+) circuit terminal 18 X1
    - **If 2 Ω or greater**

        Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
10. Ignition OFF, connect the harness connector at the B225R Sideview Camera - Right.
11. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
12. Verify DTC B399D is not set.
    - **If DTC B399D is set**

        Replace the B225R Sideview Camera - Right.

    - **If DTC B399D is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Side View Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC P15F6: FRONT OBJECT DETECTION CONTROL MODULE TORQUE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P15F6

Front Object Detection Control Module Torque Request Signal Message Counter Incorrect

Circuit/System Description

The Frontview Camera Module communicates with the Engine Control Module (ECM), requesting engine speed or torque reduction as necessary.

Conditions for Running the DTC

Engine running.

Conditions for Setting the DTC

The ECM detects that the engine speed and torque modification messages from the Frontview Camera Module are either corrupted or intermittently missing.

Action Taken When the DTC Sets

- The Frontview Camera Module sends a serial data message to display the appropriate indicator message
- The Frontview Camera Module features are unavailable.

Conditions for Clearing the DTC

- The condition for the DTC is no longer present.
- The engine control module clears the history DTC when a current DTC is not detected in 40 consecutive drive cycles.

Diagnostic Aid

This is an informational DTC set by the engine control module. It is set to provide an indication that the Frontview Camera Module will not be able to perform as intended. Diagnose any other DTCs first. During normal diagnostic and/or repair verification technicians may find that a "Service Driver Assist System" message may be displayed by the Frontview Camera Module. Do not replace the Frontview Camera Module for this condition.

If the Service Driver Assist System message is displayed with no DTCs set, perform the following steps:

1. Remove the key from the ignition, open and close the driver's door to turn off retained accessory power, and wait 60 s.
2. Ignition ON, if the Service Driver Assist message is still present, operate the vehicle at speeds greater than 15 km/h (10 mph) to complete the self test. The Frontview Camera Module should request the message to turn off.
3. If the telltales remain on with no DTCs set after the drive cycle, disconnect the battery for at least 60 s, then reconnect the battery.
4. Operate the vehicle at speeds greater than 40 km/h (25 mph), the Frontview Camera Module should request all indicators to turn off.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **DTC P15F6 is an informational DTC.**
- **Diagnose all other K20 Engine Control Module DTCs prior to DTC P15F6.**

1. Verify there are no other DTCs set in the K20 Engine Control Module and that there are no communication DTCs set in the vehicle.
    - **If any DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle

    - **If no DTCs are set**
2. Clear DTCs and operate the vehicle in the conditions that the customer experienced.
3. Verify DTC P15F6 does not set.
    - **If the DTC sets**

      Replace K109 Frontview Camera Module

    - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for control module replacement, programming, and setup.

SYMPTOMS - OBJECT DETECTION

NOTE: **The following steps must be completed before using the symptom lists.**

1. In order to verify that all of the following conditions are fulfilled before using the symptom lists perform the Diagnostic System Check:Diagnostic System Check - Vehicle
    - No DTCs Stored
    - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to:
    - Cross Traffic Alert Description and Operation
    - Forward Collision Alert Description and Operation
    - Lane Departure Warning Description and Operation
    - Lane Keep Assist Description and Operation
    - Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)
    - Rear Vision Camera Description and Operation
    - Side Blind Zone Alert Description and Operation
    - Surround Vision Camera Description and Operation

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the system. Refer to:**Checking Aftermarket Accessories**
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which may cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to:**Testing for Intermittent Conditions and Poor Connections**

Symptom List

For more information see:

- **Forward Collision Alert System Malfunction**
- **Parking Assist System Malfunction**
- **Parallel Parking Assist System Malfunction**
- **Rear Vision Camera System Malfunction**
- **Side Blind Zone Alert System Malfunction**

FORWARD COLLISION ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0987 01

Vehicle Direction Camera Indicator Circuit Short to Battery

DTC B0987 06

Vehicle Direction Camera Indicator Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lane Departure Warning Switch Indicator Ignition	B0987 06	B0987 06	-	-
Lane Departure Warning Switch Indicator Control	B0987 06	B0987 06	B0987 01	-

Circuit/System Description

The lane departure warning is enabled and disabled through a switch located in the left steering wheel controls switch. When enabled, the frontview camera module will illuminate the indicator located in the switch.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The frontview camera module has detected a short to battery or open/high resistance in the control circuit.

Action Taken When the DTC Sets

- Lane departure warning is disabled.
- SERVICE FRONT CAMERA is displayed on the driver information center.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Lane Departure Warning Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B356A is not set.
    - **If the DTC is set**

      Refer to **DTC B356A**.

    - **If the DTC is not set**
3. Verify the lane departure warning indicator turns ON and OFF while pressing and releasing the lane departure warning switch.
    - **If the indicator does not turn ON and OFF**

      Refer to Circuit/System Testing.

    - **If the indictor turns ON and OFF**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left, ignition ON.

NOTE: **Verify interior lighting dimming is turned all the way up.**

2. Test for 6.2 - 12.0 V between the dimming control circuit terminal 4 and ground.
    - **If less than 6.2 V**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to **Interior Backlighting Malfunction** .
    - **If greater than 12.0 V**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, refer to **Interior Backlighting Malfunction** .
    - **If between 6.2 - 12.0 V**
3. Connect a test lamp between the control circuit terminal 5 and B+.
4. Verify the test lamp turns ON and OFF when commanding the Lane Departure Warning Indicator parameter ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K109 Frontview Camera Module.
    - **If the test lamp is always ON**
    1. Ignition OFF, disconnect the harness connector at the K109 Frontview Camera Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K109 Frontview Camera Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the S70L Steering Wheel Controls Switch - Left.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cruise Control Switch Replacement** - Steering Wheel Controls Switch - Left replacement.
- Refer to **Control Module References** for control module replacement, programming and setup.

PARKING ASSIST SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B0967

Parking Assist On/Off Switch Circuit

DTC B0968

Parking Assist On/Off Switch Indicator Circuit

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Parking Assist Switch Signal	B0967 02, 1	1	1	-
Parking Assist Switch Indicator Illumination	B0968 06, 2	B0968 06, 2	2	-
Parking Assist Switch Indicator Control	B0968 06, 2	B0968 06, 2	B0968 01,	-
Parking Assist Switch Ground	-	1	-	-
1. Parking Assist Switch Malfunction 2. Parking Assist Indicator Malfunction				

Circuit/System Description

The parking assist can be activated/deactivated by pressing the parking assist switch. By engaging the reverse gear the parking assist can also be activated. By subsequently pressing the parking assist switch the parking assist can be disabled again.

The indicator in the parking assist switch shows the status of the parking assist. If the lamp is ON, the parking assist is activated.

Conditions for Running the DTC

- Vehicle ON
- The parking assist is activated. The activation takes place by putting in the reverse gear or by pressing the parking assist switch.

Conditions for Setting the DTC

B0967 02

The parking assist control module has detected a short to ground.

B0968 01

The parking assist control module has detected a short to battery.

B0968 06

The parking assist control module has detected a short to ground or open.

Action Taken When the DTC Sets

- The parking assist is disabled.
- The driver information center displays SERVICE PARK ASSIST.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC B0967 02 is not set.
   - **If the DTC is set**

     Refer to Parking Assist Switch Malfunction.

   - **If the DTC is not set**
3. Verify that B0968 01 or B0968 06 is not set.
   - **If the DTC is set**

     Refer to Parking Assist Switch Indicator Malfunction.

   - **If the DTC is not set**
4. Activate and deactivate the parking assist switch and verify the scan tool Park Assist Switch parameter changes between Active and Inactive.
   - **If the Parking Assist Switch parameter does not change between Active and Inactive**

     Refer to Circuit/System Testing.

   - **If the Parking Assist Switch parameter changes between Active and Inactive**
5. All OK.

Circuit/System Testing

Parking Assist Indicator Malfunction

1. Vehicle OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for 1.6 - 3.6 V between the control circuit terminal 6 and ground.
   - **If less than 1.6 V**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, refer to **Interior Backlighting Malfunction** .
   - **If greater than 3.6 V**

    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, refer to **Interior Backlighting Malfunction** .
    - **If between 1.6 - 3.6 V**
3. Connect a test lamp between the control circuit terminal 7 and signal circuit terminal 6.
4. Verify the test lamp turns On and Off when commanding the Parking Assist Switch On and Off with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, Vehicle ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit
        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance, replace the K182 Parking Assist Control Module.
    - **If the test lamp turns ON and OFF**
5. All OK.

Parking Assist Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Park Assist Switch parameter is Inactive.
    - **If not Inactive**
    1. Ignition OFF, disconnect the harness connector X1 at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K182 Parking Assist Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.
6. Verify the scan tool Park Assist Switch parameter is Active.
    - **If not Active**

1. Ignition OFF, disconnect the harness connector X1 at the K182 Parking Assist Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K182 Parking Assist Control Module.
- **If Active**

7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair

- Refer to **Instrument Panel Center Accessory Function Switch Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup.

PARALLEL PARKING ASSIST SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B096B

Parking Assist Switch Parallel Parking Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Parallel Park Assist Switch Signal	B096B 02	1	-	-
Parallel Parking Assist Switch Ground	-	1	-	-
1. Parallel Parking Assist Switch Malfunction				

Circuit/System Description

The parallel parking assist can be activated/deactivated by pressing the parallel parking assist switch.

Conditions for Running the DTC

- Vehicle ON
- The parallel parking assist is activated. The activation takes place through pressing the parallel parking assist switch.

Conditions for Setting the DTC

The parking assist control module has detected a short to ground.

Action Taken When the DTC Sets

- The parallel parking assist is disabled.

- An indicator in the driver information center shows the parking assistance is not available.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Parking Assist Description and Operation (with Rear Park Assist, UD7)Parking Assist Description and Operation (with Front and Rear Park Assist, UFQ)

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the ground circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the scan tool Advanced Parking Assist Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module.
    2. Test for infinite resistance between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K182 Parking Assist Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
6. Verify the scan tool Advanced Parking Assist Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the harness connector at the K182 Parking Assist Control Module, vehicle ON.

        2. Test for less than 1 V between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 1 and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V.
        3. Test for less than 2 Ω in the signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K182 Parking Assist Control Module.
    - **If Active**

7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Instrument Panel Center Accessory Function Switch Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup.

REAR CROSS TRAFFIC ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Side Object Sensor - Left Ground	-	U0232	-	-
Side Object Sensor - Left B+	-	U0232	-	-
Side Object Sensor - Left Communication (terminal 7)	1	U0232	1	-
Side Object Sensor - Left Communication (terminal 2)	1	U0233	1	Ã,Â
Side Object Sensor - Right Ground (terminal 8)	-	U0233	1	-
Side Object Sensor - Right Ground (terminal 3)	-	U0233	1	Ã,Â
Side Object Sensor - Right B+	1	U0233	-	-
Side Object Sensor - Right Communication	1	U0232	1	-
1. Rear Cross Traffic Alert System Malfunction				

Circuit/System Description

The side object sensor modules are located on each side of the vehicle behind the rear fascia and are not directly visible from outside the vehicle. The sensors use radar to determine the presence of objects nearby. When an object is detected in the rear cross traffic zone, the module will send out a signal through serial data communication to turn on the visual icons on the rear vision camera screen and also audio chime notification for the appropriate side. Each sensor is supplied B+ and ground. The right sensor receives an additional ground. Both sensors communicate independently on the serial data line. The serial data enters the left sensor in a pass-thru configuration, that connects to the right sensor. The scan tool is able to individually communicate with each sensor.

Diagnostic Aids

- The rear cross traffic alert system uses the same side blind zone sensors so a malfunction may affect either or both systems.
- The conditions for disabling the rear cross traffic alert system are captured by DTCs. The drivers information center will display Service Side Detection System if one of the sensors has failed.
- The rear cross traffic system can be disabled if any off the following occur:
  - The driver has selected the Off mode through vehicle personalization menus. The selected mode is retained over ignition cycles. A driver information center message stating that the Rear Cross Traffic System Alert Off shall be displayed.
  - There is a loss of serial data communication with a sensor or between modules.
  - A blockage condition exists (i.e. mud/snow buildup in front of the sensor). A driver information message stating that the side detection system is temporarily unavailable will be displayed. The rear cross traffic system transitions back to the normal operating state when the blockage is removed. Bumper sticks, fascia damage, labels, and heavy rain storms may also cause this condition. The blockage determination is performed with the vehicle in a drive gear.
  - The rear cross traffic alert system will read the GPS latitude and longitude on the serial data bus and calculate if the vehicle is within a Radio Astronomy zone. These zones are located in Europe and Japan and require the sensors to be turned off. The "Side Detection System Unavailable" message will be displayed to the driver when this occurs.
- Because the sensors are identical, they may be swapped from one side of the vehicle to the other in an attempt to isolate a concern. Sensors should NOT be swapped from one vehicle to another.
- The rear cross traffic alert system is designed to ignore stationary objects; however, the system may occasionally detect pedestrians, shopping carts, or other objects. This is normal system operation and does not require service.
- The rear cross traffic alert system may indicate an object if a trailer is attached to the vehicle, or a bicycle or object is extending out to either side of the vehicle. The system may also temporarily disable the system and display the "Side Detection System Unavailable" message.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Side Blind Zone Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool can communicate with the right side object sensor.
   - **If the scan tool can not communicate with the right side object sensor**

     Refer to Circuit/System Testing - Right Side Object Sensor Malfunction.

- **If the scan tool can communicate with the right side object sensor**

3. Verify the scan tool can communicate with the left side object sensor.
    - **If the scan tool can not communicate with the left side object sensor**

      Refer to Circuit/System Testing - Left Side Object Sensor Malfunction.

    - **If the scan tool can communicate with the left side object sensor**
4. Verify that the rear cross traffic indicators alerts turn ON and then turn OFF when commanding the Object Detection Alert Indicators ON and OFF with a scan tool.
    - **If alert indicators do not turn ON and OFF**
    1. Verify the system is enabled.
        - If disabled, refer to diagnostic aids for cause of disable.
        - If enabled, test or replace the radio.
    - **If indicators turn ON and OFF**
5. All OK.

Circuit/System Testing

Left Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the Side Object Sensor - Left.
2. Test for less than 10 Ω between ground circuit terminal 8 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle Off.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the Side Object Sensor - Left.
    - **If the test lamp illuminates**
4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 2 Ω in each of the serial data circuits end to end between the control module harness connector terminal 2 and the DLC terminal 1.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
6. Replace Side Object Sensor - Left.

Right Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the Side Object Sensor - Right.
2. Test for less than 10 Ω between the following ground circuit terminals and ground.
    - Terminal 3
    - Terminal 8
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle Off.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the Side Object Sensor - Right.
    - **If the test lamp illuminates**
4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 2 Ω in each of the serial data circuits end to end between the control module harness connector terminal 7 and the DLC terminal 1.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
6. Replace Side Object Sensor - Right.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Refer to **Control Module References** control module replacement, programming and setup

REAR VISION CAMERA SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

B127B 08

Rearview Camera Input Signal Circuit Malfunction

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	B127B 2B	-	-
Camera Module signal +	1	B127B 2B	1	-
Camera Module signal -	3	B127B 2B	1	-
Ground	-	B127B 2B	-	-
Shield	3	3	3	-
1. Rear Vision Camera Malfunction 2. Rear Vision Camera image always displayed 3. Poor Quality Image				

Circuit/System Description

When the vehicle is placed in reverse with the engine running, a video signal is sent from the rearview camera to the Radio. If the Radio does not see a signal from the camera it will set B127B 2B and display "Service Rear Vision System". The rearview camera is powered with ignition voltage and does not have a reverse signal circuit.

Conditions for Running the DTC

The vehicle must be in reverse with the engine running.

Conditions for Setting the DTC

B127B 08

Signal from the rearview camera not received by the Radio for 2.5 s.

Action Taken When the DTC Sets

- The Radio commands the driver information center to display "Service Rear Vision System".
- The Radio stores the DTC in memory.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 40 malfunction-free ignition cycles have occurred.

Diagnostic Aids

A poor video image can be caused by ice, snow, and mud buildup on the lens of the rearview camera. Also, extreme lighting conditions can affect performance, such as operating in the dark or with bright sunlight shining on the camera. Extreme high or low temperatures can also affect the image quality. An open in the shield of the video signal circuit can also cause a distorted screen.

Terminal fretting or incorrectly seated connectors can cause a poor image displayed condition. Check the circuit terminals for fretting or incorrectly seated connector. If the condition is intermittent or cannot be duplicated, disconnect the connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance condition due to terminal fretting corrosion.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Vision Camera Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add Nyogel lubricant 760G. This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Vehicle ON.
2. Verify that DTC B2545 is not set.
    - **If the DTC is set**

      Refer to DTC B2545 .

    - **If the DTC is not set**
3. Verify the rearview camera has no debris on the lens and that the bezel and bezel seal are not damaged.
    - **If debris is found on the lens**

      Clean the lens. If the lens, bezel, or bezel seal are damaged, replace as necessary.

    - **If no debris on the lens**
4. Vehicle ON, transmission in R.
5. Verify the backup lamps are illuminated.
    - **If the backup lamps are not illuminated**

      Refer to Backup Lamps Malfunction .

    - **If the backup lamps are illuminated**
6. Verify a clear rear vision image is displayed on the P17 Info Display Module.
    - **If a clear image is not displayed**

      Refer to Circuit/System Testing.

    - **If a clear image is displayed**
7. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the B87 Rearview Camera. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse. Refer to **Power Mode Mismatch** .
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the B87 Rearview Camera.
    - **If the test lamp illuminates**
5. Vehicle OFF, disconnect the X1 harness connector at the A11 Radio, vehicle ON.
6. Test for less than 1 V between the signal circuit terminal listed below and ground:
    - B87 Rearview Camera signal (+) circuit terminal 15
    - B87 Rearview Camera signal (-) circuit terminal 14
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
7. Test for infinite resistance between the signal circuit terminal listed below and ground:
    - B87 Rearview Camera signal (+) circuit terminal 15
    - B87 Rearview Camera signal (-) circuit terminal 14
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
8. Test for less than 2 Ω in the signal (+) circuit end to end.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
9. Test for less than 2 Ω in the signal (-) circuit end to end.
    - **If 2 Ω or greater**

      Test the signal circuit for an open/high resistance.

    - **If less than 2 Ω**
10. Replace the B87 Rearview Camera.
11. Vehicle ON, transmission in R,
12. Verify a clear rear vision image is displayed on the P17 Info Display Module.
    - **If a clear rear vision image is not displayed**

      Replace the A11 Radio.

    - **If a clear rear vision image is displayed**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Rearview Driver Information Camera Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup.

SIDE BLIND ZONE ALERT SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - Left Indicator	B094D 02	B094D 04	B094D 01	-
Ground - Left Indicator	-	B094D 04	-	-
Control - Right Indicator	B094E 02	B094E 04	B094E 01	-
Ground - Right Indicator	-	B094E 04	-	-

Circuit/System Description

The side blind zone alert system detects and reports objects on either side of the vehicle, within a specified blind spot zone. The system alerts with a visual indicator placed on each side rear view mirror, to the presence of objects that may not be visible in the inside rearview mirror and outside rearview mirrors. Although this system is intended to help drivers avoid lane change crashes, it does not replace driver vision and therefore should be considered a lane change aid. Even with the side blind zone system, the driver must check carefully for objects outside of the reporting zone (e.g., a fast approaching vehicle) before changing lanes. In the event that the system senses a malfunction through its diagnostic routines, the system will be disabled and the driver will be visually notified.

When the system detects a vehicle in the side blind zone while driving forward, independent if passing a vehicle or being passed, an amber warning symbol will light up in the appropriate outside mirror. This indicates that it may be unsafe to change lanes. If the driver then activates the turn signal, the amber warning symbol starts flashing as an extra warning not to change lanes.

Side blind zone alert is active when the vehicle is out of park or the parking brake is off on manual transmission vehicles and from speeds of 10 km/h (6.2 MPH) up to 140 km/h (87 MPH). Driving faster deactivates the system, indicated by dimly lighting the warning symbols in the mirrors. Driving under this speed again will turn off the warning symbols. If then a vehicle is detected in the blind zone, the warning symbols will turn on normally on the appropriate side. When the vehicle is started, both outside mirror displays will briefly come on to indicate that the system is operating.

Diagnostic Aids

- The conditions for disabling the side blind zone alert system are captured by DTCs. The drivers information center will display Service Side Detection System if one of the sensors has failed.
- The side blind zone system can be disabled if any off the following occur:
  - The driver has selected the Off mode through vehicle personalization menus. The selected mode is retained over ignition cycles. A driver information center message stating that the side blind zone system is off shall be displayed and the outside mirror indicators will be OFF.
  - There is a loss of serial data communication with a sensor or between modules.
  - A blockage condition exists (i.e. mud/snow buildup in front of the sensor). A driver information message stating that the side detection system is temporarily unavailable will be displayed. The rear cross traffic system transitions back to the normal operating state when the blockage is removed. Bumper sticks, fascia damage, labels, and heavy rain storms may

also cause this condition. The blockage determination is performed with the vehicle in a drive gear.
    - The side blind zone alert system will read the GPS latitude and longitude on the serial data bus and calculate if the vehicle is within a Radio Astronomy zone. These zones are located in Europe and Japan and require the sensors to be turned off. The "Side Detection System Unavailable" message will be displayed to the driver when this occurs.
- Because the sensors are identical, they may be swapped from one side of the vehicle to the other in an attempt to isolate a concern. Sensors should NOT be swapped from one vehicle to another.
- The side blind zone system is designed to ignore stationary objects; however, the system may occasionally detect guard rails, signs, trees, shrubs, or other stationary objects as an object in the blind zone. This is normal system operation and does not require service.
- The side blind zone system may indicate an object in the blind zone if a trailer is attached to the vehicle, or a bicycle or object is extending out to either side of the vehicle. The system may also temporarily disable the system and display the "Side Detection System Unavailable" message.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Side Blind Zone Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool can communicate with the left side object sensor.
    - **If the scan tool can not communicate with the left side object sensor**

      Refer to Circuit/System Testing - Left Side Object Sensor Malfunction.

    - **If the scan tool can communicate with the left side object sensor**
3. Verify the scan tool can communicate with the right side object sensor.
    - **If the scan tool can not communicate with the right side object sensor**

      Refer to Circuit/System Testing - Right Side Object Sensor Malfunction.

    - **If the scan tool can communicate with the right side object sensor**
4. Vehicle OFF, vehicle ON.
5. Verify that the side blind zone alert system indicator located in the appropriate outside rearview mirror turns ON and OFF when commanding the appropriate Object Detection Alert Indicator On and Off with a scan tool.
    - **If one or both indicators do not turn ON and OFF**

Refer to Circuit/System Testing - Side Object Indicator Malfunction.

- **If both indicators turn ON and OFF**

6. All OK.

Circuit/System Testing

Left Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. Disconnect the harness connector at the B218L Side Object Sensor Module - Left. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between ground circuit terminal 8 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle Off.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the B218L Side Object Sensor Module - Left.
    - **If the test lamp illuminates**
4. Vehicle OFF and all vehicle systems OFF. Disconnect the It may take up to 2 minutes for all vehicle systems to power down.
5. Test for less than 2 Ω between the serial data circuit terminal 2 and the DLC terminal 1.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
6. Replace B218L Side Object Sensor Module - Left.

Right Side Object Sensor Malfunction

1. Vehicle OFF and all vehicle systems OFF. Disconnect the harness connector at the B218R Side Object Sensor Module - Right. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the following ground circuit terminals and ground.
    - Terminal 3
    - Terminal 8
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**

3. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle Off.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the B218R Side Object Sensor Module - Right.
    - **If the test lamp illuminates**
4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 2 Ω between the serial data circuit terminal 7 and the DLC terminal 1.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
6. Replace B218R Side Object Sensor Module - Right.

Side Object Indicator Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector for the appropriate A9 Outside Rearview Mirror. It may take up to 2 min for all vehicle systems to power down.
    - X510 - Driver Door Harness to Outside Rearview Mirror
    - X610 - Passenger Door Harness to Outside Rearview Mirror
2. Test for less than 10 Ω between the ground circuit terminal 11 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON, connect a test lamp between the control circuit terminal 15 and the ground circuit terminal 11.
4. Verify the test lamp turns ON and OFF when commanding the Object Detection Alert Indicators ON and OFF with a scan tool.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the harness connector at the appropriate B218 Side Object Sensor Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the B218 Side Object Sensor Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the harness connector at the B218 Side Object Sensor Module, Vehicle ON.
    2. Test for less than 1 V between the control circuit and ground.

    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the B218 Side Object Sensor Module.
  - **If the test lamp turns ON and OFF**

5. Test or replace the appropriate E17 Outside Rearview Mirror Glass.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Outside Rearview Mirror Glass Replacement**
- Refer to **Control Module References** for control module replacement, programming and setup.

LANE DEPARTURE WARNING SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B356A

Vehicle Direction Warning Switch Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Lane Departure Warning Switch Signal	B356A 02	1	B356A 05	-
Lane Departure Warning Switch Ground	-	1	-	-
1. Lane Departure Warning Malfunction				

Circuit/System Description

The lane departure warning system is controlled by the Frontview Camera - Windshield mounted on the windshield. Lane departure warning is enabled and disabled through a switch located on the steering wheel. When enabled, the Frontview Camera - Windshield or Active Safety Control Module will illuminate the indicator located in the switch.

When the system is operating and can detect the lane markings, the Frontview Camera - Windshield will request via serial data communications that the instrument panel cluster illuminate the green lane departure ready - to - assist indicator. If the Frontview Camera - Windshield detects that the vehicle has crossed a lane marking without the turn signal being used, the module will request that the instrument cluster flash the yellow lane departure warning indicator. An audible warning may also sound three times or the haptic seat (if equipped) may pulse when the yellow Instrument Cluster indicator is flashing. The driver can select between audible or haptic alerts in the vehicle personalization menu. See the Owner's Manual for more detailed information on vehicle personalization.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

DTC B356A 02

The Frontview Camera Module has detected a short to ground for more than 10 s.

DTC B356A 05

The Frontview Camera Module has detected a short to voltage or an open/high resistance for more than 10 s.

Action Taken When the DTC Sets

- Lane departure warning is disabled.
- Service Lane Departure is displayed on the driver information center.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 100 consecutive malfunction-free ignition cycles have occurred.

Diagnostic Aids

Manually pressing the lane departure warning switch for an extended length of time will cause this DTC to set.

Reference Information

Schematic Reference

Object Detection Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Forward Collision Alert Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Lane Departure Warning Switch Status parameter changes between Open and Closed while cycling the lane departure warning switch.
    - **If the parameter does not change**

      Refer to Circuit/System Testing.

    - **If the parameter changes**
3. All OK.

Circuit/System Testing - Without MBM

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70L Steering Wheel Controls Switch - Left.

2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Vehicle Direction Warning Switch Status parameter is Open.
    - **If not Open**
    1. Ignition OFF, disconnect the harness connector at the B174W Frontview Camera - Windshield.
    2. Test for infinite resistance between the S70L Steering Wheel Controls Switch - Left signal circuit terminal 2 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the B174W Frontview Camera - Windshield.
    - **If Open**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and ground.
6. Verify within 10 s the scan tool Vehicle Direction Warning Switch Status parameter is Closed.
    - **If not Closed**
    1. Ignition OFF, disconnect harness connector at the B174W Frontview Camera - Windshield. Ignition ON.
    2. Test for less than 1 V between the S70L Steering Wheel Controls Switch - Left signal circuit terminal 2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the B174W Frontview Camera - Windshield.
    - **If Closed**
7. Test or replace the S70L Steering Wheel Controls Switch - Left.

Circuit/System Testing - with MBM

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48D Multifunction Switch 2 - Instrument Panel.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Vehicle Direction Warning Switch Status parameter is Open.
    - **If not Open**
    1. Ignition OFF, disconnect the harness connector at the B174W Frontview Camera - Windshield.
    2. Test for infinite resistance between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 3 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.

    - If infinite resistance, replace the B174W Frontview Camera - Windshield.
    - **If Open**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.
6. Verify within 10 s the scan tool Vehicle Direction Warning Switch Status parameter is Closed.
    - **If not Closed**
    1. Ignition OFF, disconnect harness connector at the B174W Frontview Camera - Windshield. Ignition ON.
    2. Test for less than 1 V between the S48D Multifunction Switch 2 - Instrument Panel signal circuit terminal 3 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the B174W Frontview Camera - Windshield.
    - **If Closed**
7. Test or replace the S48D Multifunction Switch 2 - Instrument Panel.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cruise Control Switch Replacement**
- Refer to **Instrument Panel Center Accessory Function Switch Replacement**
- Refer to **Control Module References** for control module replacement, programming, and setup.

REPAIR INSTRUCTIONS

FORWARD COLLISION ALERT DISPLAY REPLACEMENT

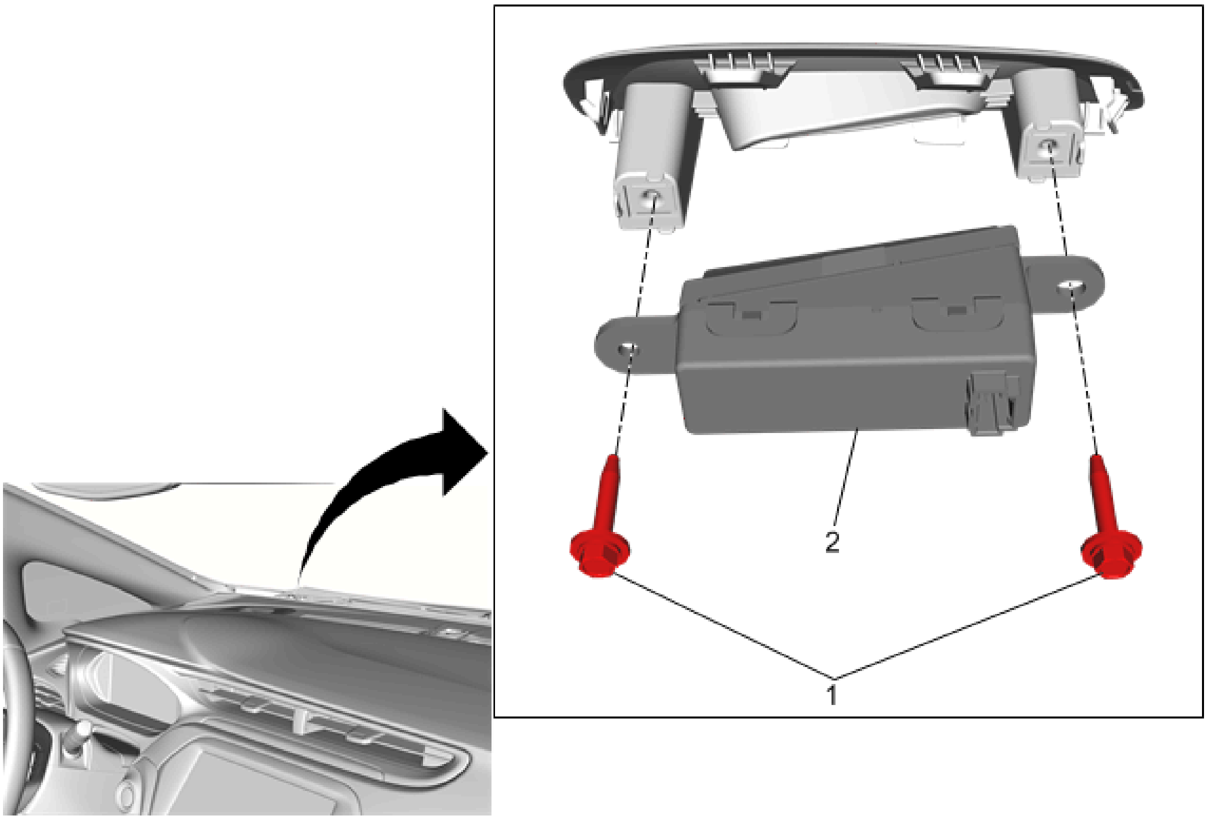


Fig. 11: Forward Collision Alert Display
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure Remove Forward Collision Alert Display Bezel. Refer to Forward Collision Alert Display Bezel Replacement	
1	Forward Collision Alert Display Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Forward Collision Alert Display **Procedure** Disconnect the electrical connector.

PARKING ASSIST CONTROL MODULE REPLACEMENT

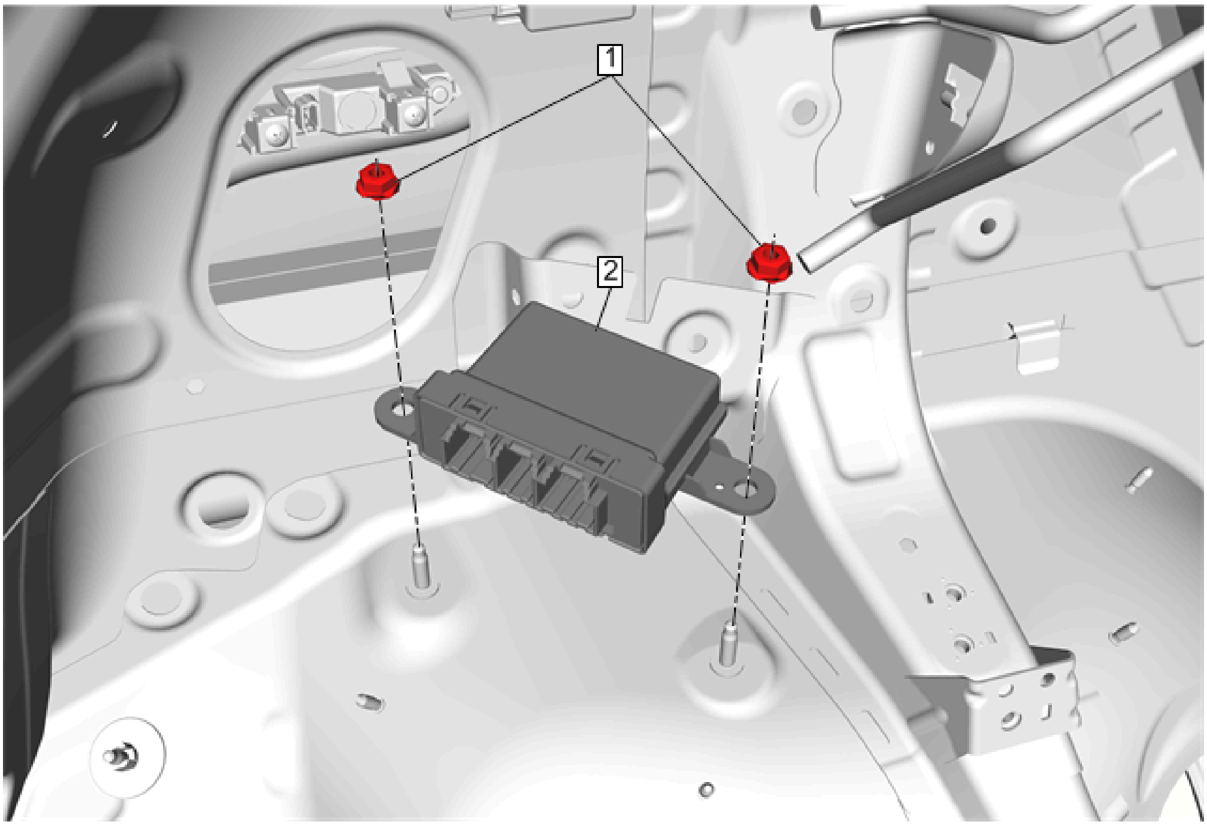


Fig. 12: Parking Assist Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Quarter Lower Rear Trim Panel - Left Side. Refer to Quarter Lower Rear Trim Panel Replacement	
1	Parking Assist Control Module Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution** **Tighten** 5 N.m (44 lb in)

Callout	Component Name
2	Parking Assist Control Module **Procedure** 1. Disconnect the electrical connector. 2. Perform the necessary programming and setup procedure. Refer to **Control Module References**

ADVANCED PARKING ASSIST ALARM SENSOR REPLACEMENT (FRONT)

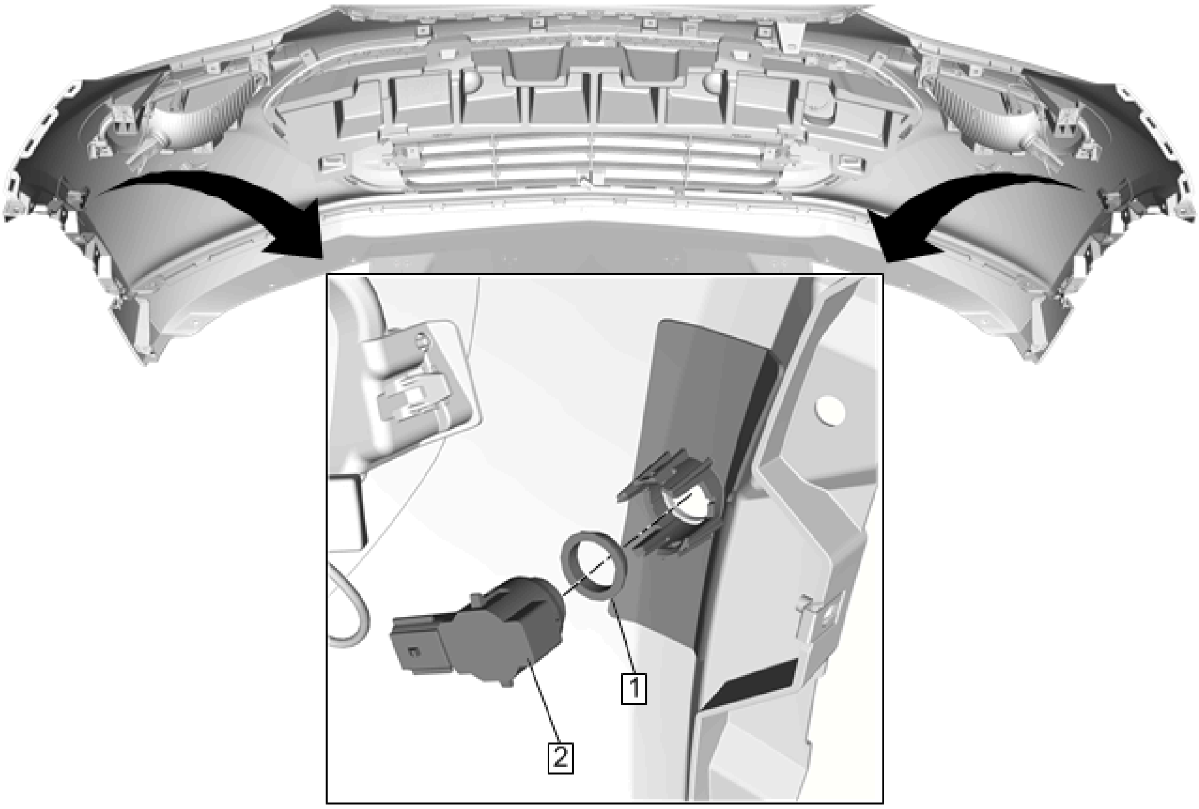


Fig. 13: Advanced Parking Assist Alarm Sensor (Front)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia. Refer to **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**	
1	Advance Parking Assist Alarm Sensor Ring
2	Advance Parking Assist Alarm Sensor **CAUTION:** **When painting the park assist sensors, DO NOT exceed a paint thickness of 80-120 micrometer. The overall thickness of the paint coat on the park assist sensors should be between 80-120 micrometer. If this paint thickness is exceeded, it may result in poor functioning of the parking assist sensors.** **Procedure** 1. Disconnect the electrical connector. 2. Lift the locking tabs on the housing and remove the parking assist alarm sensor.

ADVANCED PARKING ASSIST ALARM SENSOR REPLACEMENT (REAR)

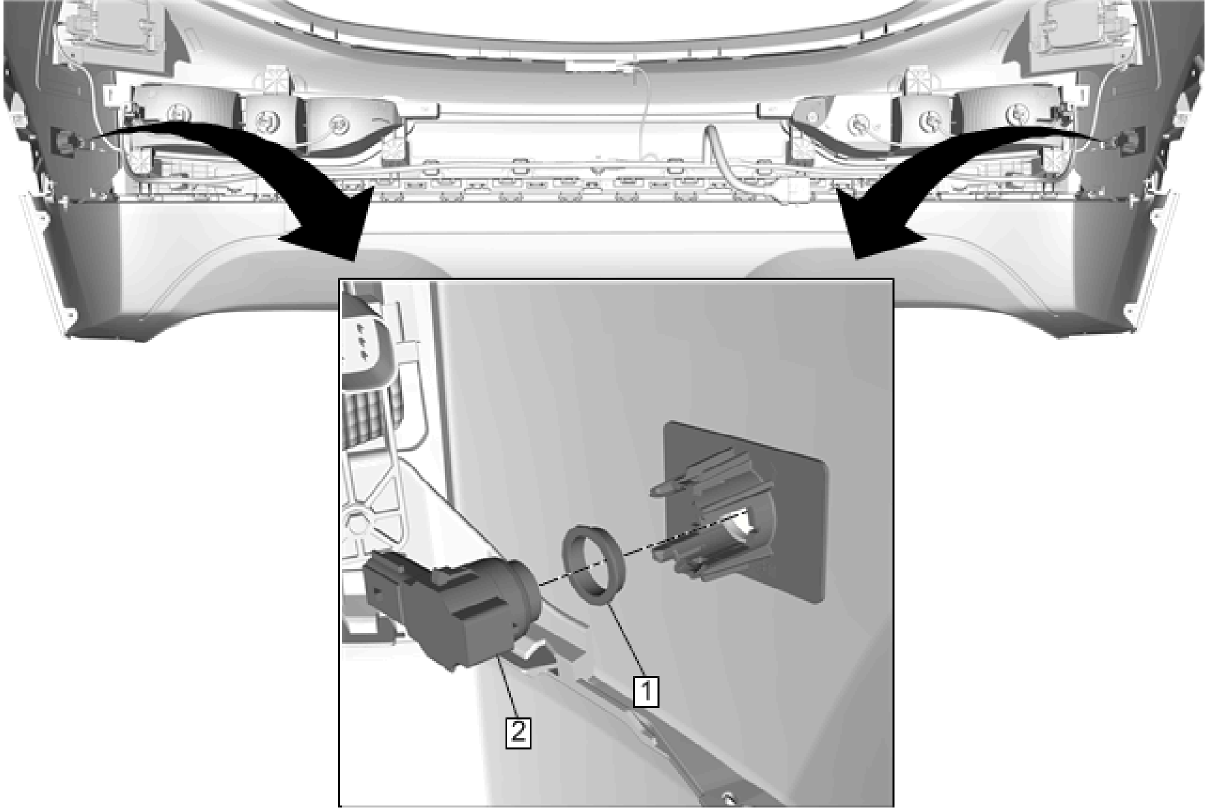


Fig. 14: Advanced Parking Assist Alarm Sensor (Rear)
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
Remove Rear Bumper Fascia. Refer to Rear Bumper Fascia Replacement</td></tr>
<tr><td>1</td><td>Advance Parking Assist Alarm Sensor Ring</td></tr>
<tr><td>2</td><td>Advance Parking Assist Alarm Sensor
CAUTION:
When painting the park assist sensors, DO NOT exceed a paint thickness of 80-120 micrometer. The overall thickness of the paint coat on the park assist sensors should be between 80-120 micrometer. If this paint thickness is exceeded, it may result in poor functioning of the parking assist sensors.
Procedure
1. Disconnect the electrical connector.
2. Lift the locking tabs on the housing and remove the parking assist alarm sensor.</td></tr>
</table>

FRONT PARKING ASSIST ALARM SENSOR REPLACEMENT

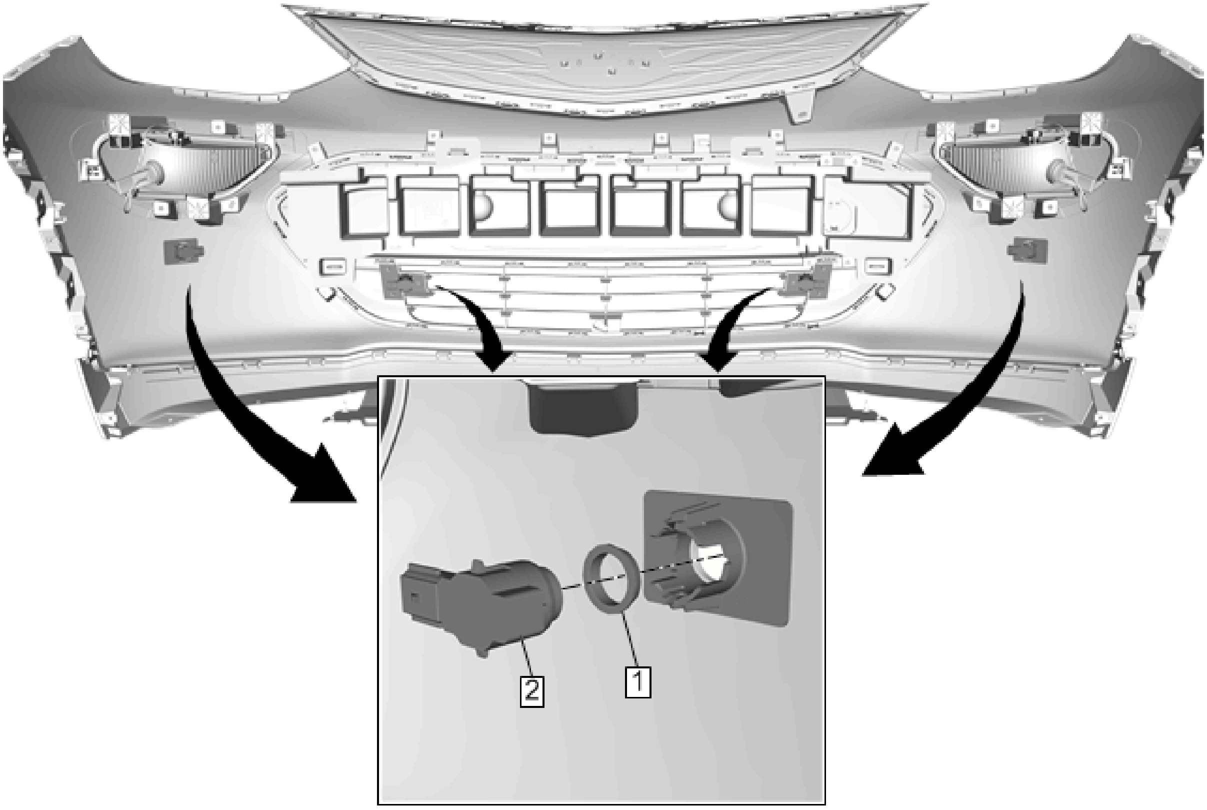


Fig. 15: Front Parking Assist Alarm Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia. Refer to **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**	
1	Front Parking Assist Alarm Sensor Ring
2	Front Parking Assist Alarm Sensor **CAUTION:** **When painting the park assist sensors, DO NOT exceed a paint thickness of 80-120 micrometer. The overall thickness of the paint coat on the park assist sensors should be between 80-120 micrometer. If this paint thickness is exceeded, it may result in poor functioning of the parking assist sensors.** **Procedure** 1. Disconnect the electrical connector. 2. Lift the locking tabs on the housing and remove the parking assist alarm sensor.

SIDE OBJECT SENSING ALERT MODULE REPLACEMENT

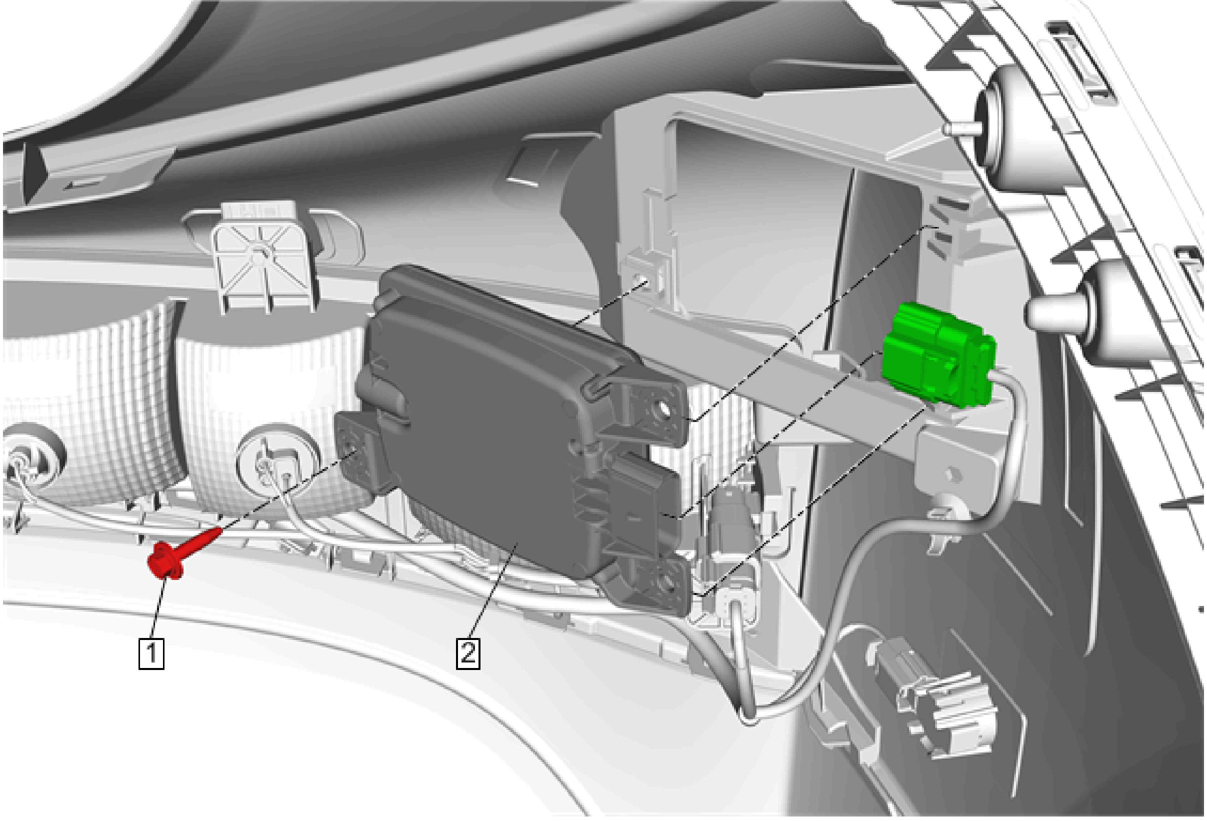


Fig. 16: Side Object Sensing Alert Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Bumper Fascia Replacement	
1	Side Object Sensing Alert Module Bolt **CAUTION:** **Refer to Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Side Object Sensing Alert Module **Procedure** 1. Disconnect the electrical connector. 2. Perform the necessary programming and setup procedure. Refer to Control Module References

REAR PARKING ASSIST ALARM SENSOR REPLACEMENT

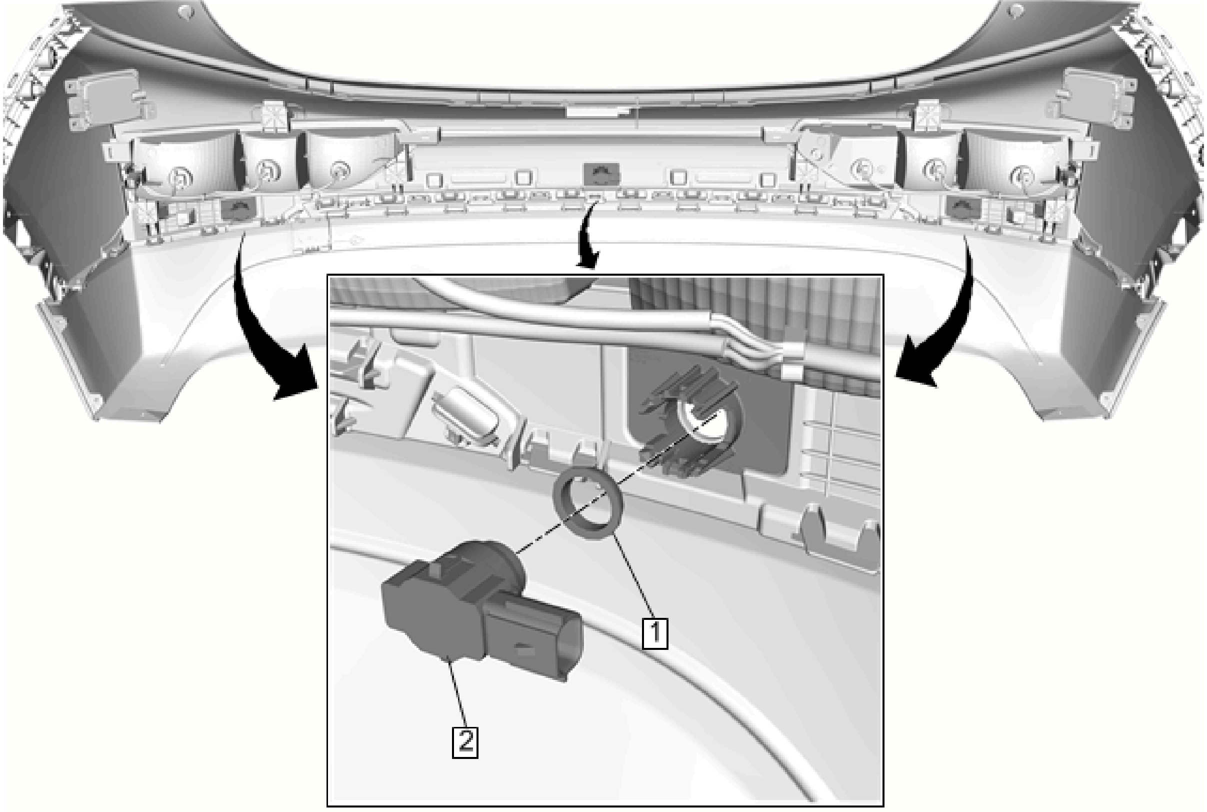


Fig. 17: Rear Parking Assist Alarm Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Bumper Fascia. Refer to **Rear Bumper Fascia Replacement**	
1	Rear Parking Assist Alarm Sensor Ring
2	Rear Parking Assist Alarm Sensor **CAUTION:** **When painting the park assist sensors, DO NOT exceed a paint thickness of 80-120 micrometer. The overall thickness of the paint coat on the park assist sensors should be between 80-120 micrometer. If this paint thickness is exceeded, it may result in poor functioning of the parking assist sensors.** **Procedure** 1. Disconnect the electrical connector. 2. Lift the locking tabs on the housing and remove the parking assist alarm sensor.

MULTIFUNCTION RELAY MODULE BRACKET REPLACEMENT (WITH FRONT VIEW CAMERA)

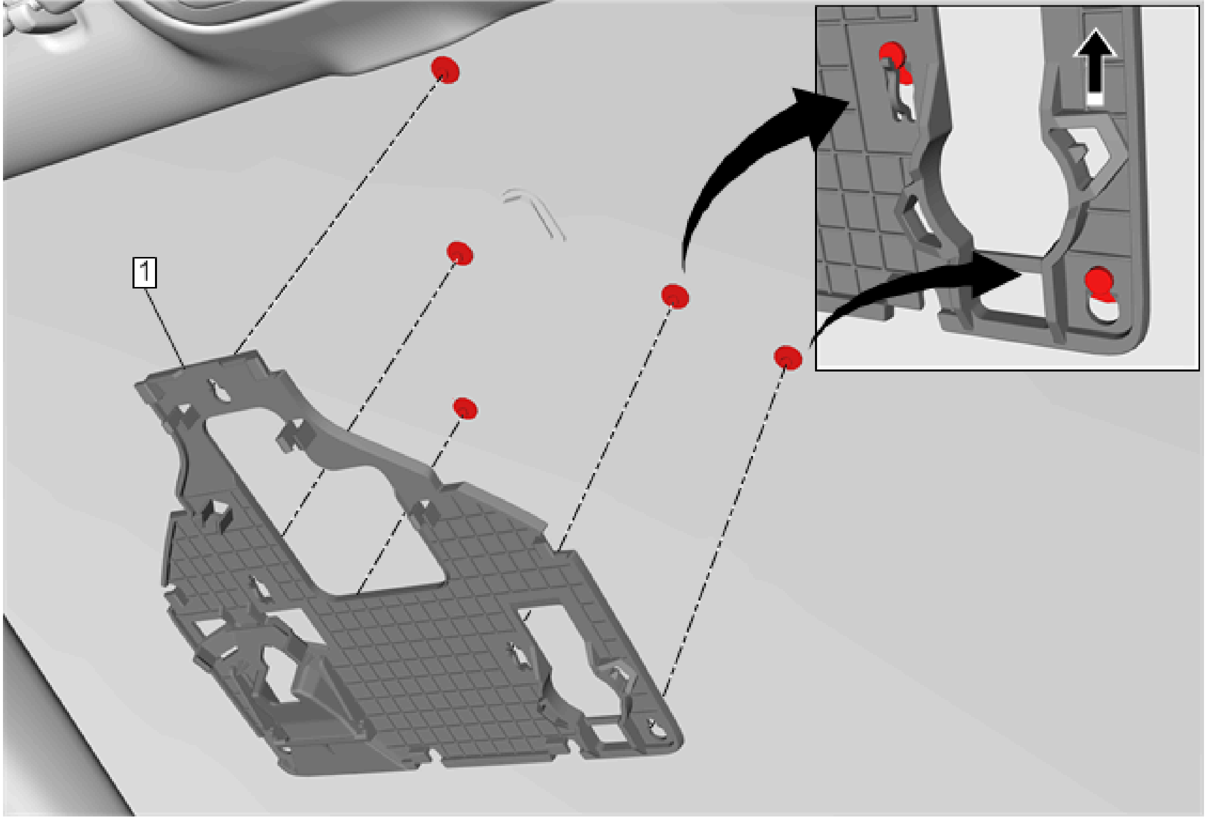


Fig. 18: Multifunction Relay Module Bracket (With Front View Camera)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove Front View Camera. Refer to Front View Camera Replacement 2. Remove Inside Air Moisture and Windshield Temperature Sensor (With Front View Camera). Refer to Inside Air Moisture and Windshield Temperature Sensor Replacement (With Front View Camera) 3. Remove Inside Rearview Mirror. Refer to Inside Rearview Mirror Replacement	
1	Multifunction Relay Module Bracket **Procedure** Slide the bracket upward to disengage tabs, gently pull from windshield.

MULTIFUNCTION RELAY MODULE BRACKET REPLACEMENT (WITHOUT FRONT VIEW CAMERA)

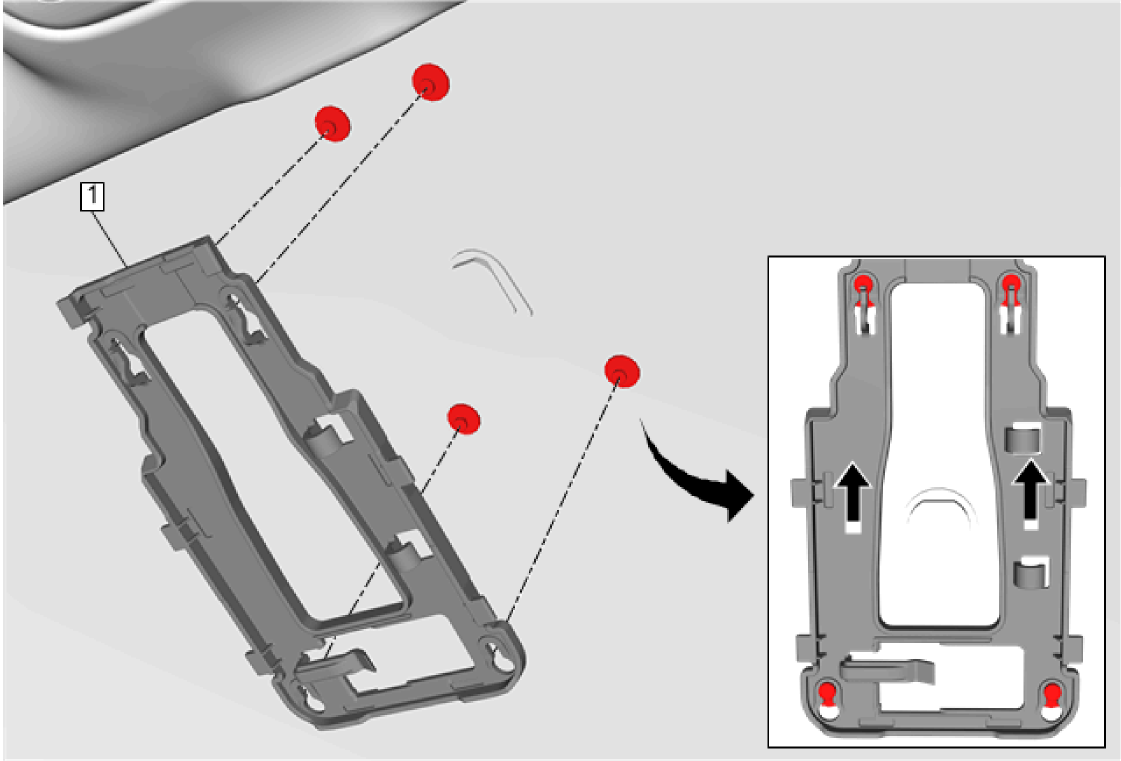


Fig. 19: Multifunction Relay Module Bracket (Without Front View Camera)
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedure
1. Remove Inside Air Moisture and Windshield Temperature Sensor (Without Front View Camera). Refer to Inside Air Moisture and Windshield Temperature Sensor Replacement (Without Front View Camera)
2. Remove Inside Rearview Mirror. Refer to Inside Rearview Mirror Replacement</td></tr>
<tr><td>1</td><td>Multifunction Relay Module Bracket
Procedure
1. Unclip wiring as necessary.
2. Slide the bracket upward to disengage tabs, gently pull from windshield.
NOTE:
Releasing the bracket is restricted by headliner. The bracket must be forced into the headliner and then released.</td></tr>
</table>

SIDE VIEW DRIVER INFORMATION CAMERA REPLACEMENT

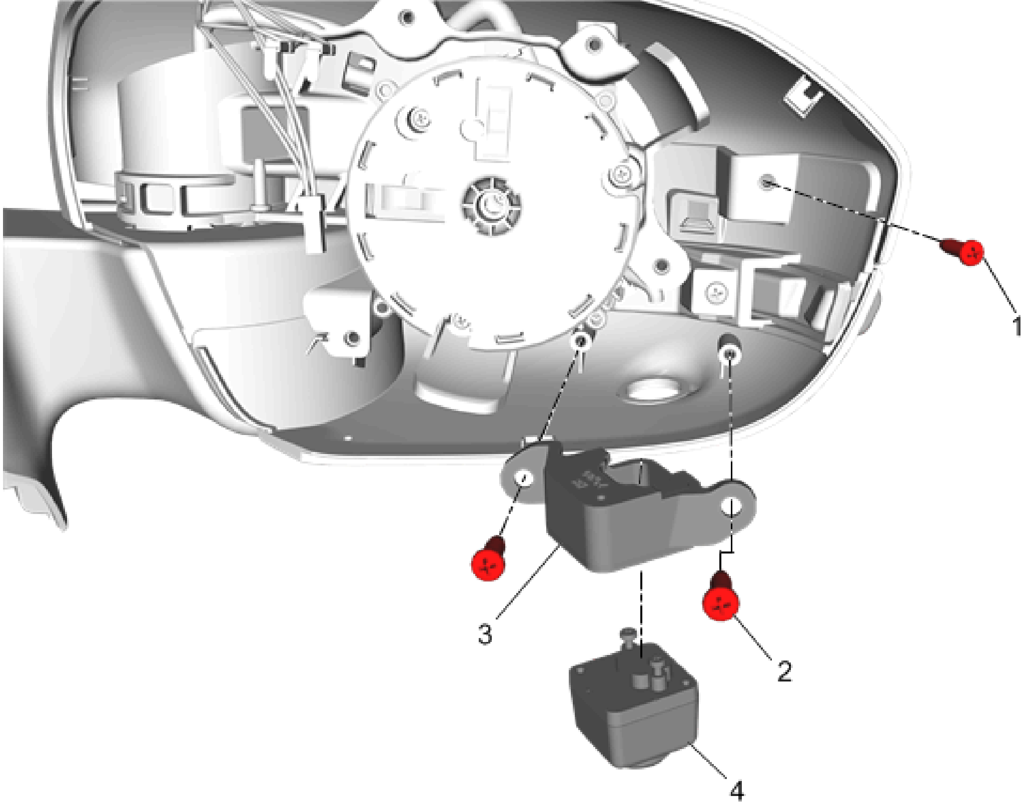


Fig. 20: Side View Driver Information Camera
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Outside Rearview Mirror Housing Bezel. Refer to Outside Rearview Mirror Housing Bezel Replacement	
1	Outside Rearview Mirror Housing Lower Cover Screw **CAUTION:** **Refer to Fastener Caution** **Tighten** 0.5 N.m (4 lb in)
2	Side View Driver Information Camera Screw (Qty: 2) **Tighten** 0.8 N.m (7 lb in)
3	Side View Driver Information Camera Bracket **Procedure** Slide off once camera is removed.
4	Side View Driver Information Camera **Procedure** 1. Separate the outside rearview mirror housing lower cover from upper cover. 2. Unclip and disconnect the electrical connector.

FRONT VIEW CAMERA REPLACEMENT

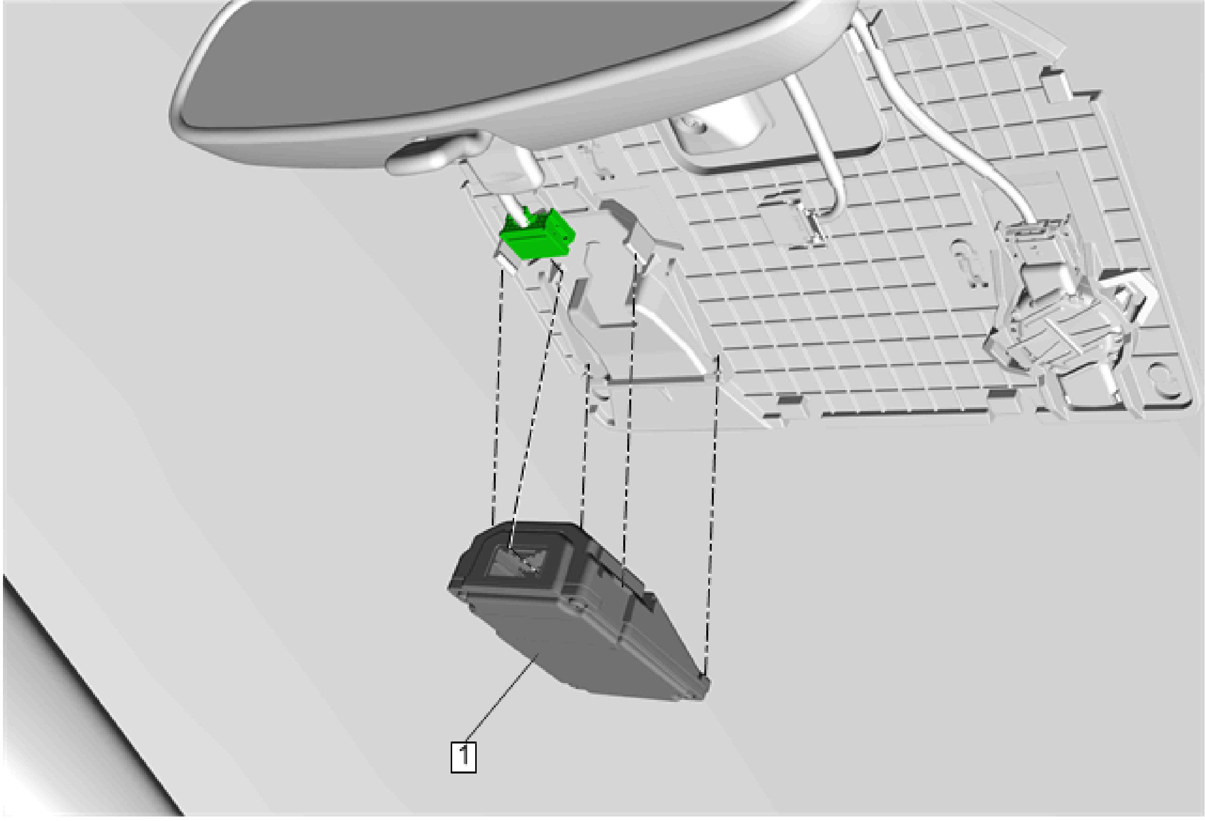


Fig. 21: Front View Camera
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Windshield Multifunction Sensor Mount Bracket Cover (with Front View Camera). Refer to **Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera)**	
1	Front View Camera **Procedure** 1. Gently release the retaining tabs on bracket. 2. Disconnect the electrical connector. 3. Perform all necessary programming and setup procedures for the control module. Refer to **Control Module References**

FRONT VIEW DRIVER INFORMATION CAMERA REPLACEMENT

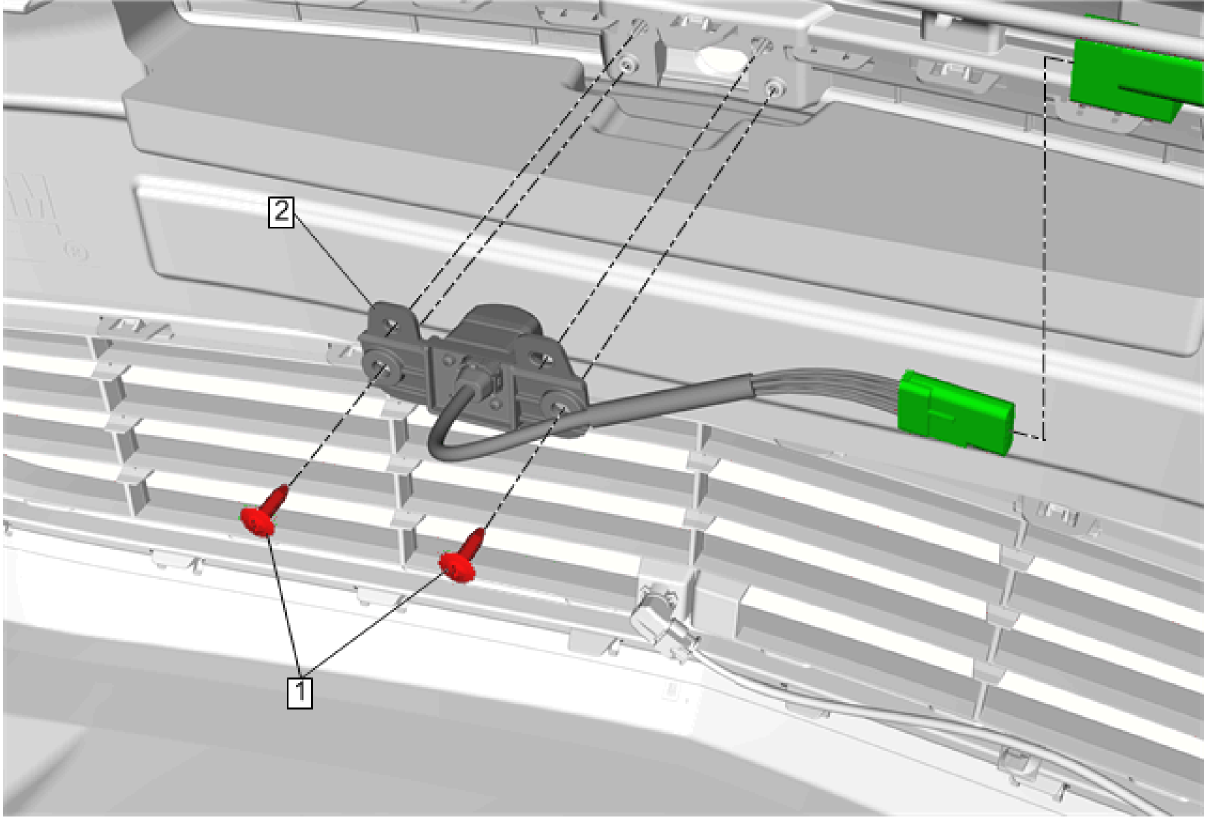


Fig. 22: Front View Driver Information Camera
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia. Refer to Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)	
1	Front View Driver Information Camera Fastener (Qty: 2) **CAUTION:** **Refer to Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Front View Driver Information Camera **Procedure** Disconnect the electrical connector.

REARVIEW DRIVER INFORMATION CAMERA REPLACEMENT

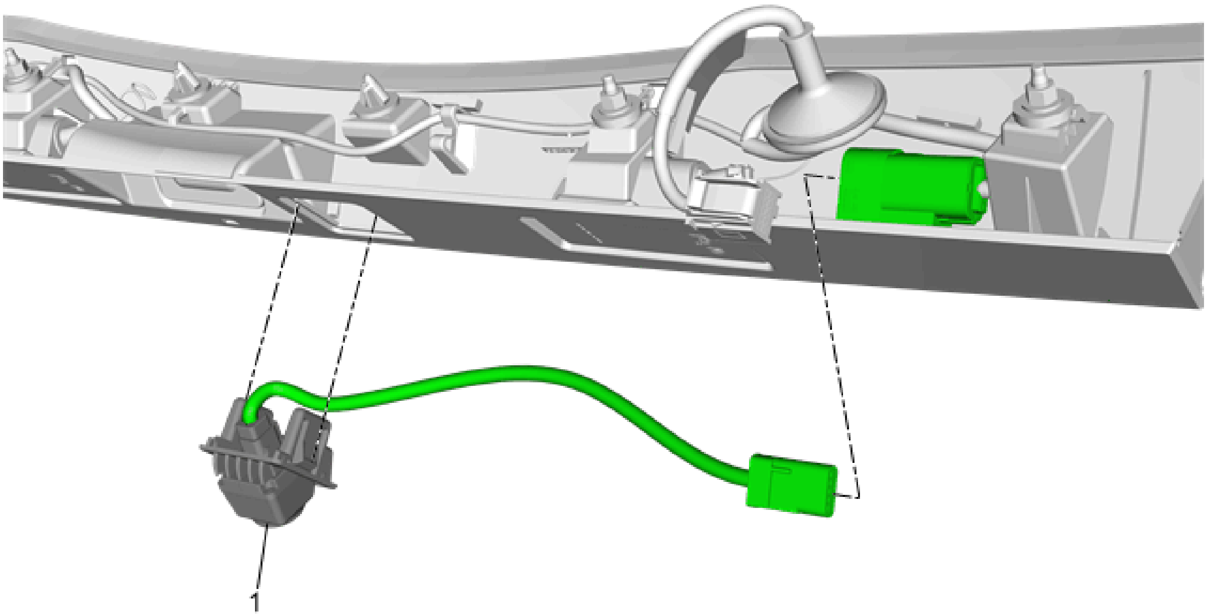


Fig. 23: Rearview Driver Information Camera
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Closure Center Applique. Refer to **Rear Closure Center Applique Replacement**	
1	Rearview Driver Information Camera **Procedure** Disconnect the electrical connector.

FRONT VIEW CAMERA MODULE LEARN

Calibration

For North American SPS users, **Calibration will NOT start automatically** and will need to be initiated with GDS2. For European SPS users, **Calibration will start automatically** and will not need to be initiated with GDS2.

The calibration process for the front view camera system is necessary when a front view camera module is replaced by a new one. **This process is required when only replacing the windshield** and the frontview camera module has been mounted again properly. This process shall be completed within 3 - 5 minutes when the correct driving conditions are met. If conditions are not met, the K109 Frontview Camera Module will attempt to complete the service point calibration for 20 minutes after initialized. If the service point calibration does not complete within 20 minutes key-off the vehicle and the service point calibration will automatically restart on the next ignition cycle. This process shall work across ignition cycles and shall not be required to be re-initialized at start up. If the Lane Departure Warning or Lane Keep Assist Switch is pressed during calibration, the indictor will flash momentarily and then stay out - this is normal operation.

During this time the Lane Departure Warning or Lane Keep Assist amber indicator will illuminate.

To calibrate the front camera, operate the vehicle in the following conditions until the calibration is complete:

NOTE: **If the front view camera module calibration is not completed during the current ignition cycle, it will restart in next ignition cycle. "Service Front Camera" will be displayed until successful calibration and DTC B1008 4B may be active.**

When Lane Departure Warning is on, the indicator is green if Lane Departure Warning is available to warn of a lane departure. If the vehicle crosses a detected lane marking without using the turn signal in that direction, the indicator changes to amber and flashes. To verify if the system is working the indicator on the switch should remain illuminated once pressed, and when up to speeds greater than 35 mph (56 km/h), the lane departure indicator will illuminate on the instrument cluster.

The power mode be in ACCY for the calibration process to become enabled by using the scan tool. GDS2 will display a "loss of com" error message when the procedure is attempted in any power mode other than ACCY.

- Clean windshield.
- Avoid lane changes.
- Maintain vehicle speeds between 56 - 90 km/h (35 - 56 MPH).
- Ensure the road contains visible references (well defined lane markings, curbs, etc.).

Calibration Procedure (Required for North American SPS users)

1. Apply the parking brake.
2. Place the transmission in Park (if applicable)
3. **Place vehicle in ACCY Power Mode**
4. Install scan tool
5. Navigate to the module diagnostics menu
6. Select Frontview Camera Module
7. Select Configuration/Reset Functions menu Item
8. Select the Frontview Camera Learn procedure and follow the directions displayed on the screen.
9. Drive the vehicle to complete calibration.

Once the procedure is complete, the amber indicator will turn off. Shortly after the green ready to assist light should turn on as long as all conditions are met for normal operation. The system is then ready to assist.

If Slow to Calibrate

The ideal calibration condition is driving on a 2 lane divided highway with markings on both sides of the lane. One or more of the following conditions may increase the length of time required to complete the self-calibration procedure: :

- Camera not properly installed. Verify it is snapped into tabs and is secure. Refer to **Front View Camera Replacement**.
- Heavy traffic
- Stop and go traffic
- Mountain roads
- Curves in roadway
- Poor contrast lane markings
- Botts' Dots type lane markings
- Operating the vehicle speed is greater than 90 km/h (56 MPH)
- Driving through snow or fog, or driving directly into the sun

No Calibration

Conditions that will prevent completion of the self-calibration procedure:

- Camera not properly installed. Verify it is snapped into tabs and is secure. Refer to **Front View Camera Replacement**.
- Dirty windshield glass or obstruction on windshield

- Operating the vehicle with speed less than 56 km/h (35 MPH)
- No visible lane markings
- Severe weather where lane markings cannot be seen

PARKING ASSIST SENSOR LEARN CALIBRATION

Calibration

The calibration process for the Parking Assist system is necessary when a parking assist sensor has been replaced or improperly learned.

To calibrate the Parking Assist sensors:

NOTE: **Parking Assist Sensors should be at or near room temperature**

1. Select **Parking Assist Sensor Learn** in the scan tool
2. Operate the vehicle in the following conditions until the calibration is complete:
    - Nothing is within 50 cm of the parking assist sensors
    - Ensure the parking assist sensors are clean
3. Vehicle OFF, scan tool disconnected, all doors closed, all accessories OFF, open and close driver door. It may take up to 2 min for all vehicle systems to power down.
4. Verify Parking Assist system is operating correctly and there are no DTCs set.

No Calibration

Conditions that will prevent completion of the self-calibration procedure:

- Dirty or contaminated obstruction on the parking assist sensor
- Objects are within 50 cm of the parking assist sensors

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for control module replacement, programming and setup

VIDEO PROCESSING MODULE REPLACEMENT

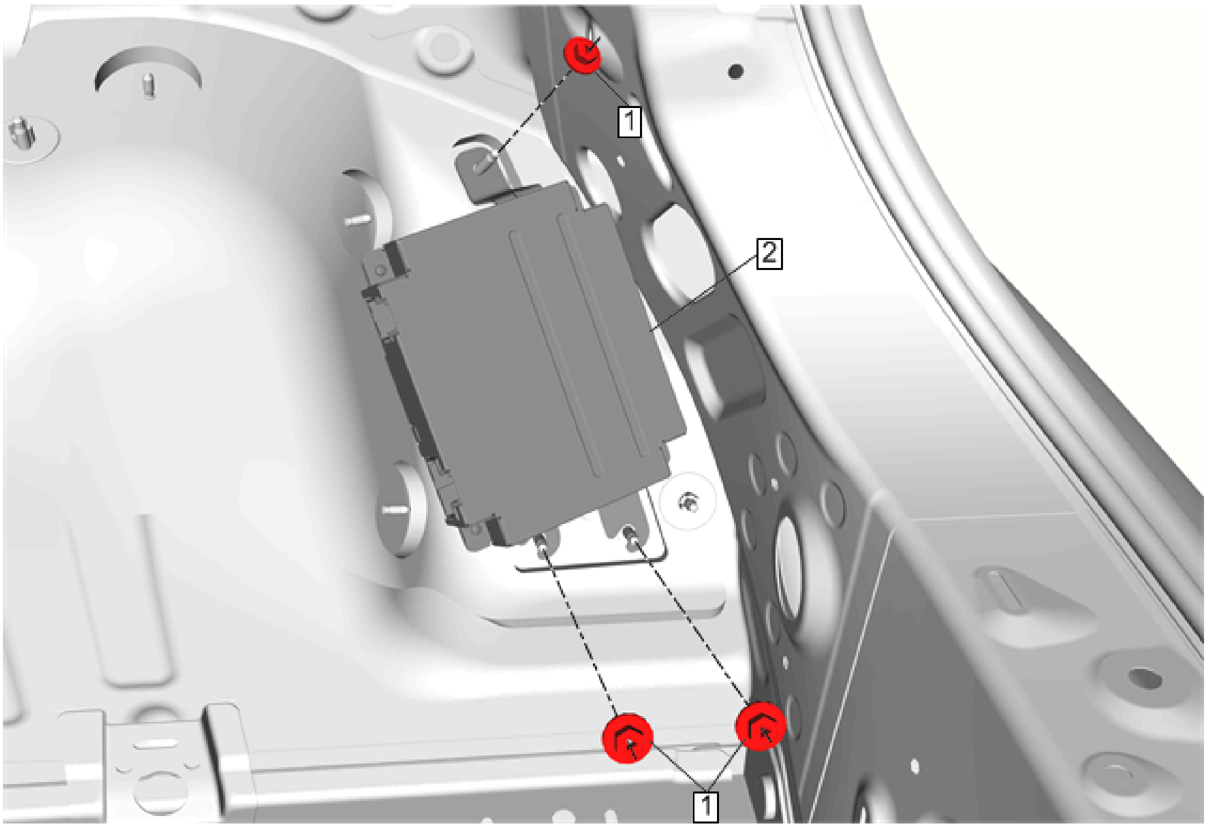


Fig. 24: Video Processing Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Quarter Lower Rear Trim Panel - Right Side. Refer to Quarter Lower Rear Trim Panel Replacement	
1	Video Processing Module Nut (Qty: 3) **CAUTION:** **Refer to Fastener Caution** **Tighten** 8 N.m (71 lb in)
2	Video Processing Module **Procedure** 1. Disconnect the electrical connector. 2. Perform the necessary programming and setup procedure. Refer to Control Module References

VIDEO PROCESSING CONTROL MODULE CALIBRATION

NOTE: **Image will be slightly distorted at all times, the camera(s) lens is a fish-eye lens meant to capture as much as possible.**

The calibration procedure is to have the Video Processing Control Module learn the new cameras and their positions. The calibration does not start automatically or if manual initialization is desired, calibration can be initiated by selecting Video Processing Control Module Camera Learn in the scantool.

Radio Display Prompt Example

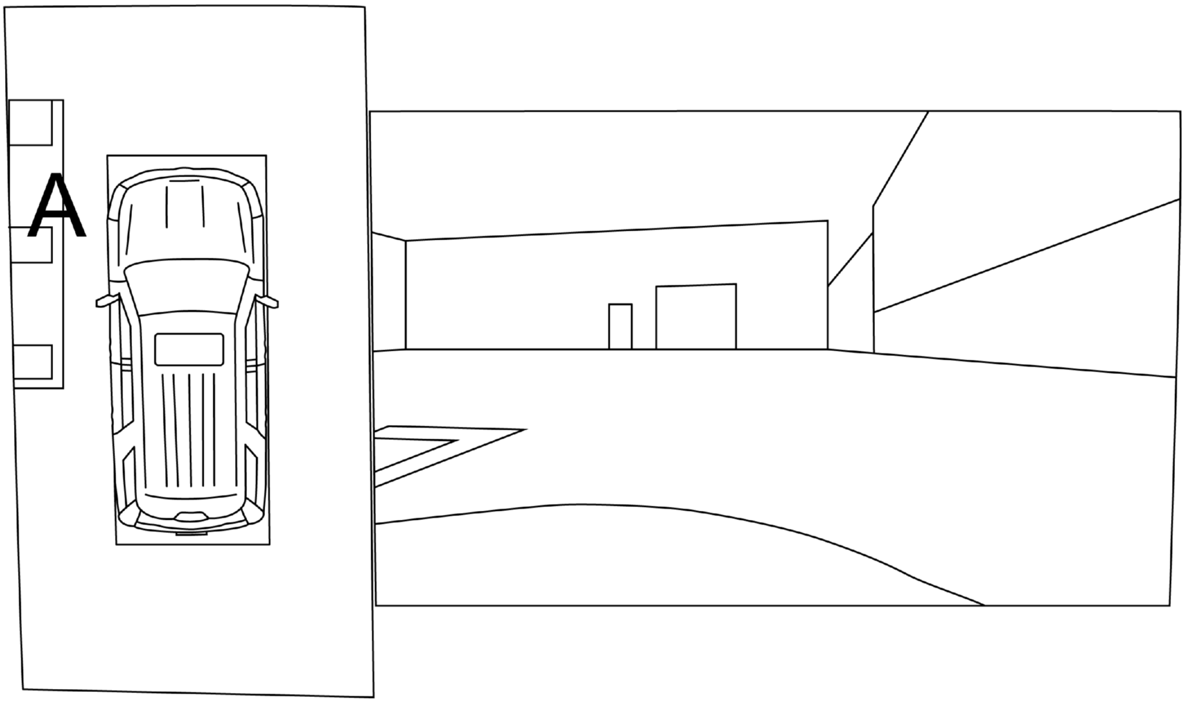


Fig. 25: Radio Display Prompt Example
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Only ONE EL-51372 Camera Calibration Mat is required for calibration.**

The left side of the screen will display where the **EL-51372** Camera Calibration Mat should be located for each step. The right side of the display is the view from the camera that is being learned during that step.

Mat Position Reference

- Position A is the left front
- Position B is the right front
- Position C is the left rear
- Position D is the right rear

Diagnostic Aids

- If any one of the cameras is replaced on the Surround Vision Camera System, the displayed image may not be correctly stitched due to a change in the location or orientation of the camera. The only way to correct an incorrectly stitched image is to perform the calibration procedure.
- Tires must be inflated properly
- Vehicle must be on a level surface
- Mirrors must be folded out
- It is a good practice to wipe camera lens' clean prior to alignment
- Interfering objects or glare from overhead lighting will fail an alignment
- All points of access to the inside of the vehicle **Must** be closed, including hood.
- **Finalize** is the very last step, this saves all the data from the alignment

Calibration

NOTE: **Diagnostic Aids MUST be followed prior to Calibration**

This is the calibration process for the Surround Vision Camera system. When the Video Processing Control Module is replaced, calibration must be performed. If the following occurs, calibration is recommended but not required:

- If a camera is replaced
- If mirrors or fascias are replaced, removed, or physically adjusted

To calibrate the cameras, operate the vehicle in the following conditions until the calibration is complete:

- Clean camera lenses.
- Follow the on screen instructions with regards to EL-51372 camera mat placement
- Vehicle must be ignition ON or Vehicle ON

NOTE:

- **Camera Calibration Mat location is very critical for the cameras to learn. If the image displayed is heavily distorted, the mat position was not correct. For correct mat location, refer to the box EL-51372 came in. Place the mat 50 cm from the vehicle when performing calibration or camera learn. For Fore/Aft alignment, place the mat so the distance from the closest edge of the center square, to the bumper, is 70 cm.**
- **Camera Calibration Mat must be as flat as possible. Wrinkles in the matt will cause a distorted view for the camera.**
- **When an exclamation (!) is seen on the radio display, camera learn was not completed or there was an error. To clear this, press Retry**
- **At any point where the Calibration is stuck and radio display does not show any camera images, clicking Cancel from the**

scan tool learn screen will resolve the issue and will return to previous learn position

- **If at any point in the calibration procedure the alignment process is interrupted, clicking Retry from the scan tool learn screen will cancel the current learn process and can be procedure can be restarted**
- **DO NOT Click Finalize prior to step 7**

1. Using the scan tool, select the desired camera to calibrate, or all cameras if necessary.
2. Click Initiate on the scan tool learn screen. This starts the calibration process.
3. The radio display will show the desired EL-51372 camera calibration mat position.

NOTE: **Mat must be flat on the floor**

4. Place the EL-51372 camera mat in the position shown on the display. Use the box EL-51372 came as a ruler to align the mat with the vehicle correctly.

NOTE: **In an event of an error, click the Retry button to reset the image and try a new capture. DO NOT Click Finalize until step 7**

5. Once the mat is correctly positioned, Click **Capture** on the scan tool learn screen. This captures the image.
    - If a red "X" is displayed, correct the EL-51372 camera mat position
    - If a green checkmark is displayed, the image was accepted.
6. Leave the EL-51372 camera mat in that position until the camera display prompts for it to be moved to the next position, or if calibration is complete.
7. Once the last camera image has been capture, click Finalize on the scan tool learn screen. This completes the learn.

Sequence of Camera Alignment

Left Camera Alignment Learn:

1. Captures an image at Position C
2. Captures an image at Position A

Right Camera Alignment Learn:

1. Captures an image at Position D
2. Captures an image at Position B

Front Camera Alignment Learn:

1. Captures an image at Position A
2. Captures an image at Position B

Rear Camera Alignment Learn:

1. Captures an image at Position D
2. Captures an image at Position C

All Cameras Alignment Learn:

1. Captures an image at Position A
2. Captures an image at Position B
3. Captures an image at Position C
4. Captures an image at Position D

Error Codes during alignment

Error Code	Cause	Possible Repair
0101 Front Camera 0103 Front Camera 0201 Right Camera 0203 Right Camera 0301 Rear Camera 0303 Rear Camera 0401 Left Camera 0403 Left Camera	Lighting Issue, Obstructed View of Target, Target Position out of Range, Poor Camera installation	Correct Lighting, Reposition Target, Verify Camera correctly installed and clean.
0102 Front 0202 Right 0302 Rear 0402 Left	Lighting Issue, Obstructed View of Target, Target Position out of Range	Correct Lighting, Reposition Target, Verify Camera is clean.
0104 Front 0204 Right 0304 Rear 0404 Left	Camera Position incorrect	Correct camera position
0120 Front 0220 Right 0320 Rear 0420 Left	NTSC error detected	Verify camera electrical connection
FFF0 Passenger Door FFF1 Left Rear Door FFF2 Right Rear Door FFF3 Driver Door FFF4 Trunk FFF5 Hood FFF6 Liftglass	Hood, Door, Liftgate, Trunk or other part of car OPEN	Close all doors, Hood, Liftgate, and Trunk

VIDEO DISPLAY INSIDE REARVIEW MIRROR CAMERA REPLACEMENT

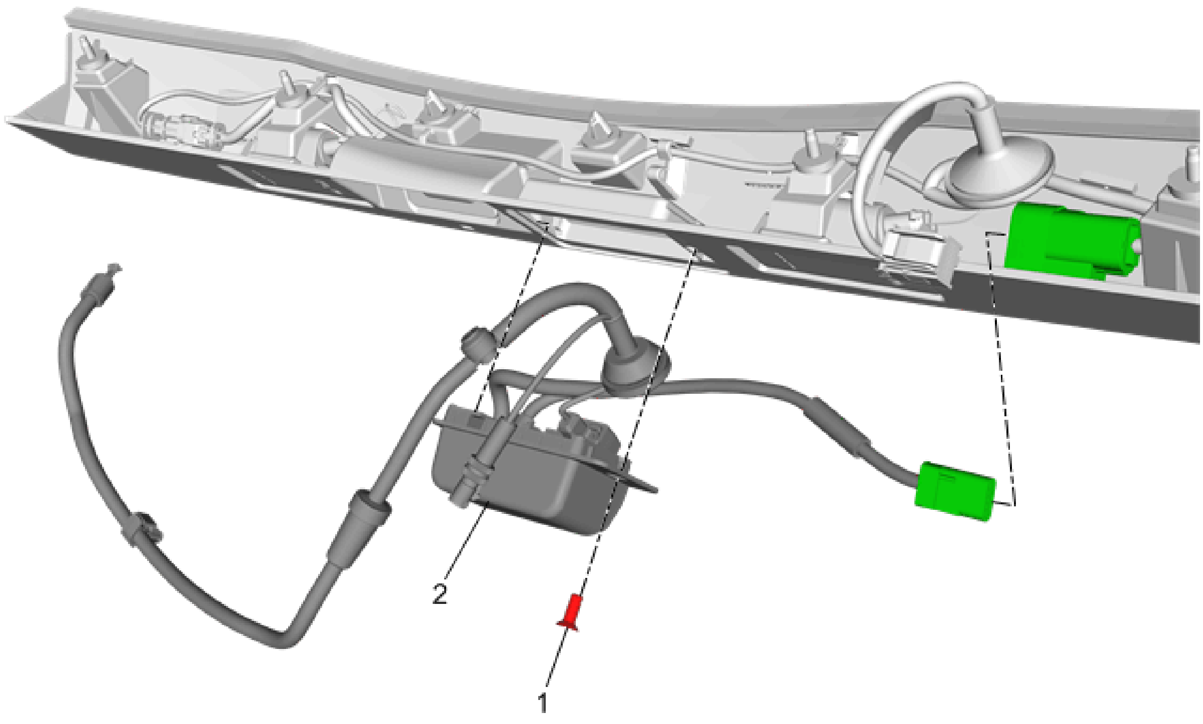


Fig. 26: Video Display Inside Rearview Mirror Camera
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Closure Center Applique. Refer to Rear Closure Center Applique Replacement	

Callout	Component Name
1	Video Display Inside Rearview Mirror Camera Screw **CAUTION:** **Refer to Fastener Caution**
2	Video Display Inside Rearview Mirror Camera **Procedure** Unclip and Disconnect the electrical connector.

DESCRIPTION AND OPERATION

PARKING ASSIST DESCRIPTION AND OPERATION (WITH REAR PARK ASSIST, UD7)

The ultrasonic parking assist system is designed to identify and notify the driver of an object in the vehicles path when reversing at speeds of less than 8 km/h (5 MPH). The distance and location of the object is determined by 4 object sensors located in the rear bumper. The parking assist system will notify the driver using an audible beep signal through the radio rear speakers.

The parking assist system is made up of the following components:

- Parking assist control module
- Rear object alarm sensors

Parking Assist Control Module

The parking assist control module provides an 8 V reference and a low reference to the four object alarm sensors. The parking assist control module receives individual signals from each of the four sensors and determines the location and distance of an object based on these inputs. When an object is detected, the parking assist control module will send a data message via CAN-Bus to the radio requesting an audible alert.

Rear Object Alarm Sensors

The object alarm sensors are located in the rear bumper of the vehicle. The sensors are used to determine the distance between an object and the bumper. Each sensor emits an ultrasonic frequency which is reflected off any object located behind the vehicle. These reflections are received by the sensors. The time difference between the emission of the frequency and when the reflection is received is known as sensor echo time, it is used to determine the distance to the object. The sensors report this information to the parking assist control module.

Rear Parking Assist Operation

When the vehicle is first placed into reverse there will be one audible beep through the rear speakers, to indicate that the system is working. If rear speakers are inoperable no audible signals will occur.

When backing up at speed of less than 8 km/h (5 MPH), the system is constantly monitoring for object of interest located behind the vehicle. The rear parking assist system can detect objects greater than 7.6 cm (3 in) wide and 25.4 cm (10 in) tall. The system cannot detect objects below the bumper, underneath the vehicle. If an object is detected within 2.5 m (8 ft) there will be a audible beep notification out of both rear speakers based upon the distance to the object. As the vehicle gets closer to an object, the time between the beeps become shorter.

If the vehicle stops in a range zone the beeping will stop after 5 s. When the distance between the object and the vehicle changes, beeping will start again.

If the rear parking assist system detects a malfunction the single audible beep will not chime when put into reverse along with a DTC being stored. The object alarm module will send a serial data message to the instrument panel cluster to display the SERVICE PARK ASSIST message on the driver information center.

Parking Assist System Driver Information Center Messages

SERVICE PARK ASSIST

The driver information center displays SERVICE PARK ASSIST when the parking assist control module detects a malfunction in the rear parking assist system and the system is disabled. The driver information center also displays SERVICE PARK ASSIST when a loss of communication occurs with the parking assist control module.

PARK ASSIST OFF

The PARK ASSIST OFF message is displayed in the driver information center when the parking assist system is disabled due to conditions that disable or inhibit the system. The parking assist control module requests the driver information center display PARK ASSIST OFF when it detects that one of the following conditions:

- The rear parking assist system is manually disabled by the vehicle operator through the audio system personalization menu.
- The park brake is applied or not fully released.
- An object is attached to the rear of the vehicle, such as a trailer, bicycle rack, trailer hitch receiver, or tow bar. Also, an object extending beyond a lowered endgate will disable the system.
- The parking assist sensors are covered by snow, mud, dirt or ice.
- The vehicle bumper is damaged.
- Excessive paint thickness on a replacement parking assist sensor.
- The parking assist sensors are disrupted by vibrations, like those caused by a large nearby vehicle or from heavy equipment such as a jackhammer.

PARKING ASSIST DESCRIPTION AND OPERATION (WITH FRONT AND REAR PARK ASSIST, UFQ)

The parking assist system is designed to identify and notify the driver of an object in the vehicle path when moving forward or reversing at speeds of less than 8 km/h (5 MPH). The distance and location of the object is determined by 8 object sensors: 4 located in the rear bumper and 4 located in the front bumper. The parking assist system will notify the driver using an audible beep signal through the radio.

The parking assist system is made up of the following components:

- Advanced parking assist control module
- Front object alarm sensors
- Rear object alarm sensors
- Parking assist switch
- Parking assist switch indicator

Advanced Parking Assist Control Module

The advanced parking assist control module provides a reference voltage and a low reference to the 8 object alarm sensors. The advanced parking assist control module receives individual signals from each of the 8 sensors and determines the location and distance of an object based on these inputs. When an object is detected, the advanced parking assist control module will send a data message via CAN-Bus to the radio requesting an audible alert.

Object Alarm Sensors

The object alarm sensors are located in the front and rear bumpers of the vehicle. The sensors are used to determine the distance between an object and the bumper. Each sensor emits an ultrasonic frequency which is reflected off any object located in front of or behind the vehicle. These reflections are received by the sensors. The time difference between the emission of the frequency and when the reflection is received is known as sensor echo time, it is used to determine the distance to the object. The sensors report this information to the advanced parking assist control module.

Parking Assist Switch

The parking assist can be activated and deactivated by pressing the parking assist switch. By engaging the reverse gear the parking assist can also be activated. By subsequently pressing the parking assist switch the parking assist can be disabled again.

Parking Assist Switch Indicator

The indicator in the parking assist switch shows the status of the parking assist. If the lamp is ON, the parking assist is activated.

Parking Assist Operation

When an object is within the measuring range of the sensor, the ultrasonic pulse is reflected and is received by the sending or a neighboring sensor. The sensor converts this signal into a voltage signal and sends this signal to the parking assist control module. The advanced parking assist control module evaluates the received sensor signals. As soon as an object is within the measuring range, the advanced parking assist control module sends a message via CAN-Bus to the radio in order to give out the acoustic distance signal.

The parking assist system can detect objects greater than 7.6 cm (3 in) wide and 25.4 cm (10 in) tall. The system cannot detect objects below the bumper, underneath the vehicle. If an object is detected, one of the following will occur:

- The measuring range of the front object alarm sensors is between 30 - 120 cm (11.8 - 47.2 in). From a distance of 120 cm (47.2 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 30 cm (11.8 in), the sound becomes continuous.
- The measuring range of the rear object alarm sensors is between 30 - 250 cm (11.8 - 98.4 in). From a distance of 250 cm (98.4 in), the acoustic signal is active. The frequency of the beep sound increases with decreasing distance. From a distance less than 30 cm (11.8 in), the sound becomes continuous.

The parking assist can be activated and deactivated by pressing the parking assist switch. When REVERSE gear is selected, park assist automatically is engaged for both front and rear sensors. When the vehicle is put into DRIVE from REVERSE the front assist sensors will be active up to speeds of 8 km/h (5 MPH) to assist with parking maneuvers. Once the vehicle is above 8 km/h (5 MPH) the front sensors are disabled and will not be re-enabled until either REVERSE gear is selected or the parking assist switch is pressed to activate the system. Once the parking assist switch is pressed during a key cycle the front sensors become active at speeds under 8 km/h (5 MPH). If the park assist switch is pressed again in the same key cycle the message "Park Assist Off" will be displayed in the driver information center if the vehicle speed is under 8 km/h (5 MPH) and front sensors detect an object within 120 cm (47.2 in). The LED indicator on the parking assist switch provides the ON/OFF state of the system. If the indicator is ON, the system is active and ready to assist.

The advanced parking assist control module carries out a self test and monitors the sensors for electrical and mechanical faults. Monitored is the power supply of each sensor and the sensor signals, which need to alter when the vehicle moves. If this is not the case, the sensor is acoustically blocked or faulty. Mud, ice and snow may cause obstruction of the function of the sensors. Besides that the advanced parking assist control module checks whether the correct type of sensor is installed. If any of these tests fails, a DTC with corresponding symptom is set, the parking assist is deactivated and the parking assist indicator in the instrument panel cluster is activated.

Parking Assist System Driver Information Center Messages

SERVICE PARK ASSIST

The driver information center displays SERVICE PARK ASSIST when the advanced parking assist control module detects a malfunction in the parking assist system and the system is disabled. The driver information center also displays SERVICE PARK ASSIST when a loss of communication occurs with the advanced parking assist control module.

PARK ASSIST OFF

The PARK ASSIST OFF message is displayed in the driver information center when the parking assist system is disabled due to conditions that disable or inhibit the system. The advanced parking assist control module requests the driver information center display PARK ASSIST OFF when it detects that one of the following conditions:

- The parking assist system is manually disabled using the parking assist switch.
- An object is attached to the rear of the vehicle, such as a trailer, bicycle rack, trailer hitch receiver, or tow bar. Also, an object extending beyond a lowered tailgate will disable the system.
- The parking assist sensors are covered by snow, mud, dirt, slush, or ice.
- The vehicle bumper is damaged.
- Excessive paint thickness on a replacement parking assist sensor.
- The parking assist sensors are disrupted by vibrations, like those caused by a large nearby vehicle or from heavy equipment such as a jackhammer.

LANE DEPARTURE WARNING DESCRIPTION AND OPERATION

The lane departure warning system is a convenience feature of the front view camera that issues a warning when the system detects that the vehicle has unintentionally crossed a lane marking. The front view camera is located behind the windshield, looking out at the road ahead and detecting any lane markings. When the vehicle unintentionally leaves a detected lane, a visual and audible alert is given to the driver.

The lane departure warning system is made up of the following components:

- Front view camera module
- Lane departure warning switch
- Instrument cluster/Vehicle Direction Display
- Radio

Front View Camera Module

The camera detects visual queues such as lane markings. When it is determined that the vehicle has unintentionally moved outside of the lane, a visual and audible warning is given to the driver. The front view camera module receives an input from the lane departure warning switch and controls the lane departure warning switch indicator output. The front view camera module also communicates via serial data with the instrument cluster and radio to request visual and audible alerts.

Lane Departure Warning Switch

The lane departure warning switch provides an input to the front view camera module to turn the lane departure warning system ON and OFF. The front view camera module provides a signal voltage to the normally open momentary switch. When the switch is pressed, the signal circuit is pulled to ground, indicating to the front view camera module that the system has been requested to turn ON or OFF. The lane departure warning switch also contains the lane departure warning switch indicator, which is controlled by the front view camera module to indicate the ON and OFF status of the lane departure warning system. When the system has been enabled by the lane departure warning switch, the front view camera module applies ground to the switch indicator and illuminates the LED. The location of the lane departure warning switch can vary with different vehicles. For the exact location please refer to the user's manual.

Instrument Cluster

The vehicle direction display contains green and amber lane departure warning indicators. These indicate to the driver the current status of the lane departure warning system and are controlled via serial data by the front view camera module. When the vehicle speed is above 56 km/h (35 MPH) and the system has detected the required lane markings and is ready to assist, the green indicator will be illuminated on the vehicle direction display. If the vehicle has unintentionally left the lane, the amber indicator will flash.

Radio

The radio controls the audible alert for the lane departure warning. If the vehicle has unintentionally left the lane, the radio will command three beeps as an audible alert to the driver.

Lane Departure Warning Operation

System operation can be describe by the following modes:

- Off State: The system has been turned off by the driver, using the lane departure warning switch. The lane departure warning indicator will not be illuminated.
- Not Ready To Assist: The system is enabled and the lane departure warning indicator is illuminated, but not ready to assist when any of the following conditions is true:
  - Vehicle speed is less than 56 km/h (35 MPH). The system is designed to function at speeds greater than 56 km/h (35 MPH).
  - The system cannot detect lane markings. This may be because there are no lane markings, as on a country road or that the lane markings cannot be determined due to snow, rain, or other driving conditions.
  - The windshield area in front of the camera or the camera lens is blocked by fog, dirt, damage to the windshield or other elements that may prevent the camera from detecting lane markings.
- Ready To Assist: The system is enabled and ready to warn of the unintentional lane crossing. The system is ready to assist when the green lane departure warning indicator is illuminated on the vehicle direction display.

Lane Crossing Alerts

- When one of the following conditions are met, the system will not give alerts:
  - The correct turn signal is activated. An activated turn signal is interpreted as an intentional lane crossing.
  - The operator makes an intentional steering maneuver.
  - The operator makes an intentional accelerating maneuver.
  - The operator makes an intentional braking maneuver.
- Lane crossing alert consists of the following:
  - Three chimes are activated through the radio.
  - The amber lane departure warning indicator will flash.

Lane Departure Warning System Driver Information Center Messages

The front view camera module can command the driver information center to display the various messages to alert the driver of a system concern or status information. For detailed information about the possible messages please refer to the user's manual.

LANE KEEP ASSIST DESCRIPTION AND OPERATION

NOTE:

- **The Lane Keep Assist system DOES NOT continuously steer the vehicle**
- **The Lane Keep Assist system replaces Lane Departure Warning System**
- **Lane Departure Warning will have more alerts than Lane Keep Assist (visual, audible, and haptic warning**

The system assists driver to keep vehicle in-lane by providing a steering push back to the vehicle when an unintended lane departure is detected. See the user's manual for more detailed information on vehicle personalization.

The lane keep assist system is made up of the following components:

- Front view camera module

- Lane Keep Assist switch/control indicator
- Instrument cluster/Vehicle Direction Display
- Radio
- Safety Alert Seat (if equipped)
- Yaw rate sensor
- Electric power steering

Front View Camera Module

The camera detects visual queues such as lane markings. When it is determined that the vehicle has unintentionally moved outside of the lane, visual, and audible or haptic warning is given to the driver. The front view camera module receives an input from the lane keep assist switch and controls the lane keep assist switch indicator output. The front view camera module also communicates via serial data with the instrument cluster, radio, and memory seat module to request visual, and audible or haptic alerts.

Lane Keep Assist Switch

The lane keep assist switch provides an input to the front view camera module to turn the lane keep assist system ON and OFF. The front view camera module provides a signal voltage to the normally open momentary switch. When the switch is pressed, the signal circuit is pulled to ground, indicating to the front view camera module that the system has been requested to turn ON or OFF. The lane keep assist switch also contains the lane keep assist switch indicator, which is controlled by the front view camera module to indicate the ON and OFF status of the lane keep assist system. When the system has been enabled by the lane keep assist switch, the front view camera module applies ground to the switch indicator and illuminates the LED. The location of the lane keep assist switch can vary with different vehicles. For the exact location please refer to the user's manual.

Instrument Cluster

The vehicle direction display contains green and amber lane keep assist indicators. These indicate to the driver the current status of the lane keep assist system and are controlled via serial data by the front view camera module. When the vehicle speed is above 56 km/h (35 MPH) and the system has detected the required lane markings and is ready to assist, the green indicator will be illuminated on the vehicle direction display. If the vehicle has unintentionally left the lane, the amber indicator will flash.

Radio

The radio controls the audible alert for the lane keep assist. If the vehicle has unintentionally left the lane, the radio will command three beeps as an audible alert to the driver.

Safety Alert Seat (if equipped)

The memory seat module controls the haptic alert provided by the seats. If the vehicle has unintentionally left the lane, and the Electric Power Steering determines the corrective action requires an above threshold amount of effort, the memory seat module will command three pulses to the left or right side of the seat, depending on the lane departure direction.

Yaw Rate Sensor

The steering intervention is based on the forward looking sensor outputs, such as lateral offset of the vehicle, relative yaw angle and time to line crossing. Over that, other vehicle dynamics signals are needed, e.g. velocity, steering angle, yaw rate for the purpose of a driver suppression.

Electric Power Steering

The electric power steering uses a torque sensor to detect driver inputs and relays that information to the frontview camera module. The electric power steering is used to provide steering push back.

Lane Keep Assist Operation

There is two stages of warning/intervention for the driver: The first stage is the steering push back, if the lane keep assist system detects that the vehicle will cross the lane marking despite it is intervening, a second stage warning shall be issued. The second stage warning is a chime or a haptic seat vibration, **if equipped** with haptic seats. If a haptic seat vibration is used as stage 2 warning, the vibration shall take place on the side of the seat, where the lane departure happened.

System operation can be described by the following modes:

- Off State: The system has been turned off by the driver using the lane keep assist switch. The lane keep assist indicator will not be illuminated.
- Not Ready To Assist: The system is enabled and the lane keep assist indicator is illuminated, but not ready to assist when any of the following conditions is true:
  - Vehicle speed is less than 37 MPH (60 km/h). The system is designed to function at speeds greater than 37 MPH (60 km/h).
  - The system cannot detect lane markings. This may be because there are no lane markings, as on a country road or that the lane markings cannot be determined due to snow, rain, or other driving conditions.
  - The windshield area in front of the camera or the camera lens is blocked by fog, dirt, damage to the windshield or other elements that may prevent the camera from detecting lane markings.
- Ready To Assist: The system is enabled and ready to warn of the unintentional lane crossing. The system is ready to assist when the green lane keep assist indicator is illuminated on the vehicle direction display.

Lane Crossing Alerts

- When one of the following conditions are met, the system will not give alerts:
  - The correct turn signal is activated. An activated turn signal is interpreted as an intentional lane crossing.
  - The operator makes an intentional steering maneuver.
  - The operator makes an intentional accelerating maneuver.
  - The operator makes an intentional braking maneuver.
- Lane crossing alert consists of the following:
  - The amber lane keep assist indicator will flash.
  - "push-back" steering torque input (or nudge) from Electric Power Steering to help prevent a lane departure
  - Three chimes are activated through the radio.
  - or **if equipped** , three pulses to the left or right side of the seat.

Lane Keep Assist System Driver Information Center Messages

The front view camera module can command the driver information center to display the various messages to alert the driver of a system concern or status information. For detailed information about the possible messages please refer to the user's manual.

CROSS TRAFFIC ALERT DESCRIPTION AND OPERATION

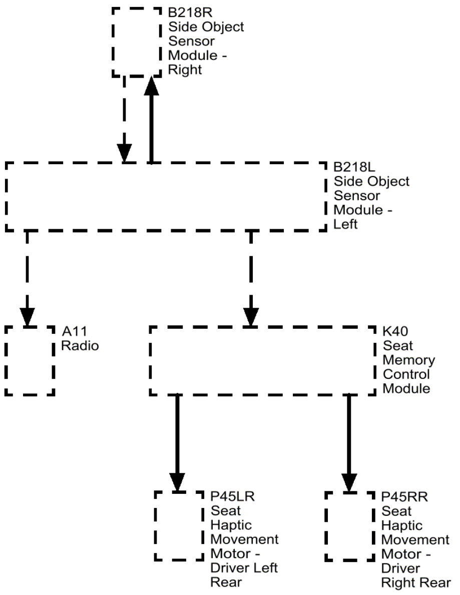

B218R
Side Object
Sensor
Module -
Right
B218L
Side Object
Sensor
Module -
Left
A11
Radio
K40
Seat
Memory
Control
Module
P45LR
Seat
Haptic
Movement
Motor -
Driver Left
Rear
P45RR
Seat
Haptic
Movement
Motor -
Driver
Right Rear

Fig. 27: Rear Cross Traffic Alert Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
B218R	B218R Side Object Sensor Module - Right
B218L	B218L Side Object Sensor Module - Left
A11	A11 Radio
K40	K40 Seat Memory Control Module
P45LR	Seat Haptic Movement Motor - Driver Left Rear
P45RR	Seat Haptic Movement Motor - Driver Right Rear

The rear cross traffic alert system is a feature that utilized two side object sensor modules to provide enhanced customer convenience while backing up by sensing and providing warnings to the driver on impending rear cross traffic. The rear cross traffic alert system is designed to detect and track moving objects as small as a 125cc motorcycle with rider within a specified coverage zone behind the vehicle. The system is designed to alert the driver, with a visual display and either an audible sound or a haptic warning, if equipped and enabled, to the presence of moving objects of interest that may cause a collision with the host vehicle. Although the system is intended to assist drivers in backing up, it does not replace driver's vision. The driver is responsible to check carefully for objects outside of the coverage zone (e.g., a fast approaching vehicle) for a safe backing maneuver.

Rear Cross Traffic Alert System Components

The side blind zone alert system is made up of the following components:

- Left side object sensor module
- Right side object sensor module
- Visual Display Icons located on the infotainment display screen
- Audio system chime
- Haptic safety seat (if equipped)

Side Object Sensor Modules

The side object sensor modules are located on each side of the vehicle behind the rear fascia and are not directly visible from outside the vehicle. The sensors use radar to determine the presence of moving objects nearby. The left side object sensor is the master that communicates on serial data. There is a private communication network between the left and right sensors. The scan tool is able to communicate only with the left sensor.

When a moving object is detected in the left rear cross traffic zone while the engine is running and the transmission in reverse, the side object sensor module sends a serial data message to the human interface module and memory seat module to provide alerts. Each sensor is supplied B+ and ground.

Display Icons

The rear cross traffic alert system visual alert display consists of two visual icons, one on each side of the display screen of the rearview camera display, that are used to alert the driver on rear cross traffic from each side of the host vehicle respectively. In addition to visual indicators, the audio system will beep (if enabled) and the haptic safety seat will vibrate (if equipped and enabled). Refer to owner's manual for vehicle customization.

Audio or Haptic Notification

The alert output type can be driver selected to either audio or haptic. The chime location will be left rear for left rear cross traffic alert and right rear for right rear cross traffic alert. The haptic seat system response will be to generate 3 repetitions of haptic vibration in the left rear area of the seat for left cross traffic alert and right rear area of the seat for right cross traffic alert. If there is a problem with the haptic seats, the audio chime will be substituted.

Rear Cross Traffic Alert Operation

The rear cross traffic alert system is designed to detect moving objects of interest as small as a 125cc motorcycle with rider. The detection zone extends approximately 30 m (99 ft) from the rear corner of the car and covers an area from behind the vehicle to 125 degrees towards the front at a height of 0.45 m (1.5 ft) to 2 m (6.5 ft) above ground. The system operates when vehicle speed is 10 kph (6 mph) or less and is designed to detect objects moving at speeds up to 36 kph (22 mph).

When the vehicle is backing up, the side object sensors receive energy that is reflected from external objects and determine if the objects are objects of interest or not. The system may at times detect pedestrians, shopping carts, or similar moving objects. This is normal and should not be considered as a false alert or problem with the system. The rear cross traffic alert system will estimate vehicle travel trajectory and use the information in conjunction with object travel trajectory information to determine if there is a potential collision between the vehicle and the object of interest. The rear cross traffic alert function will only alert on objects of interest that pose a potential collision with the host vehicle. The system is not designed to provide an alert to objects that have no potential collision with vehicle. In addition, the system will not alert to stationary objects such as signs, parked cars, etc.

If the vehicle is towing a trailer or has an object such as a bicycle rack attached to the rear of the vehicle, the rear cross traffic alert system may not function properly.

Foul weather may affect the operation of the rear cross traffic alert system. Occasional missed alerts can occur under normal circumstances and will increase in wet conditions. The number of missed alerts will increase with increased rainfall or road spray. Heavy rainfall, as well as mud, dirt, snow, ice, or slush build-up on the rear fascia, can completely disable the system.

Rear Cross Traffic Alert Driver Information Center Messages

REAR CROSS TRAFFIC ALERT OFF

This message indicates that the system has been disabled through the driver information center. Refer to the vehicle owners manual for instructions on how to set personalization options on the driver information center.

SERVICE SIDE DETECTION SYSTEM

This message indicates that the system requires service. Since the side object sensors are also used for side blind zone alert and/or lane change alert, these feature will also be inoperative. Check vehicle for DTCs to determine the cause of this notification.

SIDE DETECTION SYSTEM TEMPORARILY UNAVAILABLE

This message indicates that the system has been temporarily disabled because the sensors are blocked or can otherwise not accurately detect vehicles or objects. Verify there is no damage to rear fascia or there are any bumper stickers that may interfere with the radar signals. Ask the customer if any of the following circumstances that present when the system became unavailable: mud, dirt, snow, ice, or slush build-up on the rear fascia, heavy rainfall, or excessive road spray.

SIDE BLIND ZONE ALERT DESCRIPTION AND OPERATION

The side blind zone alert system is a lane-changing aid that assists drivers with avoiding crashes that occur with vehicles in the side blind zone (or spot) areas. When the vehicle is moving forward, the left or right side mirror display will illuminate if a vehicle is detected in the blind zone. If the turn signal is activated and a vehicle is also detected on the same side, the display will flash as an extra warning not to change lanes. The side blind zone alert monitors the blind sport area along side the vehicle, approximately 3.5 m (11 ft) from the side of the vehicle, extending 5 m (16 ft) behind the mid-point of the vehicle.

The lane change alert system is a lane-changing aid that assists drivers with avoiding lane change crashes that occur with vehicles rapidly approaching the side blind zone (or spot) areas from behind. The lane change alert warning display will illuminate in the corresponding outside rearview mirror and will flash as an extra warning not to change lanes if the turn signal is on. The lane change alert system monitors the lane area along side the vehicle, approximately 3.5 m (11 ft) from the side of the vehicle, extending up 70 m (230 ft) beyond the rear bumper.

While in reverse, the rear cross traffic alert system displays a triangle with a left or right pointing arrow on the info display module to warn of traffic coming from the left or right. This system detects objects coming from up to 20 m (65 ft) from the left or right side of the vehicle. When an object is detected, either three beeps sound from the left or right or three safety alert seat pulses occur on the left or right side, depending on the direction of the detected vehicle.

Side Blind Zone Alert System Components

The side blind zone alert system is made up of the following components:

- Side object sensor module - left
- Side object sensor module - right
- Driver outside rearview mirror
- Passenger outside rearview mirror
- Infotainment system
- Safety alert seat

Side Object Sensor Module

The side object sensor modules are located on each side of the vehicle behind the rear fascia and are not directly visible from outside the vehicle. The sensors use radar to determine the presence of objects nearby. The side object sensor module - left is the master that communicates on vehicle serial data bus. There is a private serial data bus between the left and right sensors. The scan tool is able to communicate only with the left sensor. The sensors are unique and not interchangeable from side to side.

The side object sensor module - right controls both side blind zone indicators located on the left and right outside rearview mirrors. Each indicators receives ground at all times. When an object has been detected in the vehicle's blind spot or a vehicle is fast approaching from the rear, the side object sensor module - right will apply voltage to the appropriate indicator, illuminating it. If the turn signal is on, indicating the driver intends to change lanes, side object sensor module - right will flash the appropriate indicator as an additional means of alert.

Outside Rearview Mirrors

The outside rearview mirrors contain an icon that is backlit with high intensity, amber-colored LED's located on the mirror surface. The display brightness adapts to day and night conditions. The side object sensor module - right controls both side blind zone indicators.

Infotainment System

The infotainment system controls the audible alerts for the rear cross traffic alert system. If cross traffic is present, the side object sensor module - left will command the infotainment system issue an audible alert to the driver. The audible alert will sound from the side of the vehicle where traffic is approaching from.

The infotainment system also includes the info display module. When in R, any cross traffic warnings will be overlaid over the rear vision camera image on the info display module.

Safety Alert Seat

The memory seat module controls the haptic alert provided by the seats. If cross traffic is present, the side object sensor module - left will command the safety alert seat issue a haptic alert to the driver on the side of the seat where traffic is approaching from.

Side Blind Zone Alert Operation

When the vehicle is started, both side blind zone indicators located on the left and right outside rearview mirrors will briefly illuminate to indicate that the system is operating. The system is designed to detect objects in an area approximately between 0.5 m (1.5 ft) and 2 m (6 ft) off the ground. The side blind zone alert monitors the blind sport area along side the vehicle, approximately 3.5 m (11 ft) from the side of the vehicle, extending 5 m (16 ft) behind the mid-point of the vehicle. The system may light up an indicator due to guardrails, signs, trees, shrubs, and other non-moving objects. This is normal system operation; the vehicle does not need service.

When the system detects a vehicle in the side blind zone while driving forward, an amber warning symbol will illuminate on the appropriate outside mirror. This indicates that it may be unsafe to change lanes. If the driver activates the turn signal, the amber warning symbol starts flashing as an extra warning not to change lanes.

Foul weather may affect the operation of the side blind zone system. Occasional missed alerts can occur under normal circumstances and will increase in wet conditions. The number of missed alerts will increase with increased rainfall or road spray. Heavy rainfall, as well as mud, dirt, snow, ice, or slush build-up on the rear fascia, can completely disable the system.

If the vehicle is towing a trailer or has an object such as a bicycle rack attached to the rear of the vehicle, the side blind zone system may not function properly and the indicators may illuminate intermittently or remain illuminated all the time.

Lane Change Alert Operation

The lane change alert system shall detect and report objects in the driver's blind zone, or approaching on either side of the vehicle, within a specified lane change zone. The system is designed to alert the driver, with a visual display placed on the side view mirror, to the presence of objects of interest that may not be visible in the inside rearview mirror and outside rear view mirrors. Although this system is intended to help drivers avoid lane change crashes, it does not replace driver vision and therefore should be considered a lane change aid. Even with the lane change alert system, the driver must check carefully for objects outside of the reporting zone before changing lanes. In the event that the system senses a malfunction through its diagnostic routines, the system will be disabled and the driver will be visually notified.

When the vehicle is started, both outside mirror displays will briefly come on to indicate that the system is operating. The warning symbols will vary brightness based on the ambient light conditions. Lane change alert is active when the vehicle is out of park or the parking brake is off on manual transmission vehicles. When the system detects a vehicle in the side blind zone or approaching in the lane change alert zone while driving forward, an amber warning symbol will light up in the appropriate outside mirror. This indicates that it may be unsafe to change lanes. If the driver then activates the turn signal, the amber warning symbol starts flashing as an extra warning not to change lanes.

The system is designed to detect objects of interest as small as a 125cc motorcycle with rider. The detection zone starts at the outside rearview mirror and extends out to 3.5 m (11 ft) at the back corner of the vehicle and 70 m (230 ft) behind the vehicle at a height between 0.5 m (1.5 ft) and 2.0 m (6 ft) above the ground. The system may light up an indicator due to guardrails, signs, trees, shrubs, and other non-moving objects. This is normal system operation; the vehicle does not need service.

If the vehicle is towing a trailer or has an object such as a bicycle rack attached to the rear of the vehicle, the lane change alert system may not function properly and the indicators may illuminate intermittently or remain illuminated all the time. The driver information center may display "SIDE DETECTION SYSTEM UNAVAILABLE".

Foul weather may affect the operation of the lane change alert system. Occasional missed alerts can occur under normal circumstances and will increase in wet conditions. The number of missed alerts will increase with increased rainfall or road spray. Heavy rainfall, as well as mud, dirt, snow, ice, or slush build-up on the rear fascia, can completely disable the system. The warning symbols will vary brightness based on the ambient light conditions.

Rear Cross Traffic Alert Operation

The rear cross traffic alert system is designed to detect moving objects approaching the side of the vehicle while backing up. The detection zone extends approximately 30 m (99 ft) from the rear corner of the car and covers an area from behind the vehicle to 125 degrees towards the front at a height of 0.45 m (1.5 ft) to 2 m (6.5 ft) above ground. The system operates when vehicle speed is 10 km/h (6 mph) or less and is designed to detect objects moving at speeds up to 36 km/h (22 mph).

When the vehicle is backing up, the side object sensors receive energy that is reflected from external objects and determine if the objects are objects of interest or not. The system may at times detect pedestrians, shopping carts, or similar moving objects. This is normal and should not be considered as a false alert or problem with the system. The rear cross traffic alert system will estimate vehicle travel trajectory and use the information in conjunction with object travel trajectory information to determine if there is a potential collision between the vehicle and the object of interest. The rear cross traffic alert function will only alert on objects that pose a potential collision with the host vehicle. The system is not designed to provide an alert to objects that have no potential collision with vehicle.

If the vehicle is towing a trailer or has an object such as a bicycle rack attached to the rear of the vehicle, the rear cross traffic alert system may not function properly.

Foul weather may affect the operation of the rear cross traffic alert system. Occasional missed alerts can occur under normal circumstances and will increase in wet conditions. The number of missed alerts will increase with increased rainfall or road spray. Heavy rainfall, as well as mud, dirt, snow, ice, or slush build-up on the rear fascia, can completely disable the system.

Side Blind Zone Alert Driver Information Center Messages

SIDE BLIND ZONE ALERT OFF

This message indicates that the system has been disabled through the driver information center. Refer to the vehicle owners manual for instructions on how to set personalization options on the driver information center.

LANE CHANGE ALERT OFF

This message indicates that the system has been disabled through the driver information center. Refer to the vehicle owners manual for instructions on how to set personalization options on the driver information center.

REAR CROSS TRAFFIC ALERT OFF

This message indicates that the system has been disabled through the driver information center. Refer to the vehicle owners manual for instructions on how to set personalization options on the driver information center.

SERVICE SIDE DETECTION SYSTEM

This message indicates that the system requires service. When the message is displayed, the indicators will remain illuminated at all times, notifying the driver that the side blind zone and lane change alert should not be relied upon when changing lanes and the rear cross traffic alert will also be inoperative

SIDE DETECTION SYSTEM UNAVAILABLE

This message indicates that the system has been temporarily disabled because the sensor is blocked or can otherwise not accurately detect vehicles or objects. Such instances may be mud, dirt, snow, ice, or slush build-up on the rear fascia, heavy rainfall, excessive road spray, fascia damage or stickers.

The rear cross traffic alert system will read the GPS latitude and longitude on the serial data bus and calculate if the vehicle is within a Radio Astronomy zone. These zones are located in Europe and Japan and require the sensors to be turned off. The "Side Detection System Unavailable" message will be displayed to the driver when this occurs.

FORWARD COLLISION ALERT DESCRIPTION AND OPERATION

The forward collision alert system is a convenience feature of the frontview camera module that issues a warning to the driver when a potential collision risk exists. The frontview camera module is located behind the windshield, looking toward the roadway ahead and detecting vehicles within a distance of approximately 60 meters (197 ft). The forward collision alert system is always active and operates at speeds above 40 kph (25 mph).

When the frontview camera module detects a vehicle in the path ahead, the green vehicle ahead indicator in the vehicle direction display is illuminated. When following a vehicle ahead too closely, the amber collision alert indicator will illuminate and stay on until the following distance is increased. The green vehicle ahead indicator will then be illuminated again. When approaching another vehicle too rapidly, the collision alert symbol will flash in the vehicle direction display and an audible alert sounds. The forward collision alert sensitivity can be adjusted using the forward collision alert switch in the left steering wheel controls.

Front Automatic Braking (if equipped)

When the system detects a vehicle ahead in your path that is traveling in the same direction that you may be about to crash into, it can provide a boost to braking or automatically brake the vehicle. This can help avoid or lessen the severity of crashes when driving in a forward gear. Depending on the situation, the vehicle may automatically brake moderately or hard. This front automatic braking can only occur if a vehicle is detected.

The system works when driving in a forward gear between 5 mph (8 km/h) and 37 mph (60 km/h). It can detect vehicles up to approximately 197 ft (60 m).

Forward collision does not provide a warning to help avoid a crash unless it detects a vehicle. Forward collision alert may not detect a vehicle ahead if the frontview camera module is blocked by dirt, snow, or ice, or if the windshield is damaged. It may also not detect a vehicle on winding or hilly roads, or in conditions that can limit visibility such as fog, rain, or snow, or if the headlamps or windshield are not cleaned or in proper condition. Ensure the windshield, headlamps, and frontview camera module are clean and in good repair. In some cases the forward collision alert system may provide unnecessary alerts for turning vehicles, vehicles in other lanes, objects that are not vehicles, or shadows. These alerts are normal operation and the vehicle does not need service.

The forward collision alert system is made up of the following components:

- Frontview camera module
- Forward collision alert switch
- Instrument cluster/Vehicle direction display
- Infotainment system

Frontview Camera Module

The frontview camera module detects vehicles in front of the host vehicle. The frontview camera module communicates via serial data to the instrument cluster to illuminate the appropriate indicators in the vehicle direction display. The frontview camera module also communicates via serial data with the driver information center to display messages and the radio to request audible alerts.

Forward Collision Alert Switch

The forward collision alert switch provides an input to the frontview camera module to select between four alert timing sensitivity settings. These setting will change the sensitivity for both the following too closely and forward collision alert indicators. In addition to the sensitivity setting, the alert distance will change based upon vehicle speed. The frontview camera module provides a signal voltage to the normally open switch. When the switch is pressed, the signal circuit is pulled to ground through a resistor, indicating to the frontview camera module that the system has been requested to change the alert timing sensitivity. The first button press shows the current alert timing setting on the driver information center. With every button press, the alert timing sensitivity is changed. The current alert timing setting will be maintained until it is changed. The preset alert timing setting is displayed in the top line of the driver information center. The position of the forward collision alert switch can vary with different vehicles. For the exact position please refer to the owner's manual.

Instrument Cluster

The vehicle direction display contains the indicators for the collision alert system and are controlled by the instrument cluster via serial data messages from the frontview camera module. The green vehicle ahead indicator indicates to the driver that the frontview camera module system has detected a vehicle in the driving path ahead. The amber collision alert indicator will illuminated continuously if the system determines that the vehicle ahead is too close. When approaching another vehicle too rapidly, the red collision alert symbol will flash.

Infotainment System

The infotainment system controls the audible alert for the forward collision alert system and is activated via serial data from the frontview camera module. If the host vehicle is approaching another vehicle too rapidly, the infotainment system will command an audible alert to the driver.

Forward Collision Alert System Driver Information Center Messages

The frontview camera module can command the driver information center to display the various messages to alert the driver of a system concern or status information. For detailed information about the possible messages please refer to the owner's manual.

- FORWARD COLLISION ALERT OFF
- SERVICE FRONT CAMERA

REAR VISION CAMERA DESCRIPTION AND OPERATION

Rear Vision Camera System Operation

The rear vision camera system consists of a video camera/module located at the rear of the vehicle and the infotainment display.

When the transmission is placed into REVERSE, a 12 volt signal is sent to the rear vision camera by the body control module (BCM). This signal indicates to the camera that the vehicle is in reverse and image display is requested. The rear vision camera receives ignition voltage and a constant ground to power the camera. Video signal + and video signal - circuits carry the video image from the rear vision camera to the infotainment display. Additionally, the video signal circuits are shielded to prevent any interference which may lead to a loss of video signal resolution and a degraded video image. The shield is provided a ground path by the rear vision camera.

The following conditions may cause a degraded rear vision camera image:

- Ice, snow, or mud has built up on the rear vision camera
- Dark conditions
- Extreme light conditions, such as glare from the sun or the headlights of another vehicle
- Damage to the rear of the vehicle
- Extreme high temperatures or extreme temperature changes

If a malfunction is detected in the system, Service Rear Vision Camera may be displayed on the infotainment display as an indicator to the customer that a problem exists that requires service.

SURROUND VISION CAMERA DESCRIPTION AND OPERATION

WARNING: **The Surround Vision cameras have blind spots and will not display all objects near the corners of the vehicle. Folding side mirrors that are out of position will not display surround view correctly. Always check around the vehicle when parking or backing.**

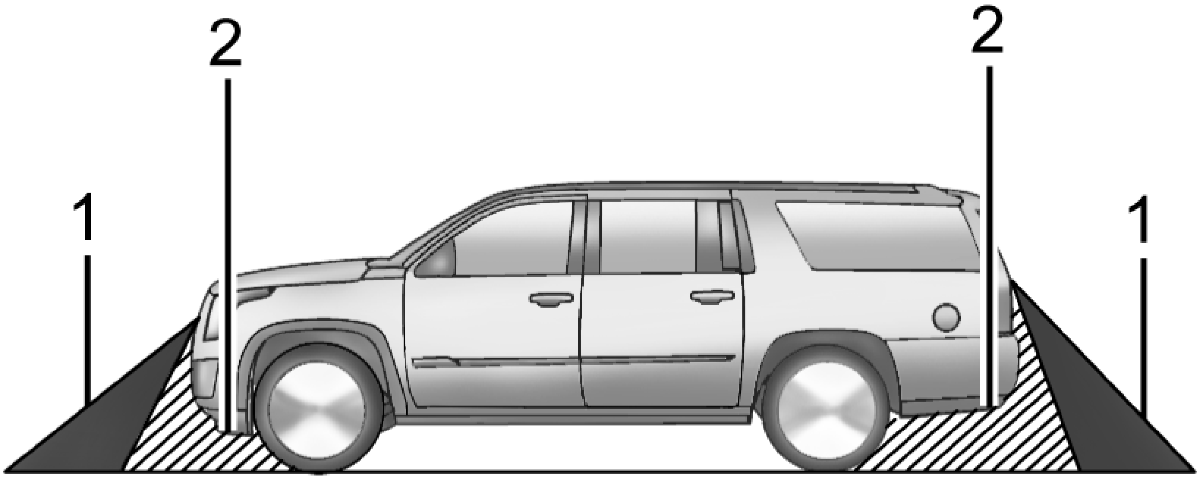


Fig. 28: Surround Vision Camera View And Area
Courtesy of GENERAL MOTORS COMPANY

1. View Displayed by the Surround Vision Camera
2. Area Not Shown

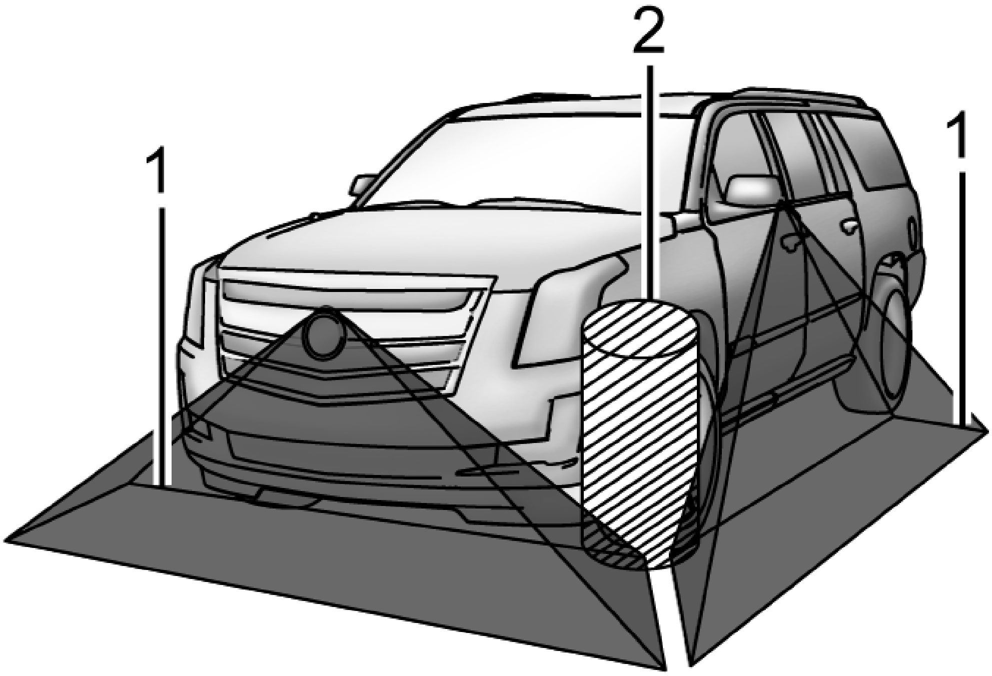


Fig. 29: Surround Vision Camera View And Area
Courtesy of GENERAL MOTORS COMPANY

1. View Displayed by the Surround Vision Camera
2. Area Not Shown

The surround vision camera system consists of the following components:

- B87 Rearview Camera
- B174G Frontview Camera - Grille

- K157 Video Processing Control Module
- A11 Radio **OR** K74 Human Machine Interface Module
- B225L Sideview Camera - Left
- B225R Sideview Camera - Right

When the vehicle is traveling at speeds slower than 6 mph (10 kph) the video processing control module will power up the cameras and send a video signal to the radio or human machine interface module.

The following conditions may cause a degraded surround vision camera image:

- Ice, snow, or mud has built up on the rear vision camera
- Dark conditions
- Extreme light conditions, such as glare from the sun or the headlights of another vehicle
- Damage to the rear of the vehicle
- Extreme high temperatures or extreme temperature changes

Surround Vision displays an overhead view of the area surrounding the vehicle, along with the front or rear camera views in the center stack. The front camera is in the grille or near the front emblem, the side cameras are on the bottom of the outside rearview mirrors, and the rear vision camera is above the license plate.

Features of the Surround Vision System

- Rear camera (B87 Rearview Camera) view alongside overhead view is displayed in reverse
- Front camera (B174G Frontview Camera - Grille) view alongside overhead view is displayed after shifting out of reverse to Neutral or Drive
- Will display front view when front park assist object is within trigger range calibration value (30 cm (12 in) in a forward gear
- Image is removed from display when vehicle speed exceeds speed calibration (10 kph/6 mph) or button press/screen touch

System Operation

The video processing control module sends voltage and a constant ground to power the cameras. Video signal + and video signal - circuits carry the video image from the cameras to the video processing control module for processing. The video processing control module will then send the processed image output to infotainment system by Video signal + and video signal - circuits. Additionally, all the video signal circuits are twisted and shielded to prevent any interference which may lead to a loss of video signal resolution and cause a degraded video image. These circuits must not be spliced/removed from shielding or will cause image degradation.

The video processing control module receives CAN information from Rear Park Assist object detection module and Steering Wheel angle from body control module during Reverse. A warning triangle may display during the 360 surround view screen if Rear Parking Assist has detected an object during a reverse. This triangle changes from amber to red and increases in size the closer the object. Also a dynamic guideline is displayed in Reverse to show the projected path of the vehicle.

[Back To Article](#)

2017 ACCESSORIES AND EQUIPMENT

Power Outlets - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

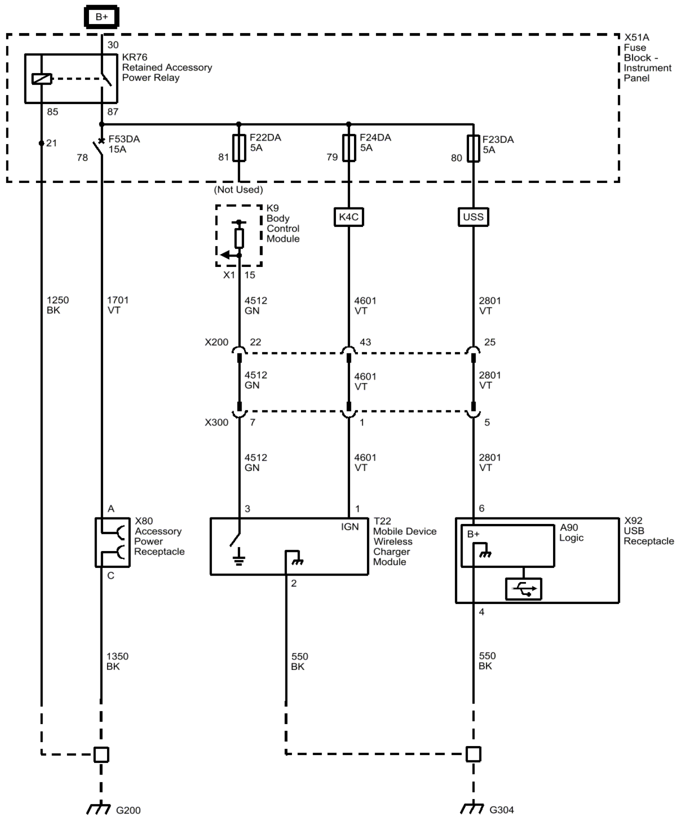
Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Wireless Charging System Module Bracket Screw	1 N.m (9 lb in)

SCHEMATIC WIRING DIAGRAMS

CIGAR LIGHTER/POWER OUTLET WIRING SCHEMATICS

Accessory Power Receptacles and Wireless Charging (K4C)


B+
30
KR76
Retained Accessory
Power Relay
X51A
Fuse
Block -
Instrument
Panel
85
87
21
78
F53DA
15A
F22DA
5A
81
F24DA
5A
79
F23DA
5A
80
(Not Used)
K9
Body
Control
Module
K4C
USS
X1
15
1250
BK
1701
VT
4512
GN
4601
VT
2801
VT
X200
22
43
25
4512
GN
4601
VT
2801
VT
X300
7
1
5
4512
GN
4601
VT
2801
VT
A
X80
Accessory
Power
Receptacle
C
3
1
IGN
T22
Mobile Device
Wireless
Charger
Module
2
6
B+
A90
Logic
X92
USB
Receptacle
4
1350
BK
550
BK
550
BK
G200
G304

[Fig. 1: Accessory Power Receptacles and Wireless Charging (K4C)](#)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - MOBILE DEVICE WIRELESS CHARGER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.
- Review the system description and operation in order to familiarize yourself with the system functions. Refer to **Mobile Device Wireless Charger Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the power outlets. Refer to **Checking Aftermarket Accessories**
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**

Symptom List

Refer to **Mobile Device Wireless Charger Malfunction (with EL-51755)** in order to diagnose the system.

SYMPTOMS - POWER OUTLETS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Visual/Physical Inspection

- Inspect for aftermarket devices which can affect the operation of the power outlets. Refer to **Checking Aftermarket Accessories** .
- Inspect the accessible system components or the visible system components for obvious damage or for obvious conditions which can cause the symptom.

Intermittent

Electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Power Outlet Receptacle Malfunction** in order to diagnose the system.

MOBILE DEVICE WIRELESS CHARGER MALFUNCTION (WITH EL-51755)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Signal	3	2	-	-
Ground	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
1. T22 Mobile Device Wireless Charger Module = Inoperative 2. Wireless Charging Indicator = Off 3. Wireless Charging Indicator = On				

Circuit/System Description

For an overview of the component/system, refer to: **Mobile Device Wireless Charger Description and Operation**

Circuit	Description
Ignition	Supplied from a relay.
Signal	The control module input circuit has an internal resistance connected to 12 V. When the switch is closed it will pull the signal voltage low.
Ground	Chassis Ground

Component	Description
T22 Mobile Device Wireless Charger Module	Inductive charging, also known as "wireless charging", uses a magnetic field to transfer energy between two objects. The wireless charger has an induction coil to create an alternating magnetic field. A second induction coil in a portable device takes power from the magnetic field and converts it back into electric current to charge the battery. The two induction coils in proximity work similar as an electrical transformer.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc. The control module also reads various switches and sensors and makes their values available via serial data.

The T22 Mobile Device Wireless Charger Module is controlled by an ignition operated relay and is operational when the ignition is in the Accessory or On position. When a wireless charging device is placed on the charging pad/pocket the charging of the device battery will start. The K9 Body Control Module detects the device battery is charging and sends a serial data message to the P17 Info Display Module which illuminates the charge indicator.

Diagnostic Aids

- Verify the mobile device can be charged with the proper wireless charging adapter. To check for phone or other device compatibility, refer to GM Total Connect website.
- Verify the charging pad/pocket is free from debris or any obstruction that may impede charging.
- The component T22 contains an internal temperature switch that will open if it exceeds 85Â°C (185Â°F).
- The ambient operating temperature is between -20 and 60Â°C (-4 and 140Â°F) for the charging system and between 0 and 35Â°C (32 and 95Â°F) for the mobile device. If the mobile device temperature exceeds 35Â°C (95Â°F) the mobile device may stop accepting a charge (this may vary with different mobile devices).
- Verify the mobile device is positioned correctly on the charging pad/pocket and there are no foreign objects between the mat and the mobile device. It may be necessary to move the device around slightly or rotate 180 degrees to properly align it on the charging pad/pocket until the device starts to charge. The use of a protective case may require more precise device placement to allow charging or may inhibit charging. Try removing the protective case.

- The mobile device may not charge if the charge mat is NOT completely flat or has an air gap which can be verified by a finger push at the target graphic located at the center of the mat. If the charge mat is NOT flat, replace the charge mat/rubber liner.
- While operating the vehicle in rough conditions, it is possible for the device to move out of position, repositioning of the device may be necessary.
- If the mobile device battery is fully charged, the charge indicator on the P17 Info Display Module may not illuminate.

Reference Information

Schematic Reference

Cigar Lighter/Power Outlet Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Mobile Device Wireless Charger Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Special Tools

EL-51755 Inductive Charging Test Tool

Equivalent regional tools: **Special Tools**

Circuit/System Verification

WARNING: **Remove all objects from the charging pad before charging your mobile device. Objects, such as coins, keys, rings, paper clips, or cards, between the phone and charging pad will become very hot. On the rare occasion that the charging system does not detect an object, and the object gets wedged between the phone and charger, remove the phone and allow the object to cool before removing it from the charging pad, to prevent burns.**

1. Ignition - On / Vehicle - In Service Mode
2. Verify the charging pad is clear of any wireless device.

   Verify the function: Wireless Charging Indicator = Off

   - If the indicator is On

     Refer to: Circuit/System Testing

   - If the indicator is Off

NOTE: **There is a charging coil located in the center of the Charging Pad/Pocket. The EL-51755 Inductive Charging Test Tool has a charging coil in the center of the tool. These coils must be aligned in order for the test tool to illuminate.**

To complete successfully, the procedure may need to be repeated 5 times. Between each attempt, remove the tool and wait 3 s.

On a charging pad, align the EL-51755 Inductive Charging Test Tool against the alignment rib. In a pocket, insert the EL-51755 Inductive Charging Test Tool until it stops. For both the pad and pocket, ensure that the flat side (non-LED side) of the EL-51755 Inductive Charging Test Tool aligns against the flat charging surface.

3. Install the special tool: EL-51755 Inductive Charging Test Tool at Charging Pad/Pocket

   Verify the function: Special Tools LED (Light Emitting Diode) = On

   - If the special tool is Off

     Refer to: Circuit/System Testing

   - If the special tool is On
4. Verify the function: Wireless Charging Indicator = On
   - If the indicator is Off

     Refer to: Circuit/System Testing

   - If the indicator is On

NOTE: **The customer's device may not be compatible or is defective.**

5. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: T22 Mobile Device Wireless Charger Module
3. Test for less than 10 Ω between the test points: Ground circuit terminal 2 & Ground
   - **If 10 Ω or greater**
   1. Disconnect ground terminal.
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 2 at Component harness & The other end of the circuit at Ground terminal
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: Ignition circuit terminal 1 & Ground
   - **If the test lamp does not turn On and the circuit fuse is OK**
   1. Remove - Test Lamp
   2. Test for less than 2 Ω between the test points: Ignition circuit terminal 1 & Output terminal at Fuse
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω Refer to: Retained Accessory Power Malfunction
   - **If the test lamp does not turn On and the circuit fuse is open**
   1. Remove - Test Lamp
   2. Test for infinite resistance between the test points: Ignition circuit terminal 1 & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: T22 Mobile Device Wireless Charger Module.

- **If the test lamp turns On**

6. Verify the function: Wireless Charging Indicator = Off
    - **If the indicator is On**
    1. Ignition/Vehicle - Off
    2. Disconnect the electrical connector: K9 Body Control Module
    3. Test for infinite resistance between the test points: Signal circuit terminal 3 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component: K9 Body Control Module
    - **If the indicator is Off**
7. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Ground circuit terminal 2
8. Verify the function: Wireless Charging Indicator = On
    - **If the indicator is Off**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: K9 Body Control Module
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Signal circuit terminal 3 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
    5. Ignition/Vehicle - Off
    6. Test for less than 2 Ω between the test points: Signal circuit terminal 3 at Component harness & The other end of the circuit at Control module harness
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: K9 Body Control Module
    - **If the indicator is On**
9. Test or replace the component: T22 Mobile Device Wireless Charger Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

Wireless Charging System Module Replacement - T22 Mobile Device Wireless Charger Module

POWER OUTLET RECEPTACLE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Ground	-	1	-	-
1. Accessory Power Receptacle Malfunction				

Circuit/System Description

The vehicle is fitted with a 12 V accessory power receptacle. The accessory power outlets are controlled by an ignition operated relay. The accessory power receptacle is operational when Vehicle in Service Mode or Vehicle ON.

Diagnostic Aids

It may be helpful to discuss with the customer the usage of any device that may have drawn too much current and caused an open fuse.

Reference Information

Schematic Reference

Cigar Lighter/Power Outlet Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Outlets Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Vehicle in Service Mode, connect an appropriate device to the X80 Accessory Power Receptacle.
2. Verify the device is powered by the X80 Accessory Power Receptacle.
    - **If the device is not powered**

      Refer to Circuit/System Testing

    - **If the device is powered**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate X80 Accessory Power Receptacle or E32 Cigarette Lighter Receptacle.
2. Test for less than 10 Ω between the ground circuit terminal C and ground.
    - **If greater than 10 Ω**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the control circuit terminal A and ground.
    - **If the test lamp does not illuminate and the circuit fuse/circuit breaker is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the control circuit end to end.
        - If greater than 2 Ω, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse/circuit breaker is not open and there is voltage at the fuse/circuit breaker. Refer to **Retained Accessory Power Malfunction** .
    - **If the test lamp does not illuminate and the circuit fuse/circuit breaker is open**
    1. Vehicle OFF.

2. Test for infinite resistance between the control circuit terminal A and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the appropriate X80 Accessory Power Receptacle.
  - **If the test lamp illuminates**
5. Replace the appropriate X80 Accessory Power Receptacle or E32 Cigarette Lighter Receptacle.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Accessory Power Receptacle Replacement

USB RECEPTACLE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Ground	-	1	-	-
1. USB Receptacle Malfunction				

Circuit/System Description

The vehicle is fitted with USB charge port receptacles which are used only for charging mobile devices. The USB receptacles are controlled by an ignition operated relay and are operational when the ignition is turned to either the On or the Accessories positions.

Reference Information

Schematic Reference

Cigar Lighter/Power Outlet Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Outlets Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the X92 USB Receptacle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If greater than 10 Ω**

        1. Ignition OFF.
        2. Test for less than 2 Ω in the ground circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**

3. Ignition ON.
4. Verify that a test lamp illuminates between the control circuit terminal 6 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
        1. Ignition OFF.
        2. Test for less than 2 Ω in the control circuit end to end.
            - If greater than 2 Ω, repair the open/high resistance in the circuit.
            - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse. Refer to **Retained Accessory Power Malfunction** .
    - **If the test lamp does not illuminate and the circuit fuse is open**
        1. Ignition OFF.
        2. Test for infinite resistance between the control circuit terminal 6 and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If infinite resistance, replace the X92 USB Receptacle.
    - **If the test lamp illuminates**
5. Test or replace the X92 USB Receptacle.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Dual Charge Only Receptacle Replacement.

REPAIR INSTRUCTIONS

WIRELESS CHARGING SYSTEM MODULE REPLACEMENT

Removal Procedure

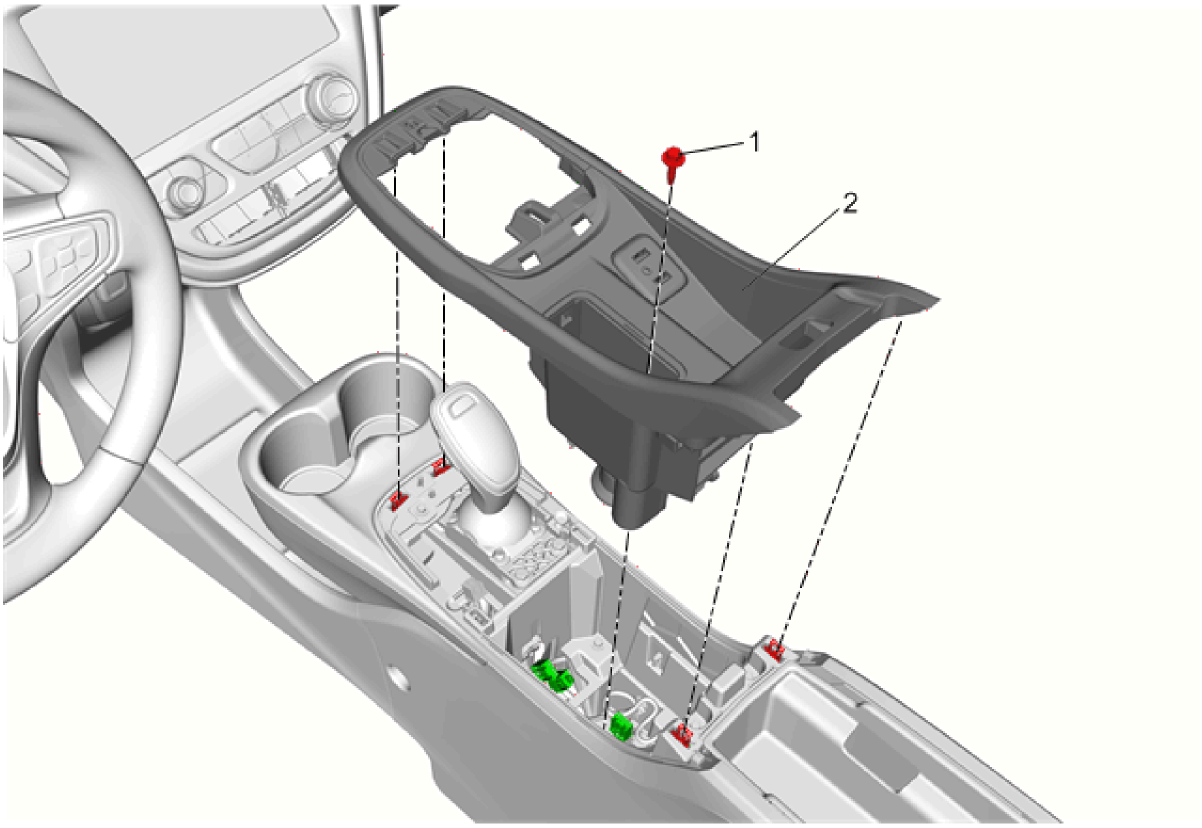


Fig. 2: Rear Floor Console Stowage Tray
Courtesy of GENERAL MOTORS COMPANY

1. Rear Floor Console Stowage Tray (2) - Remove - Rear Floor Console Stowage Tray Replacement (without K4C) Rear Floor Console Stowage Tray Replacement (with K4C)

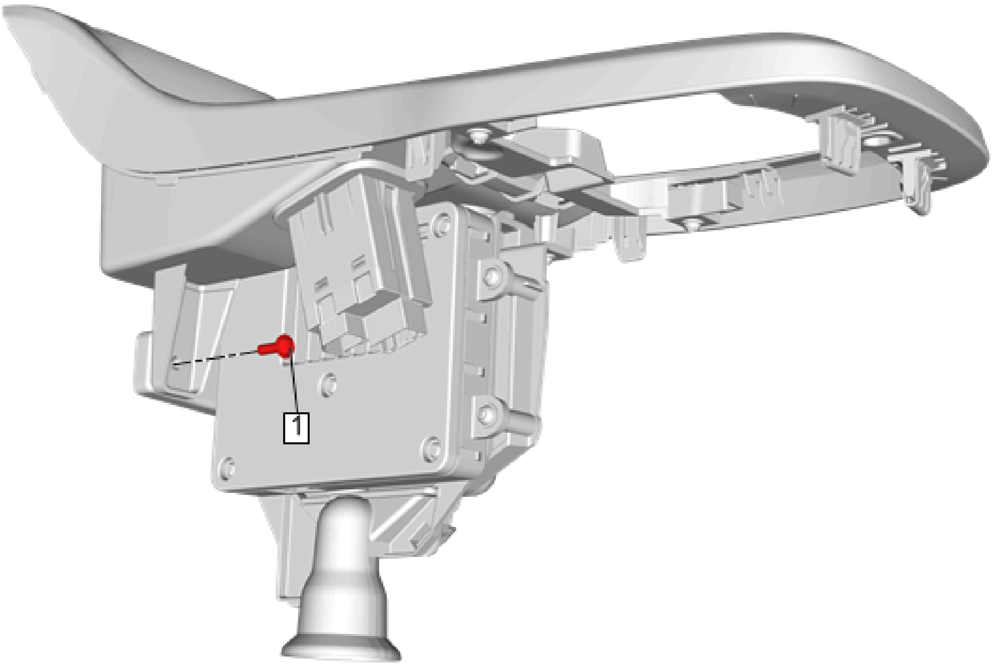


Fig. 3: Wireless Charging System Module Bracket Screw
Courtesy of GENERAL MOTORS COMPANY

2. Wireless Charging System Module Bracket Screw (1) - Remove

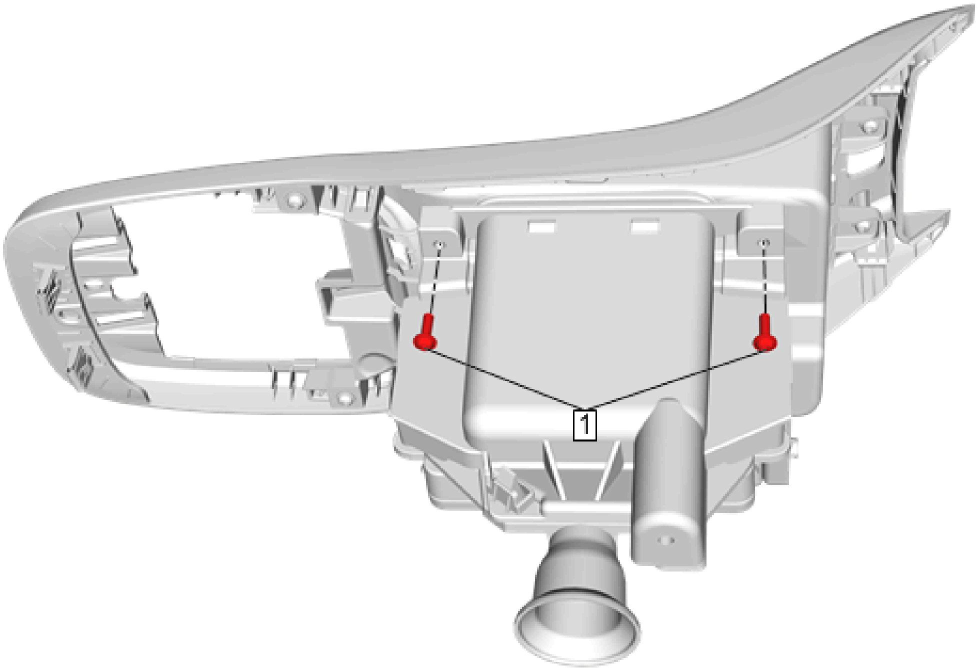


Fig. 4: Wireless Charging System Module Bracket Screw
Courtesy of GENERAL MOTORS COMPANY

3. Wireless Charging System Module Bracket Screw (1) - Remove

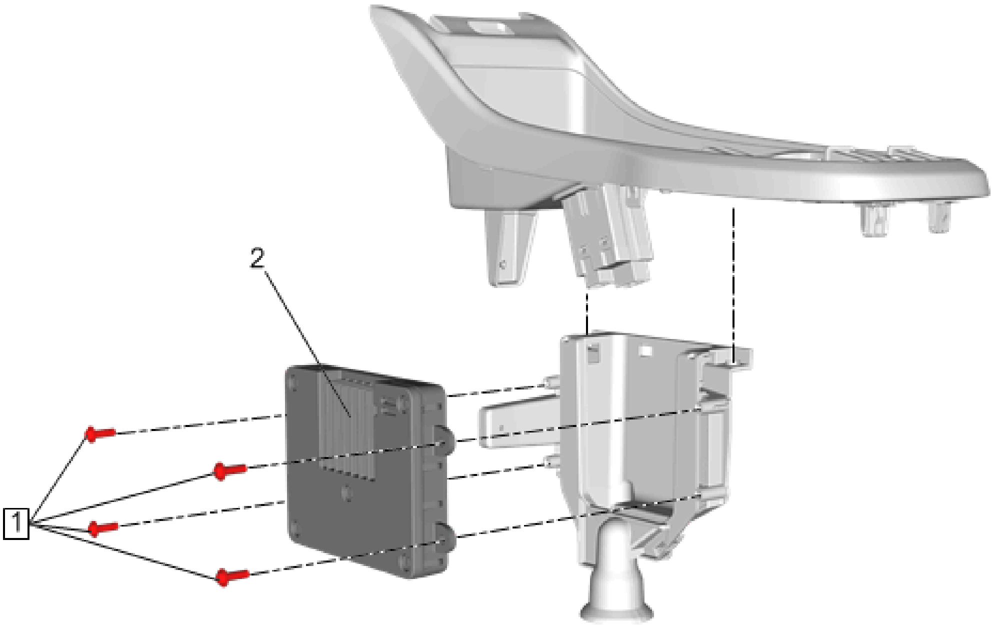


Fig. 5: Wireless Charging System Module
Courtesy of GENERAL MOTORS COMPANY

4. Wireless Charging System Module Bracket Screw (1) - Remove
5. Wireless Charging System Module (2) at Wireless Charging System Module Bracket - Remove
6. Transfer components as necessary.

Installation Procedure

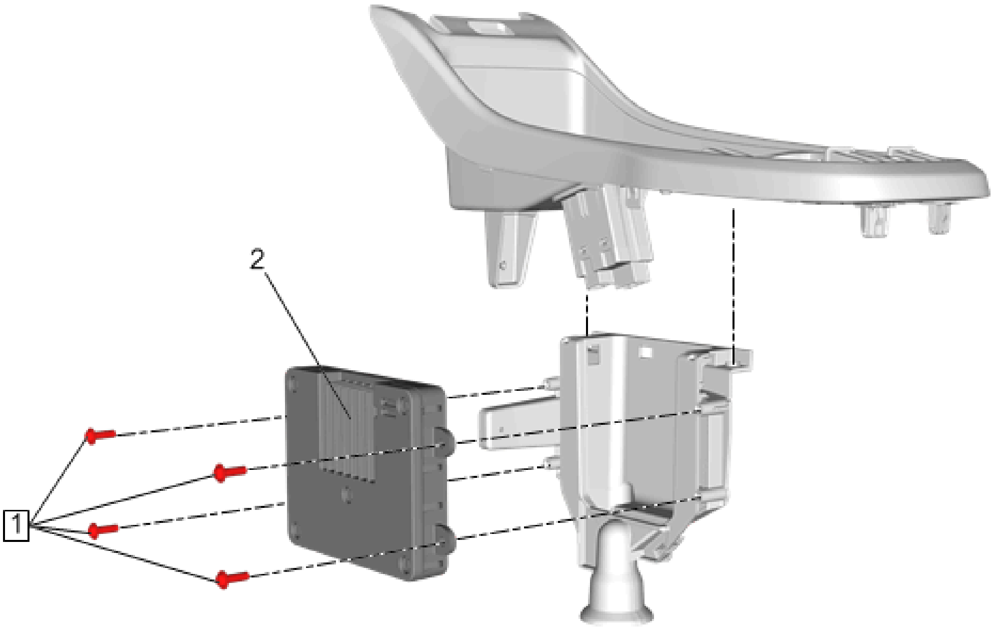
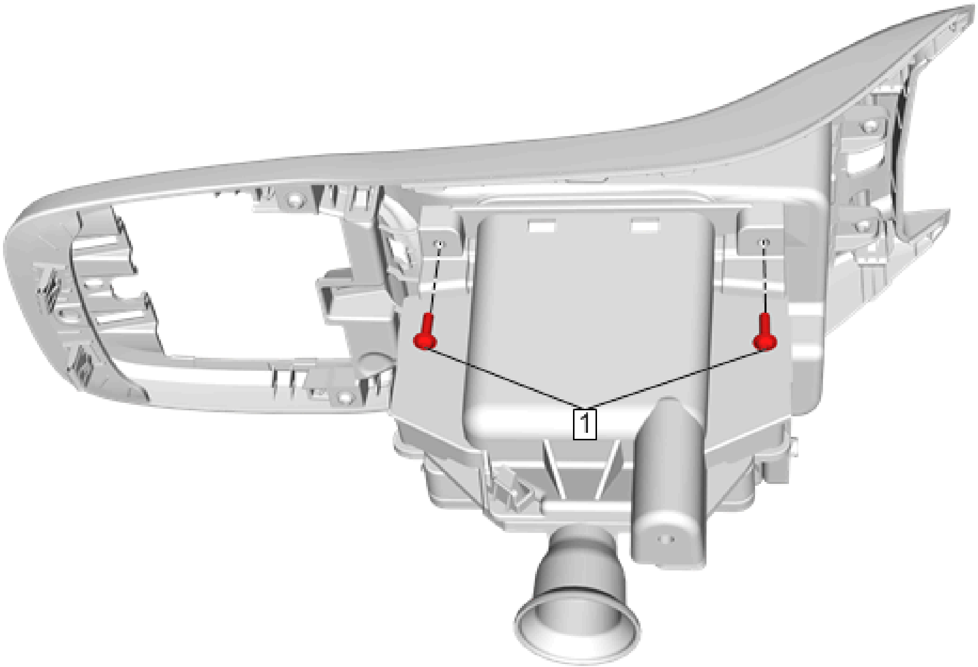


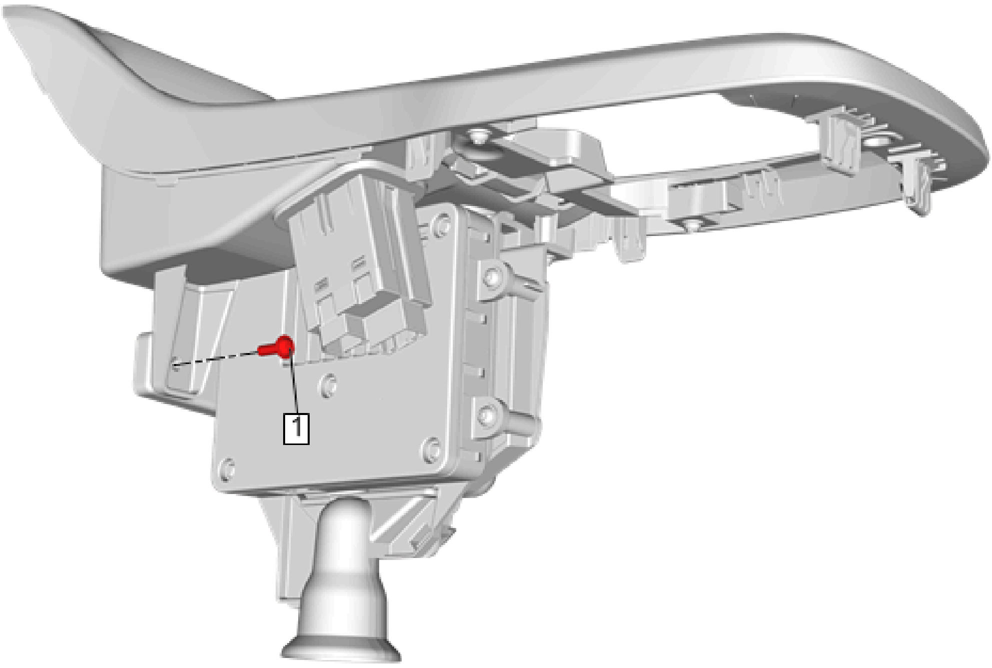
Fig. 6: Wireless Charging System Module
Courtesy of GENERAL MOTORS COMPANY

1. Wireless Charging System Module (2) at Wireless Charging System Module Bracket - Install
2. Wireless Charging System Module Bracket Screw (1) - Install and tighten to 1 N.m (9 lb in)



[Fig. 7: Wireless Charging System Module Bracket Screw]
Courtesy of GENERAL MOTORS COMPANY

3. Wireless Charging System Module Bracket Screw (1) - Install and tighten to 1 N.m (9 lb in)



[Fig. 8: Wireless Charging System Module Bracket Screw]
Courtesy of GENERAL MOTORS COMPANY

4. Wireless Charging System Module Bracket Screw (1) - Install and tighten to 1 N.m (9 lb in)

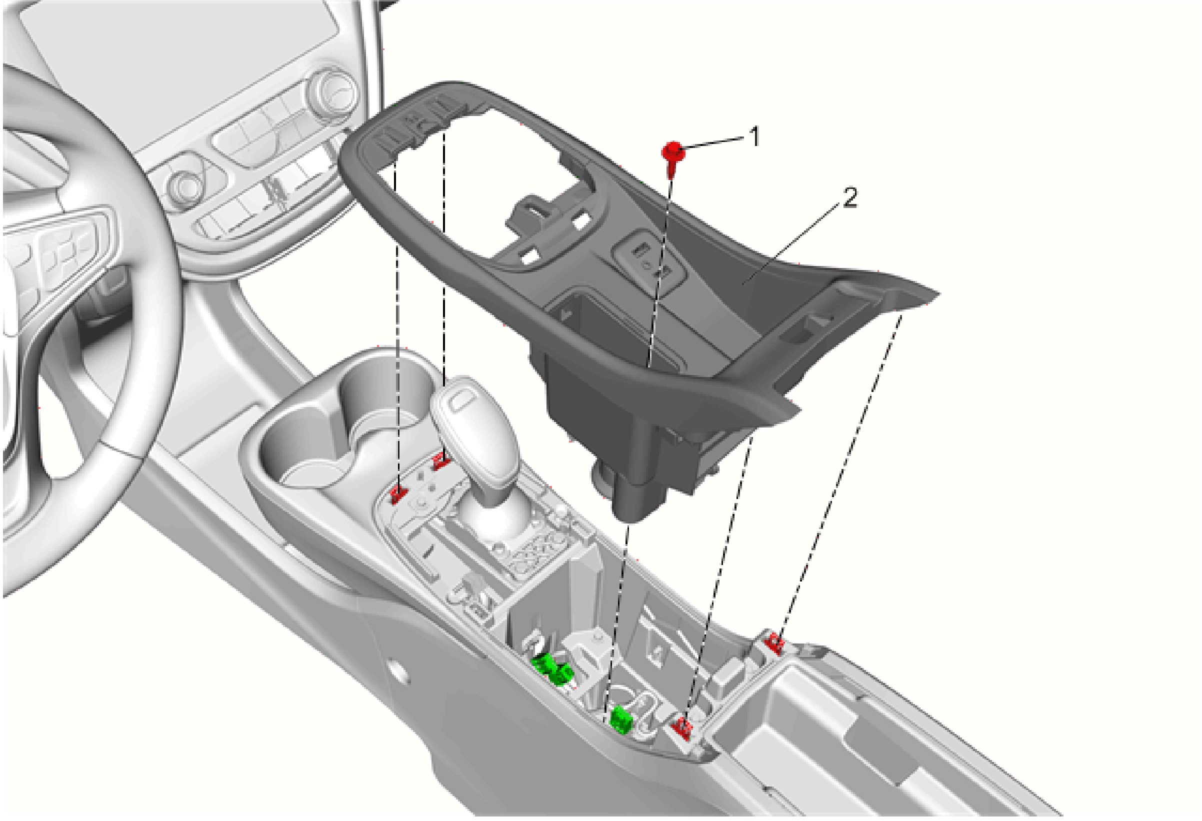


Fig. 9: Wireless Charging System Module Bracket Screw
Courtesy of GENERAL MOTORS COMPANY

5. Rear Floor Console Stowage Tray (2) - Install - **Rear Floor Console Stowage Tray Replacement (without K4C)** **Rear Floor Console Stowage Tray Replacement (with K4C)**

ACCESSORY POWER RECEPTACLE REPLACEMENT

Special Tools

EL-42059 Cigar Lighter Socket Remover

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

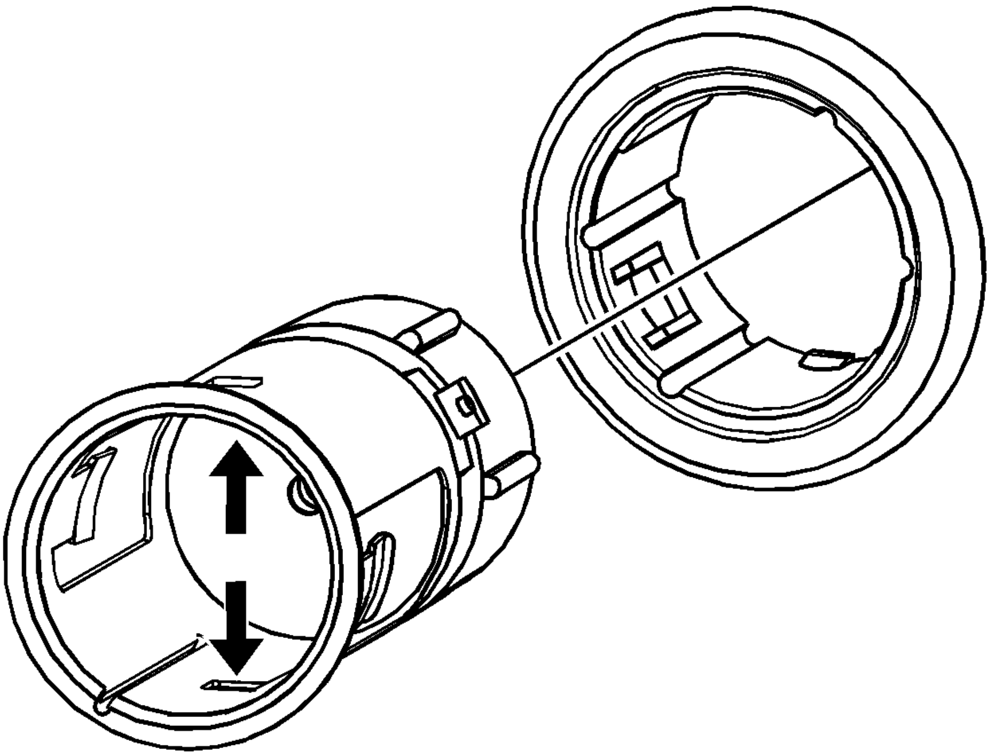


Fig. 10: Cigar Lighter Socket/Accessory Power Outlet
Courtesy of GENERAL MOTORS COMPANY

1. Remove the front floor console compartment trim plate. **Front Floor Console Compartment Trim Plate Replacement**
2. Remove the receptacle:
    1. Look into the receptacle. There are two 3 mm (0.11 in) tab windows 12 mm (0.47 in) from the front of the receptacle. The **EL-42059** remover pushes the plastic latches from these tab windows and the receptacle can be pulled straight out.
    2. Place one side of the "T" portion of the **EL-42059** remover into the tab window. The **EL-42059** remover will not fit straight into the receptacle. Angle the slightly for insertion into the receptacle.
    3. Insert the other side of the "T" into the opposite tab window.

        You must move the **EL-42059** remover handle toward horizontal to engage the other tab window.

    4. Use the **EL-42059** remover to pull the receptacle straight out.

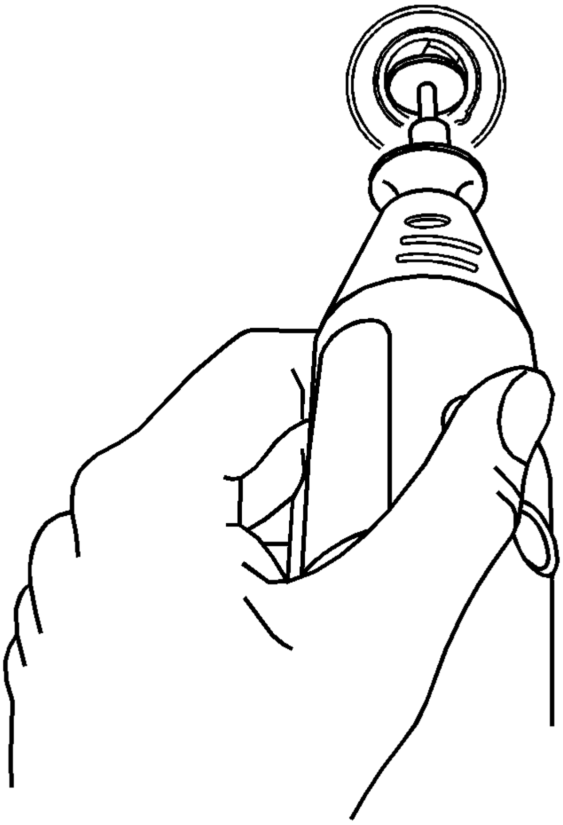


Fig. 11: Removing Cigar Housing Using Grinding Tool
Courtesy of GENERAL MOTORS COMPANY

3. If **EL-42059** remover tool fails to release the lighter socket from the retainer, perform the following alternate method:
    1. Insert a small grinding tool with a cutoff wheel into the socket.
    2. Remove the plastic latches in the 3 mm (0.11 in) square windows.
    3. Use the **EL-42059** remover as directed above to remove the socket.

Installation Procedure

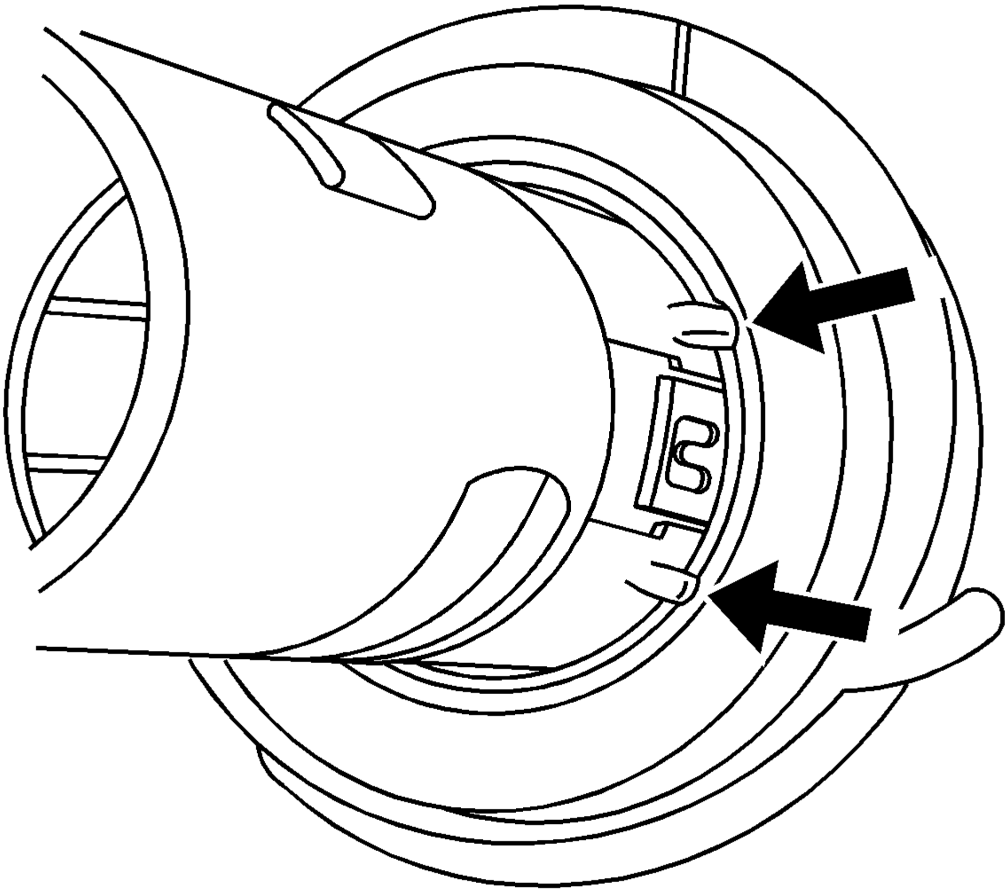


Fig. 12: Receptacle Tabs & Retainer Slots
Courtesy of GENERAL MOTORS COMPANY

1. Route the connector through the retainer. Align the accessory power receptacle retainer to the slot in the opening.
2. Install the retainer by pressing into place fully seated.
3. Align the tabs on the receptacle to the slots in the retainer. Install the accessory power receptacle by pressing into place until fully seated.
4. Install the front floor console compartment trim plate. Front Floor Console Compartment Trim Plate Replacement

DUAL CHARGE ONLY RECEPTACLE REPLACEMENT

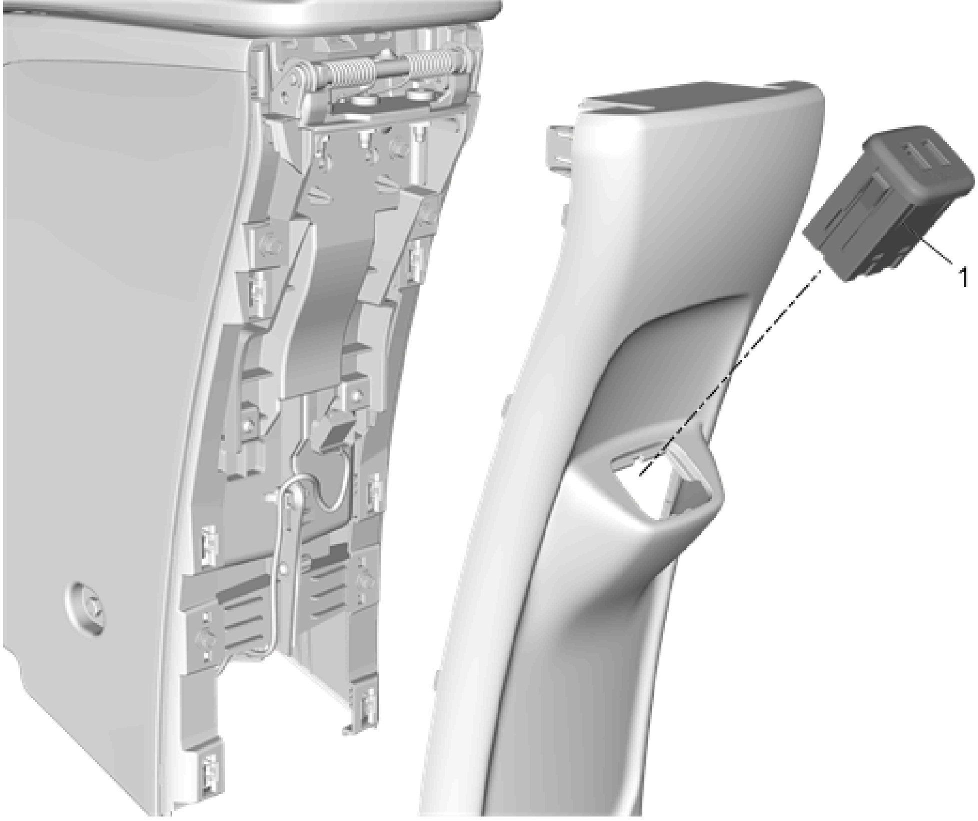


Fig. 13: Dual Charge Only Receptacle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Rear Trim Panel Replacement	
1	Dual Charge Only Receptacle **Procedure** Use a flat bladed plastic trim tool.

DESCRIPTION AND OPERATION

MOBILE DEVICE WIRELESS CHARGER DESCRIPTION AND OPERATION

Mobile Device Wireless Charging System

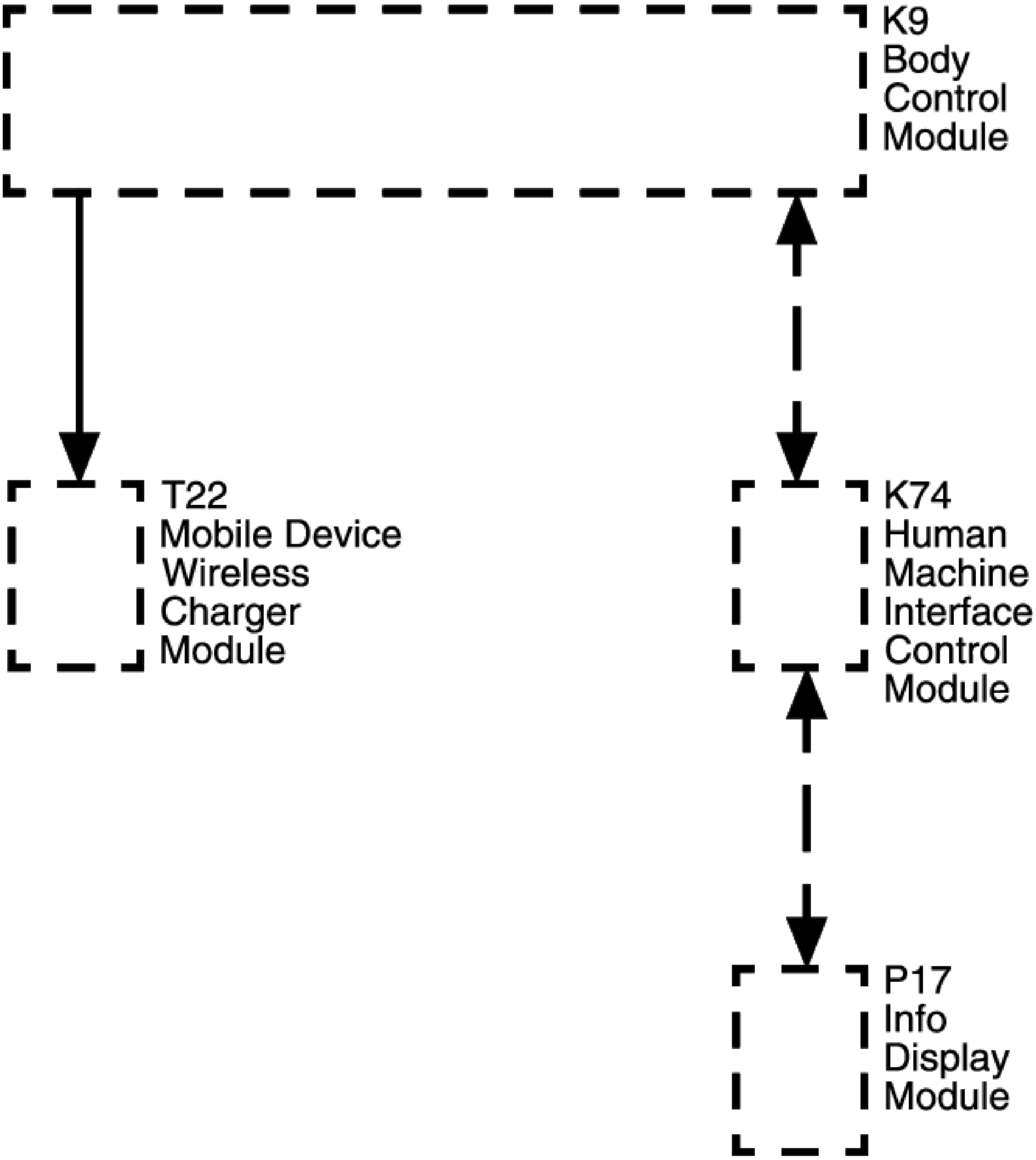


Fig. 14: Mobile Device Wireless Charging System Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K9	K9 Body Control Module
T22	Mobile Device Wireless Charger Module
K74	Human Machine Interface Control Module
P17	P17 Info Display Module

The Mobile Device Wireless Charging System (WCS) is an system for wirelessly charging mobile devices. It is capable of charging the batteries of compatible mobile devices. A compatible device is one that is compliant with Power Matters Alliance (PMA) or Wireless Power Consortium (WPC) Standard, meaning that it is equipped with a PMA or WPC wireless charge "receiver" that will work with the charge "transmitter" installed in the vehicle. The devices may utilize built-in charging circuitry or an adapter (external plug-in device which contains the charging circuitry). To check for phone or other device compatibility, refer to GM Total Connect.

WARNING: **Remove all objects from the charging pad before charging your mobile device. Objects, such as coins, keys, rings, paper clips, or cards, between the phone and charging pad will become very hot. On the rare occasion that the charging system does not detect an object, and the object gets wedged between the phone and charger, remove the phone and allow the object to cool before removing it from the charging pad, to prevent burns.**

Charging

To charge a device, place it on the charging surface in the vehicle. There is a charging coil located in the center of the charging surface. The device has a charging coil typically near the center of the device. These coils must be lined up in order for charging to proceed. When the interruptible retained accessory power (IRAP) relay is closed (this is true typically when vehicle ignition is in Run or Accessory position), the WCS will detect the device, establish communications with the device to confirm it is a compatible device, and then deliver charging power to the device via wireless interface. The WCS will be able to deliver up to 5W of power to compatible devices. It shall only enter a charging state if communication is established and a compatible device is identified.

The WCS shall not enter a charging state if there is no communication established with a compatible device. If a non-compatible device or metallic foreign object is detected, the WCS will not transfer power. The charger monitors its internal temperature and will shut down if the charger temperature exceeds 185F (85C).

Indicator

The body control module will detect the device battery is charging and send a serial data message on the GMLAN bus to the radio display. The radio display will indicate a device is currently charging. When the indicator is toggling on and off this indicates a thermal limit has been reached and the device will not charge. For more information refer to the infotainment owners manual.

POWER OUTLETS DESCRIPTION AND OPERATION

System Description

The vehicle is fitted with a cigarette lighter and/or with a 12 V accessory power receptacle. The cigarette lighter and accessory power outlets are controlled by an ignition operated relay. The accessory power receptacle and cigarette lighter are operational when the ignition is turned to either the On or the Accessories positions. To operate the cigarette lighter, press in the lighter knob. When the element is hot, the lighter automatically pops out and is ready for use.

USB Receptacle Description and Operation (USS)

The vehicle is fitted with USB charge port receptacles at the rear of the floor console. These USB receptacles are for charging devices only. The USB receptacles are controlled by an ignition operated relay and are operational when the ignition is turned to either the On or the Accessories positions.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

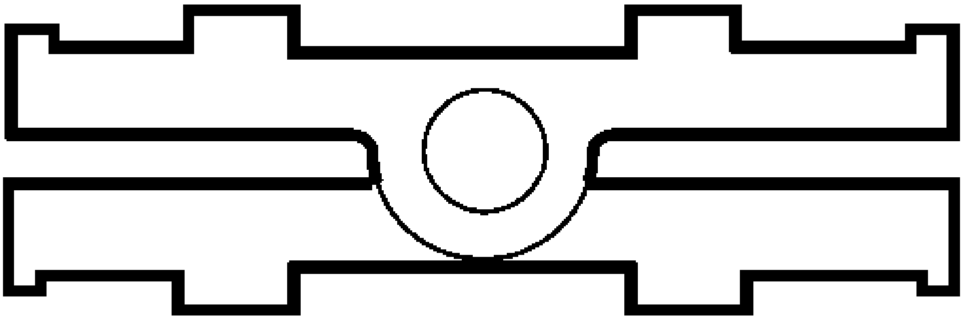
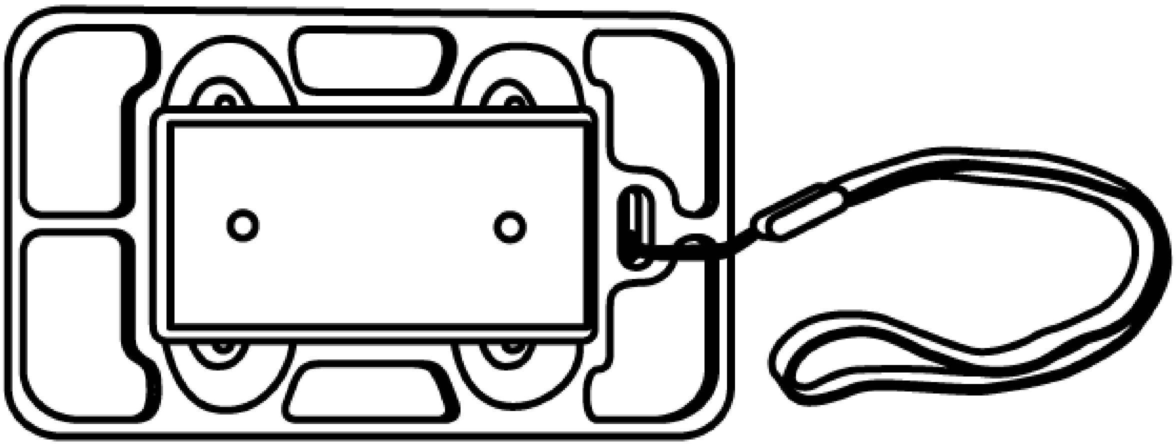
Illustration	Tool Number/ Description
	BO-48871 Cigar Lighter Socket Remover

Illustration	Tool Number/ Description
	EL-51755 Inductive Charging Test Tool

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Keyless Entry Control Module Bracket Bolt	2.5 N.m (22 lb in)

SCHEMATIC WIRING DIAGRAMS

REMOTE FUNCTION WIRING SCHEMATICS

Keyless Entry - Active

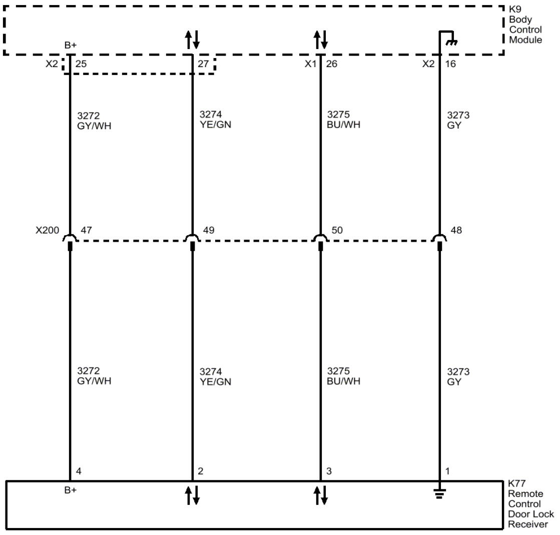

K9
Body
Control
Module
B+
X2
25
27
X1
26
X2
16
3272
GY/WH
3274
YE/GN
3275
BU/WH
3273
GY
X200
47
49
50
48
3272
GY/WH
3274
YE/GN
3275
BU/WH
3273
GY
4
2
3
1
B+
K77
Remote
Control
Door Lock
Receiver

Fig. 1: Keyless Entry - Active
Courtesy of GENERAL MOTORS COMPANY

Keyless Entry - Passive and Keyless Start

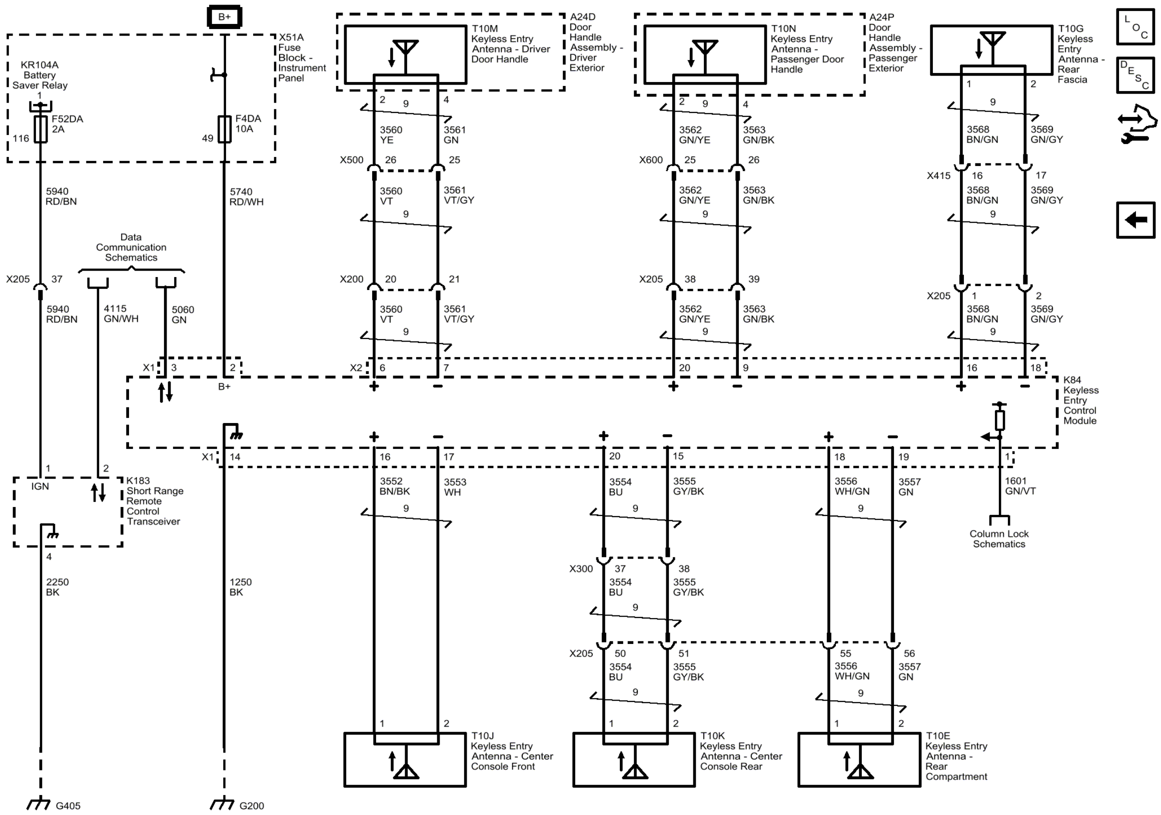

B+
X51A Fuse Block - Instrument Panel
KR104A Battery Saver Relay
F52DA 2A
F4DA 10A
116
49
1
5940 RD/BN
5740 RD/WH
Data Communication Schematics
X205
37
5940 RD/BN
4115 GN/WH
5060 GN
X1
3
2
B+
T10M Keyless Entry Antenna - Driver Door Handle
A24D Door Handle Assembly - Driver Exterior
2
9
4
3560 YE
3561 GN
X500
26
25
3560 VT
3561 VT/GY
X200
20
21
X2
6
7
T10N Keyless Entry Antenna - Passenger Door Handle
A24P Door Handle Assembly - Passenger Exterior
3562 GN/YE
3563 GN/BK
X600
25
26
X205
38
39
20
9
T10G Keyless Entry Antenna - Rear Fascia
1
2
3568 BN/GN
3569 GN/GY
X415
16
17
X205
1
2
16
18
K84 Keyless Entry Control Module
1
2
IGN
K183 Short Range Remote Control Transceiver
4
2250 BK
X1
14
1250 BK
G405
G200
16
17
3552 BN/BK
3553 WH
20
15
3554 BU
3555 GY/BK
18
19
3556 WH/GN
3557 GN
1
1601 GN/VT
Column Lock Schematics
X300
37
38
X205
50
51
55
56
T10J Keyless Entry Antenna - Center Console Front
T10K Keyless Entry Antenna - Center Console Rear
T10E Keyless Entry Antenna - Rear Compartment
LOC
DESC

Fig. 2: Keyless Entry - Passive and Keyless Start

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B305D: CHALLENGE ACTIVE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B305D

Challenge Active Circuit

For symptom byte information refer to Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Challenge Active	B305D 02	-	B305D 01	-

Circuit/System Description

The body control module (BCM) communicates with the remote control door lock receiver through the keyless entry challenge active circuit. The challenge active signal is activated by the keyless entry control module and sent to the BCM when active communication between the vehicle and the keyless entry transmitter is initiated.

Conditions for Running the DTC

- System voltage between 9 - 16 V

- Signal output activated by the keyless entry control module

Conditions for Setting the DTC

B305D 01

A short to voltage is detected on the challenge active circuit.

B305DB 02

A short to ground is detected on the challenge active circuit.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present.
- A history DTC will clear after 50 malfunction-free ignition cycles.

Reference Information

Schematic Reference

- **Power Moding Schematics**
- **Power Distribution Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON, connect a test lamp between the control circuit terminal 5 and ground circuit terminal 3.
4. Verify the test lamp turns ON and OFF when switching the ignition ON and OFF.

- **If the test lamp is always OFF**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
2. Test for infinite resistance between the control circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K84 Keyless Entry Control Module.

- **If the test lamp is always ON**

1. Ignition OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
2. Test for less than 1 V between the control circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If the test lamp turns ON and OFF**

5. Test or replace the KR76 Retained Accessory Power Relay.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- Refer to **Control Module References** for keyless entry control module replacement, programming and setup.

DTC B3101: KEYLESS ENTRY DATA LINK CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3101

Keyless Entry Data Link Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B3101 00	B3101 00	-	-
Serial Data - Enable Line	B3101 00	B3101 00	B3101 00	B3101 00
Serial Data - Receive	B3101 00	B3101 00	B3101 00	B3101 00
Low Reference	-	B3101 00	-	-

Circuit/System Description

The body control module communicates with the remote control door lock receiver through the keyless entry serial data circuits. When any button on the keyless entry transmitter is pressed, the transmitter sends a signal to the remote control door lock receiver. The remote control door lock receiver sends a function request to the body control module, depending on which button is pressed on the transmitter. The body control module receives the message and performs the appropriate function.

Conditions for Running the DTC

The body control module monitors for this DTC at all times.

Conditions for Setting the DTC

No response is received from the remote control door lock receiver after the body control module requests information from or sends configuration commands to the remote control door lock receiver.

Action Taken When the DTC Sets

In the case of power loss, the remote control door lock receiver is disabled for 65 s. Otherwise no action is taken.

Conditions for Clearing the DTC

- A current DTC will clear when the fault is no longer present.
- A history DTC will clear after 40 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Remote Function Schematics

Component Connector End Views

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, scan tool disconnected, disconnect the harness connector at the K77 Remote Control Door Lock Receiver. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 30 Ω between the low reference circuit terminal 1 and ground.
   - **If 30 Ω or greater**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If less than 30 Ω**
3. Ignition ON.
4. Test for greater than 11.5 V between the B+ circuit terminal 4 and ground.

   - **If 11.5 V or less**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If Infinite resistance.
   3. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If greater than 11.5 V**
5. Test for 1 - 6 V between the serial data circuit terminal 2 and ground.
   - **If less than 1 V**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the serial data circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If greater than 6 V**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
   2. Test for less than 1 V between the serial data circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If between 1 - 6 V**
6. Ignition OFF, disconnect the X1 and X2 harness connectors at the K9 Body Control Module, ignition ON.
7. Test for less than 1 V between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
8. Ignition OFF.
9. Test for infinite resistance between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
10. Test for less than 2 Ω between the K9 Body Control Module serial data circuit terminal 26 X1 and the K77 Remote Control Door Lock Receiver serial data circuit terminal 3.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
11. Replace the K77 Remote Control Door Lock Receiver.
12. Verify DTC B3101 does not set while operating the vehicle under the conditions for running the DTC.
    - **If the DTC sets**

Replace the K9 Body Control Module

- **If the DTC does not set**

13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for body control module or remote control door lock receiver replacement, programming, and setup.

DTC B3105: KEYLESS ENTRY TRANSMITTERS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3105

Keyless Entry Transmitters

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

The body control module monitors the number of keyless entry transmitters programmed. Until at least one transmitter is programmed, the body control module determines a malfunction condition exists.

Conditions for Running the DTC

The body control module has been set up without transmitters being programmed.

Conditions for Setting the DTC

No keyless entry transmitter programmed to the body control module.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

A current DTC is cleared when at least one transmitter has been programmed to the body control module.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the transmitter is a correct transmitter for the vehicle. This can be accomplished by comparing the part number printed on the transmitter to the appropriate part number in the parts catalog.
    - **If the transmitter is incorrect**

      Replace the transmitter.

    - **If the transmitter is correct**
2. Program the transmitter. Refer to Key with Integrated Transmitter Programming .
3. Verify the transmitter has successfully completed the programming procedure.
    - **If the transmitter does not program successfully**

      Replace the transmitter.

    - **If the transmitter programs successfully**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Key with Integrated Transmitter Programming

DTC B3106: KEYLESS ENTRY DATA LINK

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC B3106

Keyless Entry Data Link

For symptom byte information, refer to Symptom Byte List .

Circuit/System Description

The body control module communicates with the remote control door lock receiver through the keyless entry serial data circuits. When any button on the keyless entry transmitter is pressed, the transmitter sends a signal to the remote control door lock receiver. The remote control door lock receiver sends a function request to the body control module, depending on which button is pressed on the transmitter. The body control module receives the message and performs the appropriate function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

The transmitter that is sending a signal to the remote control door lock receiver is different from those transmitters stored in the body control module.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC will clear when the fault is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Remote Function Schematics

Component Connector End Views

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. With a valid and learned transmitter, press and release a button on the transmitter.
2. Verify that DTC B3106 is not set.
    - **If DTC B3106 is set**

      Replace the K77 Remote Control Door Lock Receiver.

    - **If DTC B3106 is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for remote control door lock receiver replacement, programming, and setup.

DTC B3109-B3113: KEYLESS ENTRY TRANSMITTER 1-5 BATTERY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3109

Keyless Entry Transmitter 1 Battery

DTC B3110

Keyless Entry Transmitter 2 Battery

DTC B3111

Keyless Entry Transmitter 3 Battery

DTC B3112

Keyless Entry Transmitter 4 Battery

DTC B3113

Keyless Entry Transmitter 5 Battery

For symptom byte information, refer to **Symptom Byte List** .

Circuit/System Description

With each press of a keyless entry transmitter button, a message containing the current battery state of the transmitter is sent to the remote control door lock receiver, along with the commanded keyless entry function. The remote control door lock receiver sends this to the body control module to perform the requested function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

Three consecutive low battery signals are received from the same transmitter.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

The DTC is cleared when a normal transmitter voltage signal is received from the transmitter that set the DTC.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify none of the DTCs listed below are set:
    - DTC B3109
    - DTC B3110
    - DTC B3111
    - DTC B3112
    - DTC B3113
    - **If any of the DTCs are set**
    1. Replace the battery in the appropriate keyless entry transmitter and operate the transmitter three consecutive times.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the keyless entry transmitter.
        - If the DTC does not set
    3. All OK.
    - **If none of the DTCs are set**
2. All OK.

DTC B310D-B310F: KEYLESS ENTRY TRANSMITTER 6-8 BATTERY

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B310D

Keyless Entry Transmitter 6 Battery

DTC B310E

Keyless Entry Transmitter 7 Battery

DTC B310F

Keyless Entry Transmitter 8 Battery

For symptom byte information, refer to Symptom Byte List .

Circuit/System Description

With each press of a keyless entry transmitter button, a message containing the current battery state of the transmitter is sent to the remote control door lock receiver, along with the commanded keyless entry function. The remote control door lock receiver sends this to the body control module to perform the requested function.

Conditions for Running the DTC

A keyless transmitter button is pressed.

Conditions for Setting the DTC

Three consecutive low battery signals are received from the same transmitter.

Action Taken When the DTC Sets

The keyless entry system is inoperative.

Conditions for Clearing the DTC

The DTC is cleared when a normal transmitter voltage signal is received from the transmitter that set the DTC.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify none of the DTCs listed below are set:
    - DTC B310D
    - DTC B310E
    - DTC B310F
    - **If any of the DTCs are set**
    1. Replace the battery in the appropriate keyless entry transmitter and operate the transmitter three consecutive times.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the keyless entry transmitter.
        - If the DTC does not set
    3. All OK.
    - **If none of the DTCs are set**
2. All OK.

DTC B3119: KEYLESS ENTRY ANTENNA 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3119

Keyless Entry Antenna 1

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Driver Door	B3119 02	B3119 05	B3119 05	-
Keyless Entry Antenna Low Reference - Driver Door	B3119 02	B3119 05	B3119 05	-

Circuit/System Description

The driver door handle antenna is located in the driver door handle assembly and is used to establish low frequency communications with the keyless entry transmitter. As a vehicle with locked doors is approached with a keyless entry transmitter and the exterior door handle button is pressed, the keyless entry control module communicates with the driver door handle keyless entry antenna.

Conditions for Running the DTC

The exterior driver door handle button is pressed within 15 min of last door closing.

Conditions for Setting the DTC

B3119 02

The keyless entry control module detects a short to ground on the driver door keyless entry antenna signal circuit.

B3119 05

The keyless entry control module detects a short to voltage or an open on the driver door keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Doors will not unlock/lock when the driver exterior door handle button is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

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Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC B3122, B3123, or B3124 is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10L Keyless Entry Antenna - Driver Door Handle, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
    - **If 1 V or greater**

    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the low reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the low reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
10. Replace the T10L Keyless Entry Antenna - Driver Door Handle.
11. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
12. Verify DTC B3119 is not set.
    - **If DTC B3119 is set**

      Replace the K84 Keyless Entry Control Module.

    - **If DTC B3119 is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Front Side Door Outside Handle Bracket Replacement**
- Refer to **Control Module References** for module replacement, programming, and setup

DTC B3120: KEYLESS ENTRY ANTENNA 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3120

Keyless Entry Antenna 2

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Passenger Door	B3120 02	B3120 05	B3120 05	-
Keyless Entry Antenna Low Reference - Passenger Door	B3120 02	B3120 05	B3120 05	-

Circuit/System Description

The passenger front door handle antenna is located in the passenger front door handle assembly and is used to establish low frequency communications with the keyless entry transmitter. As a vehicle with locked doors is approached with a keyless entry transmitter and the exterior door handle button is pressed, the keyless entry control module communicates with the passenger front door handle keyless entry antenna.

Conditions for Running the DTC

The exterior door handle button in the passenger front door handle is pressed within 15 min of the last change of door ajar status for any door.

Conditions for Setting the DTC

B3120 02

The keyless entry control module detects a short to ground on the passenger front door keyless entry antenna signal circuit.

B3120 05

The keyless entry control module detects a short to B+ or an open on the passenger front door keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Doors will not unlock/unlock when the passenger exterior door handle button is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B3122, B3123, or B3124 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10R Keyless Entry Antenna - Passenger Door Handle, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
   - **If 1 V or greater**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K84 Keyless Entry Control Module.
   - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
   - **If 1 V or less**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
   - **If 1 V or greater**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
   2. Test for less than 1 V between the low reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.

        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the low reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
10. Replace the T10R Keyless Entry Antenna - Passenger Door Handle.
11. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the exterior door handle button.
12. Verify DTC B3120 is not set.
    - **If DTC B3120 is set**

      Replace the K84 Keyless Entry Control Module.

    - **If DTC B3120 is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Front Side Door Outside Handle Bracket Replacement**
- Refer to **Control Module References** for module replacement, programming, and setup

DTC B3121: KEYLESS ENTRY ANTENNA 3

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3121

Keyless Entry Antenna 3

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Rear Fascia	B3121 02	B3121 05	B3121 05	-
Keyless Entry Antenna Low Reference - Rear Fascia	B3121 02	B3121 05	B3121 05	-

Circuit/System Description

The rear fascia antenna is located in the rear fascia assembly and is used to establish low frequency communications with the keyless entry transmitter. As a vehicle with locked doors is approached with a keyless entry transmitter and the exterior rear closure touch pad is pressed, the keyless entry control module communicates with the rear fascia keyless entry antenna.

Conditions for Running the DTC

- The rear closure touch pad is pressed.
- The scan tool activates a device control function to simulate the above action.

Conditions for Setting the DTC

B3121 02

The keyless entry control module detects a short to ground on the rear fascia keyless entry antenna signal circuit.

B3121 05

The keyless entry control module detects a short to B+ or an open on the rear fascia keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Rear closure will not open when rear closure touch pad is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

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Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC B3122, B3123, or B3124 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10G Keyless Entry Antenna - Rear Fascia, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the rear closure touch pad.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the low reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not**

function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the rear closure touch pad.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the low reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
10. Replace the T10G Keyless Entry Antenna - Rear Fascia.
11. Lock the vehicle doors using the keyless entry transmitter. Activate the antenna by pressing the rear closure touch pad.
12. Verify DTC B3121 is not set.
    - **If DTC B3121 is set**

      Replace the K84 Keyless Entry Control Module.

    - **If DTC B3121 is not set**
13. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Low Frequency Rear Bumper Antenna Replacement
- Refer to Control Module References for keyless entry control module replacement, programming, and setup

DTC B3122: KEYLESS ENTRY ANTENNA 4

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3122

Keyless Entry Antenna 4

For symptom byte information, refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Center Console Front	B3122 02	B3122 05	B3122 05	-
Keyless Entry Antenna Low Reference - Center Console Front	B3122 02	B3122 05	B3122 05	-

Circuit/System Description

The front center console antenna is located in front of the center console assembly and is used to establish low frequency communications with the keyless entry transmitter. When the driver attempts to change the ignition status of the vehicle, the keyless entry control module communicates with the front center console antenna.

Conditions for Running the DTC

Pressing the ignition mode switch.

Conditions for Setting the DTC

B3122 02

The keyless entry control module detects a short to ground on the front center console keyless entry antenna signal circuit.

B3122 05

The keyless entry control module detects a short to B+ or an open on the front center console keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Vehicle will not detect the transmitter in some locations inside the vehicle. If the transmitter is not detected then vehicle will not change ignition modes when ignition mode switch is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

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Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10J Keyless Entry Antenna - Center Console Front, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**
        1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
        2. Test for less than 1 V between the signal circuit and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Activate the antenna by pressing the ignition mode switch.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
        1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
        2. Test for infinite resistance between the signal circuit and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If infinite resistance
        3. Test for less than 2 Ω in the signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
    - **If 1 V or greater**
        1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
        2. Test for less than 1 V between the low reference circuit and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Activate the antenna by pressing the ignition mode switch.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
        1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
        2. Test for infinite resistance between the low reference circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**

10. Replace the T10J Keyless Entry Antenna - Center Console Front.
11. Activate the antenna by pressing the ignition mode switch.
12. Verify DTC B3122 is not set.
    - **If DTC B3122 is set**

      Replace the K84 Keyless Entry Control Module.

    - **If DTC B3122 is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Low Frequency Instrument Panel Antenna Replacement**
- Refer to **Control Module References** for keyless entry control module replacement, programming, and setup

DTC B3123: KEYLESS ENTRY ANTENNA 5

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3123

Keyless Entry Antenna 5

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Center Console Rear	B3123 02	B3123 05	B3123 05	-
Keyless Entry Antenna Low Reference - Center Console Rear	B3123 02	B3123 05	B3123 05	-

Circuit/System Description

The rear center console antenna is located in rear of the center console assembly and is used to establish low frequency communications with the keyless entry transmitter. When the driver attempts to change the ignition status of the vehicle, the keyless entry control module communicates with the rear center console antenna.

Conditions for Running the DTC

Pressing the ignition mode switch.

Conditions for Setting the DTC

B3123 02

The keyless entry control module detects a short to ground on the rear center console keyless entry antenna signal circuit.

B3123 05

The keyless entry control module detects a short to B+ or an open on the rear center console keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Vehicle will not detect the transmitter in some locations inside the vehicle. If the transmitter is not detected then vehicle will not change ignition modes when ignition mode switch is pressed. The exterior door handle buttons will not operate the keyless entry system.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.
- A history DTC will clear after 40 malfunction-free ignition cycles.

Reference Information

Schematic Reference

Remote Function Schematics

Connector End View Reference

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Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10K Keyless Entry Antenna - Center Console Rear, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange**

and manually set the DMM range to 000.0 V.

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Activate the antenna by pressing the ignition mode switch.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
   - **If 1 V or less**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
   - **If 1 V or greater**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
   2. Test for less than 1 V between the low reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K84 Keyless Entry Control Module.
   - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Activate the antenna by pressing the ignition mode switch.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
   - **If 1 V or less**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
   2. Test for infinite resistance between the low reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If greater than 1 V**
10. Replace the T10K Keyless Entry Antenna - Center Console Rear.
11. Activate the antenna by pressing the ignition mode switch.
12. Verify DTC B3123 is not set.
    - **If DTC B3123 is set**

      Replace the K84 Keyless Entry Control Module.

    - **If DTC B3123 is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Low Frequency Console Antenna Replacement**
- Refer to **Control Module References** for keyless entry control module replacement, programming, and setup

DTC B3124: KEYLESS ENTRY ANTENNA 6

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B3124

Keyless Entry Antenna 6

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Rear Compartment	B3124 02	B3124 05	B3124 05	-
Keyless Entry Antenna Low Reference - Rear Compartment	B3124 02	B3124 05	B3124 05	-

Circuit/System Description

The rear compartment antenna is located on the rear compartment floor near the seat back, centered, and is used to establish low frequency communications with the keyless entry transmitter. When the driver attempts to change the ignition status of the vehicle, the keyless entry control module communicates with the rear compartment antenna.

Conditions for Running the DTC

Pressing the ignition mode switch.

Conditions for Setting the DTC

B3124 02

The keyless entry control module detects a short to ground on the rear compartment keyless entry antenna signal circuit.

B3124 05

The keyless entry control module detects a short to B+ or an open on the rear compartment keyless entry antenna signal circuit.

Action Taken When the DTC Sets

Vehicle will not detect the transmitter in some locations inside the vehicle. If the transmitter is not detected then vehicle will not change ignition modes when ignition mode switch is pressed.

Conditions for Clearing the DTC

- A current DTC will clear when the conditions for setting the DTC are no longer present.

- A history DTC will clear after 40 malfunction-free ignition cycles.

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the T10E Keyless Entry Antenna - Rear Compartment, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
4. Activate the antenna by pressing the ignition mode switch.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**

6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the low reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V.
8. Activate the antenna by pressing the ignition mode switch.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the low reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
10. Replace the T10E Keyless Entry Antenna - Rear Compartment.
11. Activate the antenna by pressing the ignition mode switch.
12. Verify DTC B3124 is not set.
    - **If DTC B3124 is set**

      Replace the K84 Keyless Entry Control Module.

    - **If DTC B3124 is not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Low Frequency Rear Compartment Antenna Replacement**
- Refer to **Control Module References** for module replacement, programming, and setup

SYMPTOMS - REMOTE FUNCTIONS

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Keyless Entry System Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Keyless Entry System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Keyless Entry System Malfunction

NO REMOTE DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Keyless Entry Antenna Signal - Center Console Front	B3122 02	B3122 05	B3122 05	-
Keyless Entry Antenna Low Reference - Center Console Front	B3122 02	B3122 05	B3122 05	-
Keyless Entry Antenna Signal - Center Console Rear	B3123 02	B3123 05	B3123 05	-
Keyless Entry Antenna Low Reference - Center Console Rear	B3123 02	B3123 05	B3123 05	-
Keyless Entry Antenna Signal - Rear Compartment	B3124 02	B3124 05	B3124 05	-
Keyless Entry Antenna Low Reference - Rear Compartment	B3124 02	B3124 05	B3124 05	-

Circuit/System Description

When a transmitter authentication is requested, the front console, rear console, and rear compartment antennas simultaneously broadcast a challenge within the passenger compartment to the transmitter. If the response from the transmitter via radio frequency (RF) is a valid response, the body control module (BCM) determines there is a transmitter within the vehicle. If no response is received, the BCM determines that no transmitter is in the vehicle, and NO REMOTE DETECTED will be displayed on the DIC.

Diagnostic Aids

A low transmitter battery or radio frequency (RF) interference from aftermarket devices such as 2-way radios, power inverters, cellular phone chargers, computers, 12 V power outlet USB converters, etc. may cause a system malfunction. High RF traffic areas, such as gas stations which use pay-at-the-pump RF transponders, may also cause interference that could lead to a malfunction.

Conditions caused by external influences such are these are considered to be normal. Following this diagnostic will not diagnose an RF interference condition. If RF interference is suspected, question the customer about the conditions or location where the NO REMOTE DETECTED condition occurs.

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Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **This condition may be caused by low vehicle battery voltage. If the battery is not sufficiently charged (above 10 volts), the system will have difficulties detecting the transmitter and the NO REMOTE DETECTED message will be displayed. Correct the low battery voltage condition to eliminate this condition.**

1. Verify that DTC B3119, B3120, B3121, B3122, B3123, or B3124 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
2. Lock the vehicle using the keyless entry transmitter.
3. Verify that each door unlocks and opens by approaching the vehicle with a valid transmitter and operating their respective exterior door handle button.
    - **If both doors do not unlock/unlatch and open**

      Refer to **Keyless Entry System Malfunction**.

    - **If both doors unlock/unlatch and open**
4. Verify the vehicle starts with the transmitter located in the key pocket/slot.
    - **If the vehicle does not start**

      Perform the **Remote Control Door Lock and Theft Deterrent Transmitter Programming** procedure.

    - **If the vehicle starts**
5. Verify the NO REMOTE DETECTED message is not displayed on the DIC while attempting to start the vehicle, placing the keyless entry transmitter in various locations within the vehicle interior at each start attempt. The vehicle should start.
    - **If the NO REMOTE DETECTED message is displayed at any time**

Refer to Circuit/System Testing.

- **If the NO REMOTE DETECTED message is not displayed and the vehicle starts**

6. Inspect for any sources of RF interference such as cell phone chargers, power supplies, etc. that would interrupt transmitter and antenna communication. If inspection does not reveal any items causing RF interference, discuss with the customer the conditions or location where the NO REMOTE DETECTED condition occurs. Discuss any devices that are normally kept in the vehicle, such as a laptop or cell phone charger, which may have been removed when the vehicle was brought in for service. It may be necessary to explain to the customer how RF interference degrades the performance of the system.

Circuit/System Testing

NOTE: **To determine the appropriate T10 Keyless Entry Antenna to disconnect and diagnose, place the transmitter in various location within the vehicle's interior and attempt to start. The location of the transmitter when the NO REMOTE DETECTED message occurs will correspond with the T10 Keyless Entry Antenna that requires diagnosis.**

1. Ignition OFF, disconnect the harness connector at the appropriate T10 Keyless Entry Antenna, ignition ON.
2. Test for less than 1 V between the signal circuit terminal 1 and ground.
   - **If 1 V or greater**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K84 Keyless Entry Control Module.
   - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

3. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function.
4. Activate the antenna by pressing the ignition mode switch.
5. Verify the MAX voltage captured by the DMM is greater than 1 V.
   - **If 1 V or less**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If greater than 1 V**
6. Test for less than 1 V between the low reference circuit terminal 2 and ground.
   - **If 1 V or greater**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
   2. Test for less than 1 V between the low reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K84 Keyless Entry Control Module.

- **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

7. Install a DMM between the signal circuit terminal 1 and the low reference circuit terminal 2. Set the DMM to capture DC voltage using the MIN MAX function.
8. Activate the antenna by pressing the ignition mode switch.
9. Verify the MAX voltage captured by the DMM is greater than 1 V.
    - **If 1 V or less**
    1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the low reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If greater than 1 V**
10. Replace the appropriate T10 Keyless Entry Antenna.
11. Activate the antenna by pressing the ignition mode switch.
12. Verify the NO REMOTE DETECTED message is not displayed and the vehicle starts.
    - **If the NO REMOTE DETECTED message is displayed and the vehicle does not start**

      Replace the K84 Keyless Entry Control Module.

    - **If the NO REMOTE DETECTED message is not displayed and the vehicle starts**
13. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Low Frequency Instrument Panel Antenna Replacement
- Refer to Low Frequency Console Antenna Replacement
- Refer to Low Frequency Rear Compartment Antenna Replacement
- Refer to Control Module References for module replacement, programming, and setup

KEYLESS ENTRY SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

Circuit/System Description

The keyless entry transmitter is part of the vehicle key. The keyless entry system will unlock the vehicle doors or open/unlock the rear compartment when a corresponding button on the keyless entry transmitter is pressed. This is accomplished by the keyless entry transmitter sending a radio frequency to the remote control door lock receiver, which then sends the signal to the body control module (BCM). The BCM interprets the signal and activates the requested function. A low transmitter battery or radio frequency (RF) interference from aftermarket devices such as 2-way radios, power inverters, cellular phone chargers, computers, etc. may cause a system malfunction. High RF traffic areas, such as gas stations which use pay-at-the-pump RF transponders, may also cause interference that could lead to a malfunction.

Diagnostic Aids

- Unwanted or inadvertent door lock/unlock activation may be requested by the OnStarÃ‚Â® Remote Link app. It is possible that a customer may be unaware of account usage, result in an unwanted or phantom door lock/unlock. If normal system diagnosis does results in an inability to verify the customer's concern, contact Technical Assistance Center (TAC).
- If available, the EL 43241 Keyless Entry Tester may be used to diagnose a low transmitter battery or a malfunctioning transmitter. To test, place the transmitter on the test pad of the EL 43241 and press each transmitter button one at a time, holding each button for three seconds. If the green light on the tester does not illuminate and a tone does not sound, first replace the transmitter battery and retest. If the malfunction continues after replacing the transmitter battery, replace the transmitter.
- When using the EL 43241 Keyless Entry Tester, first inspect the keyless entry transmitter part number to determine that it is the correct model for the vehicle. An incorrect part number transmitter may pass the test, but it will not activate the keyless entry system.
- When the vehicle key is in the ignition, the keyless entry functions are disabled from all keyless entry transmitters.

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for remote control door lock receiver scan tool information

Special Tools

EL 43241 Keyless Entry Tester

Circuit/System Verification

1. Verify that the vehicle key is correct for the vehicle. This can be accomplished by comparing the part number printed on the key to the appropriate part number in the parts catalog.
   - **If the vehicle key is incorrect**

     Replace the vehicle key.

   - **If the vehicle key is correct**
2. Verify the K77 Remote Control Door Lock Receiver scan tool 5 V Ignition Switch parameter displays OFF.
   - **If the 5 V Ignition Switch parameter does not display OFF**

     Refer to **Vehicle Will Not Change Power Mode** .

- **If the 5 V Ignition Switch parameter displays OFF**

3. Operate the transmitter while observing the scan tool Key Fob Function parameter for the appropriate transmitter.
4. Verify the K77 Remote Control Door Lock Receiver scan tool Key Fob Function parameter corresponds with the function selected on the transmitter.
    - **If the Key Fob Function parameter does not correspond with the transmitter selection**

      NOTE: **Before replacing the transmitter, inspect the transmitter battery contacts for any corrosion or damage. If no corrosion or damage is found, replace the transmitter battery and retest before replacing the transmitter.**

    1. Replace the vehicle key.
    2. Operate the new transmitter while observing the K77 Remote Control Door Lock Receiver scan tool Key Fob Function parameter for the transmitter.
    3. Verify the K77 Remote Control Door Lock Receiver scan tool Key Fob Function parameter correspond with the function selected on the transmitter.
        - **If the Key Fob Function parameter does not correspond with the transmitter selection**

          Perform Circuit/System Testing.

        - **If the Key Fob Function parameter corresponds with the transmitter selection**
    4. All OK.
    - **If the Key Fob Function parameter corresponds with the transmitter selection**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, scan tool disconnected, disconnect the harness connector at the K77 Remote Control Door Lock Receiver. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 30 Ω between the low reference circuit terminal 1 and ground.
    - **If 30 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If less than 30 Ω**
3. Ignition ON.
4. Test for greater than 11.5 V between the B+ circuit terminal 4 and ground.
    - **If 11.5 V or less**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If Infinite resistance.
    3. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If greater than 11.5 V**
5. Test for 0.1 - 6 V between the serial data circuit terminal 2 and ground.
    - **If less than 0.1 V**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the serial data circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If greater than 6 V**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 0.1 V between the serial data circuit and ground.
        - If 0.1 V or greater, repair the short to voltage on the circuit.
        - If less than 0.1 V, replace the K9 Body Control Module.
    - **If between 0.1 - 6 V**
6. Ignition OFF, disconnect the X1 and X2 harness connectors at the K9 Body Control Module, ignition ON.
7. Test for less than 0.1 V between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.
    - **If 0.1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 0.1 V**
8. Ignition OFF.
9. Test for infinite resistance between the K9 Body Control Module serial data circuit terminal 26 X1 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
10. Test for less than 2 Ω between the K9 Body Control Module serial data circuit terminal 26 X1 and the K77 Remote Control Door Lock Receiver serial data circuit terminal 3.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
11. Replace the K77 Remote Control Door Lock Receiver.
12. Verify the keyless entry functions operate.
    - **If the keyless entry functions do not operate**

      Replace the K9 Body Control Module

    - **If the keyless entry functions operate**
13. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Key with Integrated Transmitter Programming
- Refer to Control Module References for module replacement, programming, and setup

REMOTE VEHICLE START MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of each diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

Remote start begins as a radio frequency message sent from a keyless entry transmitter to the remote control door lock receiver. The message is then transferred to the body control module (BCM). The BCM monitors system conditions such as content theft deterrent, hood ajar status, and body DTCs to determine if a remote start event will occur. If conditions are determined to be acceptable, the BCM will activate the appropriate vehicle systems.

Diagnostic Aids

- The scan tool Body Control Module Remote Vehicle Start Disable History 1 Data and Remote Vehicle Start Disable History 2 Data lists can be used to help isolate an intermittent malfunction with remote vehicle starting. These data lists identify the status of various items that may disable remote vehicle starting during the past two remote vehicle start attempts. Any parameters that does not equal the expected result required for remote vehicle starting should be diagnosed in their respective subsection.
- Only the first and second vehicle transmitters are able to control the remote vehicle start function.
- Unwanted or inadvertent door lock/unlock activation may be requested by the OnStarÃ‚Â® Remote Link application. It is possible that a customer may be unaware of account usage, resulting in an unwanted or phantom door lock/unlock. If normal system diagnosis results in an inability to verify the customer's concern, contact Technical Assistance Center (TAC).
- If the vehicle has a current vehicle DTC that illuminates the malfunction indicator lamp, the cause of the DTC must be diagnosed before proceeding with the remote start malfunction diagnostic.

Reference Information

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Remote Function Schematics

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the scan tool Body Control Module Push Button Ignition Switch parameter changes between Active and Inactive when pressing and releasing the S38 Vehicle On/Off Switch.
    - **If the parameter does not change**

      Refer to **Vehicle Will Not Change Power Mode** .

    - **If the parameter changes**
2. Verify that remote vehicle start is enabled through vehicle personalization.

- **If remote vehicle start is not enabled through vehicle personalization**

  Use vehicle personalization to turn on remote vehicle start functionality. Refer to the vehicle owners manual.

- **If remote vehicle start is enabled**

3. Verify that the keyless entry functions operate with all available keyless entry transmitters.
   - **If the keyless entry functions do not operate properly**

     Refer to Keyless Entry System Malfunction.

   - **If the keyless entry functions operate properly**
4. Verify none of the following conditions exist on the vehicle:
   - A current vehicle DTC that illuminates the malfunction indicator lamp (MIL)
   - The vehicle is in valet mode
   - More than two remote starts have been attempted
   - The hazard switch is in the ON position
   - A current hazard switch DTC is set
   - The vehicle hood is ajar
   - A current hood ajar DTC is set
   - The content theft deterrent system detects an alarm trigger
   - Accelerator pedal position greater than 0 percent
   - Vehicle not in park
   - Immobilizer malfunction
   - A current automatic transmission shift lock control system DTC is set
   - A vehicle speed sensor signal is detected by the ECM
   - The vehicle power moding is being controlled by a backup device
   - **If any of the conditions are present**

     Refer to the appropriate subsection in which the failure occurred.

   - **If none of the conditions are present**
5. All OK.

ELECTRONIC TOLL COLLECTION SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Ignition	1	1	-
Ground	-	1	1
1. Electronic Toll Collection System Inoperative			

Circuit/System Description

The electronic toll collection system uses power and ground from the inside rearview mirror. The components of the electronic toll collection system are internal to the inside rearview mirror and not serviceable.

Reference Information

Schematic Reference

Inside Rearview Mirror Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Toll Collection System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A10 Inside Rearview Mirror. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
   - If 2 Ω or greater, repair the open/high resistance in the circuit.
   - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 2 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the A10 Inside Rearview Mirror.
   - **If the test lamp illuminates**
5. Replace the A10 Inside Rearview Mirror.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Inside Rearview Mirror Replacement**

REPAIR INSTRUCTIONS

LOW FREQUENCY INSTRUMENT PANEL ANTENNA REPLACEMENT

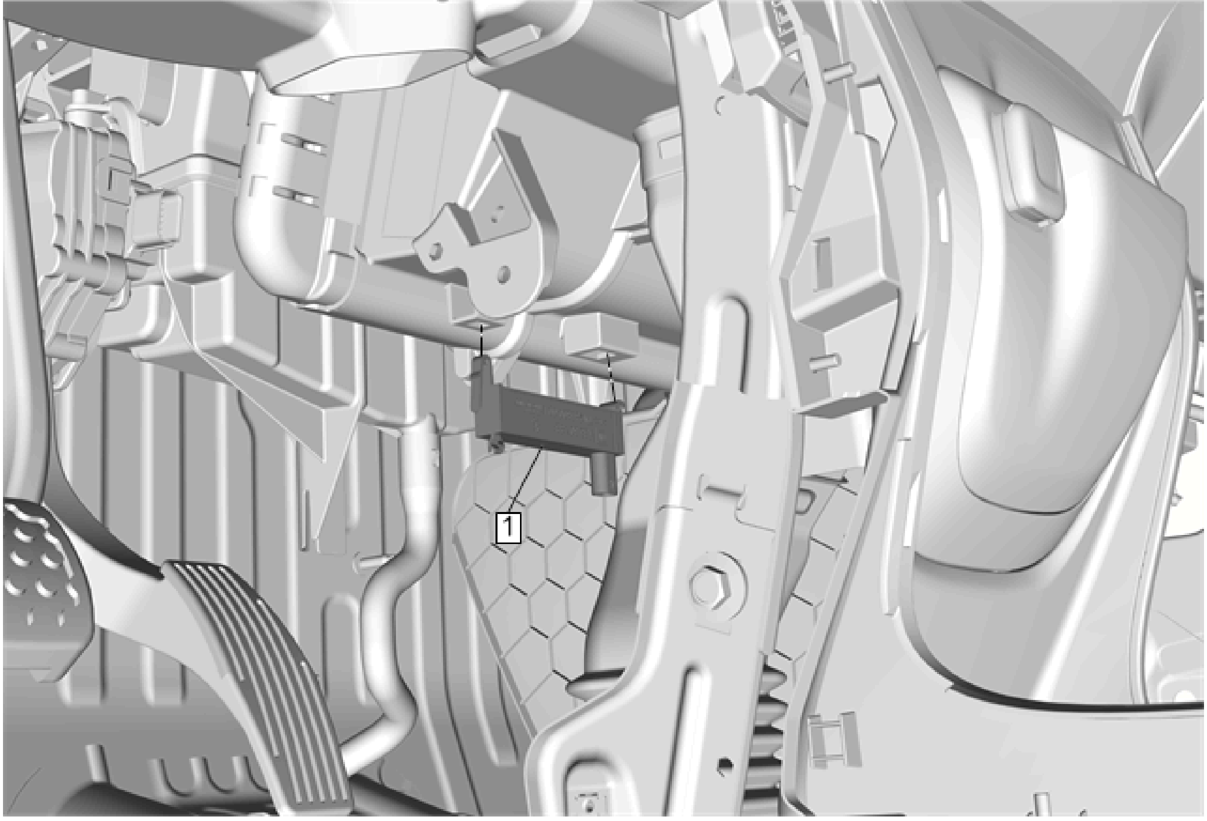


Fig. 3: Low Frequency Instrument Panel Antenna
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Floor Console. Refer to Front Floor Console Replacement	
1	Low Frequency Instrument Panel Antenna **Procedure** Disconnect the electrical connector.

LOW FREQUENCY CONSOLE ANTENNA REPLACEMENT

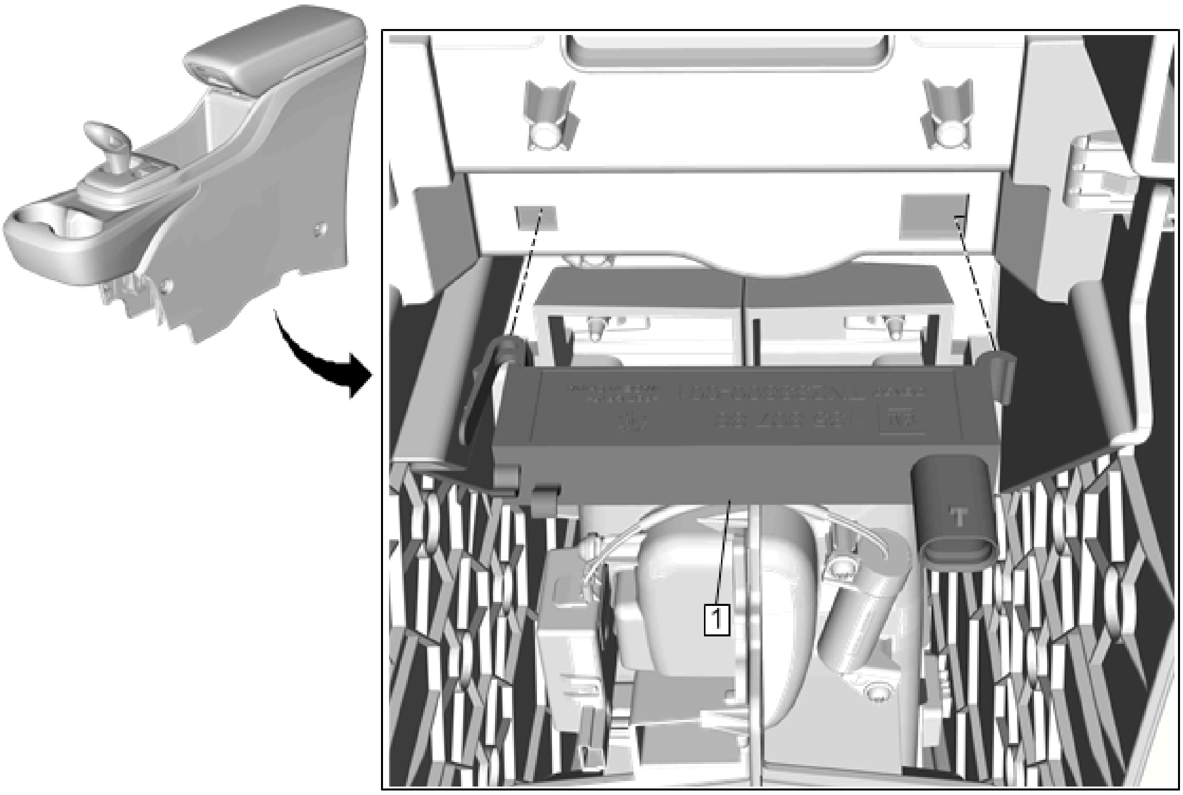


Fig. 4: Low Frequency Console Antenna
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Floor Console. Refer to Rear Floor Console Replacement	
1	Low Frequency Console Antenna **Procedure** Disconnect the electrical connector.

LOW FREQUENCY REAR COMPARTMENT ANTENNA REPLACEMENT

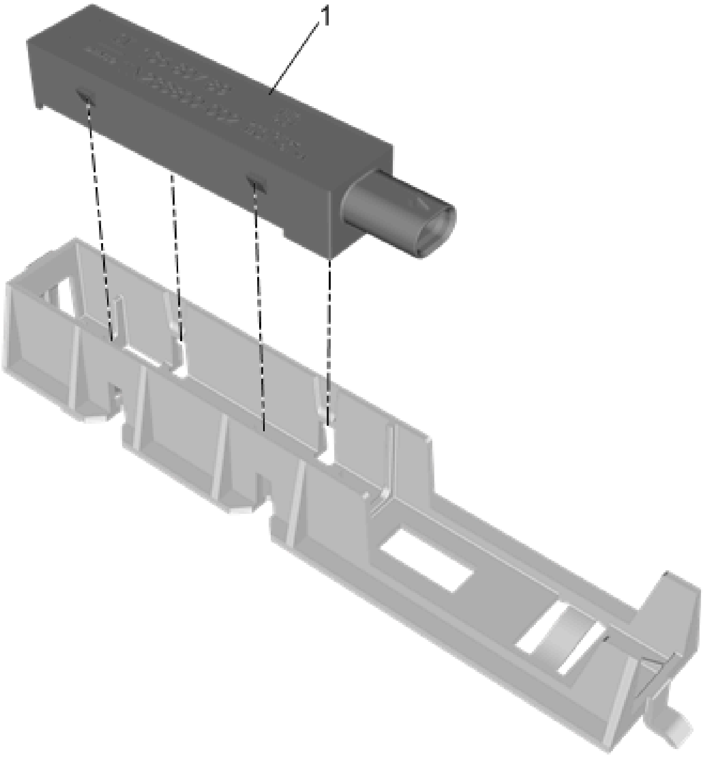


Fig. 5: Low Frequency Rear Compartment Antenna
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Low Frequency Rear Compartment Antenna Bracket. Refer to Low Frequency Rear Compartment Antenna Bracket Replacement	
1	Low Frequency Rear Compartment Antenna **Procedure** Using a suitable tool, release the retaining tabs and remove the low frequency antenna.

LOW FREQUENCY REAR BUMPER ANTENNA REPLACEMENT

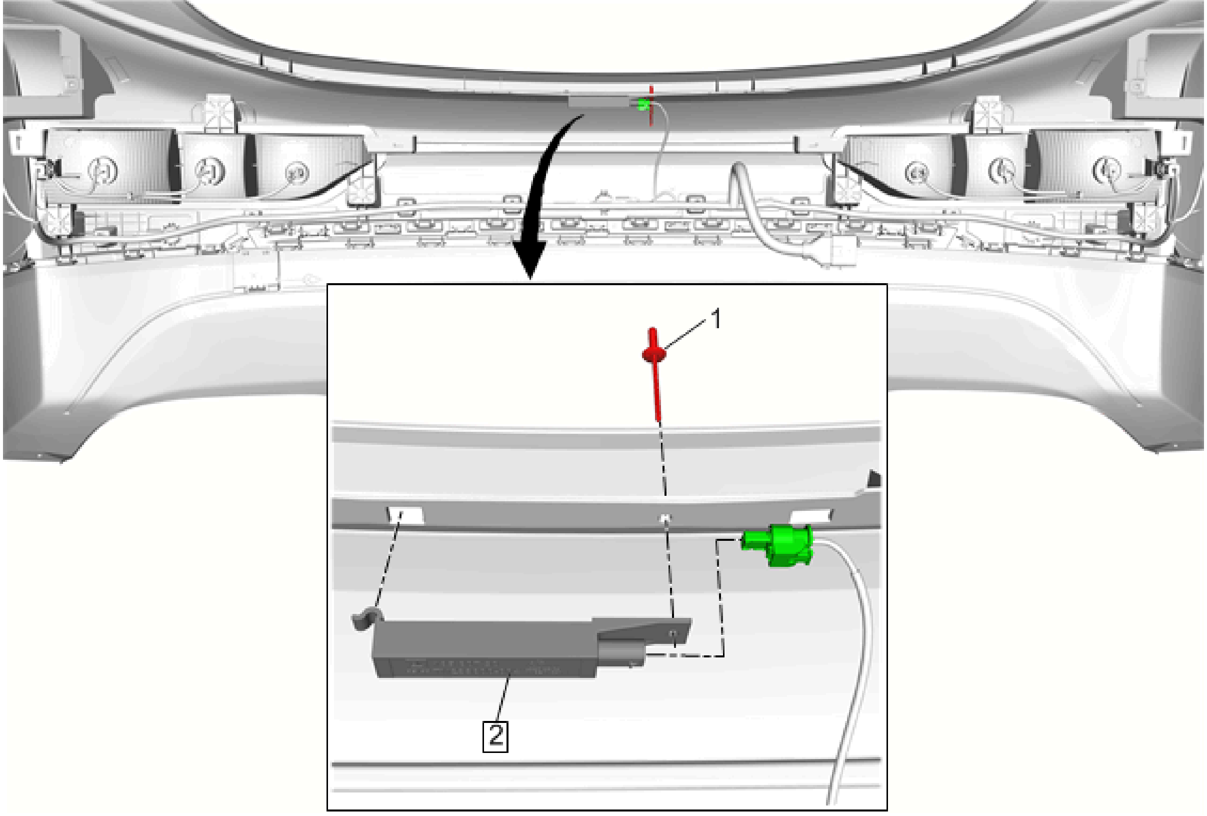


Fig. 6: Low Frequency Rear Bumper Antenna
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Rear Bumper Fascia. Refer to **Rear Bumper Fascia Replacement**	
1	Low Frequency Rear Bumper Antenna Rivet **WARNING:** **Eye protection must be worn when drilling rivets to reduce the chance of personal injury.** **Procedure** 1. Disconnect the electrical connector. 2. Drill out the rivet on the low frequency rear bumper antenna.
2	Low Frequency Rear Bumper Antenna

KEYLESS ENTRY CONTROL MODULE REPLACEMENT

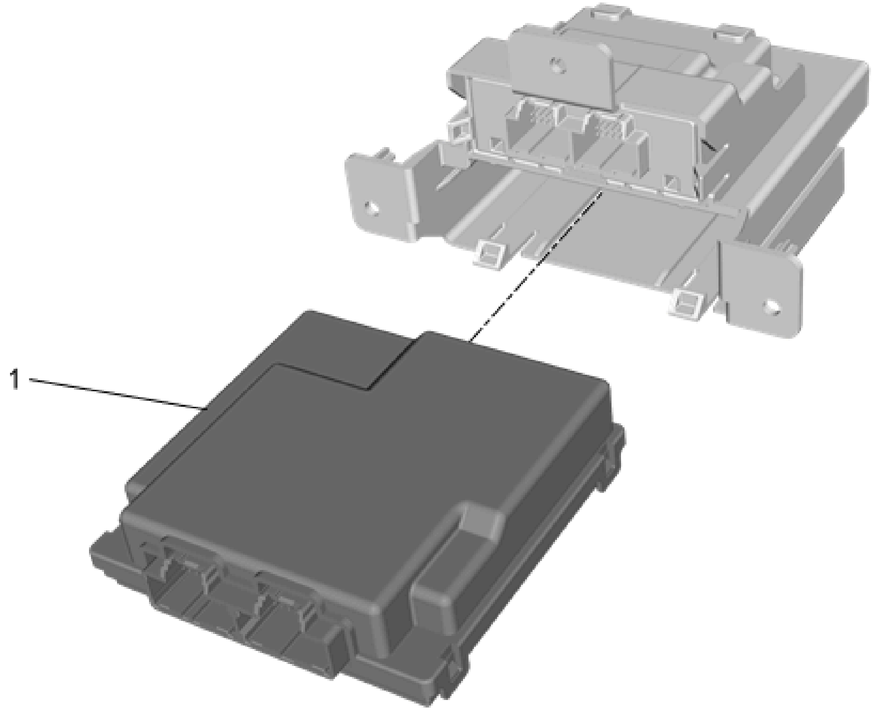


Fig. 7: Keyless Entry Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Keyless Entry Control Module Bracket. Refer to Keyless Entry Control Module Bracket Replacement	
1	Keyless Entry Control Module **Procedure** 1. Release the retaining tabs. 2. Perform the necessary programming and setup procedure. Refer to Control Module References

KEYLESS ENTRY CONTROL MODULE BRACKET REPLACEMENT

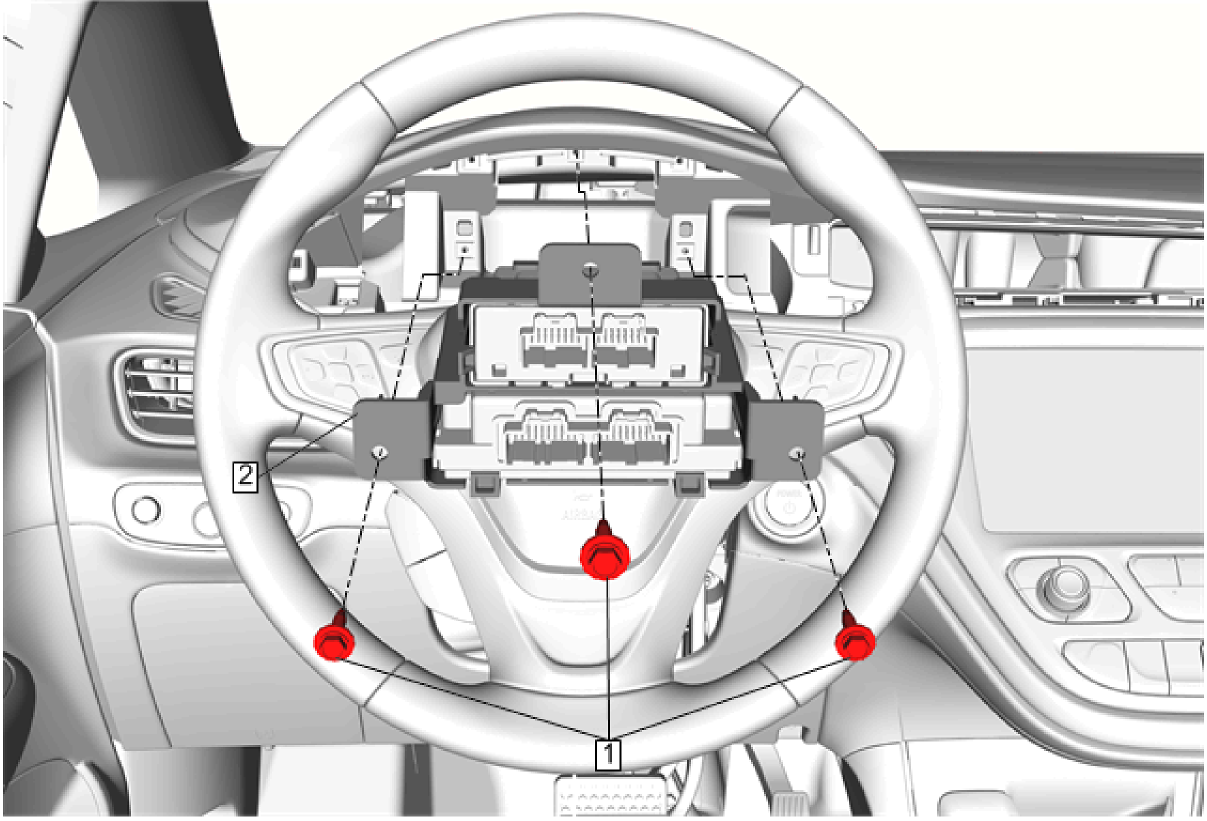


Fig. 8: Keyless Entry Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Instrument Cluster. Refer to Instrument Cluster Replacement 2. Disconnect the electrical connectors for keyless entry control module and serial data gateway module.	
1	Keyless Entry Control Module Bracket Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Keyless Entry Control Module Bracket **Procedure** Transfer keyless entry control module and serial data gateway module as necessary.

REMOTE CONTROL DOOR LOCK RECEIVER REPLACEMENT

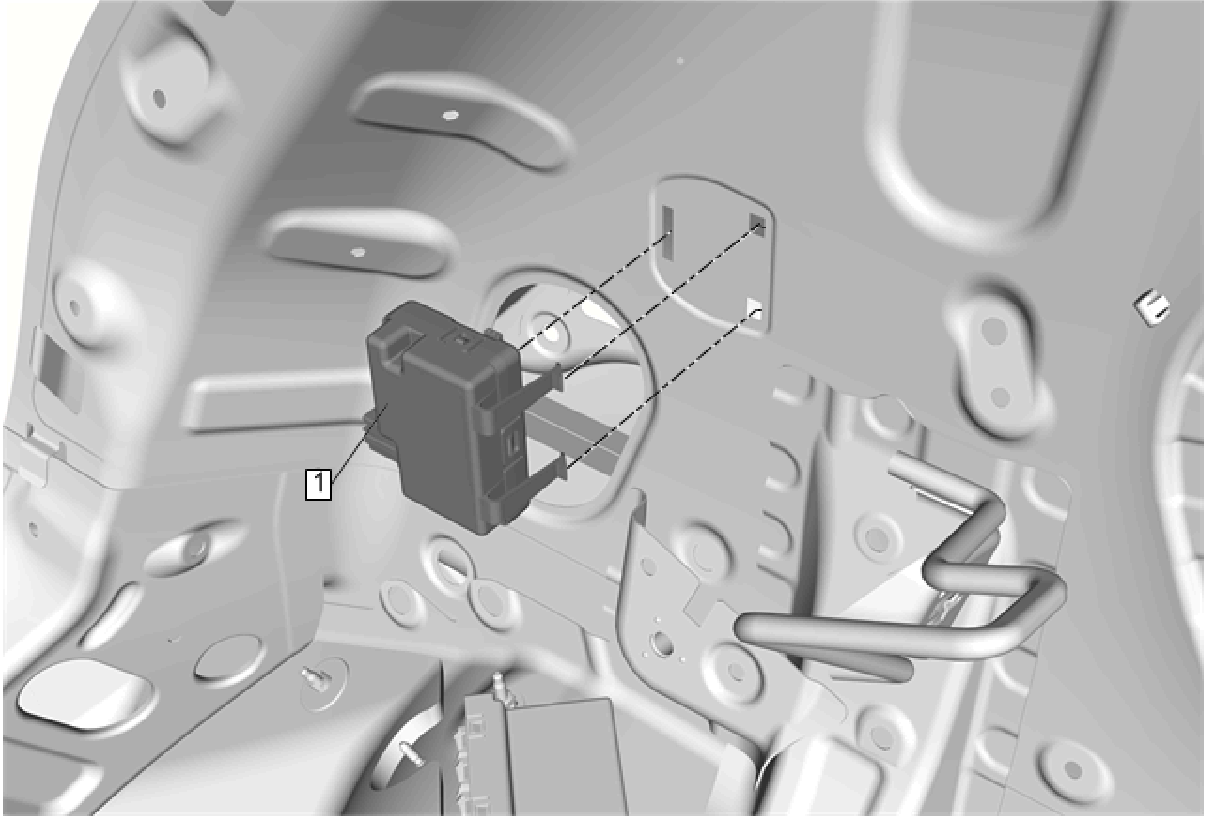


Fig. 9: Remote Control Door Lock Receiver
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Quarter Lower Rear Trim Panel - Left Side. Refer to Quarter Lower Rear Trim Panel Replacement	
1	Remote Control Door Lock Receiver **Procedure** Disconnect the electrical connector.

UHF SHORT RANGE LOW ENERGY REMOTE CONTROL ACCESS TRANSCEIVER REPLACEMENT

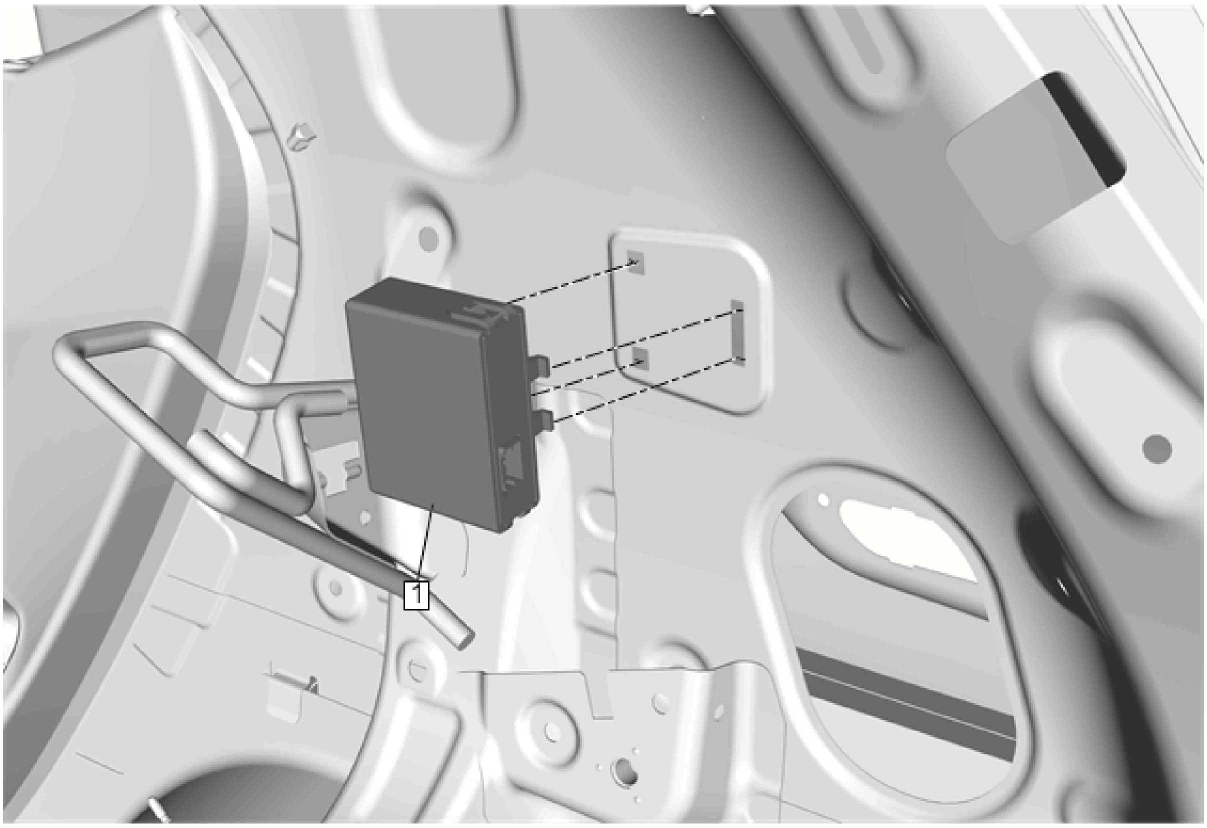


Fig. 10: UHF Short Range Low Energy Remote Control Access Transceiver
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Quarter Lower Rear Trim Panel - Right Side. Refer to **Quarter Lower Rear Trim Panel Replacement**	
1	UHF Short Range Low Energy Remote Control Access Transceiver **Procedure** Disconnect the electrical connector.

LOW FREQUENCY REAR COMPARTMENT ANTENNA BRACKET REPLACEMENT

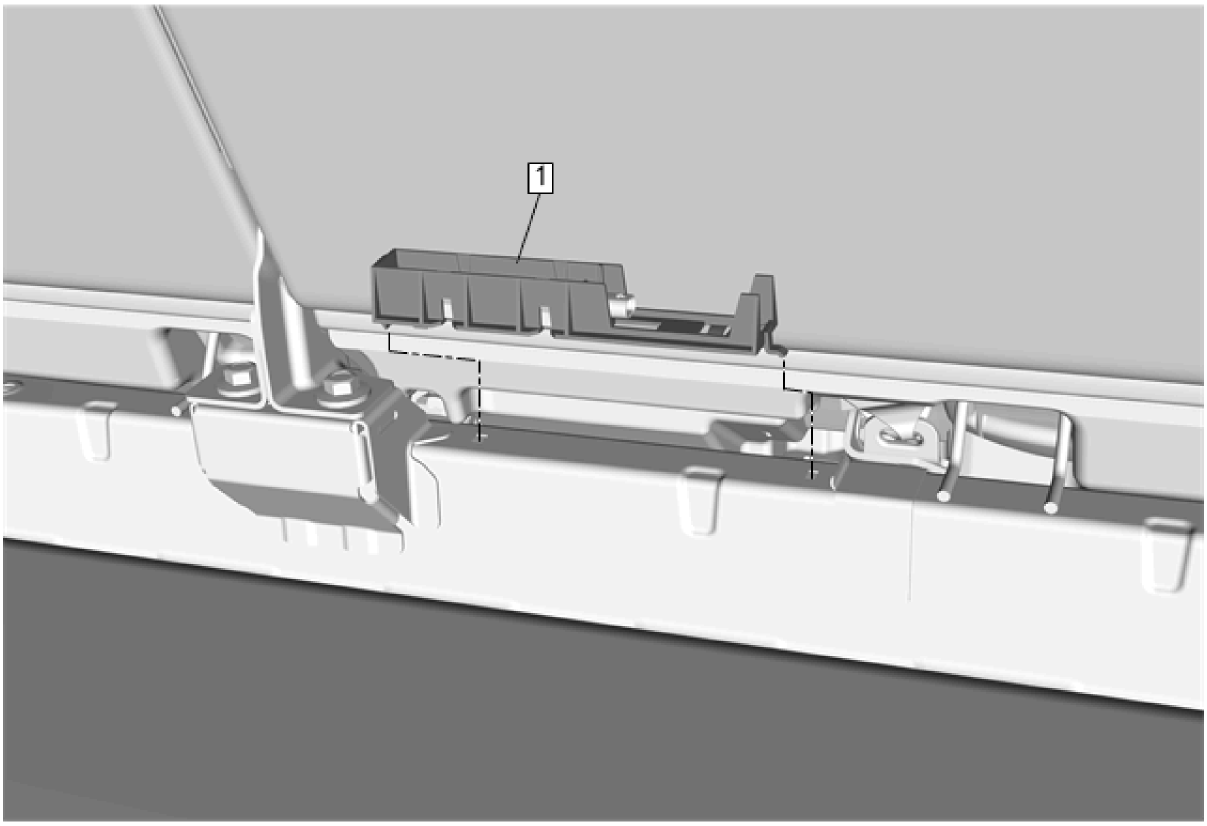


Fig. 11: Low Frequency Rear Compartment Antenna Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Load Floor Trim Panel. Refer to **Load Floor Trim Panel Replacement**	
1	Low Frequency Rear Compartment Antenna Bracket **Procedure** 1. Disconnect the electrical connector. 2. Transfer components as necessary.

REMOTE CONTROL DOOR LOCK AND THEFT DETERRENT TRANSMITTER PROGRAMMING

Keys can be programming in various ways using the procedures outlined below. Using the Replacing Keys procedure will first erase all the known keys from the vehicle. Any existing keys and any new keys will then be programmed. This procedure should be used any time a key is required to be unlearned or erased from a vehicle. If a new key is being learned to a vehicle to replace a damaged, inoperative, missing, or stolen key, the Replacing Keys procedure must be used. This ensures that the old key cannot be used to access or start the vehicle after programming.

The Adding Keys procedure does not erase any keys prior to programming. The procedure will simply program the key into the next available slot. The Adding Keys procedure should only be used when adding an additional keys to the vehicle. The Adding Keys procedure should never be used to program a key to a vehicle that is having a key replaced, regardless of the cause for the replacement.

Replacing Keys (Without SPS)

NOTE:

- **This procedure will unlearn all previously learned keys. All keys that are to be programmed must be with the vehicle.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**
- **This procedure may be used with or without existing learned keys being present. If existing keys are present, keep the keys away from the vicinity of the vehicle. Failure to keep learned keys away from the vehicle will result in the learn changing to the Adding Keys procedure.**
- **The keys to be learned must duplicate the mechanical cut of the current key.**

1. Insert the mechanical key of the new key into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The Driver Information Center (DIC) will display Remote Learn Pending, Please Wait.
2. After ten minutes, the DIC will display Press Engine Start Button To Learn. Press the ignition mode switch. The DIC will again display Remote Learn Pending, Please Wait.
3. Repeat Step 2 two additional times, for a total of thirty minutes. All previously known keys have now been unlearned. Remaining keys can be learned during the next steps. The DIC display will now display Ready For Remote # 1.

NOTE: **The key pocket is located inside the front cupholder.**

4. Place the new key into the key pocket.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

5. Press the ignition mode switch. When the key is learned the DIC will indicate that it is ready to program the next key.
6. Remove the key from the key pocket and press the unlock button. To program additional keys, repeat Steps 4 through 6.
7. When all additional keys are programmed, press and hold the ignition mode switch for 5 seconds to exit programming mode.

Replacing Keys (With SPS)

NOTE:

- **This procedure will unlearn all previously learned keys. All keys that are to be programmed must be with the vehicle.**
- **This procedure may be used with or without existing learned keys being present. If no existing keys are available, this procedure must be used.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information. This procedure will not learn any immobilizer information between the body control module (BCM) and engine control module (ECM).**

- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Delete) function.

NOTE:

- **At multiple times during the learn procedure, SPS will instruct you to turn the ignition to the run position. Make sure the vehicle is actually in the run mode before continuing on the SPS terminal. If the ignition is not in the run mode, the learn procedure will fail.**
- **The key pocket is located inside the front cupholder.**

7. Follow the on-screen instructions.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

8. After programming all keys, Programming Complete, is displayed.
9. Press and hold the ignition mode switch for 15 seconds.
10. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow passive and active keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Adding Keys (Without SPS)

NOTE:

- **To initiate, this procedure requires that 2 learned keys be available.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure adds keys only. The procedure does not erase previously learned keys.**
- **The keys to be learned must duplicate the mechanical cut of the current key.**

1. Place the recognized keys in the vehicle cupholder.
2. Insert the mechanical key of the new key into the key lock cylinder located on the outside of the driver door and turn the key to the unlock position five times within ten seconds. The Driver Information Center (DIC) will display Ready For Remote #2, 3, 4 or 5.

NOTE: **The key pocket is located inside the front cupholder.**

3. Place the new key into the key pocket.
4. Press the ignition mode switch. When the key is learned the DIC will indicate that it is ready to program the next key.

NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming**

below.

5. Remove the key from the key pocket and press the unlock button. To program additional keys, repeat Steps 3 through 5.
6. When all additional keys are programmed, press and hold the ignition mode switch for 5 seconds to exit programming mode.

Adding Keys (With SPS)

NOTE:

- **This procedure may be used with or without existing learned keys being present. If no existing keys are available, this procedure must be used.**
- **A total of eight keys maybe be learned to a single vehicle.**
- **This procedure will only learn the vehicle key information.**
- **If the battery voltage is low, charge the battery before continuing with the procedure.**

1. Connect a scan tool to the vehicle and access SPS.
2. Ensure that all power consuming devices are turned OFF on the vehicle.
3. Select the SPS application and follow the on-screen instructions.
4. Select Reprogram ECU.
5. Select IMMO Immobilizer Learn - Setup.
6. Select the Program Transponder or Remote Key (Add) function.

   NOTE:

   - **At multiple times during the learn procedure, SPS will instruct you to turn the ignition to the run position. Make sure the vehicle is actually in the run mode before continuing on the SPS terminal. If the ignition is not in the run mode, the learn procedure will fail.**
   - **The key pocket is located inside the front cupholder.**

7. Follow the on-screen instructions.

   NOTE: **If the programming does not complete or hangs during the programming operation, refer to Unable to Complete Programming below.**

8. After programming all keys, Programming Complete, is displayed.
9. Press and hold the ignition mode switch for 15 seconds.
10. Press the lock and unlock button on each key that was programmed. This will awaken each key and allow passive and active keyless entry functions to be established.
11. With a scan tool, clear any DTCs.
12. Verify each key is operating properly. Operate each of the keyless entry functions using the buttons on the key and then start the vehicle. When verifying operation, make sure that no other keys are near the vehicle.

Unable to Complete Programming

When attempting to program immobilizer components, various conditions may prevent the programming operation from completing. These conditions may be caused by normal system operation, a system malfunction, or an external influence. Common symptoms of a incomplete programming is receiving an error message during the attempt or having the SPS application become unresponsive.

- DTCs are set in the body control module (BCM)

The immobilizer system is a function of the BCM software. If immobilizer DTCs are set in the BCM, such as DTC B2955, a fault has been identified in the immobilizer system. If this is not corrected before attempting to program components, the programming may not complete. Correct all immobilizer DTCs before attempting to program any immobilizer components.

- The key has been programmed to another vehicle or is not the correct type for the vehicle

  A key can only be programmed to a single vehicle. Once a key is programming to a vehicle, it is paired for the life of the key. The key can be learned to the same vehicle again and again, but it is not able to be programmed to a different vehicle.

  Many vehicle are available with both a base keyless entry system and an optional passive entry system. These keys typically look identical but cannot be substituted for one another. To verify the key is correct, compare the part number that is etched on the key to the part number identified in the parts catalog. The key should be correct for the system installed in the vehicle.

- The theft deterrent module is not properly secured or the key is not properly positioned in the pocket/slot.

  A theft deterrent module that is not fully seated or is otherwise not properly secured may prevent a coupling between the transponder located in the key and the theft deterrent module. Being out of place by as little as 1 mm may prevent programming from completing. Make sure the theft deterrent module is properly installed and fully seated in it's clip.

  The key should be positioned in the proper orientation so that it lays flat in the pocket. If a large key ring or other item attached to the key prevents the key from laying flat, remove the key ring.

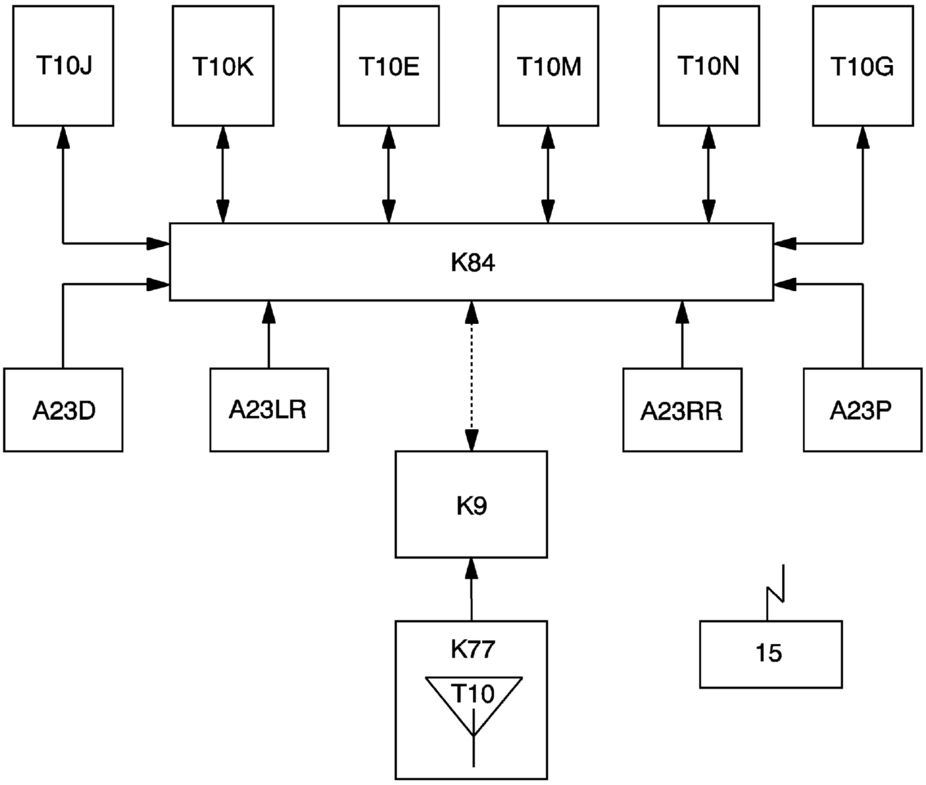
  To determine if the theft deterrent module is properly secured, remove the battery from the key and place the key into the pocket/slot. Attempt to change the vehicle mode by pressing the vehicle ON/OFF switch. The vehicle should change modes. If the NO REMOTE DETECTED message is displayed on the DIC, the theft deterrent module may not be properly secured.

- External interference is interrupting the programming operation

  External RF interference and EMI may interrupt the low frequency coupling between the key and theft deterrent module. This interference may come from many different locations. Devices plugged into the vehicle power outlets such as cell phone chargers, laptop computers, GPS devices, etc. may cause interference. Vehicle location may also cause interference. Locations near airports and military installations may causer interference. Remove all customer installed devices and, if necessary, move the vehicle if interference is suspected.

DESCRIPTION AND OPERATION

KEYLESS ENTRY SYSTEM DESCRIPTION AND OPERATION



[Fig. 12: Keyless Entry System Description And Operation Block Diagram]
Courtesy of GENERAL MOTORS COMPANY

Solid line - Hard Wire I/O **Dash line - Serial Data**	
A23D	Door Latch - Driver
A23LR	Door Latch - Left Rear
A23P	Door Latch - Passenger
A23RR	Door Latch - Right Rear
K9	Body Control Module (BCM)
K77	Remote Control Door Lock Receiver
K84	Keyless Entry Control Module
T10	Keyless Entry Antenna
T10E	Keyless Entry Antenna - Rear Compartment
T10G	Keyless Entry Antenna - Rear Fascia
T10J	Keyless Entry Antenna - Center Console Front
T10K	Keyless Entry Antenna - Center Console Rear
T10M	Keyless Entry Antenna - Driver Door Handle
T10N	Keyless Entry Antenna - Passenger Door Handle
15	Keyless Entry Transmitter

Keyless Entry System Description and Operation - Active

The keyless entry system is a vehicle entry device. The keyless entry system is used in conjunction with the door locks to unlock the vehicle. Keyless entry will lock/unlock the vehicle doors or open the rear compartment lid when a corresponding button on the keyless entry transmitter is pressed. This is accomplished by the transmitter sending a radio frequency to the remote control door lock receiver antenna that has a direct link to the body control module (BCM). The BCM interprets the signal and activates the requested function or requests the appropriate control module to activate the function via a serial data message. A low transmitter battery or radio frequency interference from aftermarket devices, such as 2-way radios, power inverters, computers, etc., may cause a system malfunction. High radio frequency traffic areas, such as gas stations that use pay-at-the-pump radio frequency transponders, may also cause interference that could lead to a malfunction. Keyless entry allows you to operate the following features:

- Door lock/unlock

- Remote start
- Illuminated entry lamps
- Panic alarm/vehicle locator
- Remote vehicle start

Keyless Entry System Description and Operation - Passive

Passive keyless entry allows entry to a locked vehicle without pressing any buttons on the keyless entry transmitter. You must only have the transmitter with you. The passive entry system use low frequency antennas in several different areas on the vehicle to determine the location of the transmitter. When passively opening a locked door or the rear compartment, you must have a programmed transmitter with you in your pocket, purse, or briefcase.

When an exterior door handle button is pressed or the rear compartment touch pad is pressed, the low frequency antenna sends out a challenge to the keyless entry transmitter. Because of the low frequency, communication range is limited. The antenna will emit the challenge in a one meter range. The transmitter must be within this range to receive the challenge. The transmitter receives this challenge and emits it's response as an RF message, which is received by the remote control door lock receiver. If the response is correct, the door or rear compartment will unlock and open.

As a customer convenience feature, the keyless entry system will notify the driver if the transmitter has been left in the vehicle after exiting by chirping the vehicle horn three times. This may be turned off using vehicle personalization. Also, if the transmitter is left in the vehicle after the central door lock switch has been used to lock the vehicle, the driver door will remain unlocked after exiting the vehicle. This is intended to prevent locking the transmitter in the vehicle and being unable to access it.

Keyless Entry System Description and Operation - Keyless Start

The keyless start portion of the keyless entry system allows vehicle starting, having only the transmitter as your key. The keyless start system uses low frequency antennas in three different locations on the vehicle to determine the location of the transmitter. Multiple antennas are used to ensure complete coverage of the vehicle interior and rear compartment. When using the keyless start system, a programmed transmitter must be in the vehicle's interior, such as the driver's pocket, purse, or briefcase.

When the ignition mode switch is pressed, the low frequency antennas emit a challenge to the keyless entry transmitter. The transmitter receives this challenge and emits it's response as an RF message, which is received by the remote control door lock receiver. If the response is correct, vehicle starting will be allowed. If RF communication is interrupted, a "No Remote Detected" message will be displayed on the DIC. In these cases, the extended transmitter key blade can be placed in the transmitter slot located in the upper instrument panel storage compartment, under the rubber mat. The immobilizer antenna coil is located directly beneath the transmitter slot. Placing the extended key blade in the slot will create a low powered coupling between the transmitter and immobilizer antenna, allowing communications to occur and enabling vehicle starting.

The keyless entry system has the following components:

- Vehicle key with integrated keyless entry transmitter
- Driver and front passenger door antennas (part of the door handle assembly)
- Driver and front passenger door handle switches (part of the door handle assembly)
- Rear fascia antenna
- Front instrument panel console antenna
- Center console antenna
- Rear compartment antenna
- Body control module (BCM)
- Keyless entry control module
- Immobilizer antenna coil
- Remote control door lock receiver
- Short range remote control transceiver

Keyless Entry Transmitters

The keyless entry transmitters are used to lock and unlock the vehicle door while away from the immediate are of the vehicle. Keyless entry functions may work at up to 20 m (65 ft) from the vehicle. The keyless entry transmitter is an integral part of the vehicle key.

Keypass

Keypass is a function of the vehicle owner's cell phone. It can perform the same functions as the keyless entry transmitters. In some model year and vehicle applications it can support additional functions.

Door Antenna

The keyless entry door antennas are used to transmit low frequency communications to the keyless entry transmitters.

The keyless entry door antennas are located in the left front and right front exterior door handle bracket. The antennas are serviced as part of the door handle assembly. The antennas are controlled by the keyless entry control module. When the exterior door handle button is pressed, the respective antenna will send out a challenge to the keyless entry transmitter, which begins the passive entry communications.

Rear Fascia Antenna

The rear fascia antenna is used to transmit low frequency communication to the keyless entry transmitters for entry to rear compartment.

The rear fascia antenna is located behind the rear fascia. The antenna is controlled by the keyless entry control module. When the rear compartment touch pad is pressed, the antenna sends out a challenge to the keyless entry transmitter, which begins the passive entry communications.

Front Console Passive (Instrument Panel) Antenna

This antenna is located in the lower instrument panel near the front of the center console.

The front console antenna is used for vehicle starting functions. When the ignition mode switch is pressed, the antenna is energized or "pinged". This emits a low frequency challenge signal that is received by the keyless entry transmitter. The transmitter will then reply to this challenge with a response and, if correct, vehicle starting will occur.

Center Console Antenna

This antenna is located in the rear of the center console.

The rear console antenna is used for vehicle starting functions. When the ignition mode switch is pressed, the antenna is energized or "pinged". This emits a low frequency challenge signal that is received by the keyless entry transmitter. The transmitter will then reply to this challenge with a response and, if correct, vehicle starting will occur.

Rear Compartment Antenna

This antenna is located in the center of the rear compartment metal floor pan, near the seatback.

The rear compartment antenna is used for vehicle starting functions. When the ignition mode switch is pressed, the antenna is energized or "pinged". This emits a low frequency challenge signal that is received by the keyless entry transmitter. The transmitter will then reply to this challenge with a response and, if correct, vehicle starting will occur.

Remote Control Door Lock Receiver

The remote control door lock receiver is located on the vehicle windshield, directly in front of the inside rearview mirror.

The remote control door lock receiver is control by and directly communicates with the body control module (BCM). When the transmitter receives a low frequency challenge from an antenna, it responds with an RF message. This RF message is received by the remote control door lock receiver and communicated to the BCM. If the RF message is a valid response to the low frequency challenge, vehicle access or starting will be allowed.

Immobilizer Antenna Coil Assembly

The keyless entry immobilizer coil assembly is located in the upper instrument panel, directly beneath the upper instrument panel storage compartment. If the transmitter battery is dead, weak, or the RF signal is being interrupted, the extended transmitter key blade can be placed in the transmitter slot located in the upper instrument panel storage compartment, under the rubber mat, to create a low powered coupling between the transmitter and immobilizer antenna, allowing communications to occur and enabling vehicle starting.

The immobilizer antenna coil is controlled by the BCM. The immobilizer control module is also active when learning vehicle keys.

Keyless Entry Control Module

The keyless entry control module is a multi-function module which performs the following keyless entry system functions:

- Activating vehicle antennas for passive keyless entry functions
- Activating vehicle antennas for keyless start functions
- Backup control for the ECM accessory wakeup and the run/crank relay
- If equipped, controls the electronic steering column lock
- Receiver of the exterior door handle switch inputs and door open switch (not the door ajar switch)
- Ignition mode switch monitoring

Short Range Remote Control Transceiver

The short range remote control transceiver is an additional communication device to provide communication between the vehicle owner's cell phone and the keyless entry control module.

OnStarÃ‚Â® Remote Link (if equipped)

A vehicle operator may have the ability to perform some of the keyless entry functions using applications on personal devices such as but not limited to smart phones. A condition may appear as if there is a malfunction in the vehicle. If it is suspected that this may be the case contact Technical Assistance if a condition cannot be determined through normal vehicle diagnostics.

Body Control Module (BCM)

The BCM is a multi-function module that performs the following functions:

- Receive and authenticate active transmitter and keyless start signals from the remote control door lock receiver
- Determines the functionality requested by the transmitter signal
- Performs the function requested by the transmitter signal

Unlock Driver Door Only - Active

Momentarily press the transmitter UNLOCK button to perform the following functions:

- Unlock only the driver door
- Illuminate the interior lamps for a determined length of time or until the ignition mode switch is pressed
- Flash the exterior lights, if enabled through personalization
- Disarm the content theft deterrent system
- Deactivate the content theft deterrent system when in the alarm mode

Unlock All Doors - Second Operation - Active

Momentarily press the transmitter UNLOCK button a second time, within 5 seconds of the first press, to perform the following function:

Unlock the remaining doors and rear compartment

Unlock Driver Door Only - Passive

If enabled through personalization, approach the driver door with a valid keyless entry transmitter and press the door handle button to perform the following functions:

- Unlock and open only the driver door when door handle is operated
- Disarm the content theft deterrent system, if equipped
- Deactivate the content theft deterrent system when in the alarm mode

Unlock All Doors - Passive

Approach any non driver door (front or rear) or, if enabled through personalization, the driver door with a valid keyless entry transmitter and press the door handle button to perform the following functions:

- Unlock all vehicle doors and rear compartment
- Disarm the content theft deterrent system, if equipped
- Deactivate the content theft deterrent system when in the alarm mode

Lock All Doors - Active

Press the transmitter LOCK button to perform the following functions:

- Lock all vehicle doors
- Immediately turn off the interior lamps
- Flash the exterior lights, if enabled through personalization
- Chirp the horn, if enabled through personalization
- Arm the content theft deterrent system

Lock All Doors - Passive

Exit the vehicle (with vehicle off) with the keyless entry transmitter to automatically perform the following functions, if equipped.

- Lock all vehicle doors and rear compartment after a delay
- Flash the exterior lights, if enabled through personalization
- Chirp horn, if enabled through personalization
- Arm the content theft deterrent system

When all doors are closed, they can also be locked from the exterior by pressing the door handle button while having a valid transmitter within range.

If more than one keyless entry transmitter is within a vehicle and the keyless entry system detects that one or more transmitters have been left in the vehicle after vehicle is locked, any transmitter left within the vehicle will be temporarily deactivated until:

- A button on the deactivated transmitter is pressed (will only activate the transmitter whose button is pressed)
- A passive unlock of vehicle occurs
- Change in power mode occurs

Rear Compartment Release - Passive

Approach the rear of the vehicle with a valid keyless entry transmitter. Press the trunk release touch pad. The trunk will open.

Vehicle Locator/Panic Alarm/Active

A single press of the panic button performs the following functions. Some functions may be dependent on personalization settings:

- Pulses the horn three times
- Flashes the exterior lamps three times

A press and hold of the panic button performs the following functions:

- Pulses the horn and flashes the parking lamps for 30 second or until the following conditions occur:
  - The panic button is pressed
  - The ignition mode switch is pressed with a valid key in the vehicle

Remote Start

The remote vehicle start function allows engine starting while not in the vehicle. It also allows the vehicle HVAC system and other vehicle systems to enable, providing a comfortable vehicle upon entry. The remote vehicle start sequence begins by pressing and releasing the lock button and then pressing and holding the remote vehicle start buttons on the keyless entry transmitter. The turn signal lamps will illuminate to indicate the vehicle has received the remote start request. Each time a remote vehicle start is performed, the vehicle doors are locked, however they may then be unlocked/locked with the transmitter at any time. Only the first and second vehicle transmitters are able to control the remote vehicle start function. Any additional remote transmitters programmed to the vehicle will perform all other remote functions. Once activated, the engine is allowed to run for 10 minutes. The remote vehicle start time may be extended by an additional 10 minutes by again pressing and releasing the lock button and then pressing and holding the remote vehicle start buttons on the transmitter. This feature is called a remote vehicle start continue and allows a maximum of 20 minutes of engine running. If the remote vehicle start continue is performed at 7 minutes into the initial 10 minute time-out, a total of 17 minutes of engine running would occur. The remote vehicle start event may be suspended at any time by pressing only the remote vehicle start button on the transmitter or by entering the vehicle and turning ON the hazard lamps.

In between ignition cycles, only two remote start events may occur or be attempted. Once two events or attempts have been made, future remote start events will be suspended until the vehicle is operated using the ignition mode switch.

Enable/Disable Remote Start

Using the driver information center, remote start may be enabled or disabled as a part of vehicle personalization. Refer to the vehicle owners manual for more information.

Remote Start System Disabled

If any of the conditions listed below occur, a remote start event may be aborted or canceled:

- Vehicle is in valet mode
- Vehicle doors are ajar
- Rear compartment lid is ajar
- The hood is open
- The doors are not locked
- The hazard switch is ON
- Vehicle power mode is incorrect
- Vehicle speed is greater than 0
- Transmission is not in P
- Excessive engine coolant temperature
- Low oil pressure
- The malfunction indicator lamp (MIL) is commanded ON
- The low fuel level indicator lamp is commanded ON
- Engine crank time is greater than 30 seconds

- Excessive engine speed
- Accelerator pedal position too high
- Remote start timer equals 0
- Immobilizer system indicates a theft attempt
- Vehicle propulsion system fault conditions
- High voltage battery fault conditions

Keyless Entry Personalization

Vehicle lock/unlock functions and remote start settings may be personalized for the vehicle. For functional descriptions and programming instructions, refer to the vehicle owners manual.

Replace Battery in Remote Key Message

A REPLACE BATTERY IN REMOTE KEY message may be seen on the driver information center when the transmitter's battery voltage has been lower than 2.16 volts for three consecutive ignition cycles.

ELECTRONIC TOLL COLLECTION SYSTEM DESCRIPTION AND OPERATION

The electronic toll collection system is an in vehicle communication system to remotely perform the transaction between a toll road collector and the vehicle operator. The system has a module contained within the mirror assembly. The module uses an antenna to send and receive an RF (radio frequency) signal. The RF message is sent to the toll road's toll collector system and an RF message is sent back to the vehicle telling the electronic toll collection system in the vehicle that the toll requirement has been satisfied. The electronic toll collection system informs the vehicle operator if the toll requirement has not been satisfied.

The electronic toll collection system uses bidirectional RF communication operating at 5.8 GHz.

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Seat Hardware, Trim, and Upholstery - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Driver or Passenger Seat Adjuster Finish Cover Screw	3 N.m (27 lb in)
Driver or Passenger Seat Adjuster Vertical Actuator Handle Screw	3.5 N.m (31 lb in)
Driver or Passenger Seat Inner Recliner Finish Cover Screw	3 N.m (27 lb in)
Front Seat Back Cushion Frame Bolt	35 N.m (26 lb ft)
Front Seat Back Cushion Latch Finish Cover Fastener-Back Panel	2.5 N.m (22 lb in)
Front Seat Back Cushion Latch Finish Cover Fastener-Front Panel	8 N.m (71 lb in)
Front Seat Back Upper Support Fastener	8 N.m (71 lb in)
Front Seat Cushion Outer Finish Cover Screw	3 N.m (27 lb in)
Front Seat Mounting Bolt	45 N.m (33 lb ft)
Front Seat Recliner Handle Bolt	2.5 N.m (22 lb in)
Rear Seat Armrest Fastener	5 N.m (44 lb in)
Rear Seat Back Bolster Bracket Bolt	8 N.m (71 lb in)
Rear Seat Back Bolster Nut	22 N.m (16 lb ft)
Rear Seat Back Cushion Hinge Fastener	58 N.m (43 lb ft)
Rear Seat Back Latch Fastener	40 N.m (30 lb ft)
Rear Seat Back Outer Pivot Bolt	45 N.m (33 lb ft)
Rear Seat Bolster Airbag Nut	4 N.m (35 lb in)

REPAIR INSTRUCTIONS

DRIVER OR PASSENGER SEAT REMOVAL AND INSTALLATION

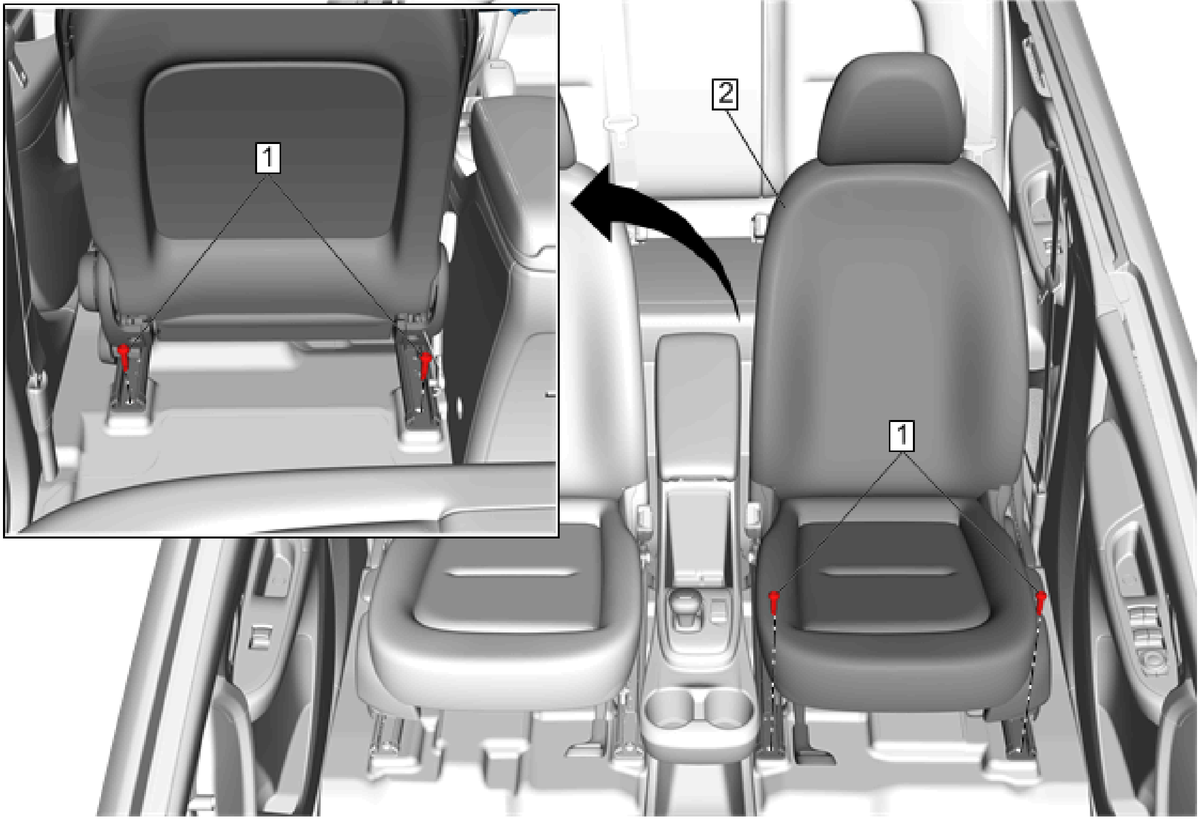


Fig. 1: Driver or Passenger Seat
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Seat Mounting Bolt **CAUTION:** Fastener Caution **Tighten** 45 N.m (33 lb ft) **NOTE:** **Adjust the seat forward or rearward to access the bolts.**
2	Driver or Passenger Seat **Procedure** Disconnect the electrical connectors.

DRIVER OR PASSENGER SEAT ADJUSTER VERTICAL ACTUATOR HANDLE REPLACEMENT

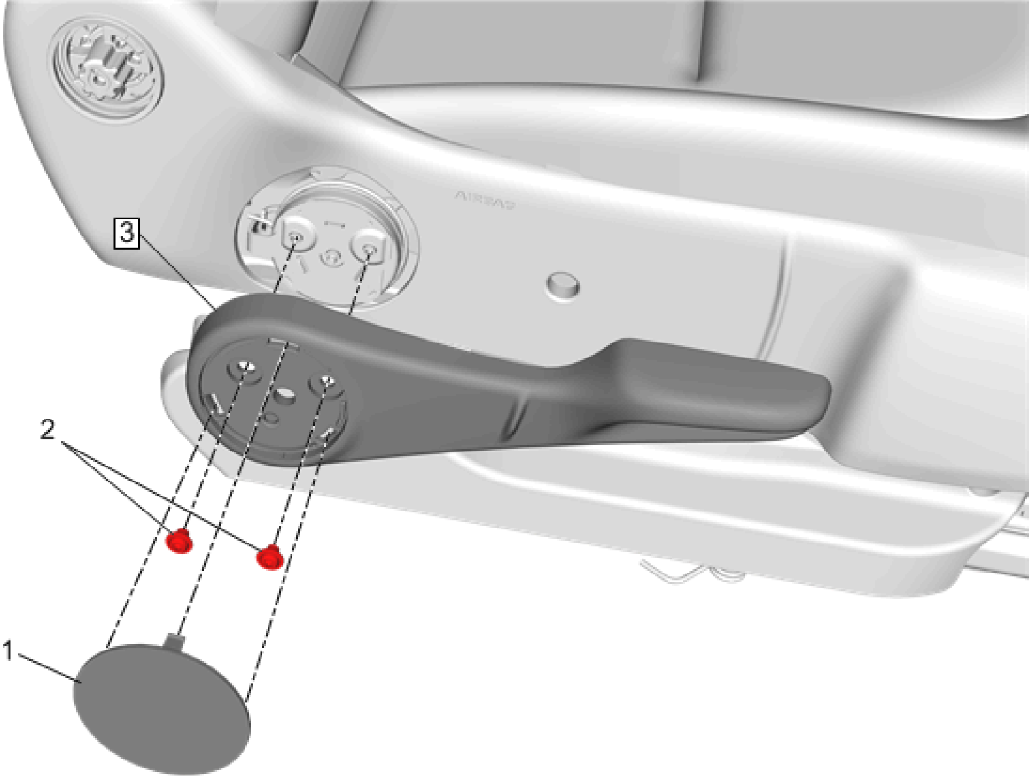


Fig. 2: Driver or Passenger Seat Adjuster Vertical Actuator Handle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Seat Recliner Handle Replacement	
1	Driver or Passenger Seat Adjuster Vertical Actuator Handle Cover **Procedure** Use a flat-bladed tool to release the handle cover from the handle assembly.
2	Driver or Passenger Seat Adjuster Vertical Actuator Handle Screw **CAUTION:** Fastener Caution **Tighten** 3.5 N.m (31 lb in)
3	Driver or Passenger Seat Adjuster Vertical Actuator Handle

DRIVER OR PASSENGER SEAT ADJUSTER HANDLE REPLACEMENT

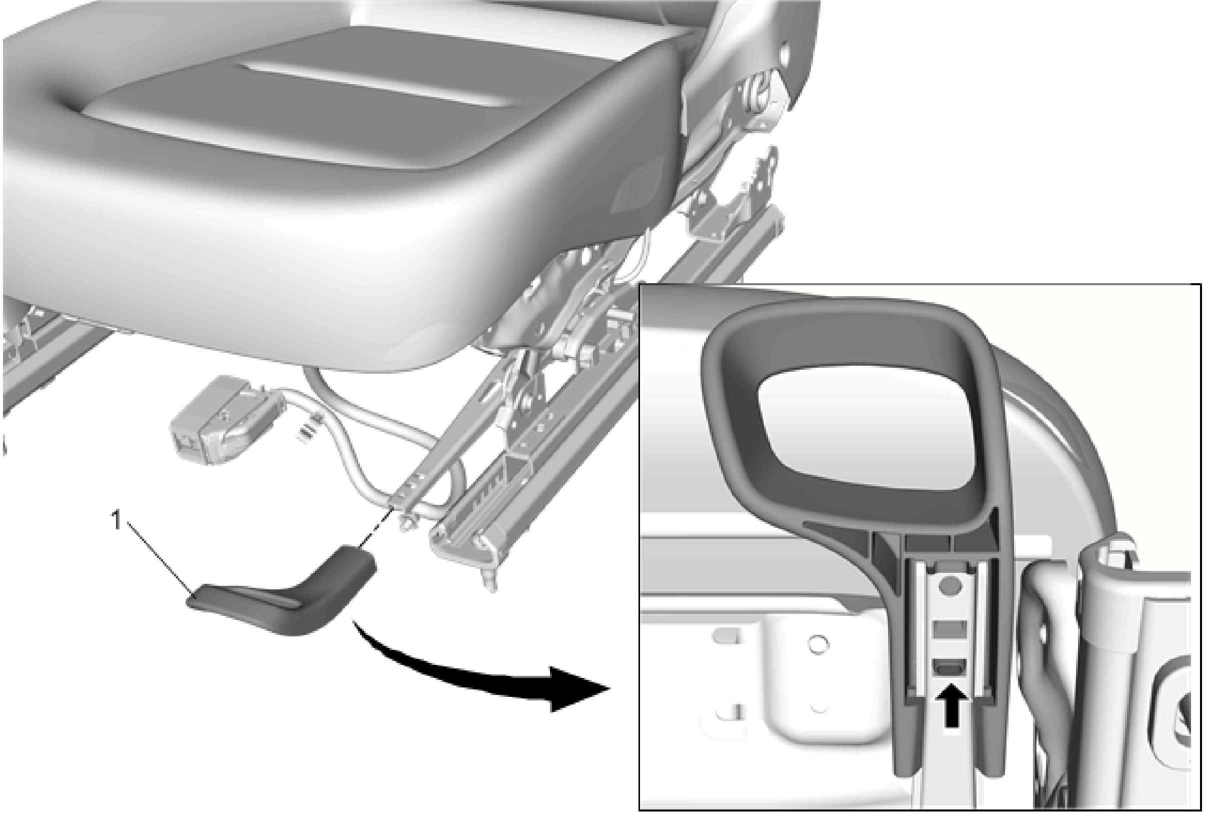


Fig. 3: Driver or Passenger Seat Adjuster Handle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Driver or Passenger Seat Adjuster Handle **Procedure** 1. Using appropriate flat bladed tools, spread the rear portion of the handle until it is released from the seat adjuster. 2. When Installing the handle, it does not slide on, it must be locked at the front position and pressed over the adjuster.

DRIVER OR PASSENGER SEAT HEAD RESTRAINT REPLACEMENT

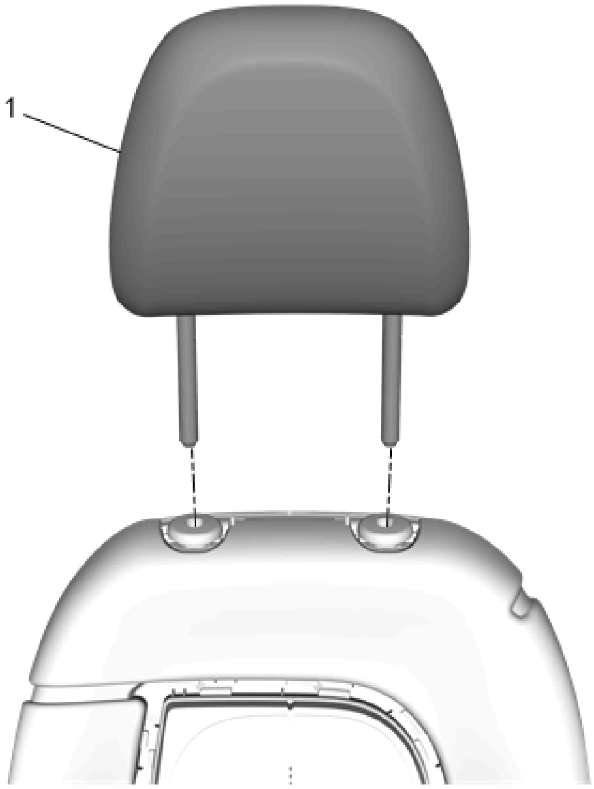


Fig. 4: Driver or Passenger Seat Head Restraint
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Driver or Passenger Seat Head Restraint **Procedure** 1. Raise the headrest to the full up position. 2. Rotate both headrest guide bezels counterclockwise and slide them upward. 3. Reposition the seat cover material to access the metal clips. 4. Using an appropriate tool, release both head restraint guide clips and remove the head restraint.

FRONT SEAT HEAD RESTRAINT GUIDE REPLACEMENT

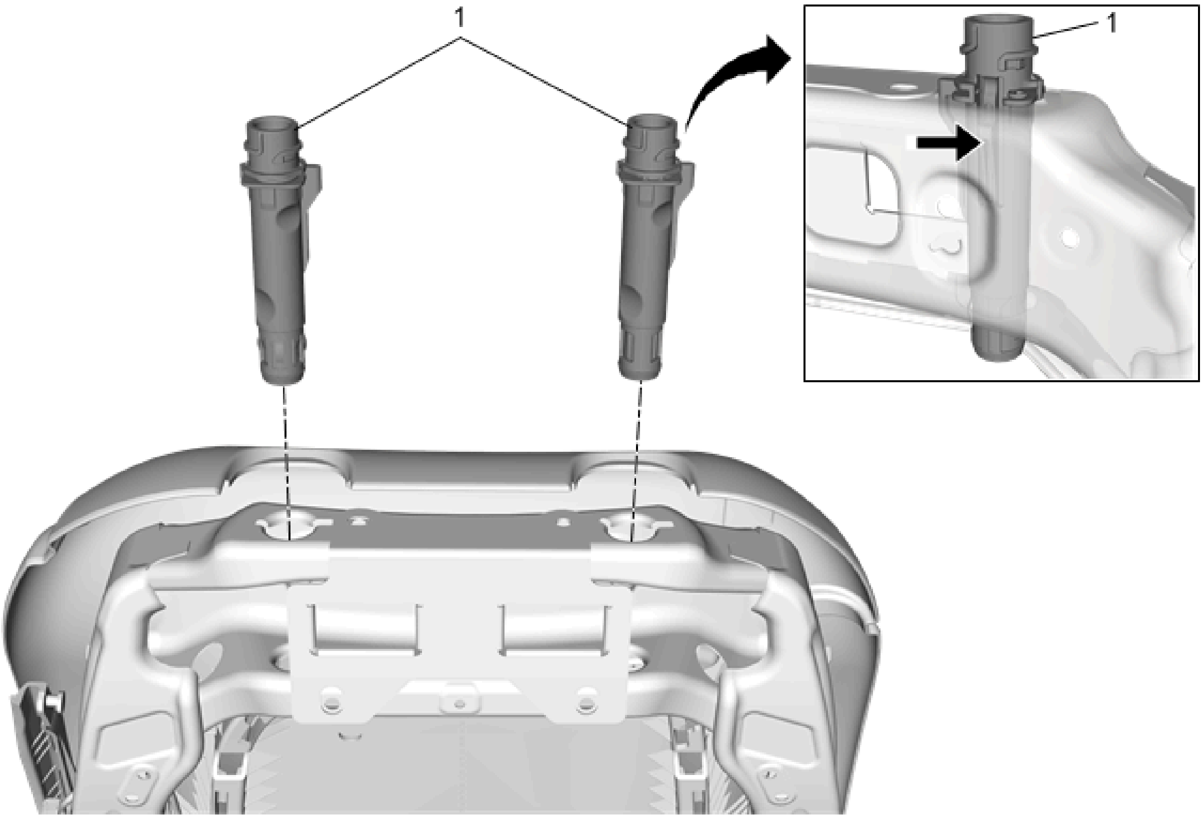


Fig. 5: Front Seat Head Restraint Guide
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Driver or Passenger Seat Head Restraint Replacement 2. Front Seat Back Cushion Latch Finish Cover - Back Panel - Remove - Front Seat Back Cushion Latch Finish Cover Replacement (Back Panel)Front Seat Back Cushion Latch Finish Cover Replacement (Front Panel)	
1	Front Seat Head Restraint Guide **Procedure** Using a suitable tool, push the guide tab inward while pulling upward to remove the guide from the seat back frame.

FRONT SEAT BELT ANCHOR PLATE TENSIONER COVER REPLACEMENT

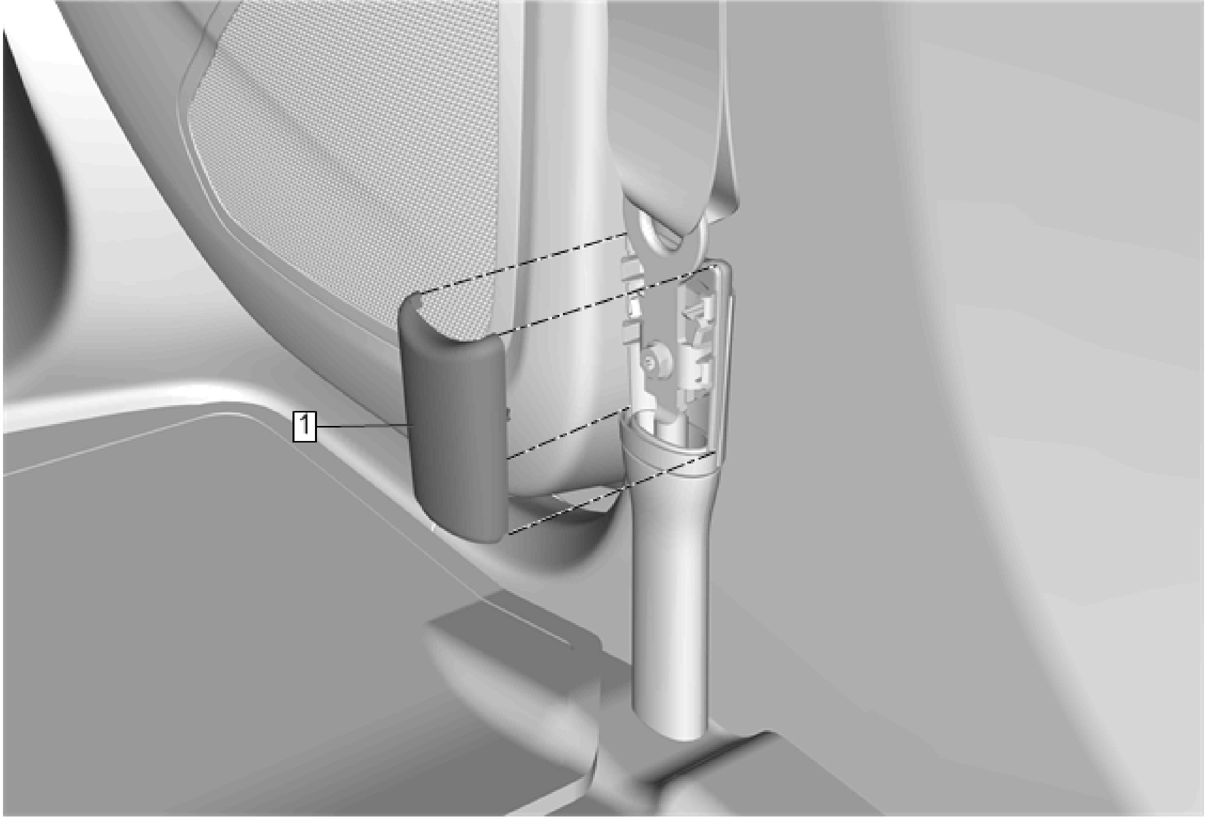


Fig. 6: Front Seat Belt Anchor Plate Tensioner Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Seat Belt Anchor Plate Tensioner Cover **Procedure** Using a suitable flat-bladed tool, remove the front seat belt anchor plate tensioner cover.

DRIVER OR PASSENGER SEAT ADJUSTER FINISH COVER REPLACEMENT

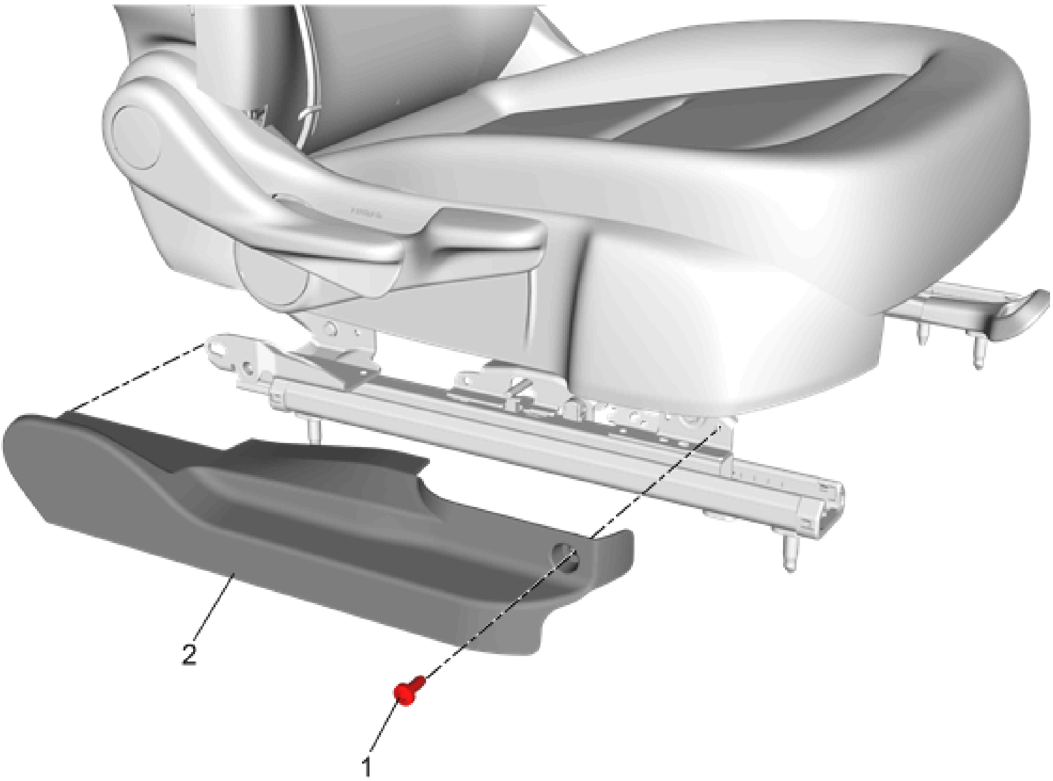


Fig. 7: Driver or Passenger Seat Adjuster Finish Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Driver or Passenger Seat Adjuster Finish Cover Screw **CAUTION:** Fastener Caution **Tighten** 3 N.m (27 lb in)
2	Driver or Passenger Seat Adjuster Finish Cover

FRONT SEAT OUTER RECLINER INNER FINISH COVER REPLACEMENT

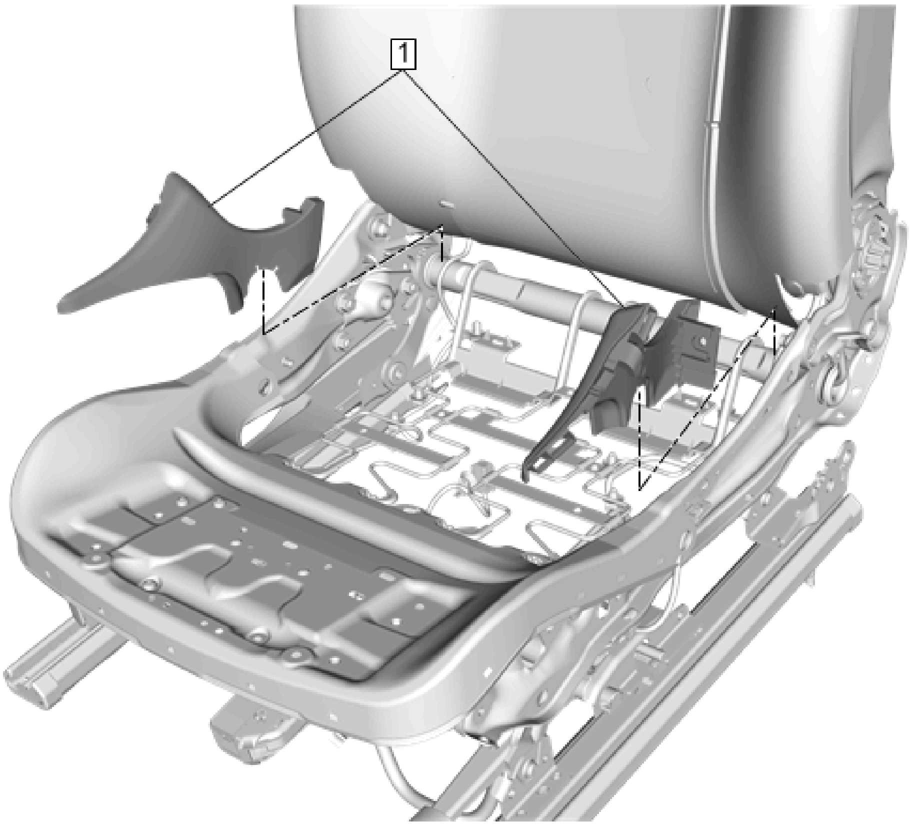


Fig. 8: Front Seat Outer Recliner Inner Finish Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Seat Cushion Cover and Pad Replacement	
1	Front Seat Outer Recliner Inner Finish Cover

DRIVER OR PASSENGER SEAT INNER RECLINER FINISH COVER REPLACEMENT

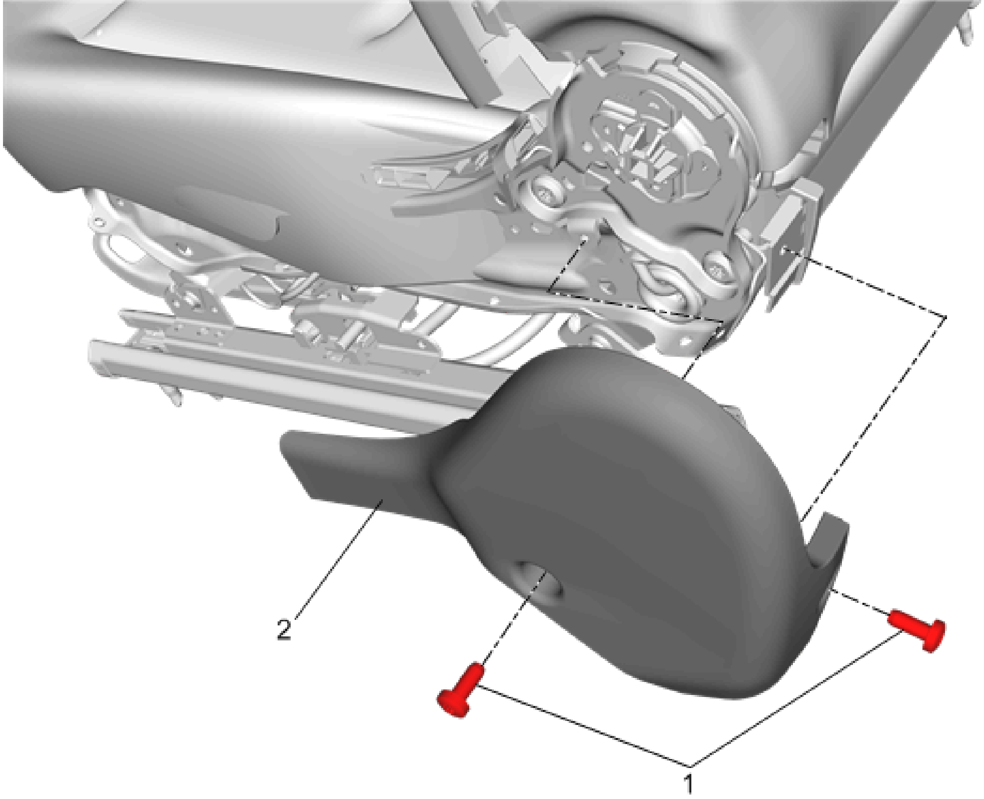


Fig. 9: Driver or Passenger Seat Inner Recliner Finish Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Driver or Passenger Seat - Remove - **Driver or Passenger Seat Removal and Installation**	
1	Driver or Passenger Seat Inner Recliner Finish Cover Screw **CAUTION:** **Fastener Caution** **Tighten** 3 N.m (27 lb in)
2	Driver or Passenger Seat Inner Recliner Finish Cover **Procedure** 1. Use a plastic trim tool to release the integral retainers. 2. Driver or Passenger Seat - Install - **Driver or Passenger Seat Removal and Installation**

FRONT SEAT BACK PAD COMFORT PAD REPLACEMENT

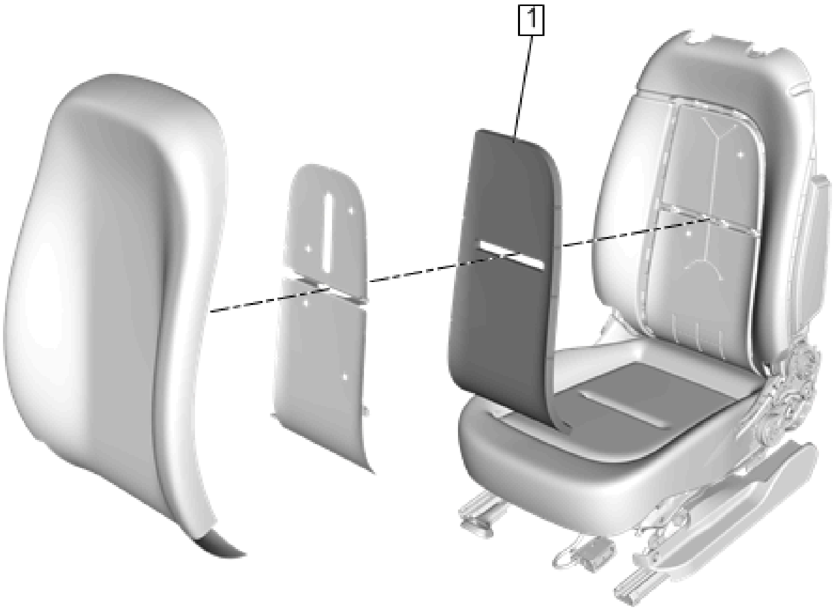


Fig. 10: Front Seat Back Pad Comfort Pad
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
SIR Warning

Preliminary Procedures
1. Driver or Passenger Seat - Remove - Driver or Passenger Seat Removal and Installation
2. Driver or Passenger Seat Head Restraint Replacement
3. Front Seat Back Cushion Latch Finish Cover - Back Panel - Remove - Front Seat Back Cushion Latch Finish Cover Replacement (Back Panel)Front Seat Back Cushion Latch Finish Cover Replacement (Front Panel)
4. Driver or Passenger Seat Back Cover and Pad Replacement
5. {If equipped} Driver or Passenger Seat Back Heater Replacement</td></tr>
<tr><td>1</td><td>Driver or Passenger Seat Back Pad Comfort Pad
Procedure
Driver or Passenger Seat - Install - Driver or Passenger Seat Removal and Installation</td></tr>
</table>

DRIVER OR PASSENGER SEAT CUSHION FRAME REPLACEMENT

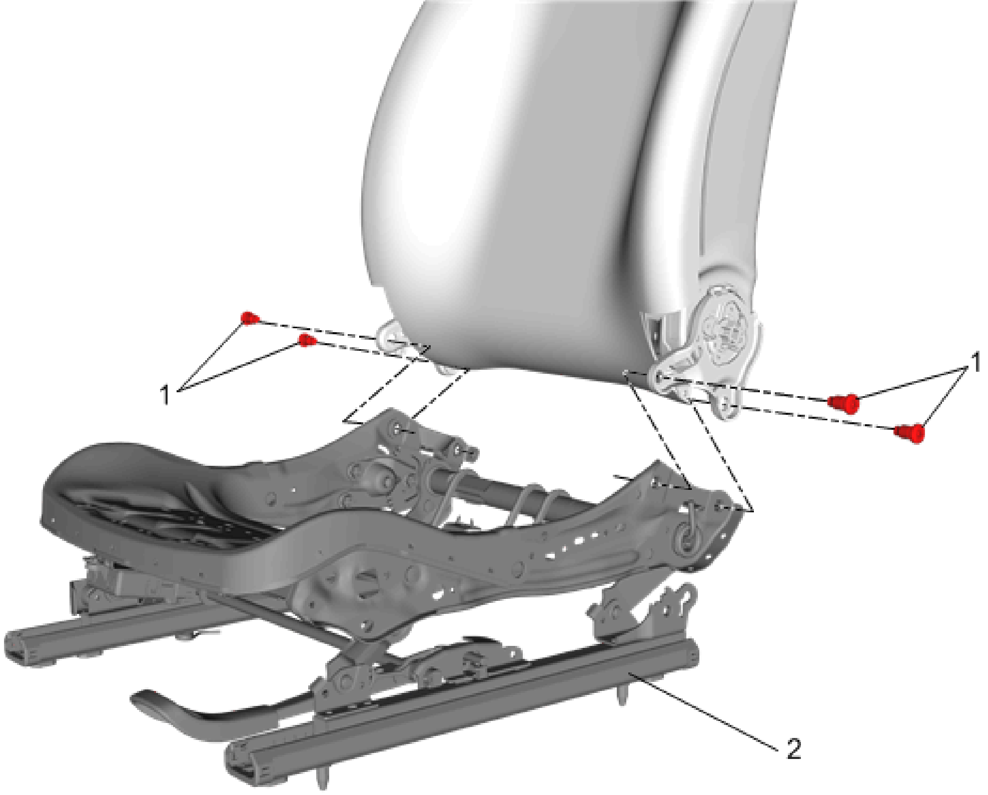


Fig. 11: Driver or Passenger Seat Cushion Frame
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **WARNING:** **To avoid personal injury, perform a preload test on the passenger presence system whenever you remove or replace the seat cushion trim. Failure to do so may cause the system to malfunction.** **Preliminary Procedures** 1. Front Seat Cushion Cover and Pad Replacement 2. {If equipped} Passenger Presence Seat Belt Sensor Replacement 3. {If equipped} Airbag Front Passenger Presence Module Replacement	
1	Front Seat Back Cushion Frame Bolt **CAUTION:** Fastener Caution **Tighten** 35 N.m (26 lb ft)
2	Driver or Passenger Seat Cushion Frame **Procedure** 1. Disconnect electrical connectors as needed. 2. Transfer components as necessary. 3. If necessary, perform the following steps:Passenger Presence System Rezeroing

FRONT SEAT CUSHION PAD SUPPORT REPLACEMENT

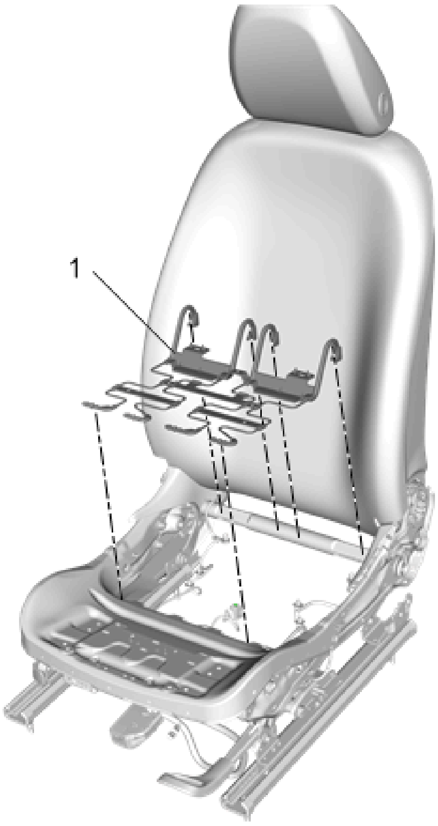


Fig. 12: Front Seat Cushion Pad Support
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
SIR Warning

WARNING:
To avoid personal injury, perform a preload test on the passenger presence system whenever you remove or replace the seat cushion trim. Failure to do so may cause the system to malfunction.

Preliminary Procedures
1. Front Seat Cushion Cover and Pad Replacement
2. {If equipped} Passenger Presence Seat Belt Sensor Replacement
3. {If equipped} Airbag Front Passenger Presence Module Replacement</td></tr>
<tr><td>1</td><td>Front Seat Cushion Pad Support
1. Disconnect and reposition electrical harness as necessary.
2. If necessary, perform the following steps:Passenger Presence System Rezeroing</td></tr>
</table>

FRONT SEAT CUSHION OUTER FINISH COVER REPLACEMENT

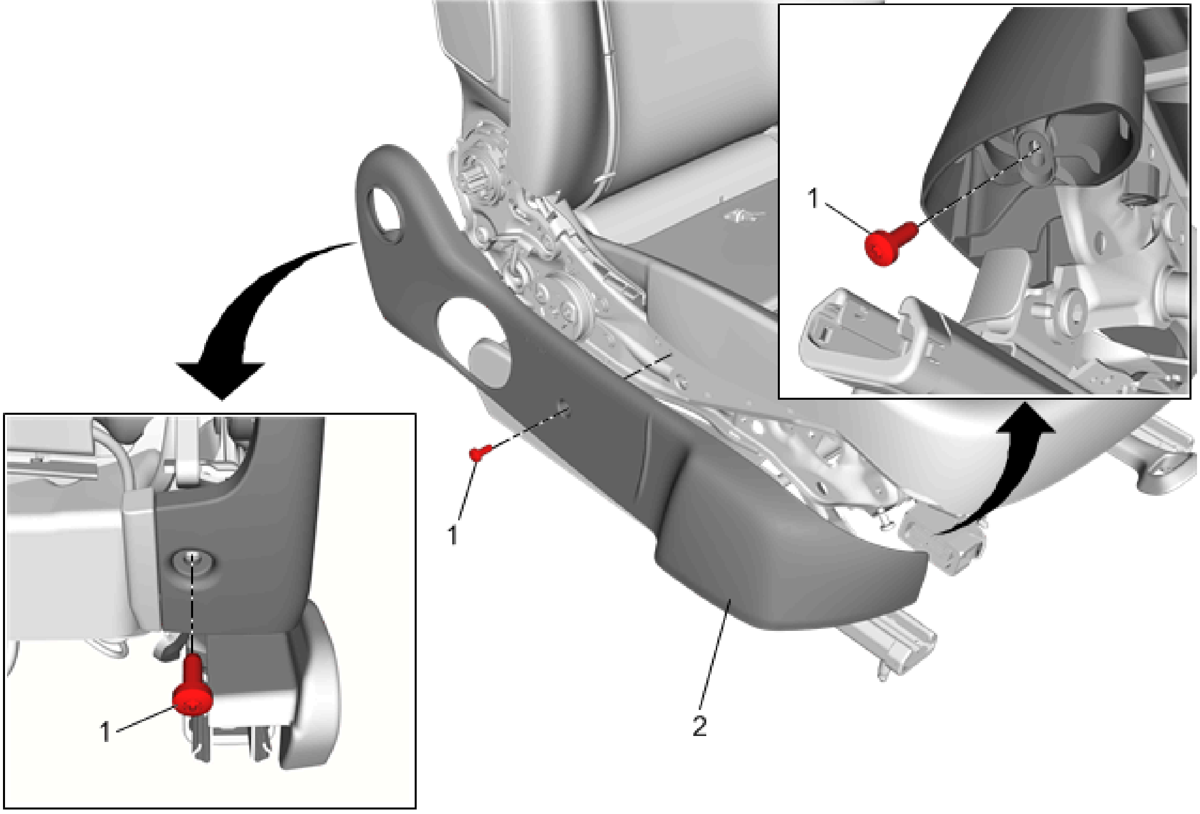


Fig. 13: Front Seat Cushion Outer Finish Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Driver or Passenger Seat Adjuster Vertical Actuator Handle Replacement 2. Front Seat Recliner Handle Replacement	
1	Front Seat Cushion Outer Finish Cover Screw **CAUTION:** Fastener Caution **Tighten** 3 N.m (27 lb in)
2	Front Seat Cushion Outer Finish Cover **Procedure** 1. Using an appropriate tool (pliers), release the large integral retainer. 2. Using a plastic trim tool, release the remaining integral retainers.

FRONT SEAT CUSHION COVER AND PAD REPLACEMENT

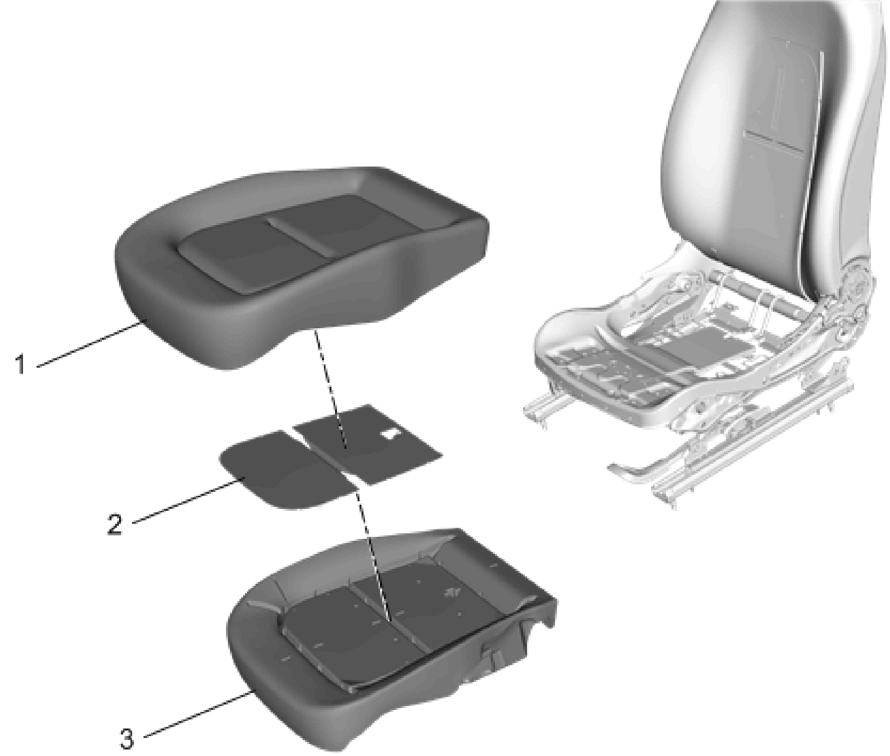


Fig. 14: Front Seat Cushion Cover and Pad
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **SIR Warning** **Preliminary Procedures** 1. Driver or Passenger Seat - Remove - **Driver or Passenger Seat Removal and Installation** 2. **Driver or Passenger Seat Inner Recliner Finish Cover Replacement** 3. **Front Seat Cushion Outer Finish Cover Replacement**	
1	Front Seat Cushion Cover **Procedure** 1. Disengage the J-channel and hog ring retainers from the seat cushion frame. 2. Disconnect the electrical connector. 3. Remove the seat cushion cover and pad from the seat cushion frame as an assembly. 4. Separate the seat cushion from the seat cushion pad by pulling the cover away from the pad.

Callout	Component Name
2	Front Seat Cushion Heater **WARNING:** **Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. All the components in the service kit are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly.** **NOTE:** **The seat belt presence sensor and heat mat, if equipped, are integral parts of the seat cushion pad.**
3	Front Seat Cushion Pad **Procedure** Driver or Passenger Seat - Install - Driver or Passenger Seat Removal and Installation

FRONT SEAT BACK UPPER SUPPORT REPLACEMENT (RIGHT)

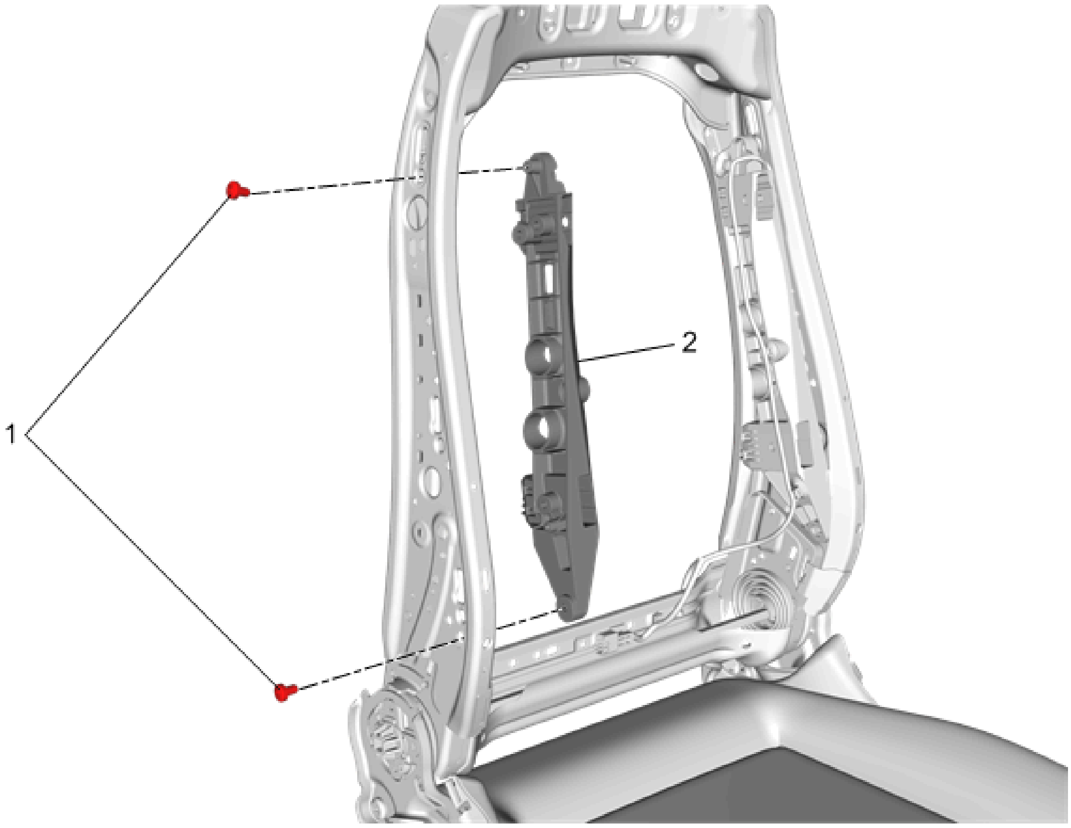


Fig. 15: Front Seat Back Upper Support (Right)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedures** 1. Disable the SIR system. SIR Disabling and Enabling 2. Front Seat Back Cushion Latch Finish Cover - Front Panel - Remove - Front Seat Back Cushion Latch Finish Cover Replacement (Front Panel)	

Callout	Component Name
1	Front Seat Back Upper Support Fastener **CAUTION:** **Fastener Caution** **Tighten** 8 N.m (71 lb in)
2	Front Seat Back Upper Support **Procedure** Enable the SIR System. **SIR Disabling and Enabling**

FRONT SEAT BACK UPPER SUPPORT REPLACEMENT (LEFT)

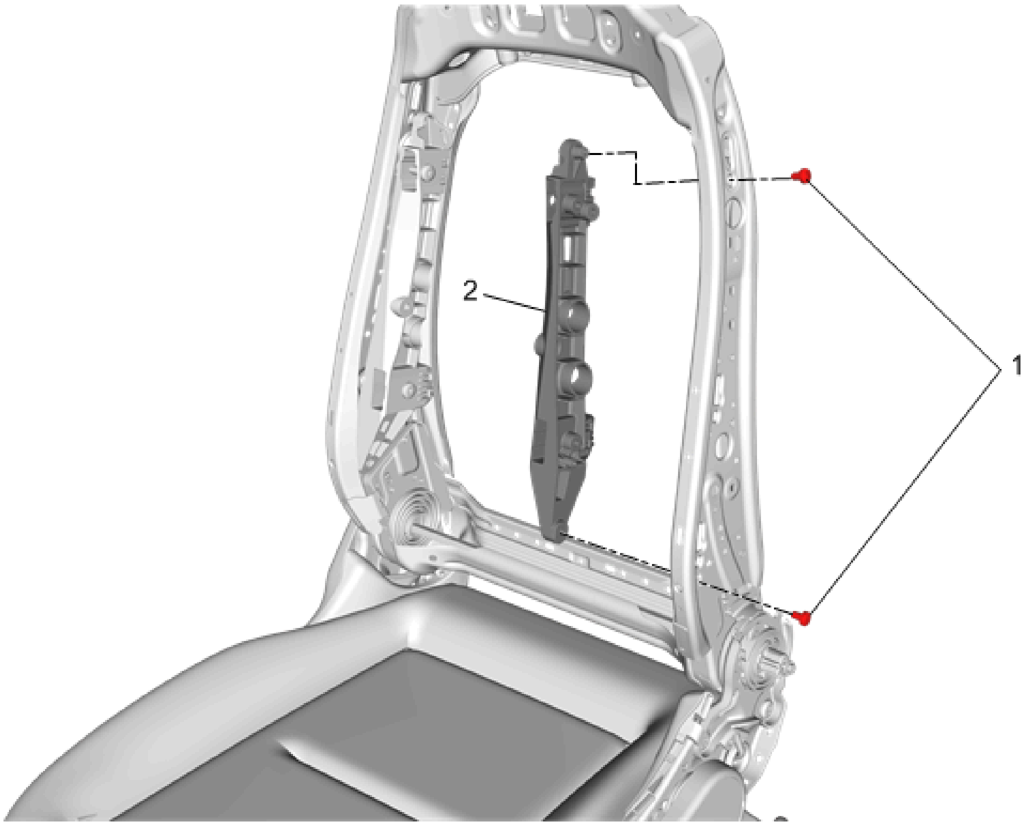


Fig. 16: Front Seat Back Upper Support (Left)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **SIR Warning** **Preliminary Procedures** 1. Disable the SIR system. **SIR Disabling and Enabling** 2. Front Seat Back Cushion Latch Finish Cover - Front Panel - Remove - **Front Seat Back Cushion Latch Finish Cover Replacement (Front Panel)** 3. **Front Seat Outboard Seat Back Airbag Replacement**	

Callout	Component Name
1	Front Seat Back Upper Support Fastener **CAUTION:** Fastener Caution **Tighten** 8 N.m (71 lb in)
2	Front Seat Back Upper Support **Procedure** **Procedure** 1. Unclip the harness. 2. Enable the SIR System. SIR Disabling and Enabling

FRONT SEAT BACK UPPER SUPPORT REPLACEMENT (SIDE AIRBAG CLOSEOUT)

Removal Procedure

WARNING: **Refer to SIR Warning .**

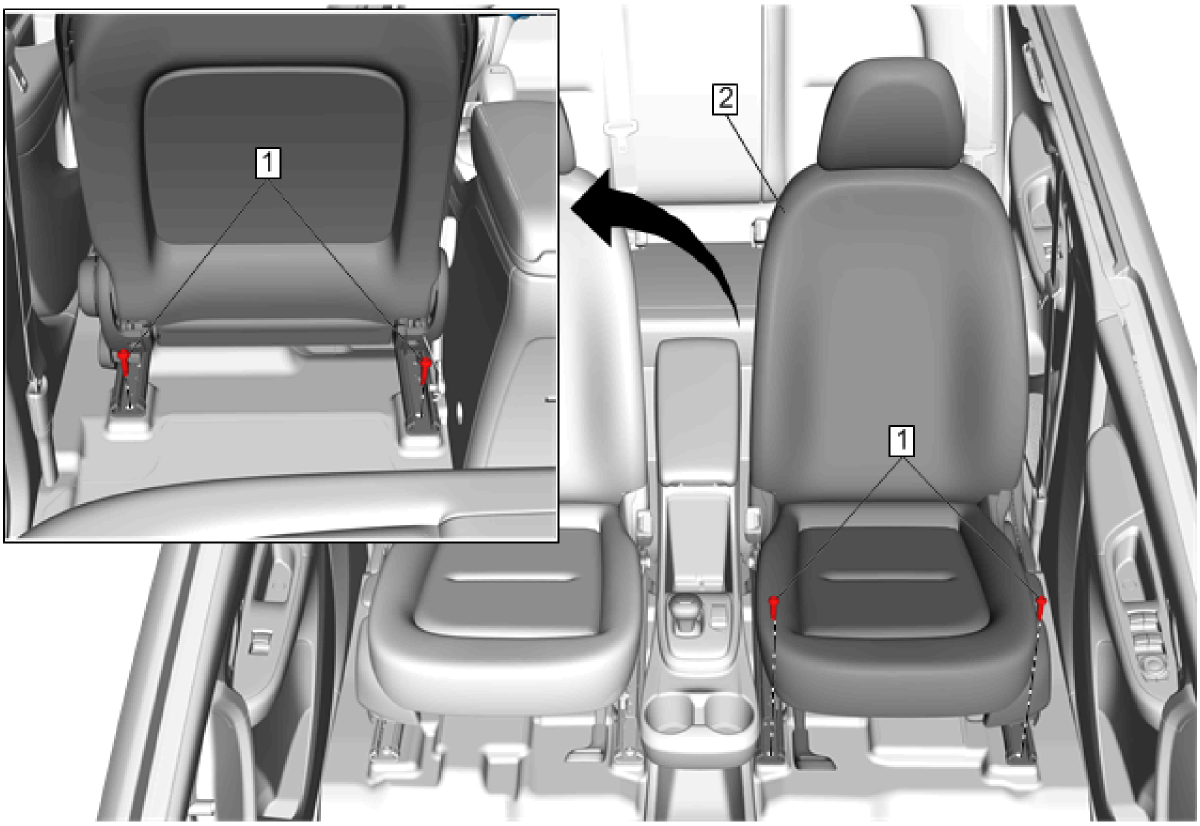


Fig. 17: Driver or Passenger Seat (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

1. Remove the driver or passenger seat (2). Driver or Passenger Seat Removal and Installation

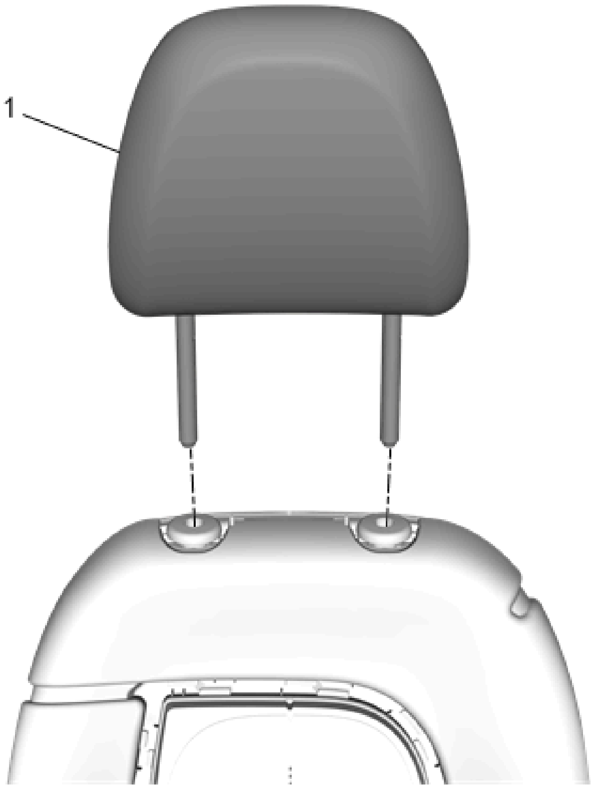


Fig. 18: Driver or Passenger Seat Head Restraint (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

2. Remove the driver or passenger seat head restraint (1). **Driver or Passenger Seat Head Restraint Replacement**

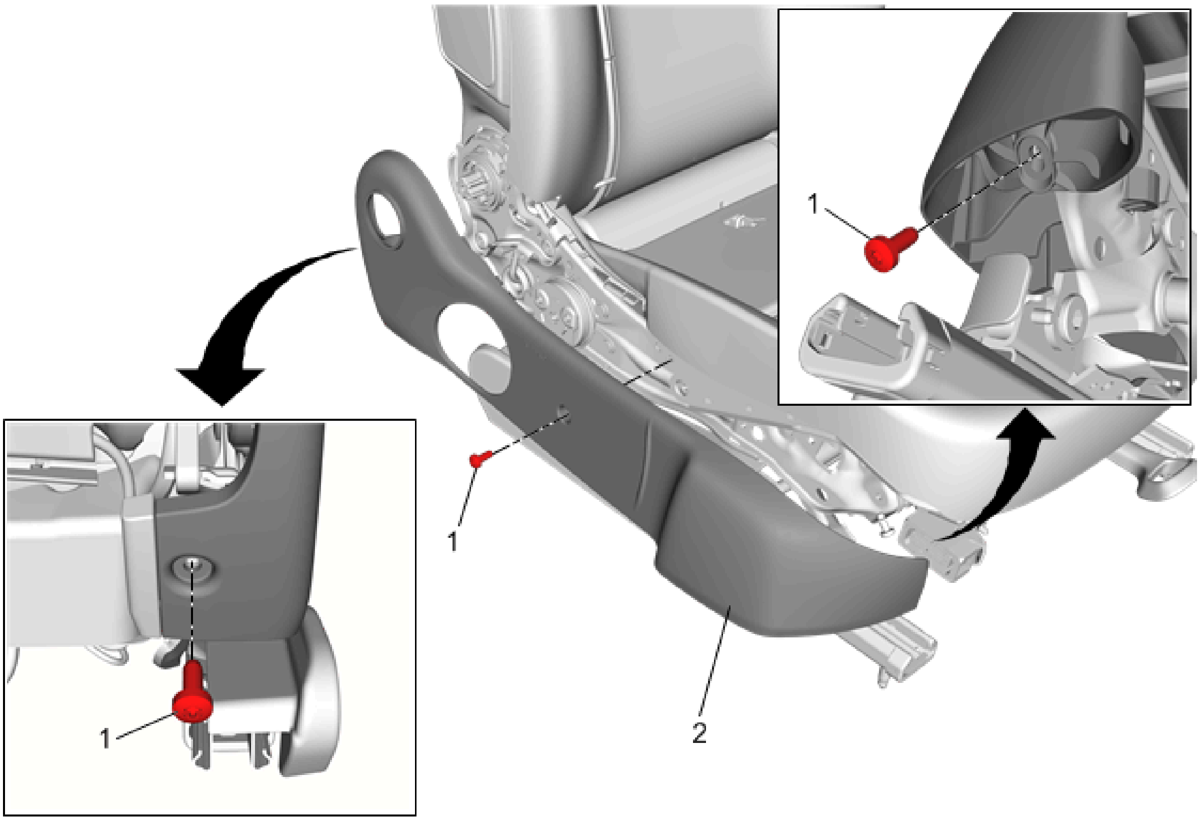


Fig. 19: Front Seat Cushion Outer Finish Cover (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

3. Remove the front seat cushion outer finish cover (2). **Front Seat Cushion Outer Finish Cover Replacement**

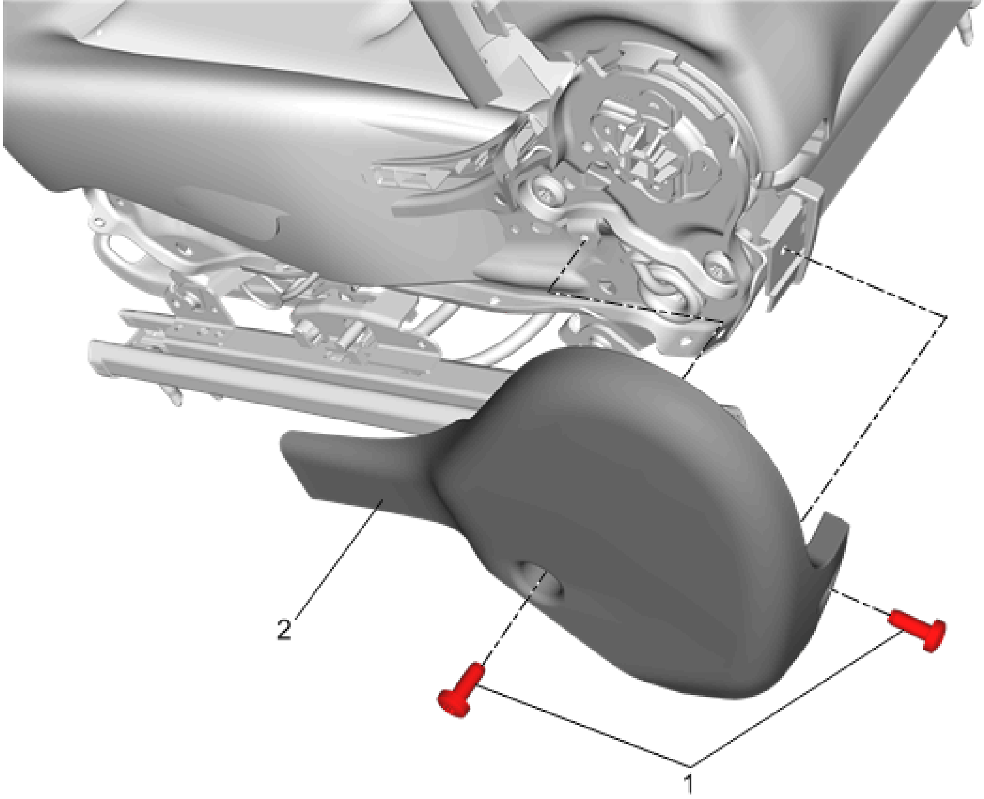


Fig. 20: Driver Or Passenger Seat Inner Recliner Finish Cover (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

4. Remove the driver or passenger seat inner recliner finish cover (2). **Driver or Passenger Seat Inner Recliner Finish Cover Replacement**

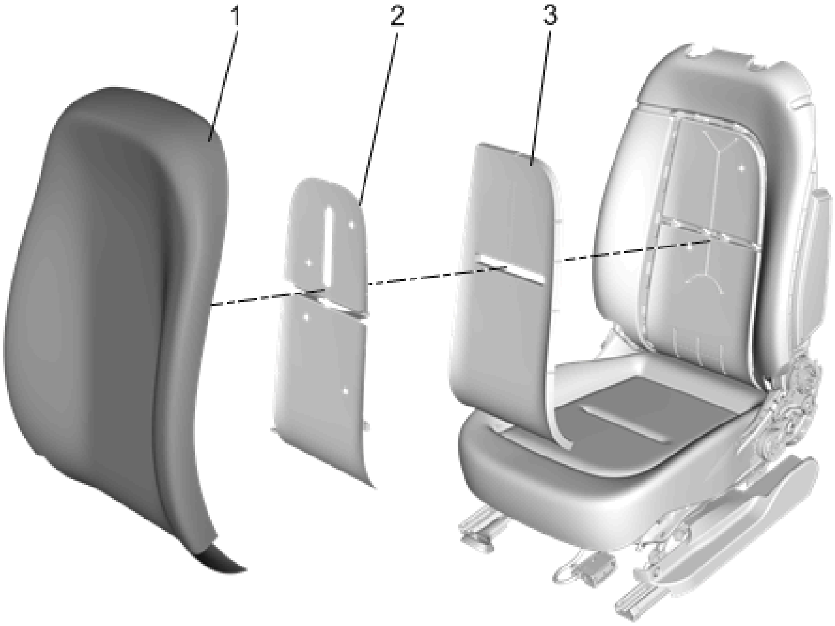


Fig. 21: Driver or Passenger Seat Back Cover and Pad (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

5. Remove the driver or passenger seat back cushion cover (1). **Driver or Passenger Seat Back Cover and Pad Replacement**
6. If equipped, remove the driver or passenger seat back heater (2).
7. Remove the front seat back pad comfort pad (3).

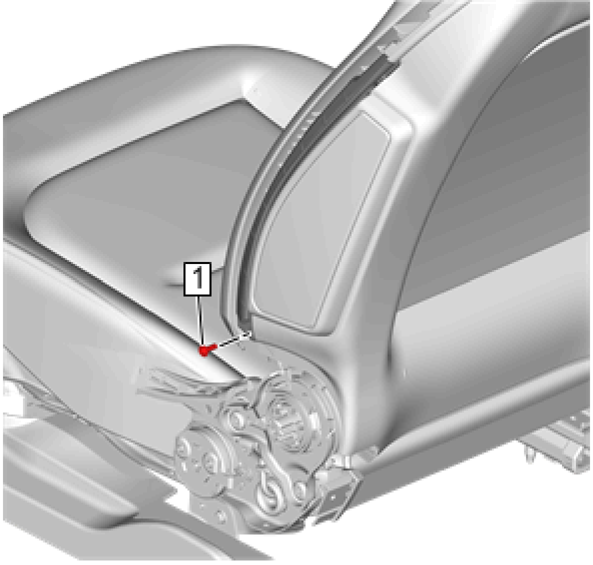


Fig. 22: Front Seat Back Cushion Latch Finish Cover Fastener (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

8. Remove the front seat back cushion latch finish cover fastener (1).

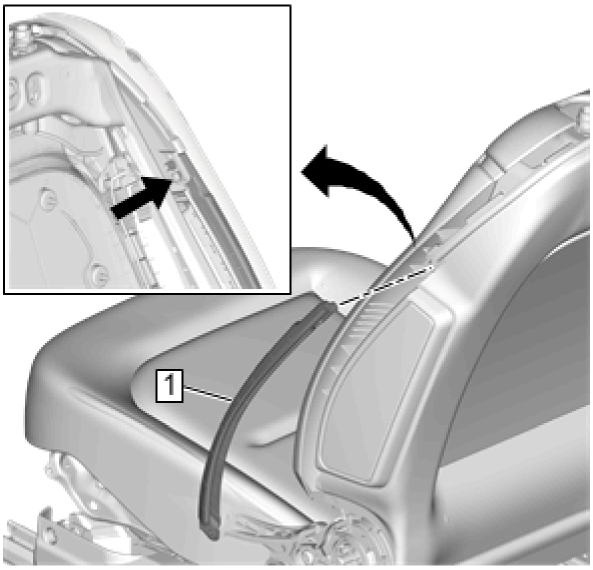


Fig. 23: Front Seat Back Upper Support (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

9. Perform the following steps to remove the front seat back upper support (1):
    1. Carefully pull the support downwards into the lower portion of the trim retainer.
    2. Carefully pull the support outwards to remove it from the lower portion of the trim retainer.

Installation Procedure

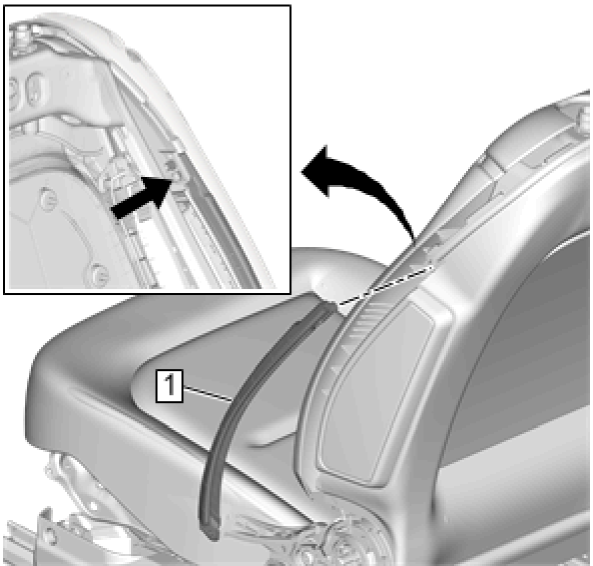


Fig. 24: Front Seat Back Upper Support (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

1. Perform the following steps to install the front seat back upper support (1):
    1. Carefully push the support inwards to install it to the lower portion of the trim retainer.
    2. Carefully push the support upwards into the upper portion of the trim retainer.

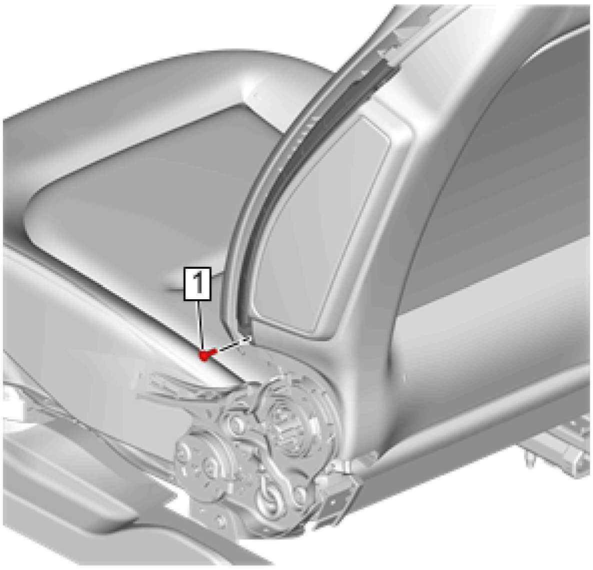


Fig. 25: Front Seat Back Cushion Latch Finish Cover Fastener (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install the front seat back cushion latch finish cover fastener (1) and tighten to 2.5 N.m (22 lb in).

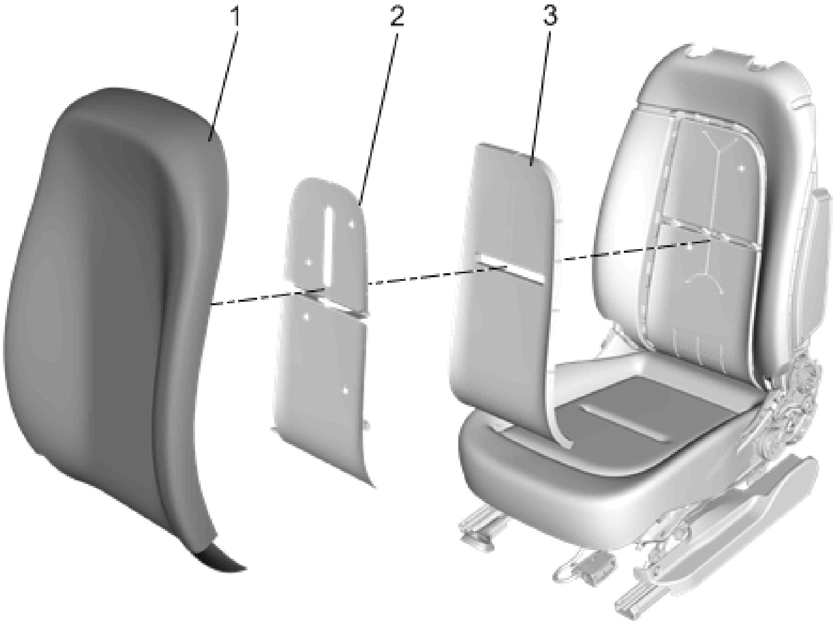


Fig. 26: Driver or Passenger Seat Back Cover and Pad (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

3. Install the front seat back pad comfort pad (3).
4. If equipped, install the driver or passenger seat back heater (2).
5. Install the driver or passenger seat back cushion cover (1). Driver or Passenger Seat Back Cover and Pad Replacement

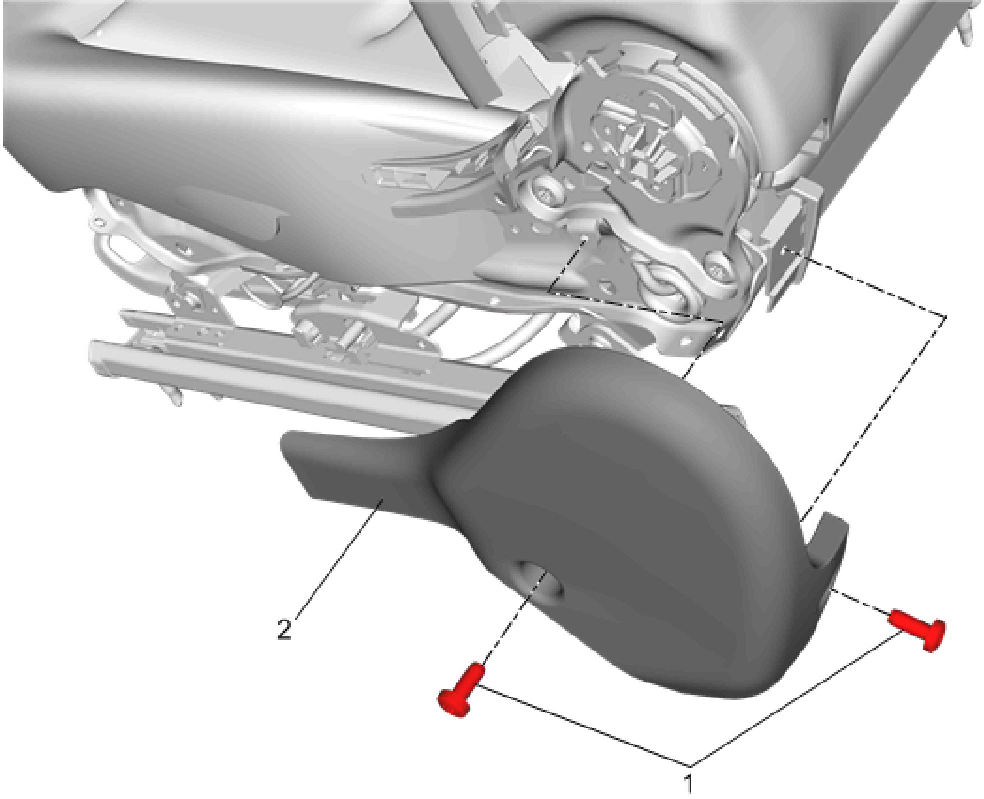


Fig. 27: Driver or Passenger Seat Inner Recliner Finish Cover (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

6. Install the driver or passenger seat inner recliner finish cover (2). **Driver or Passenger Seat Inner Recliner Finish Cover Replacement**

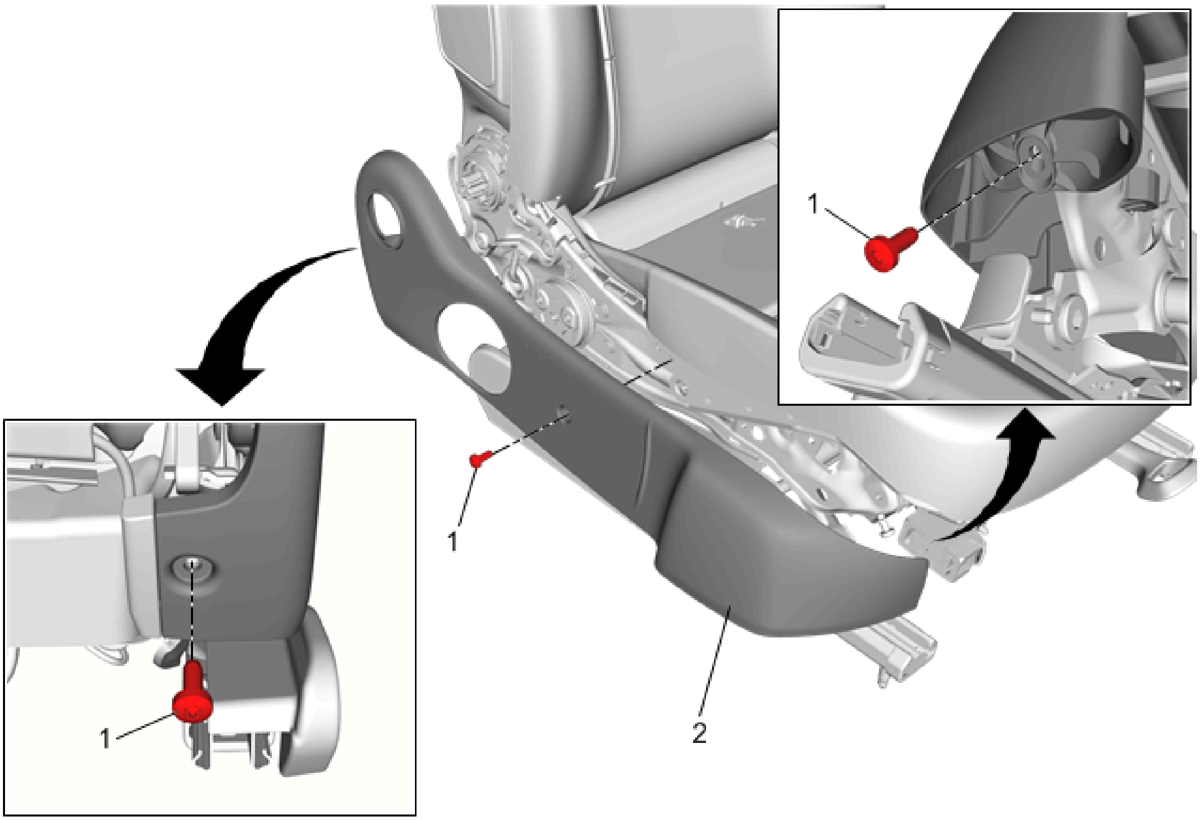


Fig. 28: Front Seat Cushion Outer Finish Cover (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

7. Install the front seat cushion outer finish cover (2). **Front Seat Cushion Outer Finish Cover Replacement**

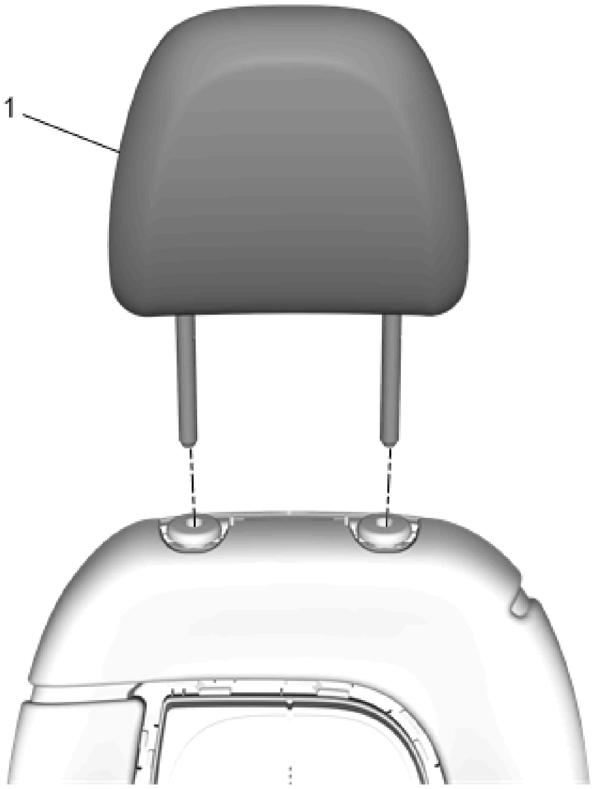


Fig. 29: Driver or Passenger Seat Head Restraint (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

8. Install the driver or passenger seat head restraint (1). Driver or Passenger Seat Head Restraint Replacement

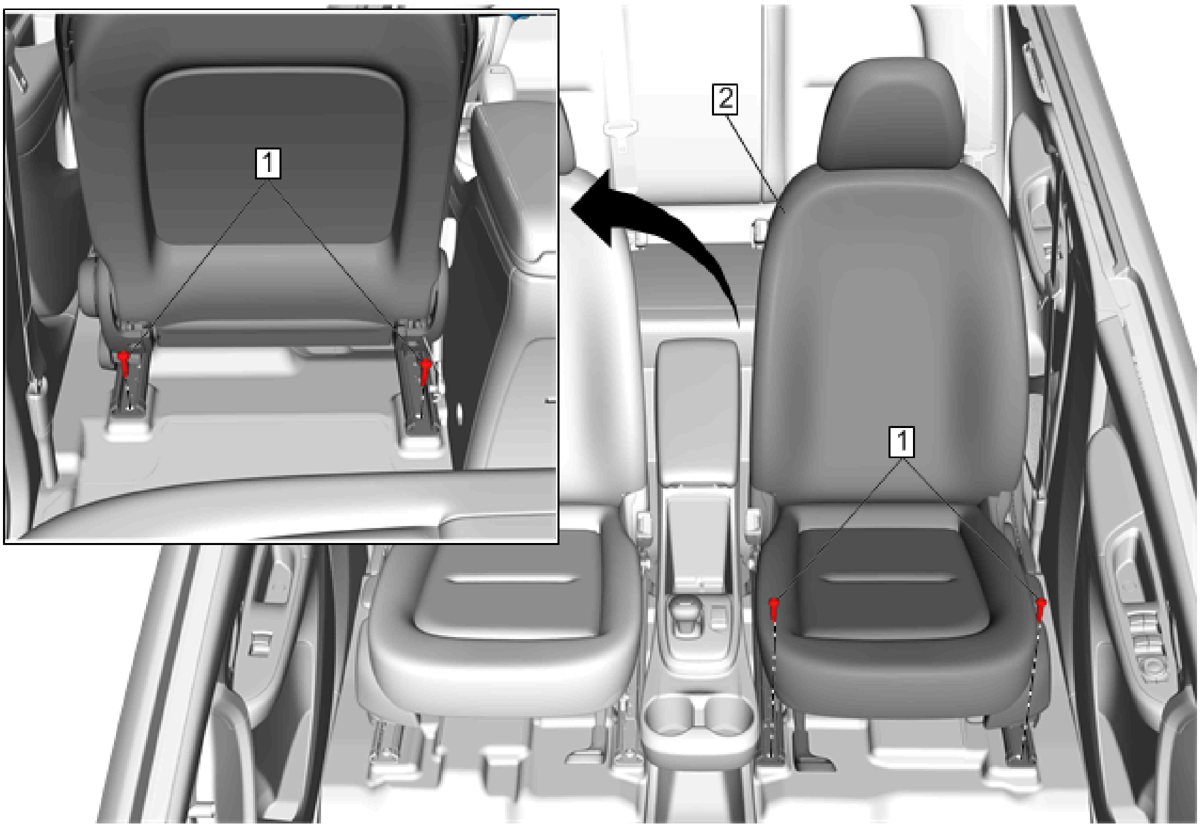


Fig. 30: Driver or Passenger Seat (Side Airbag Closeout)
Courtesy of GENERAL MOTORS COMPANY

9. Install the driver or passenger seat (2). Driver or Passenger Seat Removal and Installation

DRIVER OR PASSENGER SEAT BACK COVER AND PAD REPLACEMENT

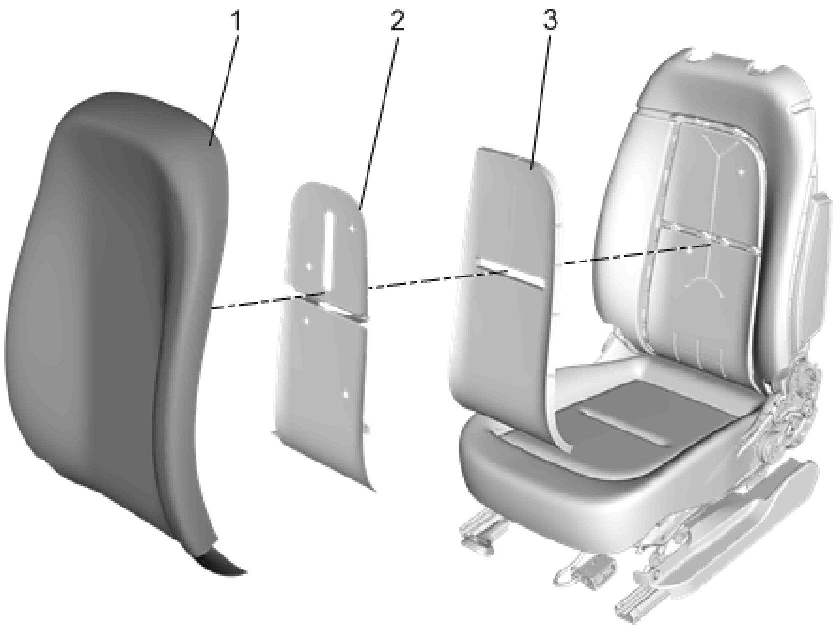


Fig. 31: Driver or Passenger Seat Back Cover and Pad
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **SIR Warning** **Preliminary Procedures** 1. Driver or Passenger Seat - Remove - **Driver or Passenger Seat Removal and Installation** 2. **Driver or Passenger Seat Head Restraint Replacement** 3. Front Seat Back Cushion Latch Finish Cover - Back Panel - Remove - **Front Seat Back Cushion Latch Finish Cover Replacement (Back Panel)**	
1	Driver or Passenger Seat Back Cushion Cover **Procedure** 1. Remove the push-in retainers. 2. Unclip the J-channels and remove cover.
2	{If equipped} Driver or Passenger Seat Back Heater **Procedure** Disconnect the electrical connector and unclip the harness.
3	Front Seat Back Pad Comfort Pad **Procedure** Driver or Passenger Seat - Install - **Driver or Passenger Seat Removal and Installation**

DRIVER OR PASSENGER SEAT BACK CUSHION FRAME REPLACEMENT

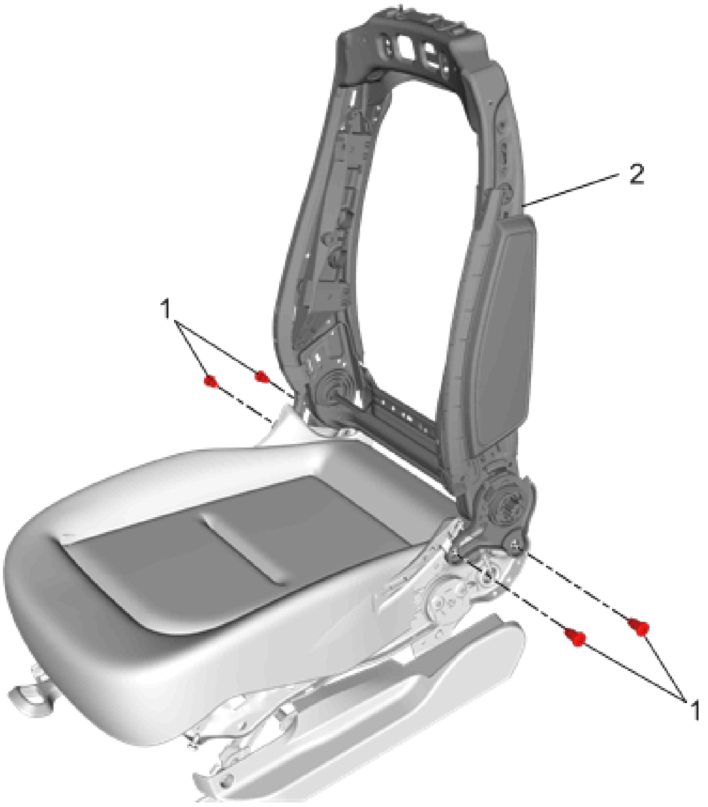


Fig. 32: Driver or Passenger Seat Back Cushion Frame
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedures** 1. Driver or Passenger Seat Inner Recliner Finish Cover Replacement 2. Front Seat Cushion Outer Finish Cover Replacement 3. Front Seat Back Cushion Latch Finish Cover Replacement (Back Panel)Front Seat Back Cushion Latch Finish Cover Replacement (Front Panel)	
1	Front Seat Back Cushion Frame Bolt **CAUTION:** Fastener Caution **Tighten** 35 N.m (26 lb ft)
2	Driver or Passenger Seat Back Cushion Frame **Procedure** 1. Disconnect the electrical connector. 2. Transfer components as necessary.

FRONT SEAT RECLINER HANDLE REPLACEMENT

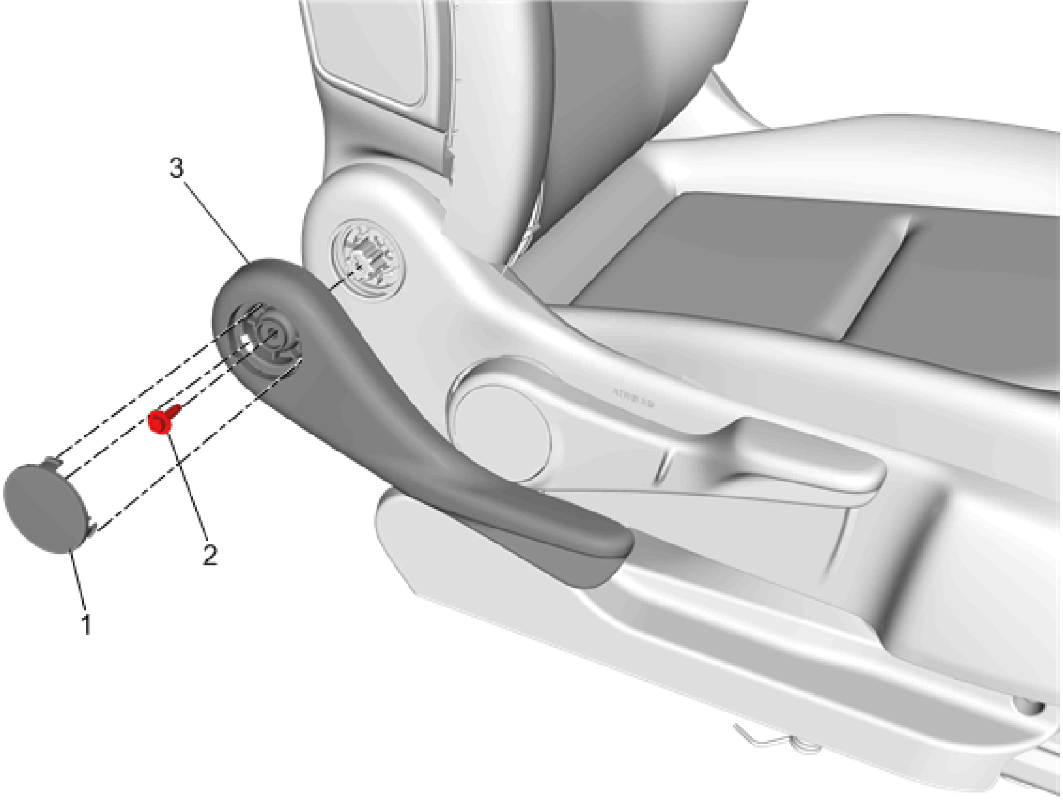


Fig. 33: Front Seat Recliner Handle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Seat Recliner Handle Cover **Procedure** Use a flat-bladed tool to release the handle cover from the handle assembly.
2	Front Seat Recliner Handle Bolt **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
3	Front Seat Recliner Handle

FRONT SEAT BACK CUSHION LATCH FINISH COVER REPLACEMENT (BACK PANEL)

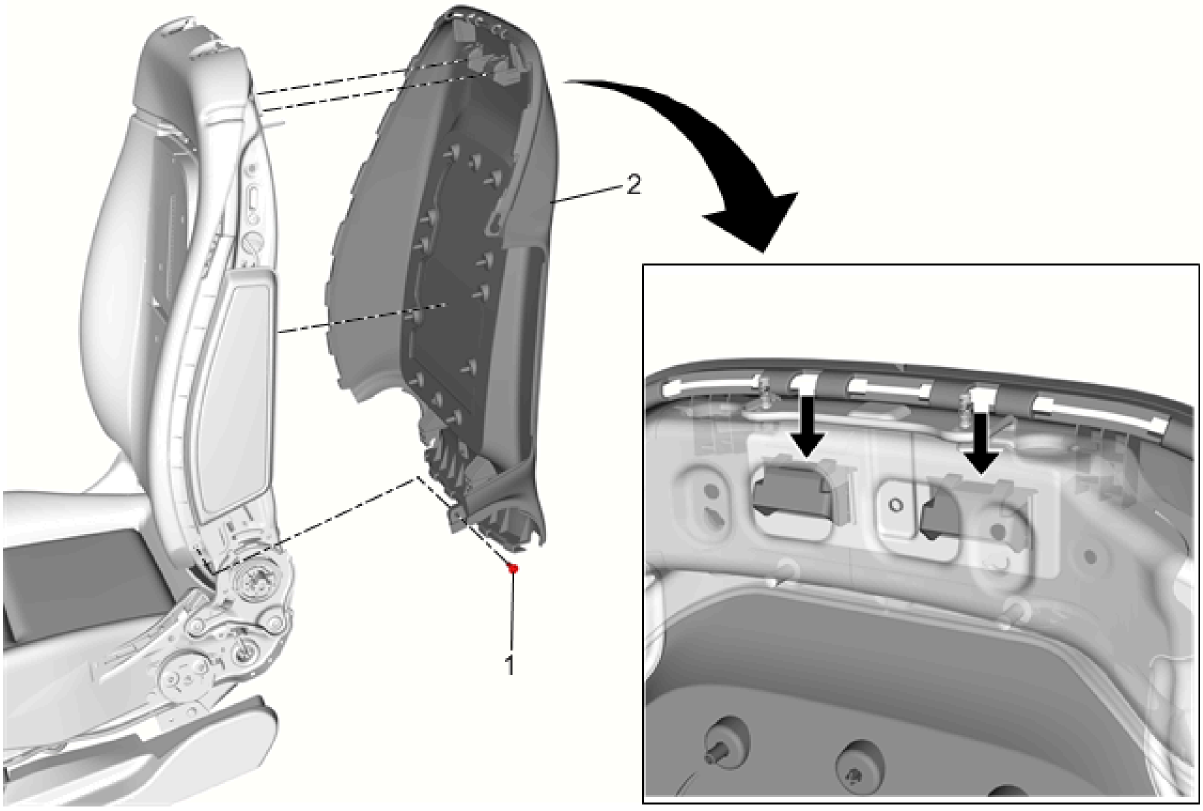


Fig. 34: Front Seat Back Cushion Latch Finish Cover (Back Panel)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedures** 1. Driver or Passenger Seat - Remove - Driver or Passenger Seat Removal and Installation 2. Driver or Passenger Seat Inner Recliner Finish Cover Replacement 3. Front Seat Cushion Outer Finish Cover Replacement	
1	Front Seat Back Cushion Latch Finish Cover Fastener **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Front Seat Back Cushion Latch Finish Cover - Back Panel **Procedure** 1. Using a suitable flat-bladed tool, push the retainer through front seat head restraint guide hole on the top of the cover and remove it from the seat back frame. 2. Driver or Passenger Seat - Install - Driver or Passenger Seat Removal and Installation

FRONT SEAT BACK CUSHION LATCH FINISH COVER REPLACEMENT (FRONT PANEL)

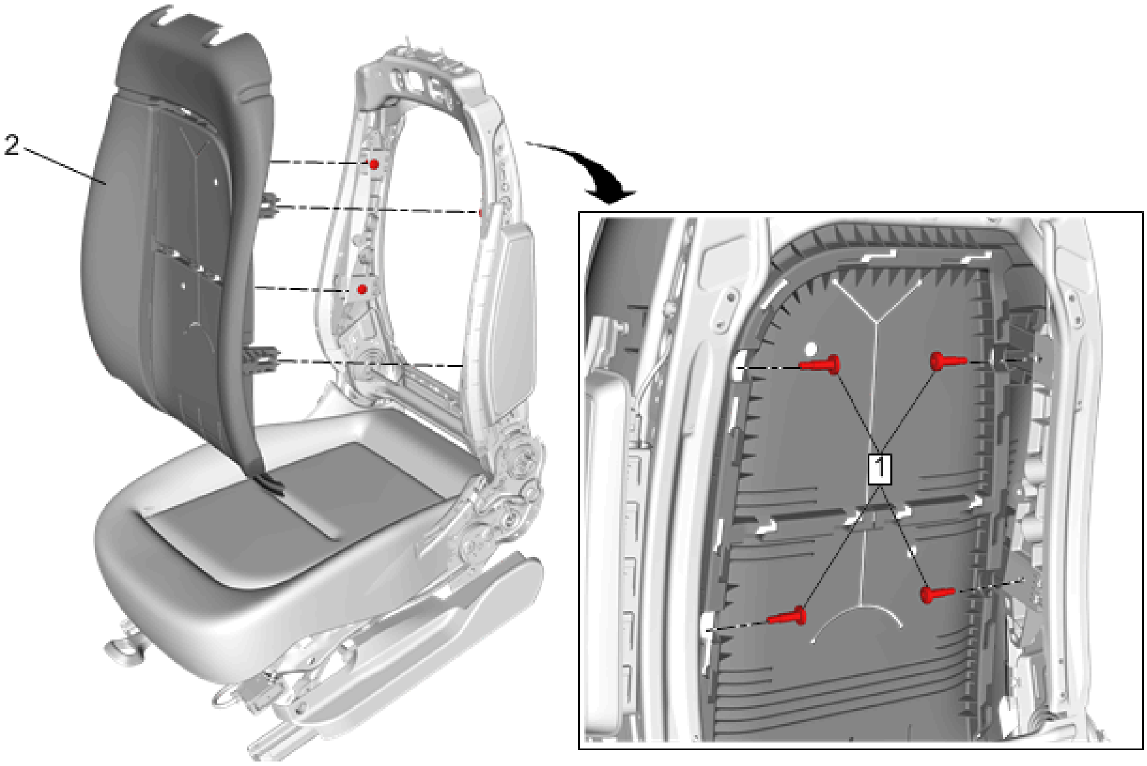


Fig. 35: Front Seat Back Cushion Latch Finish Cover (Front Panel)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedure** Driver or Passenger Seat Back Cover and Pad Replacement	
1	Front Seat Back Cushion Latch Finish Cover Fastener **CAUTION:** Fastener Caution **Tighten** 8 N.m (71 lb in)
2	Front Seat Back Cushion Latch Finish Cover - Front Panel

REAR SEAT ARMREST REPLACEMENT

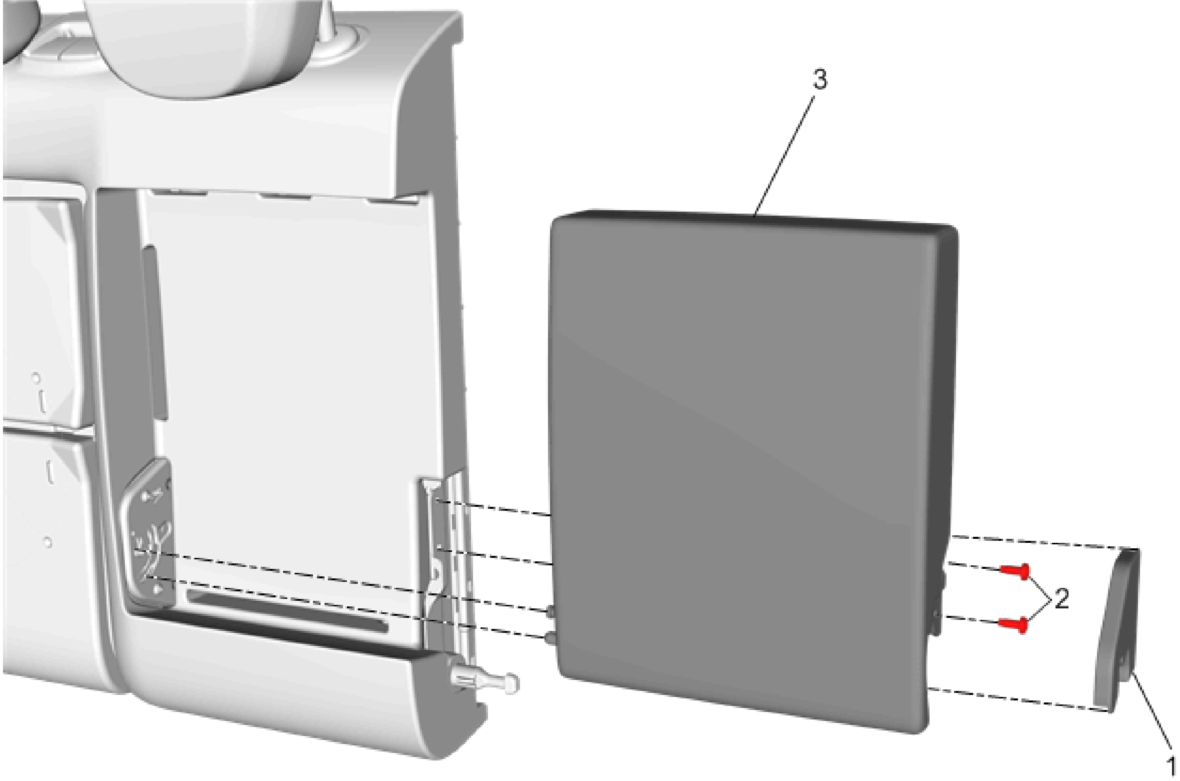


Fig. 36: Rear Seat Armrest
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Back Cushion - Right Side - Remove - Rear Seat Back Cushion Removal and Installation (40%)Rear Seat Back Cushion Removal and Installation (60%)	
1	Rear Seat Armrest Bracket Cover
2	Rear Seat Armrest Fastener **CAUTION:** Fastener Caution
3	Rear Seat Armrest **Procedure** Release the retainer on the hinge bracket.

REAR SEAT ARMREST BRACKET REPLACEMENT (BOLSTER)

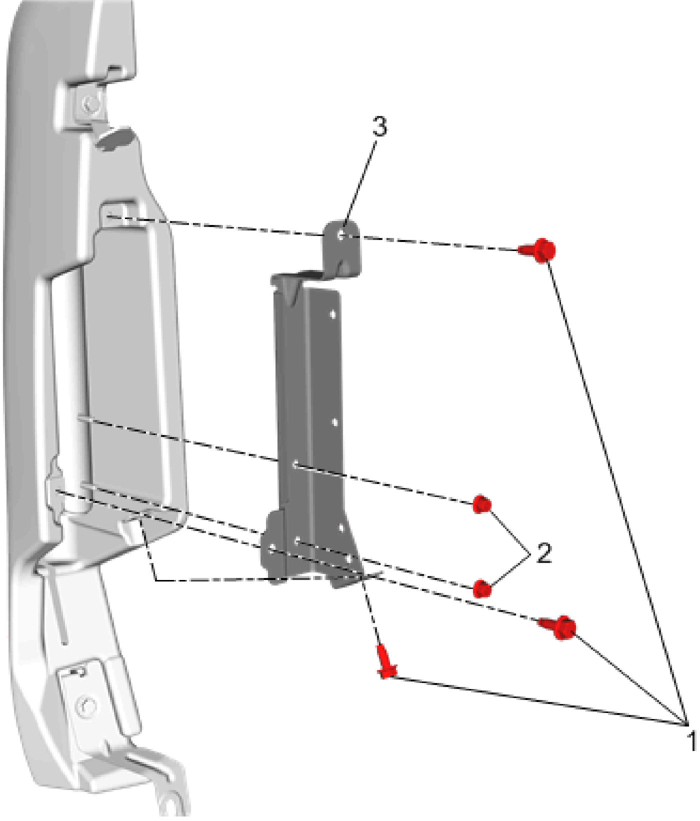


Fig. 37: Rear Seat Armrest Bracket (Bolster)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedures** 1. Disable the SIR system. SIR Disabling and Enabling 2. Rear Seat Back Side Cushion Cover Replacement	
1	Rear Seat Back Bolster Bracket Bolt (Qty: 3) **CAUTION:** Fastener Caution **Tighten** 8 N.m (71 lb in)
2	Rear Seat Bolster Airbag Nut (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 4 N.m (35 lb in)
3	Rear Seat Armrest Bracket **Procedure** Enable the SIR System. SIR Disabling and Enabling

REAR SEAT ARMREST CUP HOLDER REPLACEMENT

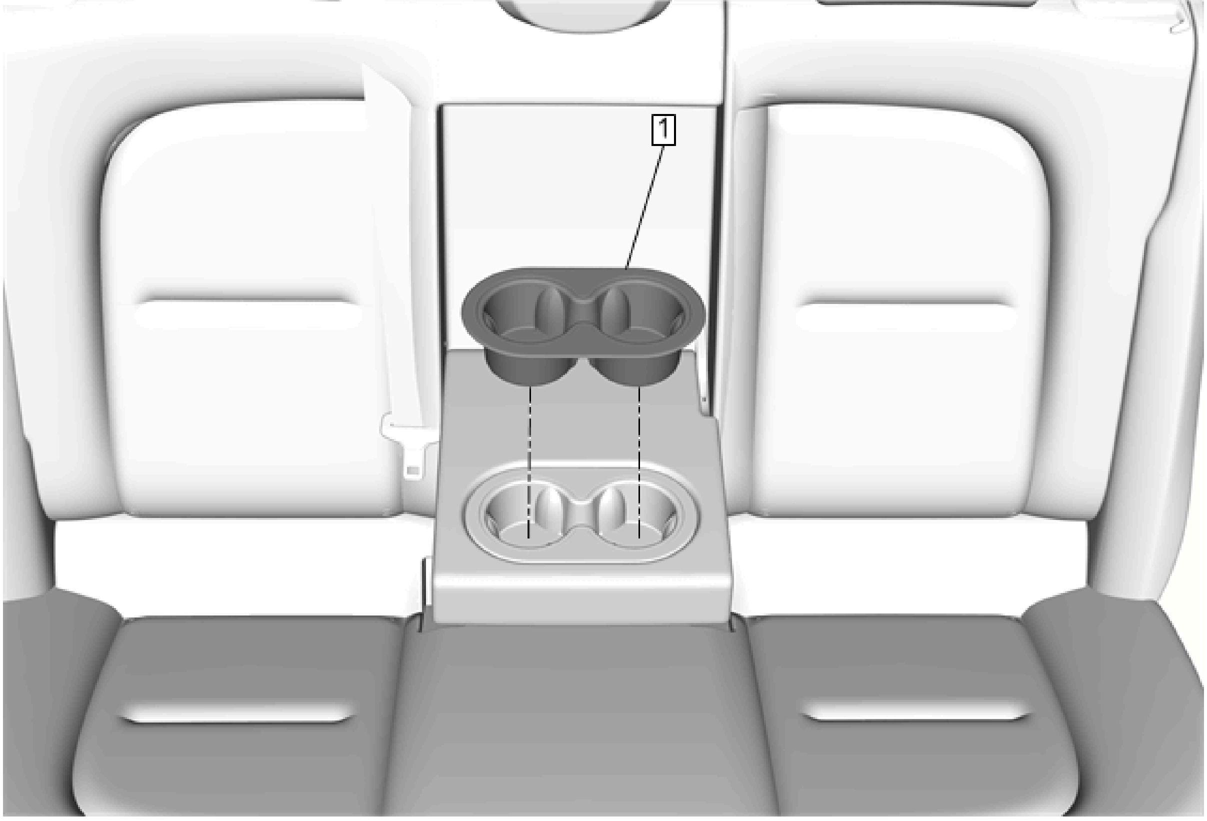


Fig. 38: Rear Seat Armrest Cup Holder
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Armrest Cup Holder

REAR SEAT HEAD RESTRAINT REPLACEMENT

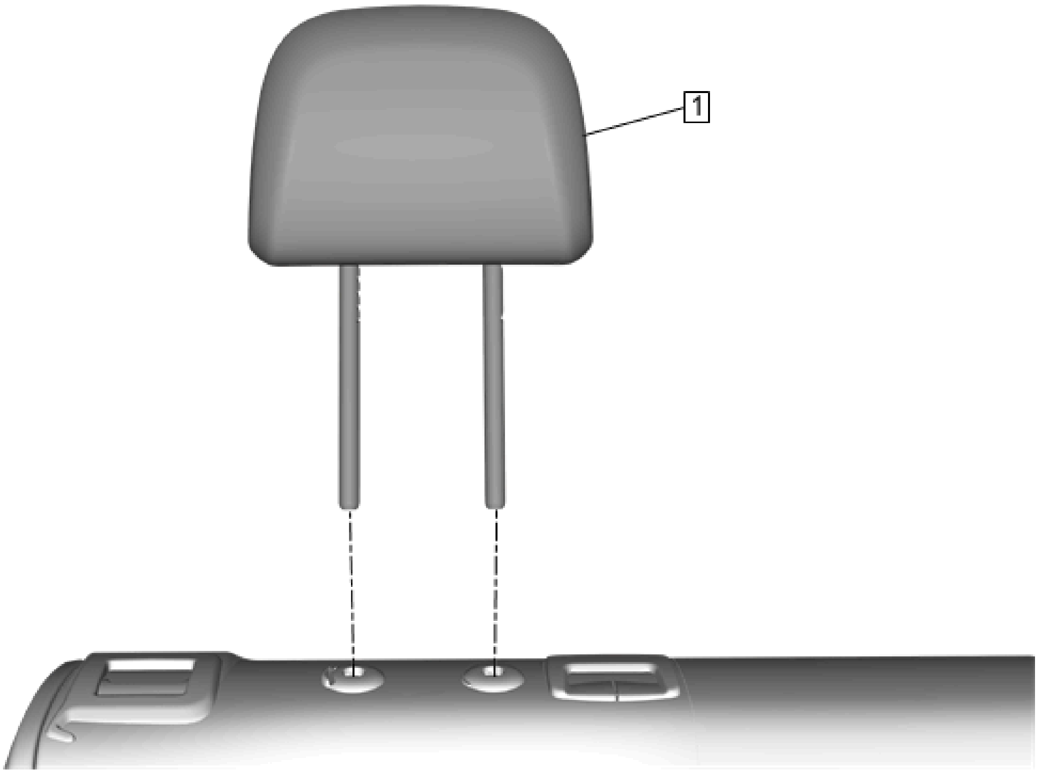


Fig. 39: Rear Seat Head Restraint
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Rear Seat Head Restraint **Procedure** Depress both buttons on the head restraint guides and pull upward to remove the head restraint from the seat.

REAR SEAT HEAD RESTRAINT GUIDE REPLACEMENT

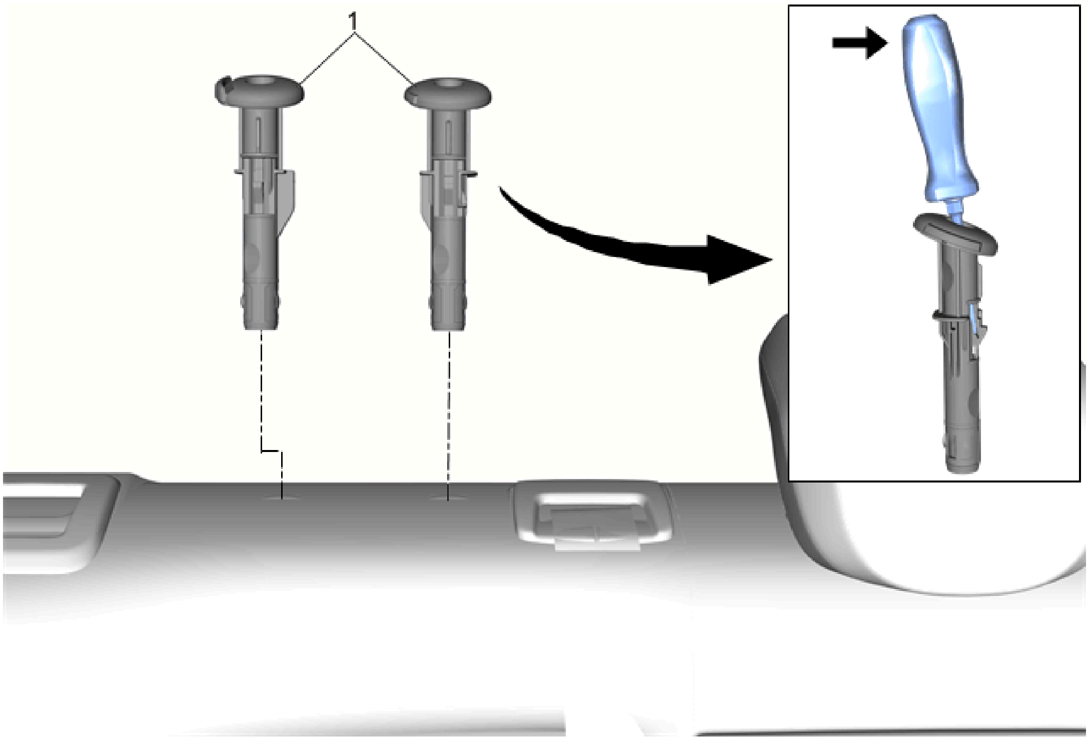


Fig. 40: Rear Seat Head Restraint Guide
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Procedure Rear Seat Head Restraint Replacement	
1	Rear Seat Head Restraint Guide **Procedure** Using a suitable flat-bladed tool, slide the tool on the inside of the guide until it finds the slot. Then push the tool forward pulling the guide tab inward, while pulling upward to remove the guide from the seat back frame.

REAR SEAT BACK HOOK REPLACEMENT (BOLSTER)

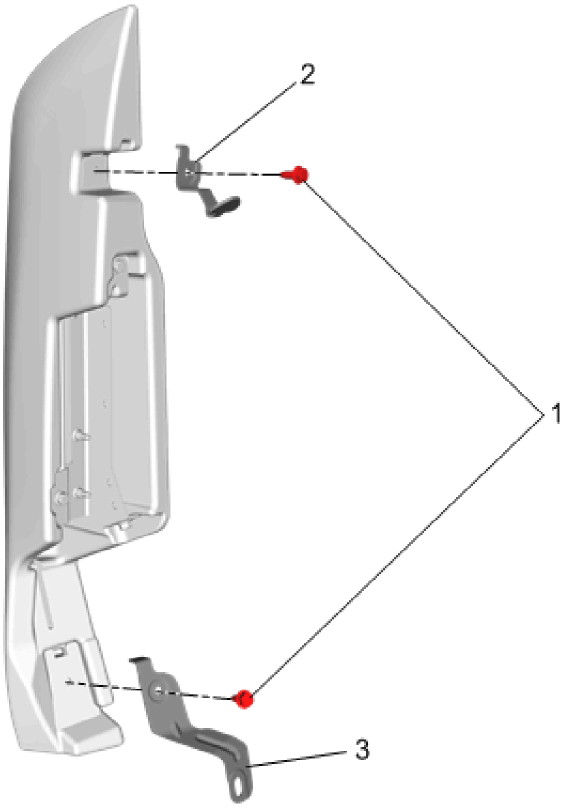


Fig. 41: Rear Seat Back Hook (Bolster)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **SIR Warning** **Preliminary Procedures** 1. Disable the SIR system. **SIR Disabling and Enabling** 2. **Rear Seat Back Side Cushion Cover Replacement**	
1	Rear Seat Back Bolster Bracket Bolt **CAUTION:** **Fastener Caution** **Tighten** 8 N.m (71 lb in)
2	Rear Seat Back Bolster Upper Bracket
3	Rear Seat Back Bolster Lower Bracket **Procedure** Enable the SIR System. **SIR Disabling and Enabling**

REAR SEAT BACK BOLSTER REPLACEMENT

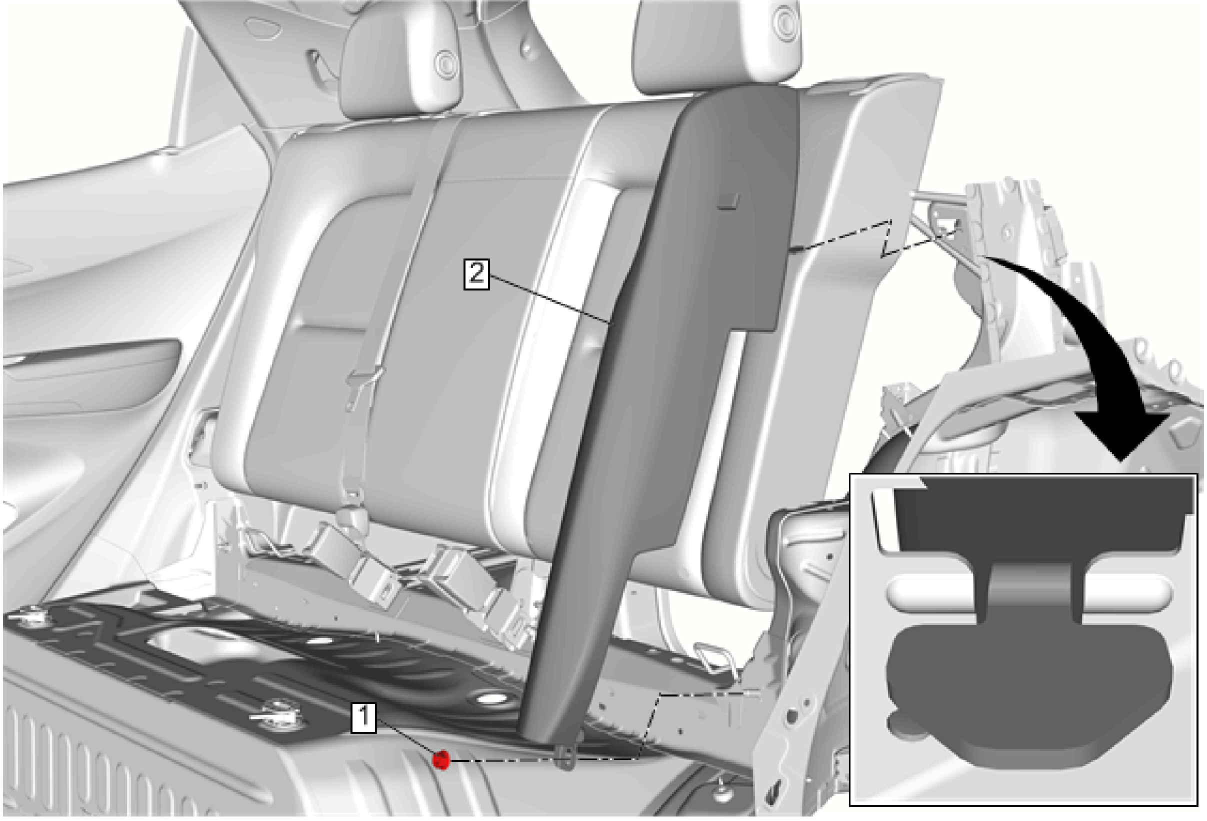


Fig. 42: Rear Seat Back Bolster
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedures** 1. Disable the SIR system. SIR Disabling and Enabling 2. Rear Seat Cushion Removal and Installation	
1	Rear Seat Back Bolster Nut **CAUTION:** Fastener Caution **Tighten** 22 N.m (16 lb ft)
2	Rear Seat Back Bolster **Procedure** Enable the SIR System. SIR Disabling and Enabling

REAR SEAT BACK SIDE CUSHION COVER REPLACEMENT

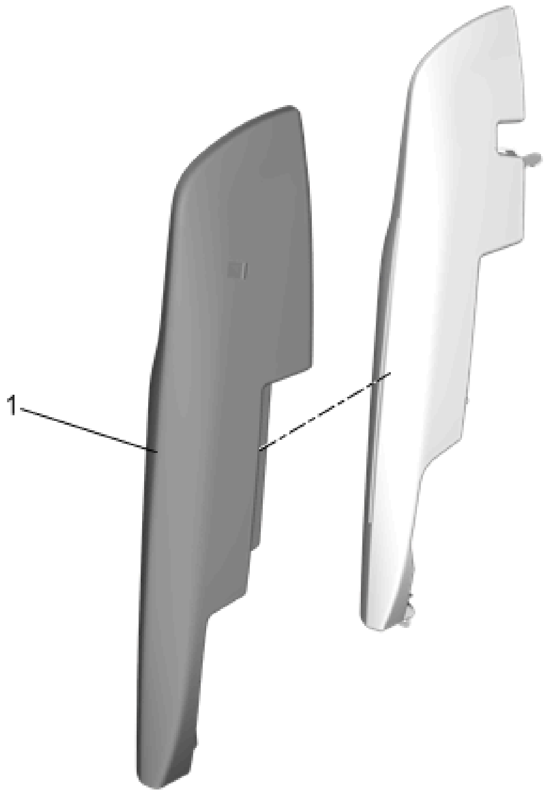


Fig. 43: Rear Seat Back Side Cushion Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedures** 1. Disable the SIR system. SIR Disabling and Enabling 2. Rear Seat Bolster Airbag Replacement 3. Rear Seat Back Hook Replacement (Bolster)	
1	Rear Seat Back Side Cushion Cover **Procedure** 1. Cut the hog rings retaining the cover to the frame and remove. 2. Separate the seat back cushion bolster cover from the bolster. 3. Enable the SIR System. SIR Disabling and Enabling

REAR SEAT CENTER HEAD RESTRAINT REPLACEMENT

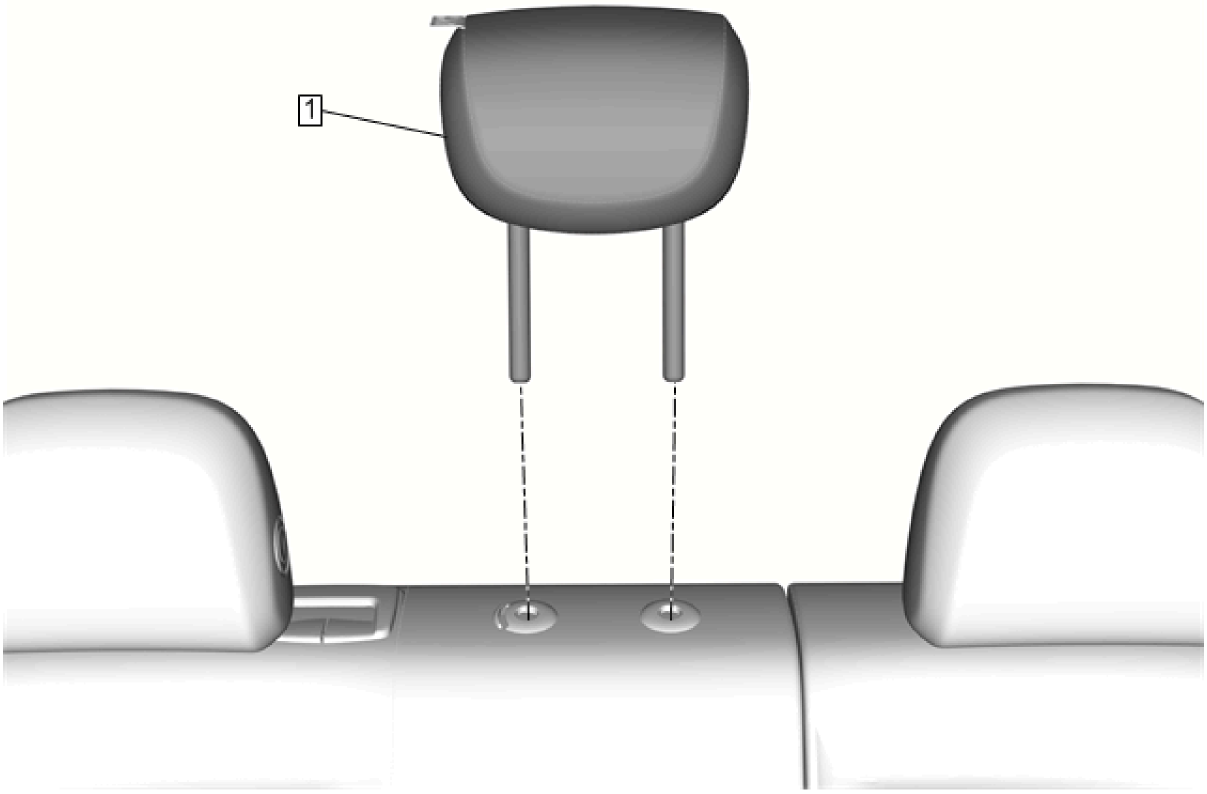


Fig. 44: Rear Seat Center Head Restraint

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Center Head Restraint **Procedure** Depress both buttons on the head restraint guides and pull upward to remove the head restraint from the seat.

REAR SEAT CUSHION COVER AND PAD REPLACEMENT

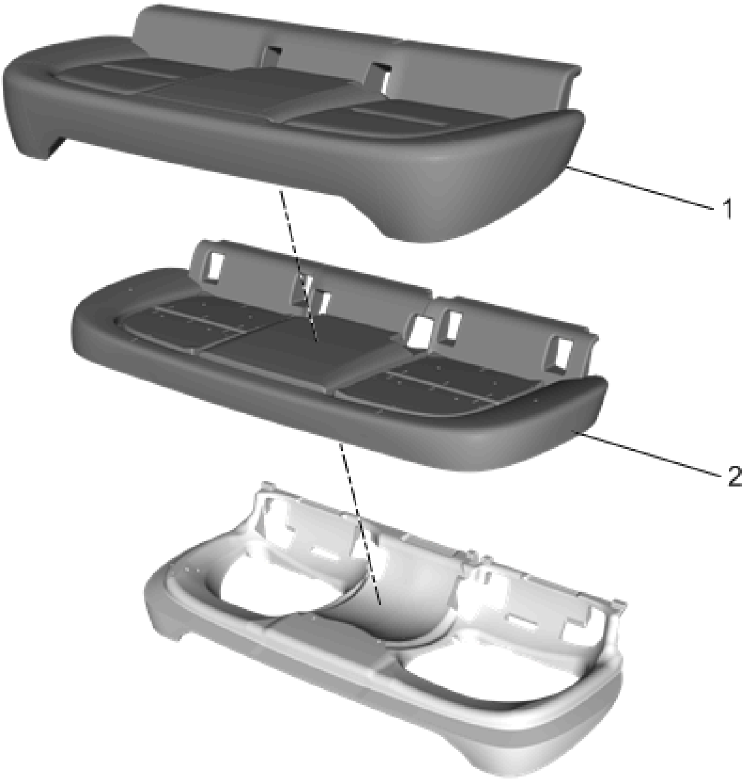


Fig. 45: Rear Seat Cushion Cover and Pad

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Cushion Removal and Installation	
1	Rear Seat Cushion Cover **Procedure** Remove the hog rings, disconnect the j-channel retainer, and remove the push-in retainers that secure the rear seat cushion cover to the pad.
2	Rear Seat Cushion Pad

REAR SEAT CUSHION REMOVAL AND INSTALLATION

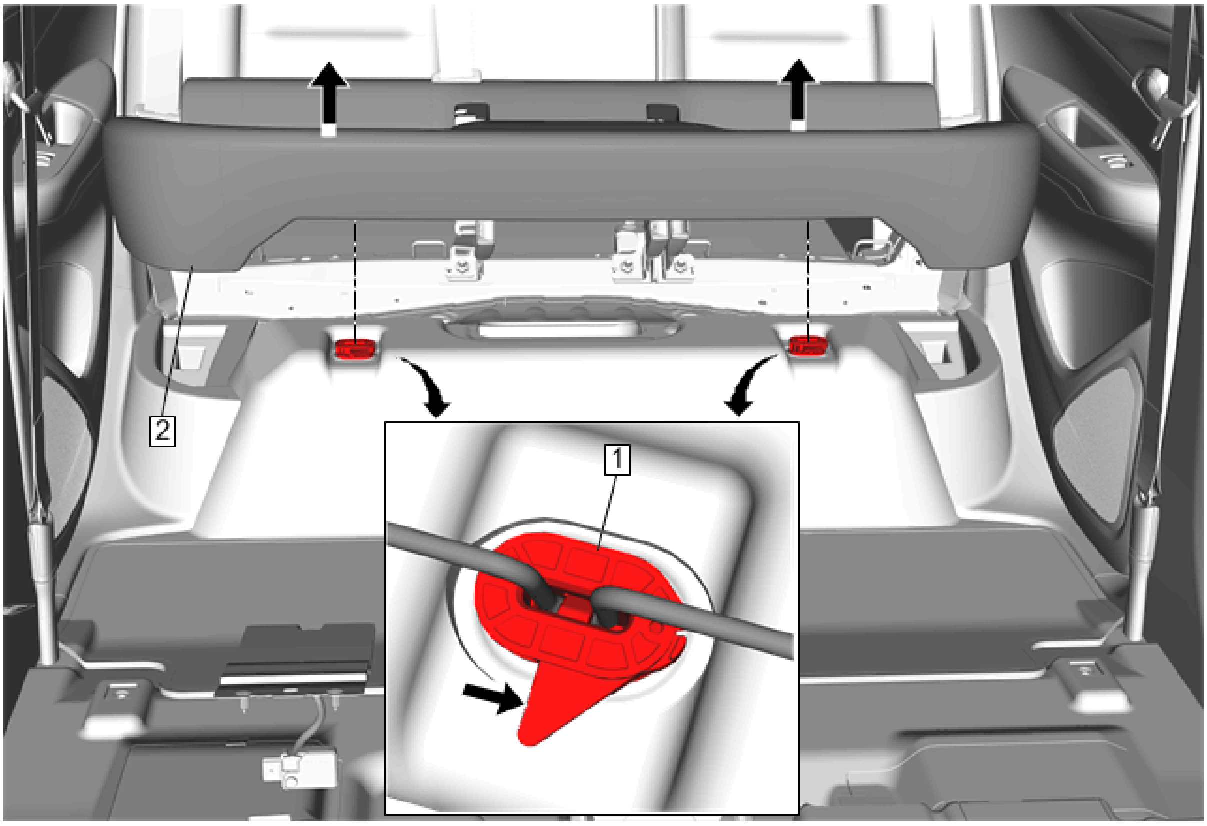


Fig. 46: Rear Seat Cushion
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Push pin in the slot on mini-buckle to disengage the rear center seat belt retractor from rear center seat belt buckle - Rear Center Seat Belt Retractor Replacement	
1	Rear Seat Cushion Clip **Procedure** Release the cushion clip tab.
2	Rear Seat Cushion **Procedure** 1. If equipped, disconnect the electrical connectors. 2. Pull up on the front of the seat cushion and lift out of the vehicle.

REAR SEAT CUSHION FRAME REPLACEMENT

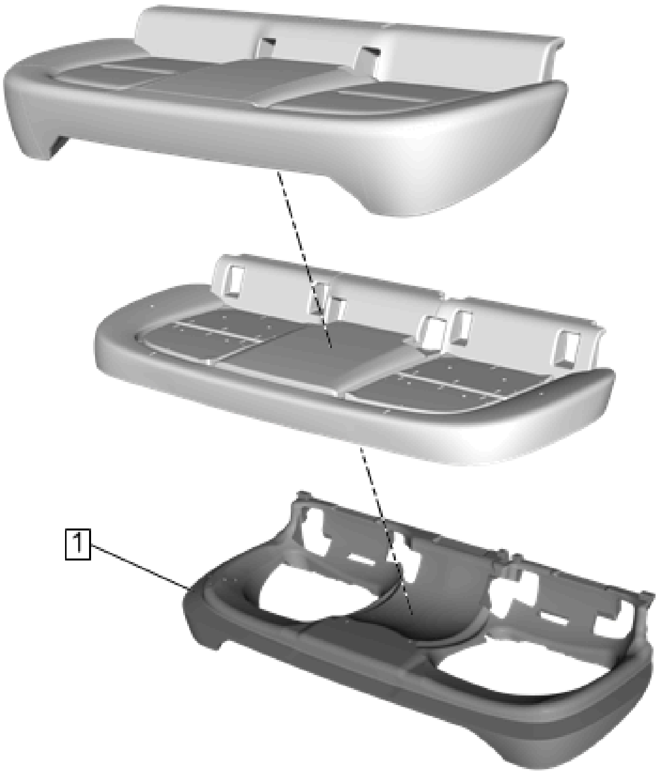


Fig. 47: Rear Seat Cushion Frame
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Cushion Cover and Pad Replacement **NOTE:** **Remove cover and pad as an assembly. Please do not separate them.**	
1	Rear Seat Cushion Frame **Procedure** Transfer components as necessary.

REAR SEAT BACK CUSHION LATCH REPLACEMENT

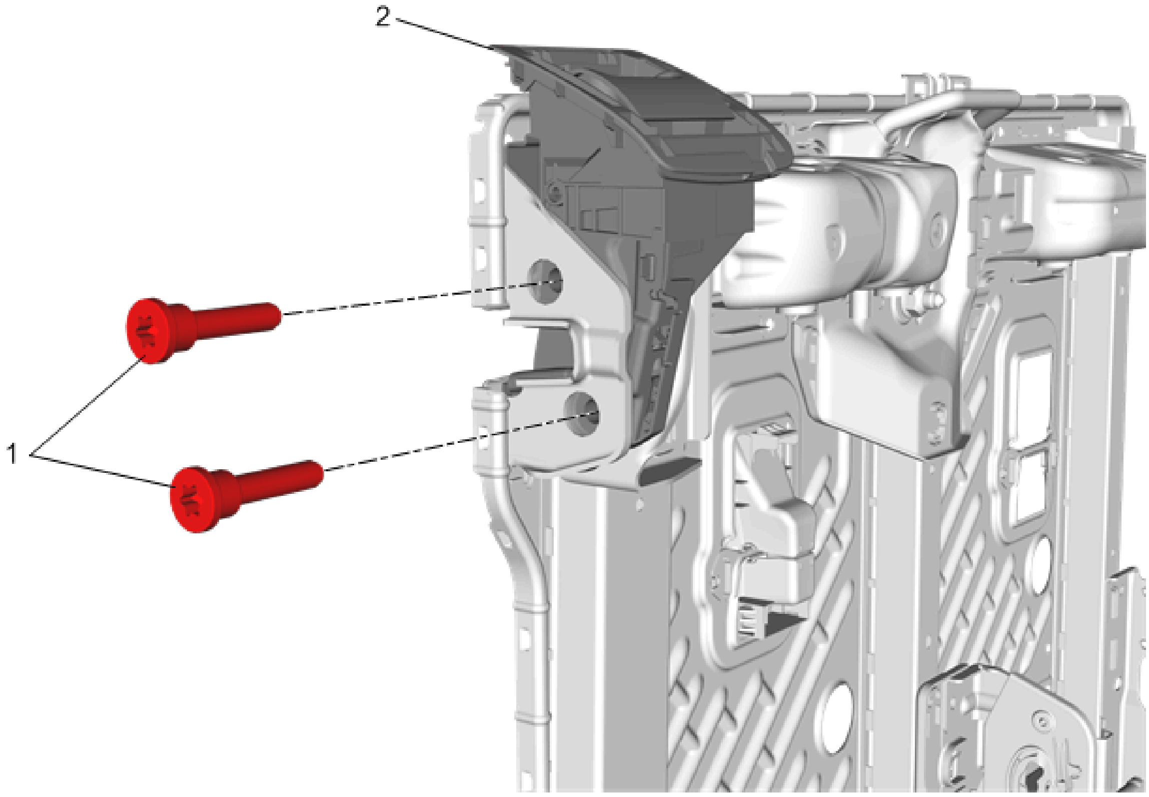


Fig. 48: Rear Seat Back Cushion Latch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Back Cushion Cover and Pad Replacement (60%)Rear Seat Back Cushion Cover and Pad Replacement (with Armrest, 60%)Rear Seat Back Cushion Cover and Pad Replacement (40%) **NOTE:** **Remove cover and pad as an assembly. Please do not separate them.**	
1	Rear Seat Back Latch Fastener **CAUTION:** Fastener Caution **Tighten** 40 N.m (30 lb ft)
2	Rear Seat Back Cushion Latch **Procedure** Remove the cloth covering the latch.

REAR SEAT BACK CUSHION REMOVAL AND INSTALLATION (40%)

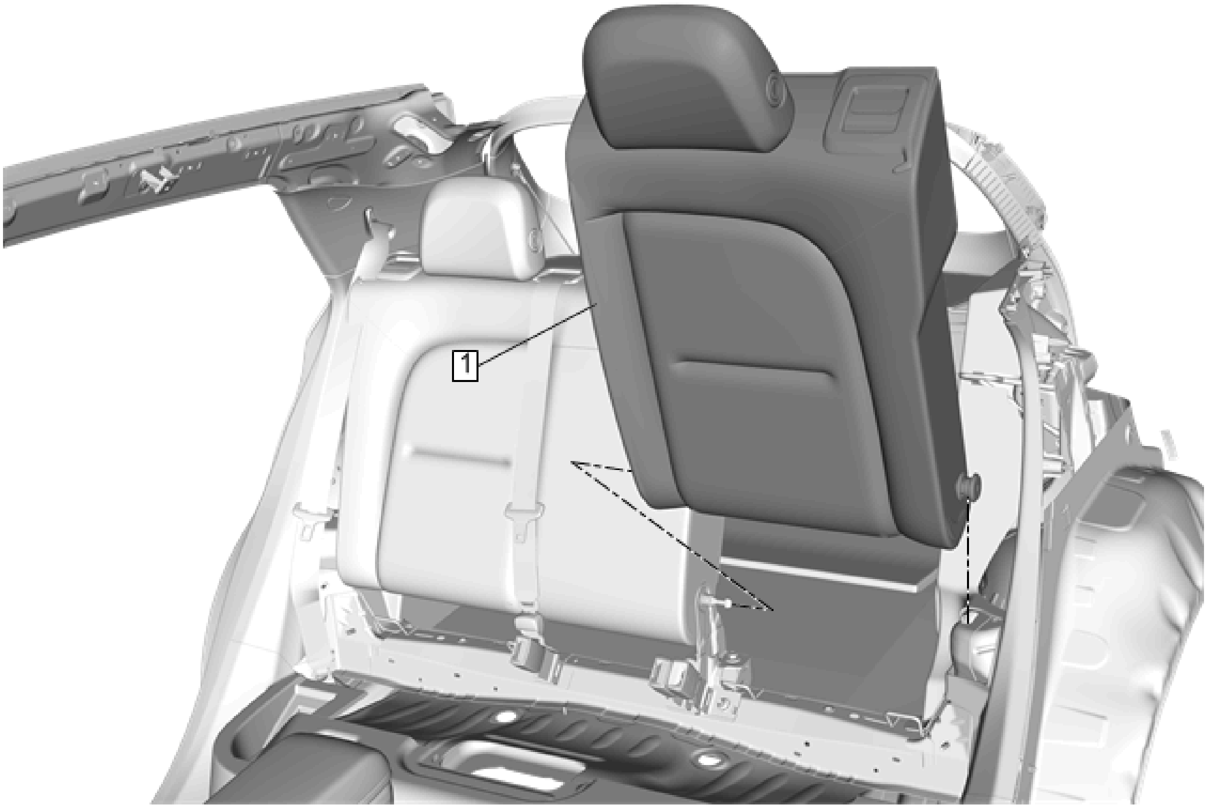


Fig. 49: Rear Seat Back Cushion (40%)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Back Bolster - Left Side - Remove - Rear Seat Back Bolster Replacement	
1	Rear Seat Back Cushion 1. Fold the rear seat back cushion assembly forward. 2. Pull up on the outer side of the rear seat back cushion and remove the rear seat back cushion from the bracket and hinge.

REAR SEAT BACK CUSHION REMOVAL AND INSTALLATION (60%)

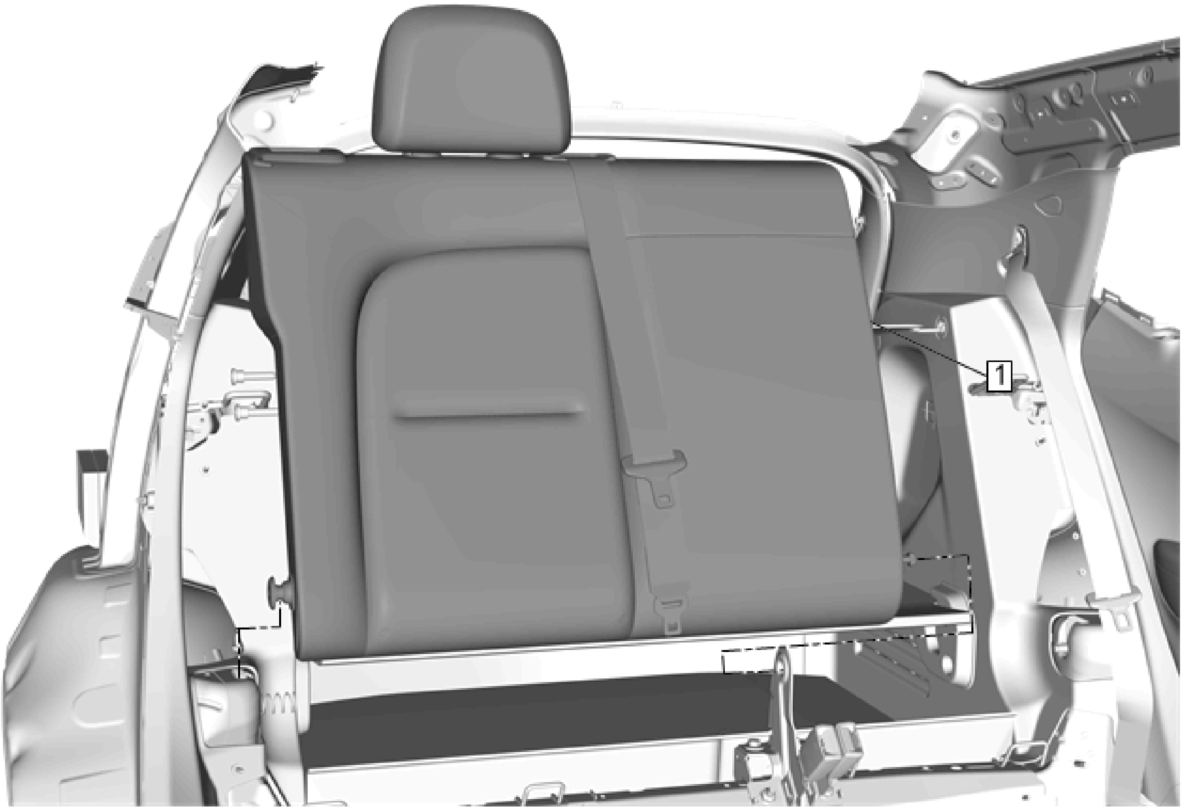


Fig. 50: Rear Seat Back Cushion (60%)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Rear Seat Back Cushion - 40 Percent Seat - Remove - Rear Seat Back Cushion Removal and Installation (40%) 2. Rear Seat Back Bolster - Right Side - Remove - Rear Seat Back Bolster Replacement 3. Rear Center Seat Belt Retractor - Disengage - Rear Center Seat Belt Retractor Replacement	
1	Rear Seat Back Cushion 1. Fold the rear seat back cushion assembly forward. 2. Pull up on the outer side of the rear seat back cushion and remove the rear seat back cushion from the bracket and hinge.

REAR SEAT BELT OPENING COVER REPLACEMENT

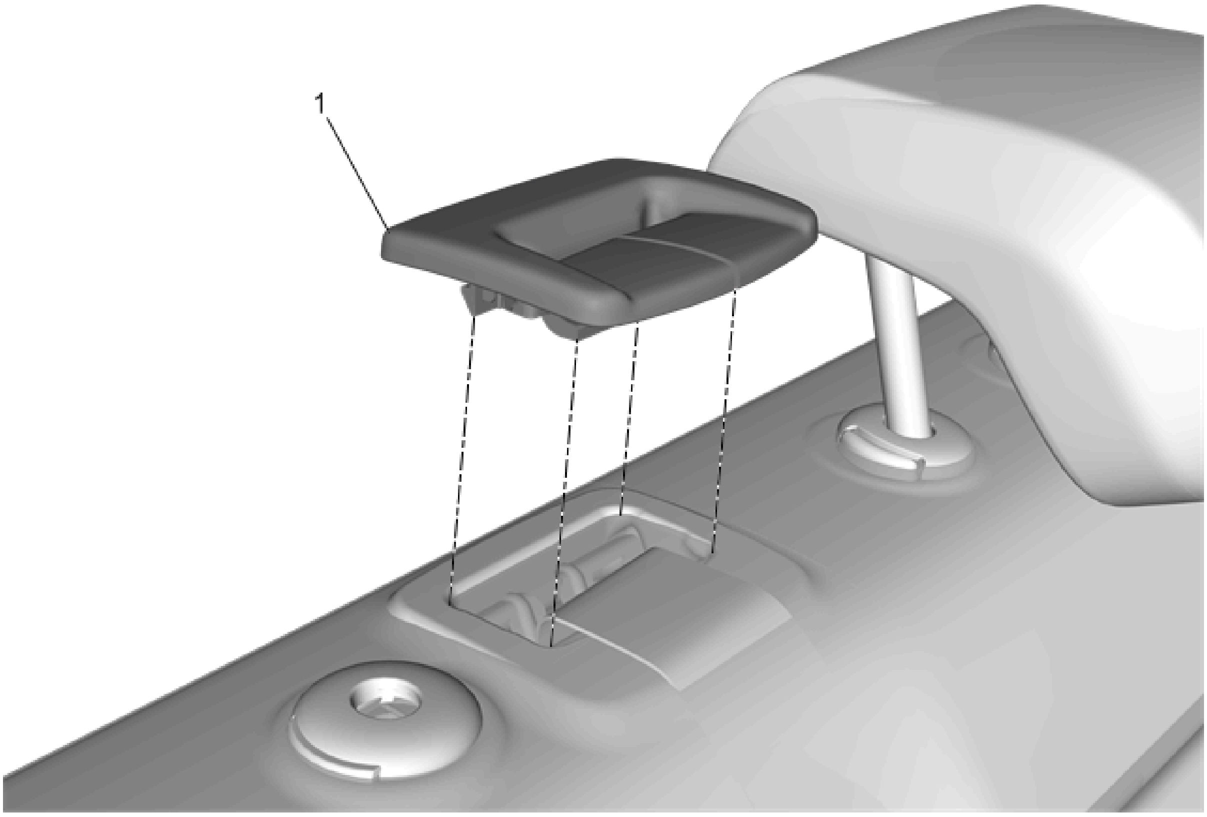


Fig. 51: Rear Seat Belt Opening Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Belt Opening Cover **Procedure** Using a suitable flat-bladed tool, release rear seat belt opening cover.

REAR SEAT BACK CUSHION COVER AND PAD REPLACEMENT (60%)

Removal Procedure

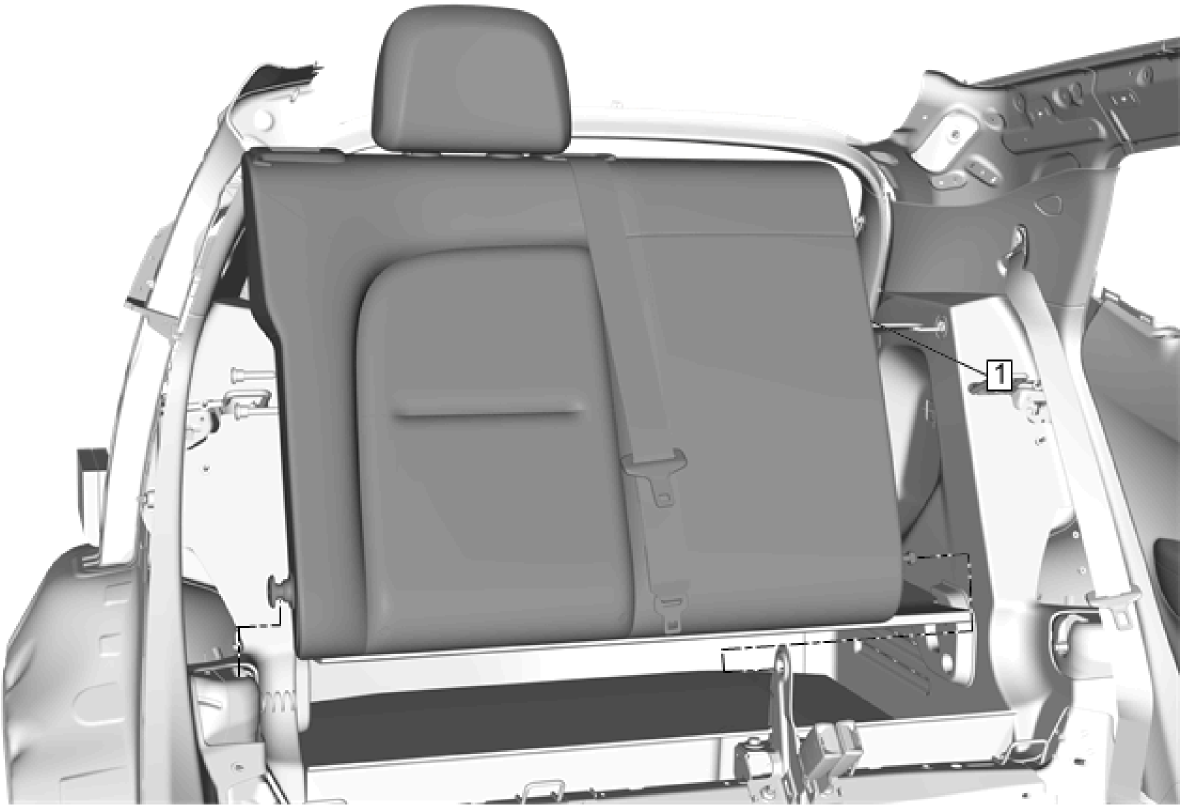


Fig. 52: Rear Seat Back Cushion (60%)
Courtesy of GENERAL MOTORS COMPANY

1. Rear Seat Back Cushion - Remove - **Rear Seat Back Cushion Removal and Installation (60%)**

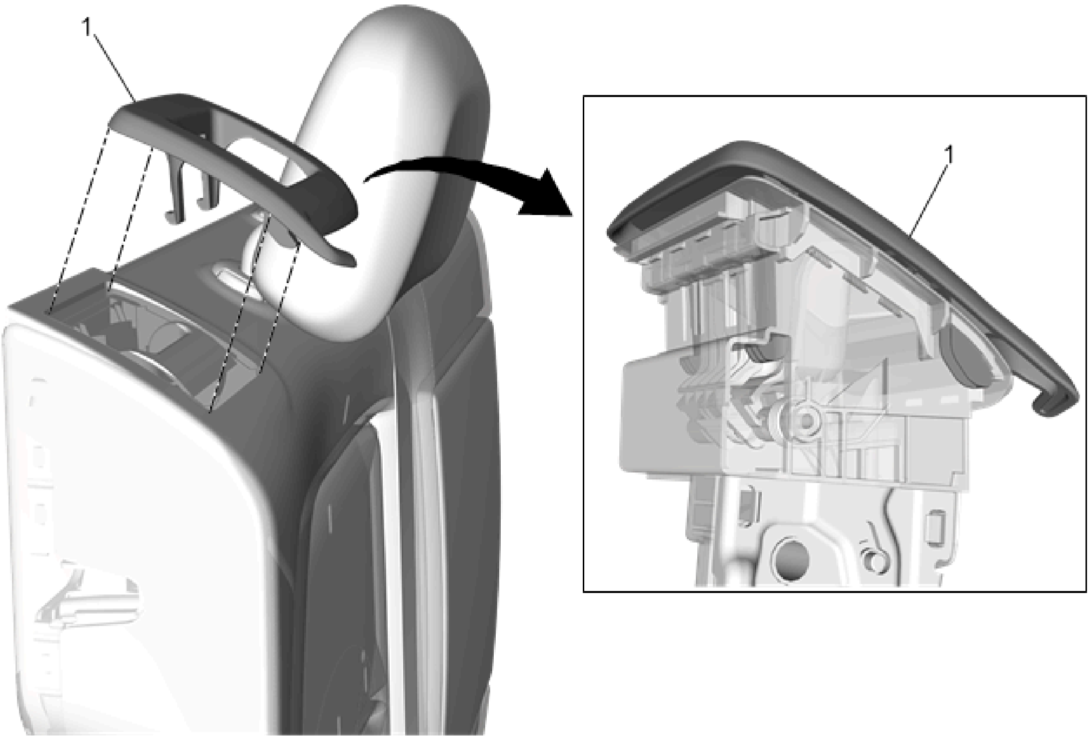


Fig. 53: Rear Seat Back Cushion Latch Release Handle Bezel (60%)
Courtesy of GENERAL MOTORS COMPANY

2. Rear Seat Back Cushion Latch Release Handle Bezel - Remove - **Rear Seat Back Latch Release Handle Bezel Replacement**

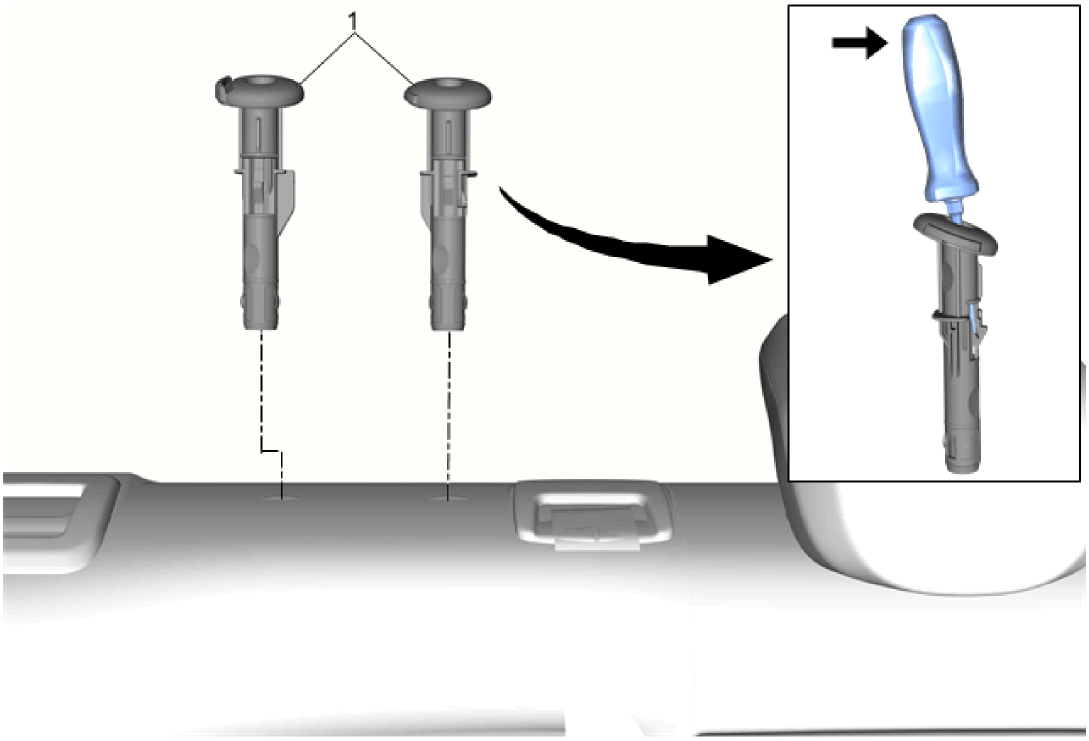


Fig. 54: Rear Seat Head Restraint Guide (60%)
Courtesy of GENERAL MOTORS COMPANY

3. Rear Seat Head Restraint Guide - Remove - **Rear Seat Head Restraint Guide Replacement**

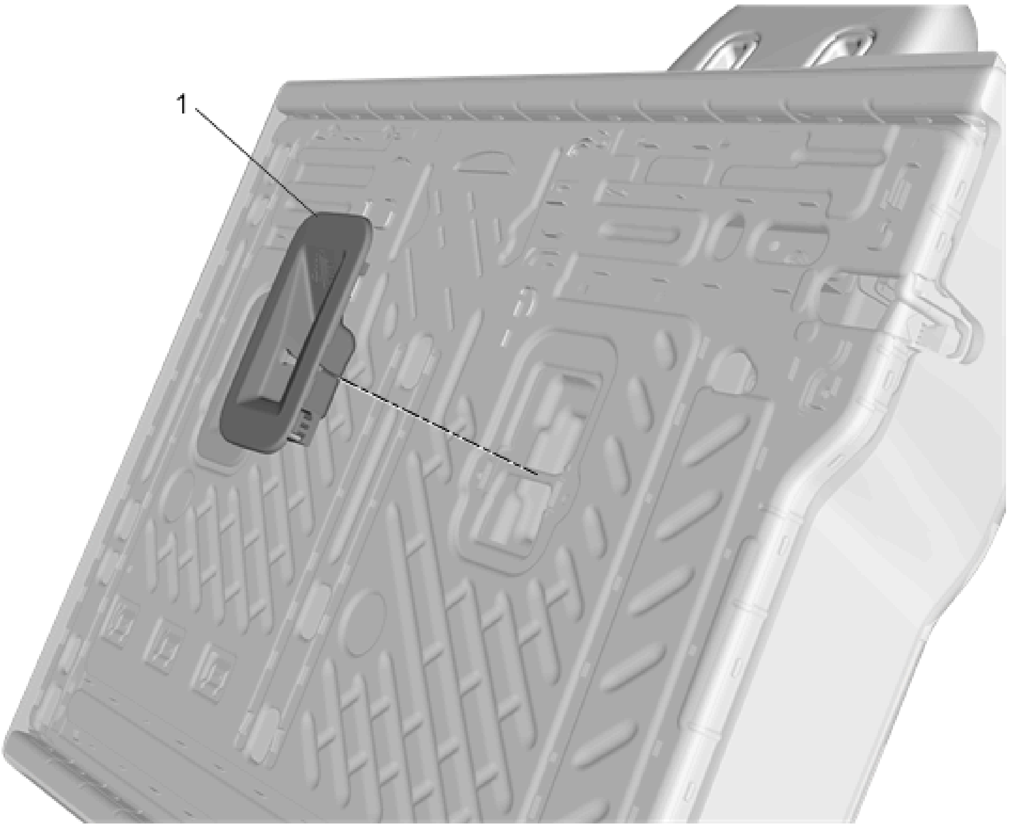


Fig. 55: Rear Seat Anchor Plate Bezel (60%)
Courtesy of GENERAL MOTORS COMPANY

4. Rear Seat Anchor Plate Bezel - Remove - **Rear Seat Anchor Plate Bezel Replacement**

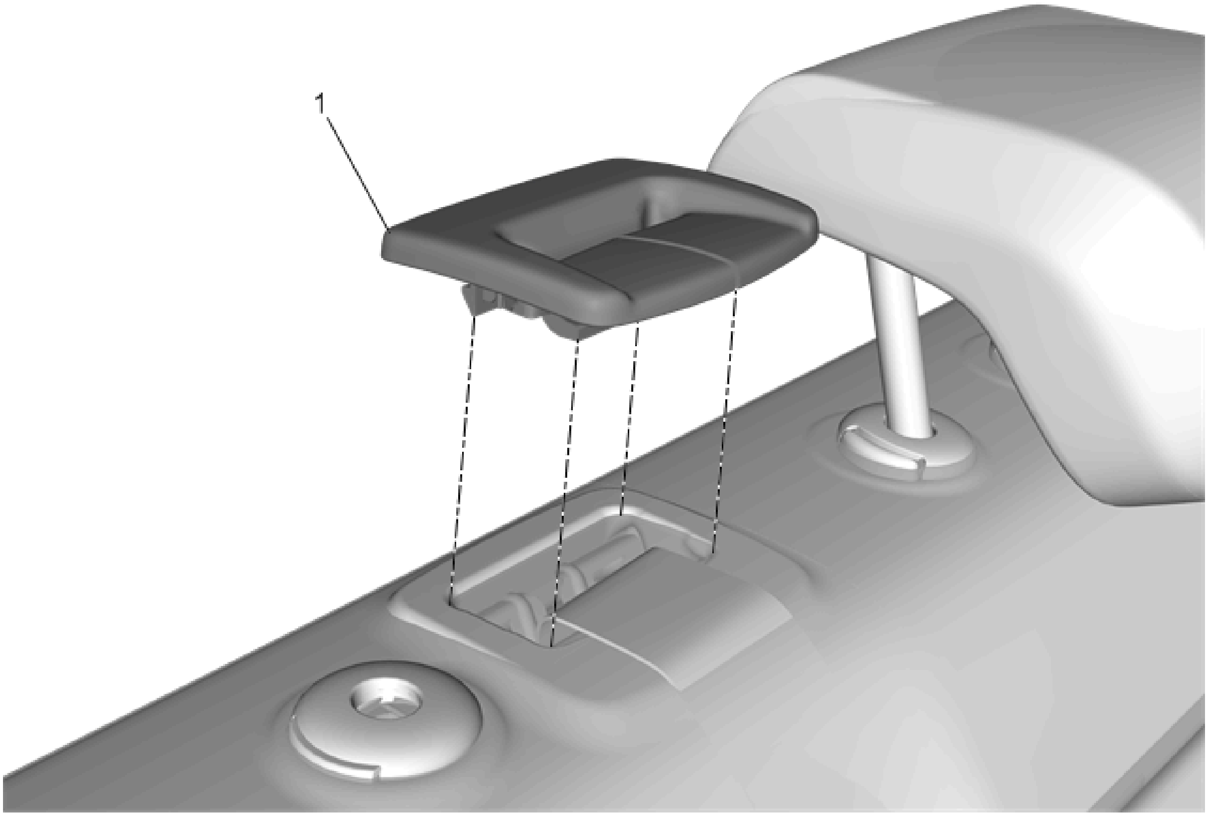


Fig. 56: Rear Seat Belt Opening Cover (60%)
Courtesy of GENERAL MOTORS COMPANY

5. Rear Seat Belt Opening Cover - Remove - Rear Seat Belt Opening Cover Replacement

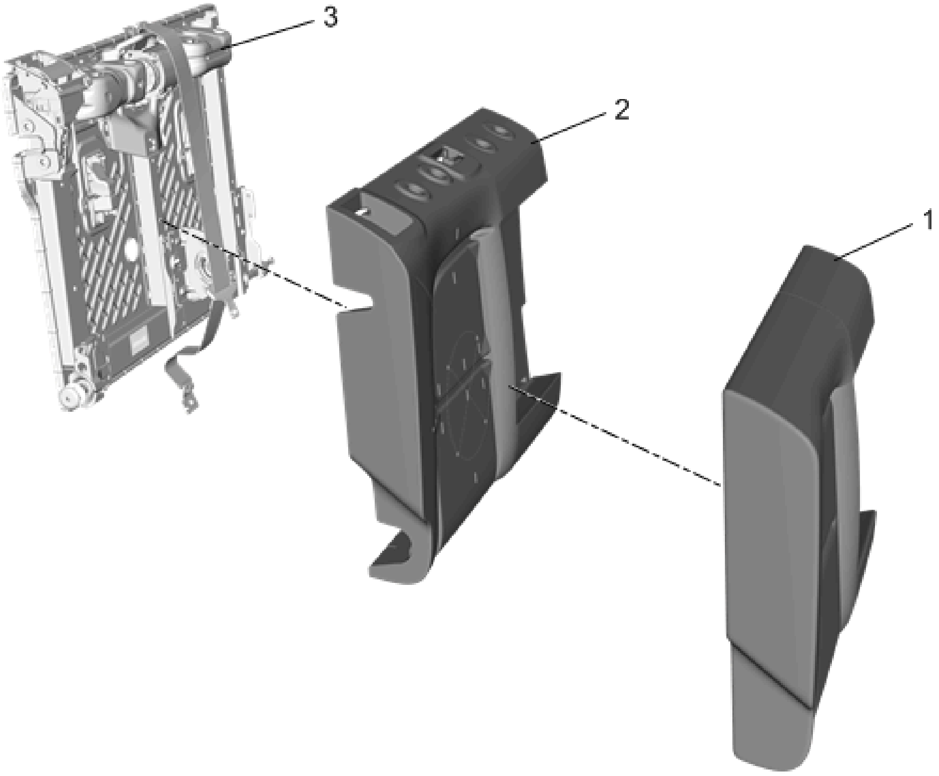


Fig. 57: Seat Back Pad (60%)
Courtesy of GENERAL MOTORS COMPANY

6. Remove the hog rings from the seat back pad.
7. Disconnect the J-channel from the seat back cushion frame.
8. Rear Seat Back Cushion Cover (1) at Rear Seat Back Cushion Pad (2) - Remove
9. Rear Seat Back Cushion Pad (2) at Rear Seat Back Cushion Frame (3) - Remove

Installation Procedure

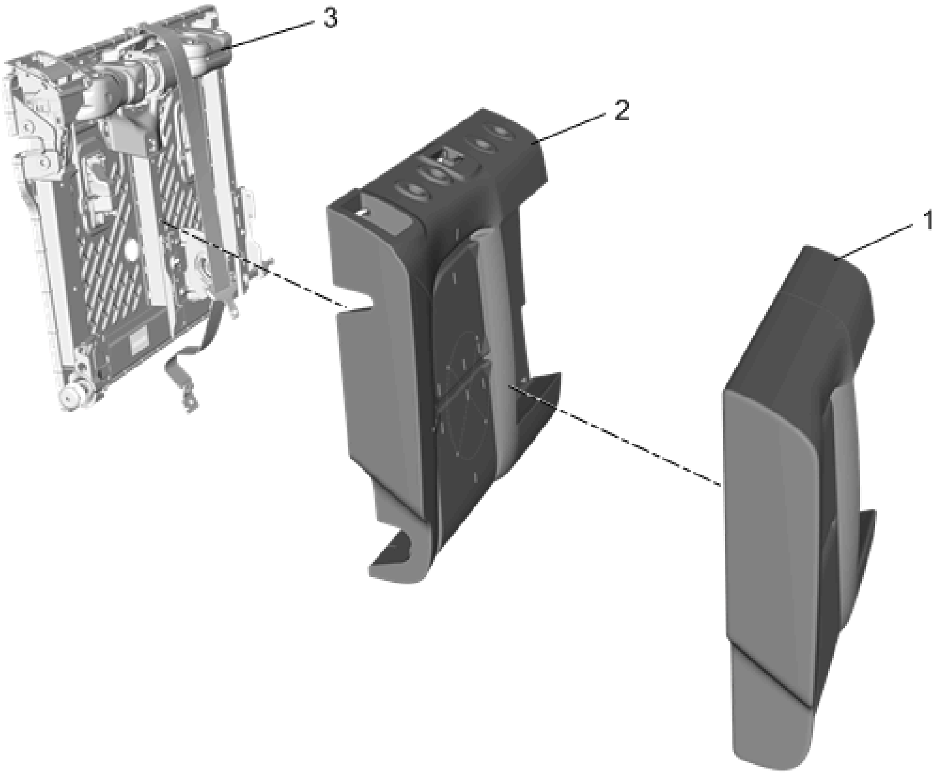


Fig. 58: Seat Back Pad (60%)
Courtesy of GENERAL MOTORS COMPANY

1. Rear Seat Back Cushion Pad (2) at Rear Seat Back Cushion Frame (3) - Install
2. Rear Seat Back Cushion Cover (1) at Rear Seat Back Cushion Pad (2) - Install
3. Connect the J-channel to the rear seat back cushion frame.
4. Install the hog rings to the seat back pad.

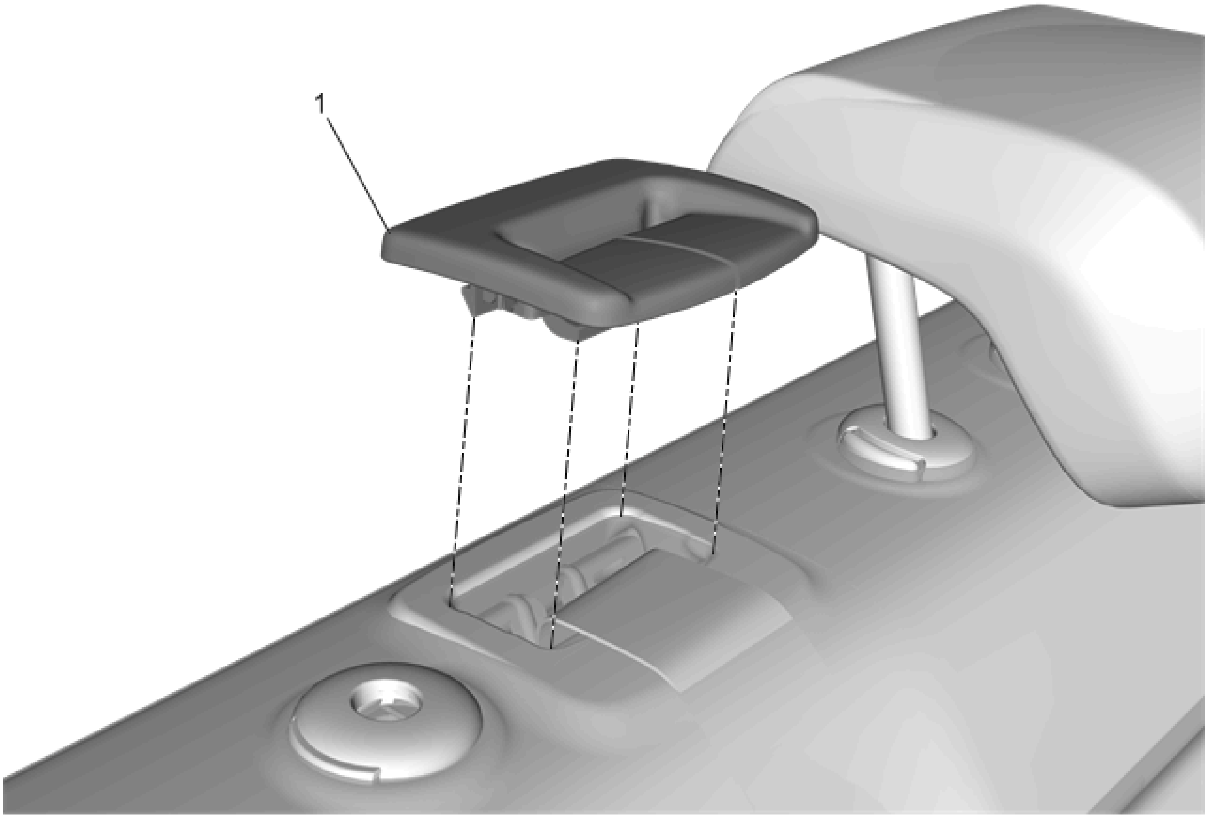


Fig. 59: Rear Seat Belt Opening Cover (60%)
Courtesy of GENERAL MOTORS COMPANY

5. Rear Seat Belt Opening Cover - Install - **Rear Seat Belt Opening Cover Replacement**

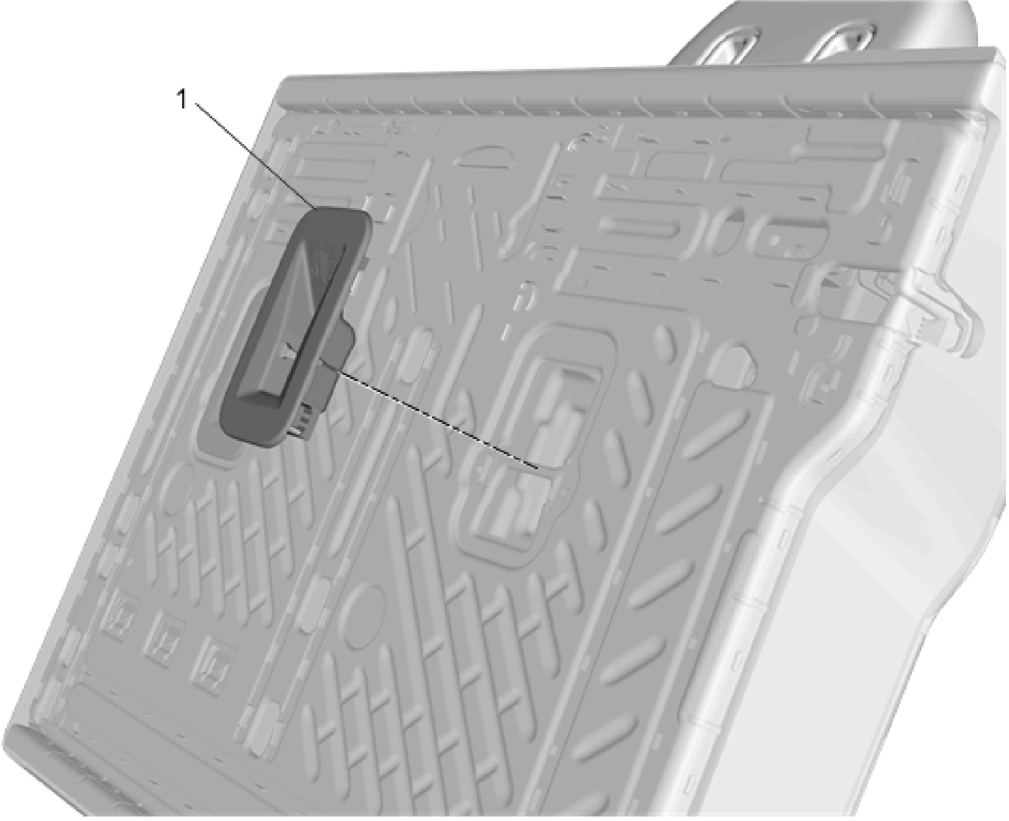


Fig. 60: Rear Seat Anchor Plate Bezel (60%)
Courtesy of GENERAL MOTORS COMPANY

6. Rear Seat Anchor Plate Bezel - Install - **Rear Seat Anchor Plate Bezel Replacement**

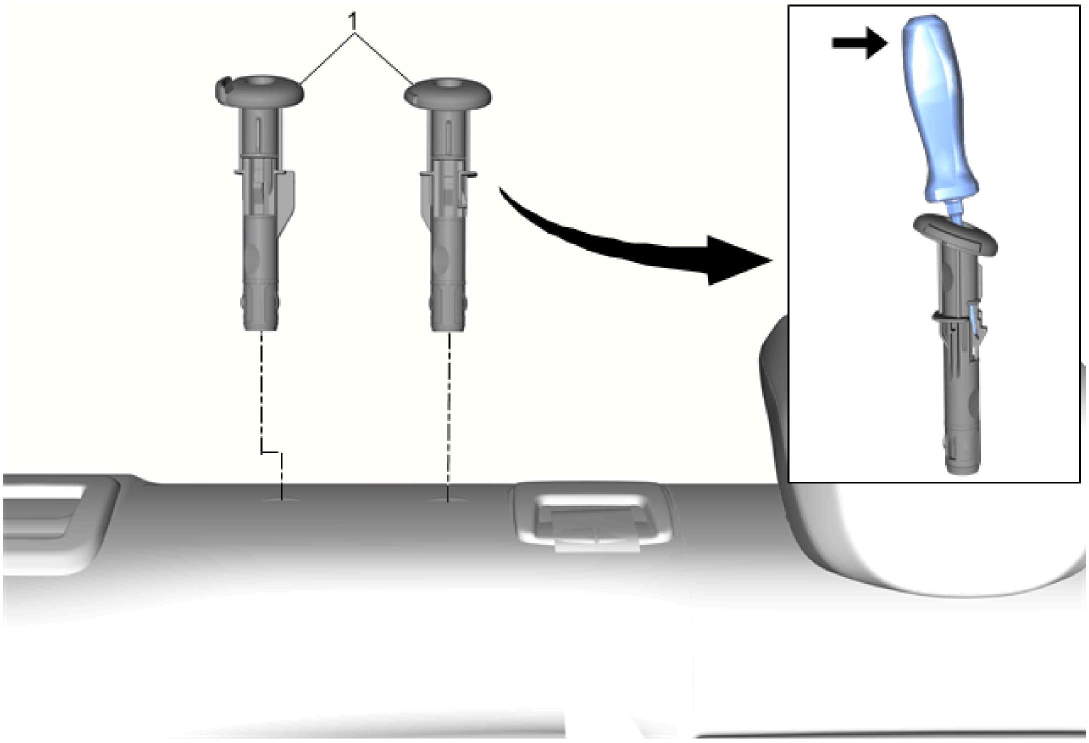


Fig. 61: Rear Seat Head Restraint Guide (60%)
Courtesy of GENERAL MOTORS COMPANY

7. Rear Seat Head Restraint Guide - Install - **Rear Seat Head Restraint Guide Replacement**

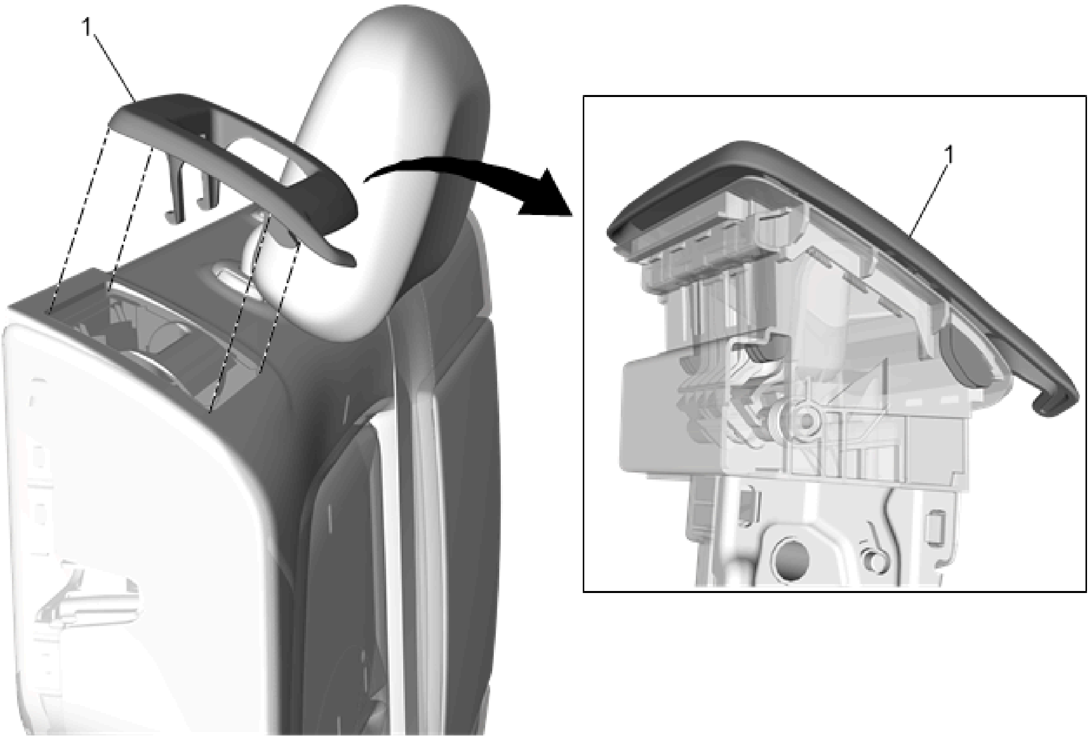


Fig. 62: Rear Seat Back Cushion Latch Release Handle Bezel (60%)
Courtesy of GENERAL MOTORS COMPANY

8. Rear Seat Back Cushion Latch Release Handle Bezel - Install - **Rear Seat Back Latch Release Handle Bezel Replacement**

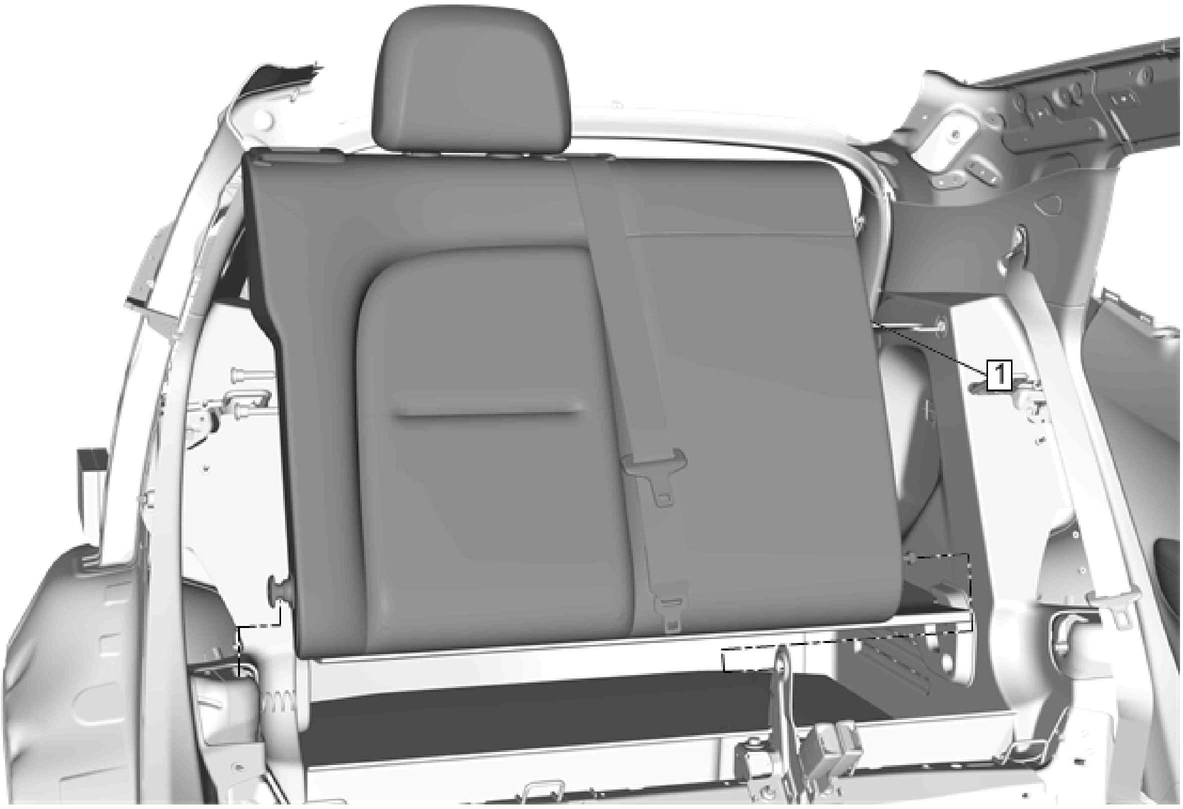


Fig. 63: Rear Seat Back Cushion (60%)
Courtesy of GENERAL MOTORS COMPANY

9. Rear Seat Back Cushion - Install - **Rear Seat Back Cushion Removal and Installation (60%)**

REAR SEAT BACK CUSHION COVER AND PAD REPLACEMENT (WITH ARMREST, 60%)

Removal Procedure

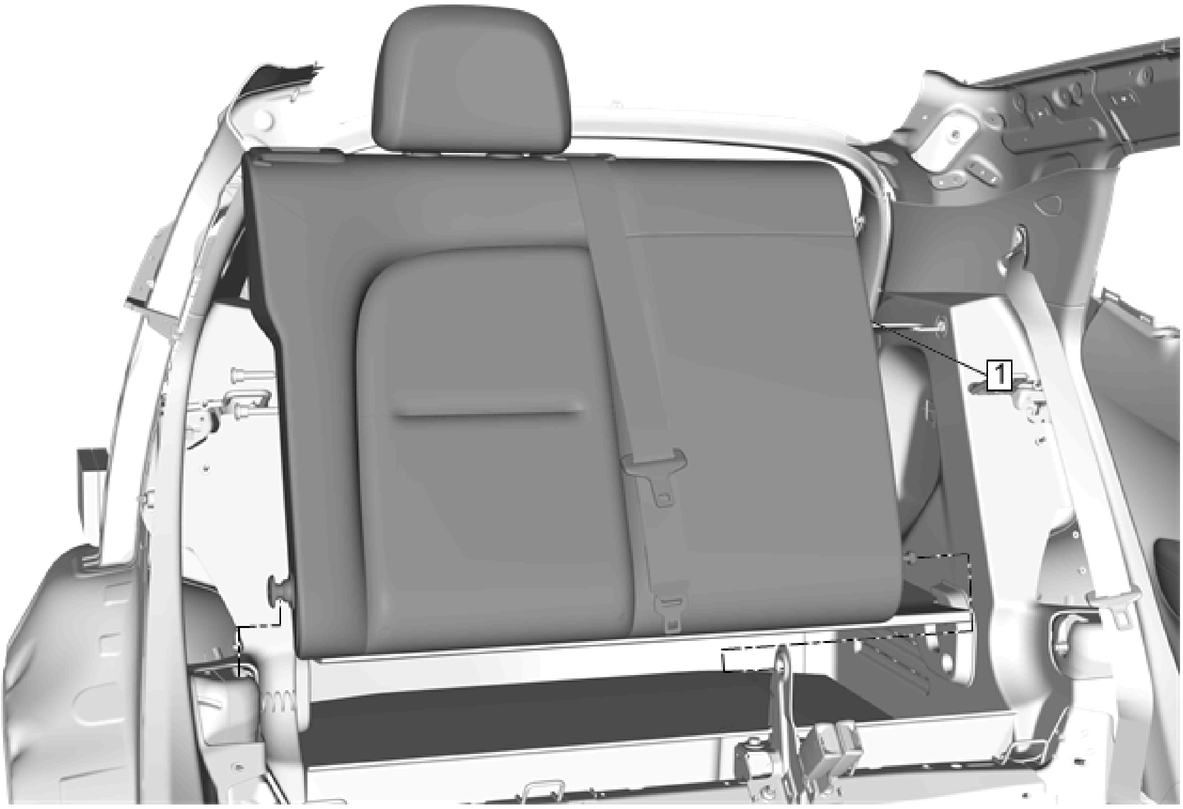


Fig. 64: Rear Seat Back Cushion (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

1. Rear Seat Back Cushion - Remove - Rear Seat Back Cushion Removal and Installation (60%)

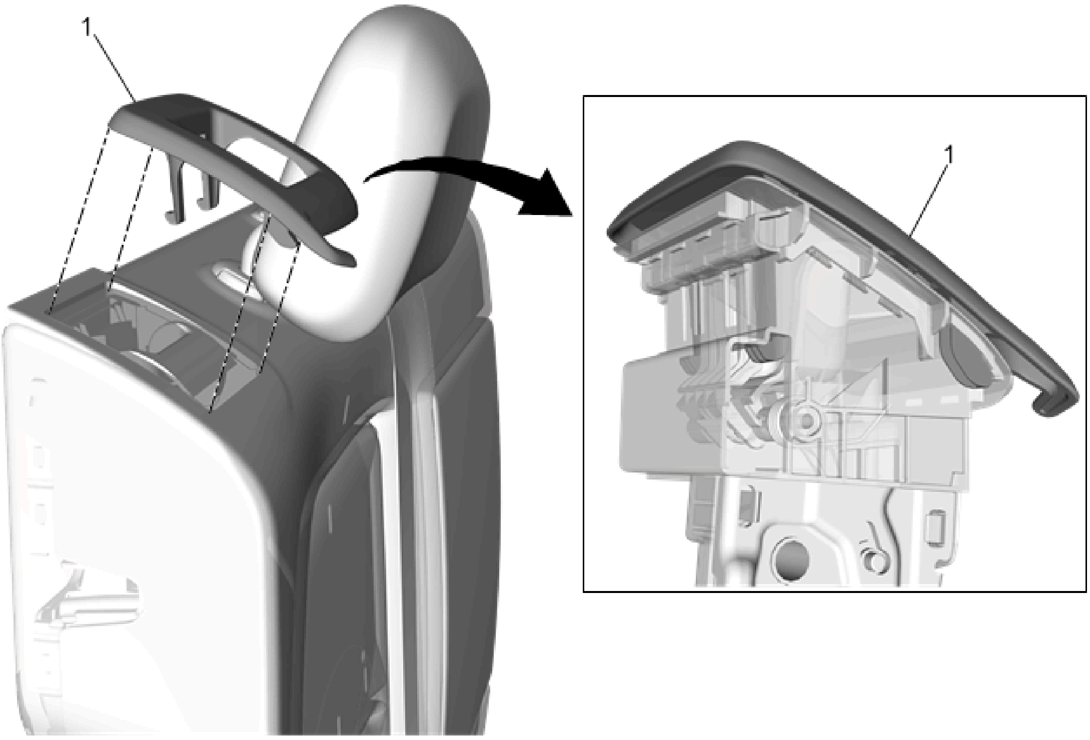


Fig. 65: Rear Seat Back Cushion Latch Release Handle Bezel (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

2. Rear Seat Back Cushion Latch Release Handle Bezel - Remove - Rear Seat Back Latch Release Handle Bezel Replacement

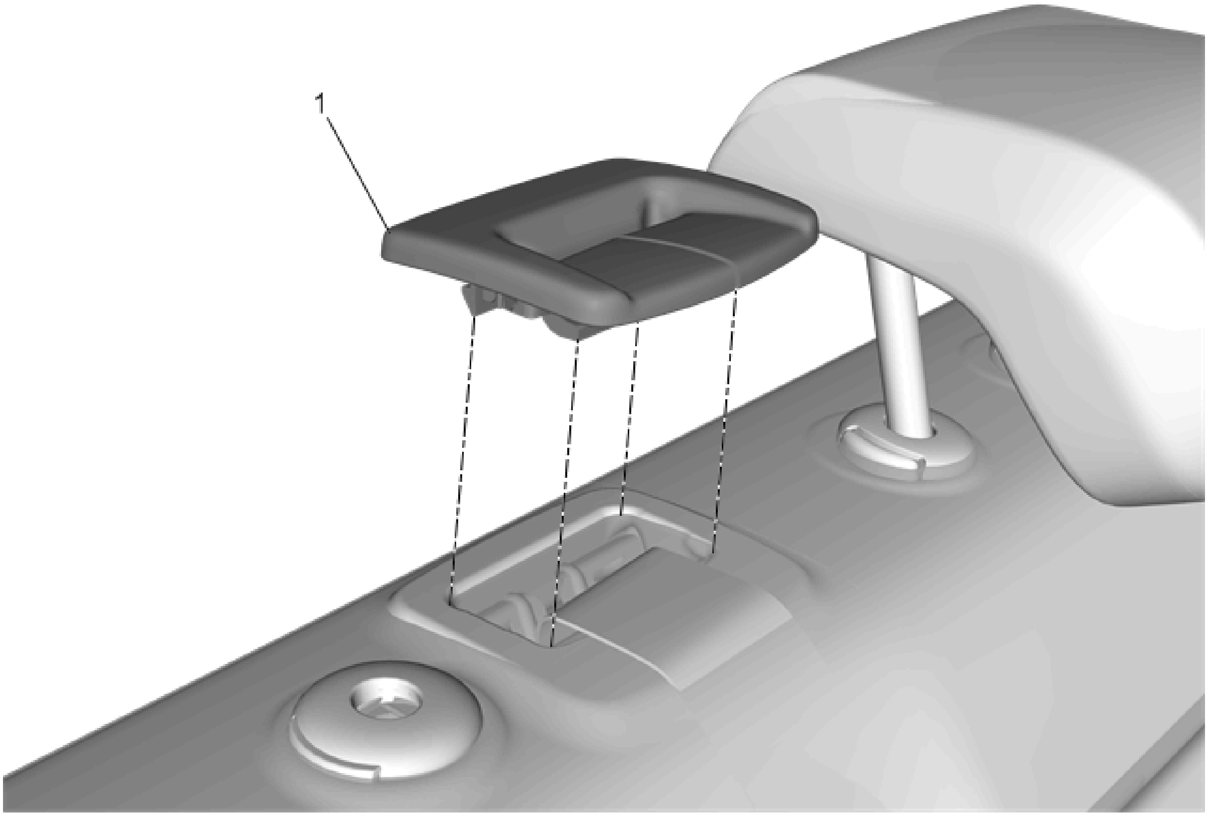


Fig. 66: Rear Seat Belt Opening Cover (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

3. Rear Seat Belt Opening Cover - Remove - **Rear Seat Belt Opening Cover Replacement**

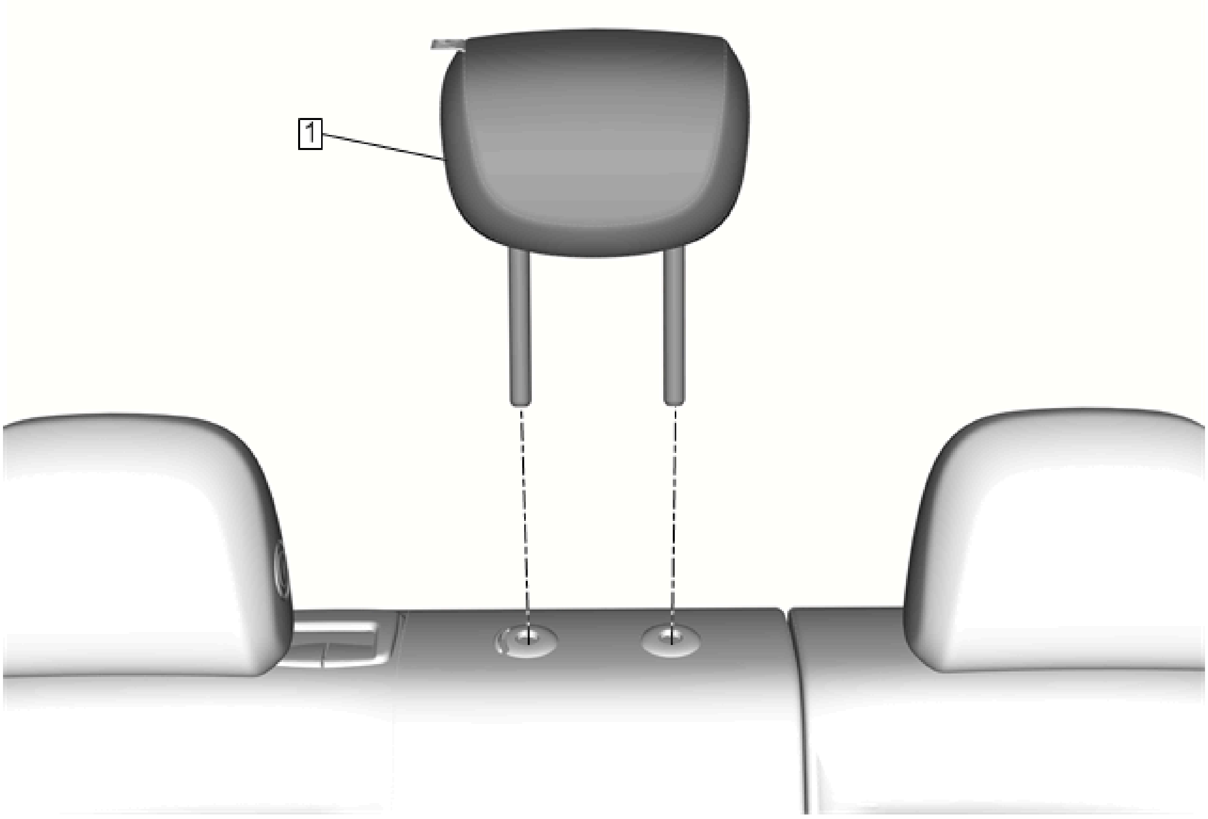


Fig. 67: Rear Seat Center Head Restraint (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

4. {If equipped} Rear Seat Center Head Restraint - Remove - **Rear Seat Center Head Restraint Replacement**

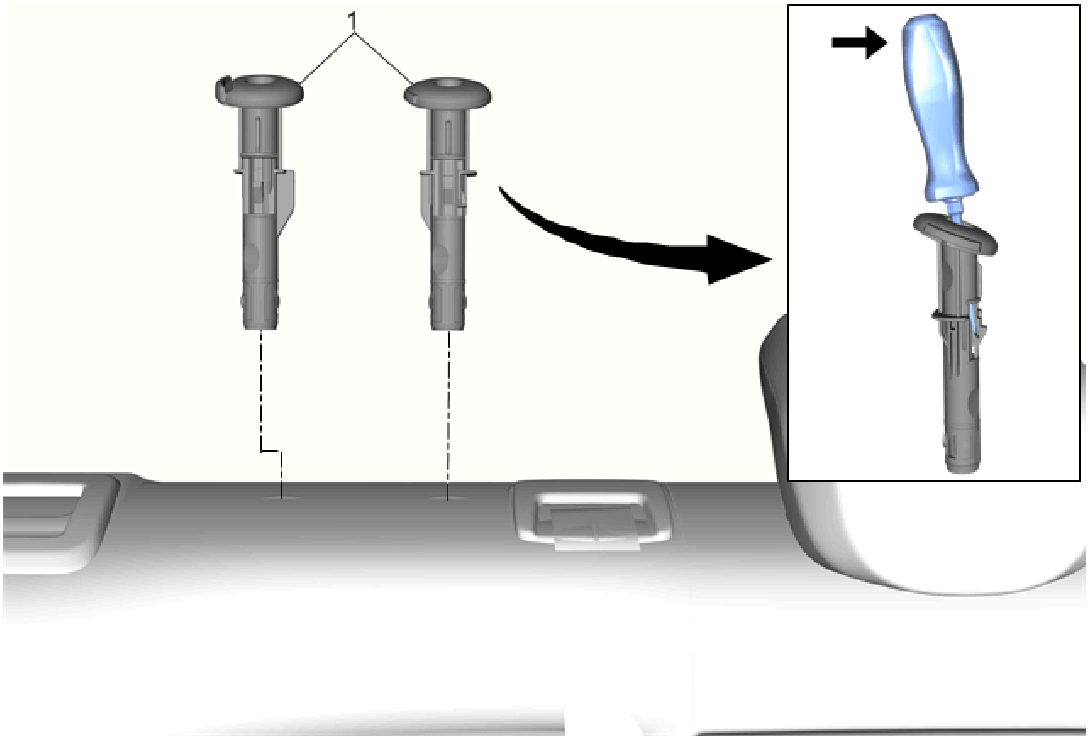


Fig. 68: Rear Seat Head Restraint Guide (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

5. Rear Seat Head Restraint Guide - Remove - Rear Seat Head Restraint Guide Replacement

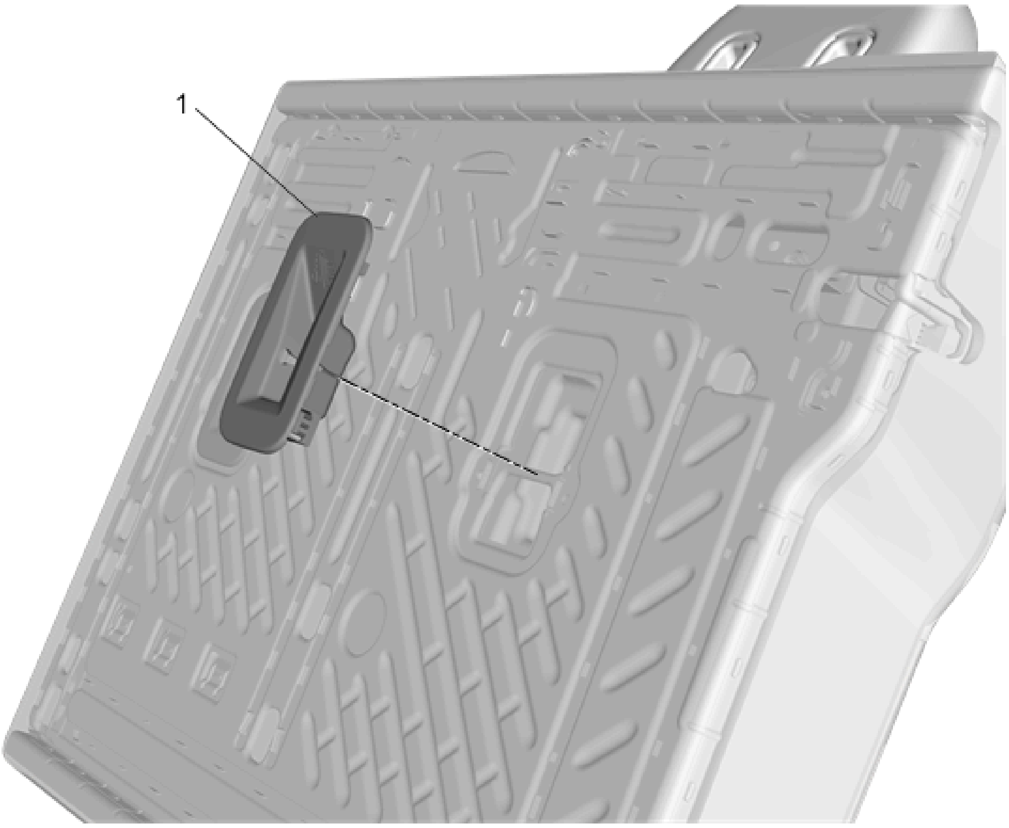


Fig. 69: Rear Seat Anchor Plate Bezel (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

6. Rear Seat Anchor Plate Bezel - Remove - Rear Seat Anchor Plate Bezel Replacement

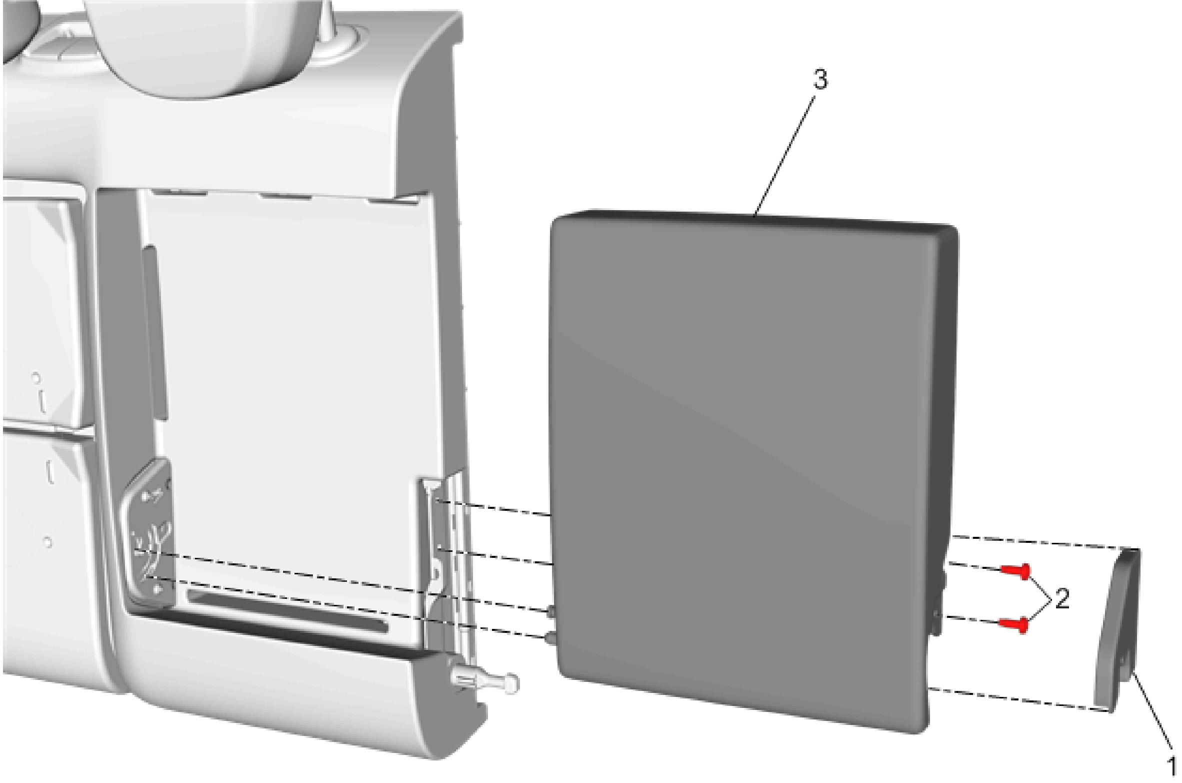


Fig. 70: Rear Seat Armrest (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

7. Rear Seat Armrest - Remove - Rear Seat Armrest Replacement
8. Unzip the cover on both sides.

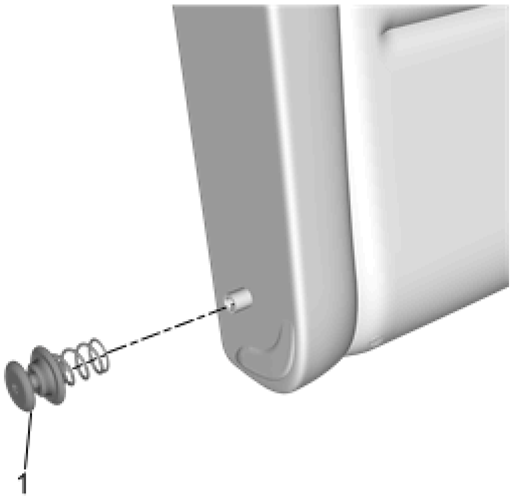


Fig. 71: Rear Seat Back Outer Pivot Bolt, Spring And Bushing Assembly (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

9. Remove the rear seat back outer pivot bolt, spring and bushing assembly. (1)

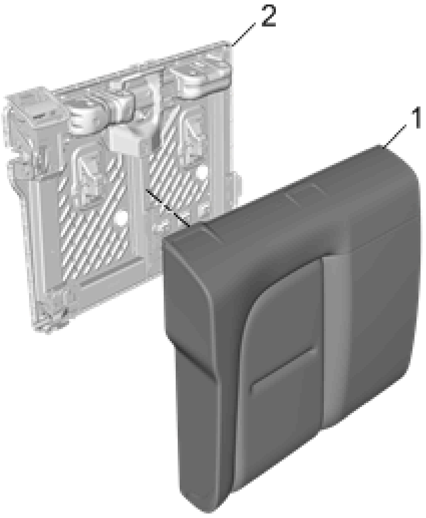


Fig. 72: Rear Seat Back Cushion Cover And Pad Assembly (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

10. Remove the rear seat back cushion cover and pad assembly (1) from the rear seat back cushion frame (2).

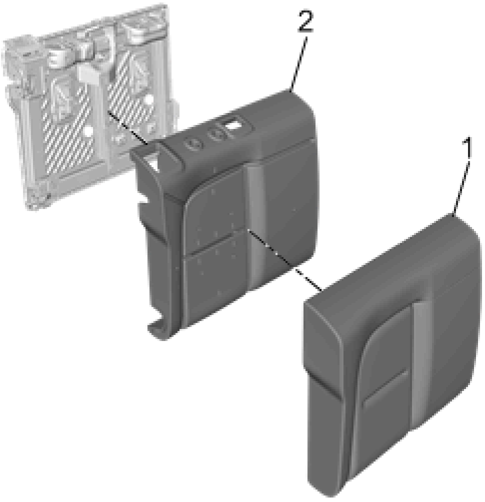


Fig. 73: Rear Seat Back Cushion Cover (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

11. Separate the rear seat back cushion cover (1) from the rear seat back cushion pad (2). Disengage the hook and loop fasteners, and cut the hog rings.

Installation Procedure

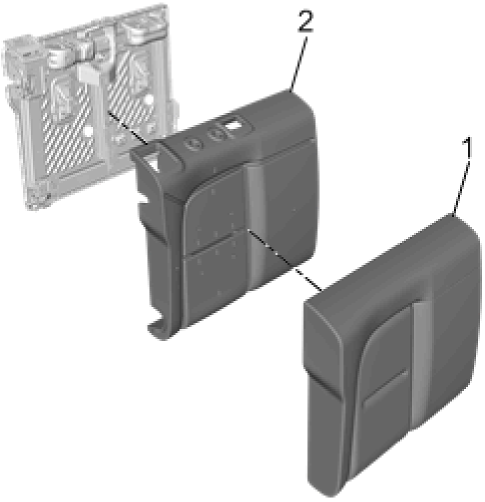


Fig. 74: Rear Seat Back Cushion Cover (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

1. Install the rear seat back cushion cover (1) to the rear seat back cushion pad (2).
2. Install hog rings to the rear seat back cushion cover (1) and rear seat back cushion pad (2).
3. Engage the hook and loop fastener channels.

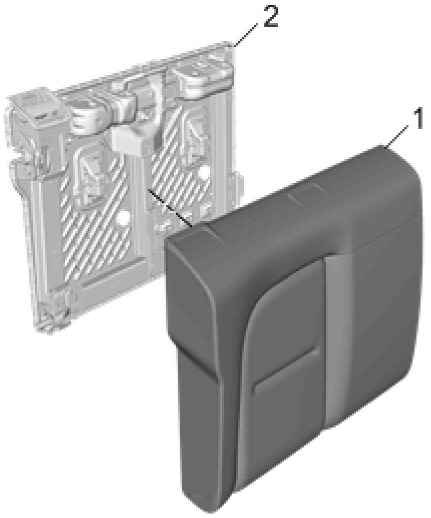


Fig. 75: Rear Seat Back Cushion Cover And Pad Assembly (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

4. Install the rear seat back cushion frame (2) to the rear seat back cushion cover and pad assembly (1).
5. Zip the zippers on both sides of the cover.
6. Install the J-channels.

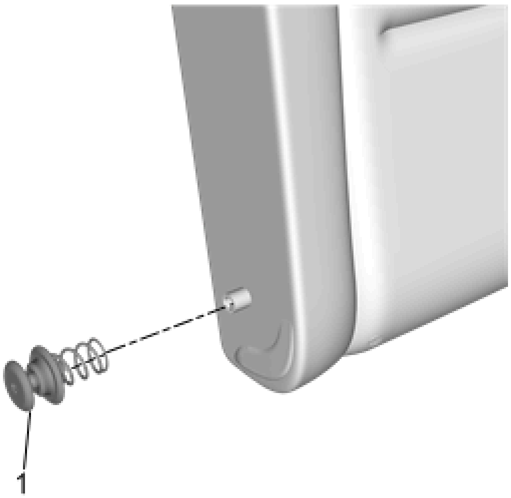


Fig. 76: Rear Seat Back Outer Pivot Bolt, Spring And Bushing Assembly (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

7. Install the rear seat back outer pivot bolt, spring and bushing assembly to 45 N.m (33 lb ft)

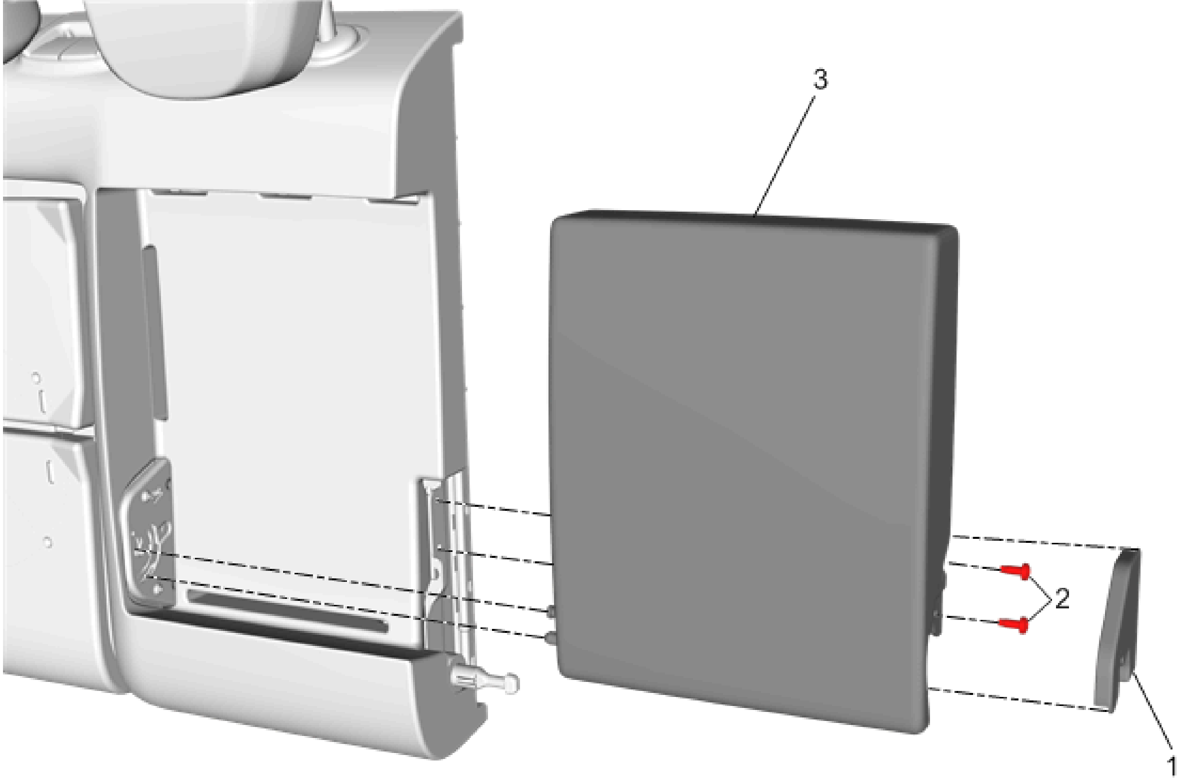


Fig. 77: Rear Seat Armrest (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

8. Rear Seat Armrest - Install - Rear Seat Armrest Replacement

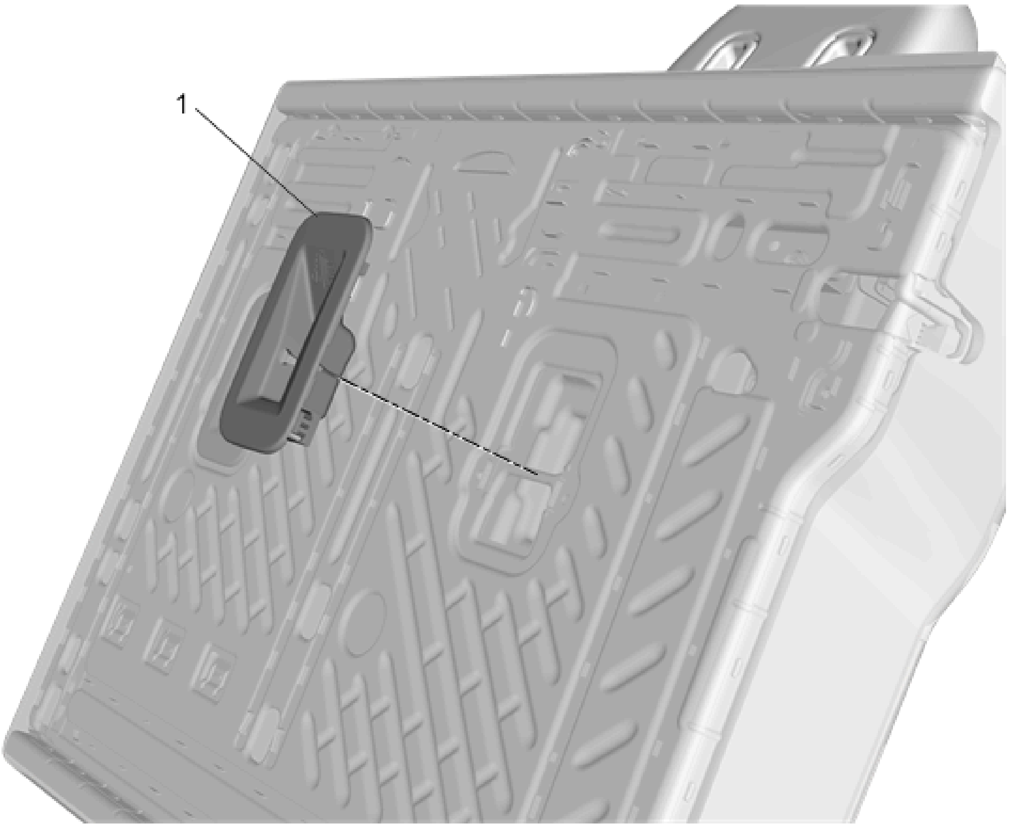


Fig. 78: Rear Seat Anchor Plate Bezel (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

9. Rear Seat Anchor Plate Bezel - Install - Rear Seat Anchor Plate Bezel Replacement

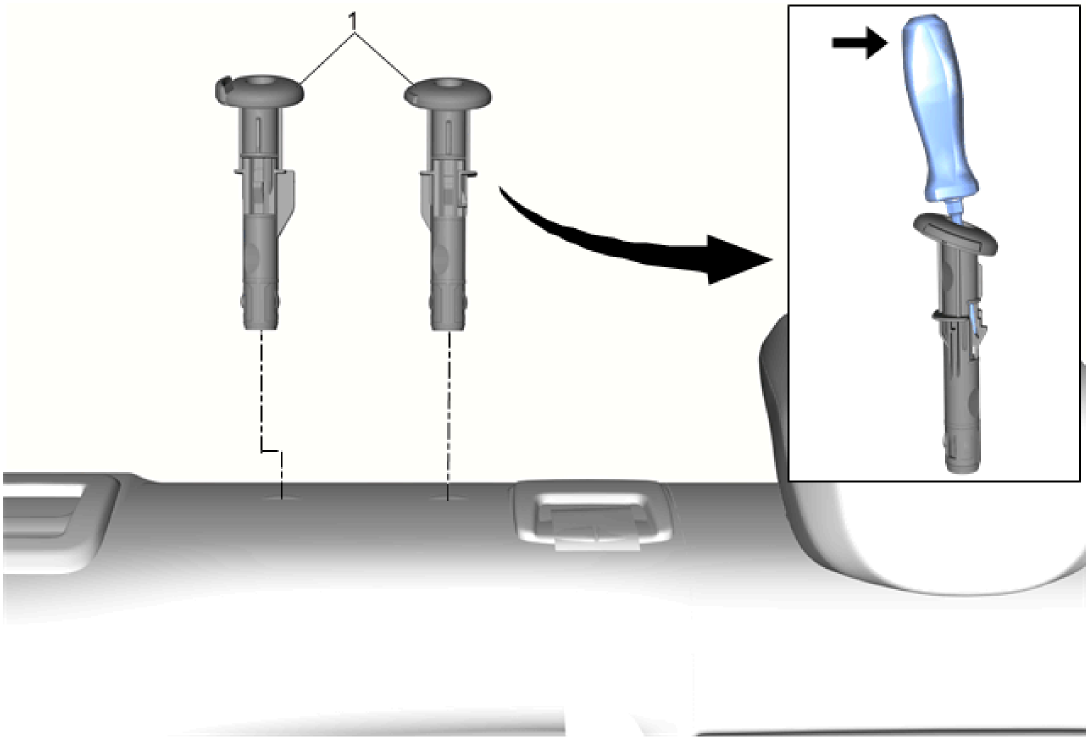


Fig. 79: Rear Seat Head Restraint Guide (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

10. Rear Seat Head Restraint Guide - Install - Rear Seat Head Restraint Guide Replacement

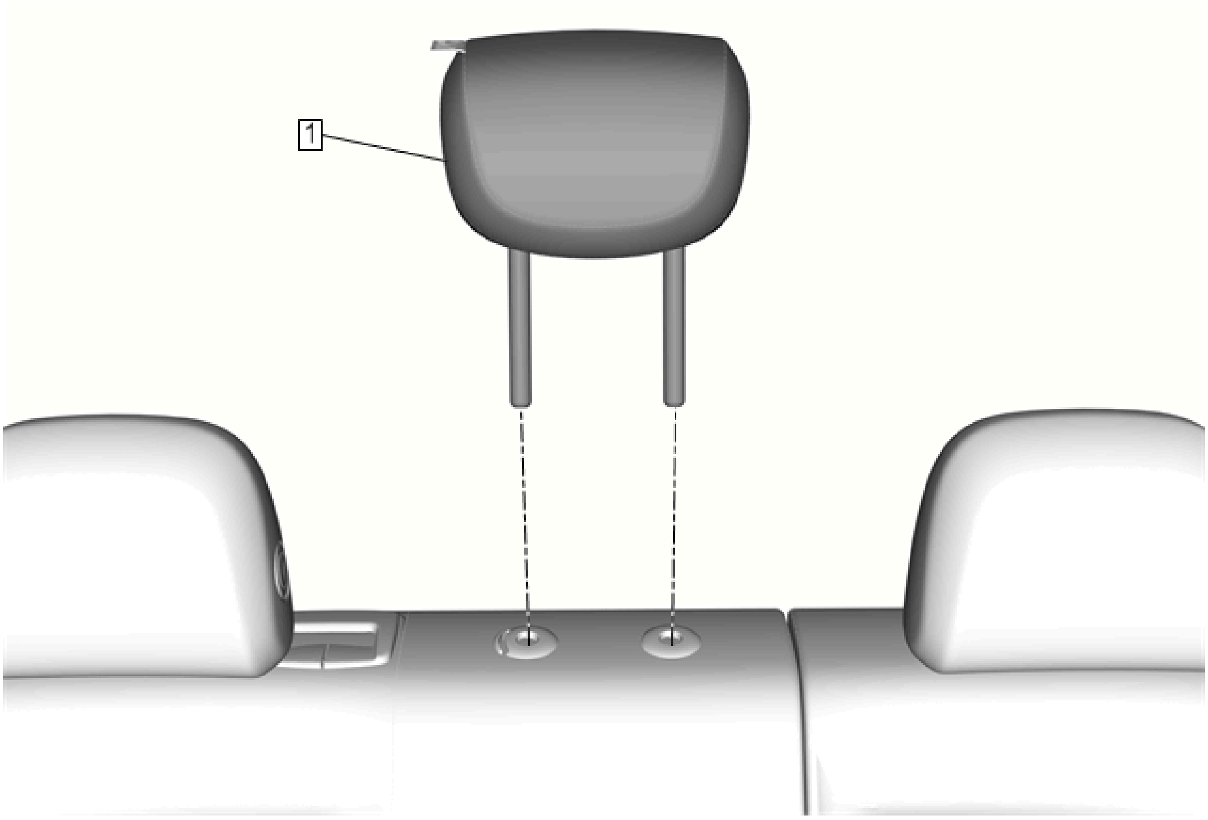


Fig. 80: Rear Seat Center Head Restraint (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

11. {If equipped} Rear Seat Center Head Restraint - Install - Rear Seat Center Head Restraint Replacement

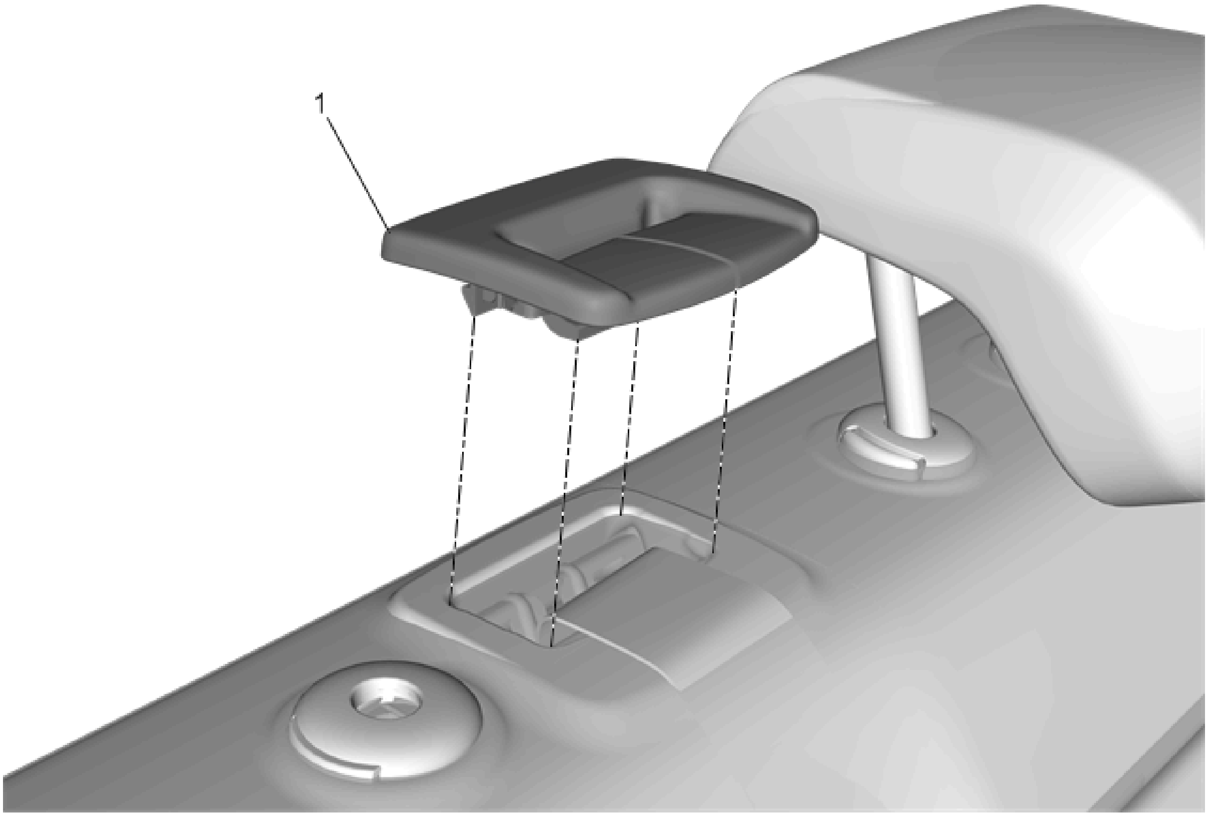


Fig. 81: Rear Seat Belt Opening Cover (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

12. Rear Seat Belt Opening Cover - Install - Rear Seat Belt Opening Cover Replacement

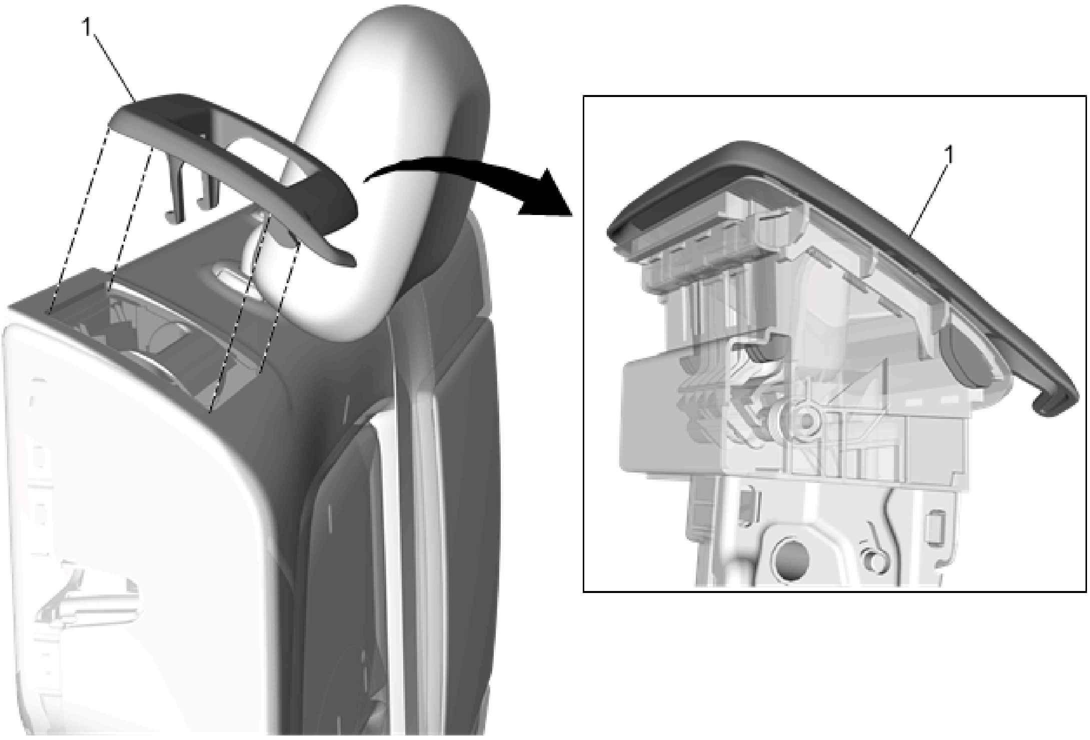
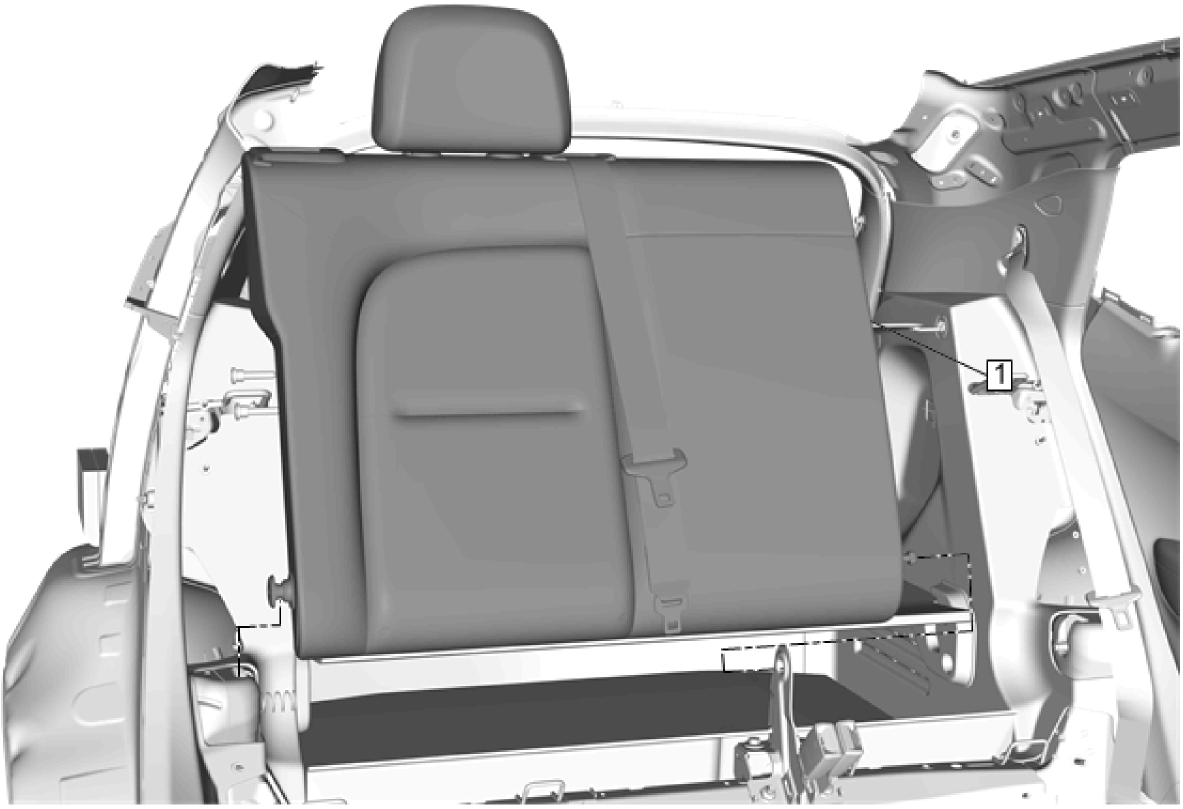


Fig. 82: Rear Seat Back Cushion Latch Release Handle Bezel (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

13. Rear Seat Back Cushion Latch Release Handle Bezel - Install - Rear Seat Back Latch Release Handle Bezel Replacement



[Fig. 83: Rear Seat Back Cushion (with Armrest, 60%)](#)
Courtesy of GENERAL MOTORS COMPANY

14. Rear Seat Back Cushion - Install - Rear Seat Back Cushion Removal and Installation (60%)

REAR SEAT BACK CUSHION COVER AND PAD REPLACEMENT (40%)

Removal Procedure

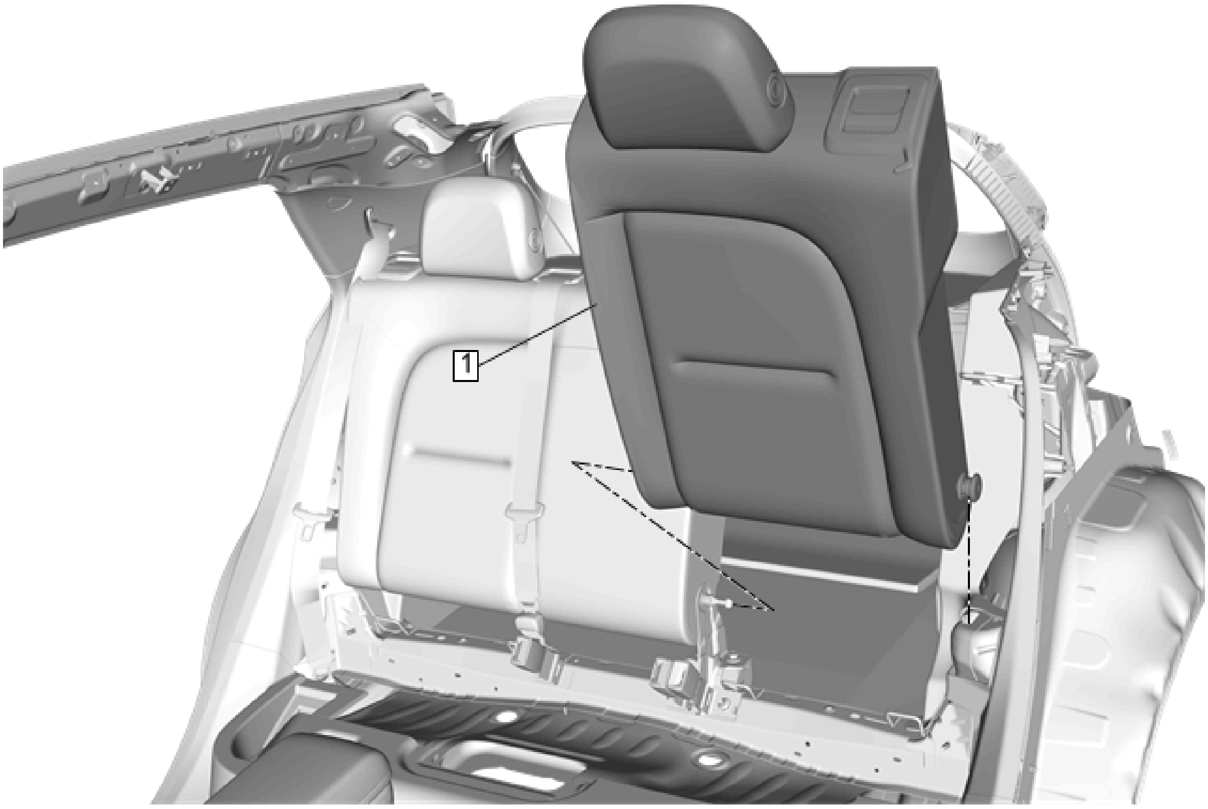


Fig. 84: Rear Seat Back Cushion (40%)
Courtesy of GENERAL MOTORS COMPANY

1. Rear Seat Back Cushion - 40 Percent Seat - Remove - Rear Seat Back Cushion Removal and Installation (40%)

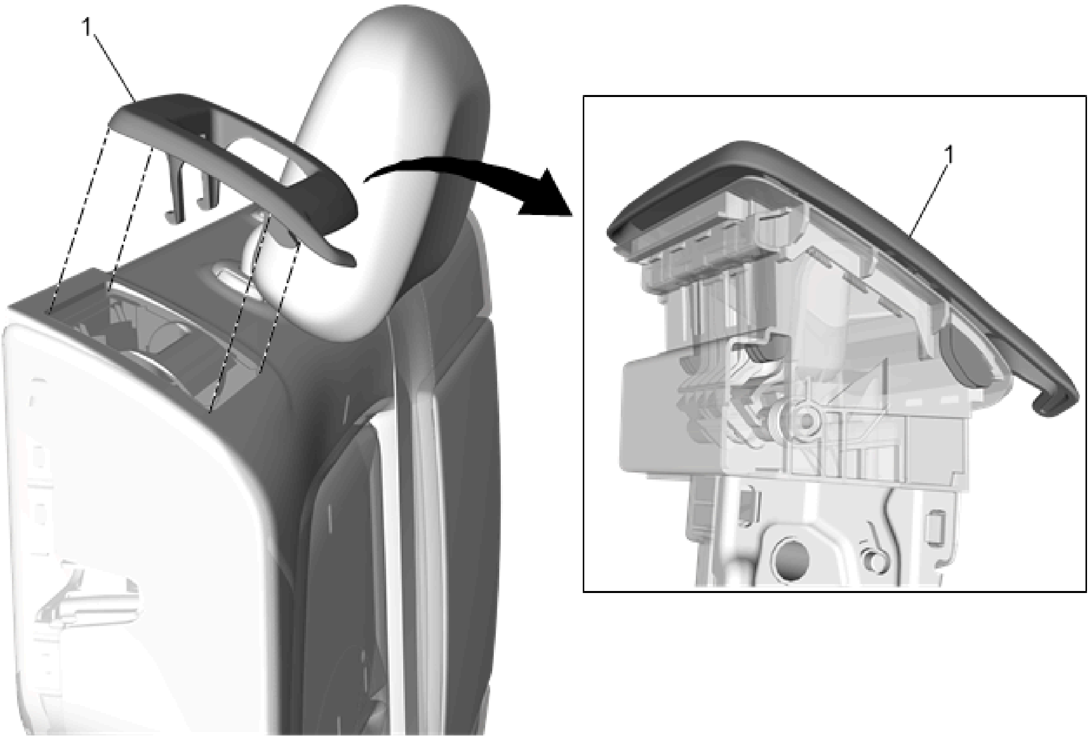


Fig. 85: Rear Seat Back Cushion Latch Release Handle Bezel (40%)
Courtesy of GENERAL MOTORS COMPANY

2. Rear Seat Back Cushion Latch Release Handle Bezel - Remove - **Rear Seat Back Latch Release Handle Bezel Replacement**

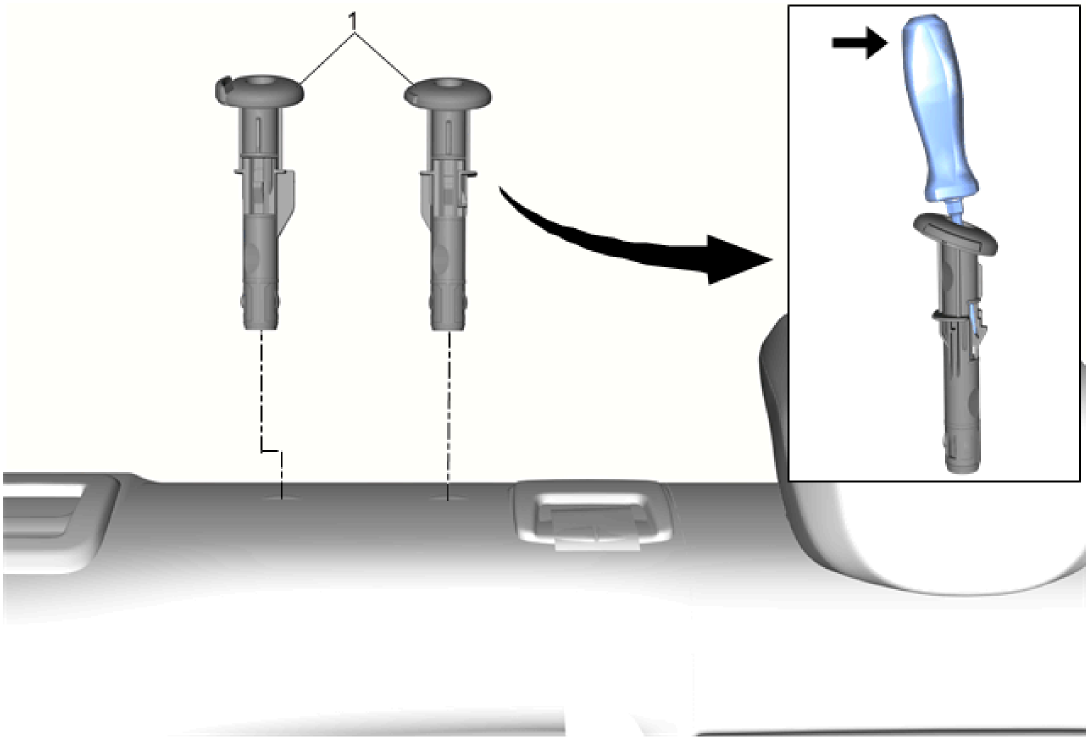


Fig. 86: Rear Seat Head Restraint Guide (40%)
Courtesy of GENERAL MOTORS COMPANY

3. Rear Seat Head Restraint Guide - Remove - **Rear Seat Head Restraint Guide Replacement**

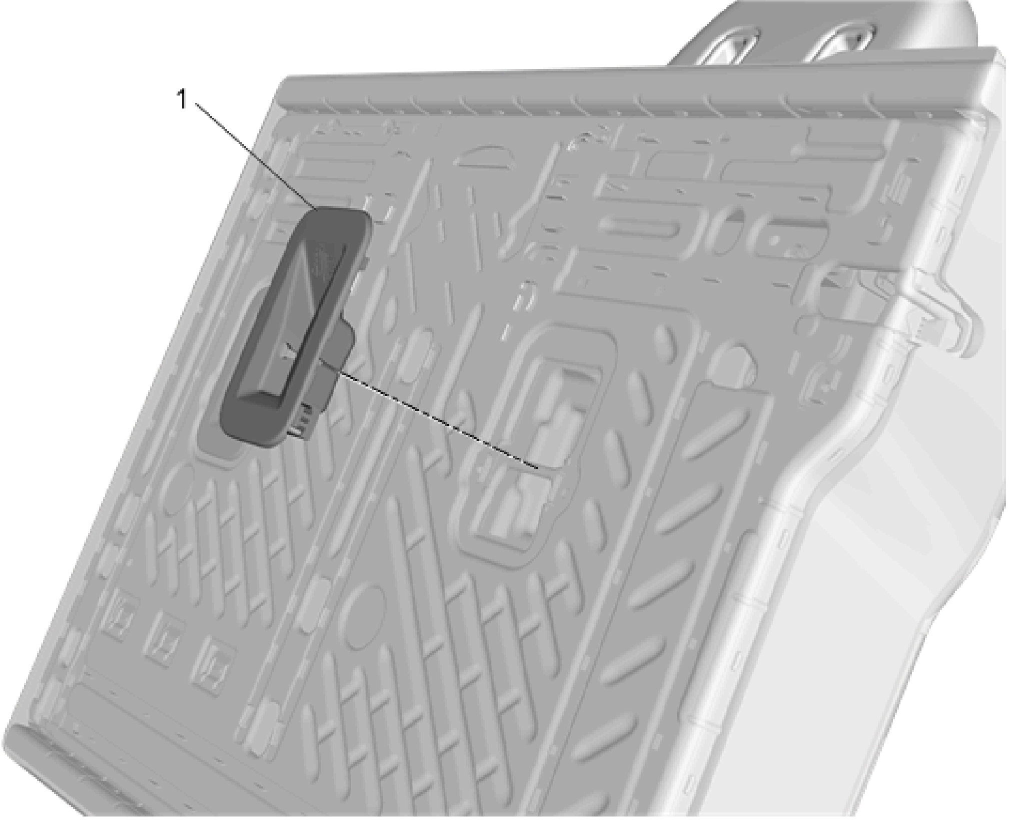


Fig. 87: Rear Seat Anchor Plate Bezel (40%)
Courtesy of GENERAL MOTORS COMPANY

4. Rear Seat Anchor Plate Bezel - Remove - Rear Seat Anchor Plate Bezel Replacement

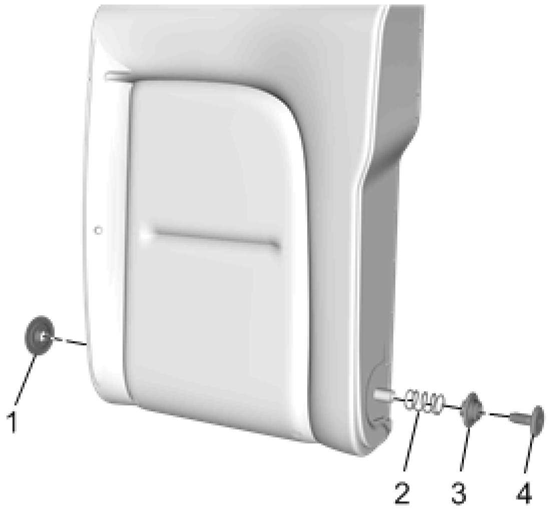


Fig. 88: Rear Seat Inner Hinge Finish Cover (40%)
Courtesy of GENERAL MOTORS COMPANY

5. Rear Seat Inner Hinge Finish Cover (1) - Remove
6. Rear Seat Back Outer Pivot Bolt (4) - Remove
7. Rear Seat Back Outer Pivot Bolt Bushing (3) - Remove
8. Rear Seat Back Outer Pivot Bolt Spring (2) - Remove

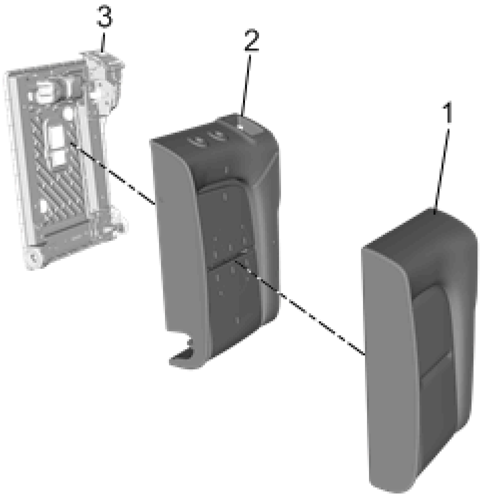


Fig. 89: Rear Seat Cover And Pad Assembly (40%)
Courtesy of GENERAL MOTORS COMPANY

9. Disengage the J-channels.
10. Unzip the zippers on both sides of the cover (1).
11. Remove the cover (1) and pad (2) assembly from the frame (3).
12. Separate the cover (1) from the pad (2) by releasing the hook and loop fasteners and cut the hog rings.

Installation Procedure

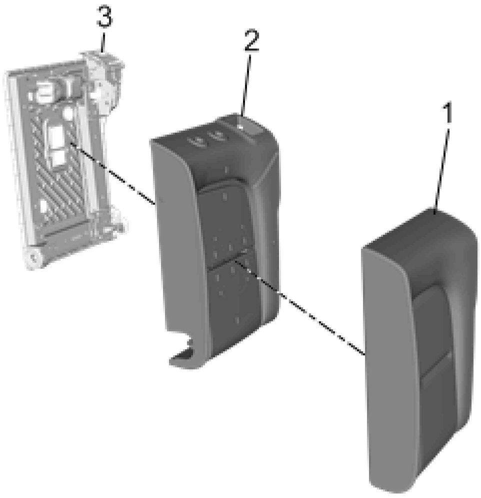


Fig. 90: Rear Seat Cover And Pad Assembly (40%)
Courtesy of GENERAL MOTORS COMPANY

1. Install the cover (1) to the pad (2).
2. Install the hog rings to the cover (1) and pad (2) assembly.
3. Engage the hook and loop fastener channels.
4. Install the seat frame (3) to the cover (1) and pad (2) assembly.
5. Zip the zippers on both sides of the cover (1).
6. Install the J-channels.

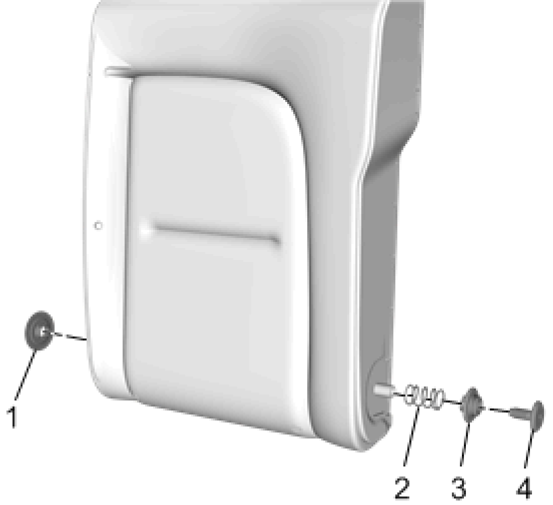


Fig. 91: Rear Seat Inner Hinge Finish Cover (40%)
Courtesy of GENERAL MOTORS COMPANY

7. Rear Seat Back Outer Pivot Bolt Spring (2) - Install
8. Rear Seat Back Outer Pivot Bolt Bushing (3) - Install
9. Rear Seat Back Outer Pivot Bolt (4) - Install and tighten to 45 N.m (33 lb ft)
10. Rear Seat Inner Hinge Finish Cover (1) - Install

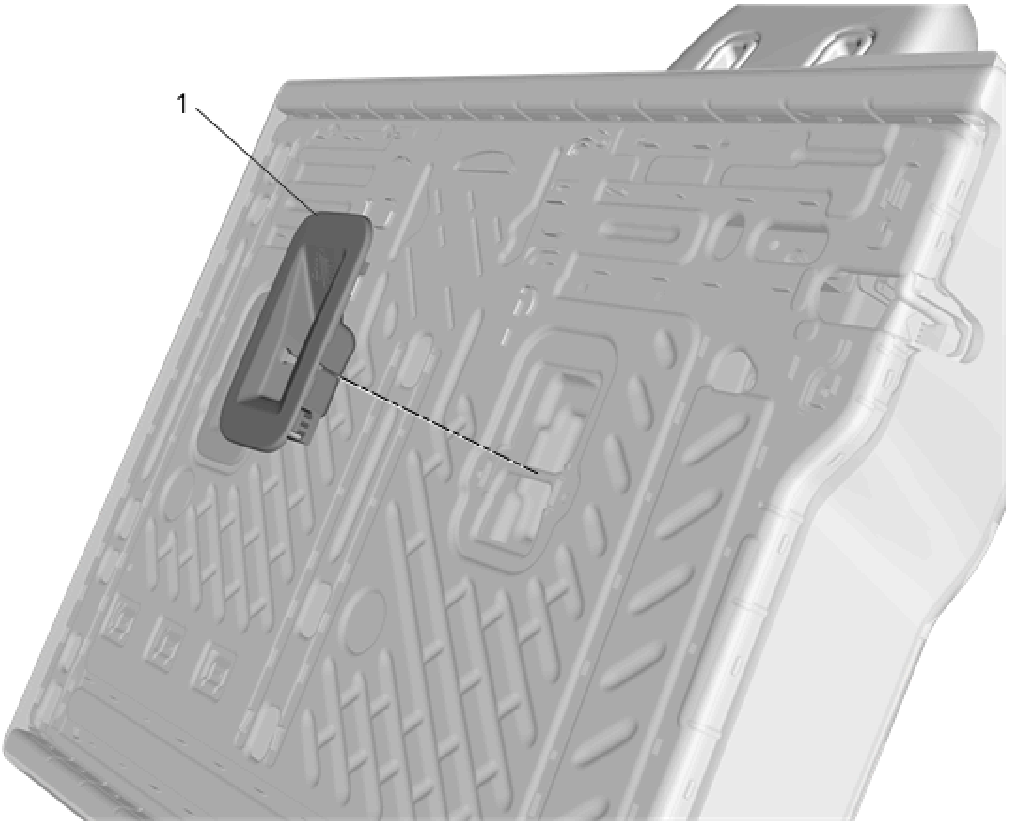


Fig. 92: Rear Seat Anchor Plate Bezel (40%)
Courtesy of GENERAL MOTORS COMPANY

11. Rear Seat Anchor Plate Bezel - Install - Rear Seat Anchor Plate Bezel Replacement

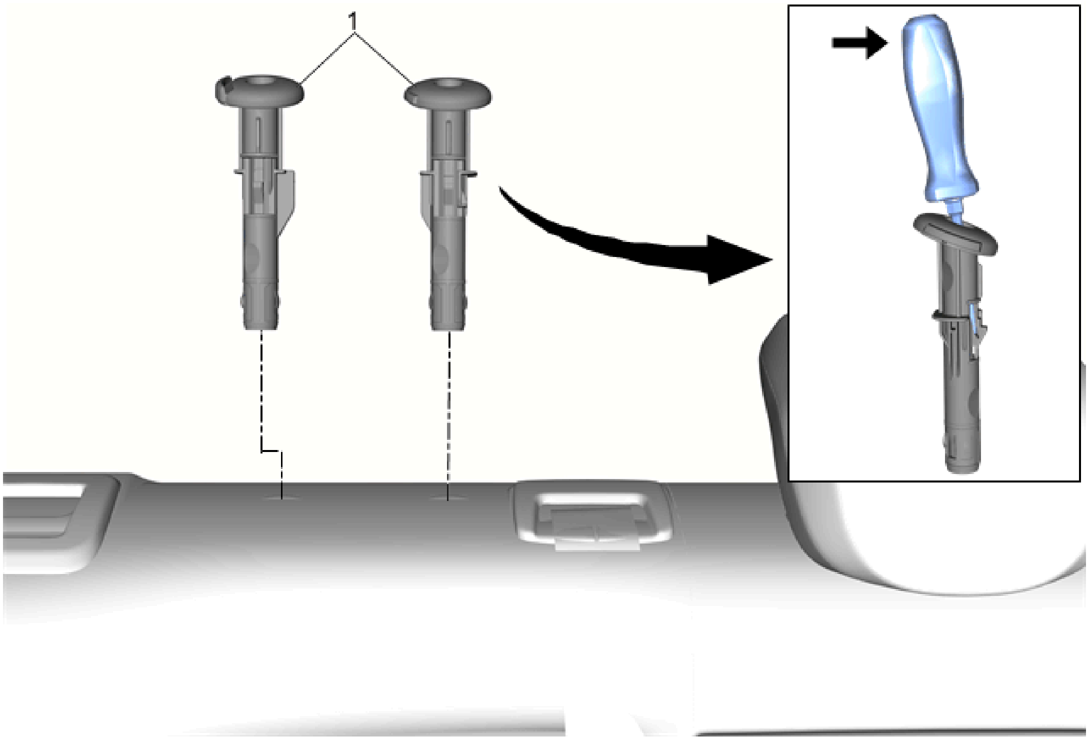


Fig. 93: Rear Seat Head Restraint Guide (40%)
Courtesy of GENERAL MOTORS COMPANY

12. Rear Seat Head Restraint Guide - Install - Rear Seat Head Restraint Guide Replacement

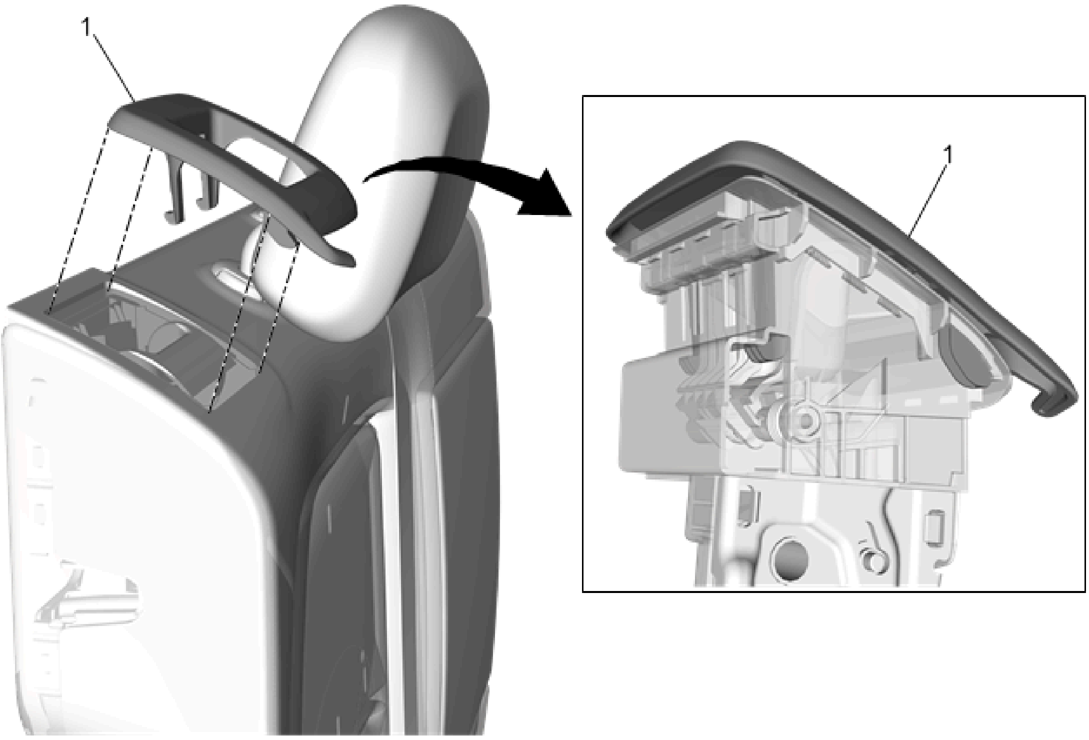


Fig. 94: Rear Seat Back Cushion Latch Release Handle Bezel (40%)
Courtesy of GENERAL MOTORS COMPANY

13. Rear Seat Back Cushion Latch Release Handle Bezel - Install - Rear Seat Back Latch Release Handle Bezel Replacement

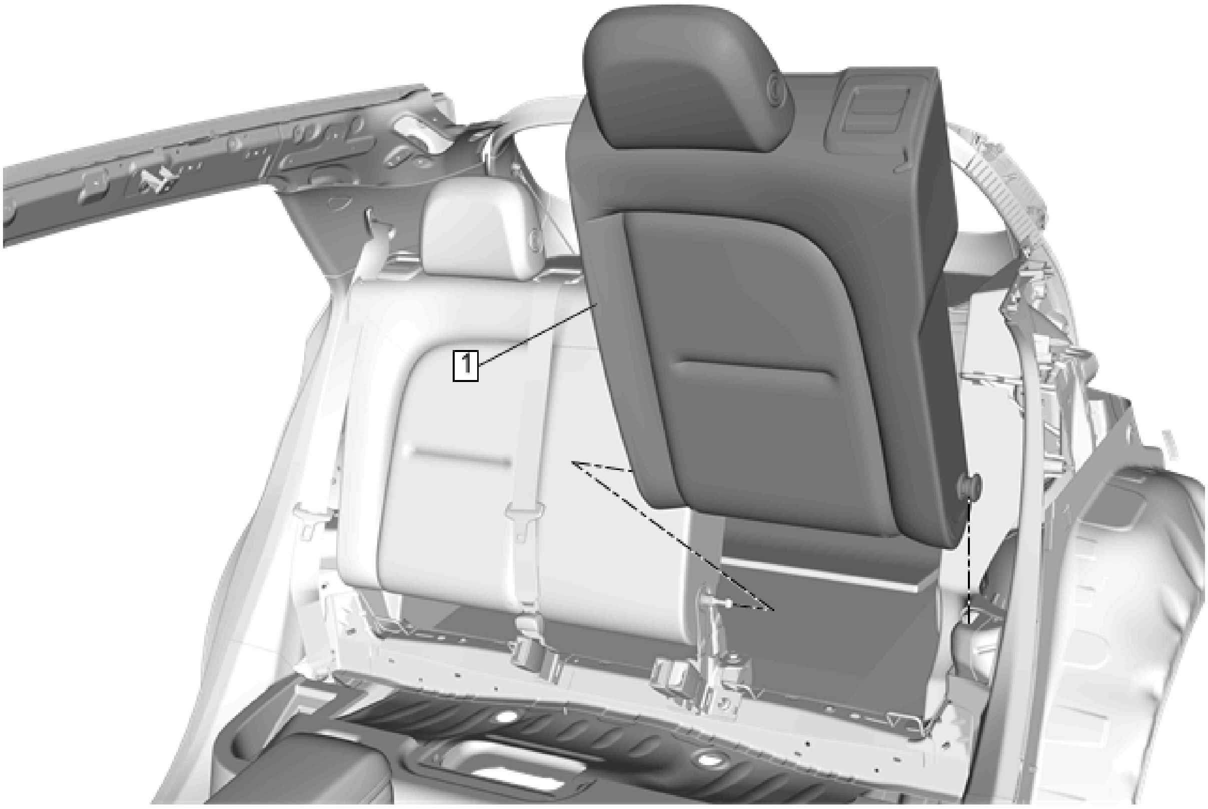


Fig. 95: Rear Seat Back Cushion (40%)
Courtesy of GENERAL MOTORS COMPANY

14. Rear Seat Back Cushion - 40 Percent Seat - Install - Rear Seat Back Cushion Removal and Installation (40%)

REAR SEAT BACK CUSHION FRAME REPLACEMENT (60%)

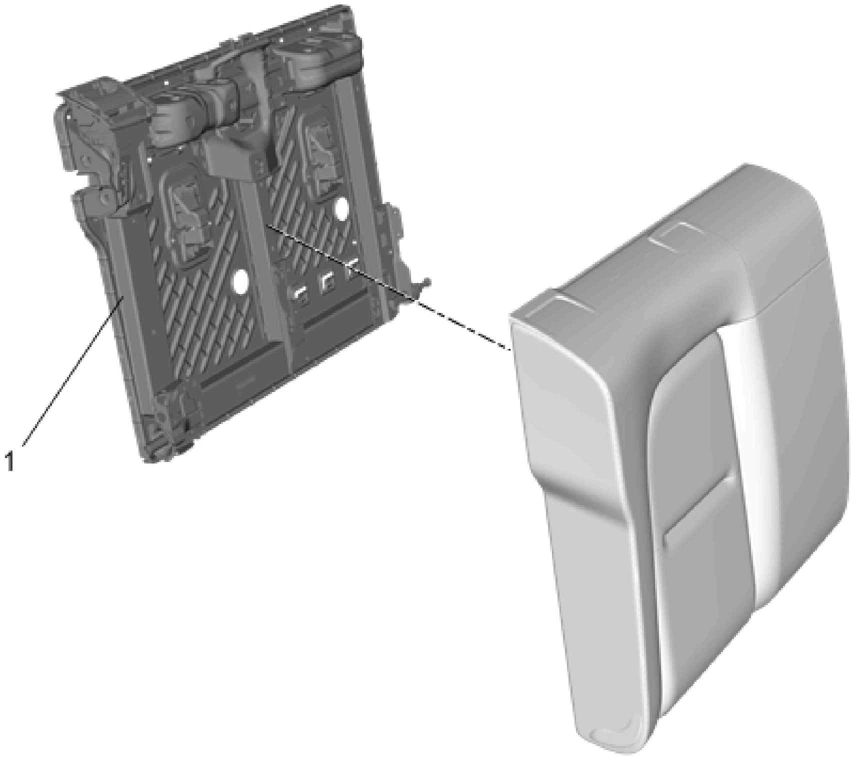


Fig. 96: Rear Seat Back Cushion Frame (60%)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure Rear Seat Back Cushion Cover and Pad - 60 Percent Seat - Remove - Rear Seat Back Cushion Cover and Pad Replacement (60%)Rear Seat Back Cushion Cover and Pad Replacement (with Armrest, 60%) **NOTE:** **Remove the cover and pad as an assembly. Do not separate the cover from the pad.**	
1	Rear Seat Back Cushion Frame **Procedure** Transfer components as necessary.

REAR SEAT BACK CUSHION FRAME REPLACEMENT (WITH ARMREST, 60%)

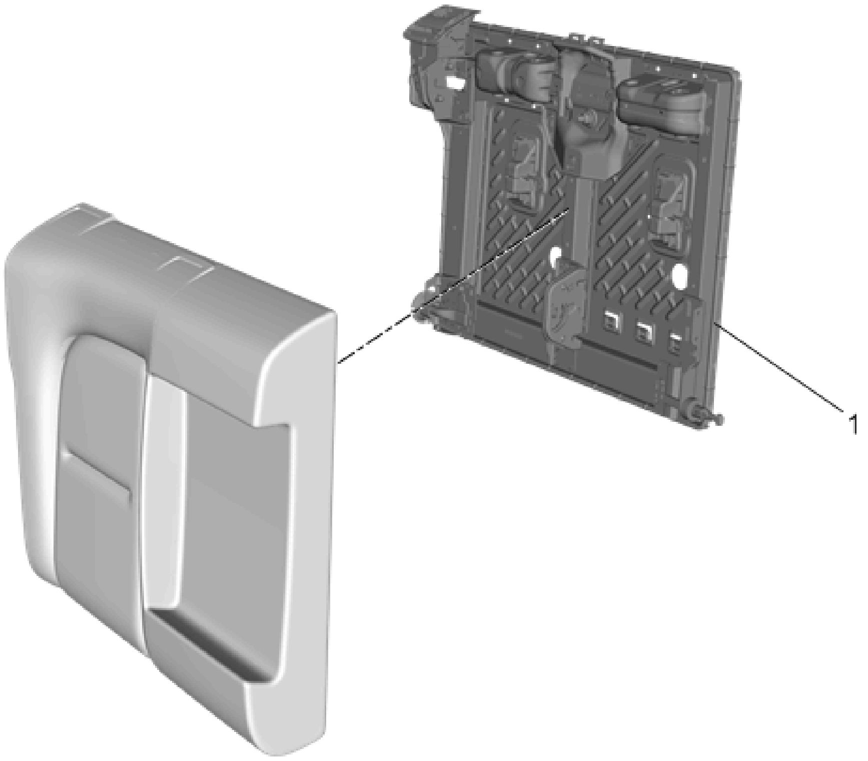


Fig. 97: Rear Seat Back Cushion Frame (with Armrest, 60%)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Back Cushion Cover and Pad - 60 Percent Seat with Armrest - Remove - Rear Seat Back Cushion Cover and Pad Replacement (with Armrest, 60%) **NOTE:** **Remove the cover and pad as an assembly. Do not separate the cover from the pad.**	
1	Rear Seat Back Cushion Frame **Procedure** Transfer components as necessary.

REAR SEAT BACK CUSHION HINGE REPLACEMENT

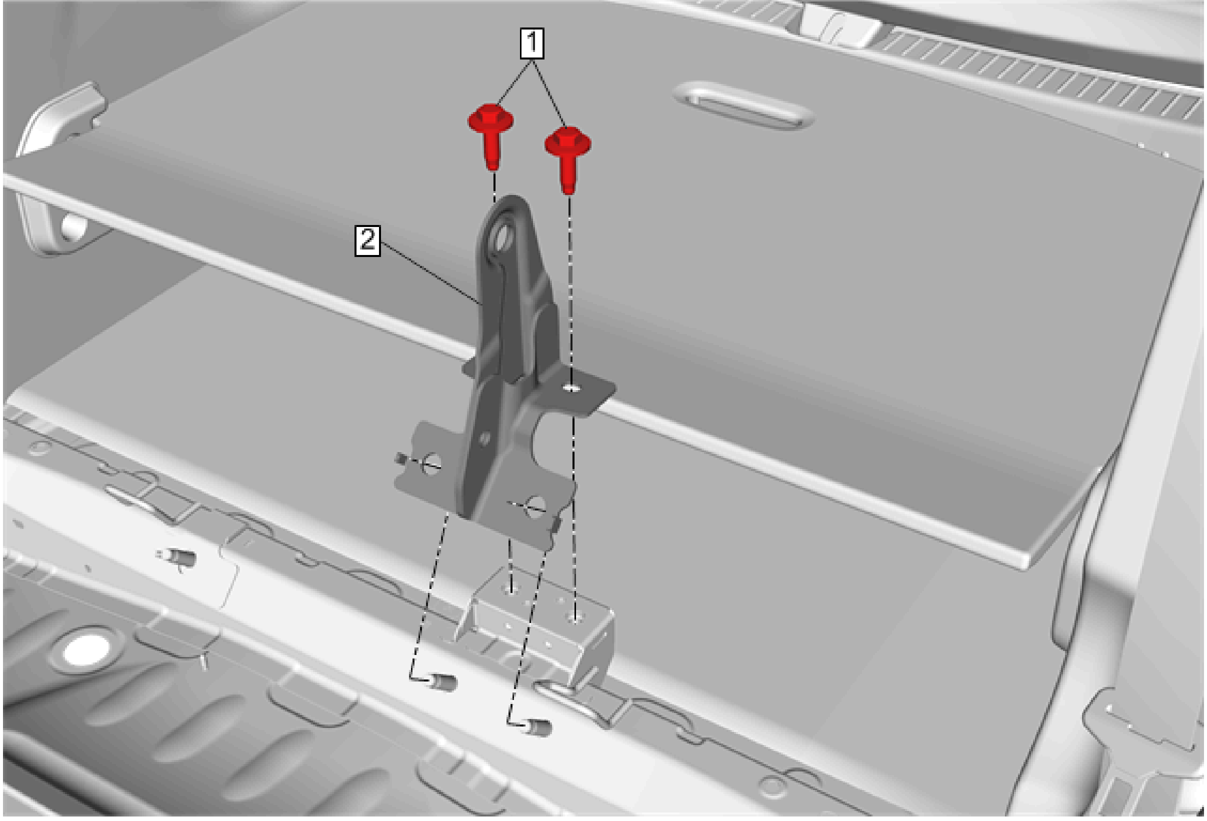


Fig. 98: Rear Seat Back Cushion Hinge
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Rear Seat Back Cushion - 40 Percent Seat - Remove - Rear Seat Back Cushion Removal and Installation (40%)
2. Rear Seat Back Cushion - 60 Percent Seat - Remove - Rear Seat Back Cushion Removal and Installation (60%)
3. Rear Seat Belt Buckle Replacement
4. Rear Center Seat Belt Buckle Replacement</td></tr>
<tr><td>1</td><td>Rear Seat Back Cushion Hinge Fastener
CAUTION:
Fastener Caution
Tighten
58 N.m (43 lb ft)</td></tr>
<tr><td>2</td><td>Rear Seat Back Cushion Hinge</td></tr>
</table>

REAR SEAT BACK LATCH RELEASE HANDLE BEZEL REPLACEMENT

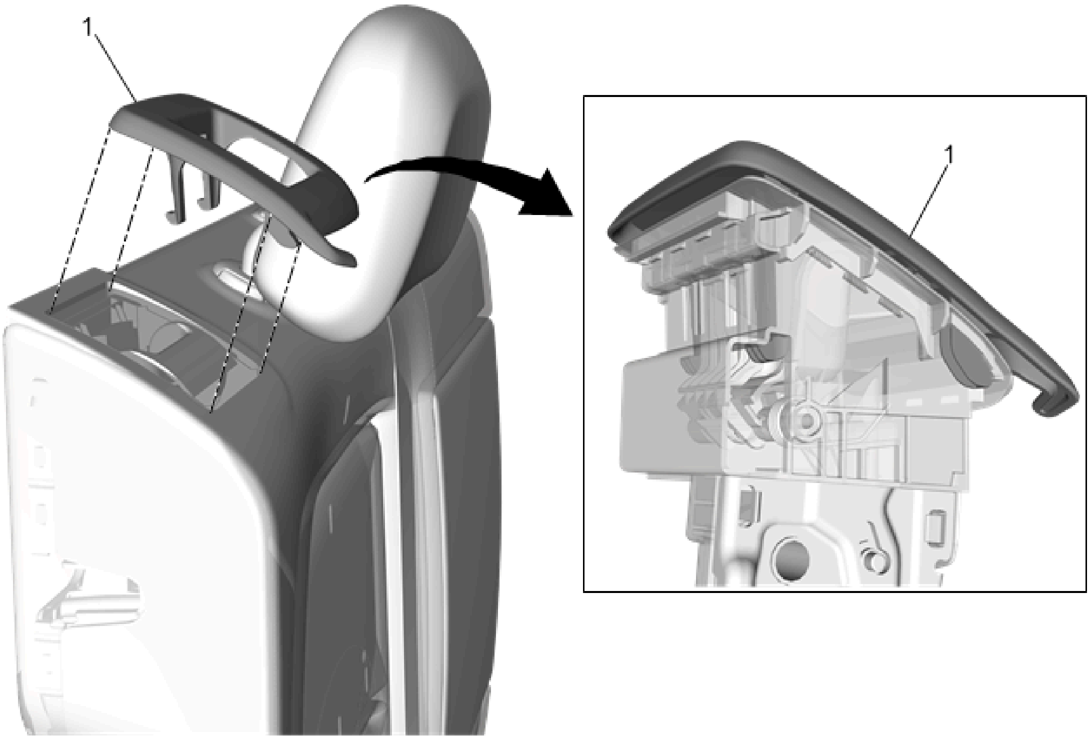


Fig. 99: Rear Seat Back Latch Release Handle Bezel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Seat Back Cushion Latch Release Handle Bezel **Procedure** Using a suitable flat-bladed tool, push inward on the rear tabs while pulling upward from the rear of the bezel to release it from the seat.

REAR SEAT ANCHOR PLATE BEZEL REPLACEMENT

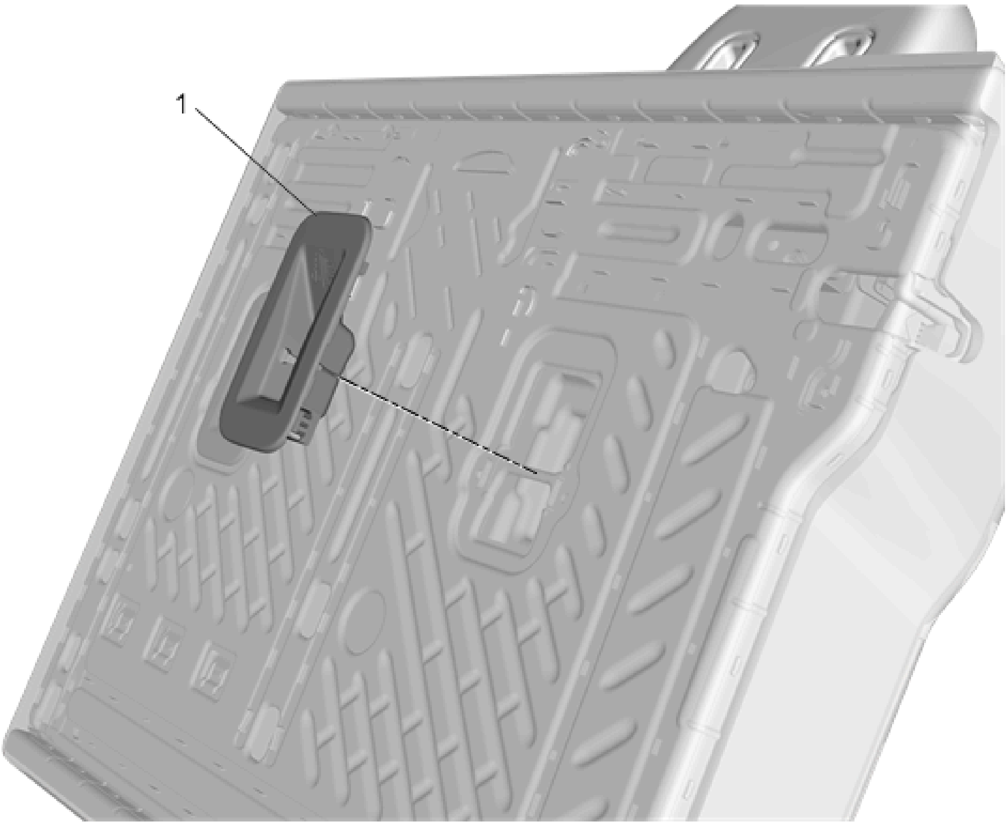


Fig. 100: Rear Seat Anchor Plate Bezel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Rear Seat Anchor Plate Bezel **Procedure** Release the rear seat anchor plate bezel using a suitable flat-bladed tool.

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Seat Heating and Cooling - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Front Seat Heater Control Module Bracket Fastener	4.7 N.m (42 lb in)
Front Seat Heater Control Module Fastener	2.5 N.m (22 lb in)

SCHEMATIC WIRING DIAGRAMS

HEATED/COOLED SEAT WIRING SCHEMATICS

Heated Seats - Front (KA1)

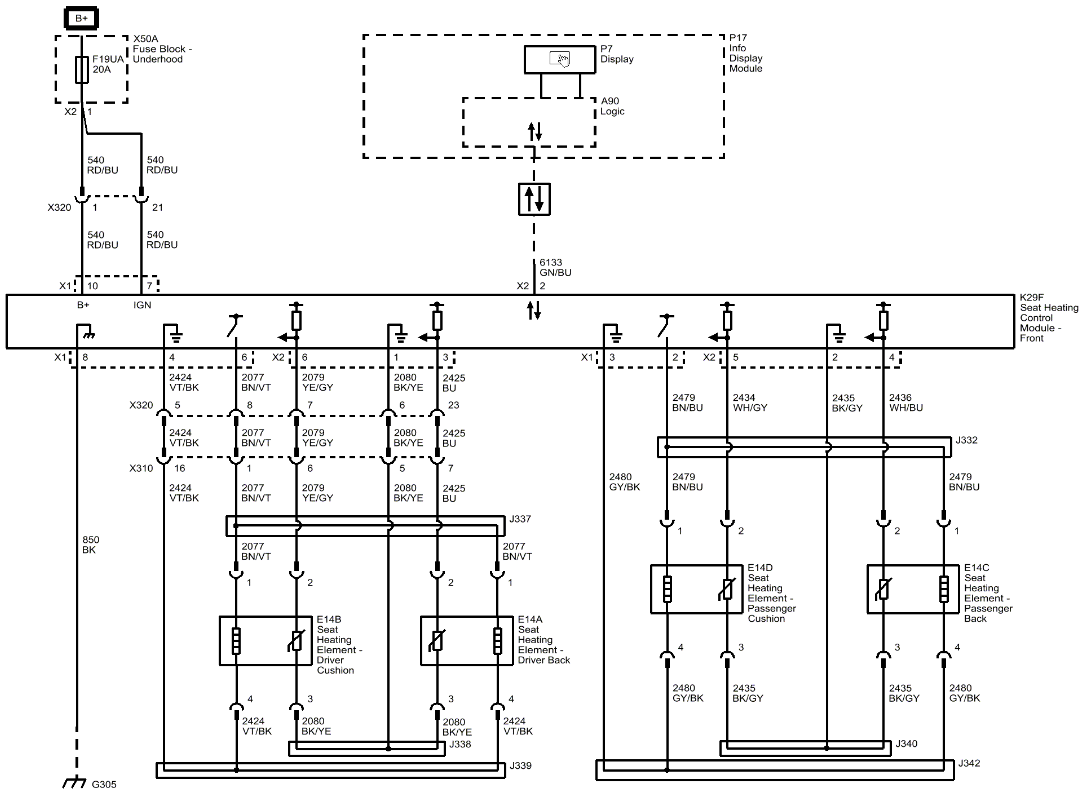

B+
X50A Fuse Block - Underhood
F19UA 20A
X2 1
540 RD/BU
540 RD/BU
X320 1
21
540 RD/BU
540 RD/BU
X1 10
7
B+
IGN
P17 Info Display Module
P7 Display
A90 Logic
6133 GN/BU
X2 2
K29F Seat Heating Control Module - Front
X1 8
4
6
X2 6
1
3
2424 VT/BK
2077 BN/VT
2079 YE/GY
2080 BK/YE
2425 BU
X320 5
8
7
6
23
X310 16
1
6
5
7
J337
850 BK
2077 BN/VT
1
2
2
1
E14B Seat Heating Element - Driver Cushion
E14A Seat Heating Element - Driver Back
4
3
3
4
2424 VT/BK
2080 BK/YE
2080 BK/YE
2424 VT/BK
J338
J339
G305
X1 3
2
X2 5
2
4
2479 BN/BU
2434 WH/GY
2435 BK/GY
2436 WH/BU
J332
2480 GY/BK
2479 BN/BU
2479 BN/BU
E14D Seat Heating Element - Passenger Cushion
E14C Seat Heating Element - Passenger Back
2480 GY/BK
2435 BK/GY
2435 BK/GY
2480 GY/BK
J340
J342

Fig. 1: Heated Seats - Front (KA1)

Courtesy of GENERAL MOTORS COMPANY

Heated Seats - Rear (KA6)

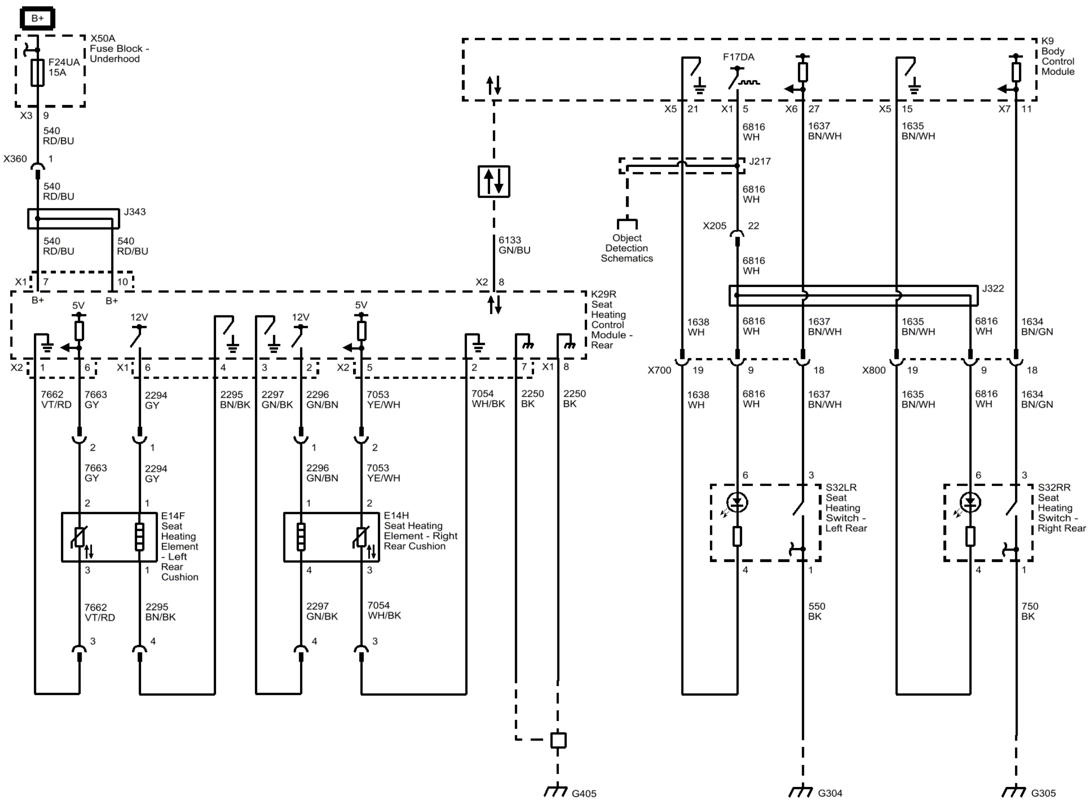

B+
X50A Fuse Block - Underhood
F24UA 15A
X3 9
540 RD/BU
X360 1
540 RD/BU
J343
540 RD/BU
540 RD/BU
X1 7
10
B+
5V
B+
12V
12V
5V
X2 8
6133 GN/BU
K29R Seat Heating Control Module - Rear
X2 1
6
X1 6
4
3
2
X2 5
2
7
X1 8
7662 VT/RD
7663 GY
2294 GY
2295 BN/BK
2297 GN/BK
2296 GN/BN
7053 YE/WH
7054 WH/BK
2250 BK
2250 BK
7663 GY
2294 GY
E14F Seat Heating Element - Left Rear Cushion
2296 GN/BN
7053 YE/WH
E14H Seat Heating Element - Right Rear Cushion
7662 VT/RD
2295 BN/BK
2297 GN/BK
7054 WH/BK
G405
K9 Body Control Module
F17DA
X5 21
X1 5
X6 27
X5 15
X7 11
6816 WH
1637 BN/WH
1635 BN/WH
J217
6816 WH
Object Detection Schematics
X205 22
6816 WH
J322
1638 WH
6816 WH
1637 BN/WH
1635 BN/WH
6816 WH
1634 BN/GN
X700 19
9
18
X800 19
9
18
1638 WH
6816 WH
1637 BN/WH
1635 BN/WH
6816 WH
1634 BN/GN
S32LR Seat Heating Switch - Left Rear
S32RR Seat Heating Switch - Right Rear
550 BK
750 BK
G304
G305

Fig. 2: Heated Seats - Rear (KA6)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B191A OR B191B: HEATED SEAT MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B191A 39

Front Heated Seat Module

DTC B191B 39

Rear Heated Seat Module

Circuit/System Description

An internal fault is detected inside the control module. No external circuits are involved.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The control module detects an internal fault.

Action Taken When the DTC Sets

The seat heating control module will disable all heated seat functions.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Heated/Cooled Seat Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Heated Seats Description and Operation**
- **Rear Heated Seats Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

DTC B191A

1. Ignition ON.
2. Verify DTC B191A is not set.
    - **If the DTC is set**

      Replace the K29F Seat Heating Control Module - Front.

    - **If the DTC is not set**
3. All OK.

DTC B191B

1. Ignition ON.
2. Verify DTC B191B is not set.
    - **If the DTC is set**

      Replace the K29R Seat Heating Control Module - Rear.

    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K29F Seat Heating Control Module - Front or K29R Seat Heating Control Module - Rear replacement, programming and setup

SYMPTOMS - SEAT HEATING AND COOLING

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control module(s) can communicate via the serial data link.
2. Refer to the system description and operation from the following list in order to familiarize yourself with the system functions:
    - **Heated Seats Description and Operation**
    - **Rear Heated Seats Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power seats. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect the seat adjuster track for conditions which may cause binding or objects within the seat adjustment range which obstruct movement or interfere with wiring.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Front Heated Seat Malfunction**
- **Rear Heated Seat Malfunction**

FRONT HEATED SEAT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 10 X1	U1524, 1	U1524, 1	-	-
B+ Terminal 7 X1	6	6	-	-
Driver Heated Seat Back Temperature Sensor Signal	2	5	5	-
Driver Heated Seat Back Temperature Sensor Low Reference	-	5	-	-
Driver Heated Seat Element Voltage Control Terminal 6 X1	1	2	1	-
Driver Heated Seat Element Ground Control Terminal 4 X1	1	2	1	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Heated Seat Back Element Voltage Control	1	3	1	-
Driver Heated Seat Back Element Ground Control	1	3	1	-
Driver Heated Seat Cushion Temperature Sensor Signal	2	5	5	-
Driver Heated Seat Cushion Temperature Sensor Low Reference	-	5	-	-
Driver Heated Seat Cushion Element Voltage Control	1	4	1	-
Driver Heated Seat Cushion Element Ground Control	1	4	1	-
Passenger Seat Back Temperature Sensor Signal	6	9	9	-
Passenger Seat Back Temperature Sensor Low Reference	-	9	-	-
Passenger Heated Seat Element Voltage Control Terminal 2 X1	1	6	1	-
Passenger Heated Seat Element Ground Control Terminal 3 X1	1	6	1	-
Passenger Heated Seat Back Element Voltage Control	1	7	1	-
Passenger Heated Seat Back Element Ground Control	1	7	1	-
Passenger Heated Seat Cushion Temperature Sensor Signal	6	9	9	-
Passenger Heated Seat Cushion Temperature Sensor Low Reference	-	9	-	-
Passenger Heated Seat Cushion Element Voltage Control	1	8	1	-
Passenger Heated Seat Cushion Element Ground Control	1	8	1	-
Front Seat Heating Control Module Ground	-	U1524, 1	-	-

1. Driver and passenger heated seats are inoperative.
2. Driver heated seat is inoperative
3. Driver seat back heat function is inoperative
4. Driver seat cushion heat function is inoperative
5. Degraded driver heated seat operation
6. Passenger heated seat is inoperative
7. Passenger seat back heat function is inoperative
8. Passenger seat cushion heat function is inoperative
9. Degraded passenger heated seat operation

Circuit/System Description

The driver and passenger heated seats switches are located on the infotainment display. When a heated seat switch is pressed, a serial data message is sent from the infotainment display to the body control module (BCM) indicating the heated seat command. The BCM serves as the heated seat system master to determine the requested operating mode. The BCM then sends a serial data message to the seat heating control module indicating the heated seat command. In response to this message, the seat heating control module attempts to drive the appropriate seat heating elements per the BCM command. The BCM also controls the seat temperature and mode indicators, via the serial data line, used to provide the operator with feedback as to the operating status of the system.

The seat heating control module controls heated seat operation for the driver and passenger seats. When active, power is applied to the seat cushion and back heater elements through a common pulse width modulated (PWM) voltage supply control circuit. Each individual heater element is switched to ground by the module through a common low side drive control circuit.

The seat back and cushion temperature sensors (thermistors) are packaged with the seat heating elements located just under the seat covers. The seat heating control module supplies each temperature sensor with a 5 V reference signal circuit and a low reference circuit. The module monitors the voltage from the signal circuit to determine the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

Diagnostic Aids

- A short to ground or B+ in either the heating element voltage control circuit or ground control circuit will cause both the driver and front passenger heated seats to be inoperative.
- An open in either the voltage control circuit or ground control circuit between the module and the splice will cause the seat cushion and seat back the heated seat function to be inoperative for that seat.
- A short to ground on either the seat cushion or seat back temperature sensor signal circuit will cause the heated seat function to be inoperative for that seat.
- An open in either the voltage control circuit or ground control circuit between the splice and the heating element will cause just that one heating element to be inoperative.
- The following faults will cause a degraded heated seat operation for both the seat back and seat cushion.
  - An open or a short to voltage on either the seat cushion or seat back temperature sensor signal circuit.
  - An open in either the seat cushion or seat back temperature sensor low reference circuit.
  - A fault in either the seat cushion or seat back temperature sensor.
- A broken wire in a heating element may cause a degraded heated seat operation for that particular heating element.
- When inactive the seat heating control module connects the heating element low side outputs to a common reference point internal to the module which is biased to approximately 3.5 V. The module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling the driver and passenger seat heating elements.
- With both the seat cushion and seat back heater elements disconnected, if the high side output of the module is measured it will display a low current 12 V bleed off voltage. This bleed off voltage does not have a meaningful diagnostic purpose. With one or both of the heater elements connected you would just see the 3.5 V biased voltage from this circuit.
- If the heated seats are on high, the temperature level may automatically be lowered after approximately 30 min of operation.

Reference Information

Schematic Reference

Heated/Cooled Seat Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Heated Seats Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Review the Diagnostic Fault Information table and Diagnostic Aids in order to get a better understanding of the possible heated seat system faults before proceeding Circuit/System Verification and Circuit/System Testing.**

1. Vehicle ON.
2. Verify the scan tool Body Control Module Driver Seat Heating/Venting/Cooling Mode parameter changes between OFF and Seat Back and Cushion Heating when pressing the driver heated seat switch.
    - **If the parameter does not change**

      Replace the P17 Info Display Module.

    - **If the parameter changes**
3. Verify the scan tool Passenger Seat Heating/Venting/Cooling Mode parameter changes between OFF and Seat Back and Cushion Heating when pressing the passenger heated seat switch.
    - **If the parameter does not change**

      Replace the P17 Info Display Module.

    - **If the parameter changes**
4. Verify the driver and front passenger heated seats operate.
    - **If the driver and front passenger heated seats are inoperative**

      Refer to Circuit/System Testing - Both Heated Seats are Inoperative

    - **If the seat cushion and back heating elements are inoperative of one seat**

      Refer to Circuit/System Testing - One Heated Seat Inoperative

    - **If just one of the heating elements is inoperative**

      Refer to Circuit/System Testing - One Heating Element is Inoperative.

    - **If the driver seat exhibits a degraded heated seat operation**

      Refer to Circuit/System Testing - Degraded Heated Seat Operation Driver Seat

    - **If the passenger seat exhibits a degraded heated seat operation**

      Refer to Circuit/System Testing - Degraded Heated Seat Operation Passenger Seat

    - **If both heated seats operate**
5. All OK.

Circuit/System Testing

Both Heated Seats are Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
2. Verify a test lamp illuminates between each B+ circuit terminal listed below and ground.
    - Terminal 7
    - Terminal 10
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K29F Seat Heating Control Module - Front.
    - **If the test lamp illuminates**
3. Vehicle OFF.
4. Test for infinite resistance between each control circuit terminal listed below and ground, one at a time.
    - Terminal 2
    - Terminal 3
    - Terminal 4
    - Terminal 6
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
5. Vehicle ON.
6. Test for less than 1 V between each control circuit terminal listed below and ground, one at a time.
    - Terminal 2
    - Terminal 3
    - Terminal 4
    - Terminal 6
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
7. Replace the K29F Seat Heating Control Module - Front.

One Heated Seat is Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 7 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K29F Seat Heating Control Module - Front.
    - **If the test lamp illuminates**
3. Vehicle OFF, connect the X1 harness connector at the K29F Seat Heating Control Module - Front. Disconnect the harness connector at the E14 Seat Heating Element - Cushion and the E14 Seat Heating Element - Back, Vehicle ON.

NOTE: **When performing this test ensure that you are testing from the correct terminal. Testing from the incorrect terminal will cause a misdiagnosis of the circuit. Three of the four terminals in this connector will not only display a voltage reading but a different voltage reading.**

4. Test for 4.8 - 5.2 V between each signal circuit terminal listed below and ground, one at a time.
    - E14 Seat Heating Element - Cushion terminal 2
    - E14 Seat Heating Element - Back terminal 2
    - **If less than 4.8 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K29F Seat Heating Control Module - Front.
    - **If greater than 5.2 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K29F Seat Heating Control Module - Front.
    - **If between 4.8 - 5.2 V**
5. Connect a test lamp between control circuit terminal 1 and control circuit terminal 4 of the E14 Seat Heating Element - Back, Vehicle ON.

NOTE: **The test lamp should turn ON for approximately 10 s after the heated seat is commanded ON.**

6. Verify the test lamp turns ON after pressing the heated seat switch.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front.

        2. Test for less than 2 Ω in each control circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K29F Seat Heating Control Module - Front.
    - **If the test lamp turns ON**
7. Vehicle OFF, connect the harness connector at the E14 Seat Heating Element - Cushion, Vehicle ON.
8. Verify the test lamp turns ON after pressing the heated seat switch.
    - **If the test lamp is always OFF**

        NOTE: **Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.**

        Test or replace the E14 Seat Heating Element - Cushion.

    - **If the test lamp turns ON**

    NOTE: **Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.**

9. Test or replace the E14 Seat Heating Element - Back.

One Heating Element is Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the appropriate E14 Seat Heating Element.
2. Connect a test lamp between control circuit terminal 1 and control circuit terminal 4, Vehicle ON.
3. Verify the test lamp turns ON after pressing the heated seat switch.
    - **If the test lamp is always OFF**
        1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K29F Seat Heating Control Module - Front.
        2. Test for less than 2 Ω in each control circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - **If the test lamp turns ON**

    NOTE: **Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.**

4. Test or replace the E14 Seat Heating Element.

Degraded Heated Seat Operation Driver Seat

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at each component listed below. It may take up to 2 min for all vehicle systems to power down.
    - E14B Seat Heating Element - Driver Cushion
    - E14A Seat Heating Element - Driver Back
2. Test for less than 40 Ω between each low reference circuit terminal listed below and ground, one at a time.
    - E14B Seat Heating Element - Driver Cushion terminal 3
    - E14A Seat Heating Element - Driver Back terminal 3
    - **If 40 Ω or greater**

1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
2. Test for less than 2 Ω in the low reference circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K29F Seat Heating Control Module - Front.

- **If less than 40 Ω**

3. Vehicle ON.
4. Test for 4.8 - 5.2 V between each signal circuit terminal listed below and ground, one at a time.
    - E14B Seat Heating Element - Driver Cushion terminal 2
    - E14A Seat Heating Element - Driver Back terminal 2
    - **If less than 4.8 V**

    1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K29F Seat Heating Control Module - Front.

    - **If greater than 5.2 V**

    1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K29F Seat Heating Control Module - Front.

    - **If between 4.8 - 5.2 V**

5. Vehicle OFF, connect the harness connector at the E14B Seat Heating Element - Driver Cushion and the E14A Seat Heating Element - Driver Back. Disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
6. Test for 500 Ω - 300 kΩ between the signal circuit and the low reference circuit terminals listed below, one at a time.
    - E14B Seat Heating Element - Driver Cushion terminal 6 and terminal 1
    - E14A Seat Heating Element - Driver Back terminal 3 and terminal 1
    - **If not between 500 Ω - 300 kΩ**

      Replace the E14 Seat Heating Element.

    - **If between 500 Ω - 300 kΩ**
7. Replace the K29F Seat Heating Control Module - Front.

Degraded Heated Seat Operation Passenger Seat

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at each component listed below. It may take up to 2 min for all vehicle systems to power down.
    - E14D Seat Heating Element - Passenger Cushion
    - E14C Seat Heating Element - Passenger Back
2. Test for less than 40 Ω between each low reference circuit terminal listed below and ground, one at a time.
    - E14D Seat Heating Element - Passenger Cushion terminal 3
    - E14C Seat Heating Element - Passenger Back terminal 3

   - **If 40 Ω or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K29F Seat Heating Control Module - Front.
   - **If less than 40 Ω**
3. Vehicle ON.
4. Test for 4.8 - 5.2 V between each signal circuit terminal listed below and ground, one at a time.
   - E14D Seat Heating Element - Passenger Cushion terminal 2
   - E14C Seat Heating Element - Passenger Back terminal 2
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K29F Seat Heating Control Module - Front.
   - **If greater than 5.2 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front, Vehicle ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K29F Seat Heating Control Module - Front.
   - **If between 4.8 - 5.2 V**
5. Vehicle OFF, connect the harness connector at the E14D Seat Heating Element - Passenger Cushion and the E14C Seat Heating Element - Passenger Back. Disconnect the X2 harness connector at the K29F Seat Heating Control Module - Front.
6. Test for 500 Ω - 300 kΩ between the signal circuit and the low reference circuit terminals listed below, one at a time.
   - E14D Seat Heating Element - Passenger Cushion terminal 5 and terminal 2
   - E14C Seat Heating Element - Passenger Back terminal 4 and terminal 2
   - **If not between 500 Ω - 300 kΩ**

     Replace the E14 Seat Heating Element.

   - **If between 500 Ω - 300 kΩ**
7. Replace the K29F Seat Heating Control Module - Front.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Driver Information Display Replacement**
- **Driver or Passenger Seat Back Heater Replacement**
- **Front Seat Cushion Heater Replacement (Korea)Front Seat Cushion Heater Replacement (North America)**
- **Control Module References** for K29F Seat Heating Control Module - Front replacement, programming and setup

REAR HEATED SEAT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ Terminal 10 X1	U1526, 1	U1526, 1	-	-
B+ Terminal 7 X1	4	4	-	-
Left Rear Heated Seat Switch Signal	7	2	2	-
Indicator Dimming Control Terminal 6	B2625 02	6	6	-
Left Rear Heated Seat High Indicator Control Terminal 4	6	6	-	-
Left Rear Heated Seat Cushion Temperature Sensor Signal	2	3	3	-
Left Rear Heated Seat Cushion Temperature Sensor Low Reference	-	3	-	-
Left Rear Heated Seat Cushion Element Voltage Control	1	2	1	-
Left Rear Heated Seat Cushion Element Ground Control	1	2	1	-
Right Rear Heated Seat Switch Signal	7	4	4	-
Indicator Dimming Control Terminal 6	B2625 02	6	6	-
Right Rear Heated Seat High Indicator Control Terminal 4	6	6	-	-
Right Rear Heated Seat Cushion Temperature Sensor Signal	4	5	5	-
Right Rear Heated Seat Cushion Temperature Sensor Low Reference	-	5	-	-
Right Rear Heated Seat Cushion Element Voltage Control	1	4	1	-
Right Rear Heated Seat Cushion Element Ground Control	1	4	1	-
Rear Seat Heating Control Module Ground Terminal 7 X2	-	8	-	-
Rear Seat Heating Control Module Ground Terminal 8 X1	-	U1526, 1	-	-

1. Left and right rear heated seats are inoperative
2. Left rear heated seat is inoperative
3. Degraded left rear heated seat operation
4. Right rear heated seat is inoperative
5. Degraded right rear heated seat operation
6. Rear heated seat switch indicator malfunction
7. The heated seat is always ON
8. No effect

Circuit/System Description

When a heated seat switch is pressed, the heated seat switch signal circuit from the body control module (BCM) is pulled low indicating the heated seat command. The BCM serves as the heated seat system master to determine the requested operating mode. The BCM then sends a LIN bus serial data message to the rear seat heating control module indicating the heated seat command. In response to this message, the seat heating control module attempts to drive the appropriate seat heating element per the BCM command.

The rear seat heating control module controls heated seat operation for the left and right rear seats. When active, power is applied to the seat cushion heater element through a pulse width modulated (PWM) voltage supply control circuit. The heater element is switched to ground by the module through a low side drive control circuit.

The seat cushion temperature sensor (thermistor) is packaged with the seat heating element located just under the seat cover. The rear seat heating control module supplies the temperature sensor with a 5 V reference signal circuit and a low reference circuit. The module monitors the voltage from the signal circuit to determine the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

Diagnostic Aids

- A short to ground or B+ in either the heating element voltage control circuit or ground control circuit will cause both rear heated seats to be inoperative.
- A short to ground on the seat cushion temperature sensor signal circuit will cause the heated seat function to be inoperative for that seat.
- The following faults will cause a degraded heated seat operation.
  - An open or a short to voltage on the seat cushion temperature sensor signal circuit.
  - An open in the seat cushion temperature sensor low reference circuit.
  - A fault in the seat cushion temperature sensor.
- A broken wire in a heating element may cause a degraded heated seat operation for that particular heating element.
- When inactive the seat heating control module connects the heating element low side outputs to a common reference point internal to the module which is biased to approximately 3.5 V. The module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling the left and right rear seat heating elements.
- With the seat cushion heater element disconnected, if the high side output of the control module is measured it will display a low current 12 V bleed off voltage. This bleed off voltage does not have a meaningful diagnostic purpose. With the heater elements connected you would just see the 3.5 V biased voltage from this circuit.
- If the heated seats are on high, the temperature level may automatically be lowered after approximately 30 min of operation.

Reference Information

Schematic Reference

Heated/Cooled Seat Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Heated Seats Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.

   NOTE: **Review the Diagnostic Fault Information table and Diagnostic Aids in order to get a better understanding of the possible heated seat system faults before proceeding Circuit/System Verification and Circuit/System Testing.**

2. Verify the scan tool Body Control Module Left Rear Seat Heating/Venting/Cooling Mode parameter changes between Off and Seat Back and Cushion Heating when pressing the left rear heated seat switch.
   - **If the parameter does not change**

     Refer to Circuit/System Testing - Heated Seat Switch Circuit Test.

   - **If the parameter changes**
3. Verify the scan tool Right Rear Seat Heating/Venting/Cooling Mode parameter changes between Off and Seat Back and Cushion Heating when pressing the right rear heated seat switch.
   - **If the parameter does not change**

     Refer to Circuit/System Testing - Rear Heated Seat Switch Circuit Test.

   - **If the parameter changes**
4. Verify the left and right rear heated seats operate.
   - **If both rear heated seats are inoperative**

     Refer to Circuit/System Testing - Both Rear Heated Seats are Inoperative

   - **If just one of the rear heated seats is inoperative**

     Refer to Circuit/System Testing - One Rear Heated Seat is Inoperative

   - **If the left rear seat exhibits a degraded heated seat operation**

     Refer to Circuit/System Testing - Degraded Heated Seat Operation Left Rear Seat

   - **If the right rear seat exhibits a degraded heated seat operation**

     Refer to Circuit/System Testing - Degraded Heated Seat Operation Right Rear Seat

   - **If both heated seats operate**
5. Verify the rear heated seat switch indicator illuminates after pressing the rear seat heating switch.
   - **If the indicator does not illuminate**

     Refer to Circuit/System Testing - Heated Seat Switch Indicator Circuit Test.

   - **If the indicator illuminates**
6. All OK.

Circuit/System Testing

Rear Heated Seat Switch Circuit Test

NOTE: **Circuit/System Verification must be performed before proceeding**

with Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S32 Seat Heating Switch - Rear. It may take up to 2 min for all vehicle system to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the appropriate scan tool Rear Seat Heating/Venting/Cooling Mode parameter is Off.
   - **If not Off**
   1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 3 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Off**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
6. Verify the scan tool scan tool Rear Seat Heating/Venting/Cooling Mode parameter is Seat Back and Cushion Heating - High.
   - **If not Seat Back and Cushion Heating - High**
   1. Vehicle OFF, remove the jumper wire, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle ON.
   2. Test for less than 1 V between the signal circuit terminal 3 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Seat Back and Cushion Heating - High**
7. Test or replace the S32 Seat Heating Switch - Rear.

Both Heated Seats are Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
2. Verify a test lamp illuminates between each B+ circuit terminal listed below and ground.
   - Terminal 7
   - Terminal 10
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF, remove the test lamp.

    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K29R Seat Heating Control Module - Rear.
    - **If the test lamp illuminates**
3. Vehicle OFF.
4. Test for infinite resistance between each control circuit terminal listed below and ground, one at a time.
    - Terminal 2
    - Terminal 6
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
5. Vehicle ON.
6. Test for less than 1 V between each control circuit terminal listed below and ground, one at a time.
    - Terminal 2
    - Terminal 6
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
7. Replace the K29R Seat Heating Control Module - Rear.

One Heated Seat is Inoperative

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the X1 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
2. Verify a test lamp illuminates between the B+ circuit terminal 7 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K29R Seat Heating Control Module - Rear.
    - **If the test lamp illuminates**
3. Vehicle OFF, connect the X1 harness connector at the K29R Seat Heating Control Module - Rear and disconnect the harness connector at the appropriate E14 Seat Heating Element - Rear Cushion, Vehicle ON.

NOTE: **When performing this test ensure that you are testing from the correct terminal. Testing from the incorrect terminal will cause a misdiagnosis of the circuit. Three of the four terminals in this connector will not only display a voltage reading but a different voltage reading.**

4. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.

    - **If less than 4.8 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K29R Seat Heating Control Module - Rear.
    - **If greater than 5.2 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K29R Seat Heating Control Module - Rear.
    - **If between 4.8 - 5.2 V**

5. Connect a test lamp between control circuit terminal 1 and control circuit terminal 4, Vehicle ON.

NOTE: **The test lamp should turn ON for approximately 20 s after the heated seat is commanded ON.**

6. Verify the test lamp turns ON after pressing the rear heated seat switch.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K29R Seat Heating Control Module - Rear.
    2. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K29R Seat Heating Control Module - Rear.
    - **If the test lamp turns ON**

NOTE: **Because of the type of material used in the heater element, a reliable resistance value is unavailable for a component test.**

7. Test or replace the E14 Seat Heating Element - Rear Cushion.

Degraded Heated Seat Operation Left Rear Seat

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at the E14F Seat Heating Element - Left Rear Cushion. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 40 Ω between the low reference circuit terminal 3 and ground.
    - **If 40 Ω or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K29R Seat Heating Control Module - Rear.
    - **If less than 40 Ω**
3. Vehicle ON.
4. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.
    - **If less than 4.8 V**

   1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K29R Seat Heating Control Module - Rear.
   - **If greater than 5.2 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K29R Seat Heating Control Module - Rear.
   - **If between 4.8 - 5.2 V**
5. Vehicle OFF, connect the harness connector at the E14F Seat Heating Element - Left Rear Cushion and disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
6. Test for 500 Ω - 300 kΩ between the signal circuit terminal 6 and the low reference circuit terminal 1.
   - **If not between 500 Ω - 300 kΩ**

     Replace the E14F Seat Heating Element - Left Rear Cushion.

   - **If between 500 Ω - 300 kΩ**
7. Replace the K29R Seat Heating Control Module - Rear.

Degraded Heated Seat Operation Right Rear Seat

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing**

1. Vehicle OFF, disconnect the harness connector at the E14H Seat Heating Element - Right Rear Cushion. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 40 Ω between the low reference circuit terminal 3 and ground.
   - **If 40 Ω or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K29R Seat Heating Control Module - Rear.
   - **If less than 40 Ω**
3. Vehicle ON.
4. Test for 4.8 - 5.2 V between the signal circuit terminal 2 and ground.
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K29R Seat Heating Control Module - Rear.

- **If greater than 5.2 V**

  1. Vehicle OFF, disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear, Vehicle ON.
  2. Test for less than 1 V between the signal circuit and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V, replace the K29R Seat Heating Control Module - Rear.

- **If between 4.8 - 5.2 V**

5. Vehicle OFF, connect the harness connector at the E14H Seat Heating Element - Right Rear Cushion and disconnect the X2 harness connector at the K29R Seat Heating Control Module - Rear.
6. Test for 500 Ω - 300 kΩ between the signal circuit terminal 5 and the low reference circuit terminal 2.
   - **If not between 500 Ω - 300 kΩ**

     Replace the E14H Seat Heating Element - Right Rear Cushion.

   - **If between 500 Ω - 300 kΩ**
7. Replace the K29R Seat Heating Control Module - Rear.

Heated Seat Switch Indicator Circuit Test

NOTE: **Circuit/System Verification must be performed before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the harness connector at the appropriate S32 Seat Heating Switch - Rear, Vehicle ON.

   NOTE: **The test lamp in the following step will illuminate at LOW intensity. This is normal circuit operation and does not indicate a circuit malfunction.**

2. Verify a test lamp illuminates at LOW intensity between the control circuit terminal 6 and ground.
   - **If the test lamp does not illuminate**
     1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K9 Body Control Module.
     2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
     3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module
   - **If the test lamp illuminates at FULL intensity**
     1. Vehicle OFF, remove the test lamp, disconnect the X1 harness connector at the K9 Body Control Module, Vehicle ON.
     2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp illuminates at LOW intensity**
3. Connect a test lamp illuminate between control circuit terminal 6 and control circuit terminal 4.
4. Verify the test lamp Does Not illuminate.
   - **If the test lamp illuminates**
     1. Vehicle OFF, remove the test lamp, disconnect the X5 harness connector at the K9 Body Control Module.
     2. Test for infinite resistance between the control circuit terminal 4 and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp does not illuminate**

5. Verify the test lamp illuminates when commanding the Rear Seat Heating Indicator Active with a scan tool.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module, Vehicle ON.
    2. Test for less than 1 V between the control circuit terminal 4 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
6. Test or replace the S32 Seat Heating Switch - Rear.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Seat Heater Switch Replacement**
- **Rear Seat Cushion Heater Replacement**
- **Control Module References** for K29R Seat Heating Control Module - Rear replacement, programming and setup

REPAIR INSTRUCTIONS

FRONT SEAT HEATER CONTROL MODULE BRACKET REPLACEMENT

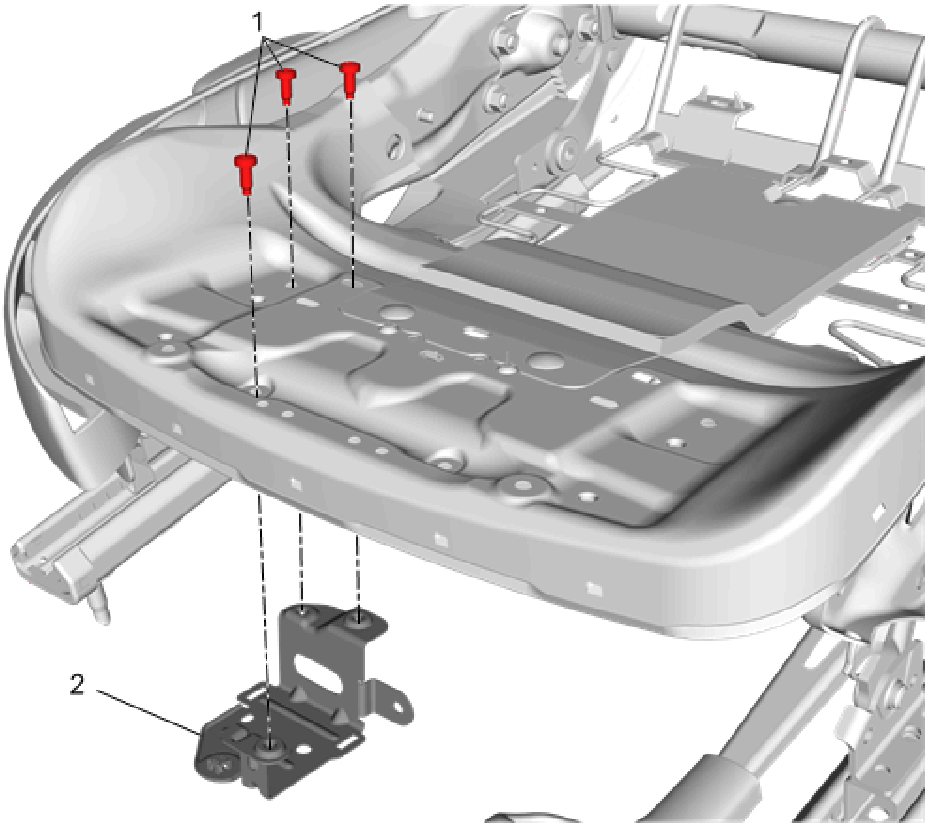


Fig. 3: Front Seat Heater Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Front Seat Cushion Cover and Pad Replacement 2. Front Seat Heater Vent Control Module Replacement	
1	Front Seat Heater Control Module Bracket Fastener **CAUTION:** Fastener Caution **Tighten** 4.7 N.m (42 lb in)
2	Front Seat Heater Control Module Bracket **Procedure** Unclip the wiring harness from the bracket.

FRONT SEAT HEATER VENT CONTROL MODULE REPLACEMENT

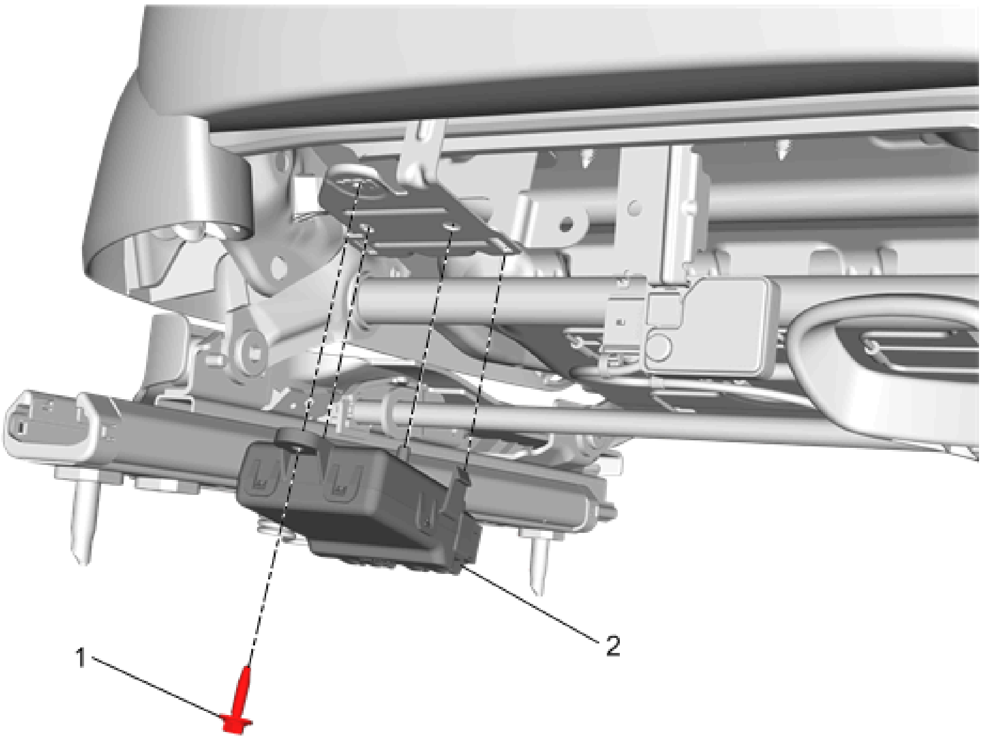


Fig. 4: Front Seat Heater Vent Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Seat Heater Control Module Fastener **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
2	Front Seat Heater Control Module **Procedure** 1. Adjust the seat to be in the full up position. 2. Disconnect the electrical connectors.

DRIVER OR PASSENGER SEAT BACK HEATER REPLACEMENT

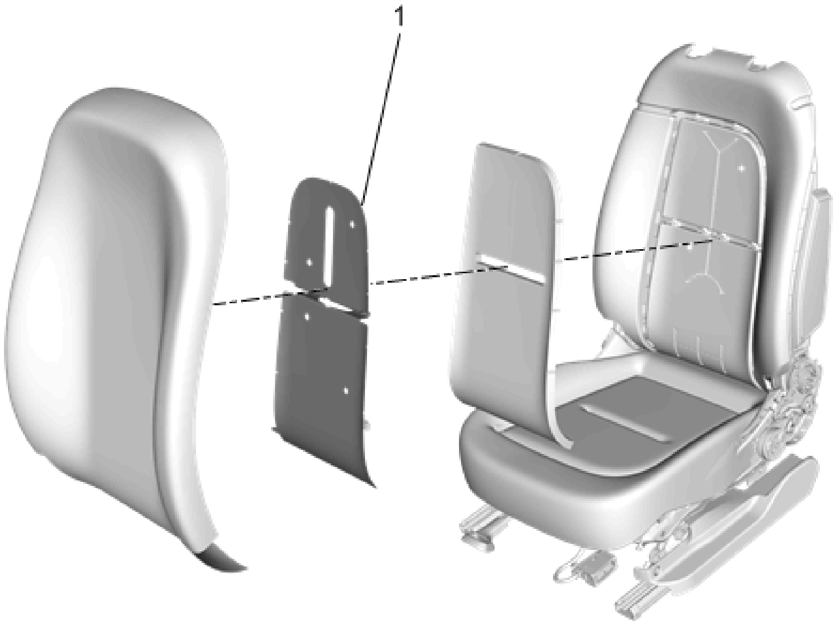


Fig. 5: Driver or Passenger Seat Back Heater

Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
SIR Warning
Preliminary Procedures
1. Driver or Passenger Seat - Remove - Driver or Passenger Seat Removal and Installation
2. Driver or Passenger Seat Head Restraint Replacement
3. Front Seat Back Cushion Latch Finish Cover &ndash;Back Panel - Remove - Front Seat Back Cushion Latch Finish Cover Replacement (Back Panel) Front Seat Back Cushion Latch Finish Cover Replacement (Front Panel)
4. Driver or Passenger Seat Back Cushion Cover - Remove - Driver or Passenger Seat Back Cover and Pad Replacement</td></tr>
<tr><td></td><td></td></tr>
</table>

Callout	Component Name
1	Driver or Passenger Seat Back Heater **Procedure** 1. Disconnect the electrical connector and unclip the harness. 2. Driver or Passenger Seat - Install - Driver or Passenger Seat Removal and Installation **NOTE:** **Separate the seat cushion heater mat from the seat cushion pad by pulling the heater mat away from the pad. Use a heat gun to loosen the glue : moving slowly from one end to the other, slowly peeling the heater mat up as you go. This makes removal easier and ensures minimum damage to the underlying foam. Be careful not to use overly high temperatures or hold the heat gun in one place for too long as this can damage the foam.**

FRONT SEAT CUSHION HEATER REPLACEMENT (KOREA)

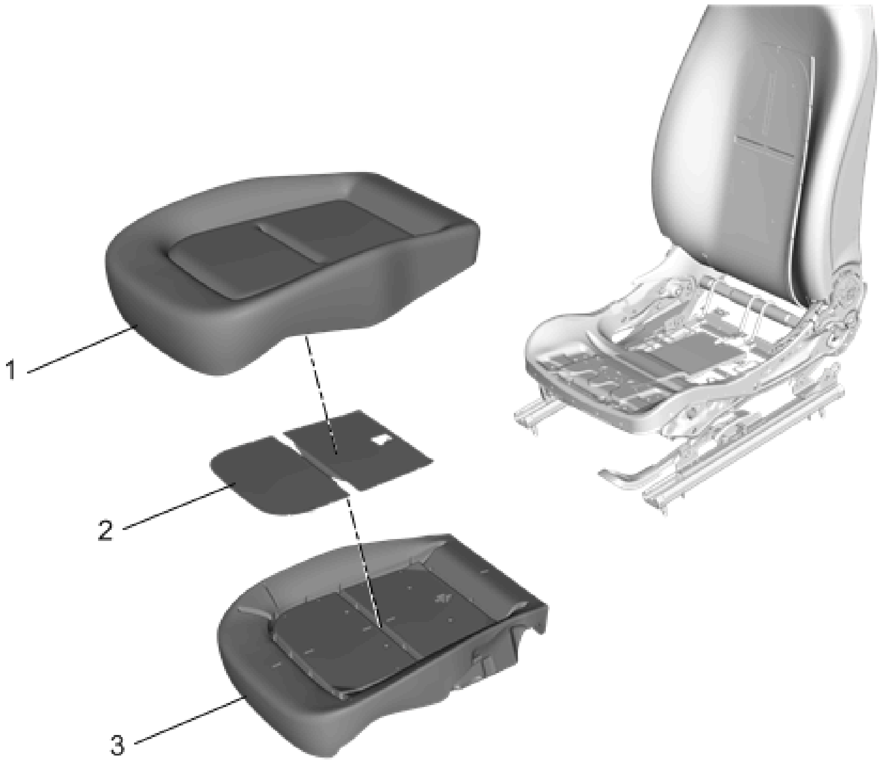


Fig. 6: Front Seat Cushion Heater (Korea)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedure** Front Seat Cushion Cover and Pad Replacement	
1	Front Seat Cushion Cover
2	Front Seat Cushion Heater

Callout	Component Name
3	Front Seat Cushion Pad **NOTE:** **Separate the seat cushion heater mat from the seat cushion pad by pulling the heater mat away from the pad. Use a heat gun to loosen the glue : moving slowly from one end to the other, slowly peeling the heater mat up as you go. This makes removal easier and ensures minimum damage to the underlying foam. Be careful not to use overly high temperatures or hold the heat gun in one place for too long as this can damage the foam.**

FRONT SEAT CUSHION HEATER REPLACEMENT (NORTH AMERICA)

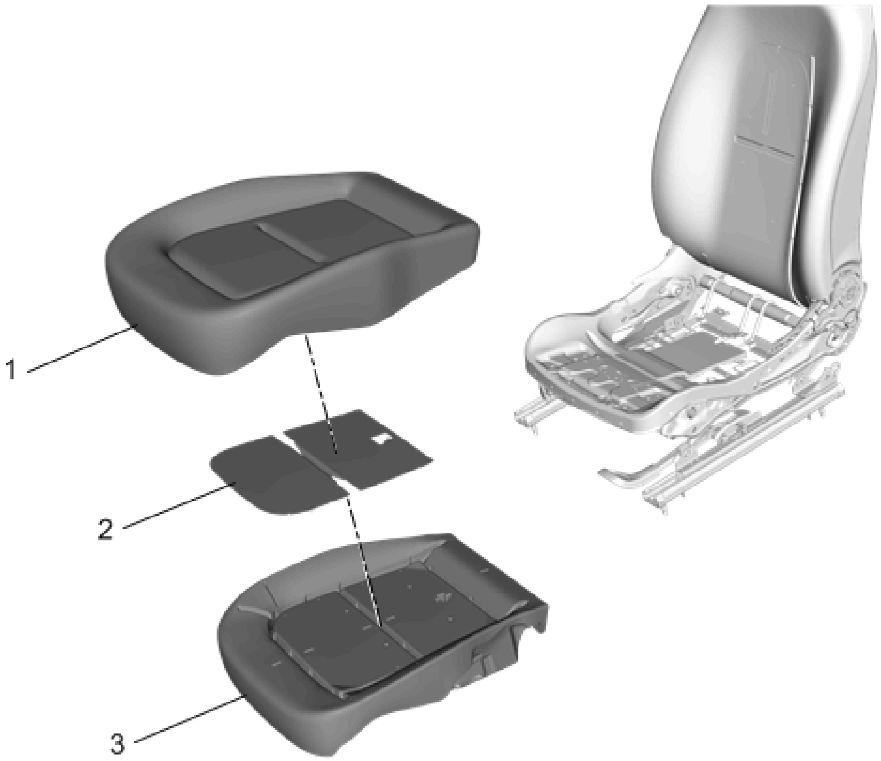


Fig. 7: Front Seat Cushion Heater (North America)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedure** Front Seat Cushion Cover and Pad Replacement	
1	Front Seat Cushion Cover

Callout	Component Name
2	Front Seat Cushion Heater **WARNING:** **Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. All the components in the service kit are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly.** **NOTE:** **The passenger seat belt presence sensor and heat mat, if equipped, are integral parts of the seat cushion pad.**
3	Front Seat Cushion Pad **NOTE:** **Separate the seat cushion heater mat from the seat cushion pad by pulling the heater mat away from the pad. Use a heat gun to loosen the glue : moving slowly from one end to the other, slowly peeling the heater mat up as you go. This makes removal easier and ensures minimum damage to the underlying foam. Be careful not to use overly high temperatures or hold the heat gun in one place for too long as this can damage the foam.**

REAR SEAT HEATER SWITCH REPLACEMENT

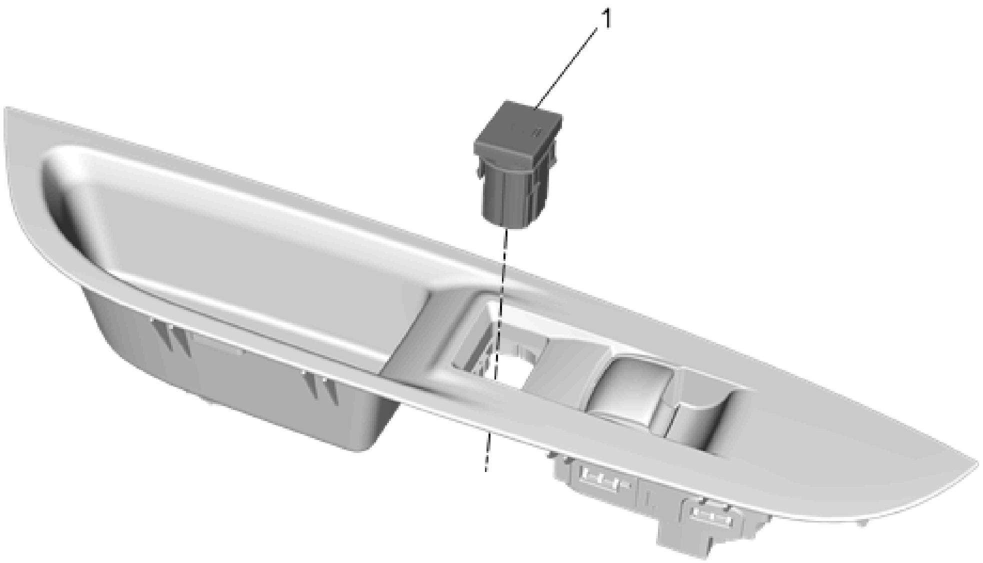


Fig. 8: Rear Seat Heater Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Rear Side Door Armrest Switch Mount Plate Replacement	

Callout	Component Name
1	Rear Seat Heater Switch **Procedure** Release the switch assembly from the switch mount plate by depressing the tabs along each side of the switch.

REAR SEAT CUSHION HEATER REPLACEMENT

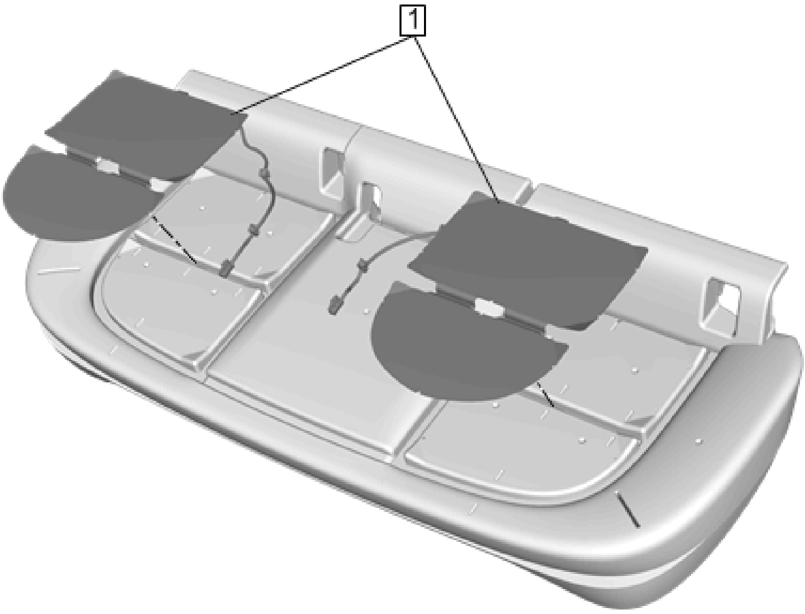


Fig. 9: Rear Seat Cushion Heater
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Cushion Cover - Remove - Rear Seat Cushion Cover and Pad Replacement	
1	Rear Seat Cushion Heater **NOTE:** **Separate the seat cushion heater mat from the seat cushion pad by pulling the heater mat away from the pad. Use a heat gun to loosen the glue : moving slowly from one end to the other, slowly peeling the heater mat up as you go. This makes removal easier and ensures minimum damage to the underlying foam. Be careful not to use overly high temperatures or hold the heat gun in one place for too long as this can damage the foam.**

DESCRIPTION AND OPERATION

HEATED SEATS DESCRIPTION AND OPERATION

Heated Seat Components

The heated seat system consists of the following components:

- Heated seat switches
- Body control module
- Seat heating control module

- Driver seat cushion heating element
- Driver seat cushion temperature sensor
- Driver seat back heating element
- Driver seat back temperature sensor
- Passenger seat cushion heating element
- Passenger seat cushion temperature sensor
- Passenger seat back heating element
- Passenger seat back temperature sensor

Heated Seat Switches

The driver and passenger heated seats switches are located on the infotainment display. The vehicle must be ON to operate the heated seat system. When a heated seat switch is pressed, a serial data message is sent from the infotainment display to the body control module (BCM) indicating the heated seat command. The BCM serves as the heated seat system master to determine the requested operating mode. The BCM then sends a serial data message to the seat heating control module indicating the heated seat command. In response to this message, the seat heating control module attempts to drive the appropriate seat heating elements per the BCM command. The BCM also controls the seat temperature and mode indicators, via the serial data line, used to provide the operator with feedback as to the operating status of the system.

Heated Seat Operation

The seat heating control module controls heated seat operation for the driver and passenger seats. When active, power is applied to the seat cushion and back heater elements through a common pulse width modulated (PWM) voltage supply control circuit. Each individual heater element is switched to ground by the module through a common low side drive control circuit.

When inactive the seat heating control module connects the heating element low side outputs to a common reference point internal to the module which is biased to approximately 3.5 V. The module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling the driver and passenger seat heating elements. During heated seat operation, the seat heating control module interrupts control of the heating elements every 10 s for approximately 10 ms to make this biased voltage check.

With both the seat cushion and seat back heater elements disconnected, if the high side output of the module is measured it will display a low current 12 V bleed off voltage. This bleed off voltage does not have a meaningful diagnostic purpose. With one or both of the heater elements connected you would just see the 3.5 V biased voltage from this circuit.

Temperature Regulation

The seat back and cushion temperature sensors (thermistors) are packaged with the seat heating elements located just under the seat covers. The seat heating control module supplies each temperature sensor with a 5 V reference signal circuit and a low reference circuit. The module monitors the voltage from the signal circuit to determine the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

If the heated seats are on high, the temperature level may automatically be lowered after approximately 30 min of operation.

REAR HEATED SEATS DESCRIPTION AND OPERATION

Heated Seat Components

The rear heated seat system consists of the following components:

- Rear heated seat switches

- Body control module
- Rear seat heating control module
- Left rear seat cushion heating element
- Left rear seat cushion temperature sensor
- Right rear seat cushion heating element
- Right rear seat cushion temperature sensor

Heated Seat Switches

When a heated seat switch is pressed, the heated seat switch signal circuit from the body control module (BCM) is pulled low indicating the heated seat command. The BCM serves as the heated seat system master to determine the requested operating mode. The BCM then sends a LIN bus serial data message to the rear seat heating control module indicating the heated seat command. In response to this message, the seat heating control module attempts to drive the appropriate seat heating element per the BCM command.

Rear Heated Seat Operation

The rear seat heating control module controls heated seat operation for the left and right rear seats. When active, power is applied to the seat cushion and back heater elements through a common pulse width modulated (PWM) voltage supply control circuit. Each individual heater element is switched to ground by the module through a common low side drive control circuit.

When inactive the rear seat heating control module connects the heating element low side outputs to a common reference point internal to the control module which is biased to approximately 3.5 V. The control module uses this biased voltage in order to check the high side and low side control circuits for a short to battery or ground before enabling either the left or right rear seat heating element. During heated seat operation, the control module interrupts control of the heating elements every 10 s for approximately 10 ms to make this biased voltage check.

Temperature Regulation

The seat cushion temperature sensor (thermistors) is packaged with the seat heating element located just under the seat cover. The rear seat heating control module supplies the temperature sensor with a 5 V reference signal circuit and a low reference circuit. The control module monitors the voltage from the signal circuit to determine the temperature of the seat.

The temperature sensor varies in resistance based on the temperature of the heating element causing the signal voltage to change. Once the rear seat heating control module senses the seat reached the set temperature, it will then begin regulate the current flow through the heater elements in order to maintain the desired seat temperature based on the feedback voltage from the sensor.

The temperature level may automatically be lowered after approximately 30 min of operation.

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Secondary and Configurable Customer Controls - Bolt EV

SCHEMATIC WIRING DIAGRAMS

STEERING WHEEL SECONDARY/CONFIGURABLE CONTROL WIRING SCHEMATICS

Steering Wheel Secondary/Configurable Control Wiring Schematics

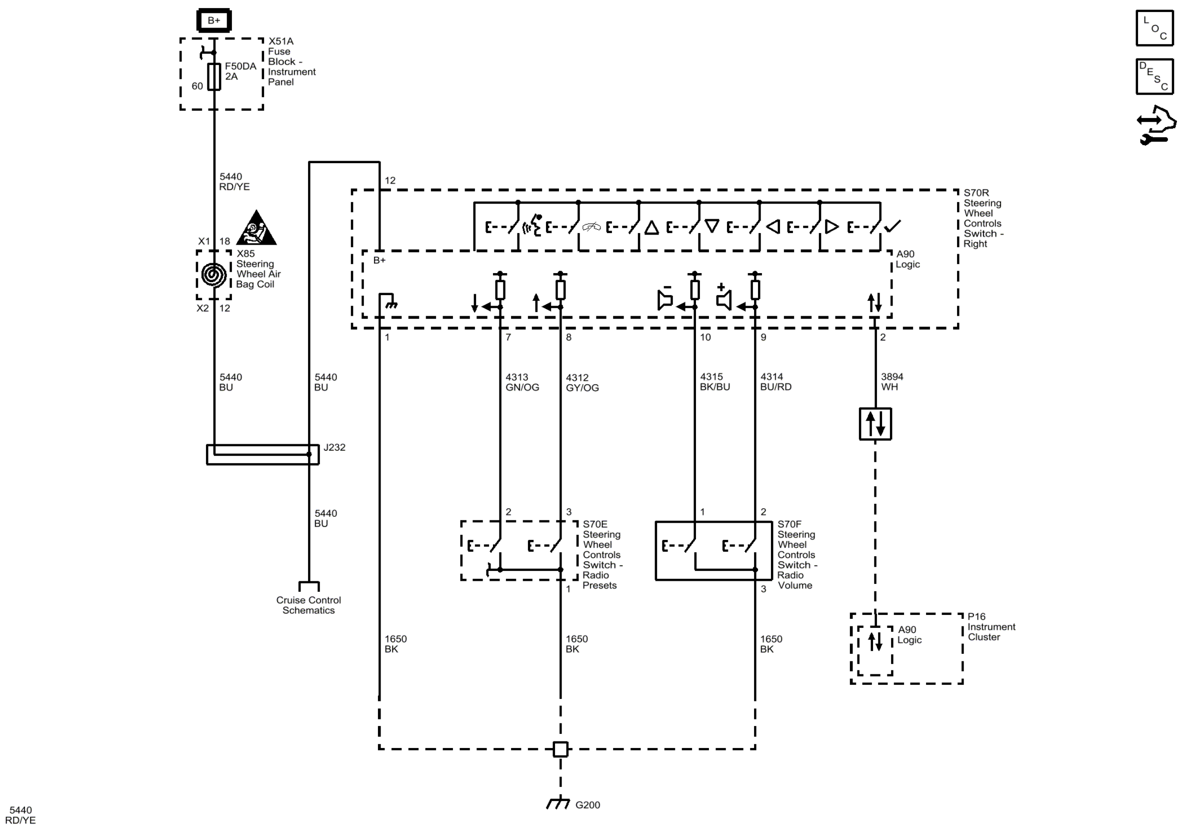

B+
X51A Fuse Block - Instrument Panel
F50DA 2A
60
5440 RD/YE
X1 18
X85 Steering Wheel Air Bag Coil
X2 12
5440 BU
5440 BU
J232
5440 BU
Cruise Control Schematics
12
S70R Steering Wheel Controls Switch - Right
B+
A90 Logic
1
7
8
10
9
2
4313 GN/OG
4312 GY/OG
4315 BK/BU
4314 BU/RD
3894 WH
2
3
S70E Steering Wheel Controls Switch - Radio Presets
1
1
2
S70F Steering Wheel Controls Switch - Radio Volume
3
P16 Instrument Cluster
A90 Logic
1650 BK
1650 BK
1650 BK
G200
5440 RD/YE
LOC
DESC

Fig. 1: Steering Wheel Secondary/Configurable Control Schematics
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B3622: STEERING WHEEL CONTROLS SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B3622

Steering Wheel Controls Signal Circuit

For symptom byte information refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1510 00	U1510 00	-	-
Volume Up Signal-Terminal 8	B3622 39, B3622 59	1	-	-
Volume Down Signal-Terminal 7	B3622 39, B3622 59	1	-	-
Next Preset Signal-Terminal 9	B3622 39, B3622 59	1	-	-
Previous Preset Signal-Terminal 10	B3622 39, B3622 59	1	-	-
Serial Data	U1510 00, B3622 59	U1510 00	U1510 00, B3622 59	-
Low Reference	-	U1510 00	-	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The steering wheel controls are divided into a right-hand set and left-hand set. The right - hand switch communicates with the instrument cluster through serial data and provides input from the rear left - hand switch and rear right - hand switch. The instrument cluster identifies the switch selection and activates the feature.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

B3622 39

An internal electrical malfunction has been detected in the steering wheel controls switch.

B3622 59

A stuck switch has been detected in the steering wheel controls switch.

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

The DTC will clear when the conditions for setting the DTC are no longer present.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify all the associated primary controls on the radio (Volume, Mute, Seek, etc.) operate properly.
    - **If any of the primary controls do not function properly**

      Refer to **Symptoms - Entertainment** .

    - **If all of the primary controls function properly**
3. Verify the scan tool Steering Wheel Control Switches parameter changes when pressing the S70R Steering Wheel Controls Switch - Right buttons.
    - **If the parameter does not change for some of the S70R Steering Wheel Controls Switch - Right switches**

      Replace S70R Steering Wheel Controls Switch - Right.

    - **If the parameter does not change for all of the S70R Steering Wheel Controls Switch - Right switches**

      Refer to S70R Steering Wheel Controls Switch Circuit/System Testing.

    - **If the parameter changes for all S70R Steering Wheel Controls Switch - Right buttons**
4. Verify the scan tool Steering Wheel Control Switches parameter changes between Volume Up and Volume Down when depressing the S70F Steering Wheel Controls Switch - Radio Volume switch.
    - **If the parameter does not change**

      Refer to S70F Steering Wheel Controls Switch - Radio Volume Circuit/System Testing.

    - **If the parameter changes**
5. Verify the scan tool Steering Wheel Control Switches parameter changes between Next Preset and Previous Preset when depressing the S70E Steering Wheel Controls Switch - Radio Presets switch.
    - **If the parameter does not change**

      Refer to S70E Steering Wheel Controls Switch - Radio Presets Circuit/System Testing.

    - **If the parameter changes**
6. All OK.

Circuit/System Testing

S70F Steering Wheel Controls Switch - Radio Volume

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.

- **If less than 10 Ω**

3. Ignition ON.
4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:
    - Terminal 1
    - Terminal 2
    - **If 4.5 V or less**
    1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S70R Steering Wheel Controls Switch - Right.
    - **If greater than 4.5 V**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 3.
6. Verify the scan tool Steering Wheel Control Switches parameter is Volume Down Button.
    - **If not Volume Down Button**

      Test or replace the S70R Steering Wheel Controls Switch - Right.

    - **If Volume Down Button**
7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.
8. Verify the scan tool Steering Wheel Control Switches parameter is Volume Up Button.
    - **If not Volume Up Button**

      Test or replace the S70R Steering Wheel Controls Switch - Right.

    - **If Volume Up Button**
9. Test or replace the S70F Steering Wheel Controls Switch - Radio Volume.

S70E Steering Wheel Controls Switch - Radio Presets

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:
    - Terminal 2
    - Terminal 3
    - **If 4.5 V or less**
    1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
    2. Test for infinite resistance between the signal circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S70R Steering Wheel Controls Switch - Right.
    - **If greater than 4.5 V**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
6. Verify the scan tool Steering Wheel Control Switches parameter is Next Preset.
    - **If not Next Preset**

      Test or replace the S70R Steering Wheel Controls Switch - Right.

    - **If Next Preset**
7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
8. Verify the scan tool Steering Wheel Control Switches parameter is Previous Preset.
    - **If not Previous Preset**

      Test or replace the S70R Steering Wheel Controls Switch - Right.

    - **If Previous Preset**
9. Test or replace the S70E Steering Wheel Controls Switch - Radio Presets.

S70R Steering Wheel Controls Switch-Right

1. Ignition OFF, disconnect the harness connector X1 at the P16 Instument Cluster.
2. Disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right. Ignition ON.
3. Test for less than 1 V between the S70R Steering Wheel Controls Switch - Right serial data circuit terminal 2 and ground.
    - **If greater than 1 V**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
4. Ignition OFF.
5. Test for infinite resistance between the serial data circuit terminal 2 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
6. Replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume.
2. Test for infinite resistance between the following signal terminals and the ground terminal 3 with the switch in the open position.
    - Terminal 1
    - Terminal 2
    - **If less than infinite resistance on either circuit**

      Replace the S70F Steering Wheel Controls Switch - Radio Volume.

  - **If infinite resistance**

3. Test for less than 10 Ω between the following signal terminals and the ground terminal 3 with the S70F Steering Wheel Controls Switch - Radio Volume in the Up position or Down position.
    - Terminal 1
    - Terminal 2
    - **If 10 Ω or greater**

      Replace the S70F Steering Wheel Controls Switch - Radio Volume.

    - **If less than 10 Ω**
4. Ignition OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets.
5. Test for infinite resistance between the following signal terminals and the ground terminal 1 with the switch in the open position.
    - Terminal 2
    - Terminal 3
    - **If less than infinite resistance on either circuit**

      Replace the S70E Steering Wheel Controls Switch - Radio Presets.

    - **If infinite resistance**
6. Test for less than 10 Ω between the following signal terminals and the ground terminal 1 with the S70E Steering Wheel Controls Switch - Radio Presets in the Up position or Down position.
    - Terminal 2
    - Terminal 3
    - **If 10 Ω or greater**

      Replace the S70E Steering Wheel Controls Switch - Radio Presets.

    - **If less than 10 Ω**
7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Steering Wheel Spoke Cover Replacement

SYMPTOMS - SECONDARY AND CONFIGURABLE CUSTOMER CONTROLS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to **Steering Wheel Controls Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the steering wheel controls. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

Refer to **Steering Wheel Controls Malfunction** in order to diagnose the symptom.

STEERING WHEEL CONTROLS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U1510 00	U1510 00	-	-
Volume Up Signal	B3622 39, B3622 59	1	-	-
Volume Down Signal	B3622 39, B3622 59	1	-	-
Next Preset Signal	B3622 39, B3622 59	1	-	-
Previous Preset Signal	B3622 39, B3622 59	1	-	-
Serial Data	-	U1510 00	-	-
Low Reference	-	U1510 00	-	-
1. Steering Wheel Controls Inoperative				

Circuit/System Description

The steering wheel controls are divided into a right-hand set and left-hand set. The right - hand switch communicates with the instrument cluster through serial data and provides input from the rear left - hand switch and rear right - hand switch. The instrument cluster identifies the switch selection and activates the feature.

Reference Information

Schematic Reference

Steering Wheel Secondary/Configurable Control Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel Controls Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON. Verify the driver information center (DIC) illuminates.
    - **If the DIC does not illuminate**

      Test or replace the instrument cluster.

    - **If the DIC illuminates**
2. Verify all the associated primary controls on the radio (Volume, Mute, Seek, etc.) operate properly.
    - **If any of the primary controls do not function properly**

      Refer to **Symptoms - Entertainment** .

    - **If all of the primary controls function properly**
3. Verify the scan tool Steering Wheel Control Switches parameter changes when pressing the S70R Steering Wheel Controls Switch - Right buttons.
    - **If the parameter does not change for some of the S70R Steering Wheel Controls Switch - Right switches**

      Replace S70R Steering Wheel Controls Switch - Right.

    - **If the parameter does not change for all of the S70R Steering Wheel Controls Switch - Right switches**

      Refer to S70R Steering Wheel Controls Switch Circuit/System Testing.

    - **If the parameter changes for all S70R Steering Wheel Controls Switch - Right buttons**
4. Verify the scan tool Steering Wheel Control Switches parameter changes between Volume Up and Volume Down when depressing the S70F Steering Wheel Controls Switch - Radio Volume switch.
    - **If the parameter does not change**

      Refer to S70F Steering Wheel Controls Switch - Radio Volume Circuit/System Testing.

    - **If the parameter changes**
5. Verify the scan tool Steering Wheel Control Switches parameter changes between Next Preset and Previous Preset when depressing the S70E Steering Wheel Controls Switch - Radio Presets switch.
    - **If the parameter does not change**

      Refer to S70E Steering Wheel Controls Switch - Radio Presets Circuit/System Testing.

    - **If the parameter changes**
6. All OK.

Circuit/System Testing

S70F Steering Wheel Controls Switch - Radio Volume

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:
    - Terminal 1
    - Terminal 2
    - **If 4.5 V or less**
    1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S70R Steering Wheel Controls Switch - Right.
    - **If greater than 4.5 V**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 3.
6. Verify the scan tool Steering Wheel Control Switches parameter is Volume Down Button.
    - **If not Volume Down Button**

      Test or replace the S70R Steering Wheel Controls Switch - Right.

    - **If Volume Down Button**
7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 3.
8. Verify the scan tool Steering Wheel Control Switches parameter is Volume Up Button.
    - **If not Volume Up Button**

      Test or replace the S70R Steering Wheel Controls Switch - Right.

    - **If Volume Up Button**
9. Test or replace the S70F Steering Wheel Controls Switch - Radio Volume.

S70E Steering Wheel Controls Switch - Radio Presets

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 4.5 V between the signal circuit terminals listed below and ground:
    - Terminal 2
    - Terminal 3
    - **If 4.5 V or less**
    1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right.

      2. Test for infinite resistance between the signal circuit and ground.
         - If less than infinite resistance, repair the short to ground on the circuit.
         - If infinite resistance
      3. Test for less than 2 Ω in the signal circuit end to end.
         - If 2 Ω or greater, repair the open/high resistance in the circuit.
         - If less than 2 Ω, test or replace the S70R Steering Wheel Controls Switch - Right.
   - **If greater than 4.5 V**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
6. Verify the scan tool Steering Wheel Control Switches parameter is Next Preset.
   - **If not Next Preset**

     Test or replace the S70R Steering Wheel Controls Switch - Right.

   - **If Next Preset**
7. Remove the jumper wire. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 1.
8. Verify the scan tool Steering Wheel Control Switches parameter is Previous Preset.
   - **If not Previous Preset**

     Test or replace the S70R Steering Wheel Controls Switch - Right.

   - **If Previous Preset**
9. Test or replace the S70E Steering Wheel Controls Switch - Radio Presets.

S70R Steering Wheel Controls Switch-Right

1. Ignition OFF, disconnect the harness connector X1 at the P16 Instument Cluster.
2. Disconnect the harness connector at the S70R Steering Wheel Controls Switch - Right. Ignition ON.
3. Test for less than 1 V between the S70R Steering Wheel Controls Switch - Right serial data circuit terminal 2 and ground.
   - **If greater than 1 V**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
4. Ignition OFF.
5. Test for infinite resistance between the serial data circuit terminal 2 and ground.
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
6. Replace the S70R Steering Wheel Controls Switch - Right.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S70F Steering Wheel Controls Switch - Radio Volume.
2. Test for infinite resistance between the following signal terminals and the ground terminal 3 with the switch in the open position.
   - Terminal 1
   - Terminal 2
   - **If less than infinite resistance on either circuit**

     Replace the S70F Steering Wheel Controls Switch - Radio Volume.

- **If infinite resistance**

3. Test for less than 10 Ω between the following signal terminals and the ground terminal 3 with the S70F Steering Wheel Controls Switch - Radio Volume in the Up position or Down position.
    - Terminal 1
    - Terminal 2
    - **If 10 Ω or greater**

      Replace the S70F Steering Wheel Controls Switch - Radio Volume.

    - **If less than 10 Ω**
4. Ignition OFF, disconnect the harness connector at the S70E Steering Wheel Controls Switch - Radio Presets.
5. Test for infinite resistance between the following signal terminals and the ground terminal 1 with the switch in the open position.
    - Terminal 2
    - Terminal 3
    - **If less than infinite resistance on either circuit**

      Replace the S70E Steering Wheel Controls Switch - Radio Presets.

    - **If infinite resistance**
6. Test for less than 10 Ω between the following signal terminals and the ground terminal 1 with the S70E Steering Wheel Controls Switch - Radio Presets in the Up position or Down position.
    - Terminal 2
    - Terminal 3
    - **If 10 Ω or greater**

      Replace the S70E Steering Wheel Controls Switch - Radio Presets.

    - **If less than 10 Ω**
7. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Steering Wheel Spoke Cover Replacement

REPAIR INSTRUCTIONS

RESET TEEN DRIVER KEY PIN

If the PIN has been lost the only way to clear a Teen Key is to follow the Body Control Module (BCM) Configuration/Reset Functions Reset Teen Driver Key PIN procedure in the scan tool. This procedure will clear all Teen Keys

1. Connect a scan tool to the vehicle.
2. Select the Reset Teen Driver Key PIN.
3. After resetting the PIN, all teen keys will be cleared.
4. Verify teen keys are cleared.

DESCRIPTION AND OPERATION

STEERING WHEEL CONTROLS DESCRIPTION AND OPERATION

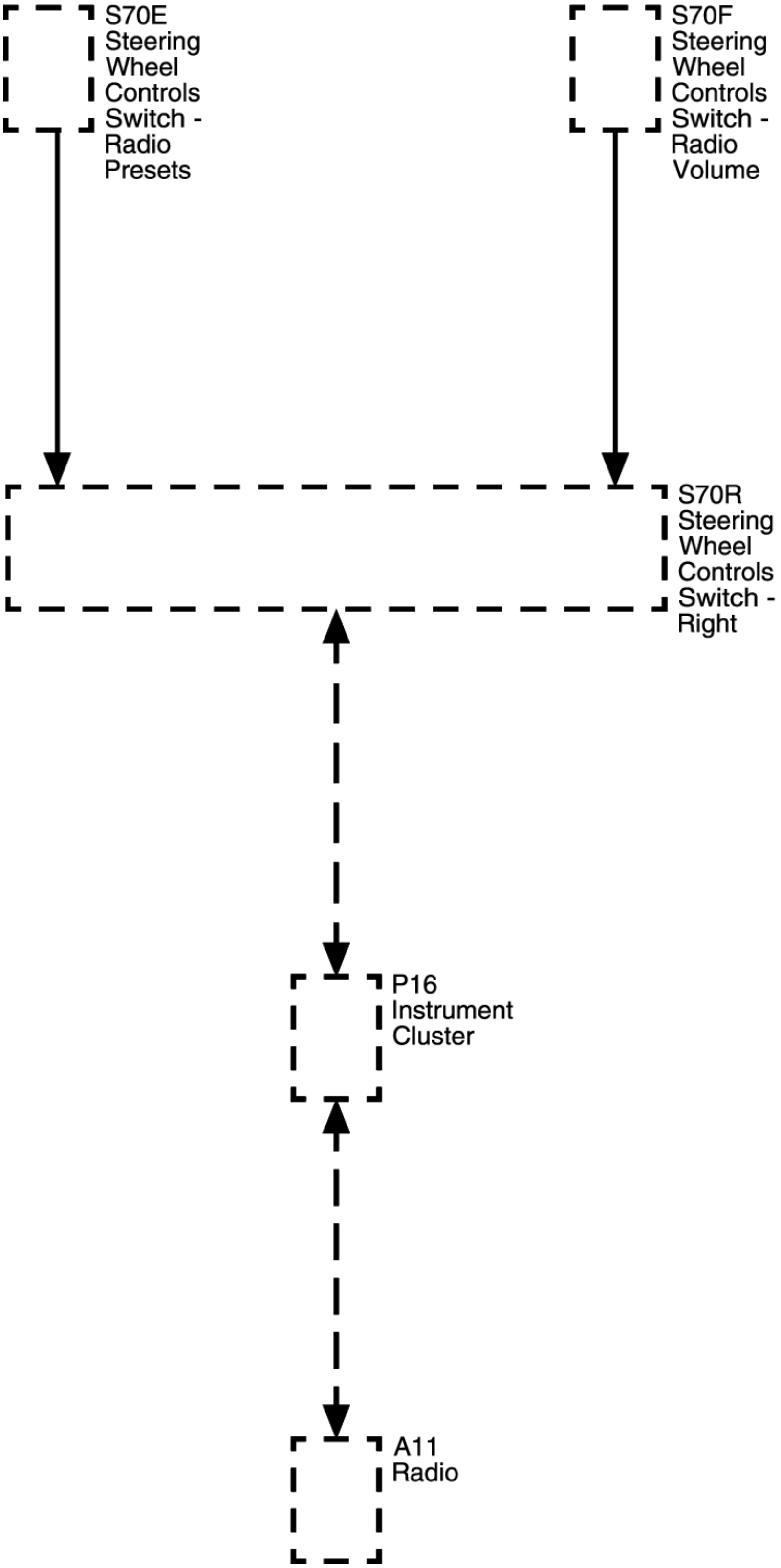

S70E Steering Wheel Controls Switch - Radio Presets
S70F Steering Wheel Controls Switch - Radio Volume
S70R Steering Wheel Controls Switch - Right
P16 Instrument Cluster
A11 Radio

Fig. 2: Secondary Controls Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S70E	Steering Wheel Controls Switch - Radio Presets
S70F	Steering Wheel Controls Switch - Radio Volume
S70R	S70R Steering Wheel Controls Switch - Right
P16	P16 Instrument Cluster
A11	A11 Radio

The steering wheel control switches duplicate the function of the primary controls of the associated component, through a network of momentary contact switches.

The Steering Wheel Controls are divided into a right-hand set and left-hand set. The right-hand switch is connected to the IPC LIN serial data and provides input from the left-hand, left-hand rear, and right-hand rear switches

The right-hand switch controller consists of UP/DOWN/LEFT/RIGHT directional, center "select", Push-to-Talk, and Mute buttons. The LEFT/RIGHT buttons navigate the display regions of the cluster. The UP/DOWN buttons navigate the menus. The right-hand rear switch consists of volume up and volume down buttons. The left-hand rear switch consists of favorite up and favorite down buttons.

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Theft Deterrent Module Screw	1 N.m (9 lb in)

SCHEMATIC WIRING DIAGRAMS

THEFT DETERRENT SYSTEM WIRING SCHEMATICS

Theft Deterrent

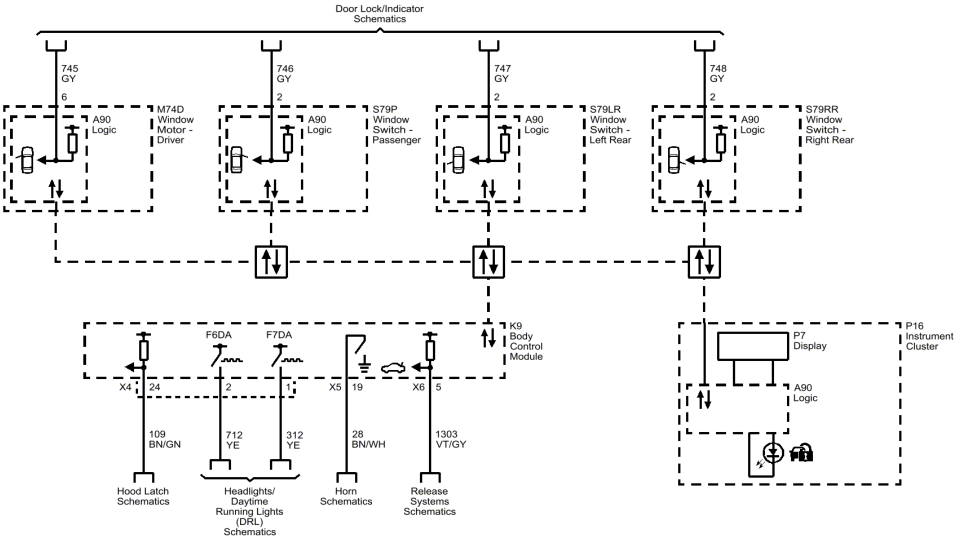

Door Lock/Indicator Schematics
745 GY
6
746 GY
2
747 GY
2
748 GY
2
A90 Logic
M74D Window Motor - Driver
A90 Logic
S79P Window Switch - Passenger
A90 Logic
S79LR Window Switch - Left Rear
A90 Logic
S79RR Window Switch - Right Rear
F6DA
F7DA
K9 Body Control Module
X4
24
2
1
X5
19
X6
5
109 BN/GN
712 YE
312 YE
28 BN/WH
1303 VT/GY
Hood Latch Schematics
Headlights/ Daytime Running Lights (DRL) Schematics
Horn Schematics
Release Systems Schematics
P16 Instrument Cluster
P7 Display
A90 Logic

Fig. 1: Theft Deterrent
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - THEFT DETERRENT

NOTE: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following **Theft Systems Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Theft Deterrent System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Content Theft Deterrent Malfunction**
- **Security Indicator Malfunction**

CONTENT THEFT DETERRENT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The content theft deterrent system is a software based system in which the Body Control Module (BCM) actively monitors certain inputs to determine if unauthorized vehicle access is being attempted. Based on inputs such as the door ajar switches, the rear compartment ajar switch, and the hood ajar switch, the BCM determines whether a content theft deterrent alarm is warranted. If unauthorized access is being detected, the BCM will pulse the vehicle horn and flash the exterior lamps as a means of theft deterrence.

Diagnostic Aids

The scan tool BCM Content Theft Deterrent Trigger History 1, 2, and 3 parameters can be used to help isolate an intermittent unwanted content theft deterrent alarm. These parameters are a rolling history of the previous three causes of a theft deterrent alarm. If all three parameters are indicating the same alarm trigger, the indicated input should be the starting point when diagnosing an intermittent concern.

Reference Information

Schematic Reference

Theft Deterrent System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify each indicator/message transition between the ajar and closed state while opening and closing each vehicle door, hood, and rear compartment.
    - **If the indicator/message does not change**

      Refer to Door Ajar Indicator Malfunction , or Hood Ajar Indicator/Message Malfunction .

    - **If each indicator/message changes**
3. Completely lower the driver door window and close all vehicle doors, ignition OFF.
4. Arm the content theft deterrent system by locking the door with the keyless entry transmitter.
5. Verify the scan tool BCM Content Theft Deterrent Alarm Status parameter is Armed.
    - **If not Armed**

      Refer to Keyless Entry System Malfunction .

    - **If Armed**
6. Without disarming the system, reach in through the open driver window and open the driver door.
7. Verify the scan tool BCM Content Theft Deterrent Alarm Status parameter is Alarm.
    - **If not Alarm**

      Replace the K9 Body Control Module.

    - **If Alarm**
8. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Body Control Module replacement, programming, and setup

SECURITY INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	2	2	1	-
1. Security Indicator Always On 2. Security Indicator Inoperative				

Circuit/System Description

The security indicator is controlled by the Body Control Module (BCM) based on commands from the content theft deterrent system. The security indicator is located in the driver information center. When the content theft deterrent system requests the indicator be illuminated, the BCM applies voltage to the control circuit, illuminating the indicator.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Theft Systems Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Arm the content theft deterrent system.
2. Verify the security indicator illuminates and/or flash during the arming sequence.
    - **If the indicator does not illuminate and/or flash**

      Refer to Circuit/System Testing

    - **If the indicator illuminates and/or flashes**
3. All OK

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the A5 Driver Information Center.
2. Connect a test lamp between the control circuit terminal 2 and ground, ignition ON.
3. Verify the test lamp turns ON and OFF when commanding the Security Indicator Active and Inactive with a scan tool.
    - **If the test lamp is always OFF**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**

    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
4. Test or replace the A5 Driver Information Center.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

-
- **Control Module References** for Body Control Module replacement, programming, and setup

REPAIR INSTRUCTIONS

THEFT DETERRENT MODULE REPLACEMENT

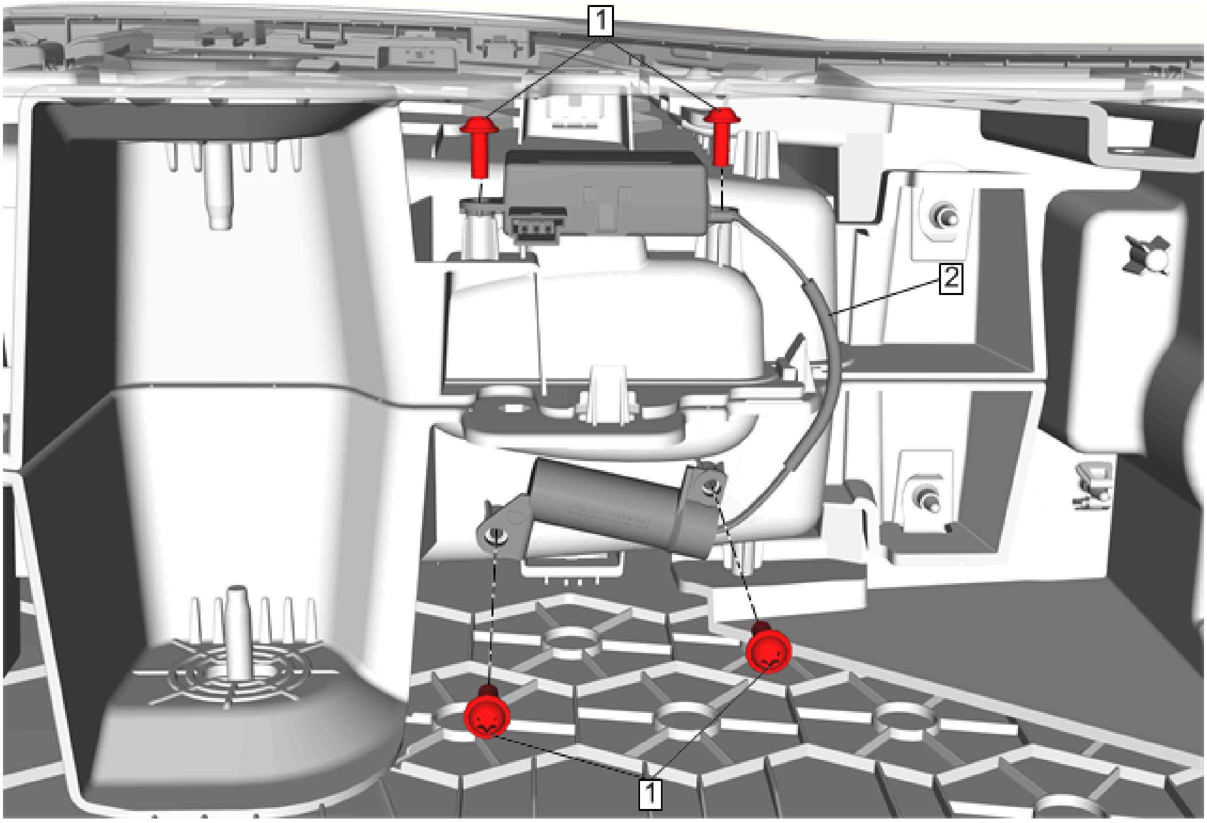


Fig. 2: Theft Deterrent Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. **Rear Floor Console Replacement** 2. Rear Console Side Panel-Right - Remove - **Front Floor Console Cup Holder Replacement**	

Callout	Component Name
1	Theft Deterrent Module screw **CAUTION:** Fastener Caution **Tighten** 1 N.m (9 lb in)
2	Theft Deterrent Module **Procedure** Disconnect the electrical connector.

DESCRIPTION AND OPERATION

THEFT SYSTEMS DESCRIPTION AND OPERATION

When armed, the content theft deterrent system is designed to deter vehicle content theft by pulsing the horns and exterior lamps for approximately 30 seconds when an unauthorized vehicle entry is detected. However, the content theft deterrent system does not affect engine starting.

An unauthorized entry can be any of the following with the content theft deterrent system armed:

- Unauthorized entry into the underhood area
- Unauthorized entry into the rear compartment
- When any door is opened without using the UNLOCK command from a keyless entry transmitter
- After a battery reconnect, if the battery was disconnected with the content theft deterrent system armed

The components of the content theft deterrent system are:

- Body Control Module (BCM)
- Remote control door lock receiver
- Door ajar switches
- Rear compartment ajar switch
- Hood ajar switch

Arming the Content Theft Deterrent System

Use the following procedure in order to arm the system:

1. Place the shift lever in P (park).
2. Turn OFF the ignition.
3. Open any door.

NOTE: **The system is not armed if the doors are locked manually; the remote keyless entry transmitter must be used to arm the content theft deterrent system.**

4. Lock the doors by pressing the LOCK button on the transmitter. The system is in standby mode and will not start the arming timer until all doors are closed.
5. The system will begin the arm sequence immediately after the last door is closed. If the keyless entry transmitter is used to arm the system after the vehicle doors are closed, the arm sequence will begin as soon as the LOCK command is received from the transmitter.
6. Pressing the LOCK button on the keyless entry transmitter a second time will bypass the delayed arming function and force the system to arm.

Locking the Vehicle Without Arming the Content Theft Deterrent System

Locking the vehicle may be accomplished without arming the content theft deterrent system. Use of the manual door locks will lock the vehicle, but will not arm the content theft deterrent system.

Disarming an Armed System/Silencing an Alarm

If system arming has been requested by the keyless entry transmitter, it must be disarmed.

NOTE: **Disconnecting the battery or removing fuses does not disable the arm or alarm modes, since the BCM stores the content theft deterrent mode status in memory.**

- To disarm the content theft deterrent system in standby mode, perform one of the following:
  - Press the UNLOCK button on the keyless entry transmitter.
  - Insert a valid key into the ignition and switch to the ON position.
- To disarm the content theft deterrent system in the armed mode (non-event) or when activated (during an alarm event):
  - Press the UNLOCK button on the keyless entry transmitter.
  - Insert a valid key into the ignition and switch to the ON position

Content Theft Deterrent Circuit Description

The following is a description of each component used in the content theft deterrent system:

Body Control Module

The content theft deterrent system is an internal function of the BCM which utilizes serial data and various switch inputs information to perform content theft deterrent functions. When the BCM detects an unauthorized entry, it activates the horns and exterior lamps. The BCM has 4 basic modes (disarmed, standby, armed, and alarm) for operating the content theft deterrent system. The different modes are described below.

1. The BCM has the content theft deterrent system in a disarmed mode until the following conditions are detected:
   - Ignition key turned to the OFF position.
   - Doors locked by the LOCK button on the transmitter.
2. The BCM enters the standby mode when the above conditions are detected. If a door was already opened when the arm mode was requested, the standby mode does not start the timer until the last door is closed.
3. When the last door is closed, a 15 second timer is activated. Once the timer has expired, the BCM enters the armed mode. After this delay, any unauthorized entry will activate the alarm mode.
4. When the BCM detects an unauthorized entry, the BCM enters the alarm mode. The BCM activates the horns and exterior lamps for 30 seconds. This is followed by a three minute time-out with the horn no longer active. If no new intrusions are detected after the time-out, the horn is not active. The system must be disarmed or the intrusion condition removed after the time-out for the system to exit alarm mode.

Remote Control Door Lock Receiver

The keyless entry system can arm and disarm the content theft deterrent system. When the remote control door lock receiver receives a door lock or unlock signal from the transmitter, the remote control door lock receiver sends a message to the BCM via serial data to perform the appropriate arm/disarm functions.

Door Ajar Switches

The content theft deterrent system uses the door ajar switches as a status indicator to activate the alarm. The door ajar switches are monitored by the body control module via a discrete input from each door ajar switch. If the BCM receives a signal indicating a door is opened when the content theft deterrent system is armed, the BCM activates the alarm.

Hood Ajar Switch

The content theft deterrent system uses the hood ajar switch as a status indicator to activate the alarm. The BCM monitors the hood ajar switch via a discrete input from the switch. If the BCM receives a signal indicating the hood has been opened when the content theft deterrent system is armed, the BCM activates the alarm.

Rear Compartment Ajar Switch

The content theft deterrent system uses the rear compartment ajar switch as a status indicator to activate the alarm. The BCM monitors the rear compartment ajar switch via a discrete input from the switch. If the BCM receives a signal indicating the rear compartment has been opened when content theft deterrent system is armed, the BCM activates the alarm.

Inputs

The BCM monitors the following inputs for content theft deterrent:

- Door ajar switches
- Keyless entry transmitter LOCK/UNLOCK buttons; a message from the remote control door lock receiver
- Immobilizer status - The BCM uses the immobilizer status for disarming the system or silencing an alarm when the correct vehicle key is used to start the vehicle
- Rear compartment ajar switch
- Hood ajar switch

Outputs

The BCM controls the following for content theft deterrent:

- Horn relay
- Exterior lamps

Back To Article

2017 ACCESSORIES AND EQUIPMENT

Vehicle Access - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Front Side Door Latch Fastener	9 N.m (80 lb in)
Front Side Door Lock Striker Screw	22 N.m (16 lb ft)
Front Side Door Outside Handle Bolt	4.5 N.m (40 lb in)
Front Side Door Outside Handle Bracket Fastener	5 N.m (44 lb in)
Liftgate Latch Bolt	22 N.m (16 lb ft)
Liftgate Latch Striker Bolt	22 N.m (16 lb ft)
Rear Side Door Latch Fastener	9 N.m (80 lb in)
Rear Side Door Lock Striker Screw	22 N.m (16 lb ft)
Rear Side Door Outside Handle Bolt	4.5 N.m (40 lb in)
Rear Side Door Outside Handle Bracket Fastener	5 N.m (44 lb in)

SCHEMATIC WIRING DIAGRAMS

DOOR LOCK/INDICATOR WIRING SCHEMATICS

Ajar Switches and Lock Indicators

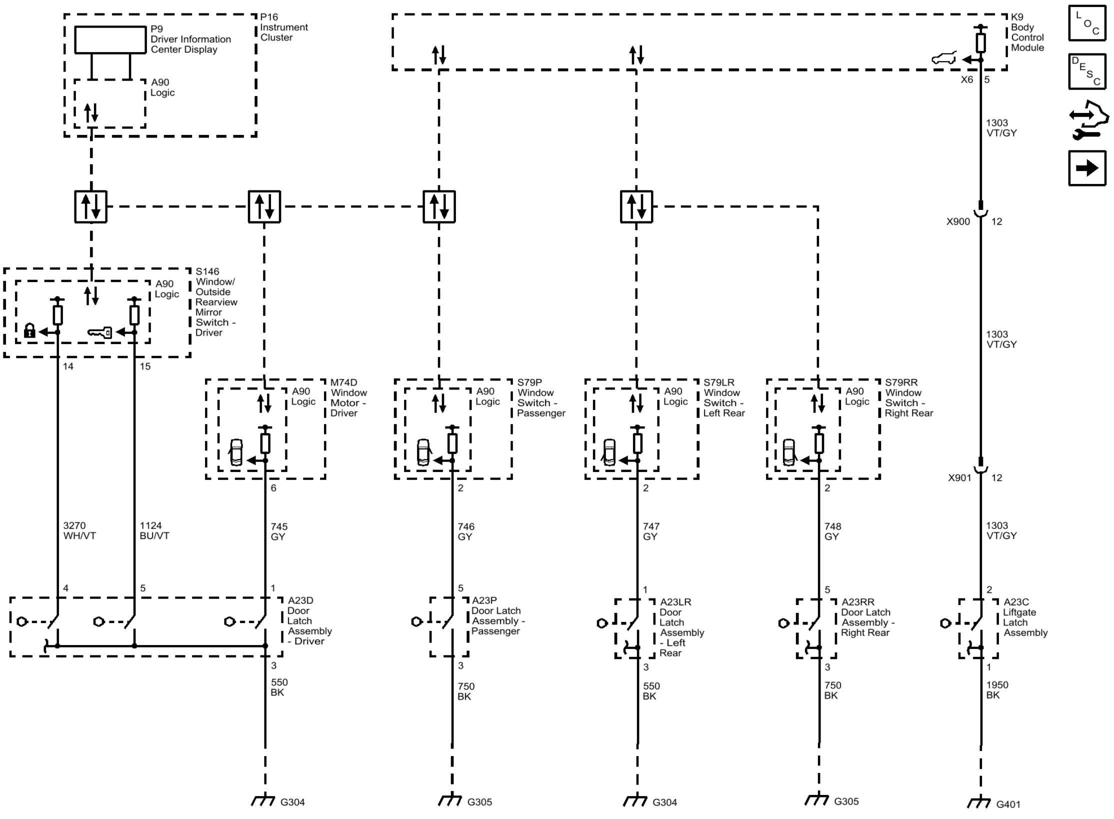

P16
Instrument
Cluster
P9
Driver Information
Center Display
A90
Logic
K9
Body
Control
Module
X6
5
1303
VT/GY
X900
12
LOC
DESC
S146
Window/
Outside
Rearview
Mirror
Switch -
Driver
A90
Logic
14
15
M74D
Window
Motor -
Driver
A90
Logic
S79P
Window
Switch -
Passenger
A90
Logic
S79LR
Window
Switch -
Left Rear
A90
Logic
S79RR
Window
Switch -
Right Rear
A90
Logic
1303
VT/GY
X901
12
6
2
2
2
3270
WH/VT
1124
BU/VT
745
GY
746
GY
747
GY
748
GY
1303
VT/GY
4
5
1
A23D
Door
Latch
Assembly
- Driver
5
A23P
Door Latch
Assembly -
Passenger
1
A23LR
Door
Latch
Assembly
- Left
Rear
5
A23RR
Door Latch
Assembly -
Right Rear
2
A23C
Liftgate
Latch
Assembly
3
550
BK
3
750
BK
3
550
BK
3
750
BK
1
1950
BK
G304
G305
G304
G305
G401

Fig. 1: Ajar Switches and Lock Indicators

Courtesy of GENERAL MOTORS COMPANY

Lock Switches

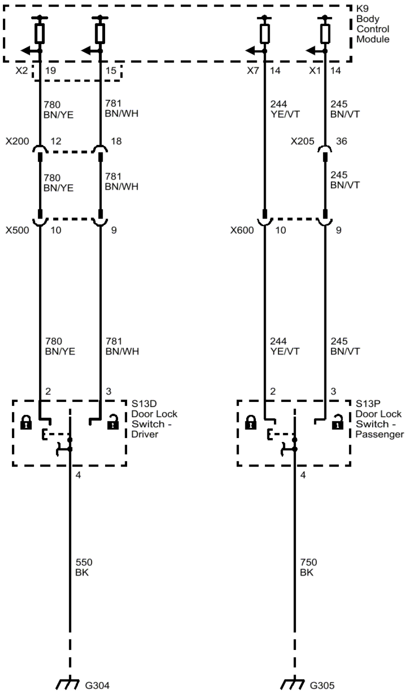

K9
Body
Control
Module
X2
19
15
X7
14
X1
14
780
BN/YE
781
BN/WH
244
YE/VT
245
BN/VT
X200
12
18
X205
36
780
BN/YE
781
BN/WH
245
BN/VT
X500
10
9
X600
10
9
780
BN/YE
781
BN/WH
244
YE/VT
245
BN/VT
2
3
S13D
Door Lock
Switch -
Driver
2
3
S13P
Door Lock
Switch -
Passenger
4
4
550
BK
750
BK
G304
G305

Fig. 2: Lock Switches

Courtesy of GENERAL MOTORS COMPANY

Door Lock Actuators

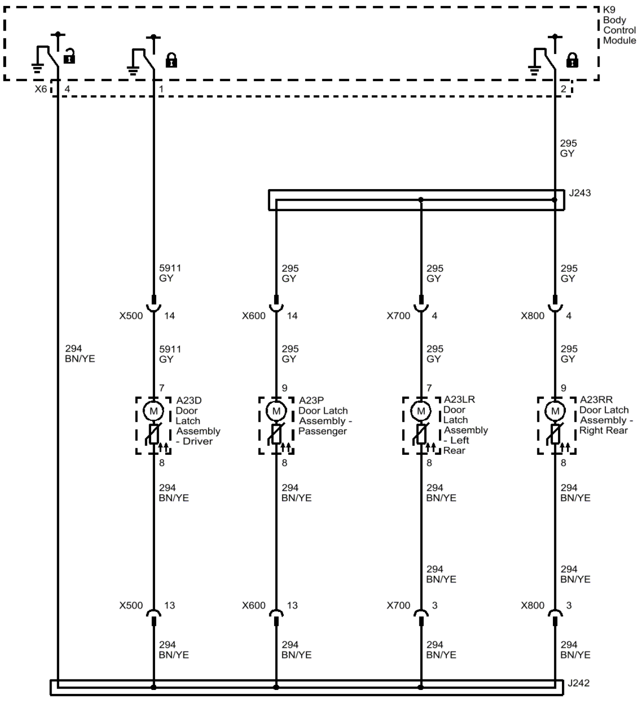

K9
Body
Control
Module
X6
4
1
2
295
GY
J243
5911
GY
295
GY
295
GY
295
GY
X500
14
X600
14
X700
4
X800
4
294
BN/YE
5911
GY
295
GY
295
GY
295
GY
7
A23D
Door
Latch
Assembly
- Driver
9
A23P
Door Latch
Assembly -
Passenger
7
A23LR
Door
Latch
Assembly
- Left
Rear
9
A23RR
Door Latch
Assembly -
Right Rear
8
8
8
8
294
BN/YE
294
BN/YE
294
BN/YE
294
BN/YE
294
BN/YE
294
BN/YE
X500
13
X600
13
X700
3
X800
3
294
BN/YE
294
BN/YE
294
BN/YE
294
BN/YE
J242

Fig. 3: Door Lock Actuators

Courtesy of GENERAL MOTORS COMPANY

Door Handle Switches

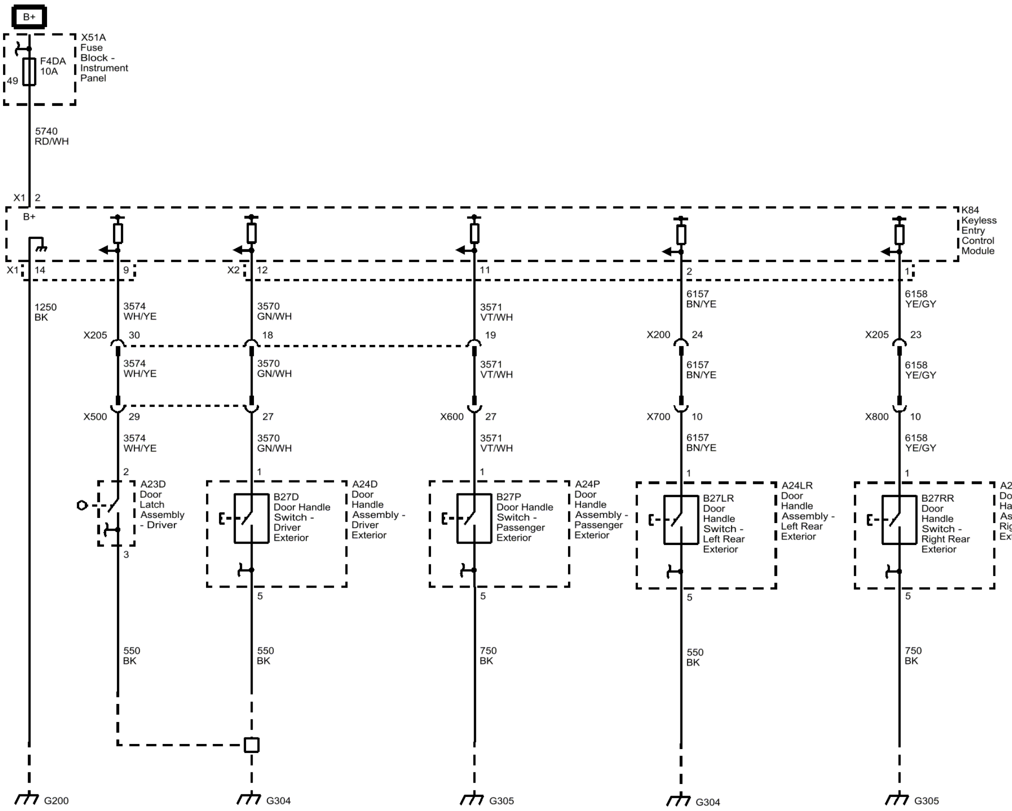

B+
X51A Fuse Block - Instrument Panel
F4DA 10A
49
5740 RD/WH
X1 2
B+
K84 Keyless Entry Control Module
X1 14
9
X2 12
11
2
1
1250 BK
3574 WH/YE
3570 GN/WH
3571 VT/WH
6157 BN/YE
6158 YE/GY
X205 30
18
19
X200 24
X205 23
3574 WH/YE
3570 GN/WH
3571 VT/WH
6157 BN/YE
6158 YE/GY
X500 29
27
X600 27
X700 10
X800 10
3574 WH/YE
3570 GN/WH
3571 VT/WH
6157 BN/YE
6158 YE/GY
2
A23D Door Latch Assembly - Driver
3
1
B27D Door Handle Switch - Driver Exterior
A24D Door Handle Assembly - Driver Exterior
5
1
B27P Door Handle Switch - Passenger Exterior
A24P Door Handle Assembly - Passenger Exterior
5
1
B27LR Door Handle Switch - Left Rear Exterior
A24LR Door Handle Assembly - Left Rear Exterior
5
1
B27RR Door Handle Switch - Right Rear Exterior
A24RR Door Handle Assembly - Right Rear Exterior
5
550 BK
550 BK
750 BK
550 BK
750 BK
G200
G304
G305
G304
G305

Fig. 4: Door Handle Switches

Courtesy of GENERAL MOTORS COMPANY

RELEASE SYSTEMS WIRING SCHEMATICS

Liftgate Release

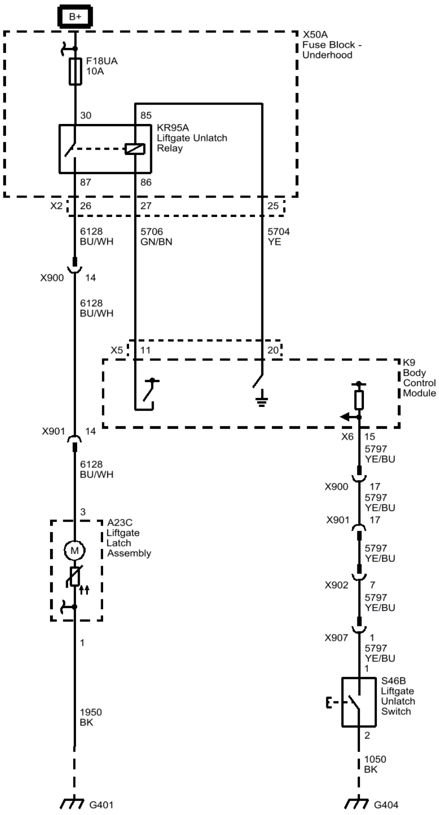

B+
X50A Fuse Block - Underhood
F18UA 10A
30
85
KR95A Liftgate Unlatch Relay
87
86
X2 26
27
25
6128 BU/WH
5706 GN/BN
5704 YE
X900 14
6128 BU/WH
X5 11
20
K9 Body Control Module
X6 15
5797 YE/BU
X900 17
5797 YE/BU
X901 17
5797 YE/BU
X902 7
5797 YE/BU
X907 1
5797 YE/BU
1
S46B Liftgate Unlatch Switch
2
1050 BK
G404
X901 14
6128 BU/WH
3
A23C Liftgate Latch Assembly
M
1
1950 BK
G401

Fig. 5: Liftgate Release
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B1474 OR B3849: PASSENGER/DRIVER EXTERIOR DOOR HANDLE SWITCH CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC B1474

Passenger Exterior Door Handle Switch Circuit

DTC B3849

Driver Exterior Door Handle Switch Circuit

Symptom Byte Information: Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Exterior Driver Door Handle Switch	B3849 02	1	1	-
Signal - Exterior Passenger Door Handle Switch	B1474 02	2	2	-
Ground - A24D Door Handle Assembly - Driver Exterior	-	1	-	-
Ground - A24P Door Handle Assembly - Passenger Exterior	-	2	-	-
1. B27D Door Handle Switch - Driver Exterior = Disabled 2. B27P Door Handle Switch - Passenger Exterior = Disabled				

Circuit/System Description

For an overview of the component/system, refer to: Power Door Locks Description and Operation

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B27D Door Handle Switch - Driver Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
B27P Door Handle Switch - Passenger Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.

Component	Description
K84 Keyless Entry Control Module	The control module also reads various switches and sensors and makes their values available via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

B1474 02

Signal at B27P Door Handle Switch - Passenger Exterior = Short to Ground - For greater than 60 s

B3849 02

Signal t B27D Door Handle Switch - Driver Exterior = Short to Ground - For greater than 60 s

Actions Taken When the DTC Sets

B1474 02

B27P Door Handle Switch - Passenger Exterior = Disabled

B3849 02

B27D Door Handle Switch - Driver Exterior = Disabled

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

- **Door Lock/Indicator Schematics**
- **Remote Function Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. B27D Door Handle Switch - Driver Exterior - Not Pressed

   Verify the scan tool parameter: Exterior Driver Door Handle Switch = Inactive

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
3. B27P Door Handle Switch - Passenger Exterior - Not Pressed

   Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Inactive

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
4. Operate the component: B27D Door Handle Switch - Driver Exterior - Pressed

   Verify the scan tool parameter: Exterior Driver Door Handle Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
5. Operate the component: B27P Door Handle Switch - Passenger Exterior - Pressed

   Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
6. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: A24D Door Handle Assembly - Driver Exterior or A24P Door Handle Assembly - Passenger Exterior
3. Test for less than 10 Ω between the test points: Ground circuit terminal 5 & Ground
   - **If 10 Ω or greater**
     1. Ground Connection - Disconnect
     2. Test for less than 2 Ω between the test points: Ground circuit terminal 5 at Component harness & Ground Connection
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Inactive
   - **If not the specified state**
     1. Ignition/Vehicle - Off
     2. Disconnect the electrical connector: K84 Keyless Entry Control Module

        3. Test for infinite resistance between the test points: Signal circuit terminal 1 at Component harness & Ground
            - If less than infinite resistance - Repair the short to ground on the circuit.
            - If infinite resistance - Replace the component: K84 Keyless Entry Control Module
    - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 5
7. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Active
    - **If not the specified state**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: K84 Keyless Entry Control Module
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Signal circuit terminal 1 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
    5. Ignition/Vehicle - Off
    6. Test for less than 2 Ω between the test points:
        - Signal circuit terminal 1 at A24D Door Handle Assembly - Driver Exterior & Terminal 12 X2 at Control module harness
        - Signal circuit terminal 1 at A24P Door Handle Assembly - Passenger Exterior & Terminal 11 X2 at Control module harness
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: K84 Keyless Entry Control Module
    - **If the specified state**
8. Test or replace the component: A24 Door Handle Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A24D Door Handle Assembly - Driver Exterior or A24P Door Handle Assembly - Passenger Exterior
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 5 - Not Pressed
    - **If less than infinite resistance**

      Replace the component: A24 Door Handle Assembly

    - **If infinite resistance**
4. Test for less than 3 Ω between the test points: Signal terminal 1 & Ground terminal 5 - Pressed
    - **If 3 Ω or greater**

      Replace the component: A24 Door Handle Assembly

    - **If less than 3 Ω**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Front Side Door Outside Handle Replacement**
- For control module replacement, programming, and setup refer to: **Control Module References**

DTC B1534 OR B1535: LEFT/RIGHT REAR DOOR HANDLE SWITCH CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC B1534

Left Rear Door Handle Switch Circuit

DTC B1535

Right Rear Door Handle Switch Circuit

Symptom Byte Information: Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Exterior Left Rear Door Handle Switch	B1534 02	1	1	-
Signal - Exterior Right Rear Door Handle Switch	B1535 02	2	2	-
Ground - A24LR Door Handle Assembly - Left Rear Exterior	-	1	-	-
Ground - A24RR Door Handle Assembly - Right Rear Exterior	-	2	-	-

1. B27LR Door Handle Switch - Left Rear Exterior = Disabled
2. B27RR Door Handle Switch - Right Rear Exterior = Disabled

Circuit/System Description

For an overview of the component/system, refer to: **Power Door Locks Description and Operation**

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B27LR Door Handle Switch - Left Rear Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
B27RR Door Handle Switch - Right Rear Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
K84 Keyless Entry Control Module	The control module also reads various switches and sensors and makes their values available via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

B1534 02

Left Rear Door Handle Switch Signal = Short to Ground - For greater than 60 s

B1535 02

Right Rear Door Handle Switch Signal = Short to Ground - For greater than 60 s

Actions Taken When the DTC Sets

B1534 02

B27LR Door Handle Switch - Left Rear Exterior = Disabled

B1535 02

B27RR Door Handle Switch - Right Rear Exterior = Disabled

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Inactive
    - **If not the specified state**

      Refer to: Circuit/System Testing

    - **If the specified state**
3. Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Inactive
    - **If not the specified state**

      Refer to: Circuit/System Testing

    - **If the specified state**

4. Operate the component: B27LR Door Handle Switch - Left Rear Exterior - Pressed

   Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
5. Operate the component: B27RR Door Handle Switch - Right Rear Exterior - Pressed

   Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
6. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: A24LR Door Handle Assembly - Left Rear Exterior or A24RR Door Handle Assembly - Right Rear Exterior
3. Test for less than 10 Ω between the test points: Ground circuit terminal 5 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 5 at Component harness & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Inactive
   - **If not the specified state**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: X2 at K84 Keyless Entry Control Module
   3. Test for infinite resistance between the test points: Signal circuit terminal 1 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: K84 Keyless Entry Control Module
   - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 5
7. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Active
   - **If not the specified state**
   1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
   2. Disconnect the electrical connector: X2 at K84 Keyless Entry Control Module
   3. Ignition On/Vehicle in Service Mode.
   4. Test for less than 1 V between the test points: Signal circuit terminal 1 at Component harness & Ground

            - If 1 V or greater - Repair the short to voltage on the circuit.
            - If less than 1 V
        5. Ignition/Vehicle - Off
        6. Test for less than 2 Ω between the test points:
            - Signal circuit terminal 1 AT A24LR Door Handle Assembly - Left Rear Exterior & Terminal 2 X2 at Control module harness
            - Signal circuit terminal 1 at A24RR Door Handle Assembly - Right Rear Exterior & Terminal 1 X2 at Control module harness
            - If 2 Ω or greater - Repair the open/high resistance in the circuit.
            - If less than 2 Ω - Replace the component: K84 Keyless Entry Control Module
    - **If the specified state**

8. Test or replace the component: A24 Door Handle Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A24LR Door Handle Assembly - Left Rear Exterior or A24RR Door Handle Assembly - Right Rear Exterior
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 5 - Not Pressed
    - **If less than infinite resistance**

      Replace the component: A24 Door Handle Assembly

    - **If infinite resistance**
4. Test for less than 3 Ω between the test points: Signal terminal 1 & Ground terminal 5 - Pressed
    - **If 3 Ω or greater**

      Replace the component: A24 Door Handle Assembly

    - **If less than 3 Ω**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

- Rear Side Door Outside Handle Replacement
- For control module replacement, programming, and setup refer to: Control Module References

DTC B297B OR B297C: DRIVER DOOR OPEN SWITCH CIRCUIT NOT PLAUSIBLE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B297B 5A

Driver Door Open Switch Circuit Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B2A00 00, B297B 5A	B2A00 00, B297B 5A	B2A00 00, B297B 5A	-
Ground	-	1	-	-
1. Ajar Indicator Inoperative				

Circuit/System Description

The keyless entry control module provides a 12 V signal to the driver door open switch signal circuit. The driver window motor provides a 12 V signal to the driver door ajar switch signal circuit. The door open switches and the door ajar switches are integral to the driver door latch assembly.

The door open switch and the door ajar switch contacts will be open with the door is fully closed, the door switches within the door latch are designed so that the when the door is ajar, the contact in the door ajar switch closes, the voltage is pulled low and the window motor will then send a serial data message to the body control module indicating that the door is ajar. When the door is opened further, the contact in the door open switch will then close providing a ground for the door open signal circuit, the keyless entry control module will then detect that the door is open.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V.

Conditions for Setting the DTC

B2A00 00

- The chassis control module detects the driver door open switch is Active while receiving a serial data message from the body control module that the driver door ajar switch is Inactive.
- The condition must be present for greater than 30 seconds

B297B 5A

- The keyless entry control module detects the driver door open switch is Active while receiving a serial data message from the body control module that the driver door ajar switch is Inactive.
- The condition must be present for greater than 30 seconds

Action Taken When the DTC Sets

B2A00 00, B297B 5A

The driver information center will display the Service Driver Door Switch message

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the keyless entry control module receives a serial data message from the body control module that the door is ajar before the keyless entry control module detects the door open switch is active, then the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

- **Remote Function Schematics**
- **Door Lock/Indicator Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Body Control Module Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.
    - **If the parameter does not change**

      Refer to **Door Ajar Indicator Malfunction**

    - **If the parameter changes**
3. Verify the scan tool Keyless Entry Control Module Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.
    - **If the parameter does not change**

      Refer to Circuit/System Testing

    - **If the parameter changes**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Driver Door Ajar Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K84 Keyless Entry Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the circuit terminals 2 and ground.
6. Verify the scan tool Driver Door Ajar Switch parameter is Active.
    - **If not Active**

    1. Vehicle OFF, disconnect the harness connector at the K84 Keyless Entry Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
  - **If Active**

7. Test or replace the A23D Door Latch Assembly-Driver

Component Testing

1. Vehicle OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 3 with the switch in the open position.
    - **If less than infinite resistance**

      Replace the A23D Door Latch Assembly-Driver.

    - **If infinite resistance**
3. Test for less than 3 Ω between the signal terminal 2 and the ground terminal 3 with the switch in the closed position.
    - **If 3 Ω or greater**

      Replace the A23D Door Latch Assembly-Driver.

    - **If less than 3 Ω**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Side Door Latch Replacement**
- **Control Module References** for keyless entry control module replacement, programming and setup

DTC B3125, B3130, OR B3135: DRIVER DOOR ONLY/ALL DOORS UNLOCK/LOCK CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC B3125

Driver Door Only Unlock Circuit

DTC B3130

All Doors Unlock Circuit

DTC B3135

All Doors Lock Circuit

Symptom Byte Information:

Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short to Voltage
B+ - Body Control Module	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-
Ground - Body Control Module	-	1, 2, 3, 4	-	-
Control - A23D Door Latch Assembly - Driver	B3125 02, B3130 02, B3135 02	1	B3125 01, B3130 01, B3135 01	-
Control - A23P Door Latch Assembly - Passenger	B3125 02, B3130 02, B3135 02	2	B3125 01, B3130 01, B3135 01	-
Control - A23LR Door Latch Assembly - Left Rear	B3125 02, B3130 02, B3135 02	3	B3125 01, B3130 01, B3135 01	-
Control - A23RR Door Latch Assembly - Right Rear	B3125 02, B3130 02, B3135 02	4	B3125 01, B3130 01, B3135 01	-

1. A23D Door Latch Assembly - Driver = Inoperative
2. A23P Door Latch Assembly - Passenger = Inoperative
3. A23LR Door Latch Assembly - Left Rear = Inoperative
4. A23RR Door Latch Assembly - Right Rear = Inoperative

Circuit/System Description

For an overview of the component/system, refer to: **Power Door Locks Description and Operation**

Circuit	Description
B+ - Body Control Module	Supplied from a fuse.
Ground - Body Control Module	Chassis Ground
Control - Driver Door Unlock	The output circuit is switched from ground to 12 V to activate the component.
Control - All Doors Lock	The output circuit is switched from ground to 12 V to activate the component.
Control - Passenger Door Unlock	The output circuit is switched from ground to 12 V to activate the component.

Component	Description
A23 Door Latch Assembly	The door locks are actuated by a bidirectional DC motor that locks/unlocks the door so that it can not be opened from outside the vehicle (but still from inside).
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc. The control module also reads various switches and sensors and makes their values available via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

- B3125 01, B3130 01, B3135 01 Condition 1 - Control Circuit = Short to Voltage
- B3125 02, B3130 02, B3135 02 Condition 2 - Control Circuit = Short to Ground
- B3125 02, B3130 02, B3135 02 Condition 3 - B+ circuit at K9 Body Control Module = Short to Ground/Open/High Resistance

Actions Taken When the DTC Sets

All Doors Lock Command & All Doors Unlock Command = Inoperative

Conditions for Clearing the DTC

- A current DTC will clear when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

- **Door Lock/Indicator Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

   Verify the scan tool parameter: Driver Door Lock Switch = Inactive & Lock & Unlock

   - **If not the specified state**

     Refer to: Refer to **Power Door Locks Malfunction**

   - **If the specified state**
3. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

   Verify the component works as specified:

   - A23D Door Latch Assembly - Driver = Lock & Unlock
   - A23LR Door Latch Assembly - Left Rear = Lock & Unlock

- A23P Door Latch Assembly - Passenger = Lock & Unlock
- A23RR Door Latch Assembly - Right Rear = Lock & Unlock
- **If the component does not activate - A23D Door Latch Assembly - Driver**

  Refer to: Circuit/System Testing - Test 1

- **If the component does not activate - A23LR Door Latch Assembly - Left Rear**

  Refer to: Circuit/System Testing - Test 2

- **If the component does not activate - A23P Door Latch Assembly - Passenger**

  Refer to: Circuit/System Testing - Test 2

- **If the component does not activate - A23RR Door Latch Assembly - Right Rear**

  Refer to: Circuit/System Testing - Test 2

- **If none of the components operate**

  Refer to: Circuit/System Testing - Test 3

- **If all functions work properly**

4. All OK.

Circuit/System Testing

Test 1

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: A23D Door Latch Assembly - Driver
3. Connect a test lamp between the test points: Control terminal 7 & Control terminal 8
4. Ignition - On / Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.
   - **If the test lamp turns On and Off**

     Test or replace the component: A23D Door Latch Assembly - Driver

   - **If the test lamp does not turn On and Off**
7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 at K9 Body Control Module
9. Test for less than 2 Ω between the test points:
   - Control circuit terminal 7 at A23D Door Latch Assembly - Driver & Terminal 1 X6 at Control module harness
   - Control circuit terminal 8 at A23D Door Latch Assembly - Driver & Terminal 4 X6 at Control module harness
   - If 2 Ω or greater - Repair the open/high resistance in the circuit.
   - **If less than 2 Ω**
10. Test or replace the component: K9 Body Control Module

Test 2

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector:
   - A23LR Door Latch Assembly - Left Rear
   - A23P Door Latch Assembly - Passenger
   - A23RR Door Latch Assembly - Right Rear

3. Connect a test lamp between the test points:
    - A23P Door Latch Assembly - PassengerControl terminal 8 & Control terminal 9
    - A23LR Door Latch Assembly - Left RearControl terminal 7 & Control terminal 8
    - A23RR Door Latch Assembly - Right RearControl terminal 8 & Control terminal 9
4. Ignition - On / Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.
    - **If the test lamp turns On and Off**

      Test or replace the component: A23 Door Latch Assembly

    - **If the test lamp does not turn On and Off**
7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 at K9 Body Control Module
9. Ignition - On / Vehicle - In Service Mode
10. Test for less than 2 Ω between the test points:
    - Control circuit terminal 7 at A23LR Door Latch Assembly - Left Rear & Terminal 2 X6 at Control module harness
    - Control circuit terminal 8 at A23LR Door Latch Assembly - Left Rear & Terminal 4 X6 at Control module harness
    - Control circuit terminal 8 at A23P Door Latch Assembly - Passenger & Terminal 4 X6 at Control module harness
    - Control circuit terminal 9 at A23P Door Latch Assembly - Passenger & Terminal 2 X6 at Control module harness
    - Control circuit terminal 8 at A23RR Door Latch Assembly - Right Rear & Terminal 4 X6 at Control module harness
    - Control circuit terminal 9 at A23RR Door Latch Assembly - Right Rear & Terminal 2 X6 at Control module harness
    - If 2 Ω or greater - Repair the open/high resistance in the circuit.
    - **If less than 2 Ω**
11. Test or replace the component: K9 Body Control Module

Test 3

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: X2 & X6 at K9 Body Control Module
3. Test for less than 10 Ω between the test points: Ground circuit terminal 3 X6 & Ground
    - **If 10 Ω or greater**
    1. Ground Connection - Disconnect
    2. Test for less than 2 Ω between the test points: Ground circuit terminal 3 X6 & Ground Connection
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 4 X2 & Ground
    - **If the test lamp does not turn On and the circuit fuse is OK**
    1. Ignition/Vehicle - Off & Remove - Test lamp

    2. Test for less than 2 Ω between the test points: B+ circuit terminal 4 X2 & Output terminal at Fuse
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not turn On and the circuit fuse is open**
    1. Ignition/Vehicle - Off & Remove - Test lamp
    2. Disconnect the electrical connector:
        - A23D Door Latch Assembly - Driver
        - A23LR Door Latch Assembly - Left Rear
        - A23P Door Latch Assembly - Passenger
        - A23RR Door Latch Assembly - Right Rear
    3. Test for infinite resistance between the test points:
        - Control circuit terminal 1 X6 at K9 Body Control Module & Ground
        - Control circuit terminal 2 X6 at K9 Body Control Module & Ground
        - Control circuit terminal 4 X6 at K9 Body Control Module & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component: A23 Door Latch Assembly
    - **If the test lamp turns On**

6. Ignition/Vehicle - Off
7. Connect the electrical connector: X2 at K9 Body Control Module
8. Ignition - On / Vehicle - In Service Mode
9. Test for less than 1 V between the test points:
    - Control circuit terminal 1 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 2 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 4 X6 at K9 Body Control Module & Ground
    - **If greater than 1 V**

      Repair the short to voltage on the circuit.

    - **If 1 V or less**
10. Ignition/Vehicle - Off
11. Test for infinite resistance between the test points:
    - Control circuit terminal 1 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 2 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 4 X6 at K9 Body Control Module & Ground
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
12. Replace the component: K9 Body Control Module

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector:
    - A23D Door Latch Assembly - Driver
    - A23P Door Latch Assembly - Passenger
    - A23LR Door Latch Assembly - Left Rear
    - A23RR Door Latch Assembly - Right Rear
3. Connect a 25 A fused jumper wire between the test points:
    - A23D Door Latch Assembly - DriverControl terminal 7 & B+

  - A23P Door Latch Assembly - PassengerControl terminal 8 & B+
  - A23LR Door Latch Assembly - Left RearControl terminal 7 & B+
  - A23RR Door Latch Assembly - Right RearControl terminal 8 & B+

CAUTION: Complete the testing as quickly as possible in order to prevent overheating and damaging the component.

4. Momentarily connect a jumper wire between the test points:
   - A23D Door Latch Assembly - DriverControl terminal 8 & Ground
   - A23P Door Latch Assembly - PassengerControl terminal 9 & Ground
   - A23LR Door Latch Assembly - Left RearControl terminal 8 & Ground
   - A23RR Door Latch Assembly - Right RearControl terminal 9 & Ground
5. Reverse the jumper wires 2 times between the terminals.

   Verify the component works as specified: A23 Door Latch Assembly = Lock & Unlock

   - **If not the specified state**

     Replace the component: A23 Door Latch Assembly

   - **If the specified state**
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Front Side Door Latch Replacement**
- **Rear Side Door Latch Replacement**
- For control module replacement, programming, and setup refer to: **Control Module References**

DTC B3140, B3145, B3150, OR B3155: DOOR UNLOCK/LOCK SWITCH CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3140 00

Driver Door Unlock Switch Circuit

DTC B3145 00

Passenger Door Unlock Switch Circuit

DTC B3150 00

Driver Front Door Lock Switch Circuit

DTC B3155 00

Passenger Front Door Lock Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Door Lock Switch Lock Signal	B3150 00	2	2	-
Driver Door Lock Switch Unlock Signal	B3140 00	3	3	-
Driver Door Lock Switch Ground	-	1	-	-
Passenger Door Lock Switch Lock Signal	B3155 00	4	4	-
Passenger Door Lock Switch Unlock Signal	B3145 00	5	5	-
Passenger Door Lock Switch Ground	-	6	-	-

1. Driver Door Lock Switch Inoperative
2. Driver Door Lock Switch Lock Inoperative
3. Driver Door Lock Switch Unlock Inoperative
4. Passenger Door Lock Switch Lock Inoperative
5. Passenger Door Lock Switch Unlock Inoperative
6. Passenger Door Lock Switch Inoperative

Circuit/System Description

The body control module (BCM) monitors the voltage level of the door lock and door unlock signal circuits. When the driver door lock switch is in the open position, the voltage level in the signal circuit will be near 12 V. When the driver door lock switch is pressed to the lock or unlock position, the voltage level in the appropriate signal circuit will drop to 0 V and the BCM will detect the voltage drop and command the door latches to perform the requested lock or unlock command.

Conditions for Running the DTC

The system voltage is 9 - 16 V.

Conditions for Setting the DTC

B3140 00

The BCM detects short to ground in the driver lock signal circuit for greater than 60 seconds.

B3145 00

The BCM detects short to ground in the passenger unlock signal circuit for greater than 60 seconds.

B3150 00

The BCM detects a short to ground in the driver lock signal circuit for greater than 60 seconds.

B3155 00

The BCM detects a short to ground in the passenger lock signal circuit for greater than 60 seconds.

Action Taken When the DTC Sets

B3140 00

The BCM will ignore the unlock signal and the doors will not unlock when using the driver door unlock switch.

B3145 00

The BCM will ignore the unlock signal and the doors will not unlock when using the passenger door unlock switch.

B3150 00

The BCM will ignore the lock signal and the doors will not lock when using the driver door lock switch.

B3155 00

The BCM will ignore the lock signal and the doors will not lock when using the passenger door lock switch.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Door Locks Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Driver Door Lock Switch parameter changes from Inactive to Lock and Unlock when pressing the S13D Door Lock Switch-Driver.
   - **If the parameter does not change**

     Refer to Circuit/System Testing.

   - **If the parameter changes**
3. Verify the scan tool Passenger Door Lock Switch parameter changes from Inactive to Lock and Unlock when pressing the S13P Door Lock Switch-Passenger.
   - **If the parameter does not change**

     Refer to Circuit/System Testing.

   - **If the parameter changes**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Door Lock Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 3 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
    3. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 4.
6. Verify the scan tool Door Lock Switch parameter is Unlock.
    - **If not Unlock**
    1. Vehicle OFF, remove the fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Unlock**
7. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the ground circuit terminal 4.
8. Verify the scan tool Door Lock Switch parameter is Lock.
    - **If not Lock**
    1. Vehicle OFF, remove the fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Lock**
9. Test or replace the S13 Door Lock Switch.

Component Testing

Door Lock Switch

1. Vehicle OFF, disconnect the harness connector at the appropriate S13 Door Lock Switch.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 4 with the switch in the open position.
    - **If less than infinite resistance**

      Replace the S13 Door Lock Switch.

    - **If infinite resistance**
3. Test for infinite resistance between the signal terminal 3 and the ground terminal 4 with the switch in the open position.
    - **If less than infinite resistance**

      Replace the S13 Door Lock Switch

    - **If infinite resistance**
4. Test for less than 2 Ω between the signal terminal 2 and the ground terminal 4 with the switch in the Lock position.
    - **If 2 Ω or greater**

      Replace the S13 Door Lock Switch.

    - **If less than 2 Ω**
5. Test for less than 2 Ω between the signal terminal 3 and the ground terminal 4 with the switch in the Unlock position.
    - **If 2 Ω or greater**

      Replace the S13 Door Lock Switch.

    - **If less than 2 Ω**
6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Door Lock Switch Replacement**
- **Control Module References** for BCM replacement, programming and setup

DTC B324A OR B3245: REAR CARGO DOOR UNLOCK MOTOR CIRCUIT/LOCK ACTUATOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B324A

Rear Cargo Door Unlock Motor Circuit

DTC B3245

Rear Cargo Door Lock Actuator Circuit

For symptom byte information refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Liftgate Unlatch Relay Control Terminal 85	B3245 02	1	1	-
Liftgate Unlatch Relay Control Terminal 86	-	1	B324A 01	-
1. Liftgate Release Malfunction				

Circuit/System Description

When the body control module (BCM) receives a liftgate release command, it will provide voltage to one side of the relay and ground to the other side of the relay. This will energize the relay causing the switch side of the relay to close and will then provide B+ voltage to the liftgate or rear closure latch.

Conditions for Running the DTC

- The system voltage is 9 - 16 V.
- When the relay is actively commanded by the BCM.

Conditions for Setting the DTC

B324A 01

The BCM detects a short to voltage in the liftgate release relay control circuit.

B3245 02

The BCM detects a short to ground in the liftgate release relay control circuit.

Action Taken When the DTC Sets

The liftgate latch will be inoperative.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the fault is no longer present, the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Hatch/Gate Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the A23C Liftgate Latch Assembly activates by pressing the S46B Liftgate Unlatch Switch.
    - **If the A23C Liftgate Latch Assembly does not UNLATCH**

      Refer to Circuit/System Testing.

    - **If the A23C Liftgate Latch Assembly does UNLATCH**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the KR95A Liftgate Unlatch Relay. Vehicle in Service Mode.
2. Connect a test lamp between the control circuit terminal 85 and ground.
3. Verify the test lamp illuminates when pressing the S46B Liftgate Unlatch Switch.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
4. Connect a test lamp between the control circuit terminal 86 and B+.
5. Verify the test lamp illuminates when pressing the S46B Liftgate Unlatch Switch.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
6. Test or replace the KR95A Liftgate Unlatch Relay.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the KR95A Liftgate Unlatch Relay.
2. Test for 60 - 200 Ω between terminals 85 and 86.
   - **If less than 60 Ω or greater than 200 Ω**

     Replace the KR95A Liftgate Unlatch Relay.

   - **If between 60 - 200 Ω**
3. Test for infinite resistance between the terminals listed below:
   - 30 and 85
   - 30 and 86
   - 30 and 87
   - 87 and 86
   - **If less than infinite resistance**

     Replace the KR95A Liftgate Unlatch Relay.

   - **If infinite resistance**
4. Install a 3 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2 Ω between terminals 30 and 87.
   - **If 2 Ω or greater**

     Replace the KR95A Liftgate Unlatch Relay.

   - **If less than 2 Ω**
6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for BCM replacement, programming and setup

DTC P0CCC, P0CCE, OR P0CCF: CHARGE PORT DOOR POSITION SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0CCC 00

Charge Port Door Position Sensor Circuit

DTC P0CCE 00

Charge Port Door Position Sensor Circuit Low Voltage

DTC P0CCF 00

Charge Port Door Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0CCE 00	P0CCC 00, P0CCE 00	P0CCF 00	-
Ground	-	P0CCC 00, P0CCE 00	-	-

Circuit/System Description

For an overview of the component/system, refer to: **Charge Port Door Description and Operation**

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Ground	Chassis Ground

Component	Description
B197 Charge Port Door Position Switch	The switch B197 has an internal resistor ladder network. A specific resistance is generated dependent on the position of the switch.
K114B Hybrid/EV Powertrain Control Module 2	The control module also reads various switches and sensors and makes their values available via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

- P0CCC 00 - Charge Port Door Position Sensor Circuit = Voltage Out of Range
- P0CCE 00 - Charge Port Door Position Sensor Circuit = Short to Ground
- P0CCF 00 - Charge Port Door Position Sensor Circuit = Short to Voltage/Open/High Resistance

Actions Taken When the DTC Sets

Driver Information Display - Charge Port Door: Open = Not Displayed

Conditions for Clearing the DTC

DTC P0CCC 00, P0CCE 00, P0CCF 00 = Type C DTC

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Operate the component: Charge Port Door - Close

   Verify the scan tool parameter: Charge Port Door = Closed

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
3. Operate the component: Charge Port Door - Open

   Verify the scan tool parameter: Charge Port Door = open

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
4. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B197 Charge Port Door Position Switch
3. Test for less than 10 Ω between the test points: Ground circuit terminal 3 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 3 at Component harness & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1 & Ground
   - **If less than 4.8 V**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: X2 at K114B Hybrid/EV Powertrain Control Module 2
   3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance
   4. Test for less than 2 Ω between the test points: 5 V Reference circuit terminal 1 at Component harness & Terminal 25 at Control module harness
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.

        - If less than 2 Ω - Replace the component: K114B Hybrid/EV Powertrain Control Module 2
    - **If greater than 5.2 V**
    1. Ignition/Vehicle - Off
    2. Disconnect the electrical connector: X2 at K114B Hybrid/EV Powertrain Control Module 2
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V - Replace the component: K114B Hybrid/EV Powertrain Control Module 2
    - **If between 4.8 and 5.2 V**
6. Test or replace the component: B197 Charge Port Door Position Switch

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B197 Charge Port Door Position Switch
3. Test for 185 to 190 Ω between the test points: Signal terminal 1 & Ground terminal 3 - The switch is in the open position.
    - **If not in the specified range**

      Replace the component: B197 Charge Port Door Position Switch

    - **If in the specified range**
4. Test for 1865 to 1875 Ω between the test points: Signal terminal 1 & Ground terminal 3 - The switch is in the closed position.
    - **If not in the specified range**

      Replace the component: B197 Charge Port Door Position Switch

    - **If in the specified range**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Charge Port Door Ajar Indicator Switch Replacement (Except Dubai)** **Charge Port Door Ajar Indicator Switch Replacement (Dubai)**
- For control module replacement, programming, and setup refer to: **Control Module References**

SYMPTOMS - VEHICLE ACCESS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the **Diagnostic System Check - Vehicle** .
    - There are no DTCs set
    - The control modules can communicate via the serial data link
2. Review the system operation in order to familiarize yourself with the system functions. Refer to the following systems description:
    - **Door Ajar Indicator Description and Operation**
    - **Charge Port Door Description and Operation**
    - **Power Door Locks Description and Operation**
    - **Rear Hatch/Gate Description and Operation**

Visual/Physical Inspection

Several of the symptom procedures ask for a careful visual/physical check. This step is extremely important, it could lead to correcting a problem without further checks and can save valuable time. These checks include the following:

- Inspect for aftermarket devices which could affect the operation of the power door systems. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components and harness connectors for obvious damage or conditions which could cause the symptom.

Intermittents

NOTE: **Inspect for proper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Ensure that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone signal may cause the condition. Faulty electrical connections or wiring may also be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .**

NOTE: **The problem may or may not turn ON the SERVICE VEHICLE SOON indicator or store a DTC. Do not use the symptom tables to diagnose intermittent conditions. The malfunction must be present in order to locate the problem.**

Poor electrical connections or wiring cause most intermittent conditions. Perform a careful visual/physical check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body
- An improperly formed or damaged terminal
- Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.
- Poor terminal to wire connection requires removing the terminal from the connector body in order to perform the check.

Use a scan tool in order to help detect intermittent conditions. The scan tool has several features that can be used to locate an intermittent condition. The snapshot feature can capture and store data parameters within the scan tool when the malfunction occurs. This information can then be reviewed in order to see what caused the malfunction.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Charger Door Ajar Indicator Malfunction**
- **Exterior Door Handle Switch Malfunction**
- **Liftgate Release Malfunction**
- **Door Ajar Indicator Malfunction**
- **Power Door Lock Key Cylinder Switches Malfunction**
- **Power Door Locks Malfunction**

CHARGER DOOR AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0CCC 00

Charge Port Door Position Sensor Circuit

DTC P0CCE 00

Charge Port Door Position Sensor Circuit Low Voltage

DTC P0CCF 00

Charge Port Door Position Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0CCE 00	P0CCC 00, P0CCE 00	P0CCF 00	-
Ground	-	P0CCC 00, P0CCE 00	-	-

Circuit/System Description

For an overview of the component/system, refer to: **Charge Port Door Description and Operation**

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 5 V.
Ground	Chassis Ground

Component	Description
B197 Charge Port Door Position Switch	The switch B197 has an internal resistor ladder network. A specific resistance is generated dependent on the position of the switch.
K114B Hybrid/EV Powertrain Control Module 2	The control module also reads various switches and sensors and makes their values available via serial data.

Conditions for Running the DTC

Ignition - On / Vehicle - In Service Mode

Conditions for Setting the DTC

- P0CCC 00 - Charge Port Door Position Sensor Circuit = Voltage Out of Range
- P0CCE 00 - Charge Port Door Position Sensor Circuit = Short to Ground
- P0CCF 00 - Charge Port Door Position Sensor Circuit = Short to Voltage/Open/High Resistance

Actions Taken When the DTC Sets

Driver Information Display - Charge Port Door: Open = Not Displayed

Conditions for Clearing the DTC

DTC P0CCC 00, P0CCE 00, P0CCF 00 = Type C DTC

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Front of Vehicle/Engine Compartment Component Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Operate the component: Charge Port Door - Close

   Verify the scan tool parameter: Charge Port Door = Closed

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
3. Operate the component: Charge Port Door - Open

   Verify the scan tool parameter: Charge Port Door = open

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
4. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the electrical connector: B197 Charge Port Door Position Switch
3. Test for less than 10 Ω between the test points: Ground circuit terminal 3 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 3 at Component harness & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Test for 4.8 to 5.2 V between the test points: 5 V Reference circuit terminal 1 & Ground
   - **If less than 4.8 V**

   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: X2 at K114B Hybrid/EV Powertrain Control Module 2
   3. Test for infinite resistance between the test points: 5 V Reference circuit terminal 1 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance
   4. Test for less than 2 Ω between the test points: 5 V Reference circuit terminal 1 at Component harness & Terminal 25 at Control module harness
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Replace the component: K114B Hybrid/EV Powertrain Control Module 2
   - **If greater than 5.2 V**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: X2 at K114B Hybrid/EV Powertrain Control Module 2
   3. Ignition - On / Vehicle - In Service Mode
   4. Test for less than 1 V between the test points: 5 V Reference circuit terminal 1 at Component harness & Ground
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V - Replace the component: K114B Hybrid/EV Powertrain Control Module 2
   - **If between 4.8 and 5.2 V**

6. Test or replace the component: B197 Charge Port Door Position Switch

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: B197 Charge Port Door Position Switch
3. Test for 185 to 190 Ω between the test points: Signal terminal 1 & Ground terminal 3 - The switch is in the open position.
   - **If not in the specified range**

     Replace the component: B197 Charge Port Door Position Switch

   - **If in the specified range**
4. Test for 1865 to 1875 Ω between the test points: Signal terminal 1 & Ground terminal 3 - The switch is in the closed position.
   - **If not in the specified range**

     Replace the component: B197 Charge Port Door Position Switch

   - **If in the specified range**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Charge Port Door Ajar Indicator Switch Replacement (Except Dubai)** **Charge Port Door Ajar Indicator Switch Replacement (Dubai)**
- For control module replacement, programming, and setup refer to: **Control Module References**

EXTERIOR DOOR HANDLE SWITCH MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**

- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Exterior Driver Door Handle Switch	B3849 02	1	1	-
Signal - Exterior Passenger Door Handle Switch	B1474 02	2	2	-
Signal - Exterior Left Rear Door Handle Switch	B1534 02	3	3	-
Signal - Exterior Right Rear Door Handle Switch	B1535 02	4	4	-
Ground - A24D Door Handle Assembly - Driver Exterior	-	1	-	-
Ground - A24P Door Handle Assembly - Passenger Exterior	-	2	-	-
Ground - A24LR Door Handle Assembly - Left Rear Exterior	-	3	-	-
Ground - A24RR Door Handle Assembly - Right Rear Exterior	-	4	-	-

1. B27D Door Handle Switch - Driver Exterior = Disabled
2. B27P Door Handle Switch - Passenger Exterior = Disabled
3. B27LR Door Handle Switch - Left Rear Exterior = Disabled
4. B27RR Door Handle Switch - Right Rear Exterior = Disabled

Circuit/System Description

For an overview of the component/system, refer to: **Power Door Locks Description and Operation**

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
B27D Door Handle Switch - Driver Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
B27P Door Handle Switch - Passenger Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
B27LR Door Handle Switch - Left Rear Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
B27RR Door Handle Switch - Right Rear Exterior	The switch has a normally open contact.When the switch is activated, the signal circuit to the control module is grounded.
K84 Keyless Entry Control Module	The control module also reads various switches and sensors and makes their values available via serial data.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. B27D Door Handle Switch - Driver Exterior - Not Pressed

   Verify the scan tool parameter: Exterior Driver Door Handle Switch = Inactive

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
3. B27P Door Handle Switch - Passenger Exterior - Not Pressed

   Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Inactive

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
4. B27LR Door Handle Switch - Left Rear Exterior - Not Pressed

   Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Inactive

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
5. B27RR Door Handle Switch - Right Rear Exterior - Not Pressed

   Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Inactive

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**
6. Operate the component: B27D Door Handle Switch - Driver Exterior - Pressed

   Verify the scan tool parameter: Exterior Driver Door Handle Switch = Active

- **If not the specified state**

  Refer to: Circuit/System Testing

- **If the specified state**

7. Operate the component: B27P Door Handle Switch - Passenger Exterior - Pressed

   Verify the scan tool parameter: Exterior Passenger Door Handle Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**

8. Operate the component: B27LR Door Handle Switch - Left Rear Exterior - Pressed

   Verify the scan tool parameter: Exterior Left Rear Door Handle Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**

9. Operate the component: B27RR Door Handle Switch - Right Rear Exterior - Pressed

   Verify the scan tool parameter: Exterior Right Rear Door Handle Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**

10. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: A24 Door Handle Assembly
3. Test for less than 10 Ω between the test points: Ground circuit terminal 5 & Ground
   - **If 10 Ω or greater**
   1. Ground Connection - Disconnect
   2. Test for less than 2 Ω between the test points: Ground circuit terminal 5 at Component harness & Ground Connection
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Inactive
   - **If not the specified state**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: X2 at K84 Keyless Entry Control Module
   3. Test for infinite resistance between the test points: Signal circuit terminal 1 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.

        - If infinite resistance - Replace the component: K84 Keyless Entry Control Module
    - **If the specified state**

6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 1 & Ground circuit terminal 5
7. Verify the scan tool parameter: Exterior Door Handle Switch Circuit = Active
    - **If not the specified state**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: X2 at K84 Keyless Entry Control Module
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Signal circuit terminal 1 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
    5. Ignition/Vehicle - Off
    6. Test for less than 2 Ω between the test points:
        - Signal circuit terminal 1 at A24D Door Handle Assembly - Driver Exterior & Terminal 12 X2 at Control module harness
        - Signal circuit terminal 1 at A24P Door Handle Assembly - Passenger Exterior & Terminal 11 X2 at Control module harness
        - Signal circuit terminal 1 at A24LR Door Handle Assembly - Left Rear Exterior & Terminal 2 X2 at Control module harness
        - Signal circuit terminal 1 at A24RR Door Handle Assembly - Right Rear Exterior & Terminal 1 X2 at Control module harness
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: K84 Keyless Entry Control Module
    - **If the specified state**
8. Test or replace the component: A24 Door Handle Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A24 Door Handle Assembly
3. Test for infinite resistance between the test points: Signal terminal 1 & Ground terminal 5 - Not Pressed
    - **If less than infinite resistance**

      Replace the component: A24 Door Handle Assembly

    - **If infinite resistance**
4. Test for less than 3 Ω between the test points: Signal terminal 1 & Ground terminal 5 - Pressed
    - **If 3 Ω or greater**

      Replace the component: A24 Door Handle Assembly

    - **If less than 3 Ω**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Front Side Door Outside Handle Replacement**
- **Rear Side Door Outside Handle Replacement**
- For control module replacement, programming, and setup refer to: **Control Module References**

LIFTGATE RELEASE MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Liftgate Unlatch Relay B+	2	2	-	-
Liftgate Unlatch Switch Signal	1	1	1	-
Liftgate Unlatch Relay Control Terminal 86	-	2	B324A 01	-
Liftgate Unlatch Relay Control Terminal 85	B3245 02	2	2	-
Liftgate Latch Assembly Ground	-	2	-	-
Liftgate Unlatch Switch Ground	-	1	-	-
1. Liftgate Release Switch Malfunction 2. Liftgate Release Malfunction				

Circuit/System Description

The liftgate unlatch switch is an input to the body control module (BCM). The BCM supplies a 12 V signal to the liftgate unlatch switch and when the switch is pressed, signal circuit voltage goes low. When the BCM receives a liftgate release signal it will monitor the status to the door latches. If the vehicle doors are locked, the BCM will ignore the request, if the doors are unlocked, the BCM will supply voltage and ground to the liftgate release relay coil, energizing the relay. When the relay is energized, battery voltage flows through the closed contacts of the relay to the Liftgate Latch Assembly assembly which activates allowing for the liftgate to be raised to the open position.

Diagnostic Aids

An intermittent short to ground in the liftgate unlatch switch signal circuit may cause the BCM to command the liftgate to open if the vehicle is in park and the doors are unlocked. If the vehicle has a history of the liftgate opening unexpectedly, inspect the point where the wires enter the liftgate unlatch switch for corrosion or evidence of water intrusion.

Reference Information

Schematic Reference

- **Release Systems Schematics**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Rear Hatch/Gate Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Trunk Lid/Liftgate Window Exterior Unlatch Switch parameter changes between Active and Inactive when pressing and releasing the S46B Liftgate Unlatch Switch.
    - **If the parameter does not change**

      Refer to Circuit/System Testing - Liftgate Release Switch Inoperative

    - **If the parameter changes**

NOTE: **Verify all doors have been commanded UNLOCK with a scan tool prior to commanding the liftgate**

3. Verify the A23C Liftgate Latch Assembly releases when commanding the Liftgate Unlatch with a scan tool
    - **If the A23C Liftgate Latch Assembly does not release**

      Refer to Circuit/System Testing - Liftgate Release Actuator Inoperative

    - **If the A23C Liftgate Latch Assembly does release**
4. All OK.

Circuit/System Testing

Liftgate Release Switch Inoperative

1. Vehicle OFF and all vehicle systems OFF, disconnect the X907 inline harness connector at the S46B Liftgate Unlatch Switch. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Trunk Lid/Liftgate Window Exterior Unlatch Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the ground circuit terminal 2.
6. Verify the scan tool Trunk Lid/Liftgate Window Exterior Unlatch Switch parameter is Active.
    - **If not Active**
    1. Vehicle OFF, remove the 3 A fused jumper wire, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.

   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If Active**
7. Test or replace the S46B Liftgate Unlatch Switch.

Release Actuator Inoperative

1. Vehicle OFF, disconnect the KR95A Liftgate Unlatch Relay. Vehicle in Service Mode
2. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
   - **If the test lamp does not illuminate**
   - Replace the X50A Fuse Block-Underhood
   - **If the test lamp illuminates**
3. Connect a test lamp between the control circuit terminal 85 and ground.
4. Vehicle in Service Mode, verify the test lamp turns ON and OFF when commanding the Liftgate Unlatch with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
5. Connect a test lamp between the control circuit terminal 86 and B+.
6. Verify the test lamp turns ON and OFF when commanding the Liftgate Unlatch with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Vehicle OFF.
   4. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.

    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K9 Body Control Module.
  - **If the test lamp turns ON and OFF**

7. Verify that a test lamp does not illuminate between the control circuit terminal 5 and ground.
  - **If the test lamp illuminates**

    Repair the short to voltage on the control circuit

  - **If the test lamp does not illuminate**

8. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the A23C Liftgate Latch Assembly. It may take up to 2 minutes for all vehicle systems to power down.
9. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
  - **If 10 Ω or greater**
  1. Vehicle OFF.
  2. Test for less than 2 Ω in the ground circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, repair the open/high resistance in the ground connection.
  - **If less than 10 Ω**

10. Connect the harness connector at the A23C Liftgate Latch Assembly
11. Vehicle in Service Mode, connect a 10 A fused jumper wire between the B+ circuit terminal 30 and the control circuit terminal 87.
12. Verify the A23C Liftgate Latch Assembly is activated.
  - **If the A23C Liftgate Latch Assembly does not activate**
  1. Vehicle OFF, disconnect the harness connector at the A23C Liftgate Latch Assembly.
  2. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the A23C Liftgate Latch Assembly.
  - **If the A23C Liftgate Latch Assembly activates**

13. Test or replace the KR95A Liftgate Unlatch Relay.

Component Testing

Liftgate Latch Assembly

1. Vehicle OFF, disconnect the harness connector at the A23C Liftgate Latch Assembly.
2. Install a 10 A fused jumper wire between the control terminal 3 and 12 V. Install a jumper wire between the ground terminal 1 and ground.
3. Verify the A23C Liftgate Latch Assembly activates
  - **If the A23C Liftgate Latch Assembly does not activate.**

    Replace the A23C Liftgate Latch Assembly.

  - **If the A23C Liftgate Latch Assembly does activate.**

4. All OK

Liftgate Release Switch

1. Vehicle OFF, disconnect the X907 inline harness connector at the S46B Liftgate Unlatch Switch.
2. Test for infinite resistance between the signal circuit terminal 1 and the ground circuit terminal 2 with the switch in the open position.
  - **If less than infinite resistance**

    Replace the S46B Liftgate Unlatch Switch.

  - **If infinite resistance**

3. Test for less than 3 Ω between the signal circuit terminal 1 and the ground circuit terminal 2 with the switch in the closed position.
    - **If 3 Ω or greater**

      Replace the S46B Liftgate Unlatch Switch.

    - **If less than 3 Ω**
4. All OK

Relay Test

1. Vehicle OFF, disconnect the KR95A Liftgate Unlatch Relay.
2. Test for 60 - 200 Ω between terminals 85 and 86.
    - **If less than 60 Ω or greater than 200 Ω**

      Replace the KR95A Liftgate Unlatch Relay.

    - **If between 60 - 200 Ω**
3. Test for infinite resistance between the terminals listed below:
    - 30 and 85
    - 30 and 86
    - 30 and 87
    - 87 and 86
    - **If less than infinite resistance**

      Replace the KR95A Liftgate Unlatch Relay.

    - **If infinite resistance**
4. Install a 3 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground.
5. Test for less than 2 Ω between terminals 30 and 87.
    - **If 2 Ω or greater**

      Replace the KR95A Liftgate Unlatch Relay.

    - **If less than 2 Ω**
6. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair procedure.

- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- **Liftgate Release Switch Replacement**
- **Liftgate Latch Replacement**
- **Control Module References** for BCM replacement, programming and setup

LIFTGATE AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	2	2	-
Ground	-	3	-	-

1. Trunk Open Display Message = Always On
2. Trunk Open Display Message = Disabled
3. A23C Liftgate Latch Assembly = Disabled

Circuit/System Description

For an overview of the component/system, refer to: **Liftgate Ajar Indicator Description and Operation**

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
A23C Liftgate Latch Assembly	The DC motor unlatches the liftgate. Once the liftgate is unlatched, a switch in the latch will close, grounding the signal circuit to the control module K9.
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.

Reference Information

Schematic Reference

Release Systems Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Luggage Compartment/Rear of Vehicle Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Operate the component: Liftgate - Closed

   Verify the scan tool parameter: Rear Closure Ajar Switch = Inactive

   - **If not the specified state**

Refer to: Circuit/System Testing

- **If the specified state**

3. Operate the component: Liftgate - Ajar

   Verify the scan tool parameter: Rear Closure Ajar Switch = Active

   - **If not the specified state**

     Refer to: Circuit/System Testing

   - **If the specified state**

4. All OK.

Circuit/System Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: A23C Liftgate Latch Assembly
3. Ignition - On / Vehicle - In Service Mode
4. Verify the scan tool parameter: Rear Closure Ajar Switch = Inactive
   - **If not the specified state**
   1. Ignition/Vehicle - Off
   2. Disconnect the electrical connector: K9 Body Control Module
   3. Test for infinite resistance between the test points: Signal circuit terminal 2 at Component harness & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: K9 Body Control Module
   - **If the specified state**
5. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 2 & Ground circuit terminal 1
6. Verify the scan tool parameter: Rear Closure Ajar Switch = Active
   - **If not the specified state**
   1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
   2. Disconnect the electrical connector: K9 Body Control Module
   3. Ignition - On / Vehicle - In Service Mode
   4. Test for less than 1 V between the test points: Signal circuit terminal 2 at Component harness & Ground
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V
   5. Ignition/Vehicle - Off
   6. Test for less than 2 Ω between the test points: Signal circuit terminal 2 at Component harness & Terminal 5 X6 at Control module harness
      - If 2 Ω or greater - Repair the open/high resistance in the circuit.
      - If less than 2 Ω - Replace the component: K9 Body Control Module
   - **If the specified state**
7. Test or replace the component: A23C Liftgate Latch Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: A23C Liftgate Latch Assembly
3. Test for infinite resistance between the test points: Signal terminal 2 & Ground terminal 1 - The switch is in the open position.
   - **If less than infinite resistance**

    Replace the component: A23C Liftgate Latch Assembly

  - **If infinite resistance**

4. Test for less than 3 Ω between the test points: Signal terminal 2 & Ground terminal 1 - The switch is in the closed position.
    - **If 3 Ω or greater**

      Replace the component: A23C Liftgate Latch Assembly

    - **If less than 3 Ω**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

- Liftgate Latch Replacement
- For control module replacement, programming, and setup refer to: Control Module References

DOOR AJAR INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Door Ajar Switch Signal	1	2	2	-
Passenger Door Ajar Switch Signal	1	2	2	-
Left Front Door Ajar Switch Signal	1	2	2	-
Right Front Door Ajar Switch Signal	1	2	2	-
Ground - A23D Door Latch Assembly - Driver	-	2	-	-
Ground - A23P Door Latch Assembly - Passenger	-	2	-	-
Ground - A23LR Door Latch Assembly - Left Rear	-	2	-	-
Ground - A23RR Door Latch Assembly - Right Rear	-	2	-	-

1. Door Ajar Indicator = Always On
2. Door Ajar Indicator - Driver Door = Always Off
3. Door Ajar Indicator - Passenger Door = Always Off
4. Door Ajar Indicator - Left Rear Door = Always Off
5. Door Ajar Indicator - Right Rear Door = Always Off

Circuit/System Description

For an overview of the component/system, refer to: Door Ajar Indicator Description and Operation

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
A23 Door Latch Assembly	The lock assemblies also contain a door ajar switch that is open when the door is closed.
M74 Window Motor	• Power Window Control • The control module also reads various switches and sensors and makes their values available via serial data.
S79 Window Switch	• Power Window Control • The control module also reads various switches and sensors and makes their values available via serial data.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the appropriate scan tool door ajar switch parameter changes when opening and closing the vehicle doors.
   - **If the parameter state does not change**

     Refer to: Circuit/System Testing

   - **If the parameter state changes**
3. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector: A23 Door Latch Assembly
3. Test for less than 10 Ω between the test points: Ground circuit terminal 3 & Ground
    - **If 10 Ω or greater**
    1. Ground Connection - Disconnect
    2. Test for less than 2 Ω between the test points: Ground circuit terminal 3 at Component harness & Ground Connection
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Door Ajar Switch = Inactive
    - **If not the specified state**
    1. Ignition/Vehicle - Off
    2. Disconnect the appropriate electrical connector:
        - M74 Window Motor
        - S79 Window Switch
    3. Test for infinite resistance between the test points:
        - A23D Door Latch Assembly - Driver Signal circuit terminal 1 at Component harness & Ground
        - A23P Door Latch Assembly - Passenger Signal circuit terminal 1 at Component harness & Ground
        - A23LR Door Latch Assembly - Left Rear Signal circuit terminal 1 at Component harness & Ground
        - A23RR Door Latch Assembly - Right Rear Signal circuit terminal 1 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component:
    - M74 Window Motor
    - S79 Window Switch
    - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points:
    - A23D Door Latch Assembly - Driver Signal circuit terminal 1 & Ground circuit terminal 3
    - A23P Door Latch Assembly - Passenger Signal circuit terminal 1 & Ground circuit terminal 3
    - A23LR Door Latch Assembly - Left Rear Signal circuit terminal 1 & Ground circuit terminal 3
    - A23RR Door Latch Assembly - Right Rear Signal circuit terminal 1 & Ground circuit terminal 3
7. Verify the scan tool parameter: Door Ajar Switch = Active
    - **If not the specified state**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector:
        - M74 Window Motor
        - S79 Window Switch
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points:

        - A23D Door Latch Assembly - Driver Signal circuit terminal 1 at Component harness & Ground
        - A23P Door Latch Assembly - Passenger Signal circuit terminal 1 at Component harness & Ground
        - A23LR Door Latch Assembly - Left Rear Signal circuit terminal 1 at Component harness & Ground
        - A23RR Door Latch Assembly - Right Rear Signal circuit terminal 1 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
    5. Ignition/Vehicle - Off
    6. Test for less than 2 Ω between the test points:
        - Signal circuit terminal 1 at A23D Door Latch Assembly - Driver & Signal circuit terminal 6 at M74D Window Motor - Driver
        - Signal circuit terminal 1 at A23P Door Latch Assembly - Passenger & Signal circuit terminal 6 at S79P Window Switch - Passenger
        - Signal circuit terminal 1 at A23LR Door Latch Assembly - Left Rear & Signal circuit terminal 6 at S79LR Window Switch - Left Rear
        - Signal circuit terminal 1 at A23RR Door Latch Assembly - Right Rear & Signal circuit terminal 6 at S79RR Window Switch - Right Rear
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component:
        - M74 Window Motor
        - S79 Window Switch
    - **If the specified state**

8. Test or replace the component: A23 Door Latch Assembly

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: A23 Door Latch Assembly
3. Test for infinite resistance between the test points:
    - A23D Door Latch Assembly - Driver: Signal terminal 1 & Ground terminal 3 - The switch is in the open position.
    - A23P Door Latch Assembly - Passenger: Signal terminal 5 & Ground terminal 3 - The switch is in the open position.
    - A23LR Door Latch Assembly - Left Rear: Signal terminal 1 & Ground terminal 3 - The switch is in the open position.
    - A23RR Door Latch Assembly - Right Rear: Signal terminal 5 & Ground terminal 3 - The switch is in the open position.
    - **If less than infinite resistance**

      Replace the component: A23 Door Latch Assembly

    - **If infinite resistance**
4. Test for less than 3 Ω between the test points:
    - A23D Door Latch Assembly - Driver: Signal terminal 1 & Ground terminal 3 - The switch is in the closed position.
    - A23P Door Latch Assembly - Passenger: Signal terminal 5 & Ground terminal 3 - The switch is in the closed position.
    - A23LR Door Latch Assembly - Left Rear: Signal terminal 1 & Ground terminal 3 - The switch is in the closed position.
    - A23RR Door Latch Assembly - Right Rear: Signal terminal 5 & Ground terminal 3 - The switch is in the closed position.

- **If 3 Ω or greater**

  Replace the component: A23 Door Latch Assembly

- **If less than 3 Ω**

5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Front Side Door Latch Replacement**
- **Rear Side Door Latch Replacement**
- **Front Side Door Window Switch Replacement**
- **Rear Side Door Window Switch Replacement**
- **Front Side Door Window Regulator Replacement**

POWER DOOR LOCK KEY CYLINDER SWITCHES MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	1	1	1	-
Ground	-	1	-	-

1. B29D Door Lock Key Cylinder Switch - Driver = Disabled

Circuit/System Description

For an overview of the component/system, refer to: **Power Door Locks Description and Operation**

Circuit	Description
Signal	The control module input circuit has an internal resistance connected to 12 V.
Ground	Chassis Ground

Component	Description
A23 Door Latch Assembly	The door locks are actuated by a bidirectional DC motor that locks/unlocks the door so that it can not be opened from outside the vehicle (but still from inside).The assembly also contains a normally open door ajar switch that closes as soon as the door is not fully closed.
S146 Window/Outside Rearview Mirror Switch - Driver	The switch assembly has a 4-way switch to control the mirror movement (up, down, left, right) and a 2-position switch to select the left and right mirror.

Reference Information

Schematic Reference

Door Lock/Indicator Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Operate the component: S13D Door Lock Switch - Driver - Unlock
2. Operate the component: B29D Door Lock Key Cylinder Switch - Driver - Lock
3. Verify the component activates: A23LR Door Latch Assembly - Left Rear/A23P Door Latch Assembly - Passenger/A23RR Door Latch Assembly - Right Rear
    - **If the component does not work as specified**

      Refer to: Circuit/System Testing

    - **If all functions work properly**
4. All OK.

Circuit/System Testing

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1.
2. Ignition/Vehicle & All vehicle systems - Off
3. Disconnect the electrical connector: A23D Door Latch Assembly - Driver
4. Test for less than 10 Ω between the test points: Ground circuit terminal 3 & Ground
    - **If 10 Ω or greater**
    1. Ground Connection - Disconnect
    2. Test for less than 2 Ω between the test points: Ground circuit terminal 3 at Component harness & Ground Connection
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
5. Ignition - On / Vehicle - In Service Mode
6. Test for greater than 10 V between the test points: Signal circuit terminal 4 & Ground circuit terminal 3
    - **If 10 V or less**
    1. Ignition/Vehicle - Off

    2. Disconnect the electrical connector: S146 Window/Outside Rearview Mirror Switch - Driver
    3. Test for infinite resistance between the test points: Signal circuit terminal 4 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance
    4. Test for less than 2 Ω between the test points: Signal circuit terminal 4 at Component harness & Signal circuit terminal 14 at S146 Window/Outside Rearview Mirror Switch - Driver
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: S146 Window/Outside Rearview Mirror Switch - Driver
    - **If greater than 10 V**

7. Test or replace the component: A23D Door Latch Assembly - Driver

Component Testing

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector.A23D Door Latch Assembly - Driver
3. Test for infinite resistance between the test points: Signal terminal 4 & Ground terminal 3 - The switch is in the open position.
    - **If less than infinite resistance**

      Replace the component: A23D Door Latch Assembly - Driver

    - **If infinite resistance**
4. Test for less than 3 Ω between the test points: Signal terminal 4 & Ground terminal 3 - The switch is in the closed position.
    - **If 3 Ω or greater**

      Replace the component: A23D Door Latch Assembly - Driver

    - **If less than 3 Ω**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Front Side Door Window Control Switch Replacement**
- **Front Side Door Latch Replacement**

POWER DOOR LOCKS MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short to Voltage
B+ - Body Control Module	B3125 02, B3130 02, B3135 02	B3125 02, B3130 02, B3135 02	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Short to Voltage
Signal terminal 2 at S13D Door Lock Switch - Driver	B3150 00	2	2	-
Signal terminal 3 at S13D Door Lock Switch - Driver	B3140 00	3	3	-
Signal terminal 2 at S13P Door Lock Switch - Passenger	B3155 00	4	4	-
Signal terminal 3 at S13P Door Lock Switch - Passenger	B3145 00	5	5	-
Control - A23D Door Latch Assembly - Driver	B3125 02, B3130 02, B3135 02	7	B3125 01, B3130 01, B3135 01	-
Control - A23P Door Latch Assembly - Passenger	B3125 02, B3130 02, B3135 02	8	B3125 01, B3130 01, B3135 01	-
Control - A23LR Door Latch Assembly - Left Rear	B3125 02, B3130 02, B3135 02	9	B3125 01, B3130 01, B3135 01	-
Control - A23RR Door Latch Assembly - Right Rear	B3125 02, B3130 02, B3135 02	10	B3125 01, B3130 01, B3135 01	-
S13P Door Lock Switch - Passenger - Ground	-	6	-	-
Ground - S13D Door Lock Switch - Driver	-	1	-	-
Ground - Body Control Module	-	7, 8, 9, 10	-	-

1. S13D Door Lock Switch - Driver = Inoperative
2. Driver Door Lock Switch = Inoperative
3. Driver Door Unlock Switch = Inoperative
4. Passenger Door Lock Switch = Inoperative
5. Passenger Door Unlock Switch = Inoperative
6. S13P Door Lock Switch - Passenger = Inoperative
7. A23D Door Latch Assembly - Driver = Inoperative
8. A23P Door Latch Assembly - Passenger = Inoperative
9. A23LR Door Latch Assembly - Left Rear = Inoperative
10. A23RR Door Latch Assembly - Right Rear = Inoperative

Circuit/System Description

For an overview of the component/system, refer to: **Power Door Locks Description and Operation**

Circuit	Description
B+ - Body Control Module	Supplied from a fuse.
Signal	The control module input circuit has an internal resistance connected to 12 V.
Control - Driver Door Unlock	The output circuit is switched from ground to 12 V to activate the component.
Control - All Doors Lock	The output circuit is switched from ground to 12 V to activate the component.
Control - Passenger Door Unlock	The output circuit is switched from ground to 12 V to activate the component.
Ground - S13D Door Lock Switch - Driver	Chassis Ground

Circuit	Description
Ground - S13P Door Lock Switch - Passenger	Chassis Ground
Ground - Body Control Module	Chassis Ground

Component	Description
A23 Door Latch Assembly	The door locks are actuated by a bidirectional DC motor that locks/unlocks the door so that it can not be opened from outside the vehicle (but still from inside).
K9 Body Control Module	The module controls various vehicle functions like lighting, central door locking, power windows, etc.
S13P Door Lock Switch - Passenger	• The switch has a normally open contact. • When the switch is activated, the signal circuit to the control module is grounded.
S13D Door Lock Switch - Driver	• The switch has a normally open contact. • When the switch is activated, the signal circuit to the control module is grounded.

Reference Information

Schematic Reference

- **Door Lock/Indicator Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Component View Reference

Door Component Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify the scan tool parameter: Driver Door Lock Switch = Inactive
    - **If not the specified state**

      Refer to: Circuit/System Testing - Test 1

    - **If the specified state**
3. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

Verify the scan tool parameter: Driver Door Lock Switch = Lock & Unlock

- **If not the specified state**

  Refer to: Circuit/System Testing - Test 1

- **If the specified state**

4. Verify the scan tool parameter: Passenger Door Lock Switch = Inactive
   - **If not the specified state**

     Refer to: Circuit/System Testing - Test 1

   - **If the specified state**
5. Operate the component: S13P Door Lock Switch - Passenger - Lock & Unlock

   Verify the scan tool parameter: Passenger Door Lock Switch = Lock & Unlock

   - **If not the specified state**

     Refer to: Circuit/System Testing - Test 1

   - **If the specified state**
6. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock

   Verify the component works as specified:

   - A23D Door Latch Assembly - Driver = Lock & Unlock
   - A23LR Door Latch Assembly - Left Rear = Lock & Unlock
   - A23P Door Latch Assembly - Passenger = Lock & Unlock
   - A23RR Door Latch Assembly - Right Rear = Lock & Unlock
   - **If the component does not activate - A23D Door Latch Assembly - Driver**

     Refer to: Circuit/System Testing - Test 2

   - **If the component does not activate - A23LR Door Latch Assembly - Left Rear**

     Refer to: Circuit/System Testing - Test 3

   - **If the component does not activate - A23P Door Latch Assembly - Passenger**

     Refer to: Circuit/System Testing - Test 3

   - **If the component does not activate - A23RR Door Latch Assembly - Right Rear**

     Refer to: Circuit/System Testing - Test 3

   - **If none of the components operate**

     Refer to: Circuit/System Testing - Test 4

   - **If all functions work properly**
7. All OK.

Circuit/System Testing

Test 1

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle & All vehicle systems - Off

2. Disconnect the appropriate electrical connector: S13D Door Lock Switch - Driver/S13P Door Lock Switch - Passenger
3. Test for less than 10 Ω between the test points: Ground circuit terminal 4 & Ground
    - **If 10 Ω or greater**
    1. Ground Connection - Disconnect
    2. Test for less than 2 Ω between the test points: Ground circuit terminal 4 at Component harness & Ground Connection
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify the scan tool parameter: Driver Door Lock Switch or Passenger Door Lock Switch = Inactive
    - **If not the specified state**
    1. Ignition/Vehicle - Off
    2. Disconnect the electrical connector: X1/X2/X7 at K9 Body Control Module
    3. Test for infinite resistance between the test points:
        - Signal circuit terminal 2 at Component harness & Ground
        - Signal circuit terminal 3 at Component harness & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component: K9 Body Control Module
    - **If the specified state**
6. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 3 & Ground circuit terminal 4
7. Verify the scan tool parameter: Driver Door Lock Switch or Passenger Door Lock Switch = Unlock
    - **If not the specified state**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: X1 or X2 at K9 Body Control Module
    3. Ignition - On / Vehicle - In Service Mode
    4. Test for less than 1 V between the test points: Signal circuit terminal 3 at Component harness & Ground
        - If 1 V or greater - Repair the short to voltage on the circuit.
        - If less than 1 V
    5. Ignition/Vehicle - Off
    6. Test for less than 2 Ω between the test points:
        - Signal circuit terminal 3 at S13D Door Lock Switch - Driver & Terminal 15 X2 at Control module harness
        - Signal circuit terminal 3 at S13P Door Lock Switch - Passenger & Terminal 14 X1 at Control module harness
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Replace the component: K9 Body Control Module
    - **If the specified state**
8. Connect a 3 A fused jumper wire between the test points: Signal circuit terminal 2 & Ground circuit terminal 4
9. Verify the scan tool parameter: Driver Door Lock Switch or Passenger Door Lock Switch = Lock
    - **If not the specified state**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: X2 or X7 at K9 Body Control Module
    3. Ignition - On / Vehicle - In Service Mode

        4. Test for less than 1 V between the test points: Signal circuit terminal 2 at Component harness & Ground
            - If 1 V or greater - Repair the short to voltage on the circuit.
            - If less than 1 V
        5. Ignition/Vehicle - Off
        6. Test for less than 2 Ω between the test points:
            - Signal circuit terminal 2 at S13D Door Lock Switch - Driver & Terminal 19 X2 at Control module harness
            - Signal circuit terminal 2 at S13P Door Lock Switch - Passenger & Terminal 14 X7 at Control module harness
            - If 2 Ω or greater - Repair the open/high resistance in the circuit.
            - If less than 2 Ω - Replace the component: K9 Body Control Module
    - **If the specified state**

10. Test or replace the component: S13D Door Lock Switch - Driver/S13P Door Lock Switch - Passenger

Test 2

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: A23D Door Latch Assembly - Driver
3. Connect a test lamp between the test points: Control circuit terminal 7 & Control circuit terminal 8
4. Ignition - On / Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.
    - **If the test lamp turns On and Off**

      Test or replace the component: A23D Door Latch Assembly - Driver

    - **If the test lamp does not turn On and Off**
7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 at K9 Body Control Module
9. Test for less than 2 Ω between the test points:
    - Control circuit terminal 7 at A23D Door Latch Assembly - Driver & Terminal 1 X6 at Control module harness
    - Control circuit terminal 8 at A23D Door Latch Assembly - Driver & Terminal 4 X6 at Control module harness
    - If 2 Ω or greater - Repair the open/high resistance in the circuit.
    - **If less than 2 Ω**
10. Test or replace the component: K9 Body Control Module

Test 3

1. Ignition/Vehicle & All vehicle systems - Off
2. Disconnect the appropriate electrical connector:
    - A23LR Door Latch Assembly - Left Rear
    - A23P Door Latch Assembly - Passenger
    - A23RR Door Latch Assembly - Right Rear
3. Connect a test lamp between the test points:
    - A23P Door Latch Assembly - Passenger Control circuit terminal 9 & Control circuit terminal 8
    - A23LR Door Latch Assembly - Left Rear Control circuit terminal 7 & Control circuit terminal 8
    - A23RR Door Latch Assembly - Right Rear Control circuit terminal 9 & Control circuit terminal 8

4. Ignition - On / Vehicle - In Service Mode
5. Operate the component: S13D Door Lock Switch - Driver - Lock & Unlock
6. Verify the test lamp does not turn On and Off.
    - **If the test lamp turns On and Off**

      Test or replace the component: A23 Door Latch Assembly

    - **If the test lamp does not turn On and Off**
7. Ignition/Vehicle - Off
8. Disconnect the electrical connector: X6 at K9 Body Control Module
9. Ignition - On / Vehicle - In Service Mode
10. Test for less than 2 Ω between the test points:
    - Control circuit terminal 7 at A23LR Door Latch Assembly - Left Rear & Terminal 2 X6 at Control module harness
    - Control circuit terminal 8 at A23LR Door Latch Assembly - Left Rear & Terminal 4 X6 at Control module harness
    - Control circuit terminal 8 at A23P Door Latch Assembly - Passenger & Terminal 4 X6 at Control module harness
    - Control circuit terminal 9 at A23P Door Latch Assembly - Passenger & Terminal 2 X6 at Control module harness
    - Control circuit terminal 8 at A23RR Door Latch Assembly - Right Rear & Terminal 4 X6 at Control module harness
    - Control circuit terminal 9 at A23RR Door Latch Assembly - Right Rear & Terminal 2 X6 at Control module harness
    - If 2 Ω or greater - Repair the open/high resistance in the circuit.
    - **If less than 2 Ω**
11. Test or replace the component: K9 Body Control Module

Test 4

NOTE: **It may take up to 2 min for all vehicle systems to power down before an accurate ground or low reference circuit continuity test can be performed.**

1. Ignition/Vehicle - Off
2. Disconnect the electrical connector: X2 & X6 at K9 Body Control Module
3. Test for less than 10 Ω between the test points: Ground circuit terminal 3 X6 & Ground
    - **If 10 Ω or greater**
    1. Ground Connection - Disconnect
    2. Test for less than 2 Ω between the test points: Ground circuit terminal 3 X6 & Ground Connection
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
4. Ignition - On / Vehicle - In Service Mode
5. Verify a test lamp turns On between the test points: B+ circuit terminal 4 X2 & Ground
    - **If the test lamp does not turn On and the circuit fuse is OK**
    1. Ignition/Vehicle - Off & Remove - Test lamp
    2. Test for less than 2 Ω between the test points: B+ circuit terminal 4 X2 & Output terminal at Fuse
        - If 2 Ω or greater - Repair the open/high resistance in the circuit.
        - If less than 2 Ω - Verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not turn On and the circuit fuse is open**

    1. Ignition/Vehicle - Off & Remove - Test lamp
    2. Disconnect the electrical connector:
        - A23D Door Latch Assembly - Driver
        - A23LR Door Latch Assembly - Left Rear
        - A23P Door Latch Assembly - Passenger
        - A23RR Door Latch Assembly - Right Rear
    3. Test for infinite resistance between the test points:
        - Control circuit terminal 1 X6 at K9 Body Control Module & Ground
        - Control circuit terminal 2 X6 at K9 Body Control Module & Ground
        - Control circuit terminal 4 X6 at K9 Body Control Module & Ground
        - If less than infinite resistance - Repair the short to ground on the circuit.
        - If infinite resistance - Replace the component: A23 Door Latch Assembly
    - **If the test lamp turns On**

6. Ignition/Vehicle - Off
7. Connect the electrical connector: X2 at K9 Body Control Module
8. Ignition - On / Vehicle - In Service Mode
9. Test for less than 1 V between the test points:
    - Control circuit terminal 1 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 2 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 4 X6 at K9 Body Control Module & Ground
    - **If greater than 1 V**

      Repair the short to voltage on the circuit.

    - **If 1 V or less**
10. Ignition/Vehicle - Off
11. Test for infinite resistance between the test points:
    - Control circuit terminal 1 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 2 X6 at K9 Body Control Module & Ground
    - Control circuit terminal 4 X6 at K9 Body Control Module & Ground
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
12. Replace the component: K9 Body Control Module

Component Testing

S13 Door Lock Switch - Test

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector: S13 Door Lock Switch
3. Test for infinite resistance between the test points:
    - Signal terminal 2 & Ground terminal 4 - Switch - Not Pressed
    - Signal terminal 3 & Ground terminal 4 - Switch - Not Pressed
    - **If less than infinite resistance**

      Replace the component: S13 Door Lock Switch

    - **If infinite resistance**
4. Test for less than 3 Ω between the test points: Signal terminal 2& Ground terminal 4 - LockSwitch - Pressed
    - **If 3 Ω or greater**

Replace the component: S13 Door Lock Switch

- **If less than 3 Ω**

5. Test for less than 3 Ω between the test points: Signal terminal 3 & Ground terminal 4 - Unlock Switch - Pressed
   - **If 3 Ω or greater**

     Replace the component: S13 Door Lock Switch

   - **If less than 3 Ω**
6. All OK.

A23 Door Latch Assembly

1. Ignition/Vehicle - Off
2. Disconnect the appropriate electrical connector:
   - A23D Door Latch Assembly - Driver
   - A23P Door Latch Assembly - Passenger
   - A23LR Door Latch Assembly - Left Rear
   - A23RR Door Latch Assembly - Right Rear
3. Connect a 25 A fused jumper wire between the test points: Control terminal 8 & B+

CAUTION: **Complete the testing as quickly as possible in order to prevent overheating and damaging the component.**

4. Momentarily connect a jumper wire between the test points:
   - A23D Door Latch Assembly - Driver: Control terminal 7 & Ground
   - A23P Door Latch Assembly - Passenger: Control terminal 9 & Ground
   - A23LR Door Latch Assembly - Left Rear: Control terminal 7 & Ground
   - A23RR Door Latch Assembly - Right Rear: Control terminal 9 & Ground
5. Reverse the jumper wires 2 times between the terminals.

   Verify the component works as specified: A23 Door Latch Assembly = Lock & Unlock

   - **If not the specified state**

     Replace the component: A23 Door Latch Assembly

   - **If the specified state**
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- **Front Side Door Latch Replacement**
- **Rear Side Door Latch Replacement**
- **Door Lock Switch Replacement**
- For control module replacement, programming, and setup refer to: **Control Module References**

DOOR WILL NOT OPEN/CLOSE, DOOR BINDING, OR LOCKS, HANDLES, OR CYLINDERS DO NOT FUNCTION

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to address the mechanical diagnosis of the door latching system, which could include the inside and outside handles, latch rods/cables, latches, or latch cylinders.			

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	Were you sent here from a Vehicle Access Symptom Table?	Go to **Step 3**	Go to **Symptoms - Vehicle Access**
3	Does the door open with the outside handle?	Go to **Step 4**	Go to **Step 10**
4	Does the door open with the inside handle?	Go to **Step 5**	Go to **Step 11**
5	Does the manual latch knob latch and unlatch the latch smoothly without binding?	Go to **Step 6**	Go to **Step 12**
6	Does the door latch switch and/or the keyless entry transmitter latch and unlatch the door latch or door latches?	Go to **Step 7**	Go to **Step 14**
7	Is the outside key cylinder loose or does it rattle or fall out? (if equipped)	Go to **Step 15**	Go to **Step 8**
8	Does the outside key cylinder latch and unlatch the latch and function smoothly without binding? (if equipped)	Go to **Step 9**	Go to **Step 16**
9	Does the door bind, does it take excessive effort to open, or is it misaligned?	Go to **Step 17**	Go to **Step 18**
10	If the door will not open with the outside handle, or the handle is obstructed or loose, check the following: • For cold weather freezing, thaw as necessary. • Check the handle for foreign material. Remove material as necessary. • Check the handle grab bar for looseness or damage. Repair as necessary. • Check the handle for full travel. If the issue is not resolved, remove the trim panel as necessary to gain access to door hardware and check the following: • Check the handle chassis for loose fasteners, broken chassis inserts, loose or missing spring, or a loose, missing or bent rod lever. • Check for bent rod to the outside handle. • Check that the handle grab bar engages the rod lever properly. • Check for interference of rod and handle to other components in the door. • Check that handle rod is securely attached at both latch and handle. • Check if rod is positioned properly in the clip on the latch. At rest position, the handle should be fully against the down stop and the latch lever should be at the bottom of its travel. Correct by opening clip, repositioning rod in clip and closing clip till it snaps, as necessary. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 11**

Step	Action	Yes	No
11	Door will not open with the inside handle: • Check the inside handle for foreign material. Remove material as necessary. • Check that the handle is secure. Correct as necessary. • If rear door, verify child security is not engaged. • Remove the trim panel as necessary to and check the inside handle rod/cable attachments at both the latch and handle. If the cable is kinked or pinched, correct as necessary. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 12**
12	The door will not or is difficult to unlatch with the inside manual latch knob: • For cold weather freezing, thaw as necessary • Check the latch knob for a loose condition. Repair or replace as necessary. Check the latch knob for binding or dragging using the following procedure: 1. Remove the latch knob. 2. If condition goes away, check for drag/interference of the latch knob against the inner belt seal, or the trim panel. Correct as required. If further action is required, remove the trim panel and check the latch rod and latch knob for interference with the following: • Water deflector/paper • Side impact foam • Rod grommet in sheet metal • Glass run channel • Other rods or cables • Trim panel Did you find and correct the condition?	Go to **Step 18**	Go to **Step 13**

Step	Action	Yes	No
13	With a manual lock, if the latch will not function properly do the following: 1. Function the lock/unlatch lever on the latch to unlatch the latch. Check for high internal resistance. 2. With the door open, manually close the latch with a screwdriver. 3. Check the latch for internal binding by actuating the latch with the inside door handle lever. 4. Manually close the latch with a screwdriver again. 5. Check the latch for internal binding by actuating the latch with the outside door handle lever. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 14**
14	If power locks are included in vehicle options and do not function with either the keyless entry transmitter or switch: 1. For cold weather freezing, thaw as necessary. 2. Remove trim pad as required and check the following: • Verify door harness has appropriate power connectors for switches and latch. • Check harness connector pins for corrosion. • Assure wire harness connectors are seated and locked properly at latch and switch. Remove and re-seat if required. • Check door harness for cuts/chafing/corrosion. Correct/replace as required. • Check for 12V at latch and door switch. Correct/proceed accordingly. • Check BCM for trouble codes. Correct/proceed accordingly. 3. If power locks still do not function do the following: 1. Remove latch from door cavity. 2. Connect latch to electrical connector outside the door. 3. Function power lock/unlatch switch in both latch and unlatch directions. Watch for lock/unlatch lever on latch to move completely from one position to the other. 4. If lever does not move, remove connector from old latch and attach to new latch outside of door cavity. 5. Verify new latch is functional, if so, attach rods and install new latch in door. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 15**

Step	Action	Yes	No
15	If the key cylinder is loose do the following: • Remove the trim if necessary. • Check that the retaining clip is properly seated. (if equipped) • Check that the fastener is properly torqued. (if equipped) Did you find and correct the condition?	Go to **Step 18**	Go to **Step 16**
16	The outside key cylinder will not latch and unlatch the latch and function smoothly without binding: 1. For cold weather freezing, thaw as necessary 2. Remove trim if required. 3. Check that the key cylinder rod is securely attached both to the key cylinder pawl and the latch. 4. Check that key cylinder lever, rod and latch lever are free of interferences. Remove interferences as required. 5. Check that latch cylinder rod is routed properly. Re-route as required. 6. Remove rod from latch cylinder and actuate cylinder. Check for internal resistance. Lubricate latch cylinder as required 7. Verify Cylinder rotates with vehicle key. If not, code and replace cylinder to match vehicle key. See latch cylinder coding and replacing. Did you find and correct the condition?	Go to **Step 18**	Go to **Step 17**
17	The door is difficult to open: • Check for interference with the fender, adjacent door, body opening or door striker and adjust as necessary. • Check for binding door hinges. Lubricate or align/adjust as necessary. • Check the door check link for binding. Lubricate as necessary. • Adjust the door as necessary. Did you find and correct the condition?	Go to **Step 18**	Go to appropriate Door Lock Striker Adjustment procedure.

Step	Action	Yes	No

18	Verify proper operation of the door closing system.
	• Outside handle
	• Inside handle
	• Manual lock/unlatch
	  ◦ Outside key cylinder
	  ◦ Inside latch knob
	  ◦ Double pull handle
	• Power lock/unlatch
	  ◦ Key fob
	  ◦ Door switches
	• Door opening/closing effort
	Is the condition still present?
		Go to **Step 1**	System OK

REPAIR INSTRUCTIONS

FRONT SIDE DOOR INSIDE HANDLE CABLE REPLACEMENT

Removal Procedure

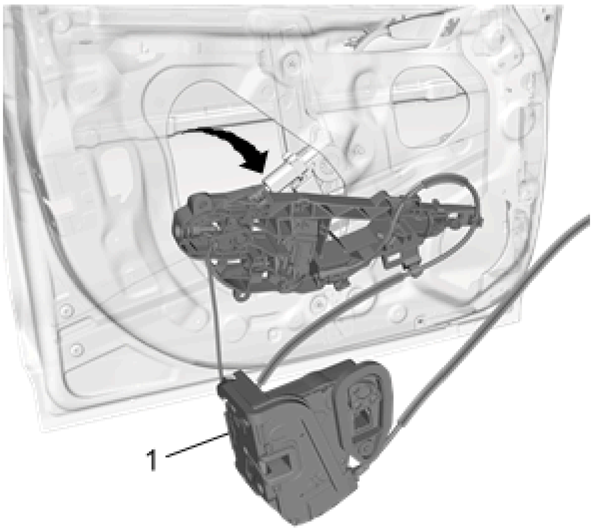
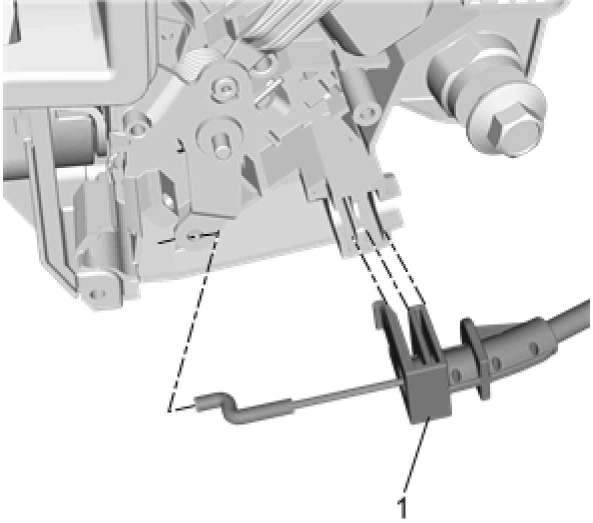


Fig. 6: Front Side Door Latch
Courtesy of GENERAL MOTORS COMPANY

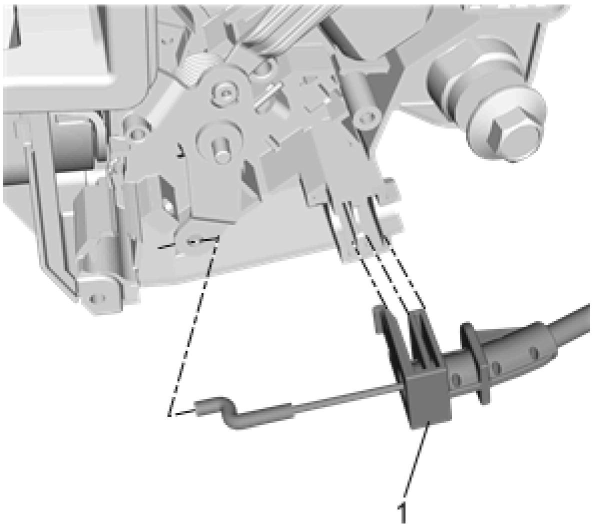
1. Front Side Door Latch - Remove - **Front Side Door Latch Replacement**
2. Open the cable access cover.



[**Fig. 7: Front Side Door Inside Handle Cable**]
Courtesy of GENERAL MOTORS COMPANY

3. Front Side Door Inside Handle Cable at Front Side Door Latch - Remove

Installation Procedure



[**Fig. 8: Front Side Door Inside Handle Cable**]
Courtesy of GENERAL MOTORS COMPANY

1. Front Side Door Inside Handle Cable at Front Side Door Latch - Install
2. Close the cable access cover.

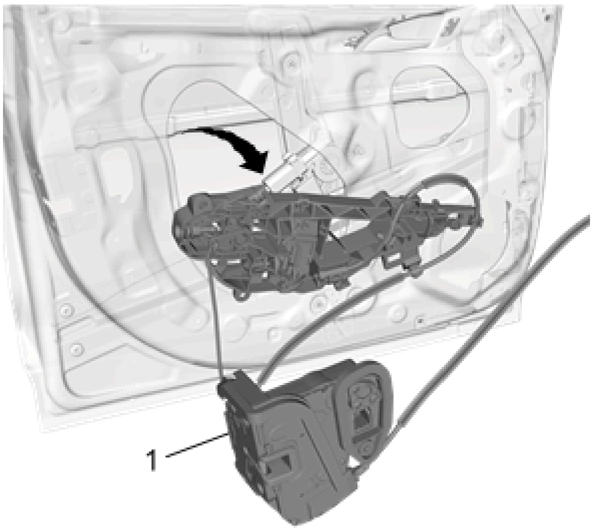


Fig. 9: Front Side Door Latch
Courtesy of GENERAL MOTORS COMPANY

3. Front Side Door Latch - Install - Front Side Door Latch Replacement

NOTE: **Ensure that the door lock system operates properly before installing the trim.**

REAR SIDE DOOR INSIDE HANDLE CABLE REPLACEMENT

Removal Procedure

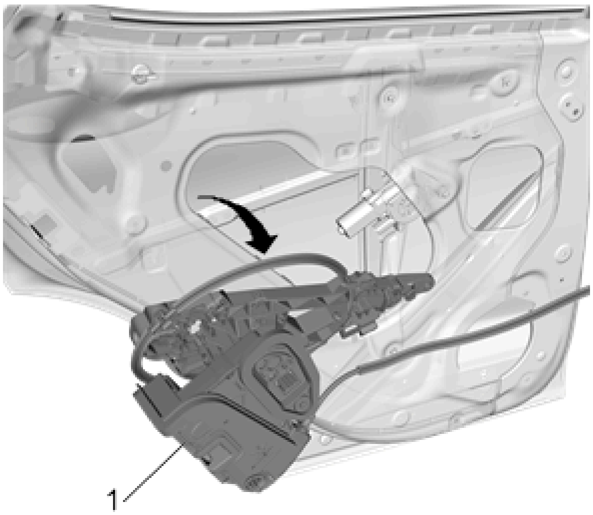


Fig. 10: Rear Side Door Latch
Courtesy of GENERAL MOTORS COMPANY

1. Rear Side Door Latch - Remove - Rear Side Door Latch Replacement
2. Open the cable access cover.

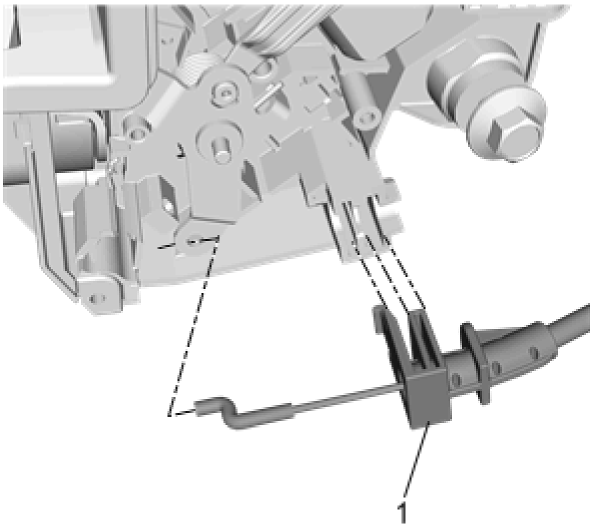
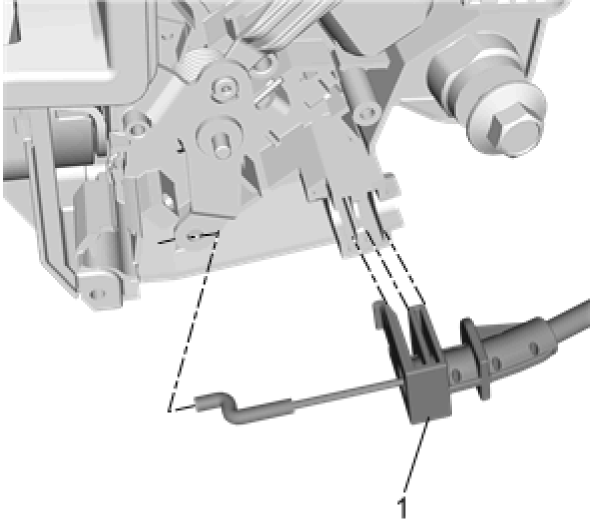


Fig. 11: Rear Side Door Inside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

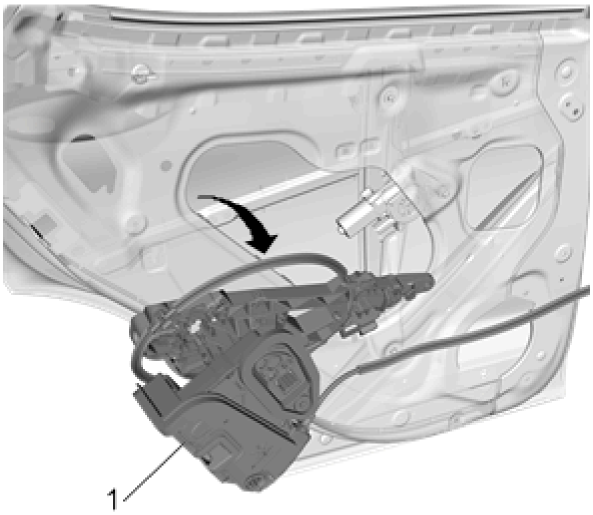
3. Rear Side Door Inside Handle Cable at Rear Side Door Latch - Remove

Installation Procedure



[Fig. 12: Rear Side Door Inside Handle Cable](#)
Courtesy of GENERAL MOTORS COMPANY

1. Rear Side Door Inside Handle Cable at Rear Side Door Latch - Install
2. Close the cable access cover.

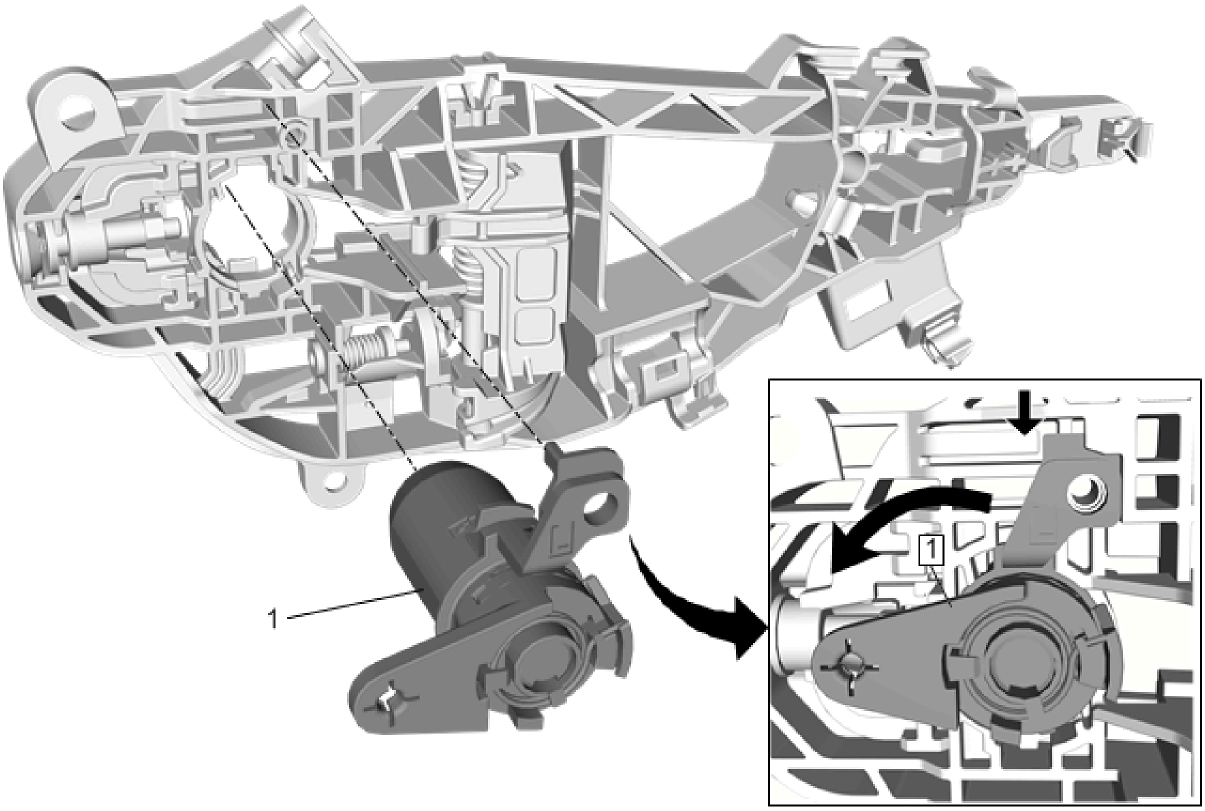


[Fig. 13: Rear Side Door Latch](#)
Courtesy of GENERAL MOTORS COMPANY

3. Rear Side Door Latch - Install - [Rear Side Door Latch Replacement](#)

NOTE: **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR LOCK CYLINDER REPLACEMENT



[Fig. 14: Front Side Door Lock Cylinder](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Side Door Lock Cylinder Rod Replacement	
1	Front Side Door Lock Cylinder **Procedure** Release the integral retainer, rotate the cylinder counter-clockwise to unlock and remove the cylinder. **NOTE:** **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR OUTSIDE HANDLE REPLACEMENT

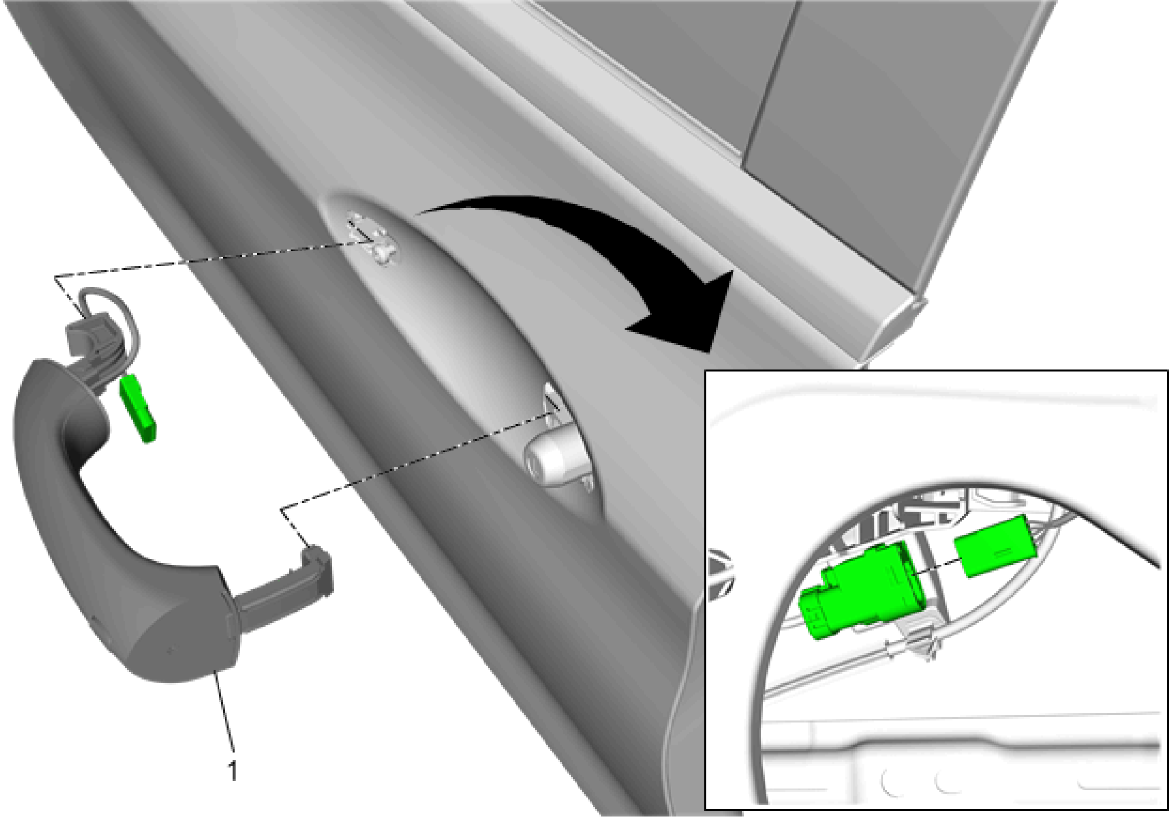


Fig. 15: Front Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. **Front Side Door Water Deflector Replacement** 2. **Front Side Door Lock Cylinder Opening Cover Replacement**	
1	Front Side Door Outside Handle **Procedure** 1. Disconnect the electrical connector. 2. Pull the front side door outside handle rearward to release it from the handle housing. **NOTE:** **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR OUTSIDE HANDLE BRACKET REPLACEMENT

Removal Procedure

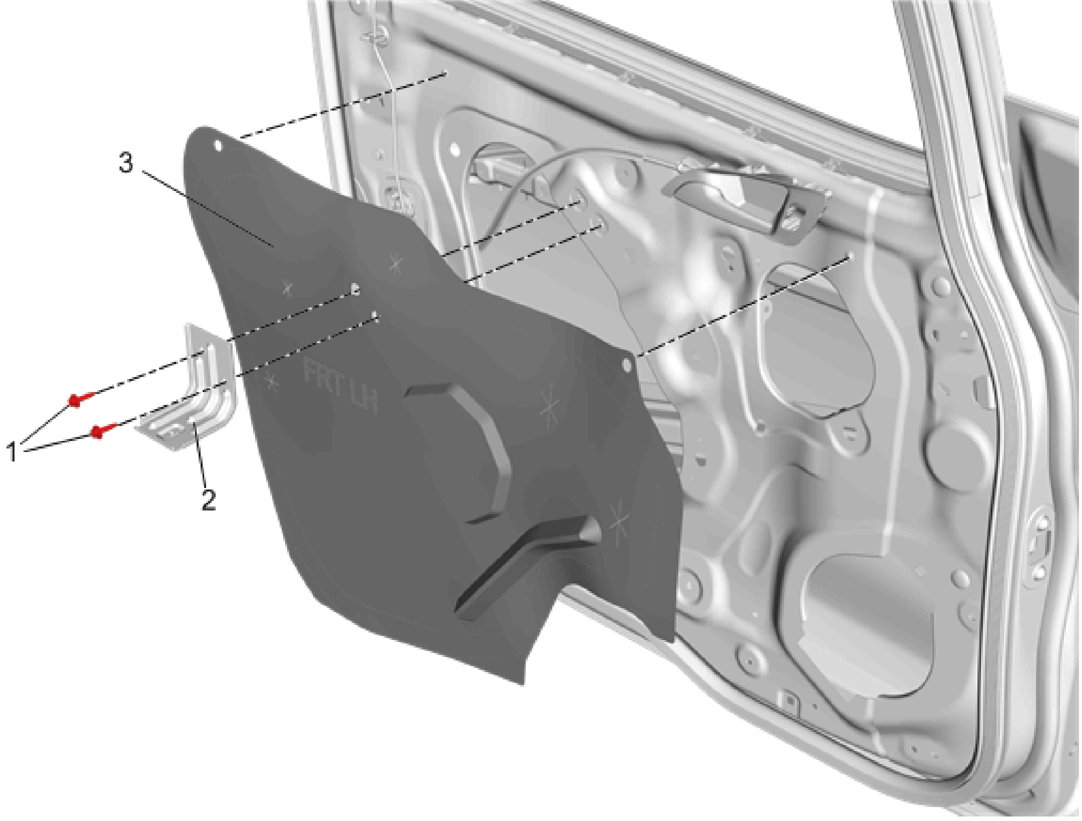


Fig. 16: Front Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

1. Front Side Door Water Deflector - Remove - **Front Side Door Water Deflector Replacement**

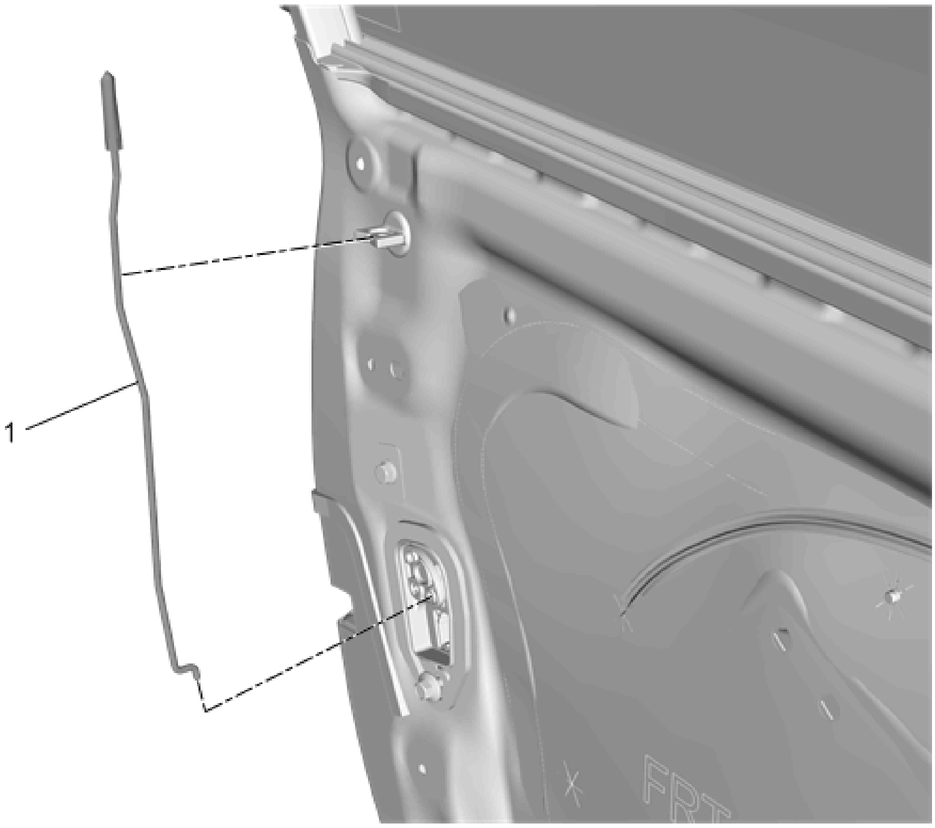


Fig. 17: Front Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

2. Front Side Door Locking Rod Knob - Remove - **Front Side Door Locking Rod Knob Replacement**

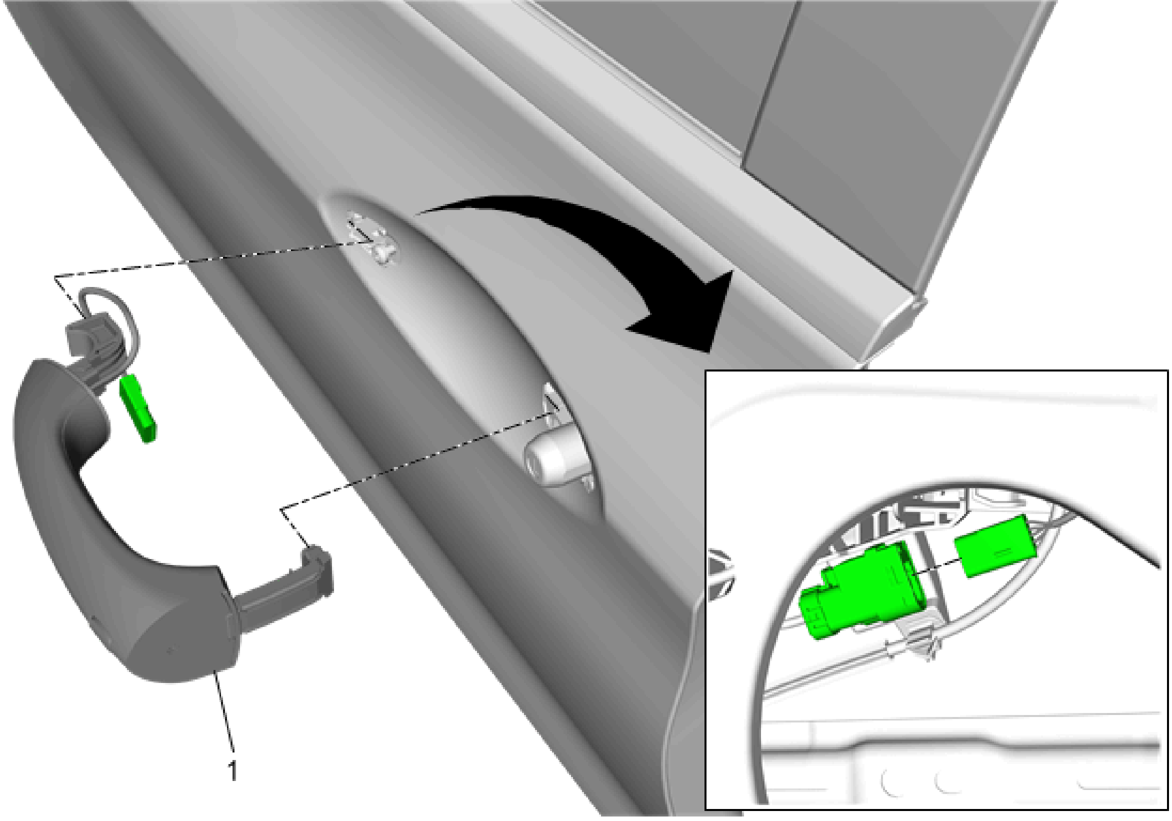


Fig. 18: Front Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

3. Front Side Door Outside Handle - Remove - **Front Side Door Outside Handle Replacement**

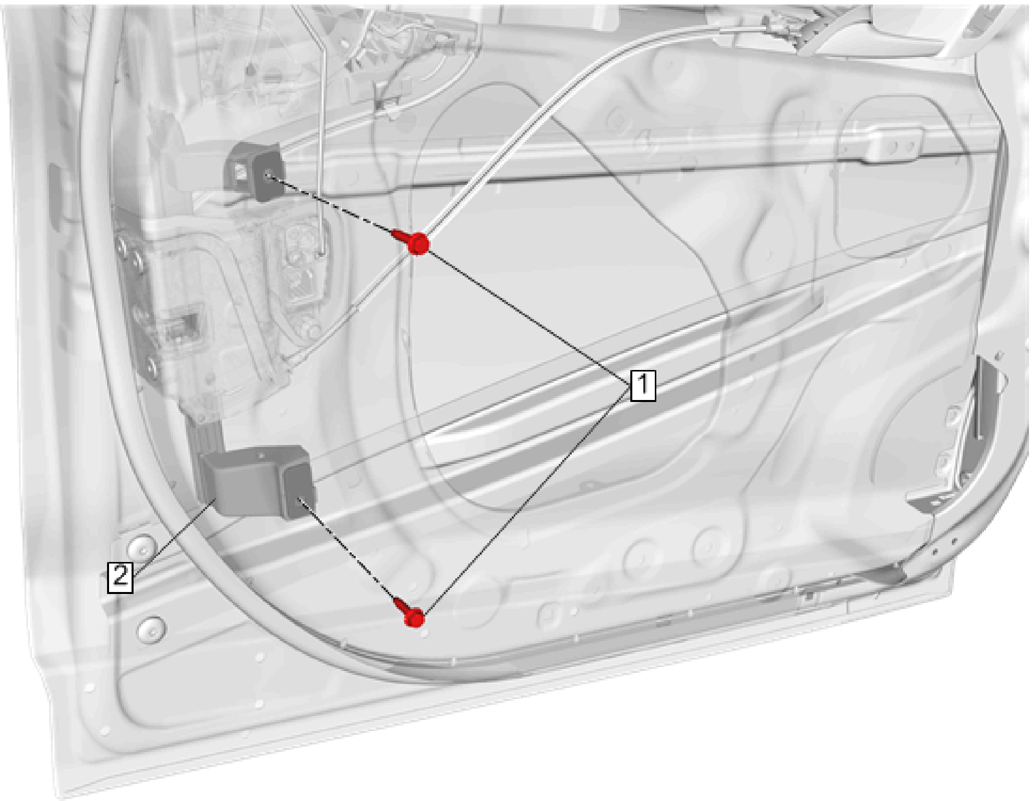


Fig. 19: Front Side Door Window Channel Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Front Side Door Window Channel Retainer - Remove - **Front Side Door Window Channel Retainer Replacement**

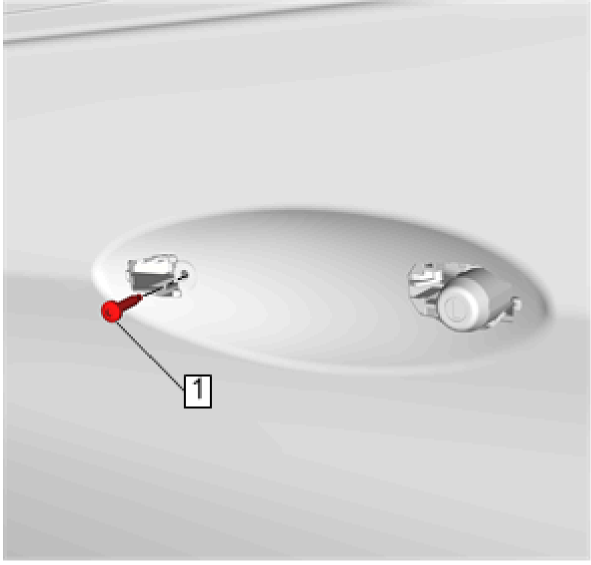


Fig. 20: Front Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

5. Front Side Door Outside Handle Bracket Fastener - Remove

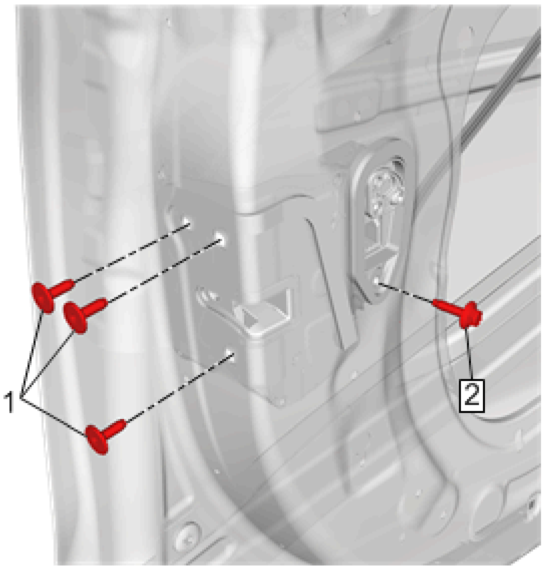


Fig. 21: Front Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Front Side Door Latch Fastener (1) (Qty: 3) - Remove
7. Front Side Door Latch Fastener (2) - Remove
8. Unclip and disconnect the electrical connector from the bracket and latch assemblies.

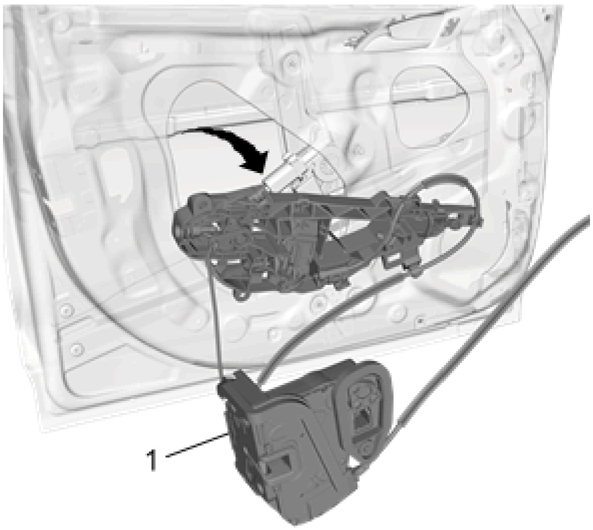


Fig. 22: Front Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the front side door latch with front side door outside handle bracket (1) from front side door.

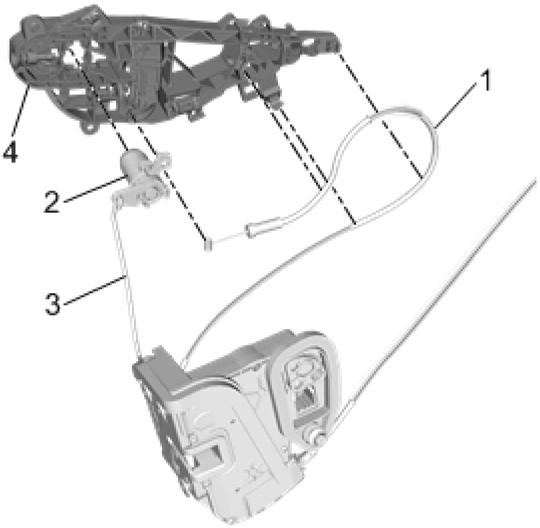


Fig. 23: Front Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

10. Front Side Door Outside Handle Cable (1) at Front Side Door Outside Handle Bracket (4) - Remove - **Front Side Door Outside Handle Cable Replacement**
11. {If equipped} Front Side Door Lock Cylinder (2) at Front Side Door Outside Handle Bracket (4) - Remove - **Front Side Door Lock Cylinder Replacement**
12. Front Side Door Lock Cylinder Rod (3) at Front Side Door Outside Handle Bracket (4) - Remove - **Front Side Door Lock Cylinder Rod Replacement**

Installation Procedure

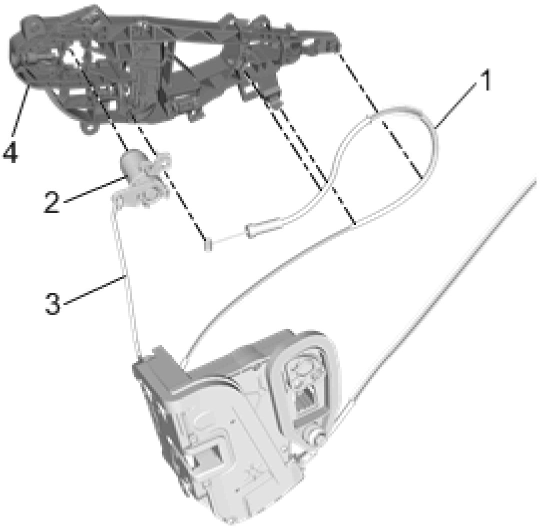


Fig. 24: Front Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

1. Front Side Door Outside Handle Cable (1) at Front Side Door Outside Handle Bracket (4) - Install - **Front Side Door Outside Handle Cable Replacement**
2. { If equipped } Front Side Door Lock Cylinder (2) at Front Side Door Outside Handle Bracket (4) - Install - **Front Side Door Lock Cylinder Replacement**
3. Front Side Door Lock Cylinder Rod (3) at Front Side Door Outside Handle Bracket (4) - Install - **Front Side Door Lock Cylinder Rod Replacement**
4. Connect and clip electrical connector in place.

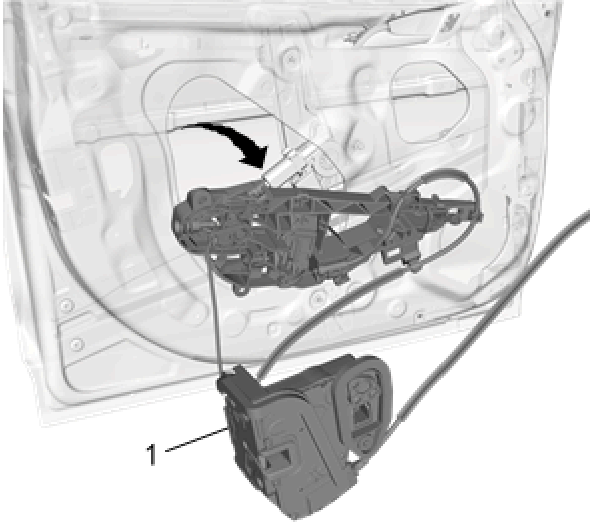


Fig. 25: Front Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Install the front side door latch with front side door outside handle bracket (1) to the front side door.

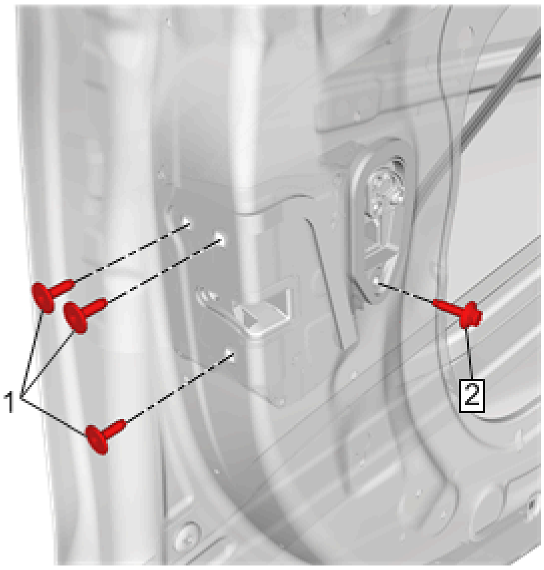


Fig. 26: Front Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

6. Front Side Door Latch Fastener (1) (Qty: 3) - Install and tighten to 9 N.m (80 lb in)
7. Front Side Door Latch Fastener (2) - Install and tighten to 9 N.m (80 lb in)

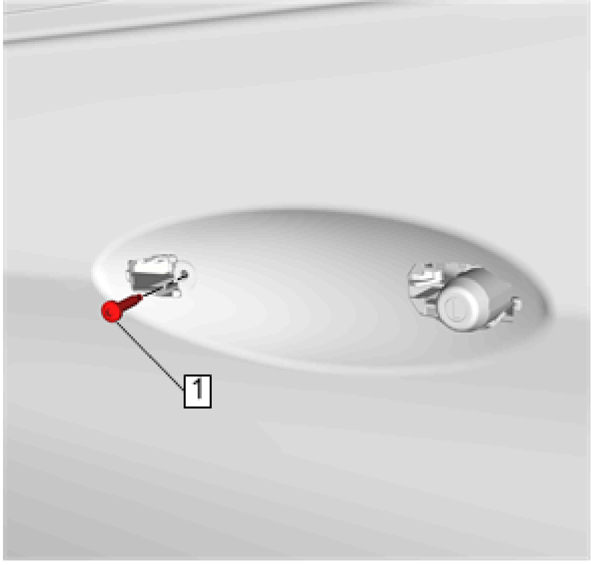


Fig. 27: Front Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

8. Front Side Door Outside Handle Bracket Fastener - Install and tighten to 5 N.m (44 lb in)

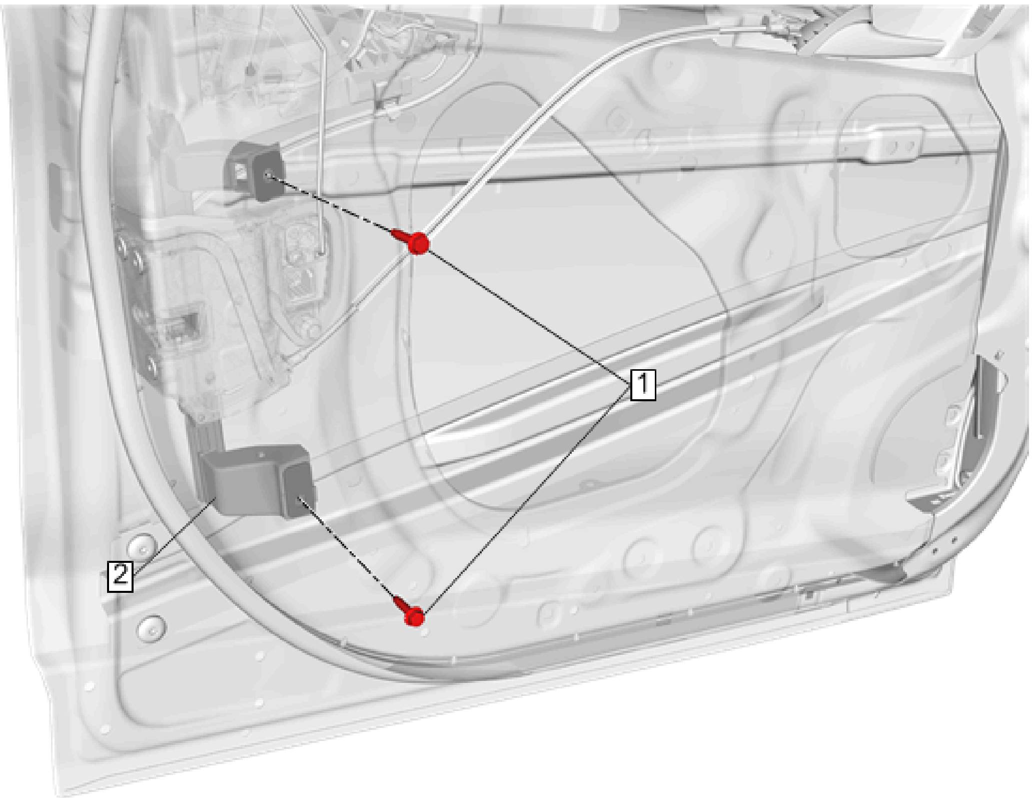


Fig. 28: Front Side Door Window Channel Retainer
Courtesy of GENERAL MOTORS COMPANY

9. Front Side Door Window Channel Retainer - Install - **Front Side Door Window Channel Retainer Replacement**

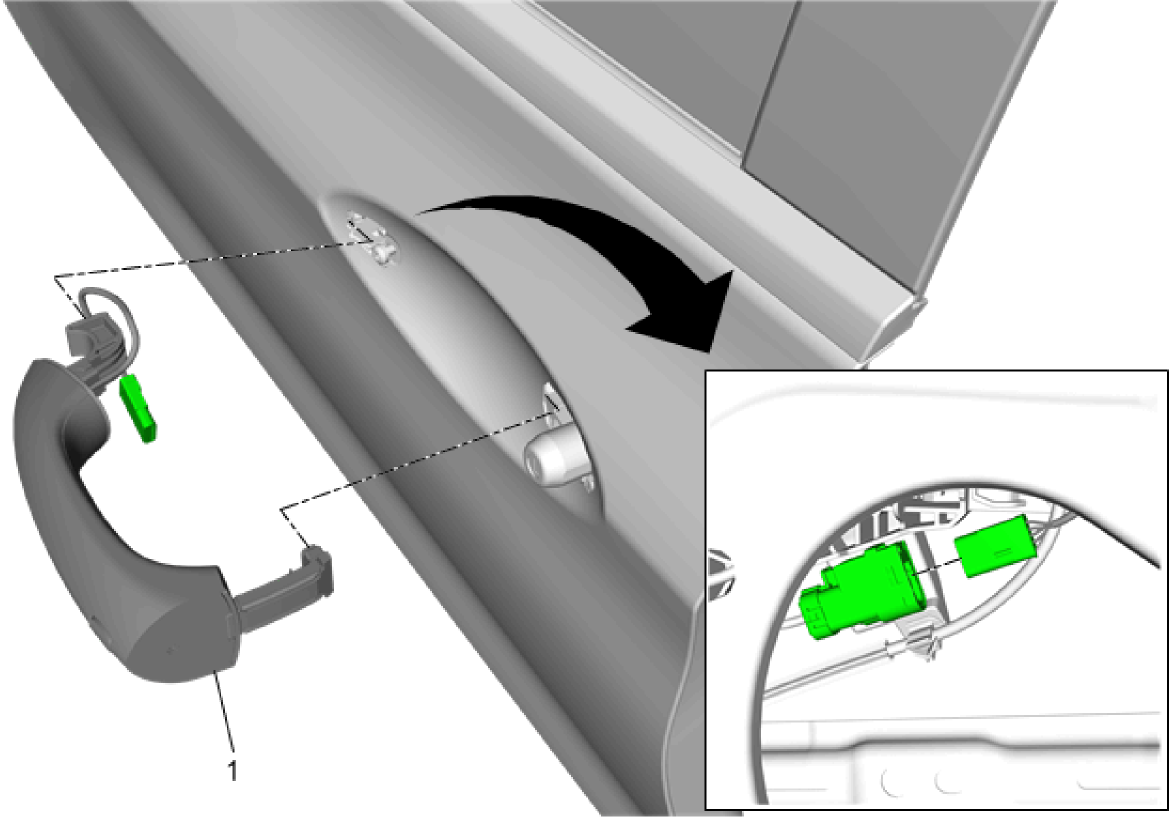


Fig. 29: Front Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

10. Front Side Door Outside Handle - Install - **Front Side Door Outside Handle Replacement**

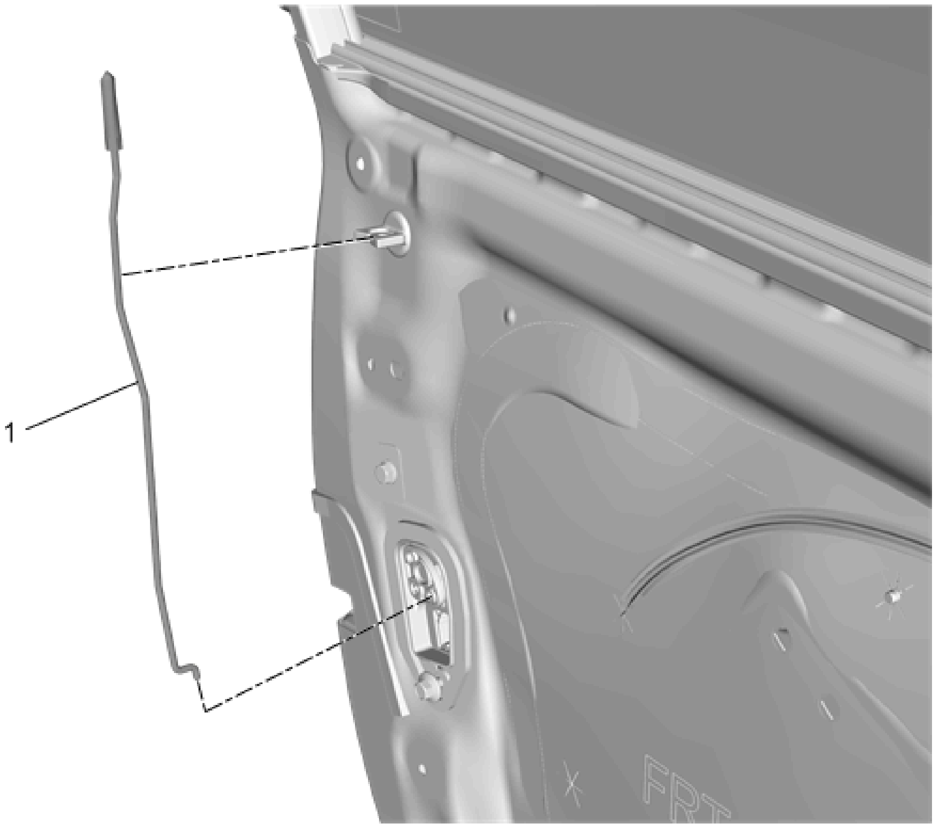


Fig. 30: Front Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

11. Front Side Door Locking Rod Knob - Install - **Front Side Door Locking Rod Knob Replacement**

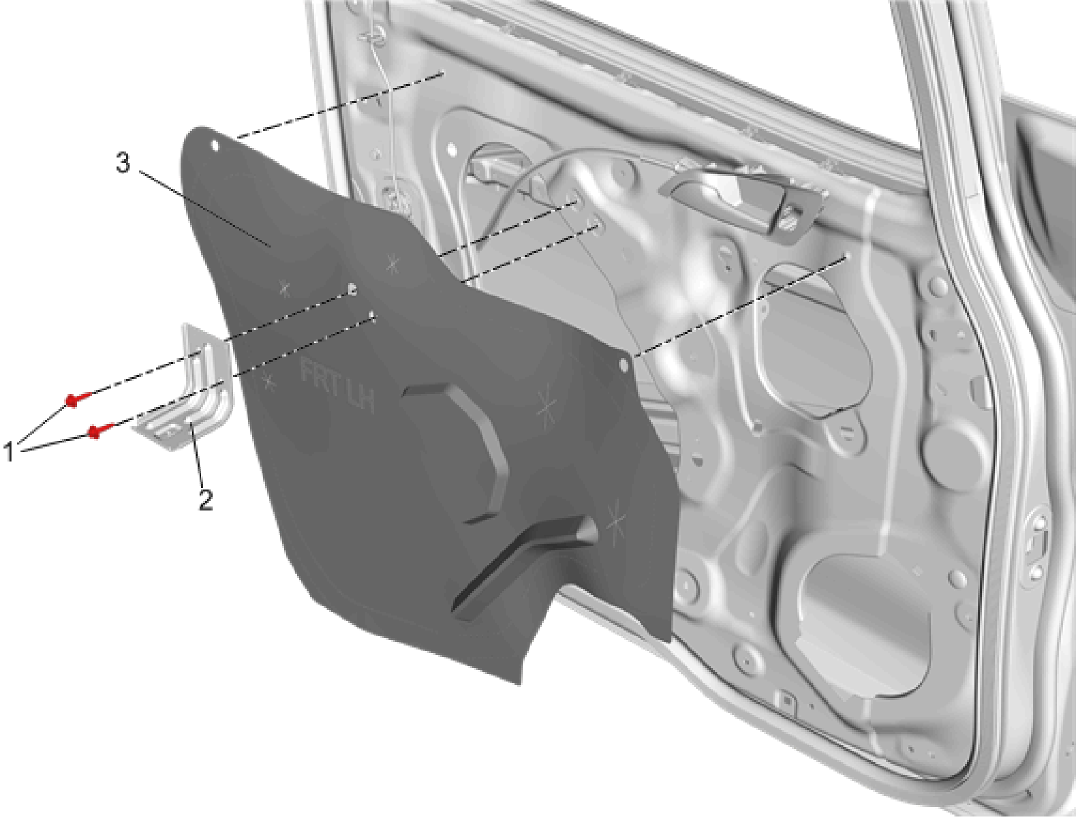


Fig. 31: Front Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

12. Front Side Door Water Deflector - Install - Front Side Door Water Deflector Replacement

NOTE: **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR OUTSIDE HANDLE CABLE REPLACEMENT

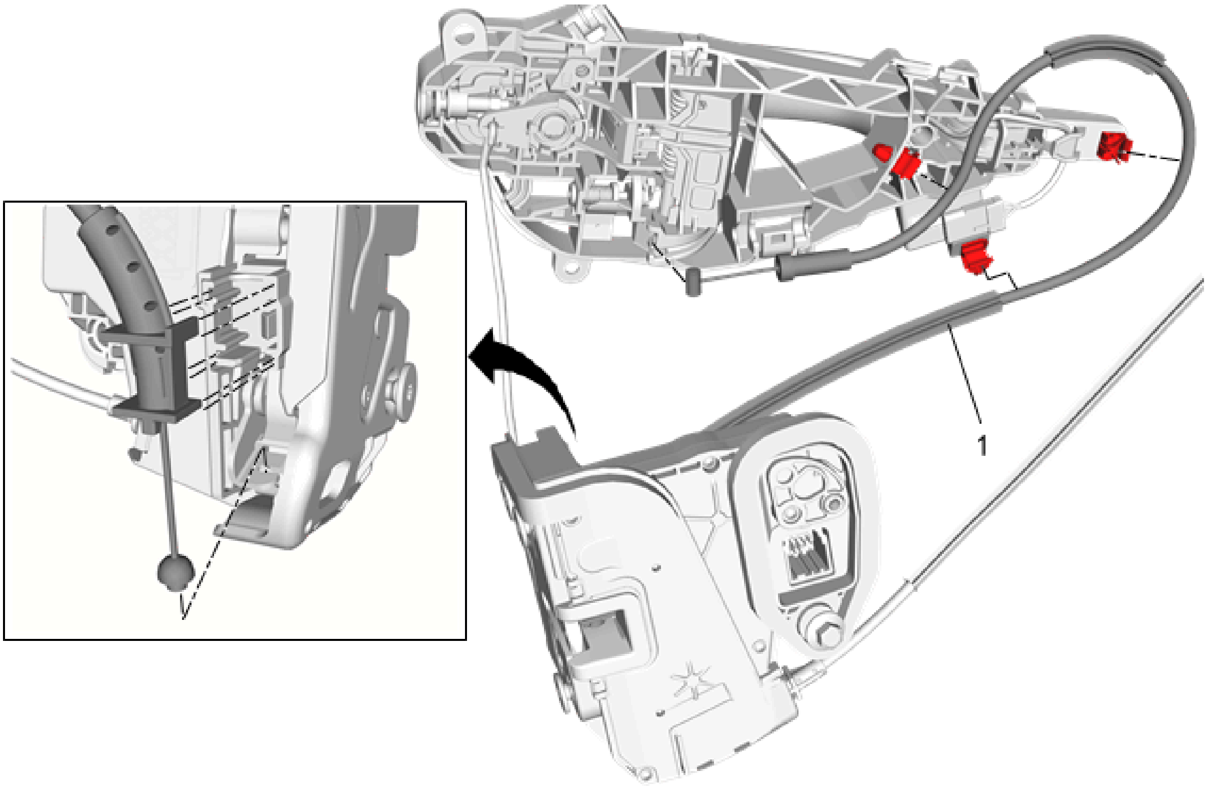


Fig. 32: Front Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure Front Side Door Latch Replacement	
1	Front Side Door Outside Handle Cable **Procedure** 1. Front Side Door Outside Handle Cable at Retainer - Remove 2. Release the cable from the back of the latch assembly 3. Front Side Door Outside Handle Cable at Front Side Door Outside Handle Bracket - Remove **NOTE:** **Ensure that the door lock system operates properly before installing the trim.**

REAR SIDE DOOR OUTSIDE HANDLE BRACKET REPLACEMENT

Removal Procedure

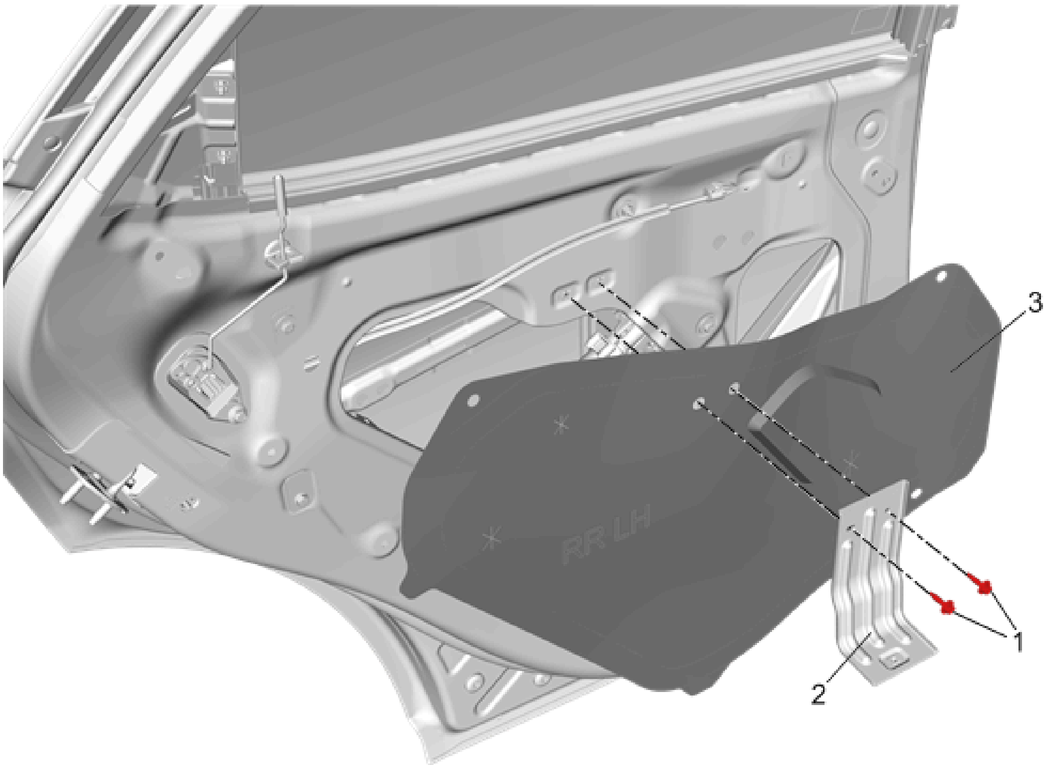


Fig. 33: Rear Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

1. Rear Side Door Water Deflector - Remove - Rear Side Door Water Deflector Replacement

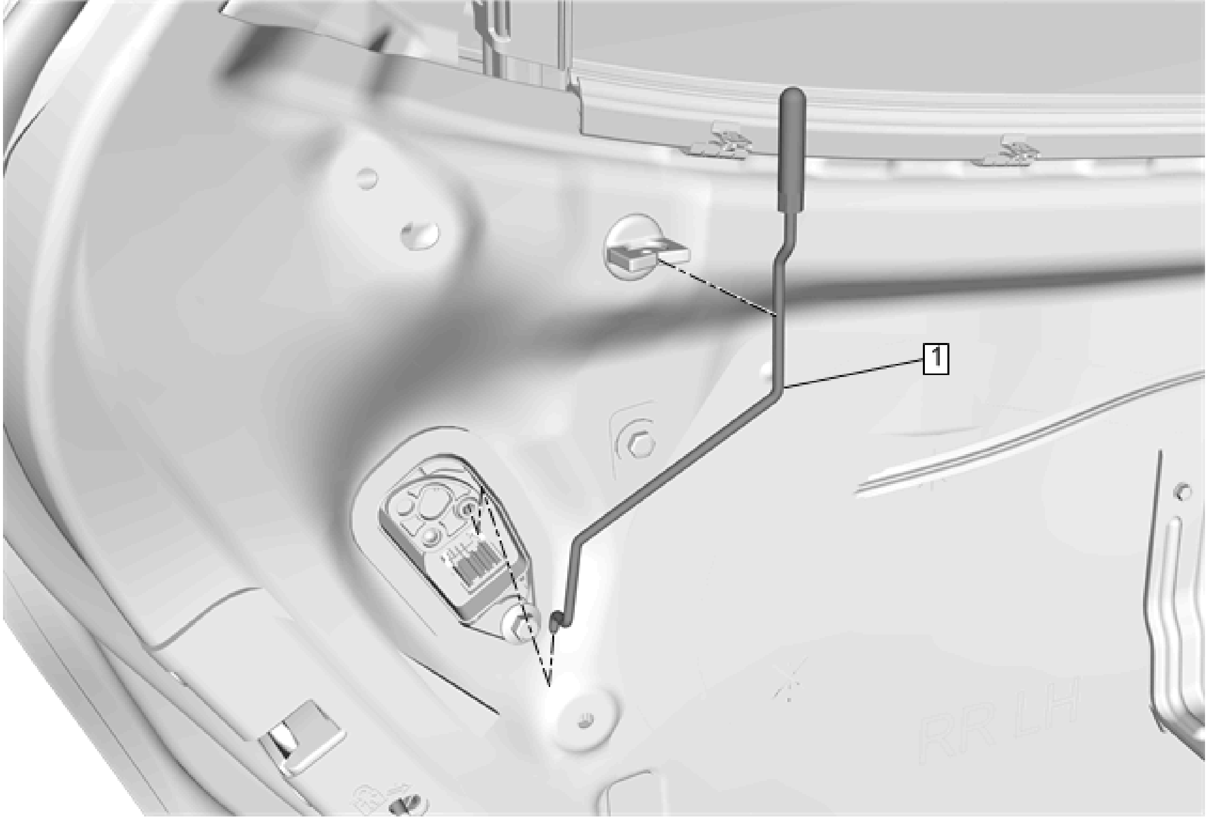


Fig. 34: Rear Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

2. Rear Side Door Locking Rod Knob - Remove - Rear Side Door Locking Rod Knob Replacement

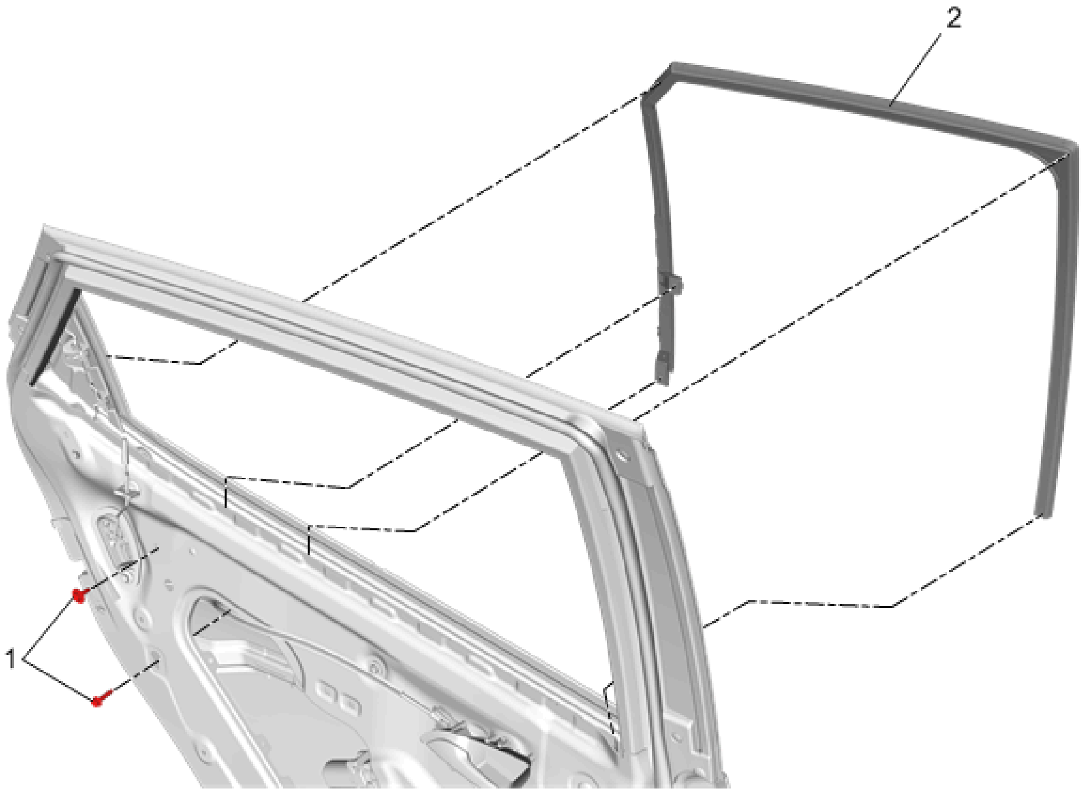


Fig. 35: Rear Side Door Window Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

3. Remove the rear side door window channel rear retainer bolts and reposition the channel as necessary. Rear Side Door Window Weatherstrip Replacement

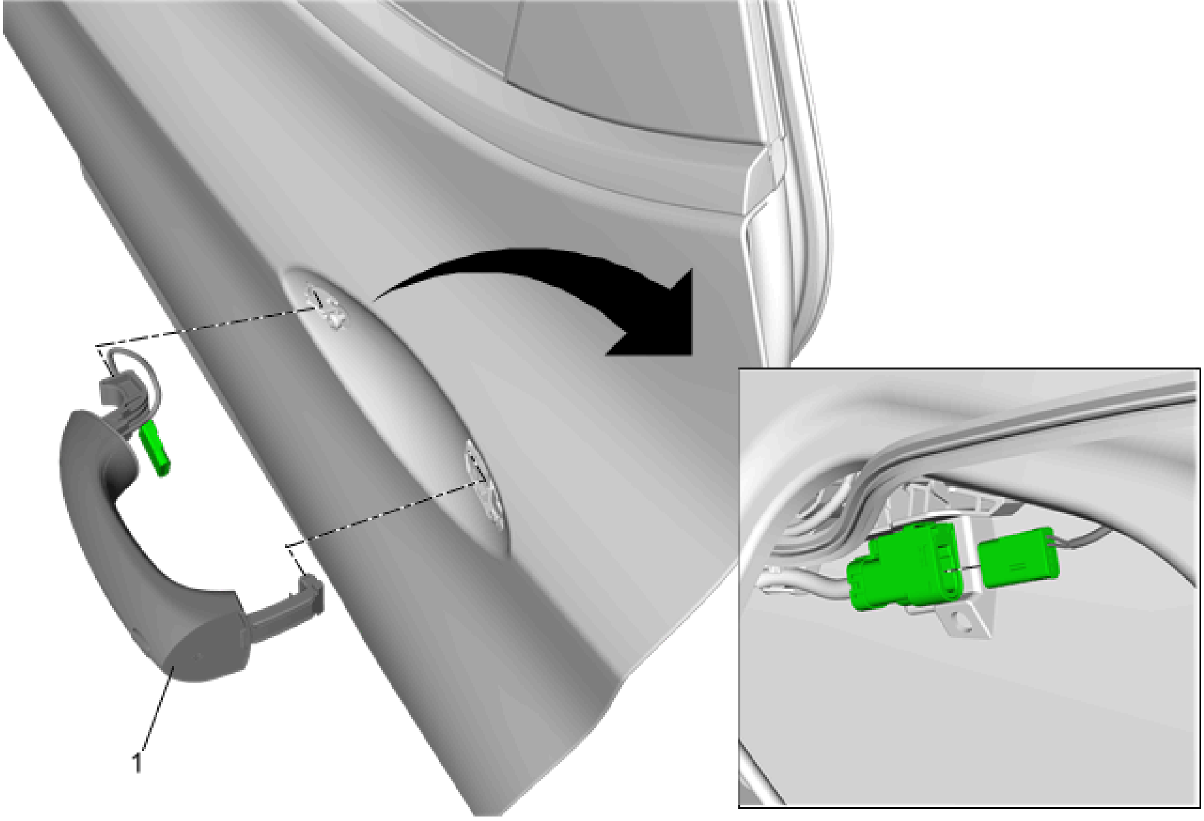


Fig. 36: Rear Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

4. Rear Side Door Outside Handle - Remove - Rear Side Door Outside Handle Replacement

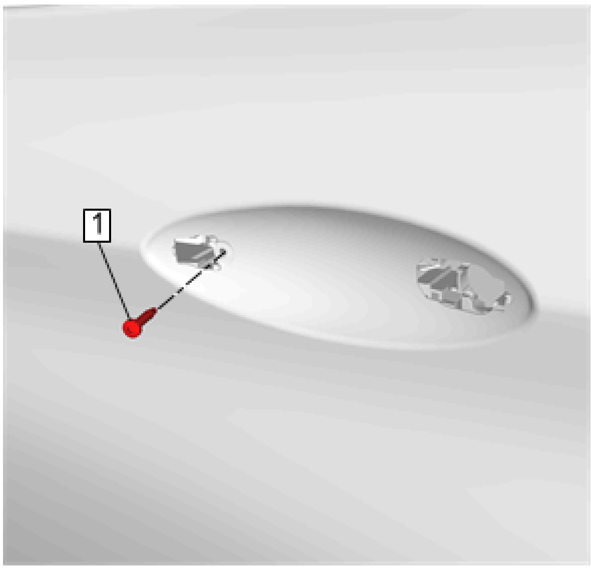


Fig. 37: Rear Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

5. Rear Side Door Outside Handle Bracket Fastener - Remove

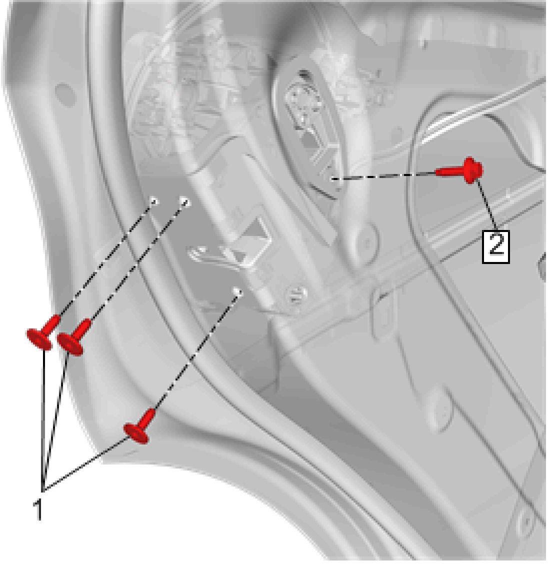


Fig. 38: Rear Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Rear Side Door Latch Fastener (1) (Qty: 3) - Remove
7. Rear Side Door Latch Fastener (2) - Remove
8. Disconnect and unclip the electrical connector.

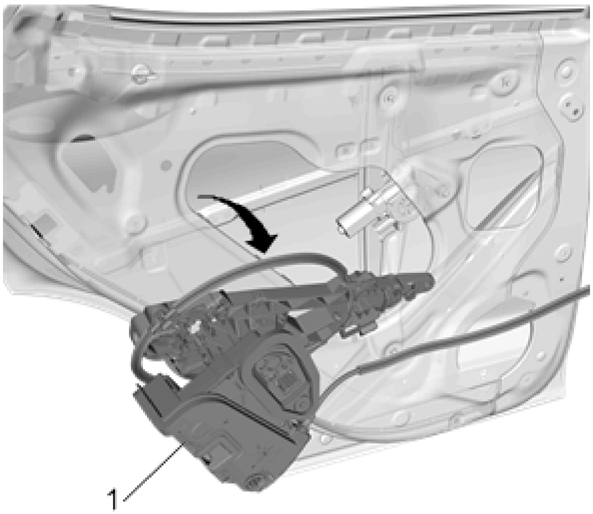


Fig. 39: Rear Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the rear side door latch with rear side door outside handle bracket (1) from rear side door.

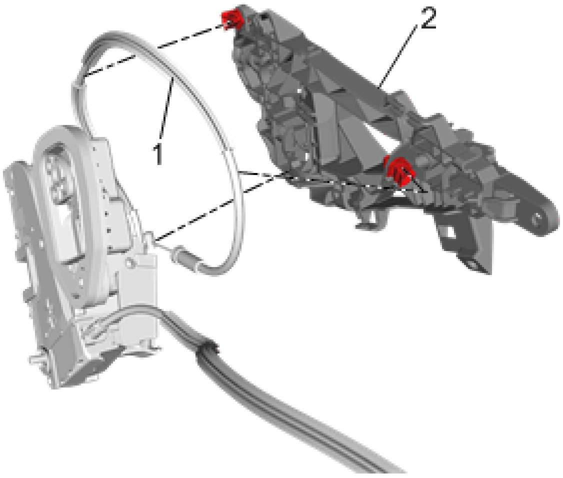


Fig. 40: Rear Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

10. Rear Side Door Outside Handle Cable at Rear Side Door Outside Handle Bracket - Remove - Rear Side Door Outside Handle Cable Replacement

Installation Procedure

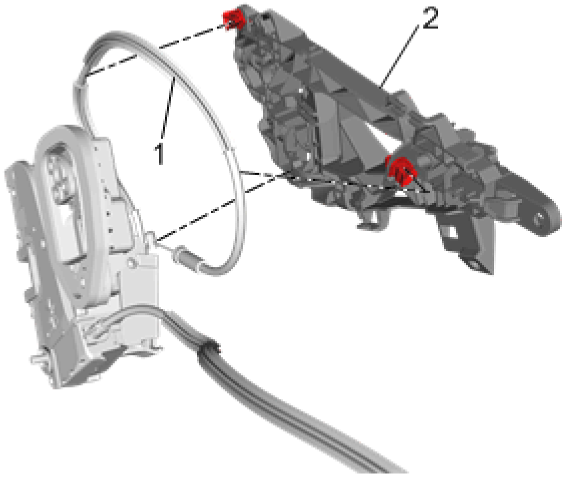


Fig. 41: Rear Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

1. Rear Side Door Outside Handle Cable at Rear Side Door Outside Handle Bracket - Install - Rear Side Door Outside Handle Cable Replacement
2. Connect and clip the electrical connector in place.

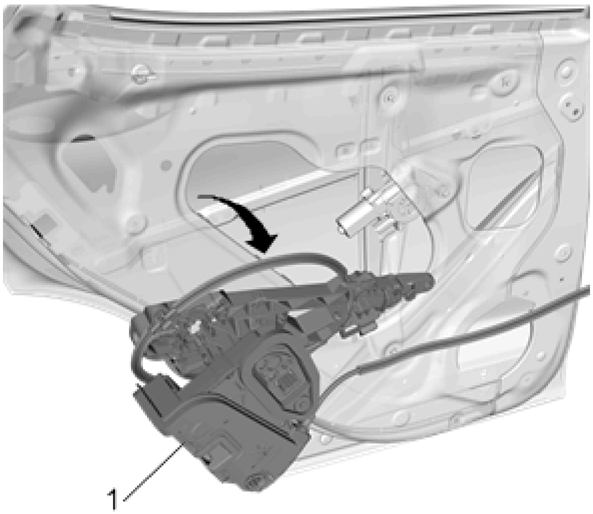


Fig. 42: Rear Side Door Latch
Courtesy of GENERAL MOTORS COMPANY

3. Install the rear side door latch with rear side door outside handle bracket to the rear side door.

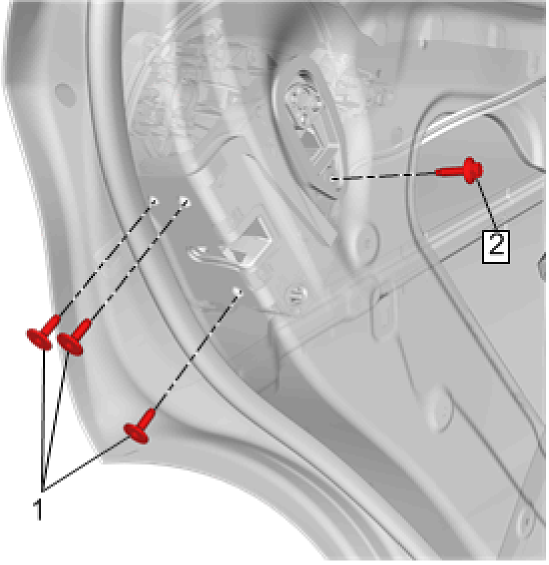


Fig. 43: Rear Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Rear Side Door Latch Fastener (1) (Qty: 3) - Install and tighten to 9 N.m (80 lb in)
5. Rear Side Door Latch Fastener (2) - Install and tighten to N.m (80 lb in)

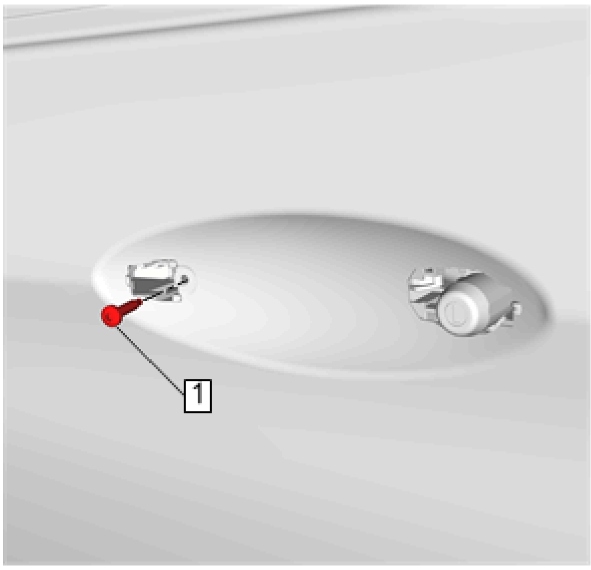


Fig. 44: Front Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Rear Side Door Outside Handle Bracket Fastener - Install and tighten to 5 N.m (44 lb in)

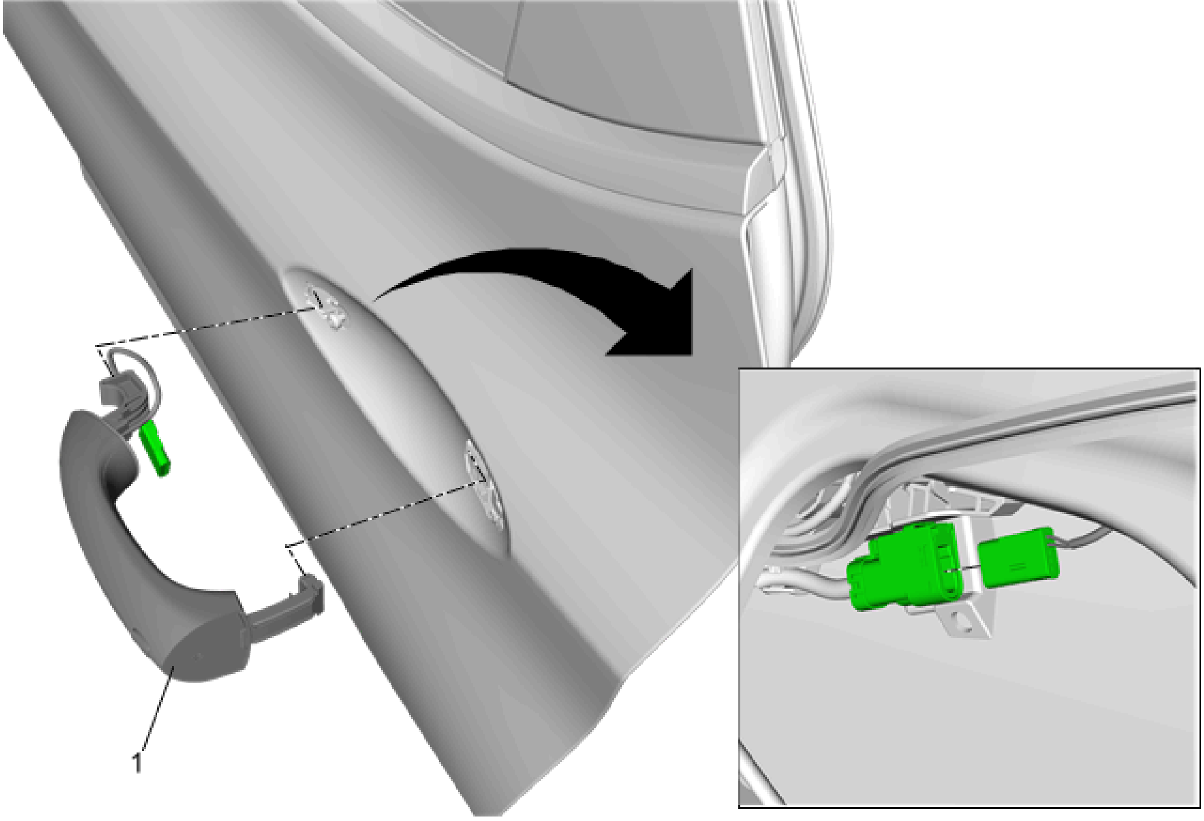


Fig. 45: Rear Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

7. Rear Side Door Outside Handle - Install - **Rear Side Door Outside Handle Replacement**

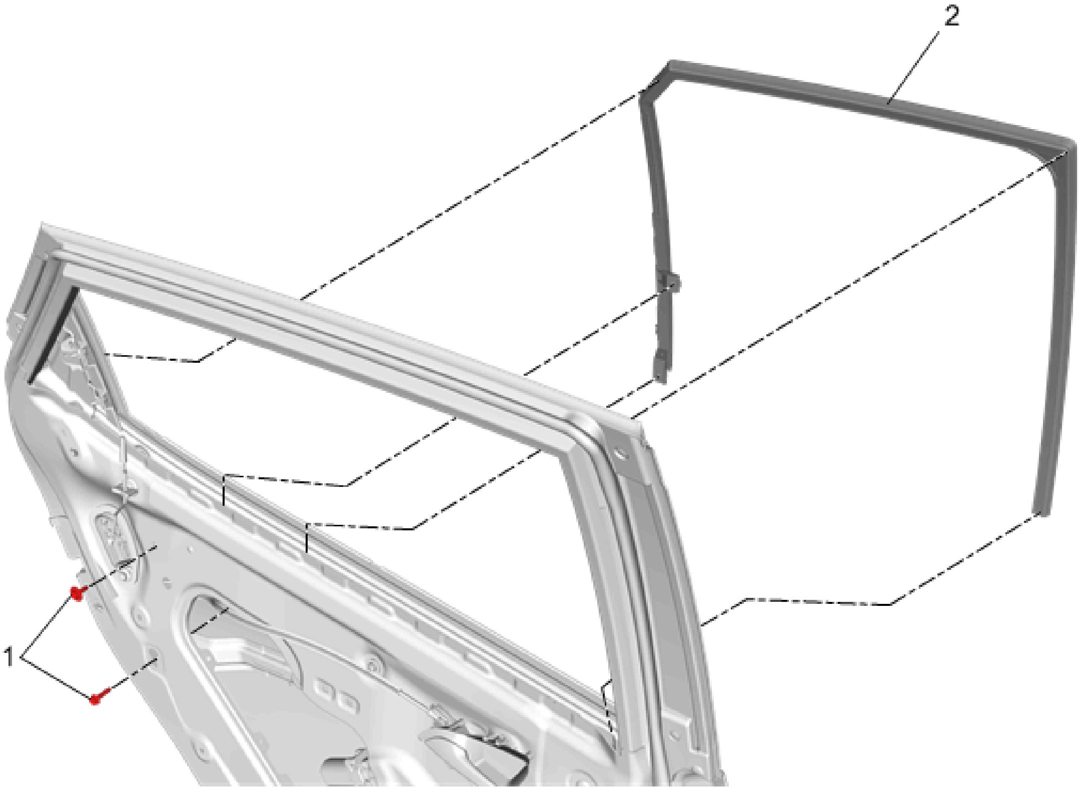


Fig. 46: Rear Side Door Window Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

8. Position channel and install the rear side door window channel rear retainer bolts. **Rear Side Door Window Weatherstrip Replacement**

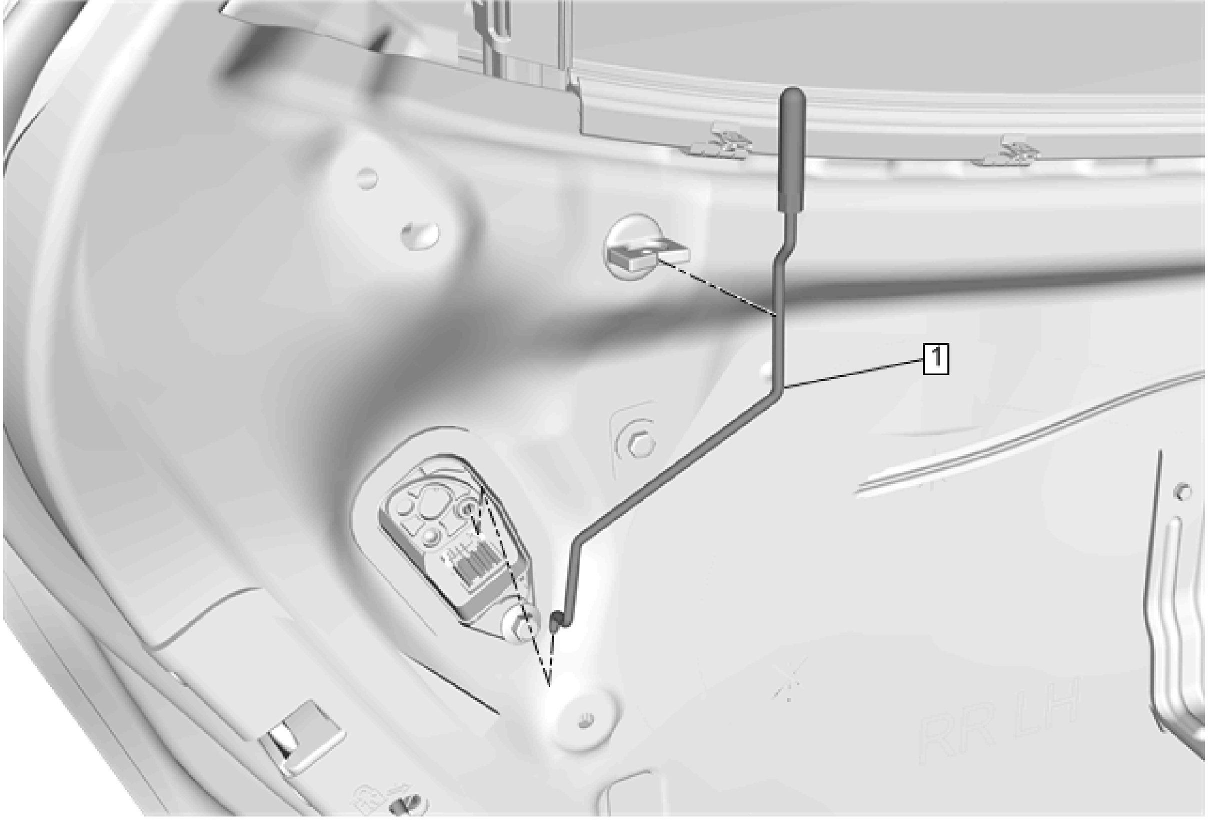


Fig. 47: Rear Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

9. Rear Side Door Locking Rod Knob - Install - Rear Side Door Locking Rod Knob Replacement

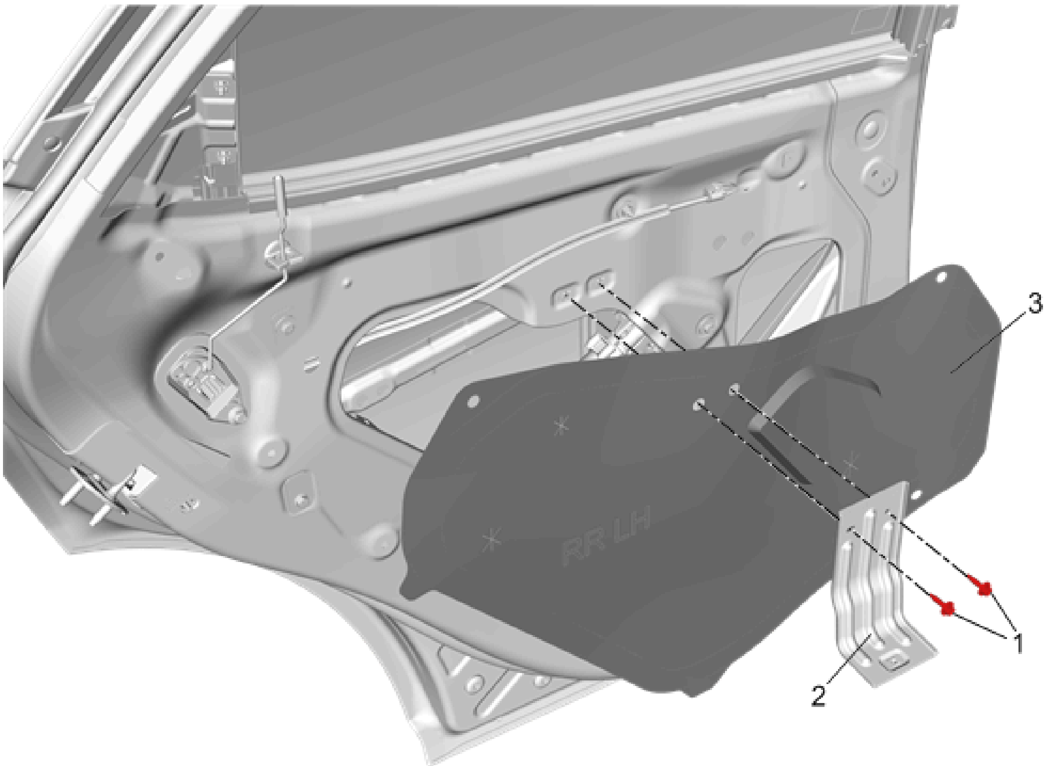


Fig. 48: Rear Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

10. Rear Side Door Water Deflector - Install - Rear Side Door Water Deflector Replacement

NOTE: **Ensure that the door lock system operates properly before installing the trim.**

LIFTGATE LATCH REPLACEMENT

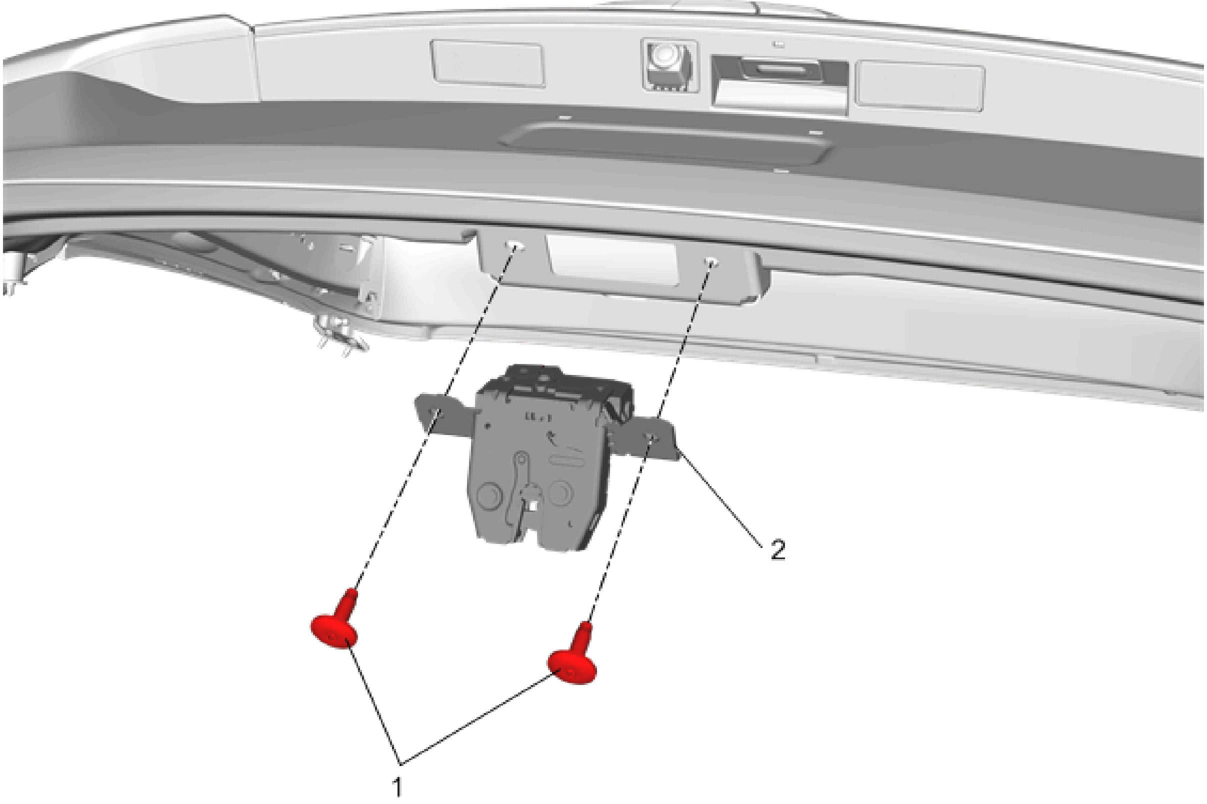


Fig. 49: Liftgate Latch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Liftgate Lower Trim Finish Panel Replacement	
1	Liftgate Latch Bolt **CAUTION:** Fastener Caution **Tighten** 22 N.m (16 lb ft)
2	Liftgate Latch **Procedure** Disconnect the electrical connector.

REAR SIDE DOOR OUTSIDE HANDLE REPLACEMENT

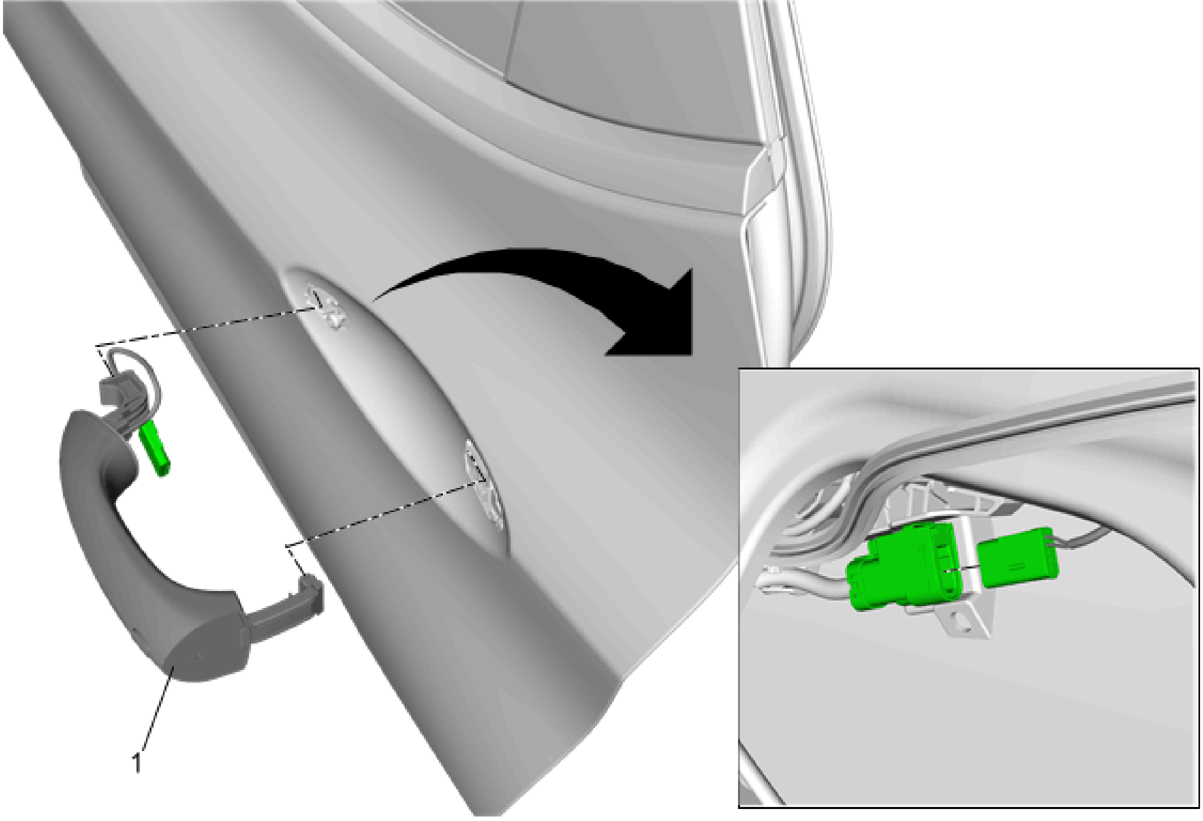


Fig. 50: Rear Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Rear Side Door Water Deflector Replacement
2. Rear Side Door Lock Cylinder Opening Cover Replacement</td></tr>
<tr><td>1</td><td>Rear Side Door Outside Handle
Procedure
1. Disconnect the electrical connector.
2. Pull the outside handle rearward to release it from the handle housing.
NOTE:
Ensure that the door lock system operates properly before installing the trim.</td></tr>
</table>

REAR SIDE DOOR OUTSIDE HANDLE CABLE REPLACEMENT

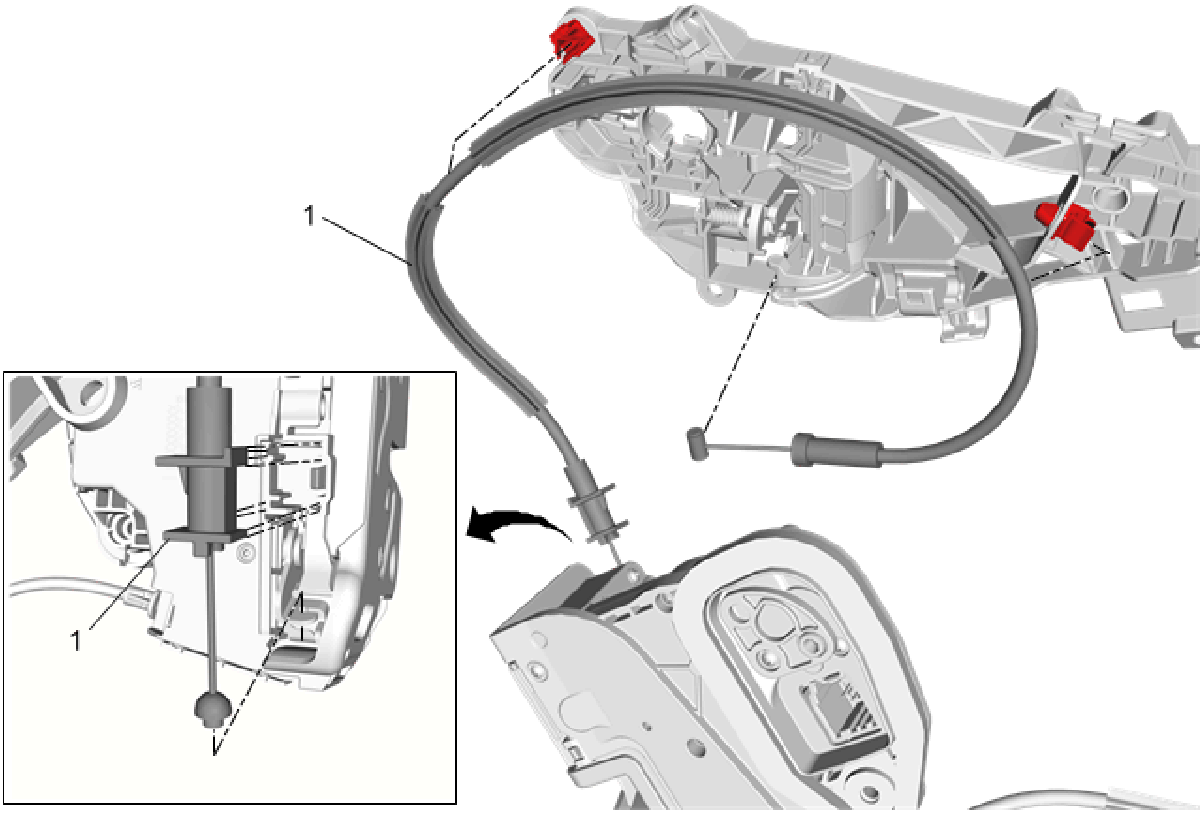


Fig. 51: Rear Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Side Door Latch Replacement	
1	Rear Side Door Outside Handle Cable **Procedure** 1. Rear Side Door Outside Handle Cable at Retainer - Remove 2. Release the cable from the back of the latch assembly 3. Rear Side Door Outside Handle Cable at Rear Side Door Outside Handle Bracket - Remove **NOTE:** **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR LATCH REPLACEMENT

Removal Procedure

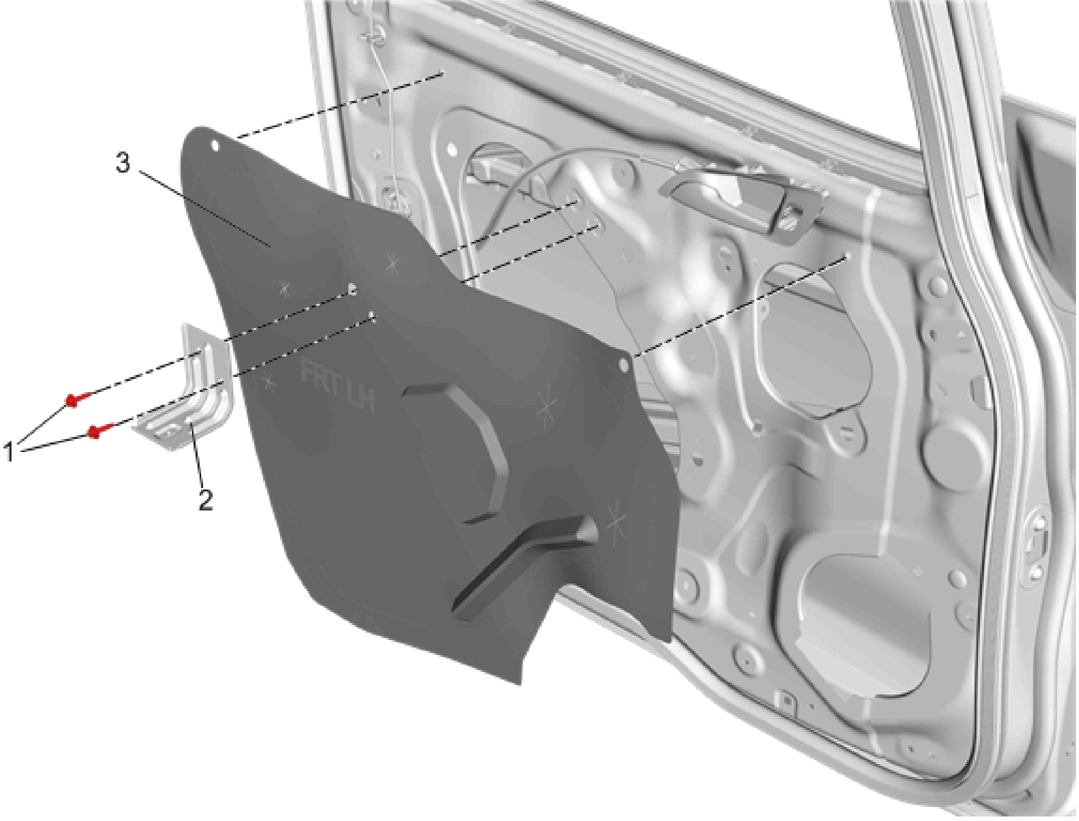


Fig. 52: Front Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

1. Front Side Door Water Deflector - Remove - **Front Side Door Water Deflector Replacement**

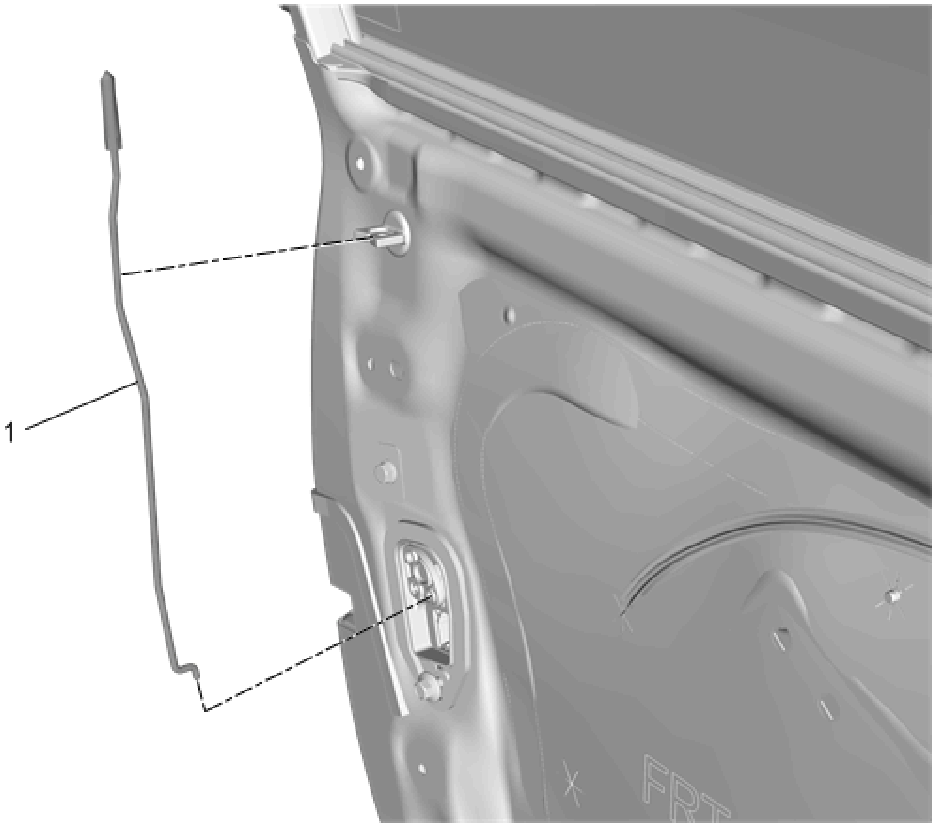


Fig. 53: Front Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

2. Front Side Door Locking Rod Knob - Remove - **Front Side Door Locking Rod Knob Replacement**

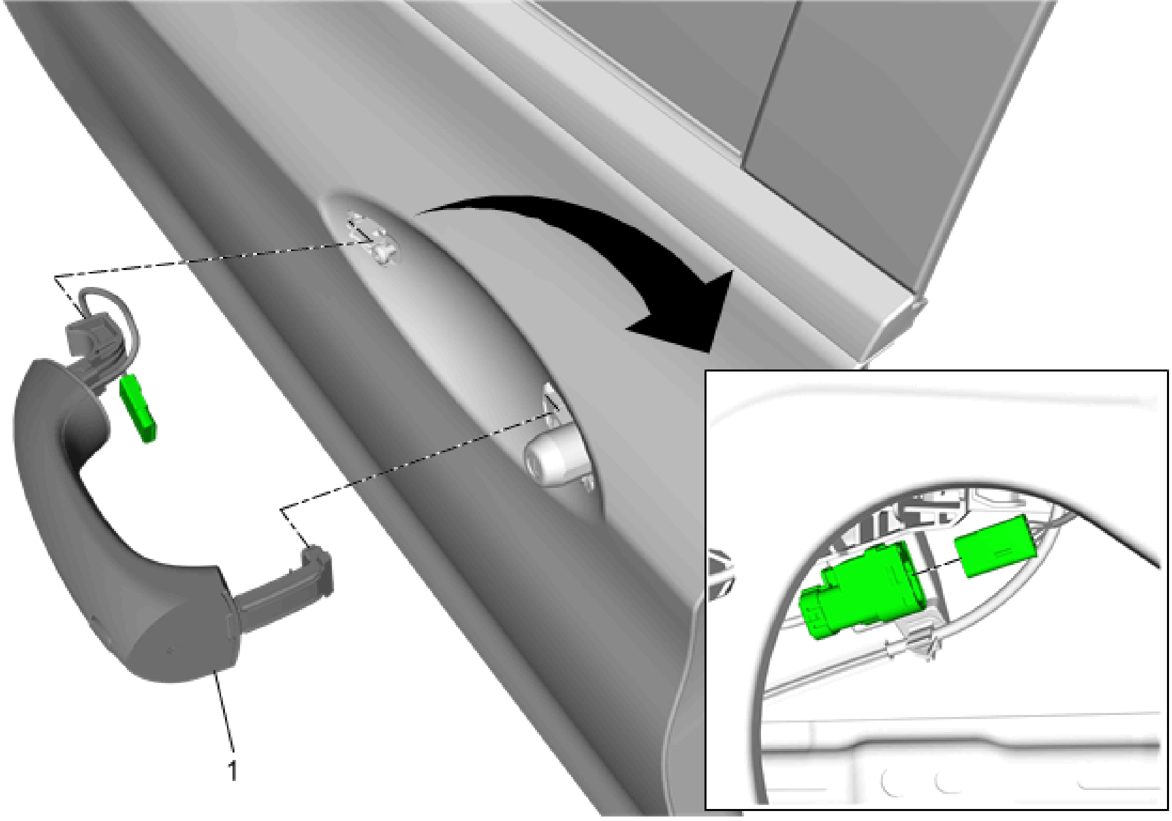


Fig. 54: Front Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

3. Front Side Door Outside Handle - Remove - **Front Side Door Outside Handle Replacement**

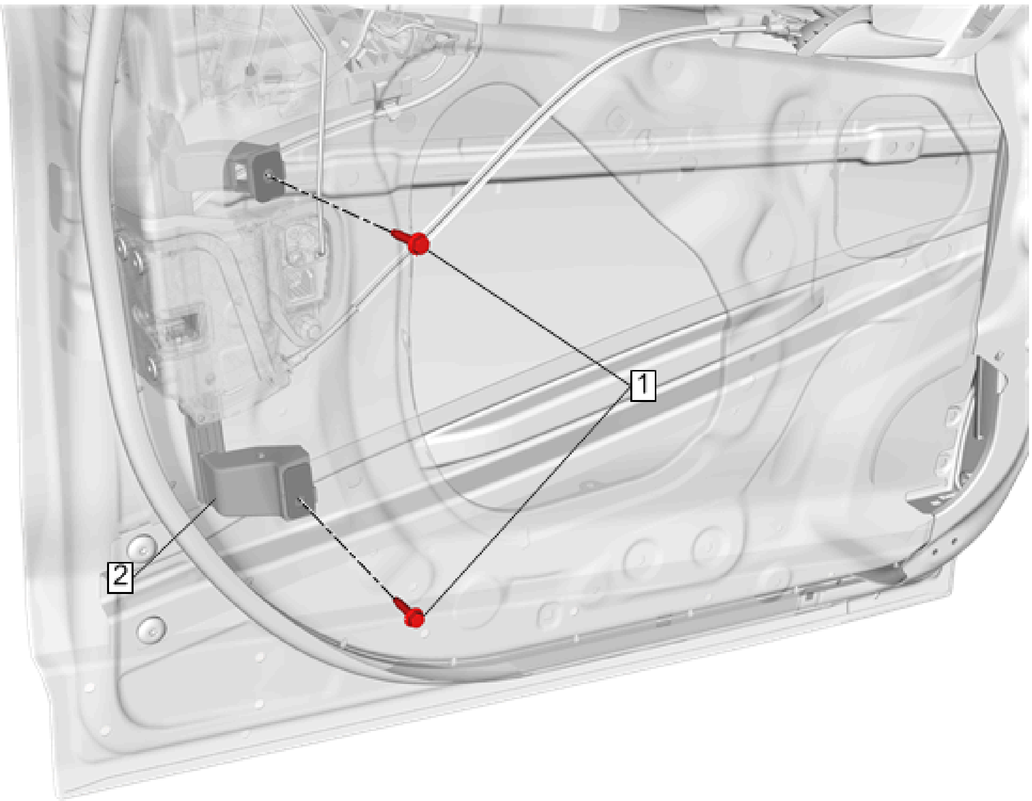


Fig. 55: Front Side Door Window Channel Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Front Side Door Window Channel Retainer - Remove - **Front Side Door Window Channel Retainer Replacement**

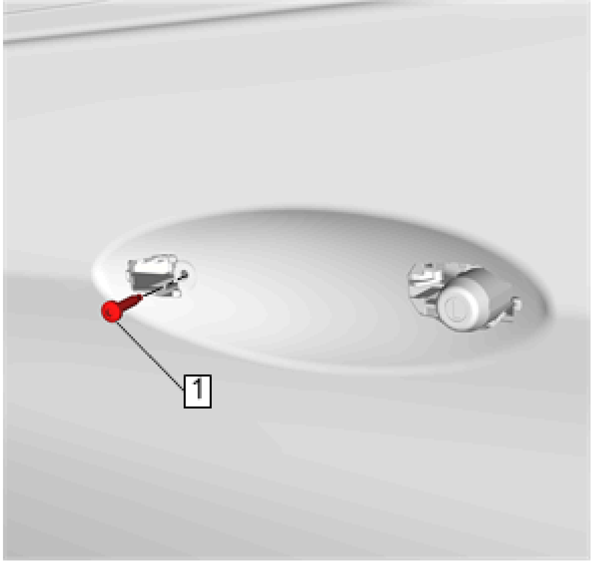


Fig. 56: Front Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

5. Front Side Door Outside Handle Bracket Fastener - Remove

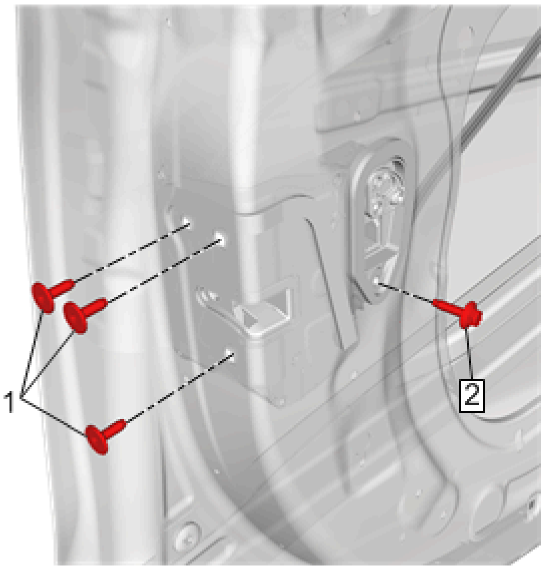


Fig. 57: Front Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Front Side Door Latch Fastener (1) (Qty: 3) - Remove
7. Front Side Door Latch Fastener (2) - Remove
8. Unclip and disconnect the electrical connector from the bracket and latch assemblies.

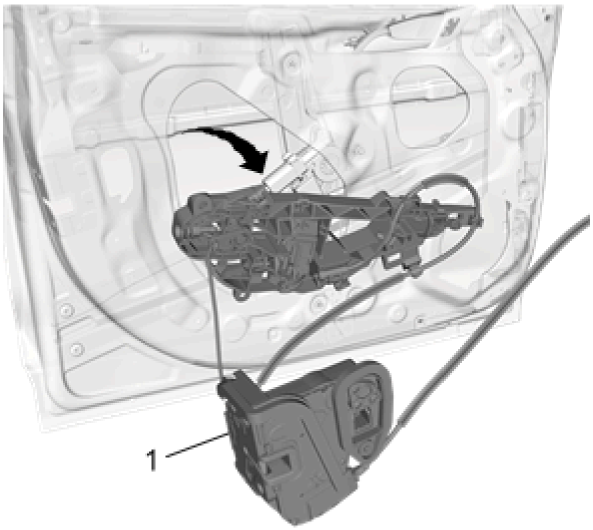


Fig. 58: Front Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the front side door latch with front side door outside handle bracket (1) from front side door.

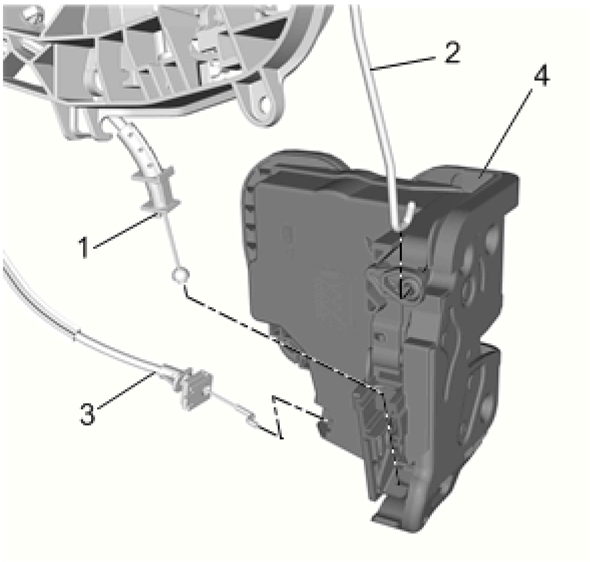


Fig. 59: Front Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

10. Front Side Door Outside Handle Cable (1) at Front Side Door Latch (4) - Remove - **Front Side Door Outside Handle Cable Replacement**
11. { If equipped } Front Side Door Lock Cylinder Rod (2) at Front Side Door Latch (4) - Remove - **Front Side Door Lock Cylinder Rod Replacement**
12. Front Side Door Inside Handle Cable (3) at Front Side Door Latch (4) - Remove - **Front Side Door Inside Handle Cable Replacement**

Installation Procedure

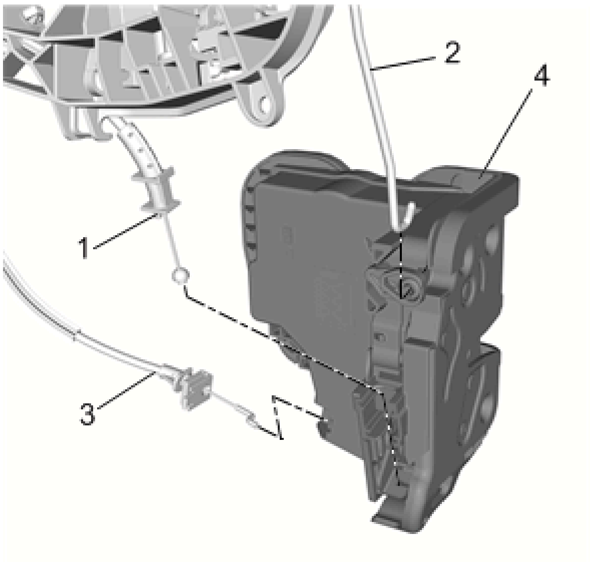


Fig. 60: Front Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

1. Front Side Door Outside Handle Cable (1) at Front Side Door Latch (4) - Install - **Front Side Door Outside Handle Cable Replacement**
2. { If equipped } Front Side Door Lock Cylinder Rod (2) at Front Side Door Latch (4) - Install - **Front Side Door Lock Cylinder Rod Replacement**
3. Front Side Door Inside Handle Cable (3) at Front Side Door Latch (4) - Install - **Front Side Door Inside Handle Cable Replacement**

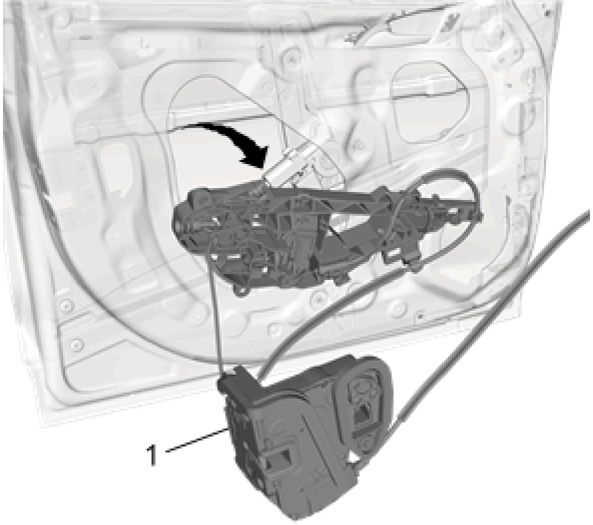


Fig. 61: Front Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Install the front side door latch with front side door outside handle bracket to the front side door.
5. Connect and clip the electrical connector in place.

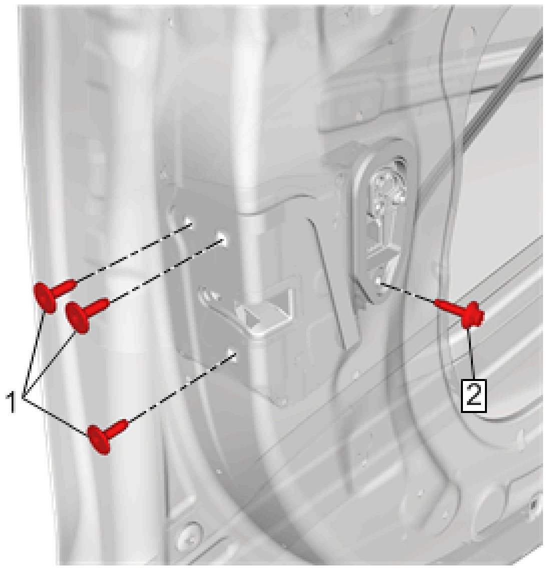


Fig. 62: Front Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

6. Front Side Door Latch Fastener (1) (Qty: 3) - Install and tighten to 9 N.m (80 lb in)
7. Front Side Door Latch Fastener (2) - Install and tighten to 9 N.m (80 lb in)

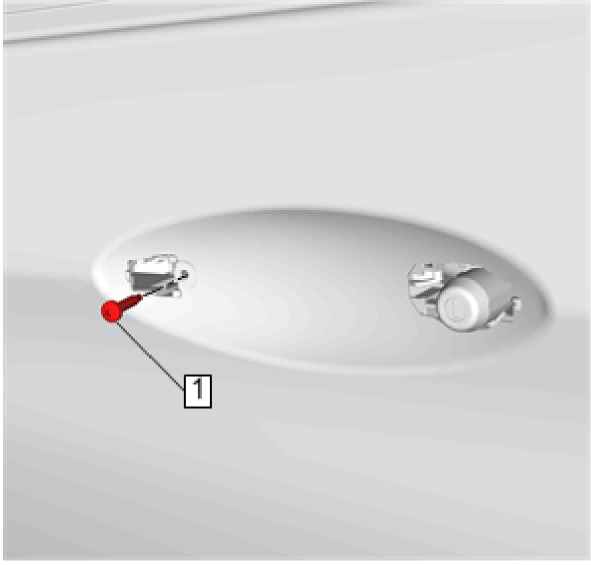


Fig. 63: Front Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

8. Front Side Door Outside Handle Bracket Fastener (1) - Install and tighten to 5 N.m (44 lb in)

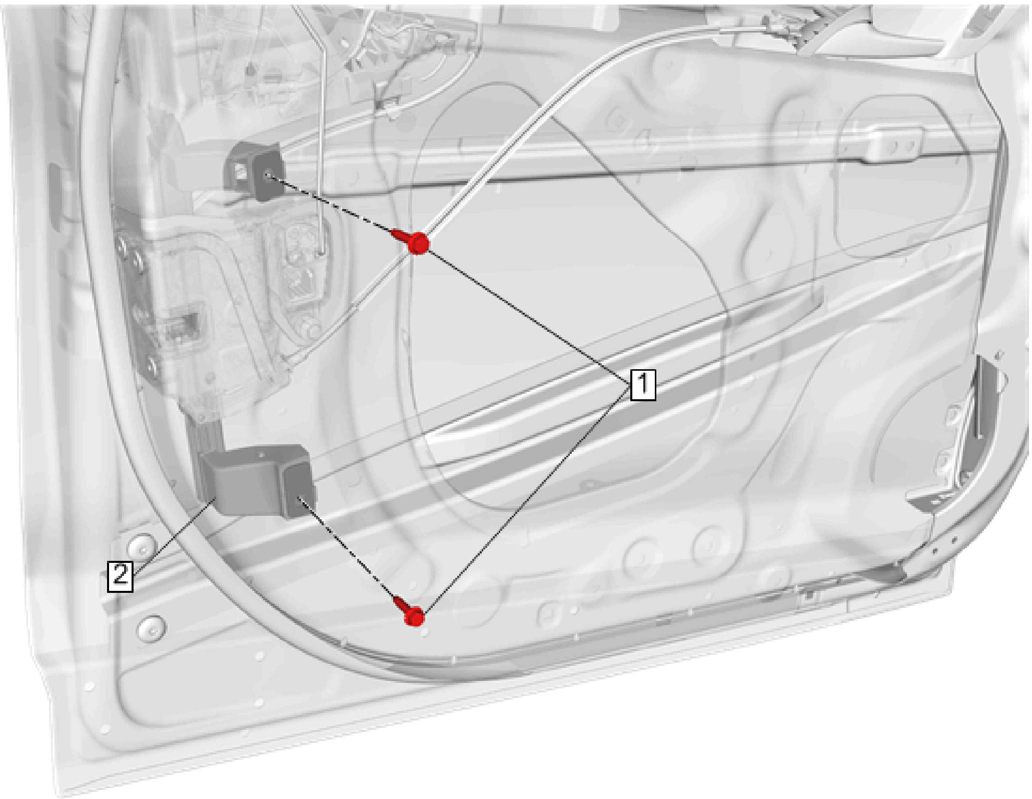


Fig. 64: Front Side Door Window Channel Retainer
Courtesy of GENERAL MOTORS COMPANY

9. Front Side Door Window Channel Retainer - Install - **Front Side Door Window Channel Retainer Replacement**

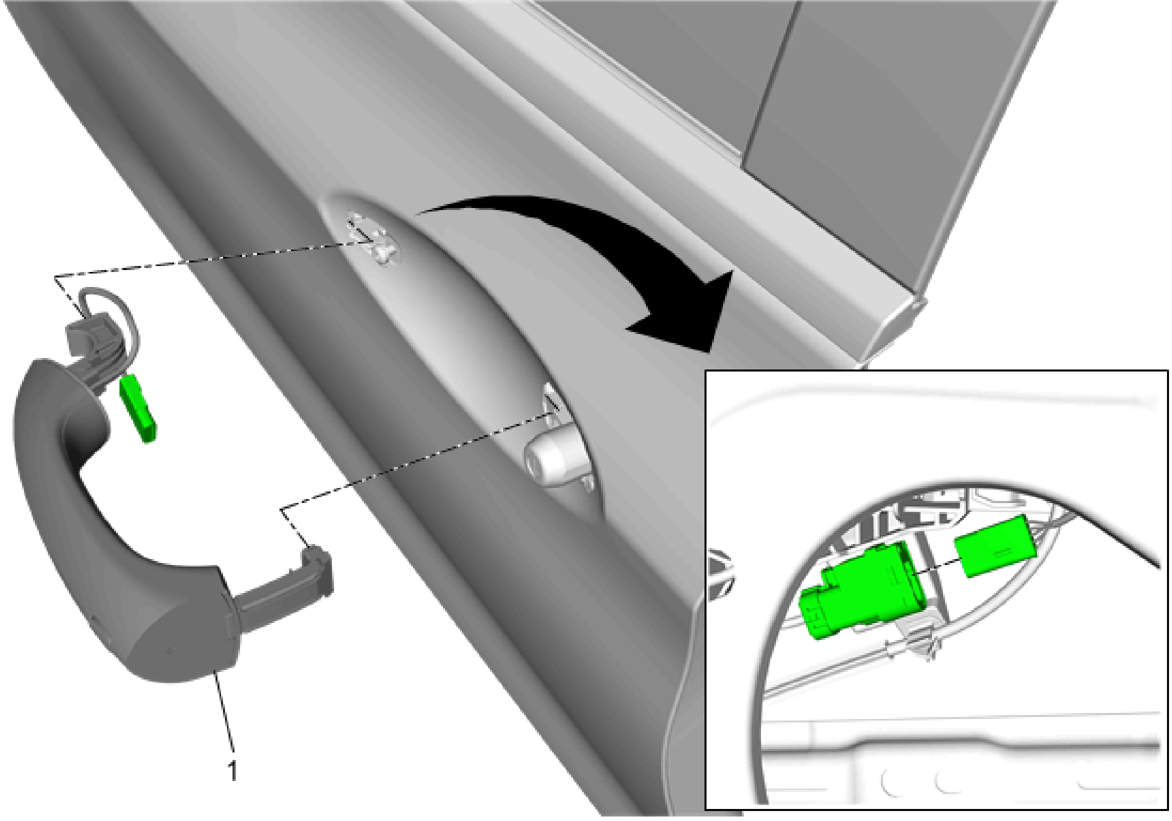


Fig. 65: Front Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

10. Front Side Door Outside Handle - Install - Front Side Door Outside Handle Replacement

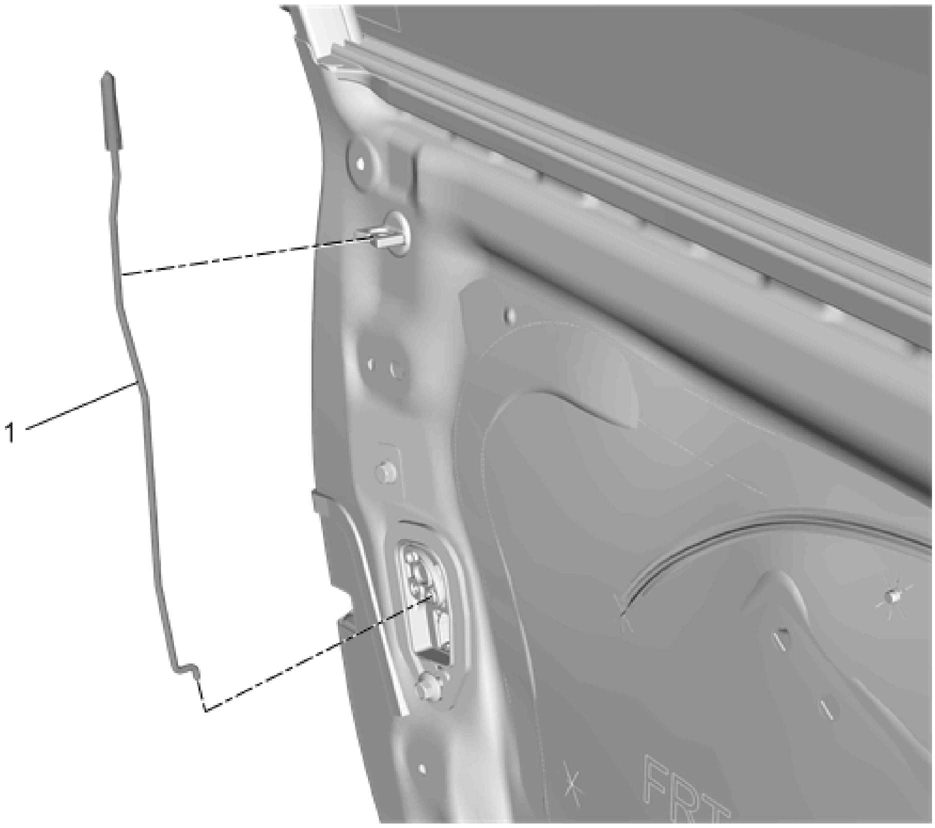


Fig. 66: Front Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

11. Front Side Door Locking Rod Knob - Install - Front Side Door Locking Rod Knob Replacement

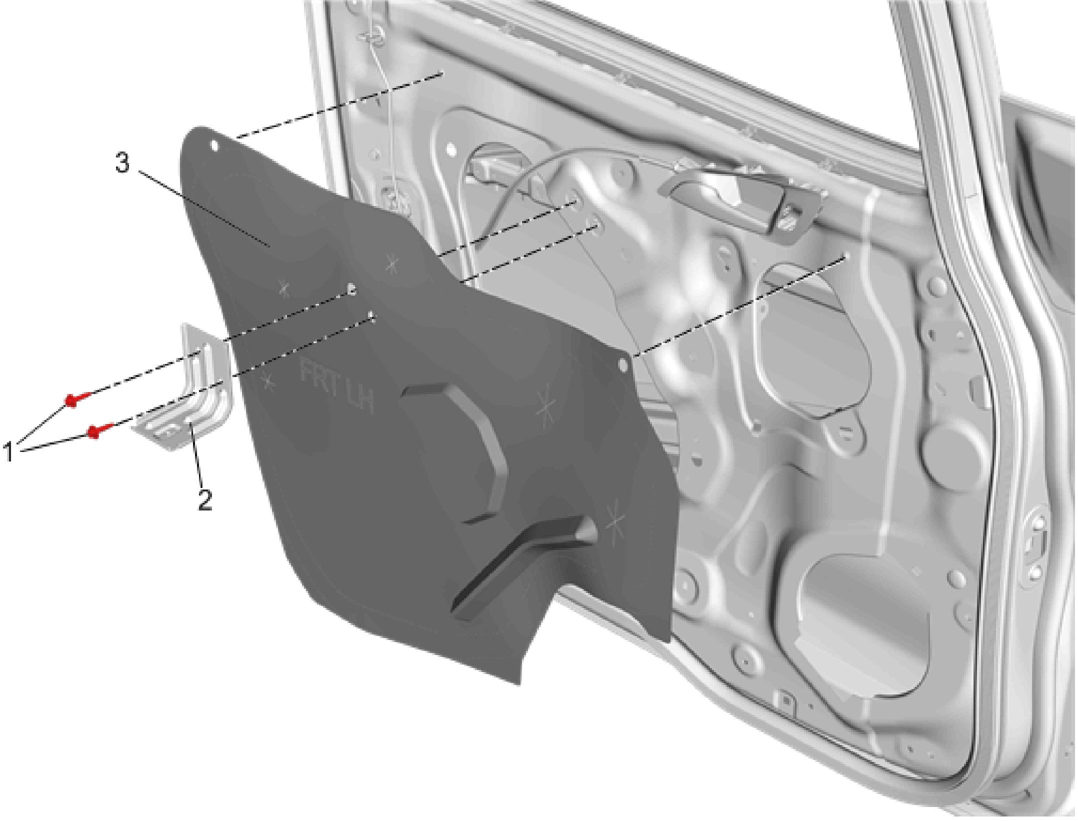


Fig. 67: Front Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

12. Front Side Door Water Deflector - Install - **Front Side Door Water Deflector Replacement**

NOTE: **Ensure that the door lock system operates properly before installing the trim.**

REAR SIDE DOOR LATCH REPLACEMENT

Removal Procedure

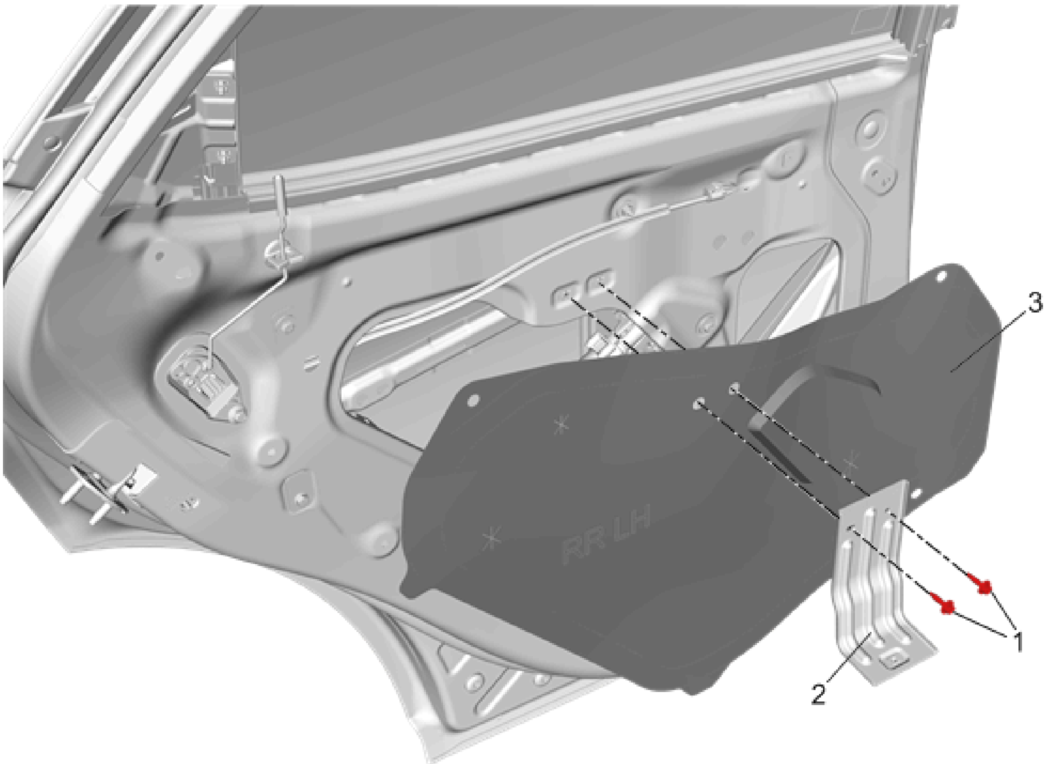


Fig. 68: Rear Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

1. Rear Side Door Water Deflector - Remove - Rear Side Door Water Deflector Replacement

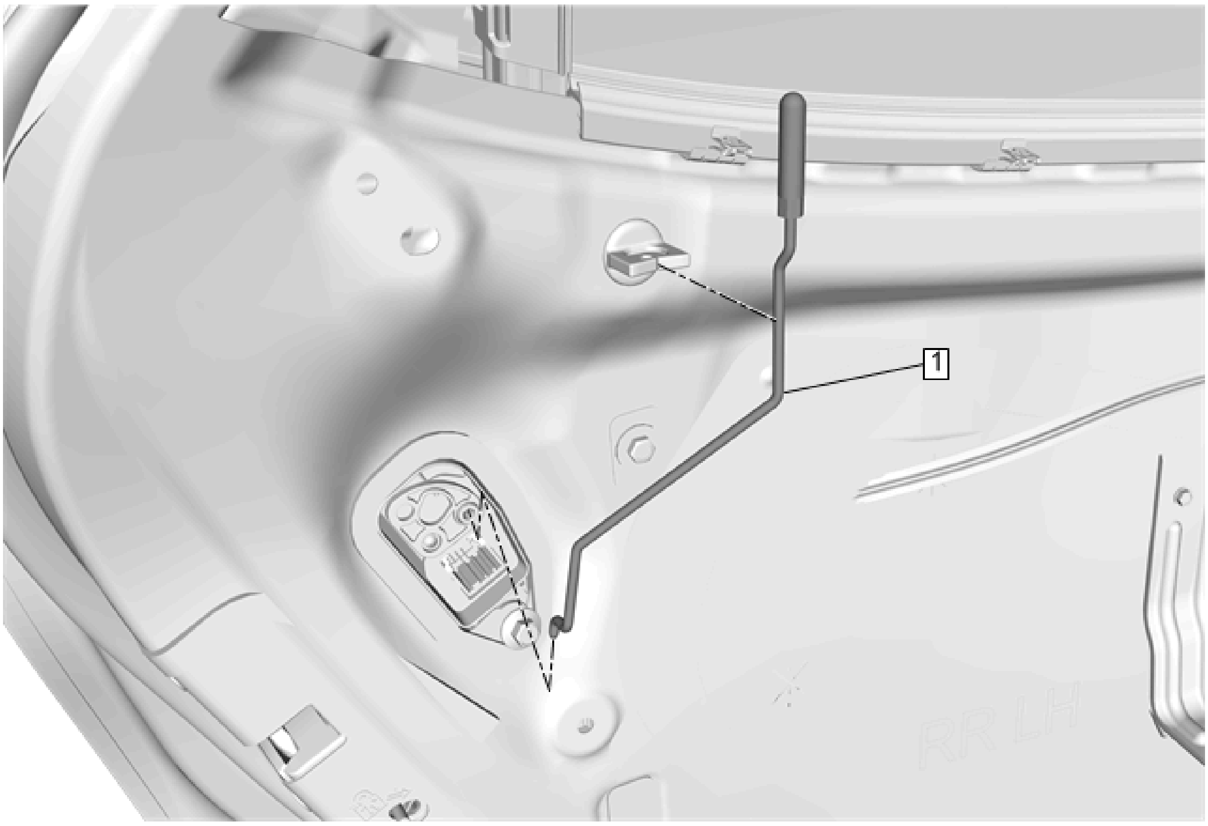


Fig. 69: Rear Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

2. Rear Side Door Locking Rod Knob - Remove - Rear Side Door Locking Rod Knob Replacement

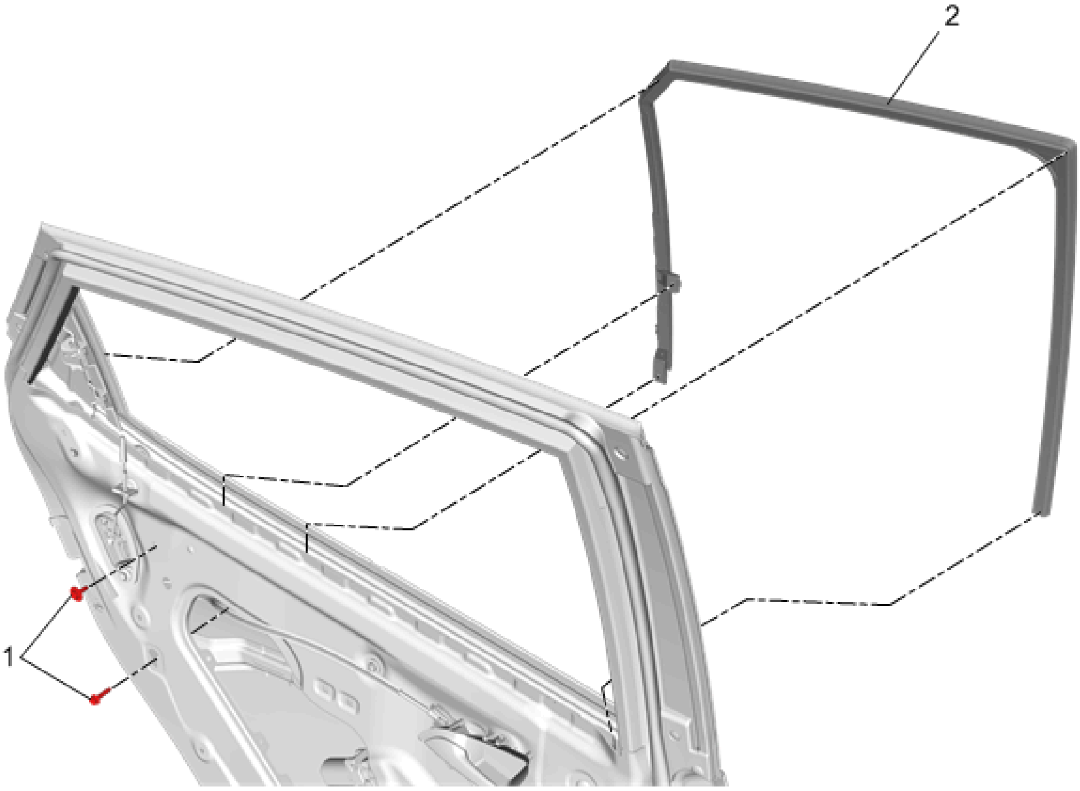


Fig. 70: Rear Side Door Window Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

3. Remove the rear side door window channel rear retainer bolts and reposition the channel as necessary. Rear Side Door Window Weatherstrip Replacement

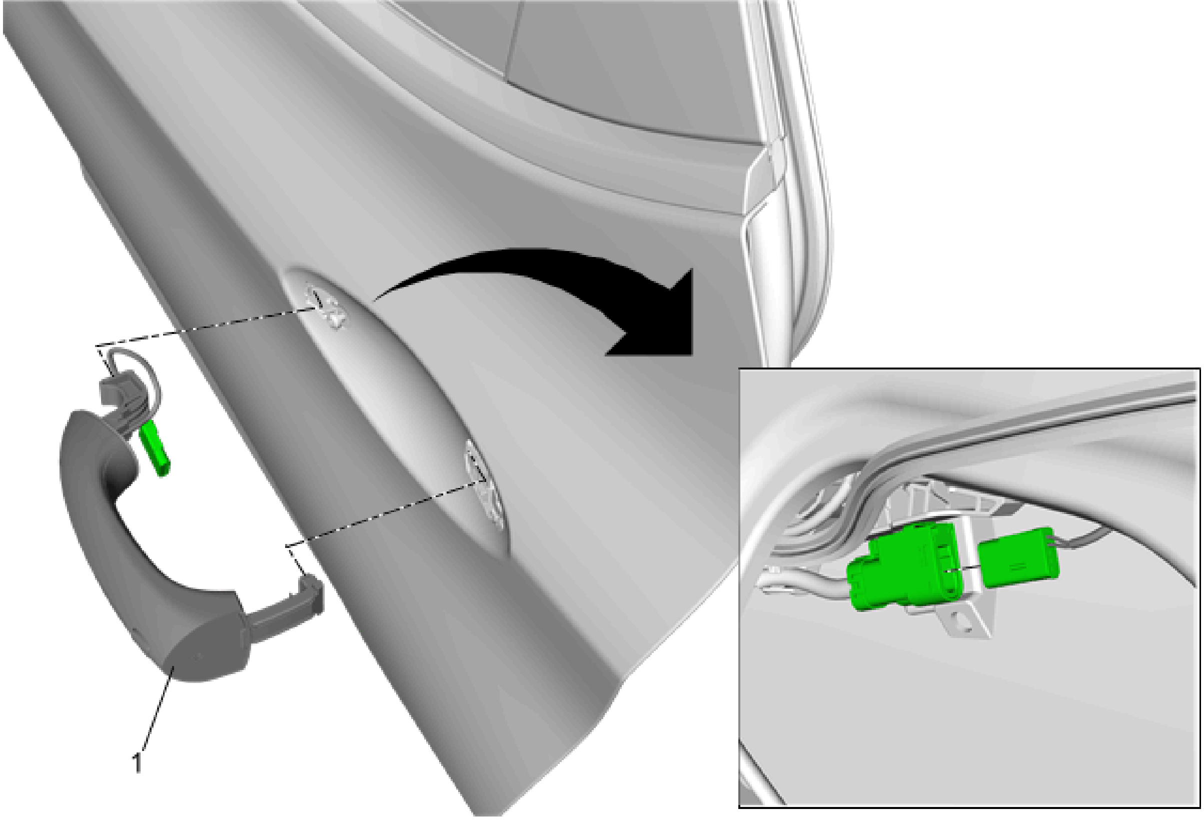


Fig. 71: Rear Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

4. Rear Side Door Outside Handle - Remove - Rear Side Door Outside Handle Replacement

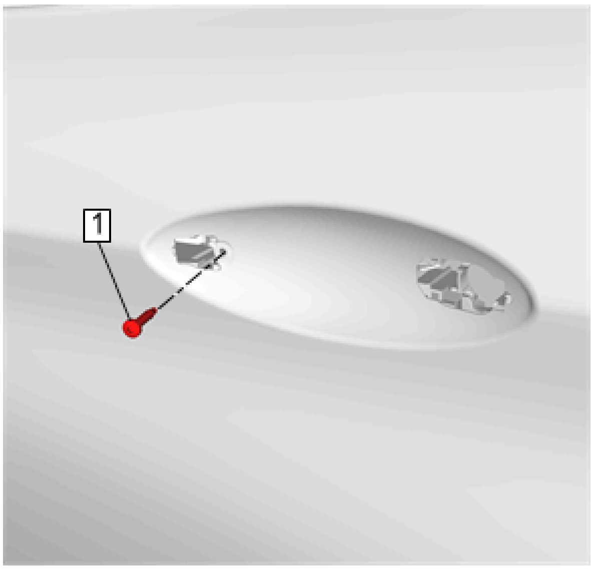


Fig. 72: Rear Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

5. Rear Side Door Outside Handle Bracket Fastener - Remove

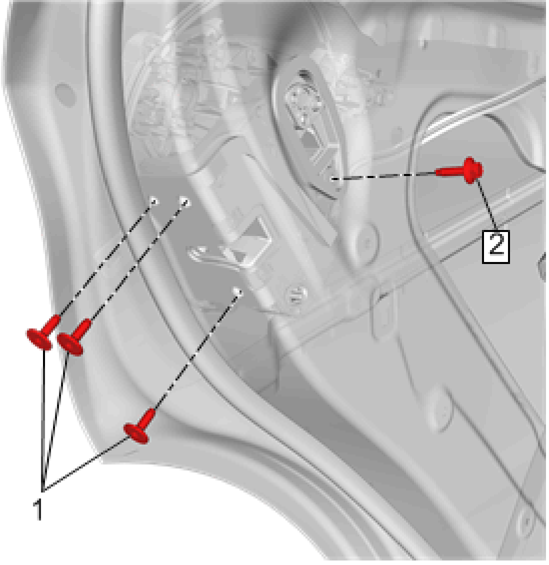


Fig. 73: Rear Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

6. Rear Side Door Latch Fastener (1) (Qty: 3) - Remove
7. Rear Side Door Latch Fastener (2) - Remove
8. Disconnect and unclip the electrical connector.

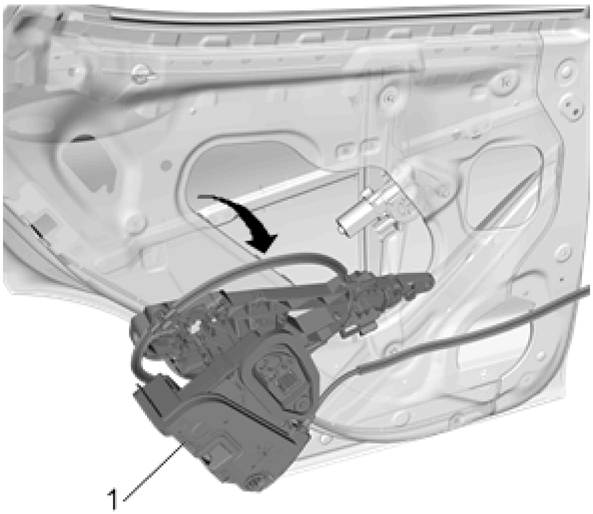


Fig. 74: Rear Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

9. Remove the rear side door latch with rear side door outside handle bracket (1) from rear side door.

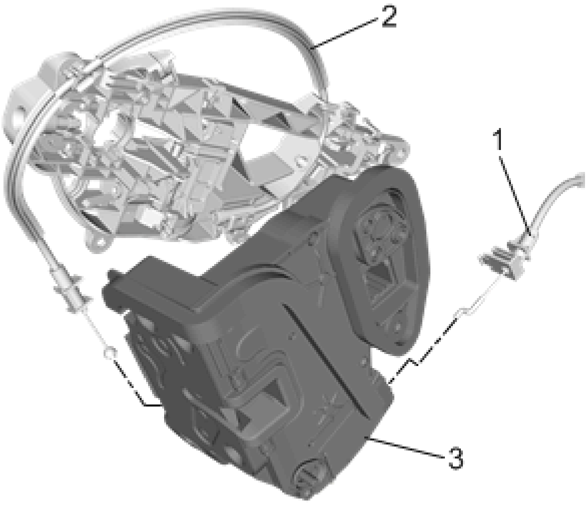


Fig. 75: Rear Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

10. Rear Side Door Outside Handle Cable (1) at Rear Side Door Latch (3) - Remove - Rear Side Door Outside Handle Cable Replacement
11. Rear Side Door Inside Handle Cable (2) at Rear Side Door Latch (3) - Remove - Rear Side Door Inside Handle Cable Replacement

Installation Procedure

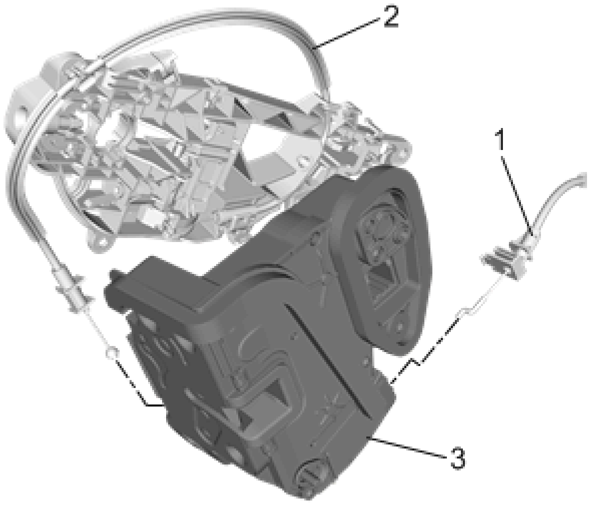


Fig. 76: Rear Side Door Outside Handle Cable
Courtesy of GENERAL MOTORS COMPANY

1. Rear Side Door Outside Handle Cable (1) at Rear Side Door Latch (3) - Install - Rear Side Door Outside Handle Cable Replacement
2. Rear Side Door Inside Handle Cable (2) at Rear Side Door Latch (3) - Install - Rear Side Door Inside Handle Cable Replacement
3. Connect and clip the electrical connector in place.

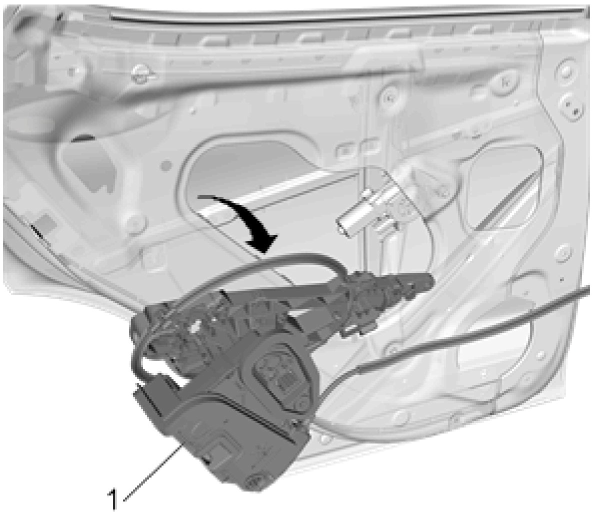


Fig. 77: Rear Side Door Outside Handle Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Install the rear side door latch with rear side door outside handle bracket to the rear side door.

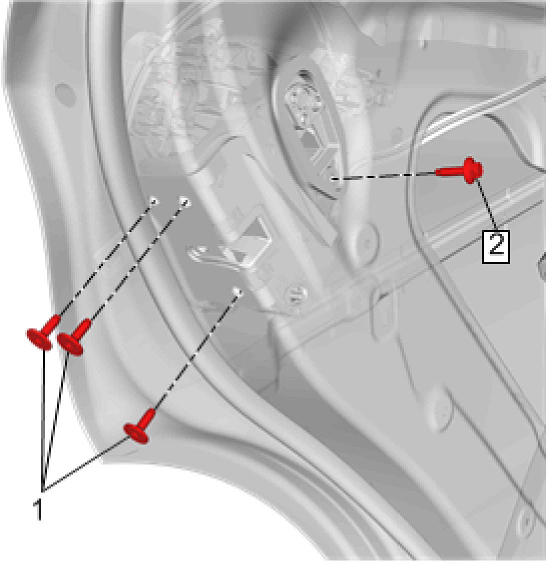


Fig. 78: Rear Side Door Latch Fastener
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

5. Rear Side Door Latch Fastener (1) (Qty: 3) - Install and tighten to 9 N.m (80 lb in)
6. Rear Side Door Latch Fastener (2) - Install and tighten to 9 N.m (80 lb in)

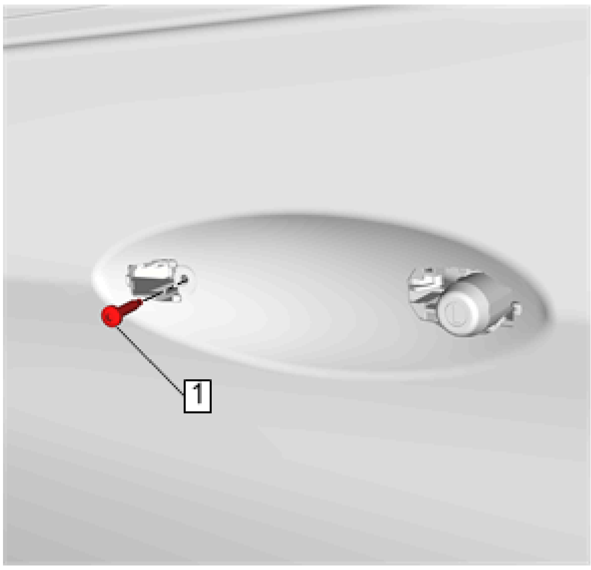


Fig. 79: Front Side Door Outside Handle Bracket Fastener
Courtesy of GENERAL MOTORS COMPANY

7. Rear Side Door Outside Handle Bracket Fastener (1) - Install and tighten to 5 N.m (44 lb in)

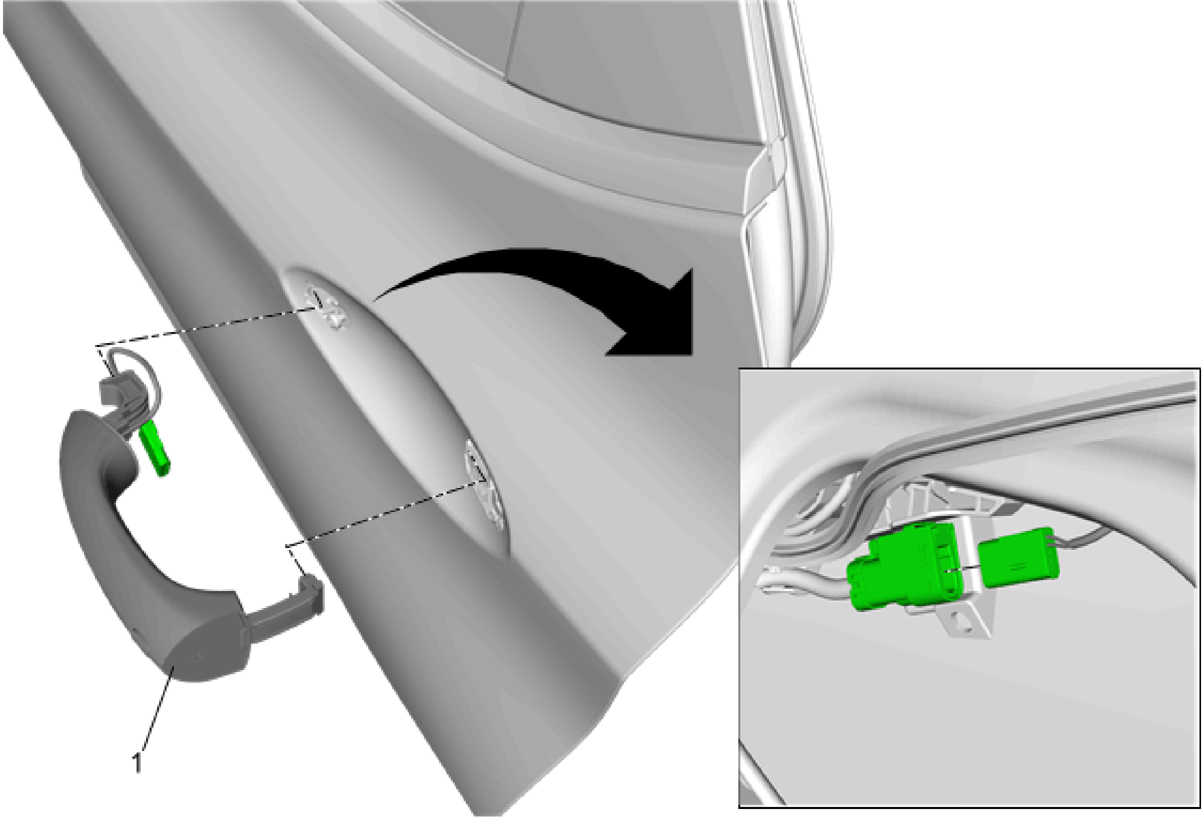


Fig. 80: Rear Side Door Outside Handle
Courtesy of GENERAL MOTORS COMPANY

8. Rear Side Door Outside Handle - Install - **Rear Side Door Outside Handle Replacement**

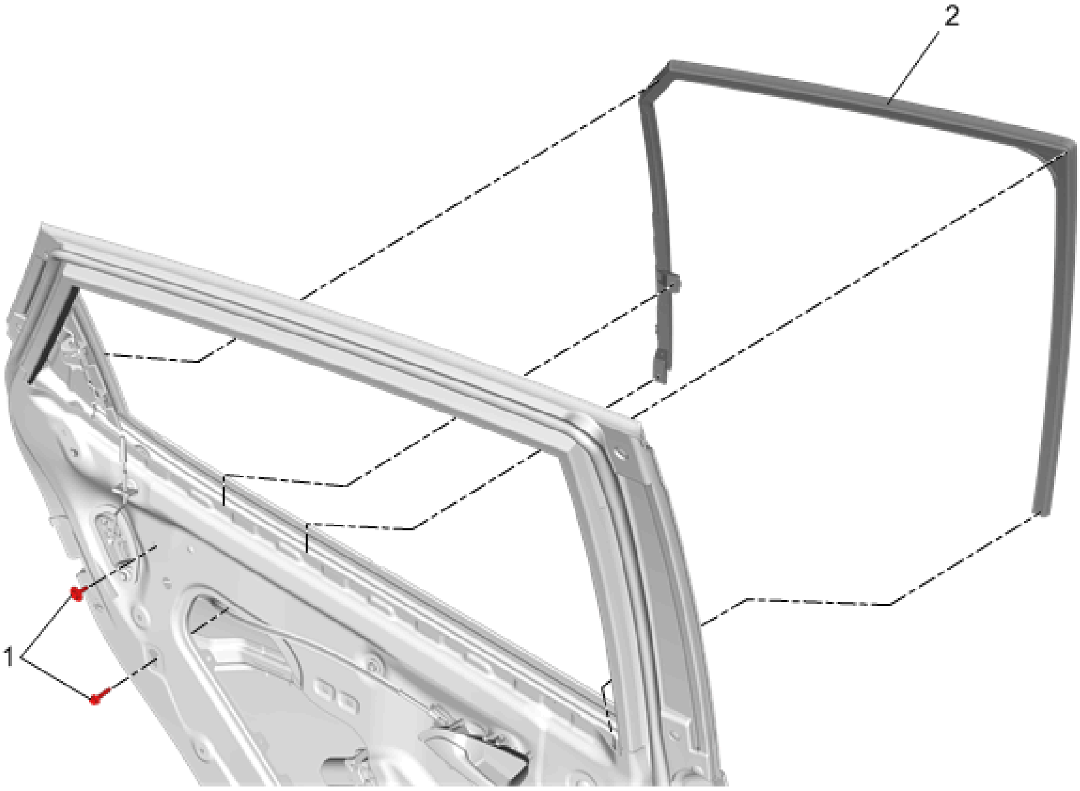


Fig. 81: Rear Side Door Window Weatherstrip
Courtesy of GENERAL MOTORS COMPANY

9. Position channel and install the rear side door window channel rear retainer bolts. **Rear Side Door Window Weatherstrip Replacement**

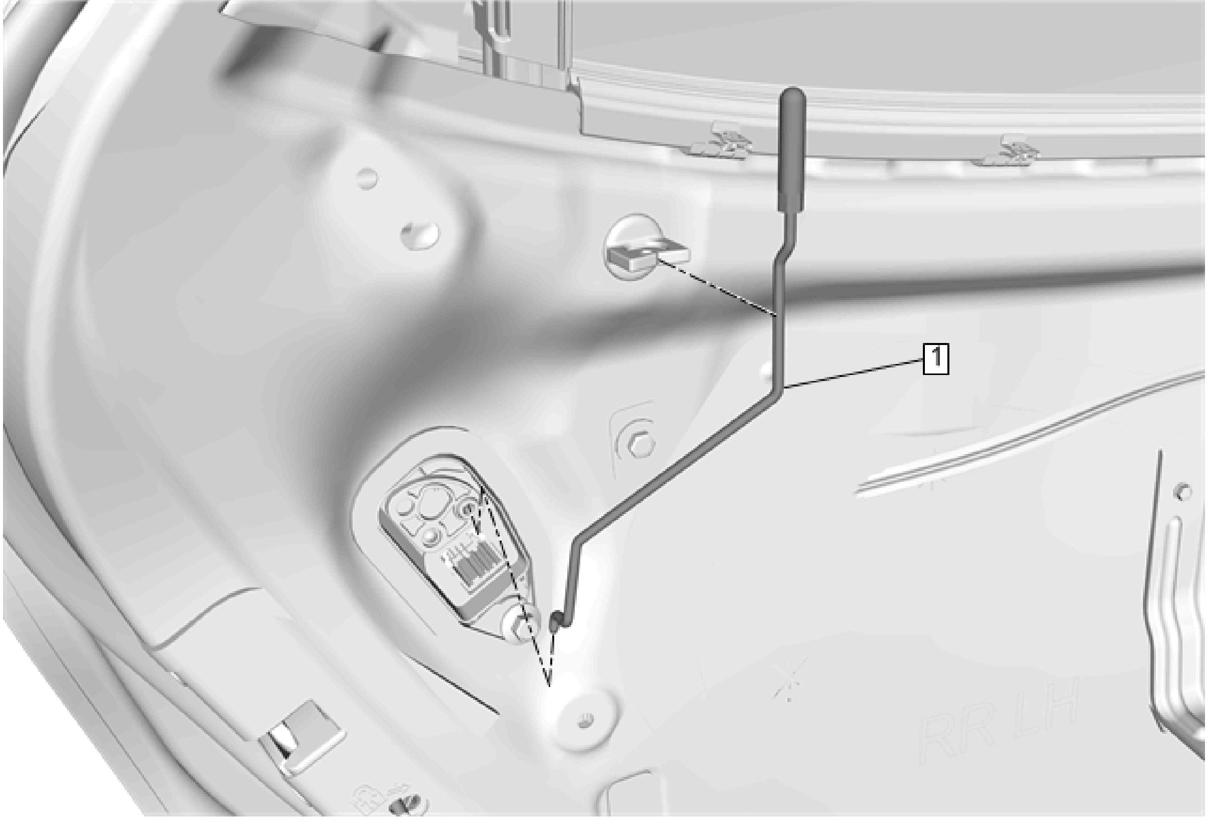


Fig. 82: Rear Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

10. Rear Side Door Locking Rod Knob - Install - Rear Side Door Locking Rod Knob Replacement

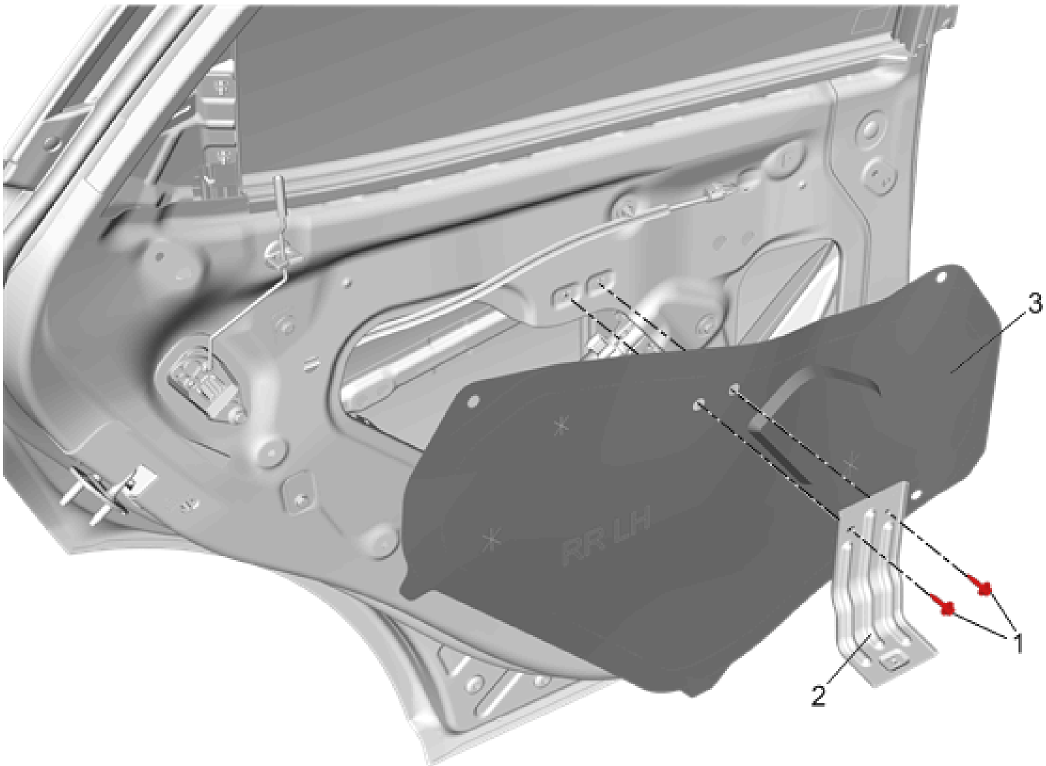


Fig. 83: Rear Side Door Water Deflector
Courtesy of GENERAL MOTORS COMPANY

11. Rear Side Door Water Deflector - Install - Rear Side Door Water Deflector Replacement

NOTE: **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR LOCK CYLINDER OPENING COVER REPLACEMENT

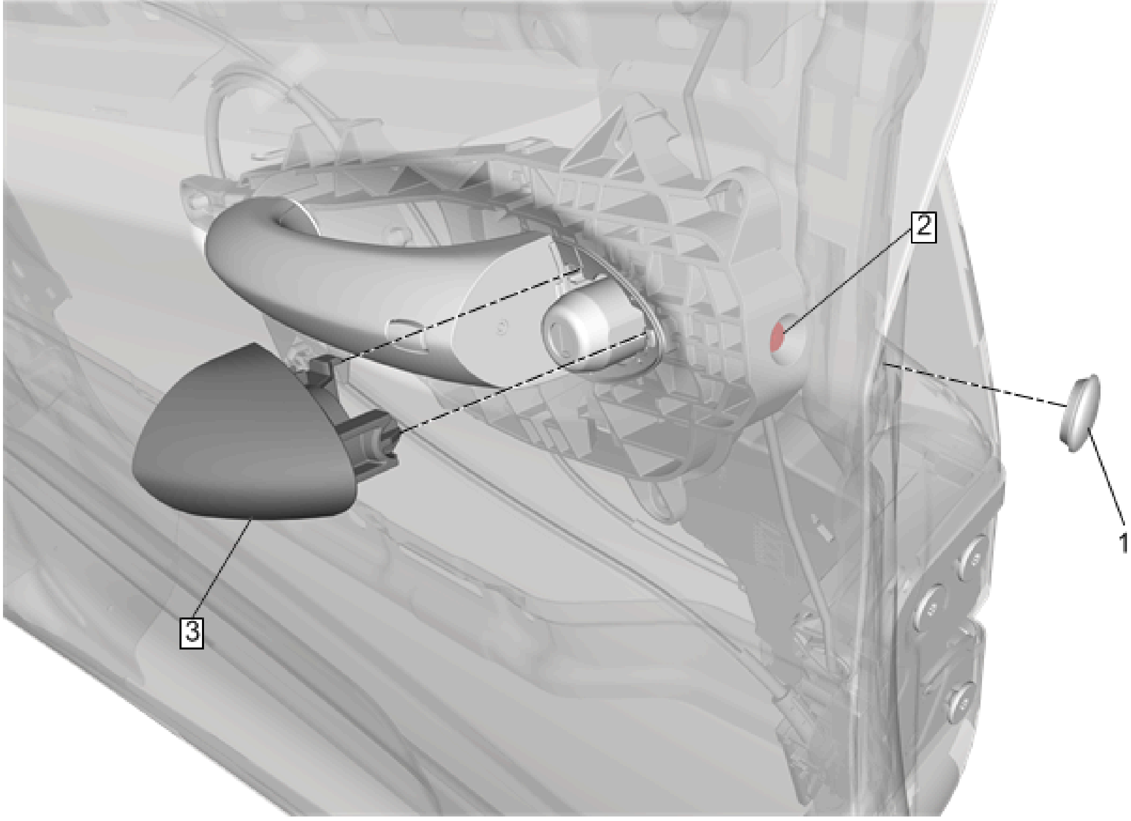


Fig. 84: Front Side Door Lock Cylinder Opening Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt Access Plug **Procedure** Use a flat bladed plastic tool to remove.
2	Front Side Door Outside Handle Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 4.5 N.m (40 lb in)
3	Front Side Door Lock Cylinder Opening Cover

REAR SIDE DOOR LOCK CYLINDER OPENING COVER REPLACEMENT

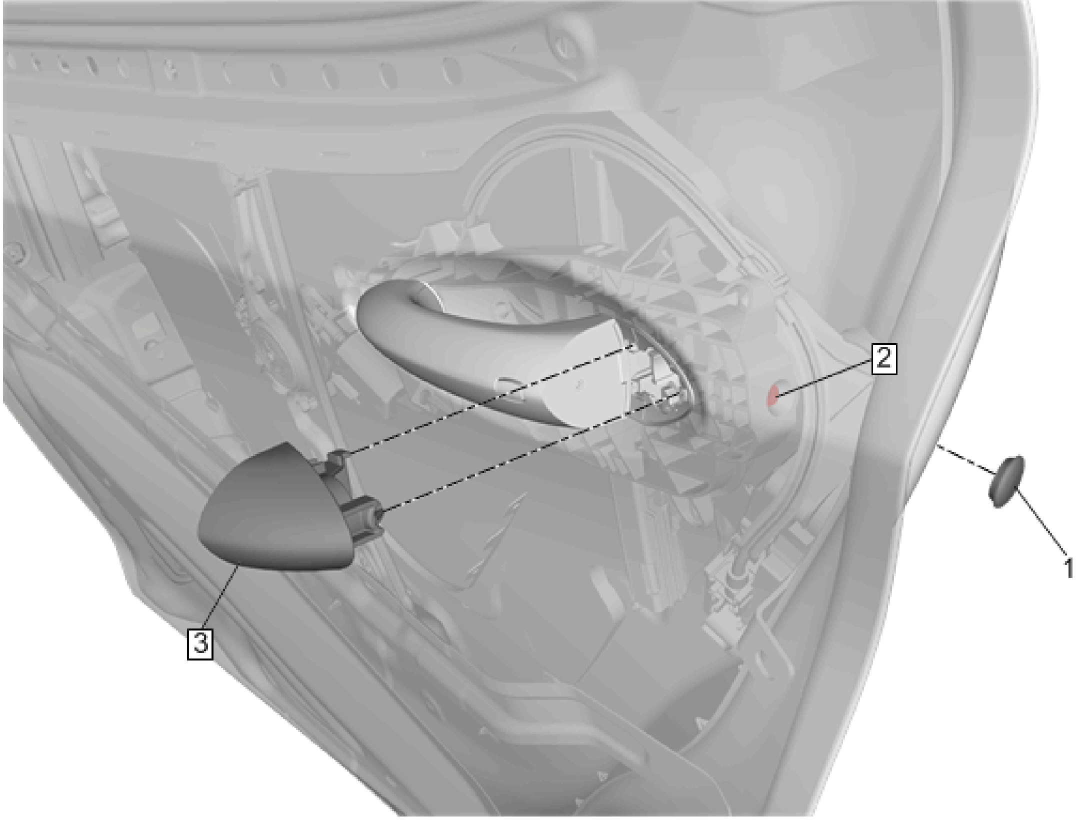


Fig. 85: Rear Side Door Lock Cylinder Opening Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt Access Plug **Procedure** Use a flat bladed plastic tool to remove.
2	Rear Side Door Outside Handle Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 4.5 N.m (40 lb in)
3	Rear Side Door Lock Cylinder Opening Cover

FRONT SIDE DOOR LOCKING ROD KNOB REPLACEMENT

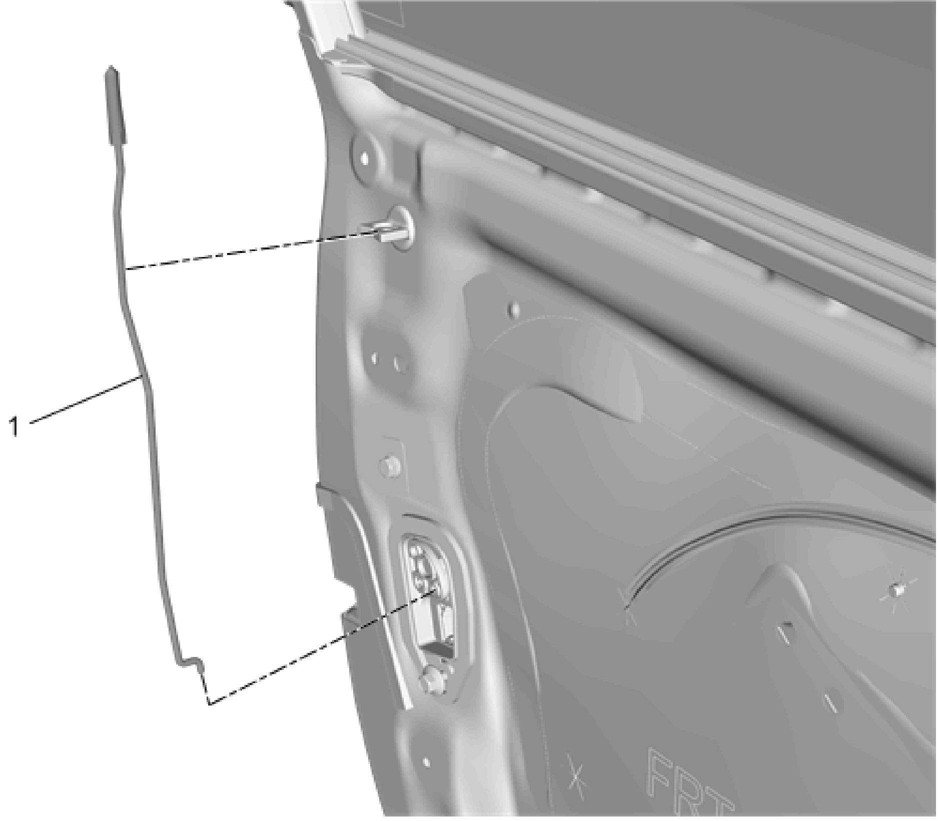


Fig. 86: Front Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Side Door Trim Replacement**	
1	Front Side Door Locking Rod Knob **NOTE:** **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR LOCK CYLINDER ROD REPLACEMENT

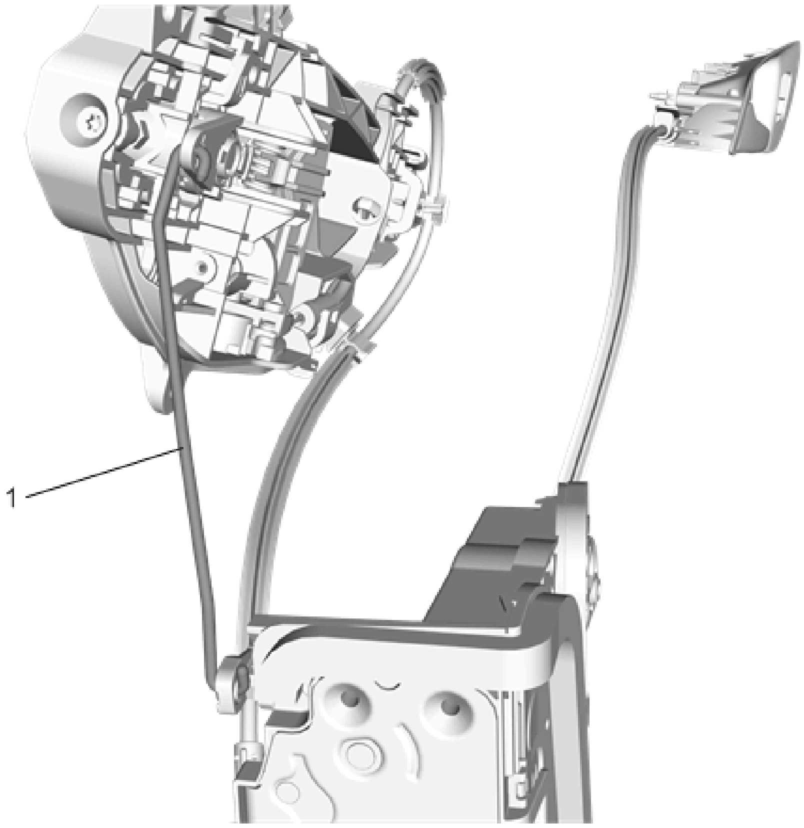


Fig. 87: Front Side Door Lock Cylinder Rod
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Side Door Latch Replacement	
1	Front Side Door Lock Cylinder Rod **Procedure** Front Side Door Lock Cylinder Rod - Remove **NOTE:** **Ensure that the door lock system operates properly before installing the trim.**

REAR SIDE DOOR LOCKING ROD KNOB REPLACEMENT

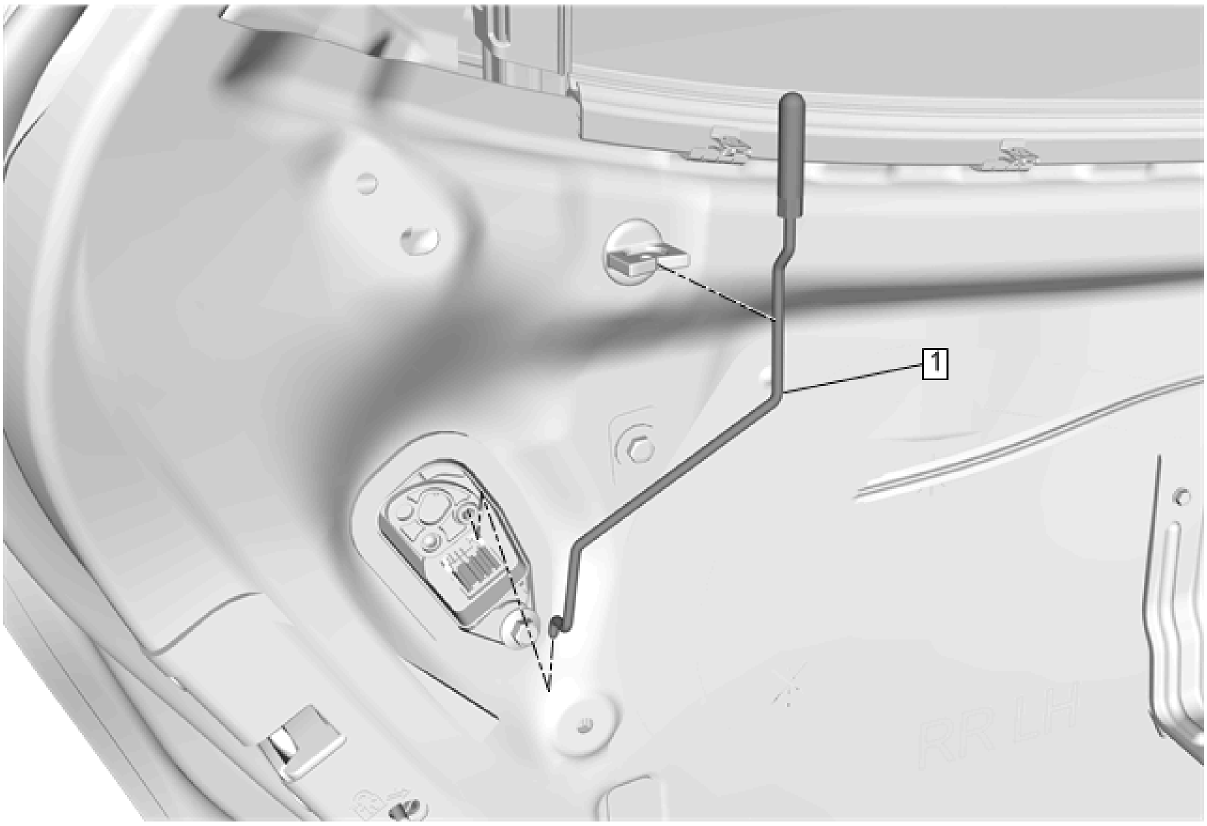


Fig. 88: Rear Side Door Locking Rod Knob
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Side Door Trim Replacement	
1	Rear Side Door Locking Rod Knob **NOTE:** **Ensure that the door lock system operates properly before installing the trim.**

FRONT SIDE DOOR LOCK STRIKER ADJUSTMENT

To determine if striker adjustment is required, proceed as follows:

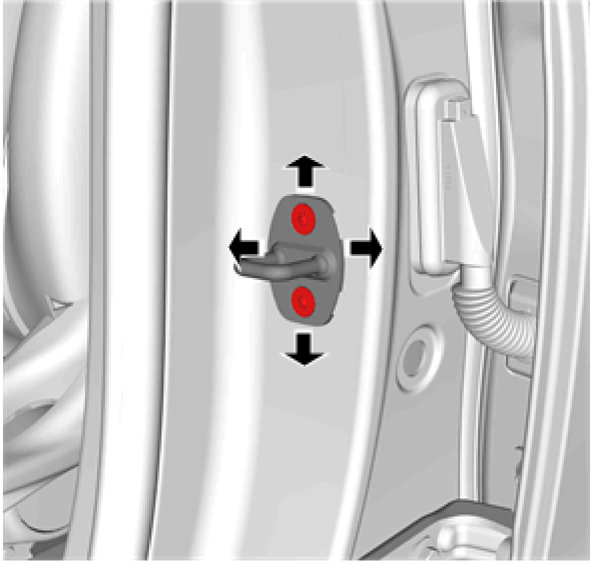


Fig. 89: Adjusting Front Side Door Lock Striker
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the door is properly aligned within the door opening before proceeding with the striker adjustment.
2. Close the door onto the striker and note if the door drags on the striker causing the door to move upward or downward upon contact with the striker. Also note the closing effort to fully engage the lock.
3. Using a grease pencil, mark around the striker for reference of the original position. Loosen the striker.
4. Move the striker to eliminate drag on the striker and door lock and to achieve the proper door position within the door opening. Start with the up/down position, then position the striker to achieve proper alignment to the door opening. Set the in/out adjustment for the proper door seal engagement making sure the door closing efforts are correct.

CAUTION: **Refer to Fastener Caution .**

5. Tighten the striker screws. Tighten the front side door striker screws to 22 N.m (16 lb ft).

FRONT SIDE DOOR LOCK STRIKER REPLACEMENT

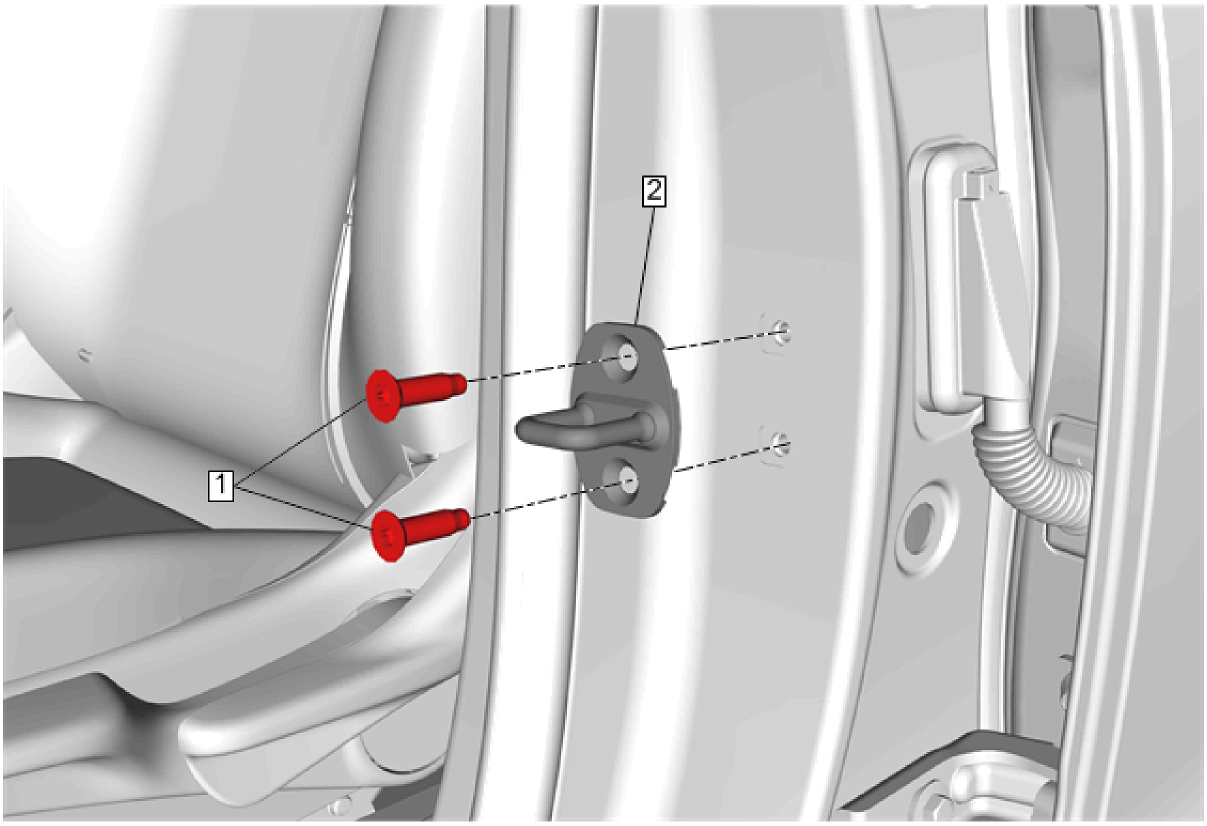


Fig. 90: Front Side Door Lock Striker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Side Door Lock Striker Screw **CAUTION:** **Refer to Fastener Caution .** **Tighten** 22 N.m (16 lb ft)
2	Front Side Door Lock Striker **Procedure** Ensure proper alignment after installation. Front Side Door Lock Striker Adjustment

LIFTGATE LATCH STRIKER REPLACEMENT

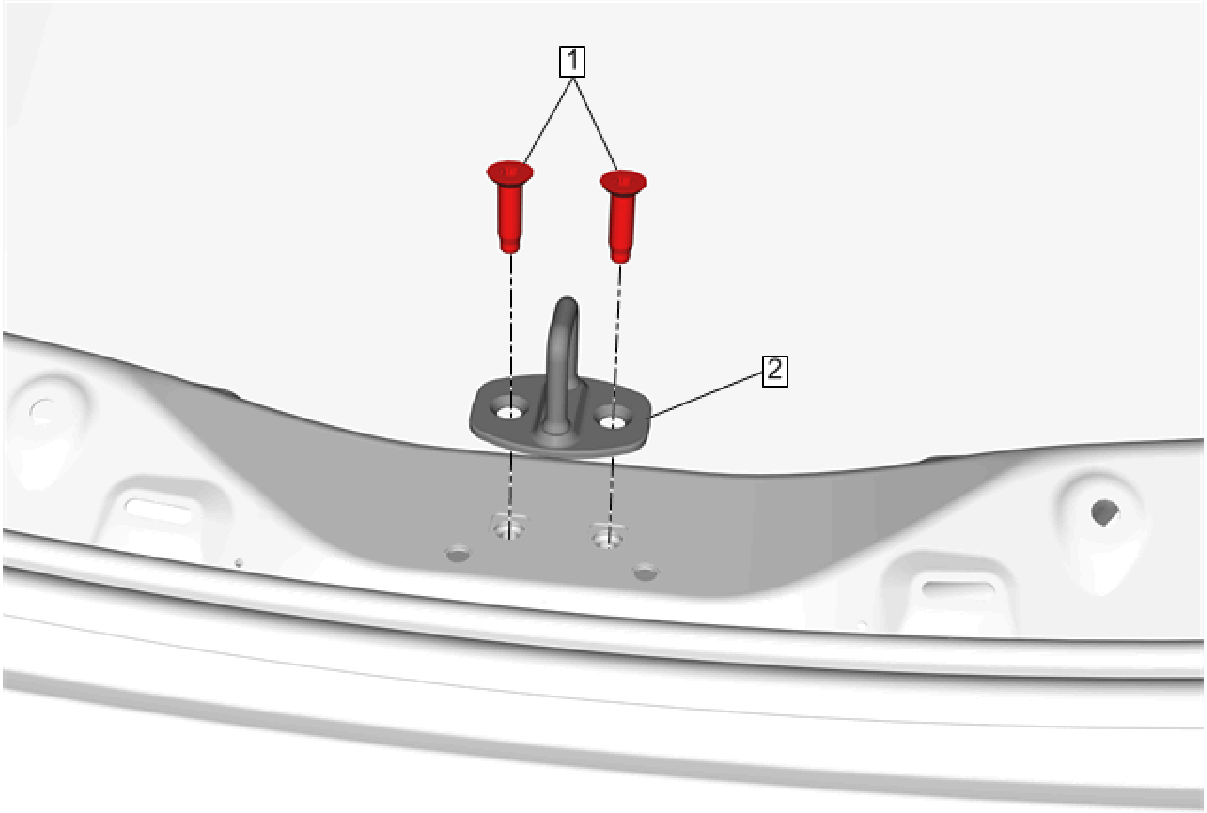


Fig. 91: Liftgate Latch Striker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Liftgate Sill Garnish Molding Replacement	
1	Liftgate Latch Striker Bolt **CAUTION:** **Fastener Caution** **Tighten** 22 N.m (16 lb ft) **Procedure** Use a grease pencil to outline the striker before removing the bolts.

Callout	Component Name
2	Liftgate Latch Striker **Procedure** Adjust the liftgate latch striker after replacing, if needed.

REAR SIDE DOOR LOCK STRIKER ADJUSTMENT

To determine if striker adjustment is required, proceed as follows:

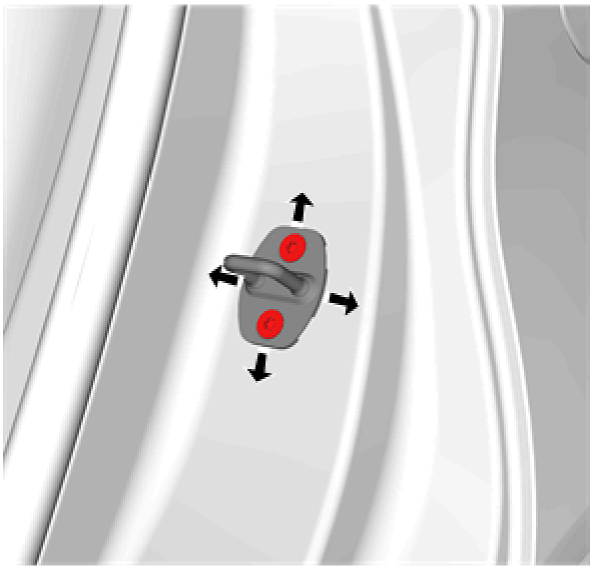


Fig. 92: Adjusting Rear Side Door Lock Striker
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the door is properly aligned within the door opening before proceeding with the striker adjustment.
2. Close the door onto the striker and note if the door drags on the striker causing the door to move upward or downward upon contact with the striker. Also note the closing effort to fully engage the lock.
3. Using a grease pencil, mark around the striker for reference of the original position. Loosen the striker.
4. Move the striker to eliminate drag on the striker and door lock and to achieve the proper door position within the door opening. Start with the up/down position, then position the striker to achieve proper alignment to the door opening. Set the in/out adjustment for the proper door seal engagement making sure the door closing efforts are correct.

CAUTION: **Refer to Fastener Caution .**

5. Tighten the striker screws. Tighten the rear side door striker screws to 22 N.m (16 lb ft).

REAR SIDE DOOR LOCK STRIKER REPLACEMENT

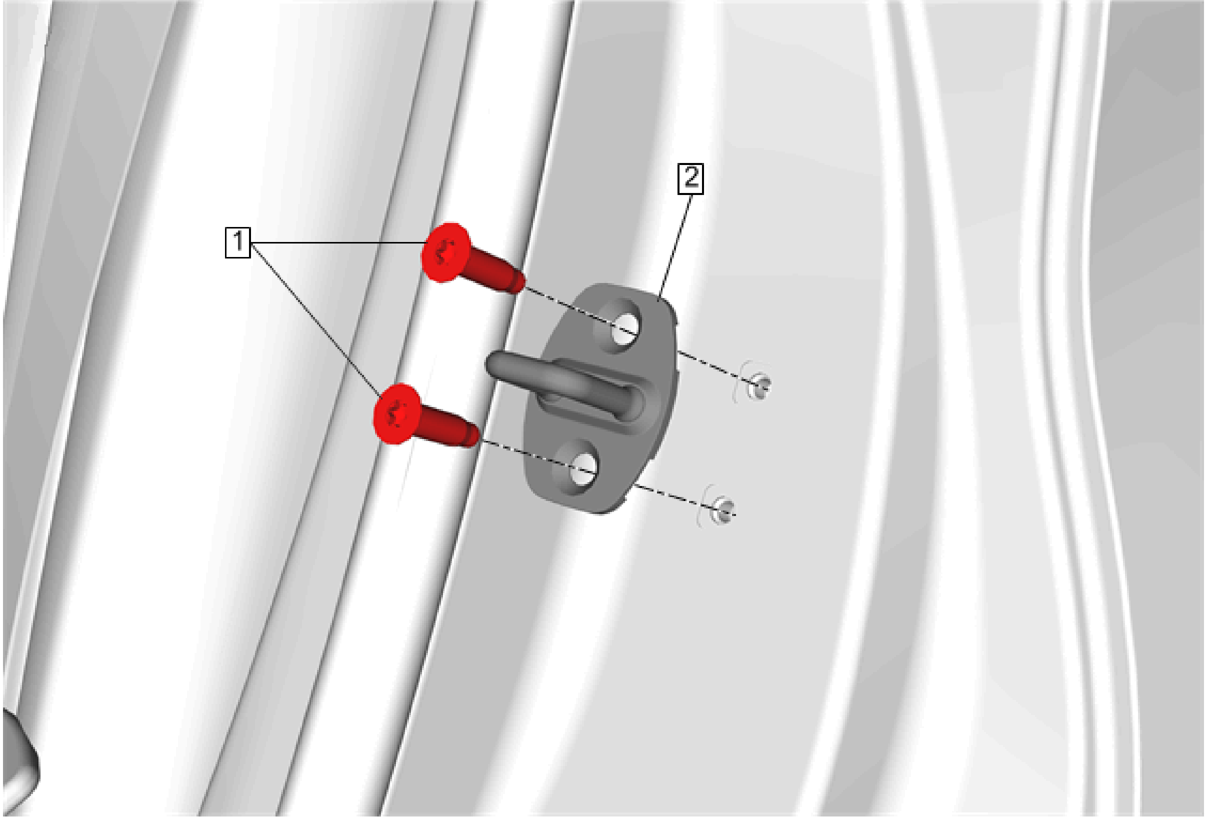


Fig. 93: Rear Side Door Lock Striker
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Side Door Lock Striker Screw **CAUTION:** **Refer to Fastener Caution .** **Tighten** 22 N.m (16 lb ft)
2	Rear Side Door Lock Striker **Procedure** Ensure proper alignment after installation. **Rear Side Door Lock Striker Adjustment**

LIFTGATE RELEASE SWITCH REPLACEMENT

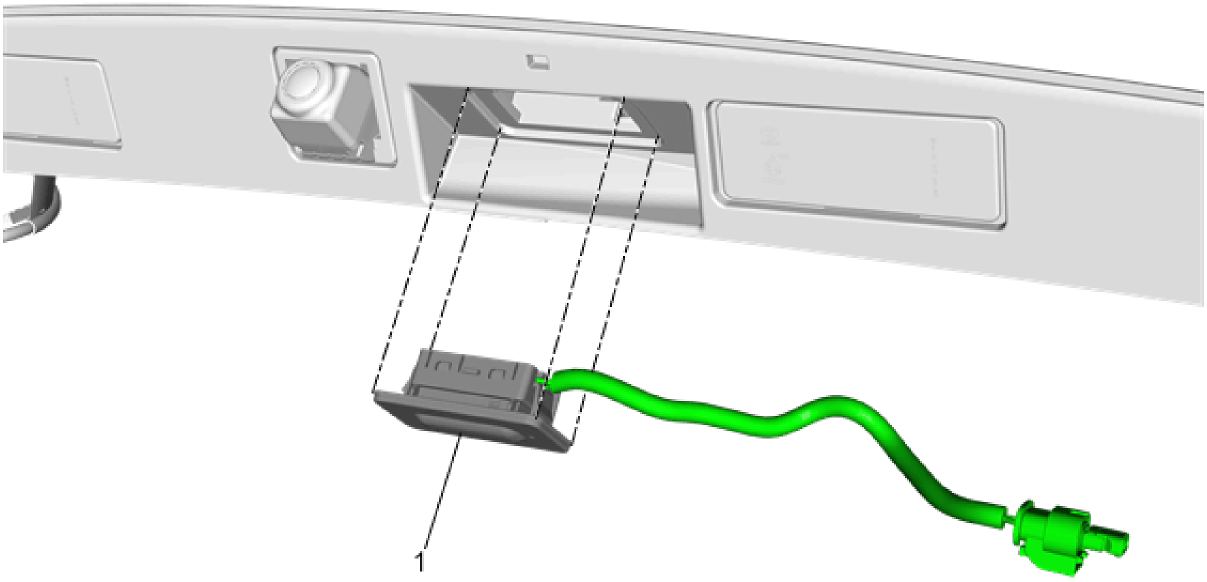


Fig. 94: Liftgate Release Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Closure Center Applique Replacement	
1	Liftgate Release Switch **Procedure** Disconnect the electrical connector.

DOOR LOCK SWITCH REPLACEMENT

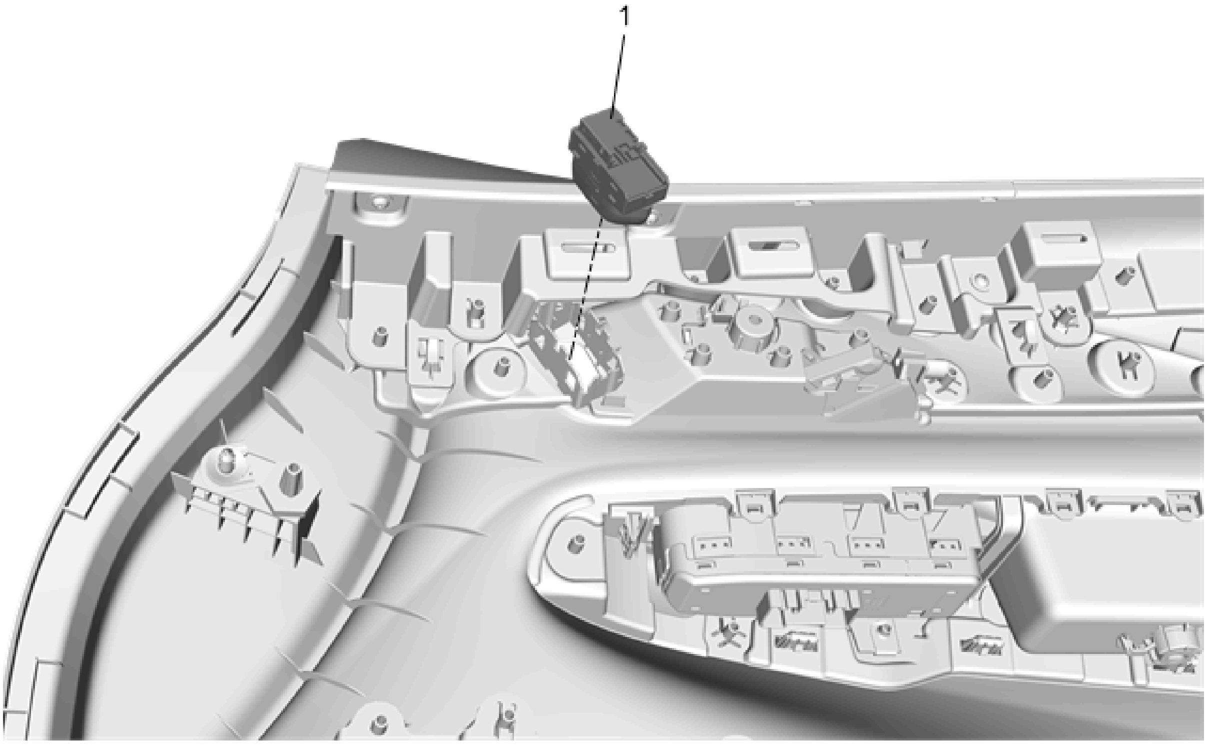


Fig. 95: Door Lock Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Front Side Door Trim Replacement**	
1	Door Lock Switch **Procedure** Press the retainers to unlock.

DESCRIPTION AND OPERATION

CHARGE PORT DOOR DESCRIPTION AND OPERATION

Charge Port System Components

The charge port system consists of the following components:

- Charge port door position sensor
- Hybrid/EV powertrain control module 2

Charge Port Ajar Message

When the vehicle is in the Service Mode or ON, the hybrid/EV powertrain control module 2 supplies a 5V signal to the charge port door position switch through the charge port door sensor signal circuit. The charge port door position switch contains a resistor ladder interface for switch position between two resistors for sensing used by the hybrid/EV powertrain control module 2 to determine if the charge port door is in the open position or the closed position. The hybrid/EV powertrain control module 2 sends a serial data message to the driver information center in the instrument panel cluster to display the Charge Door Open message.

DOOR AJAR INDICATOR DESCRIPTION AND OPERATION

Door Ajar Indicator System Components

The door ajar indicator system consists of the following components:

- Body control module (BCM)
- Instrument cluster
- Driver door latch
- Passenger door latch
- Left rear door latch
- Right rear door latch
- Driver window motor
- Passenger window switch
- Left rear window switch
- Right rear window switch

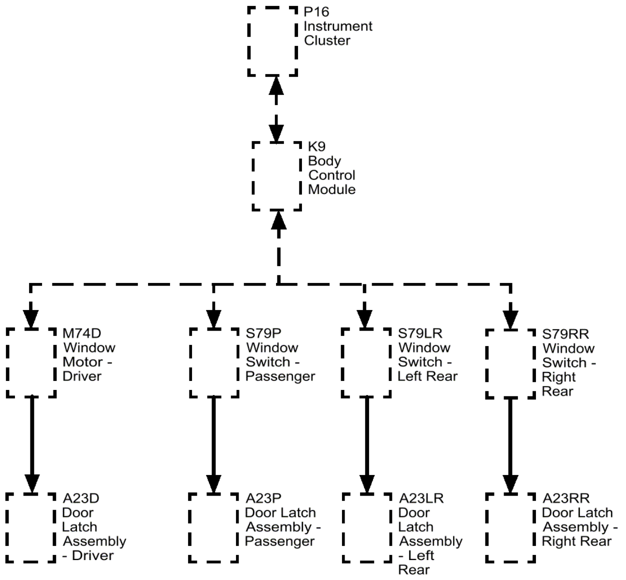

P16
Instrument
Cluster
K9
Body
Control
Module
M74D
Window
Motor -
Driver
S79P
Window
Switch -
Passenger
S79LR
Window
Switch -
Left Rear
S79RR
Window
Switch -
Right
Rear
A23D
Door
Latch
Assembly
- Driver
A23P
Door Latch
Assembly -
Passenger
A23LR
Door
Latch
Assembly
- Left
Rear
A23RR
Door Latch
Assembly -
Right Rear

Fig. 96: Door Ajar System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
M74D	M74D Window Motor - Driver
S79P	S79P Window Switch - Passenger
S79LR	S79LR Window Switch - Left Rear
S79RR	S79RR Window Switch - Right Rear
A23D	A23D Door Latch Assembly - Driver
A23P	A23P Door Latch Assembly - Passenger
A23LR	A23LR Door Latch Assembly - Left Rear
A23RR	A23RR Door Latch Assembly - Right Rear
K9	K9 Body Control Module

Driver Door Ajar

The driver window motor provides a 12V signal to the driver door ajar switch signal circuit. The driver door ajar switch is integral to the driver door latch assembly. When the driver door is opened, the normally open door ajar switch closes. With the door ajar switch closed, ground is provided to the door ajar switch signal circuit and the voltage within the signal circuit drops. The driver window motor will detect the voltage drop and will send a serial data message to the body control module which will then send a message to the instrument panel cluster to command the door ajar message

Passenger Door Ajar

The passenger window switches each provide a 12 V signal to their respective door ajar switch signal circuits. The door ajar switches are integral to each door latch assembly. When a door is opened, the normally open door ajar switch closes. With the door ajar switch closed, ground is provided to the door ajar switch signal circuit and the voltage within the signal circuit drops. The window switches will detect the voltage drop and will send a serial data message to the body control module which will then send a message to the instrument panel cluster to command the door ajar message.

LIFTGATE AJAR INDICATOR DESCRIPTION AND OPERATION

Hatch Open Indicator

The body control module (BCM) monitors the voltage level of the rear hatch ajar signal circuit which is normally at the system voltage when the hatch is closed. When the hatch is ajar or open, a switch within the rear hatch latch closes providing a path to ground for the hatch ajar signal circuit. The voltage within the signal circuit will then drop to 0 volts, the BCM will then detect the voltage drop and will send a serial data message to the instrument panel cluster (IPC). The IPC will then display an icon of the vehicle with the hatch open.

POWER DOOR LOCKS DESCRIPTION AND OPERATION

Door Lock System Components

The power door lock system consists of the following components:

- Driver door lock switch
- Passenger door lock switch
- Key cylinder switch
- Body control module (BCM)
- Driver door latch
- Passenger door latch
- Left rear door latch
- Right rear door latch
- Exterior door handle switches
- Keyless entry control module

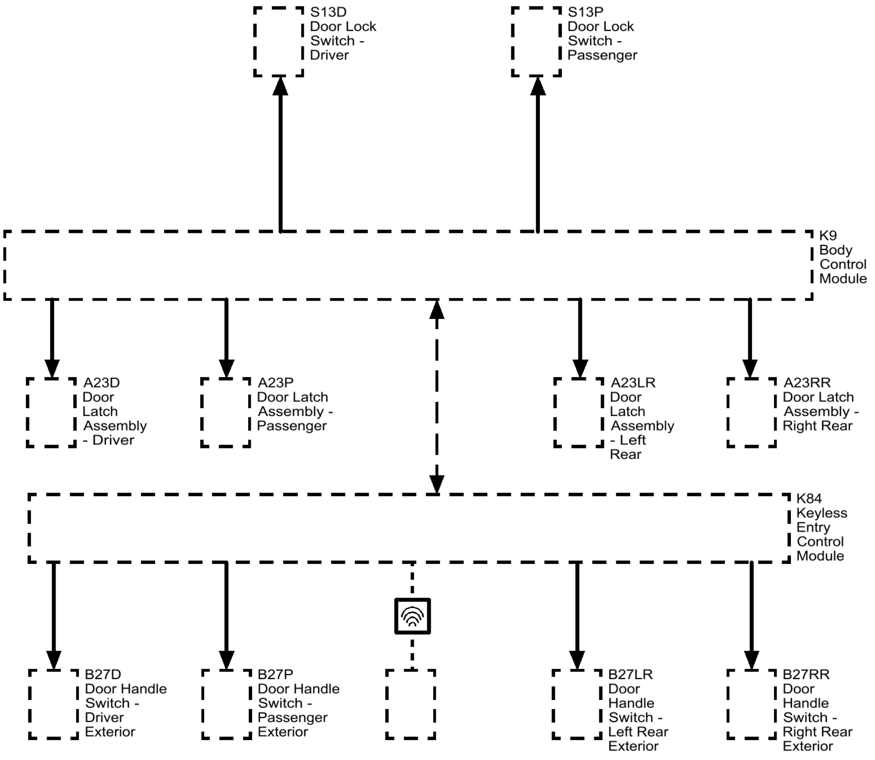

S13D Door Lock Switch - Driver
S13P Door Lock Switch - Passenger
K9 Body Control Module
A23D Door Latch Assembly - Driver
A23P Door Latch Assembly - Passenger
A23LR Door Latch Assembly - Left Rear
A23RR Door Latch Assembly - Right Rear
K84 Keyless Entry Control Module
B27D Door Handle Switch - Driver Exterior
B27P Door Handle Switch - Passenger Exterior
B27LR Door Handle Switch - Left Rear Exterior
B27RR Door Handle Switch - Right Rear Exterior

Fig. 97: Power Door Locks System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WL	Wireless
S13D	S13D Door Lock Switch - Driver
S13P	S13P Door Lock Switch - Passenger
K9	K9 Body Control Module
A23RR	A23RR Door Latch Assembly - Right Rear
A23LR	A23LR Door Latch Assembly - Left Rear
A23P	A23P Door Latch Assembly - Passenger
A23D	A23D Door Latch Assembly - Driver
K84	K84 Keyless Entry Control Module
B27RR	B27RR Door Handle Switch - Right Rear Exterior
B27LR	B27LR Door Handle Switch - Left Rear Exterior
B27P	B27P Door Handle Switch - Passenger Exterior
B27D	B27D Door Handle Switch - Driver Exterior

Door Lock and Unlock Operation

When the driver or passenger door lock switch is activated in the lock or unlock position, the BCM will receive a ground signal on either the door lock switch lock or unlock signal circuits.

The BCM, upon receipt of a lock switch lock or unlock signal, will supply battery voltage to the door lock actuator lock or unlock control circuits. Since the opposite side of the lock actuator is connected to ground through the other lock actuator control circuit, the doors will then lock or unlock as commanded.

The following three circuits are used to operate the lock:

- Driver door unlock
- Passenger door unlock
- All door lock

The driver door lock actuator is isolated so it can be unlocked by itself using the keyless entry transmitter.

Key Cylinder Switch

The driver window switch monitors the voltage level of the driver door lock motor status signal circuit. When the key is inserted into the driver door key cylinder and turned to the Lock position, a switch within the driver door latch closes causing the voltage to drop within the driver door lock motor status signal circuit. The driver window switch will detect the drop in voltage and will send a serial data message to the BCM commanding all the doors to Lock.

The driver key cylinder switch is used by the customer for programming the keyless entry transmitters, The driver window/outside rearview mirror switch monitors the voltage level of the key switch unlock signal circuit and when it detects a reprogramming request, it will send a serial data message to the body control module.

Passive Door Lock/Unlock Operation

The exterior door handle switch signal circuits provide inputs to the keyless entry control module when the exterior door handle switches are activated. These inputs allow the keyless entry control module to detect a door lock or a door unlock request. The keyless entry control module provides a 12 V signal to each exterior door handle switch via the door handle switch signal circuits. When a door handle switch is pressed, the switch closes and the voltage signal within the signal circuit is pulled to ground. The keyless entry control module will detect the voltage drop and a low frequency antenna will transmit a challenge to the keyless entry transmitter. If the challenge is met, the keyless entry transmitter will respond and the keyless entry control module will send a serial data message to the body control module to command the door(s) to be locked or unlocked

REAR HATCH/GATE DESCRIPTION AND OPERATION

Liftgate Release System Components

- Body control module (BCM)
- Liftgate unlatch switch
- Liftgate latch assembly
- Liftgate unlatch relay

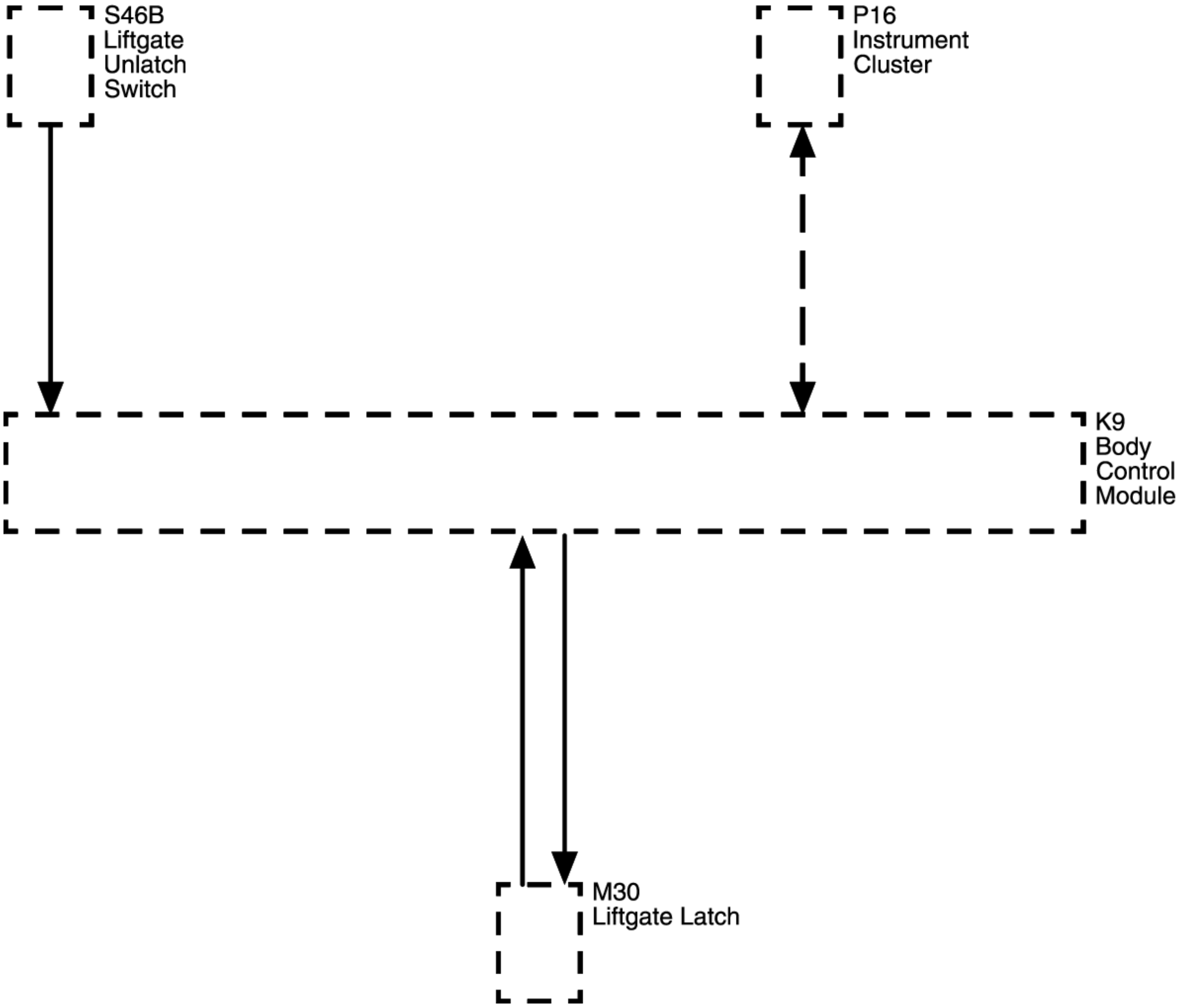


Fig. 98: Liftgate Release Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
K9	K9 Body Control Module
M30	M30 Liftgate Latch
S46B	S46B Liftgate Unlatch Switch

Liftgate Release Operation

Liftgate Unlatch Switch

The BCM monitors supplies a 12 V signal to the liftgate unlatch switch so that when the switch is pressed, the voltage within the signal circuit is pulled low and in response, the BCM will detect the voltage drop and check the status of the door lock system. If the doors are locked, the BCM will ignore the request, if the All Doors Unlock has been commanded, the BCM will recognize the request and will provide voltage to the release relay.

Liftgate Latch Assembly

When BCM receives a liftgate release command from the liftgate unlatch switch, the BCM applies brief pulse of voltage to the liftgate unlatch relay control circuit, which energizes the coil side of the relay. The switch side of the liftgate unlatch relay then momentarily closes, supplying a brief pulse of battery positive voltage to the liftgate latch assembly. The liftgate latch assembly is continuously grounded and when it receives the voltage pulse, it will become energized and the latch will activate releasing the liftgate so that it may be manually raised to an open position.

Keyless Entry Transmitter

All doors of the vehicle must first be commanded to UNLOCK prior to pressing the liftgate unlatch switch. The BCM monitors the status of the vehicle door latches. If the passenger doors are locked, the BCM will ignore the signal from the liftgate unlatch switch. Pressing the appropriate button on the keyless entry transmitter will send a request to the remote control door lock receiver which will in turn send a serial data message to unlock all doors.

Back To Article

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Air Inlet Grille Panel Bolt	4.5 N.m (40 lb in)
Rear Window Wiper Arm Nut	10 N.m (89 lb in)
Rear Window Wiper Motor Bolt	9 N.m (80 lb in)
Windshield Washer Solvent Container Nut	5 N.m (44 lb in)
Windshield Wiper Arm Nut	30 N.m (22 lb ft)
Windshield Wiper System Module Bolt	9 N.m (80 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Washer Solvent Container	3.8 liter	1.0 gallon

SCHEMATIC WIRING DIAGRAMS

WIPER/WASHER WIRING SCHEMATICS

Front Wiper/Washer Control

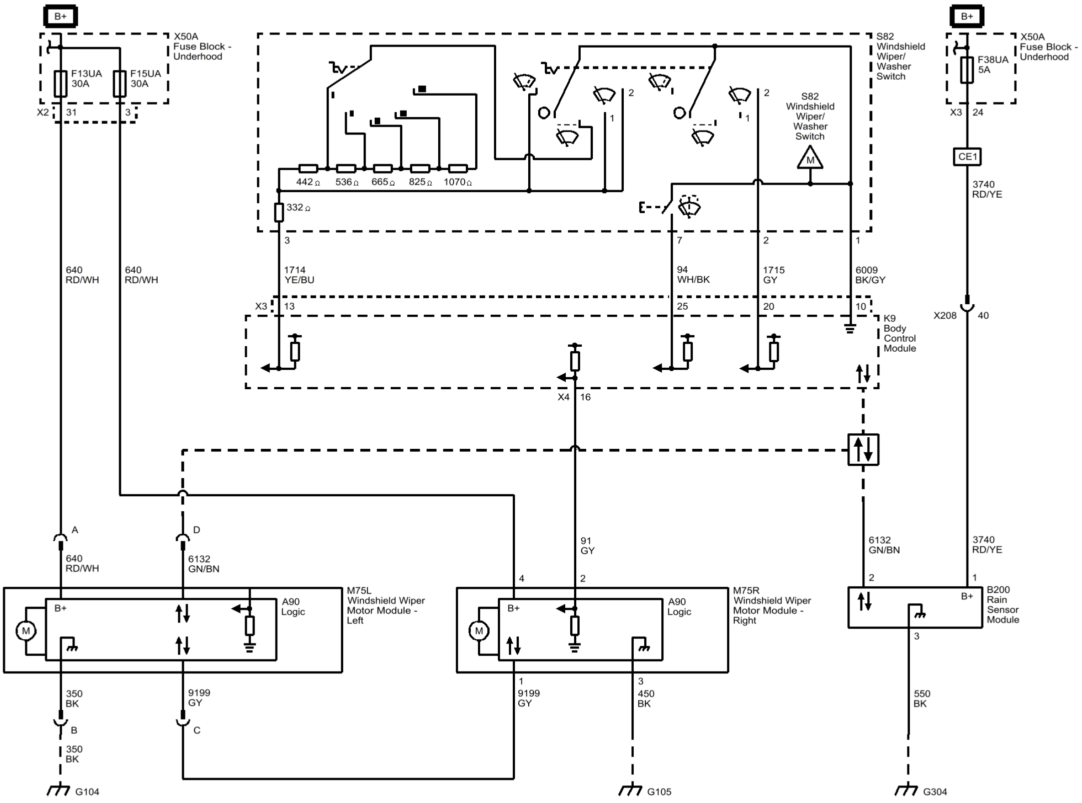

B+
X50A Fuse Block - Underhood
F13UA 30A
F15UA 30A
X2 31
3
640 RD/WH
640 RD/WH
S82 Windshield Wiper/Washer Switch
442 Ω
536 Ω
665 Ω
825 Ω
1070 Ω
332 Ω
S82 Windshield Wiper/ Washer Switch
M
3
7
2
1
1714 YE/BU
94 WH/BK
1715 GY
6009 BK/GY
X3 13
25
20
10
K9 Body Control Module
X4 16
B+
X50A Fuse Block - Underhood
F38UA 5A
X3 24
CE1
3740 RD/YE
X208 40
A
D
640 RD/WH
6132 GN/BN
M75L Windshield Wiper Motor Module - Left
A90 Logic
B+
M
350 BK
9199 GY
B
C
350 BK
G104
91 GY
4
2
M75R Windshield Wiper Motor Module - Right
A90 Logic
1
9199 GY
3
450 BK
G105
6132 GN/BN
3740 RD/YE
2
1
B200 Rain Sensor Module
3
550 BK
G304

Fig. 1: Front Wiper/Washer Control

Courtesy of GENERAL MOTORS COMPANY

Rear Wiper/Washer Control

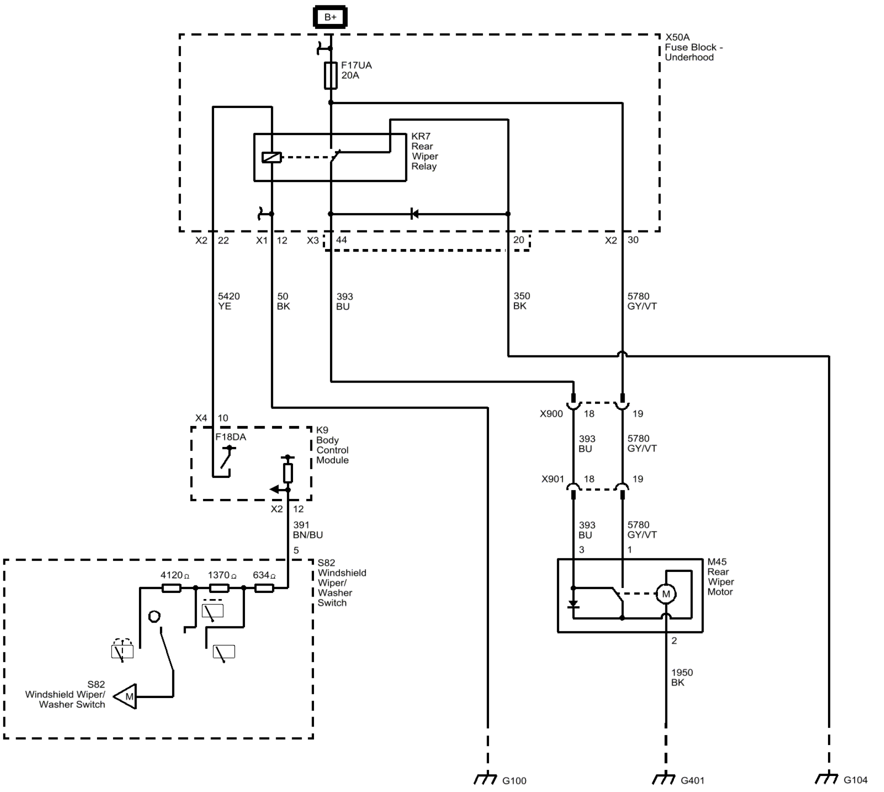

B+
X50A Fuse Block - Underhood
F17UA 20A
KR7 Rear Wiper Relay
X2 22
X1 12
X3 44
20
X2 30
5420 YE
50 BK
393 BU
350 BK
5780 GY/VT
X4 10
K9 Body Control Module
F18DA
X2 12
391 BN/BU
5
X900 18
19
393 BU
5780 GY/VT
X901 18
19
393 BU
5780 GY/VT
3
1
M45 Rear Wiper Motor
M
2
1950 BK
S82 Windshield Wiper/ Washer Switch
4120 Ω
1370 Ω
634 Ω
S82 Windshield Wiper/ Washer Switch
M
G100
G401
G104

Fig. 2: Rear Wiper/Washer Control

Courtesy of GENERAL MOTORS COMPANY

Front and Rear Washers

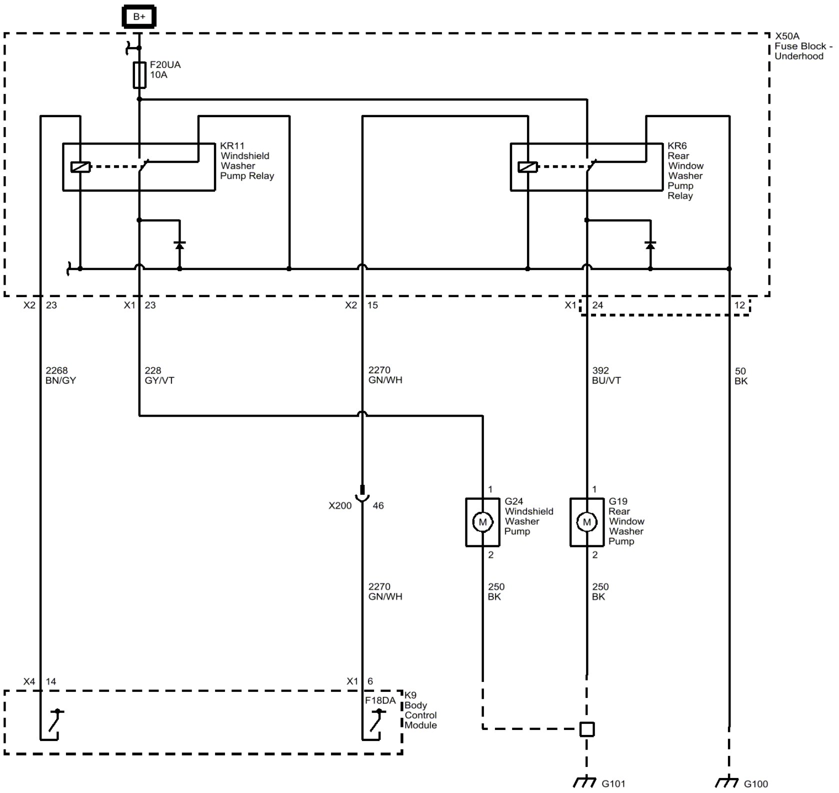

B+
X50A
Fuse Block -
Underhood
F20UA
10A
KR11
Windshield
Washer
Pump Relay
KR6
Rear
Window
Washer
Pump
Relay
X2 23
X1 23
X2 15
X1 24
12
2268
BN/GY
228
GY/VT
2270
GN/WH
392
BU/VT
50
BK
X200 46
1
G24
Windshield
Washer
Pump
2
1
G19
Rear
Window
Washer
Pump
2
2270
GN/WH
250
BK
250
BK
X4 14
X1 6
F18DA
K9
Body
Control
Module
G101
G100

Fig. 3: Front and Rear Washers
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B370A: RAIN SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B370A

Rain Sensor

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U151A	U151A	-	-
Serial Data	U151A	U151A	U151A	-
Ground	-	U151A	-	-

Circuit/System Description

B+ and ground is supplied at all times to the rain sensor. The rain sensor communicates with the body control module (BCM) via serial data. When the ignition is in the ON or ACCESSORY position and the windshield wiper/washer switch is in the intermittent delay position, the BCM monitors the rain sensor data to determine the rain build up on the windshield. As rain builds up on the windshield, the BCM will command the wipers to activate. The sensitivity of the wiper frequency is controlled by the intermittent delay of the windshield wiper/washer switch. As the sensitivity is increased, the BCM will command more frequent wiper activation based on rain build up on the windshield.

Conditions for Running the DTC

- Vehicle ON or in Service Mode
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

Communication between the BCM and the rain sensor is interrupted.

Action Taken When the DTC Sets

- If the BCM loses communication with the rain sensor while operating under manual 1X control, the windshield wiper operation will default to intermittent operation with a fixed dwell time of 4 s.
- If the BCM loses communication with the rain sensor while operating at low speed, the windshield wiper operation will default to low speed.
- If the BCM loses communication with the rain sensor while operating at high speed, the windshield wiper operation will default to high speed.

Conditions for Clearing the DTC

The DTC will clear when communication is established between the BCM and rain sensor.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS -INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U151A is not set.
    - **If the DTC is set**

      Please Refer to **DTC U1500-U15FF**

    - **If the DTC is not set**
3. Place the S82 Windshield Wiper/Washer Switch in the intermittent delay setting and spray the outside of the windshield in the area of the B177 Rain/Ambient Light Sensor Module with a water bottle. It may be necessary to increase the sensitivity of the intermittent delay to achieve windshield wiper operation.
4. Verify the windshield wipers operate at low speed.
    - **If the windshield wipers are not operating at low speed**

      Refer to Circuit/System Testing.

   - **If the windshield wipers are operating at low speed**

5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B117 Rain Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the B117 Rain Sensor.
   - **If the test lamp illuminates**
5. Test for 5.0 - 10.0 V between the serial data circuit terminal 2 and ground.
   - **If less than 5.0 V**
   1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module and the harness connector at the M75L Windshield Wiper Motor Module-Left.
   2. Test for infinite resistance between the serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the serial data circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If greater than 10.0 V**
   1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
   2. Test for less than 1 V between the serial data circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If between 5.0 - 10.0 V**
6. Test or replace the B117 Rain Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Inside Air Moisture and Windshield Temperature Sensor Replacement (With Front View Camera)** **Inside Air Moisture and Windshield Temperature Sensor Replacement (Without Front View Camera)**
- **Control Module References** for body control module replacement, programming and setup.

DTC B370B: REAR WIPER FUNCTION CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B370B

Rear Wiper Function Control Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B370B 02	1	2	-
Ground	-	1	1	-
1. Rear Wiper Inoperative. 2. Rear Wiper Always ON.				

Circuit/System Description

The rear wiper motor is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. The BCM will respond by commanding the specific rear wiper function based on an input from the rear wiper switch, which is part of the windshield wiper/washer switch. The rear wiper switch uses a resistor ladder to determine low speed, intermittent, and rear washer operation. A constant B+ and ground are supplied to the rear wiper motor. When the rear wiper switch is placed in the low speed, intermittent, or rear washer position, the voltage is pulled down through a different resistor in the resistor ladder, reducing the voltage seen at the BCM.

The BCM monitors the liftgate ajar signal circuit, and the BCM will disable the function of the rear wiper motor if the liftgate of liftglass is ajar or open

Conditions for Running the DTC

- Ignition ON
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The BCM detects a short to ground in the rear window wiper control circuit.

Action Taken When the DTC Sets

Rear wiper operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Diagnostic Aids

The rear liftgate must be closed in order for the rear wiper to work. The liftgate ajar switch signal circuit provides information to the rear window wiper module about the status of the liftgate. If the liftgate or liftglass is open the rear wiper operation is not performed.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS -INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Rear Closure Ajar Switch parameter changes between Inactive and Active when opening and closing the liftgate.
    - **If the parameter does not change**

      Refer to **Liftgate Ajar Indicator Malfunction**
    - **If the parameter changes**
3. Verify the rear wiper turns ON and OFF when commanding the Rear Wiper Active and Inactive with a scan tool.
    - **If the rear wiper does not turn ON and OFF**

      Refer to Circuit/System Testing
    - **If the rear wiper turns ON and OFF**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.
2. Verify the M45 Rear Wiper Motor is not activated.
    - **If the M45 Rear Wiper Motor is activated**
    1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
    2. Test for less than 1 V between the control circuit terminal 22 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the X50A Fuse Block - Underhood.
    - **If the M45 Rear Wiper Motor is not activated**
3. Connect a 10 A fused jumper wire between the control circuit terminal 10 and B+.
4. Verify the M45 Rear Wiper Motor activates.
    - **If the M45 Rear Wiper Motor does not activate**
    1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the control circuit terminal 22 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, test or replace the X50A Fuse Block - Underhood.
    - **If the M45 Rear Wiper Motor activates**

5. Test or replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Wiring Harness Junction Block Replacement**
- **Control Module References** or BCM replacement, programming and setup

DTC B371A: WINDSHIELD WIPER MOTOR INTERNAL MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B371A 39

Windshield Wiper Motor Internal Malfunction

Circuit/System Description

B+ voltage and ground are supplied to the windshield wiper motor. Whenever the vehice is ON or in Service Mode, the body control module (BCM) sends the wiper/washer switch status through the LIN communication bus. If a fault occurs at any time in the windshield wiper motor, the BCM will set the DTC.

Conditions for Running the DTC

The BCM runs the diagnostic to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This diagnostic runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The BCM receives an invalid signal from the windshield wiper motor.

Action Taken When the DTC Sets

The BCM ignores all additional inputs.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS -INDEX

Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that there is no communications DTC set.
   - **If there is a communications DTC set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If there is no communications DTC set**
3. Verify that DTC B371A is not set.
   - **If DTC B371A is set**

     Replace the M75 Windshield Wiper Motor.

   - **If DTC B371A is not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Windshield Wiper System Module Replacement

DTC B371C: FRONT WIPER MOTOR 2

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B371C

Front Wiper Motor 2

For symptom byte information, refer to Symptom Byte List .

Circuit/System Description

B+ voltage and ground are supplied to the windshield wiper motor. Whenever the vehice is ON or in Service Mode, the body control module (BCM) sends the wiper/washer switch status through the LIN communication bus. If a fault occurs at any time in the windshield wiper motor, the BCM will set the DTC.

Conditions for Running the DTC

The BCM runs the diagnostic to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This diagnostic runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The BCM receives an invalid signal from the windshield wiper motor.

Action Taken When the DTC Sets

The BCM ignores all additional inputs.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS -INDEX

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that there is no communications DTC set.
    - **If there is a communications DTC set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If there is no communications DTC set**
3. Verify that DTC B371C is not set.
    - **If DTC B371C is set**

      Replace the M75R Windshield Wiper Motor Module - Right..

    - **If DTC B371C is not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Windshield Wiper System Module Replacement**

DTC B3811: REAR WASHER RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3811

Rear Washer Relay Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B3811 02	B3811 04	2	-
Ground	-	B3811 04	-	-
1. Rear Washer Inoperative 2. Rear Washer Always ON				

Circuit/System Description

The rear windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. The BCM monitors the rear windshield wiper/washer switch signal circuit and when rear washer activation is requested, the BCM applies voltage through the rear window washer pump relay control circuit. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the windshield washer pump control circuit to activate the windshield washer pump.

Conditions for Running the DTC

- Ignition ON.
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

B3811 01

The body control module detects a short to B+ in the rear windshield washer pump relay control circuit

B3811 02

The body control module detects a short to ground in the rear windshield washer pump relay control circuit

B3811 04

The body control module detects an open or high resistance in the rear windshield washer pump relay control circuit or the ground circuit

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- A history DTC will clear after 50 consecutive ignition cycles without a fault present.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the rear window washer turns ON and OFF when commanding the Rear Washer Relay Active and Inactive with a scan tool.
    - **If the rear window washer does not turn ON and OFF**

      Refer to Circuit/System Testing

    - **If the rear window washer turns ON and OFF**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the X50A Fuse Block - Underhood ground circuit terminal 12 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect the X1 harness connector at the X50A Fuse Block - Underhood and disconnect the X1 harness connector at the K9 Body Control Module, ignition ON.
4. Verify the G19 Rear Window Washer Pump is not activated.
    - **If the G19 Rear Window Washer Pump is activated**
    1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
    2. Test for less than 1 V between the X50A Fuse Block - Underhood control circuit terminal 15 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, test or replace the X50A Fuse Block - Underhood.
    - **If the G19 Rear Window Washer Pump is not activated**
5. Connect a 10 A fused jumper wire between the control circuit terminal 6 X1 and B+.
6. Verify the G19 Rear Window Washer Pump activates.
    - **If the G19 Rear Window Washer Pump does not activate**
    1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the X50A Fuse Block - Underhood control circuit terminal 15 X2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the X50A Fuse Block - Underhood.
    - **If the G19 Rear Window Washer Pump activates**

7. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Wiring Harness Junction Block Replacement**
- **Control Module References** for BCM replacement, programming and setup

DTC B3873: FRONT WASHER RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B3873

Front Washer Relay Circuit

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B3873 02	B3873 04	B3873 01	-

Circuit/System Description

The windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. When the washer switch is depressed, the BCM's internally pulled high resistor is pulled low by the washer request circuit. The BCM then applies voltage through a control circuit to the PCB windshield washer pump relay. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the control circuit to activate the windshield washer fluid pump.

Conditions for Running the DTC

- Vehicle ON or in Service Mode
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

B3873 01

The body control module detects a short to B+ in the windshield washer pump relay control circuit

B3873 02

The body control module detects a short to ground in the windshield washer pump relay control circuit

B3873 04

The body control module detects an open or high resistance in the windshield washer pump relay control circuit

Action Taken When the DTC Sets

Washer operation is suspended.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

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Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G24 Windshield Washer Pump activates when commanding the Windshield Washer Relay On and Off with a scan tool.
    - **If the G24 Windshield Washer Pump does not activate**

      Refer to Circuit/System Testing

    - **If the G24 Windshield Washer Pump activates**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
2. Verify the G24 Windshield Washer Pump is not activated.
    - **If the G24 Windshield Washer Pump is activated**
    1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
    2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 14 X4 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the X50A Fuse Block - Underhood.
    - **If the G24 Windshield Washer Pump is not activated**
3. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
4. Verify the G24 Windshield Washer Pump activates.
    - **If the G24 Windshield Washer Pump does not activate**
    1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the control circuit terminal 23 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If less than infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the X50A Fuse Block - Underhood.

    - **If the G24 Windshield Washer Pump activates**

5. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Engine Wiring Harness Junction Block Replacement**
- **Control Module References** for body control module replacement, programming and setup.

SYMPTOMS - WIPER/WASHER SYSTEMS

NOTE: **The following steps must be completed before using the symptom tables:**

1. Perform **Diagnostic System Check - Vehicle** , in order to verify that all of the following conditions are true:
    - No DTCs are set.
    - The control modules can communicate via the serial data link.
2. Refer to **Wiper/Washer System Description and Operation** in order to familiarize yourself with the system functions.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the windshield wiper/washer system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Inspect the washer fluid reservoir for the proper fluid level.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Windshield Wiper System Malfunction**
- **Washer Malfunction**
- **Rain Sensor Malfunction**

WINDSHIELD WIPER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper Motor - Left B+	1	U1515 00	U1515 00	-
Windshield Wiper Motor - Right B+	1	U1515 00	-	-
Rain/Ambient Light Sensor Module B+	U151A	U151A	-	-
Windshield Wiper/Washer Switch Control Terminal 3	4	3	3	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Windshield Wiper/Washer Switch Signal Terminal 2	4	2	2	-
Windshield Wiper/Washer Switch Low Reference Terminal 1	-	1	1	-
Windshield Wiper Motor - Right Serial Data Terminal 1	1	5	5	-
Windshield Wiper Motor - Left Serial Data Terminal C	1	6	6	-
Windshield Wiper Motor Relay Coil Supply Voltage	-	-	-	-
Rain/Ambient Light Sensor Module Ground	-	U151A	-	-
Windshield Wiper Motor - Right Ground	-	5	-	-
Windshield Wiper Motor - Left Ground	-	6	-	-
1. Windshield Wipers Inoperative 2. Windshield Wipers High Speed Inoperative 3. Windshield Wipers Intermediate Speeds Inoperative 4. Windshield Wipers Always ON 5. Windshield Wiper Motor - Right, Always Inoperative 6. Windshield Wiper Motor - Left, Always Inoperative				

Circuit/System Description

The body control module (BCM) controls the windshield wiper motor based on inputs from the windshield wiper/washer switch, and when intermittent mode is selected, the rain/ambient light sensor module. The BCM monitors the windshield wiper/washer switch through two separate signal circuits and a low reference circuit. The windshield wiper/washer switch utilizes resistive multiplexing to signal a low speed and intermittent operation request to the BCM while a separate discrete signal circuit is used to indicate a high speed wiper request. When the wiper switch is placed in the low speed or intermittent position, the BCM monitors the voltage drop, which changes dependent upon switch position, over an internal pulled high resistor. The BCM will respond by commanding on the low speed or intermittent wipers. With the windshield wiper/washer switch in the high speed position, the BCM's high speed signal circuit is pulled low. The BCM will respond by commanding the windshield wiper motor to operate at high speed via serial data.

Diagnostic Aids

M75L Windshield Wiper Motor Module - Left, and M75R Windshield Wiper Motor Module - Right are identical, however, they should NOT be swapped from one side to another. Swapping Wiper motors will causes both wipers to be inoperative.

Reference Information

Schematic Reference

- **Wiper/Washer Schematics**
- **Steering Wheel Secondary/Configurable Control Schematics**

Connector End View Reference

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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC U151A is not set.
   - **If DTC U151A is set**

     Please Refer to DTC U1500-U15FF

   - **If DTC U151A is not set**
3. Verify the scan tool Windshield Wiper High Speed Switch parameter changes between Active and Inactive when cycling the S82 Windshield Wiper/Washer Switch between Off and High.
   - **If the parameter does not change**

     Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

   - **If the parameter changes**
4. Verify the scan tool Windshield Wiper Switch parameter changes between Off and Low when cycling the S82 Windshield Wiper/Washer Switch between Off and Low.
   - **If the parameter does not change**

     Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

   - **If the parameter changes**
5. Verify the scan tool Windshield Wiper Switch parameter changes between Delay 1 and Delay 5 when cycling the S82 Windshield Wiper/Washer Switch intermittent speed positions.
   - **If the parameter does not change**

     Test or replace the S82 Windsheild Wiper/Washer Switch.

   - **If the parameter changes**
6. Verify the M75L Windshield Wiper Motor Module - Left and M75R Windshield Wiper Motor Module-Right change between Off, Low, and High when commanding the Windshield Wiper Motor Relay from Off to Low to High.
   - **If the M75L Windshield Wiper Motor Module - Left and M75R Windshield Wiper Motor Module-Right does not cycle between Off, Low, and High**

     Refer to Circuit/System Testing - Windshield Wiper Motor Malfunction

   - **If the M75L Windshield Wiper Motor Module - Left and M75R Windshield Wiper Motor Module-Right cycle between Off, Low, and High**
7. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the scan tool Windshield Wiper High Speed Switch parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Wiper High Speed Switch parameter is Active.
    - **If not Active**
    1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test for greater than 8 V between the signal circuit terminal 3 and ground.
    - **If less than 8 V**
    1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit and ground
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If 8 V or greater**
8. Vehicle OFF, disconnect the X3 harness connector at the K9 Body Control Module, vehicle ON.
9. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 3 and ground.
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
10. Test or replace the S82 Windshield Wiper/Washer Switch.
11. Verify the symptom does not occur while operating the wipers.
    - **If the symptom is not corrected**

      replace the K9 Body Control Module.

    - **If the symptom is corrected**
12. All OK.

Windshield Wiper Motor Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the M75L Windshield Wiper Motor Module-Left. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the ground circuit terminal B and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify a test lamp illuminates between the B+ circuit terminal A and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the M75L Windshield Wiper Motor Module-Left.
    - **If the test lamp illuminates**
5. Test for 5 - 10 V between the serial data circuit terminal D and ground:
    - **If less than 5 V**
    1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module and the B177 Rain Sensor.
    2. Test for infinite resistance between the serial data circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the serial data circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If greater than 10 V**
    1. Ignition OFF, disconnect the X6 harness connector at the K9 Body Control Module, vehicle ON.
    2. Test for less than 1 V between the serial data circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V or greater, replace the K9 Body Control Module.
    - **If 5 - 10 V**
6. Vehicle OFF, disconnect the harness connector at the M75R Windshield Wiper Motor Module-Right, vehicle ON.
7. Test for less than 4 V between the M75L Windshield Wiper Motor Module-Left data communications circuit terminal C and ground.
    - **If 4 V or greater**

      Repair the short to voltage in the circuit.

    - **If less than 4 V**
8. Vehicle OFF.
9. Test for infinite resistance between the M75L Windshield Wiper Motor Module-Left data communications circuit terminal C and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**

10. Test for less than 2 Ω in the M75L Windshield Wiper Motor Module-Left data communications circuit end to end.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
11. Vehicle OFF, connect the harness connector at the M75L Windshield Wiper Motor Module-Left, vehicle ON.
12. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
13. Vehicle ON.
14. Verify a test lamp illuminates between the B+ circuit terminal 4 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the M75R Windshield Wiper Motor Module-Right.
    - **If the test lamp illuminates**
15. Connect a test lamp between the B+ circuit terminal 4 and ground.
16. Verify the test lamp turns ON and OFF when commanding the high speed wipers ON and OFF with the wiper high speed switch.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the X4 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, remove the test lamp, disconnect the X4 harness connector at the K9 Body Control Module, vehicle ON.
    2. Test for less than 1 V between the control circuit terminal 2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
17. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module. Connect harness connector at the M75R Windshield Wiper Motor Module-Right, vehicle ON.
18. Verify the M75R Windshield Wiper Motor Module-Right is NOT activated.
    - **If the M75R Windshield Wiper Motor Module-Right is activated**

    1. Vehicle OFF, disconnect the harness connector at the M75R Windshield Wiper Motor Module-Right, vehicle ON.
    2. Test for less than 1 V between the control circuit terminal 2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the M75R Windshield Wiper Motor Module-Right.
    - **If the M75R Windshield Wiper Motor Module-Right is not activated**

19. Connect a 20 A fused jumper wire between the control circuit terminal 16 and B+.
20. Verify the M75R Windshield Wiper Motor Module-Right activates.
    - **If the M75R Windshield Wiper Motor Module-Right does not activate**
    1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the M75R Windshield Wiper Motor Module-Right, vehicle ON.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than Infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the M75R Windshield Wiper Motor Module-Right.
    - **If the M75R Windshield Wiper Motor Module-Right activates**
21. Test or replace the M75L Windshield Wiper Motor Module-Left.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 2 and the low reference terminal 1 with the high speed switch in the open position.
    - **If less than infinite resistance**

      Replace the S82 Windshield Wiper/Washer Switch.

    - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 2 and the low reference circuit terminal 1 with the high speed switch in the closed position.
    - **If 2 Ω or greater**

      Replace the S82 Windshield Wiper/Washer Switch.

    - **If less than 2 Ω**
4. Test for infinite resistance between the signal terminal 3 and the low reference terminal 1 with the low speed switch in the open position.
    - **If less than infinite resistance**

      Replace the S82 Windshield Wiper/Washer Switch.

    - **If infinite resistance**
5. Position the S82 Windshield Wiper/Washer Switch to INT.
6. Verify the resistance readings are within the specified range listed below between the signal circuit terminal 3 and the low reference circuit terminal 1 by pushing the switch in the listed positions below.
    - Delay 1 : 3.74-4.00kΩ
    - Delay 2 : 2.75-2.85kΩ
    - Delay 3 : 1.95-2.05kΩ
    - Delay 4 : 1.25-1.35kΩ
    - Delay 5 : 765-775Ω
    - **If not within the specified range**

Replace the S82 Windshield Wiper/Washer Switch.

- **If within the specified range**

7. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Windshield Wiper and Washer Switch Replacement
- Windshield Wiper System Module Replacement
- Control Module References for Body Control Module replacement, programming and setup

WASHER MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	-	3	-	-
Windshield Washer Switch Signal	1, 2	1	1	-
Windshield Washer Pump Control	3	3	2	-
Windshield Washer Pump Relay Control	B3873 02	B3873 04	B3873 01	-
Underhood Fuse Block Ground	-	3	-	-
Windshield Washer Pump Ground	-	3	-	-
1. Windshield Washer Switch Malfunction 2. Windshield Washer Pump Always ON 3. Windshield Washer Pump Inoperative				

Circuit/System Description

The windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. When the washer switch is depressed, the BCM's internally pulled high resistor is pulled low by the washer request circuit. The BCM then applies voltage through a control circuit to the PCB windshield washer pump relay. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the control circuit to activate the windshield washer fluid pump.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

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Description and Operation

Wiper/Washer System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Windshield Washer Switch parameter changes between Active and Inactive when pressing the windshield washer switch.
   - **If the parameter does not change**

     Refer to Circuit/System Testing - Windshield Wiper/Washer Switch Malfunction.

   - **If the parameter changes**
3. Verify the G24 Windshield Washer Pump activates and deactivates when commanding the Windshield Washer Relay Active and Inactive with a scan tool.
   - **If the G24 Windshield Washer Pump does not activate or does not deactivate**

     Refer to Circuit/System Testing - Windshield Washer Pump Malfunction

   - **If the G24 Windshield Washer Pump activates and deactivates**
4. All OK.

Circuit/System Testing

Windshield Wiper/Washer Switch Malfunction

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Windshield Washer Switch parameter is Inactive.
   - **If not Inactive**
   1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit terminal 7 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 7 and the low reference circuit terminal 1.
6. Verify the scan tool Windshield Washer Switch parameter is Active.
   - **If not Active**
   1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K9 Body Control Module, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the S82 Windshield Wiper/Washer Switch.

Windshield Washer Pump Malfunction

1. Vehicle OFF, and all vehicle systems OFF. Disconnect the harness connector at the G24 Windshield Washer Pump. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 1 and the ground circuit terminal 2, vehicle in Service Mode.
4. Verify the test lamp turn ON and OFF when commanding the Windshield Washer Relay Active and Inactive with a scan tool.
    - **If the test lamp turns ON and OFF**

      Test or replace the G24 Windshield Washer Pump.

    - **If the test lamp does not turn ON and OFF**
5. Vehicle OFF, connect the harness connector at the G24 Windshield Washer Pump. Disconnect the X1 harness connector at the X50A Fuse Block - Underhood. It may take up to 2 min for all vehicle systems to power down.
6. Test for less than 10 Ω between the ground circuit terminal 12 and ground.
    - **If 10 Ω or greater**
    1. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
7. Vehicle in Service Mode.
8. Verify the G24 Windshield Washer Pump is not activated.
    - **If the G24 Windshield Washer Pump is activated**
    1. Vehicle OFF, disconnect the harness connector at the G24 Windshield Washer Pump, vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal 1 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the G24 Windshield Washer Pump.
    - **If the G24 Windshield Washer Pump is not activated**
9. Connect a 20 A fused jumper wire between the control circuit terminal 14 and B+.
10. Verify the G24 Windshield Washer Pump activates.
    - **If the G24 Windshield Washer Pump does not activate**
    1. Vehicle OFF, remove the jumper wire, disconnect the harness connector at the G24 Windshield Washer Pump.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than Infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the G24 Windshield Washer Pump.
    - **If the G24 Windshield Washer Pump activates**

11. Vehicle OFF, connect the X1 harness connector at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, vehicle in Service Mode.
12. Verify the G24 Windshield Washer Pump is not activated.
    - **If the G24 Windshield Washer Pump is activated**
    1. Vehicle OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, vehicle in Service Mode.
    2. Test for less than 1 V between the K9 Body Control Module control circuit terminal 14 X4 and ground, vehicle in Service Mode.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the X50A Fuse Block - Underhood.
    - **If the G24 Windshield Washer Pump is not activated**
13. Connect a 10 A fused jumper wire between the control circuit terminal 14 and B+.
14. Verify the G24 Windshield Washer Pump activates.
    - **If the G24 Windshield Washer Pump does not activate**
    1. Vehicle OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the control circuit terminal 23 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If less than infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the X50A Fuse Block - Underhood.
    - **If the G24 Windshield Washer Pump activates**
15. Replace the K9 Body Control Module.

Component Testing

Windshield Wiper/Washer Switch

1. Vehicle OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 7 and the low reference terminal 1 with the switch in the open position.
    - **If less than infinite resistance**

      Replace the S82 Windshield Wiper/Washer Switch.

    - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 7 and the low reference circuit terminal 1 with the switch in the closed position.
    - **If 2 Ω or greater**

      Replace the S82 Windshield Wiper/Washer Switch.

    - **If less than 2 Ω**
4. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Windshield Washer Pump Replacement
- Windshield Wiper and Washer Switch Replacement
- Engine Wiring Harness Junction Block Replacement
- Control Module References for body control module replacement, programming and setup.

RAIN SENSOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B370A

Rain Sensor

For symptom byte information, refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	U151A	U151A	-	-
Serial Data	U151A	U151A	U151A	-
Ground	-	U151A	-	-

Circuit/System Description

B+ and ground is supplied at all times to the rain sensor. The rain sensor communicates with the body control module (BCM) via serial data. When the ignition is in the ON or ACCESSORY position and the windshield wiper/washer switch is in the intermittent delay position, the BCM monitors the rain sensor data to determine the rain build up on the windshield. As rain builds up on the windshield, the BCM will command the wipers to activate. The sensitivity of the wiper frequency is controlled by the intermittent delay of the windshield wiper/washer switch. As the sensitivity is increased, the BCM will command more frequent wiper activation based on rain build up on the windshield.

Conditions for Running the DTC

- Vehicle ON or in Service Mode
- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

Communication between the BCM and the rain sensor is interrupted.

Action Taken When the DTC Sets

- If the BCM loses communication with the rain sensor while operating under manual 1X control, the windshield wiper operation will default to intermittent operation with a fixed dwell time of 4 s.
- If the BCM loses communication with the rain sensor while operating at low speed, the windshield wiper operation will default to low speed.
- If the BCM loses communication with the rain sensor while operating at high speed, the windshield wiper operation will default to high speed.

Conditions for Clearing the DTC

The DTC will clear when communication is established between the BCM and rain sensor.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC U151A is not set.
    - **If the DTC is set**

      Please Refer to **DTC U1500-U15FF**

    - **If the DTC is not set**
3. Place the S82 Windshield Wiper/Washer Switch in the intermittent delay setting and spray the outside of the windshield in the area of the B177 Rain/Ambient Light Sensor Module with a water bottle. It may be necessary to increase the sensitivity of the intermittent delay to achieve windshield wiper operation.
4. Verify the windshield wipers operate at low speed.
    - **If the windshield wipers are not operating at low speed**

      Refer to Circuit/System Testing.

    - **If the windshield wipers are operating at low speed**
5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B117 Rain Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the B117 Rain Sensor.
    - **If the test lamp illuminates**

5. Test for 5.0 - 10.0 V between the serial data circuit terminal 2 and ground.
   - **If less than 5.0 V**
   1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module and the harness connector at the M75L Windshield Wiper Motor Module-Left.
   2. Test for infinite resistance between the serial data circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the serial data circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If greater than 10.0 V**
   1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
   2. Test for less than 1 V between the serial data circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If between 5.0 - 10.0 V**
6. Test or replace the B117 Rain Sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Inside Air Moisture and Windshield Temperature Sensor Replacement (With Front View Camera)
  Inside Air Moisture and Windshield Temperature Sensor Replacement (Without Front View Camera)
- Control Module References for body control module replacement, programming and setup.

REAR WIPER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	1	1	-	-
B+ Ignition Relay	1	1	-	-
Rear Window Wiper Switch Signal	1	1	2	-
Rear Window Wiper Motor Control	1	1	2	-
Rear Window Wiper Relay Control	B370B 02	B370B 04	B370B 01	-
Windshield Wiper/Washer Switch Low Reference	-	1	-	-
Rear Window Wiper Motor Ground	-	1	-	-
Underhood Fuse Block Ground Terminal 18 X1	-	1	-	-
1. Rear Wiper Inoperative. 2. Rear Wiper Always ON.				

Circuit/System Description

The rear wiper motor is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. The BCM will respond by commanding the specific rear wiper function based on an input from the rear wiper switch, which is part of the windshield wiper/washer switch. The rear wiper switch uses a resistor ladder to determine low speed, intermittent, and rear washer operation. A constant B+ and ground are supplied to the rear wiper motor. When the rear wiper switch is placed in the low speed, intermittent, or rear washer position, the voltage is pulled down through a different resistor in the resistor ladder, reducing the voltage seen at the BCM.

The BCM monitors the liftgate ajar signal circuit, and the BCM will disable the function of the rear wiper motor if the liftgate of liftglass is ajar or open

Diagnostic Aids

The rear liftgate must be closed in order for the rear wiper to work. The liftgate ajar switch signal circuit provides information to the rear window wiper module about the status of the liftgate. If the liftgate or liftglass is open the rear wiper operation is not performed.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Rear Closure Ajar Switch parameter changes between Inactive and Active when opening and closing the liftgate.
    - **If the parameter does not change**

      Refer to **Liftgate Ajar Indicator Malfunction**

    - **If the parameter changes**
3. Verify the scan tool Rear Wiper Switch parameter changes between Off and On when turning the rear wipers ON and OFF.
    - **If the parameter does not change**

      Refer to Circuit/System Testing - Rear Wiper/Washer Switch Malfunction.

    - **If the parameter changes**
4. Verify the M45 Rear Wiper Motor turns On when commanding the Rear Wiper Active and Inactive with a scan tool.
    - **If the Rear Wiper Motor does not turn ON**

      Refer to Circuit/System Testing - Rear Wiper Motor Malfunction

    - **If the Rear Wiper Motor turns ON**
5. Verify the Rear Wiper finishes the wiping cycle and will park at the end of the rear window when cycling the S82 Rear Wiper/Washer Switch Malfunction from Rear Wiper to Off.

- **If the Rear Wiper does not park at the end of the rear window**

  Refer to Circuit/System Testing - Wiper Park Feature Malfunction

- **If the Rear Wiper park at the end of the rear window**

6. All OK.

Circuit/System Testing

Rear Wiper/Washer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 11 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 8 V between the signal circuit terminal 5 and ground.
   - **If less than 8 V**
   1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the signal circuit and ground
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If 8 V or greater**
5. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
6. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 5 and ground.
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
7. Test or replace the S82 Windshield Wiper/Washer Switch.

Rear Wiper Motor Malfunction

1. Ignition OFF, and all vehicle systems OFF. Disconnect the harness connector at the M45 Rear Wiper Motor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and the ground circuit terminal 2.
   - **If the test lamp does not illuminate**
   1. Ignition OFF, remove the test lamp. Disconnect the X2 harness connector at the X50A Fuse Block - Underhood.

   2. Test for less than 2 Ω in the control circuit terminal 30 X2 end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the X50A Fuse Block - Underhood.
   - **If the test lamp illuminates**
5. Connect a test lamp between the ignition circuit terminal 3 and the ground circuit terminal 2.
6. Verify the test lamp turn ON and OFF when commanding the Rear Wiper On and Off with a scan tool.
   - **If the test lamp does not turn On and the circuit fuse is OK**
   1. Ignition/Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not turn On and the circuit fuse is open**
7. Ignition/Vehicle OFF.
8. Test for infinite resistance between the ignition circuit and ground.
   - If less than infinite resistance, repair the short to ground on the circuit.
   - If infinite resistance, test or replace the M45 Rear Wiper Motor
   - **the test lamp turns On and OFF**
9. Ignition OFF, connect the harness connector at the M45 Rear Wiper Motor. Connect the X2 harness connector at the X50A Fuse Block - Underhood, disconnect the X1 harness connector at the X50A Fuse Block - Underhood, It may take up to 2 min for all vehicle systems to power down.
10. Test for less than 10 Ω between the ground circuit terminal 12 and ground.
    - **If 10 Ω or greater**
    1. Test for less than 2 Ω in the ground circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
11. Ignition ON.
12. Verify the M45 Rear Wiper Motor is NOT activated.
    - **If the M45 Rear Wiper Motor is activated**
    1. Ignition OFF, disconnect the harness connector at the M45 Rear Wiper Motor, ignition ON.
    2. Test for less than 1 V between the control circuit terminal 3 and ground.
       - If 1 V or greater, repair the short to voltage on the circuit.
       - If less than 1 V, replace the M45 Rear Wiper Motor.
    - **If the M45 Rear Wiper Motor is not activated**
13. Connect a 20 A fused jumper wire between the control circuit listed below and B+:
    - Terminal 30
    - Terminal 44
14. Verify the M45 Rear Wiper Motor activates.
    - **If the M45 Rear Wiper Motor does not activate**
    1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the M45 Rear Wiper Motor, ignition ON.
    2. Test for infinite resistance between the control circuit and ground.
       - If less than Infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, replace the M45 Rear Wiper Motor.
    - **If the M45 Rear Wiper Motor activates**
15. Ignition OFF, connect the X1 harness connectors at the X50A Fuse Block - Underhood. Disconnect the X4 harness connector at the K9 Body Control Module, ignition ON.

16. Verify the M45 Rear Wiper Motor is not activated.
    - **If the M45 Rear Wiper Motor is activated**
    1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block - Underhood, ignition ON.
    2. Test for less than 1 V between the control circuit terminal 22 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the X50A Fuse Block - Underhood.
    - **If the M45 Rear Wiper Motor is not activated**
17. Connect a 10 A fused jumper wire between the control circuit terminal 10 and B+.
18. Verify the M45 Rear Wiper Motor activates.
    - **If the M45 Rear Wiper Motor does not activate**
    1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block - Underhood.
    2. Test for infinite resistance between the control circuit terminal 22 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If less than infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the X50A Fuse Block - Underhood.
    - **If the M45 Rear Wiper Motor activates**
19. Test or replace the M45 Rear Wiper Motor.

Wiper Park Feature Malfunction

1. Ignition OFF, disconnect the harness connector at the M45 Rear Wiper Motor. Ignition ON
2. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
    - **If the test lamp does not illuminate**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - **If the test lamp illuminates**
3. Test or replace the M45 Rear Wiper Motor.

Component Testing

Windshield Wiper/Washer Switch

1. Ignition OFF, disconnect the harness connector at the S82 Windshield Wiper/Washer Switch.
2. Test for infinite resistance between the signal terminal 5 and the low reference terminal 1 with the rear window washer switch in the open position.
    - **If less than infinite resistance**

      Replace the S82 Windshield Wiper/Washer Switch.

    - **If infinite resistance**
3. Verify the resistance reading is within the range specified below between the signal circuit terminal 5 and the low reference circuit terminal 1 by cycling the switch between Rear Wiper position and Rear Washers position.
    - Rear Wiper : 624-644Ω
    - Rear Wiper Sweep : 1.99-2.01kΩ
    - Rear Washer : 6.11-6.13kΩ
    - **If not within range specified**

      Replace the S82 Windshield Wiper/Washer Switch.

    - **If within range specified**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Wiring Harness Junction Block Replacement**
- **Rear Window Wiper Motor Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** or BCM replacement, programming and setup

REAR WASHER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	1	1	-	-
Rear Washer Switch Signal	1	1	-	-
Rear Window Washer Pump Relay Control	1	B3811 04	B3811 01	-
Rear Windshield Washer Pump Control	1	1	2	-
Rear Windshield Washer Pump Ground	-	1	-	-
Underhood Fuse Block Ground Terminal 12 X1	-	1	-	-
1. Rear Washer Inoperative 2. Rear Washer Always ON				

Circuit/System Description

The rear windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. The BCM monitors the rear windshield wiper/washer switch signal circuit and when rear washer activation is requested, the BCM applies voltage through the rear window washer pump relay control circuit. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the rear windshield washer pump control circuit to activate the rear windshield washer pump.

Reference Information

Schematic Reference

Wiper/Washer Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Rear Washer Relay Command parameter changes between Active and Inactive when cycling the rear washer switch ON and OFF.
    - **If the parameter does not change**

      Refer to Circuit/System Testing - Rear Wiper/Washer Switch Malfunction

    - **If the parameter changes**
3. Verify the G19 Rear Window Washer Pump turns on and off when commanding the Rear Washer Relay Inactive and Active with the scan tool
    - **If the G19 Rear Window Washer Pump does not turn ON and OFF**

      Refer to Circuit/System Testing - Rear Washer Pump Malfunction

    - **If the G19 Rear Window Washer Pump turns ON and OFF**
4. All OK.

Circuit/System Testing

Rear Wiper/Washer Switch Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the X3 harness connector at the S82 Windshield Wiper/Washer Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 8 V between the signal circuit terminal 5 and ground.
    - **If less than 8 V**
    1. Ignition OFF, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit and ground
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If 8 V or greater**
5. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
6. Test for less than 1 V between the S82 Windshield Wiper/Washer Switch signal circuit terminal 5 and ground.
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
7. Test or replace the S82 Windshield Wiper/Washer Switch.

Rear Washer Pump Malfunction

1. Ignition OFF and all vehicle systems OFF, disconnect the X1 harness connector at the X50A Fuse Block - Underhood. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 12 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect the X1 harness connector at the X50A Fuse Block - Underhood, disconnect the harness connector at the G19 Rear Window Washer Pump. It may take up to 2 min for all vehicle systems to power down.
4. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
5. Connect a test lamp between the control circuit terminal 1 and ground, ignition ON.
6. Verify the test lamp does not turn ON and OFF when commanding the Rear Washer Relay Active and Inactive with a scan tool.
    - **If the test lamp turns ON and OFF**

      Test or replace the G19 Rear Window Washer Pump.

    - **If the test lamp does not turn ON and OFF**
7. Ignition OFF, connect the harness connector at the G19 Rear Window Washer Pump. Disconnect the X1 harness connector at the X50A Fuse Block-Underhood, ignition ON.
8. Verify the G19 Rear Window Washer Pump is not activated.
    - **If the G19 Rear Window Washer Pump is activated**
    1. Ignition OFF, disconnect the harness connector at the G19 Rear Window Washer Pump, ignition ON.
    2. Test for less than 1 V between the control circuit terminal 24 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, test or replace the G19 Rear Window Washer Pump.
    - **If the G19 Rear Window Washer Pump is not activated**
9. Connect a 15 A fused jumper wire between the control circuit terminal 24 and B+.
10. Verify the G19 Rear Window Washer Pump activates.
    - **If the G19 Rear Window Washer Pump does not activate**
    1. Ignition OFF, remove the jumper wire, disconnect the harness connector at the G19 Rear Window Washer Pump, ignition ON.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than Infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the G19 Rear Window Washer Pump.
    - **If the G19 Rear Window Washer Pump activates**
11. Ignition OFF, connect the X1 harness connector at the X50A Fuse Block-Underhood, disconnect X1 harness connector at the K9 Body Control Module, ignition ON.
12. Verify the G19 Rear Window Washer Pump is not activated.

- **If the G19 Rear Window Washer Pump is activated**
  1. Ignition OFF, disconnect the X2 harness connector at the X50A Fuse Block-Underhood.
  2. Test for less than 1 volt between the K9 Body Control Module control circuit terminal 6 X1 and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V, test or replace the X50A Fuse Block-Underhood.

13. Connect a 3 A fused jumper wire between the control circuit terminal 6 and B+.
14. Verify the G19 Rear Window Washer Pump activates.
    - **If the G19 Rear Window Washer Pump does not activate**
      1. Ignition OFF, remove the jumper wire, disconnect the X2 harness connector at the X50A Fuse Block-Underhood, ignition ON.
      2. Test for infinite resistance between the control circuit terminal 15 and ground.
         - If less than Infinite resistance, repair the short to ground on the circuit.
         - If infinite resistance
      3. Test for less than 2 Ω in the control circuit end to end.
         - If 2 Ω or greater, repair the open/high resistance in the circuit.
         - If less than 2 Ω, test or replace the X50A Fuse Block-Underhood.
    - **If the G19 Rear Window Washer Pump activates**
15. Replace the K9 Body Control Module.

Component Testing

Rear Windshield Washer Pump

1. Install a 15 A fused jumper wire between the B+ terminal 1 and 12 V. Install a jumper wire between the ground terminal 2 and ground.
2. Verify the G19 Rear Window Washer Pump activates.
   - **If the G19 Rear Window Washer Pump does not activate.**

     Replace the G19 Rear Window Washer Pump.

   - **If the G19 Rear Window Washer Pump does activate.**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Engine Wiring Harness Junction Block Replacement**
- **Windshield Washer Pump Replacement**
- **Windshield Wiper and Washer Switch Replacement**
- **Control Module References** for body control module replacement, programming and setup.

REPAIR INSTRUCTIONS

WINDSHIELD WIPER AND WASHER SWITCH REPLACEMENT

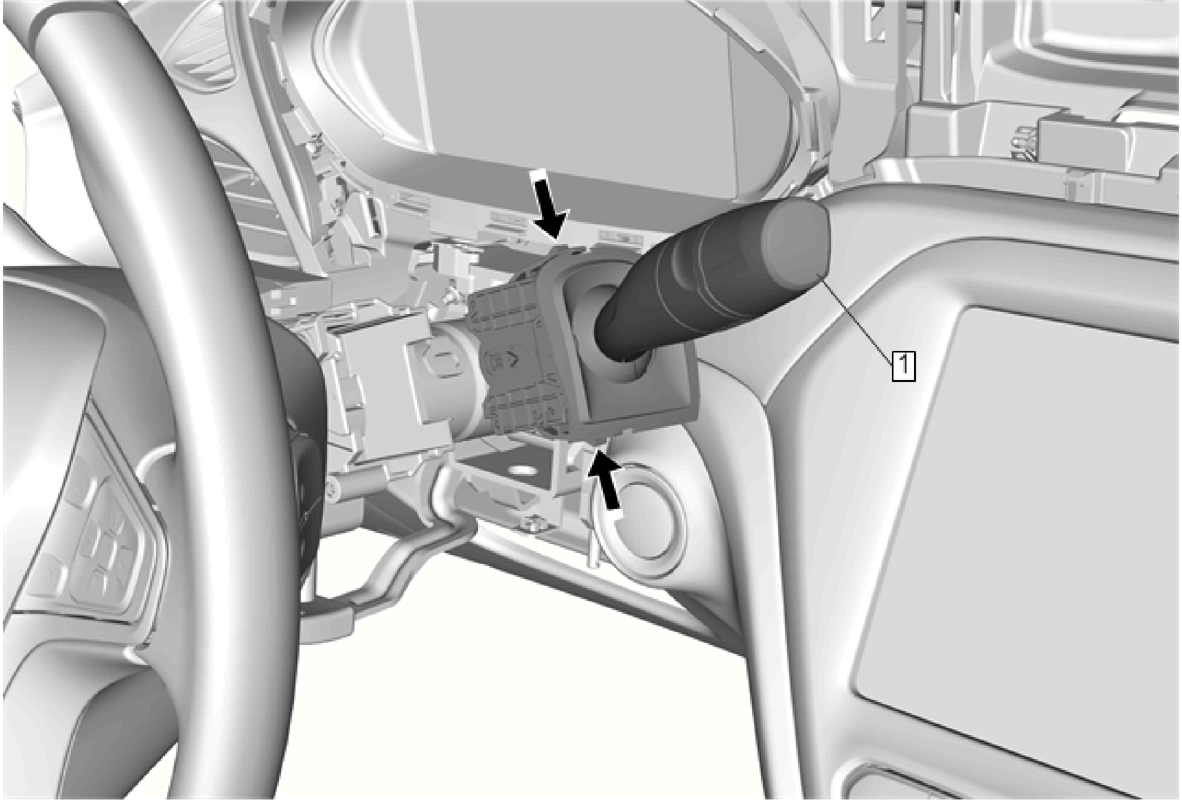


Fig. 4: Windshield Wiper and Washer Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Column Lower Trim Cover Replacement	
1	Windshield Wiper and Washer Switch **Procedure** 1. Release the retaining tabs and remove the windshield wiper and washer switch from the switch bracket. 2. Disconnect the electrical connector.

WINDSHIELD WASHER NOZZLE HOSE REPLACEMENT

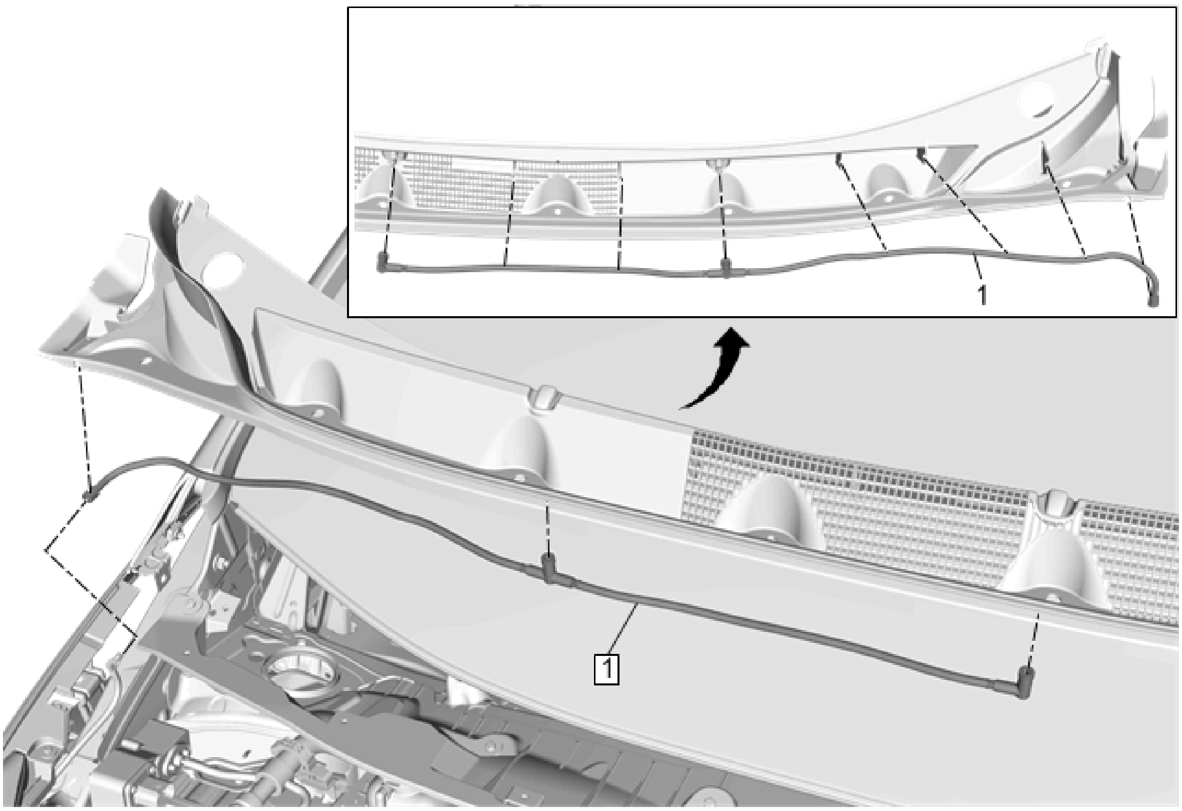


Fig. 5: Windshield Washer Nozzle Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Air Inlet Grille Panel Replacement 2. Reposition air inlet grille foam seal.	
1	Windshield Washer Nozzle Hose **Procedure** 1. Disconnect Windshield Washer Nozzle Hose@Air Inlet Grille Panel 2. Disconnect Windshield Washer Nozzle Hose@Windshield Washer Nozzle 3. Remove Windshield Washer Nozzle Hose

WINDSHIELD WASHER NOZZLE REPLACEMENT

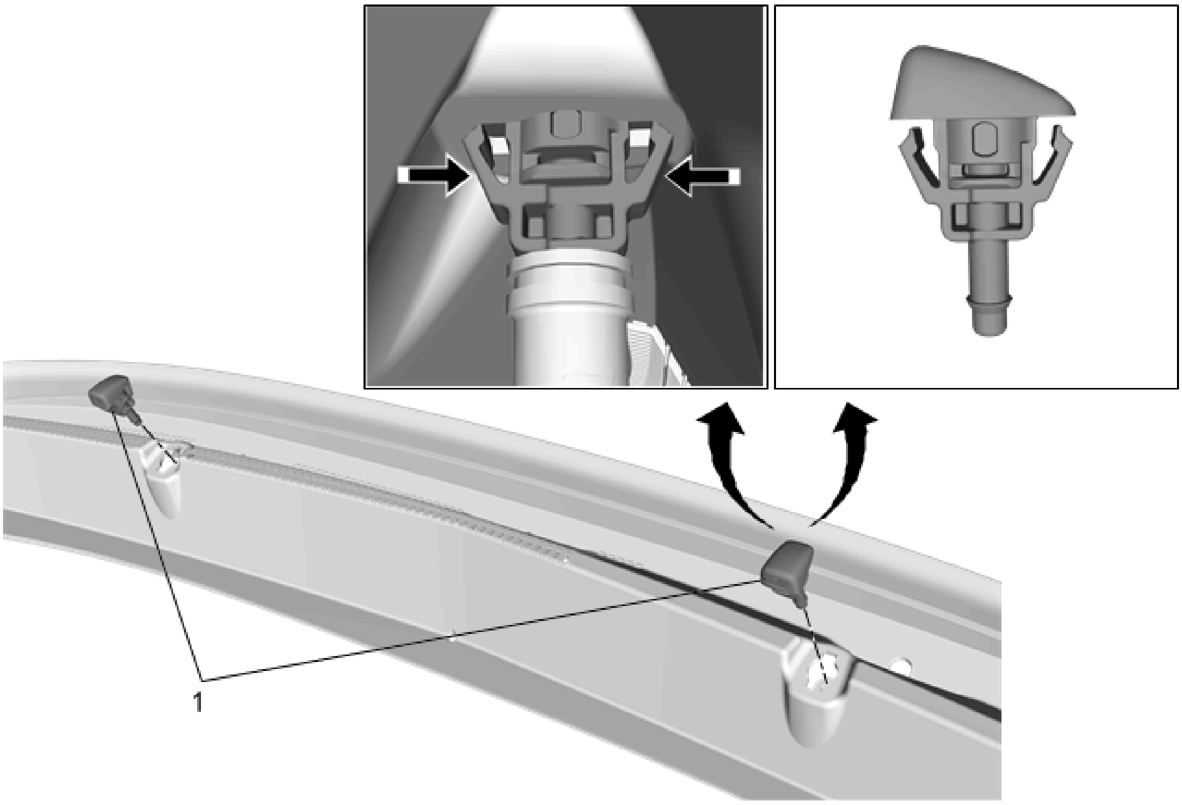


Fig. 6: Windshield Washer Nozzle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Air Inlet Grille Panel Replacement	
1	Windshield Washer Nozzle **Procedure** 1. Press the retainer to unlock. 2. DisconnectWindshield Washer Nozzle@Windshield Washer Nozzle Hose

REAR WINDOW WASHER NOZZLE REPLACEMENT

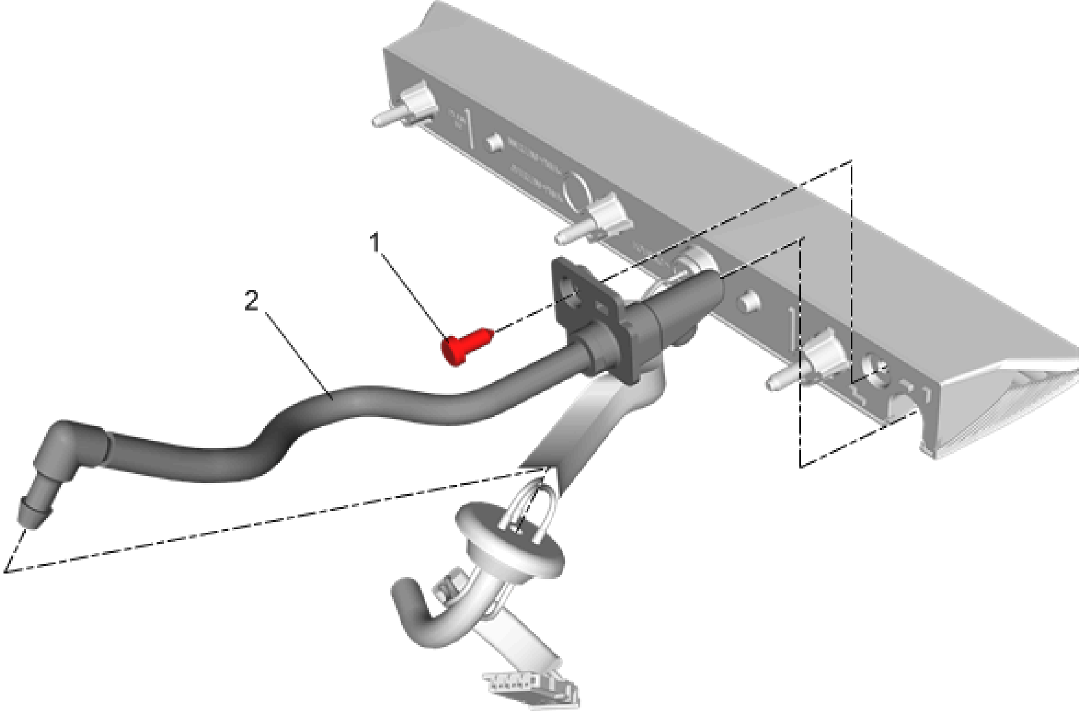


Fig. 7: Rear Window Washer Nozzle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **High Mount Stop Lamp Replacement**	
1	Rear Window Washer Nozzle Retainer
2	Rear Window Washer Nozzle

WINDSHIELD WASHER SOLVENT CONTAINER FILLER TUBE REPLACEMENT

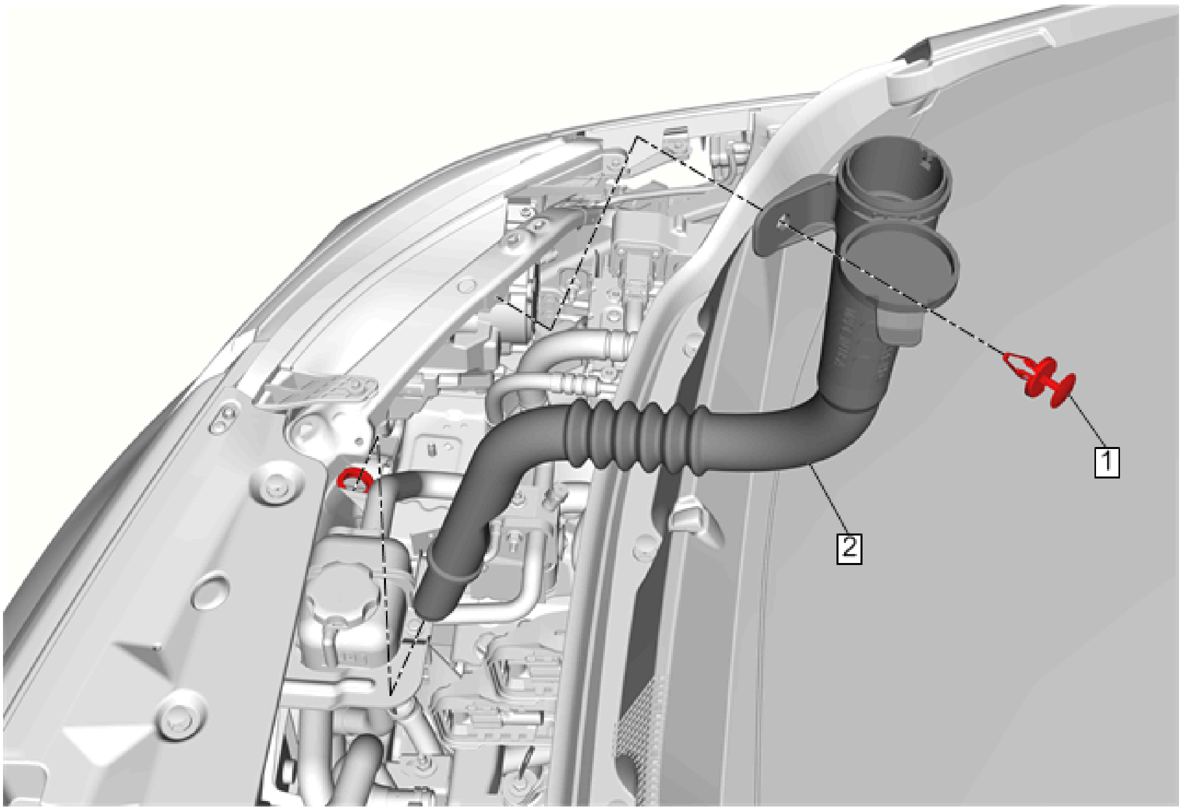


Fig. 8: Windshield Washer Solvent Container Filler Tube
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Windshield Washer Solvent Container Filler Tube Retainer
2	Windshield Washer Solvent Container Filler Tube **NOTE:** **Depending on the fluid level, fluid loss may occur when replacing the windshield washer solvent container filler tube.**

WINDSHIELD WASHER SOLVENT CONTAINER REPLACEMENT

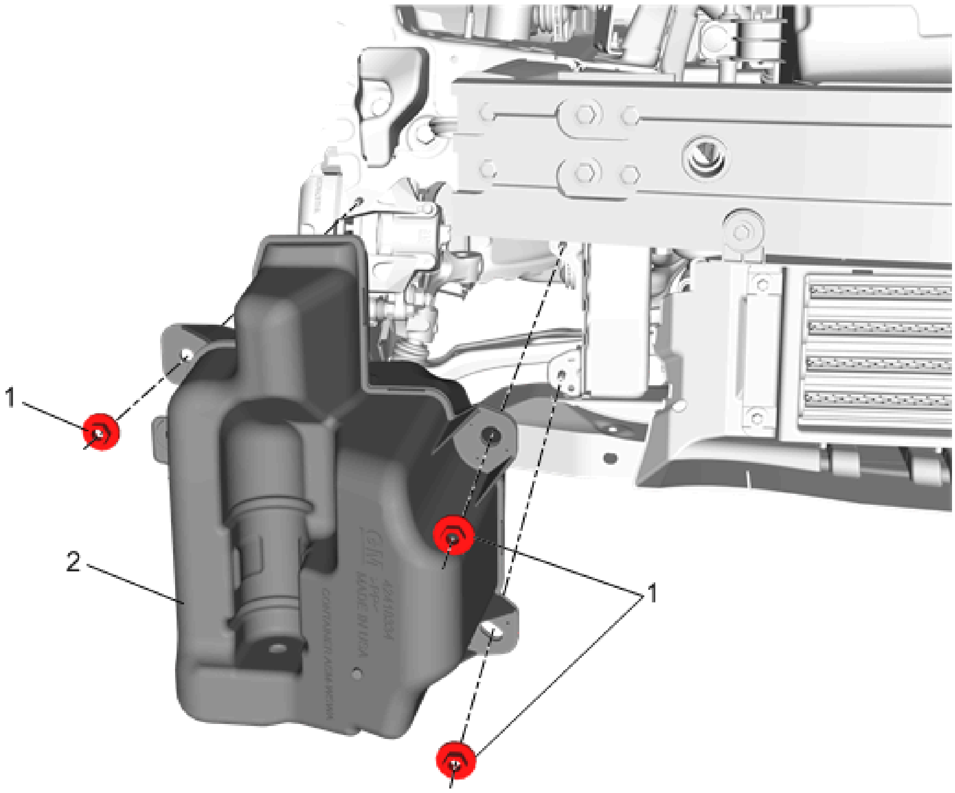


Fig. 9: Windshield Washer Solvent Container
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea) 2. Windshield Washer Solvent Container Filler Tube Replacement	
1	Windshield Washer Solvent Container Nut (Qty: 3) **CAUTION:** Fastener Caution **Tighten** 5 N.m (44 lb in)

Callout	Component Name
2	Windshield Washer Solvent Container **Procedure** 1. Unclip the harness and hose from the container. 2. Drain the windshield washer solvent into a suitable clean container. 3. Transfer components as necessary. 4. Fill the windshield washer solvent container after installation. **NOTE:** **Inspect windshield washer pump seal and replace it, if damaged.**

WINDSHIELD WASHER PUMP REPLACEMENT

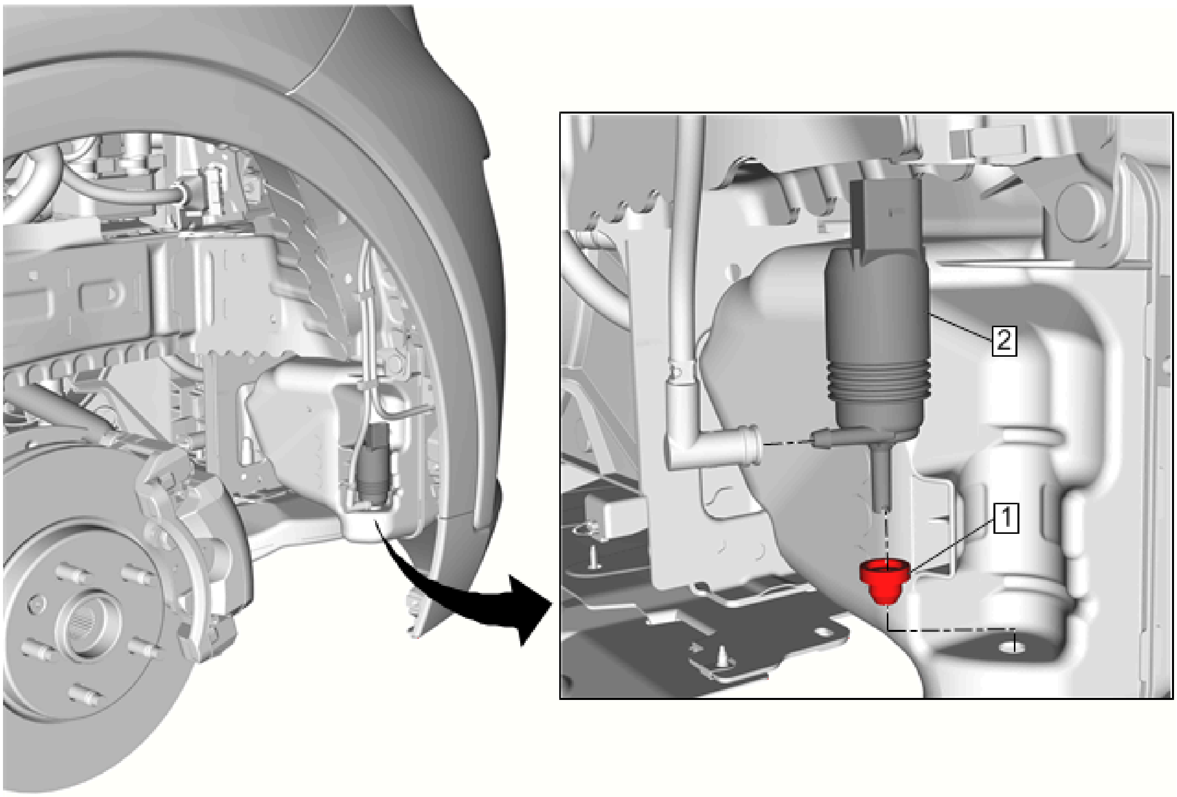


Fig. 10: Windshield Washer Pump

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Wheelhouse Liner - Right Side Front Wheelhouse Liner Replacement	
1	Windshield Washer Pump Grommet **Procedure** Using a small flat-bladed tool, remove the windshield washer pump grommet from the windshield washer solvent container and inspect the grommet. Replace if damaged.
2	Windshield Washer Pump **Procedure** 1. Disconnect the electrical connector. 2. Drain the windshield washer solvent container into a clean suitable container. 3. Disconnect Windshield Washer Pump Hose@Windshield Washer Pump 4. Using a small flat-bladed tool, remove the windshield washer pump from the windshield washer solvent container.

REAR WINDOW WASHER PUMP REPLACEMENT

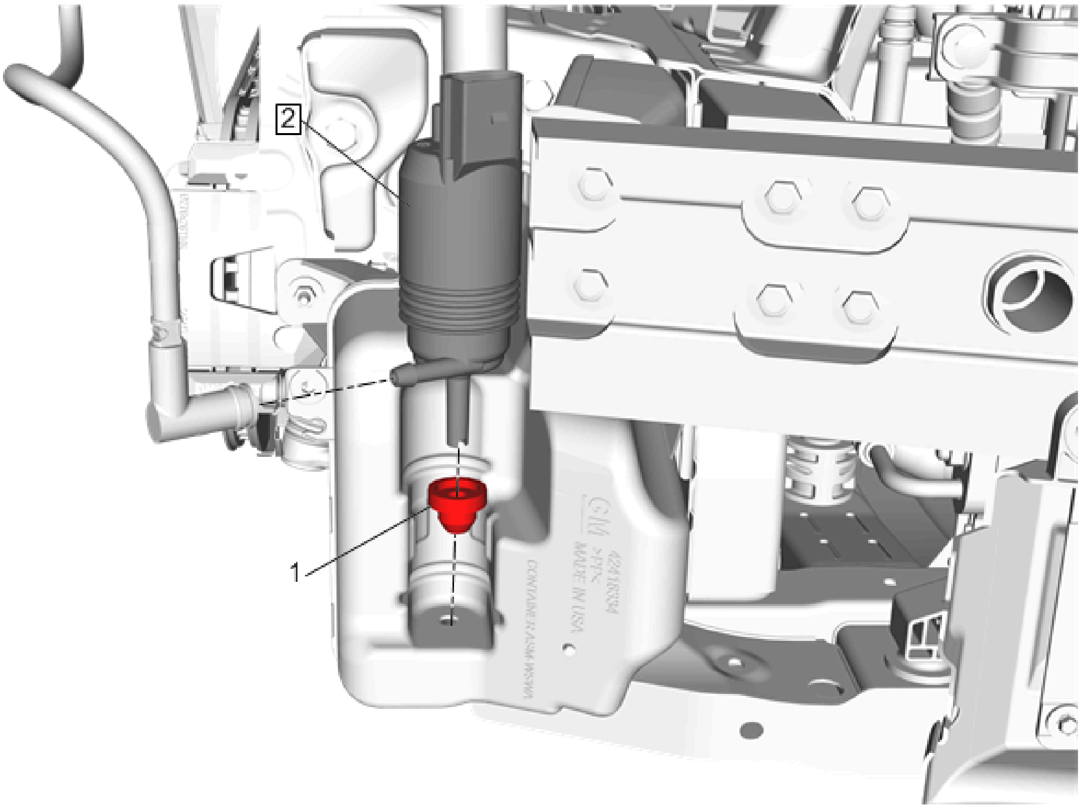


Fig. 11: Rear Window Washer Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)	
1	Rear Window Washer Pump Grommet **Procedure** Using a small flat-bladed tool, remove the rear window washer pump grommet from the windshield washer solvent container and inspect the grommet. Replace if damaged.
2	Rear Window Washer Pump **Procedure** 1. Disconnect the electrical connector. 2. Drain the windshield washer solvent container into a clean suitable container. 3. Disconnect Windshield Washer Pump Hose@Windshield Washer Pump 4. Using a small flat-bladed tool, remove the rear window washer pump from the windshield washer solvent container.

DASH PANEL UPPER EXTENSION PANEL EXTENSION REPLACEMENT

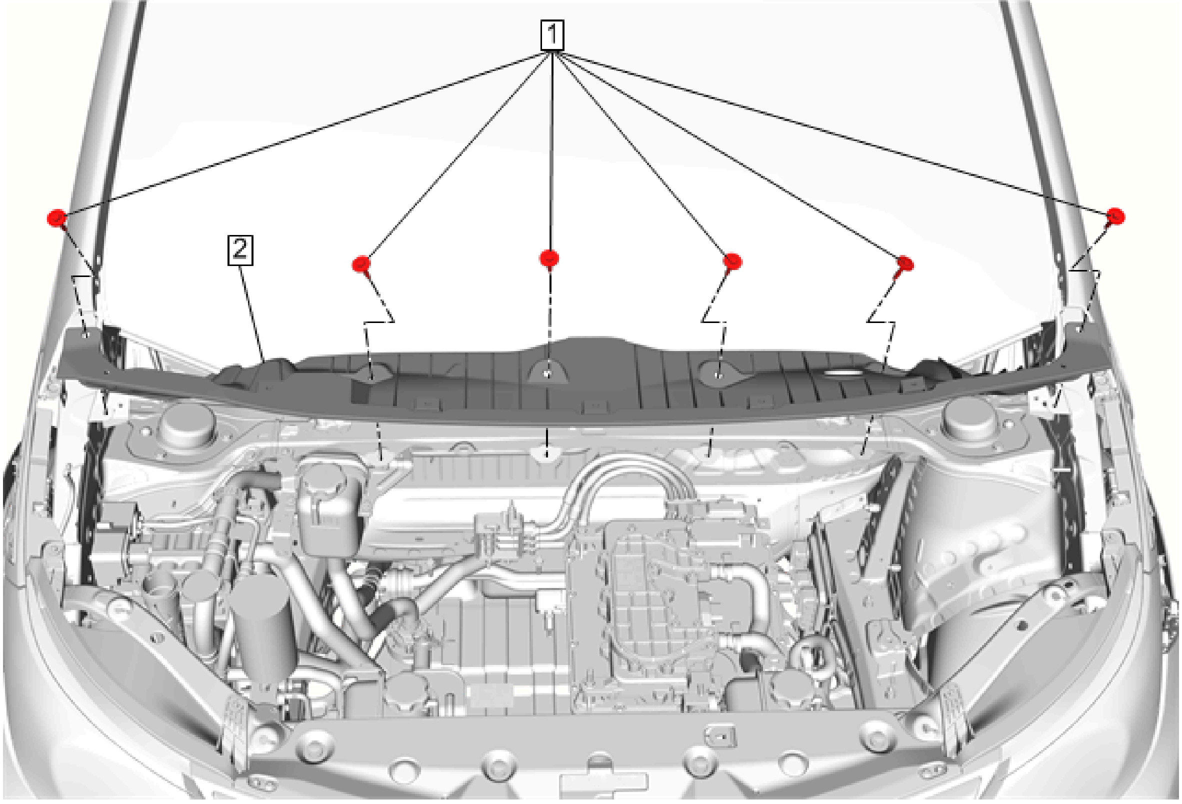


Fig. 12: Dash Panel Upper Extension Panel Extension
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Air Inlet Grille Panel Replacement 2. Windshield Wiper System Module Replacement	
1	Air Inlet Grille Panel Bolt (Qty: 6) **CAUTION:** Fastener Caution **Tighten** 4.5 N.m (40 lb in)
2	Dash Panel Upper Extension Panel Extension **Procedure** Route the electrical harness passthroughs through the extension panel.

AIR INLET GRILLE PANEL REPLACEMENT

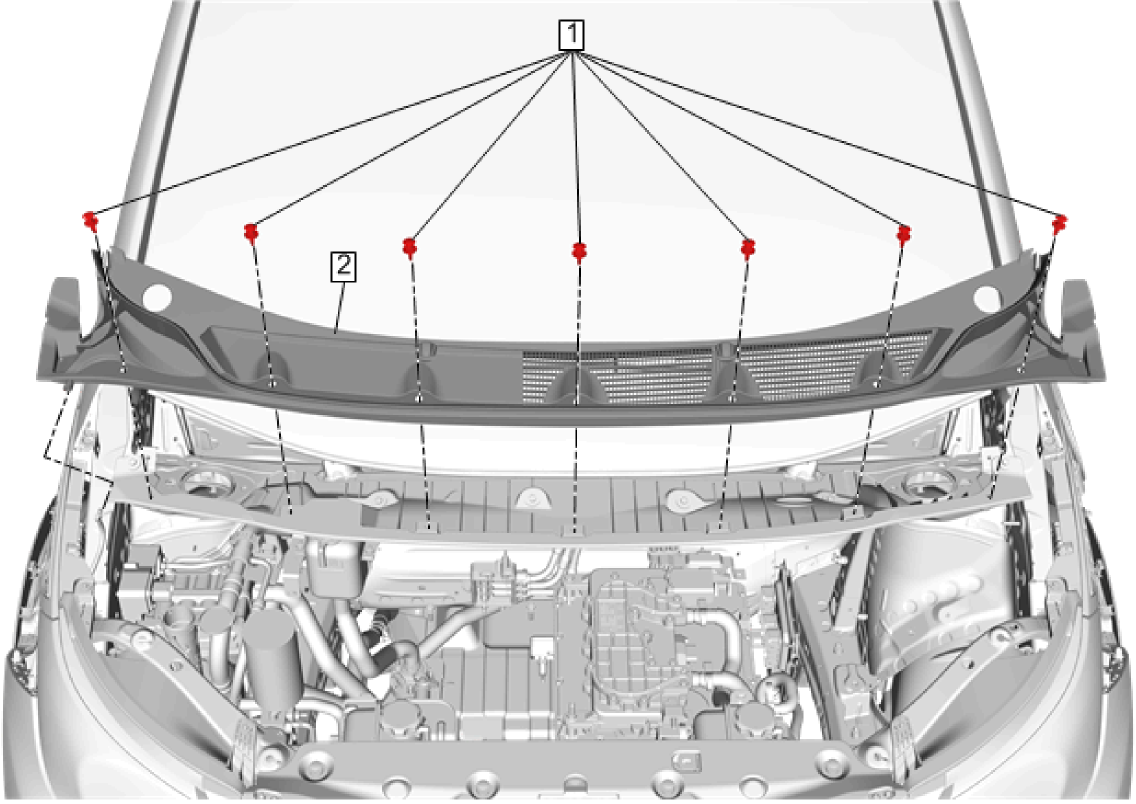
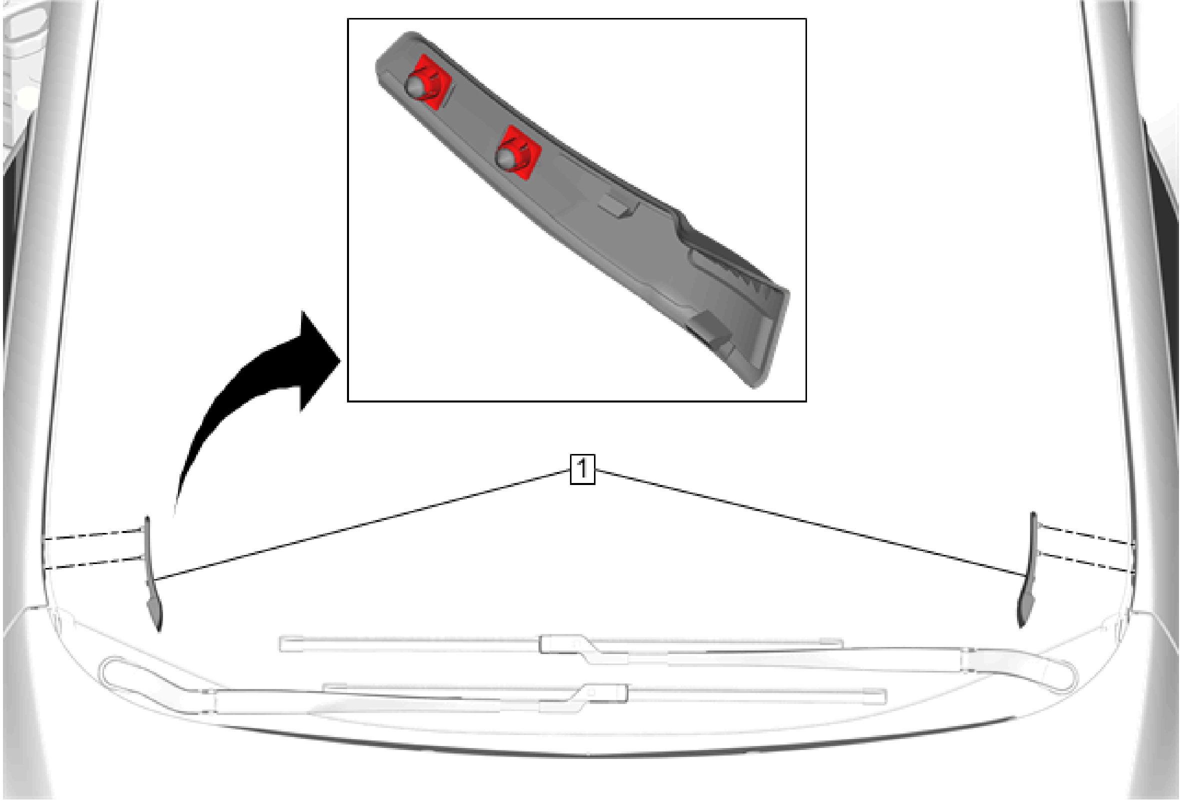


Fig. 13: Air Inlet Grille Panel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Windshield Wiper Arm Replacement 2. Air Inlet Grille Panel Extension Replacement	
1	Air Inlet Grille Panel Retainer **Procedure** Remove Air Inlet Grille Panel Retainer@Air Inlet Grille Panel
2	Air Inlet Grille Panel **Procedure** Disconnect Windshield Washer Nozzle Hose@Windshield Washer Pump Hose Windshield Washer Nozzle Hose Replacement

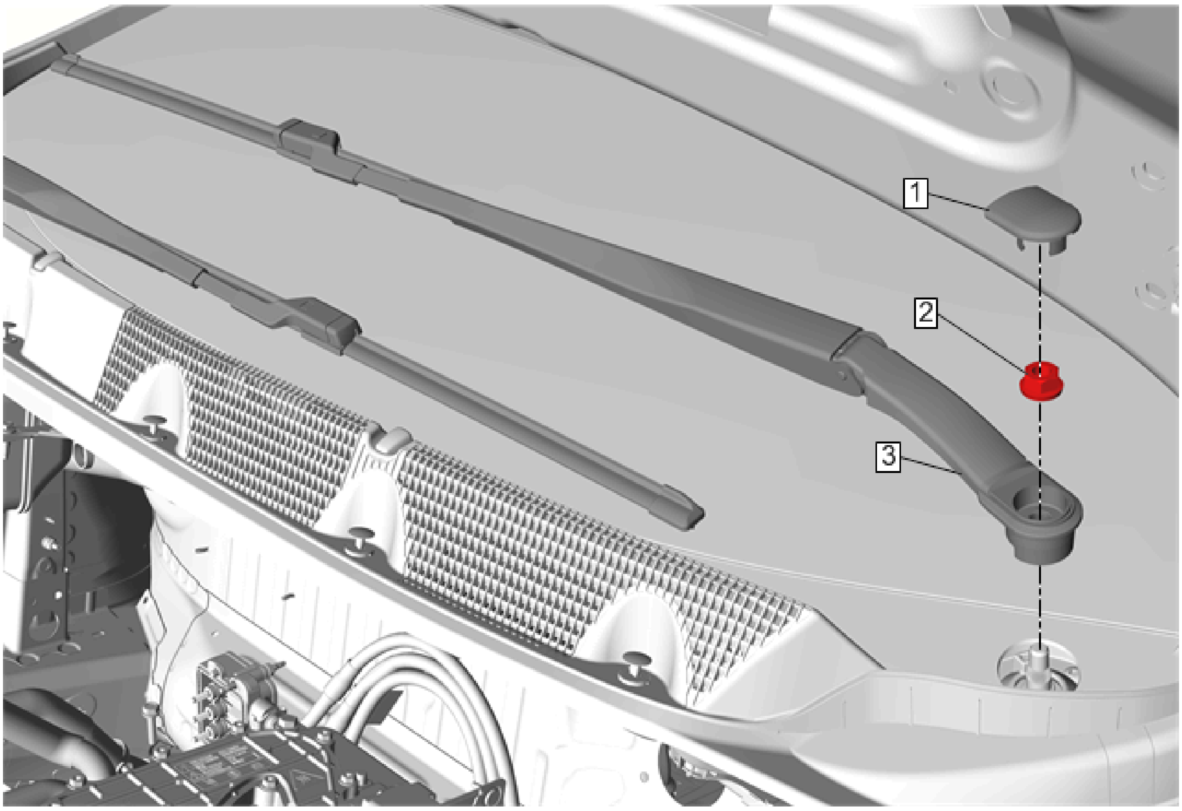
AIR INLET GRILLE PANEL EXTENSION REPLACEMENT



[Fig. 14: Air Inlet Grille Panel Extension](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Air Inlet Grille Panel Extension **Procedure** Grasp the air inlet grille panel extension and disengage the retainers from the body side outer.

WINDSHIELD WIPER ARM REPLACEMENT



[Fig. 15: Windshield Wiper Arm](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Windshield Wiper Arm Finish Cap **Procedure** Use a flat bladed plastic tool to remove.
2	Windshield Wiper Arm Nut **CAUTION:** **Fastener Caution** **Tighten** 30 N.m (22 lb ft)
3	Windshield Wiper Arm **Procedure** 1. Gently rock the windshield wiper arm to remove it from the windshield wiper transmission pivot shaft. 2. Clean the pivot shaft knurls with a soft wire brush before installing a NEW windshield wiper arm. 3. Windshield Wiper Arm - Adjust - **Windshield Wiper Arm Adjustment** **NOTE:** **Turn the ignition switch ON. The powering on of the motor before arm installation is required to prevent module pivot shaft rotation when fastening the nut.**

REAR WINDOW WIPER ARM REPLACEMENT

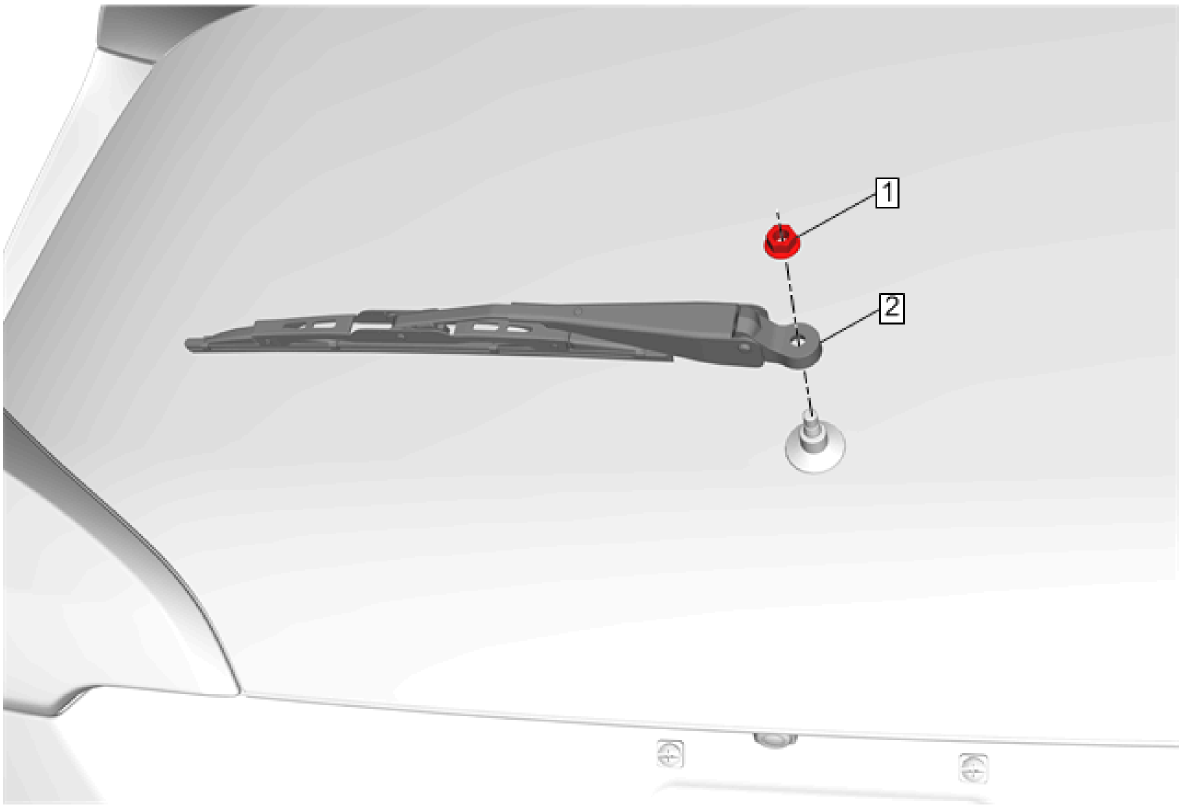


Fig. 16: Rear Window Wiper Arm
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Window Wiper Cover Replacement	

Callout	Component Name
1	Rear Window Wiper Arm Nut **CAUTION:** **Fastener Caution** **Tighten** 10 N.m (89 lb in)
2	Rear Window Wiper Arm **Procedure** 1. Note the location of the arm and mark it with tape. 2. Gently rock the arm to release it. 3. Use the **J-39822** Wiper Arm Puller or equivalent, if difficulty is encountered. **Special Tools** **J-39822** Wiper Arm Puller For equivalent regional tools, refer to **Special Tools**.

WINDSHIELD WIPER BLADE REPLACEMENT

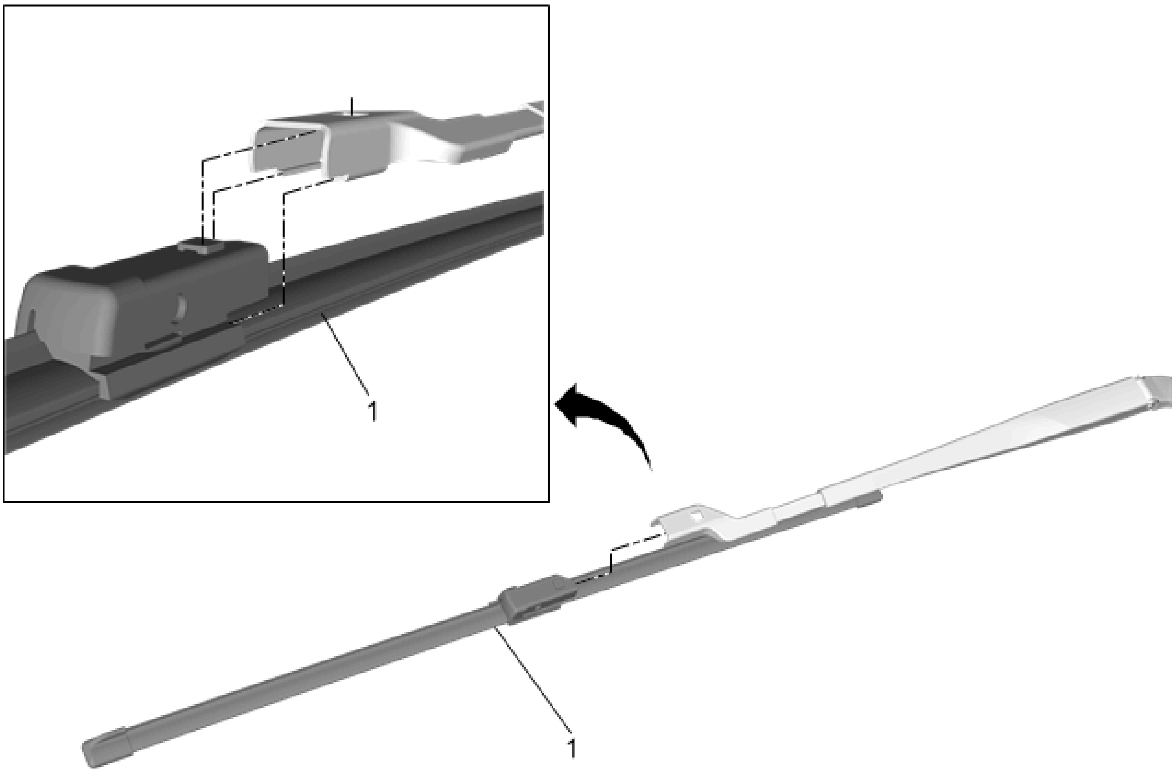


Fig. 17: Windshield Wiper Blade
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Windshield Wiper Blade **Procedure** 1. Lift the windshield wiper arm off the windshield to the service up position. 2. Depress the windshield wiper arm tab at the small square hole in the windshield wiper arm. 3. Slide the windshield wiper blade forward and remove it from the windshield wiper arm. 4. Gently return the windshield wiper arm to the windshield.

REAR WINDOW WIPER BLADE REPLACEMENT

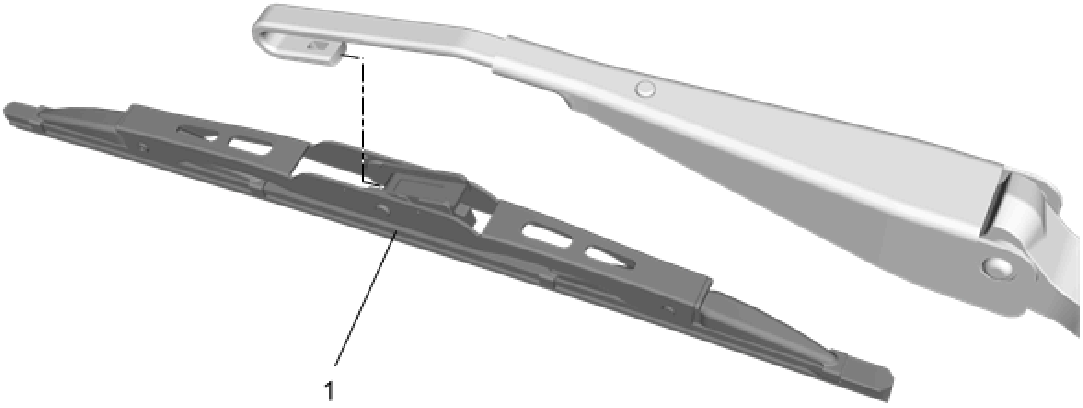


Fig. 18: Rear Window Wiper Blade
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Rear Window Wiper Cover Replacement**	
1	Rear Window Wiper Blade **Procedure** 1. Lift the rear window wiper arm off the liftgate glass. 2. Depress the rear window wiper arm tab at the small square hole in the rear window wiper arm. 3. Rotate the rear window wiper blade slightly and slide the rear window wiper blade downward from the rear window wiper arm. 4. Gently return the rear window wiper arm to the liftgate glass.

REAR WINDOW WIPER MOTOR REPLACEMENT

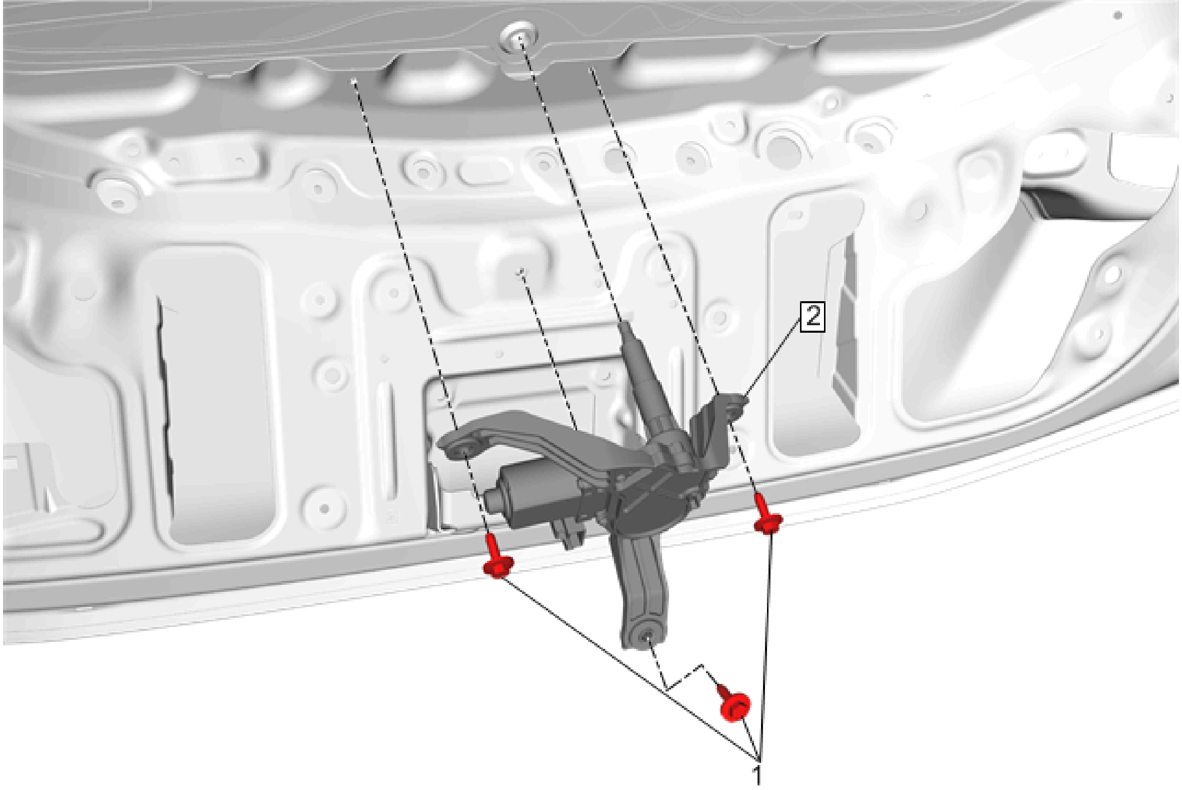


Fig. 19: Rear Window Wiper Motor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Liftgate Lower Trim Finish Panel Replacement 2. Rear Window Wiper Arm Replacement	
1	Rear Window Wiper Motor Bolt (Qty: 3) **CAUTION:** Fastener Caution **Tighten** 9 N.m (80 lb in)
2	Rear Window Wiper Motor **Procedure** 1. Pull the rear window wiper motor inward from the rear liftgate. 2. Disconnect the electrical connector. 3. Inspect the rear window wiper motor grommet for damage. Replace if needed.

REAR WINDOW WIPER COVER REPLACEMENT

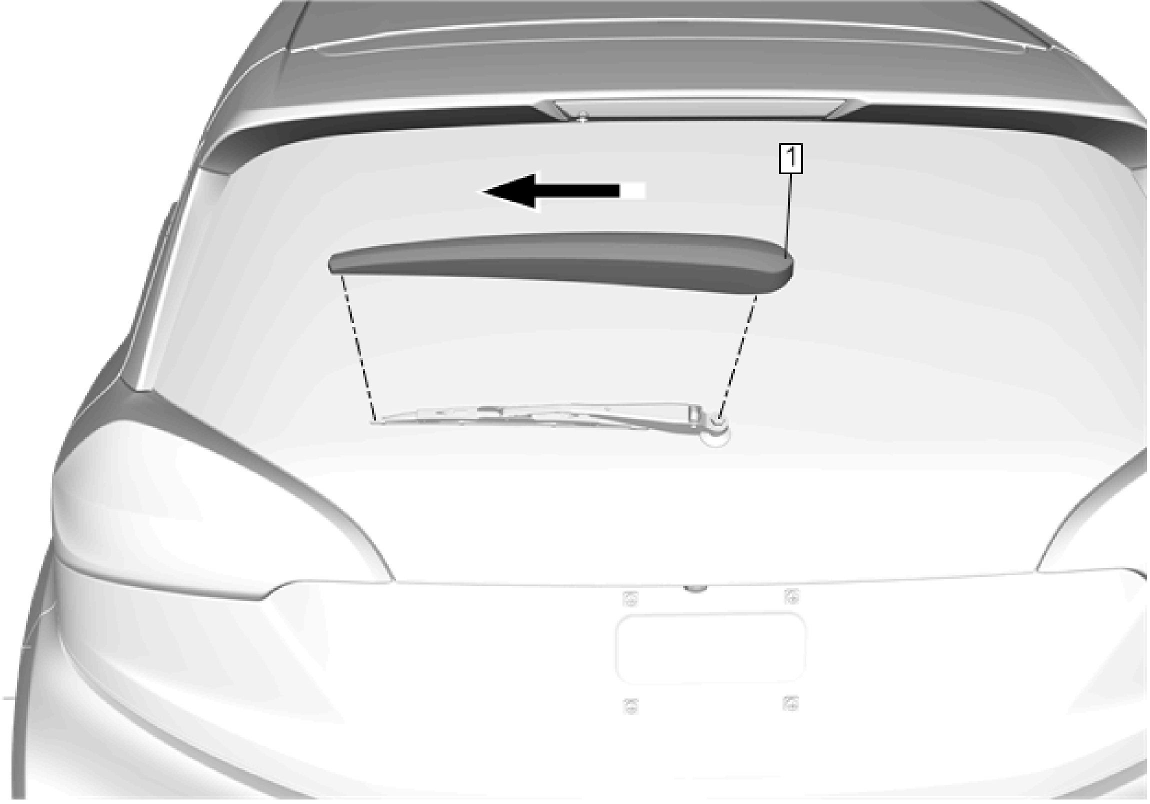


Fig. 20: Rear Window Wiper Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Rear Window Wiper Cover **Procedure** 1. Release the integral retainers at the pivot side. 2. Slide the cover toward the arm side to release the hook feature (towards the arrow).

WINDSHIELD WIPER SYSTEM MODULE REPLACEMENT

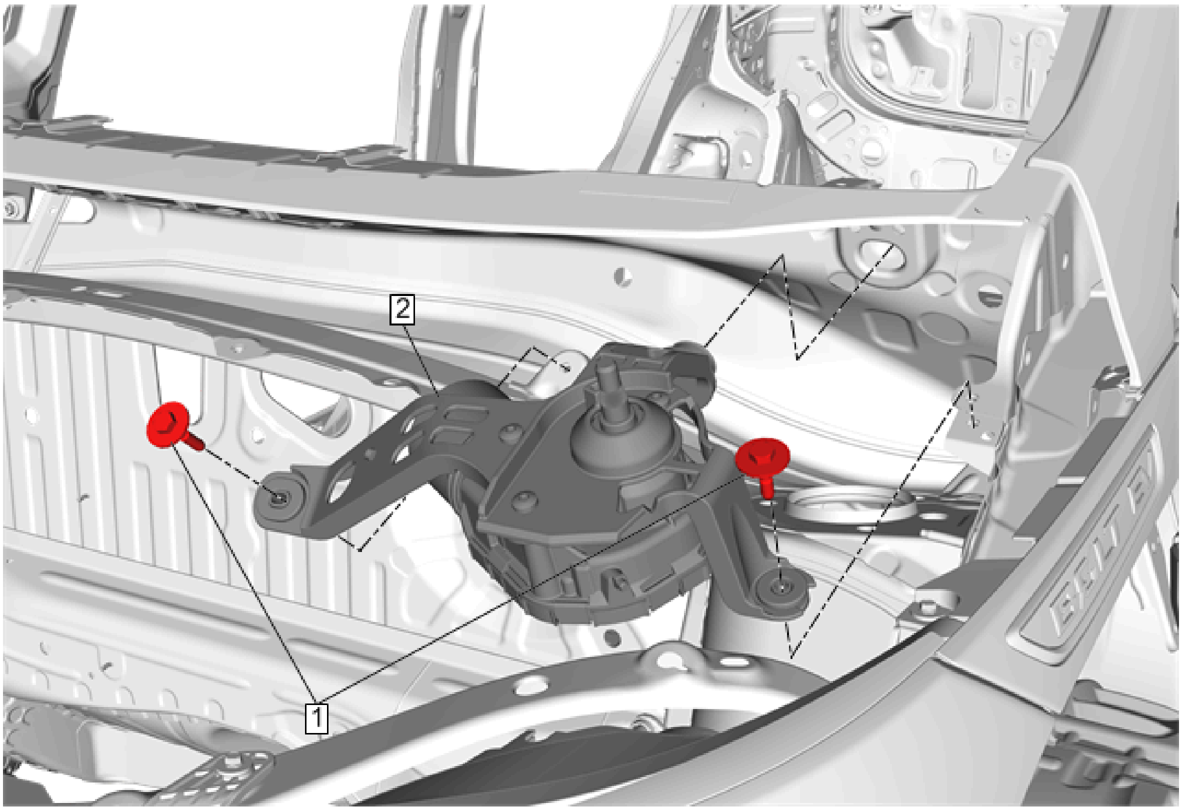


Fig. 21: Windshield Wiper System Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Air Inlet Grille Panel Replacement	
1	Windshield Wiper System Module Bolt (Qty: 2) **CAUTION:** **Fastener Caution** **Tighten** 9 N.m (80 lb in)
2	Windshield Wiper System Module **Procedure** Disconnect the electrical connector.

WINDSHIELD MULTIFUNCTION SENSOR MOUNT BRACKET COVER REPLACEMENT (WITH FRONT VIEW CAMERA)

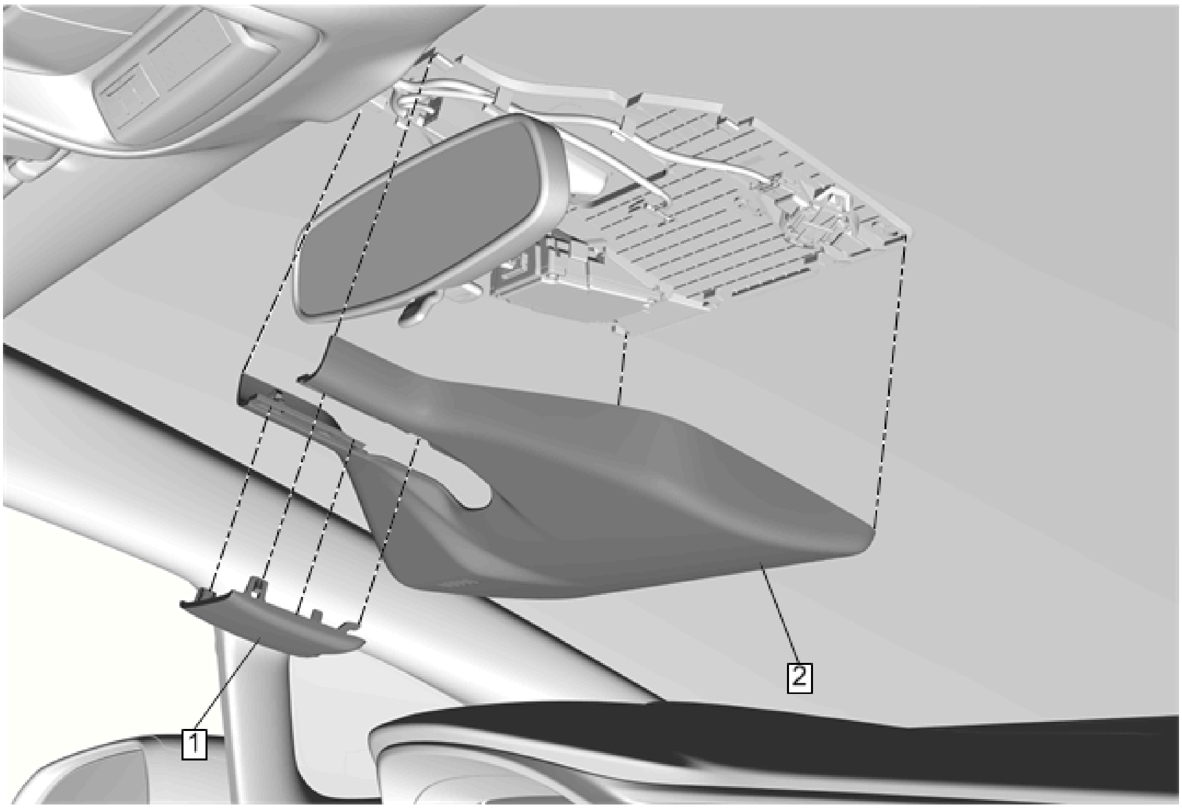


Fig. 22: Windshield Multifunction Sensor Mount Bracket Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Windshield Multifunction Sensor Mount Bracket Cover Insert
2	Windshield Multifunction Sensor Mount Bracket Cover **Procedure** 1. Using a plastic trim tool, release the cover from the windshield bracket. 2. Remove Windshield Multifunction Sensor Mount Bracket Cover Insert@Windshield Multifunction Sensor Mount Bracket Cover

WINDSHIELD MULTIFUNCTION SENSOR MOUNT BRACKET COVER REPLACEMENT (WITHOUT FRONT VIEW CAMERA)

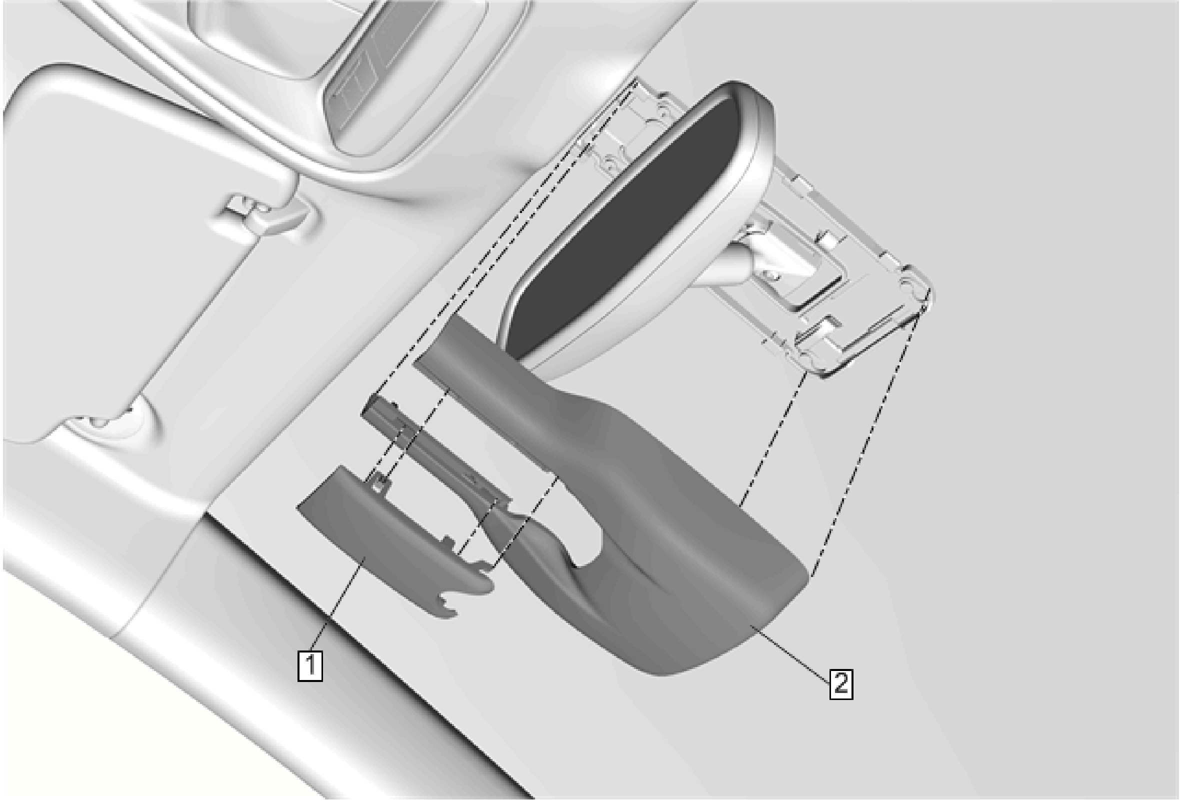


Fig. 23: Windshield Multifunction Sensor Mount Bracket Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Windshield Multifunction Sensor Mount Bracket Cover Insert
2	Windshield Multifunction Sensor Mount Bracket Cover **Procedure** 1. Using a plastic trim tool, release the cover from the windshield bracket. 2. Remove Windshield Multifunction Sensor Mount Bracket Cover Insert@Windshield Multifunction Sensor Mount Bracket Cover

WINDSHIELD WIPER ARM ADJUSTMENT

Adjustment Procedure

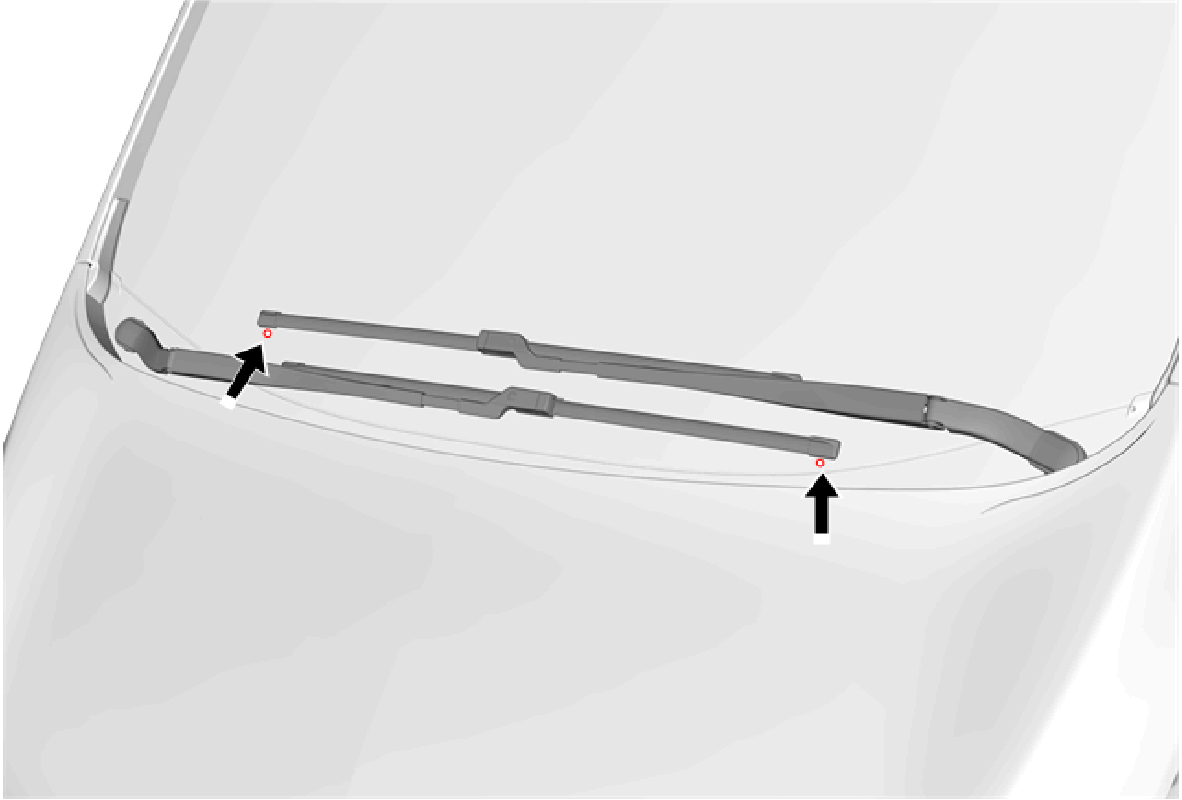


Fig. 24: Windshield Wiper Arms
Courtesy of GENERAL MOTORS COMPANY

1. Check the mark to install the wiper arm at the lower blackout of the windshield.
2. Position the wiper arm blade to this mark.

NOTE: **When installing the windshield wiper arm, perform this procedure for wiper arm to be in original position.**

DESCRIPTION AND OPERATION

WIPER/WASHER SYSTEM DESCRIPTION AND OPERATION

Wiper/Washer System Components

The wiper/washer system consists of the following electrical components:

- Windshield Washer Pump Relay
- Windshield Washer Pump
- Windshield Wiper Motor Module Right
- Windshield Wiper Motor Module Left
- Windshield Wiper/Washer Switch
- Body Control Module (BCM)
- Windshield Washer Fluid Level Switch
- Underhood Fuse Block (Contains Windshield Washer Pump PCB Relay)
- Rain Sensor
- Instrument Cluster
- Instrument Panel Right

Windshield Wiper System

The body control module (BCM) controls the wiper motor based on an input from the wiper switch, and when wiper operation is requested, the BCM will send serial data messages to the windshield wiper motor module. The front wiper systems consists of the driver's side (Windshield Wiper Motor Module Left), and the passenger's side Wiper Arm (Windshield Wiper Motor Module Right) which are connected by a mechanical linkage driven by both windshield wiper motor modules. The windshield wiper motor module contains the necessary electronics, motor, and position sensors to execute front wiper commands from the BCM. These internal electronics are integrated into the cover of the wiper motor gear housing and are not considered a serviceable item. The windshield wiper motor module wipes the front windshield by controlling the up and down wiper arm movement by the use of a reversing motor and an internal position sensor. The sensor keeps track of the gear wheel position and when the Controller determines that the wiper arms are at a position to reverse direction, it reverses the motor supply voltage by use of its internal motor control circuitry. The BCM also provides a hardwired redundant output that switches Battery power to the Wiper Motor upon activation of its low assertion High Speed Wiper Switch input.

The BCM utilizes resistive multiplexing through the wiper switch to discern the requested action from the driver. The BCM will respond by commanding the specific wiper function to operate as follows:

1. Using intermittent wipes, the wipers pause briefly on the windshield. If the wiper level is moved to OFF or if additional wipes are not required, the wipers may move to the base of the windshield.
2. If the ignition is put in OFF while the wipers are on LO, HI, or INT, they will immediately stop.
3. If the ignition is put in OFF while the wipers are performing wipes due to windshield washing, the wipers continue to run until they reach the base of the windshield.
4. Perform one immediate wipe by issuing a serial data signal set to low wipes. The windshield wiper motor shall initiate low speed wiper operation and send a serial data signal back set to low wiping.
5. Upon the wipers leaving their PARKED position, the windshield wiper motor shall send a serial data signal indicating the wipers are no longer in park.
6. Upon receipt of the Wiper out of Park serial data signal, the BCM shall transition the windshield wiper motor command serial data signal to Park. While the wiper system smart is in the process of moving the wipers to their parked position, it shall set the value of its wiper front status serial data signal to Parking.

The wipe delay interval is a function of the INTERMITTENT Delay Interval Switch setting. When enabled, the Intermittent with Speed feature affects each of the 5 normal Intermittent Delay Intervals as a function of vehicle Speed. The Delay Intervals shall be biased to a shorter delay period with faster vehicle speeds and to a longer delay period with a slower vehicle speed.

The windshield wiper system MIST operation is identical to LOW speed operation, except that the MIST switch is a press and release type switch. When the wiper switch is moved to the MIST position (1X) and released, low speed wiper motor operation is started and will continue until 1 cycle is complete. If the wiper switch is moved to the MIST position and held, the wiper motor will operate in the LOW speed mode until the switch is released.

To initiate high speed wiping operation, the BCM provides continuous high speed wiper operation through setting the serial data signal to high speed Wipe. When the wiper switch lever is moved to the high position (HI) and released, high speed wiper motor operation is started and high speed wiping operation is performed.

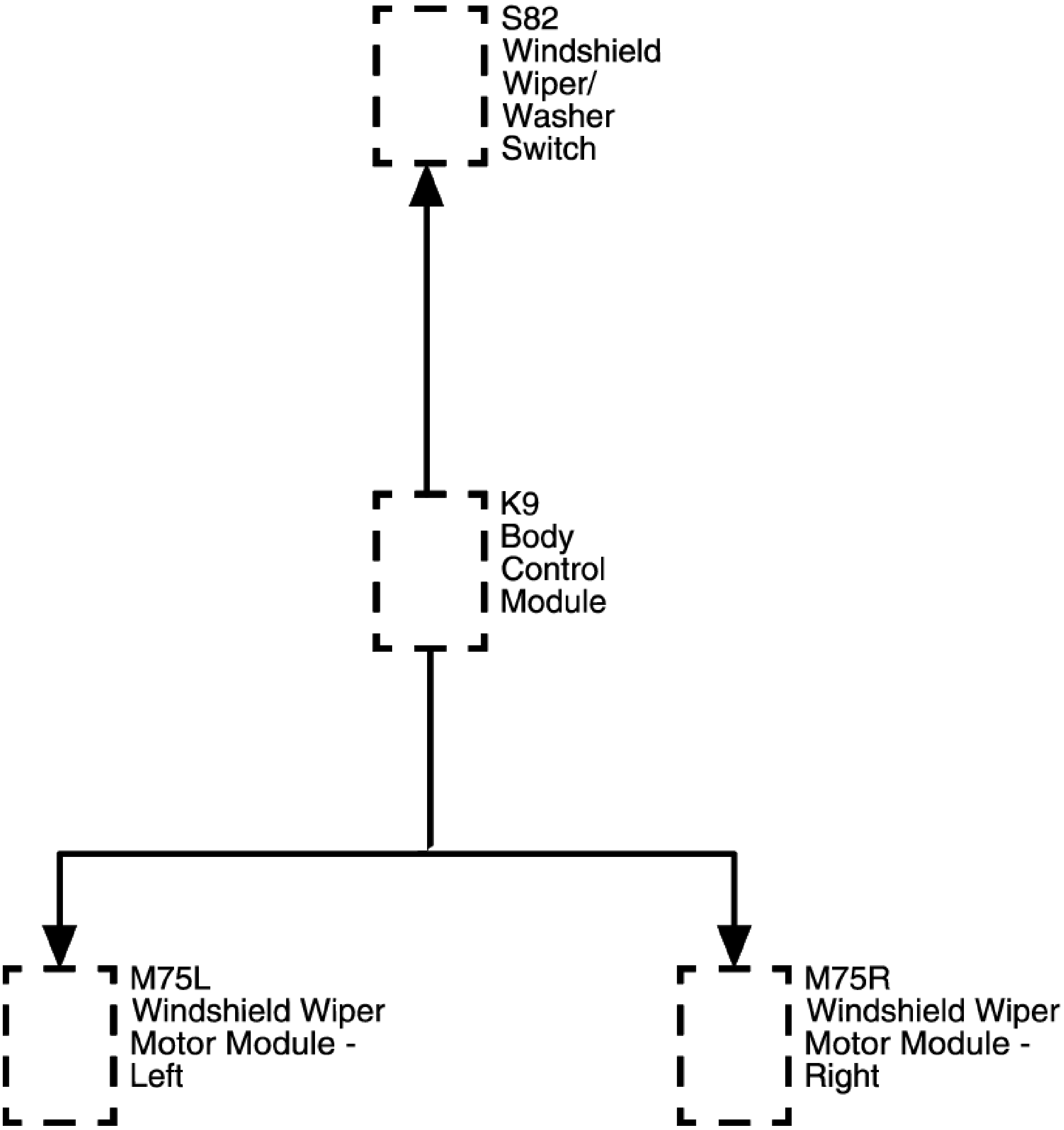

S82
Windshield
Wiper/
Washer
Switch
K9
Body
Control
Module
M75L
Windshield Wiper
Motor Module -
Left
M75R
Windshield Wiper
Motor Module -
Right

Fig. 25: Windshield Wiper/Washer Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S82	S82 Windshield Wiper/Washer Switch
K9	K9 Body Control Module
M75R	Windshield Wiper Motor Module - Right
M75L	Windshield Wiper Motor Module - Left

Windshield Washer System

The windshield washer pump is controlled by the body control module (BCM) via a printed circuit board (PCB) relay. When the washer switch is depressed, the BCM's internally pulled high resistor is pulled low by the washer request circuit. The BCM then applies voltage through a control circuit to the PCB windshield washer pump relay. With the relay energized, fused battery voltage is applied through the switch contacts of the relay and the control circuit to activate the windshield washer fluid pump.

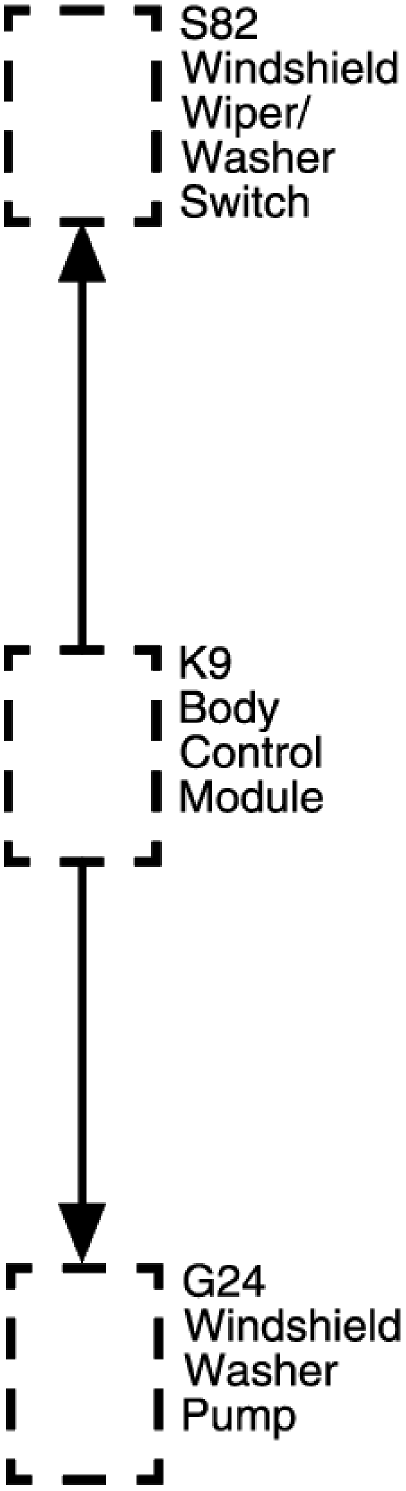


Fig. 26: Rear Wash System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
S82	S82 Windshield Wiper/Washer Switch
K9	K9 Body Control Module
G24	G24 Windshield Washer Pump

Washer Fluid Level Indicator

The check washer fluid message is controlled by the instrument cluster using an input from the washer fluid level switch. The washer fluid level signal circuit is supplied ignition voltage through a resistor then monitored within the instrument cluster. The washer fluid level switch is normally open so the instrument cluster detects ignition voltage on the washer fluid level signal circuit whenever the washer fluid level is not low. When the washer fluid reaches the point where the driver should be informed that the washer fluid is low, the washer fluid level switch closes. When the washer fluid level switch is closed the washer fluid level signal circuit voltage is pulled low, and the instrument cluster displays the Check Washer Fluid message on the driver information center. In order to prevent the check washer fluid message from being displayed while sloshing is occurring in the washer fluid container, the instrument cluster is programed with a 1 min delay before changing states of the check washer fluid message during an ignition cycle.

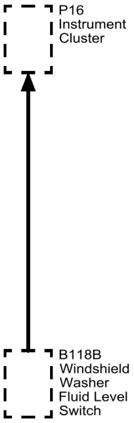


Fig. 27: Washer Fluid Level Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
B118B	B118B Windshield Washer Fluid Level Switch

Rain Sense Mode and Rain Sense Indicator

B+ voltage is supplied to the rain sensor. Whenever the ignition switch is in the on, or accessory positions, the body control module (BCM), sends the windshield wiper/washer switch status by using serial data. When a wipe cycle is needed, the rain sensor sends a data communication message to the BCM, requesting the wiper operation. The BCM commands the Windshield Wiper Motor wipe cycles. If at anytime a fault occurs between the rain sensor and BCM, the BCM will use the inputs from the windshield wiper/washer switch in the delay positions to operate the windshield wiper motor at continuous variable delay intervals.

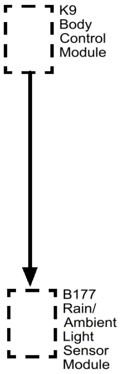

K9
Body
Control
Module
B177
Rain/
Ambient
Light
Sensor
Module

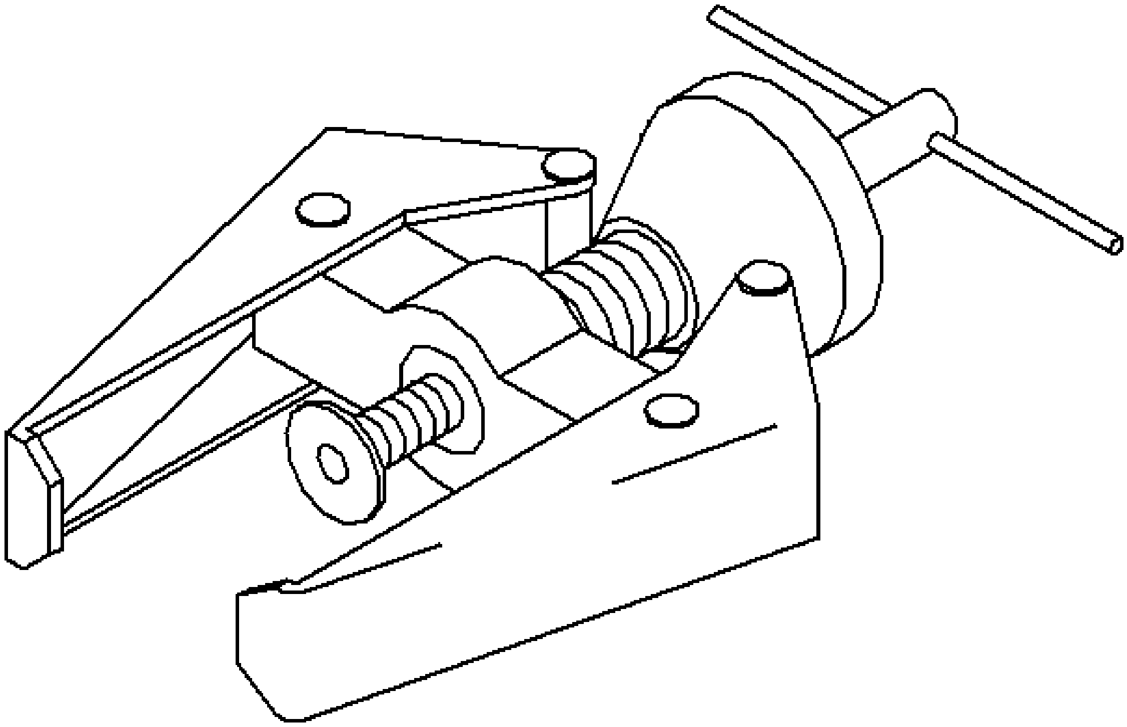
Fig. 28: Rain Sensor Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K9	K9 Body Control Module
B177	B177 Rain/Ambient Light Sensor Module

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

Illustration	Tool Number/Description
	J 39822 Wiper Arm Puller

Back To Article

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B097B: POWER MODE START SWITCH CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B097B

Power Mode Start Switch Circuit

For symptom byte information refer to Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	B097B 02	B097B 04	B097B 04	-
Low Reference	-	B097B 05*	-	-
Ground	-	B097B 04	-	-
* DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch up to 10 s, without the brake pedal applied will enter the Ignition ON/Vehicle Service Mode and the LED will illuminate. With the Ignition OFF/Vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once will enter Ignition ON/Vehicle ON mode and the LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provide redundant inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch in the same manner as the BCM. The keyless entry control module also controls the backup power for the ignition main relay 1 through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Conditions for Running the DTC

Control module voltage is 9 - 16 V.

Conditions for Setting the DTC

B097B 00

- The voltage seen at the BCM monitored switch does not match the voltage seen at the keyless entry control module monitored switch.
- The above condition exists for more than 1 s

B097B 02

- The control module detects a short to ground in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 04

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 05

- The control module detects an open in the vehicle ON/OFF switch signal circuit
- The above condition exists for more than 1 s

B097B 08

- The control module detects a change in the ignition mode without observing a switch press
- The above condition occurs 4 consecutive times

B097B 61

- The control module detects a continuously closed vehicle ON/OFF switch
- The above condition exists for more than 1 min

Action Taken When the DTC Sets

No action is taken.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears after 40 consecutive module ignition cycles without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Power Distribution Schematics**
- **Power Moding Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Power Mode Description and Operation**
- **Keyless Entry System Description and Operation**

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B097B 08 or B097B 61 is not set.
   - **If either DTC is set**

     Test or replace the S83 Vehicle On/Off Switch.

   - **If the DTCs are not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If less than 10 Ω**
4. Connect the S83 Vehicle On/Off Switch, Ignition ON/Vehicle in Service Mode.
5. Disconnect the S83 Vehicle On/Off Switch.
6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.
   - **If 11 V or less**
   1. Connect the S83 Vehicle On/Off Switch.
   2. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module.
   3. Test for infinite resistance between the signal circuit terminal 6 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K9 Body Control Module.
   - **If greater than 11 V**
7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.
   - **If 1 V or greater**
   1. Disconnect the harness connector at the K9 Body Control Module.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V

        3. Test for less than 2 Ω in signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K9 Body Control Module.
    - **If less than 1 V**
9. Connect the harness connector at the S83 Vehicle On/Off Switch.
10. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 8 - 10 V, with the S83 Vehicle On/Off Switch released.
    - **If not between 8 - 10 V**

      Test or replace the S83 Vehicle On/Off Switch.

    - **If between 8 - 10 V**
11. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 4 - 7 V, with the S83 Vehicle On/Off Switch pressed.
    - **If not between 4 - 7 V**

      Test or replace the S83 Vehicle On/Off Switch.

    - **If between 4 - 7 V**
12. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.
13. Test for infinite resistance between the signal circuit terminal 11 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
14. Ignition ON/Vehicle in Service Mode.
15. Test for less than 1 V between the signal circuit terminal 11 and ground.
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
16. Test for 4.5 - 5.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch released.
    - **If not between 4.5 - 5.5 k Ω**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch.
    2. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S83 Vehicle On/Off Switch.
    - **If between 4.5 - 5.5 k Ω**
17. Test for 1 - 1.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch pressed.
    - **If not between 1 - 1.5 k Ω**

      Test or replace the S83 Vehicle On/Off Switch.

    - **If between 1 - 1.5 k Ω**
18. Replace the K84 Keyless Entry Control Module.

Component Testing

vehicle ON/OFF Switch

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.

2. Test for 4.5 - 5.5 k Ω between the terminal listed below with the S83 Vehicle ON/OFF Switch released:
    - Signal terminal 6 and ground terminal 4
    - Signal terminal 3 and low reference terminal 7
    - **If not between 4.5 - 5.5 k Ω**

      Replace the S83 Vehicle On/Off Switch.

    - **If between 4.5 - 5.5 k Ω**
3. Test for 1 - 1.5k Ω between the terminals listed below with the S83 Vehicle On/Off Switch pressed, :
    - Signal terminal 6 and ground terminal 4
    - Signal terminal 3 and low reference terminal 7
    - **If not between 1 - 1.5 k Ω**

      Replace the S83 Vehicle On/Off Switch.

    - **If between 1 - 1.5 k Ω**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC B1370: CONTROL MODULE IGNITION ON AND START CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1370

Control Module Ignition On and Start Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Instrument Cluster Ignition (Instrument Cluster terminal 8)	B1370 06	B1370 06	B1370 01	-

Circuit/System Description

The vehicle power mode master is the body control module (BCM). The BCM monitors switch inputs and will activate relays and other direct outputs of the power mode master as needed according to the calculated power mode.

The instrument cluster has a switched voltage input and may operate in a default mode if the power mode master serial data message does not match what the individual module can see from its own connections.

Conditions for Running the DTC

B1370 01

Ignition is in Accessory mode.

B1370 06

Ignition is in Accessory/Ignition ON/Vehicle in Service Mode..

Conditions for Setting the DTC

B1370 01

Ignition circuit is shorted to voltage.

B1370 06

- Ignition circuit is open.
- Ignition circuit is shorted to ground.

Action Taken When the DTC Sets

The instrument cluster still functions except check engine light is always off.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

Instrument Cluster Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Instrument Cluster Description and Operation**
- **Power Mode Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B144B or B1380 is not set.
    - **If DTC B144B or B1380 is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If DTC B144B or B1380 is not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the P16 Instrument Cluster.
2. Verify that a test lamp does not illuminate between the ignition circuit terminal 8 and ground.
    - **If the test lamp illuminates**

      Repair the short to voltage on the ignition circuit.

    - **If the test lamp does not illuminate**
3. Ignition ON/Vehicle in Service Mode.
4. Verify that a test lamp illuminates between the ignition terminal 8 and ground.
    - **If the test lamp does not illuminate and the Ignition fuse is good**
    1. Ignition OFF/Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to **Power Mode Mismatch**.
    - **If the test lamp does not illuminate and the Ignition fuse is open**
    1. Ignition OFF/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the P16 Instrument Cluster.
    - **If the test lamp illuminates**
5. Replace the P16 Instrument Cluster.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC B1445: CONTROL MODULE VOLTAGE OUTPUT CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1445

Control Module Voltage Output Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Control	B1445 02	-	-	-

Circuit/System Description

The body control module (BCM) controls the ignition circuit by applying voltage to the retained accessory power relay coil control circuit. The ignition circuit is energized during all power modes except OFF - awake. The ignition circuit is also energized for approximately 10 min after shutting the vehicle OFF, providing no door is opened.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

The DTC will set only when the module requests the output and there is a short to ground in the ignition voltage circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the X80 Accessory Power Receptacle.
2. Connect a test lamp between the ignition circuit terminal A and ground, Ignition ON/Vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF when commanding the Accessory/Retained Accessory Power Relay On and Off with a scan tool.
    - **If the test lamp is always OFF**
    1. Ignition OFF/Vehicle OFF, remove test lamp, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance.
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.

- **If the test lamp is always ON**
  1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, ignition ON/Vehicle in Service Mode.
  2. Test for less than 1 V between the control circuit and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V, replace the K9 Body Control Module.
- **If the test lamp turns ON and OFF**

4. Test or replace the X80 Accessory Power Receptacle.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC B144A: RUN POWER RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B144A

Run Power Relay Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Run Ignition 3 Voltage	B144A 02	-	-	-

Circuit/System Description

The body control module (BCM) feeds the ignition circuit by applying voltage when the vehicle is in Ignition ON/Vehicle in Service Mode or Ignition ON/Vehicle ON mode.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The DTC can only run when the output is activated.

Conditions for Setting the DTC

The BCM detects a short to ground in the ignition circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the ignition circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC control module.
2. Connect a test lamp between the ignition circuit terminal 9 and ground.
3. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Ignition ON/Vehicle in Service Mode and Ignition OFF/Vehicle OFF.
    - **If the test lamp is always OFF**
    1. Ignition OFF/Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Ignition OFF/Vehicle OFF, remove the test lamp.
    2. Test for less than 1 V between the ignition circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**
4. Test or replace the K33 HVAC control module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC B144B: RUN/CRANK POWER RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B144B

Run/Crank Power Relay Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	B144B 02*	B144B 05*	B144B 01*	-
Control	B144B 02**	-	-	-
* DTC set in keyless entry control module ** DTC Set in BCM				

Circuit/System Description

The body control module (BCM) controls the ignition main relay 1 and the ignition main relay 2 through their control circuits by applying voltage to the ignition run/crank relay coil control circuit. The ignition main relay 1 and ignition main relay 2 are energized when the ignition is ON, or when a remote start is requested.

The keyless entry control module controls the backup power for the ignition main relays through the control circuit by applying voltage to the ignition circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the ignition is ON, or when a remote start is requested.

Conditions for Running the DTC

System voltage greater than 9 V.

Conditions for Setting the DTC

B144B 01

The ignition output is not active and a short to battery is detected 3 consecutive times on the ignition voltage circuit.

B144B 02

A short to ground is detected on the ignition run/crank relay coil control circuit.

B144B 05

The ignition output is not active and an open is detected 20 consecutive times on the ignition voltage circuit.

Action Taken When the DTC Sets

B144B 01, B144B 05

No action is taken.

B144B 02

The ignition main relay 1 and the ignition main relay 2 are deactivated when the fault is set. After 100 ms, the ignition main relay 1 and the ignition main relay 2 will be activated. If the fault is still set, the relays will be deactivated. The ignition main relay 1 and the ignition main relay 2 will again be activated after 100 ms. If this also results in a fault, the ignition main relay 1 and the ignition main relay 2 will be deactivated until a new ignition request is received.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present and an ignition request is received.
- A history DTC will clear after 50 malfunction-free ignition cycles.

Diagnostic Aids

A short to voltage on the ignition run/crank relay coil control will cause the engine to remain running after the ignition mode is changed to OFF.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the KR73A Ignition Main Relay 1 and the KR73B Ignition Main Relay 2 click ON and OFF when commanding the Run/Crank relay On and Off with a scan tool.
   - **If the KR73A Ignition Main Relay 1 or the KR73B Ignition Main Relay 2 do not click ON and OFF**

     Refer to Circuit/System Testing.

   - **If the KR73A Ignition Main Relay 1 and the KR73B Ignition Main Relay 2 click ON and OFF**
3. All OK.

Circuit/System Testing

1. Ignition ON/Vehicle in Service Mode, disconnect the X1 harness connector at the K84 Keyless Entry Control Module.
2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω, verify the fuse is good and there is voltage at the fuse.

   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K84 Keyless Entry Control Module.
   - **If the test lamp illuminates**

3. Ignition OFF/Vehicle OFF, connect the X2 harness connector at the K84 Keyless Entry Control Module and disconnect the X3 harness connector at the K9 Body Control Module.
4. Test for less than 1 V between the ignition circuit terminal 6 and ground.
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
5. Ignition ON/Vehicle in Service Mode.
6. Verify a test lamp illuminates between the ignition circuit terminal 6 and ground.
   - **If the test lamp does not illuminate**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If the test lamp illuminates**
7. Ignition OFF/Vehicle OFF, connect the X3 harness connector at the K9 Body Control Module.
8. Disconnect the KR73A Ignition Main Relay 1 and the KR73B Ignition Main Relay 2. It may take up to 2 min for all vehicle systems to power down.
9. Test for less than 10 Ω between the ground circuits listed below and ground.
   - KR73A Ignition Main Relay 1 - Ground circuit terminal 86
   - KR73B Ignition Main Relay 2 - Ground circuit terminal 86
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
10. Ignition ON/Vehicle in Service Mode, connect a test lamp between the control circuits listed below and ground.
    - KR73A Ignition Main Relay 1 - Control circuit terminal 85
    - KR73B Ignition Main Relay 2 - Control circuit terminal 85
11. Verify the test lamp turns ON and OFF when commanding the Run/Crank relay On and Off with a scan tool.
    - **If the test lamp is always OFF**
    1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the control circuit and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp is always ON**
    1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
    - **If the test lamp turns ON and OFF**

12. Test or replace the KR73A Ignition Main Relay 1 or the KR73B Ignition Main Relay 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC B1451: ACCESSORY POWER CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1451

Accessory Power Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	B1451 02	B1451 04	B1451 01	-

Circuit/System Description

The keyless entry control module provides as a backup control for the ignition power circuit, by applying voltage to the ignition power circuit. The ignition power circuit is energized when the vehicle power mode is in ACCESSORY mode or Ignition ON mode.

Conditions for Running the DTC

B1451 01, B1451 04

- Vehicle power mode is Ignition OFF
- Module is awake
- DTC B1451 not already set
- System voltage between 6 and 16 V

B1451 02

- Vehicle power mode is ACCESSORY or Ignition ON mode
- Module is awake
- The DTC is only run when the output is active
- DTC B1451 is not already set

- System voltage between 6 and 16 V

Conditions for Setting the DTC

B1451 01

Ignition output is not active and a short to battery is detected 3 consecutive times.

B1451 02

Ignition output is active and a short to ground is detected 3 consecutive times.

B1451 04

Ignition output is not active and an open circuit is detected 20 consecutive times.

Action Taken When the DTC Sets

B1451 02

The ignition output is deactivated when a short to ground is detected. After 100 ms the output is activated again. This happens 3 times and then the output is deactivated until a new ACCESSORY or Ignition ON mode request is received.

B1451 01, B1451 04

No action is taken.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present during a DTC check.
- A history DTC clears when the module power mode cycle counter reaches the reset threshold of 40, without a repeat of the malfunction.

Diagnostic Aids

- A short to voltage in the ignition control circuit will keep the vehicle modules awake, which can drain the vehicle's battery.
- A short to ground in the extension of this circuit through the body control module can back feed to the keyless entry control module. Check for a short to ground on the ignition circuit on the other side of the ignition pass thru, in the body control module, before replacing the body control module.

Reference Information

Schematic Reference

- **Power Distribution Schematics**
- **Remote Function Schematics**
- **Body Control System Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814 is not set.
   - **If DTC U1814 is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If DTC U1814 is not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition ON/Vehicle in Service Mode, disconnect the X2 harness connector at the K84 Keyless Entry Control Module.
2. Verify a test lamp illuminates between the B+ circuit terminal 5 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is good and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K84 Keyless Entry Control Module.
   - **If the test lamp illuminates**
3. Ignition OFF/Vehicle OFF, connect the X2 harness connector at the K84 Keyless Entry Control Module and disconnect the X3 harness connector at the K9 Body Control Module.
4. Test for less than 1 V between the ignition circuit terminal 5 and ground.
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
5. Ignition ON/Vehicle in Service Mode.
6. Verify a test lamp illuminates between the ignition circuit terminal 5 and ground.
   - **If the test lamp does not illuminate**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If the test lamp illuminates**
7. Replace the K9 Body Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup.

DTC B147E OR B147F: BATTERY SAVER RELAY SET/RESET SECONDARY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B147E

Battery Saver Relay Set Secondary Circuit

DTC B147F

Battery Saver Relay Reset Secondary Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Set Relay Coil Control	B147E 02	B147E 04	B147E 01	-
Reset Relay Coil Control	B147F 02	B147F 04	B147F 01	-

Circuit/System Description

Battery saver mode (transport mode) reduces the parasitic load of some modules during overseas shipment or during vehicle storage conditions. This improves the drain time on the battery (up to 70 days without the battery going dead). When a vehicle is in transport/storage, some features may have reduced functionality while in the battery saver mode, such as disabling keyless entry or content theft features. Battery saver mode is initiated by turning on the hazard flashers, applying the brake pedal, and then turning the ignition key to the start position or pushing the ignition mode switch with the foot on the brake for greater than 15 s. The mode is disengaged by repeating the previous process. The DIC (if equipped) will display transport mode is ON when battery saver mode is enabled and transport mode is OFF when battery saver mode is disabled. For vehicles not equipped with a DIC, the battery indicator light will constantly flash on the instrument cluster when battery saver mode is enabled. This feature can be used as many times as necessary if the vehicle is to be stored for an extended period of time.

Battery saver mode incorporates a latching relay that when enabled disconnects some modules from their ignition power or memory power sources. When battery saver mode is enabled and the vehicle is switched OFF, the BCM sends a momentary command to unlatch the relay disconnecting power up to 1 min after RAP is inactive. Every time the vehicle is switched ON the BCM will send a momentary command to latch the battery saver relay. This allows the use of all features when the ignition is ON. The BCM will send another command to unlatch the relay once the vehicle is switched OFF and RAP is inactive.

Conditions for Running the DTC

- The system voltage is between 9 - 16 V.
- The DTC can only run when the output is activated.

Conditions for Setting the DTC

B147E 01 or B147F 01

The BCM detects short to battery in the battery saver relay set/reset circuits.

B147E 02 or B147F 02

The BCM detects a short to ground in the battery saver relay set/reset circuits.

B147E 04 or B147F 04

The BCM detects an open/high resistance in the battery saver relay set/reset circuits.

Action Taken When the DTC Sets

B147E 01, B147E 04, B147F 01, and B147F 04

No action is taken.

B147E 02 and B147F 02

The module output driver will be shut down and not supply voltage to the battery saver relay set/reset circuits.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Power Moding Schematics**
- **Power Distribution Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Enable battery saver mode (transport mode) in the vehicle.
2. Verify that the appropriate devices controlled by the KR104A Battery Saver Relay 1 turn ON and OFF after enabling battery saver mode (transport mode).
    - **If the devices do not turn ON and OFF**

      Refer to Circuit/System Testing.

- **If the devices turn ON and OFF**

3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the KR104A Battery Saver Relay 1. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 6 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 3 and ground.
   - **If the test lamp does not illuminate and the fuse is not open**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the circuit breaker is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the fuse is open**
   1. Ignition OFF/Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test or replace the KR104A Battery Saver Relay 1.
   - **If the test lamp illuminates**
5. Enable battery saver mode (transport mode).
6. Ignition OFF/Vehicle OFF.
7. Connect a test lamp between the control circuit terminal 1 and ground.
8. Verify the test lamp momentarily flashes ON and OFF when turning the Ignition ON/Vehicle in Service Mode.
   - **If the test lamp is always OFF**
   1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Ignition ON/Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
9. Connect a test lamp between the control circuit terminal 2 and ground.
10. Verify the test lamp momentarily flashes ON and OFF after turning the Ignition OFF/Vehicle OFF.

NOTE: **It may take up to 1 min after the ignition is switched OFF and retained accessory power is disabled before the K9 Body Control Module sends a command to unlatch the relay.**

- **If the test lamp is always OFF**

1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
2. Test for infinite resistance between the control circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K9 Body Control Module.

- **If the test lamp is always ON**

1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Ignition ON/Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K9 Body Control Module.

- **If the test lamp turns ON and OFF**

11. Verify that a test lamp does not illuminate between the ignition circuit terminal 5 and ground.
    - **If the test lamp illuminates**

      Repair the short to voltage on the ignition circuit

    - **If the test lamp does not illuminate**
12. Ignition ON/Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 3 and the ignition circuit terminal 5.
13. Verify device is activated.
    - **If the device does not activate**

    1. Ignition OFF/Vehicle OFF, remove the test lamp, disconnect the harness connector at the device.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the device.

    - **If the device activates**
14. Test or replace the KR104A Battery Saver Relay 1.

Component Testing

Relay Test

1. Ignition OFF/Vehicle OFF, disconnect the KR104A Battery Saver Relay 1.
2. Test for 70 - 150 Ω between terminals the following terminals.
    - 1 and 6
    - 2 and 6
    - **If less than 70 or greater than 150 Ω**

      Replace the relay.

    - **If between 70 - 150 Ω**

3. Install a 3 A fused jumper wire between relay terminal 1 and 12 V. Install a jumper wire between relay terminal 6 and ground.
4. Test for infinite resistance between the following terminals:
    - 3 and 6
    - 3 and 5
    - 3 and 1
    - 3 and 2
    - 1 and 5
    - 2 and 5
    - **If less than infinite resistance**

      Replace the relay.

    - **If infinite resistance**
5. Install a 3 A fused jumper wire between relay terminal 1 and 12 V. Install a jumper wire between relay terminal 6 and ground.
6. Test for less than 5.0 Ω between terminals 3 and 5.
    - **If 5.0 Ω or greater**

      Replace the relay.

    - **If less than 5.0 Ω**
7. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC B305E: INTERRUPTIBLE RAP RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B305E

Interruptible RAP Relay Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Control	B305E 02	B305E 05	B305E 01, B305E 05	-

Circuit/System Description

The keyless entry control module controls the retained accessory power relay through the control circuit by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized when the ignition is in the Vehicle In Service Mode or the Vehicle On mode. The relay is also energized for approximately 10 min after shutting the vehicle OFF, providing no door is opened

Conditions for Running the DTC

- System voltage is greater than 6 V.
- The DTC can only set when the output is actively being requested by the module.

Conditions for Setting the DTC

B305E 01

The ignition output is not active and a short to battery is detected 3 consecutive times on the ignition voltage circuit.

B305E 02

The ignition output is active and a short to ground is detected on the ignition voltage circuit.

B305E 05

The ignition output is active and an open or short to battery is detected on the ignition voltage circuit.

Action Taken When the DTC Sets

B305E 01, B305E 05

No action is taken.

B305E 02

The module output driver will be shut down and not supply voltage to the circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present and the ignition output is active.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Power Moding Schematics**
- **Power Distribution Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the KR76 Retained Accessory Power Relay clicks ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
    - **If the KR76 Retained Accessory Power Relay does not click ON and OFF**

      Refer to Circuit/System Testing.

    - **If the KR76 Retained Accessory Power Relay clicks ON and OFF**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode, connect a test lamp between the control circuit terminal 86 and ground circuit terminal 85.
4. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If the test lamp turns ON and OFF**
5. Test or replace the KR76 Retained Accessory Power Relay.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Control Module References for control module replacement, programming and setup.

DTC P15B9 OR P15BA: ELECTRIC A/C COMPRESSOR CONTROL MODULE IGNITION ON/START SWITCH CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P15B9

Electric A/C Compressor Control Module Ignition On/Start Switch Circuit Low Voltage

DTC P15BA

Electric A/C Compressor Control Module Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Electric A/C compressor control module ignition	P15B9	P15B9	P15BA	-

Circuit/System Description

The body control module (BCM) controls the ignition main relay by applying voltage to the run/crank coil control circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode. The hybrid powertrain control module 2 receives the power mode status from the A/C compressor over serial data and compares this status to its own internal power mode status.

Conditions for Running the DTC

P15B9

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Hybrid powertrain control module 2 is awake.
- DTC's P2534, P2535, or U016B is not set.
- System voltage greater than 10.2 V.

P15BA

- Vehicle power mode is Vehicle OFF.
- Hybrid powertrain control module 2 is awake.
- DTC's P2534, P2535, or U016B is not set.
- System voltage greater than 10.2 V.

Conditions for Setting the DTC

P15B9

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Hybrid powertrain control module 2 ignition input is active.
- A/C compressor ignition input is not active for more than 2 s.

P15BA

- Vehicle power mode is Vehicle OFF.
- Hybrid powertrain control module 2 is awake.
- Hybrid powertrain control module 2 ignition input is not active.
- A/C compressor ignition input is active for more than 2 s

Action Taken When the DTC Sets

P15B9, P15BA

DTCs P15B9 and P15BA are type B DTCs.

Conditions for Clearing the DTC

P15B9 or P15BA

DTCs P15B9 and P15BA, are type B DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

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Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.
    - **If the DTC is set**

      Refer to **DTC B144B**.

    - **If the DTC is not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disconnect the X1 harness connector at the G1 A/C Compressor.
2. Verify that a test lamp does not illuminate between the ignition circuit terminal 3 and ground.
   - **If the test lamp illuminates**

     Repair the short to voltage on the ignition circuit.
   - **If the test lamp does not illuminate**
3. Vehicle in Service Mode
4. Verify a test lamp illuminates between the ignition circuit terminal 3 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, refer to **Power Mode Mismatch**.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF, disconnect the harness connector at the G1 A/C Compressor and all devices that share the same ignition circuit.
   2. Test for infinite resistance between the ignition circuit terminal 3 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
   3. Connect each of the devices one at a time and test for greater than 10 Ω between the ignition circuit terminal 3 and ground.
      - If 10 Ω or less, disconnect the appropriate device and retest to verify if the short is in the circuit or the component.
      - If greater than 10 Ω replace the appropriate device.
   - **If the test lamp illuminates**
5. Replace the G1 A/C Compressor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for control module replacement, programming and setup.

DTC P16E8: ENGINE CONTROLS IGNITION RELAY SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P16E8

Engine Controls Ignition Relay Signal Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Engine Controls Ignition	P16E8	P16E8	-	-
Run/Crank ignition 1	P17B3	P17B3	P17B4	-

Circuit/System Description

The transmission range control module monitors and compares the voltage of the engine controls ignition voltage circuit to the run/crank ignition 1 voltage circuit.

Conditions for Running the DTC

Ignition 1 voltage is greater than 6 V for.5 s.

Conditions for Setting the DTC

The transmission range control module detects that the ignition state of the engine controls ignition circuit and the run/crank ignition 1 circuit do not match.

Action Taken When the DTC Sets

DTC P16E8 is a Type B DTC.

Conditions for Clearing the DTC

DTC P16E8 is a Type B DTC.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

- **Electronic Transmission Range Selector Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P17B3 or P13B4 is not set.
   - **If DTC P17B3 or P13B4 is set**

     Refer to **DTC P17B3 or P17B4**.

   - **If DTC P17B3 or P13B4 is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, and all vehicle systems OFF, disconnect the harness connector at the K173 Transmission Range Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between ground circuit terminal 8 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Test for less than 1 V between the ignition circuit terminal 1 and ground.
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
4. Ignition ON/Vehicle in Service Mode.
5. Verify a test lamp illuminates between terminal 1 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF/Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, refer to **Power Mode Mismatch**.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF/Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   - **If the test lamp illuminates**
6. Replace the K173 Transmission Range Control Module.

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC P17B3 OR P17B4: TRANSMISSION RANGE CONTROL MODULE IGNITION 1 SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P17B3

Transmission Range Control Module Ignition 1 Switch Circuit Low Voltage

DTC P17B4

Transmission Range Control Module Ignition 1 Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P17B3	P17B3	P17B4	-
Ground	-	P17B3	-	-

Circuit/System Description

The transmission range control module samples the system voltage on the Ignition 1 voltage circuit every 0.25 s. Lower than normal voltage may be inadequate to operate properly.

Conditions for Running the DTC

P17B3

The ignition voltage signal is valid, with the ignition turned ON.

P17B4

The ignition voltage signal is valid, with the Ignition turned OFF.

Conditions for Setting the DTC

P17B3

The transmission range control module detects 6 V or less on the ignition voltage circuit, with the ignition turned ON.

P17B4

The transmission range control module detects greater than 6 V or greater on the ignition voltage circuit, with the ignition turned OFF.

Action Taken When the DTC Sets

DTCs P17B3 and P17B4 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P17B3 and P17B4 are Type B DTCs.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Description and Operation

- **Electronic Transmission Range Selector Description**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, and all vehicle systems OFF, disconnect the X1 harness connector at the K173 Transmission Range Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between ground circuit terminal 8 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode, verify a test lamp illuminates between B+ circuit terminal 16 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF/Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is good and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF/Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   - **If the test lamp illuminates**
4. Test for less than 1 V between the ignition circuit terminal 2 and ground.
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
5. Ignition ON/Vehicle in Service Mode.
6. Verify a test lamp illuminates between terminal 2 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF/Vehicle OFF.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, refer to **Power Mode Mismatch**.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Ignition OFF/Vehicle OFF.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   - **If the test lamp illuminates**
7. Replace the K173 Transmission Range Control Module.

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Control Module References** for control module replacement, programming, and setup.

DTC P17B5: TRANSMISSION RANGE CONTROL MODULE IGNITION SWITCH ACCESSORY POSITION CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC P17B5

Transmission Range Control Module Ignition Switch Accessory Position Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P17B5, U1814, U2099	P17B5	-	-

Circuit/System Description

The transmission range control module continuously monitors the voltage on the Ignition Accessory/Run circuit from the body control module (BCM). When the ignition is in the ACCESSORY or RUN position, the BCM sends a 12 V wake up signal to the control module. This wake up signal allows the control module to power up and start functioning before the engine is started.

Conditions for Running the DTC

The ignition is in the ACCESSORY or RUN position.

Conditions for Setting the DTC

The control module detects the Ignition Accessory/Run circuit is less than 6 V for 1 min.

Action Taken When the DTC Sets

DTC P17B5 is a Type C DTC.

Conditions for Clearing the DTC

DTC P17B5 is a Type C DTC.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX
- INLINE HARNESS CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814 or U2099 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the harness X1 connector at the K173 Transmission Range Control Module.
2. Ignition ON/Vehicle in Service Mode.
3. Verify a test lamp illuminates between the ignition circuit terminal 3 and ground.
    - **If the test lamp does not illuminate.**
    1. Ignition OFF/Vehicle OFF remove the test lamp, disconnect the X4 connector at the K9 Body Control Module.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω on the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
4. Replace the K173 Transmission Range Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for control module replacement, programming, and setup.

DTC P1A5E OR P1A5F: BATTERY ENERGY CONTROL MODULE IGNITION ON/START SWITCH CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A5E

Battery Energy Control Module Ignition On/Start Switch Circuit Low Voltage

DTC P1A5F

Battery Energy Control Module Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Energy Control Module Ignition	P1A5E	P1A5E	P1A5F	-

Circuit/System Description

The body control module (BCM) controls the ignition main relay through the control circuit by applying voltage to the run/crank coil control circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

P1A5E

- Hybrid powertrain control module 2 is awake.
- Vehicle power mode is Vehicle ON or Vehicle in Service Mode.
- Battery energy control module is awake.
- System voltage greater than 9 V.

P1A5F

- Hybrid powertrain control module 2 is awake.
- Vehicle power mode is Vehicle OFF.
- Battery energy control module is awake.
- System voltage greater than 9 V.

Conditions for Setting the DTC

P1A5E

- Hybrid powertrain control module 2 is awake.
- Ignition input is active and not above 5 V.

P1A5F

- Hybrid powertrain control module 2 is awake.
- Ignition input is not active and not below 5 V.

Action Taken When the DTC Sets

P1A5E, P1A5F

DTCs P1A5E and P1A5F are type B DTCs.

Conditions for Clearing the DTC

P1A5E, P1A5F

DTCs P1A5E and P1A5F are type B DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.
    - **If the DTC is set**

      Refer to **DTC B144B**.

    - **If the DTC is not set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**
2. Connect the 12 V battery, disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Verify that a test lamp does not illuminate between the ignition circuit terminal 4 and ground.
    - **If the test lamp illuminates**

      Repair the short to voltage on the ignition circuit.

    - **If the test lamp does not illuminate**
4. Vehicle in Service Mode

5. Verify a test lamp illuminates between the ignition circuit terminal 4 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to **Power Mode Mismatch**.
   - **If the test lamp does not illuminate and the circuit fuse is open**
     1. Vehicle OFF, disconnect the harness connector at all devices that share the same ignition circuit.
     2. Test for infinite resistance between the ignition circuit terminal 4 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance.
     3. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to **Battery Upper Cover Replacement**
     4. Connect the **EL-52014** low voltage jumper harness extension.
     5. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
     6. Test for infinite resistance between the ignition circuit terminal 9 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance.
     7. Connect each of the devices that share the same ignition circuit one at a time and test for greater than 100 Ω between the ignition circuit terminal 9 and ground.
        - If 100 Ω or less, disconnect the appropriate device and retest to verify if the short is in the circuit or the component.
        - If greater than 100 Ω replace the appropriate device.
   - **If the test lamp illuminates**
6. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to **Battery Upper Cover Replacement**
7. Connect the **EL-52014** low voltage jumper harness extension.
8. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
9. Verify that a test lamp does not illuminate between the ignition circuit terminal 9 and ground.
   - **If the test lamp illuminates**

     Repair the short to voltage on the ignition circuit.

   - **If the test lamp does not illuminate**
10. Vehicle in Service Mode
11. Verify a test lamp illuminates between the ignition circuit terminal 9 and ground.
    - **If the test lamp does not illuminate.**
      1. Vehicle OFF.
      2. Test for less than 2 Ω in the ignition circuit end to end.
         - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - **If the test lamp illuminates**
12. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup.

DTC P1A60: BATTERY ENERGY CONTROL MODULE IGNITION ACCESSORY SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P1A60

Battery Energy Control Module Ignition Accessory Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Serial Data Wake-Up	P1A60, P06E4, U1814, U2099	P1A60	-	-

Circuit/System Description

The hybrid powertrain control module 2 sends the serial data wake-up power mode status in a serial data message to the battery energy control module. The hybrid powertrain control module 2 also powers up the serial data wake-up circuit to the battery energy control module when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

- Vehicle power mode is Vehicle ON or Vehicle in Service Mode
- Battery energy control module is awake
- System voltage greater than 9 V

Conditions for Setting the DTC

Ignition input is active, and 500 ms after the ignition input transitions high, a voltage below 5 V is detected 3 consecutive times

Action Taken When the DTC Sets

DTC P1A60 is a type B DTC.

Conditions for Clearing the DTC

DTC P1A60 is a type B DTC.

Diagnostic Aids

A short to voltage in the serial data wake-up circuit will keep the vehicle bus awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814, U2099, or P06E4 is not set.
   - **If any of the DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If none of the DTCs are set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to High Voltage Disabling
2. Connect the 12 V battery, disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
3. Connect a test lamp between the serial data wake-up circuit terminal 5 and ground.
4. Verify the test lamp turns ON and OFF when cycling the S39 Ignition Mode Switch between Vehicle in Service Mode and Vehicle OFF.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 Ω in the serial data wake-up circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the ignition circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.

        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp turns ON and OFF**

5. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack cover. Refer to **Battery Upper Cover Replacement**
6. Connect the **EL-52014** low voltage jumper harness extension.
7. Disconnect the X8 harness connector at the K16 Battery Energy Control Module.
8. Connect a test lamp between the serial data wake-up circuit terminal 3 and ground.
9. Verify the test lamp turns ON and OFF when cycling the S39 Ignition Mode Switch between Vehicle in Service Mode and Vehicle OFF.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the **EL-52014** low voltage jumper harness extension.
    2. Test for less than 2 Ω in the serial data wake-up circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the **EL-52014** low voltage jumper harness extension.
    2. Test for less than 1 V between the ignition circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
    - **If the test lamp turns ON and OFF**
10. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup,

DTC P2534 OR P2535: IGNITION ON/START SWITCH CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P2534

Ignition On/Start Switch Circuit Low Voltage

DTC P2535

Ignition On/Start Switch Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2534	P2534	P2535	-

Circuit/System Description

The body control module (BCM) controls the ignition relay through the control circuit by applying voltage to the circuit. The ignition circuit is energized when the vehicle power mode is Vehicle ON or Vehicle in Service Mode.

Conditions for Running the DTC

P2534, P2535

The control module is awake.

Conditions for Setting the DTC

P2534

The control module detects 2 V or less on the ignition voltage circuit.

P2535

The control module detects greater than 5 V or greater on the ignition voltage circuit, with the ignition turned OFF.

Action Taken When the DTC Sets

P2534, P2535

DTCs P2534 and P2535 are type A DTCs.

Conditions for Clearing the DTC

P2534, P2535

DTCs P2534 and P2535 are type A DTCs.

Diagnostic Aids

A short to voltage in the ignition circuit will keep the vehicle modules awake, which can drain the vehicle's battery.

Reference Information

Schematic Reference

Power Distribution Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B144B is not set.
    - **If the DTC is set**

      Refer to **DTC B144B**.

- **If the DTC is not set**

2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF and all vehicle systems off, disconnect the harness connector at the control module setting the DTC.
2. Verify that a test lamp does not illuminate between the ignition circuit and ground.
    - **If the test lamp illuminates**

      Repair the short to voltage on the ignition circuit.

    - **If the test lamp does not illuminate**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the ignition circuit and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to **Power Mode Mismatch**
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the control module setting the DTC.
    - **If the test lamp illuminates**
5. Replace the control module setting the DTC.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for the appropriate control module replacement, programming and setup.

DTC P2537: IGNITION ACCESSORY SWITCH CIRCUIT LOW VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P2537

Ignition Accessory Switch Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2537, P06E4, U1814, U2099	P2537	-	-

Circuit/System Description

The control module continuously monitors the voltage on the ignition accessory circuit every 0.1s. Higher or lower than normal voltage may cause erratic vehicle operation.

Conditions for Running the DTC

P2537

Propulsion system is active for.5 s.

Conditions for Setting the DTC

P2537

The device detects the accessory voltage circuit is open for 0.1 s.

Action Taken When the DTC Sets

P2537

P2537 is a Type B DTC.

Conditions for Clearing the DTC

P2537

P2537 is a Type B DTC.

Diagnostic Aids

Short to ground may set multiple no communication codes for high speed GMLAN devices.

Reference Information

Schematic Reference

Data Communication Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC U1814, U2099, or P06E4 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
2. Refer to Circuit/System Testing.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

Hybrid/EV Powertrain Control Module 2 Circuit Malfunction

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Vehicle in Service Mode.
3. Verify a test lamp illuminates between the accessory wake up serial data circuit terminal 67 and ground.
    - **If the test lamp does not illuminate.**
    1. Ignition OFF remove the test lamp, disconnect the X4 connector at the K9 Body Control Module.
    2. Test for less than 2 Ω on the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If the test lamp illuminates**
4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Engine Control Module Circuit Malfunction

1. Vehicle OFF and all vehicle systems off, disconnect the X1 harness connector at the K20 Engine Control Module.
2. Vehicle in Service Mode.
3. Verify a test lamp illuminates between the Accessory Wake up Serial Data 2 circuit terminal 43 and ground.
    - **If the test lamp does not illuminate**

    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the KR114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2 Ω on the Accessory Wake up Serial Data 2 circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the KR114B Hybrid/EV Powertrain Control Module 2.
  - **If the test lamp illuminates**

4. Replace the control module setting the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup,

SYMPTOMS - WIRING SYSTEMS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to:
    - **Power Mode Description and Operation**
    - **Retained Accessory Power Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Power Mode Mismatch**
- **Retained Accessory Power Malfunction**
- **Vehicle ON/OFF Switch Indicator Malfunction**
- **Vehicle Will Not Change Power Mode**

POWER MODE MISMATCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The body control module (BCM) controls the ignition main relay by applying voltage to their individual relay control circuits. The BCM controls the ignition main relay through the control circuit by applying voltage to the run/crank relay coil control circuit. The ignition main relay is energized when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

The keyless entry control module controls the retained accessory power relay by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized during all power modes, except OFF-awake. The relay is also energized for approximately 10 min after shutting the vehicle OFF providing no door is opened. and during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle on/off switch is pressed which may result in NO REMOTE DETECTED displayed on the driver information center. The relay is also energized for approximately 10 min after shutting the vehicle OFF, providing no door is opened.

The engine control module (ECM) controls the engine controls the ignition relay by applying voltage to the engine controls relay control circuit.

Reference Information

Schematic Reference

- **Power Distribution Schematics**
- **Power Moding Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Use schematics to determine which ignition relay supplies the ignition feed for the appropriate devices. Use the connector end view to identify the ignition circuit terminal for each of those devices.**

1. Vehicle in Service Mode.
2. Verify that the appropriate devices controlled by the KR73A Ignition Main Relay 1 turn ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
   - **If the devices do not turn ON and OFF**

     Refer to Circuit/System Testing - Diagnostic A.
   - **If the devices turn ON and OFF**
3. Verify that the appropriate devices controlled by the KR73B Ignition Main Relay 2 turn ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
   - **If the devices do not turn ON and OFF**

Refer to Circuit/System Testing - Diagnostic B.

- **If the devices turn ON and OFF**

4. Verify that the appropriate devices controlled by the KR76 Retained Accessory Power Relay turn ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.
   - **If the devices do not turn ON and OFF**

     Refer to Circuit/System Testing - Diagnostic C.

   - **If the devices turn ON and OFF**
5. All OK.

Circuit/System Testing

WARNING: **High voltage enabling and disabling shall be only performed by High Voltage Qualified Technicians. The procedures for high voltage enabling/disabling can be found in the service instructions and must be strictly followed at all times. The usage of the Protocol High Voltage Disabling / Enabling is mandatory. The High Voltage Qualified Technician is responsible for the adherence to the manufacturer's service instructions as well as current national legal regulations.**

Failure to follow the procedures exactly as written may result in serious injury or death.

Questions regarding training can be answered by your national training centre.

WARNING: **Any hybrid/EV battery pack replacement shall be performed by High Voltage Qualified Technicians only. The replacement procedure can be found in the service instruction and must be strictly followed at all times. The High Voltage Qualified Technician is responsible for adherence to the manufacturer's service instructions as well as current national legal regulations. If the hybrid/EV battery pack needs to be replaced contact the Technical Assistance Centre for further instructions prior removal of the battery pack.**

Diagnostic A

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR73A Ignition Main Relay 1. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
   - **If the test lamp does not illuminate**

     Replace the X50A Fuse Block - Underhood

   - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
6. Verify the test lamp turns ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.

- **If the test lamp is always OFF**
  1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
  2. Test for infinite resistance between the control circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance.
  3. Test for less than 2 Ω in the control circuit end to end.
     - If 2 Ω or greater, repair the open/high resistance in the circuit.
     - If less than 2 Ω, replace the K9 Body Control Module.
- **If the test lamp is always ON**
  1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
  2. Test for less than 1 V between the control circuit and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V, replace the K9 Body Control Module.
- **If the test lamp turns ON and OFF**

7. Verify that a test lamp does not illuminate between the ignition circuit terminal 87 and ground.
   - **If the test lamp illuminates**

     Repair the short to voltage on the ignition circuit.

   - **If the test lamp does not illuminate**
8. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 30 and the ignition circuits listed below.
   - Ignition circuit terminal 87
   - Ignition circuit terminal 87A
9. Verify the device is activated.
   - **If the device does not activate**
     1. Vehicle OFF, disconnect the harness connector at the device.
     2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
     3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the device.
   - **If the device activates**
10. Test or replace the KR73A Ignition Main Relay 1.

Diagnostic B

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR73B Ignition Main Relay 2. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
   - **If 10 Ω or greater**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.

   - **If the test lamp does not illuminate**

     Replace the X50A Fuse Block - Underhood

   - **If the test lamp illuminates**

5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
6. Verify the test lamp turns ON and OFF when commanding the Run/Crank Relay On and Off with a scan tool.
   - **If the test lamp is always OFF**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance.
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K9 Body Control Module.
   - **If the test lamp turns ON and OFF**
7. Verify that a test lamp does not illuminate between the ignition circuit terminal 87 and ground.
   - **If the test lamp illuminates**

     Repair the short to voltage on the ignition circuit.

   - **If the test lamp does not illuminate**
8. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 30 and the ignition circuit terminal 87.
9. Verify the device is activated.
   - **If the device does not activate**
   1. Vehicle OFF, disconnect the harness connector at the device.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the device.
   - **If the device activates**
10. Test or replace the KR73B Ignition Main Relay 2.

Diagnostic C

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
    - **If the test lamp does not illuminate**

      Replace the X51A Fuse Block - Instrument Panel

    - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
6. Verify the test lamp turns ON and OFF when cycling the between Vehicle in Service Mode and Vehicle OFF.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance.
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If the test lamp turns ON and OFF**
7. Verify that a test lamp does not illuminate between the ignition circuit terminal 87 and ground.
    - **If the test lamp illuminates**

      Repair the short to voltage on the ignition circuit.

    - **If the test lamp does not illuminate**
8. Vehicle in Service Mode, connect a 40 A fused jumper wire between the B+ circuit terminal 30 and the ignition circuit terminal 87.
9. Verify device is activated.
    - **If the device does not activate**
    1. Vehicle OFF, disconnect the harness connector at the device.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the device.
    - **If the device activates**
10. Test or replace the KR76 Retained Accessory Power Relay.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the appropriate relay.

2. Test for 70 - 150 Ω between terminals (85 or 1) and (86 or 2).
   - **If less than 70 or greater than 150 Ω**

     Replace the relay.

   - **If between 70 - 150 Ω**
3. Test for infinite resistance between the terminals listed below:
   - (30 or 3) and (86 or 2)
   - (30 or 3) and (87 or 5)
   - (30 or 3) and (85 or 1)
   - (85 or 1) and (87 or 5)
   - (86 or 2) and (87 or 5)
   - **If less than infinite resistance**

     Replace the relay.

   - **If infinite resistance**
4. Install a 3 A fused jumper wire between relay terminal (85 or 1) and 12 V. Install a jumper wire between relay terminal (86 or 2) and ground.
5. Test for less than 5.0 Ω between terminals (30 or 3) and (87 or 5).
   - **If 5.0 Ω or greater**

     Replace the relay.

   - **If less than 5.0 Ω**
6. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Control Module References for control module replacement, programming and setup.

RETAINED ACCESSORY POWER MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Switch B+	1	1	1	-
Relay Switch Ignition	1	1	1, 2	-
Relay Coil Control	B305E 02	B305E 05	B305E 01, B305E 05	-
Relay Coil Ground	-	B305E 05	-	-
Ground	-	1	-	-
1. Retained accessory power malfunction 2. Retained accessory power relay always ON				

Circuit/System Description

The keyless entry control module controls the retained accessory power relay by applying voltage to the interruptible retained accessory power relay coil control circuit. The retained accessory power relay is energized during all power modes, except OFF-awake. The relay is also energized for approximately 10 min after shutting the vehicle OFF providing no door is opened. and during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle on/off switch is pressed which may result in NO REMOTE DETECTED displayed on the driver information center. The relay is also energized for approximately 10 min after shutting the vehicle OFF, providing no door is opened.

Reference Information

Schematic Reference

- Power Distribution Schematics
- Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Relay Replacement (Attached to Wire Harness) Relay Replacement (Within an Electrical Center)
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Use schematics to determine which devices are controlled by the KR76 Retained Accessory Power Relay. Use the connector end view to identify the ignition circuit terminal for each of those devices.**

1. Ignition ON.
2. Verify the appropriate devices controlled by the KR76 Retained Accessory Power Relay turn ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
    - **If the devices do not turn ON and OFF**

      Refer to Circuit/System Testing

    - **If the devices turn ON and OFF**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the KR76 Retained Accessory Power Relay. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 85 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 30 and ground.
    - **If the test lamp does not illuminate**

      Replace the X51A Fuse Block - Instrument Panel

    - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 86 and the ground circuit terminal 85.
6. Verify the test lamp turns ON and OFF when cycling the S83 vehicle ON/OFF switch between Vehicle in Service Mode and Vehicle OFF with the door open.
    - **If the test lamp is always OFF**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance.
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K84 Keyless Entry Control Module, Vehicle in Service Mode.
    2. Test for less than 1 V between the ignition circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K84 Keyless Entry Control Module.
    - **If the test lamp turns ON and OFF**
7. Connect the KR76 Retained Accessory Power Relay.
8. Disconnect the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.
9. Vehicle OFF.
10. Verify that a test lamp does not illuminate between each of the ignition circuits listed below and ground.
    - X80H Accessory Power Receptacle - Center Console - Ignition circuit terminal A
    - X80L Accessory Power Receptacle - Center Console Rear - Ignition circuit terminal A
    - T22 Mobile Device Wireless Charger Module - Ignition circuit terminal 1
    - **If the test lamp illuminates**

      Repair the short to voltage on the ignition circuit.

    - **If the test lamp does not illuminate**
11. Vehicle in Service Mode.
12. Verify that a test lamp illuminates between each of the ignition circuits listed below and ground.
    - X80H Accessory Power Receptacle - Center Console - Ignition circuit terminal A
    - X80L Accessory Power Receptacle - Center Console Rear - Ignition circuit terminal A
    - T22 Mobile Device Wireless Charger Module - Ignition circuit terminal 1
    - **If the test lamp does not illuminate and the circuit breaker or fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the K84 Keyless Entry Control Module.

- **If the test lamp does not illuminate and the circuit breaker or fuse is open**
  1. Vehicle OFF, remove the test lamp.
  2. Test for infinite resistance between the ignition circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance, test or replace the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.
- **If the test lamp illuminates**

13. Test or replace the appropriate X80 Accessory Power Receptacle or T22 Mobile Device Wireless Charger Module.

Component Testing

Relay Test

1. Vehicle OFF, disconnect the KR76 Retained Accessory Power Relay.
2. Test for 70 - 150 Ω between terminals 85 and 86.
   - **If less than 70 or greater than 150 Ω**

     Replace the relay.

   - **If between 70 - 150 Ω**
3. Test for infinite resistance between the following terminals:
   - 30 and 86
   - 30 and 87
   - 30 and 85
   - 85 and 87
   - **If less than infinite resistance**

     Replace the relay.

   - **If infinite resistance**
4. Test for less than 5.0 Ω between terminals 30 and 87.
   - **If 5.0 Ω or greater**

     Replace the relay.

   - **If less than 5.0 Ω**
5. Install a 3 A fused jumper wire between relay terminal 41 and 12 V. Install a jumper wire between relay terminal 40 and ground.
6. Test for less than 5.0 Ω between terminals 30 and 87.
   - **If 5.0 Ω or greater**

     Replace the relay.

   - **If less than 5.0 Ω**
7. All OK

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Accessory Power Receptacle Replacement
- Control Module References for control module replacement, programming and setup.

VEHICLE ON/OFF SWITCH INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	B097C 02	2	1	-
Ground	-	2	-	-
1. Vehicle ON/OFF switch indicator always ON 2. Vehicle ON/OFF switch indicator inoperative				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicates the vehicle power mode. When the vehicle is in the OFF mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch for at least 5 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains two individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through two resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch is the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch.

Reference Information

Schematic Reference

Power Moding Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the blue LED illuminates when the S83 Vehicle ON/OFF Switch is pressed and held for at least 5 s, with the brake pedal released.
   - **If the blue LED does not illuminate**

   Refer to Circuit/System Testing.

   - **If the blue LED illuminates**

2. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle ON/OFF Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Test for less than 1 V between the control circuit terminal 5 and ground.
   - **If 1 V of greater**
   1. Vehicle OFF, disconnect the harness connector at the K9 Body Control Module, Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If less than 1 V**
4. Vehicle OFF, connect the harness connector at the S83 Vehicle ON/OFF Switch.
5. Vehicle in Service Mode, disconnect the harness connector at the S83 Vehicle ON/OFF Switch.
6. Verify a test lamp illuminates between the control circuit terminal 5 and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, remove the test lamp, disconnect the harness connector at the K9 Body Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
7. Test or replace the S83 Vehicle ON/OFF Switch.

Component Testing

1. Vehicle OFF, disconnect the harness at the S83 Vehicle ON/OFF Switch.
2. Connect a jumper wire between the S83 Vehicle ON/OFF Switch terminal 4 and ground.
3. Connect a 3 A fused jumper wire between the S83 Vehicle ON/OFF Switch terminal 5 and B+.
4. Verify the blue LED illuminates.
   - **If the LED does not illuminate**

     Replace the S83 vehicle ON/OFF switch.

   - **If the LED illuminates**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for the body control module replacement, programming and setup.

VEHICLE WILL NOT CHANGE POWER MODE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal - Terminal 3	B097B 02*	B097B 05*	B097B 05*	-
Signal - Terminal 6	2	B097B 05*	2	-
Low Reference	-	B097B 05*	-	-
Ground	-	1	-	-
1. Vehicle ON/OFF Switch Indicator Always Off 2. Power Mode Mismatch * DTC set in keyless entry control module				

Circuit/System Description

The vehicle ON/OFF switch has a single LED that indicate the vehicle power mode. When the vehicle is in the off mode, the LED is not illuminated. Pressing and holding the vehicle ON/OFF switch for up to 10 s, without the brake pedal applied, will enter the Vehicle Service Mode and the blue LED will illuminate. With the vehicle OFF and the brake pedal applied, pressing the vehicle ON/OFF switch once, the vehicle will enter the Vehicle ON mode and the blue LED will illuminate.

The vehicle ON/OFF switch contains 2 individual switches that provides redundant switch inputs to both the body control module (BCM) and the keyless entry control module. The BCM supplies the vehicle ON/OFF switch a constant B+ signal. The BCM monitors this signal to determine if the switch is released or pressed. When the vehicle ON/OFF switch is not pressed, voltage on the signal circuit is pulled down through 2 resistors in the switch. When the vehicle ON/OFF switch is pressed, voltage on the signal circuit is pulled down through only one resistor, changing the voltage seen at the BCM and indicating that the vehicle ON/OFF switch is pressed.

The keyless entry control module monitors voltage on the switch is the same manner as the BCM, but monitors the second switch located in the vehicle ON/OFF switch. The keyless entry control module also controls the backup power for the ignition run relay through the control circuit by applying voltage to the ignition voltage circuit. This circuit is a pass-thru in the BCM and will energize the ignition circuit when the vehicle is in Service Mode, the vehicle is ON, or when a remote start is requested.

Reference Information

Schematic Reference

- **Power Distribution Schematics**
- **Power Moding Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Power Mode Description and Operation**
- **Keyless Entry System Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC B097B 08 or B097B 61 is not set.
   - **If either DTC is set**

     Test or replace the S83 Vehicle On/Off Switch.

   - **If the DTCs are not set**
2. Verify the blue LED illuminates when the S83 Vehicle On/Off Switch is pressed and held for up to 10 s, with the brake pedal released.
   - **If the blue LED does not illuminate**

     Refer to Circuit/System Testing.

   - **If the blue LED illuminates**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Test for less than 10 Ω between the low reference circuit terminal 7 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module.
   - **If less than 10 Ω**
4. Connect the S83 Vehicle On/Off Switch, Vehicle in Service Mode.
5. Disconnect the S83 Vehicle On/Off Switch.
6. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is greater than 11 V.
   - **If 11 V or less**
   1. Connect the S83 Vehicle On/Off Switch.
   2. Vehicle OFF, disconnect the X2 harness connector at the K9 Body Control Module and S83 Vehicle On/Off Switch.
   3. Test for infinite resistance between the signal circuit terminal 6 and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If greater than 11 V**
7. Install a 3 A fused jumper wire between the signal circuit terminal 6 and ground.
8. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is less than 1 V.
    - **If 1 V or greater**
    1. Disconnect the harness connector at the K9 Body Control Module.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If less than 1 V**
9. Connect the harness connector at the S83 Vehicle On/Off Switch.
10. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 8 - 10 V, with the S83 Vehicle On/Off Switch released.
    - **If not between 8 - 10 V**

      Test or replace the S83 Vehicle On/Off Switch.

    - **If between 8 - 10 V**
11. Verify the scan tool K9 Body Control Module Push Button Ignition Switch Voltage parameter is 4 - 7 V, with the S83 Vehicle On/Off Switch pressed.
    - **If not between 4 - 7 V**

      Test or replace the S83 Vehicle On/Off Switch.

    - **If between 4 - 7 V**
12. Disconnect the X1 harness connector at the K84 Keyless Entry Control Module.
13. Test for infinite resistance between the signal circuit terminal 11 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
14. Vehicle in Service Mode.
15. Test for less than 1 V between the signal circuit terminal 11 and ground.
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
16. Test for 4.5 - 5.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch released.
    - **If not between 4.5 - 5.5 k Ω**
    1. Vehicle OFF, disconnect the harness connector at the S83 Vehicle On/Off Switch.
    2. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, test or replace the S83 Vehicle On/Off Switch.
    - **If between 4.5 - 5.5 k Ω**
17. Test for 1 - 1.5 k Ω between the signal circuit terminal 11 and the low reference circuit terminal 12, with the S83 Vehicle On/Off Switch pressed.

- **If not between 1 - 1.5 k Ω**

  Test or replace the S83 Vehicle On/Off Switch.

- **If between 1 - 1.5 k Ω**

18. Replace the K84 Keyless Entry Control Module.

Component Testing

Ignition Mode Switch Test

1. Vehicle OFF, disconnect the harness connector at the S83 vehicle ON/OFF switch.
2. With the S83 vehicle ON/OFF switch released, test for 4.5 - 5.5 kΩ between the terminal listed below:
   - Signal terminal 6 and ground terminal 4
   - Signal terminal 3 and low reference terminal 7
   - **If not between 4.5 - 5.5 kΩ**

     Replace the S83 Vehicle On/Off Switch.

   - **If between 4.5 - 5.5 kΩ**
3. With the S83 Vehicle On/Off Switch pressed, test for 1 - 1.5k Ω between the terminals listed below:
   - Signal terminal 6 and ground terminal 4
   - Signal terminal 3 and low reference terminal 7
   - **If not between 1 - 1.5 kΩ**

     Replace the S83 Vehicle On/Off Switch.

   - **If between 1 - 1.5 kΩ**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Control Module References for the appropriate control module replacement, programming and setup.

GENERAL ELECTRICAL DIAGNOSIS

Basic Knowledge Required

Without a basic knowledge of electricity, it will be difficult to use the diagnostic procedures contained in the service manual. You should understand the basic theory of electricity, and know the meaning of voltage (V), current (A), and resistance (Ω). You should also be able to read and understand a wiring diagram, as well as understand what happens in a circuit with an open or a shorted wire.

CHECKING AFTERMARKET ACCESSORIES

WARNING: **Refer to SIR Warning .**

Do not connect aftermarket accessories into the SIR circuits, all such circuits are indicated on circuit diagrams with the SIR symbol.

Always check for aftermarket accessories (non-OEM) as the first step in diagnosing electrical problems. If the vehicle is so equipped, disconnect the system to verify that these add-on accessories are not the cause of the problems.

Possible causes of vehicle problems related to aftermarket accessories include:

- Power feeds connected to points other than the battery

- Antenna location
- Transceiver wiring located too close to vehicle electronic modules or wiring
- Poor shielding or poor connectors on antenna feed line
- Check for recent service bulletins detailing installation guidelines for aftermarket accessories.

CIRCUIT TESTING

The Circuit Testing section contains the following diagnostic testing information. Using this information along with the diagnostic procedures will identify the cause of the electrical malfunction.

- Using Connector Test Adapters
- Probing Electrical Connectors
- Troubleshooting with a Digital Multimeter
- Troubleshooting with a Test Lamp
- Using Fused Jumper Wires
- Measuring Voltage
- Measuring Voltage Drop
- Measuring Frequency
- Testing Ground and Low Reference Circuits
- Testing for Continuity
- Testing for Short to Ground
- Testing for a Short to Voltage
- Testing for Intermittent Conditions and Poor Connections
- Inducing Intermittent Fault Conditions
- Testing for Electrical Intermittents
- Scan Tool Snapshot Procedure
- Circuit Protection - Fuses
- Circuit Protection - Circuit Breakers
- Circuit Protection - Fusible Links

USING CONNECTOR TEST ADAPTERS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to Special Tools .

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.**

CAUTION: **Do not insert test equipment probes (DMM etc.) into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system failure. Always use the J-35616-F GM Approved Terminal Release Tool Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.**

When using the J-35616-F GM Approved Terminal Release Tool Kit, ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the J-35616-F GM Approved Terminal Release Tool Kit label on the inside of the J-35616-F GM Approved

Terminal Release Tool Kit for the correct adapter along with the connector end view for terminal size.

PROBING ELECTRICAL CONNECTORS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to **Special Tools** .

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.**

NOTE: **Always be sure to reinstall the connector position assurance (CPA) and terminal position assurance (TPA) when reconnecting connectors or replacing terminals.**

Front probe

Disconnect the connector and probe the terminals from the mating side (front) of the connector.

CAUTION: **Refer to Test Probe Caution .**

NOTE: **When probing female 0.64 terminals, it is important to use the correct adapter. There have been some revisions to the test adapter for 0.64 terminals. The proper adapter for 0.64 terminals is the J-35616-64B which has a gold terminal and a black wire between the base and tip. Failure to use the proper test adapter may result in damage to the terminal being tested and improper diagnosis.**

NOTE: **The proper adapter for probing the terminals for fuses, relays, or diodes in an electrical center is J-35616-35. Using any other tool or adapter may damage the terminal being tested.**

Refer to the following table as a guide in selecting the correct test adapter for front probing connectors:

Test Adapter	Description
J-35616-2A	150 Male Probe Adapter (gray)
J-35616-3	150 Female Probe Adapter (gray)
J-35616-4A	280 Male Probe Adapter (purple)
J-35616-5	280 Female Probe Adapter (purple)
J-35616-6	100W Male (round) Probe Adapter (brown)
J-35616-7	100W Female (round) Probe Adapter (brown)
J-35616-8	Weather Pack Male Probe Adapter (orange)
J-35616-9	Weather Pack Female Probe Adapter (orange)
J-35616-10	100W Male (round) Probe Adapter (green)
J-35616-11	100W Female (round) Probe Adapter (green)
J-35616-12	130 Male Probe Adapter (blue)
J-35616-13	130 Female Probe Adapter (blue)
J-35616-14	150 Male Probe Adapter (green)
J-35616-16	100 Male Probe Adapter (lt green)
J-35616-17	100 Female Probe Adapter (lt green)
J-35616-18	220 Male Probe Adapter (black)
J-35616-19	220 Female Probe Adapter (black)
J-35616-21	950 Female Probe Adapter (red)
J-35616-22	950 Male Probe Adapter (red)

Test Adapter	Description
J-35616-31	500 Male Probe Adapter (orange)
J-35616-32	500 Female Probe Adapter (orange)
J-35616-33	160/180 Male Probe Adapter (yellow)
J-35616-34	160/180 Female Probe Adapter (yellow)
J-35616-35	280 Male Probe Adapter (violet)
J-35616-40	480 Male Probe Adapter (dk blue)
J-35616-41	480 Female Probe Adapter (dk blue)
J-35616-42	630 Male Probe Adapter (red)
J-35616-43	630 Female Probe Adapter (red)
J-35616-44	800 Male Probe Adapter (yellow)
J-35616-45	800 Female Probe Adapter (yellow)
J-35616-54	280 Male (round) Probe Adapter (tan)
J-35616-55	280 Female (round) Probe Adapter (tan)
J-35616-64B	0.64 Male Probe Adapter (lt blue)
J-35616-65B	0.64 Female Probe Adapter (lt blue)
J-35616-66	150 Male (round) Probe Adapter (yellow)
J-35616-67	150 Female (round) Probe Adapter (yellow)

Backprobe

NOTE:

- **Backprobe connector terminals only when specifically required in diagnostic procedures.**
- **Do not backprobe a sealed (Weather PackÃ,Â®) connector, less than a 280 series Metri-Pack connector, a Micro-Pack connector, or a flat wire connector.**
- **Backprobing can be a source of damage to connector terminals. Use care in order to avoid deforming the terminal, either by forcing the test probe too far into the cavity or by using too large of a test probe.**
- **After backprobing any connector, inspect for terminal damage. If terminal damage is suspected, test for proper terminal contact.**

Do not disconnect the connector and probe the terminals from the harness side (back) of the connector.

TROUBLESHOOTING WITH A DIGITAL MULTIMETER

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools .

WARNING: **High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.**

CAUTION: **Refer to Test Probe Caution .**

Digital Multimeter (DMM) Basic Requirements

Service information is validated using digital multimeters that meet or exceed the following requirements. Using a multimeter that does not meet these basic requirements may give inaccurate readings which could lead to an incorrect diagnosis.

Display and Settings

1. Four digits displayed
2. Voltage, current, resistance, frequency, diode test settings, and min-max function
3. Display positive and negative values

Voltage

1. Have at least 10 M Ω input impedance
2. Test a DC voltage range of 0.1 - 1000 V.
3. Test an AC voltage range of 0.1 - 1000 V.

Current

1. Test a DC current range of 0.1µA - 10 A.
2. Test an AC current range of 0.1µA - 10 A.

Resistance

Test a resistance range of 0.1 Ω - 40 MΩ and displays infinite for a value greater than 40 M Ω (O.L. (Over-load))

Frequency

Test for a frequency range of 0.5 HZ - 199 K HZ

Diode Test

1. Apply at least 2 mA when performing the diode bias test
2. Display the break over voltage drop (0 - 3 V) of a forward biased diode
3. Display infinite (O.L. (Over-load)) when a diode is reverse biased

Min-Max Readings

1. Can update at a 25 ms sample rate
2. Saves and displays minimum and maximum values

NOTE: **Circuits which include any solid state control modules, such as the engine control module (ECM), should only be tested with a 10 megohm or higher impedance digital multimeter such as the EL-39200.**

The DMM instruction manual is a good source of information and should be read thoroughly upon receipt of the DMM as well as kept on hand for future reference.

A DMM should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The ohmmeter function on a DMM shows how much resistance exists between 2 points along a circuit. Low resistance in a circuit means good continuity.

NOTE: **Disconnect the power feed from the suspect circuit when measuring resistance with a DMM. This prevents incorrect readings. DMMs apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.**

Diodes and solid state components in a circuit can cause a DMM to display a false reading. To find out if a component is affecting a measurement take a reading once, then reverse the leads and take a second reading. If the readings differ the solid state component is affecting the measurement.

Following are examples of the various methods of connecting the DMM to the circuit to be tested:

- Probe both ends of the connector and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while you perform other operations or test driving. Refer to **Probing Electrical Connectors**.
- Disconnect the harness at both ends of the suspected circuit where it connects either to a component or to other harnesses.
- If the system that is being diagnosed has a specified pinout or breakout box, it may be used in order to simplify connecting the DMM to the circuit or for testing multiple circuits quickly.

TROUBLESHOOTING WITH A TEST LAMP

Special Tools

EL-35616-200 Test Light - Probe Kit

For equivalent regional tools, refer to **Special Tools** .

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.**

CAUTION: **Refer to Test Probe Caution .**

A test lamp can simply and quickly test a low impedance circuit for voltage. A digital multimeter (DMM) should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The **EL-35616-200** kit is Micro-Pack compatible and comprised of a 12 V light bulb with an attached pair of leads.

To properly operate this tool use the following procedures.

When testing for voltage:

1. Attach one lead to ground.
2. Touch the other lead to various points along the circuit where voltage should be present.
3. When the bulb illuminates, there is voltage at the point being tested.

When testing for ground:

1. Attach one lead to battery positive voltage.
2. Touch the other lead to various points along the circuit where ground should be present.
3. When the bulb illuminates, there is ground at the point being tested.

USING FUSED JUMPER WIRES

Special Tools

EL 35616-20F Fused Jumper Wire

For equivalent regional tools, refer to **Special Tools** .

NOTE: **A fused jumper may not protect solid state components from being damaged.**

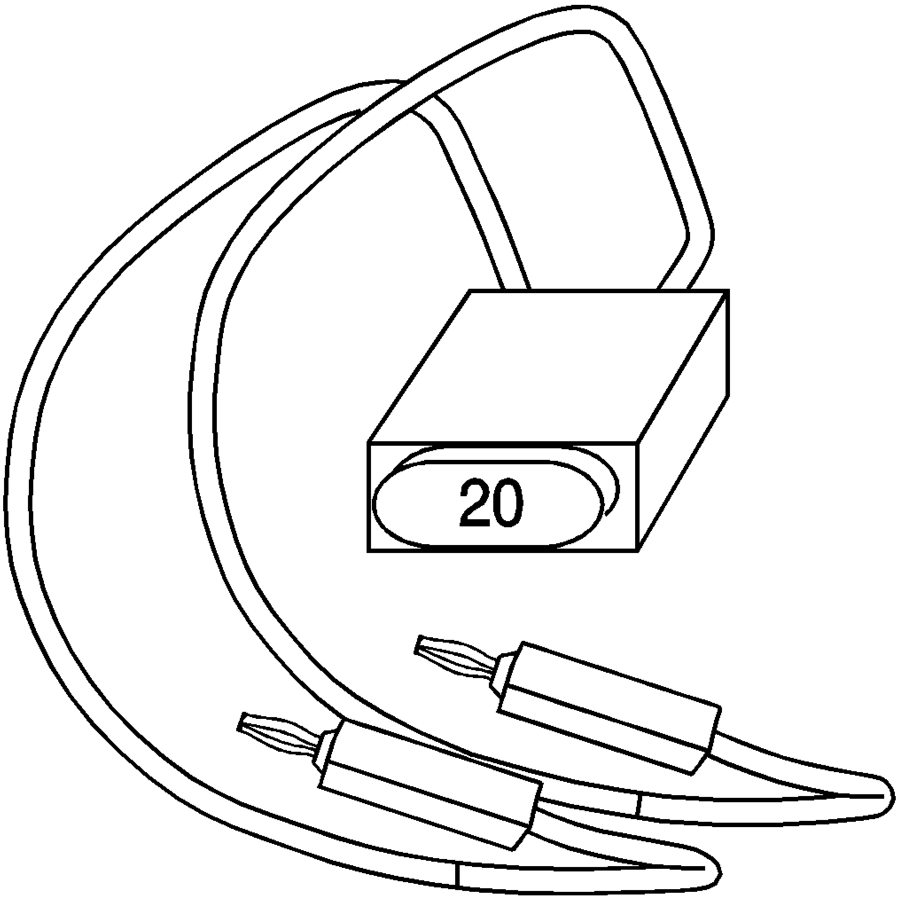


Fig. 1: Fused Jumper Wire
Courtesy of GENERAL MOTORS COMPANY

The **EL 35616-20F** Fused Jumper Wire includes banana jack connectors that provide adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 A fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

MEASURING VOLTAGE

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools .

WARNING: **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:**

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

CAUTION: **Refer to Test Probe Caution .**

The following procedure measures the voltage at a selected point in a circuit.

1. Disconnect the electrical harness connector for the circuit being tested, if necessary.
2. Enable the circuit and/or system being tested. Use the following methods:
    - Vehicle power mode to Vehicle in Service Mode or Vehicle On.
    - Turn ON the circuit and/or system with a scan tool in Output Controls.
    - Turn ON the switch for the circuit and/or system being tested.
3. Select the V (AC) or V (DC) position on the digital multimeter (DMM).
4. Connect the positive lead of the DMM to the point of the circuit to be tested.
5. Connect the negative lead of the DMM to a good ground.
6. The DMM displays the voltage measured at that point.

MEASURING VOLTAGE DROP

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools .

CAUTION: **Refer to Test Probe Caution .**

The following procedure determines the difference in voltage potential between 2 points.

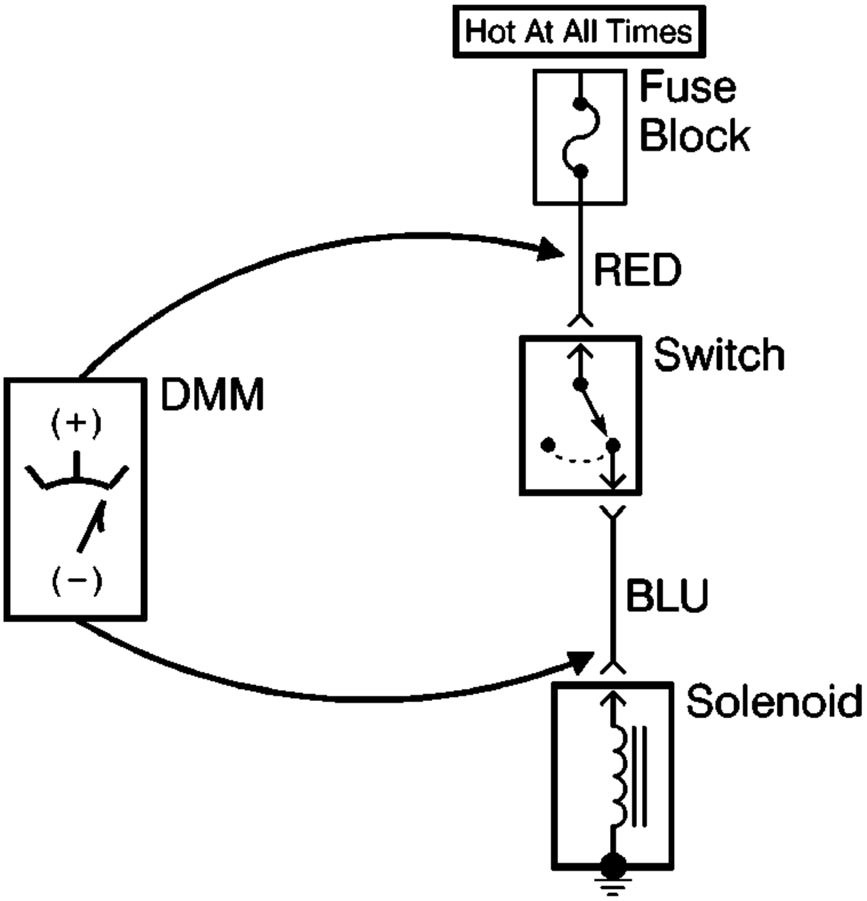


Fig. 2: Measuring Voltage Drop
Courtesy of GENERAL MOTORS COMPANY

1. Set the Digital Multimeter (DMM) to the V (DC) position.
2. Connect the positive lead of the DMM to one point of the circuit to be tested.
3. Connect the negative lead of the DMM to the other point of the circuit.
4. Operate the circuit.
5. The DMM displays the difference in voltage between the 2 points.

MEASURING FREQUENCY

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools .

CAUTION: **Refer to Test Probe Caution .**

The following procedure determines the frequency of a signal.

NOTE: **Connecting the Digital Multimeter (DMM) to the circuit before pressing the Hz button will allow the DMM to autorange to an appropriate range.**

1. Apply power to the circuit.
2. Set the DMM to the V (AC) position.
3. Connect the positive lead of the DMM to the circuit to be tested.
4. Connect the negative lead of the DMM to a good ground.
5. Set to Hz on the DMM.
6. The DMM will display the frequency measured.

TESTING GROUND AND LOW REFERENCE CIRCUITS

Because a test lamp can light with up to 200 Ω in a ground or low reference circuit they are not recommended to be used for this type of test. A low impedance test lamp can light and indicate the circuit is good when there is as much as 20 - 30 Ω present, while a high impedance test lamp can light with up to 200 Ω present in the circuit. This is why the Digital Multi-Meter (DMM) is used when validating a ground or low reference circuit continuity.

When using the DMM there are many vehicle conditions that can affect the ground and low reference continuity testing. If these conditions are not met, a ground or low reference circuit test can fail on a good circuit. This may cause longer diagnosis time and incorrect component replacement.

Any current flow through a ground or low reference circuit, while being tested, will skew the DMM continuity reading, or display a reading higher than when there is no current flowing. Performing a ground or low reference circuit continuity test, in reference to the vehicles battery negative terminal, will have the highest risk of failing a good ground or low reference circuit test than any other ground reference point. The best ground test points would be a control module housing (if the control modules housing is metal and grounded), door jamb striker (if attached to metal), under dash metal frame work, engine block, or body ground studs (other than where the negative battery cable is attached).

A typical DMM ground or low reference circuit continuity reading can be as high as 100 Ω with the vehicle power mode in Vehicle ON or Vehicle in Service Mode, and drop to 15 - 25 Ω after switching the vehicle off. The reading will drop below 10 Ω after 30 - 40 s, then below 5 Ω after 60 s. Once the vehicle completely goes to sleep (generally 3-10 min) the reading will drop below 0.3 Ω.

The following list of conditions may need to be met to ensure a valid continuity reading on a ground or low reference circuit:

- Vehicle off
- Transmitter out of range of the vehicle
- Retained Accessory Power off (open and close the driver door after vehicle off)
- Battery charger set at a 2 A or less charge rate

- Scan tool not communicating with any vehicle control module (in some cases it may need to be disconnected from the DLC)
- All entry doors closed
- Headlamps off(auto headlamps disabled)
- Any delay lighting off
- HVAC after blow off
- Any accessory that can work when the vehicle power mode is Vehicle OFF
- Wait up to 60 s (after all other listed conditions are met)

Locking the doors with a remote transmitter can greatly reduce the time to achieve a valid ground or low reference continuity test result.

There are some low reference circuits that use a driver to isolate the circuit while the ignition is off. This is done in most cases for accidental reverse battery connections or reverse polarity jump starting. When this driver is present, the ignition will need to be on to validate the circuit.

TESTING FOR CONTINUITY

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools .

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.**

CAUTION: **Refer to Test Probe Caution .**

The following procedures verify good continuity in a circuit.

With a Digital Multimeter (DMM)

1. Set the DMM to the Ω position.
2. Disconnect the power feed (i.e. fuse, control module) from the suspect circuit.
3. Disconnect the load.
4. Select the MIN MAX function on the DMM.
5. Connect one lead of the DMM to one end of the circuit to be tested.
6. Connect the other lead of the DMM to the other end of the circuit.
7. If the DMM displays low or no resistance, the circuit has good continuity.

With a Test Lamp

NOTE: **Only use the test lamp procedure on low impedance power and ground circuits.**

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to one end of the circuit to be tested.
4. Connect the other lead of the test lamp to battery positive voltage.
5. Connect the other end of the circuit to ground.
6. If the test lamp illuminates (full intensity), then the circuit has good continuity.

TESTING FOR SHORT TO GROUND

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious**

injury or death.

CAUTION: **Refer to Test Probe Caution .**

The following procedures test for a short to ground in a circuit.

With a Digital Multimeter (DMM)

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the rotary dial of the DMM to the Ω position.
4. Connect one lead of the DMM to one end of the circuit to be tested.
5. Connect the other lead of the DMM to a good ground.
6. If the DMM does NOT display infinite resistance (OL), there is a short to ground in the circuit.

With a Test Lamp

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to battery positive voltage.
4. Connect the other lead of the test lamp to one end of the circuit to be tested.
5. If the test lamp illuminates, there is a short to ground in the circuit.

Fuse Powering Several Loads

1. Review the system schematic and locate the fuse that is open.
2. Open the first connector or switch leading from the fuse to each load.
3. Connect a DMM across the fuse terminals (be sure that the fuse is powered).
    - When the DMM displays voltage the short is in the wiring leading to the first connector or switch.
    - If the DMM does not display voltage refer to the next step.
4. Close each connector or switch until the DMM displays voltage in order to find which circuit is shorted.

TESTING FOR A SHORT TO VOLTAGE

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.**

CAUTION: **Refer to Test Probe Caution .**

The following procedure tests for a short to voltage in a circuit.

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the digital multimeter (DMM) to the V (DC) position.
4. Connect the positive lead of the DMM to one end of the circuit to be tested.
5. Connect the negative lead of the DMM to a good ground.
6. Switch the vehicle power mode to Vehicle in Service Mode and operate all accessories.
7. If the voltage measured is greater than 1 V, there is a short to voltage in the circuit.

TESTING FOR INTERMITTENT CONDITIONS AND POOR CONNECTIONS

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to Special Tools .

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.**

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to Inducing Intermittent Fault Conditions in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to Testing for Electrical Intermittents for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to Scan Tool Snapshot Procedure for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers (BEC)

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center (BEC). Use **EL-35616** kit to test for proper terminal contact. Failure to use **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter from the on the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to **Circuit Testing**, and **Power Distribution Schematics** .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Operate the component to

test the ability of the circuit to carry sufficient current. Refer to **Circuit Testing**, and **Ground Distribution Schematics** .

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
  - High ambient temperatures
  - Underhood/engine generated heat
  - Circuit generated heat due to a poor connection, or high electrical load
  - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
  - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
  - The condition only occurs on a cold start.
  - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to **Inducing Intermittent Fault Conditions** in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference (EMI) or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator, etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to **Checking Aftermarket Accessories**.
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
  - A new service control module is installed.
  - A control module from another vehicle is installed.
  - Revised software/calibration files have been released for this vehicle.

NOTE: **DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.**

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to

Control Module References for replacement, setup, and programming.

INDUCING INTERMITTENT FAULT CONDITIONS

Special Tools

EL-25070 Heat Gun

For equivalent regional tools, refer to Special Tools .

WARNING: **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:**

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Many intermittent open or shorted circuits are affected by harness/connector movement that is caused by vibration, torque, bumps/rough pavement, etc. In order to duplicate the customer's concern, it may be necessary to manipulate the wiring harness if the malfunction appears to be vibration related. Manipulation of a circuit can consist of a wide variety of actions, including:

- Wiggling the harness
- Disconnecting a connector and reconnecting
- Stressing the mechanical connection of a connector
- Pulling on the harness or wire in order to identify a separation/break inside the insulation
- Relocating a harness or wires

All these actions should be performed with some goal in mind. For instance, with a scan tool connected, wiggling the wires may uncover a faulty input to the control module. The snapshot option would be appropriate here. Refer to Scan Tool Snapshot Procedure. Another option is, with the component commanded ON and OFF by the scan tool, to move related connectors and wiring and observe the component operation. With the vehicle ON, move related connectors and wiring while monitoring vehicle operation. If harness or connector movement affects the data displayed, component/system operation, or vehicle operation, inspect and repair the harness/connections as necessary.

You may need to load the vehicle in order to duplicate the concern. This may require the use of weights, floor jacks, jackstands, frame machines, etc. In these cases you are attempting to duplicate the concern by manipulating the suspension or frame. This method is useful in finding harnesses that are too short and their connectors pull apart enough to cause a poor connection. A DMM set to the Min/Max mode and connected to the suspect circuit while testing can yield desirable results. Refer to Testing for Electrical Intermittents.

Certainly, using the senses of sight, smell, and hearing while manipulating the circuit can provide good results as well.

There may be instances where circuit manipulation alone will not meet the required criteria for the fault condition to appear. In such cases it may be necessary to expose the suspect circuit to other conditions while manipulating the harness. Such conditions would include high moisture conditions, along with exceptionally high or low temperatures. The following discusses how to expose the circuit to these kinds of conditions.

High Temperature Conditions

If the complaint tends to be heat related, you can simulate the condition using the **EL-25070** heat gun.

Using the heat gun, you can heat up the suspected area or component. Manipulate the harnesses under high temperature conditions while monitoring the scan tool or DMM to locate the fault condition.

The high temperature condition may be achieved simply by test driving the vehicle at normal operating temperature. If a heat gun is unavailable, consider this option to enhance your diagnosis. This option does not allow for the same control, however.

Low Temperature Conditions

Depending on the nature of the fault condition, placing a fan in front of the vehicle while the vehicle is in the shade can have the desired effect.

If this is unsuccessful, use local cooling treatments such as ice or a venturi type nozzle (one that provides hot or cold air). This type of tool is capable of producing air stream temperatures down to -18Ã‚Â°C (0Ã‚Â°F) from one end and +71Ã‚Â°C (160Ã‚Â°F) from the other. This is ideally suited for localized cooling needs. In addition, circuit cooling spray can be used to cool down a component or circuit.

Once the vehicle, component, or harness has been sufficiently cooled, manipulate the harness or components in an effort to duplicate the concern.

Duplicating Failure Conditions

- If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions.
- Freeze Frame/Failure Records data, where applicable, contains the conditions that were present when the DTC set.
    1. Review and record Freeze Frame/Failure Records data.
    2. Clear the DTCs using the scan tool.
    3. Switch the vehicle power mode to Vehicle Off and wait 15 seconds.
    4. Operate the vehicle under the same conditions that were noted in Freeze Frame/Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text if a DTC is being diagnosed.
    5. Monitor DTC Status for the DTC being tested. The scan tool will indicate Ran, when the enabling conditions have been satisfied long enough for the DTC to run. The scan tool will also indicate whether the DTC passed or failed.
- An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the concern occurs, may help you locate the concern.

TESTING FOR ELECTRICAL INTERMITTENTS

Special Tools

EL-39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools .

WARNING: **This procedure should not be performed on high voltage circuits. Performing this procedure on high voltage circuits may result in serious injury or death.**

Perform the following procedures while wiggling the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test equipment.

- Testing for Short to Ground
- Testing for Continuity
- Testing for a Short to Voltage

If the fault is not identified, perform the procedure below using the MIN MAX feature on the **EL-39200** DMM. This feature allows you to manipulate the circuit without having to watch the DMM. The DMM will generate an audible tone when a change is detected.

NOTE: **The DMM must be used in order to perform the following procedure since the DMM can monitor current, resistance or voltage while recording the minimum (MIN), and maximum (MAX) values measured.**

1. Connect the DMM to both sides of a suspected connector (still connected), or from one end of a suspected circuit to the other. Refer to **Troubleshooting with a Digital Multimeter** for information on connecting the DMM to the circuit.
2. Set the rotary dial of the DMM to the V (AC) or V (DC) position.
3. Press the range button of the DMM in order to select the desired voltage range.

   NOTE: **The 100 ms RECORD mode is the length of time an input must stay at a new value in order to record the full change.**

4. Select the MIN MAX function of the DMM. The DMM displays the 100 ms RECORD and emits an audible tone (beep).
5. Simulate the condition that is potentially causing the intermittent connection, either by wiggling the connections or the wiring, test driving, or performing other operations. Refer to **Inducing Intermittent Fault Conditions**.
6. Listen for the audible Min Max Alert which indicates that a new minimum or maximum value has been recorded.
7. Press the MIN MAX button until the MAX value is displayed and note the value.
8. Press the MIN MAX button until the MIN value is displayed and note the value.
9. Determine the difference between the MIN and MAX values.
   - If the variation between the recorded MIN and MAX voltage values is 1 V or greater an intermittent open or high resistance condition exists. Repair the condition as necessary.
   - If the variation between the recorded MIN and MAX voltage values is less than 1 V an intermittent open or high resistance condition does not exist.

SCAN TOOL SNAPSHOT PROCEDURE

Reviewing Stored Data in Global Diagnostic System (GDS)

Overview

A snapshot is a recording of what a control module on the vehicle was receiving for information while the snapshot is being made. A snapshot is used to analyze the data during the time a vehicle condition is current. In GDS 2 there is not a traditional snapshot as there has been in the past. GDS 2 saves all past VIN and diagnostic data for future viewing. GDS 2 automatically records data whenever the user views Module Diagnostics, Vehicle Diagnostics and/or Systems Diagnostics. Module Diagnostics includes DTC Data, Identification Information, Data Display, Control Functions and Configuration/Reset Functions. Vehicle Diagnostics includes Vehicle Wide DTCs. Systems Diagnostics includes Inspection/Maintenance Status and Inspection/Maintenance Information.

Reviewing Stored Data

The Review Stored Data function allows viewing and playing of previously recorded vehicle data. This information can be used in analysis of vehicle problems and detection of trigger error conditions. The graph function can be used to compare multiple parameters to see if a component is functioning properly. Recorded sessions can be selected for viewing by the following two methods:

- From the Home Page, click on Review Stored Data. In the Review Stored Data page, highlight a vehicle in the Sessions screen located in the upper pane and highlight the desired Stored Data in the lower pane, then click the Review button.
- The user can view stored data without ending a current on-vehicle diagnostic session by clicking the Vehicle Menu button (when active) or Back button until the Session Manager is displayed in the menu. This is used when a user is viewing live data and wants the quickest way to review the

data. Click on the Session Manager button. Highlight the desired Stored Data in the lower pane and click the Review button.

Stored Data Review Selections

The following information can be selected in the tabs at the top of the screen:

- Graphical Data Display - Allows a detailed review of parameter data. The buttons on the right side modify the graph data
- Diagnostic Data Display - Displays incoming information from the file. The current value of the parameters is displayed on the screen.
- Line Graph - Allows selected locked parameters to be graphed with parameters overlaid for data comparison. The current value of the parameters is displayed on the screen. Use the buttons on the right side to modify the graph data.
- Bookmarks - If bookmarks are present, this displays the Type, Description and Time of automatic and manually generated bookmarks.
- System Information - Displays the GDS 2 Software Version and MDI Serial Number used when the session was recorded.
- Selected Vehicle Configuration - Displays vehicle identifiers, such as transmission type, for the vehicle selected on the Stored Data Review screen in the Sessions field.
- RPO - Displays vehicle build information.

Graphical Data Display

On the Graphical Data Display tab there are multiple selections at the top of the page. The selections available are:

- Create Report - Opens and internet browser page where a data display report can be printed or saved for future reference.
- Unit Switch - Toggles graph units between English and metric.
- Lock - When a parameter is selected, clicking the lock button locks a selected parameter for viewing in the Line Graph tab. In the Line Graph tab, locked parameters are isolated and overlaid for data comparison.
- Up Arrow - Click the up arrow to move a highlighted parameter up a position on the list.
- Down Arrow - Click the down arrow to move a highlighted parameter down a position on the list.
- Save As - This selection is available in the Graphical Data Display and Diagnostic Data Display tabs. This allows the user to export the graph data to a worksheet for in depth analysis and to timestamp data.

Review Stored Data Functions

To review the session there are buttons at the bottom of the window to control the cursor. From left to right the buttons are:

- Insert Bookmark - This button allows the user to insert bookmarks anywhere along the timeline. This provision allows the user to record notes regarding the inserted bookmark.
- Return Bookmark - This button moves the cursor to the previous bookmark.
- Back - This button moves the cursor back 1 frame.
- Timeline Slider Control - This allows the user to slide and select any position on the Timeline required.
- Forward - This button moves the cursor forward 1 frame.
- Forward Bookmark - This button moves the cursor forward 1 bookmark.
- Bookmarks - Allows the user to toggle bookmark visibility ON and OFF.

Graphical Preference Selections

The vertical side bar on the right side of the screen in the Graphical Data Display and Line Graph tabs toggles the Graphical Selection Panel from hidden to visible. The graphical preference selections available are:

- Reset - Resets the graph display back to the initial standard GDS 2 setting.
- Grid Line Toggle - This toggle reverses the current state of showing or removing grid lines.
- Hash Mark Toggle - This toggle reverses the current state of showing or removing data acquisition points or hash marks.
- Horizontal Graph Compression - Compresses the scale of the graph horizontally.
- Horizontal Graph Expansion - Expands the scale of the graph horizontally.
- Vertical Graph Compression - Compresses the scale of the graph vertically.
- Vertical Graph Expansion - Expands the scale of the graph vertically.
- Move Centerline of Graph Up - Moves the centerline of the graph up incrementally.
- Move Centerline of Graph Down - Moves the centerline of the graph down incrementally.

CIRCUIT PROTECTION - FUSES

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

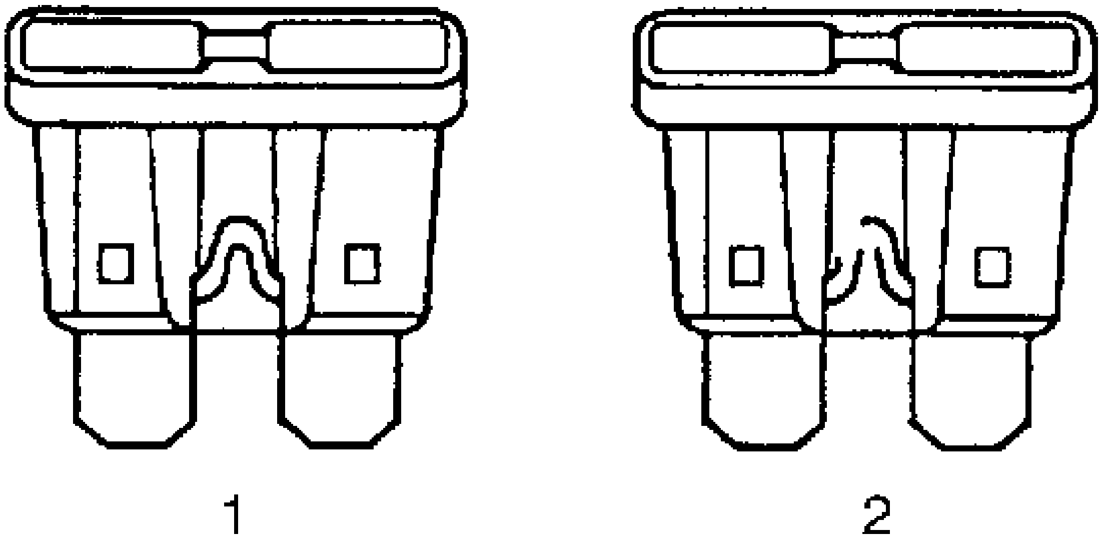


Fig. 3: Identifying Open Fuse Element
Courtesy of GENERAL MOTORS COMPANY

The fuse is the most common method of an automotive wiring circuit protection. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit. Fuses are a one time protection device and must be replaced each time the circuit is overloaded. To determine if a fuse is open, remove the suspected fuse and examine if the element in the fuse is broken (2). If not broken (1), also check for continuity using a Digital Multimeter (DMM) or a continuity tester. If the element is broken or continuity is suspect, replace the fuse with one of equal current rating.

Fuse Types

Current Rating Amperes	Color
Auto Fuses, Mini Fuses	
2	Gray
3	Violet
5	Tan
7.5	Brown
10	Red
15	Blue
20	Yellow
25	White or Natural
30	Green
Maxi Fuses	
20	Yellow
30	Light Green
40	Orange or Amber
60	Blue
50	Red
J-Case Fuses	
20	Blue
30	Pink
40	Green
50	Red
60	Yellow
Midi Fuses	
80	Black
Mega Fuses	
100	Black
150	Black
200	Black

CIRCUIT PROTECTION - CIRCUIT BREAKERS

A circuit breaker is a protective device that is designed to open the circuit when a current load is in excess of the rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. Two types of circuit breakers are used.

Circuit Breaker

This type opens when excessive current passes through it for a period of time. It closes again after a few seconds, and if the cause of the high current is still present, it will open again. The circuit breaker will continue to cycle open and closed until the condition causing the high current is removed.

Positive Temperature Coefficient (PTC) Circuit Breaker

This type greatly increases its resistance when excessive current passes through it. The excessive current heats the PTC device, as the device heats its resistance increases. Eventually the resistance gets so high that the circuit is effectively open. Unlike the ordinary circuit breaker the PTC unit will not reset until the circuit is opened, by removing the voltage from its terminals. Once the voltage is removed the circuit breaker will re-close within a second or 2.

CIRCUIT PROTECTION - FUSIBLE LINKS

Special Tools

EL - 39200 Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools .

NOTE: **When repairing a fusible link, fusible links cut longer than 225 mm (approximately 9 in) will not provide sufficient overload protection.**

Fusible link is wire designed to melt and break continuity when excessive current is applied. It is often located between or near the battery and starter or electrical center. Use a continuity tester or a Digital Multimeter (DMM) at each end of the wire containing the fusible link in order to determine if it is broken. If broken, it must be replaced with fusible link of the same gauge size.

WIRING REPAIRS

The Wiring Repairs section contains the following types of wiring repair information. Using these elements together will make wiring repair faster and easier:

- Flat Wire Repairs
- Serial Data Circuit Wiring Repairs
- High Temperature Wiring Repairs
- Heated Oxygen Sensor Wiring Repairs
- Wire to Wire Repair
- Splicing Inline Harness Diodes
- Splicing Twisted or Shielded Cable
- SIR/SRS Wiring Repairs

CONNECTOR REPAIRS

Connector Repairs contains a list of all connector repairs. The connector repairs are listed by the connector manufacturer and then by connector type. If the technician cannot identify the manufacturer of the connector, refer to Identifying Connectors below. Knowing the connector manufacturer will assist in finding the correct connector repair from the following list:

- Connector Position Assurance Locks
- Terminal Position Assurance Locks
- AFL/EPC Connectors
- Bosch Connectors (BSK) Bosch Connectors (0.64) Bosch Connectors (2.8 JPT) Bosch Connectors (ECM)
- Delphi Connectors (Weather Pack) Delphi Connectors (Push To Seat) Delphi Connectors (Pull To Seat) Delphi Connectors (Micro-Pack 100W) Delphi Connectors (Micro.64) Delphi Connectors (12-Way) Delphi Connectors (Steering Gear)
- FCI Connectors (Lever Lock) FCI Connectors (SIR)
- FEP Connectors (Steering Gear)
- JST Connectors
- Kostal Connectors (Glow Plug Control Module) Kostal Connectors (Transmission)
- Molex Connectors (Lever Lock) Molex Connectors (SIR)
- Sumitomo Connectors
- Tyco/AMP Connectors (CM 42-Way) Tyco/AMP Connectors (Sensor) Tyco/AMP Connectors (0.25 Cap) Tyco/AMP Connectors (43-Way) Tyco/AMP Connectors (Door Module) Tyco/AMP Connectors (Seat) Tyco/AMP Connectors (102-Way Inline) Tyco/AMP Connectors (SIR)
- Yazaki Connectors (2-Way) Yazaki Connectors (16-Way)

- [Repairing Connector Terminals (Terminated Lead Repair)](#) [Repairing Connector Terminals (Terminal Repair)](#)

Connector Anatomy

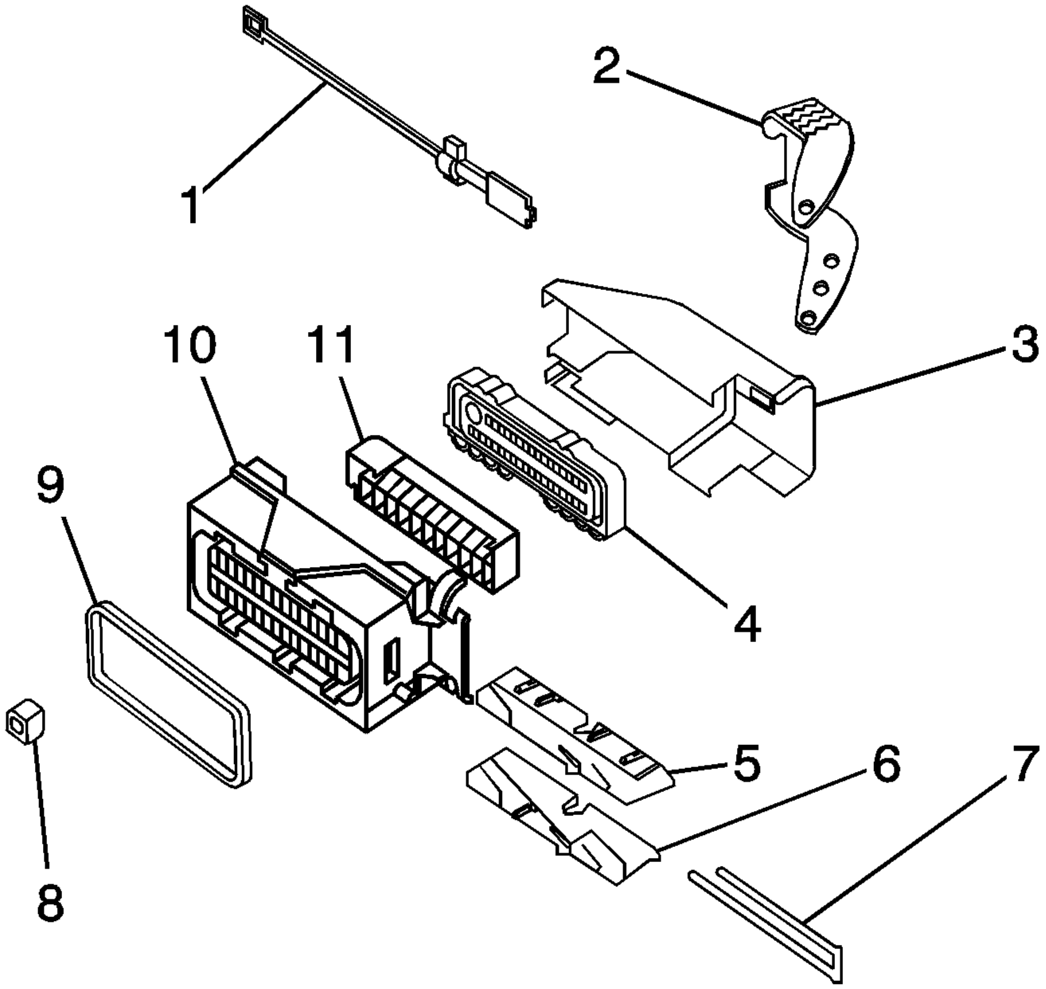


Fig. 4: Identifying Typical Connector Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Connector Positive Assurance (CPA)
2	Assist Lever
3	Wiredress Cover
4	Seal Strain/Relief
5	Slide Left Hand
6	Slide Right Hand
7	Terminal Positive Assurance (TPA)
8	Terminal Positive Assurance (TPA)
9	Connector Seal
10	Connector Housing
11	Inner Connector

Identifying Connectors

Knowing the connector manufacturer is helpful when trying to locating the correct connector repair procedure. There are many different connector designs used on GM vehicles and it is sometimes difficult to identify the connector manufacturer. The information in this document should help with the identification of connector manufactures.

The following connector manufacturers make most of the connectors found in GM vehicles:

- AFL/EPC (Alcoa Fujikura Ltd./Engineered Plastics Components)
- Bosch
- Delphi
- FCI (Framatome Connectors International)
- JAE (Japan Aviation Electronics)
- JST (Japan Solderless Terminals)
- Kostal
- Molex
- Sumitomo
- Tyco/AMP
- Yazaki

Identifying the manufacturer of a connector is often difficult. When trying to determine the manufacturer of a connector, look for specific identifying marks that are unique to that connector supplier. Most of these identify marks are hard to find or see. Check the connector carefully and refer to the information below for pictures and descriptions of connector identification markings.

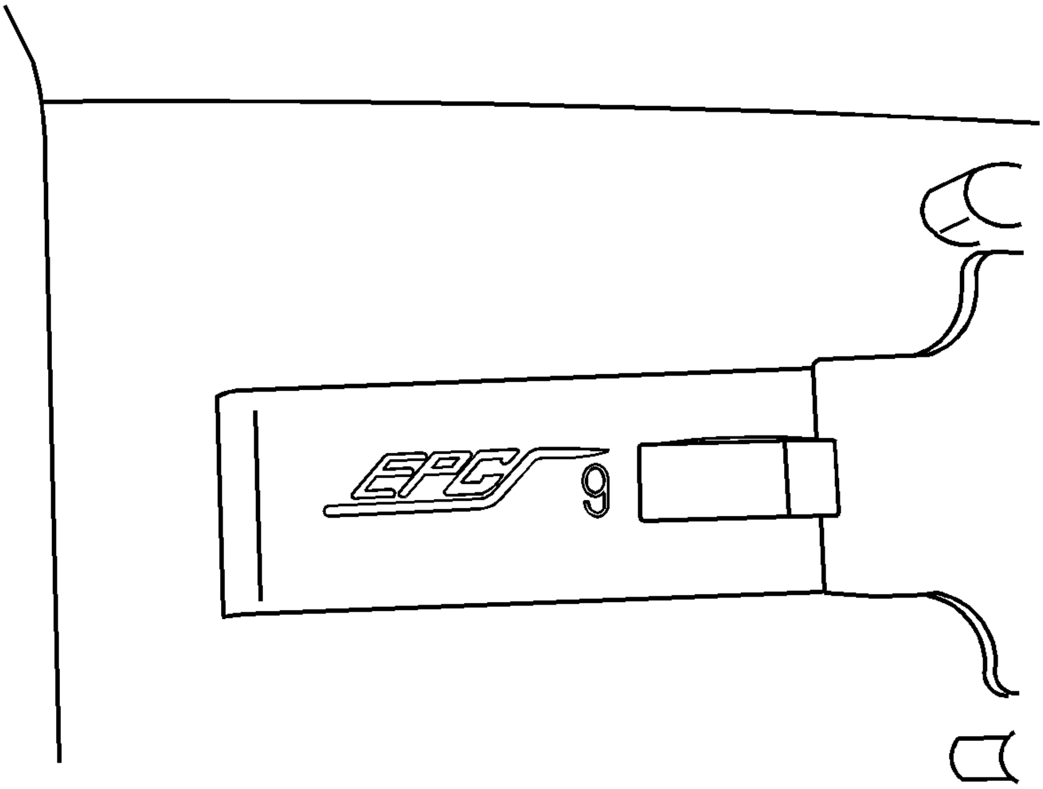


Fig. 5: View Of EPC Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- Most of AFL's connectors have EPC on their connector body. Some of the smaller connectors will not have any markings on them.

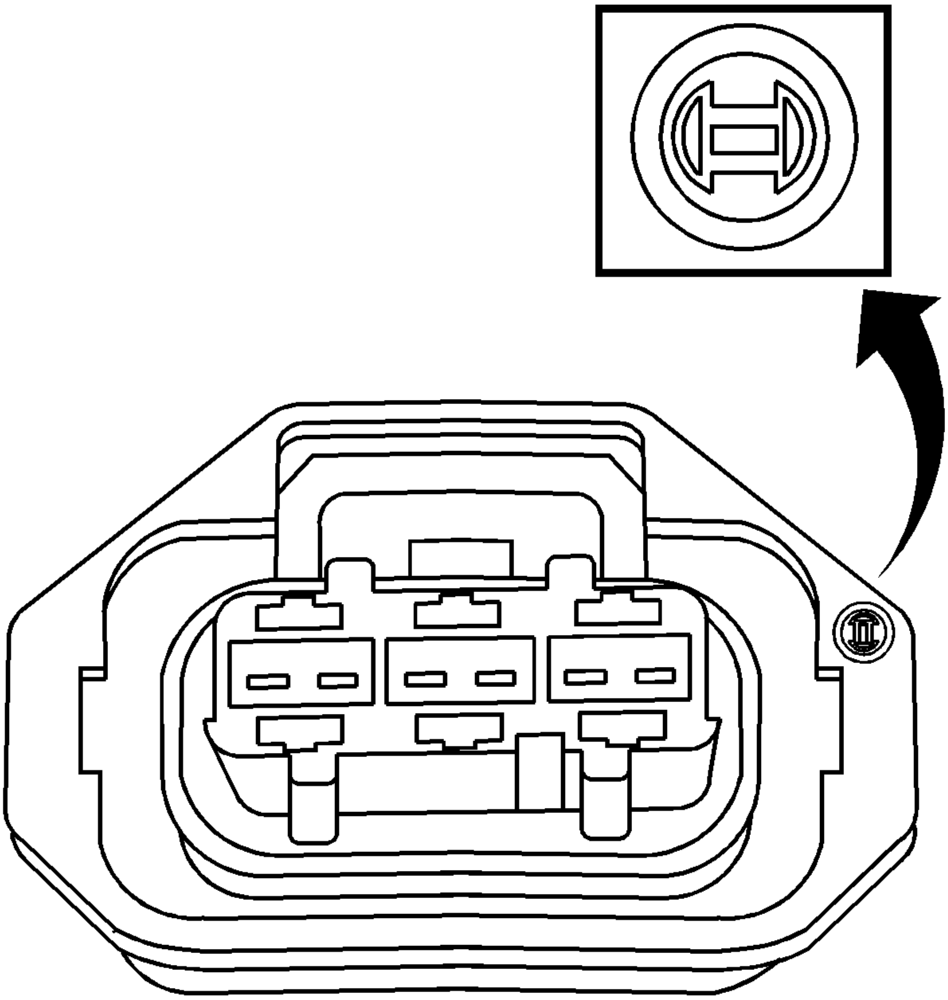


Fig. 6: View Of Bosch Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- In some cases Bosch will actually be printed on the connector. If Bosch does not appear on the connector, look for the Bosch logo. The Bosch logo is a circle with a blunted arrow inside. This logo can appear anywhere on the connector and is often very small.

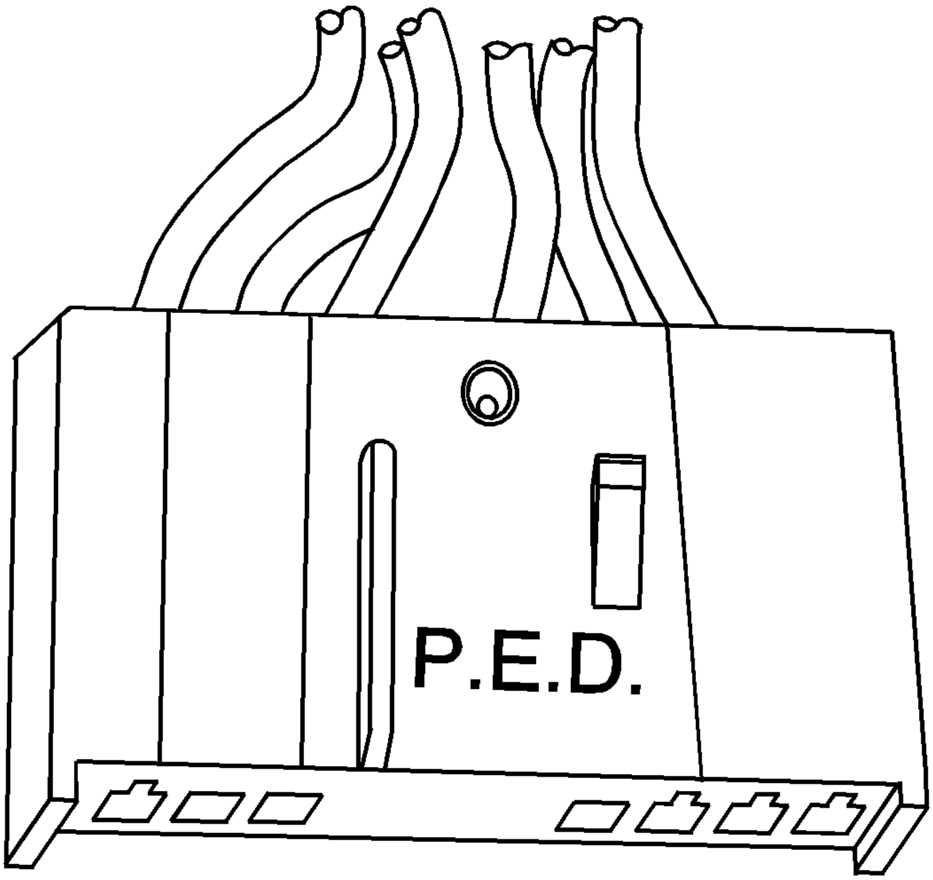


Fig. 7: View Of PED Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- In some cases Delphi will actually be printed on the connector. If Delphi is not printed on the connector, look for PED. In both cases there is no specific orientation for Delphi or PED and they can appear anywhere on the connector.

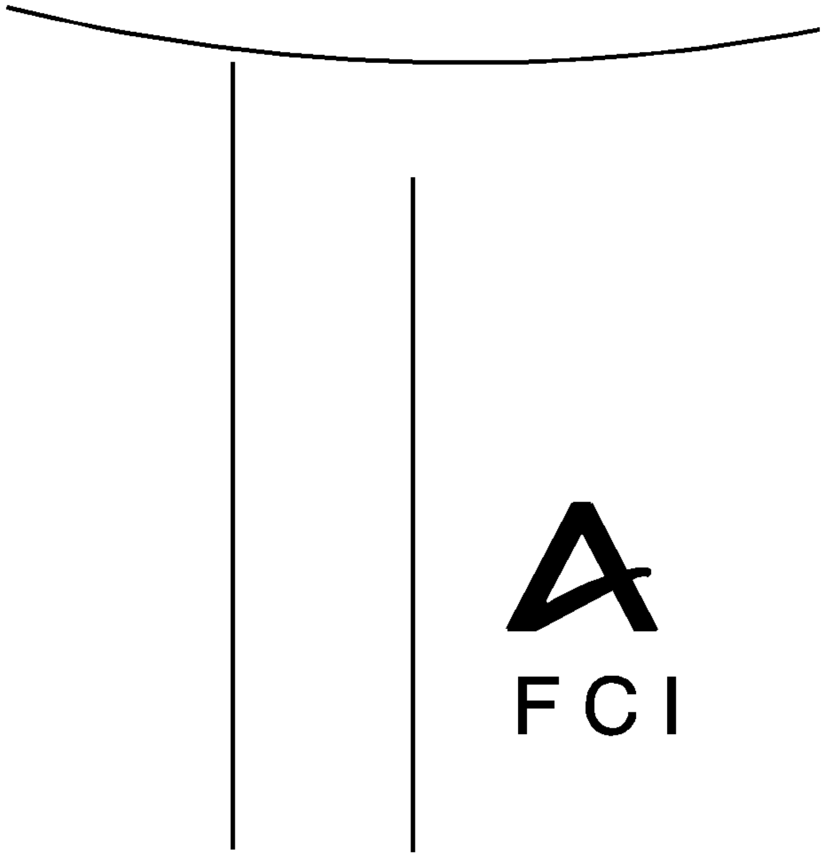


Fig. 8: View Of FCI Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- FCI connectors may have the FCI logo on their connectors. The logo is the letters FCI with an "A" above it.

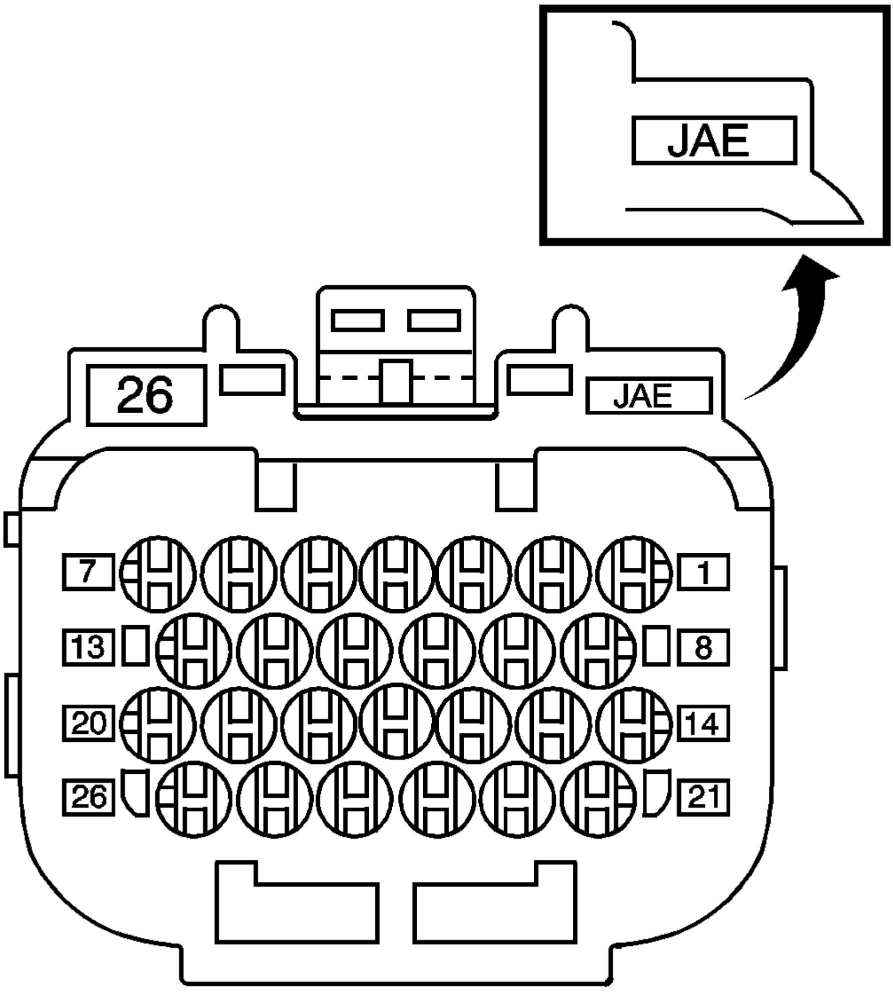

JAE
26
JAE
7
1
13
8
20
14
26
21

Fig. 9: View Of JAE Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- JAE connector have JAE in small letters on their connectors.

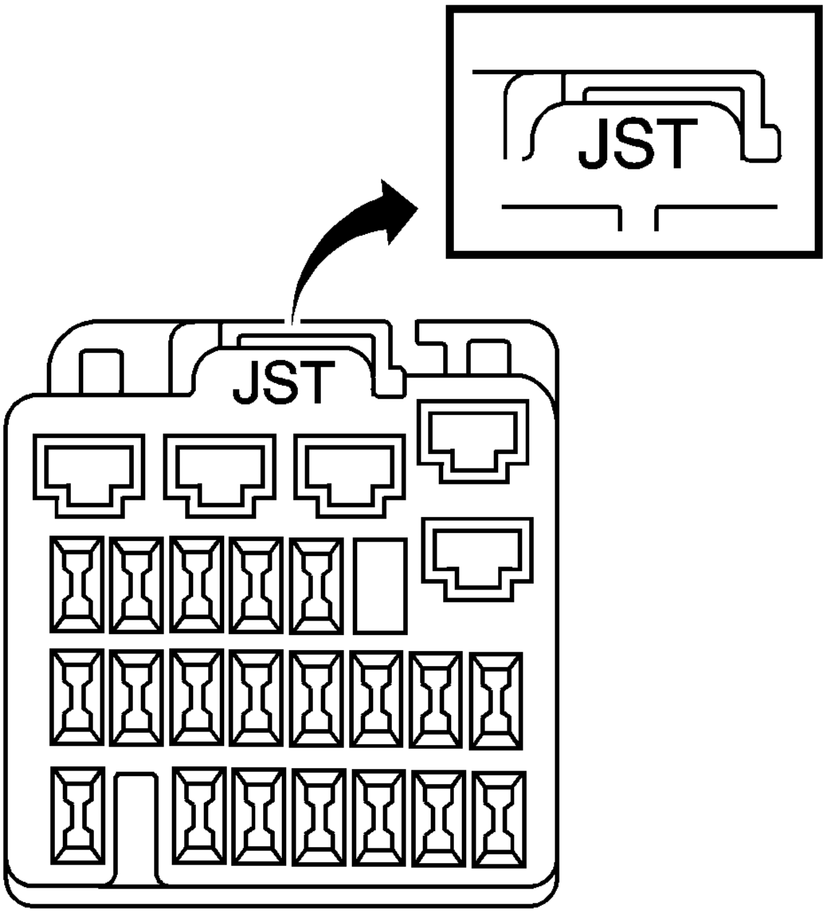


Fig. 10: View Of JST Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- JST connectors have JST in small letters on their connectors, similar to that above. The location of the logo will vary with the connector size and style.

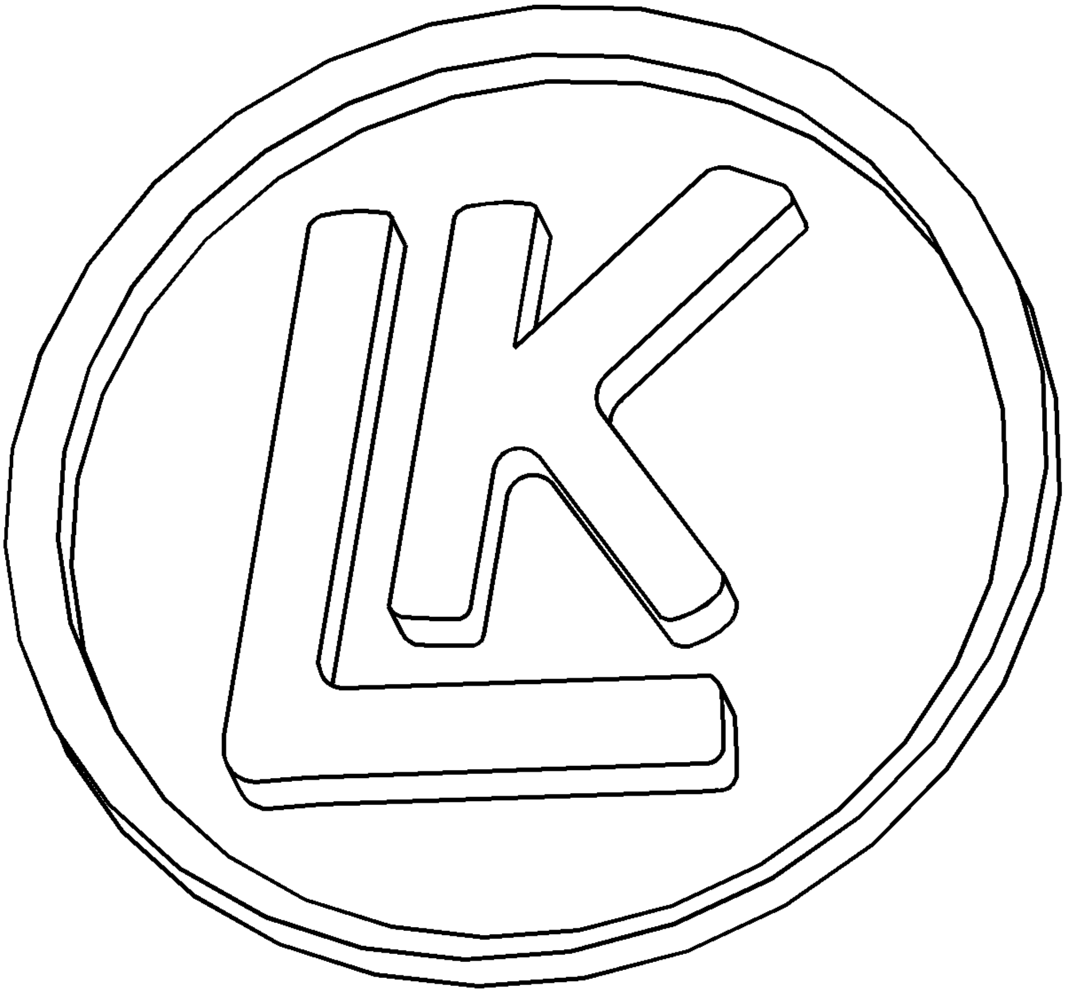


Fig. 11: View Of Kostel Connector Identifier
Courtesy of GENERAL MOTORS COMPANY

- Kostel has an "LK" with a circle around it. These connector are usually used as a transmissions connection.

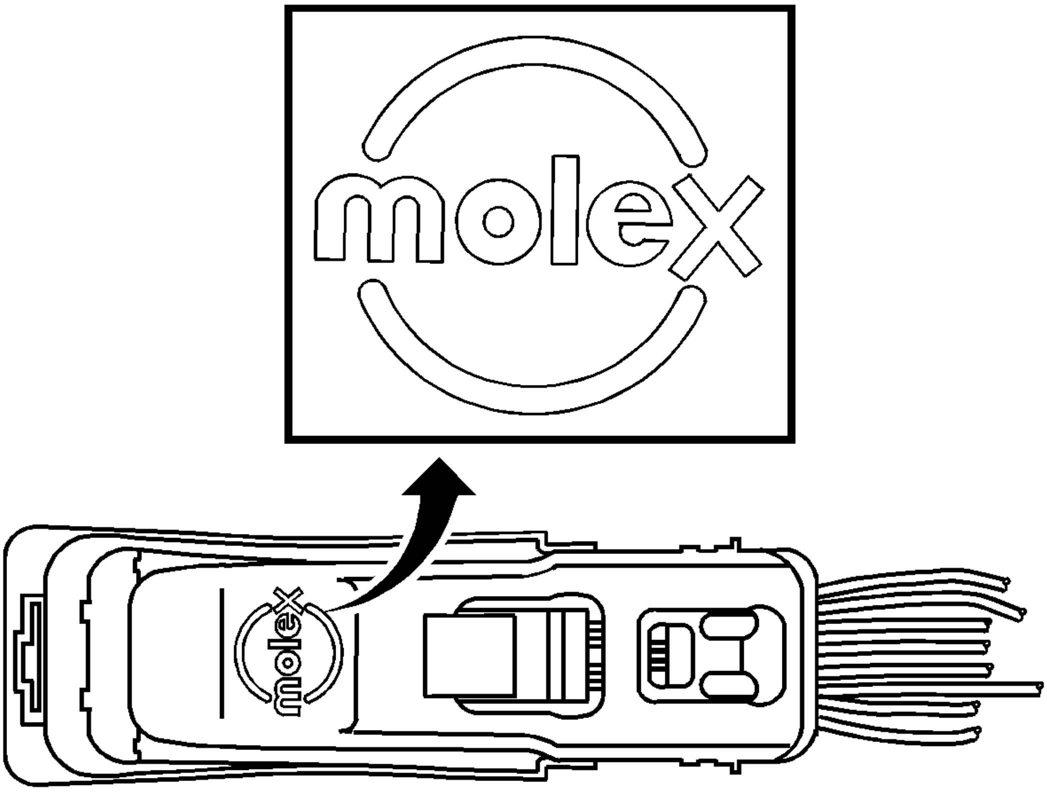

molex
molex

Fig. 12: View Of Molex Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

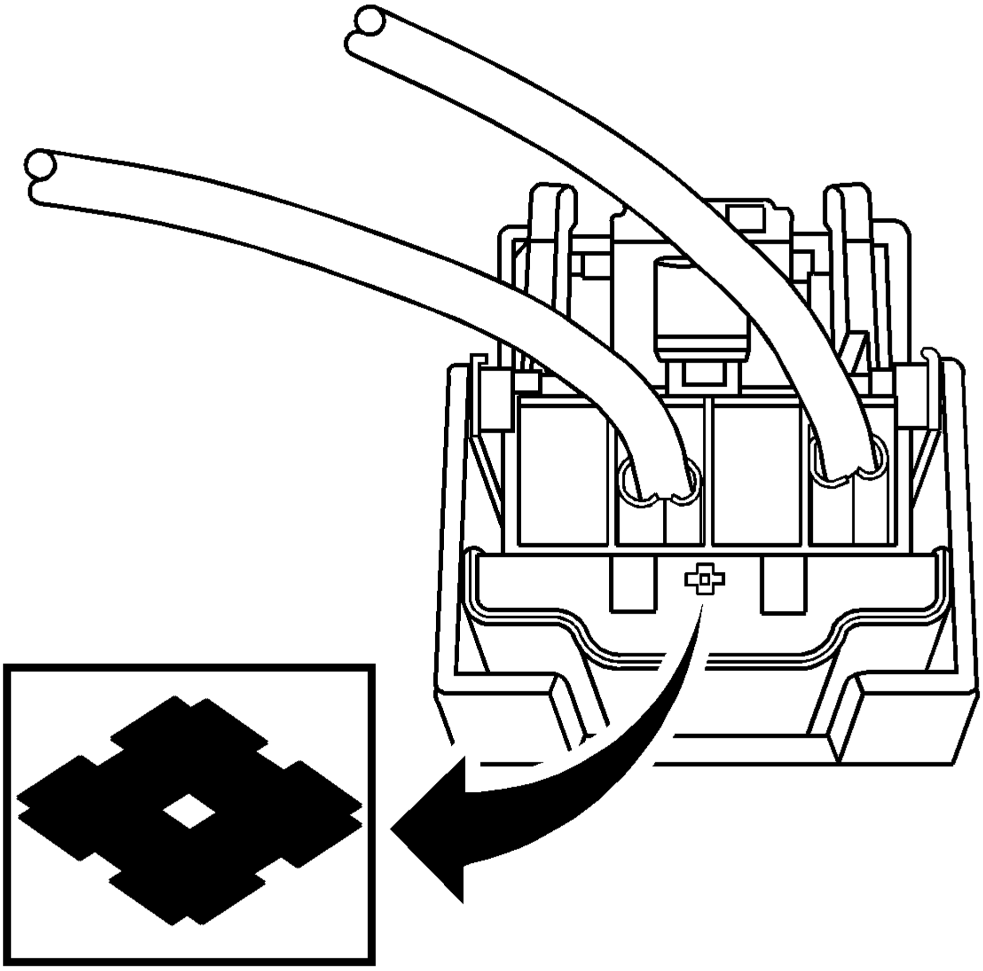


Fig. 13: Sumitomo Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- Most Molex connectors will have the Molex logo on the dresscover of the connector. In some cases the connectors may have MX followed by another letter. The third letter indicates where the connector was made. A connector with MXD is a Molex connector made in Detroit.

  Sumitomo has a unique symbol on their connector and possibly a part number. The symbol is similar to that of a diamond lying on its side, similar to that shown. The logo could appear anywhere but the most common place is at the wire side of the housing.

- Tyco/AMP has many different and unique connector designs. Some may or may not have identifiable marks on them.

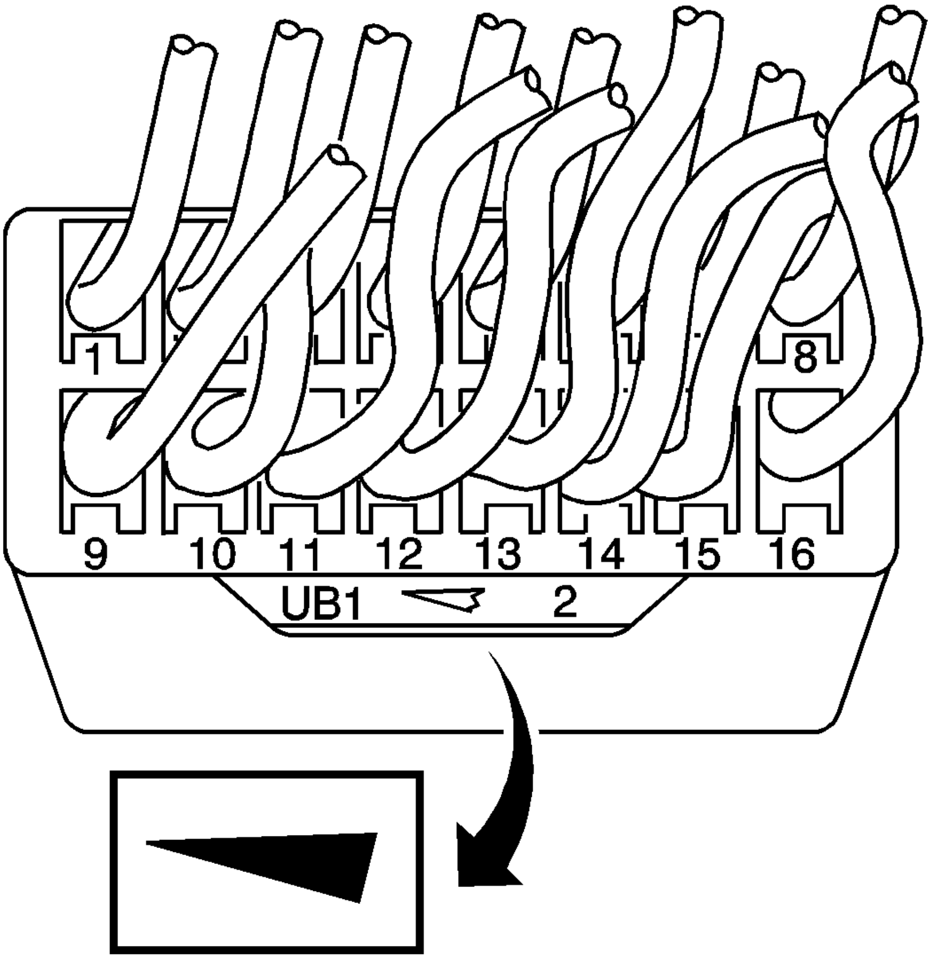

1
8
9
10
11
12
13
14
15
16
UB1
2

Fig. 14: View Of Yazaki Identification On Connector Body
Courtesy of GENERAL MOTORS COMPANY

- Yazaki has a wedge or arrow shape, similar to that shown.

Back To Article

2017 ACCESSORIES & EQUIPMENT

Wiring Systems and Power Management - Repair Instructions - Bolt EV

REPAIR INSTRUCTIONS

REPAIRING DAMAGED WIRE INSULATION

WARNING: **In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.**

If the wire insulation has been chafed, or broken, enough to show the conductive portion of the wire, and the wire is not damaged, determine the length of insulation that needs to be repaired. If the repair is less than 280 mm (11 in), cut the wire within the damaged area. Then slide the appropriate heat shrink tubing (listed below) over the wire, and repair the wire by splicing the wires together. Refer to **Wire to Wire Repair**. Once the wire is spliced together slide heat shrink tubing over the damaged area and apply heat to seal the repaired wire.

If the wire is damaged, or the damaged area is larger than 280 mm (11 in), then replace the damaged wire by splicing in a new section of wire. Refer to **Wire to Wire Repair**.

GM Part Number	Diameter		Description	Color	Length	
	Metric	English			Metric	English
12355003	9.5 mm^2	0.375 in	Tubing, Shrink 3/8	Black	305 mm^2	12 in
12355005	12.7 mm^2	0.5 in	Tubing, Shrink 1/2	Black	305 mm^2	12 in
12355011	19.1 mm^2	0.75 in	Tubing, Shrink 3/4	Black	305 mm^2	12 in
12355008	25.4 mm^2	1.0 in	Tubing, Shrink 1.00	Black	305 mm^2	12 in

Wire Size Conversion

Metric Wire Sizes (mm^2)	AWG Sizes
0.13	26
0.20	24
0.32	22
0.52	20
0.82	18
1.31	16
2.09	14
3.30	12
5.27	10
8.35	8
13.3	6

COAXIAL CABLE REPAIRS

The GM global coaxial cable repair strategy uses coaxial cables, connectors and jumpers to repair coaxial cables. The intent is to install the new service cable in vehicle, but removal of the old cable is not necessary. There are several repair scenarios:

- New cables, jumpers, and connector housing are required.
- Only new cables are required while it is possible to reuse the existing connector housing in vehicle. A jumper may or may not be needed.
- Only new connector housing are required, while it is possible to reuse the existing cable in the vehicle.
- A new cable would need to be installed from source to destination and by-pass the inline connector in some cases when an inline connector is unrepairable (Example: a cracked male end of a 1-way connector).

Coaxial Cable Kits

Four different kits will be available to repair coaxial cables. Components of each kit cannot be ordered separately from the kit.

- **Communication Interface Module Antenna Cable Kit** (Kit # 13581174) is used to repair Cellular coaxial cables. This kit uses RG58 low loss coaxial cables that are available in four lengths. The coaxial cables can be attached together in various lengths to closely match the length of the faulty/damaged coaxial cable.
- **Digital Radio and Vehicle Locator Antenna Coaxial Cable Kit** (Kit # 13581173) is used to repair XM and GPS coaxial cables. For vehicles that have a combined GPS and Cellular/OnStar signal on one cable, use Kit # 13581174. This kit uses RG316 low loss coaxial cables that are available in three lengths. The coaxial cables can be attached together in various lengths to closely match the length of the faulty/damaged coaxial cable.
- **Digital Radio, Mobile Telephone and Vehicle Locator Antenna Coaxial Cable Kit** (Kit # 19119056) is used with OnStar, XM, and GPS cables. This kit consists of jumpers and connectors. The jumpers are used to adapt different types of connectors together (to attach 2-way and 3-way connector onto the long 7, 5, and 3 foot cables). The connectors are used to replace existing connectors. The 1-way and 2-way connectors in the kit are in water-blue color (different than what the vehicle is built with) and are non-keyed (universal fit). The 3-way connectors in the kit are in the same color as in the vehicle.
- **Communication Interface Module Antenna Cable Kit** (Kit # 22803854) is used for the OnStar module on some vehicles built before the 2011 model year.

Coaxial Cable Repair Kits

Repair Kit Name	Description
Communication Interface Module Antenna Cable Kit (Kit # 13581174)	RG58 coaxial cable with female/female connectors - 7ft/2.1m
	RG58 coaxial cable with female/male connectors - 5ft/1.5m
	RG58 coaxial cable with female/male connectors - 3.5ft/1.1m
	RG58 coaxial cable with female/male connectors - 3.5ft/1.1m
Digital Radio and Vehicle Locator Antenna Coaxial Cable Kit (Kit # 13581173)	RG316 coaxial cable with female/female connectors - 7ft/2.1m
	RG316 coaxial cable with female/male connectors - 5ft/1.5m
	RG316 coaxial cable with female/male connectors - 3.5ft/1.1m

Repair Kit Name		Description
Digital Radio, Mobile Telephone and Vehicle Locator Antenna Coaxial Cable Kit (Kit # 19119056)	3-way Gen 1 sub-kit	1-way to 3-way Gen 1 jumper for female connector - Part # 13581154 - 4in/10cm 1-way to 3-way Gen 1 jumper for male connector - Part # 19119052 - 4in/10cm
		White female connector
		White male connector
		Blue female connector
		Blue male connector
	3-way Gen 2 sub-kit	1-way to 3-way Gen 2 jumper for female connector - Part # 13581155 - 4in/10cm 1-way to 3-way Gen 2 jumper for male connector - Part # 19119058 - 4in/10cm
		Tan female connector
		Tan male connector
		Gray female connector
		Gray male connector
	2-way Gen 1 sub-kit	1-way to 2-way Gen 1 jumper for female connector - Part # 13581156 - 4in/10cm
		Water-blue female connector
	2-way Gen 2 sub-kit (wide)	1-way to 2-way Gen 2 jumper for female connector - Part # 13581157 - 4in/10cm
		1-way to 2-way Gen 2 jumper for male connector - Part # 13581158 - 4in/10cm
		Water-blue female connector
		Water-blue male connector
	2-way Gen 2 and 3 sub-kit (narrow)	1-way to 2-way Gen 2 and 3 jumper for female connector - Part # 13582468 - 4in/10cm
		Use the 1-way to 2-way Gen 2 jumper for female connector 19119058 - 4in/10cm from the 2-way Gen 2 sub-kit.
		Water-blue female connector
		Water-blue male connector
	Right-angle jumper with water-blue universal 1-way connector - 4in/10cm	
Communication Interface Module Antenna Cable Kit (Kit # 22803854)		1-way to mini UHF jumper - 4in/10cm

Connector Housing Repair Procedure

The connector housings (available in Digital Radio, Mobile Telephone and Vehicle Locator Antenna Coaxial Cable Kit) are available for 1-way housings, 2-way housings and 3-way housings. Determine the connector housing required:

1-way housing

No change to the service coaxial cable is necessary in order to install the new coaxial cable into the vehicle.

2-way housing

A 4-inch jumper is required.

1. Determine the appropriate generation (1, 2, or 3) and/or size (12.7mm or 8mm) of the 2-way housing that is in the vehicle.
2. Remove the faulty/damaged coaxial cable from the 2-way connector housing by removing the terminal position assurance (TPA) from the connector housing and then slide the cable out of the connector.

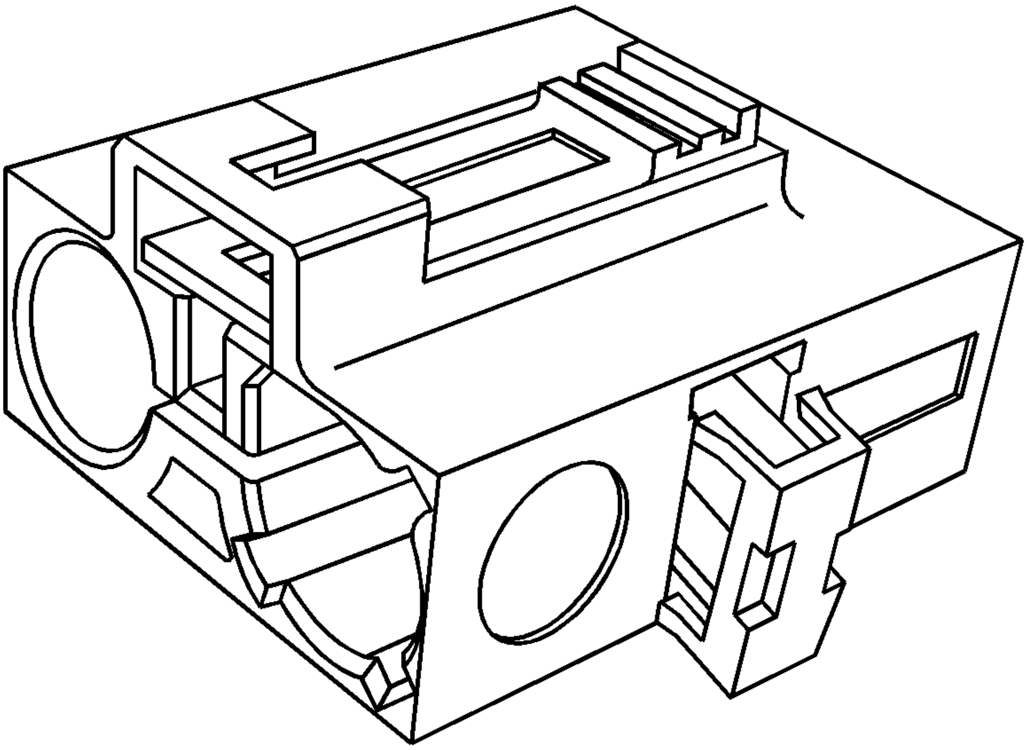


Fig. 1: Connector Housing
Courtesy of GENERAL MOTORS COMPANY

3. Install the new service coaxial cable into the vehicle. Use the 4-inch jumper for the appropriate 2-way connector housing to connect the new service coaxial cable to the connector housing.
4. If the issue is found to be the connector housing and not cable, a new connector housing may be installed while reusing all other components.

3-way housing

A 4-inch jumper is required.

1. Determine the appropriate generation (1 or 2) and keyed 3-way connector housing based on the connector housing color.
2. Note the locations of each of the cables in 3-way housing, as it is important for new cables be placed in the appropriate terminal location in the new connector. The connector housing colors are not interchangeable.
3. Remove the faulty/damaged coaxial cable from the 3-way connector housing by using a pair of side/diagonal cutters to nip and break away the housing.

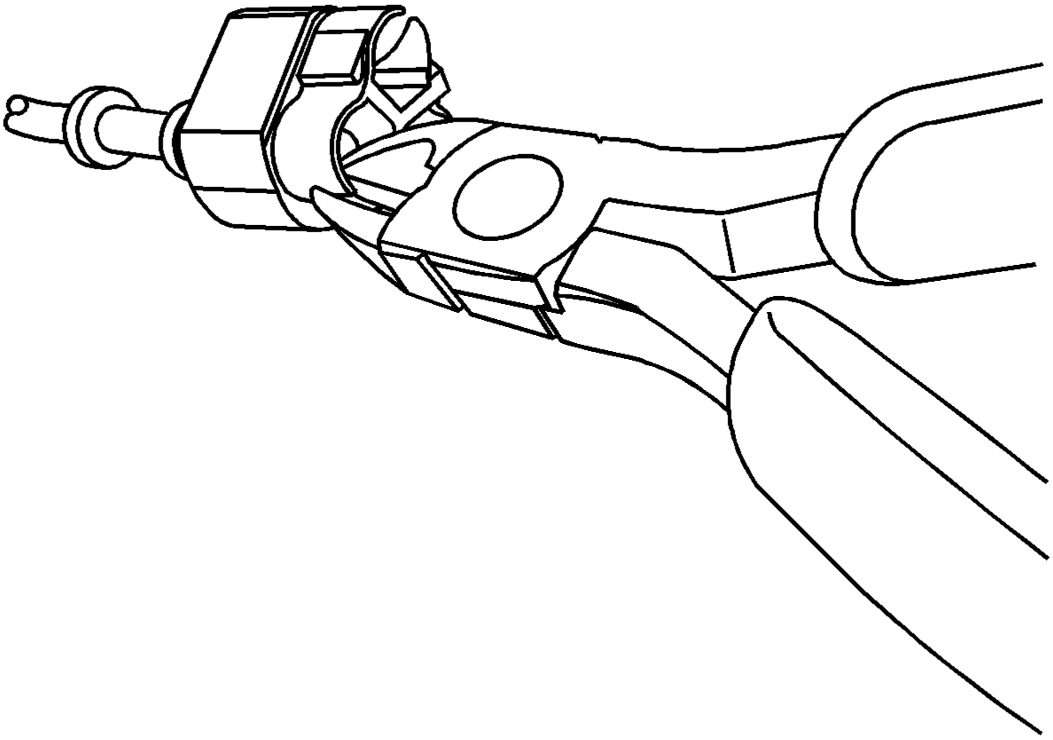


Fig. 2: Using Side/Diagonal Cutters To Nip And Break Away Connector Housing
Courtesy of GENERAL MOTORS COMPANY

4. Use caution not to damage the conductive ends of the coaxial cables inside the connector housing. Do not bend or force the terminal out or it could be damaged.

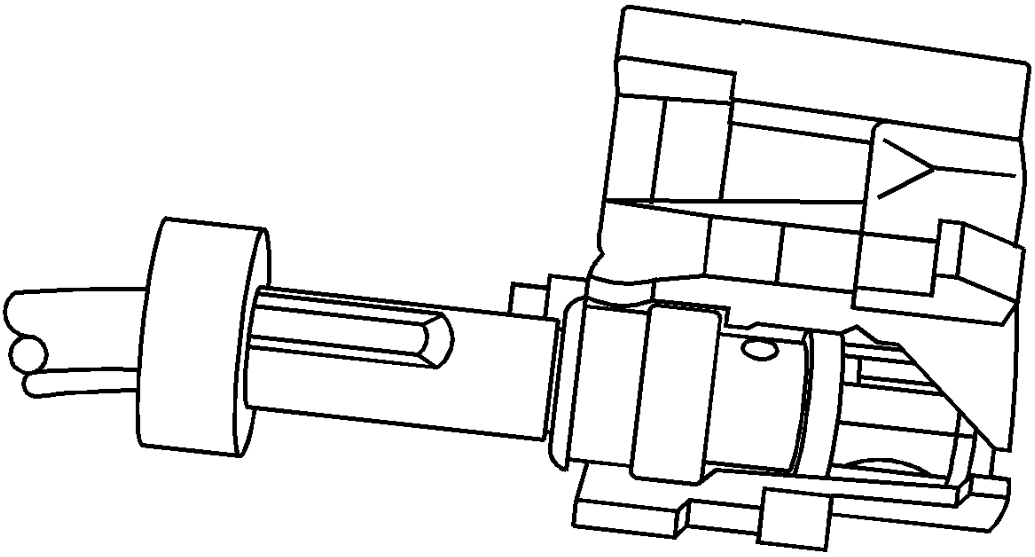


Fig. 3: Connecting New Service Coaxial Cable To New 3-Way Connector Housing
Courtesy of GENERAL MOTORS COMPANY

5. Install the new service coaxial cable into the vehicle. Use the 4-inch jumper for the appropriate color 3-way connector housing to connect the new service coaxial cable to the new 3-way connector housing.
6. If the issue is found to be the connector housing and not cable, a new connector housing may be installed while reusing all other components.

Coaxial Cable Repair Procedure

1. Identify the faulty/damaged coaxial cable.
2. Disconnect the faulty/damaged coaxial cable and leave it in the vehicle.
3. Identify the type of coaxial cable to be replaced and match up with the appropriate pieces to repair the damaged coaxial cable. Match up the type of coaxial cable, cable length and connector types. In some cases there may be extra length of cable left over.

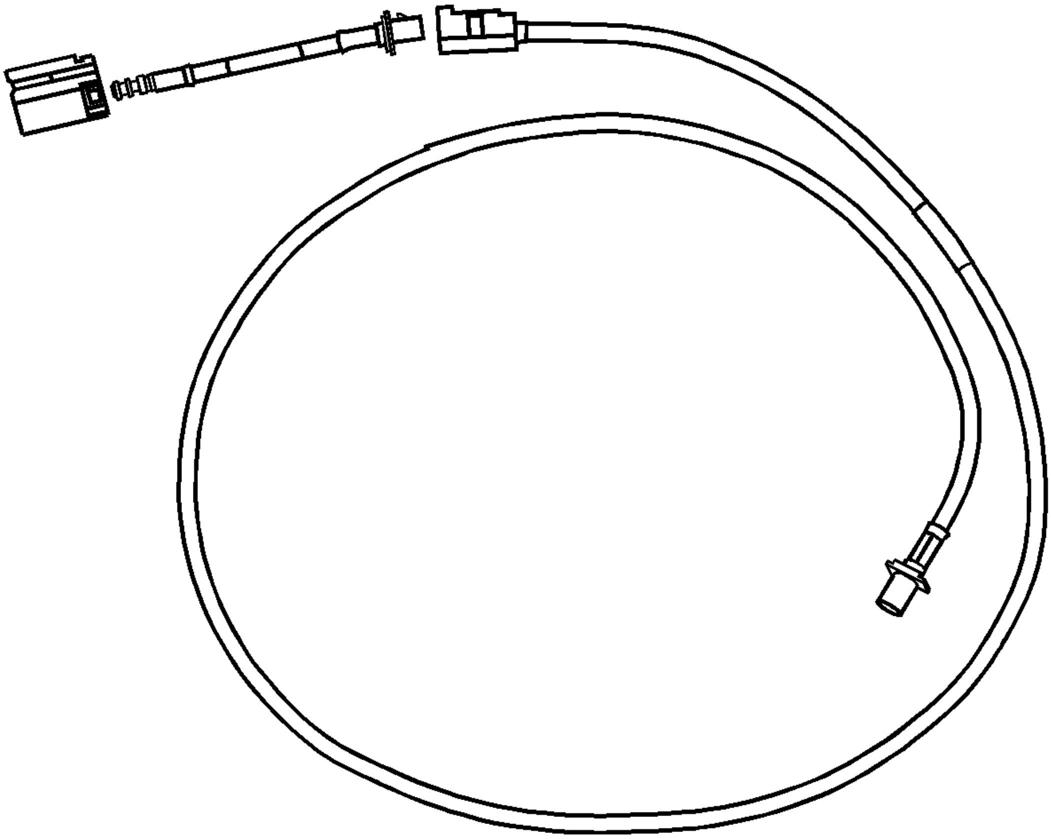


Fig. 4: Coaxial Cable
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Avoid routing the new coaxial cable near sharp edges that can damage the new coaxial cable.**

4. Install the new coaxial cable in the vehicle.

   Use tie-straps to attach the new service coaxial cable to existing harnesses or brackets. Use felt tape/foam to reduce rattles, as necessary.

   NOTE: **To avoid permanent damage, do not pinch the cable or bend it tighter than a 2 inch (5 centimeter) radius.**

5. Remove the faulty/damaged connectors, if applicable.
6. Install new connectors or jumpers, as needed. Refer to Connector Housing Repair Procedure.
7. Verify the repair by operating the system with the vehicle in Service Mode.

FLAT WIRE REPAIRS

The flat wire within the flex wiring harness is not serviceable. If an open or short exists within the flex wiring harness the complete harness must be replaced.

FOLDED-OVER WIRE REPAIR

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool (non GMNA)
- **J-38125-5A** Ultra Torch Special Tool
- **J-38125-8** Splice Sleeve Crimping Tool (GMNA)

For equivalent regional tools, refer to **Special Tools** .

The GM global wire repair strategy uses connector assemblies (pigtails) and terminated leads to repair wiring harnesses.

To reduce and manage GM Service Parts proliferation, the service pigtails and terminated leads are designed with the largest wire gauge size that can be held by either the terminal or the connector housing.

The folded over wire repair technique, in which the copper wire strands are folded over before being installed into a splice sleeve, allows the service part to be used when repairing a smaller gauge size wire in a vehicle. This technique has passed all GM testing standards.

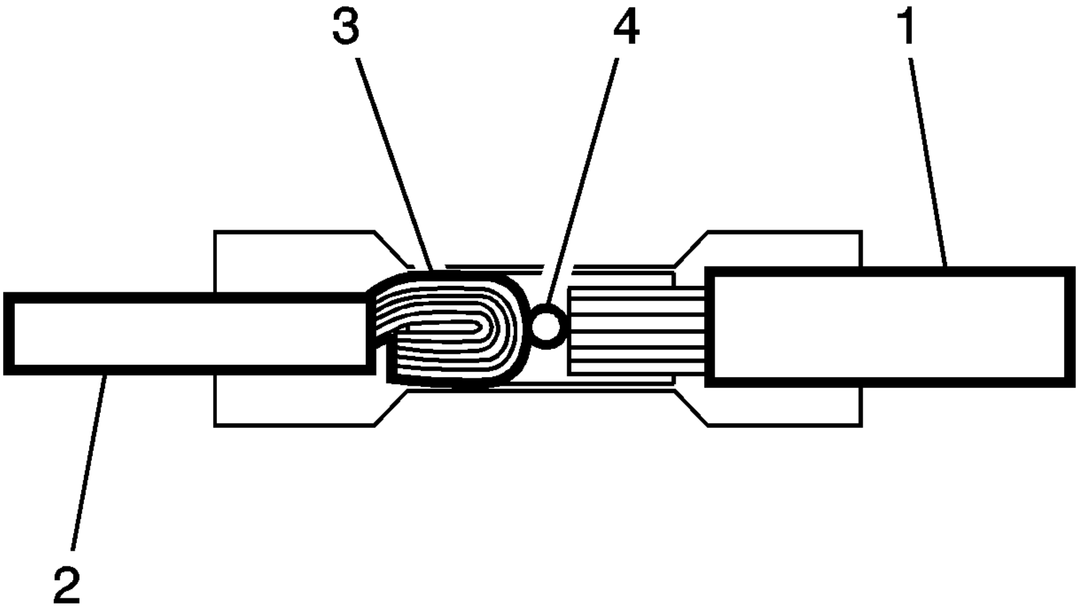


Fig. 5: View Of Stripped Wires In Splice Sleeve Connector
Courtesy of GENERAL MOTORS COMPANY

The larger harness size wires (1) will be placed in one side of the splice sleeve and match the splice sleeve closely in size. The wires are moved into the splice sleeve until they hit the stop (4) in the splice sleeve. The smaller harness size wires (2) will be placed in the other side of the splice sleeve. The smaller harness size wires will be folded over (3) to match up with the splice sleeve size.

Use the folded over wire repair for:

NOTE: **Increasing the amount of copper strands in the smaller gauge size will allow for a better crimp**

- Splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes)

NOTE: **Vehicle side needs to be of same or less gauge size (not greater than the service part's gauge size)**

- Splicing wires of different gauges

Use the Service Information (SI) connector end-views to determine:

- Gauge size of wiring harness
- Recommended Repair: Terminated Lead or Pigtail

The following table lists the acceptable variance within the gauge size

Folded-Over Wire Selection Table

Harness Wire Gauge		**Connector Assembly (Pigtail) or Terminated Lead Wire Gauge Size**			
-		Salmon Color Splice Sleeve		Blue Color Splice Sleeve	Yellow Color Splice Sleeve
Metric	-	0.35 mm	0.5 - 0.8 mm	1.0 - 2.0 mm	3.0 - 6.0 mm
-	Wire Gauge (AWG)	22	20 - 18	16 - 14	12 - 10
0.13 mm	26	Fold Over Wire	Double Fold Over Wire	Not Acceptable	Not Acceptable
0.22 mm	24	Fold Over Wire	Fold Over Wire	Not Acceptable	Not Acceptable
0.35 mm	22	Wire to Wire	Fold Over Wire	Double Fold Over Wire	Not Acceptable
0.5 mm	20	Not Acceptable	Wire to Wire	Fold Over Wire	Not Acceptable
0.75 mm	-	Not Acceptable	Wire to Wire	Fold Over Wire	Double Fold Over Wire
0.8 mm	18	Not Acceptable	Wire to Wire	Fold Over Wire	Double Fold Over Wire
1.0 mm	16	Not Acceptable	Not Acceptable	Wire to Wire	Double Fold Over Wire
1.5 mm	-	Not Acceptable	Not Acceptable	Wire to Wire	Fold Over Wire
2.0 mm	14	Not Acceptable	Not Acceptable	Wire to Wire	Fold Over Wire
2.5 mm	-	Not Acceptable	Not Acceptable	Wire to Wire	Fold Over Wire
3.0-6.0 mm	12 - 10	Not Acceptable	Not Acceptable	Not Acceptable	Wire to Wire

Example

For an IP Harness of 0.22 mm (24 gauge on left side of table) wire size, the SI connector end-view recommends a pigtail with leads of 0.8 mm (18 gauge on the top of the table) with a salmon colored DuraSeal splice sleeve of 0.5 - 1.0 mm (20 - 16 gauge).

Follow these steps to use the folded over wire (1) technique on an IP Harness.

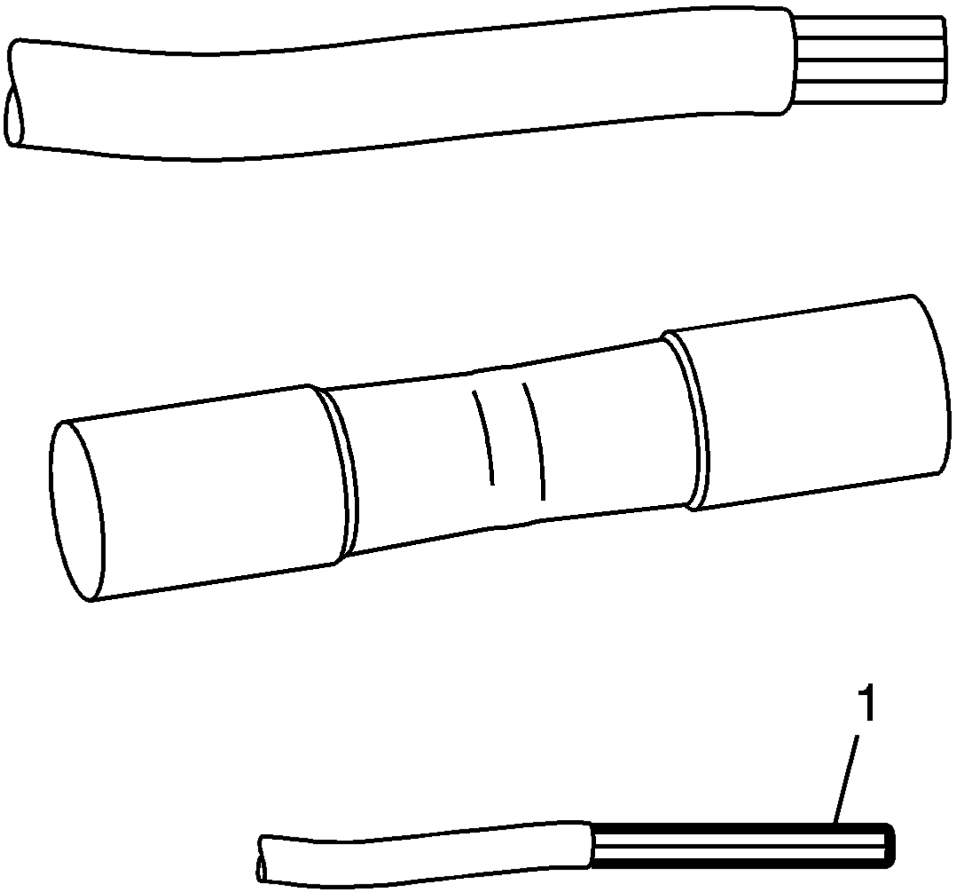


Fig. 6: View Of Stripped Wires
Courtesy of GENERAL MOTORS COMPANY

Strip twice the amount of insulation on the smaller (1) wire (IP Harness is the lower wire) than normally required. Normally, the terminated leads have 5 mm of insulation stripped off the wire.

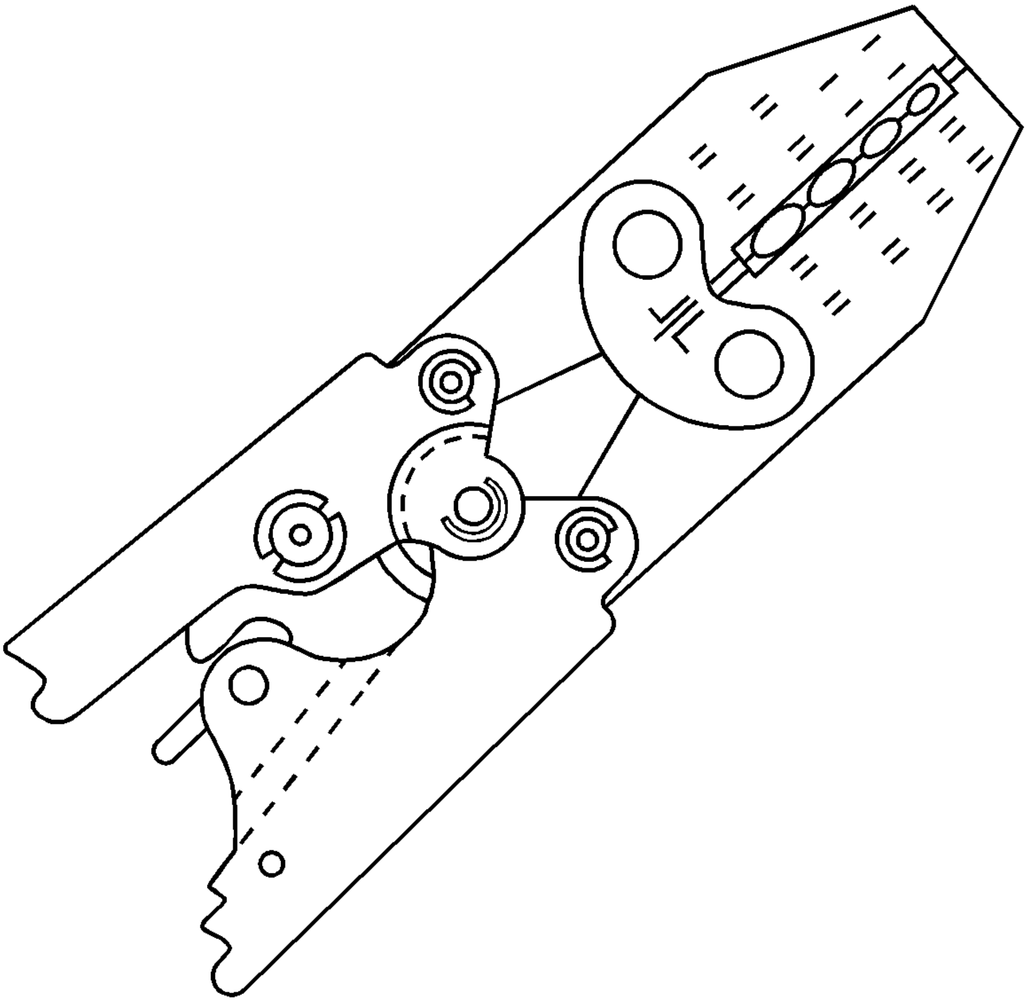


Fig. 7: Splice Sleeve Crimping Tool
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use EL-38125-10 splice sleeve crimping tool (non GMNA) or J-38125-8 splice sleeve crimping tool (GMNA).**

1. For wiring repair, refer to **Wire to Wire Repair**.

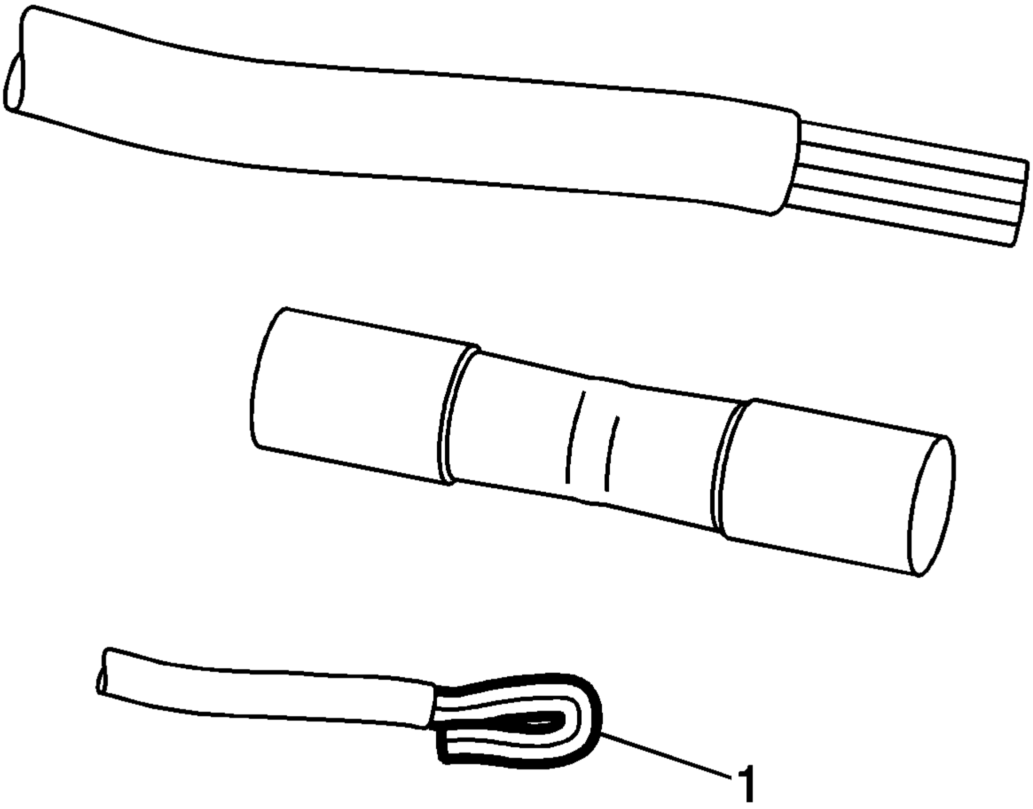


Fig. 8: View Of Twisted And Folded Wire To Length
Courtesy of GENERAL MOTORS COMPANY

2. Twist the wires before you fold them over to prevent the wire strands from opening up. Fold over the copper wire strands of the smaller (1) gauge wire so that it is the same length as the non-folded wire.

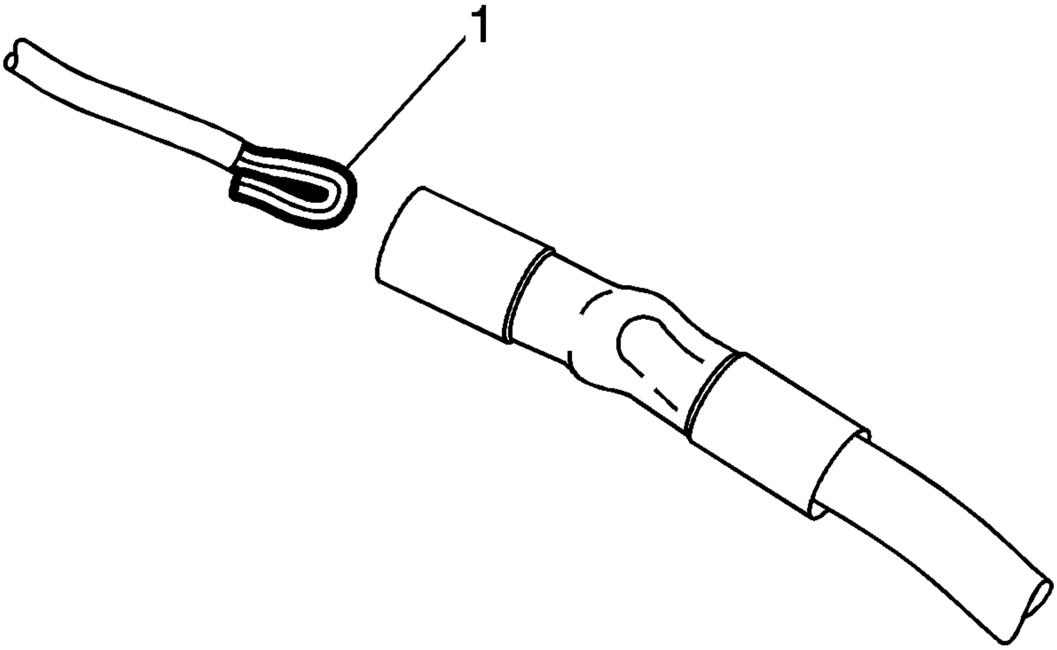


Fig. 9: View Of Folded Wire & Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

3. Insert the folded over wire (1) into the splice sleeve.

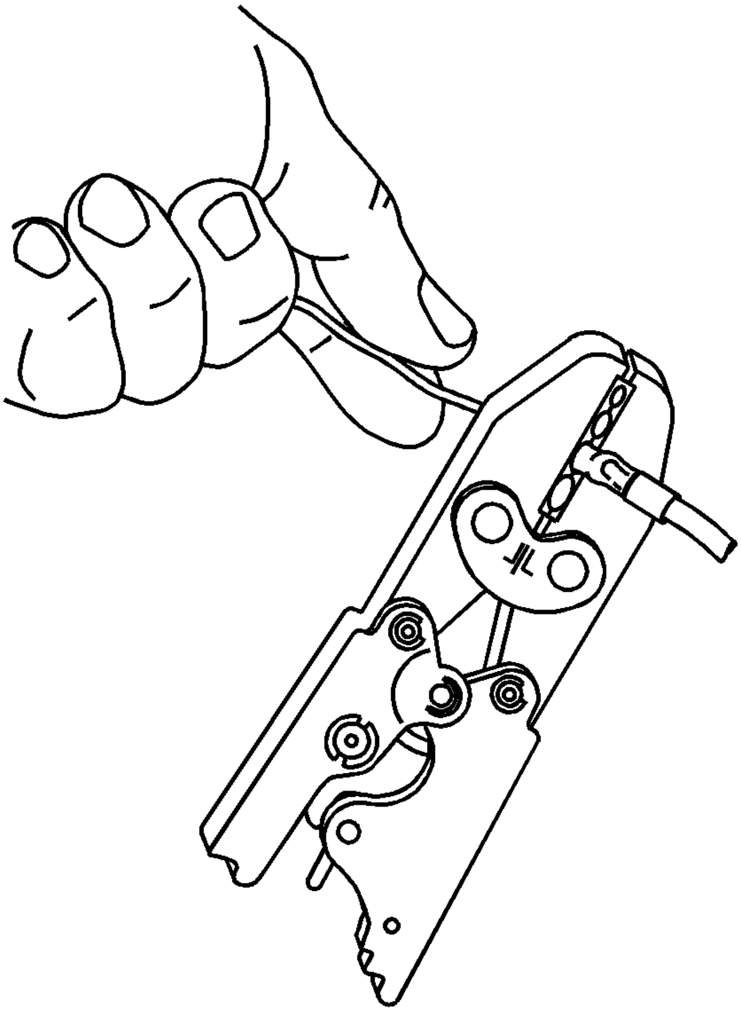


Fig. 10: Crimping The Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

4. Use the proper crimp tool to crimp the splice sleeve to the smaller wire (harness side of repair). Complete the crimp as usual (using the heat tool to shrink the tube).

SERIAL DATA CIRCUIT WIRING REPAIRS

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool
- DuraSeal splice sleeves
- A wire stripping tool

For equivalent regional tools, refer to Special Tools .

The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides necessary contact integrity for the sensitive, low energy circuits.

The GM Local Area Network (GMLAN) System requires special wiring repair procedures due to the sensitive nature of the circuitry. Follow the specific procedures and instructions when working on GMLAN connectors and terminals.

GMLAN Repairs

NOTE:	**When making a repair to any GMLAN network, the original wire length after the repair must be the same length as before the repair. If the network is a**

twisted pair, the twist must be maintained after the repair is completed.

GMLAN has 2 types of networks, low speed and high speed. Low speed GMLAN has a single wire and works at slow speeds. High speed GMLAN has 2 wires in a twisted pair and works at higher speeds. For more information on GMLAN, refer to **Data Link Communications Description and Operation** .

GMLAN Connector Terminal Repair

NOTE: **A terminated lead can be used to replace damaged connector terminals for both high speed and low speed GMLAN systems. When making a connector terminal repair on a GMLAN high speed system with twisted pair wires, do not untwist the wires more than necessary to make the repair.**

If the individual terminals are damaged on any GMLAN connection, use the appropriate connector repair procedure in order to repair the terminal. Refer to **Connector Repairs** for the appropriate connector repair procedure.

GMLAN Wire Repair

NOTE: **Refer to Wiring Repairs in the service information connector end views or the vehicle schematics in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.**

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire of the same gauge size (0.5 mm^2 , 0.8 mm^2 , 1.0 mm^2 etc.). Use the DuraSeal splice sleeves and **EL-38125-10** tool. For wiring repair, refer to **Wire to Wire Repair**.

Media Oriented Systems Transport (MOST) Wiring Repair

NOTE: **If harness repair/analysis is performed, MOST bus Twist Pair unshielded wire should be 0.35 mm^2 (22 AWG) wire with at least one twist per each 1 45/64 inch (45 mm) and must not be untwisted for more than 3 15/16 of an inch (10 cm).**

The following conditions need to be met to ensure a valid continuity:

- Untwisted length for all MOST 50 circuits at each wire harness connector should be no longer 50 mm max (25 mm preferred).
- When wire repairs are made, a minimum 25 twists/meter for all MOST 50 circuits.
- MOST 50 has specific receive and transmit I/O.

The transmit of one module is connected to receive of the next module in ring topology.

HEATED OXYGEN SENSOR WIRING REPAIRS

CAUTION: **Do not solder repairs under any circumstances as this could result in the air reference being obstructed.**

If the heated oxygen sensor pigtail wiring, connector, or terminal is damaged the entire oxygen sensor assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly it must have a clean air reference. This clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors or terminals could result in the obstruction of the air reference and degrade oxygen sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor, causing poor performance. Also, the sensor pigtail and harness wires must not be damaged in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.

- Neither the sensor nor vehicle lead wires should be bent sharply or kinked. Sharp bends, kinks, etc., could block the reference air path through the lead wire.
- Do not remove or defeat the oxygen sensor ground wire (where applicable). Vehicles that utilize the ground wire sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will also cause poor engine performance.
- To prevent damage due to water intrusion, be sure that the peripheral seal remains intact on the vehicle harness connector.

HIGH TEMPERATURE WIRING REPAIRS

NOTE: **All wiring repairs need to be 200 mm from the heat zone. Areas of consideration would be any area located near the exhaust manifolds, catalytic converter, exhaust pipes, and turbocharged engines.**

Items Required

- DuraSeal splice sleeves to crimp and seal connections
- High temperature SCT1 shrink tubing to protect the splice sleeves
- Terminated leads or pigtails
- The correct tools to remove the terminals from the connectors

Use high temperature bulk wire rated at 150Â°C (302Â°F) continuous temperature of the same or larger gauge size as the original wire when repair damage wire. Also replace any reflective tape that you remove during the repair.

High Temperature Wiring

Wiring that is exposed to high temperatures, 135Â°C (275Â°F) or higher, for prolonged periods of time may use materials i.e. wires, connectors, and shielding that has a higher heat rating than typical wiring. When making a repair in a high temperature area observe the following:

- Use high temperature bulk wire rated at 150Â°C (302Â°F) continuous temperature to replace any damaged wire.
- Replace any heat shielding that is removed.
- Cover any DuraSeal splice sleeves with SCT1 shrink tubing.
- After making a wiring repair, ensure that the location of the wiring is not moved closer to the heat source.

Identifying High Temperature Wiring

NOTE: **High temperature areas would be areas located near exhaust manifolds, catalytic converters, exhaust pipes, and turbocharged engines.**

Wiring that is exposed to high temperature, 135Â°C (275Â°F) or higher, for prolonged periods of time need special considerations when making wiring repairs. Areas that may be exposed to higher temperatures can be identified by heat resistant materials that are being used in those areas. These materials may include heat reflective tape and high temperature shrink tubing. Also conduit and other protective coverings may be used. Because conduit or similar coverings are used throughout the vehicle regardless of the temperature, it may be necessary for the technician to determine if an area is exposed to excessive heat before making a wiring repair.

SIR/SRS WIRING REPAIRS

NOTE: **Refer to SIR Service Precautions .**

For European Regions

CAUTION: **If the SIR/SRS wiring, connector, or terminal is damaged, the affected wiring harness must be replaced. Do not attempt to repair the wiring, connector, or terminals. Any attempt to repair the wires, connectors, or**

terminals could result in performance problems of the SIR/SRS System. Operations on restraint systems must only be performed by trained and qualified personnel.

For Non-European Regions

Special Tools

Splice Sleeve Crimping Tool, refer to **Special Tools** .

The Supplemental Inflatable Restraint (SIR) System/Supplemental Restraint System (SRS) requires special wiring repair procedures due to the sensitive nature of the circuitry. Follow the specific procedures and instructions when working with the SIR/SRS, and the wiring components, such as connectors and terminals.

SIR/SRS Connector Repair (Plastic Body and Terminal Metal Pin)

NOTE: **Do not use the terminals in the kit in order to replace damaged SIR/SRS system terminals. Use either an SIR/SRS pigtail or a terminated lead from the SIR Repair Kit Tray.**

The terminals in the SIR/SRS system are made with a special plating. This plating provides the necessary contact integrity for the sensitive, low energy circuits.

Pigtail repair packs are available for SIR/SRS connectors with eight or less terminals. Only the connector body is available for connectors with more than eight terminals. Terminated leads can be used to replace damaged terminals when replacing the connector body.

SIR/SRS Component Wire Pigtail Repair

NOTE: **Do not make wire, connector, or terminal repairs on components with wire pigtails.**

A wire pigtail is a wire or wires attached directly to the device, not by a connector. If a wiring pigtail is damaged, you must replace the entire component, with pigtail. The inflatable restraint steering wheel module coil is an example of a pigtail component.

SIR/SRS Wire Repair

CAUTION: **Do not install more than 2 DuraSeal splice sleeves per SIR deployment loop. A deployment loop consists of both wires from the K36 Inflatable Restraint Sensing and Diagnostic Module to the deployable component. If more than 2 DuraSeal splice sleeves are required for any SIR deployment loop, the complete circuit of the loop must be replaced. More than 2 DuraSeal splice sleeves per deployment loop may increase the resistance in the circuit causing a DTC to be set.**

NOTE: **Refer to Wiring Repairs in the service information connector end views or the vehicle schematics in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.**

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire of the same gauge size (0.5 mm, 0.8 mm, 1.0 mm etc.). Use the DuraSeal splice sleeves and the appropriate splice sleeve crimping tool. For wiring repair, refer to **Wire to Wire Repair**.

For connector position assurance (CPA), refer to **Connector Position Assurance Locks**.

For terminal position assurance (TPA), refer to **Terminal Position Assurance Locks**.

SPLICING INLINE HARNESS DIODES

Many vehicle electrical systems use a diode to isolate circuits and protect the components from voltage spikes. When installing a new diode use the following procedure.

1. Open the harness.
    - If the harness is taped, remove the tape.
    - To avoid wiring insulation damage, use a sewing seam ripper (available from sewing supply stores) in order to cut open the harness.
    - If the harness has a black plastic conduit, pull out the diode.
2. If the diode is taped to the harness, remove all of the tape.
3. Check and record the current flow direction and orientation of diode.
4. Remove the inoperative diode from the harness with a suitable soldering tool.

NOTE: **If the diode is located next to a connector terminal remove the terminal(s) from the connector to prevent damage from the soldering tool.**

5. Carefully strip away a section of insulation next to the old soldered portion of the wire(s). Do not remove any more than is needed to attach the new diode.
6. Check current flow direction of the new diode, being sure to install the diode with correct bias. Reference the appropriate service manual wiring schematic to obtain the correct diode installation position.
7. Attach the new diode to the wire(s) using 60/40 rosin core solder. Before soldering attach some heat sinks (aluminum alligator clips) across the diode wire ends to protect the diode from excessive heat. Follow the manufacturer's instruction for the soldering equipment.
8. Reinstall terminal(s) into the connector body if previously removed.

NOTE: **To prevent shorts to ground and water intrusion, completely cover all exposed wire and diode attachment points with tape.**

9. Tape the diode to the harness or connector using electrical tape.

SPLICING TWISTED OR SHIELDED CABLE

WARNING: **In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.**

Twisted/shielded cable is used in order to protect wiring from electrical noise. Two-conductor cable of this construction is used between the radio and the Delco-BoseÂ® speaker/amplifier units and other applications where low level, sensitive signals must be carried. Follow the instructions below in order to repair the twisted/shielded cable.

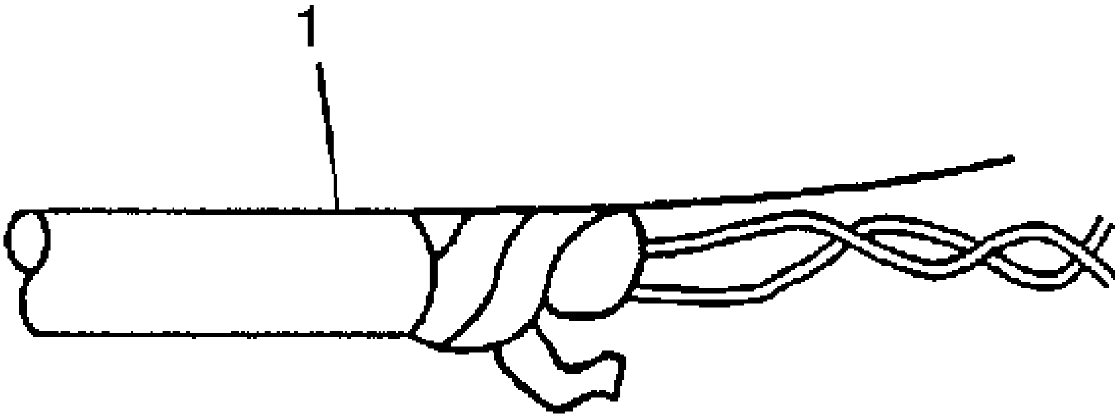


Fig. 11: View Of Outer Wiring Jacket
Courtesy of GENERAL MOTORS COMPANY

1. Remove the outer jacket (1). Use care not to cut into the drain wire of the mylar tape.
2. Unwrap the tape. Do not remove the tape. Use the tape in order to rewrap the twisted conductors after the splice is made.

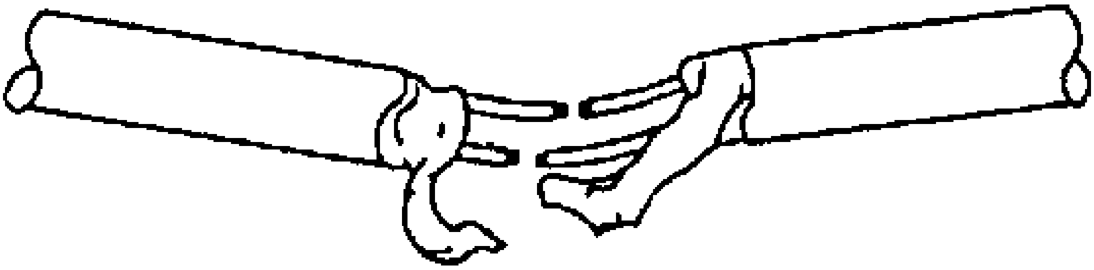


Fig. 12: Preparing Splice
Courtesy of GENERAL MOTORS COMPANY

3. Prepare the splice. Untwist the conductors and follow the instructions for **Wire to Wire Repair**. Staggering the splices by 65 mm (2.5 in) is recommended.

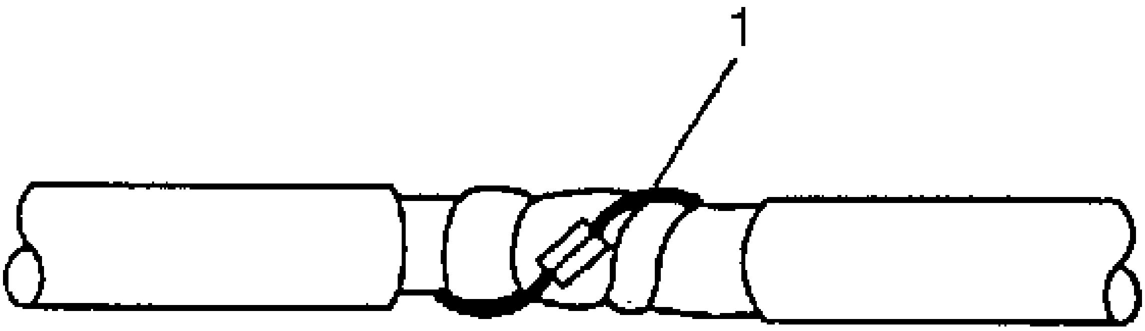


Fig. 13: Identifying Diode On Wire
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Apply the mylar tape with the aluminum side inward. This ensures good electrical contact with the drain wire.**

4. Re-assemble the cable.
    - Rewrap the conductors with the mylar tape. If the mylar tape is damaged, use 3M product AL-36FR to replace the damaged mylar tape.
    - Use caution not to wrap the drain wire in the tape (1).
    - Follow the splicing instructions for copper wire and splice the drain wire.
    - Wrap the drain wire around the conductors and tape with electrical tape to replace the outer insulation.

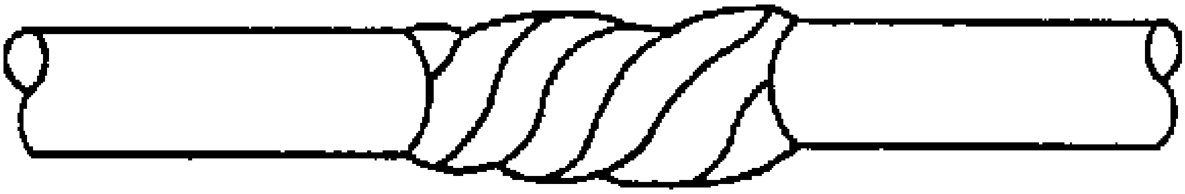


Fig. 14: View Of Repaired Wire Covered With Electrical Tape
Courtesy of GENERAL MOTORS COMPANY

5. Tape over the entire cable. Use a winding motion when you apply the tape.

WIRE TO WIRE REPAIR

Special Tools

- **EL-38125-10** Splice Sleeve Crimping Tool
- **EL-38125-5** Ultra Torch Special Tool
- DuraSeal splice sleeves, in order to repair the SIR/SRS wiring

For equivalent regional tools, refer to Special Tools .

WARNING: **In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.**

NOTE: **If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to**

repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: **Do not splice wires in Door Harness Grommets.**

NOTE:

- **Use only DuraSeal splice sleeves. Other splice sleeves may not protect the splice from moisture or provide a good electrical connection.**
- **For wire Gauge smaller than.5 mm (18 gauge) refer to Folded-Over Wire Repair**

Use DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm^2 / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19168446	Red (1) or Red/Green (1)	Red (2)	0.5 - 0.8/(18 - 20)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.6/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: **You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.**

1. Open the harness by removing any tape:
    - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
    - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
    - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

    Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
    - When adding a length of wire to the existing harness, use the same size wire as the original wire.
    - Perform one of the following items in order to find the correct wire size:
        - Find the wire on the schematic and convert to regional wiring gauge size.
        - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
    - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
    - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
    - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp

tool nests.

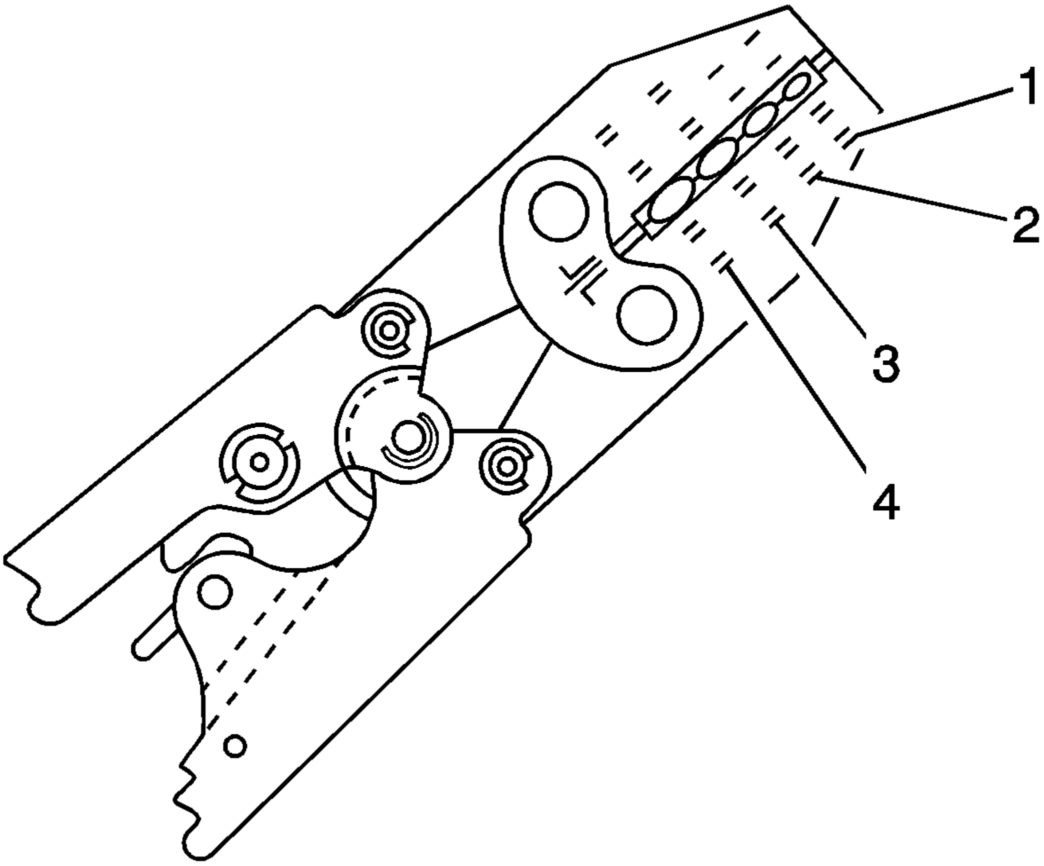


Fig. 15: Splice Sleeve Crimping Tool With 4 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

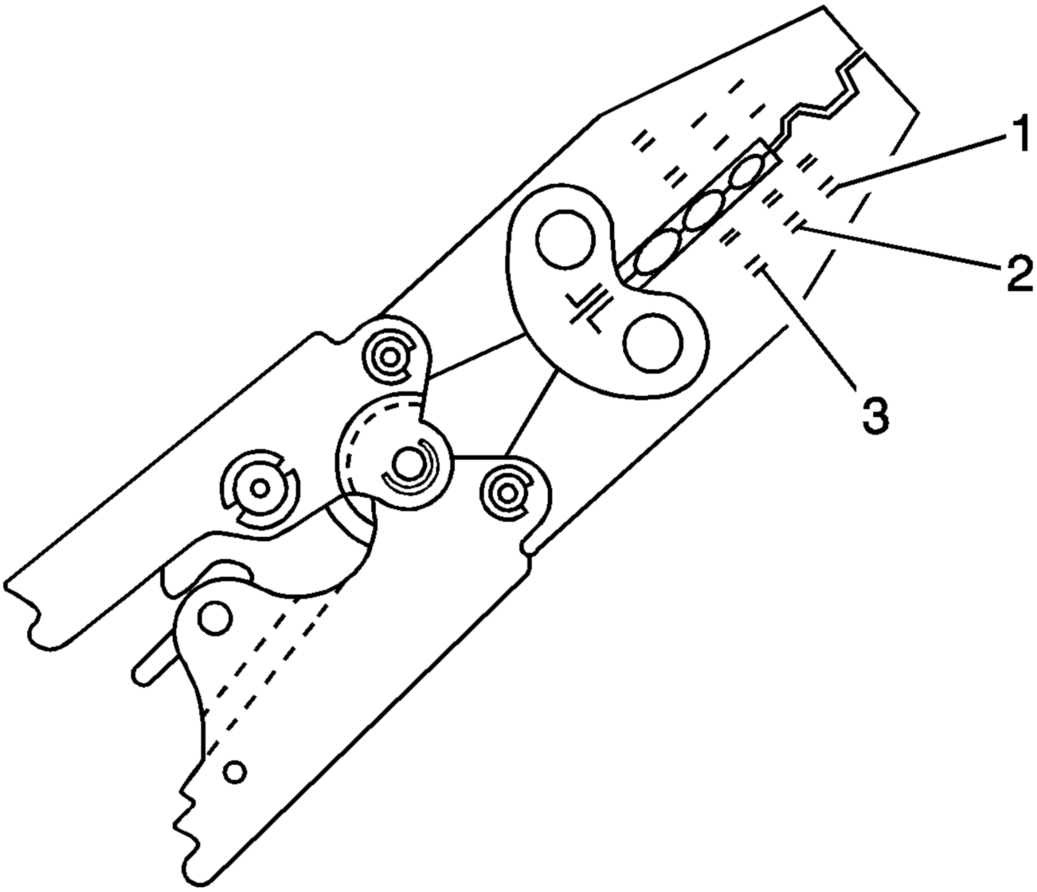


Fig. 16: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

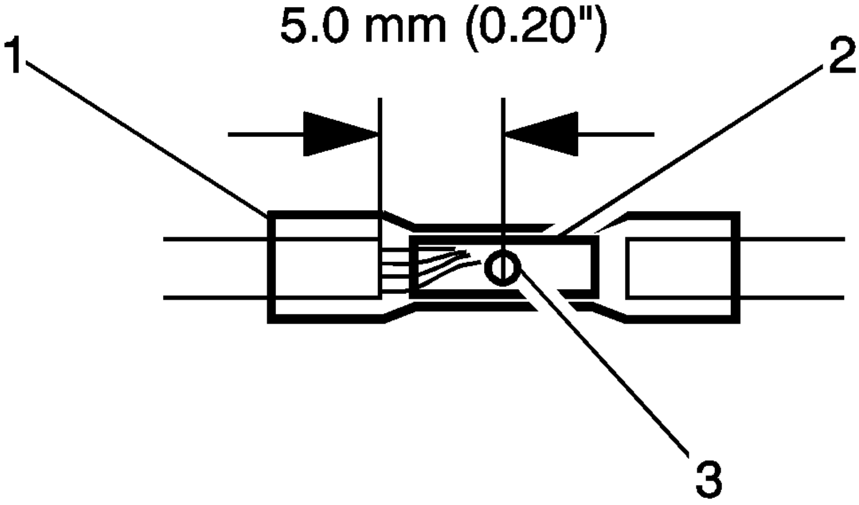


Fig. 17: Identifying Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.

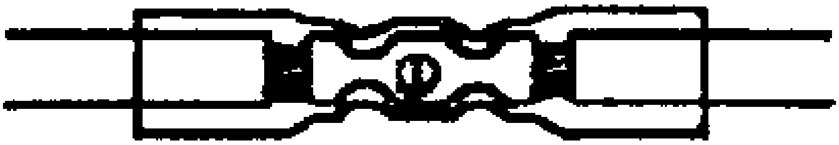


Fig. 18: Crimped Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

    The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.

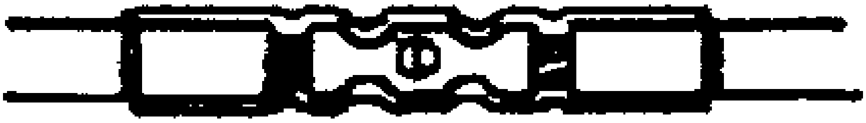


Fig. 19: Crimped Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS COMPANY

12. Using the EL-38125 - 5 ultra torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
    - The tubing will shrink completely as the heat is moved along the insulation.
    - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: **Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.**

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

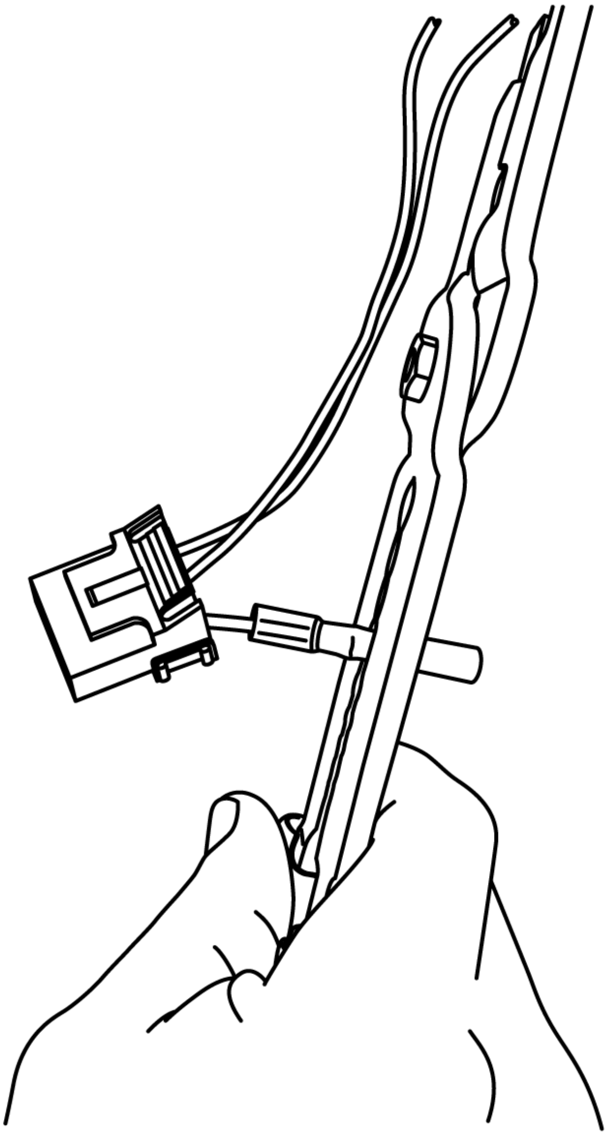


Fig. 20: Tightly Close Handles Of Crimp Tool
Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

   The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSEAL with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

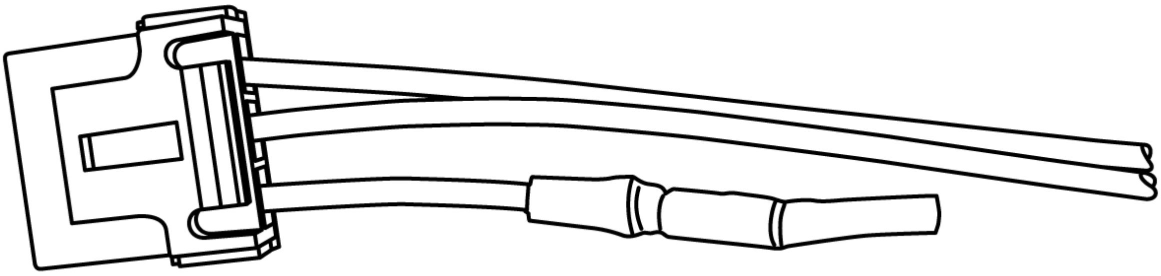


Fig. 21: Heat To Crimped Area Of Barrel
Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
    - The tubing will shrink completely as the heat is moved along the insulation.
    - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

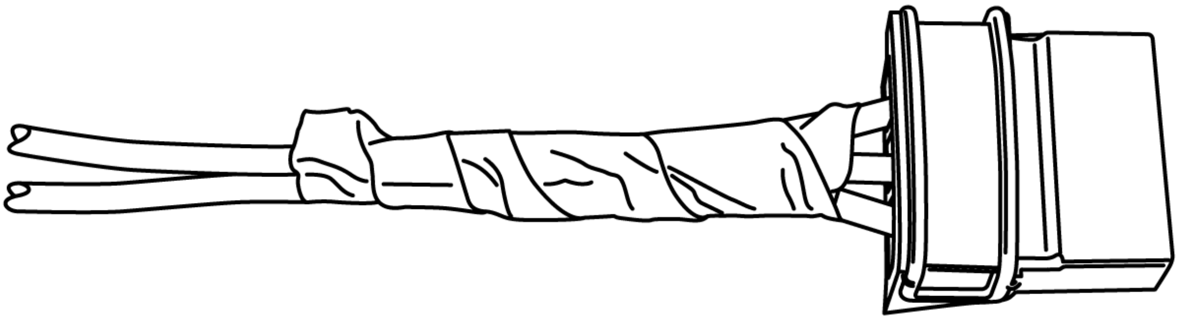


Fig. 22: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the EL-38125 - 5 ultra torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
   - The tubing will shrink completely as the heat is moved along the insulation.
   - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR POSITION ASSURANCE LOCKS

The connector position assurance (CPA) is a small plastic insert that fits through the locking tabs of the connector. CPAs are used in various connectors throughout the vehicle. CPAs are also used in all SIR system electrical connectors. The CPA ensures that the connector halves cannot vibrate apart. You must have the CPA in place in order to ensure good contact between the mating terminals of the connector.

TERMINAL POSITION ASSURANCE LOCKS

The terminal position assurance (TPA) insert resembles the plastic combs used in the control module connectors. The TPA keeps the terminal securely seated in the connector body. Do not remove the TPA from the connector body unless you remove a terminal for replacement. If the TPA is removed, be sure to reinstall it before reconnecting the connector.

AFL/EPC CONNECTORS

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool
- **J-38125-216** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

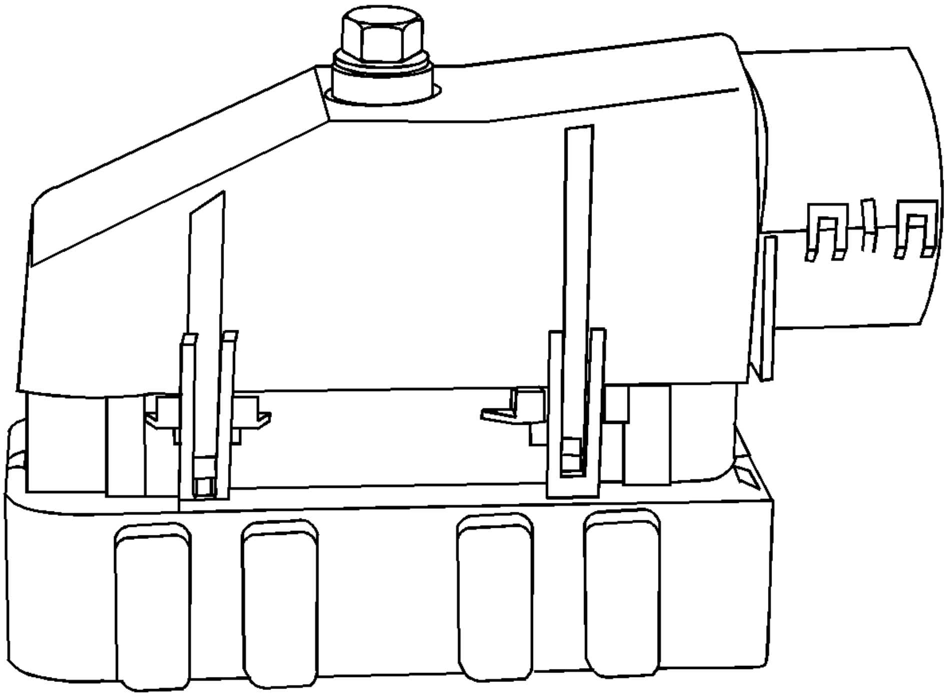
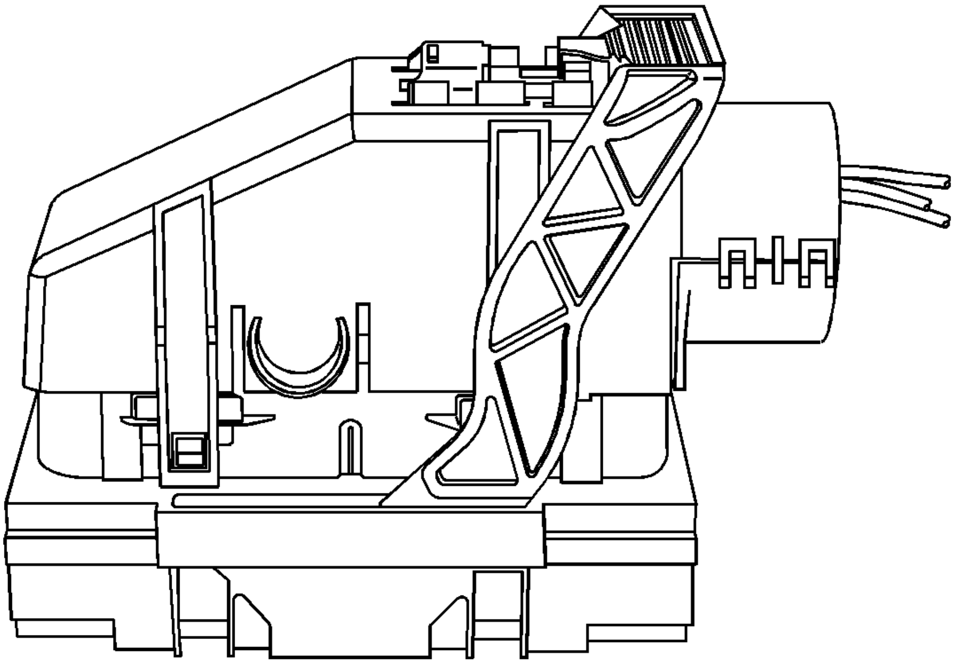


Fig. 23: View Of Bolt On Connector Cover
Courtesy of GENERAL MOTORS COMPANY



[Fig. 24: Identifying Connector Position Assurance (CPA)](#)
Courtesy of GENERAL MOTORS COMPANY

1. For connectors with a bolt in the dress cover, turn the bolt counterclockwise to remove the connector from the component.
2. Locate the connector position assurance (CPA) on the top of the wire dress cover. Slide the CPA forward.

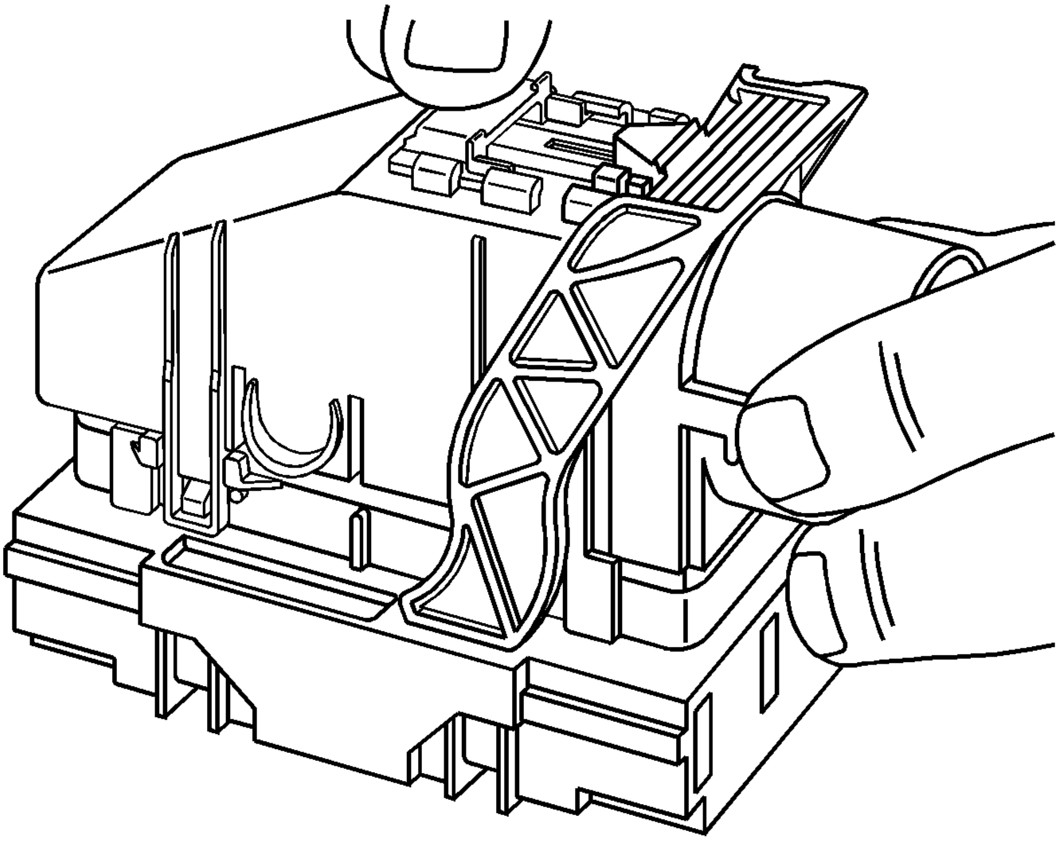


Fig. 25: Identifying Lever Lock & Lever Lock Release Tab
Courtesy of GENERAL MOTORS COMPANY

3. Slide the lever lock forward while pressing down on the lever lock release tab.

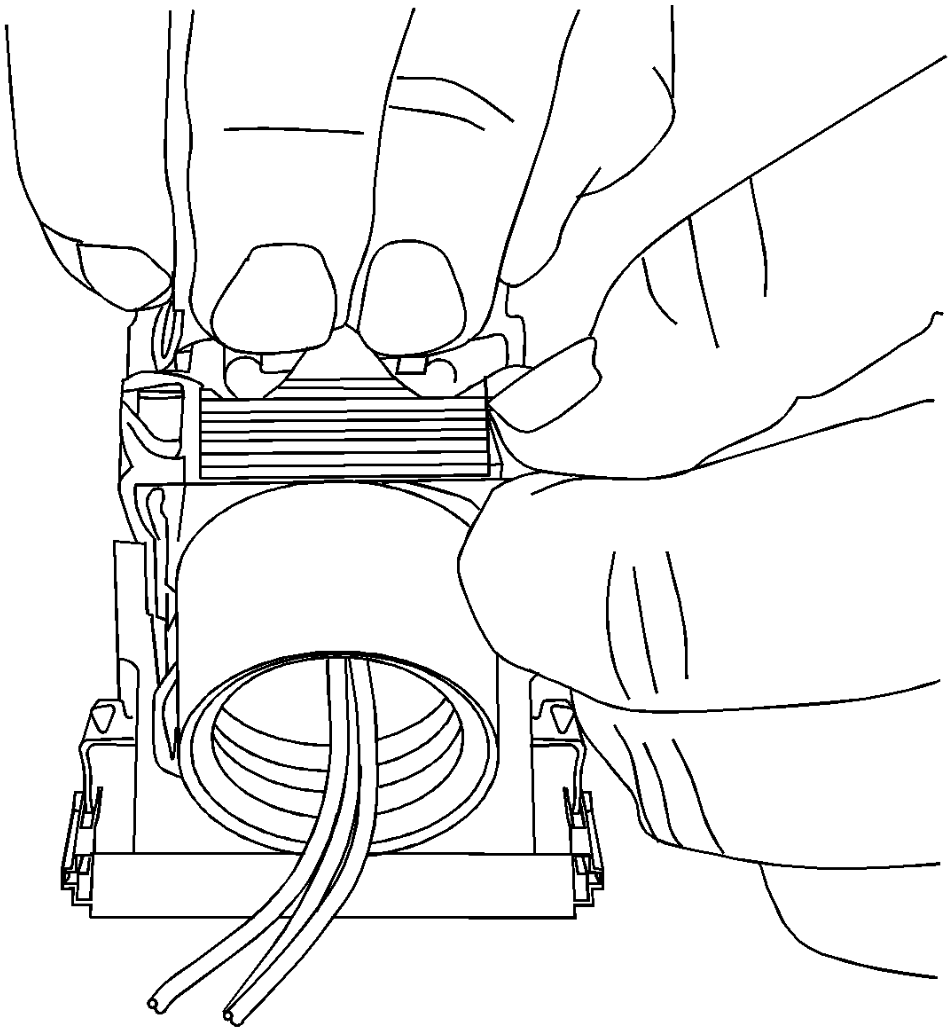


Fig. 26: View Showing Depressing Lever Lock Release Tab
Courtesy of GENERAL MOTORS COMPANY

4. View showing depressing of the lever lock release tab.

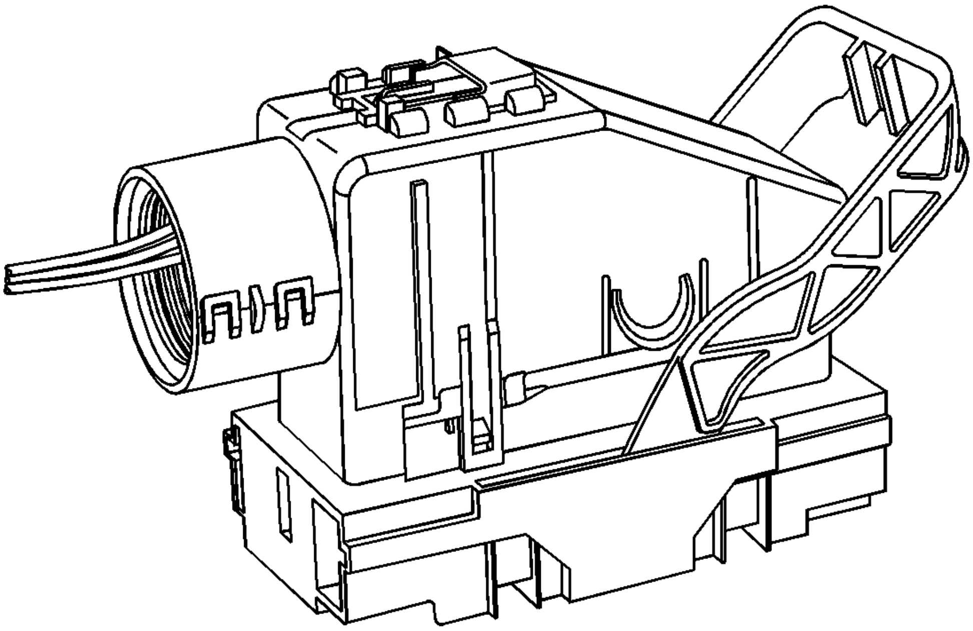


Fig. 27: View Of Connector In Released Position
Courtesy of GENERAL MOTORS COMPANY

5. View of connector in released position.
6. Disconnect the connector from the component.
7. Locate the dress cover locking tabs at the corners of the dress cover. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

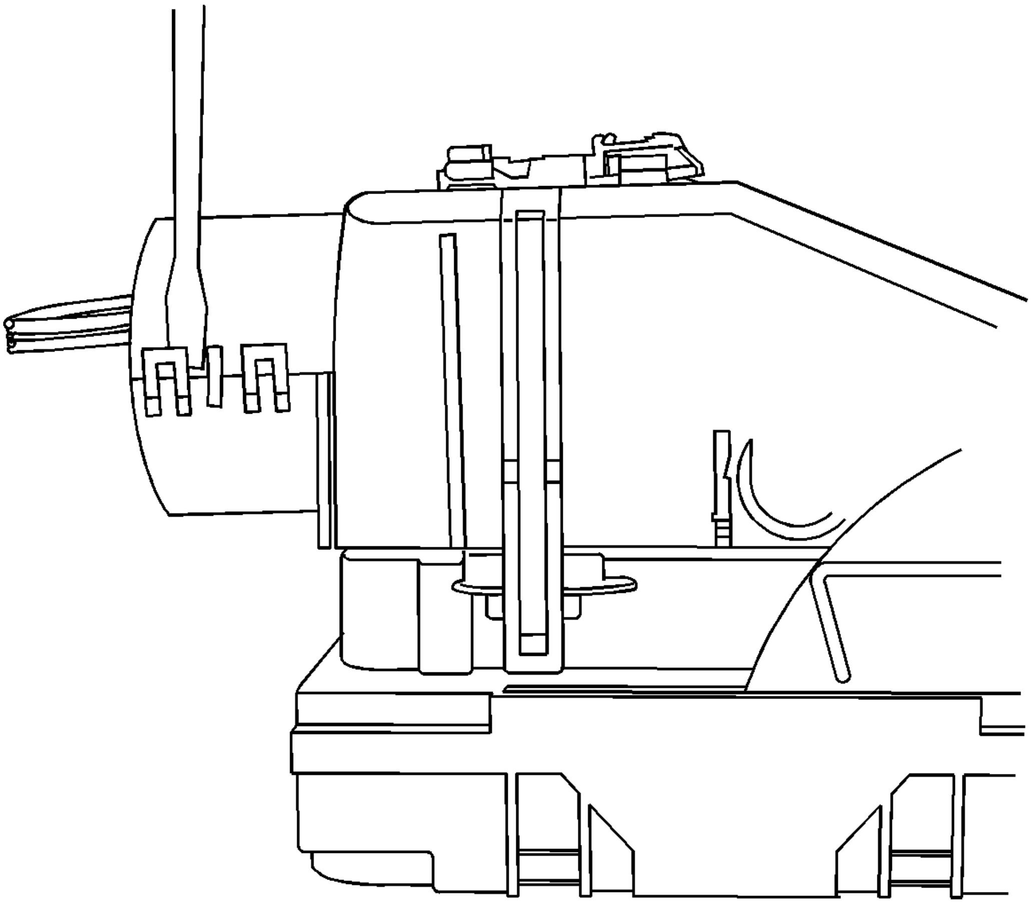


Fig. 28: View Of Connector In Released Position
Courtesy of GENERAL MOTORS COMPANY

8. Release the rear lower half of the wiredress cover.

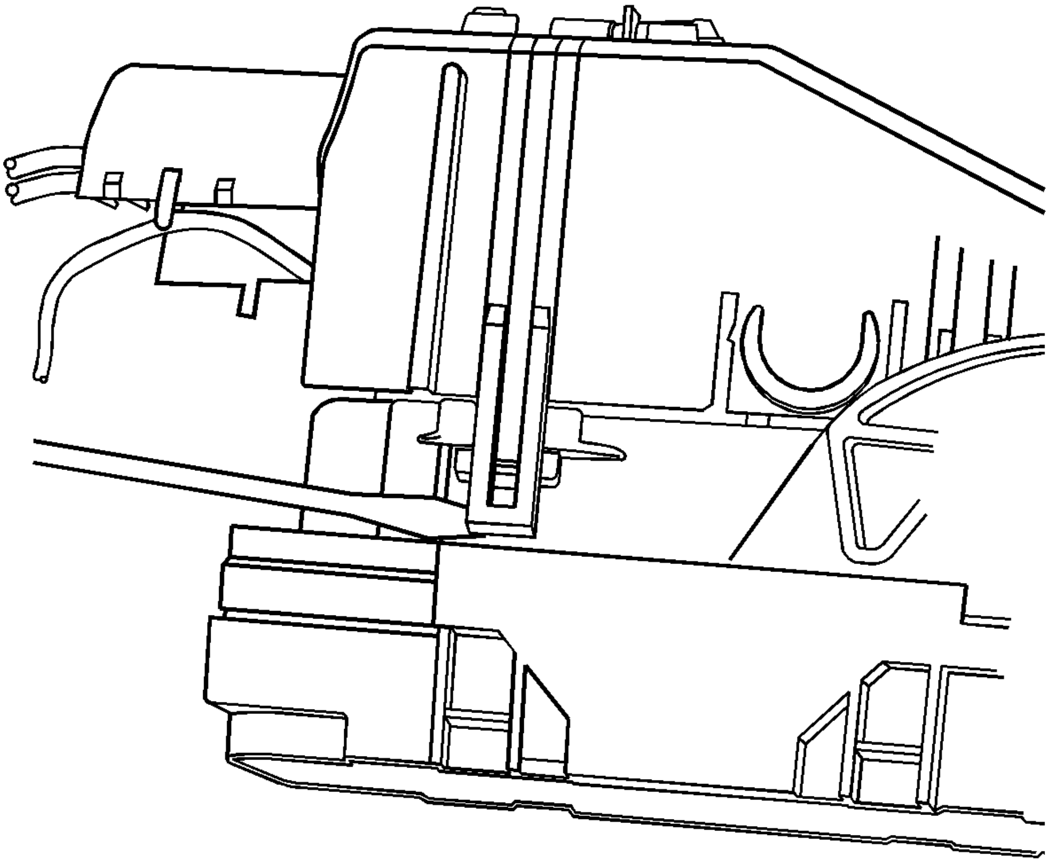


Fig. 29: Identifying Tabs Holding Wiredress Cover
Courtesy of GENERAL MOTORS COMPANY

9. Release the tabs that are holding the wiredress cover to the connector body.
10. Remove the nose piece by inserting a small flat-blade tool into the slots on both ends of the connector body. Gently pry the nose piece out of the connector. J-38125-216 can also be used to remove the nose piece.

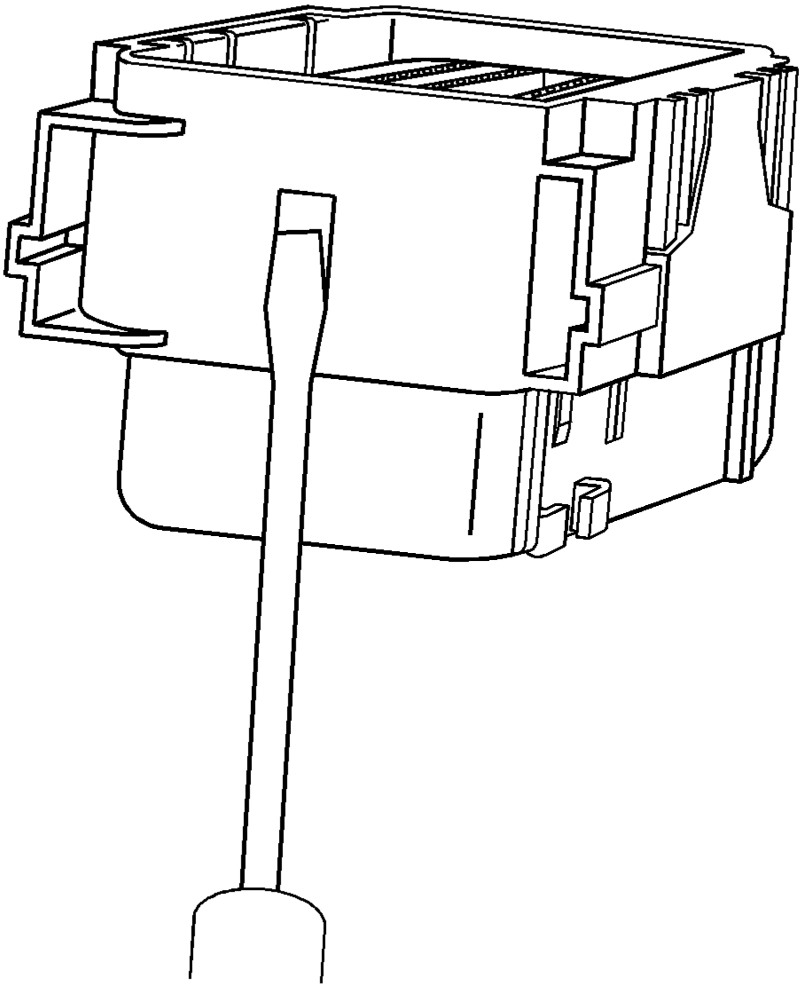


Fig. 30: Lifting Terminal Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

11. Use the J-38125-12A tool to release the terminals by lifting the terminal retaining tabs on the inside of the connector.

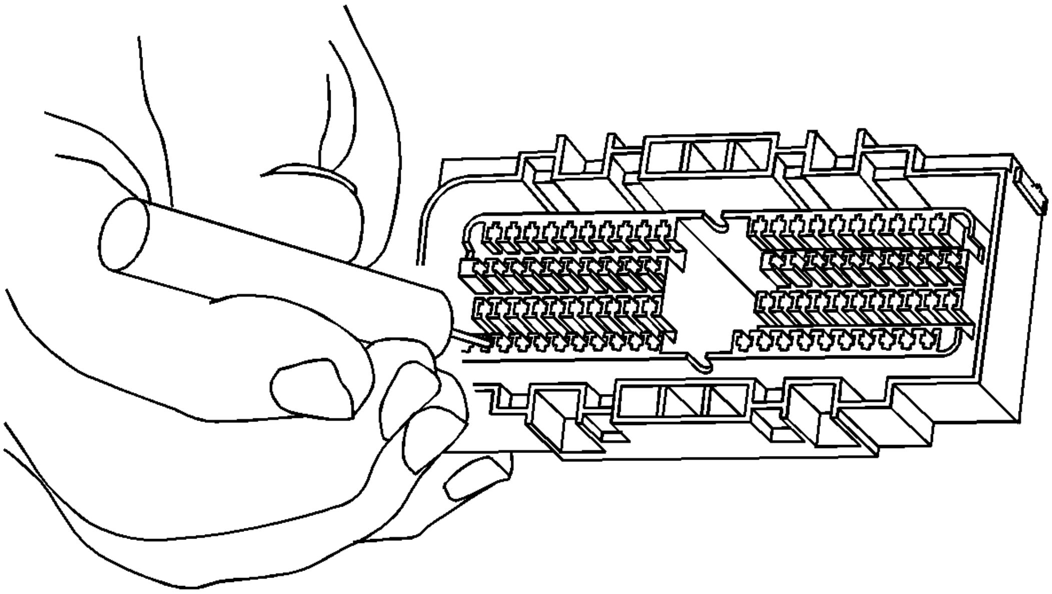


Fig. 31: Pulling Wire Out Of Back Of Connector
Courtesy of GENERAL MOTORS COMPANY

12. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
13. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
14. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

BOSCH CONNECTORS (BSK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-561** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

1. Disconnect the connector from the component.
2. Remove the wire dress cover, if necessary.
3. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

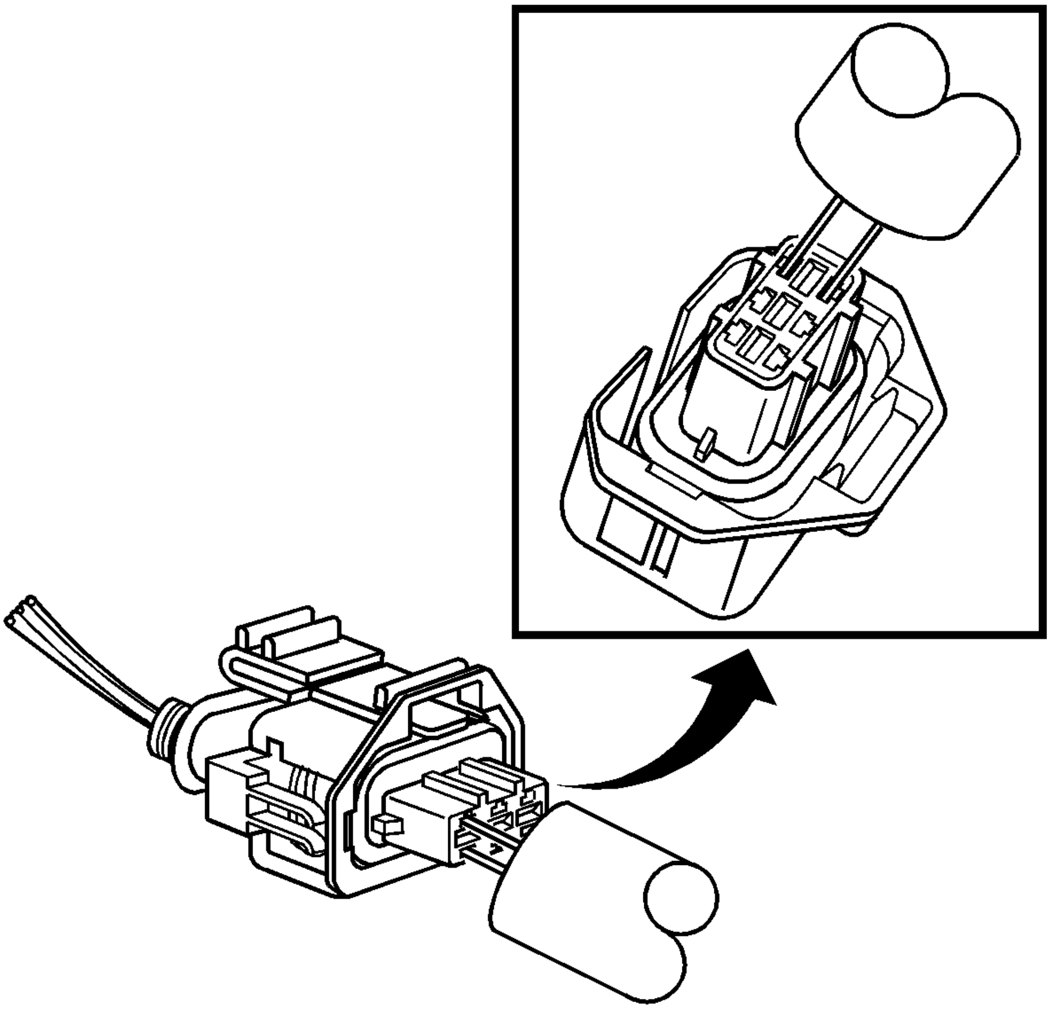


Fig. 32: View Of Bosch Connector Terminals (BSK)
Courtesy of GENERAL MOTORS COMPANY

4. Insert the J-38125-561 tool into the 2 cavities on each side of the terminal at the front of the connector and push until you feel the tool disengage the terminal retainers.
5. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
6. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

BOSCH CONNECTORS (0.64)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

1. Locate the lever lock on the wire dress cover. While pressing the lock, pull the lever over and past the lock until the lever is at the end of its travel.
2. Disconnect the connector from the component.
3. Pull the rubber boot that covers the wires back to expose the end of the connector dress cover.
4. Place the connector locking lever in the center of the connector.

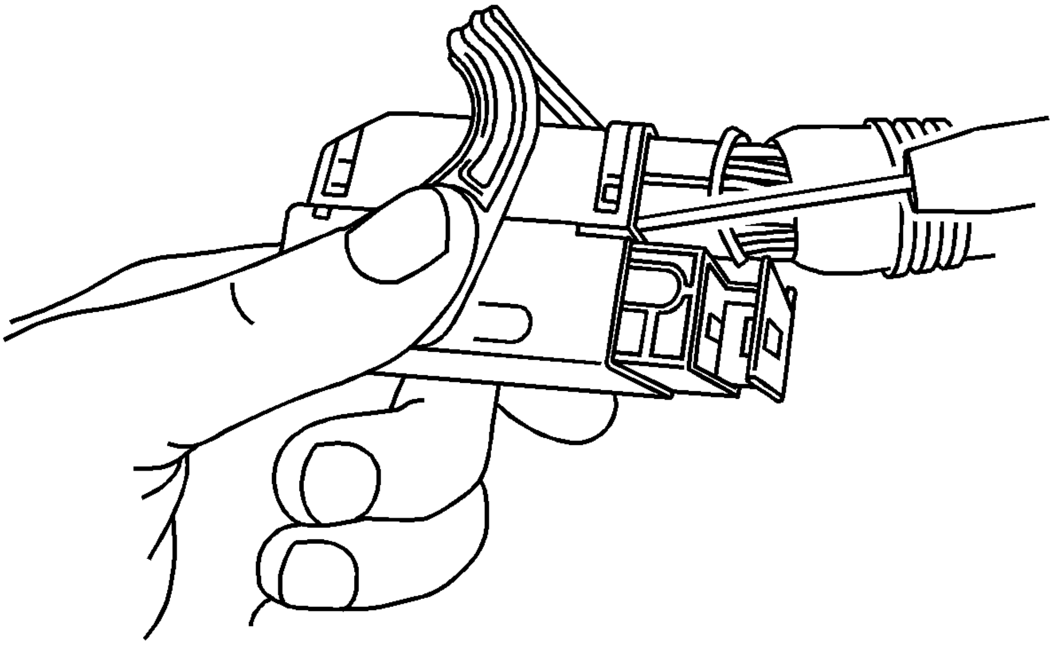


Fig. 33: View Of Flat-Bladed Tool Being Inserted Between Cover & Connector Body
Courtesy of GENERAL MOTORS COMPANY

5. Locate the 2 dress cover locking tabs that are on the wire end of the connector. Insert a small flat-bladed tool between the cover and connector body and pry up.

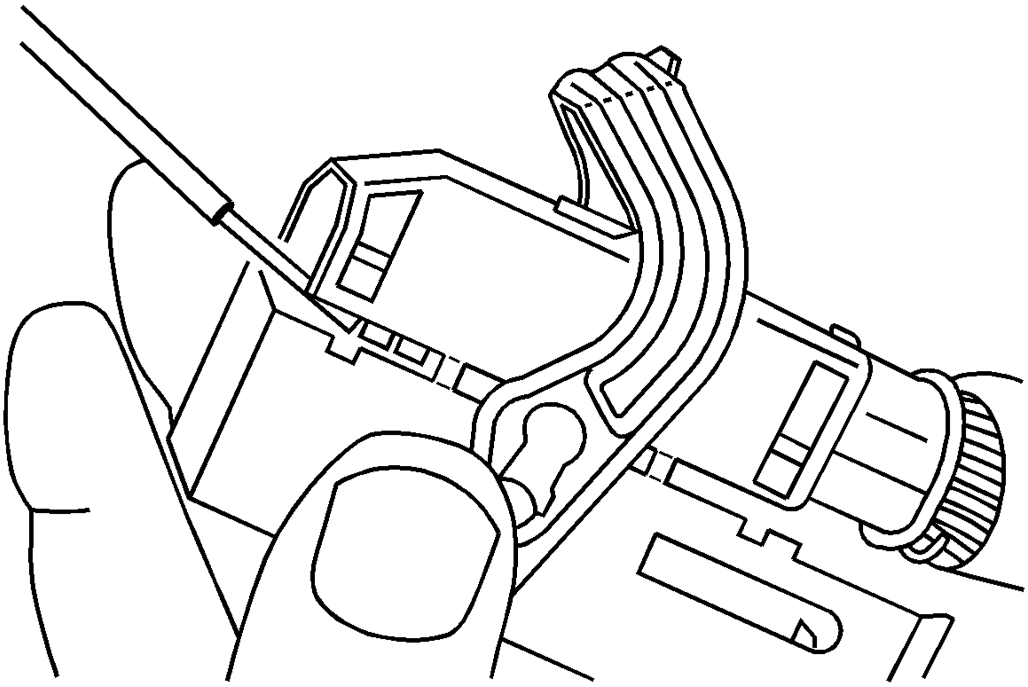


Fig. 34: View Of Flat-Bladed Tool Between Cover & Connector End
Courtesy of GENERAL MOTORS COMPANY

6. Locate the 2 dress cover locking tabs located on the opposite side of the connector. Insert a small flat-bladed tool between the cover at the connector end and pry up.
7. Remove the dress cover.
8. Cut the tie wrap on the wire bundle.

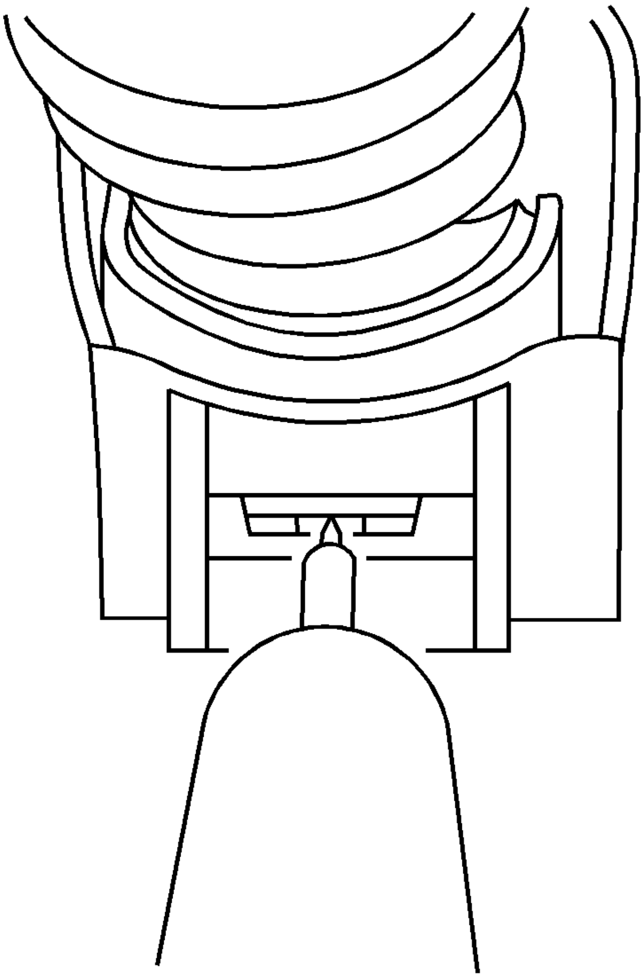


Fig. 35: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS COMPANY

9. Remove the terminal position assurance (TPA) by inserting a small flat-bladed tool into the small slot in the end of the slider and pushing on the TPA until it comes out of the connector. When the TPA exits the opposite side of the connector, gasp the TPA and pull it completely out of the connector.
10. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

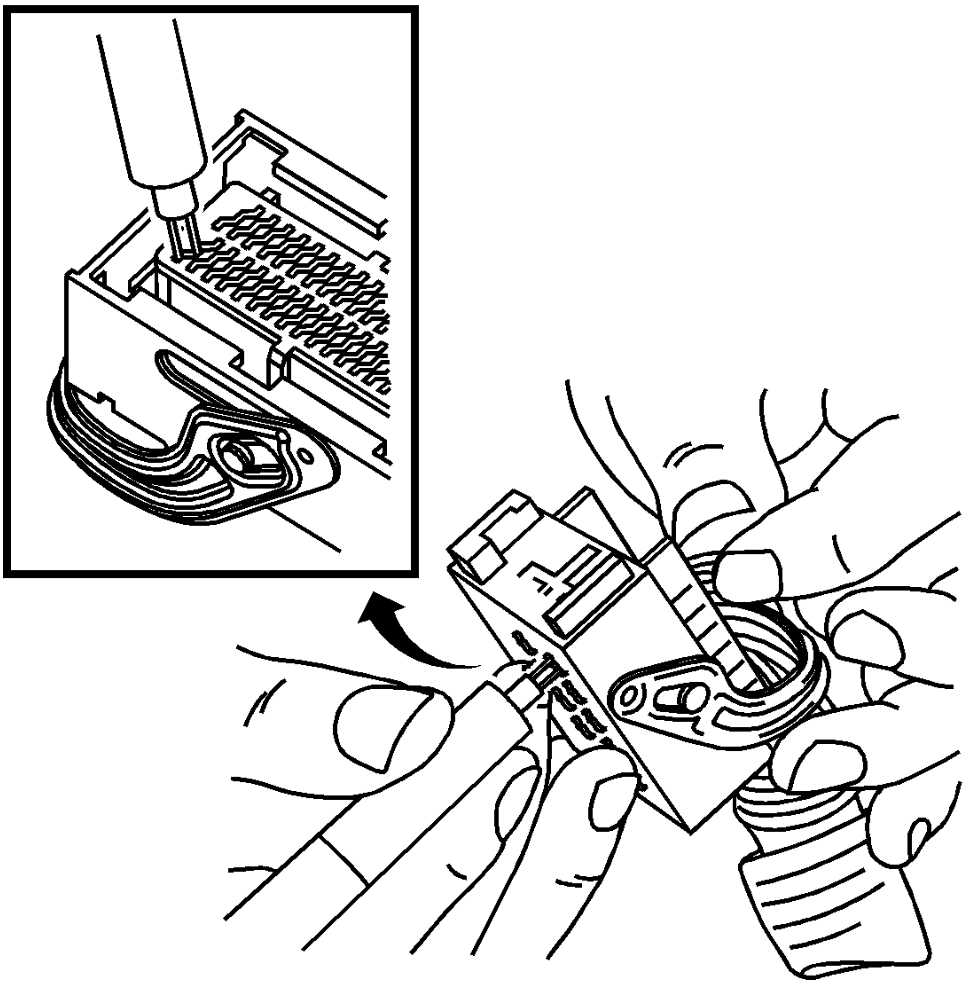


Fig. 36: View Of J 38125-560 Being Inserted Into Triangular Cavities
Courtesy of GENERAL MOTORS COMPANY

11. Insert the J-38125-560 into the 2 triangular cavities on each side of the terminal at the front of the connector.
12. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
13. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
14. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

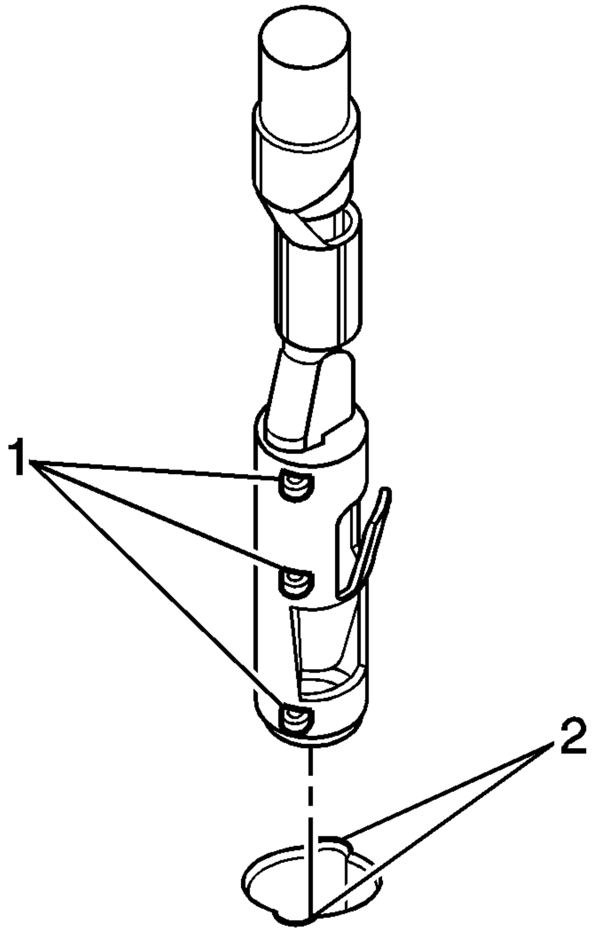


Fig. 37: Aligning Coding Lugs With Connector Coding Grooves
Courtesy of GENERAL MOTORS COMPANY

1. Prior to installation the terminal must be aligned so the (1) coding lugs align with the (2) coding grooves on the connector.
2. Once the terminal is aligned, slide the terminal into the cavity until the retainer has engaged in the cavity of the connector.
3. Slide the TPA in the connector body and seat it using a small flat bladed tool. The TPA is seated when it is flush with the contact housing.
4. Secure the wires to the connector body using a tie wrap and replace the dress cover and grommet.

BOSCH CONNECTORS (2.8 JPT)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-557** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

1. Pull out the slider on the connector position assurance (CPA) until it is at the end of its travel.
2. Disconnect the connector from the component.
3. Remove the wire dress cover, if necessary.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

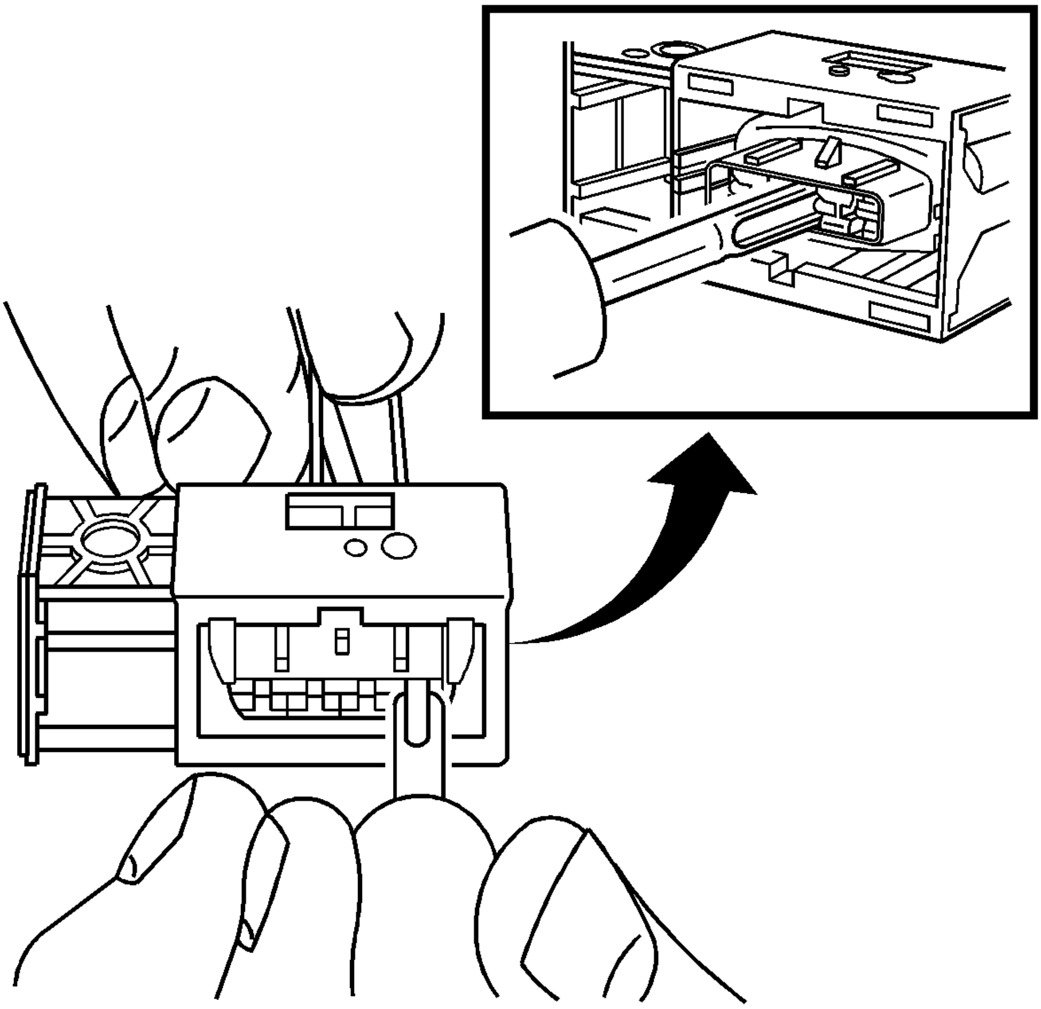


Fig. 38: View Of Bosch Connector Terminals (2.8 JPT)
Courtesy of GENERAL MOTORS COMPANY

5. Insert the J-38125-557 into the 2 cavities on each side of the terminal at the front of the connector and push until you feel the tool disengage the terminal retainers.
6. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
7. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
8. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

BOSCH CONNECTORS (ECM)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-213** Terminal Release Tool
- **J-38125-556** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

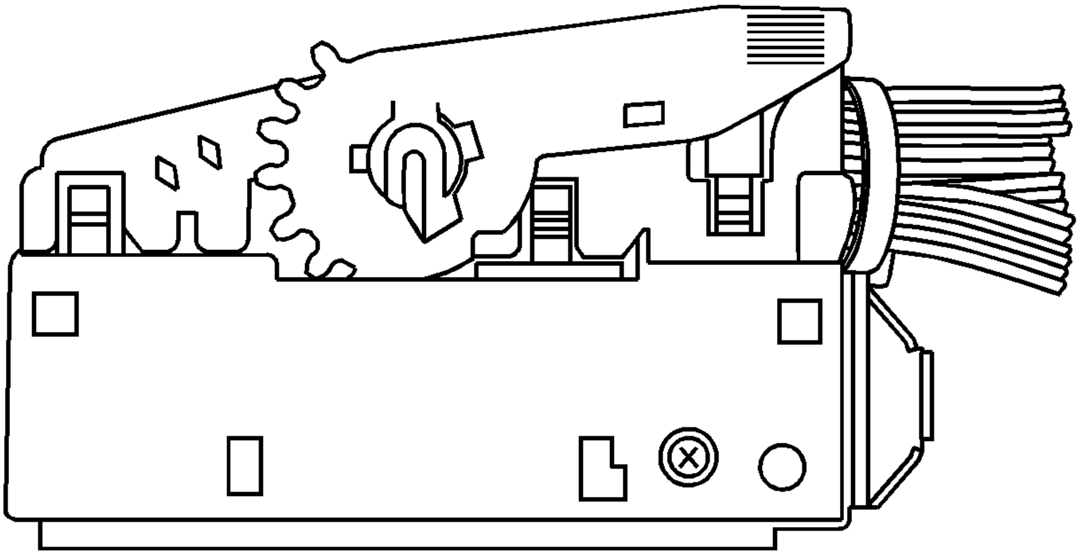


Fig. 39: View Of Bosch Connectors
Courtesy of GENERAL MOTORS COMPANY

1. Locate the assist lever on the top of the connector. Move the assist lever to the forward position.

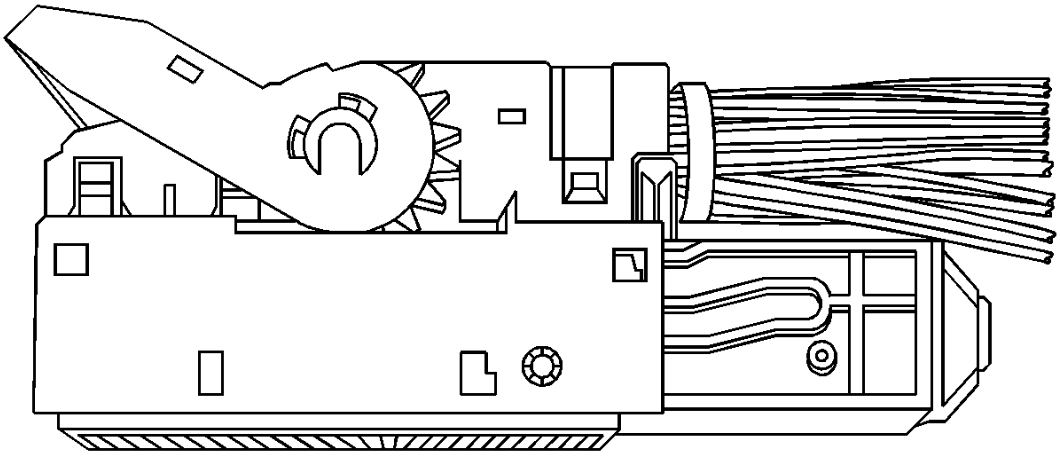


Fig. 40: Identifying Assist Lever In Forward Position
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the connector from the component.

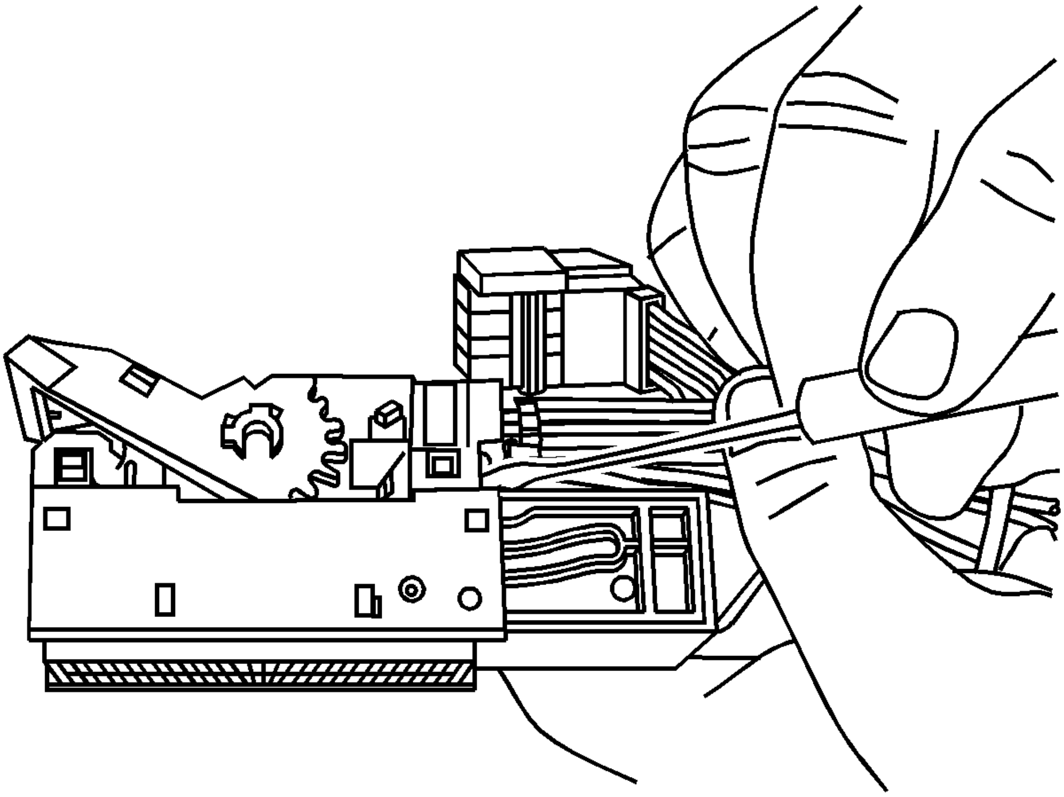


Fig. 41: View Of Releasing Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Locate the dress cover locking tabs at the corners of the connector. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

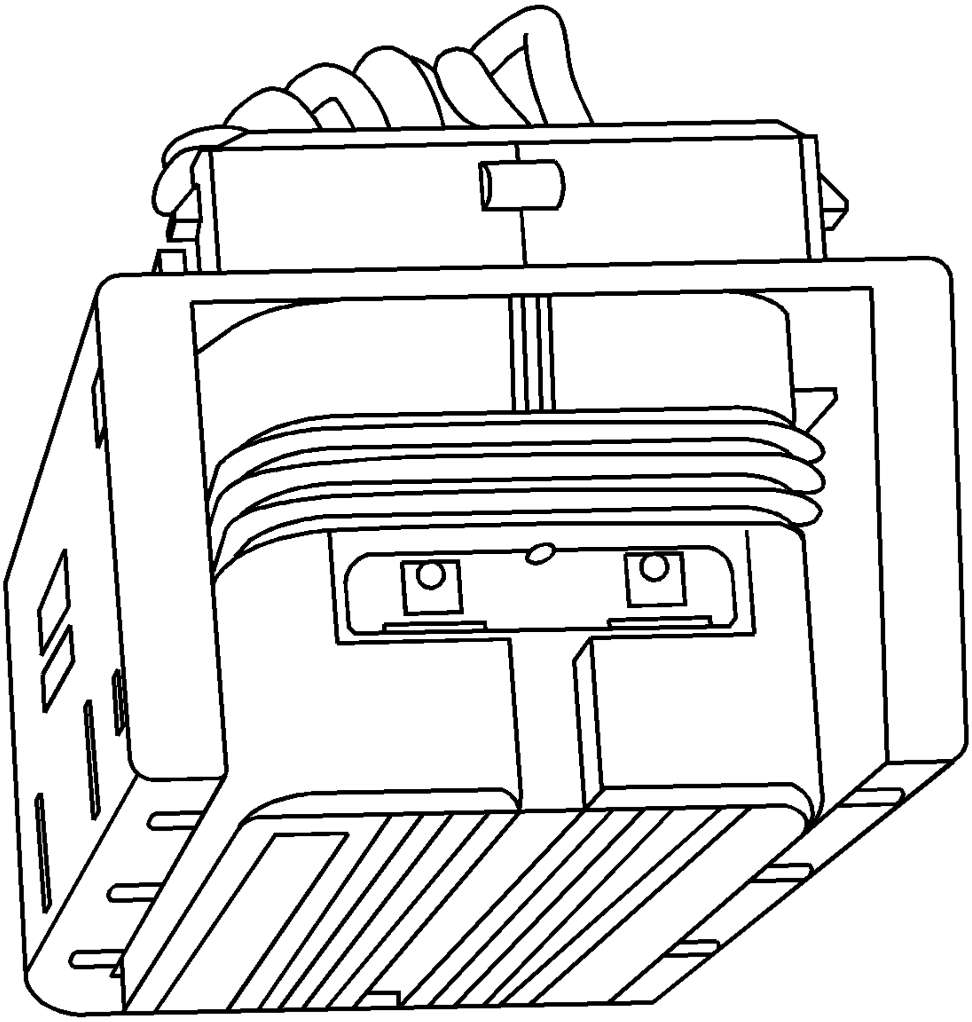


Fig. 42: View Of Terminal Positive Assurance (TPA) Connector
Courtesy of GENERAL MOTORS COMPANY

4. The terminal positive assurance (TPA) is located in the front of the connector.

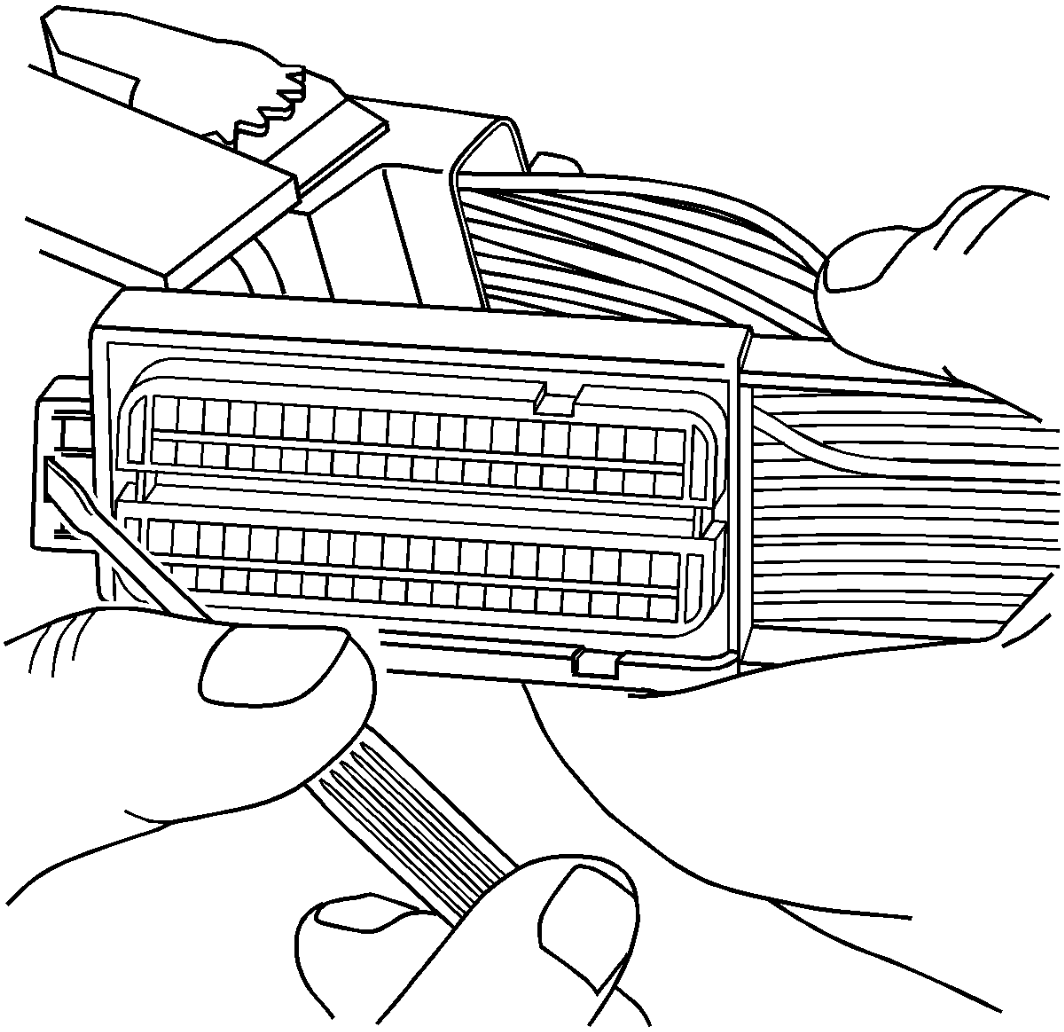


Fig. 43: View Of Removing TPA From Connector
Courtesy of GENERAL MOTORS COMPANY

5. Use a small flat-blade tool to remove TPA from the connector.

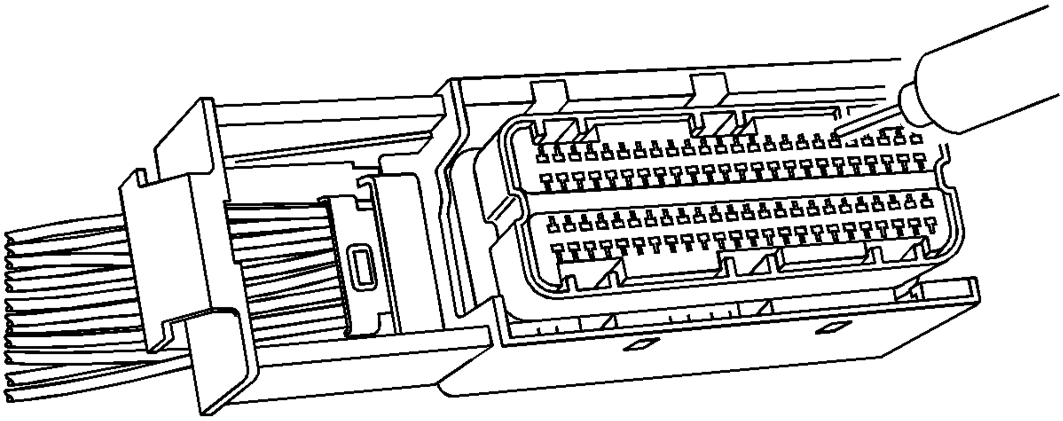


Fig. 44: View Of Special Tools And Terminals
Courtesy of GENERAL MOTORS COMPANY

6. Use the J-38125-213 or the J-38125-556 tool to release the terminals by inserting the tool into the terminal release cavity.
7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

NOTE: **Ensure that the dress cover and connector body are both in the released position before reassembling. Failure to do so may cause damage to the connector and component.**

10. Reconnect the connector bodies.

DELPHI CONNECTORS (WEATHER PACK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-10A** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

The following is the proper procedure for the repair of Weather PackÂ® Connectors.

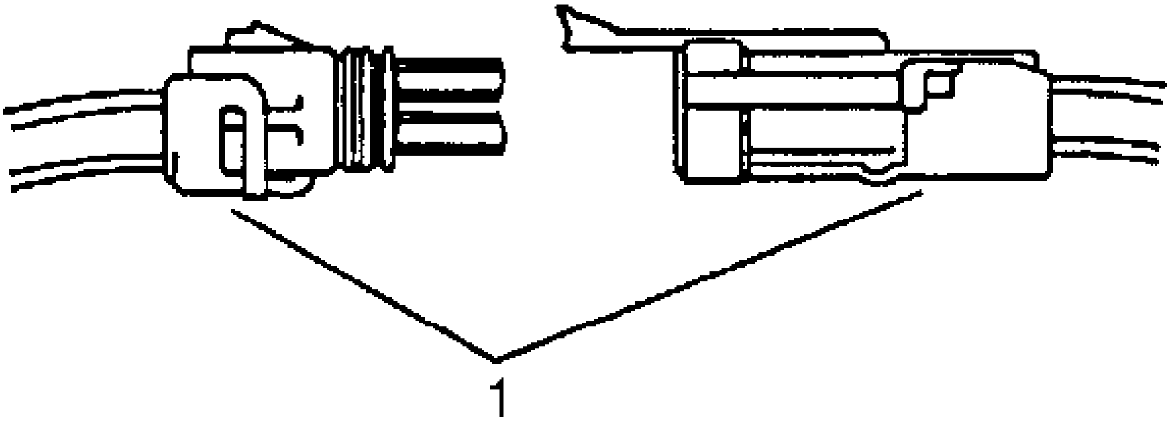


Fig. 45: View Of Connector Halves
Courtesy of GENERAL MOTORS COMPANY

1. Separate the connector halves (1).
2. Open the secondary lock. A secondary lock aids in terminal retention and is usually molded to the connector (1).
3. Grasp the wire and push the terminal to the forward most position. Hold the wire in this position.

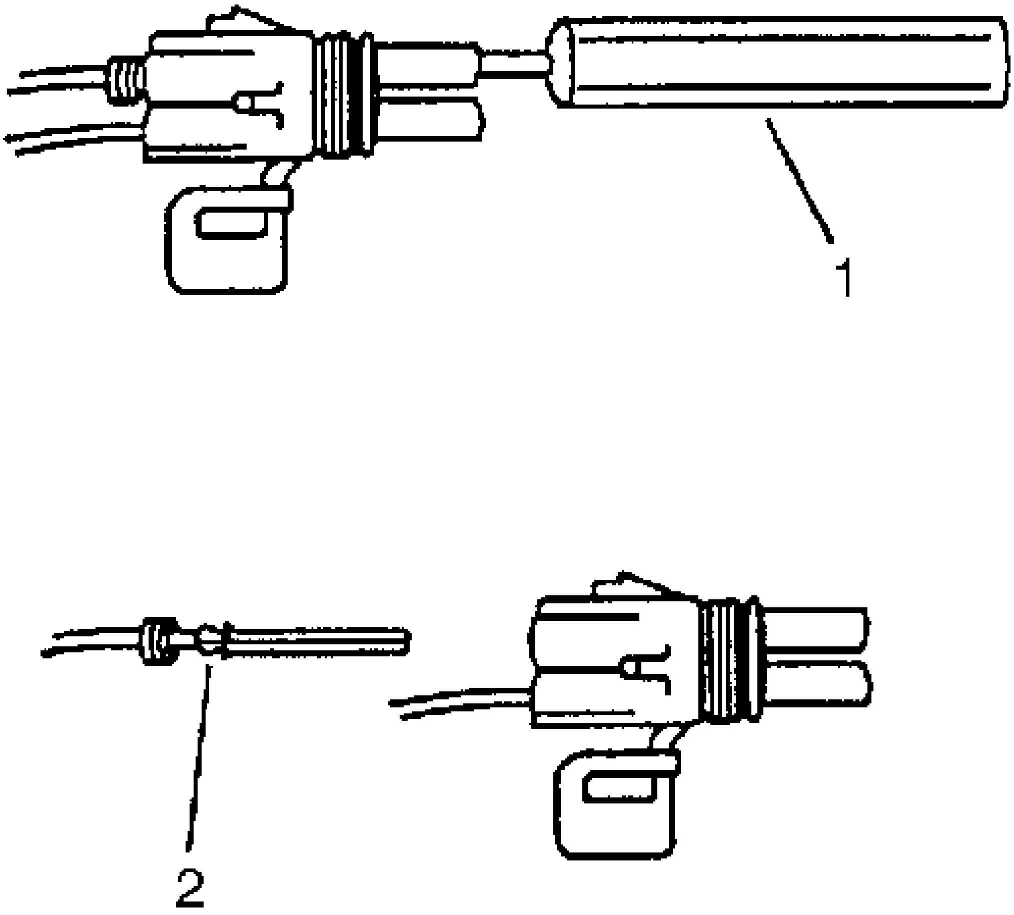


Fig. 46: Identifying Removal Tool & Terminal
Courtesy of GENERAL MOTORS COMPANY

4. Insert the Weather PackÂ® terminal removal tool J-38125-10A into the front (mating end) of the connector cavity until it rests on the cavity shoulder (1).
5. Gently pull on the wire to remove the terminal through the back of the connector (2).

NOTE: **Never use force to remove a terminal from a connector.**

6. Inspect the terminal and connector for damage. Repair as necessary. Refer to **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)**.
7. Reform the lock tang (2) and reset terminal in connector body.
8. Close secondary locks and join connector halves.
9. Verify that circuit is complete and working satisfactorily.
10. Perform system check.
11. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
12. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

DELPHI CONNECTORS (PUSH TO SEAT)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

Follow the steps below in order to repair push to seat connectors.

1. Remove the terminal position assurance (TPA) device, the connector position assurance (CPA) device, and/or the secondary lock.

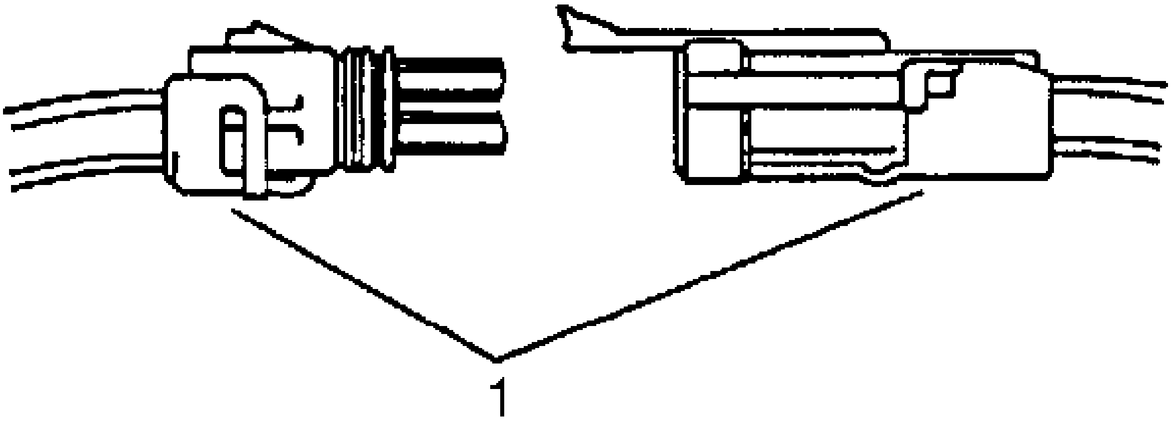


Fig. 47: View Of Connector Halves
Courtesy of GENERAL MOTORS COMPANY

2. Separate the connector halves (1).

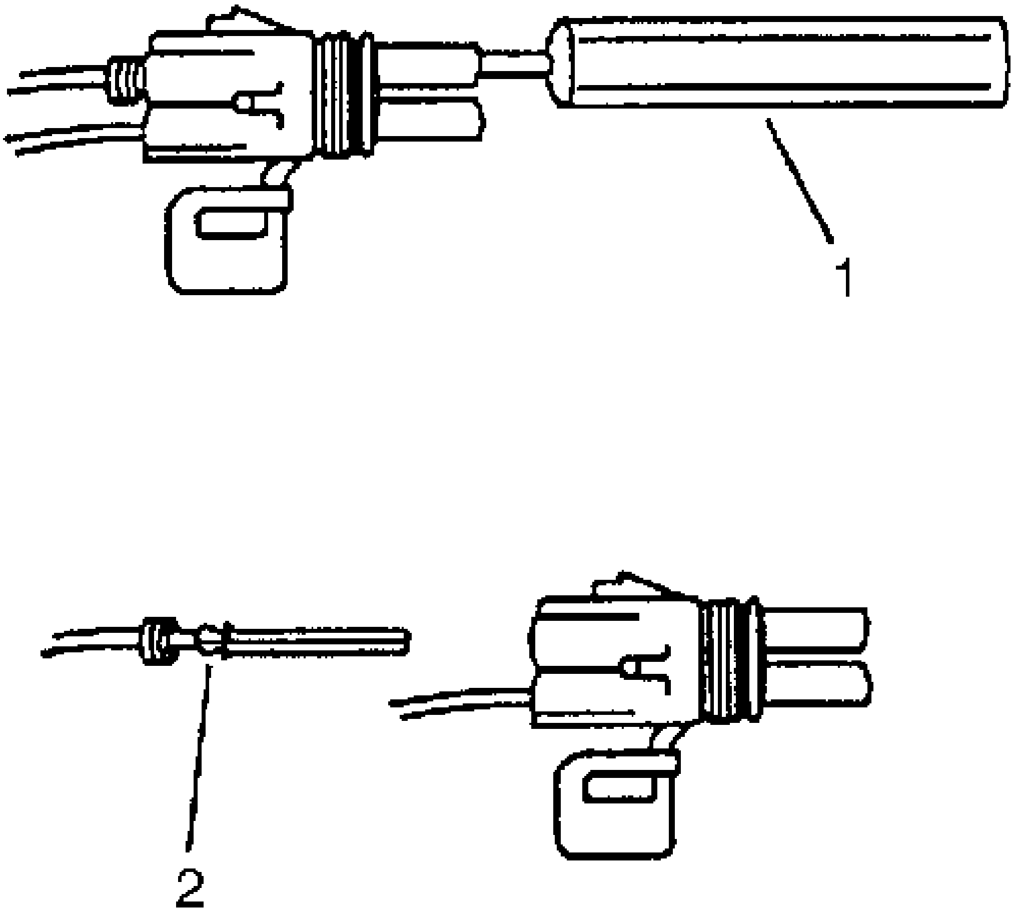


Fig. 48: Identifying Removal Tool & Terminal
Courtesy of GENERAL MOTORS COMPANY

3. Use the proper pick or removal tool (1) in order to release the terminal.
4. Gently pull the cable and the terminal (2) out of the back of the connector.

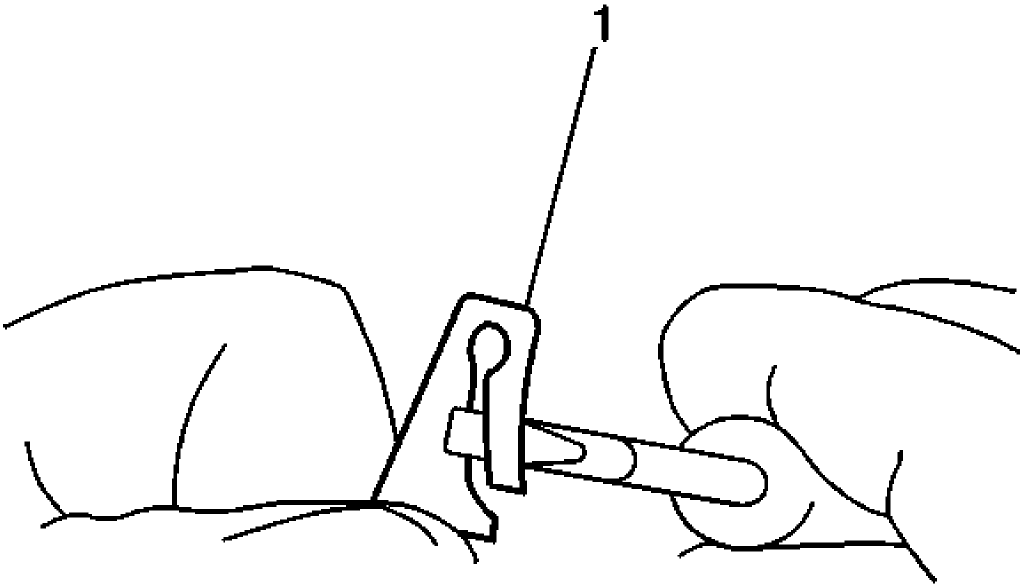


Fig. 49: Identifying Locking Device
Courtesy of GENERAL MOTORS COMPANY

5. Re-form the locking device if you are going to reuse the terminal (1).
6. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

1. In order to reuse a terminal or lead assembly, refer to **Wiring Repairs** .
2. Ensure that the cable seal is kept on the terminal side of the splice.
3. Insert the lead from the back until it catches.
4. Install the TPA, CPA, and/or the secondary locks.

DELPHI CONNECTORS (PULL TO SEAT)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

If the terminal is visibly damaged or is suspected of having a faulty connection, the terminal should be replaced.

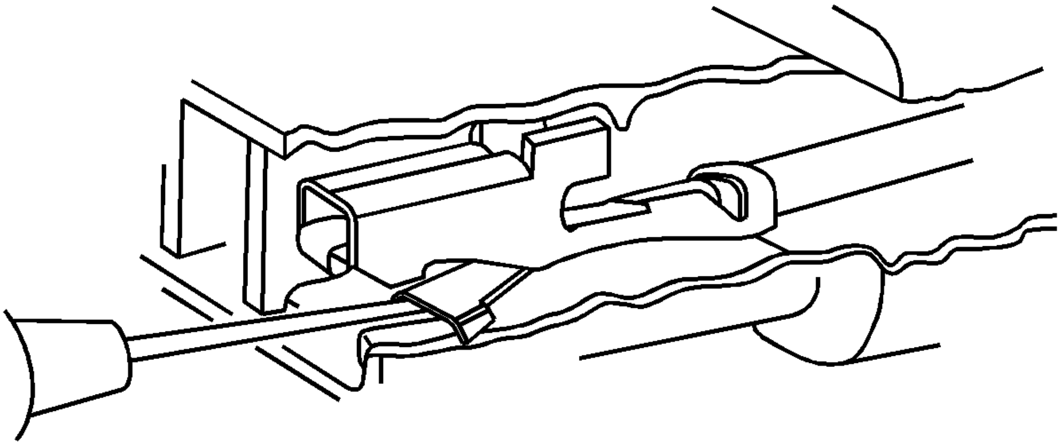


Fig. 50: Aligning Removal Tool - Delphi (Pull To Seat)
Courtesy of GENERAL MOTORS COMPANY

Follow the steps below in order to repair pull-to-seat connectors:

1. Remove the connector position assurance (CPA) device and/or the secondary lock.
2. Disconnect the connector from the component or separate the connectors for in-line connectors.
3. Remove the terminal position assurance (TPA) device.
4. Review the connector end view to determine the proper test probe and release tool.
5. Insert the release tool into the front of the connector body.
6. Grasp the wire at the back of the connector body and gently push the terminal out the front of the connector body.
7. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
8. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

1. Align the terminal and pull the wire from the back of the connector in order to seat the terminal.
2. If the connector is outside of the passenger compartment, apply dielectric grease to the connector.
3. Install the TPA, CPA, and/or the secondary locks.

DELPHI CONNECTORS (MICRO-PACK 100W)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit

- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

There are 2 styles of Micro-Pack 100W connectors. These connectors are very similar but use different terminals and have some minor physical differences also.

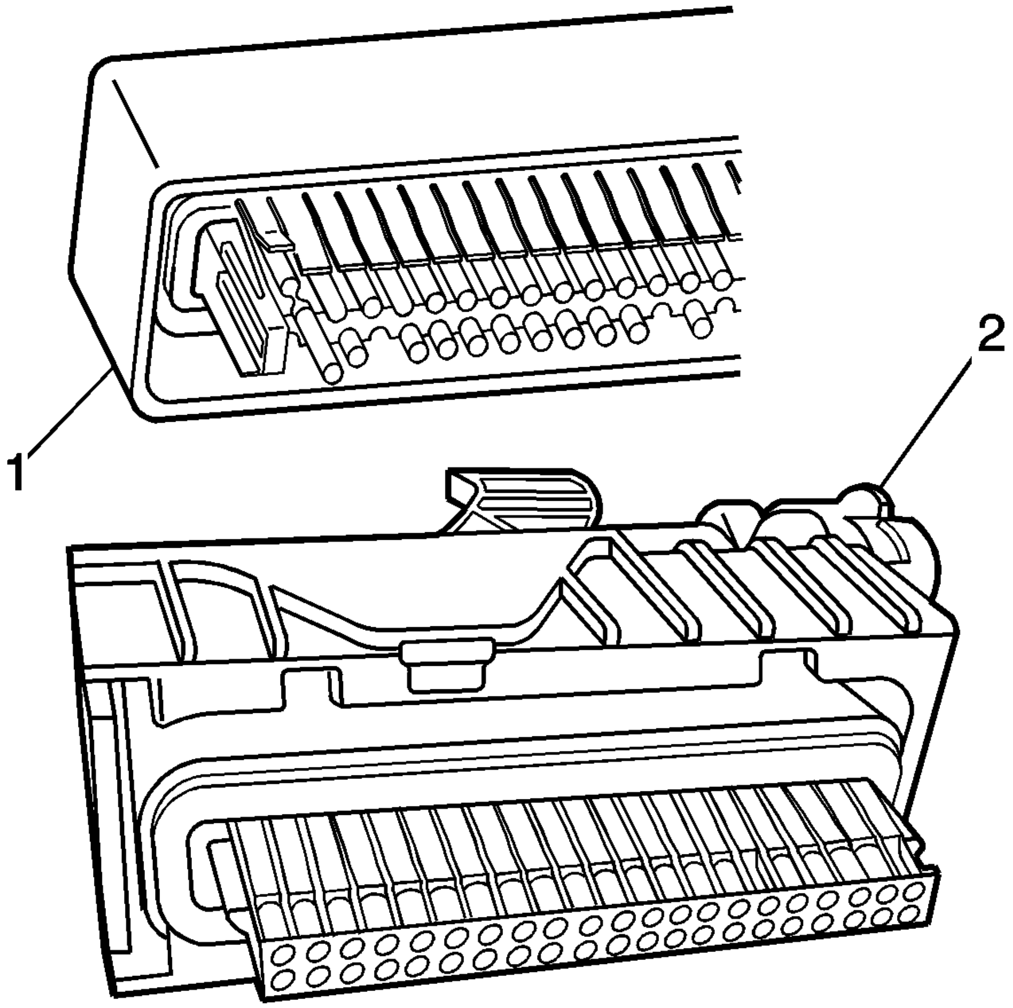


Fig. 51: Identifying Micro-Pack 100W First & Second Connector Designs
Courtesy of GENERAL MOTORS COMPANY

The first connector design of the Micro-Pack 100W (1) has a white connector interface that holds the terminals. The second design of the Micro-Pack 100W (2) has a gray interface to hold the terminals. Also, the first design has terminal cavities that are further apart (3 mm centerline) and offset from the other row of terminal cavities in the connector. The second design has terminals cavities that are closer together (2.54 mm centerline) and aligned vertically. One other way to identify the second design is the thin strip of material that runs along the outside of the cavities.

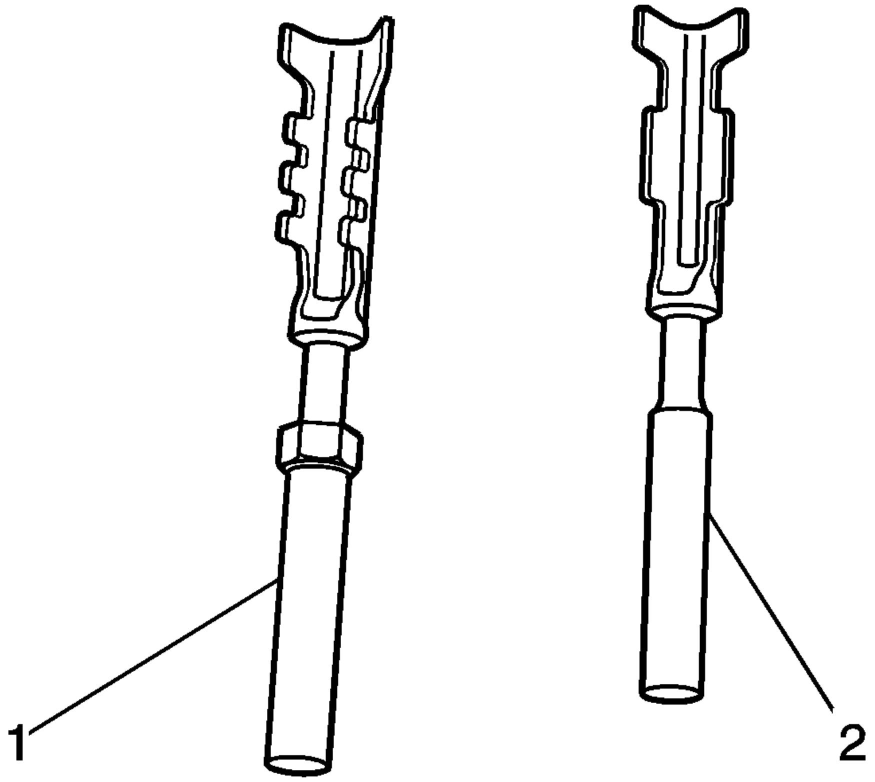


Fig. 52: Identifying Micro-Pack 100W Short & Long Terminals
Courtesy of GENERAL MOTORS COMPANY

NOTE: **There are 2 styles of Micro-Pack 100W terminals which are very similar. Ensure that you have the correct terminal before crimping the new terminal to the wire. The first design connector uses the longer terminal (1) that has a raised area in front of the recess in the terminal. The second design connector uses the shorter terminal without the raised area.**

Follow the steps below in order to remove terminals from Micro-Pack 100W connectors. Some Micro-Pack 100W connector disassembly procedures will vary. Use this procedure as a guide.

1. Disconnect the connector from the component.

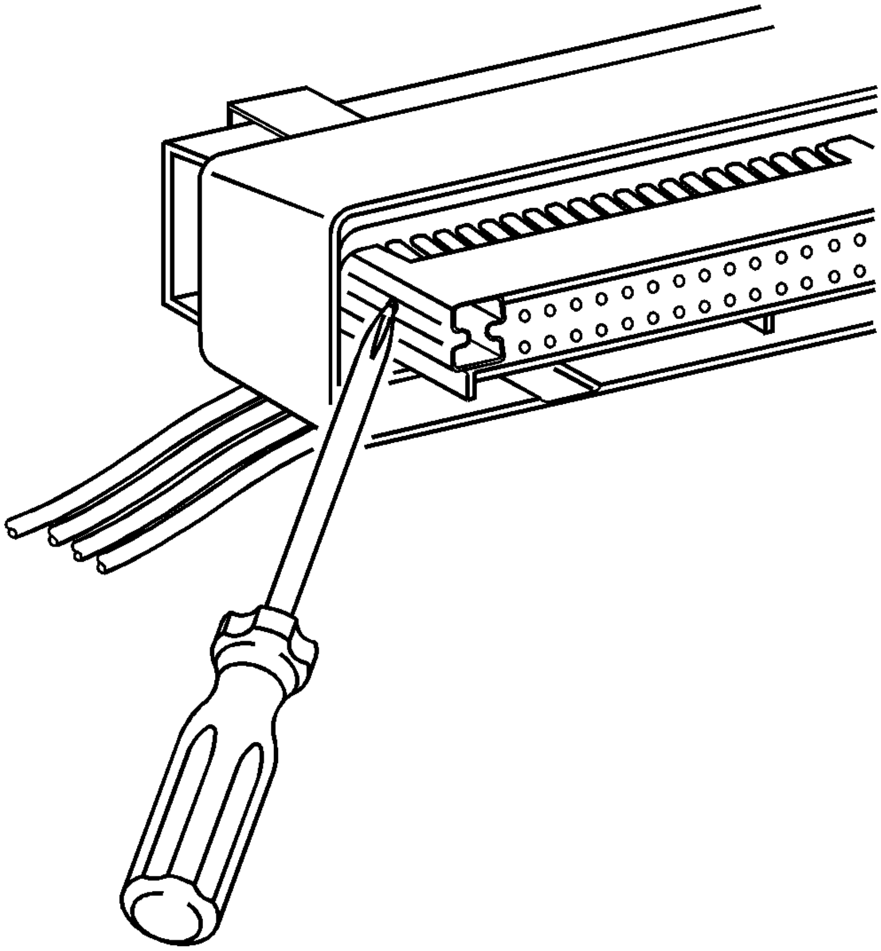


Fig. 53: Locating Nose Piece Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

2. Locate the nose piece locking tabs that are positioned on the side of the connector nose piece. The connector nose piece acts as a terminal positive assurance (TPA) and may be referred to as such.

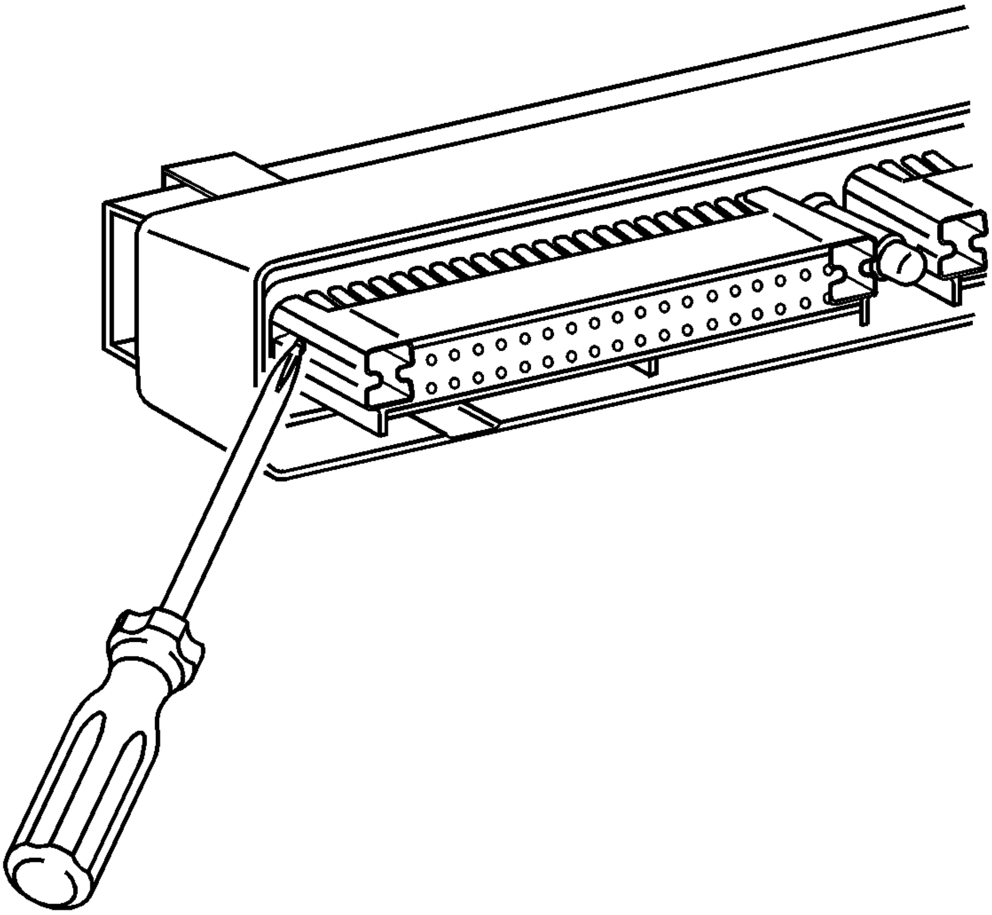


Fig. 54: Loosening Nose Piece Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Use a small flat-blade tool to push in one of the locking tabs while gently pulling on the same side of the nose piece.
4. Repeat the procedure for the other locking tab and remove the nose piece.
5. Remove the wire dress cover. The following is a general procedure for wire dress cover removal. Use this procedure as a guide, some dress cover removal procedures may vary.

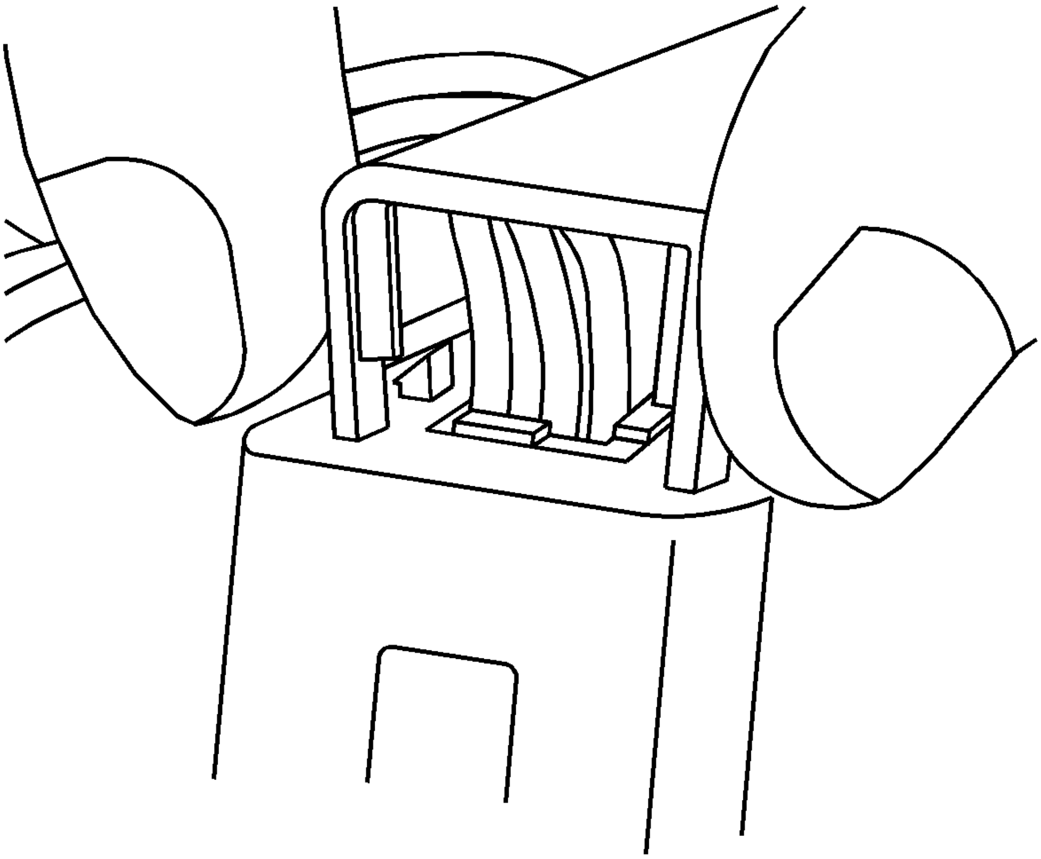


Fig. 55: Squeezing Cover Locking Legs
Courtesy of GENERAL MOTORS COMPANY

6. Use fingers to squeeze the 2 locking legs of the cover.

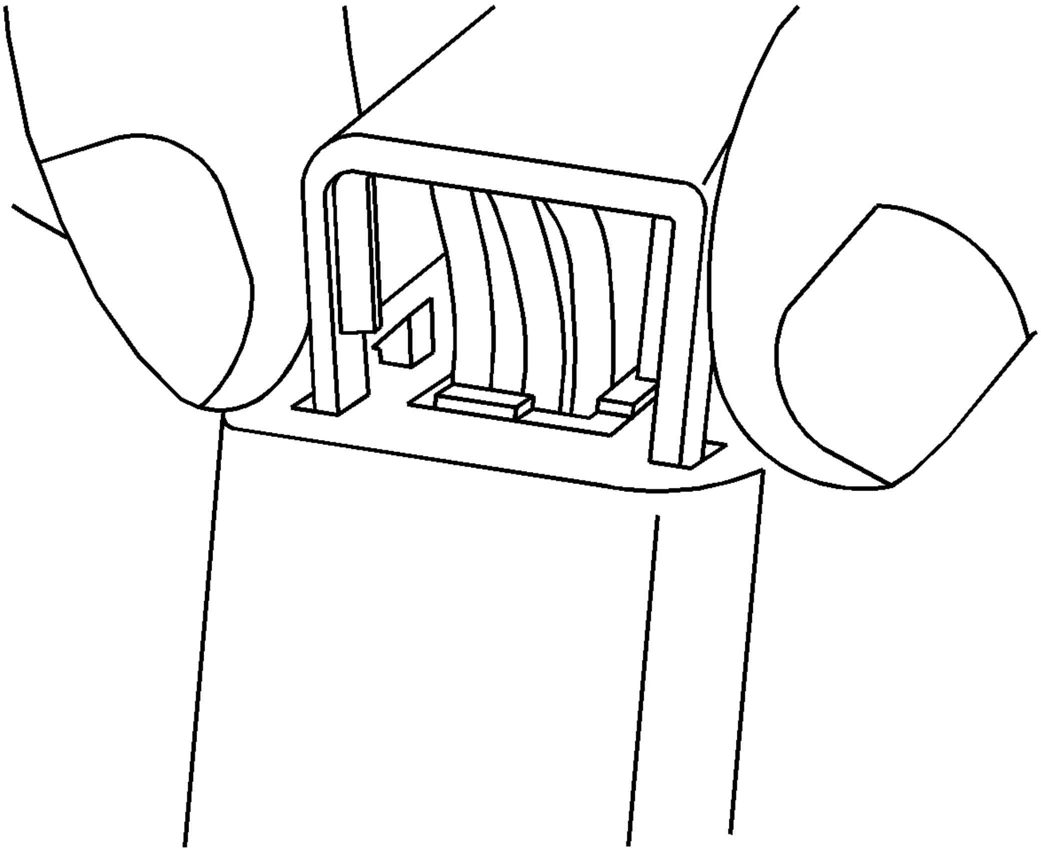


Fig. 56: Unseating Locking Leg
Courtesy of GENERAL MOTORS COMPANY

7. Apply pressure and gently rock the cover until one locking leg is unseated.

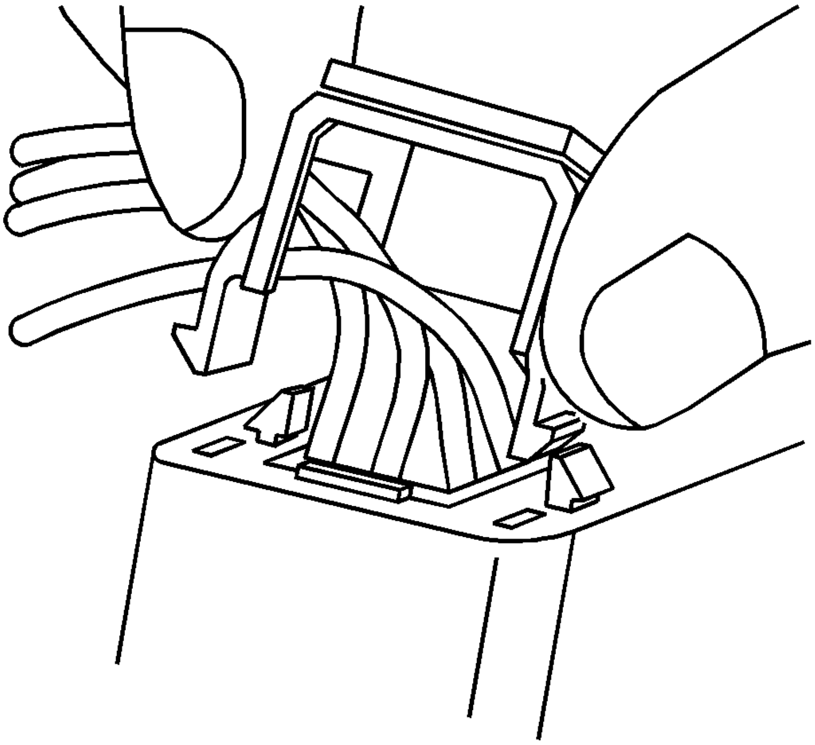


Fig. 57: Removing Cover
Courtesy of GENERAL MOTORS COMPANY

8. Continue to apply pressure and rock the cover until the second locking leg is unseated. Repeat procedure for the other side of the dress cover and remove the cover.

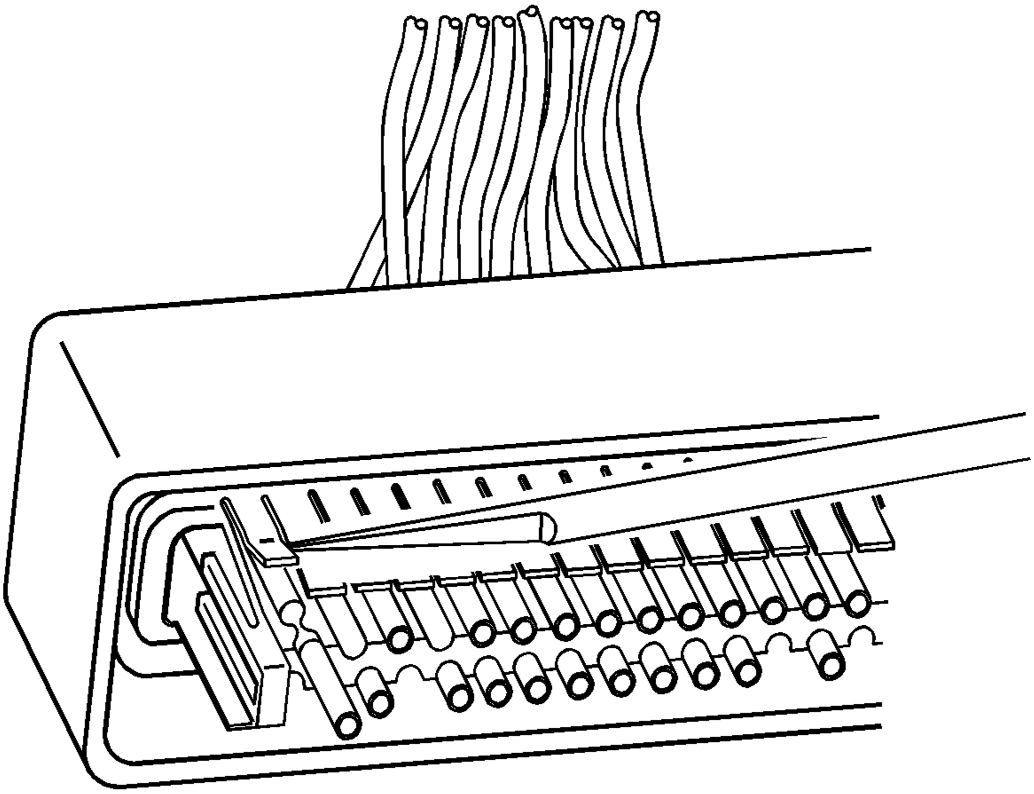


Fig. 58: Identifying Terminal Retaining Tab
Courtesy of GENERAL MOTORS COMPANY

9. Use J-38125-12A to gently lift the terminal retaining tab while gently pulling the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
10. If the terminal is severely bent or damaged, it may be possible on some connectors to push the wire out of the front of the connector instead of pulling it through. This will prevent damage to the internal seals of the connector. Once the terminal is pushed out of the connector, cut the wire as close to the terminal as possible and pull the wire through the connector.
11. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
12. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

After the terminal is crimped to the wire perform the following procedure in order to replace Micro-Pack 100 terminals.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.
3. To assemble the connector, reverse the Terminal Removal Procedure.

DELPHI CONNECTORS (MICRO.64)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit

- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-21** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from Micro.64 connectors.

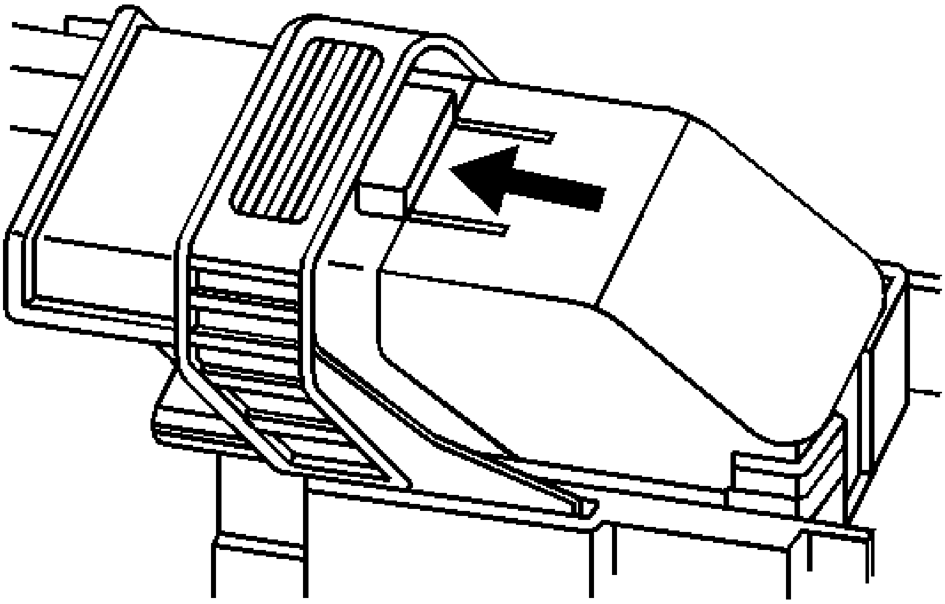


Fig. 59: Identifying Wire Dress Cover Lever Lock
Courtesy of GENERAL MOTORS COMPANY

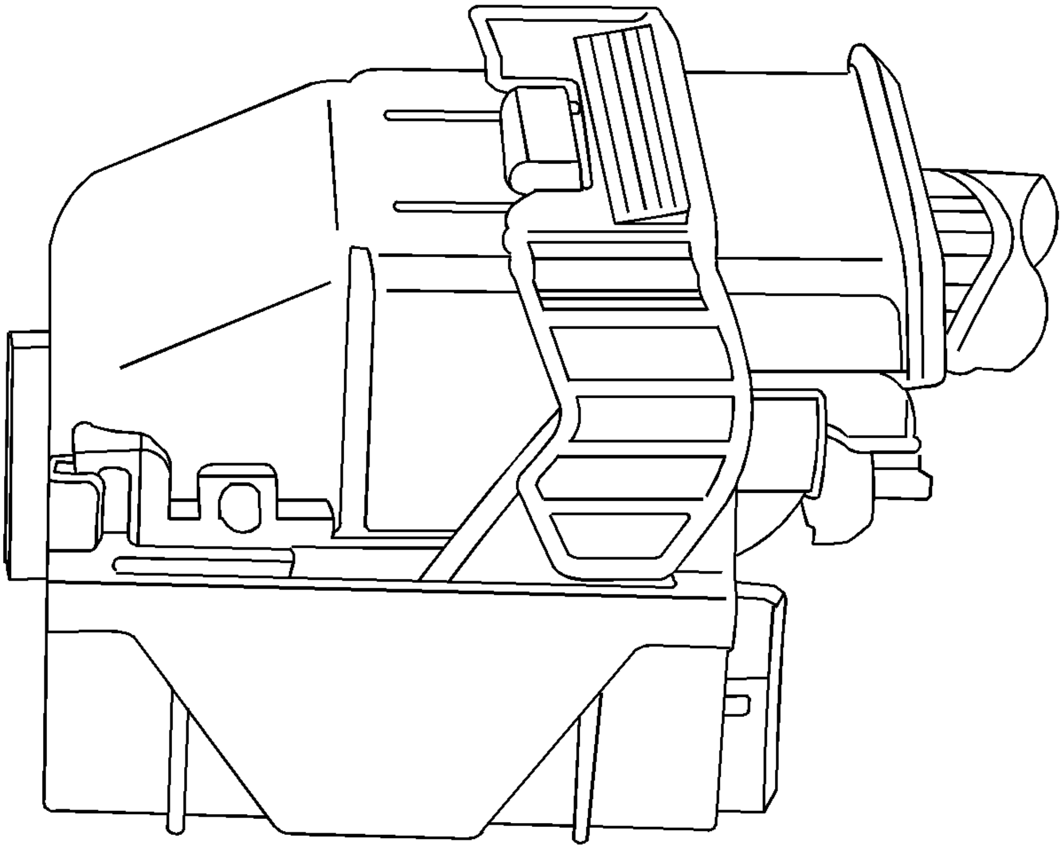


Fig. 60: View Of Typical Micro 64 Connector
Courtesy of GENERAL MOTORS COMPANY

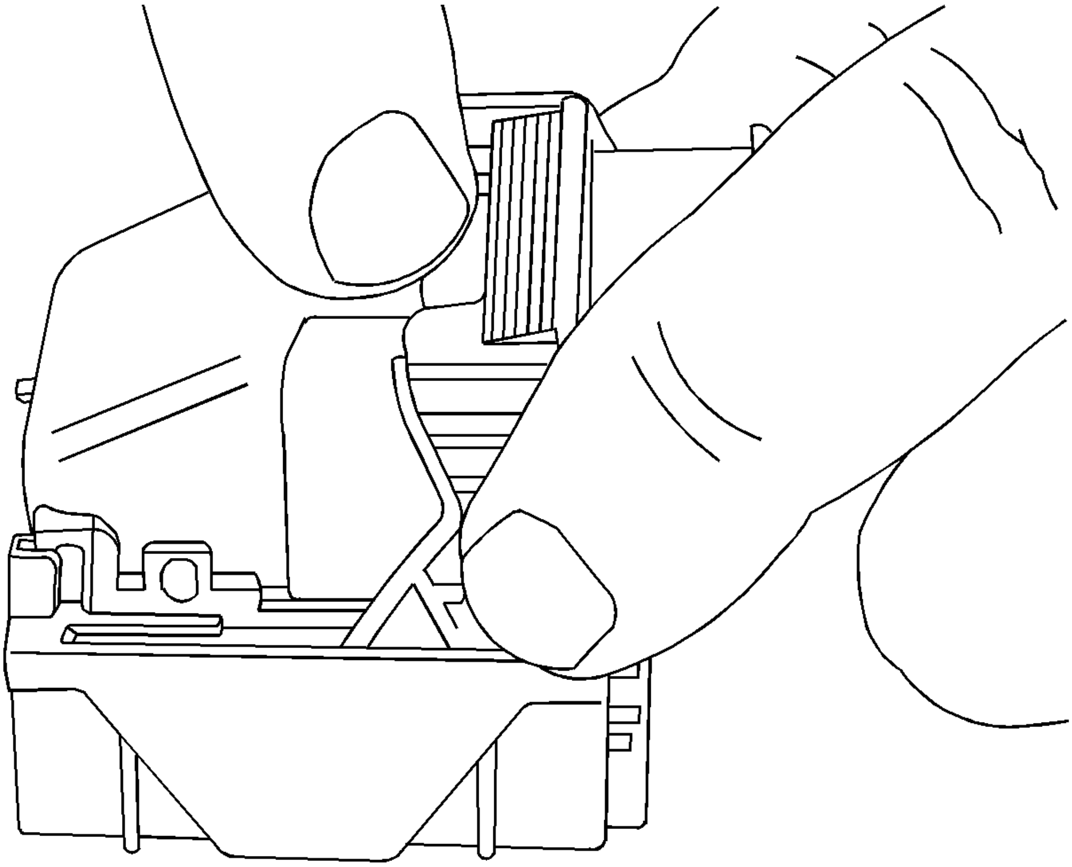


Fig. 61: Depressing Lock And Pulling Lever
Courtesy of GENERAL MOTORS COMPANY

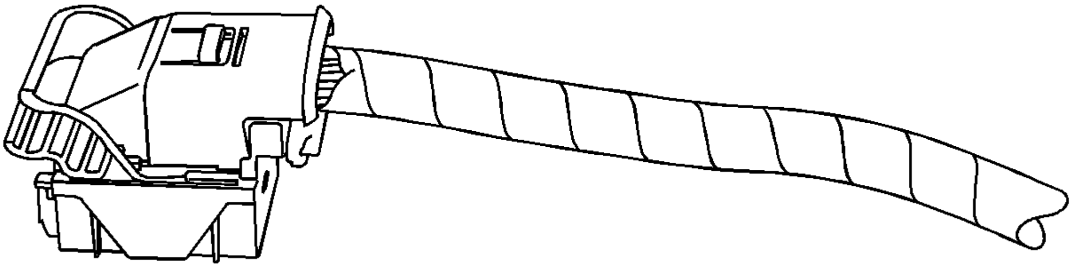


Fig. 62: View Of Connector When Released From Component
Courtesy of GENERAL MOTORS COMPANY

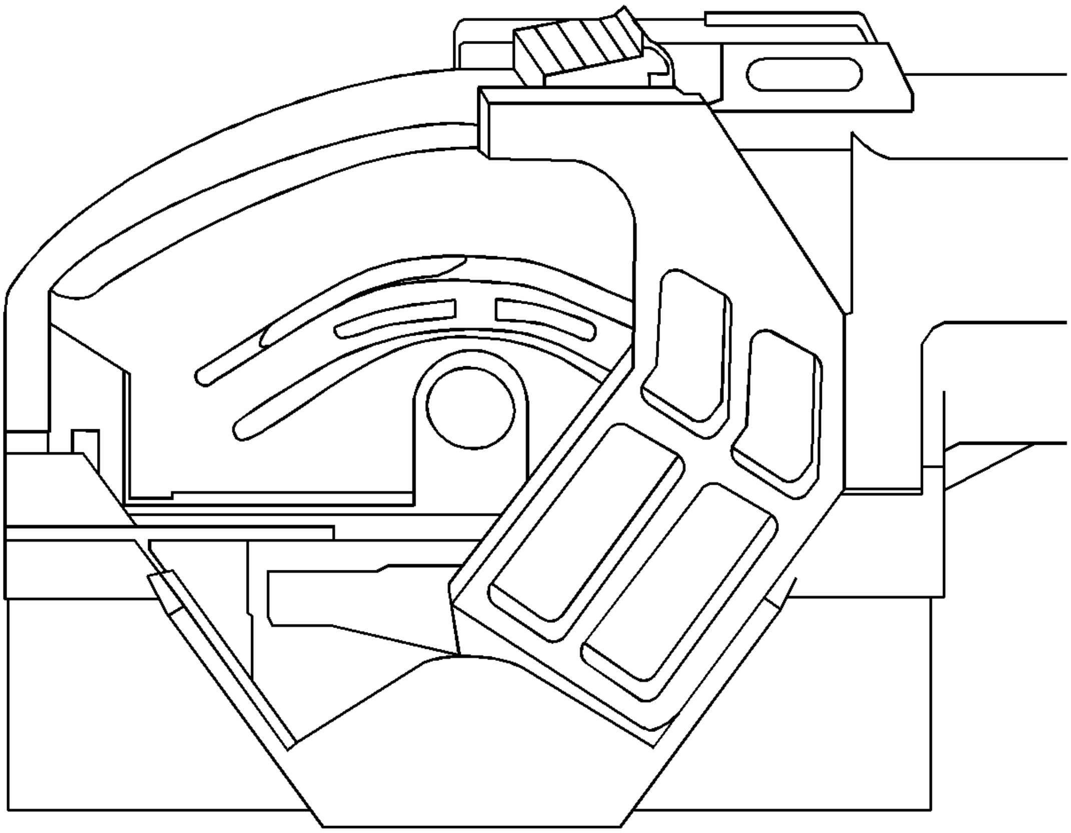


Fig. 63: View Of Another Type Of Micro 64 Connector
Courtesy of GENERAL MOTORS COMPANY

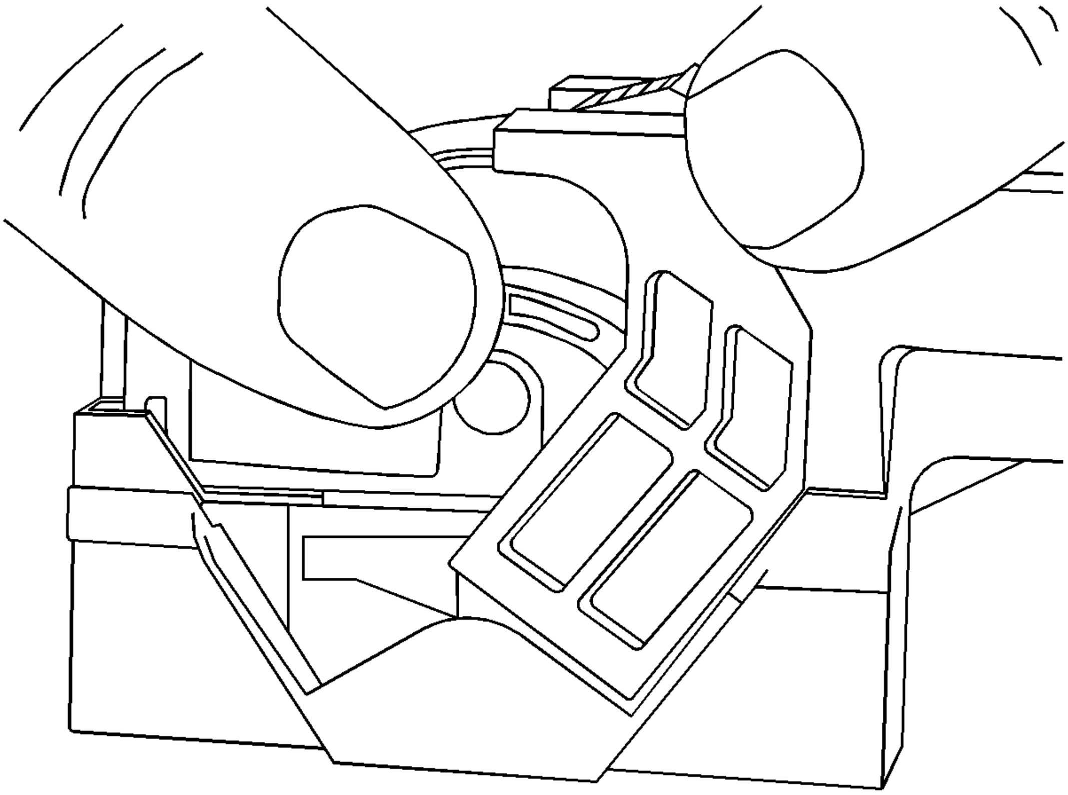


Fig. 64: Locating Locks On Both Sides Of Wiredress Cover
Courtesy of GENERAL MOTORS COMPANY

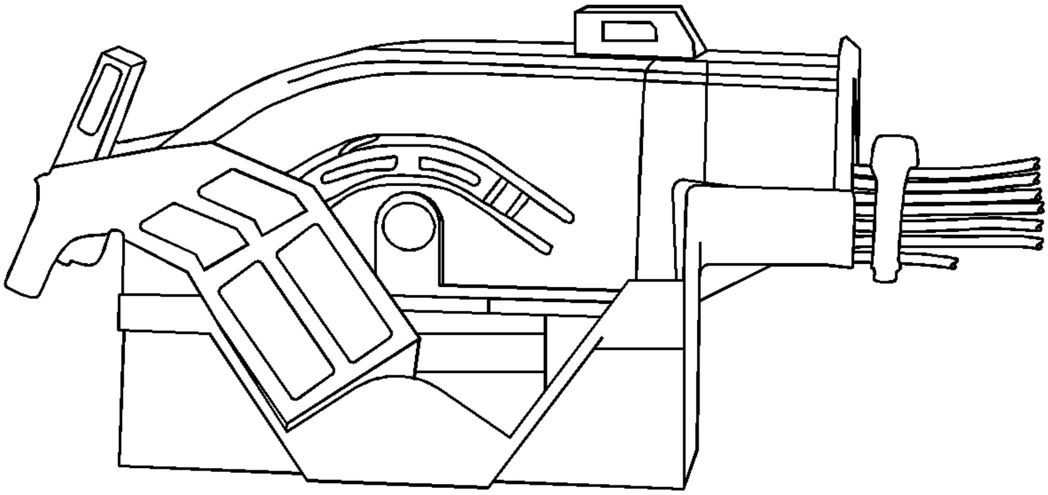


Fig. 65: View Of Connector When Released From Component
Courtesy of GENERAL MOTORS COMPANY

1. Locate the lever lock on the wire dress cover. While depressing the lock, pull the lever over and past the lock. The lever lock may be located on the top or sides of the wire dress cover.

   View of a typical Micro 64 connector.

   Depress the lock and pull the lever over and past the lock.

   View of the connector when released from the component.

   View of another type of Micro 64 connector.

   Depress the locks that are located on both sides of the wire dress cover and pull the lever over and past the locks.

   View of the connector when released from the component.

2. Disconnect the connector from the component.

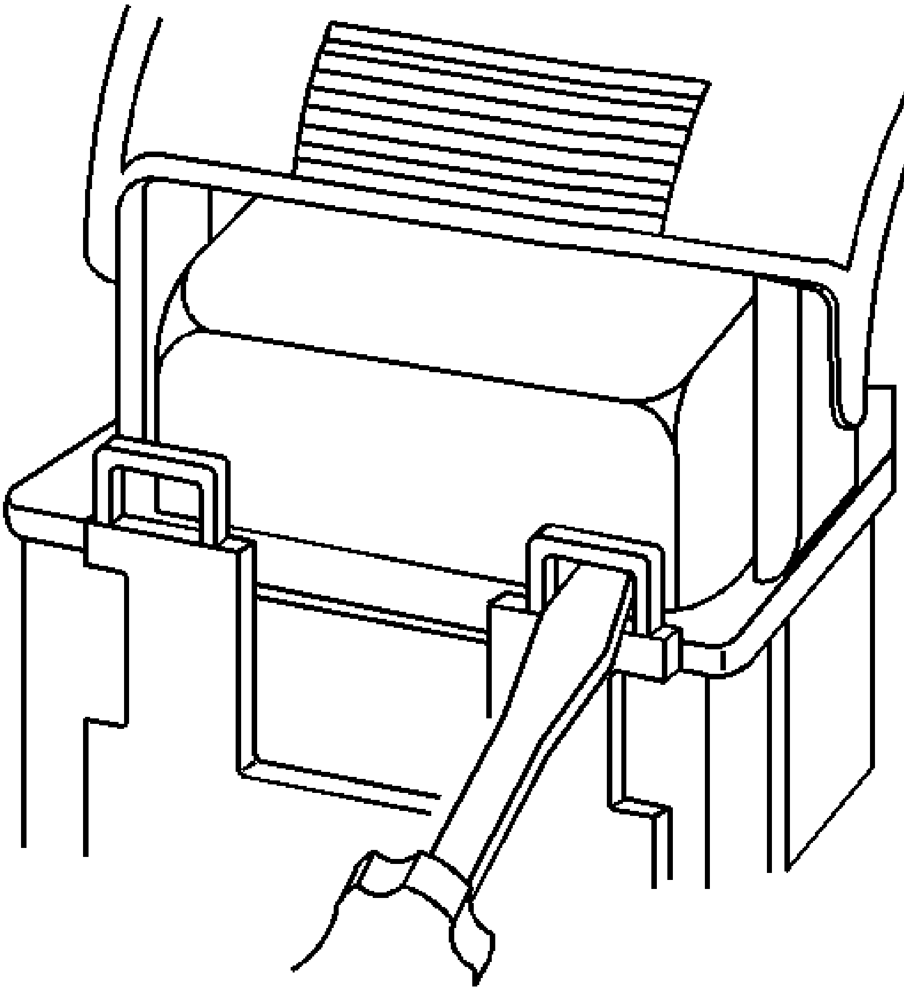


Fig. 66: View Of Releasing Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Locate the dress cover locking tabs at the front of the connector. Using a small flat-blade tool push down on one of the locking tabs and pull the cover up until the dress cover releases. Repeat this procedure for the other locking tab.
4. Once the front 2 locks are unlocked, lift the front of the dress cover and pull it forward.

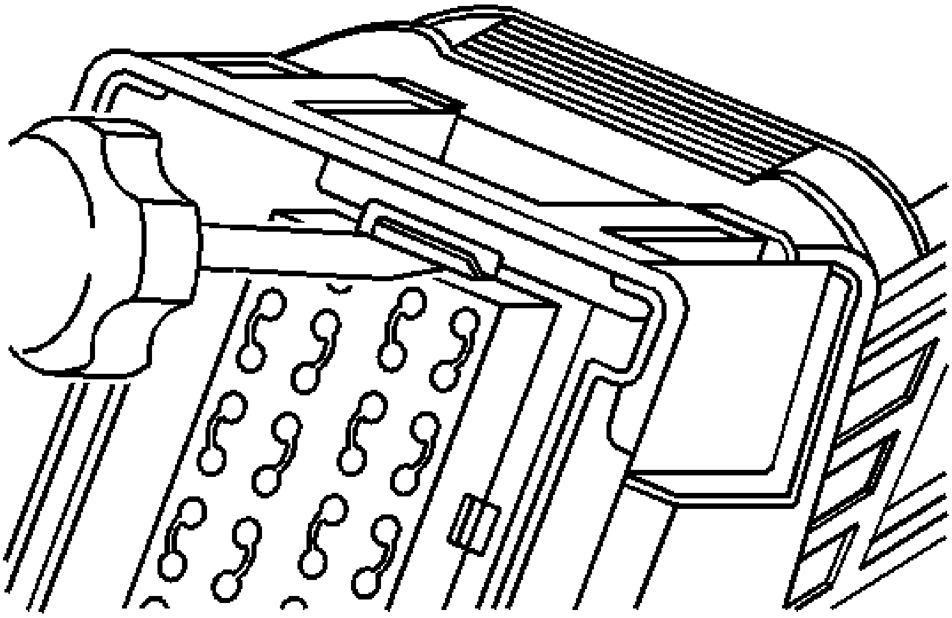


Fig. 67: View Of Removing Terminal Position Assurance
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.**

5. Remove the TPA by inserting a small flat-blade tool into the small slot on the TPA and pushing down until the TPA releases. Gently pry the TPA out of the connector.

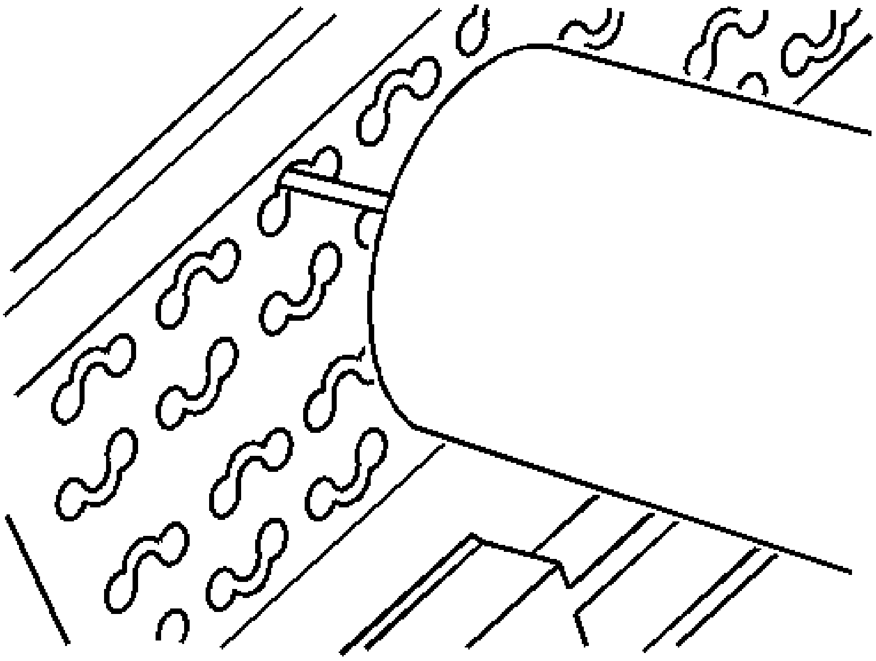


Fig. 68: Identifying Terminal Release Tool
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Be careful not to angle or rock the J-38125-21 tool when inserting it into the connector or the tool may break.**

6. Insert the J-38125-21 tool into the round canal between the terminals cavities at the front of the connector.

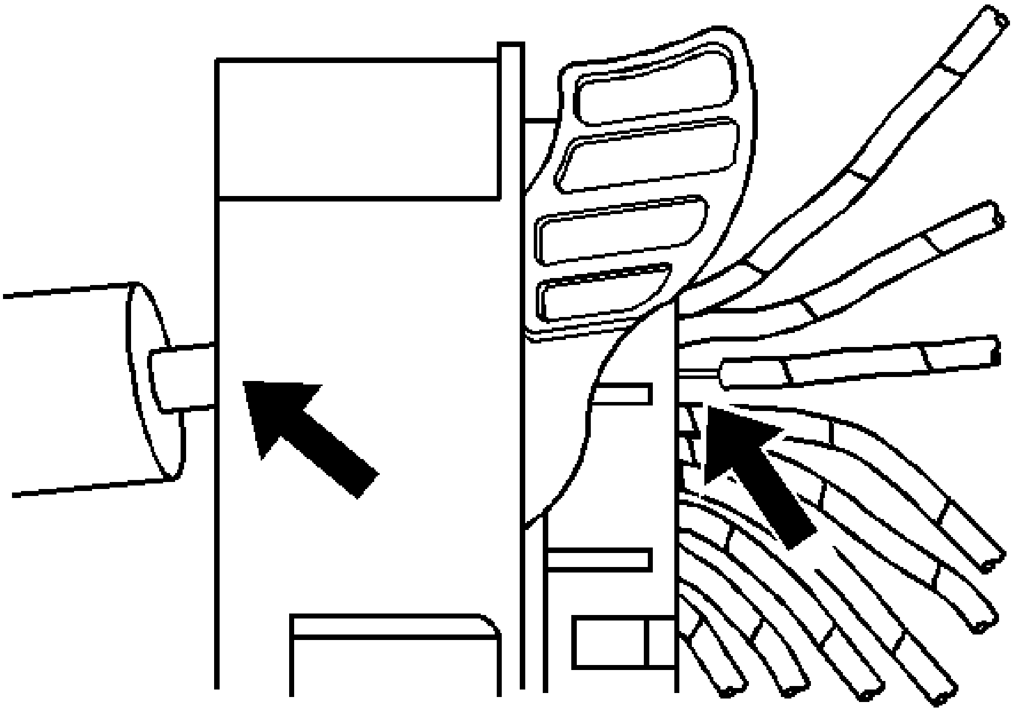


Fig. 69: Removing Wire From Back Of Connector
Courtesy of GENERAL MOTORS COMPANY

7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

DELPHI CONNECTORS (12-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

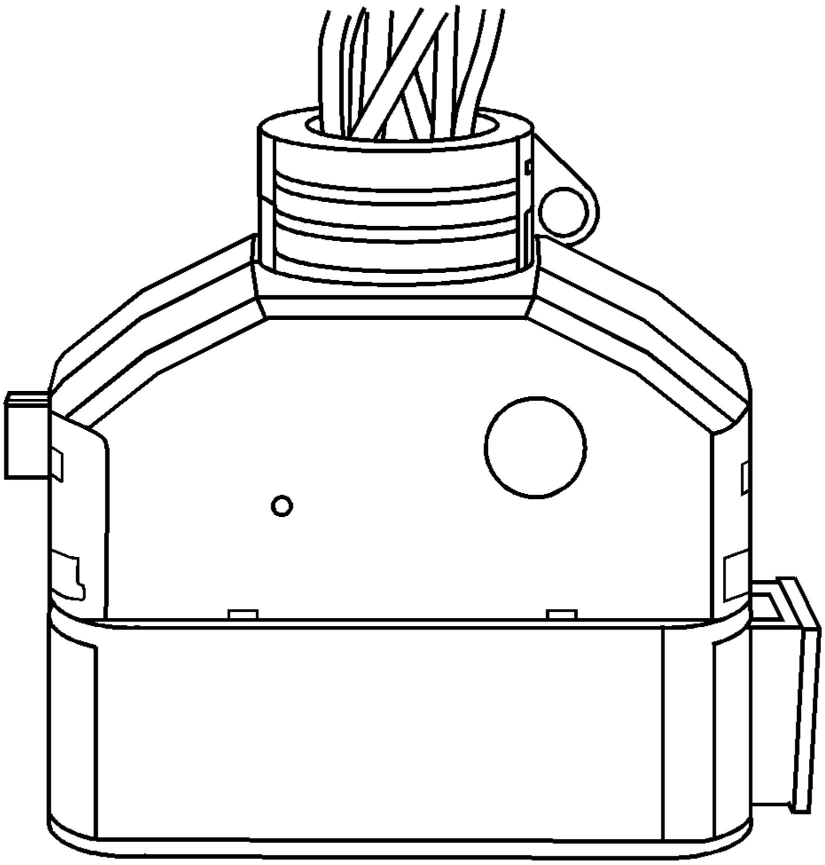


Fig. 70: Identifying Lever Lock
Courtesy of GENERAL MOTORS COMPANY

1. Locate the lever lock on the wire dress cover. Remove the connector position assurance (CPA) and slide the lever lock away from the connector body.
2. Disconnect the connector from the component.

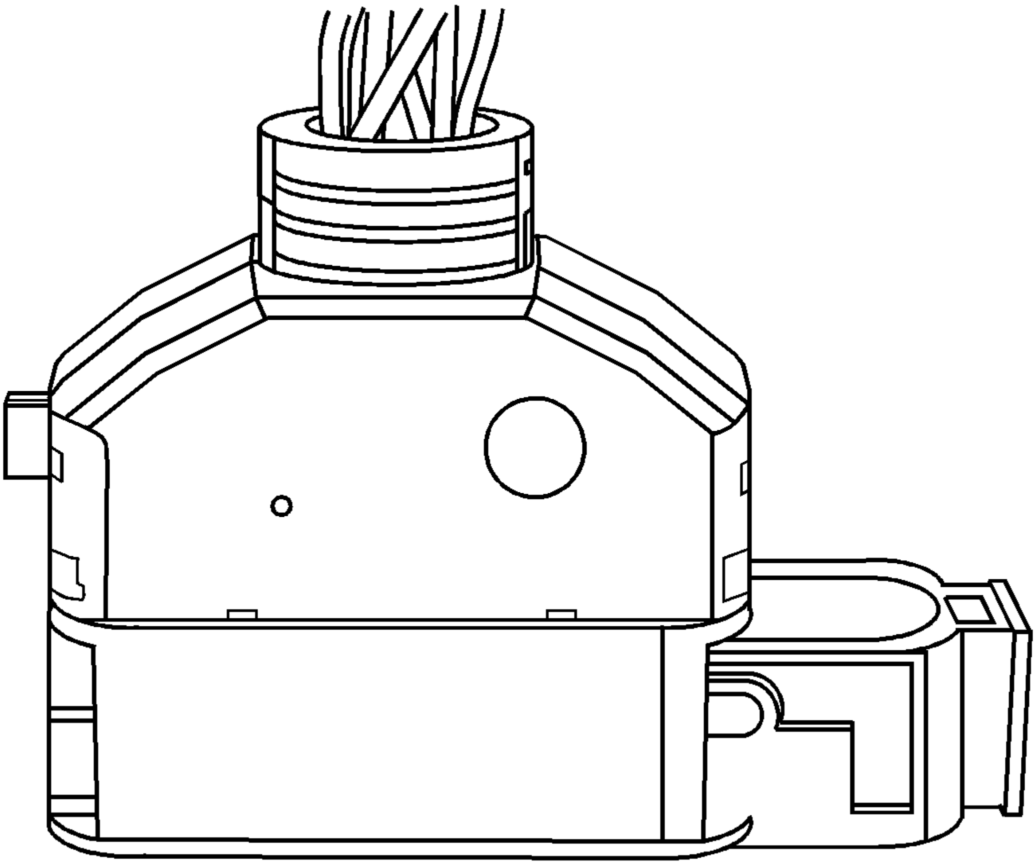


Fig. 71: Identifying Dress Cover Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Locate the dress cover locking tabs on the dress cover of the connector. Using a small flat-blade tool release all of the locking tabs.

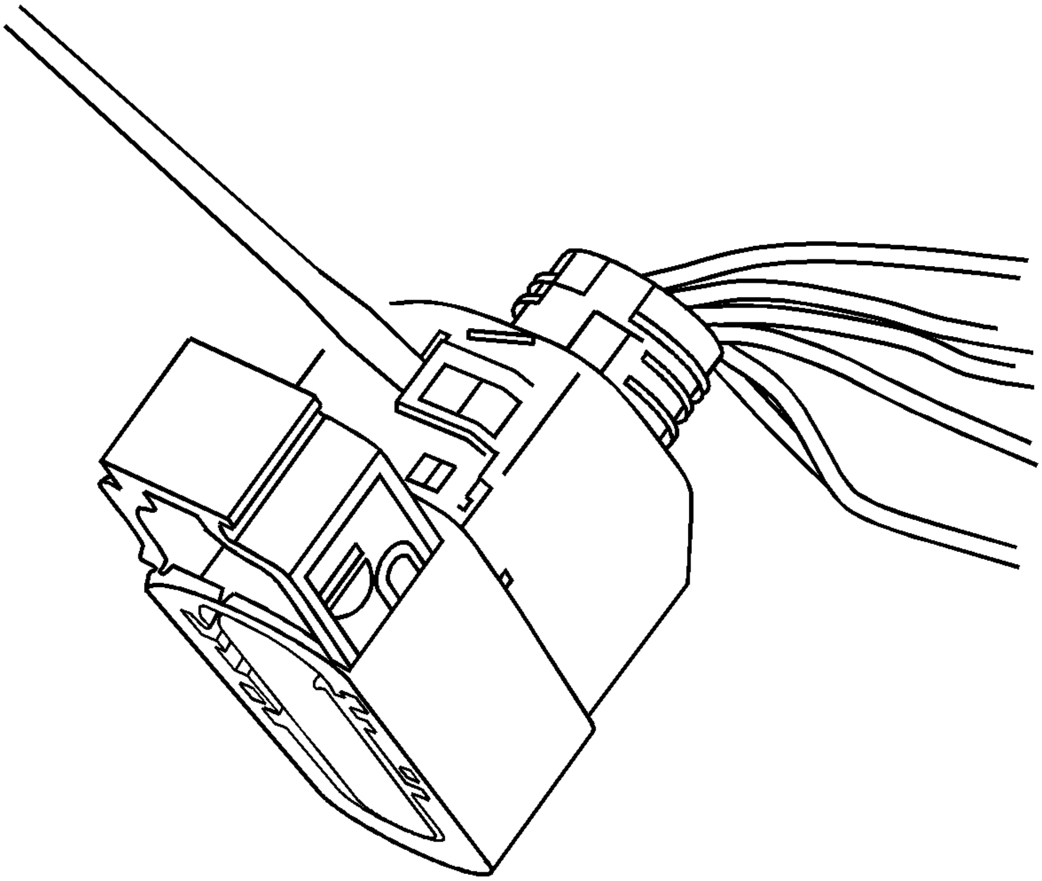


Fig. 72: Identifying Lower Wire Dress Cover Locking Tab
Courtesy of GENERAL MOTORS COMPANY

4. Release the lower wire dress cover locking tab.

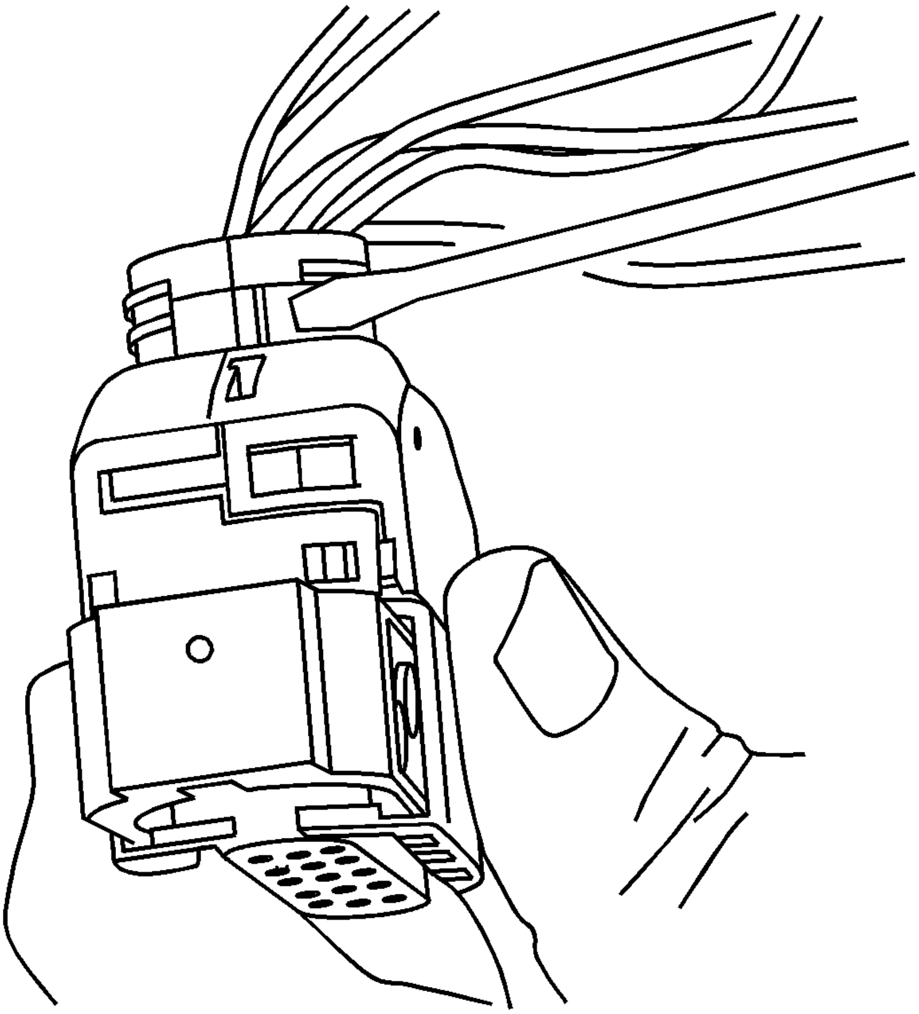


Fig. 73: Identifying Upper Wire Dress Cover Locking Tab
Courtesy of GENERAL MOTORS COMPANY

5. Release the upper wire dress cover locking tab.
6. Once the locks are unlocked, lift the dress cover off.

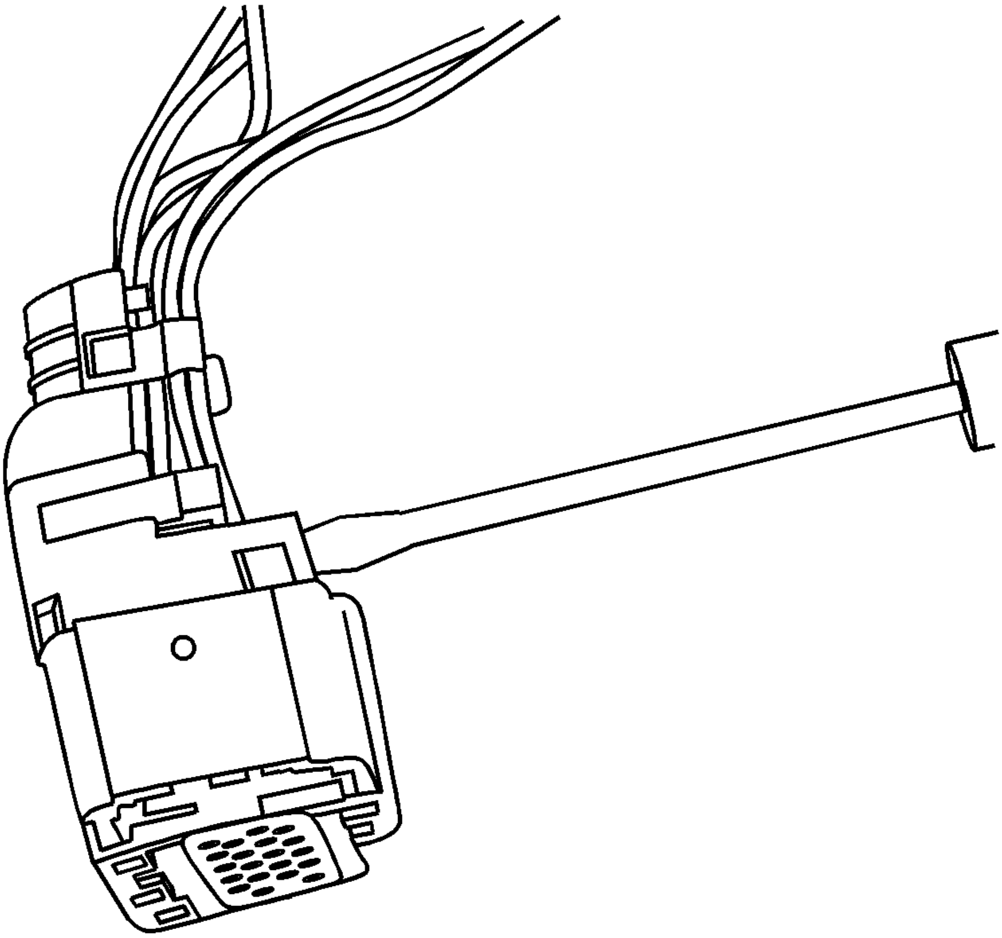


Fig. 74: View Of TPA Being Pried Out Of Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.**

7. Remove the TPA by inserting a small flat-blade tool into the locking tabs on both sides of the TPA. Gently pry the TPA out of the connector.

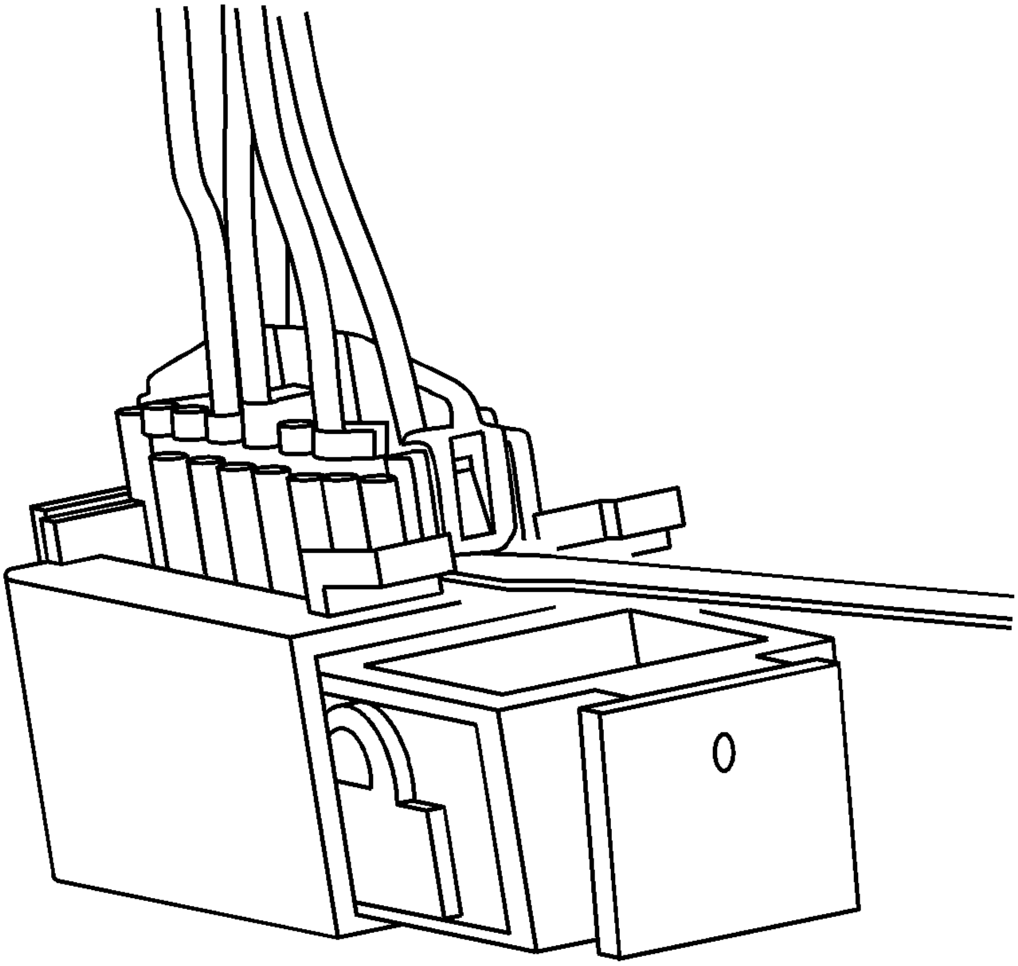


Fig. 75: Removing Nose Piece
Courtesy of GENERAL MOTORS COMPANY

8. Remove the nose piece by inserting a small flat-blade tool into the locking tabs on both sides of the nose piece. Gently pry the nose piece out of the connector.

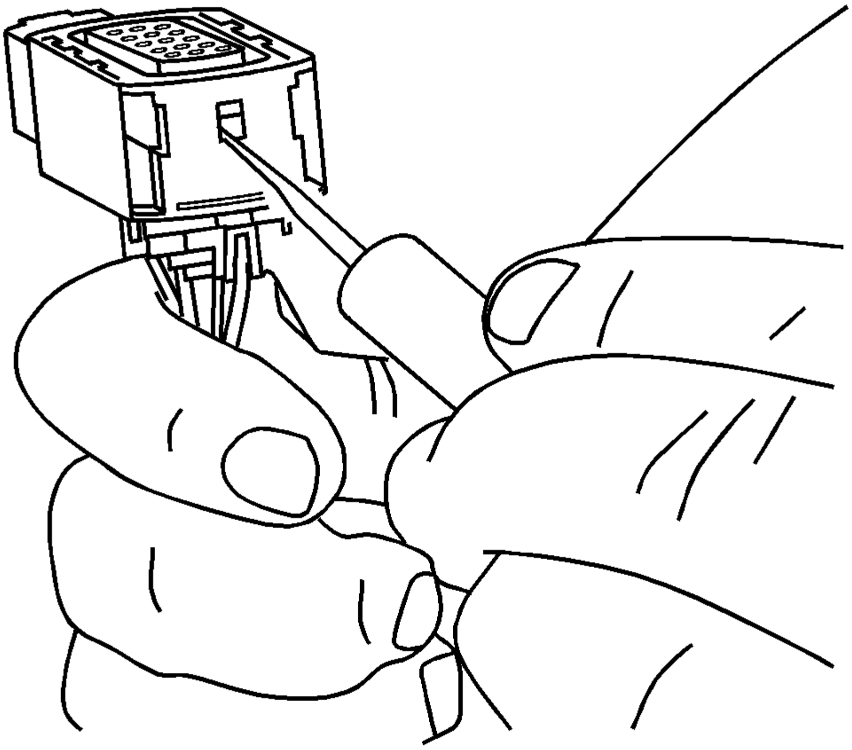


Fig. 76: Inserting Special Tool Into Terminal Release Cavity
Courtesy of GENERAL MOTORS COMPANY

9. Insert the J-38125-12A tool to release the terminals by inserting the tool into the terminal release cavity.

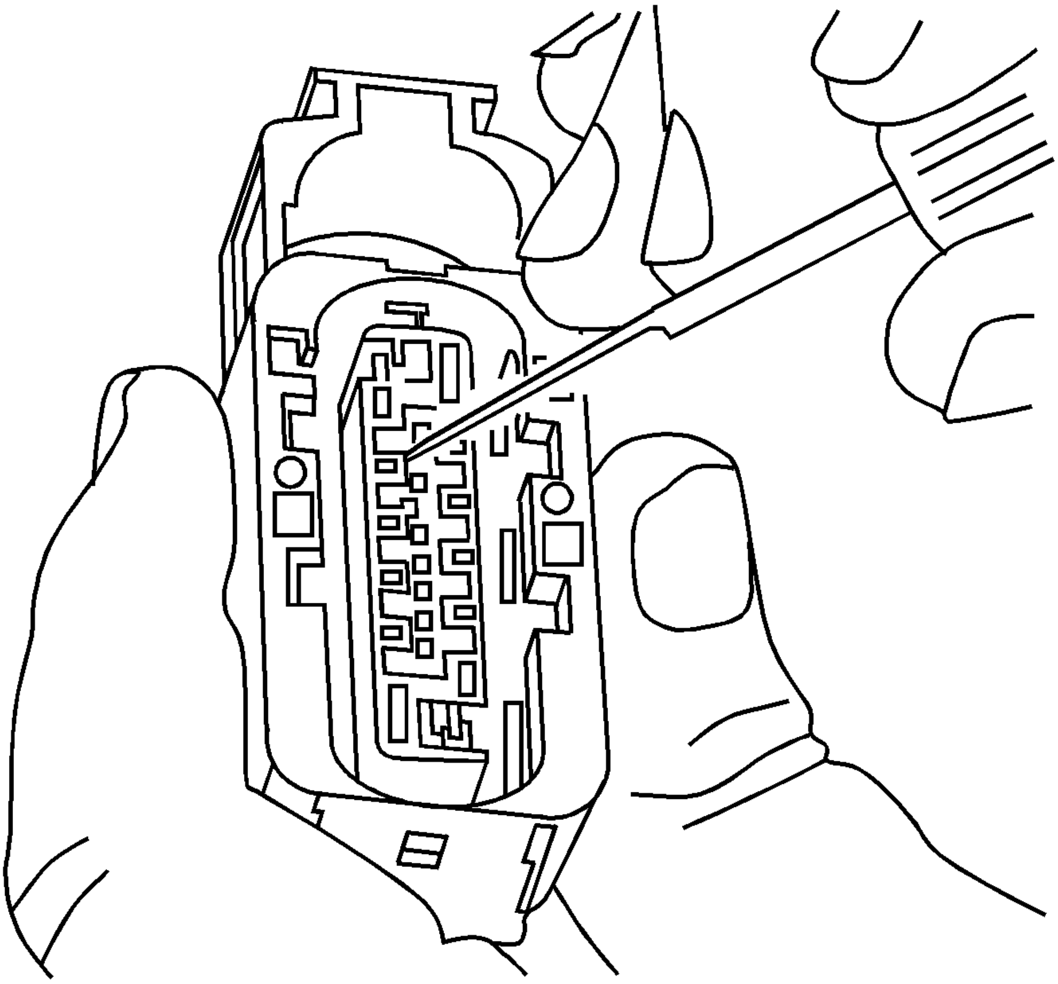


Fig. 77: Pulling Wire Out Of Back Of Connector
Courtesy of GENERAL MOTORS COMPANY

10. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
11. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
12. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

DELPHI CONNECTORS (STEERING GEAR)

Removal Procedure

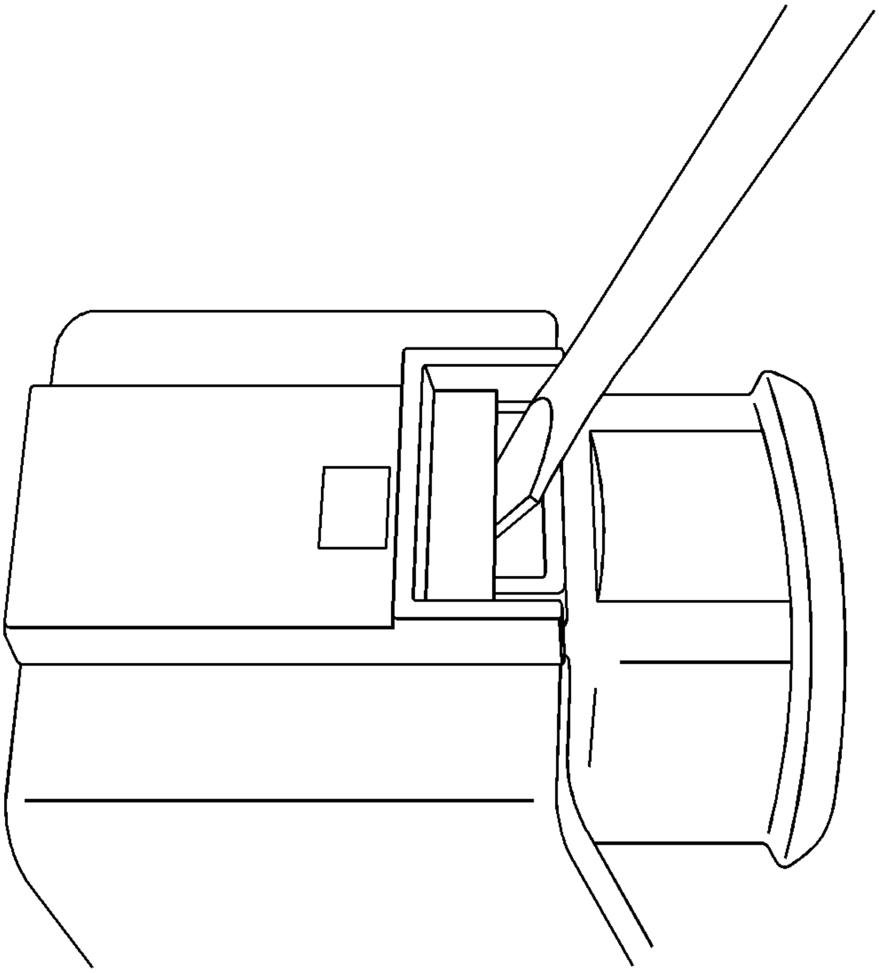


Fig. 78: Releasing Locking Tab On Connector
Courtesy of GENERAL MOTORS COMPANY

1. Use a small flat-bladed tool to release the locking tab on the connector.

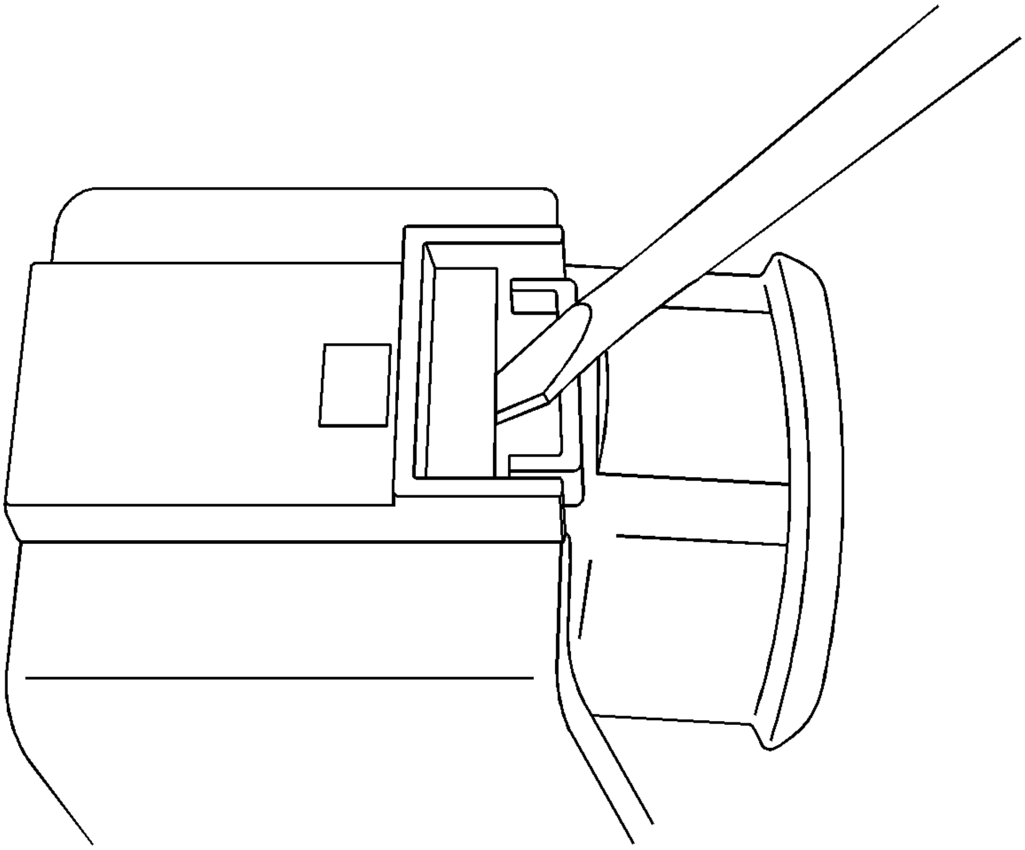


Fig. 79: Releasing Connector
Courtesy of GENERAL MOTORS COMPANY

2. Push down the locking tab to release the connector. The small flat-bladed tool may need to be pushed down and angled back slightly to depress the locking tab. Pull on the connector body while releasing the locking tab to disconnect the connector.

FCI CONNECTORS (LEVER LOCK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-556** Terminal Release Tool
- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

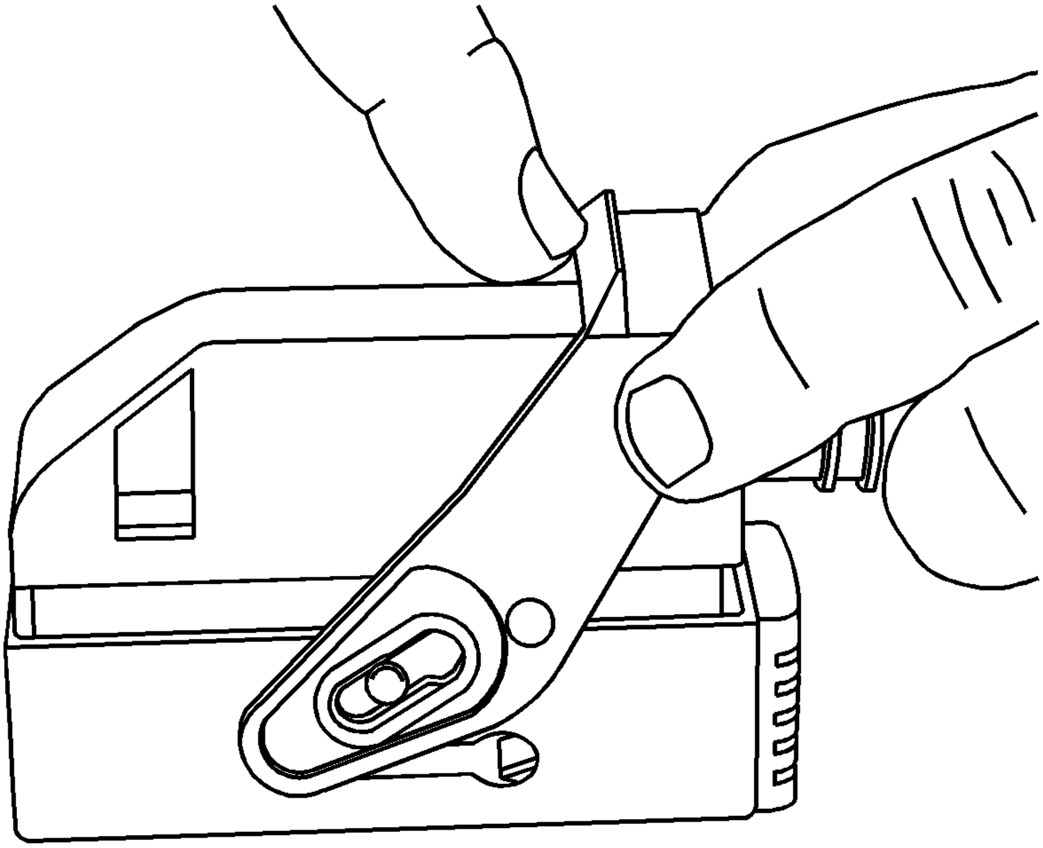


Fig. 80: Identifying Release Tab
Courtesy of GENERAL MOTORS COMPANY

1. Slide the lever lock forward while pressing down on the lever lock release tab.
2. The release tab is located on the top of the wiredress cover.

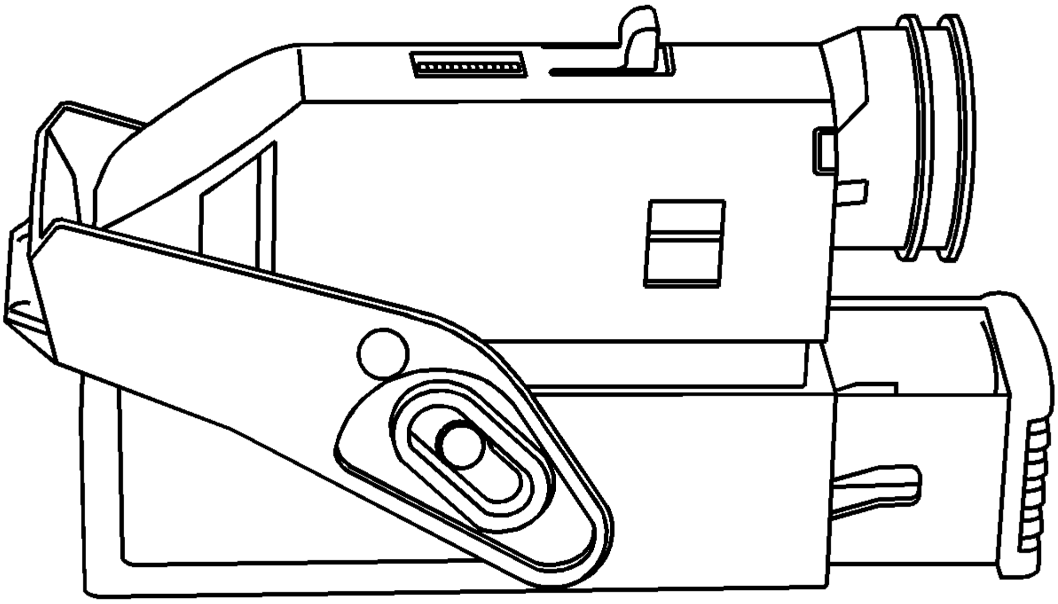


Fig. 81: View Of Connector In Released Position
Courtesy of GENERAL MOTORS COMPANY

3. View of connector in released position.
4. Disconnect the connector from the component.
5. Locate the dress cover locking tabs at the corners of the dress cover. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

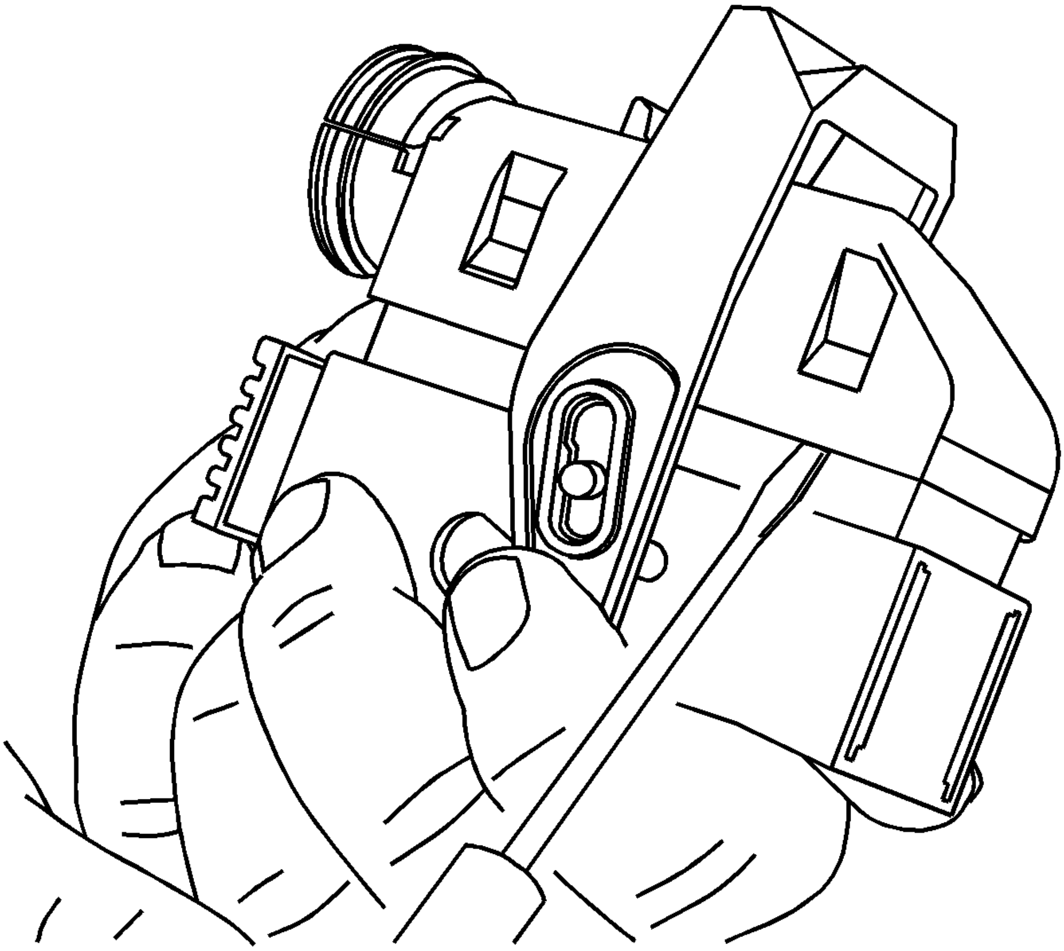


Fig. 82: View Of Sliding Terminal Position Assurance (TPA) Up One Notch
Courtesy of GENERAL MOTORS COMPANY

6. Use a small flat-blade tool to slide the terminal position assurance (TPA) up one notch on both ends of the connector. The TPA is located underneath the wire dress cover.

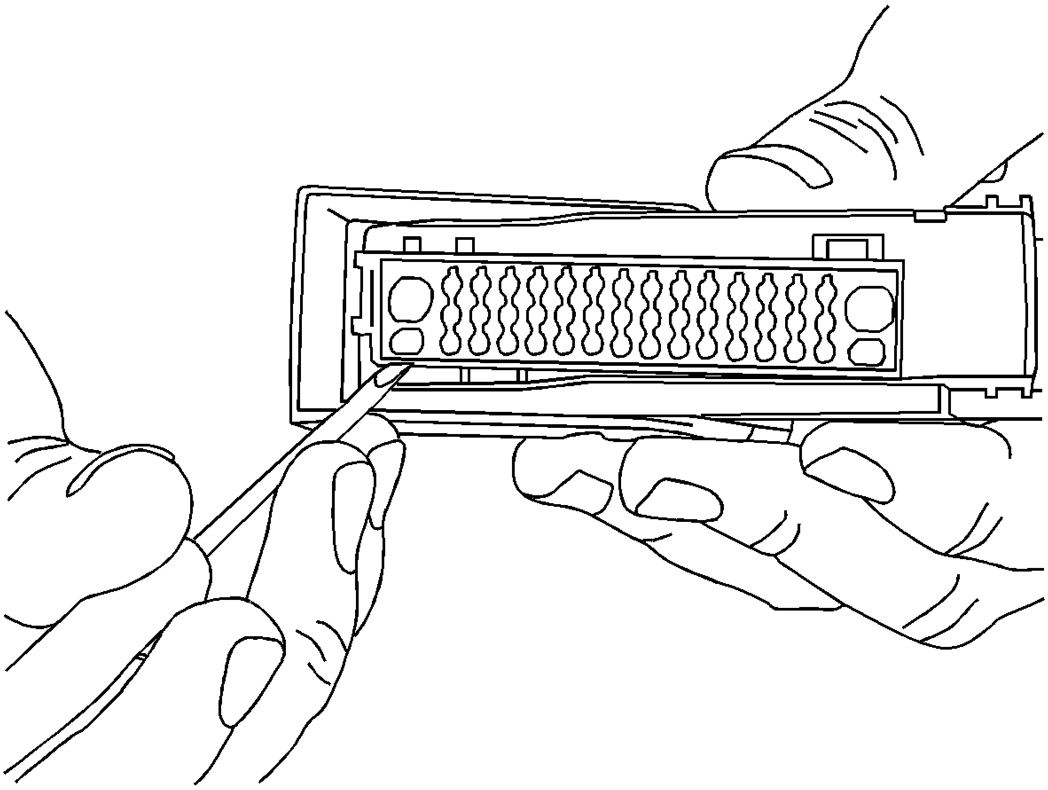


Fig. 83: View Of Releasing Terminals
Courtesy of GENERAL MOTORS COMPANY

7. For the larger terminals insert the J-38125-556 tool to release the terminals by inserting the tool into the terminal release cavity. For the smaller terminals insert the J-38125-560 tool to release the terminals by inserting the tool into the terminal release cavity.

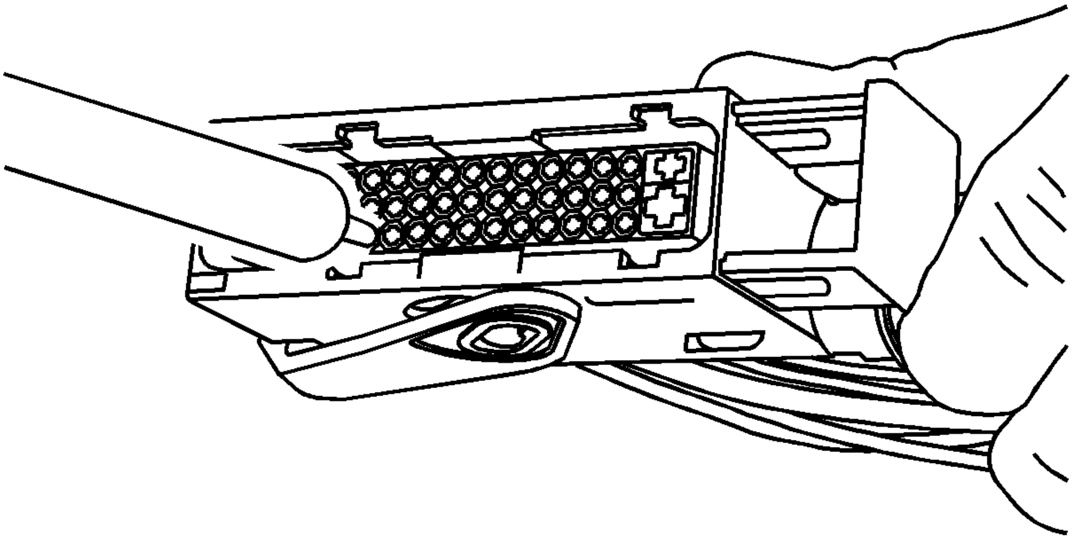


Fig. 84: View Of Wire Being Pulled Out Of Back Of Connector While Holding Removal Tool In Place

Courtesy of GENERAL MOTORS COMPANY

8. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
9. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
10. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

FCI CONNECTORS (SIR)

Removal Procedure

NOTE: **The orange or yellow connector position assurance (CPA) must be released first to disconnect or to connect the connector.**

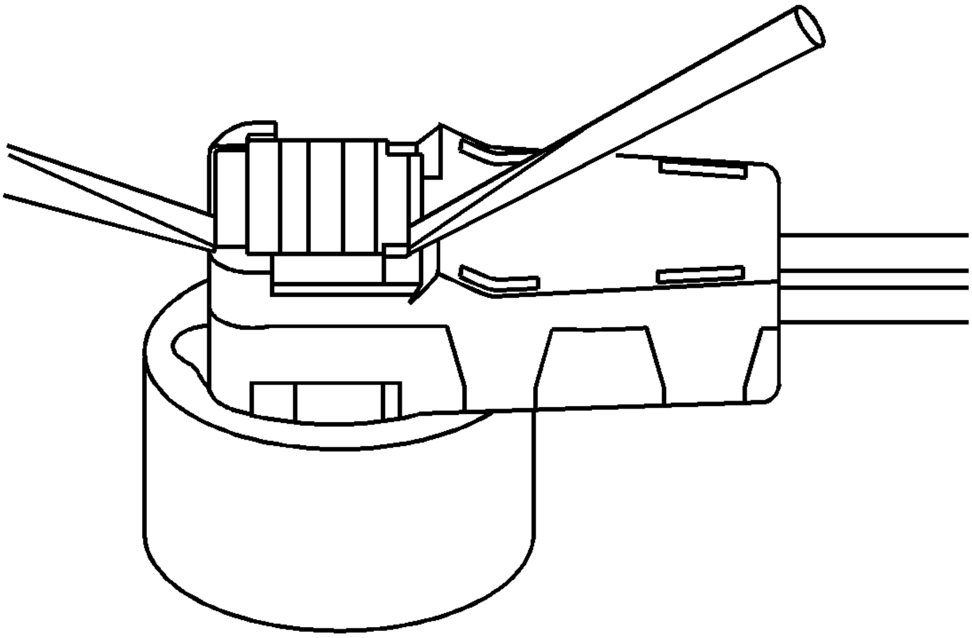


Fig. 85: Lifting Orange CPA
Courtesy of GENERAL MOTORS COMPANY

1. Lift the orange or yellow CPA vertically (avoid lifting on an angle to the connector) approximately 4 mm to release the connector. Use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

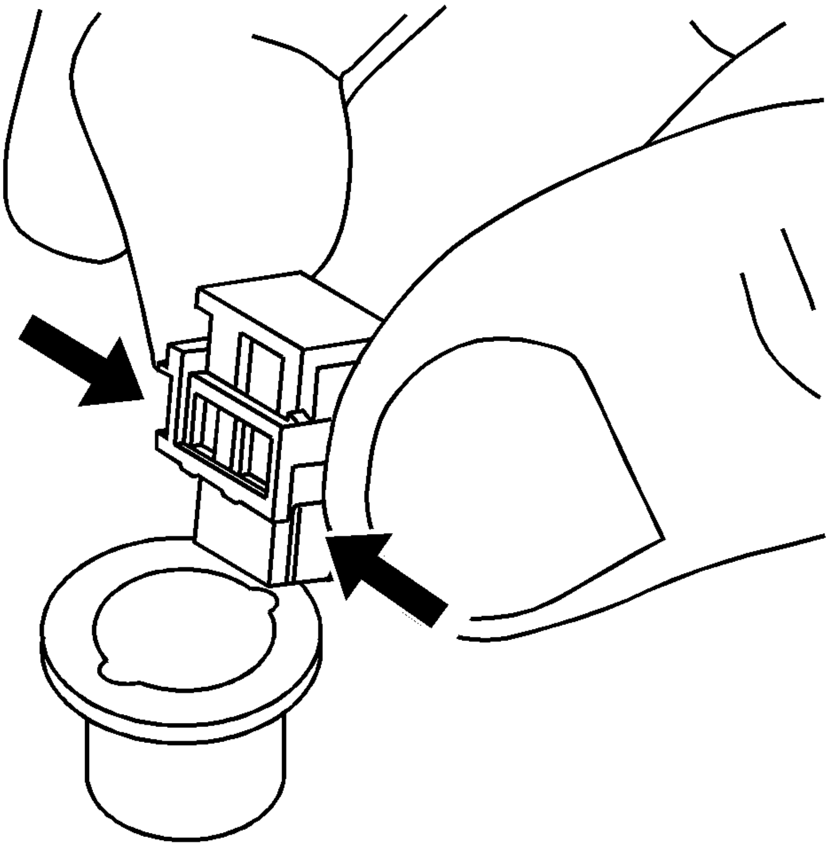


Fig. 86: Grabbing Connector On Both Sides
Courtesy of GENERAL MOTORS COMPANY

2. Grab the connector on both sides and lift vertically to disconnect the connector.

Installation Procedure

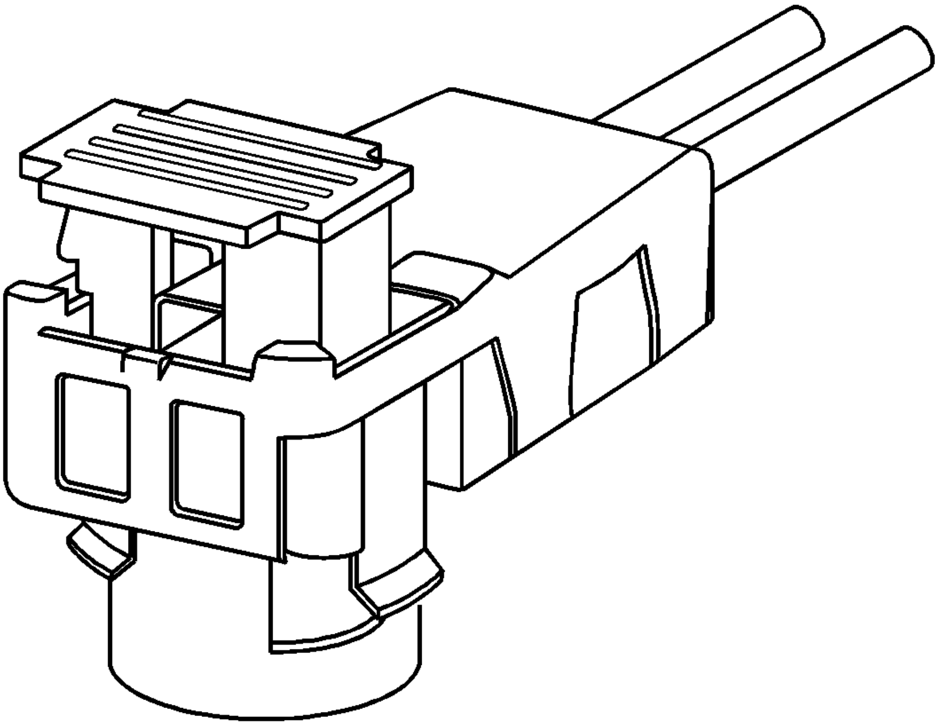


Fig. 87: Lifting Orange CPA
Courtesy of GENERAL MOTORS COMPANY

1. The CPA should be approximately 4 mm above the yellow cover before installing the connector. If not, use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

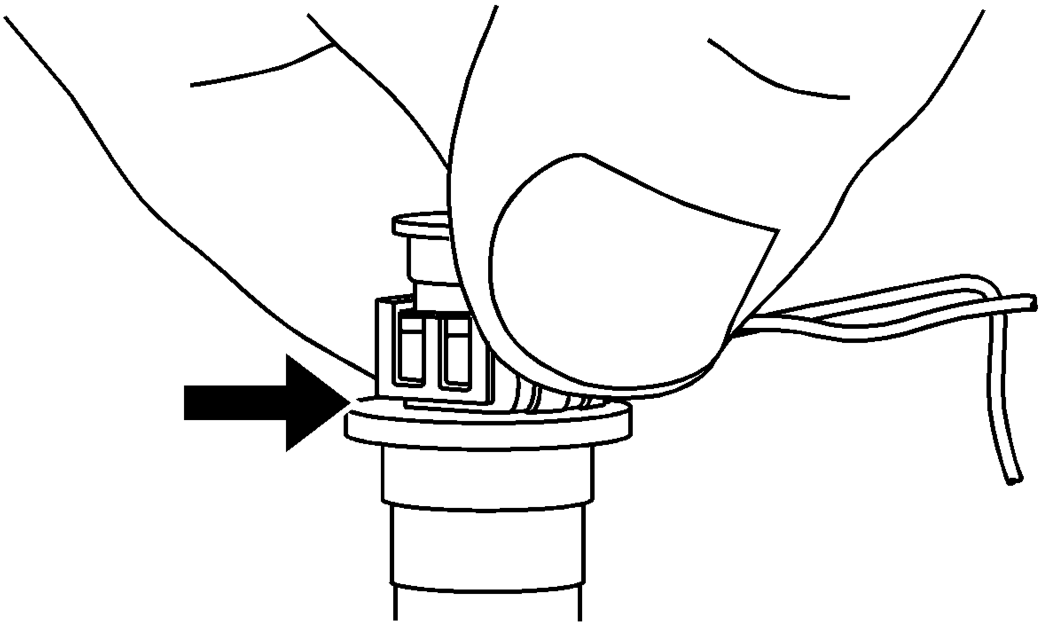


Fig. 88: Seating Connector Sub-Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Line up the connector key tabs with the initiator key slots. Grab the connector on both sides and push down into the initiator connector sub assembly until fully seated.

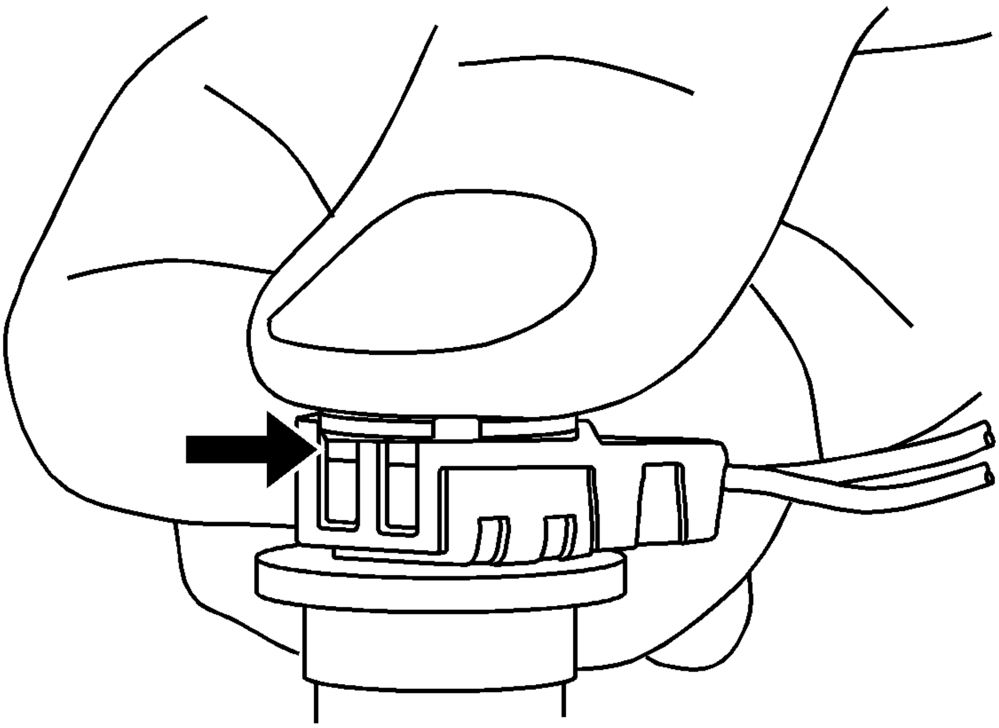


Fig. 89: Pushing CPA Down
Courtesy of GENERAL MOTORS COMPANY

3. After the connector is fully seated, push the CPA down with your thumb until the CPA is touching the yellow cover on the connector.
4. After the CPA is seated, lightly pull on the connector, it should not pull off if the connector and CPA are properly engaged.

FEP CONNECTORS (STEERING GEAR)

Removal Procedure

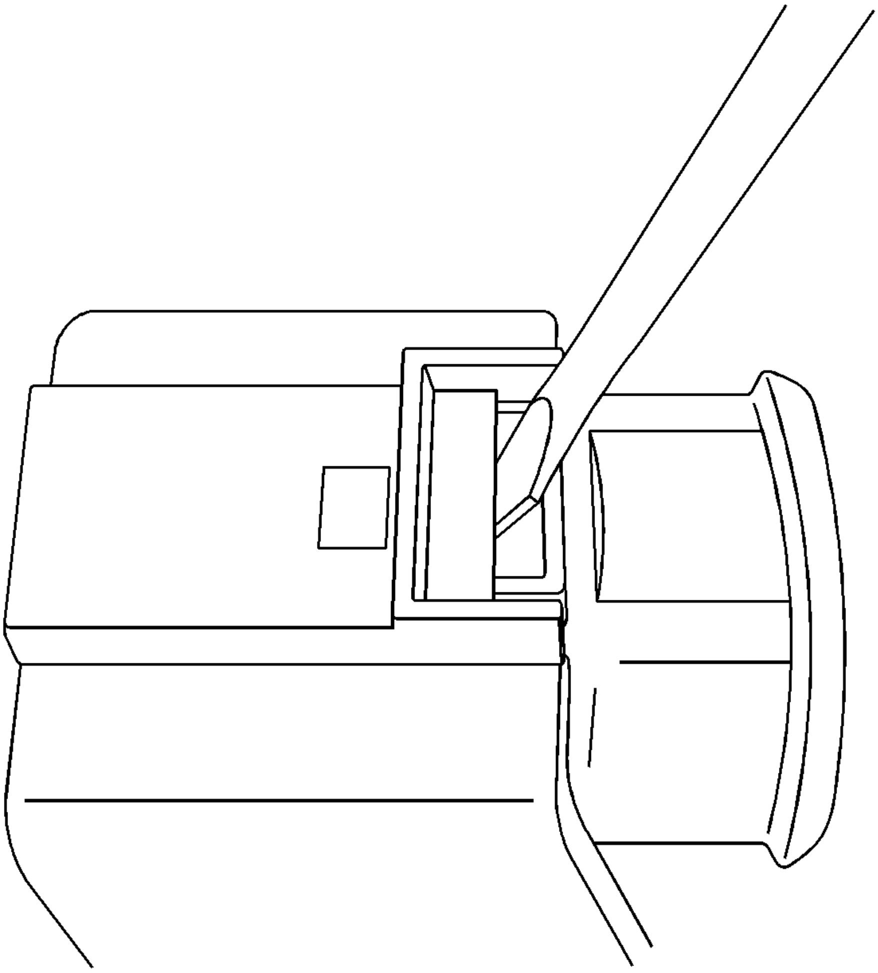


Fig. 90: Releasing Locking Tab On Connector
Courtesy of GENERAL MOTORS COMPANY

1. Use a flat-bladed tool to release the locking tab on the connector.

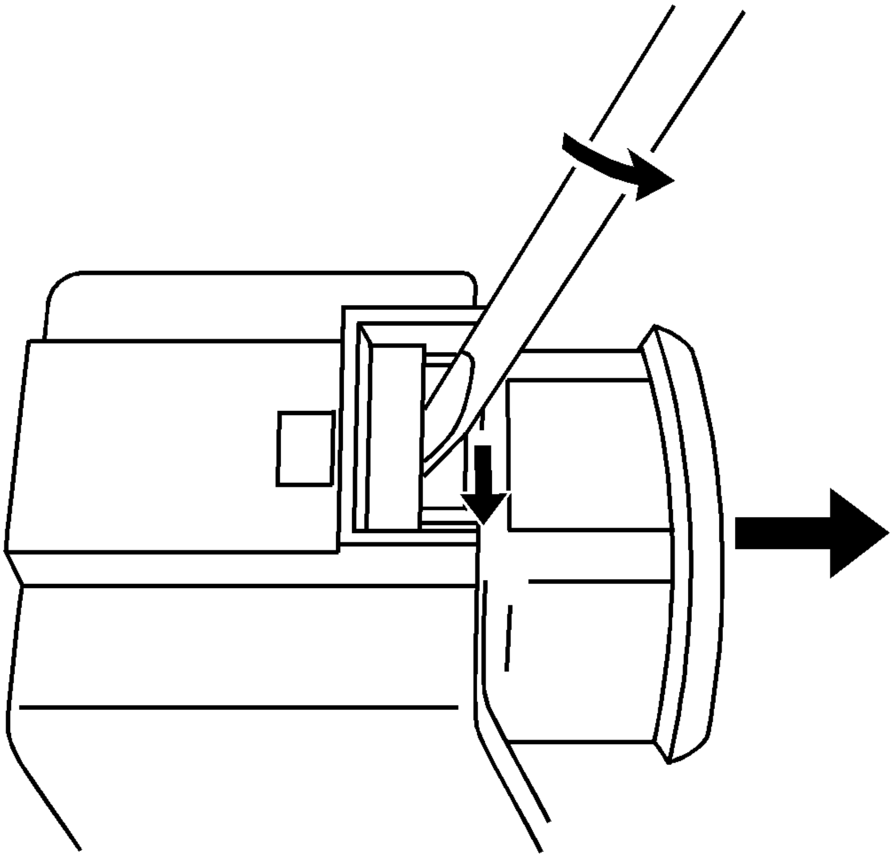


Fig. 91: Twisting Flat-Bladed Tool To Push Top Of Locking Tab Inward
Courtesy of GENERAL MOTORS COMPANY

2. Option 1: Twist the flat-bladed tool to push the top of the locking tab inward while pulling the connector body out.

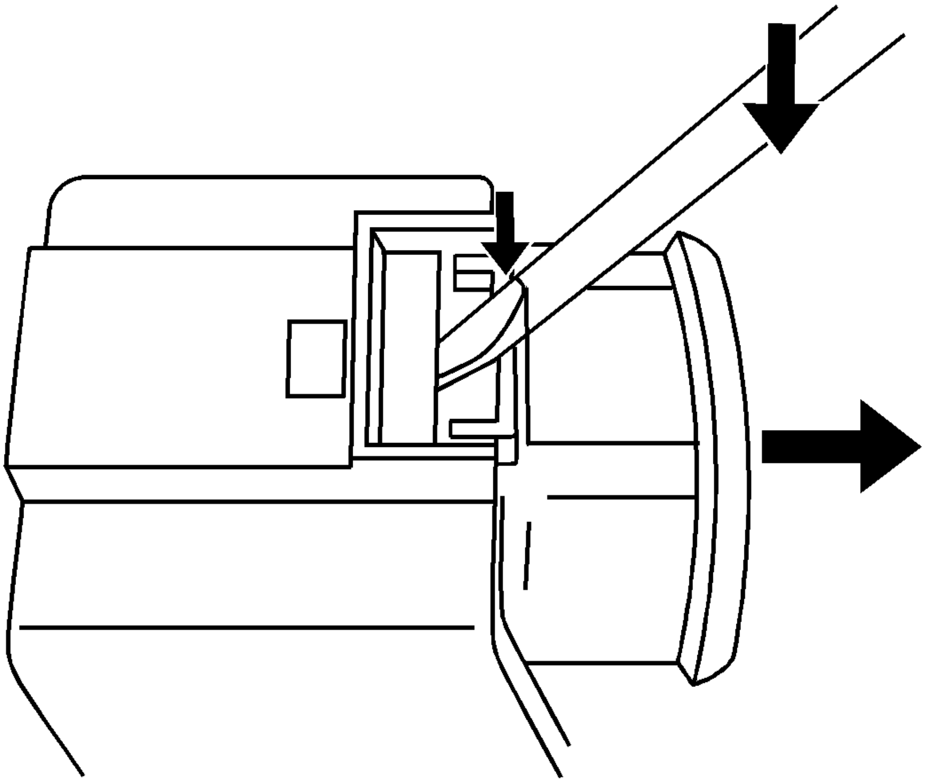


Fig. 92: Using Flat-Bladed Tool To Depress Locking Tab
Courtesy of GENERAL MOTORS COMPANY

3. Option 2: Pry using the flat-bladed tool to depress the locking tab while pulling the connector body out.

JST CONNECTORS

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-553** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

The JST connector family consists of seven unique connector housings differentiated by color and keying. This connector family is designed to use both 0.64 and 2.8 sized terminals.

JST BCM Connector

GM Service Part #	Color
88988806	Gray
88988837	Brown
88988838	Lt Green
88988839	Natural
88988840	Lt Blue
88988841	Black
88988842	Pink

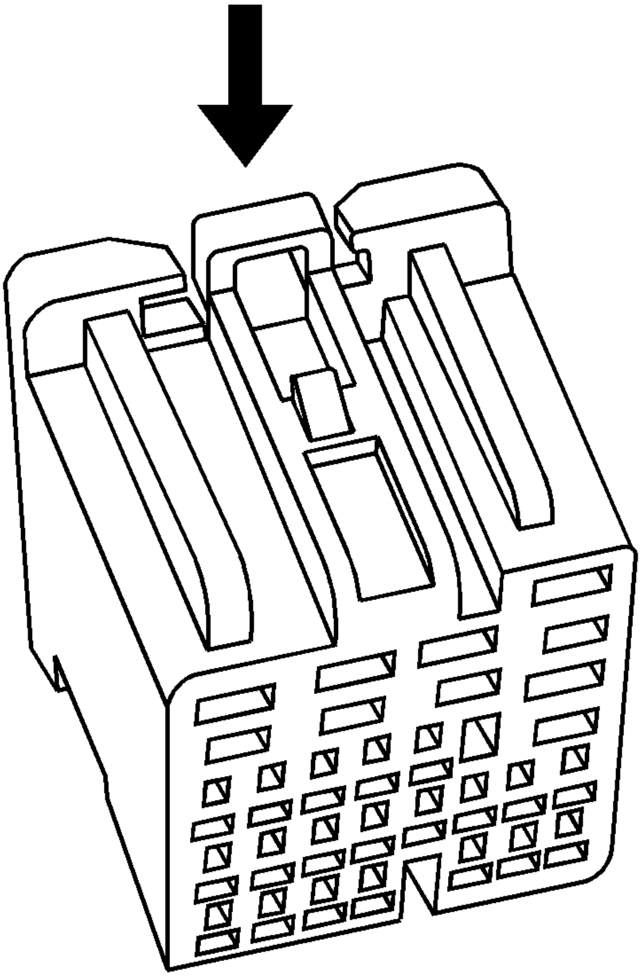


Fig. 93: Identifying Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS COMPANY

1. While depressing the lock, remove the connector from the component.

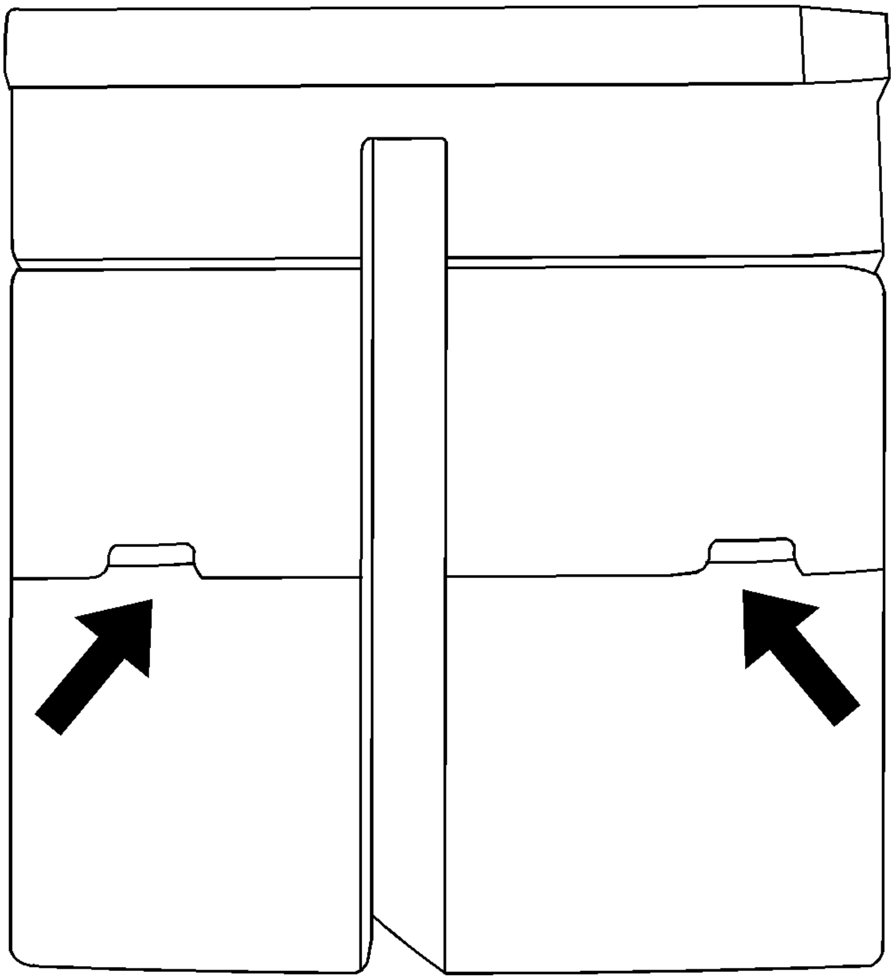


Fig. 94: Identifying TPA On Both Sides Of Connector
Courtesy of GENERAL MOTORS COMPANY

2. Unlock the terminal position assurance (TPA):
    - Position connector as shown (above) and locate TPA staging cavities.

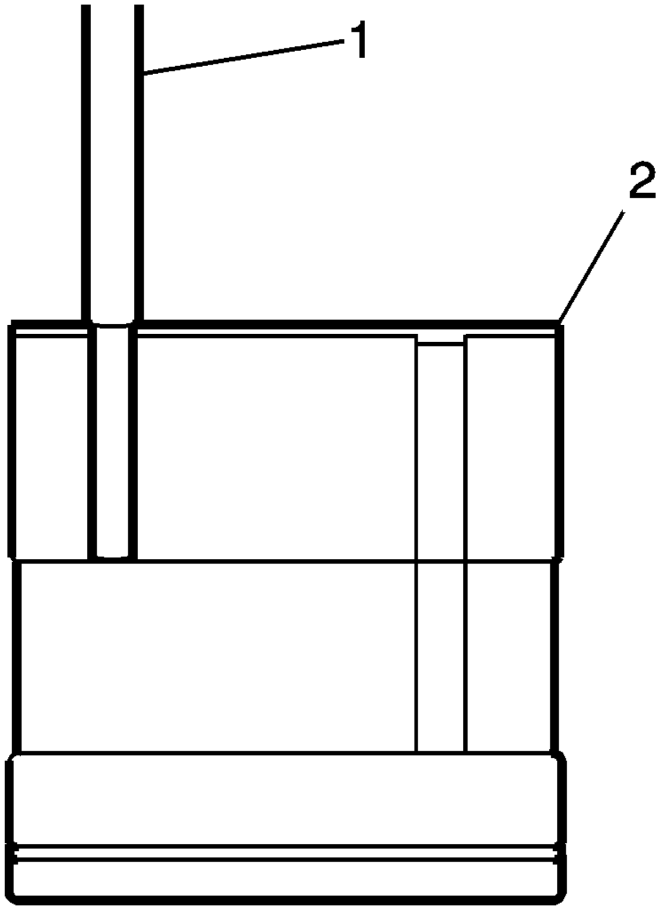


Fig. 95: Terminal Release Tool
Courtesy of GENERAL MOTORS COMPANY

- Using connector terminal release tool J-38125-553 (1) lift the TPA into the staged position. Perform this step on both sides of the TPA.

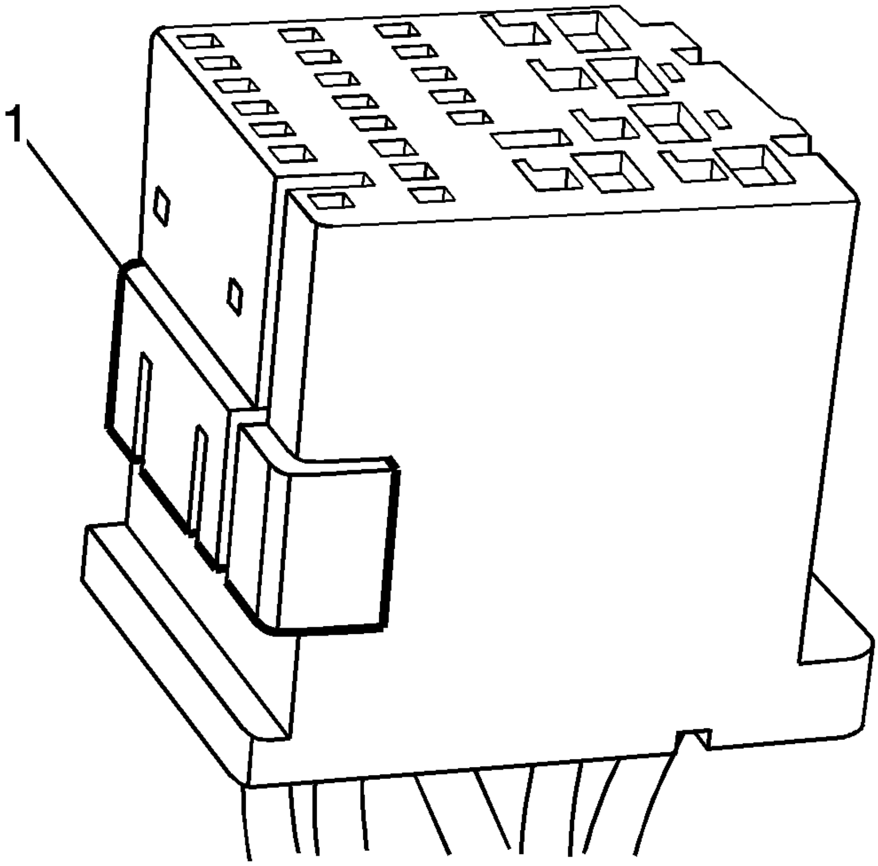


Fig. 96: TPA In Staged Position
Courtesy of GENERAL MOTORS COMPANY

- You will feel the TPA click into place when fully extended into the staged position. The figure above shows the TPA (1) in the staged position.

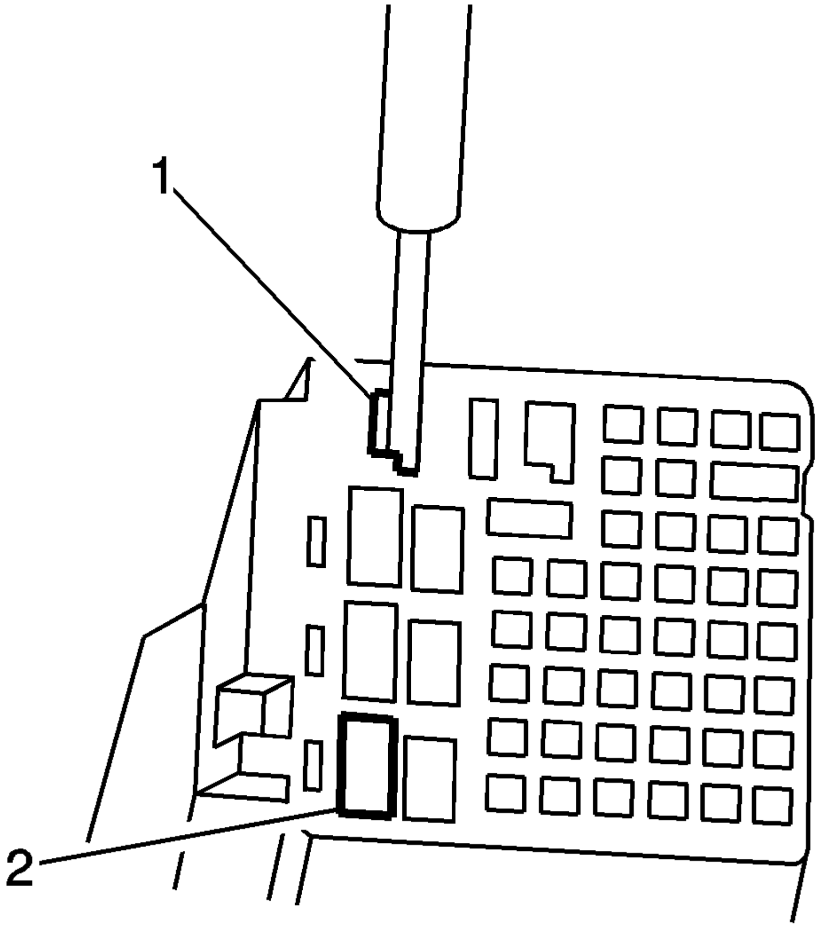


Fig. 97: Connector Terminal Release Tool
Courtesy of GENERAL MOTORS COMPANY

3. Release the terminal from the connector:
    - Position the connector as shown (above) and locate the terminal release entry canal (1) of the suspect terminal.
    - Insert the connector terminal release tool J-38125-553 into the entry canal with the angled side of the tool facing the connector wall containing cavity 4 (2).

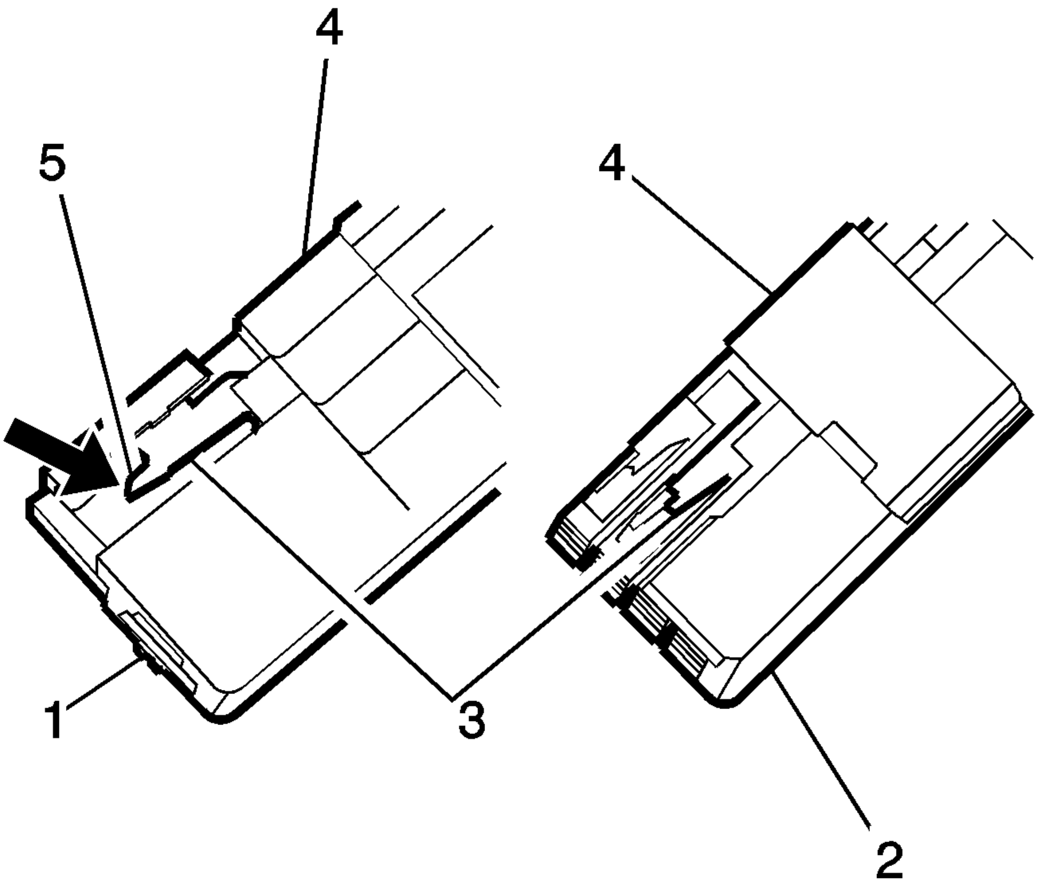


Fig. 98: Connector Lance And TPA
Courtesy of GENERAL MOTORS COMPANY

- The cavity on the left (1) is a 2.8 mm^2 cavity and the cavity on the right (2) is a 0.64 mm^2 cavity.
- Place the tip of the connector terminal release tool onto the connector lance (3) and deflect the lance to the right (5) to release the lock. Hold this released position.
- Holding the lance in the released position, slightly pull on the suspect terminal to remove it from the connector housing. The side TPA (4) is a secondary lock.

4. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
5. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

KOSTAL CONNECTORS (GLOW PLUG CONTROL MODULE)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-24** Terminal Release Tool
- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

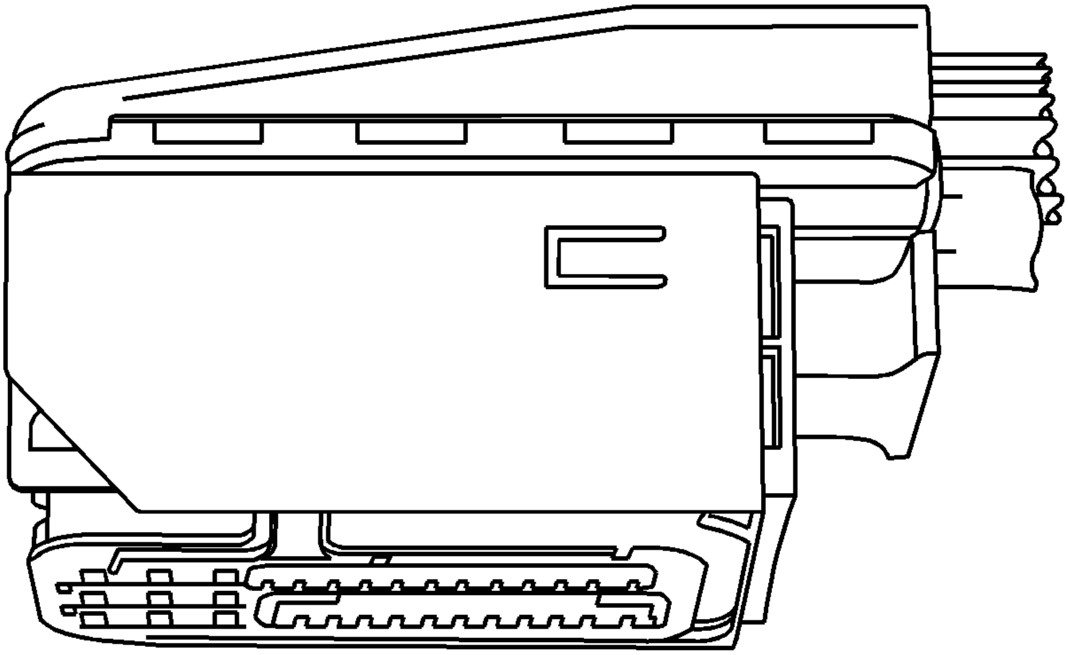


Fig. 99: View Of Typical Kostal Connector
Courtesy of GENERAL MOTORS COMPANY

View of typical connector.

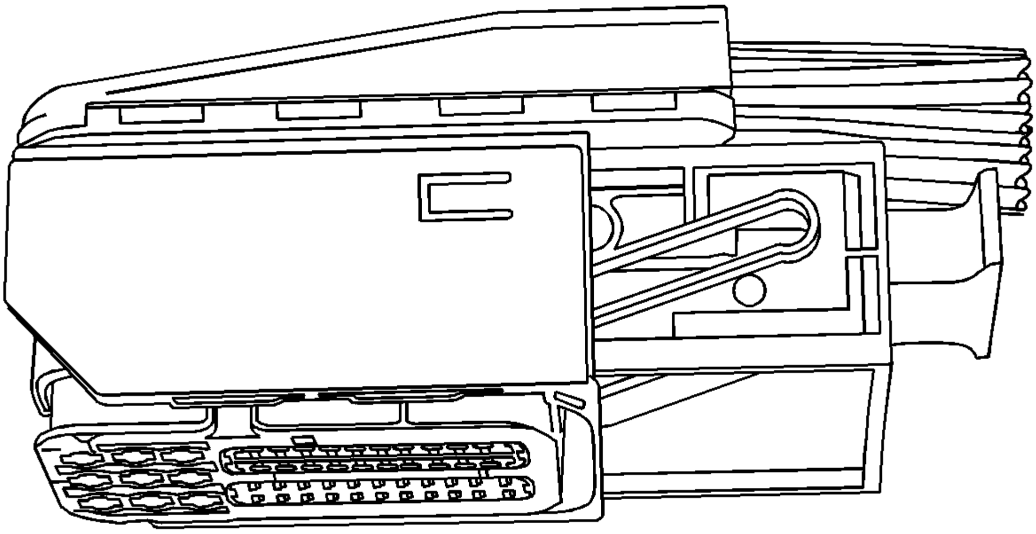


Fig. 100: View Of Connector In Released Position
Courtesy of GENERAL MOTORS COMPANY

View of connector in released position.

1. Locate the assist lever at the back of the connector. Move the assist lever to the rear position.
2. Disconnect the connector from the component.

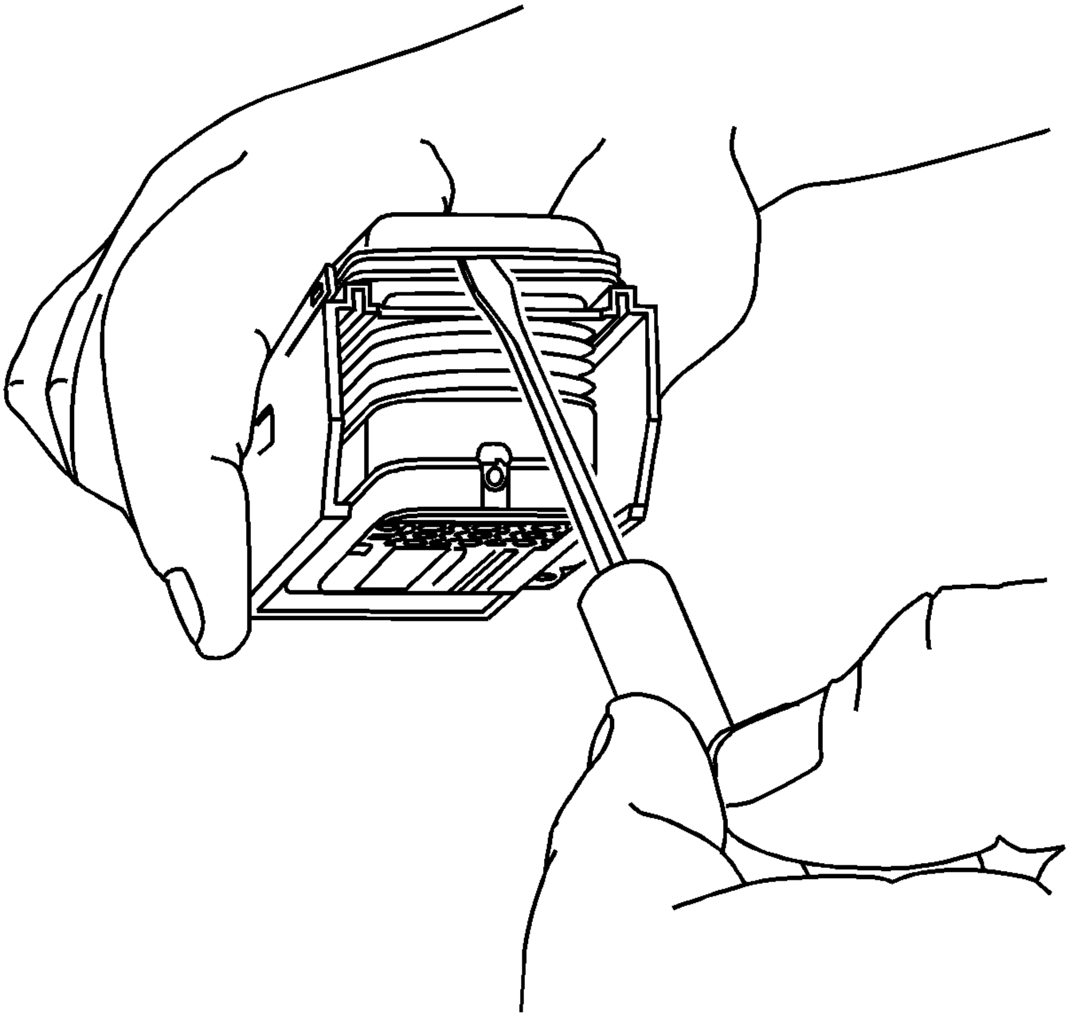


Fig. 101: Using Small Flat-Blade Tool To Remove Dress Cover
Courtesy of GENERAL MOTORS COMPANY

3. Use a small flat-blade tool to remove the dress cover.

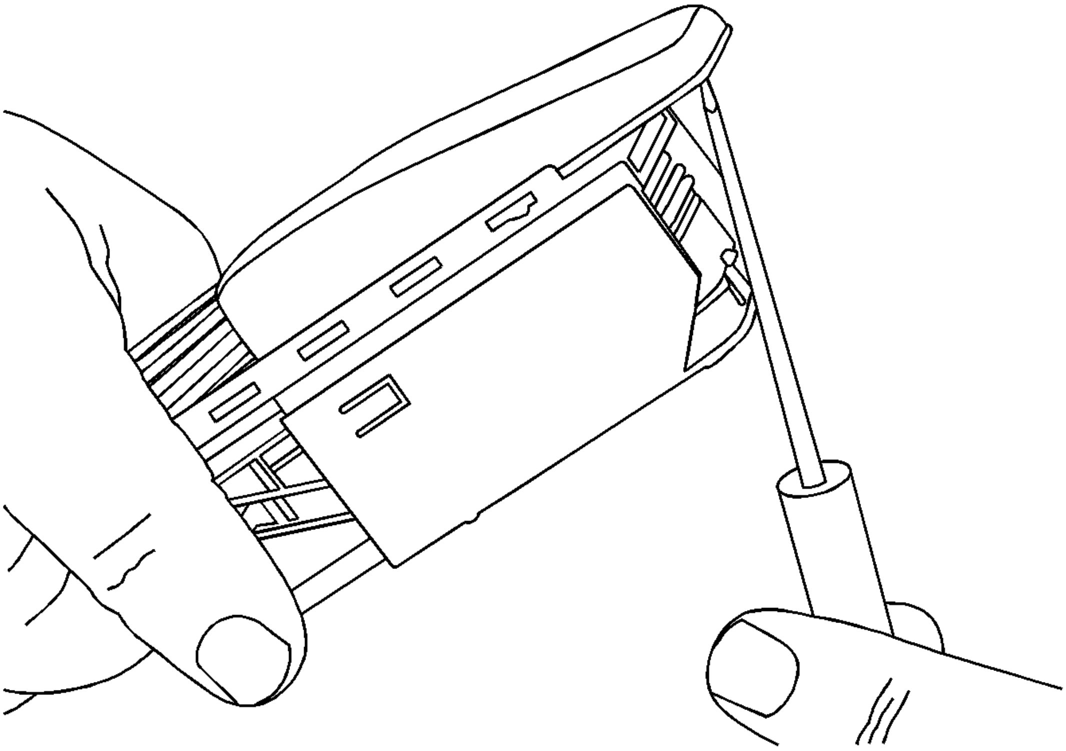


Fig. 102: Sliding Dress Cover Forward & Off Of Kostal Connector (Glow Plug Control Module)
Courtesy of GENERAL MOTORS COMPANY

4. Slide the dress cover forward and off of the connector.

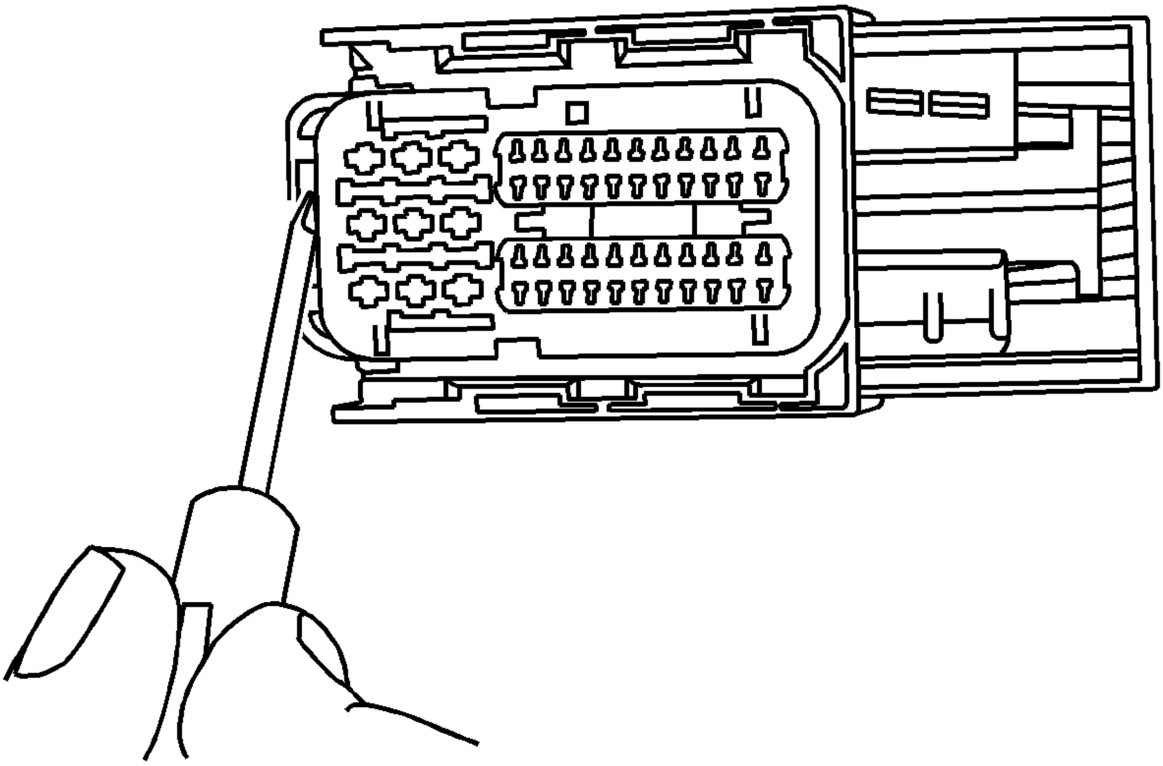


Fig. 103: Locating TPA In Front & Rear Of Connector
Courtesy of GENERAL MOTORS COMPANY

5. The terminal positive assurance (TPA) is located in the front and rear of the connector.

NOTE: **The front TPA cannot be removed from the connector. Only move it to the preset position.**

6. Use a small flat-blade tool to move the front TPA to the preset position, outboard approximately 0.125 in. (3 mm).

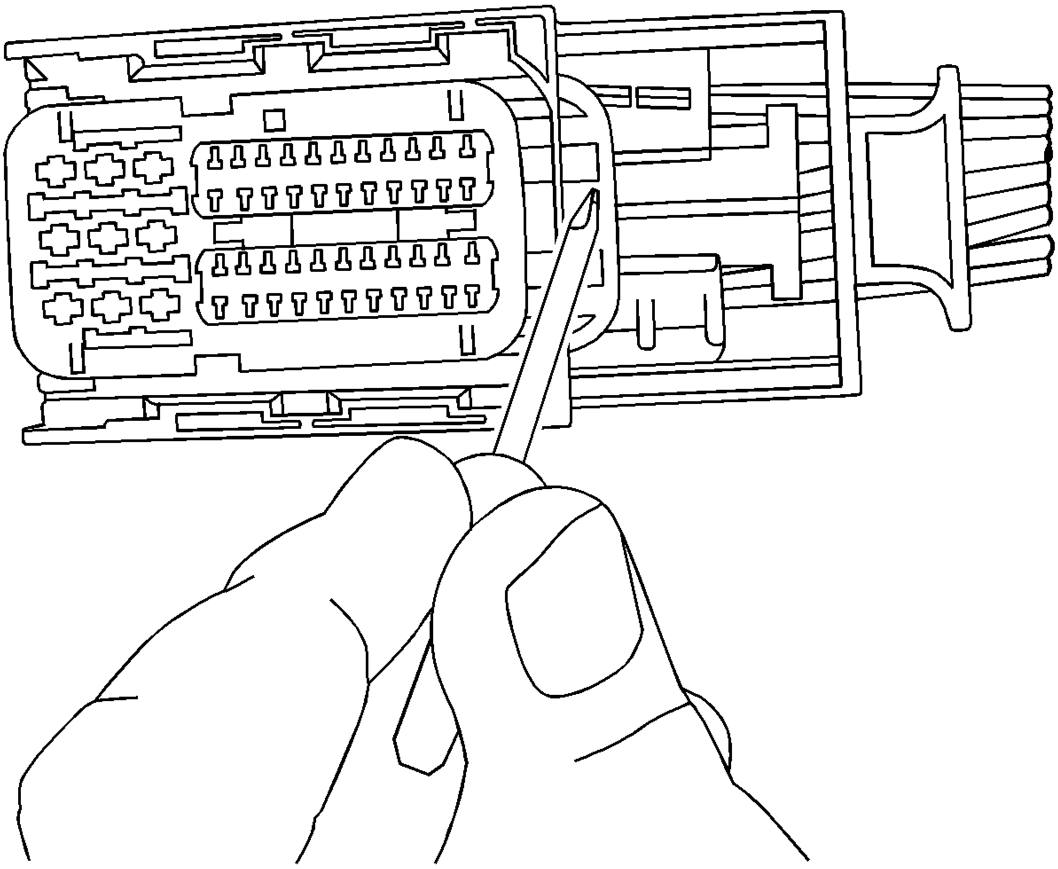


Fig. 104: Using Small Flat-Blade Tool To Remove Rear TPA
Courtesy of GENERAL MOTORS COMPANY

7. Use a small flat-blade tool to completely remove the rear TPA from the connector.

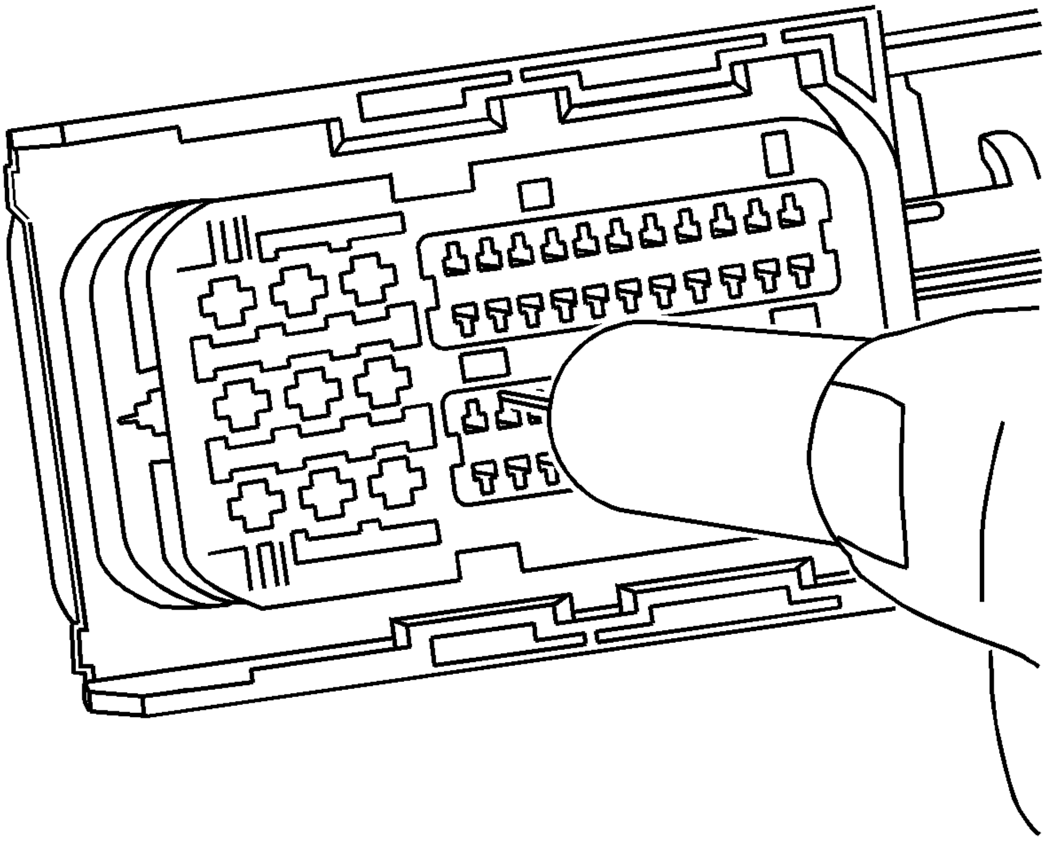


Fig. 105: Using Special Tool To Release Terminals
Courtesy of GENERAL MOTORS COMPANY

8. Use the J-38125-24 or the J-38125-560 tool to release the terminals by inserting the tool into the terminal release cavity.
9. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
10. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.

KOSTAL CONNECTORS (TRANSMISSION)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-28** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

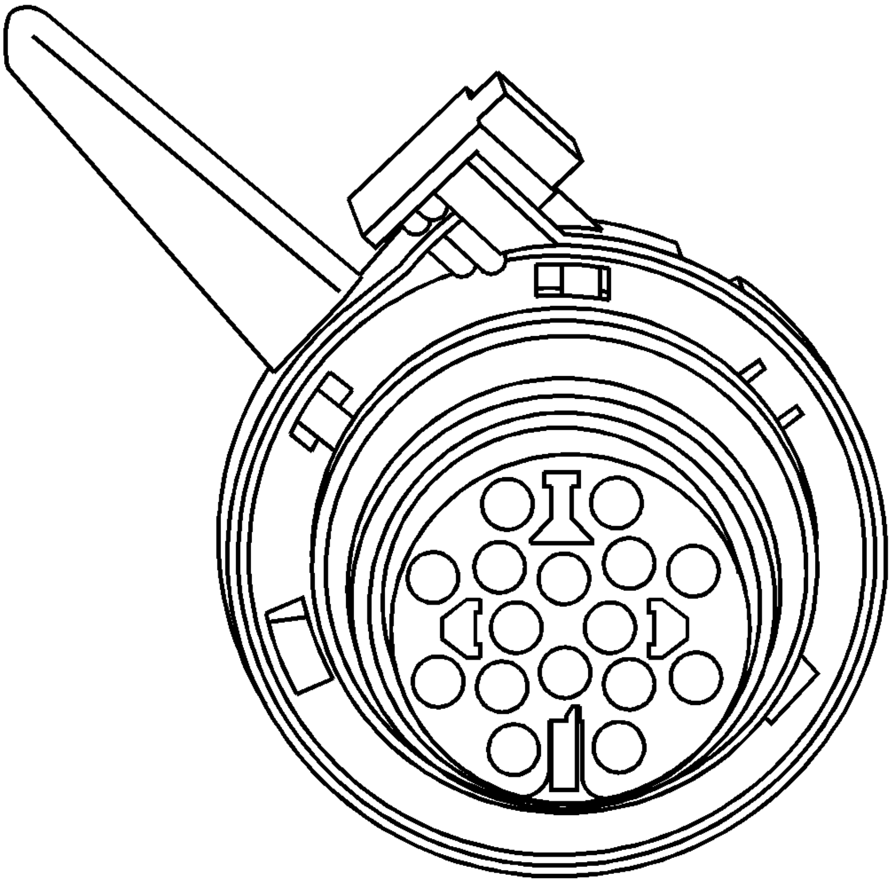


Fig. 106: View Of Connector & Lock
Courtesy of GENERAL MOTORS COMPANY

1. While depressing the lock, twist and remove the connector from the component.

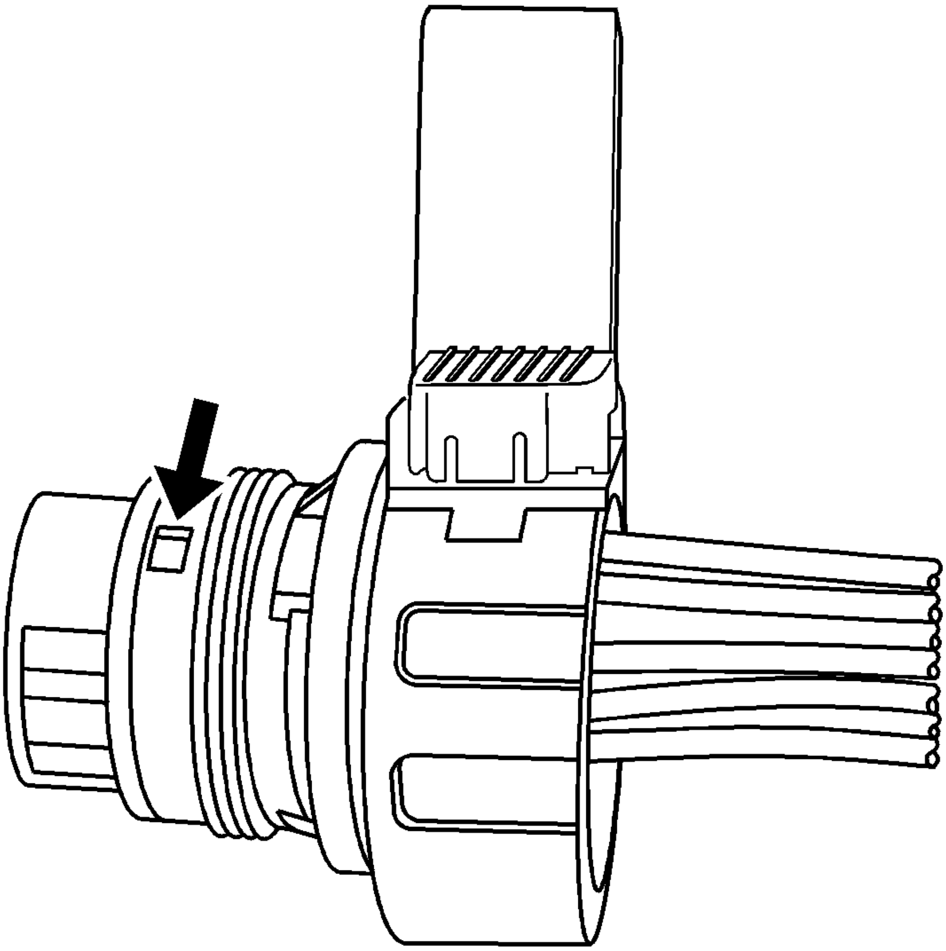


Fig. 107: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS COMPANY

2. Locate the terminal position assurance (TPA).

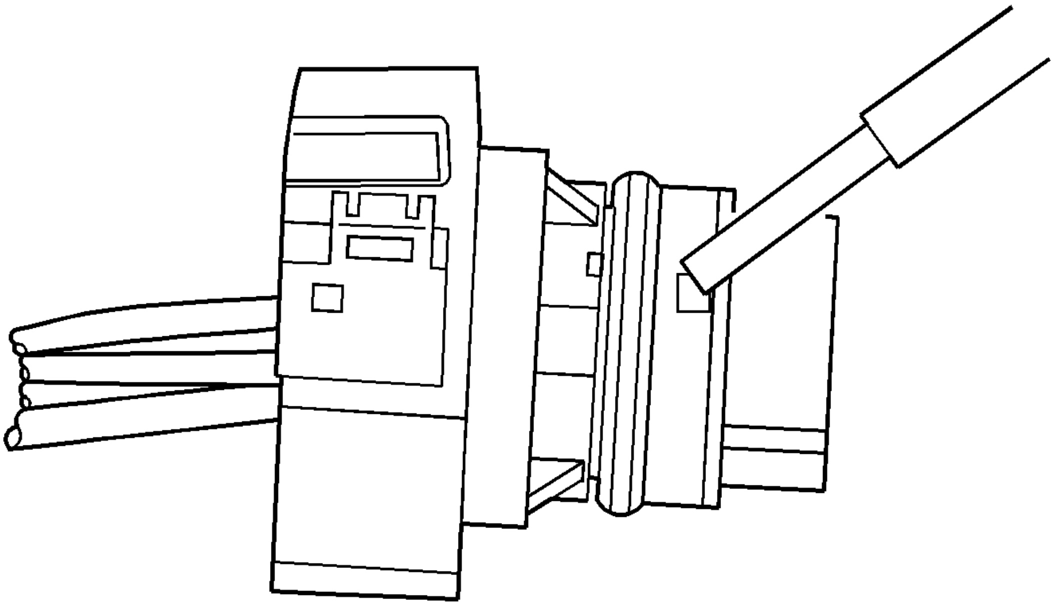


Fig. 108: View Of TPA & Flat-Bladed Tool

Courtesy of GENERAL MOTORS COMPANY

NOTE: **The TPA cannot be removed from the connector while there are terminals present in the connector body.**

3. Use a small flat-blade tool to push the TPA until it bottoms out.

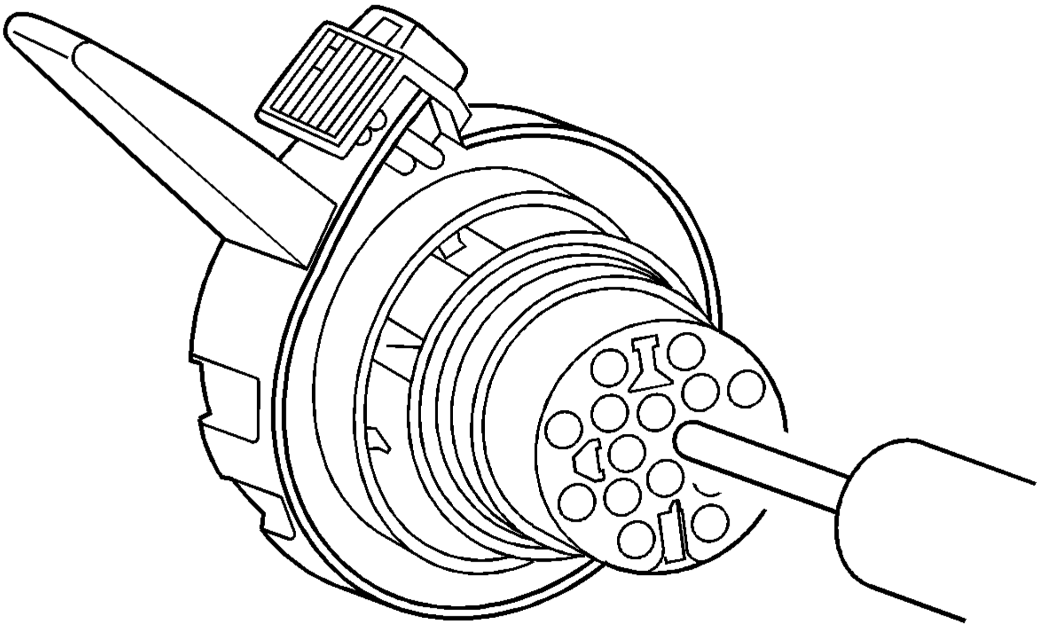


Fig. 109: Using J 38125-28 Tool To Release Terminals
Courtesy of GENERAL MOTORS COMPANY

4. Use the J-38125-28 tool to release the terminals by inserting the tool into the terminal cavity as shown in the graphic.
5. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
6. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.

Terminal Insertion Procedure

After the terminal is replaced, perform the following procedure in order to insert the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.

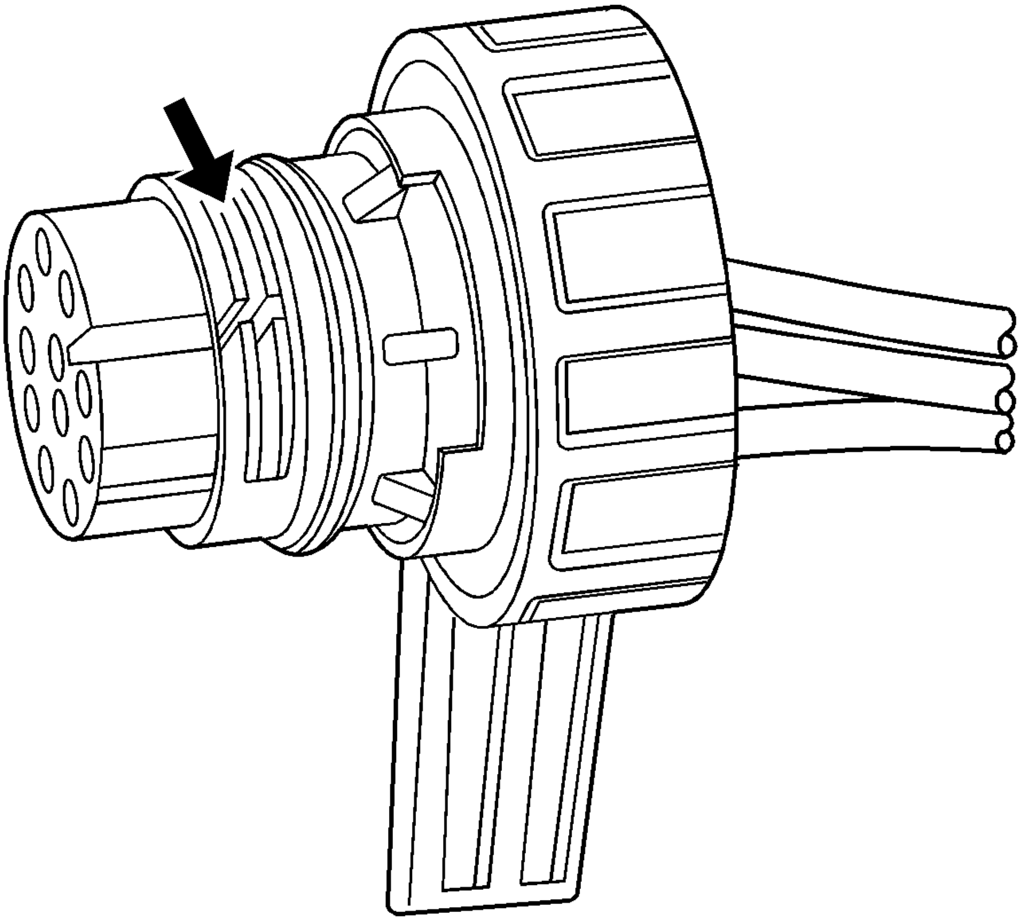


Fig. 110: Locating Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS COMPANY

3. Locate the TPA.

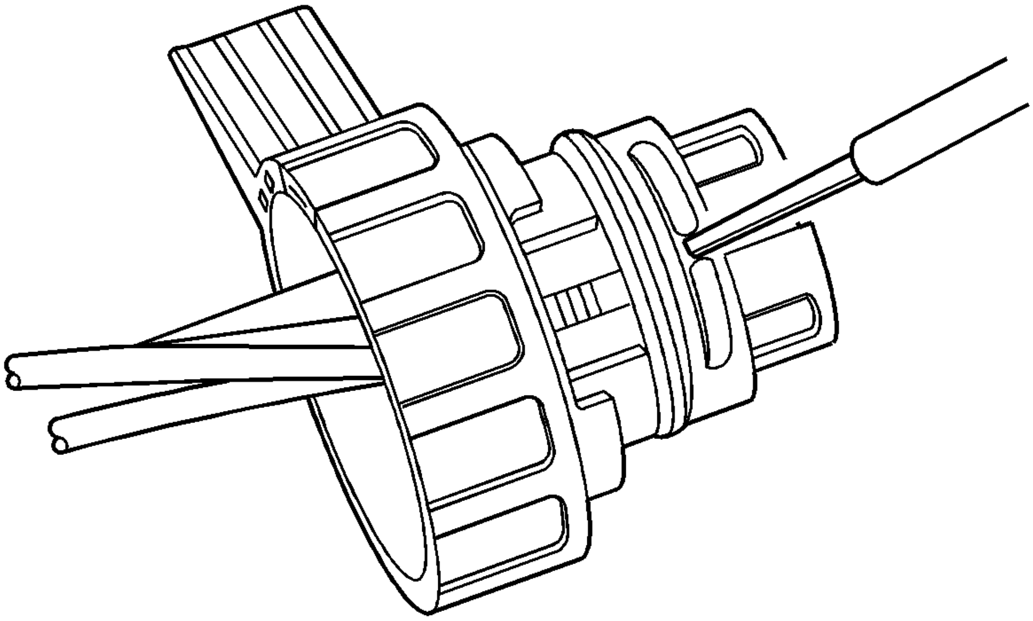


Fig. 111: View Of TPA & Flat-Bladed Tool
Courtesy of GENERAL MOTORS COMPANY

4. Use a small flat-blade tool to push the TPA until it bottoms out.

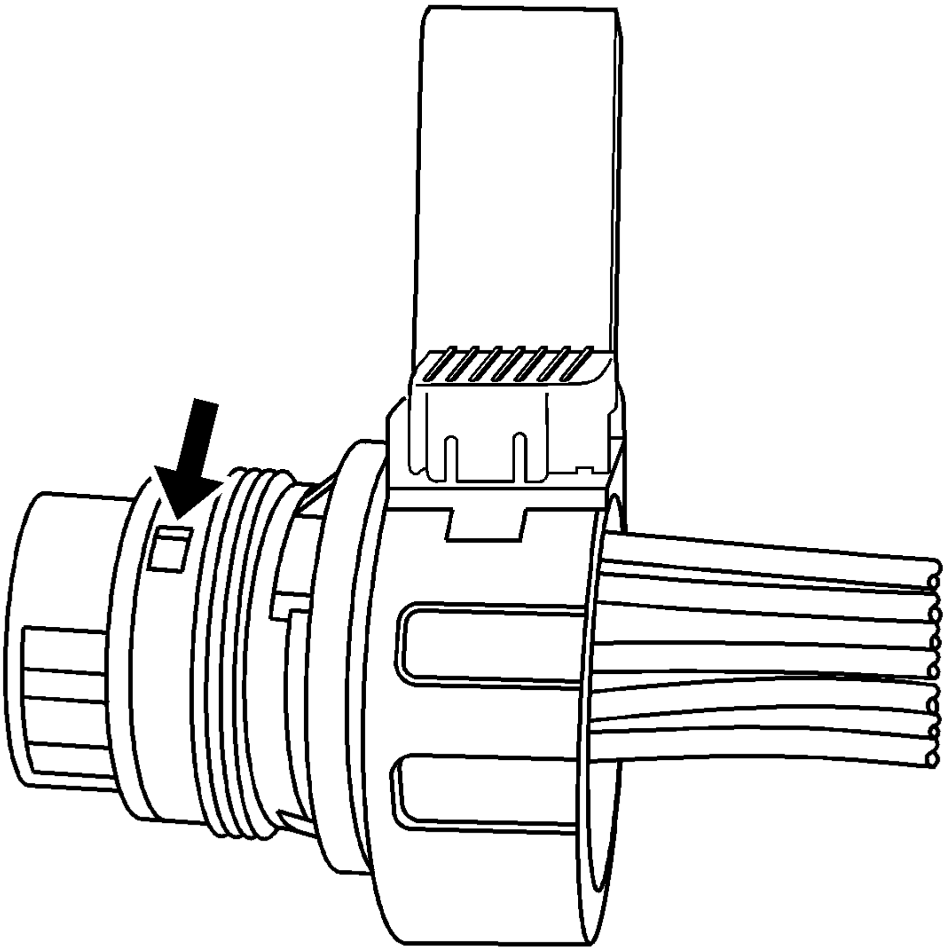


Fig. 112: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS COMPANY

5. Ensure the TPA is fully seated. The TPA should be centered and flush with the connector body when viewed.

MOLEX CONNECTORS (LEVER LOCK)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-213** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

1. Locate the connector position assurance (CPA) on the top of the wire dress cover. Slide the CPA forward.

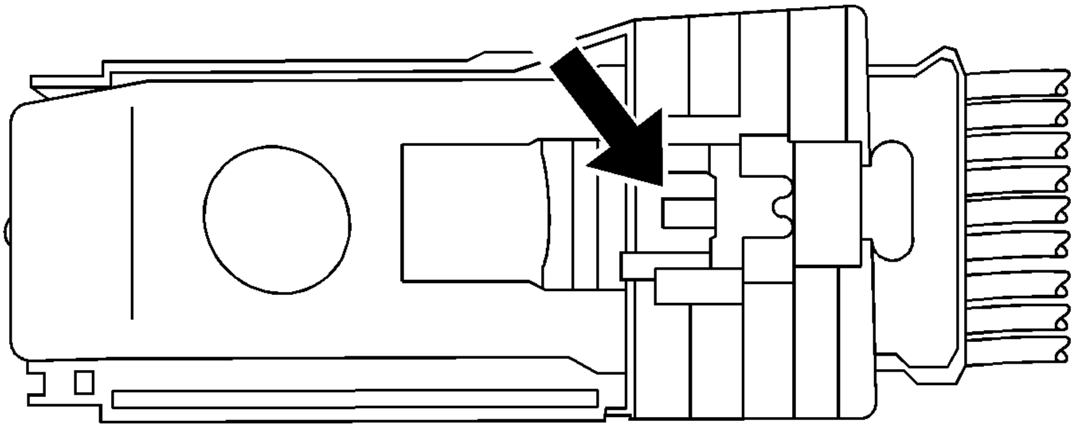


Fig. 113: Identifying Lever Lock Release Tab
Courtesy of GENERAL MOTORS COMPANY

2. Slide the lever lock forward while pressing down on the lever lock release tab.

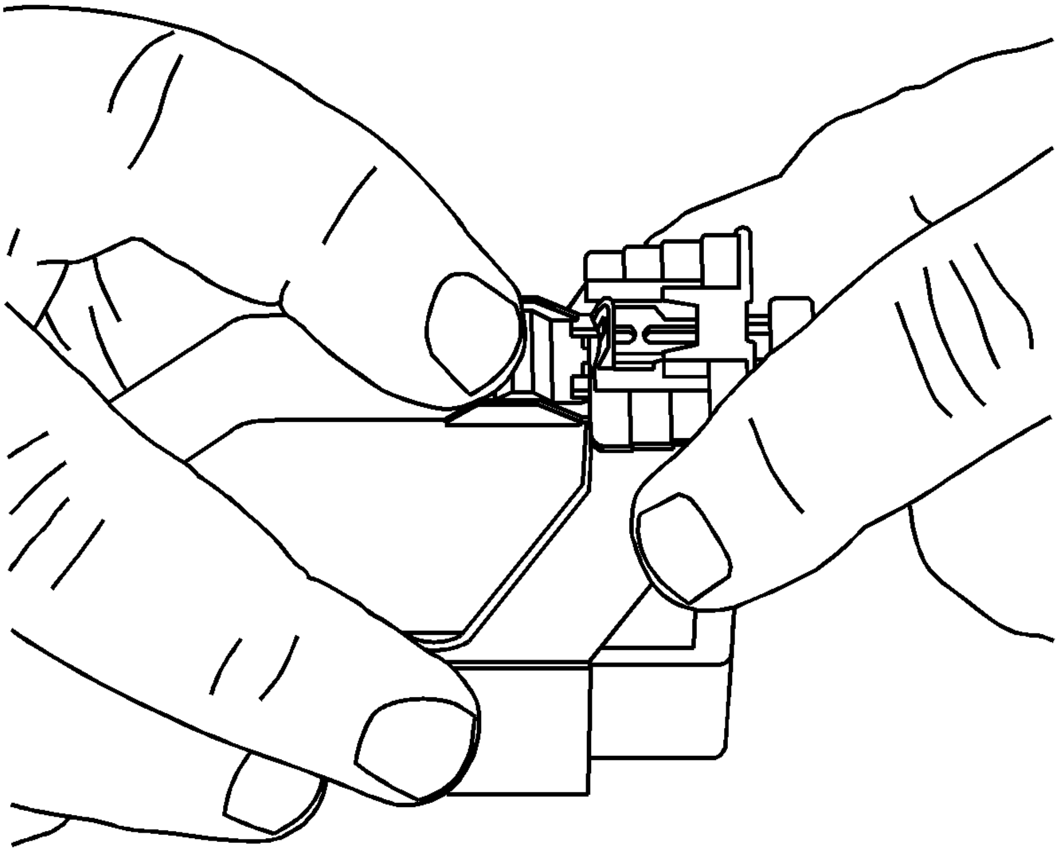


Fig. 114: View Of Lever In Full Forward Position
Courtesy of GENERAL MOTORS COMPANY

3. The lever should be in the full forward position.

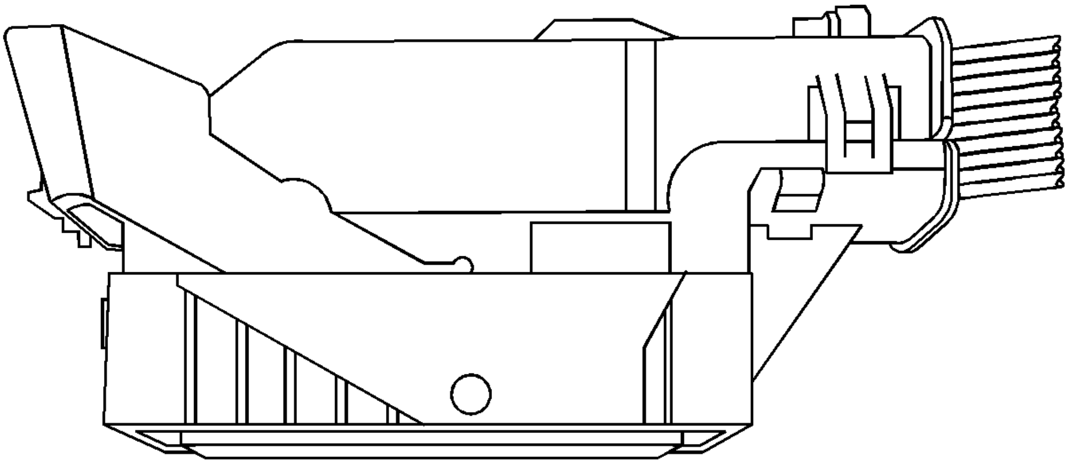


Fig. 115: View Of CPA Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the connector from the component.

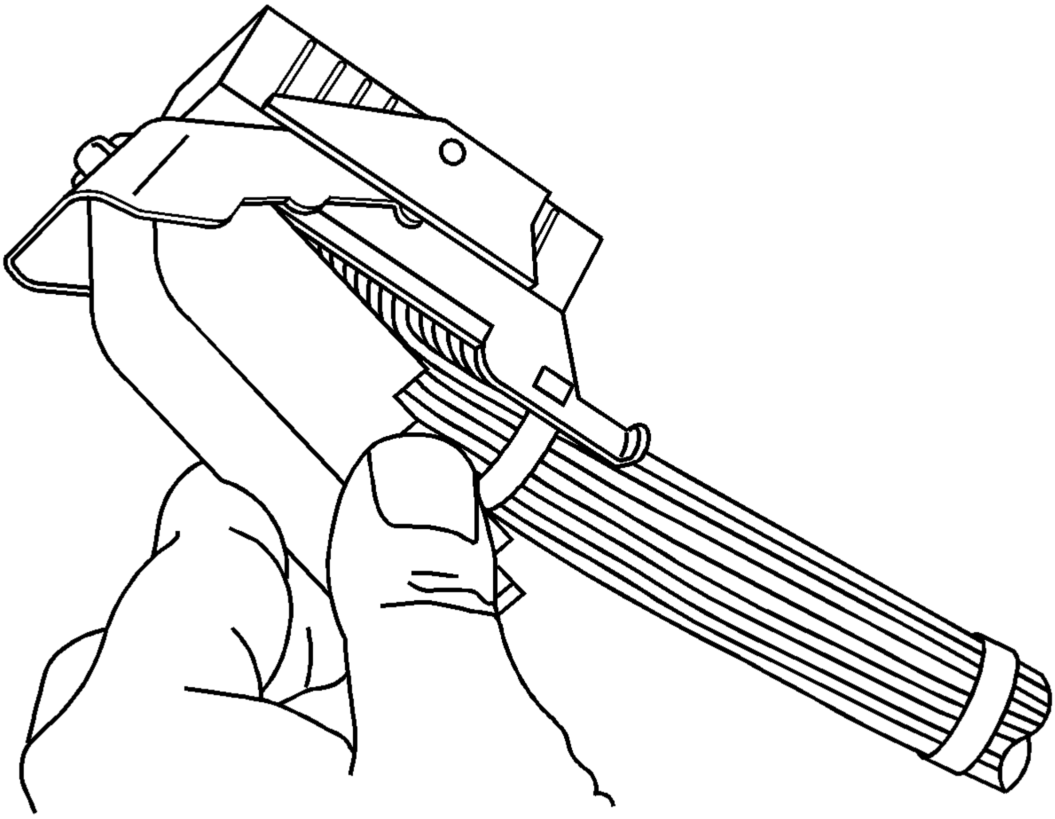


Fig. 116: View Of Dress Cover
Courtesy of GENERAL MOTORS COMPANY

5. Remove the dress cover by using a flat bladed tool to release the dress cover locking tabs and lift up on the dress cover.
6. Cut the tie wrap that holds the wires to the connector body.

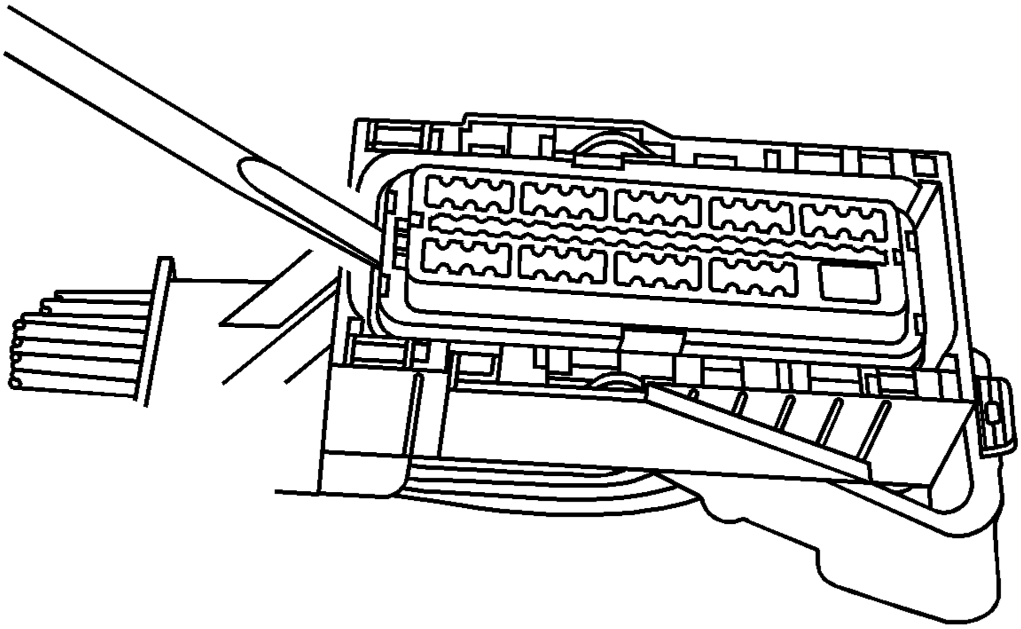


Fig. 117: Prying One Side Of Nose Piece
Courtesy of GENERAL MOTORS COMPANY

7. Use a small flat-blade tool to pry one side of the nose piece up to the pre-stage position. When the nose piece is in the pre-staged position, the nose piece will be raised above the connector body the length of the step in the nose piece.

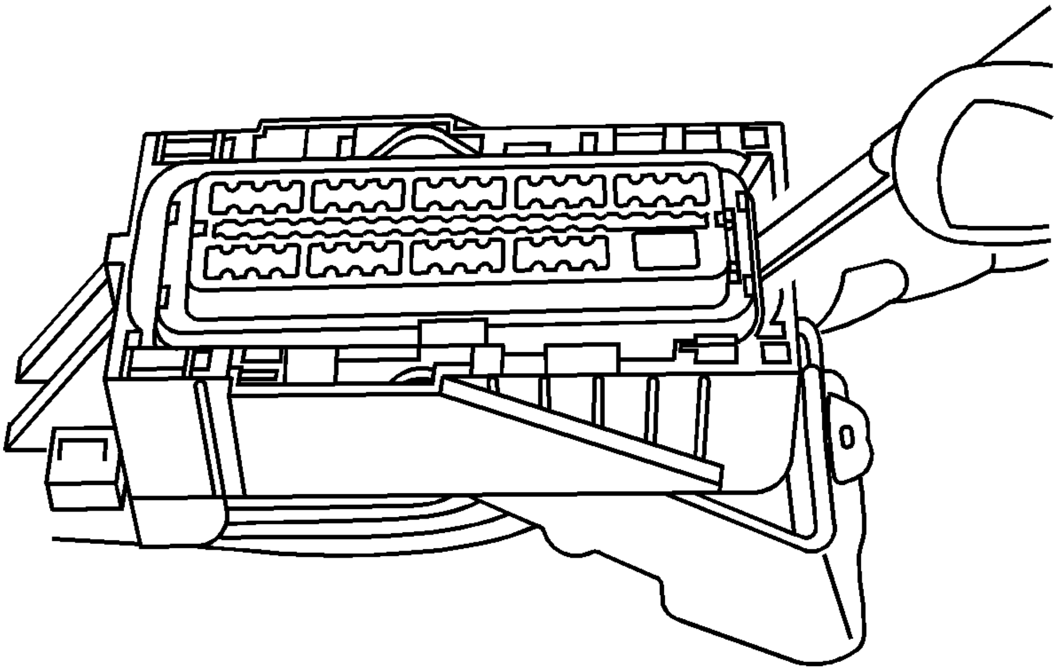


Fig. 118: Prying Side Of Nose Piece
Courtesy of GENERAL MOTORS COMPANY

8. Use a small flat-blade tool to pry the other side of the piece to the pre-stage position. If the nose piece is higher than the first step in the nose piece, gently push down on the nose piece until it meets with resistance from the connector body, you should feel the nose piece click into position.

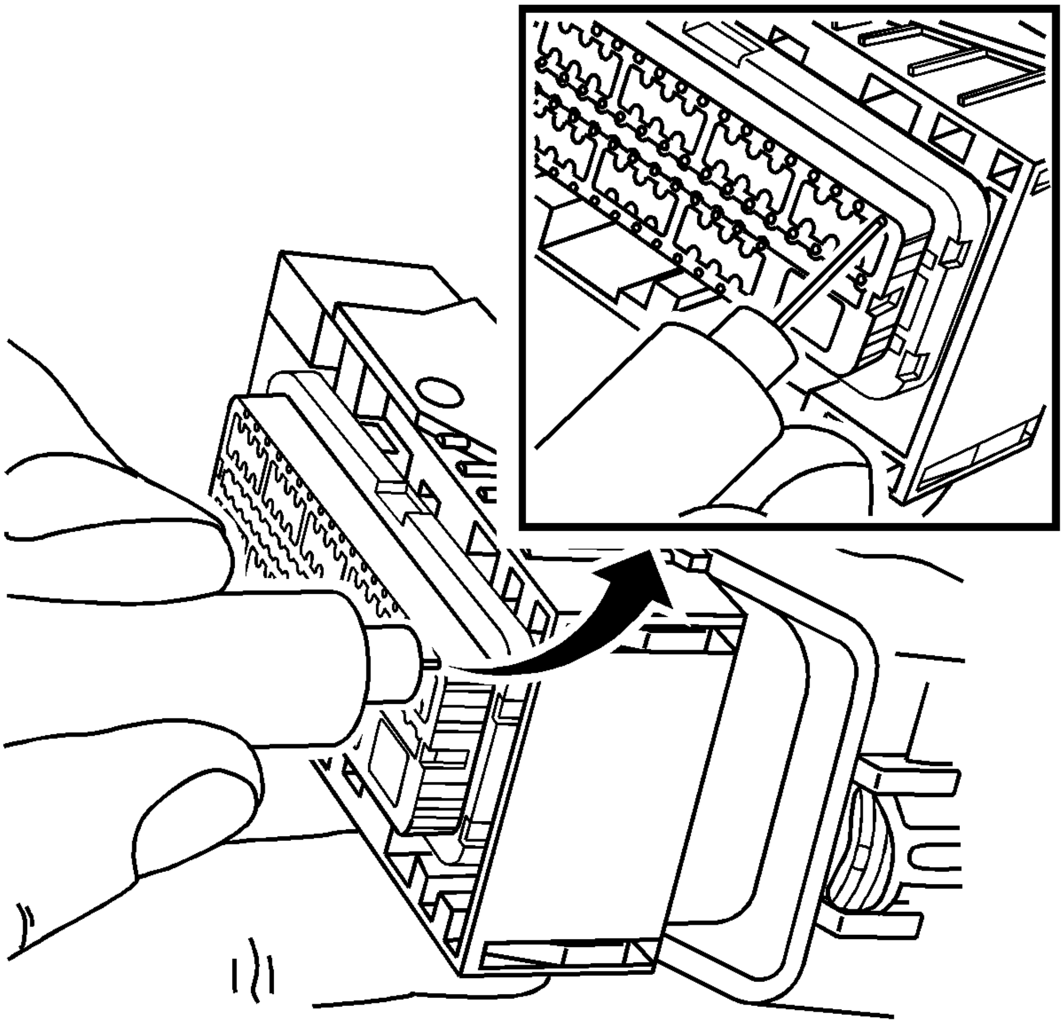


Fig. 119: Releasing Terminal
Courtesy of GENERAL MOTORS COMPANY

9. Insert the J-38125-213 into the small terminal release hole on the nose piece and gently pull on the back of the wire.
10. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
11. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminated Lead Repair

1. Remove the terminal.
2. Find the appropriate terminated lead.
3. Use the appropriate splice sleeves depending on the gauge size.
4. Refer to Wire to Wire Repair.

Terminal Insertion Procedure

After the terminal is replaced, perform the following procedure in order to insert the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Insure that the terminal is locked in place by gently pulling on the wire.
3. To assemble the connector, reverse the connector disassembly procedure.

MOLEX CONNECTORS (SIR)

Removal Procedure

NOTE: **The orange or yellow connector position assurance (CPA) must be released first to disconnect or to connect the connector.**

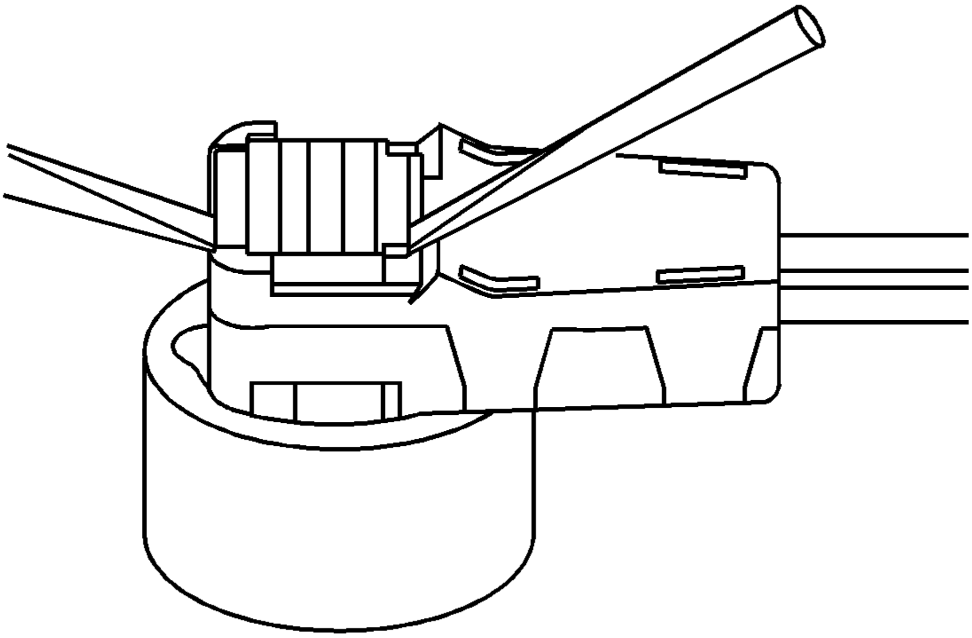


Fig. 120: Lifting Orange CPA
Courtesy of GENERAL MOTORS COMPANY

1. Lift the orange or yellow CPA vertically (avoid lifting on an angle to the connector) approximately 4 mm to release the connector. Use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

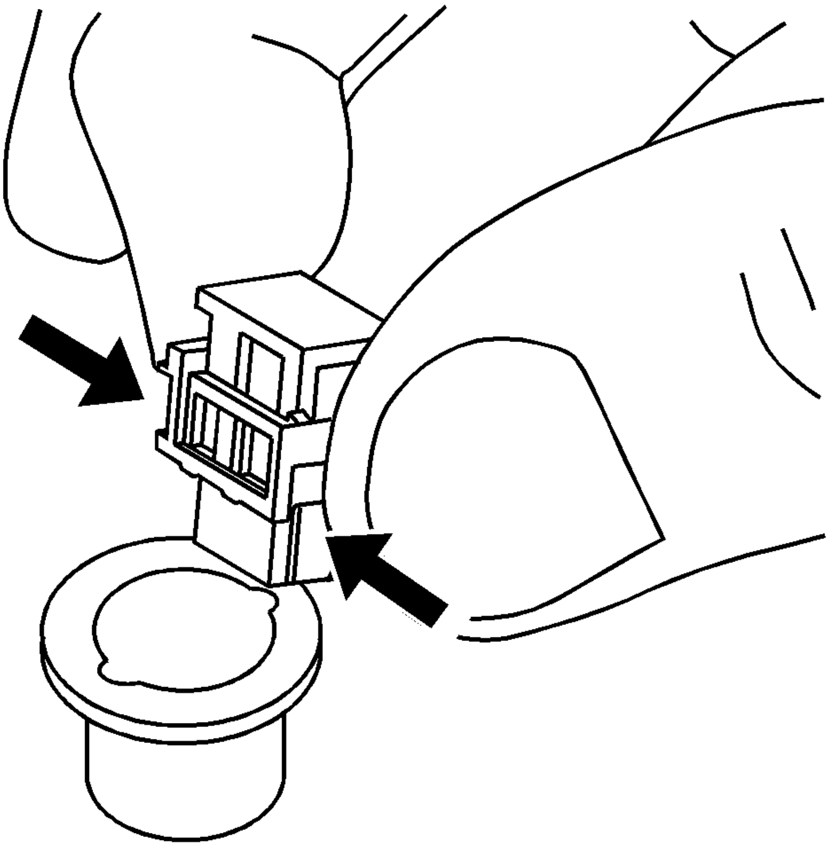


Fig. 121: Grabbing Connector On Both Sides
Courtesy of GENERAL MOTORS COMPANY

2. Grab the connector on both sides and lift vertically to disconnect the connector.

Installation Procedure

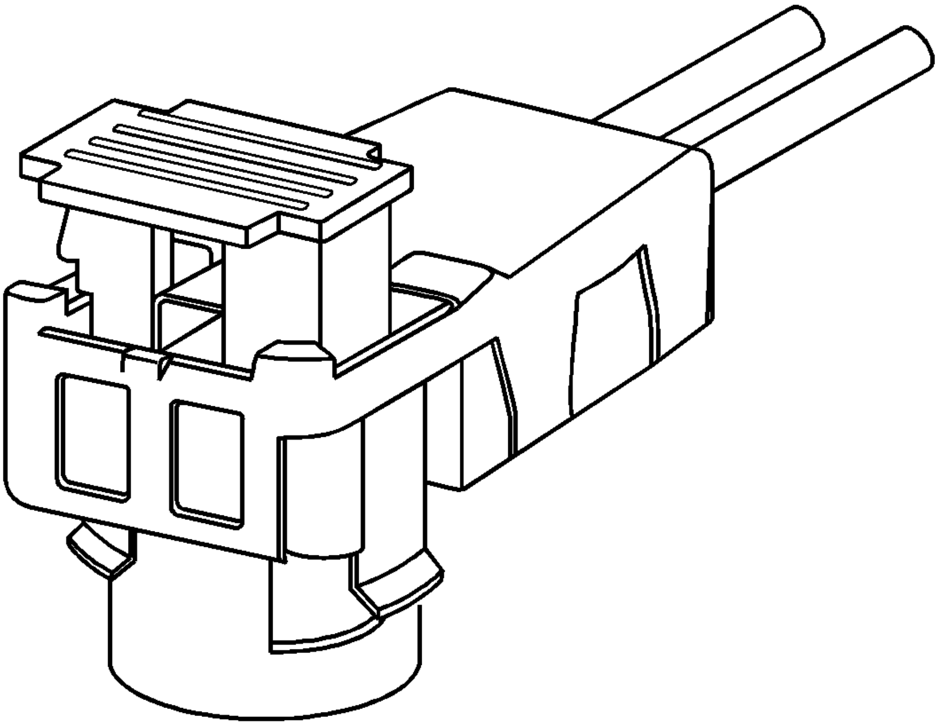


Fig. 122: Lifting Orange CPA
Courtesy of GENERAL MOTORS COMPANY

1. The CPA should be approximately 4 mm above the yellow cover before installing the connector. If not, use a small flat-bladed tool to help release the CPA. The CPA may also be released manually without any tools.

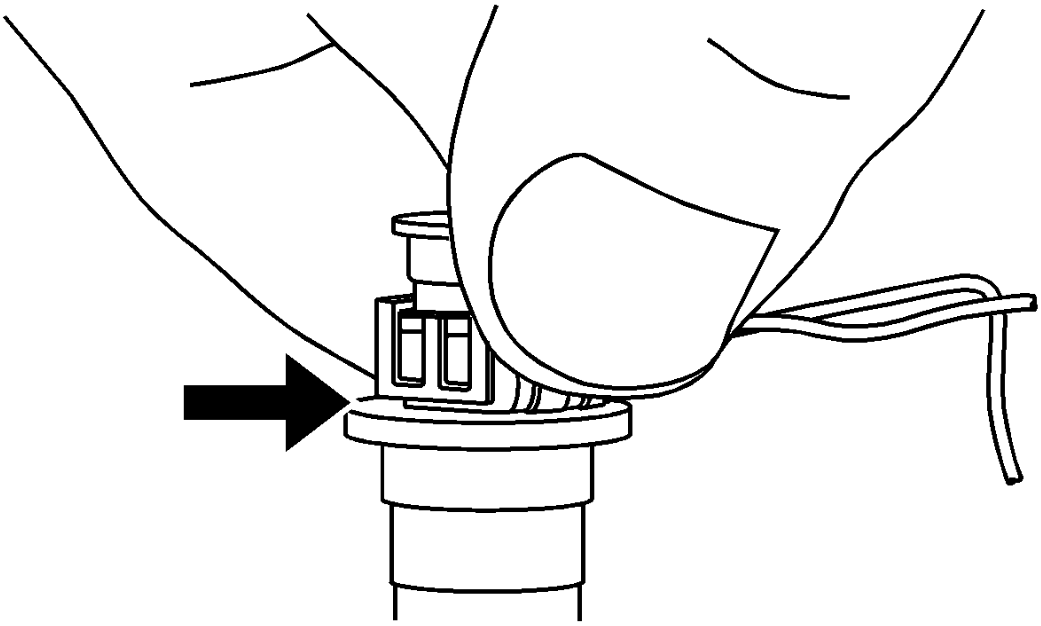


Fig. 123: Seating Connector Sub-Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Line up the connector key tabs with the initiator key slots. Grab the connector on both sides and push down into the initiator connector sub assembly until fully seated.

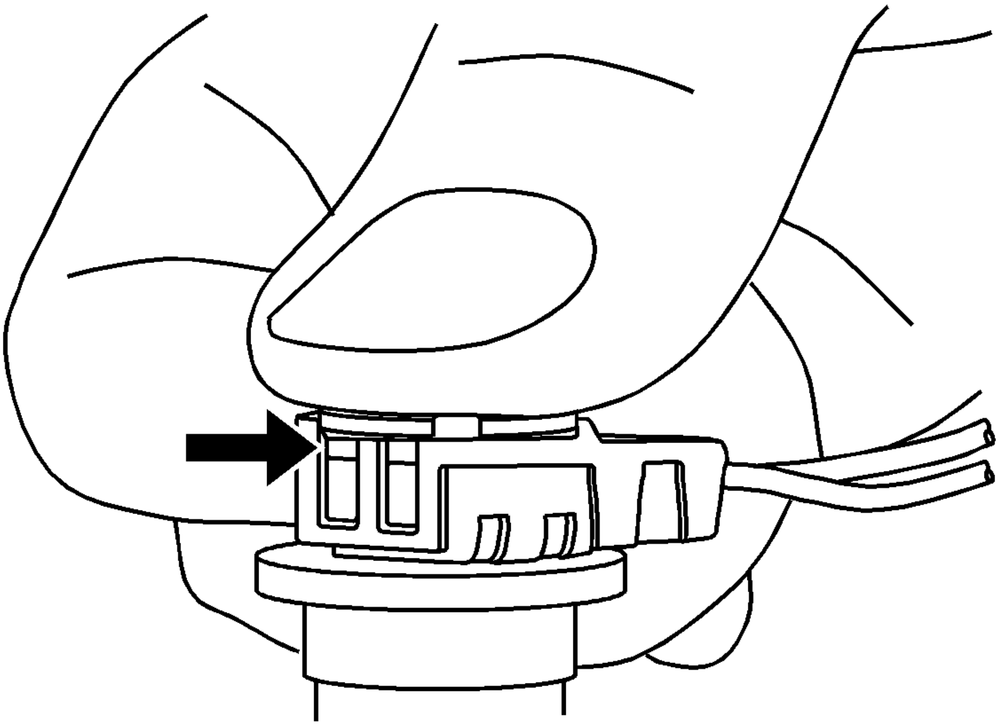


Fig. 124: Pushing CPA Down
Courtesy of GENERAL MOTORS COMPANY

3. After the connector is fully seated, push the CPA down with your thumb until the CPA is touching the yellow cover on the connector.

SUMITOMO CONNECTORS

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool
- **J-38125-552** Terminal Release Tool
- **J-38125-553** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

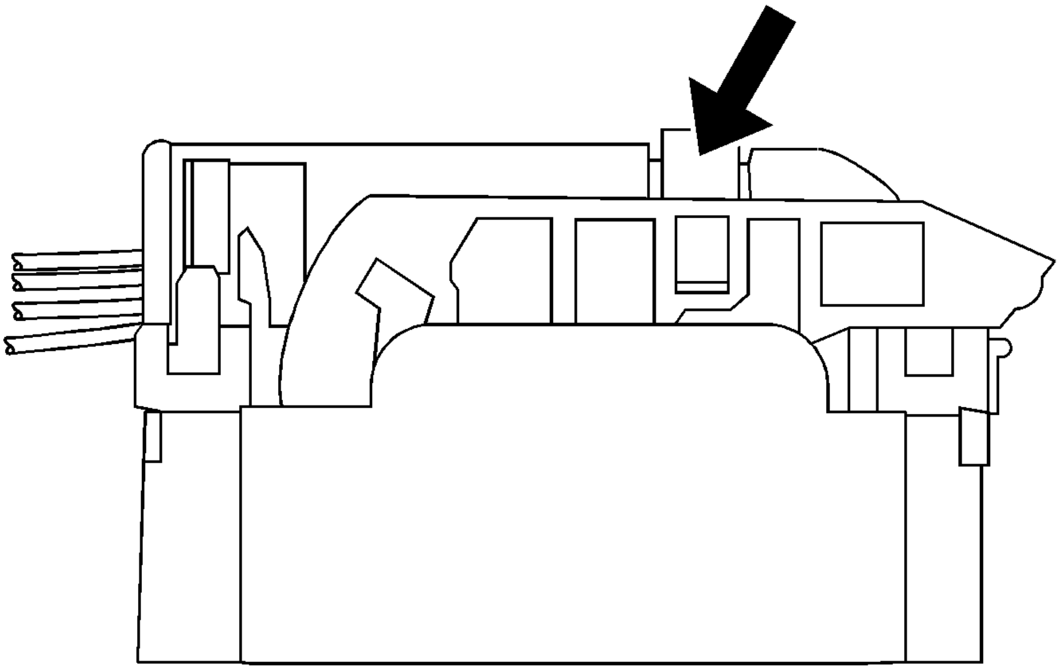


Fig. 125: Identifying Lever Lock

Courtesy of GENERAL MOTORS COMPANY

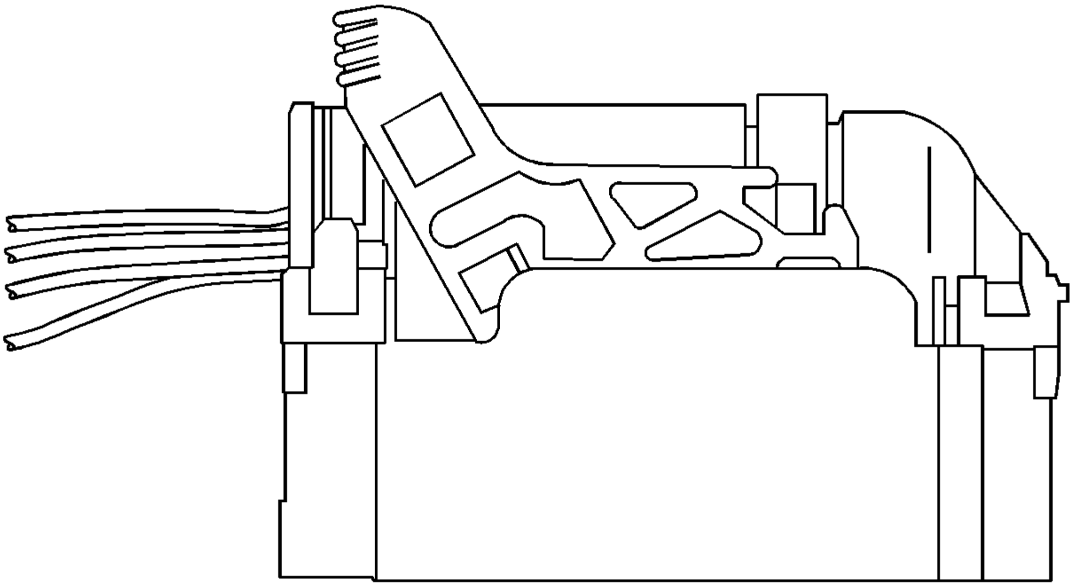


Fig. 126: View Of Lever Lock In Forward Position
Courtesy of GENERAL MOTORS COMPANY

1. Slide the lever lock forward while pressing down on the lever lock release tab.
2. Disconnect the connector from the component.

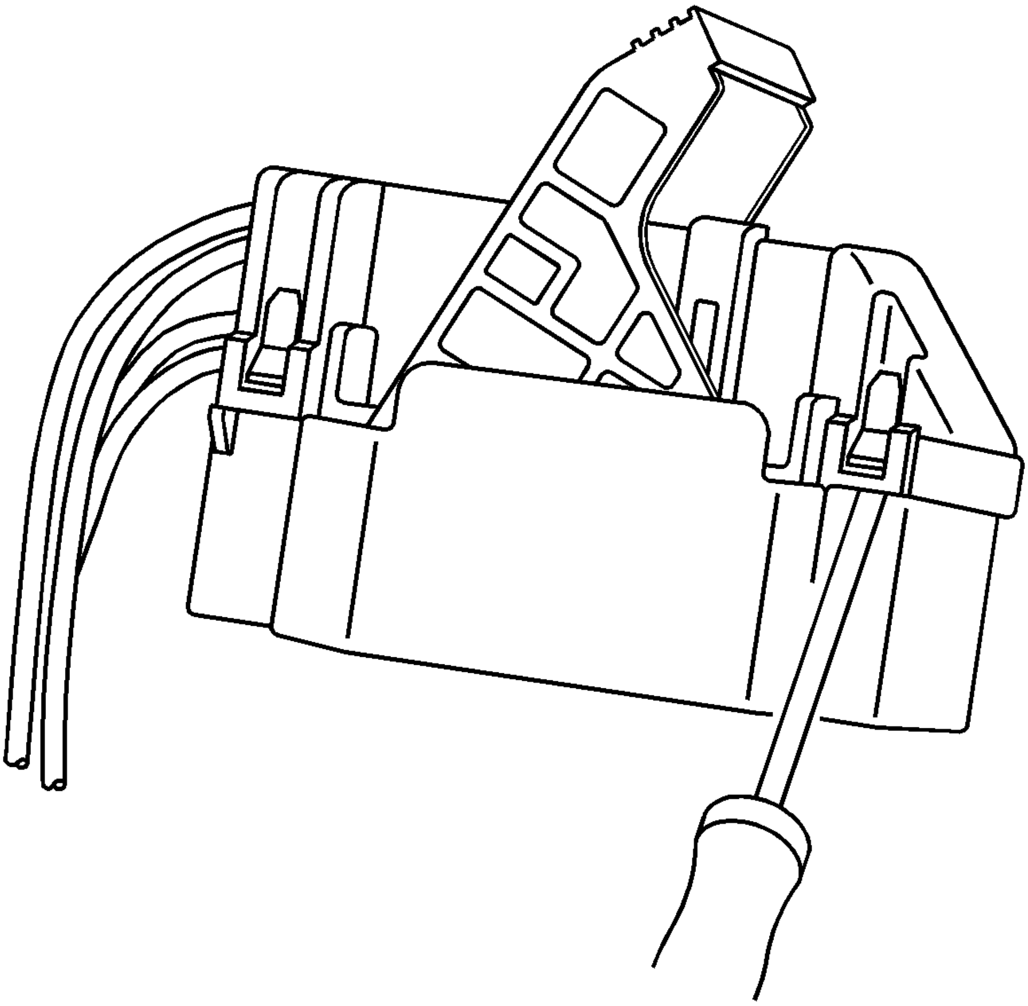


Fig. 127: View Of Connector Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Remove the dress cover by using a flat-blade tool to release the connector locking tabs and pulling off the dress cover.

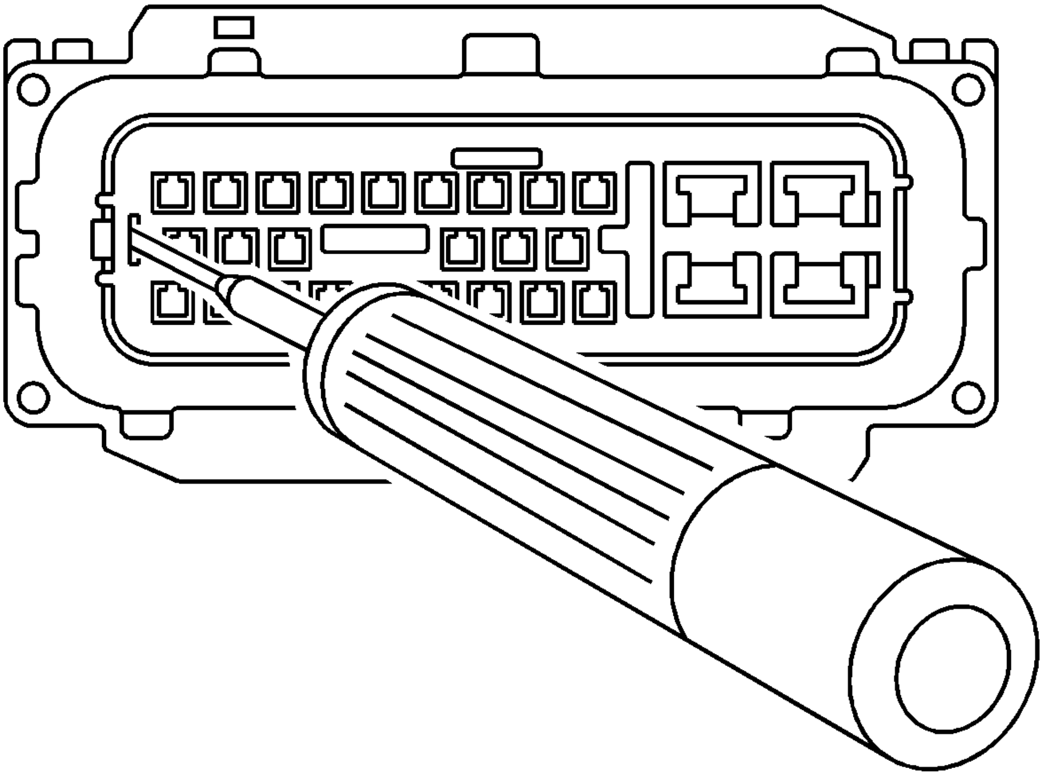


Fig. 128: Identifying Nose Piece Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

4. Relieve the tension on the nose piece retainers by inserting J-38125-12A into the single retainer slot on the end of the nose piece and gently prying out the locking tab. Repeat the process for both of the nose piece locking tabs on the opposite side of the nose piece.

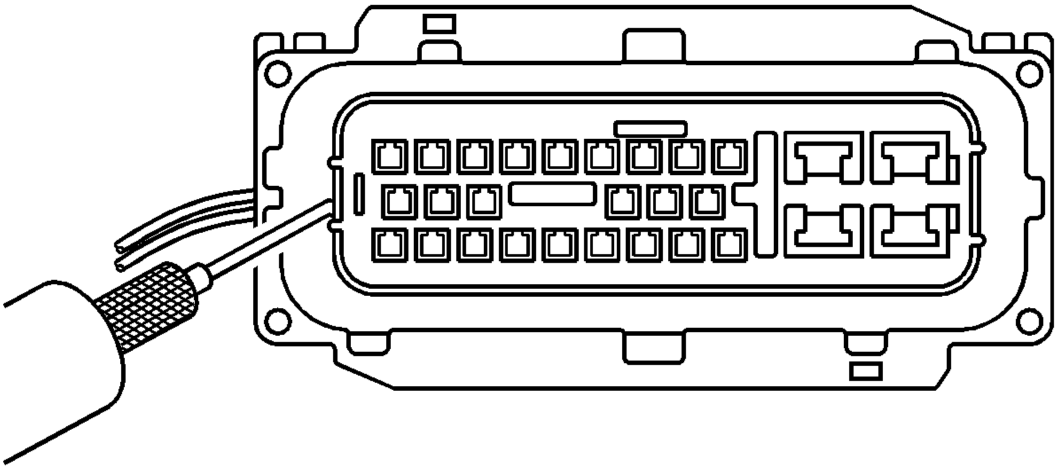


Fig. 129: Pulling Up One End Of Nose Piece (1st Side)
Courtesy of GENERAL MOTORS COMPANY

5. Once the nose piece retainers are relaxed, use the J-38125-552 to pull up the nose piece by hooking the tool under the nose piece and pulling up. The nose piece should raise slightly.

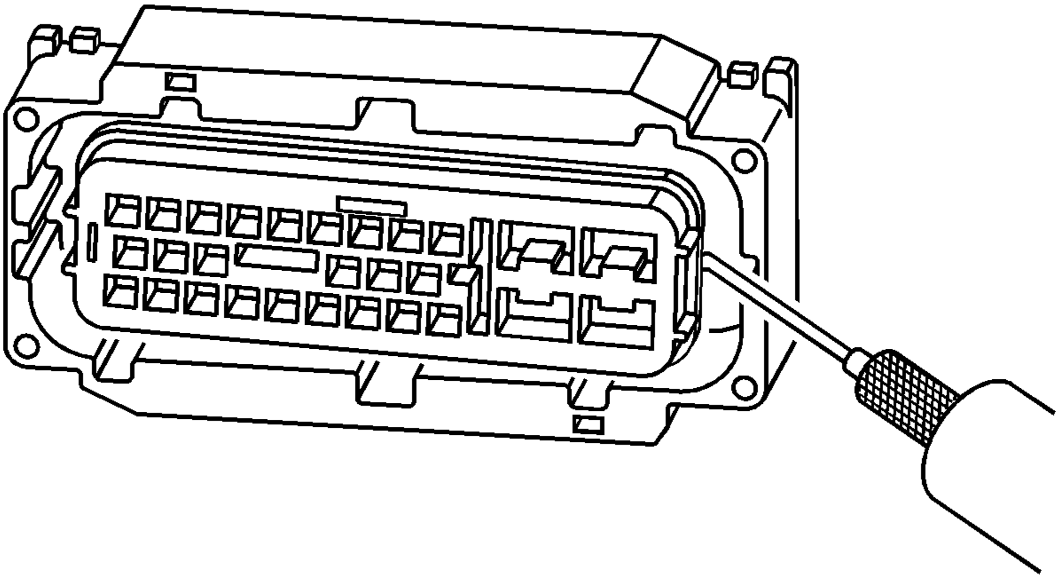


Fig. 130: Pulling Up One End Of Nose Piece (2nd Side)
Courtesy of GENERAL MOTORS COMPANY

6. On the opposite side of the nose piece, use the J-38125-552 pull up the nose piece by hooking the tool under the nose piece and pulling up. The nose piece should release completely. If the nose piece does not come off, repeat the procedure on the opposite side.

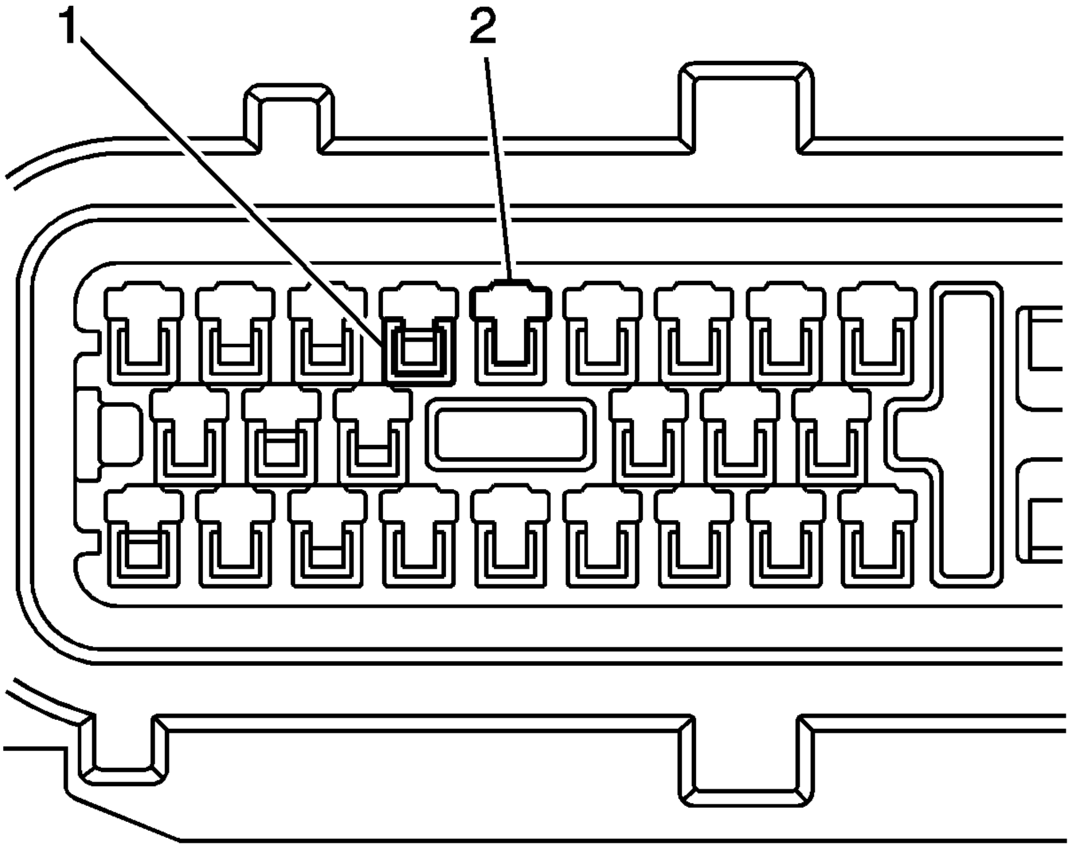


Fig. 131: View Of Terminal & Entry Canal
Courtesy of GENERAL MOTORS COMPANY

7. The illustration above identifies the entry canal where the terminal release tool will be inserted, and the terminal cavity.
    - Terminal (1)
    - Entry Canal (2)

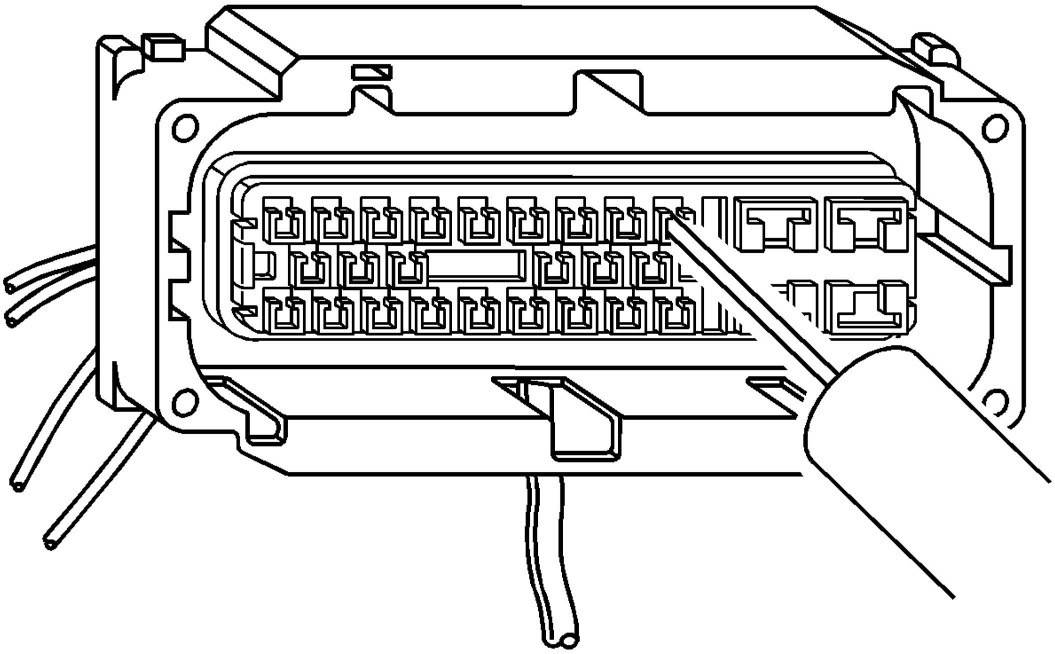


Fig. 132: Inserting J-38125-553 (15315247) Tool Into Entry Canal
Courtesy of GENERAL MOTORS COMPANY

8. Insert the J-38125-553 tool into the entry canal and pry up on the terminal retainer. The terminal retainer is a small plastic piece on the top of the terminal. The terminal retainer must be held up while the terminal is pulled out of the connector.

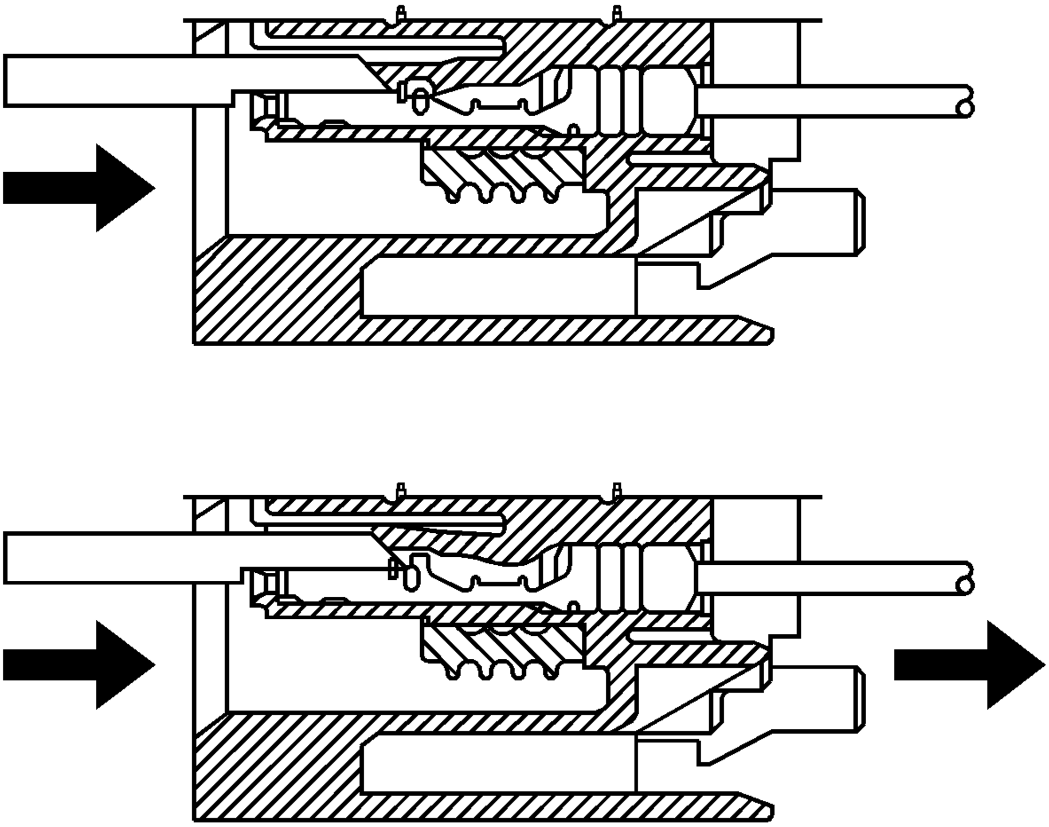


Fig. 133: Cutaway View Of Connector
Courtesy of GENERAL MOTORS COMPANY

9. The illustration shows a cutaway view of the connector to aid the technician in releasing the terminal retainer.
10. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
11. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

Terminal Insertion Procedure

After the terminal is replaced, perform the following procedure in order to insert the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.
3. To assemble the connector, reverse the connector disassembly procedure.

TYCO/AMP CONNECTORS (CM 42-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

1. Locate the connector position assurance (CPA) on the connector body and pull the CPA out. The CPA is on the wire harness side of connector.
2. Disconnect the connector from the component.

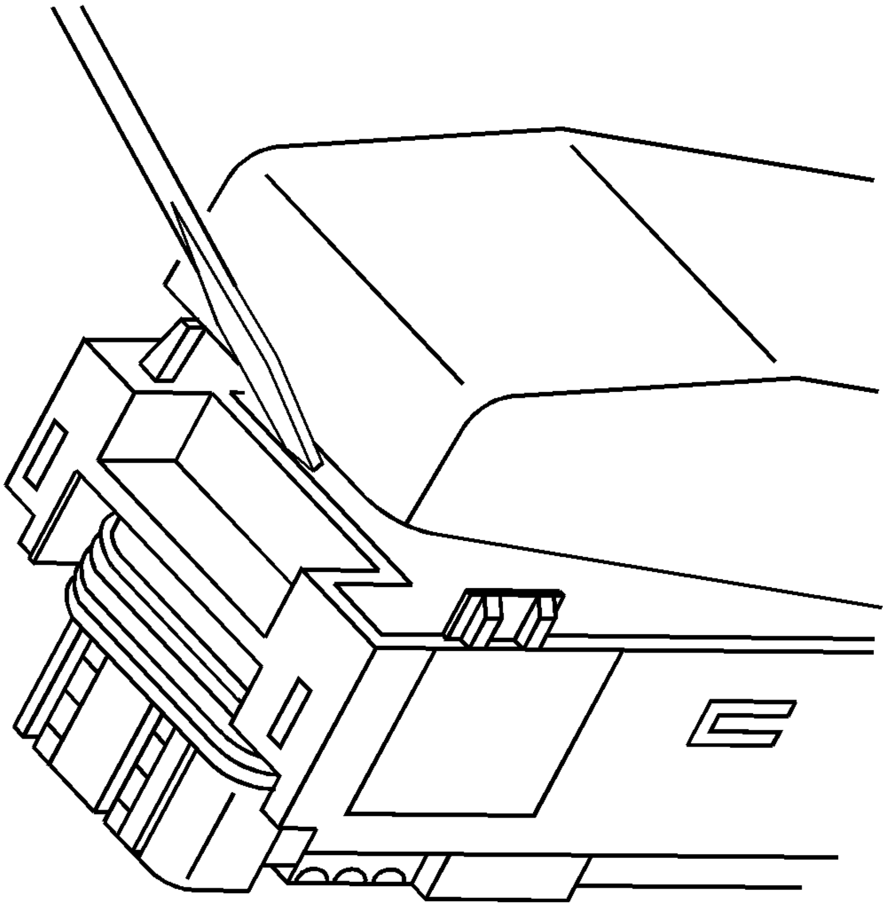


Fig. 134: View Of Dress Cover
Courtesy of GENERAL MOTORS COMPANY

3. Use a small flat-bladed tool to gently pry off the dress cover by inserting the tool under the cover opposite the harness side and prying up.
4. Remove the cover.

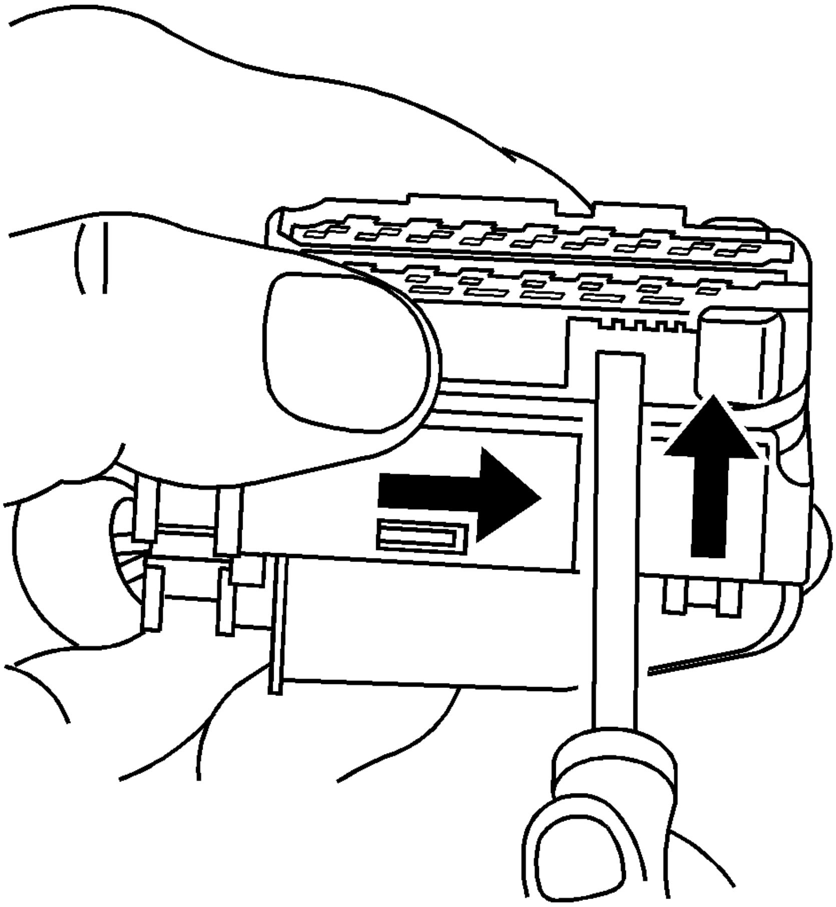


Fig. 135: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS COMPANY

5. Using a small flat-bladed tool, push on the side of the nose piece retainer while pushing the nose piece forward with your thumb. This will release the terminal position assurance (TPA).

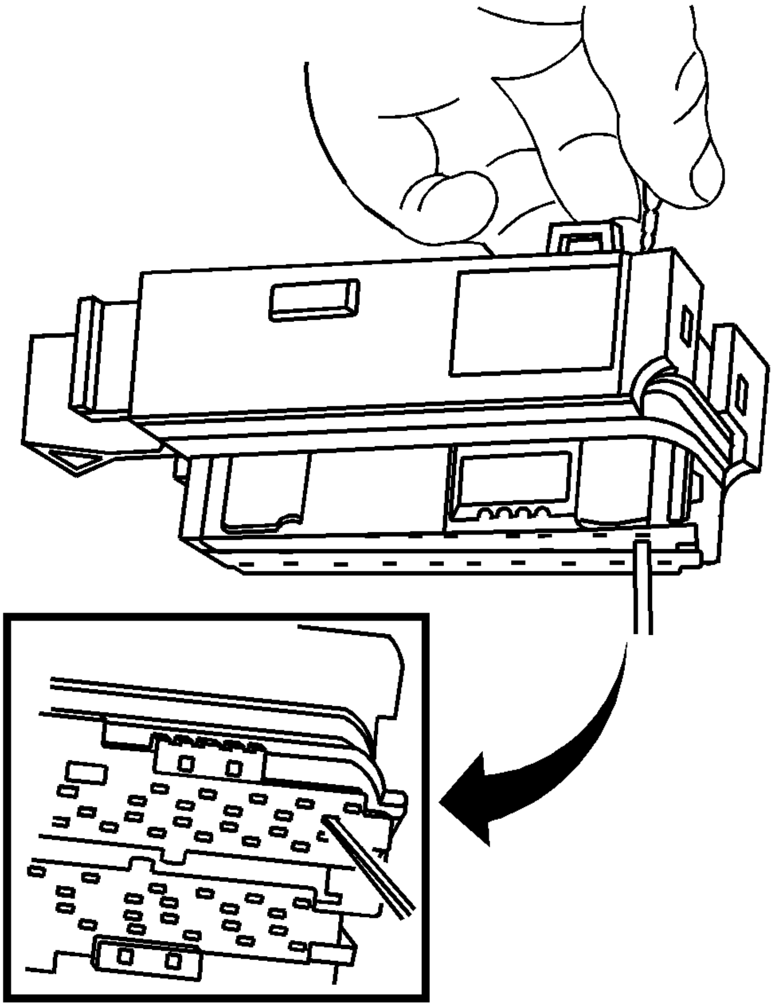


Fig. 136: Inserting Special Tool Into Terminal Release Cavity
Courtesy of GENERAL MOTORS COMPANY

6. Insert the **J-38125-12A** tool into the corresponding terminal release cavity. The release cavities are the 2 center rows of cavities on one half of the connector.

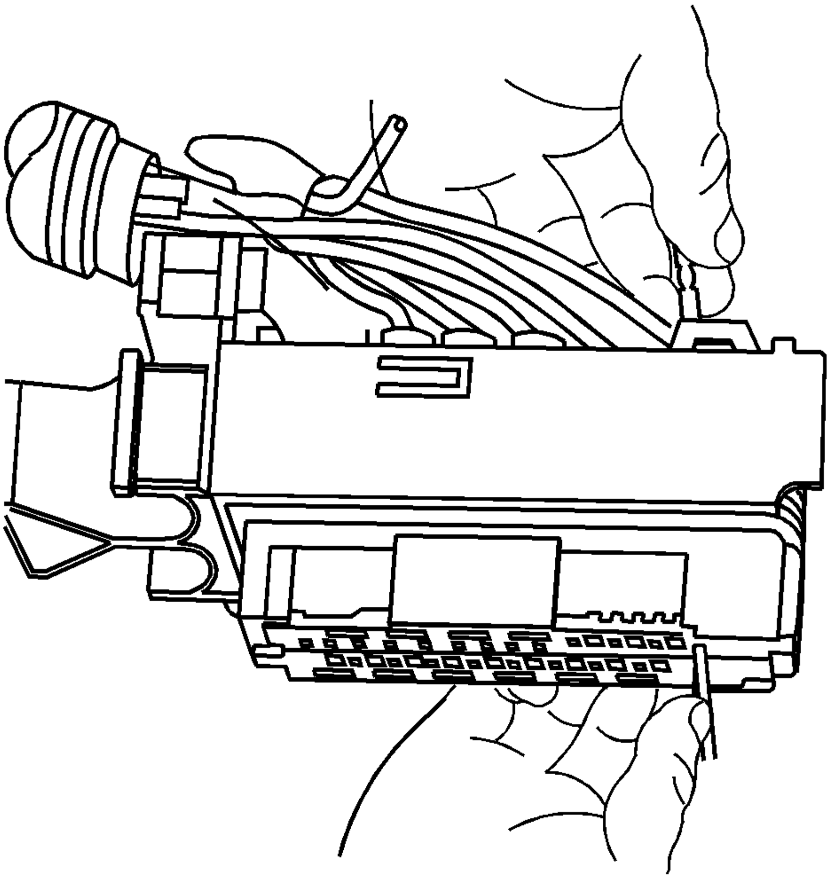


Fig. 137: Identifying Special Tool & Release Cavity
Courtesy of GENERAL MOTORS COMPANY

7. Pressing the **J-38125-12A** tool in the release cavity of the terminal you are removing, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (SENSOR)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-11A** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

1. Disconnect the connector from the component.

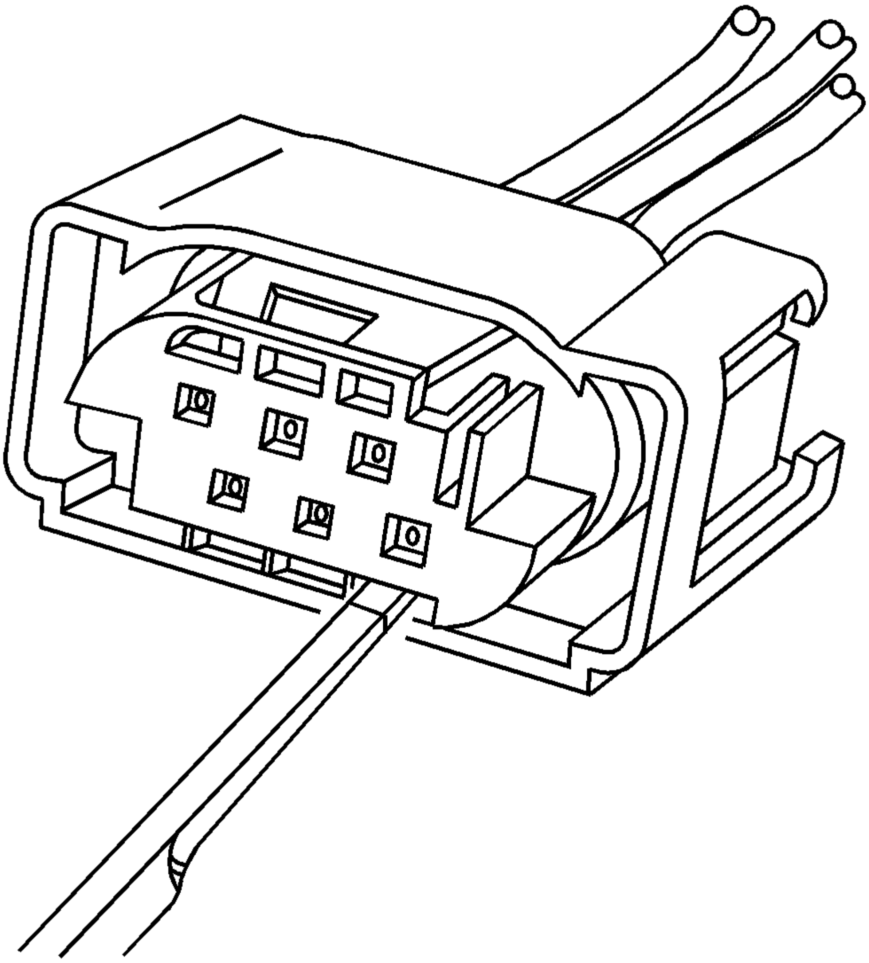


Fig. 138: View Of Inserting Special Tool Into Lower Right Face Cavity
Courtesy of GENERAL MOTORS COMPANY

2. Insert the J-38125-11A tool into the cavity on the lower right hand face of the connector until the terminal release tang access panel slides over.

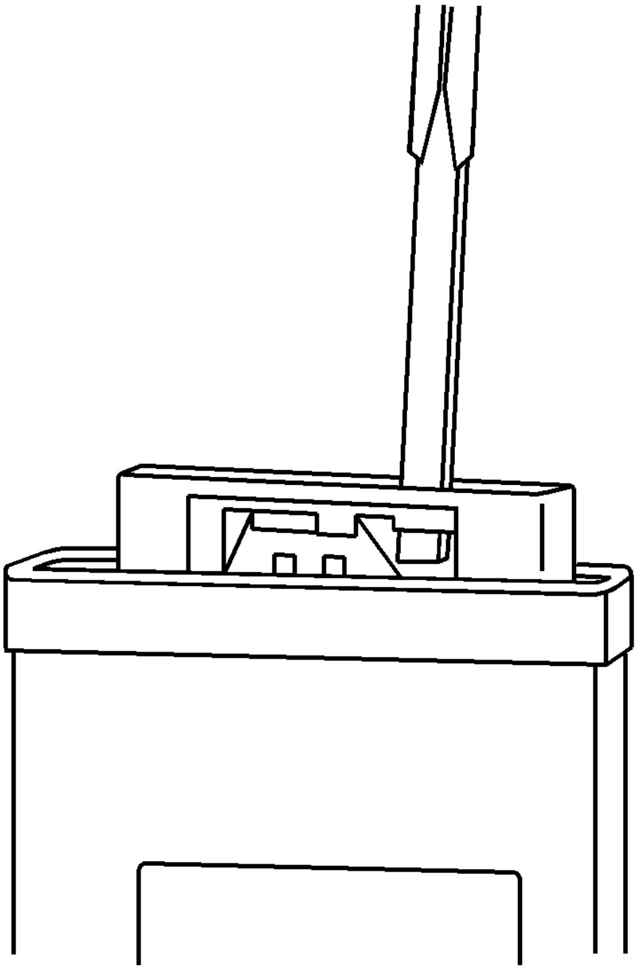


Fig. 139: Pushing Wire Side Of Terminal Toward Connector
Courtesy of GENERAL MOTORS COMPANY

3. Ensure that the terminal release tang access panel is in the correct location to access the terminals.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

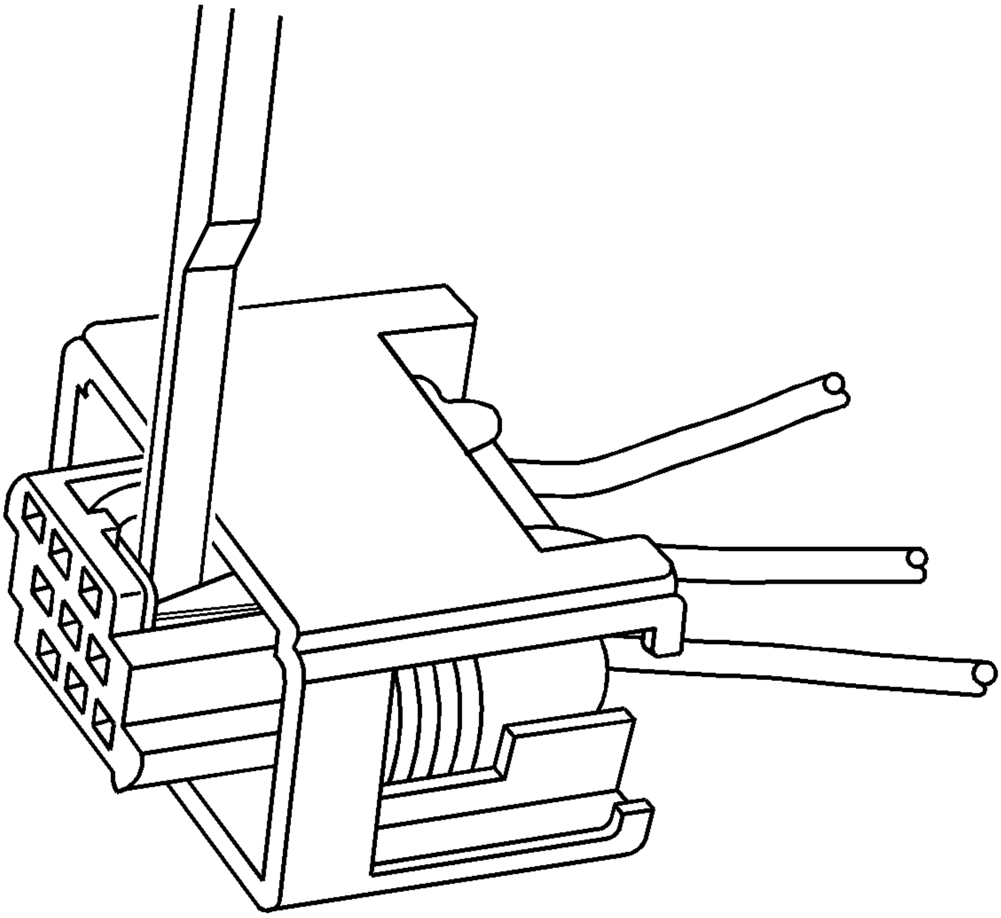


Fig. 140: View Of Inserting Tool Into Terminal Release Tang Access Slot (Sensor)
Courtesy of GENERAL MOTORS COMPANY

5. Insert the J-38125-11A into the terminal release tang access slot located behind the access panel of the connector and press down on the terminal while carefully pulling the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
6. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (0.25 CAP)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-24** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

1. Disconnect the connector from the component by pressing down on the connector position assurance (CPA).

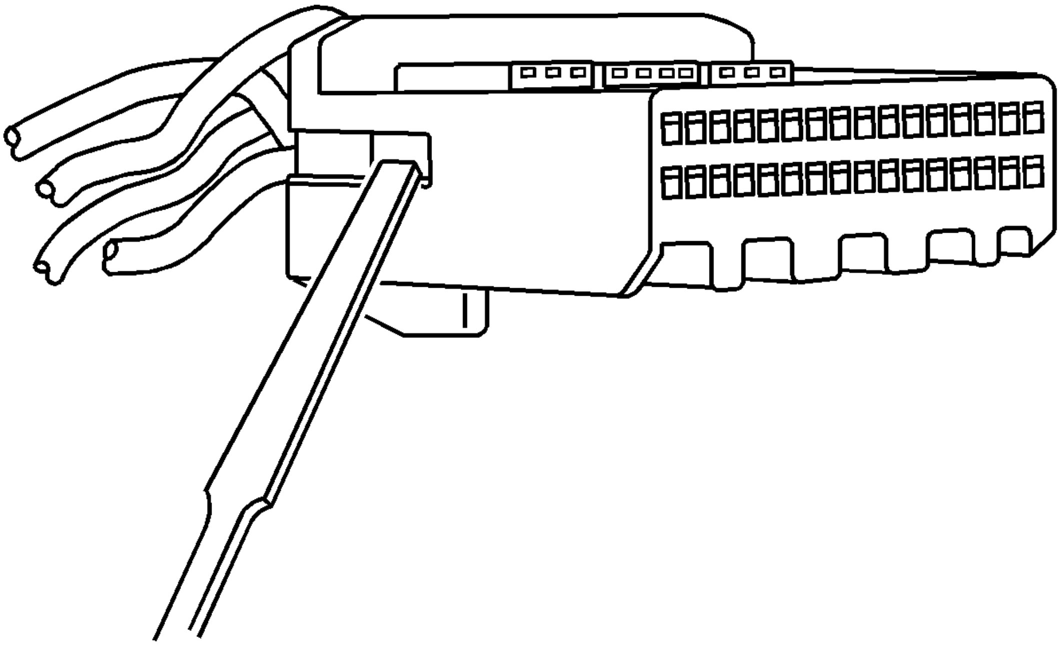


Fig. 141: Releasing TPA Using Small Flat-Bladed Tool
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The TPA on this connector cannot be removed unless the terminals are removed first. The TPA will come out of the connector body, but only slightly. When the TPA is slightly raised the terminals can be removed. Using excessive force to remove the TPA with the terminals still in the connector will damage the connector.**

2. Use a small flat-bladed tool to release the terminal position assurance (TPA) by inserting the tool in the small recess on the side of the connector and pushing up until the TPA releases from the connector body. The TPA should raise just slightly. Do not try to remove the TPA.
3. Repeat the process for the other side of the connector.

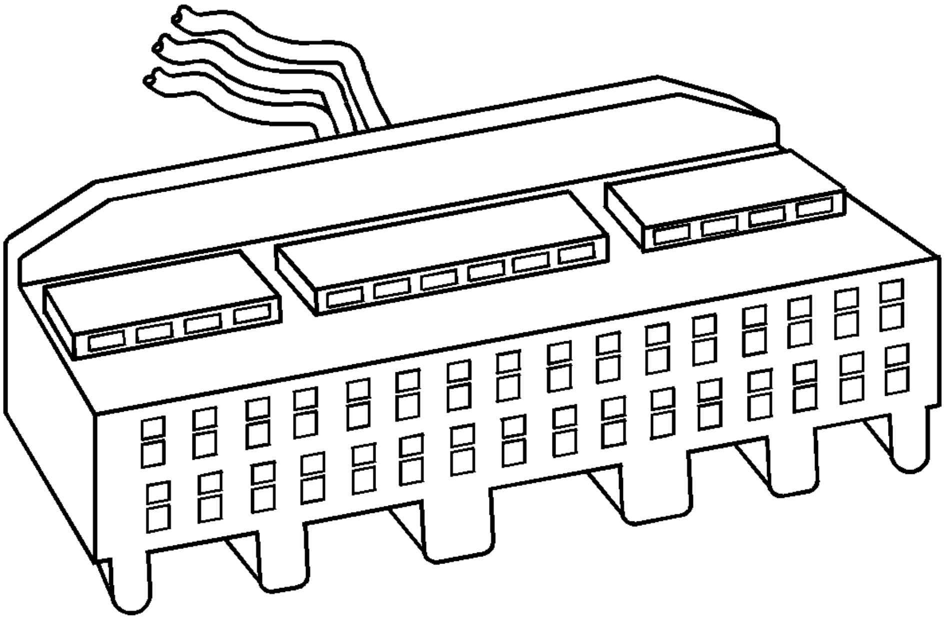


Fig. 142: View Of Terminal Position Assurance
Courtesy of GENERAL MOTORS COMPANY

4. Ensure that the TPA is in the proper position to remove the terminals.

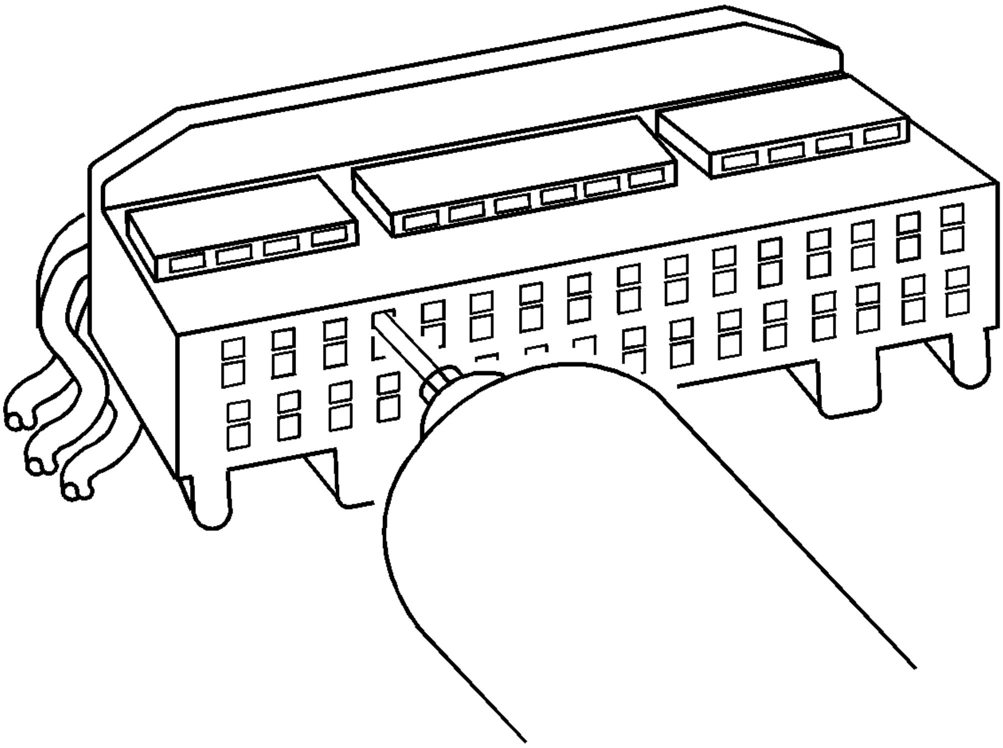


Fig. 143: Identifying Special Tool & Release Cavity
Courtesy of GENERAL MOTORS COMPANY

5. While pushing the terminal forward, insert the J-38125-24 in the release cavity above the terminal you are removing, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
6. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (43-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool
- **J-38125-13A** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

Follow the steps below in order to remove terminals from the connector.

1. Locate the lever lock on the wire dress cover. Slide the lever lock away from the connector body.
2. Disconnect the connector from the component.
3. Locate the dress cover locking tabs on the dress cover of the connector. Using a small flat-bladed tool release all of the locking tabs.

4. Once the locks are unlocked, lift the dress cover off.

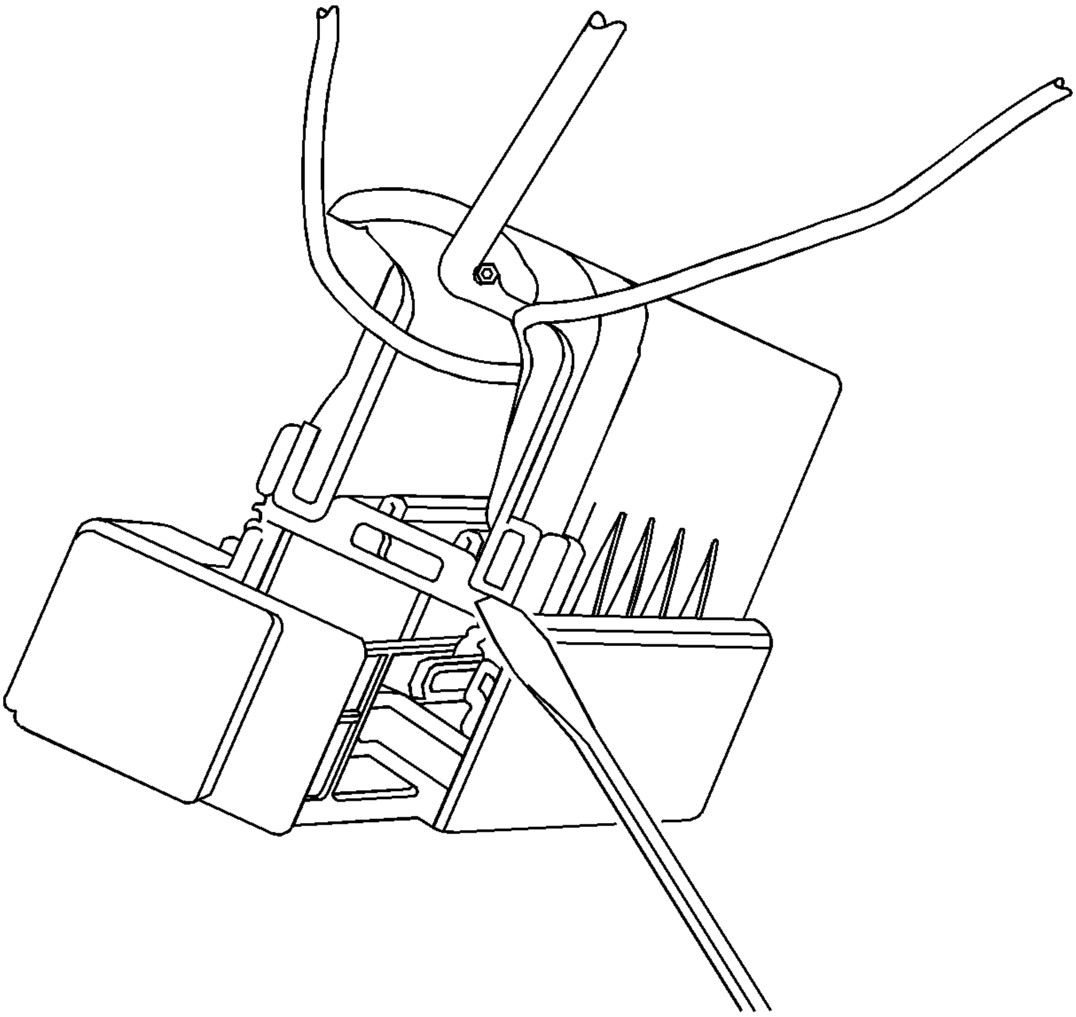


Fig. 144: Releasing TPA
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.**

5. Release the TPA by inserting a small flat-bladed tool into the blue locking tabs on both ends of the connector. Gently slide the TPA up to the released position on both ends.

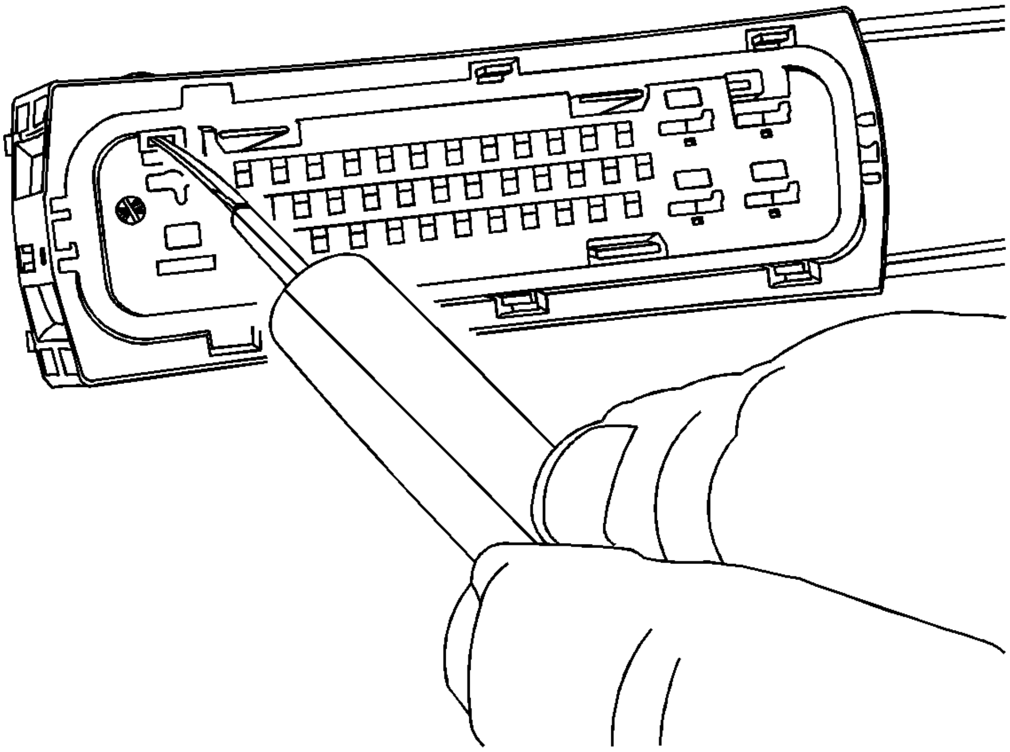


Fig. 145: View Of Inserting Tool Into Terminal Release Cavity
Courtesy of GENERAL MOTORS COMPANY

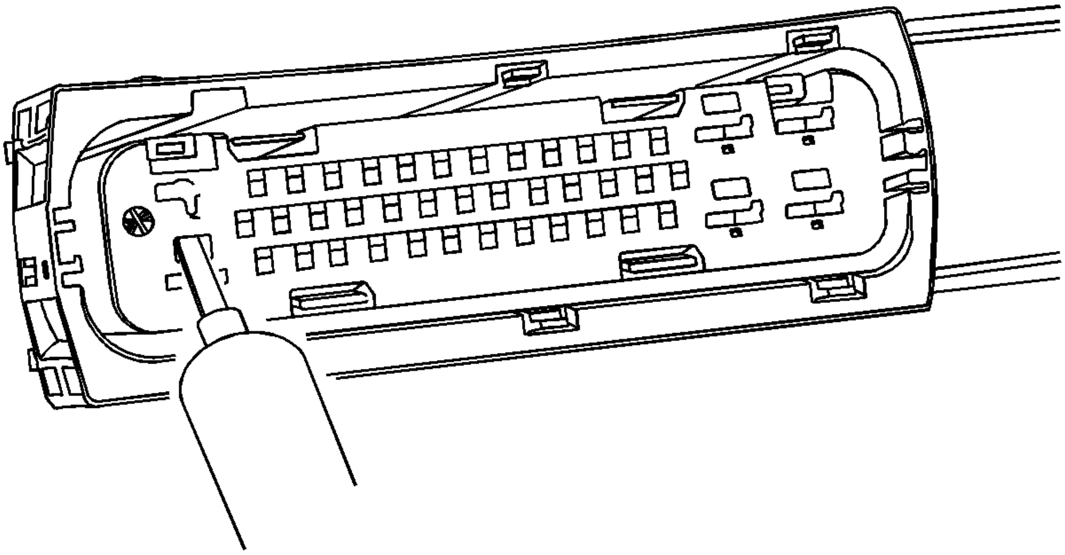


Fig. 146: View Of Release Tool Being Used For Larger Terminals
Courtesy of GENERAL MOTORS COMPANY

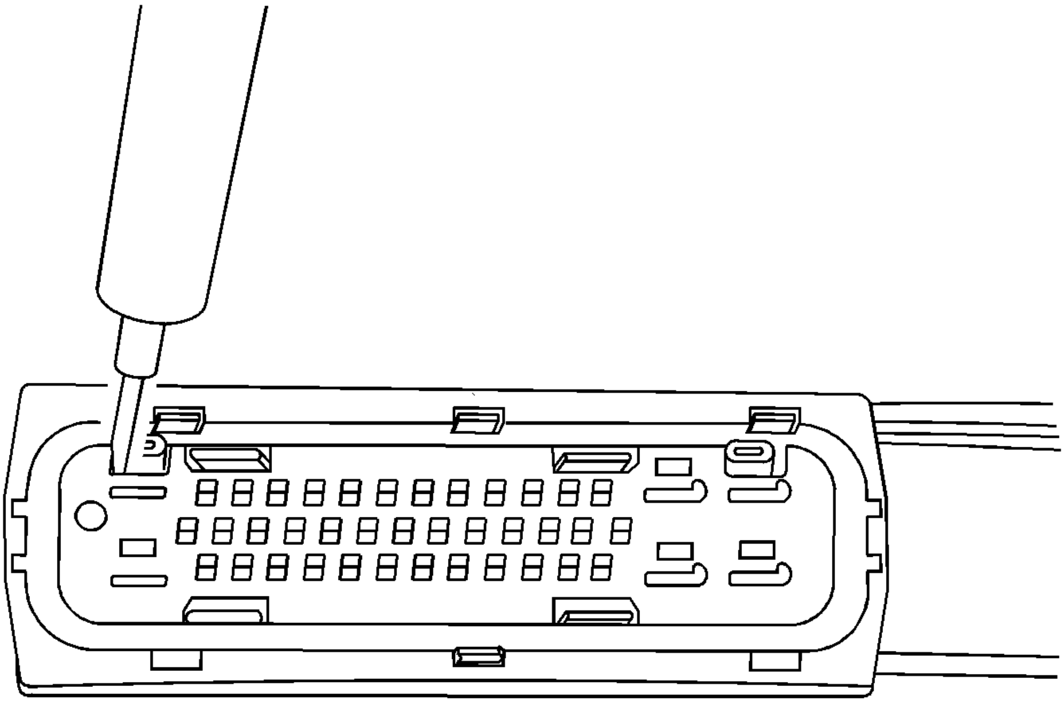


Fig. 147: View Of Release Tool Being Used For Larger Terminals

Courtesy of GENERAL MOTORS COMPANY

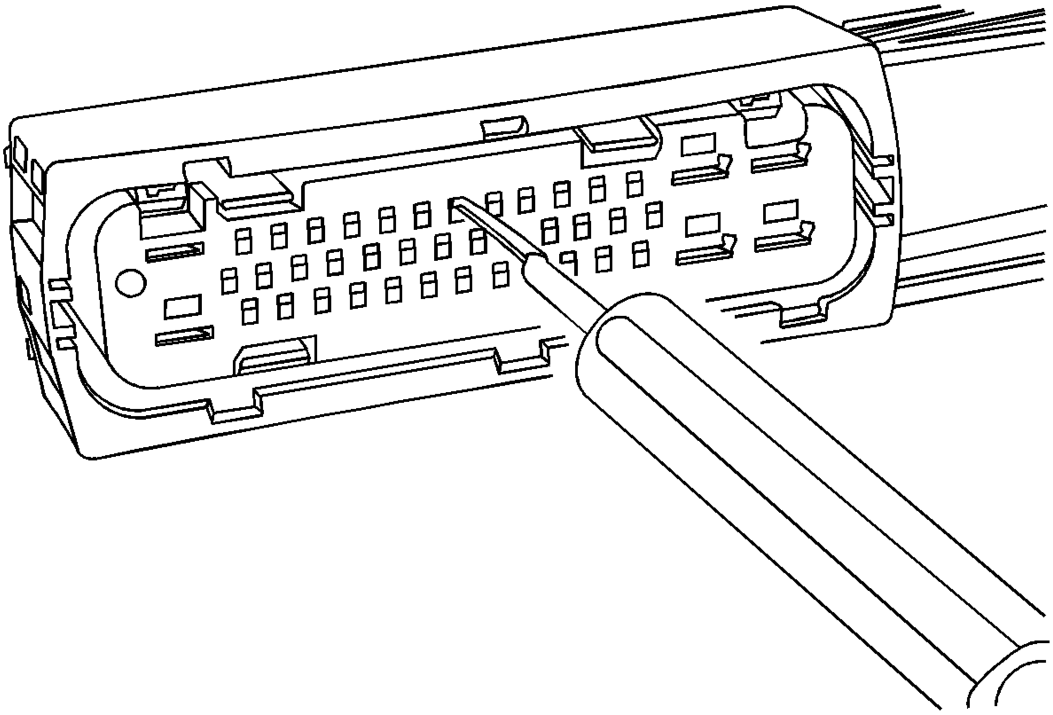


Fig. 148: View Of Release Tool Being Used For Smaller Terminals
Courtesy of GENERAL MOTORS COMPANY

6. For the larger terminals insert the **J-38125-13A** tool to release the terminals by inserting the tool into the terminal release cavity. For the smaller terminals insert the **J-38125-12A** tool to release the terminals by inserting the tool into the terminal release cavity.

   View of the release tool being used for the larger terminals.

   View of the release tool being used for the larger terminals.

   View of the release tool being used for the smaller terminals.

7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (DOOR MODULE)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-12A** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

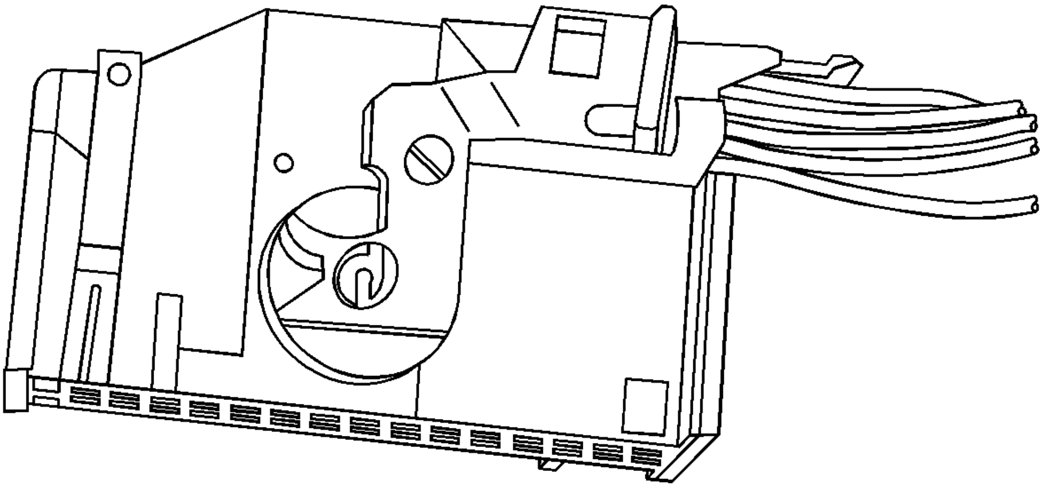


Fig. 149: Side View Of Tyco/AMP Connector
Courtesy of GENERAL MOTORS COMPANY

Side view of connector.

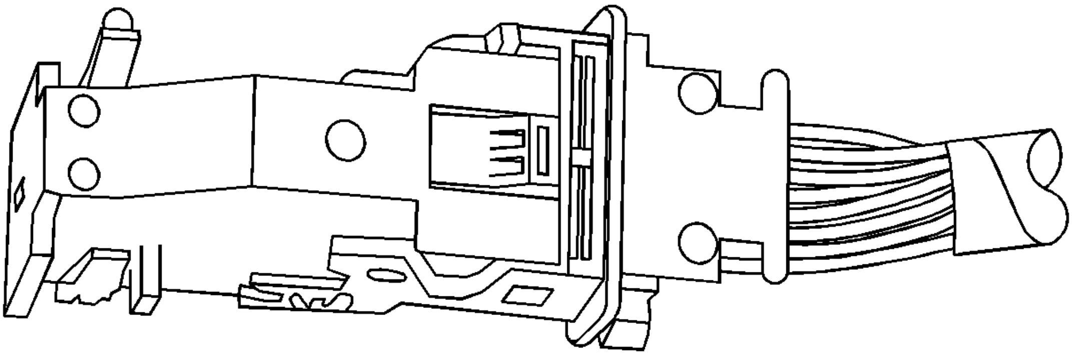


Fig. 150: Top View Of Tyco/AMP Connector
Courtesy of GENERAL MOTORS COMPANY

View of top of connector.

1. Locate the assist lever and lock on the top of the connector.

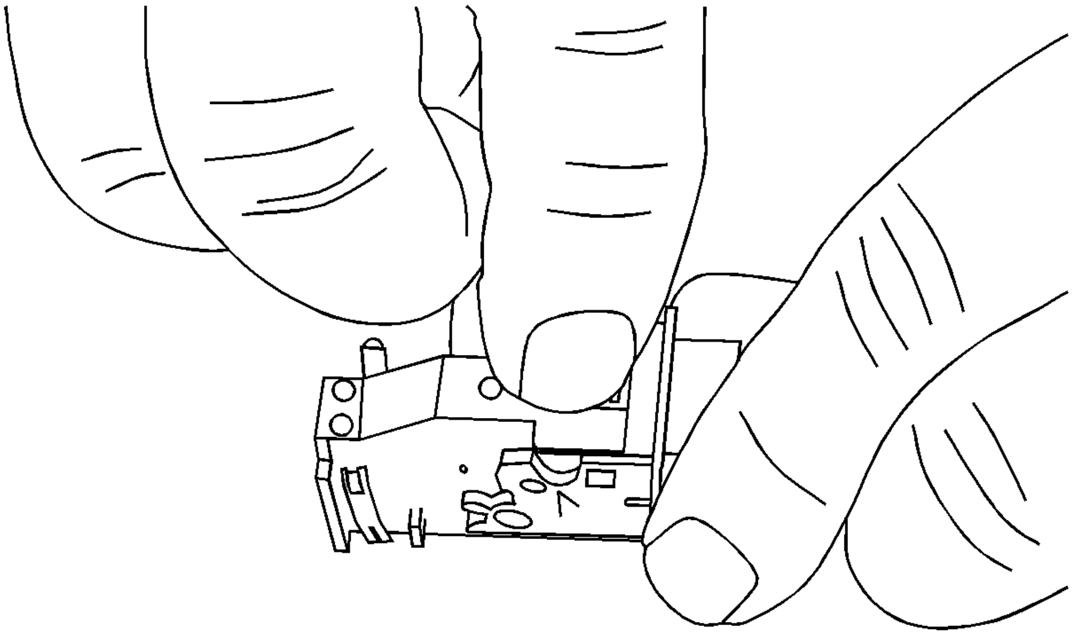


Fig. 151: View Of Depressing Lock & Pulling Assist Lever
Courtesy of GENERAL MOTORS COMPANY

2. While depressing the lock, pull the lever over and past the lock.

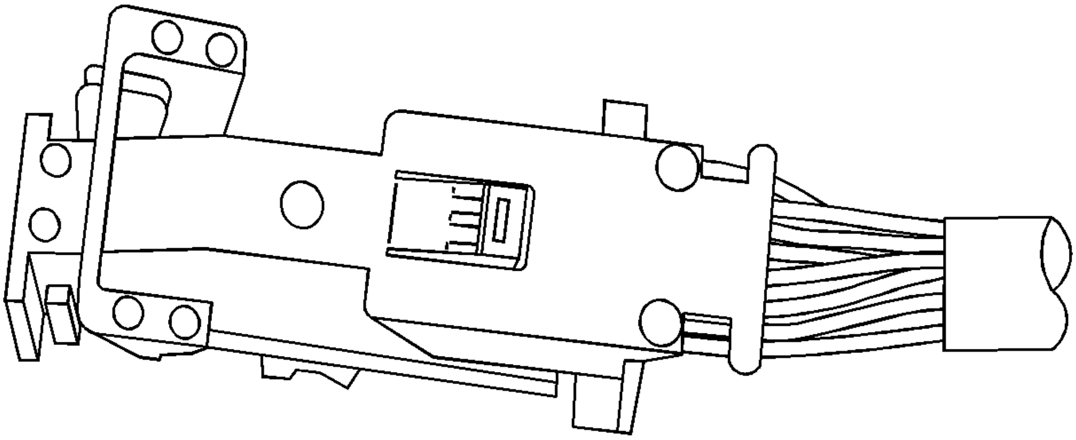


Fig. 152: View Of Component Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the connector from the component.

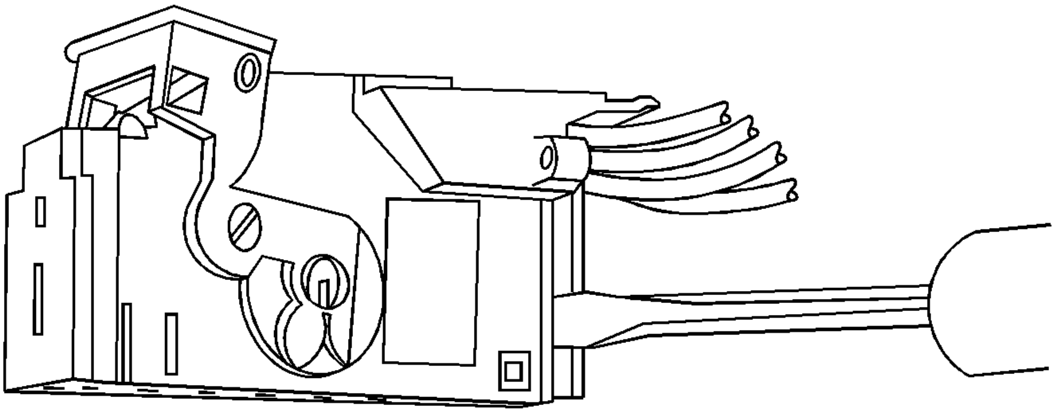


Fig. 153: Identifying Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

4. Locate the dress cover locking tabs at the rear of the connector. Use a small flat-blade tool to release the locking tabs. Repeat this procedure for the other locking tab.

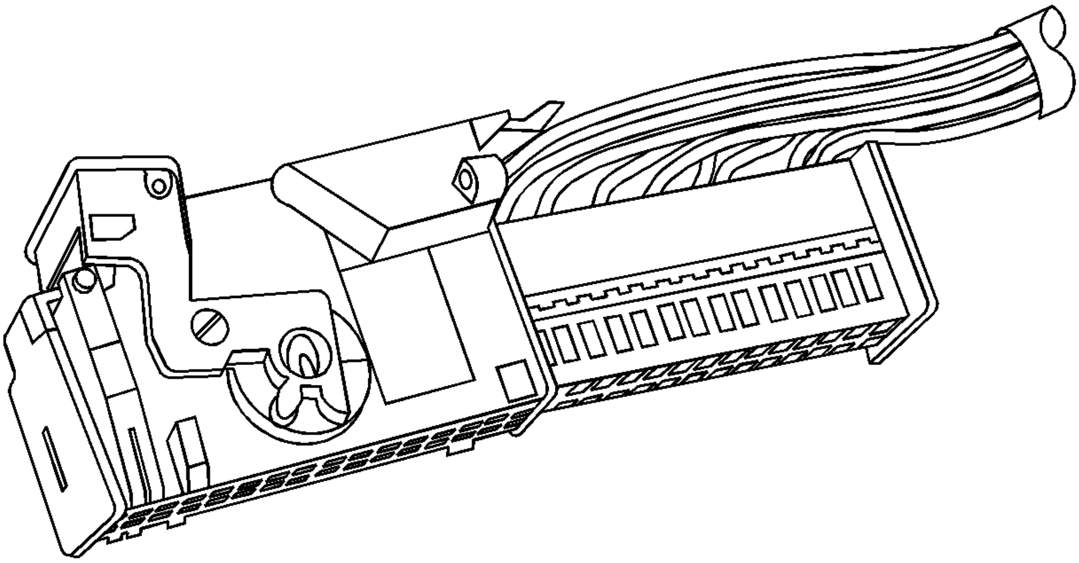


Fig. 154: Sliding Inner Connector Out Of Connector Housing
Courtesy of GENERAL MOTORS COMPANY

5. Once the locking tabs are unlocked, slide the inner connector out of the rear of the connector housing.

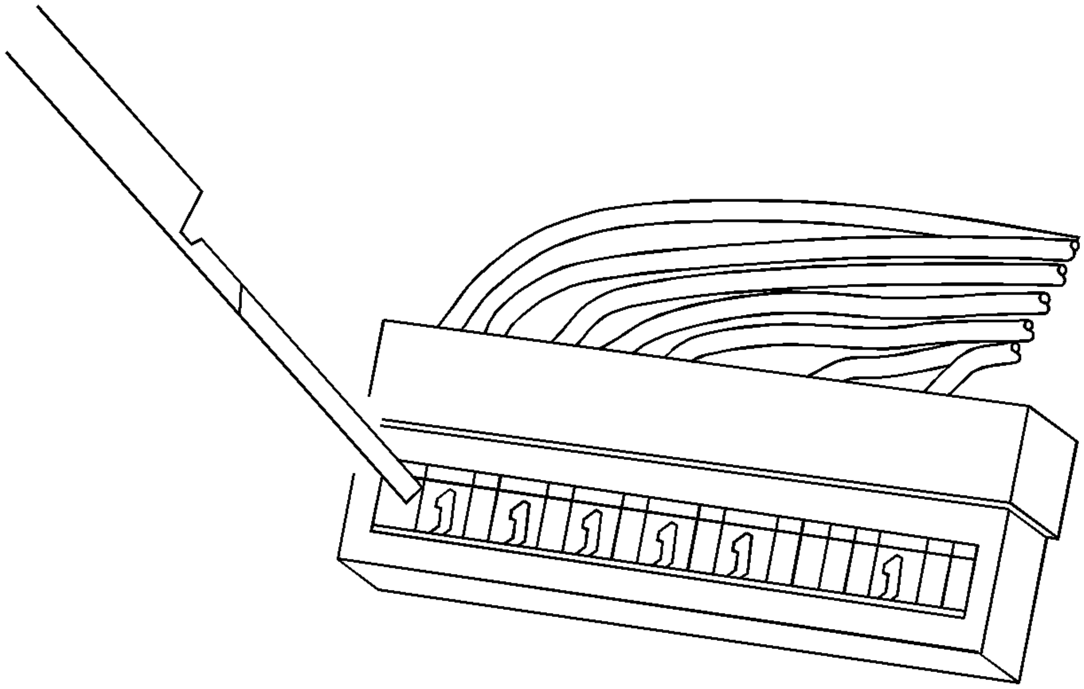


Fig. 155: Using Special Tool To Release Terminals
Courtesy of GENERAL MOTORS COMPANY

6. Use the J-38125-12A tool to release the terminals by pressing on the tang.
7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
8. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
9. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (SEAT)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-11A** Terminal Release Tool
- **J-38125-212** Terminal Release Tool
- **J-38125-556** Terminal Release Tool
- **J-38125-560** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

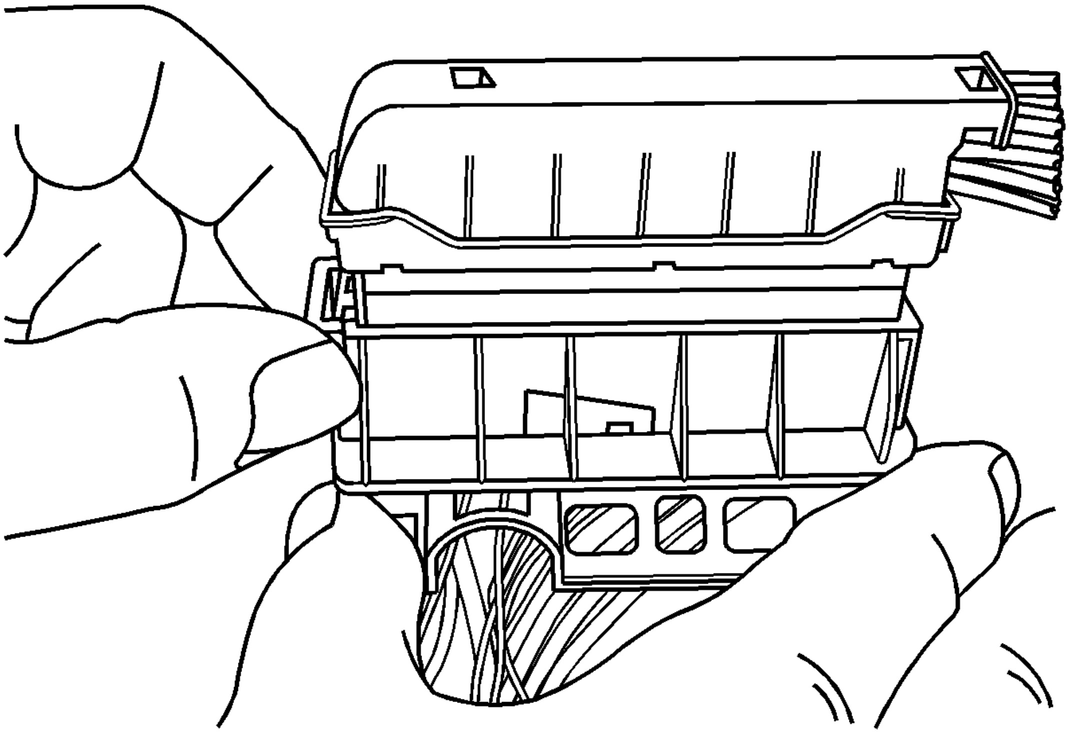


Fig. 156: Locating Locking Slide Lever
Courtesy of GENERAL MOTORS COMPANY

1. Grasp the locking slide lever and pull outward from the end of the connector.

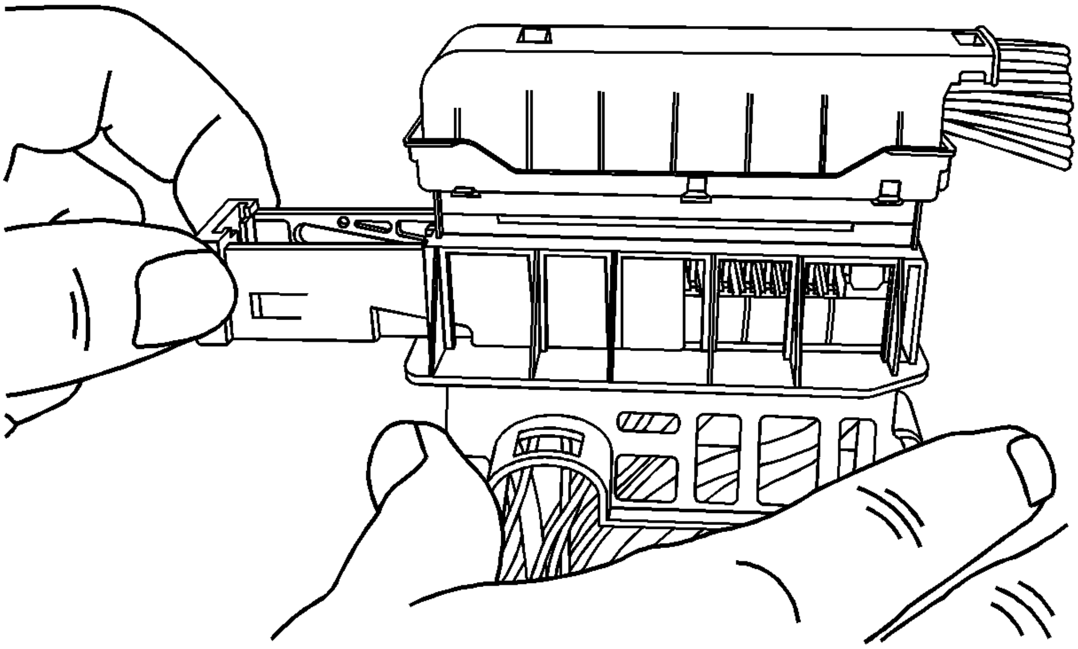


Fig. 157: Pulling Slide Lever Out Of Mating Connector
Courtesy of GENERAL MOTORS COMPANY

2. As the slide lever is pulled out the mating connector is lifted from the seated position.

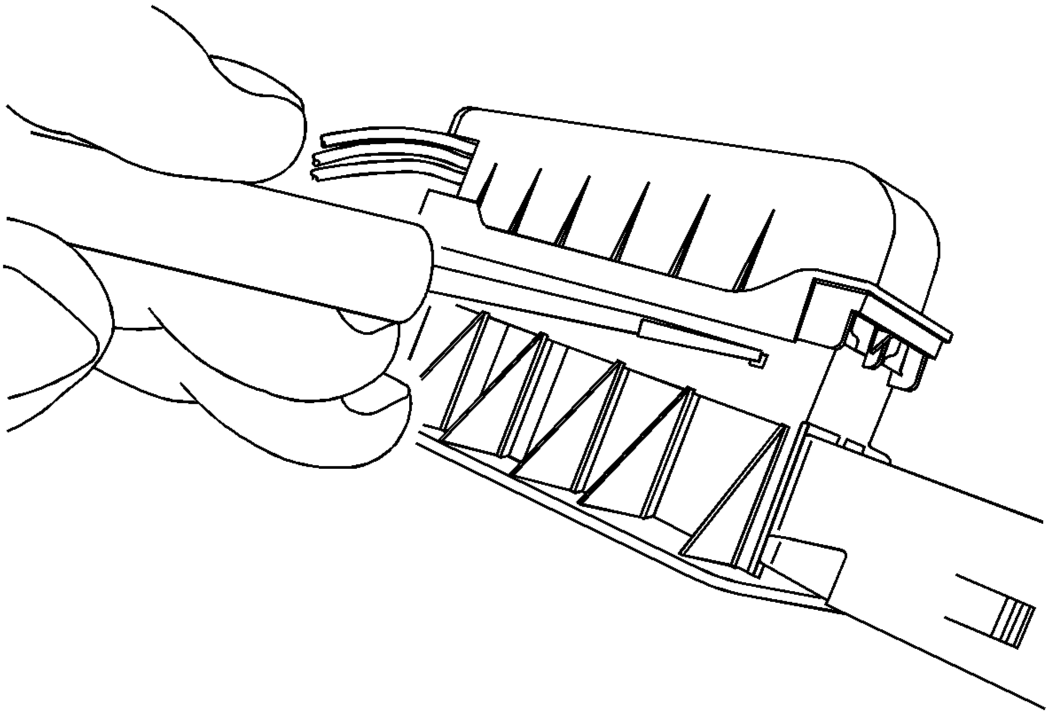


Fig. 158: Pushing TPA Tabs Into Connector Body
Courtesy of GENERAL MOTORS COMPANY

NOTE: Terminal position assurance (TPA) is keyed and can only be inserted in one direction.

3. Using terminal release tool J-38125-11A or equivalent, push the TPA tabs into the connector body.

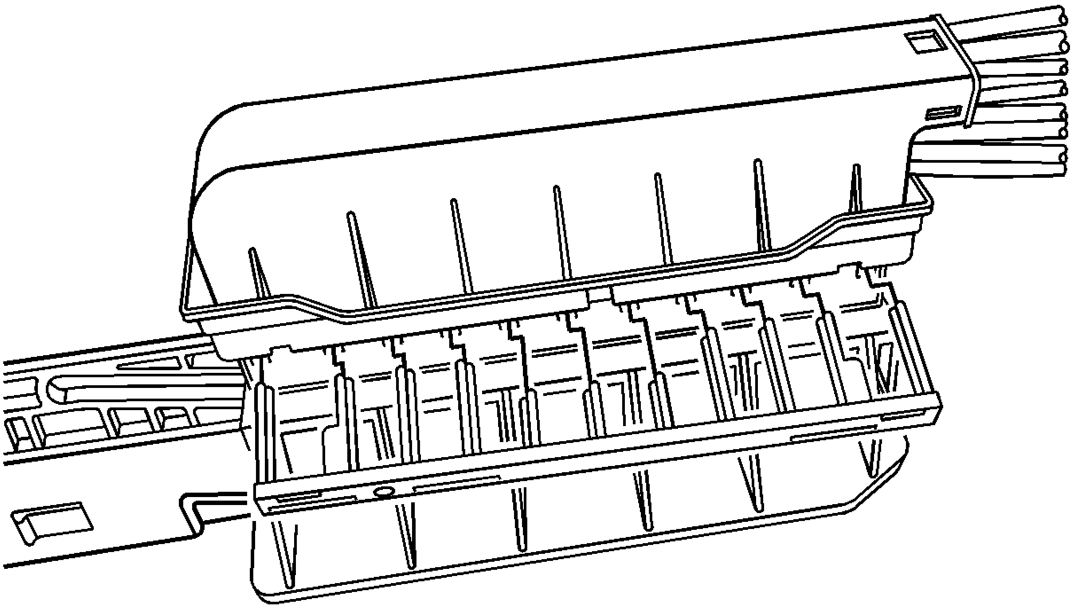


Fig. 159: Pulling TPA From Connector Body
Courtesy of GENERAL MOTORS COMPANY

4. Pull the TPA from the connector body.

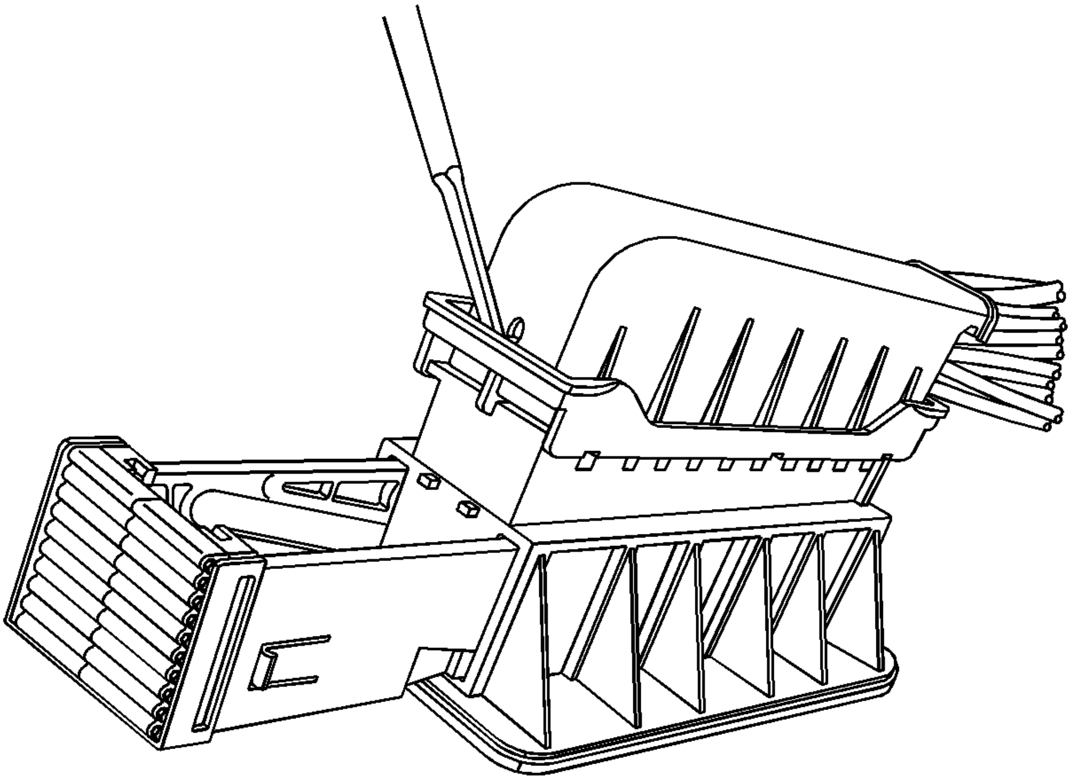


Fig. 160: Releasing Connector Wire Dress Cover Locking Tab
Courtesy of GENERAL MOTORS COMPANY

5. Using terminal release tool J-38125-11A or equivalent, release the connector wire dress cover locking tab.

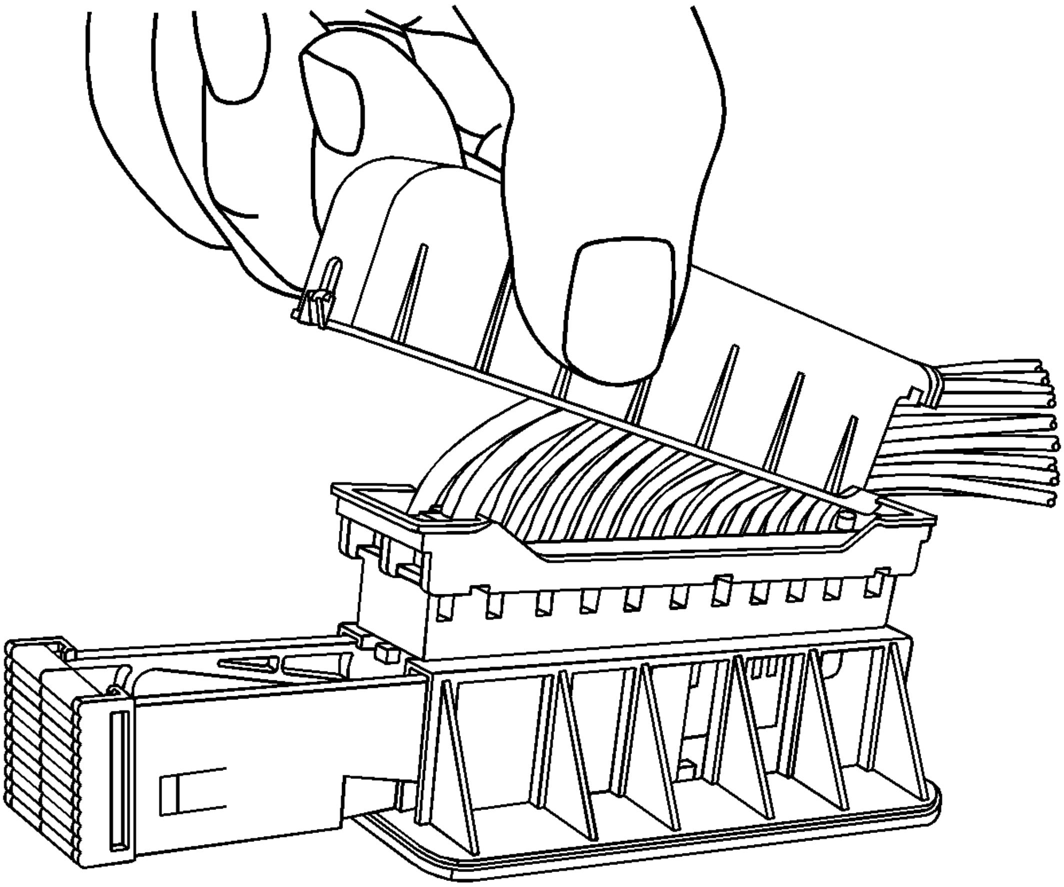


Fig. 161: Lifting Connector Wire Dress Cover From Connector Body
Courtesy of GENERAL MOTORS COMPANY

6. With the lock tab released, lift the connector wire dress cover from the connector body.

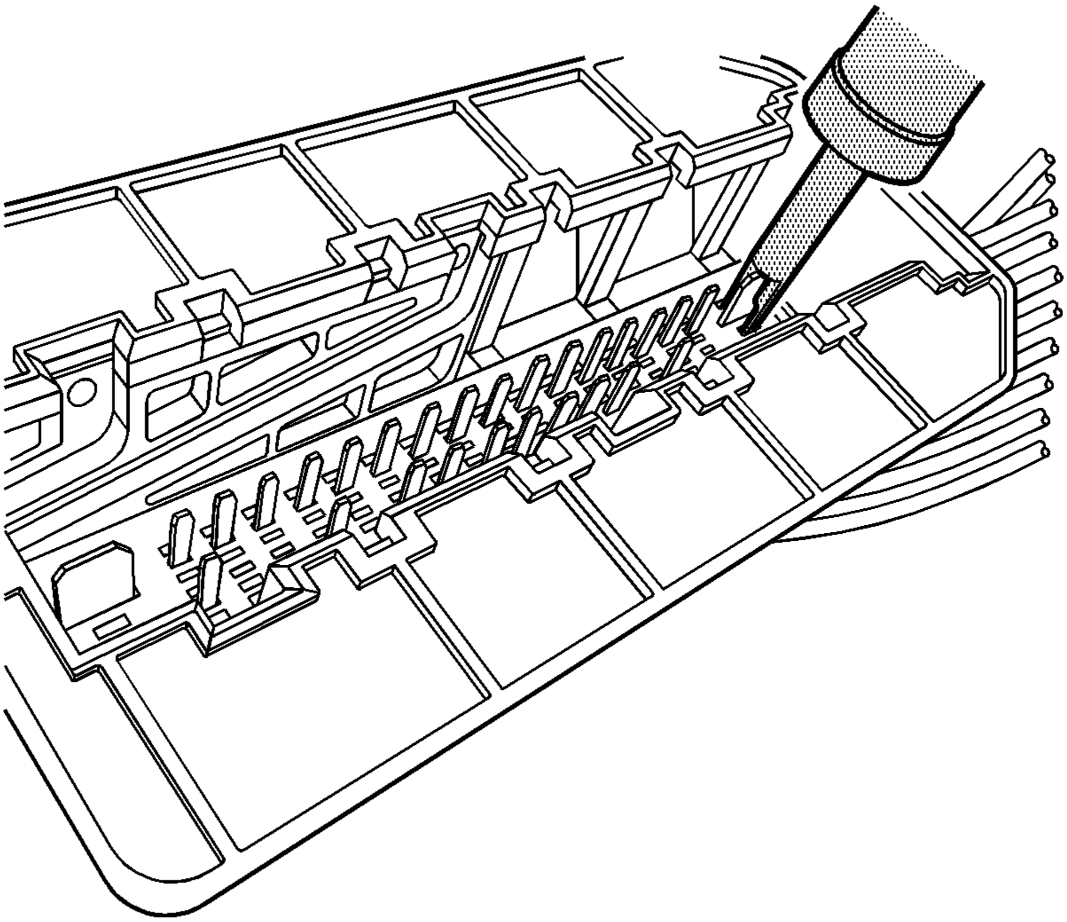


Fig. 162: Using Terminal Release Tool
Courtesy of GENERAL MOTORS COMPANY

7. Using terminal release tool J-38125-212, press the prongs into the holes each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

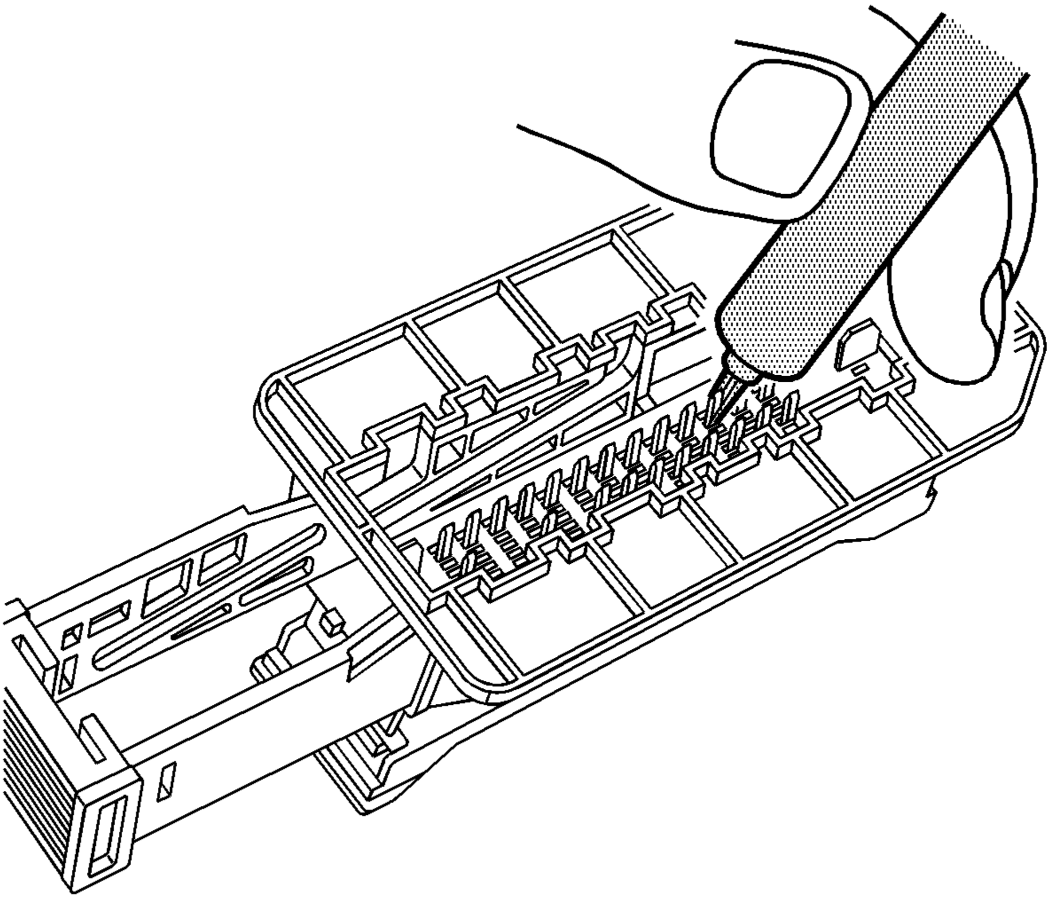


Fig. 163: Using Terminal Release Tool
Courtesy of GENERAL MOTORS COMPANY

8. Using terminal release tool J-38125-560, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

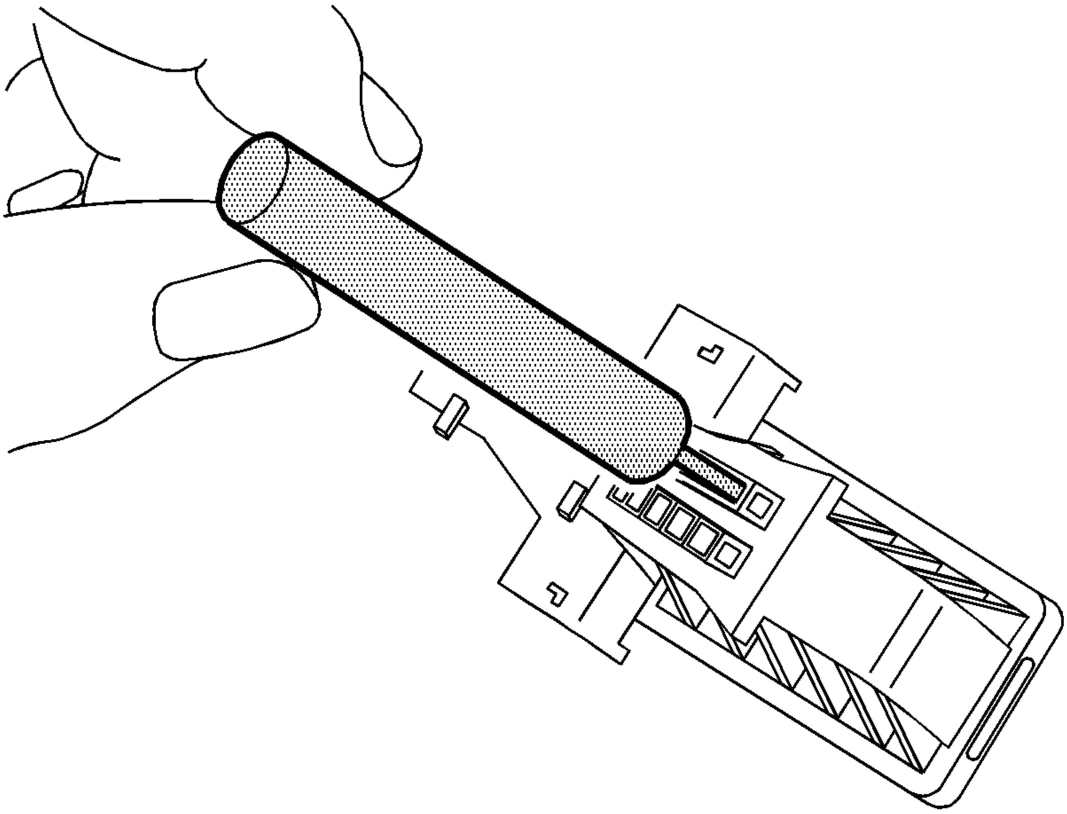


Fig. 164: Using Terminal Release Tool
Courtesy of GENERAL MOTORS COMPANY

9. Using terminal release tool J-38125-556, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.
10. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
11. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (102-WAY INLINE)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-11A** Terminal Release Tool
- **J-38125-212** Terminal Release Tool
- **J-38125-216** Terminal Release Tool
- **J-38125-221** Terminal Release Tool
- **J-38125-560** Terminal Release Tool
- **J-38125-566** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

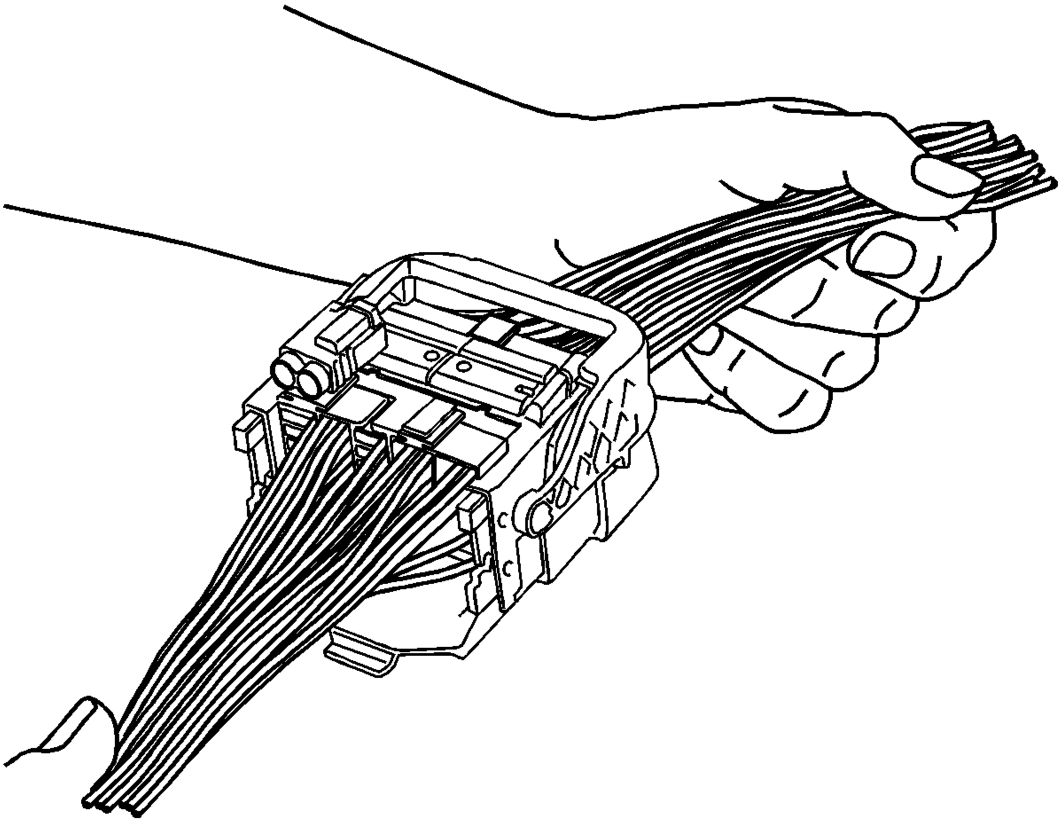


Fig. 165: View Of Typical Connector In Assembled Position
Courtesy of GENERAL MOTORS COMPANY

View of a typical connector in the assembled position.

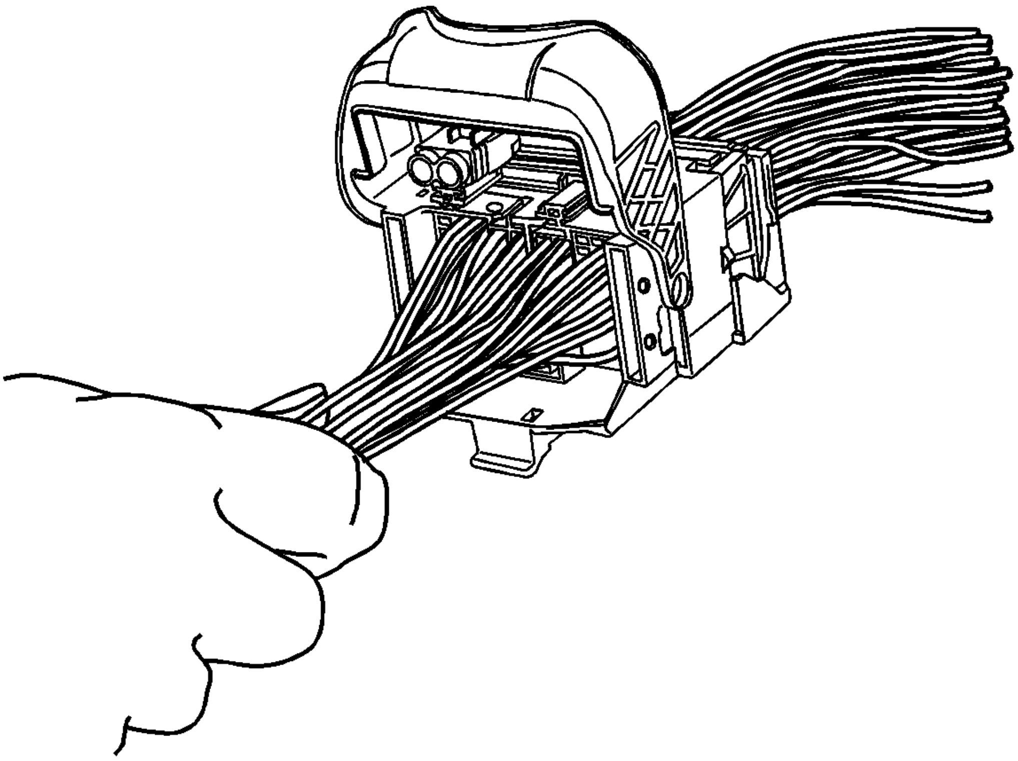


Fig. 166: View Of Locking Lever At 90 Degrees From Connector Body
Courtesy of GENERAL MOTORS COMPANY

1. Pull the locking lever to the 90 degree position from the connector body.

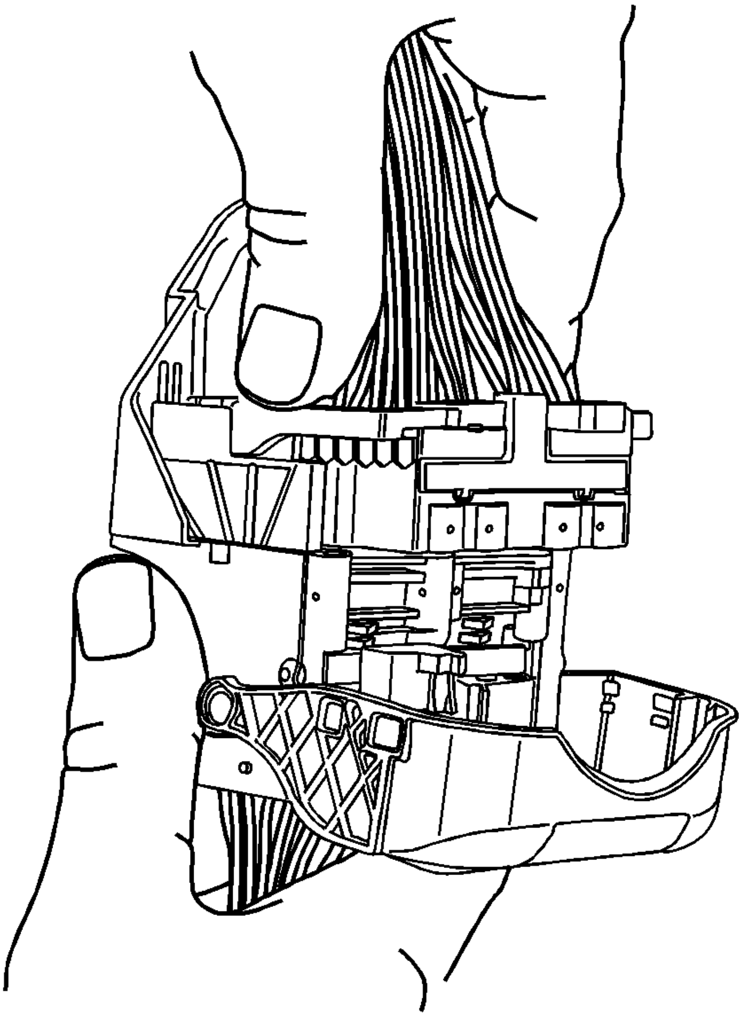


Fig. 167: Assembled View Of Connector - Tyco/AMP (102-Way Inline)
Courtesy of GENERAL MOTORS COMPANY

2. With the locking lever in the 90 degree position and the male connector body separated, it can be slid outward for removal.

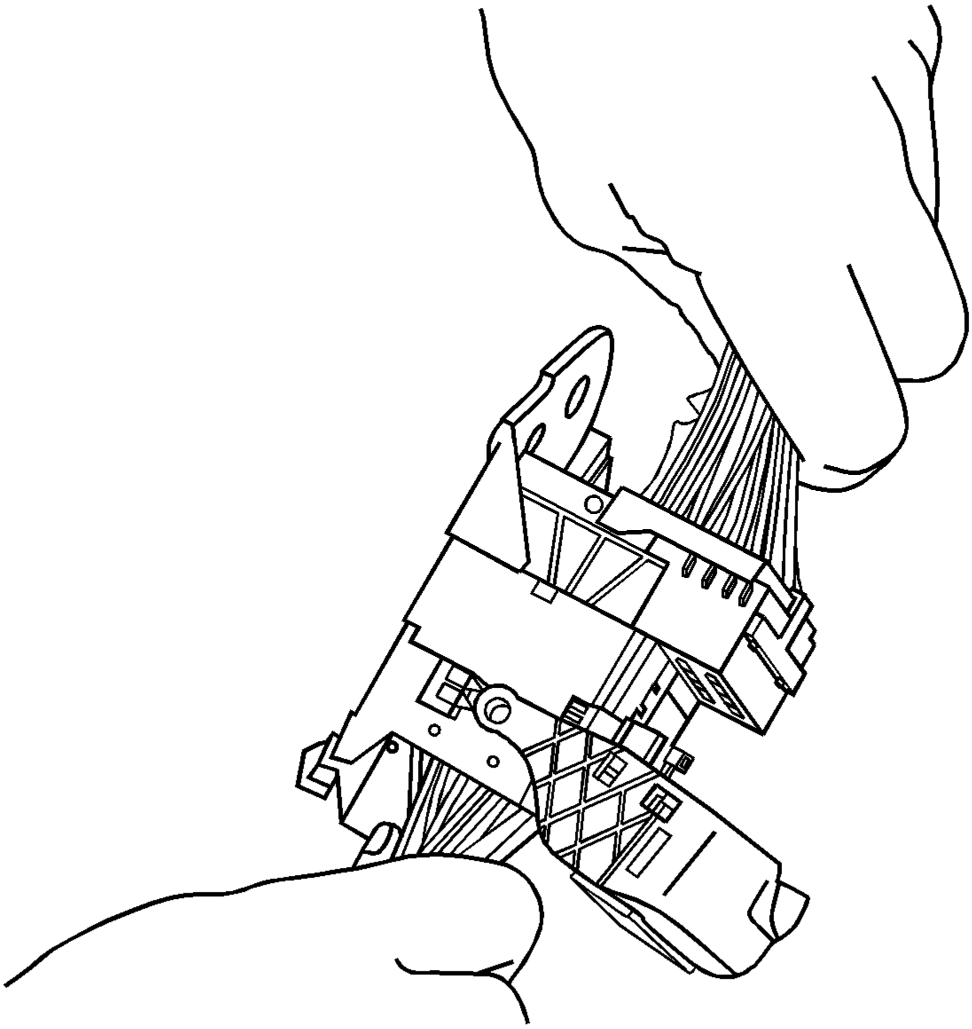


Fig. 168: Sliding Male Connector Body Away From Guide Plates
Courtesy of GENERAL MOTORS COMPANY

3. Slide the male connector body out away from the guide plates.

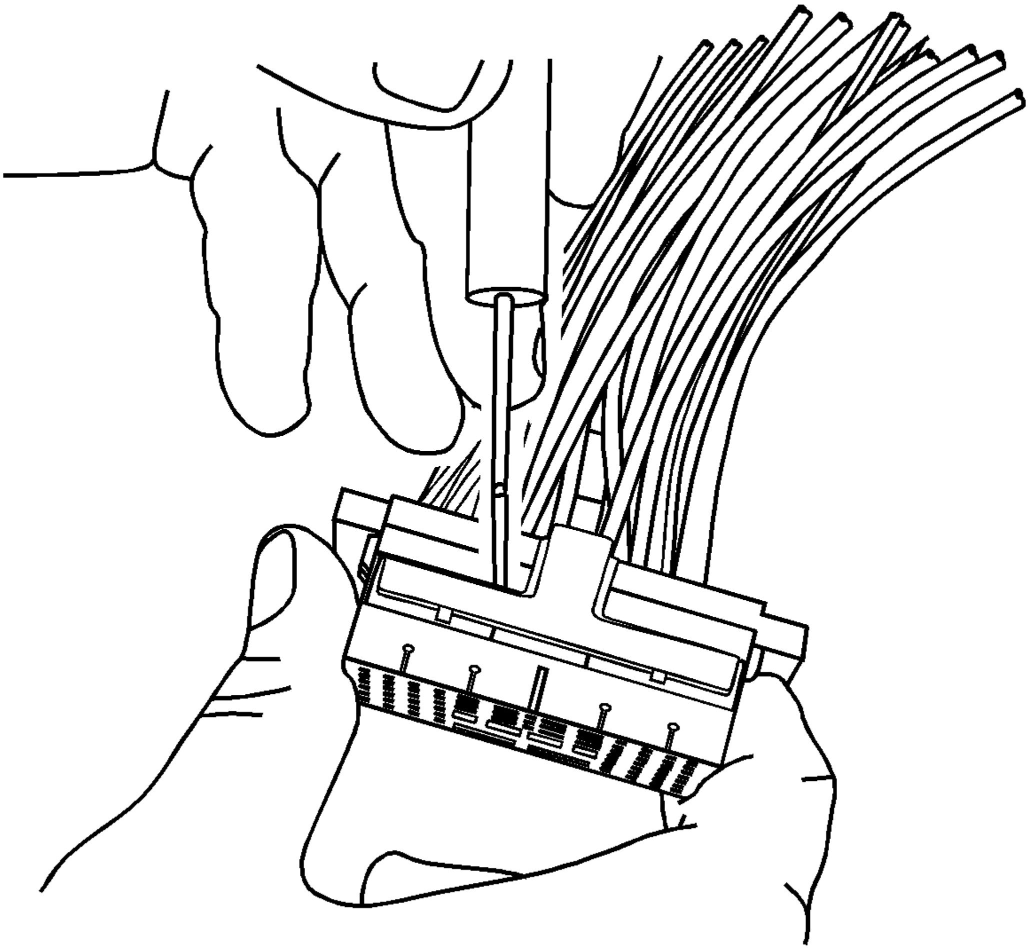


Fig. 169: View of Terminal Release Tool And TPA
Courtesy of GENERAL MOTORS COMPANY

NOTE: **During assembly the terminal position assurance (TPA) will not fully seat if any terminal is not fully seated.**

4. Using terminal release tool J-38125-11A or equivalent, remove the TPA from the connector body.

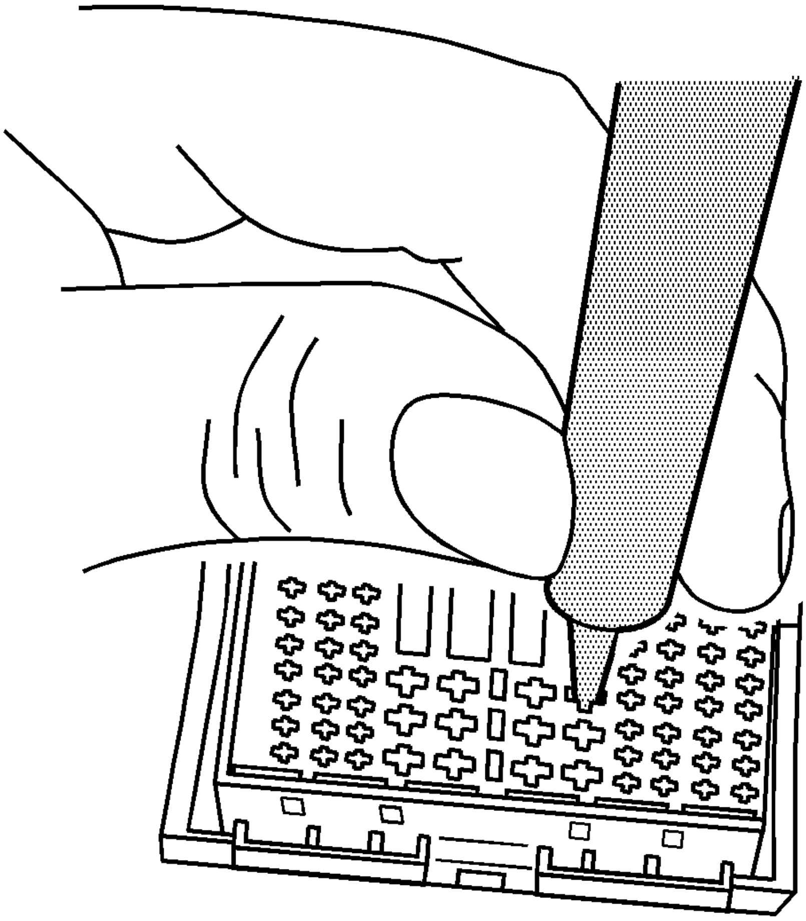


Fig. 170: Releasing Lock Tabs
Courtesy of GENERAL MOTORS COMPANY

5. Using terminal release tool J-38125-566, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

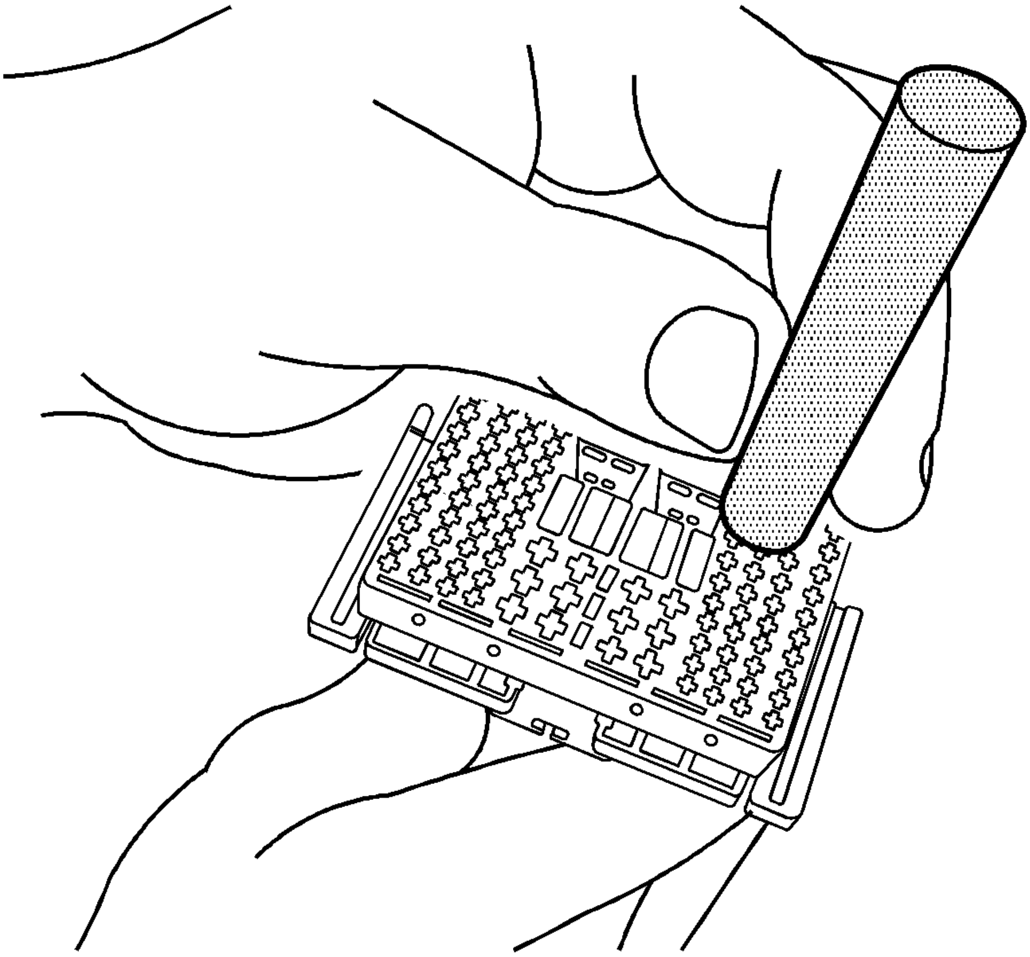


Fig. 171: Using Terminal Release Tool
Courtesy of GENERAL MOTORS COMPANY

6. Using terminal release tool J-38125-560, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

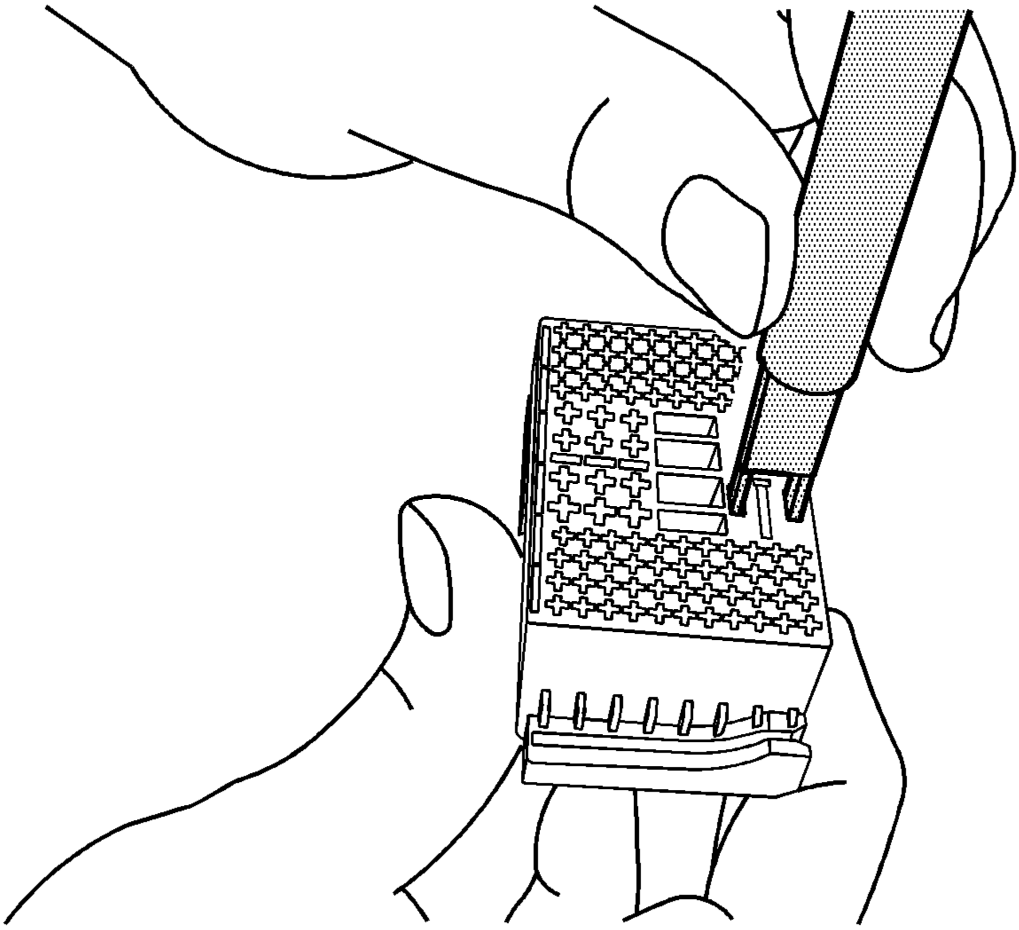


Fig. 172: Releasing Lock Tabs - Tyco/AMP (102-Way Inline)
Courtesy of GENERAL MOTORS COMPANY

7. Using terminal release tool J-38125-221, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

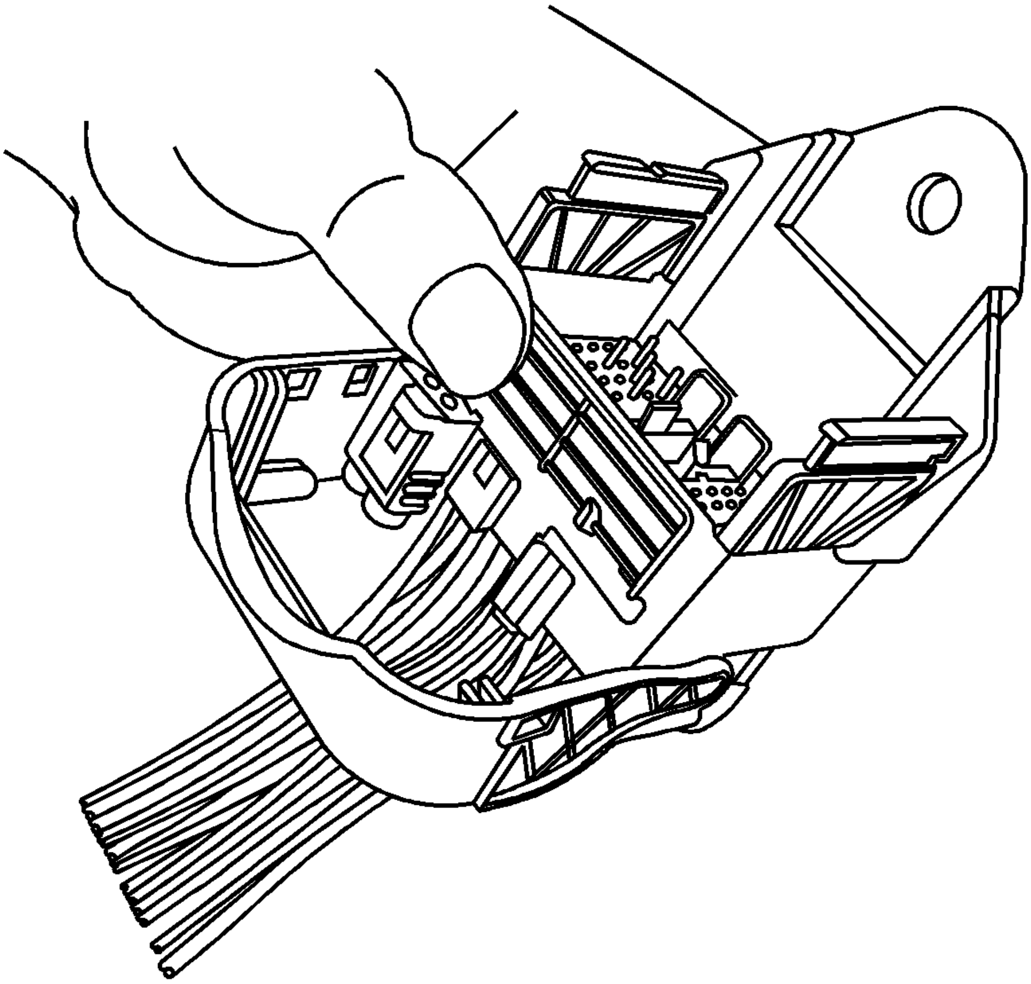


Fig. 173: View Of Female Connector Body - Tyco/AMP (102-Way Inline)
Courtesy of GENERAL MOTORS COMPANY

8. The female connector body may have an additional connector hooked to the edge of the body. Use terminal release tool J-38125-11A or equivalent to release the locking tab and slide the connector off the female body.

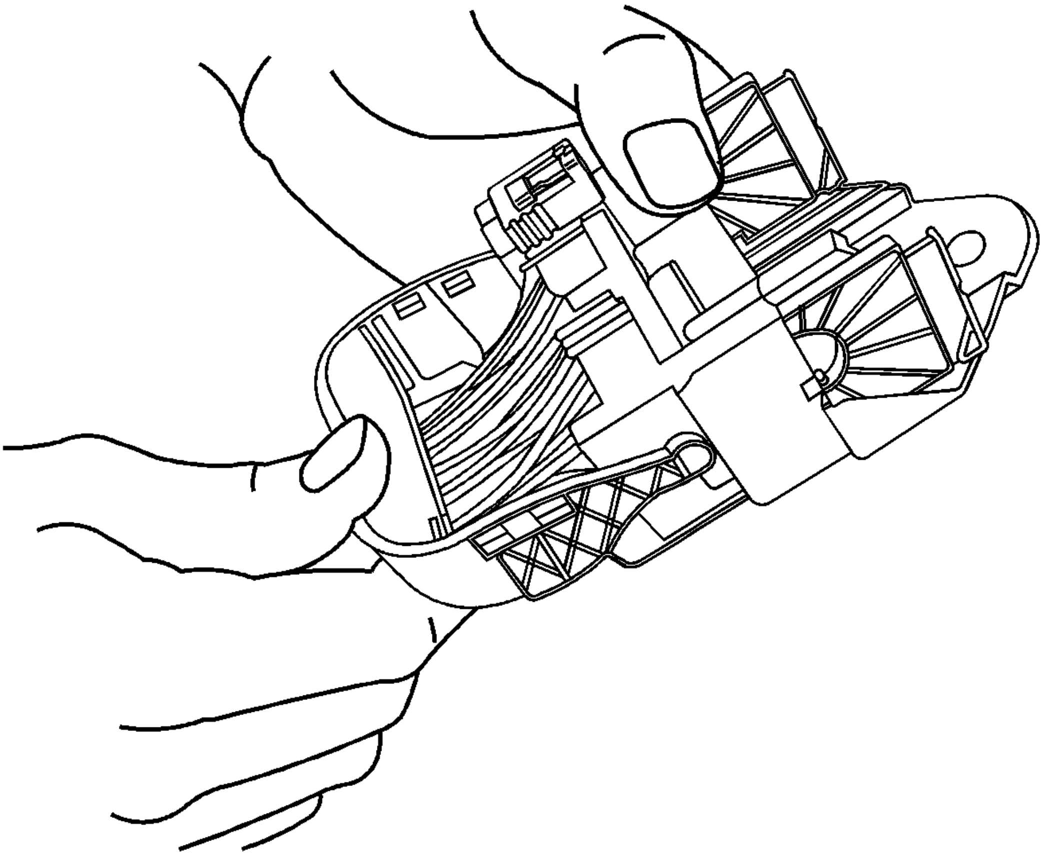


Fig. 174: Moving Locking Lever
Courtesy of GENERAL MOTORS COMPANY

9. Move the locking lever 180 degrees from the connected position.

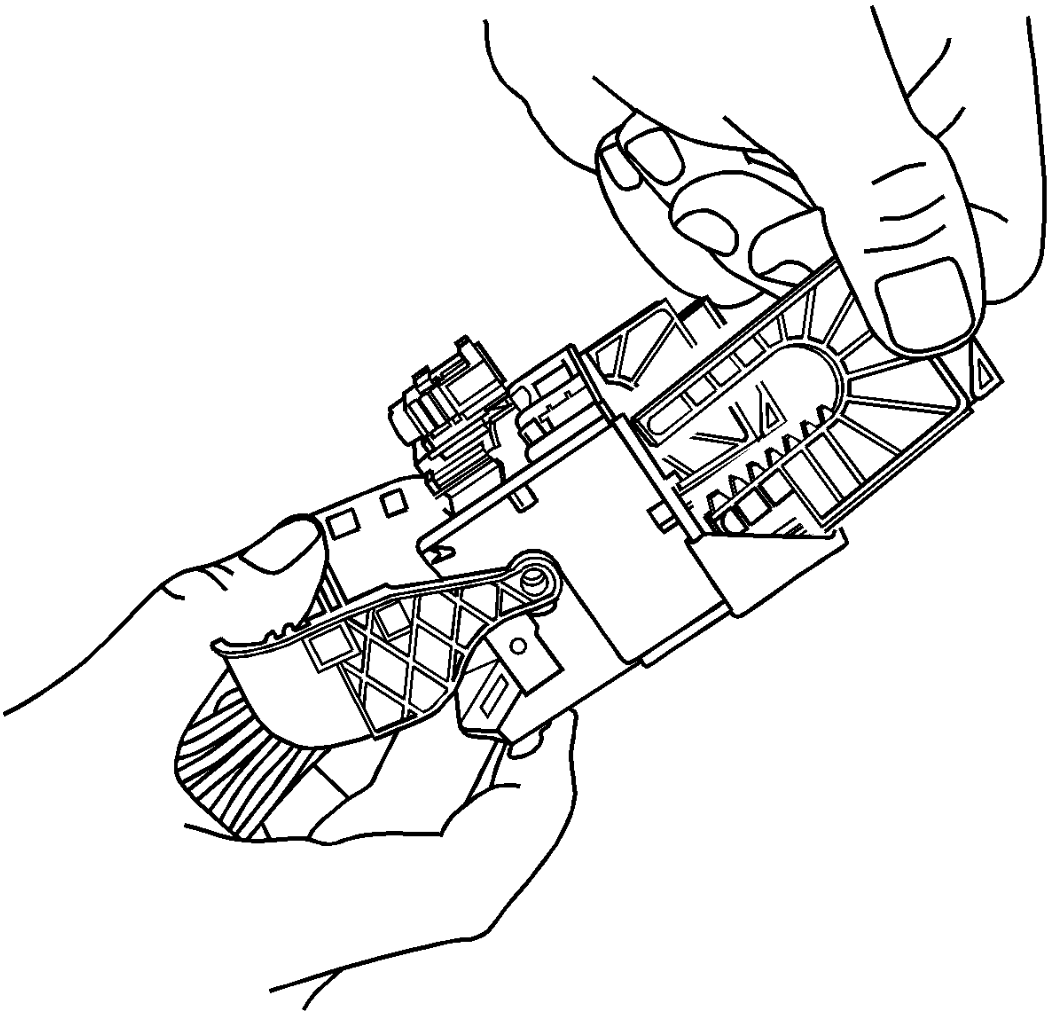


Fig. 175: Removing Guide Plates From Connector Body
Courtesy of GENERAL MOTORS COMPANY

10. With the locking lever in the 180 degree position the guide plates can be removed from the connector body.

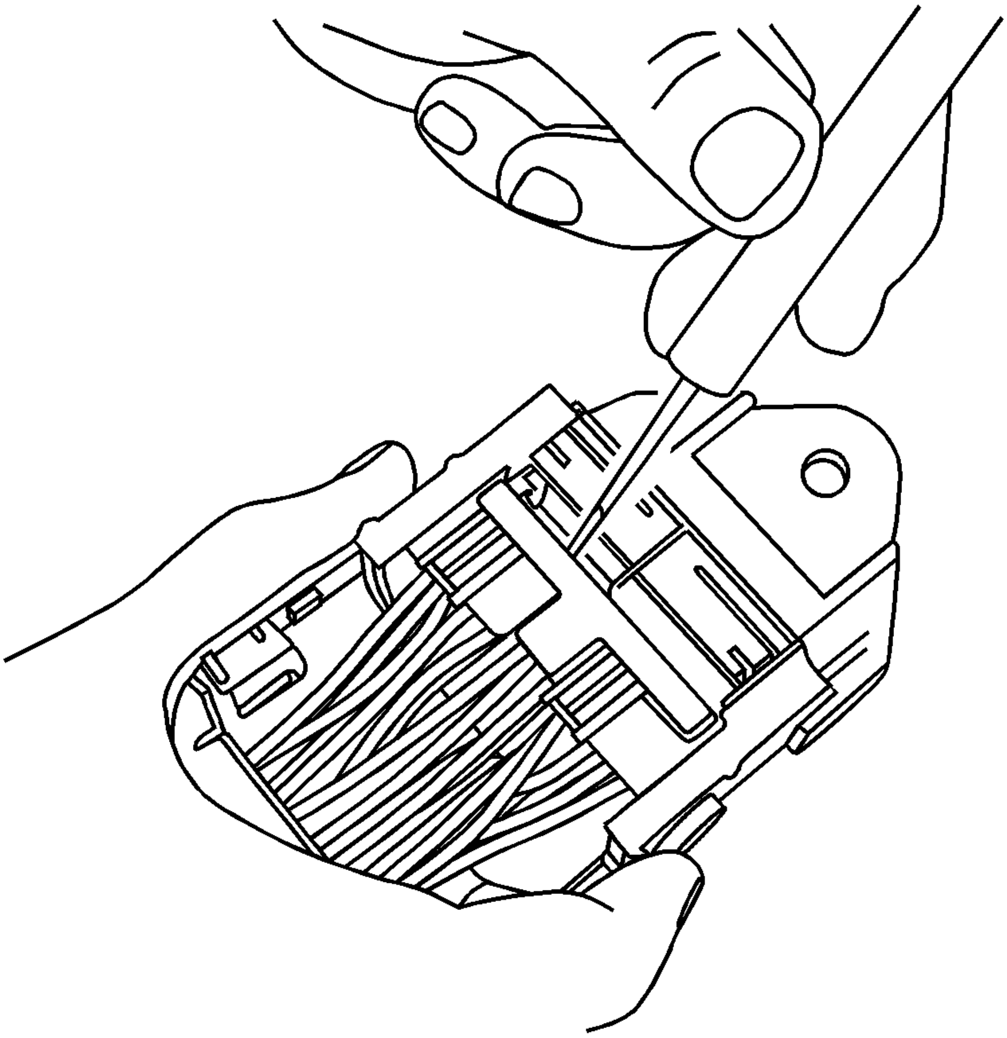


Fig. 176: Removing TPA
Courtesy of GENERAL MOTORS COMPANY

NOTE: **During assembly the TPA will not fully seat if any terminal is not fully seated.**

11. Using terminal release tool J-38125-11A or equivalent, remove the TPA from the connector body.

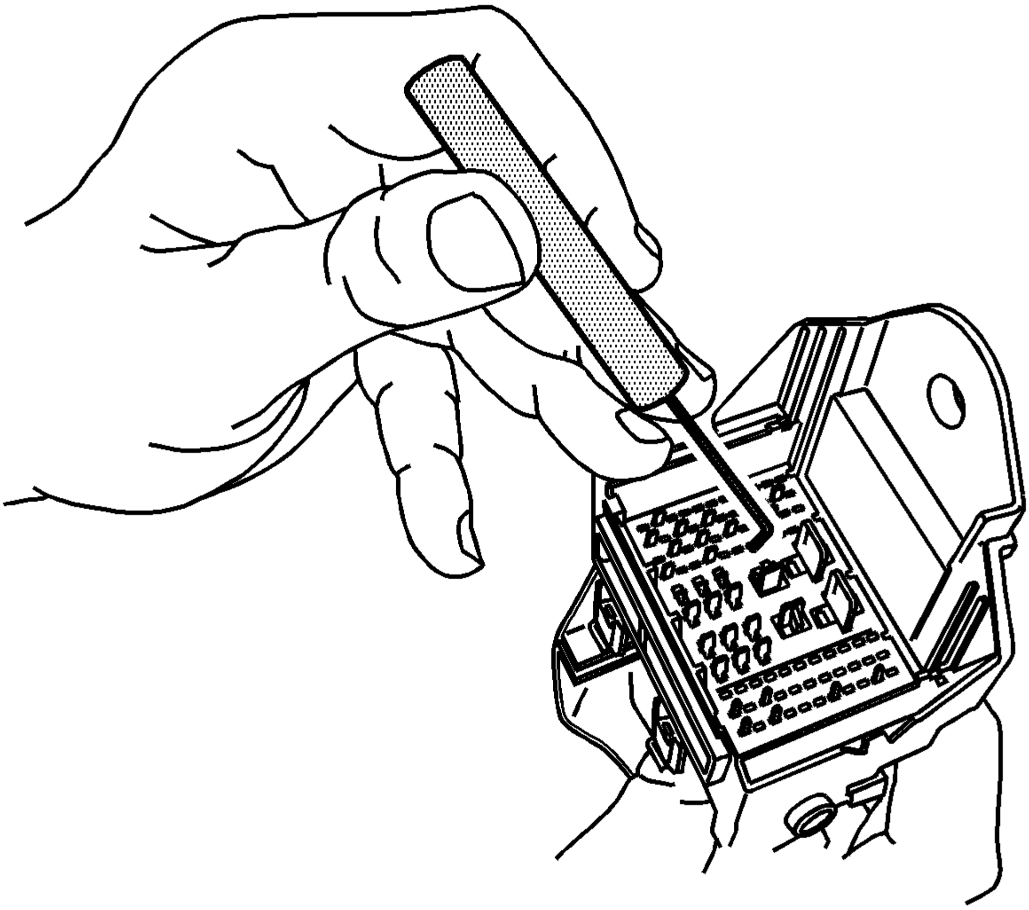


Fig. 177: Lifting Terminal Plate Past The Terminals
Courtesy of GENERAL MOTORS COMPANY

12. Using terminal release tool J-38125-216, lift the terminal plate past the terminals and out of the connector body cavity.

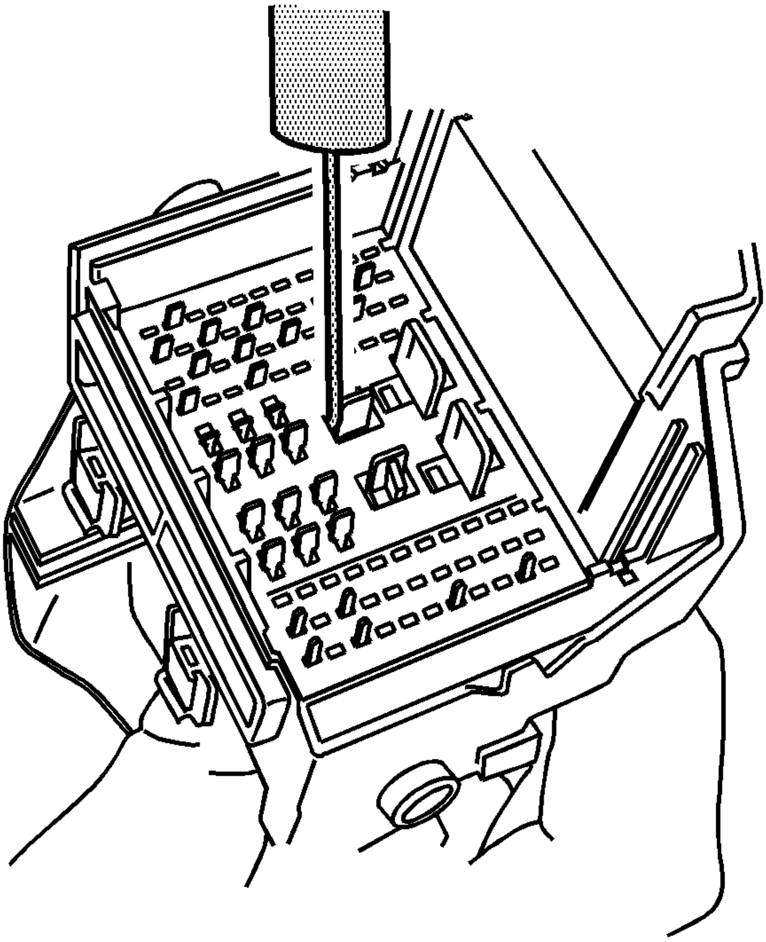


Fig. 178: View Of Terminal Plate
Courtesy of GENERAL MOTORS COMPANY

13. Terminal plate will bind slightly on each corner.

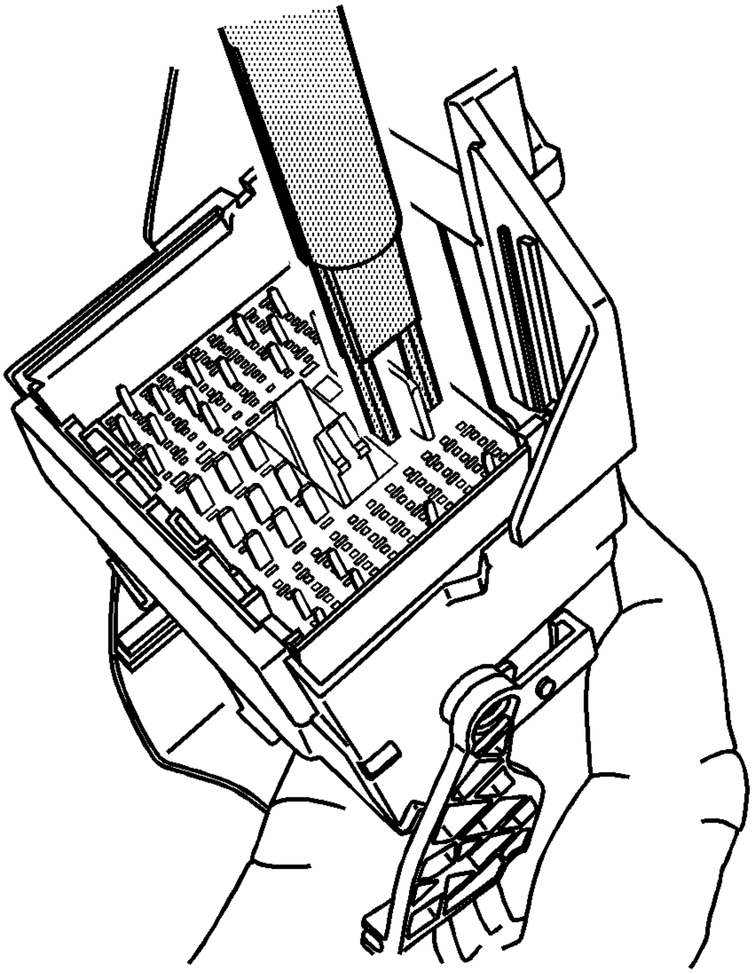


Fig. 179: Releasing Lock Tabs
Courtesy of GENERAL MOTORS COMPANY

14. Using terminal release tool J-38125-221, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

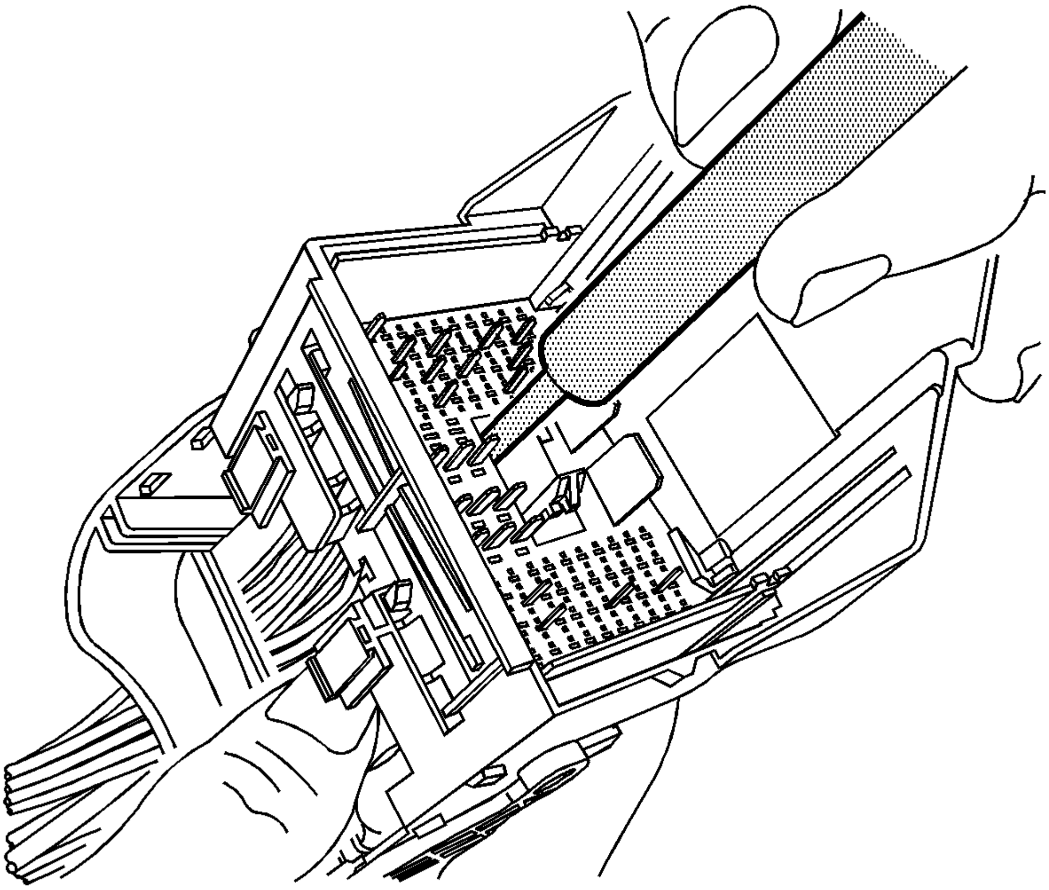


Fig. 180: View of Pressing Prongs On Each Side Of Terminal
Courtesy of GENERAL MOTORS COMPANY

15. Using terminal release tool J-38125-212, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

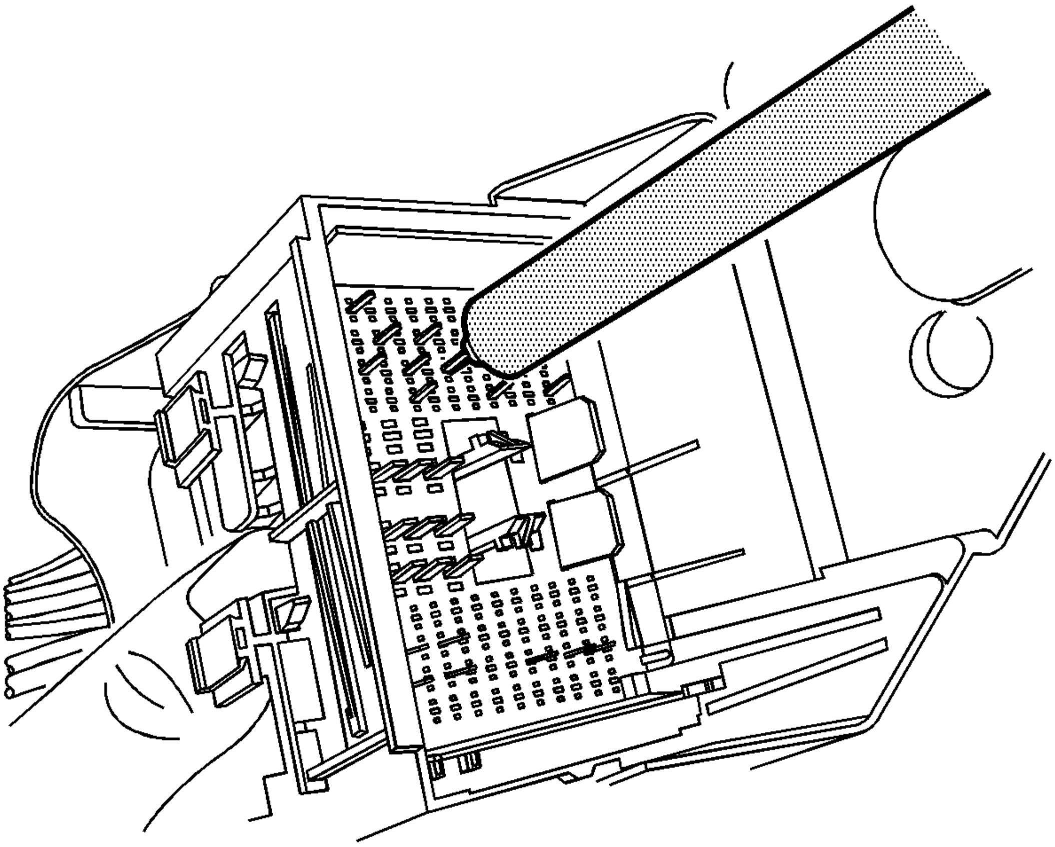


Fig. 181: Pressing Prongs On Each Side Of Terminal - Tyco/AMP (102-Way Inline)
Courtesy of GENERAL MOTORS COMPANY

16. Using terminal release tool J-38125-560, press the prongs into the holes on each side of the terminal to be removed to release the lock tabs and pull the terminal out of the connector body.

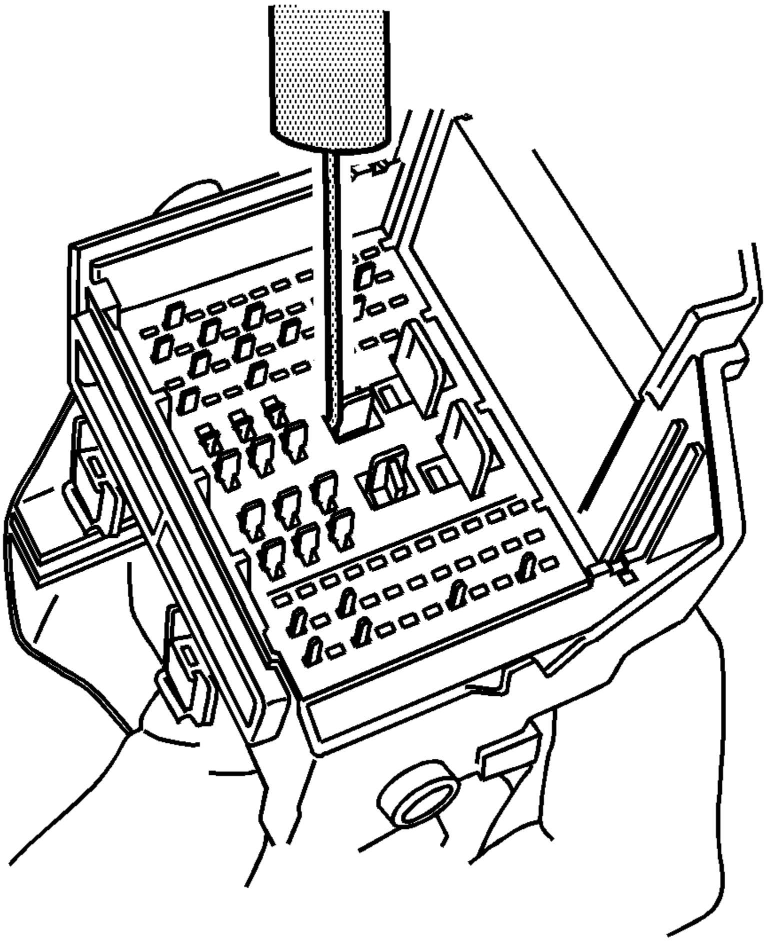


Fig. 182: View Of Terminal Plate
Courtesy of GENERAL MOTORS COMPANY

17. Press the terminal plate back into the female connector to the preset position. The plate will bind slightly on each corner.

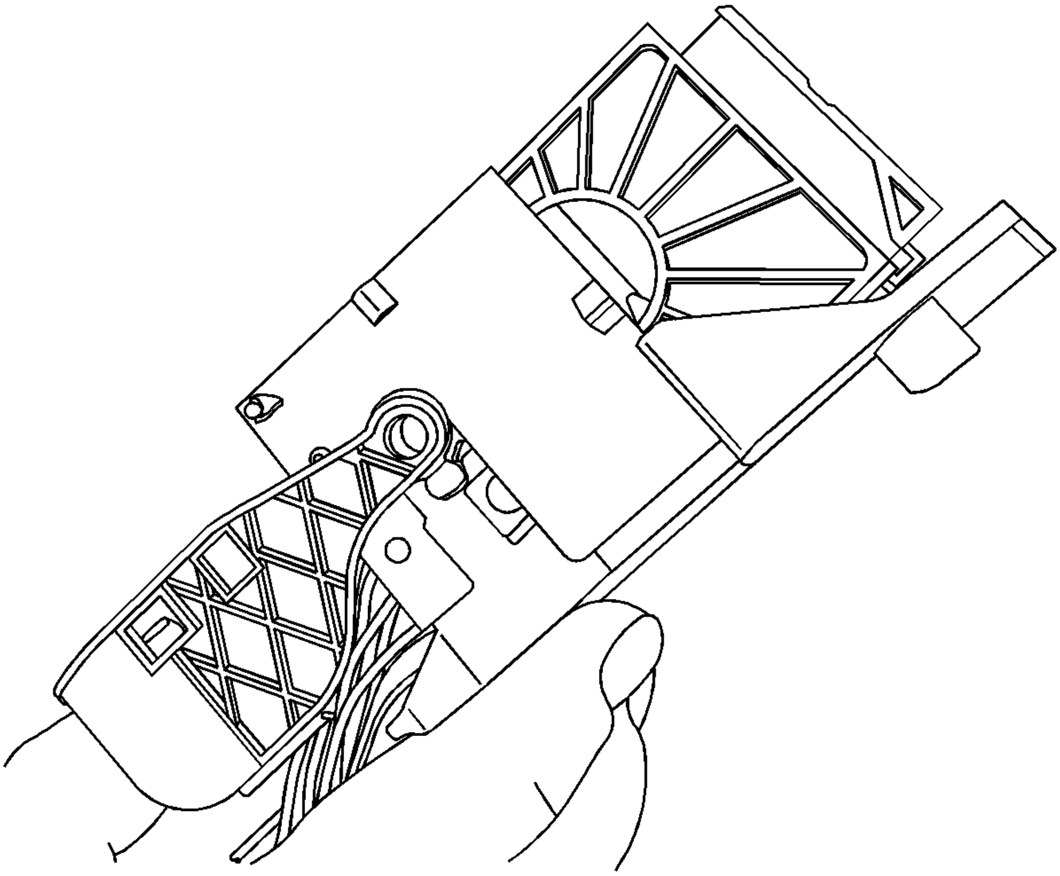


Fig. 183: Aligning Guide Plates To Mesh With Locking Lever Gears
Courtesy of GENERAL MOTORS COMPANY

18. With the locking lever in the 180 degree position, align the guide plates to mesh with the gears on the locking lever.

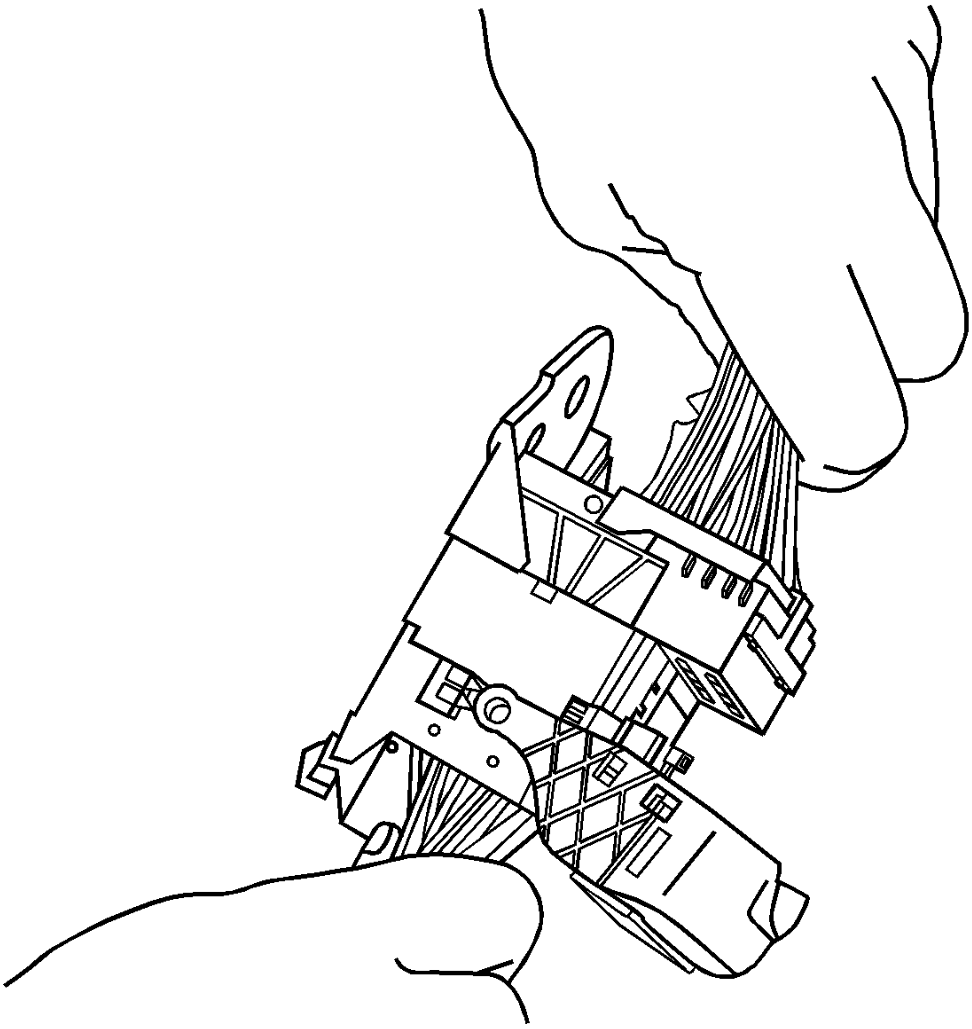


Fig. 184: Sliding Male Connector Body Away From Guide Plates
Courtesy of GENERAL MOTORS COMPANY

19. Slide the male connector body back inward toward the guide plates.

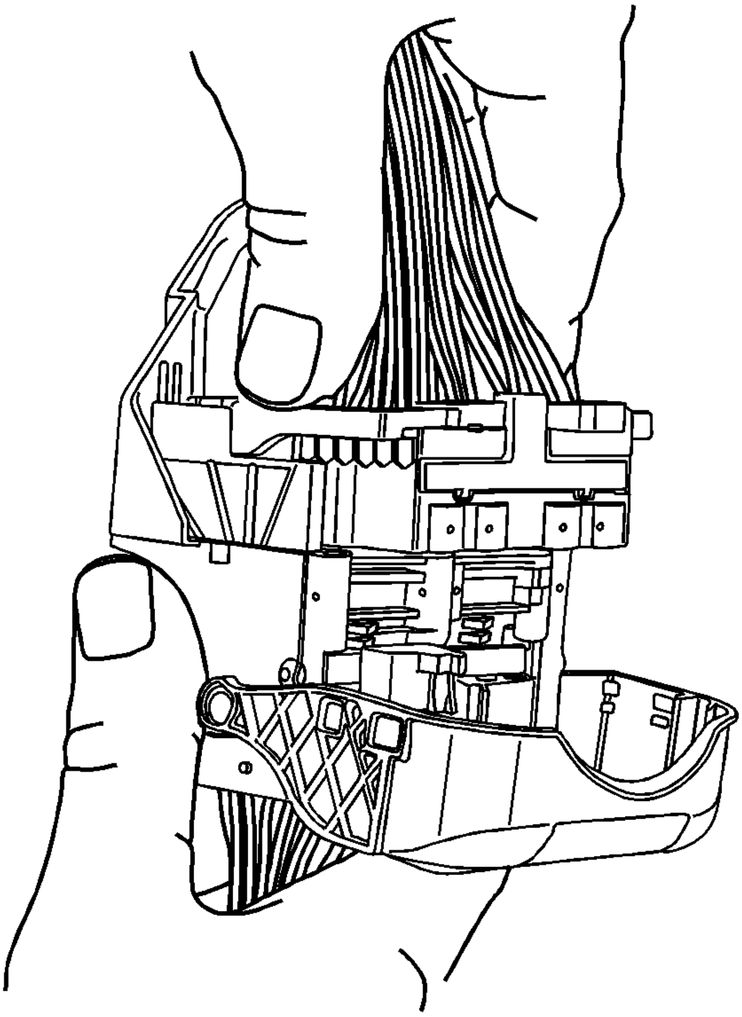


Fig. 185: Assembled View Of Connector - Tyco/AMP (102-Way Inline)
Courtesy of GENERAL MOTORS COMPANY

20. With the locking lever in the 90 degree position and the male connector body connected, it can be slid inward for assembly.

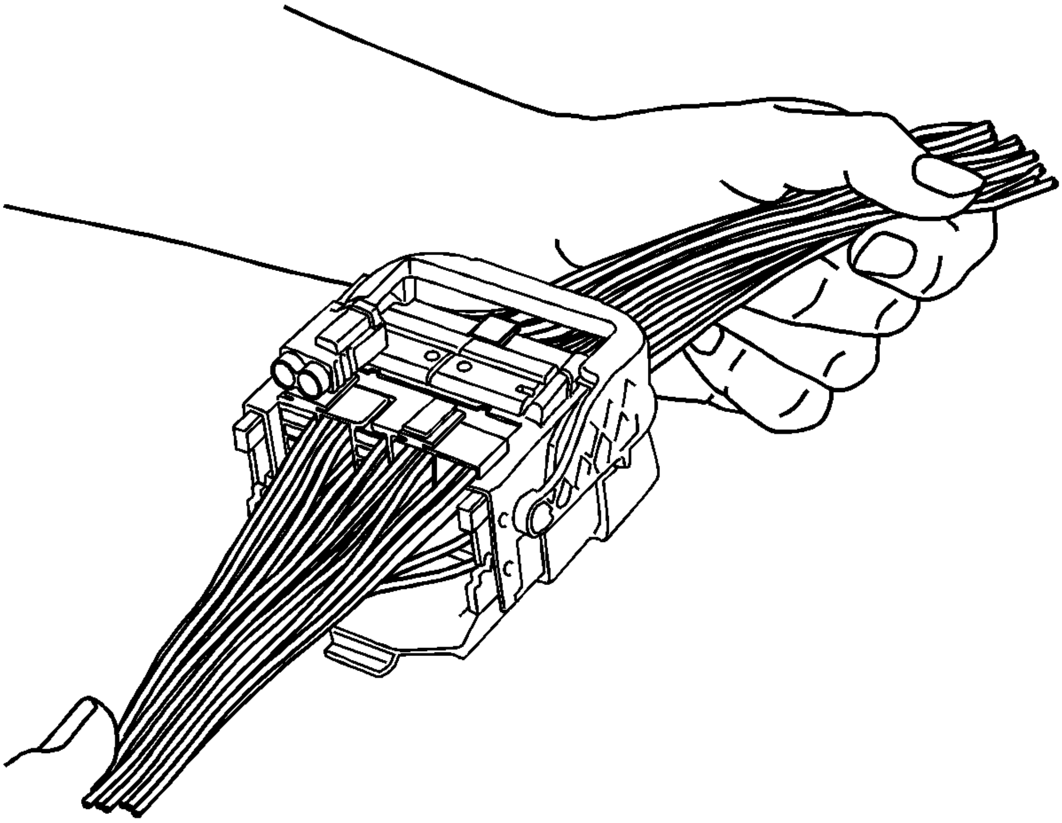


Fig. 186: View Of Typical Connector In Assembled Position
Courtesy of GENERAL MOTORS COMPANY

21. Move the lever into the locked position or in the assembled position. This will pull the male connector down into the female connector.
22. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
23. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

TYCO/AMP CONNECTORS (SIR)

Special Tools

- **EL-38125 - 550** Terminal Release Tool Kit
- **EL-38125 - 580** Terminal Release Tool Kit
- **J-38125 - 11A** Terminal Release Tool
- **J-38125-215A** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Removal Procedure

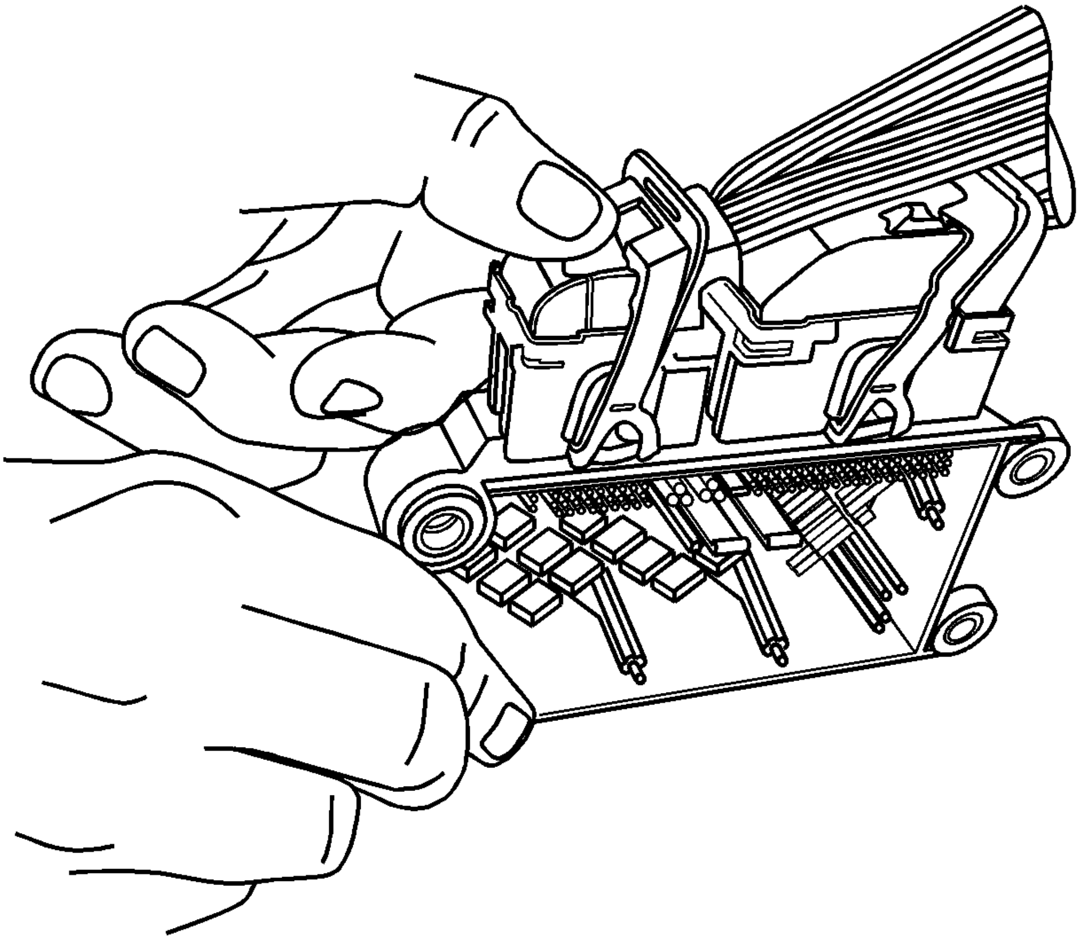


Fig. 187: Sliding Red CPA Away From Connector Lever
Courtesy of GENERAL MOTORS COMPANY

1. Using your thumbs press down and slide the red CPA away from the connector lever.

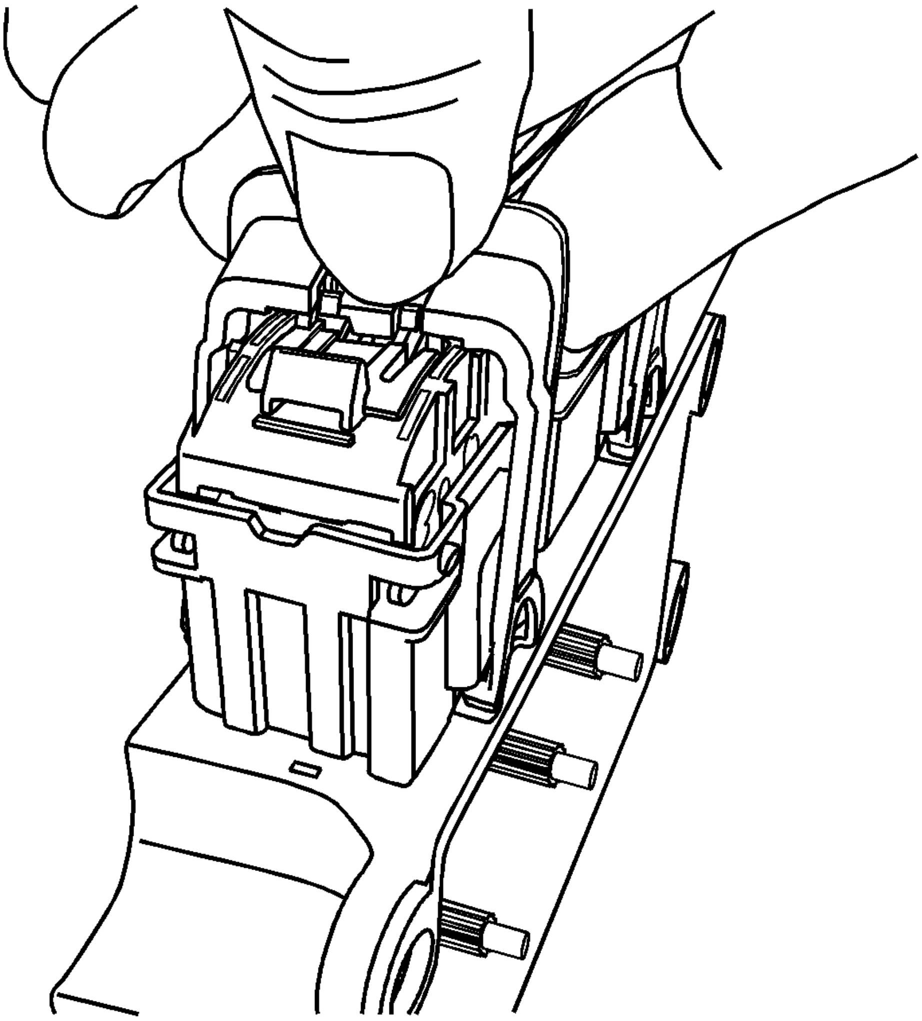


Fig. 188: Pressing Down On Locking Tab - Tyco/AMP Connectors (SIR)
Courtesy of GENERAL MOTORS COMPANY

2. Using your thumb press down on the locking tab and move the lever to the released position.

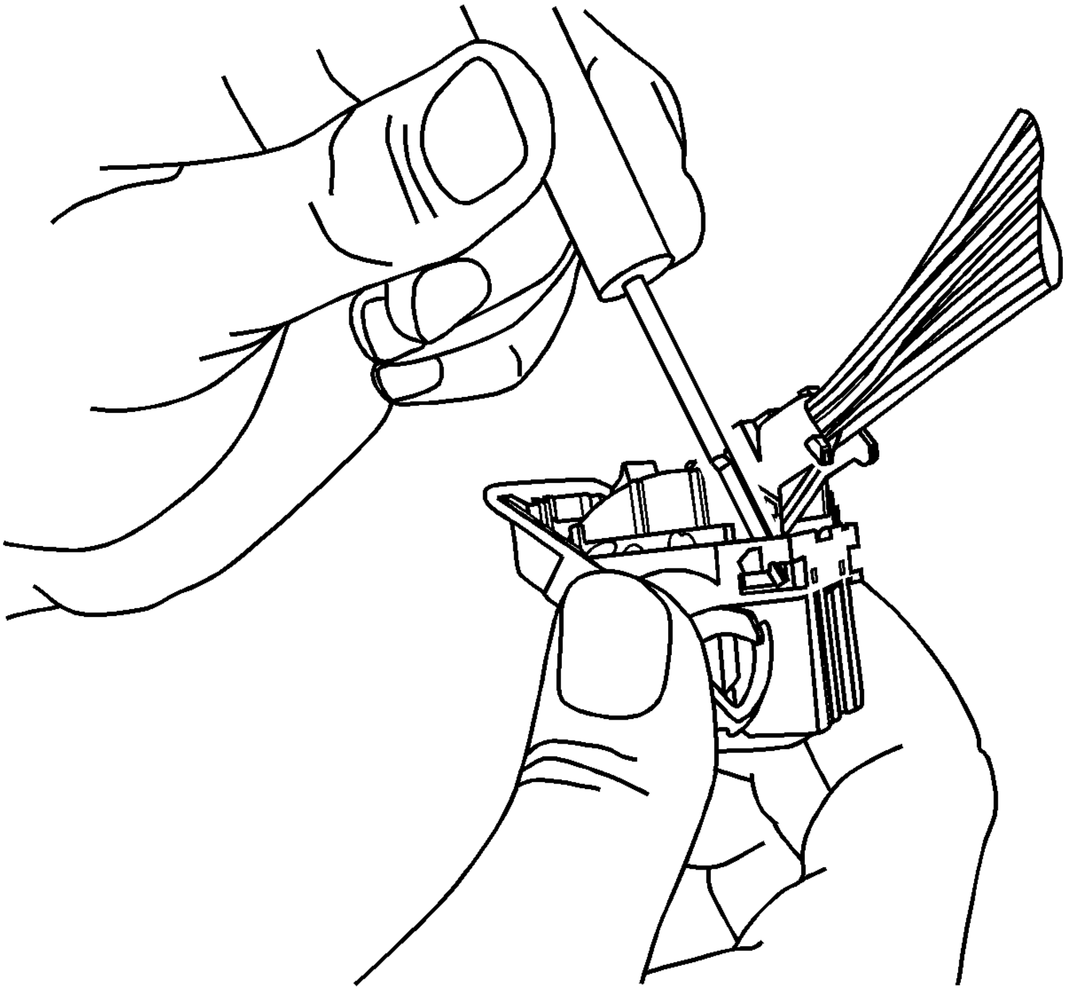


Fig. 189: Releasing Wire Dress Cover Locking Tabs
Courtesy of GENERAL MOTORS COMPANY

3. Using terminal tool J-38125-11A or equivalent, release the wire dress cover locking tabs.

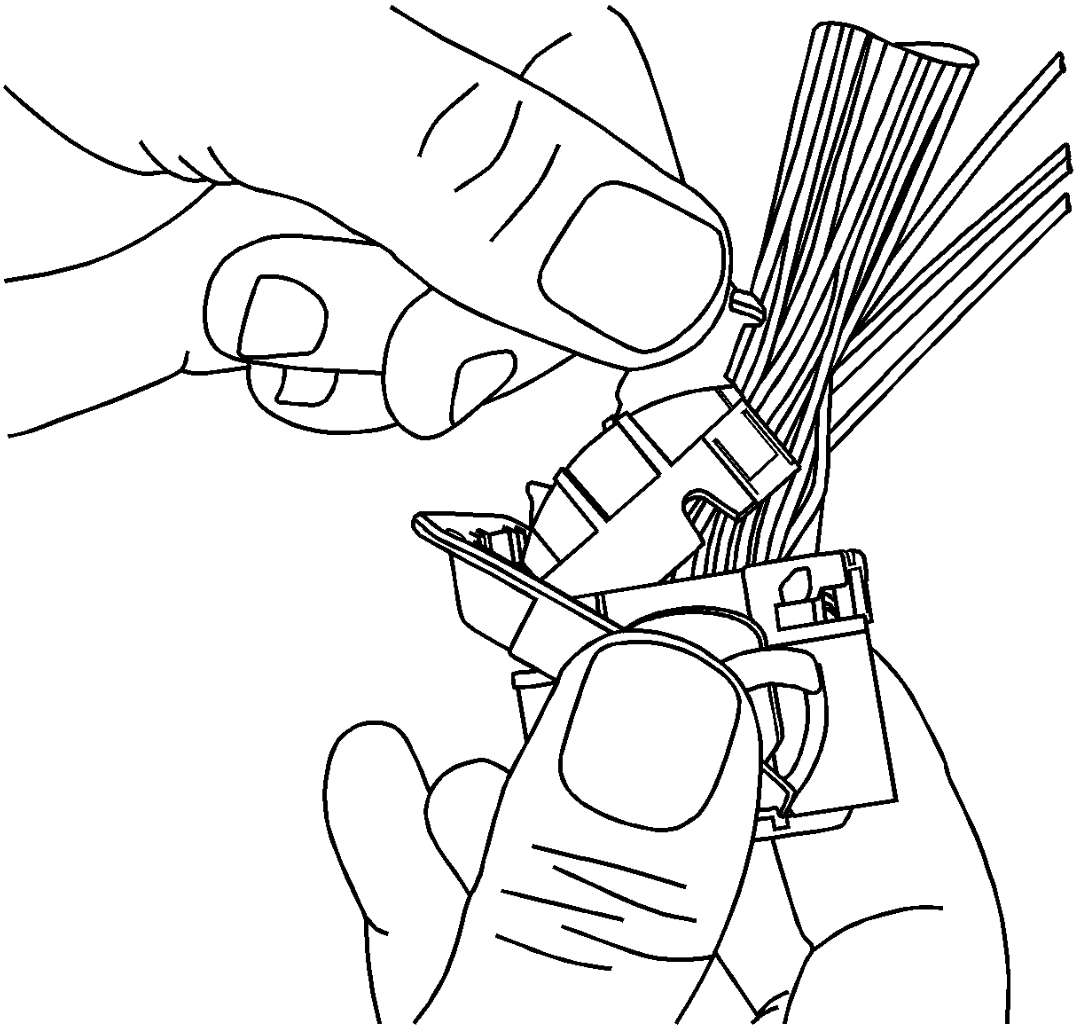


Fig. 190: Pivoting Connector Wire Dress Cover
Courtesy of GENERAL MOTORS COMPANY

4. Pivot connector wire dress cover while removing from the connector body.

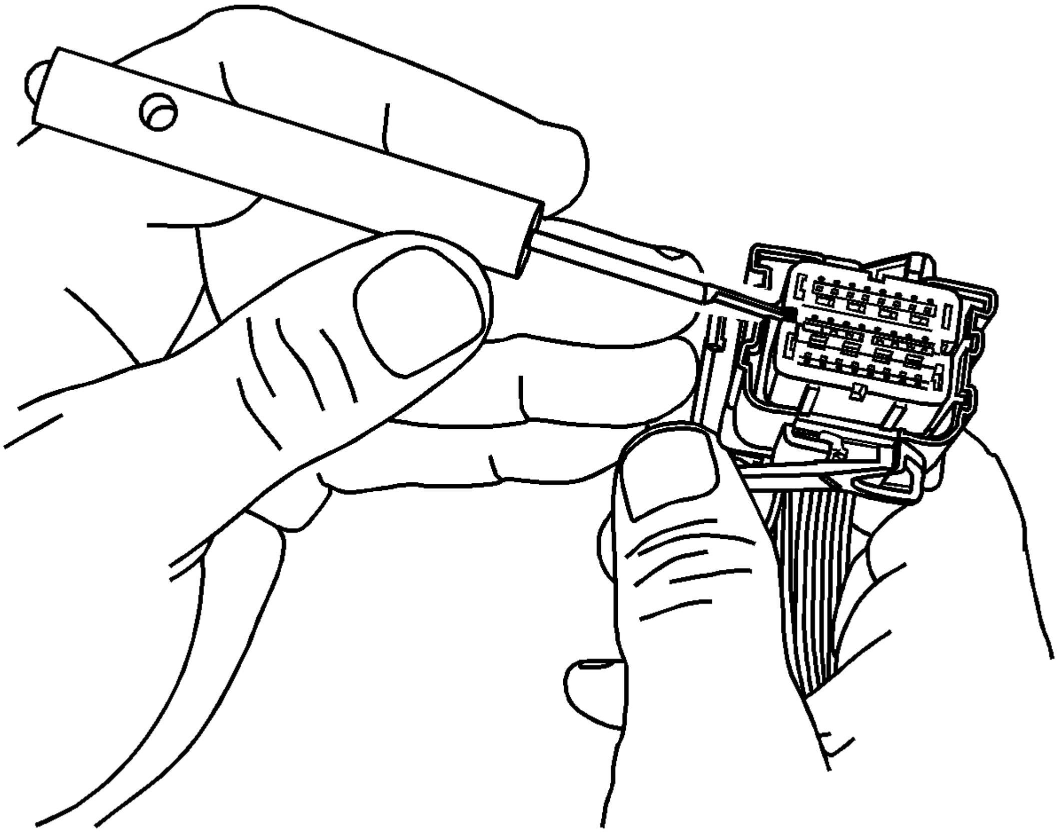


Fig. 191: Removing TPA
Courtesy of GENERAL MOTORS COMPANY

5. Using terminal tool J-38125-11A or equivalent, remove the TPA by lifting straight off the connector body.

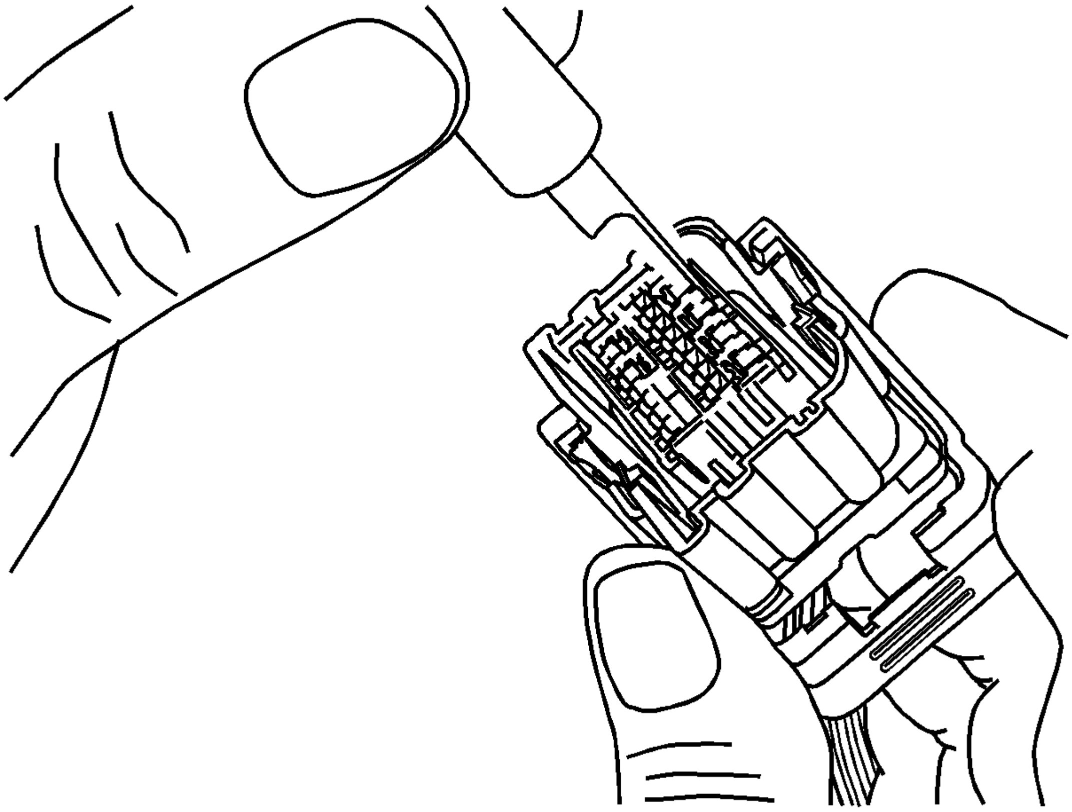


Fig. 192: View of Terminal Release Tool & Rear of Connector Body
Courtesy of GENERAL MOTORS COMPANY

6. Using terminal release tool J-38125-215A, place the tip of the tool on the outside edge next to the terminal and depress the lock tab and remove the rear of the connector body.

Terminal Repair Procedure

Use the appropriate terminal and crimper in order to replace the terminal.

YAZAKI CONNECTORS (2-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-553** Terminal Release Tool

For equivalent regional tools, refer to Special Tools .

Terminal Removal Procedure

1. Disconnect the connector from the component.

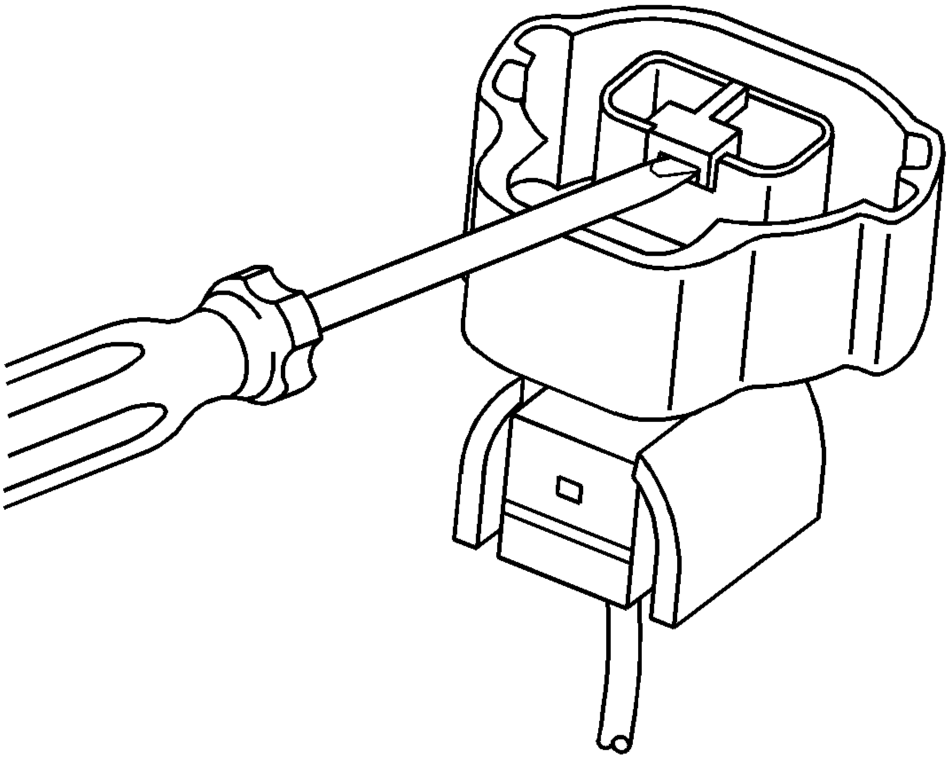


Fig. 193: Identifying Terminal Position Assurance
Courtesy of GENERAL MOTORS COMPANY

2. Insert a small flat-blade tool in the slot below the front loaded terminal position assurance (TPA) and pry up.
3. Remove the TPA by pulling it out of the connector.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

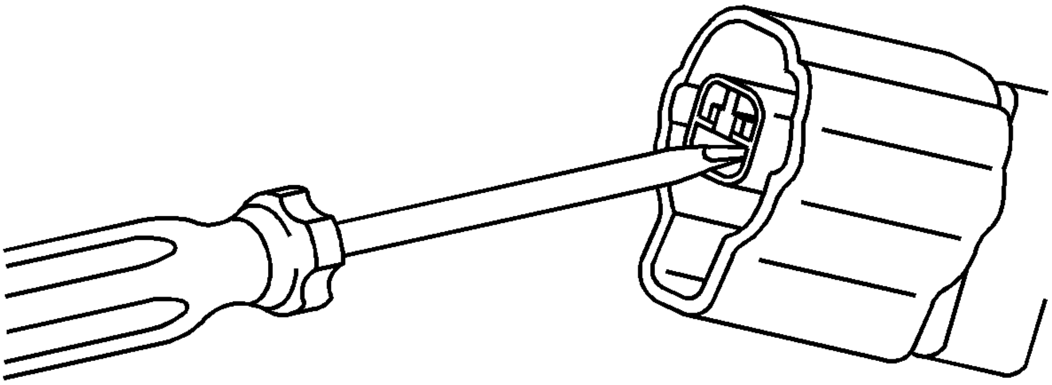


Fig. 194: Inserting Tool Into Terminal Cavity (Yazaki)
Courtesy of GENERAL MOTORS COMPANY

5. Insert the J-38125-553 on a slight upward angle into the cavity below the terminal to be removed. Ensure that the pointed on the end of the tool is facing the bottom of the terminal and it stays in contact with the terminal until it stops on the plastic terminal retainer.

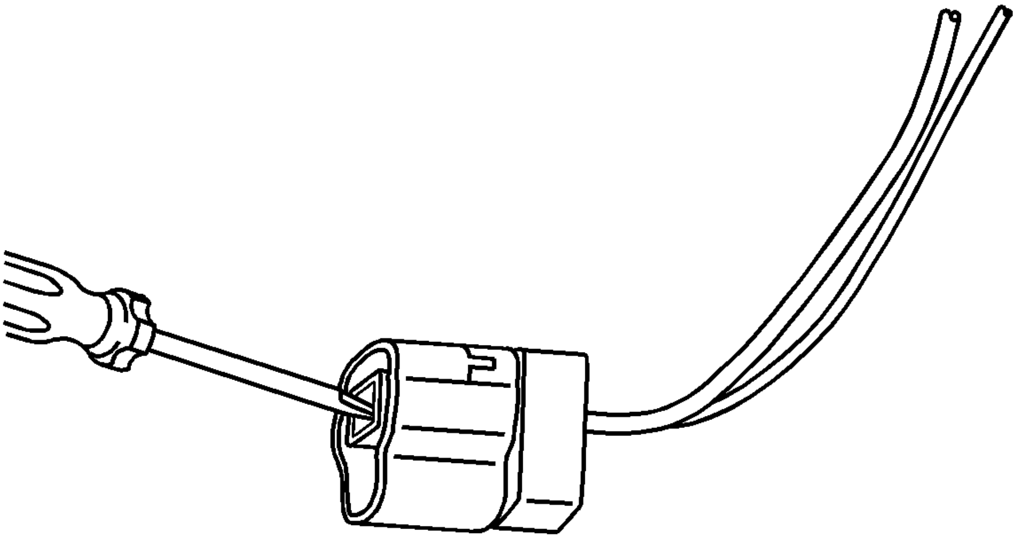


Fig. 195: Pulling Terminal Out Of Connector
Courtesy of GENERAL MOTORS COMPANY

6. Gently pry the plastic terminal retainer down and carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.
7. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
8. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

YAZAKI CONNECTORS (16-WAY)

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **J-38125-215** Terminal Release Tool

For equivalent regional tools, refer to **Special Tools** .

Terminal Removal Procedure

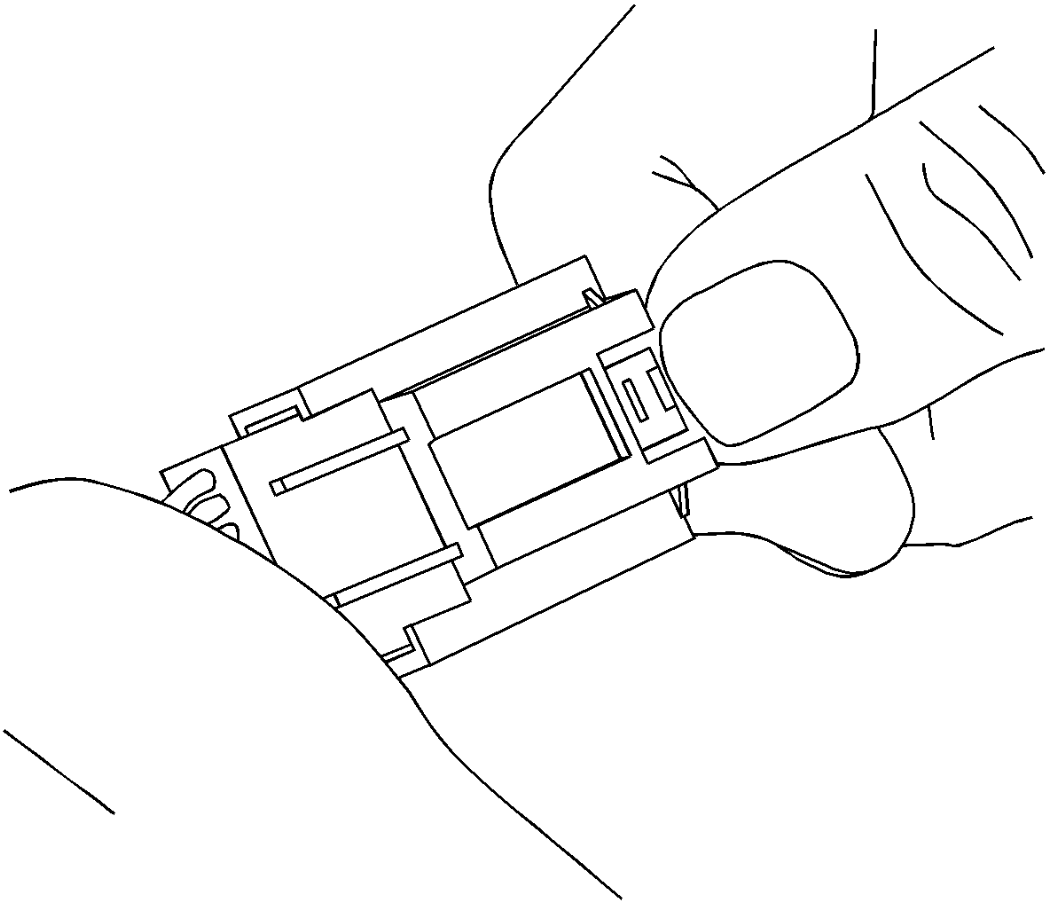


Fig. 196: Pulling Two Connector Halves Apart
Courtesy of GENERAL MOTORS COMPANY

1. While depressing the lock, pull the two connector halves apart.

NOTE: **The terminal position assurance (TPA) is fragile and may break if not done carefully.**

2. Use a small flat-blade tool to very carefully push the TPA towards the face of the connector on both sides of the connector.

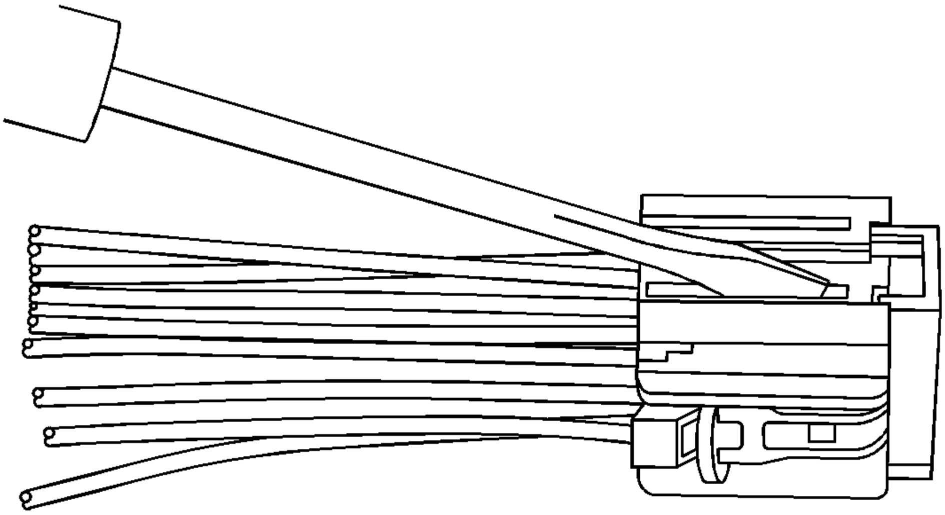


Fig. 197: View Of Male Connector Half & Female Terminals
Courtesy of GENERAL MOTORS COMPANY

3. View of the male half of the connector with female terminals.

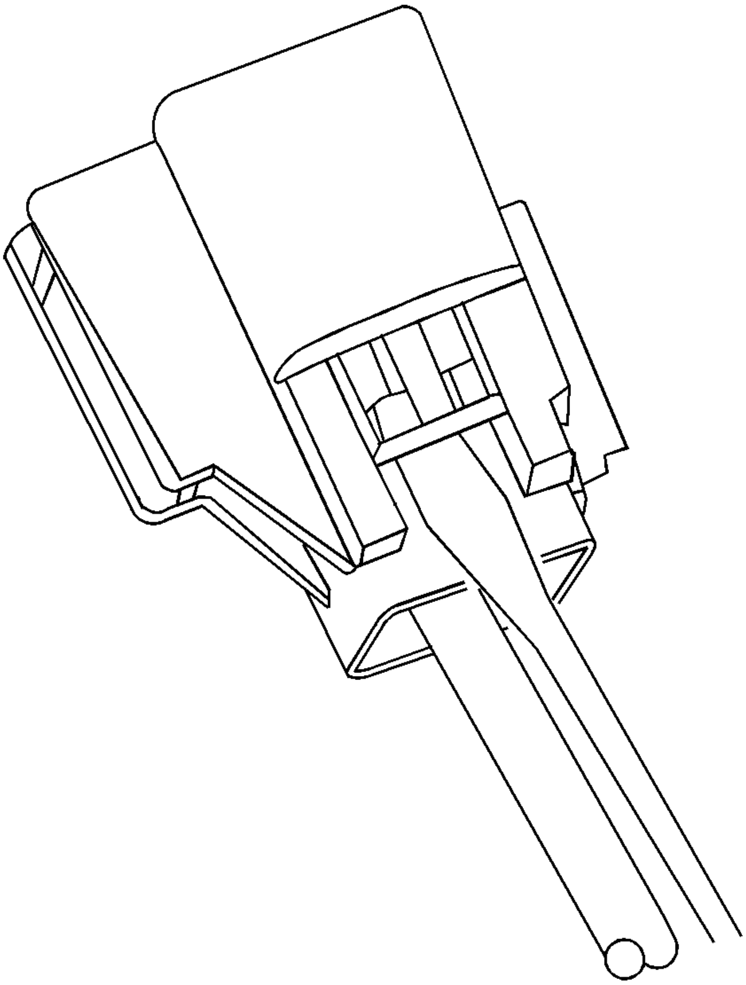


Fig. 198: View Of Female Half Of Connector With Male Terminals
Courtesy of GENERAL MOTORS COMPANY

4. View of the female half of the connector with male terminals.
5. Use the J-38125-215 tool to release the terminals by inserting the tool into the terminal release cavity.

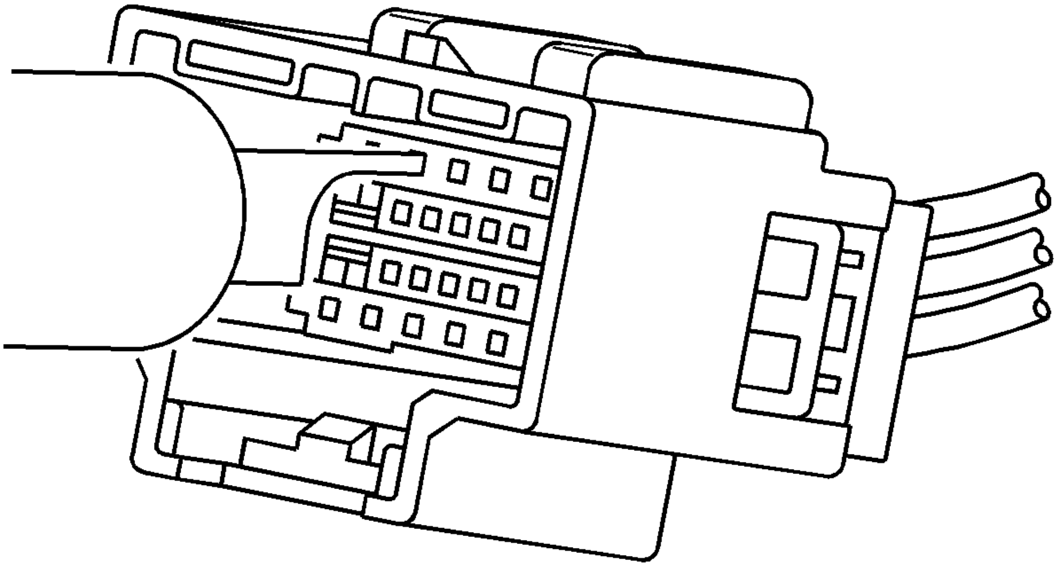


Fig. 199: Using Removal Tool On Female Half Of Connector
Courtesy of GENERAL MOTORS COMPANY

6. View of the female half of the connector with male terminals.

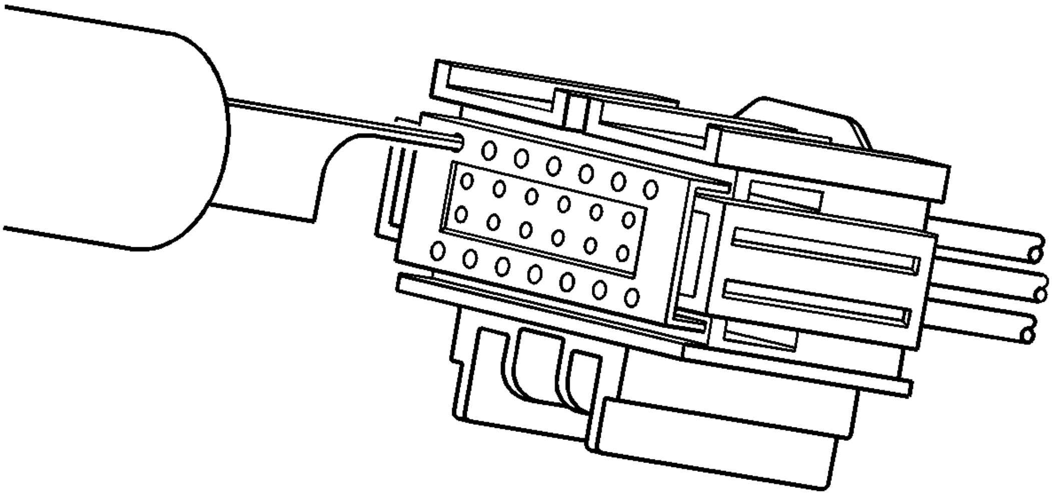


Fig. 200: Using Removal Tool On Male Half Of Connector
Courtesy of GENERAL MOTORS COMPANY

7. View of the male half of the connector with female terminals.
8. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.
9. Repair the terminal by following the **Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair)** procedure.
10. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

REPAIRING CONNECTOR TERMINALS (TERMINATED LEAD REPAIR)

Special Tools

EL-38125-10 Splice Sleeve Crimp Tool

For equivalent regional tools, refer to **Special Tools** .

NOTE: **All repairs near the engine manifold, turbo engine and all exhaust pipes should follow the High Temperature Wiring Repairs procedures.**

For high temperature wiring repairs, refer to **High Temperature Wiring Repairs**.

Terminated leads are terminals that are crimped onto wires. The terminated lead can be used throughout the vehicle since it is designed for temperatures up to 150Â°C. The length of the wire is 450 mm.

1. Use the connector end view to identify the correct terminated lead.
2. The terminated lead package should include a DuraSeal splice sleeve. If not, use the chart to in Splicing Copper Wire Using Splice Sleeves to identify the correct DuraSeal splice sleeve, refer to

Wire to Wire Repair.

REPAIRING CONNECTOR TERMINALS (TERMINAL REPAIR)

Special Tools

- **J-38125 - 580** Terminal Repair Kit
- **J-38125-6** Crimp Tool
- **J-38125-7** Crimp Tool
- **J-38125-8** Crimp Tool
- **J-38125-64** Crimp Tool
- **J-38125-101** Crimp Tool
- **J-38125-641** Crimp Tool
- **J-38125-642** Crimp Tool
- **J-38125-643** Crimp Tool

For equivalent regional tools, refer to Special Tools .

Use the following repair procedures to repair each type of terminal:

- For push to seat terminals, refer to Delphi Connectors (Weather Pack)Delphi Connectors (Push To Seat)Delphi Connectors (Pull To Seat)Delphi Connectors (Micro-Pack 100W)Delphi Connectors (Micro.64)Delphi Connectors (12-Way)Delphi Connectors (Steering Gear).
- For pull to seat terminals, refer to Delphi Connectors (Weather Pack)Delphi Connectors (Push To Seat)Delphi Connectors (Pull To Seat)Delphi Connectors (Micro-Pack 100W)Delphi Connectors (Micro.64)Delphi Connectors (12-Way)Delphi Connectors (Steering Gear).

NOTE: **The first step for all terminal repairs is to find the connector end view in SI.**

Cable Seal Terminals

1. Cut off the terminal between the core and the insulation crimp to minimize any wire loss.
2. Remove the old seal.
3. Apply the correct cable seal, per the wire gauge size, from the kit. Slide the seal back along the wire to enable removal of the insulation.
4. To minimize wire loss, remove only the insulation required.
5. Using the connector end view, determine the correct crimp tool and crimp jaw.
6. Align the seal with the end of the cable insulation.
7. Position the stripped wire and seal in the terminal.
8. Hand Crimp the core wings first.
9. Hand Crimp the insulation wings around the seal and the cable.

Unsealed Terminals

1. Cut off the terminal between the core and the insulation crimp to minimize any wire loss.
2. To minimize wire loss, remove only the insulation required.
3. Position the stripped wire in the terminal.
4. Hand Crimp the core wings first.
5. Hand Crimp the insulation wings around the cable.

Micro-Pack 100W Size Terminal

The Micro-Pack 100W connectors have small terminals that are difficult to handle and hold when crimping. In order to aid the technician when crimping these terminals, a new crimping tool was developed. The J 38125-101 (W jaw) crimping tool was developed to crimp Micro-Pack 100W terminals. The J 38125-101 (W jaw) crimping tool has a terminal holding block that will hold the terminal in place while the terminal is being crimped. After the terminal is removed from the connector perform the following procedure in order to repair Micro-Pack 100 terminals.

1. Cut the wire as close to the terminal as possible.

NOTE: **After cutting the damaged terminal from the wire, determine if the remaining wire is long enough to reach the connector without putting a strain on the wire. If the wire is not long enough, splice a small length of the same gauge wire to the existing wire, then crimp the new terminal on the added wire.**

2. Strip 5 mm (3/16 in) of insulation from the wire.

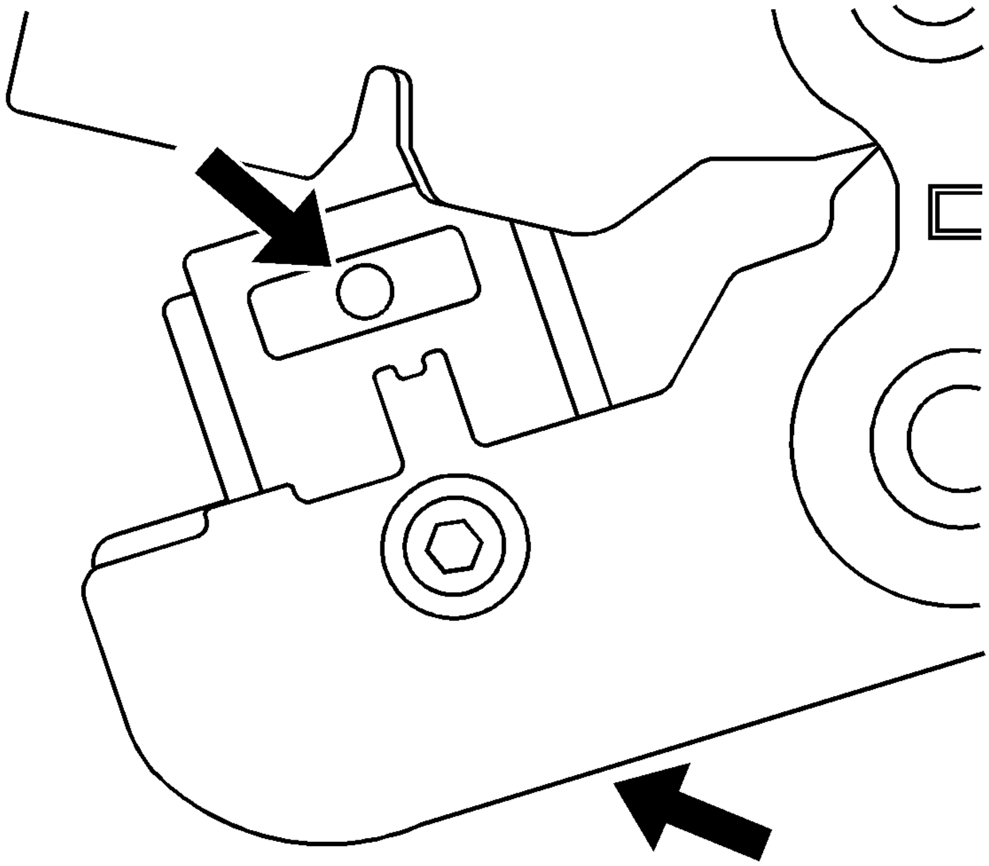


Fig. 201: Identifying Crimping Tool Spring Loaded Locator
Courtesy of GENERAL MOTORS COMPANY

3. Depress the spring loaded locator of the J 38125-101 (W jaw) crimping tool until the terminal holder is completely visible.

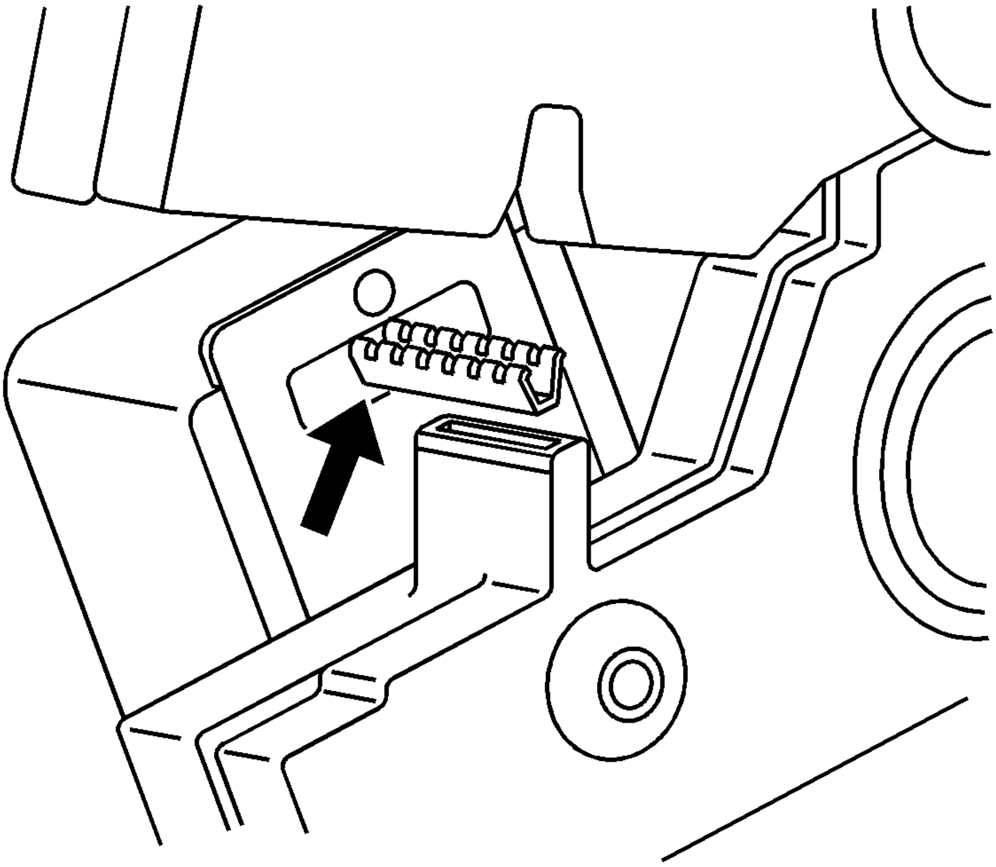


Fig. 202: Locating Terminal In Crimping Tool
Courtesy of GENERAL MOTORS COMPANY

4. Insert the terminal into the crimp tool until the core wings are flush with the anvil on the crimp tool. Be sure that the wings are pointed toward the crimp tool former and release the spring locator. The locator will hold the terminal in place. Inspect the alignment of the terminal wings with the crimp tool former. If the terminal wings are wider than the crimp tool former, remove the terminal and bend the terminal wings in slightly.
5. Place stripped wire into terminal.
6. Crimp the new terminal to the wire. If a jam occurs, press the emergency release to open applicator.

Micro 0.64 Size Terminal

The Micro 64 connectors have small terminals that are difficult to handle and hold when crimping. In order to aid the technician when crimping these terminals, a new crimping tool was developed. The J 38125-64 (M jaw) was developed to crimp Micro 64 terminals. The J-38125-64 crimping tool has a terminal holding block that will hold the terminal in place while the terminal is being crimped. The J-38125-64 crimping tool is also designed to crimp both the wire and the insulation at the same time.

After the terminal is removed from the connector perform the following procedure in order to repair Micro 64 terminals.

NOTE: **After cutting the damaged terminal from the wire, determine if the remaining wire is long enough to reach the connector without putting a strain on the wire. If the wire is not long enough, splice a small length of the same gauge wire to the existing wire, then crimp the new terminal on the added wire.**

1. Cut the wire as close to the damaged terminal as possible.
2. Strip 5 mm (3/16 in) of insulation from the wire.

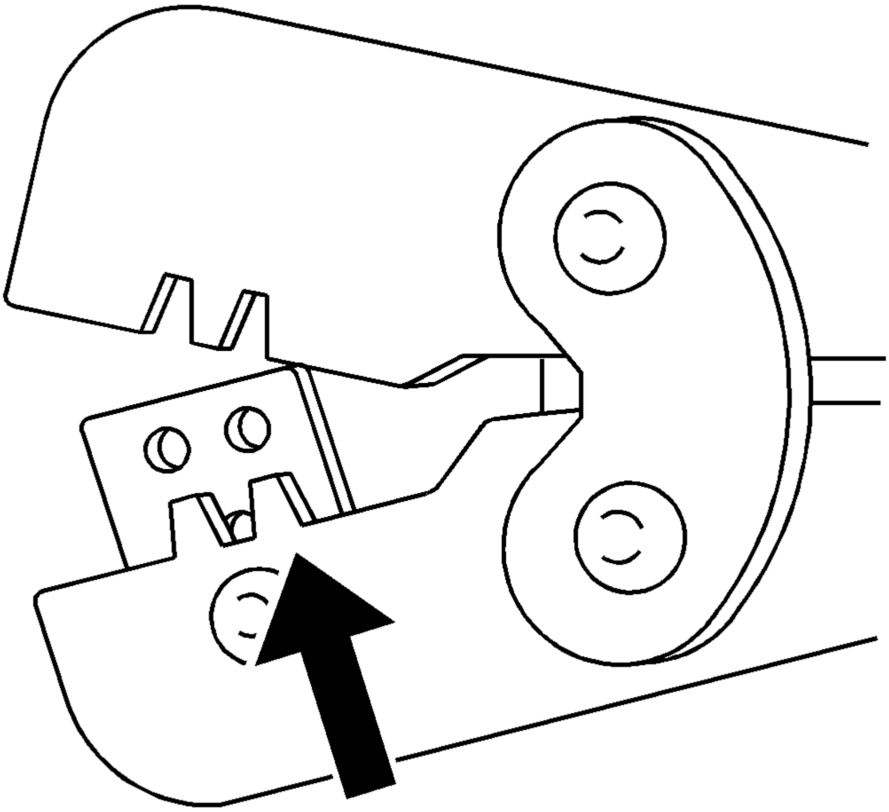


Fig. 203: Identifying Crimping Tool Spring Loaded Locator
Courtesy of GENERAL MOTORS COMPANY

3. Depress the spring loaded locator of the crimping tool until the terminal holder is completely visible.

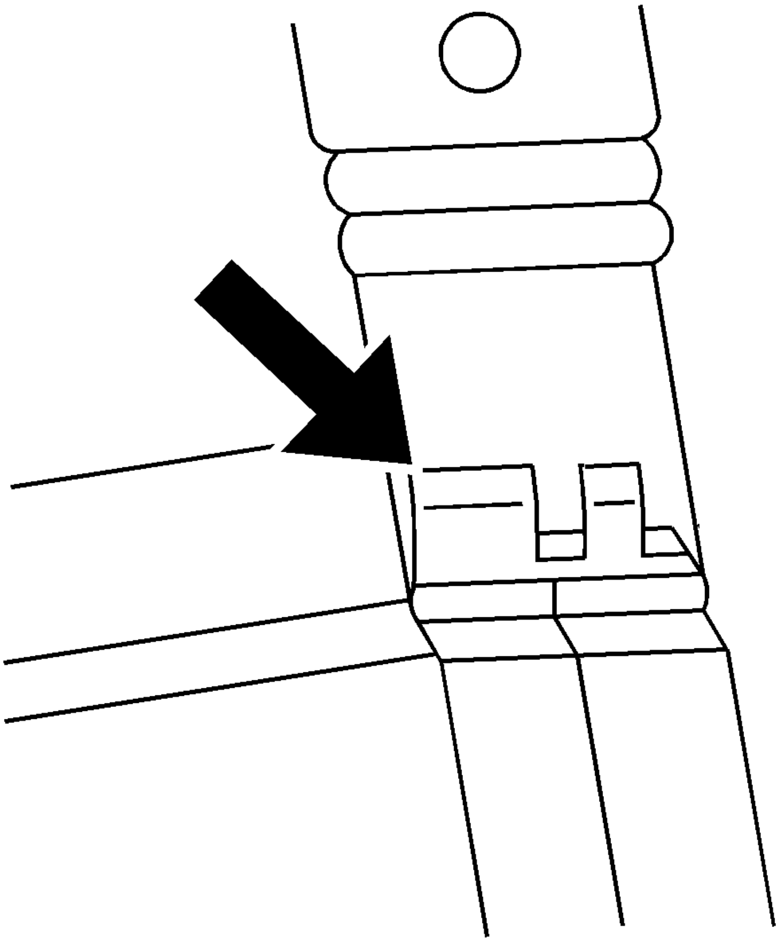


Fig. 204: Identifying Terminal Holder
Courtesy of GENERAL MOTORS COMPANY

4. Insert terminal into the appropriate terminal holder until it hits bottom and stops. The correct terminal holder is determined by the wire size. Also ensure that the terminals wings are pointing towards the former on the tool and the release locator.
5. Insert the stripped cable into the terminal. Insulation should be visible on both sides of the terminal insulation wings.
6. Compress the handles until the ratchet automatically releases.
7. Place the terminal into the appropriate cavity and assemble the connector.

TERMINAL REMOVAL

Special Tools

- **EL-38125-550** Terminal Release Tool Kit
- **EL-38125-580** Terminal Release Tool Kit
- **EL-35616** Terminal Test Probe Kit

For equivalent regional tools, refer to Special Tools .

NOTE: **All repairs near the engine manifold, turbo engine and all exhaust pipes should follow the High Temperature Wiring Repair procedures.**

1. Find the appropriate connector end view within the connector end view section. The connector end view has the following information:
    - Diagnostic probe tool
    - Terminal release tool
    - Terminal/terminated lead part numbers

NOTE: **Not using the proper test kit probe may cause damage to the terminal(s) that are probed.**

2. Determine if a terminal is damaged.
    1. Locate the diagnostic probe tool from the connector end view. The connector end view describes the color and part number to help the technician find and use the correct tool.
    2. Connect the probe tool to the Digital Multimeter.
    3. Insert the probe tool into the cavity and follow the procedures from the **Troubleshooting with a Digital Multimeter** .
3. Disconnect the connector body to perform the repair.
4. Use the following procedure to remove the terminal from the connector body.

NOTE: **Several procedures for specific connector bodies are called out in the Wiring Repairs section.**

1. The terminal position assurance (TPA) and connector position assurance (CPA) should be removed before releasing the terminal for the connector body.
2. Look at the connector end view to locate the cavity of the damaged terminal and find the proper terminal release tool from the terminal release tool kit.

NOTE: **Using the incorrect terminal release tool can damage the connector body.**

NOTE: **Some terminals have a lever that must be disengaged before the terminal can be released.**

3. Insert the terminal release tool into the cavity.

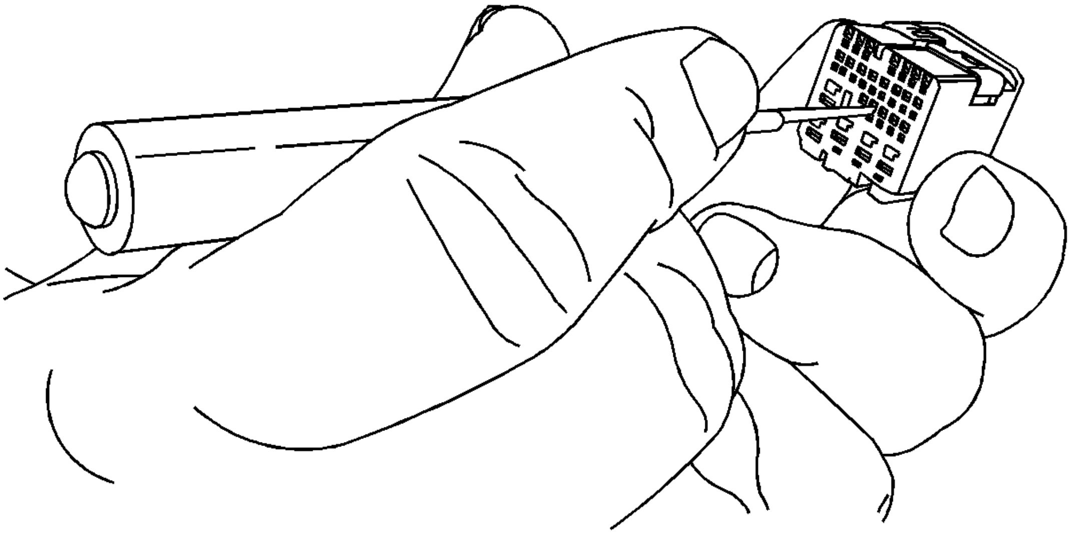


Fig. 205: Gently Pulling Wire Out Of Back Of Connector
Courtesy of GENERAL MOTORS COMPANY

5. Gently pull the wire out of the back of the connector.
6. Repair the terminal by following the Repairing Connector Terminals (Terminated Lead Repair)Repairing Connector Terminals (Terminal Repair) procedure.
7. Insert the repaired terminal back into the cavity. Repeat the diagnostic procedure to verify the repair and reconnect the connector bodies.

RELAY REPLACEMENT (ATTACHED TO WIRE HARNESS)

Removal Procedure

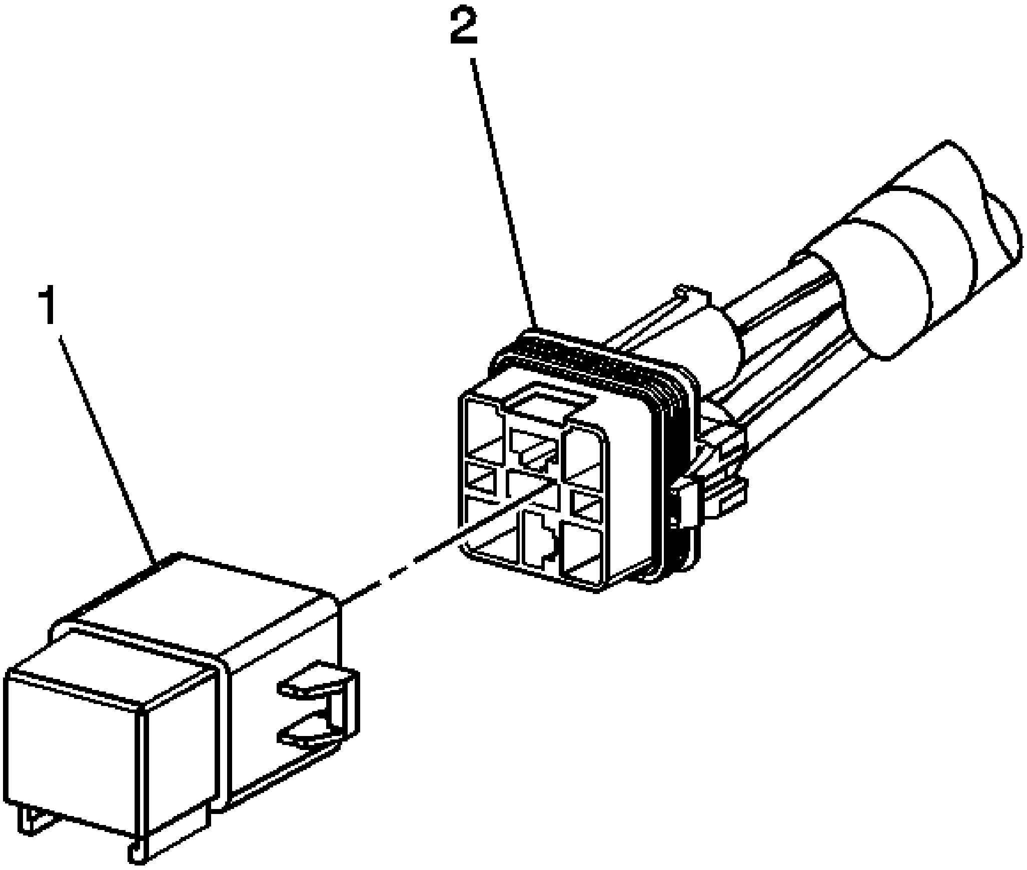


Fig. 206: Identifying Relay & Wire Harness Connector
Courtesy of GENERAL MOTORS COMPANY

1. Locate the relay. Refer to the Master Electrical Component List to locate the relay in the vehicle.
2. Remove any fasteners which hold the relay in place.
3. Remove any connector position assurance (CPA) devices or secondary locks.

NOTE: **Use care when removing a relay in a wiring harness when the relay is secured by fasteners or tape.**

4. Separate the relay (1) from the wire harness connector (2).

Installation Procedure

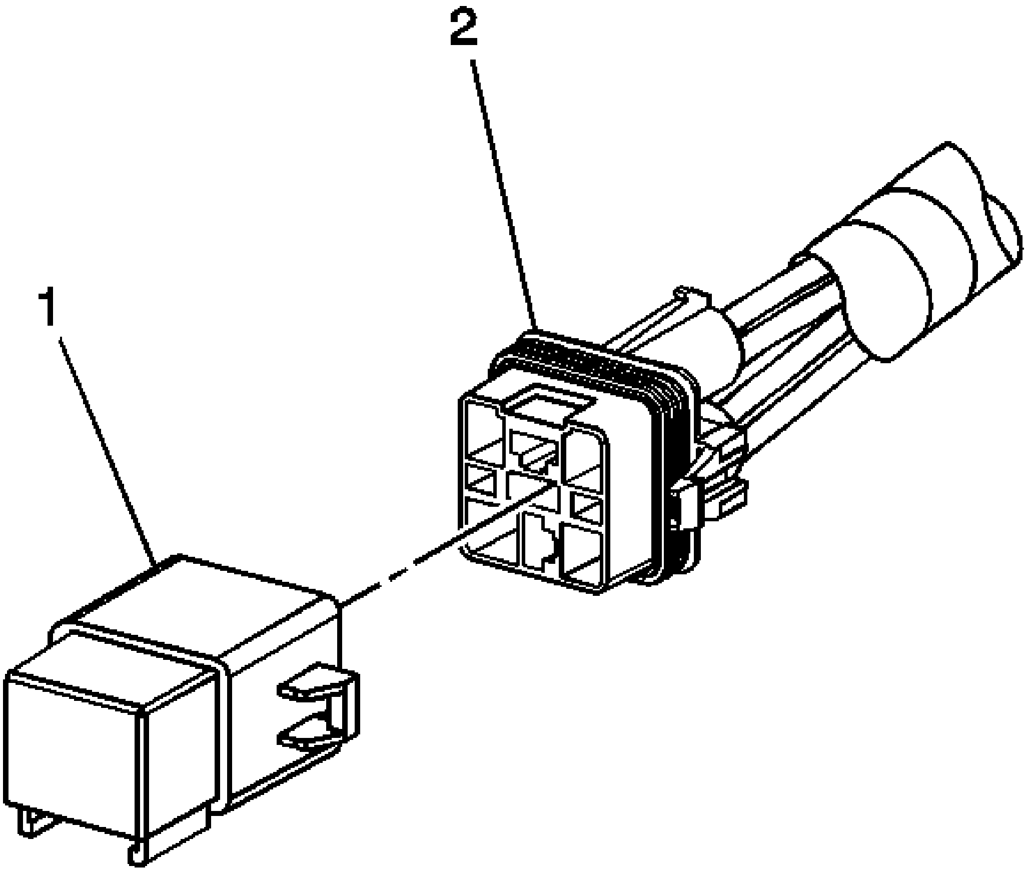


Fig. 207: Identifying Relay & Wire Harness Connector
Courtesy of GENERAL MOTORS COMPANY

1. Connect the relay (1) to the wire harness connector (2).
2. Install any connector position assurance (CPA) devices or secondary locks.
3. Install the relay using any fasteners or tape that originally held the relay in place.

RELAY REPLACEMENT (WITHIN AN ELECTRICAL CENTER)

Special Tools

EL-43244 Relay Puller Pliers

Removal Procedure

1. Remove the electrical center cover.

NOTE:

- **Always note the orientation of the relay.**
- **If equipped with a notch style relay; observe the location of the notch on the old relay to verify the new relay is installed with the notch in the same location.**
- **Ensure that the electrical center is secure, as not to put added stress on the wires or terminals.**

2. Locate the relay. Refer to Electrical Center Identification Views to locate the electrical center where the relay exists.

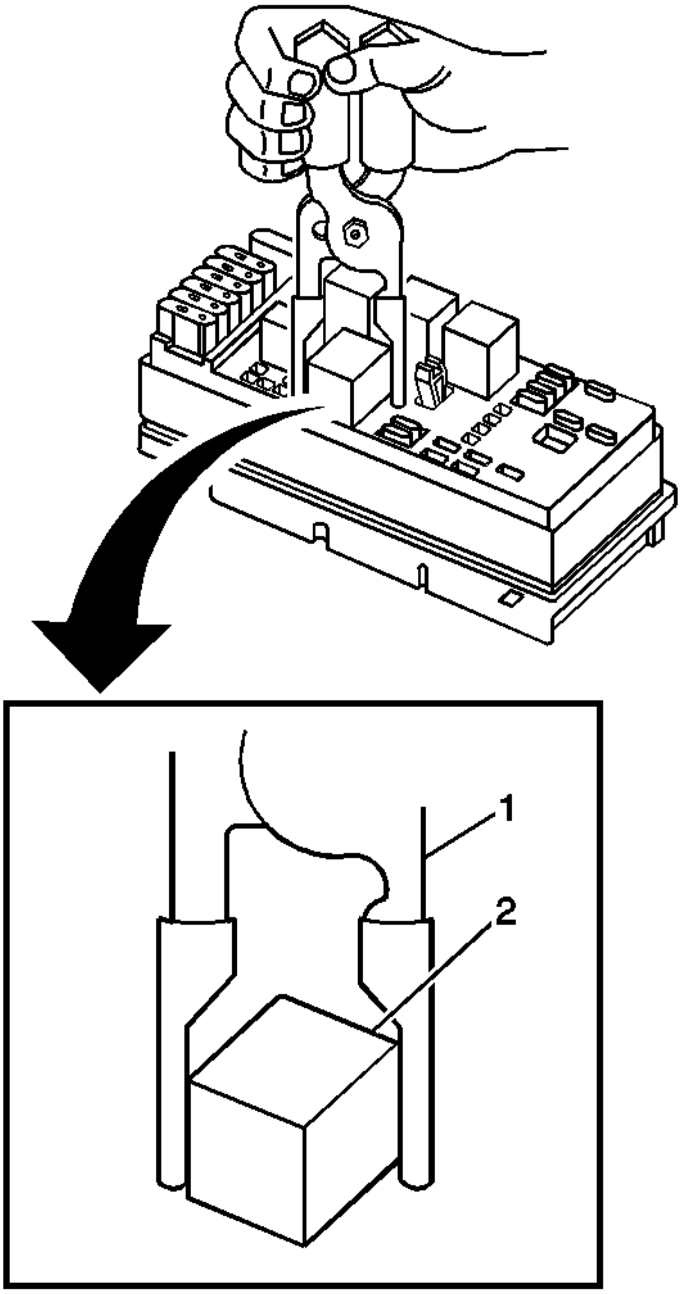


Fig. 208: Removing/Installing Relay
Courtesy of GENERAL MOTORS COMPANY

3. Using the EL-43244 (1) position the tool on opposing corners of the relay (2).

CAUTION: **Use EL-43244 to pull the relay straight out from the electrical center terminals. The use of pliers or a flat bladed tool could damage the electrical center.**

4. Remove the relay (2) from the electrical center.

Installation Procedure

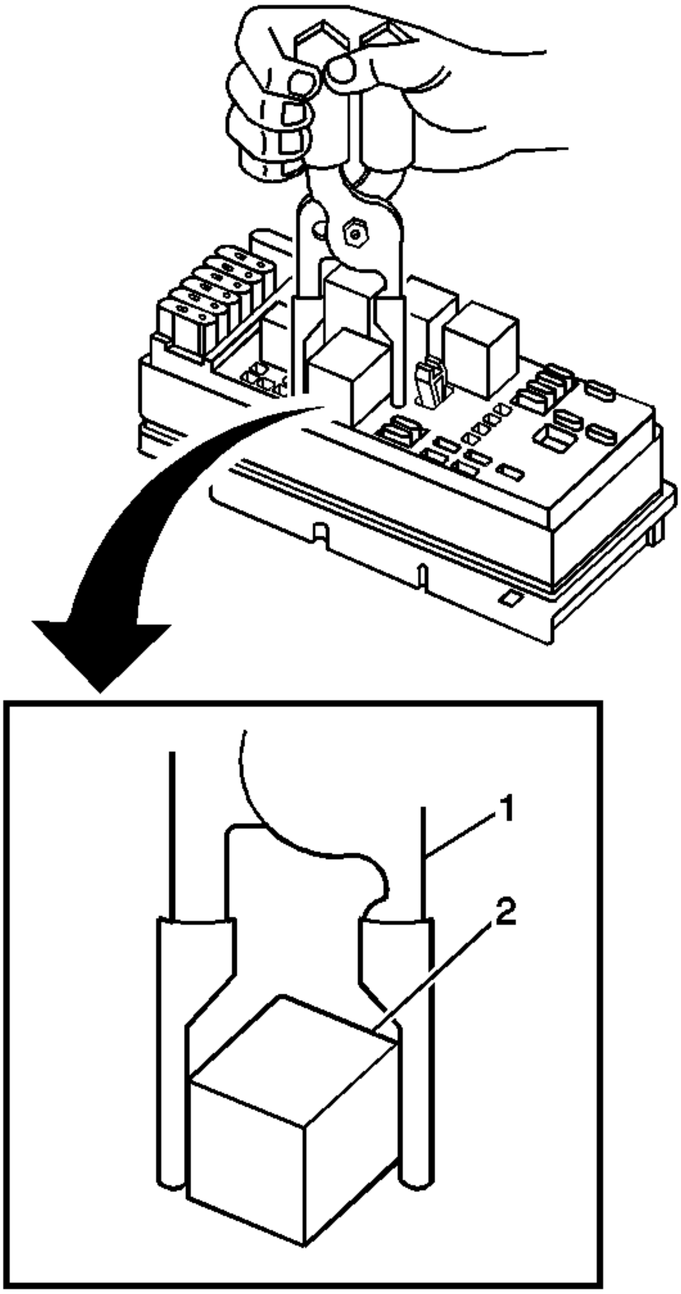


Fig. 209: Removing/Installing Relay
Courtesy of GENERAL MOTORS COMPANY

1. Install the relay (2) in the same position as removed.
2. Install the electrical center cover.

GROUND REPAIR

Electrical Grounds

Proper electrical system function relies on secure, positive, corrosion-free ground connections. Loose, stripped, or corroded connections increase the possibility of improper system function and loss of module communication. These conditions may also lead to unnecessary repairs and component replacements.

In general, electrical ground connections are accomplished using one, or a combination of, three attachment methods:

- Welded M6 stud and nut
- Welded M6 nut and bolt
- Welded M8 nut and bolt

CAUTION: Use GM approved replacement fasteners with conductive finish for electrical ground repair.

Determine which attachment method is used, and carry out the appropriate repair.

M6 Weld Stud Replacement

1. Select a location adjacent the damaged or missing M6 ground stud having 20 mm (0.79 in) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the M6 rivet stud flange.
2. Using GM approved residue-free solvent or equivalent, remove any grease from the repair site and allow to dry.

   NOTE: Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.

3. Drill a 10 mm (0.40 in) diameter hole through the panel.
4. Carefully remove paint and primer from the area surrounding the rivet stud flange until bare metal is visible.

   CAUTION: Use GM approved replacement fasteners with conductive finish for electrical ground repair.

5. Select a replacement conductive M6 rivet stud. Reference the GM parts catalog for the correct part number and application.
6. Using a rivet stud installer, install the replacement conductive M6 rivet stud.
7. Ensure the new rivet stud is securely fastened, with no detectable movement.

   NOTE: The rivet stud and surrounding panel area must be properly refinished prior to the installation of the ground terminal and nut to maintain positive electrical grounding.

8. Completely wrap the threads of the rivet stud with painters tape or equivalent.
9. Refinish the repair area using an anti-corrosion primer.
10. Allow the refinished repair area to cure sufficiently before removing the protective material applied to the rivet stud threads.
11. Remove the painters tape or equivalent from the rivet stud threads.
12. Using GM approved residue-free solvent or equivalent, thoroughly clean the rivet stud threads to remove any adhesive and allow to dry.
13. Carefully remove any corrosion from the electrical ground wire terminal. Testing for Intermittent Conditions and Poor Connections
14. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new conductive M6 rivet stud threads.
15. Install the ground terminal to the new rivet stud.
16. Select a new, conductive M6 nut. Reference the GM parts catalog for the correct part number and application.

   CAUTION: Fastener Caution

17. Install the conductive M6 nut and tighten to 8 N.m (71 lb in).
18. Check for proper system operation.

M6 Weld Nut

CAUTION: **Use GM approved replacement fasteners with conductive finish for electrical ground repair.**

1. If the M6 weld nut at the electrical ground location is damaged or stripped, a new, conductive self-threading M7 bolt may be used to secure the ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Using GM approved residue-free solvent or equivalent, remove any grease from the surface surrounding the weld nut and allow to dry.
3. Remove any loose metal particles from the damaged or stripped weld nut with a stiff brush.
4. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new, conductive, self-threading M7 bolt threads.
5. Carefully remove any corrosion from the electrical ground terminal. Testing for Intermittent Conditions and Poor Connections
6. Install the electrical ground terminal to the new, conductive M7 bolt.

CAUTION: Fastener Caution

7. Install the conductive M7 bolt and tighten to 9 N.m (80 lb in).
8. Check for proper system operation.

M6 Weld Nut (Alternative Repair)

CAUTION: **Use GM approved replacement fasteners with conductive finish for electrical ground repair.**

1. If the electrical ground location is accessible from both sides of the panel, a conductive M6 bolt and a conductive M6 nut may be used to secure the electrical ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Select a location adjacent the damaged M6 weld nut having 20 mm (0.79) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the new electrical ground site.
3. Using GM approved residue-free solvent or equivalent, remove any grease from the surface surrounding the ground location and allow to dry.

NOTE: **Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.**

4. Drill a 10 mm (0.40 in) diameter hole through the panel.
5. Carefully remove paint and primer from the area surrounding the new ground site until bare metal is visible.
6. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new, conductive M6 bolt threads.
7. Carefully remove any corrosion from the electrical ground terminal. Testing for Intermittent Conditions and Poor Connections
8. Install the electrical ground terminal and new, conductive M6 bolt to the ground location.

CAUTION: Fastener Caution

9. Install the conductive M6 nut and tighten to 8 N.m (71 lb in).

NOTE: **The repair area must be properly refinished to maintain positive electrical grounding.**

10. Refinish the repair area using an anti-corrosion primer.
11. Check for proper system operation.

M8 Weld Nut

CAUTION: **Use GM approved replacement fasteners with conductive finish for**

electrical ground repair.

1. If the M8 weld nut electrical ground location is accessible from both sides of the panel, a conductive M8 bolt and a conductive M8 nut may be used to secure the ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Select a location adjacent to M8 weld nut having 20 mm (0.79 in) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the new electrical ground site.
3. Using GM approved residue-free solvent or equivalent, remove any grease from the surface surrounding the ground location and allow to dry.

NOTE: **Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.**

4. Drill a 10 mm (0.40 in) diameter hole through the panel.
5. Carefully remove paint and primer from the area surrounding the new ground site until bare metal is visible.
6. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new, conductive M8 bolt threads.
7. Carefully remove any corrosion from the electrical ground terminal. **Testing for Intermittent Conditions and Poor Connections**
8. Install the electrical ground terminal and new, conductive M8 bolt to the ground location.

CAUTION: **Fastener Caution**

9. Install the conductive M8 nut and tighten to 22 N.m (16 lb ft).

NOTE: **The repair area must be properly refinished to maintain positive electrical grounding.**

10. Refinish the repair area using an anti-corrosion primer.
11. Check for proper system operation.

M8 Weld Nut (Alternative Repair)

CAUTION: **Use GM approved replacement fasteners with conductive finish for electrical ground repair.**

1. If the M8 weld nut electrical ground location is not accessible from both sides of the panel, a conductive M6 rivet stud and a conductive M6 nut may be used to secure the ground terminal. Reference the GM parts catalog for the correct part number and application.
2. Select a location adjacent the damaged M8 weld nut having 20 mm (0.79 in) clearance behind the panel surface and 20 mm (0.79 in) clearance surrounding the new, conductive M6 rivet stud flange.
3. Using GM approved residue-free solvent or equivalent, remove any grease from the repair site and allow to dry.

NOTE: **Ensure 20 mm (0.79 in) clearance is maintained behind the panel to be drilled.**

4. Drill a 10 mm (0.40 in) diameter hole through the panel.
5. Carefully remove paint and primer from the area surrounding the rivet stud flange until bare metal is visible.
6. Using a rivet stud installer, install the replacement conductive M6 rivet stud.
7. Ensure the new rivet stud is securely fastened, with no detectable movement.

NOTE: **The rivet stud and surrounding panel area must be properly refinished prior to the installation of the ground terminal and nut to maintain positive electrical grounding.**

8. Completely wrap the threads of the rivet stud with painters tape or equivalent.
9. Refinish the repair area using an anti-corrosion primer.
10. Allow the refinished repair area to cure sufficiently before removing the protective material applied to the rivet stud threads.
11. Remove the painters tape or equivalent from the rivet stud threads.
12. Using GM approved residue-free solvent or equivalent, thoroughly clean the rivet stud threads to remove any adhesive and allow to dry.
13. Carefully remove any corrosion from the electrical ground wire terminal. **Testing for Intermittent Conditions and Poor Connections**
14. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the new conductive M6 rivet stud threads.
15. Install the ground terminal to the new, conductive M6 rivet stud.

    CAUTION: **Fastener Caution**

16. Install the conductive M6 nut and tighten to 8 N.m (71 lb in).
17. Check for proper system operation.

Securing Loose Electrical Ground Connections

If the electrical ground connection is loose and the ground attachments are not damaged, properly securing the loose electrical ground may be all that is necessary. Carry out the following procedure to secure loose electrical ground connections.

CAUTION: **Use GM approved replacement fasteners with conductive finish for electrical ground repair.**

1. Using GM approved residue-free solvent or equivalent, thoroughly clean the ground stud threads and allow to dry.
2. Carefully remove any corrosion from the electrical ground wire terminal. **Testing for Intermittent Conditions and Poor Connections**
3. Using a small brush, apply Dielectric Lubricant GM P/N 12377900 (Canadian P/N 10953529) to the ground stud threads.
4. Install the ground wire terminal to the ground stud.

   CAUTION: **Fastener Caution**

5. Install the appropriate conductive nut.
    - Conductive M6 nut: Tighten to 8 N.m (71 lb in)
    - Conductive M8 nut: Tighten to 22 N.m (16 lb ft)
    - Conductive M10 nut: Tighten to 45 N.m 33 lb ft)
6. Check for proper system operation.

ON/OFF VEHICLE SWITCH REPLACEMENT

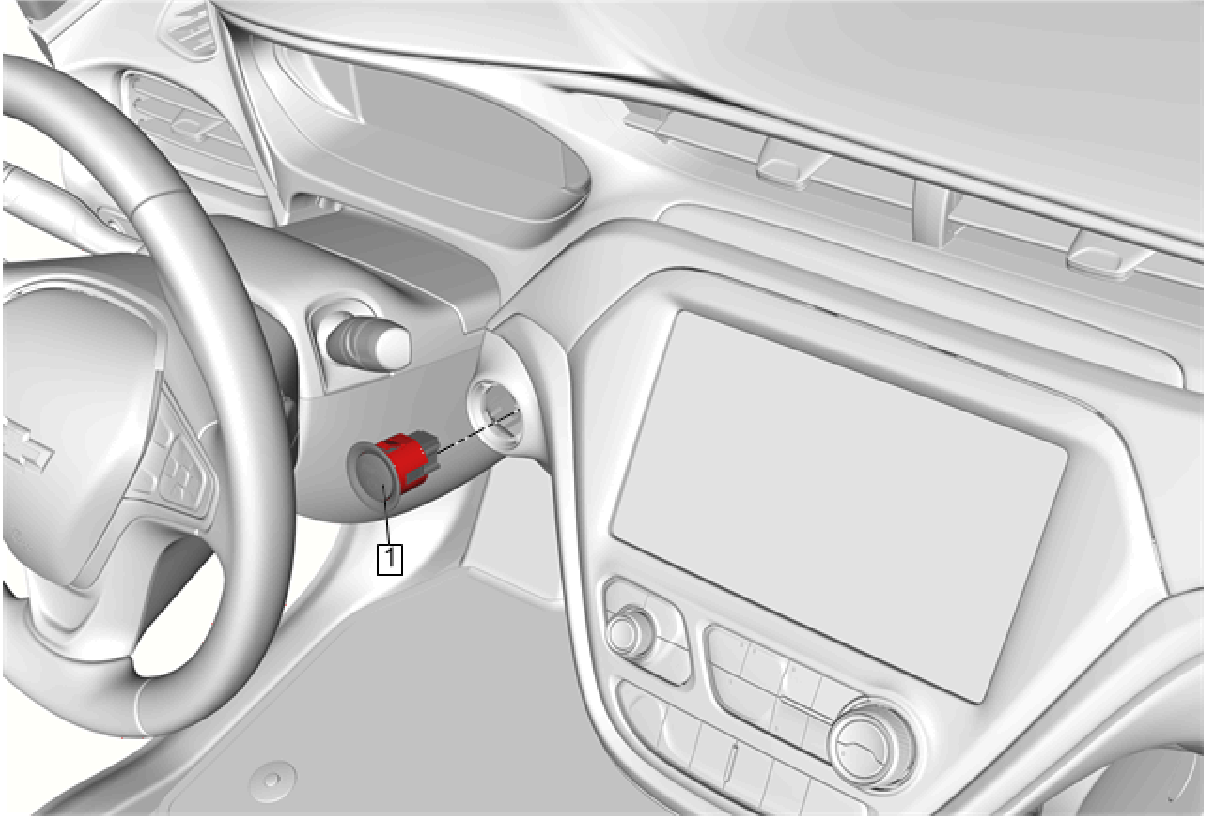


Fig. 210: On/Off Vehicle Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	On/Off Vehicle Switch **Procedure** 1. Using a plastic trim tool, release the switch bezel from the trim pad and remove. 2. Disconnect the electrical connector.

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AUTOMATIC STOP/START DISABLE

General Motors

AUTO STOP/START DISABLE

NOTE: **General Motors calls this function, Auto Stop or Engine Stop-Start System.**

DISABLE CONDITIONS

On General Motors vehicles equipped with the auto stop/start feature, there may or may not be an auto stop/start off button. For vehicles without the button, any or some of the following conditions may prevent the engine from automatically stopping while parked:

- Transmission is in P position
- Engine compartment hood is open
- Driver's seat belt is unlatched
- Driver's door is open
- Windshield defroster is on
- A/C is set to Manual and is running at Max.

DISABLE BUTTON

Vehicles with the auto stop/start off button, press the button to switch the system off. The button may illuminate. Deactivation using the button lasts only one key cycle. Press the button again to restore auto stop/start function.

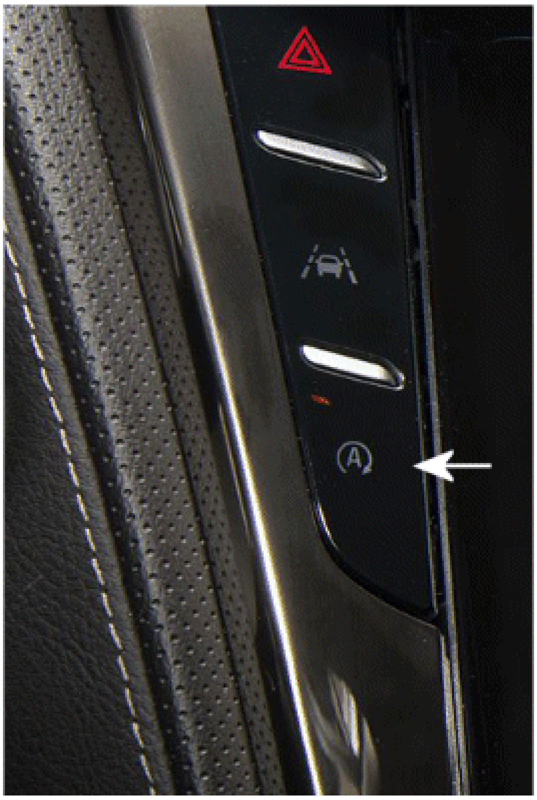

Fig. 1: Typical Auto Stop/Start Off Button
Courtesy of GM

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2017 BRAKES

Antilock Brake System - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Brake Pressure Modulator Valve Insulator
Brake Pressure Modulator Valve Insulator Nut
Brake Pressure Modulator Valve Insulator Washer

Reusable Threaded Fastener Tightening Specifications

Application	Specification Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Brake Pipe Fitting	18 N.m (13 lb ft)
Brake Pressure Modulator Valve Bracket Nut	22 N.m (16 lb ft)
Brake Pressure Modulator Valve Front Pipe Fitting	25 N.m (18 lb ft)
Brake Pressure Modulator Valve Insulator Nut	8 N.m (71 lb in)
Brake Pressure Modulator Valve Rear Pipe Fitting	25 N.m (18 lb ft)
Electronic Brake Control Module Bolt	3 N.m (27 lb in)
Front Wheel Speed Sensor Bolt	9 N.m (80 lb in)
Rear Wheel Speed Sensor Bolt	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

ANTILOCK BRAKE SYSTEM WIRING SCHEMATICS

Power, Ground, Serial Data and Traction Control Switch

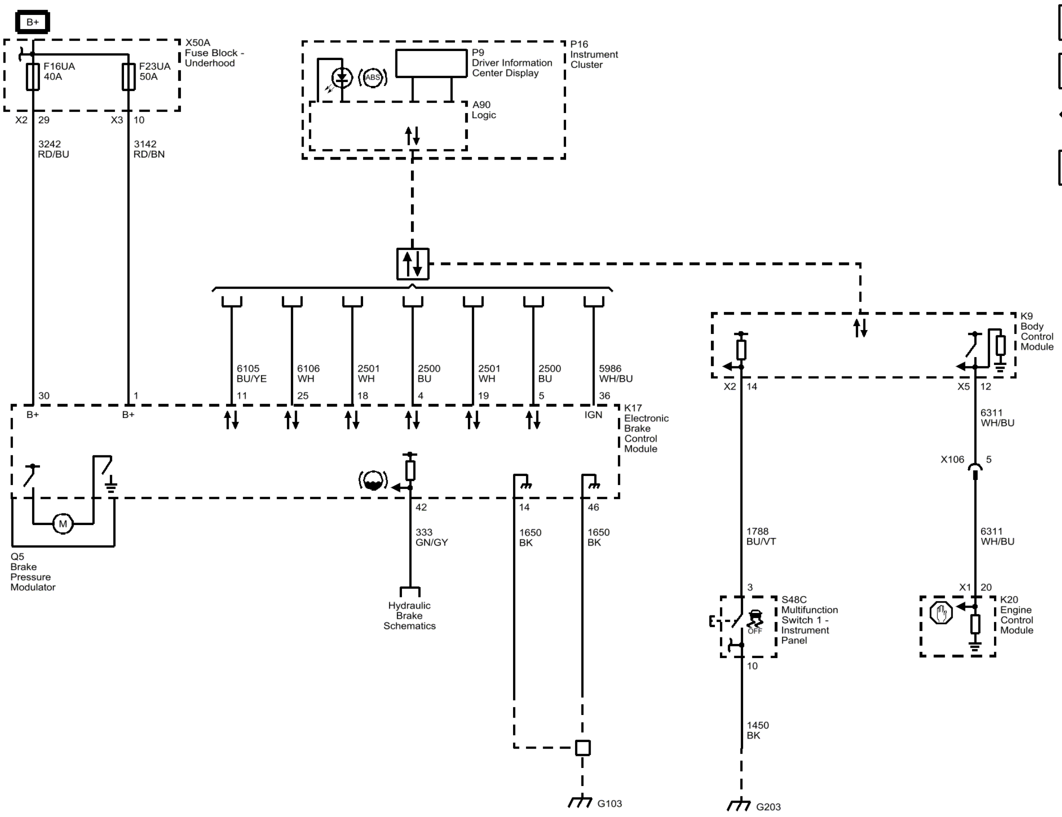
B+
X50A Fuse Block - Underhood
F16UA 40A
F23UA 50A
X2 29
X3 10
3242 RD/BU
3142 RD/BN
P16 Instrument Cluster
P9 Driver Information Center Display
ABS
A90 Logic
K9 Body Control Module
X2 14
X5 12
6105 BU/YE
6106 WH
2501 WH
2500 BU
2501 WH
2500 BU
5986 WH/BU
30
1
11
25
18
4
19
5
36
B+
B+
IGN
K17 Electronic Brake Control Module
42
14
46
M
Q5 Brake Pressure Modulator
333 GN/GY
Hydraulic Brake Schematics
1650 BK
1650 BK
G103
1788 BU/VT
3
S48C Multifunction Switch 1 - Instrument Panel
OFF
10
1450 BK
G203
6311 WH/BU
X106 5
6311 WH/BU
X1 20
K20 Engine Control Module

Fig. 1: Power, Ground, Serial Data and Traction Control Switch
Courtesy of GENERAL MOTORS COMPANY

Wheel Speed Sensors

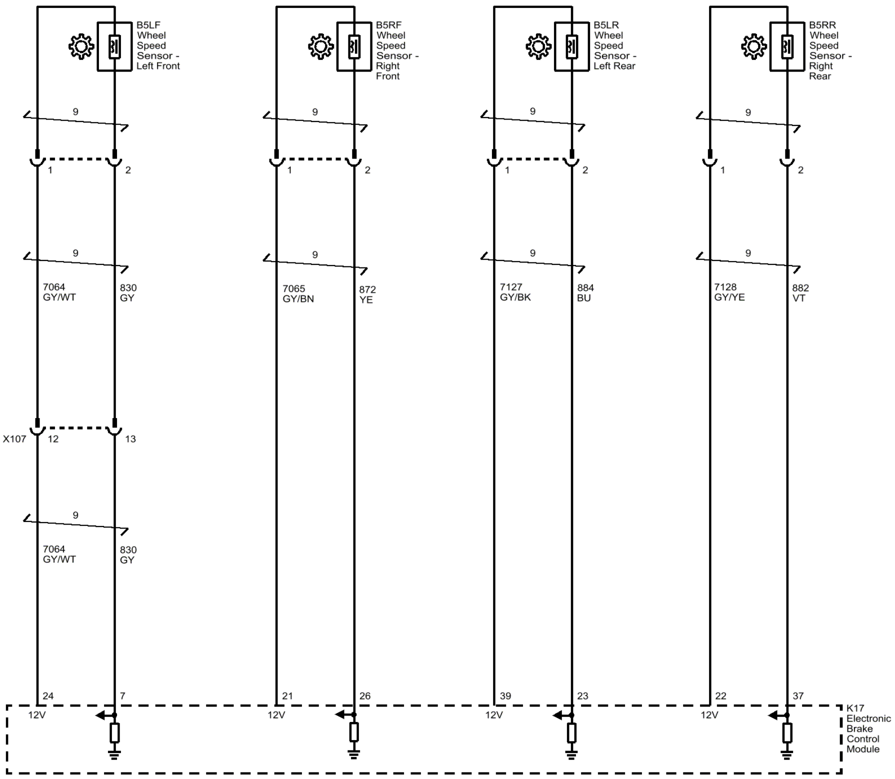
B5LF Wheel Speed Sensor - Left Front
B5RF Wheel Speed Sensor - Right Front
B5LR Wheel Speed Sensor - Left Rear
B5RR Wheel Speed Sensor - Right Rear
9
1
2
7064 GY/WT
830 GY
7065 GY/BN
872 YE
7127 GY/BK
884 BU
7128 GY/YE
882 VT
X107 12
13
24
7
21
26
39
23
22
37
12V
12V
12V
12V
K17 Electronic Brake Control Module

Fig. 2: Wheel Speed Sensors
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B2745: TRACTION CONTROL SWITCH CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B2745

Traction Control Switch Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Traction Control Switch Signal	B2745 02	1	1	-
Traction Control Switch Ground	-	1	-	-
1. Traction Control Switch Malfunction.				

Circuit/System Description

The body control module monitors the electronic stability control switch. When the electronic stability control switch is pressed once, the body control module will request the electronic brake control module via serial data to disable the traction control. When the electronic stability control switch is pressed and held for five seconds, the body control module will request the electronic brake control module to disable the stability control. The Electronic Brake Control Module will request the Instrument Cluster to turn the Traction Control Off and Stability Control Off indicator ON to notify the driver of the deactivation.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The body control module detects a short to ground on the signal circuit.

Action Taken When the DTC Sets

The body control module ignores the traction control switch signal input.

Conditions for Clearing the DTC

- When the condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

[ABS Description and Operation](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the Instrument Cluster indicators listed below turn ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
    - Traction Control Off indicator
    - Stability Control Off indicator
    - Traction/stability Control indicator
    - **If any indicator does not turn ON and OFF**

      Replace the P16 Instrument Cluster.
    - **If all indicators turn ON and OFF**
3. Verify the scan tool Body Control Module, Traction Control Switch parameter changes between Active and Inactive while pressing and releasing the S48C Multifunction Switch 1 - Instrument Panel.
    - **If the parameter does not change**

      Refer to Circuit/System Testing.
    - **If the parameter changes**
4. All OK.

Circuit/System Testing

NOTE: Circuit/System Verification must be performed before Circuit/System Testing.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48C Multifunction Switch 1 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Body Control Module, Traction Control Switch parameter is Inactive.
    - **If Active**
    1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 14 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.
6. Verify the scan tool Traction Control Switch parameter is Active.
    - **If Inactive**
    1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**
7. Test or replace the S48C Multifunction Switch 1 - Instrument Panel.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S48C Multifunction Switch 1 - Instrument Panel.
2. Test for infinite resistance between the signal terminal 3 and the ground terminal 10 with the switch in the open position.
    - **If less than infinite resistance**

      Replace the S48C Multifunction Switch 1 - Instrument Panel.

    - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 3 and the ground terminal 10 with the switch in the closed position.
    - **If 2 Ω or greater**

      Replace the S48C Multifunction Switch 1 - Instrument Panel.

    - **If less than 2 Ω**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Hazard Warning Switch Replacement
- Control Module References for Body Control Module or Instrument Cluster replacement, programming and setup.

DTC C0035-C0051: WHEEL SPEED SENSOR CIRCUITS

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC C0035

Left Front Wheel Speed Sensor Circuit

DTC C0036

Left Front Wheel Speed Sensor Range Performance

DTC C003A

Front Wheel Speed Sensors Circuits

DTC C0040

Right Front Wheel Speed Sensor Circuit

DTC C0041

Right Front Wheel Speed Sensor Range Performance

DTC C0045

Left Rear Wheel Speed Sensor Circuit

DTC C0046

Left Rear Wheel Speed Sensor Range Performance

DTC C0050

Right Rear Wheel Speed Sensor Circuit

DTC C0051

Right Rear Wheel Speed Sensor Range Performance

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal High - Left Front	C0035 00, C0035 02	C0035 00, C0035 06	C0245 00, C0245 01	C0035 18, C0035 0F, C0035 27
Signal Low - Left Front	C0035 00, C0035 02	C0035 00, C0035 06	C0035 00	C0035 18, C0035 0F, C0035 27
Signal High - Right Front	C0040 00, C0040 02	C0040 00, C0040 06	C0245 00, C0245 01	C0040 18, C0040 0F, C0040 27
Signal Low - Right Front	C0040 00, C0040 02	C0040 00, C0040 06	C0040 00	C0040 18, C0040 0F, C0040 27
Signal High - Left Rear	C0045 00, C0045 02	C0045 00, C0045 06	C0245 00, C0245 01	C0045 18, C0045 0F, C0045 27, C0055 67
Signal Low - Left Rear	C0045 00, C0045 02	C0045 00, C0045 06	C0045 00	C0045 18, C0045 0F, C0045 27, C0055 67
Signal High - Right Rear	C0050 00, C0050 02	C0050 00, C0050 06	C0245 00, C0245 01	C0050 18, C0050 0F, C0050 27, C0055 67
Signal Low - Right Rear	C0050 00, C0050 02	C0050 00, C0050 06	C0050 00	C0050 18, C0050 0F, C0050 27, C0055 67

Component	Condition	DTC Symptom Byte

Component	Condition	DTC Symptom Byte
Wheel Speed Sensor	• Physical damage • Debris on the wheel speed sensor or the encoder ring • Loose or worn wheel bearing • Loose or improperly mounted sensor • Air gap between the wheel speed sensor and the encoder ring too large • Water intrusion in the wiring harness • Incorrect part wheel speed sensor installed • Wheel speed sensor installed on incorrect side of same axle	08, 0F, 27, 29, 66, or 67

Circuit/System Description

Each wheel speed sensor receives ignition voltage through the signal high circuit from the electronic brake control module. Wheel speeds are detected by active wheel speed sensors and encoder rings. The magnetic encoder rings consists of multiple north and south pole pairs surrounding the outer circumference. When the encoder ring rotates and passes by the wheel speed sensor; it generates a sign wave in the wheel speed sensor. The sensor converts the signal to a digital square wave; the square wave values switch between 7mA (Low) and 14mA (High) DC current. As the wheel spins, the module uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

C0035 00 - C0050 00, C0035 18 - C0050 18, or C0035 27 - C0050 27

Ignition ON

C0035 0F - C0050 0F or C0035 5A - C0050 5A

Vehicle speed is greater than 60 km/h (37 MPH).

Conditions for Setting the DTC

C0035 00, C0040 00, C0045 00, or C0050 00

- A short to ground, or open/high resistance on the wheel speed sensor signal high circuit is detected for 0.2 sec.
- A short to voltage, short to ground, or open/high resistance on the wheel speed sensor signal low circuit is detected for 0.2 sec.

C0035 18, C0040 18, C0045 18, or C0050 18

- An erratic wheel speed sensor signal is detected.

C0035 0F, C0040 0F, C0045 0F, or C0050 0F

- Incorrectly mounted wheel speed sensor.
- Debris on the wheel speed sensor or the tone ring.
- Missing tooth or teeth on the wheel speed sensor tone ring.
- Air gap between the wheel speed sensor and the encoder ring.
- Electrical magnetic interference with the wheel speed sensor harness.

C0035 27, C0040 27, C0045 27, or C0050 27

- Debris on the wheel speed sensor tone ring.
- Missing tooth or teeth on the wheel speed sensor tone ring.
- Air gap between the wheel speed sensor and the encoder ring too large.

C0035 67, C0040 67, C0045 67, or C0050 67

- An incorrect part wheel speed sensor signal is detected.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- A driver information center message may be displayed.
- The electronic brake control module disables the ABS, the traction control, and the electronic stability program for the duration of the ignition cycle.

Conditions for Clearing the DTC

- When the condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the encoder ring.
- Inspect the wheel encoder ring for rust or corrosion.
- Inspect the wheel speed sensors and components for the correct parts.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If symptom code 0F, 27, or 5A is set, refer to the Diagnostic Fault Information table for possible mechanical faults or conditions.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Drive the vehicle in a straight line at a speed greater than 40 km/h (25 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.
    - **If any parameter is not within 1.6 km/h (1 MPH) of each other.**

      Refer to Circuit/System Testing.

    - **If each parameter is within 1.6 km/h (1 MPH) of each other.**
3. All OK.

Circuit/System Testing

1. Inspect the appropriate B5 Wheel Speed Sensor and encoder ring for contamination, metallic particles, physical damage, incorrect installation and the correct component.
    - **If contamination, physical damage, incorrect installation, or the wrong component is diagnosed**

      Repair or replace the applicable component.

    - **If no contamination, physical damage, incorrect installation, or the wrong component is not diagnosed**
2. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate B5 Wheel Speed Sensor and the harness connector at the K17 Electronic Brake Control Module, ignition ON.
3. Test for less than 1 V between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
    - B5LF Wheel Speed Sensor - Left Front - terminal 7 and terminal 24
    - B5LR Wheel Speed Sensor - Left Rear - terminal 23 and terminal 39
    - B5RF Wheel Speed Sensor - Right Front - terminal 26 and terminal 21
    - B5RR Wheel Speed Sensor - Right Rear - terminal 37 and terminal 22
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
4. Ignition OFF.
5. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
    - B5LF Wheel Speed Sensor - Left Front - terminal 7 and terminal 24
    - B5LR Wheel Speed Sensor - Left Rear - terminal 23 and terminal 39
    - B5RF Wheel Speed Sensor - Right Front - terminal 26 and terminal 21
    - B5RR Wheel Speed Sensor - Right Rear - terminal 37 and terminal 22
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
6. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal listed below:
    - B5LF Wheel Speed Sensor - Left Front - terminal 24
    - B5LR Wheel Speed Sensor - Left Rear - terminal 39
    - B5RF Wheel Speed Sensor - Right Front - terminal 21
    - B5RR Wheel Speed Sensor - Right Rear - terminal 22
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**

7. Test for less than 2 Ω between the B5 Wheel Speed Sensor harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal listed below:
    - B5LF Wheel Speed Sensor - Left Front - terminal 7
    - B5LR Wheel Speed Sensor - Left Rear - terminal 23
    - B5RF Wheel Speed Sensor - Right Front - terminal 26
    - B5RR Wheel Speed Sensor - Right Rear - terminal 37
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
8. Replace the B5 Wheel Speed Sensor.
9. Verify the DTC does not set while operating the vehicle within Conditions for Running the DTC.
    - **If the DTC sets**

      Replace the K17 Electronic Brake Control Module.

    - **If the DTC does not set**
10. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Wheel Speed Sensor Replacement**
- **Rear Wheel Speed Sensor Replacement**
- **Control Module References** for control module replacement, programming and setup.

DTC C0055: REAR WHEEL SPEED SENSOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0055

Rear Wheel Speed Sensor Circuit

For symptom byte information refer to **Symptom Byte List**

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors. Each wheel speed sensor receives a 12 V reference voltage from the electronic brake control module (EBCM) and provides an alternating current square wave signal to the EBCM. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed. The EBCM sends the wheel speed information as a high speed controller area network (CAN) serial data message.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

A supervised periodic message that includes the wheel speed serial data has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function or operate in degraded mode.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

This DTC can be set due to an incorrect part wheel speed sensor installed.

Circuit/System Verification

Ignition ON, observe the scan tool EBCM Wheel Speed Sensor parameters. The reading should be the same speed on all sensors when driving in a straight line at a speed greater than 20 km/h (13 MPH).

1. Drive the vehicle in a straight line at a speed greater than 40 km/h (25 MPH).
2. Verify all scan tool Wheel Speed Sensor parameters are within 1.6 km/h (1 MPH) of each other.
    - **If any parameter is not within 1.6 km/h (1 MPH) of each other.**

      Refer to Circuit/System Testing.

    - **If each parameter is within 1.6 km/h (1 MPH) of each other.**
3. All OK.

Circuit/System Testing

1. Ignition ON.
2. Verify that DTC C0035, C0040, C0045, or C0050 is not set in the EBCM.
    - **If any listed DTC is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** to diagnose that DTC prior to this diagnostic.

    - **If any listed DTC is not set**
3. Replace the K17 Electronic Brake Control Module.
4. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.

- **If the DTC sets**

  Replace the module that set the DTC.

- **If the DTC does not set**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup

DTC C005A: SIMULTANEOUS MALFUNCTION OF BOTH WHEEL SPEED SENSORS ON ONE AXLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C005A

Simultaneous Malfunction of Both Wheel Speed Sensors on One Axle

For symptom byte information refer to **Symptom Byte List**

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder ring consists of permanent magnets. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. As the wheel spins, the module uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

- Vehicle in Service Mode or Vehicle ON
- Ignition voltage is greater than 10 V.
- Two wheel speeds are greater than 5 km/h (3 MPH).

Conditions for Setting the DTC

Simultaneous dropout of both wheel speed sensors on the same axle.

Actions Taken when the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction control/stability control indicator turns ON.
- The Service Brake Assist and Service StabiliTrak messages are displayed on the driver information center.
- The electronic brake control module disables the antilock brake system, the dynamic rear proportioning, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition on.
2. Verify that DTC C005A is not set.
    - **If the DTC is set**

      Refer to **DTC C0035-C0051**.

    - **If the DTC is not set**
3. All OK.

DTC C0110: PUMP MOTOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0110

Pump Motor Circuit

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0110 03	C0110 00	C0110 07	C0110 39, C0110 59
Ground	-	C0110 00	-	-

Component	Condition	DTC

Component	Condition	DTC
Pump Motor	• Wear • Damage • Lock	C0110 61

Circuit/System Description

The pump motor is an integral part of the brake pressure modulator, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When the ABS, the traction control or the electronic stability control operation is required, the module activates the pump motor relay and turns the pump motor on.

Conditions for Running the DTC

C0110 00

- Ignition ON
- The pump motor is commanded ON.

C0110 03, or C0110 07

- Ignition ON
- Vehicle speed is greater than 30 km/h (18.6 MPH) for 7 s.

C0110 39, C0110 59, or C0110 61

- Ignition ON
- Vehicle speed is greater than 60 km/h (37.3 MPH) for 5 s.

Conditions for Setting the DTC

C0110 00

An open/high resistance is detected on the pump motor switch circuit.

C0110 03

Low voltage is detected in the pump motor circuit.

C0110 07

A short to voltage is detected on the pump motor ground circuit.

C0110 39

A shorted circuit is detected in the pump motor circuit.

C0110 59

The pump motor is overheating.

C0110 61

- The pump motor is mechanically blocked.
- The pump motor is actuated but no generated motor voltage is detected.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.

- The driver information center may display a message.
- The electronic brake control module disables the ABS, the traction control and the stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- When the condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the ABS pump motor turns On and Off when commanding the ABS Motor On and Off with a scan tool.
    - **If the pump motor does not turn On and Off**

      Refer to Circuit/System Testing.

    - **If the pump motor turns On and Off**
3. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between ground circuit terminal 14 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
        - **If less than 10 Ω**
3. Ignition ON.
4. Verify that a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate and the circuit fuse is good**
  1. Ignition OFF, remove the test lamp.
  2. Test for less than 2 Ω in the B+ circuit end to end.
     - If 2 Ω or greater, repair the open/high resistance the in the circuit.
     - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
- **If the test lamp does not illuminate and the circuit fuse is open**
  1. Ignition OFF, remove the test lamp.
  2. Test for infinite resistance between the B+ circuit and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance, replace the Q5 Brake Pressure Modulator.
- **If the test lamp illuminates**

5. Replace the Q5 Brake Pressure Modulator.
6. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
   - **If the DTC sets**

     Replace the K17 Electronic Brake Control Module.

   - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Control Module replacement, programming and setup.

DTC C0115: PUMP MOTOR STUCK

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0115 61

Pump Motor Stuck

Diagnostic Fault Information

Component	Condition	DTCs
Pump Motor	Wear Damage Lock	C0115 61

Circuit/System Description

The pump motor is an integral part of the brake pressure modulator valve, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When the ABS, the traction control or the stability control operation is required, the electronic brake control module activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

- Ignition ON.
- Vehicle speed is greater than 60 km/h (37.3 MPH) for 5 s.

Conditions for Setting the DTC

- The pump motor is mechanically blocked.
- The pump motor is actuated but no generated motor voltage is detected.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The red brake indicator turns ON.
- The traction/stability control indicator turns ON.
- The driver information center may display a message.
- The electronic brake control module disables the ABS, the traction control and the stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The electronic brake control module will turn Off the indicators in the next ignition cycle.

Diagnostic Aids

DTC C0115 61 may set due to extended operation of the ABS, traction control, or the stability control system. Review with the customer the conditions under which the DTC set.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C0110 is not set.
    - **If DTC C0110 is set**

      Refer to **DTC C0110**.

    - **If DTC C0110 is not set**

3. Verify that DTC C0115 does not set while driving the vehicle under normal braking conditions.
    - **If DTC C0115 sets**

      Replace the Q5 Brake Pressure Modulator.

    - **If DTC C0115 does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement**
- **Control Module References** for Control Module replacement, programming and setup.

DTC C0116: PUMP MOTOR RELAY CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0116

Pump Motor Relay Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Component	Condition	DTCs
Pump motor relay	- Wear - Damage - Lock	C0116

Circuit/System Description

The pump motor is an integral part of the brake pressure modulator valve assembly, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation. When the ABS, traction control or stability control operation is required, the electronic brake control module activates the pump motor relay and turns the pump motor ON.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

- The pump motor relay has an internal failure
- The pump motor relay voltage is greater than threshold.

Action Taken When the DTC Sets

- The electronic brake control module disables the ABS, traction control, stability control and hill start assist for the duration of the ignition cycle.
- The ABS warning indicator turns ON.

- The traction control/stability control-active indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The electronic brake control module will turn OFF the indicators in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C0110 is not set.
    - **If DTC C0110 is set**

      Refer to **DTC C0110**to diagnose that DTC prior to this diagnostic.

    - **If DTC C0110 is not set**
3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup.

DTC C0121: VALVE RELAY CIRCUIT MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0121

Valve Relay Circuit Malfunction

For symptom byte information refer to Symptom Byte List

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C0121 00	C0121 00	-	-
Ground	-	C0121 00	-	-

Circuit/System Description

The valve relay is an integral part of the electronic brake control module (EBCM), while the solenoid valves are integral to the brake pressure modulator valve assembly. The valve relay is engaged during normal system operation and provides voltage to the solenoid valves. When the ABS control operation is required, the EBCM controls the solenoid valves by providing ground to the active solenoid valves.

Conditions for Running the DTC

- Vehicle speed is greater than 6 km/h (4 MPH) with the brake pedal not applied.

  OR

- Vehicle speed is greater than 15 km/h (9 MPH) and the brake pedal is not actuated.

Conditions for Setting the DTC

- The EBCM is requesting valve activation and the relay output voltage is low.
- The EBCM is not requesting valve activation and the relay output voltage is B+.
- The EBCM detects 3 or more solenoid valve circuits are open or shorted during the self-test.
- A malfunction exists within the EBCM.

Action Taken When the DTC Sets

- The EBCM disables the ABS for the duration of the ignition cycle.
- The ABS indicator turns ON.

Conditions for Clearing the DTC

- A current DTC clears when the diagnostic runs and passes.
- The EBCM will turn OFF the indicator and enable the system functions in the next ignition cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
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- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Ignition ON, command the ABS Solenoid Valves On and Off with the scan tool. The solenoid valves should turn ON and OFF.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module (EBCM).
2. Test for less than 5 Ω between the ground circuit terminals listed below:
    - Ground circuit terminal 14 and ground.
    - Ground circuit terminal 46 and ground.
    - **If greater than 5 Ω**

      Test/repair the ground circuit for an open/high resistance.

    - **If less than 5 Ω**

      Replace the K17 Electronic Brake Control Module

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for EBCM replacement, setup and programming

DTC C0131: TRACTION CONTROL SYSTEM PRESSURE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0131

Traction Control System Pressure Circuit

Symptom Byte Information: **Symptom Byte List**

Circuit/System Description

For an overview of the component/system, refer to:**ABS Description and Operation**

Circuit	Description
B+ - Terminal 1	The output circuit is switched from ground to 12 V to activate the component.
Ground - Terminal 14	Grounded through the control module.

Component	Description
Q5 Brake Pressure Modulator	The pump motor is an integral part of the brake pressure modulator, while the pump motor relay is integral to the electronic brake control module. The pump motor relay is not engaged during normal system operation.

Component	Description
K17 Electronic Brake Control Module	When ABS, traction control or stability control operation is required, the electronic brake control module activates the pump motor.

Conditions for Running the DTC

- Engine Running - Gasoline/Diesel
- Propulsion Active - Hybrid/EV
- Slowly press and release the brake pedal.

Conditions for Setting the DTC

C0131 00

Brake Pedal Pressure Signal InvalidorErratic

C0131 1A

Brake Pressure Sensor=Out Of Range

C0131 3B

Brake Pressure Sensor=Not Calibrated

C0131 5A

- Brake Pressure Sensor=Out Of Range
- Brake Pedal Pressure Signal InvalidorErratic
- Brake Pressure=Not Plausible

Actions Taken When the DTC Sets

- Traction/Stability Control Indicator=ON
- The EBCM disables the ABS, traction control, stability control and hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The conditions for setting the DTC no longer exist.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Apply the brake pedal.
3. Verify the function:The stop lamps, also known as brake lamps, are activated when the driver applies the vehicle's brakes.
    - **If the function is NOT executed as expected**

      Refer to:Symptoms - Lighting
    - **If the function is executed as expected**
4. Verify DTC C0131 is not set.
    - **If DTC C0131 is set**
    1. Calibrate the brake pressure modulator valve pressure sensor.
    2. Verify the DTC does not set.
        - If the DTC sets - Replace the component:K17 Electronic Brake Control Module & Q5 Brake Pressure Modulator
        - If the DTC is not set
    3. All OK.
    - **If the DTC is not set**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

For control module replacement, programming, and setup refer to: Control Module References

DTC C0161: ANTILOCK BRAKING SYSTEM BRAKE SWITCH CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC C0161

Antilock Braking System Brake Switch Circuit

For symptom byte information, refer to Symptom Byte List

Circuit/System Description

When the brake pedal is applied, the body control module sends a serial data message to the electronic brake control module in reference to the brake pedal positions. The electronic brake control module compares the correlation between the brake pedal position and the amount of brake pressure it senses from the brake pressure sensor, which is internal to the brake pressure modulator. It uses this information to control the vehicle during an stability event.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

- The electronic brake control module detects four accelerations from standstill to a vehicle speed greater 40 km/h (26 MPH) without any brake pedal position signal changes.

- The electronic brake control module detects the vehicle speed is greater than 20 km/h (13 MPH), the brake pedal is applied for six minutes, and brake pressure is less than 15 bar (218 PSI).

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Action Taken When the DTC Sets

No actions are taken

Diagnostic Aids

This DTC may set if the brake pedal is applied while accelerating.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC C0277 or C0890 is not set.
    - **If either DTC is set**

      Refer to **DTC C0277 or C0890** .

    - **If either DTC is not set**
3. Verify the brake pedal position sensor or the brake pedal is not binding causing residual brake pressure to be detected, while the brake lights operate properly.
    - **If a condition is found**

      Repair or replace the applicable component.

    - **If a condition is not found**
4. Verify the scan tool Electronic Brake Control Module Brake Pedal Applied parameter changes between Yes and No while applying and releasing the brake pedal.
    - **If the parameter does not change between Yes and No**

      Refer to **Symptoms - Lighting** .

    - **If the parameter changes between Yes and No**

5. Refer to Diagnostic Aids, All OK.

DTC C0179: BRAKE SYSTEM CALCULATED COMPONENT OVERHEAT PROTECTION TIME-OUT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0179 59

Brake System Calculated Component Overheat Protection Time-Out

Circuit/System Description

The electronic brake control module monitors how often the traction control or the stability control system activates in order to calculate an estimate of the front brake discs temperature. In most cases the high temperatures are caused by extended traction control activation. If the electronic brake control module calculates that the front brake components temperatures are too high, the electronic brake control module will temporarily suspend the traction control system function until the front brake discs cool down.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

The electronic brake control module detects the calculated temperature of the brake components is higher than 500Ã‚Â°C (932Ã‚Â°F).

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control, the stability control and the electronic brake distribution for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

DTC C0179 does not indicate a malfunction has occurred. This DTC indicates there was excessive ABS, traction control or stability control activation that caused the high temperatures.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

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Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Since most occurrences of this DTC are caused by excessive brake usage, review with the customer the conditions under which the DTC set.**

1. Allow the brakes to cool down before performing test.
2. Verify that no other DTCs are set.
   - **If any other DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If no other DTCs are set**
3. Verify DTC C0179 does not set while driving the vehicle under normal braking conditions.
   - **If the DTC sets**

     Replace the K17 Electronic Brake Control Module.

   - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming, and setup

DTC C0186, C018B, C0196, C019B, C027E, OR C0287: LATERAL/LONGITUDINAL ACCELERATION SENSOR SIGNAL/YAW RATE SIGNAL

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC C0186

Lateral Acceleration Sensor Signal (Electronic Brake Control Module)

DTC C018B

Lateral Acceleration Sensor Signal (Multi-axis Acceleration Sensor Module)

DTC C0196

Yaw Rate Signal (Electronic Brake Control Module)

DTC C019B

Yaw Rate Signal (Multi-axis Acceleration Sensor Module)

DTC C027E

Longitudinal Acceleration Sensor Signal (Multi-axis Acceleration Sensor Module)

DTC C0287

Longitudinal Acceleration Sensor Signal (Electronic Brake Control Module)

For symptom byte information refer to **Symptom Byte List**

Circuit/System Description

The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, internal to the inflatable restraint sensing and diagnostic module. The multi-axis acceleration sensor communicates with the electronic brake control module via serial data. The electronic brake control module activates the stability control function depending on the multi-axis acceleration sensor input. The inflatable restraint sensing and diagnostic module uses the multi-axis acceleration sensor to determine if the vehicle is in a roll over or near collision incident.

Conditions for Running the DTC

- Ignition ON begins the initialization of the brake system power-up self test.
- Drive the vehicle at speeds greater than 16 km/h (10 MPH) to complete the active brake system test.

Conditions for Setting the DTC

C0186 00 or C018B 5A

The lateral acceleration signal is out of the specified range.

C0186 5A

The lateral acceleration signal is not plausible with the yaw rate signal, steering angle signal and vehicle speed.

C0186 71

- The electronic brake control module received an invalid lateral acceleration signal.
- An open/high resistance is detected on the multi-axis acceleration ground circuit.
- A short to ground or open/high resistance is detected on the multi-axis acceleration ignition circuit.

C0196 00 or C019B 5A

The yaw rate signal is out of the specified range.

C0196 5A

- The yaw rate signal offset is out of the specified range.
- The yaw rate signal is not plausible with the lateral acceleration signal, the steering angle signal and the vehicle speed.

C0196 71

- A short to ground or open/high resistance is detected on the ignition circuit.
- The electronic brake control module received an invalid lateral acceleration signal.
- An open/high resistance is detected on the multi-axis acceleration ground circuit.

C027E 5A

The longitudinal acceleration signal is not plausible.

C0287 4B

The longitudinal acceleration sensor is not calibrated.

C0287 5A

The longitudinal acceleration signal is not plausible with the vehicle speed.

C0287 71

- An open/high resistance is detected on the multi-axis acceleration ground circuit.
- The electronic brake control module received an invalid longitudinal acceleration signal.
- A short to ground or open/high resistance is detected on the multi-axis acceleration ignition circuit.

Action Taken When the DTC Sets

- The traction control Off indicator turns ON.
- The traction/stability control indicator turns ON.
- A Traction Control Off message may be displayed.
- A Service Stabilitrak message may be displayed.
- The electronic brake control module disables the traction control and the stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify DTC B101D is not set current or history in the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If DTC B101D is set current or history in the K36 Inflatable Restraint and Sensing Diagnostic Module**

Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B101D is not set current or history in the K36 Inflatable Restraint and Sensing Diagnostic Module**

2. Verify DTC C0186, C0196, or C0287 is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If any of the DTCs are set**

      Perform the **Vehicle Yaw Sensor Learn**.

    - **If none of the DTCs are set**
3. Verify DTC C0187, C0196, or C0287 is not set in the K17 Electronic Brake Control Module.
    - **If any of the DTCs are set**
    1. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
        - If the DTC sets, replace the K17 Electronic Brake Control Module.
        - If the DTC does not set
    3. All OK.
    - **If none of the DTCs are set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Module References** for Electronic Brake Control Module replacement, programming and setup

DTC C0245: WHEEL SPEED SENSOR FREQUENCY

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0245

Wheel Speed Sensor Frequency

For symptom byte information refer to **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal High - Left Front	C0035 00	C0035 00	C0245 00	-
Signal High - Right Front	C0040 00	C0040 00	C0245 00	-
Signal High - Left Rear	C0045 00	C0045 00	C0245 00	-
Signal High - Right Rear	C0050 00	C0050 00	C0245 00	-

Component	Condition	DTC Symptom Byte

Component	Condition	DTC Symptom Byte
Wheel Speed Sensor	• Wheel speed sensor incorrectly mounted	66

Circuit/System Description

Each wheel speed sensor receives ignition voltage through the signal high circuit from the electronic brake control module. Wheel speeds are detected by active wheel speed sensors and encoder rings. The magnetic encoder rings consists of multiple north and south pole pairs surrounding the outer circumference. When the encoder ring rotates and passes by the wheel speed sensor; it generates a sign wave in the wheel speed sensor. The sensor converts the signal to a digital square wave; the square wave values switch between 7mA (Low) and 14mA (High) DC current. As the wheel spins, the module uses the frequency of the square wave signal to calculate the wheel speed.

Conditions for Running the DTC

- DTC C0035, C0040, C0045, or C0050 is not present.
- Vehicle speed is between 20 km/h (13 MPH) and 50 km/h (31 MPH).
- While driving a curve with a yaw-rate of 3Ã‚Â° per second for greater than 9 s.

Conditions for Setting the DTC

- A short to voltage on any one of the wheel speed sensor ignition circuits.
- A electrical magnetic interference with the wheel speed sensor harness.
- Difference between the fastest and slowest wheel speed is greater than 6 km/h (4 MPH).
- If two or more wheel speed sensor faults are detected without the ABS warning lamp being turned ON.
- The electronic brake control module cannot determine a specific wheel speed sensor signal because of electrical interference.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction control Off indicator turns ON.
- The stability control Off indicator turns ON.
- The traction/stability control indicator turns ON.
- The driver information center displays the Service StabiliTrak message.
- The electronic brake control module disables the ABS, the traction control, and the stability control for the duration of the ignition cycle.

Conditions for Clearing the DTC

- When the condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

- Do not use a magnet to clean the encoder ring.
- Check for electrical magnetic interference with the wheel speed sensor harness.
- If two or more wheel speed sensors are inoperative, diagnose each wheel speed sensor individually.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

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ABS Description and Operation

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that all tires have the proper air pressure.
    - **If not the proper air pressure**

      Adjust all tire air pressures to the stated cold air pressure as identified on the tire placard or specification.

    - **If the proper air pressure**
2. Verify that all tires are of uniform size and matching brand.
    - **If not of uniform size or matching brand**
    1. Replace the mis-sized or non-matching brand tire.
    2. Ignition ON.
    3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
        - If the DTC set, replace the K17 Electronic Brake Control Module.
        - If the DTC does not set
    4. All OK.
    - **If all tires are of uniform size and matching brand**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
2. Test for less than 1 V between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
    - B5LF Left Front Wheel Speed Sensor - terminal 7
    - B5RF Right Front Wheel Speed Sensor - terminal 26
    - B5LR Left Rear Wheel Speed Sensor - terminal 23
    - B5RR Right Rear Wheel Speed Sensor - terminal 37
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

- **If less than 1 V**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C0274: ISOLATION VALVE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0274

Isolation Valve

Circuit/System Description

The solenoid valves are integral parts of the brake pressure modulator. The brake pressure modulator contains an isolation solenoid valve and a dump solenoid valve for each wheel. A traction/stability control supply solenoid valve and a isolation solenoid valve for each brake circuit. The solenoid valves are not engaged during normal system operation. When the ABS, the traction control or the stability control operation is required the electronic brake control module turns the required solenoid ON.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

The calculated solenoid valve temperature is greater than the threshold.

Action Taken When the DTC Sets

C0274 54

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the ABS, the traction control, the stability control and the hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

DTCs may set due to extended operation of the ABS, the traction control or the stability control.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Since most occurrences of this DTC are caused by excessive ABS or traction control usage, review with the customer the conditions under which the DTC set.**

1. Ignition ON.
2. Verify that DTC C0186, C0187, C0196, C0287, or C0710 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Ignition OFF, allow the hydraulic brake pressure modulator to cool down to ambient temperature.
4. Ignition ON.
5. Verify that DTC C0274 54 is not set while driving the vehicle within normal braking conditions.
    - **If any of the DTCs are set**

      Replace the K17 Electronic Brake Control Module with Brake Pressure Modulator.

    - **If none of the DTCs are set**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for electronic brake control module replacement, programming and setup

DTC C0280: STABILITY SYSTEM ACTIVE TOO LONG

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0280

Stability System Active Too Long

For symptom byte information, refer to **Symptom Byte List**

Circuit/System Description

The solenoid valves are integral parts of the brake pressure modulator valve. The brake pressure modulator valve contains an isolation solenoid valve and a dump solenoid valve for each wheel and a traction/ stability control supply solenoid valve and isolation solenoid valve for each brake circuit. The solenoid valves are not engaged during normal system operation. When the ABS, the traction control or the stability control operation is required the electronic brake control module turns the required solenoid valves ON.

Conditions for Running the DTC

- Ignition ON
- Vehicle speed is greater than 22 km/h (13.7 MPH).

Conditions for Setting the DTC

Calculated solenoid valve temperature is greater than threshold.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The traction/stability control indicator turns ON.
- A driver information center message may be displayed.
- The electronic brake control module disables the ABS, the traction control, the stability control, and the hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

This DTC may set due to extended operation of the ABS, the traction control or the stability control system.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **Since most occurrences of this DTC are caused by excessive ABS, traction control, or stability control usage, review with the customer the conditions under which the DTC set.**

1. Ignition ON.
2. Verify that DTC C0186, C0196, C0287, or C0710 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Ignition OFF, allow the hydraulic brake modulator valve to cool down to ambient temperature, ignition ON.
4. Verify the DTC does not set while driving the vehicle under normal braking conditions.
    - **If the DTC sets**
    1. Replace the Q5 Brake Pressure Modulator.
    2. Verify DTC C0280 does not set while driving the vehicle under normal braking conditions.
        - If the DTC does set, replace the K17 Electronic Brake Control Module.
        - If the DTC does not set.
    3. All OK.
    - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup.

DTC C0561: SYSTEM DISABLED INFORMATION STORED

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0561

System Disabled Information Stored

Symptom Byte Information: Symptom Byte List

Circuit/System Description

For an overview of the component/system, refer to:**ABS Description and Operation**

Circuit	Description
B+ - Terminal 1	The output circuit is switched from ground to 12 V to activate the component.
Low Reference	Grounded through the control module.

Component	Description

Component	Description
K17 Electronic Brake Control Module	The control module K17 can increase and decrease the brake pressure on all 4 wheels individually in order to fulfill these functions: • Antilock Braking • Traction Control • Vehicle Stability Control The control module K17 can also influence the following control modules to limit the amount of produced torque: • K20 Engine Control Module • K71 Transmission Control Module

Conditions for Running the DTC

- Engine Running - Gasoline/Diesel
- Propulsion Active - Hybrid/EV

Conditions for Setting the DTC

K17 Electronic Brake Control Module=Invalid Data Received - More than 10 times.

Actions Taken When the DTC Sets

- ABS Indicator Control=ON
- Traction/Stability Control Indicator=ON
- The EBCM disables the ABS, traction control, stability control and hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The conditions for setting the DTC no longer exist.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Diagnostic Aids

Diagnose other DTCs first.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0561 is not set.
   - **If any of the DTCs are set**
   1. Program the control module:K17 Electronic Brake Control Module
   2. Verify DTC C0561 is not set.
      - If the DTC sets - Replace the component:K17 Electronic Brake Control Module
      - If no DTC is set
   3. All OK.
   - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC C0569: SYSTEM CONFIGURATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0569

System Configuration

Circuit/System Description

The electronic brake control module receives serial data messages from other modules. The electronic brake control module must be configured with the Vehicle Identification Number (VIN), configuration data and vehicle options. If not properly configured after installation, the electronic brake control module may set a DTC.

The internal fault detection is handled inside the control module. No external circuits are involved.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

The electronic brake control module is not programmed.

Action Taken When the DTC Sets

- The traction/stability control indicator turns ON.
- The electronic brake control module disables the traction control, the stability control and the hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Diagnostic Aids

A newly replaced electronic brake control module can set one or more DTCs on its initial ignition ON cycle.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C0569 is not set.
   - **If the DTC is set**
   1. Reprogram the K17 Electronic Brake Control Module. Refer to **Control Module References** .
   2. Verity DTC C0569 is not set.
      - If the DTC is set, replace the K17 Electronic Brake Control Module.
      - If the DTC is not set
   3. All OK.
   - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C10EA: POWERTRAIN CONTROL MODULE INDICATED REQUESTED TORQUE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C10EA

Powertrain Control Module Indicated Requested Torque

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the regenerative braking. When certain engine control module DTCs are set, the engine control module will not be able to perform the regenerative braking. A serial data message is sent to the electronic brake control module indicating that regenerative braking is not allowed.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The engine control module diagnoses a condition preventing the engine control portion of the regenerative braking function and sends a serial data message to the electronic brake control module indicating that regenerative braking is not allowed.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C10EA.
    - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

3. Replace the K20 Engine Control Module.
4. Verify that DTC C10EA does not set while operating the vehicle under the Conditions for Running the DTC. You may also operate the vehicle under the conditions that you observed from the Freeze Frame/Failure Records data.
   - **If DTC C10EA sets**

     Replace the K17 Electronic Brake Control Module.

   - **If DTC C10EA does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C10EB: ENGINE CONTROL MODULE INDICATED TRACTION CONTROL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C10EB

Engine Control Module Indicated Traction Control

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the traction control. The electronic brake control module sends a serial data message to the engine control module requesting torque reduction. When certain engine control module DTCs are set, the engine control module will not be able to perform the torque reduction for traction control. A serial data message is sent to the electronic brake control module indicating that traction control is not allowed.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The engine control module diagnoses a condition preventing the engine control portion of the traction control function and sends a serial data message to the electronic brake control module indicating that torque reduction is not allowed.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C10EB.
   - **If any other DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
   - **If no other DTCs are set**
3. Replace the K20 Engine Control Module.
4. Verify that DTC C10EB does not set while operating the vehicle under the Conditions for Running the DTC. You may also operate the vehicle under the conditions that you observed from the Freeze Frame/Failure Records data.
   - **If DTC C10EB sets**

     Replace the K17 Electronic Brake Control Module.
   - **If DTC C10EB does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1200: POWERTRAIN SENSED BRAKE PEDAL INFORMATION MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C1200

Powertrain Sensed Brake Pedal Information Message Counter Incorrect

Circuit/System Description

The body control module monitors the brake pedal position sensor and sends a serial data message to the both the electronic brake control module and engine control modules when the brake pedal is applied. The engine control module compares the correlation between the brake pedal positions and the brake control brake pedal position sensor to sense the driver's application of the brake pedal.

Conditions for Running the DTC

- Vehicle ON
- The brake pedal is applied.
- The ignition voltage is greater than 10 V.
- The accelerator pedal position is greater than 20 %.

Conditions for Setting the DTC

The brake pedal position sensor signal is not applied while the brake control brake pedal position sensor indicates the brake pedal is applied.

Action Taken When the DTC Sets

A driver information center message and/or a warning indicator will not be displayed.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Diagnostic Aids

- DTC C1200 may set if the brake pedal is applied while accelerating.
- Check the Engine Control Module for any accelerator pedal DTCs and correct them first before diagnosing this DTC.

Reference Information

Schematic Reference

- **Antilock Brake System Schematics**
- **Exterior Lights Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1200.
    - **If any other DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If no other DTCs are not set**
3. Verify the brake pedal position sensor or the brake pedal is not binding causing residual brake pressure to be detected.
    - **If a condition is found**

      Repair or replace the applicable component.

    - **If a condition is not found**
4. Verify the scan tool electronic brake control module Brake Pedal Position Sensor Signal parameter changes between Applied and Released when applying and releasing the brake pedal.
    - **If the parameter does not change**

      Refer to Symptoms - Lighting .

    - **If the parameter changes**
5. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Electronic Brake Control Module replacement, programming and setup

DTC C124F OR C1250-C1254: LATERAL/LONGITUDINAL ACCELERATION SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC C124F

Lateral Acceleration Sensor Circuit Low Voltage

DTC C1250

Lateral Acceleration Sensor Circuit High Voltage

DTC C1251

Lateral Acceleration Sensor Performance

DTC C1252

Longitudinal Acceleration Sensor Circuit Low Voltage

DTC C1253

Longitudinal Acceleration Sensor Circuit High Voltage

DTC C1254

Longitudinal Acceleration Sensor Performance

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, internal to the inflatable restraint sensing and diagnostic module. The multi-axis acceleration sensor communicates with the electronic brake control module and trans control module via serial data. The electronic brake control module activates the stability control function depending on the multi-axis acceleration sensor input. The inflatable restraint sensing and diagnostic module uses the multi-axis acceleration sensor to determine if the vehicle is in a roll over or near collision incident. The transmission control module sets these DTCs.

Conditions for Running the DTC

Vehicle speed is greater than 16 km/h (10 MPH).

Conditions for Setting the DTC

The transmission control module detects a fault that prevents it from performing a hill hold start assist function.

Action Taken When the DTC Sets

- The air bag indicator turns ON.
- The traction/stability control indicator turns ON.
- The electronic brake control module disables the stability control and the hill hold start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The DTC clears when the diagnostic runs and passes.
- The history DTC will clear after 40 consecutive fault-free ignition cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that no other DTCs are set.
   - **If any other DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If no other DTCs are set**
3. Replace the K71 Transmission Control Module.
4. Verify that the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
   - **If the DTC sets**

     Replace the K17 Electronic Brake Control Module.

   - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Transmission Control Module replacement, programming, and setup

DTC C1284 OR C1285: BRAKE ASSIST INFORMATION MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C1284

Brake Assist Information 1 Message Counter Incorrect

DTC C1285

Brake Assist Information 2 Message Counter Incorrect

Circuit/System Description

The brake assist data is delivered from the brake booster control module to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the brake assist signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the brake booster control module for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1284 or C1285.
    - **If any other DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other DTCs are set**
3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1286: COMMANDED AXLE TORQUE MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C1286

Commanded Axle Torque Message Counter Incorrect

Circuit/System Description

The commanded axle torque data is delivered from the engine control module (ECM) to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the commanded axle torque signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.
- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the engine control module, hybrid powertrain control modules, and drive motor control modules for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1286.
    - **If any other DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other DTCs are set**
3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC C1287: REGENERATIVE BRAKING AXLE TORQUE ACHIEVED MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C1287

Regenerative Braking Axle Torque Achieved Message Counter Incorrect

Circuit/System Description

The regenerative braking axle torque data is delivered from the hybrid powertrain control module to the electronic brake control module (EBCM) via serial data.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The ignition voltage is greater than 10 V.

Conditions for Setting the DTC

The electronic brake control module detects that the regenerative braking axle torque signal value is not a continuous successor of the previous value.

Action Taken When the DTC Sets

- The ABS indicator turns ON.
- The MIL indicator may be on or flashing.
- The traction control/stability control indicator turns ON.
- The Service StabiliTrak message is displayed on the driver information center.

- The electronic brake control module disables the ABS, the traction control system and the electronic stability program for the duration of the drive cycle.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- The history DTC will clear after 40 consecutive fault-free drive cycles have occurred.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

Inspect the engine control module, hybrid powertrain control modules, and drive motor control modules for any DTCs.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set except for C1287.
    - **If any other DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other DTCs are set**
3. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Electronic Brake Control Module or Engine Control Module replacement, programming and setup

DTC P0856: TRACTION CONTROL TORQUE REQUEST CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**

- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC P0856

Traction Control Torque Request Circuit

Symptom Byte Information: Symptom Byte List

Circuit/System Description

For an overview of the component/system, refer to:ABS Description and Operation

Circuit	Description
B+ - Terminal 1	The output circuit is switched from ground to 12 V to activate the component.
Low Reference	Grounded through the control module.

Component	Description
K20 Engine Control Module	The control module contains a microprocessor used to process input data to control outputs. The control module controls a series of actuators to ensure optimal engine performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the engine actuators accordingly.
K17 Electronic Brake Control Module	The control module K17 can increase and decrease the brake pressure on all 4 wheels individually in order to fulfill these functions: • Antilock Braking • Traction Control • Vehicle Stability Control The control module K17 can also influence the following control modules to limit the amount of produced torque: • K20 Engine Control Module • K71 Transmission Control Module

Conditions for Running the DTC

- Engine Running - Gasoline/Diesel
- Propulsion Active - Hybrid/EV

Conditions for Setting the DTC

When certain DTCs are set in the engine control module, it will not be able to perform torque reduction for traction control. A serial data message is sent to the electronic brake control module indicating that torque reduction is currently not allowed.

Actions Taken When the DTC Sets

- Traction/Stability Control Indicator=ON
- The EBCM disables the ABS, traction control, stability control and hill start assist for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The conditions for setting the DTC no longer exist.

- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Verify there are no other DTCs set, except for DTC P0856.
    - **If any of the DTCs are set**

      Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If no other DTCs are set**
2. Replace the component:K20 Engine Control Module
3. Under normal operating conditions:Verify that no DTCs are set.
    - **If the DTC sets**

      Replace the component:K17 Electronic Brake Control Module

    - **If no DTC is set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P15F8: AUTOMATIC BRAKING ENGINE TORQUE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P15F8

Automatic Braking Engine Torque Request Signal Message Counter Incorrect

Circuit/System Description

The electronic brake control module and the engine control module simultaneously control the vehicle performance. During a automatic brake event the electronic brake control module sends a serial data message to the engine control module requesting torque reduction. If the engine control module receives corrupt data from the electronic brake control module, DTC P15F8 will set in the engine control module. The engine control module then sends a serial data message to the electronic brake control module that torque reduction is not allowed.

Conditions for Running the DTC

- The ignition is ON.
- Ignition voltage is greater than 8 V.

Conditions for Setting the DTC

The engine control module detects a corrupted data message from the electronic brake control module.

Action Taken When the DTC Sets

- The ABS remains functional.
- DTC P15F8 is a Type B DTC.
- The traction Off indicator turns ON.
- The traction/stability control indicator turns ON.
- The Service Stabilitrak message may be displayed on the driver information center.

Conditions for Clearing the DTC

DTC P15F8 is a Type B DTC.

Diagnostic Aids

Inspect the serial data circuits and connections at the engine control module and the electronic brake control module. They should be free from sources of electromagnetic interference and the connections should be clean and tight.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Verify that no other DTCs are set except for DTC P15F8.
    - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If only DTC P15F8 is set**

2. Replace the K17 Electronic Brake Control Module.
3. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
   - **If DTC sets**

     Replace the K20 Engine Control Module.

   - **If DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for electronic brake control module and engine control module replacement, programming and setup

DTC P15FD: WHEEL SPEED SENSOR MESSAGE SEQUENCE INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P15FD

Wheel Speed Sensor Message Sequence Incorrect

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors. Each wheel speed sensor receives a 12 V reference voltage from the electronic brake control module (EBCM) and provides an alternating current square wave signal to the EBCM. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed. The EBCM sends the wheel speed information as a high speed controller area network (CAN) serial data message.

Conditions for Running the DTC

Ignition ON

Conditions for Setting the DTC

A supervised periodic message that includes the wheel speed serial data has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function or operate in degraded mode.

Conditions for Clearing the DTC

A current DTC clears when the diagnostic runs and passes.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

- This DTC can be set due to an incorrect part wheel speed sensor installed.
- Inspect the wheel encoder ring for rust or corrosion.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Circuit/System Verification

Ignition ON, observe the scan tool EBCM Wheel Speed Sensor parameters. The reading should be the same speed on all sensors when driving in a straight line at a speed greater than 20 km/h (13 MPH).

Circuit/System Testing

1. Ignition ON.
2. Verify that DTC C0035, C0040, C0045, or C0050 is not set in the EBCM.
    - **If any listed DTC is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** to diagnose that DTC prior to this diagnostic.

    - **If any listed DTC is not set**
3. Replace the K17 Electronic Brake Control Module.
4. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.
    - **If the DTC sets**

      Replace the module that set the DTC.

    - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup

DTC P1B12: DRIVER INTENDED BRAKING TORQUE SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for a overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P1B12

Driver Intended Braking Torque Signal Message Counter Incorrect

Circuit/System Description

The electronic brake control module provides brake pedal position information to the engine control module, via the serial data circuit. The engine control module monitors a series of 16 rolling counts, with each count assigned a value, when the engine control module determines that too many of the counts have an incorrect value, the engine control module sets DTC P1B12.

Conditions for Running the DTC

- The propulsion system is active.
- DTC P1B12 runs continuously when the above condition is met.

Conditions for Setting the DTC

The engine control module detects that 10 of the 16 rolling counts have an incorrect value.

Action Taken When the DTC Sets

DTC P1B12 is a Type C DTC.

Conditions for Clearing the DTC

DTC P1B12 is a Type C DTC.

Diagnostic Aids

- DTC P1B12 is an informational DTC.
- Verify the electronic brake control module and engine control module contain the latest calibrations.
- Diagnose all other engine control module DTCs prior to DTC P1B12.
- Find out from the customer the conditions under which the DTC was set. This information may help duplicate the concern like the specific number of brake pedal applies in a row prior to the fault set.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that no other DTCs are set except for DTC P1B12 is set.
    - **If any other DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If no other DTCs are set**
2. Replace the K17 Electronic Brake Control Module.
3. Verify the DTC P1B12 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If only DTC P1B12 is set**

      Replace the K20 Engine Control Module.

    - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for Electronic Brake Control Module and Engine Control Module replacement, programming and setup.

SYMPTOMS - ANTILOCK BRAKE SYSTEM

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the Diagnostic System Check - Vehicle before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system description and operation in order to familiarize yourself with the system functions. Refer to ABS Description and Operation.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the ABS. Refer to Checking Aftermarket Accessories .
- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- ABS Indicator Malfunction
- Traction Control/Stability Control Indicator Malfunction
- Brake Warning Indicator Malfunction

ABS INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster turns the ABS indicator ON for 5 s after the ignition is turned ON, or when the electronic brake control module detects a fault it sends a serial data message to the instrument cluster commanding the indicator ON.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that no DTCs are set.
    - **If any DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If no DTCs are set**
3. Verify the Instrument Cluster ABS indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
    - **If ABS indicator does not turn ON and OFF**

      Replace the P16 Instrument Cluster.

    - **If the ABS indicator turns ON and OFF**
4. Verify the ABS indicator turns OFF 5 s after the ignition is turned ON.
    - **If the ABS indicator does not turn OFF**

Replace the K17 Electronic Brake Control Module.

- **If the ABS indicator turns OFF**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for electronic brake control module or instrument cluster replacement, programming and setup

TRACTION CONTROL/STABILITY CONTROL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Traction Control Switch Signal	B2745 02	1	1	-
Traction Control Switch Ground	-	1	-	-
1. Traction Control Switch Malfunction.				

Circuit/System Description

The instrument cluster illuminates the traction/stability control indicator, traction control off indicator and stability control off indicator for five seconds after the ignition is turned ON. When the electronic brake control module detects a fault it sends a serial data message to the instrument cluster commanding the traction/stability control indicator ON.

The body control module monitors the electronic stability control switch. When the electronic stability control switch is pressed once, the body control module will request the electronic brake control module via serial data to disable the traction control. When the electronic stability control switch is pressed and held for five seconds, the body control module will request the electronic brake control module to disable the stability control. The Electronic Brake Control Module will request the Instrument Cluster to turn the Traction Control Off and Stability Control Off indicator ON to notify the driver of the deactivation.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the Instrument Cluster indicators listed below turn ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
    - Traction Control Off indicator
    - Stability Control Off indicator
    - Traction/stability Control indicator
    - **If any indicator does not turn ON and OFF**

      Replace the P16 Instrument Cluster.
    - **If all indicators turn ON and OFF**
3. Verify the scan tool Body Control Module, Traction Control Switch parameter changes between Active and Inactive while pressing and releasing the S48C Multifunction Switch 1 - Instrument Panel.
    - **If the parameter does not change**

      Refer to Circuit/System Testing.
    - **If the parameter changes**
4. All OK.

Circuit/System Testing

NOTE: **Circuit/System Verification must be performed before Circuit/System Testing.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48C Multifunction Switch 1 - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON.
4. Verify the scan tool Body Control Module, Traction Control Switch parameter is Inactive.
    - **If Active**
    1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 14 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and ground.
6. Verify the scan tool Traction Control Switch parameter is Active.

- **If Inactive**
  1. Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
  2. Test for less than 1 V between the signal circuit and ground.
     - If 1 V or greater, repair the short to voltage on the circuit.
     - If less than 1 V.
  3. Test for less than 2 Ω in the signal circuit end to end.
     - If 2 Ω or greater, repair the open/high resistance in the circuit.
     - If less than 2 Ω, replace the K9 Body Control Module.
- **If Active**

7. Test or replace the S48C Multifunction Switch 1 - Instrument Panel.

Component Testing

1. Ignition OFF, disconnect the harness connector at the S48C Multifunction Switch 1 - Instrument Panel.
2. Test for infinite resistance between the signal terminal 3 and the ground terminal 10 with the switch in the open position.
   - **If less than infinite resistance**

     Replace the S48C Multifunction Switch 1 - Instrument Panel.

   - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 3 and the ground terminal 10 with the switch in the closed position.
   - **If 2 Ω or greater**

     Replace the S48C Multifunction Switch 1 - Instrument Panel.

   - **If less than 2 Ω**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Hazard Warning Switch Replacement
- Control Module References for Body Control Module or Instrument Cluster replacement, programming and setup.

REPAIR INSTRUCTIONS

ANTILOCK BRAKE SYSTEM AUTOMATED BLEED

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

NOTE: **Before performing the ABS Automated Bleed Procedure, first perform a pressure bleed of the base brake system. Refer to Hydraulic Brake System Bleeding . The automated bleed procedure is recommended when one of the following conditions exist:**

- **Base brake system bleeding does not achieve the desired pedal height or feel**
- **Extreme loss of brake fluid has occurred**
- **Air ingestion is suspected in the secondary circuits of the brake modulator assembly**

The ABS Automated Bleed Procedure uses a scan tool to cycle the system solenoid valves and run the pump in order to purge any air from the secondary circuits. These circuits are normally closed off, and are only opened during system initialization at vehicle start up and during ABS operation. The automated bleed procedure opens these secondary circuits and allows any air trapped in these circuits to flow out toward the brake corners.

Performing the Automated Bleed Procedure

CAUTION: **The Auto Bleed Procedure may be terminated at any time during the process by pressing the EXIT button. No further Scan Tool prompts pertaining to the Auto Bleed procedure will be given. After exiting the bleed procedure, relieve bleed pressure and disconnect bleed equipment per manufacturers instructions. Failure to properly relieve pressure may result in spilled brake fluid causing damage to components and painted surfaces.**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove all four tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
3. Inspect the brake system for leaks and visual damage. Repair or replace components as needed.
4. Lower the vehicle.
5. Inspect the battery state of charge. Refer to **Battery Inspection/Test** .
6. Install a scan tool.
7. Place the Power button in Service Only Mode.
8. With the scan tool, establish communications with the ABS system. Select Control Functions. Select Automated Bleed from the Control Functions menu.
9. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
10. Following the directions given on the scan tool, pressure bleed the base brake system. Refer to **Hydraulic Brake System Bleeding** .
11. Follow the scan tool directions until the desired brake pedal height is achieved.
12. If the bleed procedure is aborted, a malfunction exists. Perform the following steps before resuming the bleed procedure:
    - If a DTC is detected, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** , and diagnose the appropriate DTC.
    - If the brake pedal feels spongy, perform the conventional brake bleed procedure again. Refer to **Hydraulic Brake System Bleeding** .
13. When the desired pedal height is achieved, press the brake pedal to inspect for firmness.
14. Install the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** .
15. Lower the vehicle.
16. Remove the scan tool.
17. Inspect the brake fluid level. Refer to **Master Cylinder Reservoir Filling** .
18. Road test the vehicle while inspecting that the pedal remains high and firm.

STEERING WHEEL ANGLE SENSOR CENTERING

The steering angle sensor does not require centering often. Centering of the steering angle sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Wheel alignment
- Steering gear replacement
- Steering column replacement
- Collision or other physical damage
- Power steering control module replacement

The steering angle sensor centering procedure can be completed with a scan tool using the following steps:

1. Using the steering wheel, align and center the front wheels forward.
2. Apply the parking brake, or set the transmission in Park.
3. Install the scan tool to the data link connector.
4. Vehicle in Service Mode.
5. With the scan tool select the Power Steering Control Module.
6. Select the Steering Wheel Angle Sensor Centering under Configuration/Reset Functions list.
7. Follow the scan tool directions to complete the learn procedure.
8. With the scan tool select the Electronic Brake Control Module.
9. Select the Steering Wheel Angle Sensor Centering under Configuration/Reset Functions list.
10. Follow the scan tool directions to complete the learn procedure.
11. Clear any DTCs that may be set.
12. Vehicle OFF.

ELECTRONIC BRAKE CONTROL MODULE REPLACEMENT

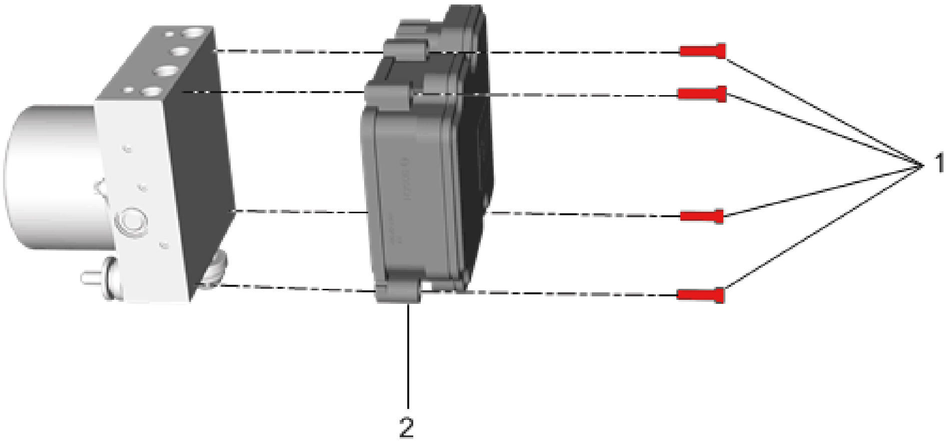


Fig. 3: Electronic Brake Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Brake Fluid Irritant Warning **CAUTION:** Brake Fluid Effects on Paint and Electrical Components Caution **CAUTION:** **Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.** **Preliminary Procedure** Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement	
1	Electronic Brake Control Module Bolt (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 3 N.m (27 lb in)
2	Electronic Brake Control Module **Procedure** 1. Program the electronic brake control module. Control Module References 2. Bleed the brake system. Hydraulic Brake System Bleeding 3. Calibrate the brake pressure modulator valve pressure sensor. Brake Pressure Modulator Valve Pressure Sensor Calibration

ELECTRONIC BRAKE CONTROL MODULE WITH BRAKE PRESSURE MODULATOR VALVE REPLACEMENT

Removal Procedure

WARNING: Brake Fluid Irritant Warning

CAUTION: Brake Fluid Effects on Paint and Electrical Components Caution

CAUTION: **Always connect or disconnect the wiring harness connector from the EBCM/EBTCM with the ignition switch in the OFF position. Failure to observe this precaution could result in damage to the EBCM/EBTCM.**

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Heater Coolant Surge Tank Replacement

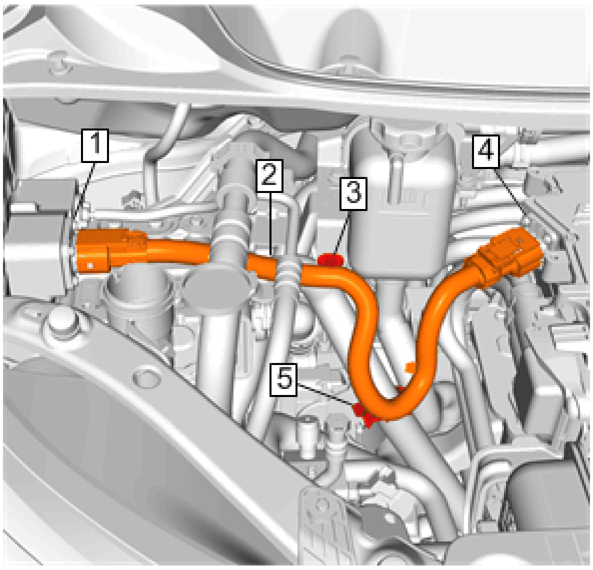


Fig. 4: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

3. Remove Drive Motor Battery Positive and Negative Cable (1)Drive Motor Battery Positive and Negative Cable Replacement

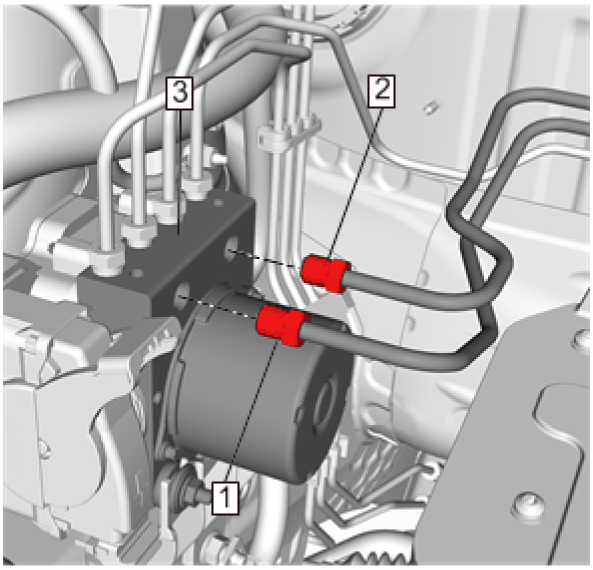


Fig. 5: Brake Pressure Modulator Valve Front Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fittings to prevent brake fluid loss and contamination.**

4. Remove Brake Pressure Modulator Valve Front Pipe Fitting (1) @Brake Pressure Modulator Valve (3)
5. Remove Brake Pressure Modulator Valve Rear Pipe Fitting (2) @Brake Pressure Modulator Valve (3)

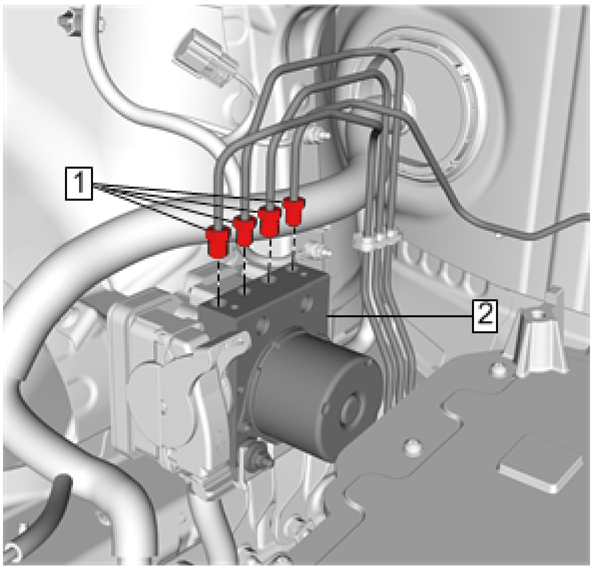


Fig. 6: Brake Pressure Modulator Valve And Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fittings to prevent brake fluid loss and contamination.**

6. Remove Brake Pipe Fitting (1) @Brake Pressure Modulator Valve (2)

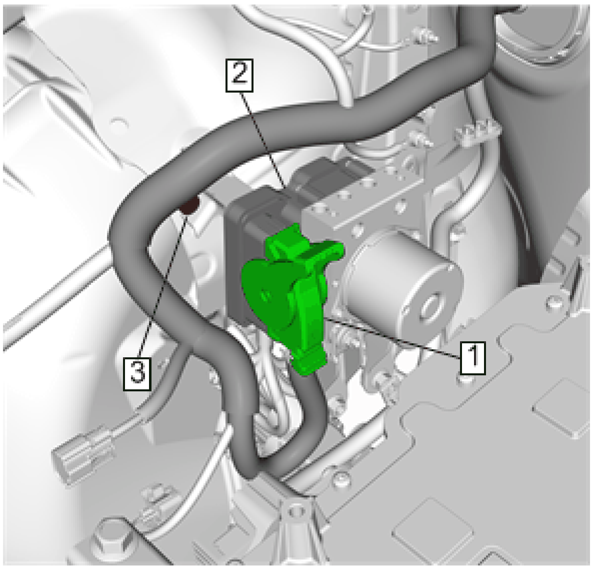


Fig. 7: Electrical Connector And Electronic Brake Control Module
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Electrical Connector (1) @Electronic Brake Control Module (2)
8. Remove Body Wiring Harness Clip (3) @Brake Pressure Modulator Valve Bracket

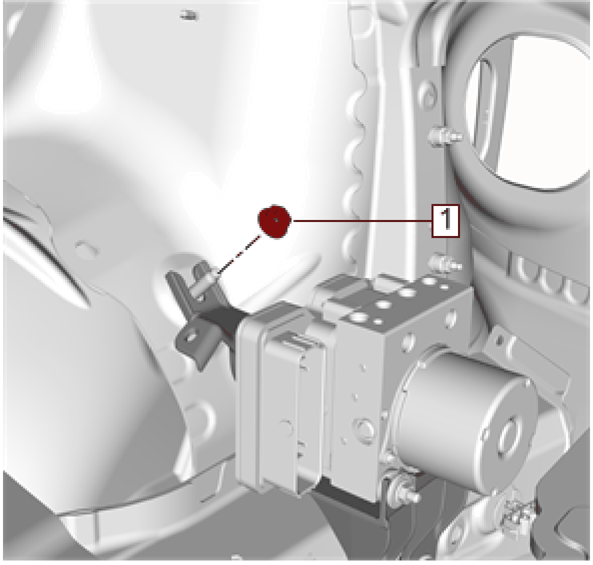


Fig. 8: Brake Pressure Modulator Valve Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

9. Remove Brake Pressure Modulator Valve Bracket Nut (1) @Front Wheel House Panel

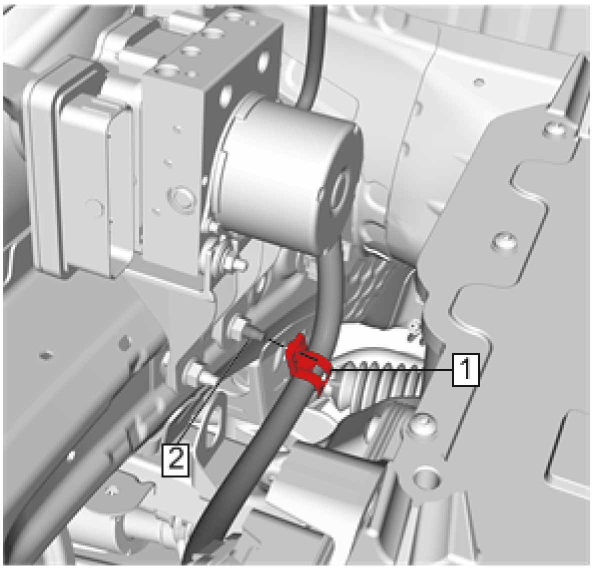


Fig. 9: Body Wiring Harness Clip And Electronic Brake Control Module Stud Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Remove Body Wiring Harness Clip (1) @Electronic Brake Control Module Stud Bolt (2)

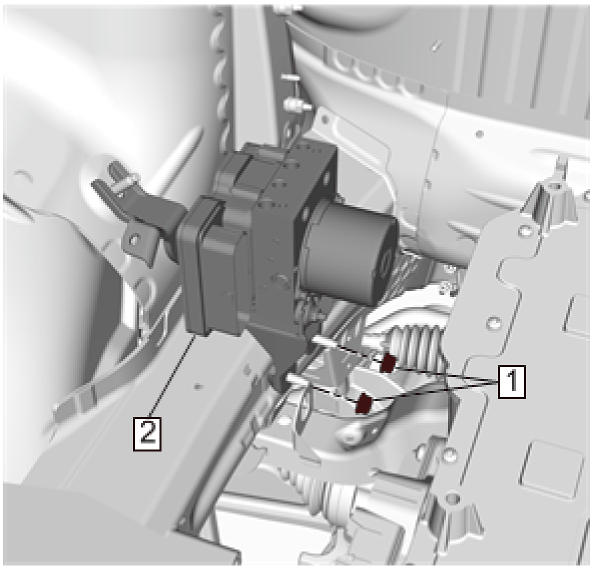


Fig. 10: Brake Pressure Modulator Valve Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

11. Remove Brake Pressure Modulator Valve Bracket Nut (1) @Front Compartment Inner Side Rail
12. Remove Electronic Brake Control Module with Brake Pressure Modulator Valve and Bracket Assembly (2) @Vehicle

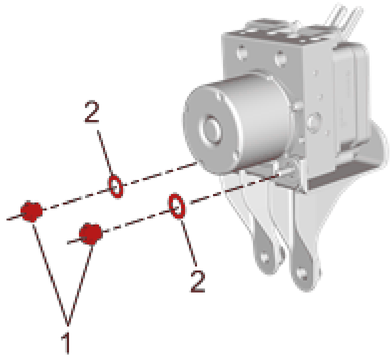


Fig. 11: Brake Pressure Modulator Valve Insulator Nut
Courtesy of GENERAL MOTORS COMPANY

13. Remove Brake Pressure Modulator Valve Insulator Nut (1) and DISCARD
14. Remove Brake Pressure Modulator Valve Insulator Washer (2) and DISCARD

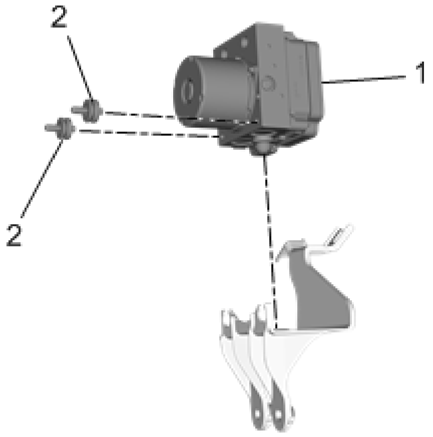
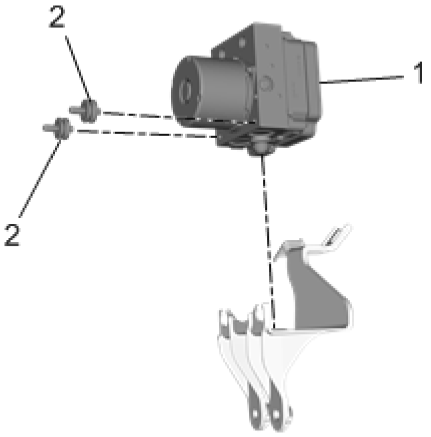


Fig. 12: Electronic Brake Control Module with Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

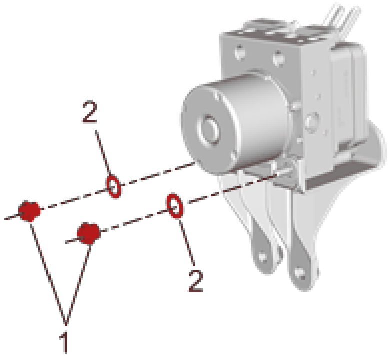
15. Remove Electronic Brake Control Module with Brake Pressure Modulator Valve (1) @Brake Pressure Modulator Valve Bracket
16. Remove Brake Pressure Modulator Valve Insulator (2) and DISCARD

Installation Procedure



[Fig. 13: Electronic Brake Control Module with Brake Pressure Modulator Valve]
Courtesy of GENERAL MOTORS COMPANY

1. Install New Brake Pressure Modulator Valve Insulator (2)
2. Install Electronic Brake Control Module with Brake Pressure Modulator Valve (1) @Brake Pressure Modulator Valve Bracket



[Fig. 14: Brake Pressure Modulator Valve Insulator Nut]
Courtesy of GENERAL MOTORS COMPANY

3. Install Brake Pressure Modulator Valve Insulator Washer (2)
4. Install Brake Pressure Modulator Valve Insulator Nut (1)

CAUTION: Fastener Caution

5. Brake Pressure Modulator Valve Insulator Nut (1) - Tighten 8 N.m (71 lb in)

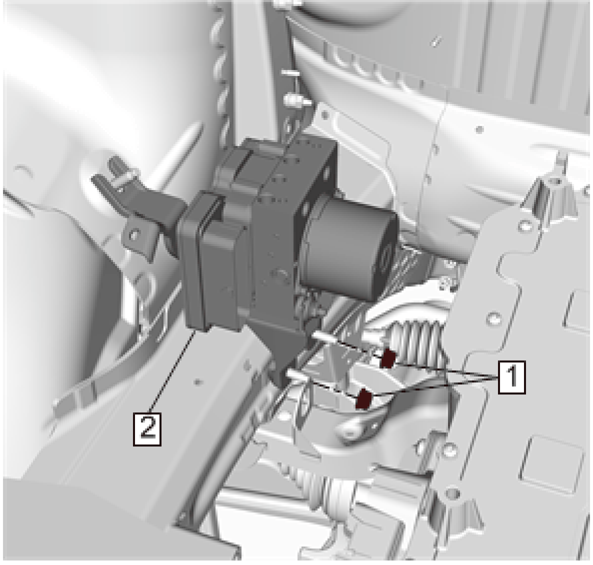


Fig. 15: Brake Pressure Modulator Valve Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

6. Install Electronic Brake Control Module with Brake Pressure Modulator Valve and Bracket Assembly (2) @Vehicle
7. Install Brake Pressure Modulator Valve Bracket Nut (1) @Front Compartment Inner Side Rail and tighten 22 N.m (16 lb ft)

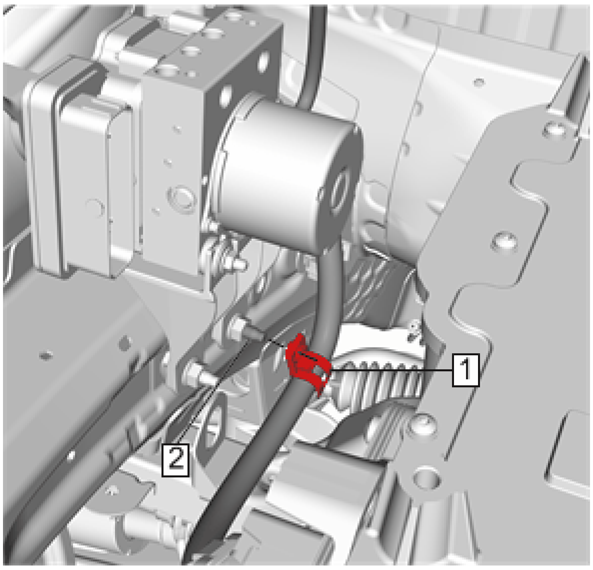


Fig. 16: Body Wiring Harness Clip And Electronic Brake Control Module Stud Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install Body Wiring Harness Clip (1) @Electronic Brake Control Module Stud Bolt (2)

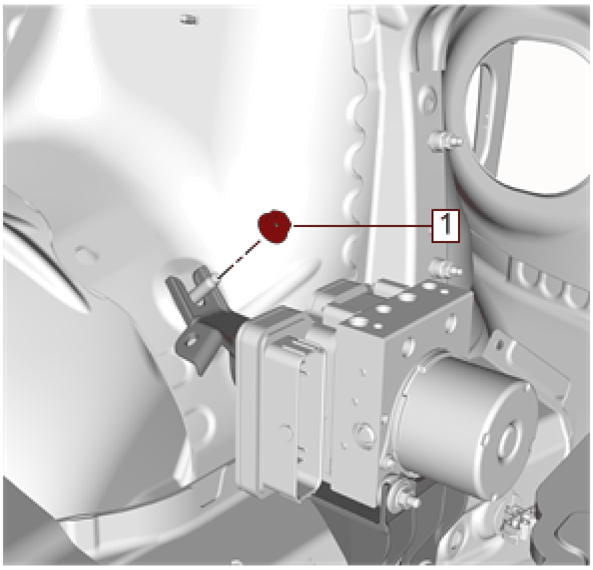


Fig. 17: Brake Pressure Modulator Valve Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

9. Install Brake Pressure Modulator Valve Bracket Nut (1) @Front Wheel House Panel and tighten 22 N.m (16 lb ft)

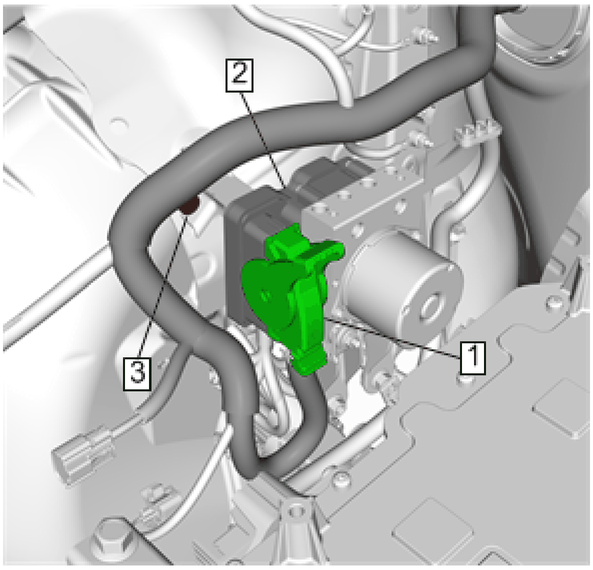


Fig. 18: Electrical Connector And Electronic Brake Control Module
Courtesy of GENERAL MOTORS COMPANY

10. Install Body Wiring Harness Clip (3) @Brake Pressure Modulator Valve Bracket
11. Connect Electrical Connector (1) @Electronic Brake Control Module (2)

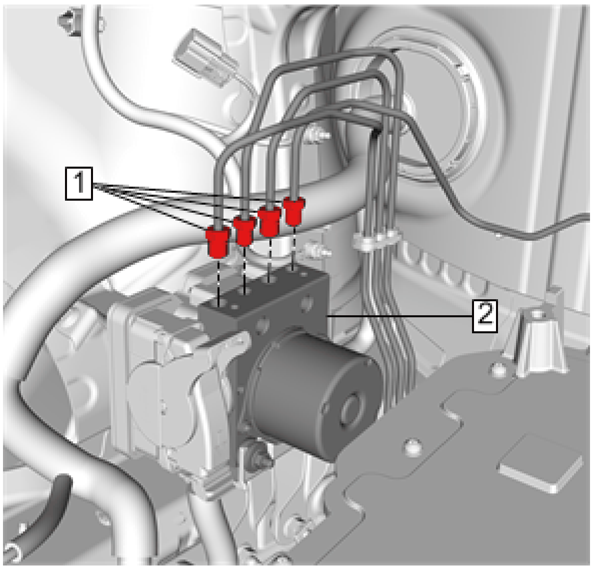


Fig. 19: Brake Pressure Modulator Valve And Brake Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Make sure brake pipes are correctly connected to brake pressure modulator valve. If brake pipes are switched by mistake, wheel lockup will occur and personal injury may result. The only two ways this condition can be detected are by using a Scan Tool or by doing an Antilock stop.**

12. Install Brake Pipe Fitting (2) @Brake Pressure Modulator Valve (3) and tighten 18 N.m (13 lb ft)

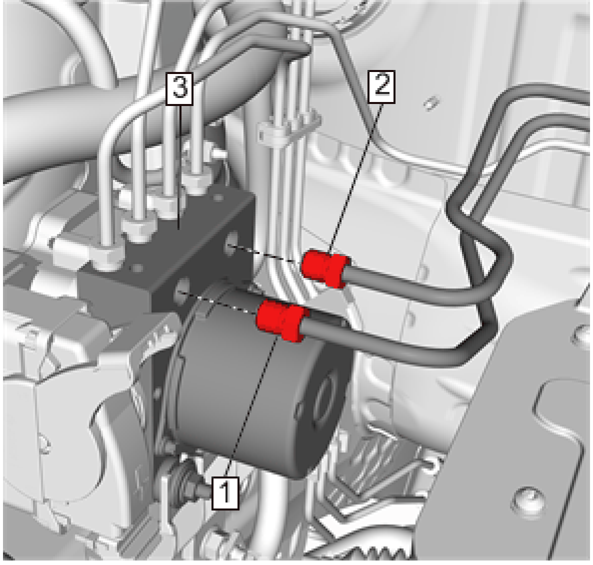


Fig. 20: Brake Pressure Modulator Valve Front Pipe Fitting
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Make sure brake pipes are correctly connected to brake pressure modulator valve. If brake pipes are switched by mistake, wheel lockup will occur and personal injury may result. The only two ways this condition can be detected are by using a Scan Tool or by doing an Antilock stop.**

NOTE: **Make sure that the electronic brake control module is fully seated into the grommets after the brake pipes are tightened.**

13. Install Brake Pressure Modulator Valve Rear Pipe Fitting (2) @Brake Pressure Modulator Valve (3) and tighten 25 N.m (18 lb ft)
14. Install Brake Pressure Modulator Valve Front Pipe Fitting (1) @Brake Pressure Modulator Valve (3) and tighten 25 N.m (18 lb ft)

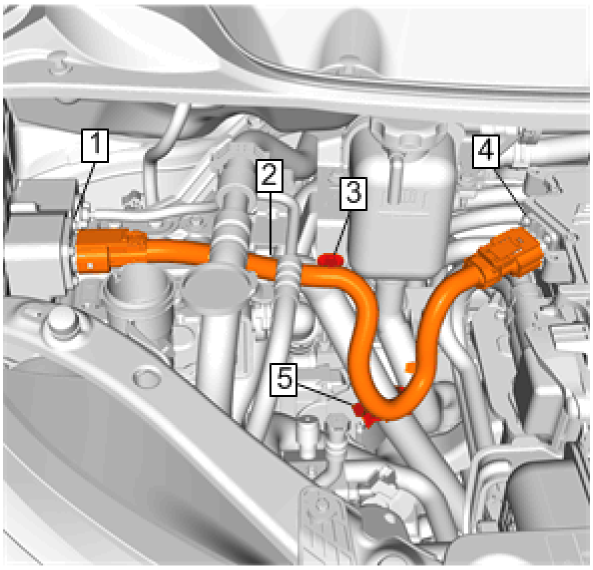


Fig. 21: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

15. Install Drive Motor Battery Positive and Negative Cable (1) Drive Motor Battery Positive and Negative Cable Replacement
16. Install the heater surge tank to the heater surge tank bracket. Heater Coolant Surge Tank Replacement
17. Enable the high voltage system. High Voltage Enabling
18. Program the electronic brake control module. Electronic Brake Control Module Programming and Setup

19. Bleed the brake system. Hydraulic Brake System Bleeding
20. Calibrate the brake pressure modulator valve pressure sensor. Brake Pressure Modulator Valve Pressure Sensor Calibration

BRAKE PRESSURE MODULATOR VALVE PRESSURE SENSOR CALIBRATION

The brake pressure sensor does not require calibration often. Calibration of the brake pressure sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Electronic brake control module (EBCM) replacement.
- Brake pressure modulator valve assembly replacement

The Brake Pressure Sensor Calibration procedure can be completed with a scan tool using the following steps:

1. Apply the parking brake, or set the transmission in the P position.
2. Release the brake pedal.
3. Install the scan tool to the data link connector.
4. Ignition ON/Vehicle in Service Mode
5. Select Brake Pressure Sensor Calibration in the EBCM Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

BRAKE PRESSURE MODULATOR VALVE BRACKET REPLACEMENT

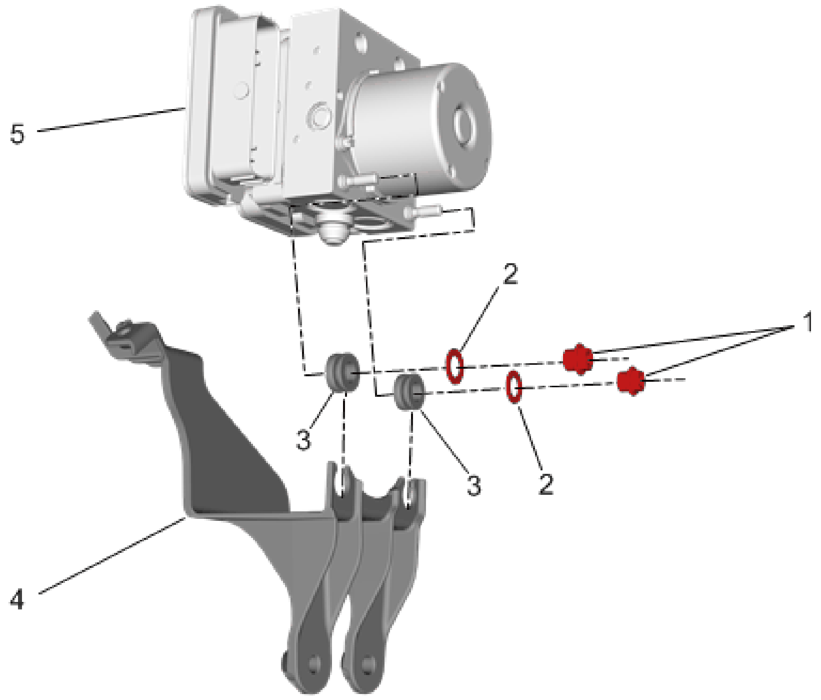


Fig. 22: Brake Pressure Modulator Valve Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement	

Callout	Component Name
1	Brake Pressure Modulator Valve Insulator Nut (Qty: 2) **Procedure** 1. Remove and DISCARD the nuts. 2. Install the NEW nuts. **CAUTION:** **Fastener Caution** **Tighten** 8 N.m (71 lb in)
2	Brake Pressure Modulator Valve Insulator Washer (Qty: 2) **Procedure** 1. Remove and DISCARD the washers. 2. Install the NEW washers.
3	Brake Pressure Modulator Valve Insulator (Qty: 2) **Procedure** 1. Remove and DISCARD the Insulators. 2. Install the NEW Insulators.
4	Brake Pressure Modulator Valve Bracket
5	Electronic Brake Control Module with Brake Pressure Modulator Valve

FRONT WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. **Tire and Wheel Removal and Installation**

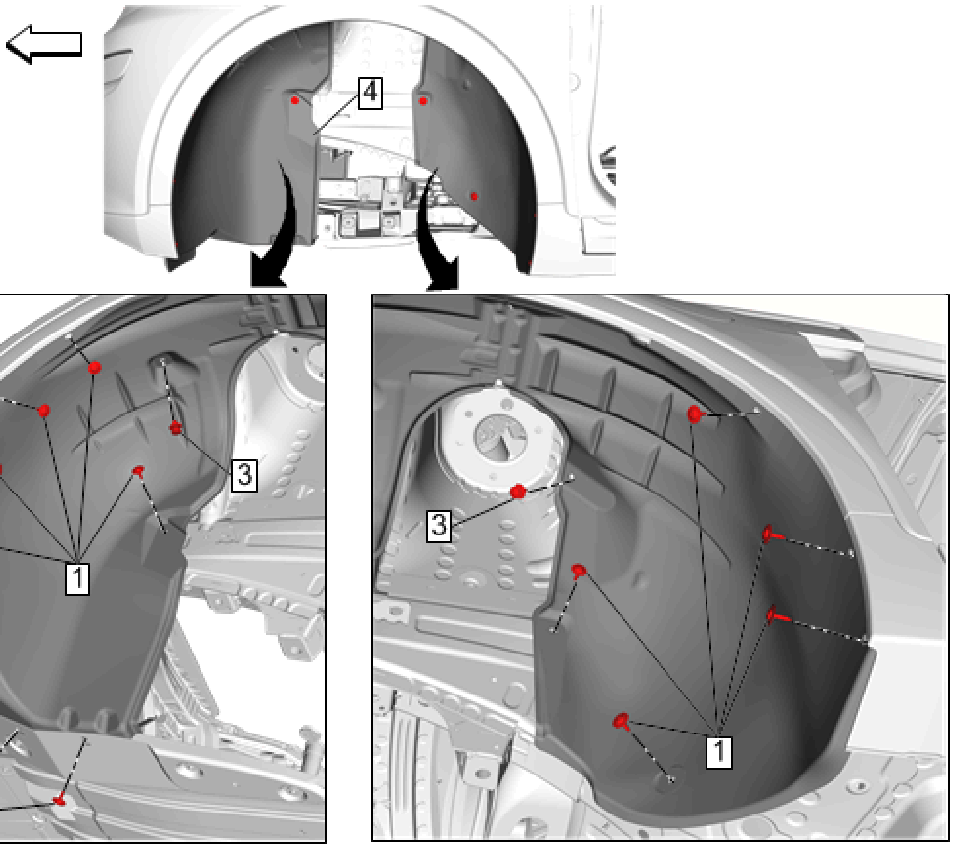


Fig. 23: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Wheelhouse Liner (3)Front Wheelhouse Liner Replacement

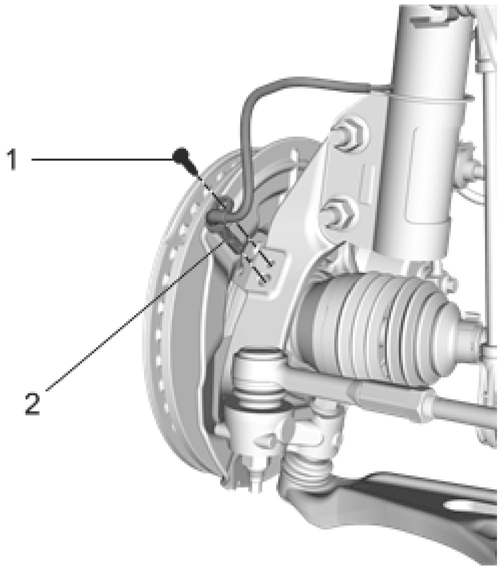


Fig. 24: Front Wheel Speed Sensor Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Front Wheel Speed Sensor Bolt (1) @Steering Knuckle
5. Remove Front Wheel Speed Sensor (2) @Steering Knuckle

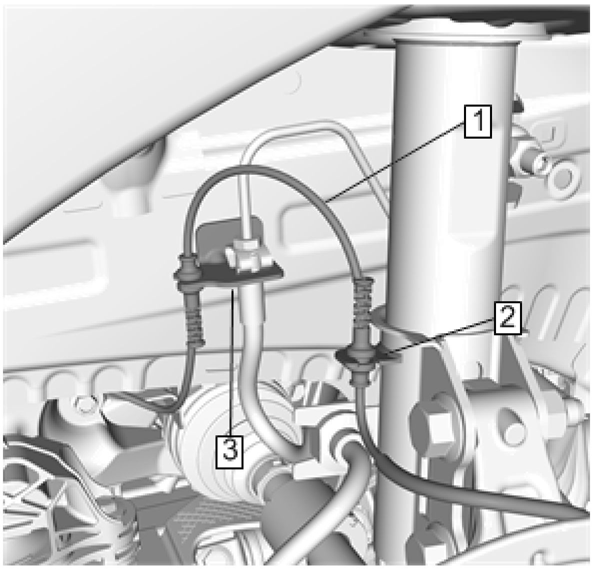


Fig. 25: Front Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

6. Unclip Front Wheel Speed Sensor Wiring Harness (1)Front Suspension Strut Mounted Bracket (2)
7. Unclip Front Wheel Speed Sensor Wiring Harness(1)Front Compartment Side Rail Mounted Bracket (3)

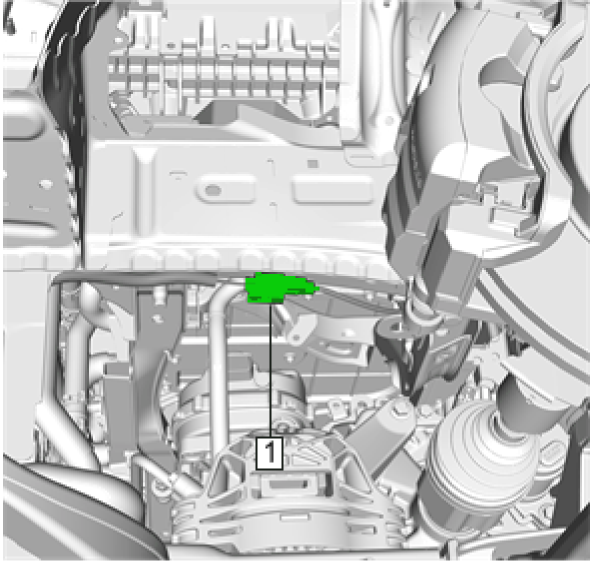


Fig. 26: Front Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Front Wheel Speed Sensor Electrical Connector (1) @Forward Lamp Wiring Harness
9. Remove Front Wheel Speed Sensor@Vehicle

Installation Procedure

1. Front Wheel Speed Sensor@Vehicle - Install

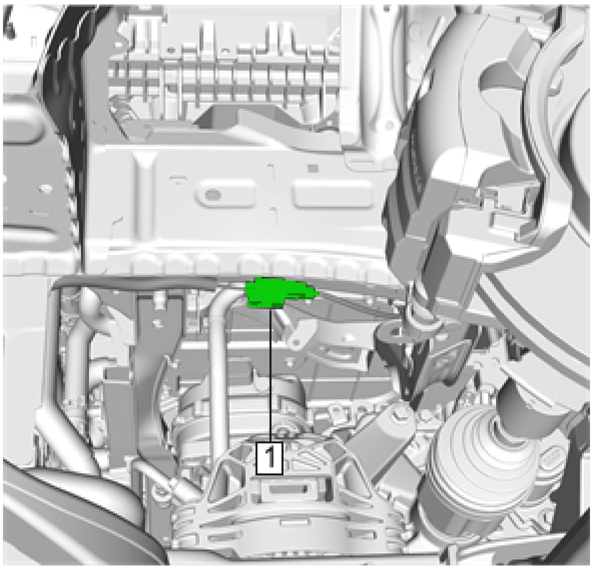


Fig. 27: Front Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Connect Front Wheel Speed Sensor Electrical Connector (1) @Forward Lamp Wiring Harness

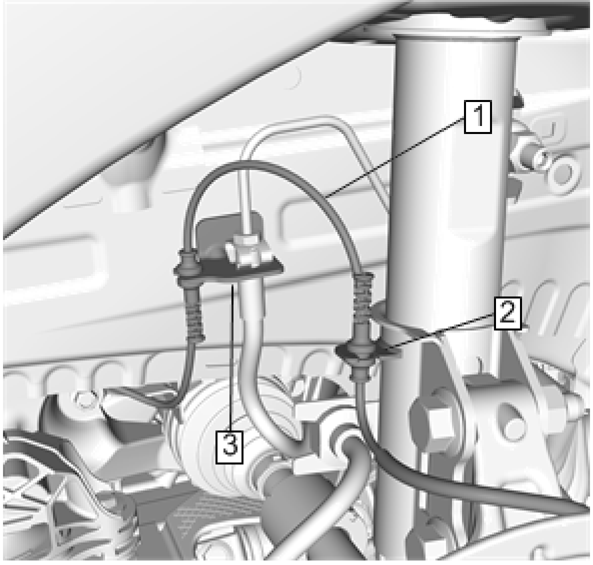


Fig. 28: Front Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Wheel Speed Sensor Wiring Harness(1)Front Compartment Side Rail Mounted Bracket (3)
4. Install Front Wheel Speed Sensor Wiring Harness(1)Front Suspension Strut Mounted Bracket (2)

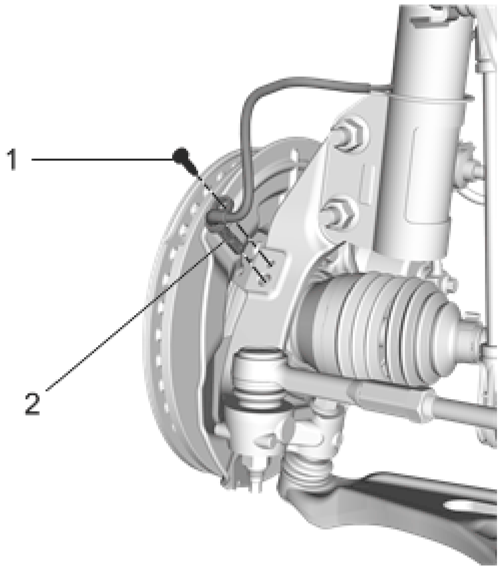


Fig. 29: Front Wheel Speed Sensor Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Wheel Speed Sensor (2) @Steering Knuckle

CAUTION: Fastener Caution

6. Install Front Wheel Speed Sensor Bolt (1) @Steering Knuckle and tighten 9 N.m (80 lb in)

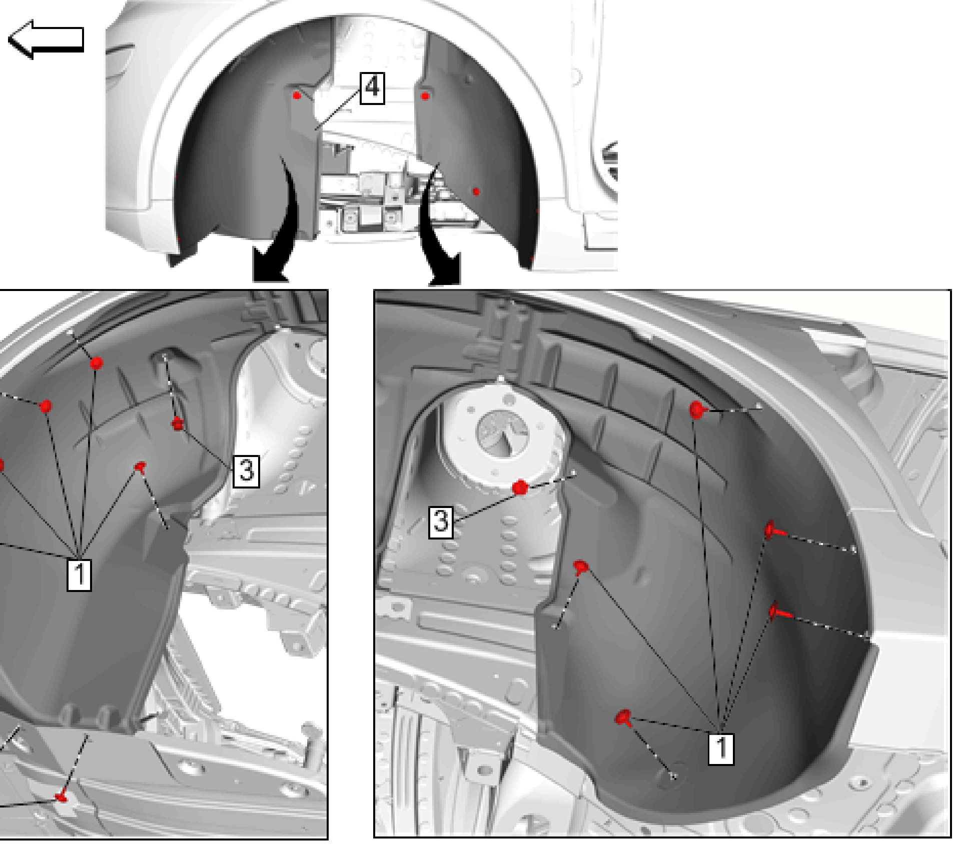


Fig. 30: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

7. Install Front Wheelhouse Liner (3)Front Wheelhouse Liner Replacement
8. Install the front tire and wheel assembly. Tire and Wheel Removal and Installation
9. Lower the vehicle.

REAR WHEEL SPEED SENSOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Lifting and Jacking the Vehicle
2. Remove the rear tire and wheel assembly. Tire and Wheel Removal and Installation

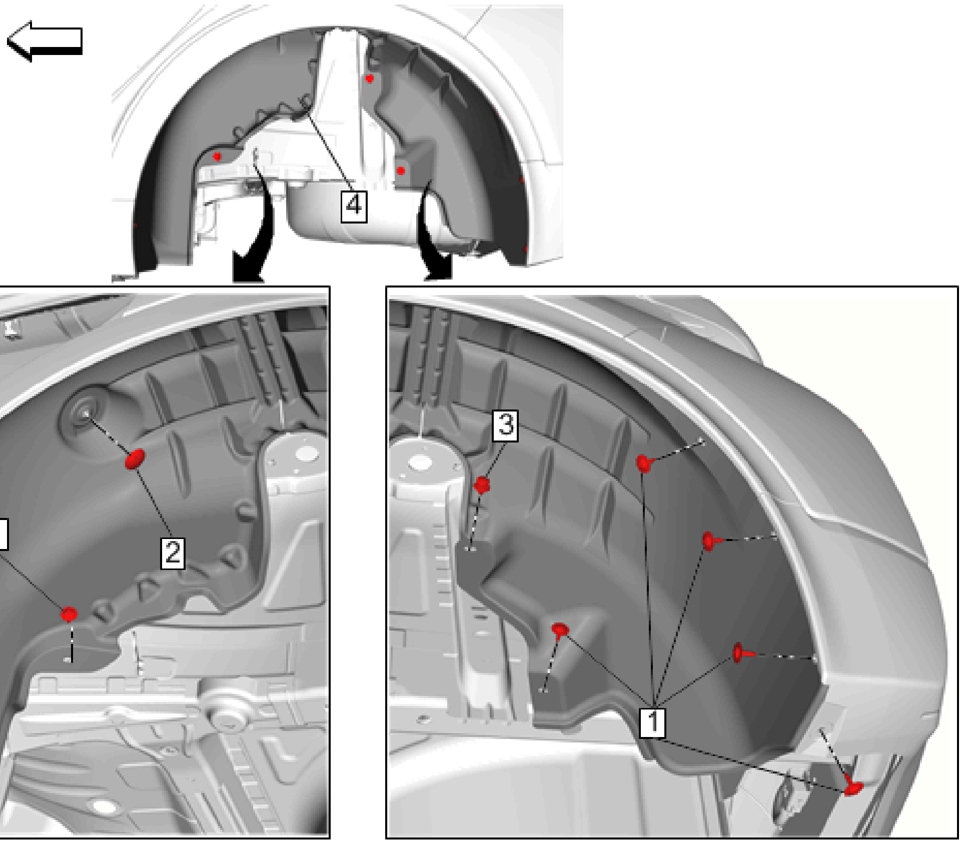


Fig. 31: Rear Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

3. Remove Rear Wheelhouse Liner (4)Rear Wheelhouse Liner Replacement

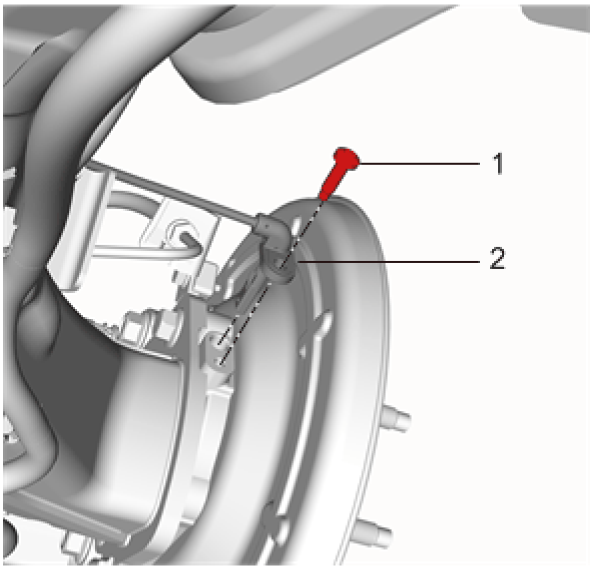


Fig. 32: Rear Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Wheel Speed Sensor Bolt (1) @Rear Brake Caliper Mount Plate
5. Remove Rear Wheel Speed Sensor (2) @Rear Brake Caliper Mount Plate

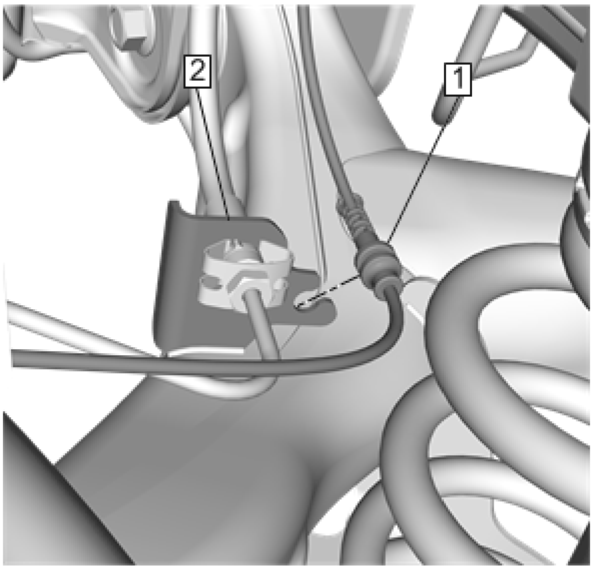


Fig. 33: Rear Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

6. Unclip Rear Wheel Speed Sensor Wiring Harness (1) @Rear Axle Mounted Bracket (2)

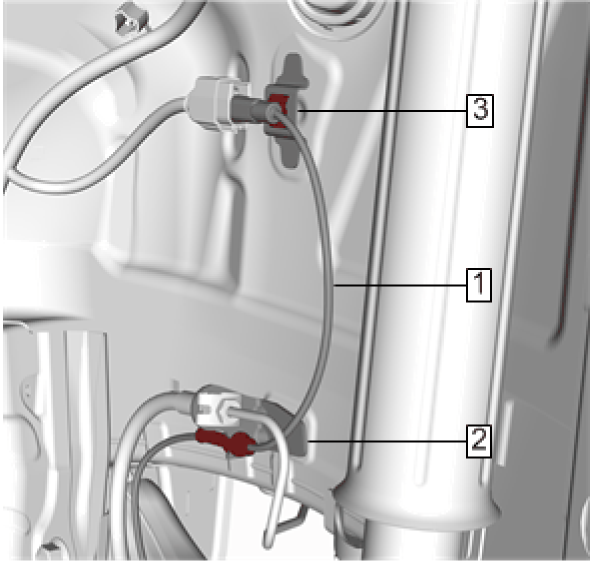


Fig. 34: Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

7. Unclip Rear Wheel Speed Sensor Wiring Harness (1) @Underbody Rear Side Rail Mounted Bracket (2)
8. Unclip Rear Wheel Speed Sensor Wiring Harness (1) @Rear Wheelhouse Panel Mounted Bracket (3)

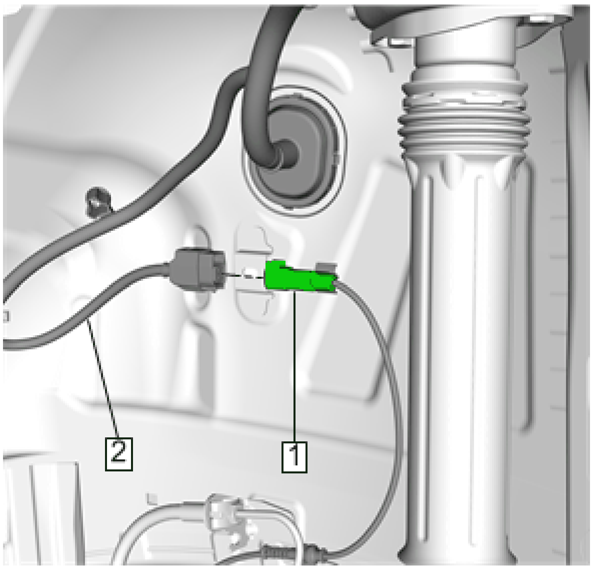


Fig. 35: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Rear Wheel Speed Sensor Electrical Connector (1) @Body Wiring Harness (2)
10. Remove Rear Wheel Speed Sensor@Vehicle

Installation Procedure

1. Install Rear Wheel Speed Sensor@Vehicle

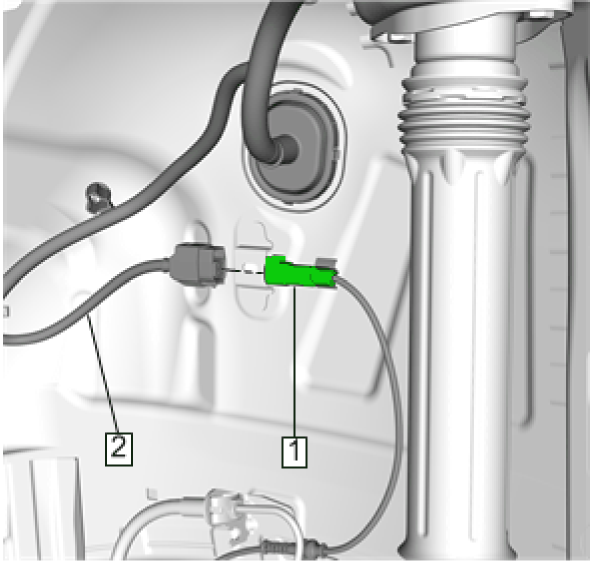


Fig. 36: Wheel Speed Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Connect Rear Wheel Speed Sensor Electrical Connector (1) @Body Wiring Harness (2)

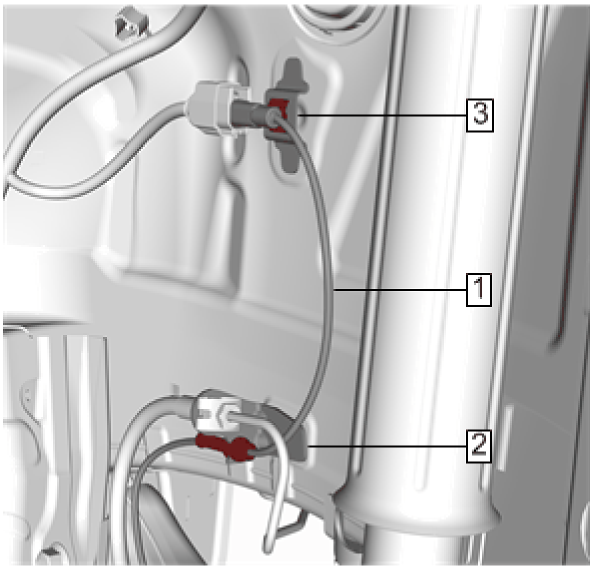


Fig. 37: Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Install Rear Wheel Speed Sensor Wiring Harness (1) @Rear Wheelhouse Panel Mounted Bracket (3)
4. Install Rear Wheel Speed Sensor Wiring Harness (1) @Underbody Rear Side Rail Mounted Bracket (2)

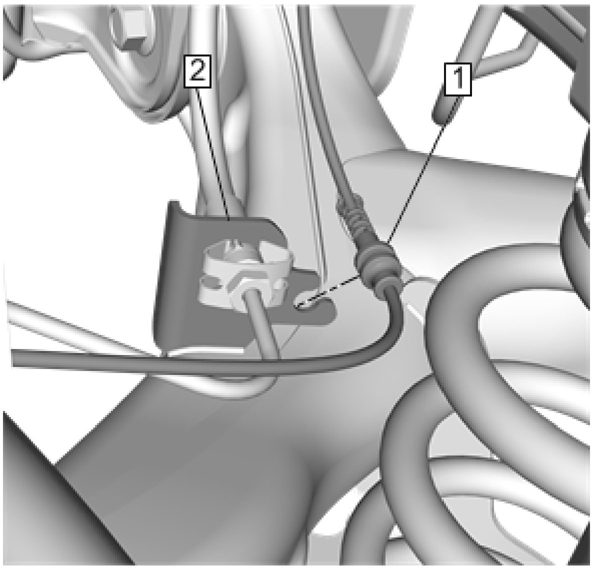


Fig. 38: Rear Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Install Rear Wheel Speed Sensor Wiring Harness (1) @Rear Axle Mounted Bracket (2)

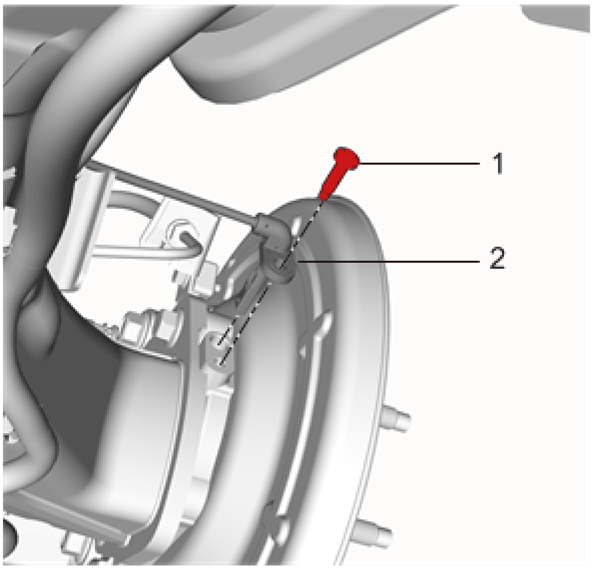


Fig. 39: Rear Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Install Rear Wheel Speed Sensor (2) @Rear Brake Caliper Mount Plate

CAUTION: **Refer to Fastener Caution .**

7.
8. Rear Wheel Speed Sensor Bolt (1) @Rear Brake Caliper Mount Plate - Tighten 9 N.m (80 lb in)

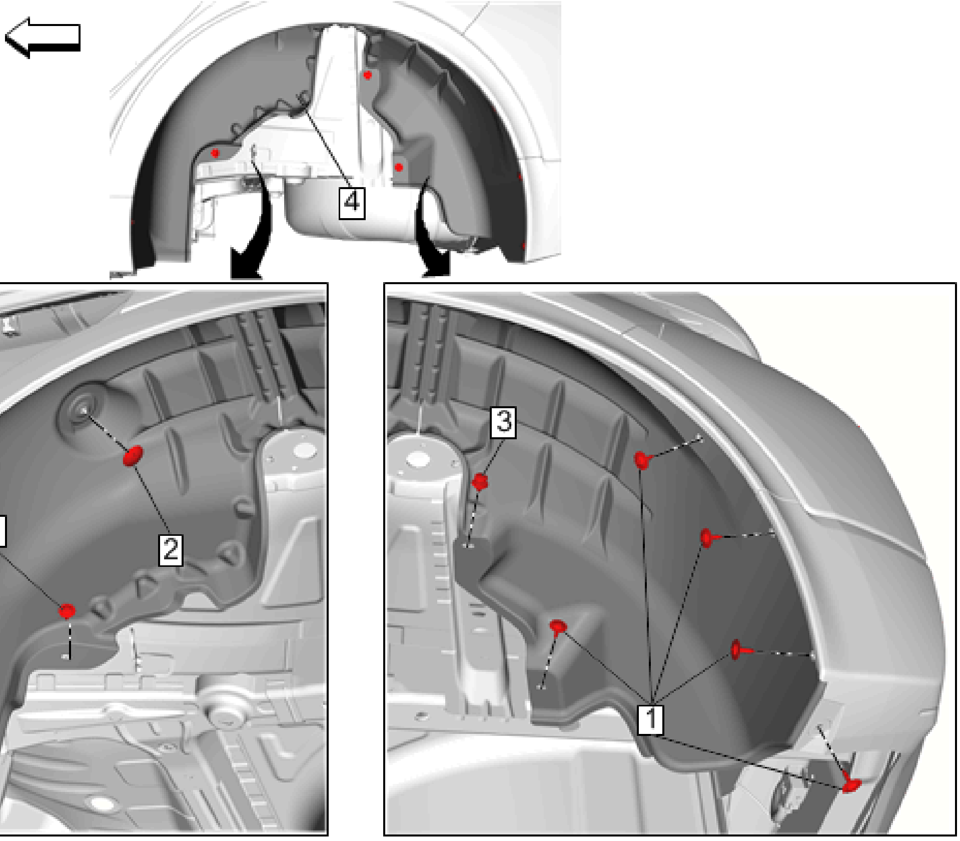


Fig. 40: Rear Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

9. Install Rear Wheelhouse Liner (4)Rear Wheelhouse Liner Replacement
10. Install the rear tire and wheel assembly. Tire and Wheel Removal and Installation
11. Lower the vehicle.

VEHICLE YAW SENSOR LEARN

The yaw rate sensor does not require calibration often. Calibrating the yaw rate sensor might be required after certain service procedures are performed. Some of these procedures are as follows:

- Yaw Rate Sensor replacement
- Electronic Brake Control Module replacement
- Inflatable Restraint Sensing and Diagnostic Module replacement

The yaw rate sensor learn procedure can be completed with a scan tool using the following steps:

1. Place vehicle on a level surface
2. Apply the parking brake, or set the transmission in the Park position.
3. Install the scan tool to the data link connector.
4. Ignition ON/Vehicle in Service Mode.
5. Select Yaw Rate Sensor Learn in the Electronic Brake Control Module Configuration/Reset Functions list.
6. Follow the scan tool directions to complete the calibration procedure.
7. Clear any DTCs that may be set.

DESCRIPTION AND OPERATION

ABS DESCRIPTION AND OPERATION

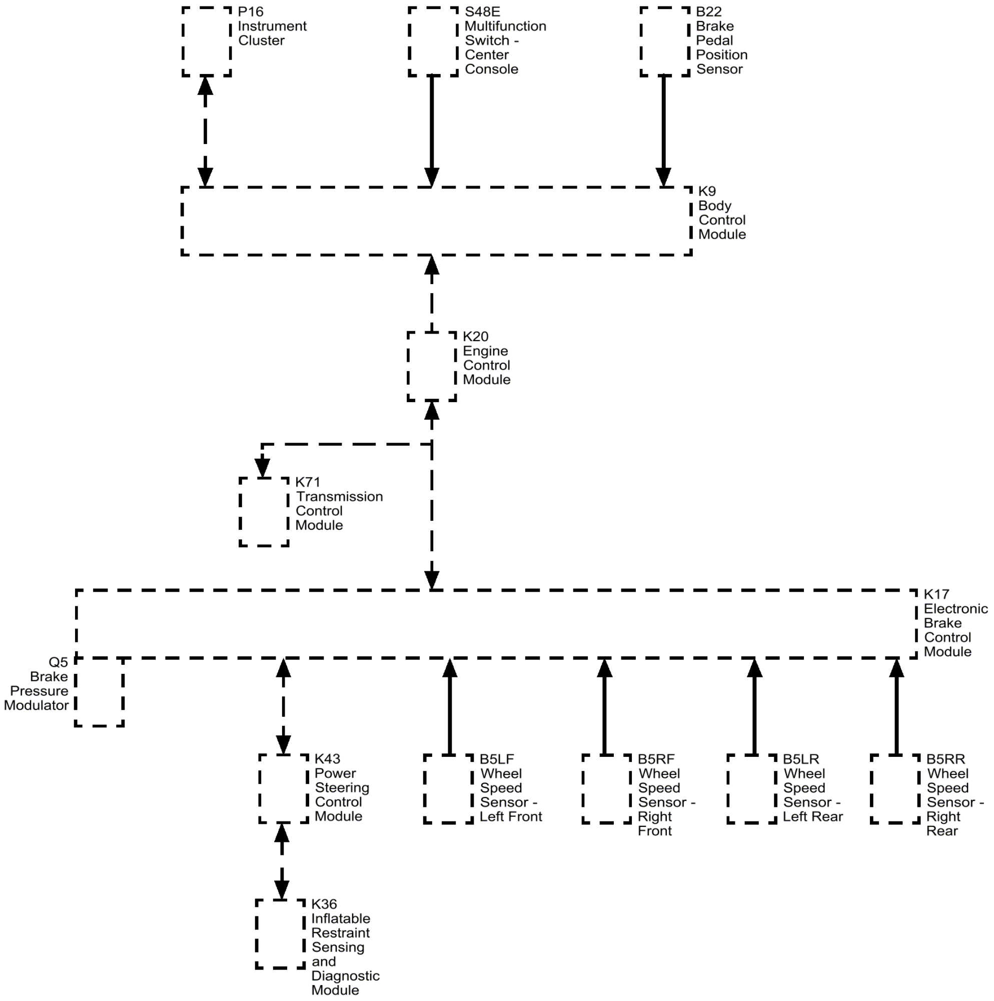

P16 Instrument Cluster
S48E Multifunction Switch - Center Console
B22 Brake Pedal Position Sensor
K9 Body Control Module
K20 Engine Control Module
K71 Transmission Control Module
K17 Electronic Brake Control Module
Q5 Brake Pressure Modulator
K43 Power Steering Control Module
B5LF Wheel Speed Sensor - Left Front
B5RF Wheel Speed Sensor - Right Front
B5LR Wheel Speed Sensor - Left Rear
B5RR Wheel Speed Sensor - Right Rear
K36 Inflatable Restraint Sensing and Diagnostic Module

Fig. 41: ABS Description and Operation Block Diagram

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
B22	B22 Brake Pedal Position Sensor
S48E	S48E Multifunction Switch - Center Console
P16	P16 Instrument Cluster
K9	K9 Body Control Module
K20	K20 Engine Control Module
K71	K71 Transmission Control Module
K17	K17 Electronic Brake Control Module
Q5	Q5 Brake Pressure Modulator
K43	K43 Power Steering Control Module
B5LF	B5LF Wheel Speed Sensor - Left Front
B5RF	B5RF Wheel Speed Sensor - Right Front
B5LR	B5LR Wheel Speed Sensor - Left Rear
B5RR	B5RR Wheel Speed Sensor - Right Rear
K36	K36 Inflatable Restraint Sensing and Diagnostic Module

NOTE: **EBCM terminal pin locations may differ between different RPO option brake systems.**

This vehicle is equipped with a Bosch ABS 9.0 brake system. The electronic brake control module and the brake pressure modulator valve are serviced separately. The brake pressure modulator valve uses a four circuit configuration to control hydraulic pressure to each wheel independently. Vehicles built with option RPO FX3 will feature stability enhancement.

The following vehicle performance enhancement systems are provided.

- ABS
- Brake Assist
- Electronic Brake Distribution
- Electronic stability control
- Hill start assist
- Traction control system

The following components are involved in the operation of the above systems:

- Electronic Brake Control Module - The electronic brake control module controls the system functions and detects failures. It supplies voltage to the solenoid valves and pump motor.
- Brake pressure modulator valve - The brake pressure modulator valve contains the hydraulic valves and pump motor that are controlled electrically by the electronic brake control module. The brake pressure modulator uses a four circuit configuration with a diagonal split. The brake pressure modulator directs fluid from the reservoir of the master cylinder to the left front and right rear wheels and fluid from the other reservoir to the right front and left rear wheels. The diagonal circuits are hydraulically isolated so that a leak or malfunction in one circuit will allow continued braking ability on the other.

  The brake pressure modulator contains the following components:

  - Brake pressure sensor
  - Four inlet valves (one per wheel)
  - Four outlet valves (one per wheel)
  - Pump motor
  - Two traction/stability control supply valves
  - Two traction/stability control isolation valves
- Body control module monitors the brake pedal position sensor signal when the brake pedal is applied and sends a high speed serial data message to the electronic brake control module indicating the brake pedal position.

- Brake pressure sensor is used to sense the action of the driver application of the brake pedal. The sensor provides an voltage signal that will increase as the brake pedal is applied. The electronic brake control module monitors the brake pressure sensor which is integral to the brake pressure modulator.
- Instrument cluster - The instrument cluster displays the vehicle speed based on the information from the engine control module. The engine control module sends the vehicle speed information via a high speed serial data to the body control module. The body control module then sends the vehicle speed information via a low speed serial data to the instrument cluster in order to display the vehicle speed, either in kilometers or miles, based on the vehicle requirements.
- Multi-axis acceleration sensor - The yaw rate, lateral acceleration and longitudinal acceleration sensors are combined into one multi-axis acceleration sensor, internal to the inflatable restraint sensing and diagnostic module. The electronic brake control module receives serial data message inputs from the yaw rate, lateral acceleration and longitudinal acceleration sensor and activates stability control and hill hold start assist function depending on multi-axis acceleration sensor input.
- Multifunction switch - The traction control switch is a multifunction momentary switch. The body control module monitors the signal circuit from the traction control switch and sends a high speed serial data message to the electronic brake control module indicating the switch position. The traction control and stability control are manually disabled or enabled by pressing the traction control switch.
- Steering angle sensor - The electronic brake control module receives serial data message inputs from the steering angle sensor. The steering angle sensor signal is used to calculate the desired yaw rate.
- Transmission control module - The electronic brake control module receives high speed serial data message inputs from the transmission control module indicating the gear position of the transmission for hill start assist functions.
- Wheel speed sensors - This vehicle is equipped with unique directional wheel speed sensors that can detect wheel direction as well as zero wheel speed. The wheel speed sensors are Active sensors that receive a 12 V power supply voltage from the electronic brake control module and provides an output signal to the module. As the wheel spins, the wheel speed sensor sends the electronic brake control module a DC square wave signal. The electronic brake control module uses the frequency of the square wave signal to calculate the wheel speed.

Power-Up-Self Test

The electronic brake control module is able to detect many malfunctions whenever the ignition is ON. However, certain failures cannot be detected unless active diagnostic tests are performed on the components. Shorted solenoid coil or motor windings, for example, cannot be detected until the components are commanded ON by the electronic brake control module. Therefore, a power-up self-test is performed to verify correct operation of system components. The electronic brake control module performs the first phase of the power-up self-test when the ignition is first turned ON. This phase consists of internal self-testing of the electronic brake control module along with electrical checks of system sensors and circuits.

Initialization Sequence

The initialization sequence cycles each solenoid valve and the pump motor, as well as the necessary relays, for approximately forty milliseconds to check component operation. The active test is initiated by the electronic brake control module at the start of the ignition cycle and the speed of the fastest wheel exceeds 16 km/h (10 MPH). If a fault condition is detected the electronic brake control module sets a DTC.

ABS

When wheel slip is detected during a brake application, an ABS event occurs. During ABS braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel. The ABS does not, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During ABS braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the electronic brake control module responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during ABS braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During ABS braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during ABS operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability. The typical ABS activation sequence is as follows.

Pressure Hold

The electronic brake control module closes the inlet valve and keeps the outlet valve closed in order to isolate the system when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

The electronic brake control module decreases the pressure to individual wheels during a deceleration when wheel slip occurs. The inlet valve is closed and the outlet valve is opened. The excess fluid is stored in the accumulator until the return pump can return the fluid to the master cylinder.

Pressure Increase

The electronic brake control module increases the pressure to individual wheels during a deceleration in order to reduce the speed of the wheel. The inlet valve is opened and the outlet valve is closed. The increased pressure is delivered from the master cylinder.

Brake Assist

The brake assist function is designed to support the driver in emergency braking situations.

The electronic brake control module receives inputs from the brake pressure sensor. When the electronic brake control module senses an emergency braking situation, the electronic brake control module will actively increase the brake pressure to a specific maximum.

Electronic Brake Distribution

The electronic brake distribution function is designed to support the driver in emergency braking situations.

The electronic brake distribution is a control system that enhances the hydraulic proportioning function of the mechanical proportioning valve in the base brake system. The electronic brake distribution control system is part of the operation software in the electronic brake control module. The electronic brake distribution uses active control with existing ABS in order to regulate the vehicle's rear brake pressure.

Electronic Stability Control (RPO FX3)

The electronic stability control adds an additional level of vehicle control to the electronic brake control module.

Yaw rate is the rate of rotation about the vehicles vertical axis. The electronic stability control is activated when the electronic brake control module determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor.

The desired yaw rate is calculated from the following parameters:

- The speed of the vehicle
- The position of the steering wheel
- The lateral acceleration of the vehicle

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of over steer or under steer. If the yaw error becomes too large, the electronic brake control module attempts to correct the vehicles yaw rate motion by applying differential braking to the appropriate wheel. The amount of differential braking applied to the left or right front wheel is based on both the yaw rate error and side slip rate error.

The electronic stability control activations generally occur during aggressive driving, in turns or on bumpy roads without much use of the accelerator pedal. When braking during electronic stability control activation, the pedal pulsations feel different than the ABS pedal pulsations. The brake pedal pulsates at a higher frequency during vehicle stability enhancement system activation.

Hill Start Assist

When stopped on a hill, the hill start assist feature prevents the vehicle from rolling before driving off, whether facing uphill or downhill by holding the brake pressure during the transition between when the driver releases the brake pedal and starts to accelerate. The electronic brake control module calculates the brake pressure, which is needed to hold the vehicle on an incline or grade greater than 5% and locks that pressure for up to two seconds by commanding the appropriate solenoid valves ON and OFF when the brake pedal is released. The stop lamps will stay illuminated during the hill start assist operation even though the brake pedal is released, this is considered normal operation.

The hill start assist feature is determined by the electronic brake control module using the following inputs:

- Accelerator pedal position
- Brake pedal position sensor
- Brake pressure
- Clutch switch, if equipped
- Engine torque
- Longitudinal acceleration
- Multi-axis acceleration sensor
- Transmission gear information
- Vehicle speed

Traction Control System

When drive wheel slip is noted while the brake is not applied, the electronic brake control module will enter traction control mode.

First, the electronic brake control module requests the engine control module to reduce the amount of torque to the drive wheels via the serial data. The engine control module reduces torque to the drive wheels by retarding spark timing and turning off fuel injectors. The engine control module reports the amount of torque delivered to the drive wheels via the serial data circuit.

- Pressure hold
- Pressure increase
- Pressure decrease

Driver Information Indicator

ABS Warning Indicator

The instrument cluster turns the ABS warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a malfunction which disables the ABS and sends a serial data message to the instrument cluster requesting illumination.

Brake Warning Indicator

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a fault and sends a serial data message to the instrument cluster requesting illumination.
- The body control module detects that the park brake is engaged. The body control module sends a serial data message to the instrument cluster requesting illumination.

Traction/Stability Active Control Indicator

The instrument cluster turns the traction/stability active control system indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The ABS system is in traction control or stability control mode.
- The electronic brake control module detects a traction control/stability control occurring and sends a serial data message to the instrument cluster requesting illumination.

Traction Control Off Indicator

The instrument cluster turns the traction control off indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The driver manually disables the traction control by pressing the traction control switch. The electronic brake control module sends a serial data message to the instrument cluster requesting illumination.

Stability Control Off Indicator

The instrument cluster turns the stability control off indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The driver manually disables the electronic stability control by pressing and holding the traction control switch for five seconds. The electronic brake control module sends a serial data message to the instrument cluster requesting illumination.

Traction/Stability Control Indicator

The instrument cluster turns the traction/stability control system indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a malfunction which disables the traction control or the electronic stability control and sends a serial data message to the instrument cluster requesting illumination.

Back To Article

2017 BRAKES

Disc Brakes - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Front Brake Caliper Piston Boot
Front Brake Caliper Piston Seal
Front Brake Hose Washer
Rear Brake Hose Washer

Single Use Threaded Fastener/Component Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***	
Â	
Front Brake Caliper Bracket Bolt	160 N.m (118 lb ft)
Rear Brake Caliper Bracket Bolt	100 N.m (74 lb ft)

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Front Brake Caliper Bleeder Valve	10 N.m (89 lb in)
Front Brake Caliper Guide Pin Bolt	40 N.m (30 lb ft)
Front Brake Hose Fitting Bolt	40 N.m (30 lb ft)
Front Brake Rotor Bolt	9 N.m (80 lb in)
Rear Brake Caliper Guide Pin Bolt	35 N.m (26 lb ft)
Rear Brake Hose Fitting Bolt	40 N.m (30 lb ft)
Rear Brake Rotor Bolt	9 N.m (80 lb in)

DISC BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Front Brakes		
Brake Pad Lining Thickness - Minimum	3.0 mm	0.118 in
Brake Pad Lining Thickness - New	11.0 mm	0.433 in
Brake Rotor Diameter	276.0 mm	10.866 in
Brake Rotor Discard Thickness	23.0 mm	0.906 in
Brake Rotor Maximum Allowable Assembled Lateral Runout	0.04 mm	0.0016 in
Brake Rotor Maximum Allowable Scoring	1.5 mm	0.059 in
Brake Rotor Maximum Allowable Thickness Variation	0.02 mm	0.0008 in
Brake Rotor Minimum Allowable Thickness After Refinish	24.0 mm	0.945 in
Brake Rotor Thickness - New	26.0 mm	1.024 in
Rear Brakes		
Brake Pad Lining Thickness - Minimum	1.6 mm	0.063 in
Brake Pad Lining Thickness - New	10.0 mm	0.394 in
Brake Rotor Diameter	264.0 mm	10.394 in
Brake Rotor Discard Thickness	8.5 mm	0.335 in
Brake Rotor Maximum Allowable Assembled Lateral Runout	0.04 mm	0.0016 in
Brake Rotor Maximum Allowable Scoring	1.5 mm	0.059 in
Brake Rotor Maximum Allowable Thickness Variation	0.02 mm	0.0008 in
Brake Rotor Minimum Allowable Thickness After Refinish	8.8 mm	0.346 in
Brake Rotor Thickness - New	10.0 mm	0.394 in

DIAGNOSTIC INFORMATION AND PROCEDURES

BRAKE ROTOR THICKNESS MEASUREMENT

Special Tools

CH-230-A Disc Gauge

Equivalent regional tools:Special Tools

WARNING: **Refer to Brake Dust Warning .**

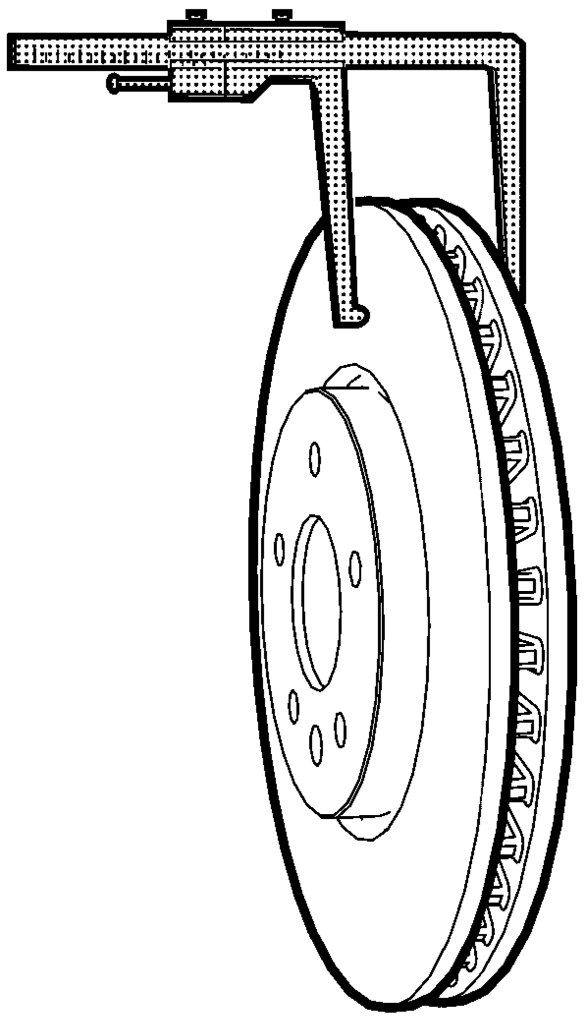


Fig. 1: Locating Disc Gauge
Courtesy of GENERAL MOTORS COMPANY

1. If the inboard friction surface of the brake rotor is not accessible, remove the brake pads. Refer to **Front Disc Brake Pads Replacement**, and/or **Rear Disc Brake Pads Replacement**, if equipped.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

NOTE: Ensure the measurements are only taken within the friction surfaces.

3. Install the **CH-230-A** gauge for lateral runout measurement.
    1. Measure and record the thickness of the brake rotor at 4 or more points from the brake rotor inside to outside.
    2. Compare the lowest thickness measurement to the disc brake component specifications. Refer to **Disc Brake Component Specifications**.
4. If the lowest thickness measurement of the brake rotor is above the minimum allowable thickness after refinishing specification, the rotor may be able to be refinished, depending upon surface and wear conditions which may be present.
5. If the lowest thickness measurement of the brake rotor is at or below the minimum allowable thickness after refinishing specification, the rotor may not be refinished.
6. If the lowest thickness measurement of the brake rotor is at or below the discard thickness specification, the rotor requires replacement. Refer to **Front Brake Rotor Replacement**, and/or **Rear Brake Rotor Replacement**.

BRAKE ROTOR THICKNESS VARIATION MEASUREMENT

Special Tools

CH-45101 Hub and Wheel Runout Gauge

For equivalent regional tools, refer to **Special Tools**.

WARNING: **Refer to Brake Dust Warning .**

NOTE: Any disc brake rotor that exhibits thickness variation exceeding the maximum acceptable level must be refinished or replaced. Thickness variation exceeding the maximum acceptable level can cause brake pulsation.

1. If the inboard friction surface of the brake rotor is not accessible, remove the brake pads. Refer to **Front Disc Brake Pads Replacement**, and/or **Rear Disc Brake Pads Replacement**, if equipped.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.

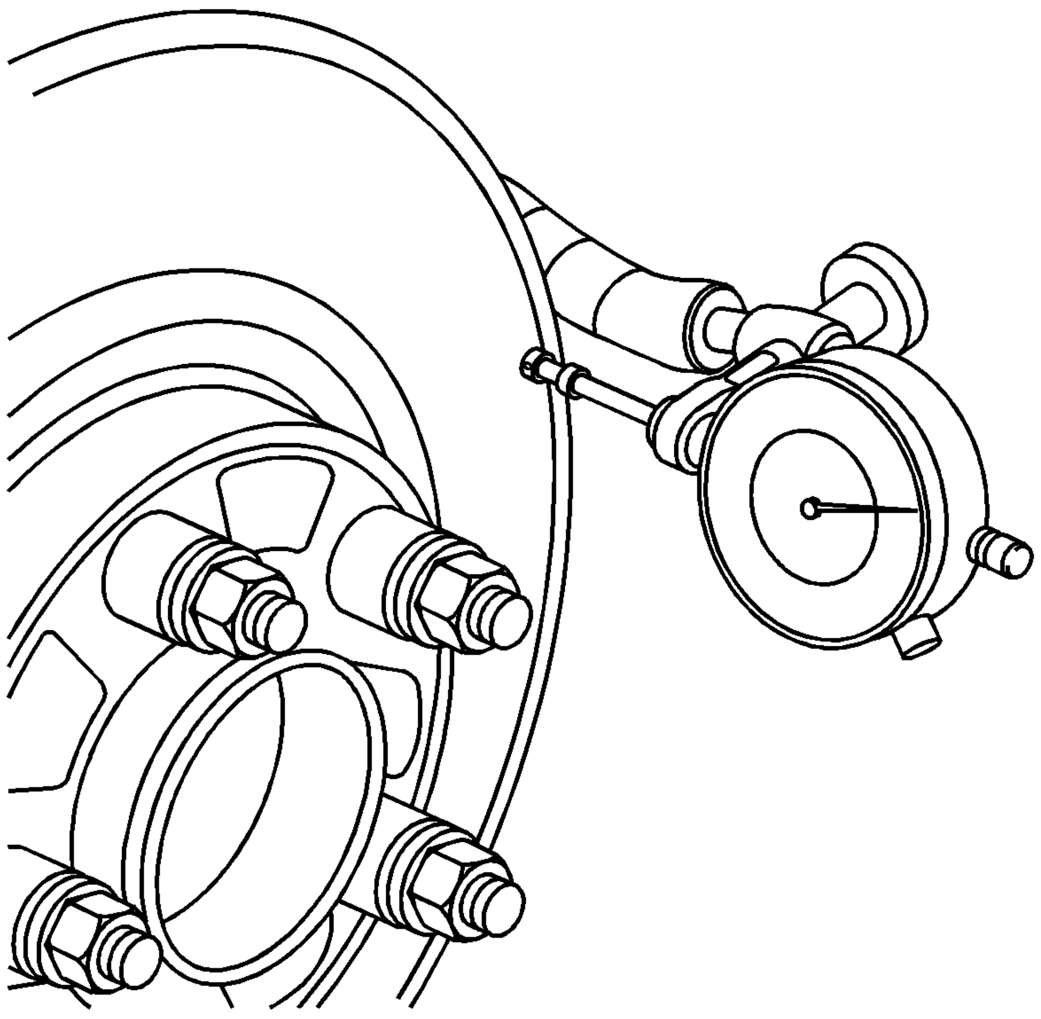


Fig. 2: Using Dial Indicator To Measure Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the measurements are only taken within the friction surfaces.

3. Install the **CH-45101** runout gauge for lateral runout measurement and compare with the correct specifications. Refer to **Disc Brake Component Specifications**.

NOTE: Whenever a brake rotor is refinished or replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.

4. If the brake rotor lateral runout measurement exceeds the specification, the rotor requires refinishing or replacement. Refer to **Front Brake Rotor Replacement**, **Rear Brake Rotor Replacement**, or **Brake Rotor Refinishing**.

BRAKE ROTOR SURFACE AND WEAR INSPECTION

WARNING: **Refer to Brake Dust Warning .**

1. If the inboard friction surface of the brake rotor is not accessible, remove the brake pads. Refer to **Front Disc Brake Pads Replacement**, or/and **Rear Disc Brake Pads Replacement**.
2. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
3. Inspect the friction surfaces of the brake rotor for the following Braking Surface Conditions:
    - Heavy rust and/or pitting.
    - Light surface rust can be removed with an abrasive disc. Heavy surface rust and/or pitting must be removed by refinishing the rotor. Refer to **Brake Rotor Refinishing**.
    - Cracks and/or heat spots.
    - Excessive bluing discoloration.
4. If the friction surfaces of the brake rotor exhibit one or more of the Braking Surface Conditions, the rotor requires refinishing or replacement. Refer to **Front Brake Rotor Replacement**, **Rear Brake Rotor Replacement**, or **Brake Rotor Refinishing**.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT MEASUREMENT

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit
- **CH-45101** Hub and Wheel Runout Gauge
- **CH-45101-100** Conical Brake Rotor Washers

For equivalent regional tool, refer to **Special Tools**.

WARNING: **Refer to Brake Dust Warning .**

NOTE:

- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4800 and 11300 km (3000 and 7000 mi).**
- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Refer to Brake Rotor Thickness Variation Measurement.**

NOTE: Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.

1. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles, corrosion, rust, or debris remaining. If the wheel hub/axle flange and/or if the brake rotor mating surfaces exhibit these conditions, perform the following steps:
    1. Remove the brake rotor from the vehicle. Refer to **Front Brake Rotor Replacement**, and/or **Rear Brake Rotor Replacement**.
    2. Using the **CH-42450-A** resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
    3. Using the **CH-41013** resurfacing kit, thoroughly clean any rust or corrosion from the mating surface of the brake rotor.

4. Clean the friction surfaces of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
2. Install the rotor to the hub/axle flange.

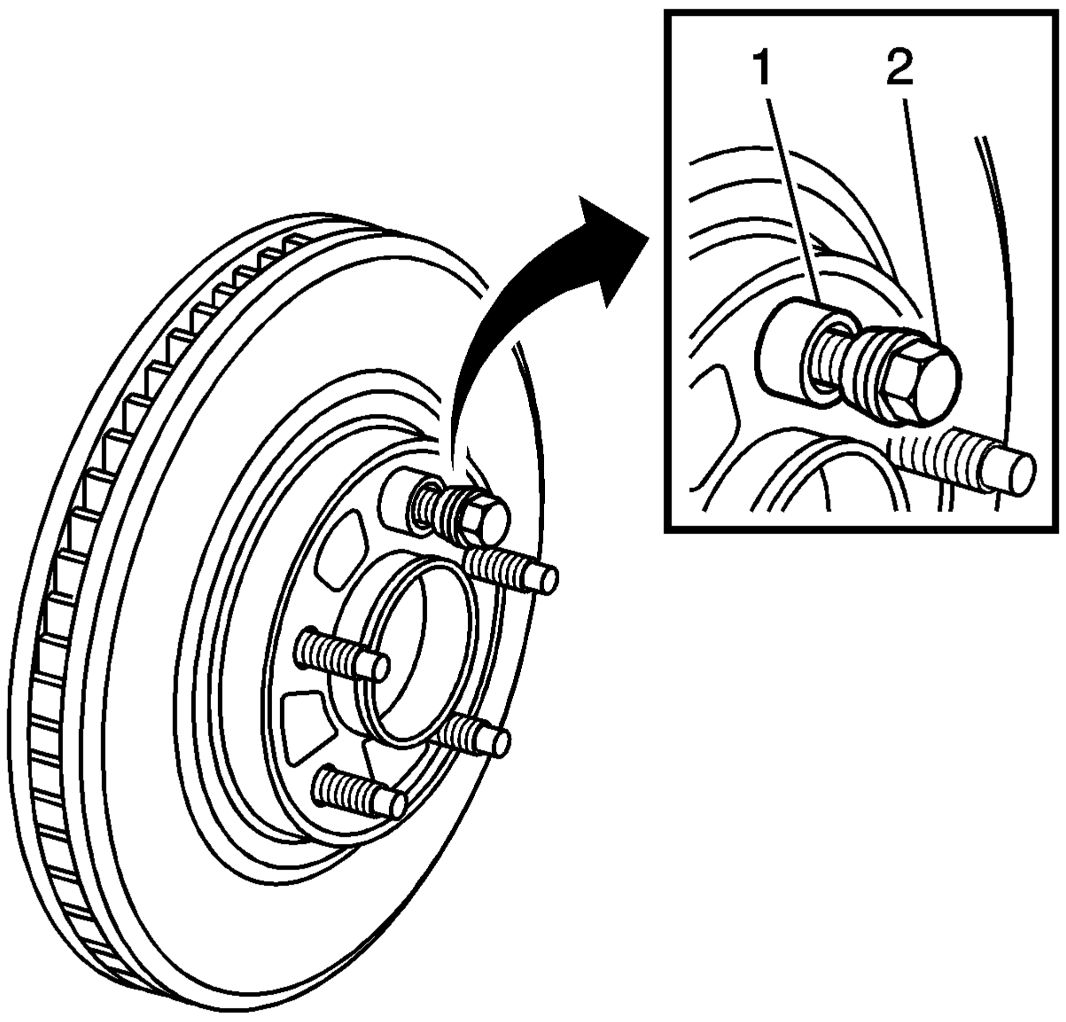


Fig. 3: Lug Nuts & Conical Washers
Courtesy of GENERAL MOTORS COMPANY

3. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** washers (1), and one lug nut (2) onto the upper-most wheel stud.
4. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

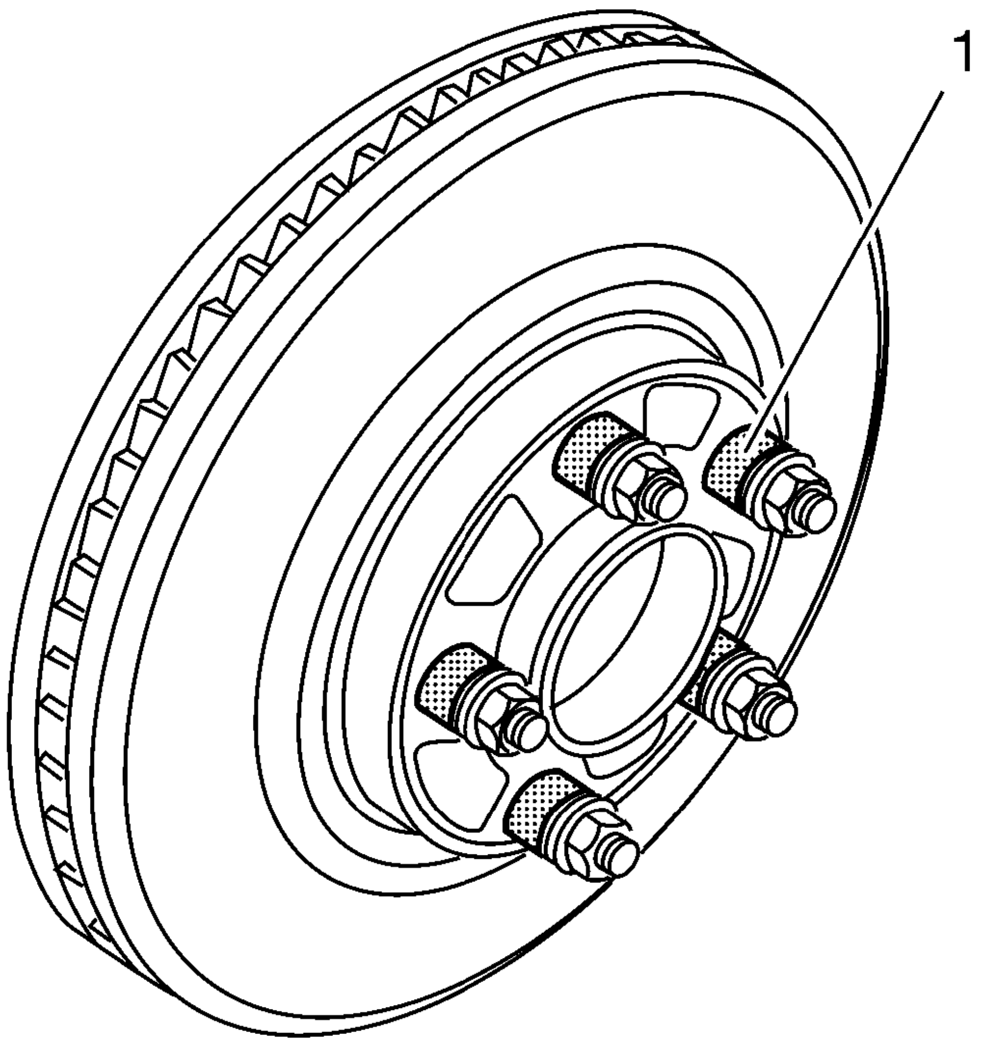


Fig. 4: Conical Washers & Lug Nuts
Courtesy of GENERAL MOTORS COMPANY

5. Install the remaining **CH-45101-100** washers (1) and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
6. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. Refer to **Tire and Wheel Removal and Installation** .
7. If the brake rotor has been REFINISHED or REPLACED with a new rotor, proceed to step 13.
8. If the brake rotor meets the following criteria, proceed to step 9.
   - The rotor is within specifications and is being REUSED.
   - The rotor has NOT been refinished.
   - The rotor does NOT exhibit thickness variation exceeding the maximum allowable level.

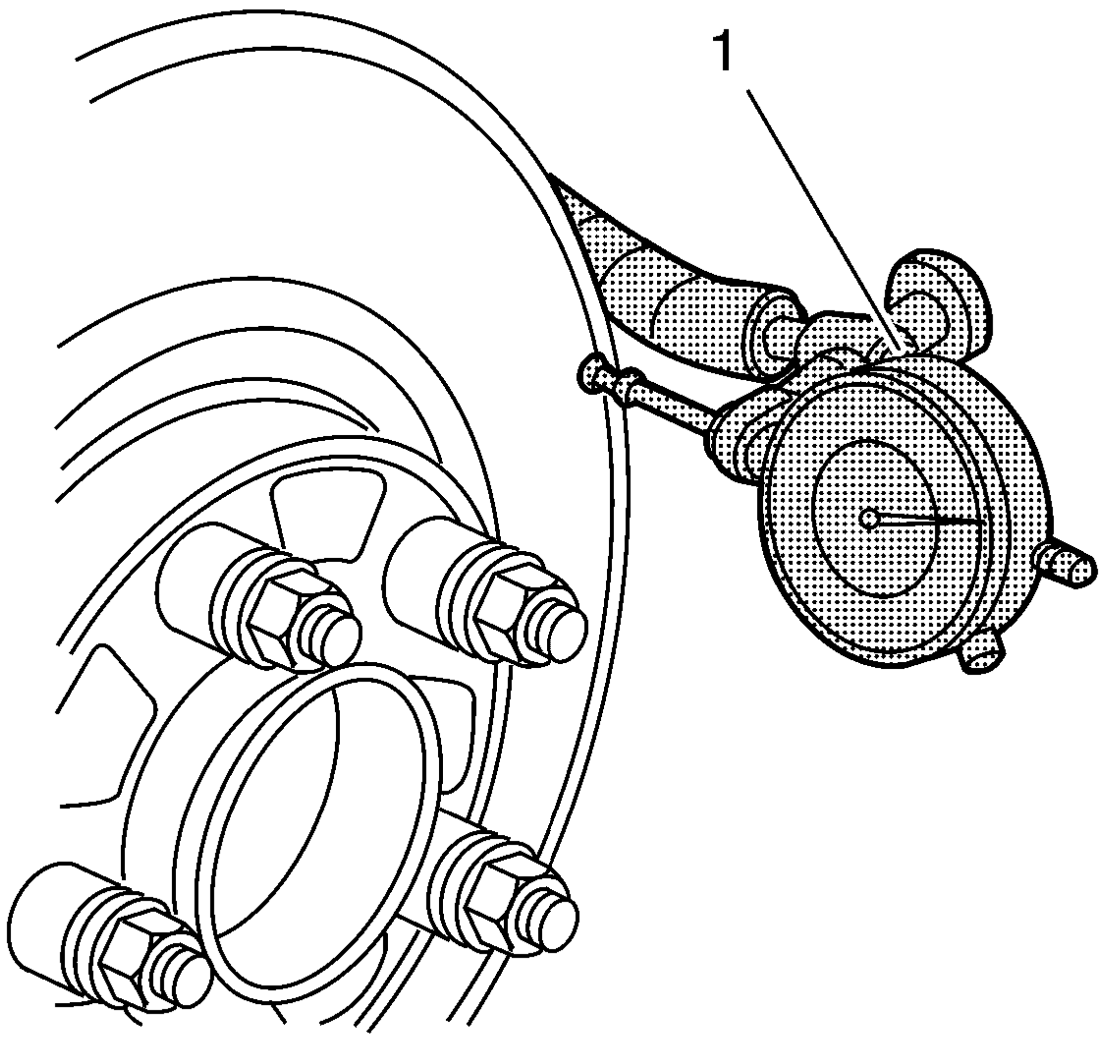


Fig. 5: Measuring Brake Rotor Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

9. Mount the **CH-45101** gauge (1) or equivalent, to the strut and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
10. Measure and record the assembled LRO of the brake rotor.
    1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    2. Rotate the rotor until the highest reading is displayed on the dial.
    3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    4. Measure and record the amount of LRO.
11. Compare the brake rotor assembled LRO to the disc brake component specifications. Refer to **Disc Brake Component Specifications**
12. If the brake rotor assembled LRO is within specifications, proceed to step 17.

    If the brake rotor assembled LRO exceeds the specification, refinish the rotor to ensure true parallelism. Refer to **Brake Rotor Refinishing**. After refinishing the rotor, proceed to step 13.

13. Mount the **CH-45101** gauge (1) or equivalent, to the strut and position the indicator button so it contacts the brake rotor friction surface at a 90 degree angle, approximately 13 mm (0.5 in) from the outer edge of the rotor.
14. Measure and record the assembled LRO of the brake rotor.
    1. Rotate the rotor until the lowest reading is displayed on the indicator dial, then set the dial to zero.
    2. Rotate the rotor until the highest reading is displayed on the dial.
    3. Mark the location of the high spot relative to the nearest wheel stud, or studs.
    4. Measure and record the amount of LRO.
15. Compare the brake rotor assembled LRO to the disc brake component specifications.
16. If the brake rotor assembled LRO measurement exceeds the specification, replace the brake rotors. Refer to **Front Brake Rotor Replacement**, and/or **Rear Brake Rotor Replacement**.
17. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** washers.

BRAKE PAD INSPECTION

Special Tools

CH-230-A Disc Gauge

For equivalent regional tools, refer to **Special Tools**.

WARNING: **Refer to Brake Dust Warning .**

1. Remove brake pads. Refer to **Front Disc Brake Pads Replacement**, and/or **Rear Disc Brake Pads Replacement**.

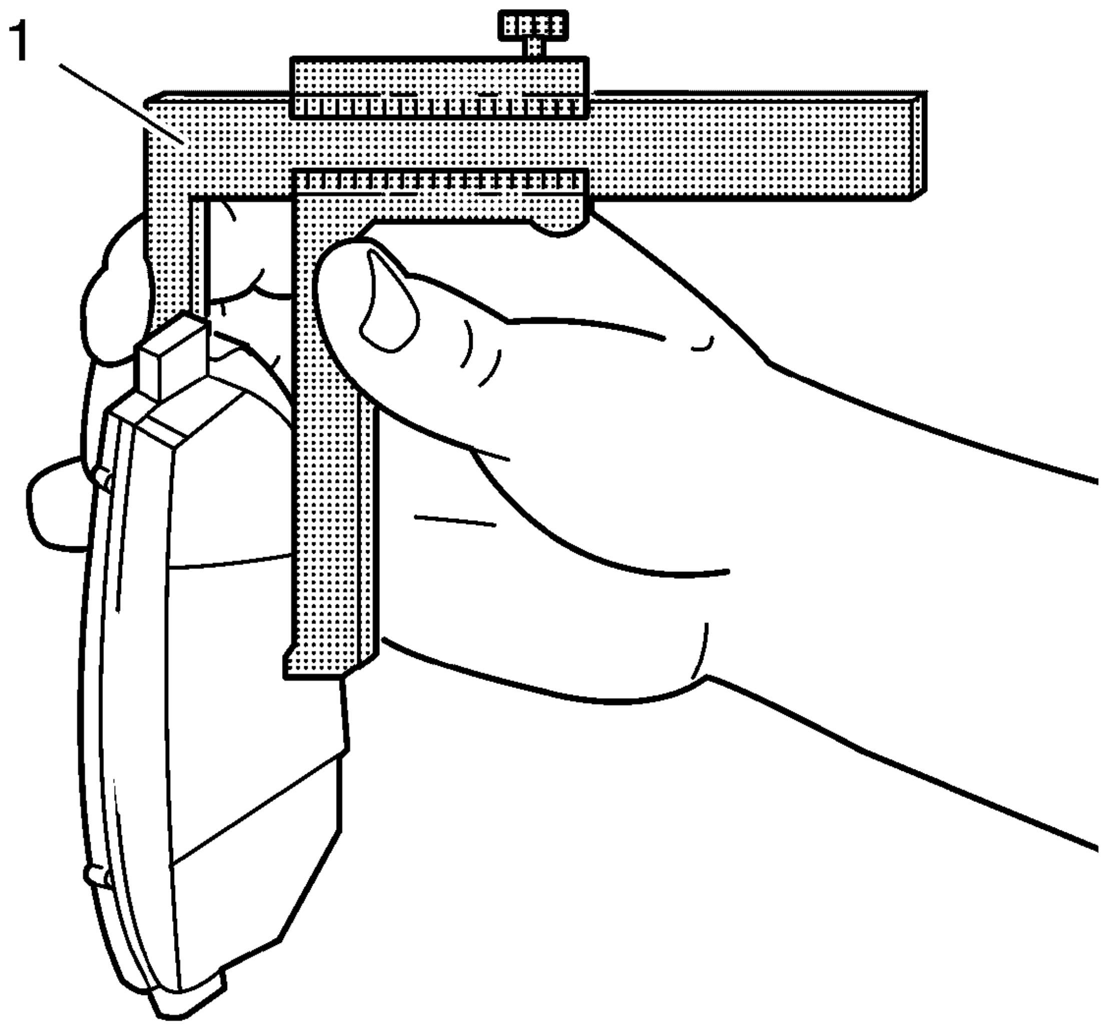


Fig. 6: Measuring Brake Pad Thickness
Courtesy of GENERAL MOTORS COMPANY

2. Measure remaining brake pad thickness at several points, using the **CH-230-A** disc gauge (1).
3. Compare brake pad thickness to disc brake component specifications.

BRAKE CALIPER INSPECTION

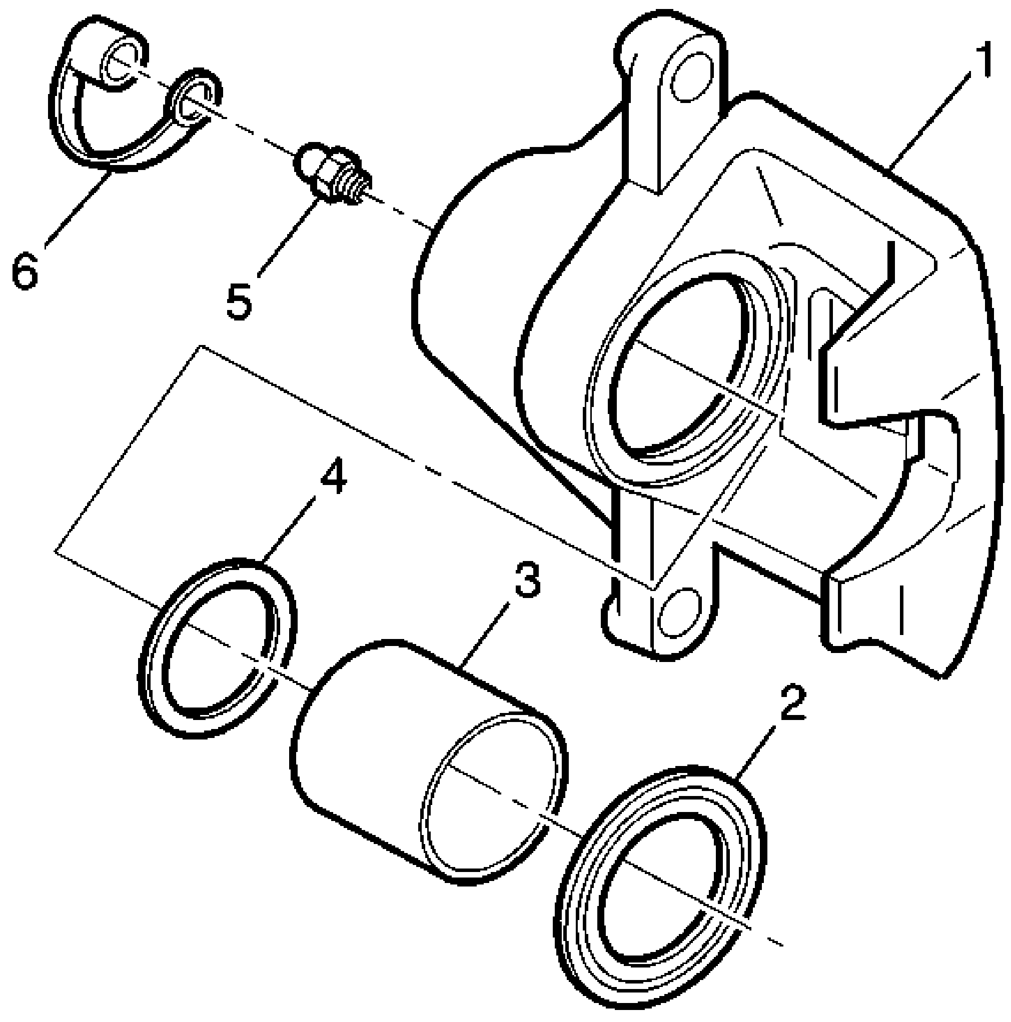


Fig. 7: Exploded View Of Brake Caliper
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Refer to Brake Dust Warning .**

1. Inspect the brake caliper housing (1) for cracks, excess wear, and/or damage. If any of these conditions are present, the brake caliper requires replacement.
2. Inspect the caliper piston dust boot seal (2) for cracks, tears, cuts, deterioration and/or improper seating in the caliper body. If any of these conditions are present, the brake caliper requires overhaul or replacement.
3. Inspect for brake fluid leakage around the caliper piston dust boot seal (2) and on the disc brake pads. If there is any evidence of brake fluid leakage, the brake caliper requires overhaul or replacement.

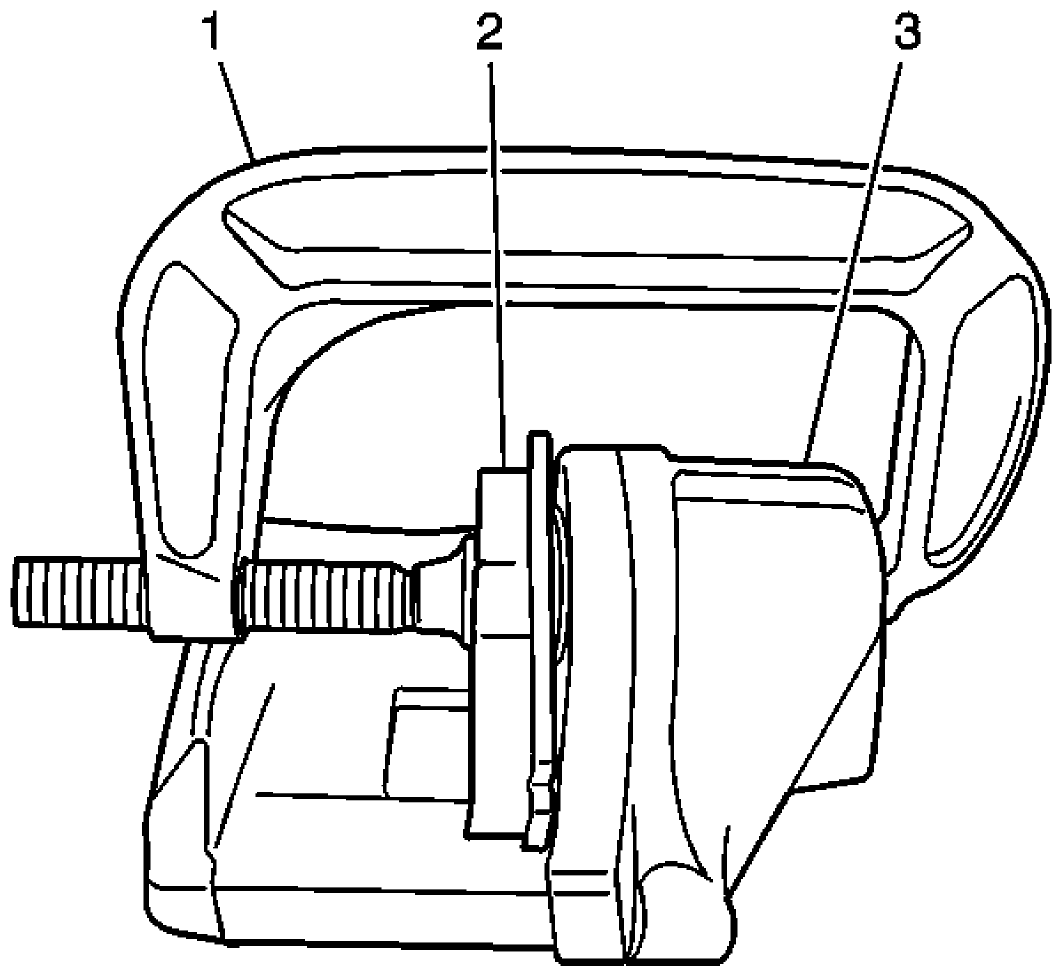


Fig. 8: Compressing Caliper Piston
Courtesy of GENERAL MOTORS COMPANY

4. Inspect for smooth and complete travel of the caliper pistons into the caliper bores:

   The movement of the caliper pistons into the caliper bores should be smooth and even. If the caliper piston is frozen or difficult to bottom, the caliper requires overhaul or replacement.

   - For single piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the piston. Using a large C-clamp (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the piston in the bore.
   - For dual piston caliper applications, insert a discarded inner brake pad (2) or block of wood in front of the pistons. Using 2 large C-clamps (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly bottom the pistons evenly into the bores.

FRONT DISC BRAKE MOUNTING AND HARDWARE INSPECTION

WARNING: **Refer to Brake Dust Warning .**

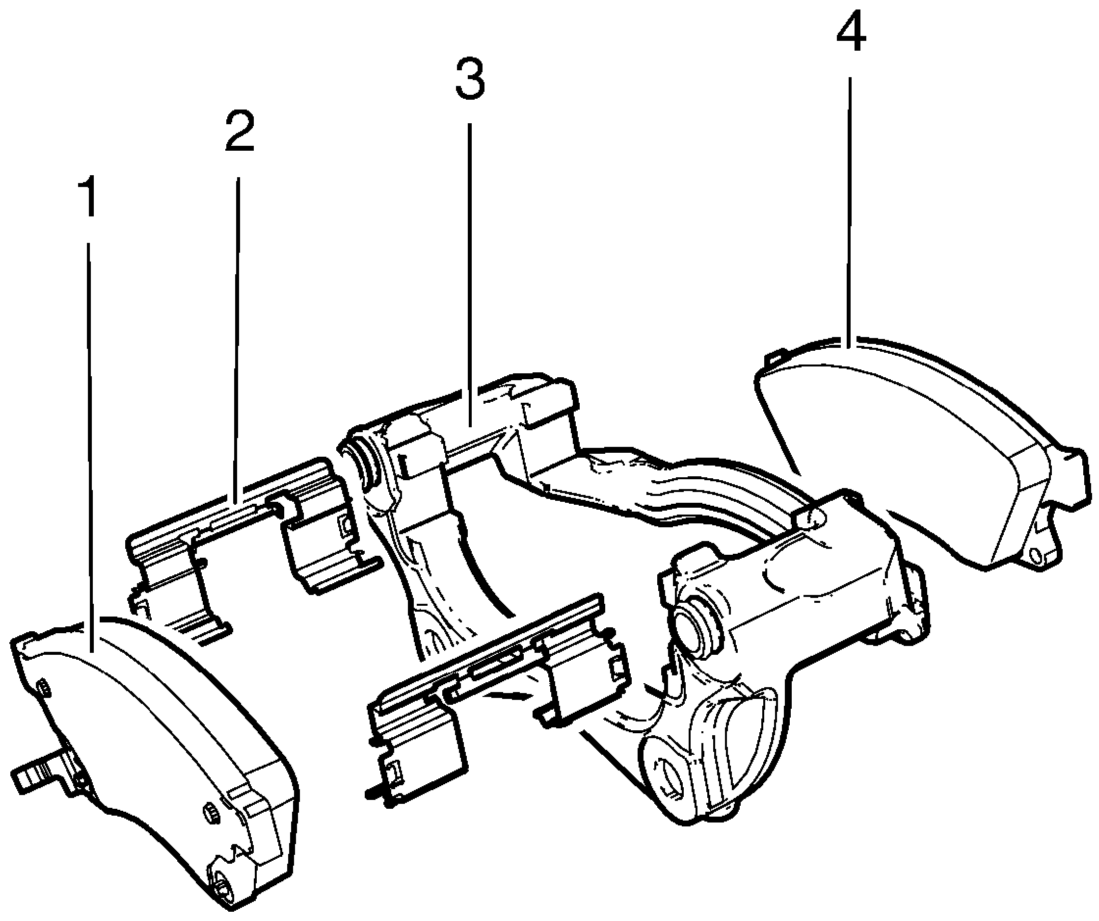


Fig. 9: Exploded View Of Brake Pads And Brake Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level then no brake fluid needs to be removed from the reservoir before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level then remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
5. Remove the tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation** .
6. Grasp the brake caliper housing and try to move the brake caliper housing up/down and forward/reverse in relation to the brake caliper mounting bracket (3). If excessive looseness is observed the brake caliper bracket bushings and/or the brake caliper mounting bolts may need to be replaced. Compress the front caliper pistons
7. Compress the front caliper pistons.
   1. Install a large C-clamp over the top of the caliper housing and against the back of the outboard pad (1).
   2. Slowly tighten the C-clamp until the pistons are pushed completely into the caliper bores.
   3. Remove the C-clamp from the caliper.
8. With the pistons compressed into the caliper bores, grasp the brake caliper housing and slide it back and forth on the brake caliper mounting bolts. Check for smooth operation. If the brake caliper housing slide force is high or the brake caliper housing does not slide smoothly, inspect the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings for wear or damage. If wear or damage conditions are found, replacement of the brake caliper mounting bolts and/or the brake caliper mounting bracket bushings is necessary.
9. Remove the brake caliper mounting bolts from the brake caliper mounting bracket and support the brake caliper using heavy mechanics wire. Do Not remove the hydraulic brake hose from the caliper. Refer to **Front Brake Caliper Replacement**.
10. Remove the disc brake pads (1, 2) from the brake caliper mounting bracket (3).
11. Inspect the disc brake pad mounting hardware for the following:
    - Missing mounting hardware.
    - Excessive corrosion.
    - Bent pad retainer spring (2).
    - Looseness at the brake caliper mounting bracket (3).
    - Looseness at the disc brake pads (1, 4).
    - Excessive contaminants in the brake caliper mounting bracket (3) surface and threads.
12. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
13. Ensure the disc brake pads are held firmly in place on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.

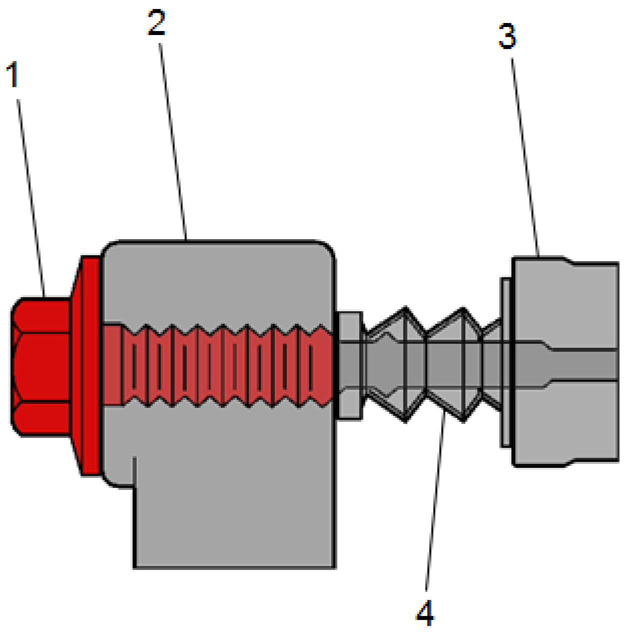


Fig. 10: View Of Caliper, Pin, Boots & Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

14. Inspect the brake caliper mounting hardware for the following:
    - Binding
    - Seizing
    - Looseness in the brake caliper mounting bracket (3).
    - Bent or damaged brake caliper mounting bolts (1).
    - Cracked or torn boots (4).
    - Missing boots.
    - Bent or damaged brake caliper mounting bracket (3).
    - Cracked or damaged brake caliper (2).
15. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.
16. Install the disc brake pads to the brake caliper mounting bracket.
17. Install the disc brake caliper to the brake caliper mounting bracket. Refer to **Front Brake Caliper Replacement**.

REAR DISC BRAKE MOUNTING AND HARDWARE INSPECTION

WARNING: **Brake Dust Warning**

1. Remove Rear Brake Caliper Bracket **Rear Brake Caliper Bracket Replacement**

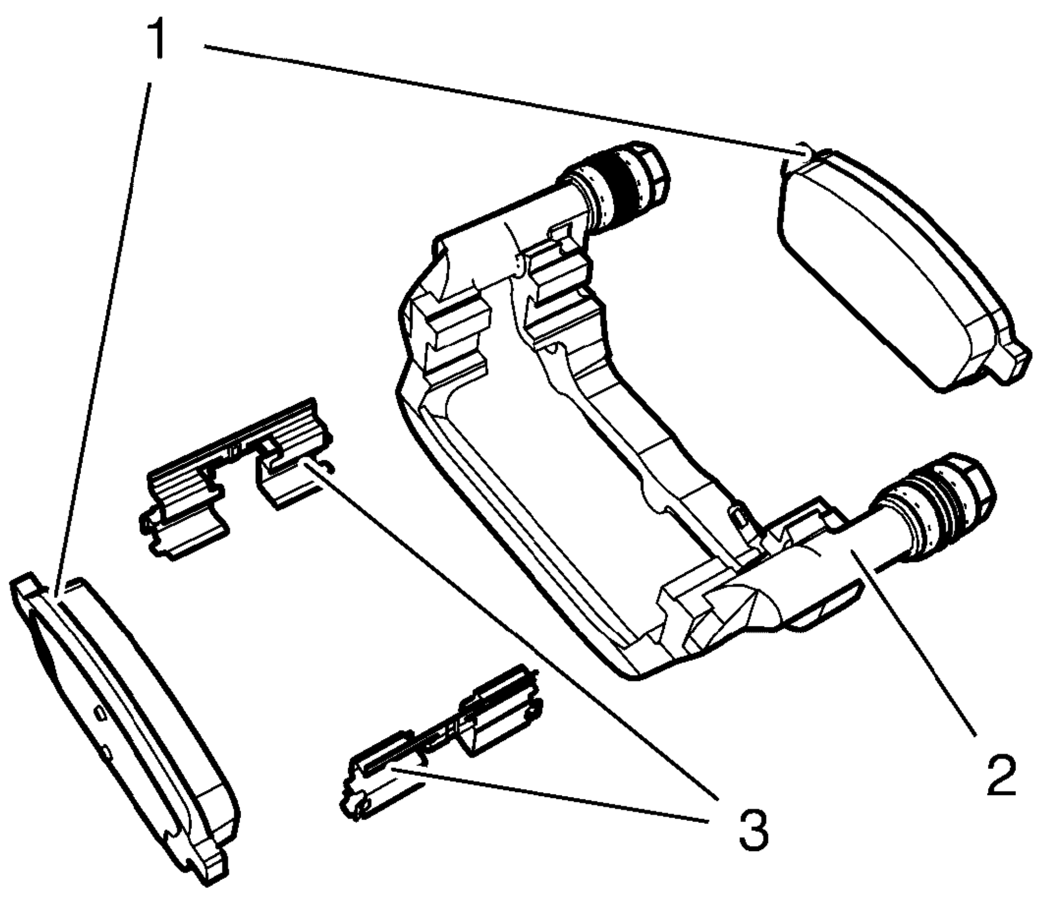


Fig. 11: Exploded View Of Brake Pads And Brake Caliper Mounting Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Remove the disc brake caliper from the caliper mounting bracket (2).
3. Remove the disc brake pads (1) from the caliper mounting bracket (2).
4. Inspect the disc brake pad mounting hardware (3) (if installed) for the following:
    - Missing mounting hardware.
    - Excessive corrosion.
    - Brake pad fastener spring is bent.
    - Looseness at the brake caliper mounting bracket.
    - Looseness at the disc brake pads.
    - Excessive contaminants in the brake caliper mounting bracket surface and threads.
5. If any of the conditions listed are found, the disc brake pad mounting hardware requires replacement.
6. Ensure the disc brake pads are held firmly on the brake caliper mounting bracket, yet slide easily on the mounting hardware without binding.

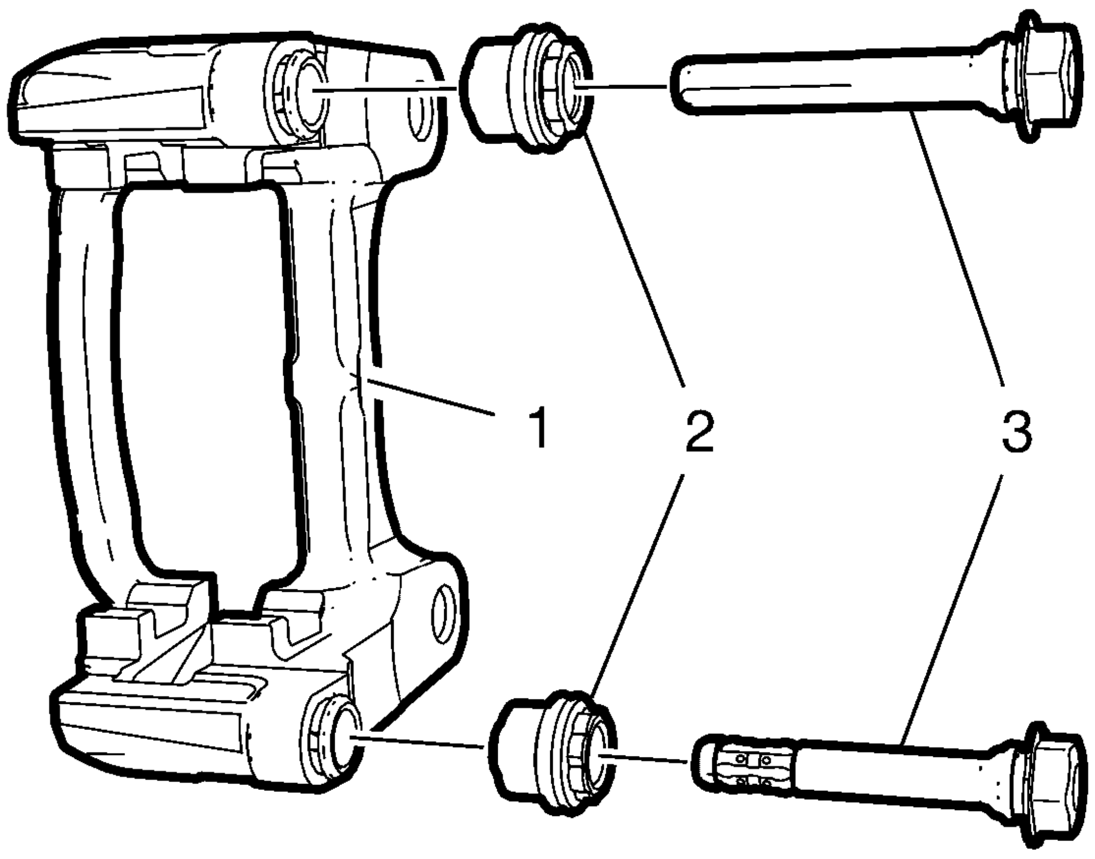


Fig. 12: Brake Caliper And Mounting Brackets
Courtesy of GENERAL MOTORS COMPANY

7. Inspect the brake caliper mounting hardware for the following:
    - Binding
    - Seizing
    - Looseness in the brake caliper mounting bracket (1)
    - Bent or damaged brake caliper mounting bolts
    - Cracked or torn boots (4)
    - Missing boots
    - Bent or damaged brake caliper mounting bracket (3)
    - Cracked or damaged brake caliper (2)
8. If any of the conditions listed are found then the brake caliper mounting hardware requires replacement.
9. Install the disc brake pads to the caliper mounting bracket.
10. Install the disc brake caliper to the mounting bracket.
11. Install Rear Brake Caliper Bracket **Rear Brake Caliper Bracket Replacement**

REPAIR INSTRUCTIONS

FRONT DISC BRAKE PADS REPLACEMENT

Removal Procedure

WARNING: **Brake Dust Warning**

WARNING: **Brake Fluid Irritant Warning**

CAUTION: **Brake Fluid Effects on Paint and Electrical Components Caution**

NOTE: **Always replace disc brake pads in axle sets.**

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
5. Remove the front tire and wheel assembly. **Tire and Wheel Removal and Installation**

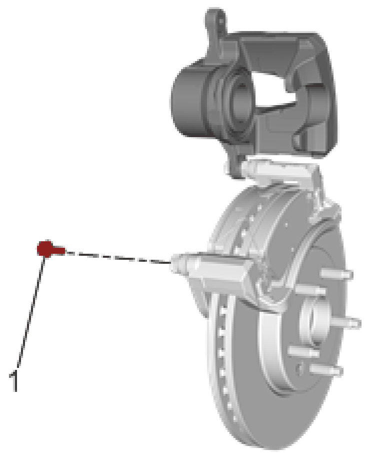


Fig. 13: Front Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE:
- **Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.**
- **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.**

6. Remove Front Brake Caliper Guide Pin Bolt (1)

CAUTION: **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

7. Pivot the brake caliper upward and secure with heavy mechanics wire, or equivalent.

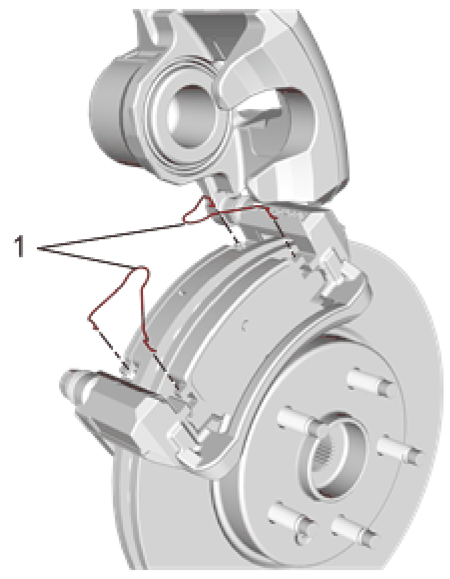


Fig. 14: Front Brake Caliper Spring
Courtesy of GENERAL MOTORS COMPANY

8. Remove Front Brake Caliper Spring (1) and DISCARD

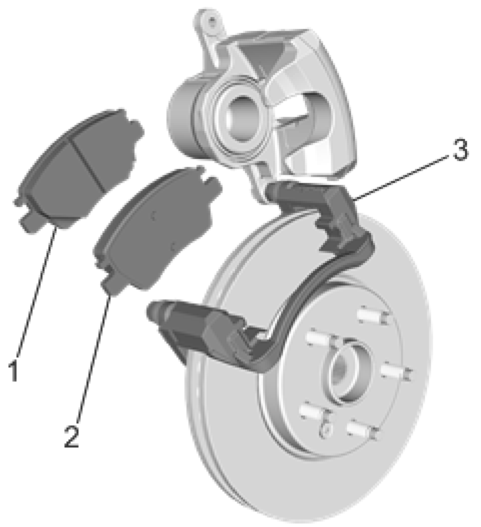


Fig. 15: Front Disc Brake Inner Pad
Courtesy of GENERAL MOTORS COMPANY

9. Remove Front Disc Brake Inner Pad (1) @Front Brake Caliper Bracket (3)
10. Remove Front Disc Brake Outer Pad (2) @Front Brake Caliper Bracket (3)

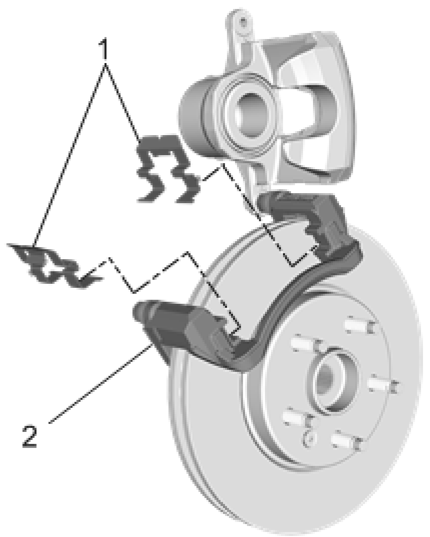


Fig. 16: Front Disc Brake Pad Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

11. Remove Front Disc Brake Pad Retainer Spring (1) @Front Brake Caliper Bracket (2)
12. Inspect the front disc brake mounting and hardware. **Front Disc Brake Mounting and Hardware Inspection**

Installation Procedure

1. Using a commercial brake caliper piston retracting tool, carefully push back the brake caliper piston until it is compressed completely into the caliper bore.

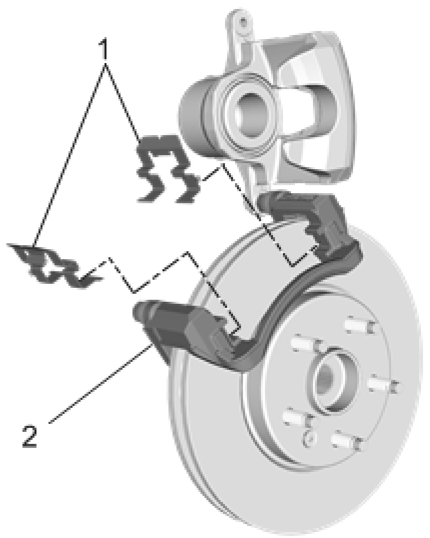


Fig. 17: Front Disc Brake Pad Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

2. Install Front Disc Brake Pad Retainer Spring (1) @Front Brake Caliper Bracket (2)

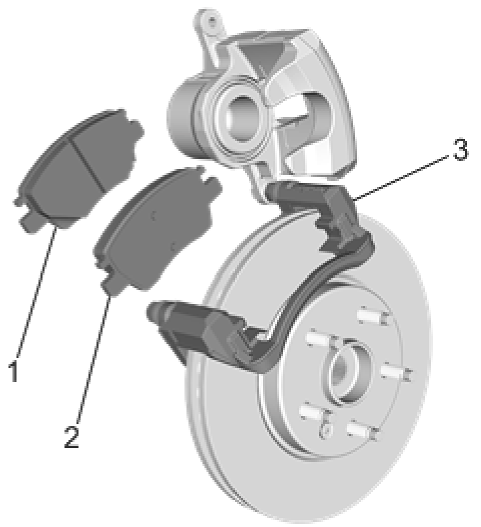


Fig. 18: Front Disc Brake Inner Pad
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The disc brake pad equipped with wear sensor has to be mounted in upper position on the inner side of the rotor.**

3. Front Disc Brake Outer Pad (2) @Front Brake Caliper Bracket (3)
4. Front Disc Brake Inner Pad (1) @Front Brake Caliper Bracket (3)

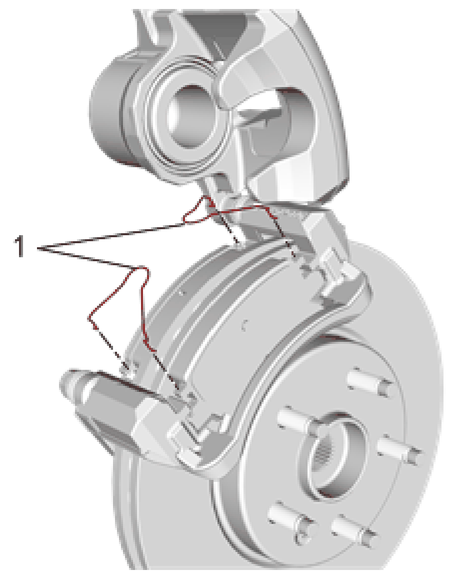


Fig. 19: Front Brake Caliper Spring
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Brake Caliper Spring (1)

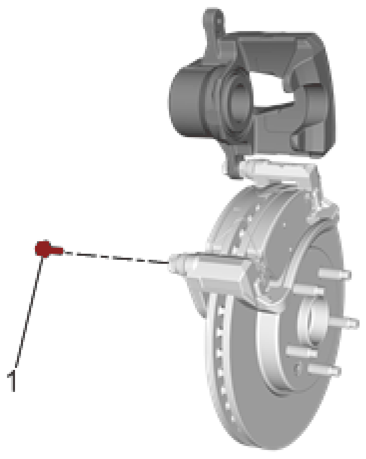


Fig. 20: Front Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove the support and rotate the front brake caliper into position over the disc brake pads and to the caliper mounting bracket.

CAUTION: Fastener Caution

NOTE: **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.**

7. Install Front Brake Caliper Guide Pin Bolt (1) and tighten 40 N.m (30 lb ft)
8. Install the front tire and wheel assembly. Tire and Wheel Removal and Installation
9. Lower the vehicle.
10. With the vehicle OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
13. Inspect the fluid level in the brake master cylinder reservoir.
14. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Master Cylinder Reservoir Filling
15. Burnish the brake pads and rotors. Brake Pad and Rotor Burnishing

REAR DISC BRAKE PADS REPLACEMENT

Removal Procedure

WARNING: Brake Dust Warning

WARNING: Brake Fluid Irritant Warning

CAUTION: Brake Fluid Effects on Paint and Electrical Components Caution

NOTE: **Always replace disc brake pads in axle sets.**

1. Inspect the fluid level in the brake master cylinder reservoir.
2. If the brake fluid level is midway between the maximum-full point and the minimum allowable level, no brake fluid needs to be removed before proceeding.
3. If the brake fluid level is higher than midway between the maximum-full point and the minimum allowable level, remove brake fluid to the midway point before proceeding.
4. Set the parking brake in service mode. Rear Parking Brake Service Mode Selection
5. Turn OFF the vehicle.
6. Raise and support the vehicle. Lifting and Jacking the Vehicle
7. Remove the rear tire and wheel assembly. Tire and Wheel Removal and Installation

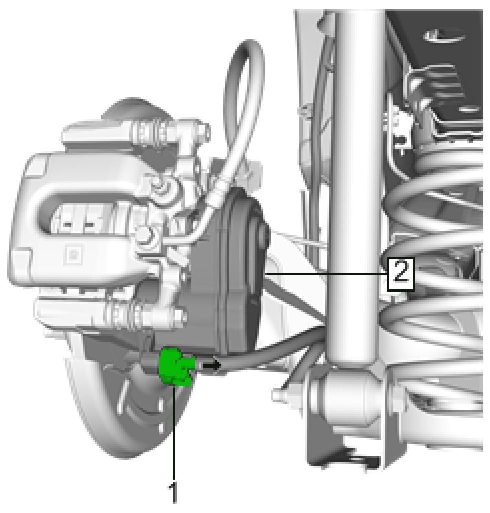


Fig. 21: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Electrical Connector (1) @Rear Park Brake Actuator (2)

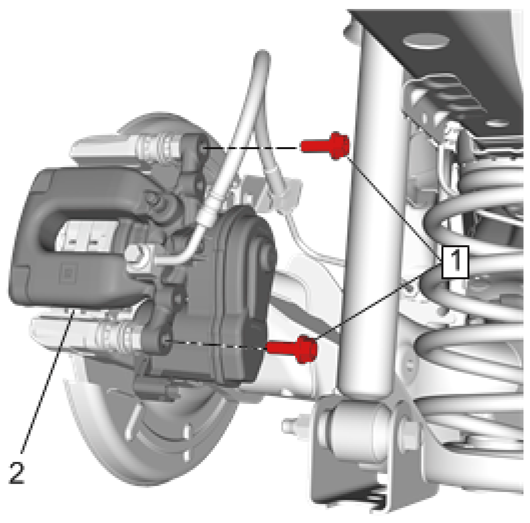


Fig. 22: Rear Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.**
- **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.**

9. Remove Rear Brake Caliper Guide Pin Bolt (1)

CAUTION: **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

10. Remove the rear brake caliper (2) from the brake caliper bracket and support the rear brake caliper (2) with heavy mechanic's wire, or equivalent. Do NOT disconnect the hydraulic brake flexible hose from the caliper.

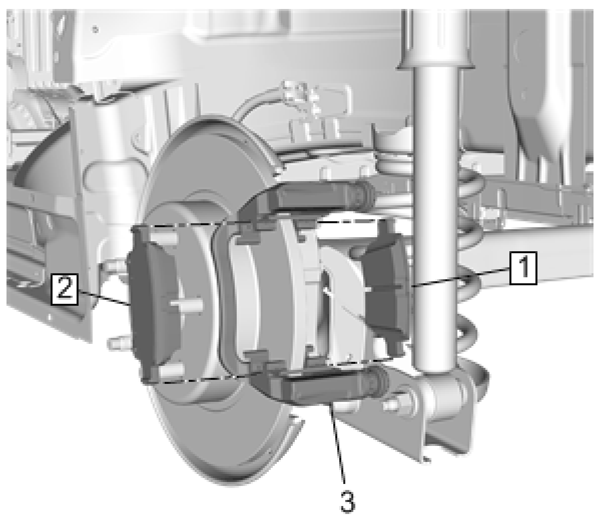


Fig. 23: Rear Disc Brake Inner Pad And Rear Brake Caliper Bracket
Courtesy of GENERAL MOTORS COMPANY

11. Remove Rear Disc Brake Inner Pad (1) @Rear Brake Caliper Bracket (3)
12. Remove Rear Disc Brake Outer Pad (2) @Rear Brake Caliper Bracket (3)

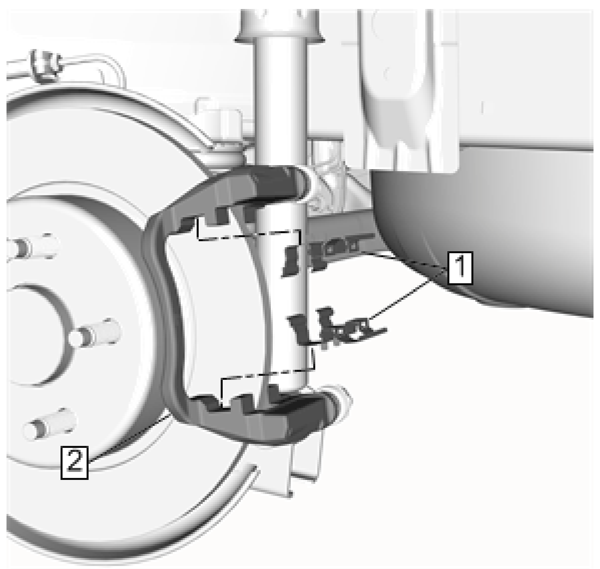


Fig. 24: Rear Disc Brake Pad Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

13. Remove Rear Disc Brake Pad Retainer Spring (1) @Rear Brake Caliper Bracket (2)
14. Inspect the rear disc brake mounting and hardware. Rear Disc Brake Mounting and Hardware Inspection

Installation Procedure

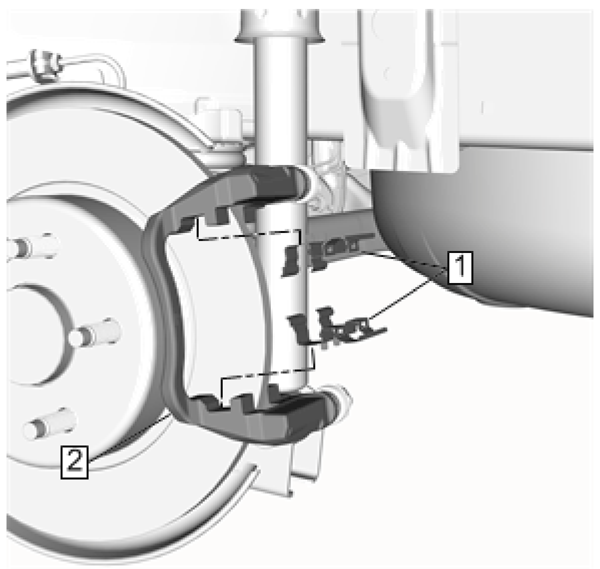


Fig. 25: Rear Disc Brake Pad Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Disc Brake Pad Retainer Spring (1) @Rear Brake Caliper Bracket (2)

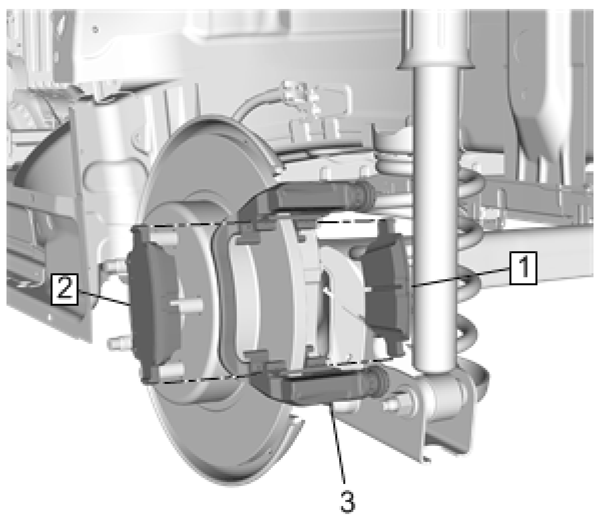


Fig. 26: Rear Disc Brake Inner Pad And Rear Brake Caliper Bracket
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The disc brake pad equipped with wear sensor has to be mounted in lower position on the inner side of the rotor.**

2. Install Rear Disc Brake Outer Pad (2) @Rear Brake Caliper Bracket (3)
3. Install Rear Disc Brake Inner Pad (1) @Rear Brake Caliper Bracket (3)

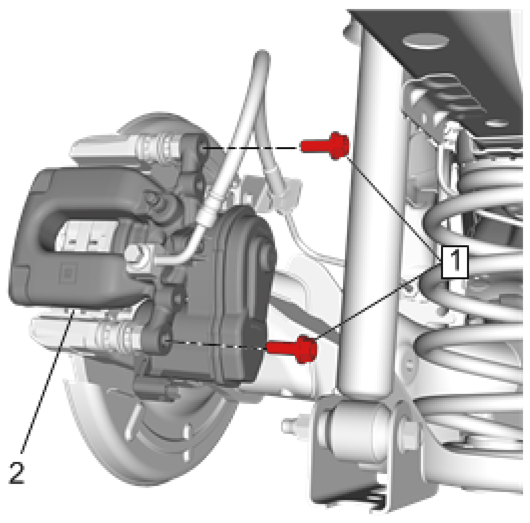


Fig. 27: Rear Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove the support and reposition the rear brake caliper (2) over the brake pads and to the rear brake caliper bracket.

CAUTION: Fastener Caution

NOTE: **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.**

5. Install Rear Brake Caliper Guide Pin Bolt (1) and tighten 35 N.m (26 lb ft)

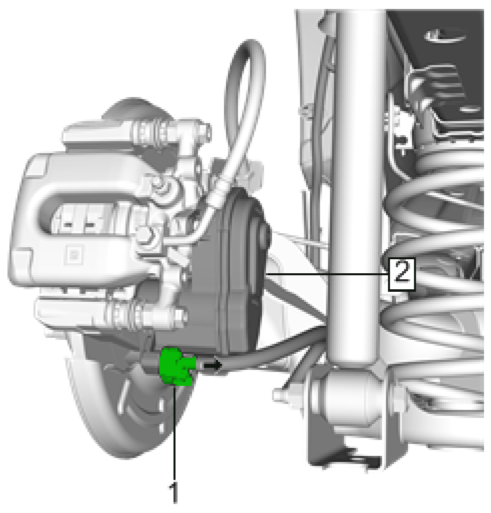


Fig. 28: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

6. Connect Electrical Connector (1) @Rear Park Brake Actuator (2)
7. Install the rear tire and wheel assembly. Tire and Wheel Removal and Installation
8. Lower the vehicle.
9. With the vehicle OFF, gradually apply the brake pedal approximately 2/3 of its travel distance.
10. Slowly release the brake pedal.
11. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
12. Inspect the fluid level in the brake master cylinder reservoir.
13. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Master Cylinder Reservoir Filling
14. Calibrate the park brake. Park Brake Calibration
15. Burnish the brake pads and rotors. Brake Pad and Rotor Burnishing

BRAKE PAD AND ROTOR BURNISHING

WARNING: **Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.**

Burnishing the brake pads and brake rotors is necessary in order to ensure that the braking surfaces are properly prepared after service has been performed on the disc brake system.

This procedure should be performed whenever the disc brake rotors have been refinished or replaced, and/or whenever the disc brake pads have been replaced.

1. Select a smooth road with little or no traffic.
2. Accelerate the vehicle to 48 km/h (30 mph).

NOTE: **Use care to avoid overheating the brakes while performing this step.**

3. Using moderate to firm pressure, apply the brakes to bring the vehicle to a stop. Do not allow the brakes to lock.
4. Repeat steps 2 and 3 until approximately 20 stops have been completed. Allow sufficient cooling periods between stops in order to properly burnish the brake pads and rotors.

FRONT BRAKE CALIPER REPLACEMENT

Removal Procedure

WARNING: Brake Dust Warning

WARNING: Brake Fluid Irritant Warning

CAUTION: Brake Fluid Effects on Paint and Electrical Components Caution

1. Raise and support the vehicle. Lifting and Jacking the Vehicle .
2. Remove the front tire and wheel assembly. Tire and Wheel Removal and Installation

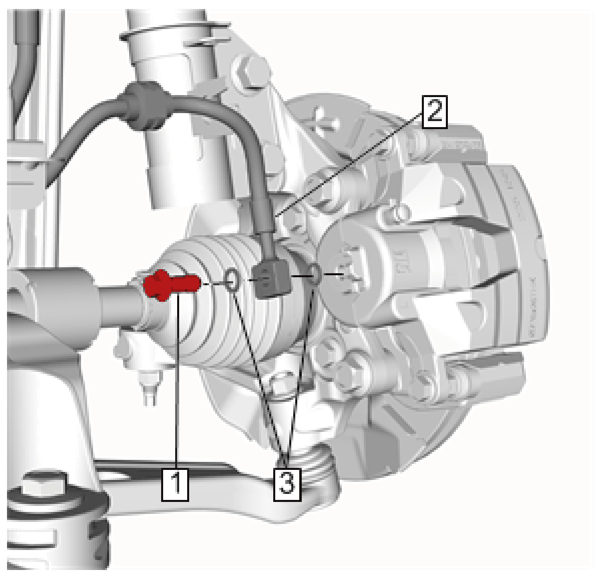


Fig. 29: Front Brake Hose, Fitting Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Brake Hose Fitting Bolt (1) @Front Brake Caliper
4. Remove Front Brake Hose (2) @Front Brake Caliper
5. Remove Front Brake Hose Washer (3) and DISCARD

NOTE: **These washers may be stuck to the brake caliper and/or the brake hose end.**

6. Cap the opening in the brake caliper and the brake hose to prevent fluid loss and contamination.

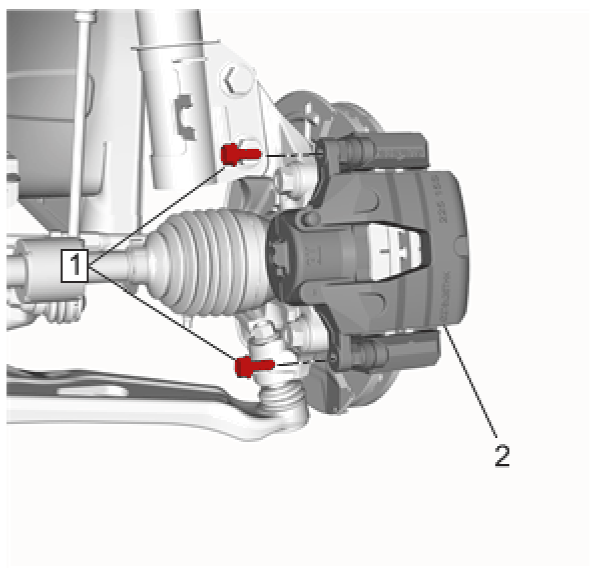


Fig. 30: Front Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE:
- **Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.**
- **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.**

7. Remove Front Brake Caliper Guide Pin Bolt (1)
8. Remove Front Brake Caliper (2) @Front Brake Caliper Bracket
9. Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
   - Restricted caliper guide pin movement
   - Looseness in the brake caliper mounting bracket
   - Seized or binding caliper guide pins
   - Split or torn boots
10. If any of the conditions listed are found, the brake caliper guide pins and/or boots require replacement.

Installation Procedure

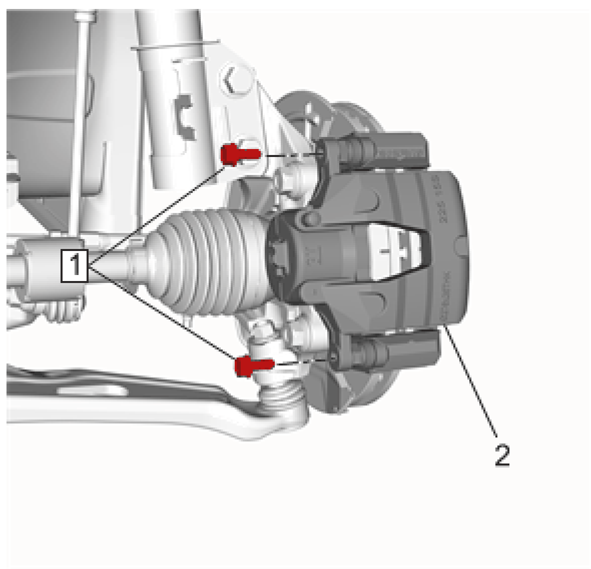


Fig. 31: Front Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Caliper (1) @Front Brake Caliper Bracket

CAUTION: **Fastener Caution**

NOTE: **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.**

2. Install Front Brake Caliper Guide Pin Bolt (1) and tighten 40 N.m (30 lb ft)

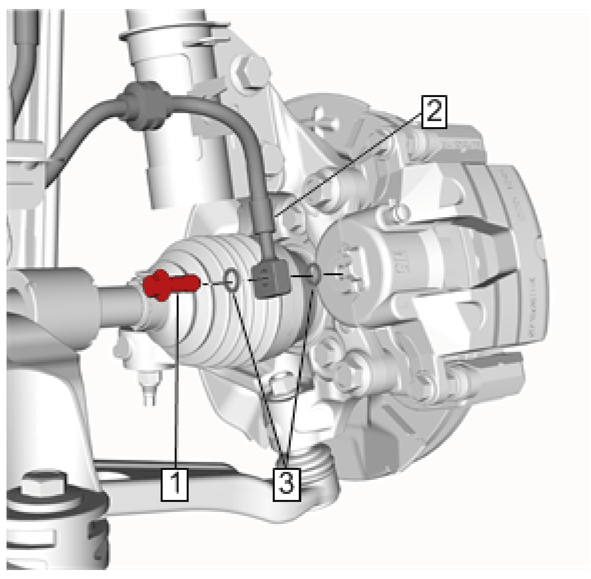


Fig. 32: Front Brake Hose, Fitting Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

3. Remove the caps from the brake caliper and the brake hose.

NOTE: **Do not reuse the copper brake hose washers.**

4. Install Front Brake Hose Washer (3)
5. Install Front Brake Hose (2) @Front Brake Caliper
6. Install Front Brake Hose Fitting Bolt (1) @Front Brake Caliper and tighten 40 N.m (30 lb ft)
7. Bleed the brake system. **Hydraulic Brake System Bleeding**
8. Install the front tire and wheel assembly. **Tire and Wheel Removal and Installation**
9. Lower the vehicle.
10. With the vehicle OFF, gradually apply the brake pedal to approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.

REAR BRAKE CALIPER REPLACEMENT

Removal Procedure

WARNING: **Brake Dust Warning**

WARNING: **Brake Fluid Irritant Warning**

CAUTION: **Brake Fluid Effects on Paint and Electrical Components Caution**

1. Set the parking brake in service mode. **Rear Parking Brake Service Mode Selection**
2. Turn OFF the vehicle.
3. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
4. Remove the rear tire and wheel assembly. **Tire and Wheel Removal and Installation**

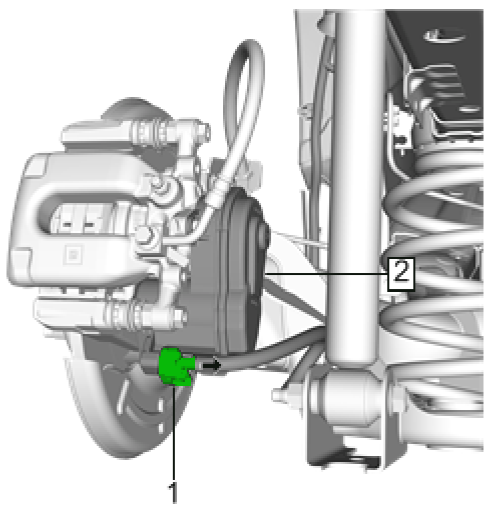


Fig. 33: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @Rear Park Brake Actuator (2)

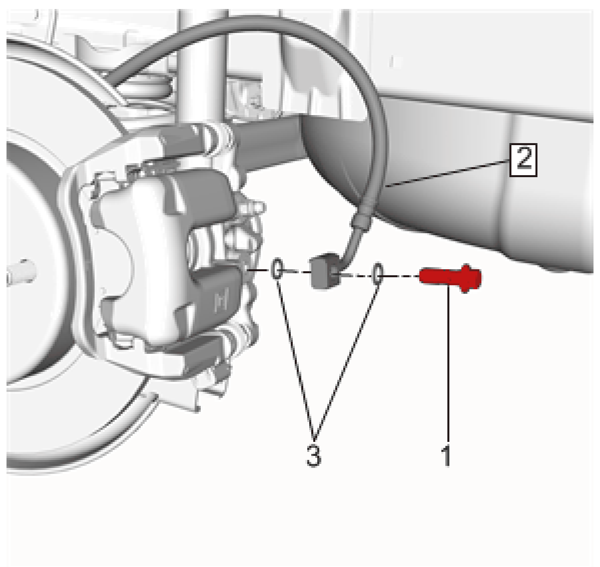


Fig. 34: Rear Brake Hose, Fitting Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Brake Hose Fitting Bolt (1) @Rear Brake Caliper
7. Remove Rear Brake Hose (2) @Rear Brake Caliper
8. Remove Rear Brake Hose Washer (3) and DISCARD

NOTE: **These washers may be stuck to the brake caliper and/or the brake hose end.**

9. Cap the opening in the brake caliper and the brake hose to prevent fluid loss and contamination.

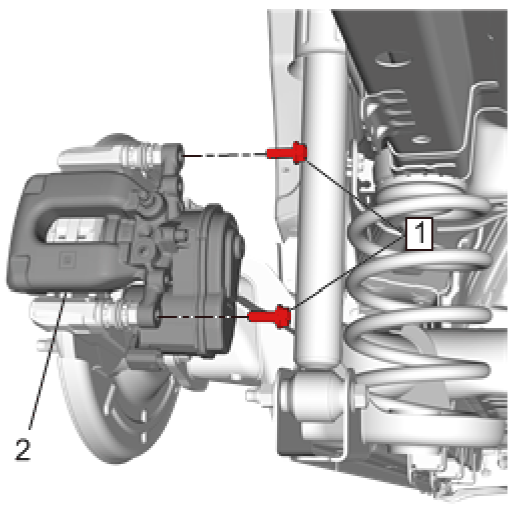


Fig. 35: Rear Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.**
- **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.**

10. Remove Rear Brake Caliper Guide Pin Bolt (1)
11. Remove Rear Brake Caliper (2) @Rear Brake Caliper Bracket
12. Inspect the brake caliper guide pins for freedom of movement, and inspect the condition of the guide pin boots. Move the guide pins inboard and outboard within the bracket bores, without disengaging the slides from the boots, and observe for the following:
    - Restricted caliper guide pin movement
    - Looseness in the brake caliper mounting bracket
    - Seized or binding caliper guide pins
    - Split or torn boots
13. If any of the conditions listed are found, the brake caliper guide pins and/or boots require replacement.
14. Remove Rear Parking Brake Actuator@Rear Brake Caliper **Rear Parking Brake Actuator Replacement**

Installation Procedure

1. Install Rear Parking Brake Actuator@Rear Brake Caliper **Rear Parking Brake Actuator Replacement**

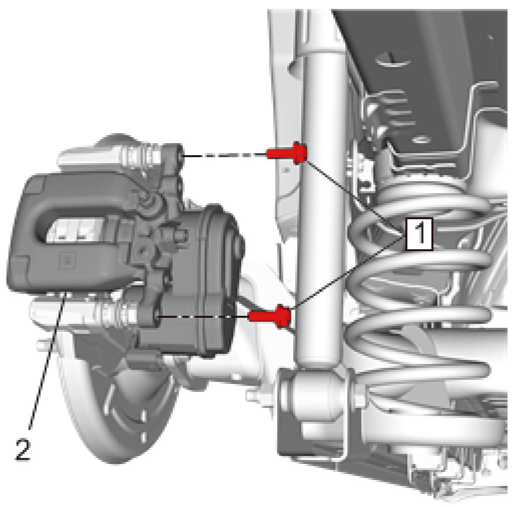


Fig. 36: Rear Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Install Rear Brake Caliper (2) @Rear Brake Caliper Bracket

CAUTION: **Fastener Caution**

NOTE: **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.**

3. Install Rear Brake Caliper Guide Pin Bolt (1) and tighten 35 N.m (26 lb ft)

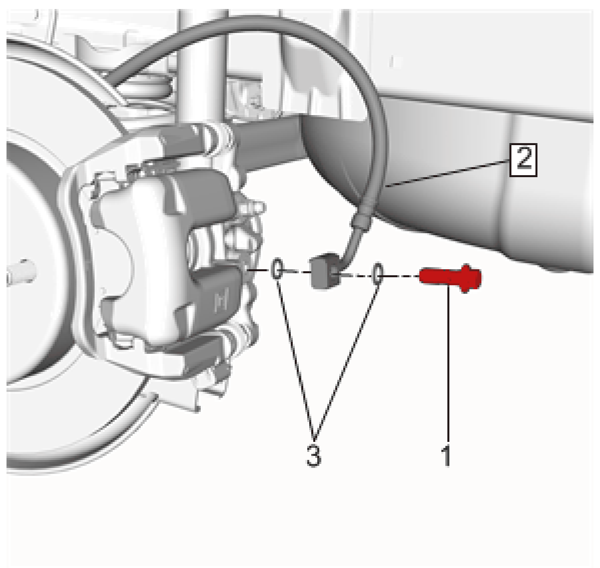


Fig. 37: Rear Brake Hose, Fitting Bolt And Washer
Courtesy of GENERAL MOTORS COMPANY

4. Remove the caps from the brake caliper and the brake hose.

NOTE: **Do not reuse the copper brake hose washers.**

5. Install Rear Brake Hose Washer (3)
6. Install Rear Brake Hose (2) @Rear Brake Caliper
7. Install Rear Brake Hose Fitting Bolt (1) @Rear Brake Caliper and tighten 40 N.m (30 lb ft)

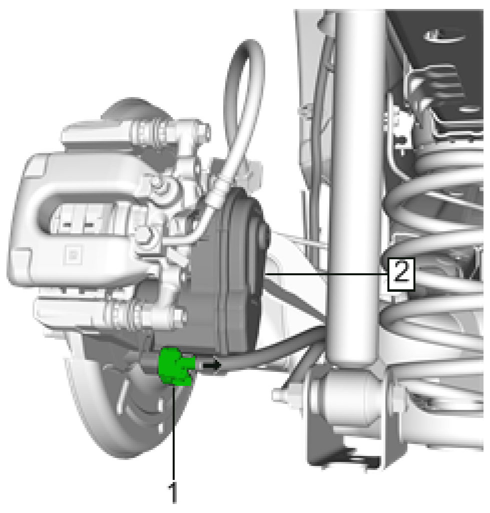


Fig. 38: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Connect Electrical Connector (1) @Rear Park Brake Actuator (2)
9. Bleed the brake system. **Hydraulic Brake System Bleeding**
10. Install the rear tire and wheel assembly. **Tire and Wheel Removal and Installation**
11. Lower the vehicle.
12. With the vehicle OFF, gradually apply the brake pedal approximately 2/3 of its travel distance.
13. Slowly release the brake pedal.
14. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
15. Calibrate the park brake. **Park Brake Calibration**

FRONT BRAKE CALIPER OVERHAUL

WARNING: **Refer to Brake Fluid Irritant Warning .**

WARNING: **Refer to Brake Dust Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

Disassembly Procedure

WARNING: **Do not place fingers in front of the caliper piston(s) in an attempt to catch or protect it when applying compressed air. The piston(s) can fly out with force and could result in serious bodily injury.**

NOTE:

- **Replace all the components included in the repair kits used to service this brake caliper.**
- **Lubricate the rubber parts with GM approved brake fluid from a clean, sealed brake fluid container to make assembly easier.**
- **If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.**
- **The torque values specified are for dry, non-lubricated fasteners.**
- **Perform the service operations on a clean bench, free from all mineral oil materials.**

1. Remove the brake caliper from the vehicle. **Front Brake Caliper Replacement**
2. Drain the brake fluid from the brake caliper.

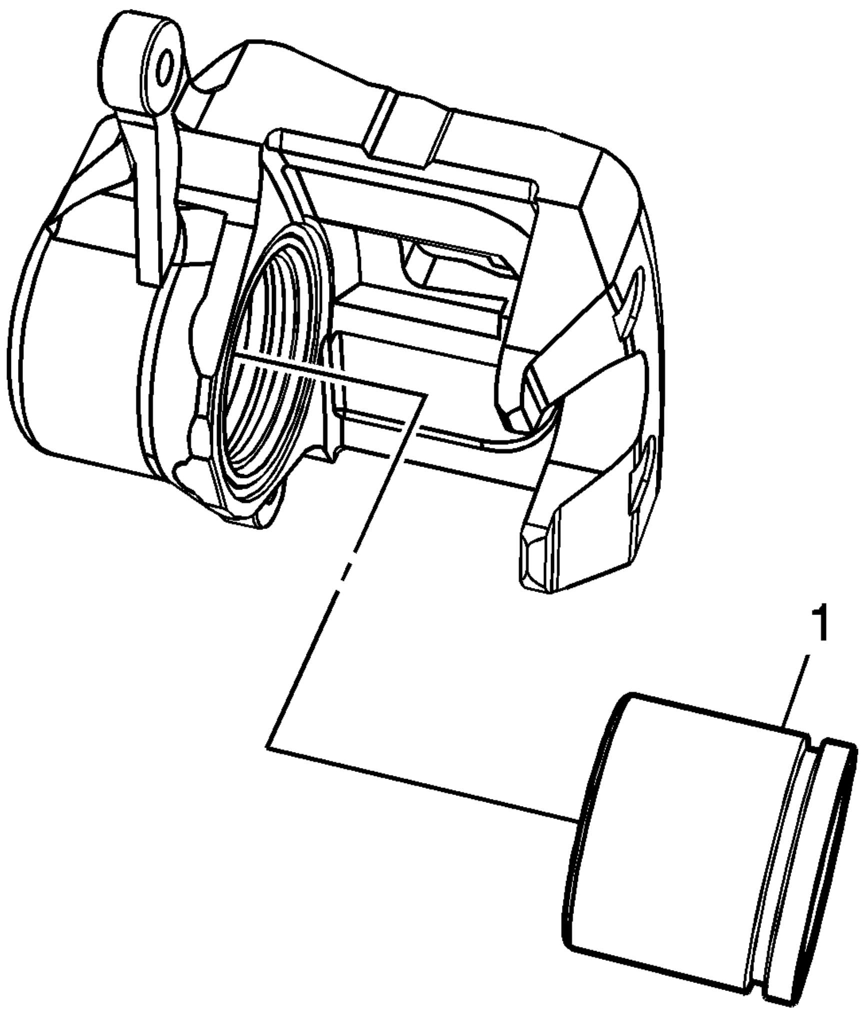


Fig. 39: Brake Caliper Piston
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Use clean cloths to pad interior of caliper housing during piston removal. Use just enough air to ease the pistons out of the bores. If the pistons are blown out, even with the padding provided, it may be damaged.**

3. Place a 25 mm (1 in) block of wood between the caliper housing and the piston.
4. Place clean shop cloths between the caliper piston and the block of wood.
5. Carefully remove the brake caliper piston (1) by directing low pressure compressed air into the brake caliper inlet hole.
6. Remove the shop cloths and the block of wood from the caliper.

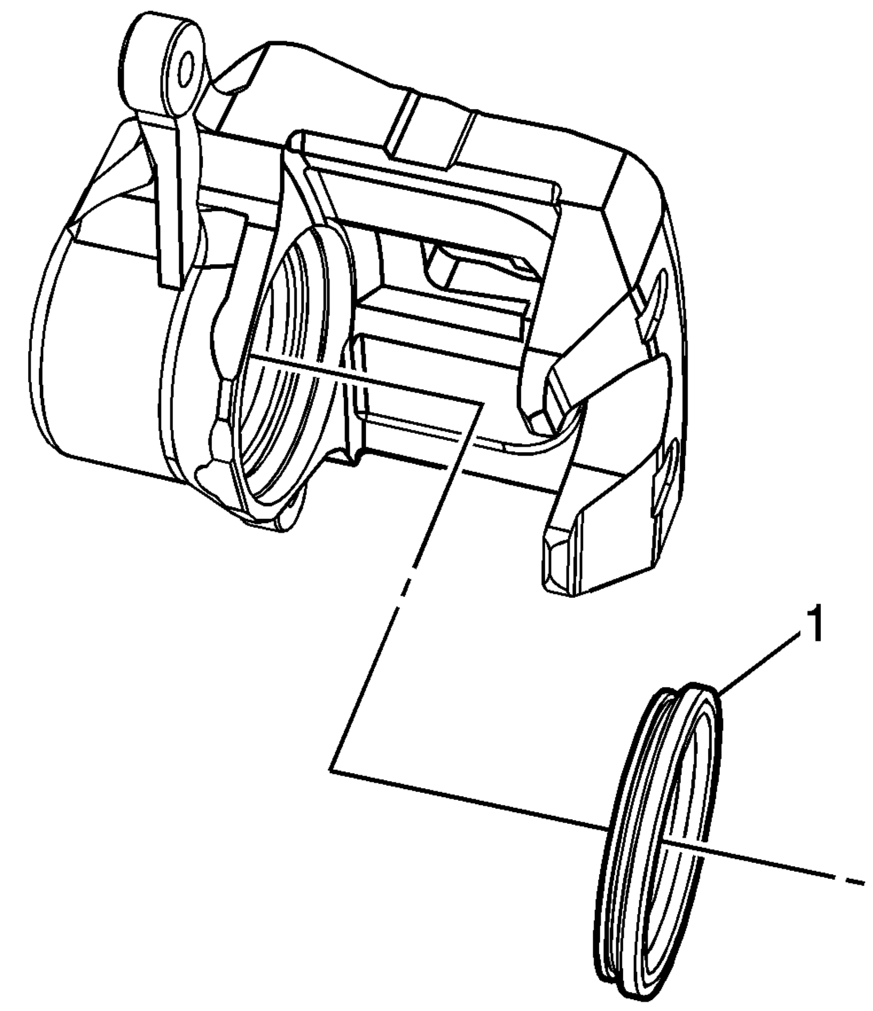


Fig. 40: Piston Dust Boot Seal
Courtesy of GENERAL MOTORS COMPANY

7. Remove the piston dust boot seal (1) from the seal counterbore in the brake caliper and discard the dust boot seal.

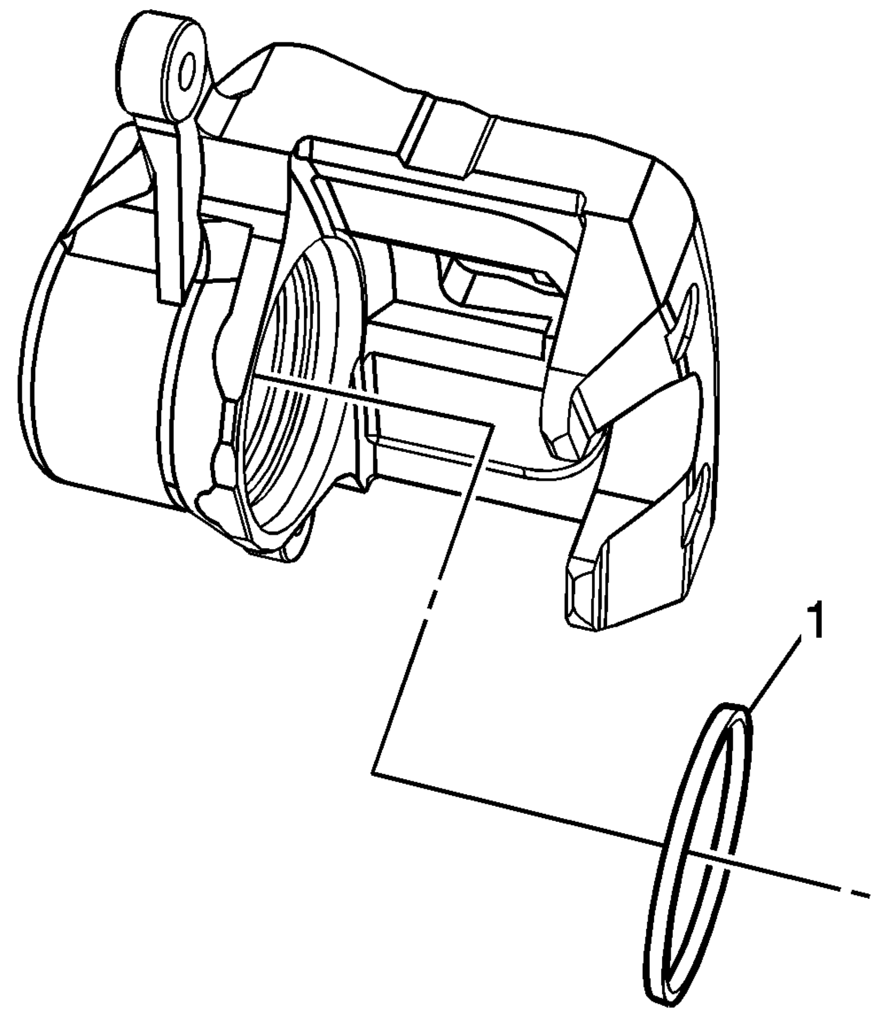


Fig. 41: Piston Seal
Courtesy of GENERAL MOTORS COMPANY

8. Using a small wooden or plastic tool, remove the piston seal (1) from the brake caliper bore and discard the piston seal.

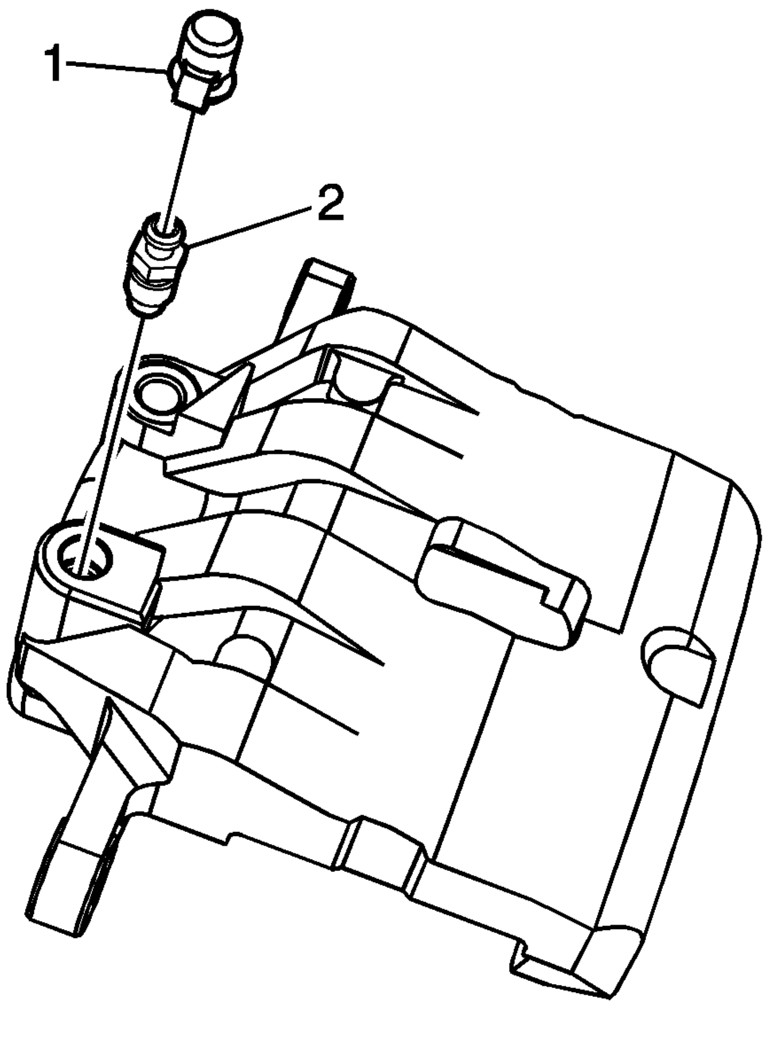


Fig. 42: Brake Caliper Bleeder Valve & Cap
Courtesy of GENERAL MOTORS COMPANY

9. Remove the brake caliper bleeder valve cap (1) and bleeder valve (2).

NOTE: **Do not use abrasives to clean the brake caliper pistons.**

10. Inspect the brake caliper mounting bracket guide surfaces for corrosion and wear. Remove and replace the brake caliper mounting bracket if damaged or worn.
11. Clean the brake caliper piston bores and seal counterbore with denatured alcohol, or equivalent.
12. Clean the brake caliper piston with denatured alcohol, or equivalent.
13. Dry the caliper piston bore and counterbore with non-lubricated, filtered air.

14. Dry the brake caliper piston with non-lubricated, filtered air.
15. Inspect the caliper bore for cracks, scoring, pitting, excessive corrosion.
16. If light corrosion is present in the caliper bore, attempt to remove the imperfection with a fine emery paper. If the imperfection cannot be removed, replace the caliper assembly.
17. If cracks, scoring, pitting, and excessive corrosion are present in the caliper bore, replace the caliper assembly.
18. Inspect the caliper piston for cracks, scoring, and/or damage. Replace the caliper piston if any of these conditions exist.

Assembly Procedure

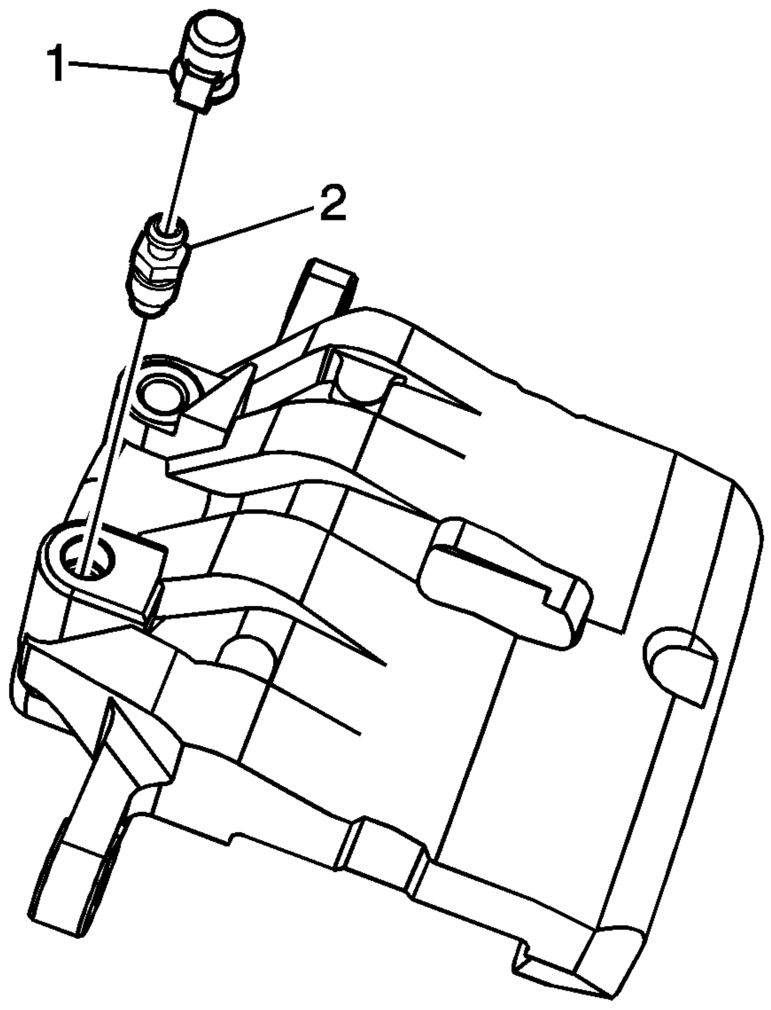


Fig. 43: Brake Caliper Bleeder Valve & Cap
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

1. Install the brake caliper bleeder valve (2) and tighten to 10 N.m (89 lb in).
2. Install the brake caliper bleeder valve cap (1).

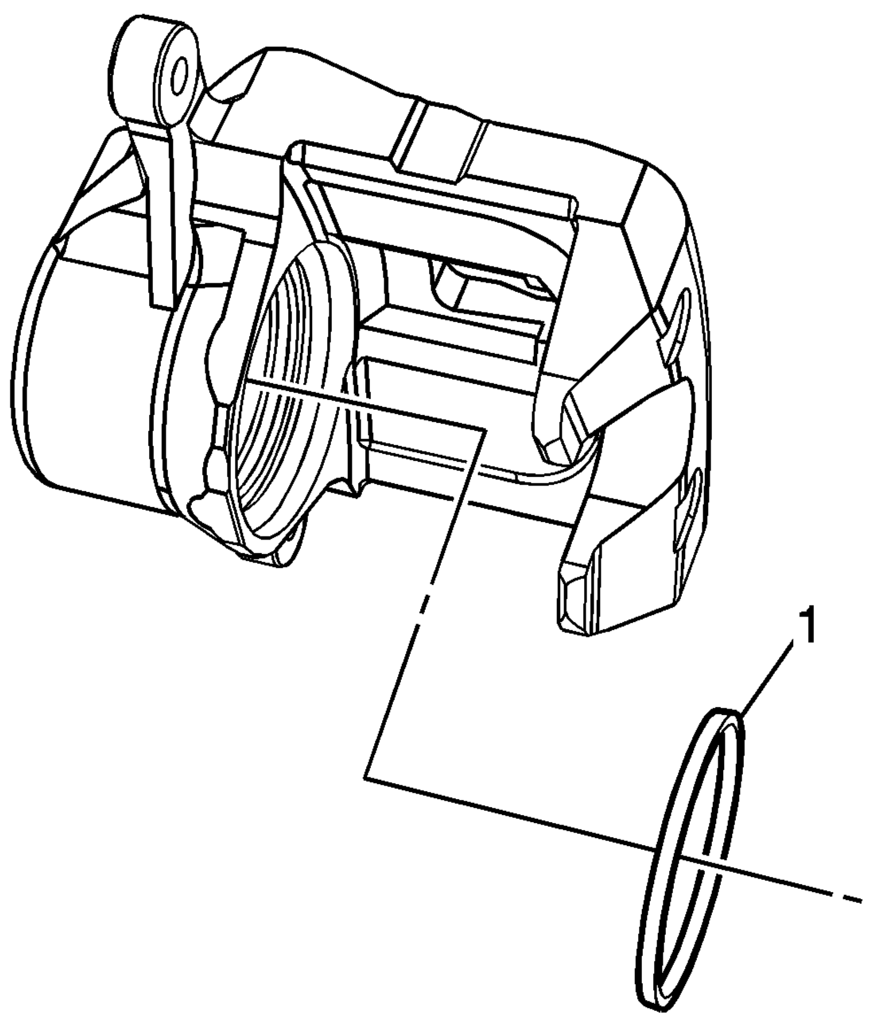


Fig. 44: Piston Seal
Courtesy of GENERAL MOTORS COMPANY

3. Lubricate the new piston seal (1) with GM approved brake fluid from a clean, sealed brake fluid container.
4. Install lubricated piston seal into the brake caliper bore seal groove.

   Ensure the seal is not twisted.

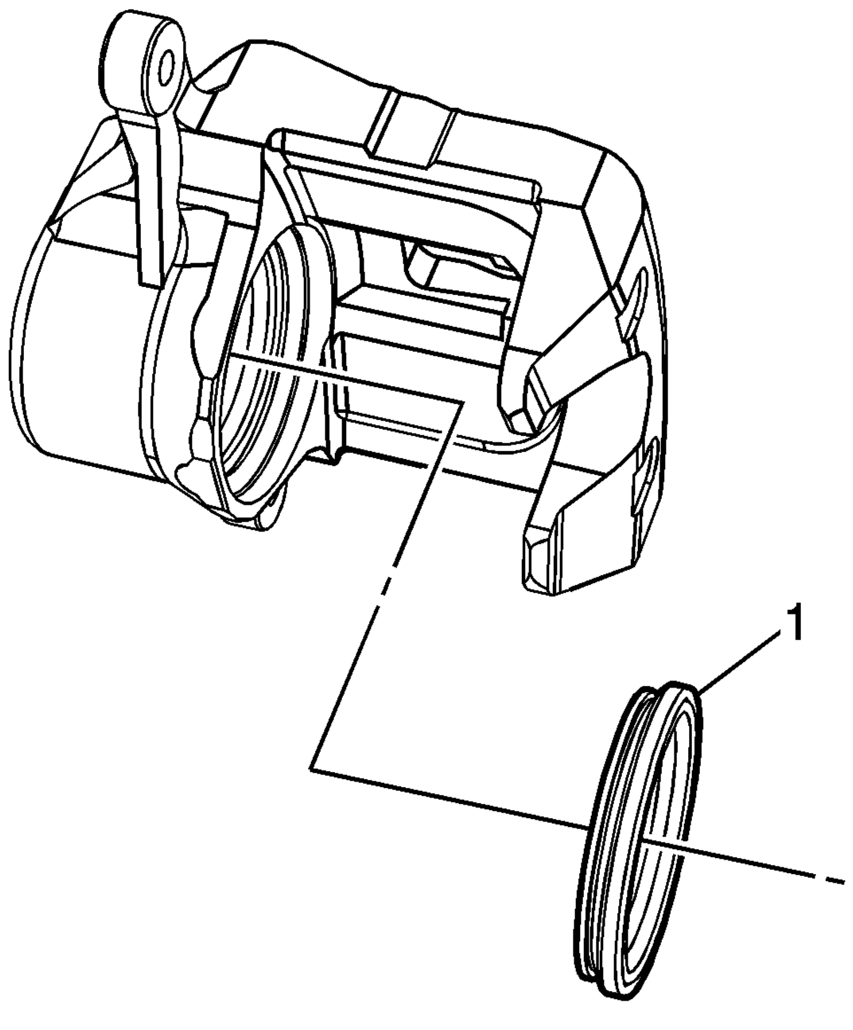


Fig. 45: Piston Dust Boot Seal
Courtesy of GENERAL MOTORS COMPANY

5. Install the piston dust boot seal (1) to the caliper.

   Ensure the seal is seated evenly and completely into the groove in the caliper housing.

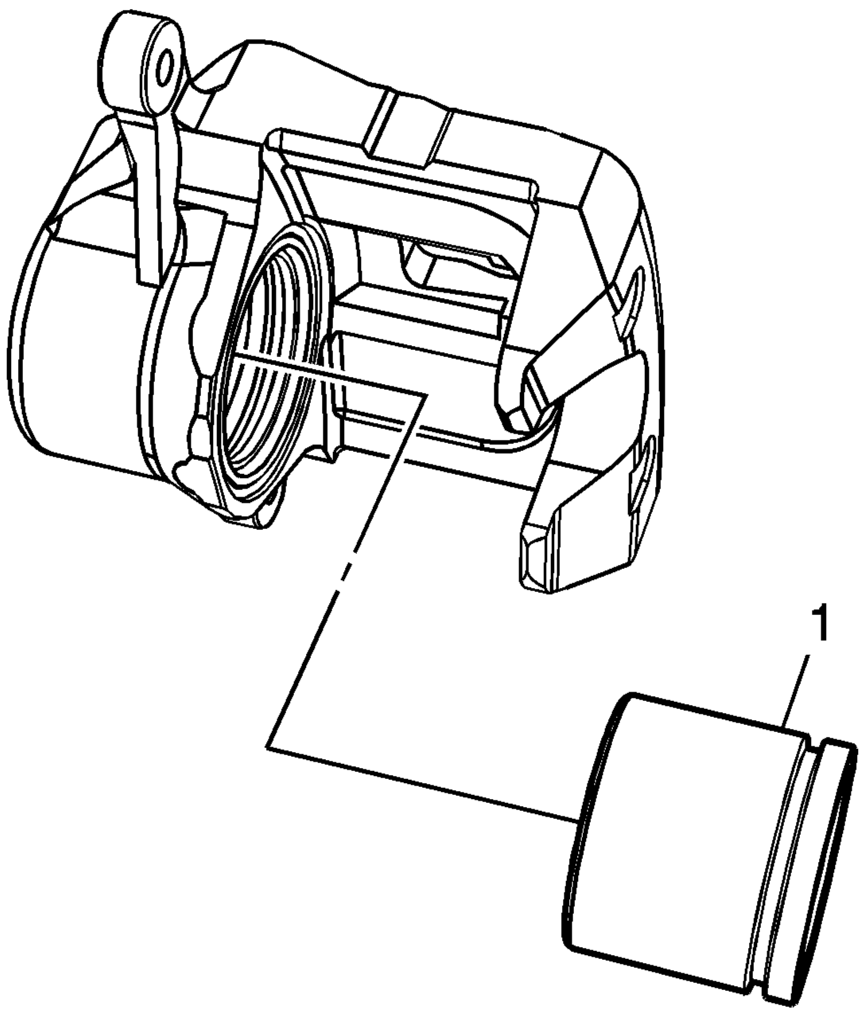


Fig. 46: Brake Caliper Piston
Courtesy of GENERAL MOTORS COMPANY

6. Place the caliper piston into the caliper housing by carefully lifting the edge of the dust boot seal.
7. Carefully push the piston (1) squarely into the brake caliper bore.
8. Ensure the caliper dust boot is properly seated into the piston groove and into the groove in the brake caliper bore.
9. Install the brake caliper to the vehicle. **Front Brake Caliper Replacement**

FRONT BRAKE CALIPER BRACKET REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Dust Warning .**

1. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. **Tire and Wheel Removal and Installation**

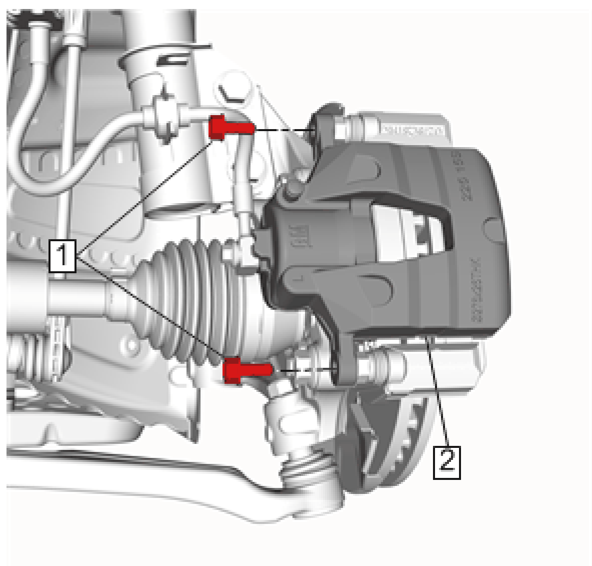


Fig. 47: Front Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.**
- **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.**

3. Remove Front Brake Caliper Guide Pin Bolt (1)

CAUTION: Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.

4. Remove the front brake caliper (2) from the front brake caliper bracket and support the front brake caliper (2) with heavy mechanic's wire, or equivalent. Do NOT disconnect the hydraulic brake flexible hose from the caliper.

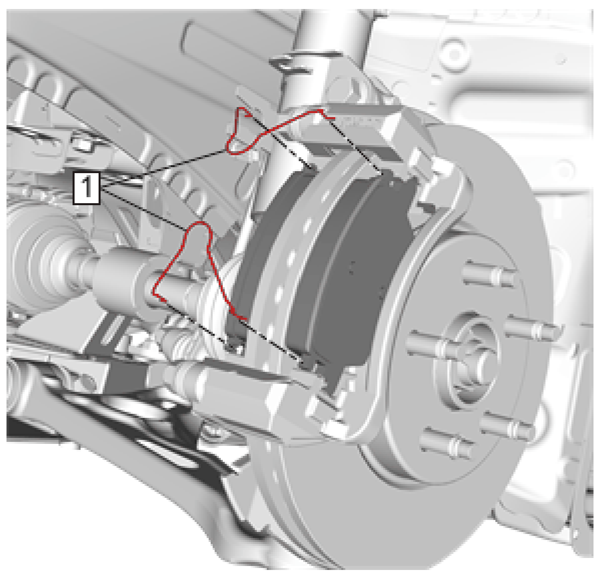


Fig. 48: Front Brake Caliper Spring
Courtesy of GENERAL MOTORS COMPANY

5. Remove Front Brake Caliper Spring (1)

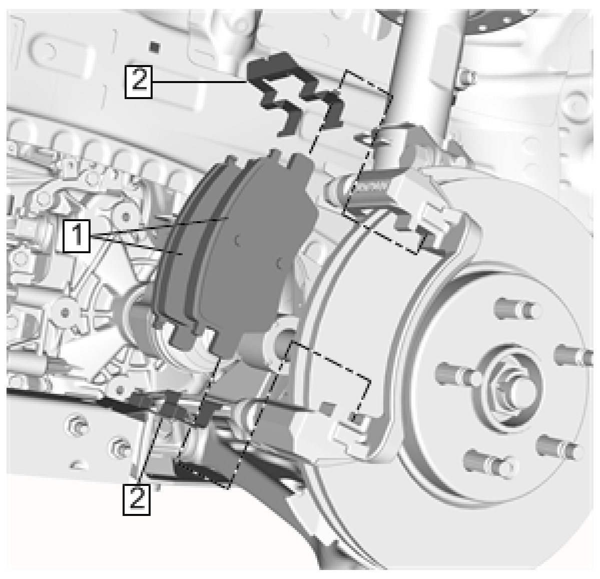


Fig. 49: Front Disc Brake Pad And Front Disc Brake Pad Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Disc Brake Pad (1) @Front Brake Caliper Bracket
7. Remove Front Disc Brake Pad Retainer Spring (2) @Front Brake Caliper Bracket

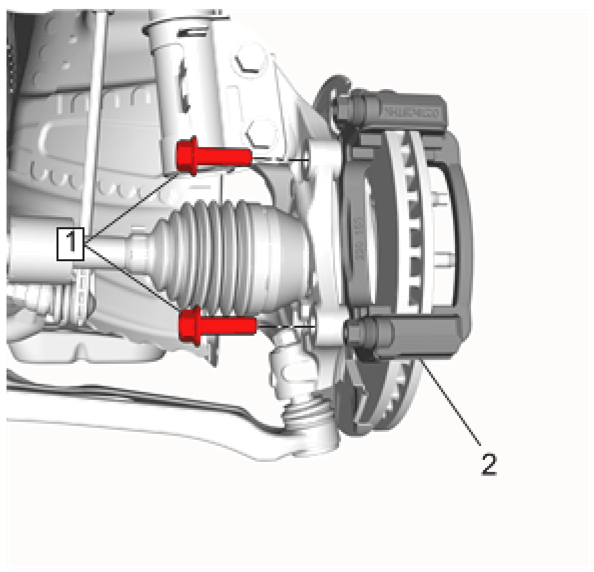


Fig. 50: Front Brake Caliper Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The brake caliper mounting bracket bolts must not be used. Replace the bolts with new bolts whenever the bolts are removed or become loose.**

8. Remove Front Brake Caliper Bracket Bolt (1) and DISCARD
9. Remove Front Brake Caliper Bracket (2) @Steering Knuckle

Installation Procedure

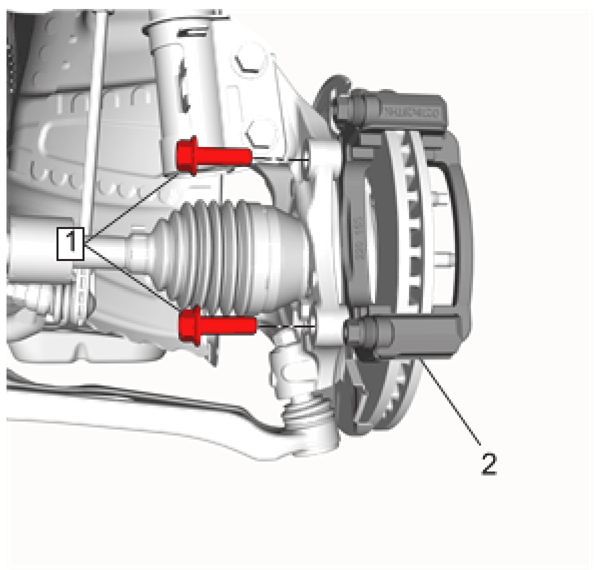


Fig. 51: Front Brake Caliper Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Caliper Bracket (2) @Steering Knuckle

CAUTION: **Refer to Fastener Caution .**

2. Install Front Brake Caliper Bracket Bolt (1) and tighten 160 N.m (118 lb ft)

   Install NEW bolts. Do NOT reuse old bolts.

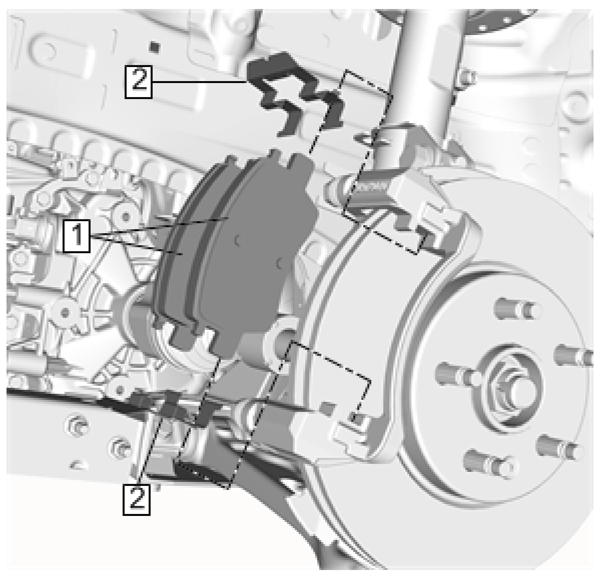


Fig. 52: Front Disc Brake Pad And Front Disc Brake Pad Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Disc Brake Pad Retainer Spring (2) @Front Brake Caliper Bracket

NOTE: **The disc brake pad equipped with wear sensor has to be mounted in upper position on the inner side of the rotor.**

4. Install Front Disc Brake Pad (1) @Front Brake Caliper Bracket

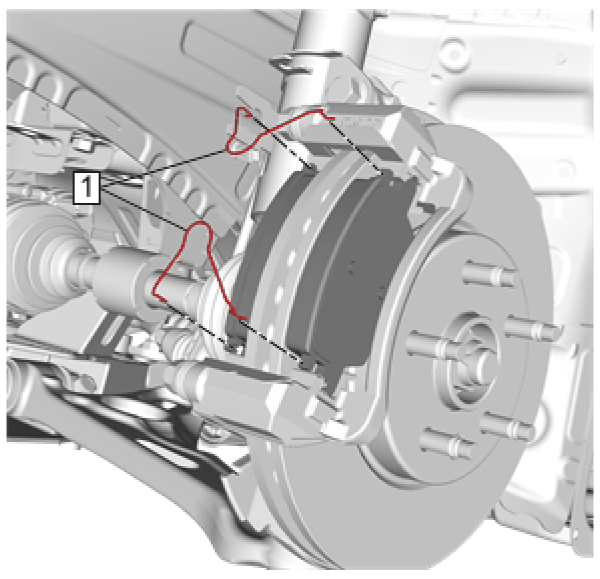
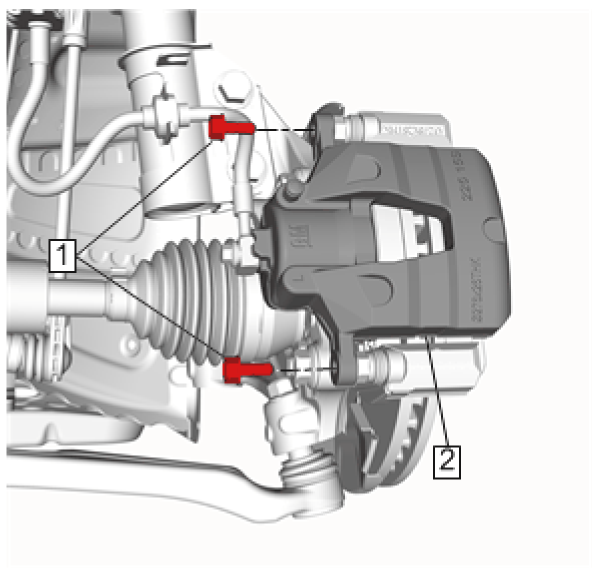


Fig. 53: Front Brake Caliper Spring
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Brake Caliper Spring (1)



[Fig. 54: Front Brake Caliper Guide Pin Bolt]

Courtesy of GENERAL MOTORS COMPANY

6. Remove the support and reposition the front brake caliper (2) over the brake pads and to the front brake caliper bracket.

NOTE: **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.**

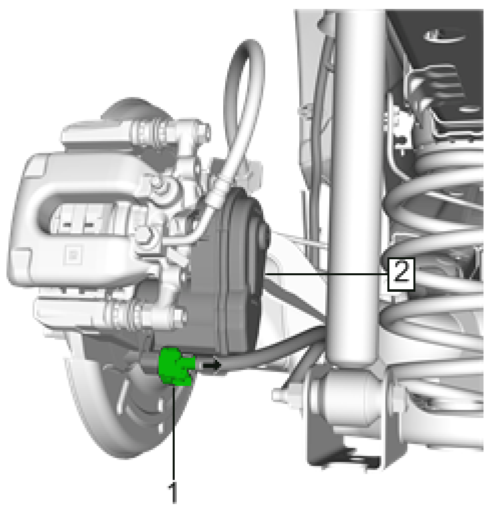
7. Install Front Brake Caliper Guide Pin Bolt (1) and tighten 40 N.m (30 lb ft)
8. Install the front tire and wheel assembly. **Tire and Wheel Removal and Installation**
9. Lower the vehicle.

REAR BRAKE CALIPER BRACKET REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Dust Warning .**

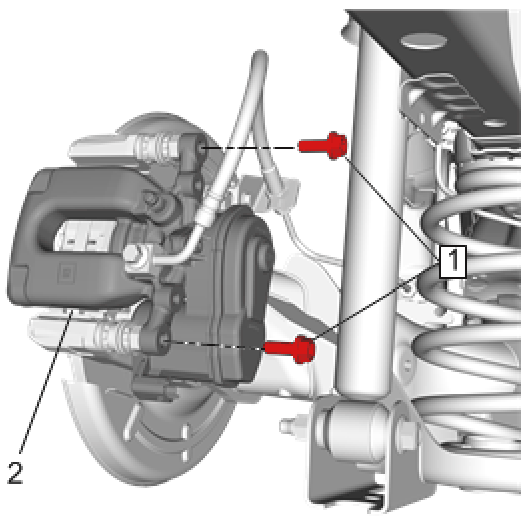
1. Set the parking brake in service mode. **Rear Parking Brake Service Mode Selection**
2. Turn OFF the vehicle.
3. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
4. Remove the rear tire and wheel assembly. **Tire and Wheel Removal and Installation**



[Fig. 55: Electrical Connector]

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @Rear Park Brake Actuator (2)



[Fig. 56: Rear Brake Caliper Guide Pin Bolt]

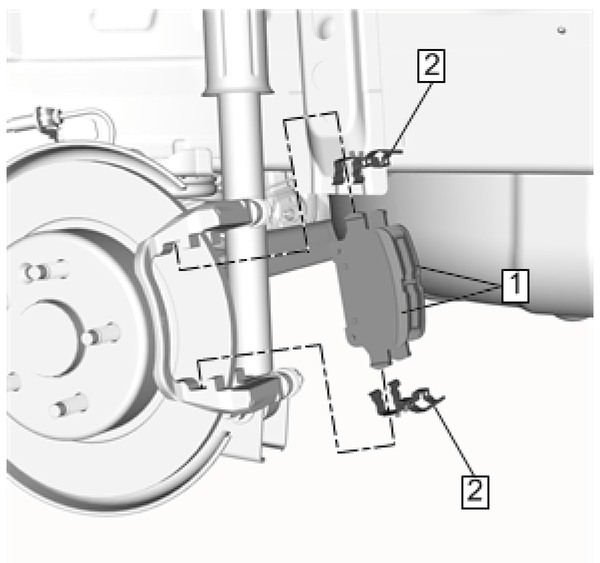
Courtesy of GENERAL MOTORS COMPANY

NOTE:
- **Do NOT use any air tools to remove or install the brake caliper guide pin bolts. Use hand tools ONLY.**
- **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.Allowing the open end wrench to come in contact with the brake caliper will cause a pulsation when the brakes are applied.**

6. Remove Rear Brake Caliper Guide Pin Bolt (1)

CAUTION: **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

7. Remove the rear brake caliper (2) from the brake caliper bracket and support the rear brake caliper (2) with heavy mechanic's wire, or equivalent. Do NOT disconnect the hydraulic brake flexible hose from the caliper.



[Fig. 57: Rear Disc Brake Pad]

Courtesy of GENERAL MOTORS COMPANY

8. Remove Rear Disc Brake Pad (1) @Rear Brake Caliper Bracket
9. Remove Rear Disc Brake Pad Retainer Spring (2) @Rear Brake Caliper Bracket

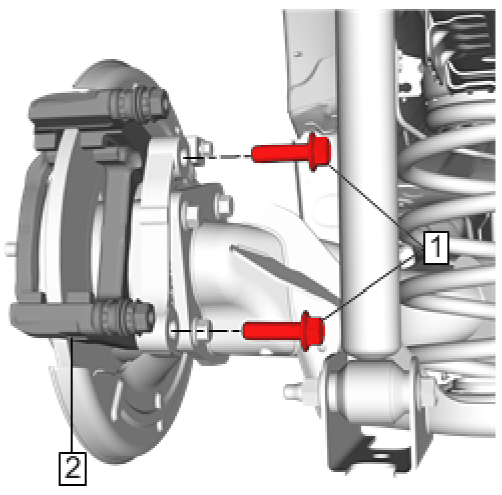


Fig. 58: Brake Caliper Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The brake caliper mounting bracket bolts must not be used. Replace the bolts with new bolts whenever the bolts are removed or become loose.**

10. Remove Rear Brake Caliper Bracket Bolt (1) and DISCARD
11. Remove Rear Brake Caliper Bracket (2) @Vehicle

Installation Procedure

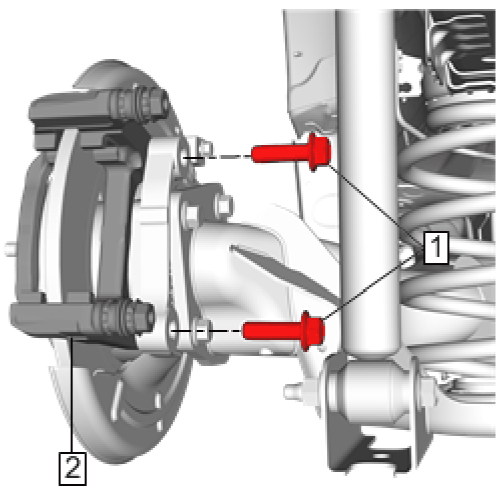


Fig. 59: Brake Caliper Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Brake Caliper Bracket (2)@Vehicle

CAUTION: **Refer to Fastener Caution .**

2. Install Rear Brake Caliper Bracket Bolt (1) and tighten 100 N.m (74 lb ft)

   Install NEW bolts. Do NOT reuse old bolts.

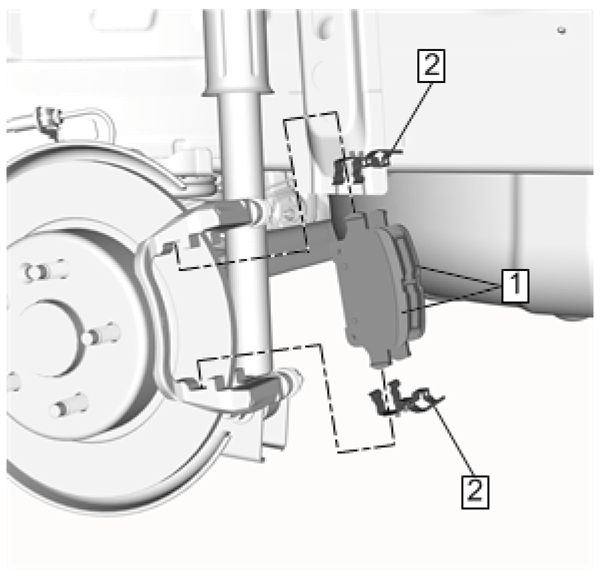


Fig. 60: Rear Disc Brake Pad
Courtesy of GENERAL MOTORS COMPANY

3. Install Rear Disc Brake Pad Retainer Spring (2) @Rear Brake Caliper Bracket

NOTE: **The disc brake pad equipped with wear sensor has to be mounted in lower position on the inner side of the rotor.**

4. Install Rear Disc Brake Pad (1) @Rear Brake Caliper Bracket

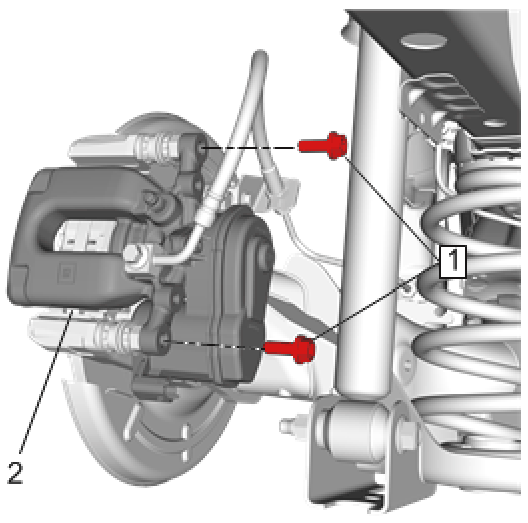


Fig. 61: Rear Brake Caliper Guide Pin Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove the support and reposition the rear brake caliper (2) over the brake pads and to the rear brake caliper bracket.

NOTE: **Install an open end wrench to hold the caliper guide pin in line with the brake caliper while removing or installing the caliper guide pin bolt.**

6. Install Rear Brake Caliper Guide Pin Bolt (1) and tighten 35 N.m (26 lb ft)

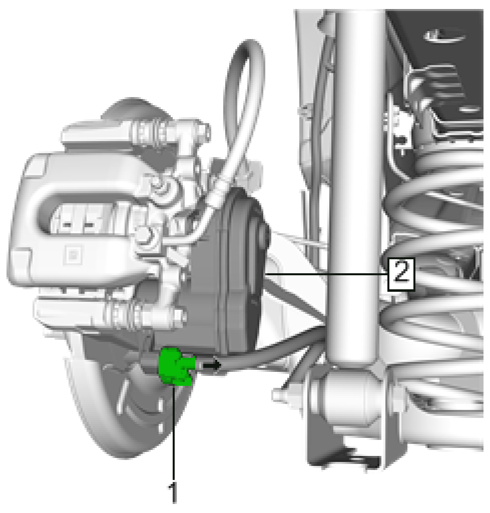


Fig. 62: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Connect Electrical Connector (1) @Rear Park Brake Actuator (2)
8. Install the rear tire and wheel assembly. **Tire and Wheel Removal and Installation**
9. Lower the vehicle.
10. With the vehicle OFF, gradually apply the brake pedal approximately 2/3 of its travel distance.
11. Slowly release the brake pedal.
12. Wait 15 seconds, then gradually apply the brake pedal approximately 2/3 of its travel distance again until a firm brake pedal apply is obtained. This will properly seat the brake caliper pistons and brake pads.
13. Calibrate the park brake. **Park Brake Calibration**

FRONT BRAKE ROTOR REPLACEMENT

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: **Refer to Brake Dust Warning .**

1. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. **Tire and Wheel Removal and Installation**

CAUTION: **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

3. Remove the front brake caliper from the front brake caliper bracket and support the front brake caliper with heavy mechanic's wire, or equivalent. Do NOT disconnect the hydraulic brake flexible hose from the caliper. **Front Brake Caliper Replacement**
4. Remove Front Brake Caliper Bracket@Steering Knuckle **Front Brake Caliper Bracket Replacement**

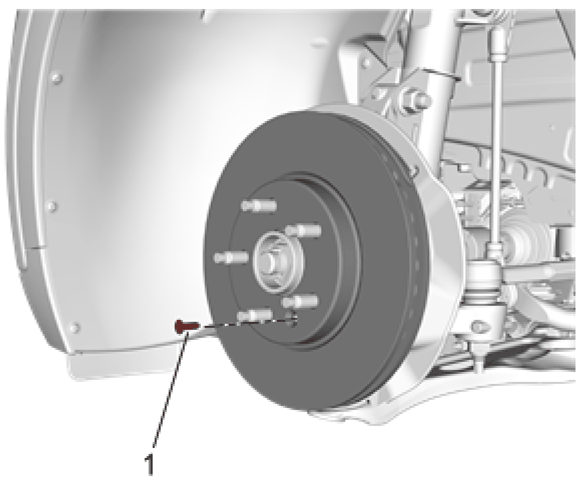


Fig. 63: Front Brake Rotor Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove Front Brake Rotor Bolt (1)

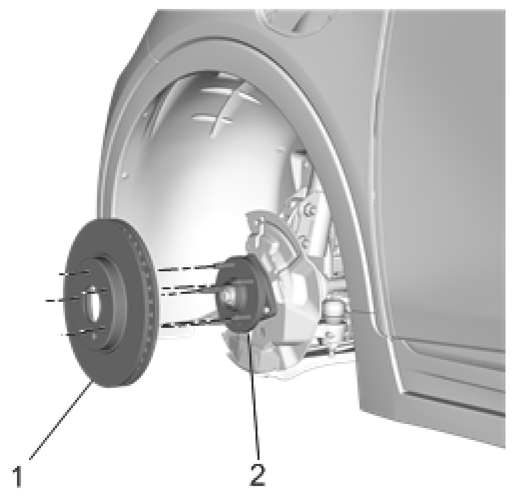


Fig. 64: Front Brake Rotor And Front Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Brake Rotor (1) @Front Wheel Hub (2)

Installation Procedure

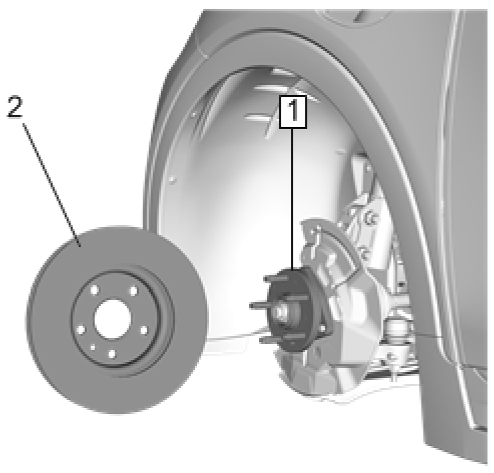


Fig. 65: NO CONTENT
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.**

1. Using the **CH-42450-A** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub flange (1).
2. Using the **CH-41013** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the rotor (2).
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.

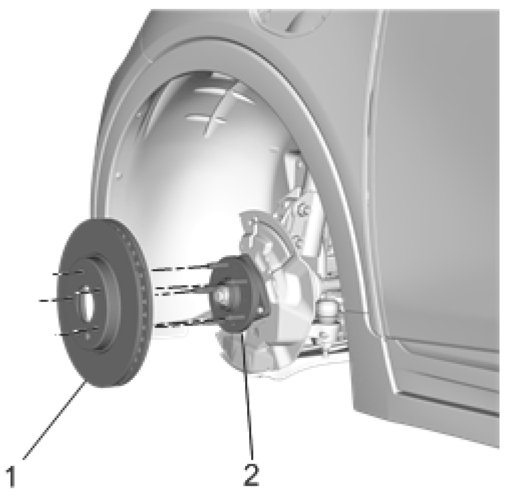


Fig. 66: Front Brake Rotor And Front Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Rotor (1) @Front Wheel Hub (2)

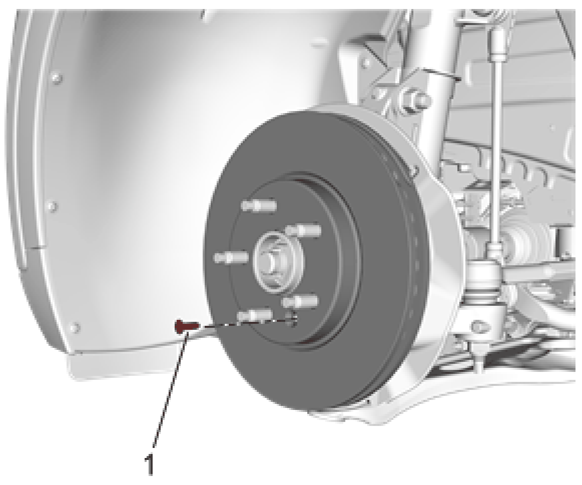


Fig. 67: Front Brake Rotor Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

5. Install Front Brake Rotor Bolt (1) and tighten 9 N.m (80 lb in)
6. Install Front Brake Caliper Bracket@Steering Knuckle **Front Brake Caliper Bracket Replacement**
7. Remove the support and install the front brake caliper to the front brake caliper bracket. **Front Brake Caliper Replacement**
8. Install the front tire and wheel assembly. **Tire and Wheel Removal and Installation**
9. Lower the vehicle.
10. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the pads and rotors. **Brake Pad and Rotor Burnishing**

REAR BRAKE ROTOR REPLACEMENT

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

Removal Procedure

WARNING: **Refer to Brake Dust Warning .**

1. Set the parking brake in service mode. **Rear Parking Brake Service Mode Selection**
2. Turn OFF the vehicle.
3. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
4. Remove the rear tire and wheel assembly. **Tire and Wheel Removal and Installation**

CAUTION: **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.**

5. Remove the rear brake caliper from the brake caliper bracket and support the rear brake caliper with heavy mechanic's wire, or equivalent. Do NOT disconnect the hydraulic brake flexible hose from the caliper. **Rear Brake Caliper Replacement**
6. Remove Rear Brake Caliper Bracket@Vehicle **Rear Brake Caliper Bracket Replacement**

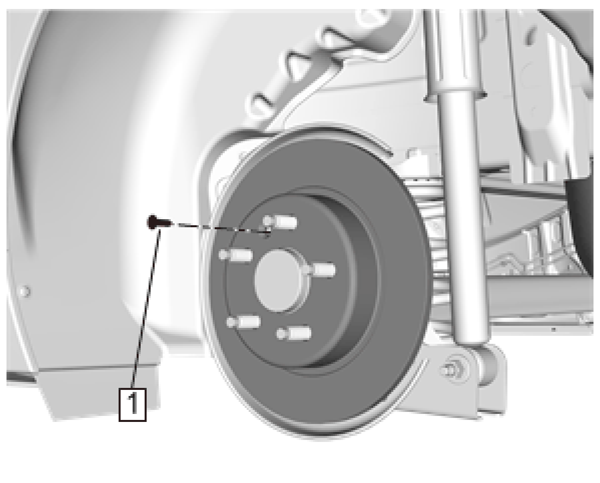


Fig. 68: Rear Brake Rotor Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Remove Rear Brake Rotor Bolt (1)

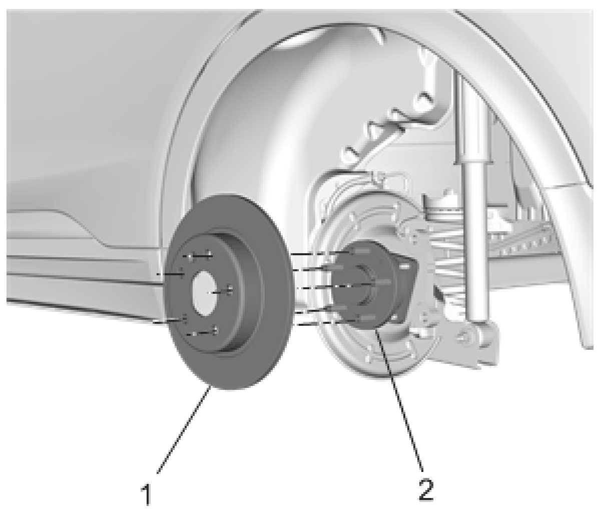


Fig. 69: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

8. Remove Rear Brake Rotor (1) Rear Wheel Hub (2)

Installation Procedure

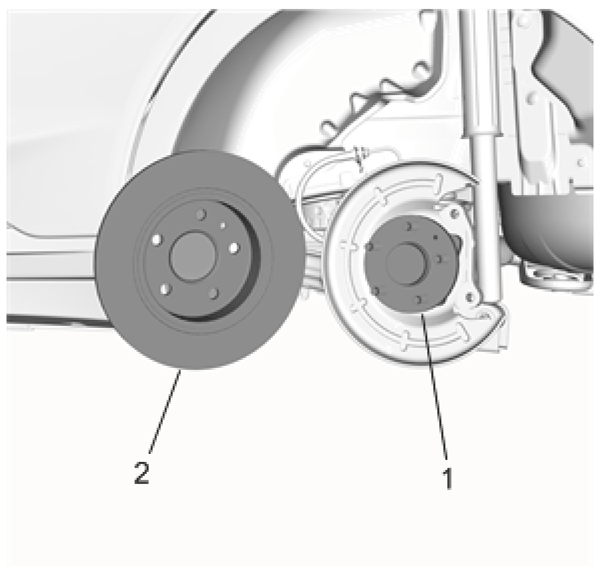


Fig. 70: Hub Flange And Rotor
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Whenever the brake rotor has been separated from the hub/axle flange, any rust or contaminants should be cleaned from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in excessive assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.**

1. Using the **CH-42450-A** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub flange (1).
2. Using the **CH-41013** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the rotor (2).
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.

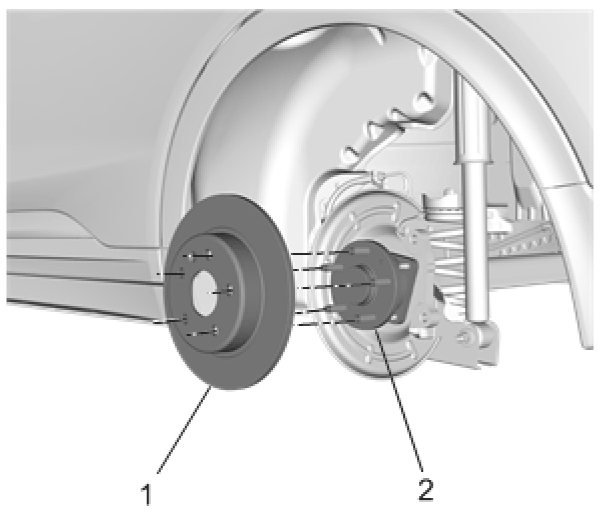


Fig. 71: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

4. Install Rear Brake Rotor (1) @Rear Wheel Hub (2)

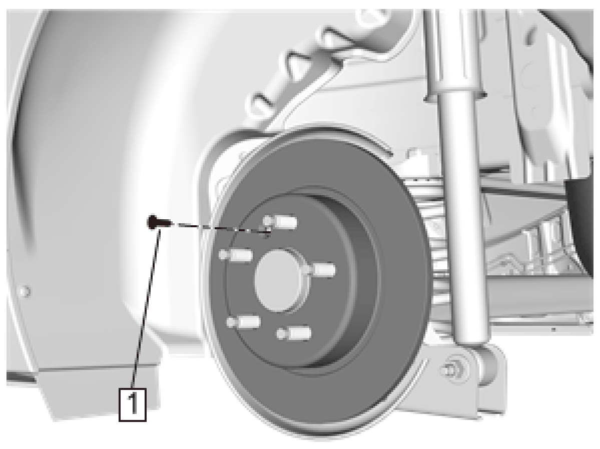


Fig. 72: Rear Brake Rotor Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

5. Install Rear Brake Rotor Bolt (1) and tighten 9 N.m (80 lb in)
6. Install Rear Brake Caliper Bracket@Vehicle **Rear Brake Caliper Bracket Replacement**
7. Remove the support and install the rear brake caliper to the rear brake caliper bracket. **Rear Brake Caliper Replacement**
8. Install the rear tire and wheel assembly. **Tire and Wheel Removal and Installation**
9. Lower the vehicle.
10. Calibrate the park brake. **Park Brake Calibration**
11. If the brake rotor was refinished or replaced, or if new brake pads were installed, burnish the pads and rotors. **Brake Pad and Rotor Burnishing**

FRONT BRAKE SHIELD REPLACEMENT

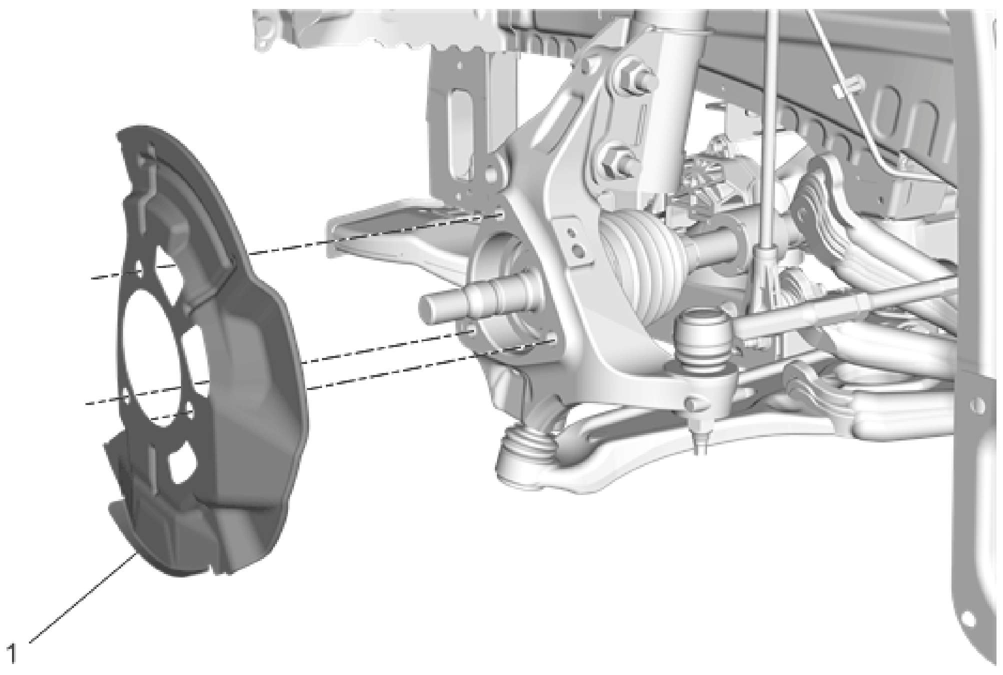


Fig. 73: Front Brake Shield
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Refer to Brake Dust Warning .

Preliminary Procedures
1. Raise and support the vehicle. Lifting and Jacking the Vehicle
2. Remove the front tire and wheel assembly. Tire and Wheel Removal and Installation
3. Front Wheel Bearing and Hub Replacement</td></tr>
<tr><td>1</td><td>Front Brake Shield

Procedure
1. Install the front tire and wheel assembly. Tire and Wheel Removal and Installation
2. Lower the vehicle.</td></tr>
</table>

REAR BRAKE SHIELD REPLACEMENT

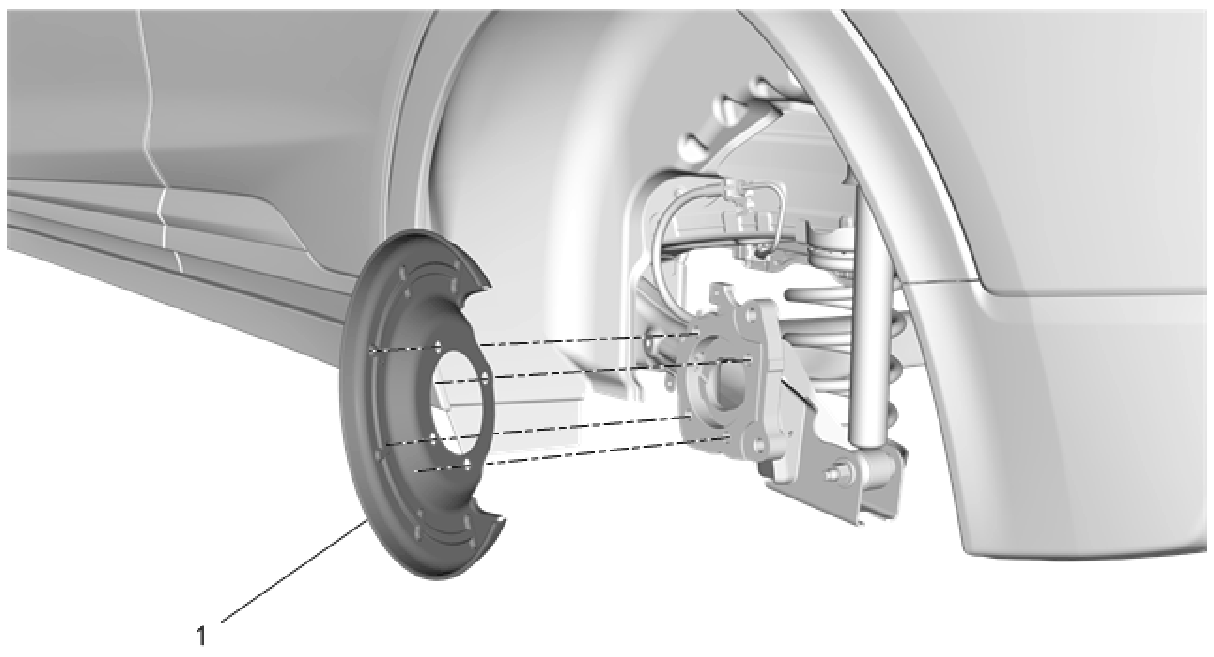


Fig. 74: Rear Brake Shield
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Refer to Brake Dust Warning .

Preliminary Procedures
1. Raise and support the vehicle. Lifting and Jacking the Vehicle
2. Remove the rear tire and wheel assembly. Tire and Wheel Removal and Installation
3. Rear Wheel Bearing and Hub Replacement</td></tr>
<tr><td>1</td><td>Rear Brake Shield

Procedure
1. Install the rear tire and wheel assembly. Tire and Wheel Removal and Installation
2. Lower the vehicle.</td></tr>
</table>

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION

NOTE:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Brake Rotor Thickness Variation Measurement**
- **Brake rotor assembled lateral runout (LRO) exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800 - 11 300 km (3, 000 - 7, 000 mi). Brake Rotor Assembled Lateral Runout Measurement**

Review the following acceptable methods for bringing the brake rotor assembled LRO to within specifications. Determine which method to use for the specific vehicle being repaired.

- The indexing method of correcting assembled LRO is most effective when the LRO specification is only exceeded by a relatively small amount: 0.025 - 0.127 mm (0.001 - 0.005 in). Indexing is used to achieve the best possible match of high spots to low spots between related components. **Brake Rotor Assembled Lateral Runout Correction - Indexing**
- The on-vehicle brake lathe method is used to bring the LRO to within specifications through compensating for LRO while refinishing the brake rotor. **Brake Rotor Assembled Lateral Runout Correction - On Vehicle Lathe**

If the assembled LRO cannot be corrected using these methods, then other components must be suspected as causing and/or contributing to the LRO concern.

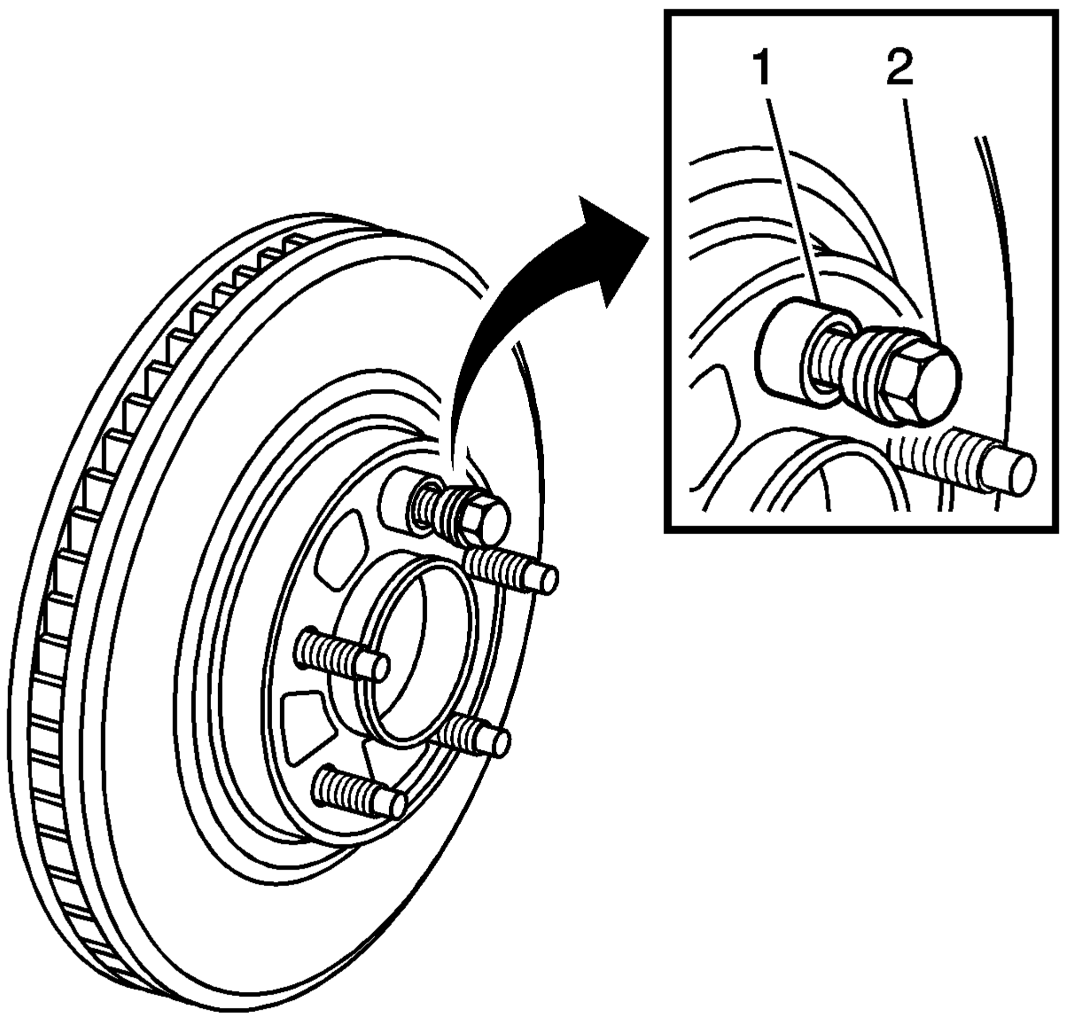
BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - INDEXING

NOTE: **This Procedure is not used in Europe**

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to **Special Tools**.



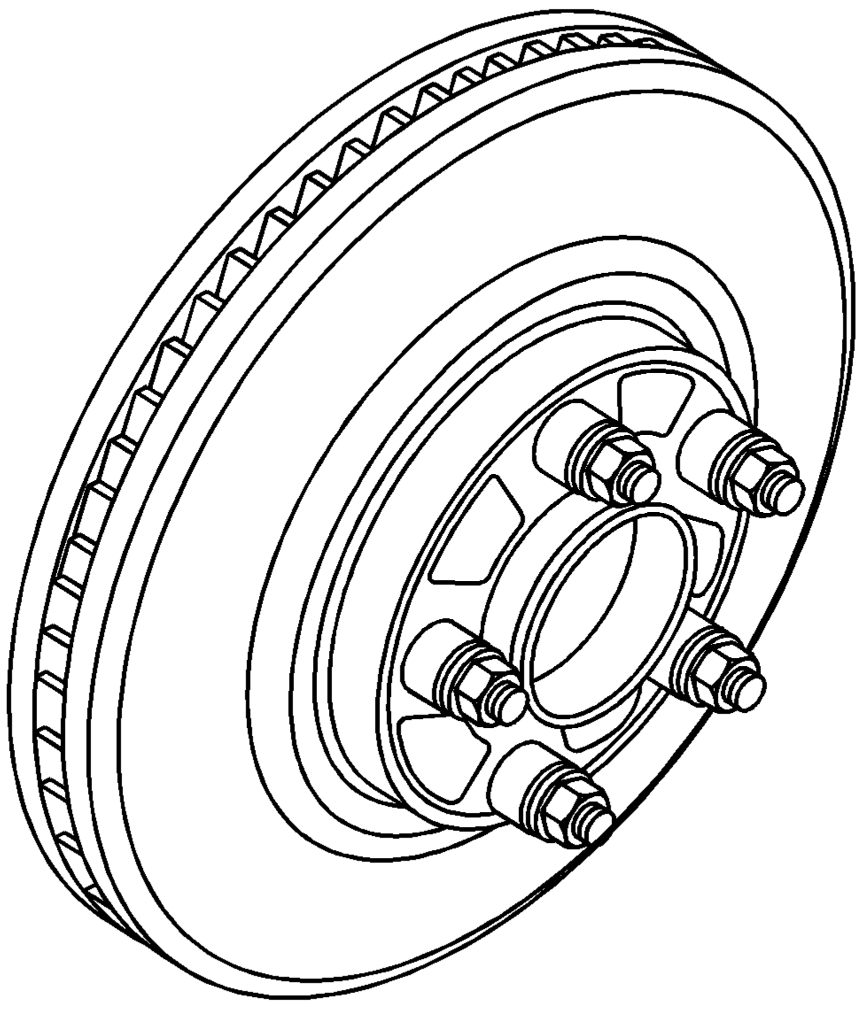
[Fig. 75: Lug Nuts & Conical Washers](#)
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Refer to [Brake Dust Warning](#) .**

NOTE:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Brake Rotor Thickness Variation Measurement**
- **Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4, 800 - 11, 300 km (3, 000 - 7, 000 mi). Brake Rotor Assembled Lateral Runout Measurement**

1. Remove the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure.
2. Inspect the mating surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
3. Index the brake rotor in a different orientation to the hub/axle flange.
4. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** Conical Brake Rotor Washers (1) and one lug nut (2) onto the upper-most wheel stud.
5. Continue to hold the rotor secure and tighten the lug nut firmly by hand.



[Fig. 76: Lug Nuts & Conical Washers](#)
Courtesy of GENERAL MOTORS COMPANY

6. Install the remaining **CH-45101-100** Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
7. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. **Tire and Wheel Removal and Installation**
8. Measure the assembled LRO of the brake rotor. **Brake Rotor Assembled Lateral Runout Measurement**
9. Compare the amount of change between this measurement and the original measurement.
10. If this measurement is within specifications, proceed to step 14.
11. If this measurement still exceeds specifications, repeat steps 1 - 9 until the best assembled LRO measurement is obtained.
12. Matchmark the final location of the rotor to the wheel studs if the orientation is different than it was originally.
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout Correction**.
14. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - CORRECTION PLATES

NOTE: **This procedure not used in Europe**

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to [Special Tools](#).

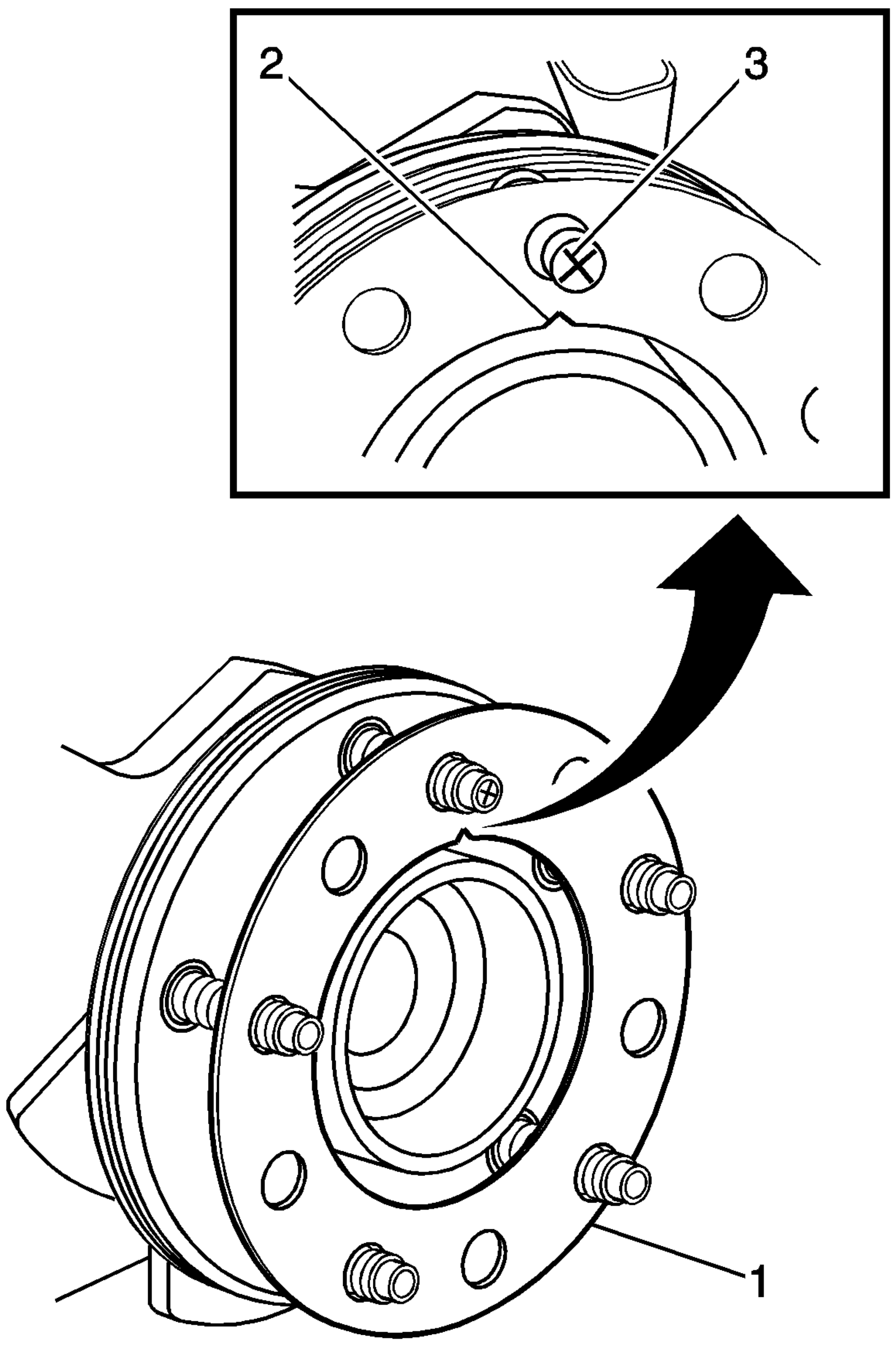


Fig. 77: Identifying Correction Plate, High Spot Mark & V-Shaped Notch
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Refer to Brake Dust Warning .**

NOTE:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation.** **Brake Rotor Thickness Variation Measurement**
- **Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4, 800 - 11, 300 km (3, 000 - 7, 000 mi).** **Brake Rotor Assembled Lateral Runout Measurement**

1. Rotate the brake rotor to position the high spot, identified and marked during the brake rotor assembled LRO measurement procedure, to face upward.
2. Remove the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Select the correction plate, following the manufacturer's instructions, which has a specification closest to the assembled LRO measurement.

   For example: If the assembled LRO measurement was 0.076 mm (0.003 in), the 0.076 mm (0.003 in) correction plate would be used. If the measurement was 0.127 mm (0.005 in), the 0.152 mm (0.006 in) correction plate would be used.

5. Determine the positioning for the correction plate (1) using the high spot mark (3) made during the brake rotor assembled LRO measurement procedure.

NOTE:

- **Do NOT install used correction plates in an attempt to correct brake rotor assembled LRO.**
- **Do NOT stack up, or install more than one correction plate onto one hub/axle flange location, in an attempt to correct brake rotor assembled LRO.**

6. Install the correction plate (1) onto the hub/axle flange, with the V-shaped notch (2) orientated to align with the high spot mark (3), that was positioned to face upward.

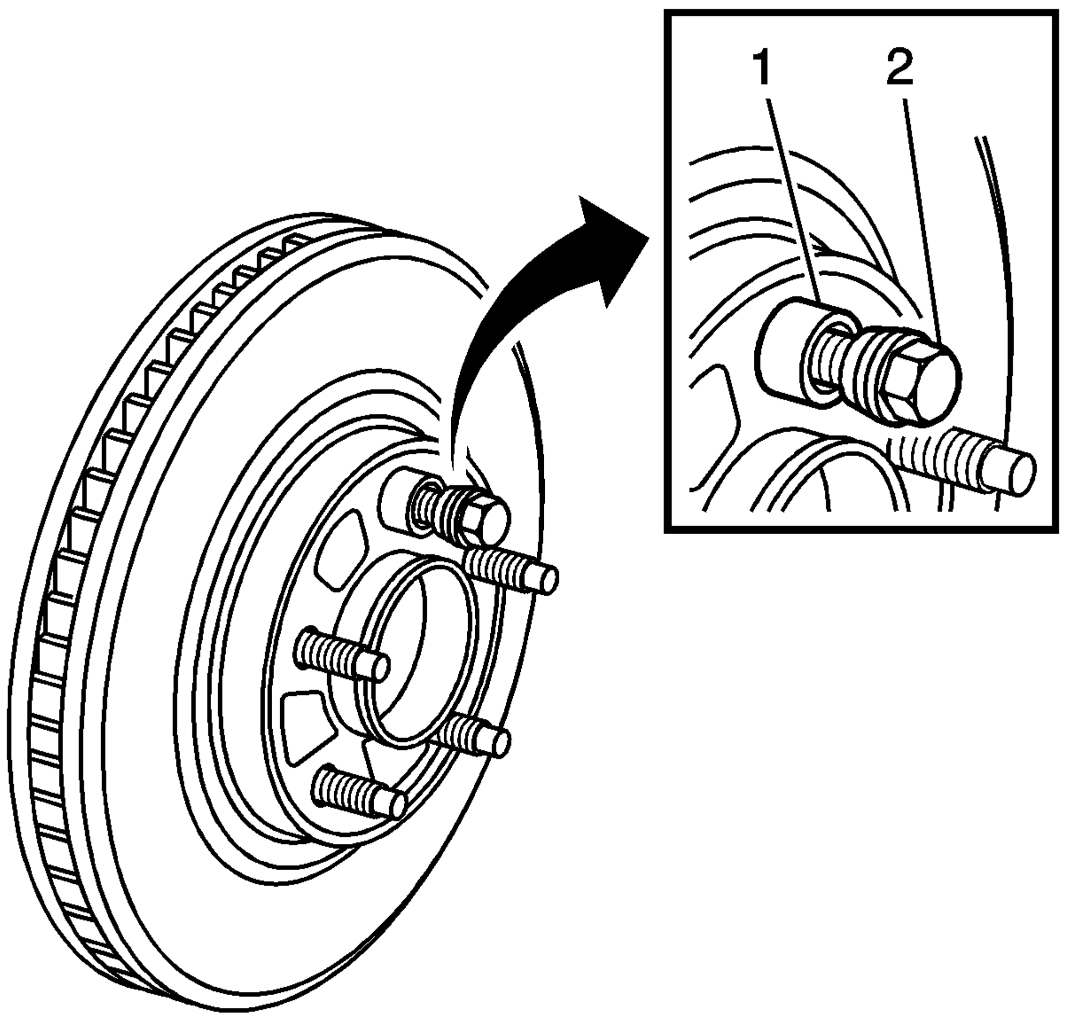


Fig. 78: Lug Nuts & Conical Washers
Courtesy of GENERAL MOTORS COMPANY

7. Install the brake rotor to the hub/axle flange. Use the matchmark made prior to removal for proper orientation to the flange.
8. Hold the rotor firmly in place against the hub/axle flange and install one of the **CH-45101-100** Conical Brake Rotor Washers (1) and one lug nut (2) onto the upper-most wheel stud.
9. Continue to hold the rotor secure and tighten the lug nut firmly by hand.

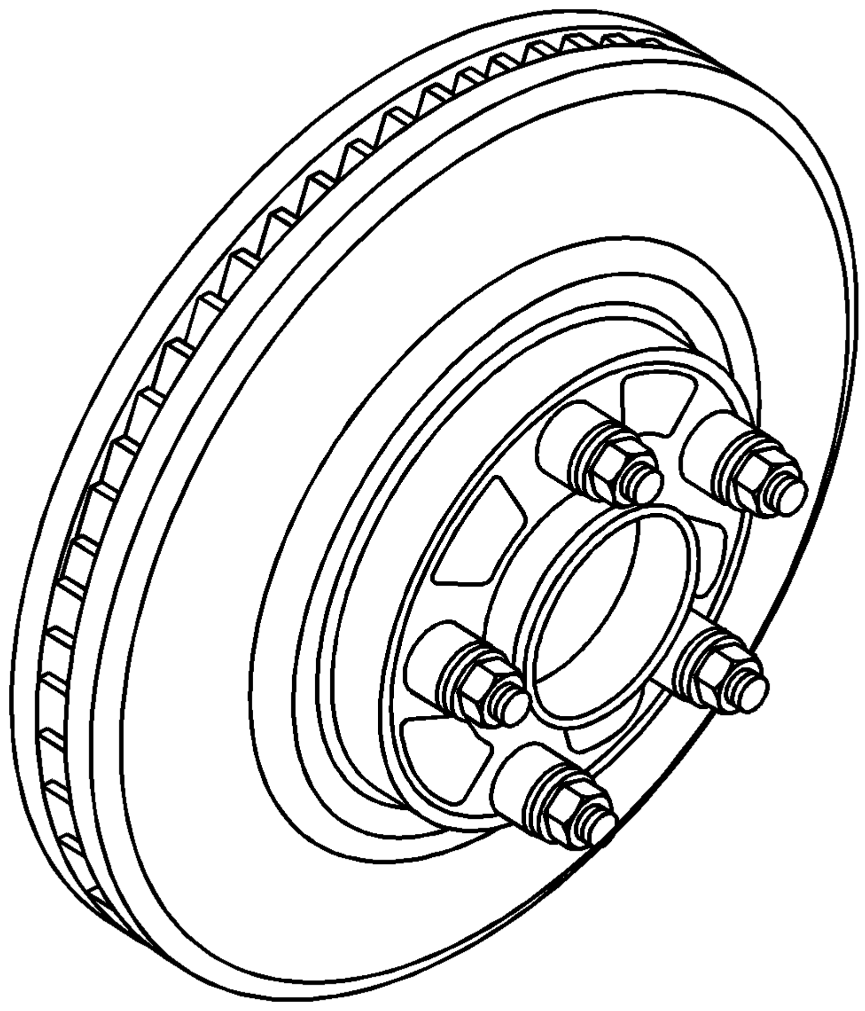


Fig. 79: Lug Nuts & Conical Washers
Courtesy of GENERAL MOTORS COMPANY

10. Install the remaining **CH-45101-100** Conical Brake Rotor Washers and lug nuts onto the wheel studs and tighten the nuts firmly by hand in a star-pattern.
11. Tighten the lug nuts in a star-pattern to specification, in order to properly secure the rotor. **Tire and Wheel Removal and Installation**
12. Measure the assembled LRO of the brake rotor. **Brake Rotor Assembled Lateral Runout Measurement**
13. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout Correction**.
14. If the brake rotor assembled LRO measurement is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR ASSEMBLED LATERAL RUNOUT CORRECTION - ON VEHICLE LATHE

NOTE: **This procedure is not used in Europe.**

Special Tools

CH-45101-100 Conical Brake Rotor Washers

For equivalent regional tools, refer to **Special Tools**.

WARNING: **Refer to Brake Dust Warning .**

NOTE:

- **Brake rotor thickness variation MUST be checked BEFORE checking for assembled lateral runout (LRO). Thickness variation exceeding the maximum acceptable level can cause brake pulsation. Brake Rotor Thickness Variation Measurement**
- **Brake rotor assembled LRO exceeding the maximum allowable specification can cause thickness variation to develop in the brake rotor over time, usually between 4 800 - 11 300 km (3, 000 - 7, 000 mi). Brake Rotor Assembled Lateral Runout Measurement**

1. Ensure that the caliper and caliper bracket that are already being supported, are clear from contacting any rotating components, such as the brake rotor.
2. Remove the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts that were installed during the assembled LRO measurement procedure and/or the indexing correction procedure.
3. Inspect the mounting surface of the hub/axle flange and the brake rotor to ensure that there are no foreign particles or debris remaining.
4. Set up the lathe, following the manufacturer's instructions.
5. Refinish the brake rotor, following the brake lathe manufacturer's instructions.
6. After each successive cut, inspect the brake rotor thickness. **Brake Rotor Thickness Measurement**
7. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced. After replacing the rotor, proceed to step 10.
8. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
    1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.
    2. Using moderate pressure, apply the non-directional finish:
        - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
        - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.
    3. After applying a non-directional finish, clean each friction surface of the brake rotor with denatured alcohol, or an equivalent approved brake cleaner.
9. Remove the lathe from the vehicle.
10. Measure the assembled LRO of the brake rotor. **Brake Rotor Assembled Lateral Runout Measurement**
11. If the brake rotor assembled LRO measurement still exceeds the maximum allowable specification, refer to **Brake Rotor Assembled Lateral Runout Correction**.
12. If the brake rotor assembled LRO is within specification, install the brake caliper and depress the brake pedal several times to secure the rotor in place before removing the **CH-45101-100** Conical Brake Rotor Washers and the lug nuts.

BRAKE ROTOR REFINISHING

Special Tools

- **CH-41013** Rotor Resurfacing Kit
- **CH-42450-A** Wheel Hub Resurfacing Kit

For equivalent regional tools, refer to **Special Tools**.

WARNING: **Refer to Brake Dust Warning .**

NOTE:

- **The disc brake rotors do not require refinishing as part of routine brake system service. New disc brake rotors do not require refinishing.**

  Do not refinish disc brake rotors in an attempt to correct the following conditions:

    - **Brake system noise - squeal, growl, groan**
    - **Uneven and/or premature disc brake pad wear**
    - **Superficial or cosmetic corrosion/rust of the disc brake rotor friction surface**
    - **Scoring of the disc brake rotor friction surface less than the maximum allowable specification**
- **Before refinishing a brake rotor, the rotor MUST first be checked for adequate thickness to allow the rotor to be refinished and remain above the minimum allowable thickness after refinish specification. Brake Rotor Thickness Measurement**

  Disc brake rotors should only be refinished if they have adequate thickness to be refinished and if one or more of the following conditions exist:

    - **Thickness variation in excess of the maximum allowable specification**
    - **Excessive corrosion/rust and/or pitting**
    - **Cracks and/or heat spots**
    - **Excessive blueing discoloration**
    - **Scoring of the disc brake rotor surface in excess of the maximum allowable specification**
- **Disc brake rotors may need to be refinished as part of the process for correcting brake rotor assembled lateral runout (LRO) that exceeds the maximum allowable specification.**

NOTE: **If the vehicle is equipped with cross-drilled rotors, use a lathe with positive rake tooling. This setup requires less cutting pressure, which will result in less vibration, and a better surface finish. Also, use a vibration dampener when cutting. Otherwise, refinish according to the following instructions.**

NOTE: **Whenever the brake rotor has been separated from the hub/axle flange, clean any rust or contaminants from the hub/axle flange and the brake rotor mating surfaces. Failure to do this may result in increased assembled lateral runout (LRO) of the brake rotor, which could lead to brake pulsation.**

1. Using the **CH-42450-A** Wheel Hub Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface of the hub/axle flange.
2. Using the **CH-41013** Rotor Resurfacing Kit, thoroughly clean any rust or corrosion from the mating surface and mounting surface of the brake rotor.
3. Inspect the mating surfaces of the hub/axle flange and the rotor to ensure that there are no foreign particles or debris remaining.
4. Mount the brake rotor to the brake lathe according to the lathe manufacturer's instructions, ensuring that all mounting attachments and adapters are clean and free of debris.
5. Ensure that any vibration dampening attachments are securely in place.
6. With the brake lathe running, slowly bring in the cutting tools until they just contact the brake rotor friction surfaces.
7. Observe the witness mark on the brake rotor. If the witness mark extends approximately three-quarters or more of the way around the brake rotor friction surface on each side, the brake rotor is properly mounted to the lathe.
8. If the witness mark does not extend three-quarters or more of the way around the brake rotor, re-mount the rotor to the lathe.
9. Following the brake lathe manufacturer's instructions, refinish the brake rotor.
10. After each successive cut, inspect the brake rotor thickness. **Brake Rotor Thickness Measurement**
11. If at any time the brake rotor exceeds the minimum allowable thickness after refinish specification, the brake rotor must be replaced.
12. After refinishing the brake rotor, use the following procedure in order to obtain the desired non-directional finish:
    1. Follow the brake lathe manufacturer's recommended speed setting for applying a non-directional finish.
    2. Using moderate pressure, apply the non-directional finish:
        - If the lathe is equipped with a non-directional finishing tool, apply the finish with 120-grit aluminum oxide sandpaper.
        - If the lathe is not equipped with a non-directional finishing tool, apply the finish with a sanding block and 150-grit aluminum oxide sandpaper.

    NOTE: **Thoroughly cleaning the brake rotor will prevent the possible transfer of finite metal dust left as a by-product of machining to the brake pad material during the burnishing process, thereby reducing the possibility for brake squeal or other brake noises to occur.**

    3. After applying a non-directional finish, clean each friction surface of the brake rotor with a solution of mild dish washing detergent and water, or a GM approved brake cleaner and a clean shop towel to remove metal particles remaining from machining. Repeat the cleaning process if necessary to remove all metal particles.
13. Remove the brake rotor from the brake lathe.
14. Measure the assembled LRO of the brake rotor to ensure optimum performance of the disc brakes. **Brake Rotor Assembled Lateral Runout Measurement**
15. If the brake rotor assembled LRO measurement exceeds the specification, bring the LRO to within specifications. **Brake Rotor Assembled Lateral Runout Correction**

DESCRIPTION AND OPERATION

DISC BRAKE SYSTEM DESCRIPTION AND OPERATION

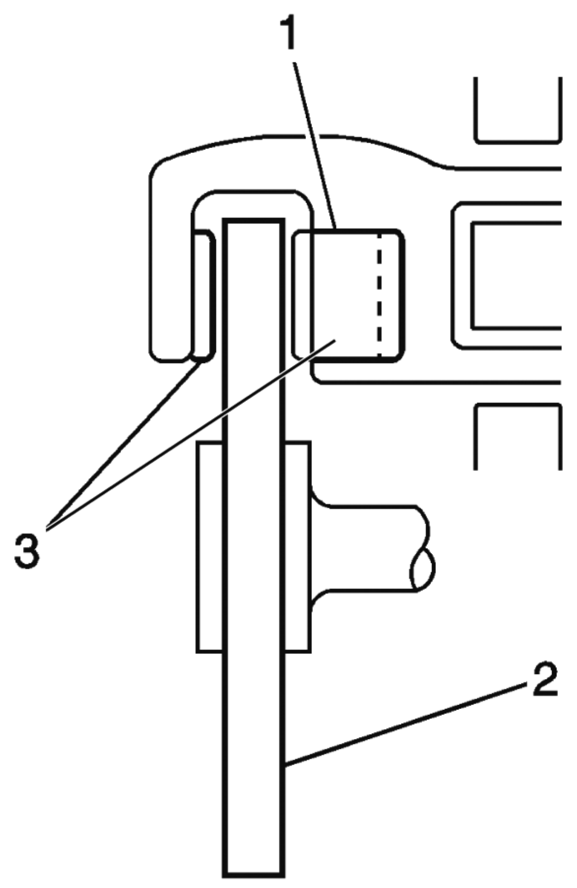


Fig. 80: Brake Caliper Piston, Rotor And Brake Pads
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Brake Caliper Caution .**

The brake caliper is single piston type; and is installed on knuckle by two mounting bolts. Brake caliper transforms hydraulic pressure generated by depressing brake pedal into braking force. The braking force evenly acts on the piston (1) and the bottom of brake caliper cylinder bore, and then move the piston outward and slide brake caliper inward so that there generates a clamping effect on brake rotor (2). The clamping effect forces brake pad (3) to attach to brake rotor, and the resulting friction will make vehicles stop.

When maintaining the brake caliper, replace all parts included in repair sets.

- Lubricate the rubber parts with clean brake fluid to make assembly easier.
- Do not apply compressed air to brake parts with workshop with lubricant, otherwise the rubber parts may be damaged.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace whole brake pad (3) according to service parts in the maintenance package.
- The torque values are specified for dry, nonlubricated fasteners.
- Perform the service operations on a clean bench, free from all mineral oil materials.

Gap Calibration

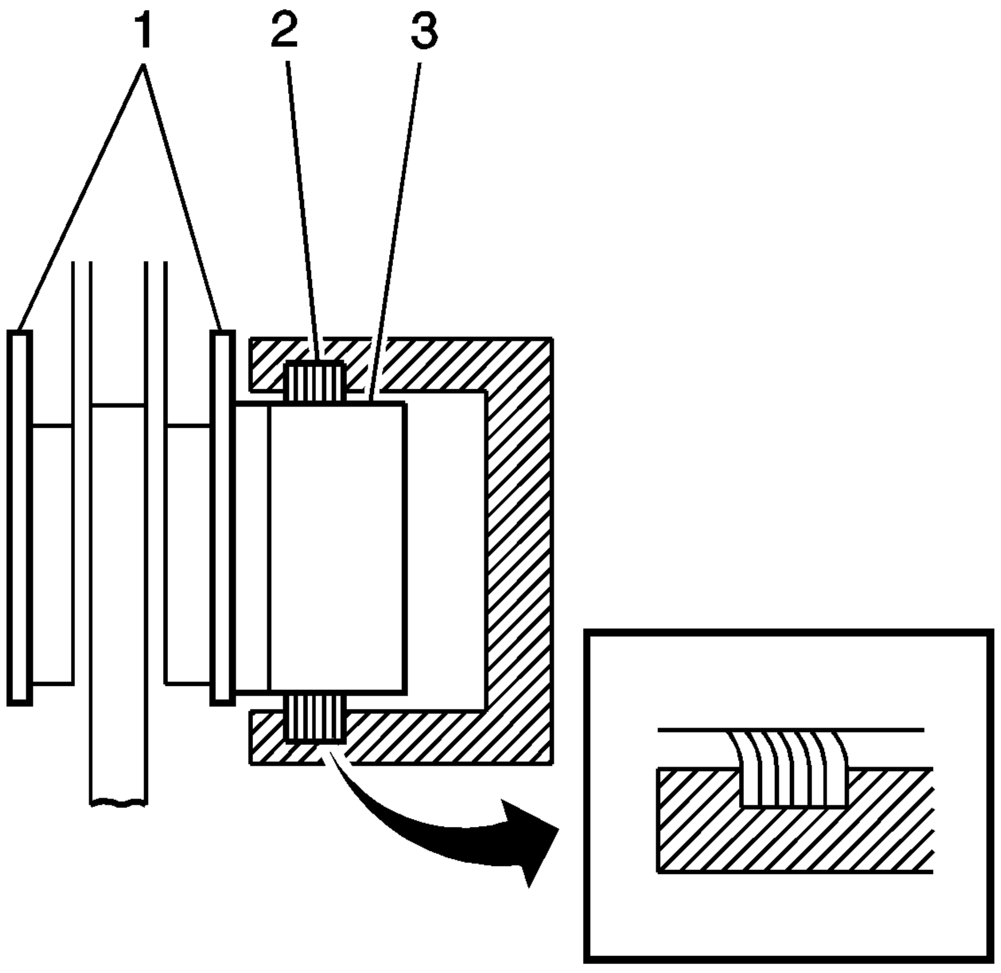


Fig. 81: Sectional View of Pads, Piston Seal, and Piston
Courtesy of GENERAL MOTORS COMPANY

When the hydraulic pressure acts on the piston (3), the piston moves left. The piston seals (2) exert pressure on the piston and move together with the cylinder. However, parts of the piston seals are fixed in the grooves of the cylinder. As shown, the shape of seals deforms toward the direction of piston.

When the pressure on the brake pedal is removed and the hydraulic pressure on the piston is released, there generates recovery elasticity on the seals. The force pushes the piston to the right side and return to its original position.

When the brake pad (1) exhibits wear, and the gap between the brake rotor and brake pad gets much larger, the piston moves farther.

Seals may further deform. Because the end of seals is fixed in the groove of the cylinder, the deformation is limited in the above-mentioned scope. Pistons further move to fill the gap. When the piston returns to the same position, the rubber seals resume original shape, and the gap between brake rotor and brake pad keeps the original level.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

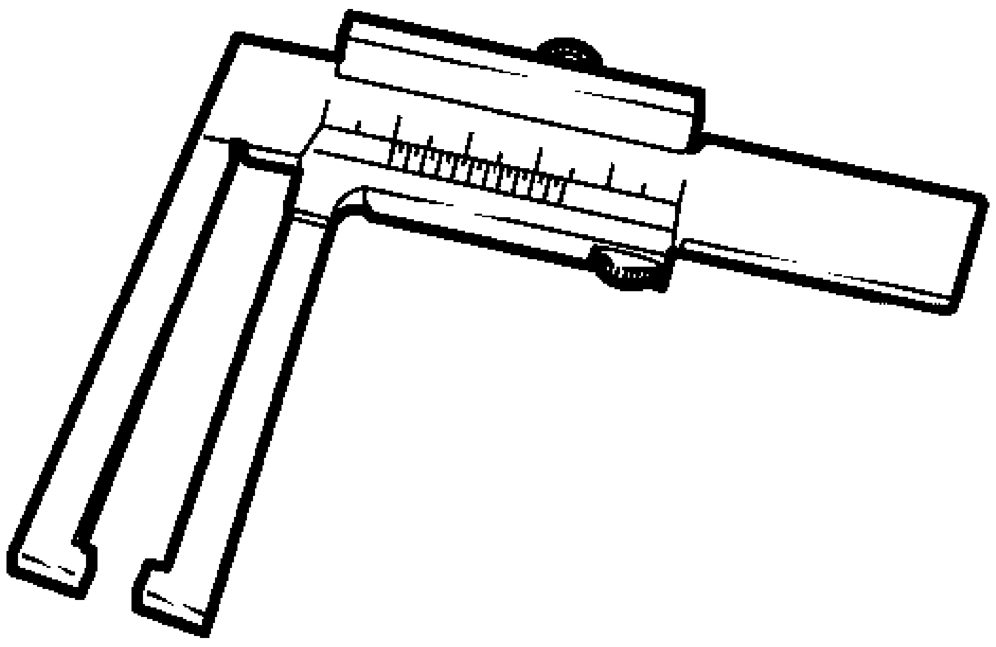
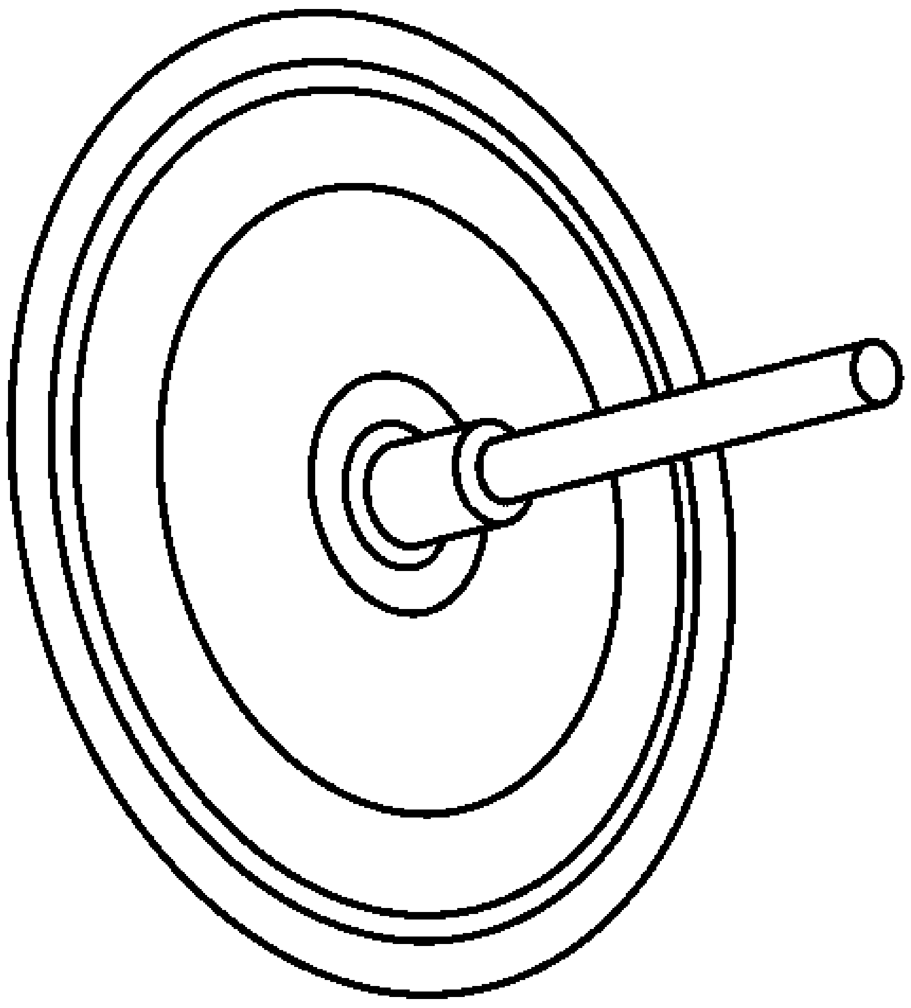
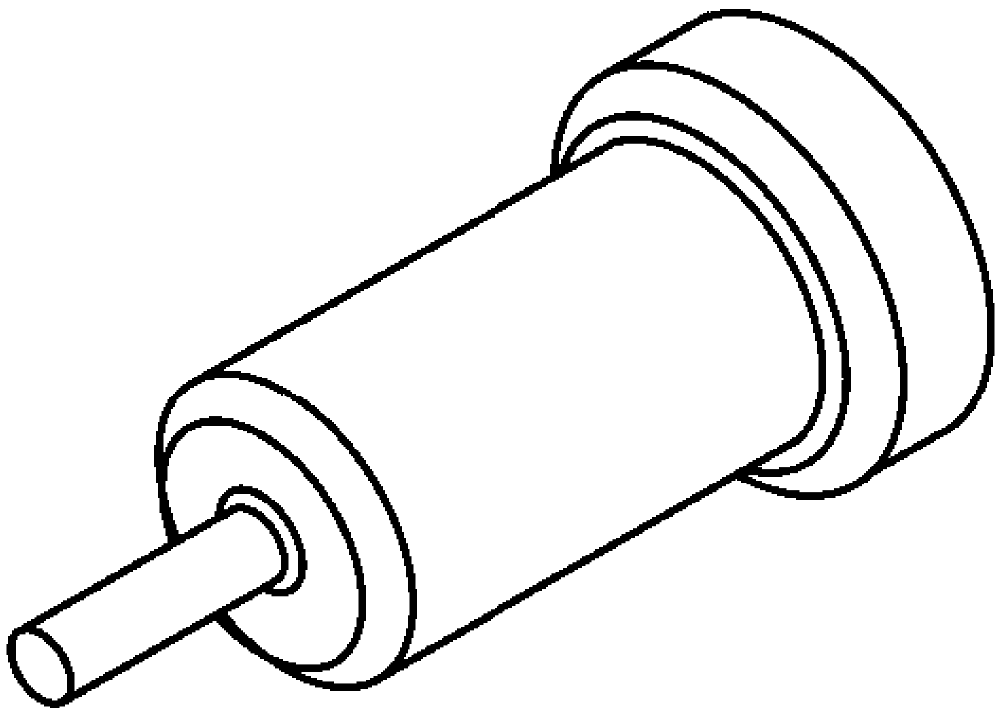
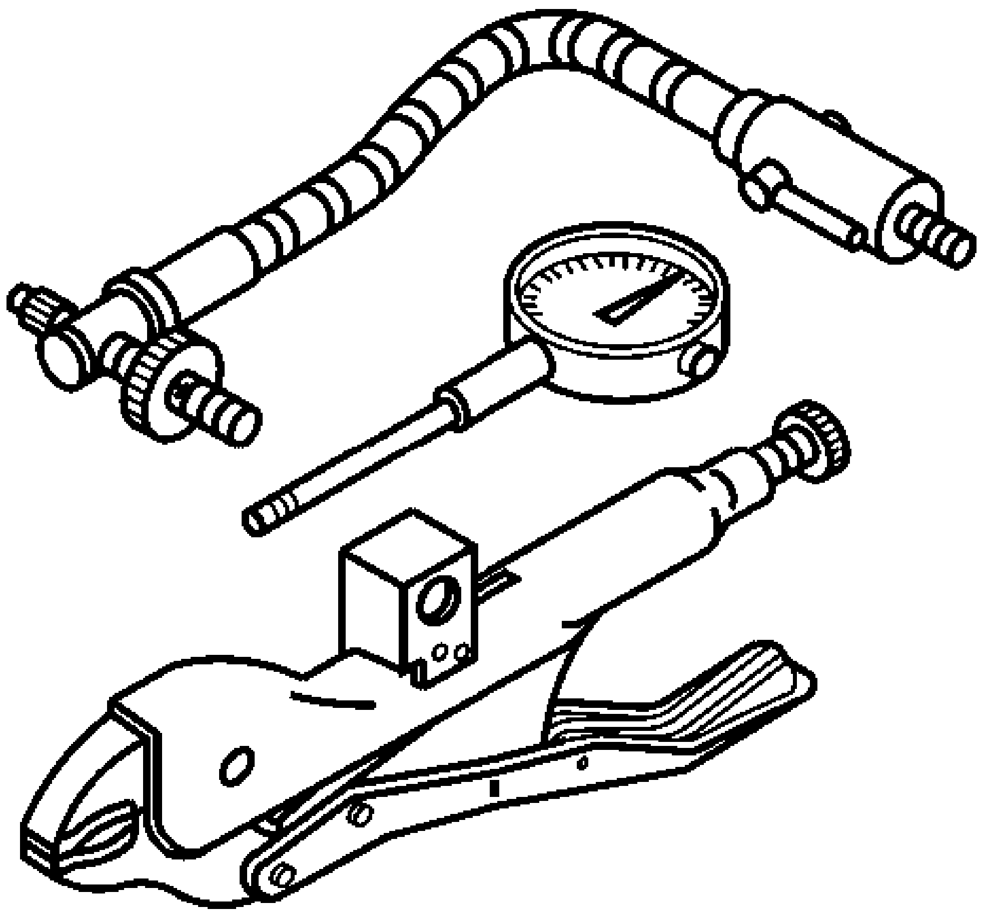
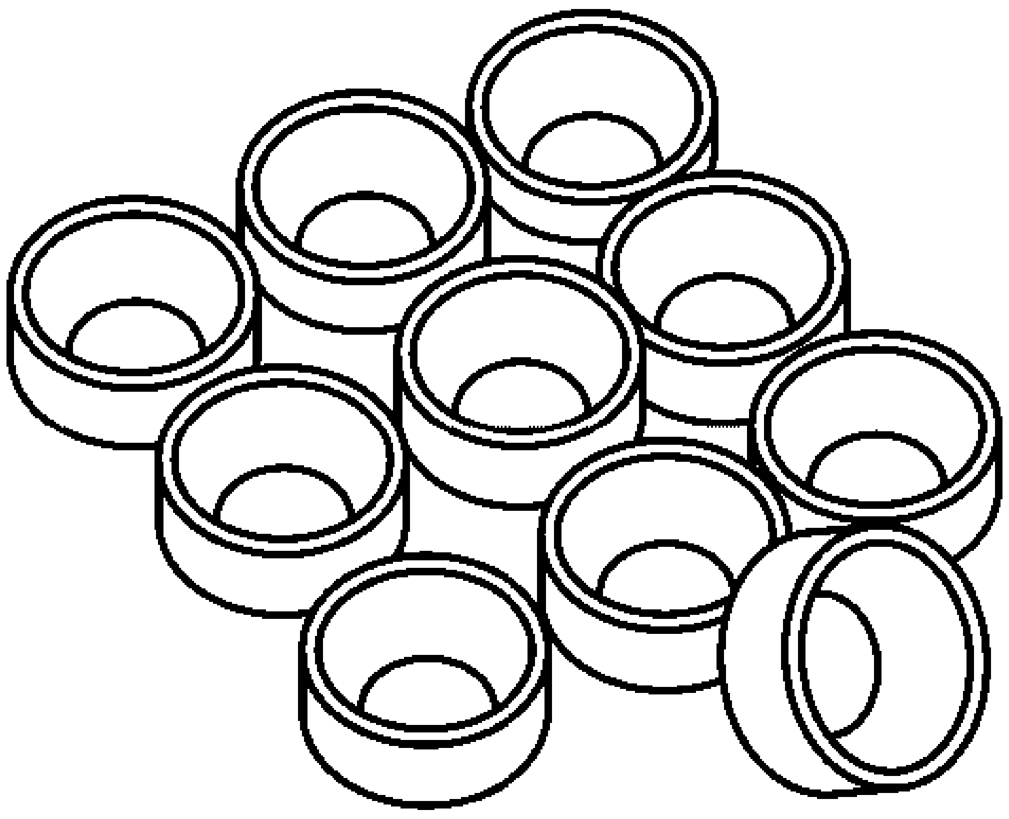
Illustration	Tool Number/Description
	CH-230-A MKM-230-A J-21177-A Disc Gauge
	CH-41013 J 41013 Rotor Resurfacing Kit

Illustration	Tool Number/Description
	CH-42450-A J 42450-A Wheel Hub Resurfacing Kit
	CH-45101 J 45101 Hub and Wheel Runout Gauge
	CH-45101-100 J 45101-100 Conical Brake Rotor Washers

Article GUID: A00890051

Back To Article

2017 BRAKES

Hydraulic Brakes - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Front Brake Hose Washer
Rear Brake Hose Washer

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Brake Master Cylinder Bolt	22 N.m (16 lb ft)
Brake Master Cylinder Reservoir Pin	7 N.m (62 lb in)
Brake Pedal Nut	22 N.m (16 lb ft)
Brake Pressure Modulator Valve Front Pipe Fitting	25 N.m (18 lb ft)
Brake Pressure Modulator Valve Rear Pipe Fitting	25 N.m (18 lb ft)
Front Brake Hose Fitting Bolt	40 N.m (30 lb ft)
Front Brake Pipe Fitting	18 N.m (13 lb ft)
Rear Brake Hose Fitting Bolt	40 N.m (30 lb ft)
Rear Brake Pipe Fitting	18 N.m (13 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Hydraulic Brake System	0.6 L	1.27 pt

BRAKE COMPONENT SPECIFICATIONS

Application	Specification	
	Metric	English
Front Brake Bleeder Valve	10 N.m	89 lb in
Rear Brake Bleeder Valve	13 N.m	115 lb in

BRAKE SYSTEM SPECIFICATIONS

Application	Specification	
	Metric	English
Maximum Brake Master Cylinder (BMC) Primary Piston Travel*	N.A.	N.A.

Application	Specification	
	Metric	English
*Measured at a brake pedal apply force (with the power button ON and the brake cool) of 5000 kPa (725 psi). N.A. = Data were not available at editorial deadline		

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Hydraulic Brake System	DOT 3 Motor Vehicle Brake Fluid	19299818	19299819

SCHEMATIC WIRING DIAGRAMS

HYDRAULIC BRAKE WIRING SCHEMATICS

Hydraulic Brakes

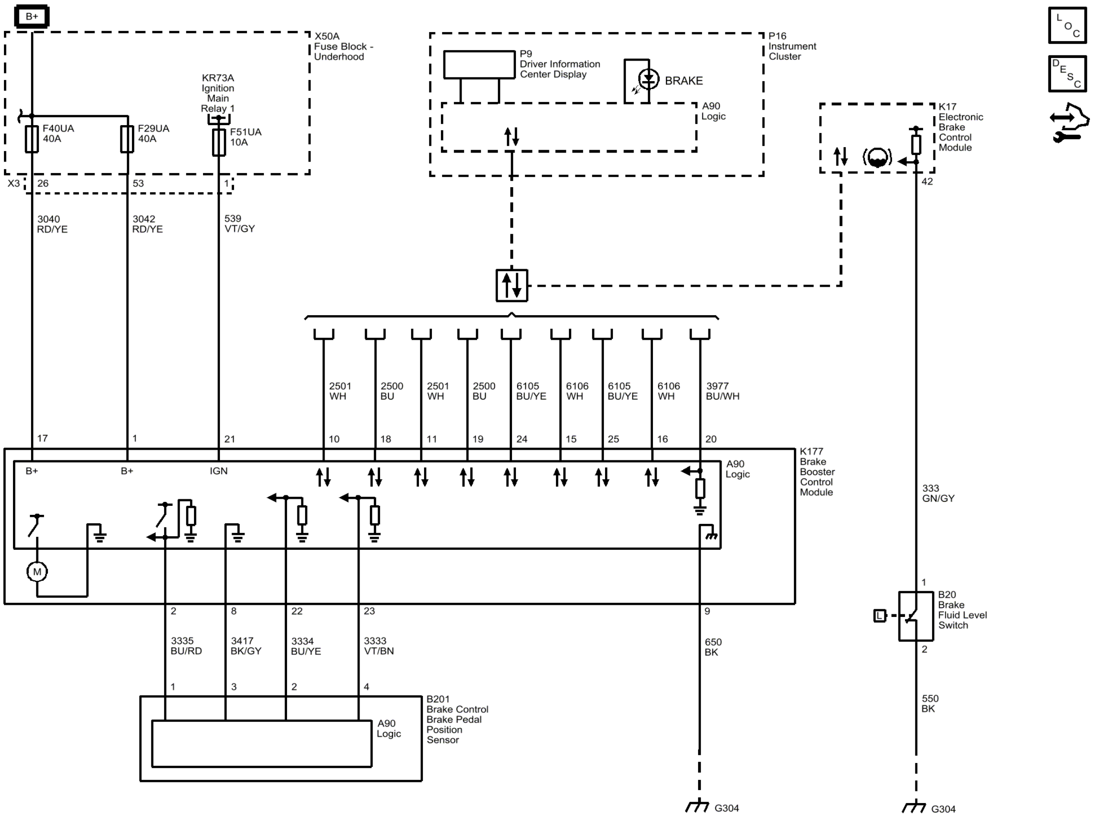

B+
X50A
Fuse Block - Underhood
KR73A
Ignition
Main
Relay 1
F40UA
40A
F29UA
40A
F51UA
10A
X3
26
53
1
3040
RD/YE
3042
RD/YE
539
VT/GY
P9
Driver Information
Center Display
BRAKE
A90
Logic
P16
Instrument
Cluster
K17
Electronic
Brake
Control
Module
42
L O C
D E S C
2501
WH
2500
BU
2501
WH
2500
BU
6105
BU/YE
6106
WH
6105
BU/YE
6106
WH
3977
BU/WH
17
1
21
10
18
11
19
24
15
25
16
20
B+
B+
IGN
A90
Logic
K177
Brake
Booster
Control
Module
M
333
GN/GY
2
8
22
23
9
3335
BU/RD
3417
BK/GY
3334
BU/YE
3333
VT/BN
650
BK
1
3
2
4
B201
Brake Control
Brake Pedal
Position
Sensor
A90
Logic
1
B20
Brake
Fluid Level
Switch
L
2
550
BK
G304
G304

Fig. 1: Hydraulic Brakes
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0075: BRAKE PEDAL POSITION SENSOR PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0075

Brake Pedal Position Sensor Performance

Symptom Byte Information: Symptom Byte List

Circuit/System Description

For an overview of the component/system, refer to: **Hydraulic Brake System Description and Operation**

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Pedal Position Sensor = Out Of Range

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0075 is not set.
    - **If the DTC is set**

      Replace the component: K177 Brake Booster Control Module

    - **If the DTC is not set**
3. All OK.

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0075 is not set.
    - **If the DTC is set**

        1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
        2. Verify the DTC does not set.
            - If the DTC sets - Replace the component: K177 Brake Booster Control Module
            - If the DTC is not set
        3. All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC C0126: BRAKE FLUID LEVEL SENSOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0126

Brake Fluid Level Sensor Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0126 05	C0126 05	-
Ground	-	C0126 05	-	-

Circuit/System Description

The brake fluid level switch monitors the level of the brake fluid in the brake fluid reservoir. When the brake fluid level switch input closed, the electronic brake control module will set the DTC.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode/Vehicle in Service Mode.

Conditions for Setting the DTC

- Low brake fluid level is detected for 5 s.
- An open is detected on the ground circuit.
- An open or short to voltage is detected on the signal circuit.

Action Taken When the DTC Sets

- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.
- The traction control/stability control-active indicator turns ON.
- The brake warning indicator turns ON.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the brake fluid level is above the minimum level.
    - **If low**

      Refer to **Brake Fluid Loss**.

    - **If above minimum level**
2. Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Brake Fluid Level Sensor parameter is OK.
    - **If the parameter is not OK**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K17 Electronic Brake Control Module.
    - **If the parameter is OK**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.

6. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
    - **If the parameter is not Low**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K17 Electronic Brake Control Module.
    - **If the parameter is Low**
7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Brake Fluid Level Indicator Switch Replacement**
- Refer to **Control Module References** for electronic brake control module replacement, programming and setup.

DTC C0267: LOW BRAKE FLUID INDICATED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0267

Low Brake Fluid Indicated

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0126 05	C0126 05	-
Ground	-	C0126 05	-	-

Circuit/System Description

The brake fluid level switch monitors the level of the brake fluid in the brake fluid reservoir. When the brake fluid level switch input closed, the electronic brake control module will set the DTC.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

Low brake fluid level is detected for 8 s.

Action Taken When the DTC Sets

- The electronic brake control module disables the traction control and stability control for the duration of the ignition cycle.

- The traction control/stability control-active indicator turns ON.
- The brake warning indicator turns ON.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the brake is above minimum level.
    - **If low**

      Refer to **Brake Fluid Loss**.

    - **If above minimum level**

      Refer to Circuit/System Testing.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Brake Fluid Level Sensor parameter is OK.
    - **If the parameter is not OK**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K17 Electronic Brake Control Module.
    - **If the parameter is OK**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and ground.
6. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
    - **If the parameter is not Low**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K17 Electronic Brake Control Module.
    - **If the parameter is Low**
7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Brake Fluid Level Indicator Switch Replacement**
- Refer to **Control Module References** for electronic brake control module replacement, programming and setup.

DTC C029F: BRAKE BOOSTER SYSTEM PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C029F

Brake Booster System Performance

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. If the electronic brake control module (EBCM) detects a brake booster system condition a DTC will be set.

Conditions for Running the DTC

Vehicle ON.

Conditions for Setting the DTC

The device has detected an internal malfunction

Action Taken When the DTC Sets

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode
2. Verify no other DTCs are set.
    - **If a DTC is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no DTCs are set**
3. Replace K177 Brake Booster Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control module replacement, programming and setup

DTC C0579, C057A, OR C057E: BRAKE BOOSTER CONTROL MODULE TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0579

Brake Booster Control Module Temperature Sensor 2 Circuit Low Voltage

DTC C057A

Brake Booster Control Module Temperature Sensor 2 Circuit High Voltage

DTC C057E

Brake Booster Control Module Temperature Sensor 1-2 Correlation

Symptom Byte Information: **Symptom Byte List**

Circuit/System Description

For an overview of the component/system, refer to: **Hydraulic Brake System Description and Operation**

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Booster Temperature = Out Of Range

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C0579, C057A, C057E is not set.
   - **If the DTC is set**
   1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
   2. Verify the DTC does not set.
      - If the DTC sets - Replace the component: K177 Brake Booster Control Module
      - If the DTC is not set
   3. All OK.
   - **If the DTC is not set**

3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, OR C1275-C1277: BRAKE BOOSTER MOTOR/BRAKE BOOSTER CONTROL MODULE/BRAKE BOOSTER ROTOR POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C057F

Brake Booster Motor 1 Phase U-V-W Circuit

DTC C0582

Brake Booster Motor 1 Phase U-V-W Circuit Performance

DTC C058A

Brake Booster Motor 1 Position Sensor Circuit Performance

DTC C0590

Brake Booster Motor 1 Phase U-V-W Circuit High Current

DTC C0591

Brake Booster Motor 1 Phase U-V-W Circuit Low Current

DTC C0595

Brake Booster Control Module Internal Driver Performance

DTC C0596

Brake Booster Motor 1 Current Sensor Circuit Performance

DTC C1275

Brake Booster Rotor Position Sensor Unexpected Reset

DTC C1276

Brake Booster Rotor Position Sensor Message Counter Incorrect

DTC C1277

Brake Booster Rotor Position Sensor Configuration Error

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. The motor is part of the brake booster unit. If the ECU detects a high or low voltage condition or a rotor position error in the booster motor a DTC will be set.

Conditions for Running the DTC

C057F, C0582, C0590, or C0591

- Ignition ON/Vehicle in Service Mode.
- Brake pedal released and no autonomous braking for at least 5 s

C058A, C0595, C0596, C1275, C1276, or C1277

- Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

C057F, C0582, C058A, C0590, C0591, C0595, C0596, C1275, C1276, or C1277

- The device has detected an internal malfunction

Action Taken When the DTC Sets

C057F, C0582, C058A, C0590, C0591, C0595, C0596, C1275, C1276, or C1277

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

C057F, C0582, C058A, C0590, C0591, C0595, C0596, C1275, C1276, or C1277

- The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode
2. Verify that DTCs U3001, U3007, U3018, U3019, U3501-U3509, or U350A are not set.
    - **If DTCs U3001, U3007, U3018, U3019, U3501-U3509, or U350A is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If DTCs U3001, U3007, U3018, U3019, U3501-U3509, or U350A is not set**

3. Replace K177 Brake Booster Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control module replacement, programming and setup

DTC C0580 OR C0594: BRAKE BOOSTER MOTOR 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C0580

Brake Booster Motor 1 Phase U-V-W Circuit Low Voltage

DTC C0594

Brake Booster Motor 1 Performance

For symptom byte information refer to **Symptom Byte List** .

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. The motor is part of the brake booster unit and if the ECU detects a low voltage condition in the booster motor a DTC will be set.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

The device has detected an internal malfunction

Action Taken When the DTC Sets

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode
2. Verify that DTCs U3001, U3007, U3018, U3019, U3501-U3509, or U350A are not set.
   - **If DTCs U3001, U3007, U3018, U3019, U3501-U3509, or U350A is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

   - **If DTCs U3001, U3007, U3018, U3019, U3501-U3509, or U350A is not set**
3. Replace K177 Brake Booster Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control module replacement, programming and setup

DTC C1278 OR C1279: BRAKE SYSTEM DATA 1/2 MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C1278

Brake System Data 1 Message Counter Incorrect

DTC C1279

Brake System Data 2 Message Counter Incorrect

Symptom Byte Information: **Symptom Byte List**

Circuit/System Description

For an overview of the component/system, refer to: **Hydraulic Brake System Description and Operation**

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C1278, C1279 is not set.
    - **If the DTC is set**
    1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
    2. Verify the DTC does not set.
        - If the DTC sets - Replace the component: K177 Brake Booster Control Module
        - If the DTC is not set
    3. All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC C1449: SYSTEM CONFIGURATION ERROR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C1449

System Configuration Error

Symptom Byte Information: Symptom Byte List

Circuit/System Description

For an overview of the component/system, refer to: **Hydraulic Brake System Description and Operation**

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Boost/Blending = Not Available

Brake System Warning Indicator = ON

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC C1449 is not set.
   - **If the DTC is set**
   1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
   2. Verify the DTC does not set.
      - If the DTC sets - Replace the component: K177 Brake Booster Control Module
      - If the DTC is not set
   3. All OK.
   - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P057B-P057E, P05DC-P05DF, OR P05E0: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P057B

Brake Pedal Position Sensor 1 Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor 1 Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

DTC P05DC

Brake Pedal Position Sensor "B" Circuit Range/Performance

DTC P05DD

Brake Pedal Position Sensor 2 Circuit Low Voltage

DTC P05DE

Brake Pedal Position Sensor 2 Circuit High Voltage

DTC P05DF

Brake Pedal Position Sensor 2 Circuit Erratic

DTC P05E0

Brake Pedal Position Sensors 1-2 Not Plausible

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P057C, P05DD	P057C, P05DE	-	-
Brake Pedal Position Sensor Signal 1	P057C	P057C	P057D	P057B, P05E0
Brake Pedal Position Sensor Signal 2	P05DD	P05DE	P05DE	P05DC, P05E0

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	P057C, P05DE	-	-

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. The pedal travel sensor is connected to the brake pedal and measures the amount of brake pedal input to control the amount of boost needed. The pedal travel sensor consists of two travel sensors in one assembly, consisting of a shared 5 volt reference, shared low reference, and two signal circuits.

Conditions for Running the DTC

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF, or P05E0

- Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

P057B

The brake pedal position sensor 1 upper and lower and lower range has been exceeded

P057E

Brake pedal position sensor 1 erratic signal

P057C

Brake pedal position sensor 1 signal shorted to ground

P057D

Brake pedal position sensor 1 signal shorted to voltage

P05DC

The brake pedal position sensor 2 upper and lower and lower range has been exceeded

P05DD

Brake pedal position sensor 2 signal shorted to ground

P05DE

Brake pedal position sensor 2 signal shorted to voltage

P05DF

Brake pedal position sensor 2 erratic signal

P05E0

The deviation between Brake pedal position sensor 1 and 2 is too large

Action Taken When the DTC Sets

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF, or P05E0

- No boost or blending is available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

P057B, P057C, P057D, P057E, P05DC, P05DD, P05DE, P05DF, or P05E0

The condition for setting the DTC is no longer present.

Diagnostic Aids

DTC P050E may set if the brake pedal is applied for 60 seconds or more while also applying the accelerator pedal.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 3 and ground.
    - **If 10 Ω or greater**
    1. Disconnect the harness connector at the K177 Brake Booster Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K177 Brake Booster Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K177 Brake Booster Control Module.
    - **If greater than 5.2 V**

    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K177 Brake Booster Control Module.
   - **If between 4.8 - 5.2 V**
5. Test for less than 1 V between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
   - **If greater than 1 V**
     1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, ignition ON.
     2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K177 Brake Booster Control Module.
   - **If less than 1 V**
6. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
7. Test for infinite resistance between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 2 and ground.
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
8. Test for less than 2 Ω in the B201 Brake Control Brake Pedal Position Sensor signal circuit end to end.
   - **If 2 Ω or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 Ω**
9. Test for less than 1 V between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 4 and ground.
   - **If greater than 1 V**
     1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, ignition ON.
     2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K177 Brake Booster Control Module.
   - **If less than 1 V**
10. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
11. Test for infinite resistance between the B201 Brake Control Brake Pedal Position Sensor signal circuit terminal 4 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
12. Test for less than 2 Ω in the B201 Brake Control Brake Pedal Position Sensor signal circuit end to end.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

13. Replace the K177 Brake Booster Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control module replacement, programming and setup

DTC P0601, P0603, P0604, P0606, P060B, OR P062F: CONTROL MODULE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0601

Control Module Read Only Memory Performance

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P060B

Control Module Analog to Digital Converter Performance

DTC P062F

Control Module Long Term Memory Performance

Circuit/System Description

For an overview of the component/system, refer to: **Hydraulic Brake System Description and Operation**

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

K177 Brake Booster Control Module = Internal Malfunction

Actions Taken When the DTC Sets

Brake System Warning Indicator = ON

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P0601, P0603, P0604, P0606, P060B, P062F is not set.
   - **If the DTC is set**
   1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
   2. Verify the DTC does not set.
      - If the DTC sets - Replace the component: K177 Brake Booster Control Module
      - If the DTC is not set
   3. All OK.
   - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

DTC P0642, P06A6, OR P06A7: SENSOR REFERENCE VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0642

Sensor Reference Voltage 1 Low Voltage

DTC P06A6

Sensor Reference Voltage 1 Performance

DTC P06A7

Sensor Reference Voltage 2 Performance

For symptom byte information refer to Symptom Byte List .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P057C, P05DD, P06A6, P06A7	P057C, P05DE, P0642	-	P06A6, P06A7

Circuit/System Description

The brake booster system consists of a motor, electronic control unit (ECU), pedal travel sensor, and a master cylinder. The pedal travel sensor is attached to the brake pedal and measures the amount of brake pedal input to control the amount of boost needed. The pedal travel sensor consists of two travel sensors in one assembly, consisting of a shared 5 volt reference, shared low reference, and two signal circuits.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

Pedal travel sensor voltage supply failure

Action Taken When the DTC Sets

- No boost or blending available
- Red brake light and MIL are illuminated

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hydraulic Brake System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF/Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B201 Brake Control Brake Pedal Position Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Ignition ON/Vehicle in Service Mode.
3. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K177 Brake Booster Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K177 Brake Booster Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K177 Brake Booster Control Module.
    - **If between 4.8 - 5.2 V**
4. Replace the K177 Brake Booster Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for control module replacement, programming and setup

DTC P25C6 OR P25C7: BRAKE BOOSTER TEMPERATURE SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P25C6

Brake Booster Temperature Sensor Circuit Low Voltage

DTC P25C7

Brake Booster Temperature Sensor 1 Circuit High Voltage

Symptom Byte Information: **Symptom Byte List**

Circuit/System Description

For an overview of the component/system, refer to: **Hydraulic Brake System Description and Operation**

Conditions for Running the DTC

Ignition - On/Vehicle - In Service Mode

Conditions for Setting the DTC

Brake Booster Control Module Temperature = Out Of Range

Actions Taken When the DTC Sets

Boost = Full

Conditions for Clearing the DTC

The conditions for setting the DTC no longer exist.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify DTC P25C6, P25C7 is not set.
    - **If the DTC is set**
    1. Perform all necessary programming and setup procedures for the control module: K177 Brake Booster Control Module
    2. Verify the DTC does not set.
        - If the DTC sets - Replace the component: K177 Brake Booster Control Module
        - If the DTC is not set
    3. All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

SYMPTOMS - HYDRAULIC BRAKES

IMPORTANT: The following steps must be completed before using the symptom tables.

1. Perform **Diagnostic System Check - Vehicle** before using the brake indicator symptom tables in order to verify that all of the following are true:

    - There are no DTCs set.
    - The control module(s) can communicate via the serial data link.
2. Perform the **Brake System Vehicle Road Test** before using the hydraulic brake symptom tables in order to duplicate the customer's concern.
3. Review the system operation in order to familiarize yourself with the system functions.
    - **Power Brake Booster Description and Operation**
    - **Brake Warning System Description and Operation**
    - **Hydraulic Brake System Description and Operation**
    - **Disc Brake System Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the brake warning system. Refer to **Checking Aftermarket Accessories**
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**

Symptom List

Perform a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Brake Warning Indicator Malfunction**
- **Brake Pulsation**
- **Brake System Noise**
- **Braking Action Uneven - Pulls to One Side**
- **Braking Action Uneven - Front to Rear**
- **Brake Pedal Excessive Travel**
- **Brake Pedal Excessive Effort**
- **Brakes Drag**
- **Brake System Slow Release**
- **Brake Fluid Loss**

BRAKE WARNING INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	C0267 00	C0267 05	C0267 05	-
Ground	-	C0267 05	-	-

Circuit/System Description

The electronic brake control module monitors the brake fluid level in the brake fluid reservoir. When the fluid within the brake fluid reservoir is below the MIN level, contacts within the brake fluid level switch closes causing the voltage within the signal circuit to drop. The electronic brake control module will detect the voltage drop and will send a serial data message to the instrument cluster commanding the brake warning indicator to illuminate.

Reference Information

Schematic Reference

Hydraulic Brake Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Brake Warning System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the brake fluid level is above the minimum level.
    - **If low**

      Refer to **Brake Fluid Loss**.

    - **If above minimum level**
2. Ignition ON.
3. Verify the scan tool Brake Fluid Level Sensor parameter is OK.
    - **If the parameter is Low**

      Refer to Circuit/System Testing

    - **If the parameter is Ok**
4. Verify the brake warning indicator turns ON and OFF when commanding the Instrument Cluster All Indicators On and Off with a scan tool.
    - **If the brake warning indicator does not turn ON and OFF**

      Replace the P16 Instrument Cluster.

    - **If the brake warning indicator turns ON and OFF**
5. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B20 Brake Fluid Level Switch. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 2 (or B) and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**

3. Ignition ON.
4. Verify the scan tool Brake Fluid Level Sensor parameter is OK.
    - **If the parameter is not OK**
    1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module.
    2. Test for infinite resistance between the signal circuit terminal 1 (or A) and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K17 Electronic Brake Control Module.
    - **If the parameter is OK**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 (or A) and ground.
6. Verify the scan tool Brake Fluid Level Sensor parameter is Low.
    - **If the parameter is OK**
    1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V.
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K17 Electronic Brake Control Module.
    - **If the parameter is Low**
7. Test or replace the B20 Brake Fluid Level Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Brake Fluid Level Indicator Switch Replacement**
- Refer to **Control Module References** for electronic brake control module and Instrument Cluster replacement, programming and setup.

BRAKE PULSATION

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="4">DEFINITION: Fluctuation or pulsation is felt through the brake pedal, steering wheel, seat, floor, and/or in the vehicle ONLY when braking.</td></tr>
<tr><td>1</td><td>Were you sent here from the Hydraulic Brake Symptom table?</td><td>Go to Step 2</td><td>Go to Symptoms - Hydraulic Brakes</td></tr>
</table>

Step	Action	Yes	No
2	1. Inspect the disc brake system for the following conditions. • Excessive thickness variation of rotor friction surfaces • Excessive assembled lateral runout (LRO) of rotor friction surfaces • Hard spots, heat checks, bluing discoloration of rotor friction surfaces; possibly due to brake drag • Excessive corrosion of rotor friction surfaces; including red, gray or black oxidation • Loose, damaged or missing caliper or lining hardware • Bent or damaged caliper or mounting component • Excessive LRO of wheel hub/axle flange; due to damage and/or loose or excessively worn bearings 2. Perform the disc brake system diagnostic procedure. Refer to **Disc Brake System Diagnosis** 3. Adjust, repair or replace components as necessary. Did you find and correct a condition?	Go to **Step 3**	Go to **Symptoms - Hydraulic Brakes**
3	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKE SYSTEM NOISE

Step	Action	Yes	No
DEFINITION: Vehicle exhibits abnormal noise when braking; vehicle may exhibit abnormal noise during motion just after brake pedal release.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**

Step	Action	Yes	No
2	1. Inspect the disc brake system for the following conditions. - Lining wear indicator contact with rotor - Debris trapped between rotor and splash shield or backing plate; and/or debris trapped between rotor and linings - Contaminated linings - Aftermarket linings - Glazed linings - Distorted, cracked or damaged linings - Excessively worn linings - Damaged or excessively worn caliper hardware and/or lining hardware - Incorrectly installed, loose or missing caliper hardware and/or lining hardware - Lack of lubrication or excessive corrosion on metal to metal contact surfaces - Bent or damaged splash shield or backing plate - Hard spots, heat checks, blueing discoloration of rotor friction surfaces - Glazed rotor friction surfaces - Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	1. Inspect the brake apply system for the following conditions. - Lack of lubrication or excessively worn pushrod or pedal pivots or pivot bushings - Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**

Step	Action	Yes	No
4	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Vehicle**
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - PULLS TO ONE SIDE

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4

Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

5

Steering components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Step	Action	Yes	No
DEFINITION: Vehicle pulls to one side only when braking.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	1. Inspect the hydraulic brake system for the following conditions. • Kinked, pinched or damaged brake pipe or flexible brake hose • Sticking or improperly operating caliper piston • Brake fluid leak 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**

Step	Action	Yes	No
3	1. Inspect the disc brake system for the following conditions. • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings on one side • Loose, damaged or missing caliper hardware and/or lining hardware • Incorrect linings on one side • Hard spots, heat checks, blueing discoloration of rotor friction surfaces; possibly due to brake drag • Glazed rotor friction surfaces • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**
4	1. Inspect the suspension system for the following conditions. • Incorrect tire pressures • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to **Diagnostic Starting Point - Vehicle** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	1. Inspect the steering system for the following conditions. • Loose steering component connections • Excessively worn or damaged steering components 2. Adjust, repair or replace components as necessary. Refer to **Diagnostic Starting Point - Vehicle** Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Vehicle**
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKING ACTION UNEVEN - FRONT TO REAR

Test Descriptions

The number below refers to the step number on the diagnostic table.

4

Suspension components that are not operating properly may cause a disturbance to the vehicle during application of the brake system.

Step	Action	Yes	No
DEFINITION: Braking action or stopping force sensitive or grabbing and/or more pronounced at the front or at the rear axle. Sensitive or grabbing brakes: Excessive brake jump-in force relative to brake pedal input.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	1. Inspect the hydraulic brake system for the following conditions: • Improper operation of caliper pistons • Kinked, pinched or damaged brake pipe or flexible brake hose • Brake fluid leak • Improper operation of dynamic rear proportion (DRP) system 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 3**
3	1. Inspect the disc brake system for the following conditions: • Contaminated linings • Glazed linings • Distorted, cracked or damaged linings • Excessively worn linings • Aftermarket linings • Damaged or excessively worn caliper hardware and/or lining hardware • Hard spots, heat checks, blueing discoloration of rotor friction surfaces • Glazed rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 4**

Step	Action	Yes	No
4	1. Inspect the suspension system for the following conditions: • Loose suspension component connections • Excessively worn or damaged suspension components 2. Adjust, repair or replace components as necessary. Refer to **Diagnostic Starting Point - Vehicle** Did you find and correct a condition?	Go to **Step 6**	Go to **Step 5**
5	1. Inspect the brake apply system for the following conditions: • Binding, bent or damaged pedal pushrod, pedal, or pedal bracket • Binding, bent or damaged brake pedal • Binding, bent or damaged brake pedal bracket 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 6**	Go to **Diagnostic Starting Point - Vehicle**
6	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKE PEDAL EXCESSIVE TRAVEL

Step	Action	Yes	No
DEFINITION: Brake pedal travels further than expected to obtain firm pedal and/or firm pedal cannot be obtained, pedal fades away, or pedal is spongy.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Symptoms - Hydraulic Brakes**
2	Inspect the travel and feel of brake pedal applies. Perform the following: 1. Place the Power button in the Service Only mode. 2. Remove one of the Electric Brake Boost fuses from the Engine Compartment Fuse Block. 3. Apply the brake pedal with light, steady pressure and hold for 15 seconds. Observe pedal travel and feel. Did you complete the brake pedal travel and feel inspections?	Go to **Step 3**	-

Step	Action	Yes	No
3	1. Inspect the hydraulic brake system for the conditions listed, based on the following symptoms observed during the pedal travel and feel inspections: • Pedal feel was spongy • Air in hydraulic system • External brake fluid leaks • Soft, weak or damaged hydraulic hoses; expanding under pressure • Pedal fell away and/or traveled to or almost to floor • External brake fluid leaks • Poor brake fluid quality; low boiling point • Internal brake fluid leaks; improperly functioning master cylinder • Pedal was somewhat firm then dropped slightly, or pedal rose with successive applies, or pedal travel was different between slow and quick applies • Internal brake fluid leaks; improperly functioning master cylinder • Poor brake fluid quality; low boiling point • Pedal returned to rest slowly after any of the applies • Internally damaged flexible brake hoses; hindering fluid return • Binding caliper pistons • Internal brake fluid leaks; improperly functioning master cylinder 2. Repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 4**

Step	Action	Yes	No
4	1. Inspect the disc brake system for the following conditions: - Cracked, excessively worn or damaged linings - Cracked, excessively worn or damaged rotors - Improperly operating, binding or damaged caliper hardware and/or lining hardware - Loose or missing caliper hardware and/or lining hardware - Excessive assembled lateral runout (LRO) of rotor friction surfaces - Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis** 3. Re-inspect brake pedal apply travel and feel. Did you find and correct a condition?	Go to **Step 9**	Go to **Step 5**
5	Inspect for proper brake pedal travel. Refer to **Brake Pedal Travel Measurement and Inspection** Is the brake pedal travel distance within the acceptable limits?	Go to **Step 8**	Go to **Step 6**
6	1. Inspect for worn, missing, misaligned, bent or damaged brake pedal system components. - Perform the brake pedal pushrod component inspection. Refer to **Brake Pedal Pushrod Inspection**. - Inspect the brake pedal bushings for binding, excessive wear and/or damage and inspect the brake pedal for a misaligned, bent, and/or damaged condition. 2. Replace the brake pedal system components that are worn, missing, misaligned, bent or damaged. Did you find and replace any worn, missing, misaligned, bent or damaged brake pedal system components?	Go to **Step 9**	Go to **Step 7**
7	1. Replace the brake master cylinder assembly. 2. Inspect the brake pedal travel. Refer to **Brake Pedal Travel Measurement and Inspection** Did you find and correct a condition?	Go to **Step 9**	Go to **Step 8**

Step	Action	Yes	No
8	1. Inspect the brake assist system for the following conditions: - Internal fluid leaks and/or restrictions within the brake modulator assembly - Damaged or improperly operating brake modulator assembly 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 9**	Go to **Symptoms - Hydraulic Brakes**
9	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKE PEDAL EXCESSIVE EFFORT

Step	Action	Yes	No
DEFINITION: Brake pedal requires an increased amount of input from the driver to obtain good braking action and/or stopping distance is increased.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	1. Inspect the brake assist system for the following conditions: - Lack of lubrication, binding or excessively worn pushrod or pedal pivots or pivot bushings - Bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 5**	Go to **Step 3**

Step	Action	Yes	No
3	1. Inspect the hydraulic brake system for the following conditions: • Binding caliper pistons • Internally damaged flexible brake hoses; hindering fluid flow • External brake fluid leaks • Kinked or damaged flexible brake hoses and/or pipes • Internal brake fluid leaks; improperly operating master cylinder • Poor brake fluid quality; low boiling point 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 5**	Go to **Step 4**
4	1. Inspect the disc brake system for the following conditions: • Excessively worn linings • Glazed linings • Cracked, distorted or damaged linings • Contaminated linings • Binding, damaged or excessively worn caliper hardware and/or lining hardware • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Excessively worn or corroded rotor friction surfaces • Glazed rotor friction surfaces • Hard spots, heat checks, blueing discoloration of rotor friction surfaces 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 5**	Go to **Diagnostic Starting Point - Vehicle**
5	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKES DRAG

Step	Action	Yes	No
DEFINITION: Brake system does not fully release or has delayed release; vehicle motion may be hindered by brake system without applying brakes.			

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	Is the vehicle equipped with an adjustable stop lamp switch and/or an adjustable cruise control release switch?	Go to **Step 3**	Go to **Step 4**
3	1. Inspect the stop lamp switch for proper adjustment to ensure that the brake pedal is fully releasing. 2. Inspect the cruise control release switch, if equipped, for proper adjustment to ensure that the brake pedal is fully releasing. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 4**
4	Is the vehicle equipped with a drum-in-rotor type of park brake system?	Go to **Step 5**	Go to **Step 7**
5	Ensure the park brake shoes are not adjusted too tightly, possibly causing drag under certain conditions. Are the park brake shoes adjusted too tightly?	Go to **Step 6**	Go to **Step 7**
6	1. Clean and inspect the park brake shoes for excessive wear and/or damage. 2. Inspect the drum portion of the rotors for excessive wear, blueing discoloration and heat spots. 3. If any of these conditions are present, replace the affected components. 4. Adjust the park brake system. Did you find and correct a condition?	Go to **Step 14**	Go to **Step 7**
7	Inspect the park brake system for proper operation. Refer to **Park Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 14**	Go to **Step 8**
8	1. Inspect the disc brake system for the following conditions: • Binding, incorrectly installed or missing caliper hardware and/or lining hardware - Ensure free movement of linings and of caliper, if equipped with sliding type caliper • Lack of lubrication or excessive corrosion on metal to metal contact surfaces • Distorted or damaged linings • Damaged or excessively worn caliper hardware and/or lining hardware • Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 14**	Go to **Step 9**

Step	Action	Yes	No
9	1. Separate the brake booster pushrod from the brake pedal. 2. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to **Step 11**	Go to **Step 10**
10	1. Inspect the pushrod for improper positioning and/or damage. Correctly position or replace the pushrod if necessary. 2. Inspect the brake pedal assembly for damage and replace if necessary. Did you complete the repair or replacement?	Go to **Step 14**	-
11	1. For vacuum boost systems, disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the brake booster. Do not disconnect any brake pipes. 3. Inspect the brake corners to determine if the brake drag condition is still present. Do the brake corners still exhibit the brake drag condition?	Go to **Step 13**	Go to **Step 12**
12	Replace the brake booster assembly. Did you complete the replacement?	Go to **Step 14**	-
13	1. Inspect the hydraulic brake system for the following conditions. • Improper operation of caliper pistons • Contaminated brake fluid • Internally damaged flexible brake hoses; hindering brake release • Damaged or improperly operating master cylinder 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 14**	Go to **Diagnostic Starting Point - Vehicle**
14	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKE SYSTEM SLOW RELEASE

Step	Action	Yes	No
DEFINITION: Brake system releases and returns to rest slowly; vehicle motion is hindered by brake system briefly after release of brake pedal.			

Step	Action	Yes	No
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Symptoms - Hydraulic Brakes**
2	1. Inspect the hydraulic brake and assist system for the following conditions: - Improper operation of caliper pistons - Internally damaged flexible brake hoses; hindering brake release - Contaminated brake fluid - Damaged or improperly operating master cylinder - Damaged or improperly operating hydraulic booster, if equipped - Binding, bent or damaged pedal pushrod, pedal, or pedal bracket 2. Adjust, repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 4**	Go to **Step 3**
3	1. Inspect the disc brake system for the following conditions: - Damaged or excessively worn caliper hardware and/or lining hardware - Distorted or damaged linings - Lack of lubrication or excessive corrosion on metal to metal contact surfaces - Bent or damaged caliper or mounting component 2. Adjust, repair or replace components as necessary. Refer to **Disc Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 4**	Go to **Symptoms - Hydraulic Brakes**
4	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle in order to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

BRAKE FLUID LOSS

Step	Action	Yes	No
DEFINITION: Brake fluid level is low not related to lining wear.			
1	Were you sent here from the Hydraulic Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**

Step	Action	Yes	No
2	1. Inspect the following hydraulic brake system components for brake fluid leaks: • Flexible brake hose connections; threaded and bolted • Flexible brake hose crimp joints • Brake pipe fittings • Caliper piston seals • Wheel cylinder piston seals, if equipped • Master cylinder reservoir • Master cylinder reservoir low pressure hose, if equipped • Brake pressure modulator valve (BPMV) assembly, if equipped 2. Repair or replace components as necessary. Refer to **Hydraulic Brake System Diagnosis** Did you find and correct a condition?	Go to **Step 8**	Go to **Step 3**
3	Is the vehicle equipped with a vacuum brake booster?	Go to **Step 4**	Go to **Step 6**
4	1. Disconnect the vacuum check valve from the booster to relieve vacuum reserve. 2. Separate the master cylinder from the vacuum brake booster. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. 4. Inspect for brake fluid in the vacuum brake booster. Did you find a brake fluid leak?	Go to **Step 5**	Go to **Diagnostic Starting Point - Vehicle**
5	Replace the brake master cylinder and the vacuum brake booster. Did you complete the replacement?	Go to **Step 8**	-
6	1. Wipe clean the external surface of the master cylinder to hydraulic brake booster area, if equipped. 2. Separate the master cylinder from the hydraulic brake booster, if equipped. Do not disconnect any brake pipes. 3. Inspect the rear of the master cylinder for a brake fluid leak. Did you find a brake fluid leak?	Go to **Step 7**	Go to **Diagnostic Starting Point - Vehicle**
7	Replace the brake master cylinder. Did you complete the replacement?	Go to **Step 8**	-

Step	Action	Yes	No
8	1. Install or connect components that were removed or disconnected during diagnosis. 2. Road test the vehicle to confirm proper operation. Refer to **Brake System Vehicle Road Test** Is the condition still present?	Go to **Step 2**	System OK

DISC BRAKE SYSTEM DIAGNOSIS

Test Description

The numbers below refer to the step numbers on the diagnostic table:

9

Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

10

Lubricant leaks from non-brake system components may come in contact with and contaminate brake system components.

12

Disc brake rotor shields/backing plates that come in contact with disc brake rotors may cause brake system noise.

15

Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

19

Disc brake rotor thickness variation that exceeds the maximum acceptable level can cause brake pulsation.

22

Disc brake rotor assembled lateral runout (LRO) that exceeds the maximum acceptable level can lead to thickness variation.

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the DISC brake system in order to determine if the DISC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**

Step	Action	Yes	No
2	Visually inspect the disc brake pads for the following conditions: **Brake Pad Inspection** - Lining thickness below specifications - Uneven and/or abnormal wear - edge-to-edge and/or side-to-side - Looseness or damage - including pad hardware - Evidence of contamination from an external substance Did you find any conditions to indicate a concern with any of the front and/or rear disc brake pads?	Go to **Step 3**	Go to **Step 12**
3	Are any of the front and/or rear disc brake pads contaminated?	Go to **Step 8**	Go to **Step 4**
4	Are any of the front and/or rear disc brake pads worn unevenly?	Go to **Step 7**	Go to **Step 5**
5	Are any of the front and/or rear disc brake pads and/or pad hardware loose or damaged?	Go to **Step 7**	Go to **Step 6**
6	1. Remove and inspect the worn disc brake pads for glazing, looseness, heat spots or damage. 2. Replace the worn disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement** , and/or **Rear Disc Brake Pads Replacement** Did you complete the inspection and replacement?	Go to **Step 12**	-

Step	Action	Yes	No
7	**CAUTION:** **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.** **NOTE:** **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 1. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets or from the suspension knuckles and support the calipers. Refer to **Front Brake Caliper Replacement** , and/or **Rear Brake Caliper Replacement** 2. Inspect the disc brake caliper mounting bracket and the mounting/sliding hardware for the following conditions: **Front Disc Brake Mounting and Hardware Inspection** , and/or **Rear Disc Brake Mounting and Hardware Inspection** • Binding or seized hardware • Worn, damaged or missing hardware components • Loose, bent, cracked, or damaged caliper mounting bracket 3. Replace components as required. Refer to the following procedures, as required: • **Front Brake Caliper Bracket Replacement** • **Rear Brake Caliper Bracket Replacement** 4. Replace the unevenly-worn, loose or damaged disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement** , and/or **Rear Disc Brake Pads Replacement** Did you complete the inspection and replacement?	Go to **Step 12**	-

Step	Action	Yes	No
8	1. Inspect the disc brake calipers, brake hoses and brake pipes for evidence of an external brake fluid leak. 2. Replace any components found to be leaking brake fluid. Refer to the following procedures as required: - **Front Brake Caliper Replacement** - **Rear Brake Caliper Replacement** - **Front Brake Hose Replacement** - **Rear Brake Hose Replacement** - **Brake Pipe Replacement** Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	Go to **Step 9**
9	1. Inspect the wheel drive shaft outer seals for damage and evidence of a grease leak. 2. Replace any wheel drive shaft seal that is found to be leaking grease which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	Go to **Step 10**
10	1. Inspect the automatic transmission cooling system lines, if equipped, for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 2. Inspect the power steering system hoses for damage and evidence of an external fluid leak which may be the source of the contamination to the pads. 3. Replace any components found to be leaking fluid which may be the source of the contamination to the pads. Did you find and correct the source of the leak causing contamination of the pads?	Go to **Step 11**	-

Step	Action	Yes	No
11	1. Clean the remaining disc brake system components to remove any traces of the contaminant. **CAUTION:** **Support the brake caliper with heavy mechanic wire, or equivalent, whenever it is separated from its mount and the hydraulic flexible brake hose is still connected. Failure to support the caliper in this manner will cause the flexible brake hose to bear the weight of the caliper, which may cause damage to the brake hose and in turn may cause a brake fluid leak.** **NOTE:** **Do NOT disconnect the hydraulic brake flex hoses from the calipers.** 2. Remove the front and/or rear disc brake calipers, as appropriate, from the mounting brackets and support the calipers. Refer to **Front Brake Caliper Replacement** , and/or **Rear Brake Caliper Replacement** 3. Inspect the disc brake caliper mounting/sliding hardware for the following conditions: **Front Disc Brake Mounting and Hardware Inspection** , and/or **Rear Disc Brake Mounting and Hardware Inspection** - Binding or seized hardware - Distorted, worn, damaged or missing hardware components 4. Replace the caliper mounting/sliding hardware components as required. 5. Replace the contaminated disc brake pads as a complete axle set. Refer to **Front Disc Brake Pads Replacement** , and/or **Rear Disc Brake Pads Replacement** Did you complete the cleaning, inspection and replacement?	Go to **Step 12**	-
12	Visually inspect each of the rear disc brake rotor shields/backing plates, if equipped, for evidence of contact with the brake rotors. Are any of the brake rotor shields/backing plates contacting the brake rotors?	Go to **Step 13**	Go to **Step 14**
13	Repair or replace the disc brake rotor shields/backing plates as required. Refer to **Front Brake Shield Replacement** , or **Rear Brake Shield Replacement** Did you complete the repair or replacement?	Go to **Step 14**	-

Step	Action	Yes	No
14	1. Check the thickness of each of the disc brake rotors. **NOTE:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor can be REFINISHED and REMAIN ABOVE the minimum requirements. Refer to **Brake Rotor Thickness Measurement** Does the disc brake rotor meet the minimum requirements for REFINISHING?	Go to **Step 15**	Go to **Step 18**
15	**NOTE:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to **Brake Rotor Thickness Variation Measurement** Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to **Step 17**	Go to **Step 16**
16	1. Inspect each of the disc brake rotors for the following surface and wear conditions: **Brake Rotor Surface and Wear Inspection** - Heavy rust and/or pitting - Cracks and/or heat spots - Excessive blueing discoloration - Deep or excessive scoring beyond maximum acceptable level **NOTE:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor requires refinishing based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires refinishing. Does the brake rotor require REFINISHING?	Go to **Step 17**	Go to **Step 22**

Step	Action	Yes	No
17	1. Refinish the brake rotor. Refer to **Brake Rotor Refinishing** 2. Inspect the brake rotor thickness. Refer to **Brake Rotor Thickness Measurement** Were you able to REFINISH the brake rotor within the minimum requirements?	Go to **Step 22**	Go to **Step 21**
18	Is the brake rotor at or below the DISCARD requirements?	Go to **Step 21**	Go to **Step 19**
19	**NOTE:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for thickness variation that exceeds the maximum acceptable level. Refer to **Brake Rotor Thickness Variation Measurement** Does the brake rotor exhibit thickness variation that exceeds the maximum acceptable level?	Go to **Step 21**	Go to **Step 20**
20	1. Inspect each of the disc brake rotors for the following surface and wear conditions: **Brake Rotor Surface and Wear Inspection** - Heavy rust and/or pitting - Cracks and/or heat spots - Excessive blueing discoloration - Deep or excessive scoring beyond maximum acceptable level **NOTE:** **Make the following determination AND ANSWER the question INDIVIDUALLY for EACH rotor.** 2. Make a determination for each brake rotor if the rotor requires replacement based upon the results of the inspection. If the brake rotor exhibits any of the conditions listed previously, it requires replacement. Does the brake rotor require REPLACEMENT?	Go to **Step 21**	Go to **Step 22**
21	**NOTE:** **Whenever a brake rotor is replaced, the assembled lateral runout (LRO) of the rotor must be measured to ensure optimum performance of the disc brakes.** Replace the brake rotor. Refer to **Front Brake Rotor Replacement** , or **Rear Brake Rotor Replacement** Did you complete the replacement?	Go to **Step 24**	-

Step	Action	Yes	No
22	**NOTE:** **Perform the following inspection AND ANSWER the question INDIVIDUALLY for EACH rotor.** Inspect each of the disc brake rotors for assembled LRO that exceeds the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout Measurement** Does the brake rotor exhibit assembled LRO that exceeds the maximum acceptable level?	Go to **Step 23**	Go to **Step 24**
23	Correct the LRO for each brake rotor that was determined to have LRO exceeding the maximum acceptable level. Refer to **Brake Rotor Assembled Lateral Runout Measurement** Did you complete the operation?	Go to **Step 24**	-
24	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Disc Brake System OK Return to Symptom Table	-

HYDRAULIC BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the HYDRAULIC brake system in order to determine if the HYDRAULIC brake system is operating properly. You will be directed by the appropriate Symptom table to go to other brake system diagnostic tables as appropriate.			
1	Were you sent here from a Brake Symptom table?	Go to **Step 2**	Go to **Symptoms - Hydraulic Brakes**
2	Inspect and adjust the brake fluid level in the brake master cylinder. Refer to **Master Cylinder Reservoir Filling** Was the brake fluid level low?	Go to **Step 3**	Go to **Step 4**
3	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination: • Fluid separation, indicating two types of fluid are present • Swirled appearance - oil-based substance • Layered appearance - silicone-based substance • Fluid discoloration • Cloudy appearance - moisture • Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust 2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination. Do any of the above conditions exist?	Go to **Step 5**	Go to **Step 6**

Step	Action	Yes	No

4	1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
	• Fluid separation, indicating two types of fluid are present
	  • Swirled appearance - oil-based substance
	  • Layered appearance - silicone-based substance
	• Fluid discoloration
	  • Cloudy appearance - moisture
	  • Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust
	2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating fluid contamination.
	Do any of the above conditions exist?
		Go to **Step 5**	Go to **Step 12**

Step	Action	Yes	No

5	1. Flush the hydraulic brake system. Refer to **Hydraulic Brake System Flushing**
	2. If the brake fluid WAS contaminated with an oil-based or a silicone-based fluid, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following steps. Refer to the procedures indicated.
	  1. Remove ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated.
	  2. Clean out the hydraulic brake pipes using denatured alcohol, or equivalent.
	  3. Dry the brake pipes using non-lubricated, filtered air.
	  4. Repair or replace ALL of the following components listed. Each component contains internal rubber seals/linings which have been contaminated.
	    - Replace the brake master cylinder reservoir cap diaphragm.
	    - **Master Cylinder Replacement**
	    - Brake master cylinder reservoir: Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air, or if necessary, replace the brake master cylinder reservoir.
	    - **Front Brake Hose Replacement**
	    - **Rear Brake Hose Replacement**
	    - **Front Brake Caliper Overhaul** , **Front Brake Caliper Replacement**
	    - **Rear Brake Caliper Replacement**
	    - **Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement**
	3. If the brake fluid was NOT contaminated with an oil-based fluid, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap diaphragm which may have allowed moisture or dirt to enter the system.
	4. Refill and bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding**
	Did you complete the operation and any required repairs and/or replacements?
		Go to **Step 9**	-

Step	Action	Yes	No
6	1. Inspect the following hydraulic brake system components for external fluid leaks. Repair or replace any of the components found to be leaking brake fluid. Refer to the appropriate procedures: - Brake master cylinder reservoir cap diaphragm - Refer to **Master Cylinder Replacement** - Refer to **Front Brake Hose Replacement** - Refer to **Rear Brake Hose Replacement** - Refer to **Brake Pipe Replacement** - Refer to **Front Brake Caliper Overhaul** , **Front Brake Caliper Replacement** - Refer to **Rear Brake Caliper Replacement** - Refer to **Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement** 2. If you repaired or replaced any of the brake system components listed, bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding** While bleeding the hydraulic brake system, observe for the following conditions: - The presence of air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced - An unrestricted and even flow of brake fluid per axle during the bleeding procedure Did you find and correct a condition?	Go to **Step 7**	Go to **Step 12**
7	Was there air in the system at a bleeder valve location other than at the repair location, except if the brake master cylinder, and/or the proportioning valve assembly, was replaced?	Go to **Step 19**	Go to **Step 8**
8	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 9**	Go to **Step 10**
9	Inspect the hydraulic function of the brake calipers and/or wheel cylinders, if equipped for proper operation. Refer to **Hydraulic Brake Component Operation Visual Inspection** Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to **Step 21**	Go to **Step 14**
10	Was the flow of brake fluid restricted or uneven through front axle hydraulic components during the bleeding procedure?	Go to **Step 13**	Go to **Step 11**
11	Was the flow of brake fluid restricted or uneven through rear axle hydraulic components during the bleeding procedure?	Go to **Step 17**	-
12	Inspect the hydraulic function of the brake calipers/wheel cylinders for proper operation. Refer to **Hydraulic Brake Component Operation Visual Inspection** Was the hydraulic function of the brake calipers/wheel cylinders operating properly?	Go to **Step 15**	Go to **Step 13**

Step	Action	Yes	No
13	Determine if the brake caliper is restricting the flow of brake fluid and/or not operating properly: 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Remove the tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** 3. Open the suspected caliper bleeder valve. 4. Using a large C-clamp, compress the caliper piston and observe for an unrestricted flow of brake fluid and for free movement of the caliper piston. 5. Close the caliper bleeder valve. Was the flow of brake fluid unrestricted and did the caliper piston move freely?	Go to **Step 17**	Go to **Step 14**
14	Repair or replace any brake caliper/wheel cylinder that was not operating properly. - Refer to **Front Brake Caliper Overhaul** , **Front Brake Caliper Replacement** - Refer to **Rear Brake Caliper Replacement** Did you complete the repair and/or replacement?	Go to **Step 21**	-
15	Bleed the hydraulic brake system to observe for the presence of air in the system and to observe for an unrestricted and even flow of brake fluid per axle during the bleeding procedure. Refer to **Hydraulic Brake System Bleeding** Was there air in the system?	Go to **Step 19**	Go to **Step 16**
16	Was the flow of brake fluid unrestricted and even per axle during the bleeding procedure?	Go to **Step 21**	Go to **Step 17**
17	1. Inspect the hydraulic brake pipes and flexible brake hoses for signs of a fluid restriction; such as being bent, kinked, pinched or damaged. Refer to **Brake Pipe and Hose Inspection** 2. Replace any of the hydraulic brake pipes and/or flexible brake hoses found to be bent, kinked, pinched, or damaged. - Refer to **Front Brake Hose Replacement** - Refer to **Rear Brake Hose Replacement** - Refer to **Brake Pipe Replacement** 3. If none of the hydraulic brake pipes or flexible brake hoses were visibly bent, kinked, pinched, or damaged, replace the hydraulic brake flex hose at the restricted location. Did you find and correct a condition?	Go to **Step 21**	Go to **Step 18**
18	Replace the brake modulator assembly, in order to correct the hydraulic brake dynamic rear proportioning mechanical operation. Refer to **Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement** Did you complete the replacement?	Go to **Step 21**	-

Step	Action	Yes	No
19	1. Inspect the hydraulic brake system components for brake fluid seepage at a seal and/or fitting location, which may have drawn air into the system. 2. Inspect the hydraulic brake system components for evidence of a recent repair, which may have introduced air into the system. 3. Repair or replace any of the components found to be installed incorrectly or seeping brake fluid. Did you find and correct a condition?	Go to **Step 21**	Go to **Step 20**
20	1. Inspect the brake master cylinder for internal fluid leaks. Refer to **Brake System Internal Leak Test** 2. Repair or replace the brake master cylinder if it is found to be leaking brake fluid internally. Refer to **Master Cylinder Replacement** Did you find and correct a condition?	Go to **Step 21**	Return to Symptom Table
21	Install or connect components that were removed or disconnected during diagnosis. Did you complete the operation?	Hydraulic Brake System OK Return to Symptom Table	-

BRAKE SYSTEM VEHICLE ROAD TEST

Preliminary Inspections

1. Visually inspect easily accessible brake system components for obvious damage and/or leaks which may indicate that the vehicle should not be driven until further inspections have been completed.
2. Inspect the brake master cylinder reservoir fluid level and adjust only if necessary for brake system road testing. Refer to **Master Cylinder Reservoir Filling**
3. Inspect the tire inflation pressures and adjust as necessary.
4. Inspect the tire tread patterns to ensure that they are the same or very similar, especially per axle.
5. Ensure that the vehicle is not loaded unevenly prior to brake system road testing.

Road Testing Procedure

WARNING: **Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.**

1. Start the engine and allow it to idle.
2. Check to see if the brake system warning lamp remains illuminated.
3. If the brake system warning lamp remains illuminated, DO NOT proceed to test drive the vehicle until it is diagnosed and repaired. Refer to **Symptoms - Hydraulic Brakes**
4. Select a smooth, dry, clean and level road or large lot that is as free of traffic and obstacles as possible for brake system low speed road testing.
5. With the transmission in PARK, lightly apply the brake pedal. Observe both the pedal feel and the pedal travel.
6. If the brake pedal apply felt spongy, or the pedal travel was excessive, DO NOT drive the vehicle until it is repaired.
7. If the brake pedal apply did not feel spongy and the pedal travel was not excessive, proceed to step 8.

8. Release and apply the brakes.
9. While continuing to apply the brakes, shift the transmission into DRIVE, release the brakes and allow the engine to idle the vehicle away from the stopped position. Observe for a slow release of the brake system.
10. With the aid of an assistant to observe the vehicle's performance from outside of the vehicle, drive the vehicle at a low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to them, while you observe both the pedal effort and the pedal travel.
11. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
12. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 13.
13. Drive the vehicle in the opposite direction, at the same low speed and lightly apply the brakes while driving past the assistant. Have the assistant observe for brake system noise from the side of the vehicle closest to him.
14. Drive the vehicle at a low speed and shift the transmission into NEUTRAL without applying the brakes. Observe for a rapid deceleration in vehicle speed, indicating possible brake drag.
15. Select a smooth, dry, clean and level road that is as free of heavy traffic as possible for brake system moderate speed road testing.
16. Drive the vehicle at a moderate speed. Observe for a pull and/or incorrect tracking of the vehicle without the brakes applied.
17. While continuing to drive the vehicle at a moderate speed, perform several light applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system noise, pulsation and/or brake drag.
18. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.
19. If the brake pedal apply effort was not excessive and the pedal travel was not excessive, proceed to step 20.
20. While continuing to drive the vehicle at a moderate speed, perform several moderate applies of the brakes. Observe the pedal effort and the pedal travel, observe for brake system pulsation and/or uneven braking action - either side to side, or front to rear.

    A small amount of vehicle front end dip is expected during a moderate apply of the brakes.

21. If the brake pedal apply effort was excessive, or the pedal travel was excessive, DO NOT continue to test drive the vehicle until it is repaired.

BRAKE PEDAL TRAVEL MEASUREMENT AND INSPECTION

NOTE: **The brake corners must be cool to obtain the most accurate measurement.**

1. Install a scan tool to the vehicle.
2. Place the power button in the Service Only Mode without applying the brake pedal.
3. Using the scan tool, perform the following steps:
    1. Select Diagnostics
    2. Enter the VIN
    3. Select Electronic Brake Control Module (EBCM)
    4. Select Data Display
    5. Scroll through the Data List, select Brake Pressure
4. While observing the master cylinder pressure on the scan tool data display, using moderate speed and moderate effort, apply the brake pedal to a force of 5000 kPa (725 psi) and maintain this pedal force.
5. Select Brake Boost Control Module.
6. Select Data Display.
7. Scroll through the Data List, select Output Rod Position.

8. Record the distance displayed on the scan tool that the brake pedal has travelled at a pedal apply force of 5000 kPa (725 psi).
9. Release the brake pedal.

   Specification

   Maximum brake pedal travel: 18 mm (0.71 in)

BRAKE SYSTEM EXTERNAL LEAK INSPECTION

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. In order to inspect for external brake fluid leaks, first check the fluid level in the master cylinder.

   While a slight brake fluid level drop can be considered a normal condition due to brake lining wear, a very low level may indicate a brake fluid leak in the hydraulic system.

   If the fluid level is abnormally low, adjust the brake fluid level. Refer to **Master Cylinder Reservoir Filling**

2. Start the engine and allow it to idle.
3. Apply constant, moderate foot pressure to the brake pedal.

   If the brake pedal gradually falls away while under foot pressure, there may be a brake fluid leak.

4. Turn OFF the ignition.
5. Visually inspect the following brake system components for brake fluid leaks, excessive corrosion, and damage. Give particular attention to all brake pipe and flexible hose connections to ensure that there are not any slight brake fluid leaks - even though the brake pedal may feel firm and hold steady:
   - Master cylinder brake pipe fittings
   - All brake pipe connections
   - Brake pipes
   - Brake hoses and connections
   - Brake calipers and/or wheel cylinders, if equipped
6. While slight dampness around the master cylinder reservoir can be considered acceptable, brake fluid leaking from any of the brake system components requires immediate attention. If any of these components exhibit signs of brake fluid leakage, repair or replace those components. After the repair or replacement, reinspect the hydraulic brake system to assure proper function.

BRAKE SYSTEM INTERNAL LEAK TEST

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Ensure is ignition is OFF for at least 60 seconds to allow the system to depressurize and deplete the power reserve.
2. Apply the brake pedal several times to verify the power reserve is fully depleted.
3. Apply light, steady pressure to the brake pedal. Observe both the brake pedal feel and travel.
4. Release the brake pedal.
5. If the brake pedal apply felt spongy, but the brake pedal travel was not excessive, perform the following steps:
   1. Inspect the brake system for external leaks. Refer to **Brake System External Leak Inspection**

2. Pressure bleed the brake system in order to purge any air that may be trapped in the system. Refer to **Hydraulic Brake System Bleeding**

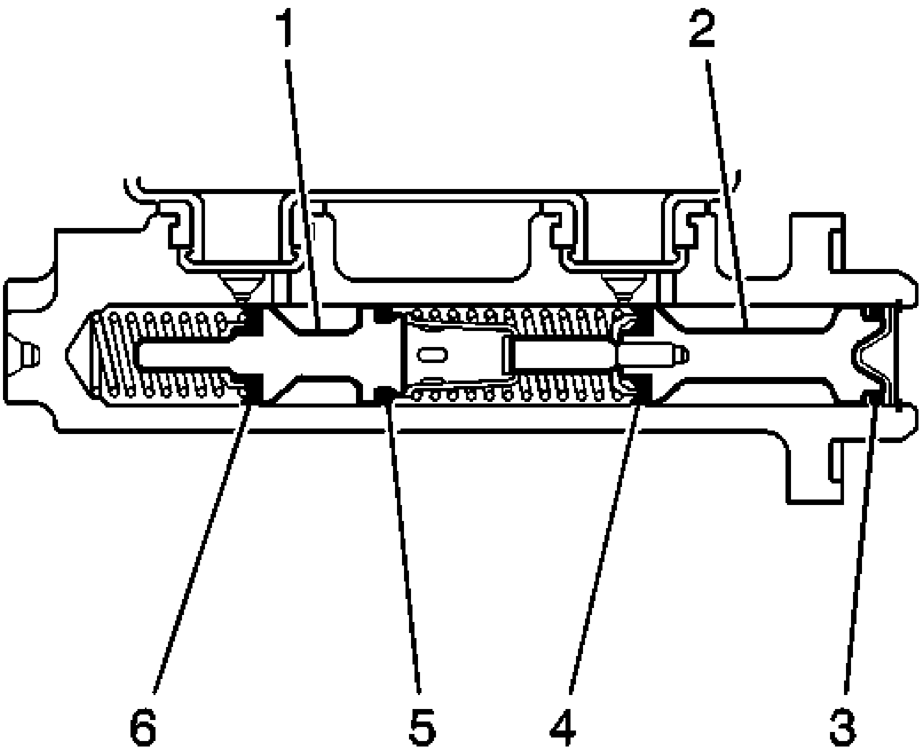


Fig. 2: Cross Sectional View Of Brake Master Cylinder And Components
Courtesy of GENERAL MOTORS COMPANY

6. If the brake pedal apply did not feel spongy, but the brake pedal travel was excessive, perform the following steps:
    1. Loosen the master cylinder-to-adapter mounting nuts.
    2. Carefully pull the master cylinder away from the adapter just enough to inspect the mounting surface of the master cylinder.
    3. Inspect the master cylinder mounting surface at the primary piston (2) for brake fluid leaks.
7. If the master cylinder exhibits any leakage around the primary piston (2), then the primary piston primary seal (4) and/or secondary seal (3) is leaking and the master cylinder requires replacement.
8. If the master cylinder primary piston (2) does not exhibit any leakage, install the master cylinder to the adapter and pressure bleed the brake system. Refer to **Hydraulic Brake System Bleeding**
9. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, but then gradually fell, then the master cylinder requires replacement due to an internal leak past a piston seal.
10. If the brake pedal apply did not feel spongy, and the brake pedal travel was initially steady and not excessive, then fell slightly, then became steady again, then the brake pressure modulator valve (BPMV) may be leaking internally, and may require replacement.

HYDRAULIC BRAKE COMPONENT OPERATION VISUAL INSPECTION

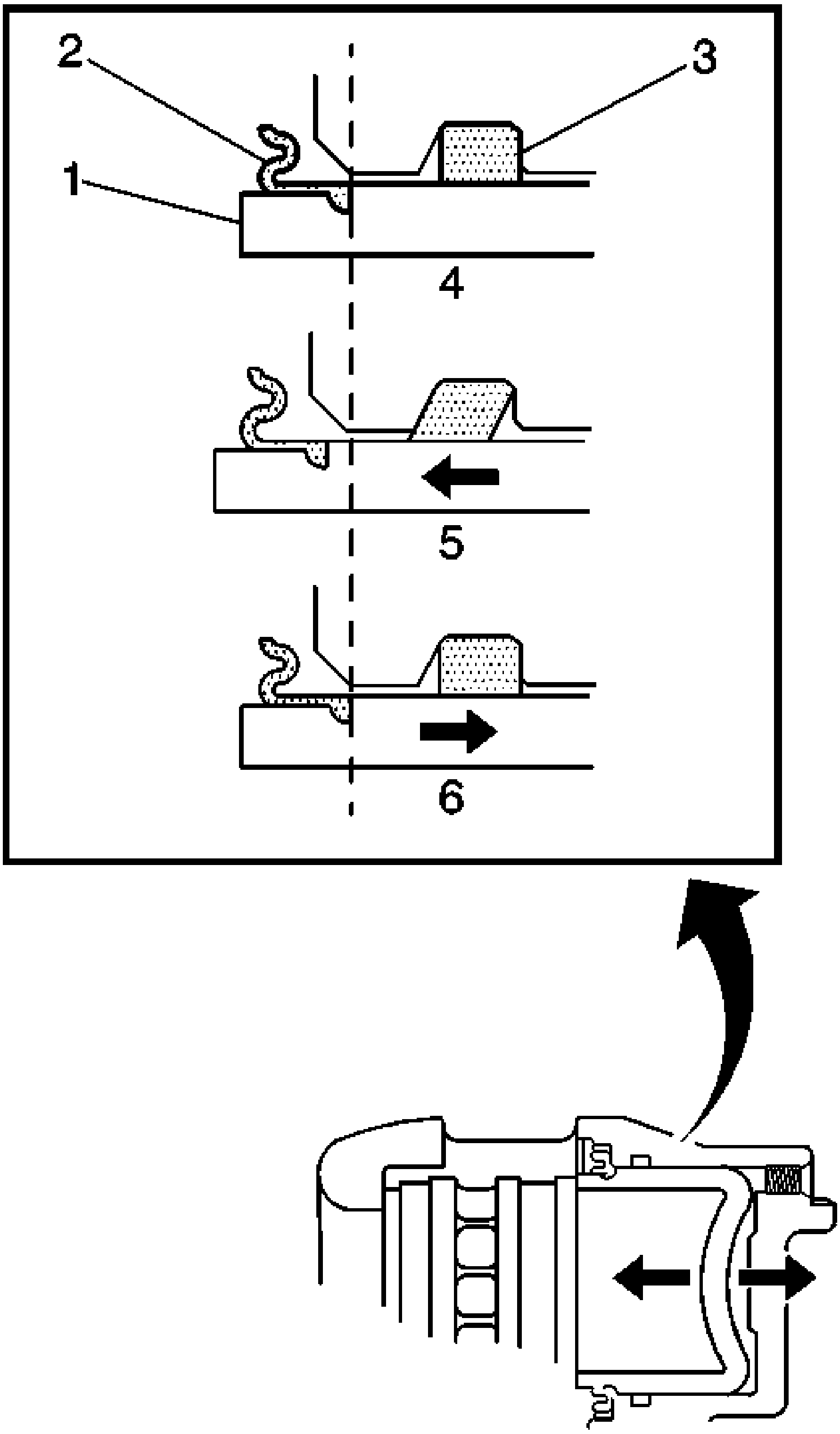


Fig. 3: Brake Caliper/Pad Inspection Areas
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. With the tire and wheel assemblies removed and the brake rotors retained by wheel lug nuts, visually inspect the caliper piston dust boot (2) sealing area to ensure that there are no brake fluid leaks.
2. If any evidence of a brake fluid leak is present, the brake caliper requires overhaul or replacement.
3. While the brake system is at rest (4), observe the position of the caliper piston (1) in relation to the caliper housing.

4. Have an assistant apply and release the brake pedal several times while you observe the operation of the hydraulic brake caliper.
    1. Observe the caliper piston (1) for unrestricted and even movement during each apply of the brake system (5).
    2. Observe the caliper piston (1) for an unrestricted and even return motion during each release of the brake system (6).
5. If the caliper piston (1) did not exhibit unrestricted and even movement during brake system apply and/or release, the piston square seal (3) may be worn or damaged and the caliper may require overhaul or replacement.

BRAKE PIPE AND HOSE INSPECTION

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Visually inspect all of the brake pipes for the following conditions:
    - Kinks, improper routing, missing or damaged retainers, Leaking fittings, excessive corrosion
2. If any of the brake pipes exhibited any of the conditions listed, then the identified pipe, or pipes, require replacement.
3. Ensure that the vehicle axles are properly supported at ride height in order to maintain the proper relationship of the flexible brake hoses to the chassis.

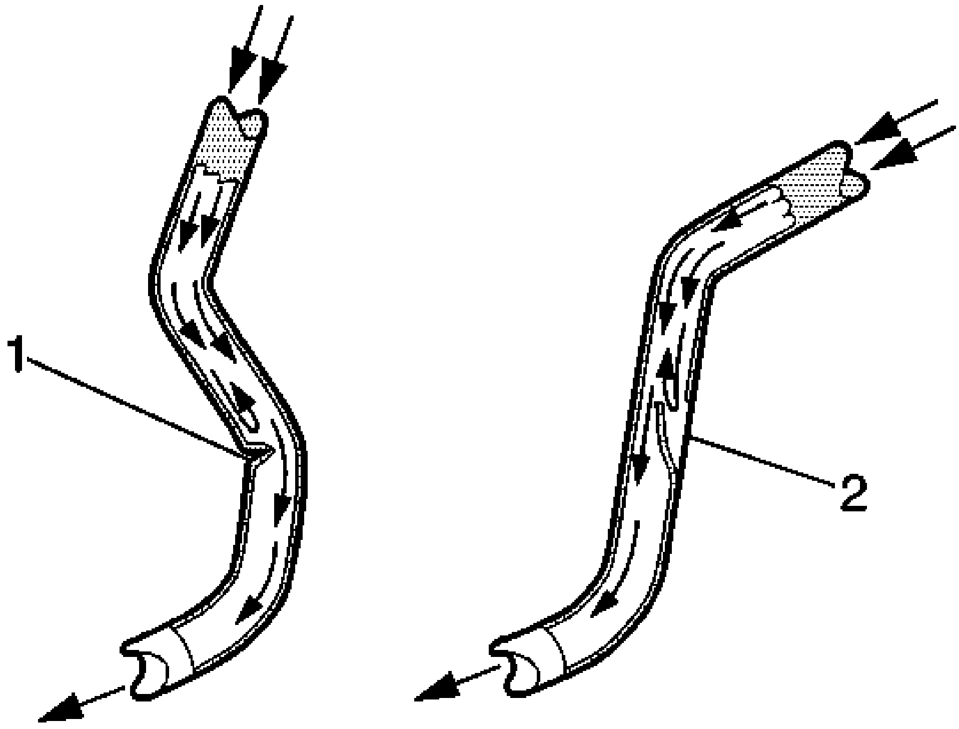


Fig. 4: Flexible Brake Hose Failure Conditions
Courtesy of GENERAL MOTORS COMPANY

4. Visually inspect all of the flexible brake hoses for the following conditions:
    - Kinks (1), improper routing, twists, chafing, missing or damaged retainers

- Leaking connections, cracking, dry-rot, blisters, bulges

5. If any of the flexible brake hoses exhibited any of the conditions listed, then the identified flexible brake hose, or hoses require replacement.
6. Tightly press the flexible brake hose with fingers to check whether there are any spongy spots (2) (which indicates the existence of interior blocking). Inspect the entire length of each hose.
7. If any of the flexible brake hoses were found to have soft spots (2), then the identified flexible brake hose, or hoses require replacement.

BRAKE PEDAL PUSHROD INSPECTION

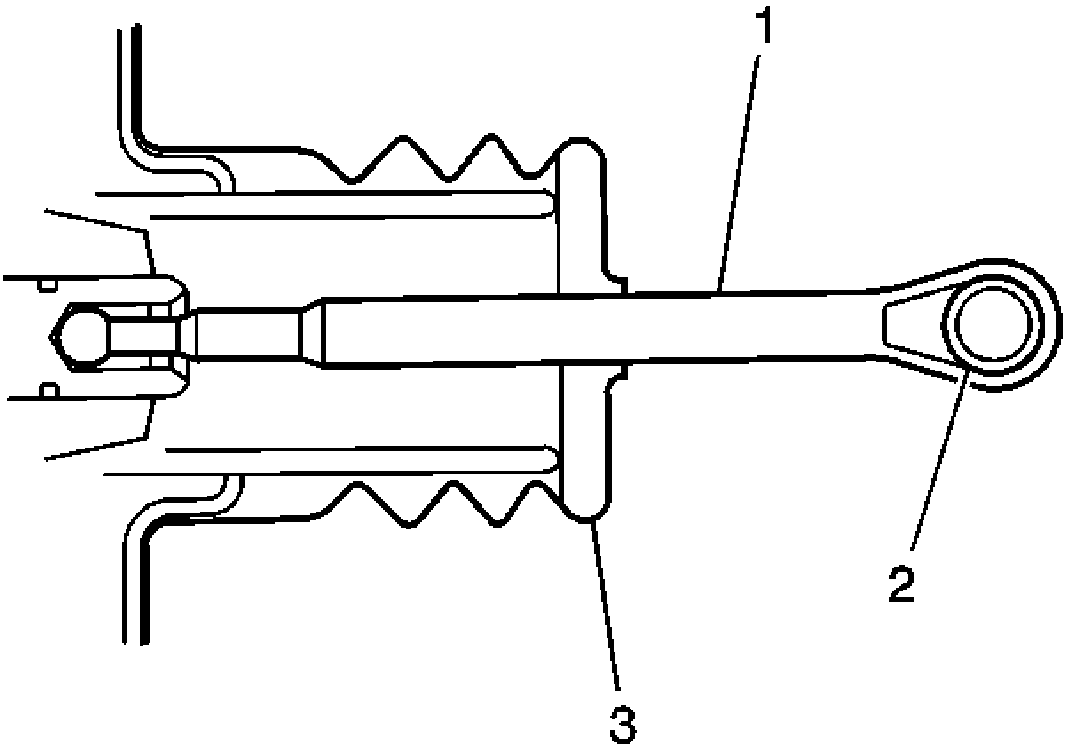


Fig. 5: Brake Pedal Pushrod, Eyelet Bushing And Boot
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the brake pedal pushrod (1) from the brake pedal.
2. Inspect the brake pedal pushrod eyelet bushing (2), if equipped, for cracks and/or excessive wear.
3. Reposition the pedal pushrod boot (3) toward the front of the vehicle to expose as much of the pedal pushrod (1) as possible.
4. Inspect the brake pedal pushrod (1) for straightness.
5. If the brake pedal pushrod eyelet bushing (2) exhibited cracks and/or excessive wear, then the bushing requires replacement.
6. If the brake pedal pushrod (1) is not straight, then the pushrod requires replacement.
7. Return the pedal pushrod boot (3) to its original position on the pedal pushrod (1).
8. Connect the brake pedal pushrod (1) to the brake pedal.

REPAIR INSTRUCTIONS

HYDRAULIC BRAKE FLUID REPLACEMENT

WARNING: **Refer to Brake Fluid Irritant Warning**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution**

CAUTION: **Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.**

1. With the engine OFF, apply and release the brake pedal several times until the pedal effort becomes firm to deplete the brake booster power reserve.
2. Clean the outer surface of the master cylinder brake fluid reservoir, on and around the reservoir cap, prior to removing the cap and diaphragm. Refer to **Master Cylinder Reservoir Filling**
3. Fill the master cylinder brake fluid reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Adhesives, Fluids, Lubricants, and Sealers**
4. Maintain the brake fluid level in the master cylinder brake fluid reservoir to between the minimum and maximum-fill level during the brake fluid replacement procedure.
5. Following the hydraulic brake system bleeding procedure, bleed each of the hydraulic brake wheel circuits until clean, clear brake fluid is observed coming from each bleeder valve. Refer to **Hydraulic Brake System Bleeding**
6. Fill the master cylinder brake fluid reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Master Cylinder Reservoir Filling**
7. Securely install the master cylinder brake fluid reservoir diaphragm and cap.
8. Slowly apply and release the brake pedal, observing the brake pedal feel.
9. If the brake pedal feels spongy, perform the following:
    1. Visually inspect the hydraulic brake system for external leaks. Refer to **Brake System External Leak Inspection**
    2. Using a scan tool, perform the antilock brake system automated bleed procedure to remove any air that may have become trapped in the brake pressure modulator valve (BPMV). Refer to **Antilock Brake System Automated Bleed**

MASTER CYLINDER RESERVOIR FILLING

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Visually inspect the brake fluid level through the brake master cylinder reservoir.
2. If the brake fluid level is at or below the half-full point during routine fluid checks, the brake system should be inspected for wear and possible brake fluid leaks.
3. If the brake fluid level is at or below the half-full point during routine fluid checks, and an inspection of the brake system did not reveal wear or brake fluid leaks, the brake fluid may be topped-off up to the maximum-fill level.
4. If brake system service was just completed, the brake fluid may be topped-off up to the maximum-fill level.
5. If the brake fluid level is above the half-full point, adding brake fluid is not recommended under normal conditions.

6. If brake fluid is to be added to the master cylinder reservoir, clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
7. Use only GM approved brake fluid from a clean, sealed brake fluid container. Refer to Adhesives, Fluids, Lubricants, and Sealers.

MASTER CYLINDER RESERVOIR REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

WARNING: **Use of eye goggles is necessary to prevent personal injury.**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Using an appropriate siphon device, remove as much brake fluid from the reservoir as possible.
2. Place absorbent towels beneath the reservoir to catch any residual fluid.
3. Remove Engine Control Module @ Vehicle. Refer to Engine Control Module Replacement

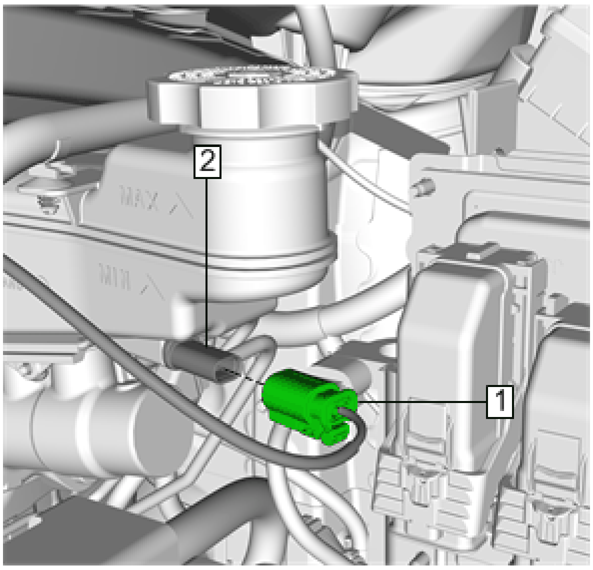


Fig. 6: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

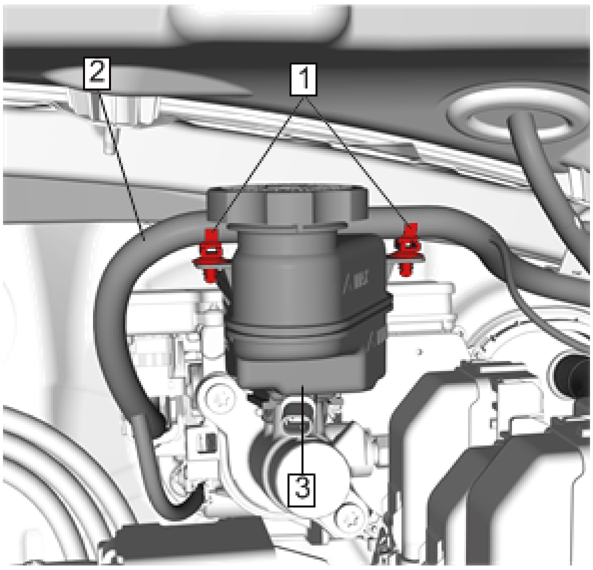


Fig. 7: Brake Master Cylinder Reservoir, Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

5. Unclip Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)

6. Reposition Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)

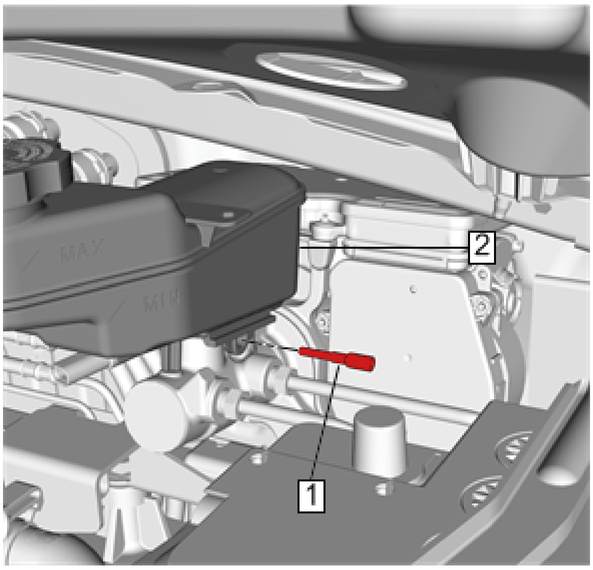


Fig. 8: Brake Master Cylinder Reservoir And Pin
Courtesy of GENERAL MOTORS COMPANY

7. Remove Brake Master Cylinder Reservoir Pin (1) @ Brake Master Cylinder Reservoir (3)

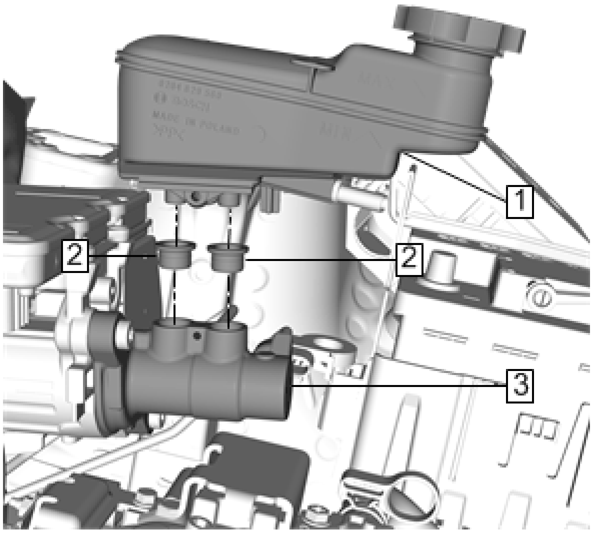


Fig. 9: Brake Master Cylinder, Reservoir And Seals
Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Master Cylinder Reservoir (1)@ Brake Master Cylinder (3)
9. Remove and DISCARD Brake Master Cylinder Reservoir Seals (2) (Qty: 2) @ Brake Master Cylinder (3)
10. Remove Brake Fluid Level Indicator Switch @ Brake Master Cylinder Reservoir. Refer to **Brake Fluid Level Indicator Switch Replacement**

Installation Procedure

1. Install Brake Fluid Level Indicator Switch @ Brake Master Cylinder Reservoir. Refer to **Brake Fluid Level Indicator Switch Replacement**

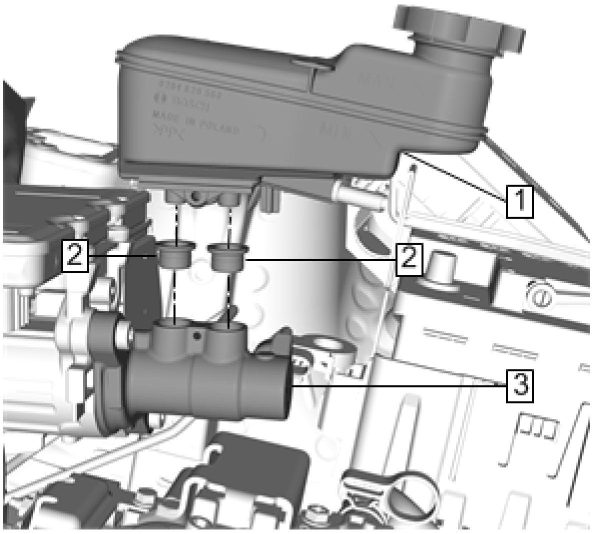


Fig. 10: Brake Master Cylinder, Reservoir And Seals
Courtesy of GENERAL MOTORS COMPANY

2. Lubricate the brake master cylinder reservoir seals with GM approved brake fluid from a clean, sealed, brake fluid container.
3. Install NEW Brake Master Cylinder Reservoir Seals (2) (Qty: 2) @ Brake Master Cylinder (3)
4. Install Brake Master Cylinder Reservoir (1) @ Brake Master Cylinder (3)

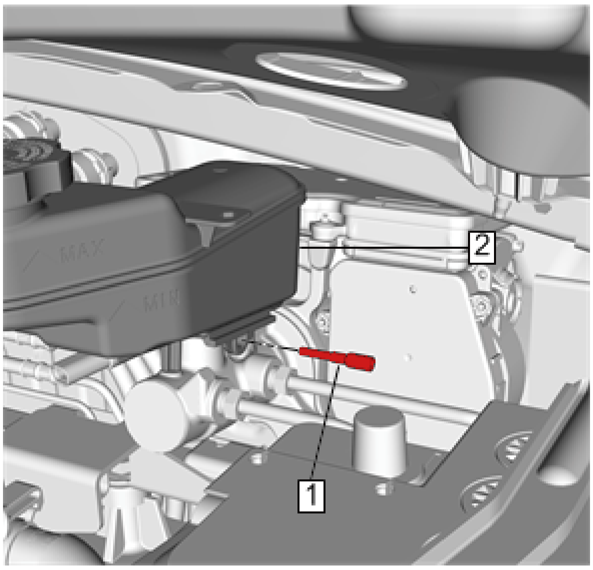


Fig. 11: Brake Master Cylinder Reservoir And Pin
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

5. Install and tighten Brake Master Cylinder Reservoir Pin (1) @ Brake Master Cylinder Reservoir (3) to 7 N.m (62 lb in)

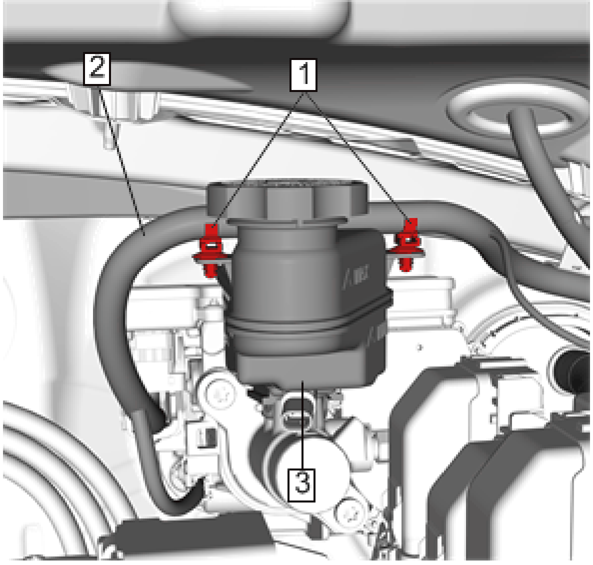


Fig. 12: Brake Master Cylinder Reservoir, Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

6. Install Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)
7. Install Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)

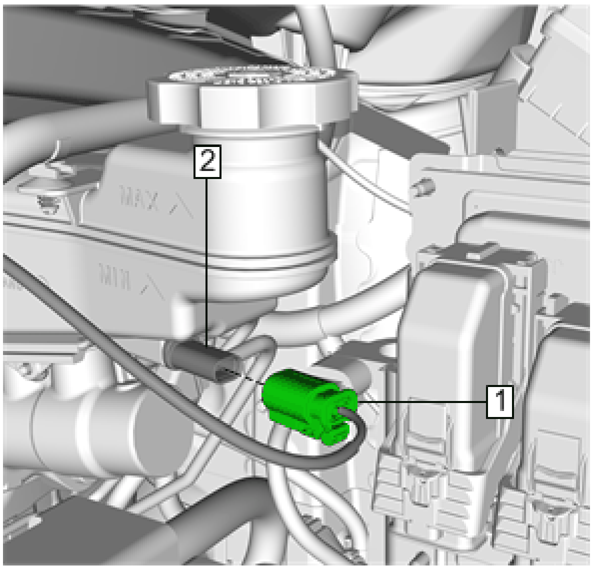


Fig. 13: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Connect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)
9. Install Engine Control Module @ Vehicle. Refer to **Engine Control Module Replacement**
10. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding**

MASTER CYLINDER REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

WARNING: **Use of eye goggles is necessary to prevent personal injury.**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Remove Engine Control Module @ Vehicle. Refer to **Engine Control Module Replacement**

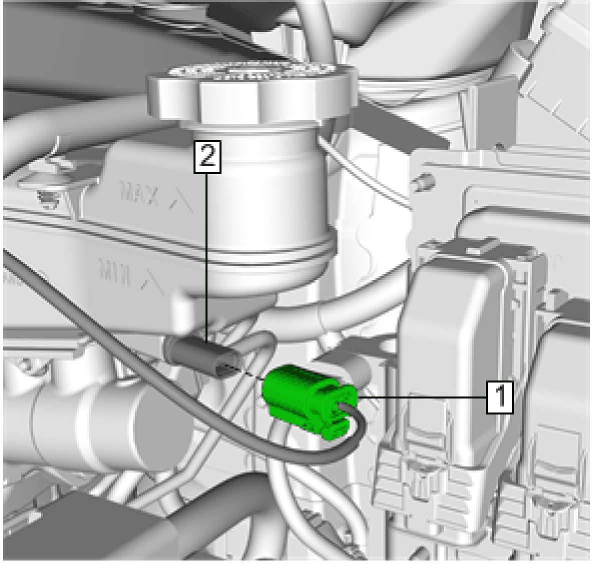


Fig. 14: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

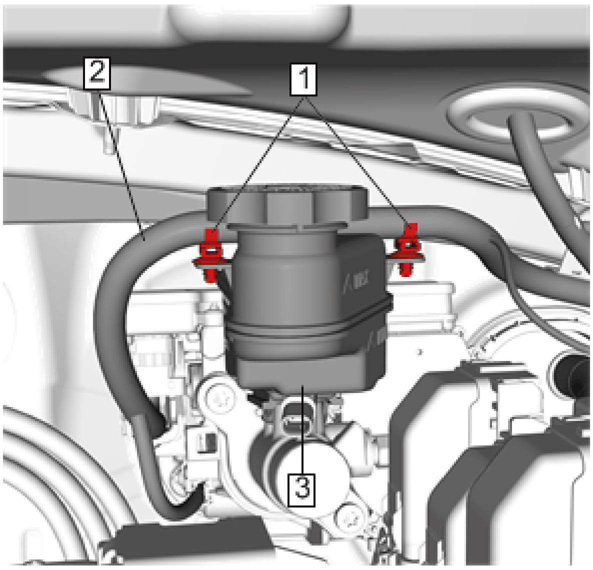


Fig. 15: Brake Master Cylinder Reservoir, Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

3. Unclip Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)
4. Reposition Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)

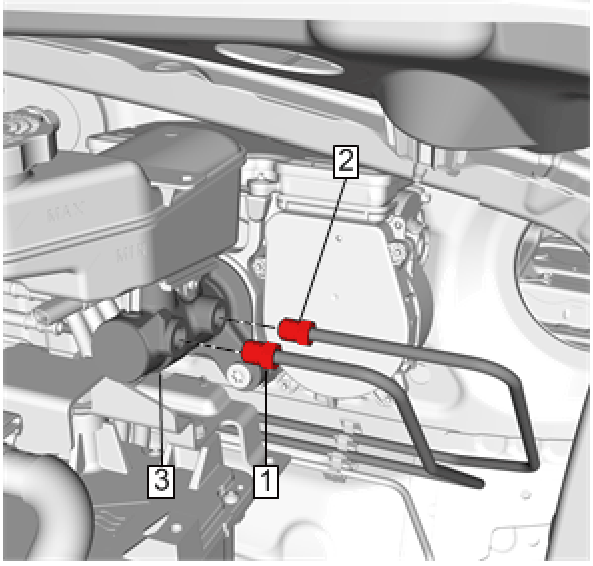


Fig. 16: BPMV Front And Rear Pipe Fittings At Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fittings to prevent brake fluid loss and contamination.**

5. Remove Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (3)
6. Remove Brake Pressure Modulator Valve Rear Pipe Fitting (2) @ Brake Master Cylinder (3)

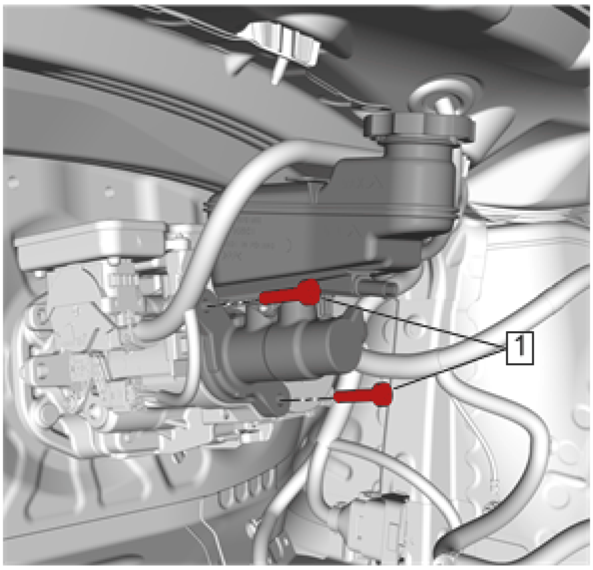


Fig. 17: Brake Master Cylinder Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove Brake Master Cylinder Bolts (1) (Qty: 2)

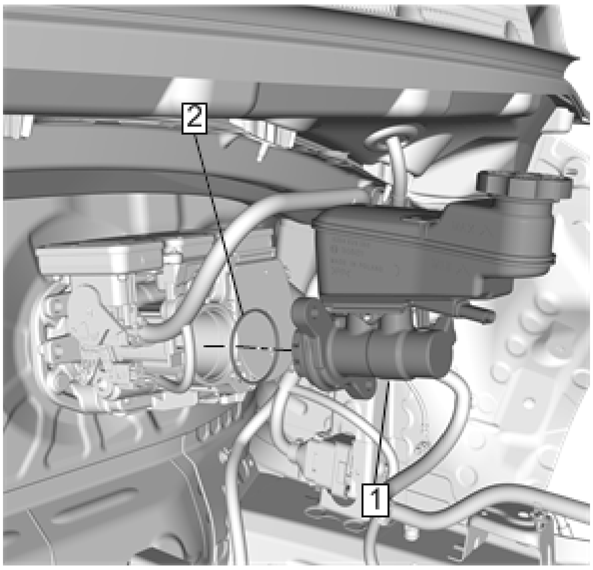


Fig. 18: Brake Master Cylinder And Seal
Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Master Cylinder (1)
9. Remove Brake Master Cylinder Seal (2)
10. Remove Brake Master Cylinder Reservoir @ Brake Master Cylinder. Refer to Master Cylinder Reservoir Replacement

Installation Procedure

1. Install Brake Master Cylinder Reservoir @ Brake Master Cylinder. Refer to Master Cylinder Reservoir Replacement

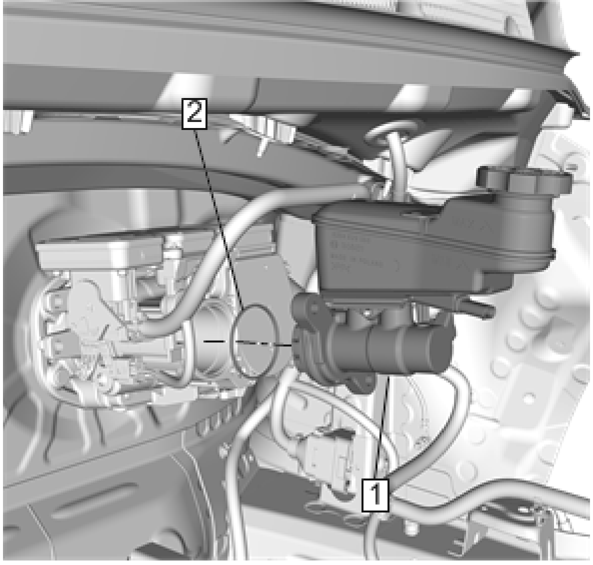


Fig. 19: Brake Master Cylinder And Seal
Courtesy of GENERAL MOTORS COMPANY

2. Install Brake Master Cylinder Seal (2)
3. Install Brake Master Cylinder (1)

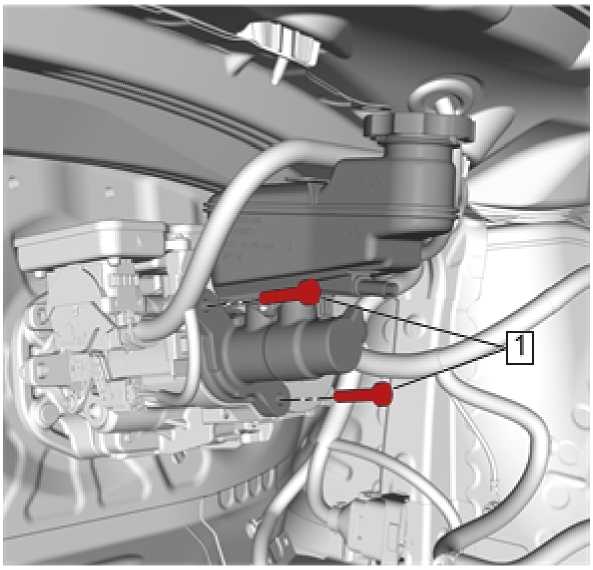


Fig. 20: Brake Master Cylinder Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

4. Install and tighten Brake Master Cylinder Bolts (1) (Qty: 2) to 22 N.m (16 lb ft)

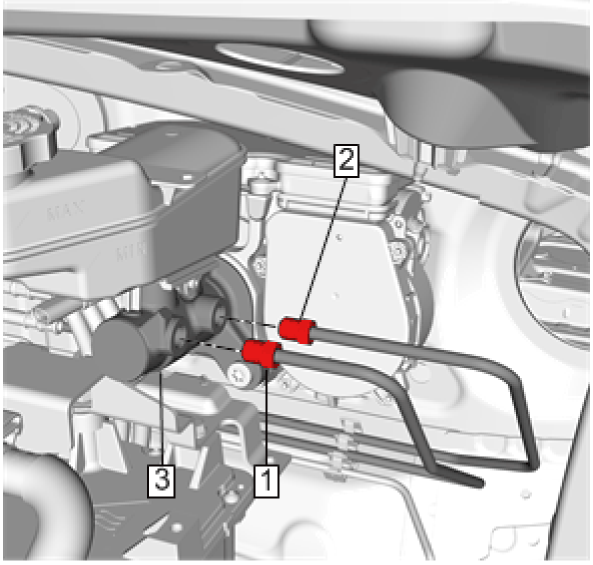


Fig. 21: BPMV Front And Rear Pipe Fittings At Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten Brake Pressure Modulator Valve Rear Pipe Fitting (2) @ Brake Master Cylinder (3) to 25 N.m (18 lb ft)
6. Install and tighten Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (3) to 25 N.m (18 lb ft)

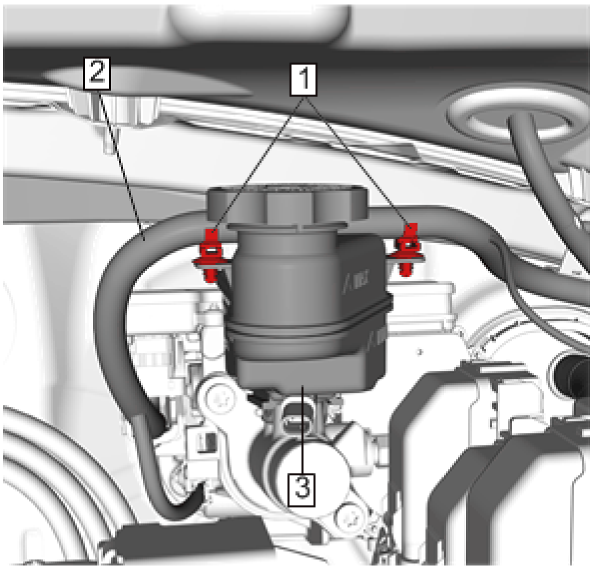


Fig. 22: Brake Master Cylinder Reservoir, Wiring Harness And Clips
Courtesy of GENERAL MOTORS COMPANY

7. Install Body Wiring Harness (2) @ Brake Master Cylinder Reservoir (3)
8. Install Clips (1) (Qty: 2) @ Brake Master Cylinder Reservoir (3)

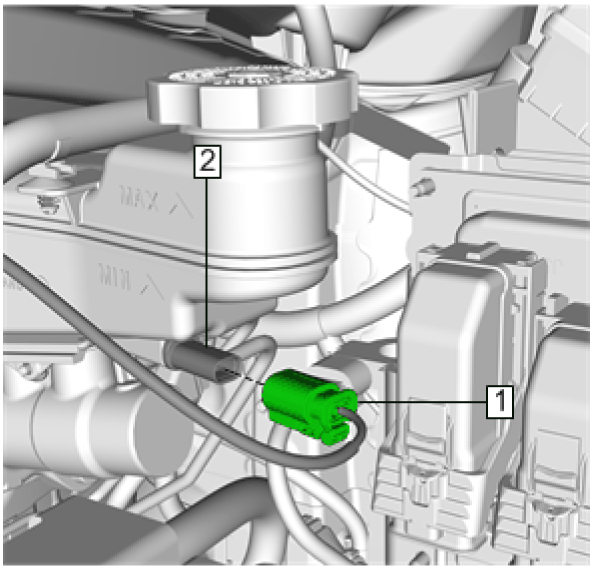


Fig. 23: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

9. Connect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)
10. Install Engine Control Module @ Vehicle. Refer to **Engine Control Module Replacement**
11. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding**

BRAKE FLUID LEVEL INDICATOR SWITCH REPLACEMENT

Removal Procedure

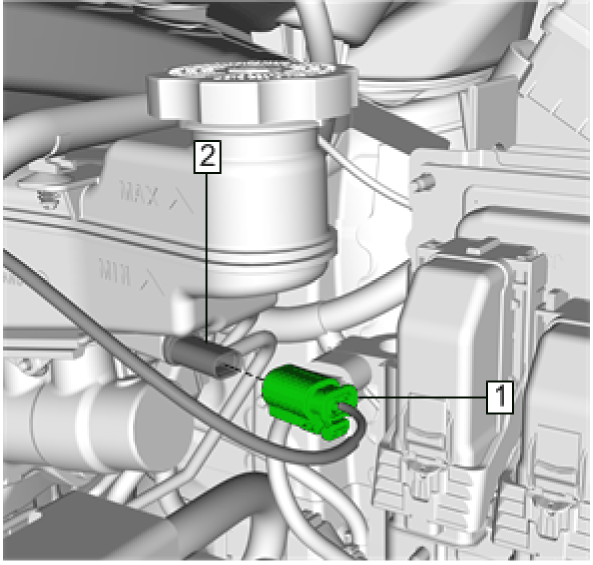


Fig. 24: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Disconnect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

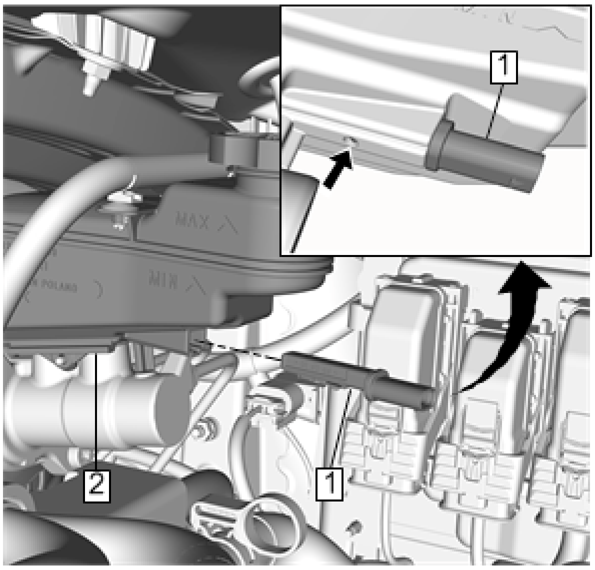


Fig. 25: Brake Fluid Level Indicator Switch And Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

2. Using an appropriate tool, lift upward to release the brake fluid level indicator switch locking tab.
3. Remove Brake Fluid Level Indicator Switch (1) @ Brake Master Cylinder Reservoir (2)

Installation Procedure

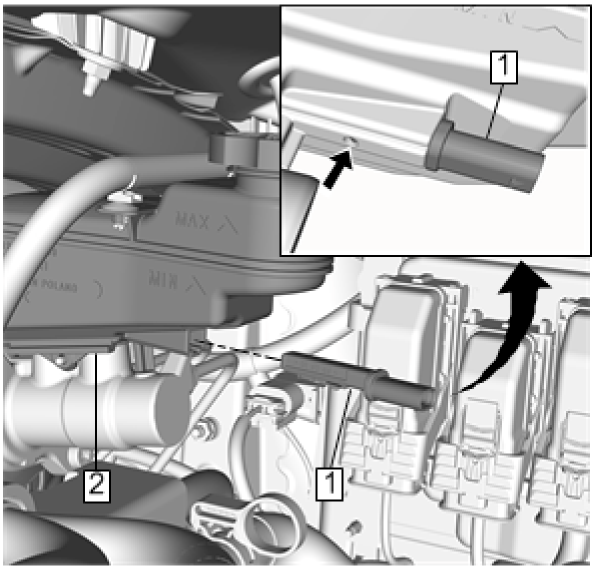


Fig. 26: Brake Fluid Level Indicator Switch And Brake Master Cylinder Reservoir
Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Fluid Level Indicator Switch (1) @ Brake Master Cylinder Reservoir (2)
2. Ensure the brake fluid level indicator switch locking tab is fully engaged.

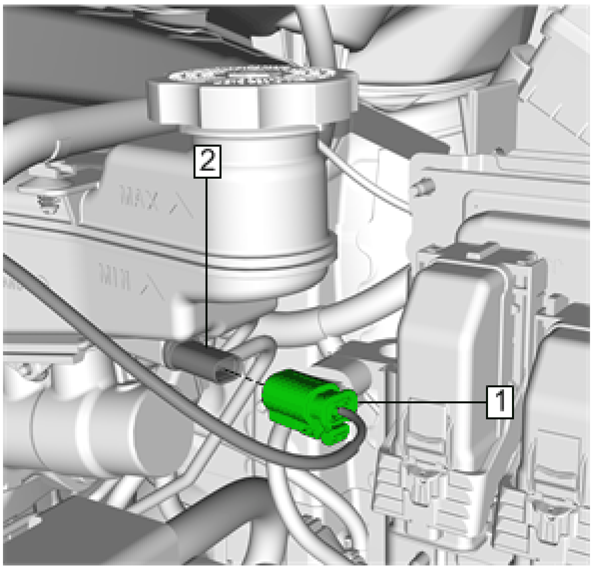


Fig. 27: Brake Fluid Level Indicator Switch And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Connect Electrical Connector (1) @ Brake Fluid Level Indicator Switch (2)

BRAKE AND ACCELERATOR PEDAL ASSEMBLY REPLACEMENT

Removal Procedure

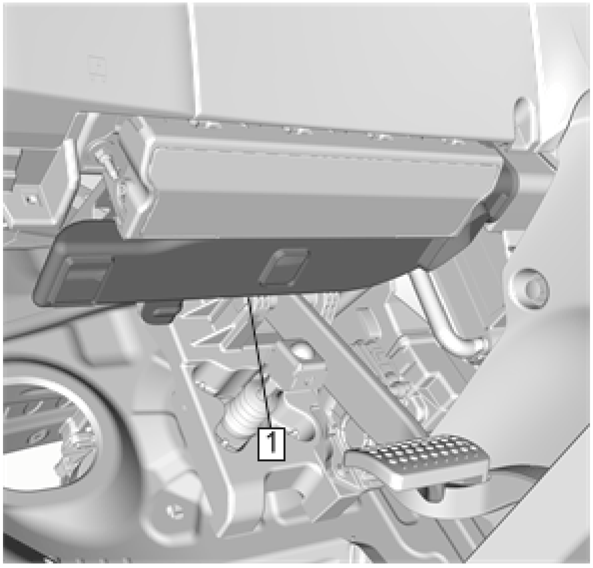


Fig. 28: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

1. Remove Floor Front Air Outlet Duct - Left Side (1). Refer to Floor Front Air Outlet Duct Replacement - Left Side

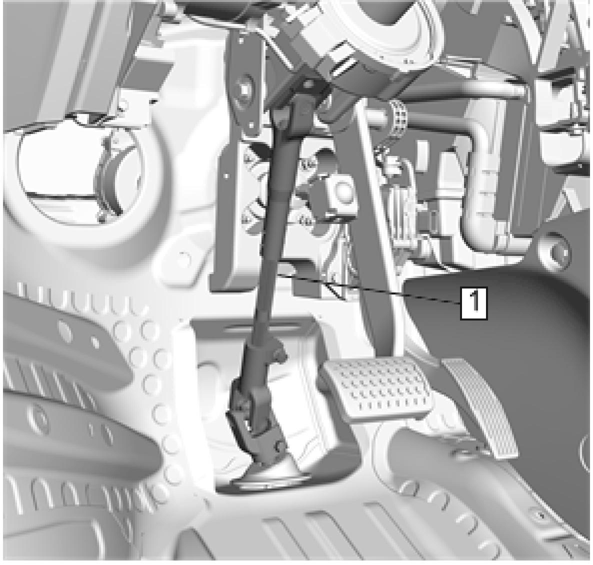


Fig. 29: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

2. Remove Intermediate Steering Shaft (1). Refer to **Intermediate Steering Shaft Replacement**

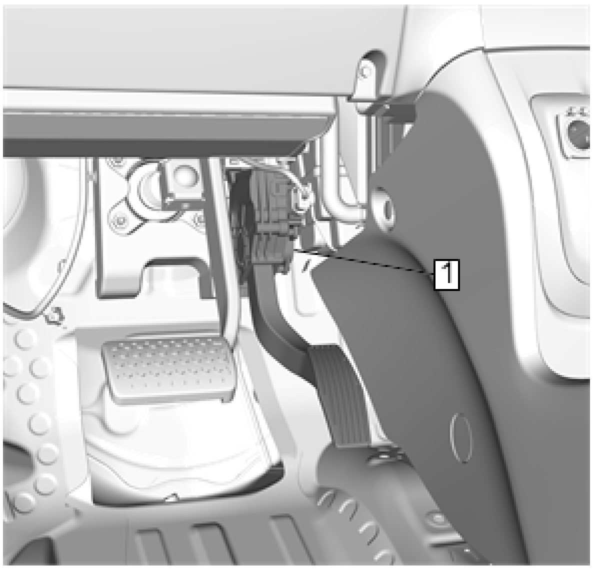


Fig. 30: Accelerator Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Remove Accelerator Pedal Assembly (1) @ Vehicle. Refer to **Accelerator Pedal Assembly Replacement**

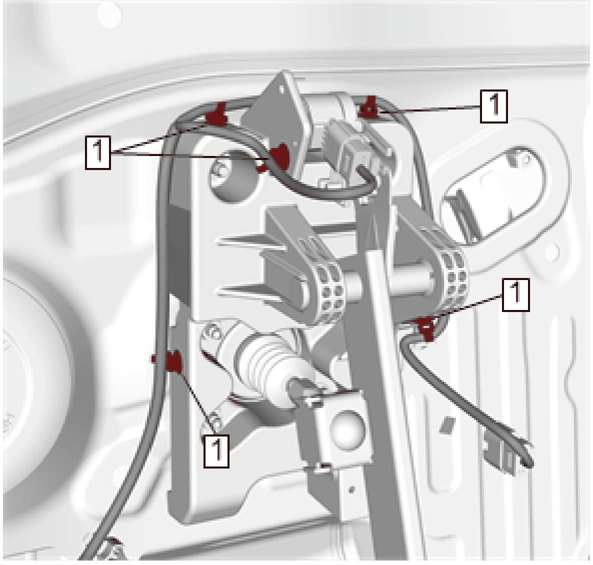


Fig. 31: Body Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Unclip Body Wiring Harness Retainers (1) (Qty: 5) @ Vehicle

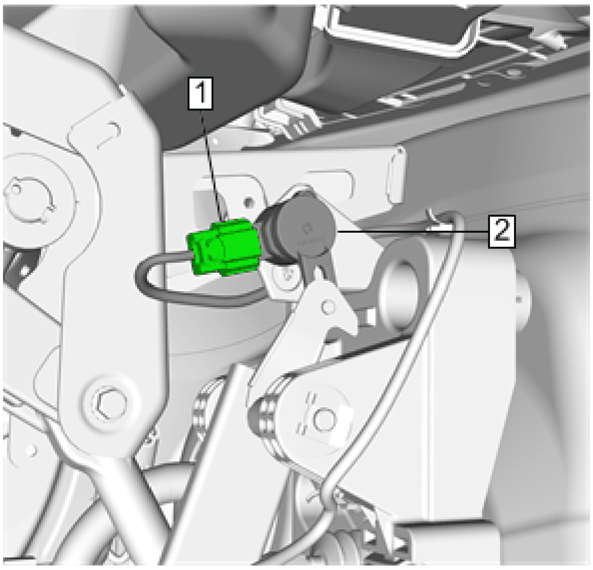


Fig. 32: Brake Pedal Position Sensor And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @ Brake Pedal Position Sensor (2)

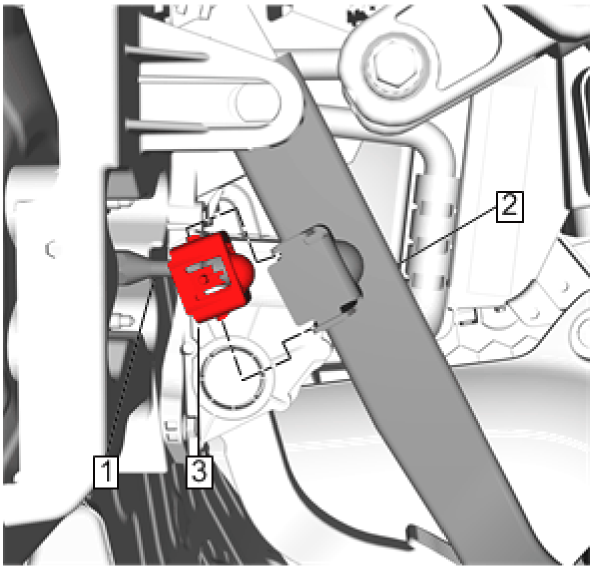


Fig. 33: Brake Pedal, Pushrod And Click Fit Connector
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Brake Pedal Pushrod (1) @ Brake Pedal (2)

   Press the 2 tabs of the click fit connector (3) together and pull the brake pedal a bit to facilitate the removal.

7. Remove and DISCARD Click Fit Connector (3) @ Brake Pedal Pushrod (1)

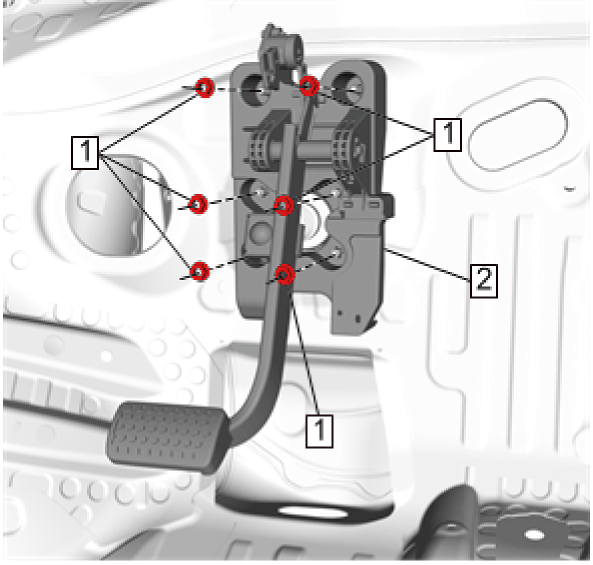


Fig. 34: Brake/Accelerator Pedal Assembly And Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove Brake Pedal Nuts (1) (Qty: 6)
9. Remove Brake and Accelerator Pedal Assembly (2) @ Vehicle
10. Remove Brake Pedal Position Sensor. Refer to **Brake Pedal Position Sensor Replacement**

Installation Procedure

1. Install Brake Pedal Position Sensor. Refer to **Brake Pedal Position Sensor Replacement**

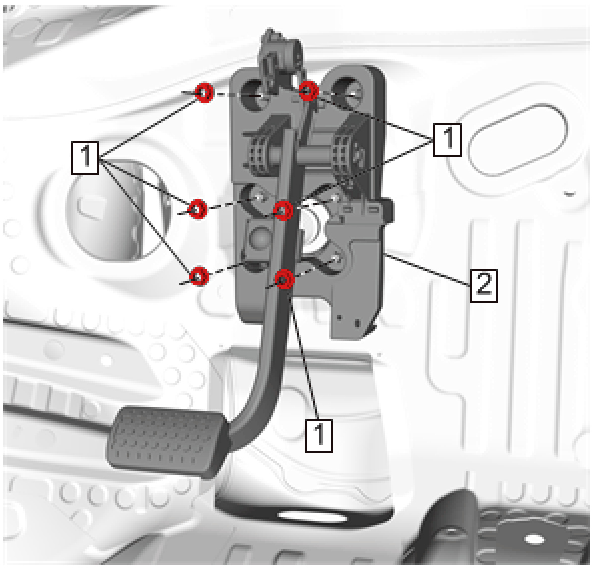


Fig. 35: Brake/Accelerator Pedal Assembly And Nuts
Courtesy of GENERAL MOTORS COMPANY

2. Install Brake and Accelerator Pedal Assembly (2) @ Vehicle

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Brake Pedal Nuts (1) (Qty: 6) to 22 N.m (16 lb ft)

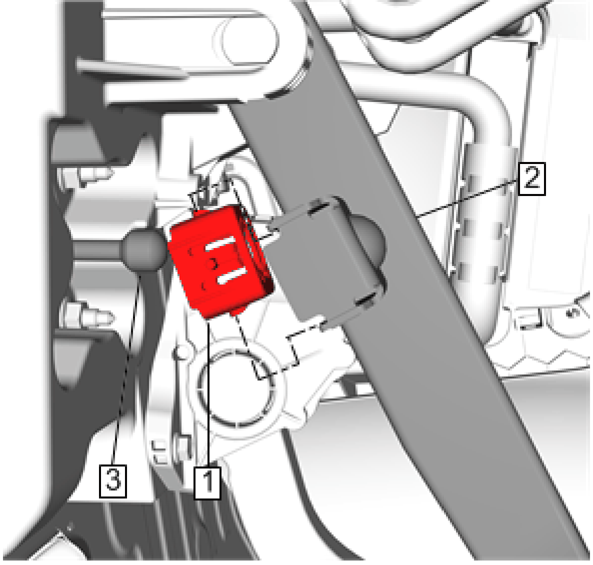


Fig. 36: Brake Pedal, Pushrod And Click Fit Connector
Courtesy of GENERAL MOTORS COMPANY

4. Install NEW Click Fit Connector (1) @ Brake Pedal (2)
5. Connect Brake Pedal Pushrod (3) @ Brake Pedal (2)

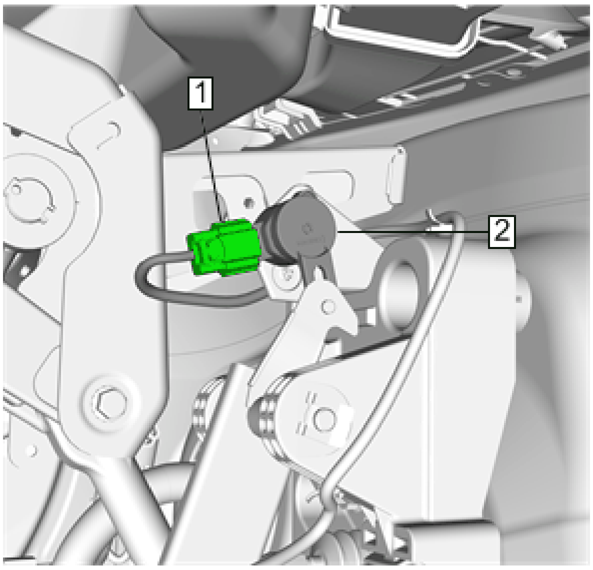


Fig. 37: Brake Pedal Position Sensor And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

6. Connect Electrical Connector (1) @ Brake Pedal Position Sensor (2)

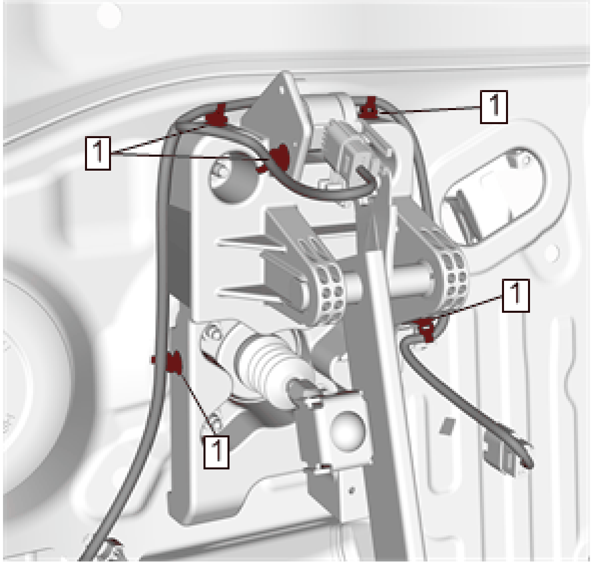


Fig. 38: Body Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

7. Install Body Wiring Harness Retainers (1) (Qty: 5) @ Vehicle

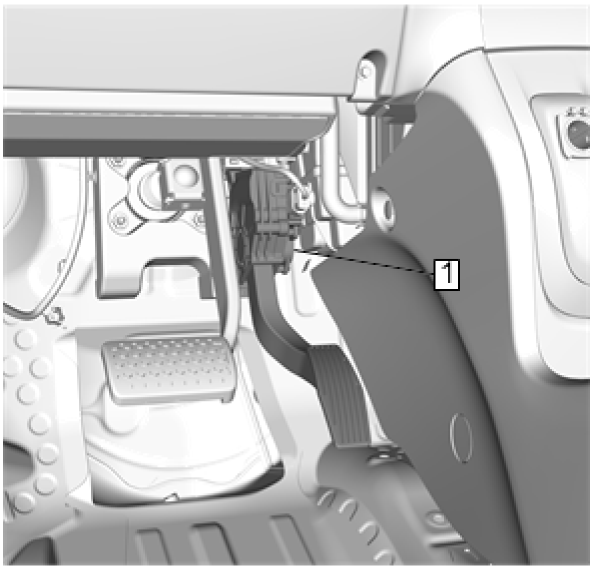


Fig. 39: Accelerator Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Install Accelerator Pedal Assembly (1) @ Vehicle. Refer to **Accelerator Pedal Assembly Replacement**

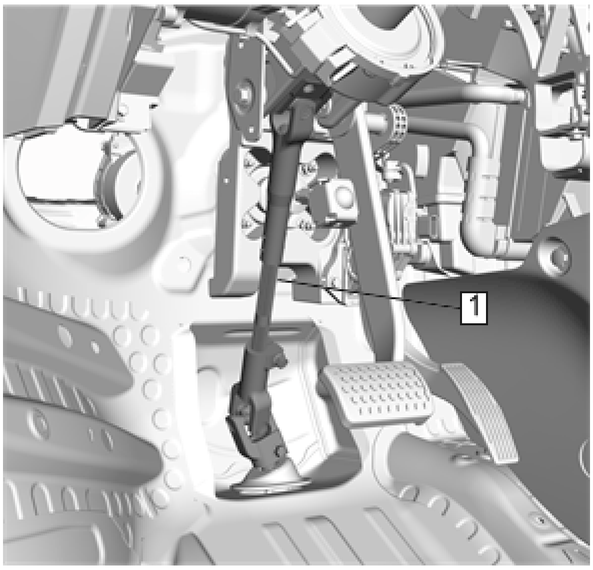


Fig. 40: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

9. Install Intermediate Steering Shaft (1). Refer to **Intermediate Steering Shaft Replacement**

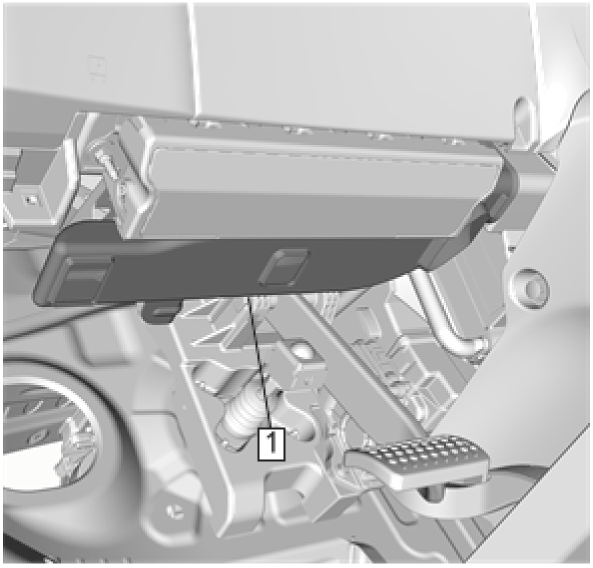


Fig. 41: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

10. Install Floor Front Air Outlet Duct - Left Side (1). Refer to Floor Front Air Outlet Duct Replacement - Left Side

BRAKE PRESSURE MODULATOR VALVE FRONT PIPE REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Disable the high voltage system. Refer to High Voltage Disabling
2. Remove Engine Control Module @ Vehicle. Refer to Engine Control Module Replacement
3. Clean all dirt and foreign material from the brake pipe fitting.

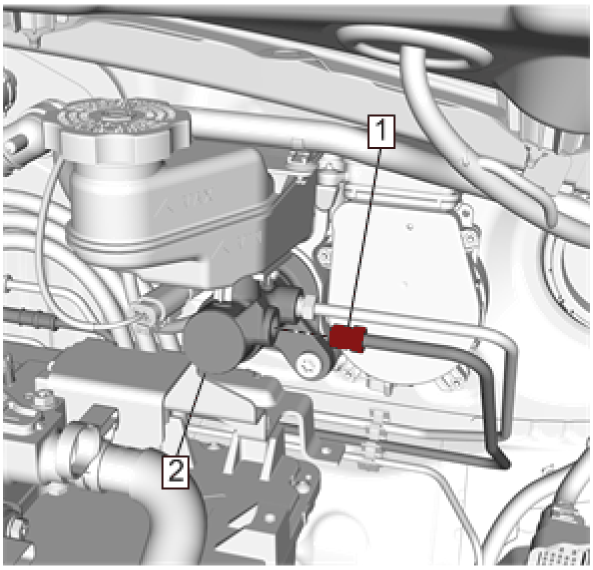


Fig. 42: Brake Pressure Modulator Valve Front Pipe Fitting And Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fitting and plug the brake master cylinder outlet port to prevent brake fluid loss and contamination.**

4. Remove Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (2)

   Drain the brake fluid out of the master cylinder.

5. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to Heater Coolant Surge Tank Replacement

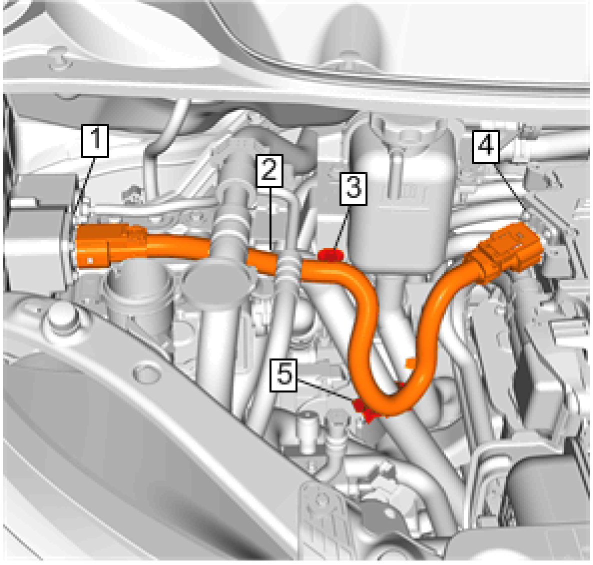


Fig. 43: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to **Drive Motor Battery Positive and Negative Cable Replacement**

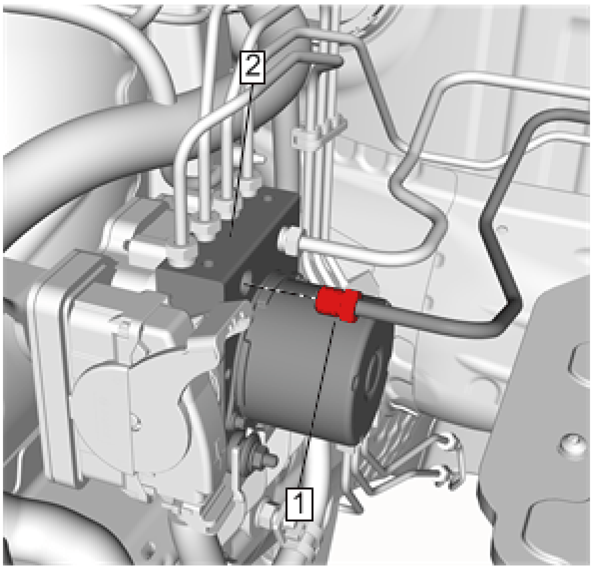


Fig. 44: Brake Pressure Modulator Valve Front Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fitting and plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.**

7.
8. Remove Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

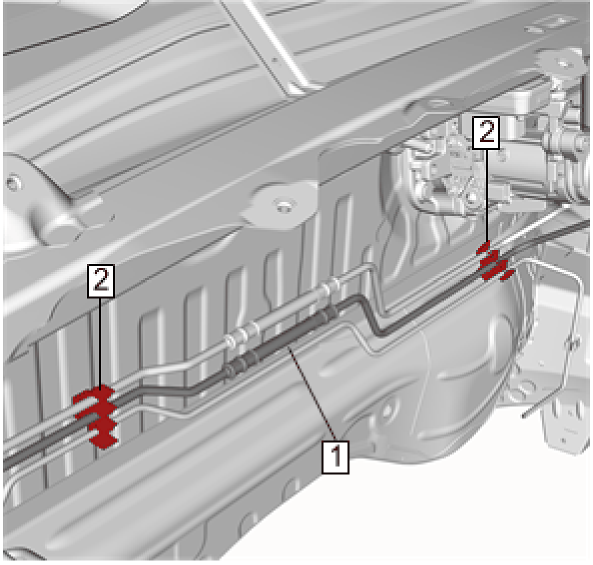


Fig. 45: Brake Pressure Modulator Valve Front Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

9. Unclip Brake Pressure Modulator Valve Front Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)
10. Remove Brake Pressure Modulator Valve Front Pipe (1) @ Vehicle

Installation Procedure

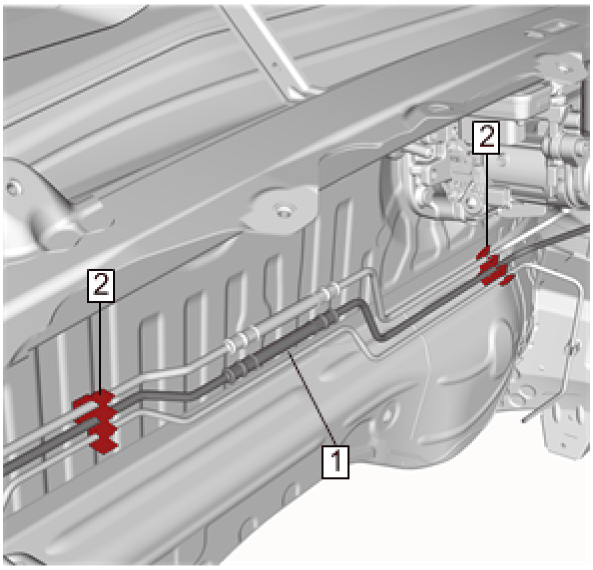


Fig. 46: Brake Pressure Modulator Valve Front Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Pressure Modulator Valve Front Pipe (1) @ Vehicle
2. Install Brake Pressure Modulator Valve Front Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

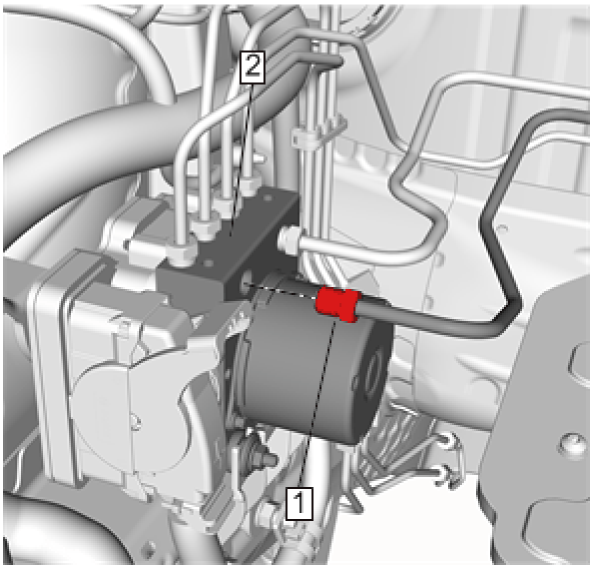


Fig. 47: Brake Pressure Modulator Valve Front Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 25 N.m (18 lb ft)

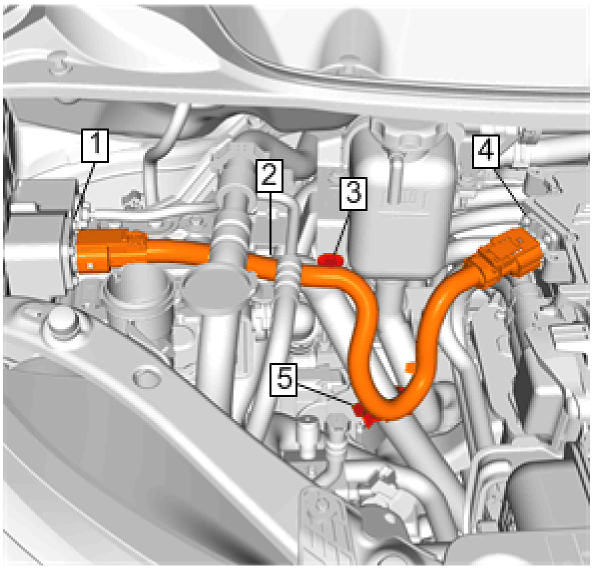


Fig. 48: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

4. Install Drive Motor Battery Positive and Negative Cable (1). Refer to Drive Motor Battery Positive and Negative Cable Replacement
5. Install the heater surge tank to the heater surge tank bracket. Refer to Heater Coolant Surge Tank Replacement

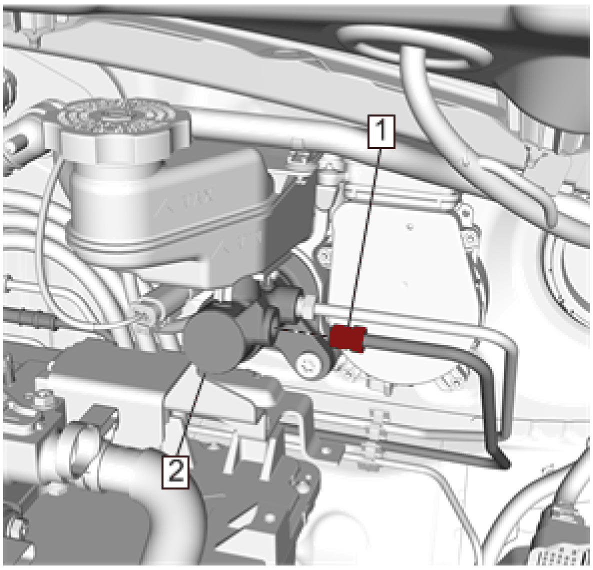


Fig. 49: Brake Pressure Modulator Valve Front Pipe Fitting And Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Brake Pressure Modulator Valve Front Pipe Fitting (1) @ Brake Master Cylinder (2) to 25 N.m (18 lb ft)
7. Install Engine Control Module @ Vehicle. Refer to Engine Control Module Replacement
8. Enable the high voltage system. Refer to High Voltage Enabling
9. Bleed the brake system. Refer to Hydraulic Brake System Bleeding

BRAKE PRESSURE MODULATOR VALVE REAR PIPE REPLACEMENT

Removal Procedure

WARNING: Refer to Brake Fluid Irritant Warning .

CAUTION: Refer to Brake Fluid Effects on Paint and Electrical Components Caution .

1. Disable the high voltage system. Refer to High Voltage Disabling
2. Remove Engine Control Module @ Vehicle. Refer to Engine Control Module Replacement
3. Clean all dirt and foreign material from the brake pipe fitting.

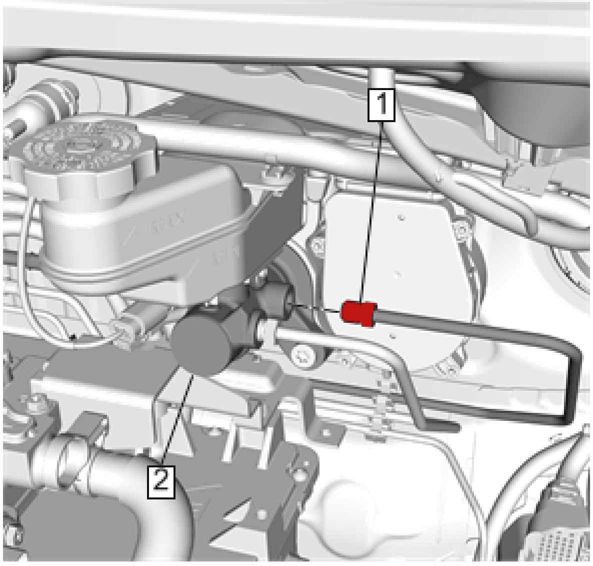


Fig. 50: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fitting and plug the brake master cylinder outlet port to prevent brake fluid loss and contamination.**

4. Remove Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Master Cylinder (2)

   Drain the brake fluid out of the master cylinder.

5. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to Heater Coolant Surge Tank Replacement

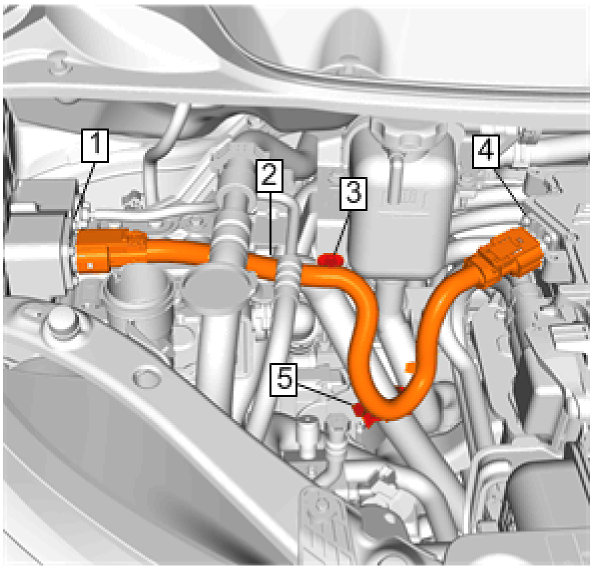


Fig. 51: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to Drive Motor Battery Positive and Negative Cable Replacement

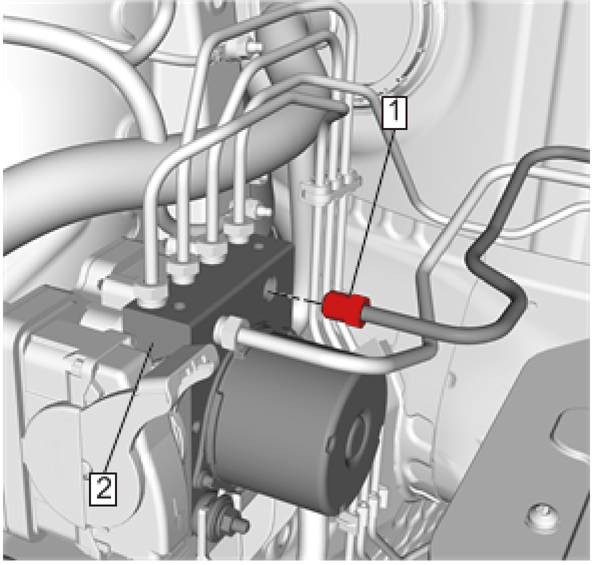


Fig. 52: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fitting and plug the brake pressure modulator valve inlet port to prevent brake fluid loss and contamination.**

7.
8. Remove Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

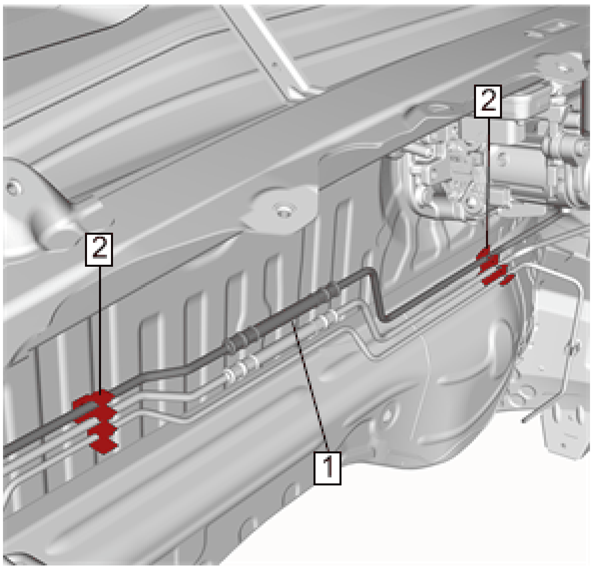


Fig. 53: Brake Pressure Modulator Valve Rear Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

9. Unclip Brake Pressure Modulator Valve Rear Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)
10. Remove Brake Pressure Modulator Valve Rear Pipe (1) @ Vehicle

Installation Procedure

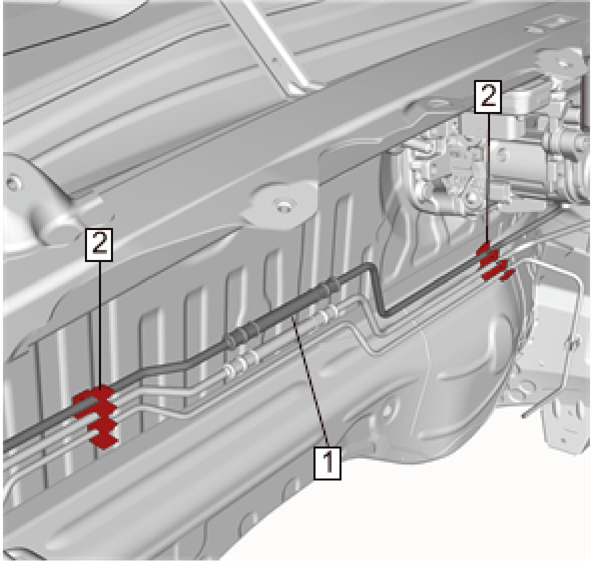


Fig. 54: Brake Pressure Modulator Valve Rear Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

1. Install Brake Pressure Modulator Valve Rear Pipe (1) @ Vehicle
2. Install Brake Pressure Modulator Valve Rear Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

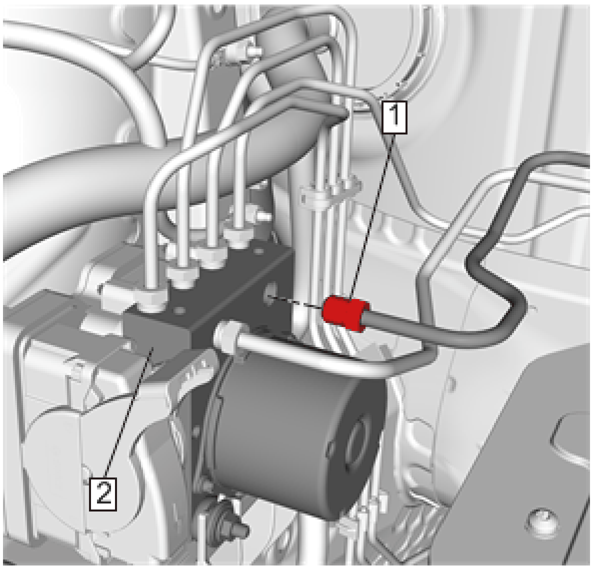


Fig. 55: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 25 N.m (18 lb ft)

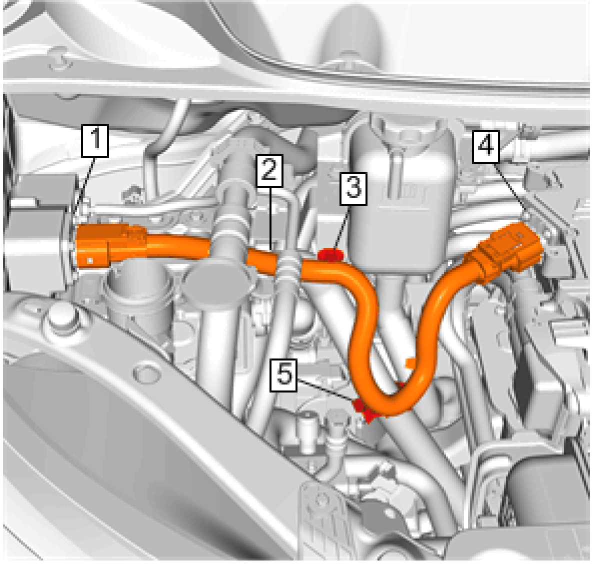


Fig. 56: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

4. Install Drive Motor Battery Positive and Negative Cable (1). Refer to **Drive Motor Battery Positive and Negative Cable Replacement**
5. Install the heater surge tank to the heater surge tank bracket. Refer to **Heater Coolant Surge Tank Replacement**

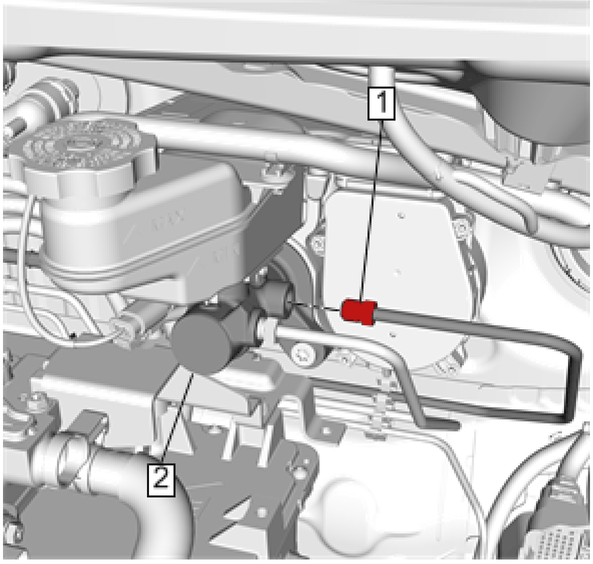


Fig. 57: Brake Pressure Modulator Valve Rear Pipe Fitting And Brake Master Cylinder
Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Brake Pressure Modulator Valve Rear Pipe Fitting (1) @ Brake Master Cylinder (2) to 25 N.m (18 lb ft)
7. Install Engine Control Module @ Vehicle. Refer to **Engine Control Module Replacement**
8. Enable the high voltage system. Refer to **High Voltage Enabling**
9. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding**

BRAKE PIPE REPLACEMENT

Special Tools

CH-45405 Brake Pipe Flaring Kit

For equivalent regional tools, refer to **Special Tools**.

WARNING: **Refer to Brake Fluid Irritant Warning .**

WARNING: **Always use double walled steel brake pipe when replacing brake pipes.**

The use of any other pipe is not recommended and may cause brake system failure. Carefully route and retain replacement brake pipes. Always use the correct fasteners and the original location for replacement brake pipes. Failure to properly route and retain brake pipes may cause damage to the brake pipes and cause brake system failure.

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

NOTE: **When servicing the brake pipes, note the following:**

- **If sectioning the brake pipe, use replacement pipe of the same type and outside diameter.**
- **Use fittings of the appropriate size and type.**
- **Only create flares of the same type or design as originally equipped on the vehicle.**

1. Inspect the area of brake pipe to be repaired or replaced.
2. Remove components as necessary to gain access to the brake pipe to be repaired or replaced.
3. Release the brake pipe to be replaced from the retainers, as required.
4. Select an appropriate location to section the brake pipe, if necessary.
    - Allow adequate clearance in order to maneuver the **CH-45405** Brake Pipe Flaring Kit.
    - Avoid sectioning the brake pipe at bends or mounting points.
5. Using a string or wire, measure the length of the pipe to be replaced including all pipe bends.
6. Add to the measurement taken the appropriate additional length required for each flare to be created.

    Specification

    - 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
    - 9.50 mm (0.374 in) for 6.35 mm (1/4 in) diameter pipe
    - 12.67 mm (0.499 in) for 7.94 mm (5/16 in) diameter pipe

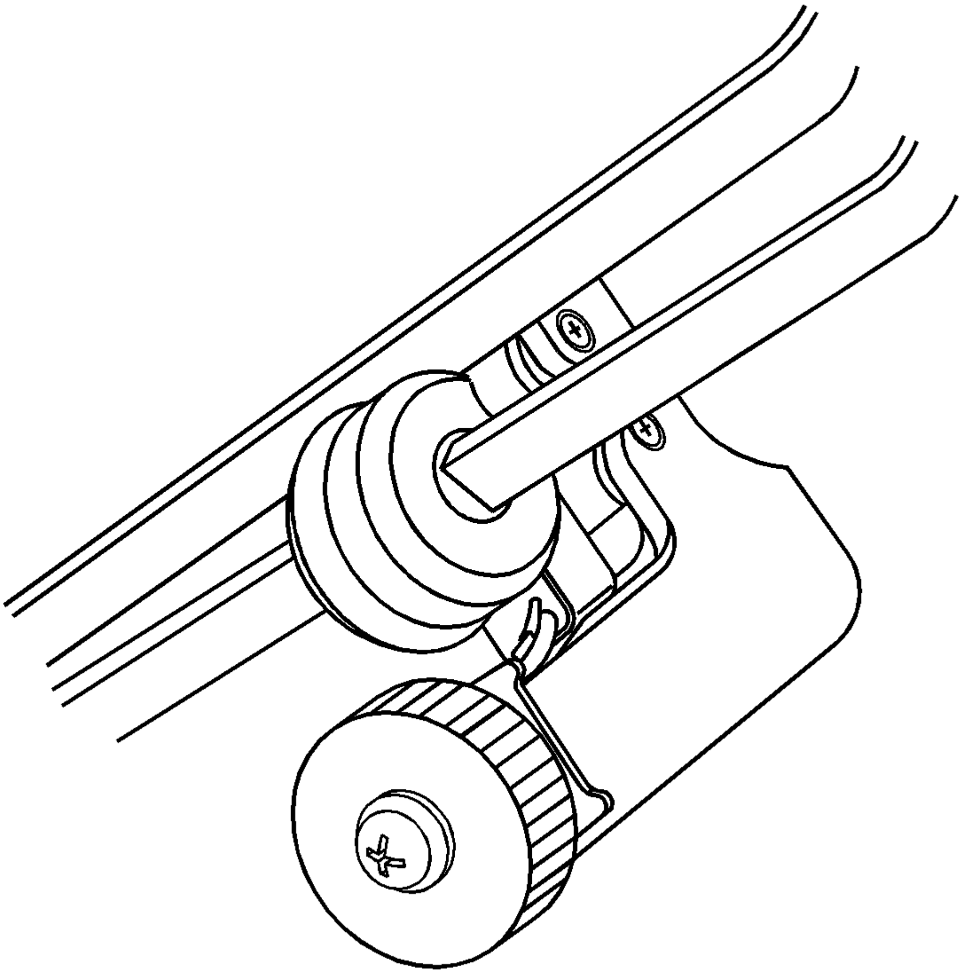


Fig. 58: Brake Pipe And Pipe Cutter
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Ensure that the brake pipe end to be flared is cut at a square, 90 degree angle to the pipe length.**

7. Using the pipe cutter included in the **CH-45405** Brake Pipe Flaring Kit, carefully cut the brake pipe squarely to the measured length.
8. Remove the sectioned brake pipe from the vehicle.
9. Select the appropriate size of brake pipe and tube nuts, as necessary. The brake pipe outside diameter determines brake pipe size.

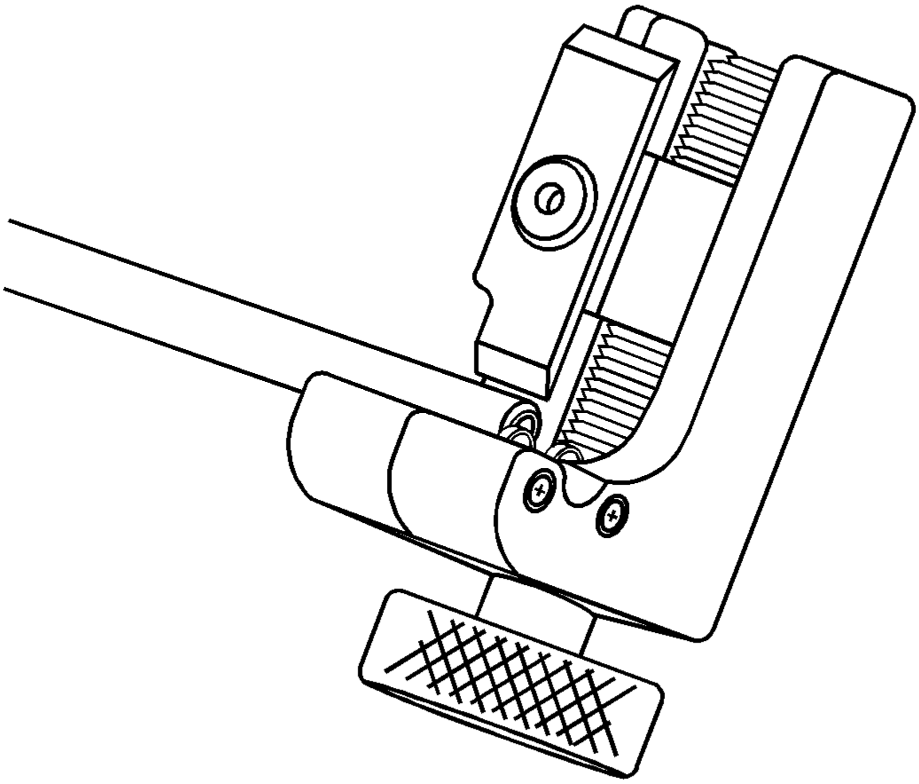


Fig. 59: Stripping Nylon Coating From Brake Pipe Ends
Courtesy of GENERAL MOTORS COMPANY

10. Strip the nylon coating from the brake pipe end to be flared, if necessary.
    - Select the appropriate blade on the coating stripping tool included in the **CH-45405** Brake Pipe Flaring Kit, by unthreading the blade block from the stripping tool and installing the block with the desired blade facing the tool rollers.

      Specification

      - 6.35 mm (0.250 in) blade for 4.76 mm (3/16 in) diameter pipe
      - 9.50 mm (0.374 in) blade for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe
    - Insert the brake pipe end to be flared into the stripping tool to the depth of the ledge on the tool rollers.
    - While holding the brake pipe firmly against the stripping tool roller ledges, rotate the thumbwheel of the tool until the blade contacts the brake pipe coated surface.

      NOTE: **Do not gouge the metal surface of the brake pipe.**

    - Rotate the stripping tool in a clockwise direction, ensuring that the brake pipe end remains against the tool roller ledges.
    - After each successive revolution of the stripping tool, carefully rotate the thumbwheel of the tool clockwise, in order to continue stripping the coating from the brake pipe until the metal pipe surface is exposed.
    - Loosen the thumbwheel of the tool and remove the brake pipe.

      NOTE: **Ensure that all loose remnants of the nylon coating have been removed from the brake pipe.**

- Inspect the stripped end of the brake pipe to ensure that the proper amount of coating has been removed.

  Specification

  - 6.35 mm (0.250 in) for 4.76 mm (3/16 in) diameter pipe
  - 9.50 mm (0.374 in) for 6.35 mm (1/4 in) and 7.94 mm (5/16 in) diameter pipe

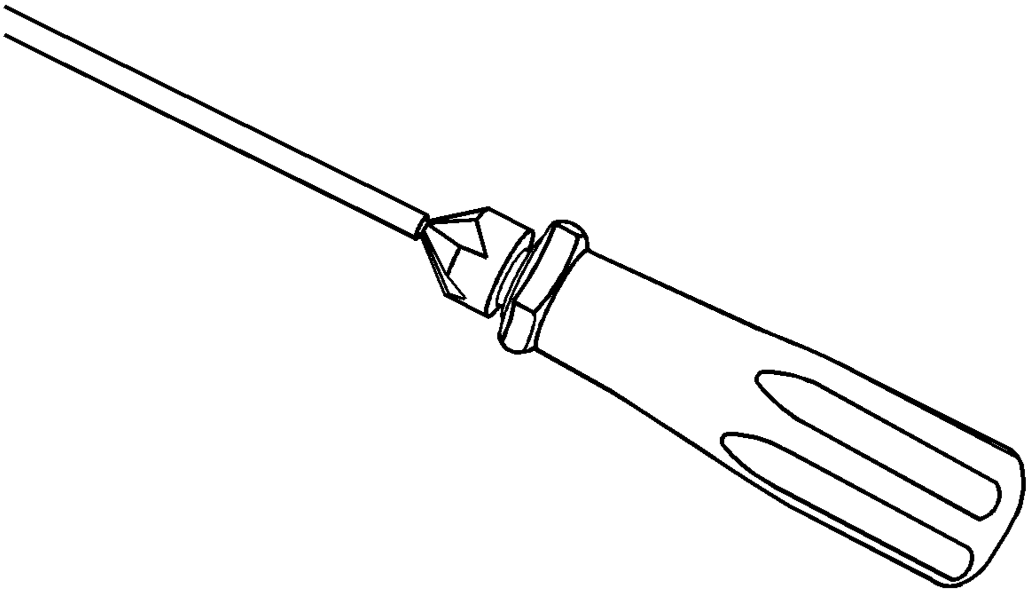


Fig. 60: Chamfering Pipe Using De-Burring Tool
Courtesy of GENERAL MOTORS COMPANY

11. Chamfer the inside and outside diameter of the pipe with the de-burring tool included in the **CH-45405** Brake Pipe Flaring Kit.
12. Install the tube nuts on the brake pipe, noting their orientation.
13. Clean the brake pipe and the **CH-45405** Brake Pipe Flaring Kit of lubricant, contaminants, and debris.

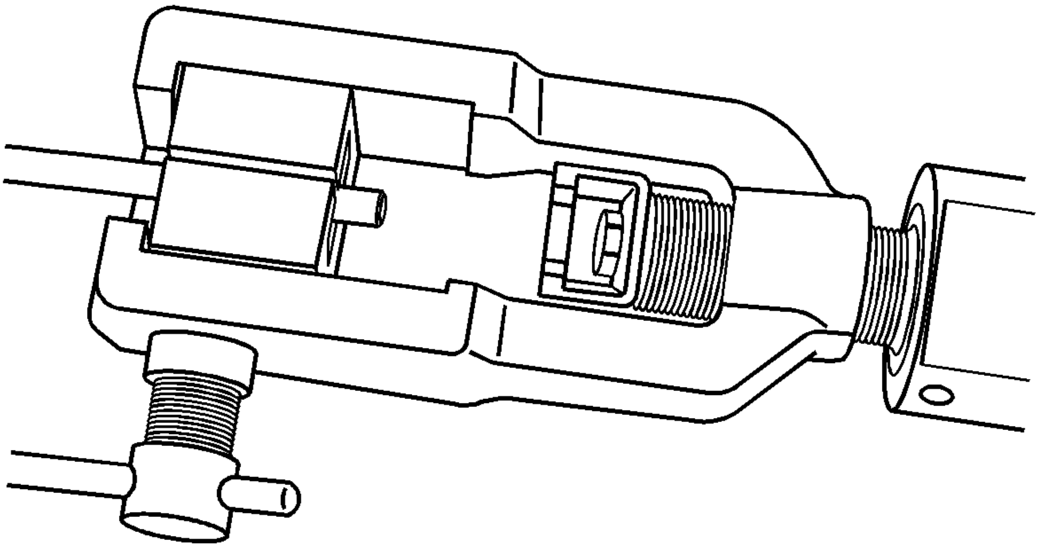


Fig. 61: Installing Die Halves Into Die Cage
Courtesy of GENERAL MOTORS COMPANY

14. Loosen the die clamping screw of the **CH-45405** Brake Pipe Flaring Kit.
15. Select the corresponding die set and install the die halves into the die cage with the full, flat face of one die facing the clamping screw, and the counterbores of both dies facing the forming ram.

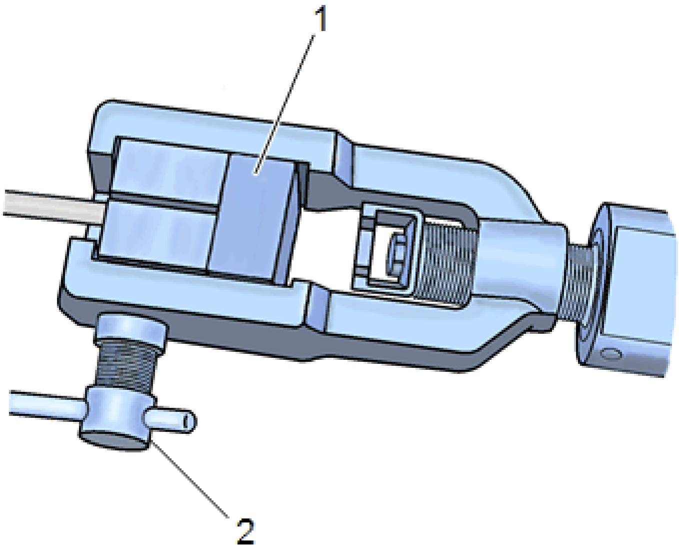


Fig. 62: Clamping Screw And Unused Die
Courtesy of GENERAL MOTORS COMPANY

16. Place the flat face of an unused die (1) against the die halves in the clamping cage and hold firmly against the counterbored face of the dies.
17. Insert the prepared end of the pipe to be flared through the back of the dies until the pipe is seated against the flat surface of the unused die (1).
18. Remove the unused die (1).
19. Ensure that the rear of both dies are seated firmly against the enclosed end of the die cage.
20. Firmly hand tighten the clamping screw (2) against the dies.

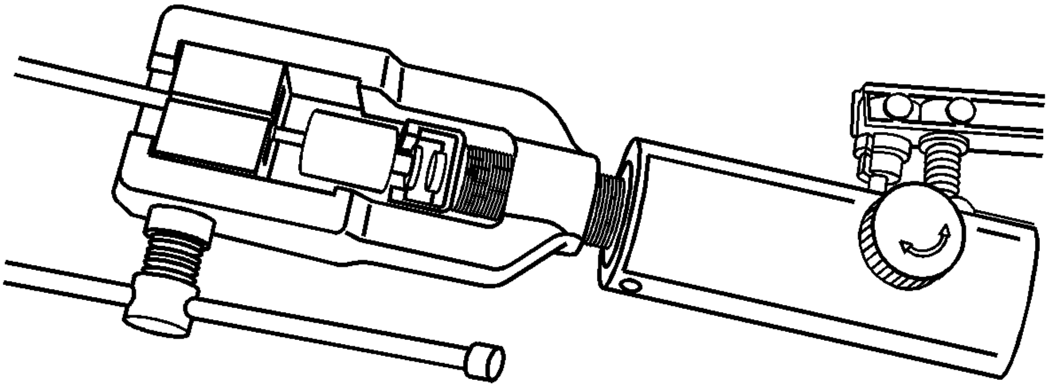


Fig. 63: Rotating Body Of Special Tool To Bottom Against Die Cage
Courtesy of GENERAL MOTORS COMPANY

21. Select the appropriate forming mandrel and place into the forming ram.
22. Rotate the hydraulic fluid control valve clockwise to the closed position.
23. Rotate the body of the **CH-45405** Brake Pipe Flaring Kit until it bottoms against the die cage.

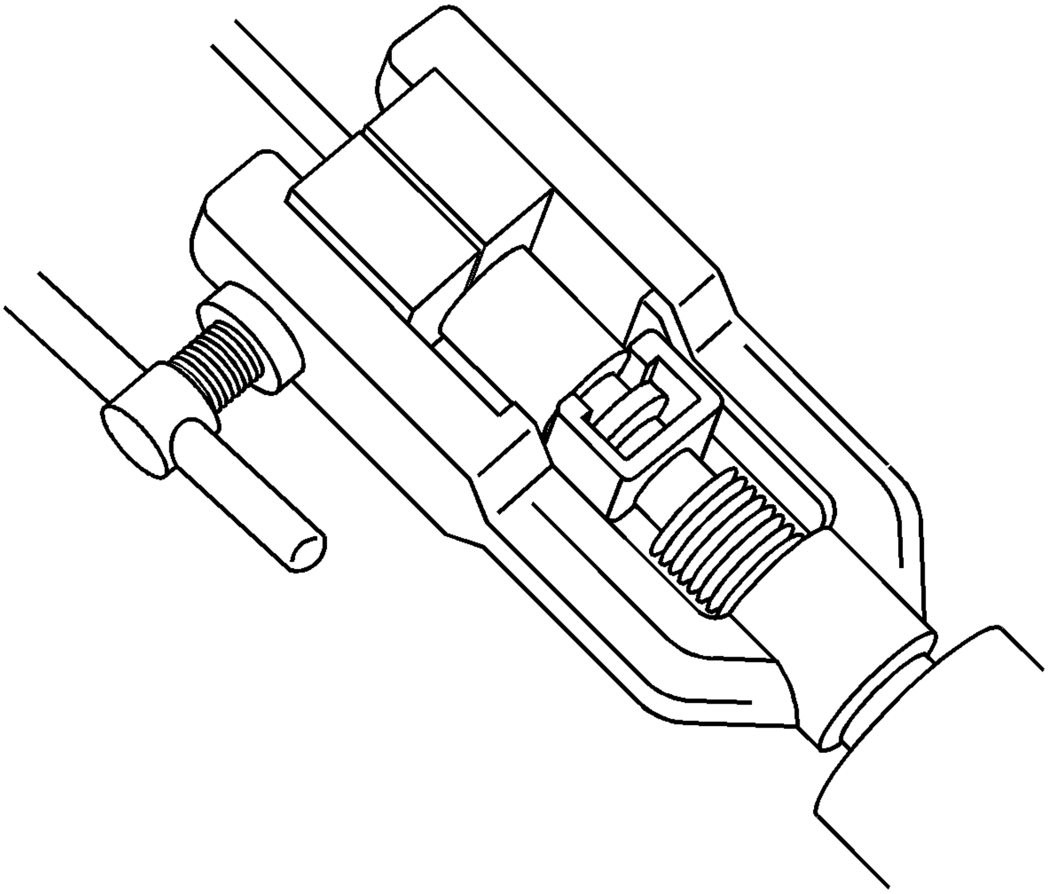


Fig. 64: Bottoming Forming Mandrel Against Clamping Dies Using Pipe Flaring Tool
Courtesy of GENERAL MOTORS COMPANY

24. While guiding the forming mandrel into the exposed end of pipe to be flared, operate the lever of the **CH-45405** Brake Pipe Flaring Kit until the forming mandrel bottoms against the clamping dies.
25. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.

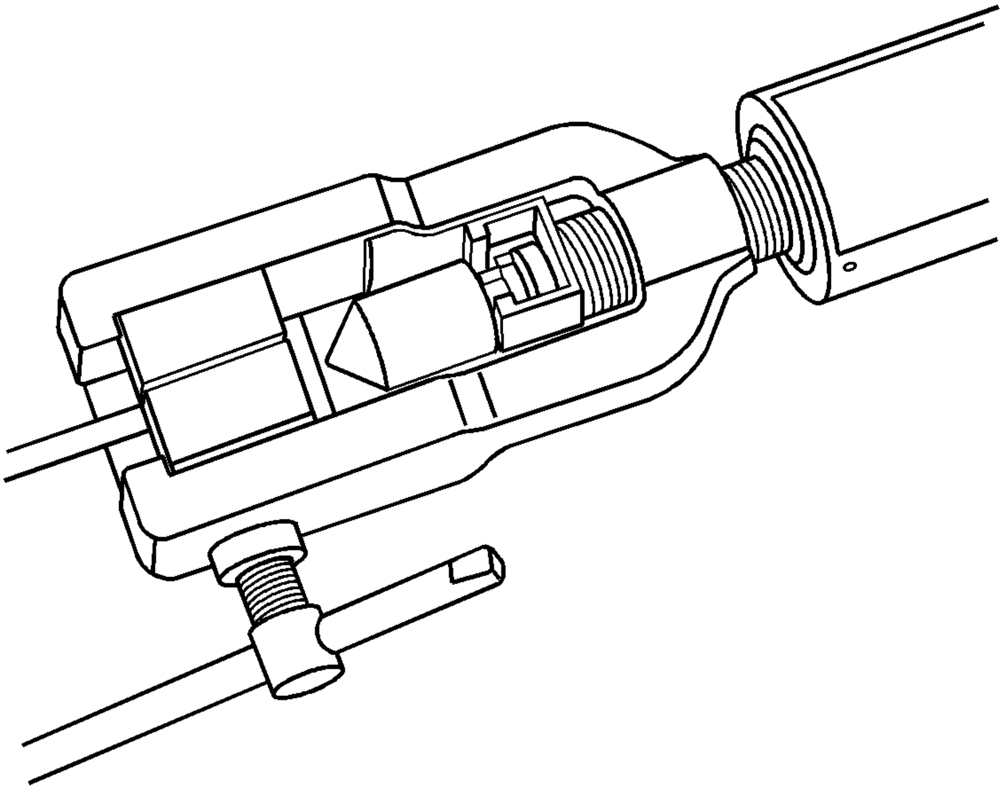


Fig. 65: Finishing Cone In Forming Ram
Courtesy of GENERAL MOTORS COMPANY

26. Insert the finishing cone into the forming ram.
27. Rotate the hydraulic fluid control valve clockwise to the closed position.
28. Rotate the body of the **CH-45405** Brake Pipe Flaring Kit until it bottoms against the die cage.
29. While guiding the finishing cone into the exposed end of pipe to be flared, operate the lever of the **CH-45405** Brake Pipe Flaring Kit until the finishing cone bottoms against the dies.
30. Rotate the hydraulic fluid control valve counterclockwise to the open position to allow the hydraulic forming ram to retract.
31. Loosen the die clamping screw and remove the dies and pipe.
32. If necessary, lightly tap the dies until the die halves separate.

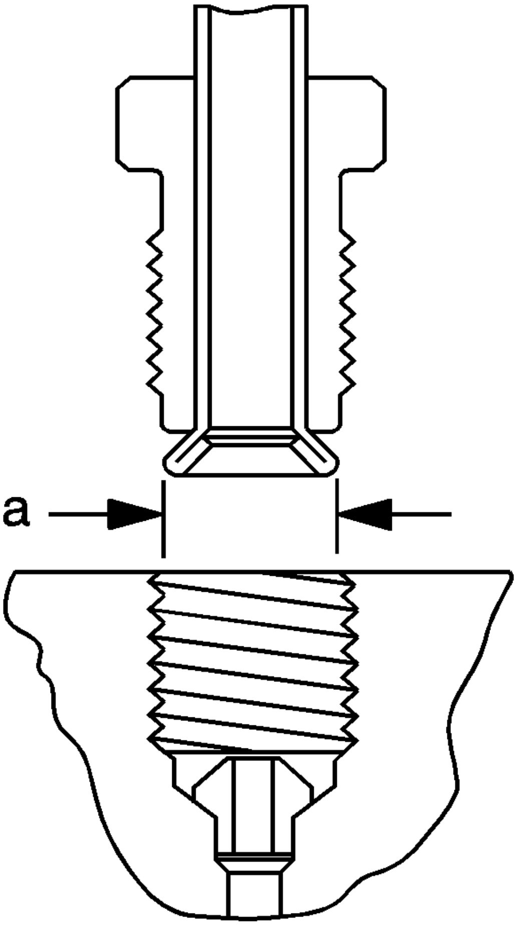


Fig. 66: Identifying Correct Brake Pipe Flare Shape & Diameter
Courtesy of GENERAL MOTORS COMPANY

33. Inspect the brake pipe flare for correct shape and diameter (a).

    Specification

    - 6.74 - 7.10 mm (0.265 - 0.279 in) flare diameter for 4.76 mm (3/16 in) diameter pipe
    - 8.57 - 9.27 mm (0.344 - 0.358 in) flare diameter for 6.35 mm (1/4 in) diameter pipe
    - 10.42 - 10.79 mm (0.410 - 0.425 in) flare diameter for 7.94 mm (5/16 in) diameter pipe
34. If necessary, using the removed section of brake pipe as a template, shape the new pipe with a suitable brake pipe bending tool.

    NOTE: **When installing the pipe, maintain a clearance of 19 mm (3/4 in) from all moving or vibrating components.**

35. Install the pipe to the vehicle with the appropriate brake pipe unions, as required.
36. If previously released, secure the brake pipe to the retainers.
37. Install any components that may have been removed to gain access to the brake pipe.
38. Bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding**
39. With the aid of an assistant, inspect the brake pipe flares for leaks by starting the engine and applying the brakes.

FRONT BRAKE PIPE REPLACEMENT - RIGHT SIDE

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

3. Disable the high voltage system. Refer to **High Voltage Disabling**
4. Remove Front Wheelhouse Liner-Right Side @ Vehicle. Refer to **Front Wheelhouse Liner Replacement**
5. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to **Heater Coolant Surge Tank Replacement**

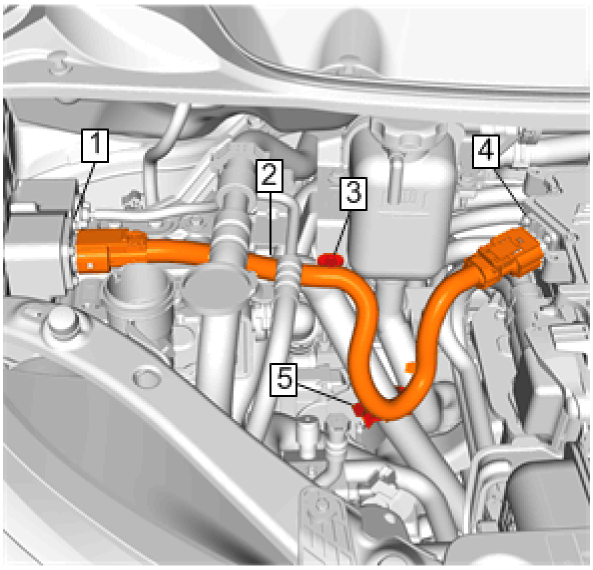


Fig. 67: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to **Drive Motor Battery Positive and Negative Cable Replacement**

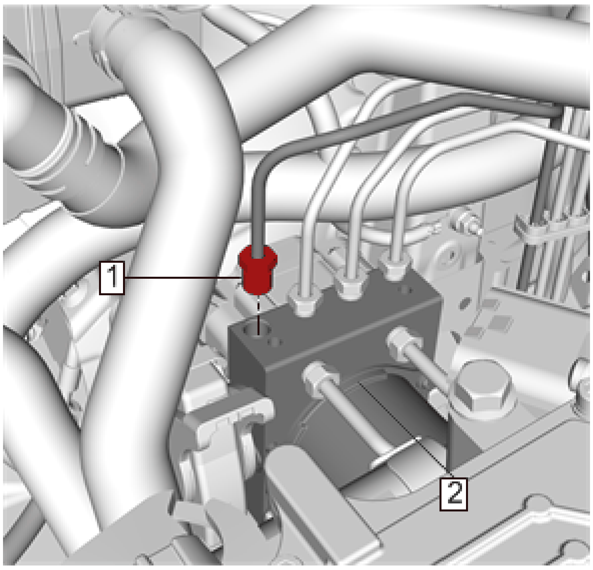


Fig. 68: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pressure modulator valve port to prevent brake fluid loss and contamination.**

5. Remove Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

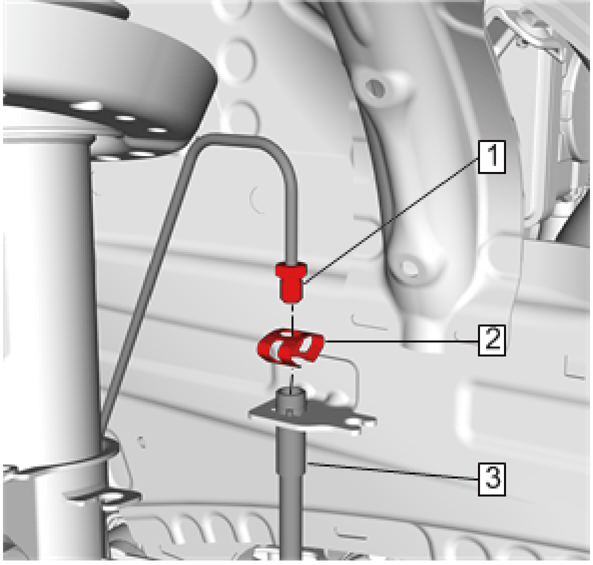


Fig. 69: Front Brake Pipe Fitting, Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Brake Pipe Fitting (1) @ Front Brake Hose (3)
7. Remove Front Brake Hose Retainer (2)

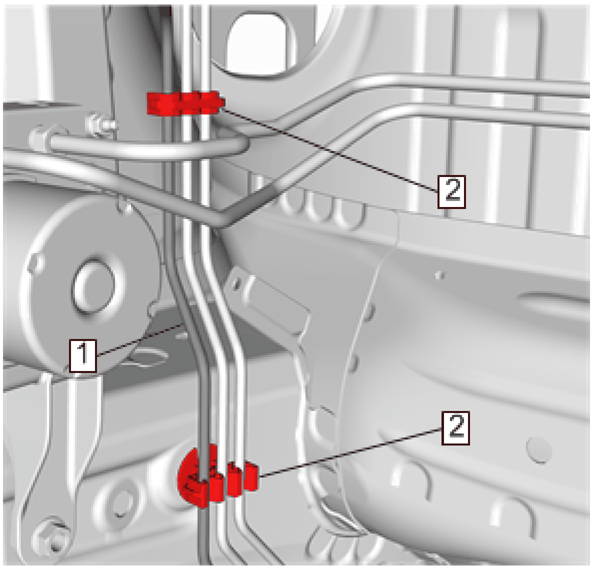


Fig. 70: Front Brake Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

8. Unclip Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

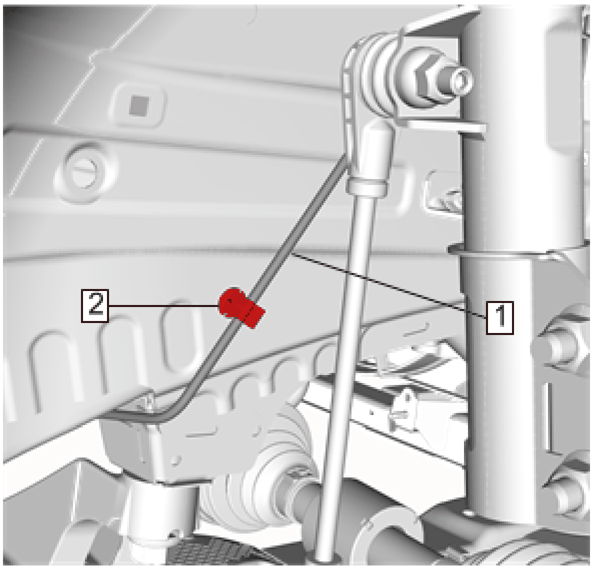


Fig. 71: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

9. Unclip Front Brake Pipe (1) @ Brake Pipe Clip (2)
10. Remove Front Brake Pipe (1) @ Vehicle

Installation Procedure

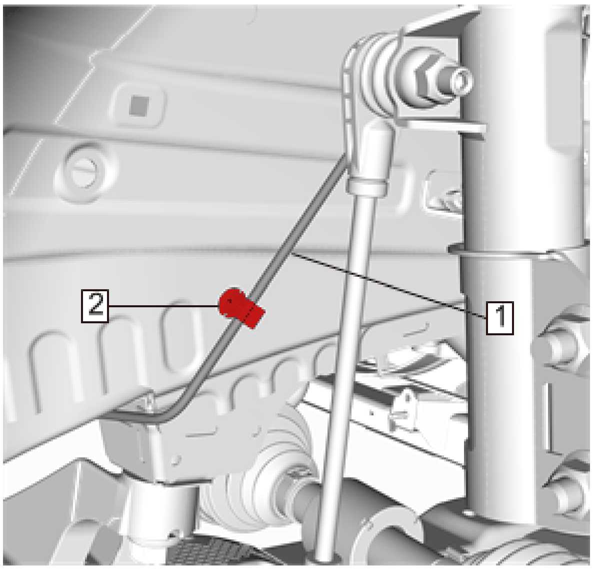


Fig. 72: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Pipe (1) @ Vehicle
2. Install Front Brake Pipe (1) @ Brake Pipe Clip (2)

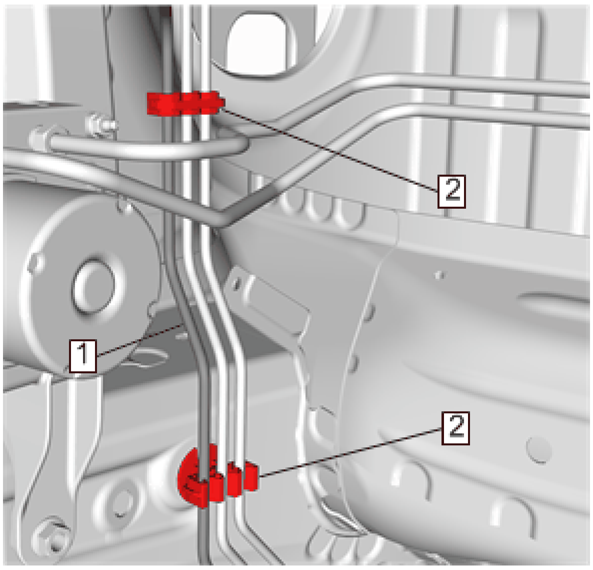


Fig. 73: Front Brake Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

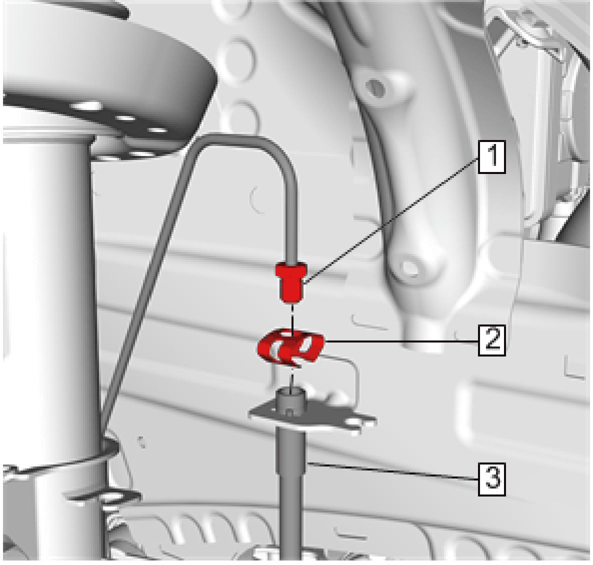


Fig. 74: Front Brake Pipe Fitting, Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Hose Retainer (2)

CAUTION: **Refer to Fastener Caution .**

5. Install and tighten Front Brake Pipe Fitting (1) @ Front Brake Hose (3) to 18 N.m (13 lb ft)

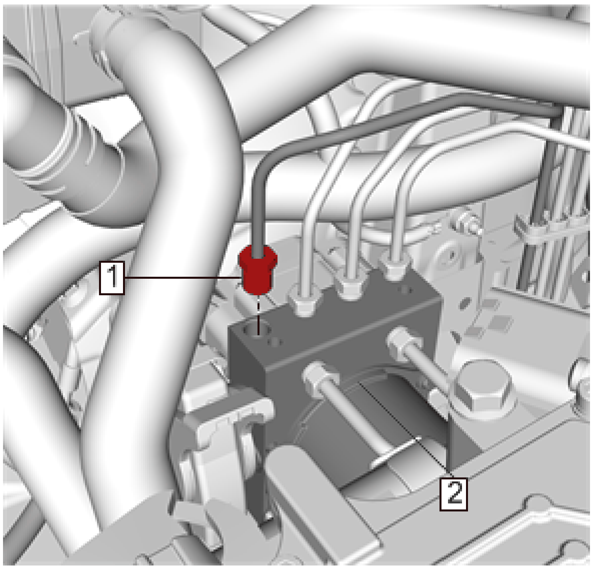


Fig. 75: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 18 N.m (13 lb ft)

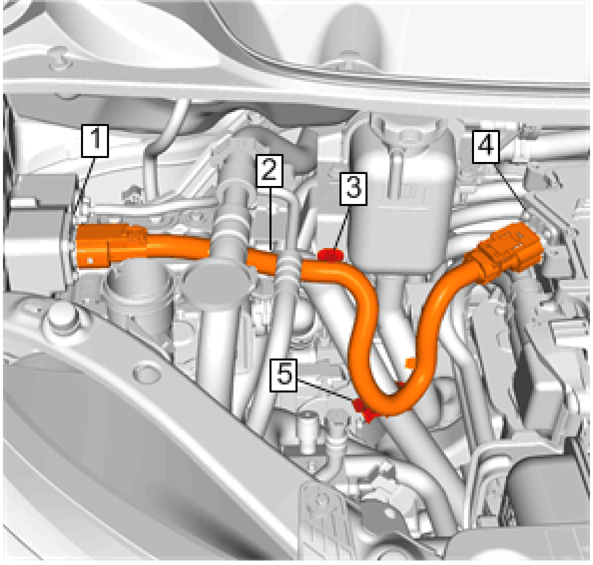


Fig. 76: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

7. Install Drive Motor Battery Positive and Negative Cable (1). Refer to **Drive Motor Battery Positive and Negative Cable Replacement**
8. Install the heater surge tank to the heater surge tank bracket. Refer to **Heater Coolant Surge Tank Replacement**
9. Install Front Wheelhouse Liner-Right Side @ Vehicle. Refer to **Front Wheelhouse Liner Replacement**
10. Enable the high voltage system. Refer to **High Voltage Enabling**
11. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding**

FRONT BRAKE PIPE REPLACEMENT - LEFT SIDE

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Disable the high voltage system. Refer to **High Voltage Disabling**
2. Remove the radiator surge tank bolts and reposition the heater surge tank from the heater surge tank bracket with the hoses connected. Refer to **Heater Coolant Surge Tank Replacement**

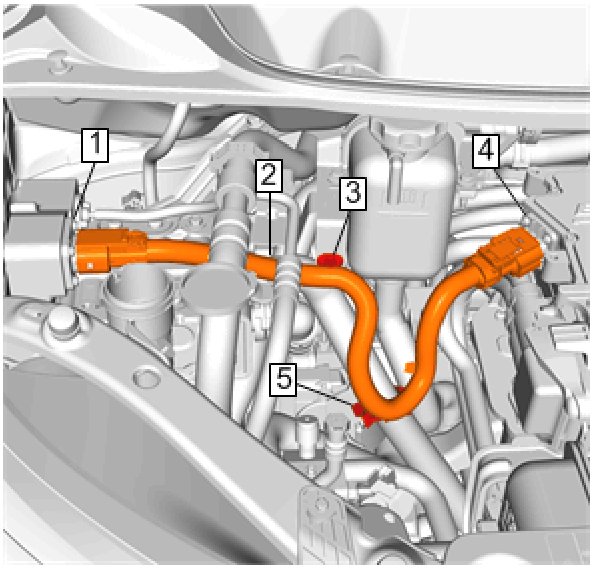


Fig. 77: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

3. Remove Drive Motor Battery Positive and Negative Cable (1). Refer to **Drive Motor Battery Positive and Negative Cable Replacement**

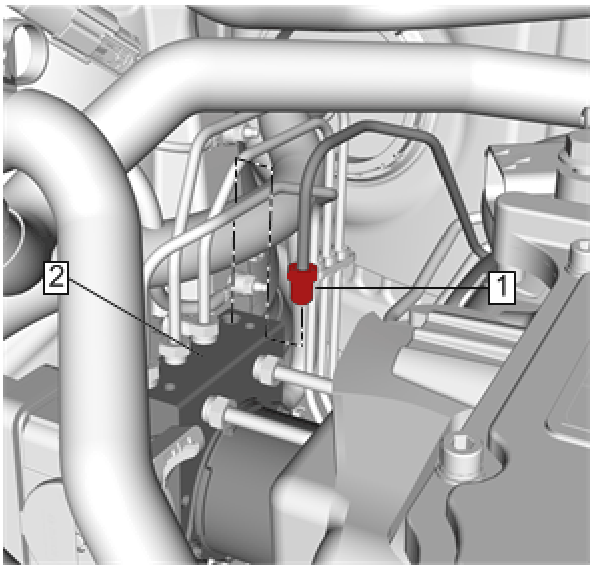


Fig. 78: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pressure modulator valve port to prevent brake fluid loss and contamination.**

4. Remove Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2)

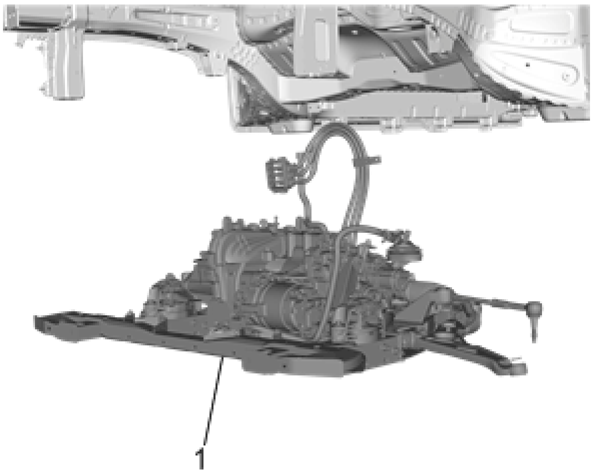


Fig. 79: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

5. Remove Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to **Drivetrain and Front Suspension Frame Removal and Installation**

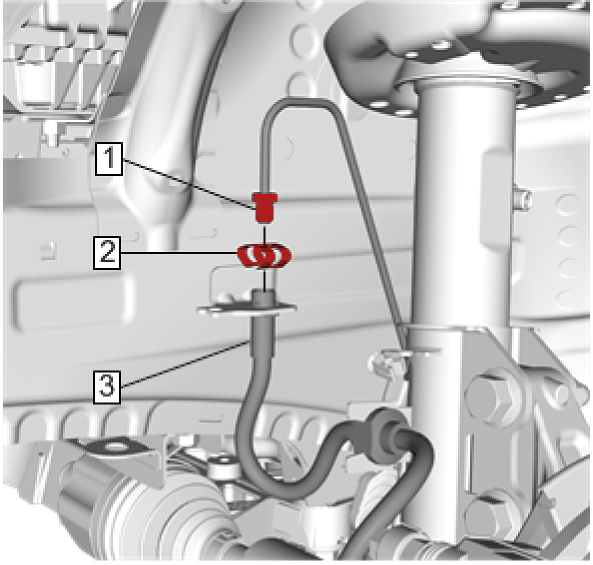


Fig. 80: Front Brake Pipe Fitting, Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Brake Pipe Fitting (1) @ Front Brake Hose (3)
7. Remove Front Brake Hose Retainer (2)

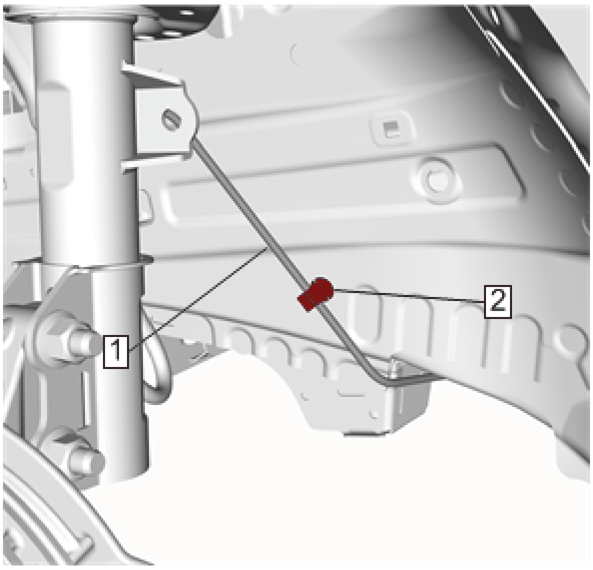


Fig. 81: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

8. Unclip Front Brake Pipe (1) @ Brake Pipe Clip (2)

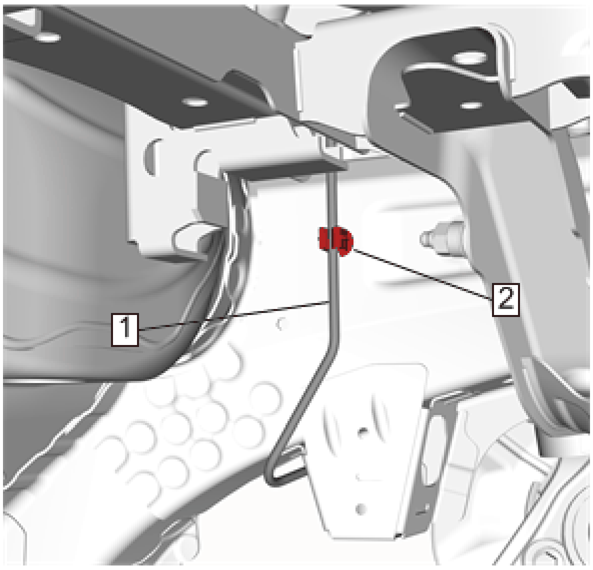


Fig. 82: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

9. Unclip Front Brake Pipe (1) @ Brake Pipe Clip (2)

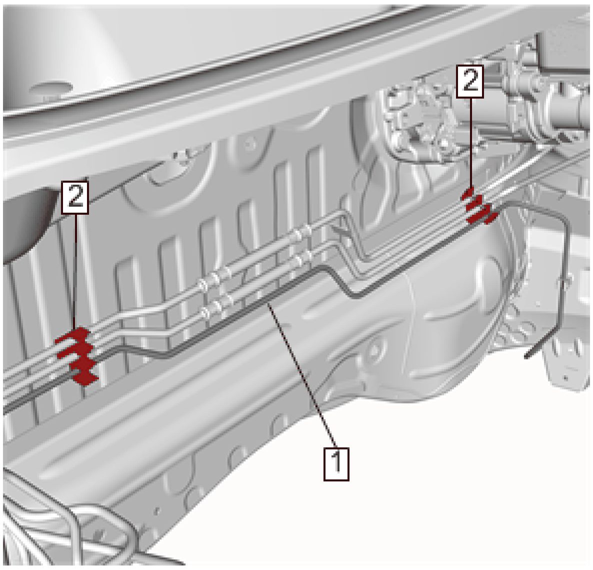


Fig. 83: Front Brake Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

10. Unclip Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)
11. Remove Front Brake Pipe (1) @ Vehicle

Installation Procedure

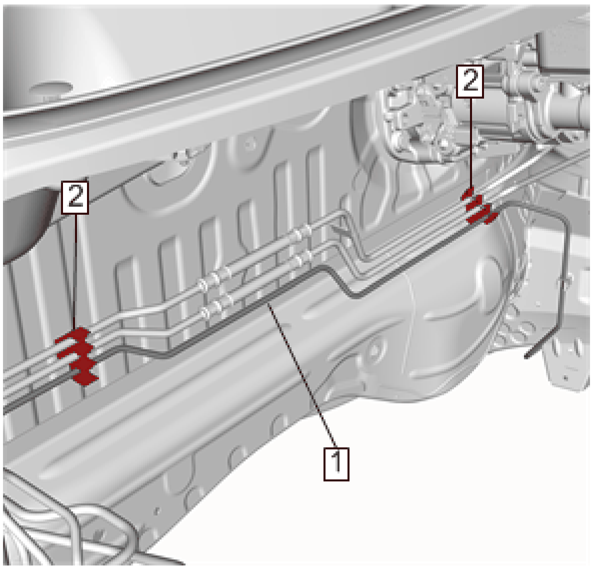


Fig. 84: Front Brake Pipe And Brake Pipe Clips
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Pipe (1) @ Vehicle
2. Install Front Brake Pipe (1) @ Brake Pipe Clips (2) (Qty: 2)

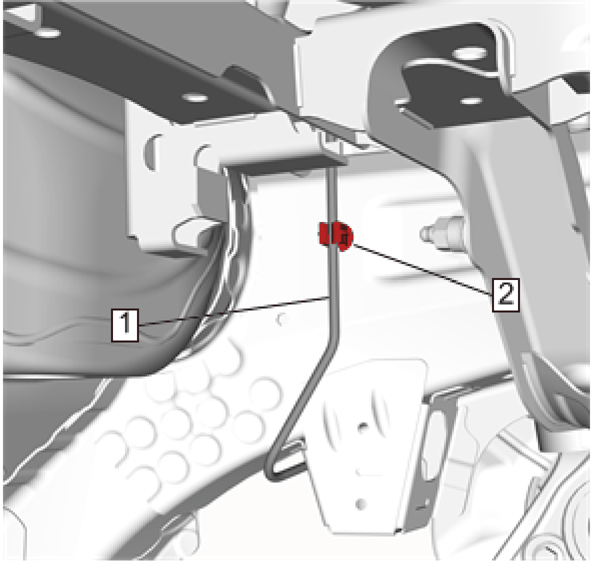


Fig. 85: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Brake Pipe (1) @ Brake Pipe Clip (2)

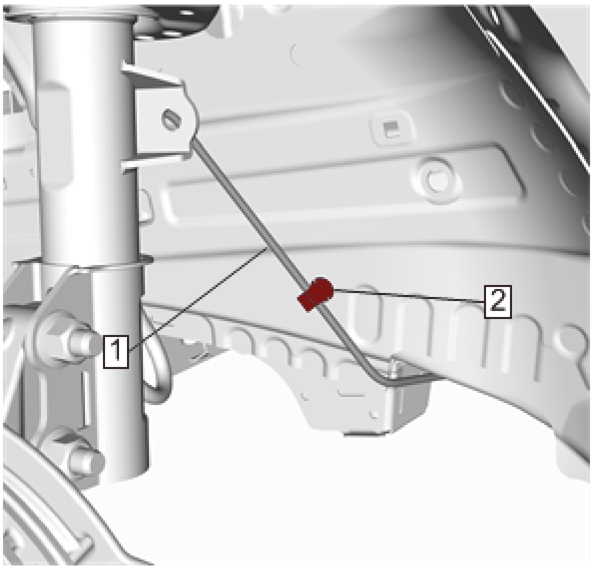


Fig. 86: Front Brake Pipe And Brake Pipe Clip
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Pipe (1) @ Brake Pipe Clip (2)

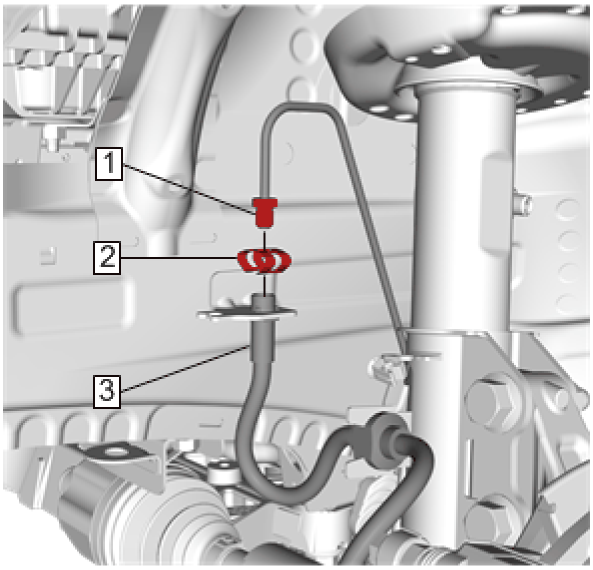


Fig. 87: Front Brake Pipe Fitting, Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Brake Hose Retainer (2)

CAUTION: **Refer to Fastener Caution .**

6. Install and tighten Front Brake Pipe Fitting (1) @ Front Brake Hose (3) to 18 N.m (13 lb ft)

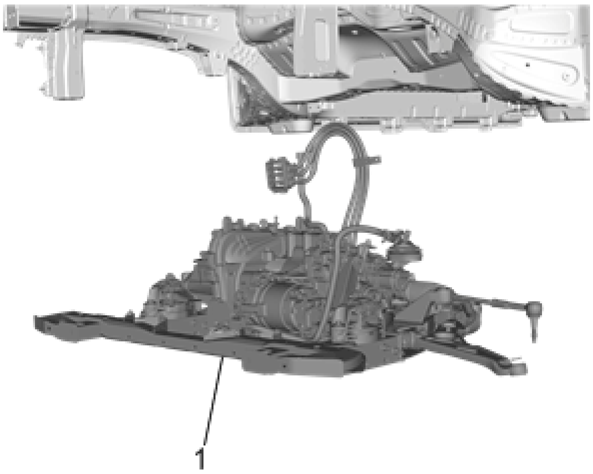


Fig. 88: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to **Drivetrain and Front Suspension Frame Removal and Installation**

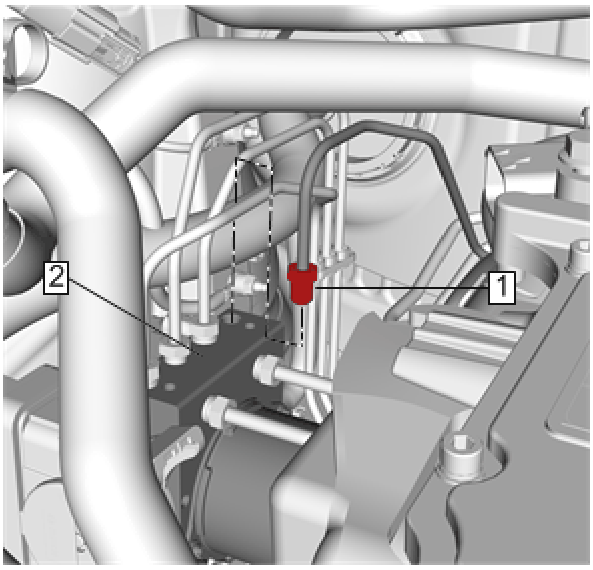


Fig. 89: Front Brake Pipe Fitting And Brake Pressure Modulator Valve
Courtesy of GENERAL MOTORS COMPANY

8. Install and tighten Front Brake Pipe Fitting (1) @ Brake Pressure Modulator Valve (2) to 18 N.m (13 lb ft)

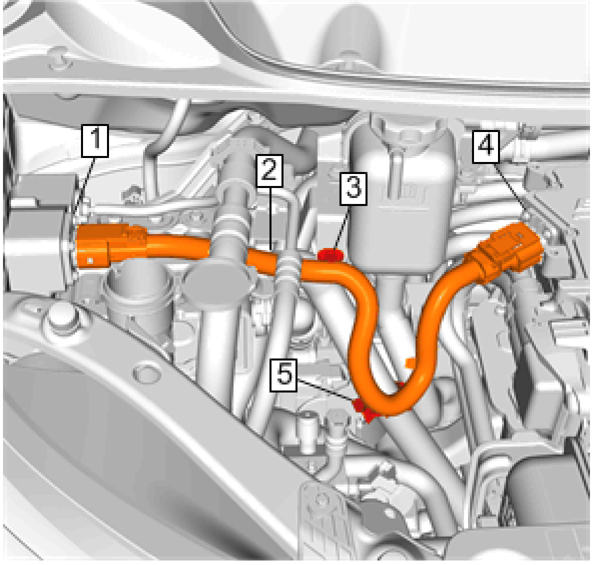


Fig. 90: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

9. Install Drive Motor Battery Positive and Negative Cable (1). Refer to **Drive Motor Battery Positive and Negative Cable Replacement**
10. Install the heater surge tank to the heater surge tank bracket. Refer to **Heater Coolant Surge Tank Replacement**
11. Enable the high voltage system. Refer to **High Voltage Enabling**
12. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding**

FRONT BRAKE HOSE REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.

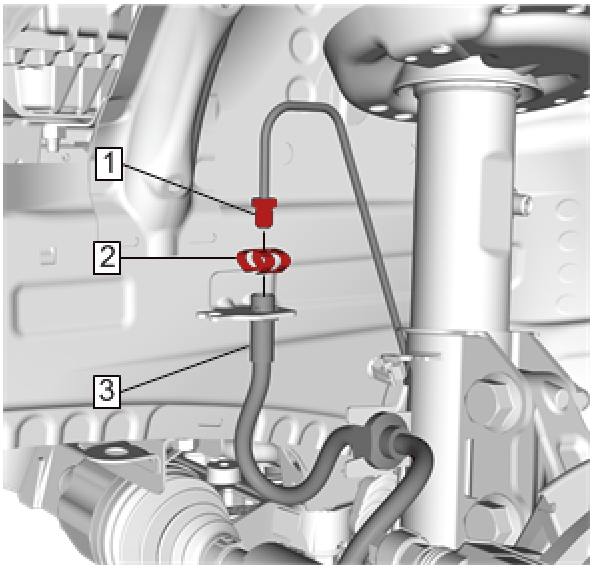


Fig. 91: Front Brake Pipe Fitting, Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fitting to prevent brake fluid loss and contamination.**

4. Remove Front Brake Pipe Fitting (1) @ Front Brake Hose (3)
5. Remove Front Brake Hose Retainer (2)

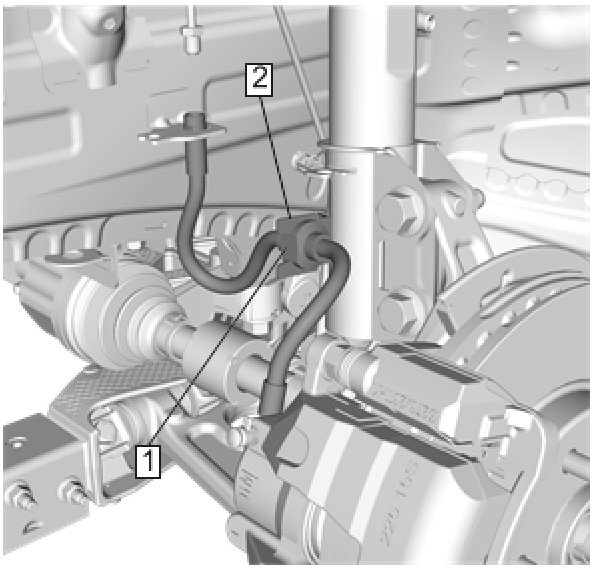


Fig. 92: Front Brake Hose And Front Suspension Strut Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Unclip Front Brake Hose (1) @ Front Suspension Strut Mounted Bracket (2)

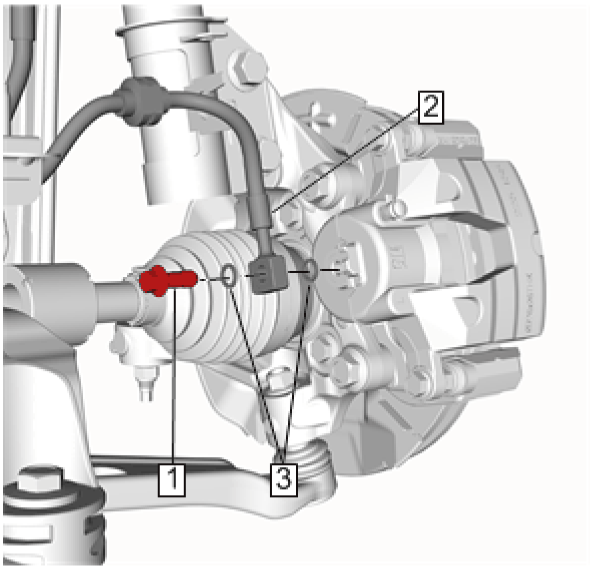


Fig. 93: Front Brake Hose, Fitting Bolt And Washers
Courtesy of GENERAL MOTORS COMPANY

7. Remove Front Brake Hose Fitting Bolt (1) @ Front Brake Caliper
8. Remove Front Brake Hose (2) @ Front Brake Caliper
9. Remove and DISCARD Front Brake Hose Washers (3) (Qty: 2)

NOTE: **These washers may be stuck to the brake caliper and/or the brake hose end.**

Installation Procedure

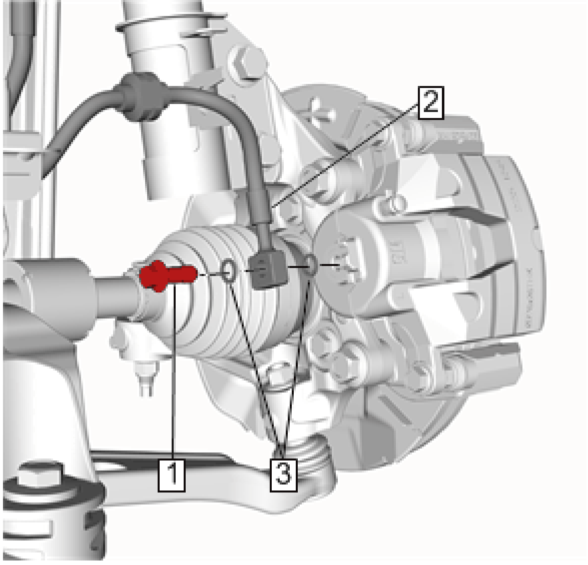


Fig. 94: Front Brake Hose, Fitting Bolt And Washers
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do NOT reuse the brake hose washers.**

1. Install NEW Front Brake Hose Washers (3) (Qty: 2). Install NEW.
2. Install Front Brake Hose (2) @ Front Brake Caliper

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Front Brake Hose Fitting Bolt (1) @ Front Brake Caliper to 40 N.m (30 lb ft)

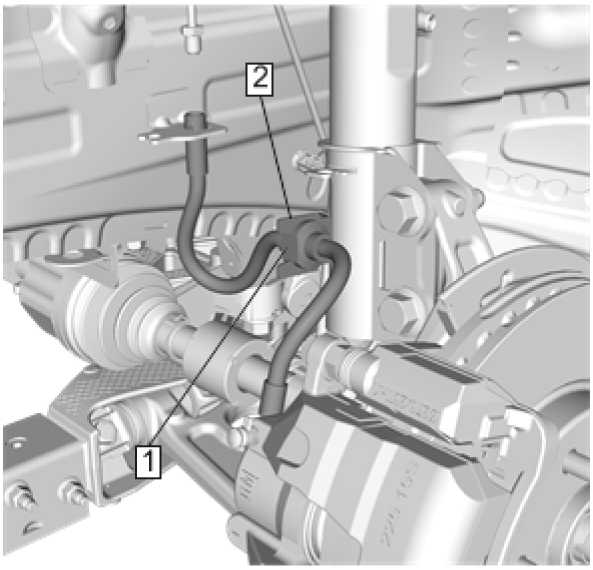


Fig. 95: Front Brake Hose And Front Suspension Strut Mounted Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Hose (1) @ Front Suspension Strut Mounted Bracket (2)

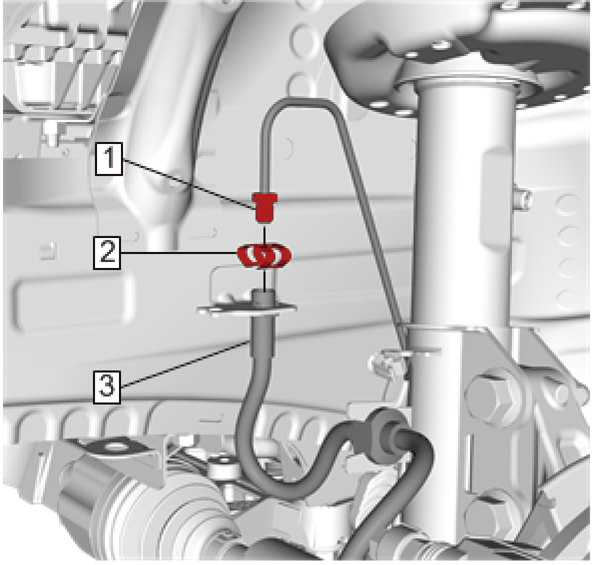


Fig. 96: Front Brake Pipe Fitting, Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Brake Hose Retainer (2)
6. Install and tighten Front Brake Pipe Fitting (1) @ Front Brake Hose (3) to 18 N.m (13 lb ft)
7. Bleed the brake system. Refer to Hydraulic Brake System Bleeding
8. Install the front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
9. Lower the vehicle.

REAR BRAKE PIPE REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle
2. Remove the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.

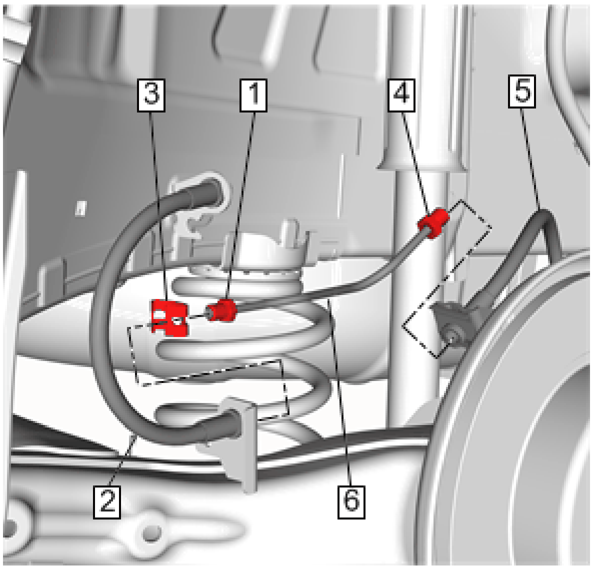


Fig. 97: Rear Brake Pipe, Fittings, Hoses And Retainer
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fitting to prevent brake fluid loss and contamination.**

4. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Hose (2)

5. Remove Rear Brake Pipe Fitting (4) @ Rear Brake Front Hose (5)
6. Remove Rear Brake Pipe (6) @ Vehicle
7. Remove Rear Brake Hose Retainer (3)

Installation Procedure

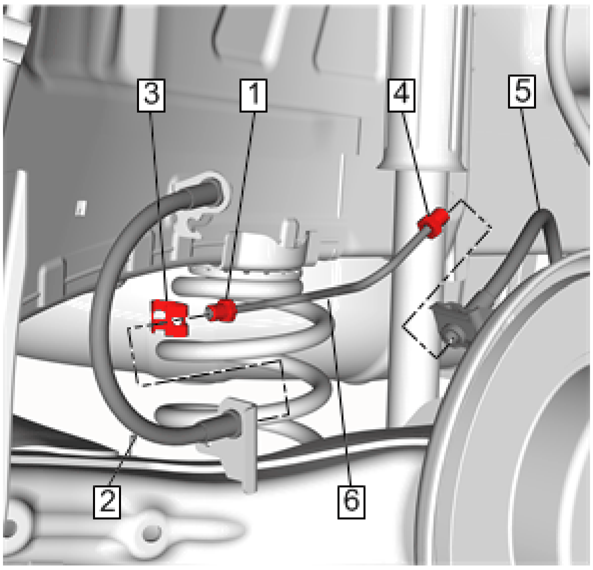


Fig. 98: Rear Brake Pipe, Fittings, Hoses And Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Brake Hose Retainer (3)
2. Install Rear Brake Pipe (6) @ Vehicle

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Rear Brake Pipe Fitting (4) @ Rear Brake Front Hose (5) to 18 N.m (13 lb ft)
4. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Hose (2) to 18 N.m (13 lb ft)
5. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding**
6. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
7. Lower the vehicle.

REAR BRAKE FRONT HOSE REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.

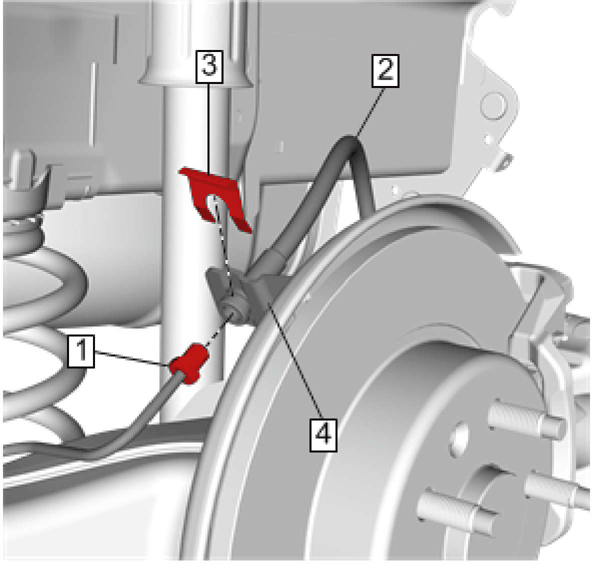


Fig. 99: Rear Brake Pipe Fitting, Rear Brake Front Hose, Clip And Bracket
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Cap the brake pipe fitting to prevent brake fluid loss and contamination.**

4. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Front Hose (2)
5. Remove Rear Brake Hose Clip (3) @ Rear Brake Hose Bracket (4)

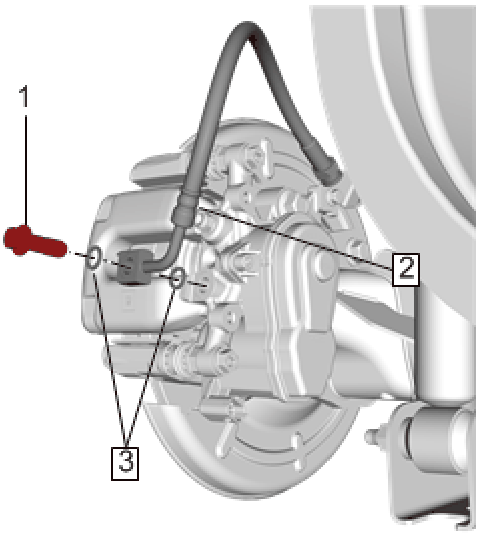


Fig. 100: Rear Brake Front Hose, Fitting Bolt And Sealing Washers
Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Brake Hose Fitting Bolt (1) @ Rear Brake Caliper
7. Remove Rear Brake Front Hose (2) @ Rear Brake Caliper
8. Remove and DISCARD Rear Brake Hose Washers (3) (Qty: 2)

NOTE: **These washers may be stuck to the brake caliper and/or the brake hose end.**

Installation Procedure

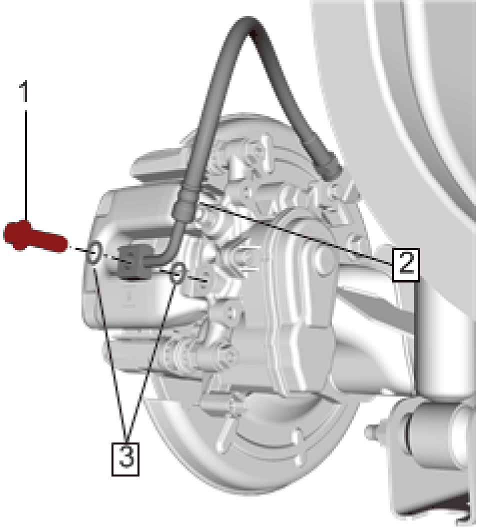


Fig. 101: Rear Brake Front Hose, Fitting Bolt And Sealing Washers
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do NOT reuse the brake hose washers.**

1. Install NEW Rear Brake Hose Washers (3) (Qty: 2). Install NEW.
2. Install Rear Brake Front Hose (2) @ Rear Brake Caliper

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Rear Brake Hose Fitting Bolt (1) @ Rear Brake Caliper to 40 N.m (30 lb ft)

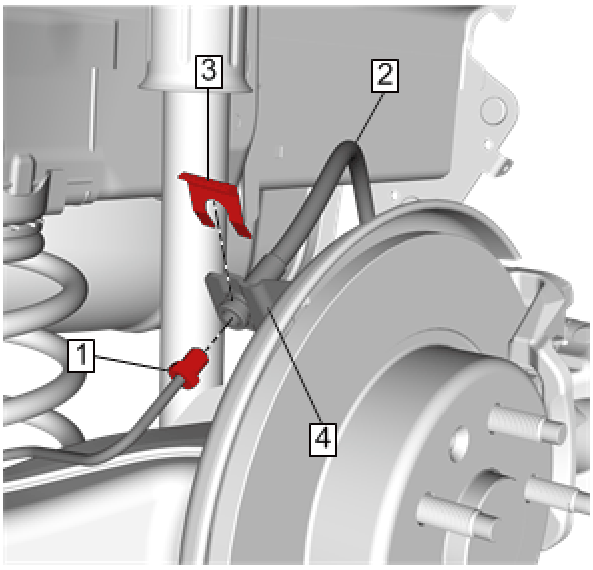


Fig. 102: Rear Brake Pipe Fitting, Rear Brake Front Hose, Clip And Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Install Rear Brake Hose Clip (3) @ Rear Brake Hose Bracket (4)
5. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Front Hose (2) to 18 N.m (13 lb ft)
6. Bleed the brake system. Refer to Hydraulic Brake System Bleeding
7. Install the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
8. Lower the vehicle.

REAR BRAKE HOSE REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle
2. Remove the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
3. Clean all dirt and foreign material from the brake hose ends and the brake pipe fitting.
4. Unclip Rear Wheel Speed Sensor Harness @ Rear Brake Hose

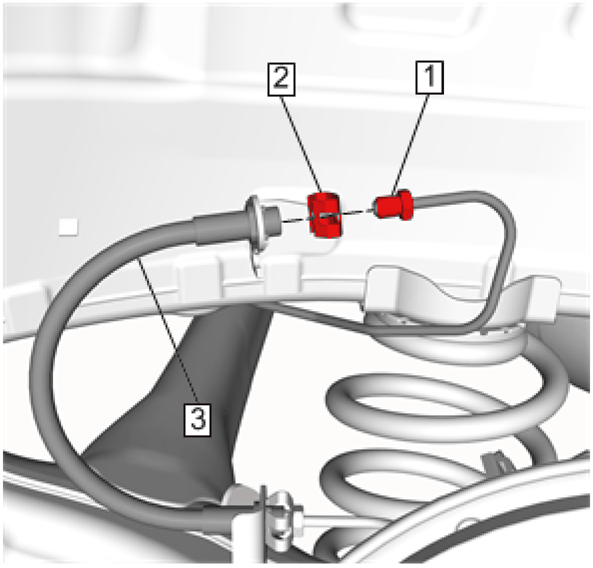


Fig. 103: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

NOTE: Cap the brake pipe fitting to prevent brake fluid loss and contamination.

5. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3)
6. Remove Rear Brake Hose Retainer (2)

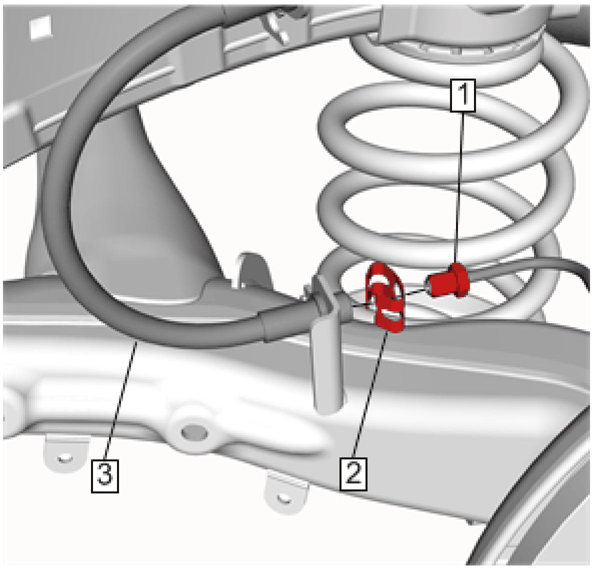


Fig. 104: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

7. Remove Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3)
8. Remove Rear Brake Hose Retainer (2)
9. Remove Rear Brake Hose (3) @ Vehicle

Installation Procedure

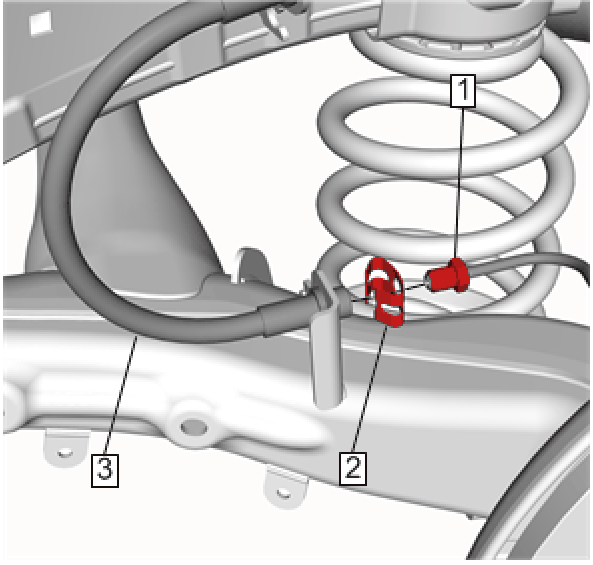


Fig. 105: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Brake Hose (3) @ Vehicle
2. Install Rear Brake Hose Retainer (2)

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3) to 18 N.m (13 lb ft)

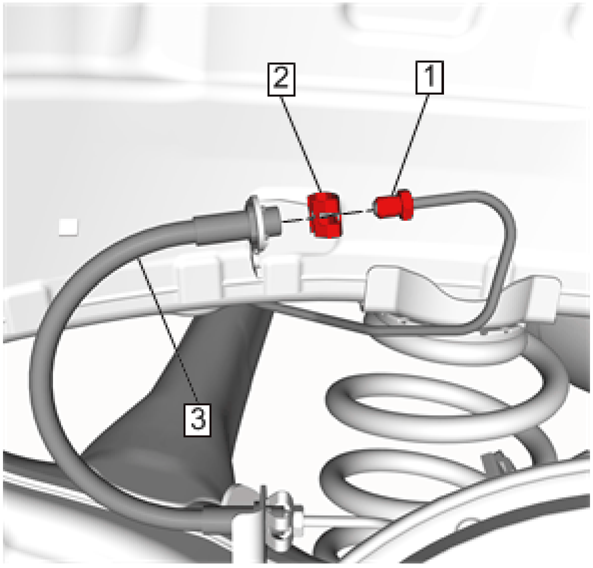


Fig. 106: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install Rear Brake Hose Retainer (2)
5. Install and tighten Rear Brake Pipe Fitting (1) @ Rear Brake Hose (3) to 18 N.m (13 lb ft)
6. Clip Rear Wheel Speed Sensor Harness @ Rear Brake Hose
7. Bleed the brake system. Refer to Hydraulic Brake System Bleeding
8. Install the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
9. Lower the vehicle.

HYDRAULIC BRAKE SYSTEM BLEEDING

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

CAUTION: **Only use products that comply with GM specifications and check**

manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.

If hydraulic components were serviced on only one wheel hydraulic circuit, perform the following procedure.

Bleeding a Single Hydraulic Brake Circuit

1. Place the Power button in the Service Only Mode.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Adhesives, Fluids, Lubricants, and Sealers**

NOTE: **The pressure bleeding equipment must be the diaphragm type. The rubber diaphragm between the air supply and the brake fluid prevents air, moisture, oil, and other contaminants from entering the hydraulic system.**

5. Following the brake pressure bleeder manufacturer's instructions, fill the brake pressure bleeder with GM approved brake fluid from a clean, sealed brake fluid container.
6. Install the appropriate master cylinder reservoir adapter and connect the brake pressure bleeder.
7. Charge the brake pressure bleeder air tank to 170-200 kPa/1.7-2.0 bar (25-30 psi), or as recommended by the brake pressure bleeder manufacturer's instructions.
8. Open the brake pressure bleeder fluid tank valve to allow pressurized brake fluid to enter the brake hydraulic system.

NOTE: **Any brake fluid leaks identified require repair prior to completing this procedure.**

9. Wait approximately 30 seconds, then inspect the entire hydraulic brake system for external brake fluid leaks.
10. Install a proper box-end wrench onto the wheel hydraulic circuit bleeder valve which has been serviced.
11. Install a transparent hose over the end of the bleeder valve.
12. Submerge the open end of the transparent hose into a transparent container partially filled with brake fluid from a clean, sealed brake fluid container.
13. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
14. Allow fluid to flow until air bubbles stop flowing from the bleeder.
15. After all air has been purged from the hydraulic circuit, tighten the bleeder valve and install the dust cap.

NOTE: **The brake reservoir may have residual pressure after the bleeding operation is complete. Wrap a clean shop towel around the bleeder adapter and all hose connections before disconnecting the pressure bleeding equipment to prevent brake fluid from contacting and damaging vehicle components and painted surfaces.**

16. Close the brake pressure bleeder fluid tank valve then disconnect the brake pressure bleeder from the master cylinder reservoir bleeder adapter.
17. Remove the master cylinder reservoir bleeder adapter from the master cylinder reservoir.
18. Fill the brake master cylinder reservoir to the maximum-fill level with GM approved brake fluid from a clean, sealed brake fluid container.
19. Slowly press and release the brake pedal. Observe the brake pedal feel.

20. If the brake pedal feels spongy, perform the Bleeding the Complete Brake Hydraulic System procedure:
21. Turn the ignition key ON, with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

NOTE: **DO NOT allow the vehicle to be driven until it is diagnosed and repaired.**

22. If the brake system warning lamp remains illuminated, refer to **Diagnostic Starting Point - Vehicle** .

Bleeding the Complete Brake Hydraulic System

1. Place the Power button in the Service Only Mode.
2. Place a clean shop cloth beneath the brake master cylinder to catch brake fluid spills.
3. Clean the outside of the reservoir on and around the reservoir cap prior to removing the cap and diaphragm.
4. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Adhesives, Fluids, Lubricants, and Sealers**

NOTE: **The pressure bleeding equipment must be the diaphragm type. The rubber diaphragm between the air supply and the brake fluid prevents air, moisture, oil, and other contaminants from entering the hydraulic system.**

5. Following the brake pressure bleeder manufacturer's instructions, fill the brake pressure bleeder with GM approved brake fluid from a clean, sealed brake fluid container.
6. Install the appropriate master cylinder reservoir adapter and connect the brake pressure bleeder.
7. Charge the brake pressure bleeder air tank to 170-200 kPa/1.7-2.0 bar (25-30 psi), or as recommended by the brake pressure bleeder manufacturer's instructions.
8. Open the brake pressure bleeder fluid tank valve to allow pressurized brake fluid to enter the brake hydraulic system.

NOTE: **Any brake fluid leaks identified require repair prior to completing this procedure.**

9. Wait approximately 30 seconds, then inspect the entire hydraulic brake system for external brake fluid leaks.
10. Install a proper box-end wrench onto the RIGHT REAR wheel hydraulic circuit bleeder valve.
11. Install a transparent hose over the end of the bleeder valve.
12. Submerge the open end of the transparent hose into a transparent container partially filled with GM approved brake fluid from a clean, sealed brake fluid container.
13. Loosen the bleeder valve to purge air from the wheel hydraulic circuit.
14. Allow fluid to flow until air bubbles stop flowing from the bleeder.
15. After all air has been purged from the hydraulic circuit, tighten the bleeder valve and install the dust cap.
16. Install a proper box-end wrench onto the LEFT REAR wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
17. Install a proper box-end wrench onto the RIGHT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
18. Install a proper box-end wrench onto the LEFT FRONT wheel hydraulic circuit bleeder valve, then repeat steps 12-16.
19. Close the brake pressure bleeder fluid tank valve.

NOTE: **The brake reservoir may have residual pressure after the bleeding operation is complete. Wrap a clean shop towel around the bleeder adapter and all hose connections before disconnecting the pressure**

bleeding equipment to prevent brake fluid from contacting and damaging vehicle components and painted surfaces.

20. Remove the brake pressure bleeding equipment from the vehicle.
21. Fill the brake master cylinder reservoir to the maximum-full level with GM approved brake fluid from a clean, sealed brake fluid container. Refer to **Adhesives, Fluids, Lubricants, and Sealers**
22. Slowly press and release the brake pedal. Observe the brake pedal feel.
23. If the brake pedal feels spongy, perform the following procedure.
    1. If equipped with antilock brakes, install a scan tool and perform the **Antilock Brake System Automated Bleed** to remove air which may be trapped in the BPMV.
    2. Inspect the hydraulic brake system for external leaks. Refer to **Brake System External Leak Inspection**
    3. Repeat the Bleeding the Complete Brake Hydraulic System procedure.
24. If the brake pedal still feels spongy, pressure bleed the hydraulic brake system. Refer to **Hydraulic Brake System Bleeding**
25. Turn the ignition switch ON with the engine OFF. Check to see if the brake system warning lamp remains illuminated.

NOTE: **DO NOT allow the vehicle to be driven until the brake system is diagnosed and repaired.**

26. If the brake system warning lamp remains illuminated, refer to **Diagnostic Starting Point - Vehicle** .

HYDRAULIC BRAKE SYSTEM FLUSHING

WARNING: **Refer to Brake Fluid Irritant Warning .**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

CAUTION: **Only use products that comply with GM specifications and check manufacturer information respectively. We recommend the use of GM genuine products. Instructions must be followed at all times. The use of any type of fluid other than the recommended type of brake fluid, may cause contamination which could result in damage to the internal rubber seals and/or rubber linings of hydraulic brake system components.**

1. Inspect the brake fluid for the following conditions, indicating brake fluid contamination:
    - Fluid separation, indicating two types of fluid are present; a substance other than the recommended brake fluid has been introduced into the brake hydraulic system
        - Swirled appearance - oil-based substance
        - Layered appearance - silicone-based substance
    - Fluid discoloration, indicating the presence of moisture or particles that have been introduced into the brake hydraulic system
        - Cloudy appearance - moisture
        - Dark appearance/suspended particles in fluid - dirt, rust, corrosion, brake dust
2. Inspect the master cylinder reservoir cap diaphragm and the reservoir-to-master cylinder grommets for swelling, indicating brake fluid contamination.
3. If the brake fluid WAS contaminated with an oil-based or a silicone-based substance, indicated by fluid separation and/or a swollen master cylinder reservoir cap diaphragm and/or swollen reservoir-to-master cylinder grommets, perform the following:
    1. Remove ALL of the following components listed from the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

       Refer to the procedures indicated as applicable:

    - **Master Cylinder Replacement**
    - **Front Brake Hose Replacement**
    - **Rear Brake Hose Replacement**
    - **Front Brake Caliper Replacement**
    - **Rear Brake Caliper Replacement**
    - **Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement**
  2. Clean out all the hydraulic brake pipes using denatured alcohol, or equivalent.
  3. Dry the brake pipes using non-lubricated, filtered air.
  4. Repair or replace ALL of the following components listed and install them to the vehicle. Each component contains internal rubber seals/linings which have been contaminated by the contaminated brake fluid in the brake hydraulic system.

     Refer to the procedures indicated as applicable:

     - **Master Cylinder Replacement** ; also perform the following:

       Clean the brake master cylinder reservoir using denatured alcohol, or equivalent, then dry the reservoir using non-lubricated, filtered air. Inspect the reservoir for cracks and/or damage and replace if necessary. **Master Cylinder Reservoir Replacement**

       Replace the brake master cylinder reservoir cap.

     - **Front Brake Hose Replacement**
     - **Rear Brake Hose Replacement**
     - **Front Brake Caliper Replacement**
     - **Rear Brake Caliper Replacement**
     - **Electronic Brake Control Module with Brake Pressure Modulator Valve Replacement**

4. If the brake fluid was NOT contaminated with an oil-based or a silicone-based substance, but WAS contaminated with water or dirt, rust, corrosion, and/or brake dust, replace the brake master cylinder reservoir cap. The diaphragm may have allowed the moisture or particles to enter the hydraulic system.
5. Fill the brake master cylinder reservoir to the maximum-fill level with GM recommended brake fluid. Refer to **Adhesives, Fluids, Lubricants, and Sealers**
6. Pressure bleed the hydraulic brake system. Begin the procedure with the pressure bleeder reservoir filled to the maximum-fill level with the correct brake fluid as indicated. Refer to **Hydraulic Brake System Bleeding**

POWER BRAKE MASTER CYLINDER BOOSTER ASSEMBLY REPLACEMENT

Removal Procedure

WARNING: **Refer to Brake Fluid Irritant Warning .**

WARNING: **Use of eye goggles is necessary to prevent personal injury.**

CAUTION: **Refer to Brake Fluid Effects on Paint and Electrical Components Caution .**

1. Remove Brake Master Cylinder. Refer to **Master Cylinder Replacement**

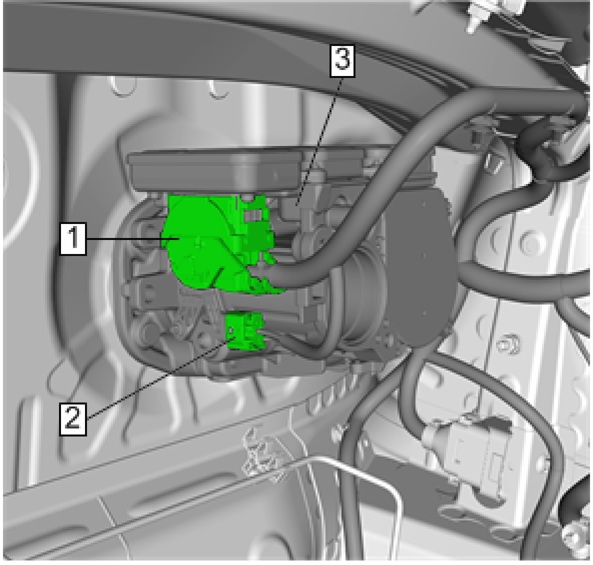


Fig. 107: Power Brake Booster And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Brake Booster Control Module Electrical Connector (1) @ Power Brake Booster (3)
3. Disconnect Brake Control Brake Pedal Position Sensor Electrical Connector (2) @ Power Brake Booster (3)

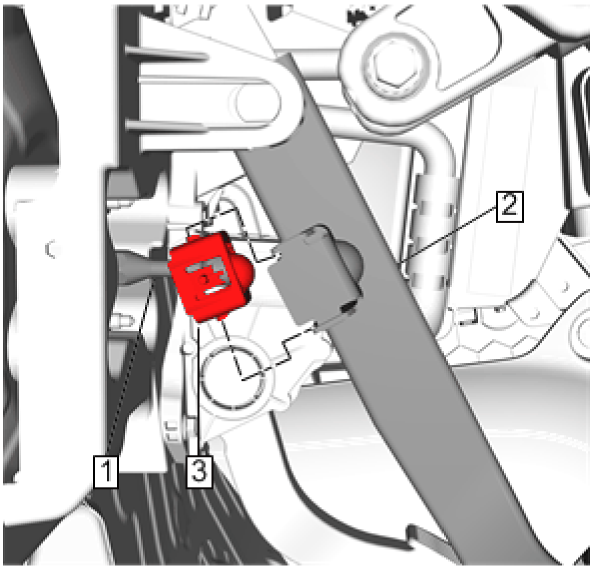


Fig. 108: Brake Pedal, Pushrod And Click Fit Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Brake Pedal Pushrod (1) @ Brake Pedal (2)

   Press the 2 tabs of the click fit connector (3) together and pull the brake pedal a bit to facilitate the removal.

5. Remove and DISCARD Click Fit Connector (3) @ Brake Pedal Pushrod (1)

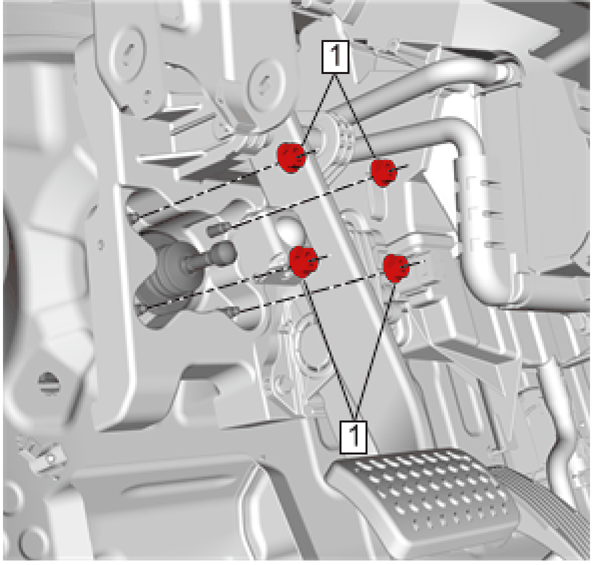


Fig. 109: Brake Pedal Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Remove Brake Pedal Nuts (1) (Qty: 4)

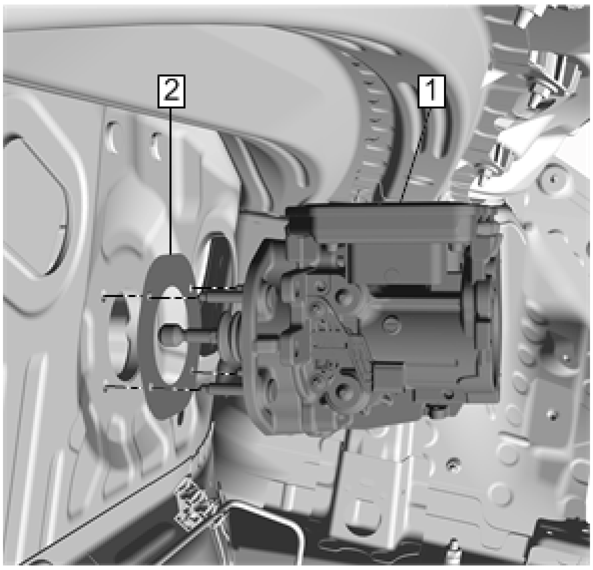


Fig. 110: Power Brake Booster And Brake Master Cylinder Spacer Gasket
Courtesy of GENERAL MOTORS COMPANY

7. Remove Power Brake Booster (1) @ Vehicle
8. Remove and DISCARD Brake Master Cylinder Spacer Gasket (2) @ Power Brake Booster (1)

Installation Procedure

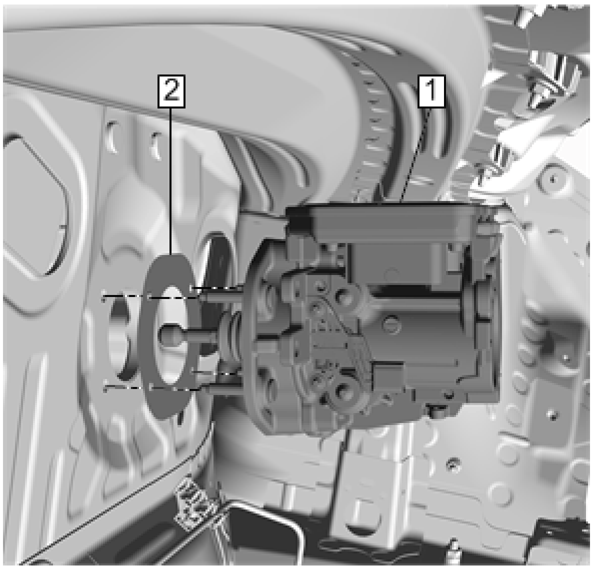


Fig. 111: Power Brake Booster And Brake Master Cylinder Spacer Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW Brake Master Cylinder Spacer Gasket (2) @ Power Brake Booster (1).
2. Install Power Brake Booster (1) @ Vehicle

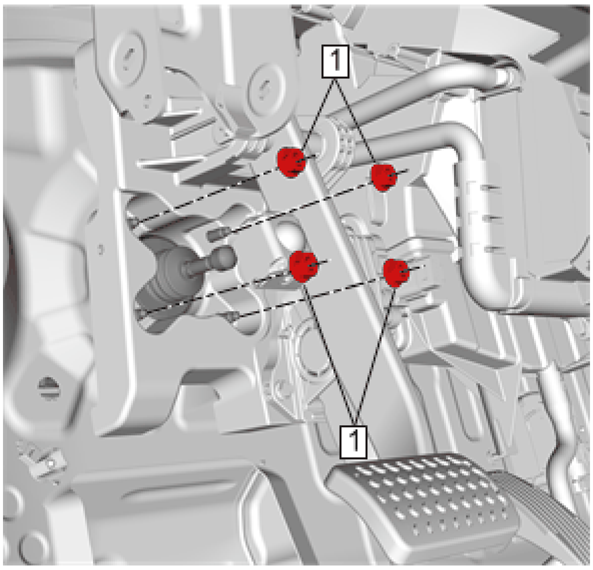


Fig. 112: Brake Pedal Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install and tighten Brake Pedal Nuts (1) (Qty: 4) to 22 N.m (16 lb ft)

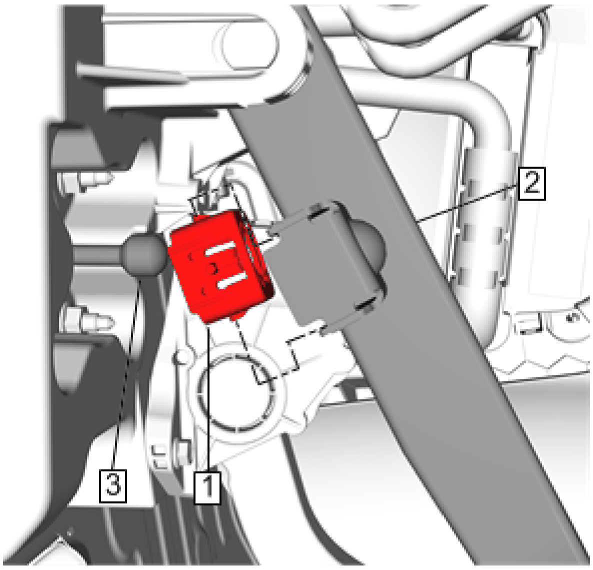


Fig. 113: Brake Pedal, Pushrod And Click Fit Connector
Courtesy of GENERAL MOTORS COMPANY

4. Install NEW Click Fit Connector (1) @ Brake Pedal (2)
5. Connect Brake Pedal Pushrod (3) @ Brake Pedal (2)

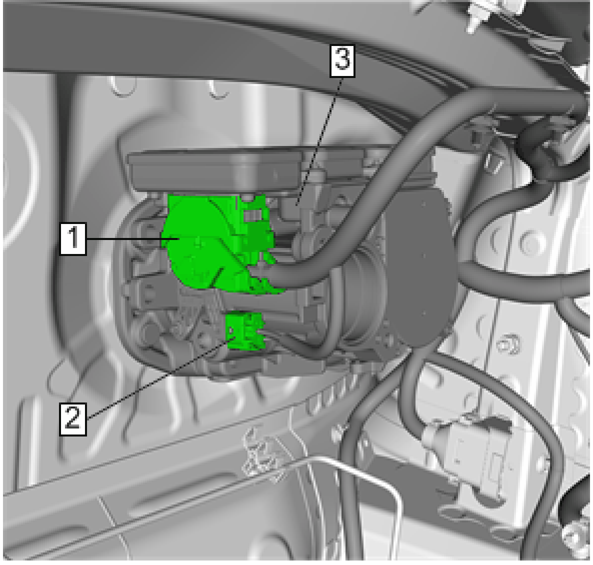


Fig. 114: Power Brake Booster And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

6. Connect Brake Control Brake Pedal Position Sensor Electrical Connector (2) @ Power Brake Booster (3)
7. Connect Brake Booster Control Module Electrical Connector (1) @ Power Brake Booster (3)
8. Install Brake Master Cylinder. Refer to **Master Cylinder Replacement**
9. Bleed the brake system. Refer to **Hydraulic Brake System Bleeding**
10. Program and calibrate the power brake booster control module. Refer to **Control Module References**

DESCRIPTION AND OPERATION

POWER BRAKE BOOSTER DESCRIPTION AND OPERATION

Power Brake Booster Description and Operation

The brake booster is an electromechanical brake booster that replaces a vacuum booster including its vacuum supply. It is designed to make hybrid and electric vehicles more efficient by providing situation-dependent support when a driver initiates braking.

The brake booster unit takes the driver applied brake demand and transforms this into an amplified brake pressure and does not rely on vacuum to function. The brake booster unit is designed to operate together with an electronic stability control module which is normally responsible for ABS, traction control and stability control.

Since the brake booster unit operates electromechanically, it does not require vacuum from the engine and recovers almost all the energy lost in typical braking. It uses electrical current only during braking.

The brake booster unit consists of a PSM motor for force build up, and ECU for the control of the brake booster, a stage gear control to transmit the motor torque to the output pressure in the master cylinder, a vehicle interface to connect the brake booster and the vehicle, a pedal coupling unit to couple the brake booster with the vehicle pedal unit, a pedal travel sensor to detect the driver brake request, TMC to connect the brake booster with the braking system and a reservoir to support the braking system with brake fluid.

For maximum efficiency, a hybrid or EV must recover as much energy as possible when braking. Ideally, a vehicle would be slowed down purely by the electric motor, avoiding the loss of valuable energy through braking. The system recovers almost all the energy lost in typical braking operations by ensuring deceleration rates of up to 0.3 g are achieved using the electric motor alone. If the brakes are applied harder, the brake booster system generates the additional braking pressure needed in the traditional way, using the brake master cylinder.

The brake booster unit is purely electromechanical, without brake fluid, which means it can be rotated flexibly about the longitudinal axis.

BRAKE WARNING SYSTEM DESCRIPTION AND OPERATION

Brake Warning Indicator

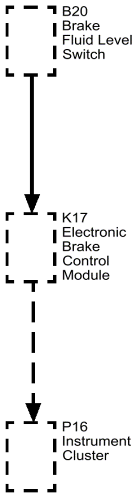


Fig. 115: Brake Warning System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
B20	B20 Brake Fluid Level Switch
K17	K17 Electronic Brake Control Module

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check. The brake warning indicator illuminates for 5 seconds.
- When the EBCM detects a too low brake fluid level it sets a DTC and sends a serial data message to the instrument cluster, which will illuminate.

Electronic brake control module (EBCM) monitors the brake fluid level in the brake fluid reservoir. When the fluid within the brake fluid reservoir is below the MIN level, contacts within the brake fluid level switch closes causing the voltage within the signal circuit to drop. The electronic brake control module (EBCM) will detect the voltage drop and will send a serial data message to the instrument cluster commanding the brake warning indicator to illuminate.

HYDRAULIC BRAKE SYSTEM DESCRIPTION AND OPERATION

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.
Hydraulic output pressure is distributed from the master cylinder through 2 hydraulic circuits,

supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.
Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

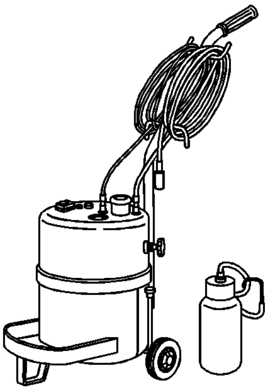
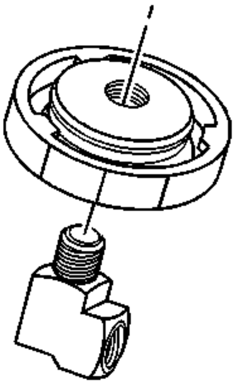
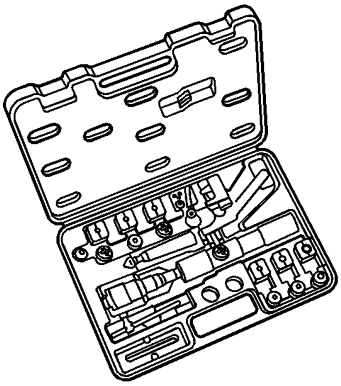
Converts hydraulic input pressure into mechanical output force.

System Operation

Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses linings against rotating brake system components.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	CH 29532-A J 29532-A Pressure Brake Bleeder
	CH 35589-A J 35589-A Brake Pressure Bleeder Adapter
	CH 45405 J 45405 Brake Pipe Flaring Kit

Back To Article

2017 BRAKES

Park Brake - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Park Brake Actuator Bolt	12 N.m (106 lb in)

SCHEMATIC WIRING DIAGRAMS

PARK BRAKE SYSTEM WIRING SCHEMATICS

Electric Park Brake

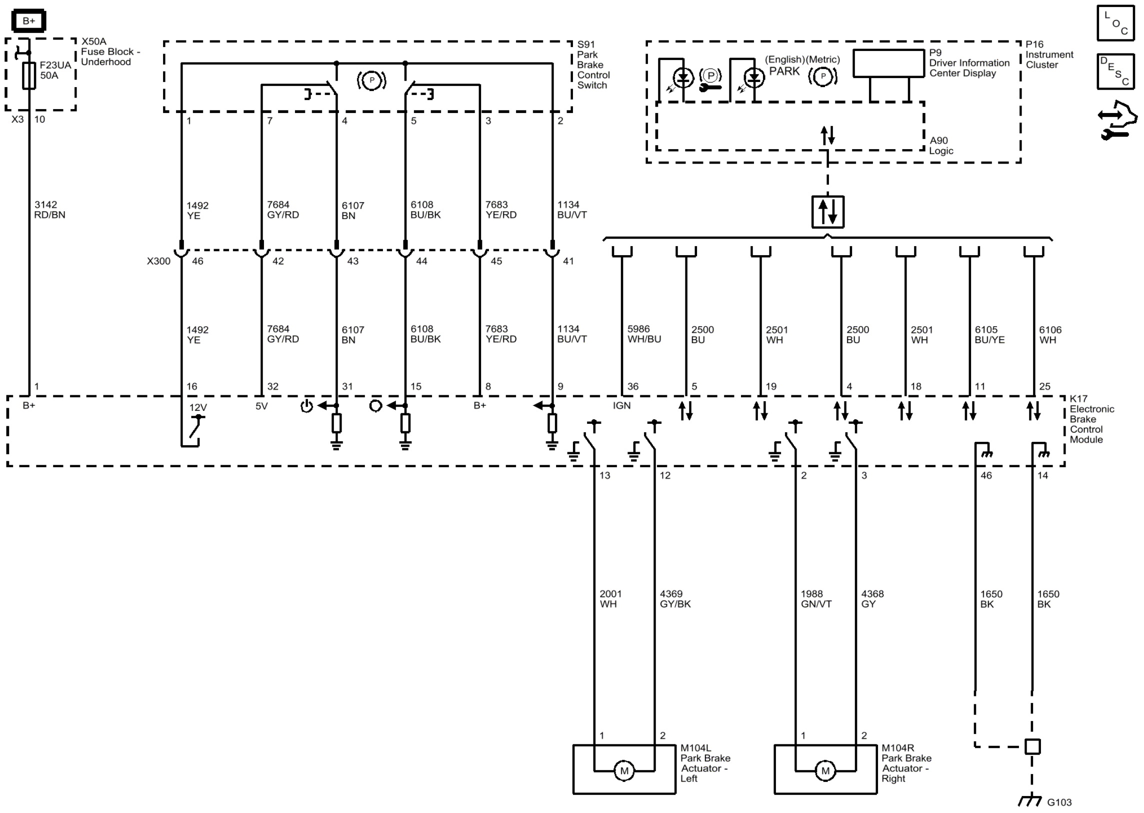

B+
X50A
Fuse Block -
Underhood
F23UA
50A
X3
10
3142
RD/BN
S91
Park
Brake
Control
Switch
1
7
4
5
3
2
1492
YE
7684
GY/RD
6107
BN
6108
BU/BK
7683
YE/RD
1134
BU/VT
X300
46
42
43
44
45
41
1492
YE
7684
GY/RD
6107
BN
6108
BU/BK
7683
YE/RD
1134
BU/VT
1
16
32
31
15
8
9
B+
12V
5V
B+
P16
Instrument
Cluster
(English)(Metric)
PARK
P9
Driver Information
Center Display
A90
Logic
LOC
DESC
5986
WH/BU
2500
BU
2501
WH
2500
BU
2501
WH
6105
BU/YE
6106
WH
36
5
19
4
18
11
25
IGN
K17
Electronic
Brake
Control
Module
13
12
2
3
46
14
2001
WH
4369
GY/BK
1988
GN/VT
4368
GY
1650
BK
1650
BK
1
2
M
M104L
Park Brake
Actuator -
Left
1
2
M
M104R
Park Brake
Actuator -
Right
G103

Fig. 1: Electric Park Brake
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C028B: PARK BRAKE MOTOR POSITION SENSOR - SIGNAL NOT PLAUSIBLE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC C028B 5A

Park Brake Motor Position Sensor - Signal Not Plausible

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

The Park Brake Motor Position Sensor is an internal sensor to the park brake actuator, this sensor is used to monitor the park brake motor position.

Conditions for Running the DTC

Ignition OFF, ACCESSORY, or RUN mode.

Conditions for Setting the DTC

The electronic brake control module detects a park brake actuator motor position sensor signal malfunction.

Action Taken When the DTC Sets

- The electric parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The electronic brake control module clears the history DTC when a current DTC is not detected in 40 ignition cycles.
- Calibrate the electronic brake control module.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC C028B is not set.
    - **If the DTC is set**
    1. Perform the Park Brake Calibration learn procedure. Refer to **Park Brake Calibration**.
    2. Vehicle ON.
    3. Apply and release the park brake.
    4. Verify the DTC is not set.
        - If the DTC is set, replace the K17 Electronic Brake Control Module.
        - If the DTC is not set
    5. All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification**

- **Control Module References** for control module replacement, programming and setup

DTC C028F: LEFT PARK BRAKE ACTUATOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC C028F

Left Park Brake Actuator Circuit

For symptom byte information, refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Park Brake Actuator Apply Control	C028F 02	C028F 04	C028F 01 C028F 0B C028F 63	C028F 00 C028F 0B
Left Park Brake Actuator Release Control	C028F 02	C028F 04	C028F 01 C028F 0B C028F 63	C028F 00 C028F 0B

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Ignition OFF, ACCESSORY, or RUN mode.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the left park brake actuator or its circuits.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Diagnostic Aids

After repairing any fault, the DTC will still be set as current and the park brakes will not function. It is necessary to clear the DTC with a scan tool in order to place the DTC in history and regain park brake function.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the M104L Park Brake Actuator - Left apply when pulling the S91 Park Brake Switch.
    - **If the M104L Park Brake Actuator - Left does not apply**

      Refer to the Circuit/System Testing.

    - **If the M104L Park Brake Actuator - Left does apply**
2. Verify the M104L Park Brake Actuator - Left release when pressing the S91 Park Brake Switch.

- **If the M104L Park Brake Actuator - Left does not release**

  Refer to the Circuit/System Testing.

- **If the M104L Park Brake Actuator - Left does release**

3. All OK.

Circuit/System Testing

NOTE: **It is necessary to clear the DTC after any repair is made to regain park brake output control and have the DTC to set as history.**

1. Ignition OFF, disconnect the harness connector at the M104L Park Brake Actuator - Left and the harness connector at the K17 Electronic Brake Control Module. Ignition ON
2. Test for less than 1 V between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
   - Terminal 12
   - Terminal 13
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
3. Ignition OFF.
4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
   - Terminal 12
   - Terminal 13
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
5. Test for less than 2 Ω between the M104L Park Brake Actuator - Left harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal 13
   - **If 2 Ω or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 Ω**
6. Test for less than 2 Ω between the M104L Park Brake Actuator - Left harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal 12
   - **If 2 Ω or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 2 Ω**
7. Install a 25 A fused jumper wire between one of the control terminals at the M104L Park Brake Actuator - Left and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M104L Park Brake Actuator - Left should perform the apply and release function.
   - **If the actuator does not perform the apply and release function**

     Replace the M104L Park Brake Actuator - Left.

   - **If the actuator performs the apply and release function**
8. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Parking Brake Actuator Replacement**
- **Control Module References** for control module replacement, programming and setup

DTC C0293: PARK BRAKE CONTROL SWITCH CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC C0293

Park Brake Control Switch Circuit

For symptom byte information, refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Park Brake Control Switch Supply Voltage Terminal 16	C0293 02	C0293 04, C0293 05	C0293 01, C0293 05	C0293 08
Park Brake Apply Switch Voltage Reference Terminal 32	C0293 02	C0293 04, C0293 05	C0293 01, C0293 05	C0293 08
Park Brake Release Switch Voltage Reference Terminal 8	C0293 02	C0293 04, C0293 05	C0293 01, C0293 05	C0293 08
Park Brake Control Switch Signal Terminal 9	C0293 02	C0293 04, C0293 05	C0293 01, C0293 05	C0293 08
Park Brake Apply Switch Signal Terminal 31	C0293 02	C0293 04, C0293 05	C0293 01, C0293 05	C0293 08
Park Brake Release Switch Signal Terminal 15	C0293 02	C0293 04, C0293 05	C0293 01, C0293 05	C0293 08

Circuit/System Description

The parking brake function is integrated into the Electronic Brake Control Module. The Electronic Brake Control Module contains the logic for applying and releasing the parking brake when commanded by the Park Brake Control Switch. The Electronic Brake Control Module will perform diagnostics on the Park Brake Control Switch and its wiring harness to verify it is functioning properly.

The Park Brake Control Switch diagnostic checks for failure conditions in the Park Brake Control Switch and associated wiring into the Electronic Brake Control Module.

Conditions for Running the DTC

Ignition OFF, ACCESSORY, or RUN mode.

Conditions for Setting the DTC

The Electronic Brake Control Module detects a short to battery, short to ground, open circuit, or an internal Parking Brake Control Switch malfunction. The Electronic Brake Control Module detects the apply or release button was activated for more than 90 s.

Action Taken When the DTC Sets

- The parking brake is disabled.

- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.
- The Park Brake Control Switch button is INACTIVE using the scan tool without the switch being activated.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Park Brake Control Switch parameter changes between Released and Apply while pressing and releasing the S91 Park Brake Control Switch.
    - **If the parameter does not change**

      Refer to Circuit/System Test.

    - **If the parameter changes**
3. All OK.

Circuit/System Test

1. Ignition OFF, disconnect the harness connector at the K17 Electronic Brake Control Module. Ignition ON.
2. Test for less than 1 V between each circuit terminals listed below and ground;
    - Terminal 16
    - Terminal 32
    - Terminal 9
    - Terminal 15
    - Terminal 31
    - Terminal 8
    - **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Ignition OFF.
4. Test for infinite resistance between the circuit terminals listed below and ground;
    - Terminal 16
    - Terminal 32
    - Terminal 9
    - Terminal 15
    - Terminal 31
    - Terminal 8
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
5. Test for less than 5 Ω between the circuit terminal 32 and the circuit terminal 31.
    - **If 5 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the S91 Park Brake Control Switch.
    2. Test for less than 2 Ω in the circuits end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S91 Park Brake Control Switch.
    - **If less than 5 Ω**
6. Test for less than 5 Ω between the circuit terminal 8 and the circuit terminal 15.
    - **If 5 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the S91 Park Brake Control Switch.
    2. Test for less than 2 Ω in the circuits end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S91 Park Brake Control Switch.
    - **If less than 5 Ω**
7. Test for less than 5 Ω between the circuit terminal 16 and the circuit terminal 9.
    - **If 5 Ω or greater**
    1. Ignition OFF, disconnect the harness connector at the S91 Park Brake Control Switch.
    2. Test for less than 2 Ω in the circuits end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the S91 Park Brake Control Switch.
    - **If less than 5 Ω**
8. Test for less than 5 Ω between the circuit terminal 9 and the circuit terminal 31 while closing the switch.
    - **If 5 Ω or greater**

      Replace the S91 Park Brake Control Switch.

    - **If less than 5 Ω**
9. Test for less than 5 Ω between the circuit terminal 9 and the circuit terminal 15 while closing the switch.
    - **If 5 Ω or greater**

      Replace the S91 Park Brake Control Switch.

    - **If less than 5 Ω**
10. Ignition OFF, all access doors closed, all vehicle systems OFF, disconnect the harness connector at the S91 Park Brake Control Switch.

11. Test for less than 10 Ω between the ground circuit terminal 8 at the S91 Park Brake Control Switch and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
12. Replace the S91 Park Brake Control Switch.
13. Verify that DTC C0293 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC sets**

      Replace the K17 Electronic Brake Control Module.

    - **If DTC does not set**
14. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Parking Brake Actuator Switch Replacement**
- **Control Module References** for module replacement, programming and setup.

DTC C1280 OR C1281: ELECTRIC PARK BRAKE AVAILABILITY STATUS MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C1280

Electric Park Brake Availability Status Message Counter Incorrect

DTC C1281

Electric Park Brake Availability Status Message Counter Incorrect

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	C1280, C1281, U1803	C1280, C1281, U1803	-	-
Ignition	C1280, C1281, U1803	C1280, C1281, U1803	-	-
Accessory Wakeup Serial Data	C1280, C1281, U1803	C1280, C1281, U1803	-	-
Low Speed GMLAN Serial Data	1	C1280, C1281, U1803	1	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Speed GMLAN Serial Data (+)	2	C1280, C1281, U1803, U0073	2	-
High Speed GMLAN Serial Data (-)	2	C1280, C1281, U1803, U0073	2	-
Powertrain High Speed GMLAN Serial Data (+)	C1280, C1281, U0074	C1280, C1281, U1803, U0074	C1280, C1281, U0074	-
Powertrain High Speed GMLAN Serial Data (-)	C1280, C1281, U0074	C1280, C1281, U1803, U0074	C1280, C1281, U0074	-
High Voltage Energy Management High Speed GMLAN Serial Data (+)	C1280, C1281, U007A	C1280, C1281, U1803, U007A	C1280, C1281, U007A	-
High Voltage Energy Management High Speed GMLAN Serial Data (-)	C1280, C1281, U007A	C1280, C1281, U1803, U007A	C1280, C1281, U007A	-
Ground	-	C1280, C1281, U1803	-	-
1. Scan Tool Does Not Communicate With Low Speed GMLAN Device 2. Scan Tool Does Not Communicate With High Speed GMLAN Device				

Circuit/System Description

The serial data circuit is the means by which the devices in the vehicle communicate with each other. Once the scan tool is connected to the serial data circuit through the data link connector (DLC), the scan tool can be used to monitor each device for diagnostic purposes and to check for diagnostic trouble codes (DTC). When the vehicle is on, each device communicating on the serial data circuit sends a state of health message to ensure that the device is operating properly. When a device stops communicating on the serial data circuit, for example if the device loses power or ground, the state of health message it normally sends on the serial data circuit disappears. Other devices on the serial data circuit, which expect to receive that state of health message, detect its absence; those devices in turn set a DTC associated with the loss of state of health of the non communicating device. A loss of serial data communications DTC does not represent a failure of the devices that contain the stored DTC.

Conditions for Running the DTC

The system voltage is between 9 - 16 V.

Conditions for Setting the DTC

A supervised periodic message from the electronic brake control module has not been received or the hybrid/EV powertrain control module 2 has detected an incorrect message counter.

Action Taken When the DTC Sets

DTC C1280 and C1281 are type A DTCs.

Conditions for Clearing the DTC

- DTC C1280 and C1281 are type A DTCs.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- Sometimes, while diagnosing a specific customer concern or after a repair, you may notice a history U-code present. However, there is no associated "current" or "active" status. Loss-of-communication U-codes such as these can set for a variety of reasons. Many times, they are transparent to the vehicle operator and technician, and/or have no associated symptoms.

Eventually, they will erase themselves automatically after a number of fault-free ignition cycles. This condition would most likely be attributed to one of these scenarios:

  - A device on the data communication circuit was disconnected while the communication circuit is awake.
  - Power to one or more devices was interrupted during diagnosis.
  - A low battery condition was present, so some devices stop communicating when battery voltage drops below a certain threshold.
  - Battery power was restored to the vehicle and devices on the communication circuit did not all re-initialize at the same time.
  - If a loss-of-communication U-code appears in history for no apparent reason, it is most likely associated with one of the scenarios above. These are all temporary conditions and should never be interpreted as an intermittent fault, causing you to replace a part.
- A device may have a U-code stored in history that does not require any repairs. Issues with late or corrupted messages between devices can be temporary with no apparent symptom or complaint; this does not mean the device is faulty. Do not replace a device based only on a history U-code.
- Do not replace a device reporting a U-code. The U-code identifies which device needs to be diagnosed for a communication issue.
- Communication may be available between the device and the scan tool with one or more GMLAN serial data systems inoperative. This condition is due to the device using multiple GMLAN busses.
- Use **Data Link References** to determine what GMLAN serial data communications the non communicating device uses.
- The device may not have internal protection for specific control circuits and may open a B+ or ignition fuse. If a fuse is open and the B+ or ignition circuit is not shorted to ground, ensure none of the control circuits are shorted to ground before replacing the non communicating device.

Reference Information

Schematic Reference

- **Data Communication Schematics**
- **Control Module References**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Data Link Communications Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U0073, U0074, U0077, U0078, U007A, U1814, U2099, B1325, B1330, B1370, B1380, B1424, B1428, B1440, B1441, B1517, C0800, C0899, C12E1, P0560, or P0562 is not set.
   - **If any of the DTCs are set**

   Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**

3. Refer to Circuit/System Testing.

Circuit/System Testing

NOTE: **Use the schematics and connector end views to identify the device's ground, B+, ignition, accessory wake up serial data, and serial data circuit terminals.**

1. Vehicle OFF, all access doors closed, all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the K17 Electronic Brake Control Module.
2. Test for less than 10 Ω between the following ground circuit terminals and ground:
   - Terminal 14
   - Terminal 46
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K17 Electronic Brake Control Module.
   - **If the test lamp illuminates**
5. Verify a test lamp illuminates between the ignition circuit terminal 36 and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the harness connectors at the K9 Body Control Module.
   2. Test for infinite resistance between the ignition circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the ignition circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K9 Body Control Module.
   - **If the test lamp illuminates**
6. Vehicle OFF, all access doors closed, all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connectors at the K114B Hybrid/EV Powertrain Control Module 2.
7. Test for less than 2 Ω in each serial data circuits end to end between the K17 Electronic Brake Control Module and the K114B Hybrid/EV Powertrain Control Module 2.
   - **If 2 Ω or greater**

Repair the open/high resistance in the serial data circuit.

- **If less than 2 Ω**

8. Reconnect all of the harness connectors at the K17 Electronic Brake Control Module and the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
9. Program the K17 Electronic Brake Control Module. Refer to **Electronic Brake Control Module Programming and Setup**
10. Vehicle in Service Mode. Apply and release the park brake.
11. Verify that DTC C1280 or C1281 is not set.
    - **If DTC C1280 or C1281 is set**
    1. Replace the K17 Electronic Brake Control Module.
    2. Vehicle in Service Mode.
    3. Verify that DTC C1280 or C1281 is not set.
        - If DTC C1280 or C1281 is set, replace the K114B Hybrid/EV Powertrain Control Module 2.
        - If DTC C1280 or C1281 is not set
    4. All OK.
    - **If DTC C1280 or C1281 is not set**
12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup.

DTC C1303: AUTOMATIC PARK BRAKE FUNCTION MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C1303

Automatic Park Brake Function Malfunction

Circuit/System Description

For an overview of the component/system, refer to:**Electronic Parking Brake Description**

Conditions for Running the DTC

System Voltage= 9 to 16 V

Conditions for Setting the DTC

Electric Park Brake=Inoperative - When requested by the One-Pedal Driving function.

Actions Taken When the DTC Sets

One-Pedal Driving=Unavailable

Conditions for Clearing the DTC

- Malfunction=Not Present
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

- **Park Brake System Schematics**
- **Hybrid/EV Controls Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On / Vehicle - In Service Mode
2. Verify no other DTCs are set.
    - **If any other DTCs are set**

      Refer to:**Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other DTCs are set**
3. Perform all necessary programming and setup procedures for the control module:K17 Electronic Brake Control Module
4. Ignition - On / Vehicle - In Service Mode
5. Apply the parking brake.
6. Release the parking brake.
7. Verify the DTC does not set.
    - **If DTC C1303 is set**
    1. Replace the component:K17 Electronic Brake Control Module
    2. Ignition - On / Vehicle - In Service Mode
    3. Verify DTC C1303 is not set.
        - If the DTC sets - Replace the component:K114A Hybrid/EV Powertrain Control Module 1
        - If DTC C1303 is not set
    4. All OK.
    - **If DTC C1303 is not set**
8. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- For control module replacement, programming, and setup refer to: **Control Module References**

DTC C1586: RIGHT PARK BRAKE ACTUATOR CIRCUIT (HEV)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC C1586

Right Park Brake Actuator Circuit

For symptom byte information, refer to: **Symptom Byte List**

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Right Park Brake Actuator Apply Control	C1586 0C	C1586 04	C1586 0B	C1586 00 C1586 0F
Right Park Brake Actuator Release Control	C1586 0C	C1586 04	C1586 0B	C1586 00 C1586 0F

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Vehicle ON or in SERVICE MODE.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the right park brake actuator or its circuits.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Diagnostic Aids

After repairing any fault, the DTC will still be set as current and the park brakes will not function. It is necessary to clear the DTC with a scan tool in order to place the DTC in history and regain park brake function.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the M104R Park Brake Actuator - Right apply when pulling the S91 Park Brake Switch.
   - **If the M104R Park Brake Actuator - Right does not apply**

     Refer to the Circuit/System Testing.

   - **If the M104R Park Brake Actuator - Right does apply**
2. Verify the M104R Park Brake Actuator - Right release when pressing the S91 Park Brake Switch.
   - **If the M104R Park Brake Actuator - Right does not release**

     Refer to the Circuit/System Testing.

   - **If the M104R Park Brake Actuator - Right does release**
3. All OK.

Circuit/System Testing

NOTE: **It is necessary to clear the DTC after any repair is made to regain park brake output control and have the DTC to set as history.**

1. Ignition OFF, disconnect the harness connector at the M104R Park Brake Actuator - Right and the harness connector at the K17 Electronic Brake Control Module. Ignition ON
2. Test for less than 1 V between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
   - Terminal 2
   - Terminal 3
   - **If 1 V or greater**

     Repair the short to voltage on the circuit.

   - **If less than 1 V**
3. Ignition OFF.
4. Test for infinite resistance between the K17 Electronic Brake Control Module harness connector terminals listed below and ground:
   - Terminal 2
   - Terminal 3

    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**

5. Test for less than 2 Ω between the M104R Park Brake Actuator - Right harness connector terminal 1 and the K17 Electronic Brake Control Module harness connector terminal 2
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**

6. Test for less than 2 Ω between the M104R Park Brake Actuator - Right harness connector terminal 2 and the K17 Electronic Brake Control Module harness connector terminal 3
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**

7. Install a 25 A fused jumper wire between one of the control terminals at the M104R Park Brake Actuator - Right and 12 V. Momentarily install a jumper wire between the other control terminal and ground. Reverse the jumper wires at least two times, the M104R Park Brake Actuator - Right should perform the apply and release function.
    - **If the actuator does not perform the apply and release function**

      Replace the M104R Park Brake Actuator - Right.

    - **If the actuator performs the apply and release function**

8. Replace the K17 Electronic Brake Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Parking Brake Actuator Replacement**
- **Control Module References** for control module replacement, programming and setup

DTC C1587: LEFT PARK BRAKE ACTUATOR (HEV)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC C1587

Left Park Brake Actuator

For symptom byte information, refer to: **Symptom Byte List**

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Vehicle ON or in SERVICE MODE.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the left park brake actuator.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC C1587 is not set.
    - **If the DTC is set**
    1. Perform the Park Brake Calibration learn procedure. Refer to **Park Brake Calibration**.
    2. Ignition ON.
    3. Apply and release the park brake.
    4. Verify the DTC is not set.
        - If the DTC is set, replace the M104L Park Brake Actuator - Left.
        - If the DTC is not set

        5. All OK.
            - **If the DTC is not set**
    3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Parking Brake Actuator Replacement**
- **Control Module References** for control module replacement, programming and setup

DTC C1588: RIGHT PARK BRAKE ACTUATOR (HEV)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provide an overview of each diagnostic category.

DTC Descriptors

DTC C1588

Right Park Brake Actuator

For symptom byte information, refer to: **Symptom Byte List**

Circuit/System Description

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

Conditions for Running the DTC

- Vechicle ON or in SERVICE MODE.
- Battery voltage is between 9 - 16 V

Conditions for Setting the DTC

The Electronic Brake Control Module detects a malfunction in the right park brake actuator.

Action Taken When the DTC Sets

- The parking brake is disabled, one release allowed.
- A message and/or a warning indicator may be displayed.

Conditions for Clearing the DTC

- The Electronic Brake Control Module will clear the DTC after 40 consecutive ignition on/off cycles with at least one test pass in each ignition cycle and no test fail result.
- The condition for the DTC is no longer present.

Reference Information

Schematic Reference

Park Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Parking Brake Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC C1588 is not set.
    - **If the DTC is set**
    1. Perform the Park Brake Calibration learn procedure. Refer to **Park Brake Calibration**.
    2. Ignition ON.
    3. Apply and release the park brake.
    4. Verify the DTC is not set.
        - If the DTC is set, replace the M104R Park Brake Actuator - Right.
        - If the DTC is not set
    5. All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Rear Parking Brake Actuator Replacement**
- **Control Module References** for control module replacement, programming and setup

SYMPTOMS - PARK BRAKE

NOTE: **Review the system operation in order to familiarize yourself with the system functions. Refer to Electronic Parking Brake Description.**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the park brake system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Park Brake Will Not Hold or Release
- Park Brake System Diagnosis

PARK BRAKE WILL NOT HOLD OR RELEASE

Step	Action	Yes	No
1	Were you sent here from the Park Brake Symptom Table?	Go to **Step 2**	Go to Symptoms - Park Brake
2	Inspect the park brake system for proper operation. Refer to Park Brake System Diagnosis. Did you find and correct a condition?	Go to **Step 4**	Go to **Step 3**
3	Inspect the disc brake system for proper operation. Refer to Disc Brake System Diagnosis . Did you find and correct a condition?	Go to **Step 4**	Go to Symptoms - Park Brake
4	Road test the vehicle in order to confirm proper operation. Refer to Brake System Vehicle Road Test . Is the condition still present?	Go to **Step 2**	System OK

PARK BRAKE SYSTEM DIAGNOSIS

Step	Action	Yes	No
DEFINITION: This diagnostic table is designed to diagnose ONLY the components of the PARK brake system in order to determine if the PARK brake system is operating properly. You will be directed by the appropriate Symptom Table to go to other brake system diagnostic tables as appropriate.			
1	1. Raise and support the vehicle with the rear axle supported by jack stands. Lifting and Jacking the Vehicle . 2. Shift the transmission into NEUTRAL. 3. With the park brake RELEASED, attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to **Step 4**	Go to **Step 2**
2	1. Shift the transmission into NEUTRAL. 2. Apply the park brake. 3. Attempt to rotate the rear wheels to check the rear brakes for a significant amount of drag. Do the rear brakes have a significant amount of drag?	Go to **Step 4**	Go to **Step 3**
3	Do the electronic park brake actuators working?	Go to **Step 10**	Go to **Step 5**
4	Calibrate the park brake. Park Brake Calibration Do the rear brakes have a significant amount of drag?	Go to **Step 5**	Go to **Step 10**

Step	Action	Yes	No
5	1. Check the fuse of the electronic park brake. 2. Check visual the electronic park brake actuators, the wiring harness and the electrical connectors. 3. Check visual the electronic brake control module, the wiring harness and the electrical connector. 4. Check the electronic park brake system with a scan tool. Did you find the condition?	Go to **Step 6**	Go to **Step 7**
6	- Replace the fuse as necessary. - Replace the wiring harness as necessary. - Replace the park brake actuator switch as necessary. **Parking Brake Actuator Switch Replacement** - Replace the parking brake actuators as necessary. **Rear Parking Brake Actuator Replacement** Did you correct the condition?	Go to **Step 9**	Go to **Step 6**
7	**CAUTION:** **Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.** 1. Remove the rear disc brake pads. **Rear Disc Brake Pads Replacement** . 2. Inspect the disc brake pads for looseness, damaged, broken or missing components. 3. Check the brake caliper piston seals for cracks. 4. Check the brake caliper pistons for movement 5. Check the electronic park brake actuators for a seized condition. Does the park brake hardware and/or the park brake actuators require replacement?	Go to **Step 8**	Go to **Step 10**
8	1. Replace the rear brake hardware components as necessary. **Rear Disc Brake Pads Replacement** 2. Replace the rear brake calipers as necessary. **Rear Brake Caliper Replacement** Did you complete the replacement?	Go to **Step 9**	-

Step	Action	Yes	No
9	1. Calibrate the electronic brake system. Park Brake Calibration Did you complete the replacement and adjustment?	Go to **Step 10**	Go to Symptoms - Park Brake
10	Install or connect any components that were removed or disconnected during diagnosis. Did you complete the operation?	Park Brake System OK	Go to Symptoms - Park Brake

REPAIR INSTRUCTIONS

PARK BRAKE CALIBRATION

1. Block the drive wheels.
2. Install a scan tool to the vehicle.
3. Turn the ignition switch to the ON/RUN position with the engine OFF.
4. Select Configuration/Reset Functions from the electronic brake control module menu.
5. Perform the parking brake calibration procedure.

PARKING BRAKE ACTUATOR SWITCH REPLACEMENT

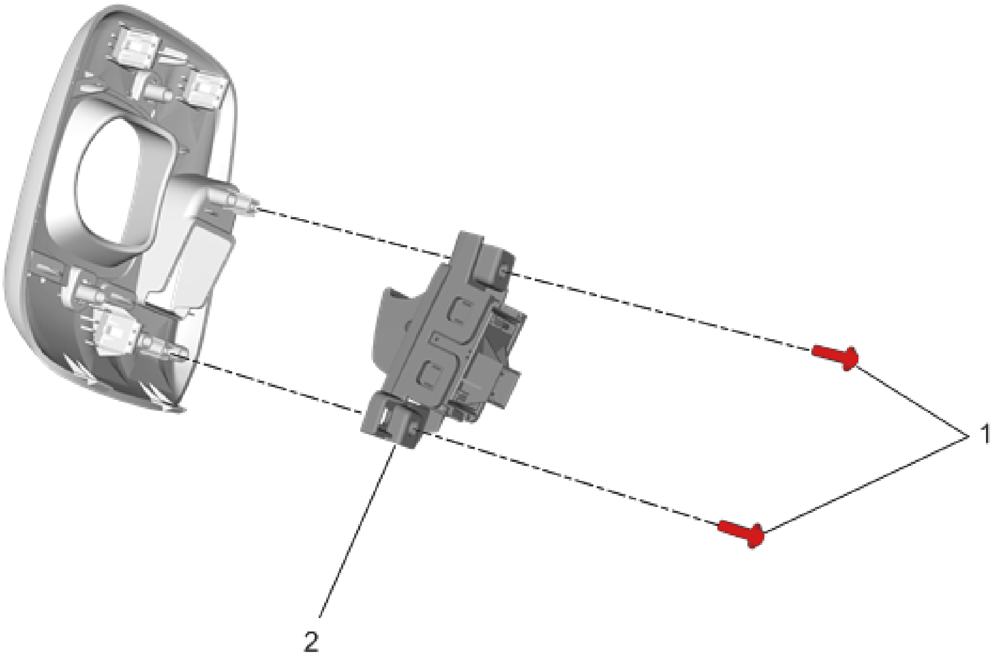


Fig. 2: Parking Brake Actuator Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Front Floor Console Trim Plate Replacement	
1	Park Brake Control Switch Bracket Bolt (Qty: 2)
2	Park Brake Control Switch

REAR PARKING BRAKE ACTUATOR REPLACEMENT

Removal Procedure

1. Set the parking brake in service mode. Rear Parking Brake Service Mode Selection

2. Turn OFF the vehicle.
3. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
4. Remove the rear tire and wheel assembly. **Tire and Wheel Removal and Installation**

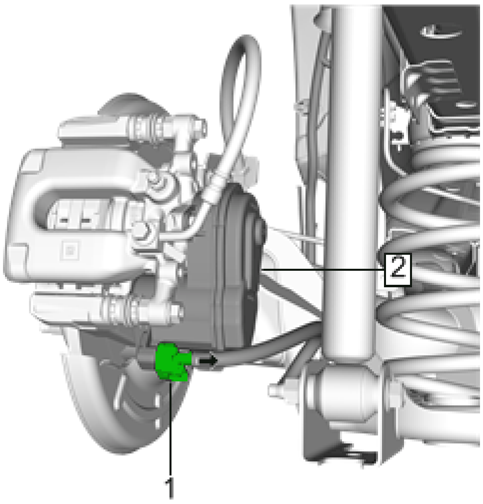


Fig. 3: Electrical Connector And Rear Park Brake Actuator
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (1) @Rear Park Brake Actuator (2)

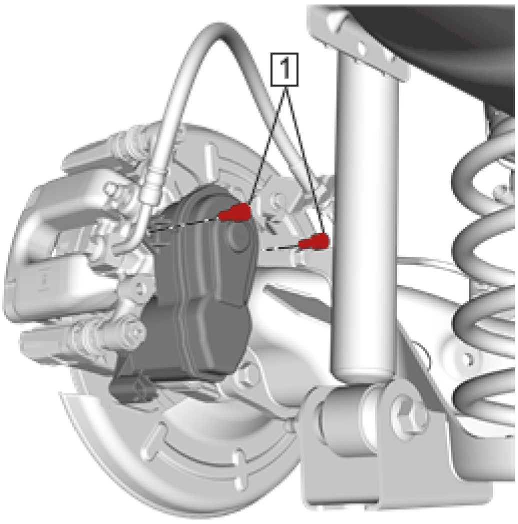


Fig. 4: Park Brake Actuator Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove Park Brake Actuator Bolt (1) @Rear Brake Caliper

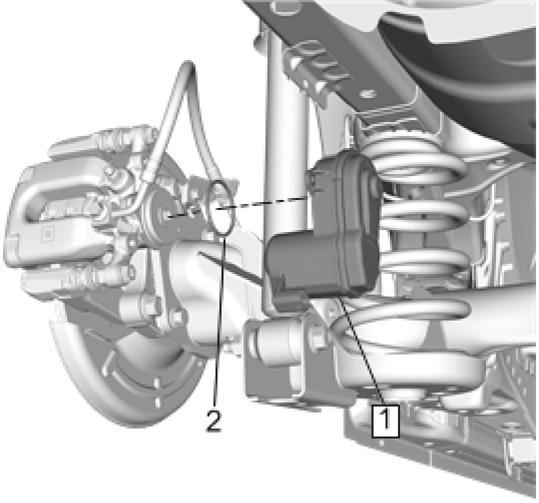


Fig. 5: Rear Park Brake Actuator Lever Seal
Courtesy of GENERAL MOTORS COMPANY

7. Remove Rear Park Brake Actuator (1) @Rear Brake Caliper
8. Remove Rear Park Brake Actuator Lever Seal (2) and DISCARD

Installation Procedure

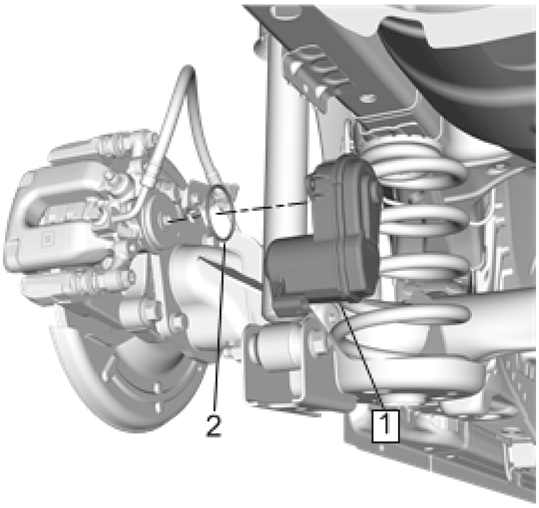


Fig. 6: Rear Park Brake Actuator Lever Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW Rear Park Brake Actuator Lever Seal (2)
2. Install Rear Park Brake Actuator (1) @Rear Brake Caliper

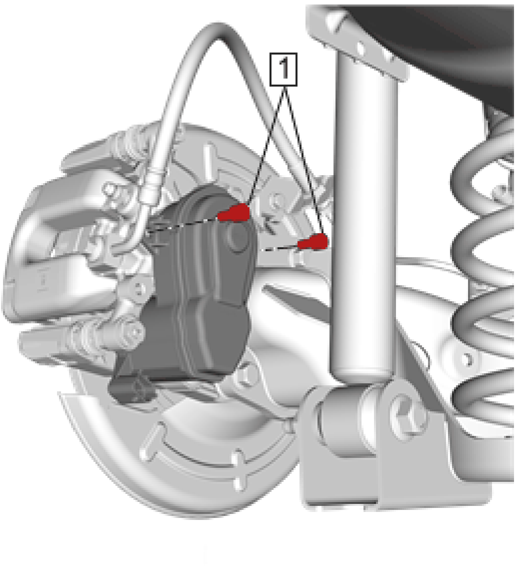


Fig. 7: Park Brake Actuator Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Fastener Caution**

3. Install Park Brake Actuator Bolt (1) @Rear Brake Caliper and tighten 12 N.m (106 lb in)

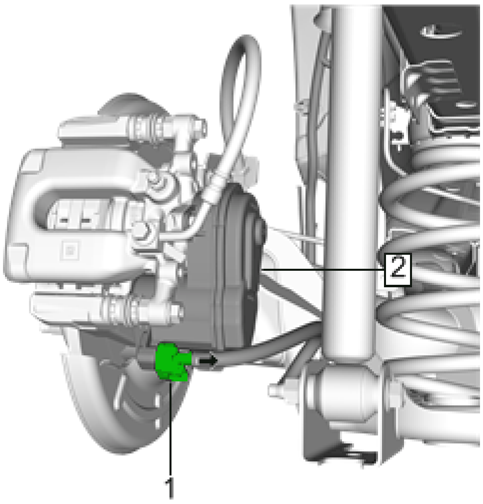


Fig. 8: Electrical Connector And Rear Park Brake Actuator
Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connector (1) @Rear Park Brake Actuator (2)
5. Install the rear tire and wheel assembly. Tire and Wheel Removal and Installation
6. Lower the vehicle.
7. Calibrate the park brake. Park Brake Calibration

REAR PARKING BRAKE SERVICE MODE SELECTION

In order to perform repairs on certain parts of the rear brake system, it is necessary to fully retract the park brake caliper pistons. There are two ways to set the park brake into service mode. The preferred method is with a scan tool.

With Scan Tool

1. Install a scan tool.
2. Turn the ignition ON with the engine OFF.
3. Select Electronic Brake Control Module.
4. Select Control Functions.

NOTE: **Do NOT apply any brake pressure during this step.**

5. Select Rear Brake Caliper Piston Retract.

Without Scan Tool

1. Turn the ignition ON with the engine OFF.
2. Press accelerator pedal halfway down.
3. Place the park brake switch in the release position and hold for 10 seconds. Release the park brake switch.
4. Within 5 seconds, place the park brake switch into the release position again.

Exiting Service Mode

The park brake can be taken out of service mode with either of the following methods:

- With a scan tool, select Rear Brake Caliper Piston Extend.
- Place the park brake switch in the apply position.

DESCRIPTION AND OPERATION

ELECTRONIC PARKING BRAKE DESCRIPTION

Vehicles with the electric parking brake have a switch in the center console or on the dash, which takes the place of the manual parking brake system, the foot pedal and release handle. In case of insufficient electrical power, the electric parking brake cannot be applied or released.

Electronic Brake Control Module

The parking brake function is integrated into the Electronic Brake Control Module. The Electronic Brake Control Module contains the logic for applying and releasing the parking brake when commanded by the Park Brake Switch.

When the Park Brake Switch is pulled, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the apply control circuits and ground to the release control circuits which will cause the left and right park brake actuators to activate causing the park brakes to engage. When the Park Brake Switch is pressed, a signal is sent to the Electronic Brake Control Module which will supply 12 V to the released control circuits and ground to the apply control circuits which will cause the left and right park brake actuators to activate causing the park brakes to release.

The Electronic Brake Control Module will diagnose the park brake motor circuits to verify that they are functioning properly. The park brake motor circuits are used to command actuator motor operation, which will apply and release the parking brake. These circuits are used to activate the actuator, which applies or releases pressure on the rear caliper pistons, ultimately applying and releasing the park brake.

The Park Brake Motor Position Sensor is an internal sensor to the park brake actuator, this sensor is used to monitor the park brake motor position.

Electric Parking Brake Apply

The electric parking brake can be applied any time the vehicle is stopped or in motion. The electric parking brake is applied by momentarily lifting up on the park brake control switch. The red park brake light will momentarily flash while the parking brake is being applied. Once fully applied, the red park brake light will turn on. If the electric parking brake is applied while the vehicle is in motion, a chime will sound, and the message "Release Park Brake Switch" will be displayed.

If the red park brake light is flashing, the electric parking brake is only partially applied or released, or there is a problem with the electric parking brake. The message "Service Park Brake" will be displayed.

The vehicle may automatically apply the electric parking brake in some situations when the vehicle is not moving. This is normal, and is done to periodically check the correct operation of the electric parking brake system.

Electric Parking Brake Release

To release the electric parking brake, turn the ignition switch to the ON or RUN position, apply and hold the brake pedal, and push down momentarily on the park brake control switch. When the electric parking brake is released the red park brake light turns off.

The electric parking brake can be used to prevent roll back for vehicles with a manual transmission taking off on a hill. In a situation where no roll back is desired, an applied electric parking brake will allow both feet to be used for the clutch and accelerator pedals in preparation for starting the vehicle moving in the intended direction. In this situation, perform the normal clutch and accelerator actions required to begin moving the vehicle. There is no need to push the switch to release the electric parking brake. To disable this feature lift and hold the park brake control switch while the vehicle is in motion, this will keep the electric parking brake applied.

One-Pedal Driving

The Electronic Brake Control Module contains the logic for the parking brake function. The EBCM sends out a EPB availability and application status signal on the high speed GMLAN which is monitored by the Hybrid Powertrain Control Module. The electronic parking brake can be automatically applied during One-Pedal Driving (OPD).

The vehicle provides One-Pedal Driving modes that are selectable using the drive unit shifter or Regen on Demand. One-Pedal Driving modes allow for increased deceleration without use of the brake and will bring the vehicle to a complete stop in many cases. The brake pedal should still be used to hold the vehicle at a stop, even when it may not seem necessary. The brake pedal may be required to bring the vehicle to a stop on sloped surfaces.

In One-Pedal Driving modes, the accelerator pedal can be used to control the deceleration rate of the car all the way to a stop. Completely lifting off of the accelerator pedal will result in an aggressive deceleration. However, by slowly lifting off of the accelerator pedal and making adjustments lightly on the accelerator pedal, the deceleration of the vehicle can be adjusted as desired.

If the vehicle begins to move after coming to a complete stop, the Electric Parking Brake may apply to prevent undesired movement. Applying the accelerator pedal will automatically release the Electric Parking Brake as the car moves forward.

Back To Article

CANADIAN MODEL REFERENCE

Canadian-To-U.S. Model Reference Tables

* PLEASE READ THIS FIRST *

NOTE: **This GENERAL INFORMATION article is displayed for all vehicles. Data contained in this article may not apply to the specific vehicle selected.**

ACURA

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ACURA MODEL CROSS-REFERENCE

Canadian Model	US Model
1996-2000 1.6EL	Canadian Only (Based on 1996-2000 Japanese Market Honda Domani)
2001-2005 1.7EL	2001-2005 Honda Civic
2004-2005 EL	2004-2005 Honda Civic
2006-2011 CSX	2006-2011 Honda Civic

ASUNA

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ASUNA MODEL CROSS-REFERENCE

Canadian Model	US Model
1992-93 Sunfire	1990-92 Isuzu Impulse & 1990-93 Geo Storm ("R" Body)
1993 GT/ SE	1988-93 Pontiac LeMans ("T Body)
1992-93 Sunrunner	1989-99 Geo Tracker ("J" Body)

AUDI

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AUDI MODEL CROSS-REFERENCE

Canadian Model	US Model
1985-86 Quattro	Nearest Match: 1984 Quattro Similar To: 1985-86 Coupe

Canadian Model	US Model
1996-97 S6	Nearest Match: 1996-97 A6

CHRYSLER CORP.

CHRYSLER

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CHRYSLER MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-93 Daytona	1984-93 Dodge Daytona
1988-93 Dynasty	1988-93 Dodge Dynasty
1993-04 Intrepid	1993-04 Dodge Intrepid
2000-02 Neon	2000-02 Dodge Neon

DODGE

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DODGE MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-90 2000	1989-90 Mitsubishi Galant
1992-93 Colt Wagon	1992-93 Plymouth Colt Vista
1994 Colt Wagon	1994 Mitsubishi Expo (LRV)
1987-88 Expo	1987-88 Colt Vista
1995-96 Colt	1995-96 Eagle Summit 1995-96 Mitsubishi Mirage
2003-05 SX	2003-05 Neon

EAGLE

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EAGLE MODEL CROSS-REFERENCE

Canadian Model	US Model
1991-93 2000 GTX	1989-93 Mitsubishi Galant
1989-91 Vista (Sedan/Notchback)	1989-91 Dodge Colt
1992 Vista	1992 Plymouth Colt
1989-91 Vista Wagon	1989-91 Dodge Colt Vista

PLYMOUTH

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PLYMOUTH MODEL CROSS-REFERENCE

Canadian Model	US Model
1978-81 Caravelle	1978-87 Dodge Diplomat
1982-84 Caravelle	1982-84 Gran Fury Also: Dodge 600
1990-92 Colt 100/200	1990-92 Colt
1995-96 Colt	1995-96 Eagle Summit 1995-96 Mitsubishi Mirage
1992-94 Colt Wagon	1992-94 Mitsubishi Expo (LRV)
1987-89 Expo	1987-89 Colt Vista

GENERAL MOTORS

BUICK

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BUICK MODEL CROSS-REFERENCE

Canadian Model	US Model
2005-09 Allure	2005-09 Buick LaCrosse
1986-87 Somerset Regal	1986-87 Regal (Somerset is a Regal trim level)

CHEVROLET

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CHEVROLET MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-92 Sprint	1989-92 Geo Metro 1989-92 Suzuki Swift
1989-92 Tracker	1989-92 Geo Tracker 1989-92 Suzuki Sidekick
2004-08 Optra (Sedan/Wagon)	2004-08 Suzuki Forenza
2004-08 Optra5	2004-08 Suzuki Reno
2004-06 Epica	2004-06 Suzuki Verona
2012 Orlando	Canadian Only
2009 Uplander	Canadian Only Best Match: 2008 Uplander
2013-4 Chevrolet Trax	2015 Chevrolet Trax

GMC

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GMC MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-92 Tracker	1989-94 Geo Tracker
2002-05 Jimmy	2002-05 Chevrolet Blazer (Not TrailBlazer)

OLDSMOBILE

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OPTIMA/PASSPORT MODEL CROSS-REFERENCE

Canadian Model	US Model
1989-90 Delta 88	1989-90 Eighty-Eight

OPTIMA

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OPTIMA/PASSPORT MODEL CROSS-REFERENCE

Canadian Model	US Model
1988-91 Optima (Passport)	1988-91 Pontiac LeMans ("T" Body)

PONTIAC

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PONTIAC MODEL CROSS-REFERENCE

Canadian Model	US Model
1982 Parisienne	Best Match: 1983 Parisienne
1985-89 Firefly	1985-89 Chevrolet Sprint
1990-00 Firefly	1990-00 Suzuki Swift 1998-00 Chevrolet Metro
1987-91 Tempest	1987-91 Chevrolet Corsica

Canadian Model	US Model
2007 Montana SV6	2007 Buick Terraza 2007 Saturn Relay 2007 Chevrolet Uplander
2008-09 Montana SV6	2008 Chevrolet Uplander
1982-83 Grand LeMans	1982-82 Bonneville 1981 Oldsmobile Cutlass
1985-87 Sunburst	1985-87 Chevrolet Spectrum
1994-97 Sunrunner	1994-97 Geo Tracker
2005-09 Wave & G3 Wave	2005-09 Chevrolet Aveo
2010 G3	2010 Chevrolet Aveo
2005-08 G5 Pursuit, G5, & Pursuit	2005-08 Chevrolet Cobalt
1982-87 Acadian	1982-87 Chevrolet Chevette

HYUNDAI

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HYUNDAI MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-87 Pony	Canadian Only
1985-88 Stellar	Canadian Only

JAGUAR

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JAGUAR MODEL CROSS-REFERENCE

Canadian Model	US Model
1983-92 XJ12	Canadian Only

KIA

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KIA MODEL CROSS-REFERENCE

Canadian Model	US Model
2010-11 Borrego	Canadian Only Best Match: 2009 Borrego
2001-10 Magentis	2001-10 Optima
2011-12 Rondo	Canadian Only Best Match: 2010 Rondo

MAZDA

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MAZDA MODEL CROSS-REFERENCE

Canadian Model	US Model
1992-96 MX3 Precidia	1992-95 MX3
1995 323	1995 Protege
1997 B3000	1997 B4000 1997 Ford Ranger
2010 B-Series Trucks	Canadian Only Best Match: 2009 B-Series Trucks
1993-97 MX6 Mystere	1993-97 MX6 193-97 Ford Probe
1992-95 929 Serenia	1988-95 929
1993-97 626 Cronos	1988-97 626

MERCEDES-BENZ

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MERCEDES-BENZ MODEL CROSS-REFERENCE

Canadian Model	US Model
1992 350SD / 350SDL	1992 300SD
2006-11 B200	Canadian Only
2008-09 C230	2008-09 C300
2010-11 C250	2010-11 C300
2009 CLK63	Canadian Only Best Match: 2008 CLK63
2007 E280	2007 E320
2008-09 E300	2008-09 E350
2009-11 S450	2010-11 S400

MERCURY

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MERCURY MODEL CROSS-REFERENCE

Canadian Model	US Model
1987 Tracer	1987 Mazda 323

MERKUR

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MERKUR MODEL CROSS-REFERENCE

Canadian Model	US Model
1987 Scorpio	Canadian Only Best Match: 1988 Scorpio

MITSUBISHI

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MITSUBISHI MODEL CROSS-REFERENCE

Canadian Model	US Model
2009 Endeavor	Canadian Only Best Match: 2008 Endeavor
2011-13 RVR	2011-13 Outlander Sport

NISSAN

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NISSAN MODEL CROSS-REFERENCE

Canadian Model	US Model
1991-95 Axxess Wagon	Canadian Only Best Match: 1990 Axxess Wagon
1986-88 Multi Wagon	1986-88 Stanza Wagon
1984 Micra	Canadian Only
2005-06 X-Trail	Canadian Only

RENAULT

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RENAULT MODEL CROSS-REFERENCE

Canadian Model	US Model
1984-86 LeCar	Canadian Only Best Match: 1983 LeCar

SATURN

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SATURN MODEL CROSS-REFERENCE

Canadian Model	US Model
2009 Astra	Canadian Only Same As: 2008 Astra

SMART

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SMART MODEL CROSS-REFERENCE

Canadian Model	US Model
2005-07 Fortwo	Canadian Only Best Match: 2008 Fortwo

SUBARU

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SUBARU MODEL CROSS-REFERENCE

Canadian Model	US Model
1988-89 Chaser	1988-89 GL (Chaser is a hatchback version of the GL)

SUZUKI

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SUZUKI MODEL CROSS-REFERENCE

Canadian Model	US Model
1986-88 Forsa	1986-88 Chevrolet Sprint
1982-85 Samurai (SJ410)	Canadian Only
2004-08 Swift+	2004-08 Chevrolet Aveo
2009 Swift+	2009 Chevrolet Aveo

TOYOTA

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TOYOTA MODEL CROSS-REFERENCE

Canadian Model	US Model
1998-99 Paseo	Canadian Only Best Match: 1997 Paseo
1999 Tercel	Canadian Only Best Match: 1998 Tercel
2006 Yaris	Canadian Only Best Match: 2007 Yaris

VOLKSWAGEN

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VOLKSWAGEN MODEL CROSS-REFERENCE

Canadian Model	US Model
1995 Corrado	Canadian Only
1992 & 1994 EuroVan (Gas)	Canadian Only Best Match: 1993 Eurovan
1993-97 EuroVan (Diesel)	Canadian Only (No Diesel Eurovans Sold in U.S.)
2007-08 Golf (A5)	Canadian Only Best Match: 2006 Golf
2008-09 Golf (A6)	Canadian Only Best Match: 2010 Golf
1993 GTI	Canadian Only Best Match: 1993 Cabriolet
1994 GTI	Canadian Only Best Match: 1994 Jetta III
1989 Scirocco	Same As: 1988 Scirocco
1985-92 Transporter Van/Pickup	Canadian Only
1993-03 Transporter Van	1993-03 EuroVan

VOLVO

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VOLVO MODEL CROSS-REFERENCE

Canadian Model	US Model

Canadian Model	US Model
1987-88 244 & 245	Canadian Only Best Match: 1987-88 240
2007 C30	Canadian Only Best Match: 2007 S40, V50, C70 Are Similar

ALL OTHERS

NOTE: **This GENERAL INFORMATION article is displayed for all vehicles. Data contained in this article may not apply to the specific vehicle selected.**

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Information for other vehicles is not available or known.

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2017 COLLISION

Paint and Coatings - Bolt EV

INTRODUCTION

BASECOAT/CLEARCOAT PAINT SYSTEMS

WARNING: **Exposure to isocyanates during paint preparation and application processes can cause severe breathing problems. Read and follow all of the instructions from the manufacturers of painting materials, equipment, and protective gear.**

All paint finish repairs of rigid exterior surfaces must meet GM standards. Refer to the latest revision of the GM Approved Refinish Materials book to identify the paint systems you may use that have been engineered to meet GM standards. The GM Approved Refinish Materials book supplies all approved products, including volatile organic compound (VOC) compliant regulations recommended by the individual manufacturer, and detailed procedures for materials used in their paint system.

The latest revision of the GM Approved Refinish Materials booklet is located on the Genuine GM Parts website at www.genuinegmparts.com.

ANTI-CORROSION TREATMENT AND REPAIR

WARNING: **When applying sound deadeners, or anti-corrosion materials due care and preventative measures must be exercised to prevent any material from being sprayed into door and quarter panel mechanisms such as door locks, window run channels, window regulators and seat belt retractors, as well as any moving or rotating mechanical or suspension parts on the underbody, particularly the parking brake cable. After material application, be sure that all body drain holes are open. Improper application may increase chance of corrosion damage or limit the operation of moving parts, resulting in personal injury.**

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Proper recoating of these surfaces with service-type anti-corrosion material is essential.

After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and reprimed. Refer to the GM Approved Refinish Materials book which identifies the paint systems you may use.

The latest revision of the GM Approved Refinish Materials booklet is located on the Goodwrench website at www.gmgoodwrench.com.

Anti-corrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces, such as pinch-weld joints, hem flanges, and integral panel attaching points where metal surfaces are difficult to coat with conventional undercoating materials, and are inaccessible for painting. The materials that are suitable for interior and exterior are listed in the chart below. Conventional undercoating is recommended in order to coat large areas, such as replacement door and quarter outer panels, floor pan sections, lids, hoods, fenders, etc. During undercoating operations, care should be taken to prevent the material from being sprayed into door and quarter panel hardware mechanisms, such as door locks, window run channels, window regulators, and seat belt retractors. On the underbody, the material should not be applied to any moving or rotating part, energy absorbing bumper components, or shock absorbers. After undercoating, ensure that all body drain holes are open.

Interior Protectant

The following products are available from GM Dealer Equipment. For technical information, call 187-Permatex (1-877-376-2839):

Permatex Part Number	Description
310-JDI-UCA1	Permatex Canister and Wand Assembly
310-81881	Permatex Amber Rust Proofing (24 oz) (Qty of 12)
310-81882	Permatex Amber Rust Proofing (1 gal)

Exterior Protectants

The following product is available from *ECP, Inc. Contact them at 1-800-323-3521 or www.ecpinc.net.

Part Number	Description
178660	Nox Rust X-121B (12 cans per case)

The following products are available from your local *3MÂ® distributor, or call 1-800-521-8180, ext. 779-5165.

3MÂ® Part Number	Description
08804	Water-Based Undercoat
08801	No Clean-Up Applicator Gun
05917	Weld-Thru Coating
08891	Rust Fighter-I

The following product is available from *Transtar Autobody Technologies. Contact the company at 1-800-824-2843 or www.tat-co.com.

Part Number	Description
4353	Weld-Through Primer

*We believe these sources and their products to be reliable. There may be additional manufacturers of such material. General Motors does not endorse, indicate any preference for, or assume any responsibility for the products from these firms, or for any such items which may be available from other sources.

These sealers are intended to prevent water and dust from entering the vehicle and also are anti-corrosion barriers. Sealers are applied to such areas as rear compartment lid hem flanges, wheelhouse, quarter outer, floor, cowl, roof, and various other panel to panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations should be corrected by resealing. Attaching points of new replacement panels should be resealed. Replacement lids and doors will also require sealing in the hem flange areas.

Flanged joints, overlap joints, and seams should be sealed using a quality sealer of medium-bodied consistency. The sealer used must retain its flexible characteristics after curing and be paintable.

Open joints which require bridging of the sealer in order to close a gap should be sealed using a heavy-bodied caulking material. Follow the label directions for the material selected.

Color application may be required in order to restore repaired areas such as hood, fenders, doors, quarters, lid, roof, engine compartment, underbody, and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat buildup, and color application techniques should be followed.

Deadener materials, spray-on type, are used on various metal panels in order to provide corrosion resistance and joint sealing. They control the general noise level inside the passenger area of the vehicle. When deadeners are disturbed because of damage, are removed during repair operations, or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

Cleaning of the interior and underbody panel surfaces is necessary when original galvanized or other anti-corrosion materials have been burned off during welding or heating operations. Removal of the residue from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to interior surfaces.

REPAIR INSTRUCTIONS

CLEARCOAT REPAIR WITHOUT REPAINTING

1. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870 or the equivalent.
2. Environmental damage may be corrected. Refer to Environmental Fallout (Acid Rain), or Rail Dust Damage Repair.

NOTE: Follow all of the instructions from the manufacturer of the polishing material.

3. Use a paint gauge before, during, and after sanding and/or polishing, to avoid removing too much clearcoat. Refer to Paint Gauges.

ENVIRONMENTAL FALLOUT (ACID RAIN)

CAUTION: Refer to Clearcoat/Ultraviolet Screeners Caution .

NOTE: Always refer to the manufacturer's packaged instructions for the detailed procedures of materials used for compounding and/or polishing.

Since the severity of the condition varies from area to area, proper diagnosis of the contamination extent is critical to the success of the repairs. Perform the diagnosis under high intensity fluorescent lighting on the horizontal surfaces (hood, roof panel, rear compartment lid), after the surfaces have been properly cleaned by washing the vehicle with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203), or equivalent.

There are 3 basic types of acid rain damage:

Surface Level Contamination

May be repaired by simply washing the vehicle, cleaning the surface with a silicone wax and grease remover, neutralizing acidic residue, and finesse polishing. Refer to Surface Level Contamination Repair.

Clearcoat Etching

Slight etching is still noticeable after the above washing and finesse polishing procedure. Refer to Slight Clearcoat Damage - Wet Sanding, Finesse Polishing.

Basecoat Etching

Severe etching beyond the clearcoat into the basecoat in the affected areas will require refinishing. Refer to Basecoat/Clearcoat Paint Systems.

Surface Level Contamination Repair

1. Thoroughly wash and dry the contaminated area with GM Wash and Wax GM P/N 1237841 (Canadian P/N 10953203), or equivalent.
2. Clean the affected area with silicone, wax and grease remover.
3. Remove and neutralize acidic residue by cleaning the contaminated areas with a mixture of baking soda and water (1 tablespoon of baking soda per 1 liter or 1 quart of water). Rinse thoroughly and dry the panel completely.
4. Apply finesse-type polish with a foam panel. If damage has been repaired, remove any swirl marks with a dual action orbital polisher and foam pad.
5. If some damage remains, refer to Slight Clearcoat Damage - Wet Sanding, Finesse Polishing.

Slight Clearcoat Damage - Wet Sanding, Finesse Polishing

1. Select a small contaminated test area.
2. Film thickness should be taken prior to the sanding and polishing. Refer to **Paint Gauges**.
3. Wet sand and finesse polish the contaminated test area. If during the polishing you suspect or observe that etching has penetrated into the basecoat, too much clearcoat has been removed during sanding, or base color is transferred to the polishing pad during polishing, then the affected areas will require refinishing. Refer to **Basecoat/Clearcoat Paint Systems**.

PAINT GAUGES

Paint thickness gauges measure the total thickness of the vehicle finish. It is important to accurately measure the thickness of the finish on each vehicle as the thickness of the finish will vary on each vehicle. Use a paint gauge before the sanding process in order to accurately measure how much finish there is to remove before, during, and after the sanding process. Paint gauges range from magnetic pull type to sophisticated electronic types, and are available from a variety of sources. The older magnetic type gauges, at best have a 5 percent accuracy range and are not sensitive enough to detect removal of 0.02 mm 0.5 mil (0.0005 in) clearcoat. The newer type magnetic gauges have improved accuracy ranges. Most gauges are confined to checking either ferrous metal, steel, non-ferrous metal, or aluminum panel. At this time, there are no viable gauges for reading film thickness on composite (SCM doors, RIM fenders) panels. The more sophisticated electronic paint thickness gauges (ETG) digital type gauges are able to read film thickness on both ferrous and non-ferrous metal panel. Digital ETG gauges may have an accuracy range of 1 percent and include thickness standards for recalibration. The following paint thickness gauges are available. Call 1-800-GM-TOOLS for information:

Paint Thickness Gauges

- 147-5437-ETG Standard model
- 147-5437-ETG-P Standard model with print option
- 147-5437-N-ETG-N Non-ferrous model for aluminum panels
- 147-5437-NP-ETG-NP Non-ferrous model with print option
- 147-54437-SD-ETG Steel and aluminum gauge

CLEARCOAT THICKNESS

The clearcoat on the vehicle is typically 0.059 - 0.078 mm (1.5 - 2 mils [0.0015 - 0.0020 in]) thick. The clearcoat contains ultraviolet screeners. Removing more than 0.5 mils (0.019 in) of the clearcoat may result in early paint failure.

RAIL DUST DAMAGE REPAIR

WARNING: **Refer to Eye Protection Warning .**

NOTE: **If rail dust has penetrated into the basecoat, the panel requires refinishing. Ensure all the rail dust has been removed prior to refinishing or the rust spots will return.**

Rail dust damage comes from the tiny iron particles produced from the friction between the train wheels and the track. It can also be deposited on vehicles if stored near any operation producing iron dust (i.e., steel ore yards). This dust can either lay on top of, or embed into the paint surface. It is usually diagnosed as bumps in the paint surface or rust colored spots in the paint.

1. Move the vehicle to a cool shaded area and ensure the vehicle surfaces are cool during the removal process.
2. Thoroughly wash the repair area with Liquid Wash and Wax GM P/N 1052870, or equivalent.
3. Wipe the area dry.
4. Clean the affected area with silicone, wax and grease remover.
5. Perform the removal process according to the manufacturer's directions of the type of repair material used (Gel Type Oxalic Acid or Clay Type Non-Acid Based). If, upon inspection, some

particles are still present, the process may be repeated. If the damage has been repaired, complete the repair to the entire panel.

6. Polish the entire panel after the removal process. If small pits remain in the clearcoat after all of the damage has been repaired, refer to **Clearcoat Repair without Repainting**.

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2017 COMMON SPECS & PROCEDURES

Bolt EV

COMMON SPECS & PROCEDURES INDEX

(BOLT EV) COMMON SPECS & PROCEDURES

System	Specification/Procedure
Air Conditioning	
Service	Approximate Fluid Capacities
Torque	Fastener Specifications
Axle Nut/Hub Nut	
Front	First pass - 150 (111 lb ft) Second pass - Loosen 45Â° Final pass - 250 (184 lb ft)
Brakes	
Bleeding Sequence	RR, LR, RF, LF See Hydraulic Brake System Bleeding
Disc Brakes	
Service Specifications	Disc Brake Component Specifications
Torque	Fastener Specifications
Cooling System	
Hybrid	Specifications
Wheel Alignment	
Adjustment Specifications	Wheel Alignment Specifications
Torque	Fastener Specifications
Wheel & Tire	
Wheel Lug Nut Torque	140 N.m (103 lb ft) See tightening sequence illustration under tire Installation Procedure

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2017 DRIVELINE/AXLE

Wheel Drive Shafts - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Front Wheel Drive Shaft Retaining Ring
Front Wheel Drive Shaft Seal

Single Use Threaded Fastener/Component Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***	
Front Wheel Drive Shaft Nut	
• First Pass:	150 N.m (111 lb ft)
• Second Pass:	Loosen 45 Degrees
• Final Pass:	250 N.m (184 lb ft)

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - WHEEL DRIVE SHAFTS

IMPORTANT: Complete the following steps prior to beginning the wheel drive shaft diagnosis.

1. Review the **Vibration Diagnosis, Starting Point, and Correction** .
2. Perform the **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)** **Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)** in order to effectively diagnose the concern.
3. Review the system operation in order to become familiar with the system function. Refer to **Wheel Drive Shafts Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the wheel drive shafts or other rotating components.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Thoroughly inspect the entire wheel drive shaft for visible damage, leaking joint seals, and missing seal clamps.

- Inspect the wheel drive shaft seals for cuts, tears, or other damage which may allow the loss of lubricant and the entry of contaminants.

Symptom List

After performing the Visual/Physical Inspection and no visual signs of damage or other interference impairing the wheel drive shaft function is apparent, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the joints manually. Any binding or otherwise impeded movement of the joints may indicate damage which could contribute to the concern. Refer to the following:

- **Click Noise In Turns**
- **Clunk When Accelerating from Coast**
- **Clunk Noise When Accelerating During Turns**
- **Shudder or Vibration During Acceleration**

CLICK NOISE IN TURNS

A click noise occurring during turns may be caused by a worn or damaged wheel drive shaft outer joint. This may be more apparent while simultaneously turning and accelerating. This click is caused by wear and/or damage to the constant velocity joint bearings and/or races. Commonly, this damage or wear is caused by the loss of lubricating grease from the constant velocity joint and the entry of foreign material or contaminants.

Carefully inspect the wheel drive shaft seals for cuts, tears or other damage which may allow the lubricating grease to escape. The loss of this grease will cause damage to the wheel drive shaft constant velocity joint in a very short period of time.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the inner joint manually. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

CLUNK WHEN ACCELERATING FROM COAST

A clunk noise occurring when accelerating from coast or a standing start may be caused by a worn or damaged wheel drive shaft inner joint. The common cause of wheel drive shaft inner joint damage is the loss of lubricating grease and/or the presence of foreign material and contaminants in the joint. This usually occurs as a result of a torn or damaged inner joint seal.

Carefully inspect the wheel drive shaft seal for cuts, tears or other damage that may allow the loss of the lubricating grease and/or the entry of contaminants.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the inner joint manually. Do not allow the outer joint to separate from the wheel drive shaft bar. Any binding or impeded movement of the joint may indicate damage which could contribute to the concern.

CLUNK NOISE WHEN ACCELERATING DURING TURNS

A clunk noise that occurs while accelerating during turns may be caused by wear and/or damage to the inboard and the outboard joints in combination. The loss of lubricant and/or the presence of contaminants can cause damage to the internal components of the joints.

Carefully inspect the joint seals for cuts, tears or other damage. Joint seals that are damaged may allow lubricant leakage and the entry of contaminants.

If inspection reveals no visual evidence of wear or damage, it may be necessary to remove the wheel drive shaft from the vehicle and manipulate the inner joint manually. Do not allow the outer joint to separate from the wheel drive shaft bar. Any binding or impeded movement of the joints may indicate damage which could contribute to the concern.

SHUDDER OR VIBRATION DURING ACCELERATION

In order to diagnose a shudder or vibration during acceleration, refer to **Vibration Diagnosis, Starting Point, and Correction** .

REPAIR INSTRUCTIONS

FRONT WHEEL DRIVE SHAFT REPLACEMENT

Special Tools

- **CH-49376** Wheel Hub Holding Tool
- **CH-49400** Hub Spindle Remover
- **EN-956-1** Extension

Equivalent regional tools: Special Tools

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
3. Remove Front Compartment Air Deflector. Refer to Front Compartment Air Deflector Replacement

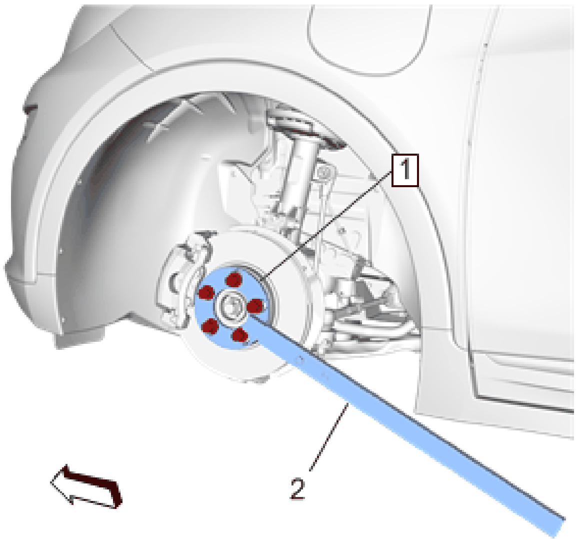


Fig. 1: Wheel Hub Holding Tool And Extension
Courtesy of GENERAL MOTORS COMPANY

4. Install the CH-49376 wheel hub holding tool (1) with the EN-956-1 extension (2) to the wheel hub with the wheel nuts and support the wheel hub holding tool outer end on a safety stand.

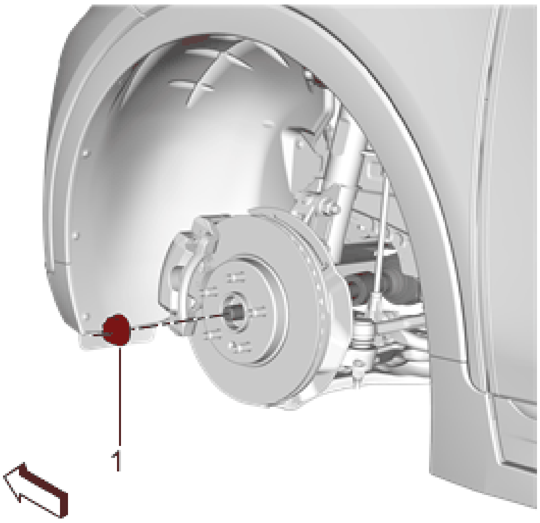


Fig. 2: Front Wheel Drive Shaft Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: The wheel drive shaft nut must be discarded after removal.

5. Remove and DISCARD Front Wheel Drive Shaft Nut (1) @ Front Wheel Drive Shaft

6. Remove the CH-49376 wheel hub holding tool from the wheel hub.

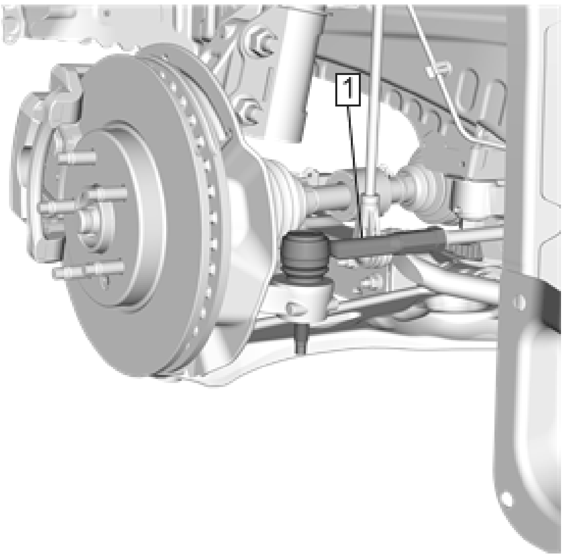


Fig. 3: Steering Linkage Outer Tie Rod

Courtesy of GENERAL MOTORS COMPANY

7. Separate Steering Linkage Outer Tie Rod (1) @ Steering Knuckle. Refer to Steering Linkage Outer Tie Rod Replacement

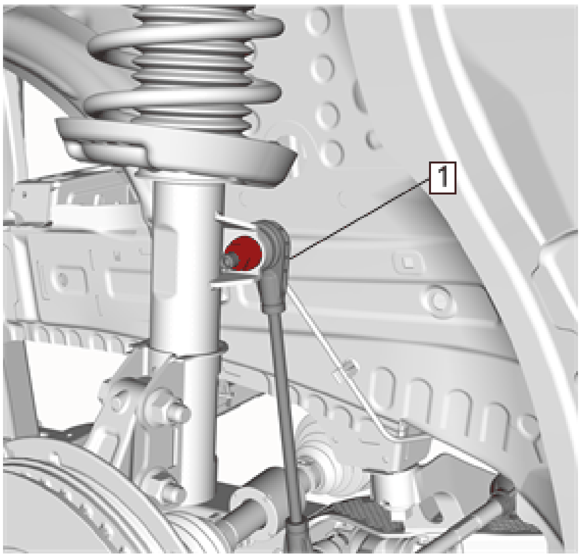


Fig. 4: Front Stabilizer Shaft Link

Courtesy of GENERAL MOTORS COMPANY

8. Separate Front Stabilizer Shaft Link (1) @ Front Suspension Strut. Refer to Stabilizer Shaft Link Replacement

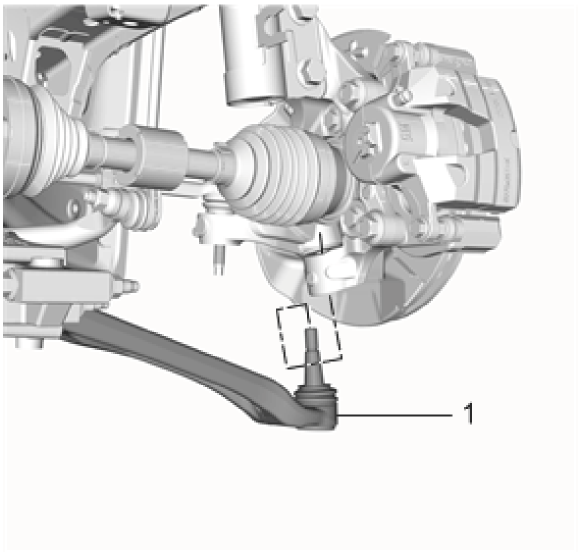


Fig. 5: Front Lower Control Arm Ball Joint
Courtesy of GENERAL MOTORS COMPANY

9. Separate Front Lower Control Arm Ball Joint (1) @ Steering Knuckle. Refer to **Lower Control Arm Replacement**

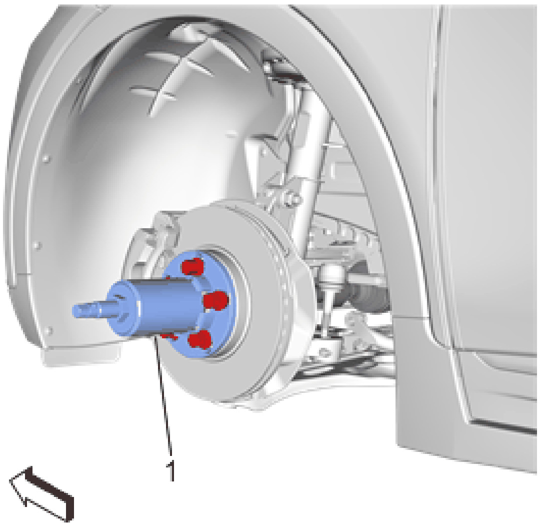


Fig. 6: Hub Spindle Remover
Courtesy of GENERAL MOTORS COMPANY

10. Using the CH-49400 hub spindle remover (1), disconnect the wheel drive shaft from the steering knuckle.

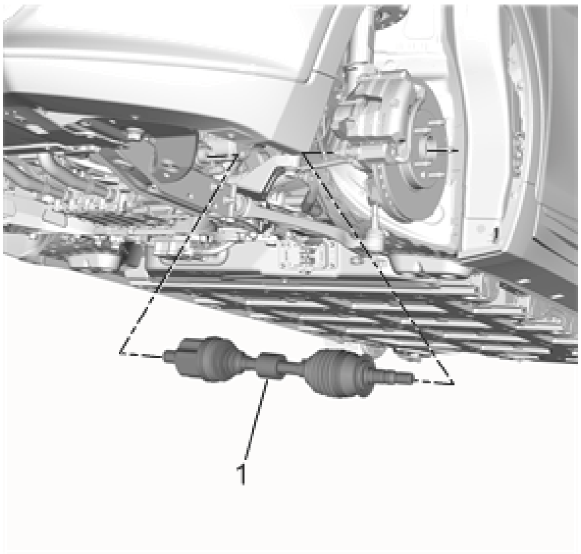


Fig. 7: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

11. Remove Front Wheel Drive Shaft (1) @ Vehicle

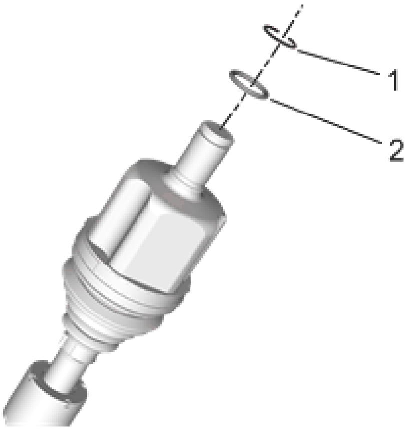


Fig. 8: Front Wheel Drive Shaft Retaining Ring And Seal
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The wheel drive shaft retaining ring and seal must be discarded after removal.**

12. Remove and DISCARD Front Wheel Drive Shaft Retaining Ring (1) @ Front Wheel Drive Shaft
13. Remove and DISCARD Front Wheel Drive Shaft Seal (2) @ Front Wheel Drive Shaft

Installation Procedure

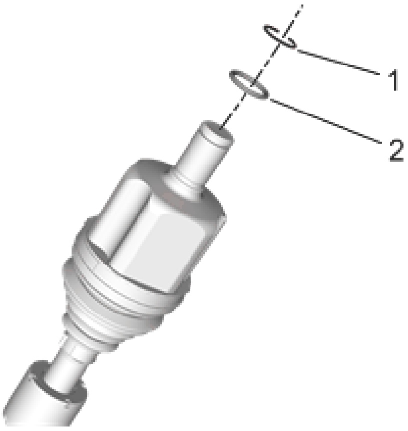


Fig. 9: Front Wheel Drive Shaft Retaining Ring And Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW Front Wheel Drive Shaft Seal (2) @ Front Wheel Drive Shaft
2. Install NEW Front Wheel Drive Shaft Retaining Ring (1) @ Front Wheel Drive Shaft

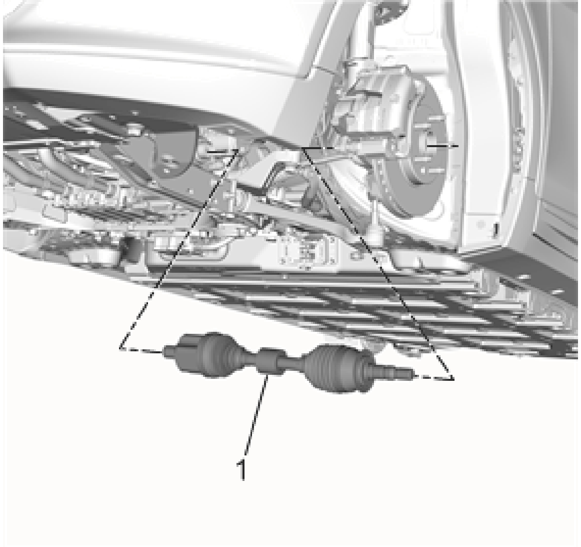


Fig. 10: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Wheel Drive Shaft (1) @ Vehicle

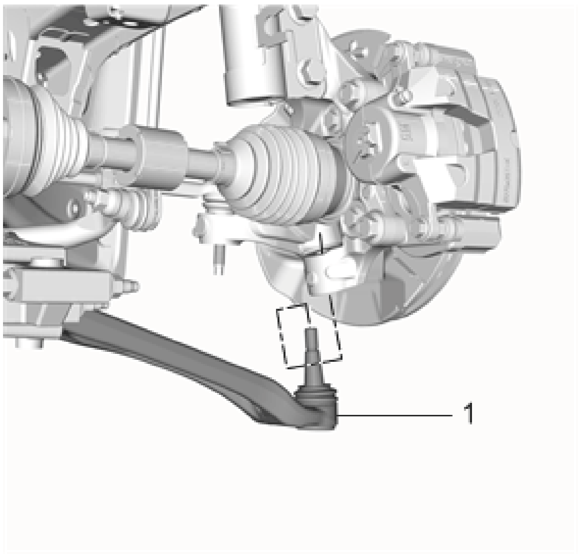


Fig. 11: Front Lower Control Arm Ball Joint
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Lower Control Arm Ball Joint (1) @ Steering Knuckle. Refer to **Lower Control Arm Replacement**

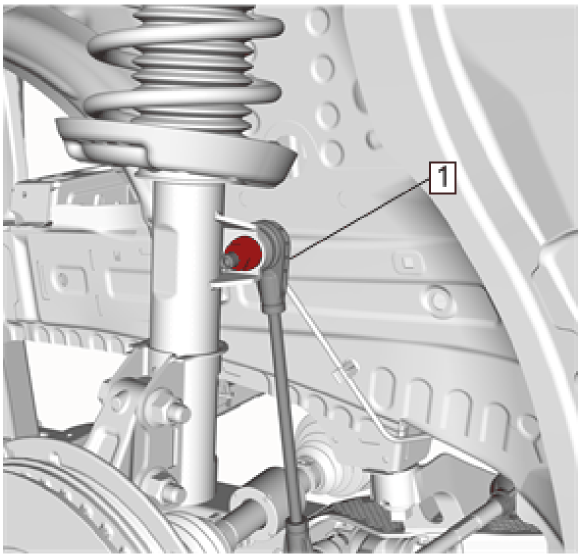


Fig. 12: Front Stabilizer Shaft Link
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Stabilizer Shaft Link (1) @ Front Suspension Strut. Refer to **Stabilizer Shaft Link Replacement**

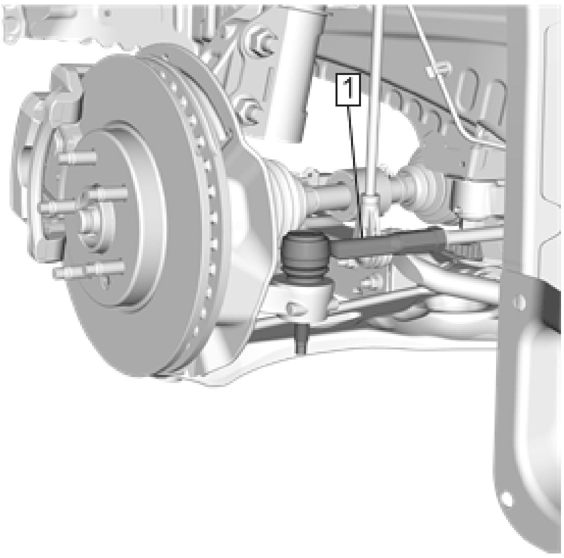


Fig. 13: Steering Linkage Outer Tie Rod
Courtesy of GENERAL MOTORS COMPANY

6. Install Steering Linkage Outer Tie Rod (1) @ Steering Knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement**

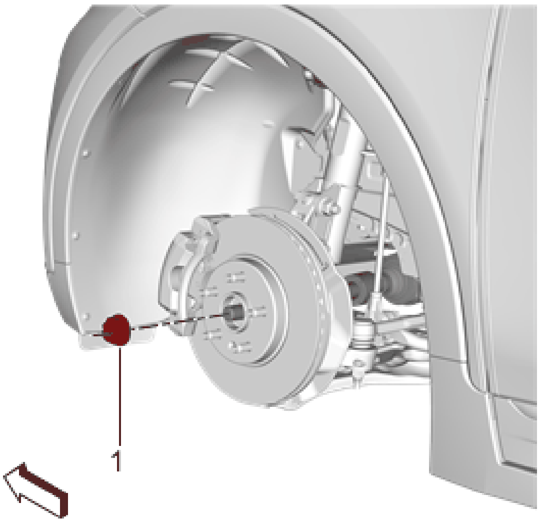


Fig. 14: Front Wheel Drive Shaft Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install NEW Front Wheel Drive Shaft Nut (1) @ Front Wheel Drive Shaft

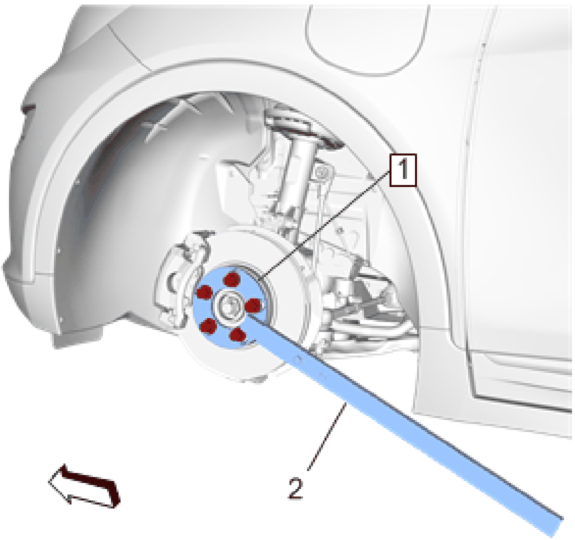


Fig. 15: Wheel Hub Holding Tool And Extension
Courtesy of GENERAL MOTORS COMPANY

8. Install the CH-49376 wheel hub holding tool (1) with the EN-956-1 extension (2) to the wheel hub with the wheel nuts and support the wheel hub holding tool outer end on a safety stand.

CAUTION: **Refer to Fastener Caution**

9. Tighten Front Wheel Drive Shaft Nut @ Front Wheel Drive Shaft
    1. First Pass: 150 N.m (111 lb ft)
    2. Second Pass: Loosen 45 Degrees
    3. Final Pass: 250 N.m (185 lb ft)
10. Remove the CH-49376 wheel hub holding tool from the wheel hub.
11. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
12. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
13. Lower the vehicle.

FRONT WHEEL DRIVE SHAFT INNER JOINT AND BOOT REPLACEMENT

Removal Procedure

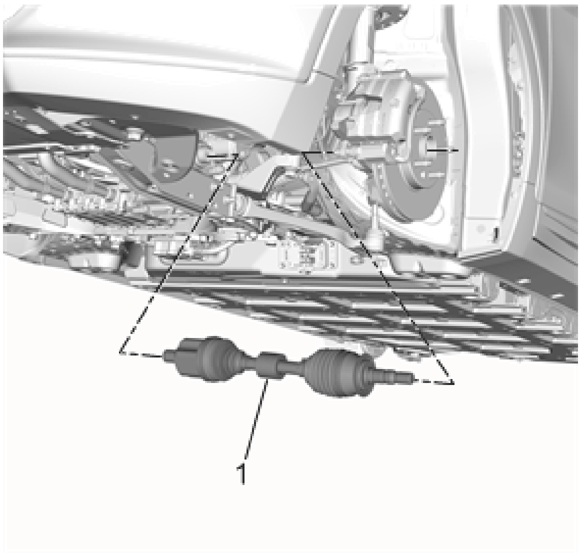


Fig. 16: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

1. Remove Front Wheel Drive Shaft (1) @ Vehicle. Refer to **Front Wheel Drive Shaft Replacement**

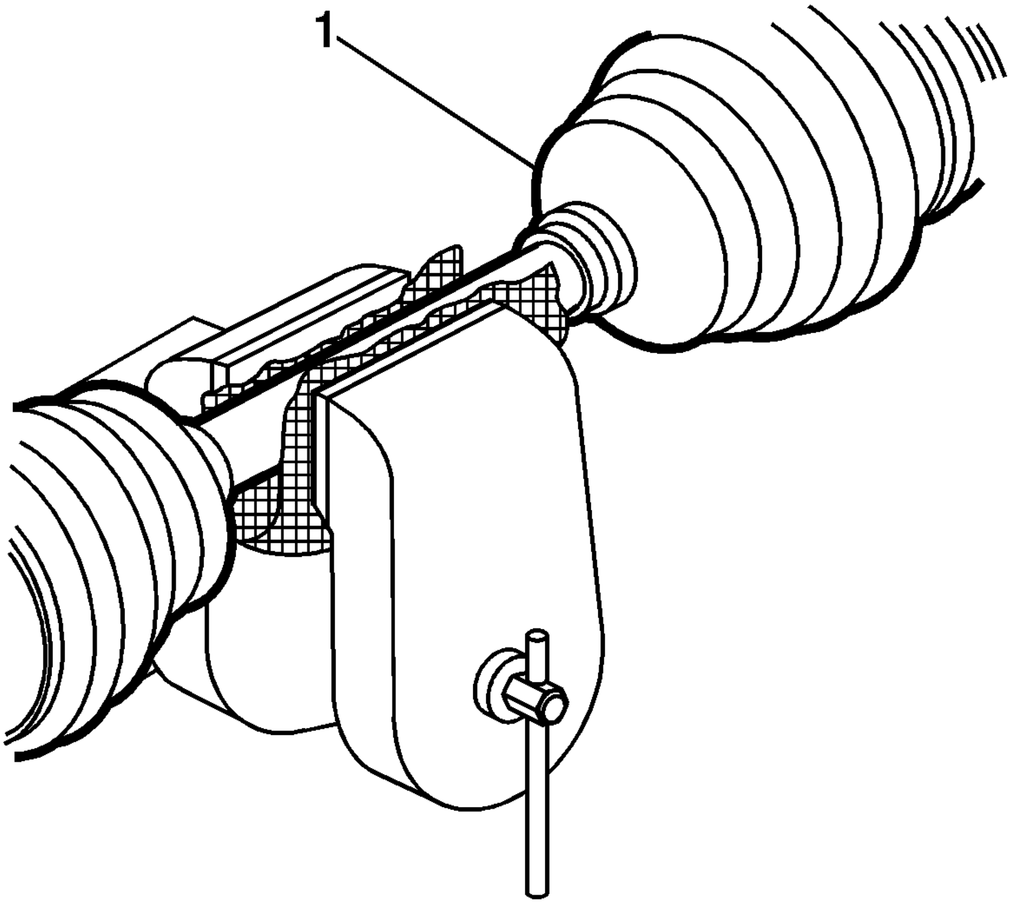


Fig. 17: Wheel Drive Shaft In Vise
Courtesy of GENERAL MOTORS COMPANY

2. Position the wheel drive shaft (1) in a soft jawed vise and clamp securely.

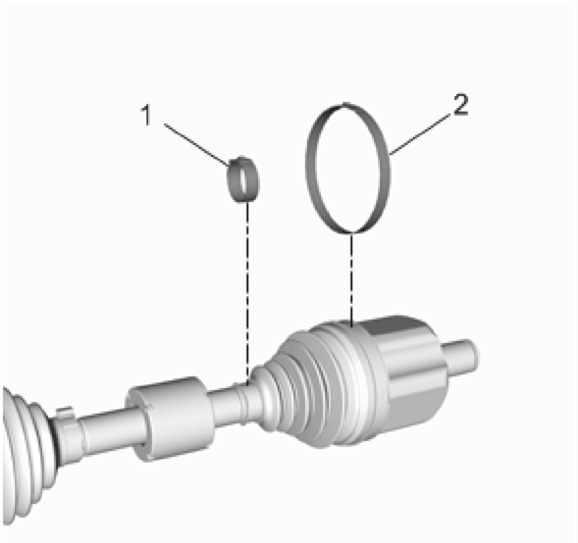


Fig. 18: Inboard Boot Inner Clamp And Outer Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Using a flat-bladed tool, remove and DISCARD the inboard boot inner clamp (1) and outer clamp (2).

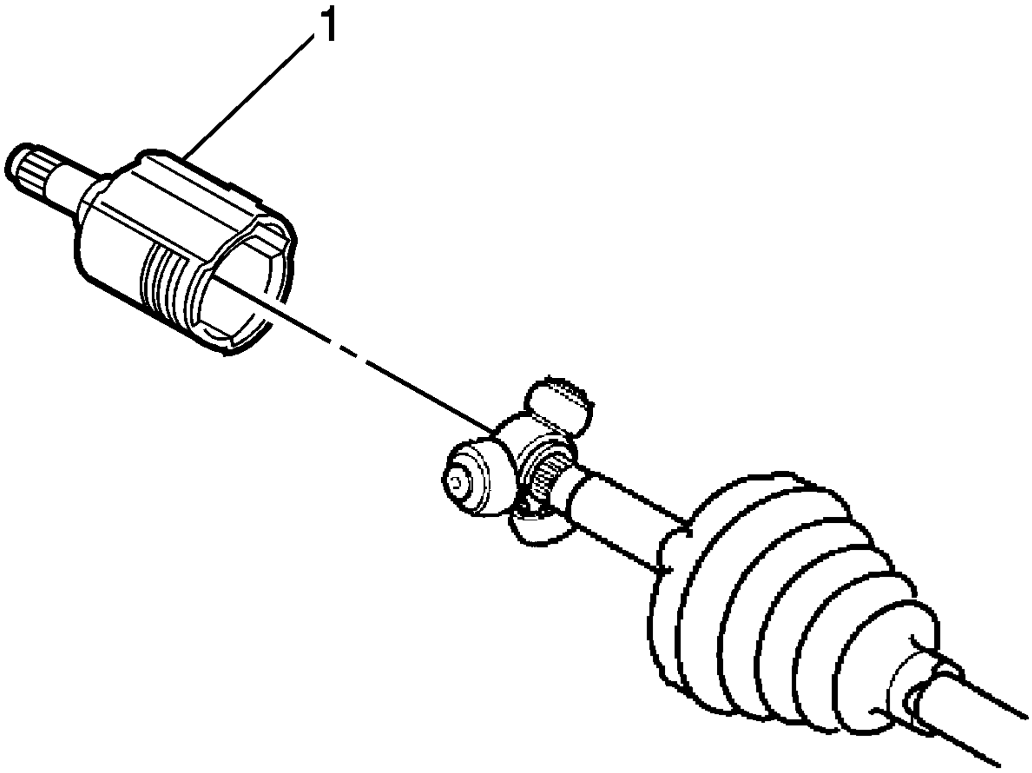


Fig. 19: Tripot Housing
Courtesy of GENERAL MOTORS COMPANY

4. Remove the tripot housing (1) from the wheel drive shaft.

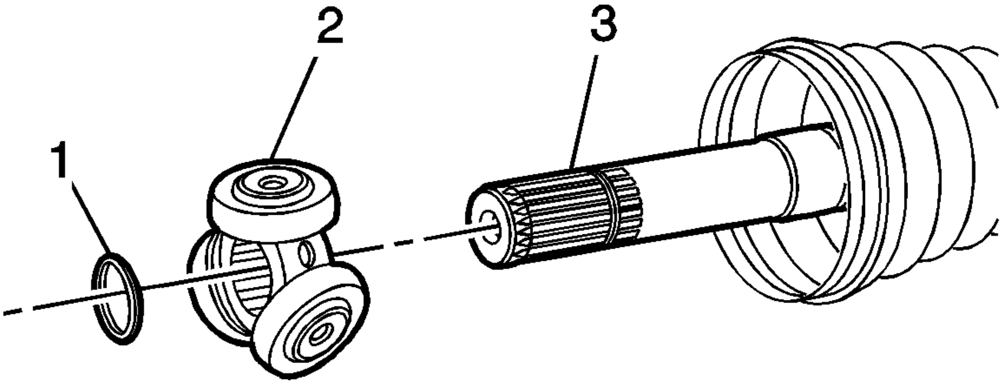


Fig. 20: Wheel Drive Shaft, Tripot Spider And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

5. Remove the retaining clip (1) and the tripot spider (2) from the wheel drive shaft (3).

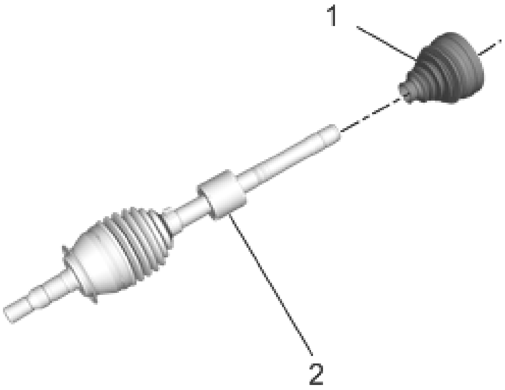


Fig. 21: Wheel Drive Shaft And Boot
Courtesy of GENERAL MOTORS COMPANY

6. Remove the boot (1) from the wheel drive shaft (2).

Installation Procedure

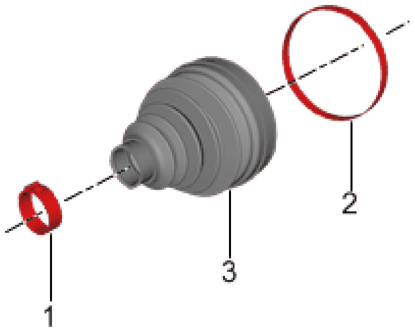


Fig. 22: Inboard Boot, Inner Clamp And Outer Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW inboard boot inner clamp (1) and a NEW outer clamp (2) on the boot (3).

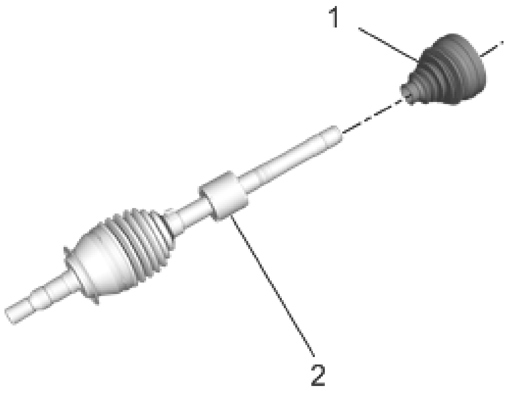


Fig. 23: Wheel Drive Shaft And Boot
Courtesy of GENERAL MOTORS COMPANY

2. Position the boot (1) on the wheel drive shaft (2).

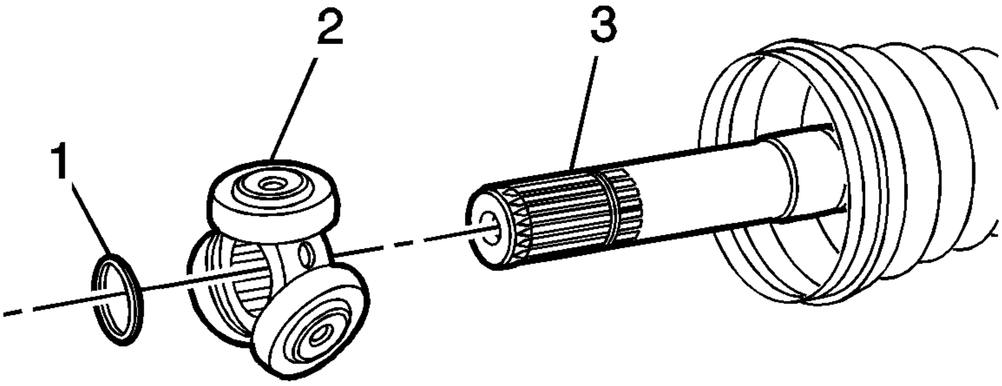
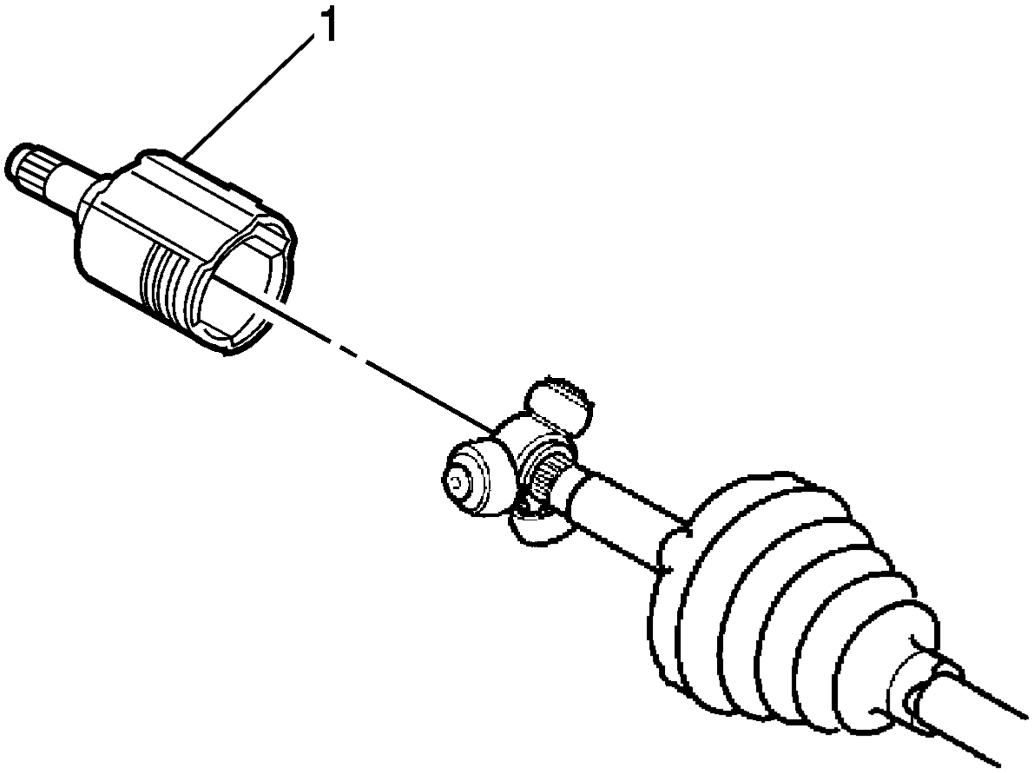


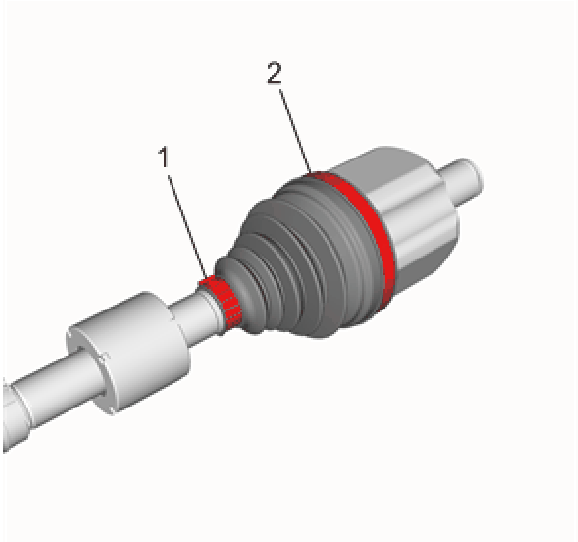
Fig. 24: Wheel Drive Shaft, Tripot Spider And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

3. Install the tripot spider assembly (2) to the wheel drive shaft (3), until seated against the shoulder.
4. Install the retaining ring (1) in the wheel drive shaft (3).
5. Place approximately half of the grease in the kit into the boot and place the remainder in the tripot housing.



[Fig. 25: Tripot Housing](#)
Courtesy of GENERAL MOTORS COMPANY

6. Install the tripot housing (1) on the wheel drive shaft.



[Fig. 26: Inboard Boot Inner Clamp And Outer Clamp](#)
Courtesy of GENERAL MOTORS COMPANY

7. Compress and lock the inboard boot inner clamp (1) and outer clamp (2) using an appropriate earless seal clamp tool.

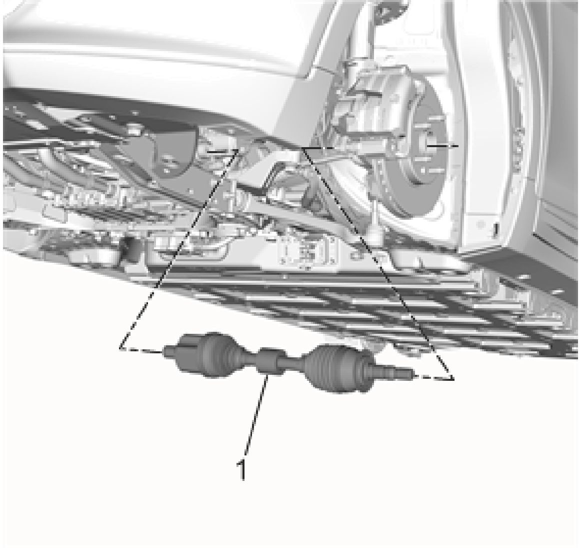


Fig. 27: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

8. Install Front Wheel Drive Shaft (1) @ Vehicle. Refer to **Front Wheel Drive Shaft Replacement**

FRONT WHEEL DRIVE SHAFT OUTER JOINT AND BOOT REPLACEMENT

NOTE: **The front wheel drive shaft outer joint and boot should be replaced with the half shaft as a subassembly.**

Removal Procedure

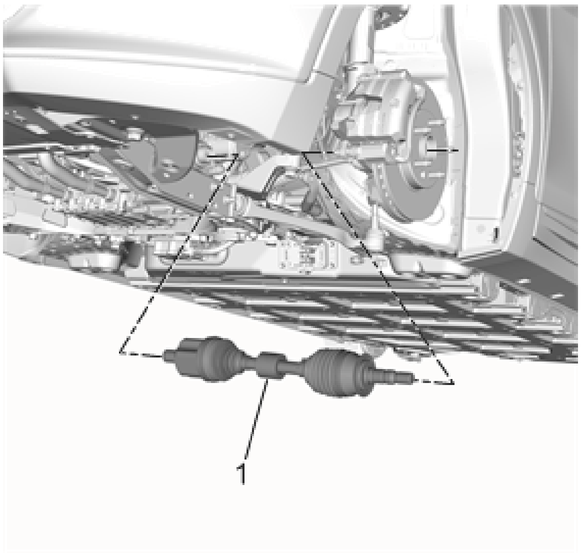


Fig. 28: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

1. Remove Front Wheel Drive Shaft (1) @ Vehicle. Refer to **Front Wheel Drive Shaft Replacement**

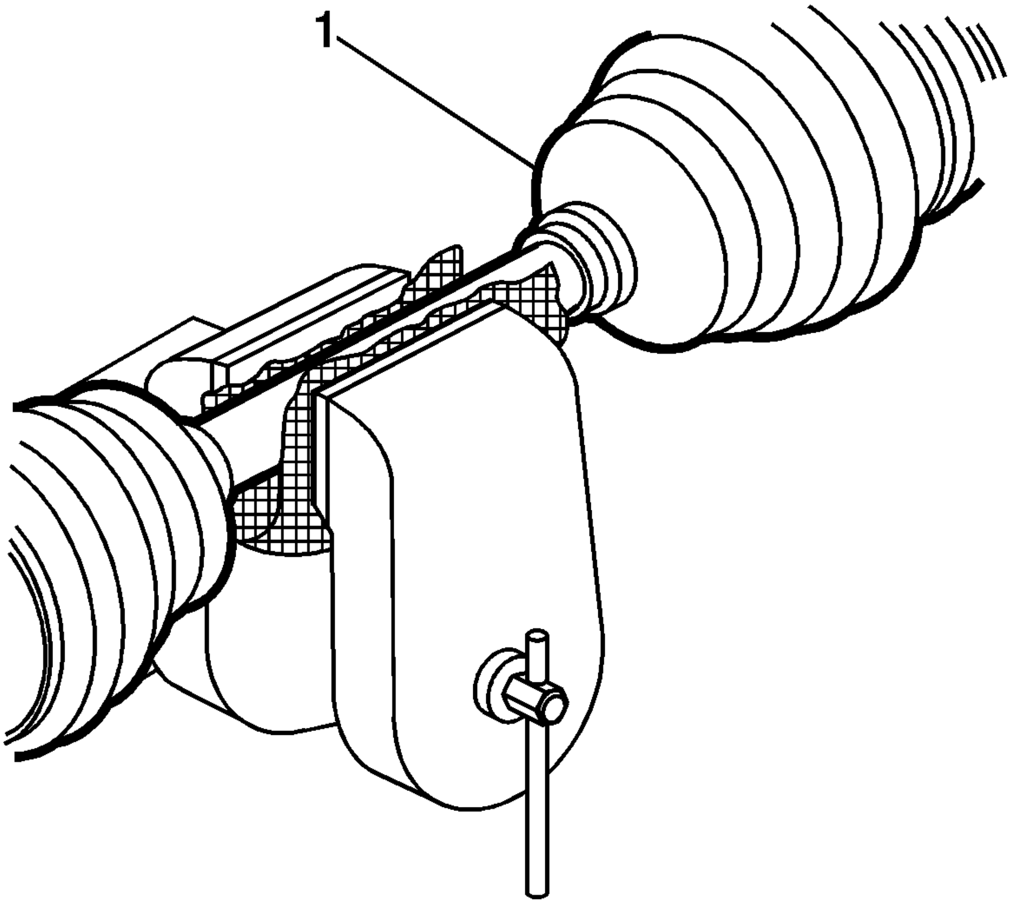


Fig. 29: Wheel Drive Shaft In Vise
Courtesy of GENERAL MOTORS COMPANY

2. Position the wheel drive shaft (1) in a soft jawed vise and clamp securely.

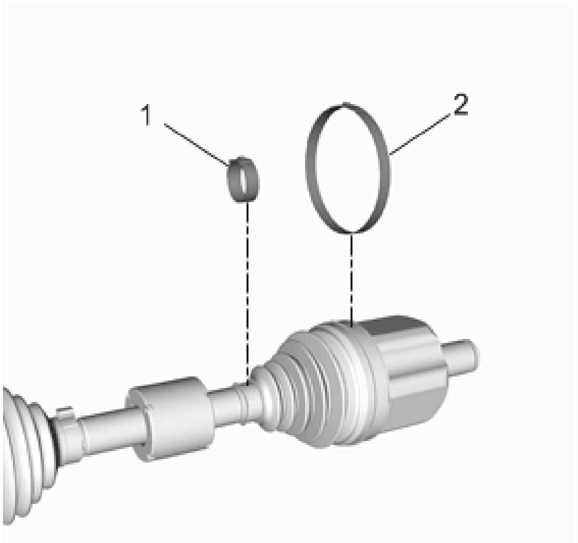


Fig. 30: Inboard Boot Inner Clamp And Outer Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Using a flat-bladed tool, remove and DISCARD the inboard boot inner clamp (1) and outer clamp (2).

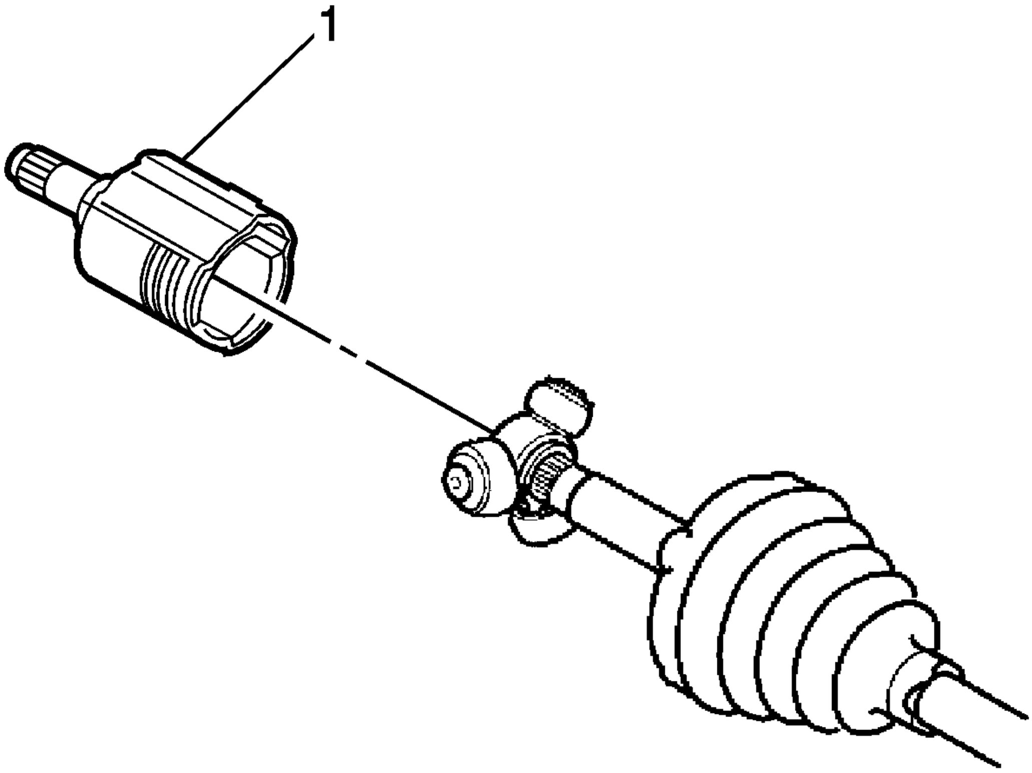


Fig. 31: Tripot Housing
Courtesy of GENERAL MOTORS COMPANY

4. Remove the tripot housing (1) from the wheel drive shaft.

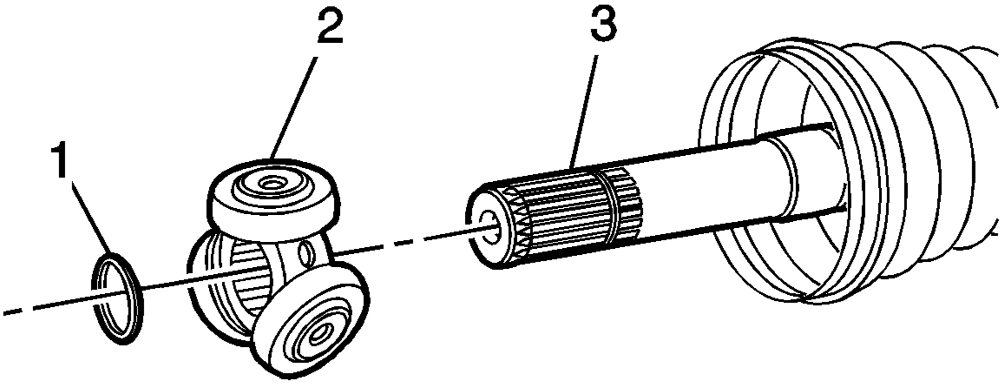


Fig. 32: Wheel Drive Shaft, Tripot Spider And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

5. Remove the retaining clip (1) and the tripot spider (2) from the wheel drive shaft (3).

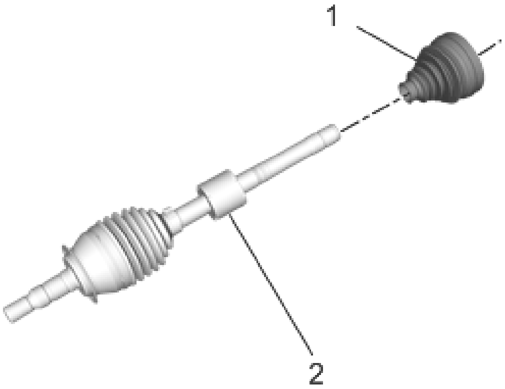
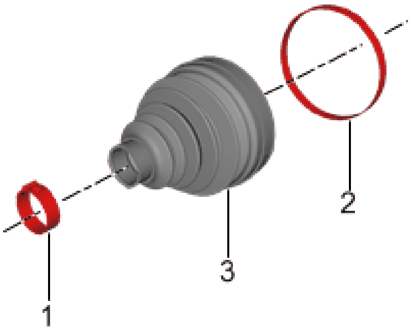


Fig. 33: Wheel Drive Shaft And Boot
Courtesy of GENERAL MOTORS COMPANY

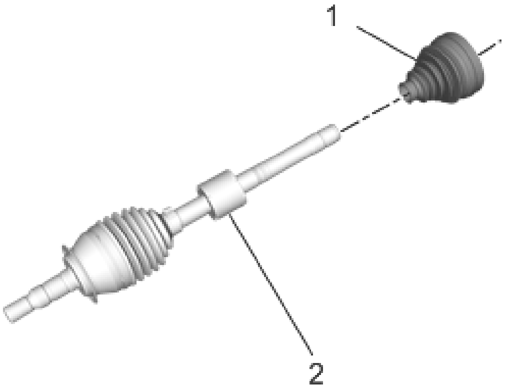
6. Remove the boot (1) from the wheel drive shaft (2).

Installation Procedure



[Fig. 34: Inboard Boot, Inner Clamp And Outer Clamp](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW inboard boot inner clamp (1) and a NEW outer clamp (2) on the boot (3).



[Fig. 35: Wheel Drive Shaft And Boot](#)
Courtesy of GENERAL MOTORS COMPANY

2. Position the boot (1) on the wheel drive shaft (2).

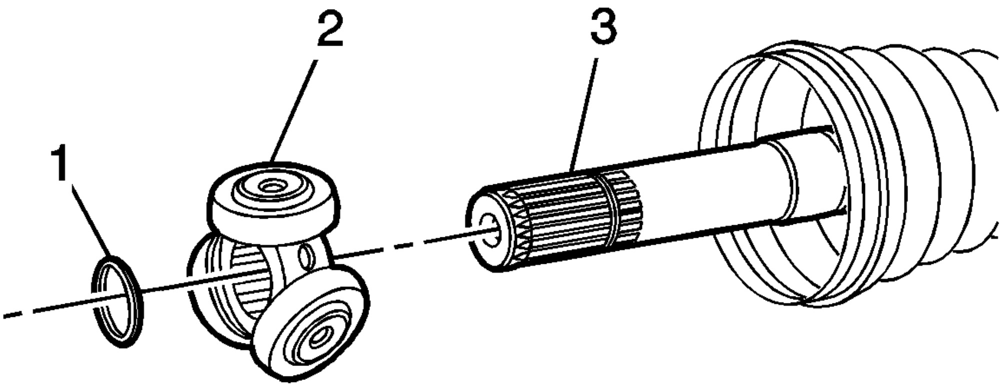


Fig. 36: Wheel Drive Shaft, Tripot Spider And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

3. Install the tripot spider assembly (2) to the wheel drive shaft (3), until seated against the shoulder.
4. Install the retaining ring (1) in the wheel drive shaft (3).
5. Place approximately half of the grease in the kit into the boot and place the remainder in the tripot housing.

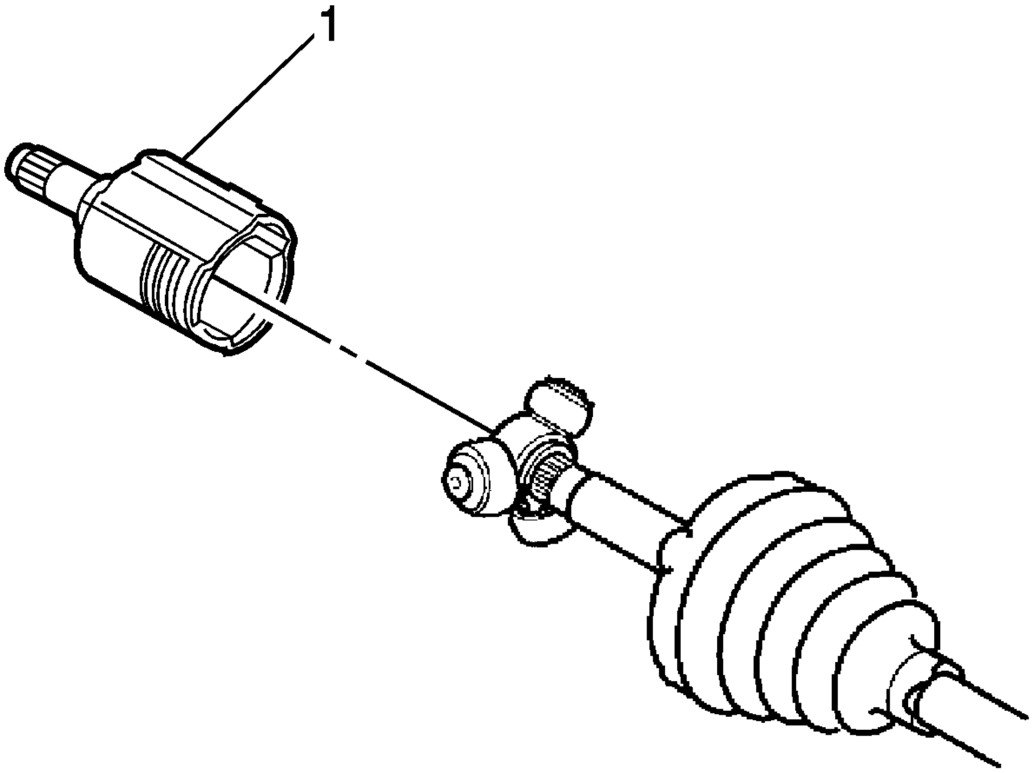


Fig. 37: Tripot Housing
Courtesy of GENERAL MOTORS COMPANY

6. Install the tripot housing (1) on the wheel drive shaft.

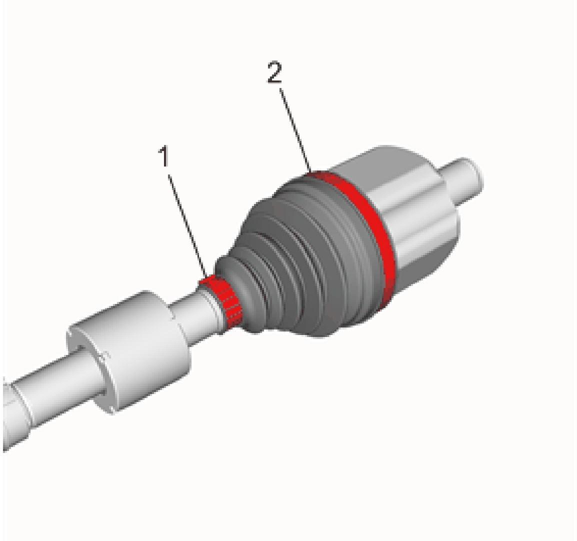


Fig. 38: Inboard Boot Inner Clamp And Outer Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Compress and lock the inboard boot inner clamp (1) and outer clamp (2) using an appropriate earless seal clamp tool.

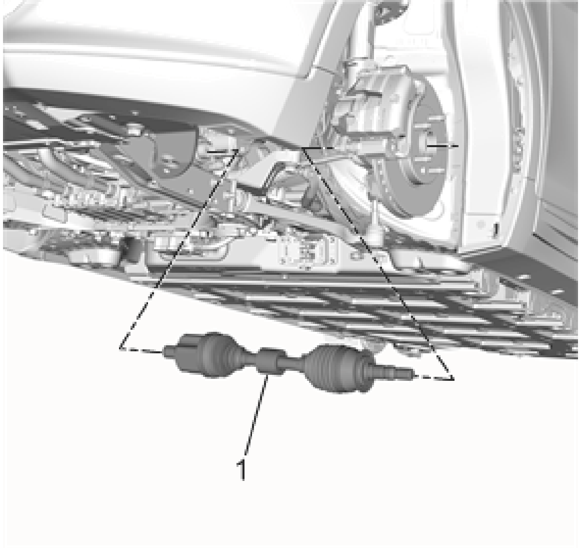


Fig. 39: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

8. Install Front Wheel Drive Shaft (1) @ Vehicle. Refer to **Front Wheel Drive Shaft Replacement**

DESCRIPTION AND OPERATION

WHEEL DRIVE SHAFTS DESCRIPTION AND OPERATION

Front wheel drive axles are flexible assemblies.

Front wheel drive axles consist of the following components:

- A front wheel drive shaft tripot joint (inner joint)
- A front wheel drive shaft constant velocity joint (outer joint)
- A front wheel drive shaft

  The front wheel drive shaft connects the front wheel drive shaft tripot joint and the front wheel drive shaft constant velocity joint.

The front wheel drive shaft tripot joint is completely flexible. The front wheel drive shaft tripot joint can move in and out.

The front wheel drive shaft constant velocity joint is flexible, but the front wheel drive shaft constant velocity joint cannot move in and out.

Boots And Clamps

The front wheel drive shaft constant velocity joint and the front wheel drive shaft tripot joint boots in the front wheel drive axle are made of a thermoplastic material.

The clamps in the front wheel drive axle are made of stainless steel.

The boot provides the following functions:

- Protection of the internal parts of the front wheel drive shaft constant velocity joint and the front wheel drive shaft tripot joint

  The boot protects the grease from the following sources of damage:

  - Harmful atmospheric conditions, such as extreme temperatures or ozone gas
  - Foreign material, such as dirt or water
- Allows angular movement and the axial movement of the front wheel drive shaft tripot joint
- Allows angular movement of the front wheel drive shaft constant velocity joint

NOTE: **Protect the boots from sharp tools and from the sharp edges of the surrounding components. Any damage to the boots or the clamps will result in leakage. Leakage**

will allow water to leak into the front wheel drive shaft tripot joint and the front wheel drive shaft constant velocity joints. Leakage will also allow grease to leak out of the front wheel drive shaft tripot joints and the front wheel drive shaft constant velocity joints. Leakage may cause noisy front wheel drive axle operation and eventual failure of the internal components.

The clamps provide a leak proof connection for the front wheel drive shaft tripot joint and the front wheel drive shaft constant velocity joint at the following locations:

- The housing
- The front wheel drive shaft

The thermoplastic material performs well under normal conditions and normal operation. However, the material is not strong enough to withstand the following conditions:

- Abusive handling
- Damage from sharp objects, such as sharp tools or any sharp edges of the surrounding components in the vehicle

Front Wheel Drive Shaft Tripot Joint (Inner Joint)

The front wheel drive shaft tri-pot joint is made with the tripot design without an over-extension limitation retainer.

The joint is constructed as follows for vehicles that are equipped with an automatic transmission:

- The left front wheel drive axle has a female spline. The female spline installs over a stub shaft that protrudes from the transaxle.
- The right front wheel drive axle has a female spline. The right front wheel drive axle uses barrel type snap rings in order to interlock with the intermediate shaft.

Front Wheel Drive Shaft Constant Velocity Joint (Outer Joint)

The front wheel drive shaft constant velocity joint is made with the Rzeppa joint design.

The shaft end (which mates with the knuckle/hub) has a helical spline. The helical spline ensures a tight, press-type fit.

This design prevents end play between the hub bearing and the front wheel drive axle.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

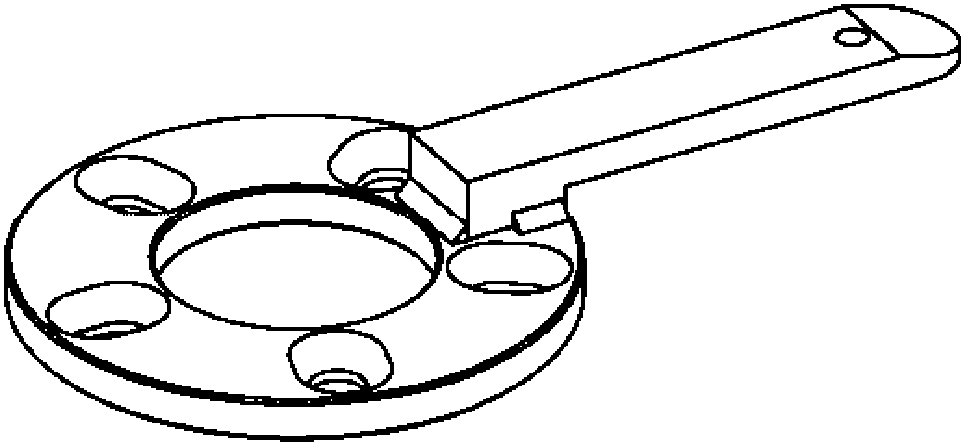
Illustration	Tool Number/Description
	CH 49376 Wheel Hub Holding Tool

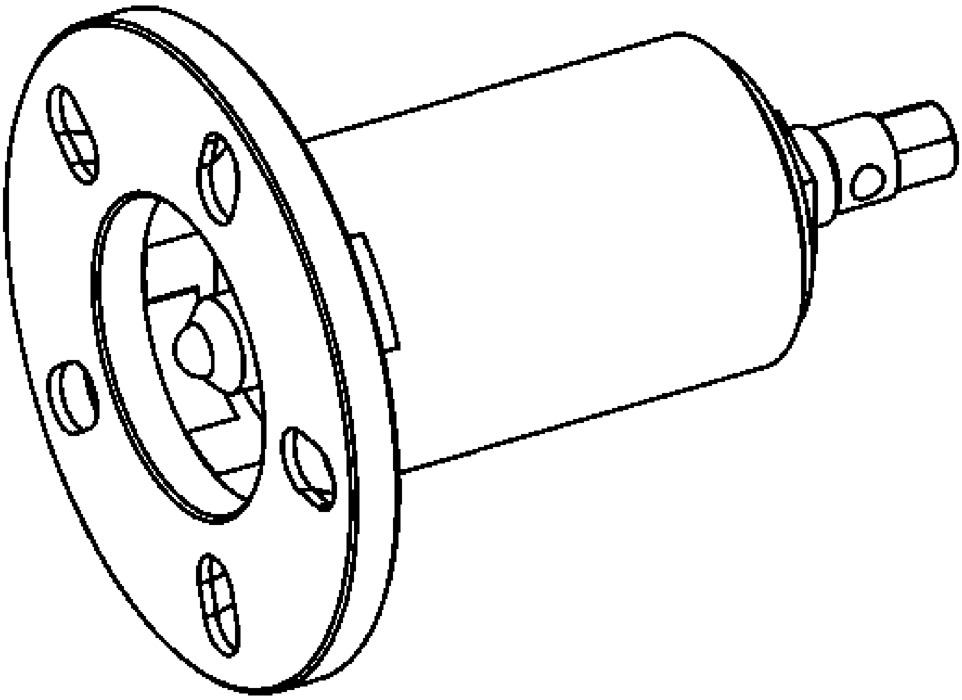
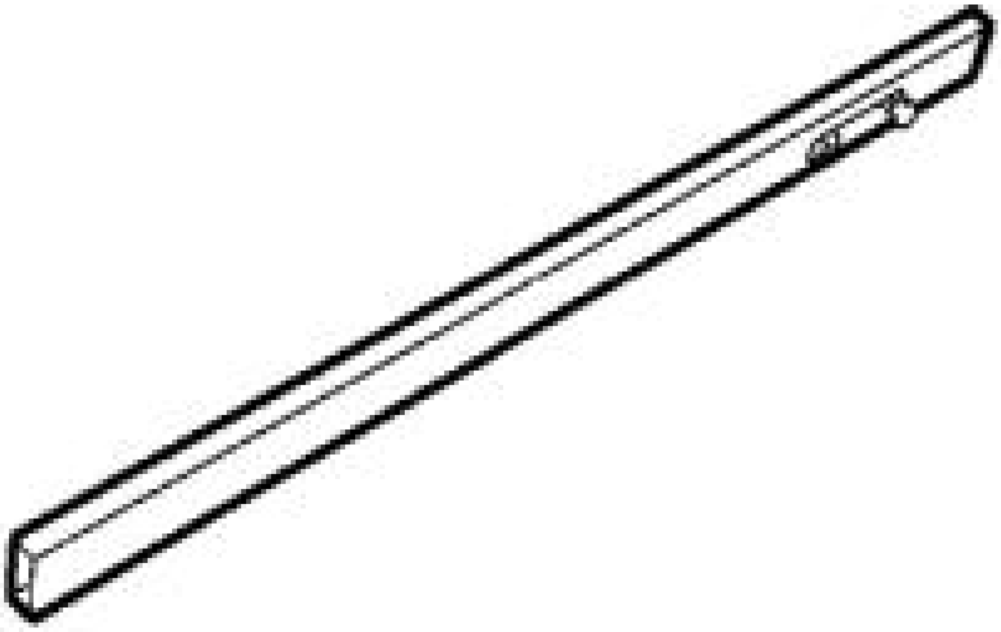
Illustration	Tool Number/Description
	CH 49400 Hub Spindle Remover

Illustration	Tool Number/Description
	EN 956-1 Extension

Back To Article

2017 DTC INDEX

Bolt EV

ANTILOCK BRAKE SYSTEM - DTCS

ANTILOCK BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B2745	Traction Control Switch Circuit
DTC C0035, C0051	Wheel Speed Sensor Circuits
DTC C0055	Rear Wheel Speed Sensor Circuit
DTC C005A	Simultaneous Malfunction of Both Wheel Speed Sensors on One Axle
DTC C0110	Pump Motor Circuit
DTC C0115	Pump Motor Stuck
DTC C0116	Pump Motor Relay Circuit
DTC C0121	Valve Relay Circuit Malfunction
DTC C0131	Traction Control System Pressure Circuit
DTC C0161	Antilock Braking System Brake Switch Circuit
DTC C0179	Brake System Calculated Component Overheat Protection Time-Out
DTC C0186, C018B, C0196, C019B, C027E, or C0287	Lateral/Longitudinal Acceleration Sensor Signal/Yaw Rate Signal
DTC C0245	Wheel Speed Sensor Frequency
DTC C0274	Isolation Valve
DTC C0280	Stability System Active Too Long
DTC C0561	System Disabled Information Stored
DTC C0569	System Configuration
DTC C10EA	Powertrain Control Module Indicated Requested Torque
DTC C10EB	Engine Control Module Indicated Traction Control
DTC C1200	Powertrain Sensed Brake Pedal Information Message Counter Incorrect
DTC C124F or C1250, C1254	Lateral/Longitudinal Acceleration Sensor Circuit
DTC C1284 or C1285	Brake Assist Information Message Counter Incorrect
DTC C1286	Commanded Axle Torque Message Counter Incorrect
DTC C1287	Regenerative Braking Axle Torque Achieved Message Counter Incorrect
DTC P0856	Traction Control Torque Request Circuit
DTC P15F8	Automatic Braking Engine Torque Request Signal Message Counter Incorrect
DTC P15FD	Wheel Speed Sensor Message Sequence Incorrect
DTC P1B12	Driver Intended Braking Torque Signal Message Counter Incorrect

AUTOMATIC TRANSMISSION - 1ET25 (MMF) - DTCS

AUTOMATIC TRANSMISSION - 1ET25 (MMF) - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description

DTC	Description
DTC C1217, C1301, or C1302	Message Counter Incorrect
DTC P0711, P0713	Transmission Fluid Temperature Sensor
DTC P152A or P152D	Regenerative Braking Control Switch Circuit
DTC P152C	Regenerative Braking Control Switch Signal Message Counter Incorrect
DTC P152E	Unexpected Vehicle Movement
DTC P175F	Acceleration Sensor Signal Message Counter Incorrect
DTC P1762	Transmission Mode Switch Signal Message Counter Incorrect
DTC P1775	Transmission Range Request Signal Message Counter Incorrect
DTC P1824, P182A, P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3	Internal Mode Switch Circuit
DTC P215B	Vehicle Speed - Output Shaft Speed Not Plausible

BATTERY, CHARGING SYSTEM AND STARTING SYSTEM - DTCS

BATTERY, CHARGING SYSTEM AND STARTING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561, P0563, P1A0C, P1A0D, or P1EFC	Power Circuit Voltage
DTC B1516	Battery Current Sensor
DTC B151A	Low Battery Capacity Detected
DTC B1527	Parasitic Load
DTC P0AF7	14V Power Module High Temperature
DTC U3001, U3003, U3006, U3009, U3013, U3014, U3018, U3019, or U3500-U350B	Control Module

BOLTED EXTERIOR BODY PANELS AND CLOSURES - DTCS

BOLTED EXTERIOR BODY PANELS AND CLOSURES - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B3006	Hood Ajar Circuit
DTC P257D, P257F	Engine Hood Switch

BUMPERS AND FASCIAS - DTCS

BUMPERS AND FASCIAS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC P059F or P151E	Active Grille Air Shutter

CELLULAR SYSTEM, ENTERTAINMENT SYSTEM, AND NAVIGATION SYSTEM - DTCS

CELLULAR SYSTEM, ENTERTAINMENT SYSTEM, AND NAVIGATION SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B123E	Radio Keypad Button Signal Circuit
DTC B124B	USB 1 Circuit

DTC	Description
DTC B124F	Universal Serial Bus (USB) Programming
DTC B125A	Antenna Signal Circuit
DTC B125C	Satellite Antenna Circuit
DTC B1265	Switched 14 Volt Performance Short to Ground
DTC B1271	Theft Protection Active
DTC B1277	Cellular Phone Microphone Circuit
DTC B127E	Front Video Display Output Signal
DTC B1287	Amplifier Control Signal Circuit
DTC B1446 or B1447	Backup Power Source
DTC B2455	Cellular Phone Microphone Circuit
DTC B2462	Global Positioning System (GPS) Signal
DTC B2470	Cellular Phone Antenna Circuit Malfunction
DTC B2476 or B2482	Cellular Phone Select Service Switch

CRUISE CONTROL SYSTEM - DTCS

CRUISE CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC P0572 or P0573	Brake Switch Circuit 1 Low/High Voltage
DTC P0575	Cruise Control Switch Signal Message Counter Incorrect
DTC P0703	Brake Switch Signal Message Counter Incorrect
DTC P158A	Cruise Control Calibration Incorrect

DATA COMMUNICATION SYSTEM - DTCS

DATA COMMUNICATION SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION (1 OF 2)

DTC	Description
DTC B1000	Electronic Control Unit
DTC B1001	Option Configuration
DTC B1016	Vehicle Identification Number Information Not Programmed
DTC B101D	Electronic Control Unit Hardware
DTC B101E	Electronic Control Unit Software
DTC C056D	Electronic Control Unit Hardware
DTC C056E	Electronic Control Unit Software
DTC P0601, P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B	Control Module
DTC P06E4 (Hybrid/EV Powertrain Control Module 2)	Control Module Wake-Up Circuit Performance
DTC P0A1F, P1A01, P1A05, or P1A06	Battery Energy Control Module
DTC P16B7	Electric A/C Compressor Control Module Wake-Up Circuit Performance
DTC P16B8, P16BA	Electric A/C Compressor Control Module
DTC P1E8E, P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042	Hybrid/EV Battery Interface Control Module
DTC P1EB1	Hybrid/EV Battery Interface Control Module Software Incompatible
DTC P1EB2, P1EB5, P1FA6-P1FAB, P3030, or P303B	Hybrid/EV Battery Interface Control Module Not Programmed

DTC	Description
DTC P1EB9	High Voltage Energy Management Communication Bus Enable Circuit
DTC P1EC1 or P1EC2	Battery Energy Control Module High Voltage Energy Management Communication Bus Enable Circuit Low Voltage
DTC U0020	Low Speed CAN Bus
DTC U0073 or U2100	Control Module Communication Bus A Off, CAN Bus Communication
DTC U0074	Control Module Communication Powertrain Expansion CAN Bus Off
DTC U0077	Control Module Communication Chassis Expansion CAN Bus Off
DTC U0078	Control Module Communication Low Speed CAN Bus Off
DTC U007A	Control Module Communication High Voltage Energy Management CAN Bus Off
DTC U007B	Control Module Communication High Speed Extension CAN Bus Off
DTC U007C	Control Module Communication High Speed Extension CAN Bus 2 Off
DTC U007D	Control Module Communication Low Speed Extension CAN Bus Off
DTC U0100, U02FF	Lost Communication
DTC U0300, U0336	Software Incompatibility
DTC U0400, U05FF	Invalid Data Received
DTC U1026	Lost Communication with Transfer Case Control Module
DTC U1340, U135F	Chassis/Engine Control Module, Lost Communication
DTC U1500, U15FF	LIN Bus
DTC U1653	Chassis Systems High Speed Communication Enable Circuit
DTC U179A	Lost Communication with Hybrid Powertrain Control Module 2
DTC U179D	Lost Communication with Brake System Control Module 2 on Chassis Expansion Bus
DTC U1803	Lost Communication with Hybrid Powertrain Control Module 2
DTC U1806	Battery Energy Control Module High Voltage Energy Management CAN Bus Off
DTC U180B	Battery Energy Control Module High Speed CAN Bus Off
DTC U1814	Powertrain Wake-Up Communication Circuit
DTC U1817	Lost Communication with Hybrid Powertrain Control Module on Powertrain Expansion CAN Bus

DATA COMMUNICATION SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION (2 OF 2)

DTC	Description
DTC U1818	Lost Communication with Engine Control Module on Powertrain Expansion Communication Bus
DTC U182D	Lost Communication with Hybrid Powertrain Control Module 2 on Powertrain Expansion Communication Bus

DTC	Description
DTC U1833	Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
DTC U183E	Lost Communication with Telematics Communication Interface Control Module on Low Speed CAN Bus
DTC U184A	Lost Communication with Body Control Module on Low Speed CAN Bus
DTC U184B	Lost Communication with Remote Heater and Air Conditioning Control Module on Low Speed CAN Bus
DTC U184C	Lost Communication with Instrument Cluster on Low Speed CAN Bus
DTC U184D	Lost Communication with Radio on Low Speed CAN Bus
DTC U184E	Lost Communication with Inflatable Restraint Sensing and Diagnostic Module on Low Speed CAN Bus
DTC U185A	Lost Communication with Battery Energy Control Module on High Voltage Energy Management CAN Bus
DTC U185B	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2 on High Voltage Energy Management CAN Bus
DTC U1860	Electric A/C Compressor Control Module Lost Communication with Hybrid Powertrain Control Module 2
DTC U1885	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module
DTC U18A4	Lost Communication with Hybrid/EV Battery DC Charging Communications Gateway Module on High Voltage Energy Management CAN Bus
DTC U18A6	Lost Communication with Right Object Detection Control Module on Dedicated Bus 1
DTC U18A9	Lost Communication With Transmission Range Control Module on Chassis Expansion CAN Bus
DTC U18AA	Transmission Range Control Module Lost Communication with Engine Control Module
DTC U18AB	Transmission Range Control Module Lost Communication with Chassis Control Module on High Speed CAN Bus
DTC U18AC	Transmission Range Control Module Lost Communication with Chassis Control Module on Chassis Expansion CAN Bus
DTC U18AD	Transmission Range Control Module Lost Communication with Electronic Brake Control Module on Chassis Expansion CAN Bus
DTC U18AF, U18B4	Lost Communication
DTC U18B5	Lost Communication With Hybrid Powertrain Control Module on Chassis Expansion CAN Bus
DTC U18B9, U18BF	Primary/Secondary High Speed CAN Bus Subnet Configuration List
DTC U2099	High Speed Communication Enable Circuit
DTC U2160, U2231	Lost Communication
DTC U2401	Battery Energy Control Module Dedicated Bus 1 Off

DTC	Description
DTC U2409	Transmission Range Control Module High Speed CAN Bus Off
DTC U240A	Transmission Range Control Module Chassis Expansion CAN Bus Off
DTC U2500, U25FF	Invalid Data Received
DTC U2602	Battery Energy Control Module Lost Communication with Hybrid/EV Powertrain Control Module 2
DTC U2603, U2606 or U2617-U2624	Battery Energy Control Module Lost Communication with Hybrid/EV Battery Interface Control Module
DTC U3000	Control Module
DTC U3012	Control Module Improper Wake-up Perfomance

FIXED AND MOVEABLE WINDOWS - DTCS

FIXED AND MOVEABLE WINDOWS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B0283	Rear Defogger Circuit
DTC B316B, B317A, B318A, or B319A	Window Switch
DTC B3205	Driver Window Motor Circuit

HORN SYSTEM - DTCS

HORN SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B010E	Pedestrian Friendly Alert Audio Output Circuit
DTC B274E or B274F	Low Horn Output Short to Battery

HVAC SYSTEM - AUTOMATIC - DTCS

HVAC SYSTEM - AUTOMATIC - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B0173 or B0178	Upper/Lower Left Duct Air Temperature Sensor Circuit
DTC B018A, B048C, B048F, or B1395	Windshield Temperature Sensor/Humidity Sensor Circuit
DTC B0193	Front Blower Motor Speed Circuit
DTC B0223, B0233, B023A, or B0408	Air Flow/Temperature Control
DTC B048E	Auxiliary Heater System Malfunction
DTC B3844	Engine Coolant Circulation Pump Circuit
DTC P0532 or P0533	Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low/High Voltage
DTC P0534	Air Conditioning (A/C) Refrigerant Charge Low
DTC P0D69, P0D7F	A/C Compressor
DTC P151C or P2516, P2518	Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor
DTC P154F	Electric A/C Compressor motor Input Current-Positive Contactor State Not Plausible
DTC P156A, P156C	Air Conditioning (A/C) Pressure Too High when A/C Off, Too Low when A/C On
DTC P15C6 or P15C8, P15CB	Electric A/C Compressor
DTC P1F0A, P1F0D	A/C Compressor Motor, Electric A/C Compressor Control Module

HYBRID / EV BATTERY HEATING AND COOLING - DTCS

HYBRID / EV BATTERY HEATING AND COOLING - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC P0480	Cooling Fan Relay Control Circuit
DTC P0A7E	Hybrid/EV Battery Pack High Temperature
DTC P0A9C, P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36	Hybrid/EV Battery Temperature Sensor
DTC P0C43, P0C46	Hybrid/EV Battery Pack Coolant Temperature Sensor
DTC P0C47, P1E8C, or P1E8D	Hybrid/EV Battery Pack Coolant Pump Circuit
DTC P0CE9, P1F44, or P1F45	Hybrid/EV Electronics Coolant Pump Circuit
DTC P0CEF, P0CF2	Hybrid/EV Electronics Coolant Temperature Sensor
DTC P1485, P1487	Cooling Fan Output Circuit
DTC P19FA, P19FC	Hybrid/EV Electronics Coolant Pump Feedback Circuit
DTC P19FD, P19FF	Hybrid/EV Battery Pack Coolant Pump Feedback Circuit
DTC P148A, P148C	Cooling Fan Signal Circuit
DTC P1EC6	Hybrid/EV Battery Pack Heater Performance
DTC P1FFB, P1FFE	Hybrid/EV Battery Pack Coolant Level Sensor Circuit
DTC P1FFF	System Isolation / Coolant Level Sensor Fault - Hybrid/EV Battery Charging System Disabled

HYBRID / EV CONTROL SYSTEM - DTCS

HYBRID / EV CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC P057B, P057E	Brake Pedal Position Sensor
DTC P0601, P0604, P0606, or P062F (Hybrid Powertrain Control Module 1)	Control Module
DTC P0601, P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)	Control Module
DTC P061B	Control Module Torque Calculation Performance
DTC P0641, P0651, P0697, or P06A3	5 V Reference 1/2/3/4 Circuit
DTC P0650, P263A, or P263B	Malfunction Indicator Lamp (MIL) Control Circuit
DTC P0685, P0687, P0689, P0690, or P1682	Engine Controls Ignition Relay Control/Feedback Circuit
DTC P06AF	Torque Management System Performance - Forced Engine Shutdown
DTC P06B1 or P06B2	Sensor Supply Voltage Circuit Low/High Voltage
DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03	Drive Motor Position Sensor
DTC P0A5E, P0A61, or P0A64	Drive Motor Phase U/V/W Low Current
DTC P0A78	Drive Motor Inverter Performance
DTC P0A8D or P0A8F	14 V Power Module System Voltage Low/High Voltage
DTC P0AC4, P1E00, P25A2, P25C9, or P26C8	Hybrid/EV Powertrain/Brake System/Chassis Control Module

DTC	Description
DTC P0AEE, P0AEF, P0AF0, P0BD2, P0BD4, or P0BDC-P0BDE	Drive Motor Inverter Temperature Sensor
DTC P0BE6, P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0	Drive Motor Phase U/V/W Current Sensor
DTC P0BFD	Drive Motor Phases U-V-W Not Plausible
DTC P0C01	Drive Motor High Current
DTC P0C0B	Drive Motor Inverter Supply Voltage Circuit
DTC P0C11, P0C13	Drive Motor Inverter Phase U/V/W High Temperature
DTC P0C17 or P1B0F	Drive Motor 1 Position Not Learned/Learn Incorrect
DTC P0C19	Drive Motor Torque Delivered Performance
DTC P0C2D or P0C2E	Electric/Auxiliary Transmission Fluid Pump Control Module Feedback Circuit Low/High Voltage
DTC P0C4E	Drive Motor Position Exceeded Learning Limit
DTC P0C76	Hybrid/EV Battery System High Voltage Present
DTC P150D or P150E	Supply Voltage Circuit 2/Circuit 1 Low Voltage
DTC P15F1	Axle Torque Request Signal Message Counter Incorrect
DTC P15FC	Hybrid/EV Battery Contactor Status Message Counter Incorrect
DTC P16F3	Control Module Redundant Memory Performance
DTC P16F4	Control Module Transmission Range Switch Input Circuitry Performance
DTC P16FF	Engine Controls Ignition Relay Request Signal Message Counter Incorrect
DTC P190A, P190C	Drive Motor 1 Inverter Phase U/V/W Temperature Erratic
DTC P1AE8 or P1AE9	Drive Motor Control Module Hybrid/EV Battery Voltage Sense Circuit Low/High Voltage
DTC P1AEC or P1AEE	Drive Motor Control Module Hybrid/EV Battery System Voltage
DTC P1AF0	Drive Motor Control Module Hybrid/EV Battery Voltage System Isolation Lost
DTC P1AF4 or P1AF5	Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low/High Voltage
DTC P1B0B or P1B0C	Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low/High Voltage
DTC P1B0D	Drive Motor 1 Control Module Drive Motor 1 Overspeed
DTC P1B41	Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance
DTC P1E0A	Drive Motor Control Module Torque Calculation Performance
DTC P1E4A	Control Module Redundant Drive Motor 1 Speed Sensing Circuit
DTC P1F59, P1F5A, or P1F5B	14 Volt Power Module Status Terminal Circuit
DTC P1F5D or P1F5E	14 Volt Power Module L-Terminal Circuit Low/High Voltage
DTC P2122, P2123, P2127, P2128, or P2138	Accelerator Pedal Position (APP) Sensor
DTC P2797	Auxiliary Transmission Fluid Pump Performance

DTC	Description
DTC P2798 or P2799	Auxiliary Transmission Fluid Pump Control Circuit Low/High Voltage

HYBRID / EV ENERGY STORAGE - DTCS

HYBRID / EV ENERGY STORAGE - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC P0A0C or P0A0D	High Voltage System Interlock Circuit Low/High Voltage
DTC P0A7F	Hybrid/EV Battery Pack Life
DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3	Hybrid/EV Battery, Battery Charging System
DTC P0AA6 or P1AE6	Hybrid/EV Battery, Battery Energy Control Module
DTC P0ABB, P0ABC, or P0ABD	Hybrid/EV Battery Voltage Sensor
DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB	Hybrid/EV Battery Low/High Resolution Current Sensor
DTC P0AF8	Hybrid System Voltage
DTC P0AFA or P0AFB	Hybrid/EV Battery System Voltage Low/High Voltage
DTC P0B3B, P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B	Hybrid/EV Battery 1 Through 96 Circuit
DTC P0C78 or P3061	Hybrid/EV Battery Precharge
DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC8, P3035, or P3040	Hybrid/EV Battery Interface Control Module
DTC P1B3F or P1B40	High Voltage System Interlock Circuit 2 Low/High Voltage
DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCE, P3036, or P3041	Hybrid/EV Battery Interface Control Module 1 Through 12 Cell Balancing Circuit
DTC P1EAB or P1EAC	Battery Energy Control Module, Hybrid/EV Battery Cell Overvoltage Signal
DTC P1EAD, P1EB0 or P3240-P3253	Hybrid/EV Battery Interface Control Module 1 Through 12 Cell Overvoltage
DTC P1FD5, P1FF2, P3038-P303A, or P3043-P3045	Hybrid/EV Battery Interface Control Module 1 Through 12 Voltage Sensor
DTC P1F17	System Isolation / Impact Sensor Fault - Hybrid/EV Battery System Contactors Open
DTC P1FF4	System Isolation / Impact Sensor Fault - Hybrid/EV Battery System Contactors Open

HYBRID / EV PLUG-IN CHARGING - DTCS

HYBRID / EV PLUG-IN CHARGING - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC P0CF4, P0CF6 (North America, Korea)	Control Pilot Circuit
DTC P0CF9 or P0D01	Control Pilot Charging Switch/Ventilation Switch Performance
DTC P0D1F	Control Module Date/Time Synchronization Performance
DTC P0D26	Battery Charger System Precharge Time Too Long

DTC	Description
DTC P0D2B or P0D2C	Control Pilot Indicator Control Circuit/Charge Status Indicator Control Circuit
DTC P0D3E, P0D40	Battery Charger Input Voltage Sensor
DTC P0D4D, P0D4F	Battery Charger Hybrid/EV Battery Output Voltage Sensor
DTC P0D57, P0D59 (North America, Korea)	Proximity Detection Circuit
DTC P0D5A	Proximity Detection Circuit Erratic
DTC P0D5E	Battery Charger System High Voltage Present
DTC P0E61 or P0E65	Battery Charger Enable/Control Circuit
DTC P1ECE	Battery Charger Total Output Power Performance
DTC P1EE6 (North America, Korea)	Battery Charger AC Voltage Not Present
DTC P3002, P3003, P301F, or P3020	Hybrid/EV Battery DC Charging Positive Voltage Sensor
DTC P3005, P3006, P3021, or P3022	Hybrid/EV Battery DC Charging Negative Voltage Sensor
DTC P300B	Hybrid/EV Battery DC Charging Output Current Performance
DTC P300C, P300D, or P300F	Hybrid/EV Battery DC Charging Port Temperature Sensor Circuit Low/High/Erratic
DTC P3010, P3013, or P3014	Hybrid/EV Battery DC Charging Port Lock
DTC P3015, P3018, P301C, or P301D	Hybrid/EV Battery DC Charging Positive/Negative Contactor
DTC P301E	Hybrid/EV Battery DC Charging Contactors Opened Under Load - DC Charging Disabled
DTC P3027, P302A (Dubai)	Charge Port Lock Position Sensor
DTC P302B, P302D	Charge Port Lock Actuator Position Sensor
DTC P302F (North America, Korea)	Hybrid/EV Battery DC Charging System Isolation Fault
DTC P325C or P325D	Hybrid/EV Battery DC Charging Communication Gateway Module Processor Performance
DTC P325F (North America, Korea)	Hybrid/EV Battery DC Charging Communication Gateway Module - Offboard DC Charger Communication Interrupted

HYDRAULIC BRAKE SYSTEM - DTCS

HYDRAULIC BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC C0075	Brake Pedal Position Sensor Performance
DTC C0126	Brake Fluid Level Sensor Circuit
DTC C0267	Low Brake Fluid Indicated
DTC C029F	Brake Booster System Performance
DTC C0579, C057A, or C057E	Brake Booster Control Module Temperature Sensor
DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275, C1277	Brake Booster Motor/Rotor/Control Module
DTC C0580 or C0594	Brake Booster Motor 1
DTC C1278 or C1279	Brake System Data 1/Data 2 Message Counter Incorrect
DTC C1449	System Configuration Error
DTC P057B, P057E, P05DC-P05DF, or P05E0	Brake Pedal Position Sensor
DTC P0601, P0603, P0604, P0606, P060B, or P062F	Control Module
DTC P0642, P06A6, or P06A7	Sensor Reference Voltage

DTC	Description
DTC P25C6 or P25C7	Brake Booster Temperature Sensor Circuit

IMMOBILIZER SYSTEM - DTCS

IMMOBILIZER SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B2955	Security Sensor Data Circuit Malfunction
DTC B302A	Mobile Telephone Communications Interface Requested Immobilization
DTC B3031	Security Controller In Learn Mode
DTC B3055	No Transponder Modulation or No Transponder
DTC B305C	Immobilizer Transponder of Wrong Type Programmed
DTC B3060	Unprogrammed Transponder Identification Code Received
DTC B389A	Environment Identification
DTC B3902	Incorrect Immobilizer Identifier Received
DTC B3924, B3928	Incorrect Environmental Identifier Received
DTC B3935	Transponder Authentication
DTC B3976	Unconfigured Transponder
DTC B3984	Device 1 Environment Identifier Not Programmable
DTC P0513	Immobilizer Key Incorrect
DTC P0633	Immobilizer Key Not Programmed
DTC P162B	Remote Vehicle Speed Limiting Signal Message Counter Incorrect
DTC P1631	Immobilizer Fuel Enable Signal Not Correct
DTC P1649	Immobilizer Security Code Not Programmed

INSTRUMENT PANEL SYSTEM DISPLAYS AND GAUGES - DTCS

INSTRUMENT PANEL SYSTEM DISPLAYS AND GAUGES - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B0550	Odometer Circuit General Memory Malfunction
DTC B071F	Transmission Range Indicator Internal Malfunction
DTC P0071, P0074	Ambient Air Temperature Sensor

KEYLESS ENTRY SYSTEM AND REMOTE FUNCTIONS - DTCS

KEYLESS ENTRY SYSTEM AND REMOTE FUNCTIONS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B305D	Challenge Active Circuit
DTC B3101	Keyless Entry Data Link Circuit
DTC B3105	Keyless Entry Transmitters
DTC B3106	Keyless Entry Data Link
DTC B3109, B3113	Keyless Entry Transmitter 1/2/3/4 Battery
DTC B310D, B310F	Keyless Entry Transmitter 6/7/8 Battery
DTC B3119	Keyless Entry Antenna 1
DTC B3120	Keyless Entry Antenna 2
DTC B3121	Keyless Entry Antenna 3
DTC B3122	Keyless Entry Antenna 4

DTC	Description
DTC B3123	Keyless Entry Antenna 5
DTC B3124	Keyless Entry Antenna 6

LIGHTING SYSTEM - DTCS

LIGHTING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B1395	Control Module Voltage Reference Output Circuit Low/High Voltage
DTC B1480	Battery Rundown Protection Circuit Short to Ground
DTC B2540	Rear Fog Lamps Control Circuit
DTC B2545	Backup Lamps Circuit
DTC B2570	Trunk Lamp Control Circuit Short to Ground
DTC B257A	Headlamp Switch Input Signals Correlation Malfunction
DTC B2580	Headlamp High Beam Control Circuit
DTC B2585 or B3867	Left/Right Park Lamps Control Circuit
DTC B258A	Low Beam Control Circuit
DTC B2600 or B2605	Left/Right Daytime Running Lamps Control Circuit Short to Ground
DTC B2610	Passenger Compartment Dimming 1 Circuit
DTC B2615	Passenger Compartment Dimming 2 Circuit Short to Ground
DTC B2625	Display Dimming Pulse Width Modulation Output Circuit Short to Ground
DTC B3588	Rear Fog Lamp Switch Circuit Malfunction
DTC B3596	Hazard Lamps Request Circuit Malfunction
DTC B3600	Passenger Compartment Dimming Request Signal Circuit Low/High Voltage
DTC B3650	High Beam Request Signal Circuit Performance - Signal Invalid
DTC B3806	High Beam and Headlamp Flash Select Circuit Malfunction
DTC B3881 or B3882 (MBM)	Left/Right Tail Lamp Circuit
DTC B3881 or B3882 (MAH/MBC/MAW/MCX)	Left/Right Tail Lamp Circuit
DTC B3883	License Plate Lamp Circuit
DTC B3884	Center High Mounted Stop Lamp Circuit
DTC B388B or B388C (MBM)	Auxiliary Left/Right Tail and Stop Lamp Circuit
DTC B388B or B388C (MAH/MBC/MAW/MCX)	Auxiliary Left/Right Tail and Stop Lamp Circuit
DTC B3890 or B3891 (MBM)	Trailer Backup/Fog Lamps Circuit
DTC B3890 or B3891 (MAH/MBC/MAW/MCX)	Trailer Backup/Fog Lamps Circuit
DTC B3948 or B3949	Left/Right Front Turn Signal Circuit
DTC B3950 or B3951	Left/Right Rear Turn Signal Circuit
DTC C0277 or C0890	Brake Pedal Position Sensor Circuit
DTC C0297	Brake Applied Output Circuit Short to Ground

OBJECT DETECTION SYSTEM AND PEDESTRIAN PROTECTION SYSTEM - DTCS

OBJECT DETECTION SYSTEM AND PEDESTRIAN PROTECTION SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B094C	Right Side Object Detection Control Module
DTC B0954, B0955, B0956, or B0957	Parking Assist Front Sensor
DTC B095D or B095E	Parking Assist Rear Sensor Left/Right Side Circuit
DTC B0958, B0959, B0960, or B0961	Parking Assist Rear Sensor
DTC B0967 or B0968	Parking Assist On/Off Switch
DTC B096B	Parking Assist Switch Parallel Parking Circuit
DTC B096C or B096D	Parking Assist Side Sensor Left/Right Front Circuit
DTC B0987	Vehicle Direction Camera Indicator Circuit
DTC B1008	Calibration Data Not Programmed
DTC B1011	System Disabled Information Stored
DTC B1015	Vehicle Identification Number Information
DTC B101D (DTC set in K109 Frontview Camera Module)	Electronic Control Unit Hardware
DTC B127B	Rearview Camera Input Signal Circuit Malfunction
DTC B1405	Control Module Voltage Reference Output 2 Circuit
DTC B356A	Vehicle Direction Warning Switch Circuit
DTC B390D	Frontview Camera Module Incorrect Mounting
DTC B390F	Frontview Camera
DTC B395A	Rearview Camera
DTC B395B	Sideview Camera - Left
DTC B395C	Sideview Camera - Right
DTC B399A	Frontview Camera Supply Circuit Short to Battery/Ground
DTC B399B	Rearview Camera Supply Circuit Short to Battery/Ground
DTC B399C	Sideview Camera - Left Supply Circuit Short to Battery/Ground
DTC B399D	Sideview Camera - Right Supply Circuit Short to Battery/Ground
DTC P15F6	Front Object Detection Control Module Torque Request Signal Message Counter Incorrect

PARKING BRAKE SYSTEM - DTCS

PARKING BRAKE SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC C028B	Park Brake Motor Position Sensor - Signal Not Plausible
DTC C028F	Left Park Brake Actuator Circuit
DTC C0293	Park Brake Control Switch Circuit
DTC C1280 or C1281	Electric Park Brake Availability Status Message Counter Incorrect
DTC C1303	Automatic Park Brake Function Malfunction
DTC C1586 (HEV)	Right Park Brake Actuator Circuit
DTC C1587 (HEV)	Left Park Brake Actuator
DTC C1588 (HEV)	Right Park Brake Actuator

POWER DOOR LOCK SYSTEM AND RELEASE SYSTEMS - DTCS

POWER DOOR LOCK SYSTEM AND RELEASE SYSTEMS - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B1474 or B3849	Passenger/Driver Exterior Door Handle Switch Circuit
DTC B1534 or B1535	Left/Right Rear Door Handle Switch Circuit
DTC B297B or B297C	Driver Door Open Switch Circuit Not Plausible
DTC B3125, B3130, or B3135	Driver Door Only/All Doors Unlock/Lock Circuit
DTC B3140, B3145, B3150, or B3155	Door Unlock/Lock Switch Circuit
DTC B324A or B3245	Rear Cargo Door Unlock Motor Circuit/Lock Actuator Circuit
DTC P0CCC, P0CCE, or P0CCF	Charge Port Door Position Sensor Circuit

POWER STEERING SYSTEM - DTCS

POWER STEERING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC C0176	Control Module Temperature Sensor
DTC C0460	Steering Wheel Angle Sensor
DTC C0545	Steering Wheel Torque Sensor
DTC C056E	Electronic Control Unit Software

SEAT BELT SYSTEM - DTCS

SEAT BELT SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B0072 or B0073	Driver/Passenger Seat Belt Switch Circuit
DTC B059A	Passenger Seat Belt Indicator Circuit

SECONDARY AND CONFIGURABLE CUSTOMER CONTROL SYSTEM - DTCS

SECONDARY AND CONFIGURABLE CUSTOMER CONTROL SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B3622	Steering Wheel Controls Signal Circuit

SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM - DTCS

SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B0012 or B0013	Driver Steering Wheel Air Bag Deployment Loop Stage 1/Stage 2
DTC B0014, B0021, B0031, or B0038	Seat Side Air Bag Deployment Loop
DTC B0015, B001A, B001B, or B0022	Driver/Passenger Seat Belt Retractor/Anchor Pretensioner Deployment Loop
DTC B0016, B0018, B0023, or B0025	Roof Rail Air Bag Deployment Loop
DTC B0017 or B0024	Driver/Passenger Knee Air Bag Deployment Loop
DTC B0019 or B0020	Passenger Instrument Panel Air Bag Deployment Loop Stage 1/Stage 2
DTC B0052	Deployment Commanded
DTC B0071	Passenger Seat Belt Tension Sensor Circuit
DTC B0081 (Passenger Presence System)	Passenger Presence Module

DTC	Description
DTC B0081 (Inflatable Restraint Sensing and Diagnostic Module)	Passenger Presence Module
DTC B0082	Passenger Presence Detection Sensor
DTC B0083 or B0084	Left Front/Right Front Impact Sensor
DTC B0085 or B0088	Left Front/Right Rear Side Impact Sensor
DTC B0086 or B0087	Right Front/Left Rear Side Impact Sensor
DTC B0091	Center Front Impact Sensor
DTC B0092 or B0093	Left Center/Right Center Side Impact Sensor
DTC B067F or B0680	Passenger Air Bag On/Off Indicator Circuit
DTC B1001 (Inflatable Restraint Sensing and Diagnostic Module)	Option Configuration
DTC B1001 (Passenger Presence System)	Option Configuration Error
DTC B1019	System Configuration Error

TIRE PRESSURE MONITORING SYSTEM - DTCS

TIRE PRESSURE MONITORING SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC C0569	System Configuration Malfunction
DTC C0750, C0755, C0760, or C0765	Tire Pressure Sensor
DTC C0775	Tire Pressure Monitoring System Sensors Malfunction

WIPER SYSTEM AND WASHER SYSTEM - DTCS

WIPER SYSTEM AND WASHER SYSTEM - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B370A	Rain Sensor
DTC B370B	Rear Wiper Function Control Circuit
DTC B371A	Windshield Wiper Motor Internal Malfunction
DTC B371C	Front Wiper Motor 2
DTC B3811	Rear Washer Relay Circuit
DTC B3873	Front Washer Relay Circuit

WIRING SYSTEMS AND POWER MANAGEMENT - DTCS

WIRING SYSTEMS AND POWER MANAGEMENT - DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION

DTC	Description
DTC B097B	Power Mode Start Switch Circuit
DTC B1370	Control Module Ignition On and Start Circuit
DTC B1445	Control Module Voltage Output Circuit
DTC B144A	Run Power Relay Circuit
DTC B144B	Run/Crank Power Relay Circuit
DTC B1451	Accessory Power Circuit
DTC B147E or B147F	Battery Saver Relay Set/Reset Secondary Circuit
DTC B305E	Interruptible RAP Relay Circuit
DTC P15B9 or P15BA	Electric A/C Compressor Control Module Ignition On/Start Switch Circuit Low/High Voltage
DTC P16E8	Engine Controls Ignition Relay Signal Message Counter Incorrect

DTC	Description
DTC P17B3 or P17B4	Transmission Range Control Module Ignition 1 Switch Circuit Low Voltage
DTC P17B5	Transmission Range Control Module Ignition Switch Accessory Position Circuit Low Voltage
DTC P1A5E or P1A5F	Battery Energy Control Module Ignition On/Start Switch Circuit Low/High Voltage
DTC P1A60	Battery Energy Control Module Ignition Accessory Switch Circuit Low Voltage
DTC P2534 or P2535	Ignition On/Start Switch Circuit Low/High Voltage
DTC P2537	Ignition Accessory Switch Circuit Low Voltage

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2017 ELECTRICAL

12 V Starting and Charging - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Auxiliary Battery Negative Cable Fastener	22 N.m (16 lb ft)
Auxiliary Battery Positive Cable Fastener	22 N.m (16 lb ft)
Auxiliary Battery Positive Cable Nut	22 N.m (16 lb ft)
Battery Distribution Fuse Block Nut	22 N.m (16 lb ft)
Battery Negative Cable Clamp Ground Wire Fastener	5 N.m (44 lb in)
Battery Negative Cable Extension Cable Fastener - Lower	22 N.m (16 lb ft)
Battery Negative Cable Extension Cable Fastener - Upper	15 N.m (11 lb ft)
Battery Negative Cable Fastener	5 N.m (44 lb in)
Battery Negative Cable Nut	9 N.m (80 lb in)
Battery Positive and Negative Cable Ground Nut	22N.m (16 lb in)
Battery Positive Cable Clamp Fastener	5 N.m (44 lb in)
Battery Positive Cable Nut - 12V battery	22 N.m (16 lb in)
Battery Positive Cable Nut - Module	15 N.m (11 lb ft)
Battery Retainer Assembly Bolt	8 N.m (71 lb in)
Battery Tray Bolt	11.5 N.m (102 lb in)
Battery Tray Support Nut	9 N.m (80 lb in)
Body Wiring Harness Nut	5 N.m (44 lb in)
Engine Wiring Harness Bracket Bolt	9 N.m (80 lb in)
Engine Wiring Harness Bracket Nut	9 N.m (80 lb in)
Engine Wiring Harness Junction Block Bolt	1.5 N.m (13 lb in)

SCHEMATIC WIRING DIAGRAMS

STARTING AND CHARGING WIRING SCHEMATICS

12V Battery Management

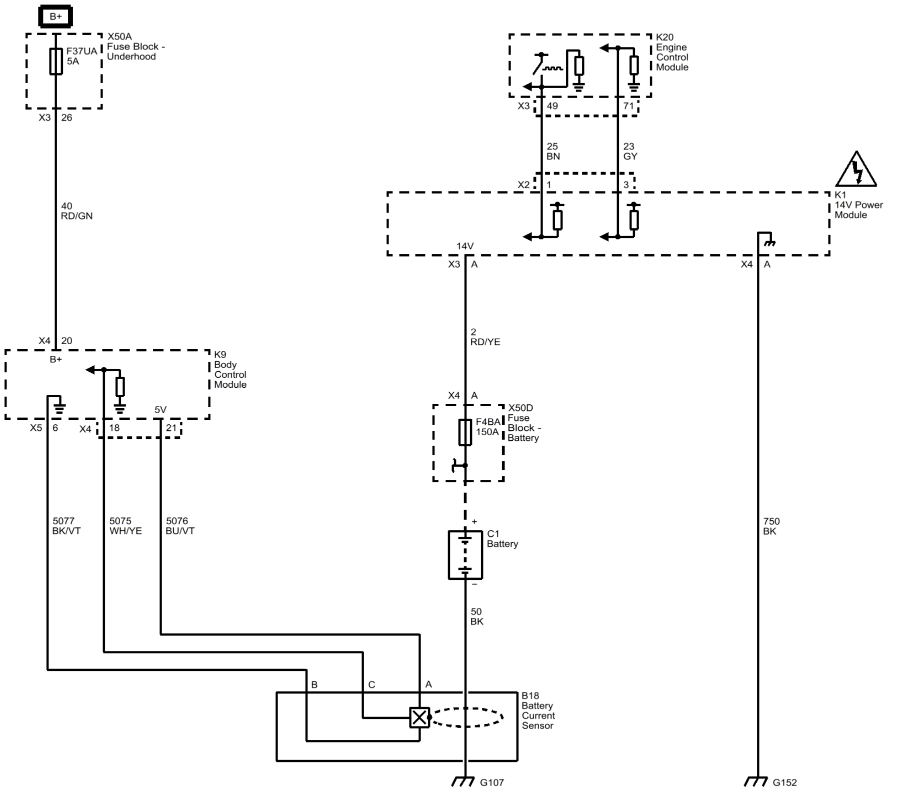
B+
X50A
Fuse Block -
Underhood
F37UA
5A
X3
26
40
RD/GN
X4
20
B+
K9
Body
Control
Module
5V
X5
6
X4
18
21
5077
BK/VT
5075
WH/YE
5076
BU/VT
K20
Engine
Control
Module
X3
49
71
25
BN
23
GY
X2
1
3
K1
14V Power
Module
14V
X3
A
X4
A
2
RD/YE
X4
A
X50D
Fuse
Block -
Battery
F4BA
150A
+
C1
Battery
–
50
BK
750
BK
B
C
A
B18
Battery
Current
Sensor
G107
G152

Fig. 1: 12V Battery Management
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, OR P1EFC: POWER CIRCUIT VOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B1325 03

Device Power Circuit Voltage Below Threshold

DTC B1325 07

Device Power Circuit Voltage Above Threshold

DTC B1330 03

Device Power 2 Circuit Voltage Below Threshold

DTC B1330 04

Device Power 2 Circuit Voltage Open Circuit

DTC B1517 03

Battery Voltage Below Threshold

DTC B1517 07

Battery Voltage Above Threshold

DTC B1517 5A

Battery Voltage Plausibility Failure

DTC C0800 03

Device Power 1 Circuit Voltage Below Threshold

DTC C0800 07

Device Power 1 Circuit Voltage Above Threshold

DTC C0800 11

Device Power 1 Circuit High Input

DTC C0800 0D

Device Power 1 Circuit High Resistance

DTC C0899 00

Device Voltage Low

DTC C0899 03

Device Voltage Low

DTC C0900 00

Device Voltage High

DTC C0900 07

Device Voltage Above Threshold

DTC C12E1

Electronic Brake Control Module Supply Circuit Low Voltage

DTC C12E2

Electronic Brake Control Module Supply Circuit High Voltage

DTC P0561

System Voltage Performance

DTC P0562

System Voltage Low Voltage

DTC P0563

System Voltage High Voltage

DTC P1A0C

Battery Energy Control Module System Voltage Low Voltage

DTC P1A0D

Battery Energy Control Module System Voltage High Voltage

DTC P1EFC

Battery Charger Control Module System Voltage Low Voltage

Circuit/System Description

The vehicle control modules or sensors monitor the system voltage to verify the system voltage is within the normal operating range.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The control module or sensor detects a system voltage of less than approximately 9 V or greater than 18 V for approximately 5 seconds.

Action Taken When the DTC Sets

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

Conditions for Clearing the DTC

The system voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the 12 V charging system.
- A possible cause of this DTC could be overcharging with a 12 V battery charger or jump starting.

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

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- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle OFF, disconnect the T18 battery charger cord set. Measure and record the 12 V battery voltage at the battery terminals. The battery voltage should stabilize between 12.4 and 12.8 V within a few minutes of turning the Vehicle OFF.
    - If not within the specified range, refer to **Battery Inspection/Test**.

2. Vehicle ON, accessories OFF, measure and record the 12 V battery voltage at the battery terminals. The voltage should be at least 0.5 V greater than the voltage measured in step 1 but less than 15 V.
    - If not within the specified range, refer to DC Power Conversion Test .
3. Observe the appropriate module scan tool B+ and ignition voltage parameters. The voltage readings should be within 1 V of the battery voltage.

Circuit/System Testing

NOTE: **Use the schematic to identify the following:**

- **Control modules the vehicle is equipped with**
- **The control modules ground, B+, and Ignition circuit terminal IDs and connectors**

1. Vehicle OFF, disconnect the harness connectors at the appropriate control module.

    NOTE: **Some control module ground circuits may require up to 20 minutes to achieve a resistance reading of less than 10 Ω. In most cases the readings will drop below 20 Ω within 1 minute indicating the control modules are going to sleep.**

2. Vehicle OFF, scan tool disconnected, open and close the driver door and wait 1 minute. Test for less than 10 Ω between each ground circuit terminal and ground.
    - If greater than the specified range, test the ground circuit for an open/high resistance.
3. If equipped, verify that a test lamp illuminates between each B+ circuit terminal and ground.
    - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance.
4. If equipped, Vehicle in Service Mode, verify that a test lamp illuminates between each ignition circuit terminal and ground.
    - If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance.
5. If all circuits test normal, replace the control module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for control module replacement, programming and setup

DTC B1516: BATTERY CURRENT SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B1516 08

Battery Current Sensor Signal Invalid

DTC B1516 66

Battery Current Sensor Wrong Mounting Position

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1516 08	B1516 08	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B1516 08	B1516 08	B1516 08	B1516 08, B1516 66
Low Reference	-	B1516 08	-	-

Circuit/System Description

The battery current sensor is a 3-wire hall effect current sensor. The body control module (BCM) supplies 5 V and ground to the battery current sensor. The battery current sensor measures the amount of current flowing to or from the battery, and supplies a pulse width modulation (PWM) signal to the BCM.

Conditions for Running the DTC

B1516 08

The BCM is awake.

B1516 08

The BCM is awake.

Conditions for Setting the DTC

B1516 08

The battery current signal is less than 4 percent or greater than 96 percent duty cycle for 2 minutes.

B1516 66

The battery current polarity is positive for 2 minutes.

Action Taken When the DTC Sets

The regulated voltage control is disabled.

Conditions for Clearing the DTC

The DTC passes when the battery current returns to the normal range for 15 seconds.

Diagnostic Aids

DTC B1516 08 could be set by overcharging with a battery charger or jump starting.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

B1516 08

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B18 Battery Current Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 30 Ω between the low reference circuit terminal B and ground.
   - **If 30 Ω or greater**
     1. Vehicle OFF, disconnect the X5 harness connector at the K9 Body Control Module.
     2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If less than 30 Ω**
3. Vehicle ON.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal A and ground.
   - **If less than 4.8 V**
     1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
     2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
     3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If greater than 5.2 V**
     1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle ON.
     2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
   - **If between 4.8 - 5.2 V**
5. Test for 4.8 - 5.2 V between the signal circuit terminal C and ground.
   - **If less than 4.8 V**
     1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module.
     2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
     3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
   - **If greater than 5.2 V**
     1. Vehicle OFF, disconnect the X4 harness connector at the K9 Body Control Module, Vehicle ON.
     2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K9 Body Control Module.
   - **If between 4.8 - 5.2 V**
6. Test or replace the B18 Battery Current Sensor.

B1516 66

1. Verify that the B18 Battery Current Sensor is installed securely around the negative battery cable, with the tape tab pointing away from the negative terminal on the C1 Battery.
   - **If the B18 Battery Current Sensor is not installed correctly**

Remove and reinstall the B18 Battery Current Sensor properly.

- **If the B18 Battery Current Sensor is installed correctly**

2. Replace the B18 Battery Current Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Battery Current Sensor Replacement**
- **Control Module References** for BCM replacement, programming, and setup.

DTC B151A: LOW BATTERY CAPACITY DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B151A 58

Low Battery Capacity Detected

Circuit/System Description

The body control module (BCM) monitors the battery voltage level during an engine crank event to detect a low battery voltage condition.

Conditions for Running the DTC

The vehicle is ON

Conditions for Setting the DTC

A minimum crank battery voltage is less than the minimum crank battery voltage threshold for 16 consecutive crank events.

Action Taken When the DTC Sets

A driver information center message is displayed.

Conditions for Clearing the DTC

The DTC will clear if the minimum crank voltage is greater than the minimum crank voltage threshold during a crank event.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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- **Circuit Testing**

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- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Refer to the Battery Inspection/Test.
- Refer to the Charging System Test.

DTC B1527: PARASITIC LOAD

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B1527 00

Parasitic Load

Circuit/System Description

The body control module (BCM) monitors the state of charge of the electrical system.

Conditions for Running the DTC

The ignition is in Accessory or Run mode.

Conditions for Setting the DTC

The state of charge at ignition ON is 30% lower than when the engine was running and battery drain is more than 2 A.

Action Taken When the DTC Sets

There is no battery telltale illuminated or DIC message displayed.

Conditions for Clearing the DTC

- The DTC will clear if the fault does not return after 50 consecutive ignition cycles.
- The DTC will clear when run state of charge is greater than or equal to 80%.

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

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Electrical Information Reference

- Circuit Testing

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Refer to **Battery Electrical Drain/Parasitic Load Test**.

DTC P0AF7: 14V POWER MODULE HIGH TEMPERATURE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis:**Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0AF7

14V Power Module High Temperature

Circuit/System Description

The 14 V power module, also called the accessory DC power control module. The 14 V power module is an electronic device that takes the place of the generator on a traditional vehicle. On a hybrid or electric vehicle the 14 V power module converts high voltage (300 V) direct current (DC) to low voltage (12 V) DC for accessory electrical operation and to charge the 12 V battery. Normally, the 14 V power module only supplies 12 V DC when the vehicle is under a normal drive cycle. There are certain instances when the vehicle is being charged through a standard wall socket where the 14 V power module operation is required to sustain the 12 V battery. The 14 V power module is capable of supplying up to 130 Amps of 12 V DC.

Conditions for Running the DTC

- The ignition is ON.
- The run/crank voltage is 9 V or greater.

Conditions for Setting the DTC

The 14V Power Module Status is Voltage Conversion Disabled or Limited - Due to High Operating Temperature.

Actions Taken When the DTC Sets

- The charging system light will illuminate, and Service Battery Charging System will display on the Driver Information Center.
- DTC P0AF7 is a Type C DTC.

Conditions for Clearing the DTC

DTC P0AF7 is a Type C DTC.

Diagnostic Aids

This DTC may set due to inadequate cooling of the 14V power module. A faulty hybrid/EV electronics coolant pump, hybrid/EV electronics coolant fan, or restricted coolant lines could cause high 14V power module operating temperatures.

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**

Description and Operation

- **Hybrid Modes of Operation Description**
- **Hybrid/EV Cooling System Description and Operation**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Inspect for proper coolant level in the radiator surge tank.
    - **If coolant level is low**

      Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling** . Repair the cause of low coolant level.

    - **If coolant level is OK**
2. Inspect the hybrid/EV cooling system for leaks.
    - **If a leak is found**

      Repair or replace the leaking component. Refer to the appropriate repair.

    - **If a leak is not found**
3. Inspect the hybrid/EV cooling hoses for pinches or obstructions.
    - **If a concern is found**

      Repair or replace hoses as necessary.

    - **If a concern is not found**
4. Inspect the hybrid/EV electronics cooling system radiator for debris or obstruction.
    - **If a concern is found**

      Repair or replace the restricted or damaged components as necessary.

    - **If a concern is not found**
5. Inspect for proper operation of the hybrid/EV system coolant pump.
    - **If a concern is found**

      Repair or replace the coolant pump as necessary.

    - **If a concern is not found**
6. If the DTC sets: Replace - 14V Power Module

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair:**Diagnostic Repair Verification**

For replacement of 14V Power Module - **Accessory DC Power Control Module Replacement**

DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, OR U3500-U350B: CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC U3001

Control Module Improper Shutdown

DTC U3003

Battery Voltage

DTC U3006

Control Module Input Power 1

DTC U3007

Control Module Supply Circuit 2

DTC U3008

Control Module Ground 1

DTC U3009

Control Module Ground 2

DTC U3013

Control Module Input Power 3

DTC U3014

Control Module Input Power 4

DTC U3018

Control Module Supply Circuit 1-2 Not Plausible

DTC U3019

Control Module Supply Circuit 3-4 Not Plausible

DTC U3500

Control Module Input Power "A" Circuit Range/Performance

DTC U3501

Control Module Supply Circuit 1 Low Voltage

DTC U3502

Control Module Supply Circuit 1 High Voltage

DTC U3503

Control Module Input Power "A" Circuit Intermittent/Erratic

DTC U3504

Control Module Input Power "B" Circuit Range/Performance

DTC U3505

Control Module Supply Circuit 2 Low Voltage

DTC U3506

Control Module Supply Circuit 2 High Voltage

DTC U3507

Control Module Input Power "B" Circuit Intermittent/Erratic

DTC U3508

Control Module Input Power "C" Circuit Range/Performance

DTC U3509

Control Module Supply Circuit 3 Low Voltage

DTC U350A

Control Module Supply Circuit High Voltage

DTC U350B

Control Module Input Power "C" Circuit Intermittent/Erratic

Circuit/System Description

The vehicle control modules or sensors monitor the system voltage to verify the system voltage is within the normal operating range.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The control module or sensor detects a system voltage of less than approximately 9 V for approximately 5 s.

Action Taken When the DTC Sets

- A driver information center message and/or warning indicator may be displayed.
- The control module may be temporarily disabled.

Conditions for Clearing the DTC

The system voltage returns to normal operating range.

Diagnostic Aids

- A high or low voltage DTC set or voltage value in multiple modules/sensors indicates a concern in the charging system.
- A possible cause of this DTC could be overcharging with a battery charger or jump starting.

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition OFF, measure and record the battery voltage at the battery terminals.
2. Verify the battery voltage stabilizes between 12.4 and 12.8 V within a few minutes of turning the ignition OFF.
   - **If battery voltage is less than 12.4 V or more than 12.8 V**

     Refer to **Battery Inspection/Test**.

   - **If battery voltage is between 12.4 and 12.8 V**
3. Engine running, headlights ON, measure and record the battery voltage at the battery terminals.
4. Verify the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.
   - **If the voltage is not at least 1 V greater than the voltage measured in step 1 or is greater than 15 V.**

     Refer to **Charging System Test**.

   - **If the voltage is at least 1 V greater than the voltage measured in step 1, but less than 15 V.**
5. Verify the appropriate control module battery voltage and ignition voltage parameters are available in the scan tool.
   - **If parameters are not available in the scan tool**

     Refer to Circuit/System Testing

   - **If parameters are available in the scan tool**
6. Verify the appropriate control module scan tool battery voltage and ignition voltage parameters are within 1 V of the battery voltage.
   - **If not within 1 V of the battery voltage**

     Refer to Circuit/System Testing

   - **If within 1 V of the battery voltage**
7. All OK.

Circuit/System Testing

NOTE: **Use the schematic to identify the following:**

- **Control modules the vehicle is equipped with**
- **The control module's ground, B+, and Ignition circuit terminal IDs and connectors**

NOTE: **Some control module ground circuits may require up to 20 min after the ignition is turned off before achieving a resistance reading of less than 5 Ω. In most cases the readings will drop below 20 Ω within 1 min indicating the control module is going to sleep.**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the appropriate control module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between each ground circuit terminal and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. If equipped, verify a test lamp illuminates between each B+ circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the appropriate control module.
    - **If the test lamp illuminates**
4. Ignition ON.
5. If equipped, verify a test lamp illuminates between each ignition circuit terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, refer to **Power Mode Mismatch** .
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF.
    2. Test for infinite resistance between the ignition circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the appropriate control module.
    - **If the test lamp illuminates**
6. Replace the control module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup.

SYMPTOMS - ENGINE ELECTRICAL

The following steps must be completed before using the symptom tables.

- Perform **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
    - The power modes are correct.
    - The control modules can communicate via the serial data link.
    - There are no DTCs set.
- Review the system descriptions and operations in order to familiarize yourself with the system functions. Refer to one of the following system operations:
    - **Battery Description and Operation**
    - **Charging System Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the 12 V charging system. Refer to **Checking Aftermarket Accessories** .

- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Battery Inspection/Test**
- **Battery Charging**
- **Battery Electrical Drain/Parasitic Load Test**
- **Charging System Test**

BATTERY INSPECTION/TEST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Aids

NOTE: **For Warranty repairs -**

You must use regionally required battery test equipment for warranty repairs.

For accurate test results the battery must be disconnected from the vehicle and the equipment connected directly to the battery posts. When setting up the equipment, select "Out of Vehicle" and then the correct battery type (Flooded, AGM, or Stop/Start AGM) and rated CCA (both from the battery label) must be entered.

- **Failure to obtain the correct connections during the test may result in a failed test on a good battery.**
- **Use the Out of Vehicle test (battery disconnected with test equipment connected directly to the posts) for each battery when testing a vehicle with dual batteries.**

Reference Information

Schematic Reference

Starting and Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Battery Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 50313 Battery Tester

Circuit/System Testing

WARNING: **Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.**

For Vehicles equipped with OnStarÃ‚Â® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStarÃ‚Â® functionality in the event of a main vehicle battery power disruption to the VCIM (OnStarÃ‚Â®module). Do not disconnect the main vehicle battery or remove the OnStarÃ‚Â® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStarÃ‚Â® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStarÃ‚Â® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

1. Verify the C1 Battery case is not cracked, broken, or damaged, which may be indicated by battery acid leakage.
    - **If there is any apparent damage**

      Replace the C1 Battery.

    - **If there is no damage**
2. Verify that the battery cables are clean and tight. The battery terminal bolts should be torqued as specified in **Fastener Specifications**.
    - **If the battery cables need to be cleaned or tightened**

      Clean as required and tighten as specified.

    - **If the battery cables are clean and tight**
3. Disconnect battery from the vehicle. There is no need to remove the battery from the vehicle.
4. Connect the EL-50313 directly to the battery terminal posts.
5. Select "Charging," "Diagnostic" and "Out of Vehicle" when setting up the test.
6. Select the proper battery type, Flooded, AGM or Stop/Start AGM.
7. Enter the CCA as shown on the battery label.
8. Verify the test result is not REPLACE BATTERY or BAD CELL-REPLACE

    NOTE: **Always write the test code displayed by the tester on the repair order for any warranty purposes. The number is a unique code that describes the test data for a particular battery at a particular time. The test code may occasionally repeat when you retest the same battery. More often, each test will result in a different code. Use the test code from the Out of Vehicle test.**

    - **If the test result is REPLACE BATTERY or BAD CELL-REPLACE**

      Replace the C1 Battery.

        - **If the test result is not REPLACE BATTERY or BAD CELL-REPLACE**

9. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Battery Replacement

BATTERY CHARGING

12 V Battery

The following procedure is for the 12 V battery only.

Special Tools

EL 50313 Midtronics GR8 Battery Tester Charger

For equivalent regional tools, refer to **Special Tools**.

Diagnostic Aids

NOTE: **This vehicle is equipped with an Absorbent Glass Matt Battery. This type of battery requires different charging and testing parameters than the more common regular flooded lead acid type battery. ANY time you perform charging and or testing you MUST set up the charging/testing equipment or permanent damage to the battery may result.**

- The charging area should be well ventilated.
- Do not charge a battery that appears to be frozen. Allow the battery to warm to room temperature and test it using the EL 50313 before charging.
- An AGM battery may be damaged if charged to more than 14.5 V.
- A Flooded Cell battery may be damaged if charged to more than 16.5 V.
- Vehicles with dual batteries must be charged individually which will result in two printouts.

Battery State of Charge

NOTE: **Using voltage to determine the battery's state of charge is only accurate after the battery has been at rest for 24 hours. This is enough time for the acid in each cell to equalize. If the battery has been charged or discharged in the past 24 hours, the battery state of charge will only be an estimate.**

The maintenance-free batteries state of charge is estimated by reading the voltage of the battery across the battery terminals. Because the voltage is affected by current flow into or out of the battery, the engine must be stopped and all electrical loads turned OFF, including parasitic loads, when checking the voltage. The voltage can also be affected if the battery has just been charged or discharged, so it is important to consider what has happened to the battery in the time just before testing. Use the following procedure to determine the battery's state of charge:

1. Be sure all electrical loads are turned OFF.
2. Determine whether the battery has been used in a vehicle or charged within the past 12 hours.
    - If the answer is no, the terminal voltage will be stabilized and no action is necessary before reading the voltage. Skip to step 3.
    - If the answer is yes, terminal voltage will not be stabilized and you should wait 12 hours since the last time the battery was used.
3. Estimate the battery temperature by determining the average temperature to which the battery has been exposed for the past 12 hours.

    NOTE: **The table is accurate to 10 percent only after the battery has been at rest for 12 hours.**

4. Measure the battery voltage at the battery terminals. Refer to the following table to determine the state of charge according to the estimated battery temperature:

Battery Voltage	% Charge at 0Ã‚Â°C (32Ã‚Â°F)	% Charge at 25Ã‚Â°C (75Ã‚Â°F)
12.75 V	100%	100%
12.7 V	100%	90%
12.6 V	90%	75%
12.45 V	75%	65%
12.2 V	65%	45%
12.0 V	40%	20%

Use the state of charge information as follows:

- A battery with a state of charge that is below 65 percent must always be recharged before returning it to service or continuing storage.
- A battery with a state of charge that is 65 percent or greater is generally considered to be charged enough in order to be returned to normal service or in order to continue storage. However, if the battery is being used in slow traffic or with short drive times, or if the temperature is very hot or very cold, the battery should be fully charged, to at least 90 percent, before returning it to service or continuing storage.

Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- The battery charger capacity - The higher the charger amperage, the less time it will take to charge the battery.
- The state of charge of the battery - A completely discharged battery requires more than twice as much charging time as a half charged battery. In a discharged battery with a voltage below 11 V, the battery has a very high internal resistance and may only accept a very low current at first. Later, as the charging current causes the acid content to increase in the electrolyte, the charging current will increase. Extremely discharged batteries may not activate the reversed voltage protection in some chargers. Refer to the manufacturer's instructions for operating this circuitry.
- The temperature of the battery - The colder the battery is, the more time it takes to recharge the battery. The charging current accepted by a cold battery is very low at first. As the battery warms, the charging current will increase.

Charging Procedure

CAUTION: **Turn OFF the ignition when connecting or disconnecting the battery cables, the battery charger or the jumper cables. Failure to do so may damage the ECM/PCM or other electronic components.**

CAUTION: **Refer to Fastener Caution .**

When charging side-terminal batteries with the battery cables connected, connect the charger to the positive cable bolt and to a ground located away from the battery. When charging side-terminal batteries with the battery cables disconnected, install the battery side terminal adapters and connect the charger to the adapters.

Use the following procedure to charge the battery:

1. Ensure that all of the battery terminal connections are clean and tight.
2. Connect the charger positive lead to the battery positive terminal on the battery or the remote jumper stud underhood.

   CAUTION: **Do not connect the negative charger lead to the housings of other vehicle electrical accessories or equipment. The action of the battery charger may damage such equipment.**

3. Connect the negative charger lead to a solid engine ground or to a ground stud in the engine compartment that is connected directly to the battery negative terminal, but away from the battery. If the negative battery cable is disconnected and a terminal adapter is being used, connect directly to the adapter.
4. Select "Charging," "PDI" and "In Vehicle" when setting up the charger.

5. Select the proper battery type, Flooded, AGM, Spiral AGM or Stop/Start AGM.
6. Enter the CCA as shown on the battery label.

BATTERY ELECTRICAL DRAIN/PARASITIC LOAD TEST

12 V Battery

The following procedure is for the 12 V battery only.

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

Components most likely to cause a parasitic draw on the vehicle's battery are switches, relays, and control modules. After the vehicle is turned OFF the control modules will begin to go to sleep (shut OFF). All control modules do not go to sleep at the same time, some may take up to 30 minutes or longer after turning the Vehicle OFF before going to sleep, like the HVAC and body control modules. Others such as the telematics communication interface control module and remote control door lock receiver may periodically wake up then go back to sleep. These are all normal conditions.

Diagnostic Aids

- Rule out any possible aftermarket equipment causing an unacceptable parasitic current drain. Aftermarket accessories installed into the courtesy lamp circuit can cause the inadvertent power timer in the body control module (BCM) to keep resetting. This would cause the BCM to remain awake and cause a current drain on the battery.
- Rule out customer driving habits such as regular short trips that do not allow enough time to properly charge the battery. Refer to **Battery Description and Operation**.
- Verify that the battery and charging system are in proper working order. Refer to **Battery Charging**, and **Charging System Test**.
- A battery discharging for no apparent reason while the vehicle is parked can be caused by an intermittent draw, such as a module waking up, or a continuous draw, such as a dome light or stuck relay.
- Some systems and modules such as OnStarÃ‚Â®, and regulated voltage control, if equipped, are designed to wake-up, perform a task, and go back asleep at regular intervals. Refer to **Body Control System Description and Operation** for the system or modules description and operation.
- An engine off natural vacuum evaporative test can occur if the engine control module (ECM) determines the drive cycle has met the appropriate criteria immediately after key off. The ECM will stay awake and the vent solenoid will stay energized for as long as 45 minutes. The typical current draw for this is about 1 A.
- The telematics communication interface control module current draw is very low, less than 40 mA, so the OnStar system is left in that "awake" state for up to the first 48 hours. Parasitic draw of up to 40 mA with an occasional spike as high as 80 mA through the telematics communication interface control module for the first 48 hours is normal.
- Some automatic climate control systems can remain in a semi-awake state for up to three hours, actual draw amounts vary by vehicle platform but are typically not greater than 50 mA.
- An extremely low mA current level is consumed by the RKE receiver for monitoring purposes, actual system wake up only occurs when the fobs for the vehicle are used. When other devices on the same RKE operating frequency are activated, such as the 4 tire pressure monitoring sensors and other vehicle transmitters in the vicinity, the RKE receiver will have a 100 mA spike. These spikes are normal and occur too briefly to have a significant effect on battery drain. Competing signals may cause RKE performance issues such as jamming but should not cause excessive battery draw.
- If an excessive current draw is not present during initial testing, continue periodic testing over a 1-2 hour period to see if the current draw increases and stays above an unacceptable level.

NOTE: **The battery specification listed below is a generic specification. Refer to the battery specification label on the original battery when testing the battery.**

- The battery run down time will vary depending on the batteries reserve capacity. If the reserve capacity is higher, then the battery run down time would be longer. If the reserve capacity is lower, then the battery run down time would be shorter. The graph below indicates roughly how many days a 690 cold cranking amp battery with a 110 minute reserve capacity starting at 80 percent state of charge will last with a constant current draw until it reaches 50 percent state of charge. Differences in battery reserve capacity and temperature will affect the results.

Current Drain	Days
25 mA	33
50 mA	16.5
75 mA	11
100 mA	8.25
250 mA	3.3
500 mA	1.65
750 mA	1
1 A	0.8
2 A	0.4

Reference Information

Schematic Reference

Control Module References

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL 38758 Parasitic Draw Test Switch

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

NOTE:

- **Most vehicle systems will go to sleep within 30 min but it can take up to 2 hours before all systems power down allowing the parasitic draw test to pass. An occasional increase in the parasitic draw is normal as long as it returns within 1 s.**
- **Closing the door latches/ajar switch while leaving the doors open is recommended, this allows the vehicle systems to perform in a "doors closed" mode while allowing vehicle interior access that may be needed to complete the diagnostic steps.**
- **Locking doors will arm the vehicle content theft deterrent system if equipped. Failure to arm the system may cause a theft system fault to not be present during testing.**
- **There are many things that can prevent the vehicle from completely going to sleep and passing the parasitic draw test. Make sure all the conditions listed below are met before performing the parasitic current draw test.**

- **Vehicle OFF**
- **Retained Accessory Power RAP OFF - open and close the driver door after Vehicle OFF**
- **Scan tool not communicating with a vehicle control module - in some cases it may need to be disconnected from the data link connector.**
- **All access doors closed**
- **Headlamps OFF - auto headlamps disabled**
- **Any delay lighting OFF**
- **If equipped with an under hood lamp disable it**
- **HVAC after blow OFF**
- **Any accessory that can work with Vehicle OFF inactive or OFF**
- **Wait up to 2 min or longer, after all other listed conditions are met**

Using an Inductive Pickup Probe

1. Connect an inductive pickup probe to the negative battery cable that can read down to 1 mA.
2. Vehicle OFF, as the vehicle systems shut down test for less than 30 mA of parasitic current drain.
   - If greater than the specified range, refer to Circuit/System Testing.

Using the EL 38758 Parasitic Draw Test Switch

WARNING: **Refer to Battery Disconnect Warning .**

CAUTION: **When a fused jumper wire or digital multimeter is connected to the test switch terminals, always turn the test switch ON before opening any access door, turning the ignition on, or turning any accessory on. This is to prevent damaging the jumper wire or digital multimeter fuse.**

NOTE: **The switch knob on the EL 38758 switch is marked ON and OFF. When the switch knob is in the ON position, the circuit is closed and electrical current will pass through the switch. When the switch knob is in the OFF position, the circuit is open and electrical current will not pass through the switch.**

1. Vehicle OFF, disconnect the battery negative cable from the battery. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Turn the **EL 38758** switch knob to the OFF position.
3. Install the male end of the **EL 38758** switch to the battery ground terminal.
4. Install the battery negative cable to the female end of the **EL 38758** switch.
5. Turn the **EL 38758** switch knob to the ON position.
6. Road test the vehicle and activate all of the accessories such as the radio and air conditioning.
7. Vehicle OFF, connect a 10 A fused jumper wire to the test switch tool terminals.
8. Turn the **EL 38758** switch knob to the OFF position. The current now flows through the jumper wire.
9. Check the fuse in the jumper wire. The fuse should be OK.
   - Failed: If the jumper wire fuse is blown, refer to Circuit/System Testing.
   - Passed
10. Turn the **EL 38758** switch knob to the ON position. Remove the fused jumper wire.
11. Connect a digital multimeter set to the 10 A DC scale between the test switch tool terminals.
12. Turn the **EL 38758** switch knob to the OFF position. The current now flows through the DMM.
13. As the vehicle systems shut down test for less than 30 mA of parasitic current drain.
    - If greater than the specified range, refer to Circuit/System Testing.

Circuit/System Testing

NOTE:

- **Removing or installing a fuse, relay, or connector, to determine the area**

causing high parasitic draw may wake up control modules. You must wait for the control modules to go back to sleep before retesting. It is best to install any removed or disconnected components after the diagnosis is completed.

- **Fuses for power mode master components such as the BCM should be removed last to avoid misdiagnosis.**
- **If a scan tool is connected to the DLC, either disconnect it or subtract the scan tool current draw from the DMM reading to get the actual vehicle parasitic current draw.**

If the vehicle has an unacceptable amount of parasitic current draw, remove each fuse one at a time until the current draw falls to an acceptable level. A drop of more than 10-20 mA, when disabling a single system or circuit, is an indication of an overly high current draw that could be causing the battery drain. Refer to **Power Distribution Schematics** to diagnose exactly which circuit of the suspect system is causing the high parasitic drain. The follow is a list of common components that could cause a high current draw:

- Stuck switch
- Stuck relay
- Control module

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for control module replacement, programming and setup

CHARGING SYSTEM TEST

The accessory power module (APM) supplies the energy that flows between the high voltage (300 volt) direct current (DC) and low voltage (14 volt) DC to charge the 12 volt battery and power accessories. To test the charging system, refer to **DC Power Conversion Test** .

REPAIR INSTRUCTIONS

BATTERY NEGATIVE CABLE DISCONNECTION AND CONNECTION

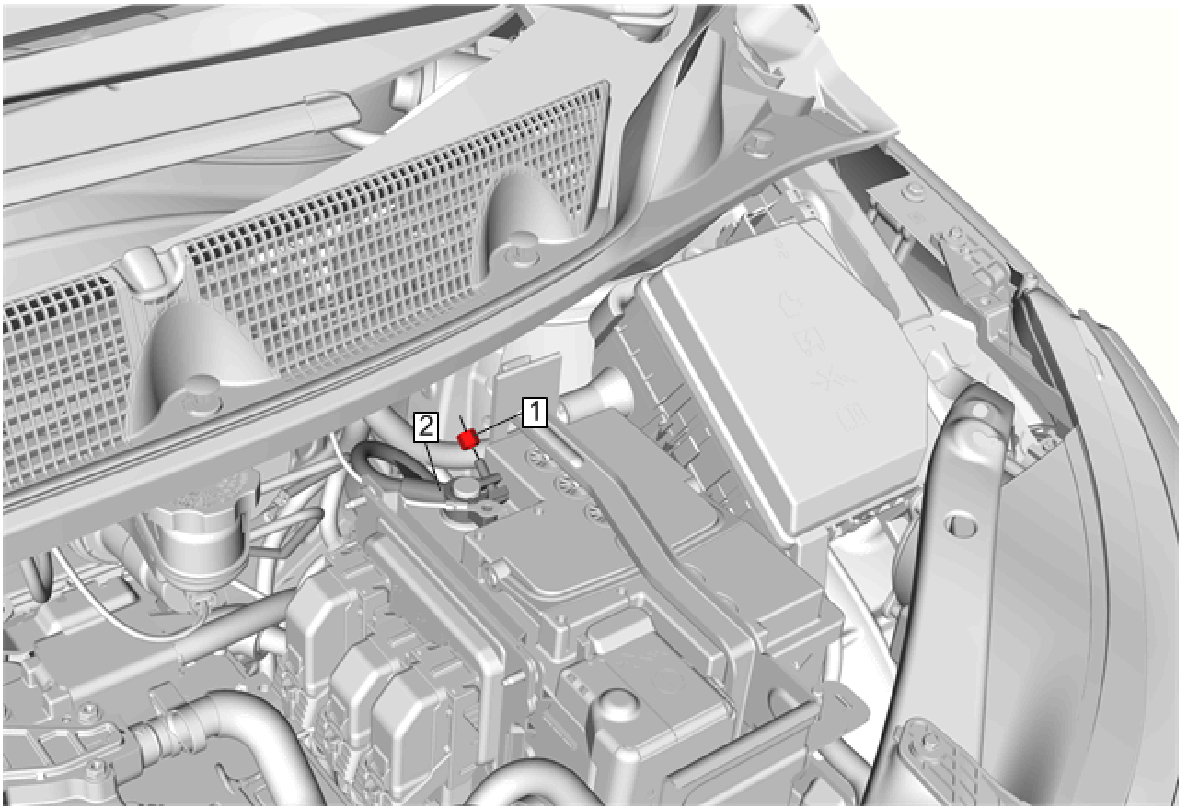


Fig. 2: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Turn the ignition OFF. 2. Disconnect and remove all 12V battery chargers and the AC charger cable from the hybrid battery charger receptacle.	
1	Battery Negative Cable Fastener **WARNING:** **Refer to Battery Disconnect Warning** **CAUTION:** **Refer to Fastener Caution .** **Tighten** 5 N.m (44 lb in)
2	Battery Negative Cable

BATTERY DISTRIBUTION FUSE BLOCK REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection

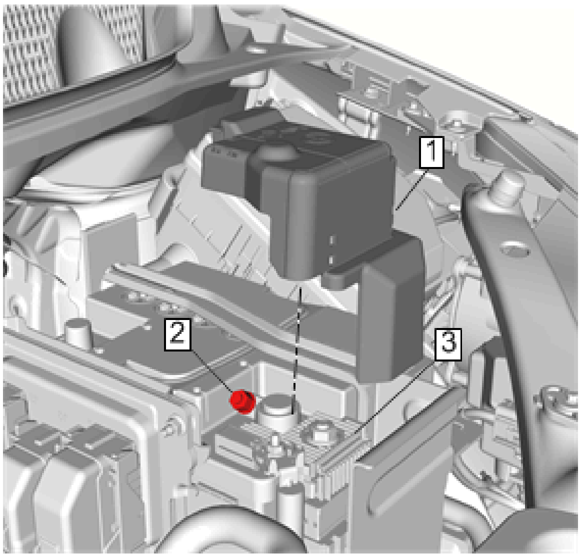


Fig. 3: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

2. Remove Battery Positive Cable Protective Cover (1)

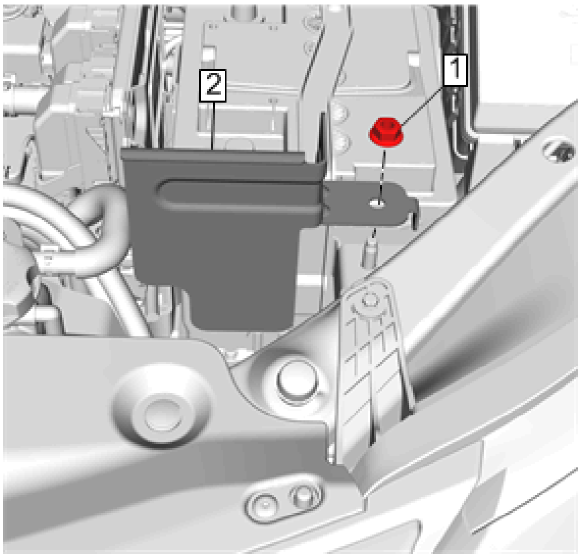


Fig. 4: Battery Tray Support Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove Battery Tray Support Nut (1)
4. Remove Battery Tray Support (2)

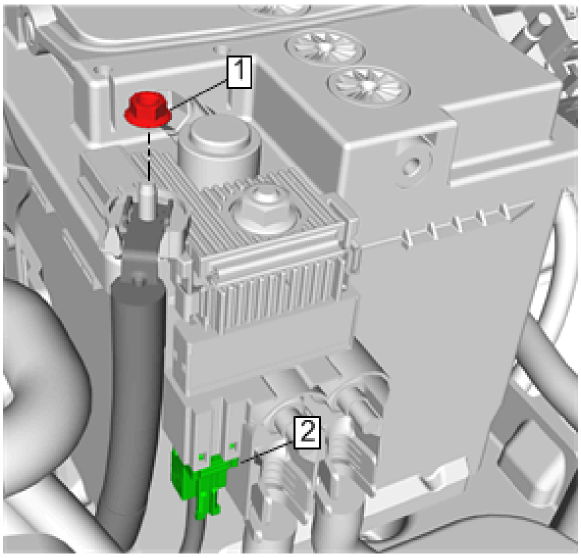


Fig. 5: Body Wiring Harness Nut And Connector
Courtesy of GENERAL MOTORS COMPANY

5. Remove Body Wiring Harness Nut (1)@Battery Distribution Fuse Block
6. Disconnect Body Wiring Harness Connector (2)@Battery Distribution Fuse Block

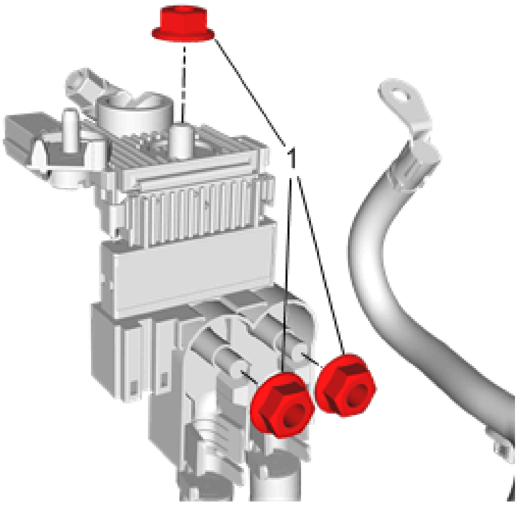


Fig. 6: Battery Distribution Fuse Block Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove Battery Distribution Fuse Block Nut (1)

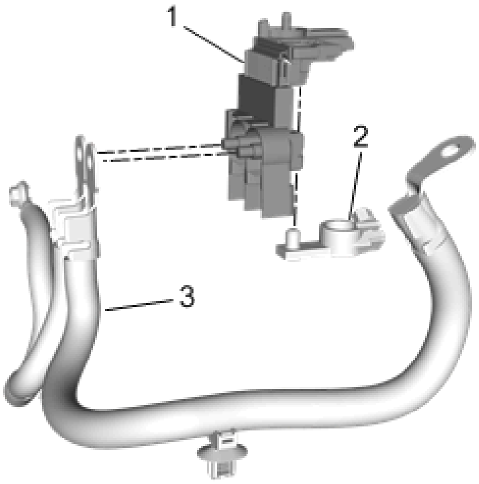


Fig. 7: Battery Positive Post Terminal And Cable
Courtesy of GENERAL MOTORS COMPANY

8. Remove Battery Positive Post Terminal (2) @ Battery Distribution Fuse Block (1)
9. Remove Battery Positive Cable (3) @ Battery Distribution Fuse Block (1)

Installation Procedure

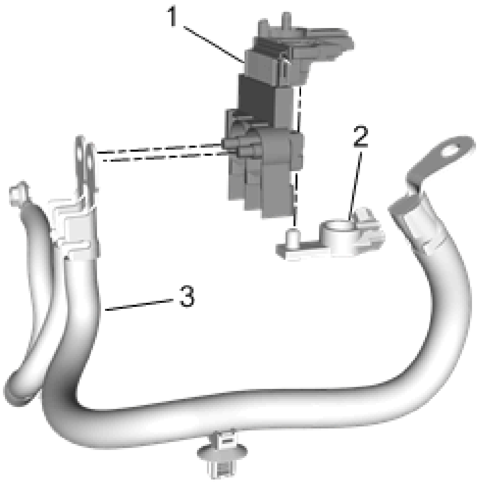


Fig. 8: Battery Positive Post Terminal And Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Positive Post Terminal (2) @ Battery Distribution Fuse Block (1)
2. Install Battery Positive Cable (3) @ Battery Distribution Fuse Block (1)

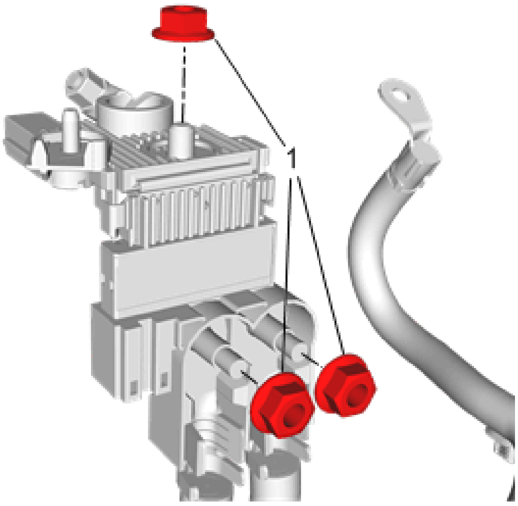


Fig. 9: Battery Distribution Fuse Block Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install Battery Distribution Fuse Block Nut (1) and tighten 22 N.m (16 lb ft)

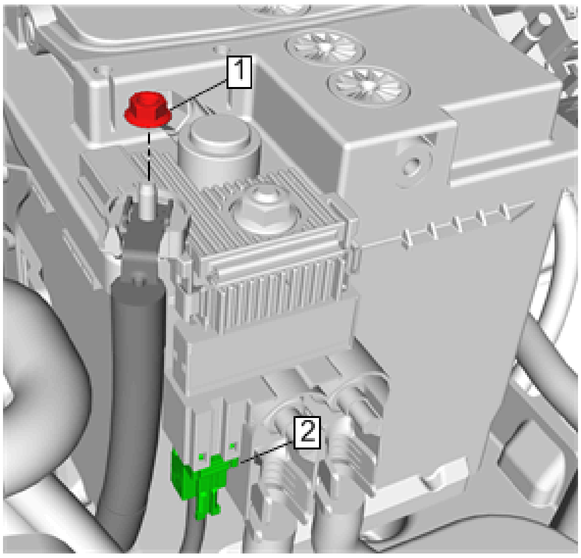


Fig. 10: Body Wiring Harness Nut And Connector
Courtesy of GENERAL MOTORS COMPANY

4. Connect Body Wiring Harness Connector (2) @Battery Distribution Fuse Block
5. Install Body Wiring Harness Nut (1) @Battery Distribution Fuse Block and tighten 5 N.m (44 lb in)

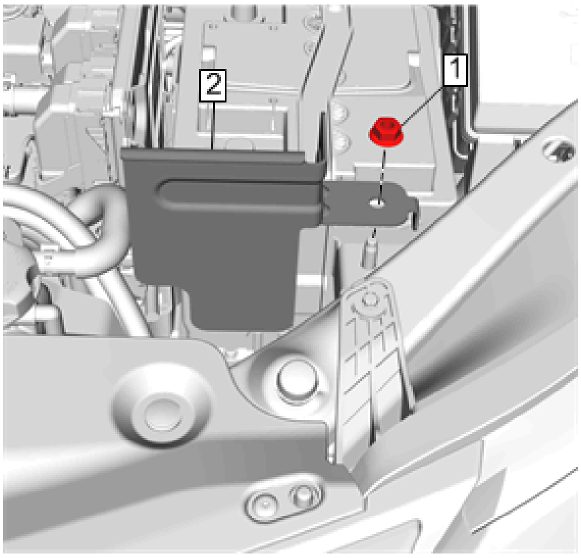


Fig. 11: Battery Tray Support Nut
Courtesy of GENERAL MOTORS COMPANY

6. Install Battery Tray Support (2)
7. Install Battery Tray Support Nut (1) and tighten 9 N.m (80 lb in)

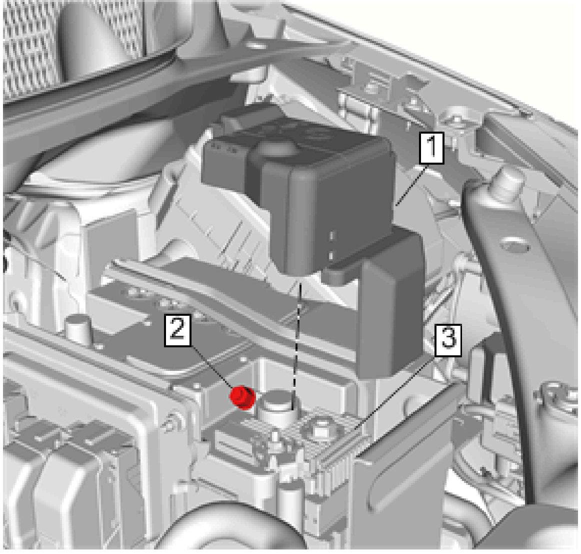


Fig. 12: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

8. Install Battery Positive Cable Protective Cover (1)
9. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

BATTERY CURRENT SENSOR REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
2. Remove Battery **Battery Replacement**

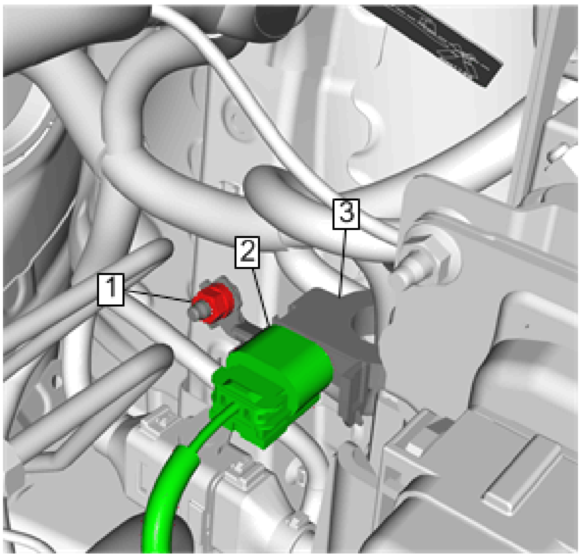
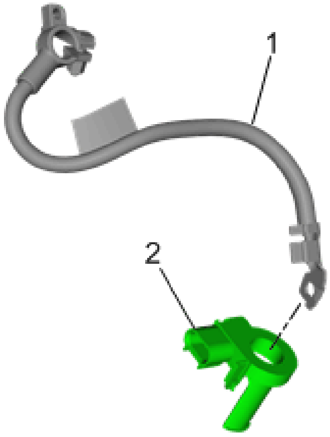


Fig. 13: Battery Current Sensor And Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Battery Current Sensor Connector (2)
4. Remove Battery Positive and Negative Cable Ground Nut (1) @ Front Wheelhouse Panel
5. Remove Battery Current Sensor (3) Battery Tray

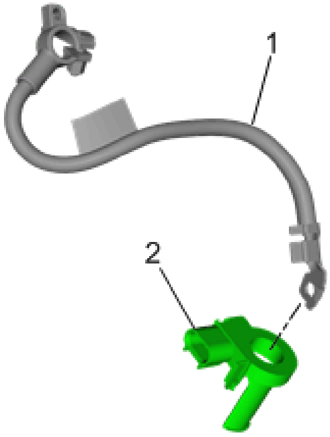


[Fig. 14: Battery Current Sensor And Cable](#)
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Note the orientation of the battery current sensor when removing.**

6. Remove Battery Current Sensor (2) @ Battery Negative Cable (1)

Installation Procedure



[Fig. 15: Battery Current Sensor And Cable](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Current Sensor (2) @ Battery Negative Cable (1)

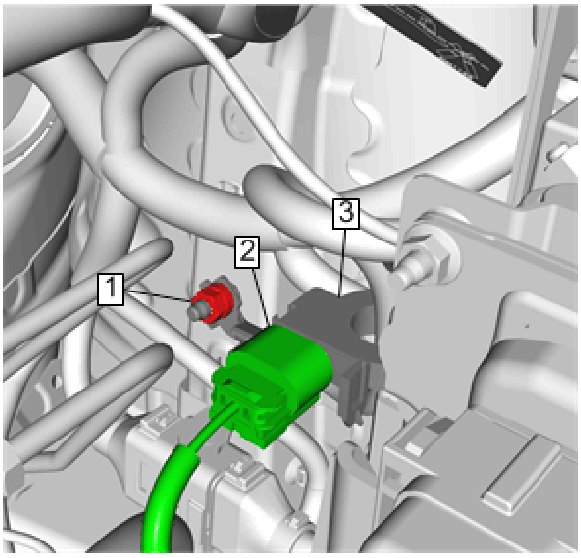


Fig. 16: Battery Current Sensor And Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install Battery Positive and Negative Cable Ground Nut (1) @ Front Wheelhouse Panel and tighten 22 N.m (16 lb ft)
3. Install Battery Current Sensor (3) Battery Tray
4. Connect Battery Current Sensor Connector (2)
5. Install Battery Battery Replacement
6. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

BATTERY NEGATIVE CABLE REPLACEMENT (HIGH VOLTAGE BATTERY TO BODY STRUCTURE)

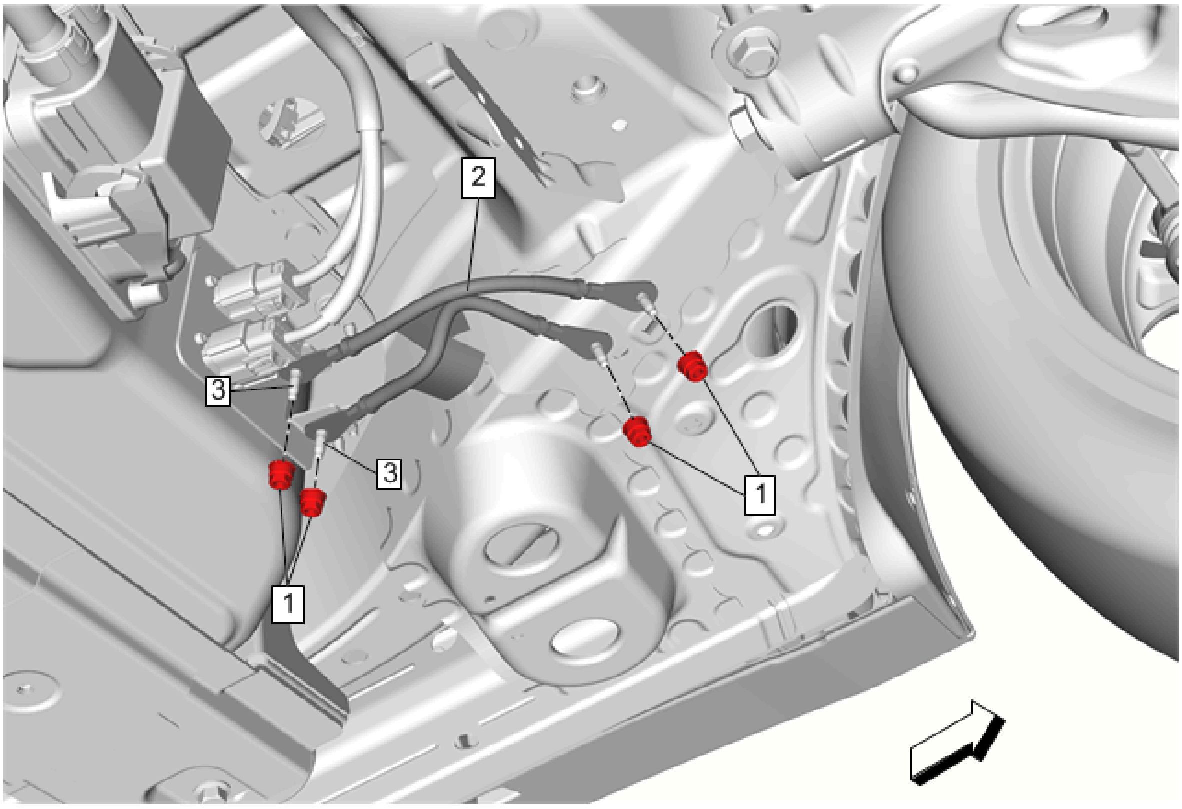


Fig. 17: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
Visually and functionally inspect the gloves before use.
Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.
Failure to follow the procedure exactly as written may result in serious injury or death.</td></tr>
<tr><td colspan="2">Preliminary Procedure Raise and support the vehicle. Lifting and Jacking the Vehicle</td></tr>
</table>

Callout	Component Name
1	Battery Negative Cable Nut (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **Tighten:** 9 N.m (80 lb in) **NOTE:** **Must take a pair of pliers to hold onto the ground bracket, then crack the nut and provide relief to the bracket.**
2	Battery Negative Cable
3	High Voltage Battery Tray Ground Stud **NOTE:** **If corrosion is visual on threads, wire brush threads.**

BATTERY NEGATIVE CABLE REPLACEMENT (12V BATTERY TO BODY STRUCTURE)

Removal Procedure

1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection
2. Remove the battery. Battery Replacement

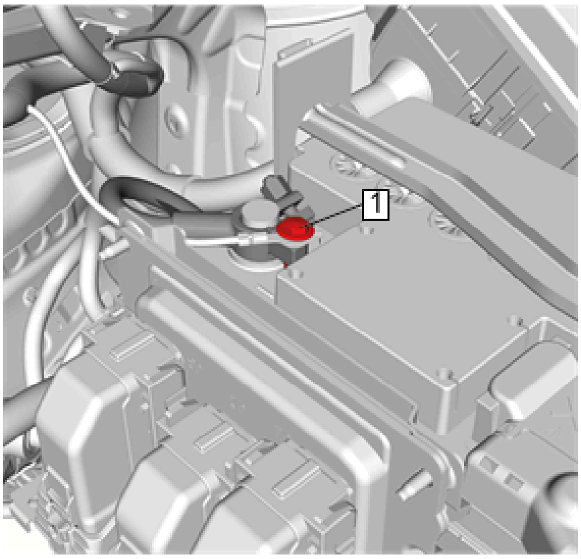


Fig. 18: Small Ground Wire And Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the small ground wire and bolt (1) from the battery negative cable clamp.

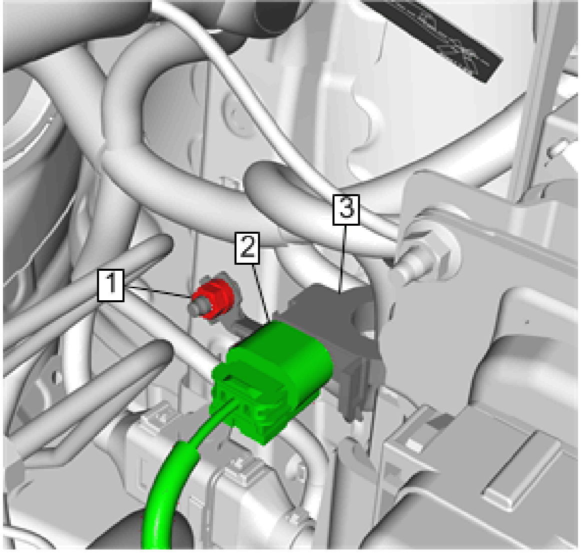


Fig. 19: Battery Current Sensor And Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Battery Current Sensor Connector (2)
5. Remove Battery Positive and Negative Cable Ground Nut (1) @ Front Wheelhouse Panel
6. Remove Battery Current Sensor (3) Battery Tray

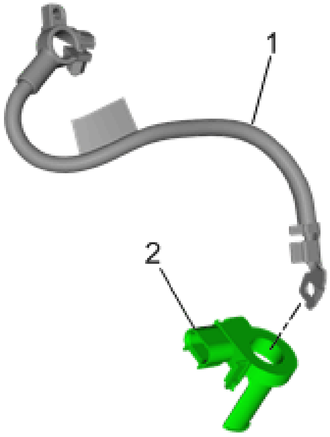


Fig. 20: Battery Current Sensor And Cable
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Note the orientation of the battery current sensor when removing.**

7. Remove Battery Current Sensor (2) @ Battery Negative Cable (1)

Installation Procedure

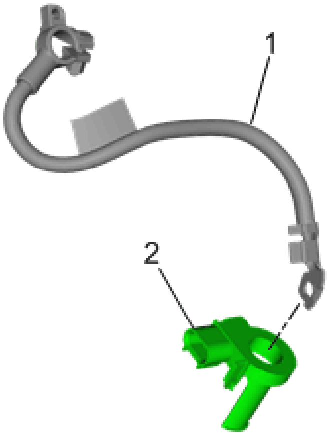


Fig. 21: Battery Current Sensor And Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Current Sensor (2) @ Battery Negative Cable (1)

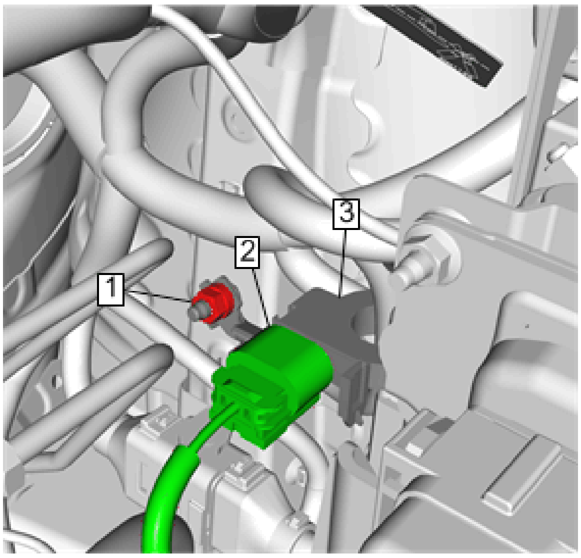


Fig. 22: Battery Current Sensor And Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Battery Positive and Negative Cable Ground Nut (1) @ Front Wheelhouse Panel and tighten 22 N.m (16 lb ft)
3. Install Battery Current Sensor (3) Battery Tray
4. Connect Battery Current Sensor Connector (2)

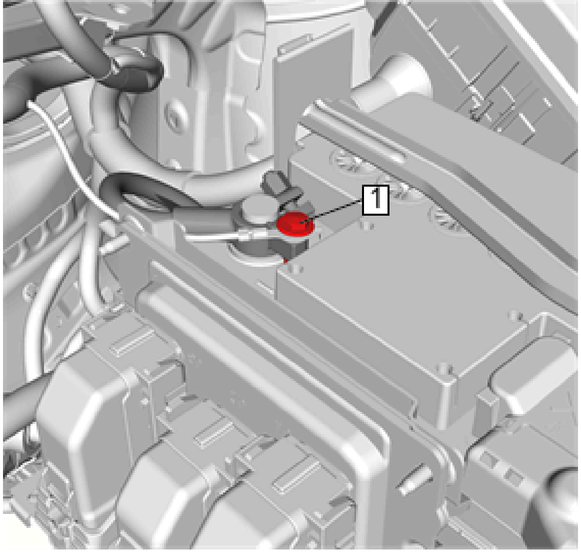


Fig. 23: Small Ground Wire And Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Install the small ground wire and bolt (1) to the battery negative cable clamp. Tighten the bolt (1) to 5 N.m (44 lb in)
6. Install the battery. Battery Replacement
7. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

BATTERY NEGATIVE CABLE EXTENSION CABLE REPLACEMENT

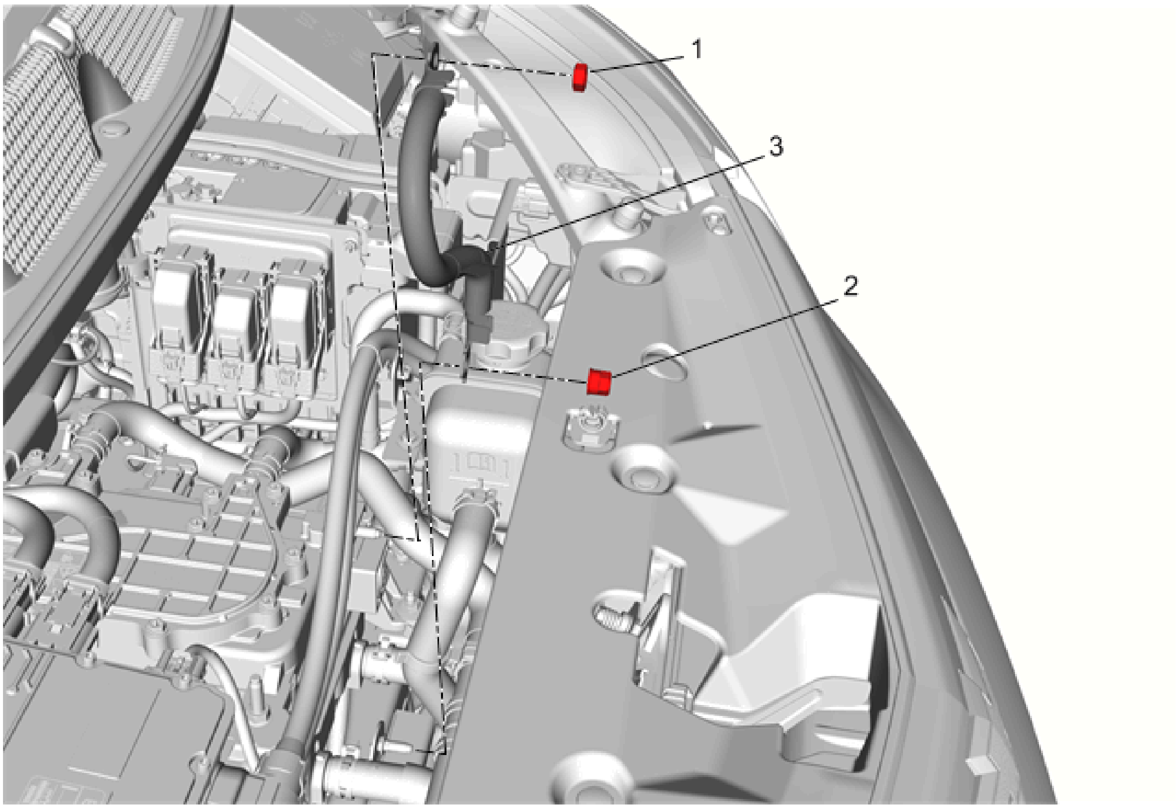


Fig. 24: Battery Negative Cable Extension Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:
• Identify how to disable high voltage.
• Identify how to test for the presence of high voltage.
• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
• Visually and functionally inspect the gloves before use.
• Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

1.</td></tr>
<tr><td>1</td><td>Battery Negative Cable Extension Cable Fastener

CAUTION:
Refer to Fastener Caution .

Tighten
15 N.m (11 lb ft)</td></tr>
<tr><td>2</td><td>Battery Negative Cable Extension Cable Fastener
Tighten
22 N.m (16 lb ft)</td></tr>
<tr><td>3</td><td>Battery Negative Cable Extension Cable</td></tr>
</table>

AUXILIARY BATTERY NEGATIVE CABLE REPLACEMENT (DU TO CHASSIS STRUCTURE, 2ND CABLE)

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
2. Remove Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
3. Remove Front Wheelhouse Liner - Right Side **Front Wheelhouse Liner Replacement**

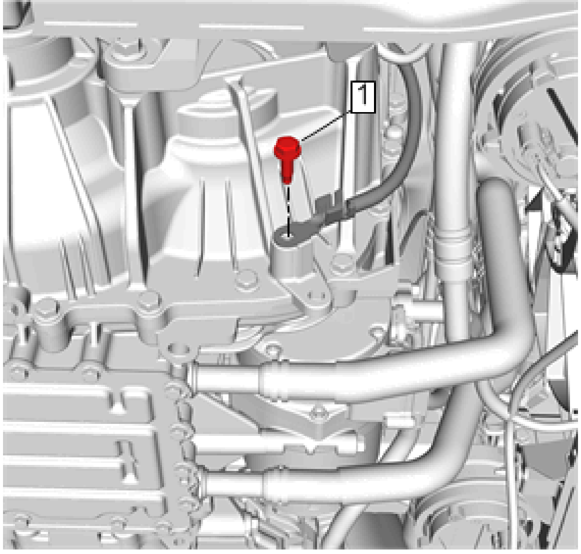


Fig. 25: Auxiliary Battery Positive Cable Fastener
Courtesy of GENERAL MOTORS COMPANY

4. Remove Auxiliary Battery Positive Cable Fastener (1) @ Automatic Transmission

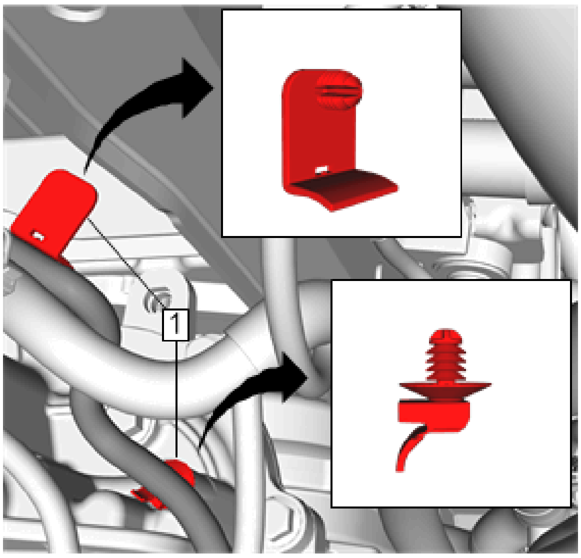


Fig. 26: Auxiliary Battery Positive Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Detach Auxiliary Battery Positive Cable Retainer (1) @Automatic Transmission

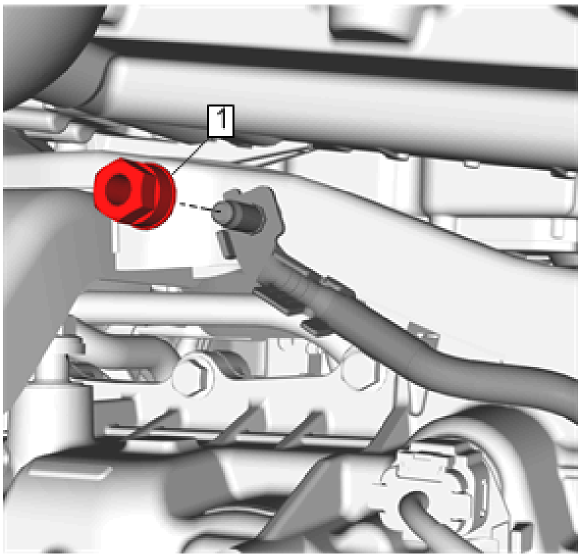


Fig. 27: Auxiliary Battery Positive Cable Nut
Courtesy of GENERAL MOTORS COMPANY

6. Remove Auxiliary Battery Positive Cable Nut (1)

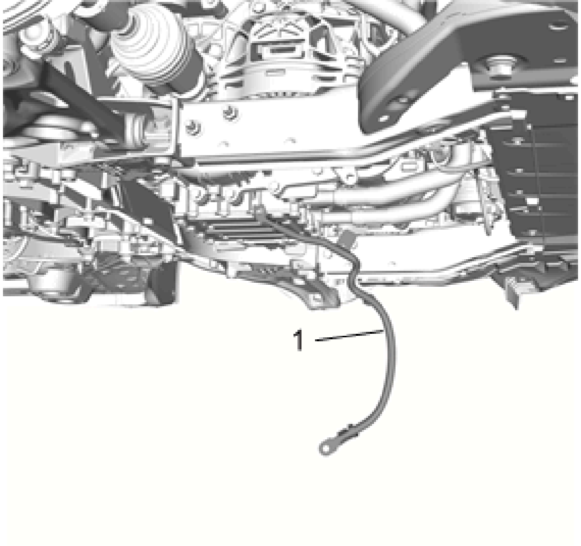


Fig. 28: Auxiliary Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove Auxiliary Battery Positive Cable (1)

Installation Procedure

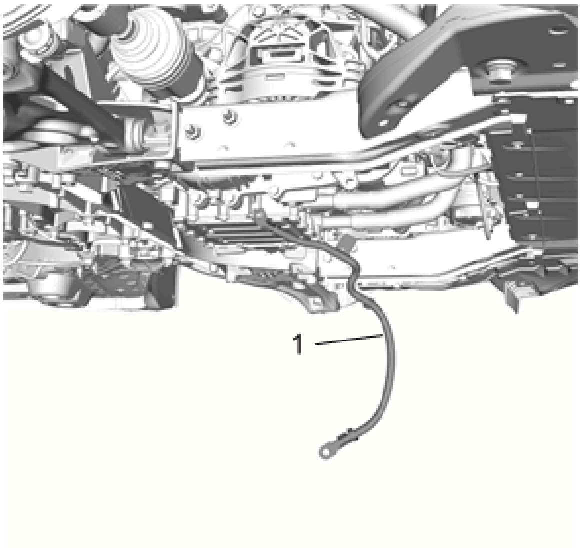


Fig. 29: Auxiliary Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Auxiliary Battery Positive Cable (1)

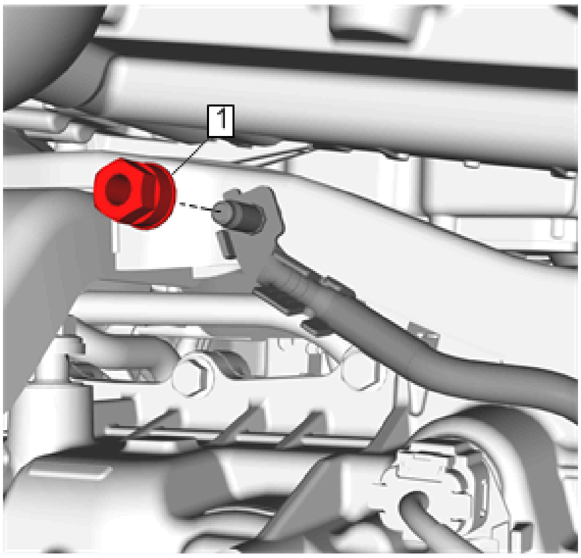


Fig. 30: Auxiliary Battery Positive Cable Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Auxiliary Battery Positive Cable Nut (1) and tighten 22 N.m (16 lb ft)

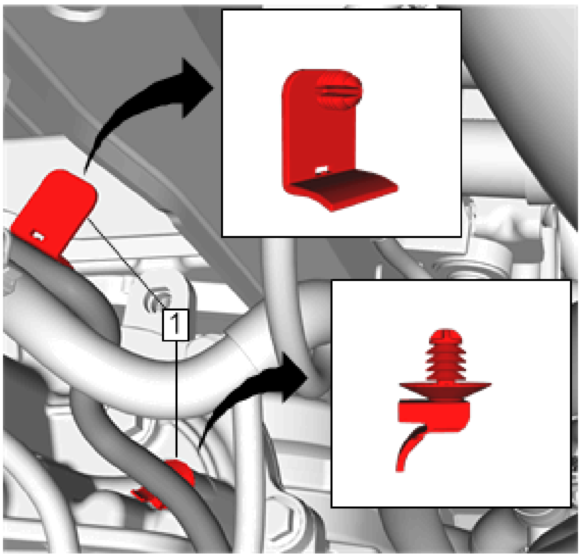


Fig. 31: Auxiliary Battery Positive Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Attach Auxiliary Battery Positive Cable Retainer (1) @Automatic Transmission

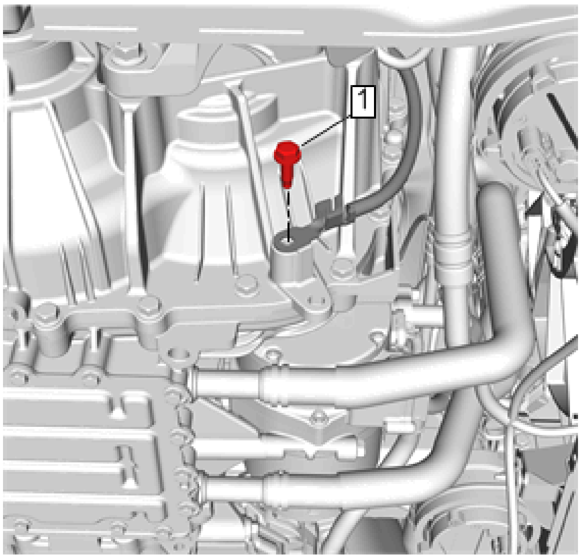


Fig. 32: Auxiliary Battery Positive Cable Fastener
Courtesy of GENERAL MOTORS COMPANY

4. Install Auxiliary Battery Positive Cable Fastener (1) @ Automatic Transmission and tighten 22 N.m (16 lb ft)
5. Install Front Wheelhouse Liner - Right Side **Front Wheelhouse Liner Replacement**
6. Install Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
7. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

AUXILIARY BATTERY NEGATIVE CABLE REPLACEMENT (CHASSIS STRUCTURE TO FRONT COMPARTMENT SIDE RAIL)

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
2. Remove Battery Tray **Battery Tray Replacement**

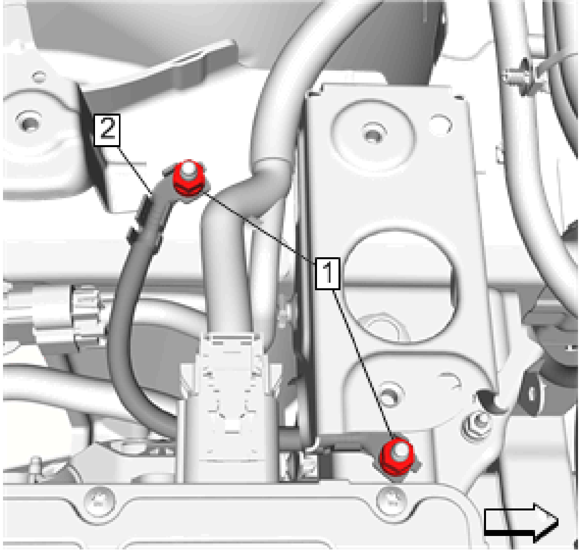


Fig. 33: Auxiliary Battery Negative Cable Fastener
Courtesy of GENERAL MOTORS COMPANY

3. Remove Auxiliary Battery Negative Cable Fastener (1) @ Power Electric Carrier Frame

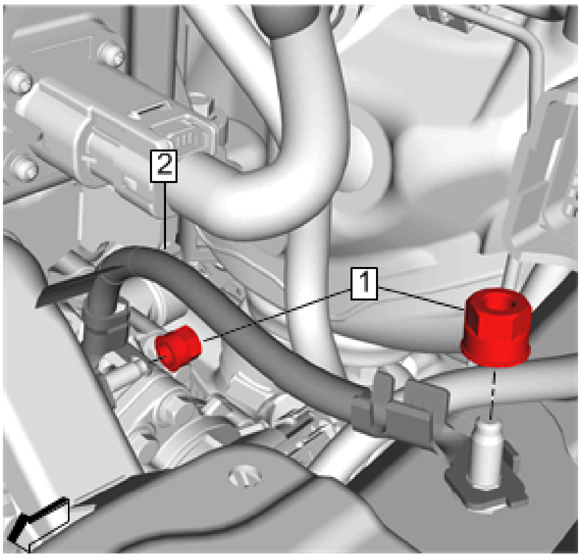


Fig. 34: Auxiliary Battery Negative Cable Fastener
Courtesy of GENERAL MOTORS COMPANY

4. Remove Auxiliary Battery Negative Cable Fastener (1) @ Power Electric Carrier Frame

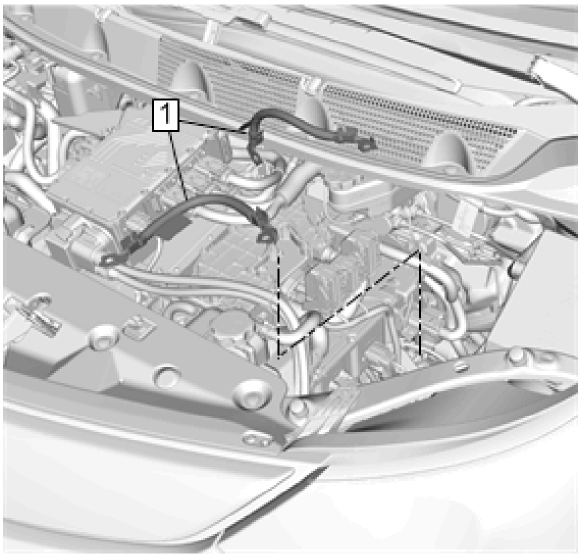
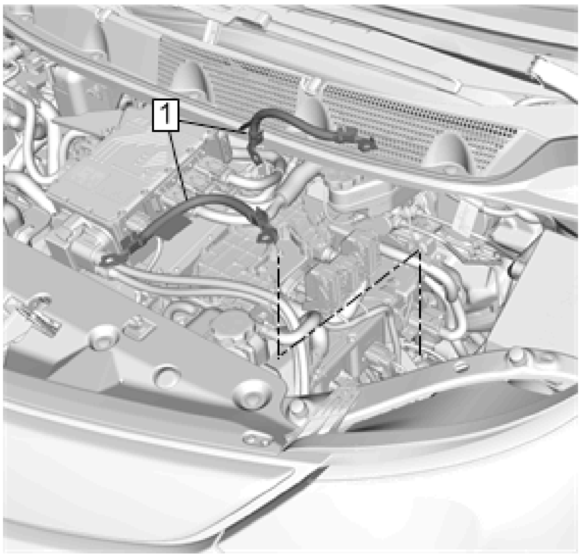


Fig. 35: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

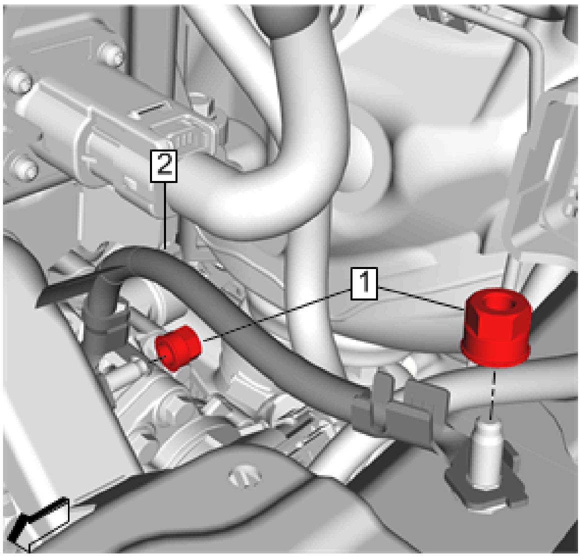
5. Remove Auxiliary Battery Negative Cable (1)

Installation Procedure



[Fig. 36: Battery Negative Cable](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Auxiliary Battery Negative Cable (1)



[Fig. 37: Auxiliary Battery Negative Cable Fastener](#)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to [Fastener Caution](#) .**

2. Install Auxiliary Battery Negative Cable (2)
3. Install Auxiliary Battery Negative Cable Fastener (1) and tighten 22 N.m (16 lb ft)

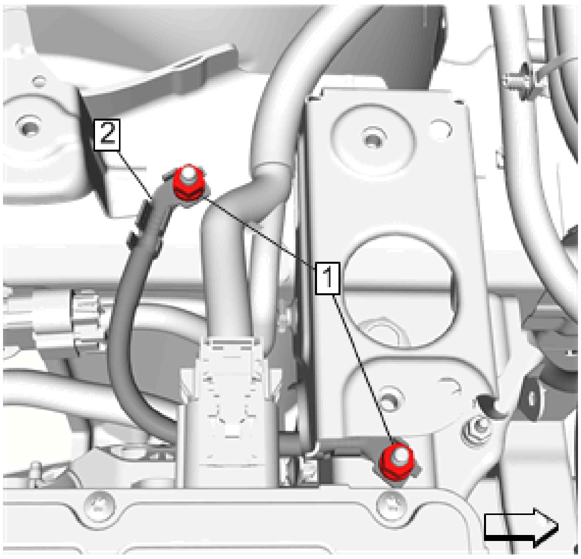


Fig. 38: Auxiliary Battery Negative Cable Fastener
Courtesy of GENERAL MOTORS COMPANY

4. Install Auxiliary Battery Negative Cable (2)
5. Install Auxiliary Battery Negative Cable Fastener (1) and tighten 22 N.m (16 lb ft)
6. Install Battery Tray Battery Tray Replacement
7. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

AUXILIARY BATTERY NEGATIVE CABLE REPLACEMENT (DU TO CHASSIS STRUCTURE, 1ST CABLE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Remove Front Compartment Air Deflector Front Compartment Air Deflector Replacement

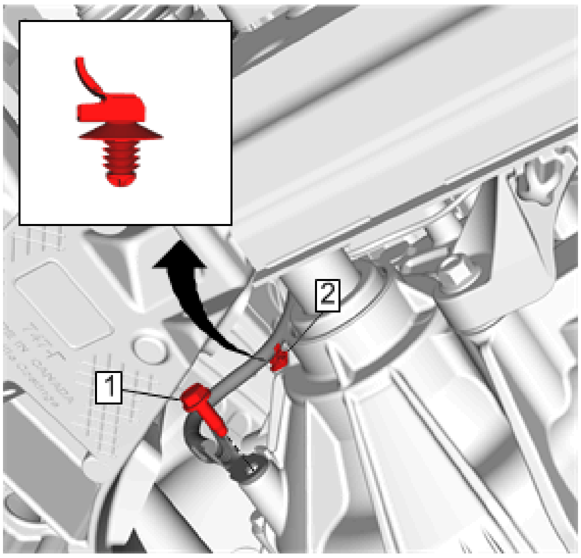


Fig. 39: Auxiliary Battery Negative Cable Fastener And Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Remove Auxiliary Battery Negative Cable Fastener (1)
4. Detach Auxiliary Battery Negative Cable Retainer (2)
5. Remove High Voltage Battery Heater **High Voltage Battery Heater Replacement**

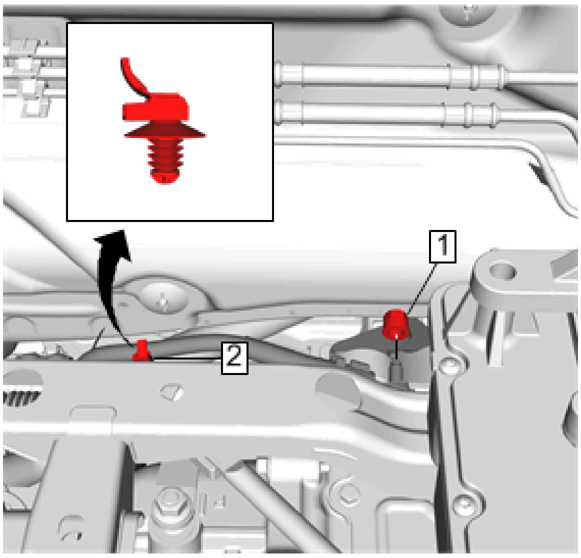


Fig. 40: Auxiliary Battery Negative Cable Fastener And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Remove Auxiliary Battery Negative Cable Fastener (1)
7. Detach Auxiliary Battery Negative Cable Retainer (2)

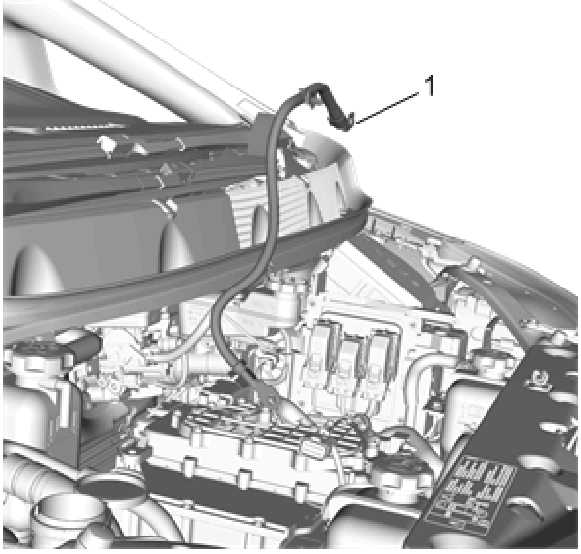


Fig. 41: Auxiliary Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

8. Remove Auxiliary Battery Negative Cable (1)

Installation Procedure

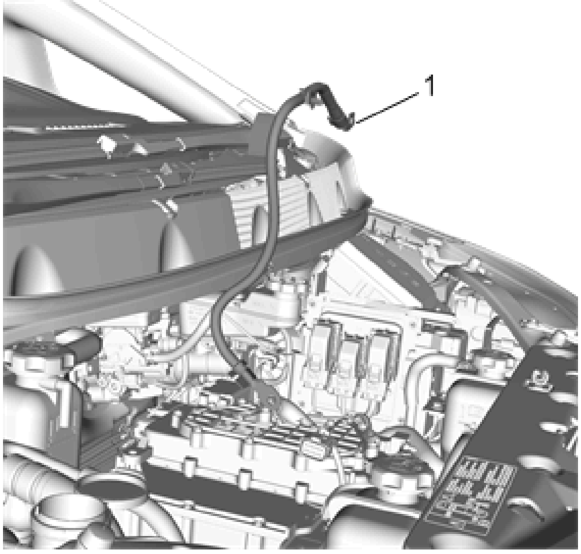


Fig. 42: Auxiliary Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Auxiliary Battery Negative Cable (1)

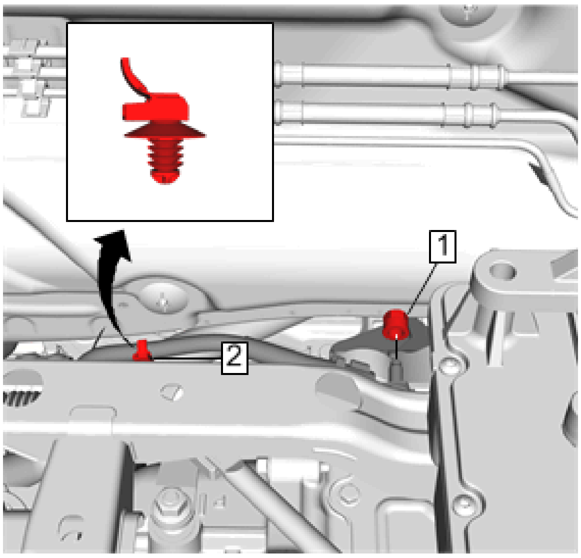


Fig. 43: Auxiliary Battery Negative Cable Fastener And Retainer
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Attach Auxiliary Battery Negative Cable Retainer (2)
3. Install Auxiliary Battery Negative Cable Fastener (1) and tighten 22 N.m (16 lb ft)
4. Install High Voltage Battery Heater **High Voltage Battery Heater Replacement**

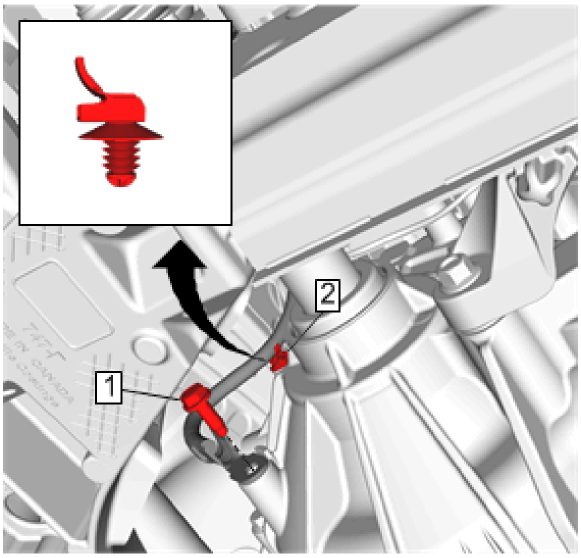


Fig. 44: Auxiliary Battery Negative Cable Fastener And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Attach Auxiliary Battery Negative Cable Retainer (2)
6. Auxiliary Battery Negative Cable Fastener (1) and tighten 22 N.m (16 lb ft)
7. Install Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
8. Enable the high voltage system. **High Voltage Enabling**

BATTERY POSITIVE CABLE REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

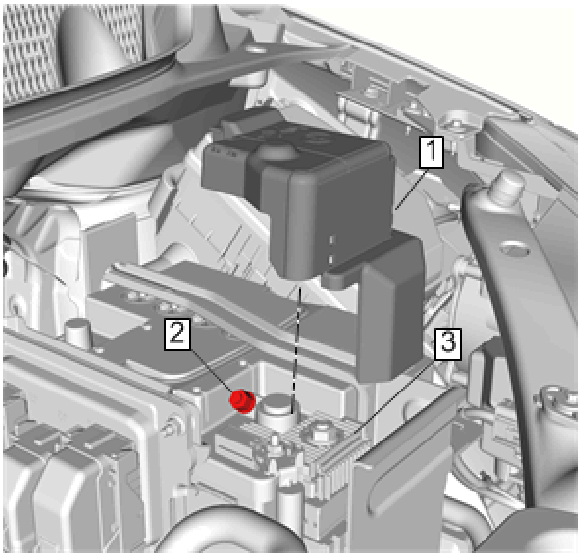


Fig. 45: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

2. Remove Battery Positive Cable Protective Cover (1)
3. Loosen Battery Positive Cable Clamp Fastener
4. Remove Battery Positive Cable (3) @ Battery Post

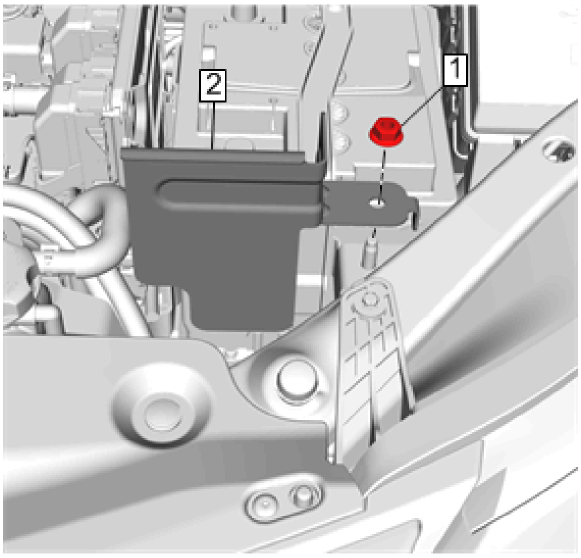


Fig. 46: Battery Tray Support Nut
Courtesy of GENERAL MOTORS COMPANY

5. Remove Battery Tray Support Nut (1)
6. Remove Battery Tray Support (2)

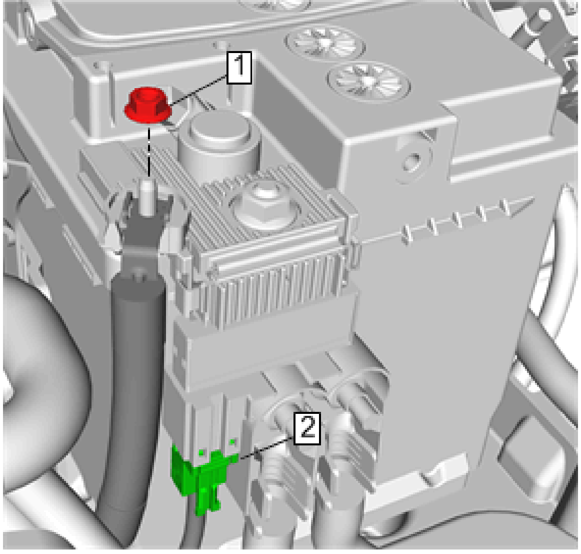


Fig. 47: Body Wiring Harness Nut And Connector
Courtesy of GENERAL MOTORS COMPANY

7. Remove Body Wiring Harness Nut (1) @ Battery Distribution Fuse Block
8. Disconnect Body Wiring Harness Connector (2) @Battery Distribution Fuse Block

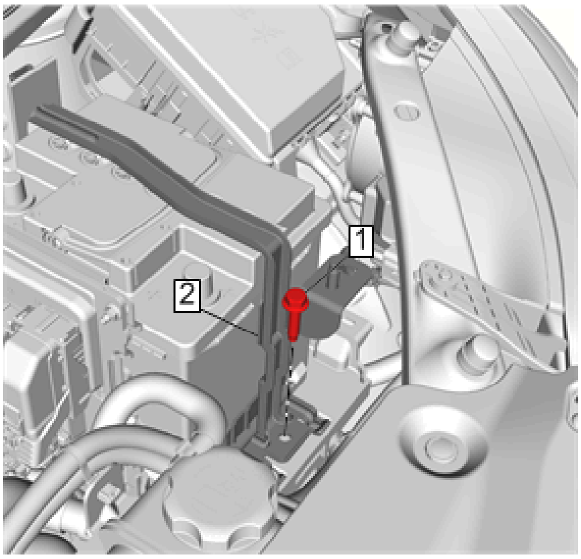


Fig. 48: Battery Retainer Assembly Bolt And Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Remove Battery Retainer Assembly Bolt (1)
10. Remove Battery Retainer Assembly (2)

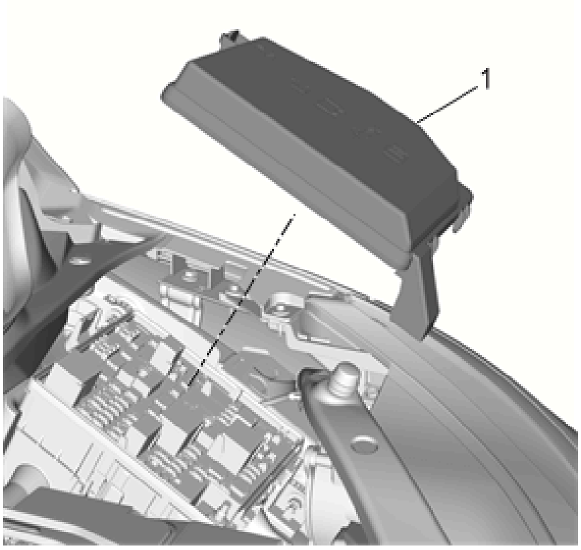


Fig. 49: Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

11. Remove Remove Fuse Block Cover (1)

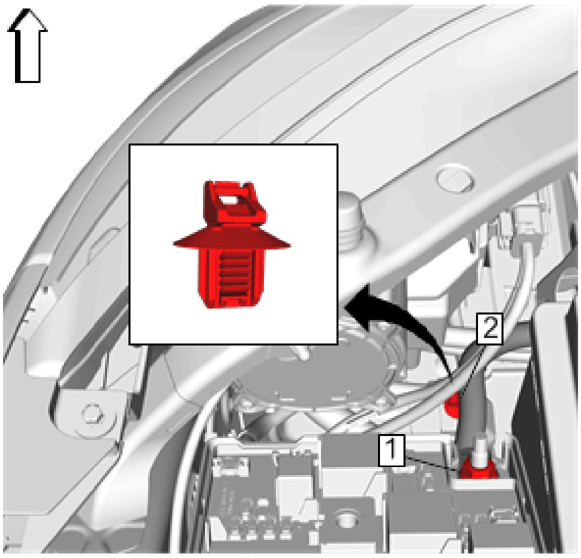


Fig. 50: Battery Positive Cable Nut And Retainer
Courtesy of GENERAL MOTORS COMPANY

12. Remove Battery Positive Cable Nut (1)
13. Battery Positive Cable Retainer (2)

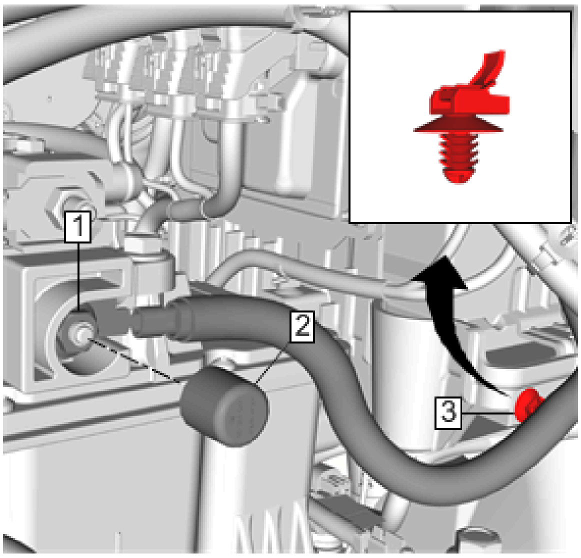


Fig. 51: Battery Positive Cable Protector And Retainer
Courtesy of GENERAL MOTORS COMPANY

14. Remove Battery Positive Cable Protector (2)
15. Remove Battery Positive Cable Nut (1)
16. Detach Battery Positive Cable Retainer (3)

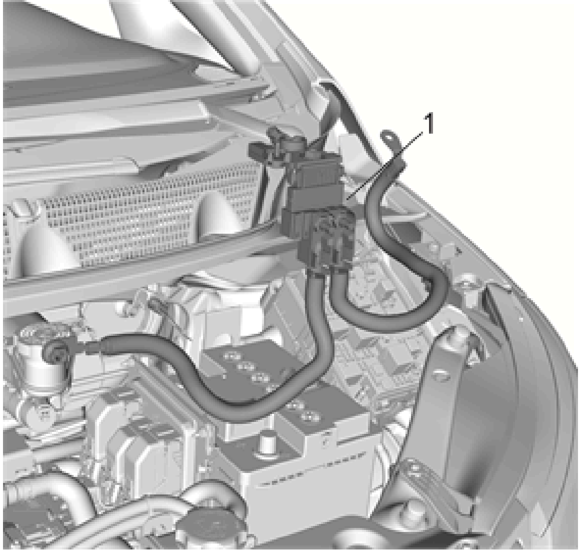


Fig. 52: Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

17. Remove Battery Positive Cable (1)

Installation Procedure

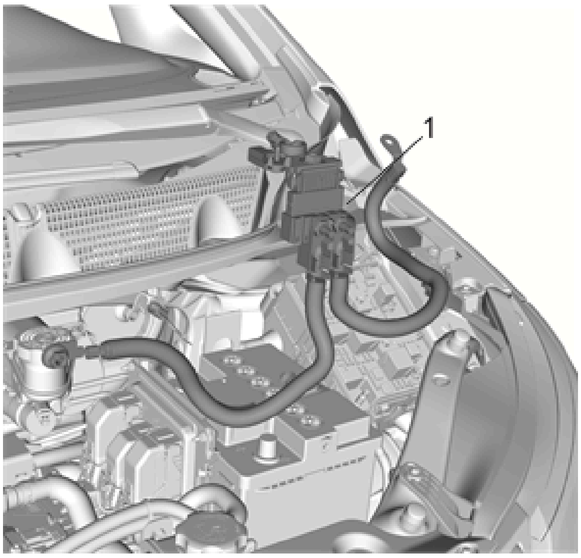


Fig. 53: Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Positive Cable (1)

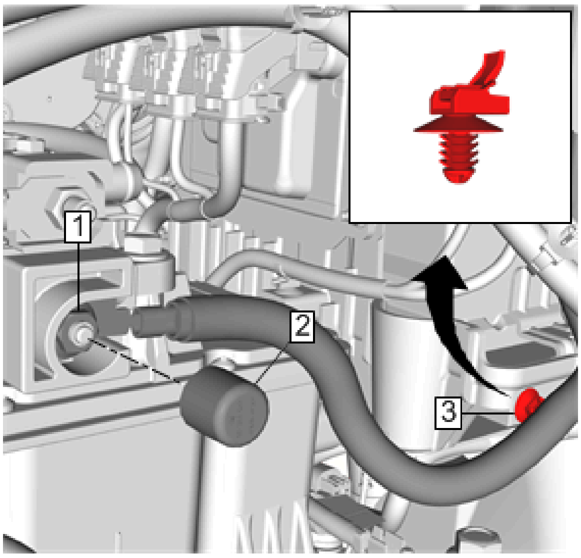


Fig. 54: Battery Positive Cable Protector And Retainer
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Attach Battery Positive Cable Retainer (3)
3. Install Battery Positive Cable Nut (1) and tighten 15 N.m (11 lb ft)
4. Install Battery Positive Cable Protector (2)

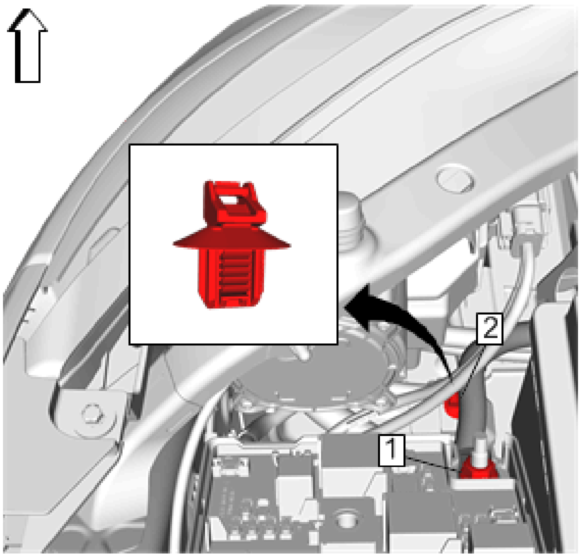


Fig. 55: Battery Positive Cable Nut And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Attach Battery Positive Cable Retainer (2)
6. Install Battery Positive Cable Nut (1) and tighten 22 N.m (16 lb ft)

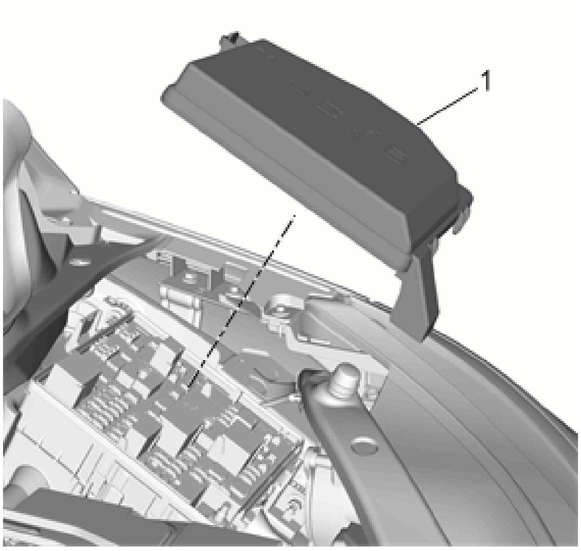


Fig. 56: Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

7. Install Fuse Block Cover (1)

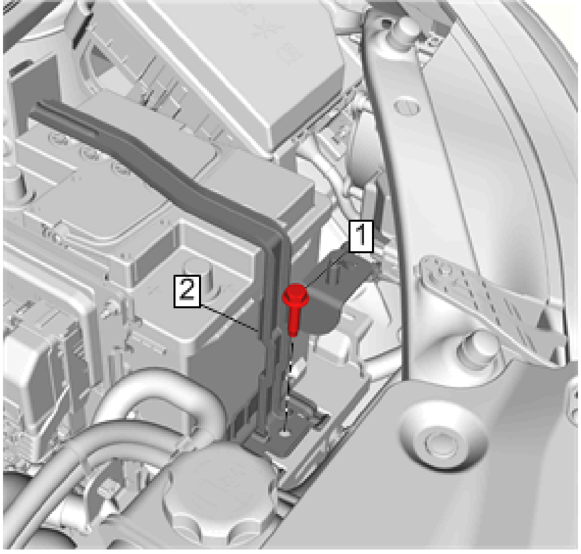


Fig. 57: Battery Retainer Assembly Bolt And Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Install Battery Retainer Assembly (2)
9. Install Battery Retainer Assembly Bolt (1) and tighten 8 N.m (71 lb in)

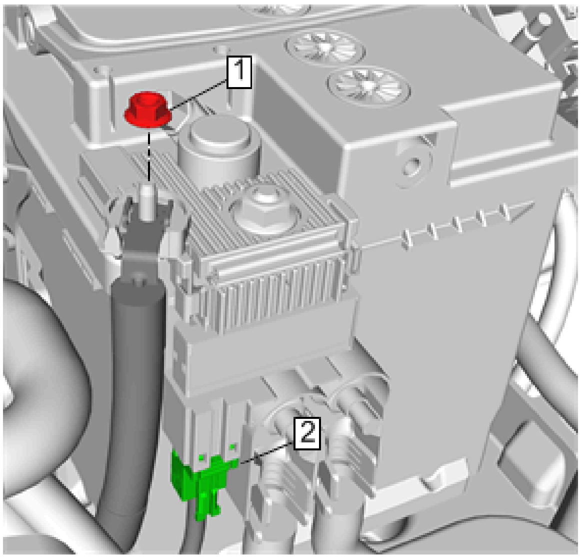


Fig. 58: Body Wiring Harness Nut And Connector
Courtesy of GENERAL MOTORS COMPANY

10. Connect Body Wiring Harness Connector (2) @Battery Distribution Fuse Block
11. Install Body Wiring Harness Nut (1) @ Battery Distribution Fuse Block and tighten 5 N.m (44 lb in)

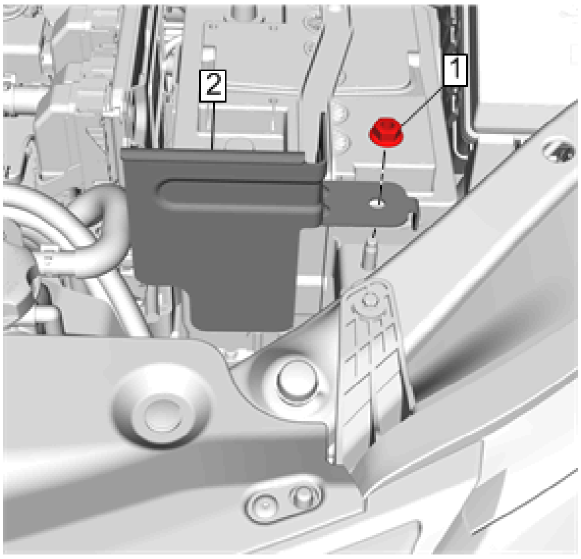


Fig. 59: Battery Tray Support Nut
Courtesy of GENERAL MOTORS COMPANY

12. Install Battery Tray Support (2)
13. Install Battery Tray Support Nut (1) and tighten 9 N.m (80 lb in)

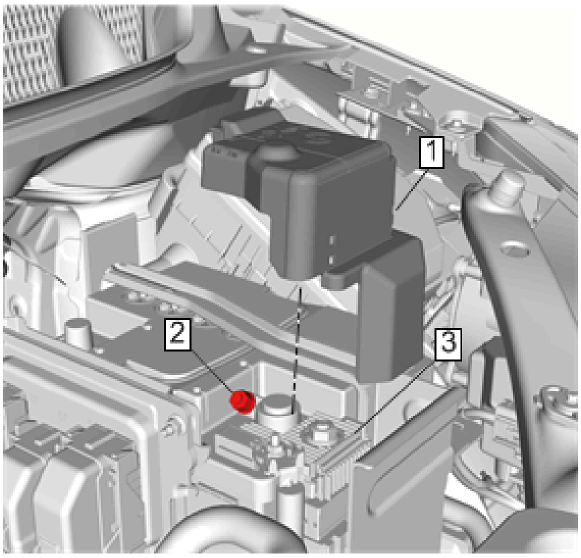


Fig. 60: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

14. Install Battery Positive Cable (3) @ Battery Post
15. Install Battery Positive Cable Clamp Fastener and tighten 5 N.m (44 lb in)
16. Install Battery Positive Cable Protective Cover (1)
17. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

ENGINE WIRING HARNESS JUNCTION BLOCK REPLACEMENT

Removal Procedure

Preliminary Procedures

1. Disconnect Battery Negative Cable Battery Negative Cable Disconnection and Connection
2. Remove Battery Battery Replacement

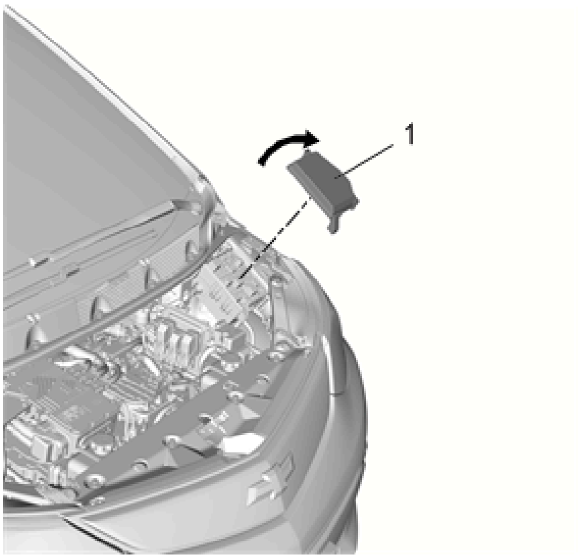


Fig. 61: Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

3. Remove Fuse Block Cover(1)

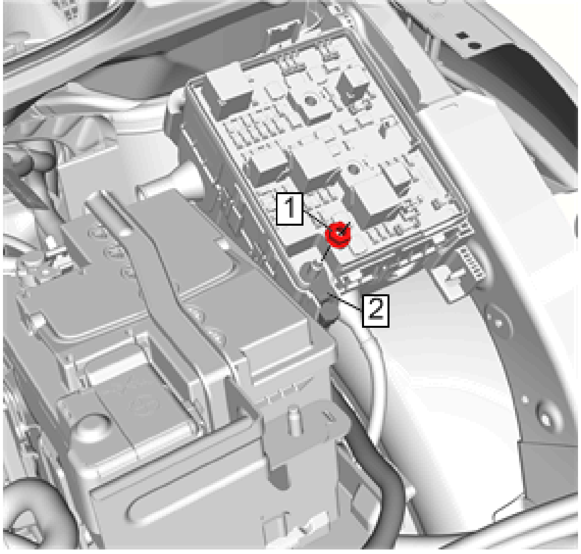


Fig. 62: Battery Positive Cable Nut
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery positive cable nut (1) and the cable (2) from the engine wiring harness junction block assembly.

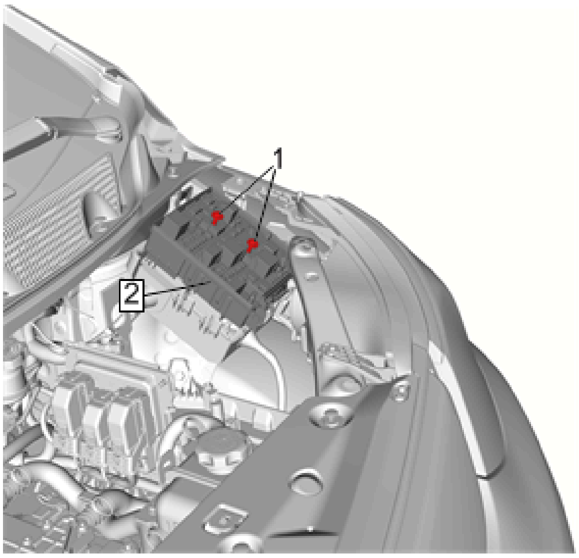


Fig. 63: Engine Wiring Harness Junction Block
Courtesy of GENERAL MOTORS COMPANY

5. Loosen Engine Wiring Harness Junction Block Bolt (1)
6. Release the seven retainers while removing the block.
7. Remove Engine Wiring Harness Junction Block(2)

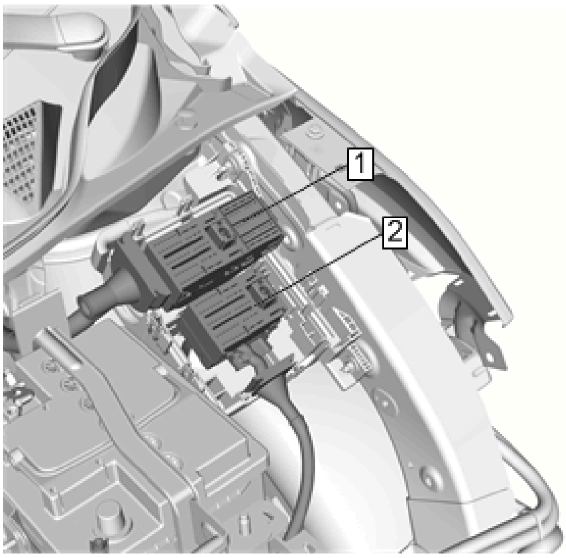


Fig. 64: Body Wiring Harness Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove Body Wiring Harness Assembly (1) @Engine Wiring Harness Fuse Block Bracket
9. Remove Engine Wiring Harness Assembly (2)@Engine Wiring Harness Fuse Block Bracket

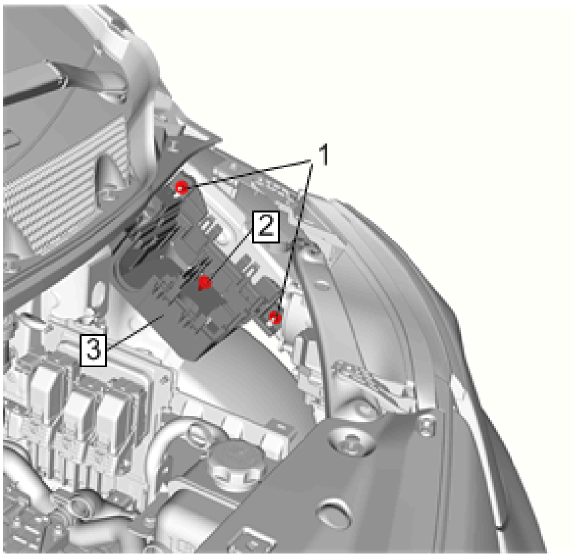


Fig. 65: Engine Wiring Harness Fuse Block Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

10. Remove Engine Wiring Harness Fuse Block Bracket Nut (1)
11. Remove Engine Wiring Harness Fuse Block Bracket Bolt (2)
12. Remove Engine Wiring Harness Fuse Block Bracket (3)

Installation Procedure

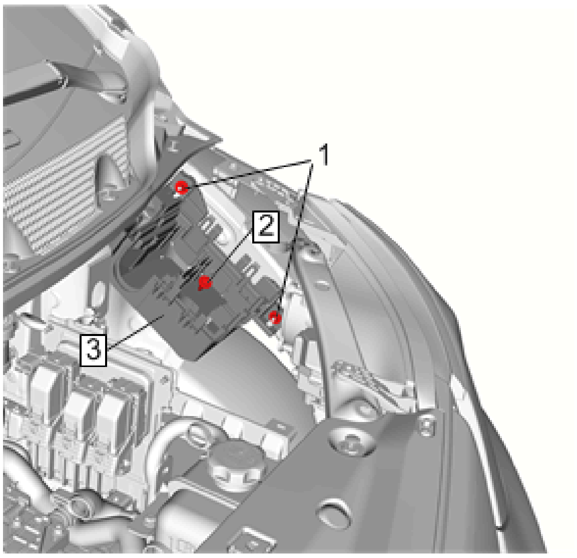


Fig. 66: Engine Wiring Harness Fuse Block Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

1. Install Engine Wiring Harness Fuse Block Bracket (3)
2. Install Engine Wiring Harness Fuse Block Bracket Bolt (2) and tighten 9 N.m (80 lb in)
3. Install Engine Wiring Harness Fuse Block Bracket Nut (1) and tighten 9 N.m (80 lb in)

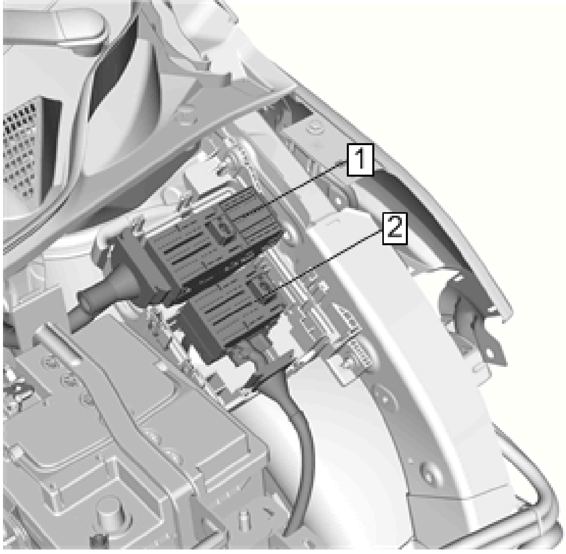


Fig. 67: Body Wiring Harness Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Install Engine Wiring Harness Assembly (2)@Engine Wiring Harness Fuse Block Bracket
5. Install Body Wiring Harness Assembly (1)@Engine Wiring Harness Fuse Block Bracket

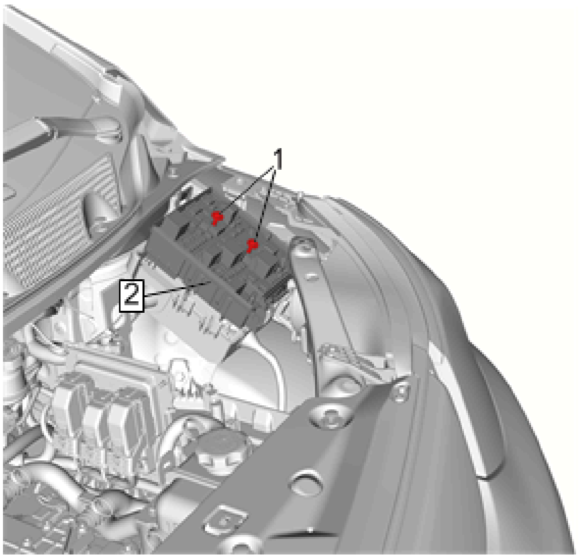


Fig. 68: Engine Wiring Harness Junction Block
Courtesy of GENERAL MOTORS COMPANY

6. Install Engine Wiring Harness Junction Block (2)
7. Install Engine Wiring Harness Junction Block Bolt (1) and tighten 1.5 N.m (13 lb in)

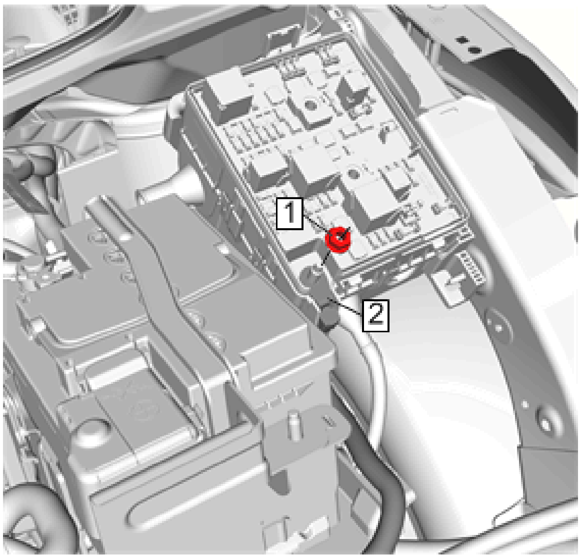


Fig. 69: Battery Positive Cable Nut
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery positive cable nut (1) and the cable (2) to the engine wiring harness junction block assembly. Tighten the nut to 22 N.m (16 lb ft)

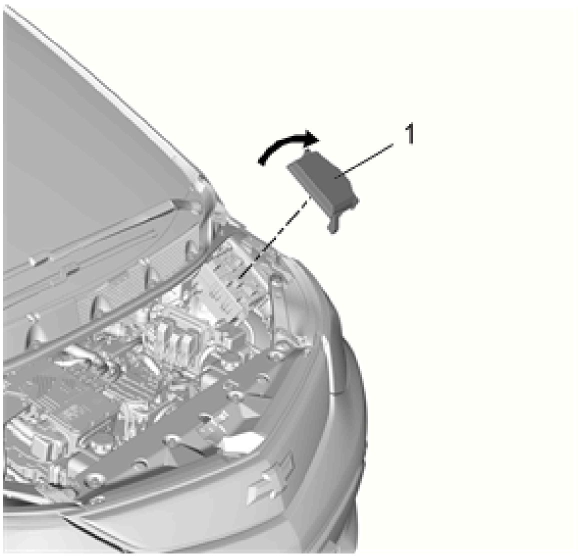


Fig. 70: Fuse Block Cover
Courtesy of GENERAL MOTORS COMPANY

9. Install Fuse Block Cover(1)
10. Install Battery **Battery Replacement**
11. Connect Battery Negative Cable **Battery Negative Cable Disconnection and Connection**

BATTERY REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**.

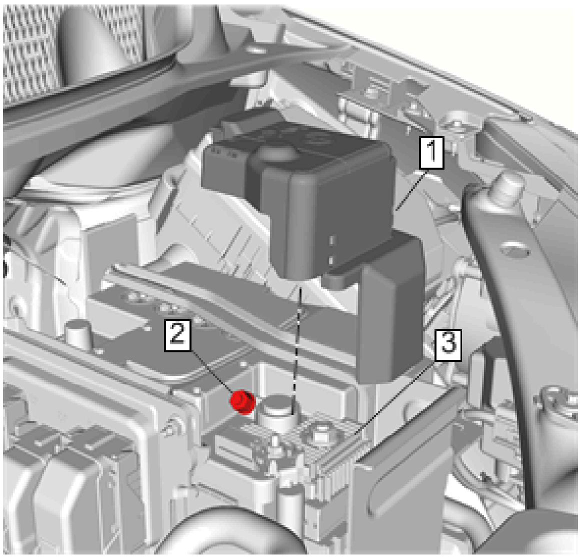


Fig. 71: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

2. Remove Battery Positive Cable Protective Cover (1)
3. Loosen Battery Positive Cable Clamp Fastener
4. Remove Battery Positive Cable (3) @ Battery Post

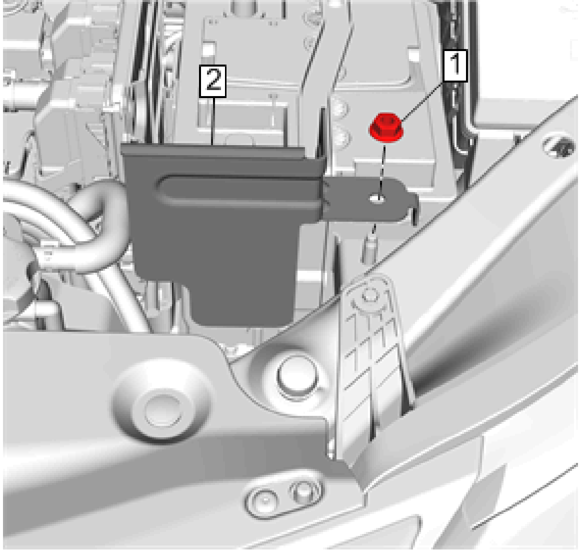


Fig. 72: Battery Tray Support Nut
Courtesy of GENERAL MOTORS COMPANY

5. Remove Battery Tray Support Nut (1)
6. Remove Battery Tray Support (2)

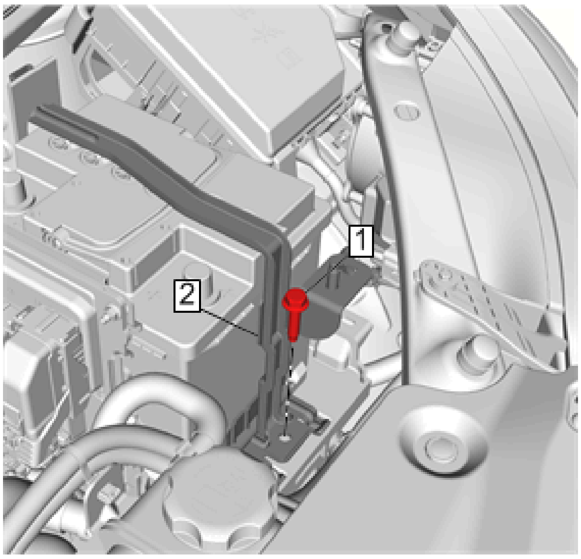


Fig. 73: Battery Retainer Assembly Bolt And Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Remove Battery Retainer Assembly Bolt (1)
8. Remove Battery Retainer Assembly (2)

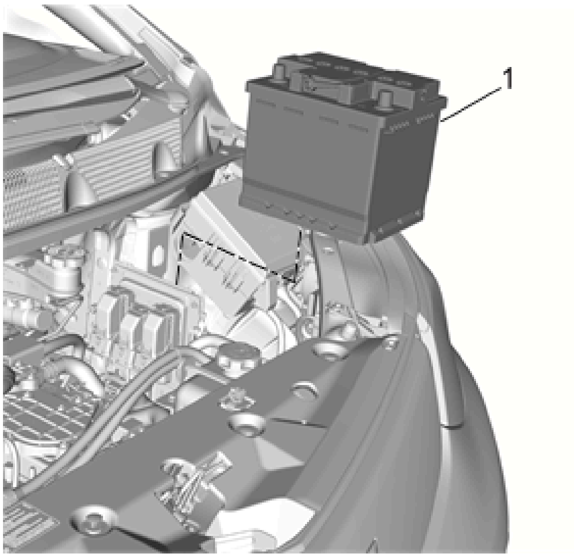


Fig. 74: Battery
Courtesy of GENERAL MOTORS COMPANY

9. Remove Battery (1)

Installation Procedure

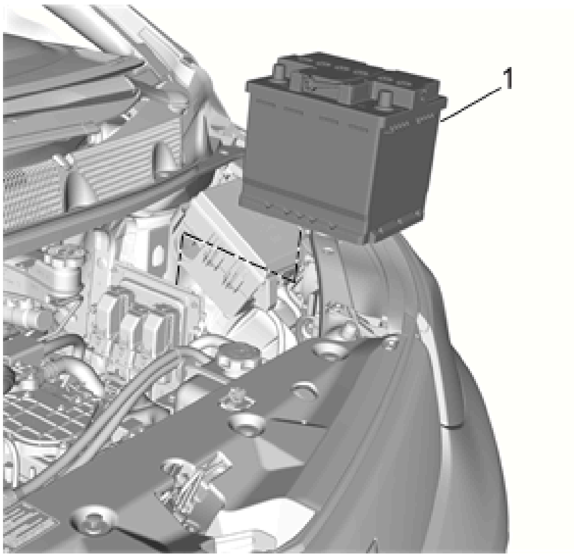


Fig. 75: Battery
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery (1)

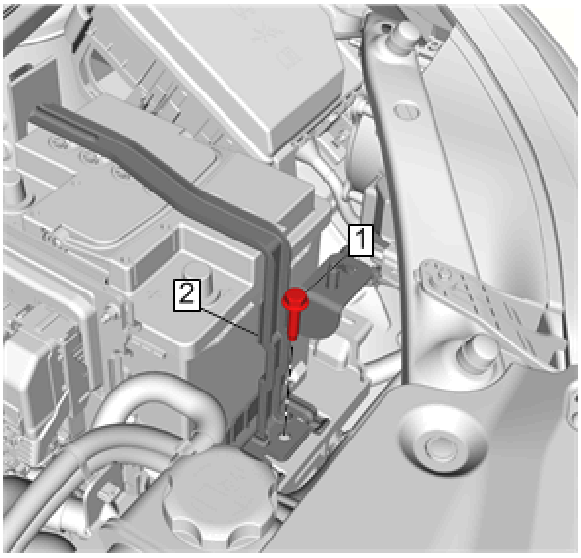


Fig. 76: Battery Retainer Assembly Bolt And Assembly
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Battery Retainer Assembly (2)
3. Install Battery Retainer Assembly Bolt (1) and tighten 8 N.m (71 lb in)

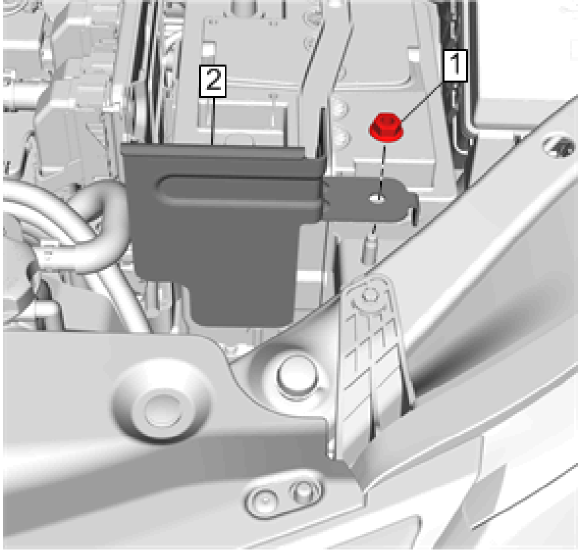


Fig. 77: Battery Tray Support Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install Battery Tray Support (2)
5. Install Battery Tray Support Nut (1) and tighten 9 N.m (80 lb in)

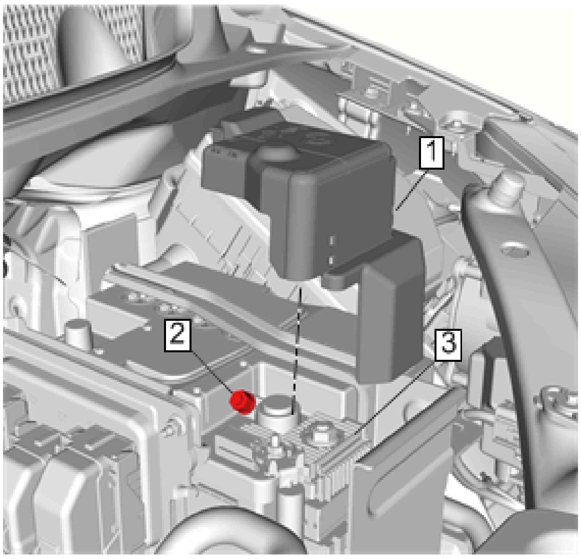


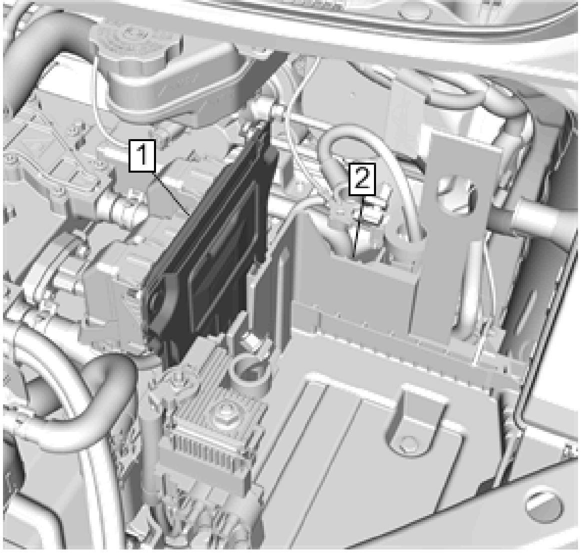
Fig. 78: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

6. Install Battery Positive Cable (3) @ Battery Post
7. Install Battery Positive Cable Clamp Fastener and tighten 5 N.m (44 lb in)
8. Install Battery Positive Cable Protective Cover (1)
9. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**.

BATTERY TRAY REPLACEMENT

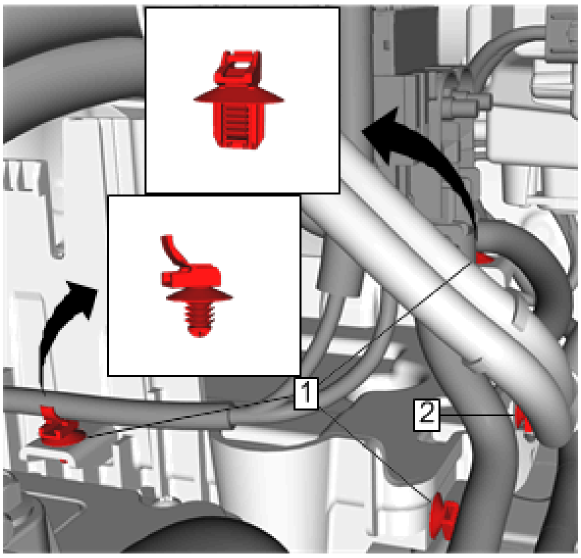
Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**.
2. Remove the battery. **Battery Replacement**



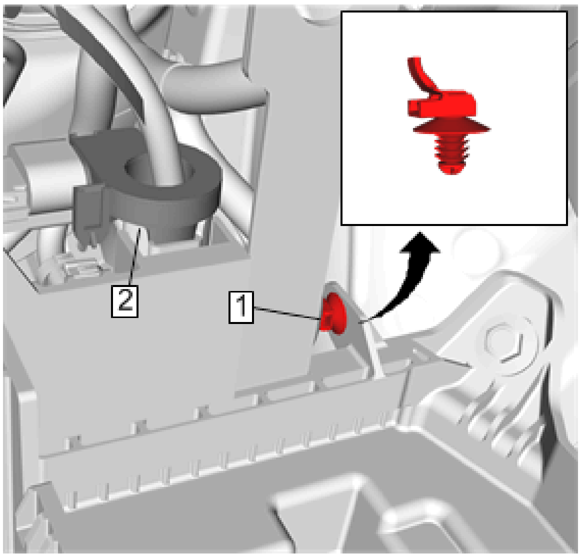
[Fig. 79: Engine Control Module](#)
Courtesy of GENERAL MOTORS COMPANY

3. Detach Engine Control Module (1) @ Battery Tray (2)



[Fig. 80: Battery Positive Cable Retainer](#)
Courtesy of GENERAL MOTORS COMPANY

4. Detach Battery Positive Cable Retainer (1) @ Battery Tray
5. Detach {If equipped} Drive Motor Battery Charger Receptacle Retainer (2) @ Battery Tray



[Fig. 81: Body Harness Retainer](#)
Courtesy of GENERAL MOTORS COMPANY

6. Detach {If equipped} Body Harness Retainer (1) @ Battery Tray
7. Remove Battery Current Sensor (2) @ Battery Tray

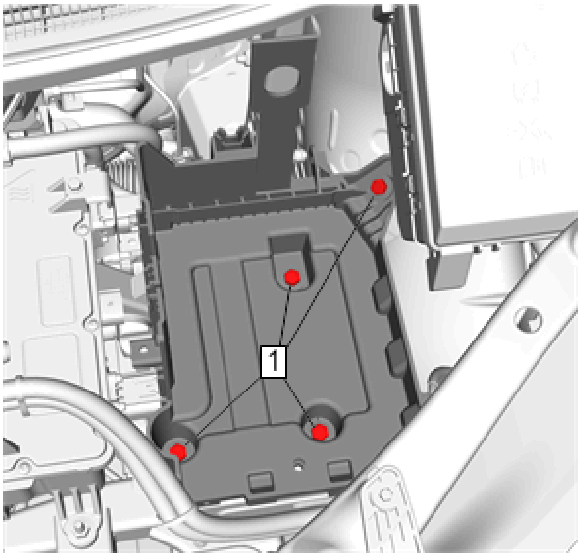


Fig. 82: Battery Tray Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove Battery Tray Bolt (1)

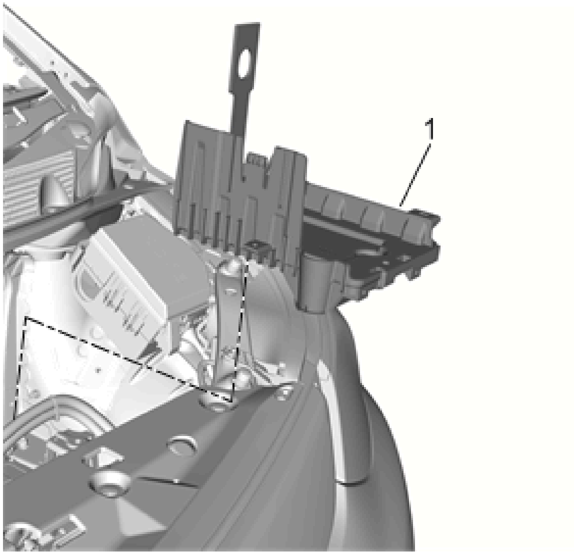


Fig. 83: Battery Tray
Courtesy of GENERAL MOTORS COMPANY

9. Remove Battery Tray (1)

Installation Procedure

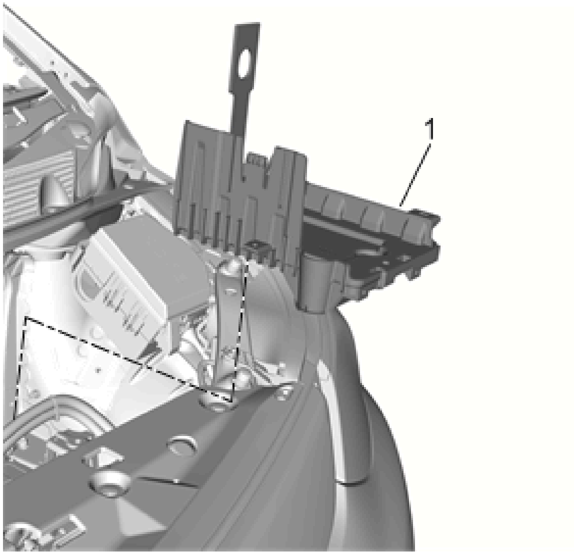


Fig. 84: Battery Tray
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Tray (1)

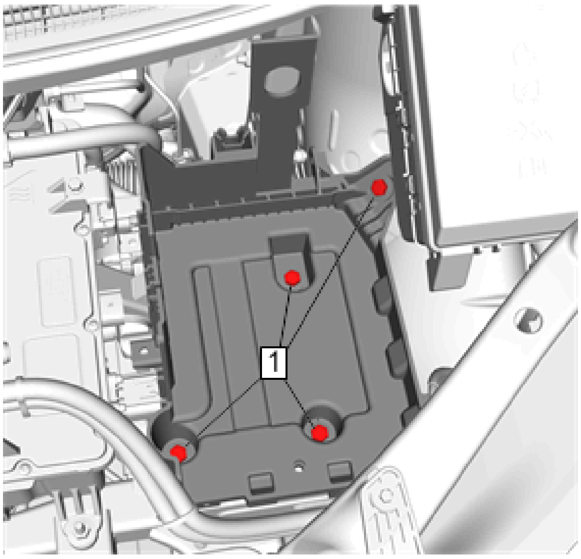


Fig. 85: Battery Tray Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Battery Tray Bolt (1) and tighten 11.5 N.m (102 lb in)

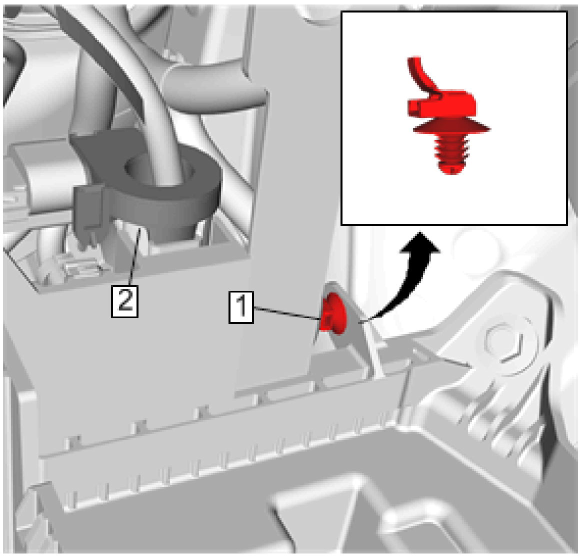


Fig. 86: Body Harness Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Attach {If equipped} Body Harness Retainer (1) @ Battery Tray
4. Install Battery Current Sensor (2) @ Battery Tray

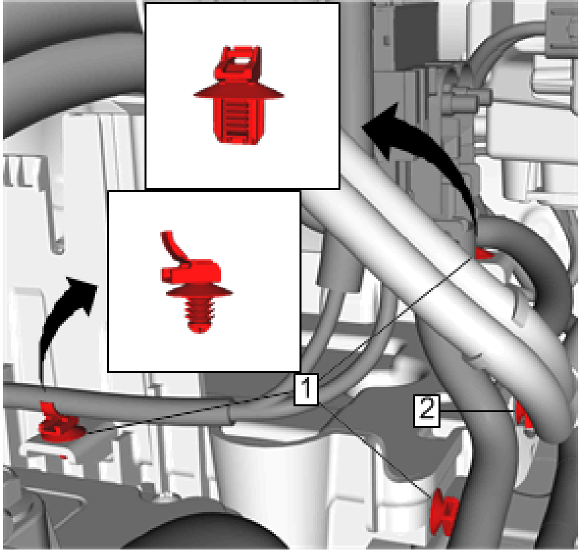


Fig. 87: Battery Positive Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Attach Battery Positive Cable Retainer (1) @ Battery Tray
6. Attach {If equipped} Drive Motor Battery Charger Receptacle Retainer (2) @ Battery Tray

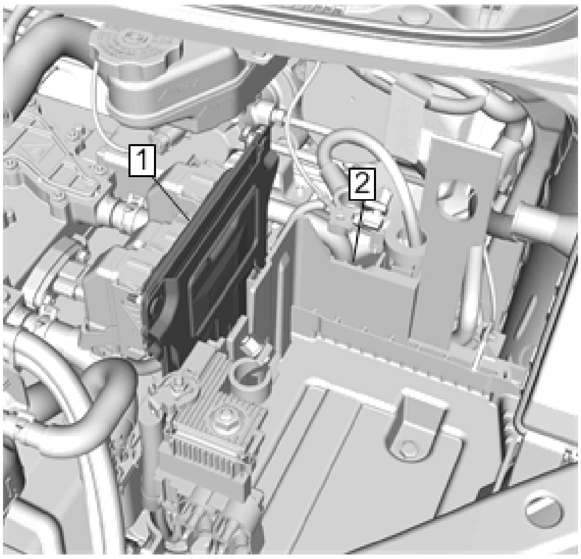


Fig. 88: Engine Control Module
Courtesy of GENERAL MOTORS COMPANY

7. Attach Engine Control Module (1) @ Battery Tray (2)
8. Install the battery. Battery Replacement
9. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection.

DESCRIPTION AND OPERATION

BATTERY DESCRIPTION AND OPERATION

300 V Battery

For information about the 355 V hybrid drive motor battery, refer to Drive Motor Battery System Description .

Absorbent Glass Mat Battery

This vehicle is equipped with an absorbent glass mat battery. This is similar to current vehicle lead acid flood batteries, except they use glass mats that absorb electrolytes that are pressed between the plates instead of immersing the plates in electrolytes. This allows a smaller, lighter battery with the same amount of power and is less susceptible to heat.

The maximum permissible voltage allowed for the absorbent glass mat battery is 14.8 V (at room temperature).

12 V Battery

WARNING: **Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:**

- **Always shield your eyes and avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.**
- **Follow each step of the jump starting procedure in order.**
- **Treat both the booster and the discharged batteries carefully when using the jumper cables.**

NOTE: **Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by OSHA, EPA, DOT, and various state or local agencies. Other regulations may also apply in other locations. Always know and follow these regulations when handling batteries.**

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.

The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for 2 small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

Battery Ratings

A battery has 2 ratings:

- Cold cranking amperage
- Amp hours

When a battery is replaced use a battery with similar ratings. Refer to the battery specification label on the original battery.

Amp Hours

The amp hour rating tells you how much amperage is available when discharged evenly over a 20 hour period. The amp hour rating is cumulative, so in order to know how many constant amps the battery will output for 20 hours, you have to divide the amp hour rating by 20. Example: If a battery has an amp hour rating of 74, dividing by 20 = 3.75. Such a battery can carry a 3.75 A load for 20 hours before dropping to 10.5 V. (10.5 V is the fully discharged level, at which point the battery needs to be recharged.) A battery with an amp hour rating of 55 will carry a 2.75 A load for 20 hours before dropping to 10.5 V.

Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at - 18Ã‚Â°C (0Ã‚Â°F) while maintaining at least 7.2 V. Refer to the battery specification label on the original battery for the cold cranking amperage rating for this vehicle.

CHARGING SYSTEM DESCRIPTION AND OPERATION

12 V Battery

The following information is for the 12 V battery only.

For information about charging the high voltage drive motor batteries, refer to **Drive Motor Battery System Description** .

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. The main difference between a conventional generator charging system and this system is that the generator has been replaced by the 14V Power Module. The 14V Power Module provides the power to charge the battery from the high voltage system. There are 7 modes of operation and they include:

- Battery Sulfation Mode
- Normal Mode
- Fuel Economy Mode
- Headlamp Mode
- Voltage Reduction Mode
- Battery Maintenance Mode
- Plant Assembly Mode

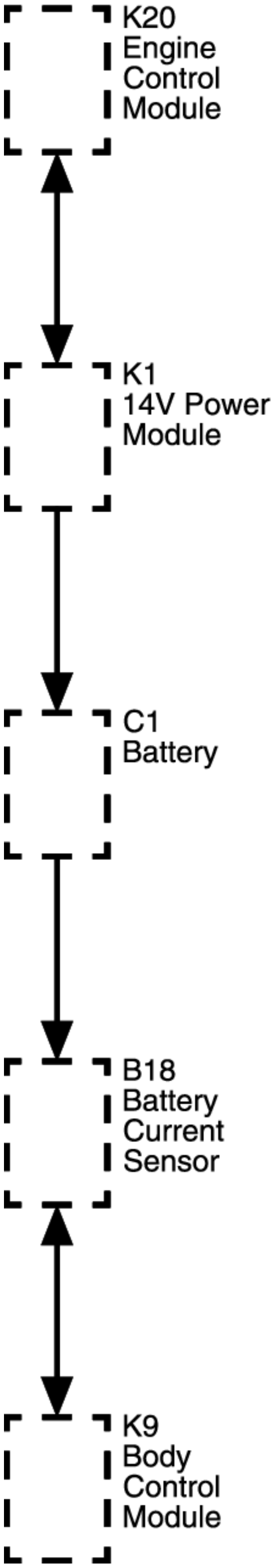

K20
Engine
Control
Module
K1
14V Power
Module
C1
Battery
B18
Battery
Current
Sensor
K9
Body
Control
Module

Fig. 89: Charging Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K1	K1 14V Power Module
C1	C1 Battery
B18	B18 Battery Current Sensor
K20	K20 Engine Control Module
K9	K9 Body Control Module

Charging System Components

14 V Power Module

The 14V Power Module provides the power to charge the battery from the high voltage system. The ECM provides a pulse width charge request signal (L Terminal) to the 14V Power Module. The 14V Power Module returns a PWM feedback signal (F Terminal) to the ECM. The 14V Power Module reports status and fault modes as a function of duty cycle. The 14V Power Module charges the battery based on the ECM signal.

Drive Motor/Generators

The drive motor/generators are serviceable components located within the transmission housing. When the rotors are spun, an alternating current (AC) is induced into the stator windings. This AC voltage is then sent to the drive motor generator power inverter module (PIM) where it is converted to high voltage direct current (DC) power. The output of the PIM is converted into low voltage electrical power by the accessory DC power converter module 14V Power Module for use by the vehicle's electrical system to maintain electrical loads and battery charge.

Body Control Module (BCM)

The body control module (BCM) is a GMLAN device. It communicates with the engine control module (ECM) and the instrument panel cluster for electrical power management operation. The BCM determines the desired voltage set point and sends the information to the engine control module (ECM) which sends this information to the 14V Power Module. The BCM monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state of charge.

Battery Current Sensor

The battery current sensor is a serviceable component that is connected to the negative battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates a 5 V pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0 - 100 percent. Normal duty cycle is between 5 - 95 percent. Between 0 - 5 percent and 95 - 100 percent are for diagnostic purposes.

Engine Control Module (ECM)

The ECM receives control decisions based on messages from the BCM as well as the HPCM2

Instrument Panel Cluster

The instrument panel cluster provides a means of customer notification in case of a failure and a voltmeter. There are 2 means of notification, a charge indicator and a driver information center message of SERVICE BATTERY CHARGING SYSTEM.

Hybrid/EV Powertrain Control Module 2 (HPCM2)

The Hybrid/EV Powertrain control module (HPCM2) is a GMLAN device. It communicates with the engine control module (ECM) to control the voltage set point sent to the 14V Power Module during the battery maintenance mode.

Battery Sulfation Mode

Battery sulfation mode is used to help maintain the battery life. The charging system will enter a battery sulfation mode which tries to increase the vehicle charging when the charging system voltage is less than 13.2 V for about 30 minutes. Once in this mode, the BCM will set a targeted output voltage between 13.9 - 15.5 V for about 5 minutes. Following this 5 minutes, the BCM will then determine which mode to enter depending on the system voltage requirements.

Normal Mode

The BCM will enter Normal Mode whenever one of the following conditions are met.

- The wipers are ON for more than 3 seconds.
- GMLAN Climate Control Voltage Boost Mode Request is true, as sensed by the HVAC control head. High speed cooling fan, rear defogger and HVAC high speed blower operation can cause the BCM to enter the Charge Mode.
- The estimated battery temperature is less than 0Ã‚Â°C (32Ã‚Â°F).
- Vehicle Speed is greater than 145 km/h (90 mph)
- Current Sensor Fault Exists
- System Voltage was determined to be below 12.56 V
- Tow/Haul Mode is enabled

When any one of these conditions is met, the system will set targeted generator output voltage to a charging voltage between 13.9 - 15.5 V, depending on the battery state of charge and estimated battery temperature.

Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the ambient air temperature is at least 0Ã‚Â°C (32Ã‚Â°F) but less than or equal to 80Ã‚Â°C (176Ã‚Â°F), the calculated battery current is greater than -8 A but less than 5 A, and the battery state of charge is greater than or equal to 85 percent. Its targeted 14V Power Module set-point voltage is the open circuit voltage of the battery and can be between 12.6 - 13.2 V. The BCM will exit this mode and enter Normal Mode when any of the conditions described above are present.

Headlamp Mode

The BCM will enter Headlamp Mode whenever the high or low beam headlamps are ON. Voltage will be regulated between 13.9 - 14.5 V.

Voltage Reduction Mode

The BCM will enter Voltage Reduction Mode when the calculated battery temperature is above 0Ã‚Â°C (32Ã‚Â°F) and the calculated battery current is greater than -7 A but less than 1 A. Its targeted 14V Power Module set-point voltage is 12.9 - 13.2 V. The BCM will exit this mode once the criteria are met for Normal Mode.

Battery Maintenance Mode

That battery maintenance mode is designed to ensure the 12V battery has a good state of charge. It accomplishes this by checking the voltage of the 12V battery and providing a charge if needed.

When the vehicle cord is plugged in

- The Hybrid/EV Powertrain control module (HPCM2) will check the 12V battery every 6 hours if the ignition is off. If the voltage is below a temperature dependent threshold ranging from 12.1 (cold) to 12.4 (warm)V, the Hybrid/EV Powertrain control module (HPCM2) will send the voltage set point to the engine control module (ECM). The engine control module (ECM) will send this to the 14V Power Module. Battery maintenance mode will charge the battery for 2-3 hours. If the Ignition is ON, the APM will cycle on as needed to maintain the 12V SOC.

When the vehicle cord is not plugged in

- The Hybrid/EV Powertrain control module (HPCM2) will check the 12V battery every 4 days (2.5 to 3 days) and if the voltage is below a threshold of 12.0 may activate battery maintenance. If the high voltage battery state of charge is greater than 40% and the propulsion system is not active, Hybrid/EV Powertrain control module (HPCM2) will send the voltage set point to the engine control module (ECM). The engine control module (ECM) will send this to the 14V Power Module. Battery maintenance mode will charge the battery for 45-90 minutes..

Plant Assembly Mode

The BCM will increase charging voltage for the first 500 miles of operation in an effort to ensure that the 12 V battery is fully charged when the vehicle is delivered to the customer.

Electrical Power Management Overview

The electrical power management system is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems. This electrical power management system primarily utilizes existing on-board computer capability to maximize the effectiveness of the charging system, manage the load, improve battery state of charge and life, and minimize the system's impact on fuel economy. The electrical power management system performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery condition is estimated during Vehicle OFF and during Vehicle in Service Mode. During Vehicle OFF the state of charge of the battery is determined by measuring the open-circuit voltage. The state of charge is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open circuit voltage when the battery has been at rest for several hours.

The state of charge can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. During Vehicle ON mode, the algorithm continuously estimates state of charge based on adjusted net amp hours, battery capacity, initial state of charge, and temperature.

While running, the battery degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the electrical power management function is designed to perform regulated voltage control to improve battery state of charge, battery life, and fuel economy. This is accomplished by using knowledge of the battery state of charge and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

Instrument Panel Cluster Operation

Charge Indicator Operation

The instrument panel cluster illuminates the charge indicator and displays a charging system warning message in the driver information center when the one or more of the following occurs:

- The engine control module (ECM) detects system voltage less than 11 V or greater than 16 V. The instrument panel cluster receives a GMLAN message from the ECM requesting illumination.
- The BCM determines that the system voltage is less than 11 V or greater than 16 V.
- The instrument panel cluster receives a GMLAN message from the BCM indicating there is a system voltage range concern.
- The instrument panel cluster performs the displays test at the start of each Vehicle ON cycle. The indicator illuminates for approximately 3 seconds.
- Vehicle ON, with the engine OFF.

Battery Voltage Gauge Operation

The instrument panel cluster displays the system voltage as received from the BCM over the GMLAN serial data circuit. If there is no communication with the BCM then the gauge will indicate minimum.

This vehicle is equipped with a regulated voltage control system. This will cause the voltmeter to fluctuate between 12 - 14 V, as opposed to non-regulated systems which usually maintain a more consistent reading of 14 V. This fluctuation with the regulated voltage control system is normal system operation and NO repairs should be attempted.

SERVICE BATTERY CHARGING SYSTEM

The BCM and the ECM will send a GMLAN message to the driver information center for the SERVICE BATTERY CHARGING SYSTEM message to be displayed. It is displayed whenever the charge indicator is commanded ON due to a failure.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

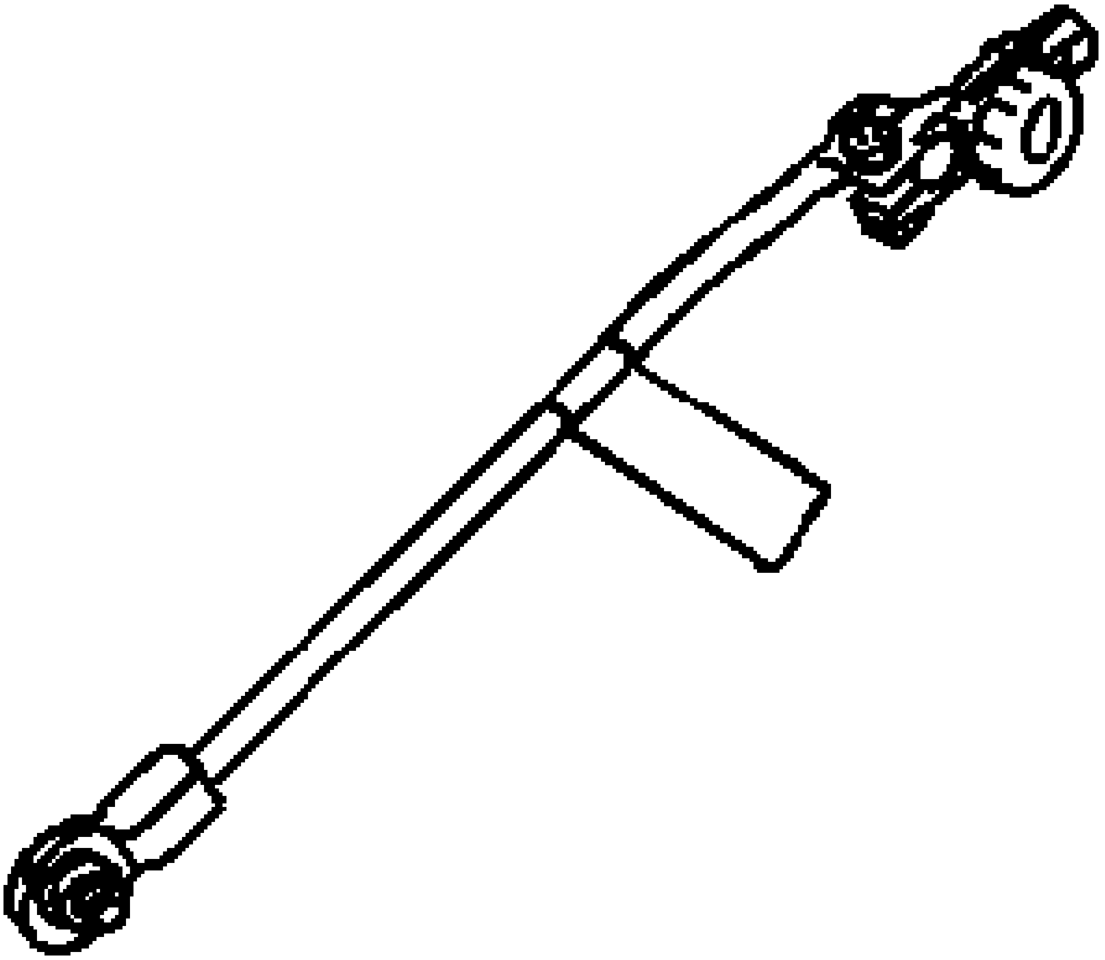
Illustration	Tool Number/Description
	EL 38758 EL 50074 J 38758 Parasitic Draw Test Switch
	J 42000 Battery Tester

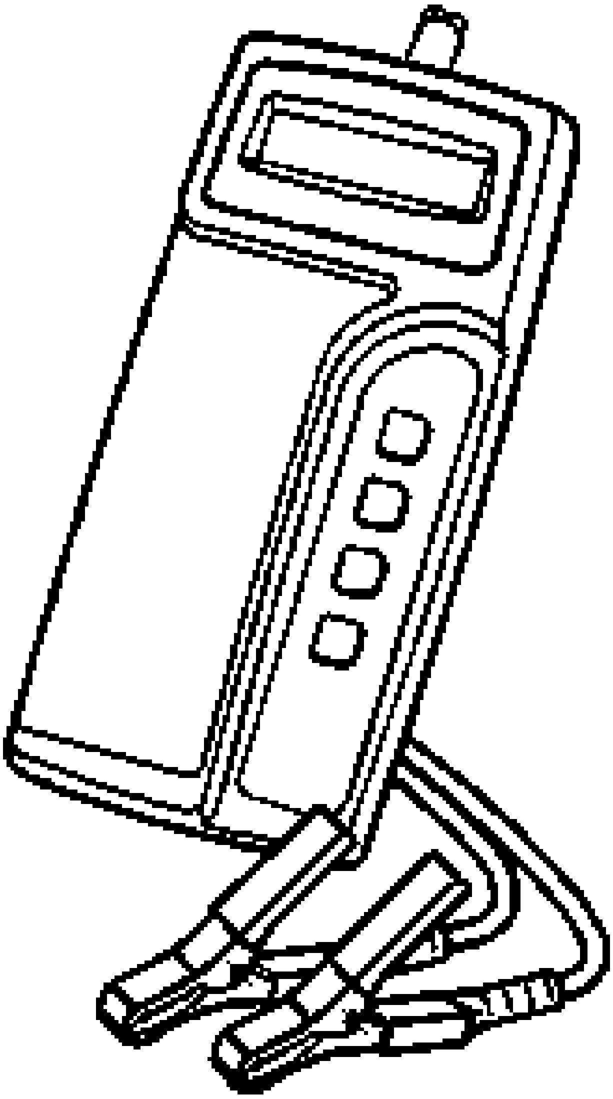
Illustration	Tool Number/Description
	

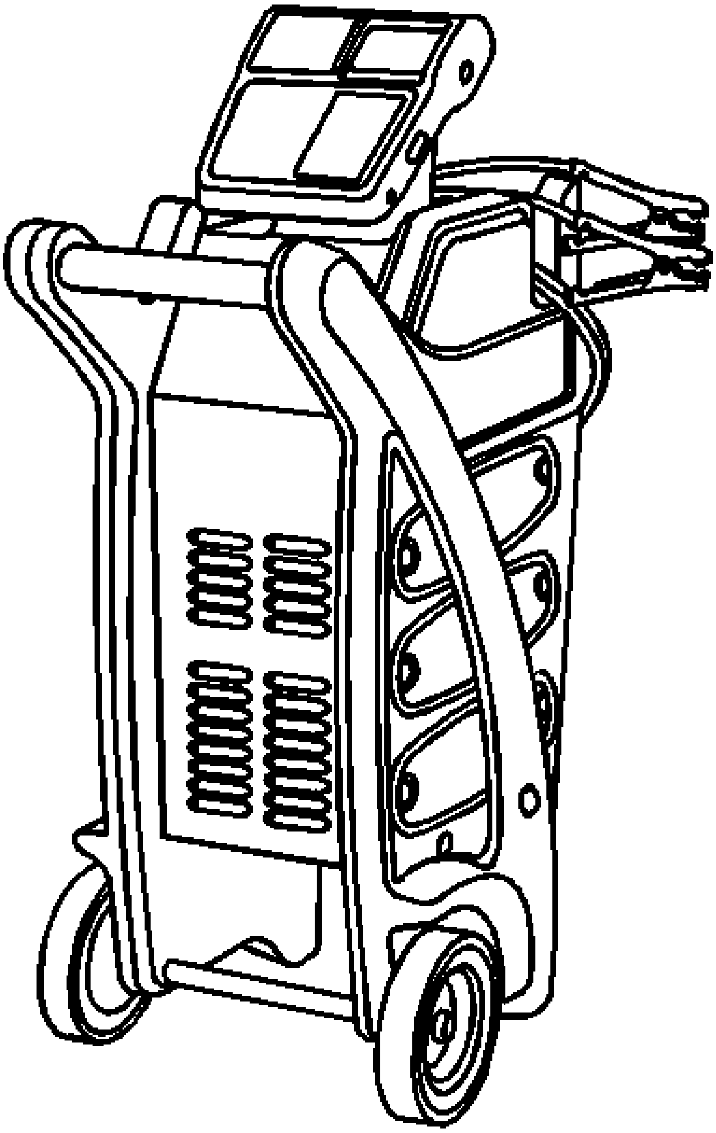
Illustration	Tool Number/Description
	EL 50313 EL 42000 EL 50076 Battery Tester

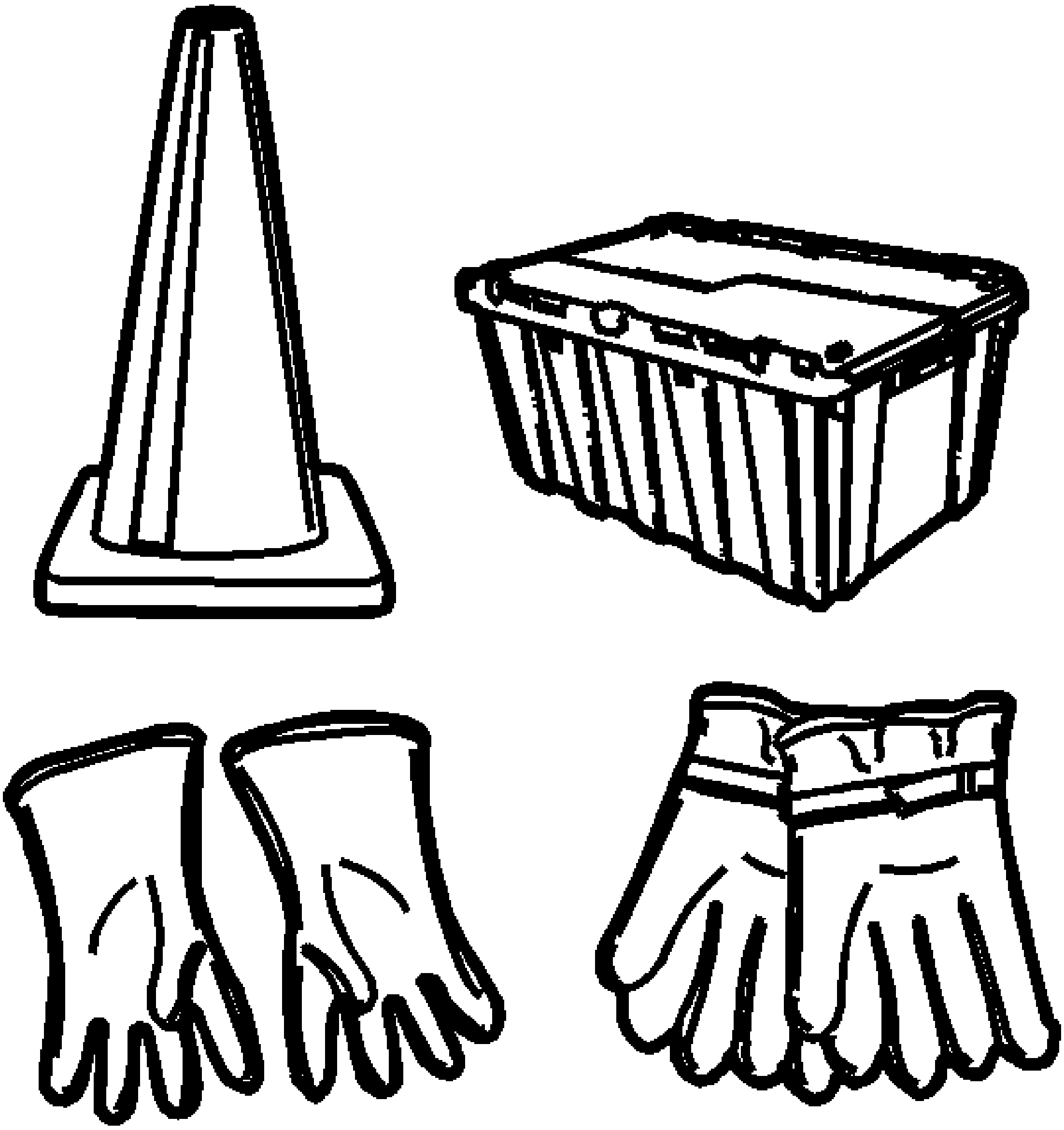
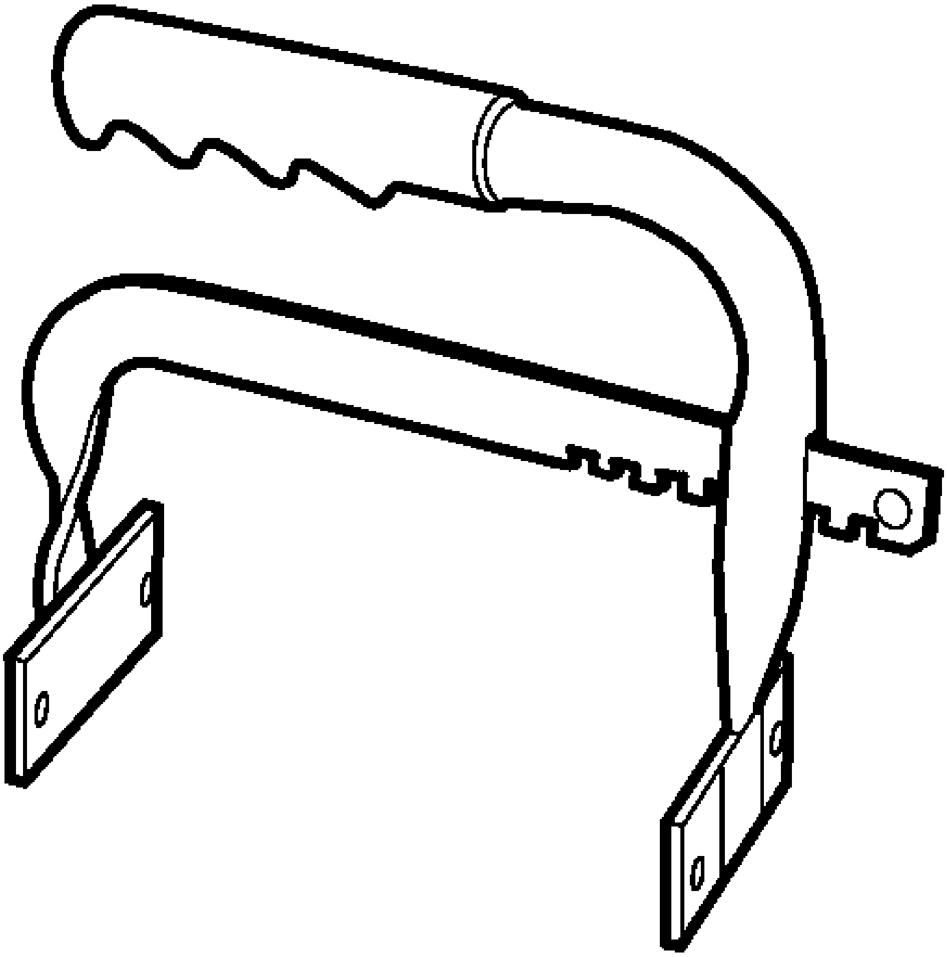
Illustration	Tool Number/Description
	EL-48900 HEV Safety Kit

Illustration	Tool Number/Description
	GE-49379 Battery Remover / Installer

Back To Article

2017 ELECTRICAL

Data Communications - Schematic Wiring Diagrams - Bolt EV

SCHEMATIC WIRING DIAGRAMS

DATA COMMUNICATION WIRING SCHEMATICS

Serial Data Gateway Module, Data Link Connector and Auxiliary Data Connector Power and Ground

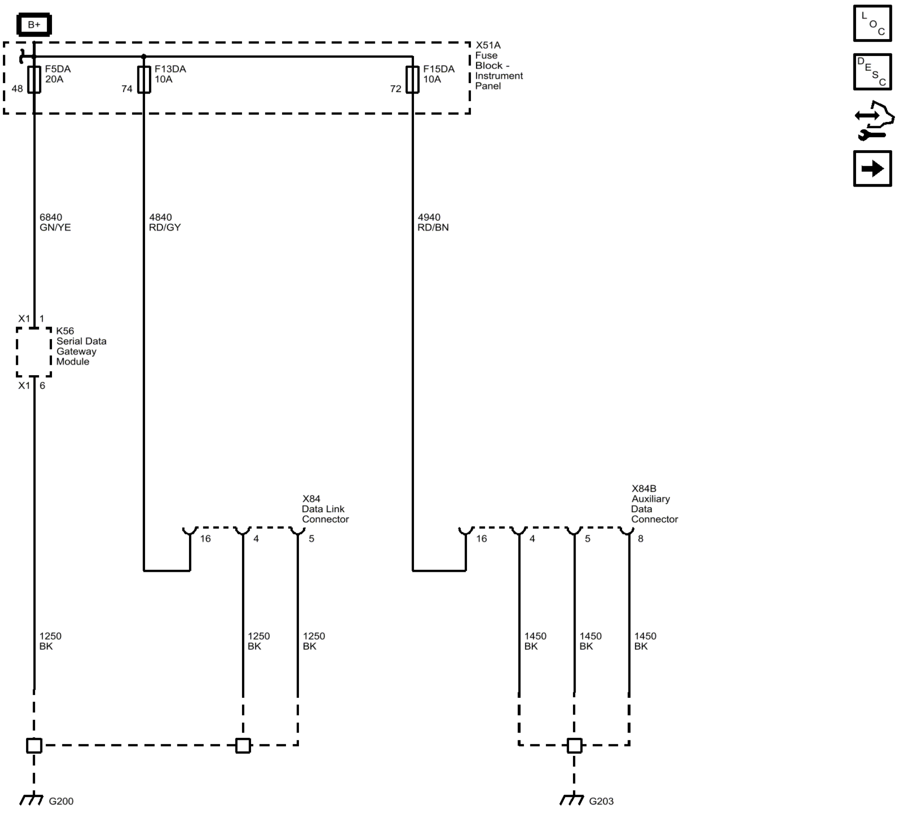

B+
X51A Fuse Block - Instrument Panel
F5DA 20A
48
F13DA 10A
74
F15DA 10A
72
6840 GN/YE
4840 RD/GY
4940 RD/BN
X1 1
K56 Serial Data Gateway Module
X1 6
X84 Data Link Connector
16
4
5
X84B Auxiliary Data Connector
16
4
5
8
1250 BK
1250 BK
1250 BK
1450 BK
1450 BK
1450 BK
G200
G203
L O C
D E S C

Fig. 1: Serial Data Gateway Module, Data Link Connector and Auxiliary Data Connector Power and Ground
Courtesy of GENERAL MOTORS COMPANY

High Speed GMLAN (1 of 2)

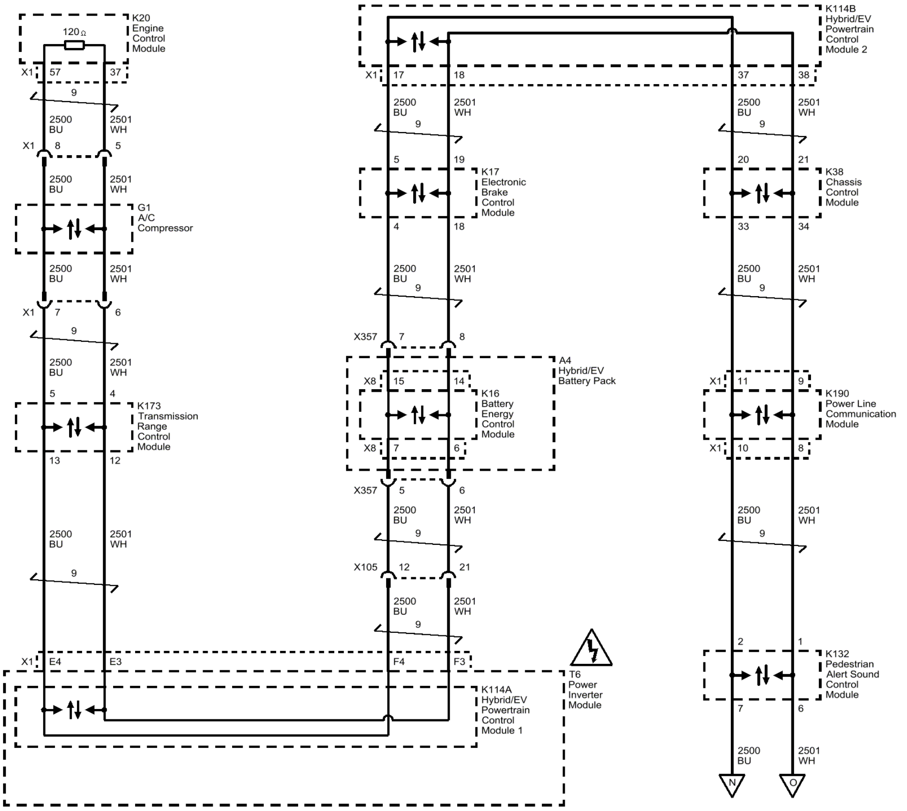

K20
Engine
Control
Module
120Ω
X1
57
37
9
2500
BU
2501
WH
X1
8
5
G1
A/C
Compressor
X1
7
6
K173
Transmission
Range
Control
Module
5
4
13
12
X1
E4
E3
F4
F3
K114A
Hybrid/EV
Powertrain
Control
Module 1
T6
Power
Inverter
Module
K114B
Hybrid/EV
Powertrain
Control
Module 2
X1
17
18
37
38
K17
Electronic
Brake
Control
Module
5
19
4
18
K38
Chassis
Control
Module
20
21
33
34
X357
7
8
A4
Hybrid/EV
Battery Pack
X8
15
14
K16
Battery
Energy
Control
Module
X8
7
6
X357
5
6
X105
12
21
X1
11
9
K190
Power Line
Communication
Module
X1
10
8
K132
Pedestrian
Alert Sound
Control
Module
2
1
7
6
N
O

Fig. 2: High Speed GMLAN (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

High Speed GMLAN (2 of 2)

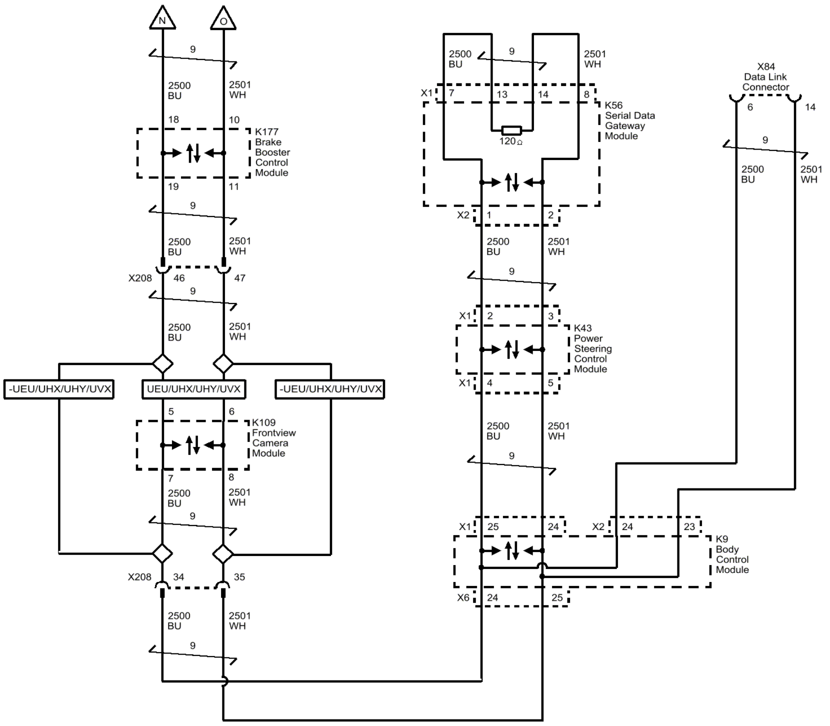

N
O
9
2500
BU
2501
WH
18
10
K177
Brake
Booster
Control
Module
19
11
X208
46
47
-UEU/UHX/UHY/UVX
UEU/UHX/UHY/UVX
-UEU/UHX/UHY/UVX
5
6
K109
Frontview
Camera
Module
7
8
X208
34
35
K56
Serial Data
Gateway
Module
X1
7
13
14
8
120Ω
X2
1
2
K43
Power
Steering
Control
Module
X1
2
3
X1
4
5
K9
Body
Control
Module
X1
25
24
X2
24
23
X6
24
25
X84
Data Link
Connector
6
14

Fig. 3: High Speed GMLAN (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Serial Data Wake-Up

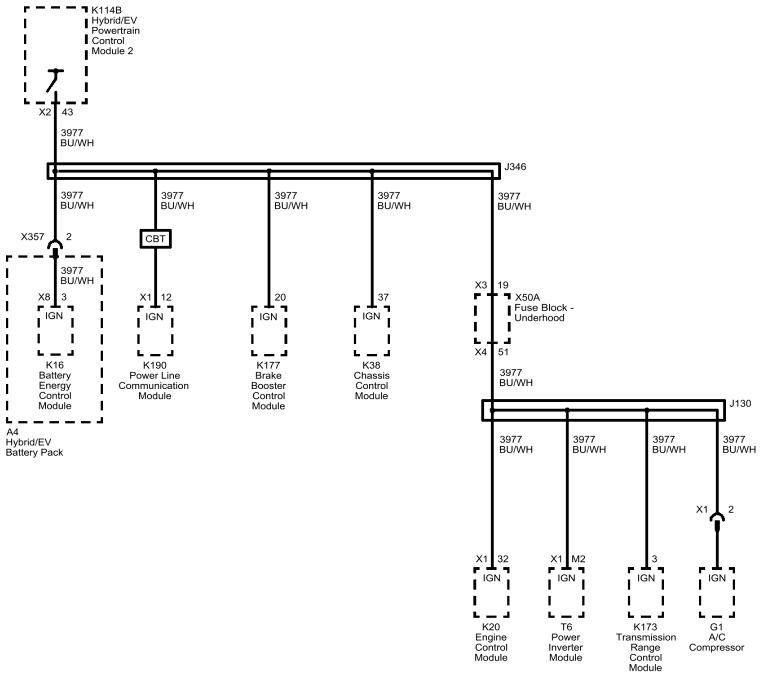

K114B
Hybrid/EV
Powertrain
Control
Module 2
X2
43
3977
BU/WH
J346
3977
BU/WH
3977
BU/WH
3977
BU/WH
3977
BU/WH
3977
BU/WH
X357
2
CBT
3977
BU/WH
X8
3
IGN
X1
12
IGN
20
IGN
37
IGN
X3
19
X50A
Fuse Block -
Underhood
X4
51
K16
Battery
Energy
Control
Module
K190
Power Line
Communication
Module
K177
Brake
Booster
Control
Module
K38
Chassis
Control
Module
A4
Hybrid/EV
Battery Pack
3977
BU/WH
J130
3977
BU/WH
3977
BU/WH
3977
BU/WH
3977
BU/WH
X1
2
X1
32
IGN
X1
M2
IGN
3
IGN
IGN
K20
Engine
Control
Module
T6
Power
Inverter
Module
K173
Transmission
Range
Control
Module
G1
A/C
Compressor

Fig. 4: Serial Data Wake-Up

Courtesy of GENERAL MOTORS COMPANY

Isolated High Speed GMLAN

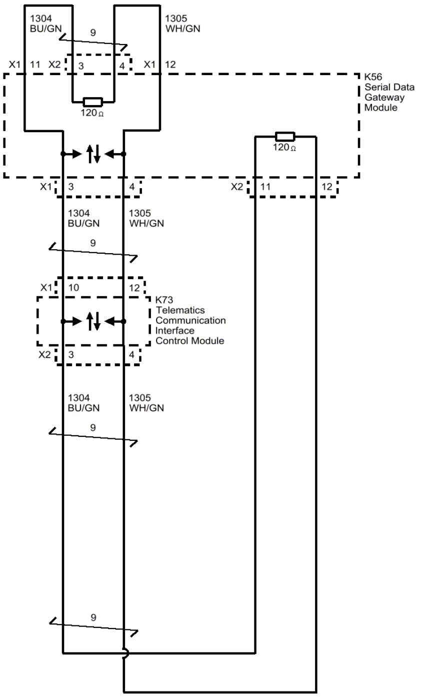
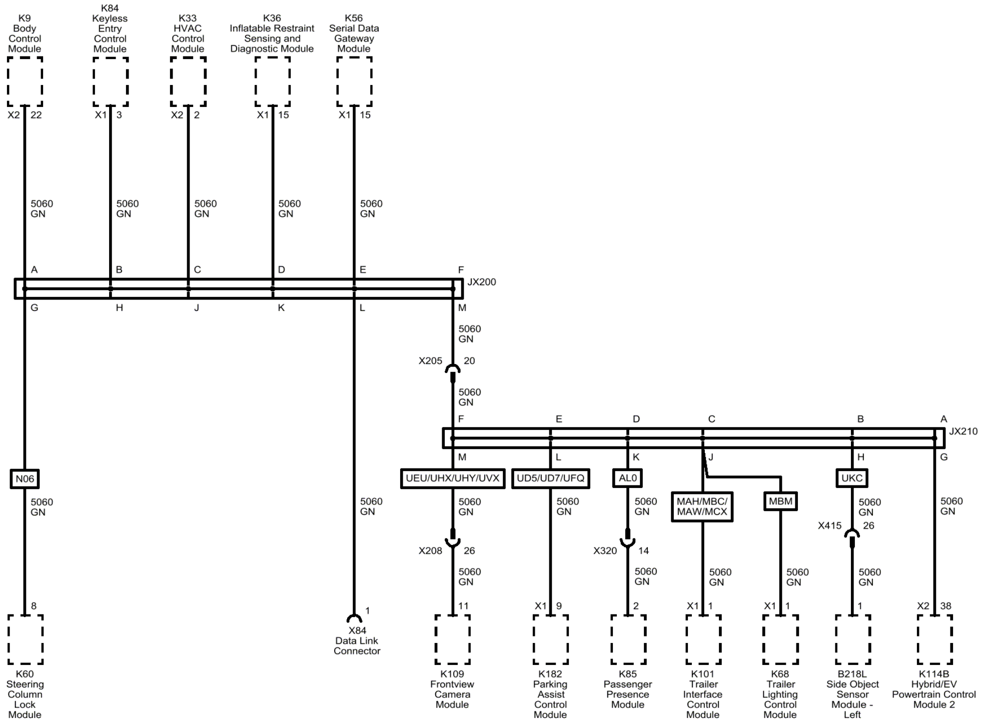

1304
BU/GN
9
1305
WH/GN
X1
11
X2
3
4
X1
12
K56
Serial Data
Gateway
Module
120 Ω
120 Ω
X1
3
4
X2
11
12
1304
BU/GN
1305
WH/GN
9
X1
10
12
K73
Telematics
Communication
Interface
Control Module
X2
3
4
1304
BU/GN
1305
WH/GN
9
9

Fig. 5: Isolated High Speed GMLAN

Courtesy of GENERAL MOTORS COMPANY

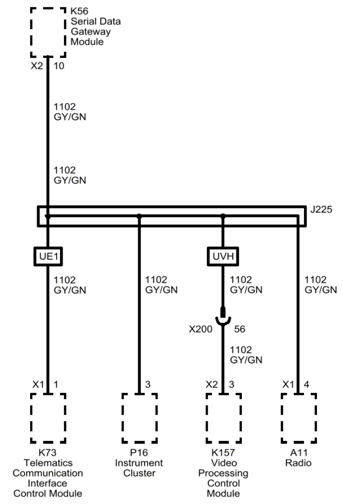
Low Speed GMLAN


K9 Body Control Module
K84 Keyless Entry Control Module
K33 HVAC Control Module
K36 Inflatable Restraint Sensing and Diagnostic Module
K56 Serial Data Gateway Module
X2 22
X1 3
X2 2
X1 15
X1 15
5060 GN
A
B
C
D
E
F
JX200
G
H
J
K
L
M
X205 20
F
E
D
C
B
A
JX210
M
L
K
J
H
G
N06
UEU/UHX/UHY/UVX
UD5/UD7/UFQ
AL0
MAH/MBC/ MAW/MCX
MBM
UKC
X208 26
X320 14
X415 26
8
1
11
X1 9
2
X1 1
X1 1
1
X2 38
K60 Steering Column Lock Module
X84 Data Link Connector
K109 Frontview Camera Module
K182 Parking Assist Control Module
K85 Passenger Presence Module
K101 Trailer Interface Control Module
K68 Trailer Lighting Control Module
B218L Side Object Sensor Module - Left
K114B Hybrid/EV Powertrain Control Module 2

[Fig. 6: Low Speed GMLAN](#)

Courtesy of GENERAL MOTORS COMPANY

Isolated Low Speed GMLAN


K56 Serial Data Gateway Module
X2 10
1102 GY/GN
J225
UE1
UVH
X200 56
X1 1
3
X2 3
X1 4
K73 Telematics Communication Interface Control Module
P16 Instrument Cluster
K157 Video Processing Control Module
A11 Radio

[Fig. 7: Isolated Low Speed GMLAN](#)

Courtesy of GENERAL MOTORS COMPANY

High Voltage Management Bus

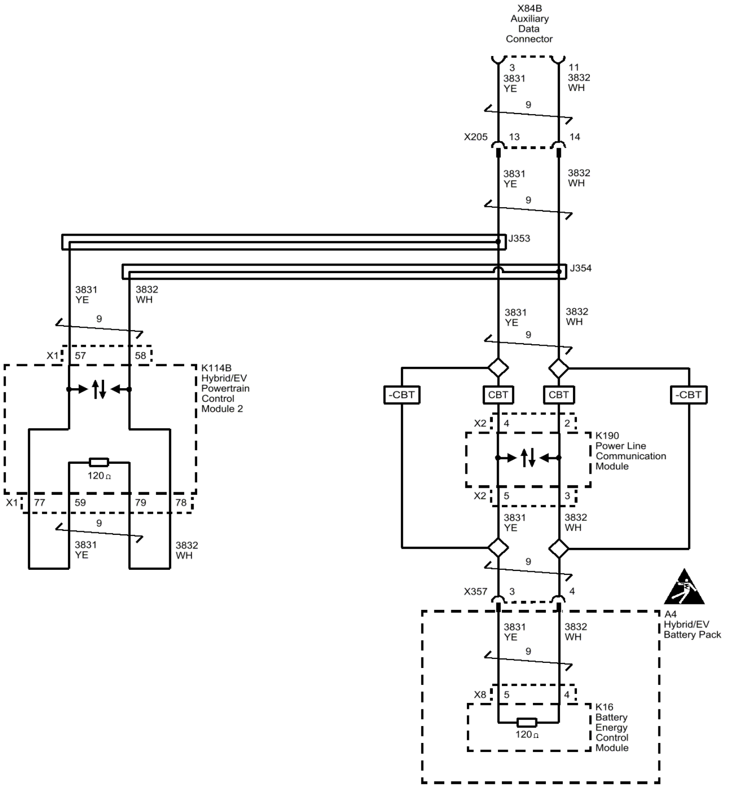

X84B Auxiliary Data Connector
3
3831 YE
11
3832 WH
9
X205
13
14
3831 YE
3832 WH
9
J353
J354
3831 YE
3832 WH
9
X1
57
58
K114B Hybrid/EV Powertrain Control Module 2
120 Ω
X1
77
59
79
78
9
3831 YE
3832 WH
3831 YE
3832 WH
9
-CBT
CBT
CBT
-CBT
X2
4
2
K190 Power Line Communication Module
X2
5
3
3831 YE
3832 WH
9
X357
3
4
A4 Hybrid/EV Battery Pack
3831 YE
3832 WH
9
X8
5
4
120 Ω
K16 Battery Energy Control Module

Fig. 8: High Voltage Management Bus
Courtesy of GENERAL MOTORS COMPANY

Powertrain Expansion Bus

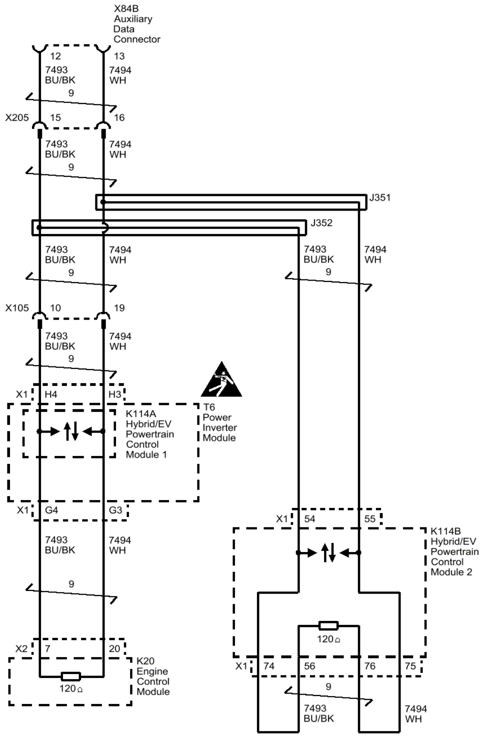
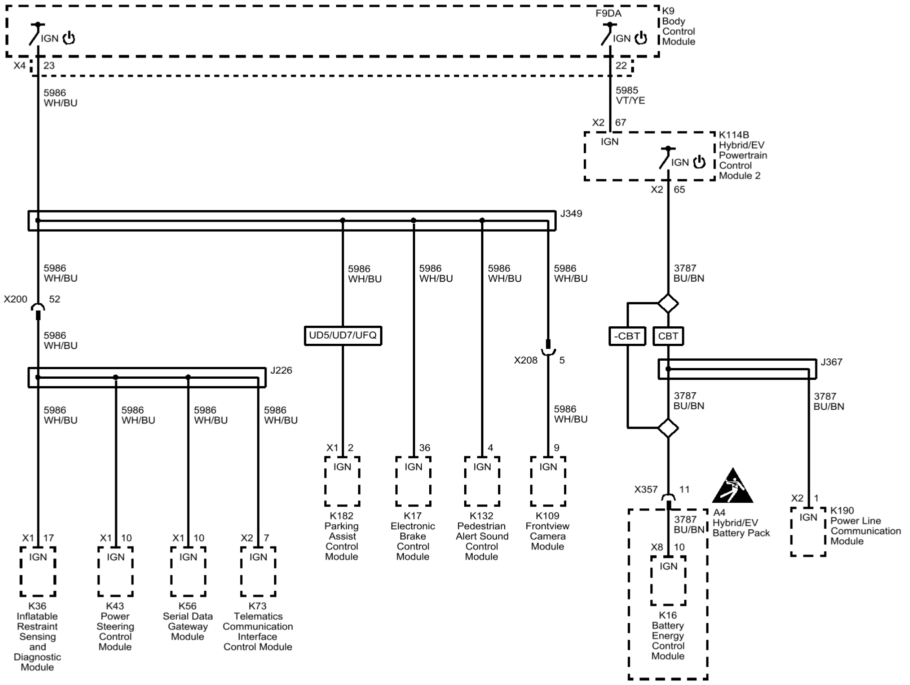

X84B Auxiliary Data Connector
12
13
7493 BU/BK
7494 WH
9
X205
15
16
7493 BU/BK
7494 WH
9
J351
J352
7493 BU/BK
7494 WH
9
7493 BU/BK
7494 WH
9
X105
10
19
7493 BU/BK
7494 WH
9
X1
H4
H3
K114A Hybrid/EV Powertrain Control Module 1
T6 Power Inverter Module
X1
G4
G3
7493 BU/BK
7494 WH
9
X2
7
20
120 Ω
K20 Engine Control Module
X1
54
55
K114B Hybrid/EV Powertrain Control Module 2
120 Ω
X1
74
56
76
75
9
7493 BU/BK
7494 WH

Fig. 9: Powertrain Expansion Bus
Courtesy of GENERAL MOTORS COMPANY

GMLAN Communication Enable

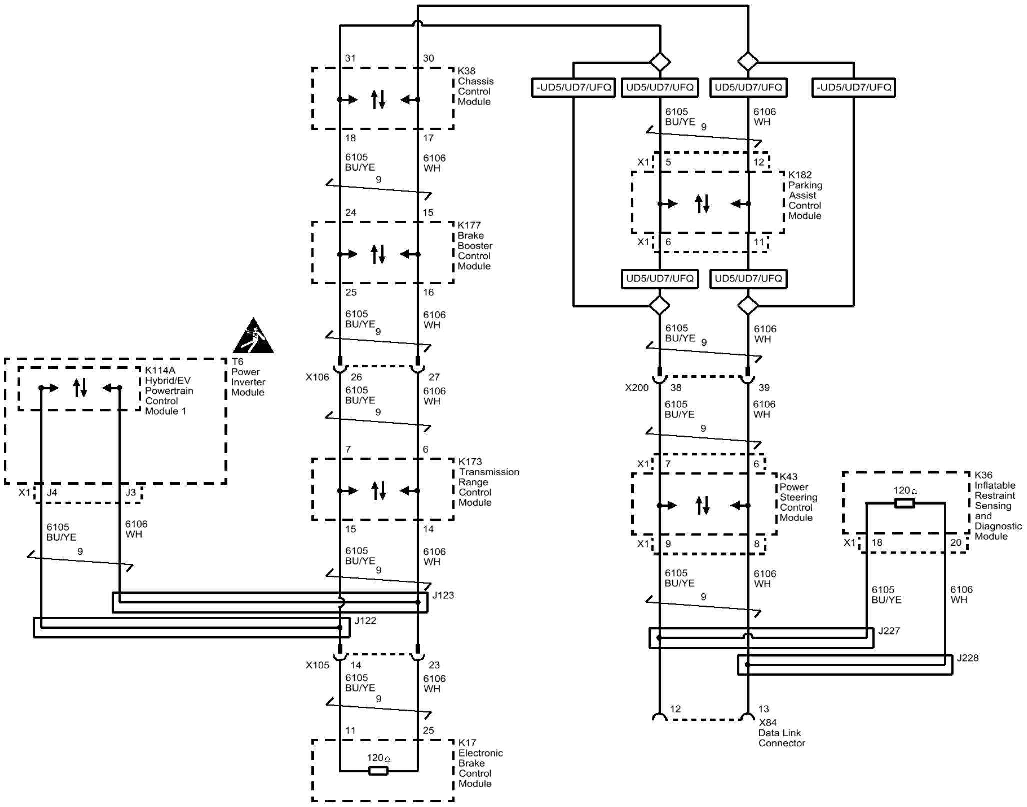


IGN
F9DA
IGN
K9 Body Control Module
X4 23
22
5986 WH/BU
5985 VT/YE
X2 67
IGN
IGN
K114B Hybrid/EV Powertrain Control Module 2
X2 65
J349
5986 WH/BU
5986 WH/BU
5986 WH/BU
5986 WH/BU
5986 WH/BU
3787 BU/BN
X200 52
UD5/UD7/UFQ
-CBT
CBT
5986 WH/BU
X208 5
J367
J226
3787 BU/BN
3787 BU/BN
5986 WH/BU
5986 WH/BU
5986 WH/BU
5986 WH/BU
5986 WH/BU
X1 2
36
4
9
IGN
IGN
IGN
IGN
X357 11
X2 1
IGN
K182 Parking Assist Control Module
K17 Electronic Brake Control Module
K132 Pedestrian Alert Sound Control Module
K109 Frontview Camera Module
3787 BU/BN
A4 Hybrid/EV Battery Pack
K190 Power Line Communication Module
X1 17
X1 10
X1 10
X2 7
X8 10
IGN
IGN
IGN
IGN
IGN
K36 Inflatable Restraint Sensing and Diagnostic Module
K43 Power Steering Control Module
K56 Serial Data Gateway Module
K73 Telematics Communication Interface Control Module
K16 Battery Energy Control Module

Fig. 10: GMLAN Communication Enable

Courtesy of GENERAL MOTORS COMPANY

Chassis High Speed GMLAN



31
30
K38 Chassis Control Module
-UD5/UD7/UFQ
UD5/UD7/UFQ
UD5/UD7/UFQ
-UD5/UD7/UFQ
6105 BU/YE 9
6106 WH
18
17
6105 BU/YE
6106 WH
9
X1 5
12
K182 Parking Assist Control Module
24
15
K177 Brake Booster Control Module
X1 6
11
25
16
UD5/UD7/UFQ
UD5/UD7/UFQ
6105 BU/YE 9
6106 WH
6105 BU/YE 9
6106 WH
T6 Power Inverter Module
K114A Hybrid/EV Powertrain Control Module 1
X106
26
27
6105 BU/YE
6106 WH
9
X200
38
39
6105 BU/YE
6106 WH
9
7
6
K173 Transmission Range Control Module
X1 7
6
K43 Power Steering Control Module
X1 J4
J3
120Ω
K36 Inflatable Restraint Sensing and Diagnostic Module
6105 BU/YE
6106 WH
9
15
14
X1 9
8
X1 18
20
6105 BU/YE
6106 WH
9
6105 BU/YE
6106 WH
9
6105 BU/YE
6106 WH
J123
J122
J227
J228
X105
14
23
6105 BU/YE
6106 WH
9
12
13
X84 Data Link Connector
11
25
120Ω
K17 Electronic Brake Control Module

Fig. 11: Chassis High Speed GMLAN

Courtesy of GENERAL MOTORS COMPANY

Linear Interconnect Network (LIN) Communication Busses

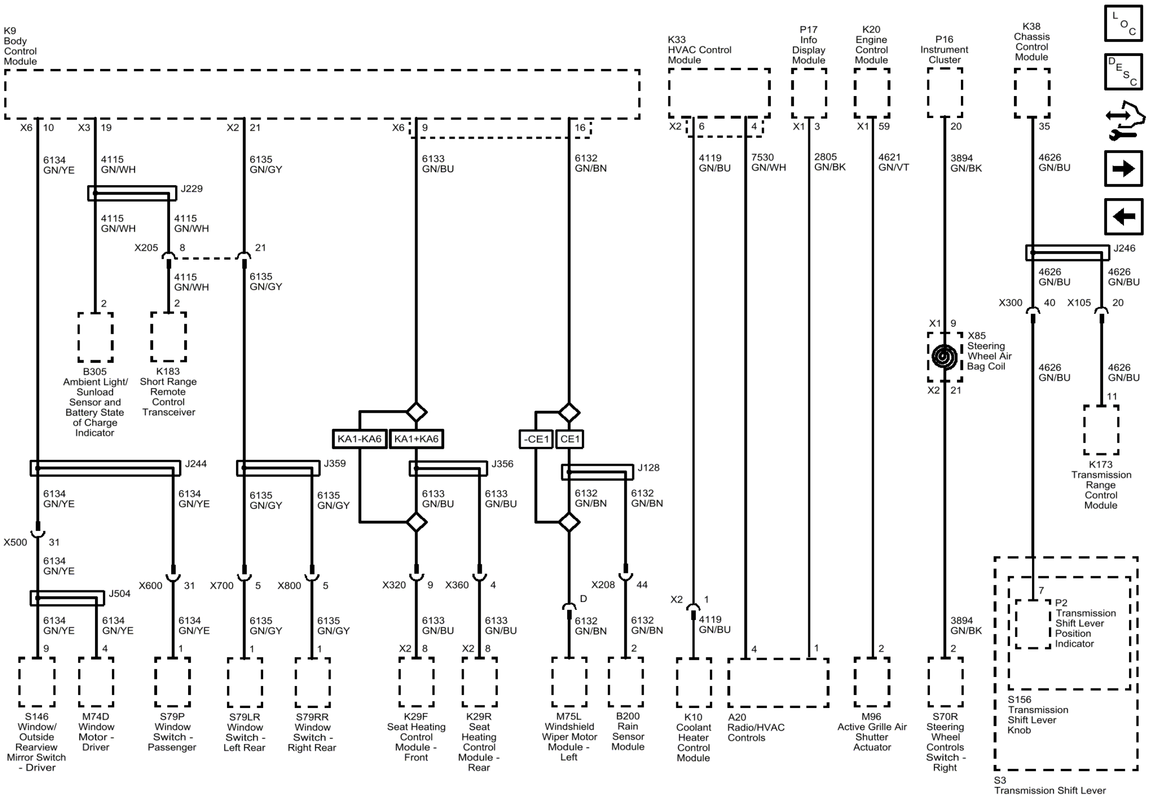

K9 Body Control Module
X6 10
6134 GN/YE
X3 19
4115 GN/WH
J229
4115 GN/WH
4115 GN/WH
X205 8
4115 GN/WH
2
2
B305 Ambient Light/ Sunload Sensor and Battery State of Charge Indicator
K183 Short Range Remote Control Transceiver
X2 21
6135 GN/GY
21
6135 GN/GY
X6 9
6133 GN/BU
16
6132 GN/BN
KA1-KA6
KA1+KA6
-CE1
CE1
J244
6134 GN/YE
6134 GN/YE
X500 31
6134 GN/YE
J504
6134 GN/YE
6134 GN/YE
X600 31
6134 GN/YE
J359
6135 GN/GY
6135 GN/GY
X700 5
X800 5
6135 GN/GY
6135 GN/GY
J356
6133 GN/BU
6133 GN/BU
X320 9
X360 4
6133 GN/BU
6133 GN/BU
J128
6132 GN/BN
6132 GN/BN
X208 44
D
6132 GN/BN
6132 GN/BN
9
4
1
1
1
X2 8
X2 8
2
S146 Window/ Outside Rearview Mirror Switch - Driver
M74D Window Motor - Driver
S79P Window Switch - Passenger
S79LR Window Switch - Left Rear
S79RR Window Switch - Right Rear
K29F Seat Heating Control Module - Front
K29R Seat Heating Control Module - Rear
M75L Windshield Wiper Motor Module - Left
B200 Rain Sensor Module
K33 HVAC Control Module
X2 6
4
4119 GN/BU
7530 GN/WH
X2 1
4119 GN/BU
K10 Coolant Heater Control Module
4
1
A20 Radio/HVAC Controls
P17 Info Display Module
X1 3
2805 GN/BK
K20 Engine Control Module
X1 59
4621 GN/VT
2
M96 Active Grille Air Shutter Actuator
P16 Instrument Cluster
20
3894 GN/BK
X1 9
X85 Steering Wheel Air Bag Coil
X2 21
3894 GN/BK
2
S70R Steering Wheel Controls Switch - Right
K38 Chassis Control Module
35
4626 GN/BU
J246
4626 GN/BU
4626 GN/BU
X300 40
X105 20
4626 GN/BU
4626 GN/BU
11
K173 Transmission Range Control Module
7
P2 Transmission Shift Lever Position Indicator
S156 Transmission Shift Lever Knob
S3 Transmission Shift Lever

Fig. 12: Linear Interconnect Network (LIN) Communication Busses
Courtesy of GENERAL MOTORS COMPANY

Ethernet Bus

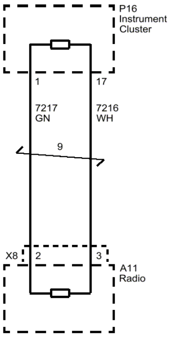

P16 Instrument Cluster
1
17
7217 GN
7216 WH
9
X8 2
3
A11 Radio

Fig. 13: Ethernet Bus
Courtesy of GENERAL MOTORS COMPANY

BODY CONTROL SYSTEM WIRING SCHEMATICS

Power, Ground and Data Communications

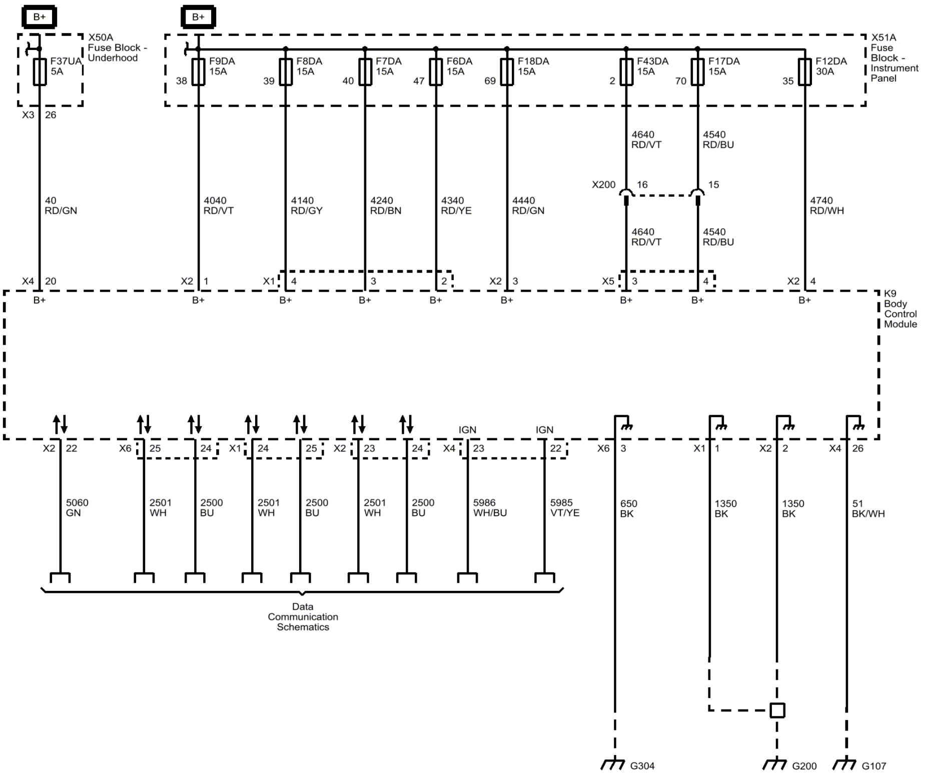

B+
B+
X50A Fuse Block - Underhood
F37UA 5A
X3 26
X51A Fuse Block - Instrument Panel
F9DA 15A
38
F8DA 15A
39
F7DA 15A
40
F6DA 15A
47
F18DA 15A
69
F43DA 15A
2
F17DA 15A
70
F12DA 30A
35
40 RD/GN
4040 RD/VT
4140 RD/GY
4240 RD/BN
4340 RD/YE
4440 RD/GN
4640 RD/VT
4540 RD/BU
X200 16
15
4640 RD/VT
4540 RD/BU
4740 RD/WH
X4 20
X2 1
X1 4
3
2
X2 3
X5 3
4
X2 4
B+
K9 Body Control Module
IGN
IGN
X2 22
X6 25
24
X1 24
25
X2 23
24
X4 23
22
X6 3
X1 1
X2 2
X4 26
5060 GN
2501 WH
2500 BU
2501 WH
2500 BU
2501 WH
2500 BU
5986 WH/BU
5985 VT/YE
650 BK
1350 BK
1350 BK
51 BK/WH
Data Communication Schematics
G304
G200
G107

Fig. 14: Power, Ground and Data Communications

Courtesy of GENERAL MOTORS COMPANY

Subsystem References (1 of 3)

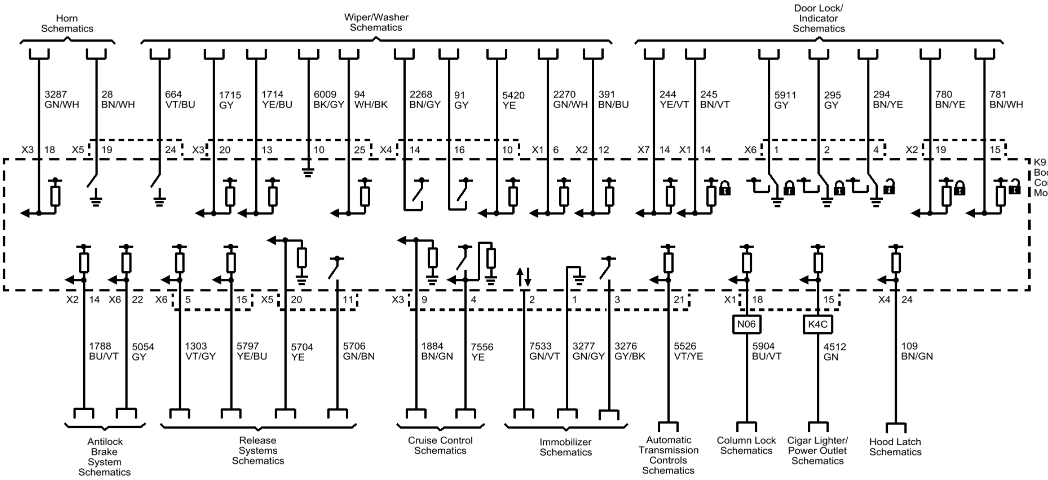
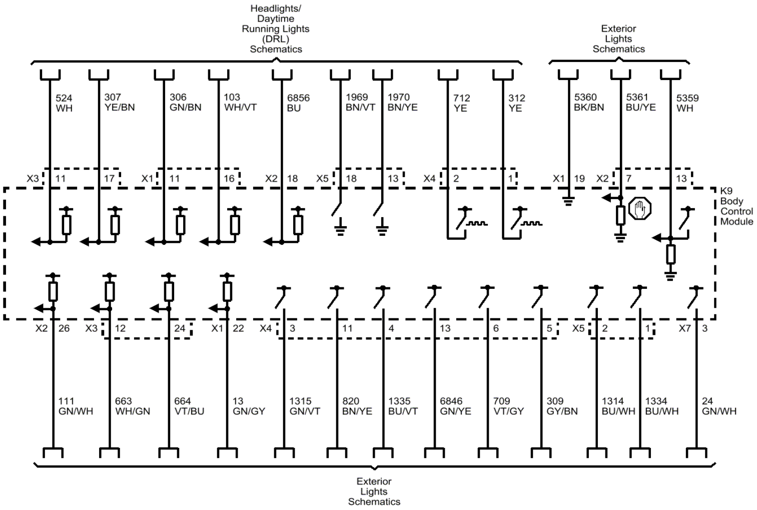

Horn Schematics
Wiper/Washer Schematics
Door Lock/ Indicator Schematics
3287 GN/WH
28 BN/WH
664 VT/BU
1715 GY
1714 YE/BU
6009 BK/GY
94 WH/BK
2268 BN/GY
91 GY
5420 YE
2270 GN/WH
391 BN/BU
244 YE/VT
245 BN/VT
5911 GY
295 GY
294 BN/YE
780 BN/YE
781 BN/WH
X3 18
X5 19
24
X3 20
13
10
25
X4 14
16
10
X1 6
X2 12
X7 14
X1 14
X6 1
2
4
X2 19
15
K9 Body Control Module
X2 14
X6 22
X6 5
15
X5 20
11
X3 9
4
2
1
3
21
X1 18
15
X4 24
N06
K4C
1788 BU/VT
5054 GY
1303 VT/GY
5797 YE/BU
5704 YE
5706 GN/BN
1884 BN/GN
7556 YE
7533 GN/VT
3277 GN/GY
3276 GY/BK
5526 VT/YE
5904 BU/VT
4512 GN
109 BN/GN
Antilock Brake System Schematics
Release Systems Schematics
Cruise Control Schematics
Immobilizer Schematics
Automatic Transmission Controls Schematics
Column Lock Schematics
Cigar Lighter/ Power Outlet Schematics
Hood Latch Schematics

Fig. 15: Subsystem References (1 of 3)

Courtesy of GENERAL MOTORS COMPANY

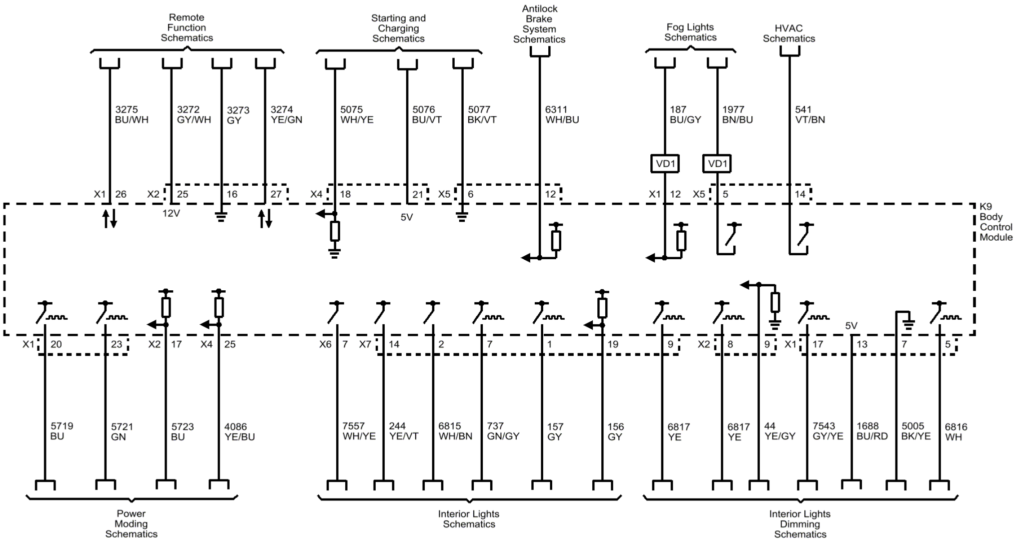
Subsystem References (2 of 3)


Headlights/ Daytime Running Lights (DRL) Schematics
Exterior Lights Schematics
524 WH
307 YE/BN
306 GN/BN
103 WH/VT
6856 BU
1969 BN/VT
1970 BN/YE
712 YE
312 YE
5360 BK/BN
5361 BU/YE
5359 WH
X3 11
17
X1 11
16
X2 18
X5 18
13
X4 2
1
X1 19
X2 7
13
K9 Body Control Module
X2 26
X3 12
24
X1 22
X4 3
11
4
13
6
5
X5 2
1
X7 3
111 GN/WH
663 WH/GN
664 VT/BU
13 GN/GY
1315 GN/VT
820 BN/YE
1335 BU/VT
6846 GN/YE
709 VT/GY
309 GY/BN
1314 BU/WH
1334 BU/WH
24 GN/WH
Exterior Lights Schematics

[Fig. 16: Subsystem References (2 of 3)]

Courtesy of GENERAL MOTORS COMPANY

Subsystem References (3 of 3)


Remote Function Schematics
Starting and Charging Schematics
Antilock Brake System Schematics
Fog Lights Schematics
HVAC Schematics
3275 BU/WH
3272 GY/WH
3273 GY
3274 YE/GN
5075 WH/YE
5076 BU/VT
5077 BK/VT
6311 WH/BU
187 BU/GY
1977 BN/BU
541 VT/BN
VD1
VD1
X1 26
X2 25
16
27
X4 18
21
X5 6
12
X1 12
X5 5
14
12V
5V
K9 Body Control Module
5V
X1 20
23
X2 17
X4 25
X6 7
X7 14
2
7
1
19
9
X2 8
9
X1 17
13
7
5
5719 BU
5721 GN
5723 BU
4086 YE/BU
7557 WH/YE
244 YE/VT
6815 WH/BN
737 GN/GY
157 GY
156 GY
6817 YE
6817 YE
44 YE/GY
7543 GY/YE
1688 BU/RD
5005 BK/YE
6816 WH
Power Moding Schematics
Interior Lights Schematics
Interior Lights Dimming Schematics

[Fig. 17: Subsystem References (3 of 3)]

Courtesy of GENERAL MOTORS COMPANY

Back To Article

2017 ELECTRICAL

Hybrid/EV Controls - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Seal

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Accelerator Pedal Pad Bolt	7 N.m (62 lb in)
Accessory DC Power Control Module Bolt	22 N.m (16 lb ft)
Accessory DC Power Control Module High Voltage Connector Protector Bolt	9 N.m (80 lb in)
Accessory DC Power Control Module High Voltage Connector Protector Bolt	22 N.m (16 lb ft)
Accessory DC Power Control Module High Voltage Connector Protector Nut	9 N.m (80 lb in)
Accessory DC Power Control Module Stud	22 N.m (16 lb ft)
Battery Negative Cable Extension Cable Nut	15 N.m (11 lb ft)
Battery Positive Cable and Nut	15 N.m (11 lb ft)
Drive Motor Power Inverter Module 3-Phase Cable Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Nut	9 N.m (80 lb in)
Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module Bolt	22 N.m (16 lb ft)
Drive Motor Power Inverter Module Nut	22 N.m (16 lb ft)
Drive Motor Power Inverter Module Shield Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module Shield Bolt	25 N.m (18 lb ft)
Engine Control Module Bracket Nut	4.7 N.m (42 lb in)
Engine Wiring Harness Bracket Bolt to Accessory DC Power Control Module	22 N.m (16 lb ft)
Generator Battery Control Wiring Junction Block Bolt	22 N.m (16 lb ft)
Generator Battery Control Wiring Junction Block Cover Lower Bolt	2.5 N.m (22 lb in)
Generator Battery Control Wiring Junction Block Cover Upper Bolt	2.5 N.m (22 lb in)
15A Fuse Nut	4.5 N.m (40 lb in)
40A Fuse Nut	4.5 N.m (40 lb in)

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV CONTROLS WIRING SCHEMATICS

ECM Power, Ground, Serial Data and MIL

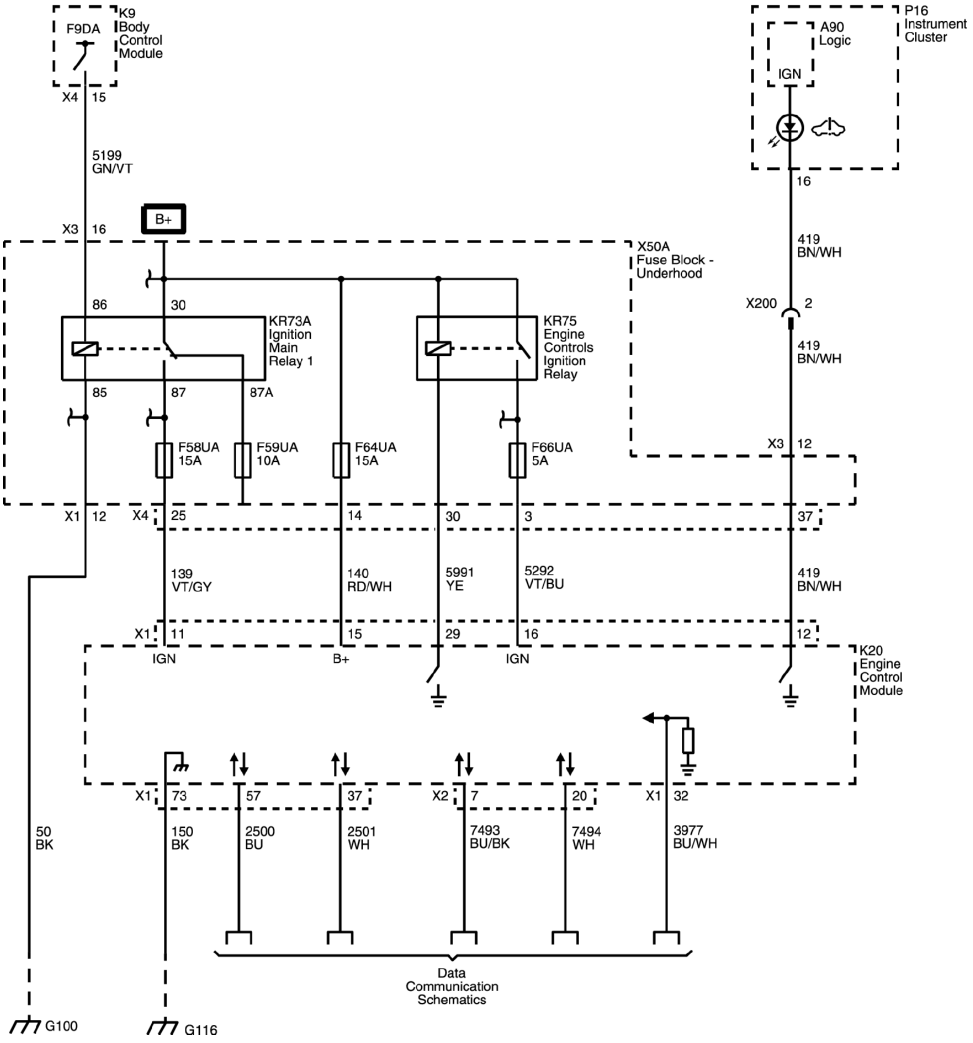

F9DA
K9
Body
Control
Module
X4
15
5199
GN/VT
X3
16
B+
X50A
Fuse Block -
Underhood
86
30
KR73A
Ignition
Main
Relay 1
85
87
87A
KR75
Engine
Controls
Ignition
Relay
F58UA
15A
F59UA
10A
F64UA
15A
F66UA
5A
X1
12
X4
25
14
30
3
37
139
VT/GY
140
RD/WH
5991
YE
5292
VT/BU
419
BN/WH
X1
11
15
29
16
12
IGN
B+
IGN
K20
Engine
Control
Module
P16
Instrument
Cluster
A90
Logic
IGN
16
419
BN/WH
X200
2
419
BN/WH
X3
12
X1
73
57
37
X2
7
20
X1
32
50
BK
150
BK
2500
BU
2501
WH
7493
BU/BK
7494
WH
3977
BU/WH
Data
Communication
Schematics
G100
G116

Fig. 1: ECM Power, Ground, Serial Data and MIL

Courtesy of GENERAL MOTORS COMPANY

ECM 5-Volt and Low Reference Busses

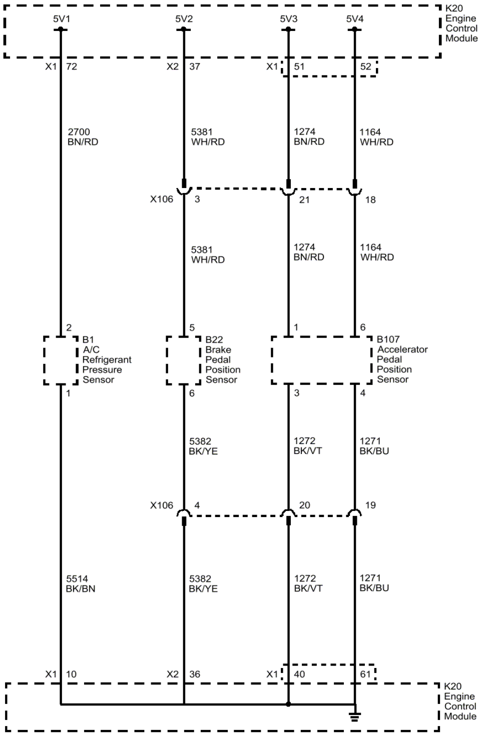

K20
Engine
Control
Module
5V1
5V2
5V3
5V4
X1
72
X2
37
X1
51
52
2700
BN/RD
5381
WH/RD
1274
BN/RD
1164
WH/RD
X106
3
21
18
5381
WH/RD
1274
BN/RD
1164
WH/RD
2
B1
A/C
Refrigerant
Pressure
Sensor
5
B22
Brake
Pedal
Position
Sensor
1
6
B107
Accelerator
Pedal
Position
Sensor
1
6
3
4
5382
BK/YE
1272
BK/VT
1271
BK/BU
X106
4
20
19
5514
BK/BN
5382
BK/YE
1272
BK/VT
1271
BK/BU
X1
10
X2
36
X1
40
61
K20
Engine
Control
Module

Fig. 2: ECM 5-Volt and Low Reference Busses
Courtesy of GENERAL MOTORS COMPANY

ECM Data Sensors - Throttle Controls and Override

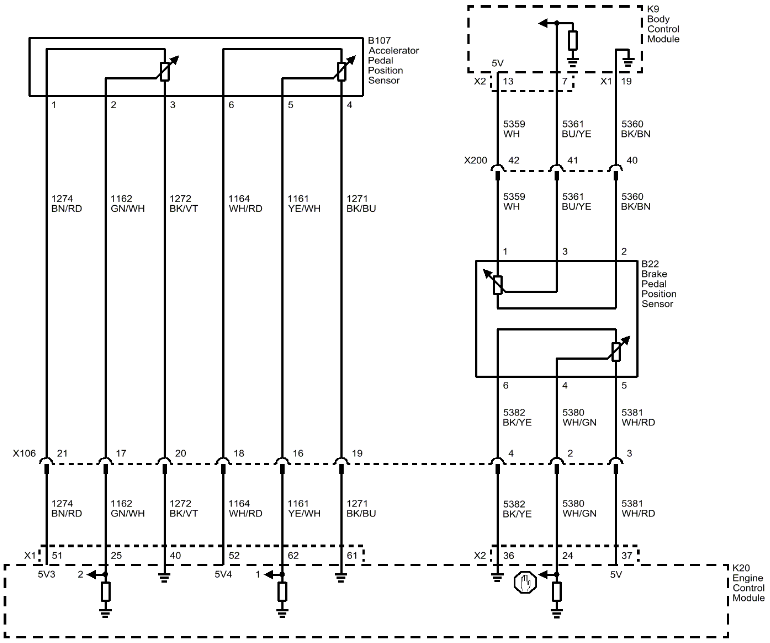

B107
Accelerator
Pedal
Position
Sensor
1
2
3
6
5
4
1274
BN/RD
1162
GN/WH
1272
BK/VT
1164
WH/RD
1161
YE/WH
1271
BK/BU
K9
Body
Control
Module
5V
X2
13
7
X1
19
5359
WH
5361
BU/YE
5360
BK/BN
X200
42
41
40
5359
WH
5361
BU/YE
5360
BK/BN
1
3
2
B22
Brake
Pedal
Position
Sensor
6
4
5
5382
BK/YE
5380
WH/GN
5381
WH/RD
X106
21
17
20
18
16
19
4
2
3
1274
BN/RD
1162
GN/WH
1272
BK/VT
1164
WH/RD
1161
YE/WH
1271
BK/BU
5382
BK/YE
5380
WH/GN
5381
WH/RD
X1
51
25
40
52
62
61
X2
36
24
37
5V3
2
5V4
1
5V
K20
Engine
Control
Module

Fig. 3: ECM Data Sensors - Throttle Controls and Override
Courtesy of GENERAL MOTORS COMPANY

ECM Controlled/Monitored Subsystem References

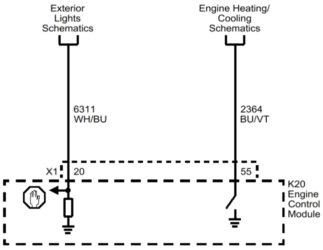
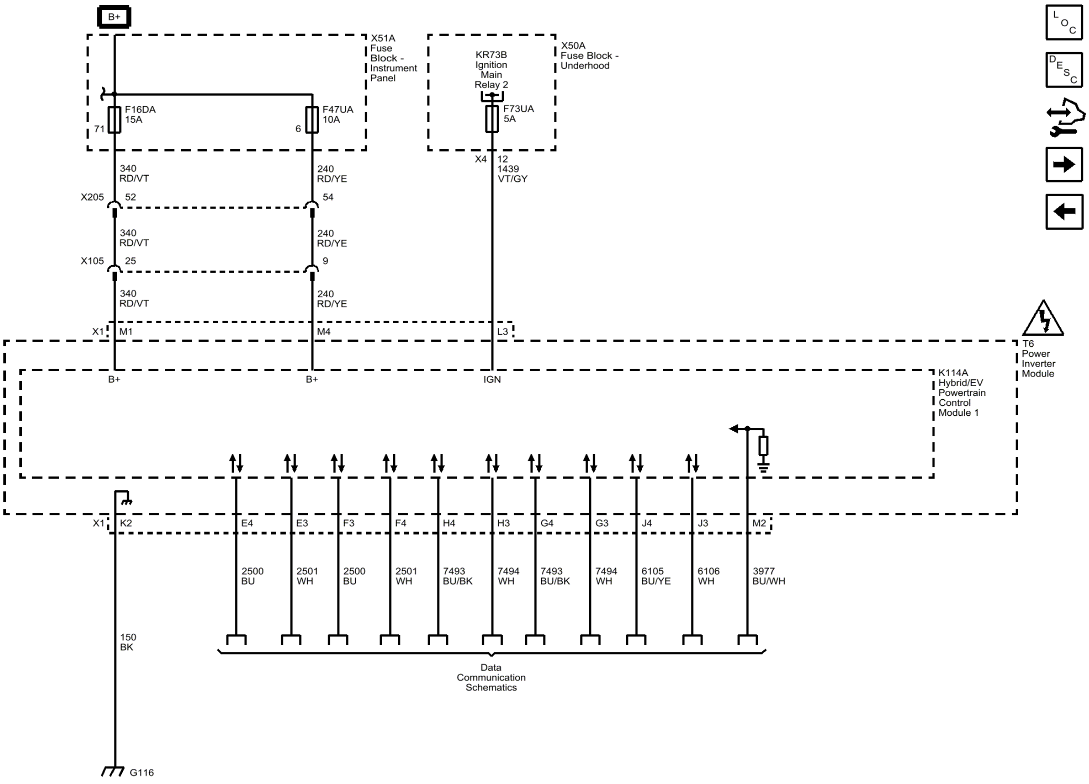

Exterior
Lights
Schematics
Engine Heating/
Cooling
Schematics
6311
WH/BU
2364
BU/VT
X1
20
55
K20
Engine
Control
Module

Fig. 4: ECM Controlled/Monitored Subsystem References
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Powertrain Control Module 1/Power Inverter Module Power, Ground, and Data Communication

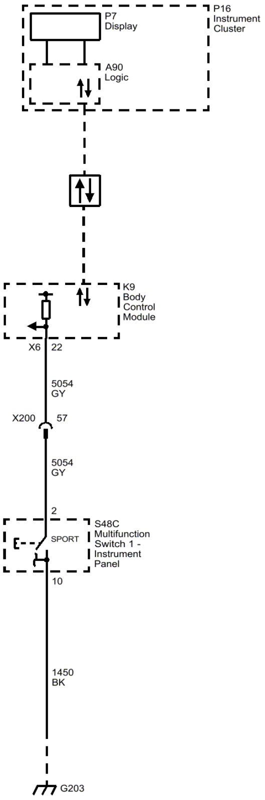


B+
X51A Fuse Block - Instrument Panel
F16DA 15A
71
F47UA 10A
6
X50A Fuse Block - Underhood
KR73B Ignition Main Relay 2
F73UA 5A
X4
12
1439 VT/GY
340 RD/VT
240 RD/YE
X205
52
54
X105
25
9
X1
M1
M4
L3
T6 Power Inverter Module
K114A Hybrid/EV Powertrain Control Module 1
B+
B+
IGN
K2
E4
E3
F3
F4
H4
H3
G4
G3
J4
J3
M2
2500 BU
2501 WH
2500 BU
2501 WH
7493 BU/BK
7494 WH
7493 BU/BK
7494 WH
6105 BU/YE
6106 WH
3977 BU/WH
150 BK
Data Communication Schematics
G116

Fig. 5: Hybrid/EV Powertrain Control Module 1/Power Inverter Module Power, Ground, and Data Communication

Courtesy of GENERAL MOTORS COMPANY

Drive Mode Select Switch



P7 Display
P16 Instrument Cluster
A90 Logic
K9 Body Control Module
X6
22
5054 GY
X200
57
5054 GY
2
SPORT
S48C Multifunction Switch 1 - Instrument Panel
10
1450 BK
G203

Fig. 6: Drive Mode Select Switch

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Monitoring

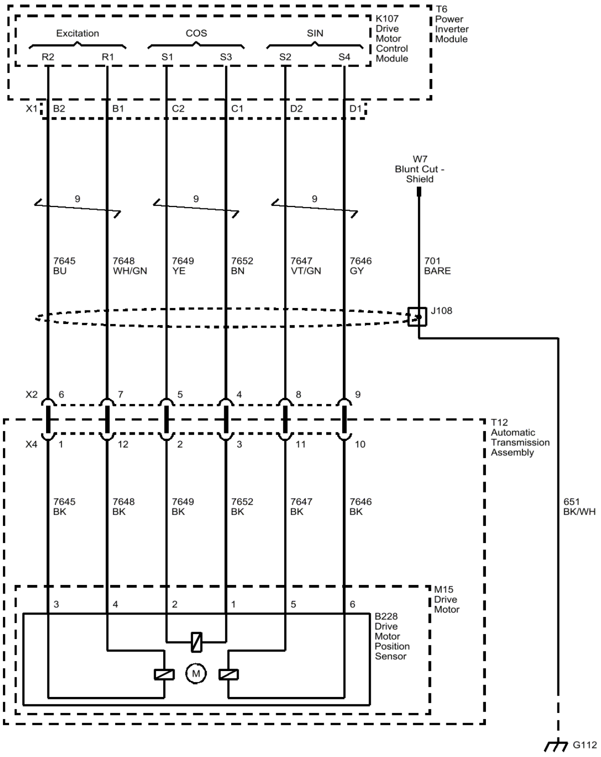

T6
Power
Inverter
Module
K107
Drive
Motor
Control
Module
Excitation
COS
SIN
R2
R1
S1
S3
S2
S4
X1
B2
B1
C2
C1
D2
D1
W7
Blunt Cut -
Shield
9
9
9
7645
BU
7648
WH/GN
7649
YE
7652
BN
7647
VT/GN
7646
GY
701
BARE
J108
X2
6
7
5
4
8
9
X4
1
12
2
3
11
10
T12
Automatic
Transmission
Assembly
7645
BK
7648
BK
7649
BK
7652
BK
7647
BK
7646
BK
651
BK/WH
M15
Drive
Motor
3
4
2
1
5
6
B228
Drive
Motor
Position
Sensor
M
G112

Fig. 7: Drive Motor Monitoring
Courtesy of GENERAL MOTORS COMPANY

Drive Motor and Transmission Fluid Pump Controls

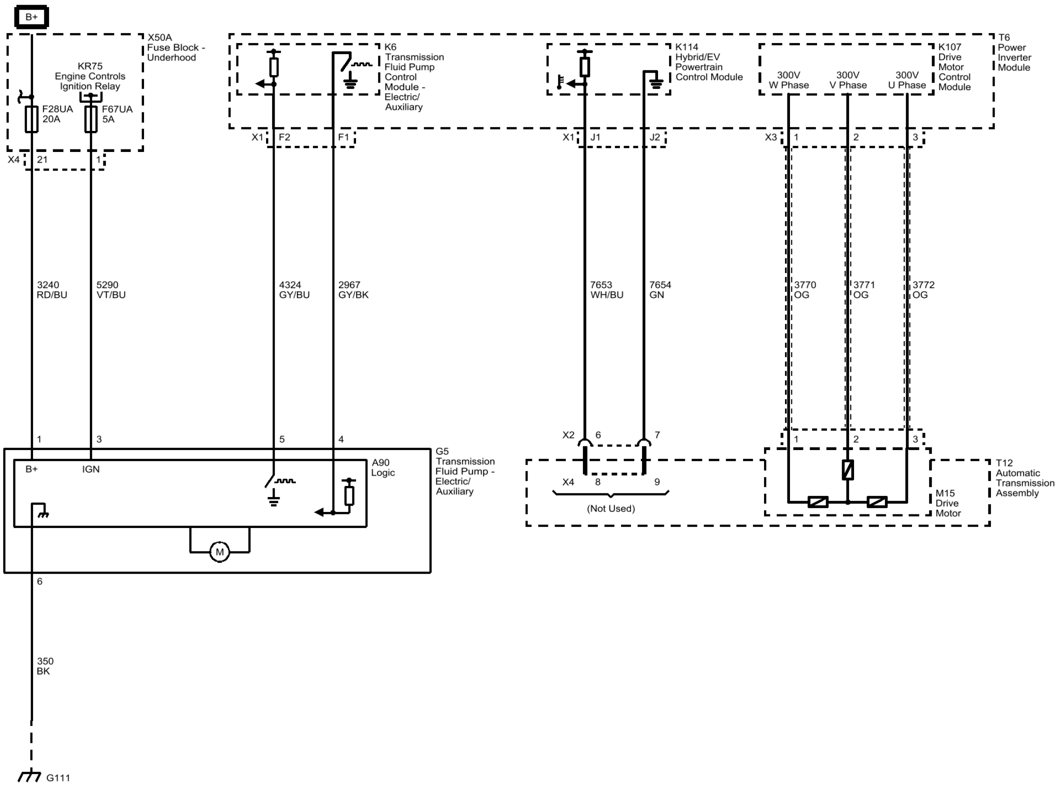

B+
X50A
Fuse Block -
Underhood
KR75
Engine Controls
Ignition Relay
F28UA
20A
F67UA
5A
X4
21
1
K6
Transmission
Fluid Pump
Control
Module -
Electric/
Auxiliary
X1
F2
F1
K114
Hybrid/EV
Powertrain
Control Module
X1
J1
J2
K107
Drive
Motor
Control
Module
300V
W Phase
300V
V Phase
300V
U Phase
T6
Power
Inverter
Module
X3
1
2
3
3240
RD/BU
5290
VT/BU
4324
GY/BU
2967
GY/BK
7653
WH/BU
7654
GN
3770
OG
3771
OG
3772
OG
1
3
5
4
G5
Transmission
Fluid Pump -
Electric/
Auxiliary
B+
IGN
A90
Logic
M
6
X2
6
7
X4
8
9
(Not Used)
1
2
3
T12
Automatic
Transmission
Assembly
M15
Drive
Motor
350
BK
G111

Fig. 8: Drive Motor and Transmission Fluid Pump Controls
Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

HYBRID CONTROLS ELECTRONIC COMPONENT VIEWS

Hybrid/EV Battery System Components

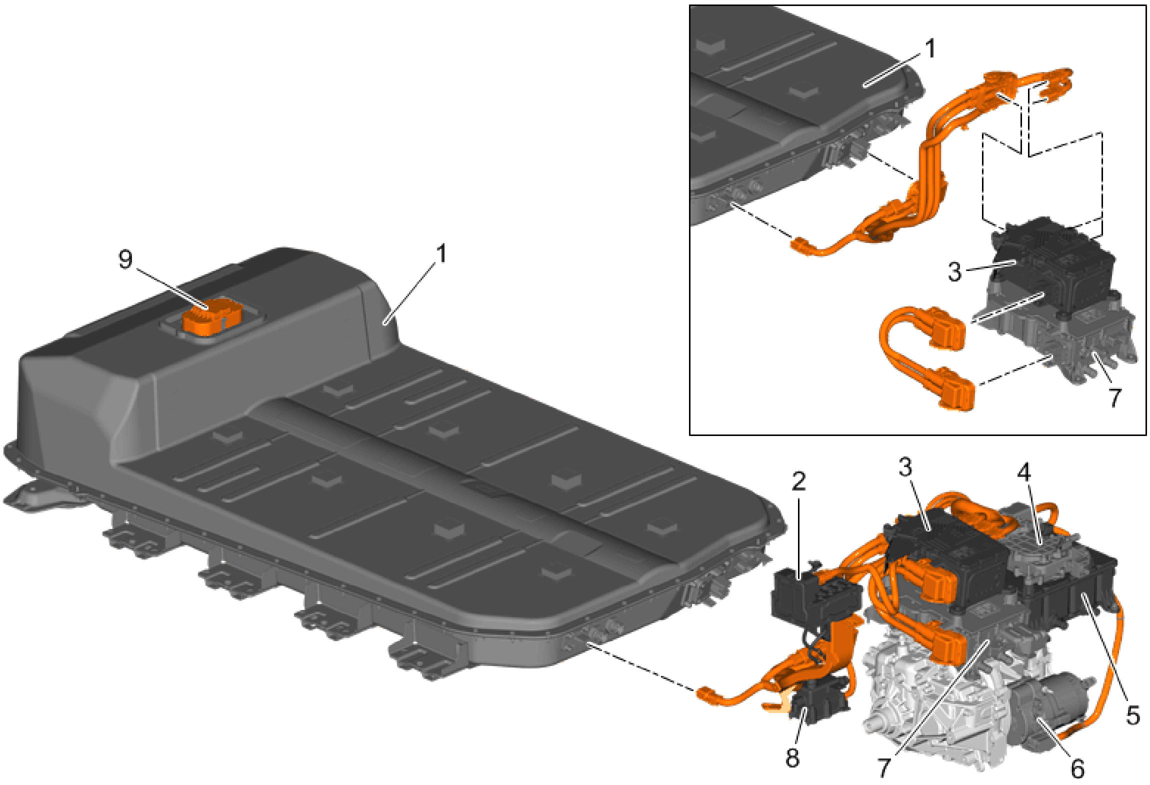


Fig. 9: Hybrid/EV Battery System Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery
2	Heater Coolant Heater
3	High Voltage Battery Disconnect Control Module Assembly
4	Accessory DC Power Control Module
5	Drive Motor Battery Charger
6	Air Conditioning and Drive Motor Battery Cooling Compressor
7	Drive Motor Power Inverter Module
8	High Voltage Battery Heater
9	Drive Motor Battery High Voltage Manual Disconnect Lever

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P057B-P057E: BRAKE PEDAL POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P057B

Brake Pedal Position Sensor Performance

DTC P057C

Brake Pedal Position Sensor Circuit Low Voltage

DTC P057D

Brake Pedal Position Sensor Circuit High Voltage

DTC P057E

Brake Pedal Position Sensor Circuit Erratic

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P057C	P057C	P057D	P057B, P057E
5 V Reference	P057C P0651	P057C	P0651	-
Low Reference	-	P057D	P057D	-

Typical Scan Tool Data

Brake Pedal Position Sensor

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle in Service Mode **Normal Range:** 0.25 - 4.75 V			
5 V Reference	0 V	0 V	-
Signal	0 V	0 V	5 V
Low Reference	-	5 V	-

Circuit/System Description

The brake pedal position (BPP) sensor is part of the one pedal driving feature. The engine control module (ECM) continuously monitors the vehicle speed and the position of the brake pedal. These two main inputs, along with other ECM inputs are used to determine if the vehicle is decelerating at the proper speed and rate with the brake pedal applied.

The BPP sensor is a six wire sensor, and is part of a dual brake position sensor. One BPP Sensor is used for the stop lamps and the other BPP Sensor is used for the one pedal driving feature. The BPP Sensor for one pedal driving communicates with the ECM. The ECM supplies a 5 V reference circuit, low reference circuit, and signal circuit to the BPP sensor. The BPP sensor sends a voltage signal to the ECM on the signal circuit. The voltage on the signal circuit will vary from a voltage greater than 0.25 V when the brake pedal is released to a voltage less than 4.75 V when the brake pedal is fully applied.

For information on the Stop Lamps side of the BPP Sensor, refer to **Exterior Lighting Systems Description and Operation** .

Conditions for Running the DTC

P057B

- DTCs P0722, P0723, P077C, P077D, P182E, P1915, U0073, or U0101 are not set.
- Run/Crank voltage is greater than 10 V.
- Shift lever has been in Park at least once during key ON.
- Shift lever is not in Park.
- Vehicle speed is greater than 8 Km/h (5 mph).
- Accelerator Pedal Position is less than 5%.
- DTC runs once per key cycle when above conditions are met.

P057C, P057D, or P057E

Run/Crank voltage is greater than 10 V.

Conditions for Setting the DTC

P057B

ECM detects the BPP sensor signal is stuck in a range for greater than 1 s.

P057C

ECM detects the BPP sensor voltage is less than 0.25 V greater than 1 s.

P057D

ECM detects the BPP sensor voltage is greater than 4.75 V greater than 1 s.

P057E

ECM detects the BPP sensor value varies greater than a calibrated value for 0.50 s.

Action Taken When the DTC Sets

- P057B, P057C, P057D, and P057E are Type A DTCs.
- Cruise control is disabled.

Conditions for Clearing the DTC

P057B, P057C, P057D, and P057E are Type A DTCs

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**
- **Exterior Lights Schematics**

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **The Brake Pedal Position sensor scan tool data is located in the ECM automatic transmission data list.**

1. Vehicle in Service Mode.
2. Verify DTC P0641, P0651, P0697, or P06A3 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Transmission in Park, and service brake pedal released.
4. Verify the scan tool Brake Pedal Position Sensor Signal parameter in the ECM displays No.
   - **If Yes is displayed**

Refer to Circuit/System Testing.

- **If No is displayed**

5. Verify the scan tool Brake Pedal Position Sensor Signal parameter changes as the brake pedal is applied and displays Yes on a scan tool when the brake pedal is fully applied.
   - **If Yes is not displayed**

     Refer to Circuit/System Testing.

   - **If Yes is displayed**
6. All OK.

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification first.**

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B22 Brake Pedal Position Sensor. It may take up to 2 minutes for all vehicle systems to power down.

NOTE: **All terminal references are for the vehicle harness brake pedal position sensor connector.**

2. Test for less than 10 Ω between the low reference circuit terminal 6 and ground.
   - **If 10 Ω or greater**
     1. Disconnect the harness connector at the K20 Engine Control Module.
     2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 5 and ground.
   - **If less than 4.8 V**
     1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module.
     2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance.
     3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
   - **If greater than 5.2 V**
     1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle ON.
     2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K20 Engine Control Module.
   - **If between 4.8 - 5.2 V**
5. Verify the scan tool Brake Pedal Position Sensor Signal parameter is released.
   - **If released is not displayed**
     1. Vehicle OFF, disconnect the harness connector at the K20 Engine Control Module, vehicle ON.
     2. Test for less than 0.25 V between the signal circuit terminal 4 and ground.
        - If 0.25 V or greater, repair the short to voltage on the circuit.
        - If less than 0.25 V, replace the K20 Engine Control Module.
   - **If released is displayed**
6. Install a 3 A fused jumper wire between the signal circuit terminal 4 and the 5 V reference circuit terminal 5.
7. Verify the scan tool Brake Pedal Position Sensor parameter is applied.

    - **If applied is not displayed**
        1. Vehicle OFF, remove the jumper wire, and disconnect the harness connector at the K20 Engine Control Module.
        2. Test for infinite resistance between the signal circuit terminal 4 and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If infinite resistance.
        3. Test for less than 2 Ω in the signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K20 Engine Control Module.
            - **If applied is displayed**

8. Replace the B22 Brake Pedal Position Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Brake Pedal Position Sensor Replacement**
- Perform the **Brake Pedal Position Sensor Calibration** following the replacement of the ECM or BPP sensor, or any repair that effects the BPP sensor alignment.
- Refer to **Control Module References** for Engine Control Module replacement, programming and setup.

DTC P0601-P0604, P0606, OR P062F: CONTROL MODULE (HYBRID POWERTRAIN CONTROL MODULE 1)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P062F

Control Module Long Term Memory Performance

Circuit/System Description

This is an internal fault detection of the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

P0601 - P0604, and P0606

The vehicle is ON.

P062F

This diagnostic is executed at system power-up; both at vehicle ON and at the start of a plug in charging event.

Conditions for Setting the DTC

P0601 - P0604, P0606, and P062F

The control module has detected an internal malfunction or a service module has been installed but not yet programmed.

Action Taken When the DTC Sets

- P0601 - P0604 and P0606 are Type A DTCs.
- P062F is a Type B DTC.
- P0601, P0602, P0604, and P0606 propulsion will be disabled.

Conditions for Clearing the DTC

- P0601 - P0604 and P0606 are Type A DTCs.
- P062F is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.
    - **If the DTC is set**

      Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC** .

    - **If the DTC is not set**
3. Verify DTC P0602 is not set.
    - **If the DTC is set**
    1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
        - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
        - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC is set, replace the T6 Power Inverter Module.
        - If the DTC does not set
4. All OK.
    - **If the DTC is not set**
5. Verify DTC P0601, P0603, P0604, P0606, or P062F is not set.
    - **If the DTC P0601, P0603, P0604, P0606, or P062F is set**

      Replace the T6 Power Inverter Module.

- **If the DTC is not set**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0601-P0604, P0606, P062F, P0630, P16F3, OR P262B: CONTROL MODULE (ECM)

Diagnostic Instructions

- Preform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P0630

VIN Not Programmed or Mismatched - Engine Control Module (ECM)

DTC P16F3

Control Module Redundant Memory Performance

DTC P262B

Control Module Power Off Timer Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). This diagnostic also addresses if the ECM is not programmed.

The ECM monitors its ability to read and write to the memory. It also monitors a timing function.

Conditions for Running the DTC

P0601, P0602, P0630, P16F3

- The vehicle is ON.
- These DTCs run continuously when the above condition is met.

P0603, P062F

- The vehicle is ON.
- These DTCs run once per ignition cycle.

P0604

- The vehicle is ON.
- DTC P0604 runs continuously when the above condition is met.

P0606

- The system voltage is greater than 11 V.
- DTC P0606 runs continuously when the above condition is met.

P262B

- Vehicle OFF.
- The ECM is not powered down.
- DTC P262B runs continuously when the above conditions are met.

Conditions for Setting the DTC

The ECM detects an internal failure or incomplete programming.

Action Taken When the DTC Sets

- DTCs P0601, P0602, P0603, P0604, P0606, P0630, and P16F3 are Type A DTCs.
- DTCs P062F and P262B is a Type B DTC.

Conditions for Clearing the DTC

- DTCs P0601, P0602, P0603, P0604, P0606, P0630, and P16F3 are Type A DTCs.
- DTCs P062F and P262B is a Type B DTC.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the ECM may cause a DTC to set. Verify the following:

- The battery cables are clean and tight, and the battery is fully charged. Refer to **Battery Inspection/Test**
- The ECM ground circuits do not have an open or high resistance.
- The ECM power circuits do not have an open, short to ground, or high resistance.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify DTC P0602 or P0630 is not set.
    - **If the DTC is set**
    1. Verify the K20 ECM has the latest calibration in Calibration Information.
        - If the K20 ECM does not have the latest calibration, program the K20 ECM.
        - If the K20 ECM has the latest calibration, replace the K20 ECM.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K20 ECM.
        - If the DTC does not set
    3. All OK.
    - **If the DTC is not set**
3. Verify DTC P0601, P0603, P0604, P0606, P062F, P16F3 or P262B is not set.
    - **If DTC P0601, P0603, P0604, P0606, P062F, P16F3 or P262B is set**

      Replace the K20 ECM.

    - **If the DTC is not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for ECM replacement, programming and setup.

DTC P061B: CONTROL MODULE TORQUE CALCULATION PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P061B

Control Module Torque Calculation Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated axle torque requested calculation is correct.

Conditions for Running the DTC

- Vehicle is ON.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P061B is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P061B is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P061B is not set.
    - **If the DTC is set**

      Replace the T6 Power Inverter Module.

    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as Drive Motor Generator Power Inverter Module, replacement, setup, and programming.

DTC P0641, P0651, P0697, OR P06A3: 5 V REFERENCE 1-4 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0641

5 V Reference 1 Circuit

DTC P0651

5 V Reference 2 Circuit

DTC P0697

5 V Reference 3 Circuit

DTC P06A3

5 V Reference 4 Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference 1	P0641	P0641	P0641	P0641
5 V Reference 2	P0651	P0651	P0651	P0651
5 V Reference 3	P0697	P0697	P0697	P0697
5 V Reference 4	P06A3	P06A3	P06A3	P06A3

Circuit/System Description

The ECM has four internal 5 V reference circuits. Each 5 V internal reference circuit provides a 5 V bias voltage to the sensor it is connected to. An open, short to ground, or short to voltage on one external 5 V reference circuit can affect the component it is connected to.

Conditions for Running the DTC

DTCs P0641, P0651, P0697, and P06A3 run continuously when the Run/Crank Voltage is greater than 6.4 V for greater than 2 s.

Conditions for Setting the DTC

The ECM detects the 5 V reference 1, 2, 3, or 4 circuit is not 4.8 - 5.2 V for 0.2 s.

Action Taken When the DTC Sets

DTCs P0641, P0651, P0697, and P06A3 are Type A DTCs.

P0641

Air conditioning is disabled.

P0651

Regenerative braking is disabled.

P0697 and P06A3

- Reduced performance.
- No creep or hill hold torque when the brake pedal is released.

Conditions for Clearing the DTC

DTCs P0641, P0651, P0697, and P06A3 are Type A DTCs.

Diagnostic Aids

P0641

The 5 V reference 1 circuit provides 5 V to the A/C Refrigerant Pressure Sensor.

P0651

The 5 V reference 2 circuit provides 5 V to the Brake Pedal Switch Position Sensor.

P0697

The 5 V reference 3 circuit provides 5 V to the Accelerator Pedal Position Sensor 2.

P06A3

The 5 V reference 4 circuit provides 5 V to the Accelerator Pedal Position Sensor 1.

It may be possible to locate the fault by disconnecting one component at a time from the appropriate 5 V reference circuit while viewing the corresponding 5-volt Reference 1, 3, 4 Circuit Status parameter on the scan tool. The scan tool parameter will change from Malfunction to OK when the source of the fault is disconnected. If all 5 V reference components have been disconnected and a fault is still indicated, the fault may exist in the wiring harness.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the scan tool parameters listed below display OK:
    - 5 V Reference 1 Circuit Status
    - 5 V Reference 2 Circuit Status
    - 5 V Reference 3 Circuit Status
    - 5 V Reference 4 Circuit Status
    - **If not OK**

      Refer to Circuit/System Testing.

    - **If OK**
2. Verify the scan tool parameters listed below display 4.8 - 5.2 V:
    - 5 V Reference 1
    - 5 V Reference 2
    - 5 V Reference 3
    - 5 V Reference 4
    - **If not between 4.8 - 5.2 V**

      Refer to Circuit/System Testing.

    - **If between 4.8-5.2 V**
3. All OK.

Circuit/System Testing

NOTE: **Additional DTCs will set when disconnecting components.**

1. Vehicle in Service Mode.

2. Test for 4.8 - 5.2 V between the 5 V reference circuit terminals listed below and ground:
    - B107 Accelerator Pedal Position Sensor terminal 1
    - B107 Accelerator Pedal Position Sensor terminal 6
    - B22 Brake Pedal Position Sensor terminal 5.
    - B1 A/C Refrigerant Pressure Sensor terminal 2
    - **If less than 4.8 V**
    1. Vehicle Off, disconnect the harness connector at the K20 ECM.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 ECM.
    - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connector at the K20 ECM, vehicle ON.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K20 ECM.
    - **If between 4.8 - 5.2 V**
3. Replace the appropriate sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Accelerator Pedal Assembly Replacement** for B107 Accelerator Pedal Position Sensor replacement.
- Refer to **Air Conditioning Refrigerant Pressure Sensor Replacement - High Pressure**
- Refer to **Brake and Accelerator Pedal Assembly Replacement** for B201 Brake Control Brake Pedal Position Sensor replacement.
- Refer to **Brake Pedal Position Sensor Replacement**
- Refer to **Control Module References** for K20 ECM replacement, programming, and setup.

DTC P0650, P263A, OR P263B: MALFUNCTION INDICATOR LAMP (MIL) CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0650

Malfunction Indicator Lamp (MIL) Control Circuit

DTC P263A

Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage

DTC P263B

Malfunction Indicator Lamp (MIL) Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition Voltage	P0650	P0650	-	-
MIL Control	P0650, P263A*	P0650, P263A	P263B	-
* The MIL remains ON				

Circuit/System Description

The MIL illuminates to inform the driver that a fault has occurred and a vehicle system requires service. Ignition voltage is supplied directly to the MIL and, when a fault occurs, the ECM turns the MIL ON by grounding the MIL control circuit. Under normal operating conditions, the MIL should be ON only during bulb check.

Conditions for Running the DTC

Remote Vehicle Start is not active.

P0650

Ignition voltage is greater than 11 V.

P263A and P263B

Run/Crank Voltage is greater than 11 V.

Conditions for Setting the DTC

P0650

The ECM detects low voltage during the MIL control circuit driver OFF state.

P263A

The ECM detects low voltage during the MIL control circuit driver OFF state.

P263B

The ECM detects high voltage on the MIL control circuit during the driver ON state.

Action Taken When the DTC Sets

- DTC P0650, P263A, and P263B are Type B DTCs.
- No MIL illumination.

Conditions for Clearing the DTC

DTC P0650, P263A, and P263B are Type B DTCs.

Diagnostic Aids

- If the condition is intermittent, move the related harnesses and connectors with the vehicle ON while monitoring the scan tool MIL control circuit status parameters. The MIL control circuit status parameters will change from OK or Not Run to Fault if there is a condition with the circuit or a connection.
- If the ECM detects low voltage on the MIL control circuit during the MIL control circuit driver OFF state, DTCs P0650 and DTC P263A may set simultaneously.

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**
- **Instrument Cluster Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON, command the malfunction indicator lamp ON and OFF with a scan tool.
2. Verify that the malfunction indicator lamp turns ON and OFF as commanded.
    - **If the malfunction indicator lamp does not turn ON and OFF as commanded**

      Refer to Circuit/System Testing.

    - **If the malfunction indicator lamp turns ON and OFF as commanded**
3. Vehicle ON, command the malfunction indicator lamp ON and OFF with a scan tool.
4. Verify that the control circuit status parameters listed below display OK or Not Run:
    - MIL Control Circuit Low Voltage Test Status
    - MIL Control Circuit Open Test Status
    - MIL Control Circuit High Voltage Test Status
    - **If Malfunction is displayed**

      Refer to Circuit/System Testing.

    - **If OK or Not Run is displayed**
5. Vehicle ON, command the malfunction indicator lamp ON and OFF with a scan tool.
6. Verify that the control circuit status parameters listed below display OK or Not Run:
    - MIL Control Circuit Low Voltage Test Status
    - MIL Control Circuit Open Test Status
    - MIL Control Circuit High Voltage Test Status
    - **If Malfunction is displayed**

      Refer to Circuit/System Testing.

    - **If OK or Not Run is displayed**
7. Operate the vehicle within the Conditions for Running the DTC to verify the DTC does not reset. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    - **If any DTC sets**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle for further diagnosis.

    - **If a DTC does not set**
8. All OK.

Circuit/System Testing

1. Vehicle OFF.
2. Disconnect the X1 harness connector at the K20 ECM.
3. Vehicle in Service Mode, verify the malfunction indicator lamp does not illuminate.
    - **If the malfunction indicator lamp illuminates**

    1. Test for infinite resistance between the malfunction indicator lamp control circuit X1 terminal 12 and ground.
        - If less than infinite resistance, repair the short to ground in the circuit end to end.
        - If infinite resistance
    2. Replace the P16 instrument cluster.
    - **If the malfunction indicator lamp does not illuminate**
4. Connect a 3 A fused jumper wire between the malfunction indicator lamp control circuit X1 terminal 12 and ground.
5. Verify the malfunction indicator lamp illuminates.
    - **If the malfunction indicator lamp does not illuminate**
    1. Test the malfunction indicator lamp control circuit X1 terminal 12 for a short to voltage or an open/high resistance end to end.
        - If the malfunction indicator lamp control circuit X1 terminal 12 is shorted to voltage or has an open/high resistance, repair as necessary.
        - If the malfunction indicator lamp control circuit X1 terminal 12 tests normal
    2. Test the instrument cluster ignition voltage circuit for a short to ground or open/high resistance end to end.
        - If the instrument cluster ignition voltage circuit is shorted to ground or has an open/high resistance, repair as necessary.
        - If the instrument cluster ignition voltage circuit tests normal
    3. Replace the P16 instrument panel cluster.
    - **If the malfunction indicator lamp illuminates**
6. Replace the K20 ECM.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Instrument Cluster Replacement**
- Refer to **Control Module References** for K20 ECM replacement, programming, and setup.

DTC P0685-P0687, P0689, P0690, OR P1682: ENGINE CONTROLS IGNITION RELAY/IGNITION 1 SWITCH CIRCUIT 2

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0685

Engine Controls Ignition Relay Control Circuit

DTC P0686

Engine Controls Ignition Relay Control Circuit Low Voltage

DTC P0687

Engine Controls Ignition Relay Control Circuit High Voltage

DTC P0689

Engine Controls Ignition Relay Feedback Circuit Low Voltage

DTC P0690

Engine Controls Ignition Relay Feedback Circuit High Voltage

DTC P1682

Ignition 1 Switch Circuit 2

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+ - Relay Coil	P0689, P1682	P0685, P0689, P1682	-	-
B+ - Relay Switch	P0689, P1682	P0685, P0689, P1682	-	-
Control - Component	P0689, P1682	P0689, P1682	P0690, P16B3	-
Control - Relay Coil	P0686, P0690	P0685, P0689, P1682	P0685, P0687, P0689, P1682*	-
*Internal control module or component damage may occur if the circuit shorts to B+.				

Circuit/System Description

Circuit	Description
B+ - Relay Coil	Supplied directly from the battery.
B+ - Relay Switch	Supplied directly from the battery.
Control - Component	The output circuit is switched to 12 V to activate the component.
Control - Relay Coil	The output circuit is switched to ground to activate the component.

Components

Component	Description
KR75 Engine Controls Ignition Relay	Relays are used to control a high power circuit with a low power signal.
K20 Engine Control Module	The control module controls a series of actuators to ensure optimal system performance. The control module does this by reading values from a variety of sensors, interprets the data and adjusts the actuators accordingly.

4 ignition voltage circuits supply the ECM. The 4 circuits are supplied by 2 relay(s):

- KR73 Ignition Main Relay
- KR75 Engine Controls Ignition Relay

The ECM monitors and compares the voltages supplied by the relay(s).

Conditions for Running the DTC

P0685, P0686

- Run/Crank voltage is greater than 5 V.
- System voltage is greater than 11 V.
- Run/Crank voltage is greater than 5 V.

THEN

- Less than 5 V for 5 s.

P0687

- Run/Crank voltage is greater than 5 V.
- System voltage is greater than 11 V.

P0689, P0690

- DTCs P0685, P0686, or P0687 are not set.
- Ignition voltage is greater than 11 V.
- Engine Controls Ignition Relay Command is On.

P1682

- Engine Controls Ignition Relay is commanded On.
- Ignition voltage is greater than 5 V.
- Run/Crank voltage is greater than 5.5 V.

Conditions for Setting the DTC

P0685, P0686, P0687

The commanded state of the driver and the actual state of the control circuit do not match for greater than 2 s.

P0689

Engine Controls Ignition Relay Feedback Circuit is less than 5 V for greater than 5 s.

P0690

Engine Controls Ignition Relay Feedback Circuit is greater than 4 V for greater than 5 s.

P1682

The following parameters are not within 3 V of each other:

- Run/Crank Voltage
- Engine Controls Ignition Relay Voltage

Actions Taken When the DTC Sets

DTCs P0685, P0686, P0687, P0689, P0690, and P1682 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0685, P0686, P0687, P0689, P0690, and P1682 are Type C DTCs.

Diagnostic Aids

If the condition is intermittent, wiggle the related wiring harnesses and connectors, with the ignition/vehicle on or engine running, while monitoring the scan tool circuit status parameters for the component. The parameters will display if there is a condition with the circuit or a connection.

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**
- **Power Distribution Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Electrical Center Identification Views**
- **Relay Replacement (Attached to Wire Harness)** **Relay Replacement (Within an Electrical Center)**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

1. Ignition - On/Vehicle - In Service Mode
2. Verify no other DTCs are set.
    - **If other DTCs are set**

      Refer to: Diagnostic Trouble Code (DTC) List - Vehicle

    - **If no other DTCs are set**
3. Ignition/Vehicle - Cycle On and Off

   Verify the component produces a clicking sound: KR75 Engine Controls Ignition Relay

    - **If the component does not produce a sound**

      Refer to: Circuit/System Testing

    - **If the component produces a sound**
4. Verify the following parameters are within 3 V of each other:
    - Ignition 1 Signal
    - Engine Controls Ignition Relay Feedback Signal
    - **If not within 3 V of each other**

      Refer to: Circuit/System Testing

    - **If within 3 V of each other**
5. Verify the following parameters display OK:
    - Engine Controls Ignition Relay Control Circuit Low Voltage Test Status
    - Engine Controls Ignition Relay Control Circuit Open Test Status
    - Engine Controls Ignition Relay Control Circuit High Voltage Test Status
    - **If OK is not displayed**

      Refer to: Circuit/System Testing

    - **If OK is displayed**
6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    - **If the DTC sets**

      Refer to: Circuit/System Testing

    - **If the DTC does not set**
7. All OK.

Circuit/System Testing

1. Vehicle Off.
2. Remove the component: KR75 Engine Controls Ignition Relay
3. Verify a test lamp turns On between the test points:

  - B+ circuit terminal 30 & Ground
  - B+ circuit terminal 85 & Ground
  - **If the test lamp does not turn On**

    Replace the component: X50A Fuse Block - Underhood

  - **If the test lamp turns On**

4. Ignition - On/Vehicle - In Service Mode
5. Connect a test lamp between the test points: Control circuit terminal 86 & B+ circuit
6. Perform the scan tool control function: KR75 Engine Controls Ignition Relay - On and Off

   Verify the test lamp turns On and Off.

   - **If the test lamp is always Off**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
   3. Ignition - On/Vehicle - In Service Mode
   4. Test for less than 1 V between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 67 @ Control module harness
      - If 1 V or greater - Repair the short to voltage on the circuit.
      - If less than 1 V
   5. Ignition/Vehicle - Off
   6. Test for less than 2 ohms between the test points: Control circuit terminal 86 @ Relay Socket & Terminal 67 @ Control module harness
      - If 2 ohms or greater - Repair the open/high resistance in the circuit.
      - If less than 2 ohms - Replace the component: K20 Engine Control Module
   - **If the test lamp is always On**
   1. Ignition/Vehicle - Off & Remove - Test lamp
   2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
   3. Test for infinite resistance between the test points: Control circuit terminal 86 @ Relay Socket & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: K20 Engine Control Module
   - **If the test lamp turns On and Off**
7. Verify the fuse is not open: F66UA Fuse
   - **If the fuse is open**
   1. Vehicle Off.
   2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
   3. Test for infinite resistance between the test points: Output terminal @ Fuse & Ground
      - If less than infinite resistance - Repair the short to ground on the circuit.
      - If infinite resistance - Replace the component: K20 Engine Control Module
   - **If the fuse is not open**
8. Ignition - On/Vehicle - In Service Mode
9. Verify a test lamp does not turn On between the test points: KR75 Engine Controls Ignition Relay Terminal 87 & Ground
   - **If the test lamp turns On**
10. Disconnect the electrical connector: X1 @ K20 Engine Control Module
11. Test for less than 1 V between the test points:
    - Control circuit X1 terminal 29 @ Control module harness & Ground
    - Switch circuit X1 terminal 16 @ Control module harness & Ground
    - If 1 V or greater - Repair the short to voltage on the circuit.
    - **If the test lamp does not turn On**
12. Vehicle Off.

13. Connect a 30 A fused jumper wire between the test points: Control circuit terminal 87 & B+ circuit terminal 30
14. Ignition - On/Vehicle - In Service Mode
15. Verify the scan tool parameter: Engine Controls Ignition Relay Feedback Signal = Within 1 V of the battery voltage
    - **If not within 1 V of the battery voltage**
    1. Ignition/Vehicle - Off & Remove - Jumper wire(s)
    2. Disconnect the electrical connector: X1 @ K20 Engine Control Module
    3. Test for less than 2 ohms between the test points:
        - Control circuit terminal 87 @ Relay Socket & Control circuit terminal 29 @ Control module harness
        - Control circuit terminal 87 @ Relay Socket & Control circuit terminal 16 @ Control module harness
        - If 2 ohms or greater - Repair the open/high resistance in the circuit.
        - If less than 2 ohms - Replace the component: K20 Engine Control Module
    - **If within 1 V of the battery voltage**
16. Test or replace the component: KR75 Engine Controls Ignition Relay

Component Testing

Relay Test

1. Vehicle Off.
2. Remove the component: KR75 Engine Controls Ignition Relay
3. Test for 70 to 110 ohms between the test points: Component terminal 85 & 86
    - **If not between 70 and 110 ohms**

      Replace the component: KR75 Engine Controls Ignition Relay

    - **If between 70 and 110 ohms**
4. Test for infinite resistance between the test points:
    - Component terminal 30 & 85
    - Component terminal 30 & 86
    - Component terminal 30 & 87
    - Component terminal 85 & 87
    - **If less than infinite resistance**

      Replace the component: KR75 Engine Controls Ignition Relay

    - **If infinite resistance**
5. Connect a 3 A fused jumper wire between the test points: Component terminal 86 & B+

   Connect a jumper wire between the test points: Component terminal 85 & Ground

6. Test for less than 2 ohms between the test points: Component terminal 30 & 87
    - **If 2 ohms or greater**

      Replace the component: KR75 Engine Controls Ignition Relay

    - **If less than 2 ohms**
7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

Refer to **Control Module References** for control module replacement, programming, and setup.

DTC P06AF: TORQUE MANAGEMENT SYSTEM PERFORMANCE - FORCED ENGINE SHUTDOWN

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P06AF

Torque Management System Performance - Forced Engine Shutdown

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors a state of health message that the ECM transmits to verify the ECM is functioning properly. The hybrid/EV powertrain control module 1 is part of the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- The system voltage is greater than 9.5 V.
- Vehicle is Run Crank Active for more than 0.1 s.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 does not detect a valid state of health message from the ECM.

Action Taken When the DTC Sets

- DTC P06AF is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTC P06AF is a Type A DTC.

Reference Information

Schematic Reference

- **Hybrid/EV Controls Schematics**
- **Data Communication Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify ECM DTC P0606 is not set.
    - **If the DTC is set**

      Refer to **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**.
    - **If the DTC is not set**
3. Verify DTC P06AF is not set.
    - **If the DTC is set**
    1. Replace the K20 Engine Control Module.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    3. Verify the DTC does not set.
        - If the DTC is set
        1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
            - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
            - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
        2. Verify the DTC does not set.
            - If the DTC sets, replace the T6 Power Inverter Module.
            - If the DTC does not set
        3. All OK.
        - If the DTC is not set
    4. All OK.
    - **If the DTC is not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K20 ECM or T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming.

DTC P06B1 OR P06B2: SENSOR SUPPLY VOLTAGE CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P06B1

Sensor Supply Voltage Circuit Low Voltage

DTC P06B2

Sensor Supply Voltage Circuit High Voltage

Circuit/System Description

The motor control module shares an internal 15 V reference power supply in order to operate the drive motor. This fault is handled inside the power inverter module, often referred to as the drive motor generator power inverter module, and no external circuits are involved. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.

  OR

- The controller is Awake.
- The system voltage is greater than 10.50 V AND less than 11.0 V.

Conditions for Setting the DTC

P06B1

The reference voltage is less than 8.4 V.

P06B2

The reference voltage is greater than 15.6 V.

Action Taken When the DTC Sets

P06B1 and P06B2 are Type B DTCs.

Conditions for Clearing the DTC

P06B1 and P06B2 are Type B DTCs.

Diagnostic Aids

Low voltage or a momentary loss of power or ground to the hybrid/EV powertrain control module 1 may cause a DTC to set. Verify the following:

- The battery cables are clean and tight, and the battery is fully charged. Refer to **Battery Inspection/Test** .
- The hybrid/EV powertrain control module 1 ground circuits do not have an open or high resistance.
- The hybrid/EV powertrain control module 1 power circuits do not have an open, short to ground, or high resistance.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562 is not set.
    - **If the DTC is set**

      Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC** .

    - **If the DTC is not set**
3. Verify DTC P06B1, P06B2, P06E7 or P06E8 is not set.
    - **If any of the DTCs are set**
    1. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.

- If the DTC does not set.

2. All OK.

- **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, OR P1B03: DRIVE MOTOR POSITION SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0A3F

Drive Motor Position Sensor Circuit

DTC P0A40

Drive Motor Position Sensor Performance

DTC P0C52

Drive Motor Position Sensor Circuit 1 Low Voltage

DTC P0C53

Drive Motor Position Sensor Circuit 1 High Voltage

DTC P0C5C

Drive Motor Position Sensor Circuit 2 Low Voltage

DTC P0C5D

Drive Motor Position Sensor Circuit 2 High Voltage

DTC P1B03

Drive Motor Position Sensor Circuit Tracking Lost

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Reference* - Excitation	P0A3F	P0A3F	P0A3F	P1B03, P0A40
Signal* - SIN	P0C52	P0A3F	P0C53, P0A3F	P1B03, P0A40
Signal* - COS	P0C5C	P0A3F	P0C5D, P0A3F	P1B03, P0A40
*Represents a differential circuit consisting of a pair of wires. See Circuit/System Description and schematic for detailed description.				

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils, and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor. At vehicle ON, the motor control module outputs a 4.2 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for return signals - Sine and Cosine waveforms, often referred to as SIN and COS. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coil signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

Conditions for Running the DTC

P0A3F, P0A40, or P1B03

The drive motor is operating.

P0C52, P0C53, P0C5C, or P0C5D

The vehicle is ON.

Conditions for Setting the DTC

P0C52, P0C5C

Circuit voltage is less than 0.5 V.

P0C53, P0C5D

Circuit voltage is greater than 4.5 V.

P0A3F

SIN or COS signal is less than 2.3 V. The motor control module cannot determine the motor position based upon the sensor signals.

P0A40

SIN or COS signal is greater than 4 V. The motor control module detects a degraded motor position sensor signal.

P1B03

The motor control module is unable to track the motor position based upon the sensor signals.

Action Taken When the DTC Sets

- DTCs P0A3F, P0A40 and P1B03 are Type A DTCs.
- DTCs P0C52, P0C53, P0C5C, and P0C5D are Type B DTCs.

Conditions for Clearing the DTC

- DTCs P0A3F, P0A40 and P1B03 are Type A DTCs.
- DTCs P0C52, P0C53, P0C5C, and P0C5D are Type B DTCs.

Diagnostic Aids

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module, often referred to as the drive motor generator power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

DT-52010 Jumper Harness (12 Pins)

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Testing

NOTE: **You must perform the Component Testing before proceeding with Circuit/System Testing.**

1. Vehicle OFF, disconnect the X2 harness connector at the T12 Automatic Transmission Assembly.
2. Install the **DT-52010** harness to the vehicle harness side only.
3. Vehicle ON.
4. Test for 0.8 - 1.4 V between the signal circuit terminals listed below and ground:
    - Signal (COS) circuit terminal 5
    - Signal (COS) circuit terminal 4
    - Signal (SIN) circuit terminal 8
    - Signal (SIN) circuit terminal 9
    - **If less than 0.8 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify proper terminal contact and if OK replace the T6 Power Inverter Module.
    - **If greater than 1.4 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module, Vehicle ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the T6 Power Inverter Module.

- **If between 0.8 - 1.4 V**

NOTE: **Switch DMM setting to measure AC voltage for this step.**

5. Test for 3 - 4.5 V AC between the reference circuit terminals listed below:
    - Terminal 6
    - Terminal 7
    - **If less than 3 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Test for infinite resistance between EACH reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in EACH reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify proper terminal contact and if OK replace the T6 Power Inverter Module.
    - **If greater than 4.5 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module, Vehicle ON.
    2. Test for less than 1 V between EACH reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the T6 Power Inverter Module.
    - **If between 3 - 4.5 V**
6. All OK.

Component Testing

NOTE: **If the a/trans wiring harness assembly circuits fail the circuit tests, replace the harness; do not repair.**

1. Vehicle ON.
2. Verify that DTC P1AF0, P1B44, P1E1E, P1E22, P1B0B, or P1B0C is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If none of the DTCs are set**
3. Vehicle OFF, disconnect the X2 harness connector at the T12 Automatic Transmission Assembly.
4. Install the **DT-52010** jumper harness to the transmission side only.
5. Test for 5 - 20 Ω between the reference circuit terminal 6 and the reference circuit terminal 7.
    - **If less than 5 Ω**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.
    2. Test for infinite resistance between the reference circuit terminal 6 and the reference circuit terminal 7.
        - If less than infinite resistance, replace the a/trans wiring harness assembly.
        - If infinite resistance, replace the B228 Drive Motor Position Sensor.
    - **If greater than 20 Ω**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.
    2. Test for less than 2 Ω in the reference circuits end to end.
        - If 2 Ω or greater, replace the a/trans wiring harness assembly.
        - If less than 2 Ω, replace the B228 Drive Motor Position Sensor.
    - **If between 5 - 20 Ω**
6. Test for 15 - 30 Ω between the signal (COS) circuit terminal 5 and the signal (COS) circuit terminal 4.
    - **If less than 15 Ω**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.

    2. Test for infinite resistance between the signal (COS) circuit terminal 5 and the signal (COS) circuit terminal 4.
        - If less than infinite resistance, replace the a/trans wiring harness assembly.
        - If infinite resistance, replace the B228 Drive Motor Position Sensor.
    - **If greater than 30 Ω**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.
    2. Test for less than 2 Ω in the signal circuits end to end.
        - If 2 Ω or greater, replace the a/trans wiring harness assembly.
        - If less than 2 Ω, replace the B228 Drive Motor Position Sensor.
    - **If between 15 - 30 Ω**
7. Test for 15 - 30 Ω between the signal (SIN) circuit terminal 8 and the signal (SIN) circuit terminal 9.
    - **If less than 15 Ω**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.
    2. Test for infinite resistance between the signal (SIN) circuit terminal 8 and the signal (SIN) circuit terminal 9.
        - If less than infinite resistance, replace the a/trans wiring harness assembly.
        - If infinite resistance, replace the B228 Drive Motor Position Sensor.
    - **If greater than 30 Ω**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.
    2. Test for less than 2 Ω in the signal circuits end to end.
        - If 2 Ω or greater, replace the a/trans wiring harness assembly.
        - If less than 2 Ω, replace the B228 Drive Motor Position Sensor.
    - **If between 15 - 30 Ω**
8. Test for greater than 10,000 Ω between the terminals listed below and ground:
    - Reference terminal 6
    - Reference terminal 7
    - Signal (COS) circuit terminal 5
    - Signal (COS) circuit terminal 4
    - Signal (SIN) circuit terminal 8
    - Signal (SIN) circuit terminal 9
    - **If less than 10,000 Ω**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.
    2. Test for less than infinite resistance between the appropriate terminal and ground.
        - If less than infinite resistance, replace the a/trans wiring harness assembly.
        - If infinite resistance, replace the B228 Drive Motor Position Sensor.
    - **If 10,000 Ω or greater**
9. Test for infinite resistance between the terminals listed below:
    - Terminals 9 and 4
    - Terminals 9 and 7
    - Terminals 8 and 6
    - **If less than infinite resistance**
    1. Disconnect the X1 harness connector at the M15 Drive Motor.
    2. Test for less than infinite resistance between the appropriate terminals.
        - If less than infinite resistance, replace the a/trans wiring harness assembly.
        - If infinite resistance, replace the B228 Drive Motor Position Sensor.
    - **If infinite resistance**
10. Refer to Circuit/System Testing.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Automatic Transmission Control Wiring Harness Removal - Transmission Case Cover** , or **Drive Motor Position Sensor Stator Removal** for A/Trans Wiring Harness Assembly or B228 Drive Motor Position Sensor replacement.

DTC P0A5E, P0A61, OR P0A64: DRIVE MOTOR PHASE U/V/W LOW CURRENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A5E

Drive Motor Phase U Low Current

DTC P0A61

Drive Motor Phase V Low Current

DTC P0A64

Drive Motor Phase W Low Current

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the drive motor generator power inverter module and no external circuits are involved.

The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0 are not set.
- The control module runs the program to detect an internal fault when the Hybrid wake-up circuit is active.

Conditions for Setting the DTC

The control module has detected a malfunction.

Action Taken When the DTC Sets

- DTCs P0A5E, P0A61, and P0A64 are Type A DTCs.
- The power inverter module requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

DTCs P0A5E, P0A61, and P0A64 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A5E, P0A61, and P0A64 is not set.

- **If any of the DTCs are set**

3. Verify the DTC does not set. If the DTC sets, replace the T6 Power Inverter Module.
    - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0A78: DRIVE MOTOR INVERTER PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A78

Drive Motor Inverter Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each insulated gate bipolar transistor assembly is monitored for fault conditions. The motor control module is part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

- The high voltage contactor relays are closed.
- High voltage greater than 100 V.

Conditions for Setting the DTC

The motor control module detects excessive current flow through the switched portion of the insulated gate bipolar transistor.

Action Taken When the DTC Sets

- P0A78 is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P0A78 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A78 is not set.
    - **If the DTC is set**
    1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    3. Verify the DTC does not set.
        - If the DTC sets, continue to Circuit/System Testing.
        - If the DTC does not set.
    4. All OK.
    - **If none of the DTCs are set**
3. All OK.

Circuit/System Testing

NOTE: **Perform Circuit/System Verification before Circuit/System Testing.**

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the High Voltage Disabling procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to Drive Motor Power Inverter Module 3 Phase Cable Replacement.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the M15 Drive Motor:
    - X3 terminal 3 phase U
    - X3 terminal 2 phase V
    - X3 terminal 1 phase W
    - **If less than infinite resistance**
    1. Disconnect the 3-phase cable assembly from the transmission. Refer to Drive Motor Power Inverter Module 3 Phase Cable Replacement.
    2. Test for infinite resistance between the AC circuit terminal and ground.
        - If less than infinite resistance, replace the 3-phase cable assembly.

        - If infinite resistance, replace the M15 Drive Motor Stator.
    - **If infinite resistance for all AC circuits**
4. Replace the T6 Power Inverter Module.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the M15 Drive Motor Stator.

    - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement** for Drive Motor 1 3-Phase Cable Assembly replacement or M15 Drive Motor replacement.
- Refer to **Drive Motor Stator Removal** for M15 Drive Motor Stator replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0A8D OR P0A8F: 14 V POWER MODULE SYSTEM VOLTAGE LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A8D

14 V Power Module System Voltage Low Voltage

DTC P0A8F

14 V Power Module System Voltage High Voltage

Circuit/System Description

The 14 V power module, often referred to as the accessory DC power control module, converts the high voltage (360 V) direct current (DC) to low voltage (14 V) DC to charge the 12 V battery and to operate the power accessories. The ECM controls the 14 V power module by supplying a 5 V pulse width modulated (PWM) signal through a control circuit. The ECM monitors 12 V battery voltage to ensure the 14 V power module is maintaining the desired voltage.

Conditions for Running the DTC

14 V power module is commanded ON.

Conditions for Setting the DTC

The ECM monitored battery voltage is less than or equal to 11 V for 60 s within a 75 s window.

Action Taken When the DTC Sets

- The charge indicator is illuminated.
- The 14 V power module stops supplying power to the 12 V system.
- DTCs P0A8D and P0A8F are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0A8D and P0A8F are Type C DTCs.

Diagnostic Aids

An improperly fastened 150-amp in-line mega-fuse may cause this DTC to set.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

1. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
   - **If the DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
   - **If the DTC is not set**
2. Perform the **DC Power Conversion Test**.

DTC P0AC4, P1E00, P25A2, P25C9, OR P26C8: HYBRID/EV POWERTRAIN/BRAKE SYSTEM/CHASSIS - CONTROL MODULE(S) REQUESTED MIL ILLUMINATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each of the diagnostic category.

DTC Descriptor

DTC P0AC4

Hybrid/EV Powertrain Control Module Requested MIL Illumination

DTC P1E00

Hybrid/EV Powertrain Control Module 2 Requested MIL Illumination

DTC P25A2

Brake System Control Module Requested MIL Illumination

DTC P25C9

Brake System Control Module 2 Requested MIL Illumination

DTC P26C8

Chassis Control Module Requested MIL Illumination

Circuit/System Description

Control modules constantly monitor the vehicle for any condition which may adversely affect vehicle performance. If a condition is detected, the module sets a DTC and sends a serial data message to the engine control module (ECM). The ECM sets a DTC to inform the technician that the module has set a DTC. The serial data message sent by the module also contains a request for the ECM to illuminate the malfunction indicator lamp (MIL).

The technician can observe the DTC that was set by the module by reviewing the ECM Freeze Frame records on the scan tool. The ECM Freeze Frame records also contain the engine operating conditions present when the DTC set.

Conditions for Running the DTC

- The vehicle is ON for greater than 3 s.
- These DTCs run continuously.

Conditions for Setting the DTC

The ECM receives a serial data message from a specific module indicating that DTC has set in the module.

Action Taken When the DTC Sets

DTCs P0AC4, P1E00, P25A2, P25C9, or P26C8 are Type A DTCs.

Conditions for Clearing the MIL/DTC

DTCs P0AC4, P1E00, P25A2, P25C9, or P26C8 are Type A DTCs.

Diagnostic Aids

Communication codes, U-codes, and P-codes that set in a module can request a DTC to be set in the ECM.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **Do not replace the engine control module for these informational DTCs.**
- **Correct any engine control and communication DTCs before diagnosing these DTCs.**

1. Vehicle in Service Mode.
2. Verify there are no engine control or communication DTCs set.
   - **If a DTC is set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If a DTC is not set**
3. Verify there are no DTCs set in any other control module.
   - **If a DTC is set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If a DTC is not set**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
   - **If the DTC sets**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If the DTC does not set**
6. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, OR P0BDC-P0BDE: DRIVE MOTOR INVERTER TEMPERATURE SENSOR(S)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AEE

Drive Motor Inverter Temperature Sensor Performance

DTC P0AEF

Drive Motor Inverter Temperature Sensor Circuit Low Voltage

DTC P0AF0

Drive Motor Inverter Temperature Sensor Circuit High Voltage

DTC P0BD2

Drive Motor Inverter Temperature Sensor 3 Performance

DTC P0BD3

Drive Motor Inverter Temperature Sensor 3 Circuit Low Voltage

DTC P0BD4

Drive Motor Inverter Temperature Sensor 3 Circuit High Voltage

DTC P0BDC

Drive Motor Inverter Temperature Sensor 5 Performance

DTC P0BDD

Drive Motor Inverter Temperature Sensor 5 Circuit Low Voltage

DTC P0BDE

Drive Motor Inverter Temperature Sensor 5 Circuit High Voltage

Circuit/System Description

This is an internal fault detection of the power inverter module, often called the drive motor generator power inverter module. This fault is handled inside the drive motor generator power inverter module and no external circuits are involved.

The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

P0AEE, P0BD2, and P0BDC

- P0AEF, P0AF0, P0BD3, P0BD4, P0BDD, and P0BDE are not set.
- 12 hours have elapsed since the vehicle has been ON.
- Ignition ON and more than 7 hours have elapsed since battery pack conditioning or charging has taken place.

- Transmission fluid and hybrid/EV powertrain control module 1 temperature sensor average is greater than 20Ã‚Â°C (68Ã‚Â°F).

P0AEF, P0BD3, and P0BDD

The ignition is ON.

P0AF0, P0BD4, and P0BDE

- The ignition is ON.
- Ignition ON, the drive motor must operate at greater than 20 N.m (14.75 lb ft) for a cumulative time of 1.5 minutes before the DTC will run.

Conditions for Setting the DTC

P0AEE, P0BD2, and P0BDC

- A 20Ã‚Â°C (68Ã‚Â°F) difference is observed between the individual inverter phase temperature sensor and the average of all the inverter phase temperatures.
- The above condition is present for 4.75 seconds.

P0AEF, P0BD3, and P0BDD

The inverter phase temperature sensor is greater than 159Ã‚Â°C (318Ã‚Â°F) for 2.5 seconds.

P0AF0, P0BD4, and P0BDE

The inverter phase temperature sensor is less than -45Ã‚Â°C (-49Ã‚Â°F) for 3 seconds.

Action Taken When the DTC Sets

- P0AEF, P0AF0, P0BD3, P0BD4, P0BDD, and P0BDE are Type A DTCs.
- P0AEE, P0BD2, and P0BDC are Type B DTCs.
- Power to the motor will be limited.

Conditions for Clearing the DTC

- P0AEF, P0AF0, P0BD3, P0BD4, P0BDD, and P0BDE are Type A DTCs.
- P0AEE, P0BD2, and P0BDC are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AEE, P0AEF, P0AF0, P0BD2, P0BD3, P0BD4, P0BDC, P0BDD, or P0BDE is not set.
    - **If any of the DTCs are set**
    1. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
    2. All OK.
    - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Drive Motor Generator Power Inverter Module replacement, programming and setup.

DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, OR P0BF0: DRIVE MOTOR PHASE U/V/W CURRENT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0BE6

Drive Motor Phase U Current Sensor Performance

DTC P0BE7

Drive Motor Phase U Current Sensor Circuit Low Voltage

DTC P0BE8

Drive Motor Phase U Current Sensor Circuit High Voltage

DTC P0BEA

Drive Motor Phase V Current Sensor Performance

DTC P0BEB

Drive Motor Phase V Current Sensor Circuit Low Voltage

DTC P0BEC

Drive Motor Phase V Current Sensor Circuit High Voltage

DTC P0BEE

Drive Motor Phase W Current Sensor Performance

DTC P0BEF

Drive Motor Phase W Current Sensor Circuit Low Voltage

DTC P0BF0

Drive Motor Phase W Current Sensor Circuit High Voltage

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the drive motor generator power inverter module and no external circuits are involved.

Conditions for Running the DTC

The control module runs the program to detect an internal fault when the Hybrid wake-up circuit is active.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, and P0BF0 are Type A DTCs.

- Propulsion will be disabled.

Conditions for Clearing the DTC

DTCs P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, and P0BF0 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, or P0BF0 is not set.
   - **If any of the DTCs are set**
3. Verify the DTC does not set. If the DTC sets, replace the T6 Power Inverter Module.
   - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0BFD: DRIVE MOTOR PHASES U-V-W NOT PLAUSIBLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0BFD

Drive Motor Phases U-V-W Not Plausible

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. Each drive motor operates utilizing 3-phase alternating current (AC) electricity. Each insulated gate bipolar transistors operates a single phase of the drive motor. Each phase is individually identified as U, V and W. The motor control module monitors the current of each phase in order to detect power inverter module over current conditions.

Because all the motor generator phase circuits are electrically joined together, they should each flow about the same amount of current. The motor control modules perform a mathematical calculation to verify that the phase current sensors are accurate. If the U-V-W phase current sensors indicate about the same amount of phase current, the sum of the calculation should be near zero. If the U-V-W phase currents are not similar, this DTC will set.

Conditions for Running the DTC

- The vehicle is ON.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

The sum of the 3 phase current sensors is greater than 149 A.

Action Taken When the DTC Sets

- P0BFD is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

P0BFD is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0BFD is not set.
    - **If any of the DTCs are set**
    1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    3. Verify the DTC does not set.
        - If the DTC sets, continue to Circuit/System Testing.
        - If the DTC does not set.
    4. All OK.
    - **If none of the DTCs are set**
3. All OK.

Circuit/System Testing

NOTE: **Perform Circuit/System Verification before Circuit/System Testing.**

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module cable connections.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the M15 Drive Motor:
    - X3 terminal 3 phase U
    - X3 terminal 2 phase V
    - X3 terminal 1 phase W
    - **If less than infinite resistance**
    1. Disconnect the 3-phase cable assembly from the transmission. Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement**.
    2. Test for infinite resistance between the AC circuit terminal and ground for each phase of the M15 Drive Motor:
        - X3 terminal 3 phase U
        - X3 terminal 2 phase V
        - X3 terminal 1 phase W
        - If less than infinite resistance, replace the 3-phase cable assembly.
        - If infinite resistance, replace the M15 Drive Motor Stator.
    - **If infinite resistance for all AC circuits**
4. Replace the T6 Power Inverter Module.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the M15 Drive Motor Stator.

    - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Stator Removal** for T15 Drive Motor Stator replacement.
- Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement** for Drive Motor 3-Phase Cable Assembly replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C01: DRIVE MOTOR HIGH CURRENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C01

Drive Motor High Current

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. The drive motor operates utilizing 3-phase AC electricity. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. The motor control module monitors the current of each phase in order to detect power inverter module overcurrent conditions. The motor control module is part of the power inverter module, and are not serviced separately.

Conditions for Running the DTC

- P0BFD, P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, and P0BF0 are not set
- The hybrid wakeup circuit is active.

Conditions for Setting the DTC

One or more phase currents are greater than 706 A.

Action Taken When the DTC Sets

- DTC P0C01 is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P0C01 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C01 is not set.
   - **If any of the DTCs are set**
   1. Clear the DTC, vehicle OFF for 2 minutes to allow all control modules to shut down.
   2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   3. Verify the DTC does not set.
      - If the DTC sets, continue to Circuit/System Testing.
      - If the DTC does not set.
   4. All OK.
   - **If none of the DTCs are set**
3. All OK.

Circuit/System Testing

NOTE: **Perform Circuit/System Verification before Circuit/System Testing.**

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the M15 Drive Motor:
    - X3 terminal 3 phase U
    - X3 terminal 2 phase V
    - X3 terminal 1 phase W
    - **If less than infinite resistance**
    1. Disconnect the 3-phase cable assembly from the transmission. Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement**.
    2. Test for infinite resistance between the AC circuit terminal and ground for each phase of the M15 Drive Motor:
    3. X3 terminal 3 phase U
    4. X3 terminal 2 phase V
    5. X3 terminal 1 phase W
        - If less than infinite resistance, replace the 3-phase cable assembly.
        - If infinite resistance, replace the M15 Drive Motor Stator.
    - **If infinite resistance for all AC circuits**
4. Replace the T6 Power Inverter Module.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the M15 Drive Motor.

    - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Stator Removal** for T15 Drive Motor Stator replacement.
- Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement** for Drive Motor 3-Phase Cable Assembly replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C0B: DRIVE MOTOR INVERTER SUPPLY VOLTAGE CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C0B

Drive Motor Inverter Supply Voltage Circuit

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- Vehicle is ON or Charge Mode is active.
- The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module does not detect voltage at the insulated gate bi-polar transistor bias supply.

Action Taken When the DTC Sets

- P0C0B is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P0C0B is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C0B is not set.
   - **If any of the DTCs are set**
   1. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   2. All OK.
   - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C11-P0C13: DRIVE MOTOR INVERTER PHASE U/V/W HIGH TEMPERATURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C11

Drive Motor Inverter Phase U High Temperature

DTC P0C12

Drive Motor Inverter Phase V High Temperature

DTC P0C13

Drive Motor Inverter Phase W High Temperature

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon hybrid/EV powertrain control module 1 commands. The motor control module controls the speed, direction and output torque of the drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors. The drive motor operates utilizing 3 phase AC. Each insulated gate bipolar transistor operates a single phase of the drive motor. Each phase is individually identified as U, V and W. The motor control module monitors the temperature of each phase in order to detect power inverter module over-temperature conditions.

Conditions for Running the DTC

- DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, P0BDC-P0BDE, P190B, or P190C is not set.
- Vehicle ON.

Conditions for Setting the DTC

The phase temperature has exceeded 97Ã‚Â°C (206Ã‚Â°F) for 2 seconds.

Action Taken When the DTC Sets

- DTCs P0C11, P0C12, and P0C13 are Type A DTCs.
- As the temperature increases, power to the motor will be limited.

Conditions for Clearing the DTC

DTCs P0C11, P0C12, and P0C13 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Power Inverter Module Description and Operation

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify DTC P0480, P0C47, P1E8C, P1E8D, P0CE9, P1F44, P1F45, or P1EC6 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
2. Inspect for proper coolant level in the hybrid cooling system reservoir.
   - **If coolant level is low**

     Refer to **Hybrid Cooling System Loss of Coolant (Drive Motor Battery Cooling System)** **Hybrid Cooling System Loss of Coolant (Drive Motor Generator Power Inverter Module Cooling System)** for Drive Motor Generator Power Inverter Module Cooling System.

   - **If coolant level is OK**
3. Inspect the hybrid/EV cooling system radiator for debris or obstruction.
   - **If a concern is found**

     Repair or replace the restricted or damaged components as necessary.

   - **If no concern is found**
4. Inspect for proper operation of all hybrid/EV system coolant pumps. Refer **Hybrid/EV Electronics Cooling Diagnostic (Drive Motor Generator Power Inverter Module Cooling System)** **Hybrid/EV Electronics Cooling Diagnostic (Drive Motor Battery Cooling System)** for Drive Motor Generator Power Inverter Module Cooling System.
   - **If a concern is found**

     Repair or replace the coolant pumps as necessary.

   - **If no concern is found**
5. Command the cooling fans through all operating speeds.
   - **If the cooling fans do not operate in all speeds**

     Refer to **Hybrid/EV Electronics Cooling Diagnostic (Drive Motor Generator Power Inverter Module Cooling System)** **Hybrid/EV Electronics Cooling Diagnostic (Drive Motor Battery Cooling System)** for Drive Motor Generator Power Inverter Module Cooling System.

   - **If the cooling fans operate in all speeds**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P0C17 OR P1B0F: DRIVE MOTOR 1 POSITION NOT LEARNED/LEARN INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C17

Drive Motor 1 Position Not Learned

DTC P1B0F

Drive Motor 1 Position Learn Incorrect

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

The motor control module will attempt to learn the position at hybrid wake-up, vehicle ON only if no valid offset value has ever been learned. The non-learned condition would normally occur only after a motor control module reprogramming event.

Conditions for Running the DTC

P0C17

- Vehicle is cycled from OFF to ON.
- The motor control module has no valid drive motor position sensor offset value in memory.

P1B0F

- Vehicle is cycled from ON to OFF.
- The motor control module has learned a valid drive motor position sensor offset value at least once.

Conditions for Setting the DTC

Condition 1

Position sensor offset value not learned because drive motor speed is greater than 150 RPM.

Condition 2

Position sensor offset value not learned because hybrid battery voltage as observed at the motor control module is less than 191 V.

Condition 3

Position sensor offset value not learned because drive motor phase to phase current difference is less than 30 A.

Action Taken When the DTC Sets

P0C17

- DTC P0C17 is a Type A DTC.
- Propulsion is disabled. The vehicle cannot operate without a previously stored offset value or the ability to learn offset.

P1B0F

- DTC P1B0F is a Type B DTC.
- The motor control module operates the drive motor generator using the last valid learned offset.

Conditions for Clearing the DTC

- DTC P0C17 is a Type A DTC.

- DTC P1B0F is a Type B DTC.

Diagnostic Aids

- If the vehicle is powered off while driving DTC P1B0F may set.
- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module, often referred to as the drive motor generator power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 suggests intermittent position sensor circuit or connector problems.
- The drive motor control module 1 monitors and report the Drive Motor Position Sensor Offset Learn Status. This information can be observed using a scan tool. Status is updated during the transition from vehicle ON to vehicle OFF during normal conditions. Alternating, and possibly intermittent, appearance of "Not Run," "Learn Failed Motor Speed Not Zero," and "Motor Current Incorrect" suggests intermittent position sensor circuit or connector problems.
- Intermittent appearance of "Motor Current Incorrect" suggests loose 3-phase cable assembly connections at the power inverter module or drive motor.

Drive Motor Position Sensor Offset Learn Status Descriptions

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
Not Run	Not run yet, waiting for key off	NA
	Aborted run due to detecting high voltage too low or motor speed too high	Key off while rolling, drive motor position sensor circuit problems, or high voltage system problems
	Ran but failed due to out of range values	Resolver or drive motor problems
Learn Successful	Position offset learned and stored successfully	NA
Learn Failed Motor Speed Not Zero	Speed high during offset learn but not before	Drive motor position sensor circuit problems
Learn Failed - High Voltage Too Low	High voltage contactors opened during offset learn	High voltage system problems
Motor Current Incorrect	Low current on 3-phase circuits between power inverter module and drive motor	Drive motor, power inverter module, or 3-phase cable assembly problem

Reference Information

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTCs P0A3F, P0A40, P0A78, P0C01, P0C05, P0C0B, P0C4E, P0C52, P0C53, P0C5C, P0C5D, P1B03, or P1B0D is not set.
    - **If any of the DTCs are set**
    - Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
    - **If none of the DTCs are set**

NOTE: **When turning vehicle OFF, open and close the driver door and wait 1 minute to**

allow all modules to shut down.

3. Cycle vehicle power 4 times, using a scan tool to monitor the state of the Drive Motor Position Sensor Offset Learn Status.
    - **If Drive Motor Position Sensor Offset Learn Status showed Motor Current Incorrect all 4 cycles**

      Refer to 3-Phase Circuit Malfunction in Circuit/System Testing.

    - **If Drive Motor Position Sensor Offset Learn Status did not show Motor Current Incorrect all 4 cycles**
4. Vehicle ON.
5. Verify DTC P0C17 or P1B0F is not set.
    - **If any of the DTCs are set**
    1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
        - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
        - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
    3. All OK.
    - **If none of the DTCs are set**
6. All OK.

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification before proceeding with Circuit/System Testing**

3-Phase Circuit Malfunction

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Perform the **High Voltage Disabling** procedure for servicing the T6 Power Inverter Module or T12 Transmission.
2. Remove the 3-phase cable assembly from the T6 Power Inverter Module. Refer to **Drive Motor Power Inverter Module Replacement**.
3. Test for infinite resistance between each of the AC circuit terminals listed below and ground for each phase of the M15 Drive Motor:

   Drive Motor

   - X5 terminal 3 phase U
   - X5 terminal 2 phase V
   - X5 terminal 1 phase W
   - **If less than infinite resistance**
   1. Disconnect the 3-phase cable assembly from the transmission.
   2. Test for infinite resistance between the AC circuit terminal and ground and between the AC circuit terminal and the aluminum cable mounting block.
      - If less than infinite resistance, replace the 3-phase cable assembly.
      - If infinite resistance, replace the M15 Drive Motor Stator.
   - **If infinite resistance for all AC circuits**
4. Replace the T6 Power Inverter Module.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
   - **If the DTC sets**

     Replace the M15 Drive Motor Stator.

   - **If the DTC does not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement** for Drive Motor 3-Phase Cable Assembly replacement.
- Refer to **Drive Motor Stator Removal** for T15 Drive Motor Stator replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C19: DRIVE MOTOR TORQUE DELIVERED PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C19

Drive Motor Torque Delivered Performance

Circuit/System Description

The drive motor is controlled by a motor control module. The motor control module constantly monitors the requested torque and the delivered torque of the drive motor. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- Vehicle ON.
- DTCs P1AEC, P1AE8, P1AE9, P1B41, P1AF5, P1B0C, P0BE6, P0BE7, P0BE8, P0BEA, P0BEB, P0BEC, P0BEE, P0BEF, P0BF0 are not set.
- The drive motor is commanded to develop torque greater than 148 N.m (109 lb ft).

Conditions for Setting the DTC

The motor control module has detected that drive motor torque is not being delivered as expected.

Action Taken When the DTC Sets

- P0C19 is a Type A DTC.
- The power to the motor will be limited.

Conditions for Clearing the DTC

P0C19 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0C19 is not set.
    - **If the DTC is set**
    1. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set.
    2. All OK.
    - **If the DTC is not set**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the M15 Drive Motor Stator and Rotor.

    - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Stator Removal** for M15 Drive Motor Stator replacement.
- Refer to **Drive Motor Rotor Removal**
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C2D OR P0C2E: ELECTRIC/AUXILIARY TRANSMISSION FLUID PUMP CONTROL MODULE FEEDBACK CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C2D

Electric/Auxiliary Transmission Fluid Pump Control Module Feedback Circuit Low Voltage

DTC P0C2E

Electric/Auxiliary Transmission Fluid Pump Control Module Feedback Circuit High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump by providing a 12 V ground pulse width modulation (PWM) signal to the pump motor to request a specific motor speed.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

DTC P0C2D

The pulse width modulated (PWM) feedback signal measured by hybrid/EV powertrain control module 1 is less than 2% for 6 seconds.

DTC P0C2E

The pulse width modulated (PWM) feedback signal measured by hybrid/EV powertrain control module 1 is greater than 98% for 6 seconds.

Action Taken When the DTC Sets

- DTCs P0C2D and P0C2E are Type A DTCs.
- Vehicle speed will be limited, the Propulsion Power is Reduced message will be illuminated.

Conditions for Clearing the DTC

- DTCs P0C2D and P0C2E are Type A DTCs.
- The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Power Inverter Module Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no ECM loss of communication DTCs U0100/U1818 are set indicating that a KR75 Engine Controls Ignition Relay concern is present.
    - **If any of the DTCs were set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If the DTCs were not set**
2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
3. Verify the DTC does not set.
    - **If the DTC sets**

      Refer to Circuit/System Testing.

    - **If the DTC is not set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G5 Transmission Fluid Pump Electric/Auxiliary.
2. Test for less than 5 Ω between the ground circuit terminal 6 and ground.
    - **If 5 Ω or greater**

      Repair the open/high resistance on the ground circuit.

    - **If less than 5 Ω**
3. Vehicle ON.
4. Test for B+ between the B+ circuit terminal 1 and the ground circuit terminal 6.
    - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω and the fuse is blown
    3. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.
    - **If B+**

NOTE: **This ignition circuit is powered by the KR75 Engine Controls Ignition Relay.**

5. Test for B+ between the ignition circuit terminal 3 and the ground circuit terminal 6.
    - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 3 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω and the fuse is blown

   3. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.
   - **If B+**
6. Connect a test lamp between the enable circuit terminal 5 and the ground circuit terminal 6.
7. Vehicle OFF. Verify the test lamp is OFF.
   - **If the test lamp is ON**
   1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
   2. Test for less than 1 V between the pump enable circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Replace the T6 Power Inverter Module.
   - **If the test lamp is OFF**
8. Vehicle ON, verify the test lamp illuminates. Command the Auxiliary Transmission Fluid Pump ON (20 - 70%) with a scan tool if necessary.
   - **If the test lamp is OFF**
   1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
   2. Test for infinite resistance between the enable circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the enable circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω
   4. Replace the X1 harness connector at the T6 Power Inverter Module.
   - **If the test lamp is ON**
9. Connect a test lamp between the control circuit terminal 4 and the B+ circuit terminal 1.
10. Verify that a test lamp changes illumination between bright (20%) and dim (70%) when commanding the Auxiliary Transmission Fluid Pump ON between 20% and 70% with a scan tool.
    - **If the test lamp is always dim or does not illuminate**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module. Vehicle ON.
    2. Test for less than 1 V between the control circuit terminal and ground.
       - If 1 V or greater, repair the short to voltage on the circuit.
       - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω
    4. Replace the T6 Power Inverter Module.
    - **If the test lamp is always bright**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Test for infinite resistance between the control circuit and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω
    4. Replace the T6 Power Inverter Module.
    - **The test lamp changes illumination between bright (20%) and dim (70%)**
11. Remove the test lamp.
12. Verify the scan tool, Auxiliary Transmission Fluid parameter is 0%.
    - **If greater than 0%**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Test for infinite resistance between the feedback circuit terminal 5 and ground.

    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
  3. Replace the T6 Power Inverter Module.
  - **If 0%**
13. Install a 3 A fused jumper wire between the feedback circuit terminal 5 and the ground circuit terminal 6.
14. Verify the scan tool Hybrid Battery Pack Coolant Pump parameter is greater than 90%.
  - **If 90% or less**
  1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
  2. Test for less than 1 V between the feedback circuit terminal and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
  3. Test for less than 2 Ω in the feedback circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω
  4. Replace the T6 Power Inverter Module.
  - **If greater than 90%**
15. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Transmission Fluid Pump Removal** for G5 Auxiliary Transmission Fluid Pump Electric/Auxiliary, often referred to as the A/Trans Aux Fluid Pump Motor, replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming.

DTC P0C4E: DRIVE MOTOR POSITION EXCEEDED LEARNING LIMIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C4E

Drive Motor Position Exceeded Learning Limit

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The motor control module monitors the angular position, speed and direction of the drive motor rotor based upon the signals of the resolver-type position sensor. The position sensor contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At vehicle ON, the motor control module outputs a 7 V AC, 12 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact position, speed and direction of the drive motor rotor.

A measurement called offset is needed for accurate determination of the motor position. Offset is the relationship between the position sensor and the drive motor generator output shaft. Whenever the vehicle is cycled to OFF, the motor control module attempts to learn the offset of the drive motor position sensor by rapidly oscillating the motor and observing the position sensor signals.

Conditions for Running the DTC

The vehicle is cycled OFF.

Conditions for Setting the DTC

- The position sensor total offset exceeds 15 degrees during the learning process.
- The current learned value differs from the previous learned value by greater than 10 degrees.

Action Taken When the DTC Sets

DTC P0C4E is a Type A DTC.

Conditions for Clearing the DTC

DTC P0C4E is a Type A DTC.

Diagnostic Aids

- The drive motor position sensor circuits operate at very low current. These circuits are susceptible to moisture intrusion, corrosion, and terminal damage. Extreme care must be taken when probing terminals and manipulating harnesses. Poor terminal connections can result in intermittent operation.
- If the customer comments that the problem occurs only during moist environmental conditions: rain, snow, vehicle wash, etc., inspect the sensor wiring for signs of water intrusion.
- The sensor circuit loops are a twisted pair with each pair covered in a foil shield. The shield circuits outside of the transmission are grounded to a stud on the power inverter module, often referred to as the drive motor generator power inverter module.
- The drive motor position sensor harness circuits are shielded. Improperly grounded shield circuits may cause inaccurate sensor signals.
- Intermittent appearance of DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 suggests intermittent position sensor circuit or connector problems.
- Drive motor control module monitors and reports the Drive Motor Position Sensor Offset Learn Status. This information can be observed using a scan tool. Status is updated during the transition from vehicle ON to vehicle OFF during normal conditions. Alternating, and possibly intermittent, appearance of "Not Run," "Learn Failed Motor Speed Not Zero," and "Motor Current Incorrect" suggests intermittent position sensor circuit or connector problems.

Drive Motor Position Sensor Offset Learn Status Descriptions

Drive Motor Position Sensor Offset Learn Status	Description	May Be Caused By
Not Run	Not run yet, waiting for key off	NA
	Aborted run due to detecting high voltage too low or motor speed too high	Key off while rolling, drive motor position sensor circuit problems, or high voltage system problems
	Ran but failed due to out of range values	Resolver or drive motor problems
Learn Successful	Position offset learned and stored successfully	NA
Learn Failed Motor Speed Not Zero	Speed high during offset learn but not before	Drive motor position sensor circuit problems
Learn Failed - High Voltage Too Low	High voltage contactors opened during offset learn	High voltage system problems
Motor Current Incorrect	Low current on 3-phase circuits between power inverter module and drive motor	Drive motor, power inverter module, or 3-phase cable assembly problem

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03 is not set.
    - **If any of the DTCs are set**

      Refer to **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**.

    - **If none of the DTCs are set**
3. Verify DTC P0C4E is not set.
    - **If the DTC sets**
    1. Perform each of the operations listed below one at a time until the fault is corrected.
        1. Replace the B228 Drive Motor Position Sensor
        2. Replace the T6 Power Inverter Module
    2. Repeat the DTC check in step 3.
    - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Position Sensor Stator Removal** for B228 Drive Motor Position Sensor replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P0C76: HYBRID/EV BATTERY SYSTEM HIGH VOLTAGE PRESENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0C76

Hybrid/EV Battery System High Voltage Present

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors system high voltage via the battery energy control module. The battery energy control module will diagnose its own systems and determine when a fault condition is present. Diagnostics and system status is communicated from the battery energy control module to the hybrid/EV powertrain control module 2 through serial data. The hybrid/EV powertrain control module 2 is the host controller for diagnostic trouble code (DTC) information.

The hybrid/EV battery pack contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC to be connected to the vehicle or safely contained within the hybrid/EV battery pack. For more information on the high voltage contactors, refer to **Drive Motor Battery System Description** .

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

The high voltage bus voltage is greater than 60 V 3.5 seconds after the contactors have been commanded open.

Action Taken When the DTC Sets

- DTC P0C76 is a Type A DTC.
- The hybrid/EV powertrain control module 1 requests hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

- DTC P0C76 is a Type A DTC.
- The **Clear Secured High Voltage DTCs** reset function must be performed to prevent resetting the DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify the contactors are operating normally. Refer to **Hybrid/EV Battery Voltage Present** .
   - **If the contactors are not operating properly**

     Repair as necessary.

   - **If the contactors are operating properly**
2. Vehicle ON.
3. With a scan tool, perform the **Clear Secured High Voltage DTCs** reset function.
4. Verify DTC P0C76 is not set.
   - **If the DTC is set**

     Replace the T6 Power Inverter Module.

   - **If the DTC is not set**
5. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P150D OR P150E: SUPPLY VOLTAGE CIRCUIT 2/1 LOW VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P150D

Supply Voltage Circuit 2 Low Voltage

DTC P150E

Supply Voltage Circuit 1 Low Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 and the motor control modules share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground. The motor control modules and the hybrid/EV powertrain control module 1 are part of the power inverter module and are not serviced separately.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P150D

Battery voltage on circuit 2 is less than 8.0 V for more than 2.0 seconds.

P150E

Battery voltage on circuit 1 is less than 8.0 V for more than 2.0 seconds.

Action Taken When the DTC Sets

- DTC P150D and P150E are Type C DTCs.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P150D and P150E are Type C DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Testing

1. Vehicle ON.
2. Verify DTC P0562 or P0563 is not set.
    - **If any of the DTCs are set**

Refer to **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC** .

- **If none of the DTCs are set**

3. Verify DTC P150D or P150E is not set.
    - **If DTC P150D is set**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Verify a test lamp illuminates between the B+ circuit terminal M4 and ground.
        - If the test lamp does not illuminate and the circuit fuse is good
        1. Remove the test lamp.
        2. Test for less than 2 Ω in the B+ circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
        - If the test lamp does not illuminate and the circuit fuse is open
        1. Remove the test lamp.
        2. Test for infinite resistance between the B+ circuit and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If infinite resistance, replace the T6 Power Inverter Module.
        - If the test lamp illuminates
    3. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
        - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
        - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
    4. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
    5. All OK.
    - **If DTC P150E is set**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Verify a test lamp illuminates between the B+ circuit terminal M1 and ground.
        - If the test lamp does not illuminate and the circuit fuse is good
        1. Remove the test lamp.
        2. Test for less than 2 Ω in the B+ circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
        - If the test lamp does not illuminate and the circuit fuse is open
        1. Remove the test lamp.
        2. Test for infinite resistance between the B+ circuit and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If infinite resistance, replace the T6 Power Inverter Module.
        - If the test lamp illuminates
    3. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
        - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
        - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
    4. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set

    5. All OK.
        - **If none of the DTCs are set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P15F1: AXLE TORQUE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P15F1

Axle Torque Request Signal Message Counter Incorrect

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor monitors the data to verify that the indicated axle torque requested calculation is correct.

Conditions for Running the DTC

- Vehicle is ON for more than 0.5 s.
- The system voltage is above 9.5 V.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15F1 is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P15F1 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P15F1 is not set.
    - **If the DTC is set**

      Replace the K20 ECM.

- **If the DTC is not set**

3. Verify the DTC does not set.
    - **If the DTC is set**

      Replace the T6 Power Inverter Module.

    - **If the DTC is not set**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P15FC: HYBRID/EV BATTERY CONTACTOR STATUS MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P15FC

Hybrid/EV Battery Contactor Status Message Counter Incorrect

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the drive motor generator power inverter module and no external circuits are involved.

Conditions for Running the DTC

The control module runs the program to detect an internal fault when the Hybrid wake-up circuit is active.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Action Taken When the DTC Sets

- DTC P15FC is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P15FC is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify no 12V battery system voltage LOW DTCs are set or that a low 12V battery condition was not present at the time P15FC was set.
    - **If any of the DTCs were set or a low 12V battery condition was present**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If the DTCs were not set or a low 12V battery condition was not present**

3. Verify DTC P15FC is not set.
    - **If the DTC is set**

      Replace the T6 Power Inverter Module.

    - **If the DTC is not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.

DTC P16F3: CONTROL MODULE REDUNDANT MEMORY PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P16F3

Control Module Redundant Memory Performance

Circuit/System Description

This diagnostic applies to internal microprocessor integrity conditions within the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately. The hybrid/EV powertrain control module 1 monitors its ability to read and write to the memory. The hybrid/EV powertrain control module 1 processor stores identical data in two locations and compares the data to verify that the stored data is correct.

Conditions for Running the DTC

The system voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected that when some critical data is stored it is not the same as when it is retrieved.

Action Taken When the DTC Sets

- P16F3 is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P16F3 is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.

2. Verify any communication U-code DTC is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Verify DTC P16F3 is not set.
    - **If the DTC is set**
4. Verify the DTC does not set. If the DTC sets, replace the T6 Power Inverter Module.
    - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P16F4: CONTROL MODULE TRANSMISSION RANGE SWITCH INPUT CIRCUITRY PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P16F4

Control Module Transmission Range Switch Input Circuitry Performance

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, is a hall-effect switch attached to the transmission case within the transmission. The 5 outputs from the switch indicate which position is selected by the transmission manual shaft. Five outputs (A, B, C, P, S) are range selection inputs to the hybrid/EV powertrain control module 1. The input voltage at the modules is high when the switch is open and low when the switch is closed to ground. The state of each input is displayed on the scan tool as Internal Mode Switch A/B/C/P/S. The Internal Mode Switch Range input parameters represented are transmission range signal A, signal B, signal C, and signal P signal S. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

- The vehicle is ON.
- Ignition voltage is greater than 9.5 V.

Conditions for Setting the DTC

The control module has detected the commanded transmission range state is not correct based upon internal calculations or by a comparison to input or output torque conditions.

Action Taken When the DTC Sets

- P16F4 is a Type A DTC.
- Vehicle propulsion will be disabled.

Conditions for Clearing the DTC

P16F4 is a Type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3 is not set.
    - **If any of the DTCs are set**

      Refer to **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3** .

    - **If none of the DTCs are set**
2. Verify that DTC P16F4 is not set.
    - **If the DTC is set**
    1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
        - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
        - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
    2. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
    3. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
    4. All OK
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.

DTC P16FF: ENGINE CONTROLS IGNITION RELAY REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P16FF

Engine Controls Ignition Relay Request Signal Message Counter Incorrect

Circuit/System Description

The Chassis Control Module sends a powertrain relay request to the ECM over serial data. The ECM sets this DTC when it detects a discrepancy in the structure of this message, causing the message integrity to be questioned.

Conditions for Running the DTC

- The propulsion system is active.
- Arbitrated battery voltage is greater than 11 V.
- Serial data communication is greater than 3 s.

Conditions for Setting the DTC

- The ECM has detected 8 engine controls ignition relay signal rolling count errors out of 10 samples.

  OR

- Continuous engine controls ignition relay signal rolling count errors for 2 s out of a 2.5 s window.

Action Taken When the DTC Sets

DTC P16FF is a Type A DTC.

Conditions for Clearing the DTC

DTC P16FF is a Type A DTC.

Diagnostic Aids

When attempting to set ECM serial data DTCs, run the vehicle in propulsion system active mode for at least 1 minute, and then shut the vehicle off for 30 seconds. Following this procedure will allow for a complete ECM shutdown.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Run the vehicle in propulsion system active mode for 1 minute, then vehicle OFF for 30 seconds.
2. Verify DTC P16FF is not set.
    - **If the DTC is set**
    1. Verify the K20 ECM has the latest calibration in Calibration Information.
        - If the K20 ECM does not have the latest calibration, program the K20 ECM.
        - If the K20 ECM has the latest calibration, replace the K20 ECM.
    2. Verify the DTC does not set.
        - If the DTC is set, replace the K20 ECM.
        - If the DTC does not set
    3. All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for ECM replacement, programming and setup.

DTC P190A-P190C: DRIVE MOTOR 1 INVERTER PHASE U/V/W TEMPERATURE ERRATIC

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P190A

Drive Motor 1 Inverter Phase U Temperature Erratic

DTC P190B

Drive Motor 1 Inverter Phase V Temperature Erratic

DTC P190C

Drive Motor 1 Inverter Phase W Temperature Erratic

Circuit/System Description

This is an internal fault detection of the power inverter module, often referred to as the drive motor generator power inverter module. This fault is handled inside the power inverter module, and no external circuits are involved.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

The inverter phase temperature is intermittent.

Actions Taken When the DTC Sets

- DTCs P190A-P190C are Type A DTCs.
- Propulsion will be reduced.

Conditions for Clearing the DTC

DTCs P190A-P190C are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTCs P190A-P190C are not set.
    - **If any of the DTCs are set**
    1. Verify the K114A Hybrid Powertrain Control Module has the latest calibration in Calibration Information.
        - If the K114A Hybrid Powertrain Control Module does not have the latest calibration, program the K114A Hybrid Powertrain Control Module.
        - If the K114A Hybrid Powertrain Control Module has the latest calibration, replace the T6 Power Inverter Module.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the T6 Power Inverter Module.
        - If the DTC does not set
    3. All OK.
    - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module replacement, programming, and setup

DTC P1AE8 OR P1AE9: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SENSE CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1AE8

Drive Motor Control Module Hybrid/EV Battery Voltage Sense Circuit Low Voltage

DTC P1AE9

Drive Motor Control Module Hybrid/EV Battery Voltage Sense Circuit High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The drive motor control module monitors its internal high voltage sensor for correct operation, no external circuits are involved. The modules listed below are part of the power inverter module and are not serviced separately.

- Hybrid/EV powertrain control module 1
- Motor control module

Conditions for Running the DTC

- The vehicle is ON.
- The system voltage is greater than 9.5 V.
- The high voltage contactor relays are closed.

Conditions for Setting the DTC

P1AE8

With the hybrid/EV battery system contactors closed, the drive motor control module detects high voltage sensor voltage less than 30 V.

P1AE9

The drive motor control module detects high voltage sensor voltage greater than 600 V.

Action Taken When the DTC Sets

- P1AE8 and P1AE9 are Type A DTCs.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P1AE8 and P1AE9 are Type A DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1AEE is not set.
    - **If the DTC is set**

      Refer to **DTC P1AEC or P1AEE**.

    - **If the DTC is not set**
3. Verify DTC P1AE8 and P1AE9 is not set.
    - **If any of the DTCs are set**
4. Verify the DTC does not set. If the DTC sets, replace the T6 Power Inverter Module.
    - **If none of the DTCs are set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.

DTC P1AEC OR P1AEE: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1AEC

Drive Motor Control Module Hybrid/EV Battery System Voltage

DTC P1AEE

Drive Motor Control Module Hybrid/EV Battery System Voltage High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module contains the drive motor control module. The motor control module measures hybrid battery high voltage with several internal sensors. The hybrid/EV powertrain control module 2 also monitors high voltage with several internal sensors. The hybrid/EV powertrain control module 2 high voltage measurement is broadcast over serial data. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

P1AEC

The motor control module compares the motor control module voltage value with the hybrid/EV powertrain control 2 battery pack voltage value to insure accuracy.

P1AEE

The motor control module monitors for high voltage that is greater than the system expects during normal operation.

Conditions for Running the DTC

The hybrid/EV battery system contactor relays are closed.

P1AEC

P1AE8 or P1AE9 are not set.

Conditions for Setting the DTC

P1AEC

A difference of more than 40 V on the high voltage circuit is detected between the hybrid/EV powertrain control module 1 and the hybrid/EV powertrain control module 2 high voltage sensor.

Or

A difference of more than 50 V on the high voltage circuit is detected between the motor control module and the sum of the isolation voltage sensor values.

P1AEE

Greater than 443 V on the high voltage circuit is detected by the motor control module.

Action Taken When the DTC Sets

P1AEC

- P1AEC is a Type A DTC.
- The power to the motor will be limited.

P1AEE

- P1AEE is a Type A DTC.
- Propulsion will be disabled

Conditions for Clearing the DTC

- P1AEC is a Type A DTC.
- P1AEE is a Type A DTC.

Diagnostic Aids

Conditions such as loss of battery energy control module power or ground or removal of the high voltage manual disconnect while the vehicle was driving could create a voltage surge that may set DTC P1AEE. History DTC P1AEE may indicate that the high voltage contactor relays opened while large current flow was present.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0ABB, P0ABC, or P0ABD is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Verify DTC P1AEC or P1AEE is not set.
    - If the DTC sets, replace the T6 Power Inverter Module.
    - If the DTC does not set.
4. All OK.
    - **If none of the DTCs are set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1AF0: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE SYSTEM ISOLATION LOST

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1AF0

Drive Motor Control Module Hybrid/EV Battery Voltage System Isolation Lost

Circuit/System Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis.

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module and the hybrid/EV powertrain control module 1. The motor control module monitors high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis when the high voltage contactors are closed. The hybrid/EV powertrain control module 2 also tests the hybrid/EV battery pack for high voltage loss of isolation but when the high voltage contactors are open.

If the motor control module detects an isolation fault on either the positive or negative high voltage bus, the hybrid/EV powertrain control module 1 reports a fault. The isolation fault may be caused by any component in the high voltage system.

Conditions for Running the DTC

- P1AE8, P1AE9, P1AEC, P1AF5, P1B0C, or P1B41 is not set.
- The high voltage contactor relays are closed.
- High voltage is greater than 50 V.
- Ignition is ON.
- The vehicle is not being charged or the drive motor is commanded to develop torque.

Conditions for Setting the DTC

The ratio between negative Mid-Pack Voltage and positive Mid-Pack Voltage is greater than 4.53 V or less than 0.21 V for greater than 2.5 seconds.

Action Taken When the DTC Sets

P1AF0 is a Type B DTC.

Conditions for Clearing the DTC

P1AF0 is a Type B DTC.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AA6 is not set.
    - **If the DTC is set**

      Refer to **DTC P0AA6 or P1AE6** .

- **If the DTC is not set**

3. Verify DTC P0A78, P0BFD or P0C01 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
4. Verify DTC P1AF0 is not set.
    - **If the DTC is set**

      Refer to **Loss of Isolation on the High Voltage Main Bus** .

    - **If the DTCs is not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P1AF4 OR P1AF5: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 1 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1AF4

Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 Low Voltage

DTC P1AF5

Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 1 High Voltage

Circuit/System Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis.

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The motor control module measures hybrid battery high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis. The motor control module tests for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 also tests the hybrid/EV battery pack for high voltage loss of isolation, but only when the high voltage contactor relays are open.

Conditions for Running the DTC

P1AF4 and P1AF5

- The vehicle is ON.
- The hybrid/EV contactors are closed.
- The vehicle is not being charged or the drive motor is commanded to develop torque.

Conditions for Setting the DTC

P1AF4

The motor control module detects isolation sensor voltage less than 15 V.

P1AF5

The motor control module detects the value of the mid-pack voltage subtracted from the pack voltage is greater than 30 V.

Action Taken When the DTC Sets

DTCs P1AF4 and P1AF5 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1AF4 and P1AF5 are Type B DTCs.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AA6 is not set.
    - **If the DTC is set**

      Refer to **DTC P0AA6 or P1AE6** .

    - **If the DTC is not set**
3. Verify DTC P1AF4 or P1AF5 is not set.
    - **If any of the DTCs are set**

      Refer to **Loss of Isolation on the High Voltage Main Bus** .

    - **If the DTC is not set**
4. Verify no other DTCs are set.
    - **If any DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other DTCs are set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P1B0B OR P1B0C: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING CIRCUIT 2 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1B0B

Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 Low Voltage

DTC P1B0C

Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Circuit 2 High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The motor control module measures hybrid battery high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis. The motor control module tests for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 also tests the hybrid/EV battery pack for high voltage loss of isolation, but only when the high voltage contactor relays are open.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

P1B0B

The motor control module detects isolation sensor voltage less than 15 V.

P1B0C

The motor control module detects isolation sensor voltage greater than 30 V.

Action Taken When the DTC Sets

DTCs P1B0B and P1B0C are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1B0B and P1B0C are Type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1BOB or P1B0C is not set.
   - **If any of the DTCs are set**

     Refer to **Loss of Isolation on the High Voltage Main Bus** .

   - **If none of the DTCs are set**

3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P1B0D: DRIVE MOTOR 1 CONTROL MODULE DRIVE MOTOR 1 OVERSPEED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1B0D

Drive Motor 1 Control Module Drive Motor 1 Overspeed

Circuit/System Description

The drive motor position sensor is monitored by the drive motor control module. The drive motor control module monitors the angular position, speed and direction of the drive motor based upon the signals of the resolver-type position sensor. The position sensor allows the drive motor control module to determine the exact position, speed and direction of the drive motor. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

Vehicle is ON.

Conditions for Setting the DTC

Drive motor 1 speed is greater than 9,250 RPM.

Action Taken When the DTC Sets

- DTC P1B0D is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P1B0D is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify no other Hybrid Transmission DTCs are set.
    - **If other Hybrid Transmission DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other Hybrid Transmission DTCs are set**
3. Verify DTC P1B0D is not set.
    - **If any of the DTCs are set**

1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
2. Verify the DTC does not set.
    - If the DTC sets, replace the T6 Power Inverter Module.
    - If the DTC does not set.
3. All OK

- **If none of the DTCs are set**

4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup

DTC P1B41: DRIVE MOTOR CONTROL MODULE HYBRID/EV BATTERY VOLTAGE ISOLATION SENSING PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1B41

Drive Motor Control Module Hybrid/EV Battery Voltage Isolation Sensing Performance

Circuit/System Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis.

The power inverter module, often referred to as the drive motor generator power inverter module, contains the drive motor control module. The motor control module measures hybrid battery high voltage with several internal sensors. The motor control module tests for loss of isolation between each high voltage bus and vehicle chassis. The motor control module tests for isolation when the high voltage contactor relays are closed. The hybrid/EV powertrain control module 2 only tests the hybrid/EV battery pack for high voltage loss of isolation when the high voltage contactor relays are open.

Conditions for Running the DTC

- DTC P1AE8, P1AE9, P1B0B, P1B0C, P1AEC, P1AF5, or P1AF4 is not set.
- The vehicle is ON.
- The hybrid/EV contactors are closed.
- The vehicle is not being charged or the drive motor is commanded to develop torque.

Conditions for Setting the DTC

The difference between the voltage sensed and hybrid battery voltage is greater than 50 V.

Action Taken When the DTC Sets

DTC P1B41 is a Type B DTC.

Conditions for Clearing the DTC

DTC P1B41 is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0AA6 is not set.
    - **If the DTC is set**

      Refer to DTC P0AA6 or P1AE6 .

    - **If the DTC is not set**
3. Verify DTC P1B41 is not set.
    - **If the DTC is set**

      Refer to Loss of Isolation on the High Voltage Main Bus .

    - **If the DTC does not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

DTC P1E0A: DRIVE MOTOR CONTROL MODULE TORQUE CALCULATION PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1E0A

Drive Motor Control Module Torque Calculation Performance

Circuit/System Description

The motor control module performs redundant calculations of desired and achieved torque values. These values are continuously compared and should always be the same. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

The vehicle is in RUN.

Conditions for Setting the DTC

The redundant torque calculation does not match the primary calculation.

Action Taken When the DTC Sets

- P1E0A is a Type A DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

P1E0A is a Type A DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify no transmission or motor control module DTCs are set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Verify DTC P1E0A is not set.
   - **If any of the DTCs are set**
   1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the T6 Power Inverter Module.
      - If the DTC does not set.
   3. All OK.
   - **If none of the DTCs are set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1E4A: CONTROL MODULE REDUNDANT DRIVE MOTOR 1 SPEED SENSING CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1E4A

Control Module Redundant Drive Motor 1 Speed Sensing Circuit

Circuit/System Description

The drive motor position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor based upon the signals of the resolver-type position sensor. The position sensor allows the motor control module to determine the exact position, speed and direction of the drive motor. The hybrid/EV powertrain control module 1 also calculates motor speed and compares it to the motor control module's value to insure the accuracy of the hybrid/EV powertrain control module's value. This fault is handled inside the power inverter module, often referred to as the drive motor generator power inverter module, and no external circuits are involved. The control modules listed below are part of the power inverter module and are not serviced separately:

- Hybrid/EV powertrain control module 1
- Drive motor control module

Conditions for Running the DTC

- The vehicle must be ON.
- The system voltage is greater than 9.5 V.
- DTC P1E0A is not set.

Conditions for Setting the DTC

The calculated motor speed is greater than 600 RPM different from the measured speed.

Action Taken When the DTC Sets

- DTC P1E4A is a Type B DTC.
- Propulsion will be disabled.

Conditions for Clearing the DTC

DTC P1E4A is a Type B DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P0562, P0563, or P0606 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
3. Verify DTC P1E4A is not set.
    - If the DTC sets, replace the T6 Power Inverter Module.
    - If the DTC does not set.
4. All OK.
    - **If none of the DTCs are set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P1F59, P1F5A, OR P1F5B: 14 VOLT POWER MODULE STATUS TERMINAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1F59

14 Volt Power Module Status Terminal Circuit Performance

DTC P1F5A

14 Volt Power Module Status Terminal Circuit Low Voltage

DTC P1F5B

14 Volt Power Module Status Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-
Status - F Terminal	P1F59, P1F5A	P1F59, P1F5A	P1F59, P1F5B	P1F59

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module.

The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled 5V signal to the 14V Power Module. The duty cycles controls the 14V power module output.

The status circuit functions much like the F Terminal circuit on a generator equipped vehicle. A high side driver in the 14V power module applies a duty cycled voltage to the ECM. The duty cycle indicates 14V power module internal temperature and operational condition. The ECM will detect faults on the 14V power module status circuit when the vehicle is ON.

The 14V Power Module high voltage circuit is fuse protected within the A28 hybrid/EV battery contactor assembly. The fuse protects both the T18 battery charger and the K1 14V power module. The fuse is not serviceable.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5A: The ECM detects a 5% or lower PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F5B: The ECM detects a 96% or higher PWM signal on the 14V power module status circuit for 8 seconds out of a 10 second window.
- P1F59: The status circuit PWM signal is not in a valid range.

Action Taken When the DTC Sets

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F59, P1F5A and P1F5B are type C DTCs.

Reference Information

Schematic Reference

- Starting and Charging Schematics
- Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections

- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle OFF. Connect the vehicle to an AC supply to begin charging.
2. Vehicle in Service Mode.
3. Verify that DTC P0D26 is not set and that the vehicle will charge.
    - **If the DTC is set or the vehicle will not charge**

      Refer to DTC P0D26 .

    - **If the DTC is not set**

NOTE: **Do not have a 12V battery charger connected during the testing.**

4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
    - **If the DTC sets**

      Refer to Circuit/System Testing.

    - **If the DTC does not set**
6. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

DTC P1F5A or P1F5B Diagnosis

NOTE: **You must perform Circuit/System Verification first.**

1. Verify a test lamp illuminates between the 14V Power Module B+ circuit ring terminal and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Remove the test lamp and disconnect the B+ cable at the 14V power module.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the mega fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**

   1. Remove the test lamp and disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**
   2. Disconnect the 14V power module B+ cable.
   3. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance replace the K1 14V Power Module and the mega fuse.
   - **If the test lamp illuminates**
2. Disconnect the X2 harness connector at the 14V power module, vehicle ON.
3. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.
   - **If less than 3.0 V**
   1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If greater the 2 Ω, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 ECM.
   - **If greater than 5.5 V**
   1. Vehicle OFF, disconnect the harness connectors at the K20 ECM, Vehicle ON.
   2. Test for less than 1 V between the control circuit and ground.
      - If greater than 1 V, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 ECM.
   - **If between 3.0 - 5.5 V**
4. Vehicle OFF, disconnect the harness connectors at the K20 ECM.
5. Test for infinite resistance between the 14V power module status circuit terminal X2-03 and ground.
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
6. Test for less than 2 Ω in the status circuit end to end.
   - **If greater the 2 Ω**

     Repair the open/high resistance in the circuit.

   - **If less than 2 Ω**
7. Disable the high voltage for servicing at the K1 14V Power Module. Refer to **High Voltage Disabling** .
8. Replace the K1 14V Power Module.
9. Enable high voltage. Refer to **High Voltage Enabling** .
10. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the K20 ECM.

    - **If the DTC does not set**
11. All OK.

DTC P1F59 Diagnosis

NOTE: **You must perform Circuit/System Verification first.**

1. Disable the high voltage system for servicing the T18 Battery Charger, K1 14V Power Module and the T24 Battery Charger-DC. Refer to **High Voltage Disabling** .
2. Disconnect the X3 connector at the T18 Battery Charger, the X1 connector at the K1 14V Power Module and the X6 connector at the T24 Battery Charger-DC.

3. Verify that all HV harness connector and the mating module connector terminals are free from moisture, corrosion, and arc flash damage.
   - **If any terminals show signs of damage**

     Replace the HV wiring harness and affected modules as necessary.

   - **If no arc flash damage, moisture, or corrosion is found**
4. Test the following HV harness terminals for less than 2 Ω end to end:
   - X6-A to X1-A
   - X6-A to X3-A
   - X6-B to X1-B
   - X6-B to X3-B
   - **If greater than 2 Ω**

     Replace the HV wiring harness.

   - **If less than 2 Ω**
5. Replace the K1 14V Power Module.
6. Enable high voltage. Refer to **High Voltage Enabling** .
7. Verify the DTC does not set.
   - **If the DTC sets**

     Replace the K20 ECM.

   - **If the DTC does not set**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Battery to Battery Positive Cable Replacement** for K1 14V Power Module/T18 Battery Charger combination cable - includes G1 A/C compressor cable.
- Refer to **Control Module References** for ECM or for K1 14V Power Module - often referred to as the Accessory DC Power Control Module replacement, programming, and setup.

DTC P1F5D OR P1F5E: 14 VOLT POWER MODULE L-TERMINAL CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1F5D

14 Volt Power Module L-Terminal Circuit Low Voltage

DTC P1F5E

14 Volt Power Module L-Terminal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control - L Terminal	P1F5D	-	P1F5E	-
Status - F Terminal	P1F59, P1F5A	P1F59, P1F5A	P1F59, P1F5B	P1F59

Circuit/System Description

The ECM uses two circuits to control and monitor the state of the 14V power module, often referred to as the accessory DC power control module. The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled voltage to the 14V power module. The duty cycle controls the 14V power module output. The ECM monitors the state of the 14V power module control circuit. The ECM will detect faults on the 14V power module control circuit when the vehicle is ON.

Conditions for Running the DTC

The vehicle is ON.

Conditions for Setting the DTC

- P1F5D: The ECM detects a low voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.
- P1F5E: The ECM detects a high voltage on the 14V power module control circuit for 8 seconds out of a 10 second window.

Action Taken When the DTC Sets

DTCs P1F5D and P1F5E are type C DTCs.

Conditions for Clearing the DTC

DTCs P1F5D and P1F5E are type C DTCs.

Reference Information

Schematic Reference

- **Starting and Charging Schematics**
- **Hybrid/EV Controls Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Do not have a 12V battery charger connected during the testing.**

1. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
2. Verify the DTC does not set.
   - **If the DTC sets**

     Refer to Circuit/System Testing.

  - **If the DTC does not set**

3. All OK.

Circuit/System Testing

1. Verify a test lamp illuminates between the 12V B+ circuit ring terminal X3-A at the 14V power module and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Remove the test lamp and disconnect the B+ cable at the 14V power module.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Remove the test lamp, disconnect the battery negative cable, and disconnect the 14V power module B+ cable.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   - **If the test lamp illuminates**
2. Disconnect the X2 harness connector at the 14V power module, vehicle ON.
3. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.
   - **If less than 3.0 V**
   1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If greater the 2 Ω, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 ECM.
   - **If greater than 5.5 V**
   1. Vehicle OFF, disconnect the harness connectors at the K20 ECM, Vehicle ON.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If greater than 1 V, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 ECM.
   - **If between 3.0 - 5.5 V**
4. Test or replace the K1 14V Power Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for ECM replacement, programming, and setup or for K1 14V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

DTC P2122, P2123, P2127, P2128, OR P2138: ACCELERATOR PEDAL POSITION (APP) SENSOR 1-2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2122

Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage

DTC P2123

Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage

DTC P2127

Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage

DTC P2128

Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage

DTC P2138

Accelerator Pedal Position (APP) Sensors 1 - 2 Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accelerator Pedal Position (APP) Sensor 1 5V Reference	P2122	P2138	P06A3, P2135	P2138
Accelerator Pedal Position (APP) Sensor 2 5V Reference	P2127	P2128	P2128	P2138
Accelerator Pedal Position (APP) Sensor 1 Signal	P2122	P2122, P2138	P2123	P2138
Accelerator Pedal Position (APP) Sensor 2 Signal	P2127	P2127, P2138	P2128, P2138	P2138
Accelerator Pedal Position (APP) Sensor 1 Low Reference	-	P2123, P2138	-	P2138
Accelerator Pedal Position (APP) Sensor 2 Low Reference	-	P2128, P2138	-	P2138

Typical Scan Tool Data

APP Sensor 1

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle is On, and accelerator pedal not depressed. **Parameter Normal Range:** APP Sensor 1 0.88 - 1.08V			
Accelerator Pedal Position Sensor 1 5V Reference	0.00V	0.00V	5 - 12V
Accelerator Pedal Position Sensor 1 Signal	0.00V	0.00V	5 - 12V
Accelerator Pedal Position Sensor 1 Low Reference	-	4 - 5V	-

APP Sensor 2

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle is On, and accelerator pedal not depressed. **Parameter Normal Range:** APP Sensor 2 0.39 - 0.59V			
Accelerator Pedal Position Sensor 2 5V Reference	0.00V	0.00V	1 - 3V
Accelerator Pedal Position Sensor 2 Signal	0.00V	0.00V	2 - 5V
Accelerator Pedal Position Sensor 2 Low Reference	-	4 - 5V	-

Circuit/System Description

The accelerator pedal assembly contains 2 accelerator pedal position (APP) sensors. The APP sensors are mounted to the accelerator pedal assembly and are not serviceable. The APP sensors provide a signal voltage that changes relative to pedal position. The ECM supplies each APP sensor with a 5V reference circuit, a low reference circuit, and a signal circuit. Both the APP sensors 1 and 2 signal percentages increase as the pedal is depressed, from approximately 0% at rest to above 95% when fully depressed.

The ECM provides the accelerator pedal position or driver torque request to the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 determines how the torque output will be distributed.

Conditions for Running the DTC

P2122, P2123, P2127, P2128

- DTC P0697 is not set - P2127 or P2128.
- DTC P06A3 is not set - P2122 or P2123.
- The vehicle is ON.
- The run voltage is greater than 6.4V.
- The DTCs run continuously when the above conditions are met.

P2138

- DTCs P06A3, P0697, P2122, P2123, P2127, or P2128 are not set.
- The vehicle is ON.
- The run voltage is greater than 6.4V.
- The DTC runs continuously when the above conditions are met.

Conditions for Setting the DTC

P2122

The ECM detects that the APP sensor 1 voltage is less than 0.46V for greater than 1 s.

P2123

The ECM detects that the APP sensor 1 voltage is greater than 4.7V for greater than 1 s.

P2127

The ECM detects that the APP sensor 2 voltage is less than 0.32V for greater than 1 s.

P2128

The ECM detects that APP sensor 2 voltage is greater than 2.6V for greater than 0.5 s.

P2138

The voltage difference between APP sensor 1 and APP sensor 2 exceeds a predetermined value for greater than 1 s.

Action Taken When the DTC Sets

- DTCs P2122, P2123, P2127, and P2128, and P2138 are Type A DTCs.
- ECM commands the reduced power mode.
- Creep torque and hill hold are disabled.
- Service Parking Brake light is illuminated.

Conditions for Clearing the DTC

DTCs P2122, P2123, P2127, and P2128, and P2138 are Type A DTCs.

Diagnostic Aids

- A high resistance condition on the accelerator pedal sensor circuits could cause a DTC to set.
- Ensure that the in-line harness connector seals are installed correctly. Improper installation could result in water intrusion into the connector and cause a DTC to set.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid Modes of Operation Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0641, P0697, or P06A3 is not set.
    - **If any of the DTCs are set**

      Refer to **DTC P0641, P0651, P0697, or P06A3** for further diagnosis.

    - **If none of the DTCs are set**
3. Verify the APP Sensor 1 Circuit Status and APP Sensor 2 Circuit Status parameter displays OK.
    - **If Malfunction is displayed**

      Refer to Circuit/System Testing.

    - **If OK is displayed**
4. Verify the scan tool APP Sensor 1 and 2 percent parameters are equal while performing the tests listed below:
    1. Rapidly depress the accelerator pedal from the rest position to the wide open throttle position (WOT) and release pedal. Repeat the procedure several times.
    2. Slowly depress the accelerator pedal to WOT and then slowly return the pedal to closed throttle. Repeat the procedure several times.
    - **If not equal**

      Refer to Circuit/System Testing.

    - **If equal**
5. Verify that DTC P2122, P2123, P2127, P2128, or P2138 is not set.
    - **If any of the DTCs are set**

      Refer to Circuit/System Testing.

    - **If none of the DTCs set**
6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
7. Verify DTC P2122, P2123, P2127, P2128, or P2138 is not set.

   - **If any DTC sets**

     Refer to Circuit/System Testing.

   - **If no DTCs set**
8. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B107 accelerator pedal assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between each low reference circuit terminal listed below and ground:
   - Low reference circuit X1 terminal 4
   - Low reference circuit X1 terminal 3
   - **If 5 Ω or greater**
   1. Vehicle OFF, disconnect the harness connector at the K20 ECM.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 ECM.
   - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2V between each 5V reference circuit terminals listed below and ground:
   - 5V reference circuit terminal 1
   - 5V reference circuit terminal 6
   - **If less than 4.8V**
   1. Vehicle OFF, disconnect the harness connector at the K20 ECM.
   2. Test for infinite resistance between the 5V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 5V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K20 ECM.
   - **If greater than 5.2V**
   1. Vehicle OFF, disconnect the harness connector at the K20 ECM, vehicle in Service Mode.
   2. Test for less than 1V between the 5V reference circuit and ground.
      - If 1V or greater, repair the short to voltage on the circuit.
      - If less than 1V, replace the K20 ECM.
   - **If between 4.8 - 5.2V**
5. Verify each APP sensor voltage parameter is less than 0.2V.
   - **If 0.2V or greater**
   1. Vehicle OFF, disconnect the harness connector at the K20 ECM, vehicle in Service Mode.
   2. Test for less than 1V between the signal circuit terminal listed below and ground:
      - APP sensor 1 signal circuit terminal 5
      - APP sensor 2 signal circuit terminal 2
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K20 ECM.
   - **If less than 0.2V**
6. Install a 3A fused jumper wire between each signal circuit terminals listed below and the 5V reference circuit terminal 1:
   - APP sensor 1 signal circuit terminal 5
   - APP sensor 2 signal circuit terminal 2
7. Verify the scan tool APP sensor voltage parameter is greater than 4.8V.

- **If 4.8V or less**
  1. Vehicle OFF, disconnect the harness connector at the K20 ECM.
  2. Test for infinite resistance between the signal circuit terminal and ground.
     - If less than infinite resistance, repair the short to ground on the circuit.
     - If infinite resistance
  3. Test for less than 2 Ω in the signal circuit end to end.
     - If 2 Ω or greater, repair the open/high resistance in the circuit.
     - If less than 2 Ω, replace the K20 ECM.
- **If greater than 4.8V**

8. Test or replace the B107 accelerator pedal assembly.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Accelerator Pedal Assembly Replacement**
- Refer to **Control Module References** for K20 ECM replacement, programming, and setup.

DTC P2797: AUXILIARY TRANSMISSION FLUID PUMP PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2797

Auxiliary Transmission Fluid Pump Performance

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, utilizes a pulse-width modulated signal to control the auxiliary transmission fluid pump. The hybrid/EV powertrain control module 1 and the motor control module share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground.

Conditions for Running the DTC

- The vehicle is ON.
- The auxiliary transmission fluid pump is commanded greater than 800 RPM.

Conditions for Setting the DTC

The difference between desired and actual auxiliary transmission fluid pump speed is greater than 600 RPM for 30 seconds.

Action Taken When the DTC Sets

- DTC P2797 is a Type A DTC.
- Vehicle speed will be limited.
- Propulsion will be reduced.
- Propulsion Power is Reduced message will be illuminated.

Conditions for Clearing the DTC

DTC P2797 is a Type A DTC.

Diagnostic Aids

There should always be other hybrid/EV powertrain control module 1 or motor control module DTCs set along with DTC P2797. Always diagnose other DTCs before addressing this DTC.

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify that no other hybrid/EV powertrain control module 1 or motor control module DTC is set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
2. Verify DTC P2797 is not set.
   - **If the DTC is set**
3. Verify the DTC does not set. If the DTC sets, replace the G5 Auxiliary Transmission Fluid Pump.
4. Verify the DTC does not set. If the DTC sets, replace the T6 Power Inverter Module.
   - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Transmission Fluid Pump Removal** for G5 Auxiliary Transmission Fluid Pump, often referred to as the A/Trans Aux Fluid Pump Motor, replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming, and setup.

DTC P2798 OR P2799: AUXILIARY TRANSMISSION FLUID PUMP CONTROL CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P2798

Auxiliary Transmission Fluid Pump Control Circuit Low Voltage

DTC P2799

Auxiliary Transmission Fluid Pump Control Circuit High Voltage

Circuit/System Description

The power inverter module, often referred to as the drive motor generator power inverter module, contains the motor control module and the hybrid/EV powertrain control module 1. The hybrid/EV powertrain control module 1 controls the auxiliary transmission fluid pump by providing a 12 V ground pulse width modulation (PWM) signal to the pump motor to request a specific motor speed.

Conditions for Running the DTC

Ignition ON.

Conditions for Setting the DTC

DTC P2798

The voltage at the hybrid/EV powertrain control module 1 output to the auxiliary transmission fluid pump control is open or shorted to ground for 4 seconds.

DTC P2799

The voltage at the hybrid/EV powertrain control module 1 output to the auxiliary transmission fluid pump control is shorted to voltage for 4 seconds.

Action Taken When the DTC Sets

- DTCs P2798 and P2799 are Type A DTCs.
- Vehicle speed will be limited, the Propulsion Power is Reduced message will be illuminated.

Conditions for Clearing the DTC

- DTCs P2798 and P2799 are Type A DTCs.
- The condition for setting the DTC is no longer present.

Diagnostic Aids

DTC P2798 may set under low 12V battery conditions. Always diagnose low 12V battery concerns first.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Power Inverter Module Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify no 12V battery system voltage LOW DTCs are set or that a low 12V battery condition was not present at the time the DTC was set.
    - **If any of the DTCs were set or a low 12V battery condition was present**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
    - **If the DTCs were not set or a low 12V battery condition was not present**
2. Verify no ECM loss of communication DTCs U0100/U1818 are set indicating that a KR75 Engine Controls Ignition Relay concern is present.
    - **If any of the DTCs were set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If the DTCs were not set**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
    - **If the DTC sets**

      Refer to Circuit/System Testing.

    - **If the DTC is not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G5 Transmission Fluid Pump Electric/Auxiliary.
2. Connect a test lamp between the enable circuit terminal 5 and the ground circuit terminal 6.
3. Vehicle OFF. Verify the test lamp is OFF.
    - **If the test lamp is ON**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Test for less than 1 V between the pump enable circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Replace the T6 Power Inverter Module.
    - **If the test lamp is OFF**
4. Vehicle ON, verify the test lamp illuminates. Command the Auxiliary Transmission Fluid Pump ON (20 - 70%) with a scan tool if necessary.
    - **If the test lamp is OFF**
    1. Vehicle OFF, disconnect the X1 harness connector at the T6 Power Inverter Module.
    2. Test for infinite resistance between the enable circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω
    4. Replace the T6 Power Inverter Module.
    - **If the test lamp is ON**
5. Replace the G5 Transmission Fluid Pump Electric/Auxiliary.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Transmission Fluid Pump Removal for G5 Auxiliary Transmission Fluid Pump, often referred to as the A/Trans Aux Fluid Pump Motor, replacement.
- Refer to Control Module References for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, setup, and programming.

SYMPTOMS - HYBRID CONTROLS

NOTE: **The following steps must be completed before using the symptom tables.**

1. Perform the Diagnostic System Check - Vehicle before using the symptom tables in order to verify that all of the following are true:
    - There are no DTCs set.
    - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions.

Refer to the following procedures:

- **Accessory DC Power Control Module Description and Operation**
- **Drive Motor Power Inverter Module Description and Operation**
- **Engine Control Module (ECM) Description and Operation**
- **Electromagnetic Compatibility Description**
- **High Voltage Monitoring Systems Description**
- **Hybrid Modes of Operation Description**
- **Drive Motor Battery System Description**
- **Transmission General Description**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the Hybrid System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **DC Power Conversion Test**
- **Sport Mode Indicator Malfunction**

SPORT MODE INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	Stuck in Normal Mode	Stuck in Normal Mode	Stuck in Normal Mode	P1762
Ground	Stuck in Normal Mode	Stuck in Normal Mode	Stuck in Normal Mode	P1762

Circuit/System Description

The body control module monitors the signal circuit from the Sport Mode switch. When the Sport Mode switch is pressed once, the body control module will request the ECM via serial data to enable Sport Mode. The ECM will request the instrument cluster via serial data to turn the Sport Mode indicator ON to notify the driver of the activation.

When the Sport Mode switch is pressed again, the body control module will request the ECM to disable the Sport Mode. The ECM will request the instrument cluster via serial data to turn the Sport Mode Off and the instrument cluster will display Normal to notify the drive of the deactivation. The Sport Mode switch is part of the S48E Multifunction Switch-Center Console and is not serviced separately.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Sport Mode parameter in the ECM Hybrid/EV data list changes between Active and Inactive while pressing and releasing the Sport Mode switch.
    - **If the parameter does not change**

      Refer to Circuit/System Testing.

    - **If the parameter changes**
3. Replace the P16 Instrument Cluster.

Circuit/System Testing

1. Vehicle OFF, scan tool disconnected, and all vehicle systems OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 10 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Sport Mode parameter in the ECM Hybrid/EV data list is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module.
    2. Test for infinite resistance between the signal circuit terminal 22 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 Body Control Module.
    - **If Inactive**
5. Install a 3 A fused jumper wire between the signal circuit terminal 5 and the ground circuit terminal 10.
6. Verify the scan tool Sport Mode parameter in the ECM Hybrid/EV data list is Active.
    - **If not Active**
    1. Vehicle OFF, disconnect the X6 harness connector at the K9 Body Control Module, vehicle in service mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.

    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 Body Control Module.
    - **If Active**

7. Test or replace the S48E Multifunction Switch-Center Console.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console.
2. Test for infinite resistance between the signal terminal 2 and the ground terminal 10 with the switch in the open position.
    - **If less than infinite resistance**

      Replace the S48E Multifunction Switch-Center Console.

    - **If infinite resistance**
3. Test for less than 2 Ω between the signal circuit terminal 2 and the ground terminal 10 with the switch in the closed position.
    - **If 2 Ω or greater**

      Replace the S48E Multifunction Switch-Center Console.

    - **If less than 2 Ω**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Instrument Cluster Replacement**
- Refer to **Front Floor Console Trim Plate Replacement** for S48E Multifunction Switch-Center Console replacement.
- Refer to **Control Module References** for body control module or instrument cluster replacement, programming and setup

DC POWER CONVERSION TEST

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

Circuit/System Description

The 14 V power module, often referred to as the accessory DC power control module, converts the high voltage (360 V) direct current (DC) to low voltage (14 V) DC to charge the 12 V battery and to operate the power accessories.

The ECM uses two circuits to control and monitor the state of the 14 V power module, often referred to as the accessory DC power control module.

The status circuit functions much like the F Terminal circuit on a generator equipped vehicle. A high side driver in the 14 V power module applies a duty cycled voltage to the ECM. The duty cycle indicates the 14 V power module internal temperature and operational condition.

The control circuit functions much like the L Terminal circuit on a generator equipped vehicle. A high side driver in the ECM applies a duty cycled voltage to the 14 V power module. The duty cycle controls the 14 V power module output.

The 14 V power module generates more power as the commanded duty cycle increases.

Diagnostic Aids

Using a carbon pile tester is the preferred method to test the 14 V power module. The carbon pile tester can put an increasing load on the system to reach a target current level. If a carbon pile tester is not available, the alternative method is using the scan tool 14 V power module setpoint.

Reference Information

Schematic Reference

- **Starting and Charging Schematics**
- **Hybrid/EV Controls Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Accessory DC Power Control Module Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If the DTCs are not set**
3. Vehicle OFF. Measure and record the C1 battery voltage at the C1 battery terminals. The C1 battery voltage should stabilize between 12.4 and 12.8 V within a few minutes of turning the vehicle OFF.
    - **If not within the specified range**

      Refer to **Battery Inspection/Test** .

    - **If within the specified range**
4. Vehicle ON, accessories OFF.
5. Measure and record the C1 battery voltage at the C1 battery terminals. The voltage should be at least 1 V greater than the voltage measured in step 1 but less than 15 V.
    - **If not within the specified range**

      Refer to Circuit/System Testing.

    - **If within the specified range**
6. All OK.

Circuit/System Testing

NOTE: **If a carbon pile tester is available, refer to With Carbon Pile Tester section. Otherwise, refer to Without Carbon Pile Tester section.**

With Carbon Pile Tester

1. Vehicle ON.
2. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If the DTCs are not set**
3. Verify that no K1 14 V Power Module or B18 Battery Current Sensor DTCs are set that would cause a charging system concern.
    - **If an applicable DTC is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no applicable DTCs are set**
4. Vehicle OFF.
5. Test for 12.4 V or greater at room temperature across the C1 Battery terminals.
    - **If not within the specified range**

      Refer to **Battery Inspection/Test** .

    - **If within the specified range**
6. Connect a carbon pile tester to the C1 Battery.
7. Vehicle ON, turn all accessories off. Observe the voltage reading on the tester. The voltage should read between 12.6 - 15.5 V.
8. Adjust the carbon pile tester so that the Low - Voltage Battery Current parameter on the 14 V Power Module data list of the Engine Control Module is reading 125 amps.
9. Verify the voltage reading remains between 12.6 - 15.5 V.
    - **If not within the specified range**
    1. Disconnect the X2 harness connector at the 14 V power module, vehicle ON.
    2. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.
        - If less than 3.0 V
        1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.
        2. Test for less than 2 Ω in the control circuit end to end.
            - If greater than 2 Ω, repair the open/high resistance in the circuit.
            - If less than 2 Ω
        3. Replace the K20 ECM.
        - If within 3.0 - 5.5 V
    3. Replace the K1 14 V Power Module.
    - **If within the specified range**
10. All OK.

Without Carbon Pile Tester

1. Vehicle ON.
2. Verify DTC P1F59, P1F5A, P1F5B, P1F5D, or P1F5E is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If the DTCs are not set**
3. Verify that no K1 14 V Power Module or B18 Battery Current Sensor DTCs are set that would cause a charging system concern.
    - **If an applicable DTC is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no applicable DTCs are set**

4. Vehicle OFF.
5. Test for 12.4 V or greater at room temperature across the C1 Battery terminals.
    - **If not within the specified range**

      Refer to **Battery Inspection/Test** .

    - **If within the specified range**
6. Vehicle ON.
7. Verify the scan tool Engine Control Module Ignition 1 Signal parameter continually increases when controlling the Engine Control Module 14 V Power Module Setpoint from 10 - 80% with a scan tool. It may take up to 10 s for the battery voltage to stabilize between each setpoint change.
    - **If the battery voltage does not continually increase**
    1. Disconnect the X2 harness connector at the 14 V power module, vehicle ON.
    2. Test for 3.0 - 5.5 V between the control circuit terminal X2-01 and ground.
        - If less than 3.0 V
        1. Vehicle OFF, disconnect the harness connectors at the K20 ECM.
        2. Test for less than 2 Ω in the control circuit end to end.
            - If greater than 2 Ω, repair the open/high resistance in the circuit.
            - If less than 2 Ω
        3. Replace the K20 ECM.
        - If within 3.0 - 5.5 V
    3. Replace the K1 14 V Power Module.
    - **If the battery voltage continually increases**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K1 14 V Power Module, often referred to as the Accessory DC Power Control Module, replacement, programming, and setup.

REPAIR INSTRUCTIONS

ENGINE CONTROL MODULE REPLACEMENT

Removal Procedure

CAUTION:

- **Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage.**
- **Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables, or when charging the vehicle battery.**
- **In order to prevent any possible electrostatic discharge damage to the control module, do no touch the connector pins or the soldered components on the circuit board.**
- **Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module.**
- **The replacement control module must be programmed.**

1. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection

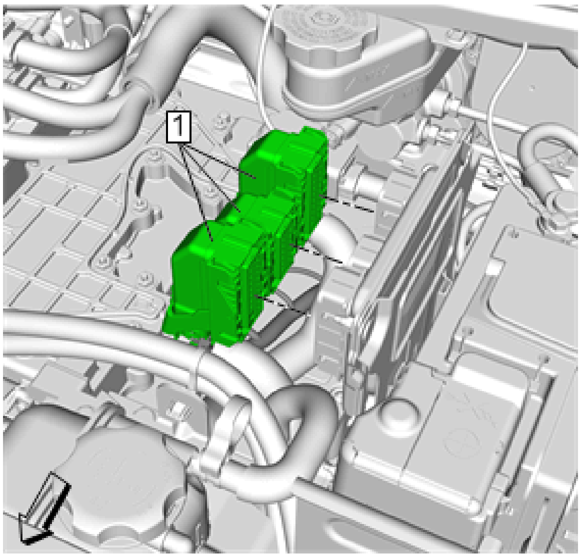


Fig. 10: Engine Control Module Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Engine Control Module Electrical Connectors (1) (Qty: 3)

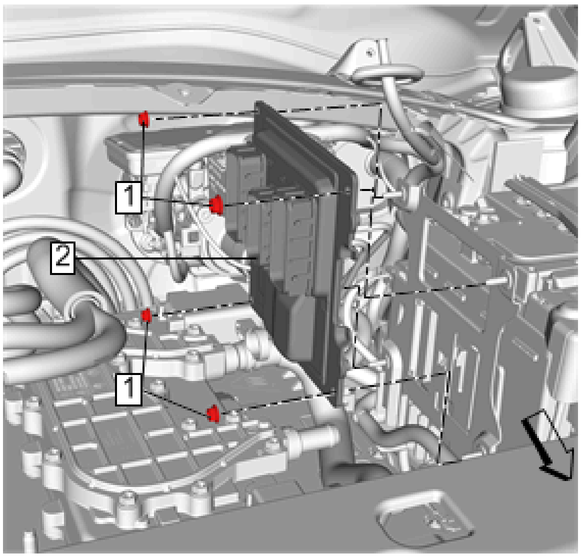


Fig. 11: Engine Control Module And Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Engine Control Module Bracket Nuts (1) (Qty: 4)
4. Remove Engine Control Module (2)

Installation Procedure

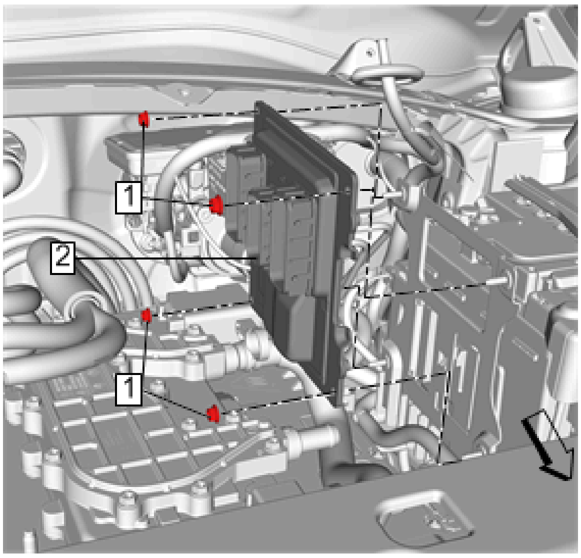


Fig. 12: Engine Control Module And Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Using a flat bladed tool, release the ECM bracket retainer. Slide the ECM and bracket assembly to the battery tray.
2. Install Engine Control Module (2)

CAUTION: **Refer to Fastener Caution**

3. Install and tighten Engine Control Module Bracket Nuts (1) (Qty: 4) to 4.7 N.m (42 lb in)

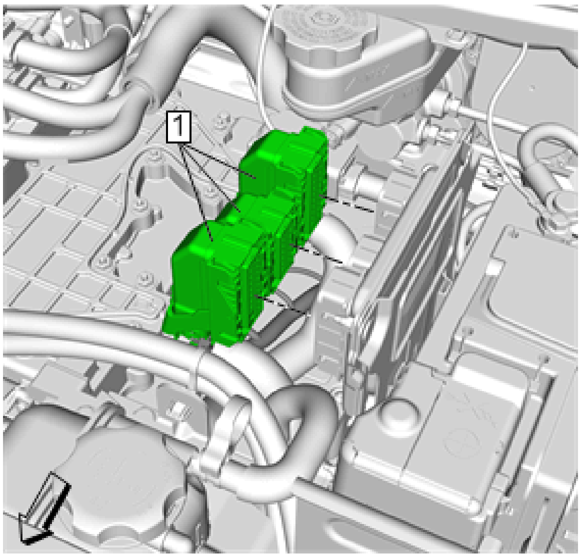


Fig. 13: Engine Control Module Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

4. Connect Engine Control Module Electrical Connectors (1) (Qty: 3)
5. Connect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection
6. If replacing the engine control module, reprogram the module. Refer to Control Module References

ENGINE CONTROL MODULE BRACKET REPLACEMENT

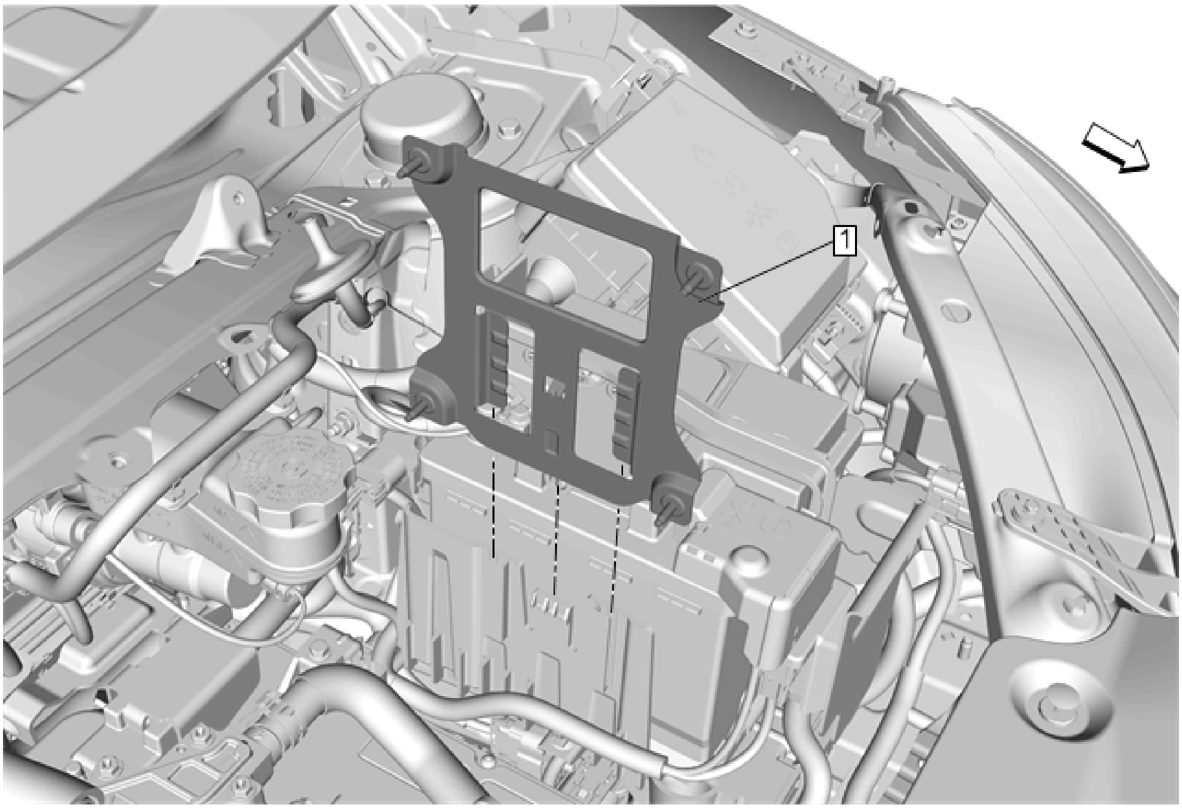


Fig. 14: Engine Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove Engine Control Module. Refer to Engine Control Module Replacement	
1	Engine Control Module Bracket

DRIVE MOTOR POWER INVERTER MODULE 3 PHASE CABLE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to High Voltage Disabling
2. Remove Drive Motor Rear Mount Bracket. Refer to Drive Motor Rear Mount Bracket Replacement

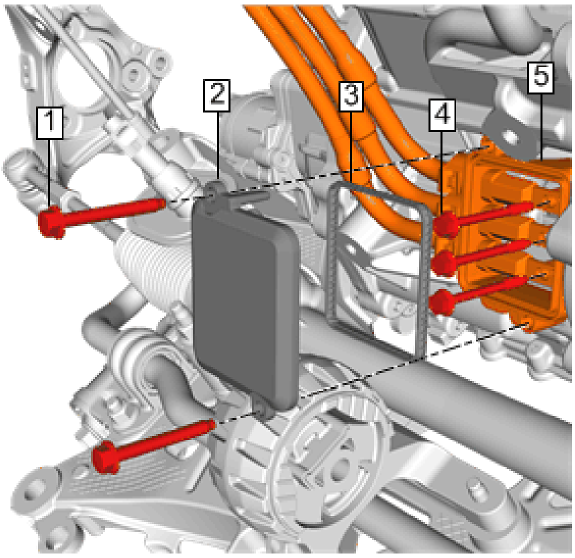


Fig. 15: Drive Motor Power Inverter Module 3-Phase Cable Connector Cover, Bolts And Seal
Courtesy of GENERAL MOTORS COMPANY

3. Remove Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Bolts (1) (Qty: 2)
4. Remove Drive Motor Power Inverter Module 3-Phase Cable Connector Cover (2)
5. Remove and DISCARD Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Seal (3)
6. Loosen Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3)

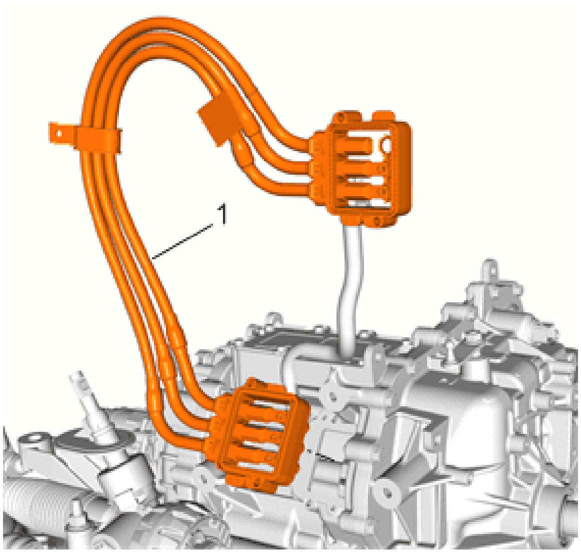


Fig. 16: Drive Motor Power Inverter Module 3-Phase Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove Drive Motor Power Inverter Module 3-Phase Cable (1)

Installation Procedure

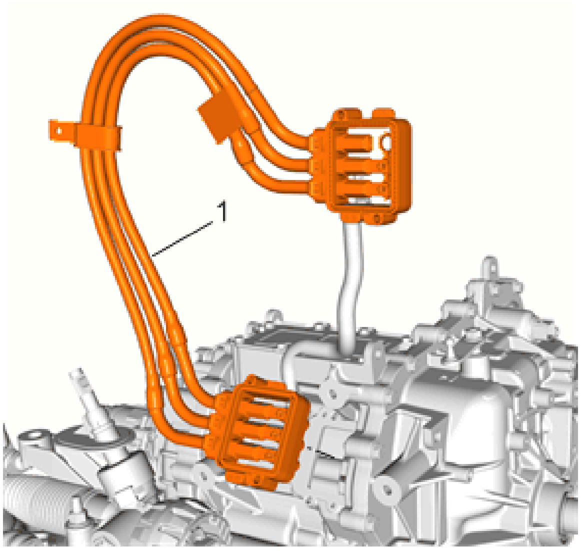


Fig. 17: Drive Motor Power Inverter Module 3-Phase Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Power Inverter Module 3-Phase Cable (1)

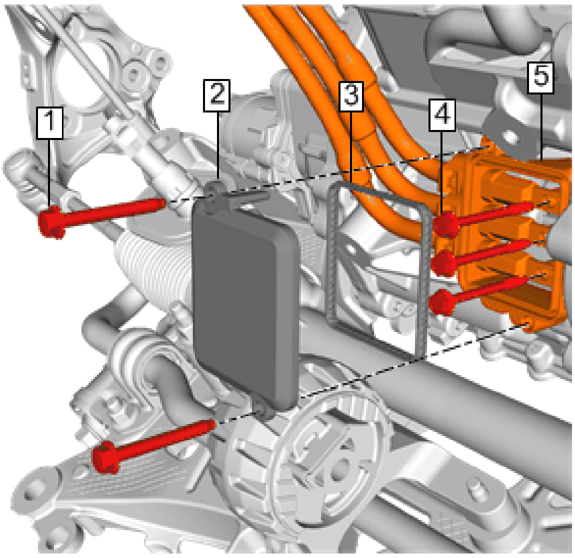


Fig. 18: Drive Motor Power Inverter Module 3-Phase Cable Connector Cover, Bolts And Seal
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Tighten Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3) 9 N.m (80 lb in)
3. Install NEW Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Seal (3)
4. Install Drive Motor Power Inverter Module 3-Phase Cable Connector Cover (2)
5. Install Drive Motor Power Inverter Module 3-Phase Cable Connector Cover Bolts (1) (Qty: 2) to 9 N.m (80 lb in)
6. Install Drive Motor Rear Mount Bracket. Refer to **Drive Motor Rear Mount Bracket Replacement**
7. Enable the high voltage system. Refer to **High Voltage Enabling**

DRIVE MOTOR POWER INVERTER MODULE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to **High Voltage Disabling**
2. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
3. Remove Radiator Surge Tank Support Bracket (RESS). Refer to **Radiator Surge Tank Support Bracket Replacement (Radiator)** **Radiator Surge Tank Support Bracket Replacement (Heater)** **Radiator Surge Tank Support Bracket Replacement (RESS)**
4. Remove High Voltage Battery Control Wiring Junction Block. Refer to **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)**

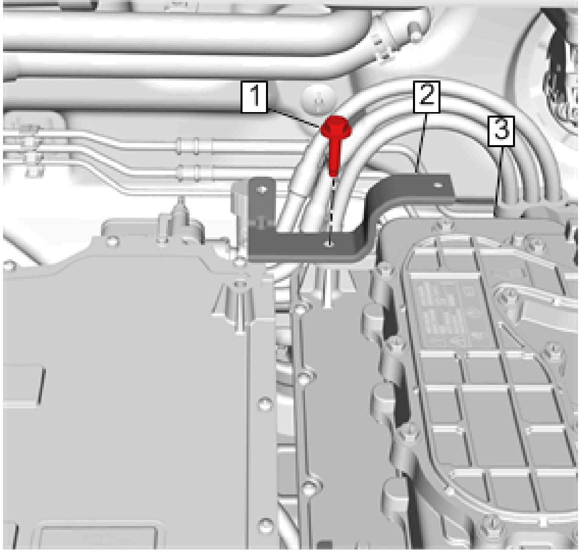


Fig. 19: Engine Wiring Harness Bracket, Bolt And Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

5. Remove Engine Wiring Harness Bracket Bolt (1) @ Accessory DC Power Control Module (3)
6. Reposition Engine Wiring Harness Bracket (2) @ Accessory DC Power Control Module (3)

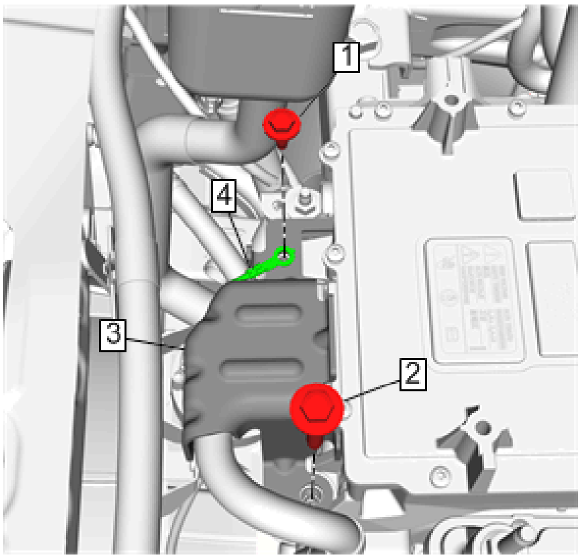


Fig. 20: Drive Motor Power Inverter Module Shield, Bolts And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove Drive Motor Power Inverter Module Shield Bolts (1, 2)
8. Remove Ground Cable (4)
9. Remove Drive Motor Power Inverter Module Shield (3)

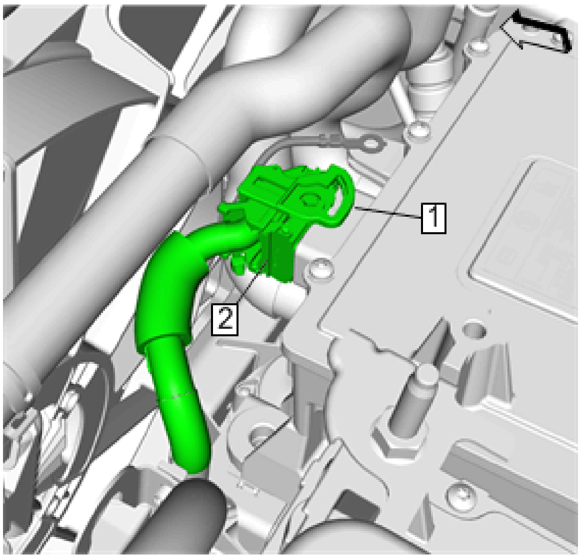


Fig. 21: Engine Wiring Harness Connector And Handle
Courtesy of GENERAL MOTORS COMPANY

10. Release Engine Wiring Harness Connector Handle (1) catch, and rotate forward
11. Remove Engine Wiring Harness Connector (2)

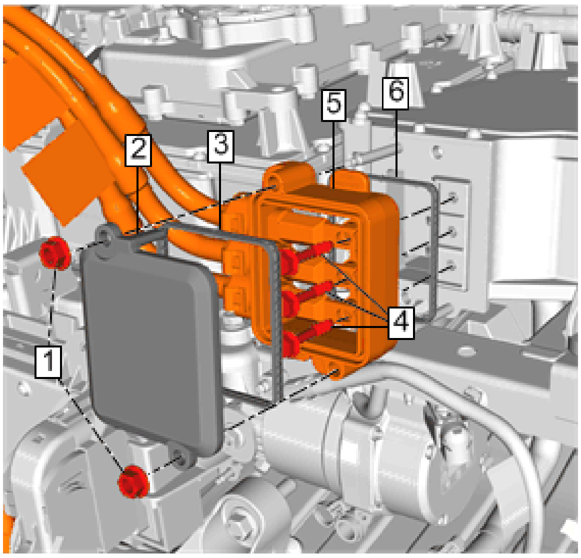


Fig. 22: Drive Motor Power Inverter Module 3-Phase Cable, Cover, Nuts, Bolts And Seals
Courtesy of GENERAL MOTORS COMPANY

12. Remove Drive Motor Power Inverter Module 3-Phase Cable Cover Nuts (1) (Qty: 2)
13. Remove Drive Motor Power Inverter Module 3-Phase Cable Cover (2)
14. Remove and DISCARD Drive Motor Power Inverter Module 3-Phase Cable Cover Seal (3)
15. Loosen Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3)
16. Remove Drive Motor Power Inverter Module 3-Phase Cable (5)
17. Remove and DISCARD Drive Motor Power Inverter Module 3-Phase Cable Seal (6)

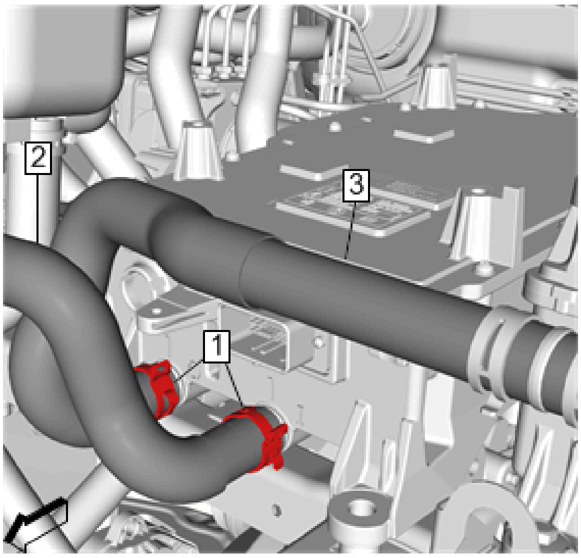


Fig. 23: Drive Motor Generator Control Module Radiator/Cooling Outlet Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

18. Release Clamp (1) and remove Drive Motor Generator Control Module Radiator Outlet Hose (2)
19. Release Clamp (1) and remove Drive Motor Generator Control Module Cooling Outlet Hose (3)

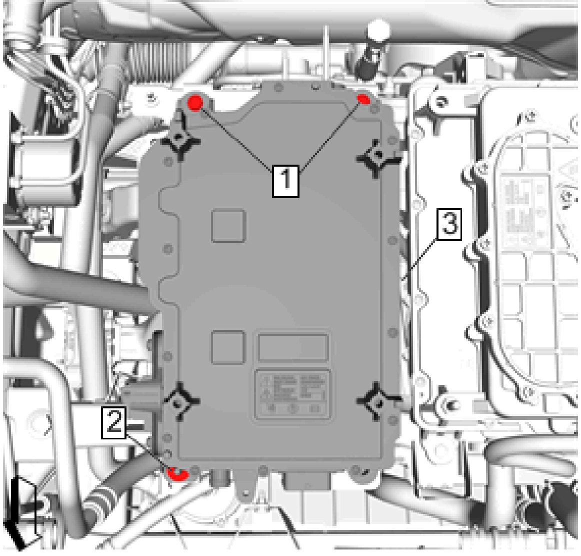


Fig. 24: Drive Motor Power Inverter Module Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

20. Remove Drive Motor Power Inverter Module Bolts (1) (Qty: 2)
21. Remove Drive Motor Power Inverter Module Nut (2)

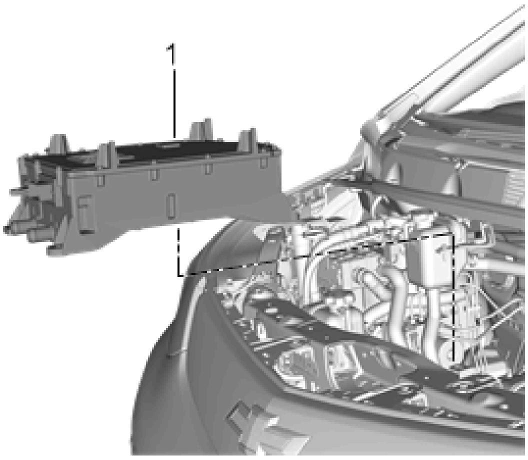


Fig. 25: Drive Motor Power Inverter Module
Courtesy of GENERAL MOTORS COMPANY

22. Remove Drive Motor Power Inverter Module (1)

Installation Procedure

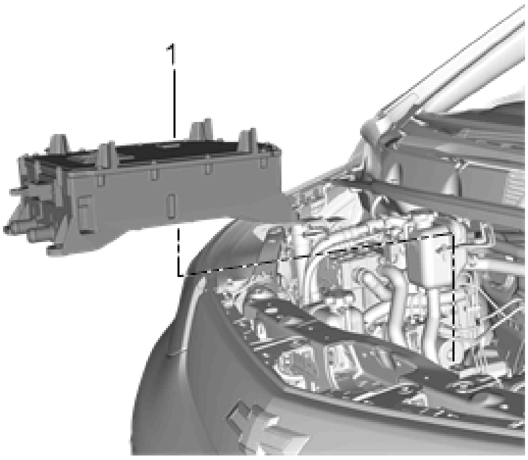


Fig. 26: Drive Motor Power Inverter Module

Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Power Inverter Module (1)

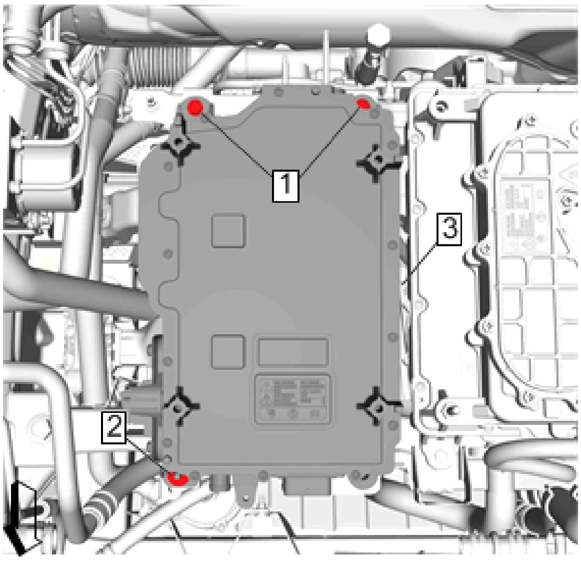


Fig. 27: Drive Motor Power Inverter Module Bolts And Nut

Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Drive Motor Power Inverter Module Bolts (1) (Qty: 2) and tighten to 22 N.m (16 lb ft)
3. Install Drive Motor Power Inverter Module Nut (2) and tighten to 22 N.m (16 lb ft)

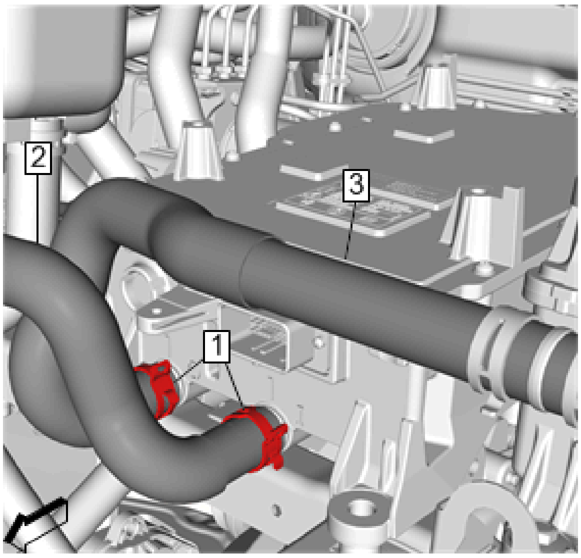


Fig. 28: Drive Motor Generator Control Module Radiator/Cooling Outlet Hoses And Clamps

Courtesy of GENERAL MOTORS COMPANY

4. Install the Drive Motor Generator Control Module Cooling Outlet Hose (3) and Engage the Clamp (1)
5. Install the Drive Motor Generator Control Module Radiator Outlet Hose (2) and Engage the Clamp (1)

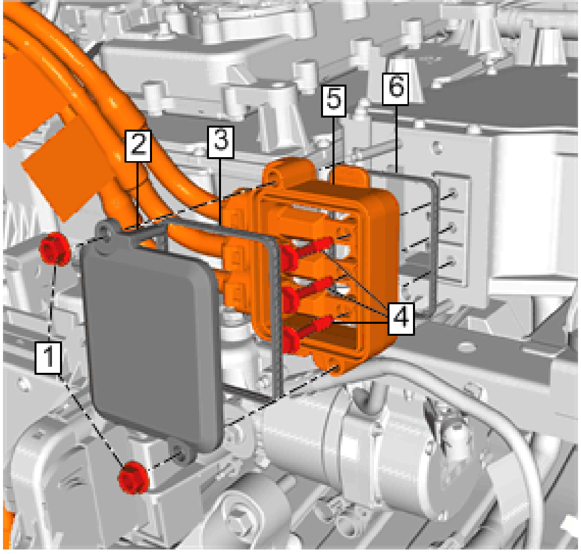


Fig. 29: Drive Motor Power Inverter Module 3-Phase Cable, Cover, Nuts, Bolts And Seals
Courtesy of GENERAL MOTORS COMPANY

6. Clean all of the gasket surfaces.
7. Install NEW Drive Motor Power Inverter Module 3-Phase Cable Seal (6)
8. Install Drive Motor Power Inverter Module 3-Phase Cable (5)

CAUTION: **Refer to Fastener Caution .**

9. Tighten Drive Motor Power Inverter Module 3-Phase Cable Bolts (4) (Qty: 3) to 9 N.m (80 lb in)
10. Install NEW Drive Motor Power Inverter Module 3-Phase Cable Cover Seal (3)
11. Install Drive Motor Power Inverter Module 3-Phase Cable Cover (2)
12. Install Drive Motor Power Inverter Module 3-Phase Cable Cover Nuts (1) (Qty: 2) and tighten to 9 N.m (80 lb in)

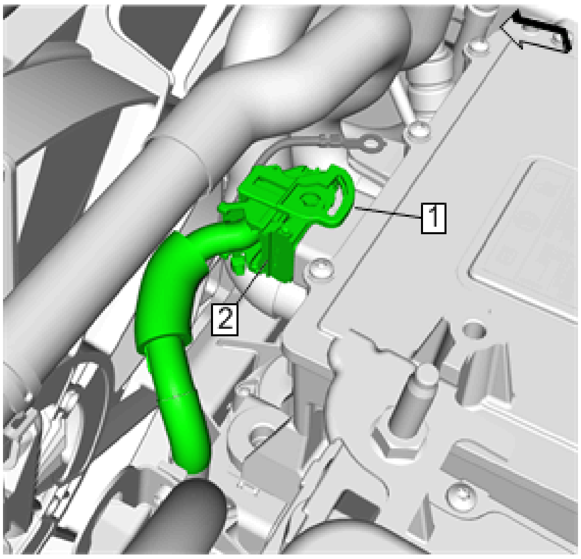


Fig. 30: Engine Wiring Harness Connector And Handle
Courtesy of GENERAL MOTORS COMPANY

13. Install Engine Wiring Harness Connector (2).
14. Lock the handle (1) into lock position.

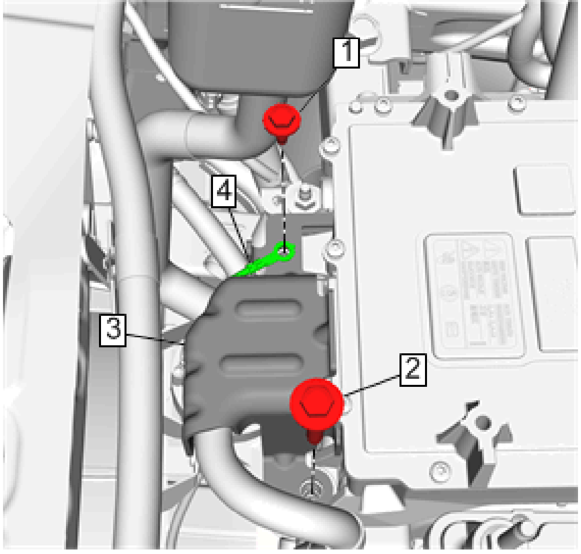


Fig. 31: Drive Motor Power Inverter Module Shield, Bolts And Ground Cable
Courtesy of GENERAL MOTORS COMPANY

15. Install Drive Motor Power Inverter Module Shield (3)
16. Install Ground Cable (4)
17. Install Drive Motor Power Inverter Module Shield Bolt (1) and tighten to 9 N.m (80 lb in)
18. Install Drive Motor Power Inverter Module Shield Bolt (2) and tighten to 25 N.m (18 lb ft)

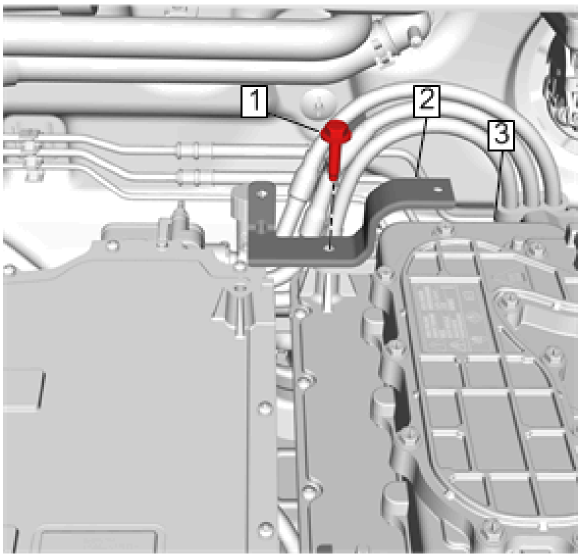


Fig. 32: Engine Wiring Harness Bracket, Bolt And Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

19. Install Engine Wiring Harness Bracket (2) @ Accessory DC Power Control Module (3)
20. Install Engine Wiring Harness Bracket Bolt (1) @ Accessory DC Power Control Module (3) and tighten to 22 N.m (16 lb ft)
21. Install High Voltage Battery Control Wiring Junction Block. Refer to **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)**
22. Install Radiator Surge Tank Support Bracket (RESS). Refer to **Radiator Surge Tank Support Bracket Replacement (Radiator) Radiator Surge Tank Support Bracket Replacement (Heater) Radiator Surge Tank Support Bracket Replacement (RESS)**
23. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
24. Enable the high voltage system. Refer to **High Voltage Enabling**
25. Program the Drive Motor Power Inverter Module. Refer to **Control Module References**

HIGH VOLTAGE BATTERY CONTROL WIRING JUNCTION BLOCK REPLACEMENT (WITH QUICK CHARGE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable High Voltage System. Refer to **High Voltage Disabling**

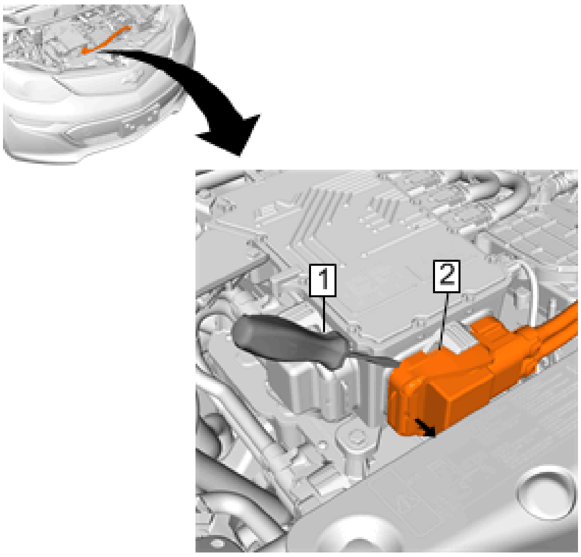


Fig. 33: Flat Blade Screwdriver And Connector Handle Lock
Courtesy of GENERAL MOTORS COMPANY

2. Using a flat blade screwdriver (1), pry the edge of the connector handle lock (2) from the holding tab.
3. Release the connector handle lock by rotating the connector handle forward.
4. With the connector handle in the release position, disconnect the high voltage charger connector, from the high power distribution module.

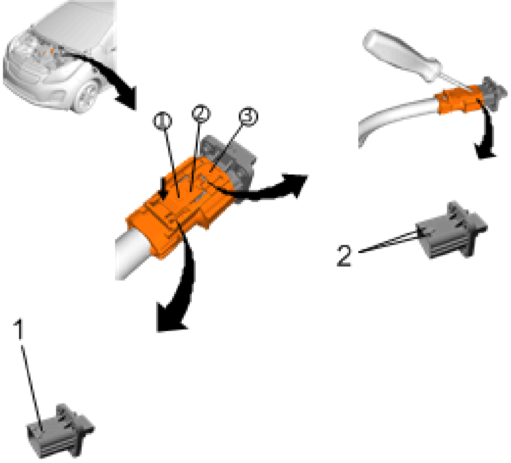


Fig. 34: First Stage Connector Tab And Connector Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the 2-stage high voltage connectors in the following sequence:
   - Push down on the connector tab and release the connector from the first stage connector tab (1).
   - Using a flat blade screwdriver inserted into the connector as shown, release the second stage safety catch, from the 2 connector retaining tabs (2).

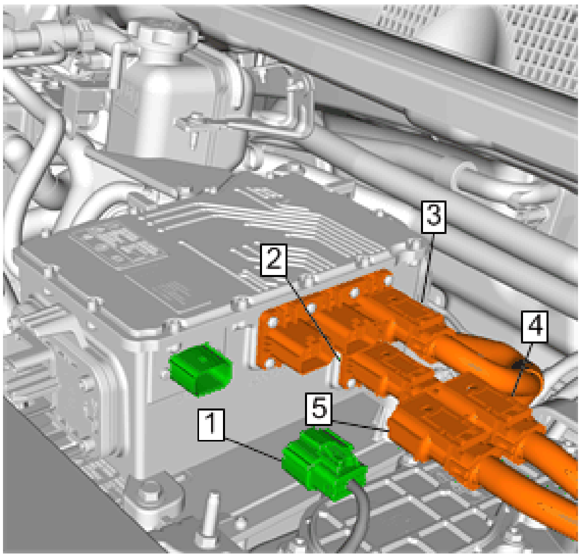


Fig. 35: Generator Battery Control Wiring Junction Block And Connectors
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block
7. After releasing the 2-stage safety connectors, remove the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) from the Generator Battery Control Wiring Junction Block.
8. Remove the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) from the Generator Battery Control Wiring Junction Block.

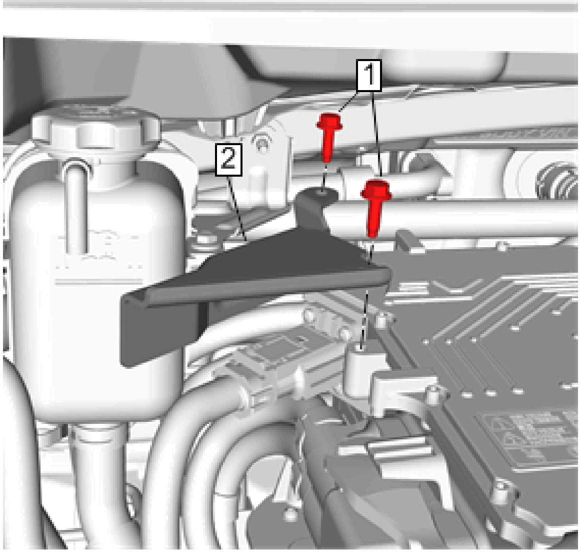


Fig. 36: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolt (1) (Qty: 2)
10. Remove Accessory DC Power Control Module High Voltage Connector Protector (2)

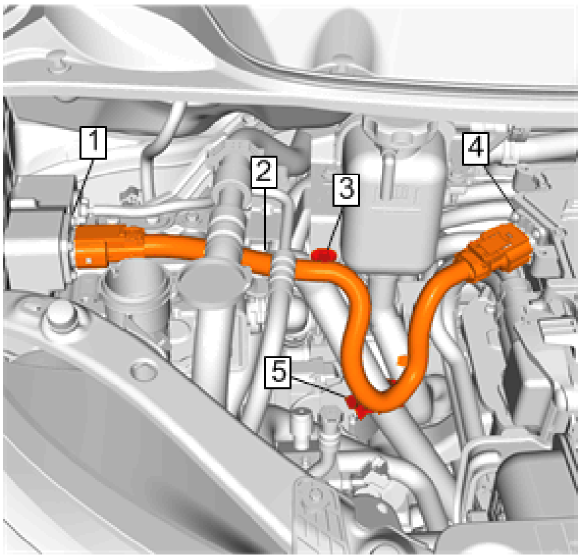


Fig. 37: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

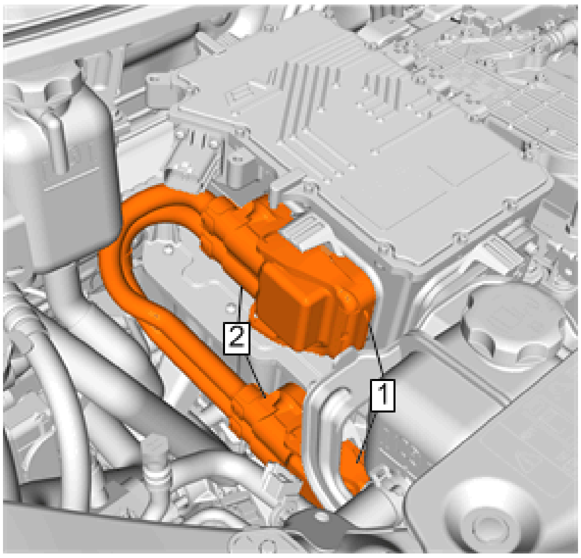


Fig. 38: Battery Positive Cable Extension Cable And Connector Handle
Courtesy of GENERAL MOTORS COMPANY

12. Insert Small, flat bladed tool at Battery Positive Cable Extension Cable Connector Handle (1) release tab and lift to disengage
13. Remove Battery Positive Cable Extension Cable (2)

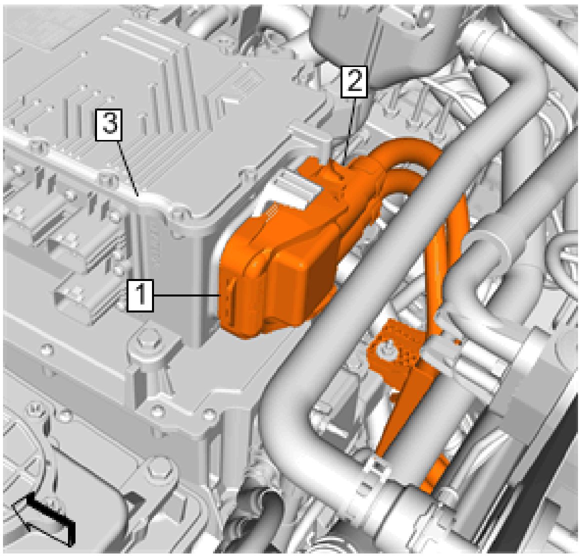


Fig. 39: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

14. Sliding 300-Volt Battery Positive and Negative Cable Connection Handle (1) Forward
15. Release 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

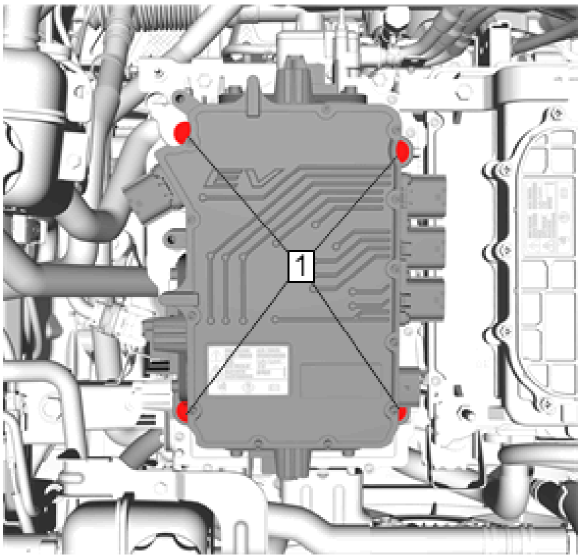


Fig. 40: Generator Battery Control Wiring Junction Block Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4)

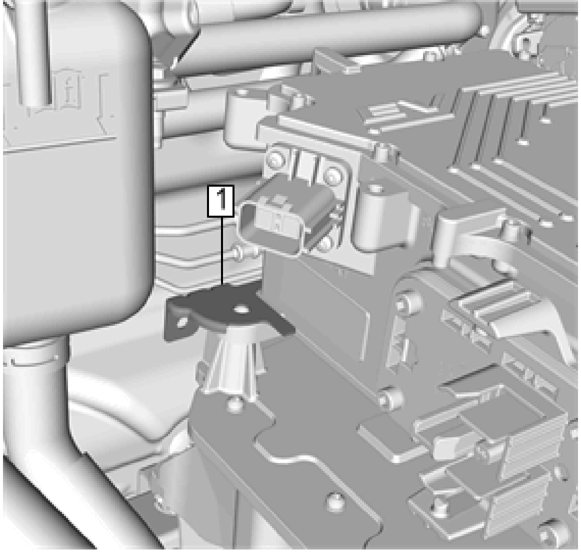


Fig. 41: Engine Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

17. Remove Engine Wiring Harness Bracket (1)

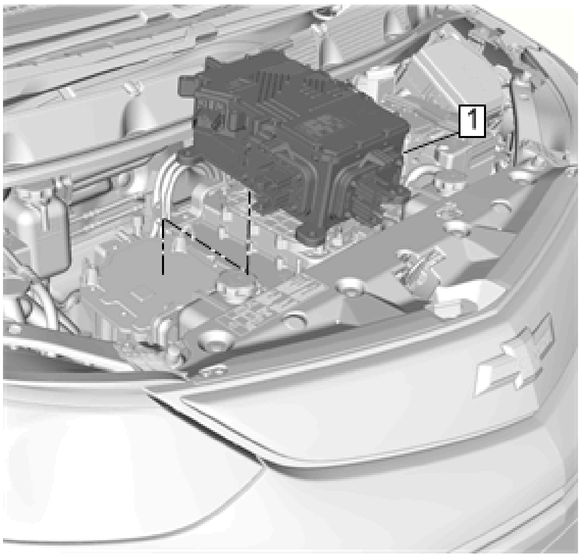


Fig. 42: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

18. Remove Generator Battery Control Wiring Junction Block (1)

Installation Procedure

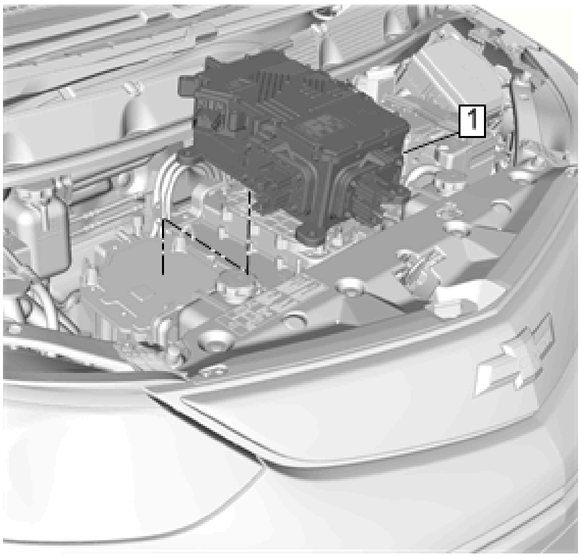


Fig. 43: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

1. Install Generator Battery Control Wiring Junction Block (1)

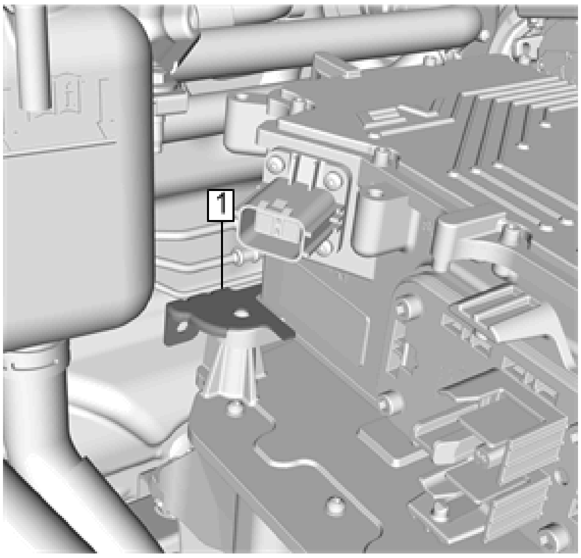


Fig. 44: Engine Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Wiring Harness Bracket (1)

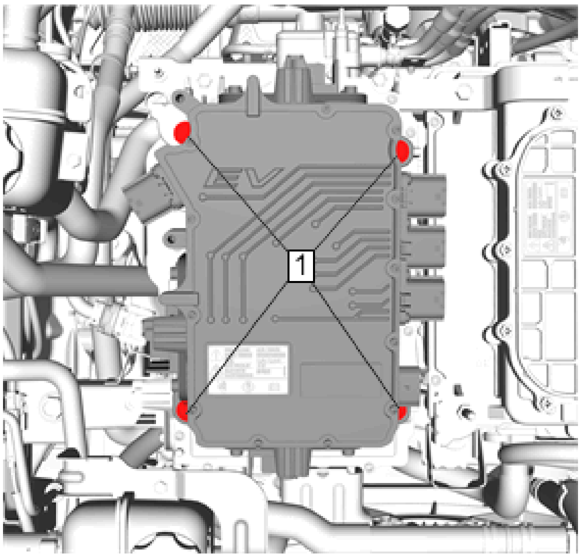


Fig. 45: Generator Battery Control Wiring Junction Block Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4) and tighten to 22 N.m (16 lb ft)

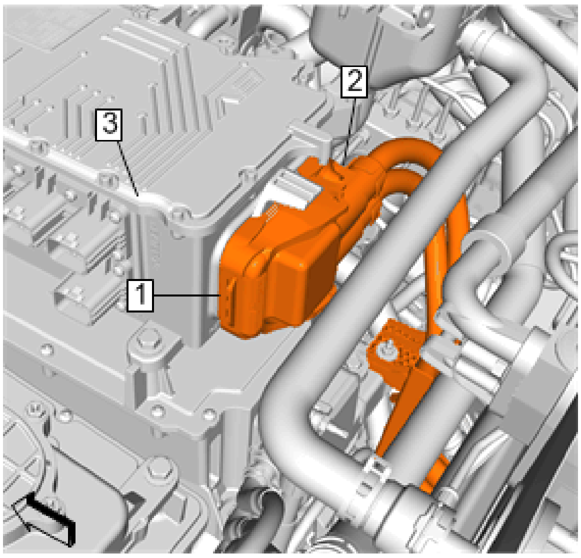


Fig. 46: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

4. Connect 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

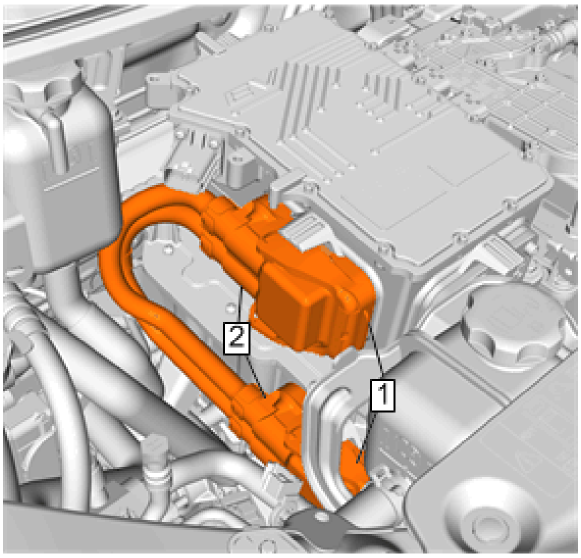


Fig. 47: Battery Positive Cable Extension Cable And Connector Handle
Courtesy of GENERAL MOTORS COMPANY

5. Connect Battery Positive Cable Extension Cable (2)

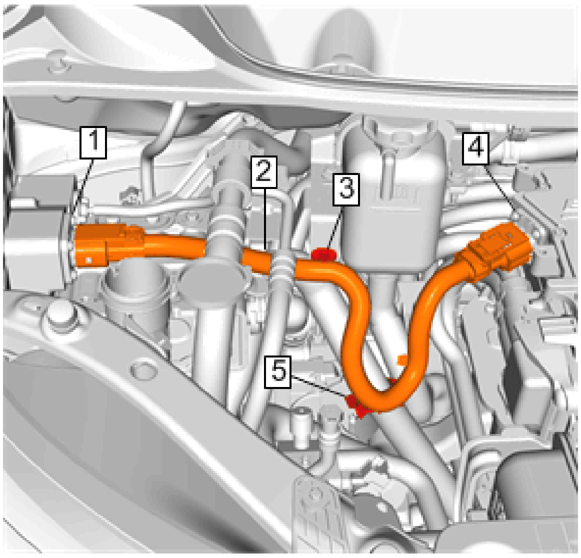


Fig. 48: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

6. Connect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

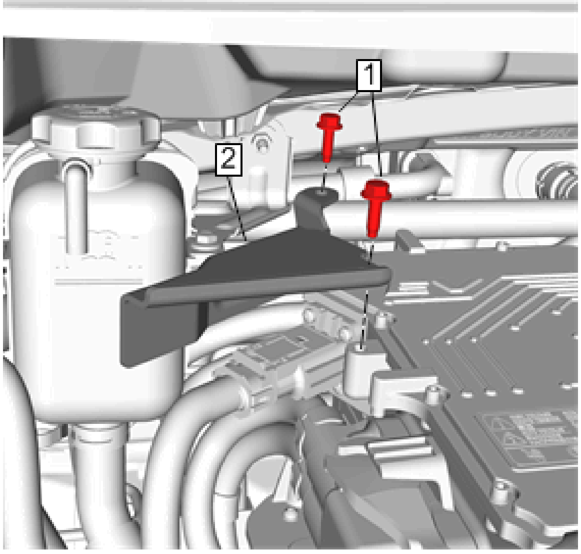


Fig. 49: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install Accessory DC Power Control Module High Voltage Connector Protector (2)
8. Install Accessory DC Power Control Module High Voltage Connector Protector Bolts (1) (Qty: 2) and tighten to 9 N.m (80 lb in)

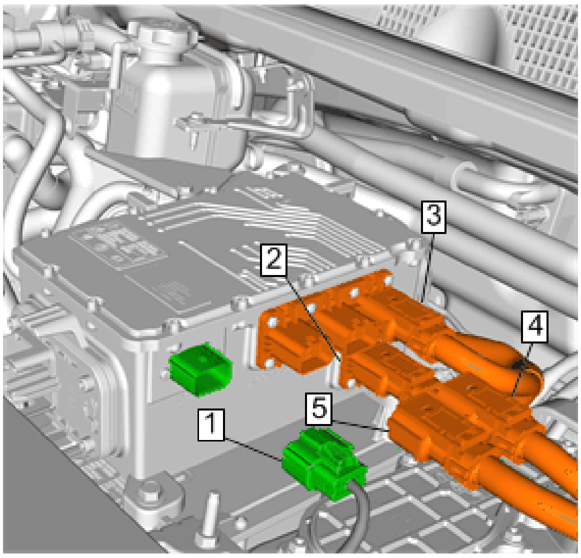


Fig. 50: Generator Battery Control Wiring Junction Block And Connectors
Courtesy of GENERAL MOTORS COMPANY

9. Install the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) to the Generator Battery Control Wiring Junction Block.
10. Install the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) to the Generator Battery Control Wiring Junction Block.
11. Connect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block

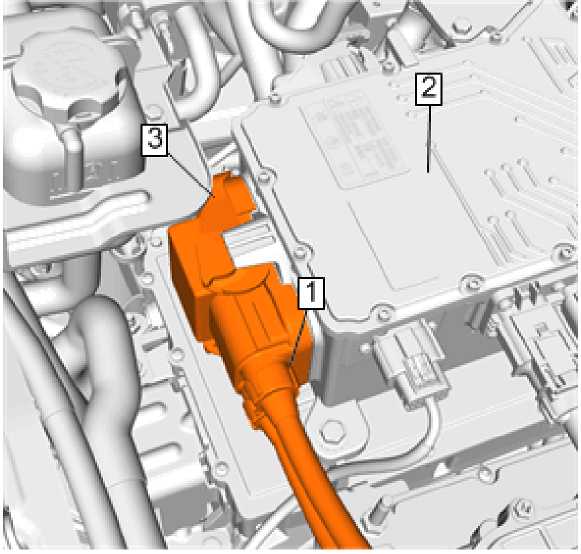


Fig. 51: Drive Motor Battery Charger Receptacle, Generator Battery Control Wiring Junction Block And Handle
Courtesy of GENERAL MOTORS COMPANY

12. Install the Drive Motor Battery Charger Receptacle (1) to the generator battery control wiring junction block (2), and lock the handle (3) into the lock position.
13. Enable High Voltage Stem. Refer to High Voltage Enabling

HIGH VOLTAGE BATTERY CONTROL WIRING JUNCTION BLOCK REPLACEMENT (WITHOUT QUICK CHARGE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable High Voltage System. Refer to High Voltage Disabling

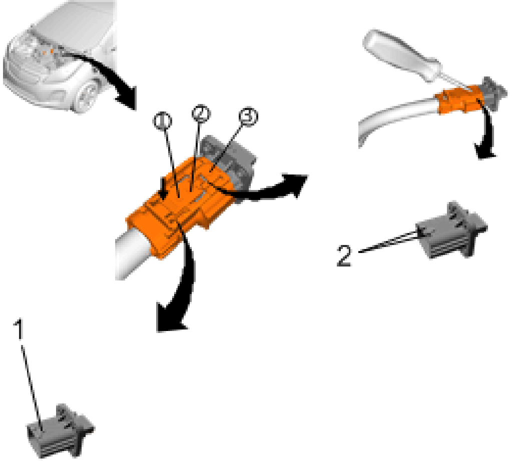


Fig. 52: First Stage Connector Tab And Connector Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the high voltage connectors in the following sequence:
   - Release the CPA. Push down on the connector tab, and release the connector.

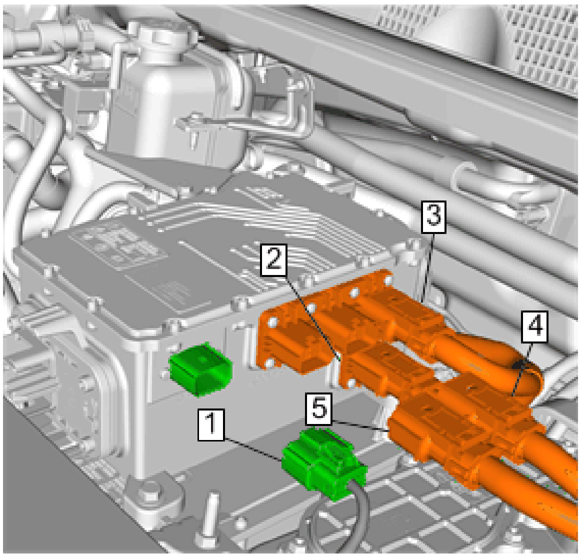


Fig. 53: Generator Battery Control Wiring Junction Block And Connectors
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block
4. After releasing the 2-stage safety connectors, remove the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) from the Generator Battery Control Wiring Junction Block.
5. Remove the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) from the Generator Battery Control Wiring Junction Block.

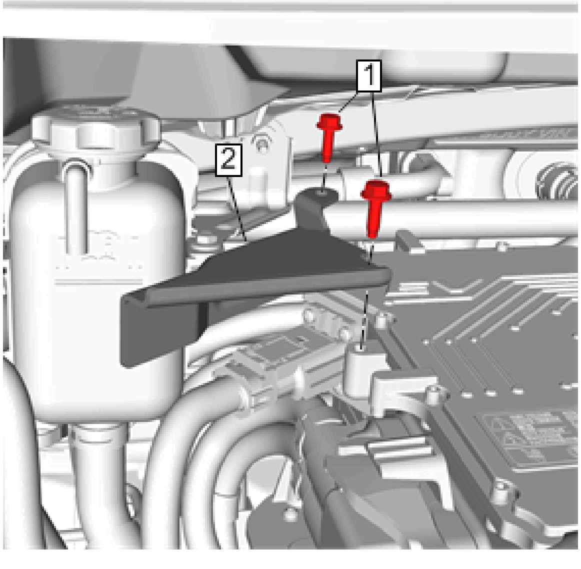


Fig. 54: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolts (1) (Qty: 2)
7. Remove Accessory DC Power Control Module High Voltage Connector Protector (2)

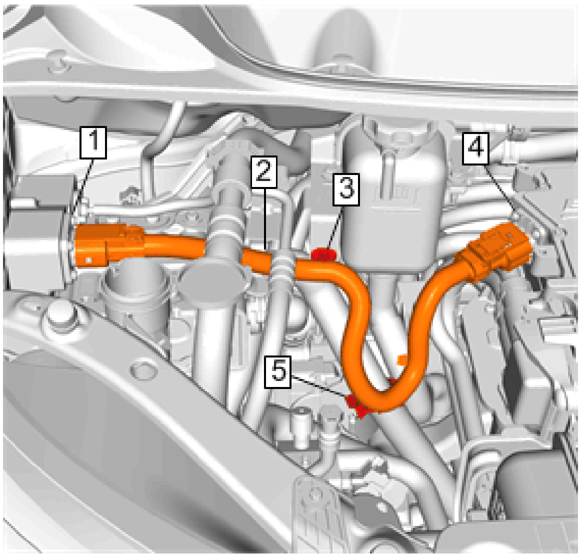


Fig. 55: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

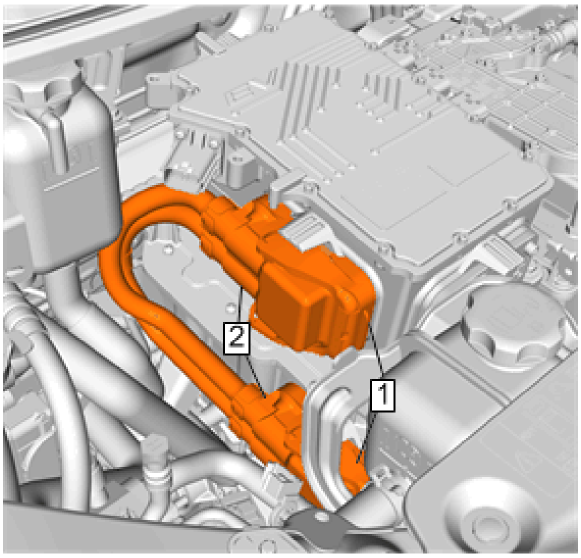


Fig. 56: Battery Positive Cable Extension Cable And Connector Handle
Courtesy of GENERAL MOTORS COMPANY

9. Insert Small, flat bladed tool at Battery Positive Cable Extension Cable Connector Handle (1) release tab and lift to disengage
10. Remove Battery Positive Cable Extension Cable (2)

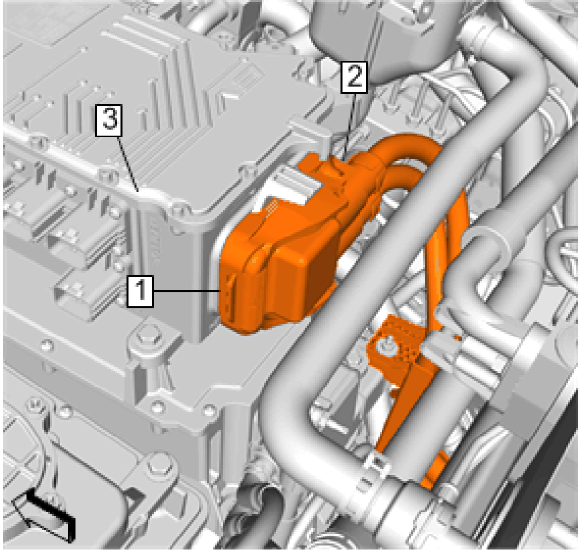


Fig. 57: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

11. Insert Small, flat bladed tool at 300-Volt Battery Positive and Negative Cable Connection Handle (1) release tab and lift to disengage
12. Release 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

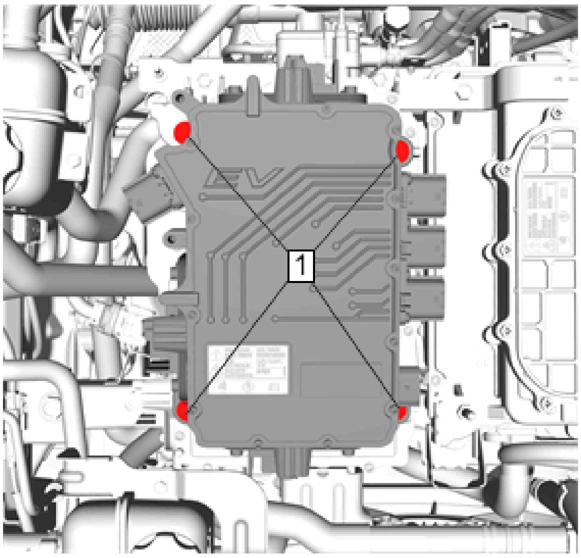


Fig. 58: Generator Battery Control Wiring Junction Block Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4)

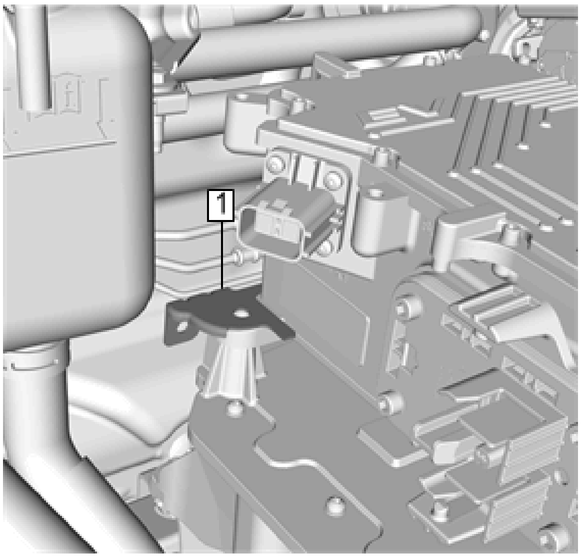


Fig. 59: Engine Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

14. Remove Engine Wiring Harness Bracket (1)

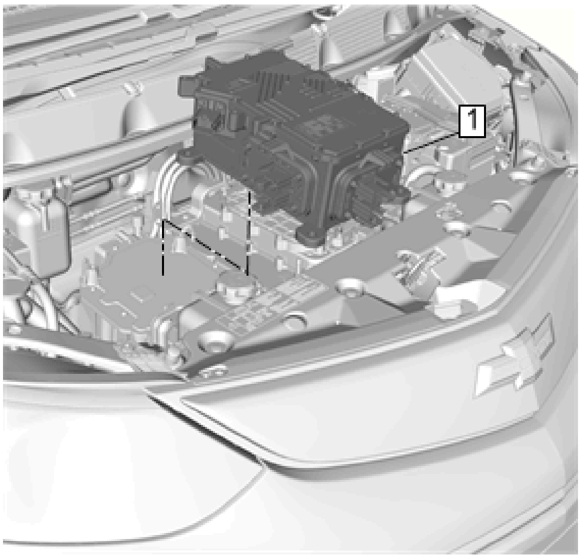


Fig. 60: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

15. Remove Generator Battery Control Wiring Junction Block (1)

Installation Procedure

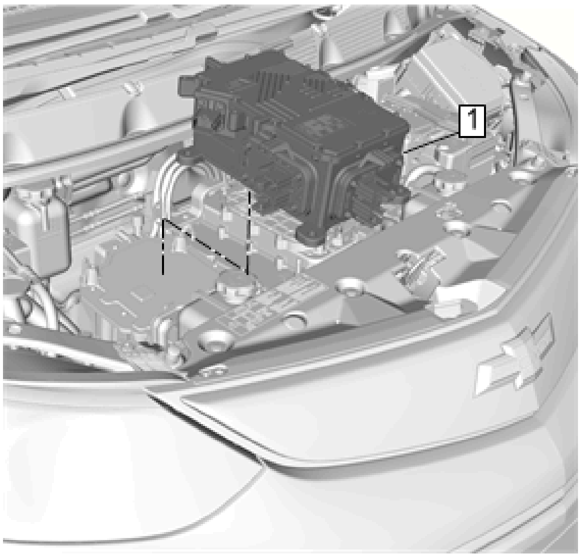


Fig. 61: Generator Battery Control Wiring Junction Block
Courtesy of GENERAL MOTORS COMPANY

1. Install Generator Battery Control Wiring Junction Block (1)

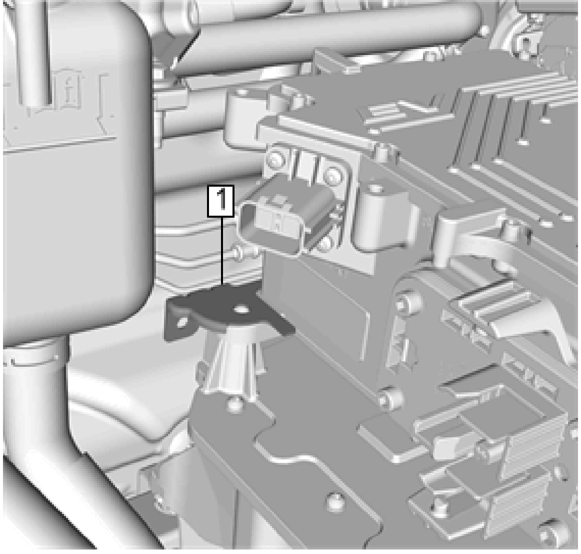


Fig. 62: Engine Wiring Harness Bracket
Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Wiring Harness Bracket (1)

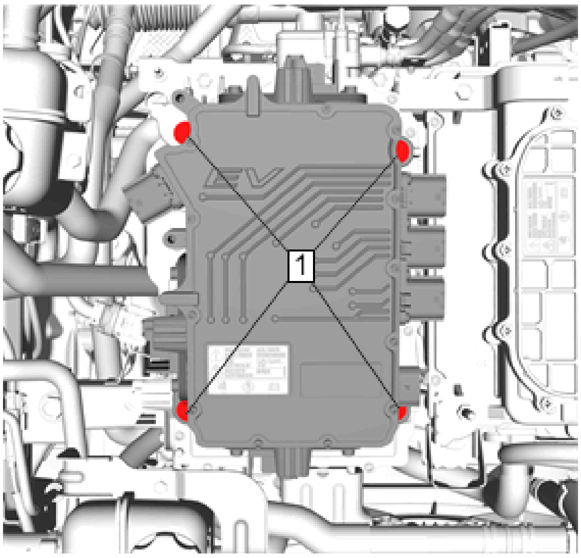


Fig. 63: Generator Battery Control Wiring Junction Block Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install Generator Battery Control Wiring Junction Block Bolts (1) (Qty: 4) and tighten to 22 N.m (16 lb ft)

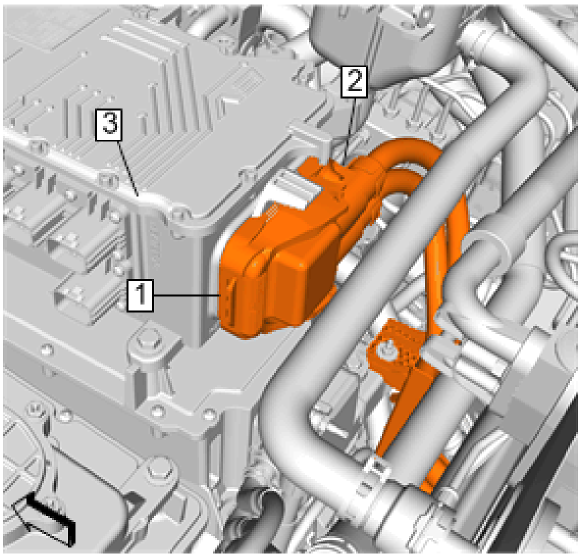


Fig. 64: 300-Volt Battery Positive and Negative Cable, Connection Handle And Generator Battery Control Wiring Junction Block

Courtesy of GENERAL MOTORS COMPANY

4. Connect 300-Volt Battery Positive and Negative Cable (2) @ Generator Battery Control Wiring Junction Block (3)

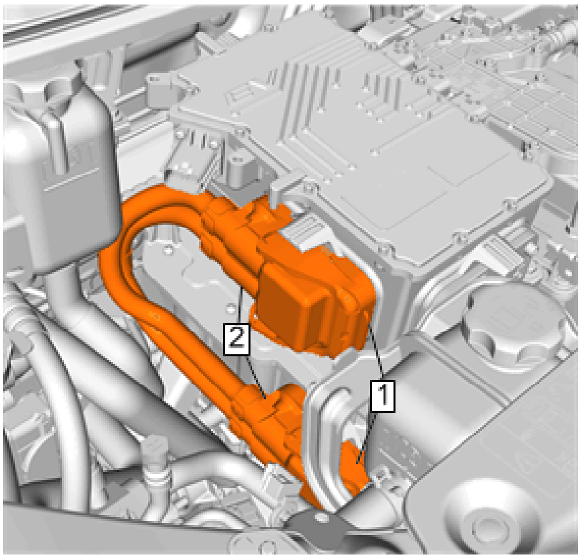


Fig. 65: Battery Positive Cable Extension Cable And Connector Handle
Courtesy of GENERAL MOTORS COMPANY

5. Connect Battery Positive Cable Extension Cable (2)

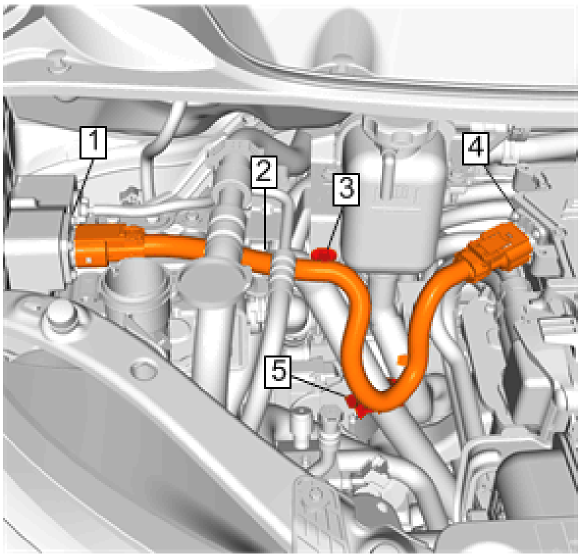


Fig. 66: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

6. Connect Drive Motor Battery Positive and Negative Cable (1) @ Generator Battery Control Wiring Junction Block

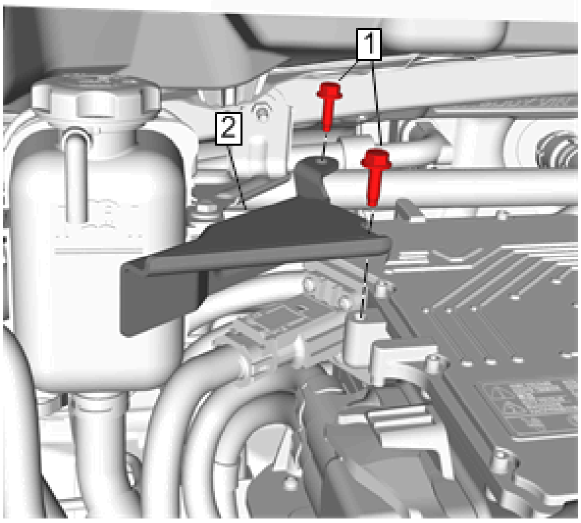


Fig. 67: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install Accessory DC Power Control Module High Voltage Connector Protector (2)
8. Install Accessory DC Power Control Module High Voltage Connector Protector Bolts (1) (Qty: 2) and tighten to 9 N.m (80 lb in)

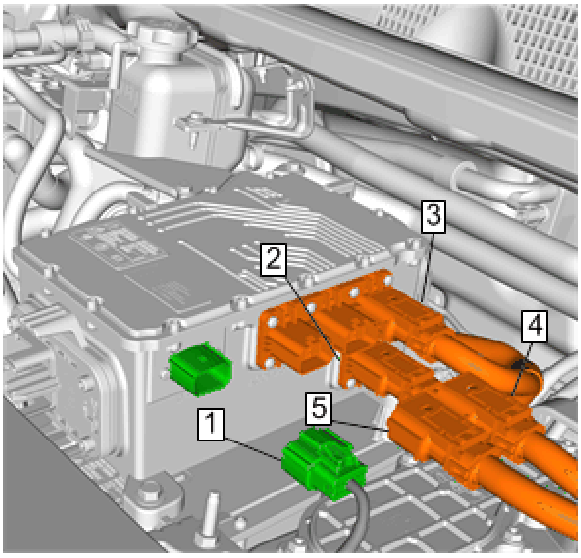


Fig. 68: Generator Battery Control Wiring Junction Block And Connectors
Courtesy of GENERAL MOTORS COMPANY

9. Install the RESS heater connector (3) and Drive Motor Battery Charger & auxiliary power module to RESS connector (2) to the Generator Battery Control Wiring Junction Block.
10. Install the A/C Control module connector (5) and Drive Motor Battery Charger & auxiliary power module connector (4) to the Generator Battery Control Wiring Junction Block.
11. Connect Low Voltage connection connector (1) @ Generator Battery Control Wiring Junction Block
12. Enable High Voltage System. Refer to High Voltage Enabling

HIGH VOLTAGE BATTERY DISCONNECT CONTROL MODULE FUSE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable High Voltage System. Refer to High Voltage Disabling
2. Remove Generator Battery Control Wiring Junction Block. Refer to High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)

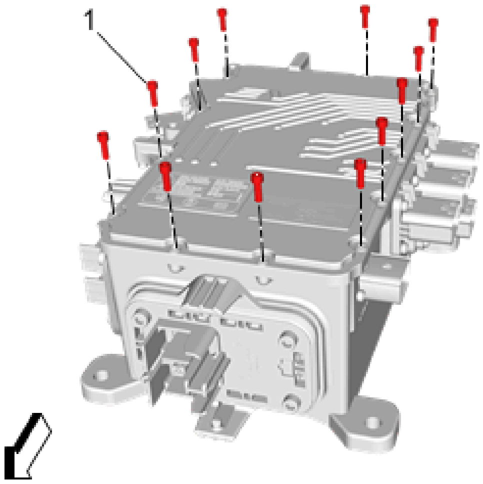


Fig. 69: Generator Battery Control Wiring Junction Block Cover Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Generator Battery Control Wiring Junction Block Cover Upper Bolts (1) (Qty: 12)

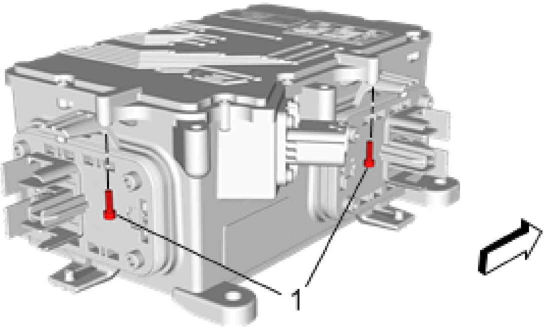


Fig. 70: Generator Battery Control Wiring Junction Block Cover Lower Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Generator Battery Control Wiring Junction Block Cover Lower Bolts (1) (Qty: 2)

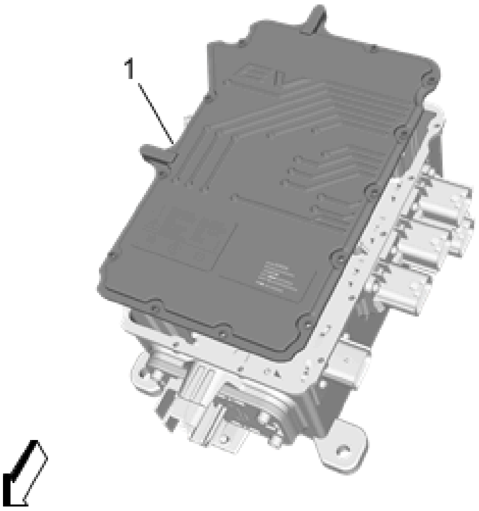


Fig. 71: Generator Battery Control Wiring Junction Block Cover
Courtesy of GENERAL MOTORS COMPANY

5. Remove Generator Battery Control Wiring Junction Block Cover (1)

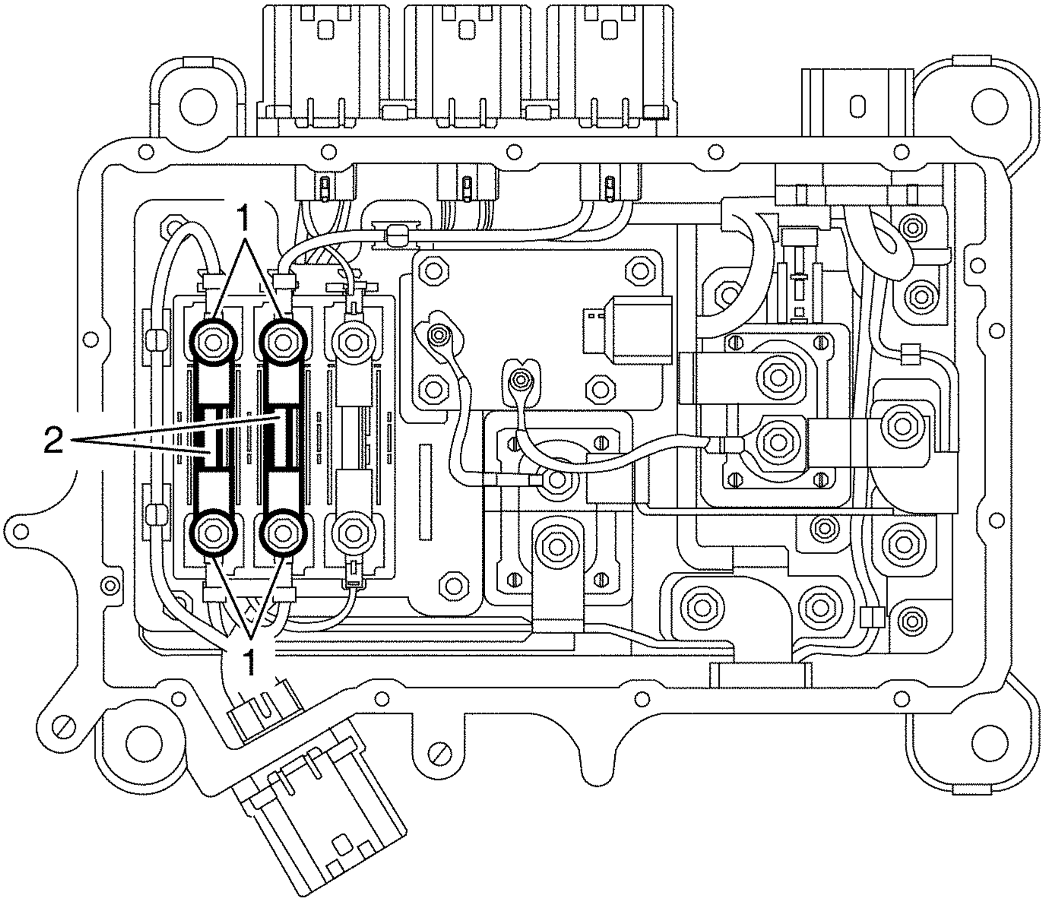


Fig. 72: 40A Fuses And Nuts
Courtesy of GENERAL MOTORS COMPANY

6. Remove 40A Fuse Nuts (1) (Qty: 4)
7. Remove 40A Fuses (2)

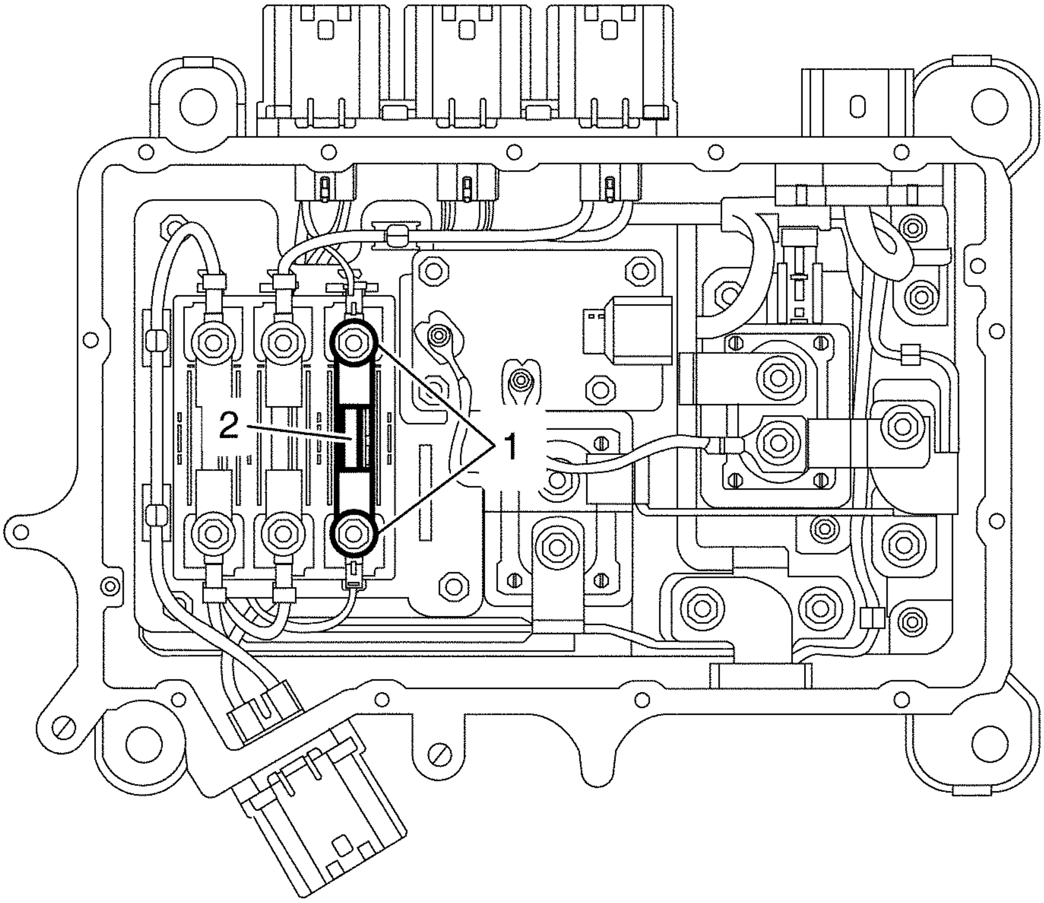


Fig. 73: 15A Fuse And Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove 15A Fuse Nuts (1) (Qty: 2)
9. Remove 15A Fuse (2)

Installation Procedure

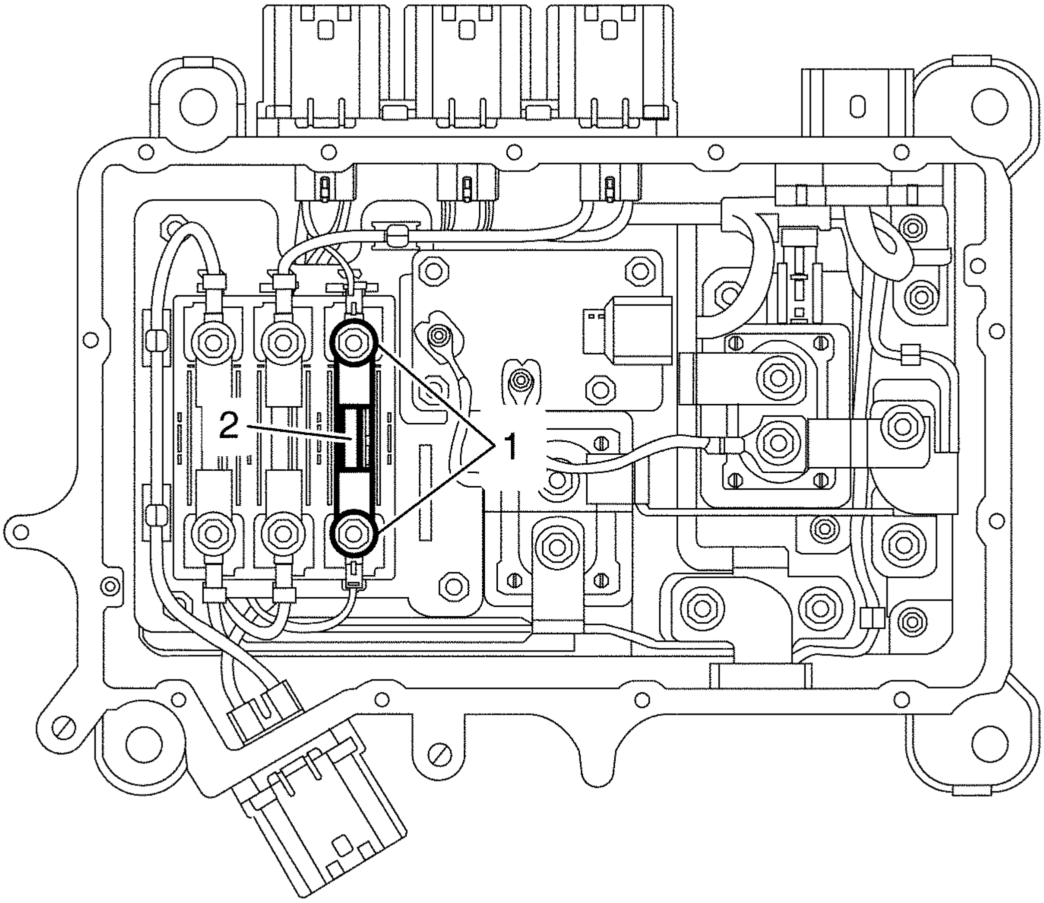


Fig. 74: 15A Fuse And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

1. Install 15A Fuse (2)
2. Install and tighten 15A Fuse Nuts (1) (Qty: 2) to 4.5 N.m (40 lb in)

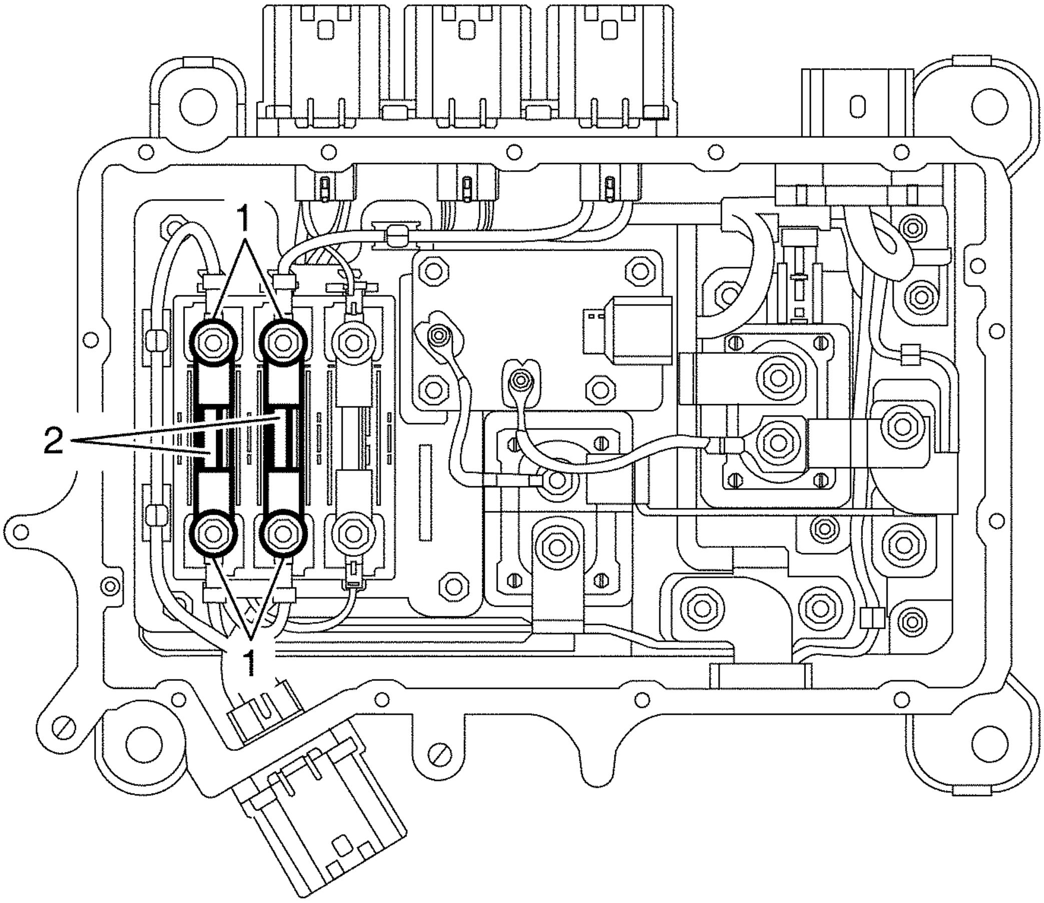


Fig. 75: 40A Fuses And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Install 40A Fuses (2)
4. Install and tighten 40A Fuse Nuts (1) (Qty: 4) to 4.5 N.m (40 lb in)

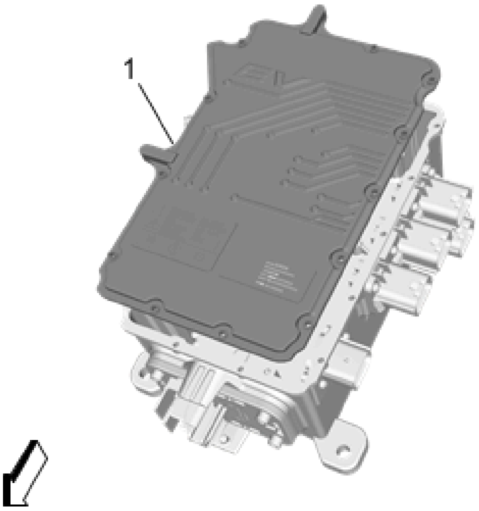


Fig. 76: Generator Battery Control Wiring Junction Block Cover
Courtesy of GENERAL MOTORS COMPANY

5. Install Generator Battery Control Wiring Junction Block Cover (1)

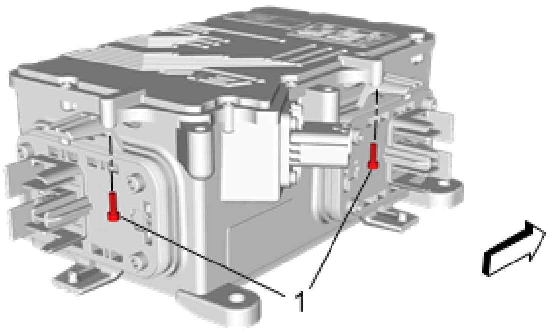


Fig. 77: Generator Battery Control Wiring Junction Block Cover Lower Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Generator Battery Control Wiring Junction Block Cover Lower Bolts (1) (Qty: 2) to 2.5 N.m (22 lb in)

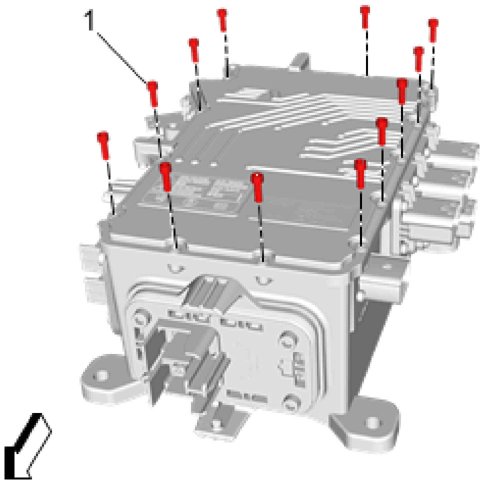


Fig. 78: Generator Battery Control Wiring Junction Block Cover Upper Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Install and tighten Generator Battery Control Wiring Junction Block Cover Upper Bolts (1) (Qty: 12) to 2.5 N.m (22 lb in)
8. Install Generator Battery Control Wiring Junction Block. Refer to High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)
9. Enable High Voltage System. Refer to High Voltage Enabling

ACCESSORY DC POWER CONTROL MODULE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable High Voltage System. Refer to **High Voltage Disabling**
2. Drain Drive Motor Generator Power Inverter Module Cooling System. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

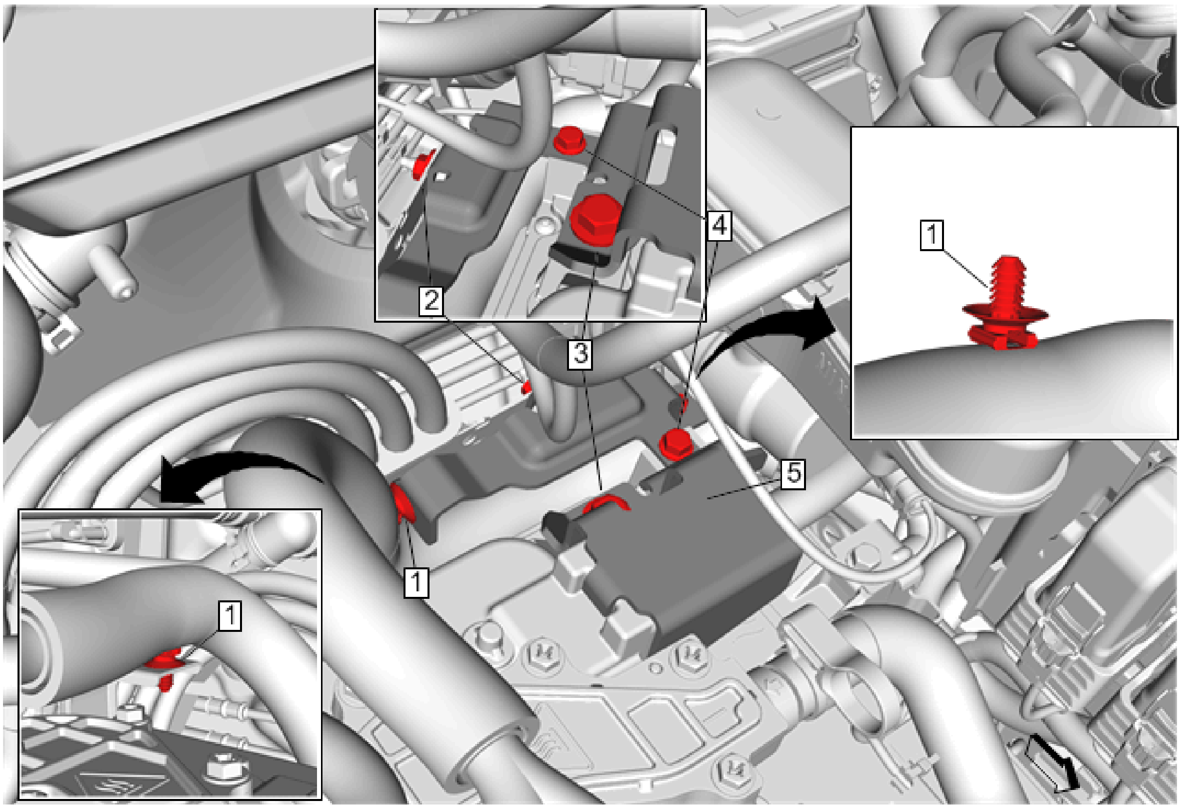
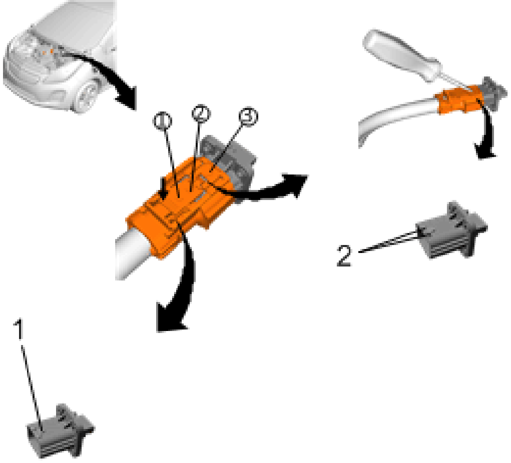


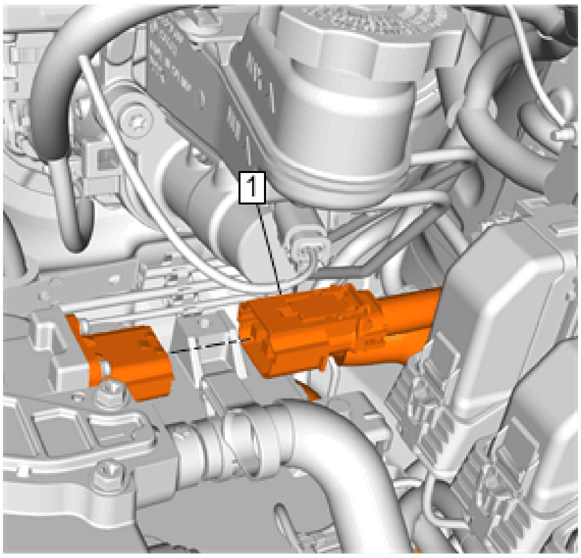
Fig. 79: DC Power Control Module High Voltage Connector Protector, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the battery to battery positive cable retainers.
4. Remove Accessory DC Power Control Module High Voltage Connector Protector Nut (2)
5. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolts (3, 4)
6. Remove Accessory DC Power Control Module High Voltage Connector Protector (5)



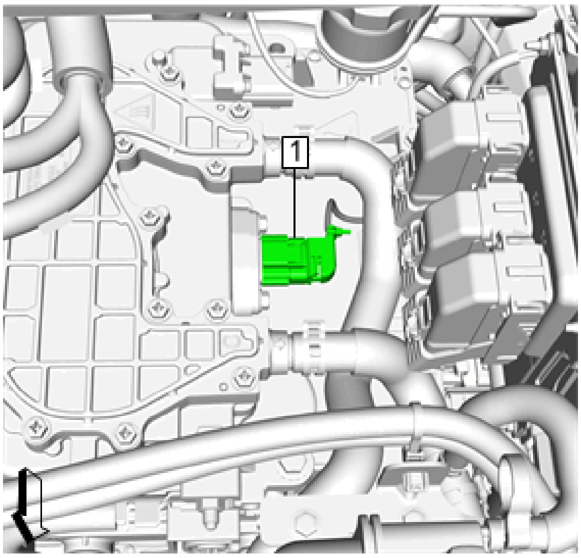
[Fig. 80: First Stage Connector Tab And Connector Retaining Tabs](#)
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the high voltage connectors in the following sequence:
    - Release the CPA. Push down on the connector tab, and release the connector.



[Fig. 81: Auxiliary Power Module Connector](#)
Courtesy of GENERAL MOTORS COMPANY

8. After releasing the 2-stage safety connectors, remove the auxiliary power module connector (1).



[Fig. 82: Low Voltage Connection Connector](#)
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Low Voltage Connection Connector (1) @ Accessory DC Power Control Module

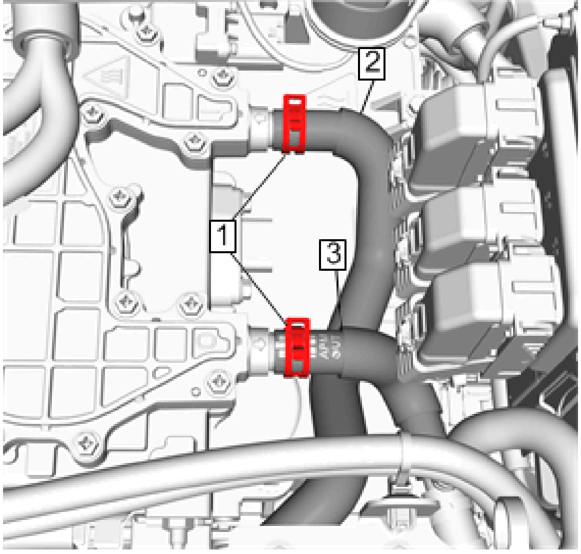


Fig. 83: Drive Motor Generator Control Module Cooling Outlet Hose, Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

10. Release Clamp (1) and Remove the Drive Motor Generator Control Module Cooling Outlet Hose (2)
11. Release Clamp (1) and Remove the Electric Differential Drive Motor Power Inverter Module Cooling Hose (3)

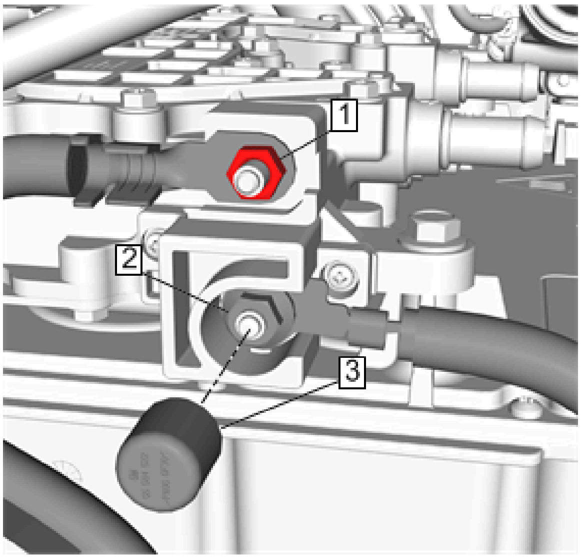


Fig. 84: Battery Negative Cable Extension Cable And Battery Positive Cable Components
Courtesy of GENERAL MOTORS COMPANY

12. Remove Battery Negative Cable Extension Cable Fastener (1)
13. Remove Battery Positive Cable Protector (3)
14. Remove Battery Positive Cable and Nut (2)
15. Remove Battery Negative Cable Extension Cable & Battery Positive Cable - Remove

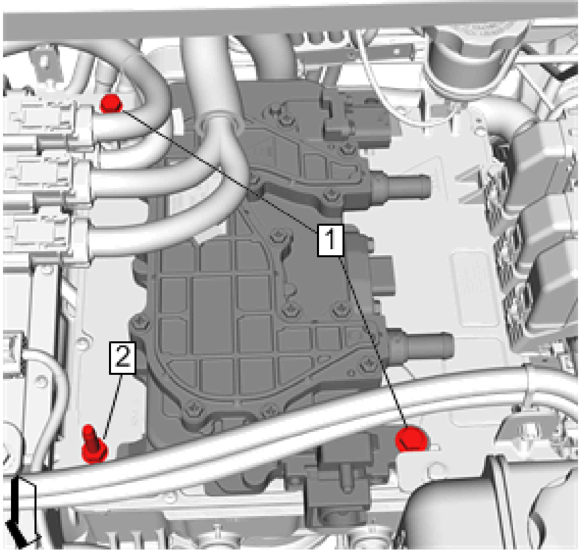


Fig. 85: Accessory DC Power Control Module Bolts And Studs
Courtesy of GENERAL MOTORS COMPANY

16. Remove Accessory DC Power Control Module Bolts (1) (Qty: 2)
17. Remove Accessory DC Power Control Module Stud (2)

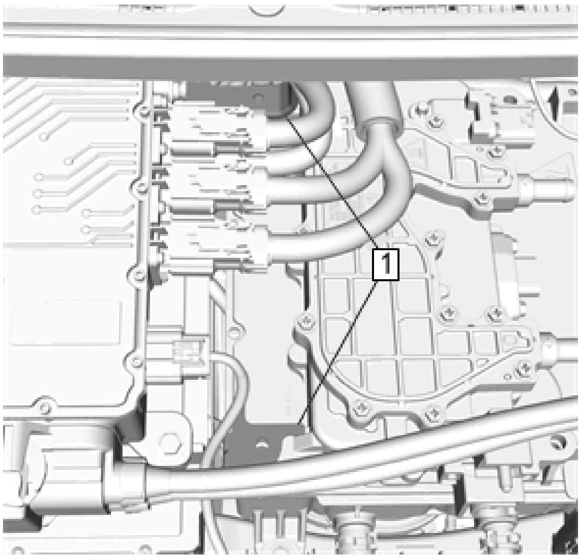


Fig. 86: Engine Wiring Harness Brackets
Courtesy of GENERAL MOTORS COMPANY

18. Position aside Engine Wiring Harness Brackets (1) (Qty: 2)

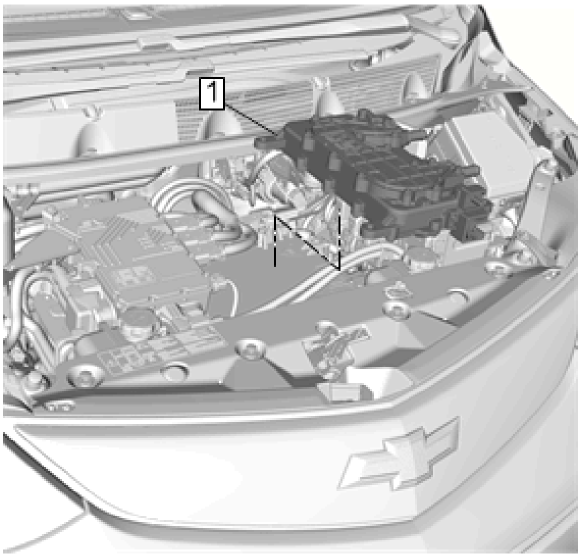


Fig. 87: Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

19. Remove Accessory DC Power Control Module (1)

Installation Procedure

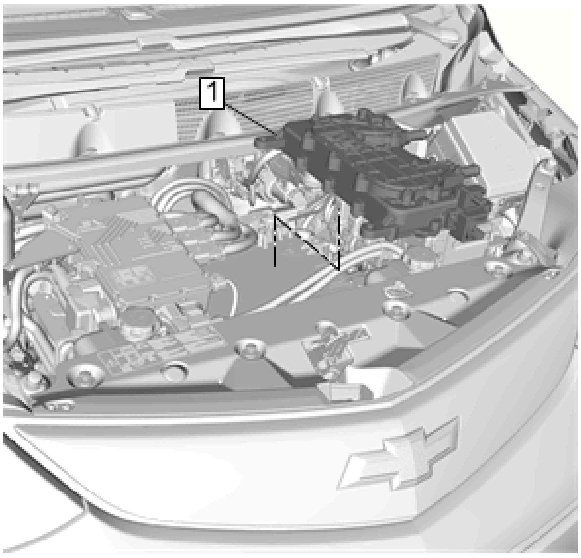


Fig. 88: Accessory DC Power Control Module
Courtesy of GENERAL MOTORS COMPANY

1. Install Accessory DC Power Control Module (1)

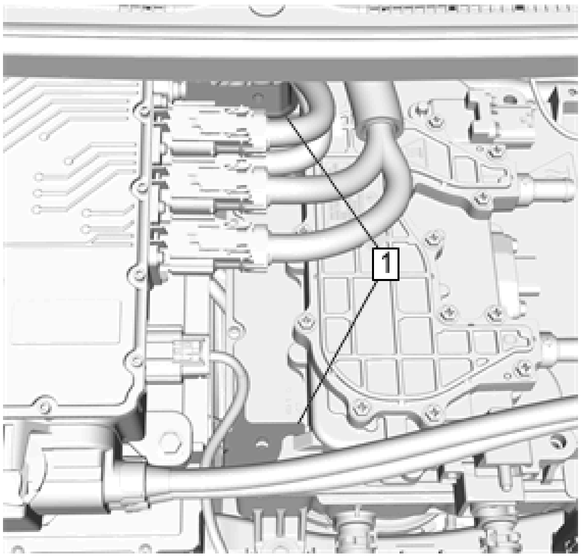


Fig. 89: Engine Wiring Harness Brackets
Courtesy of GENERAL MOTORS COMPANY

2. Install Engine Wiring Harness Brackets (1) (Qty: 2)

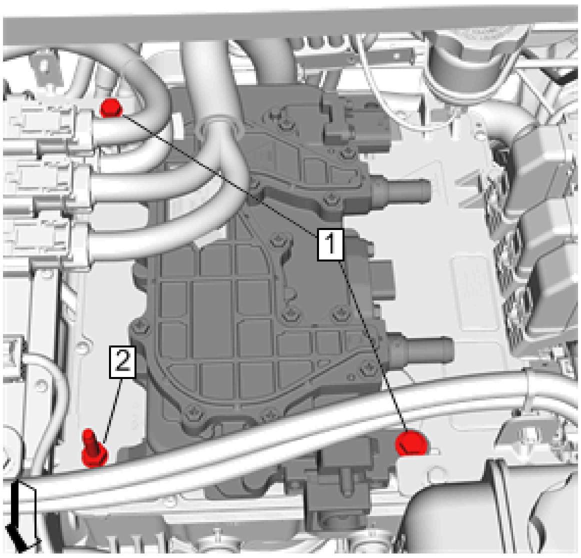


Fig. 90: Accessory DC Power Control Module Bolts And Studs
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Install Accessory DC Power Control Module Bolts (1) (Qty: 2) and tighten to 22 N.m (16 lb ft)
4. Install Accessory DC Power Control Module Stud (2) and tighten to 22 N.m (16 lb ft)

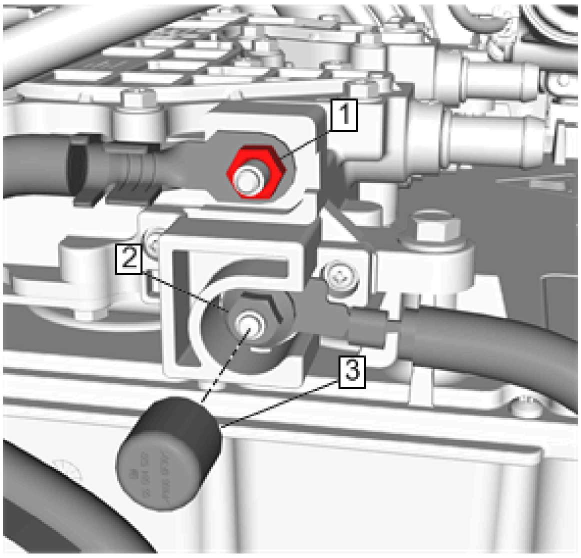


Fig. 91: Battery Negative Cable Extension Cable And Battery Positive Cable Components
Courtesy of GENERAL MOTORS COMPANY

5. Install Battery Negative Cable Extension Cable & Battery Positive Cable
6. Install and tighten Battery Positive Cable and Nut (2) to 15 N.m (11 lb ft)
7. Install Battery Positive Cable Protector (3)
8. Install and tighten Battery Negative Cable Extension Cable Fastener (1) to 15 N.m (11 lb ft)

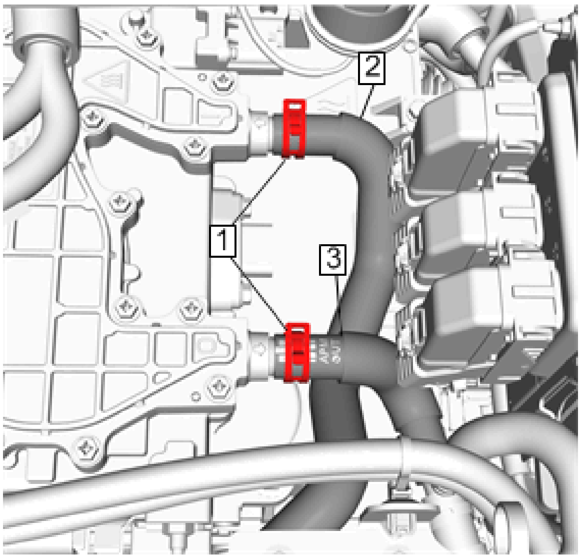


Fig. 92: Drive Motor Generator Control Module Cooling Outlet Hose, Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

9. Install the Electric Differential Drive Motor Power Inverter Module Cooling Hose (3) and Engage the Clamp (1)
10. Install the Drive Motor Generator Control Module Cooling Outlet Hose (2) and Engage the Clamp (1)

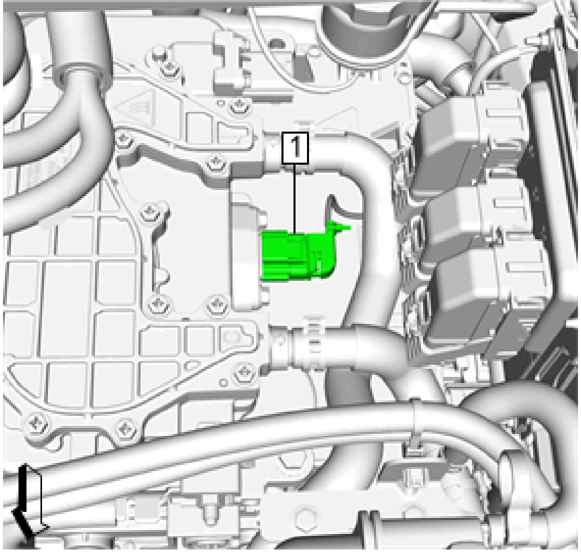


Fig. 93: Low Voltage Connection Connector
Courtesy of GENERAL MOTORS COMPANY

11. Connect Low Voltage connection connector (1) @ Accessory DC Power Control Module

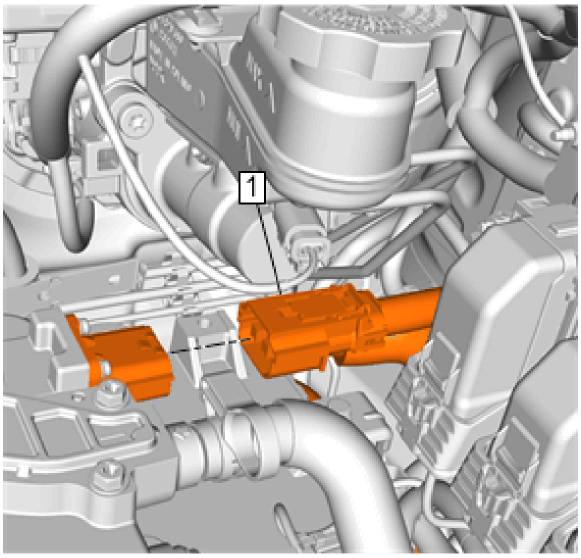


Fig. 94: Auxiliary Power Module Connector
Courtesy of GENERAL MOTORS COMPANY

12. Connect Auxiliary Power Module Connector (1)

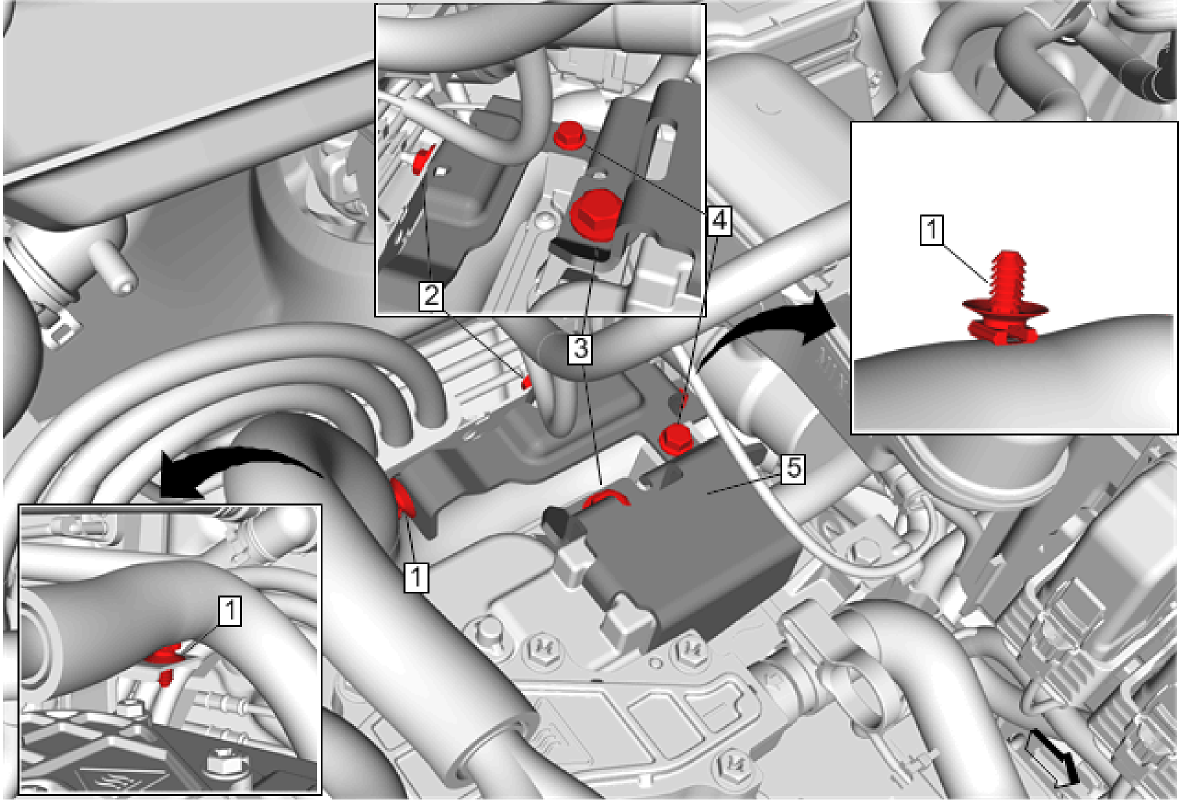


Fig. 95: DC Power Control Module High Voltage Connector Protector, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Install Accessory DC Power Control Module High Voltage Connector Protector (5)
14. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt (4) and tighten to 9 N.m (80 lb in)
15. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt (3) and tighten to 22 N.m (16 lb ft)
16. Install Accessory DC Power Control Module High Voltage Connector Protector Nut (2) and tighten to 9 N.m (80 lb in)
17. Install the battery to battery positive cable retainers.
18. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
19. Enable the high voltage system. Refer to **High Voltage Enabling**

ACCELERATOR PEDAL ASSEMBLY REPLACEMENT

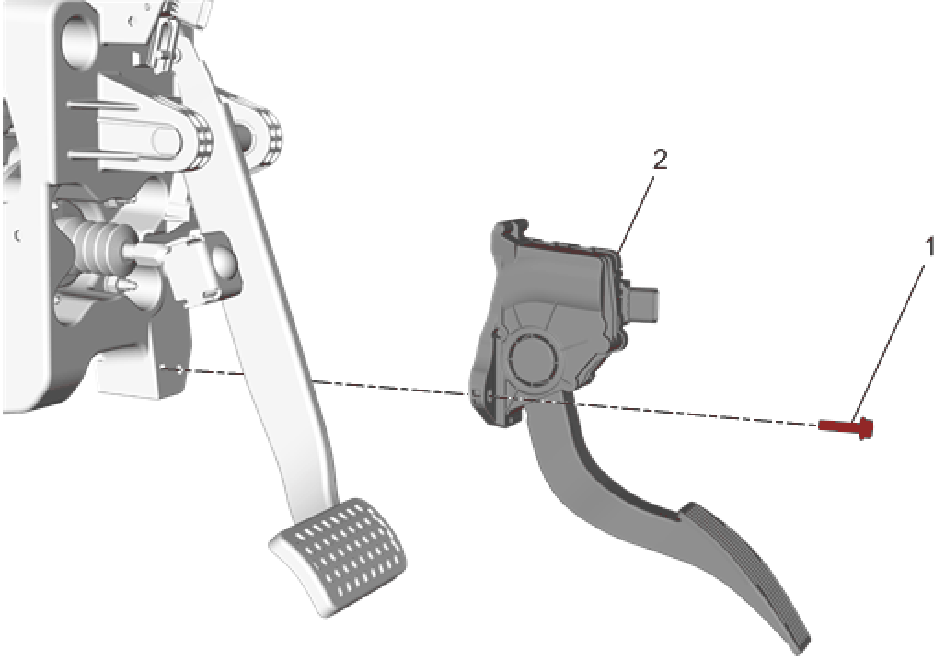


Fig. 96: Accelerator Pedal Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Accelerator Pedal Pad Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 7 N.m (62 lb in)
2	Accelerator Pedal Assembly **Procedure** Disconnect the electrical connector.

DESCRIPTION AND OPERATION

ACCESSORY DC POWER CONTROL MODULE DESCRIPTION AND OPERATION

Location

The 14 V power module, also called the accessory DC power control module, is located in the in the front compartment. The 14 V power module is cooled with pre-mixed DexcoolÃ‚Â® circulating through a cooling system that is separate from the engine cooling system.

Operating Functions

The 14 V power module is an electronic device that takes the place of the generator on a traditional vehicle. On a hybrid or electric vehicle the 14 V power module converts high voltage (300 V) direct current (DC) to low voltage (12 V) DC for accessory electrical operation and to charge the 12 V battery.

Normally, the 14 V power module only supplies 12 V DC when the vehicle is under a normal drive cycle. However there are certain instances when the vehicle is being charged through a standard wall socket where the 14 V power module operation is required to sustain the 12 V battery.

The 14 V power module is capable of supplying up to 130 Amps of 12 V DC.

Communication and Hosted Diagnostics

The 14 V power module has no internal diagnostic tests and does not communicate over serial data. The engine control module (ECM) monitors and controls the 14 V power module and will report DTCs if a fault is detected.

Circuit Inputs

Inputs to the 14 V power module include the high voltage and 12 V circuits. The 14 V power module also has a pulse width modulated set point input from the engine control module (ECM). This input enables conversion of voltage from high to the desired 12 V output level.

For more information on the 12 V Battery Charging System, refer to **Charging System Description and Operation** .

Circuit Outputs

The only outputs supported by the 14 V power module are the status feedback circuit to the engine control module (ECM) and 12 V DC which powers the 12 V components in the vehicle and charges the 12 V battery. Low voltage 12 V cables on the hybrid/EV vehicle do not require unique coloring or servicing procedures.

DRIVE MOTOR POWER INVERTER MODULE DESCRIPTION AND OPERATION

Overview

The power inverter module, often referred to as the drive motor generator power inverter module, converts high voltage direct current (DC) electrical energy to 3 phase alternating current (AC) electrical energy. The power inverter module contains the motor control module and the hybrid/EV powertrain control module 1. The motor control module operates the drive motor based upon power inverter module commands. The hybrid/EV powertrain control module 1 also controls the auxiliary transmission fluid pump using a Pulse Width Modulated (PWM) signal. The hybrid/EV powertrain control module 1 and the motor control module share the power inverter module ignition voltage circuit, battery voltage circuits and chassis ground. The modules are flash-programmable micro-processors. The power inverter module is cooled with pre-mixed DexcoolÃ‚Â® circulating through a cooling system that is separate from the engine cooling system. The hybrid cooling system utilizes a heat exchanger at the front of the vehicle and electric pumps to circulate the coolant. The ECM monitors a temperature sensor in the hybrid cooling system and operates the radiator fan and the hybrid coolant pumps in response to system temperature.

High Voltage Circuits

Direct Current (DC)

The power inverter module is connected to the positive and negative terminals of the high voltage DC hybrid/EV battery pack. Both of the negative and positive high voltage DC battery poles are isolated from the vehicle chassis by a specific amount of resistance. Each high voltage DC bus is switched ON or OFF by a high voltage, high current contactor relay contained within the hybrid/EV battery pack. All high voltage DC negative and positive DC cables are individually shielded and orange in color to alert the technician to the potential presence of high voltage. The electric air conditioning compressor receives high voltage from DC cables connected to the battery charger DC.

Three Phase Alternating Current (AC)

Three individual cables connect each phase of the drive motor to the power inverter module. Each individually shielded cable is orange in color to alert the technician to the potential presence of high voltage. A harness connects the auxiliary transmission fluid pump to the power inverter module. This harness contains individual wires that are connected to the 3 phases of the auxiliary transmission fluid pump, and is orange in color to alert the technician to the potential presence of high voltage.

Low Voltage Circuits

The 14 V power module, also called the accessory DC power control module, is the device which converts high voltage (300V) DC to low voltage (12V) DC for accessory electrical operation and to charge the 12 V accessory battery.

Low Voltage (12V) Direct Current

Low voltage (12V) cables on the hybrid-electric vehicle do not require unique coloring or servicing procedures.

Hybrid Powertrain Control Module

Location

The hybrid/EV powertrain control module 1 is a non-serviceable, flash-programmable micro-processor contained within the power inverter module.

Operating Functions

The hybrid/EV powertrain control module 1 is the main controller of powertrain operation. The hybrid/EV powertrain control module 1 determines when to perform normal operating modes such as electric mode and regenerative braking. The hybrid/EV powertrain control module 1 also operates in conjunction with the hybrid/EV powertrain control module 2 to determine when to enable and disable the DC high voltage circuits. The hybrid/EV powertrain control module 2 is external to the drive motor generator power inverter module.

Communication and Hosted Diagnostics

The hybrid/EV powertrain control module 1 is the host controller for DTC information for the Drive motor 1 control module.

The module diagnoses its own operation and determines when a fault condition is present.

The motor control module and the hybrid/EV powertrain control module 1 exchange information and commands on a serial peripheral interface bus internal communication circuit as well as the hi-speed hybrid GMLAN communication circuit.

In the event a hosted module communicates a fault condition, the hybrid/EV powertrain control module 1 will determine if one or more operating modes are affected and notify the vehicle operator by requesting the MIL illuminate and/or by displaying a message in the Driver Information Center. In addition, the hybrid/EV powertrain control module 1 will store the associated DTC information for retrieval by a scan tool. Some hosted modules may require an ignition cycle to clear certain DTCs from the hybrid/EV powertrain control module 1.

Circuit Inputs

In addition to data parameters, the hybrid/EV powertrain control module 1 directly monitors the following signal circuits:

- Transmission internal mode switch direction and Park/Neutral switch signals
- High voltage interlock circuit

Motor Control Module

Location

The drive motor and the auxiliary transmission fluid pump motor are located within the transmission. The drive motor is controlled by the motor control module. The motor control module is contained within the power inverter module. Also contained within the power inverter module is the hybrid/EV powertrain control module 1 micro-processor.

Operating Functions

The motor control module operates the motor based upon hybrid/EV powertrain control module 1 commands. the motor control module controls the speed, direction, and output torque of the drive motor through the sequencing actuation of high current switching transistors called insulated gate bipolar transistors.

Communication and Hosted Diagnostics

In addition to the internal serial peripheral interface bus communication circuit that the hybrid/EV powertrain control module 1 and the motor control module control use to communicate, the motor control module also communicates on the hi-speed and hybrid serial data circuits. The motor control module does not store its own Diagnostic Trouble Code (DTC) information. The hybrid/EV powertrain control module 1 will store motor control module associated DTC information for retrieval by a scan tool.

Circuit Inputs

In addition to data parameters, the motor control module monitors its respective motor for voltage, current, speed, direction and temperature. Additionally, the motor control module monitors the insulated gate bipolar transistor components for temperature and proper operation. Some of the motor control module operation data is shared with the hybrid/EV powertrain control module 1.

Circuit Outputs

The motor control module controls its respective insulated gate bipolar transistor driver board that in-turn controls the motor. The motor operates using 3 - phase AC electricity. Three cables connect the drive motor to the power inverter module. Each individually shielded cable is orange in color to alert the technician that the potential for high voltage is present.

ENGINE CONTROL MODULE (ECM) DESCRIPTION AND OPERATION

The ECM on this vehicle is also called an engine control module and is used in electric, hybrid, and conventional vehicle applications. The ECM interacts with many related components and systems, and monitors them for deterioration. Diagnostics monitor the system performance and a diagnostic trouble code (DTC) sets if the system performance degrades. The ECM is part of a network and communicates with various other vehicle control modules.

Malfunction indicator lamp (MIL) operation and DTC storage are dictated by the DTC type. A DTC is ranked as a Type A, B, or C DTC. Refer to **Powertrain Diagnostic Trouble Code (DTC) Type Definitions** . Other system control modules may request the ECM to illuminate the MIL. In these cases there is no fault with the ECM, and a DTC will set in the ECM indicating which control module requested the MIL illumination.

The ECM is the control center of the some of the vehicle control systems. Review the components and wiring diagrams in order to determine which systems are controlled by the ECM.

The ECM constantly monitors the information from various sensors and other inputs, and controls the systems that affect vehicle performance. The ECM also performs diagnostic tests on various parts of the system and may illuminate the MIL when it detects a malfunction that affects vehicle performance. When the ECM detects a malfunction, the ECM stores a DTC. The condition area is identified by the particular DTC that is set. This aids the technician in making repairs.

ECM Function

The ECM can supply 5V or 12V to various sensors or switches. This is done through pull-up resistors to regulated power supplies within the ECM. During testing, a digital multimeter (DMM) with at least 10 megaohms input impedance is required in order to ensure accurate voltage readings.

The ECM controls the output circuits by controlling the ground or the voltage circuit through transistors or a device called a high side or low side driver.

EEPROM

The electronically erasable programmable read only memory (EEPROM) is an integral part of the ECM. The EEPROM contains program and calibration information that the ECM needs in order to control engine operation.

Special equipment, as well as the correct program and calibration for the vehicle, are required in order to reprogram the ECM, refer to **Control Module References** for ECM replacement, programming, and setup.

Data Link Connector (DLC)

The data link connector (DLC) provides serial data communication for ECM and vehicle diagnosis. This connector allows the technician to use a scan tool in order to monitor various serial data parameters, and display DTC information. The DLC is located on the left side of the driver's compartment, underneath the instrument panel.

Malfunction Indicator Lamp (MIL)

The electric vehicle malfunction indicator lamp (MIL) is displayed in the instrument panel cluster (IPC) during bulb check or if a fault has been detected. The MIL is controlled by the ECM and illuminates when the ECM detects a condition that affects vehicle performance or when another module on the vehicle requests MIL illumination.

ECM Service Precautions

The ECM is designed to withstand normal current draws that are associated with normal vehicle operations. However, care must be used in order to avoid overloading any of these circuits. When testing for opens or shorts, do not ground or apply voltage to any of the ECM circuits unless the diagnostic procedure instructs you to do so. These circuits should only be tested with a DMM unless the diagnostic procedure instructs otherwise.

Aftermarket (Add-On) Electrical Equipment

CAUTION: **Connect any add-on electrically operated equipment to the vehicle's electrical system at the 12 V battery (power and ground) in order to prevent damage to the vehicle.**

Add-on electrical equipment, even when installed to these strict guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system, such as portable telephones and radios. Therefore, the first step in diagnosing any powertrain condition is to eliminate all of the aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, the problem may be diagnosed in the normal manner.

Electrostatic Discharge (ESD) Damage

NOTE: **In order to prevent possible electrostatic discharge damage to the ECM, DO NOT touch the connector pins on the ECM.**

The electronic components that are used in the control systems are often designed to carry very low voltage. These electronic components are susceptible to damage caused by electrostatic discharge. Less than 100V of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4,000 V for a person to even feel a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat.

Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore, it is important to use care when handling and testing electronic components.

ELECTROMAGNETIC COMPATIBILITY DESCRIPTION

Overview

Vehicles are typically subject to certain legal requirements that limit the amount of electromagnetic interference (EMI) that can be generated by the vehicles electronic devices. Additionally, the electronic devices within the vehicle must be able to withstand a certain amount of EMI without affecting their operation. EMI is generated whenever electrical current flows through a circuit. The amount of EMI generated, or amplitude, is usually dependent upon the amount of current flow, amperage, and the on-off pattern of current flow through the circuit, frequency. The EMI requirements are generally referred to as electromagnetic compatibility.

There are many ways of ensuring the vehicle meets electromagnetic compatibility requirements. These include:

- Adding capacitors and resistors to certain electrical circuits
- Regulating the frequency at which a component may operate
- Shielding the wires, cables and components

Circuit Design

The power inverter module, often referred to as the drive motor generator power inverter module, and the 14 V power module, often referred to as the accessory DC power control module, each contain filter capacitors connected to the high voltage circuits. These capacitors are necessary to reduce the voltage spikes that occur as a result of the switching of current On and Off. Reducing voltage spikes reduces EMI. The frequency of current switching is also closely regulated. Too high a frequency can cause an increase in EMI generation.

Wiring/Cable Design

Different types of wire/cable shielding methods are utilized in the vehicle. Common types of circuit shielding include twisted-pair and internal braid or foil. Twisted pair is typically used in circuits such as serial data circuits. The wire pair is twisted together at a particular turns-per-length ratio. Shielded cable is utilized for all other circuits requiring either protection from external EMI or to reduce EMI radiation of the cable itself into other nearby components or circuits.

High Voltage Cable

- 300-Volt Battery Positive and Negative Cable

- Drive Motor Generator Power Inverter Module 3 Phase Cable Assembly
- Air Conditioning and Drive Motor Battery Cooling Compressor

The high voltage cables utilize internal braid shielding. Typically, both ends of the internal braid shield are attached to chassis ground. All of the high voltage, internally shielded cables are grounded at their cable end attachment points. Mounting blocks, where used, perform the shield to chassis ground connection. Connection points not serviced with a mounting block utilize a separate ring terminal.

Low and Intermediate Voltage Wiring

The signal circuits for the transmission sensors utilize shielding protection. The drive motor position sensor circuits utilize internal foil shielding. The wiring harness external of the transmission assembly is connected to chassis ground with ring terminals at the power inverter module. The internal transmission wiring harness is attached to chassis ground with a ring terminal at the valve body assembly.

The auxiliary transmission fluid pump 3 phase cables utilize internal foil shielding. The wiring harness shield is connected to chassis ground within the power inverter module.

Component Shielding

Certain components utilize their structure to effectively shield EMI. Metal covers, chassis grounded metal cases and electro-magnetically conductive gaskets may all be part of a components electromagnetic compatibility design.

Shielding Loss

A loss of proper shielding may result in poor AM band radio reception and/or incorrect sensor circuit readings depending upon the location of the shield loss. Damage that has penetrated to the insulated conductor of high voltage cables is not repairable. Minor damage to the outer sheathing can be repaired, refer to **Drive Motor Power Inverter Module 3 Phase Cable Inspection** . Certain Low and Intermediate voltage shielded wiring harnesses may be repairable. Refer to **Wiring Repairs** , and **Splicing Twisted or Shielded Cable** .

HIGH VOLTAGE MONITORING SYSTEMS DESCRIPTION

The hybrid/EV system monitors several high voltage components for attempted access. Additionally, a minimum amount of isolation resistance is maintained at all times between both negative and positive poles of the hybrid/EV battery and the vehicle chassis. Microprocessors internal to the power inverter module, often referred to as the drive motor generator power inverter module, and the hybrid/EV powertrain control module 2 monitor the hybrid/EV system for access and loss of isolation.

High Voltage Interlock Circuit

The high voltage interlock circuit is a wire loop that passes through certain high voltage components. The high voltage interlock circuit is used to determine if access to high voltage components is being attempted. The opening of these high voltage components causes the high voltage interlock circuit to open. The hybrid/EV system may react to the loss of high voltage interlock circuit continuity by opening the high voltage contactor relays and discharging the high voltage capacitors. The high voltage interlock circuit signal is generated by the hybrid/EV powertrain control module 2. The high voltage interlock circuit status is monitored by the hybrid/EV powertrain control module 2, the hybrid/EV powertrain control module 1, and each drive motor control module.

High Voltage DC Chassis Isolation

The hybrid/EV system monitors the electrical potential between each high voltage bus and the vehicle chassis. High voltage should always be isolated from the vehicle chassis by a certain amount of resistance to avoid the potential for a life threatening current path. In the event that a high voltage leak path to the vehicle chassis is detected, the hybrid/EV system will set a diagnostic trouble code (DTC). High voltage DC chassis isolation is monitored by the drive motor control modules and the hybrid/EV powertrain control module 2.

Testing for loss of isolation requires special tools and procedures. Because of the high voltage present in the hybrid/EV system, a loss of isolation may occur due to insulation breakdown. Insulation breakdown typically occurs only when high voltages and/or current is present. Conditions such as insulation breakdown cannot be diagnosed with a typical DMM because high voltage is not used by the DMM when measuring resistance.

HYBRID MODES OF OPERATION DESCRIPTION

Vehicle Operating Modes Description

This vehicle is a Battery Electric Vehicle. It uses only an electric propulsion system to drive the vehicle at all times. Electricity is the vehicle's only source of energy.

Electric Mode

Electric Mode is the only mode of operation for this vehicle. The vehicle is powered by electrical energy stored in the high voltage hybrid/EV battery pack. The vehicle will operate in this mode until the high voltage battery has reached a low state of charge.

Service Mode

Service Mode is available for service and diagnostics and to verify the proper operation of the MIL and may be required for emission inspection purposes. With vehicle OFF, and the brake pedal not applied, pressing and holding the POWER button for more than 5 seconds will place the vehicle in Service Mode. The instruments and audio systems will operate as they do in ON, but the vehicle will not be able to be driven. The propulsion system will not start in Service Mode.

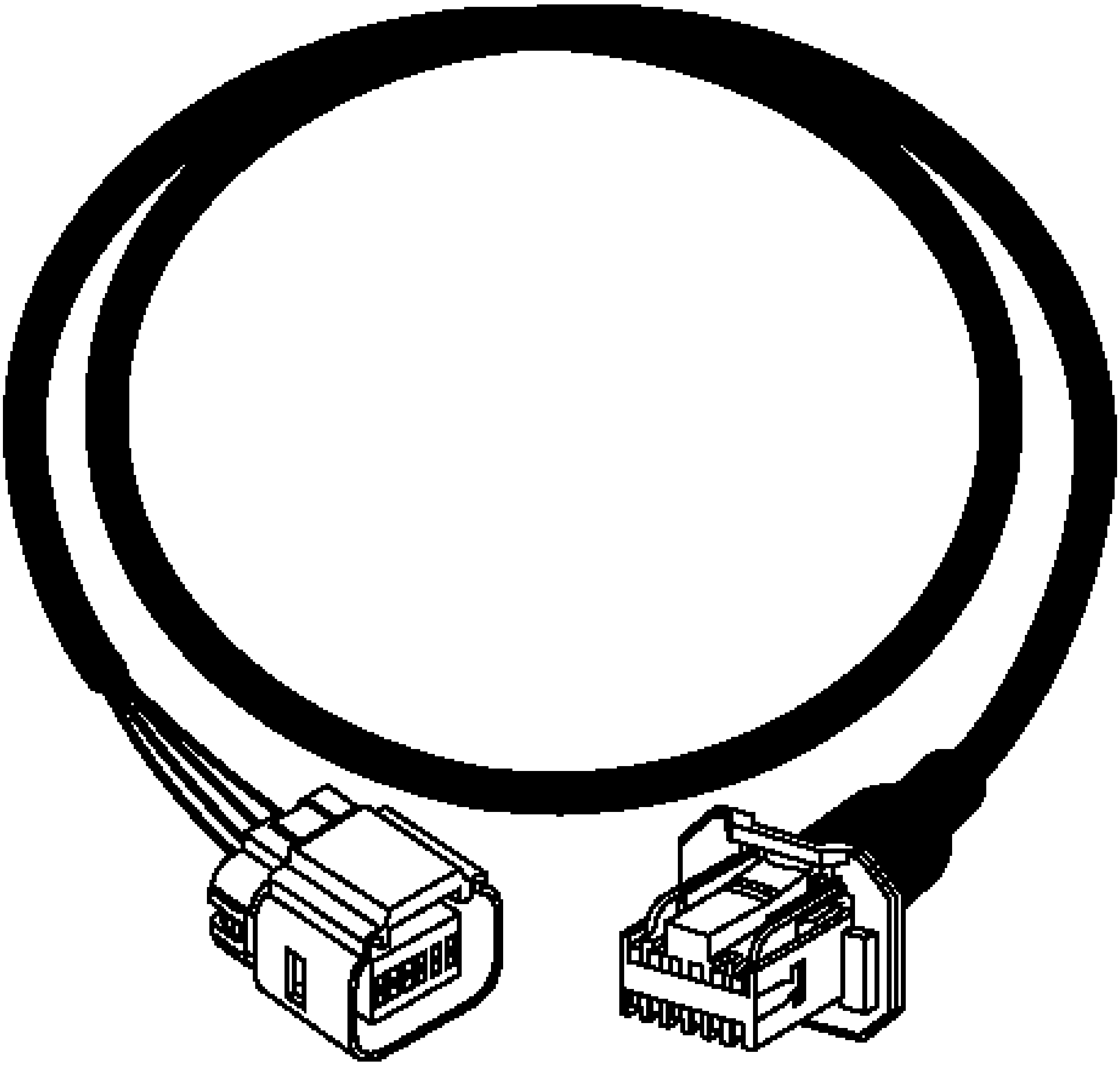
Regenerative Braking

When the vehicle is coasting or braking, the drive motor generator power inverter module may operate the drive motor as a generator in an Electrical Generation Mode. Operating as an electrical generator, the drive motor exerts a driveline load that helps to slow the vehicle. The electrical energy that the drive motor creates is transferred by the drive motor generator power inverter module to the hybrid/EV battery pack. Constant communication between the drive motor generator power inverter module and the electronic brake control module allows the blending of regenerative braking force with hydraulic braking force.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	EL-52010 Jumper Harness, 12 Terminal

Illustration	Tool Number/Description
	

Back To Article

Hybrid/EV Energy Storage - Component Locator - Disassembled Views - Bolt EV

DISASSEMBLED VIEWS

BATTERY COVER ASSEMBLY

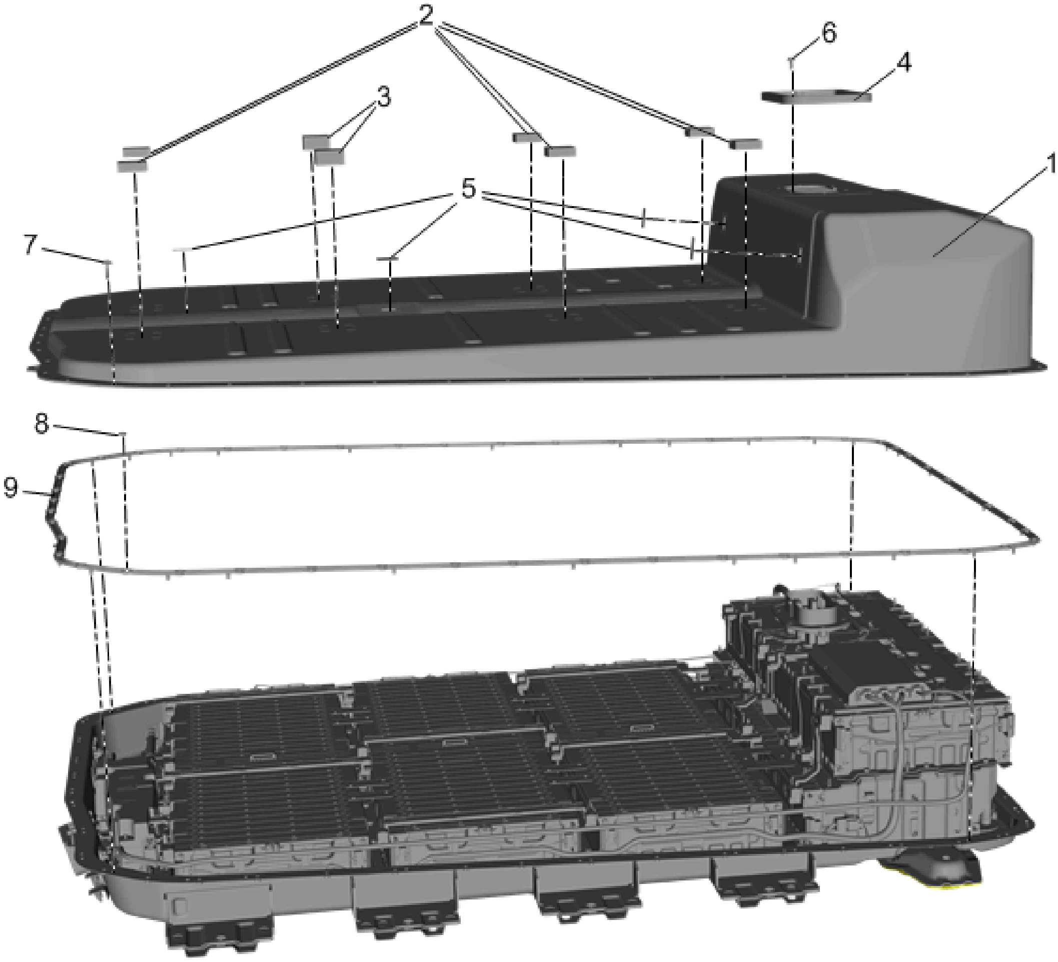


Fig. 1: Battery Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	High Voltage Battery Cover
2	Snubber Type 1
3	Snubber Type 2
4	Manual Disconnect Insulator
5	Valve Vent
6	Bolt
7	Bolt
8	Sealing Gasket Washer
9	Battery Sealing Gasket

BATTERY HARNESS MODULE ASSEMBLY

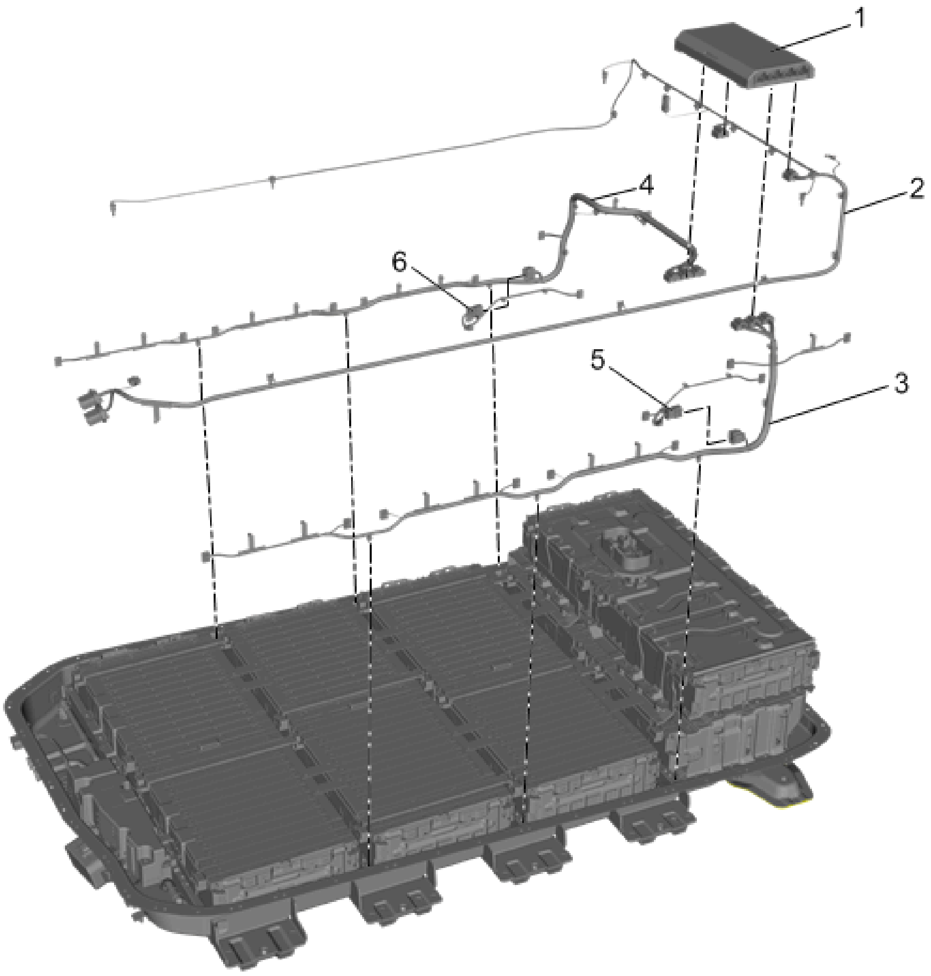


Fig. 2: Battery Harness Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Battery Energy Control Module
2	Wiring Control Harness Assembly
3	Wiring Sensing Harness Assembly-Left
4	Wiring Sensing Harness Assembly-Right
5	Wiring Sensing Harness Assembly-Left Sub
6	Wiring Sensing Harness Assembly-Right Sub

BATTERY CABLE ASSEMBLY

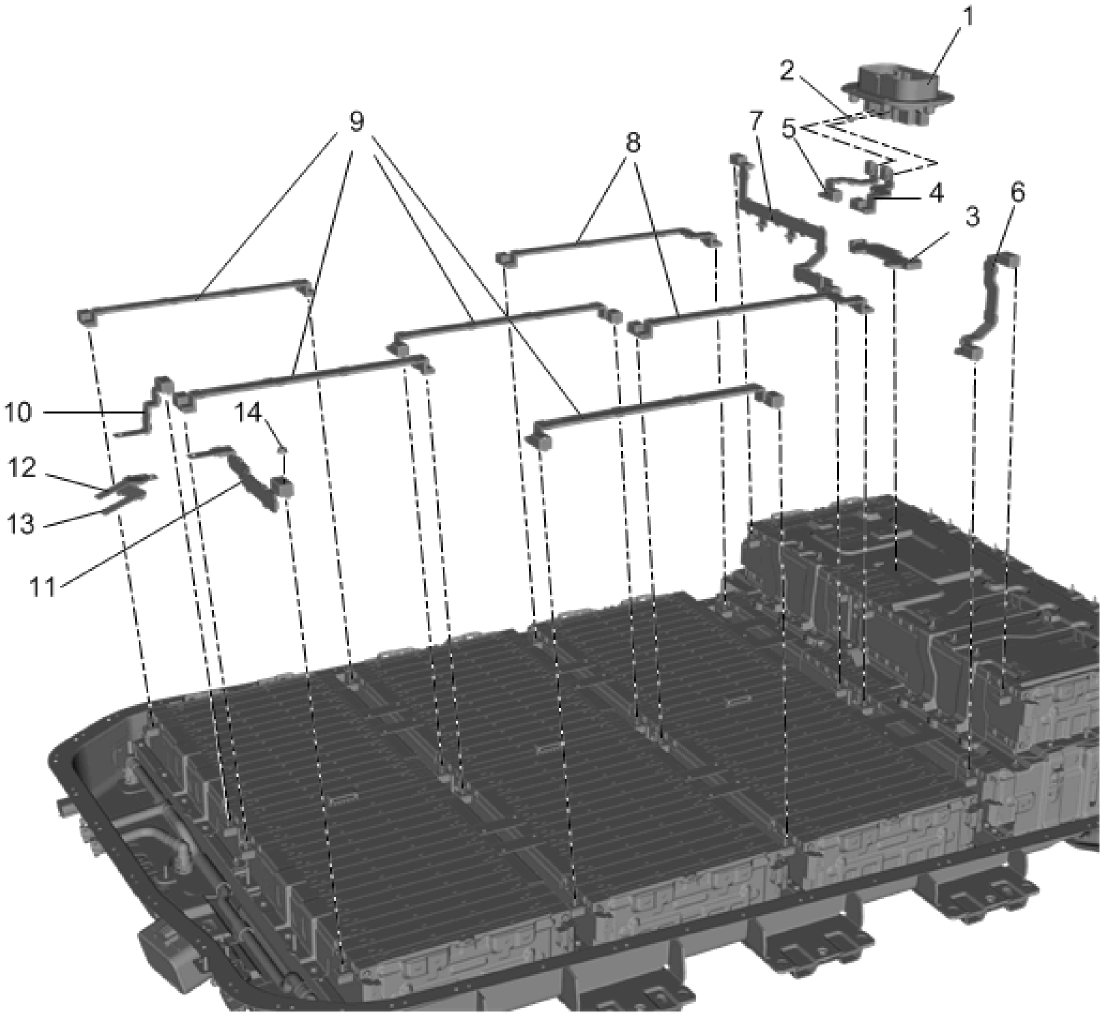


Fig. 3: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Disconnect Base
2	Bolt
3	Insulation Pad-Manual Disconnect
4	High Voltage Battery Disconnect Negative Cable Assembly
5	High Voltage Battery Disconnect Positive Cable Assembly
6	High Voltage Battery Positive and Negative Cable Assembly
7	High Voltage Battery Positive and Negative Cable Assembly
8	High Voltage Battery Positive and Negative Cable Assembly
9	High Voltage Battery Positive and Negative Cable Assembly
10	High Voltage Battery to Disconnect Relay Negative Cable Assembly
11	High Voltage Battery to Disconnect Relay Positive Cable Assembly
12	High Voltage Battery Negative Cable Assembly
13	High Voltage Battery Positive Cable Assembly
14	Nut

BATTERY CELL ASSEMBLY

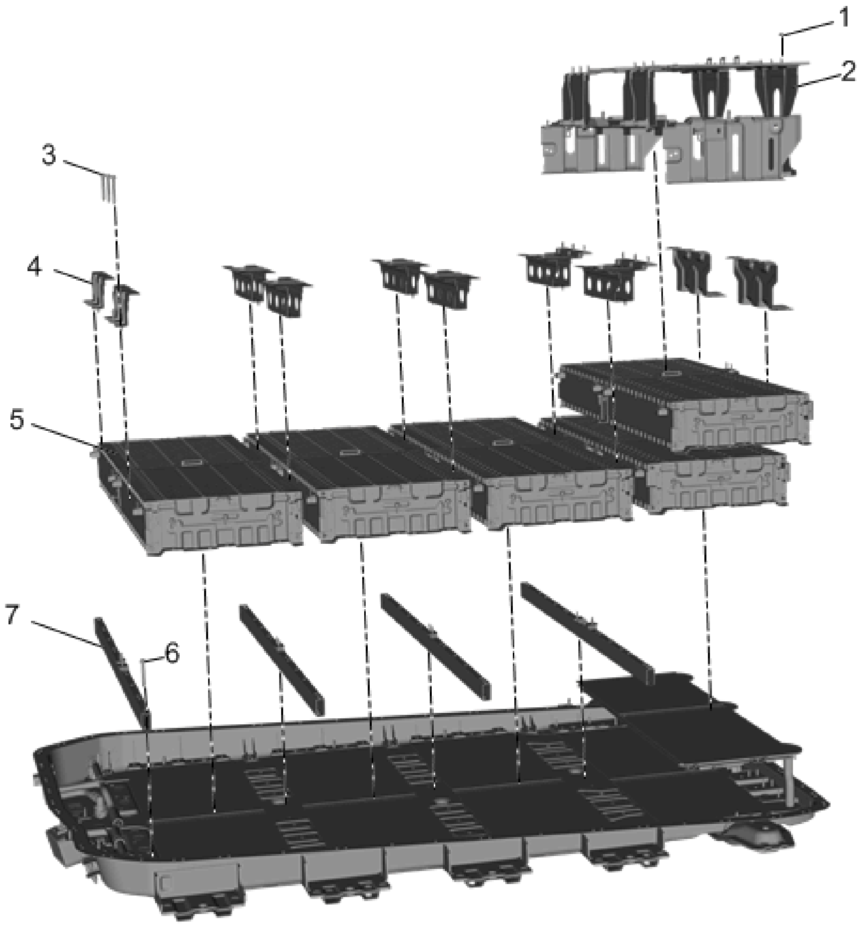


Fig. 4: Battery Cell
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt
2	Cell Bracket Assembly
3	Bolt
4	Cell Battery Frame Plate Assembly
5	High Voltage Battery Cell Module
6	Bolt
7	High Voltage Battery Cell Module Reinforcement

BATTERY CONNECTOR ASSEMBLY

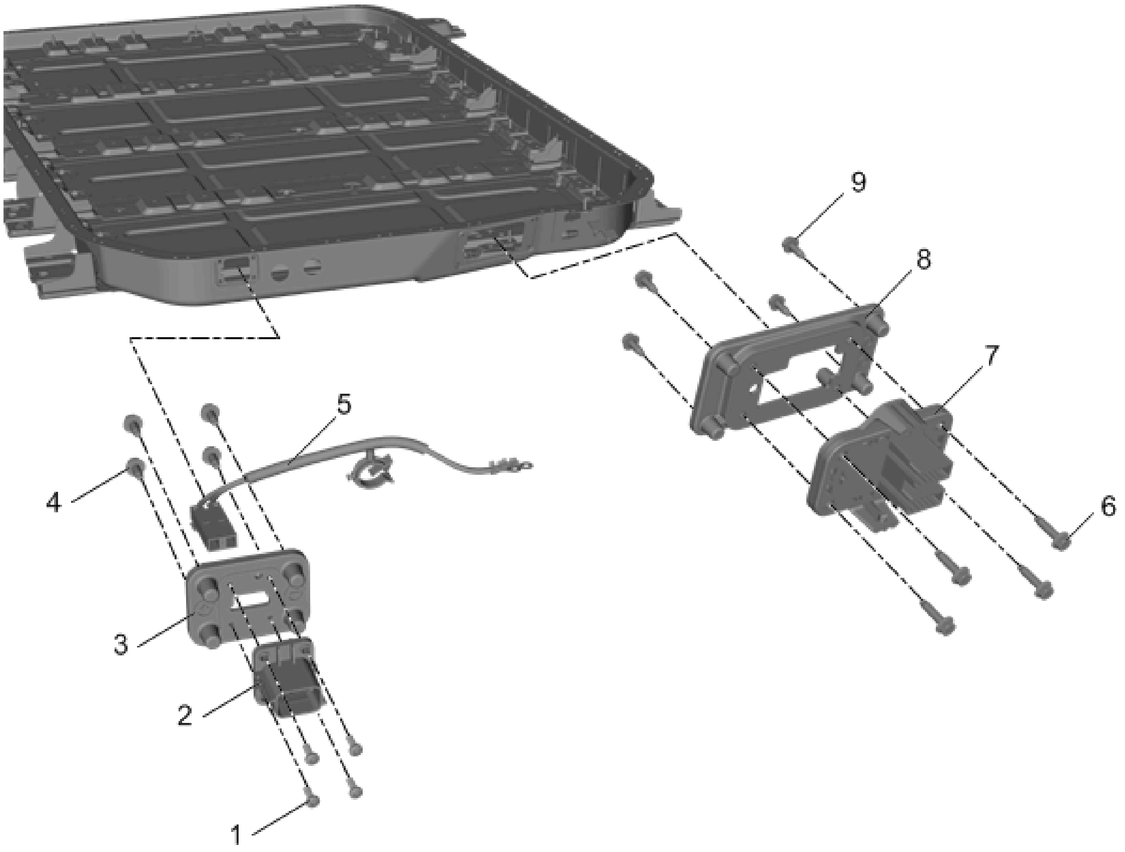


Fig. 5: Battery Connector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt
2	High Voltage X4 Connector Header
3	High Voltage X4 Connector Block Assembly
4	Bolt
5	High Voltage X4 Connector Cable Assembly
6	Bolt
7	High Voltage X3 Connector Assembly
8	High Voltage X3 Connector Block Assembly
9	Bolt

BATTERY COOLING ASSEMBLY

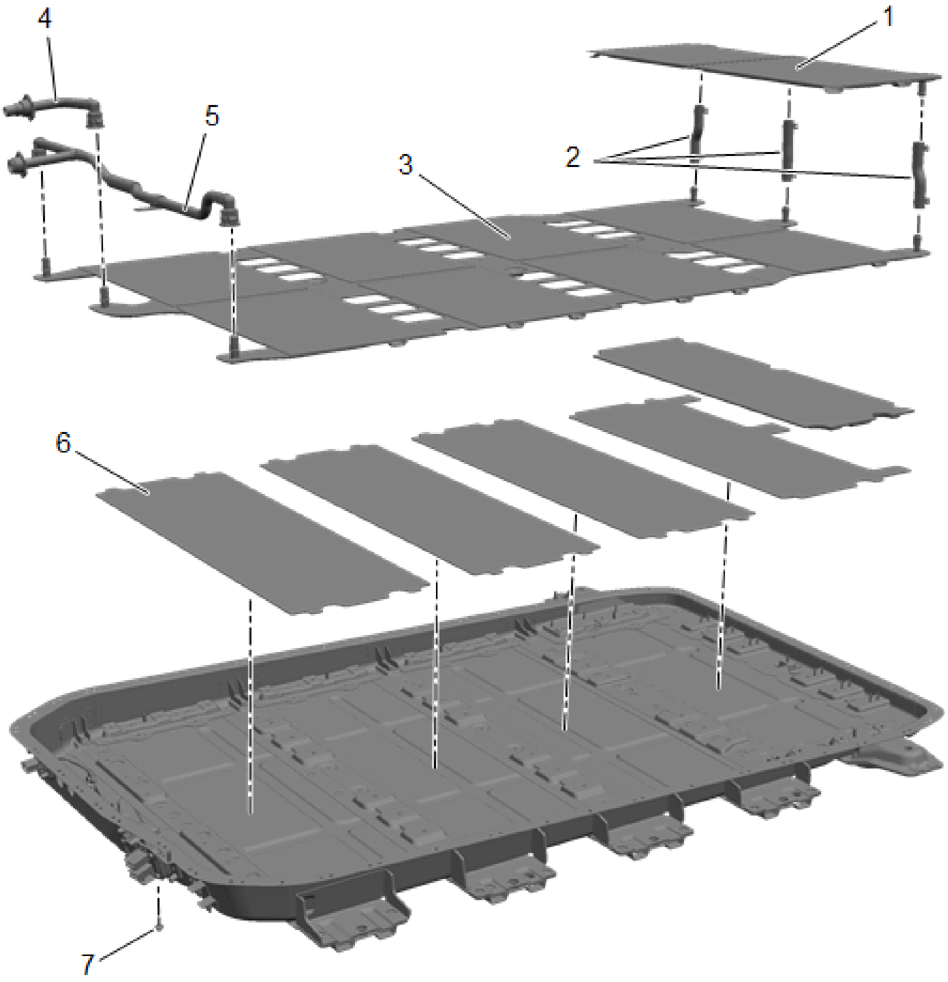


Fig. 6: Battery Cooling
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Cooling Plate-Upper
2	Cooling Hose
3	Cooling Plate-Lower
4	Cell Battery Cooling Manifold Assembly-Outlet
5	Cell Battery Cooling Manifold Assembly-Inlet
6	Insulation Pad

HIGH VOLTAGE BATTERY DISCONNECT RELAY ASSEMBLY

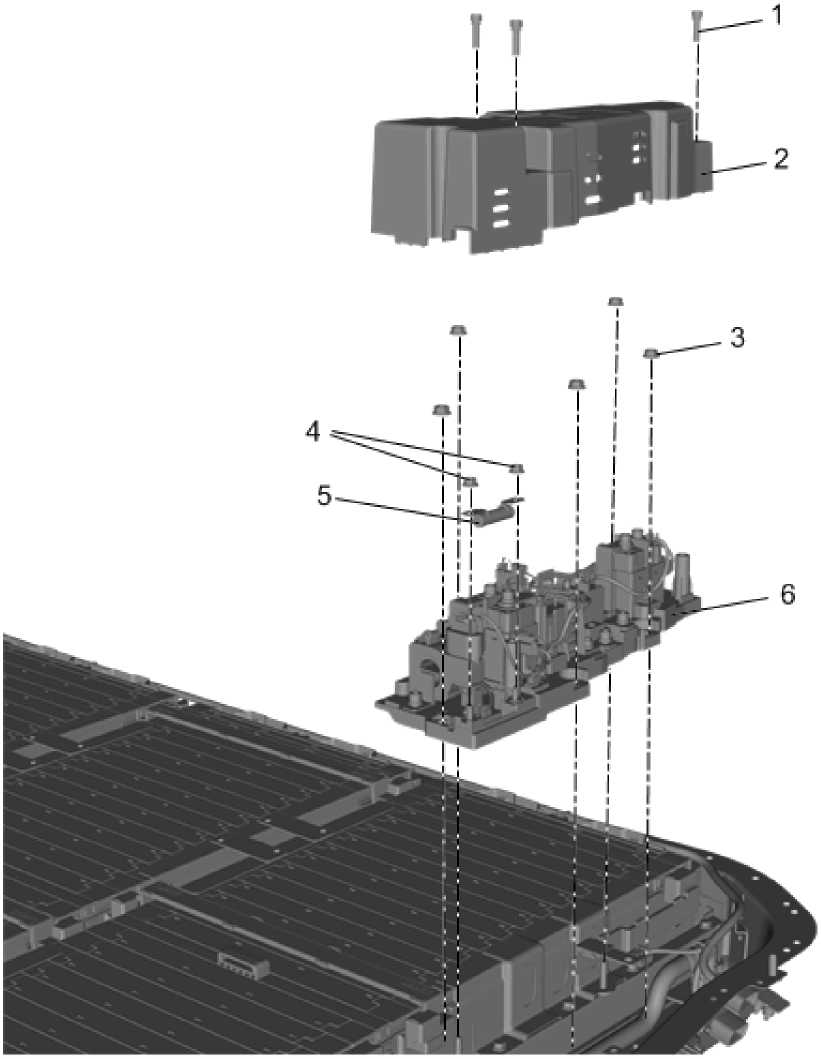


Fig. 7: High Voltage Battery Disconnect Relay
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Bolt
2	High Voltage Battery Disconnect Relay Cover
3	Nut
4	Nut
5	High Voltage Battery Disconnect Relay Fuse
6	High Voltage Battery Disconnect Relay Assembly

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DESCRIPTION AND OPERATION

DRIVE MOTOR BATTERY SYSTEM DESCRIPTION

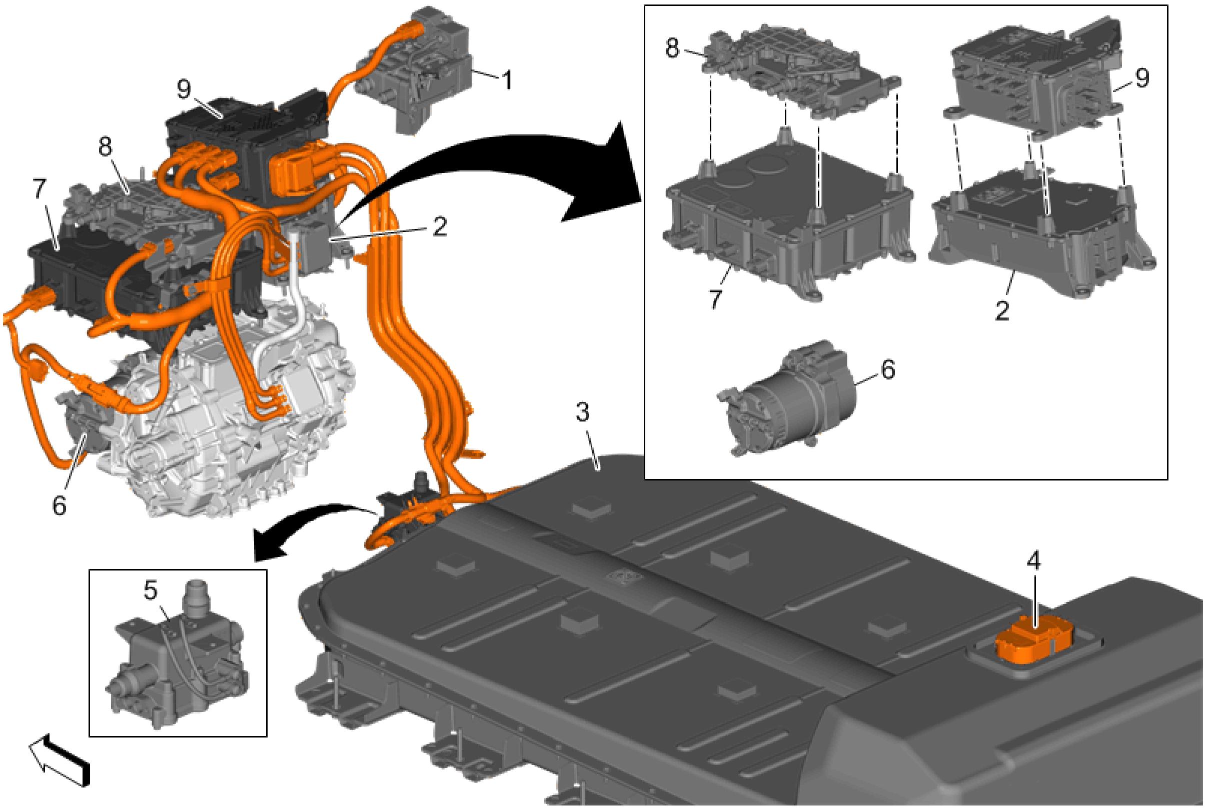


Fig. 1: Drive Motor Battery System
Courtesy of GENERAL MOTORS COMPANY

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name or Electronic Part Catalog Name
1	K10 Coolant Heater Control Module	Electric Passenger Compartment Heater parameters hosted by Hybrid Powertrain Control Module 2	Heater Coolant Heater
2	T6 Power Inverter Module	• Hybrid Powertrain Control Module • Drive Motor Control Module 1	Drive Motor Power Inverter Module
3	A4 Hybrid/EV Battery Pack	Not Applicable	High Voltage Battery
4	S15 Manual Service Disconnect	Not Applicable	Drive Motor Battery High Voltage Manual Disconnect Lever
5	E54 Hybrid/EV Battery Pack Coolant Heater	Hybrid/EV Battery Pack Heater parameters hosted by Hybrid Powertrain Control Module 2	High Voltage Battery Heater

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name or Electronic Part Catalog Name
6	G1 A/C Compressor	Electric A/C Compressor Control Module	Air Conditioning Compressor
7	T18 Battery Charger	Battery Charger parameters hosted by Hybrid Powertrain Control Module 2	Drive Motor Battery Charger
8	K1 14V Power Module	14V Power Module	Accessory DC Power Control Module
9	T24 Battery Charger - DC	DC Charging Control Module (CBT)	High Voltage Battery Control Wiring Junction Block

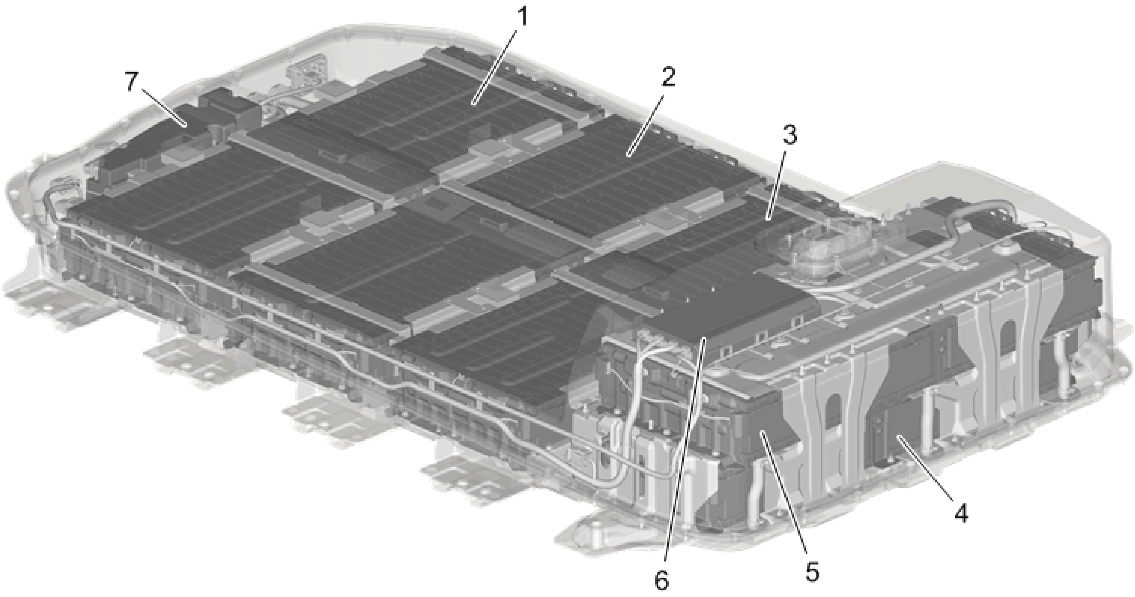


Fig. 2: Hybrid/EV Battery Internal Components
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Internal Components

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name
1	C4A Hybrid/EV Battery Section 1	Not Applicable	Cell Battery Module (Row 1, 3)
2	C4B Hybrid/EV Battery Section 2	Not Applicable	Cell Battery Module (Row 2)
3	C4C Hybrid/EV Battery Section 3	Not Applicable	Cell Battery Module (Row 1, 3)
4	C4D Hybrid/EV Battery Section 4	Not Applicable	Cell Battery Module (Row 4)
5	C4E Hybrid/EV Battery Section 5	Not Applicable	Cell Battery Module (Row 5)
6	K16 Battery Energy Control Module	Battery Energy Control Module	Battery Energy Control Module
7	A28 Hybrid/EV Battery Contactor Assembly	Not Applicable	High Voltage Battery Disconnect Relay

Hybrid/EV Battery Section/Row, Cell Modules and Groups

Section (Row)	Cell Module	Cell Group
C4A Hybrid/EV Battery Section 1(Row 1)	C5A Hybrid/EV Battery Module 1*	10
		9
		8
		7
		6
		5
		4
		3
		2
		1
	C5K Hybrid/EV Battery Module 10	87
		88
		89
		90
		91
		92
		93
		94
		95
		96
C4B Hybrid/EV Battery Section 2(Row 2)	C5B Hybrid/EV Battery Module 2*	11
		12
		13
		14
		15
		16
		17
		18
		19
		20
	C5J Hybrid/EV Battery Module 9	86
		85
		84
		83
		82
		81
		80
		79
		78
		77
C4C Hybrid/EV Battery Section 3(Row 3)	C5C Hybrid/EV Battery Module 3*	30
		29
		28
		27
		26
		25
		24
		23
		22
		21

Section (Row)	Cell Module	Cell Group
	C5H Hybrid/EV Battery Module 8	67
		68
		69
		70
		71
		72
		73
		74
		75
		76
C4D Hybrid/EV Battery Section 4(Row 4)	C5D Hybrid/EV Battery Module 4*	31
		32
		33
		34
		35
		36
		37
		38
		39
		40
	C5G Hybrid/EV Battery Module 7	66
		65
		64
		63
		62
		61
		60
		59
C4E Hybrid/EV Battery Section 5(Row 5)	C5E Hybrid/EV Battery Module 5*	41
		42
		43
		44
		45
		46
		47
		48
	C5F Hybrid/EV Battery Module 6	49
		50
		51
		52
		53
		54
		55
		56
		57
		58
*On right side of section (row)		

Overview

The high voltage hybrid/EV battery contains 288 individual lithium-ion cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at

3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules. There are eight electrical modules comprised of 10 cell groups and two electrical modules comprised of 8 cell groups. Two battery cell modules are physically mounted together to form a section/row. Section/row 1 and 3 are interchangeable while section/row 2, 4 and 5 are unique to their location. With the exception of section/row 5, the two battery cell modules are not electrically connected within their respective section/row. The hybrid/EV battery pack contains a total of six battery temperature sensors mounted to certain battery cell modules. The hybrid/EV battery pack also contains a coolant inlet temperature sensor. Refer to **Hybrid/EV Cooling System Description and Operation** .

Located within the high voltage Hybrid/EV battery pack, the K16 battery energy control module monitors the temperature, current and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the end of the battery cell module. A voltage sense harness joins this connector to the K16 battery energy control module.

The K16 battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the K16 battery energy control module to the K114B hybrid powertrain control module 2 through serial data. The K114B hybrid powertrain control module 2 is the host controller for K16 battery energy control module diagnostic trouble code information.

Location

The high voltage hybrid/EV battery is installed from beneath the vehicle. The K16 battery energy control module, a current sensor, and the high voltage contactors are located within the hybrid battery assembly. The K114B hybrid powertrain control module 2 is mounted within the passenger compartment, beneath the right front seat.

High Voltage Control

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. The high voltage contactors are located within the A28 hybrid/EV battery contactor assembly.

In order to prevent large in-rush current to capacitors located in the vehicles high voltage components, the contactors close in a specific precharge sequence controlled by the K114B hybrid/EV powertrain control module 2.

Contactor Close Sequence (Precharge)

1. Plug-In Charge Positive Contactor
2. Main Positive Contactor
3. Precharge Negative Contactor

NOTE: **Wait for bus high voltage to attain almost the same level as hybrid/EV battery voltage.**

4. Main Negative Contactor
5. The precharge contactor opens when bus voltage and hybrid/EV battery voltage are equal.

Thermal Management

The hybrid/EV battery is cooled and heated with pre-mixed DEX-COOLÂ®, which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. A refrigerant/coolant heat exchanger (chiller) and the G1 A/C compressor cools down the high voltage hybrid/EV battery. A high voltage heater can also heat the coolant entering the hybrid/EV battery when needed. Thermal transfer occurs between the bottom of the Hybrid/EV Battery Modules and coolant plates that circulate the heated or cooled coolant. Refer to **Hybrid/EV Cooling System Description and Operation** , and **Disassembled Views** in Hybrid/EV Energy Storage.

HYBRID/EV SYSTEM HIGH VOLTAGE ISOLATION DESCRIPTION

Loss of Isolation Description

Vehicles equipped with high voltage storage and propulsion capability are designed with the high voltage circuits isolated from the vehicle chassis. If either the positive or negative high voltage Direct Current (DC) circuits or any of the high voltage Alternating Current (AC) phase circuits lose this isolation to the vehicle chassis, one or more diagnostic trouble codes (DTCs) may set.

Similar to typical 12V vehicle systems, loss of isolation can be as simple as a direct conductor-to-chassis short. Unlike 12V systems however, the potential within high voltage systems means that insulation breakdown is also a cause for loss of isolation. Therefore diagnosis for isolation loss requires testing with high voltage potential. Special insulation testing meters that utilize their own built-in high voltage are used to test the isolation capability of high voltage components and circuits. Additionally, monitoring certain scan tool parameters when high voltage is active may also help to identify which high voltage components and circuits may have lost their chassis isolation.

Vehicle Loss of Isolation Detection

The vehicle performs two independent tests for isolation:

1. Passive isolation testing which is performed within the power inverter module by the hybrid powertrain control module 1.
2. Active isolation testing which is performed within the Hybrid/EV battery pack by the hybrid powertrain control module 2.

Passive Isolation Testing

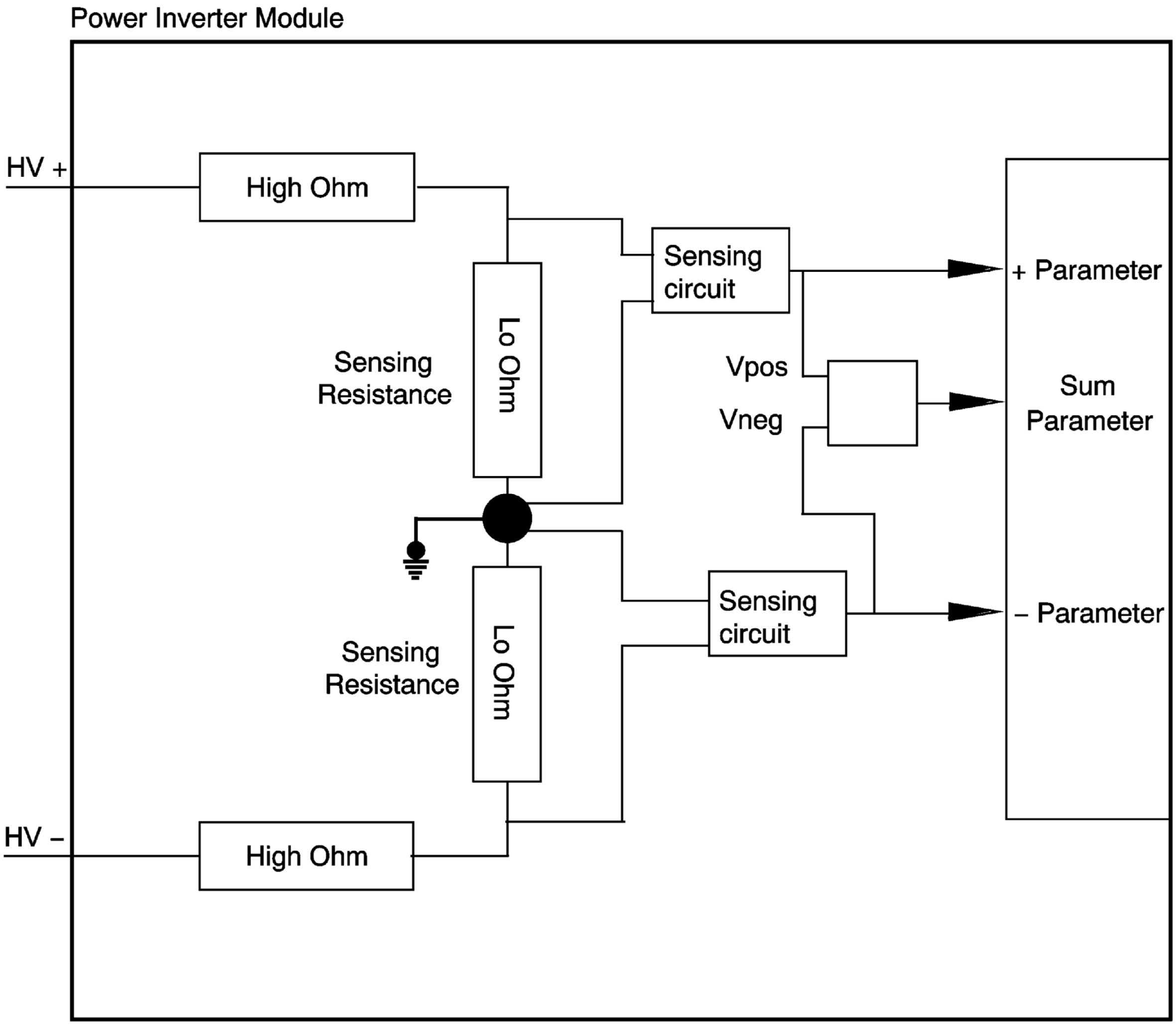


Fig. 3: Power Inverter Module Operation Graph
Courtesy of GENERAL MOTORS COMPANY

The power inverter module continuously performs isolation testing whenever high voltage to the module is present. The power inverter module has one isolation sensing circuit although the drive motor and aux pump control modules monitor and display the sensor data redundantly. The Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters give a real-time indication of Isolation status. Under normal operating conditions each of the parameters will indicate about half of the total Hybrid/EV battery pack high voltage potential. When a loss of isolation condition is observed, the Voltage scan tool parameter values will shift in respect to each other. When the voltage shift exceeds a set ratio, DTCs P1AF0, P1AF2, or P1E22 will set.

NOTE: **Some high voltage components contain internal switching or inverter circuits that can interrupt a portion of their high voltage circuitry. If such a component, for example the passenger cabin heater, is OFF its complete internal circuitry is not being monitored. Likewise, these internally switched components cannot be fully tested off-vehicle with the Insulation Testing Meter EL-50772 , EL-50774 , or equivalent.**

Scan Tool Parameters

- Drive Motor Positive Supply Isolation Voltage
- Aux Trans Fluid Pump Positive Supply Isolation Voltage
- Drive Motor Negative Isolation Voltage
- Aux Trans Fluid Pump Negative Supply Isolation Voltage

The power inverter module isolation sensing circuit communicates one value, which is displayed redundantly by different modules. The data within the parameters for each module is identical.

Isolation Loss between HV Components and Chassis, Positive Side*

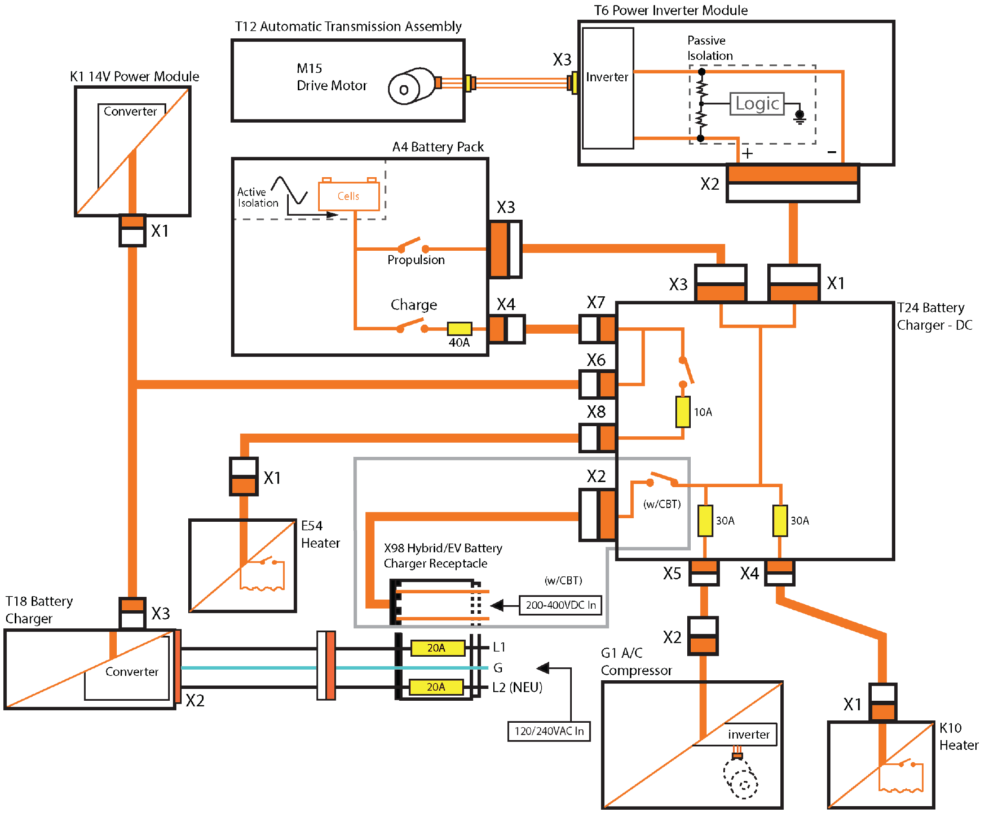
Isolation between HV Bus and Chassis	Normal Vehicle	10M	5M	1M	500K	200K Approximate DTC set	100K	None - Direct Short
Positive Isolation Parameter*	198V	180V	165V	110V	75V	35V	20V	0V
Negative Isolation Parameter*	192V	210V	225V	280V	315V	355V	370V	390V
Difference Between Parameters	0 - 15V	30V	60V	170V	240V	320V	350V	390V
*Typical values observed with a fully charged pack, 390V. A short to the positive bus is shown, a short to the negative bus would display inverted voltages of similar value.								

Active Isolation Testing

Active isolation testing is dedicated to monitoring the internal Hybrid/EV battery pack HV circuits. The battery energy control module switches fixed resistors between the high voltage system and vehicle chassis. The difference between the switched-to-chassis and the unswitched state is used to calculate a resistance-to-chassis value. When resistance-to-chassis decreases below a set value, DTC P0AA6 will set.

Active isolation testing occurs when the main high voltage contactor relays are open. For this reason most testing of the Hybrid/EV battery pack occurs just after the vehicle is shut off following a drive trip. The Isolation Test Resistance scan tool parameter indicates the resistance-to-chassis calculation determined when the last Active isolation test was performed.

High Voltage System


T12 Automatic Transmission Assembly
M15
Drive Motor
T6 Power Inverter Module
X3
Inverter
Passive
Isolation
Logic
+
–
X2
K1 14V Power Module
Converter
X1
A4 Battery Pack
Active
Isolation
Cells
X3
Propulsion
Charge
40A
X4
X7
X3
X1
T24 Battery
Charger - DC
X6
10A
X8
X1
X2
(w/CBT)
30A
30A
E54
Heater
X98 Hybrid/EV Battery
Charger Receptacle
(w/CBT)
200-400VDC In
X5
X4
T18 Battery
Charger
X3
Converter
X2
20A
20A
L1
G
L2 (NEU)
120/240VAC In
X2
G1 A/C
Compressor
inverter
X1
K10
Heater

[Fig. 4: High Voltage System](#)

Courtesy of GENERAL MOTORS COMPANY

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2017 ELECTRICAL

Hybrid/EV Energy Storage - Diagnostic Information and Procedures - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

HIGH VOLTAGE SAFETY

The High Voltage Safety procedure will perform the following tasks:

- Identify precautions when performing service or inspections.
- Identify labels for components, wire harness, and connectors.
- Identify high voltage insulation glove inspection procedure.

When applicable, additional region-specific high voltage service requirements and/or Dangers will be located in the General Information, Safety Regulations service category and take precedence over the information presented here.

General High Voltage Dangers

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **For European Region, a face shield is required in place of safety glasses.**

WARNING: **High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.**

NOTE: **For European Region, a special voltage tester such as the EL-52229 may be required. A multimeter that can measure current is prohibited.**

WARNING: **This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Precautions when Performing Service or Inspections

- Always verify that the high voltage has been disabled before working on or around high voltage components, wires, cables, or harnesses.
- Remove all metal objects such as rings and watches.
- The **EL-48900** HEV safety kit contains safety cones. Place the safety cones around the vehicle to alert other technicians that you are working on the high voltage system.
- Remove all keyless entry transmitters and the manual service disconnect from the vehicle and secure in a place outside the vehicle.
- Always wear certified and tested high voltage insulation gloves when inspecting or testing any high voltage wires and components.
- Use the "One Hand" rule whenever possible:
  - Work with only one hand.
  - Keep the other hand behind your back.
- DO NOT carry any metal objects such as a mechanical pencil or a measuring tape that could fall and cause a short circuit.
- After removing ring-terminal style high voltage wires, protect and insulate the terminal ends immediately with the **EL-50209** high voltage terminal cover and ULÂ® Listed or equivalent insulation tape rated at a minimum of 600 V.
- Always tighten the high voltage terminal fasteners to the specified torque. Insufficient or excessive torque will cause malfunctions or damage.
- After finishing work on the high voltage systems and before reinstalling the high voltage manual disconnect, inspect for the following:
  - Verify high voltage system integrity and that all connectors are installed.
  - Verify that all tools or loose components have been removed.

Labels for Components, Wire Harness, and Connectors

The wire harnesses and cables for high voltage circuits are encased in an orange colored covering. In addition, high voltage components such as the Energy Storage System and high voltage cables are affixed with "High Voltage" red danger and orange warning labels.

High Voltage Insulation Glove Inspection Procedure

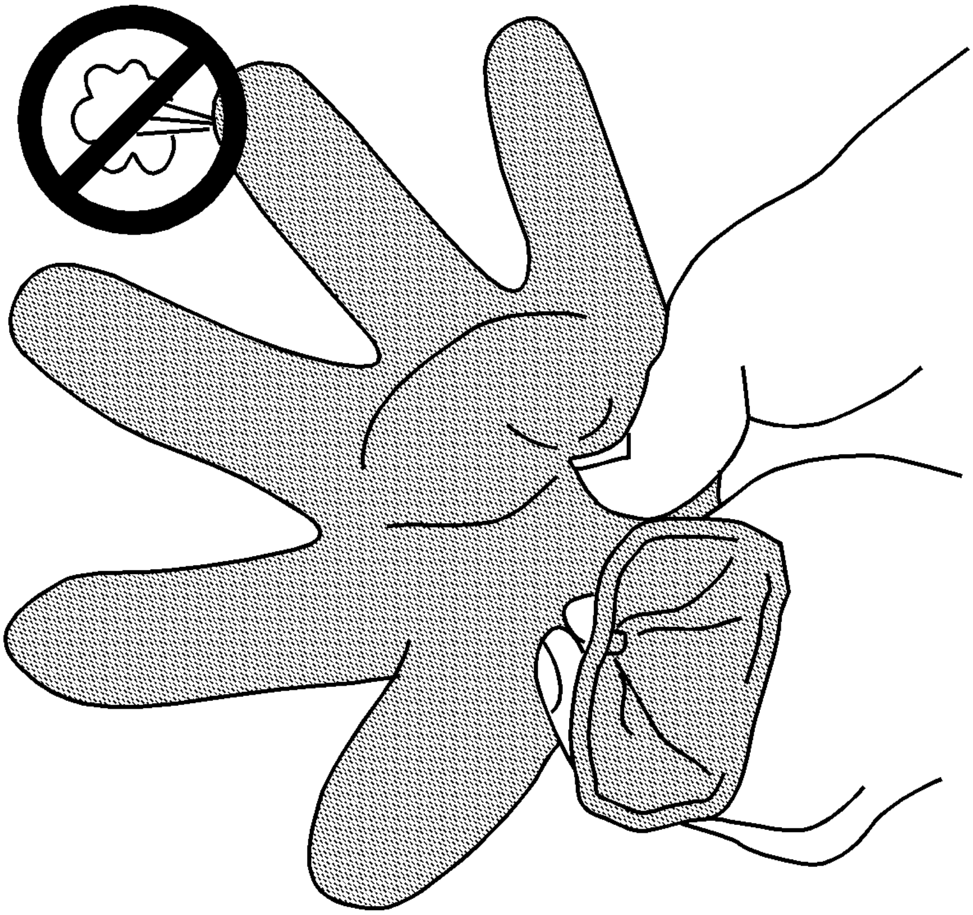


Fig. 1: Glove Inspection Procedure
Courtesy of GENERAL MOTORS COMPANY

The following procedure visually and functionally inspects the insulation gloves to be used while performing service on high voltage systems. This inspection procedure should be performed prior to any procedure that requires the use of class "0" insulation gloves rated at 1000 V.

1. Remove glove from leather protector.
2. Trap air in the glove and seal opening. Pinch or roll the opening closed tightly to prevent any air loss.
3. Press glove to increase pressure.
4. Inspect for the following conditions:
    - Pin holes
    - Air leaks
    - Wear, tears, or abrasions
    - Damp or wet material
    - Expired certification
    - **If any of the above conditions are met**

      Do not use the gloves.

    - **If none of the above conditions are met**
5. All OK. Gloves are OK to use.

HIGH VOLTAGE DISABLING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure utilizes two possible methods to disable high voltage:

NOTE: **The High Voltage Disable procedure, regardless of the method, only de-energizes the high voltage circuits and components outside of the Hybrid/EV battery pack, dangerous voltage levels always exist within the Hybrid/EV battery pack.**

1. Scan Tool Method: The on-vehicle control module software, initiated by the GDS2 scan tool, disables and discharges high voltage outside of the Hybrid/EV battery pack.
2. DMM Method: If the GDS2 Scan Tool Method does not complete or cannot be implemented, A DMM-based physical measurement method is performed at certain high voltage connectors.

A successful GDS2 Scan Tool High Voltage Disable Procedure will:

1. Perform an analysis of the vehicle condition by verifying specific DTCs have run and passed.
2. Calculate the high voltage isolation resistance to the vehicle chassis.
3. Open the high voltage contactor relays and discharge the high voltage system by setting a crash event lockout. When this stage is reached the **Clear Secured High Voltage DTCs** procedure will have to be performed to enable the system again.
4. Latch a Service Lockout condition to prevent unintended enabling of the high voltage system.
5. Instruct you when to remove the manual service disconnect.
6. Indicate successful high voltage disabling by:
    - Displaying a PROCEDURE COMPLETE message on the scan tool
    - Displaying a CHECK VEHICLE'S HIGH VOLTAGE STATUS message on the scan tool which will require you to verify:
        1. Vehicle is displaying an Instrument Cluster DIC message.
        2. Vehicle is sounding a continuous audible response from the vehicle Pedestrian Alert alarm.
        3. High Voltage Inverter Voltage parameter on scan tool indicates system high voltage has been lowered to a safe level.

An Unsuccessful GDS2 Scan Tool High Voltage Disable Procedure:

If vehicle conditions DO NOT permit the GDS2 scan tool procedure to complete, you will have to verify high voltage disabling by measuring the applicable connectors for safe voltage level with a DMM.

Diagnostic Aids

Review the **High Voltage Connectors** information for connector identification and the approved procedures for disconnecting and connecting high voltage connectors.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

Circuit Testing

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Testing

WARNING: **Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.**

WARNING: **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:**

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Review the high voltage safety information. Refer to **High Voltage Safety**.

NOTE: **Ensure the 12V battery is fully charged and tested prior to continuing.**

2. Disconnect and remove all 12 V Battery Chargers and the Charge Cable from the X98 Hybrid Battery Charger Receptacle.

NOTE: **If vehicle conditions do not allow for GDS2 scan tool usage, proceed to GDS2 Scan Tool Procedure Unsuccessful below.**

3. Access the GDS2 scan tool High Voltage Disable Procedure located under HPCM2 Control Functions.
4. Perform the actions as specified within the GDS2 scan tool procedure.

NOTE: **If at any point the GDS2 scan tool displays a "PROCEDURE UNSUCCESSFUL" warning message or you lose communication, stop the GDS2 procedure and proceed to GDS2 Scan Tool Procedure Unsuccessful below.**

5. WHEN INSTRUCTED by the GDS2 procedure, remove the S15 Manual Service Disconnect. Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement** . Place the S15 Manual Service Disconnect in a secure place outside the vehicle. Cover the exposed high voltage opening with UL listed, or equivalent, insulation tape rated at a minimum of 600 V.
6. Verify the GDS2 scan tool procedure completed successfully by observing a GDS2 scan tool "PROCEDURE COMPLETE" message followed by a "CHECK VEHICLE'S HIGH VOLTAGE STATUS" message. Verify these messages are combined with ALL the following conditions:
   - A Continuous Audible Vehicle Response of the Pedestrian Alert alarm
   - DIC message
   - High Voltage Inverter Voltage parameter on scan tool indicates system high voltage is less than 10 volts
   - **If the procedure was unsuccessful**

     Proceed to GDS2 Scan Tool Procedure Unsuccessful below.

   - **If the procedure successfully completed**

   1. Turn the vehicle power mode to OFF.

   NOTE: **Disconnecting the 12 V battery is the only method to deactivate the audible**

vehicle response. If the 12 V battery is reconnected while the S15 Manual Service Disconnect is removed, the audible vehicle response will continue for several minutes.

2. Disconnect the 12 V battery. Refer to Battery Negative Cable Disconnection and Connection .

NOTE: **You will have to perform the Clear Secured High Voltage DTCs GDS2 scan tool procedure in order to re-enable the high voltage system upon completion of the required vehicle servicing.**

3. The high voltage circuits and components OUTSIDE of the Hybrid/EV battery pack are now disabled/discharged.

NOTE: **Print the High Voltage Disable Confirmation table if necessary. Circle Steps Completed to identify which components have been disabled.**

High Voltage Disable Confirmation Table

Was the GDS2 Scan Tool Procedure SUCCESSFUL?	**Circle One:**	**NO**	**YES**
	If YES, all high voltage external of the A4 Hybrid/EV Battery Pack is now disabled. Fill-out and Print form as necessary. **If NO, perform GDS2 Scan Tool Procedure Unsuccessful steps as required**		
Confirm GDS2 Scan Tool Procedure Unsuccessful Steps Completed Below			
High Voltage Components you wish to Disable	**GDS2 Scan Tool Procedure Unsuccessful Steps that must be completed**	**Steps Completed**	
• General Vehicle Servicing around or near but not directly at high voltage components • T6 Power Inverter Module and connectors • T12 Transmission and connectors • A4 Hybrid/EV Battery Pack - external • 300V cables A4 Hybrid/EV Battery Pack to T24 Battery Charger - DC	Steps 1 - 19	NO	YES
K1 14V Power Module	Steps 1 - 24*	NO	YES
T18 Battery Charger	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to K1 14V Power Module and T18 Battery Charger	Steps 1 - 24*	NO	YES
K10 Heater	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to K10 Heater	Steps 1 - 24*	NO	YES
G1 A/C Compressor	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to G1 A/C Compressor	Steps 1 - 24*	NO	YES
E54 Heater	Steps 1 - 24*	NO	YES
300V cable - T24 Battery Charger - DC to E54 Heater	Steps 1 - 24*	NO	YES
T24 Battery Charger - DC	Steps 1 - 24*	NO	YES
*Perform testing at each component as applicable			
Technician:			
VIN:			
License Plate:			

GDS2 Scan Tool Procedure Unsuccessful

NOTE: **If the GDS2 Scan Tool Procedure was unsuccessful, follow the steps below as applicable.**

1. Remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Attempt to start the vehicle with the Ignition Mode Switch.
    - **If the vehicle enters Propulsion System Active mode or the engine starts**

Locate and remove all keyless entry transmitters from within the vehicle and return to the beginning of the GDS2 Scan Tool Procedure Unsuccessful procedure.

- **If the vehicle did not enter Propulsion System Active mode and the engine did not start**

NOTE: **The 12 V battery must be disconnected to ensure proper test results.**

NOTE: **You must ensure Battery Maintenance Mode is not active before disconnecting the 12V battery.**

3. Disconnect the 12 V battery. Refer to **Battery Negative Cable Disconnection and Connection** .
4. Remove the S15 Manual Service Disconnect. Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement** . Place the S15 Manual Service Disconnect in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.

NOTE: **5 min must elapse before removing any high voltage connectors. Removal of non high voltage components is allowed during this wait time.**

5. Wait 5 min before continuing, to allow the high voltage capacitors to discharge.

NOTE: **A 9 V DC battery or the vehicles 12 V battery can be used to test the DMM.**

6. Verify the test DMM by measuring a known good 9 to 12 V battery.
   - **If the DMM does not properly measure the test battery**

     Repair or replace the DMM and repeat all voltage measurements.

   - **If the DMM properly measures the test battery**

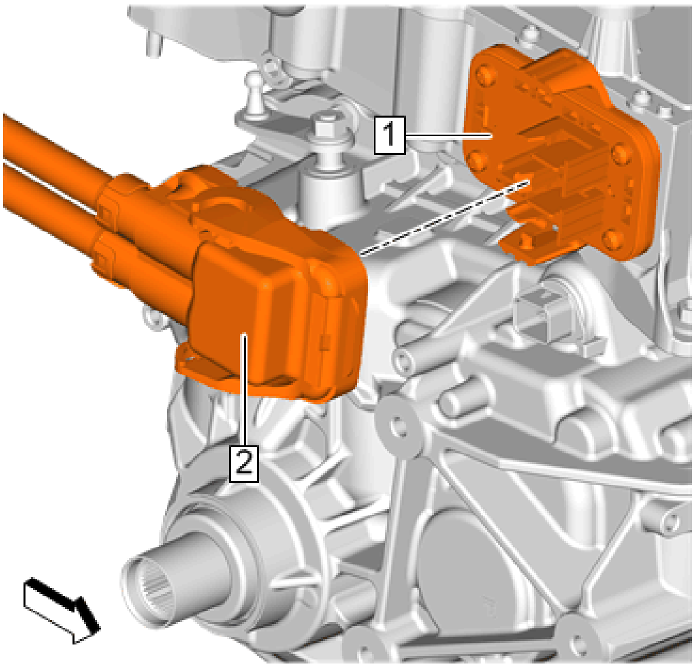


Fig. 2: T6 Power Inverter Module Connector And T24 Battery Charger - DC High Voltage Harness Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE:
- **Wear your High Voltage Insulation gloves until you have determined that a high voltage exposure risk is no longer present.**
- **Inspect the High Voltage DC connection seal for deformation or damage. Inspect the High Voltage DC connector for seal residue or debris. Always replace damaged seals and clean seal remnants from the connector with a non-marring tool.**

7. Disconnect the T24 Battery Charger - DC high voltage harness connector (2) at the T6 Power Inverter Module.

NOTE: **5 min must have elapsed since removing the S15 Manual Service Disconnect before continuing to allow the high voltage capacitors to discharge and ensure**

proper test results.

8. Verify the voltage measures less than 3 V at the T6 Power Inverter Module connector (1) at the following points:
    - High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
    - **If 3 V or greater**

      Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

    - **If less than 3 V**
9. Verify the voltage measures less than 3 V at the HV DC harness connector (2) to the T6 Power Inverter Module at the following points:
    - High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
    - **If 3 V or greater**

      There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to **Hybrid/EV Battery Voltage Present**.

    - **If less than 3 V**
10. Raise the vehicle and remove the underbody forward air deflector.

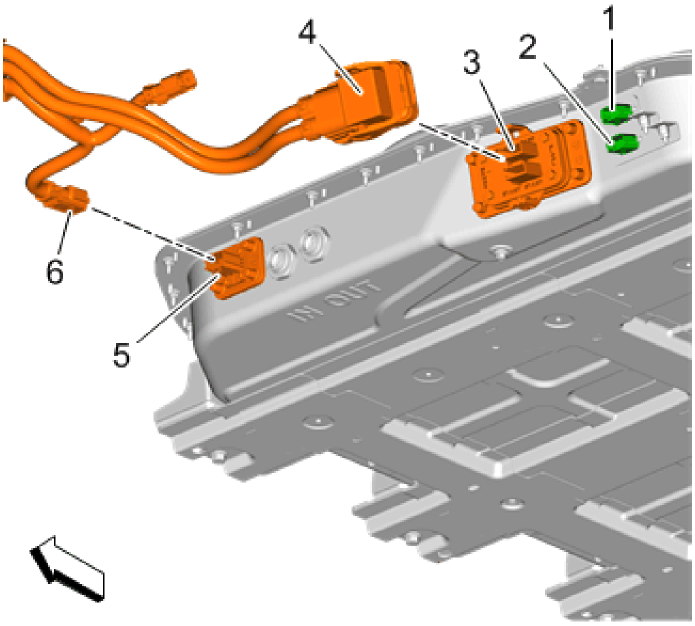


Fig. 3: A4 Hybrid/EV Battery Pack Connectors, T18/T24 Battery Charger Harness Connectors And Low Voltage Harness Connectors
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect the low voltage harness connectors (1, 2) at the A4 Hybrid/EV Battery Pack.
12. Disconnect the T18 Battery Charger harness connector (6) at the A4 Hybrid/EV Battery Pack.
13. Verify the voltage measures less than 3 V at the A4 Hybrid/EV Battery Pack connector (5) at the following points:
    - High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
    - **If 3 V or greater**

      There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to **Hybrid/EV Battery Voltage Present**.

    - **If less than 3 V**
14. Verify the voltage measures less than 3V at the T18 Battery Charger harness connector (6) at the following points:

  - High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
  - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
  - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
  - **If 3 V or greater**

    Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

  - **If less than 3 V**

15. Disconnect the T24 Battery Charger - DC connector (4) at the A4 Hybrid/EV Battery Pack.
16. Verify the voltage measures less than 3 V at the T24 Battery Charger - DC harness connector (4) at the following points:
    - High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
    - **If 3 V or greater**

      Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

    - **If less than 3 V**
17. Verify the voltage measures less than 3 V at the A4 Hybrid/EV Battery Pack connector (3) at the following points:
    - High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
    - **If 3 V or greater**

      There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack. Refer to **Hybrid/EV Battery Voltage Present**.

    - **If less than 3 V**

NOTE: **Discard any 300 V Battery Positive and Negative cable connector seal that may be deformed or damaged. Replace any seal that is deformed, missing, or damaged.**

NOTE: **A 9 V DC battery or the vehicles 12 V battery can be used to test the DMM.**

18. Verify the test DMM by measuring a known good 9 to 12 V battery.
    - **If the DMM does not properly measure the test battery**

      Repair or replace the DMM and repeat all voltage measurements.

    - **If the DMM properly measures the test battery**
19. The high voltage connectors at the A4 Hybrid/EV battery pack are now discharged. You may perform A4 Hybrid/EV battery pack removal and exit the High Voltage Disabling procedure at this time but you MUST continue if additional high voltage component service is required.
    - **If you do not need to perform additional high voltage component service**

      HV Disable for T6 power inverter module, T12 Transmission and A4 Hybrid battery pack is complete.

    - **If you need to perform additional high voltage component service**
20. Disconnect the high voltage connector(s) at the component(s) to be serviced.
21. Verify the voltage measures less than 3 V at the Module-side connector at the following points:
    - High voltage DC (-360 V) negative terminal B to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A to vehicle chassis ground.
    - High voltage DC (+360 V) positive terminal A and high voltage DC (-360 V) negative terminal B.
    - **If 3 V or greater**

      Leave the DMM connected to the terminals until the voltage drops below 3 V to allow the high voltage capacitors to discharge. Continue to the next step once the voltage is below 3 V.

- **If less than 3 V**

22. Repeat the previous step at all high voltage module connectors for any additional high voltage components requiring service.
23. Verify the test DMM by measuring a known good 9 to 12 V battery.
    - **If the DMM does not properly measure the test battery**

      Repair or replace the DMM and repeat all voltage measurements.

    - **If the DMM properly measures the test battery**
24. High voltage is disabled/discharged at all TESTED modules.

HIGH VOLTAGE ENABLING

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The High Voltage Enabling procedure will perform the following tasks:

- Identify how to enable high voltage.
- Verify high voltage system integrity and that all connectors are installed.

Diagnostic Aids

Review the **High Voltage Connectors** information for connector identification and the approved procedures for disconnecting and connecting high voltage connectors.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

WARNING: **Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.**

WARNING: **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:**

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**

- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Review the high voltage safety information prior to performing the High Voltage Enabling procedure. Refer to High Voltage Safety
2. Ensure that the 12 V battery is disconnected. Refer to Battery Negative Cable Disconnection and Connection

NOTE:

- **Always tighten the high voltage fasteners to the specified torque. Insufficient or excessive torque will cause malfunctions or damage.**
- **The high voltage connectors that have been disconnected do not require a specific sequence when connecting.**

3. After finishing work on the high voltage systems and before installing the S15 Manual Service Disconnect, inspect for the following:
   - Verify that all tools or loose components have been removed.
   - Inspect any disconnected 300 V Battery Positive and Negative cable seals for being deformed, missing, or damaged. Replace any seals that are deformed, missing, or damaged.
   - Verify high voltage system integrity and that all connectors are installed.
   - Verify that all high voltage interlock circuit connectors and covers are installed.
   - Install any components or connectors that have been removed or replaced during diagnosis.
4. Install the S15 Manual Service Disconnect (1). Refer to Drive Motor Battery High Voltage Manual Disconnect Lever Replacement
5. Connect the 12 V battery. Refer to Battery Negative Cable Disconnection and Connection .
6. Vehicle in Service Mode.
7. Verify if the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has been replaced.
   - **If the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has been replaced**

     Program the K16 Battery Energy Control Module. Refer to Battery Energy Control Module Programming and Setup . Continue to the next step once programming is complete.

   - **If the A4 Hybrid/EV Battery Pack or the K16 Battery Energy Control Module has not been replaced**
8. Verify if the High Voltage Disabling procedure performed prior to vehicle repair utilized the GDS2 scan tool method.
   - **If the GDS2 scan tool high voltage disabling procedure was performed, the high voltage contactor relays are in a lockout state.**

     Perform the Clear Secured High Voltage DTCs procedure and return to the next step.

   - **If the DMM Method high voltage disabling procedure was performed**
9. Vehicle in Service Mode, perform the driver window express learn and clear all DTC Information with a scan tool. Refer to Window Motor Programming - Express Function .
10. Vehicle OFF and all vehicle systems OFF. It may take up to 5 min for all vehicle systems to power down.
11. Vehicle in Service Mode.
12. Verify with a scan tool no DTCs are set.
    - **If any DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If no DTCs are set**
13. Vehicle ON.
14. Vehicle OFF and wait 5 min.
15. Vehicle in Service Mode. Verify with the scan tool the Hybrid/EV Powertrain Control Module and K114B Hybrid/EV Powertrain Control Module 2 DTC Information that the following DTCs have Ran Since Code Clear and have not set:

- Motor position sensor learn DTC P0C17.
- Contactor DTCs P0AD9, P0ADD, P0D0A, and P1EBD.
- Discharge and Pre-charge DTCs P0C76, P0C78, P0AFB, and P3061.
- High voltage loss of isolation DTCs P0AA6, P1AE6, and P1AF0.
- **If any DTCs are set**

  Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If the DTCs have Not Ran Since Code Clear**

1. Review and operate the vehicle according to the applicable DTC Conditions for Running and ensure the DTCs run and pass.
2. Verify with the scan tool the Hybrid/EV Powertrain Control Module and K114B Hybrid/EV Powertrain Control Module 2 DTC Information that the specified DTCs have Ran Since Code Clear and have not set:
   - If any DTCs are set, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
   - If the DTCs have Ran and Passed
3. Test drive the vehicle and verify no DTCs are set.

- **If the DTCs have Ran and Passed**

16. Test drive the vehicle and verify no DTCs are set.

EL-48571 HIGH VOLTAGE BATTERY PIN OUT BOX REFERENCE

Section (Row)	Cell Module	Cell Group	EL-48571 Harness	EL-48571 Selector Switch Position
C4A Hybrid/EV Battery Section 1 (Row 1)	C5A Hybrid/EV Battery Module 1*	10	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	B, 10
		9		B, 9
		8		B, 8
		7		B, 7
		6		A, 6
		5		A, 5
		4		A, 4
		3		A, 3
		2		A, 2
		1		A, 1
	C5J Hybrid/EV Battery Module 10	87	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	A, 1
		88		A, 2
		89		A, 3
		90		A, 4
		91		A, 5
		92		A, 6
		93		B, 7
		94		B, 8
		95		B, 9
		96		B, 10
C4B Hybrid/EV Battery Section 2 (Row 2)	C5B Hybrid/EV Battery Module 2*	11	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	C, 13
		12		C, 14
		13		C, 15
		14		C, 16
		15		C, 17
		16		C, 18
		17		D, 19
		18		D, 20
		19		D, 21
		20		D, 22
	C5I Hybrid/EV Battery Module 9	86	EL-48571-63 X1 at Forward	D, 22
		85		D, 21

Section (Row)	Cell Module	Cell Group	connector, X2 at Aft connector** EL-48571 Harness	EL-48571 Selector Switch Position
		84		D, 20
		83		D, 19
		82		C, 18
		81		C, 17
		80		C, 16
		79	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	C, 15
		78		C, 14
		77		C, 13
C4C Hybrid/EV Battery Section 3 (Row 3)	C5C Hybrid/EV Battery Module 3*	30		B, 10
		29		B, 9
		28		B, 8
		27		B, 7
		26		A, 6
		25		A, 5
		24		A, 4
		23		A, 3
		22		A, 2
		21		A, 1
	C5H Hybrid/EV Battery Module 8	67	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	A, 1
		68		A, 2
		69		A, 3
		70		A, 4
		71		A, 5
		72		A, 6
		73		B, 7
		74		B, 8
		75		B, 9
		76		B, 10
C4D Hybrid/EV Battery Section 4 (Row 4)	C5D Hybrid/EV Battery Module 4*	31	EL- 48571-61	A, 1
		32		A, 2
		33		A, 3
		34		A, 4
		35		A, 5
		36		A, 6
		37		B, 7
		38		B, 8
		39		B, 9
		40		B, 10
	C5G Hybrid/EV Battery Module 7	66	EL-48571-62	B, 8
		65		B, 7
		64		A, 6
		63		A, 5
		62		A, 4
		61		A, 3
		60		A, 2
		59		A, 1
C4E Hybrid/EV Battery Section 5 (Row 5)	C5E Hybrid/EV Battery Module 5*	41	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	C, 15
		42		C, 16
		43		C, 17
		44		C, 18
		45		D, 19
		46		D, 20
		47		D, 21

Section (Row)	Cell Module	Cell Group	EL-48571 Harness	EL-48571 Selector Switch Position
		48		D, 22
	C5F Hybrid/EV Battery Module 6	49	EL-48571-63 X1 at Forward connector, X2 at Aft connector**	A, 1
		50		A, 2
		51		A, 3
		52		A, 4
		53		A, 5
		54		A, 6
		55		B, 7
		56		B, 8
		57		B, 9
		58		B, 10

*On right side of section (row)

**Reversed connection will result in inaccurate results

HIGH VOLTAGE CONNECTORS

Connector Type Identification

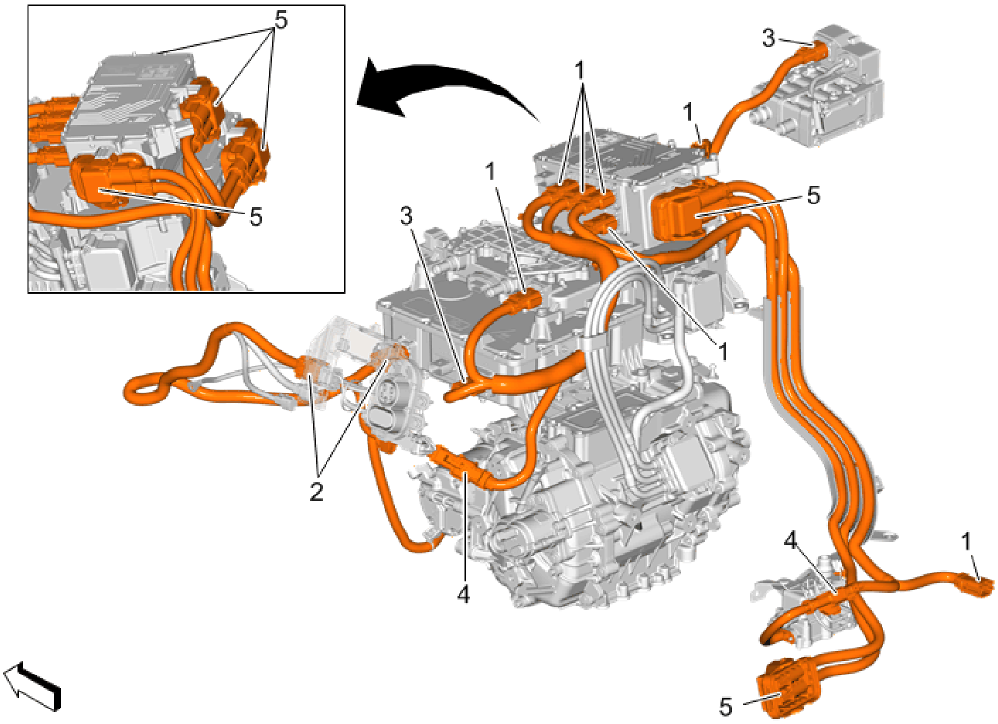


Fig. 4: Connector Type Identification
Courtesy of GENERAL MOTORS COMPANY

Connector Type		Connector Location								
		T6 Power Inverter Module	A4 Hybrid/EV Battery Pack	G1 A/C Compressor	K10 Coolant Heater Control Module	E54 Hybrid/EV Battery Pack Coolant Heater	K1 14V Power Module	T18 Battery Charger	T24 Battery Charger - DC	X98 Hybrid/EV Battery Charger Receptacle
Callout	Connector									
1	HV280 1 Click	-	X4	-	-	-	X1	-	X4, X5, X6, X7, X8	-
2	HV280	-	-	-	-	-	-	X2	-	X1
3	AMP+HVA280	-	-	-	X1	-	-	X3	-	-
4	MP280	-	-	X2	-	X1	-	-	-	-

Connector Type		Connector Location								
Callout	Connector	T6 Power Inverter Module	A4 Hybrid/EV Battery Pack	G1 A/C Compressor	K10 Coolant Heater Control Module	E54 Hybrid/EV Battery Pack Coolant Heater	K1 14V Power Module	T18 Battery Charger	T24 Battery Charger - DC	X98 Hybrid/EV Battery Charger Receptacle
5	PP2000 90 NFS	X2	X3	-	-	-	-	-	X1, X2, X3	-

WARNING: **Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.**

Review the high voltage safety information. Refer to High Voltage Safety.

HVA280 1 Click Connector Procedure

HVA280 1 click Disconnect Procedure

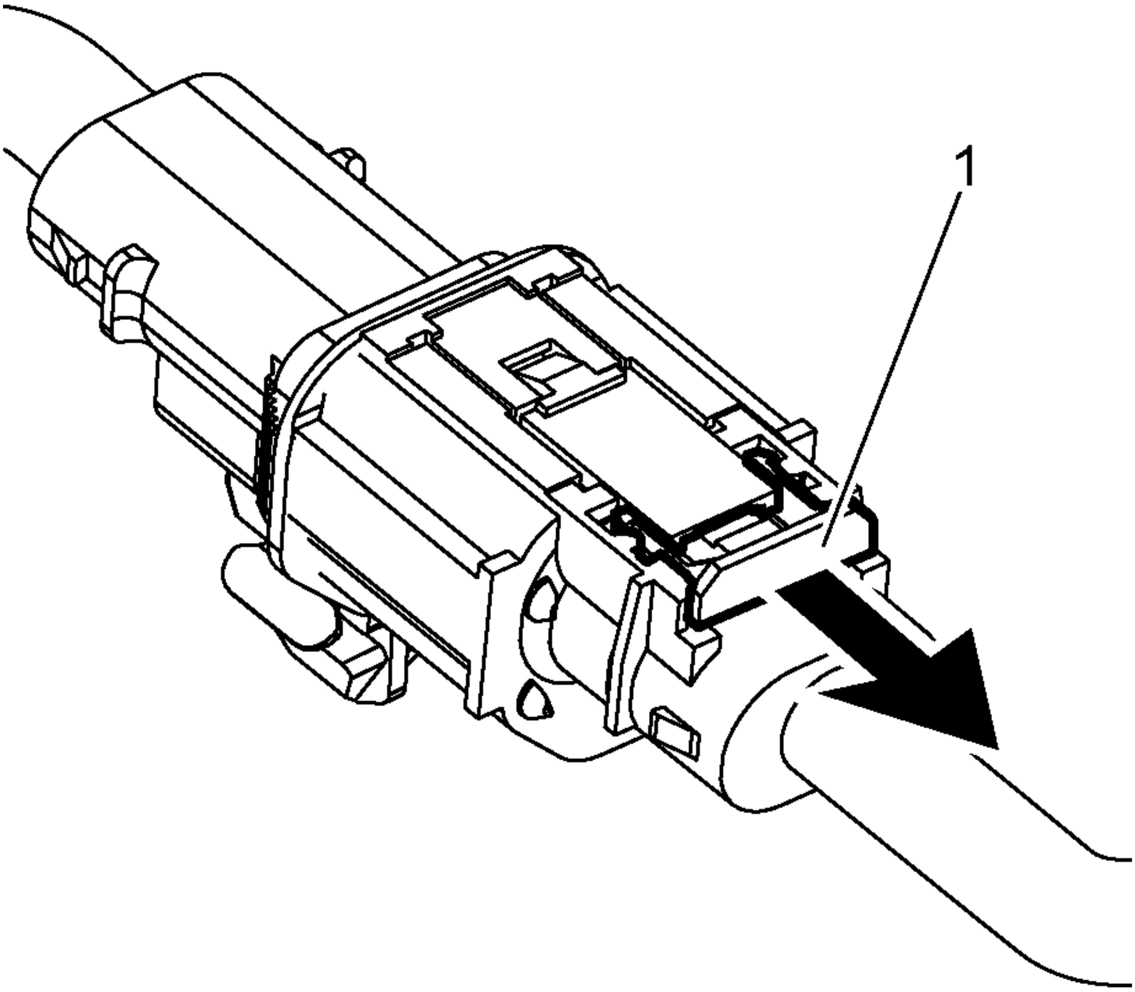


Fig. 5: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) tab (1) back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

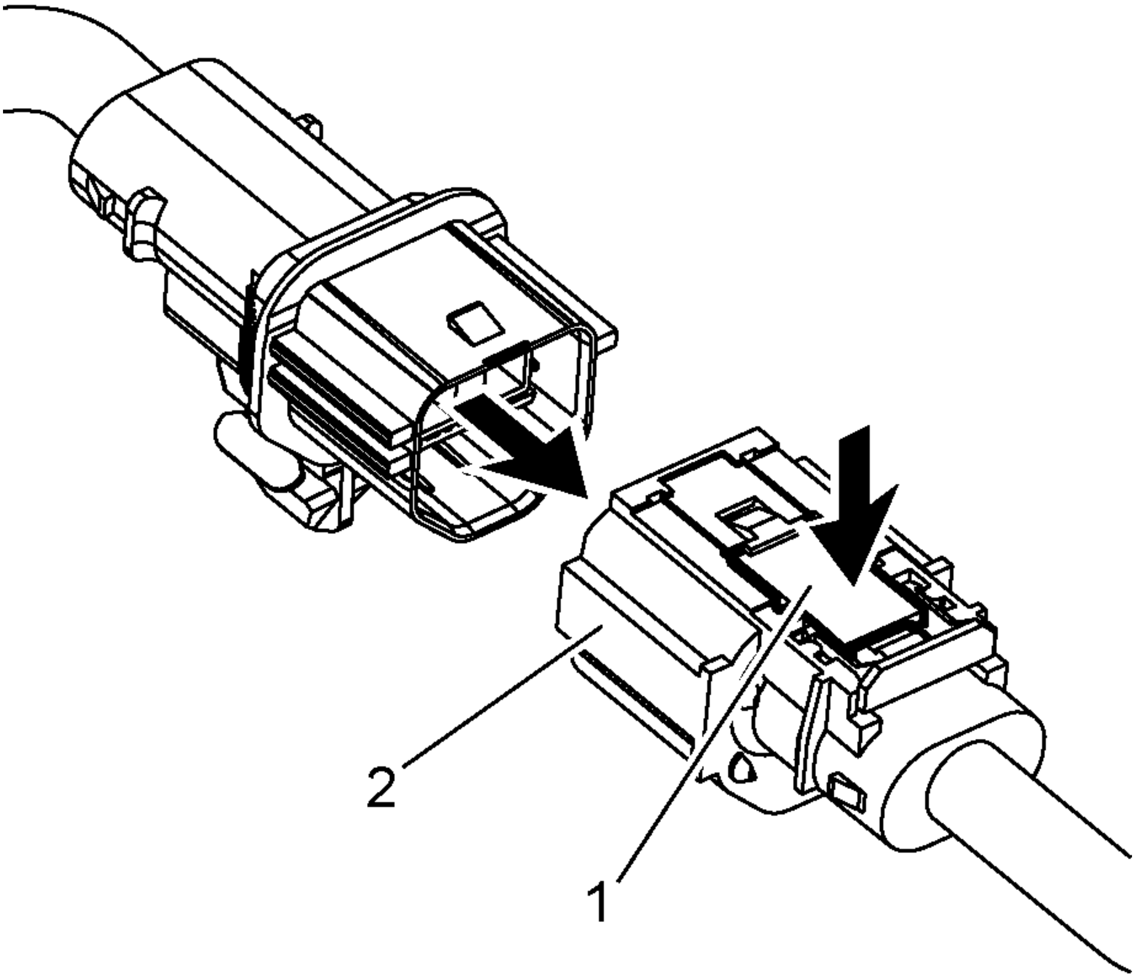


Fig. 6: Primary Lock Feature And Female Connector
Courtesy of GENERAL MOTORS COMPANY

2. Depress the primary lock feature (1) to release the lock and pull back on the female connector (2) to disconnect the connector completely.

HVA280 1 click Connect Procedure

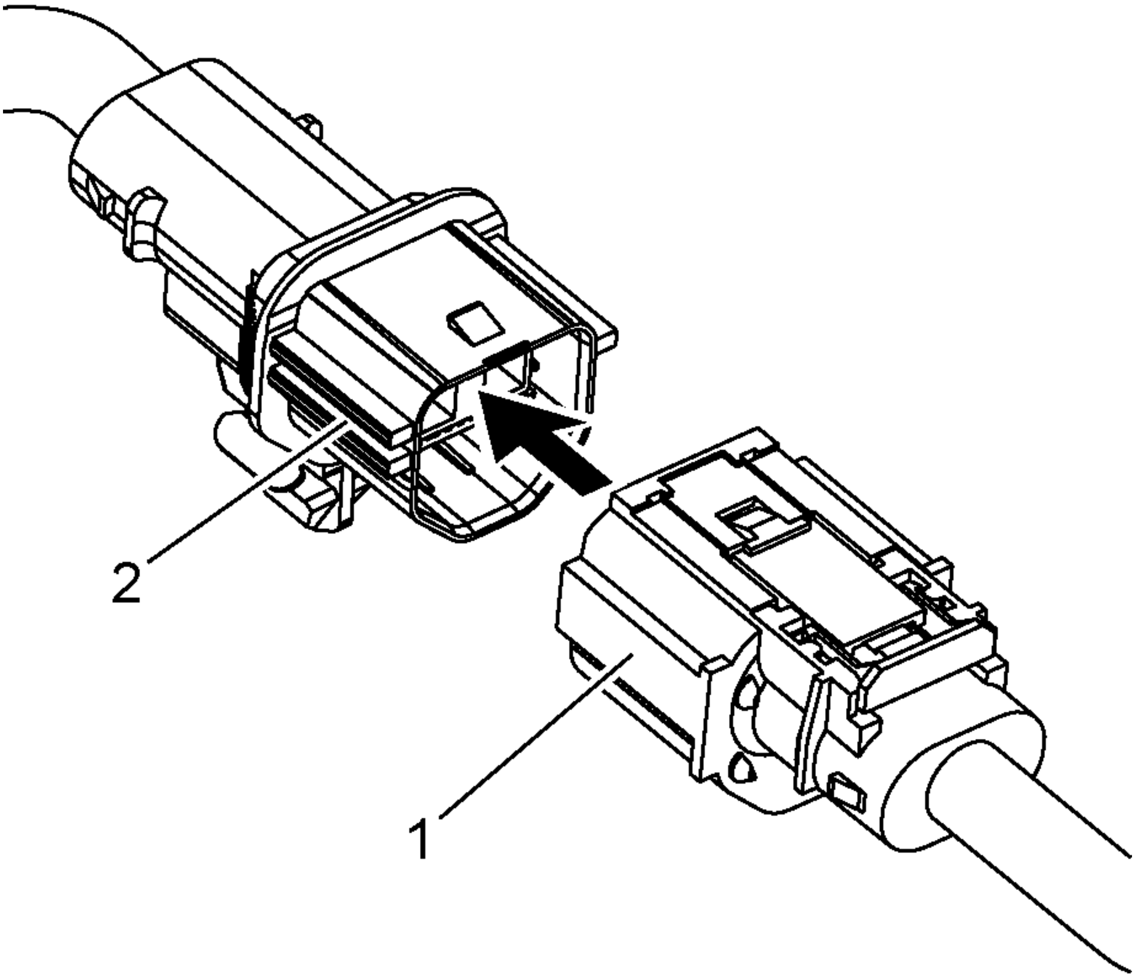


Fig. 7: Index Features
Courtesy of GENERAL MOTORS COMPANY

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (1). There will be an audible click sound when the connector lock is secured.

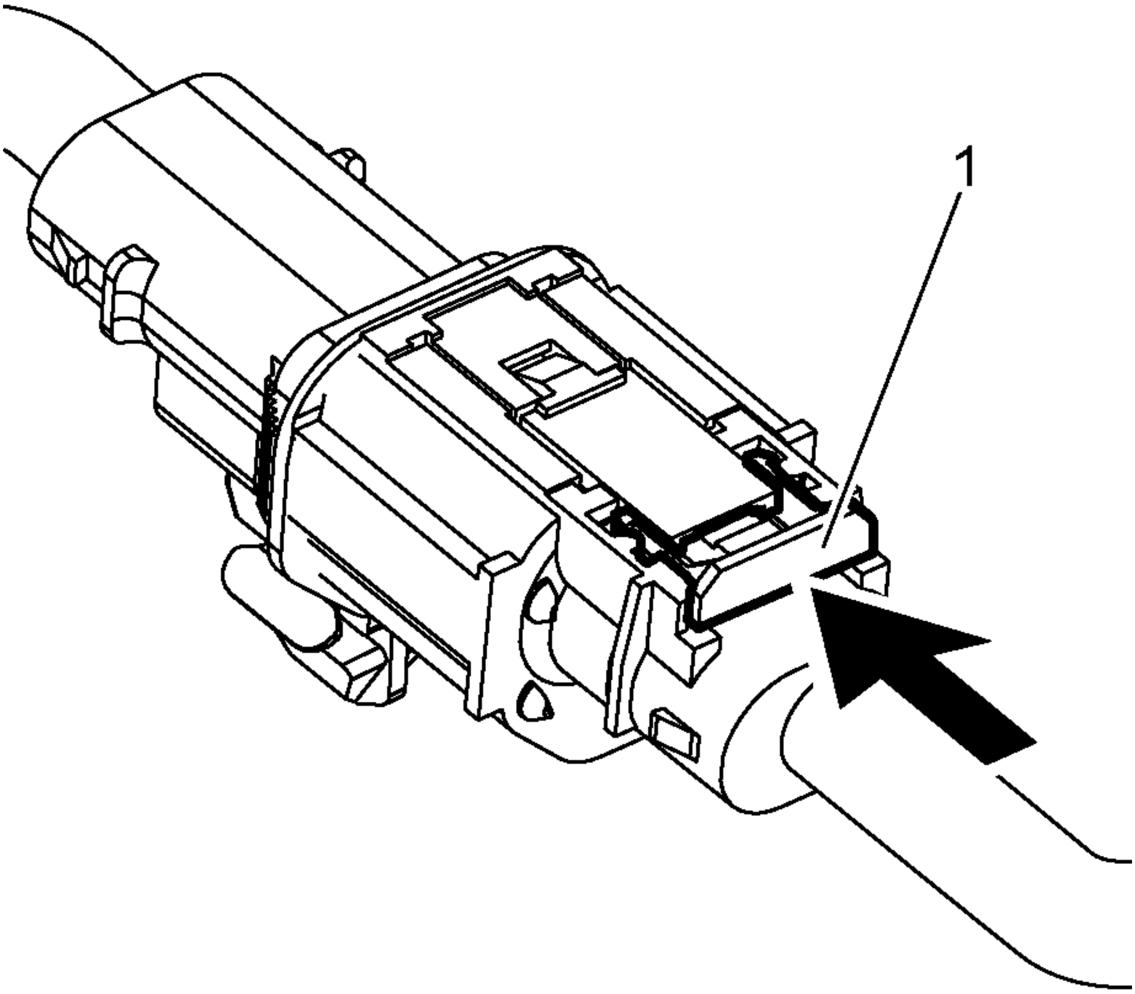


Fig. 8: CPA Tab
Courtesy of GENERAL MOTORS COMPANY

2. Push the CPA tab (1) to lock the connector in the full-stage position. There will be an audible click sound when the CPA tab is secured.

HV280 Connector Procedure

HV280 Disconnect Procedure

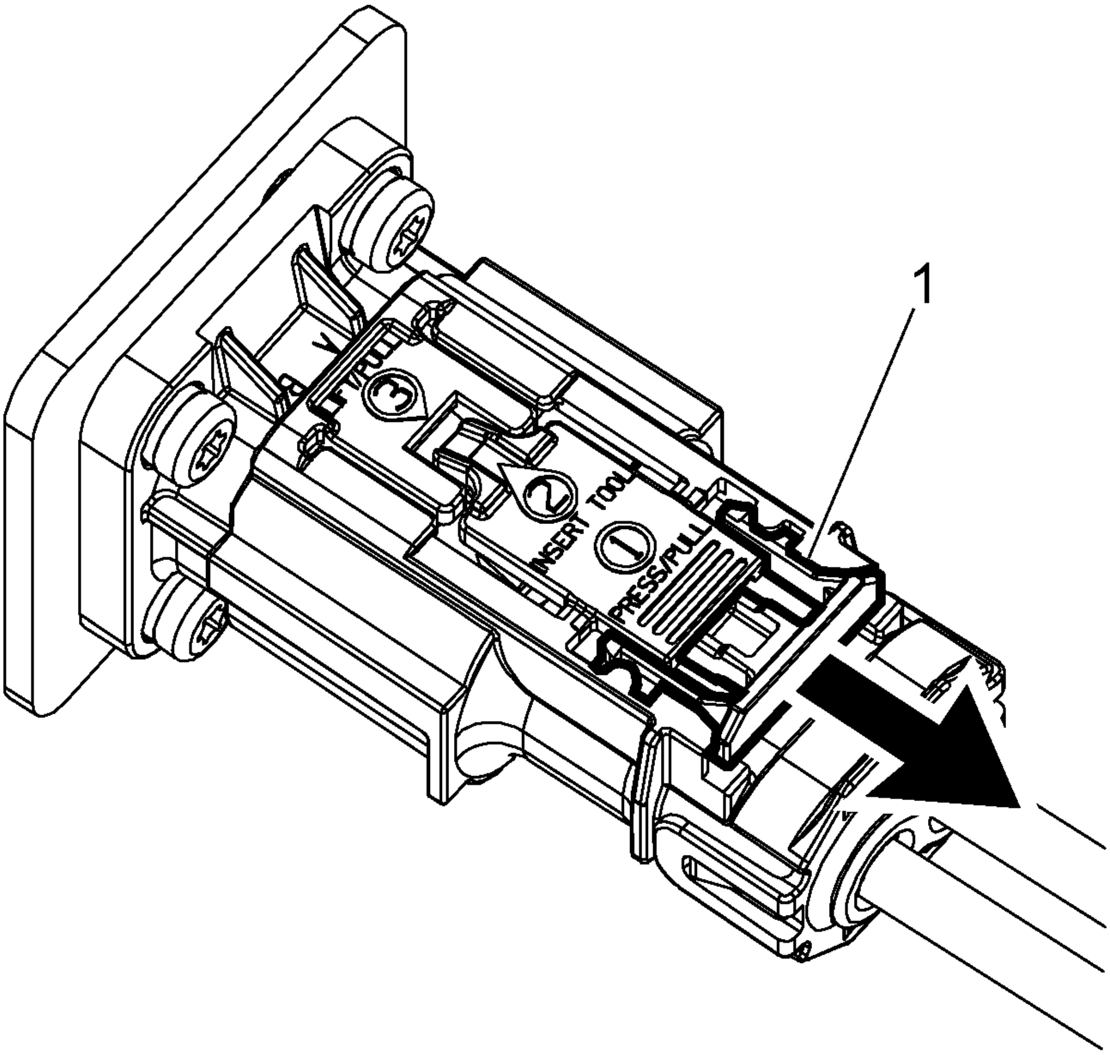


Fig. 9: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) (1) tab back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

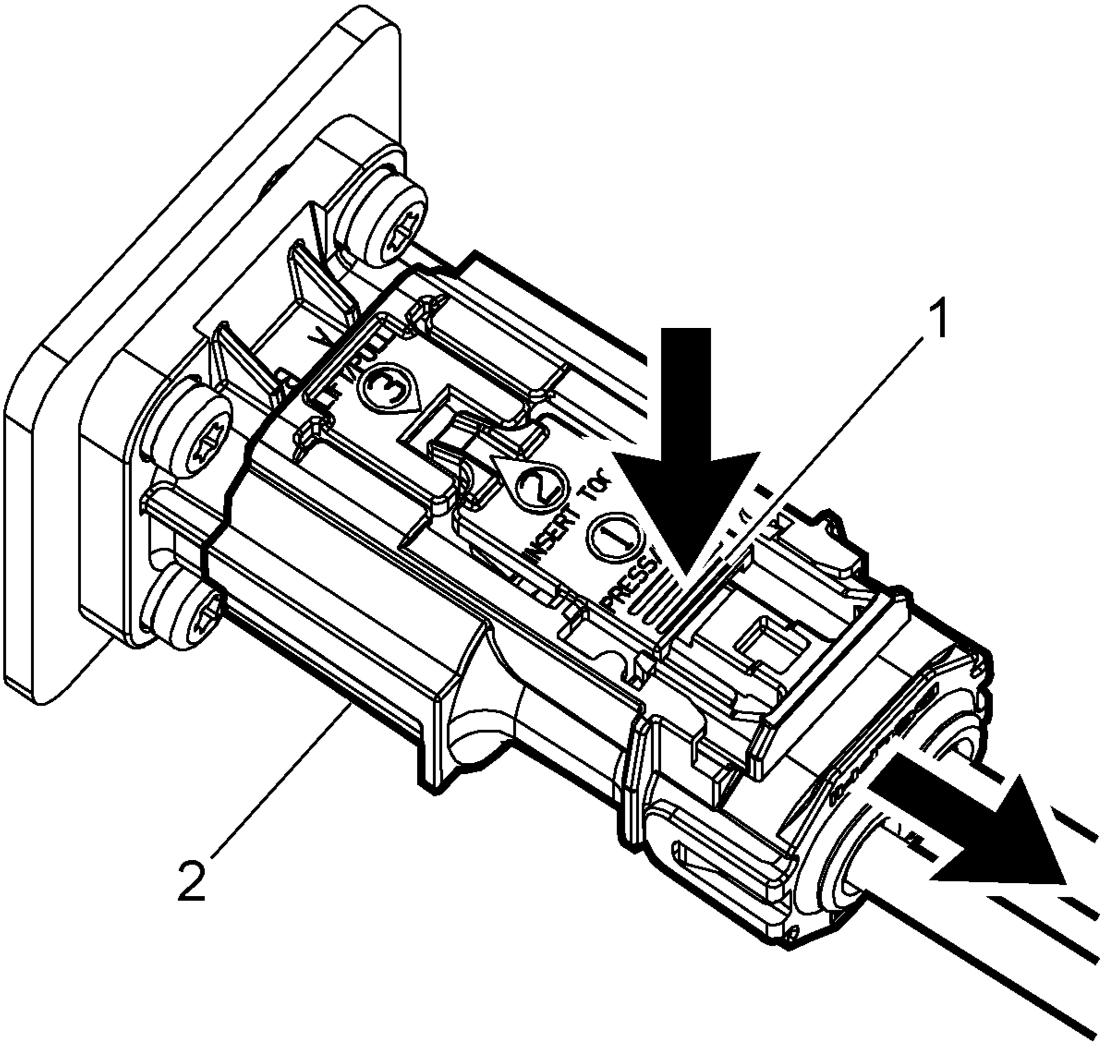


Fig. 10: Female Connector And Female Connector Lock
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Pull on the sides of the connectors only. The connector will stop in a partial-mate position when performing the next step.**

2. Press firmly on the back of the female connector lock (1) and hold down, while pulling the female connector (2) assembly halfway apart, until the connector is in the partial-mate position.

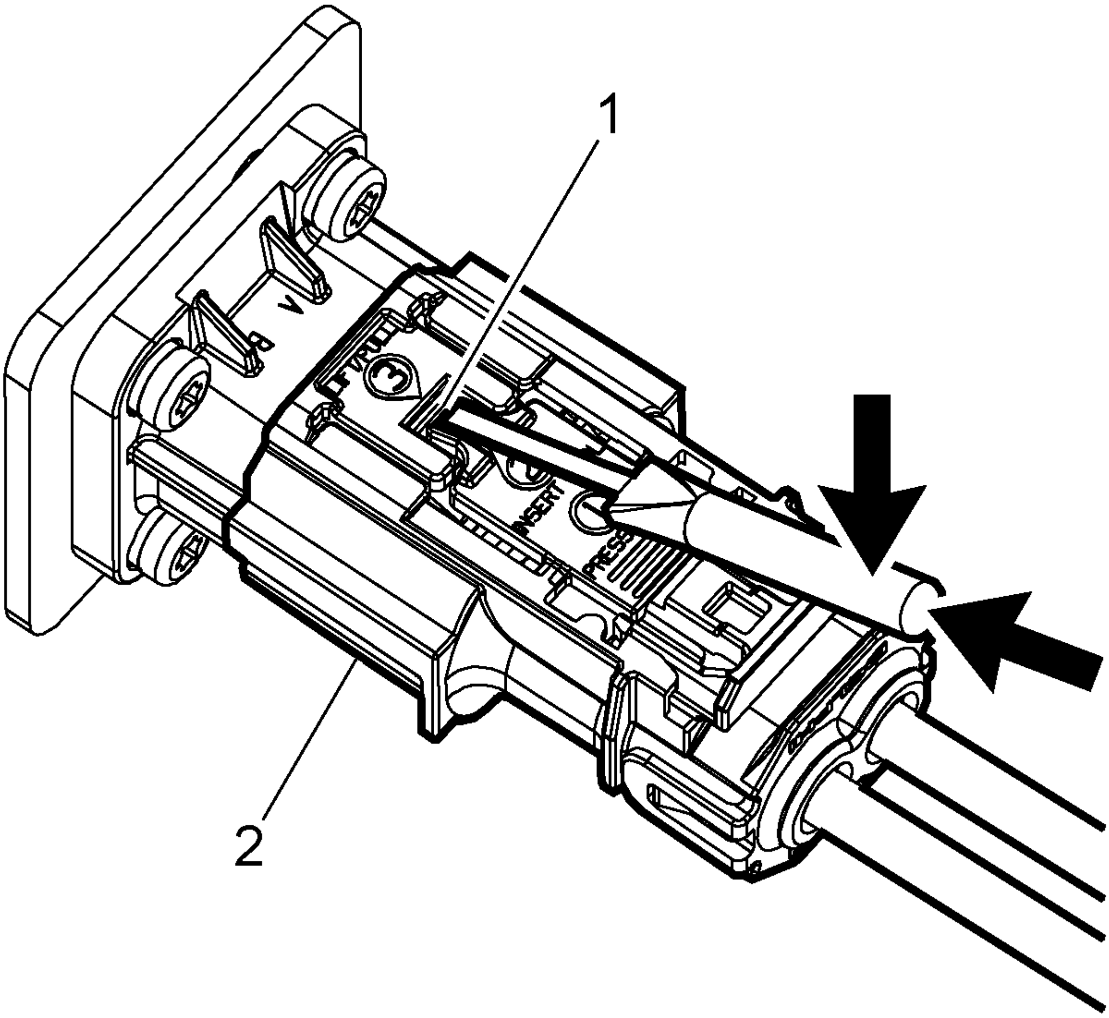


Fig. 11: Second Connector Lock And Female Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: **If the connector does not separate easily when pulled after the second connector lock is released, check that both sides of the second connector lock have been released.**

3. Insert a suitable tool into the slot under the second connector lock (1). Using the tool as a lever, release the female connector by gently raising the second connector lock. An audible click or clicks will be heard on both sides of the connector as the second lock is released.
4. Remove the tool and pull the female connector (2) to fully disconnect.

HV280 Connect Procedure

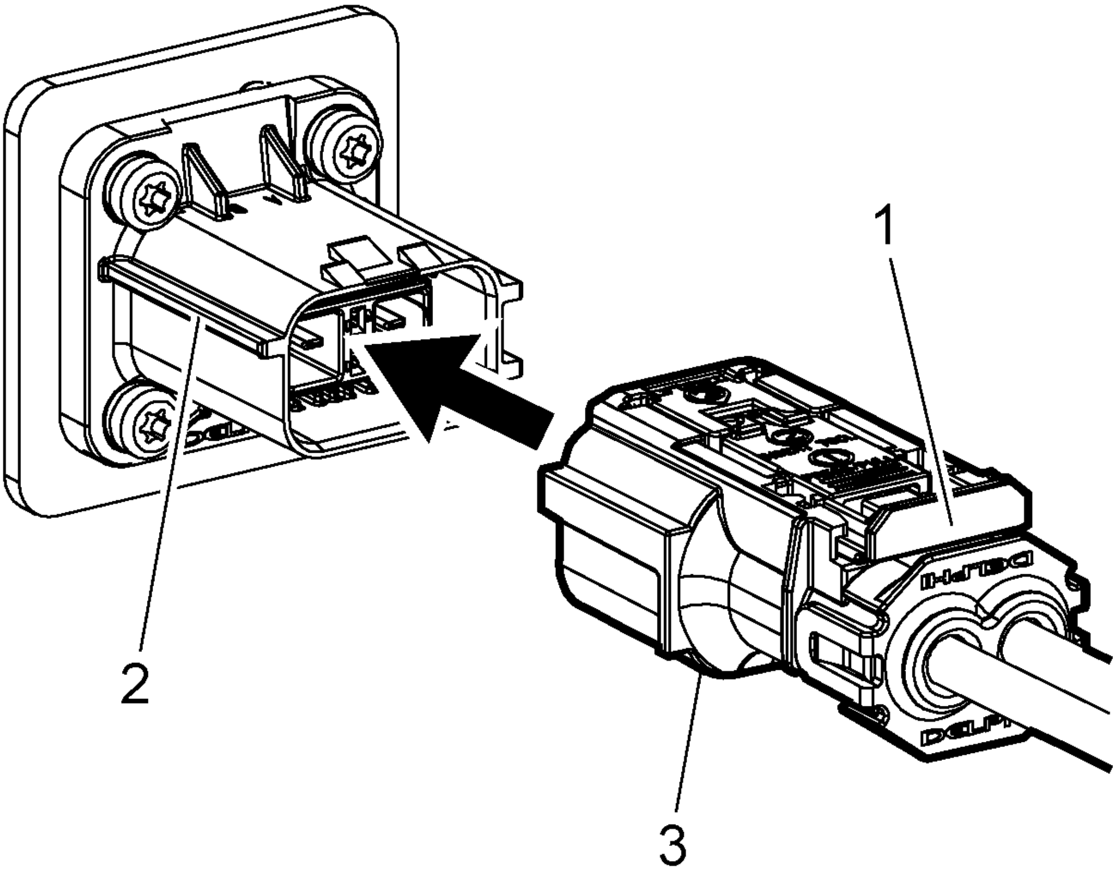
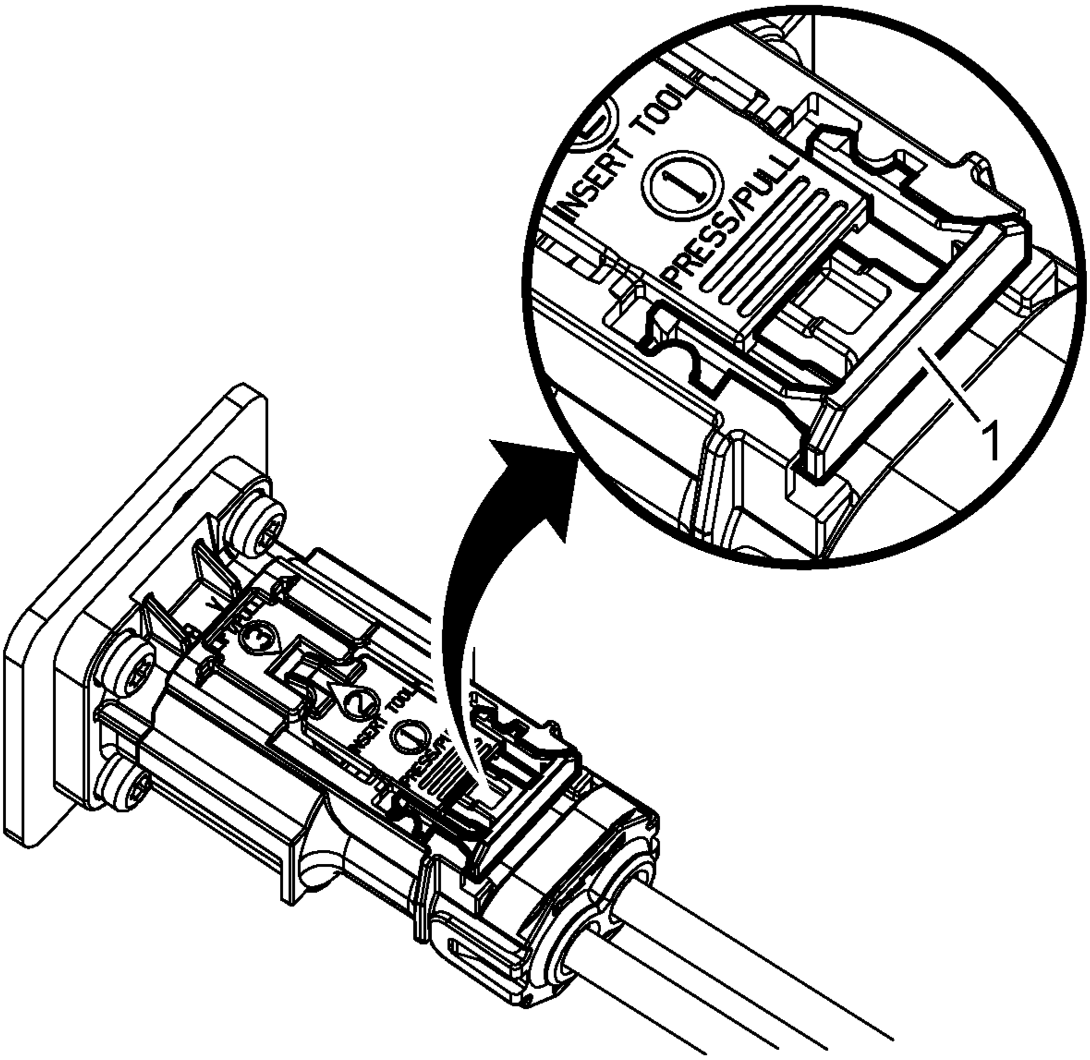


Fig. 12: Connector Position Assurance (CPA) Tab, Index Guides And Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Ensure the CPA tab (1) is in the pre-stage position.**
- **The connector will be fully mated when a series of 2 audible clicks is heard.**

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (3).



[Fig. 13: Connector Position Assurance (CPA) Tab](#)
Courtesy of GENERAL MOTORS COMPANY

NOTE: **There will be an audible click sound when the CPA tab is placed in the locked position. The CPA tab and connector body touch when fully seated.**

2. Push the CPA tab (1) forward from the pre-stage position to the locked position.

AMP+HVA280 Connector Procedure

AMP+HVA280 Disconnect Procedure

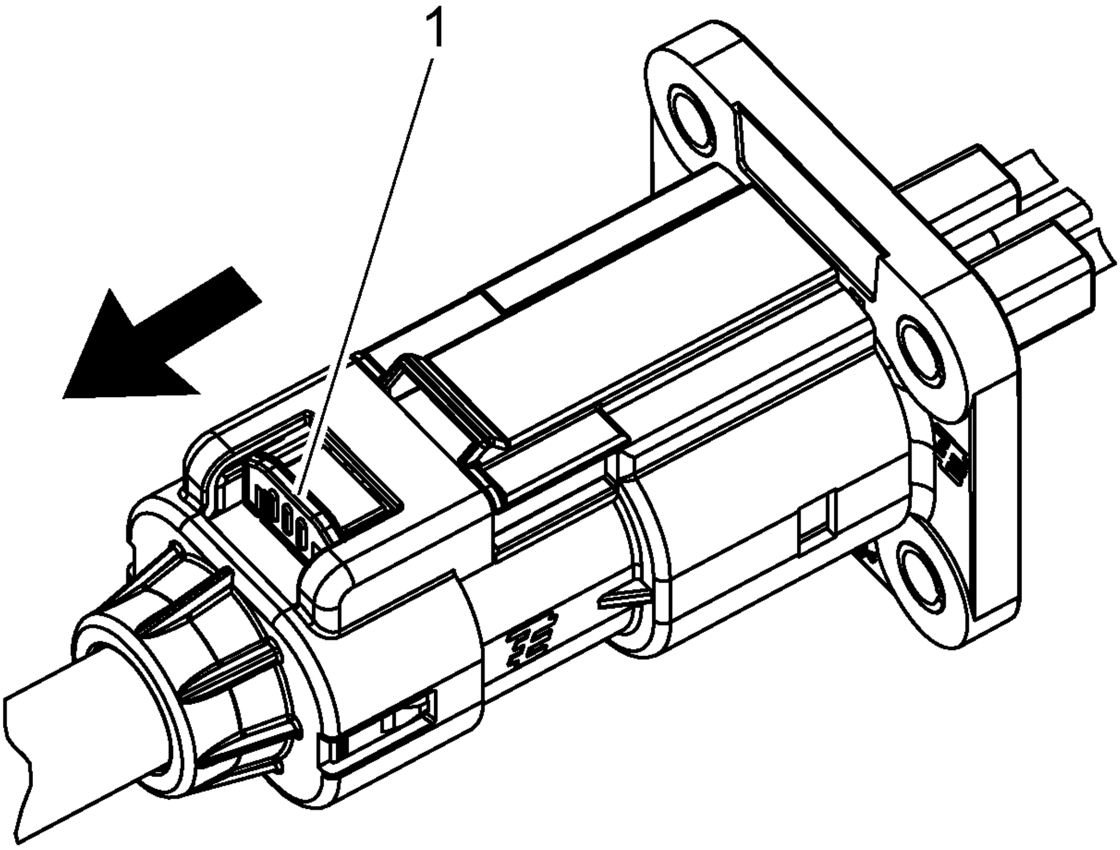


Fig. 14: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Pull the connector position assurance (CPA) (1) tab back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

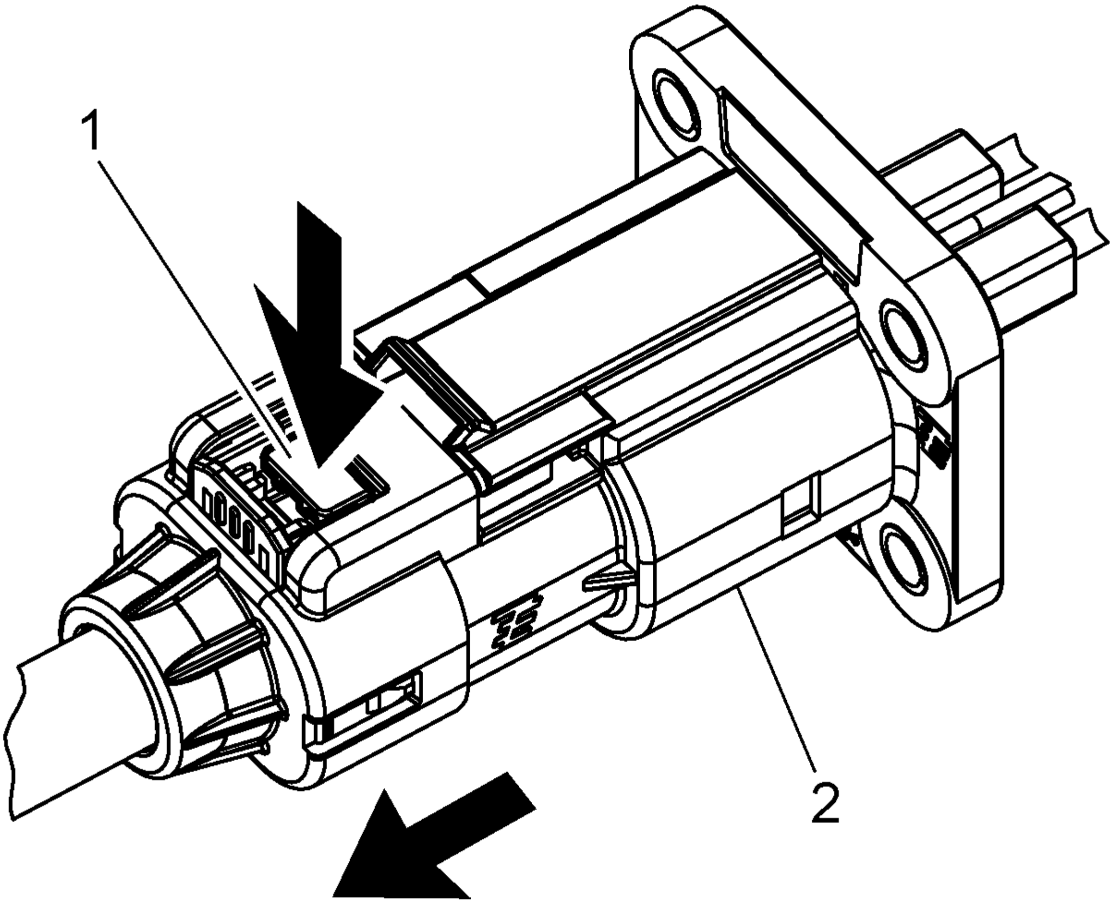


Fig. 15: Female Connector Lock And Female Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Pull on the sides of the connectors only. The connector will stop in a partial-mate position when performing the next step.**

2. Press firmly on the back of the female connector lock (1) and hold down, while pulling the female connector (2) assembly halfway apart, until the connector is in the partial-mate position.

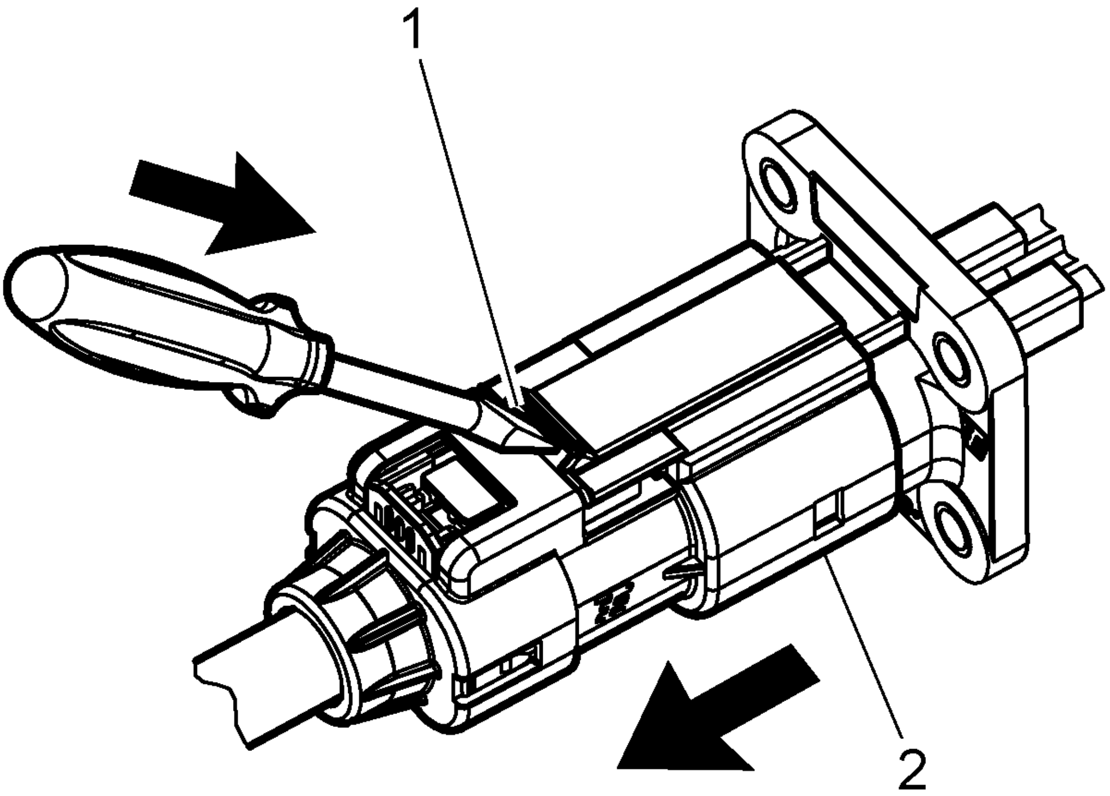


Fig. 16: Depressing Second Connector Lock To Disconnect Female Connector
Courtesy of GENERAL MOTORS COMPANY

3. Insert a suitable tool into the slot (1) and depress the second connector lock. An audible click will be heard as the second lock is released.
4. Remove the tool and pull the female connector (2) to fully disconnect.

AMP+HVA280 Connect Procedure

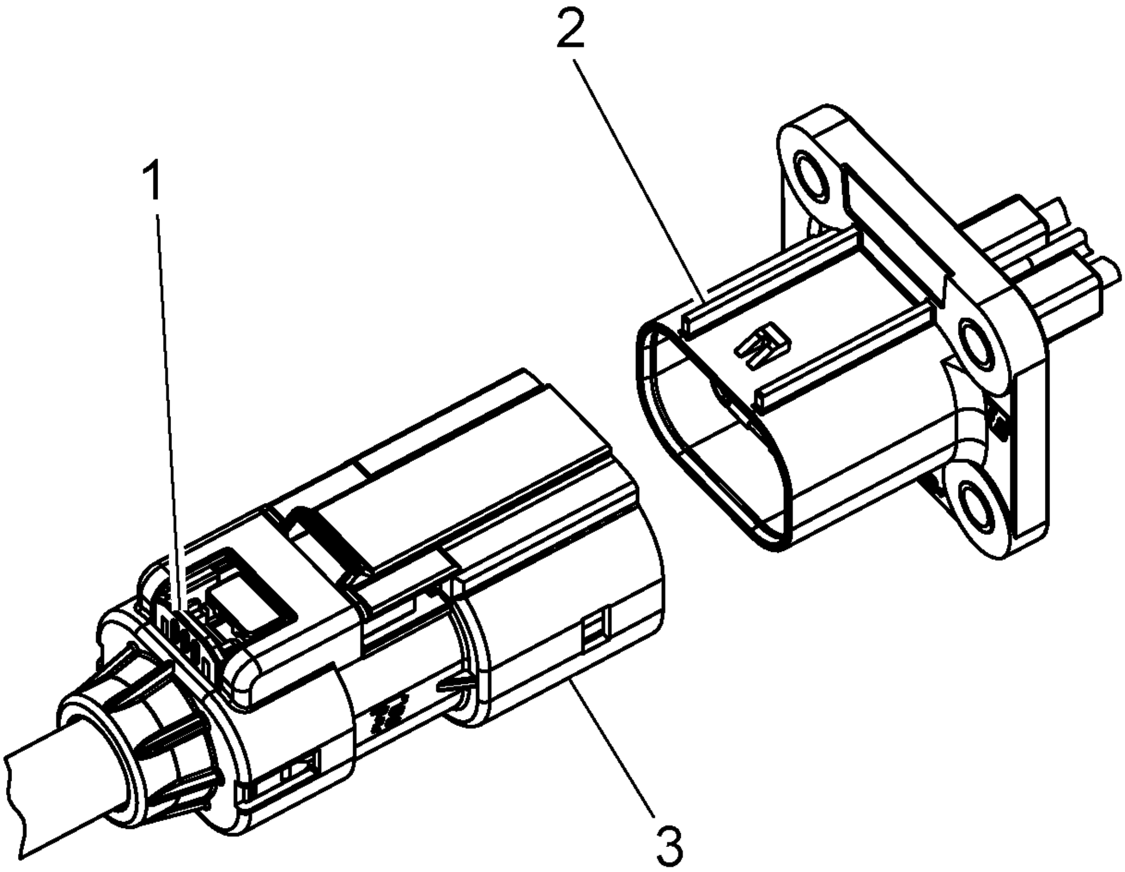


Fig. 17: Connector Position Assurance (CPA) Tab, Index Guides And Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Ensure the CPA tab (1) is in the pre-stage position.**
- **The connector will be fully mated when a series of two audible clicks is heard.**

1. Align the connector with the index features (2) and install the connector by pushing on the sides of the connector (3).

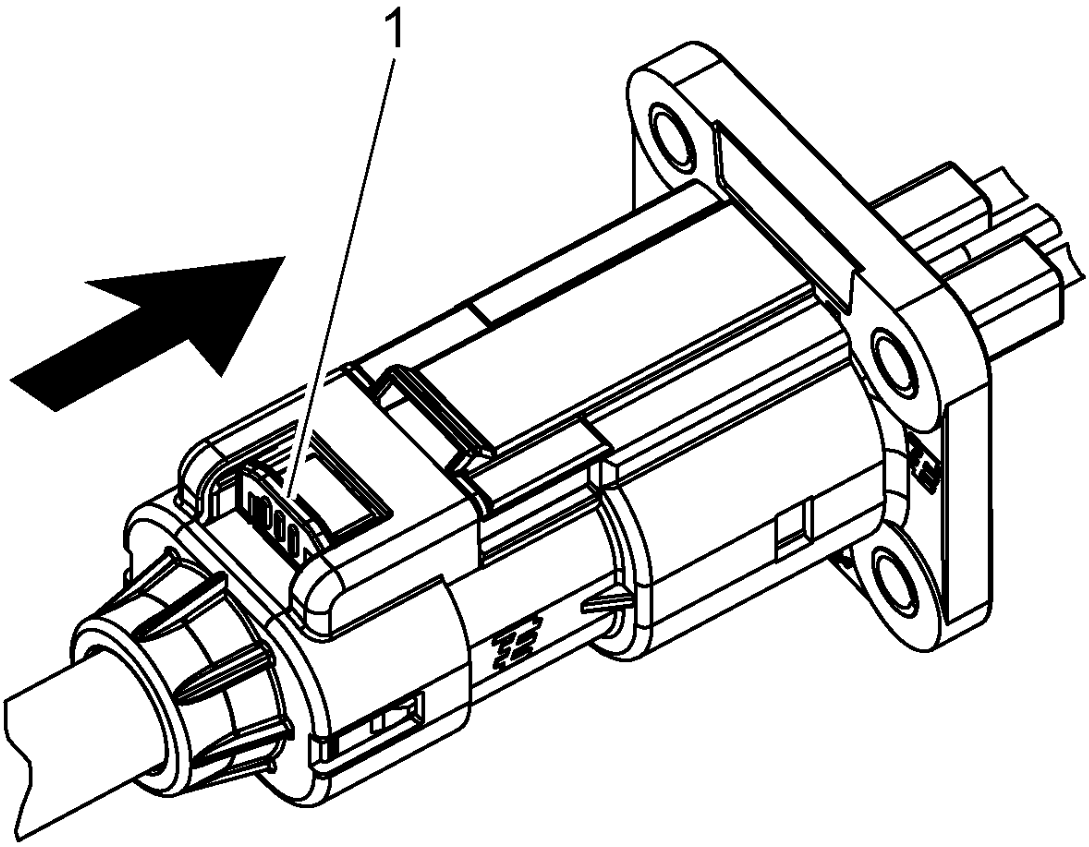


Fig. 18: Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

NOTE: **There will be an audible click sound when the CPA tab is placed in the locked position. The CPA tab and connector body touch when fully seated.**

2. Push the CPA tab (1) forward from the pre-stage position to the locked position.

MP280 Connector Procedure

MP280 Disconnect Procedure

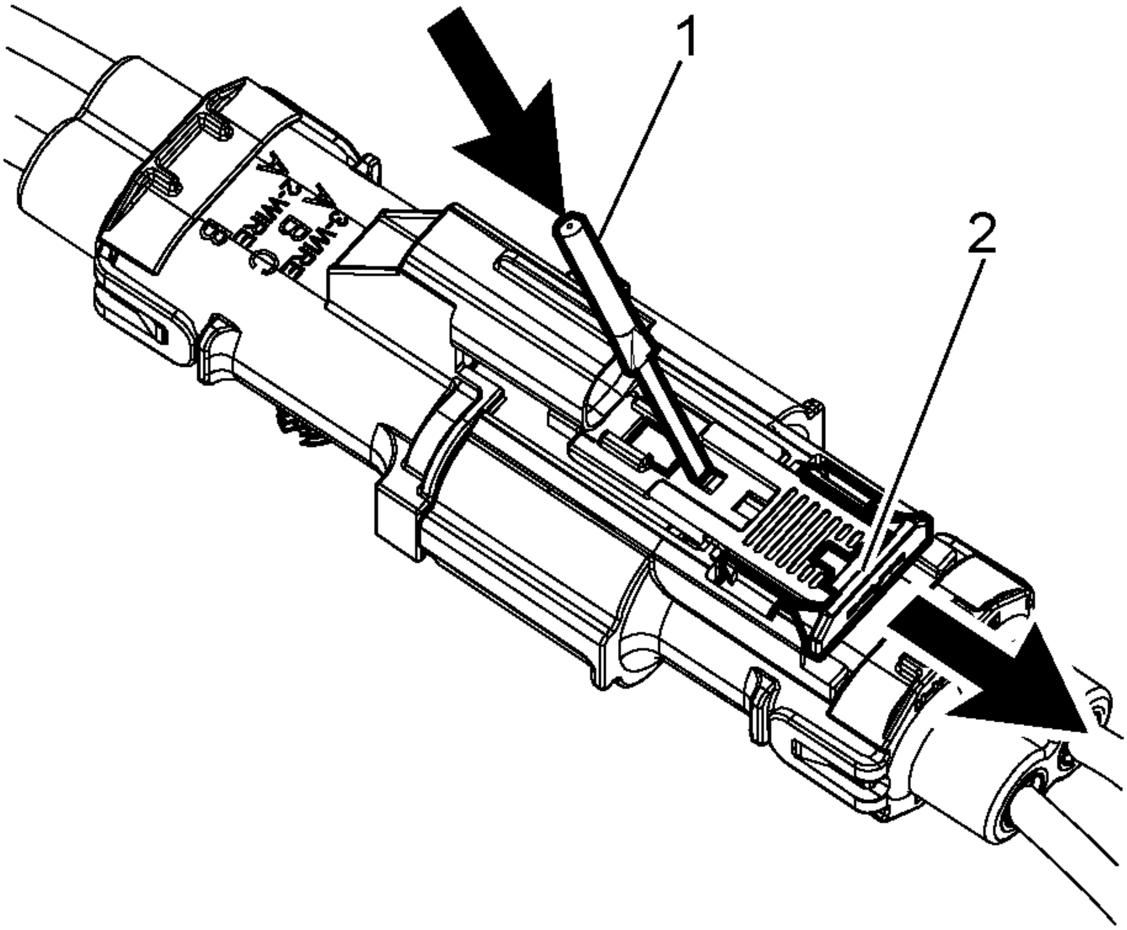


Fig. 19: Suitable Tool To Release Connector Position Assurance (CPA) Tab
Courtesy of GENERAL MOTORS COMPANY

1. Insert a suitable tool (1) and press firmly to release the connector position assurance (CPA) lock. Pull the CPA tab (2) back from the locked position to the pre-stage position. There will be an audible click sound when the CPA tab is in the correct position.

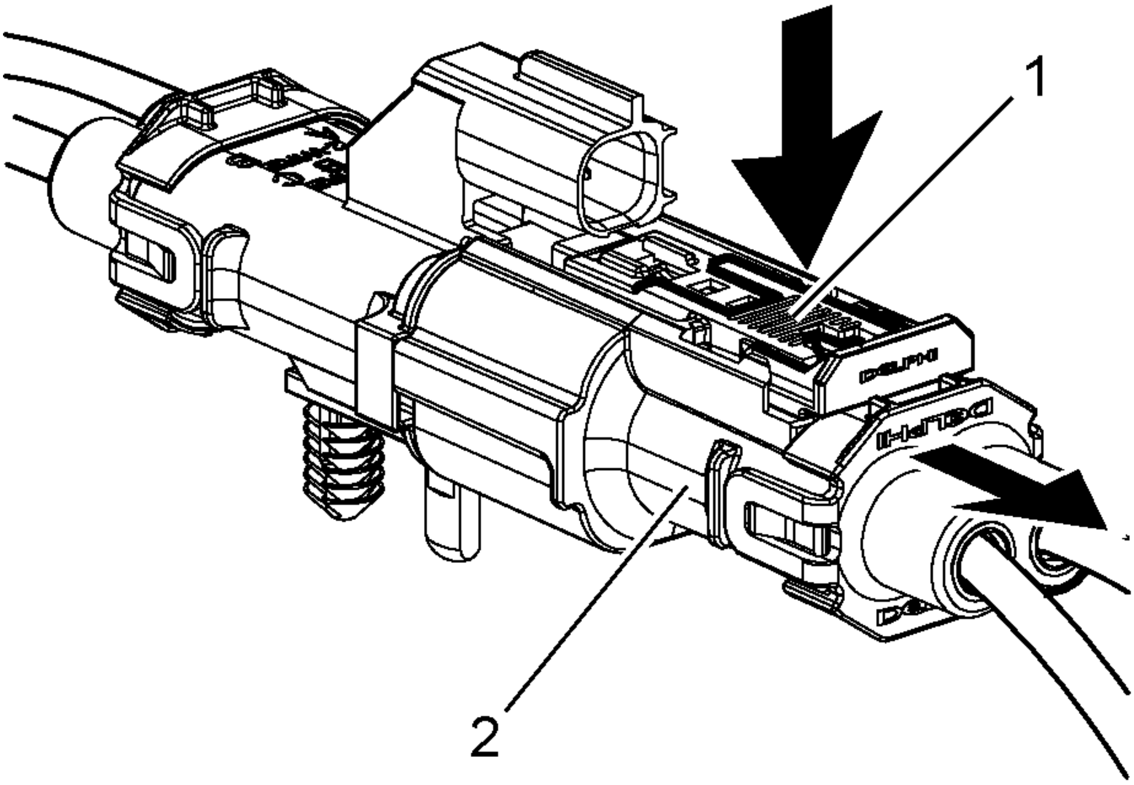


Fig. 20: Connector Lock And Female Connector
Courtesy of GENERAL MOTORS COMPANY

2. Depress the connector lock (1) and hold down. Keep the lock depressed and pull the female connector (2) apart to disconnect.

MP280 Connect Procedure

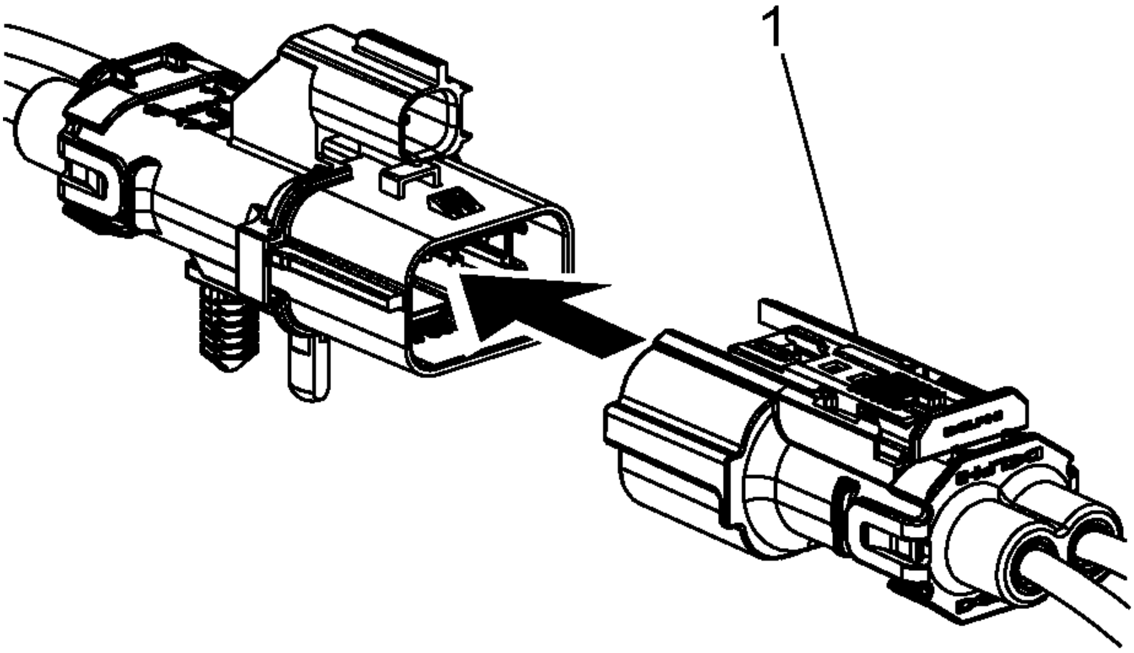
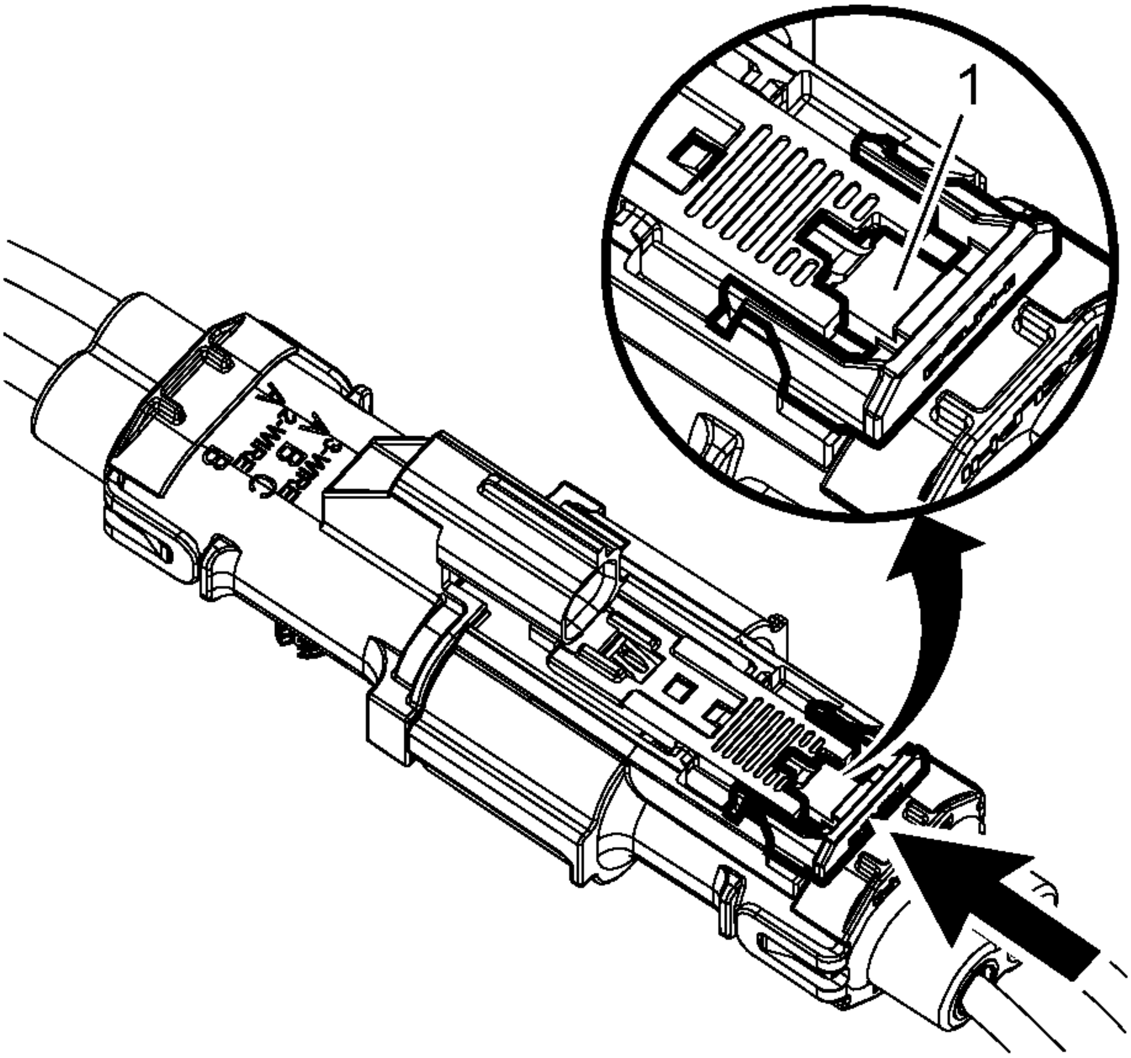


Fig. 21: Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Ensure the CPA tab is in the pre-stage position.**

1. Align the connector (1) with the index features and install the connector. There will be an audible click sound when the connector is in the correct position.

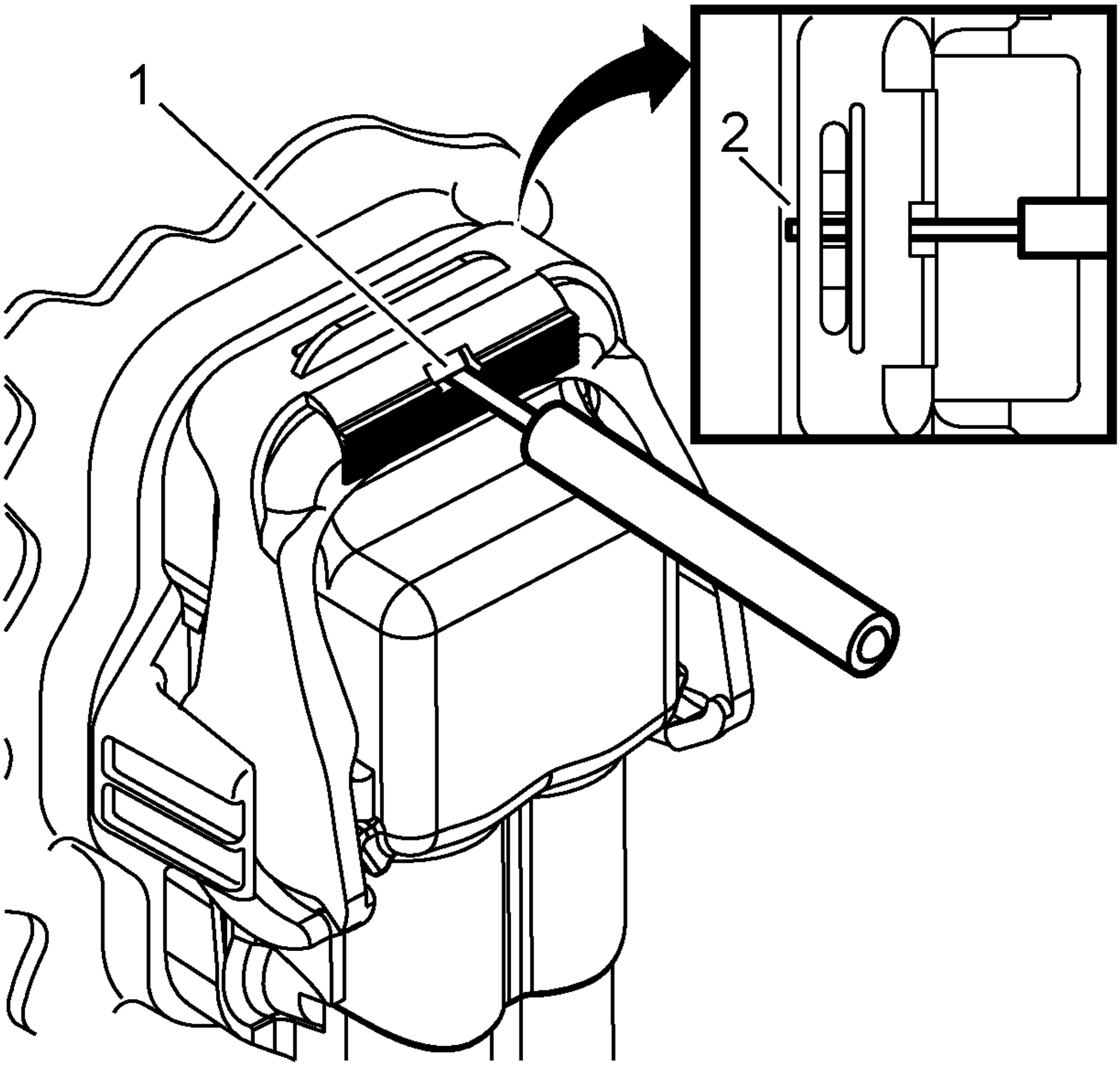


[Fig. 22: Connector Position Assurance (CPA) Tab](#)
Courtesy of GENERAL MOTORS COMPANY

2. Push the CPA tab (1) to lock the connector in the full-stage position. There will be an audible click sound when the CPA tab is in the correct position.

PP2000 90 NFS Connector Procedure

PP2000 90 NFS Disconnect Procedure



[Fig. 23: Using Tool Through Opening To Unlock Lever]

Courtesy of GENERAL MOTORS COMPANY

1. Place a suitable tool, such as a small flat-blade screwdriver, through the opening (1) at the front of the lever, and extend the tip down to near the base of the connector (2).
2. Rotate the tool slightly in either direction to unlock the lever.

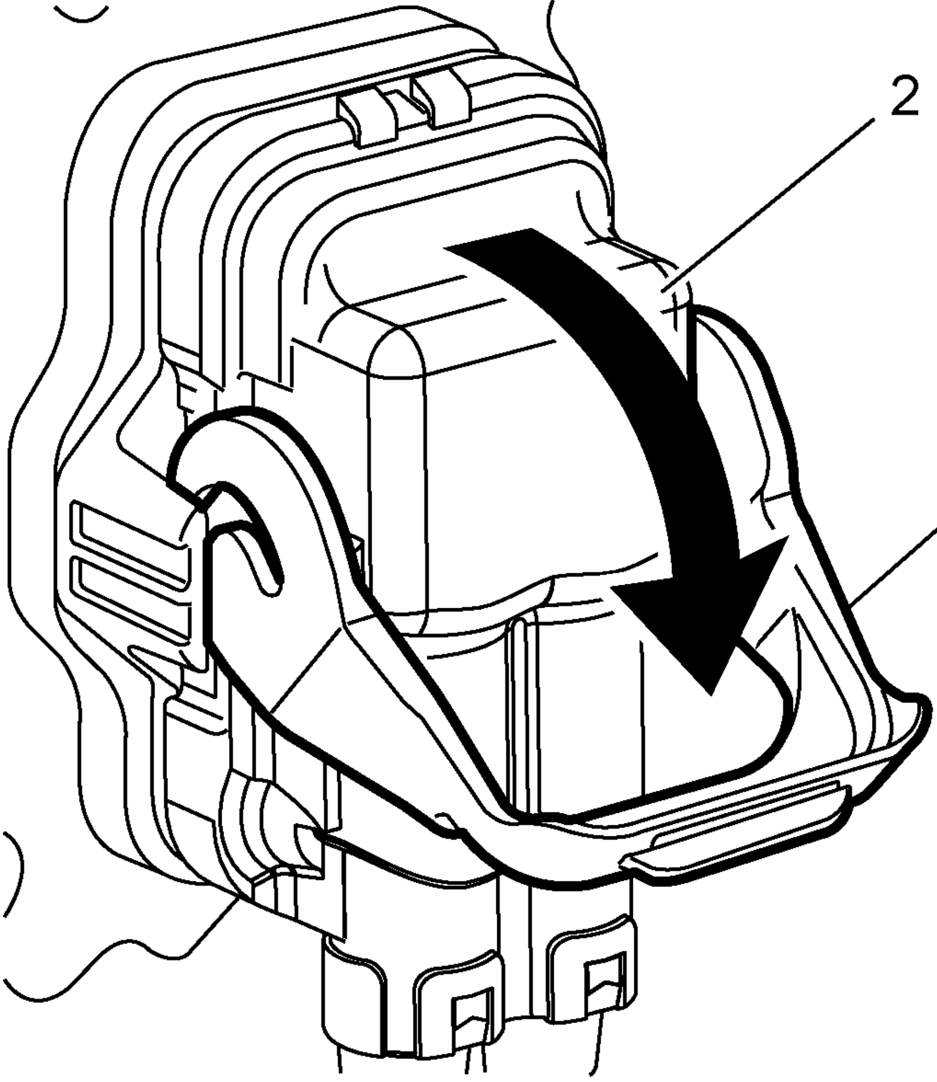


Fig. 24: Lever And Female Connector
Courtesy of GENERAL MOTORS COMPANY

3. Rotate the lever (1) to place the connector in a partial-mate position.
4. Remove the female connector (2) to complete the disconnection.

NOTE: **Always clean seal remnants from the connector with a non-marring tool.**

5. Inspect the High Voltage DC harness connector for seal residue or debris. Clean as necessary.
6. Inspect the High Voltage DC header connector seal for deformation or damage. Replace the DC connector header when seal damage is observed.

PP2000 90 NFS Connect Procedure

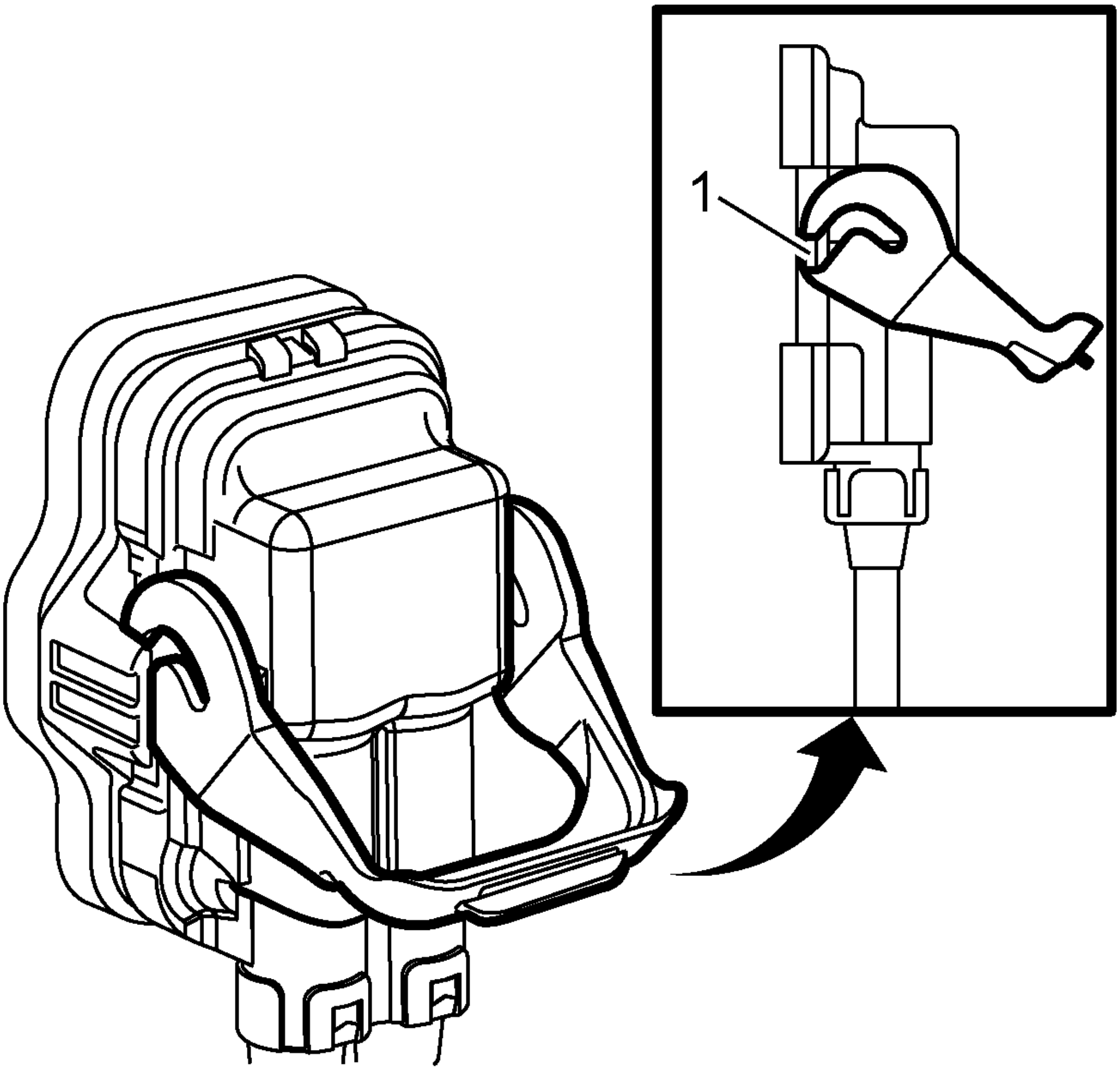


Fig. 25: Lever In Pre-Stage Assembly Position
Courtesy of GENERAL MOTORS COMPANY

1. Ensure the lever is in the pre-stage assembly position (1).

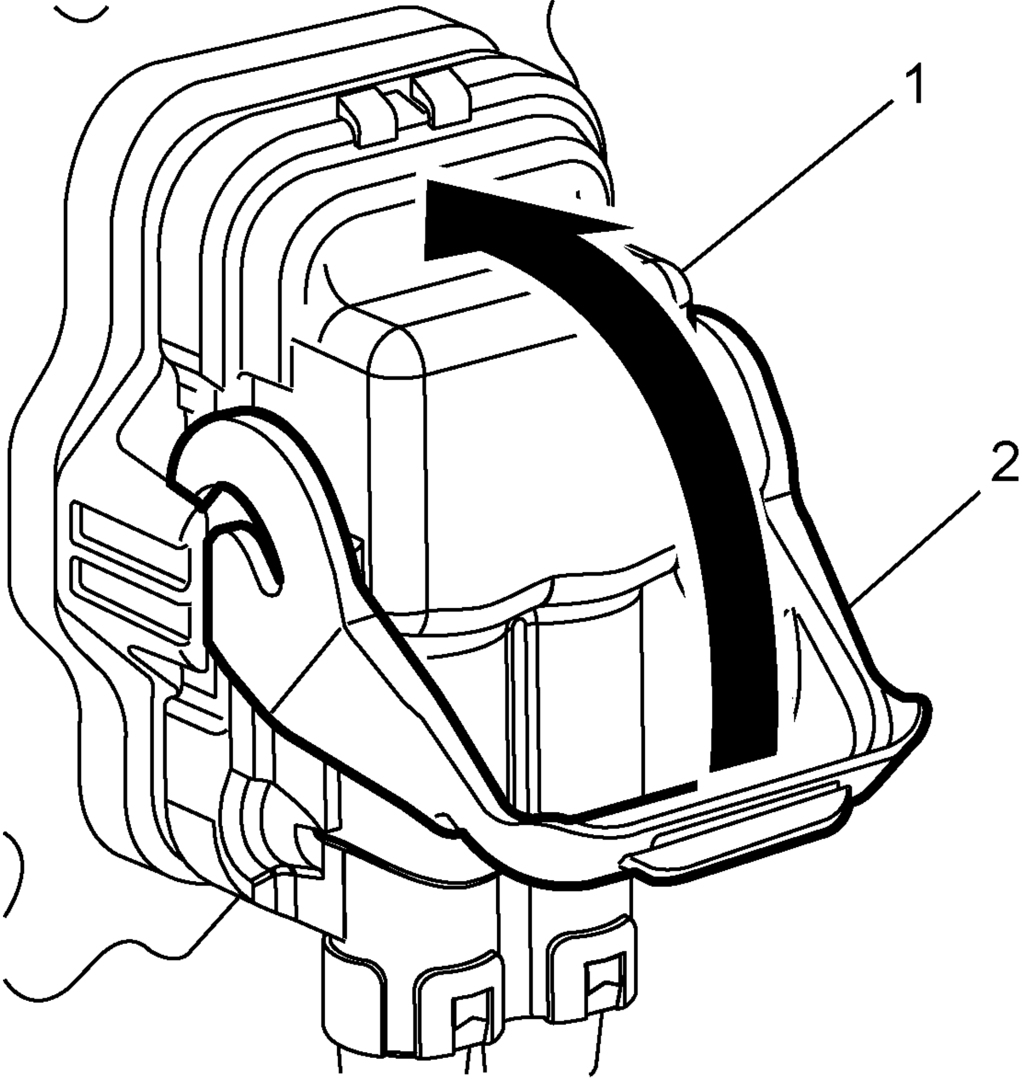


Fig. 26: Female Connector And Lever
Courtesy of GENERAL MOTORS COMPANY

2. Install the female connector (1) in the partial-mate position.
3. Rotate the lever (2) to place the connector in the full-mate position. There will be a very audible click sound when the lever locks in the full-stage position.

DTC P0A0C OR P0A0D: HIGH VOLTAGE SYSTEM INTERLOCK CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A0C

High Voltage System Interlock Circuit Low Voltage

DTC P0A0D

High Voltage System Interlock Circuit High Voltage

Circuit/System Description

A high voltage interlock circuit is used to determine if access to high voltage components or connectors is being attempted. The opening of these high voltage components causes the high voltage interlock circuit to open. The hybrid/EV powertrain control module 2 sources about 5 V on the high voltage interlock circuit 1 loop. When the hybrid/EV powertrain control module 2 detects a loss of high voltage interlock circuit current, the high voltage contactors are commanded open.

The high voltage interlock circuit monitors for integrity of the S15 Manual Service Disconnect.

Conditions for Running the DTC

P0A0C

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock circuit.

P0A0D

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 0 V on the high voltage interlock signal circuit.

  OR

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock signal circuit.

Conditions for Setting the DTC

P0A0C

The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is less than 30% of the commanded 5 V signal voltage.

P0A0D

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 24% of the commanded 0 V signal voltage for 62.5 ms.

  OR

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 44% of the commanded 5 V signal voltage for 75 ms.

Action Taken When the DTC Sets

- DTCs P0A0C and P0A0D are Type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTCs P0A0C and P0A0D are Type A DTCs.

Diagnostic Aids

- Test for a fully engaged hybrid battery pack high voltage S15 manual service disconnect whenever an open or intermittent high voltage interlock circuit condition is observed. The hybrid battery pack high voltage manual disconnect lever must be pressed down fully in order to completely engage the high voltage interlock circuit terminals.
- With all monitored high voltage components engaged and the High Voltage Interlock Circuit is Energized, observe the scan tool hybrid/EV powertrain control module 2 High Voltage Interlock Circuit Status parameter for a PASS status. To help identify intermittent conditions, manipulate the monitored components and inline connectors. An open interlock circuit will display a FAIL status.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

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- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

1. Verify all monitored high voltage components and connectors are connected.
2. Vehicle in Service Mode.
3. Observe the hybrid/EV powertrain control module 2 High Voltage Interlock Circuit Status parameter. Verify the parameter indicates a PASS condition.
    - **The parameter indicates a FAIL condition**

      Refer to Circuit/System Testing.

    - **The parameter indicates a PASS condition**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **An S15 Manual Service Disconnect that is not fully engaged may result in an intermittent DTC P0A0C.**

1. Disable high voltage at the A4 hybrid/EV battery pack. Refer to **High Voltage Disabling** procedure.
2. Verify that terminal 1 and terminal 2 of the S15 Manual Service Disconnect are not bent or broken and are OK.
   - **If not OK**

     Replace the S15 Manual Service Disconnect.

   - **If OK**
3. Test for 35 - 45 Ω between terminal 1 and terminal 2 of the S15 Manual Service Disconnect.
   - **If not within the specified range**

     Replace the S15 Manual Service Disconnect.

   - **If within the specified range**
4. With the S15 Manual Service Disconnect removed, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
5. Test for infinite resistance between each of the terminals listed below and ground;
   - Terminal 45
   - Terminal 47
   - **If less than infinite resistance**

     Repair the short to ground on the appropriate circuit.

   - **If infinite resistance**
6. Test for less than 10 Ω between the low reference circuit terminal 45 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 2 at the X21 Manual Service Disconnect Receptacle.
   - **If 10 Ω or greater**
   1. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
   2. Test for less than 10 Ω between the low reference circuit terminal 45 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 2 X358 harness connector.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω, replace the A4 Hybrid/EV Battery Pack internal harness.
   - **If less than 10 Ω**
7. Test for less than 10 Ω between the 5 V signal circuit terminal 47 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 1 at the X21 Manual Service Disconnect Receptacle.
   - **If not within the specified range**
   1. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
   2. Test for less than 10 Ω between the 5 V signal circuit terminal 47 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal 1 X358 harness connector.
      - If 10 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 10 Ω
   3. Replace the A4 Hybrid/EV Battery Pack internal harness.
   - **If within the specified range**
8. Install the S15 Manual Service Disconnect ensuring the lever is fully engaged.
9. Connect the 12 V battery. Vehicle in Service Mode.
10. Test for less than 1 V between terminals listed below and ground;
    - Terminal 45
    - Terminal 47
    - **If 1 V or greater**

      Repair the short to voltage in the circuit.

    - **If less than 1 V**
11. Vehicle OFF. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
12. Test for 35 - 45 Ω between the 5 V signal circuit terminal 1 and low reference terminal 2 X358 harness connector.
    - **If not within the specified range**

      Replace the A4 Hybrid/EV Battery Pack internal harness.

- **If within the specified range**

13. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement** for S15 Manual Service Disconnect
- Refer to **Drive Motor Battery Control Module Wiring Harness Replacement** for A4 Hybrid/EV Battery Pack internal harness
- Refer to **Control Module References** for K114B Hybrid/EV Powertrain Control Module 2 replacement, programming and setup.

DTC P0A7F: HYBRID/EV BATTERY PACK LIFE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0A7F

Hybrid/EV Battery Pack Life

Circuit/System Description

The hybrid/EV powertrain control module 2 calculates the high voltage battery pack capability and determines the high voltage battery pack end of life.

Conditions for Running the DTC

- Vehicle ON.
- The system voltage is at least 10.2 V.
- Hybrid battery temperature is greater than 20Â°C (68Â°F).
- Hybrid battery temperature is less than 50Â°C (122Â°F).
- Hybrid battery state of charge is between 30% and 100%.
- When the hybrid/EV powertrain control module 2 calculates the actual battery power has exceeded the power limits multiplied by seconds of duration is greater than 50%.
- None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0ABB, P0ABC, P0ABD, P0AC1, P0AC2, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0AF8, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36, P1A07, P1E8E, P1E8F, P1E90, P1E91, P1E93, P1E94, P1E95, P1E96, P1E97, P1E99, P1E9A, P1E9B, P1E9C, P1E9D, P1E9F, P1EA0, P1EA1, P1EA2, P1EA3, P1EA5, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, P1EBA, P1EBB, U0111, U185A, U2401, U2603, U2604, U2605, or U2606.

Conditions for Setting the DTC

- Battery voltage and current is varying. Requires more than 10 minutes of city driving.
- When the hybrid/EV powertrain control module 2 calculates the power limits is less than the KW end of life power threshold.

Action Taken When the DTC Sets

DTC P0A7F is a type B DTC.

Conditions for Clearing the DTC

DTC P0A7F is a type B DTC.

Diagnostic Aids

Removing the manual service disconnect without being specifically instructed to do so during the High Voltage Disabling procedure may cause a DTC P0A7F to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

NOTE: **Removal of the manual service disconnect outside of the High Voltage Disabling procedure may cause a DTC P0A7F to set.**

1. Verify that no other DTCs are set.

    - **If any other DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **No other DTCs are set**
2. Verify DTC P0A7F is set.
    - **If DTC P0A7F is set**
    1. Clear the DTC. Vehicle OFF, disconnect the 12 V battery. Refer to **Battery Negative Cable Disconnection and Connection**
    2. Wait 30 seconds. Reconnect the 12 V battery. Refer to **Battery Negative Cable Disconnection and Connection**
    3. Review and operate the vehicle according to the DTC Conditions for Running. Operate the vehicle for more than 10 minutes of city driving.
    4. Verify that DTC P0A7F does not reset.
        - If DTC P0A7F resets
        1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
        2. Remove the A4 Hybrid/EV Battery Pack cover. Refer to **Battery Upper Cover Replacement** .
        3. Inspect all internal high voltage busbar/cable terminals for arc-flash damage.
            - If high voltage terminal damage is present, replace the effected components.
            - If high voltage terminal damage is not present, replace the A4 hybrid/EV battery pack.
        - If DTC P0A7F does not reset
    5. All OK.
    - **If DTC P0A7F is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, OR P1EC3: HYBRID/EV BATTERY OR BATTERY CHARGING SYSTEM

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0AA1

Hybrid/EV Battery Positive Contactor Circuit Stuck Closed

DTC P0AA4

Hybrid/EV Battery Negative Contactor Circuit Stuck Closed

DTC P0AD9

Hybrid/EV Battery Positive Contactor Control Circuit

DTC P0ADD

Hybrid/EV Battery Negative Contactor Control Circuit

DTC P0AE4

Hybrid/EV Battery Precharge Contactor Control Circuit

DTC P0D0A

Battery Charging System Positive Contactor Control Circuit

DTC P0D09

Battery Charging System Positive Contactor Stuck Open

DTC P1EBD

Battery Charging System Contactor(s) Stuck Open

DTC P1EC0

Hybrid/EV Battery System Contactor(s) Stuck Open

DTC P1EC3

Hybrid/EV Battery Pack Heater Transistor Control Circuit

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. A transistor within the T24 Battery Charger controls the battery heater high voltage negative circuit. The contactors and transistor close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for each high voltage contactor/transistor. Ground is provided through a vehicle ground external of the high voltage battery.

Conditions for Running the DTC

P0AA1

- The main negative contactor is open.
- The main positive contactor has been open for more than 2 minutes.
- The charger positive contactor has been open for more than 2 minutes.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P0AF8, or P1A07.

P0AA4

- The main negative contactor is open.
- The main positive contactor has been open for more than 2 minutes.
- The charger positive contactor has been open for more than 2 minutes.

P0AD9, P0ADD, P0AE4, P0D0A, P1EC3 and P1EBD

The 12 V battery voltage is greater than 10.2 V.

P0D09

- The precharge contactor is closed.
- The negative contactor is open.
- The charger contactor is closed.
- Negative bus voltage is greater than 40 V.

P1EC0

- The 12 V battery voltage is greater than 10.2 V.
- The main positive and negative contactors have been closed.
- The charger positive contactor is closed.
- None of the following DTCs are set; P1AE8, P1AE9, or P1AEC.

Conditions for Setting the DTC

P0AA1

The positive bus voltage is greater than 30 V.

P0AA4

The negative bus voltage is greater than 30 V.

P0AD9, P0ADD and P0D0A

The hybrid/EV powertrain control module 2 has detected an open or short to voltage in the control circuit for the corresponding contactor.

P0AE4

The hybrid/EV powertrain control module 2 has detected a short to voltage in the control circuit.

P0D09

The battery charger sensed voltage is less than 10 V.

P1EBD

The battery charger sensed voltage is less than 80% of hybrid/EV battery voltage.

P1EC0

The main bus voltage is less than 80% of hybrid/EV battery voltage.

P1EC3

The hybrid/EV powertrain control module 2 has detected an open, short to ground or short to voltage in the heater transistor control circuit.

Actions Taken When the DTC Sets

- DTCs P0D09, P1EBD, or P1EC0 are type A DTCs.
- DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 are type B DTCs.

Conditions for Clearing the DTC

- DTCs P0D09, P1EBD, or P1EC0 are type A DTCs.
- DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 are type B DTCs.

Diagnostic Aids

DTC P1EC3 will prevent battery heating and the vehicle will be unable to start in cold weather with battery temperatures below -25Â°C (-13Â°F).

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

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- Wiring Repairs

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Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 is not set.
    - **If any of the DTCs are set**

      Refer to Circuit/System Testing, specific to the DTC or DTCs set.

    - **If none of the DTCs are set**
3. Verify that DTC P0AA1 and/or P0AA4 is set without any of the above contactor Control Circuit DTCs.
    - **If the DTC is set**

      Replace the A28 Hybrid/EV Battery Contactor Assembly.

    - **If the DTC is not set**
4. Connect the drive motor battery charger cable. Verify DTC P0D26 is not set and the vehicle will charge.
    - **If the DTC is set and the vehicle will not charge**

      Refer to DTC P0D26 .

    - **If the DTC is not set and the vehicle charges**
5. Verify that DTC P0C78 is not set.
    - **If the DTC is set**

      Refer to DTC P0C78 or P3061.

    - **If the DTC is not set**

NOTE: **The following setup steps must be performed exactly in order to exercise the contactors.**

6. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
7. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: **The parking lamps must remain ON throughout the remainder of the contactor steps.**

8. Turn ON the parking lamps.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode.**

9. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.
10. Disconnect the S15 Manual Service Disconnect.

NOTE: **DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.**

11. Command the Hybrid/EV Battery Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
12. Verify the Hybrid/EV Battery Negative Contactor should be heard closing and opening.
    - **If the Hybrid/EV Battery Negative Contactor does not open and close**

    Refer to Circuit/System Testing.

   - **If the Hybrid/EV Battery Negative Contactor does open and close**

13. Command the Hybrid/EV Battery Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
14. Verify the Hybrid/EV Battery Positive Contactor should be heard closing and opening.
    - **If the Hybrid/EV Battery Positive Contactor does not open and close**

      Refer to Circuit/System Testing.

    - **If the Hybrid/EV Battery Positive Contactor does open and close**
15. Command the Hybrid/EV Battery Precharge Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
16. Verify the Hybrid/EV Battery Precharge Contactor should be heard opening and closing.
    - **If the Hybrid/EV Battery Precharge Contactor does not open and close**

      Refer to Circuit/System Testing.

    - **If the Hybrid/EV Battery Precharge Contactor does open and close**
17. Command the Hybrid/EV Battery Charger Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
18. Verify the Hybrid/EV Battery Charger Contactor should be heard opening and closing.
    - **If the Hybrid/EV Battery Charger Contactor does not open and close**

      Refer to Circuit/System Testing.

    - **If the Hybrid/EV Battery Charger Contactor does open and close**
19. All OK.

Circuit/System Testing

NOTE: **You must perform Circuit/System Verification before proceeding.**

DTC P0AD9, P0ADD, P0AE4, or P0D0A Contactor Diagnosis

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
   - **If more than 10 Ω**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
5. Verify that a test lamp illuminates between the A4 Hybrid/EV Battery Pack harness B+ circuit terminal 1 X357 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
     1. Vehicle OFF.
     2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
     1. Vehicle OFF.
     2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K16 Battery Energy Control Module and hybrid/EV battery pack internal wiring harness.

- **If the test lamp illuminates**

6. Vehicle in Service Mode.
7. Verify that a test lamp does not illuminate between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:
   - Terminal 3 X358
   - Terminal 4 X358
   - Terminal 5 X358
   - Terminal 7 X358
   - **If the test lamp illuminates on any circuit**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
   - **If the test lamp does not illuminate on all circuits**
8. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
9. Test for infinite resistance between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:
   - Terminal 3 X358
   - Terminal 4 X358
   - Terminal 5 X358
   - Terminal 7 X358
   - **If less than infinite resistance on either circuit**

     Repair the short to ground on the circuit.

   - **If infinite resistance on both circuits**
10. Test for less than 2 Ω between the harness connector terminals listed below:
    - Terminal 3 X358 at the A4 Hybrid/EV Battery Pack and terminal 9 X1 at the K114B Hybrid Powertrain Control Module 2
    - Terminal 4 X358 at the A4 Hybrid/EV Battery Pack and terminal 6 X1 at the K114B Hybrid Powertrain Control Module 2
    - Terminal 7 X358 at the A4 Hybrid/EV Battery Pack and terminal 8 X1 at the K114B Hybrid Powertrain Control Module 2
    - Terminal 5 X358 at the A4 Hybrid/EV Battery Pack and terminal 3 X1 at the K114B Hybrid Powertrain Control Module 2
    - **If 2 Ω or greater on any circuit**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω on all circuits**
11. Replace the A28 Hybrid/EV Battery Contactor Assembly.
12. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, P0D09, P1EBD, P1EC0, P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If any of the DTCs set**

      Replace the K114B Hybrid Powertrain Control Module 2.

    - **If none of the DTCs are set**
13. All OK.

P1EC3 - Hybrid/EV Battery Pack Heater Transistor Diagnosis

1. Vehicle OFF, disconnect the X9 low voltage harness connector at the T24 Battery Charger.
2. Vehicle in Service Mode.
3. Verify that a test lamp does not illuminate between the T24 Battery Charger harness control circuit terminal 6 and ground.
   - **If the test lamp illuminates**

    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
  - **If the test lamp does not illuminate**
4. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
5. Test for infinite resistance between the T24 Battery Charger harness control circuit terminal 6 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**

      Test for less than 2 Ω in the control circuit end to end.

    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
6. Replace the T24 Battery Charger.
7. Verify that DTC P1EC3 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC is set**

      Replace the K114B Hybrid Powertrain Control Module 2.

    - **If the DTC is not set**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **High Voltage Battery Disconnect Relay Replacement** for A28 Hybrid/EV battery contactor assembly replacement.
- Refer to **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)** **High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)** for T24 battery charger replacement.
- Refer to **Control Module References** for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0AA6 OR P1AE6: HYBRID/EV BATTERY AND/OR BATTERY ENERGY CONTROL MODULE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0AA6

Hybrid/EV Battery Voltage System Isolation Lost

DTC P1AE6

Battery Energy Control Module Hybrid/EV Battery Voltage Isolation Sensor Circuit

Circuit/System Description

The vehicle is equipped with a high voltage isolation monitor feature. The purpose of the battery energy control module high voltage isolation monitor circuit is to test the resistance between the high voltage positive and negative direct current (DC) bus and chassis ground. The battery energy control module isolation monitoring method is sometimes referred to as the active isolation monitor. The hybrid powertrain control module 2 requests the battery energy control module to perform this test. Measurement values are reported to the hybrid powertrain control module 2, which makes the determination of an isolation fault.

The isolation check for P0AA6 Hybrid Battery Voltage System Isolation Lost runs when all the contactors are open. This check monitors isolation in the battery system. This check runs only once during the time that the hybrid powertrain control module 2 is awake and runs after the contactors have been open for 35 seconds. This monitor typically runs when the vehicle is turned off after a drive. It could also run when the vehicle is first started, if there is a long enough period between the hybrid powertrain control module 2 waking up and the main contactors closing.

The battery energy control module runs an internal self check of this sensor circuit. When this test fails, DTC P1AE6 will be set.

Conditions for Running the DTC

P0AA6

- The hybrid powertrain control module 2 and battery energy control module are awake and communicating
- All the contactors have been open for 35 s.

P1AE6

- The 12 V battery voltage is greater than 9 V.
- The hybrid powertrain control module 2 and battery energy control module are awake and communicating.
- The hybrid powertrain control module 2 has requested the battery energy control module to run the isolation test.
- The main contactors are open.
- DTC U185B is not set.

Conditions for Setting the DTC

P0AA6

- The battery energy control module has detected active isolation resistance is less than 265K Ω if P0AA6 has not failed, or less than 318K Ω if P0AA6 has failed at least once.
- 5 out of 10 tests have failed, one test is run per Hybrid/EV powertrain control module 2 wake-up cycle.

P1AE6

The battery energy control module has detected a fault with the active isolation sensing circuits.

Actions Taken When the DTC Sets

P0AA6 and P1AE6 are Type A DTCs.

Conditions for Clearing the DTC

- P0AA6 and P1AE6 are Type A DTCs.
- P0AA6 requires one passing test at greater than 318K Ω resistance.

Diagnostic Aids

- A single high voltage contactor stuck closed may set this DTC.
- Liquid intrusion into the hybrid/EV battery pack may cause P0AA6 or P1AE6 to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

1. Verify that DTC P0A7E, P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0C32, P0D0A, P0D09, P1EBD, P1EC0 or P1EC3 is not set.
    - **If any DTC is set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If none of the DTCs are set**
2. Verify that DTC P1AE6 is set and P0AA6 is not set.
    - **If DTC P1AE6 is set without DTC P0AA6**
    1. Verify the K114B Hybrid Powertrain Control Module 2 has the latest calibration in Calibration Information.
        - If the K114B Hybrid Powertrain Control Module 2 does not have the latest calibration, program the K114B Hybrid Powertrain Control Module 2 first, and then also replace the K16 Battery Energy Control Module.
        - If the K114B Hybrid Powertrain Control Module 2 has the latest calibration
    2. Replace the K16 Battery Energy Control Module.
    - **If both DTCs are set, or only DTC P0AA6 is set**
3. Verify with a scan tool the hybrid powertrain control module 2, Isolation Test Resistance parameter is greater than 318k Ω.
    - **If the parameter is 318k Ω or less**

      Refer to Circuit/System Testing.

    - **If the parameter is greater than 318k Ω**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
2. Replace the A4 Hybrid/EV Battery Pack.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)** for A4 Hybrid/EV Battery Pack replacement.
- Refer to **Control Module References** for K16 battery energy control module replacement, programming and setup.

DTC P0ABB, P0ABC, OR P0ABD: HYBRID/EV BATTERY VOLTAGE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0ABB

Hybrid/EV Battery Voltage Sensor Performance

DTC P0ABC

Hybrid/EV Battery Voltage Sensor Circuit Low Voltage

DTC P0ABD

Hybrid/EV Battery Voltage Sensor Circuit High Voltage

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors individual cell voltage readings from the battery energy control module. The battery energy control module monitors the voltage of the 96 battery cell groups. Voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on each end of the of the battery module. A voltage sense harness joins this connector to the battery energy control module.

Conditions for Running the DTC

P0ABB

- The hybrid/EV powertrain control module 2 and battery energy control module are awake and communicating.
- No other DTCs are set.

P0ABC and P0ABD

- The hybrid/EV powertrain control module 2 and battery energy control module are awake and communicating.

- The 12 V battery voltage is greater than 10.2 V.
- DTC P1A07 is not set.

Conditions for Setting the DTC

P0ABB

The hybrid/EV powertrain control module 2 detects difference of 12 V between the average cell group voltage multiplied by 96 and the voltage measured at battery side of the main contactors.

P0ABC

The battery energy control module detects the terminal voltage is less than 24 V on the battery side of the main contactors.

P0ABD

The battery energy control module detects the terminal voltage is greater than 479 V on the battery side of the main contactors.

Actions Taken When the DTC Sets

- DTCs P0ABB, P0ABC, and P0ABD are Type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P0ABB, P0ABC, and P0ABD are Type A DTCs.

Diagnostic Aids

- The hybrid/EV battery pack high voltage manual service disconnect is out, not installed correctly, or a blown manual service disconnect fuse may cause P0ABB and/or P0ABC to set.
- The hybrid/EV battery pack high voltage manual service disconnect was removed, out of sequence, or was out during a service procedure with the 12 V battery connected may cause P0ABB and/or P0ABC to set.

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

- The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-63** Pinout Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set.
   - **If any DTCs are set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle

   - **If no other DTCs are set**
3. Verify and record with a scan tool, the battery energy control module Hybrid Battery Pack Terminal 1 Voltage parameter and the hybrid/EV powertrain control module 2 Hybrid Battery Pack Voltage parameters are between 205 - 419 V and within 12 V of each other.
   - **If not within the specified range and not within 12 V of each other**

     Refer to Circuit/System Testing.

   - **If within the specified range and within 12 V of each other**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**
2. Remove the S15 Manual Service Disconnect.
3. Test for less than 10 Ω across the S15 Manual Service Disconnect fuse terminals.
    - **If 10 Ω or greater**

      Replace the S15 Manual Service Disconnect.

    - **If less than 10 Ω**
4. Remove the A4 hybrid/EV battery pack cover. Refer to **Battery Upper Cover Replacement** .

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

5. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
6. Inspect the harness connectors and the K16 battery energy control module connectors for corrosion.
    - **If corrosion is present**

      Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module as applicable.

    - **If corrosion is not present**

NOTE: **The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group.**

7. Disconnect the harness connectors at C5A Hybrid/EV Battery Module 1 and C5J Hybrid/EV Battery Module 10.
8. Inspect the harness connectors and the appropriate C5A and C5J Hybrid/EV Battery module connectors for corrosion.
    - **If corrosion is present**

      Replace the A4 Hybrid/EV Battery Pack Internal Harness and the C4A Hybrid/EV Battery Section 1.

    - **If corrosion is not present**
9. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-63** adapter to the C5A Hybrid/EV Battery Module 1 connectors. Refer to **EL-48571 High Voltage Battery Pin Out Box Reference** for proper X1, X2 orientation.
10. Insert the DMM probes into the **EL-48571** High Voltage Battery Pin Out Box test cavities.
11. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** High Voltage Battery Pin Out Box through each of the switch positions. Refer to **EL-48571 High Voltage Battery Pin Out Box Reference**.
12. Verify each cell group voltage reading is between 3.28-4.16 V.
    - **If not within the specified range**

      Replace the C4A Hybrid/EV Battery Section 1.

    - **If within the specified range**
13. Verify each cell group voltage reading is within 0.03 V of each other.
    - **If greater than 0.03 V**

      Replace the C4A Hybrid/EV Battery Section 1.

- **If 0.03 V or less**

14. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-63** adapter to the C5J Hybrid/EV Battery Module 10 connectors. Refer to **EL-48571 High Voltage Battery Pin Out Box Reference** for proper X1, X2 orientation.
15. Insert the DMM probes into the **EL-48571** High Voltage Battery Pin Out Box test cavities.
16. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** High Voltage Battery Pin Out Box through each of the switch positions. Refer to **EL-48571 High Voltage Battery Pin Out Box Reference**.
17. Verify each cell group voltage reading is between 3.28-4.16 V.
    - **If not within the specified range**

      Replace the C4A Hybrid/EV Battery Section 1.

    - **If within the specified range**
18. Verify each cell group voltage reading is within 0.03 V of each other.
    - **If greater than 0.03 V**

      Replace the C4A Hybrid/EV Battery Section 1.

    - **If 0.03 V or less**
19. Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cell Battery Module Replacement (Row 1)** **Cell Battery Module Replacement (Row 2)** **Cell Battery Module Replacement (Row 3)** **Cell Battery Module Replacement (Row 4)** **Cell Battery Module Replacement (Row 5)** for C4A Hybrid/EV Battery Section 1 replacement.
- Refer to **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)** **Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)** **Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)** **Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)** for Hybrid/EV Battery Pack Internal Harness replacement.
- Refer to **Control Module References** for K16 battery energy control module replacement, programming and setup.

DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, OR P1EBB: HYBRID/EV BATTERY LOW/HIGH RESOLUTION CURRENT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AC1

Hybrid/EV Battery Low Resolution Current Sensor Circuit Low Voltage

DTC P0AC2

Hybrid/EV Battery Low Resolution Current Sensor Circuit High Voltage

DTC P0B10

Hybrid/EV Battery High Resolution Current Sensor Circuit Low Voltage

DTC P0B11

Hybrid/EV Battery High Resolution Current Sensor Circuit High Voltage

DTC P0B13

Hybrid/EV Battery Low Resolution Current Sensor - High Resolution Current Sensor Not Plausible

DTC P1EBA

Hybrid/EV Battery Low Resolution Current Sensor Exceeded Learning Limit

DTC P1EBB

Hybrid/EV Battery High Resolution Current Sensor Exceeded Learning Limit

Circuit/System Description

The hybrid/EV battery current sensor is mounted inside the hybrid/EV battery pack. The negative high voltage cable that goes to the main contactor relay passes through the hybrid/EV battery pack current sensor. The hybrid/EV battery pack current sensor detects the amperage that flows in and out of the hybrid/EV batteries. The battery energy control module supplies and monitors a 5 V reference signal to the hybrid/EV battery pack current sensor. The hybrid/EV battery pack current sensor returns a signal between 0 and 5 V to the battery energy control module. The hybrid/EV battery pack current sensor signal is in proportion to the amperage going in and out of the hybrid/EV battery pack. The hybrid/EV battery pack current sensor has 2 measurement ranges in order to maintain accuracy. The ranges are low resolution and high resolution. The measurement ranges of the hybrid/EV battery pack current sensor have some overlap with each other. A signal voltage of the high resolution hybrid/EV battery pack current sensor greater than 2.5 V indicates that the hybrid/EV battery is being charged, and a signal voltage less than 2.5 V indicates discharging. A signal voltage of the low resolution hybrid/EV battery pack current sensor greater than 3.24 V indicates that the hybrid/EV battery is being charged and a signal voltage less than 3.24 V indicates discharging. The high resolution measures from -20 to +20 A. The low resolution measures from -500 to +230 A.

Conditions for Running the DTC

P0AC1, P0AC2, P0B10, and P0B11

- The 12 V battery voltage is greater than 10.2 V.
- The battery energy control module is awake and communicating.

P0B13

- The hybrid/EV battery low resolution current sensor or the hybrid/EV battery high resolution current sensor value is between -20 and +20 A.
- None of the following DTCs are set: P0AC1, P0AC2, P1EBA, P0B10, P0B11, P1EBB, U0111, U185A.

P1EBA and P1EBB

- Runs during battery energy control module initialization.
- The 12 V battery voltage is greater than 10.2 V.
- The high voltage main and charger contactors are open (during wake-up).
- DTC U185B is not set.

Conditions for Setting the DTC

P0AC1

The battery energy control module detects that the hybrid/EV battery pack current sensor low resolution is less than -555 A.

P0AC2

The battery energy control module detects that the hybrid/EV battery pack current sensor low resolution is greater than +285 A.

P0B10

The battery energy control module detects that the hybrid/EV battery pack current sensor high resolution is less than -23 A.

P0B11

The battery energy control module detects that the hybrid/EV battery pack current sensor high resolution is greater than +23 A.

P0B13

The difference between the Hybrid/EV Battery's low resolution current sensor value and its high resolution current sensor value is greater than 10 A.

P1EBA

The battery energy control module detects that the Pack Current Low Resolution Offset is greater than the calibration Low Resolution Offset of 8 A.

P1EBB

The battery energy control module detects that the Pack Current High Resolution Offset is greater than the calibration High Resolution Offset of 2.5 A.

Action Taken When the DTC Sets

- DTC P0AC1, P0AC2, P0B10, P0B11, P1EBA and P1EBB are type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTC P0AC1, P0AC2, P0B10, P0B11, P1EBA and P1EBB are type A DTCs.

Diagnostic Aids

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

Refer to **Battery Energy Control Module Replacement** .

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50214** Low Voltage Jumper Harness Extension

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle in Service Mode, all accessories OFF.

   NOTE: **Typical current in a parked vehicle with the Vehicle in Service Mode and all accessories OFF is between 1 A and 10 A.**

2. Verify the scan tool battery energy control module Hybrid/EV Battery Pack Low Resolution Current Sensor parameter is between -555 A and +285 A and changes with the amount of current draw on the hybrid/EV battery pack.
   - **If not within the specified range**

     Refer to Circuit/System Testing.

   - **If within the specified range**

   NOTE: **Typical current in a parked vehicle with the Vehicle in Service Mode and all accessories OFF is between 1 A and 10 A.**

3. Verify the scan tool Hybrid/EV Battery Pack High Resolution Current Sensor parameter is between -23 A and +23 A, and changes with the amount of current draw on the hybrid/EV battery pack.
   - **If not within the specified range**

     Refer to Circuit/System Testing.

   - **If within the specified range**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
2. Remove the A4 Hybrid/EV Battery Pack cover. Refer to **Battery Upper Cover Replacement** .

3. Connect the **EL-50214** low voltage jumper harness extension.
4. Disconnect the A28 Hybrid/EV Battery Contactor Assembly connector.
5. Connect the 12 V battery, vehicle OFF.
6. Test for less than 10 Ω between the low reference circuit terminal 13 and ground.
   - **If 10 Ω or greater**
     1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module.
     2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
   - **If less than 10 Ω**
7. Vehicle in Service Mode.
8. Test for 4.8 - 5.5 V between the 5 V reference circuit terminal 12 and ground.
   - **If less than 4.8 V**
     1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module.
     2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
     3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
   - **If greater than 5.5 V**
     1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module, vehicle in Service Mode.
     2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
   - **If within the specified range**
9. Verify the scan tool Hybrid/EV Battery Pack High Resolution Current Sensor parameter is less than 0 A.
   - **If 0 A or greater**
     1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module, vehicle in Service Mode.
     2. Test for less than 1 V between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 14 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
   - **If less than 0 A**
10. Install a 3 A fused jumper wire between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 14 and the 5 V reference circuit terminal 12.
11. Verify the scan tool Hybrid/EV Battery Pack High Resolution Current Sensor parameter is greater than 0 A.
    - **If 0 A or less**
      1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module.
      2. Test for infinite resistance between the signal circuit and ground.
         - If less than infinite resistance, repair the short to ground on the circuit.
         - If infinite resistance
      3. Test for less than 2 Ω in the signal circuit end to end.
         - If 2 Ω or greater, repair the open/high resistance in the circuit.

    - If less than 2 Ω, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
  - **If greater than 0 A**

12. Verify the scan tool Hybrid/EV Battery Pack Low Resolution Current Sensor parameter is less than 100 A.
    - **If 100 A or greater**
    1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 11 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
    - **If less than 100 A**
13. Install a 3 A fused jumper wire between the A28 Hybrid/EV battery contactor assembly connector signal circuit terminal 11 and the 5 V reference circuit terminal 12.
14. Verify with a scan tool, the Hybrid/EV Battery Pack Low Resolution Current Sensor parameter is greater than 100 A.
    - **If less than 100 A**
    1. Vehicle OFF, disconnect the X7 harness connector at the K16 Battery Energy Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
    - **If 100 A or greater**
15. Replace the B30 Hybrid/EV Battery Pack Current Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **High Voltage Battery Disconnect Relay Replacement** for B30 Hybrid/EV Battery Pack Current Sensor replacement
- Refer to **Drive Motor Battery Control Module Wiring Harness Replacement**
- Refer to **Control Module References** for K16 battery energy control module replacement, programming, and setup.

DTC P0AF8: HYBRID SYSTEM VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AF8

Hybrid System Voltage

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the side of the battery cell module. A voltage sense harness joins this connector to the battery energy control module.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

- The hybrid/EV battery main contactors are closed.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P1A07, P1AE8, P1AE9, P1AEA, P1AEB, P1AEC, P1AED, P1E20, P1E21, P1E28, or U1817.

OR

- Battery charging is active.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, P1AF5, P1B0C, P1B41, P1B42, P1B44, P1ED1, P1EF1, P1E1B, U1817.

Conditions for Setting the DTC

- The difference between the Hybrid/EV Battery pack voltage and the hybrid/EV powertrain control module 1 bus voltage is greater than 16 V.

  OR

- The difference between the Hybrid/EV Battery pack voltage and the charger module's bus voltage is greater than 16 V.

Action Taken When the DTC Sets

- DTC P0AF8 is a type A DTC.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTC P0AF8 is a type A DTC.

Diagnostic Aids

- An open high voltage fuse for the T18 Battery Charger may cause DTC P0AF8 to set.
- DTC P1EC0 may set a DTC P0AF8 if the vehicle is ON or vehicle in service mode while the contactors are stuck OPEN

Reference Information

Schematic Reference

- **Hybrid/EV Energy Storage Schematics**
- **Plug-In Charging Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to Special Tools .

Circuit/System Verification

1. Verify that no other DTCs are set.
    - **If any DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle

    - **If no DTCs are set**
2. Ensure the battery charge cord is not connected.
3. Vehicle ON.

   NOTE: **The contactors must be closed.**

4. Verify with a scan tool, the hybrid/EV powertrain control module High Voltage Circuit and the battery energy control module Hybrid/EV Battery Pack Terminal 1 Voltage are within 16 V of each other and DTC P0AF8 did not reset.
    - **If the parameters are not within 16 V of each other or DTC P0AF8 is set**

      Refer to Circuit/System Testing, Battery Main Bus Diagnostics.

    - **If the parameters are within 16 V of each other and DTC P0AF8 is not set**
5. Connect the battery charge cord.
6. Verify with a scan tool, the hybrid/EV powertrain control module 2 Battery Charger High Output and the battery energy control module Hybrid Battery Pack Terminal 1 Voltage are within 16 V of each other and DTC P0AF8 did not reset.
    - **If the parameters are not within 16 V of each other or DTC P0AF8 is set**

      Refer to Circuit/System Testing, Battery Charger Bus Diagnostics.

    - **If the parameters are within 16 V of each other and DTC P0AF8 is not set**
7. All OK

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Battery Charger Bus Diagnostics

1. Vehicle OFF, disable the high voltage at the T18 Battery Charger and the T24 Battery Charger-DC. Refer to **High Voltage Disabling**.
2. Disconnect the T18 Battery Charger high voltage DC connector.
3. Disconnect the K1 14 V Power Module high voltage connector.
4. Disconnect the T24 Battery Charger-DC high voltage connectors X6 and X7.
5. Disconnect the X4 harness connector at the A4 Hybrid/EV Battery Pack.
6. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X4 harness connector.
    - **If less than infinite resistance**

      Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

    - **If infinite resistance**
7. Test for less than 10 Ω between the terminals listed below:
    - High voltage DC (-360 V) negative terminal B X7 harness connector at the T24 Battery Charger-DC and the high voltage DC (-360 V) negative terminal B X4 harness connector at the A4 Hybrid/EV Battery Pack.
    - High voltage DC (+360 V) positive terminal A X7 harness connector at the T24 Battery Charger-DC and the high voltage DC (+360 V) negative terminal A X4 harness connector at the A4 Hybrid/EV Battery Pack.
    - **If 10 Ω or greater**

      Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

    - **If less than 10 Ω**
8. Test for less than 10 Ω between the terminals listed below:
    - High voltage DC (-360 V) negative terminal B X6 harness connector at the T24 Battery Charger-DC and the high voltage DC (-360 V) negative terminal B X3 harness connector at the T18 Battery Charger.
    - High voltage DC (+360 V) positive terminal A X6 harness connector at the T24 Battery Charger-DC and the high voltage DC (+360 V) negative terminal A X3 harness connector at the T18 Battery Charger.
    - **If 10 Ω or greater**

      Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

    - **If less than 10 Ω**

NOTE: **The T18 battery charger Fuse is located within the A28 Hybrid/EV Battery Contactor Assembly.**

9. Replace the T18 Battery Charger, K1 14 V Power Module and the T18 Battery Charger fuse, if open.
10. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If DTC P0AF8 sets**

      Replace the T24 Battery Charger-DC.

    - **If DTC P0AF8 does not set**
11. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.

  - **If DTC P0AF8 sets**

    Replace the A28 Hybrid/EV Battery Contactor Assembly.

  - **If DTC P0AF8 does not set**

12. All OK.

Battery Main Bus Diagnostics

1. Vehicle OFF, disable the high voltage at the T6 Power Inverter Module, A4 Hybrid/EV Battery Pack and T24 Battery Charger-DC. Refer to **High Voltage Disabling**.
2. Disconnect the X3 harness connector at the A4 Hybrid/EV Battery Pack.
3. Disconnect the X2 high voltage connector at the T6 power inverter module.
4. Disconnect the X1 and X3 connectors at the T24 Battery Charger-DC.
5. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X3 connector at the A4 Hybrid/EV Battery Pack, harness side.
   - **If less than infinite resistance**

     Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

   - **If infinite resistance**
6. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X2 connector at the T6 Power Inverter Module, harness side.
   - **If less than infinite resistance**

     Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

   - **If infinite resistance**
7. Test for infinite resistance between the High voltage DC (+360 V) positive terminal A and the high voltage DC (-360 V) negative terminal B X1 connector at the T24 Battery Charger - DC, module side.
   - **If less than infinite resistance**

     Replace the T24 Battery Charger-DC. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

   - **If infinite resistance**
8. Test for less than 10 Ω between the terminals listed below:
   - High voltage DC (-360 V) negative terminal B X3 harness connector at the A4 Hybrid/EV Battery Pack and the high voltage DC (-360 V) negative terminal B X3 harness connector at the T24 Battery Charger-DC.
   - High voltage DC (+360 V) positive terminal A X3 harness connector at the A4 Hybrid/EV Battery Pack and the high voltage DC (+360 V) negative terminal A X3 harness connector at the T24 Battery Charger-DC.
   - **If 10 Ω or greater**

     Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

   - **If less than 10 Ω**
9. Test for less than 10 Ω between the terminals listed below:
   - High voltage DC (-360 V) negative terminal B X2 harness connector at the T6 Power Inverter Module and the high voltage DC (-360 V) negative terminal B X1 harness connector at the T24 Battery Charger-DC.
   - High voltage DC (+360 V) positive terminal A X2 harness connector at the T6 Power Inverter Module and the high voltage DC (+360 V) negative terminal A X1 harness connector at the T24 Battery Charger-DC.
   - **If 10 Ω or greater**

     Replace the high voltage DC cables. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

   - **If less than 10 Ω**
10. Test for less than 10 Ω between the terminals listed below:

- High voltage DC (-360 V) negative terminal B X3 module connector at the T24 Battery Charger-DC and the high voltage DC (-360 V) negative terminal B X1 module connector at the T24 Battery Charger-DC.
- High voltage DC (+360 V) positive terminal A X3 module connector at the T24 Battery Charger-DC and the high voltage DC (+360 V) negative terminal A X1 module connector at the T24 Battery Charger-DC.
- **If 10 Ω or greater**

  Replace the T24 Battery Charger-DC. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

- **If less than 10 Ω**

11. Replace the T6 Power Inverter Module.
12. Verify that DTC P0AF8 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If DTC P0AF8 sets**

      Replace the A28 Hybrid/EV Battery Contactor Assembly.

    - **If DTC P0AF8 does not set**
13. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **300-Volt Battery Positive and Negative Cable Replacement (Generator Battery Control Wiring Junction Block to Drive Motor Battery)**
- Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)** for T18 Battery Charger replacement.
- Refer to **Accessory DC Power Control Module Replacement** for K1 14 V Power Module replacement.
- Refer to **High Voltage Battery Disconnect Relay Fuse Replacement** for T18 battery charger fuse replacement.
- Refer to **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)** **High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)** for T24 Battery Charger-DC replacement.
- Refer to **High Voltage Battery Disconnect Relay Replacement** for A28 hybrid/EV battery contactor assembly replacement.
- Refer to **Control Module References** for T6 power inverter module replacement, programming and setup.

DTC P0AFA OR P0AFB: HYBRID/EV BATTERY SYSTEM VOLTAGE LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0AFA

Hybrid/EV Battery System Voltage Low Voltage

DTC P0AFB

Hybrid/EV Battery System Voltage High Voltage

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules.

Located within the high voltage Hybrid/EV battery pack, the K16 battery energy control module monitors the temperature, current and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the end of the battery cell module. A voltage sense harness joins this connector to the K16 battery energy control module.

Conditions for Running the DTC

- The battery energy control module is awake and communicating.
- None of the following DTCs are set; P0ABB, P0ABC, P0ABD, U0111, U185A.

Conditions for Setting the DTC

P0AFA

The Hybrid Battery Pack Voltage is less than 168.1 V when at temperatures of 9Â°C (48Â°F) or less.

OR

The Hybrid Battery Pack Voltage is less than 174.5 V when temperatures of greater than 9Â°C (48Â°F).

P0AFB

The Hybrid Battery Pack Voltage is greater than 438 V when at temperatures of 19Â°C (66Â°F).

OR

The Hybrid Battery Pack Voltage is greater than 441 V when at temperatures of greater than 19Â°C (66Â°F).

Action Taken When the DTC Sets

DTCs P0AFA and P0AFB are type A DTCs.

DTC P0AFB

Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

- DTCs P0AFA and P0AFB are type A DTCs.
- The Clear Secured High Voltage DTCs reset function must be performed with a scan tool before clear codes.

Diagnostic Aids

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

The hybrid/EV battery pack high voltage manual service disconnect is not installed correctly, or a blown manual service disconnect fuse will cause P0AFA to set.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-63** Pinout Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0AA1, P0AD9, P0ADD, P0AE2, P0AE4, P0B3B, P0B3C, P0B3D, P0B3E, P0B40, P0B41, P0B42, P0B43, P0B45, P0B46, P0B47, P0B48, P0B4A, P0B4B, P0B4D, P0B4C, P0B4F, P0B50, P0B51, P0B52, P0B54, P0B55, P0B56, P0B57, P0B59, P0B5A, P0B5B, P0B5C, P0B5E, P0B60, P0B5F, P0B61, P0B63, P0B64, P0B65, P0B66, P0B69, P0B68, P0B6A, P0B6D, P0B6B, P0B6E, P0B70, P0B6F, P0B72, P0B74, P0B73, P0B75, P0B77, P0B78, P0B79, P0B7A, P0B7D, P0B7C, P0B7E, P0B7F, P0B81, P0B82, P0B83, P0B84, P0B86, P0B87, P0B88, P0B89, P0B8B, P0B8C, P0B8D, P0B8E, P0B90, P0B91, P0B92, P0B93, P0B95, P0B96, P0B97, P0B98, P0B9A, P0B9B, P0B9C, P0B9D, P0B9F, P0BA1, P0BA0, P0BA2, P0BA4, P0BA5, P0BA6, P0BA7, P0BA9, P0BAA, P0BAB, P0BAC, P0BAE, P0BAF, P0BB0, P0BB1, P0BB3, P0BB4, P0BB5, P0BB6, P0BB8, P0BB9, P0BBA, P0BBB, P0D0A, P0D11, P1B16, P1B17, P1B18, P1B19, P1B1A, P1B1B, P1B1C, P1B1D, P1B1E, P1B1F, P1B20, P1B21, P1B22, P1B23, P1B24, P1B25, P1B26, P1B27, P1B28, P1B29, P1B2B, P1B2A, P1B2C, P1B2D, P1B45, P1B46, P1B47, P1B48, P1B49, P1B4A, P1B4B, P1B4C, P1B4D, P1B4E, P1B4F, P1B50, P1B51, P1B52, P1B53, P1B54, P1B55, P1B56, P1B57, P1B58, P1B59, P1B5A, P1B5B, P1B5C, P1B5D, P1B5E, P1B5F, P1B60, P1B61, P1B62, P1B63, P1B64, P1B65, P1B66, P1B67, P1B68, P1B69, P1B6A, P1B6B, P1B6C, P1B6D, P1B6E, P1B6F, P1B70, P1B71, P1B72, P1B73, P1B74, P1B75, P1B76, P1B77, P1B78, P1B79, P1B7A, P1B7B, P1B7C, P1B7D, P1B7F, P1B7E, P1B80, P1B81, P1B82, P1B83, P1B84, P1B85, P1B86, P1B87, P1B88, P1B89, P1B8A, P1B8B, P1B8C, P1B8D, P1B8E, P1B8F, P1B90, P1B91, P1B92, P1B93, P1B94, P1B95, P1B97, P1B96, P1B98, P1B99, P1B9A, P1B9B, P1B9C, P1B9D, P1B9E, P1B9F, P1BA0, P1BA1, P1BA2, P1BA3, P1BA4, P1BA5, P1BA6, P1BA7, P1BA8, P1BA9, P1BAB, P1BAA, P1BAC, P1BAD, P1BAE, P1BAF, P1BB0, P1BB1, P1BB2, P1BB3, P1BB4, P1BB5, P1BB6, P1BB7, P1BB8, P1BB9, P1BBA, P1BBB, P1BBC, P1BBD, P1BBE, P1BBF, P1BC0, P1BC1, P1BC2, P1BC3, P1BC4, P1BC5, P1BC6, P1BC7, P1BC8, P1BC9, P1BCA, P1BCB, P1BCC, P1BCE, P1BCD, P1BCF, P1BD0, P1BD2, P1BD1, P1BD3, P1BD4, P1BD5, P1BD6, P1BD7, P1BD8, P1BD9, P1BDA, P1BDB, P1BDD, P1BDC, P1BDE, P1BDF, P1BE1, P1BE0, P1BE3, P1BE2, P1BE4, P1BE5, P1BE6, P1BE7, P1BE8, P1BE9, P1BEA, P1BEB, P1BEC, P1BED, P1BEE, P1BF0, P1BEF, P1BF1, P1BF2, P1BF4, P1BF3, P1BF5, P1BF4, P1BF7, P1BF8, P1BF9, P1BFA, P1BFB, P1BFC, P1BFD, P1BFE, P1E01, P1E02, P1E03, P1E04, P1E05, P1E06, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E62, P1E61, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6D, P1E6C, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E76, P1E75, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1EBC, P1EBF, P1EC0, P1EC3, P1EC4, P1EC5, U2603, U2604, U2605, U2606, or U2401 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If none of the DTCs are set**
3. Verify the scan tool Hybrid/EV Battery Pack Terminal 1 Voltage is between 168.1 - 441 V.
    - **If not within the specified range**

      Refer to Circuit/System Testing, Hybrid Battery Pack Voltage Diagnosis.

- **If within the specified range**

4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**
2. Remove the S15 manual service disconnect.
3. Test for less than 10 Ω across the S15 manual service disconnect fuse terminals.
   - **If 10 Ω or greater**

     Replace the S15 manual service disconnect and repeat Circuit/System Verification.

   - **If less than 10 Ω**
4. Remove the A4 hybrid/EV battery pack cover. Refer to **Battery Upper Cover Replacement** .
5. Install a known good S15 manual service disconnect.

   WARNING: **High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.**

   NOTE: **You are testing high voltage.**

6. Test for 168 - 441 V between the negative (300 V) C5A and positive (300 V) C5K at the A28 Hybrid/EV Battery Contactor Assembly.
   - **If not within the specified range**

     Replace the A4 Hybrid/EV Battery Pack. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

   - **If within the specified range**
7. Replace the K16 Battery Energy Control Module. Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions. After the repair is complete with a scan tool, the **Clear Secured High Voltage DTCs** reset function must be performed.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
- Refer to **Control Module References** for K16 battery energy control module replacement, programming and setup.

DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, OR P1E4C-P1E8B: HYBRID/EV BATTERY 1-96 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P0B3B

Hybrid/EV Battery 1 Circuit

DTC P0B3C

Hybrid/EV Battery 1 Circuit Performance

DTC P0B3D

Hybrid/EV Battery 1 Circuit Low Voltage

DTC P0B3E

Hybrid/EV Battery 1 Circuit High Voltage

DTC P0B40

Hybrid/EV Battery 2 Circuit

DTC P0B41

Hybrid/EV Battery 2 Circuit Performance

DTC P0B42

Hybrid/EV Battery 2 Circuit Low Voltage

DTC P0B43

Hybrid/EV Battery 2 Circuit High Voltage

DTC P0B45

Hybrid/EV Battery 3 Circuit

DTC P0B46

Hybrid/EV Battery 3 Circuit Performance

DTC P0B47

Hybrid/EV Battery 3 Circuit Low Voltage

DTC P0B48

Hybrid/EV Battery 3 Circuit High Voltage

DTC P0B4A

Hybrid/EV Battery 4 Circuit

DTC P0B4B

Hybrid/EV Battery 4 Circuit Performance

DTC P0B4C

Hybrid/EV Battery 4 Circuit Low Voltage

DTC P0B4D

Hybrid/EV Battery 4 Circuit High Voltage

DTC P0B4F

Hybrid/EV Battery 5 Circuit

DTC P0B50

Hybrid/EV Battery 5 Circuit Performance

DTC P0B51

Hybrid/EV Battery 5 Circuit Low Voltage

DTC P0B52

Hybrid/EV Battery 5 Circuit High Voltage

DTC P0B54

Hybrid/EV Battery 6 Circuit

DTC P0B55

Hybrid/EV Battery 6 Circuit Performance

DTC P0B56

Hybrid/EV Battery 6 Circuit Low Voltage

DTC P0B57

Hybrid/EV Battery 6 Circuit High Voltage

DTC P0B59

Hybrid/EV Battery 7 Circuit

DTC P0B5A

Hybrid/EV Battery 7 Circuit Performance

DTC P0B5B

Hybrid/EV Battery 7 Circuit Low Voltage

DTC P0B5C

Hybrid/EV Battery 7 Circuit High Voltage

DTC P0B5E

Hybrid/EV Battery 8 Circuit

DTC P0B5F

Hybrid/EV Battery 8 Circuit Performance

DTC P0B60

Hybrid/EV Battery 8 Circuit Low Voltage

DTC P0B61

Hybrid/EV Battery 8 Circuit High Voltage

DTC P0B63

Hybrid/EV Battery 9 Circuit

DTC P0B64

Hybrid/EV Battery 9 Circuit Performance

DTC P0B65

Hybrid/EV Battery 9 Circuit Low Voltage

DTC P0B66

Hybrid/EV Battery 9 Circuit High Voltage

DTC P0B68

Hybrid/EV Battery 10 Circuit

DTC P0B69

Hybrid/EV Battery 10 Circuit Performance

DTC P0B6A

Hybrid/EV Battery 10 Circuit Low Voltage

DTC P0B6B

Hybrid/EV Battery 10 Circuit High Voltage

DTC P0B6D

Hybrid/EV Battery 11 Circuit

DTC P0B6E

Hybrid/EV Battery 11 Circuit Performance

DTC P0B6F

Hybrid/EV Battery 11 Circuit Low Voltage

DTC P0B70

Hybrid/EV Battery 11 Circuit High Voltage

DTC P0B72

Hybrid/EV Battery 12 Circuit

DTC P0B73

Hybrid/EV Battery 12 Circuit Performance

DTC P0B74

Hybrid/EV Battery 12 Circuit Low Voltage

DTC P0B75

Hybrid/EV Battery 12 Circuit High Voltage

DTC P0B77

Hybrid/EV Battery 13 Circuit

DTC P0B78

Hybrid/EV Battery 13 Circuit Performance

DTC P0B79

Hybrid/EV Battery 13 Circuit Low Voltage

DTC P0B7A

Hybrid/EV Battery 13 Circuit High Voltage

DTC P0B7C

Hybrid/EV Battery 14 Circuit

DTC P0B7D

Hybrid/EV Battery 14 Circuit Performance

DTC P0B7E

Hybrid/EV Battery 14 Circuit Low Voltage

DTC P0B7F

Hybrid/EV Battery 14 Circuit High Voltage

DTC P0B81

Hybrid/EV Battery 15 Circuit

DTC P0B82

Hybrid/EV Battery 15 Circuit Performance

DTC P0B83

Hybrid/EV Battery 15 Circuit Low Voltage

DTC P0B84

Hybrid/EV Battery 15 Circuit High Voltage

DTC P0B86

Hybrid/EV Battery 16 Circuit

DTC P0B87

Hybrid/EV Battery 16 Circuit Performance

DTC P0B88

Hybrid/EV Battery 16 Circuit Low Voltage

DTC P0B89

Hybrid/EV Battery 16 Circuit High Voltage

DTC P0B8B

Hybrid/EV Battery 17 Circuit

DTC P0B8C

Hybrid/EV Battery 17 Circuit Performance

DTC P0B8D

Hybrid/EV Battery 17 Circuit Low Voltage

DTC P0B8E

Hybrid/EV Battery 17 Circuit High Voltage

DTC P0B90

Hybrid/EV Battery 18 Circuit

DTC P0B91

Hybrid/EV Battery 18 Circuit Performance

DTC P0B92

Hybrid/EV Battery 18 Circuit Low Voltage

DTC P0B93

Hybrid/EV Battery 18 Circuit High Voltage

DTC P0B95

Hybrid/EV Battery 19 Circuit

DTC P0B96

Hybrid/EV Battery 19 Circuit Performance

DTC P0B97

Hybrid/EV Battery 19 Circuit Low Voltage

DTC P0B98

Hybrid/EV Battery 19 Circuit High Voltage

DTC P0B9A

Hybrid/EV Battery 20 Circuit

DTC P0B9B

Hybrid/EV Battery 20 Circuit Performance

DTC P0B9C

Hybrid/EV Battery 20 Circuit Low Voltage

DTC P0B9D

Hybrid/EV Battery 20 Circuit High Voltage

DTC P0B9F

Hybrid/EV Battery 21 Circuit

DTC P0BA0

Hybrid/EV Battery 21 Circuit Performance

DTC P0BA1

Hybrid/EV Battery 21 Circuit Low Voltage

DTC P0BA2

Hybrid/EV Battery 21 Circuit High Voltage

DTC P0BA4

Hybrid/EV Battery 22 Circuit

DTC P0BA5

Hybrid/EV Battery 22 Circuit Performance

DTC P0BA6

Hybrid/EV Battery 22 Circuit Low Voltage

DTC P0BA7

Hybrid/EV Battery 22 Circuit High Voltage

DTC P0BA9

Hybrid/EV Battery 23 Circuit

DTC P0BAA

Hybrid/EV Battery 23 Circuit Performance

DTC P0BAB

Hybrid/EV Battery 23 Circuit Low Voltage

DTC P0BAC

Hybrid/EV Battery 23 Circuit High Voltage

DTC P0BAE

Hybrid/EV Battery 24 Circuit

DTC P0BAF

Hybrid/EV Battery 24 Circuit Performance

DTC P0BB0

Hybrid/EV Battery 24 Circuit Low Voltage

DTC P0BB1

Hybrid/EV Battery 24 Circuit High Voltage

DTC P0BB3

Hybrid/EV Battery 25 Circuit

DTC P0BB4

Hybrid/EV Battery 25 Circuit Performance

DTC P0BB5

Hybrid/EV Battery 25 Circuit Low Voltage

DTC P0BB6

Hybrid/EV Battery 25 Circuit High Voltage

DTC P0BB8

Hybrid/EV Battery 26 Circuit

DTC P0BB9

Hybrid/EV Battery 26 Circuit Performance

DTC P0BBA

Hybrid/EV Battery 26 Circuit Low Voltage

DTC P0BBB

Hybrid/EV Battery 26 Circuit High Voltage

DTC P1B16

Hybrid/EV Battery 27 Circuit Performance

DTC P1B17

Hybrid/EV Battery 27 Circuit Low Voltage

DTC P1B18

Hybrid/EV Battery 27 Circuit High Voltage

DTC P1B19

Hybrid/EV Battery 28 Circuit Performance

DTC P1B1A

Hybrid/EV Battery 28 Circuit Low Voltage

DTC P1B1B

Hybrid/EV Battery 28 Circuit High Voltage

DTC P1B1C

Hybrid/EV Battery 29 Circuit Performance

DTC P1B1D

Hybrid/EV Battery 29 Circuit Low Voltage

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Hybrid/EV Battery 29 Circuit High Voltage

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Hybrid/EV Battery 30 Circuit Performance

DTC P1B20

Hybrid/EV Battery 30 Circuit Low Voltage

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Hybrid/EV Battery 32 Circuit High Voltage

DTC P1B28

Hybrid/EV Battery 27 Circuit

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Hybrid/EV Battery 28 Circuit

DTC P1B2A

Hybrid/EV Battery 29 Circuit

DTC P1B2B

Hybrid/EV Battery 30 Circuit

DTC P1B2C

Hybrid/EV Battery 31 Circuit

DTC P1B2D

Hybrid/EV Battery 32 Circuit

DTC P1B45

Hybrid/EV Battery 33 Circuit Performance

DTC P1B46

Hybrid/EV Battery 33 Circuit Low Voltage

DTC P1B47

Hybrid/EV Battery 33 Circuit High Voltage

DTC P1B48

Hybrid/EV Battery 34 Circuit Performance

DTC P1B49

Hybrid/EV Battery 34 Circuit Low Voltage

DTC P1B4A

Hybrid/EV Battery 34 Circuit High Voltage

DTC P1B4B

Hybrid/EV Battery 35 Circuit Performance

DTC P1B4C

Hybrid/EV Battery 35 Circuit Low Voltage

DTC P1B4D

Hybrid/EV Battery 35 Circuit High Voltage

DTC P1B4E

Hybrid/EV Battery 36 Circuit Performance

DTC P1B4F

Hybrid/EV Battery 36 Circuit Low Voltage

DTC P1B50

Hybrid/EV Battery 36 Circuit High Voltage

DTC P1B51

Hybrid/EV Battery 37 Circuit Performance

DTC P1B52

Hybrid/EV Battery 37 Circuit Low Voltage

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Hybrid/EV Battery 39 Circuit High Voltage

DTC P1B5A

Hybrid/EV Battery 40 Circuit Performance

DTC P1B5B

Hybrid/EV Battery 40 Circuit Low Voltage

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Hybrid/EV Battery 40 Circuit High Voltage

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Hybrid/EV Battery 41 Circuit Performance

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Hybrid/EV Battery 41 Circuit Low Voltage

DTC P1B5F

Hybrid/EV Battery 41 Circuit High Voltage

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Hybrid/EV Battery 42 Circuit Performance

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Hybrid/EV Battery 42 Circuit Low Voltage

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Hybrid/EV Battery 44 Circuit Performance

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Hybrid/EV Battery 44 Circuit Low Voltage

DTC P1B68

Hybrid/EV Battery 44 Circuit High Voltage

DTC P1B69

Hybrid/EV Battery 45 Circuit Performance

DTC P1B6A

Hybrid/EV Battery 45 Circuit Low Voltage

DTC P1B6B

Hybrid/EV Battery 45 Circuit High Voltage

DTC P1B6C

Hybrid/EV Battery 46 Circuit Performance

DTC P1B6D

Hybrid/EV Battery 46 Circuit Low Voltage

DTC P1B6E

Hybrid/EV Battery 46 Circuit High Voltage

DTC P1B6F

Hybrid/EV Battery 47 Circuit Performance

DTC P1B70

Hybrid/EV Battery 47 Circuit Low Voltage

DTC P1B71

Hybrid/EV Battery 47 Circuit High Voltage

DTC P1B72

Hybrid/EV Battery 48 Circuit Performance

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Hybrid/EV Battery 48 Circuit Low Voltage

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Hybrid/EV Battery 49 Circuit Performance

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Hybrid/EV Battery 49 Circuit High Voltage

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Hybrid/EV Battery 50 Circuit Performance

DTC P1B79

Hybrid/EV Battery 50 Circuit Low Voltage

DTC P1B7A

Hybrid/EV Battery 50 Circuit High Voltage

DTC P1B7B

Hybrid/EV Battery 51 Circuit Performance

DTC P1B7C

Hybrid/EV Battery 51 Circuit Low Voltage

DTC P1B7D

Hybrid/EV Battery 51 Circuit High Voltage

DTC P1B7E

Hybrid/EV Battery 52 Circuit Performance

DTC P1B7F

Hybrid/EV Battery 52 Circuit Low Voltage

DTC P1B80

Hybrid/EV Battery 52 Circuit High Voltage

DTC P1B81

Hybrid/EV Battery 53 Circuit Performance

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Hybrid/EV Battery 55 Circuit High Voltage

DTC P1B8A

Hybrid/EV Battery 56 Circuit Performance

DTC P1B8B

Hybrid/EV Battery 56 Circuit Low Voltage

DTC P1B8C

Hybrid/EV Battery 56 Circuit High Voltage

DTC P1B8D

Hybrid/EV Battery 57 Circuit Performance

DTC P1B8E

Hybrid/EV Battery 57 Circuit Low Voltage

DTC P1B8F

Hybrid/EV Battery 57 Circuit High Voltage

DTC P1B90

Hybrid/EV Battery 58 Circuit Performance

DTC P1B91

Hybrid/EV Battery 58 Circuit Low Voltage

DTC P1B92

Hybrid/EV Battery 58 Circuit High Voltage

DTC P1B93

Hybrid/EV Battery 59 Circuit Performance

DTC P1B94

Hybrid/EV Battery 59 Circuit Low Voltage

DTC P1B95

Hybrid/EV Battery 59 Circuit High Voltage

DTC P1B96

Hybrid/EV Battery 60 Circuit Performance

DTC P1B97

Hybrid/EV Battery 60 Circuit Low Voltage

DTC P1B98

Hybrid/EV Battery 60 Circuit High Voltage

DTC P1B99

Hybrid/EV Battery 61 Circuit Performance

DTC P1B9A

Hybrid/EV Battery 61 Circuit Low Voltage

DTC P1B9B

Hybrid/EV Battery 61 Circuit High Voltage

DTC P1B9C

Hybrid/EV Battery 62 Circuit Performance

DTC P1B9D

Hybrid/EV Battery 62 Circuit Low Voltage

DTC P1B9E

Hybrid/EV Battery 62 Circuit High Voltage

DTC P1B9F

Hybrid/EV Battery 63 Circuit Performance

DTC P1BA0

Hybrid/EV Battery 63 Circuit Low Voltage

DTC P1BA1

Hybrid/EV Battery 63 Circuit High Voltage

DTC P1BA2

Hybrid/EV Battery 64 Circuit Performance

DTC P1BA3

Hybrid/EV Battery 64 Circuit Low Voltage

DTC P1BA4

Hybrid/EV Battery 64 Circuit High Voltage

DTC P1BA5

Hybrid/EV Battery 65 Circuit Performance

DTC P1BA6

Hybrid/EV Battery 65 Circuit Low Voltage

DTC P1BA7

Hybrid/EV Battery 65 Circuit High Voltage

DTC P1BA8

Hybrid/EV Battery 66 Circuit Performance

DTC P1BA9

Hybrid/EV Battery 66 Circuit Low Voltage

DTC P1BAA

Hybrid/EV Battery 66 Circuit High Voltage

DTC P1BAB

Hybrid/EV Battery 67 Circuit Performance

DTC P1BAC

Hybrid/EV Battery 67 Circuit Low Voltage

DTC P1BAD

Hybrid/EV Battery 67 Circuit High Voltage

DTC P1BAE

Hybrid/EV Battery 68 Circuit Performance

DTC P1BAF

Hybrid/EV Battery 68 Circuit Low Voltage

DTC P1BB0

Hybrid/EV Battery 68 Circuit High Voltage

DTC P1BB1

Hybrid/EV Battery 69 Circuit Performance

DTC P1BB2

Hybrid/EV Battery 69 Circuit Low Voltage

DTC P1BB3

Hybrid/EV Battery 69 Circuit High Voltage

DTC P1BB4

Hybrid/EV Battery 70 Circuit Performance

DTC P1BB5

Hybrid/EV Battery 70 Circuit Low Voltage

DTC P1BB6

Hybrid/EV Battery 70 Circuit High Voltage

DTC P1BB7

Hybrid/EV Battery 71 Circuit Performance

DTC P1BB8

Hybrid/EV Battery 71 Circuit Low Voltage

DTC P1BB9

Hybrid/EV Battery 71 Circuit High Voltage

DTC P1BBA

Hybrid/EV Battery 72 Circuit Performance

DTC P1BBB

Hybrid/EV Battery 72 Circuit Low Voltage

DTC P1BBC

Hybrid/EV Battery 72 Circuit High Voltage

DTC P1BBD

Hybrid/EV Battery 73 Circuit Performance

DTC P1BBE

Hybrid/EV Battery 73 Circuit Low Voltage

DTC P1BBF

Hybrid/EV Battery 73 Circuit High Voltage

DTC P1BC0

Hybrid/EV Battery 74 Circuit Performance

DTC P1BC1

Hybrid/EV Battery 74 Circuit Low Voltage

DTC P1BC2

Hybrid/EV Battery 74 Circuit High Voltage

DTC P1BC3

Hybrid/EV Battery 75 Circuit Performance

DTC P1BC4

Hybrid/EV Battery 75 Circuit Low Voltage

DTC P1BC5

Hybrid/EV Battery 75 Circuit High Voltage

DTC P1BC6

Hybrid/EV Battery 76 Circuit Performance

DTC P1BC7

Hybrid/EV Battery 76 Circuit Low Voltage

DTC P1BC8

Hybrid/EV Battery 76 Circuit High Voltage

DTC P1BC9

Hybrid/EV Battery 77 Circuit Performance

DTC P1BCA

Hybrid/EV Battery 77 Circuit Low Voltage

DTC P1BCB

Hybrid/EV Battery 77 Circuit High Voltage

DTC P1BCC

Hybrid/EV Battery 78 Circuit Performance

DTC P1BCD

Hybrid/EV Battery 78 Circuit Low Voltage

DTC P1BCE

Hybrid/EV Battery 78 Circuit High Voltage

DTC P1BCF

Hybrid/EV Battery 79 Circuit Performance

DTC P1BD0

Hybrid/EV Battery 79 Circuit Low Voltage

DTC P1BD1

Hybrid/EV Battery 79 Circuit High Voltage

DTC P1BD2

Hybrid/EV Battery 80 Circuit Performance

DTC P1BD3

Hybrid/EV Battery 80 Circuit Low Voltage

DTC P1BD4

Hybrid/EV Battery 80 Circuit High Voltage

DTC P1BD5

Hybrid/EV Battery 81 Circuit Performance

DTC P1BD6

Hybrid/EV Battery 81 Circuit Low Voltage

DTC P1BD7

Hybrid/EV Battery 81 Circuit High Voltage

DTC P1BD8

Hybrid/EV Battery 82 Circuit Performance

DTC P1BD9

Hybrid/EV Battery 82 Circuit Low Voltage

DTC P1BDA

Hybrid/EV Battery 82 Circuit High Voltage

DTC P1BDB

Hybrid/EV Battery 83 Circuit Performance

DTC P1BDC

Hybrid/EV Battery 83 Circuit Low Voltage

DTC P1BDD

Hybrid/EV Battery 83 Circuit High Voltage

DTC P1BDE

Hybrid/EV Battery 84 Circuit Performance

DTC P1BDF

Hybrid/EV Battery 84 Circuit Low Voltage

DTC P1BE0

Hybrid/EV Battery 84 Circuit High Voltage

DTC P1BE1

Hybrid/EV Battery 85 Circuit Performance

DTC P1BE2

Hybrid/EV Battery 85 Circuit Low Voltage

DTC P1BE3

Hybrid/EV Battery 85 Circuit High Voltage

DTC P1BE4

Hybrid/EV Battery 86 Circuit Performance

DTC P1BE5

Hybrid/EV Battery 86 Circuit Low Voltage

DTC P1BE6

Hybrid/EV Battery 86 Circuit High Voltage

DTC P1BE7

Hybrid/EV Battery 87 Circuit Performance

DTC P1BE8

Hybrid/EV Battery 87 Circuit Low Voltage

DTC P1BE9

Hybrid/EV Battery 87 Circuit High Voltage

DTC P1BEA

Hybrid/EV Battery 88 Circuit Performance

DTC P1BEB

Hybrid/EV Battery 88 Circuit Low Voltage

DTC P1BEC

Hybrid/EV Battery 88 Circuit High Voltage

DTC P1BED

Hybrid/EV Battery 89 Circuit Performance

DTC P1BEE

Hybrid/EV Battery 89 Circuit Low Voltage

DTC P1BEF

Hybrid/EV Battery 89 Circuit High Voltage

DTC P1BF0

Hybrid/EV Battery 90 Circuit Performance

DTC P1BF1

Hybrid/EV Battery 90 Circuit Low Voltage

DTC P1BF2

Hybrid/EV Battery 90 Circuit High Voltage

DTC P1BF3

Hybrid/EV Battery 91 Circuit Performance

DTC P1BF4

Hybrid/EV Battery 91 Circuit Low Voltage

DTC P1BF5

Hybrid/EV Battery 91 Circuit High Voltage

DTC P1BF6

Hybrid/EV Battery 92 Circuit Performance

DTC P1BF7

Hybrid/EV Battery 92 Circuit Low Voltage

DTC P1BF8

Hybrid/EV Battery 92 Circuit High Voltage

DTC P1BF9

Hybrid/EV Battery 93 Circuit Performance

DTC P1BFA

Hybrid/EV Battery 93 Circuit Low Voltage

DTC P1BFB

Hybrid/EV Battery 93 Circuit High Voltage

DTC P1BFC

Hybrid/EV Battery 94 Circuit Performance

DTC P1BFD

Hybrid/EV Battery 94 Circuit Low Voltage

DTC P1BFE

Hybrid/EV Battery 94 Circuit High Voltage

DTC P1E01

Hybrid/EV Battery 95 Circuit Performance

DTC P1E02

Hybrid/EV Battery 95 Circuit Low Voltage

DTC P1E03

Hybrid/EV Battery 95 Circuit High Voltage

DTC P1E04

Hybrid/EV Battery 96 Circuit Performance

DTC P1E05

Hybrid/EV Battery 96 Circuit Low Voltage

DTC P1E06

Hybrid/EV Battery 96 Circuit High Voltage

DTC P1E4C

Hybrid/EV Battery 33 Circuit

DTC P1E4D

Hybrid/EV Battery 34 Circuit

DTC P1E4E

Hybrid/EV Battery 35 Circuit

DTC P1E4F

Hybrid/EV Battery 36 Circuit

DTC P1E50

Hybrid/EV Battery 37 Circuit

DTC P1E51

Hybrid/EV Battery 38 Circuit

DTC P1E52

Hybrid/EV Battery 39 Circuit

DTC P1E53

Hybrid/EV Battery 40 Circuit

DTC P1E54

Hybrid/EV Battery 41 Circuit

DTC P1E55

Hybrid/EV Battery 42 Circuit

DTC P1E56

Hybrid/EV Battery 43 Circuit

DTC P1E57

Hybrid/EV Battery 44 Circuit

DTC P1E58

Hybrid/EV Battery 45 Circuit

DTC P1E59

Hybrid/EV Battery 46 Circuit

DTC P1E5A

Hybrid/EV Battery 47 Circuit

DTC P1E5B

Hybrid/EV Battery 48 Circuit

DTC P1E5C

Hybrid/EV Battery 49 Circuit

DTC P1E5D

Hybrid/EV Battery 50 Circuit

DTC P1E5E

Hybrid/EV Battery 51 Circuit

DTC P1E5F

Hybrid/EV Battery 52 Circuit

DTC P1E60

Hybrid/EV Battery 53 Circuit

DTC P1E61

Hybrid/EV Battery 54 Circuit

DTC P1E62

Hybrid/EV Battery 55 Circuit

DTC P1E63

Hybrid/EV Battery 56 Circuit

DTC P1E64

Hybrid/EV Battery 57 Circuit

DTC P1E65

Hybrid/EV Battery 58 Circuit

DTC P1E66

Hybrid/EV Battery 59 Circuit

DTC P1E67

Hybrid/EV Battery 60 Circuit

DTC P1E68

Hybrid/EV Battery 61 Circuit

DTC P1E69

Hybrid/EV Battery 62 Circuit

DTC P1E6A

Hybrid/EV Battery 63 Circuit

DTC P1E6B

Hybrid/EV Battery 64 Circuit

DTC P1E6C

Hybrid/EV Battery 65 Circuit

DTC P1E6D

Hybrid/EV Battery 66 Circuit

DTC P1E6E

Hybrid/EV Battery 67 Circuit

DTC P1E6F

Hybrid/EV Battery 68 Circuit

DTC P1E70

Hybrid/EV Battery 69 Circuit

DTC P1E71

Hybrid/EV Battery 70 Circuit

DTC P1E72

Hybrid/EV Battery 71 Circuit

DTC P1E73

Hybrid/EV Battery 72 Circuit

DTC P1E74

Hybrid/EV Battery 73 Circuit

DTC P1E75

Hybrid/EV Battery 74 Circuit

DTC P1E76

Hybrid/EV Battery 75 Circuit

DTC P1E77

Hybrid/EV Battery 76 Circuit

DTC P1E78

Hybrid/EV Battery 77 Circuit

DTC P1E79

Hybrid/EV Battery 78 Circuit

DTC P1E7A

Hybrid/EV Battery 79 Circuit

DTC P1E7B

Hybrid/EV Battery 80 Circuit

DTC P1E7C

Hybrid/EV Battery 81 Circuit

DTC P1E7D

Hybrid/EV Battery 82 Circuit

DTC P1E7E

Hybrid/EV Battery 83 Circuit

DTC P1E7F

Hybrid/EV Battery 84 Circuit

DTC P1E80

Hybrid/EV Battery 85 Circuit

DTC P1E81

Hybrid/EV Battery 86 Circuit

DTC P1E82

Hybrid/EV Battery 87 Circuit

DTC P1E83

Hybrid/EV Battery 88 Circuit

DTC P1E84

Hybrid/EV Battery 89 Circuit

DTC P1E85

Hybrid/EV Battery 90 Circuit

DTC P1E86

Hybrid/EV Battery 91 Circuit

DTC P1E87

Hybrid/EV Battery 92 Circuit

DTC P1E88

Hybrid/EV Battery 93 Circuit

DTC P1E89

Hybrid/EV Battery 94 Circuit

DTC P1E8A

Hybrid/EV Battery 95 Circuit

DTC P1E8B

Hybrid/EV Battery 96 Circuit

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly. These cell groups are electrically connected in series. Each individual cell group is rated at 3.65 V, for a nominal system voltage of 350 V direct current. The battery cell groups are electrically joined to form 10 distinct electrical modules.

Located within the high voltage Hybrid/EV battery pack, the K16 battery energy control module monitors the temperature, current and voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at a connector located on the end of the battery cell module. A voltage sense harness joins this connector to the K16 battery energy control module.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of the battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

Hybrid/EV Battery Circuit Open DTCs

- Vehicle ON.
- The hybrid/EV battery energy control module is awake and communicating.
- None of the following DTCs are set; U0111 or U185A.

Hybrid/EV Battery Circuit Performance, Hybrid/EV Battery Circuit Low Voltage and Hybrid/EV Battery Circuit High Voltage DTCs:

- Vehicle ON.
- The hybrid/EV battery energy control module is awake and communicating.
- None of the following DTCs are set: P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B72, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B90, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B, P1F86, P1F87, P1F88, P1F89, P1F8A, P1F8B, P1F8C, P1F8D, P1F8E, P1F8F, P1F90, P1F91, P1F92, P1F93, P1F94, P1F95, U0111, or U185A

Conditions for Setting the DTC

Battery Circuit

- P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B72, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B90, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71,

P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B are Type A DTCs.
- The hybrid/EV battery energy control module detects high resistance on the circuit.

Circuit Performance

- P0B3C, P0B41, P0B46, P0B4B, P0B50, P0B55, P0B5A, P0B5F, P0B64, P0B69, P0B6E, P0B73, P0B78, P0B7D, P0B82, P0B87, P0B8C, P0B91, P0B96, P0B9B, P0BA0, P0BA5, P0BAA, P0BAF, P0BB4, P0BB9, P1B19, P1B1F, P1B25, P1B45, P1B48, P1B4B, P1B4E, P1B51, P1B54, P1B57, P1B5A, P1B5D, P1B60, P1B63, P1B66, P1B69, P1B6C, P1B6F, P1B72, P1B75, P1B78, P1B7B, P1B7E, P1B81, P1B84, P1B87, P1B8A, P1B8D, P1B90, P1B93, P1B96, P1B99, P1B9C, P1B9F, P1BA2, P1BA5, P1BA8, P1BAB, P1BAE, P1BB1, P1BB4, P1BB7, P1BBA, P1BBD, P1BC0, P1BC3, P1BC6, P1BC9, P1BCC, P1BCF, P1BD2, P1BD5, P1BD8, P1BDB, P1BDE, P1BE1, P1BE4, P1BE7, P1BEA, P1BED, P1BF0, P1BF3, P1BF6, P1BF9, P1BFC, P1E01, P1E04 are Type A DTCs.
- The faulted cell group does not change voltage.

Low Voltage

- P0B3D, P0B42, P0B47, P0B4C, P0B51, P0B56, P0B5B, P0B60, P0B65, P0B6A, P0B6F, P0B74, P0B79, P0B7E, P0B83, P0B88, P0B8D, P0B92, P0B97, P0B9C, P0BA1, P0BA6, P0BAB, P0BB0, P0BB5, P0BBA, P1B17, P1B1A, P1B1D, P1B20, P1B23, P1B26, P1B46, P1B4C, P1B4F, P1B52, P1B55, P1B58, P1B5B, P1B5E, P1B61, P1B64, P1B67, P1B6A, P1B6D, P1B70, P1B73, P1B76, P1B79, P1B7C, P1B7F, P1B82, P1B85, P1B88, P1B8B, P1B8E, P1B91, P1B94, P1B97, P1B9A, P1B9D, P1BA0, P1BA3, P1BA6, P1BA9, P1BAC, P1BAF, P1BB2, P1BB5, P1BB8, P1BBB, P1BBE, P1BC1, P1BC4, P1BC7, P1BCA, P1BCD, P1BD0, P1BD3, P1BD6, P1BD9, P1BDC, P1BDF, P1BE2, P1BE5, P1BE8, P1BEB, P1BEE, P1BF1, P1BF4, P1BF7, P1BFA, P1BFD, P1E02, P1E05 are Type A DTCs.
- Any hybrid/EV battery voltage signal is less than 1.75 V.

High Voltage

- P0B3E, P0B43, P0B48, P0B4D, P0B52, P0B57, P0B5C, P0B61, P0B66, P0B6B, P0B70, P0B75, P0B7A, P0B7F, P0B84, P0B89, P0B8E, P0B93, P0B98, P0B9D, P0BA2, P0BA7, P0BAC, P0BB1, P0BB6, P0BBB, P1B18, P1B1B, P1B1E, P1B21, P1B24, P1B27, P1B47, P1B4A, P1B4D, P1B50, P1B53, P1B56, P1B59, P1B5C, P1B5F, P1B62, P1B65, P1B68, P1B6B, P1B6E, P1B71, P1B74, P1B77, P1B7A, P1B7D, P1B80, P1B83, P1B86, P1B89, P1B8C, P1B8F, P1B92, P1B95, P1B98, P1B9B, P1B9E, P1BA1, P1BA4, P1BA7, P1BAA, P1BAD, P1BB0, P1BB3, P1BB6, P1BB9, P1BBC, P1BBF, P1BC2, P1BC5, P1BC8, P1BCB, P1BCE, P1BD1, P1BD4, P1BD7, P1BDA, P1BDD, P1BE0, P1BE3, P1BE6, P1BE6, P1BE9, P1BEC, P1BEF, P1BF2, P1BF5, P1BF8, P1BFB, P1BFE, P1E03, P1E06 are Type A DTCs.
- Any hybrid/EV battery voltage signal is greater than 4.58 V.

Action Taken When the DTC Sets

- DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06 or P1E4C-P1E8B are type A DTCs.
- If any performance DTCs are set, the vehicle will operate in a reduced power mode.
- Battery Circuit, Low Voltage or High Voltage DTCs set: Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will not CLOSE the high voltage contactors until the DTC has been cleared.

Conditions for Clearing the DTC

- DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06 or P1E4C-P1E8B are type A DTCs.
- Battery Circuit, Low Voltage or High Voltage DTCs set: The **Clear Secured High Voltage DTCs** reset function must be performed with a scan tool before clear codes.

Diagnostic Aids

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**

3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48571** High Voltage Battery Pin Out Box
- **EL-48571-61** Pinout Box Adapter
- **EL-48571-62** Pinout Box Adapter
- **EL-48571-63** Pinout Box Adapter
- **EL-48900** HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Battery 1 - 96 voltages are between 3.28-4.16 V and all readings are within 0.03 V of each other.
   - **If not between 3.28-4.16 V or not within 0.03 V of each other**

     Refer to Circuit/System Testing.

   - **If between 3.28-4.16 V and within 0.03 V of each other**
3. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable high voltage at the A4 hybrid/EV battery pack. Refer to **High Voltage Disabling**
2. Remove the A4 hybrid/EV battery pack cover. Refer to **Battery Upper Cover Replacement** .

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

3. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
4. Inspect the harness connectors and the K16 battery energy control module connectors for corrosion.
   - **If corrosion is present**

     Replace the Hybrid/EV Battery Pack Internal Harness and the K16 Battery Energy Control Module as applicable.

   - **If corrosion is not present**

NOTE: **The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.**

5. Disconnect the harness connectors at the appropriate C5 Hybrid/EV Battery Module as indicated by the voltages observed during Circuit/System Verification.
6. Inspect the harness connectors and the C5 Hybrid/EV Battery Module connectors for corrosion.
   - **If corrosion is present**

     Replace the Hybrid/EV Battery Pack Internal Harness and the C4 Hybrid/EV Battery Section, as applicable.

   - **If corrosion is not present**
7. Connect the **EL-48571** High Voltage Battery Pin Out Box with the **EL-48571-61** , **EL-48571-62** , or **EL-48571-63** adapter to the battery module. Refer to **EL-48571 High Voltage Battery Pin Out Box Reference** for proper X1, X2 orientation.
8. Insert the DMM probes into the **EL-48571** test cavities.
9. Measure and record the voltage of each of the cell groups by cycling the **EL-48571** through each of the switch positions. Refer to **EL-48571 High Voltage Battery Pin Out Box Reference**

10. Verify each cell group voltage reading is between 3.28-4.16 V.
    - **If not within the specified range**

      Replace the appropriate C4 Hybrid/EV Battery Section.

    - **If within the specified range**
11. Verify each cell group voltage reading is within 0.03 V of each other.
    - **If greater than 0.03 V**

      Replace the appropriate C4 Hybrid/EV Battery Section.

    - **If 0.03 V or less**

NOTE: **Perform the following testing at the hybrid/EV battery pack internal wiring harness connector.**

12. Test for infinite resistance between each appropriate voltage sense circuit terminals and ground.
    - **If less than infinite resistance**

      Replace the Hybrid/EV Battery Pack Internal Harness.

    - **If infinite resistance**
13. Test for less than 2 Ω in each appropriate voltage sense circuits end to end.
    - **If 2 Ω or greater**

      Replace the Hybrid/EV Battery Pack Internal Harness.

    - **If less than 2 Ω**
14. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cell Battery Module Replacement (Row 1)** **Cell Battery Module Replacement (Row 2)** **Cell Battery Module Replacement (Row 3)** **Cell Battery Module Replacement (Row 4)** **Cell Battery Module Replacement (Row 5)** for C4 hybrid/EV battery section replacement
- Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
- Refer to **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)** **Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)** **Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)** **Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)** for hybrid/EV battery pack internal harness replacement
- Refer to **Control Module References** for K16 hybrid/EV battery energy control module replacement, programming and setup.

DTC P0C78 OR P3061: HYBRID/EV BATTERY PRECHARGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0C78

Hybrid/EV Battery System Precharge Time Too Long

DTC P3061

Hybrid/EV Battery Precharge High Current

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and a precharge negative high voltage contactor. The contactors close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors. Ground is provided through the case ground.

In order to prevent large in-rush current, system bus high voltage is routed through a pre-charge resistor whenever high voltage is commanded ON. The hybrid/EV powertrain control module 2 monitors the time and current it takes the system bus voltage to attain the same level as the battery pack voltage. If it takes too long, or too much current flows, a DTC is set.

Conditions for Running the DTC

P0C78

- Battery voltage sensor has not failed.
- Bus voltage sensor has not failed.
- Contactor status is Precharging.
- Cabin heating is Off.

P3061

- Battery voltage sensor has not failed.
- Battery current sensor has not failed.
- Precharge is active.

Conditions for Setting the DTC

P0C78

The bus voltage has not reached 95% of battery voltage or is greater than 105% within 700 ms of the contactors closing.

P3061

The bus current is greater than 3 amps for 88 ms during precharge.

Actions Taken When the DTC Sets

- DTC P0C78 and P3061 are type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTC P0C78 and P3061 are type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Record the freeze frame/failure records.
2. Vehicle in Service Mode.
3. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, or P1EC3 is not set.
    - **If any of the DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle

    - **If none of the DTCs are set**

NOTE: **The following setup steps must be performed exactly in order to exercise the contactors.**

4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
5. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: **The parking lamps must remain ON throughout the remainder of the contactor steps.**

6. Turn ON the parking lamps.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode.**

7. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.
8. Disconnect the S15 Manual Service Disconnect.

NOTE: **DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.**

9. Command the Hybrid/EV Battery Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
10. Verify the Hybrid/EV Battery Negative Contactor should be heard closing and opening.
    - **If the Hybrid/EV Battery Negative Contactor does not open and close**

      Refer to Circuit/System Testing, Contactor Function Diagnosis.

    - **If the Hybrid/EV Battery Negative Contactor does open and close**
11. Command the Hybrid/EV Battery Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
12. Verify the Hybrid/EV Battery Positive Contactor should be heard closing and opening.
    - **If the Hybrid/EV Battery Positive Contactor does not open and close**

      Refer to Circuit/System Testing, Contactor Function Diagnosis.

    - **If the Hybrid/EV Battery Positive Contactor does open and close**
13. Command the Hybrid/EV Battery Precharge Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
14. Verify the Hybrid/EV Battery Precharge Contactor should be heard opening and closing.
    - **If the Hybrid/EV Battery Precharge Contactor does not open and close**

Refer to Circuit/System Testing, Contactor Function Diagnosis.

- **If the Hybrid/EV Battery Precharge Contactor does open and close**

15. Command the Hybrid/EV Battery Charger Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
16. Verify the Hybrid/EV Battery Charger Contactor should be heard opening and closing.
    - **If the Hybrid/EV Battery Charger Contactor does not open and close**

      Refer to Circuit/System Testing, Contactor Function Diagnosis.

    - **If the Hybrid/EV Battery Charger Contactor does open and close**
17. Test for less than 10 Ω across the S15 manual service disconnect fuse terminals.
    - **If 10 Ω or greater**

      Obtain a new S15 manual service disconnect and Refer to Circuit/System Testing, High Voltage System Bus Diagnosis without DTC P0D26.

    - **If less than 10 Ω**
18. Vehicle OFF.
19. Install the S15 Manual Service Disconnect.
20. Clear the DTC information. Vehicle OFF and wait 5 minutes. Vehicle ON, verify DTC P0C78 or P3061 do not set.
    - **If any of the DTCs are set**

      NOTE: The vehicle must remain OFF to prevent DTC P0C78 from running.

      1. Vehicle OFF. Wait 5 minutes.
      2. Connect the drive motor battery charger cable.
      3. Verify DTC P0D26 is not set and the vehicle will charge.
         - If the DTC is set and the vehicle will not charge, Refer to Circuit/System Testing, High Voltage System Bus Diagnosis with DTC P0D26.
         - If the DTC is not set and the vehicle charges, Refer to Circuit/System Testing, High Voltage System Bus Diagnosis without DTC P0D26.
    - **If none of the DTCs are set**
21. All OK.

Circuit/System Testing

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Contactor Function Diagnosis

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. Disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
3. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
   - **If greater than 10 Ω**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
4. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
5. Verify that a test lamp illuminates between the A4 Hybrid/EV Battery Pack harness B+ circuit terminal 1 X357 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
   - **If the test lamp does not illuminate and the circuit fuse is open**
   1. Vehicle OFF.
   2. Test for infinite resistance between the B+ circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K16 Battery Energy Control Module and hybrid/EV battery pack internal wiring harness.
   - **If the test lamp illuminates**
6. Vehicle in Service Mode.
7. Verify that a test lamp does not illuminate between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:
   - Terminal 3 X358
   - Terminal 4 X358
   - Terminal 5 X358
   - Terminal 7 X358
   - **If the test lamp illuminates on any circuit**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
   - **If the test lamp does not illuminate on all circuits**
8. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
9. Test for infinite resistance between each A4 Hybrid/EV Battery Pack harness connector control circuit terminals listed below and ground:
   - Terminal 3 X358
   - Terminal 4 X358
   - Terminal 5 X358
   - Terminal 7 X358
   - **If less than infinite resistance on either circuit**

     Repair the short to ground on the circuit.

   - **If infinite resistance on both circuits**
10. Test for less than 2 Ω between the harness connector terminals listed below:
    - Terminal 3 X358 at the A4 Hybrid/EV Battery Pack and terminal 9 X1 at the K114B Hybrid Powertrain Control Module 2

- Terminal 4 X358 at the A4 Hybrid/EV Battery Pack and terminal 6 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 7 X358 at the A4 Hybrid/EV Battery Pack and terminal 8 X1 at the K114B Hybrid Powertrain Control Module 2
- Terminal 5 X358 at the A4 Hybrid/EV Battery Pack and terminal 3 X1 at the K114B Hybrid Powertrain Control Module 2
- **If 2 Ω or greater on any circuit**

  Repair the open/high resistance in the circuit.

- **If less than 2 Ω on all circuits**

11. Replace the A28 Hybrid/EV Battery Contactor Assembly.
12. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If DTC P0C78 or P3061 sets**

      Replace the K114B Hybrid Powertrain Control Module 2.

    - **If DTC P0C78 or P3061 does not set**
13. All OK.

High Voltage System Bus Diagnosis with DTC P0D26

1. Disable the high voltage for servicing at the A4 Battery Pack, K1 14V Power Module and the T18 Battery Charger. Refer to High Voltage Disabling.
2. Disconnect the X3 connector at the T18 Battery Charger and the X1 connector at the K1 14V Power Module.
3. Verify that all HV harness connector and mating module connector terminals are free from moisture, corrosion and arc flash damage.
   - **If any terminals show signs of damage**

     Replace the HV wiring harness and effected modules as necessary.

   - **If no arc flash damage, moisture, or corrosion is found**

NOTE: **This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.**

4. Test the K1 14 V Power Module X1 terminals for greater than 10K Ω, X1-A to X1-B.
   - **If 10K Ω or less**
   1. Replace the K1 14V Power Module.
   2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
      - If DTC P0C78 or P03061 sets

        Replace the A28 Hybrid/EV Battery Contactor Assembly.

      - If DTC P0C78 or P03061 does not set
   3. All OK.
   - **If greater than 10K Ω**

NOTE: **This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.**

5. Test the T18 Battery Charger terminals for greater than 10K Ω, X3-1 to X3-2.
   - **If 10K Ω or less**
   1. Replace the T18 Battery Charger.

    2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If DTC P0C78 or P03061 sets

          Replace the A28 Hybrid/EV Battery Contactor Assembly.

        - If DTC P0C78 or P03061 does not set
    3. All OK.
  - **If greater than 10K Ω**
6. Remove and open the A4 Battery Pack. Refer to **Battery Upper Cover Replacement** .
7. Inspect the High Voltage bus bars for loose/damaged terminal fasteners.
   - **If a terminal concern is found**

     Replace all affected components.

   - **If no internal concerns are observed**
8. Replace the A28 Hybrid/EV Battery Contactor Assembly.
9. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
   - **If DTC P0C78 or P3061 sets**

     Replace the K114B Hybrid Powertrain Control Module 2.

   - **If DTC P0C78 or P3061 does not set**
10. All OK.

High Voltage System Bus Diagnosis without DTC P0D26

1. Disable the high voltage for servicing at the A4 Battery Pack, G1 A/C Compressor, T6 Power Inverter Module, T24 Battery Charger and the K10 Coolant Heater. Refer to **High Voltage Disabling**.
2. Disconnect the X2 connector at the T6 Power Inverter Module, the X1 and X3 connectors at the T24 Battery Charger and the X3 connector at the A4 Battery Pack.
3. Verify that all HV harness connector and mating module connector terminals are free from moisture, corrosion and arc flash damage.
   - **If any terminals show signs of damage**

     Replace the HV wiring harness and effected modules as necessary.

   - **If no arc flash damage, moisture, or corrosion is found**

NOTE: **This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.**

4. Test the T6 Power Inverter Module X2 terminals for greater than 10K Ω, X2-A to X2-B.
   - **If 10K Ω or less**
     1. Replace the T6 Power Inverter Module.
     2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If DTC P0C78 or P03061 sets

          Replace the A28 Hybrid/EV Battery Contactor Assembly.

        - If DTC P0C78 or P03061 does not set
     3. All OK.
   - **If greater than 10K Ω**

NOTE: **This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.**

5. Test the K10 Coolant Heater X1 terminals for greater than 10K Ω, X1-1 to X1-2.
    - **If 10K Ω or less**
    1. Replace the K10 Coolant Heater Control Module.
    2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If DTC P0C78 or P03061 sets

          Replace the A28 Hybrid/EV Battery Contactor Assembly.

        - If DTC P0C78 or P03061 does not set
    3. All OK.
    - **If greater than 10K Ω**

NOTE: **This test is performed at the module terminals with the test measurement initially several Meg ohms and slowly decreasing to a minimal value. You must measure with a high-impedance Digital Multimeter (DMM). DO NOT use the EL-50772 to measure insulation resistance.**

6. Test the G1 A/C Compressor X2 terminals for greater than 10K Ω, X2-A to X2-B.
    - **If 10K Ω or less**
    1. Replace the G1 A/C Compressor.
    2. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If DTC P0C78 or P03061 sets

          Replace the A28 Hybrid/EV Battery Contactor Assembly.

        - If DTC P0C78 or P03061 does not set
    3. All OK.
    - **If greater than 10K Ω**
7. Test the following T24 Battery Charger terminals for less than 2 Ω, terminal to terminal:
    - X1-A to X3-A
    - X1-B to X3-B
    - **If 2 Ω or greater**

      Replace the T24 Battery Charger.

    - **If less than 2 Ω**
8. Remove and open the A4 Battery Pack. Refer to Battery Upper Cover Replacement .
9. Inspect the High Voltage bus bars for loose/damaged terminal fasteners.
    - **If a terminal concern is found**

      Replace all affected components.

    - **If no internal concerns are observed**
10. Replace the A28 Hybrid/EV Battery Contactor Assembly and the K16 Battery Energy Control Module.
11. Verify that DTC P0C78 or P3061 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If DTC P0C78 or P3061 sets**

      Replace the K114B Hybrid Powertrain Control Module 2.

    - **If DTC P0C78 or P3061 does not set**
12. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to High Voltage Battery Control Wiring Junction Block Replacement (With quick charge) High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge) for T24 battery charger replacement

- Refer to **Air Conditioning and Drive Motor Battery Cooling Compressor Replacement** for G1 A/C compressor replacement
- Refer to **Heater Coolant Heater Replacement** for K10 coolant heater replacement
- Refer to **High Voltage Battery Disconnect Relay Replacement** for A28 Hybrid/EV Battery Contactor Assembly
- Refer to **Control Module References** for K16 battery energy control module, T6 power inverter module, K1 14V power module, or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, OR P3040: BATTERY ENERGY CONTROL MODULE 5 V REFERENCE CIRCUIT AND/OR HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 5 V REFERENCE CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1A07

Battery Energy Control Module 5 V Reference Circuit

DTC P1E93

Hybrid/EV Battery Interface Control Module 1 5 V Reference Circuit

DTC P1E99

Hybrid/EV Battery Interface Control Module 2 5 V Reference Circuit

DTC P1E9F

Hybrid/EV Battery Interface Control Module 3 5 V Reference Circuit

DTC P1EA5

Hybrid/EV Battery Interface Control Module 4 5 V Reference Circuit

DTC P1FC3

Hybrid/EV Battery Interface Control Module 5 5 V Reference Circuit

DTC P1FC4

Hybrid/EV Battery Interface Control Module 6 5 V Reference Circuit

DTC P1FC5

Hybrid/EV Battery Interface Control Module 7 5 V Reference Circuit

DTC P1FC6

Hybrid/EV Battery Interface Control Module 8 5 V Reference Circuit

DTC P1FC7

Hybrid/EV Battery Interface Control Module 9 5 V Reference Circuit

DTC P1FC8

Hybrid/EV Battery Interface Control Module 10 5 V Reference Circuit

DTC P3035

Hybrid/EV Battery Interface Control Module 11 5 V Reference Circuit

DTC P3040

Hybrid/EV Battery Interface Control Module 12 5 V Reference Circuit

Circuit/System Description

The hybrid battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of each battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1A07

- The battery energy control module is awake and communicating.
- The 12 V battery voltage greater than or equal to 9 V.

P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040

- The battery energy control module is awake and communicating.
- None of the following DTCs are set; U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, U2624

Conditions for Setting the DTC

P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040

The battery energy control module has detected an internal 5V reference circuit voltage is less than 2.8 V or greater than 3.2 V.

Actions Taken When the DTC Sets

- DTCs P1A07 P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040 are Type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P1A07 P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, and P3040 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Verify that DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, or P3040 is not set.
   - **If DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3, P1FC4, P1FC5, P1FC6, P1FC7, P1FC8, P3035, or P3040 is set**
   1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
   2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
   - **If none of the DTCs are set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K16 battery energy control module programming and setup.

DTC P1B3F OR P1B40: HIGH VOLTAGE SYSTEM INTERLOCK CIRCUIT 2 LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1B3F

High Voltage System Interlock Circuit 2 Low Voltage

DTC P1B40

High Voltage System Interlock Circuit 2 High Voltage

Circuit/System Description

A high voltage interlock circuit is used to determine if access to high voltage components or connectors is being attempted. The opening of these high voltage components causes the high voltage interlock circuit to open. The hybrid/EV powertrain control module 2 sources about 5 V on the high voltage interlock circuit loop. When the hybrid/EV powertrain control module 2 detects a loss of high voltage interlock circuit current, the high voltage contactors are commanded open.

The T6 Power Inverter Module and the T24 Battery Charger Module - DC each contain 35 - 45 Ω resistors in order to detect attempted bypassing of the high voltage interlock circuit.

The high voltage interlock circuit 2 monitors for integrity of the following components:

- T24 Battery Charger - DC high voltage connectors - CBT only*:
  - X1
  - X2

    - X3
- T6 Power Inverter Module high voltage DC harness connector

*w/o CBT the high voltage interlock circuit 2 connects to the T24 Battery Charger - DC but does not monitor any high voltage connectors.

Conditions for Running the DTC

P1B3F

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock circuit.

P1B40

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 0 V on the high voltage interlock signal circuit.

  OR

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV powertrain control module 2 is commanding 5 V on the high voltage interlock signal circuit.

Conditions for Setting the DTC

P1B3F

The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is less than 24% of the commanded 5 V signal voltage.

P1B40

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 24% of the commanded 0 V signal voltage.

  OR

- The hybrid/EV powertrain control module 2 detects high voltage interlock circuit 5 V low reference voltage is greater than 44% of the commanded 5 V signal voltage.

Action Taken When the DTC Sets

- DTCs P1B3F and P1B40 are Type A DTCs.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors when vehicle speed is less than 5 km/h (3 mph).

Conditions for Clearing the DTC

DTCs P1B3F and P1B40 are Type A DTCs.

Diagnostic Aids

With all monitored high voltage components engaged and the Battery Charging System High Voltage Interlock Circuit is energized, observe the scan tool hybrid/EV powertrain control module 2 Battery Charging System High Voltage Interlock Circuit Status parameter for a PASS status. To help identify intermittent conditions, manipulate the monitored components and inline connectors. An open interlock circuit will display a FAIL status.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Verify all monitored high voltage components and connectors are connected.
2. Vehicle in Service Mode.
3. Observe the hybrid/EV powertrain control module 2 Battery Charging System High Voltage Interlock Circuit Status parameter. Verify the parameter indicates a PASS condition.
   - **The parameter indicates a FAIL condition**

     Refer to Circuit/System Testing.

   - **The parameter indicates a PASS condition**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable high voltage at the T24 Battery Charger - DC and the T6 Power Inverter Module. Refer to **High Voltage Disabling** procedure.

2. Verify the vehicle is not equipped with RPO CBT.
   - **If the vehicle is equipped with RPO CBT**
     1. Disconnect T24 Battery Charger-DC high voltage connectors X1, X2 and X3, if not already removed during the High Voltage Disabling procedure. Verify that the high voltage interlock circuit terminals at each high voltage connector - harness side are not bent or broken and are OK.
        - If not OK, replace the applicable high voltage harness.
        - If OK
     2. Test for less than 10 Ω between the high voltage interlock circuit terminals at each high voltage connector - harness side.
        - If 10 Ω or greater, replace the applicable high voltage harness.
        - If less than 10 Ω
     3. Reconnect the T24 Battery Charger high voltage connector X1, X2 and X3 and continue.
   - **If the vehicle is NOT equipped with RPO CBT or steps 2.1 - 2.3 have passed**
3. Disconnect the T24 Battery Charger-DC connector X9.
4. Test for 35 - 45 Ω between the 5 V signal circuit terminal 7 and the low reference circuit terminal 12 at T24 Battery Charger-DC connector X9, module side.
   - **If not within the specified range**

     Replace the T24 Battery Charger-DC.

   - **If within the specified range**
5. Test for infinite resistance between each of the terminals listed below and ground:
   - Terminal 7, module side
   - Terminal 12, module side
   - **If less than infinite resistance**

     Replace the T24 Battery Charger-DC.

   - **If infinite resistance**
6. Disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
7. Test for less than 10 Ω between the 5 V signal circuit terminal 67 at the K114B Hybrid/EV Powertrain Control Module 2 connector X1 and T24 Battery Charger-DC X9 terminal 7.
   - **If 10 Ω or greater**

     Repair the open/high resistance in the circuit.

   - **If less than 10 Ω**
8. Test for infinite resistance between K114B Hybrid/EV Powertrain Control Module 2 harness connector X1 terminal 67 and ground.
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
9. Disconnect T6 Power Inverter Module connector X1.
10. Test for less than 10 Ω between the 5 V signal circuit terminal 12 at the T24 Battery Charger-DC and terminal G2 at the T6 Power Inverter Module connector X1.
    - **If 10 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 10 Ω**
11. Test for infinite resistance between the 5 V signal circuit terminal 12 at the T24 Battery Charger-DC and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
12. Test for less than 10 Ω between the low reference circuit terminal 65 at the K114B Hybrid/EV Powertrain Control Module 2 and terminal G1 at the T6 Power Inverter Module connector X1.

  - **If 10 Ω or greater**

    Repair the open/high resistance in the circuit.

  - **If less than 10 Ω**

13. Test for infinite resistance between low reference circuit terminal 65 at the K114B Hybrid/EV Powertrain Control Module 2 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
14. Disconnect T6 Power Inverter Module high voltage connector X2, if not already removed during the High Voltage Disabling procedure. Verify that the high voltage interlock circuit terminals at the high voltage connector - harness side, are not bent or broken and are OK.
    - **If not OK**

      Replace the high voltage harness.

    - **If OK**
15. Test for less than 10 Ω between the high voltage interlock circuit terminals at the high voltage connector - harness side.
    - **If 10 Ω or greater**

      Replace the high voltage harness.

    - **If less than 10 Ω**
16. Reconnect T6 Power Inverter Module high voltage connector X2.
17. Test for 35 - 45 Ω between the 5 V signal circuit terminal G2 and low reference terminal G1 at T6 Power Inverter Module connector X1, module side.
    - **If not within the specified range**

      Replace the T6 Power Inverter Module.

    - **If within the specified range**
18. Test for infinite resistance between each of the terminals listed below and ground:
    - Terminal G2, module side
    - Terminal G1, module side
    - **If less than infinite resistance**

      Replace the T6 Power Inverter Module.

    - **If infinite resistance**
19. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **300-Volt Battery Positive and Negative Cable Replacement (Generator Battery Control Wiring Junction Block to Drive Motor Battery)** for high voltage harness replacement
- Refer to **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)** **High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)** for T24 battery charger-DC replacement.
- Refer to **Control Module References** for T6 power inverter module or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, OR P3041: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 CELL BALANCING CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**

- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1E92

Hybrid/EV Battery Interface Control Module 1 Cell Balancing Circuit

DTC P1E98

Hybrid/EV Battery Interface Control Module 2 Cell Balancing Circuit

DTC P1E9E

Hybrid/EV Battery Interface Control Module 3 Cell Balancing Circuit

DTC P1EA4

Hybrid/EV Battery Interface Control Module 4 Cell Balancing Circuit

DTC P1FC9

Hybrid/EV Battery Interface Control Module 5 Cell Balancing Circuit

DTC P1FCA

Hybrid/EV Battery Interface Control Module 6 Cell Balancing Circuit

DTC P1FCB

Hybrid/EV Battery Interface Control Module 7 Cell Balancing Circuit

DTC P1FCC

Hybrid/EV Battery Interface Control Module 8 Cell Balancing Circuit

DTC P1FCD

Hybrid/EV Battery Interface Control Module 9 Cell Balancing Circuit

DTC P1FCE

Hybrid/EV Battery Interface Control Module 10 Cell Balancing Circuit

DTC P3036

Hybrid/EV Battery Interface Control Module 11 Cell Balancing Circuit

DTC P3041

Hybrid/EV Battery Interface Control Module 12 Cell Balancing Circuit

Circuit/System Description

The high voltage hybrid/EV battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid/EV battery assembly.

To maintain a similar state of charge on the cell groups, the hybrid/EV powertrain control module 2 looks at the cell group voltages and determines which cell groups need energy removed in order to maintain the battery groups at a similar state of charge. This is known as cell balancing. There is a transistor switched resistor wired in parallel with the cell group internal to the hybrid/EV battery interface control module portion of the battery energy control module. The hybrid/EV powertrain control module 2 sends a command to the hybrid/EV battery energy control module to begin cell balancing.

Conditions for Running the DTC

- The hybrid/EV battery energy control module is awake and communicating.
- The high voltage fault circuit diagnostic is not running.
- The cell balancing circuit is greater than 3.0 V.

- None of the following DTCs are set, P1E8E, P1E94, P1E9A, P1EA0, P1FBD, P1FBE, P1FBF, P1FC0, P1FC1, P1FC2, P3037, P3042, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, or U2624.

Conditions for Setting the DTC

The battery energy control module has detected an internal cell balancing switch fault.

Actions Taken When the DTC Sets

- DTCs P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, and P3041 are Type A DTCs.
- Cell balancing is disabled.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, and P3041 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Verify that no other DTCs are set.
   - **If any other DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If no other DTCs are set**
2. Verify that DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036, or P3041 is set.
   - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA, P1FCB, P1FCC, P1FCD, P1FCE, P3036 or P3041 is set**
     1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.

    2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .

    - **If none of the DTCs are set**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K16 battery energy control module replacement, programming and setup.

DTC P1EAB OR P1EAC: BATTERY ENERGY CONTROL MODULE HYBRID/EV BATTERY CELL HIGH VOLTAGE AND/OR HYBRID/EV BATTERY CELL OVERVOLTAGE SIGNAL CIRCUIT PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1EAB

Battery Energy Control Module Hybrid/EV Battery Cell High Voltage

DTC P1EAC

Hybrid/EV Battery Cell Overvoltage Signal Circuit Performance

Circuit/System Description

The 2nd protection circuit is a redundant method to monitor cell group overvoltage. The 2nd protection circuit is the actual hardwire signal from the battery energy control module to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 monitors this line to determine when a cell group overvoltage condition exists, independently of the cell group diagnostic trouble codes transmitted via serial data from the battery energy control module to the hybrid powertrain control module 2.

The 2nd protection self test diagnostic is used to check the signal circuit. The battery energy control module performs this test, once, every power up cycle. When run/crank input signal transitions high and after a calibrated delay, the battery energy control module informs the hybrid/EV powertrain control module 2, via serial data communication bus that it is about to run the diagnostics on the 2nd protection circuit. The battery energy control module then proceeds to command, via internal serial data, each of its internal battery interface control modules to run the check on its hardwire output. Each of the battery interface control modules pulls the signal circuit low and releases it, in sequence. If any pulses are missing, the battery energy control module sets a related fault, and sends this information to the hybrid/EV powertrain control module 2 on the serial data. Additionally, the hybrid powertrain control module 2 monitors the 2nd protection circuit for opens, shorts to ground and shorts to voltage.

Conditions for Running the DTC

P1EAB

- The battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- DTC P0B3D, P0B42, P0B47, P0B4C, P0B51, P0B56, P0B5B, P0B60, P0B65, P0B6A, P0B6F, P0B74, P0B79, P0B7E, P0B83, P0B88, P0B8D, P0B92, P0B97, P0B9C, P0BA1, P0BA6, P0BAB, P0BB0, P0BB5, P0BBA, P1B17, P1B1A, P1B1D, P1B20, P1B23, P1B26, P1B46, P1B49, P1B4C, P1B4F, P1B52, P1B55, P1B58, P1B5B, P1B5E, P1B61, P1B64, P1B67, P1B6A, P1B6D, P1B70, P1B73, P1B76, P1B79, P1B7C, P1B7F, P1B82, P1B85, P1B88, P1B8B, P1B8E, P1B91, P1B94, P1B97, P1B9A, P1B9D, P1BA0, P1BA3, P1BA6, P1BA9, P1BAC, P1BAF, P1BB2, P1BB5, P1BB8, P1BBB, P1BBE, P1BC1, P1BC4, P1BC7, P1BCA, P1BCD, P1BD0, P1BD3, P1BD6, P1BD9, P1BDC, P1BDF, P1BE2, P1BE5, P1BE8, P1BEB, P1BEE, P1BF1, P1BF4, P1BF7, P1BFA, P1BFD, P1E02, P1E05, P0B3E, P0B43, P0B48, P0B4D, P0B52, P0B57, P0B5C, P0B61, P0B66, P0B6B, P0B70, P0B75, P0B7A, P0B7F, P0B84, P0B89, P0B8E, P0B93, P0B98, P0B9D, P0BA2, P0BA7, P0BAC, P0BB1, P0BB6, P0BBB, P1B18, P1B1B, P1B1E, P1B21, P1B24, P1B27, P1B47, P1B4A, P1B4D, P1B50, P1B53, P1B56, P1B59, P1B5C, P1B5F, P1B62, P1B65, P1B68, P1B6B, P1B6E, P1B71, P1B74, P1B77, P1B7A, P1B7D, P1B80, P1B83, P1B86, P1B89, P1B8C, P1B8F, P1B92, P1B95, P1B98, P1B9B, P1B9E, P1BA1, P1BA4, P1BA7, P1BAA, P1BAD, P1BB0, P1BB3, P1BB6, P1BB9, P1BBC, P1BBF, P1BC2, P1BC5, P1BC8, P1BCB, P1BCE, P1BD1, P1BD4, P1BD7, P1BDA, P1BDD, P1BE0, P1BE3, P1BE6, P1BE9, P1BEC, P1BEF, P1BF2, P1BF5, P1BF8,

P1BFB, P1BFE, P1E03, P1E06, P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E86, P1E87, P1E88, P1E89, P1E8A, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, U2624, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, P1FA6, P1FA7, P1FA8, P1FA9, P1FAA, P1FAB, P3030, P303B, U0111, or U185A is not set

- The 12 V battery voltage is greater than or equal to 10.2 V.
- Vehicle must be cycled from Vehicle OFF to Vehicle ON.
- Vehicle is ON for greater than 5 seconds.
- Hybrid powertrain control module 1 detects high voltage bus is greater than 312 V.
- Battery charging is not active.

P1EAC

- The battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- DTC U0111 or U185A is not set.
- The 12 V battery voltage greater than or equal to 10.2 V.
- Vehicle must be cycled from Vehicle OFF to Vehicle ON.
- Vehicle is ON for greater than 5 seconds.

Conditions for Setting the DTC

P1EAB

A cell group voltage of greater than 4.5 V is detected.

OR

The hybrid powertrain control module 2 has detected a fault with the 2nd protection circuit.

P1EAC

The hybrid/EV powertrain control module 2 has detected a fault with the 2nd protection circuit.

Action Taken When the DTC Sets

DTCs P1EAB and P1EAC are type A DTCs.

P1EAB

Once the vehicle has been turned OFF, the hybrid/EV powertrain control module 2 will lock out the high voltage contactors until the **Clear Secured High Voltage DTCs** procedure has been performed.

P1EAC

The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

- DTCs P1EAB and P1EAC are type A DTCs.
- Vehicle Power cycled from ON to OFF after code clear.

P1EAB

After the repair for DTC P1EAB, with a scan tool, perform the **Clear Secured High Voltage DTCs** repair instruction.

Diagnostic Aids

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

The Hybrid/EV Battery Section schematics in Energy Storage identify the battery section and voltage sense circuit terminal locations appropriate to each cell group and corresponding DTC.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50214** Low Voltage Jumper Harness Extension

Equivalent regional tools: **Special Tools** .

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0B3B, P0B3D, P0B3E, P0B40, P0B42, P0B43, P0B45, P0B47, P0B48, P0B4A, P0B4C, P0B4D, P0B4F, P0B51, P0B54, P0B52, P0B56, P0B57, P0B59, P0B5B, P0B5C, P0B5E, P0B60, P0B61, P0B63, P0B65, P0B66, P0B68, P0B6A, P0B6B, P0B6D, P0B6F, P0B70, P0B72, P0B74, P0B75, P0B77, P0B79, P0B7A, P0B7C, P0B7E, P0B7F, P0B81, P0B83, P0B84, P0B86, P0B88, P0B89, P0B8B, P0B8D, P0B8E, P0B90, P0B92, P0B93, P0B95, P0B97, P0B98, P0B9A, P0B9C, P0B9D, P0B9F, P0BA1, P0BA2, P0BA4, P0BA6, P0BA7, P0BA9, P0BAB, P0BAC, P0BAE, P0BB0, P0BB1, P0BB3, P0BB5, P0BB6, P0BB8, P0BBA, P0BBB, P1B17, P1B18, P1B1A, P1B1B, P1B1D, P1B1E, P1B20, P1B21, P1B23, P1B24, P1B26, P1B27, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1B46, P1B47, P1B4A, P1B4C, P1B4D, P1B4F, P1B50, P1B52, P1B53, P1B55, P1B56, P1B58, P1B59, P1B5B, P1B5C, P1B5E, P1B5F, P1B61, P1B64, P1B62, P1B65, P1B67, P1B68, P1B6A, P1B6B, P1B6D, P1B6E, P1B70, P1B71, P1B73, P1B74, P1B76, P1B77, P1B79, P1B7A, P1B7C, P1B7D, P1B7F, P1B80, P1B82, P1B83, P1B85, P1B86, P1B88, P1B89, P1B8B, P1B8C, P1B8E, P1B8F, P1B91, P1B92, P1B94, P1B95, P1B97, P1B98, P1B9A, P1B9B, P1B9D, P1B9E, P1BA0, P1BA1, P1BA3, P1BA4, P1BA6, P1BA7, P1BA9, P1BAA, P1BAC, P1BAD, P1BAF, P1BB0, P1BB2, P1BB3, P1BB5, P1BB6, P1BB8, P1BB9, P1BBB, P1BBC, P1BBE, P1BBF, P1BC1, P1BC2, P1BC4, P1BC5, P1BC7, P1BC8, P1BCA, P1BCB, P1BCD, P1BCE, P1BD0, P1BD1, P1BD3, P1BD4, P1BD6, P1BD7, P1BD9, P1BDA, P1BDC, P1BDD, P1BDF, P1BE0, P1BE2, P1BE3, P1BE5,

P1BE6, P1BE8, P1BE9, P1BEB, P1BEC, P1BEE, P1BEF, P1BF1, P1BF2, P1BF4, P1BF5, P1BF7, P1BF8, P1BFA, P1BFB, P1BFD, P1BFE, P1E02, P1E03, P1E05, P1E06, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, U2603, U2604, U2605, or U2606 is not set.

- **If any of the DTCs are set**

  Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

- **If none of the DTCs are set**

3. Verify that DTC P1EAB or P1EAC is not set.
   - **If DTC P1EAB or P1EAC is set**

     Refer to Circuit/System Testing

   - **If DTC P1EAB or P1EAC is not set**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle in Service Mode.
2. Verify the hybrid/EV powertrain control module 2 scan tool Maximum Hybrid/EV Battery Module Voltage parameter is 4.5 V or less.
   - **If greater than 4.5 V**

     Replace the A4 Hybrid/EV Battery Pack.

   - **If 4.5 V or less**
3. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.

   NOTE: **Connecting the 12 V battery with the manual service disconnect removed will set DTCs.**

4. Connect the 12 V battery. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack. Vehicle in Service Mode.
5. Test for 4.8 - 5.2 V between the signal circuit terminal 9 and ground.

- **If less than 4.8 V**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid Powertrain Control Module 2.
2. Test for infinite resistance between the signal circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K114B Hybrid Powertrain Control Module 2. After the repair, with a scan tool, perform the **Clear Secured High Voltage DTCs** repair instruction.

- **If 5.2 V or greater**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2. After the repair, with a scan tool, perform the **Clear Secured High Voltage DTCs** repair instruction.

- **If between 4.8 - 5.2 V**

6. Vehicle OFF, remove the A4 Hybrid/EV Battery Pack Cover. Refer to **Battery Upper Cover Replacement** .
7. Connect **EL-50214** Low Voltage Jumper Harness Extension. Disconnect the X8 harness connector at the K16 Battery Energy Control Module. Vehicle in Service Mode.
8. Test for 4.8 - 5.2 V between the signal circuit terminal 8 and ground.
    - **If not within the specified range**

      Replace the Hybrid/EV Battery Pack Internal Harness. After the repair, with a scan tool, perform the **Clear Secured High Voltage DTCs** repair instruction.

    - **If within the specified range**
9. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)** for A4 Hybrid/EV Battery Pack replacement.
- Refer to **Drive Motor Battery Control Module Wiring Harness Replacement** for hybrid/EV battery pack internal harness replacement
- Refer to **Control Module References** for K16 battery energy control module or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1EAD-P1EB0 OR P3240-P3253: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 CELL OVERVOLTAGE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1EAD

Hybrid/EV Battery Interface Control Module 1 Cell Overvoltage Signal Circuit

DTC P1EAE

Hybrid/EV Battery Interface Control Module 2 Cell Overvoltage Signal Circuit

DTC P1EAF

Hybrid/EV Battery Interface Control Module 3 Cell Overvoltage Signal Circuit

DTC P1EB0

Hybrid/EV Battery Interface Control Module 4 Cell Overvoltage Signal Circuit

DTC P3240

Hybrid/EV Battery Interface Control Module 1 Cell Overvoltage

DTC P3241

Hybrid/EV Battery Interface Control Module 2 Cell Overvoltage

DTC P3242

Hybrid/EV Battery Interface Control Module 3 Cell Overvoltage

DTC P3243

Hybrid/EV Battery Interface Control Module 4 Cell Overvoltage

DTC P3244

Hybrid/EV Battery Interface Control Module 5 Cell Overvoltage

DTC P3245

Hybrid/EV Battery Interface Control Module 5 Cell Overvoltage Signal Circuit

DTC P3246

Hybrid/EV Battery Interface Control Module 6 Cell Overvoltage

DTC P3247

Hybrid/EV Battery Interface Control Module 6 Cell Overvoltage Signal Circuit

DTC P3248

Hybrid/EV Battery Interface Control Module 7 Cell Overvoltage

DTC P3249

Hybrid/EV Battery Interface Control Module 7 Cell Overvoltage Signal Circuit

DTC P324A

Hybrid/EV Battery Interface Control Module 8 Cell Overvoltage

DTC P324B

Hybrid/EV Battery Interface Control Module 8 Cell Overvoltage Signal Circuit

DTC P324C

Hybrid/EV Battery Interface Control Module 9 Cell Overvoltage

DTC P324D

Hybrid/EV Battery Interface Control Module 9 Cell Overvoltage Signal Circuit

DTC P324E

Hybrid/EV Battery Interface Control Module 10 Cell Overvoltage

DTC P324F

Hybrid/EV Battery Interface Control Module 10 Cell Overvoltage Signal Circuit

DTC P3250

Hybrid/EV Battery Interface Control Module 11 Cell Overvoltage

DTC P3251

Hybrid/EV Battery Interface Control Module 11 Cell Overvoltage Signal Circuit

DTC P3252

Hybrid/EV Battery Interface Control Module 12 Cell Overvoltage

DTC P3253

Hybrid/EV Battery Interface Control Module 12 Cell Overvoltage Signal Circuit

Circuit/System Description

The hybrid battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of the battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1EAD, P1EAE, P1EAF, P1EB0, P3240, P3241, P3242, P3243, P3244, P3245, P3246, P3247, P3248, P3249, P324A, P324B, P324C, P324D, P324E, P324F, P3250, P3251, P3252, and P3253

- The battery energy control module is awake and communicating.
- The 12 V battery voltage greater than or equal to 10.2 V.
- The high voltage bus as measured by the hybrid powertrain control module 1 is greater than 312V.
- None of the following DTCs are set; P0B3B, P0B40, P0B45, P0B4A, P0B4F, P0B54, P0B59, P0B5E, P0B63, P0B68, P0B6D, P0B72, P0B77, P0B7C, P0B81, P0B86, P0B8B, P0B90, P0B95, P0B9A, P0B9F, P0BA4, P0BA9, P0BAE, P0BB3, P0BB8, P1B28, P1B29, P1B2A, P1B2B, P1B2C, P1B2D, P1E4C, P1E4D, P1E4E, P1E4F, P1E50, P1E51, P1E52, P1E53, P1E54, P1E55, P1E56, P1E57, P1E58, P1E59, P1E5A, P1E5B, P1E5C, P1E5D, P1E5E, P1E5F, P1E60, P1E61, P1E62, P1E63, P1E64, P1E65, P1E66, P1E67, P1E68, P1E69, P1E6A, P1E6B, P1E6C, P1E6D, P1E6E, P1E6F, P1E70, P1E71, P1E72, P1E73, P1E74, P1E75, P1E76, P1E77, P1E78, P1E79, P1E7A, P1E7B, P1E7C, P1E7D, P1E7E, P1E7F, P1E80, P1E81, P1E82, P1E83, P1E84, P1E85, P1E86, P1E87, P1E88, P1E89, P1E8A, P1E8B, U2603, U2604, U2605, U2606, U2617, U2618, U2619, U2620, U2621, U2622, U2623, or U2624.

Conditions for Setting the DTC

P1EAD, P1EAE, P1EAF, P1EB0, P3245, P3247, P3249, P324B, P324D, P324F, P3251, and P3253

The battery energy control module has not detected a response from the internal interface control module overvoltage signal circuit test that occurs within 50 seconds of key-ON.

P3240, P3241, P3242, P3243, P3244, P3246, P3248, P324A, P324C, P324E, P3250, and P3252

The battery energy control module has detected a cell group voltage of greater than 4.5V.

OR

The battery energy control module detects a failure of the internal interface control module overvoltage signal circuit.

Actions Taken When the DTC Sets

DTCs P1EAD, P1EAE, P1EAF, P1EB0, P3240, P3241, P3242, P3243, P3244, P3245, P3246, P3247, P3248, P3249, P324A, P324B, P324C, P324D, P324E, P324F, P3250, P3251, P3252, and P3253 are Type A DTCs.

Conditions for Clearing the DTC

DTCs P1EAD, P1EAE, P1EAF, P1EB0, P3240, P3241, P3242, P3243, P3244, P3245, P3246, P3247, P3248, P3249, P324A, P324B, P324C, P324D, P324E, P324F, P3250, P3251, P3252, and P3253 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Verify that DTC P1EAD, P1EAE, P1EAF, P1EB0, P3245, P3247, P3249, P324B, P324D, P324F, P3251, or P3253 is not set.
   - **If DTC P1EAD, P1EAE, P1EAF, P1EB0, P3245, P3247, P3249, P324B, P324D, P324F, P3251, or P3253 is set**
   1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
   2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
   - **If none of the DTCs are set**
2. Verify that DTC P3240, P3241, P3242, P3243, P3244, P3246, P3248, P324A, P324C, P324E, P3250, or P3252 is not set.
   - **If DTC P3240, P3241, P3242, P3243, P3244, P3246, P3248, P324A, P324C, P324E, P3250, or P3252 is set**
   1. Disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
   2. Replace the A4 Hybrid/EV Battery Pack.
   - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)** for A4 Hybrid/EV Battery Pack replacement
- Refer to **Control Module References** for K16 battery energy control module programming and setup.

DTC P1FD5-P1FF2, P3038-P303A, OR P3043-P3045: HYBRID/EV BATTERY INTERFACE CONTROL MODULE 1-12 VOLTAGE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1FD5

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Circuit Low Voltage

DTC P1FD6

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Circuit Low Voltage

DTC P1FD7

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Circuit Low Voltage

DTC P1FD8

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Circuit Low Voltage

DTC P1FD9

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Circuit Low Voltage

DTC P1FDA

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Circuit Low Voltage

DTC P1FDB

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Circuit Low Voltage

DTC P1FDC

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Circuit Low Voltage

DTC P1FDD

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Circuit Low Voltage

DTC P1FDE

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Circuit Low Voltage

DTC P1FDF

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Circuit High Voltage

DTC P1FE0

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Circuit High Voltage

DTC P1FE1

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Circuit High Voltage

DTC P1FE2

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Circuit High Voltage

DTC P1FE3

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Circuit High Voltage

DTC P1FE4

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Circuit High Voltage

DTC P1FE5

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Circuit High Voltage

DTC P1FE6

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Circuit High Voltage

DTC P1FE7

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Circuit High Voltage

DTC P1FE8

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Circuit High Voltage

DTC P1FE9

Hybrid/EV Battery Interface Control Module 1 Voltage Sensor Performance

DTC P1FEA

Hybrid/EV Battery Interface Control Module 2 Voltage Sensor Performance

DTC P1FEB

Hybrid/EV Battery Interface Control Module 3 Voltage Sensor Performance

DTC P1FEC

Hybrid/EV Battery Interface Control Module 4 Voltage Sensor Performance

DTC P1FED

Hybrid/EV Battery Interface Control Module 5 Voltage Sensor Performance

DTC P1FEE

Hybrid/EV Battery Interface Control Module 6 Voltage Sensor Performance

DTC P1FEF

Hybrid/EV Battery Interface Control Module 7 Voltage Sensor Performance

DTC P1FF0

Hybrid/EV Battery Interface Control Module 8 Voltage Sensor Performance

DTC P1FF1

Hybrid/EV Battery Interface Control Module 9 Voltage Sensor Performance

DTC P1FF2

Hybrid/EV Battery Interface Control Module 10 Voltage Sensor Performance

DTC P3038

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit Low Voltage

DTC P3039

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit High Voltage

DTC P303A

Hybrid/EV Battery Interface Control Module 11 Voltage Sensor Circuit Performance

DTC P3043

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit Low Voltage

DTC P3044

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit High Voltage

DTC P3045

Hybrid/EV Battery Interface Control Module 12 Voltage Sensor Circuit Performance

Circuit/System Description

The hybrid battery contains 288 individual cells. Three cells are welded together in parallel and called a cell group. There are a total of 96 cell groups in the hybrid battery assembly.

The battery energy control module monitors the voltage of the 96 battery cell groups. The voltage sense lines are attached to each individual cell group, and these sense lines terminate at connectors located on the end of the battery module. A voltage sense harness joins these connectors to the battery energy control module.

The battery energy control module contains internal interface control modules that monitor specific cell groups.

The battery energy control module will determine when a fault condition is present. Diagnostics and system status are communicated from the battery energy control module to the hybrid powertrain control module 2 through serial data. The hybrid powertrain control module 2 is the host controller for diagnostic trouble code information.

Conditions for Running the DTC

P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P3038, P3039, P3043, and P3044

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- None of the hybrid/EV battery energy control module loss of communication with hybrid/EV battery interface control module 1 - 12 DTCs are set.
- None of the hybrid/EV battery interface control module 1 - 12 performance DTCs are set.

P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P303A, and P3045

- The hybrid/EV battery energy control module and hybrid/EV powertrain control module 2 are awake and communicating.
- None of the hybrid/EV battery energy control module loss of communication with hybrid/EV battery interface control module 1 - 12 DTCs are set.
- None of the hybrid/EV battery interface control module 1 - 12 performance DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit low voltage DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit high voltage DTCs are set.
- None of the hybrid/EV battery 1 - 96 circuit DTCs are set.

Conditions for Setting the DTC

P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P3038, and P3043

A hybrid/EV battery interface control module has detected the voltage sum of 8 cell groups in a section are less than 1.5 V.

P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P3039, and P3044

A hybrid/EV battery interface control module has detected the voltage sum of 8 cell groups in a section are greater than 48.5 V.

P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P303A, and P3045

A hybrid/EV battery interface control module has detected a deviation between the module voltage sum of a half section minus the voltage sum of 8 individual cell groups in a section is greater than 0.6 V

Actions Taken When the DTC Sets

- DTCs P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P3038, P3039, P303A, P3043, P3044, and P3045 are Type A DTCs.
- The vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P1FD5, P1FD6, P1FD7, P1FD8, P1FD9, P1FDA, P1FDB, P1FDC, P1FDD, P1FDE, P1FDF, P1FE0, P1FE1, P1FE2, P1FE3, P1FE4, P1FE5, P1FE6, P1FE7, P1FE8, P1FE9, P1FEA, P1FEB, P1FEC, P1FED, P1FEE, P1FEF, P1FF0, P1FF1, P1FF2, P3038, P3039, P303A, P3043, P3044, and P3045 are Type A DTCs.

Reference Information

Description and Operation

Drive Motor Battery System Description

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Verify that DTC P1FD5-P1FF2, P3038, P3039, P303A, or P3043-P3045 is not set.
    - **If DTC P1FD5-P1FF2, P3038, P3039, P303A, or P3043-P3045 is set**
    1. Vehicle OFF, disable high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling**.
    2. Replace the K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
    - **If none of the DTCs are set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K16 battery energy control module replacement, programming and setup.

DTC P1F17: SYSTEM ISOLATION/IMPACT SENSOR FAULT - HYBRID/EV BATTERY SYSTEM CONTACTORS OPEN

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1F17

System Isolation/Impact Sensor Fault - Hybrid/EV Battery System Contactors Open

Circuit/System Description

The hybrid/EV powertrain control module 2 will set DTC P1F17 if the hybrid/EV powertrain control module 1 has detected a passive loss of isolation, the supplemental inflatable restraint sensors are not working or has lost communications with the hybrid/EV powertrain control module 1 and the supplemental inflatable restraint module.

Conditions for Running the DTC

Vehicle ON.

Conditions for Setting the DTC

- P1AF0, P1AF2, or P1E22 is set in the hybrid/EV powertrain control module 1.
- The supplemental inflatable restraint module roll over, air bag, or inertia sensors are not working.

OR

- P1AF0, P1AF2, or P1E22 is set in the hybrid/EV powertrain control module 1.
- DTC U184E is set.

OR

- The hybrid/EV powertrain control module 2 has lost communications with the hybrid/EV powertrain control module 1.
- DTC U184E is set.

OR

- The hybrid/EV powertrain control module 2 has lost communications with the hybrid/EV powertrain control module 1.
- The supplemental inflatable restraint module roll over, air bag, or inertia sensors are not working.

Action Taken When the DTC Sets

- DTC P1F17 is a type A DTC.
- All of the contactors will be prevented from closing.

Conditions for Clearing the DTC

- DTC P1F17 is a type A DTC.
- The **Clear Secured High Voltage DTCs** reset function must be performed with a scan tool before clear codes.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that no other DTCs are set.
    - **If any other DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If none of the DTCs are set**
3. Verify that DTC P1F17 is not set.
    - **If DTC P1F17 is set**
    1. Verify the K36 Inflatable Restraint Sensing And Diagnostic Module is programmed with the correct software calibration.
        - If the correct software is not installed, program the K36 Inflatable Restraint Sensing And Diagnostic Module.
        - If the correct software is installed
    2. Perform the **Clear Secured High Voltage DTCs** repair instruction.
    3. Verify that DTC P1F17 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If DTC P1F17 is set, replace the K114B Hybrid Powertrain Control Module 2.
        - If DTC P1F17 is not set
    4. All OK.
    - **If DTC P1F17 is not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for hybrid/EV powertrain control module 2 and inflatable restraint sensing and diagnostic module replacement, programming and setup.

DTC P1FF4: SYSTEM ISOLATION/IMPACT SENSOR FAULT - HYBRID/EV BATTERY SYSTEM CONTACTORS OPEN

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1FF4

System Isolation/Impact Sensor Fault - Hybrid/EV Battery System Contactors Open

Circuit/System Description

The hybrid/EV powertrain control module 2 will set DTC P1FF4 if the hybrid/EV powertrain control module 1 has detected a passive loss of isolation, the supplemental inflatable restraint sensors are not working or has lost communications with the hybrid/EV powertrain control module 1 and the supplemental inflatable restraint module.

Conditions for Running the DTC

- Vehicle ON.
- The 12 V battery voltage is greater than 9 V.

Conditions for Setting the DTC

- P0AA1 and P301C is set.

  OR

- P0AA4 and P301D is set.

  OR

- P301C and P301D is set.

Action Taken When the DTC Sets

- DTC P1FF4 is a type A DTC.
- All of the contactors will be prevented from closing.
- Charging is disabled.

Conditions for Clearing the DTC

- DTC P1FF4 is a type A DTC.
- The **DC Charging Disabled Reset** function must be performed with a scan tool before clear codes.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that no other DTCs are set.
    - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

2. Verify the K36 Inflatable Restraint Sensing And Diagnostic Module is programmed with the correct software calibration.
   - **If the correct software is not installed**

     Program the K36 Inflatable Restraint Sensing And Diagnostic Module. Refer to **Control Module References**

   - **If the correct software is installed**
3. Perform the **High Voltage System Inspection**
4. Perform the **DC Charging Disabled Reset** .
5. If DTC P1FF4 is set, clear the DTC. Review and operate the vehicle according to the DTC Conditions for Running. Verify that DTC P1FF4 does not reset and no other DTCs are set.
   - **If any other DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If DTC P1FF4 is set**

     Replace the K114B Hybrid/EV Powertrain Control Module 2.

   - **If no DTCs are set**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for hybrid/EV powertrain control module 2 and inflatable restraint sensing and diagnostic module replacement, programming and setup.

LOSS OF ISOLATION ON THE HIGH VOLTAGE MAIN BUS

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

Vehicles equipped with high voltage energy storage are designed with the high voltage circuits isolated from the vehicle chassis. If either the positive or negative high voltage Direct Current (DC) circuits or any of the high voltage Alternating Current (AC) phase circuits lose this isolation to the vehicle chassis, one or more diagnostic trouble codes (DTCs) may set.

The vehicle utilizes Passive and Active isolation testing to determine the amount of isolation between the high voltage and the chassis.

Passive isolation testing is performed within the power inverter module and tests whenever the high voltage main contactors are closed. Utilizing a high impedance resistor network, passive isolation detection monitors all high voltage components including the hybrid/EV battery pack and isolation loss results in DTCs P1AF0, P1AF2 and/or P1E22. Real-time status of passive isolation detection can be determined by observing the delta between the Positive Supply Isolation Voltage and Negative Supply Isolation Voltage scan tool parameters. The parameters are displayed by any of the Motor Control Modules and can also be observed in certain hybrid powertrain control module 2 data lists.

Active isolation testing is performed by the hybrid powertrain control module 2 and tests after the high voltage main contactors open. Utilizing an injected AC signal, active isolation detection monitors the internal Hybrid/EV battery pack as well as the charging system direct current (DC) high voltage circuits and isolation loss results in DTCs P0AA6 or P0DAA. Status for the prior active isolation detection event can be determined by observing the hybrid powertrain control module 2 Isolation Test Resistance scan tool parameter. Real-time status observation requires the HPCM2 scan tool control function Hybrid/EV Battery Pack Isolation Test.

Diagnosis for isolation requires testing with high voltage potential. Special insulation testing multimeters such as the **EL-50772** utilize their own internal high voltage and must be used to test the isolation capability of high voltage components and circuits. Refer to Troubleshooting With an Insulation Multimeter.

Diagnostic Aids

Prior to disabling high voltage:

Monitoring certain scan tool parameters when high voltage is active may help to identify which high voltage components and circuits have lost their chassis isolation. The Vehicle Information selection within the HPCM2 scan tool Data Display contains many parameters related to isolation diagnosis. The Drive Motor Control Module Positive Supply Isolation Voltage and Drive Motor Control Module Negative Supply Isolation Voltage parameters provide a real-time indication of isolation status. The parameters will shift in respect to one another relative to the level of isolation loss. The greater the delta, or difference, between parameters, the less isolation exists between high voltage and the vehicle chassis.

Isolation Loss between HV Components and Chassis, Positive Side*

Isolation between HV Bus and Chassis	Normal Vehicle	10M	5M	1M	500K	200K Approximate Passive Isolation DTC set point	100K	None - Direct Short
Positive Isolation Parameter*	198V	180V	165V	110V	75V	35V	20V	0V
Negative Isolation Parameter*	192V	210V	225V	280V	315V	355V	370V	390V
Delta Between Parameters	0 - 15V	30V	60V	170V	240V	320V	350V	390V
*Typical values observed with a fully charged pack, 390V. A short to the positive bus is shown, a short to the negative bus would display inverted voltages of similar value.								

Certain isolation loss concerns may only appear during high moisture environmental conditions. Drive the vehicle thru an underbody spraying-style car wash while monitoring the delta between Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters.

Isolation loss might only occur when a high voltage device is active. Use the High Voltage Component Test Method table and operate each HV component while monitoring the delta between Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters.

High Voltage Component Test Methods

HV Component	Scan Tool Parameter	Most Complete Test Method
G1 Electric A/C Compressor	Power Requested by Electric A/C Compressor from Hybrid/EV Battery Pack (HPCM2)	HVAC Cabin Controls and monitor parameter Isolation Voltages Delta
K10 Coolant Heater	Power Requested by Electric Passenger Compartment Heater from Hybrid/EV Battery Pack (HPCM2)	HVAC Cabin Controls and monitor parameter Isolation Voltages Delta
E54 Battery Heater*	Hybrid/EV Battery Pack Heater Power Command (HPCM2)	Hybrid/EV Battery Pack Heater Power GDS2 Scan Tool Control Function (HPCM2) and monitor parameter Isolation Voltages Delta
		Review the DTC P1EC6 Conditions for Running and monitor parameter Isolation Voltages Delta while heater is commanded ON
T18 Battery Charger	N/A - Active During Charge	Insulation Multimeter
T24 Battery Charger - DC (CBT)	N/A - Active During Charge and Active with High Voltage Enabled	Insulation Multimeter
T24 Battery Charger - DC (w/o CBT)	N/A - Always Active with High Voltage Enabled	Insulation Multimeter
K1 14V Power Module	14V Module High Voltage Circuit Current (HPCM1)	Insulation Multimeter
T6 Power Inverter Module	N/A - Always Active with High Voltage Enabled	Insulation Multimeter
M15 Drive Motor	N/A - Always Active with High Voltage Enabled	Insulation Multimeter

HV Component	Scan Tool Parameter	Most Complete Test Method
A4 Battery Pack - Internal Side of Contactors	Isolation Concern Results in DTC P0AA6/P0DAA	
*Because the E54 Battery Heater is always connected to the positive bus, an isolation fault may result in a delta decrease when commanded ON.		

After disabling high voltage:

High Voltage cables disconnected at each end from their respective modules must be tested with the insulation meter connected to their shield circuit and not to vehicle chassis.

The **EL-50772** insulation meter, when set to the 500V scale, indicates 550M Ω when measuring infinite or open circuit conditions. An equivalent meter may display 'infinite' value in a different manner.

Reference Information

Schematic Reference

- **Hybrid/EV Energy Storage Schematics**
- **Hybrid/EV Controls Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV System High Voltage Isolation Description for:

- Passive Isolation circuit detail
- Active Isolation circuit detail
- Complete High Voltage system schematic

Electrical Information Reference

Troubleshooting With an Insulation Multimeter

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50772** Insulation Multimeter

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Remove all vehicle chargers.
2. Vehicle ON.
3. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3 is not set.
    - **If any DTC is set**

      Refer to **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**.

    - **If none of the DTCs are set**
4. Verify that DTC P0AA6 or P1AE6 is not set.
    - **If any DTC is set**

      Refer to **DTC P0AA6 or P1AE6**.

    - **If none of the DTCs are set**

5. Vehicle ON. Confirm propulsion system is active with battery positive and negative high voltage contactors closed. You cannot continue with loss of isolation diagnosis if high voltage is not active.
   - **If high voltage is not active**

     Diagnose and repair appropriate DTCs and repeat Circuit/System Verification. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If high voltage is active**

NOTE: **Isolation related parameters from several modules can all be observed in hybrid powertrain control module 2, Data Display, Vehicle Information.**

6. Vehicle ON, observe the scan tool Drive Motor Positive Supply Isolation Voltage and the Drive Motor Negative Supply Isolation Voltage scan tool parameters.
7. Is the delta, or difference, between the Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters greater than 15 volts?
   - **If the delta is greater than 15 volts**

     Using the High Voltage Component Test Methods table as a guide, observe and record which components are active. Refer to Circuit/System Testing.

   - **If the delta is 15 volts or less**
8. Using the High Voltage Component Test Method table as a guide, turn ON devices one at a time while monitoring the isolation voltage delta.
9. Is the delta between the Drive Motor Positive Supply Isolation Voltage and the Drive Motor Negative Supply Isolation Voltage scan tool parameters greater than 15 volts when a component is active?
   - **If the delta is greater than 15 volts**

     Observe and record which components are active. Refer to Circuit/System Testing.

   - **If the delta is 15 volts or less**
10. Turn the vehicle OFF, open and close the drivers door and wait 2 minutes.
11. PRESS and HOLD the brake pedal and activate the HPCM2 scan tool control function Hybrid/EV Battery Pack Isolation Test. The battery pack isolation test will complete in less than a minute. Verify the Isolation Test Resistance parameter when the test is complete is greater than 600K Ω.
    - **If the resistance is 600K Ω or less**

      Refer to **DTC P0AA6 or P1AE6**.

    - **If the resistance is greater than 600K Ω**
12. Vehicle OFF. Connect the vehicle charge cord-AC. Ensure charge mode is active.
13. With charge mode already active, Vehicle ON and observe the scan tool Drive Motor Positive Supply Isolation Voltage and the Drive Motor Negative Supply Isolation Voltage scan tool parameters.
14. Is the delta between the Positive Supply Isolation Voltage and the Negative Supply Isolation Voltage scan tool parameters greater than 15 volts?
    - **If the delta is greater than 15 volts**

      Refer to Circuit/System Testing.

    - **If the delta is less than 15 volts**
15. All OK, review Diagnostic Aids.

Circuit/System Testing

WARNING: **Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.**

WARNING: **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:**

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**

- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: **This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.**

Failure to follow the procedure exactly as written may result in serious injury or death.

NOTE: **Wear your High Voltage Insulation gloves until you have determined that a high voltage exposure risk is no longer present.**

1. Vehicle OFF, disable the high voltage for every high voltage component. Refer to High Voltage Disabling.
2. Ensure only the **EL-50772** Insulation Multimeter or equivalent is used with this procedure. Select the Isolation Test setting, then select the 500V range. Refer to Troubleshooting With an Insulation Multimeter for important usage instructions.
3. Print the Complete High Voltage system schematic to assist you in your testing. Refer to Hybrid/EV System High Voltage Isolation Description .
4. Print the Component Isolation Test Table below.

NOTE:

- **You may test components in any order, if you identified a component in Circuit/System Verification that affects the isolation delta, test that component first.**
- **The component should be disconnected from all other high voltage components when testing.**
- **Test cables between their high voltage terminals and the cable shield, not chassis ground.**
- **Test HV modules/components between their high voltage terminals and the module case if conductive or chassis ground if not conductive.**
- **Test from the components positive high voltage terminal to the shield or chassis ground and then the negative high voltage terminal to the shield or chassis ground, never test from the positive high voltage terminal to the negative high voltage terminal.**
- **Print the Component Isolation Test Table and record your testing results.**

5. Test and record the minimum resistance between each components high voltage terminals and the shield or case/chassis ground as indicated by the Component Isolation Test table.
6. Replace any component that tests less than the expected resistance at any terminal.

Component Isolation Test Table

Component	Component Setup	Insulation Multimeter Test Point	EL-50772 Expected Results	Actual Result
NOTE: **High Voltage MUST be disabled and S15 Manual Service Disconnect removed prior to testing any components. Refer to Circuit/System Verification and Circuit/System Testing.**				
A4 Battery Pack - X3	Test battery pack side	DC Neg- HV terminal to battery pack ground strap	550M Ω	Â
		DC Pos+ HV terminal to battery pack ground strap	550M Ω	Â
A4 Battery Pack - X4	Test battery pack side	DC Neg- HV terminal to battery pack ground strap	550M Ω	Â

Component	Component Setup	Insulation Multimeter Test Point	EL-50772 Expected Results	Actual Result
NOTE: **High Voltage MUST be disabled and S15 Manual Service Disconnect removed prior to testing any components. Refer to Circuit/System Verification and Circuit/System Testing.**				
G1 Electric A/C Compressor	None	DC Pos+ HV terminal to battery pack ground strap	550M Ω	Â
		DC Neg- HV terminal to case/chassis	550M Ω*	Â
		DC Pos+ HV terminal to case/chassis	550M Ω*	Â
K10 Coolant Heater	Plug one coolant port and fill with coolant	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
E54 Battery Heater	Plug one coolant port and fill with coolant	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
T18 Battery Charger - X3 - module side	None	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
NOTE: **Except RPO CBT connector X2** T24 Battery Charger - DC - X1 and X3 thru X8 - module side	All high voltage connectors on component disconnected	DC Neg- HV terminal to case/chassis	550M Ω	Â
		DC Pos+ HV terminal to case/chassis	550M Ω	Â
NOTE: **RPO CBT Only** T24 Battery Charger - DC - X2- module side	All high voltage connectors on component disconnected	DC Neg- HV terminal to case/chassis	Greater than 15M Ω	Â
		DC Pos+ HV terminal to case/chassis	Greater than 15M Ω	Â
K1 14V Power Module	None	DC Neg- HV terminal to case/chassis	Greater than 100M Ω	Â
		DC Pos+ HV terminal to case/chassis	Greater than 100M Ω	Â
T6 Power Inverter Module - module side	M15 Drive Motor 3 phase AC HV cable terminals disconnected	DC Neg- HV terminal to case/chassis	1.1M - 1.3M Ω	Â
		DC Pos+ HV terminal to case/chassis	1.1M - 1.3M Ω	Â
		3 phase AC HV terminal U to case/chassis	1.1M - 1.3M Ω	Â
		3 phase AC HV terminal V to case/chassis	1.1M - 1.3M Ω	Â
		3 phase AC HV terminal W to case/chassis	1.1M - 1.3M Ω	Â
M15 Drive Motor	3 phase AC HV cable terminals disconnected	3 phase AC HV terminal U, V, or W to transmission case	550M Ω*	Â
300V Battery Positive and Negative Cable - G1 Electric A/C Compressor to T24 Battery Charger-DC	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - K10 Heater to T24 Battery Charger-DC	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â

Component	Component Setup	Insulation Multimeter Test Point	EL-50772 Expected Results	Actual Result
NOTE: **High Voltage MUST be disabled and S15 Manual Service Disconnect removed prior to testing any components. Refer to Circuit/System Verification and Circuit/System Testing.**				
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - E54 Heater to T24 Battery Charger-DC	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - T18 Battery Charger to K1 14V power Module and T24 Battery Charger-DC	Disconnect cable at all three modules	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - T6 Power Inverter Module to T24 Battery Charger-DC	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - A4 Battery Pack X3 to T24 Battery Charger-DC X3	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
300V Battery Positive and Negative Cable - A4 Battery Pack X4 to T24 Battery Charger-DC X7	Disconnect cable at both ends	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
NOTE: **RPO CBT ONLY.** 300V Battery Positive and Negative Cable - X98 Hybrid/EV Battery Charger Receptacle to T24 Battery Charger-DC X2	Charge Cord removed	DC Neg- HV terminal to cable shield	550M Ω	Â
		DC Pos+ HV terminal to cable shield	550M Ω	Â
3 phase AC cable - T6 Power Inverter Module to M15 Drive Motor	Disconnect cable at both ends	3 phase AC HV terminal U to cable shield	550M Ω	Â
		3 phase AC HV terminal V to cable shield	550M Ω	Â
		3 phase AC HV terminal W to cable shield	550M Ω	Â
* There may be up to a 5 second delay for proper test results to be displayed, always press and hold the **EL-50772** test button until maximum measurement values are observed.				

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **300-Volt Battery Positive and Negative Cable Replacement (Generator Battery Control Wiring Junction Block to Drive Motor Battery)**
- Refer to **Air Conditioning and Drive Motor Battery Cooling Compressor Replacement**
- Refer to **Heater Coolant Heater Replacement**
- Refer to **Accessory DC Power Control Module Replacement**
- Refer to **Drive Motor Rotor Removal** , and **Drive Motor Stator Removal** for drive motor replacement.
- Refer to **Drive Motor Power Inverter Module 3 Phase Cable Replacement**
- Refer to **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge) High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)** for T24 Batter Charger-DC.
- Refer to **High Voltage Battery Disconnect Relay Replacement** for BDU replacement.

- Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**
- Refer to **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)** **Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)** **Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)** **Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**
- Refer to **High Voltage Battery Heater Replacement**
- Refer to **Control Module References** for the T6 power inverter module replacement, programming and setup.

HYBRID/EV BATTERY VOLTAGE PRESENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or safely contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor and precharge negative high voltage contactor. The contactors close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for each high voltage contactor. Ground is provided through a vehicle ground external of the high voltage battery.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **Testing for Intermittent Conditions and Poor Connections**

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High**

Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

WARNING: **This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.**

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Review the high voltage safety information prior to performing the High Voltage Disabling procedure. Refer to High Voltage Safety
2. Verify the High Voltage Disabling procedure has been performed and the S15 manual service disconnect has been removed.
   - **The procedure has not been performed**

     Refer to High Voltage Disabling before continuing to the next step.

   - **The procedure has been performed**

NOTE: **Connecting the 12 V battery while leaving the S15 manual service disconnect out will set DTCs. Clear these DTCs after all repairs are complete.**

3. Disconnect the low voltage (X357) and (X358) harness connectors at the A4 Hybrid/EV Battery Pack. Connect the 12 V battery. Vehicle in Service Mode.
4. Test for less than 9.5 V at the following points and ground:
   - X358, Terminal 3
   - X358, Terminal 4
   - X358, Terminal 5
   - X358, Terminal 7
   - **If 9.5 V or greater**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
   - **If less than 9.5 V**
5. Vehicle OFF.

NOTE:

- **Wear your High Voltage Insulation gloves until you have determined that a**

high voltage exposure risk is no longer present.
- **A 9 V battery or the vehicles 12 V battery can be used to test the DMM.**

6. Test the DMM by measuring a known good 9 to 12 V battery.
   - **If the DMM does not properly measure the test battery**

     Repair or replace the DMM and repeat all voltage measurements.

   - **If the DMM does properly measure the test battery**
7. Replace the A4 Hybrid/EV Battery Pack. There is a stuck closed contactor and a loss of isolation within the A4 Hybrid/EV Battery Pack.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)** for A4 hybrid/EV battery pack replacement.

TROUBLESHOOTING WITH AN INSULATION MULTIMETER

Special Tools

EL-50772 Insulation Multimeter

For regional equivalent tools, refer to **Special Tools**

Diagnosis for isolation loss requires insulation testing with high voltage potential. Special multimeters that utilize their own built-in high voltage, such as the **EL-50772** Insulation Multimeter, test the isolation capability of high voltage components and circuits. Understanding an insulation multimeter and how it functions is necessary to obtain proper test results.

How to Use the Insulation Multimeter

1. Read all instructions and warnings that came with your insulation multimeter.

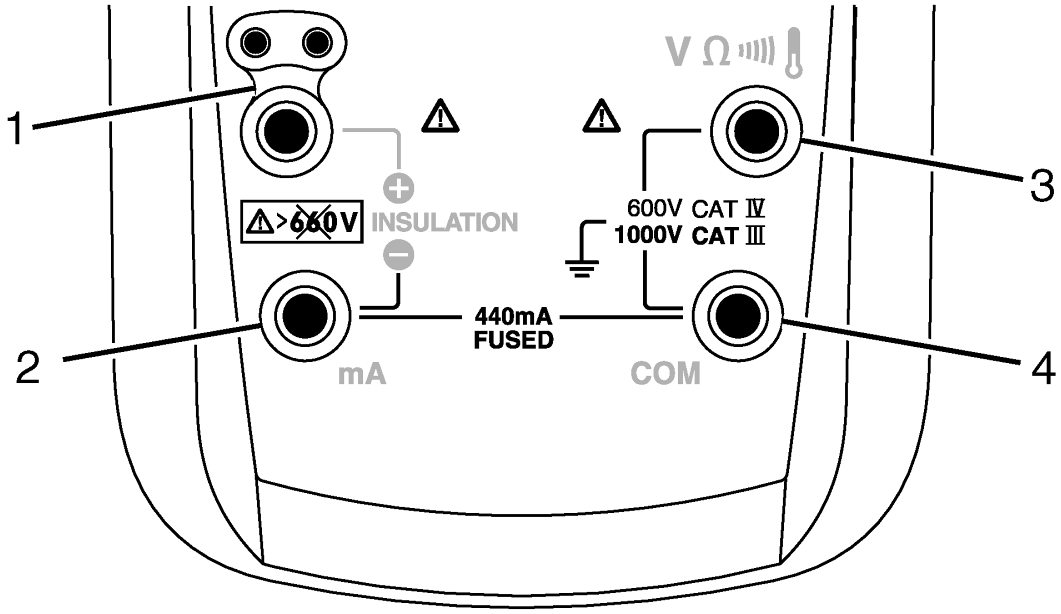

1
2
3
4
V Ω
⚠>660V
INSULATION
+
−
600V CAT IV
1000V CAT III
440mA
FUSED
mA
COM

Fig. 27: Ports
Courtesy of GENERAL MOTORS COMPANY

2. Plug into the correct ports (1, 2) for insulation testing. This is easy to get wrong especially if you use the **EL-50772** for standard DMM testing too. Do NOT use ports (3, 4) for insulation testing.
3. Always test at the 500V range.

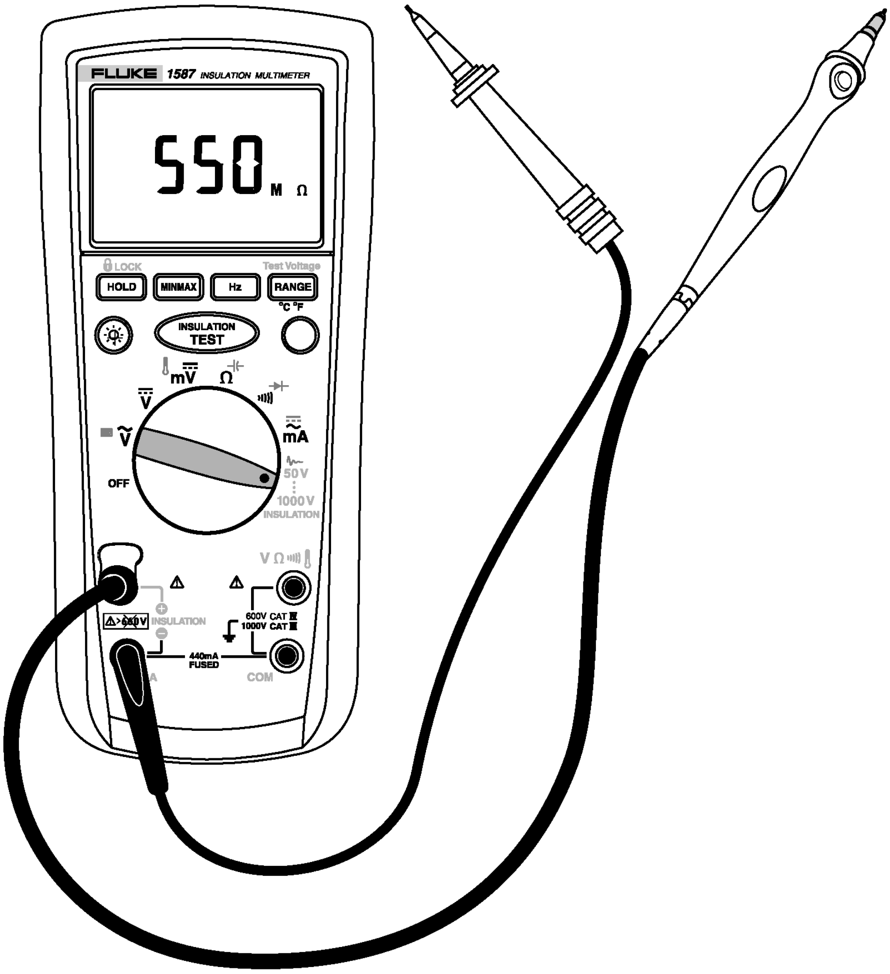

FLUKE 1587 INSULATION MULTIMETER
550 M Ω
LOCK
Test Voltage
HOLD
MINMAX
Hz
RANGE
°C °F
INSULATION TEST
mV
Ω
V
mA
OFF
50V
1000V
INSULATION
V Ω
600V CAT III
1000V CAT II
440mA FUSED
COM
A

Fig. 28: Insulation Multimeter (550)
Courtesy of GENERAL MOTORS COMPANY

4. With the test leads not connected to anything, press and hold test button to know how your meter displays an infinite measurement. The **EL-50772** will display 550M Ω when measuring an open circuit while set to the 500V range.

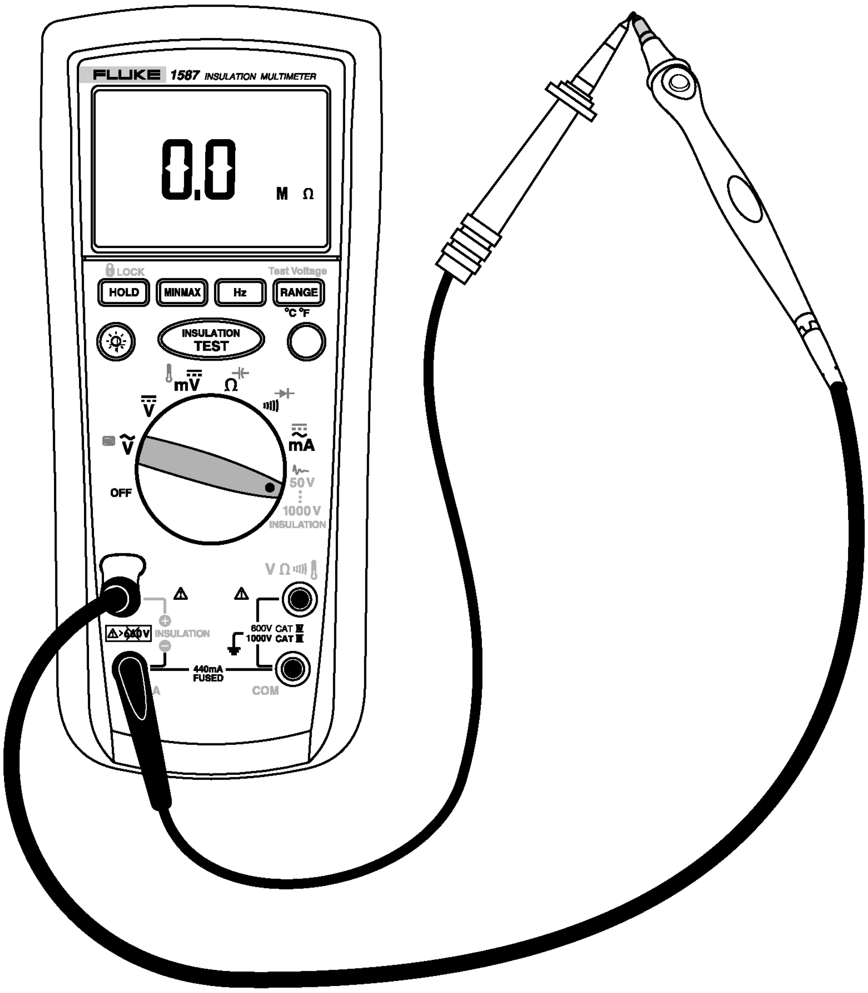

FLUKE
1587 INSULATION MULTIMETER
0.0
M Ω
LOCK
Test Voltage
HOLD
MINMAX
Hz
RANGE
°C °F
INSULATION TEST
mV
Ω
V
mA
OFF
50 V
1000 V
INSULATION
V Ω
600V CAT IV
1000V CAT III
INSULATION
440mA FUSED
A
COM

Fig. 29: Insulation Multimeter (0.0)
Courtesy of GENERAL MOTORS COMPANY

5. With the test leads connected together, press and hold test button to know how your meter displays continuity. The **EL-50772** will display 0.0 Ω.

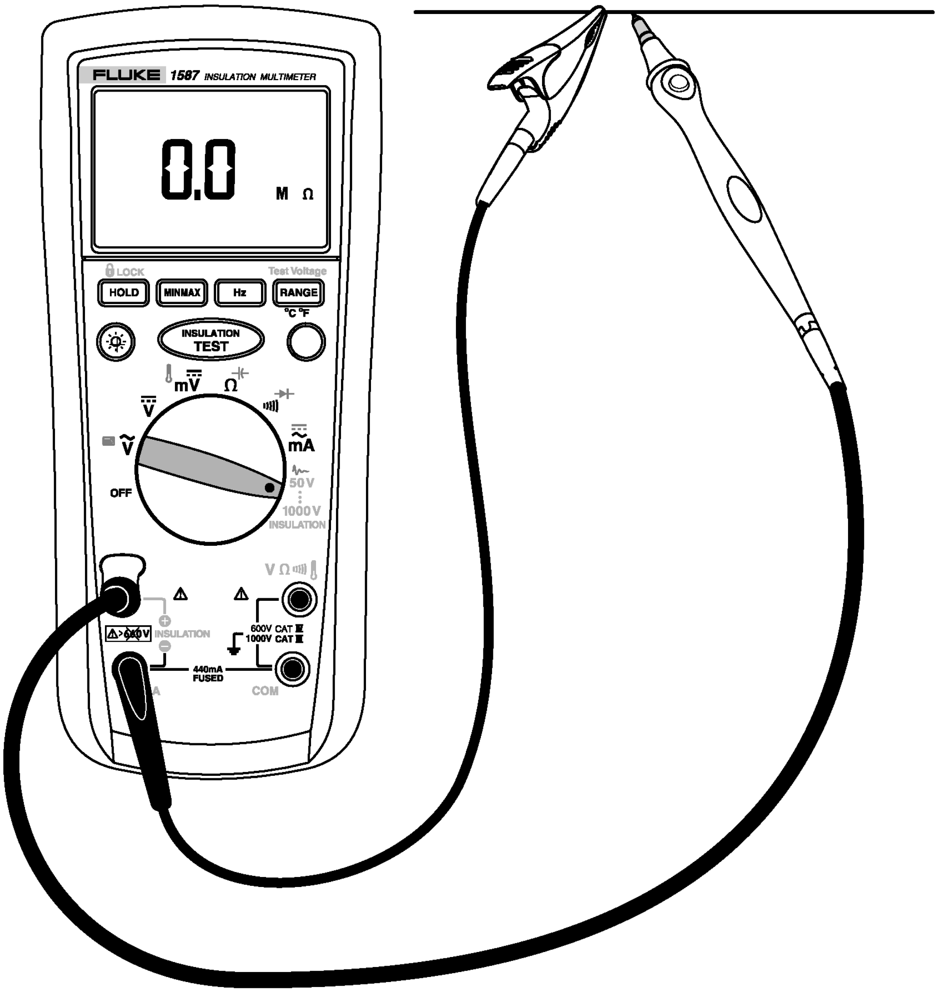

FLUKE 1587 INSULATION MULTIMETER
0.0
M Ω
LOCK
Test Voltage
HOLD
MINMAX
Hz
RANGE
°C °F
INSULATION TEST
mV
Ω
V
mA
OFF
50 V
1000 V
INSULATION
V Ω
600V CAT III
1000V CAT II
440mA FUSED
COM

Fig. 30: Insulation Multimeter (0.0)
Courtesy of GENERAL MOTORS COMPANY

6. When performing insulation testing you need a good ground reference. When possible use an alligator clamp to attach the ground lead. Typically, the reference point will be to vehicle chassis except cable testing which requires connection to the cable shield termination at the connector and not to the chassis.
7. Verify your ground connection prior to every test measurement at a suitable ground location near your test point. The **EL-50772** should display 0.0 Ω, indicating continuity.
8. When testing components with large capacitance or inductance, such as certain modules and larger motor stators, it may be necessary to hold the test for a few seconds until the maximum resistance value is displayed.

RECHARGEABLE ENERGY STORAGE SYSTEM SMOKE TEST

Special Tools

- **EL-52015** Volt Battery Smoke Test Leak Adapters
- **GE 41413-A** Evaporative Emissions System Tester (EEST)

Equivalent regional tools: Special Tools

1. Remove the drive motor battery. Refer to Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254) Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254) Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

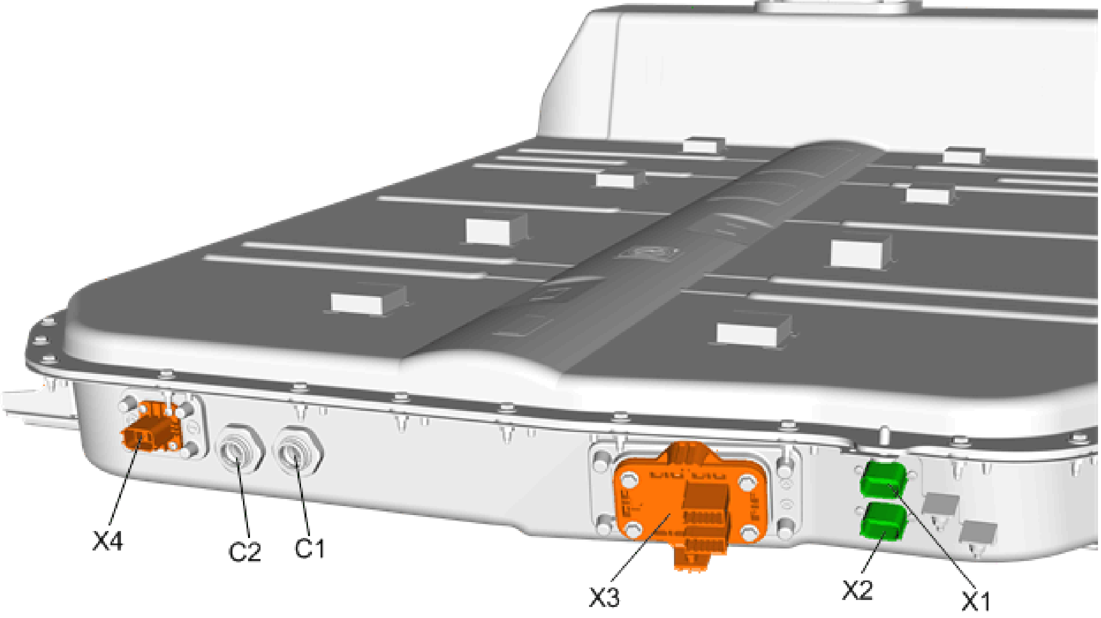


Fig. 31: Drive Motor Battery Connectors
Courtesy of GENERAL MOTORS COMPANY

2. Install the **EL-52015** Drive Motor Battery smoke test leak adapters to the following Drive Motor Battery Connectors:
    - X1
    - X2
    - X3

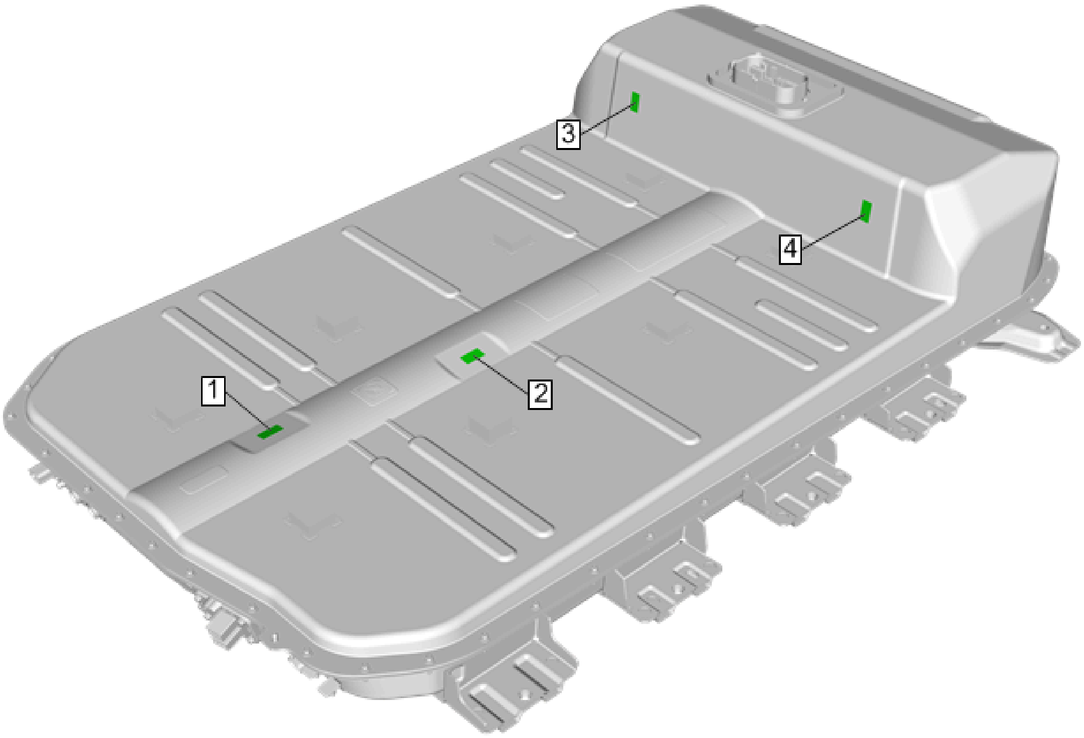


Fig. 32: Gore Patches
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Duct tape is not recommended because of damage to the Gore patches when removing.**

3. Cover all gore patches (1, 2, 3 and 4) with tape.

NOTE: **It is not recommended to use the tester in an outside repair bay area because wind**

and sunlight may affect temperature and your ability to see the smoke.

4. Turn OFF any fans that may cause air movement around or near the Drive Motor Battery.

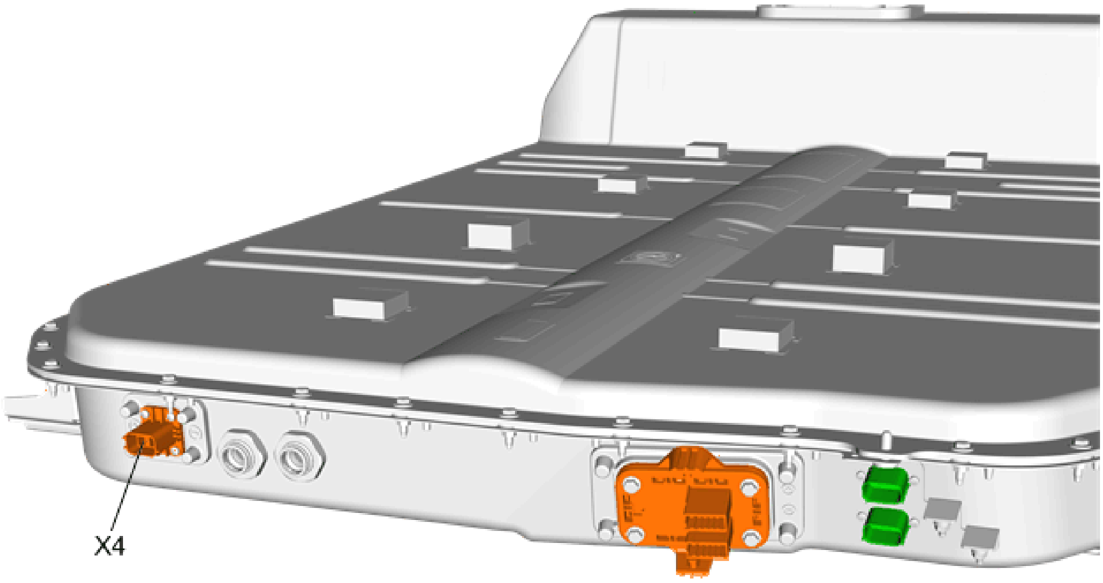


Fig. 33: Drive Motor Battery Connector X4
Courtesy of GENERAL MOTORS COMPANY

5. Install the **GE 41413-A** Evaporative Emissions System Tester (EEST) to connector (X4).

NOTE: **Completely unwind the smoke hose from the bracket for optimal tester performance.**

6. Turn the nitrogen/smoke valve on the control panel to smoke.

NOTE: **The remote switch operates in a push ON, push OFF fashion.**

7. Press and release the remote switch to activate the tester and inject smoke into the Drive Motor Battery.

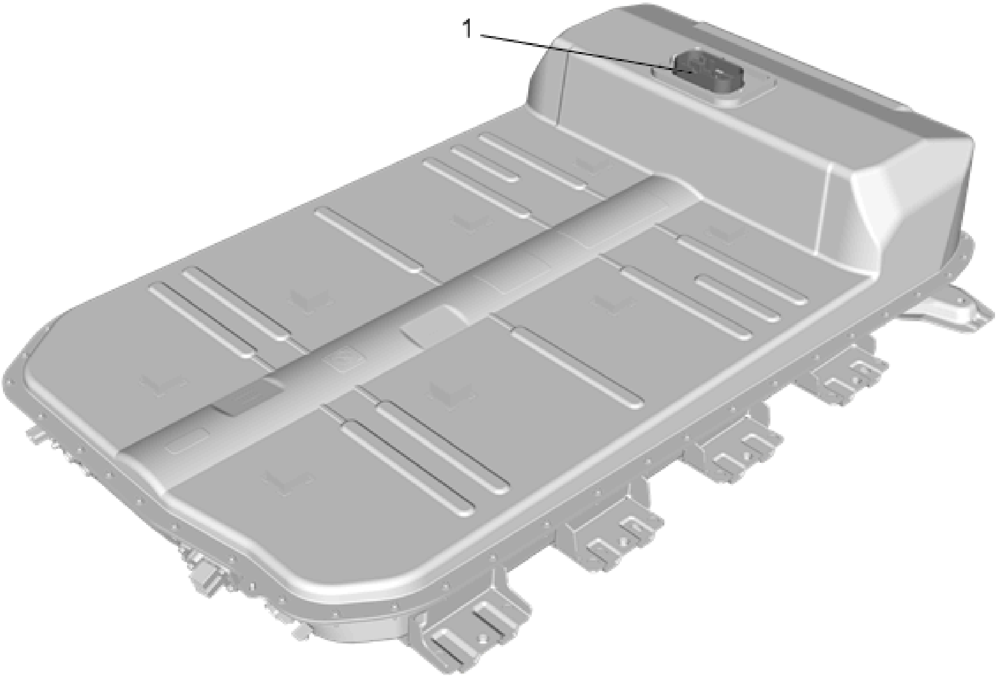


Fig. 34: Manual Service Disconnect Connector
Courtesy of GENERAL MOTORS COMPANY

8. Soak/Fill the RESS with smoke for FIVE MINUTES until smoke is observed from the manual service disconnect connector (1).
9. Install the manual service disconnect lever. Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement**
10. Introduce smoke into the Drive Motor Battery for up to THREE MINUTES. Using a high-intensity white light, look for any visible smoke emitting anywhere from the Drive Motor Battery.
11. Press and release the remote switch to deactivate the tester.
12. Repair any visible leaks by retightening the fasteners or by resealing any areas.
13. Retest the Drive Motor Battery, to ensure repair has been completed.
14. Remove the masking tape from the gore patches (1, 2, 3 and 4).
15. Remove the manual service disconnect lever. Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement**
16. Open the nitrogen tank valve and turn the nitrogen/smoke valve on the control panel to Nitrogen.
17. Press and release the remote switch to activate the tester and inject nitrogen into the Drive Motor Battery for FIVE MINUTES, verify no smoke is coming from the vent.
18. Remove all old vents from the Drive Motor Battery.
19. Install NEW Gore patches (P/N 20791600), replacing the old vents.
20. Disconnect the tester and remove the adapters from the Drive Motor Battery.
21. Install the drive motor battery. Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

Back To Article

REPAIR INSTRUCTIONS

HIGH VOLTAGE SYSTEM INSPECTION

Circuit/System Description

WARNING: **Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.**

Failure to follow these precautions could result in personal injury, death and property damage.

The Inspection Process

The high voltage system and Hybrid/EV battery pack inspection process consists of two levels of inspection:

1. Component Initial Inspection
2. High Voltage Operation Inspection

Results of the inspection processes may result in:

- Hybrid/EV Battery Depower
- Repair, or replacement and recycling of the Hybrid/EV Battery
- Replacement of high voltage components

Vehicle Collision Detection/High Voltage Lockout

The supplemental inflatable restraint system supplements the protection offered by the seat belts. The supplemental inflatable restraint sensing and diagnostic module determines the severity of a collision with the assistance of impact sensors located at strategic points on the vehicle. The hybrid powertrain control module 2 will open the high voltage contactor relays, placing the vehicle in a high voltage lockout state and disabling the vehicle whenever a crash event of sufficient intensity has been detected.

The supplemental inflatable restraint module transmits through serial data to the hybrid powertrain control module 2 both the crash event status and whenever a sensor fault is detected.

NOTE: **The Crash Event Detected/Air Bag Deployed high voltage lockout state will remain active until cleared by the Clear Secured High Voltage DTCs procedure.**

A complete inspection of the high voltage system must be performed if the vehicle has been involved in a collision.

High Voltage Battery Moisture Exposure

The Lithium Ion hybrid/EV battery pack should be depowered whenever internal components have been exposed to moisture, whether due to vehicle flood, coolant leakage within the hybrid/EV battery pack assembly, etc.

Reference Information

Schematic Reference

- Hybrid/EV Energy Storage Schematics
- Hybrid/EV Controls Schematics
- Plug-In Charging Schematics

Description and Operation

Drive Motor Battery System Description

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50332** EV/HEV Battery Service Tool
- **J-35616-35** Test Probes

Equivalent regional tools: Special Tools .

Component Initial Inspection

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

WARNING: **High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.**

WARNING: **This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test**

equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or death.

1. Disconnect the 12 V battery.
2. Remove the S15 Manual Service Disconnect. If vehicle damage does not allow for access to the S15 Manual Service Disconnect, remove the damaged portion of the vehicle until such time as the S15 Manual Service Disconnect can be removed.
3. Inspect the Hybrid/EV battery pack for evidence of exposure to fire, either directly or in close proximity.
    - **If exposure to fire is evident**
    1. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

    NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

    2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
    3. Continue with inspection.
    - **If not exposed to fire**
4. Inspect the Hybrid/EV battery pack enclosure for damage including foreign object intrusion.
    - **If damage is evident**
    1. Depowering of the Hybrid/EV battery pack and/or damaged module section is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

    NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

    2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
    3. Continue with inspection.
    - **If not damaged**
5. Inspect the vehicle for exposure to water at a level higher than the vehicle rocker panel.
    - **If the vehicle was exposed to flood**
    1. Remove the battery drain plug, capture and discard any drained fluid.
    2. Lift the vehicle rear slightly to assist in fluid extraction.
        - If fluid is present
        1. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

        NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

        2. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
        3. Continue with inspection.

    - If fluid was not present

      Install a new drain plug and continue with inspection.

  - **If the vehicle was not flooded**

6. Inspect the battery coolant system for proper level.
   - **If battery coolant level is low**
   1. Verify if the low coolant is the result of system damage external of the A4 Hybrid/EV battery pack.
      - If the cooling system external of the A4 Hybrid/EV Battery Pack is not damaged and/or leaking
      1. Remove the battery drain plug, capture and discard any drained fluid.
      2. Lift the vehicle rear slightly to assist in fluid extraction.
         - If fluid is present
      3. Depowering of the Hybrid/EV battery pack is recommended. Maintain post-crash 50 foot vehicle isolation until depowering completion. See Battery Depower after inspection is complete.

         NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

      4. After depowering, repair or replace and recycle battery as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
      5. Continue with inspection.
         - If fluid is not present
      6. Install a new drain plug and continue with inspection.
      - If the cooling system external of the A4 Hybrid/EV Battery Pack is damaged and/or leaking
   2. Continue with inspection.
   - **If the battery coolant system is at the proper level**

   NOTE: **Post-crash 50 foot vehicle isolation is no longer required if the Hybrid/EV battery pack did not exhibit damage assessed in the steps above.**

7. Inspect each high voltage component listed below for visible damage. Record the results on the High Voltage Component Inspection Table below.
   - E54 Hybrid/EV Battery Pack Coolant Heater
   - G1 Electric A/C Compressor
   - K1 14 V Power Module
   - K10 Coolant Heater Control Module
   - S15 Manual Service Disconnect
   - T6 Power Inverter Module
   - T18 Battery Charger
   - T24 Battery Charger
   - Transmission case
   - All High voltage orange cables
   - **If any high voltage component inspection failed and Hybrid/EV battery Depower is recommended**

     Disconnect the damaged components from the high voltage bus before attempting in-vehicle depowering of the Hybrid/EV battery pack. In extreme cases depowering may need to occur by connecting directly within the Hybrid/EV battery pack with the cover removed. See Battery Depower below.

- **If any high voltage component inspection failed and Hybrid/EV battery Depower is NOT recommended**
    1. Perform the **High Voltage Disabling** procedure and replace the damaged components before attempting to operate the vehicle.
    2. Once you have confirmed or repaired all high voltage component visual integrity, perform High Voltage Operation Inspection below.
- **If all high voltage component inspection passed**

    Perform High Voltage Operation Inspection below.

High Voltage Component Inspection Table

High Voltage Component	Inspection (passed/failed)
E54 Hybrid/EV Battery Pack Coolant Heater	Â
G1 Electric A/C Compressor	Â
K1 14 V Power Module	Â
K10 Coolant Heater Control Module	Â
S15 Manual Service Disconnect	Â
T6 Power Inverter Module	Â
T18 Battery Charger	Â
T24 Battery Charger	Â
Transmission case	Â
All High voltage orange cables	Â

High Voltage Operation Inspection

NOTE: **The vehicle must have a functioning 12 V system and serial data communications to continue.**

1. Verify you have successfully passed the Component Initial Inspection.
    - **If the Component Initial Inspection has failed or not been performed**

        DO NOT CONTINUE. Restart the Inspection procedure.

    - **If the Component Initial Inspection has passed**
2. Install the S15 Manual Service Disconnect. Refer to **Drive Motor Battery High Voltage Manual Disconnect Lever Replacement**.
3. Connect the 12 V battery.
4. Vehicle in Service Mode. With a scan tool select the Hybrid/EV powertrain Control Module 2, Hybrid Battery Pack Contactor Open Reasons data list. Verify if either the Crash Event Detected or Air Bag Deployed parameters indicate YES.
    - **If either parameter displays YES**

        The high voltage contactors may be prevented from closing. The vehicle will not start. Perform the Clear Secured High Voltage DTCs procedure and proceed to the next step.

    - **If BOTH parameters indicate NO**
5. Vehicle ON. With a scan tool check for the following HV system DTCs: Contactor DTCs P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D0A, P0D09, P1EBD, P1EC0, P1EC3, Isolation DTCs P0AA6, P1AE6, P1AF0, or P1AF2, Precharge DTCs P0C76, P0C78 or P3061.
    - **If any DTCs are set**

        Perform the applicable DTC diagnosis/repair. refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If any of the listed DTCs have not run**

        Review the applicable Conditions for Running the DTC.

- **If all the specified DTCs have ran and passed**

  High Voltage System Inspection passed.

Battery Depower

WARNING: **Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Store the vehicle with hybrid/EV battery pack installed or the hybrid/EV battery pack assembly outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture until the hybrid/EV battery pack has been discharged. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V. Contact the GM Technical Assistance Center for discharge instructions prior to storage and shipping of the hybrid/EV battery pack.**

Failure to follow these precautions could result in personal injury, death and property damage.

NOTE: **Depowering of the battery:**

- **Will NOT reduce battery voltage to a safe level. The battery will contain high voltage after depower procedure is complete.**
- **Reduces the state of charge to the lowest level thus reducing the likelihood of a battery fire.**
- **Requires special tool EL-50332 battery service tool.**
- **Allows for future recovery of the battery after an internal battery inspection and/or repair is completed.**

NOTE: **Depowering is not required if hybrid/EV battery pack voltage as either monitored by the hybrid powertrain control module 2 scan tool Hybrid/EV Battery Pack High Voltage parameter or measured with a DMM directly across the battery terminals is 285 volts or less.**

NOTE: **With a full state of charge, the depower process for the complete Hybrid/EV battery pack make take up to 20 hours to complete. You may stop or pause the process at any time.**

Depowering can occur with the Hybrid/EV battery pack in or out of the vehicle. You can configure the **EL-50332** connections to the Hybrid/EV battery pack at any of the following locations:

- High Voltage T24 Battery Charger connection under hood with **EL-50332-335** *
- High Voltage connection at Hybrid/EV Battery Pack with **EL-50332-335** *
- Directly at battery section/cell module terminals with **EL-50332-170**

  *Also requires connection to the contactor relay control circuits with **EL-50332-325** .

The **EL-50332** can be 12 V powered for instances when outlet power is not available. Use the following to operate from a 12 V power source:

- **EL-50332-160** 12 V Auxiliary Power Cable
- **EL-50332-165** 12 V Auxiliary Clamps Adapter Cable

In-Vehicle or Hybrid/EV Battery Pack Cover Installed Depower Instructions

NOTE:

- **The EL-50332 will close the Hybrid/EV battery pack contactors. You must verify the vehicles high voltage system integrity prior**

- **to enabling high voltage. Disconnect visually damaged high voltage components/cables from the high voltage system before attempting in-vehicle depowering.**
- **You must be able to connect to the hybrid/EV battery pack low voltage connectors.**
- **Wear your Personal Protective Equipment for the duration of the battery depower event.**

1. Ensure the integrity of the vehicles high voltage system.
2. Connect the **EL-50332** to the contactor control circuits at the hybrid/EV battery pack low voltage connectors with the **EL-50332-270** interface module and **50332-325** harness.
3. Connect the **EL-50332** to the applicable high voltage connector.
4. Install the manual service disconnect lever.
5. Follow the **EL-50332** on-screen prompts until depower is completed.

NOTE: **Post-crash 50 foot vehicle isolation is no longer required upon successful depower completion.**

6. Remove the manual service disconnect lever.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

7. Repair, replace or recycle the hybrid/EV battery pack as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
8. Replace any damaged components noted in the High Voltage Component Inspection before attempting to operate the vehicle.
9. Perform the High Voltage Operation Inspection before attempting to operate the vehicle.

Hybrid/EV Battery Pack Cover Removed Depower Instructions

1. Connect the **EL-50332-145** Black HV Banana Jack Cable, **EL-50332-150** Red HV Banana Jack Cable, **EL-50332-155** Green HV Banana Jack Cable, and **EL-50332-170** High Voltage Alligator Clamps harness to the applicable battery section/cell module terminals and ground. If depowering all battery sections/cell modules install the manual service disconnect lever.
2. Follow the **EL-50332** on-screen prompts until depower is completed.

NOTE: **Post-crash 50 foot vehicle isolation is no longer required upon successful depower completion.**

3. Remove the manual service disconnect lever.

NOTE: **Never return a damaged battery pack or section to the Warranty Parts Center (WPC), Electronic Service Center (ESC) or Battery Service Center (BSC).**

4. Repair, replace or recycle the hybrid/EV battery pack as applicable. Vehicle dismantlers should refer to www.recyclemybattery.com.
5. Replace any damaged components noted in the High Voltage Component Inspection before attempting to operate the vehicle.
6. Perform the High Voltage Operation Inspection before attempting to operate the vehicle.

DRIVE MOTOR BATTERY HIGH VOLTAGE MANUAL DISCONNECT LEVER REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing**

any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove Rear Seat Cushion **Rear Seat Cushion Removal and Installation**

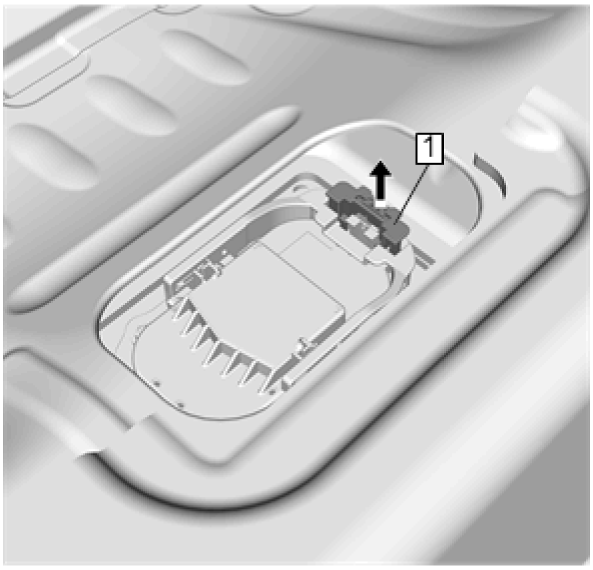


Fig. 1: Lever CPA
Courtesy of GENERAL MOTORS COMPANY

2. Lift up the lever CPA (1).

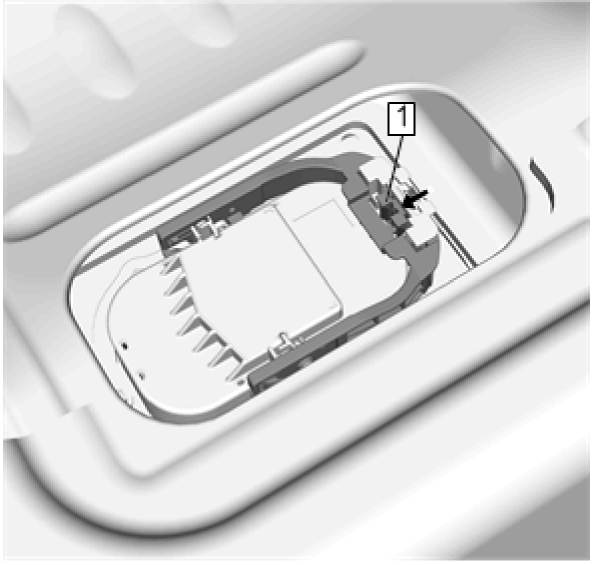


Fig. 2: Lever Button Inward
Courtesy of GENERAL MOTORS COMPANY

3. Push the lever button inward (1).

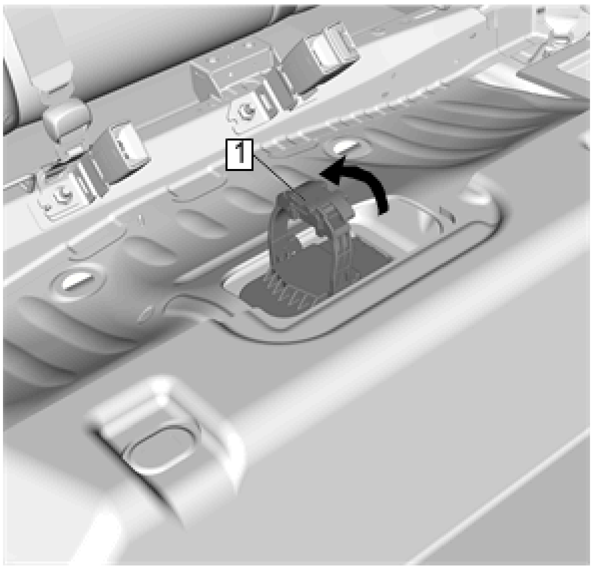


Fig. 3: Drive Motor Battery High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

4. Lift Upwards Drive Motor Battery High Voltage Manual Disconnect Lever (1)

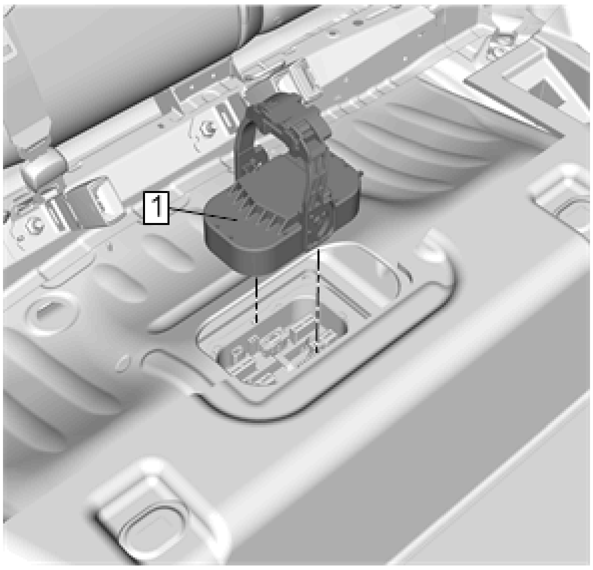


Fig. 4: Drive Motor Battery High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

5. Remove Drive Motor Battery High Voltage Manual Disconnect Lever (1)

Installation Procedure

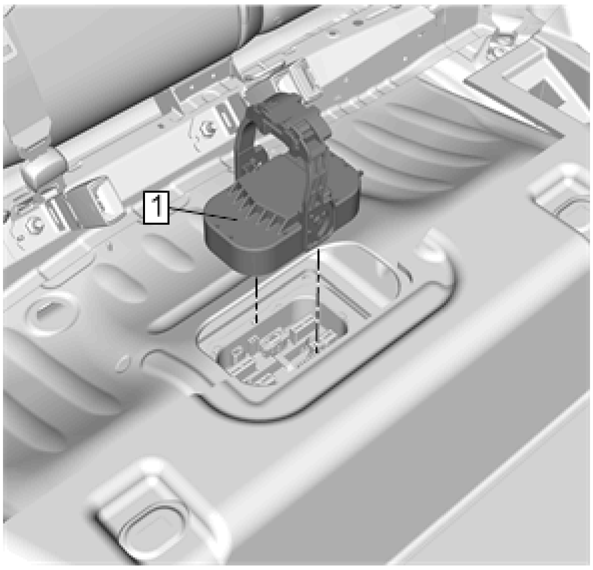


Fig. 5: Drive Motor Battery High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery High Voltage Manual Disconnect Lever (1)

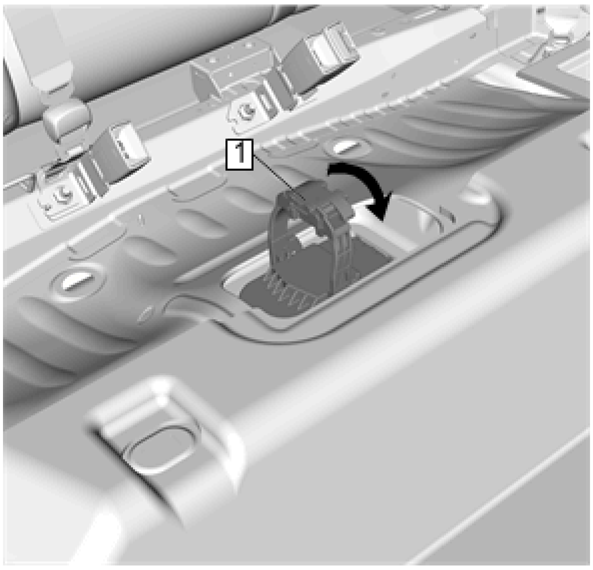


Fig. 6: Drive Motor Battery High Voltage Manual Disconnect Lever
Courtesy of GENERAL MOTORS COMPANY

2. Engage Drive Motor Battery High Voltage Manual Disconnect Lever (1)

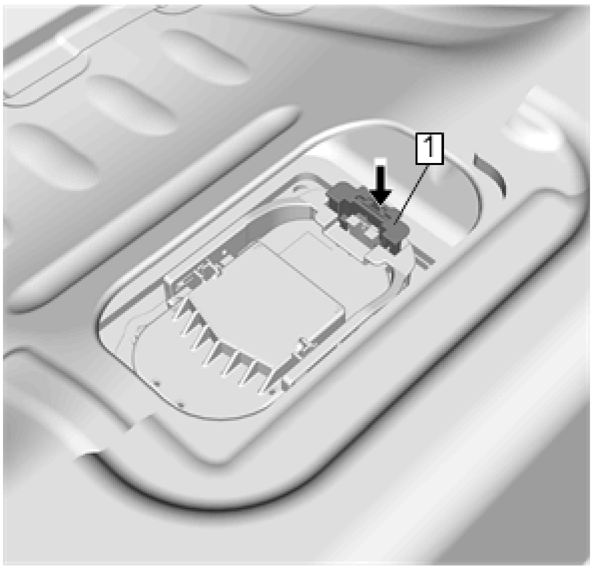


Fig. 7: Lever CPA
Courtesy of GENERAL MOTORS COMPANY

3. Push and engage the lever CPA (1).
4. Install Rear Seat Cushion Rear Seat Cushion Removal and Installation
5. Enable the high voltage system. High Voltage Enabling

HIGH VOLTAGE BATTERY HIGH VOLTAGE MANUAL DISCONNECT CONNECTOR REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Battery Upper Cover Replacement

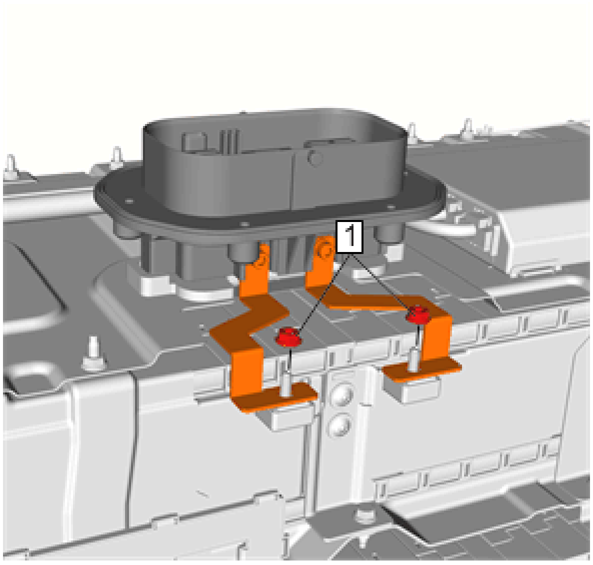


Fig. 8: Battery Cable Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the battery cable bolts. (1) [2x]

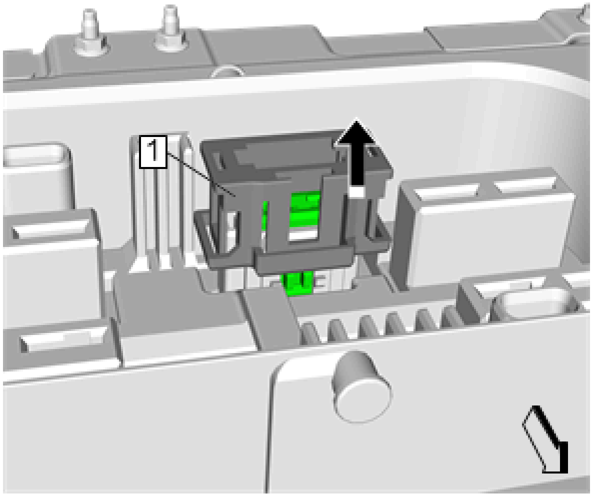


Fig. 9: Connector Guide
Courtesy of GENERAL MOTORS COMPANY

4. Slightly release the connector guide (1) from the manual service disconnect connector. Do not need to remove it completely.

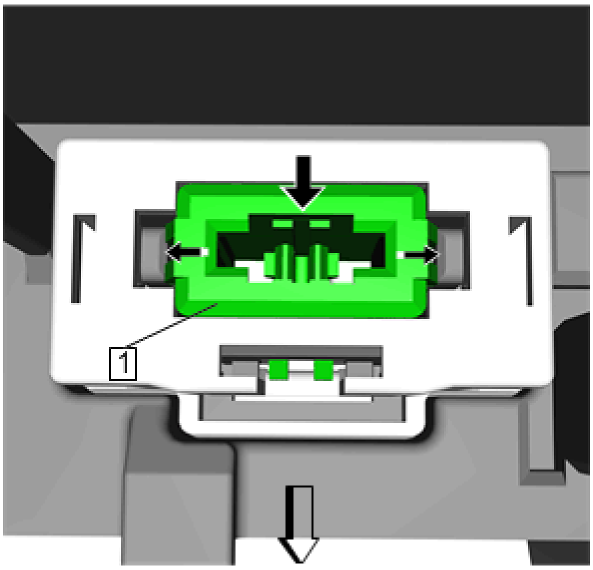


Fig. 10: Connector
Courtesy of GENERAL MOTORS COMPANY

5. While pushing the connector tabs to the side direction, push down the connector (1) and remove it.

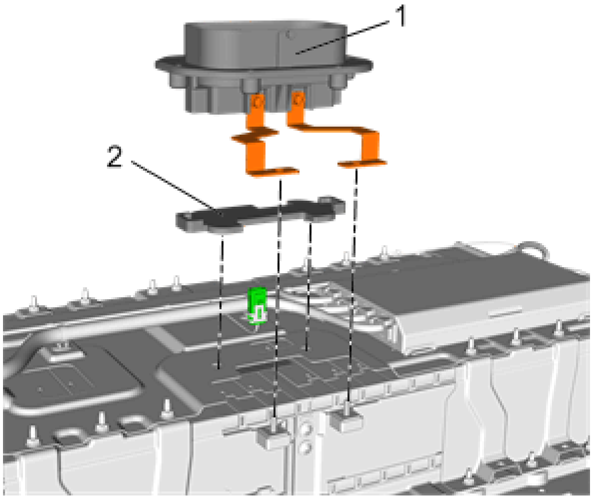


Fig. 11: Connector And Connector Insulator
Courtesy of GENERAL MOTORS COMPANY

6. Remove the high voltage battery high voltage manual disconnect connector (1) with the battery cable.
7. Remove the high voltage battery high voltage manual disconnect connector insulator (2).

Installation Procedure

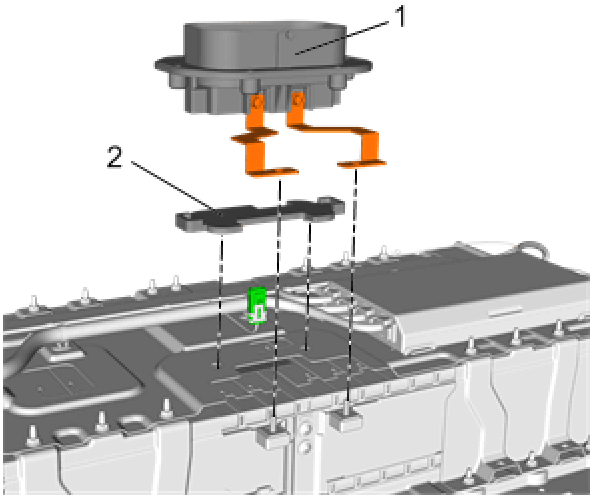


Fig. 12: Connector And Connector Insulator
Courtesy of GENERAL MOTORS COMPANY

1. Install the high voltage battery high voltage manual disconnect connector insulator (2).
2. Install the high voltage battery high voltage manual disconnect connector (1) with the battery cable.
3. Connect the electrical connector to the high voltage battery high voltage manual disconnect connector.

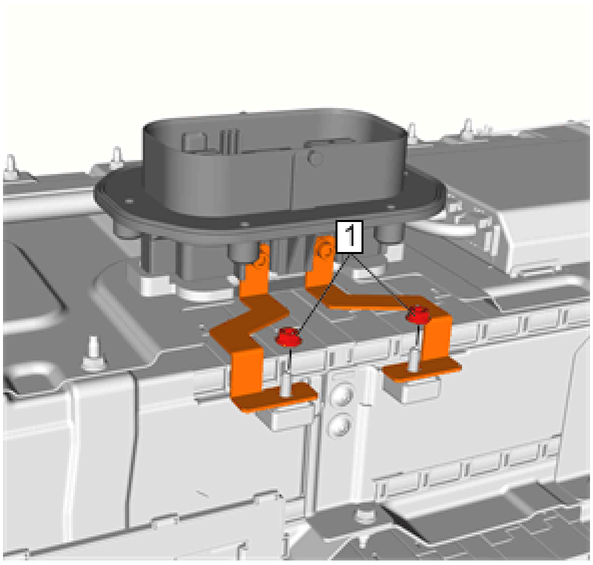


Fig. 13: Battery Cable Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

NOTE: **Critical high voltage fastener. Perform second torque verification check following re-assembly.**

NOTE: **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.**

4. Tighten the battery cable bolts. (1) 9 N.m (80 lb in)
5. Tighten the battery cable bolts again. (1) 9 N.m (80 lb in).
6. Battery Upper Cover Replacement
7. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

HIGH VOLTAGE BATTERY TRAY REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**

- **Visually and functionally inspect the gloves before use.**
- **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
2. Remove the battery upper cover. **Battery Upper Cover Replacement**

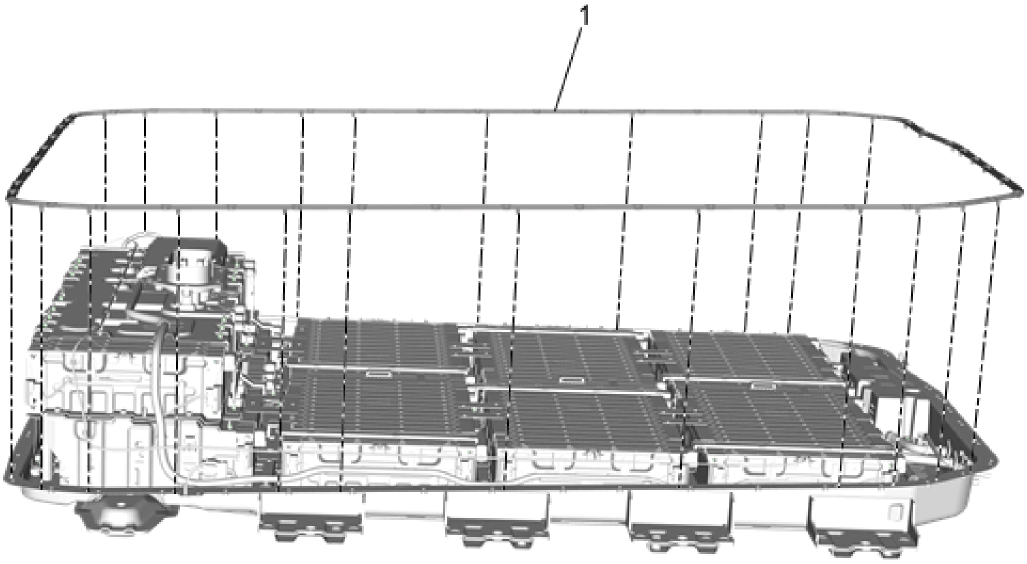


Fig. 14: Battery Cover Seal
Courtesy of GENERAL MOTORS COMPANY

3. Remove the battery cover seal (1). **Battery Cover Seal Replacement**

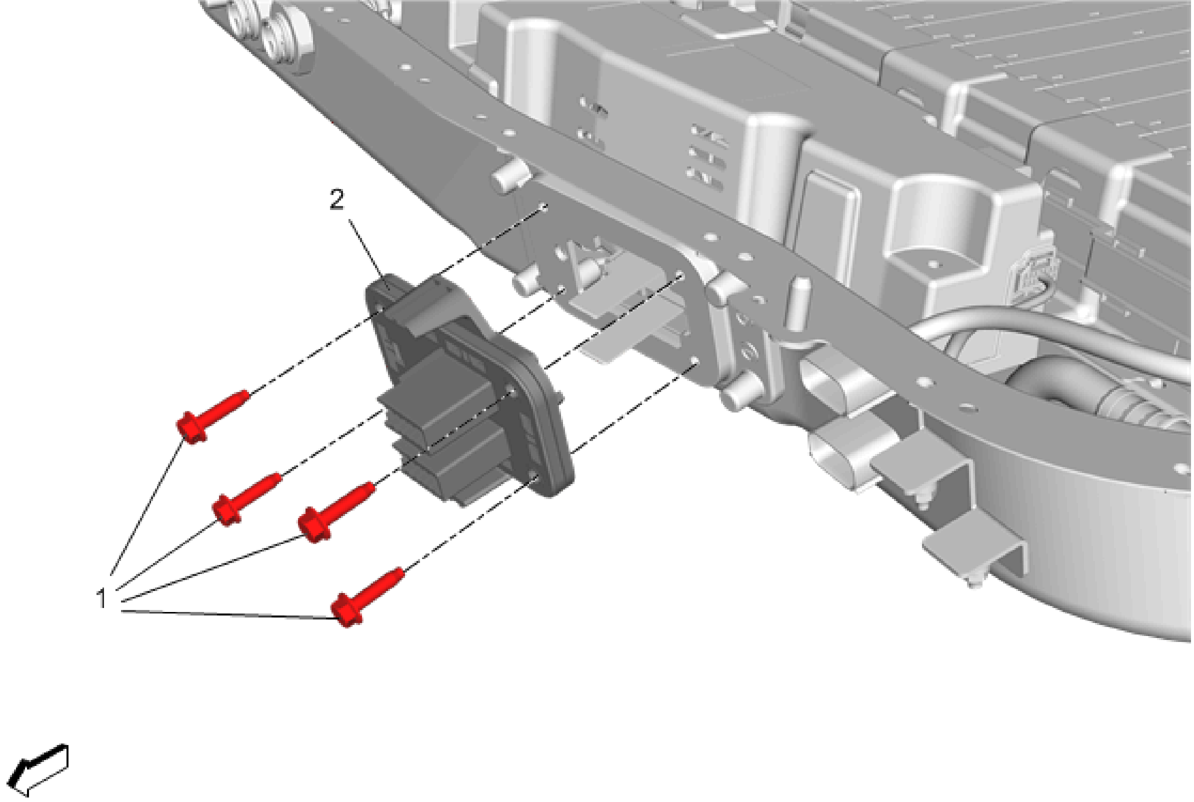


Fig. 15: High Voltage Battery Connector X3
Courtesy of GENERAL MOTORS COMPANY

4. Remove the high voltage battery connector X3 (2). High Voltage Connector Replacement (X3)

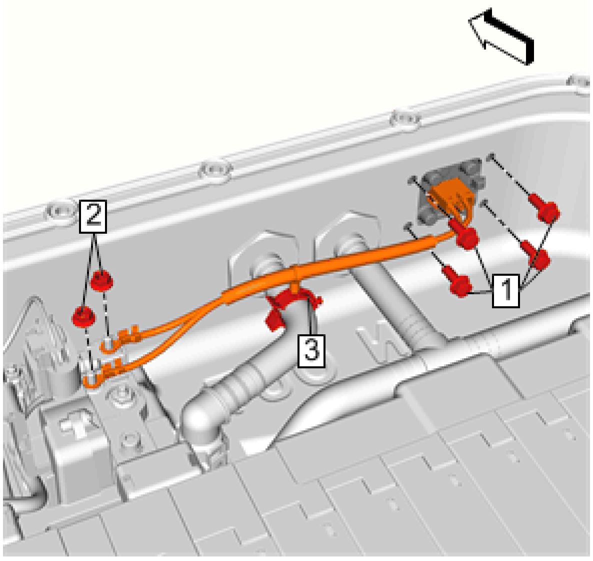


Fig. 16: High Voltage Battery Connector X4
Courtesy of GENERAL MOTORS COMPANY

5. Remove the high voltage battery connector X4. High Voltage Connector Replacement (X4)

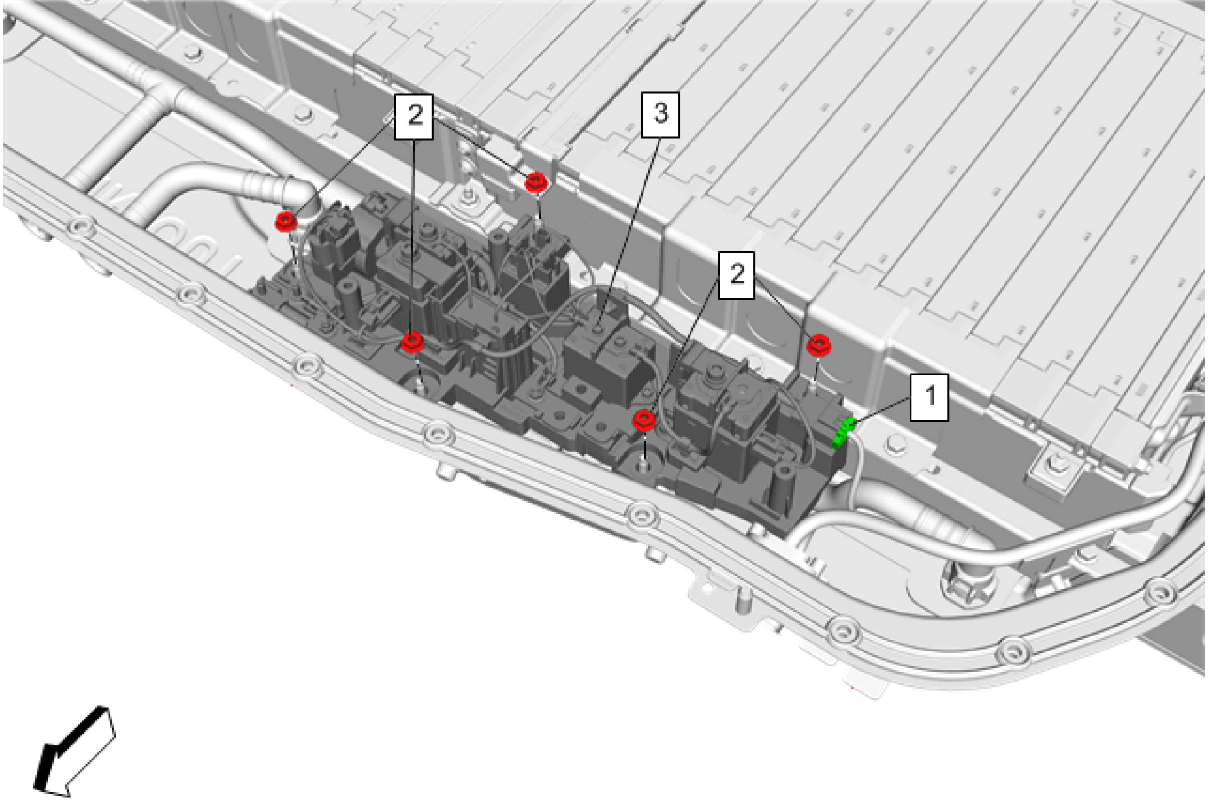


Fig. 17: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Remove the high voltage battery disconnect relay assembly (3). **High Voltage Battery Disconnect Relay Replacement**

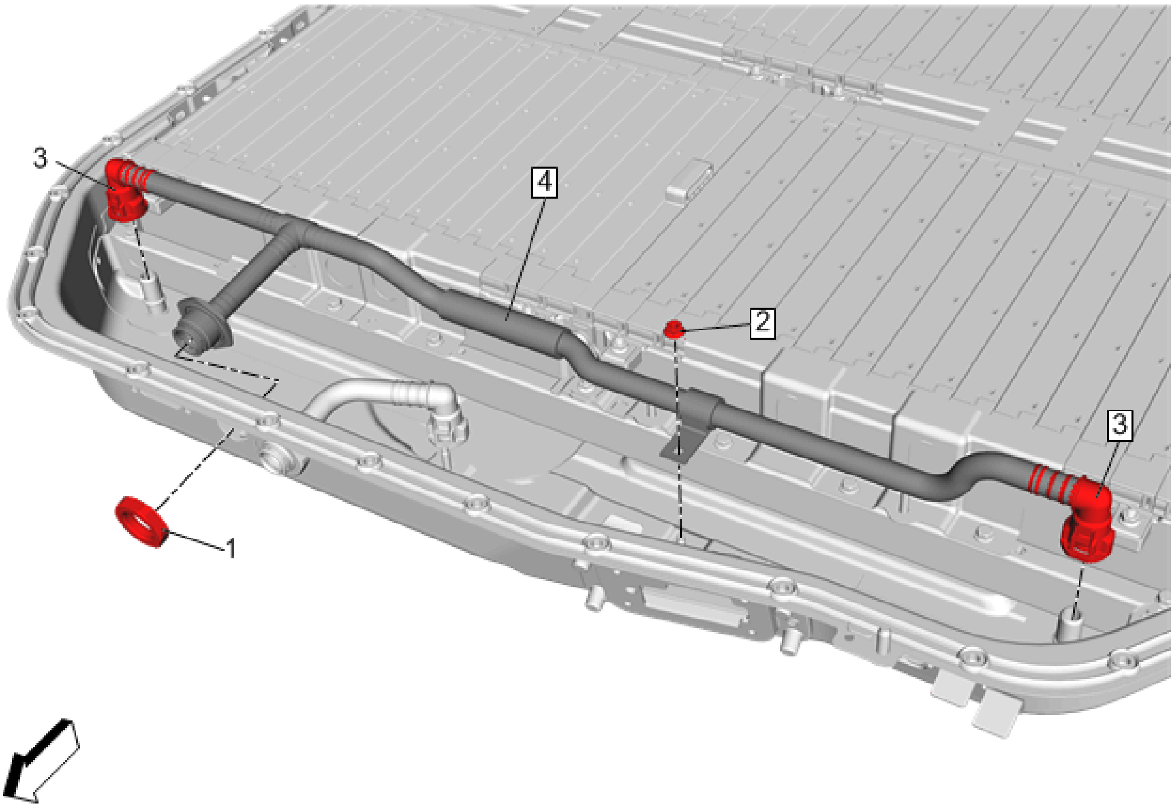
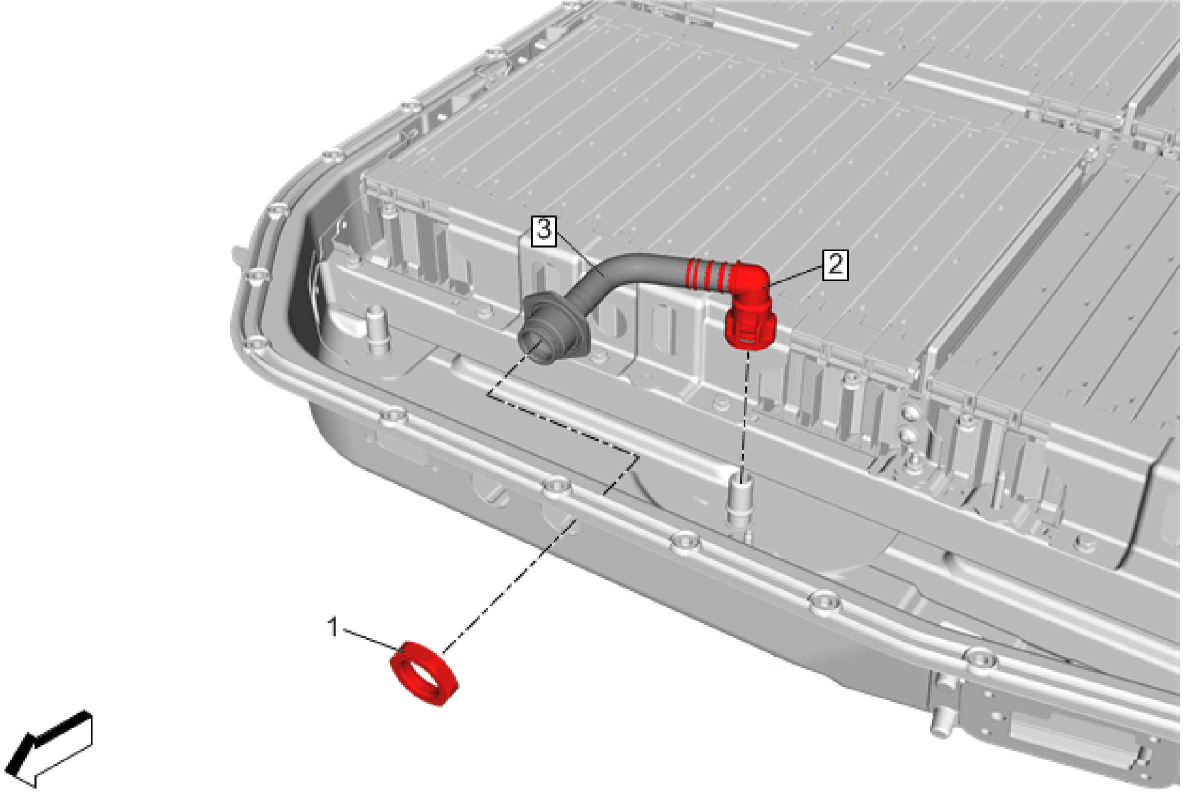


Fig. 18: Drive Motor Battery Coolant Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

7. Remove the drive motor battery coolant inlet hose (4) from the drive motor battery tray. **Drive Motor Battery Coolant Inlet Hose Replacement**



[Fig. 19: Drive Motor Battery Coolant Outlet Hose](#)
Courtesy of GENERAL MOTORS COMPANY

8. Remove the drive motor battery coolant outlet hose (3) from the drive motor battery tray. **Drive Motor Battery Coolant Outlet Hose Replacement**
9. Remove all the cell battery modules. **Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 2)Cell Battery Module Replacement (Row 3)Cell Battery Module Replacement (Row 4)Cell Battery Module Replacement (Row 5)**

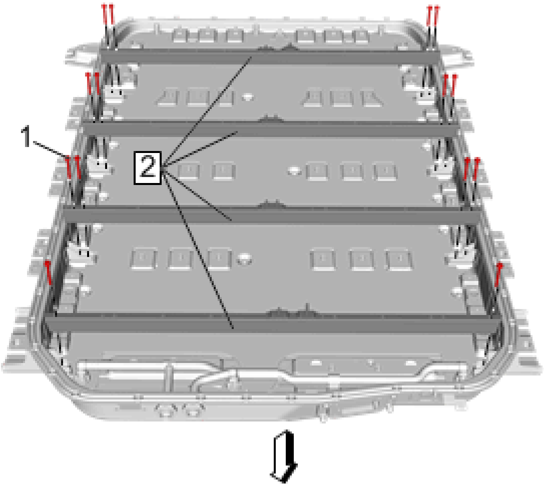


Fig. 20: Tube Bolts And Tube Assemblies
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tube assembly number 4 is directional. Need to mark orientation of it within the battery tray before removing.**

10. Remove the tube bolts (1) and the tube assemblies (2).

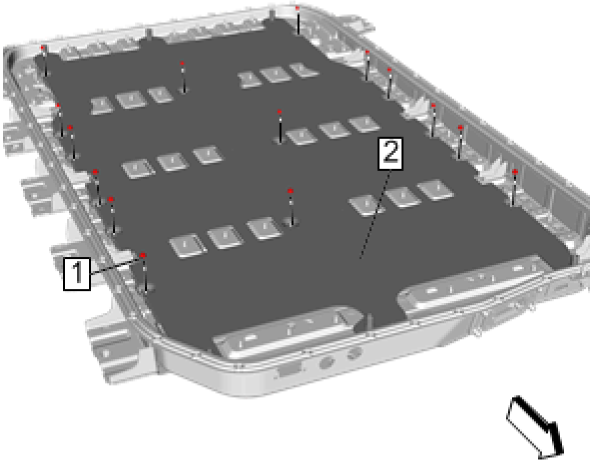


Fig. 21: Cooling Plate Nuts And Plate
Courtesy of GENERAL MOTORS COMPANY

11. Remove the cooling plate nuts (1) and the plate (2).

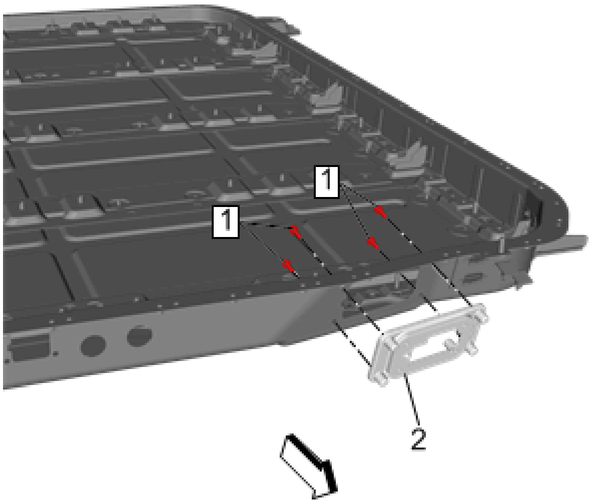


Fig. 22: High Voltage Battery Connector X3 Die Casting Block Bolts
Courtesy of GENERAL MOTORS COMPANY

12. Remove the high voltage battery connector X3 die casting block bolts (1) and the block (2).

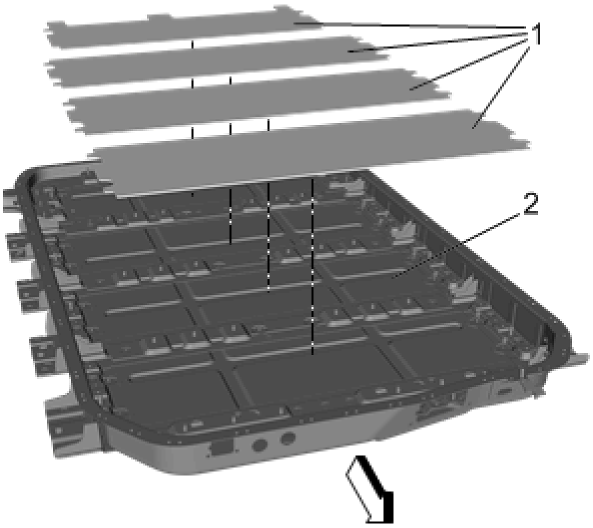


Fig. 23: Insulation Pads
Courtesy of GENERAL MOTORS COMPANY

13. Remove the insulation pads (1)
14. Replace the high voltage battery tray (2) if needed.

Installation Procedure

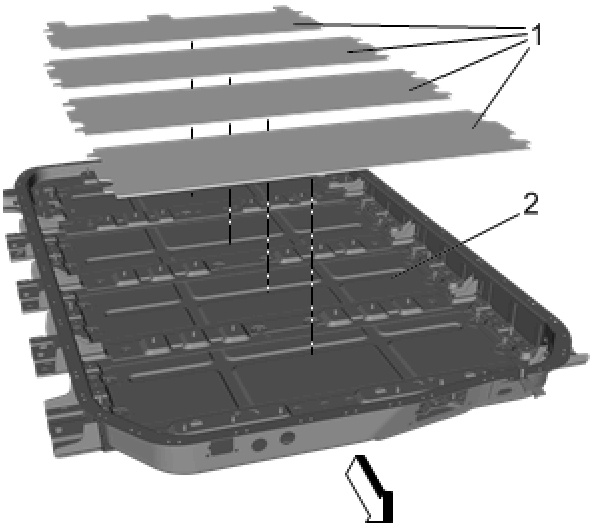


Fig. 24: Insulation Pads
Courtesy of GENERAL MOTORS COMPANY

1. Install the insulation pads (1).

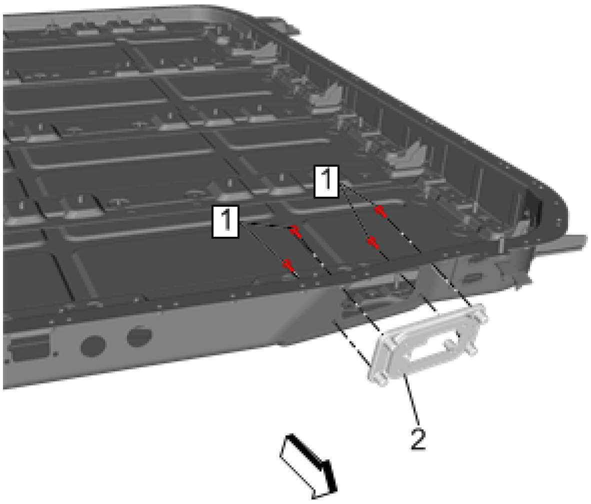


Fig. 25: High Voltage Battery Connector X3 Die Casting Block Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install the high voltage connector X3 die casting block bolts (1) and the block (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

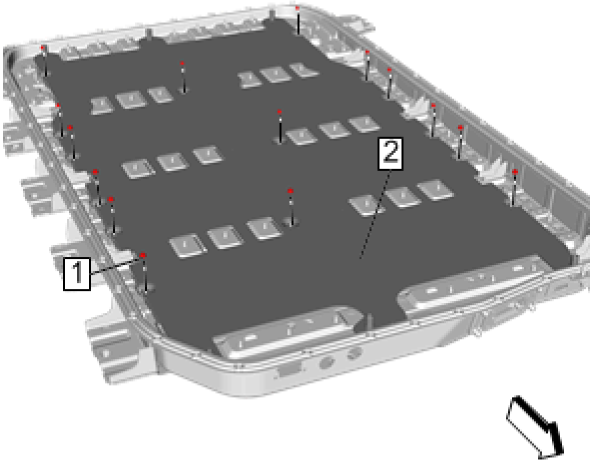


Fig. 26: Cooling Plate Nuts And Plate
Courtesy of GENERAL MOTORS COMPANY

3. Install the cooling plate nuts (1) and the plate (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

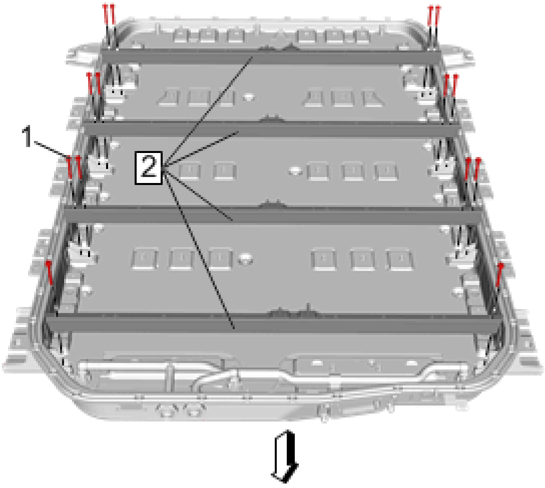


Fig. 27: Tube Bolts And Tube Assemblies
Courtesy of GENERAL MOTORS COMPANY

4. Install the tube bolts (1) and the tube assemblies (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

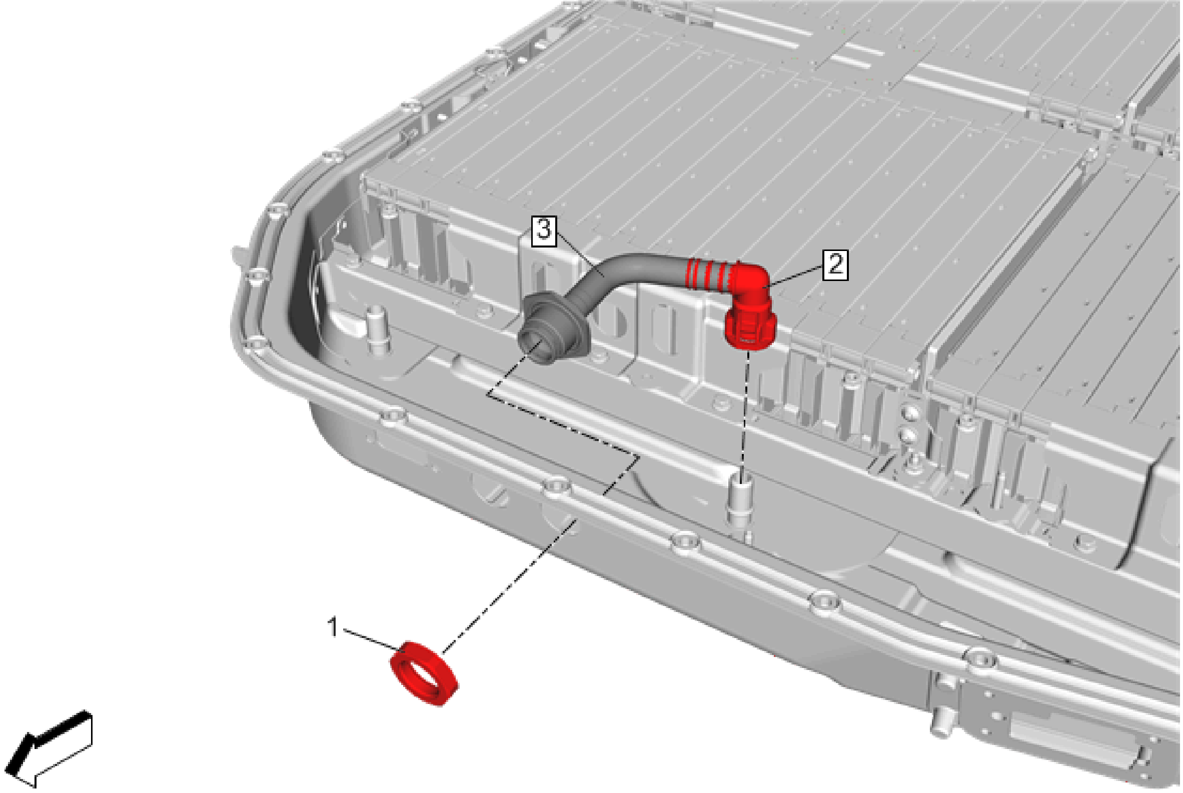


Fig. 28: Drive Motor Battery Coolant Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Install the drive motor battery coolant outlet hose (3) to the drive motor battery tray. Drive Motor Battery Coolant Outlet Hose Replacement

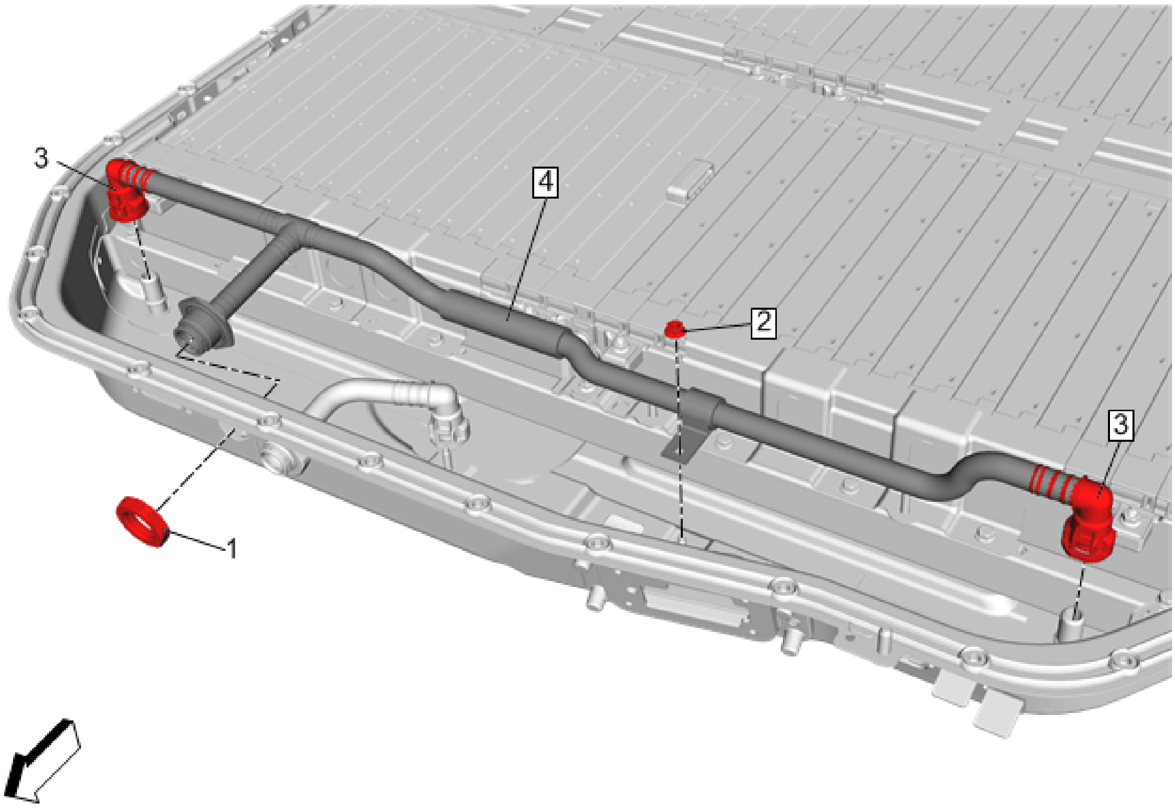


Fig. 29: Drive Motor Battery Coolant Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Install the drive motor battery coolant inlet hose (4) to the drive motor battery tray. Drive Motor Battery Coolant Inlet Hose Replacement
7. Install all the cell battery modules. Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 2)Cell Battery Module Replacement (Row 3)Cell Battery Module Replacement (Row 4)Cell Battery Module Replacement (Row 5)

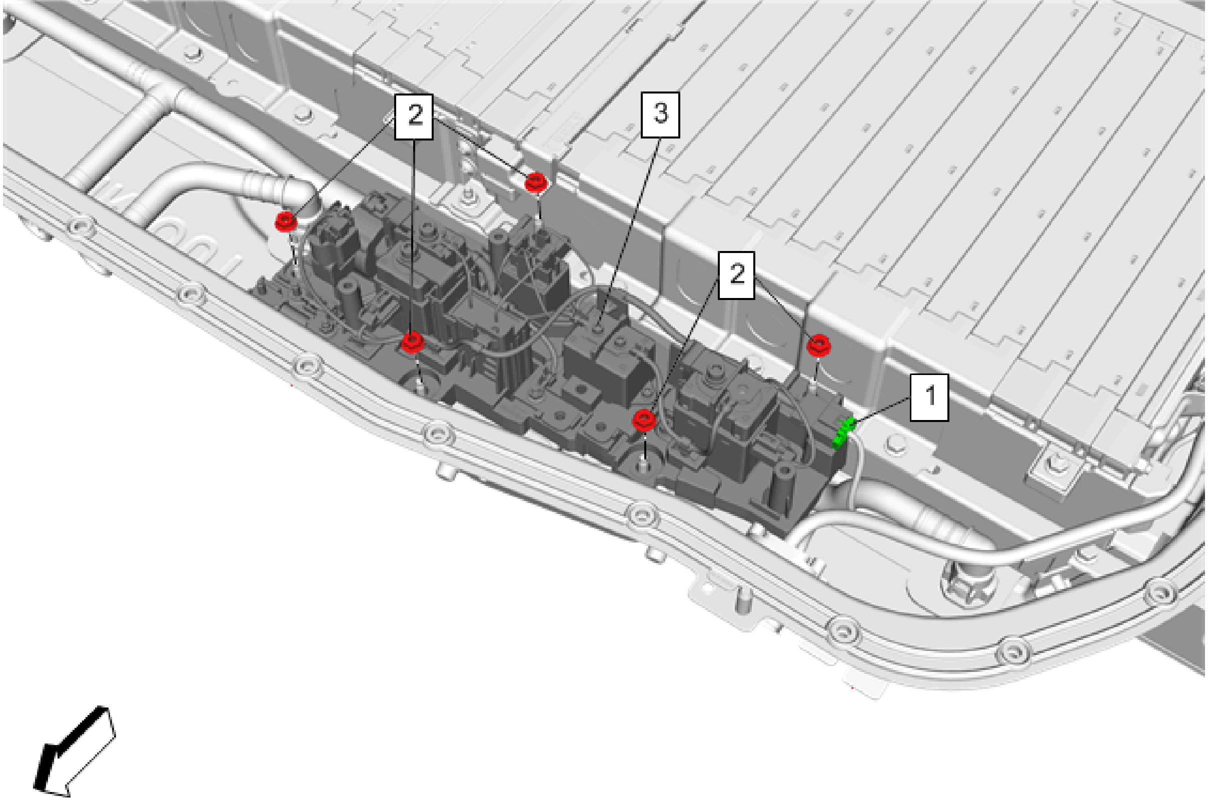


Fig. 30: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Install the high voltage battery disconnect relay assembly (3). High Voltage Battery Disconnect Relay Replacement

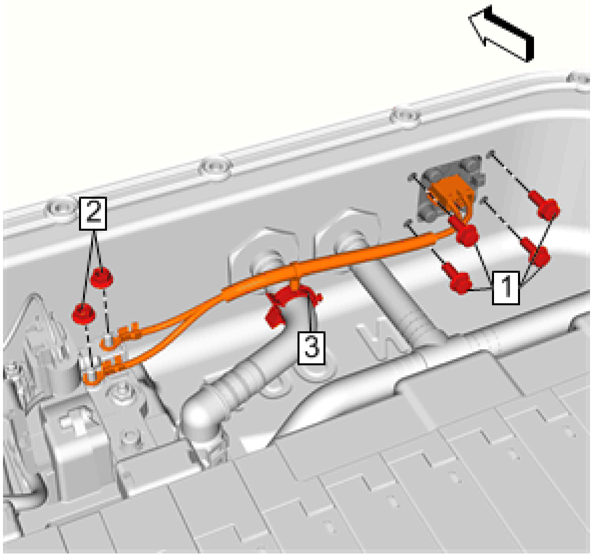


Fig. 31: High Voltage Battery Connector X4
Courtesy of GENERAL MOTORS COMPANY

9. Install the high voltage battery connector X4 assembly (4). High Voltage Connector Replacement (X4)

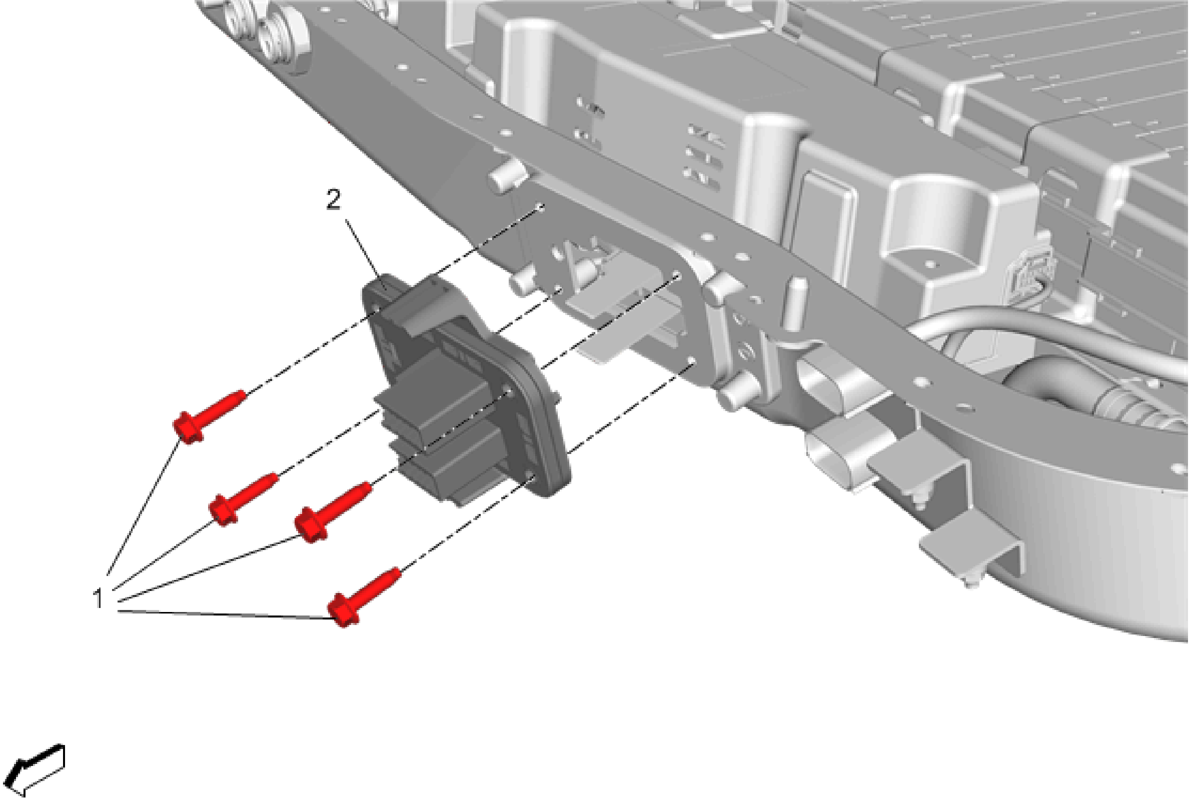


Fig. 32: High Voltage Battery Connector X3
Courtesy of GENERAL MOTORS COMPANY

10. Install the high voltage battery connector X3 (2). **High Voltage Connector Replacement (X3)**

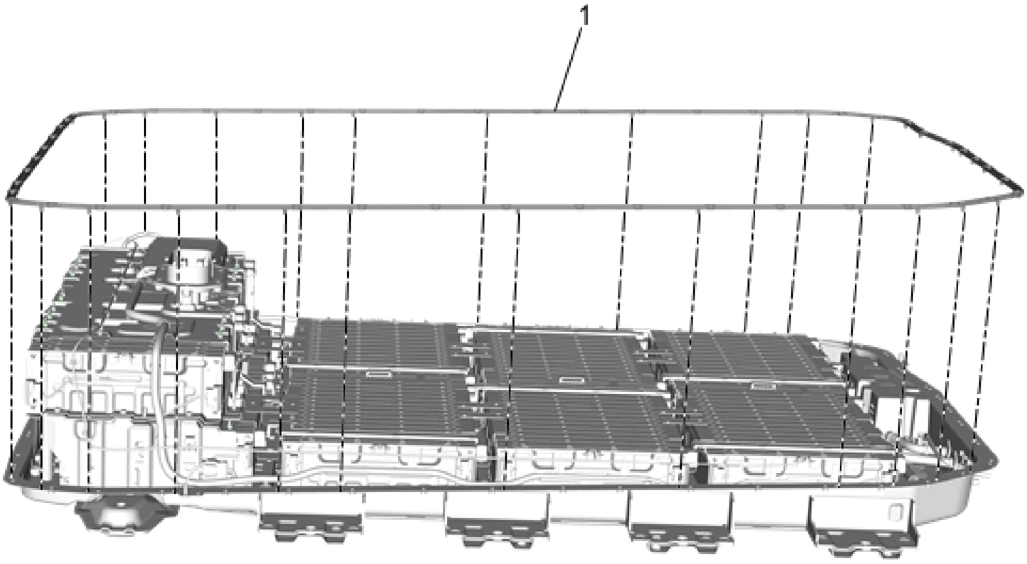


Fig. 33: Battery Cover Seal
Courtesy of GENERAL MOTORS COMPANY

11. Install the battery cover seal (1). **Battery Cover Seal Replacement**
12. Install the battery upper cover. **Battery Upper Cover Replacement**
13. Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built**

before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY COVER SEAL REPLACEMENT

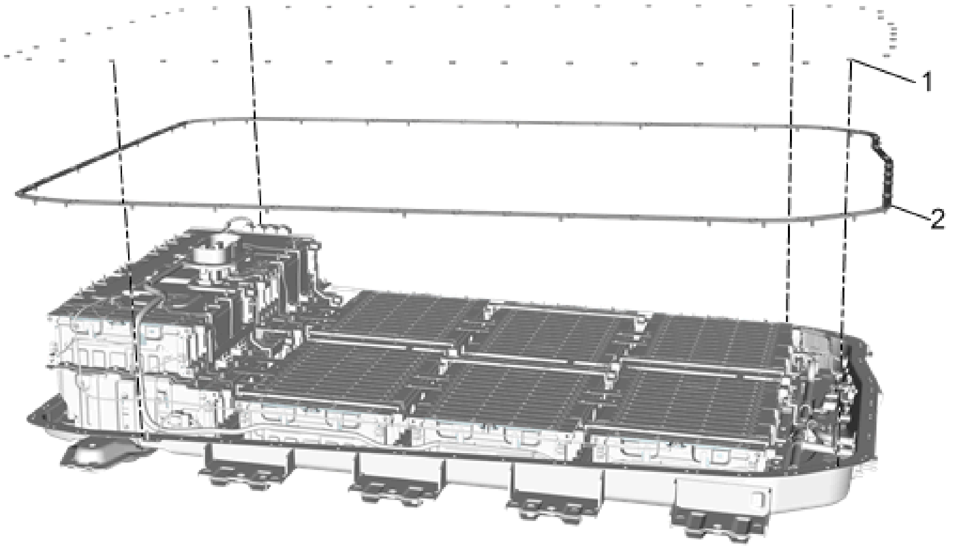


Fig. 34: Battery Cover Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedure

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement
3. Clean the sealing surface using acetone, toluene or methyl ethyl ketone.

Callout	Component Name
1	Battery Cover Seal Washer **Procedure** If needed, replace the old washer to new one. **NOTE:** **Washers are not included with a new seal.**
2	Battery Cover Seal **NOTE:** **Make sure the seal washers are in battery upper cover bolt holes.**

BATTERY ENERGY CONTROL MODULE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper**

procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

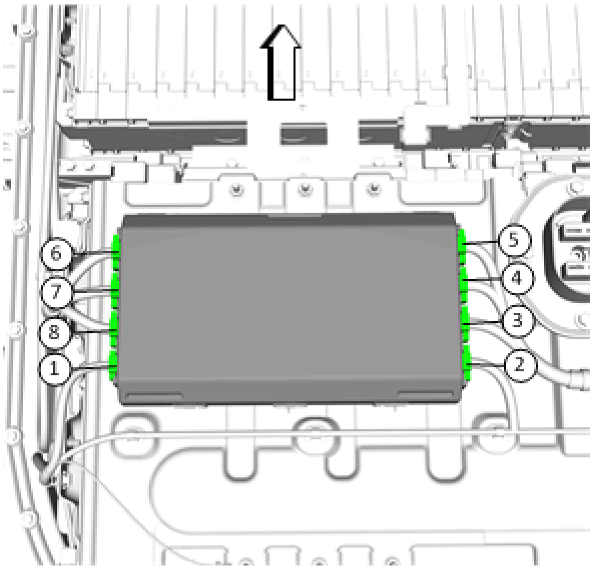
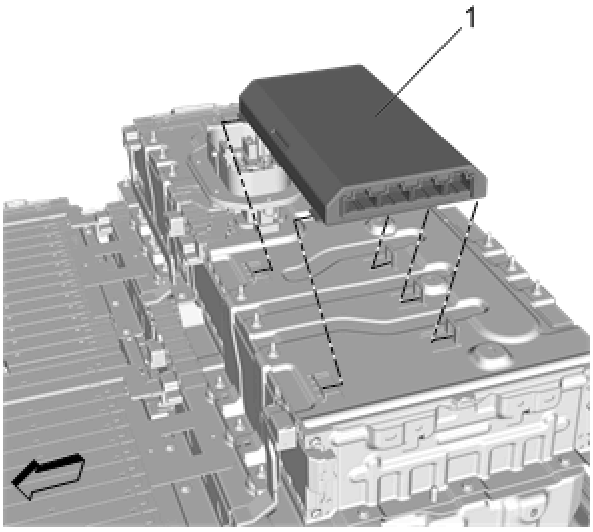


Fig. 35: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control module may be damaged if the connector removal and installation sequence is not followed. If the battery energy control module is damaged, it must be replaced.**

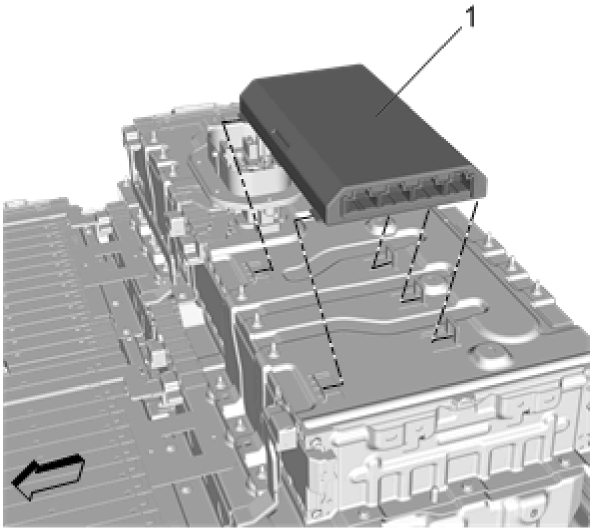
3. Disconnect the battery energy control module connectors in the sequence shown.



[Fig. 36: Battery Energy Control Module](#)
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery energy control module (1).

Installation Procedure



[Fig. 37: Battery Energy Control Module](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery energy control module (1).

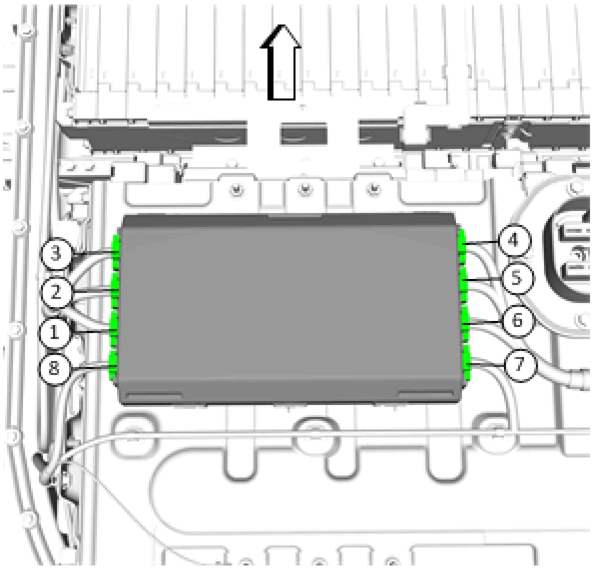


Fig. 38: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control module may be damaged if the connector removal and installation sequence is not followed. If the battery energy control module is damaged, it must be replaced.**

2. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.
3. Install the battery upper cover. Battery Upper Cover Replacement
4. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

300-VOLT BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT (GENERATOR BATTERY CONTROL WIRING JUNCTION BLOCK TO DRIVE MOTOR BATTERY)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Remove High Voltage Battery Control Wiring Junction Block High Voltage Battery Control Wiring Junction Block Replacement (With quick charge) High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)
3. Remove Drivetrain and Front Suspension Frame Drivetrain and Front Suspension Frame Removal and Installation

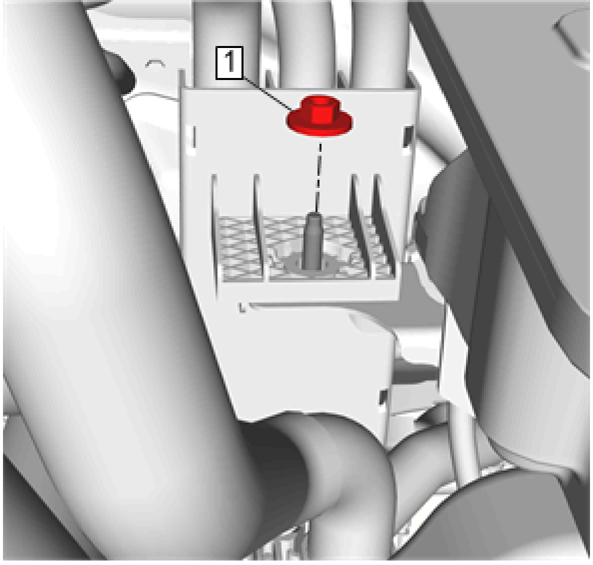


Fig. 39: High Voltage Cable Channel Nut
Courtesy of GENERAL MOTORS COMPANY

4. Remove High Voltage Cable Channel Nut (1)

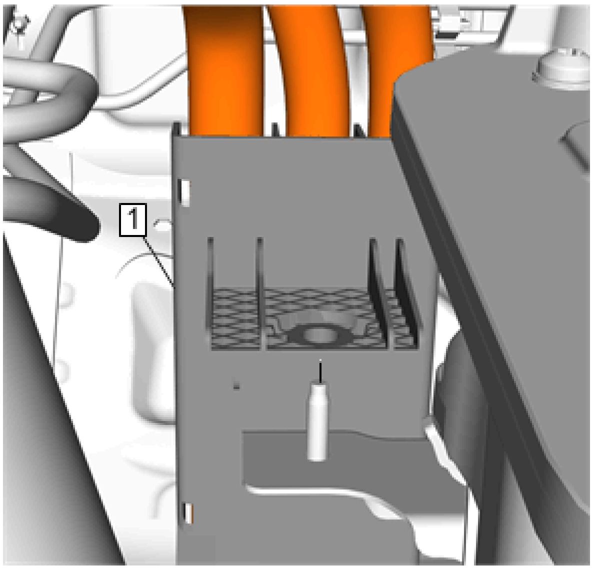


Fig. 40: High Voltage Cable Channel
Courtesy of GENERAL MOTORS COMPANY

5. Remove High Voltage Cable Channel @Stud
6. Raise and support the vehicle.

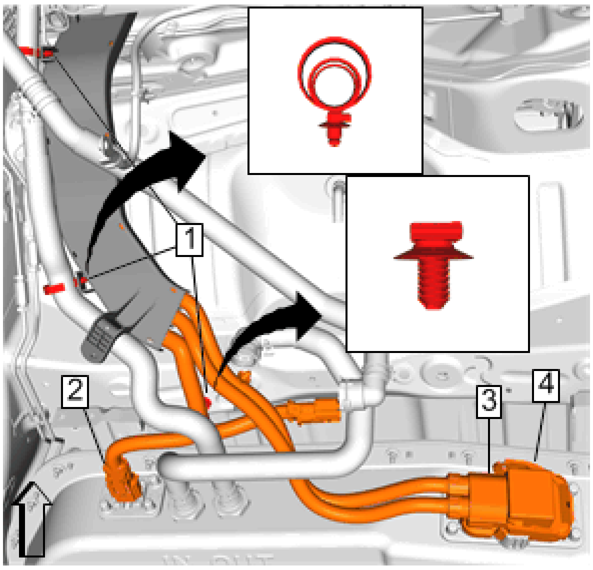


Fig. 41: RESS Heater Connector And Retainer
Courtesy of GENERAL MOTORS COMPANY

7. Remove Retainer(1)
8. Disconnect RESS Heater Connector (2)
9. Sliding Forward 300-Volt Battery Positive and Negative Cable Electrical Connector Handle (4)
10. Release 300-Volt Battery Positive and Negative Cable(3)

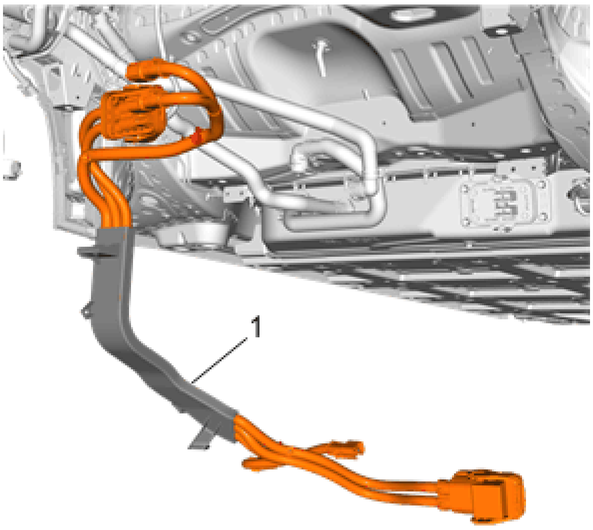


Fig. 42: 300-Volt Battery Positive And Negative Cable
Courtesy of GENERAL MOTORS COMPANY

11. Remove 300-Volt Battery Positive and Negative Cable

Installation Procedure

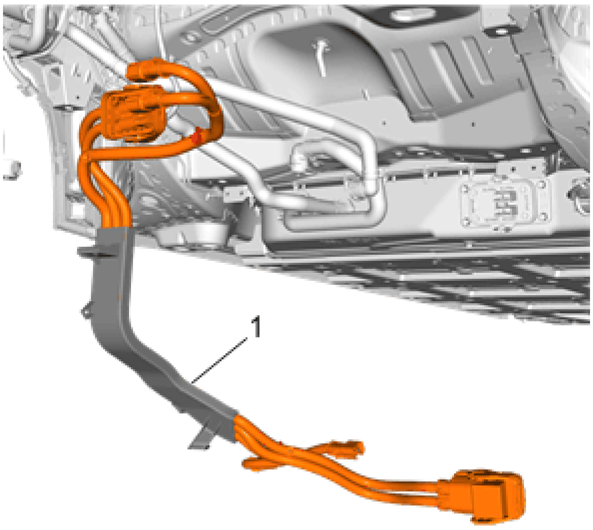


Fig. 43: 300-Volt Battery Positive And Negative Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install 300-Volt Battery Positive and Negative Cable

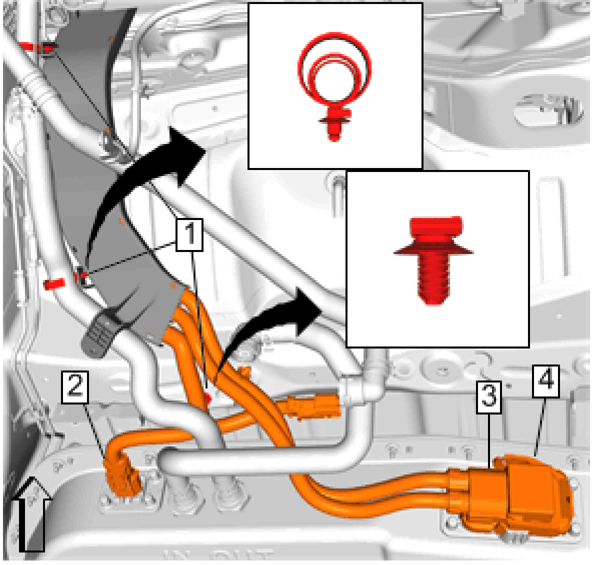


Fig. 44: RESS Heater Connector And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Install 300-Volt Battery Positive and Negative Cable(3)
3. Connect RESS Heater Connector (2)
4. Install Retainer(1)
5. Lower the vehicle.

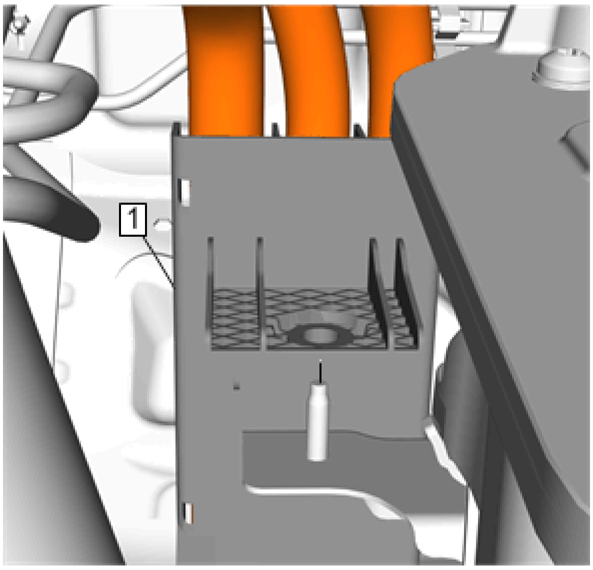


Fig. 45: High Voltage Cable Channel
Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Cable Channel @Stud

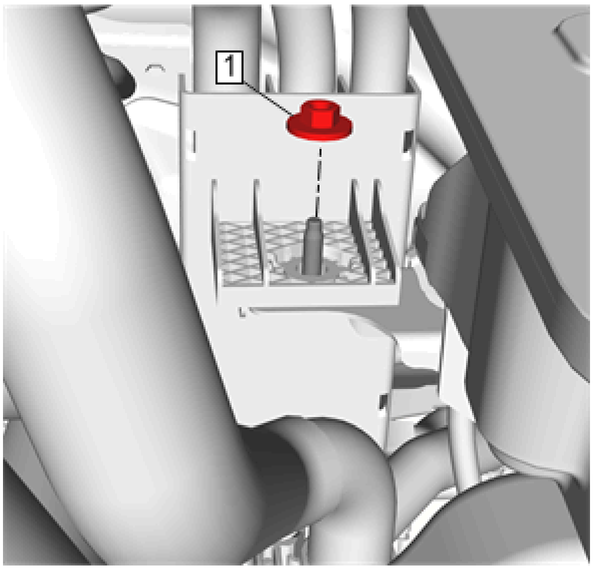


Fig. 46: High Voltage Cable Channel Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

7. Install High Voltage Cable Channel Nut (1) 9 N.m (80 lb in)
8. Install Drivetrain and Front Suspension Frame **Drivetrain and Front Suspension Frame Removal and Installation**
9. Install High Voltage Battery Control Wiring Junction Block **High Voltage Battery Control Wiring Junction Block Replacement (With quick charge)** **High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge)**
10. Enable the high voltage system. **High Voltage Enabling**

BATTERY TO BATTERY POSITIVE CABLE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Remove Battery Tray **Battery Tray Replacement**

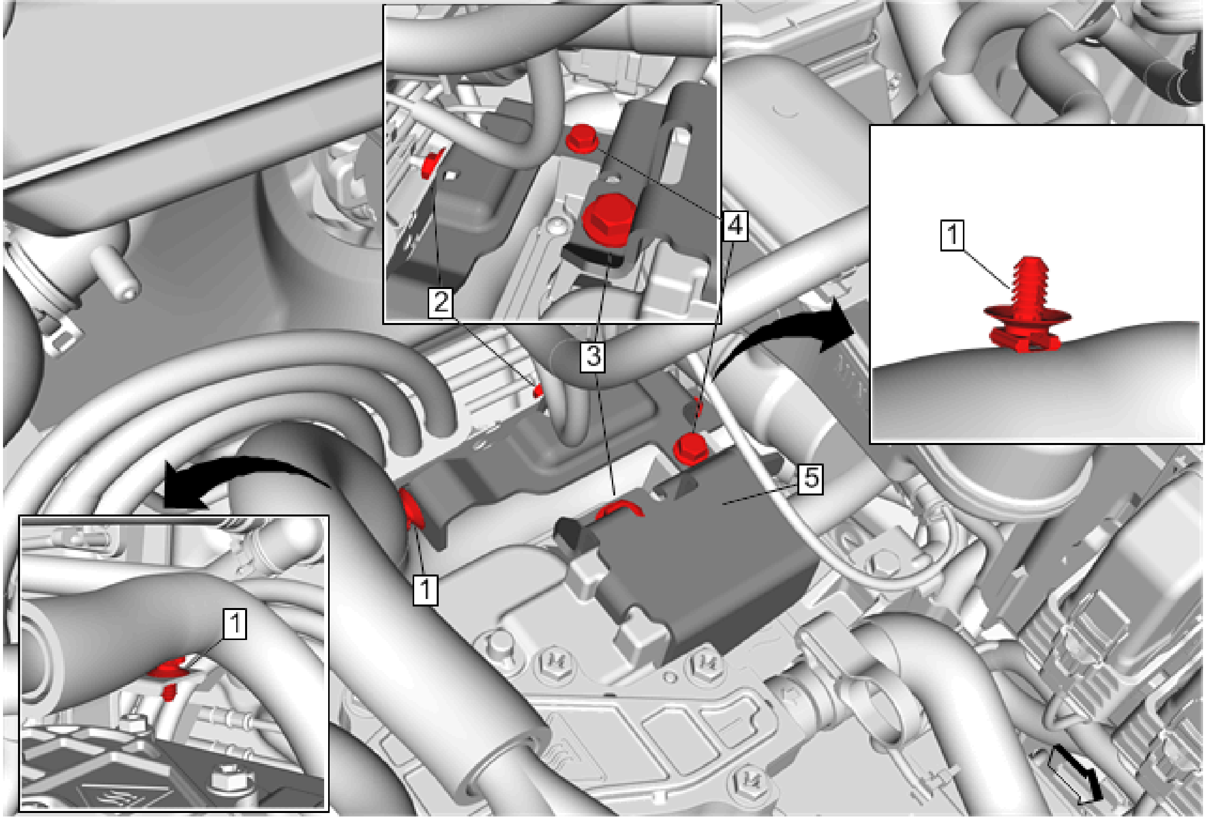


Fig. 47: DC Power Control Module High Voltage Connector Protector, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Battery Positive Cable Retainer (1)
4. Remove Accessory DC Power Control Module High Voltage Connector Protector Nut(2)
5. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolt(3),(4)
6. Remove Accessory DC Power Control Module High Voltage Connector Protector(5)

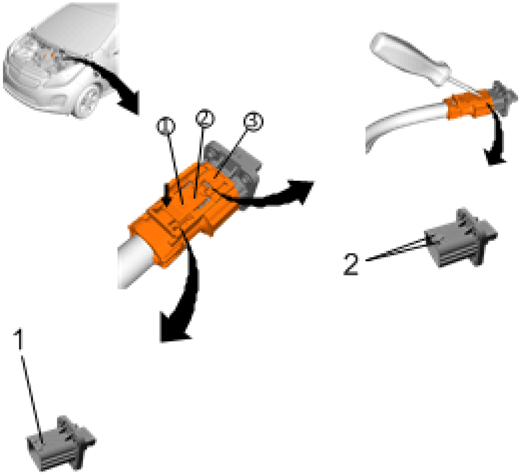


Fig. 48: First Stage Connector Tab And Connector Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the 2-stage high voltage connectors in the following sequence:
    - Push down on the connector tab and release the connector from the first stage connector tab (1).
    - Using a flat blade screwdriver inserted into the connector as shown, release the second stage safety catch, from the 2 connector retaining tabs (2).

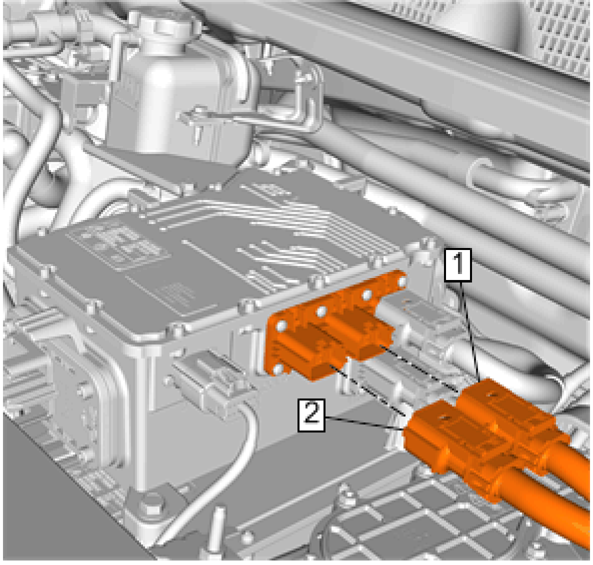


Fig. 49: Air Conditioning And Drive Motor Battery Cooling Compressor Connector
Courtesy of GENERAL MOTORS COMPANY

8. After releasing the connectors, remove the air conditioning and drive motor battery cooling compressor connector (2) and the drive motor battery charger & accessory DC power control module connector (1) from the high voltage battery disconnect control module assembly.

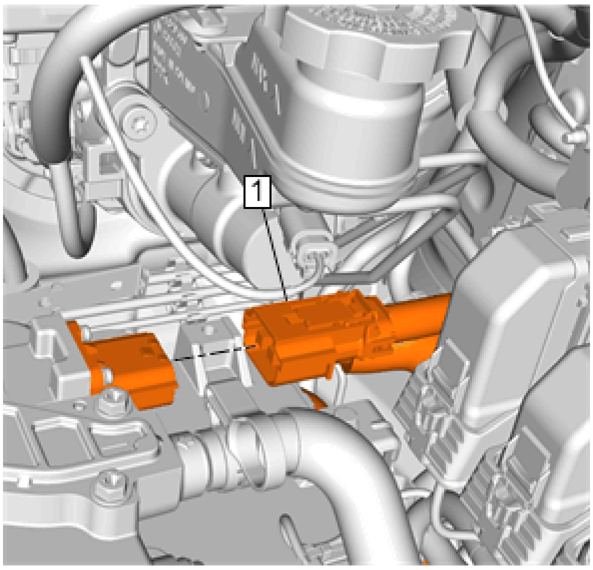


Fig. 50: Auxiliary Power Module Connector
Courtesy of GENERAL MOTORS COMPANY

9. After releasing the connectors, remove the accessory DC power control module connector (1).

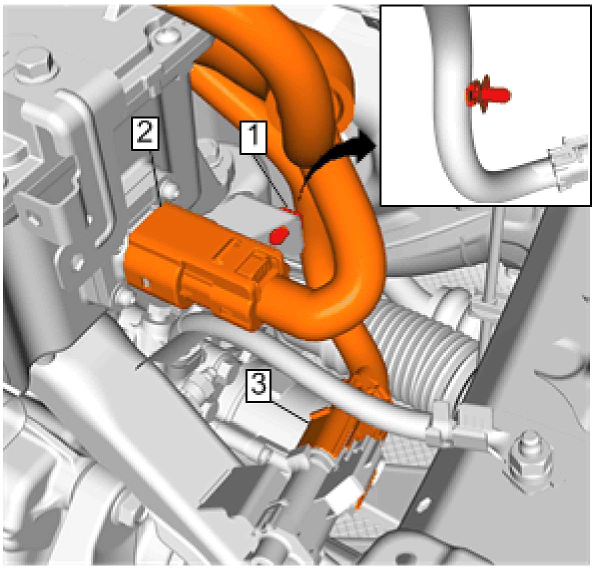


Fig. 51: Drive Motor Battery Charger Cable Retainer And Cooling Compressor Connector
Courtesy of GENERAL MOTORS COMPANY

10. Remove the accessory DC power control module to drive motor battery charger cable retainer (1).
11. After releasing the 2-stage safety connectors, remove the drive motor battery charger electrical connector (2)and the air conditioning and drive motor battery cooling compressor connector (3).

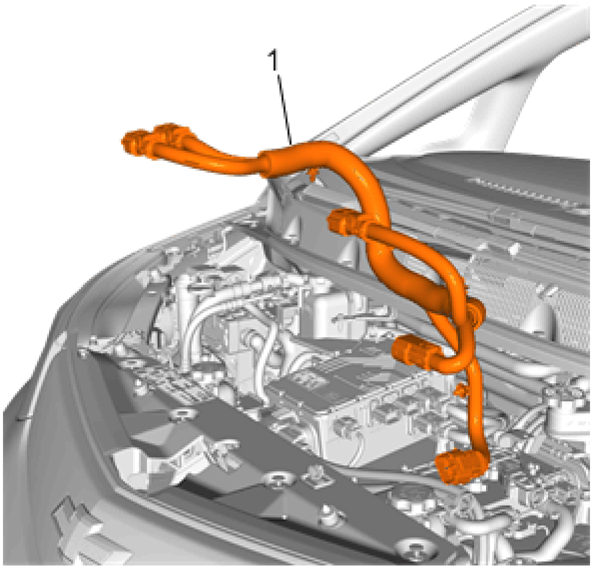


Fig. 52: Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

12. Remove the battery to battery positive cable.

Installation Procedure

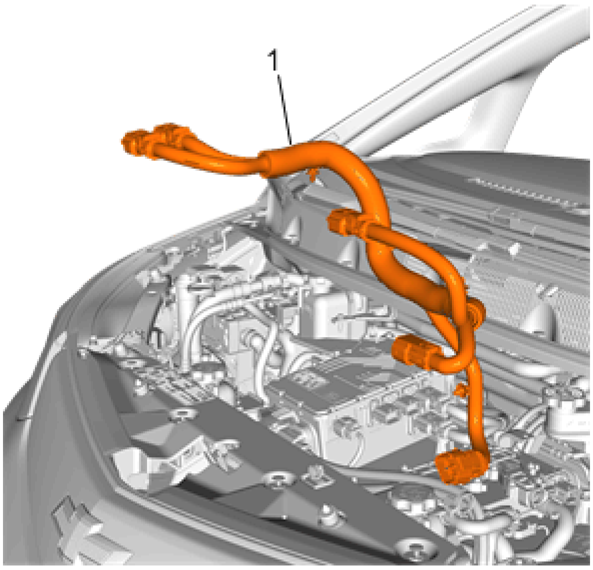


Fig. 53: Battery Positive Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery to battery positive cable.

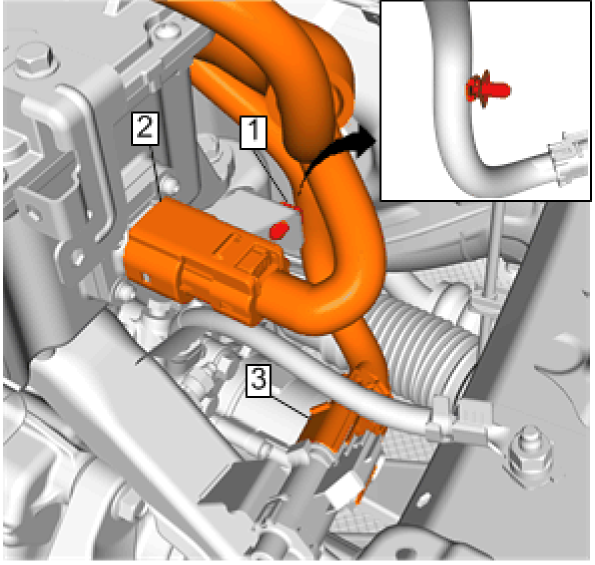


Fig. 54: Drive Motor Battery Charger Cable Retainer And Cooling Compressor Connector
Courtesy of GENERAL MOTORS COMPANY

2. Install the drive motor battery charger electrical connector (2)and the air conditioning and drive motor battery cooling compressor connector (3).
3. Remove the accessory DC power control module to drive motor battery charger cable retainer (1).

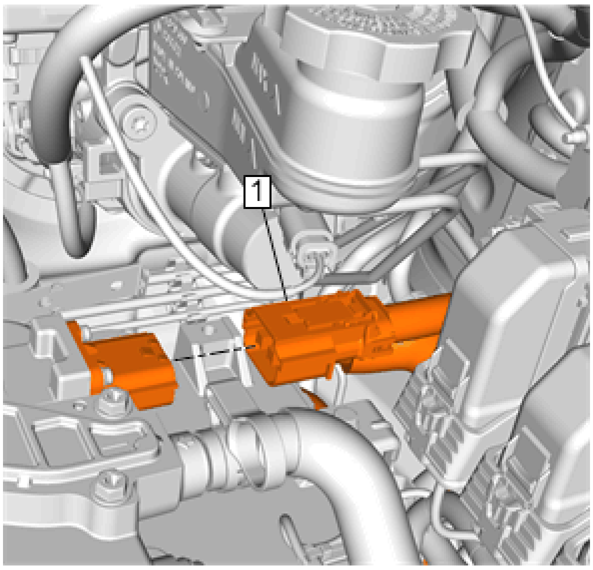


Fig. 55: Auxiliary Power Module Connector
Courtesy of GENERAL MOTORS COMPANY

4. Install the accessory DC power control module connector (1).

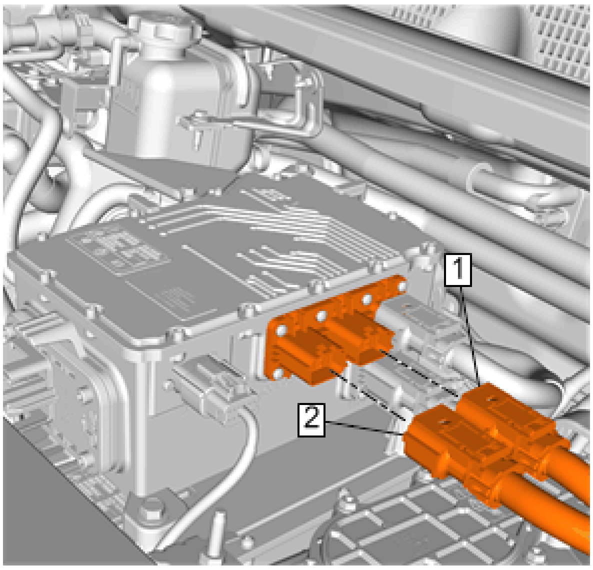


Fig. 56: Air Conditioning And Drive Motor Battery Cooling Compressor Connector
Courtesy of GENERAL MOTORS COMPANY

5. Install the air conditioning and drive motor battery cooling compressor connector (2) and the drive motor battery charger & accessory DC power control module connector (1) to the high voltage battery disconnect control module assembly.

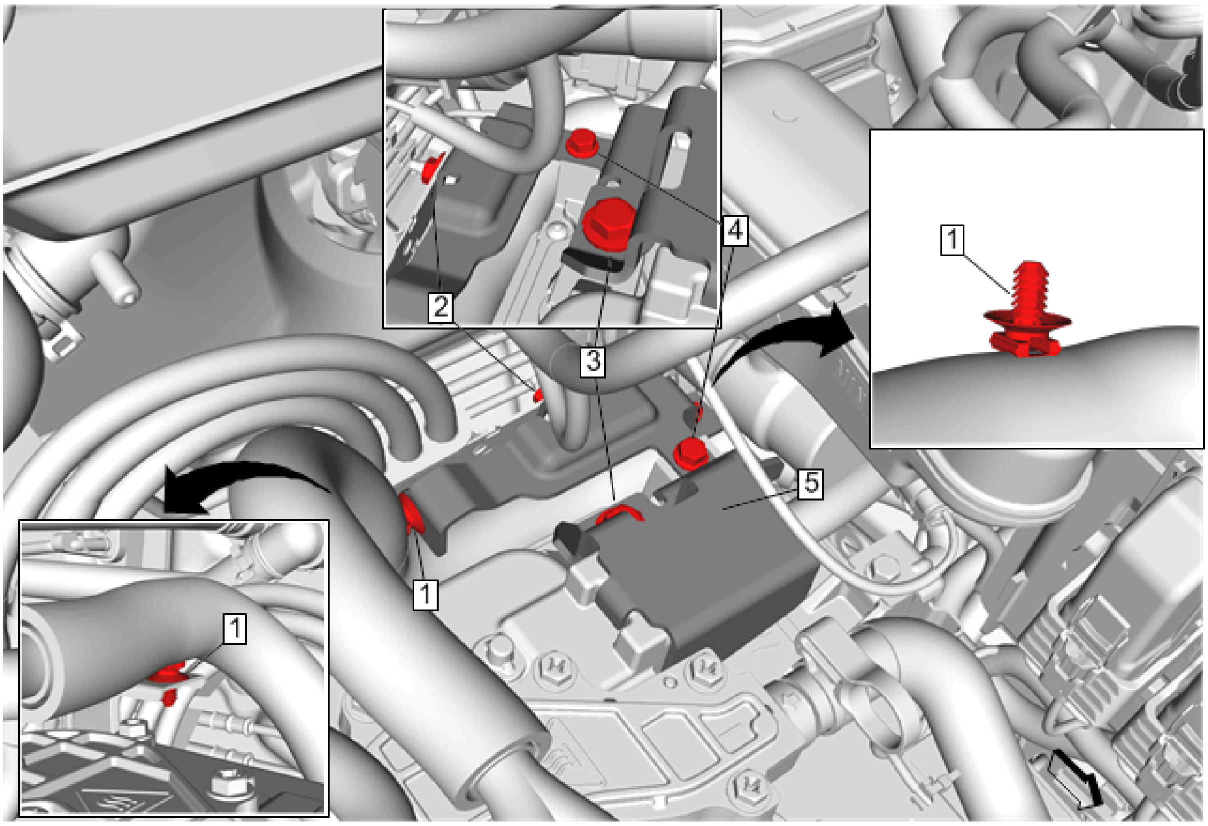


Fig. 57: DC Power Control Module High Voltage Connector Protector, Nut And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install Accessory DC Power Control Module High Voltage Connector Protector(5)

CAUTION: **Refer to Fastener Caution .**

7. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt(4) 9 N.m (80 lb in)
8. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt(3) 22 N.m (16 lb ft)
9. Install Accessory DC Power Control Module High Voltage Connector Protector Nut(2) 9 N.m (80 lb in)
10. Install Battery Positive Cable Retainer (1)
11. Install Battery Tray Battery Tray Replacement
12. Enable the high voltage system. High Voltage Enabling

CELL BATTERY MODULE REPLACEMENT (ROW 1)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

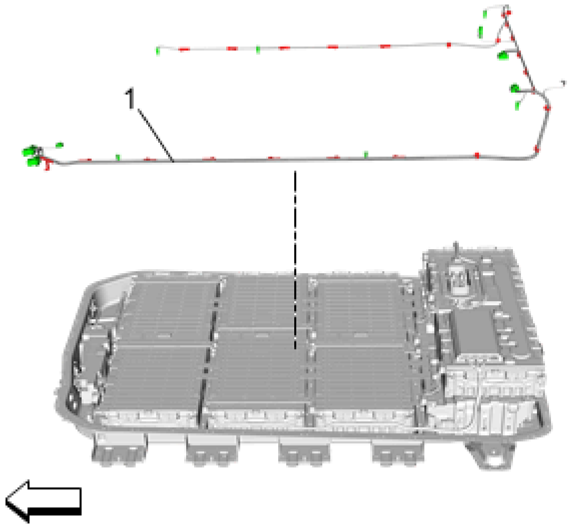


Fig. 58: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). Drive Motor Battery Control Module Wiring Harness Replacement

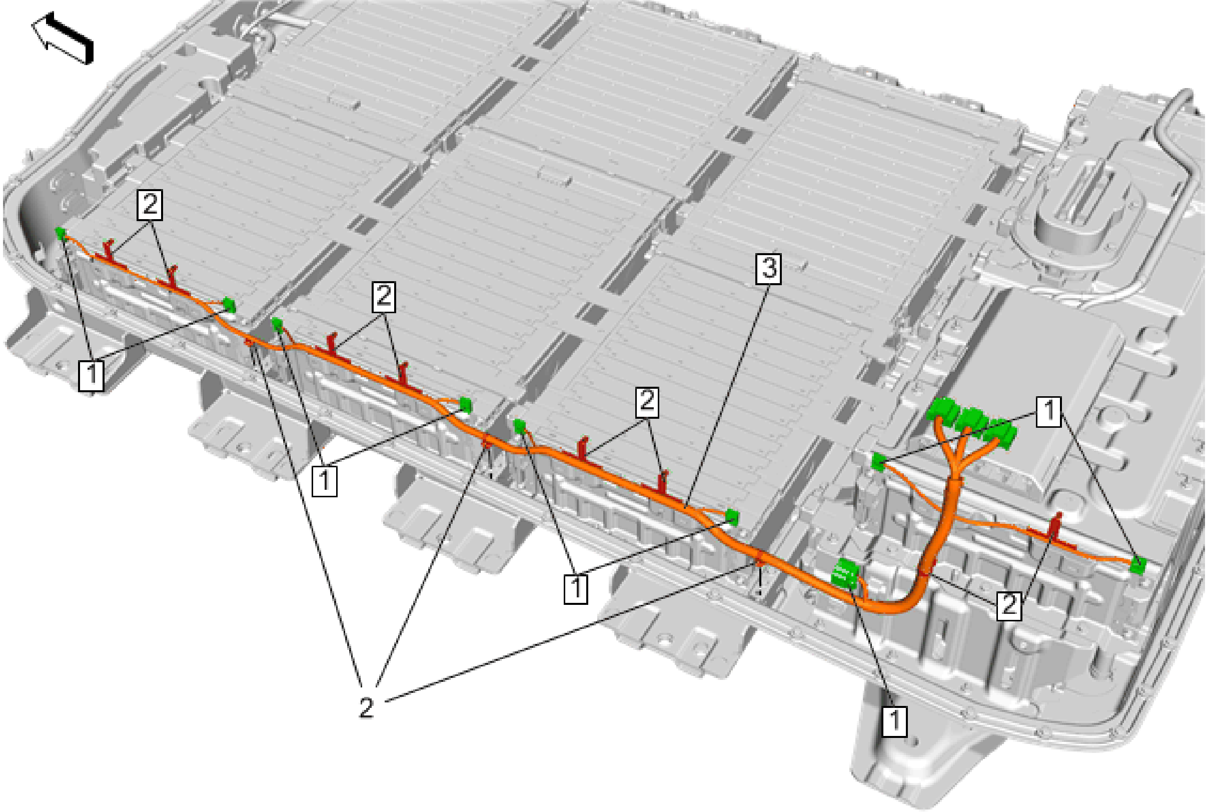


Fig. 59: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)**

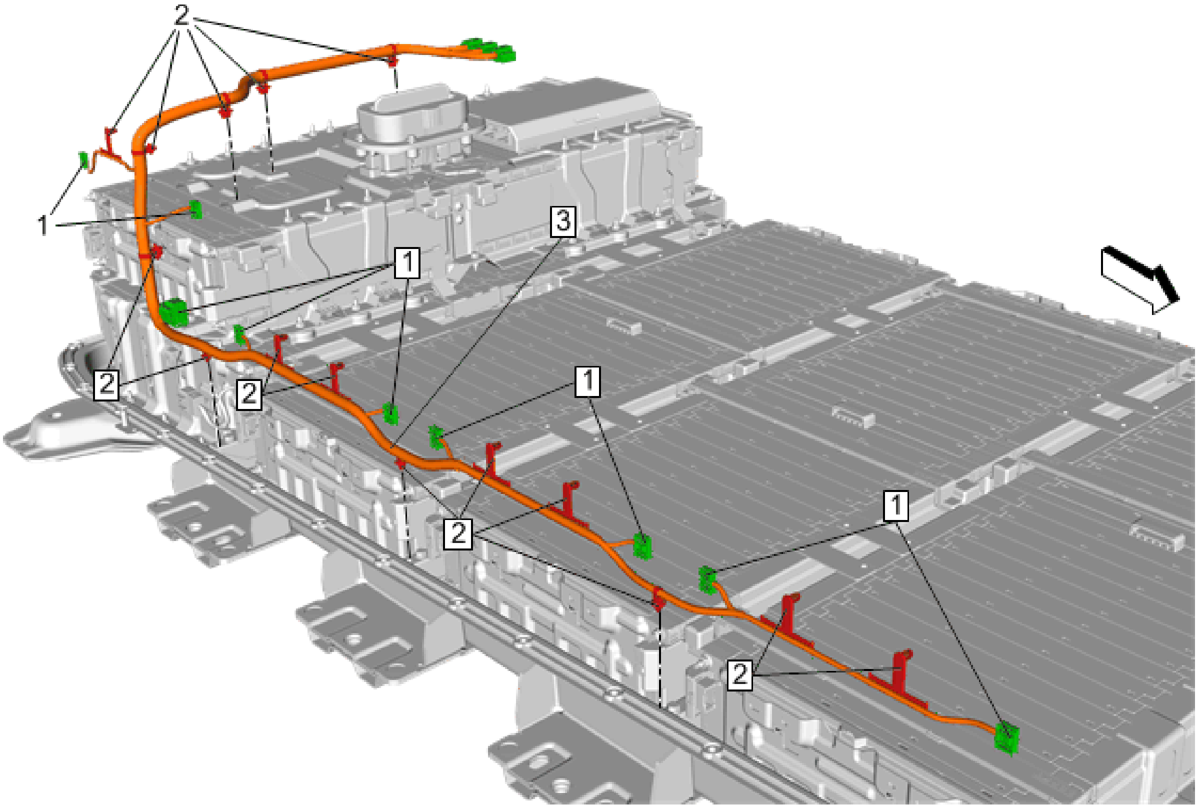


Fig. 60: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

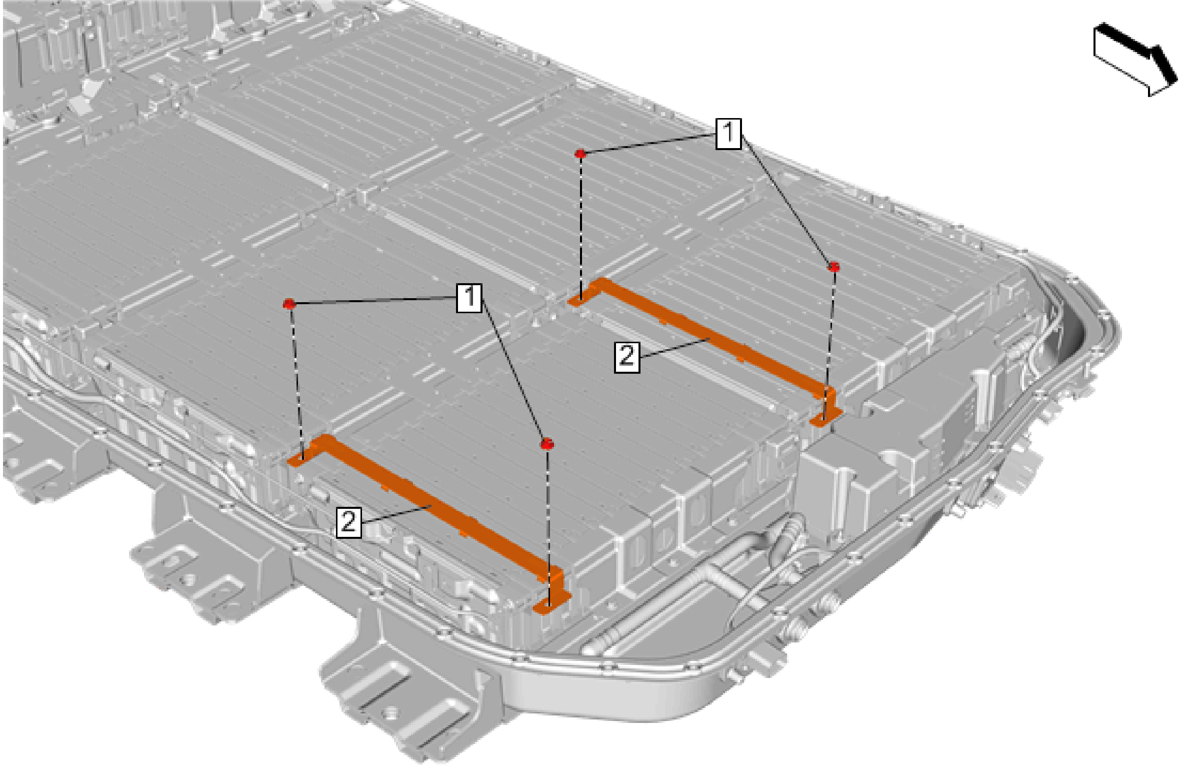


Fig. 61: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

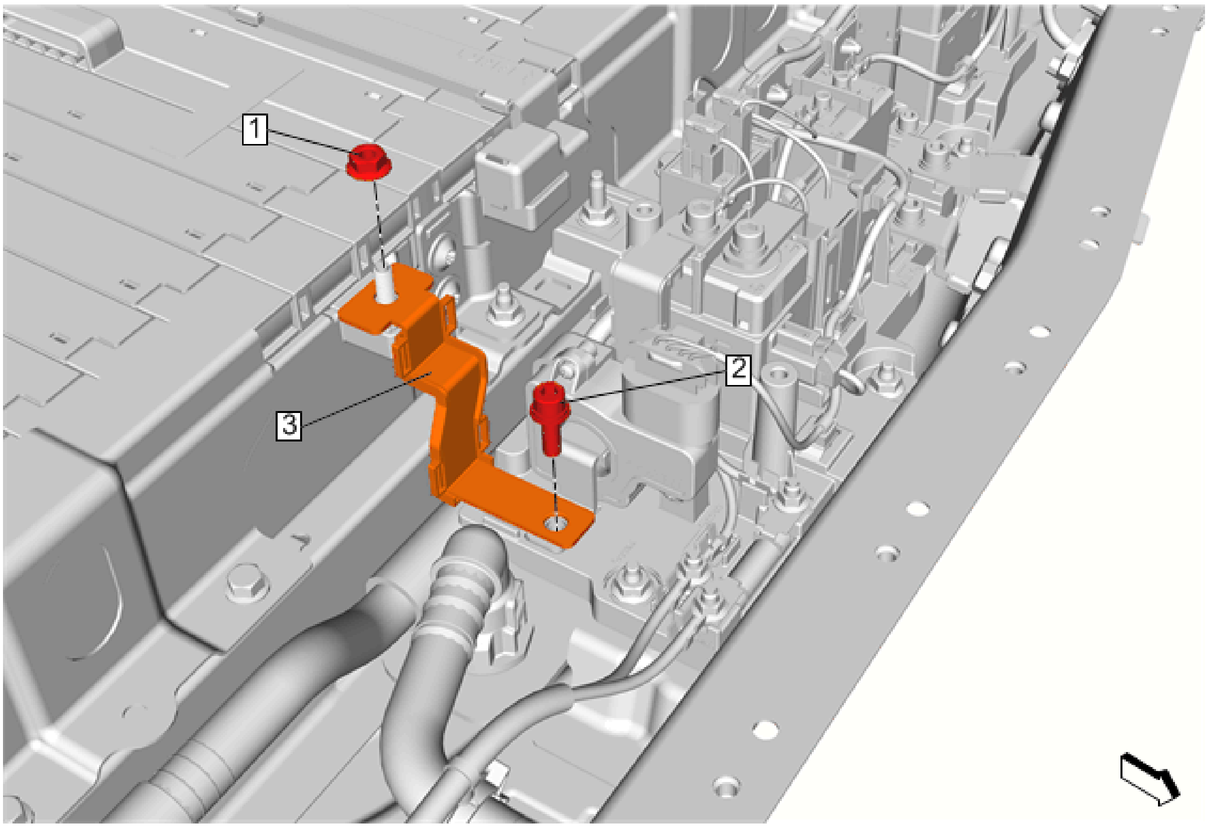


Fig. 62: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

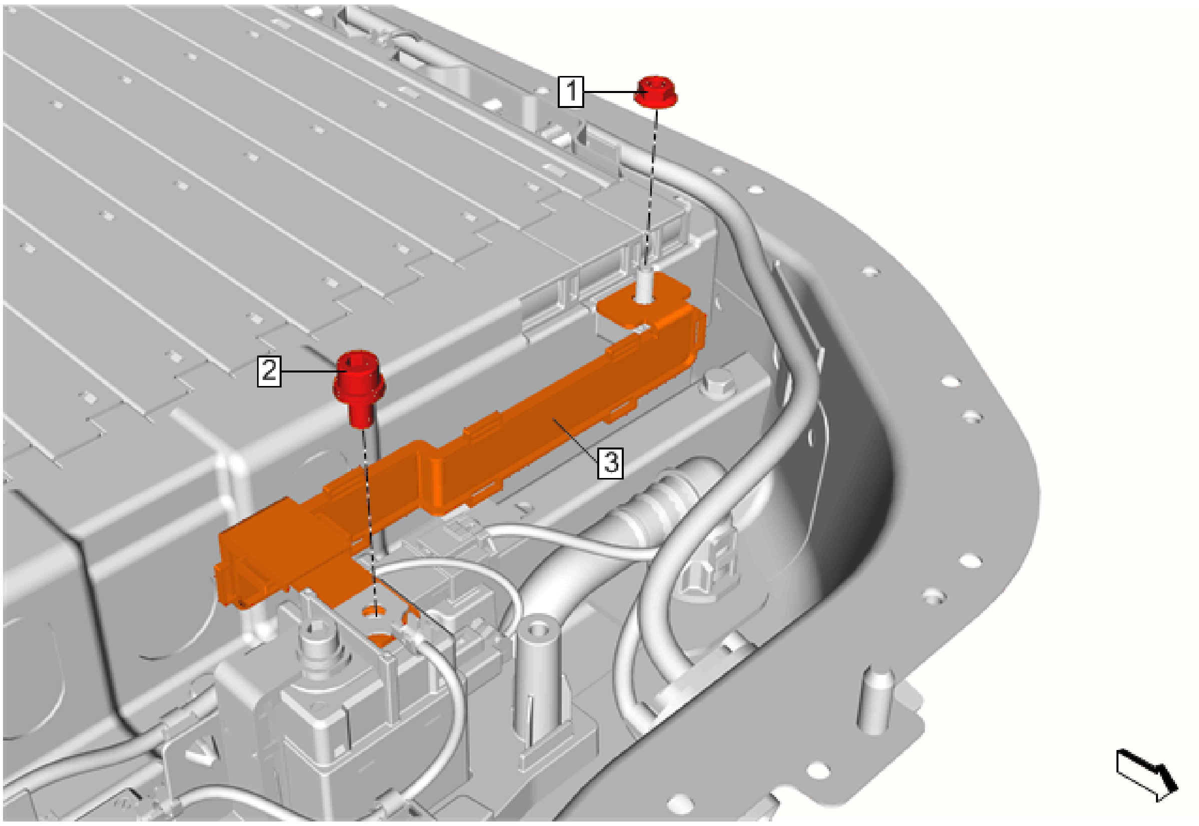
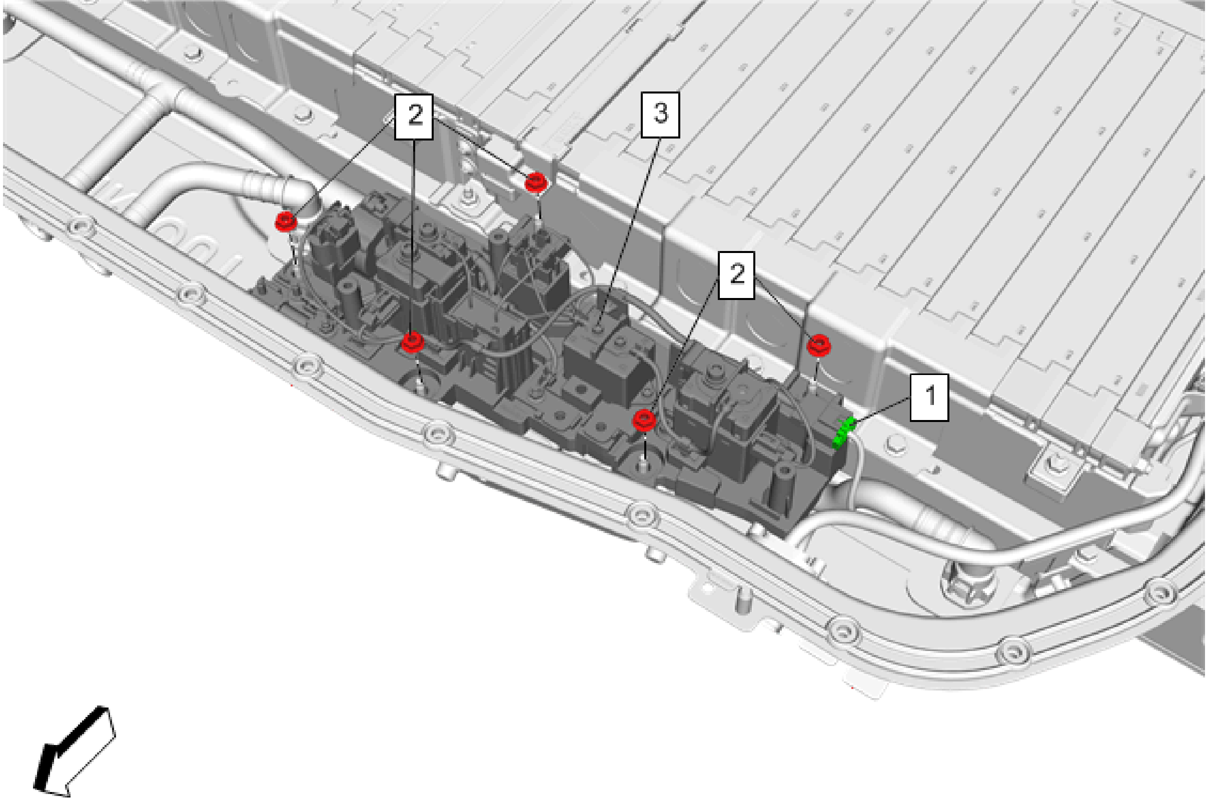


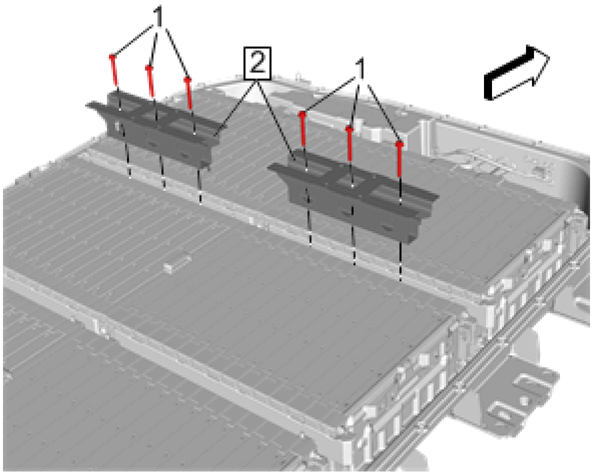
Fig. 63: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)



[Fig. 64: High Voltage Battery Disconnect Relay Assembly](#)
Courtesy of GENERAL MOTORS COMPANY

9. Remove the high voltage battery disconnect relay assembly (3). [High Voltage Battery Disconnect Relay Replacement](#)



[Fig. 65: Cell Battery Module Bracket Bolts And Brackets](#)
Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

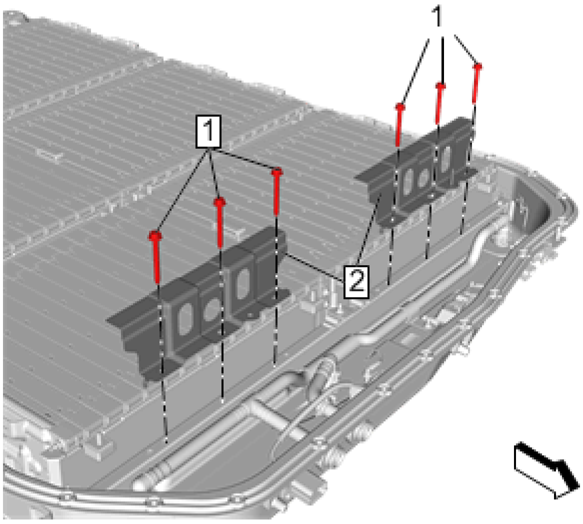


Fig. 66: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

11. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

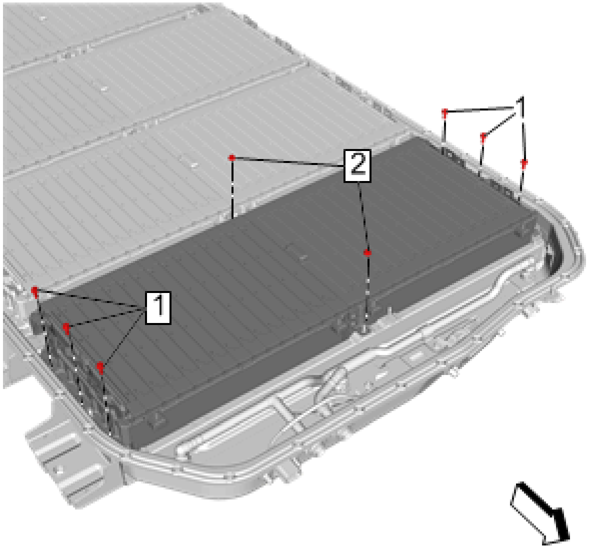


Fig. 67: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

12. Remove the cell battery module side bolts (1) [6x].
13. Remove the cell battery module securing nuts (2) [2x].

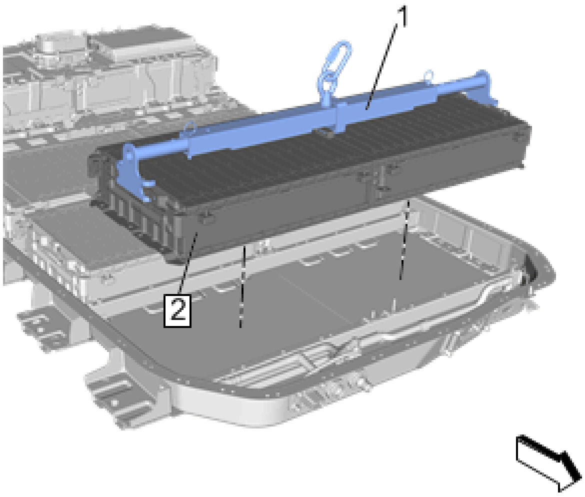


Fig. 68: Battery Lift Tool And Lift Cell Battery
Courtesy of GENERAL MOTORS COMPANY

14. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

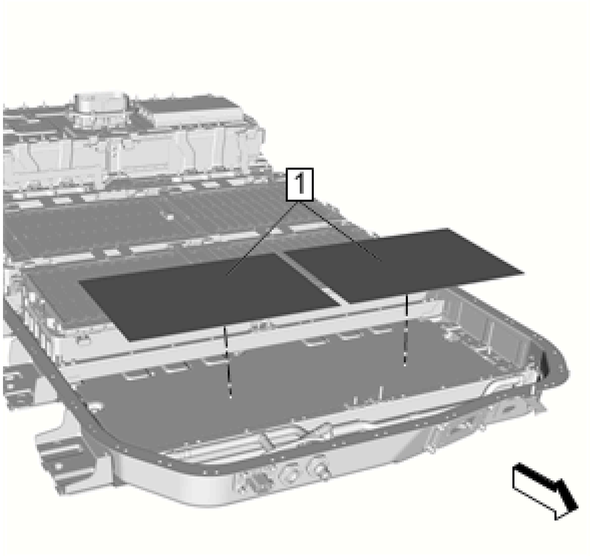


Fig. 69: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

15. Remove the thermal pads (1).

Installation Procedure

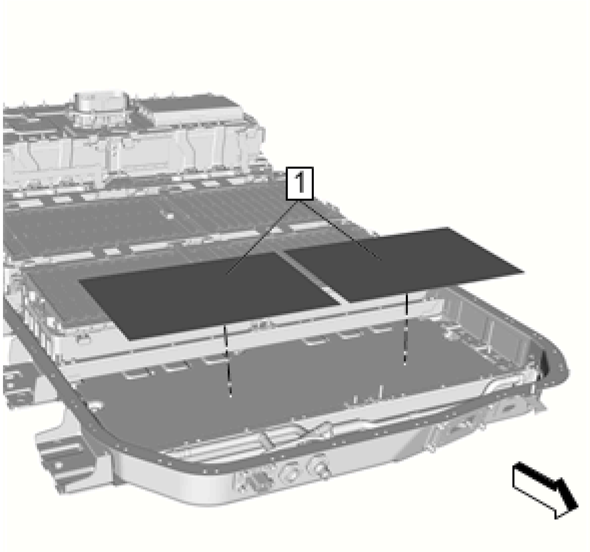


Fig. 70: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.**

1. Install the thermal pads (1).

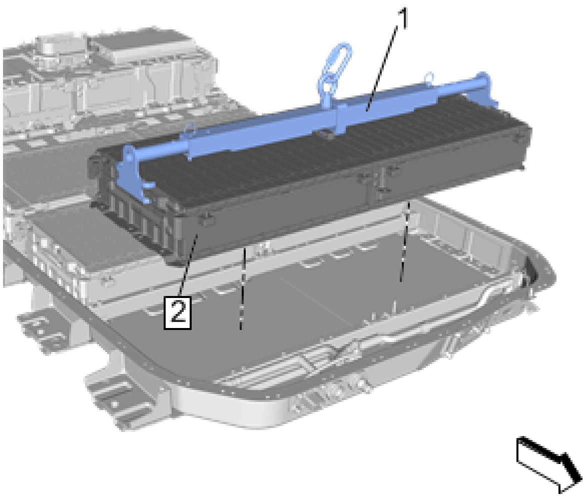


Fig. 71: Battery Lift Tool And Lift Cell Battery
Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

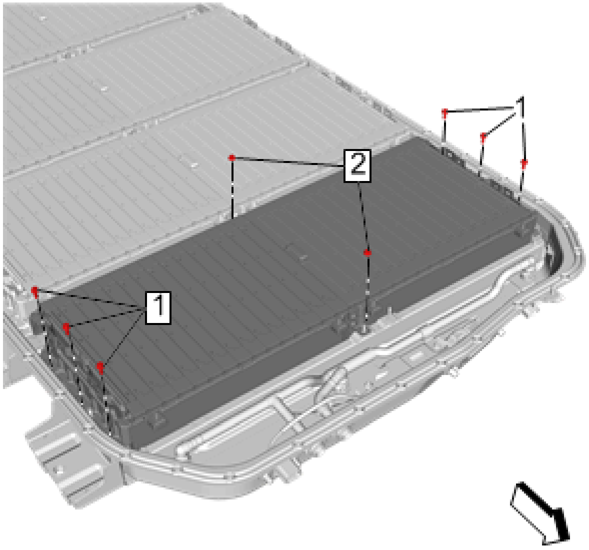


Fig. 72: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (90 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 lb in).

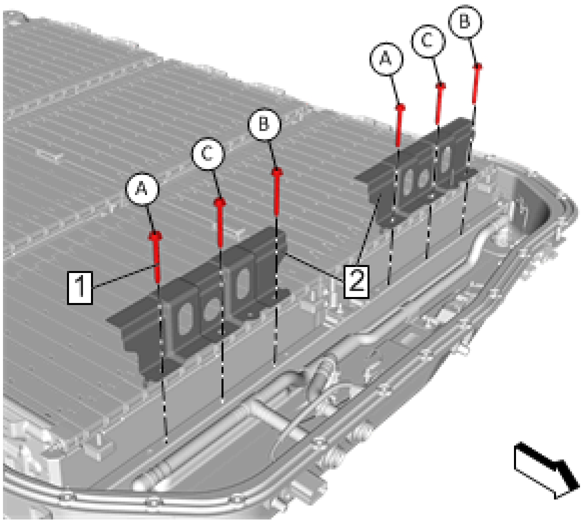


Fig. 73: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery module bracket bolts in the sequence shown.**

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

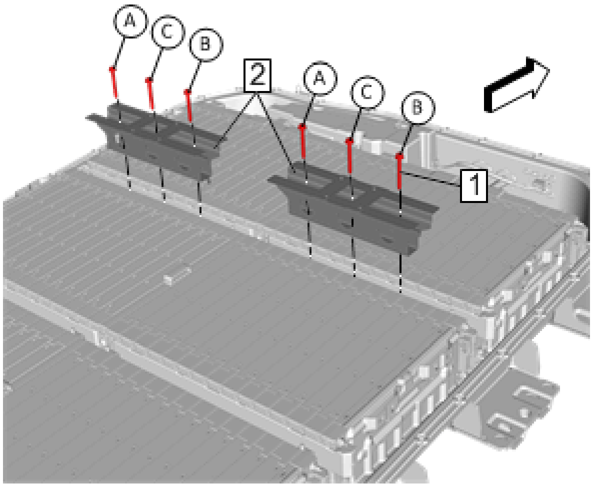


Fig. 74: Cell Battery Module Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery module bracket bolts in the sequence shown.**

6. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

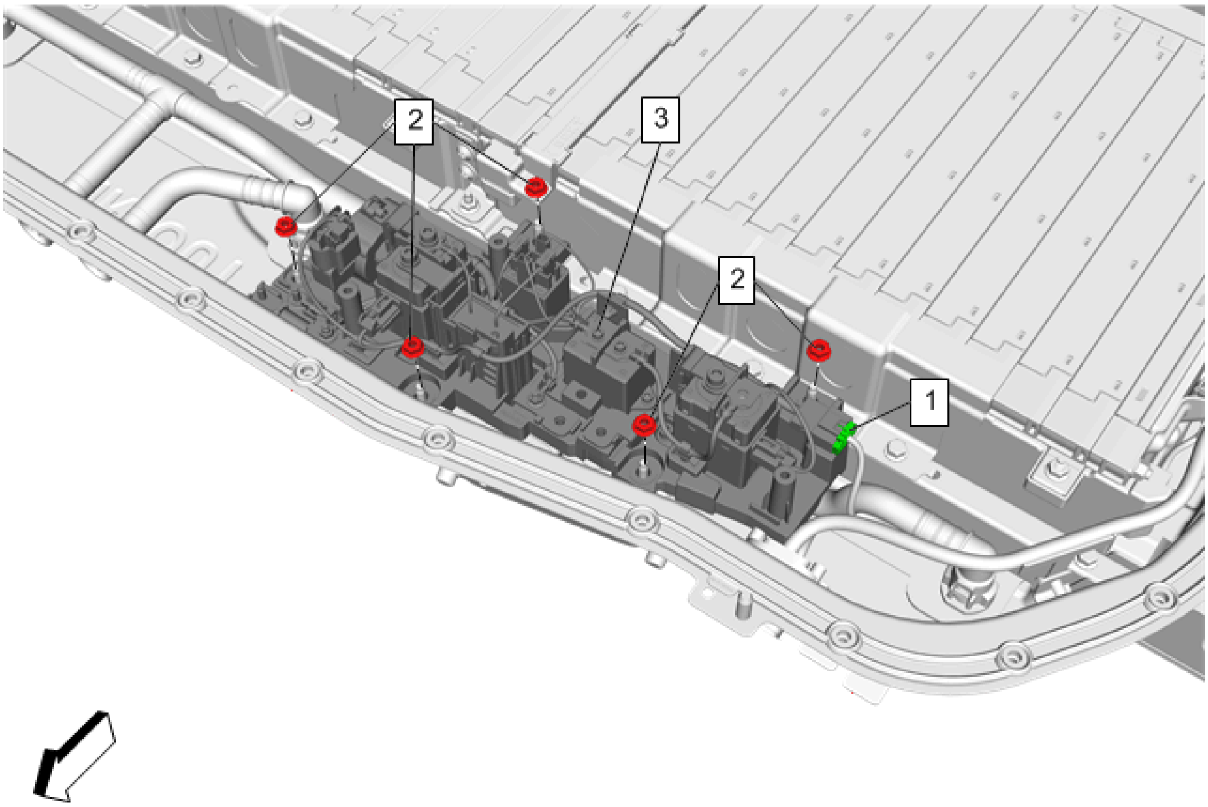


Fig. 75: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install the high voltage battery disconnect relay assembly (3). High Voltage Battery Disconnect Relay Replacement

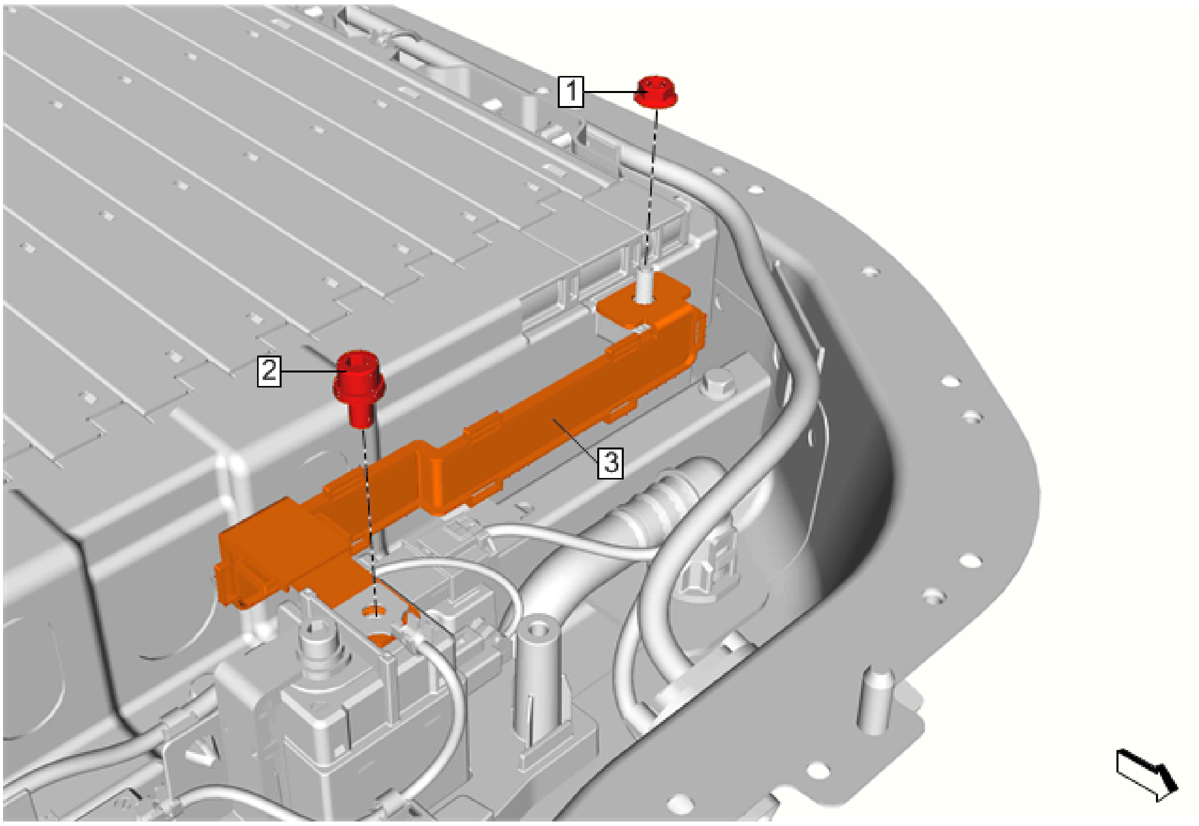


Fig. 76: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

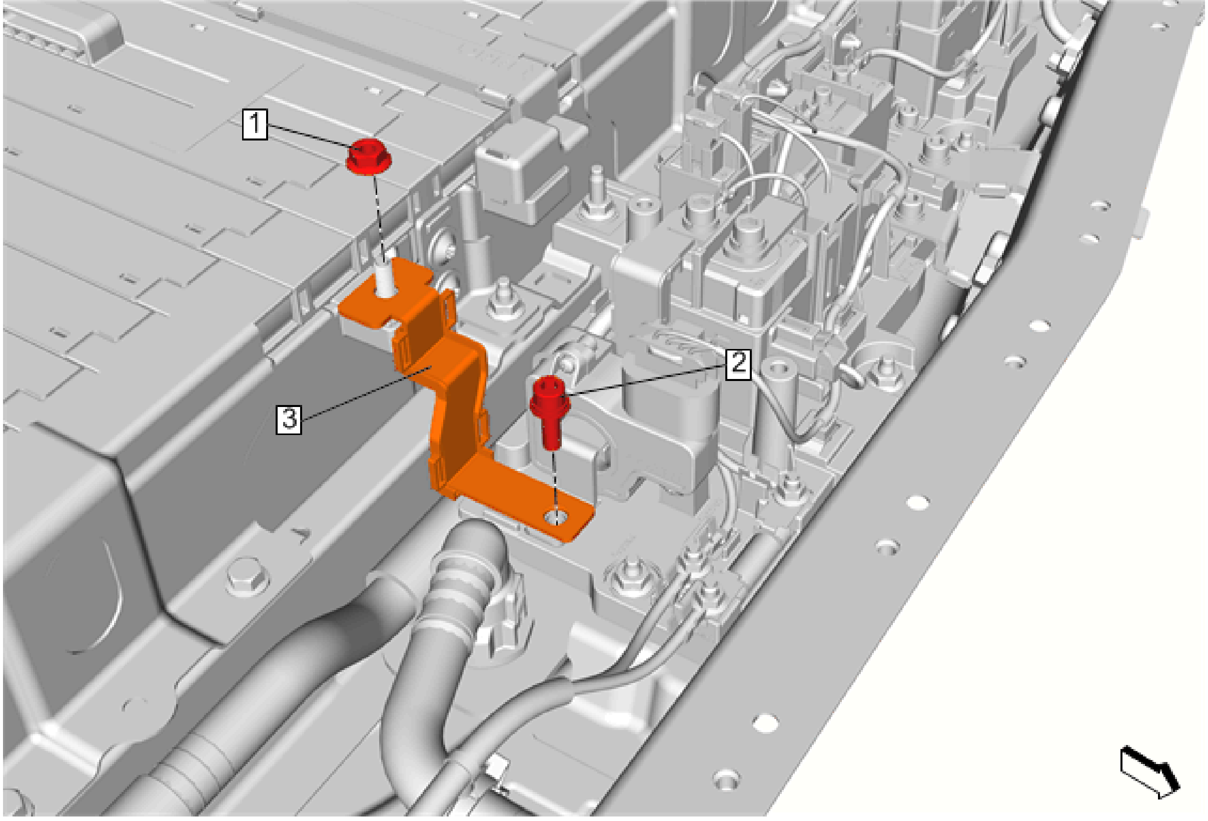


Fig. 77: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

9. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

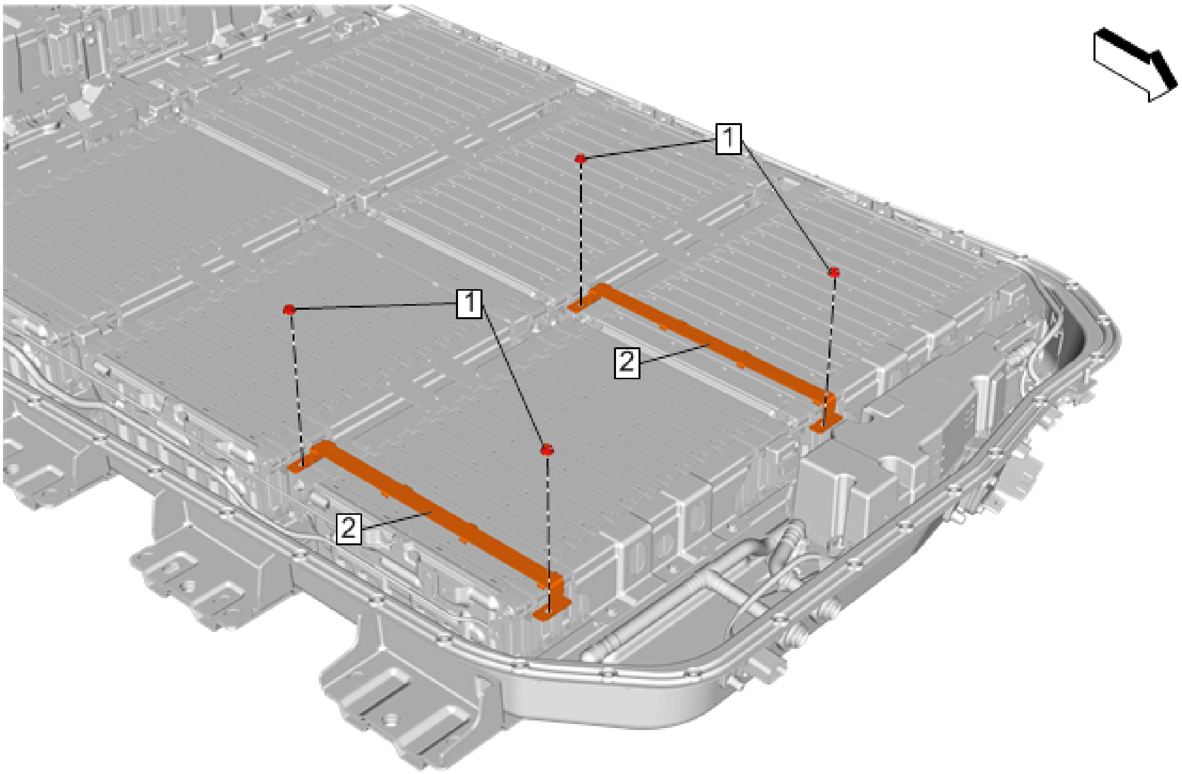


Fig. 78: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

10. Install the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

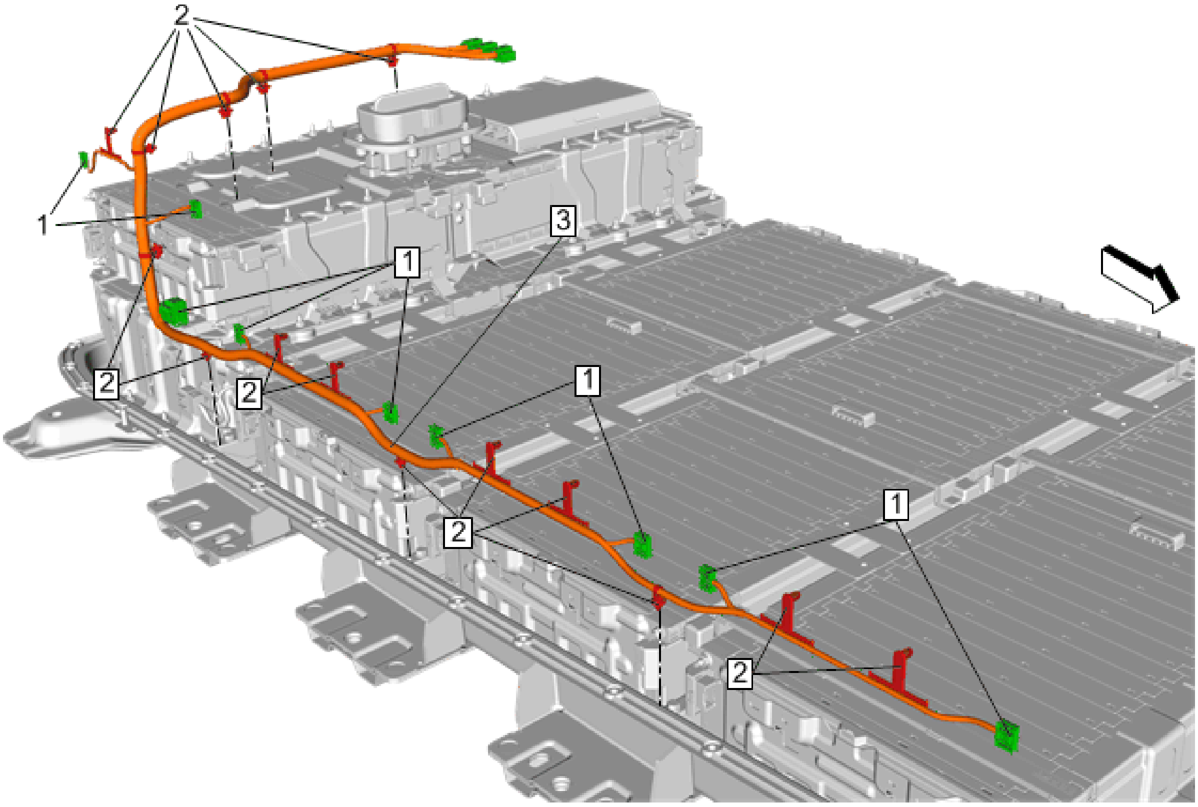


Fig. 79: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

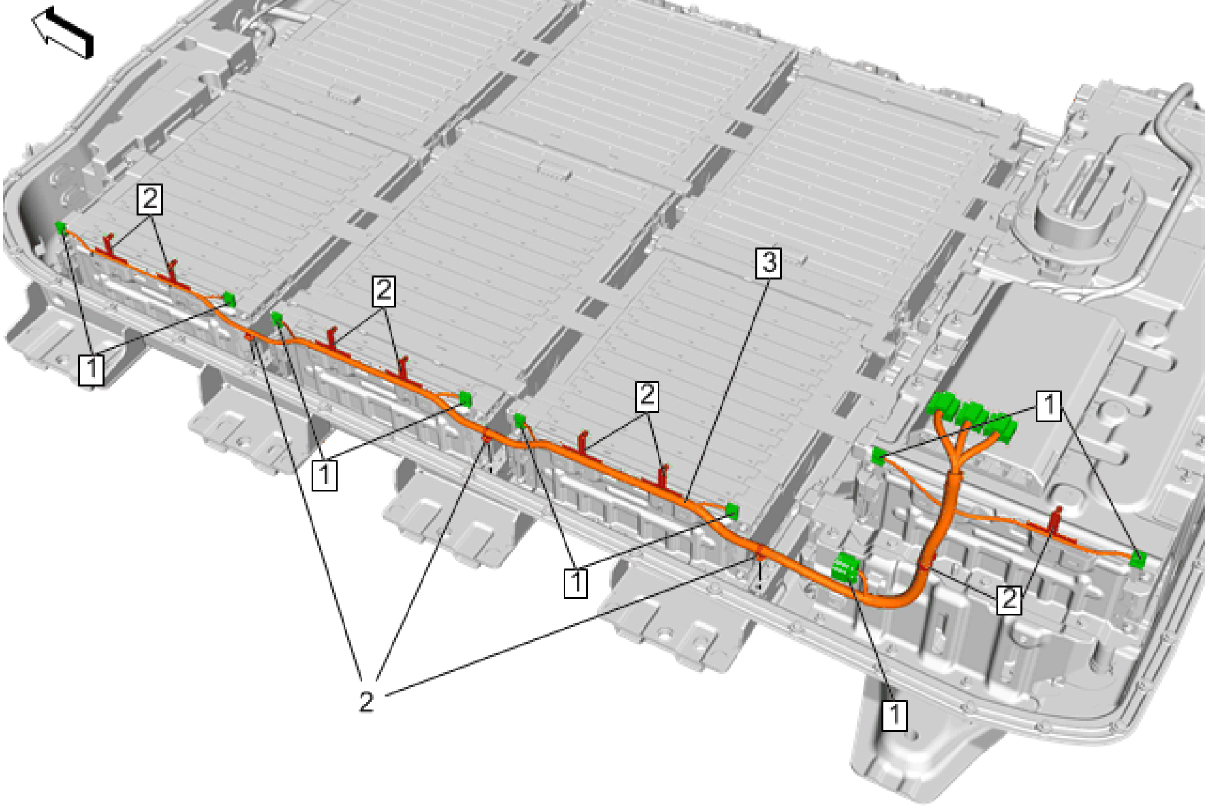


Fig. 80: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Install the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

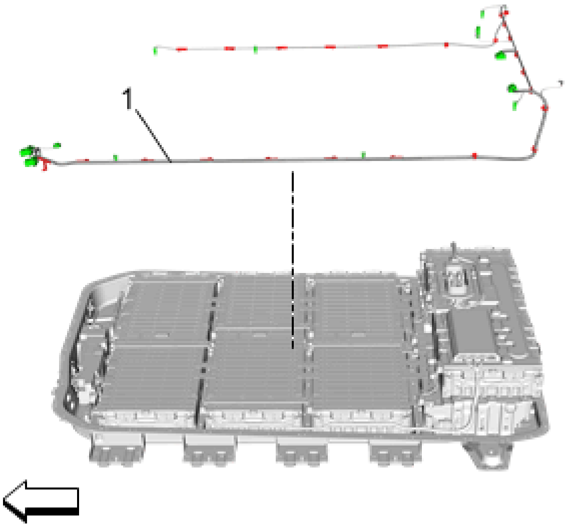


Fig. 81: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

13. Install the drive motor battery control module wiring harness (1). **Drive Motor Battery Control Module Wiring Harness Replacement**
14. Perform the cell battery balancing if replaced. **Hybrid/EV Battery Cell Balancing**
15. Install the battery upper cover. **Battery Upper Cover Replacement**
16. Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

17. Reprogram the battery energy control module. Battery Energy Control Module Programming and Setup
18. Program the hybrid powertrain control module 2. Hybrid Powertrain Control Module 2 Programming and Setup
19. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. Hybrid/EV Battery Pack Capacity Learn

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

CELL BATTERY MODULE REPLACEMENT (ROW 2)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

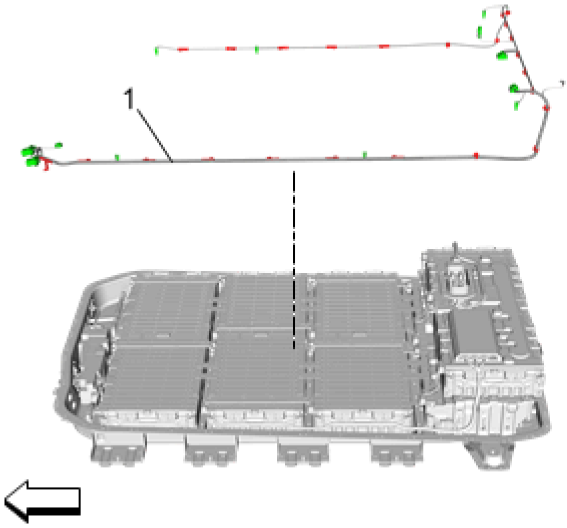


Fig. 82: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). **Drive Motor Battery Control Module Wiring Harness Replacement**

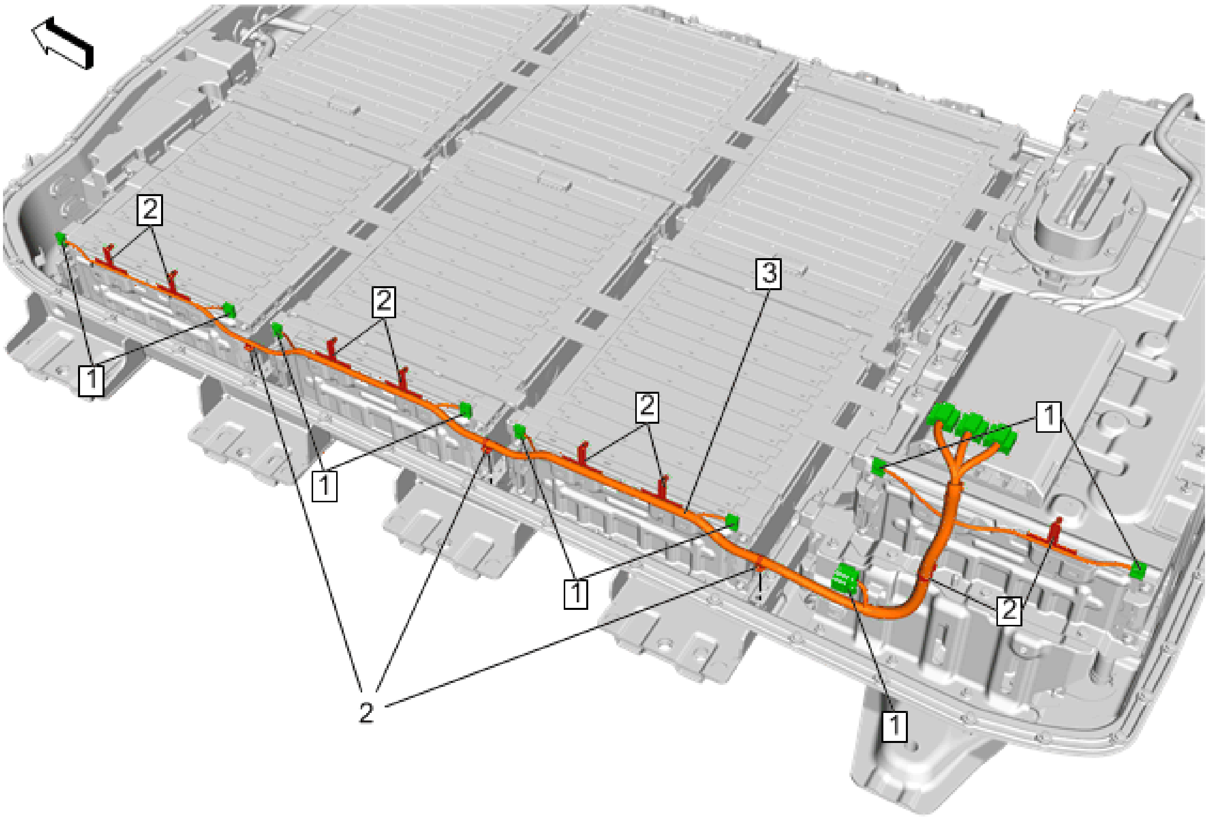


Fig. 83: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

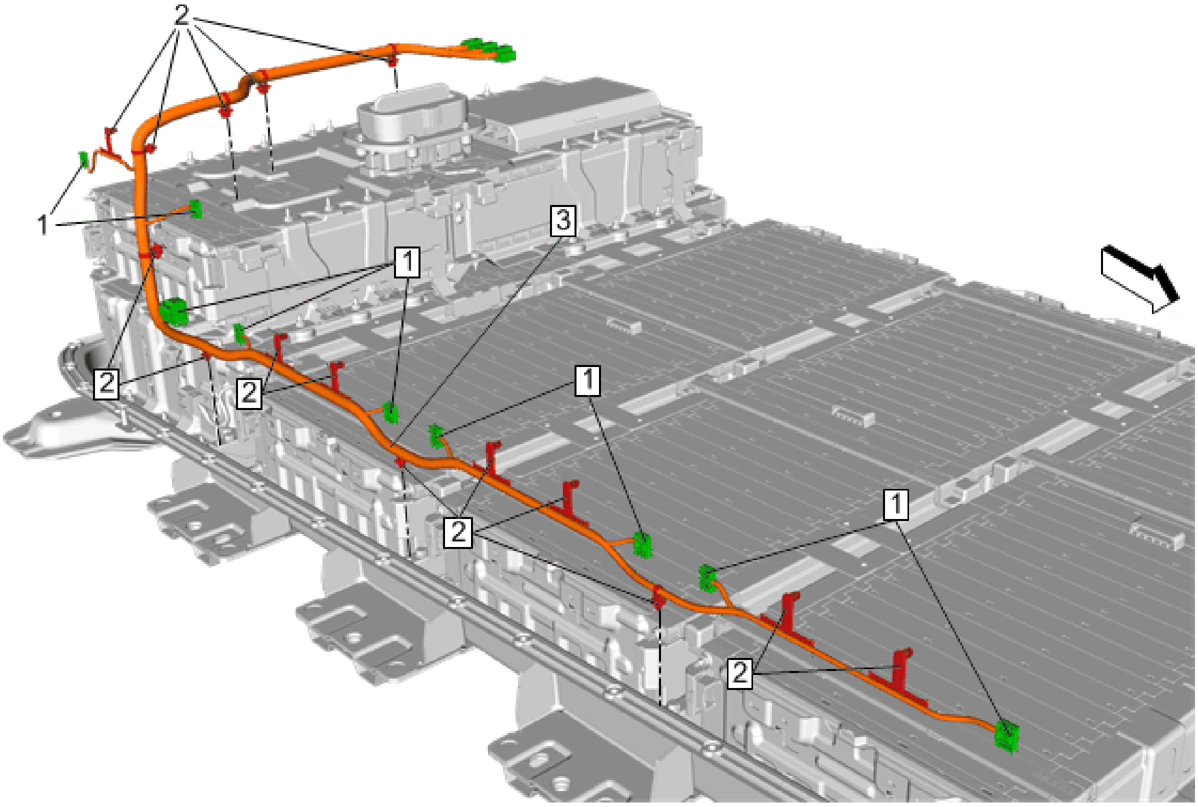


Fig. 84: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

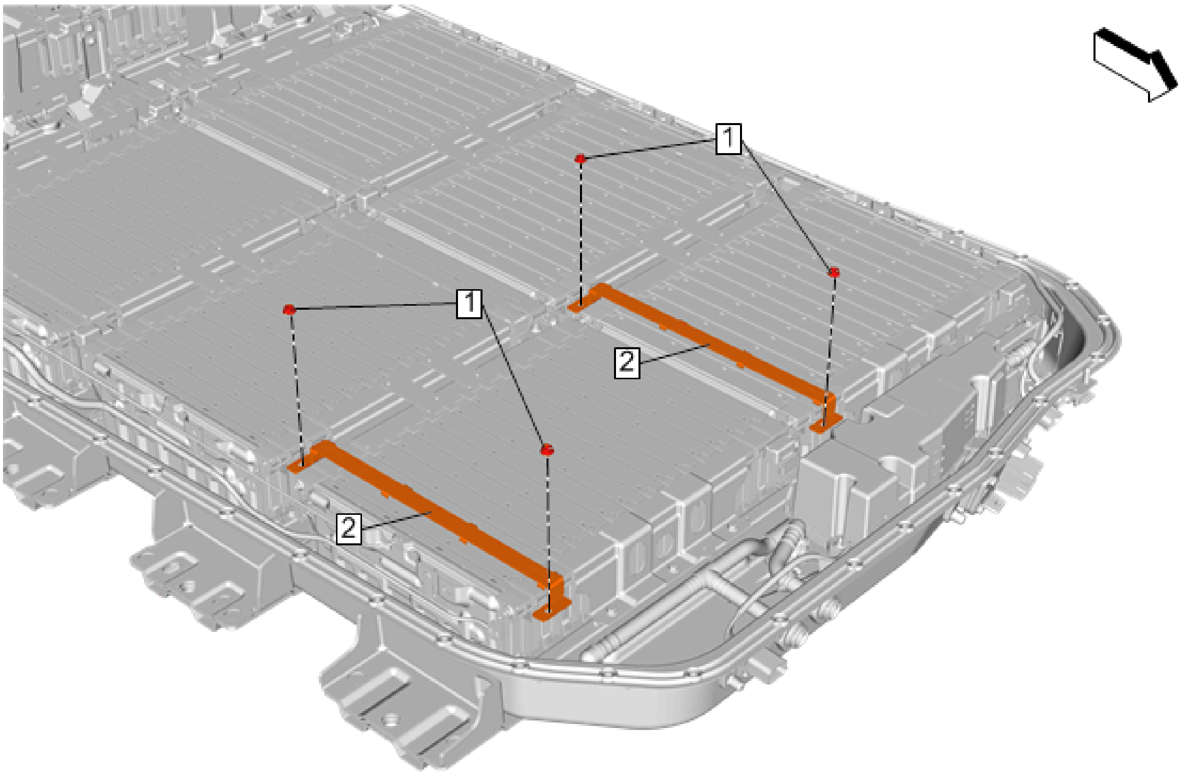


Fig. 85: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable**

Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

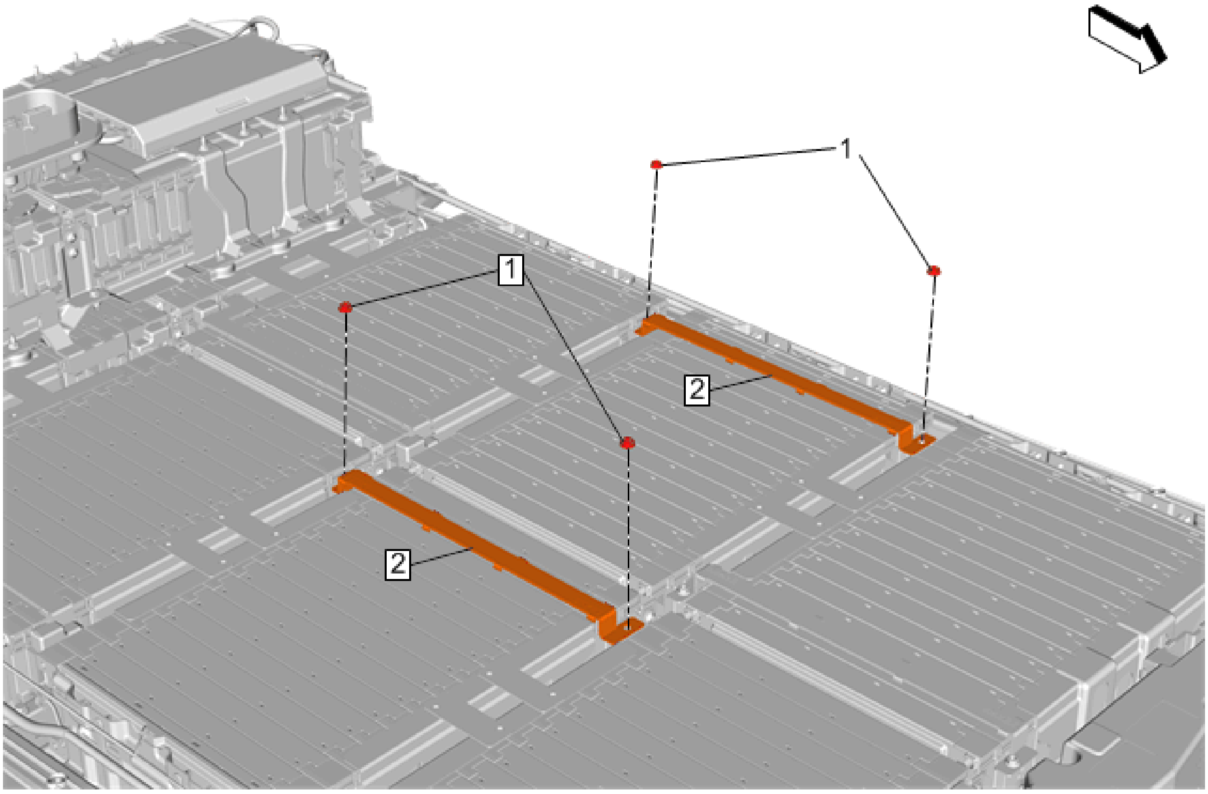


Fig. 86: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery cable (2) - bus bar, cell battery module 2 to cell battery module 3. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

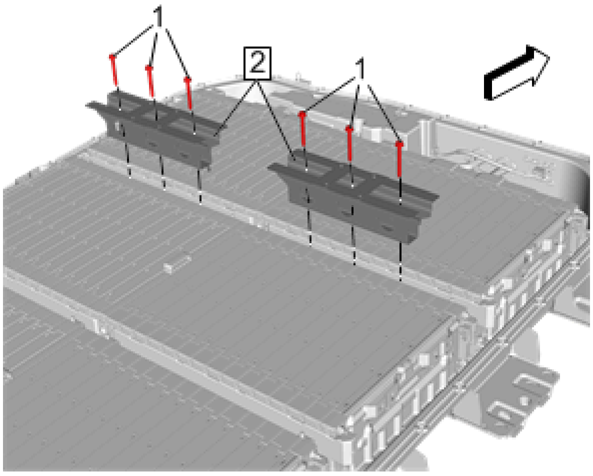


Fig. 87: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

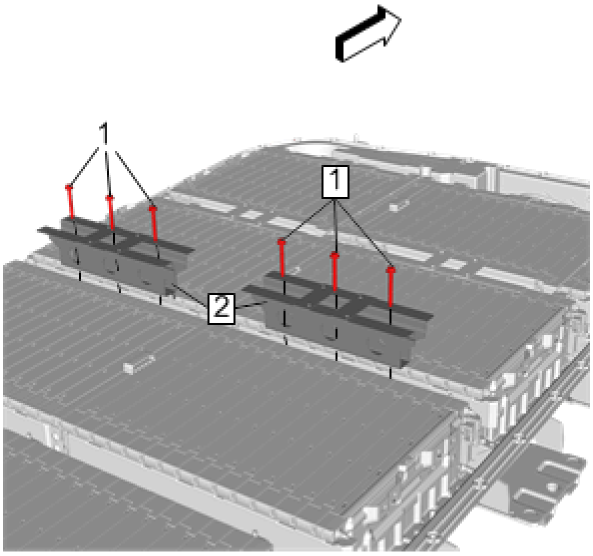


Fig. 88: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

9. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

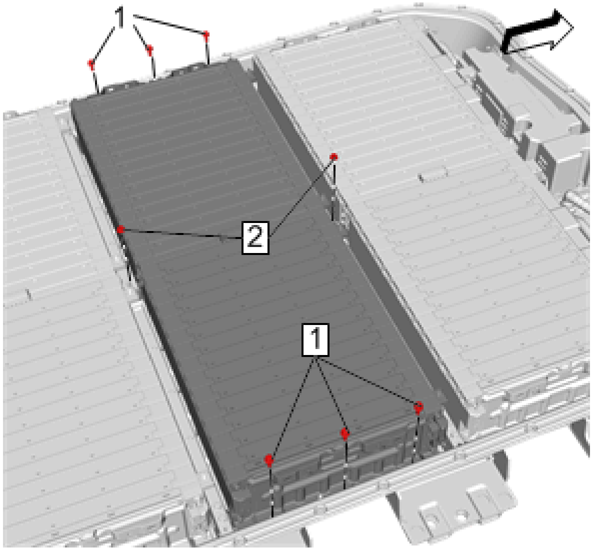


Fig. 89: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module side bolts (1) [6x].
11. Remove the cell battery module securing nuts (2) [2x].

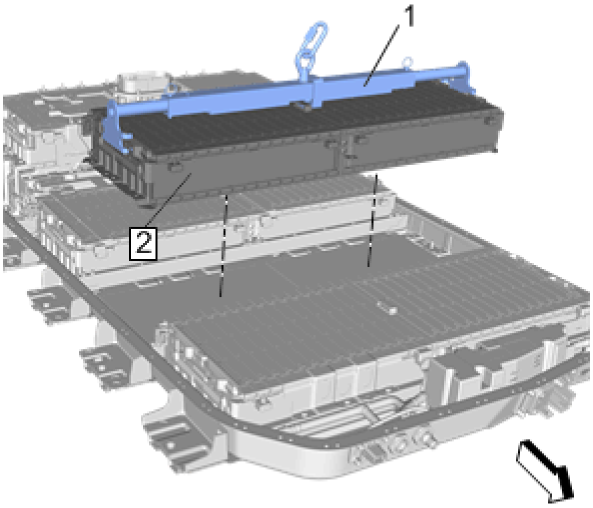


Fig. 90: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

12. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

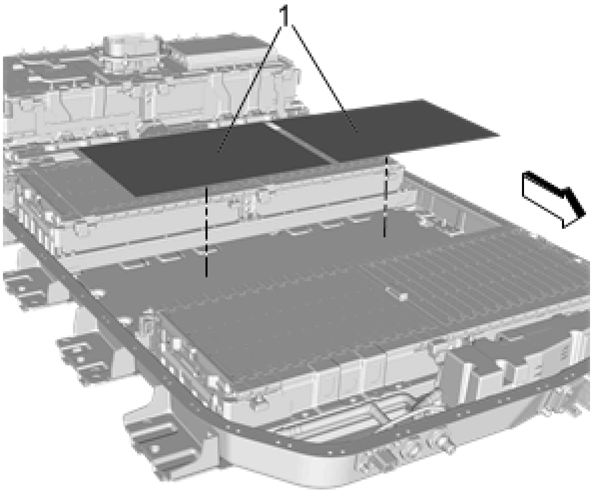


Fig. 91: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

13. Remove the thermal pads (1).

Installation Procedure

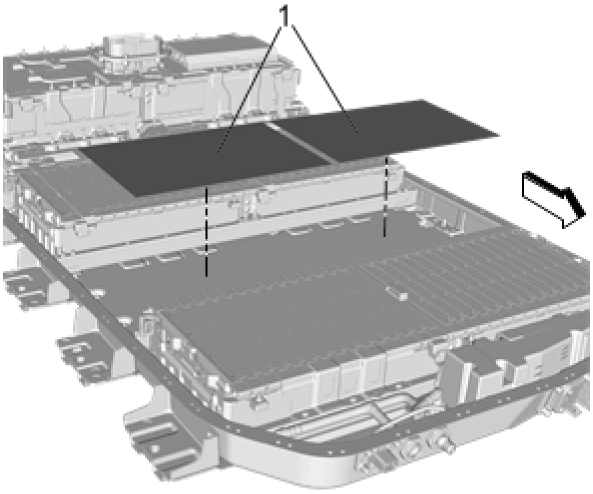


Fig. 92: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.**

1. Install the thermal pads (1).

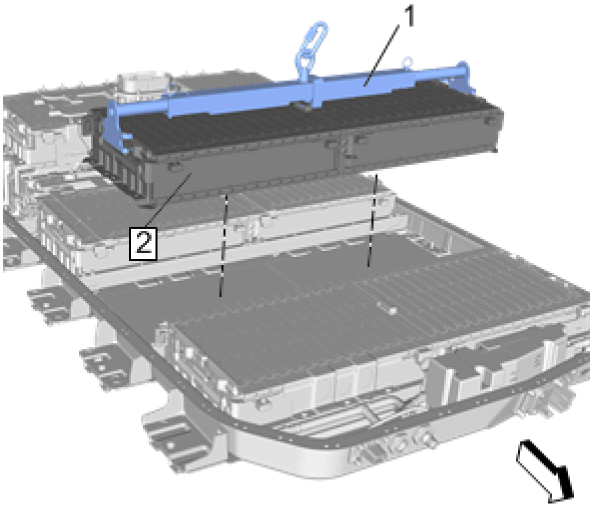


Fig. 93: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

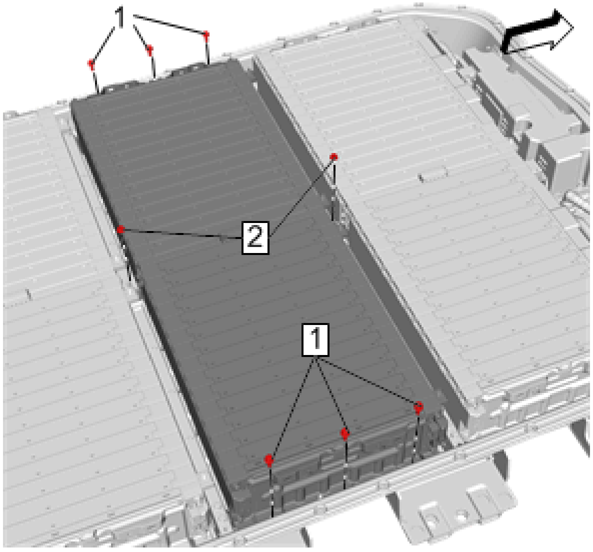


Fig. 94: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution .

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (80 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 lb in).

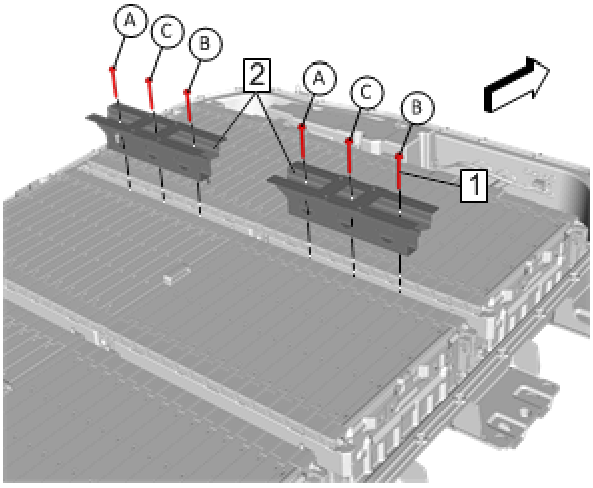


Fig. 95: Cell Battery Module Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery module bracket bolts in the sequence shown.**

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

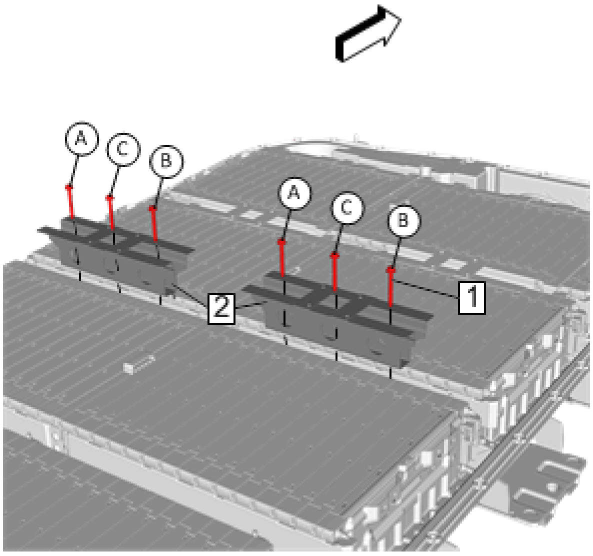


Fig. 96: cell battery module bracket bolts And brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery module bracket bolts in the sequence shown.**

6. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

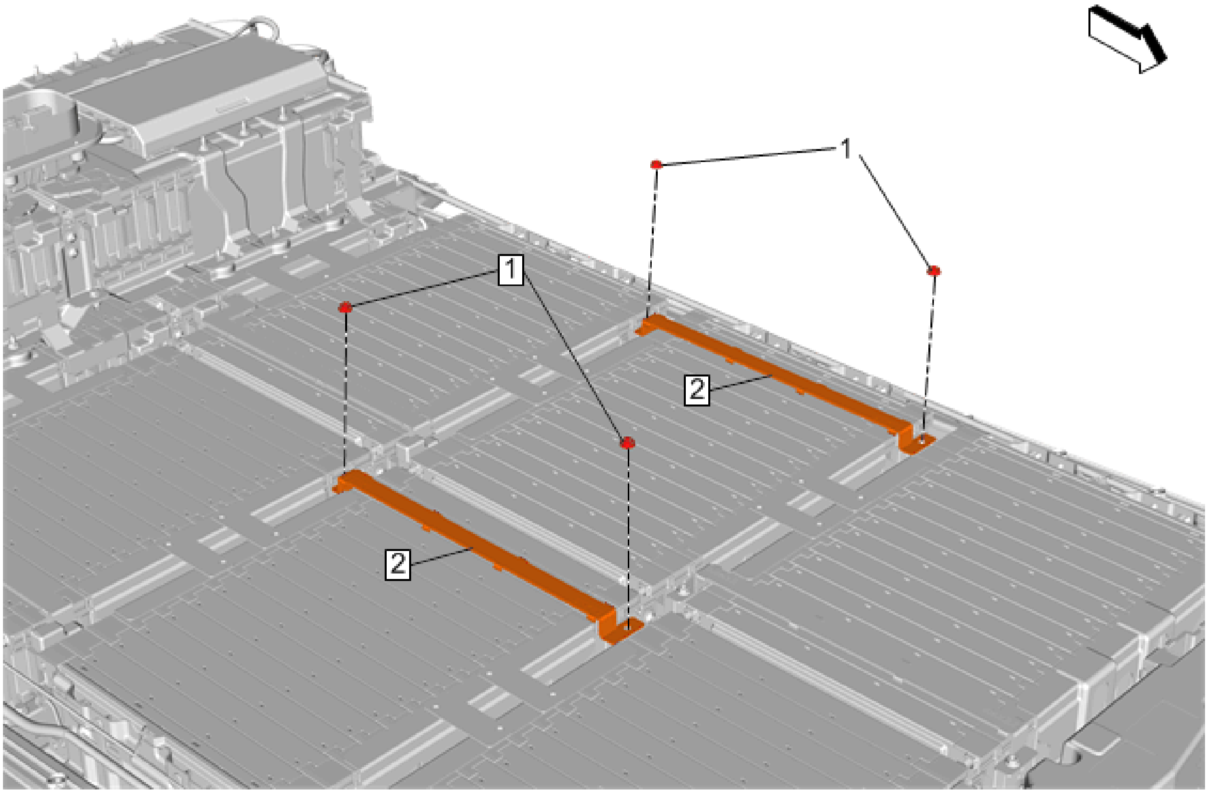


Fig. 97: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

7. Install the battery cable (2) - bus bar, cell battery module 2 to cell battery module 3. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

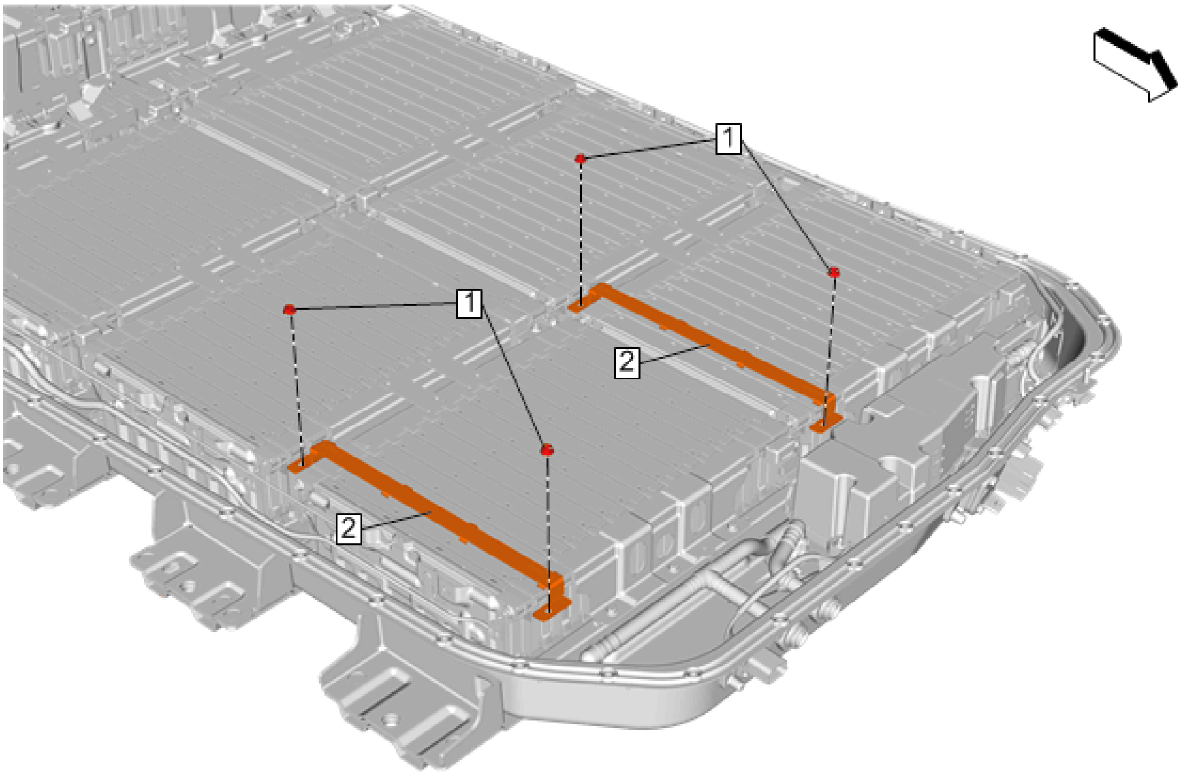


Fig. 98: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (2) - bus bar, cell battery module 1 to cell battery module 2. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

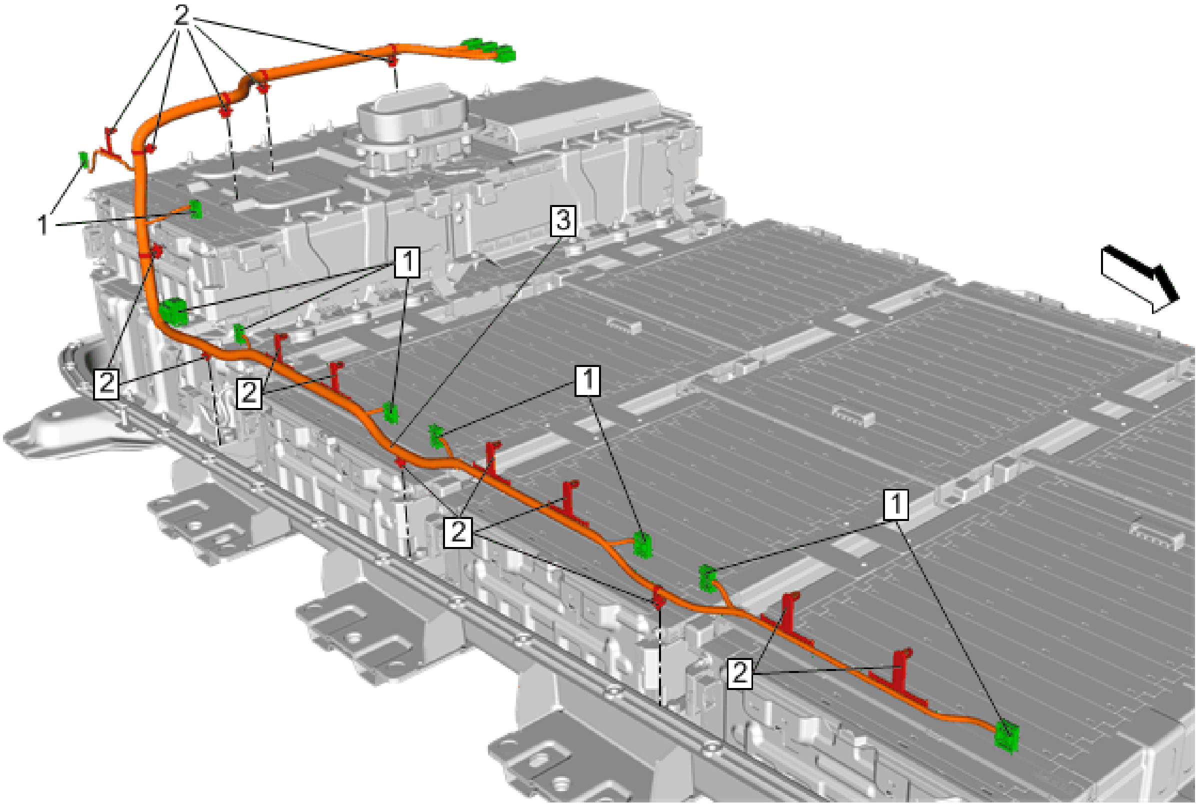


Fig. 99: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

9. Install the drive motor battery sensor module wiring harness (3) - right side. Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)

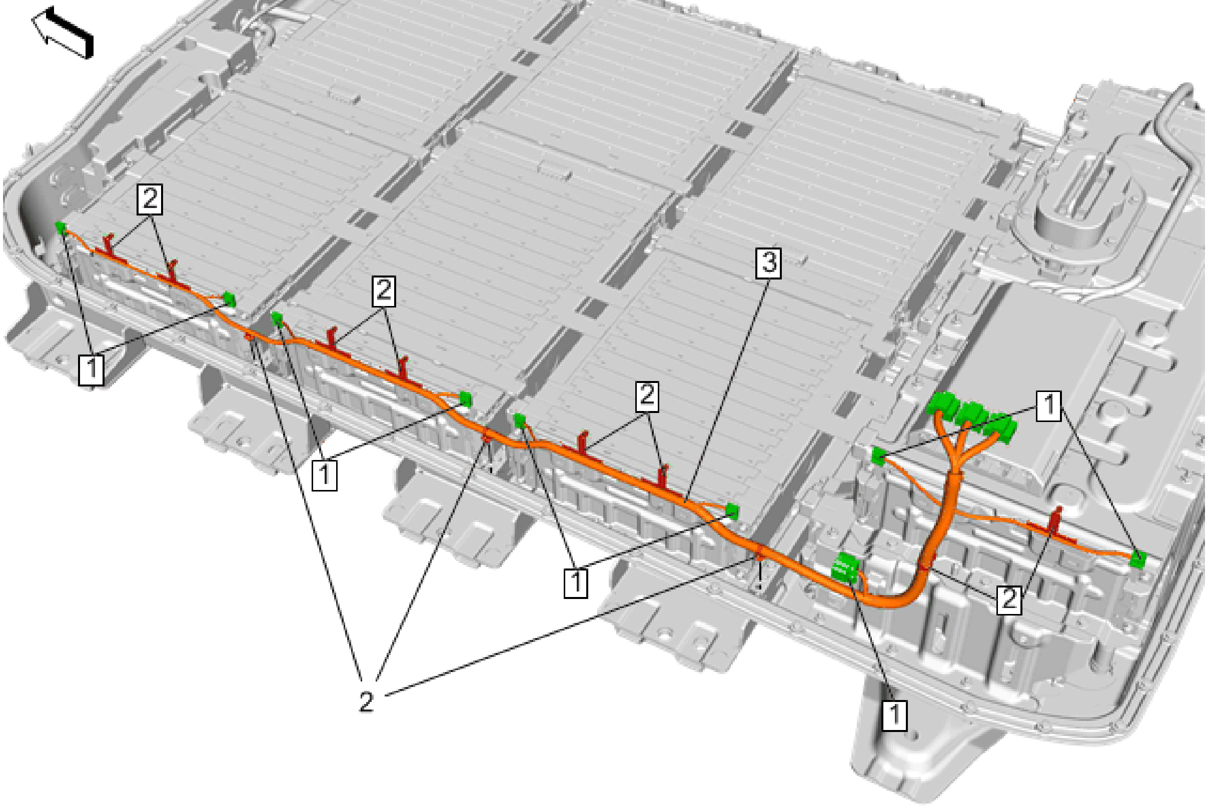


Fig. 100: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

10. Install the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub)**

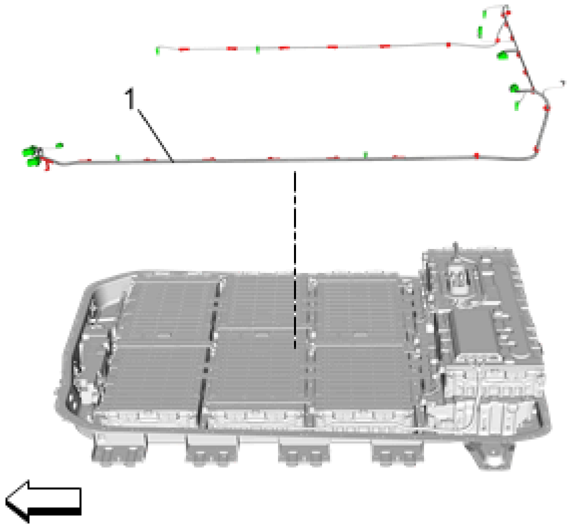


Fig. 101: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery control module wiring harness (1). **Drive Motor Battery Control Module Wiring Harness Replacement**
12. Perform the cell battery balancing if replaced. **Hybrid/EV Battery Cell Balancing**
13. Install the battery upper cover. **Battery Upper Cover Replacement**
14. Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

15. Reprogram the battery energy control module. Battery Energy Control Module Programming and Setup
16. Program the hybrid powertrain control module 2. Hybrid Powertrain Control Module 2 Programming and Setup
17. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. Hybrid/EV Battery Pack Capacity Learn

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

CELL BATTERY MODULE REPLACEMENT (ROW 3)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

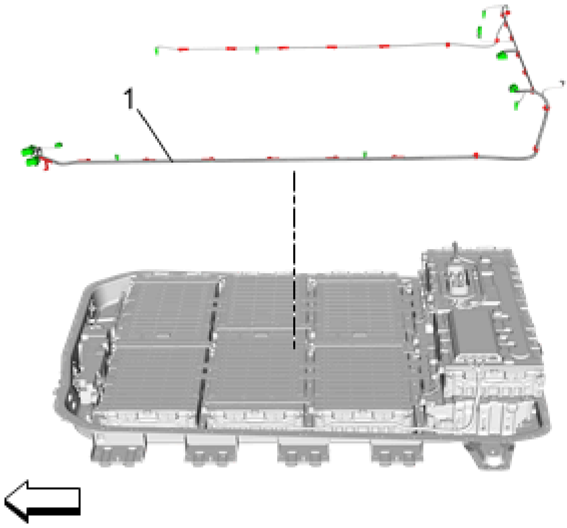


Fig. 102: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). Drive Motor Battery Control Module Wiring Harness Replacement.

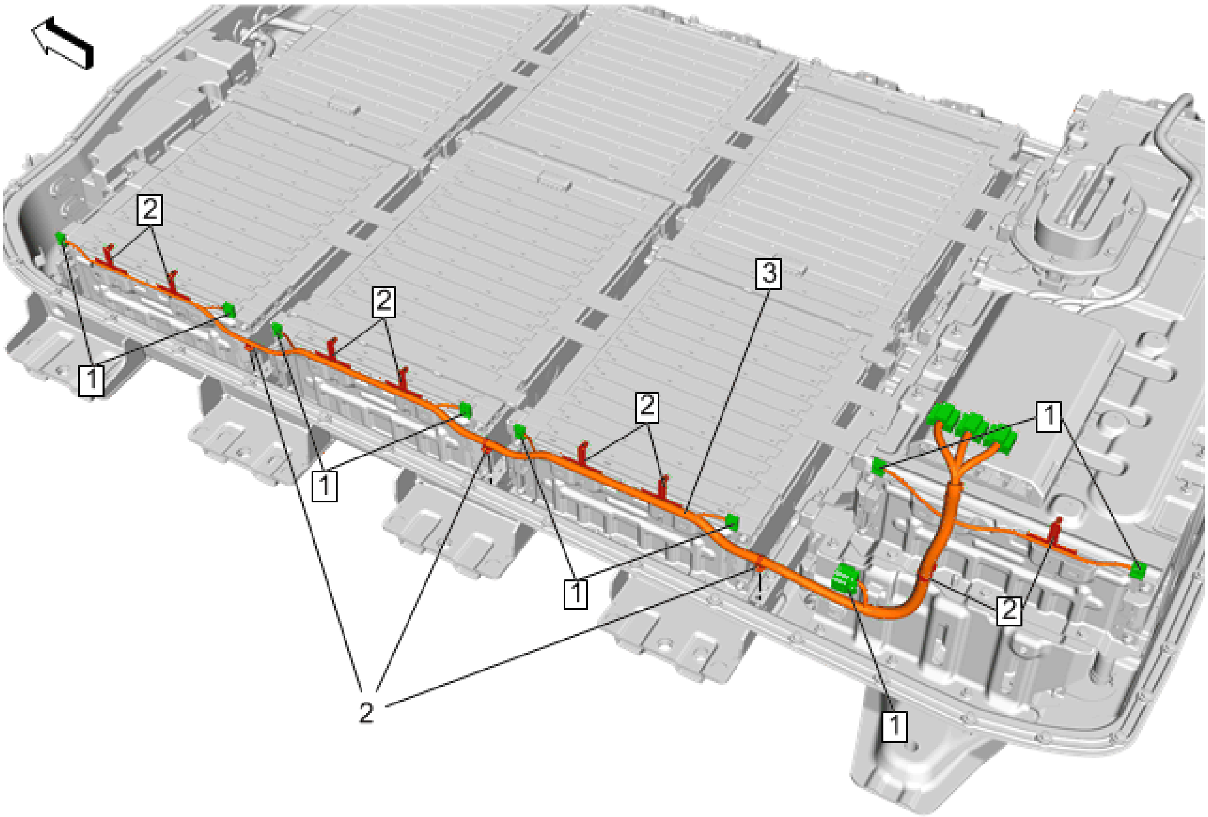


Fig. 103: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

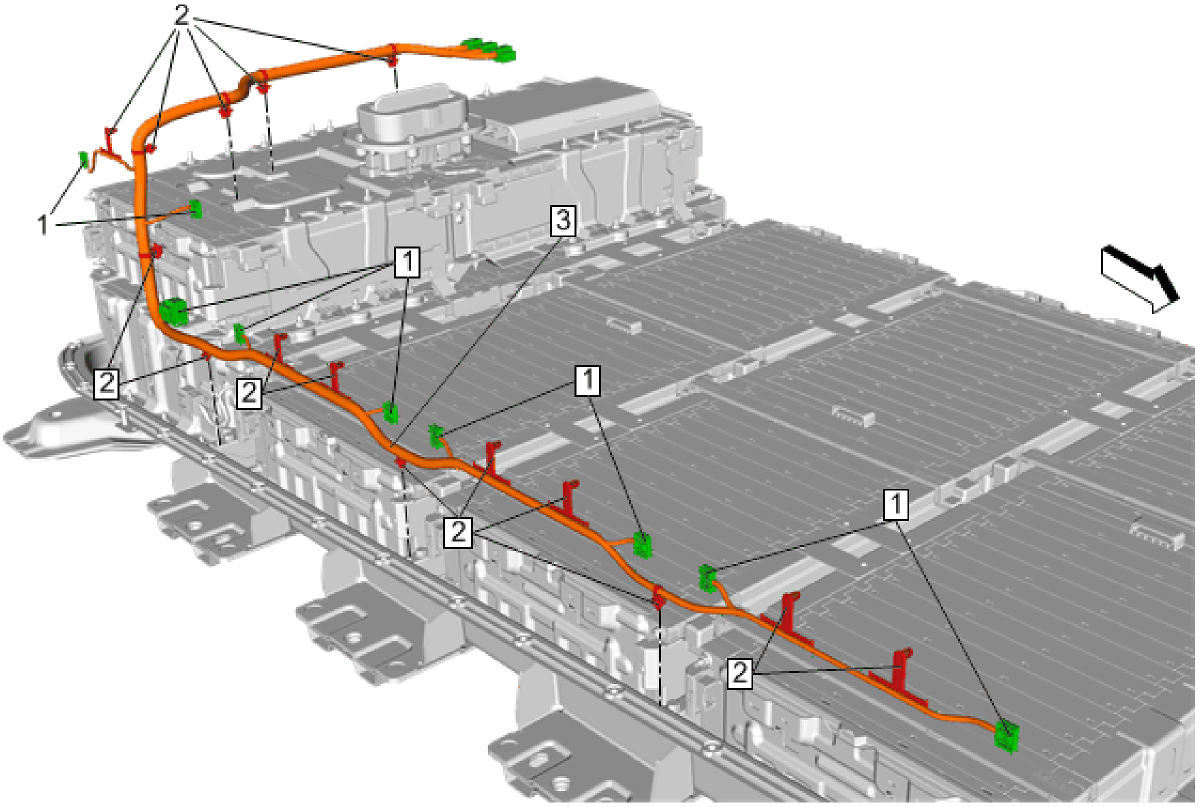


Fig. 104: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

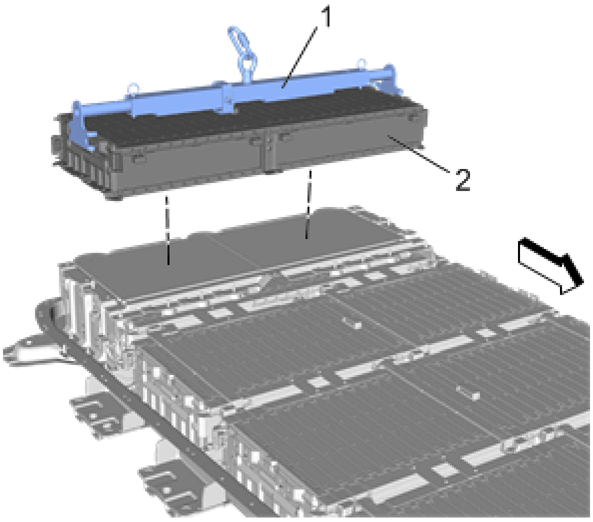


Fig. 105: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

6. Remove the row 5 cell battery module (2). **Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 5)**

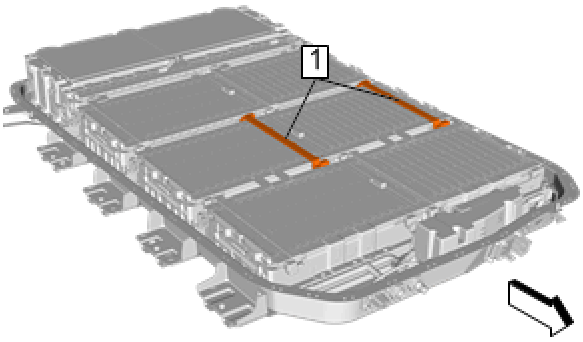


Fig. 106: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery cable (1) - bus bar, cell battery module 2 to cell battery module 3. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

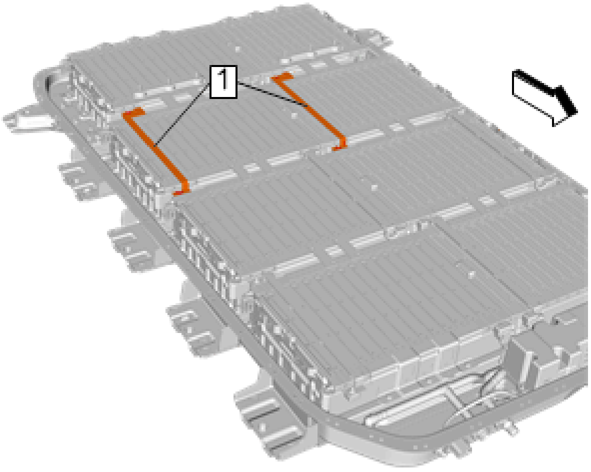


Fig. 107: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable

Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

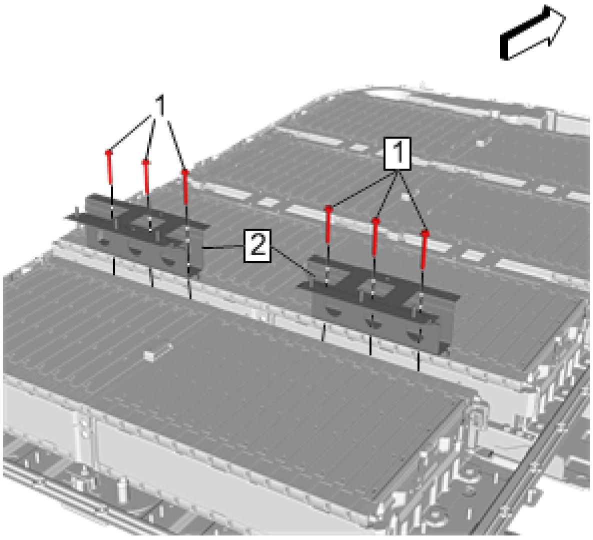


Fig. 108: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

9. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

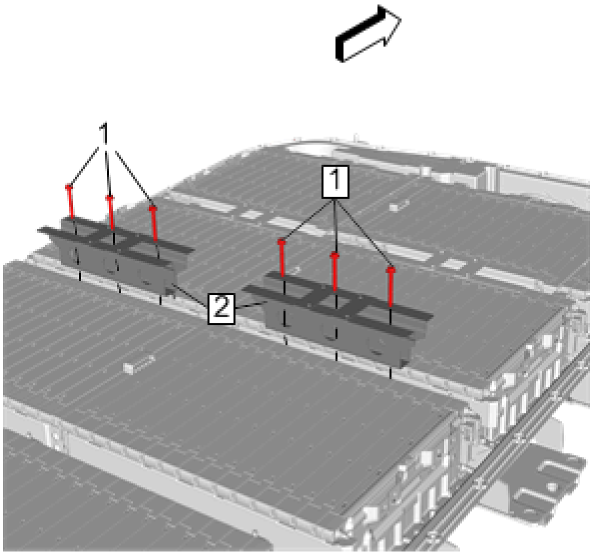


Fig. 109: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).

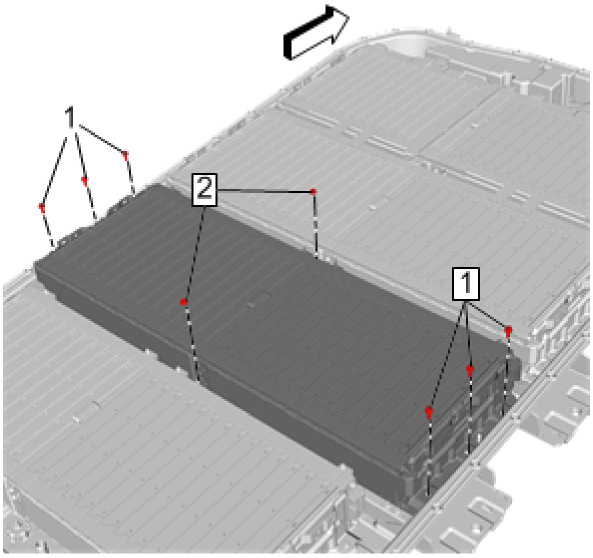


Fig. 110: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the cell battery module side bolts (1) [6x].
12. Remove the cell battery module securing nuts (2) [2x].

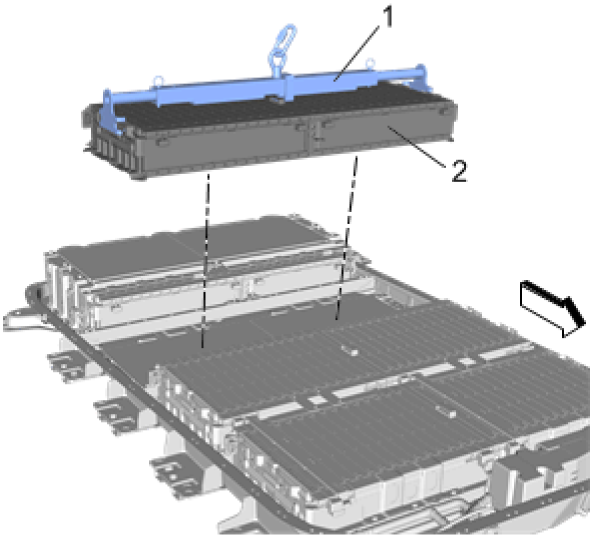


Fig. 111: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

13. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

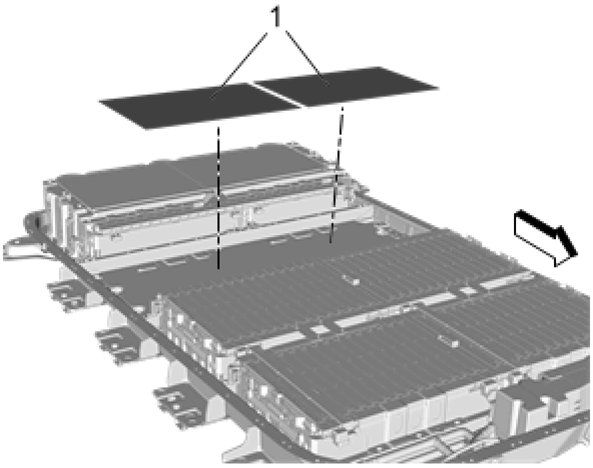


Fig. 112: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

14. Remove the thermal pads (1).

Installation Procedure

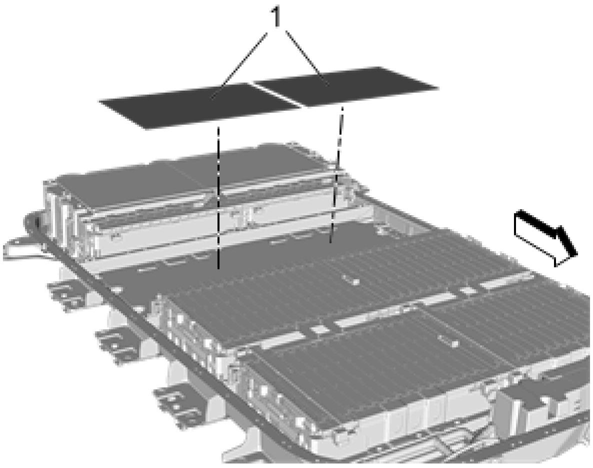


Fig. 113: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.**

1. Install the thermal pads (1).

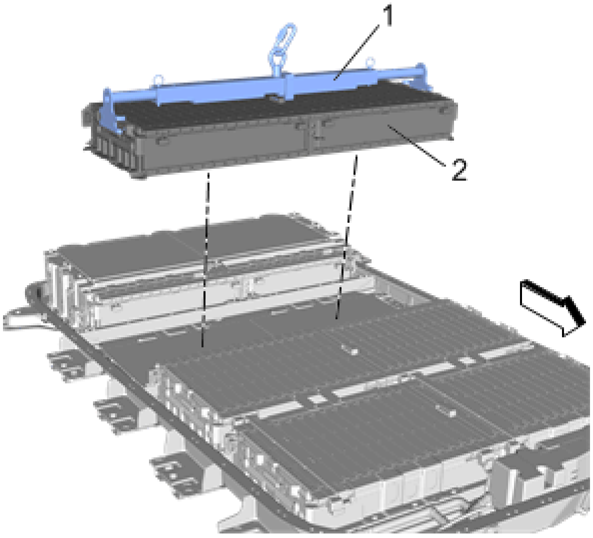


Fig. 114: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

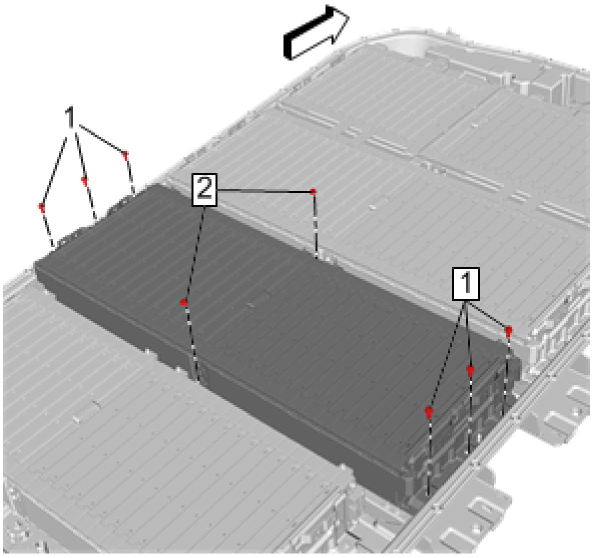


Fig. 115: Cell Battery Module Side Bolts And Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (80 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 b in).

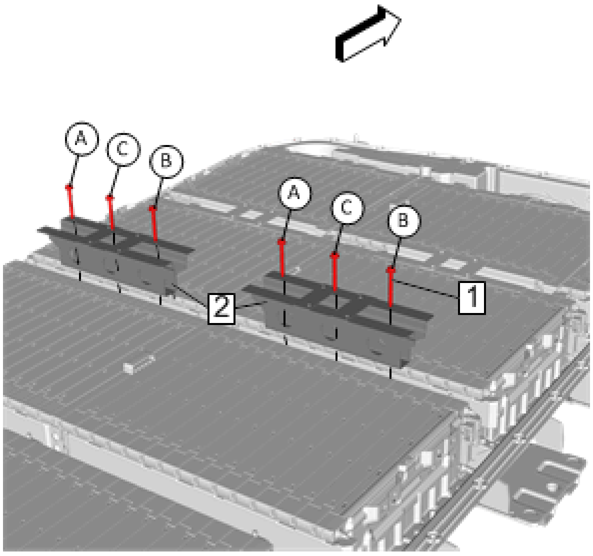


Fig. 116: cell battery module bracket bolts And brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery module bracket bolts in the sequence shown.**

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

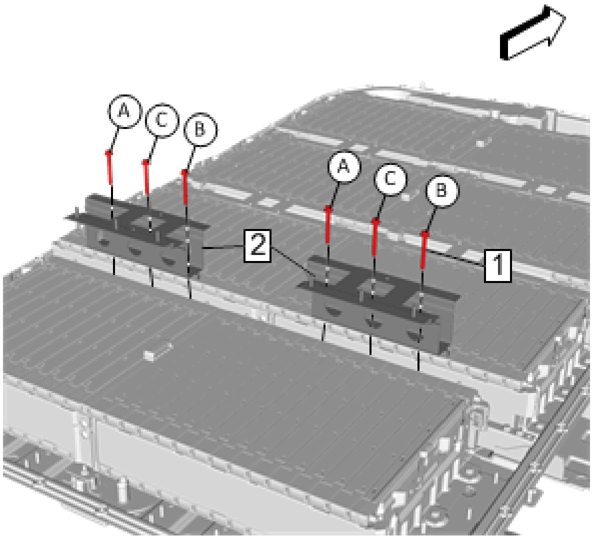


Fig. 117: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery module bracket bolts in the sequence shown.**

NOTE: **See the OUT sign on the bracket and this sign should be outside.**

6. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

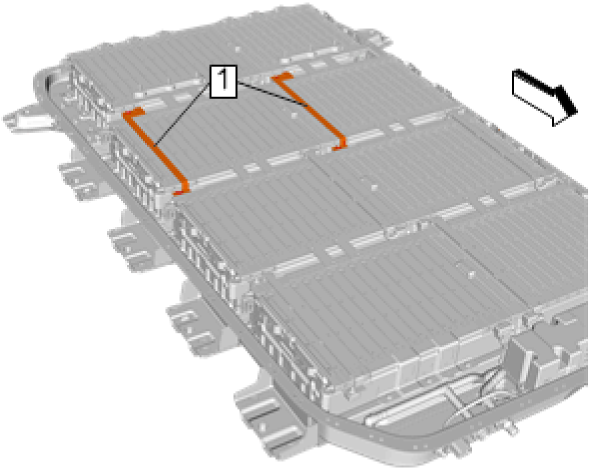


Fig. 118: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

7. Install the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

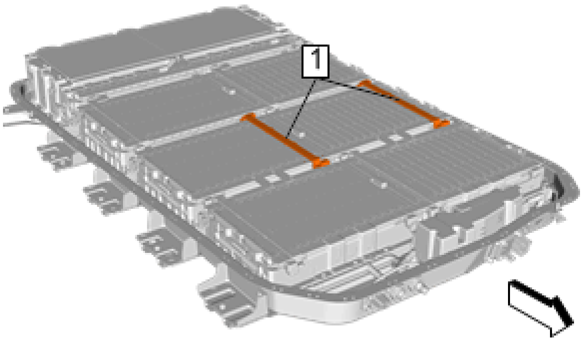


Fig. 119: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (1) - bus bar, cell battery module 2 to cell battery module 3. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable

Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

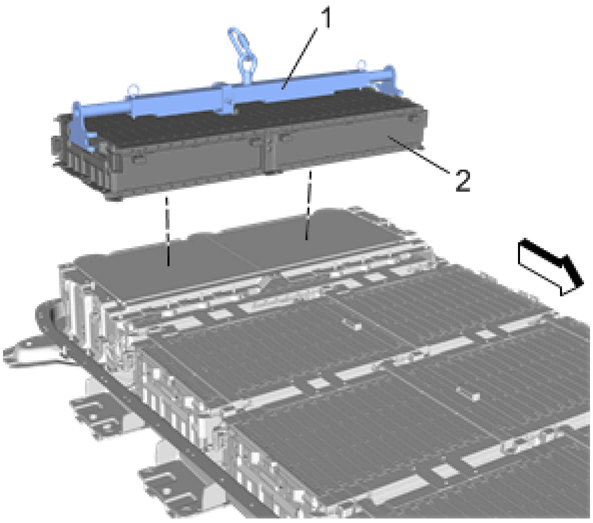


Fig. 120: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

9. Install the row 5 cell battery module (2). Cell Battery Module Replacement (Row 5)

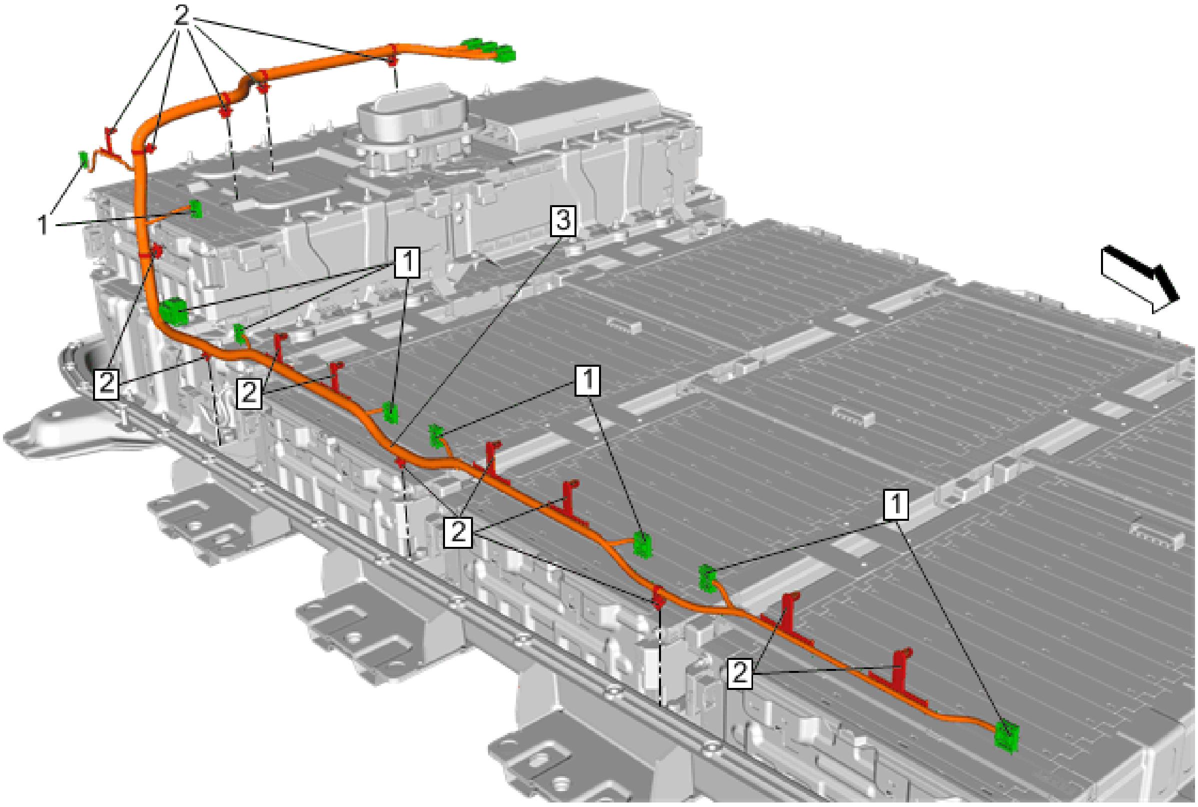


Fig. 121: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

10. Install the drive motor battery sensor module wiring harness (3) - right side. Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub).

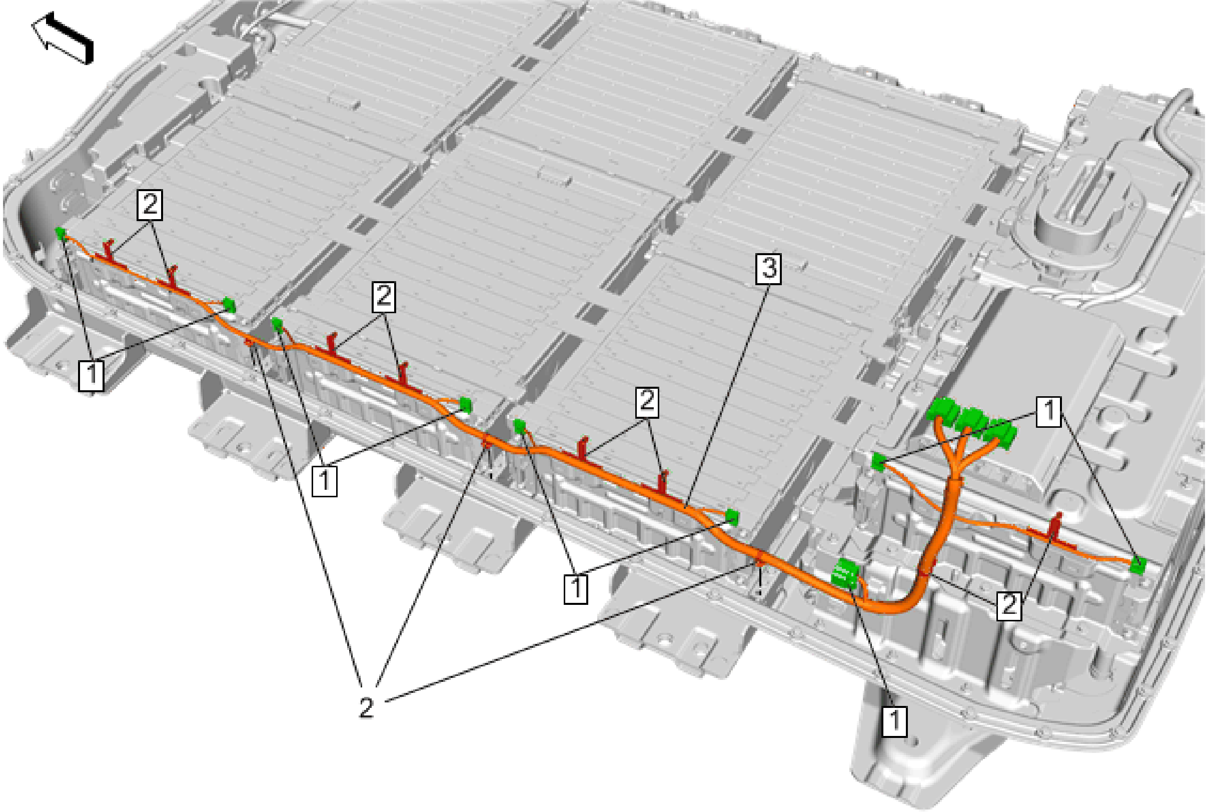


Fig. 122: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery sensor module wiring harness (3) - left side. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)**.

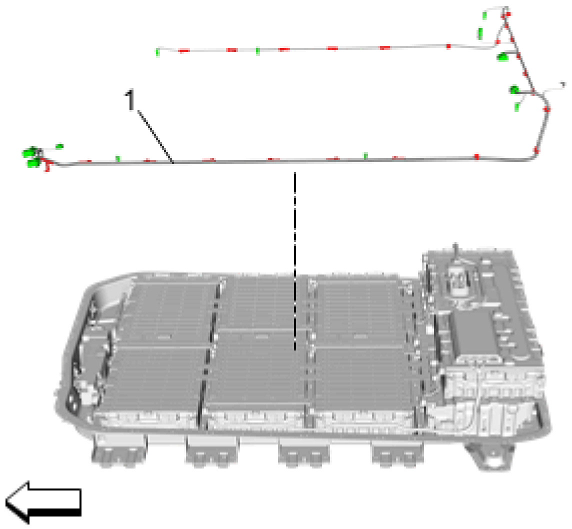


Fig. 123: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Install the drive motor battery control module wiring harness (1). **Drive Motor Battery Control Module Wiring Harness Replacement**.
13. Perform the cell battery balancing if replaced. **Hybrid/EV Battery Cell Balancing**.
14. Install the battery upper cover. **Battery Upper Cover Replacement**
15. Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
16. Reprogram the battery energy control module. **Battery Energy Control Module Programming and Setup**

17. Program the hybrid powertrain control module 2. Hybrid Powertrain Control Module 2 Programming and Setup
18. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. Hybrid/EV Battery Pack Capacity Learn

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

CELL BATTERY MODULE REPLACEMENT (ROW 4)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

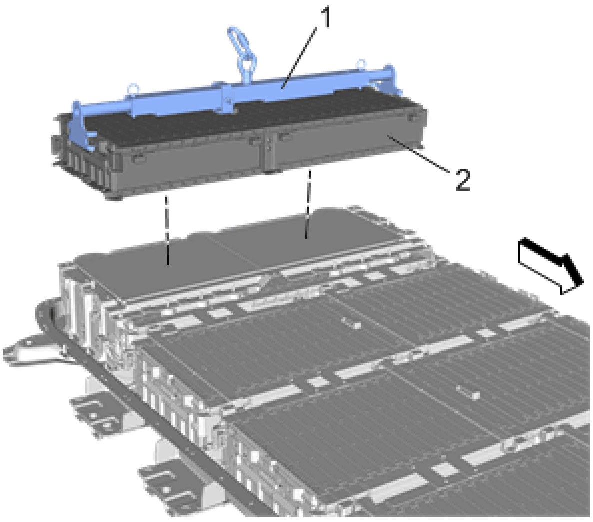


Fig. 124: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

3. Remove the row 5 cell battery module (2). **Cell Battery Module Replacement (Row 5)**

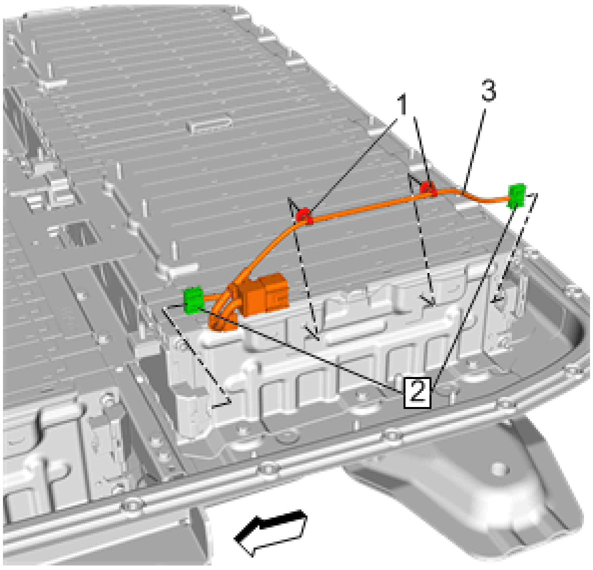


Fig. 125: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - LH, Sub. **Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub)**.

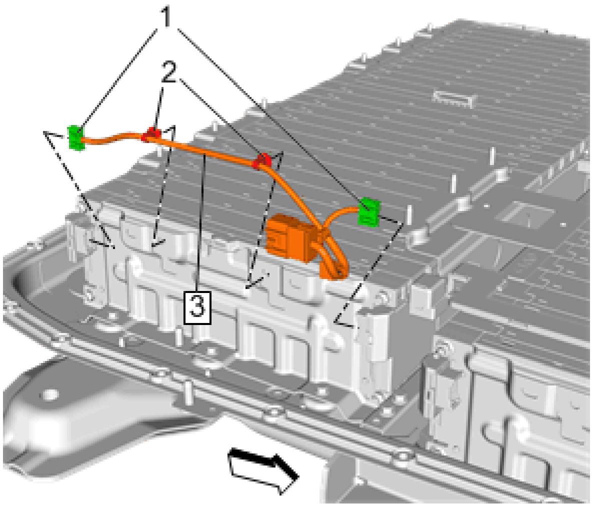


Fig. 126: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - RH, Sub. Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub).

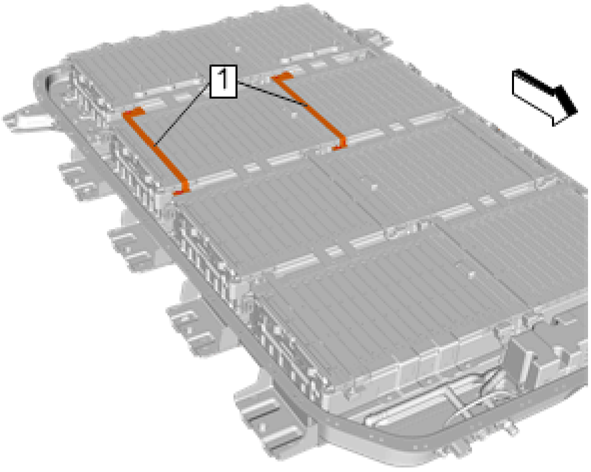


Fig. 127: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

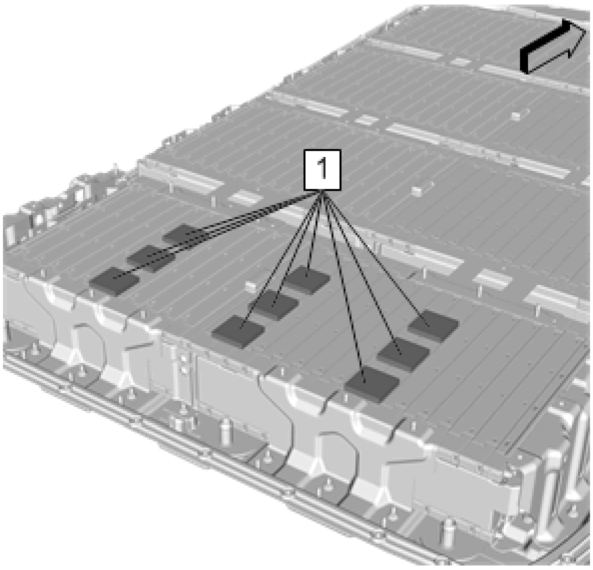
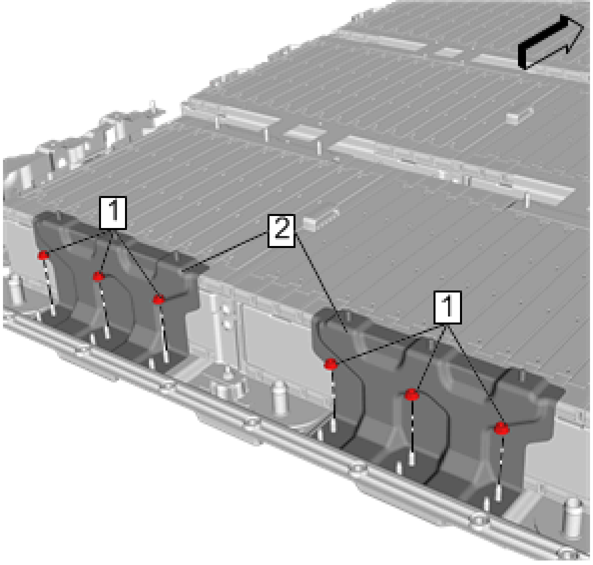


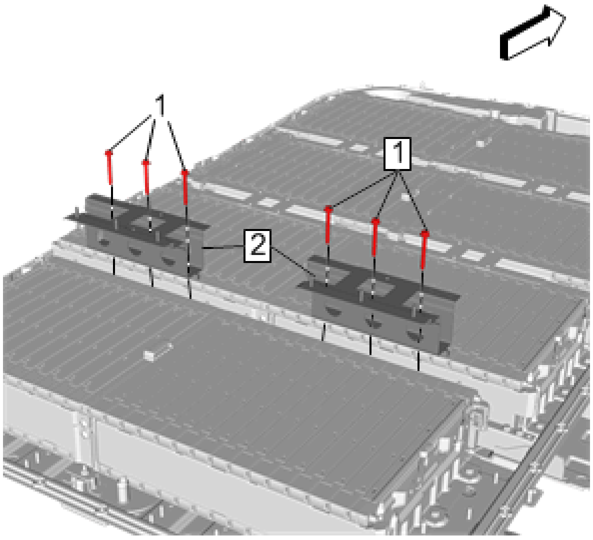
Fig. 128: Snubbers
Courtesy of GENERAL MOTORS COMPANY

7. Remove the snubbers (1).



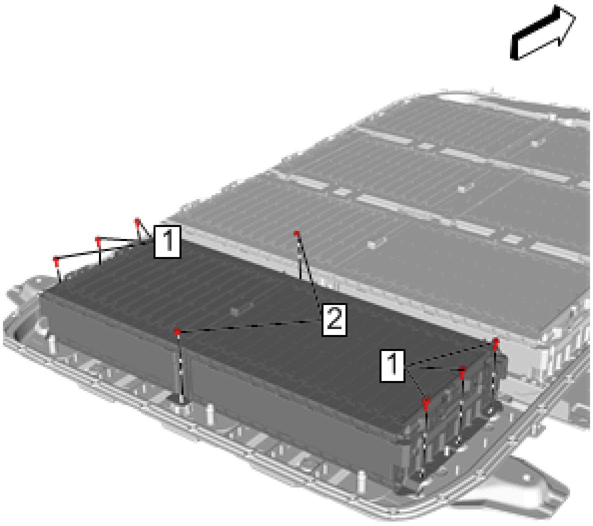
[Fig. 129: Cell Battery Securing Nuts](#)
Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery securing nuts (1) [6x] and the one side rear panels (2).



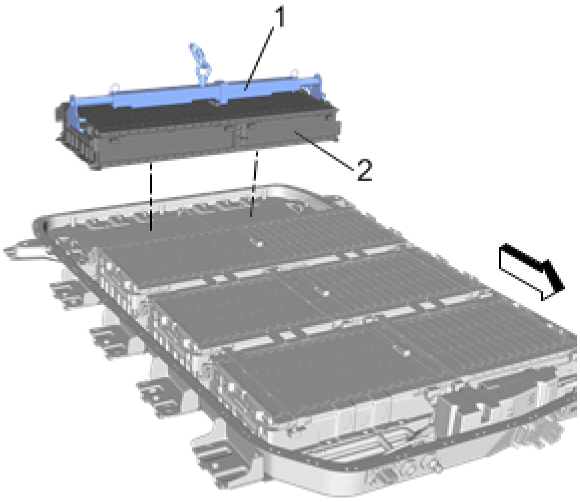
[Fig. 130: Cell Battery Module Bracket Bolts And Brackets](#)
Courtesy of GENERAL MOTORS COMPANY

9. Remove the cell battery module bracket bolts (1) [6x] and the brackets (2).



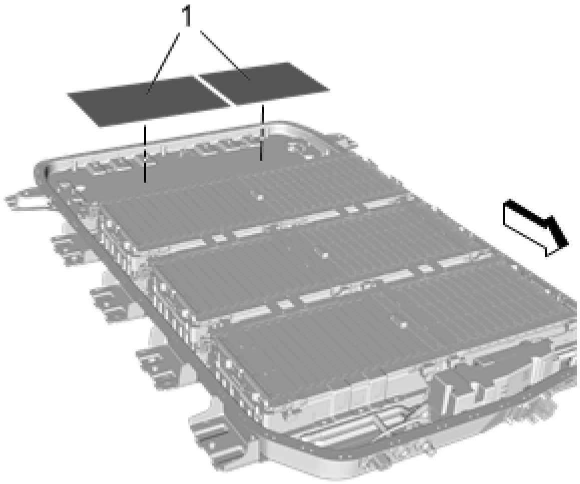
[Fig. 131: Cell Battery Module Side Bolts](#)
Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery module side bolts (1) [6x].
11. Remove the cell battery module securing nuts (2) [2x].



[**Fig. 132: Battery Lift Tool And Cell Battery**]
Courtesy of GENERAL MOTORS COMPANY

12. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).



[**Fig. 133: Thermal Pads**]
Courtesy of GENERAL MOTORS COMPANY

13. Remove the thermal pads (1).

Installation Procedure

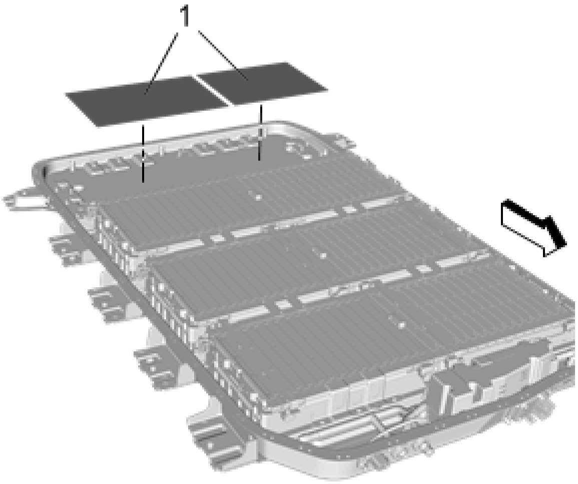


Fig. 134: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.**

1. Install the thermal pads (1).

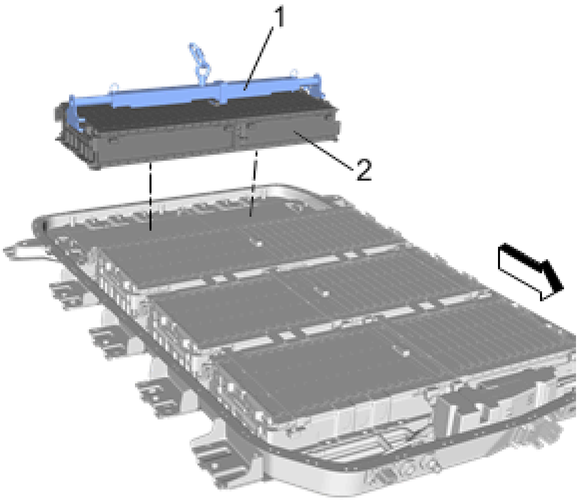


Fig. 135: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

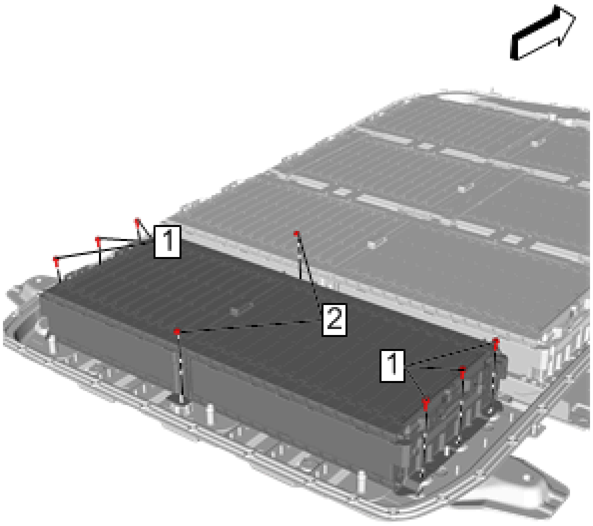


Fig. 136: Cell Battery Module Side Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Tighten the cell battery module securing nuts (2) [2x] to 9 N.m (80 lb in).
4. Tighten the cell battery module side bolts (1) [6x] to 9 N.m (80 lb in)

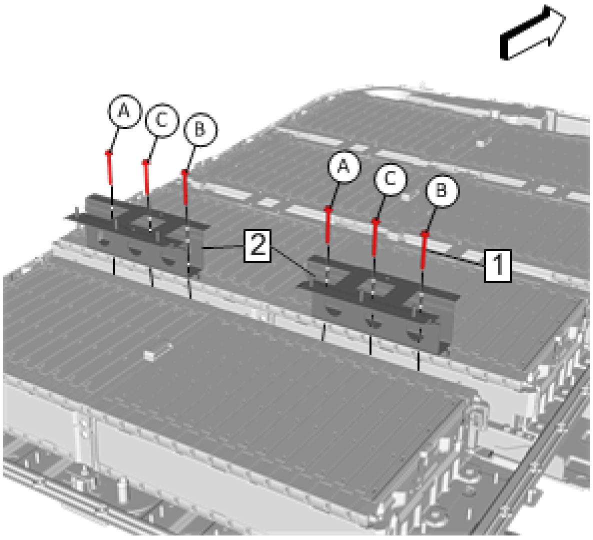


Fig. 137: Cell Battery Module Bracket Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery module bracket bolts in the sequence shown.**

NOTE: **See the OUT sign on the bracket and this sign should be outside.**

5. Install the cell battery module bracket bolts (1) [6x] and the brackets (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

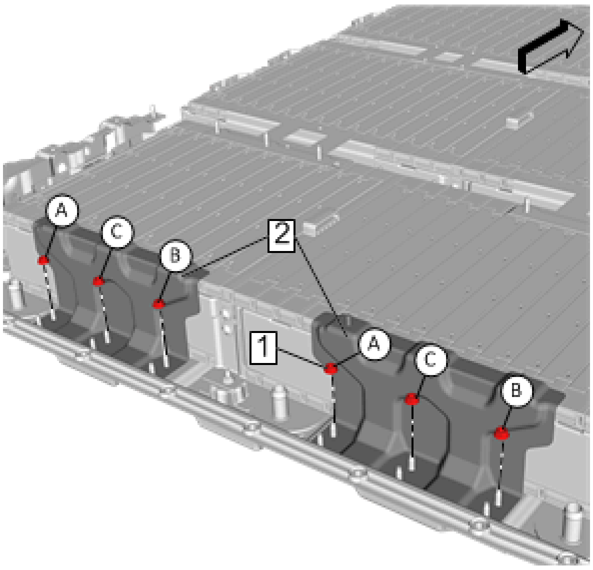


Fig. 138: Cell Battery Securing Nuts And One Side Rear Panel
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery securing nuts in the sequence shown.**

6. Install the cell battery securing nuts (1) [6x] and the one side rear panel (2). Tighten the fasteners (1) to 9 N.m (80 lb in)

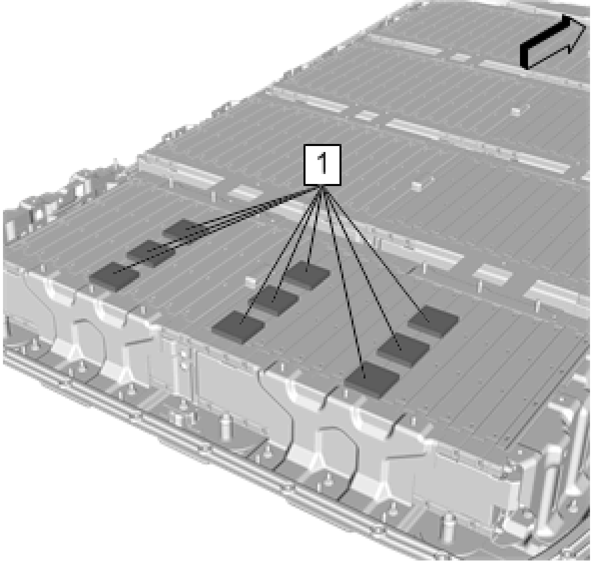


Fig. 139: Snubbers
Courtesy of GENERAL MOTORS COMPANY

7. Install the snubbers (1).

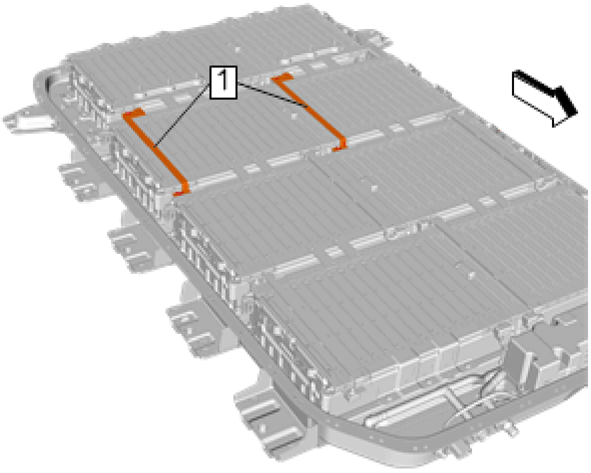


Fig. 140: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (1) - bus bar, cell battery module 3 to cell battery module 4. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

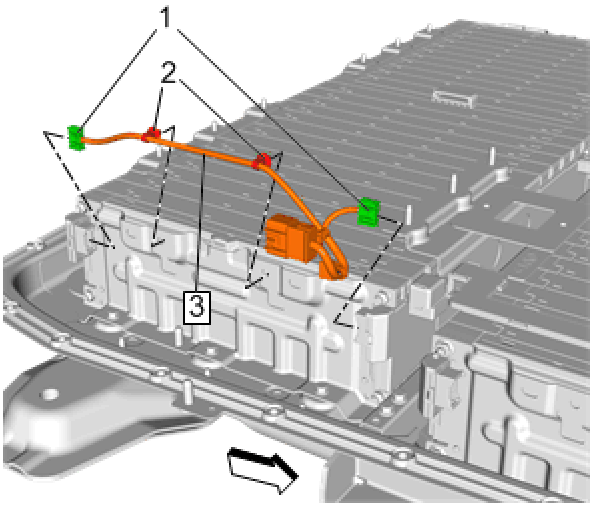


Fig. 141: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

9. Install the drive motor battery sensor module wiring harness (3) - RH, Sub. Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub).

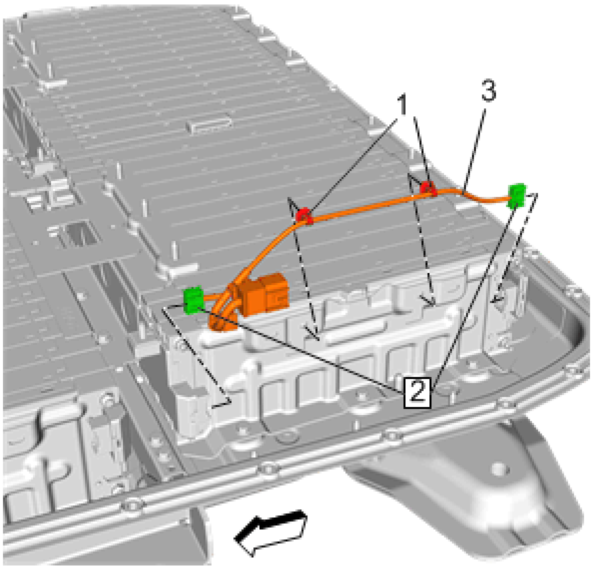


Fig. 142: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

10. Install the drive motor battery sensor module wiring harness (3) - LH, Sub. Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub).

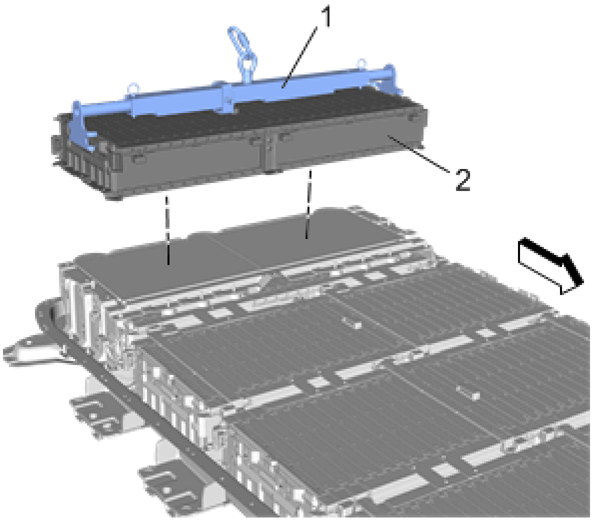


Fig. 143: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

11. Install the row 5 cell battery module (2). Cell Battery Module Replacement (Row 5)
12. Perform the hybrid battery pack coolant passage leak test. Hybrid Battery Pack Coolant Passage Leak Test .
13. Perform the cell battery balancing if replaced. Hybrid/EV Battery Cell Balancing.
14. Install the battery upper cover. Battery Upper Cover Replacement
15. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
16. Reprogram the battery energy control module. Battery Energy Control Module Programming and Setup
17. Program the hybrid powertrain control module 2. Hybrid Powertrain Control Module 2 Programming and Setup
18. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. Hybrid/EV Battery Pack Capacity Learn

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

CELL BATTERY MODULE REPLACEMENT (ROW 5)

Special Tools

EL-48264 Battery Lift Tool

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

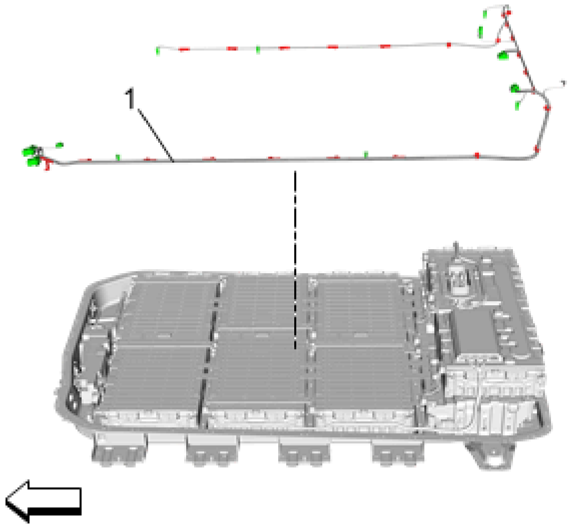


Fig. 144: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drive motor battery control module wiring harness (1). Drive Motor Battery Control Module Wiring Harness Replacement.

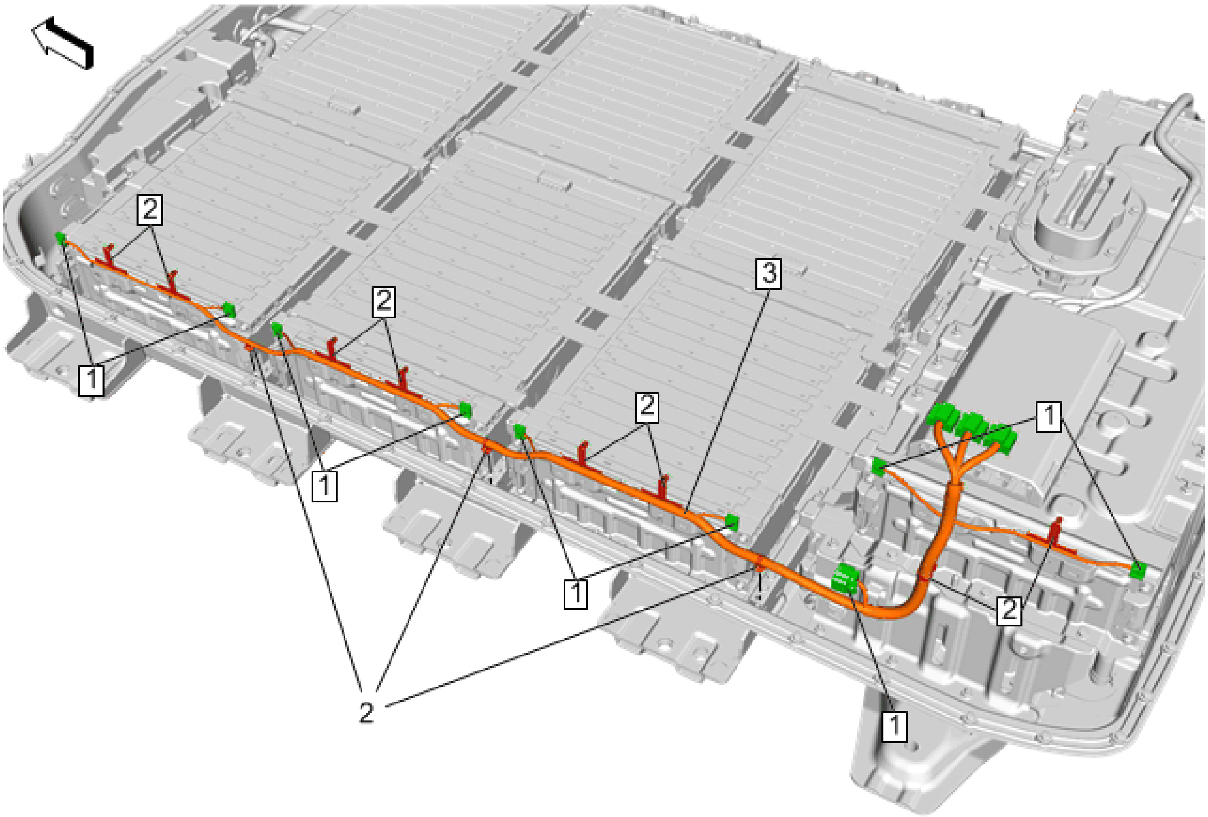


Fig. 145: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Remove the drive motor battery sensor module wiring harness (3) - left side. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect

Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

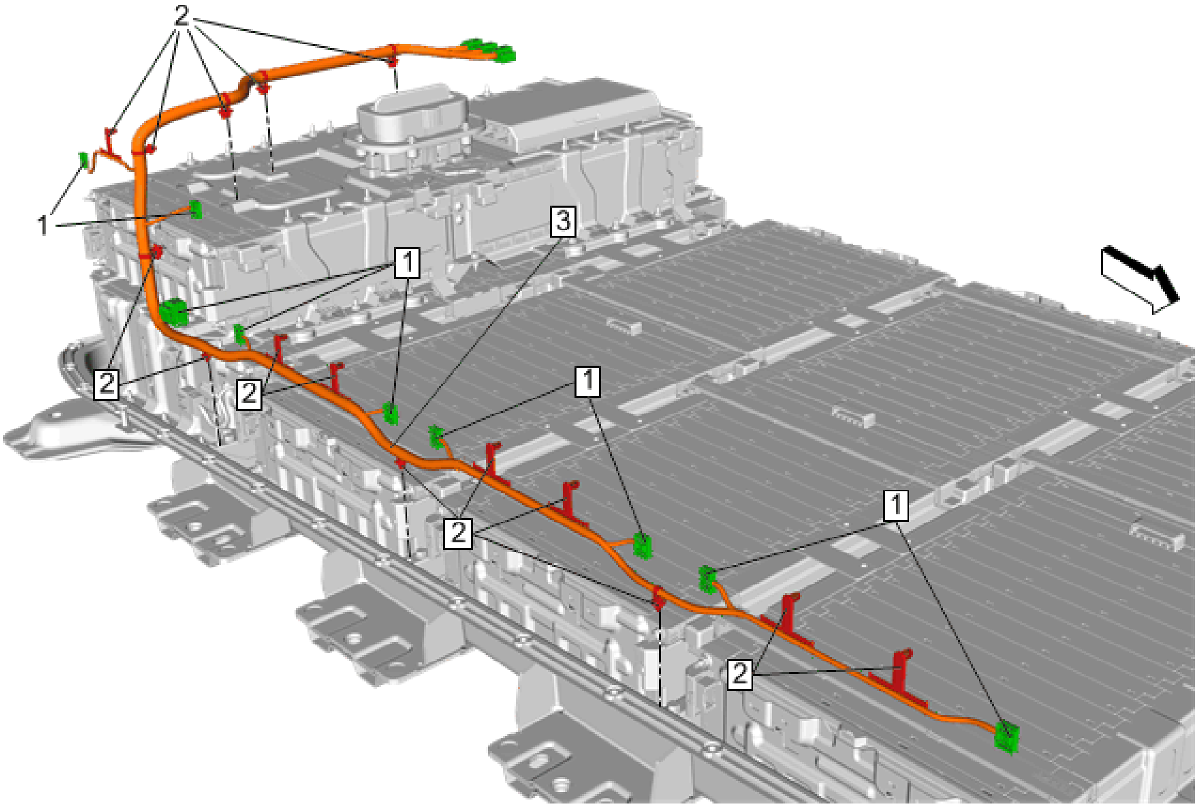


Fig. 146: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Remove the drive motor battery sensor module wiring harness (3) - right side. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

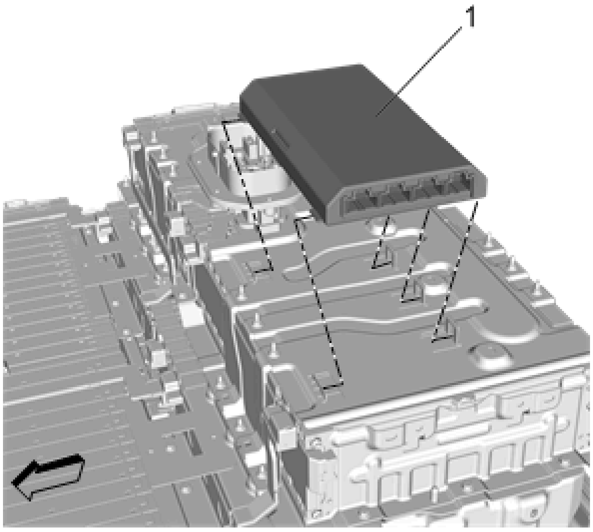


Fig. 147: Battery Energy Control Module
Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery energy control module (1). **Battery Energy Control Module Replacement**.

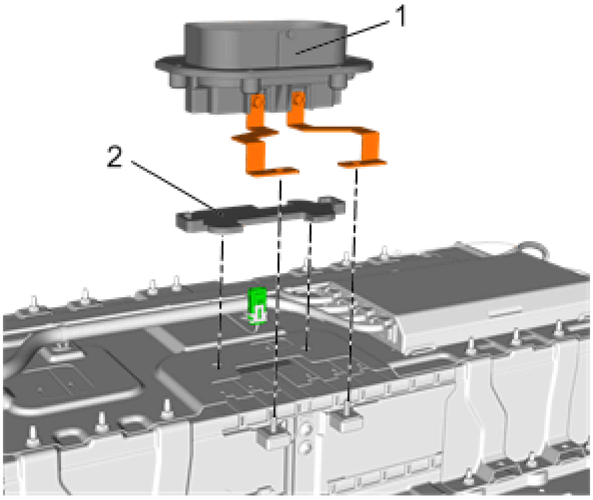


Fig. 148: Connector And Connector Insulator
Courtesy of GENERAL MOTORS COMPANY

7. Remove the high voltage battery high voltage manual disconnect connector (1). **High Voltage Battery High Voltage Manual Disconnect Connector Replacement**.

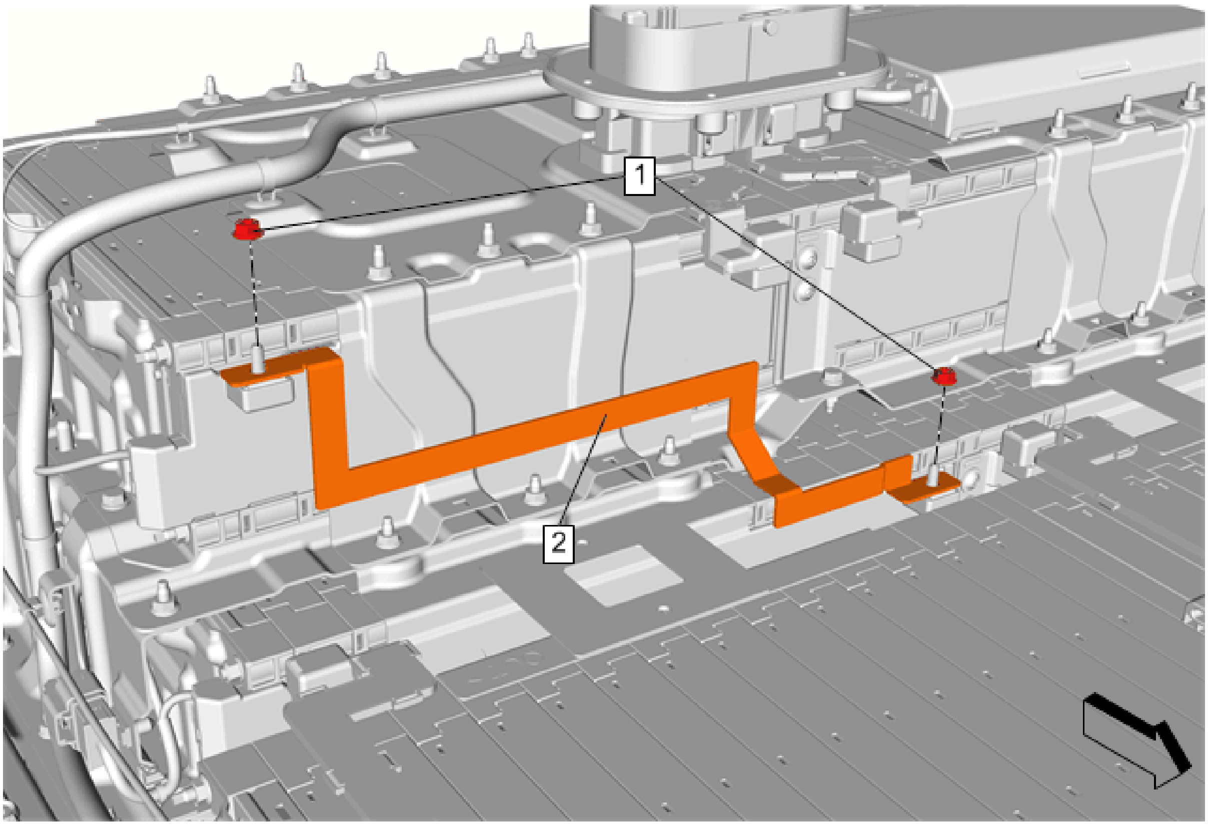


Fig. 149: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, RH. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus**

Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

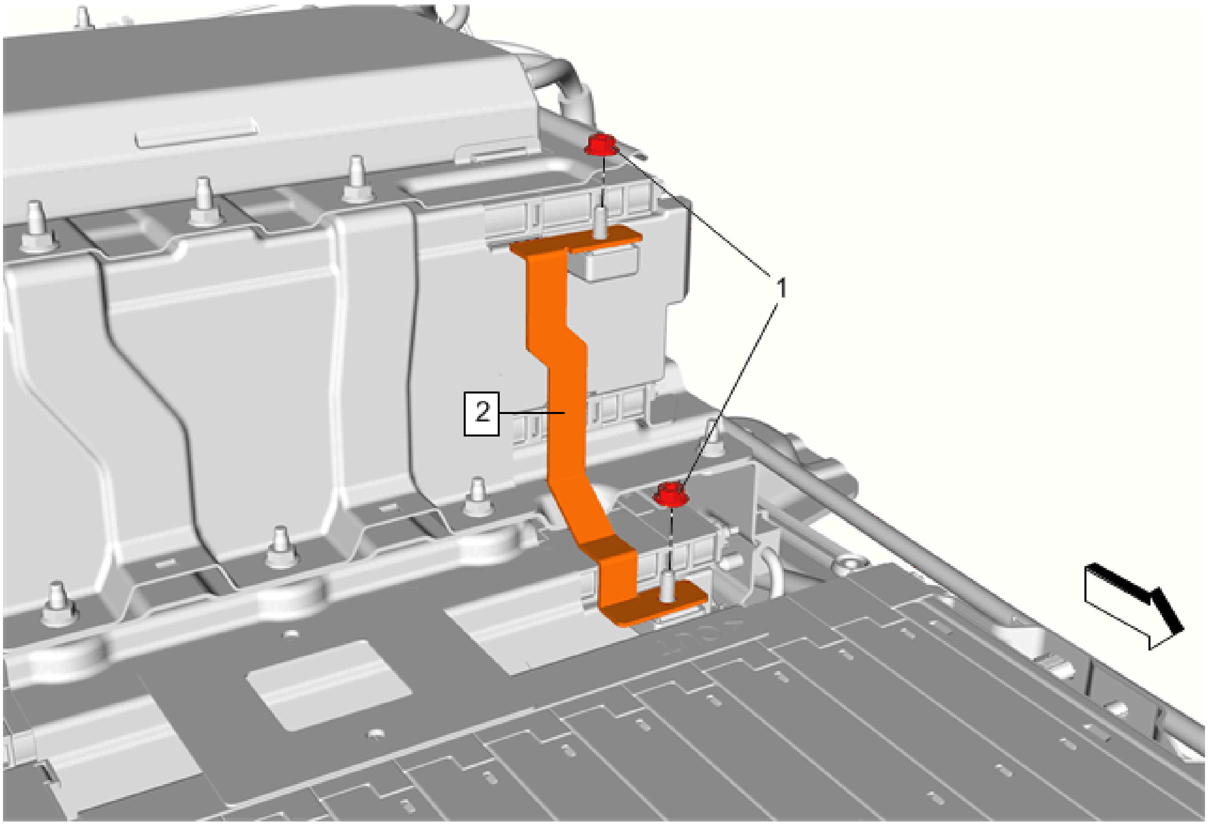


Fig. 150: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

9. Remove the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, LH. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

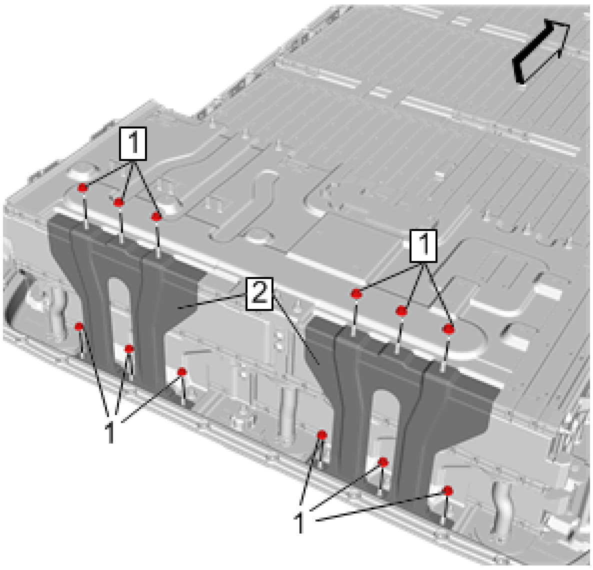


Fig. 151: Cell Battery Securing Nuts And Cell Battery Rear Bracket
Courtesy of GENERAL MOTORS COMPANY

10. Remove the cell battery securing nuts (1) [12x] and the row 5 cell battery rear bracket (2).

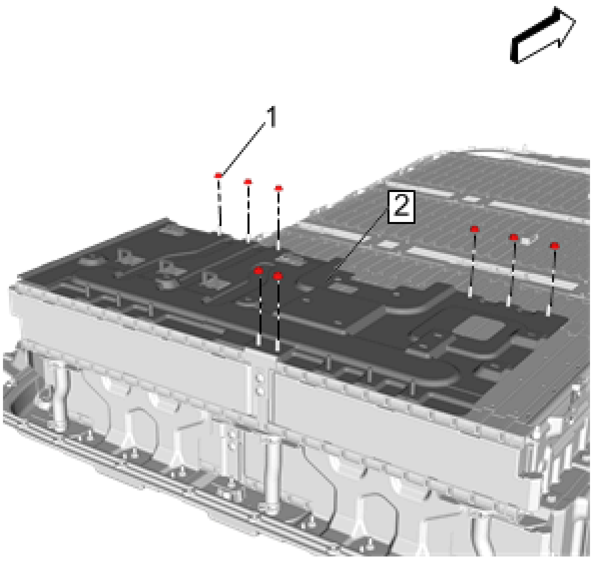


Fig. 152: Cell Battery Securing Nuts And Cell Battery Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

11. Remove the cell battery securing nuts (1) [8x] and the row 5 cell battery upper bracket (2).

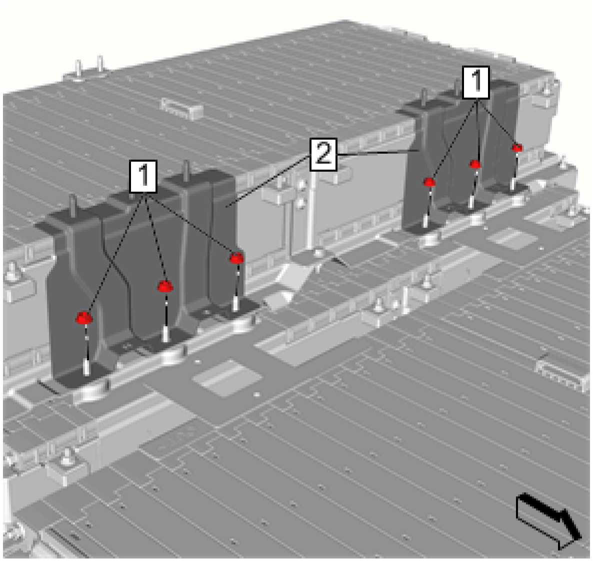


Fig. 153: Cell Battery Securing Nuts And Cell Battery Front Bracket
Courtesy of GENERAL MOTORS COMPANY

12. Remove the cell battery securing nuts (1) [6x] and the row 5 cell battery front bracket (2).

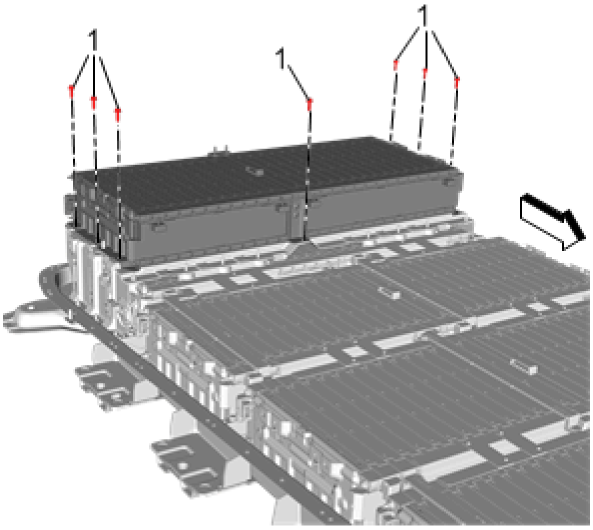


Fig. 154: Cell Battery Securing Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the row 5 cell battery securing bolts (1) [7x].

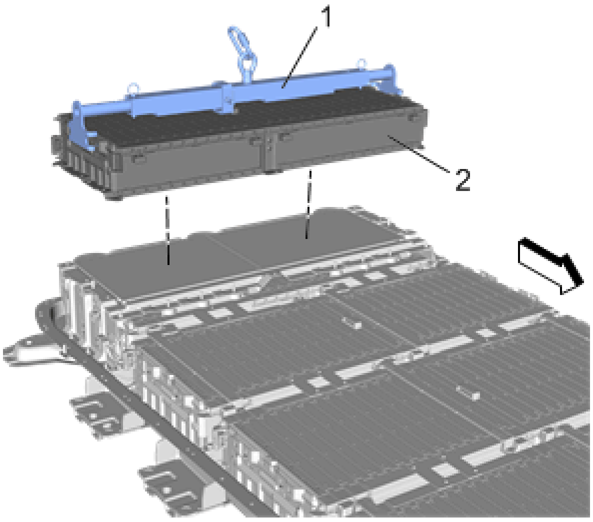


Fig. 155: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

14. Use the **EL-48264** Battery Lift Tool (1) to lift the cell battery (2).

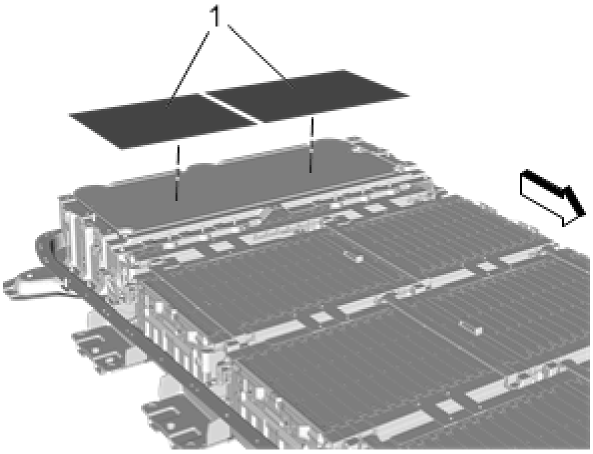


Fig. 156: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

15. Remove the thermal pads (1).

Installation Procedure

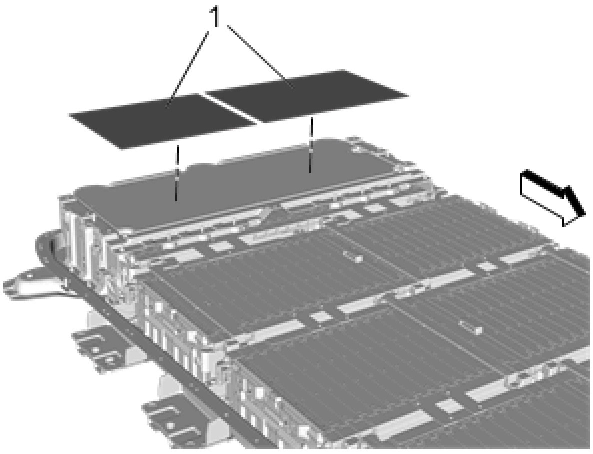


Fig. 157: Thermal Pads
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing the thermal pad, ensure there are no air bubbles during installation on the cold plate.**

1. Install the thermal pads (1).

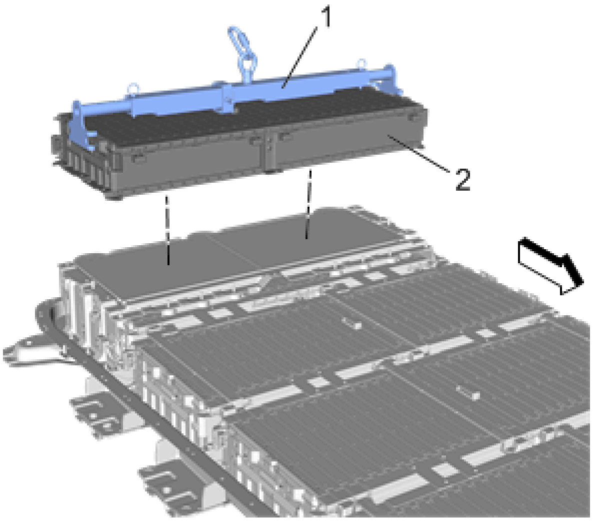


Fig. 158: Battery Lift Tool And Cell Battery
Courtesy of GENERAL MOTORS COMPANY

2. Use the **EL-48264** Battery Lift Tool (1) to install the cell battery (2).

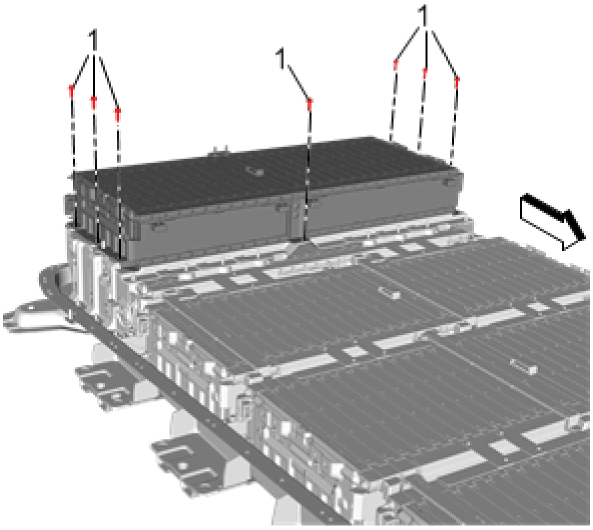


Fig. 159: Cell Battery Securing Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution .

3. Install the row 5 cell battery securing bolts (1) [7x] to 9 N.m (80 lb in).

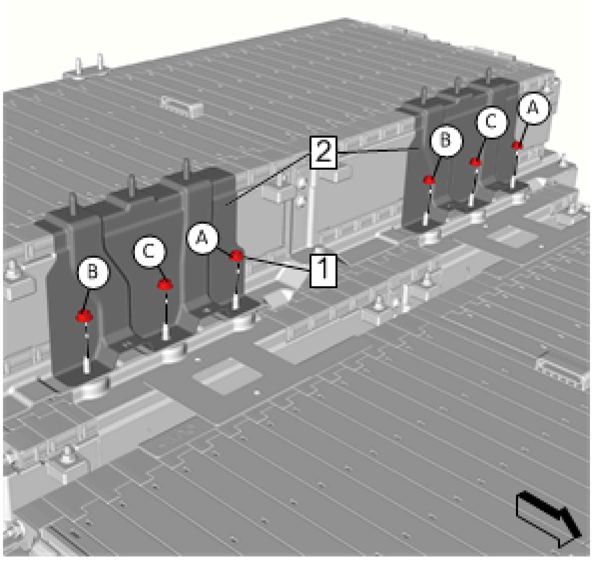


Fig. 160: Cell Battery Securing Nuts In Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery securing nuts in the sequence shown.**

4. Install the cell battery securing nuts (1) [6x] and the row 5 cell battery front bracket (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

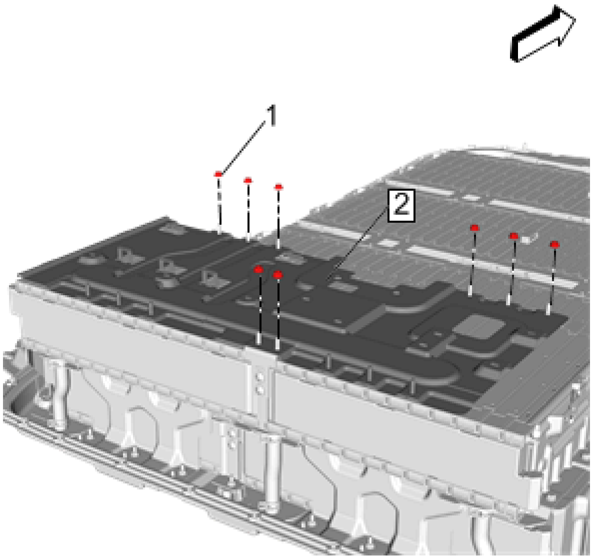


Fig. 161: Cell Battery Securing Nuts And Cell Battery Upper Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Install the cell battery securing nuts (1) [8x] and the row 5 cell battery upper bracket (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

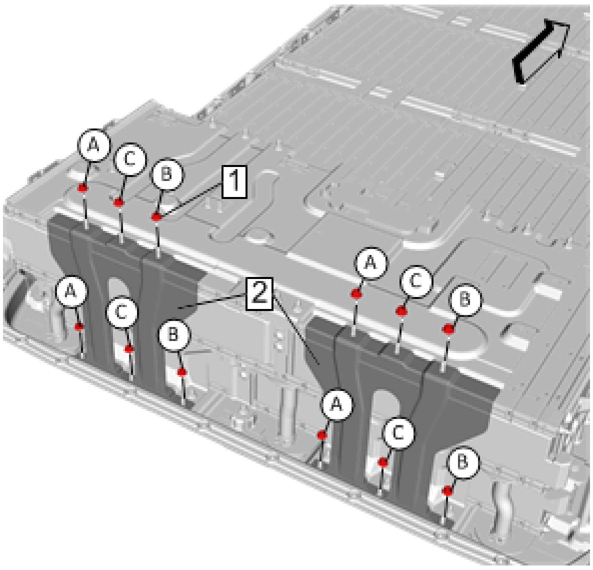


Fig. 162: Cell Battery Securing Nuts In Sequence
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Tighten the cell battery securing nuts in the sequence shown.**

6. Install the cell battery securing nuts (1) [12x] and the row 5 cell battery rear bracket (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

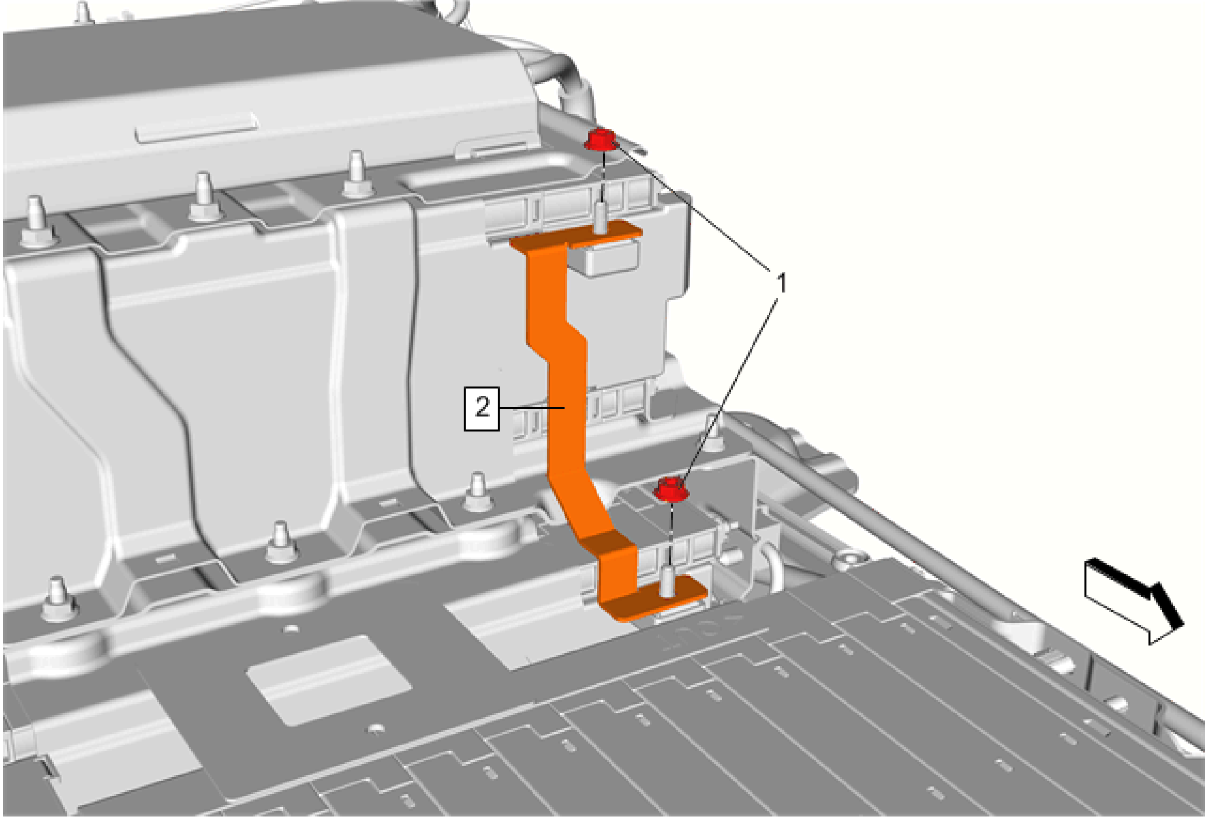


Fig. 163: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

7. Install the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, LH. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

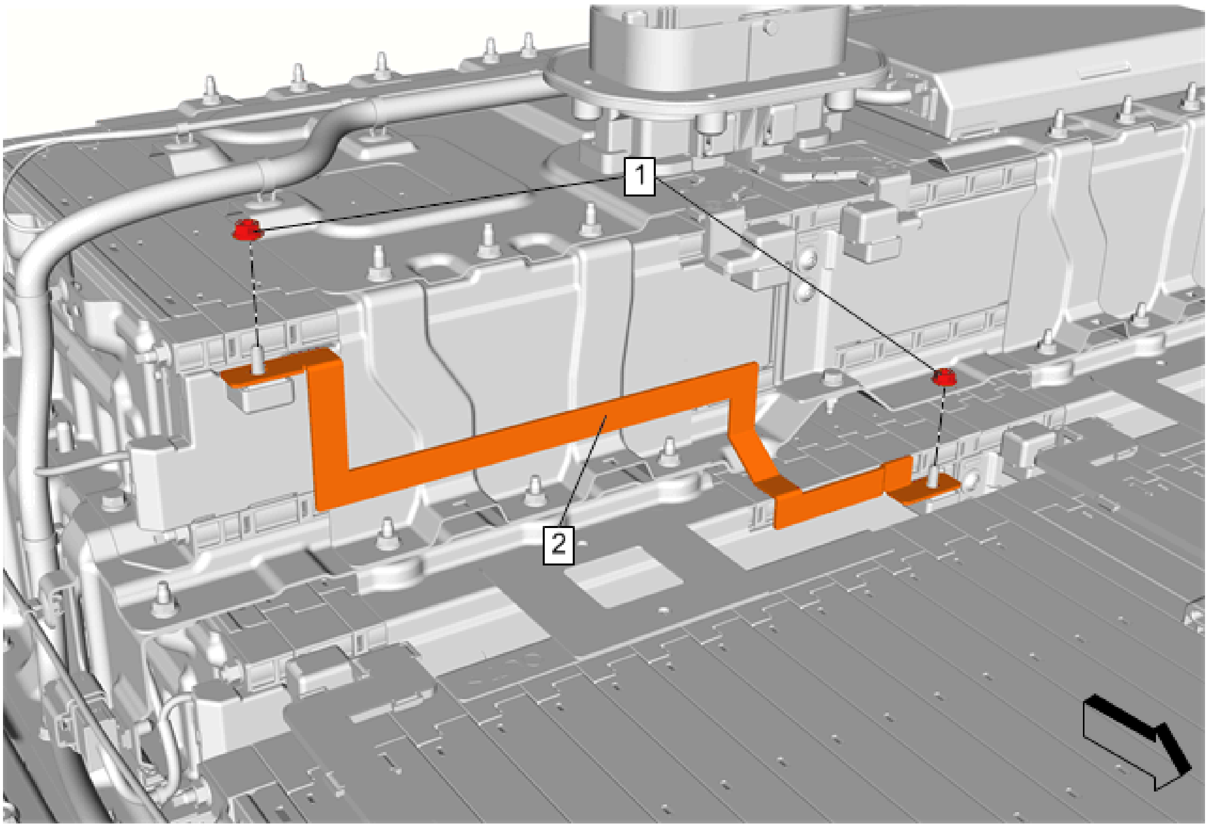


Fig. 164: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (2) - bus bar, cell battery module 4 to cell battery module 5, RH. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative).

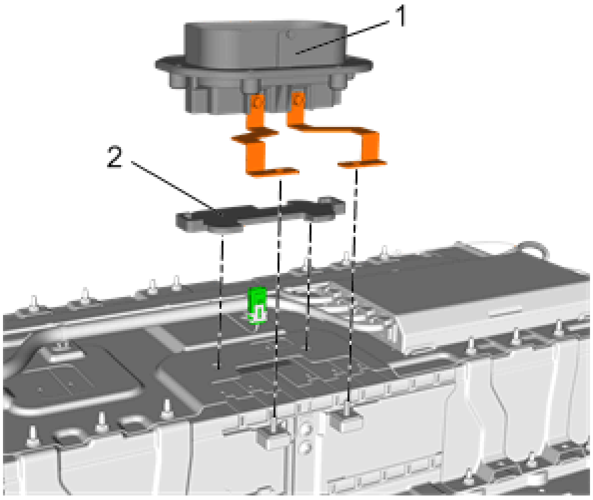


Fig. 165: Connector And Connector Insulator
Courtesy of GENERAL MOTORS COMPANY

9. Install the high voltage battery high voltage manual disconnect connector (1). High Voltage Battery High Voltage Manual Disconnect Connector Replacement.

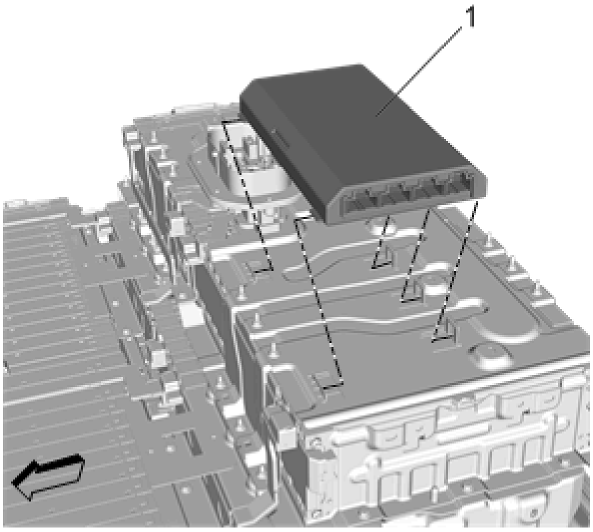


Fig. 166: Battery Energy Control Module
Courtesy of GENERAL MOTORS COMPANY

10. Install the battery energy control module (1). Battery Energy Control Module Replacement.

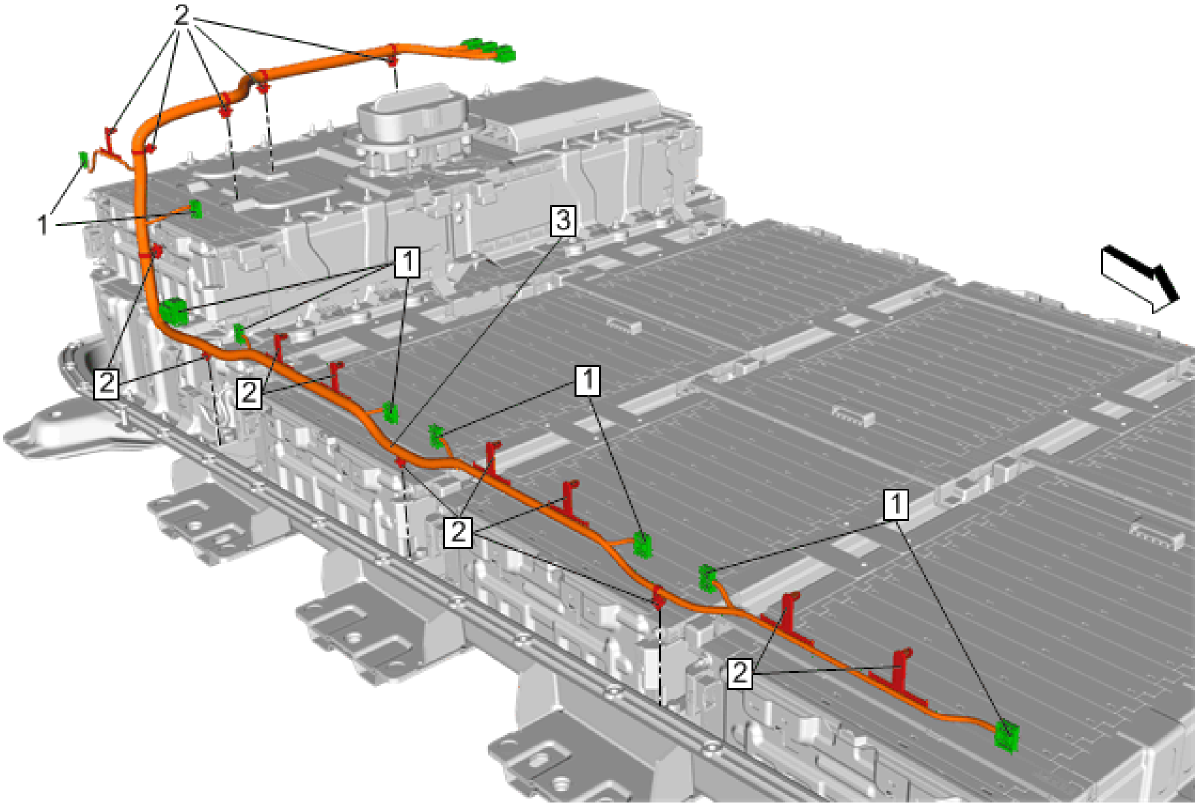


Fig. 167: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery sensor module wiring harness (3) - right side. Drive Motor Battery Sensor Module Wiring Harness Replacement (Right)Drive Motor Battery Sensor Module Wiring Harness Replacement (RH, Sub).

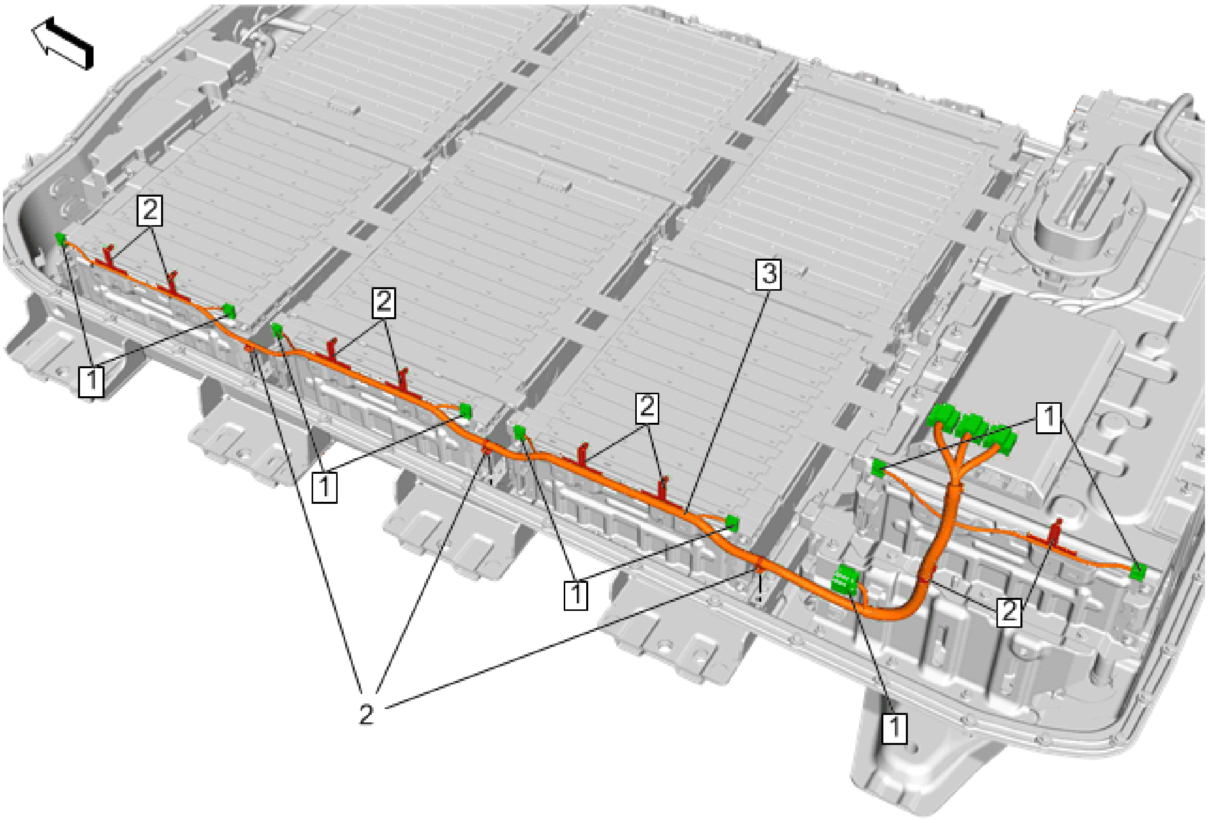


Fig. 168: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Install the drive motor battery sensor module wiring harness (3) - left side. Drive Motor Battery Sensor Module Wiring Harness Replacement (Left)Drive Motor Battery Sensor Module Wiring Harness Replacement (LH, Sub).

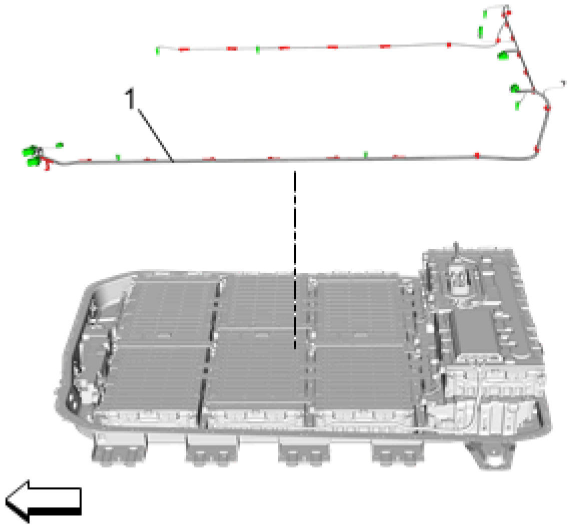


Fig. 169: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

13. Install the drive motor battery control module wiring harness (1). Drive Motor Battery Control Module Wiring Harness Replacement.
14. Perform the cell battery balancing if replaced. Hybrid/EV Battery Cell Balancing.
15. Install the battery upper cover. Battery Upper Cover Replacement
16. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
17. Reprogram the battery energy control module. Battery Energy Control Module Programming and Setup
18. Program the hybrid powertrain control module 2. Hybrid Powertrain Control Module 2 Programming and Setup
19. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. Hybrid/EV Battery Pack Capacity Learn

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

HIGH VOLTAGE CONNECTOR REPLACEMENT (X3)

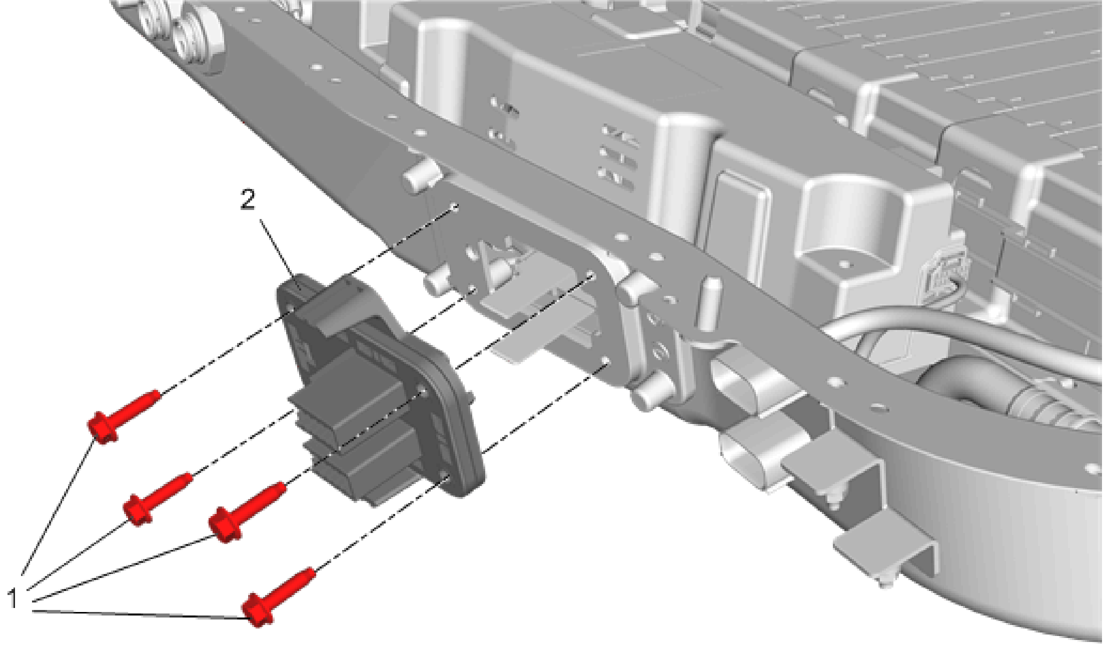


Fig. 170: High Voltage Battery Connector X3
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
• Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
• Visually and functionally inspect the gloves before use.
• Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedure
1. Disable the high voltage system. High Voltage Disabling
2. Disconnect the X3 harness connector by rotating the connector handle until 90 degrees.</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Callout	Component Name
1	High Voltage Battery X3 Connector Block Bolt (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **Tighten** 9 N.m (80 lb in)
2	High Voltage Battery Connector X3 1. Slowly and gently slide X3 connector out from the high voltage battery. 2. Enable the high voltage system. High Voltage Enabling

HIGH VOLTAGE CONNECTOR REPLACEMENT (X4)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove Battery Upper Cover Battery Upper Cover Replacement

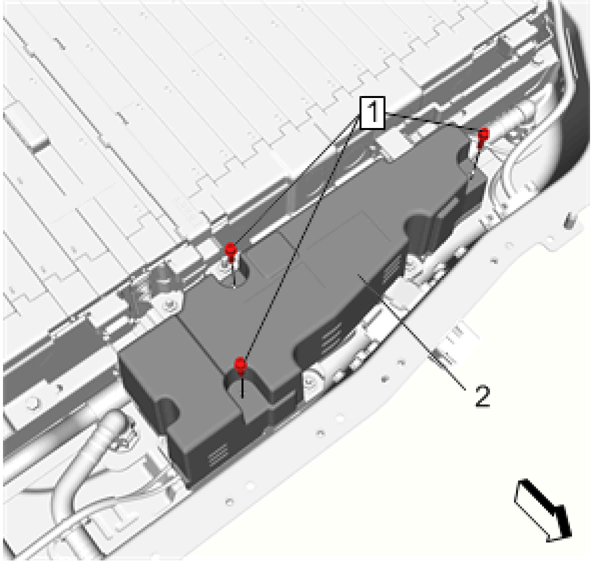


Fig. 171: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

3. Remove the high voltage battery disconnect relay cover (2). **High Voltage Battery Disconnect Relay Replacement**

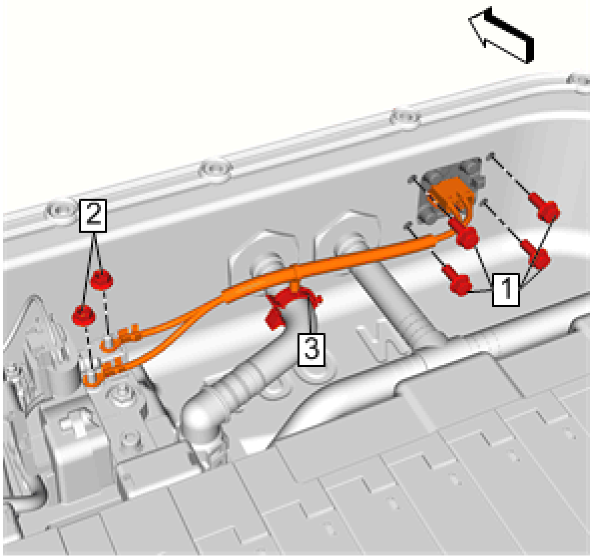


Fig. 172: High Voltage Battery Connector X4
Courtesy of GENERAL MOTORS COMPANY

4. Remove the high voltage battery connector X4 die casting block bolts (1)
5. Remove the high voltage battery connector X4 harness nuts (2)
6. Detach the clip (3).

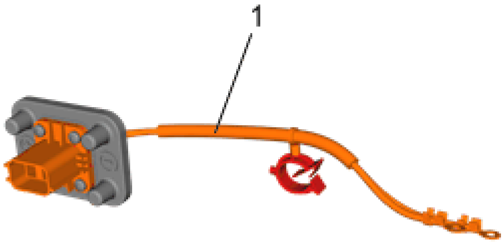


Fig. 173: High Voltage Battery Connector
Courtesy of GENERAL MOTORS COMPANY

NOTE: **High voltage battery connector X4 connector head and harness assembly can not be separated.**

7. Remove the high voltage battery connector X4 (1) from the drive motor battery tray.

Installation Procedure

1. When installing the OLD X4 high voltage connector, follow the step 3 - 5 and 10 - 12.
2. When replacing the X4 high voltage connector with NEW one, follow the step 6 - 12.

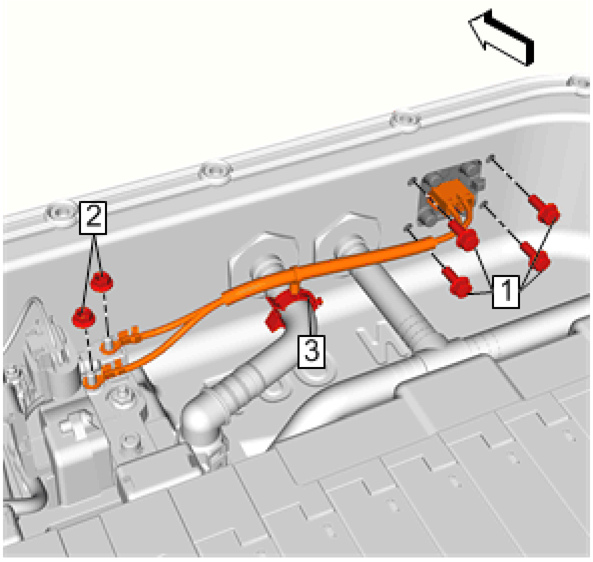


Fig. 174: High Voltage Battery Connector X4
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

3. Attach the clip (3).
4. Install the high voltage battery connector X4 harness nuts (2). Tighten the fasteners (1) to 4.5 N.m (40 lb in).
5. Install the high voltage battery connector X4 die casting block bolts (1). Tighten the fasteners (1) to 9 N.m (80 lb in).

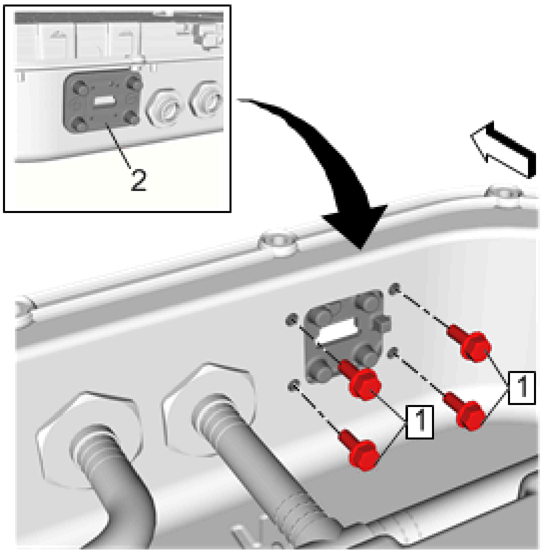


Fig. 175: High Voltage Battery Connector X4 Die Casting Block Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install the high voltage battery connector X4 die casting block bolts (1) and the block (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

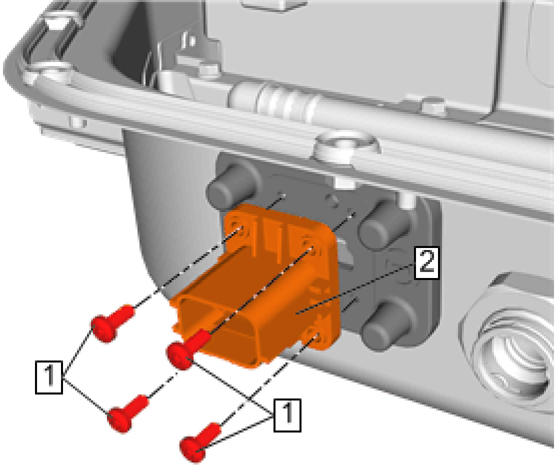


Fig. 176: High Voltage Battery Connector X4 Head Screws
Courtesy of GENERAL MOTORS COMPANY

7. Install the high voltage battery connector X4 head screws (1) and X4 head (2). Tighten the fasteners (1) to 25 N.m (22 lb in).

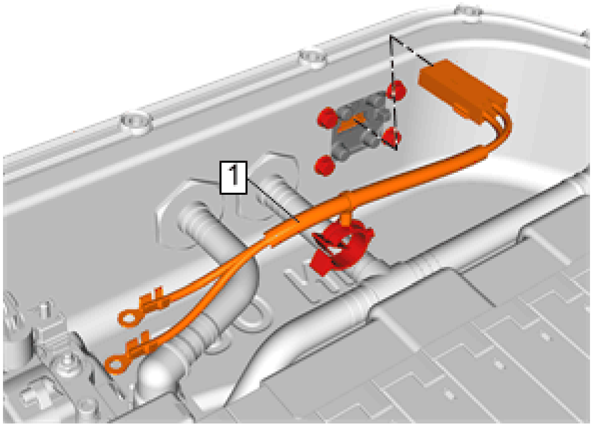


Fig. 177: Slide wiring harness into connector block
Courtesy of GENERAL MOTORS COMPANY

8. Slide the wiring harness (1) into the X4 connector block.

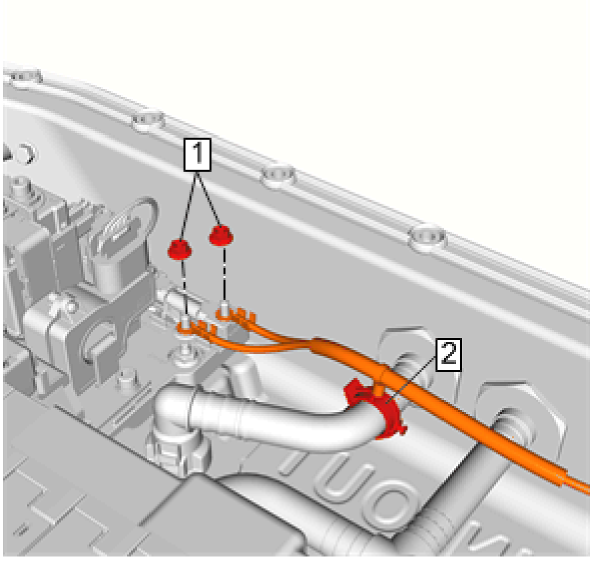


Fig. 178: High Voltage Connector X4 Harness Nuts
Courtesy of GENERAL MOTORS COMPANY

9. Install the high voltage battery connector X4 harness nuts (1) and clip (2). Tighten the fasteners (1) to 4.5 N.m (40 lb in).
10. Perform second pass and tighten the fasteners (1) to 4.5 N.m (40 lb in).

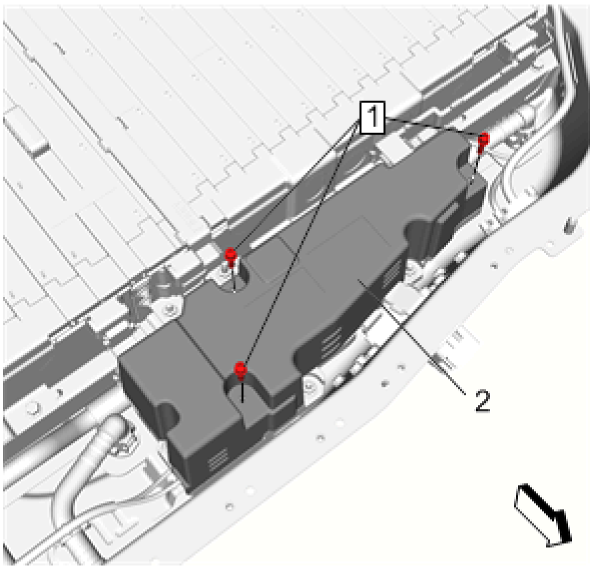


Fig. 179: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

11. Install the high voltage battery disconnect relay cover (2). **High Voltage Battery Disconnect Relay Replacement**
12. Install Battery Upper Cover **Battery Upper Cover Replacement**
13. Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

HIGH VOLTAGE BATTERY DISCONNECT RELAY REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

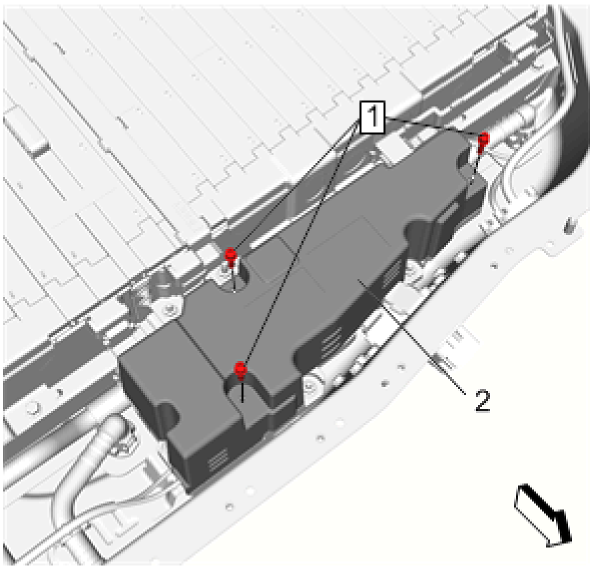


Fig. 180: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

3. Remove the high voltage battery disconnect relay cover bolts (1) and the cover (2).

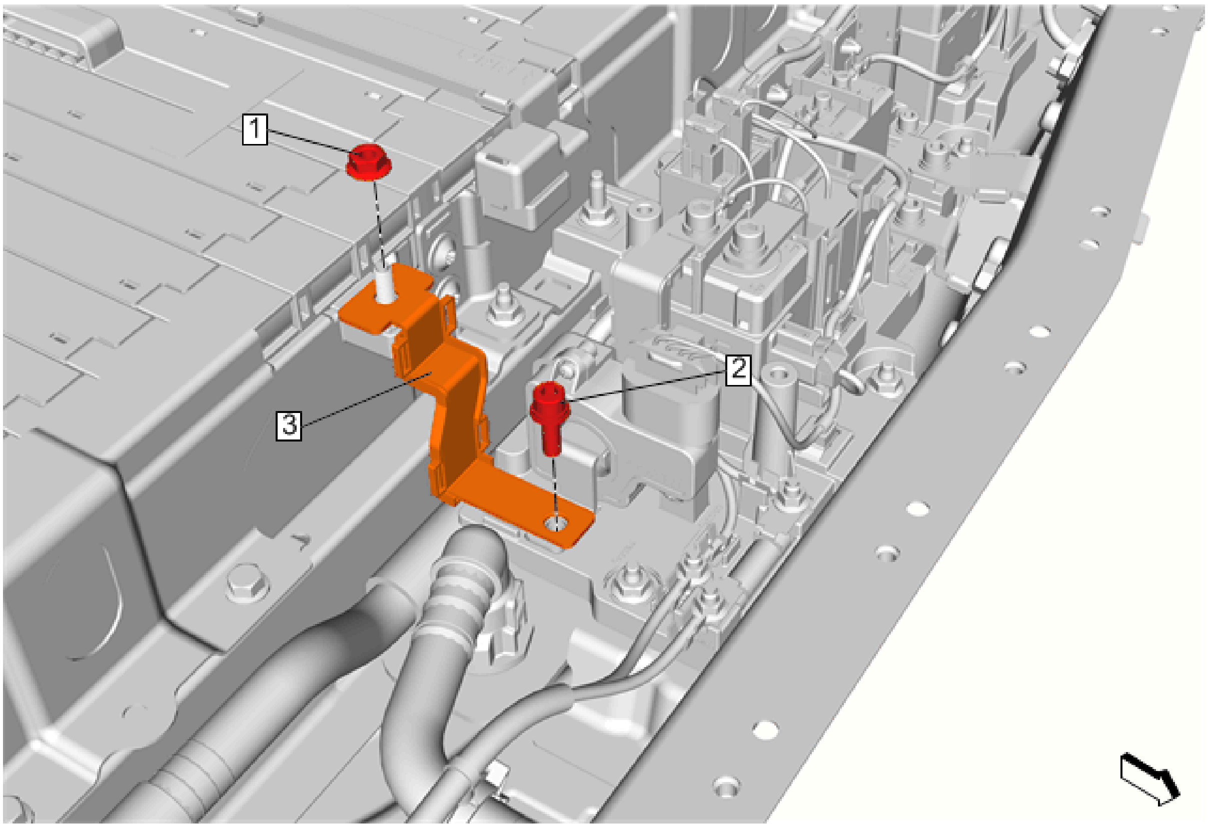


Fig. 181: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery

Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

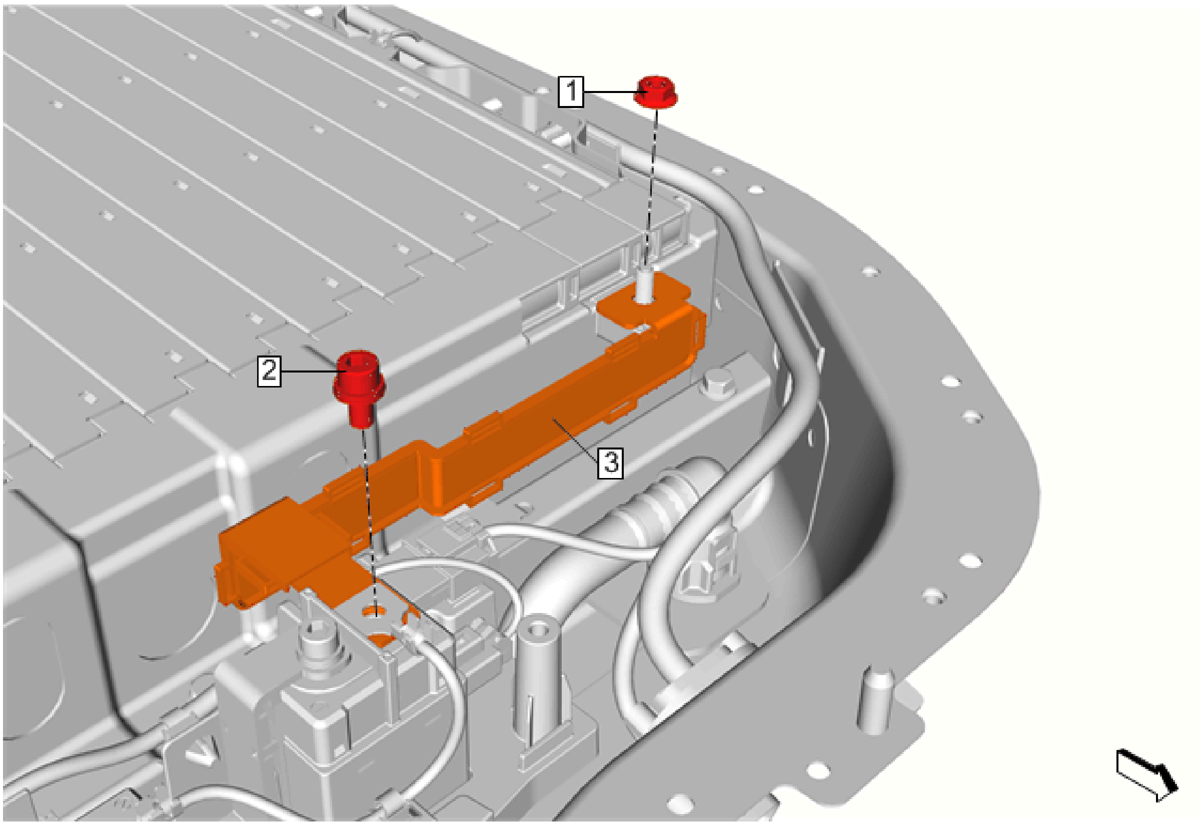


Fig. 182: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

5. Remove the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

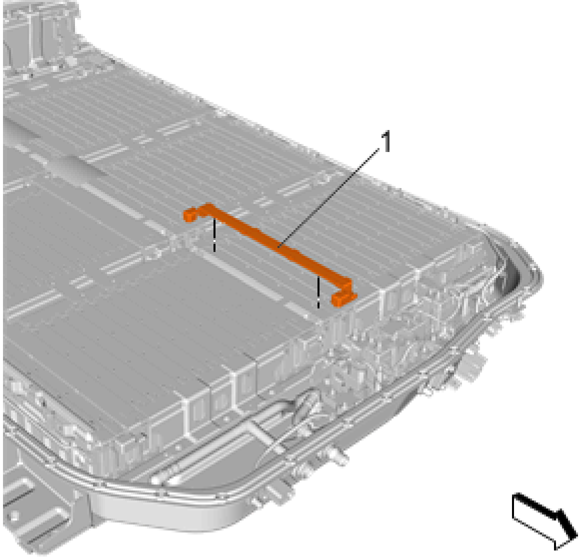


Fig. 183: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

6. Remove the battery cable (1) - bus bar, cell battery module 1 to cell battery module 2. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

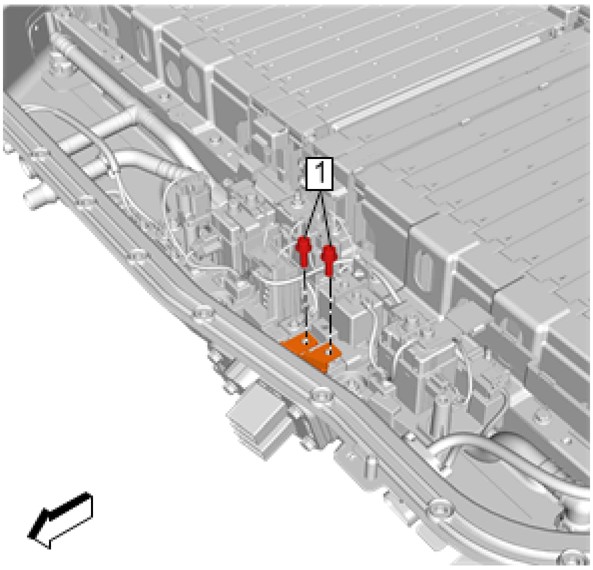


Fig. 184: Battery Cable Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Remove Battery Cable Bolt (1)

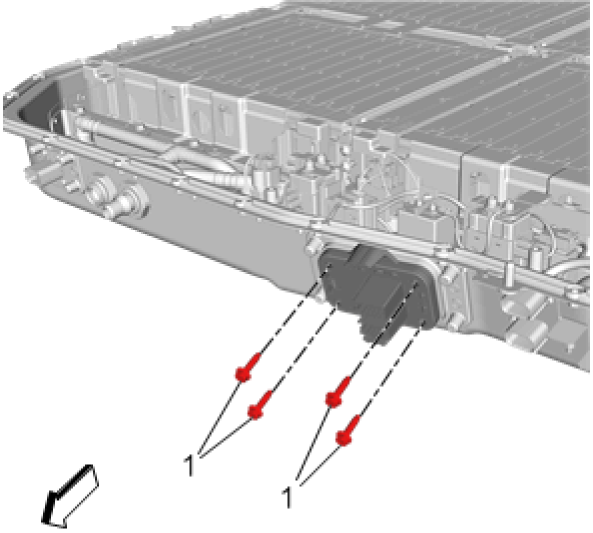


Fig. 185: High Voltage Battery X3 Connector Block Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove High Voltage Battery X3 Connector Block Bolt (1)

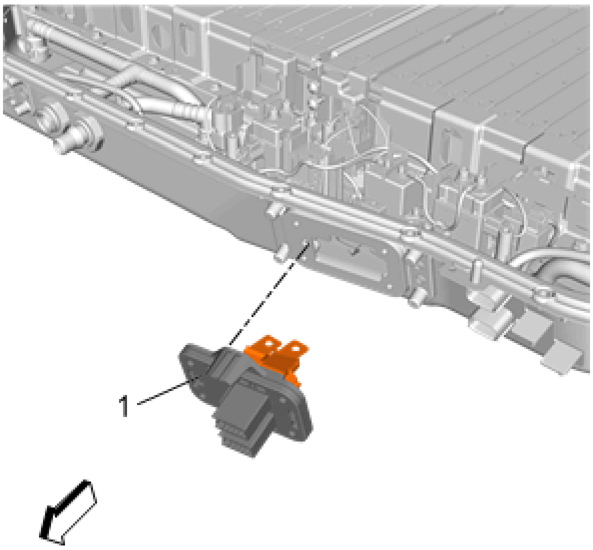


Fig. 186: High Voltage Battery X3 Connector With Battery Cables
Courtesy of GENERAL MOTORS COMPANY

9. Remove the high voltage battery X3 connector (1) with battery cables.

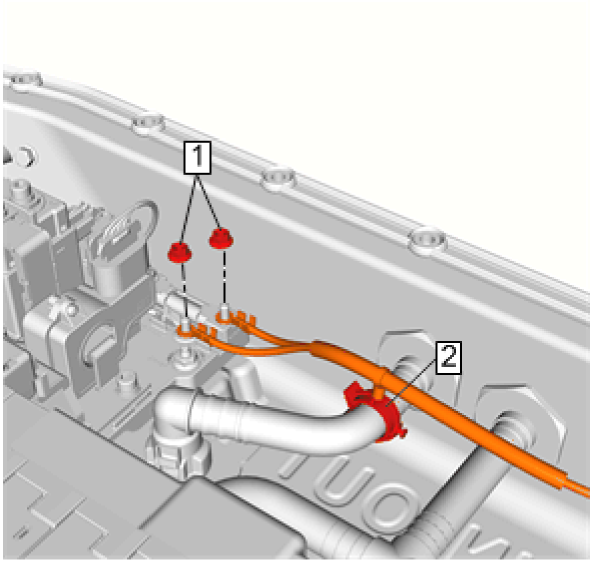


Fig. 187: High Voltage Connector X4 Harness Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Remove the high voltage connector X4 harness nuts (1).**High Voltage Connector Replacement (X4)**

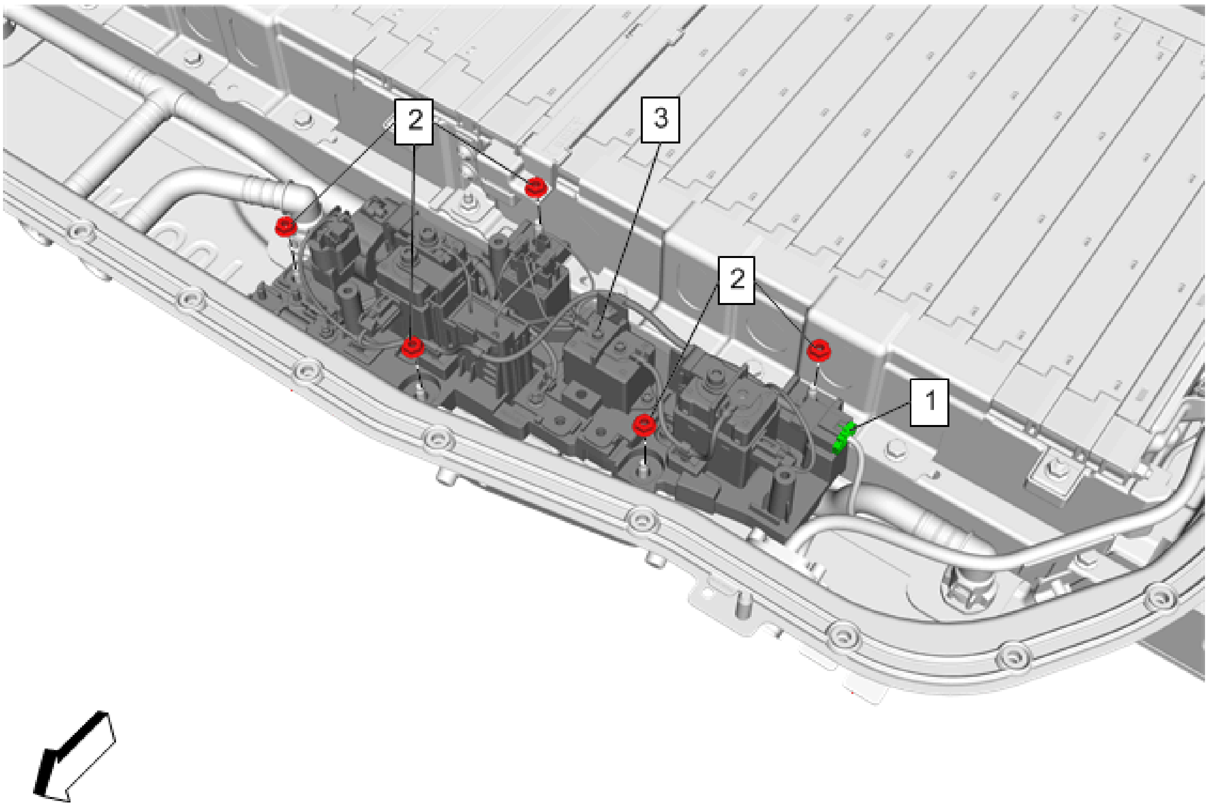


Fig. 188: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Disconnect the drive motor battery control module wiring harness connector (1).
12. Remove the high voltage battery disconnect relay assembly nuts (2)
13. Remove the high voltage battery disconnect relay assembly (3).

Installation Procedure

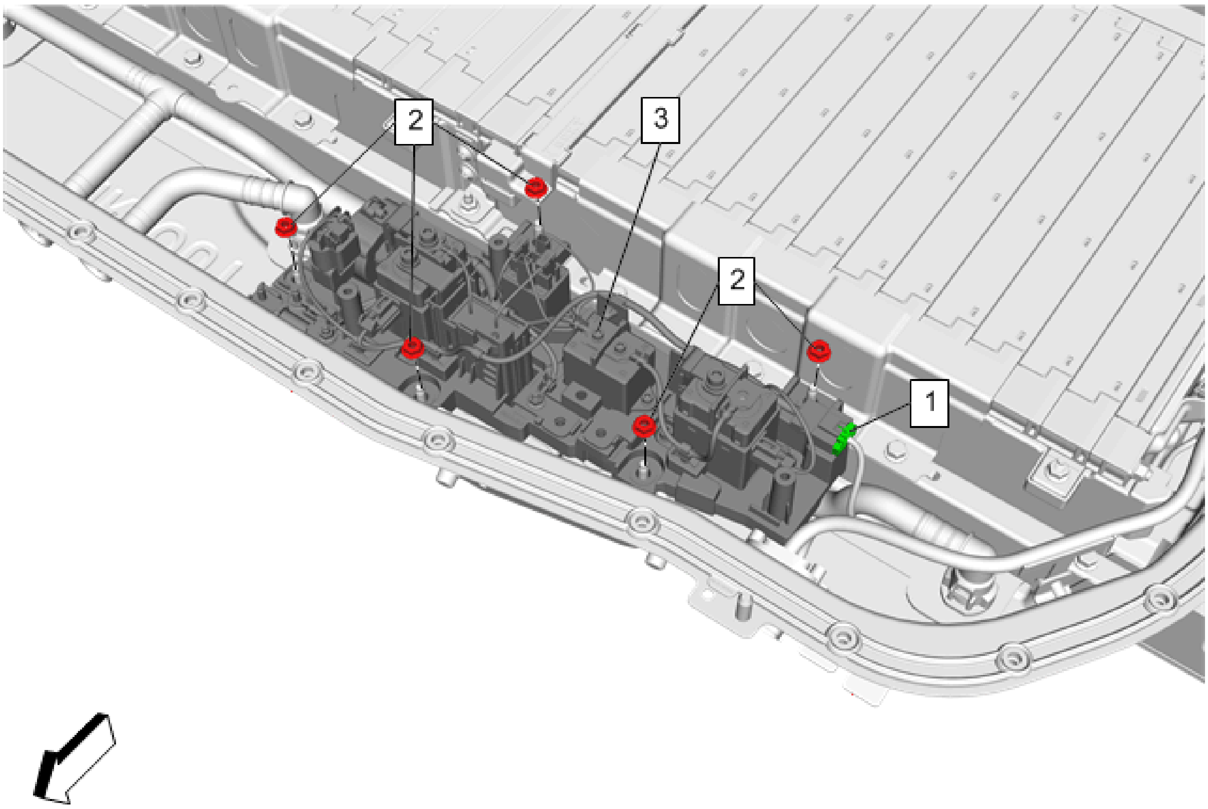


Fig. 189: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

1. Install the high voltage battery disconnect relay assembly (3).
2. Tighten the high voltage battery disconnect relay assembly nuts (2) 9 N.m (80 lb in).
3. Connect the drive motor battery control module wiring harness connector (1).

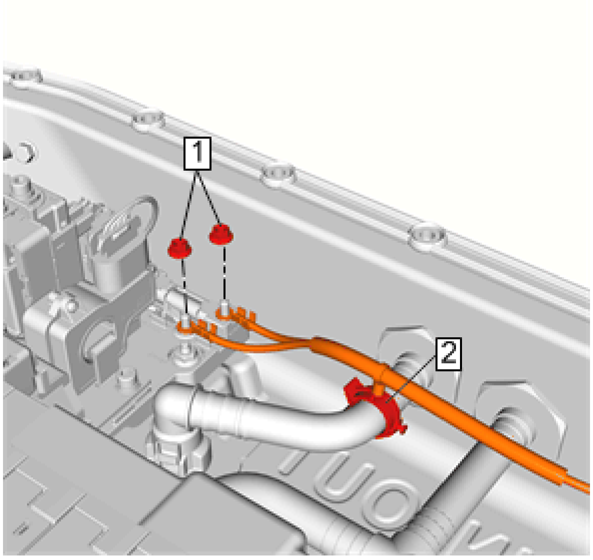


Fig. 190: High Voltage Connector X4 Harness Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Install the high voltage connector X4 harness nuts (1) High Voltage Connector Replacement (X4)

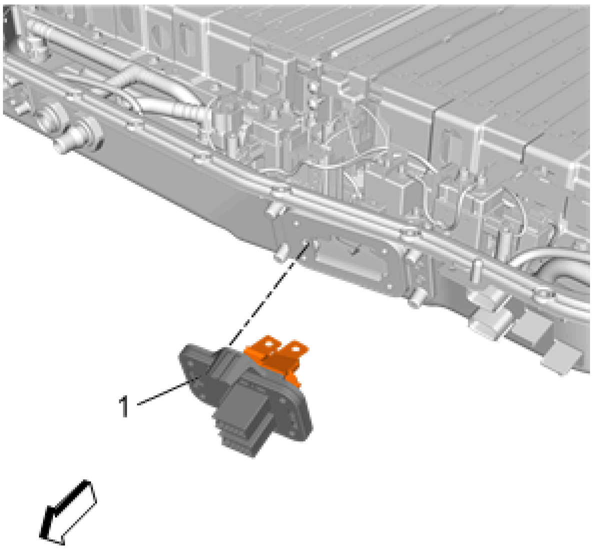


Fig. 191: High Voltage Battery X3 Connector With Battery Cables
Courtesy of GENERAL MOTORS COMPANY

5. Install the high voltage battery X3 connector (1) with battery cables.

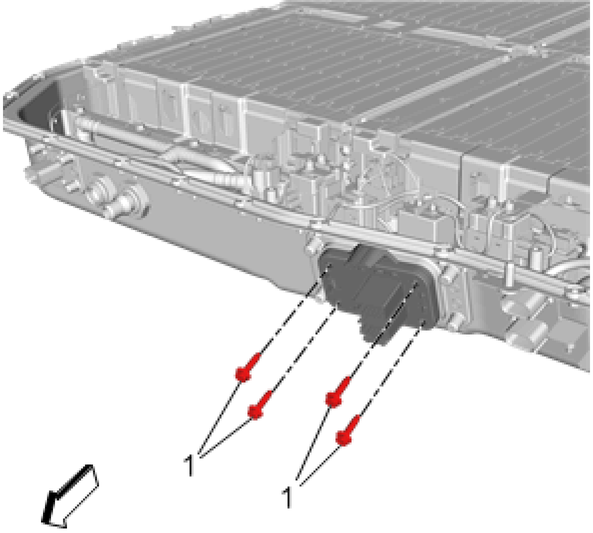


Fig. 192: High Voltage Battery X3 Connector Block Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Battery X3 Connector Block Bolt (1) and tighten 9 N.m (80 lb in)

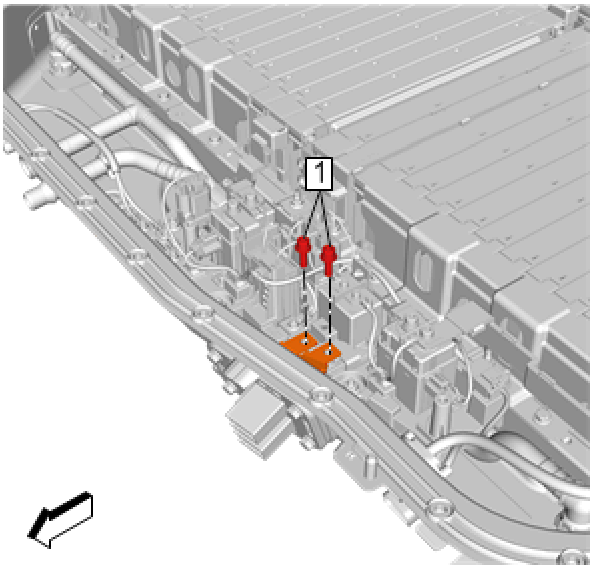


Fig. 193: Battery Cable Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Install Battery Cable Bolt (1) and tighten

    7.1. First Pass: 9 N.m (80 lb in)

    7.2. Final Pass: 9 N.m (80 lb in)

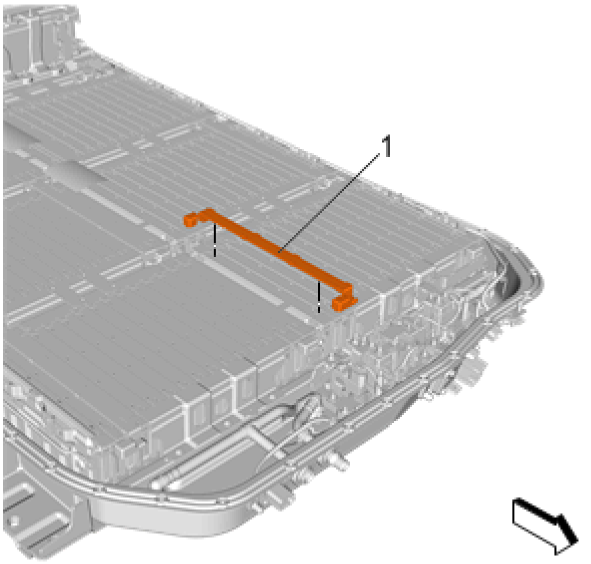


Fig. 194: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

8. Install the battery cable (1) - bus bar, cell battery module 1 to cell battery module 2. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

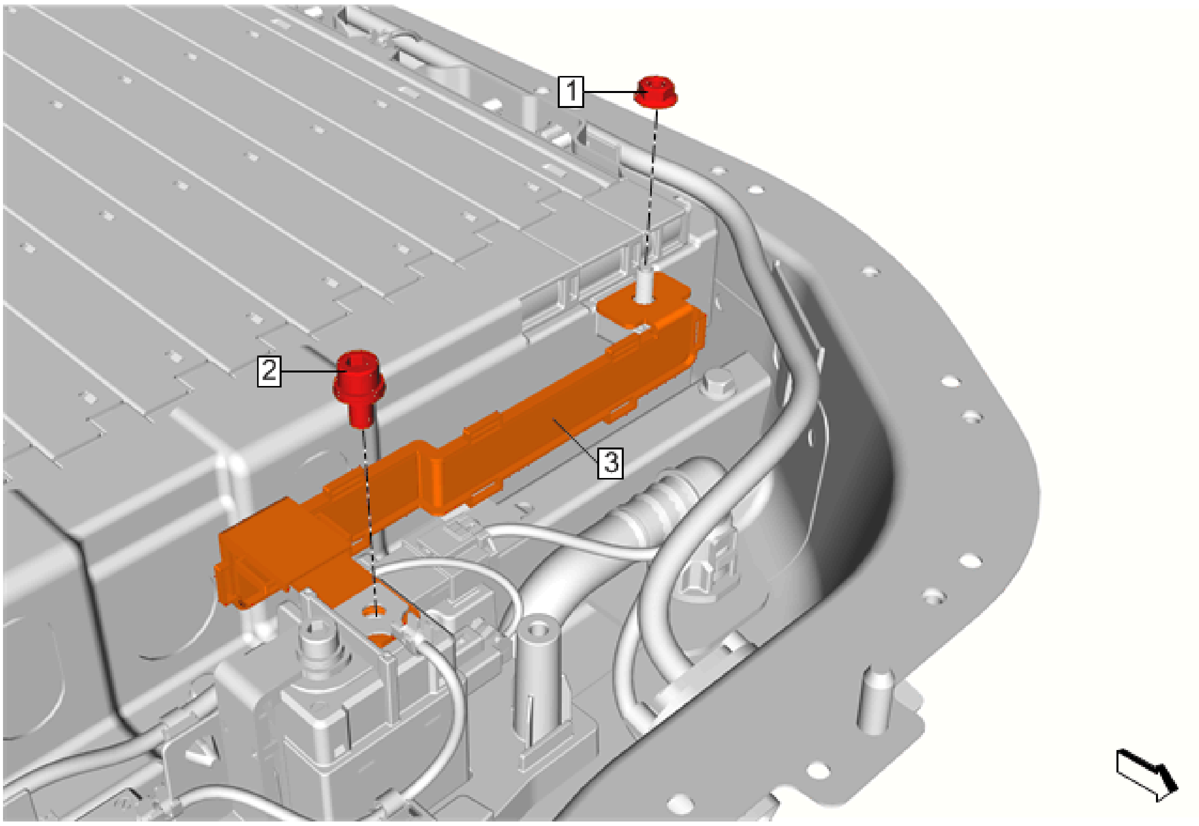


Fig. 195: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

9. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, positive. Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)

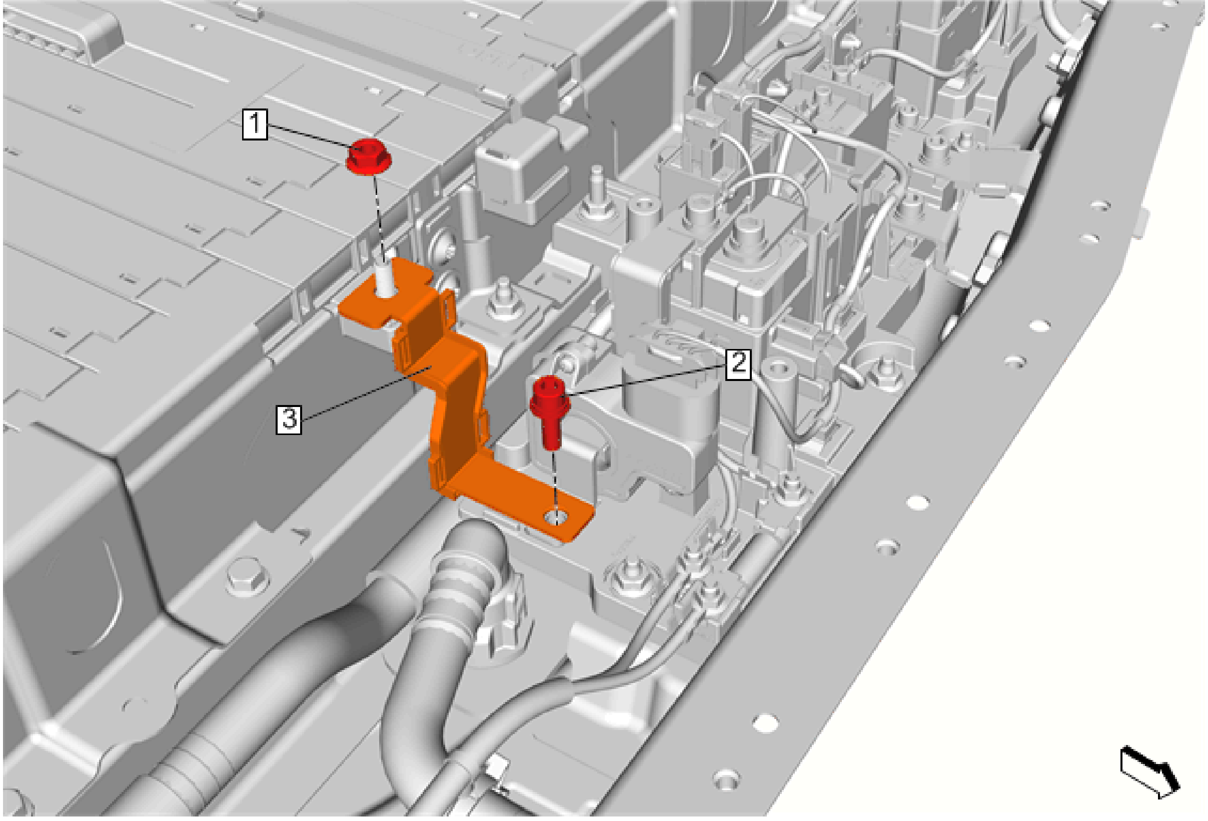


Fig. 196: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

10. Install the battery cable (3) - bus bar, battery to high voltage battery disconnect relay assembly, negative. **Battery Cable Replacement (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH)Battery Cable Replacement (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)Battery Cable Replacement (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)Battery Cable Replacement (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2)Battery Cable Replacement (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3)Battery Cable Replacement (Bus Bar, X3, Positive & Negative)**

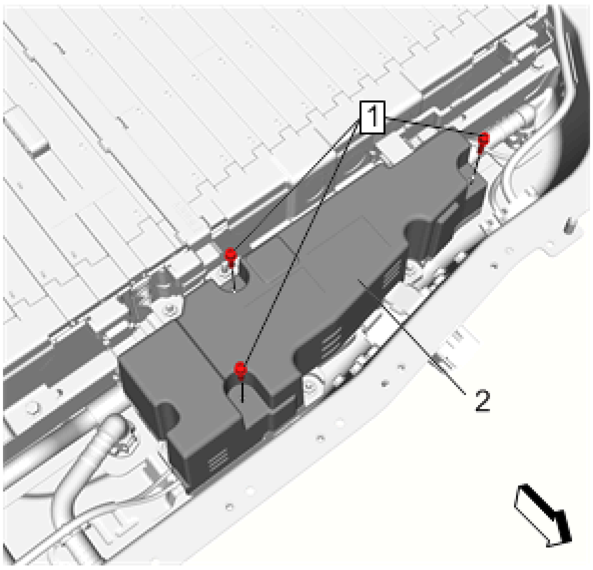


Fig. 197: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

11. Install the high voltage battery disconnect relay cover (2).
12. Tighten the high voltage battery disconnect relay cover bolts (1) to 4.5 N.m (40 lbin)
13. Install the battery upper cover. **Battery Upper Cover Replacement**

14. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

HIGH VOLTAGE BATTERY DISCONNECT RELAY FUSE REPLACEMENT

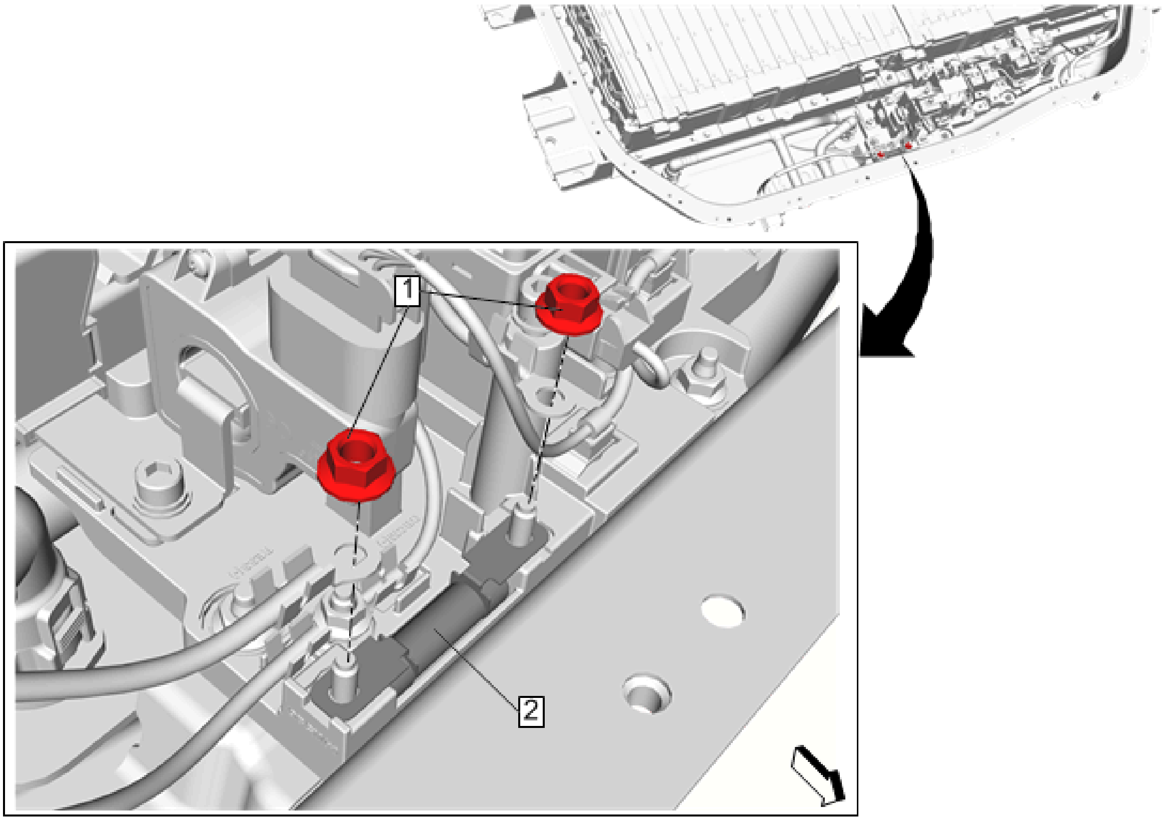


Fig. 198: High Voltage Battery Disconnect Relay Fuse
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

	WARNING:
	Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
	
	WARNING:
	Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
	- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
	- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
	  - **Visually and functionally inspect the gloves before use.**
	  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
	
	Failure to follow the procedure exactly as written may result in serious injury or death.
	
	Preliminary Procedure
	1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
	2. Remove the battery upper cover. Battery Upper Cover Replacement
	3. Remove the high voltage battery disconnect relay cover. High Voltage Battery Disconnect Relay Replacement

1	High Voltage Battery Disconnect Relay Fuse Nut (Qty: 2) **CAUTION:** Fastener Caution **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **Procedure** 1. Tighten the nuts to 4.5 N.m (40 lb in). 2. Tighten the nuts to 4.5 N.m (40 lb in) again.
2	High Voltage Battery Disconnect Relay Fuse

DRIVE MOTOR BATTERY POSITIVE AND NEGATIVE CABLE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**

- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling

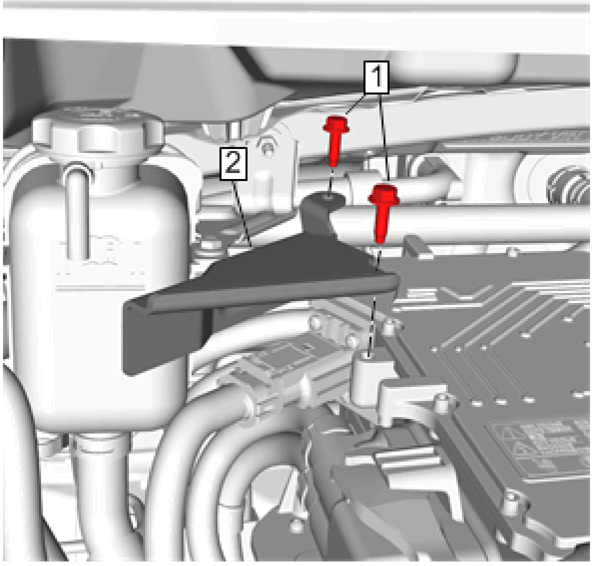


Fig. 199: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Remove Accessory DC Power Control Module High Voltage Connector Protector Bolt(1)
3. Remove Accessory DC Power Control Module High Voltage Connector Protector(2)

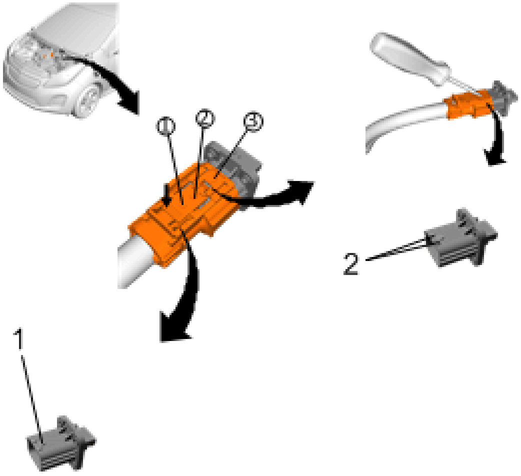


Fig. 200: First Stage Connector Tab And Connector Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the 2-stage high voltage connectors in the following sequence:
    - Push down on the connector tab and release the connector from the first stage connector tab (1).
    - Using a flat blade screwdriver inserted into the connector as shown, release the second stage safety catch, from the 2 connector retaining tabs (2).

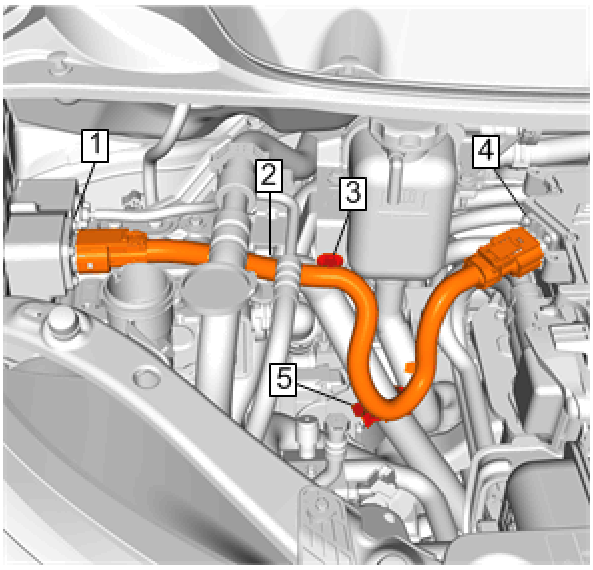


Fig. 201: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

5. Detach Drive Motor Battery Positive and Negative Cable Retainer (3)
6. Unclip Drive Motor Battery Positive and Negative Cable Retainer (5)
7. Disconnect the drive motor battery positive and negative cable (2) from the high voltage battery disconnect control module assembly (4) and heater coolant heater assembly (1).
8. Remove Drive Motor Battery Positive and Negative Cable (2)

Installation Procedure

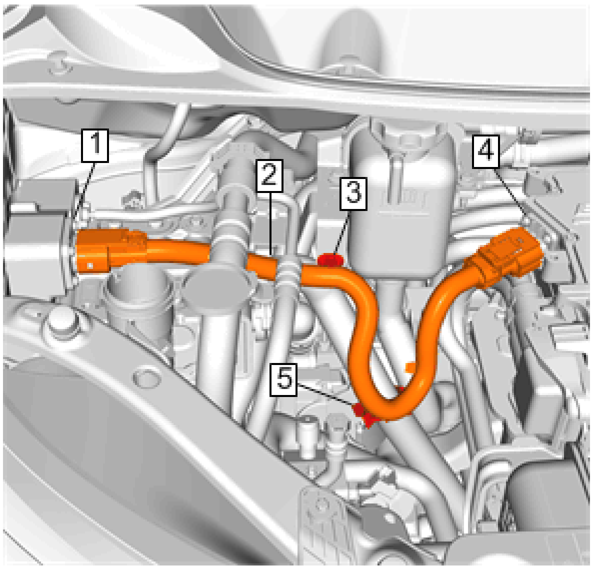


Fig. 202: Drive Motor Battery Positive and Negative Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Positive and Negative Cable (2)
2. Attach Drive Motor Battery Positive and Negative Cable Retainer (3)
3. Install Drive Motor Battery Positive and Negative Cable Retainer (5)
4. Connect the drive motor battery positive and negative cable (2) to the high voltage battery disconnect control module assembly (4) and heater coolant heater assembly (1).

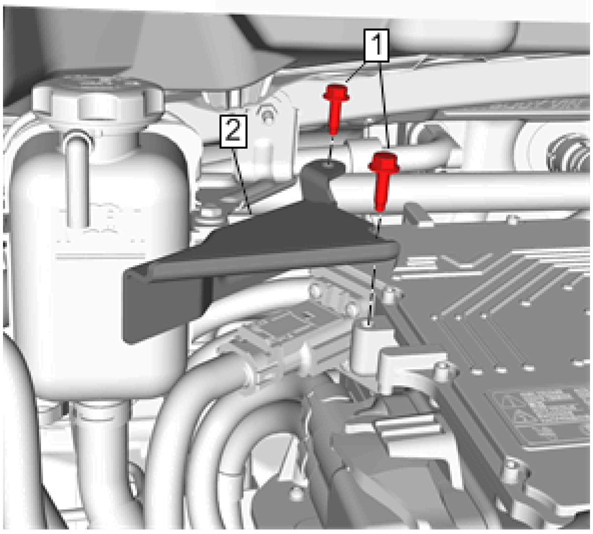


Fig. 203: Accessory DC Power Control Module High Voltage Connector Protector And Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

5. Install Accessory DC Power Control Module High Voltage Connector Protector (2)
6. Install Accessory DC Power Control Module High Voltage Connector Protector Bolt (1) 9 N.m (80 lb in)
7. Enable the high voltage system. **High Voltage Enabling**

DRIVE MOTOR BATTERY POSITIVE AND NEGATIVE RELAY CABLE REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Remove Front Wheelhouse Liner **Front Wheelhouse Liner Replacement**

3. Remove Battery Tray **Battery Tray Replacement**

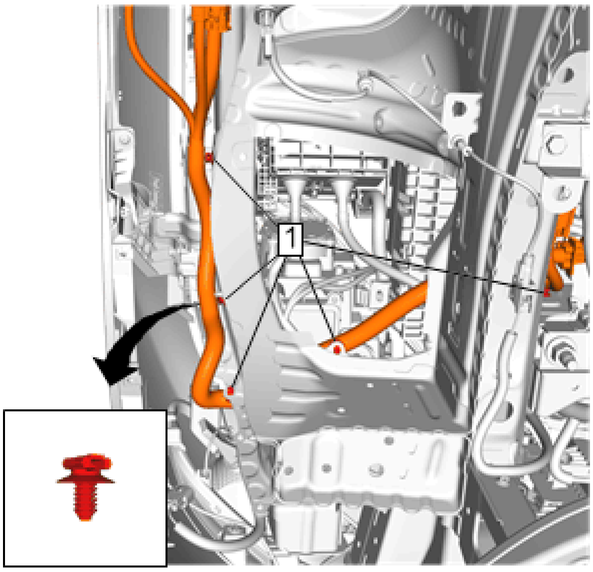


Fig. 204: Drive Motor Battery Positive and Negative Relay Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Remove Drive Motor Battery Positive and Negative Relay Cable Retainer

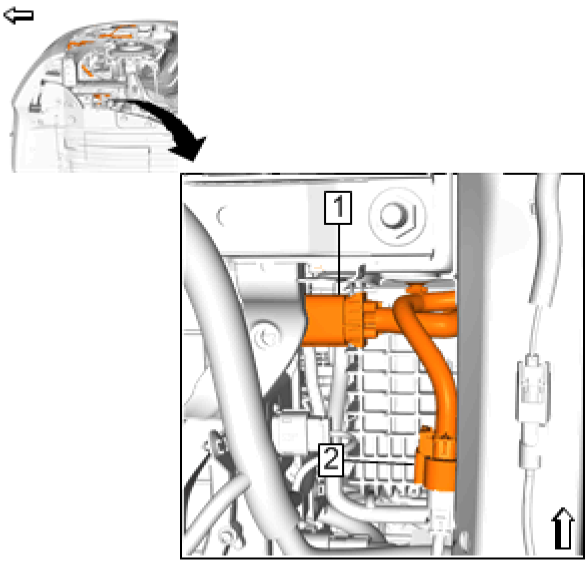


Fig. 205: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector@Drive Motor Battery Charger(1)
6. Disconnect Electrical Connector@Body Wiring Harness(2)

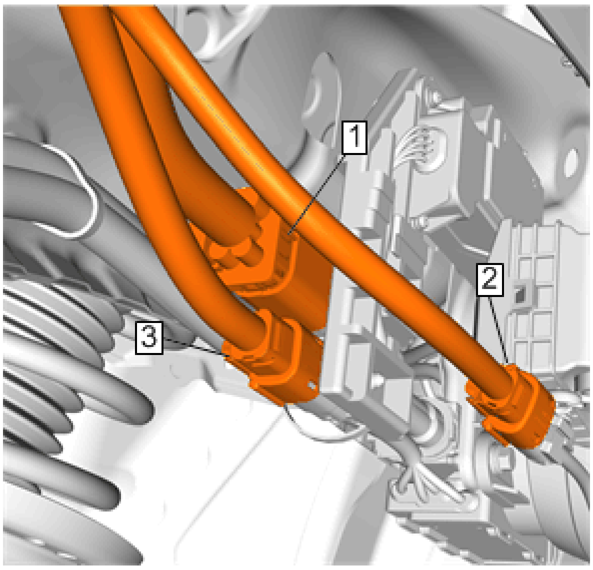


Fig. 206: Drive Motor Battery Charger Receptacle And Charge Port Door Ajar Switch
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Electrical Connector@Drive Motor Battery Charger Receptacle(1, 3)
8. Disconnect Electrical Connector@Charge Port Door Ajar Switch(2)

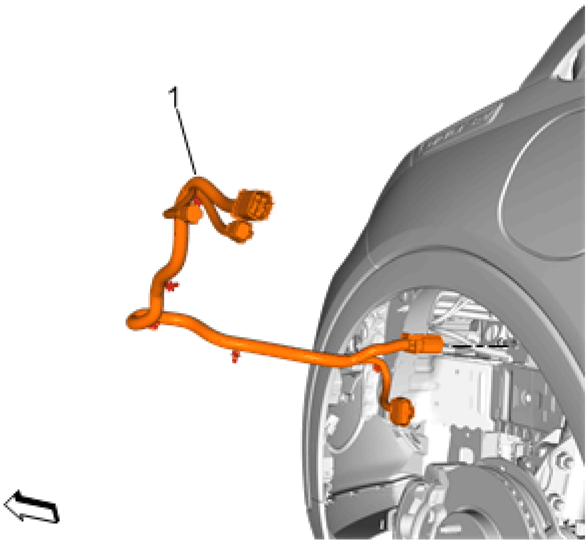


Fig. 207: Drive Motor Battery Positive And Negative Relay Cable
Courtesy of GENERAL MOTORS COMPANY

9. Remove Drive Motor Battery Positive and Negative Relay Cable (1)

Installation Procedure

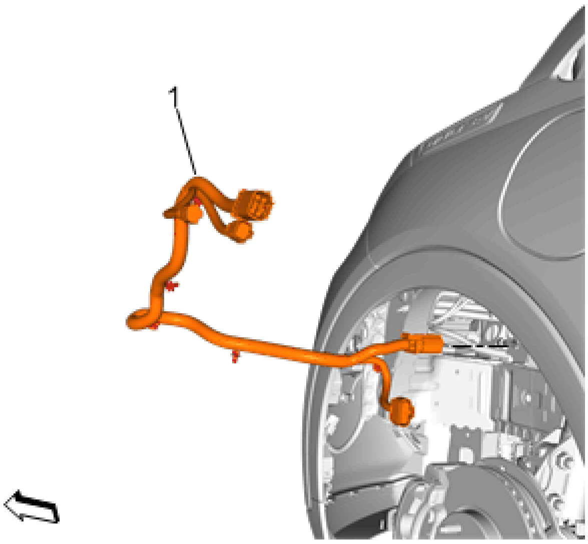


Fig. 208: Drive Motor Battery Positive And Negative Relay Cable
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Positive and Negative Relay Cable (1)

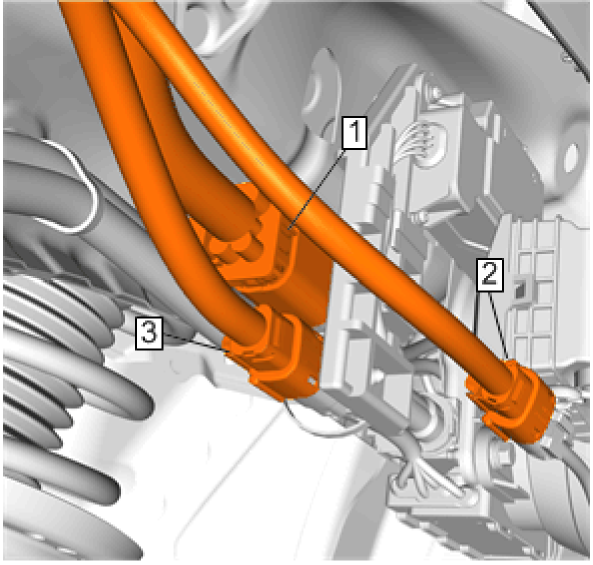


Fig. 209: Drive Motor Battery Charger Receptacle And Charge Port Door Ajar Switch
Courtesy of GENERAL MOTORS COMPANY

2. Connect Electrical Connector@Drive Motor Battery Charger Receptacle (1, 3)
3. Connect Electrical Connector@Charge Port Door Ajar Switch (2)

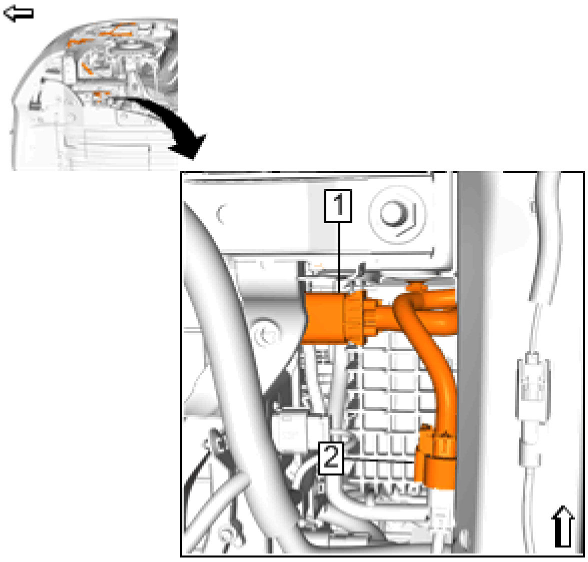


Fig. 210: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connector@Drive Motor Battery Charger (1)
5. Connect Electrical Connector@Body Wiring Harness (2)

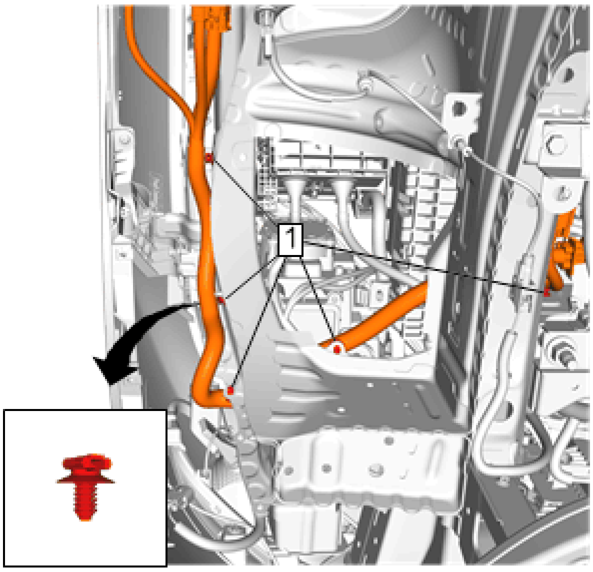


Fig. 211: Drive Motor Battery Positive and Negative Relay Cable Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Install Drive Motor Battery Positive and Negative Relay Cable Retainer
7. Install Battery Tray **Battery Tray Replacement**
8. Install Front Wheelhouse Liner **Front Wheelhouse Liner Replacement**
9. Enable the high voltage system. **High Voltage Enabling**

DRIVE MOTOR BATTERY CONTROL MODULE WIRING HARNESS REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
2. Remove the battery upper cover. **Battery Upper Cover Replacement**

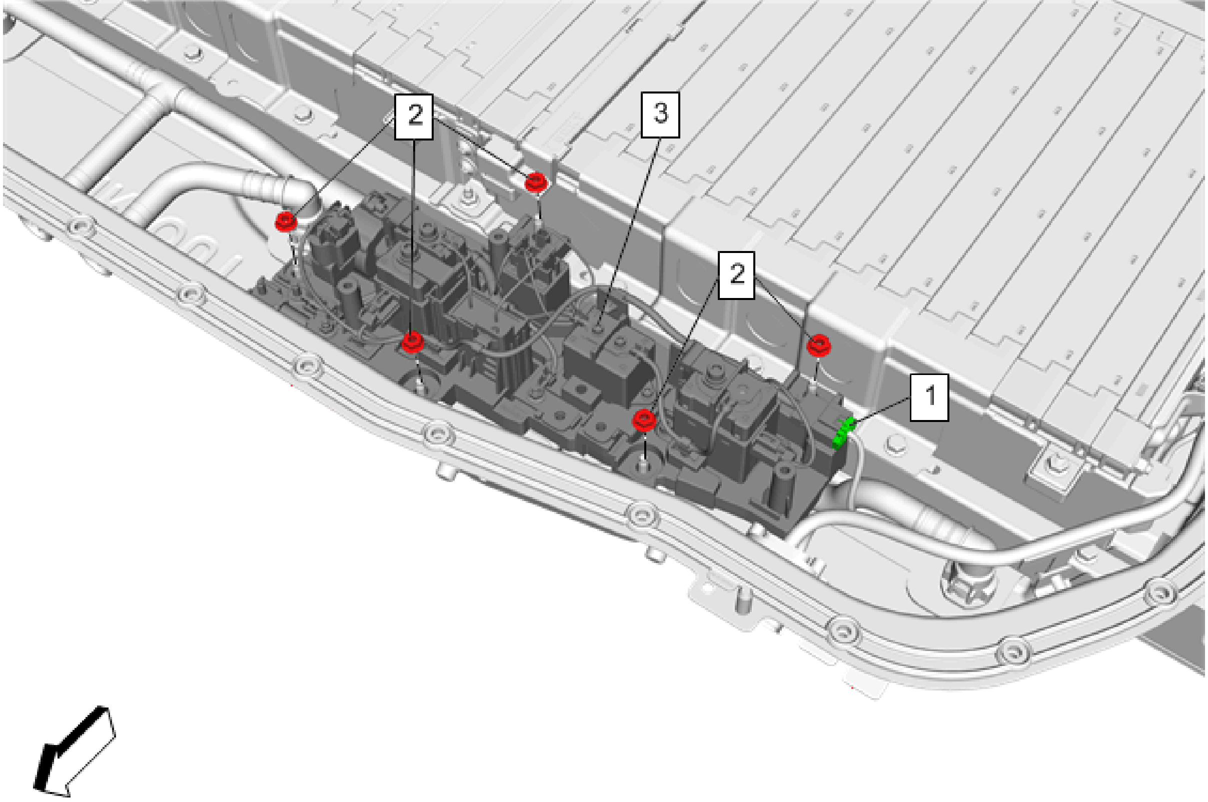


Fig. 212: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Remove High Voltage Battery Disconnect Relay (3)High Voltage Battery Disconnect Relay Replacement

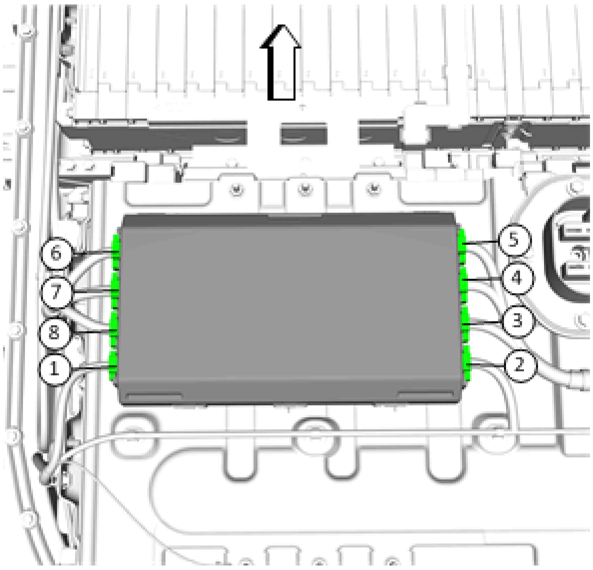


Fig. 213: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

4. Disconnect the battery energy control module connectors in the sequence shown.

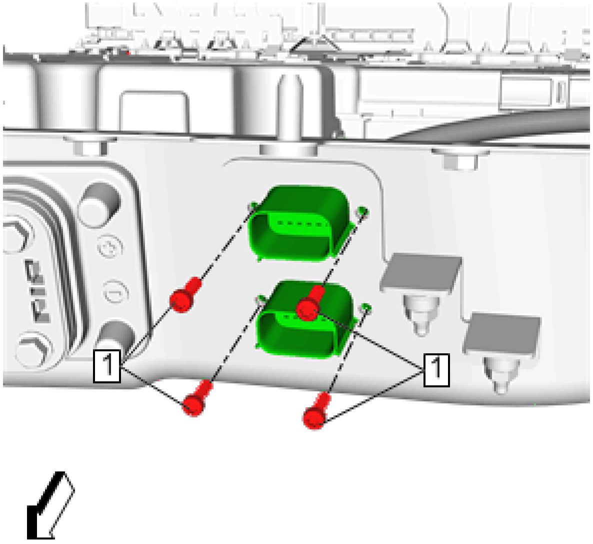


Fig. 214: Fasteners
Courtesy of GENERAL MOTORS COMPANY

5. Remove the fasteners (1)from the wiring harness connector.

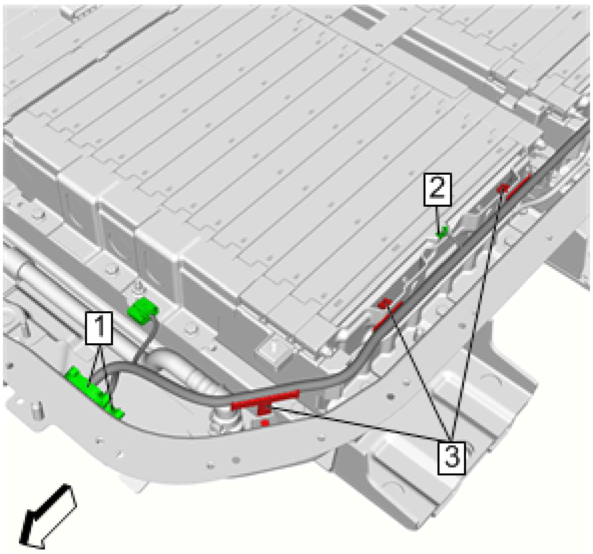


Fig. 215: Drive Motor Battery Control Module Wiring Harness Connectors
Courtesy of GENERAL MOTORS COMPANY

6. Remove the drive motor battery control module wiring harness connectors (1).
7. Remove the battery cell temperature sensor (2) from the battery section.
8. Detach the wiring harness retainers (3).

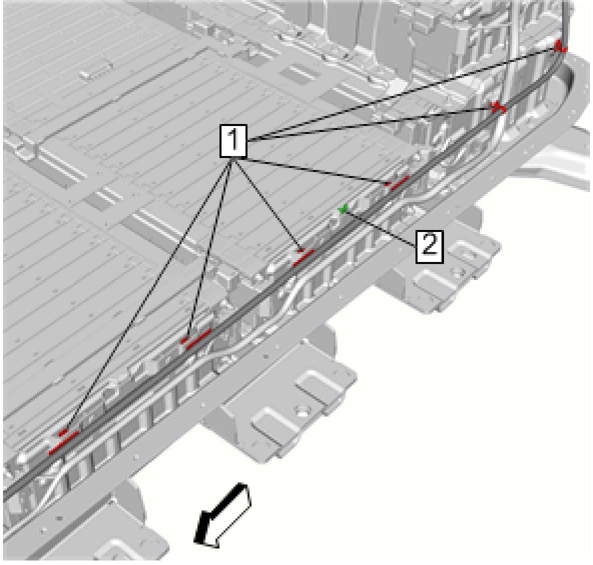


Fig. 216: Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

9. Detach the wiring harness retainers (1)
10. Remove the battery cell temperature sensor (2) from the battery section.

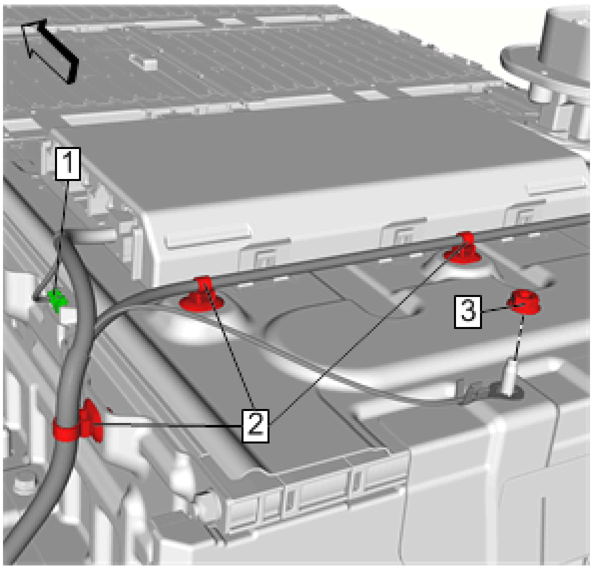


Fig. 217: Battery Cell Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

11. Remove the battery cell temperature sensor (1) from the battery section.
12. Detach the wiring harness retainers (2)
13. Remove the fastener (3) and the wiring harness ground terminal.

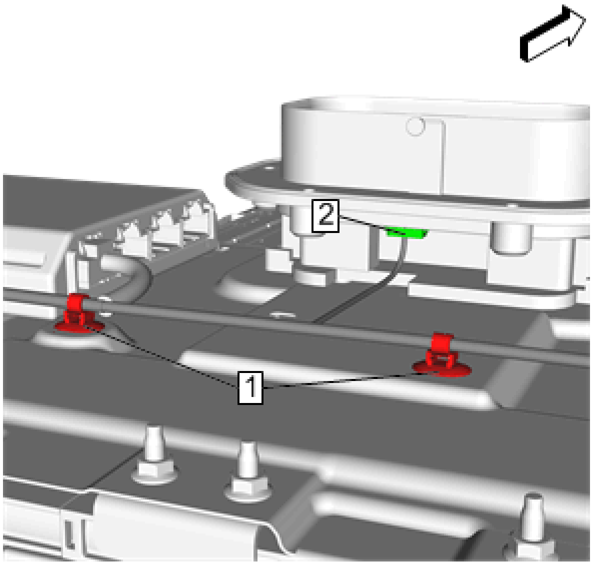


Fig. 218: Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

14. Detach the wiring harness retainers (1)
15. Disconnect the electrical connector (2) from the high voltage battery high voltage manual disconnect connector. Refer to the below step 16 and 17.

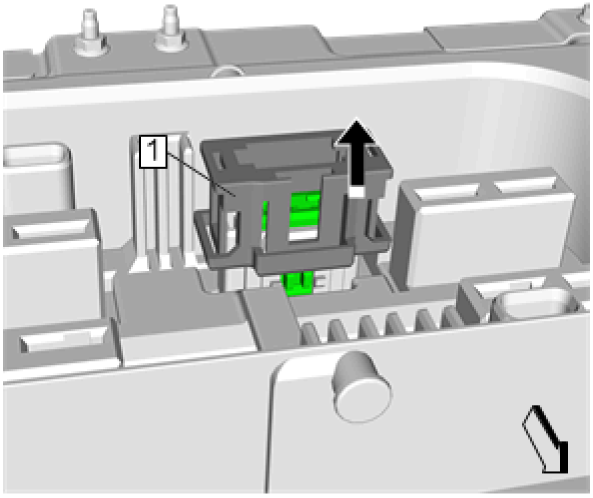


Fig. 219: Connector Guide
Courtesy of GENERAL MOTORS COMPANY

16. Slightly pick up the connector guide (1). Do not need to remove it completely.

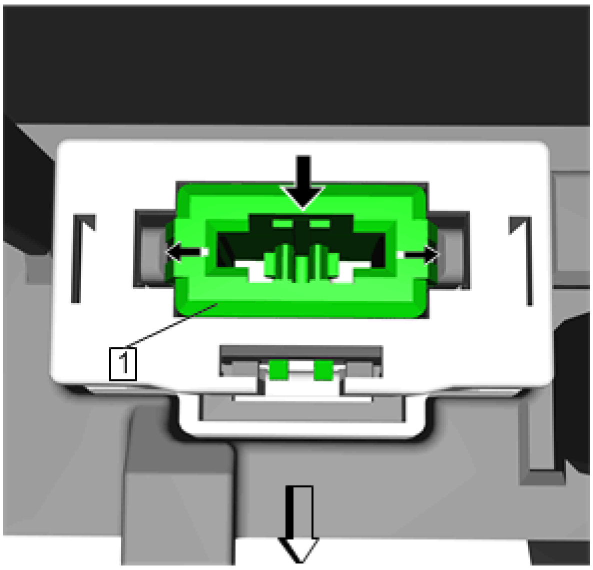


Fig. 220: Connector
Courtesy of GENERAL MOTORS COMPANY

17. While pushing the connector tabs to the side direction, push down the connector (1) and remove it.

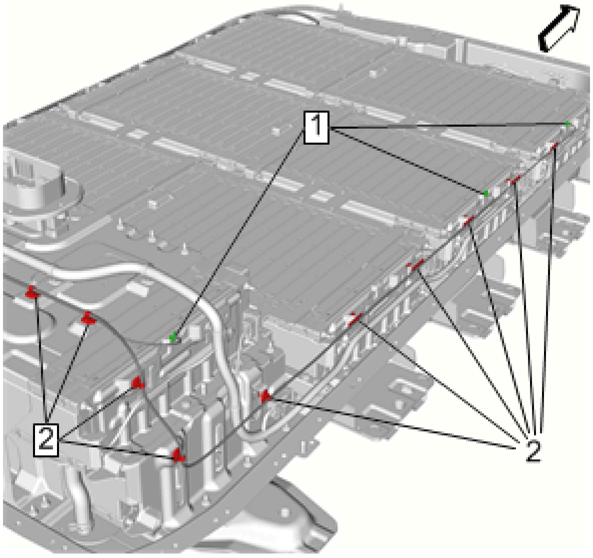


Fig. 221: Battery Cell Temperature Sensors
Courtesy of GENERAL MOTORS COMPANY

18. Remove the battery cell temperature sensors (1) from the battery sections.
19. Detach the wiring harness retainers (2).

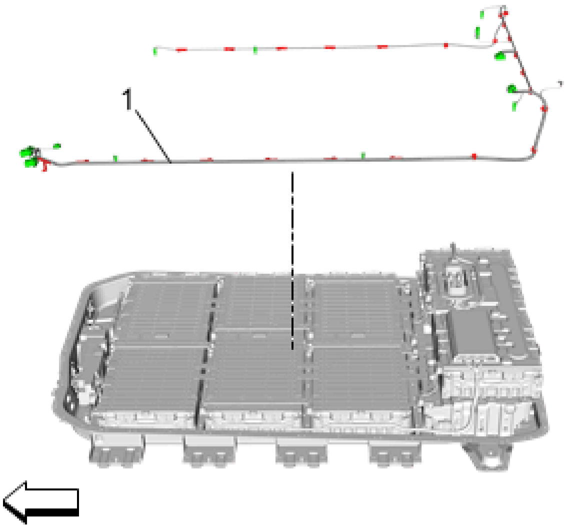


Fig. 222: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Note the routing of the harness within the drive motor battery.**

20. Remove the drive motor battery control module wiring harness (1) from the drive motor battery.

Installation Procedure

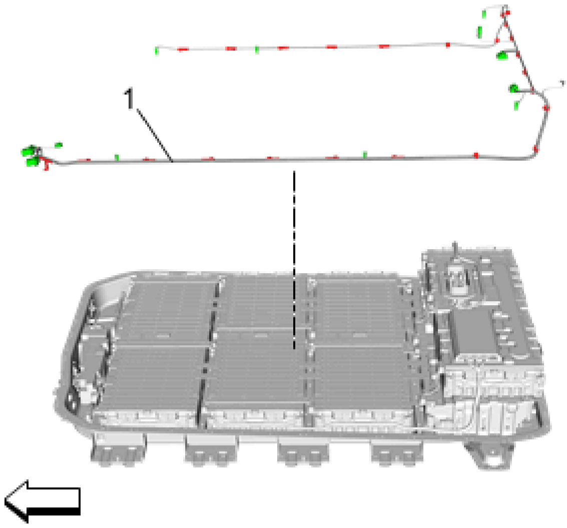


Fig. 223: Drive Motor Battery Control Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery control module wiring harness (1) to the drive motor battery.

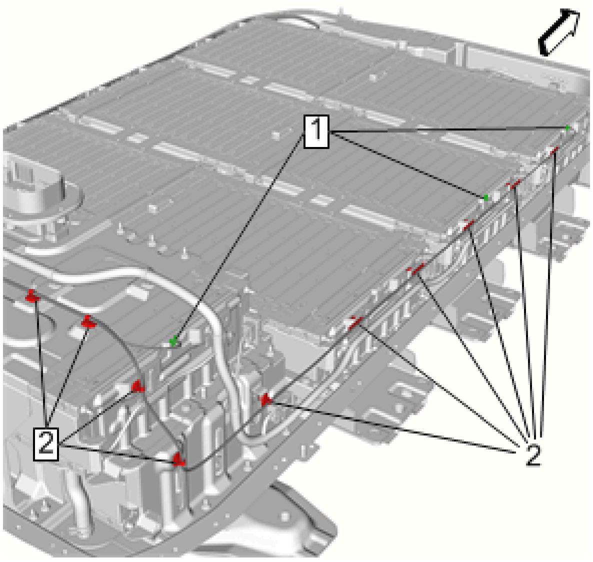


Fig. 224: Battery Cell Temperature Sensors
Courtesy of GENERAL MOTORS COMPANY

2. Install the battery cell temperature sensors (1) into the battery sections.
3. Attach the harness retainers (2) to the bracket.

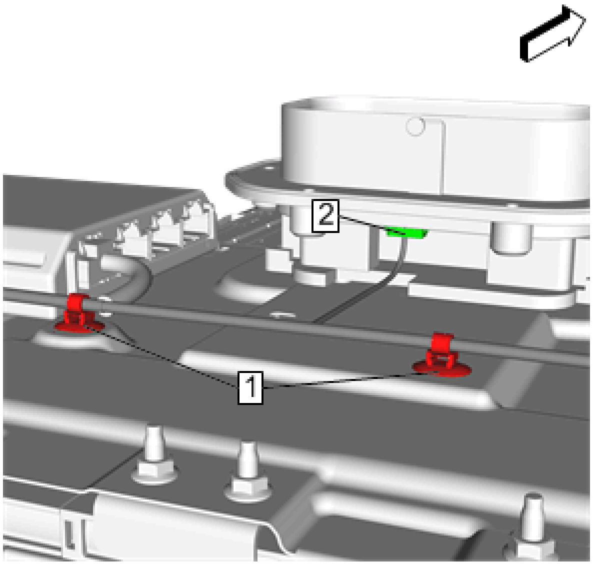


Fig. 225: Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Connect the electrical connector (2) to the high voltage battery high voltage manual disconnect connector.
5. Attach the harness retainers (1) to the bracket.

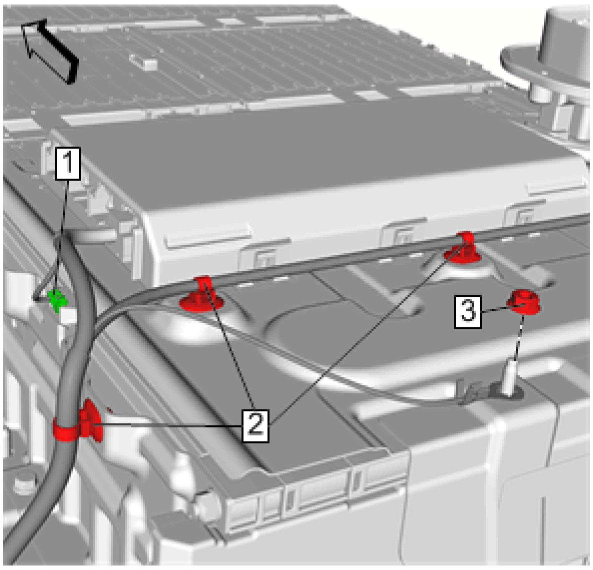


Fig. 226: Battery Cell Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

6. Tighten the drive motor battery control module wiring harness ground terminal nut (3) to 6 N.m (53 lb in).
7. Install the battery cell temperature sensor (1) into the battery section.
8. Attach the harness retainers (2).

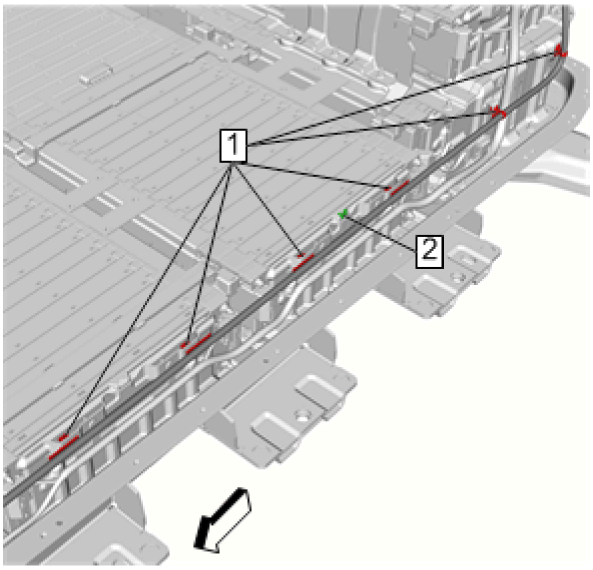


Fig. 227: Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

9. Install the battery cell temperature sensor (2) into the battery section.
10. Attach the harness retainers (1).

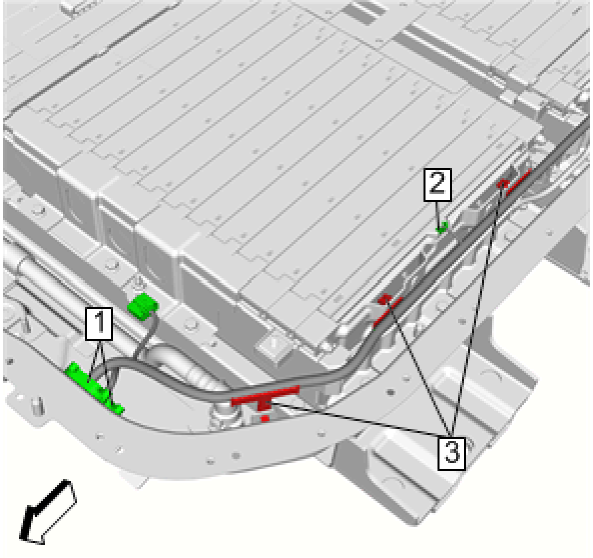


Fig. 228: Drive Motor Battery Control Module Wiring Harness Connectors
Courtesy of GENERAL MOTORS COMPANY

11. Install the drive motor battery control module wiring harness connectors (1)
12. Install the battery cell temperature sensor (2) into the battery section.
13. Attach the wiring harness retainers (3)

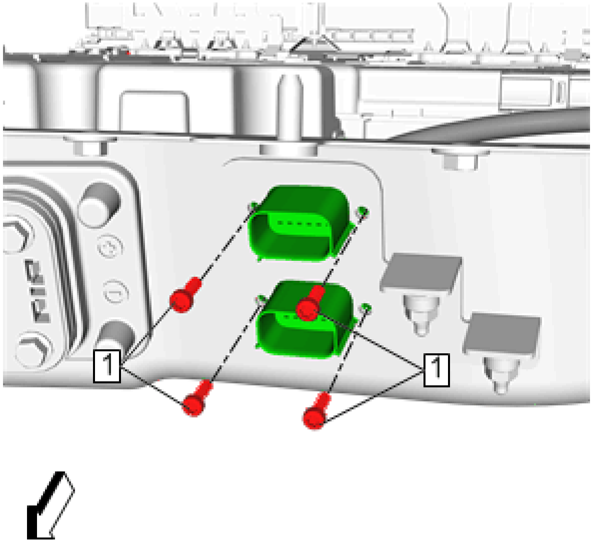


Fig. 229: Fasteners
Courtesy of GENERAL MOTORS COMPANY

14. Tighten the fasteners (1) to the wiring harness connectors to 1.7 N.m (15 lb in).

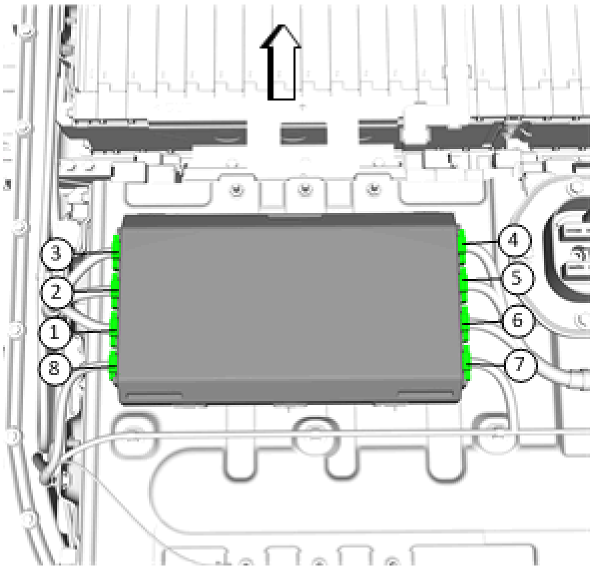


Fig. 230: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

15. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.

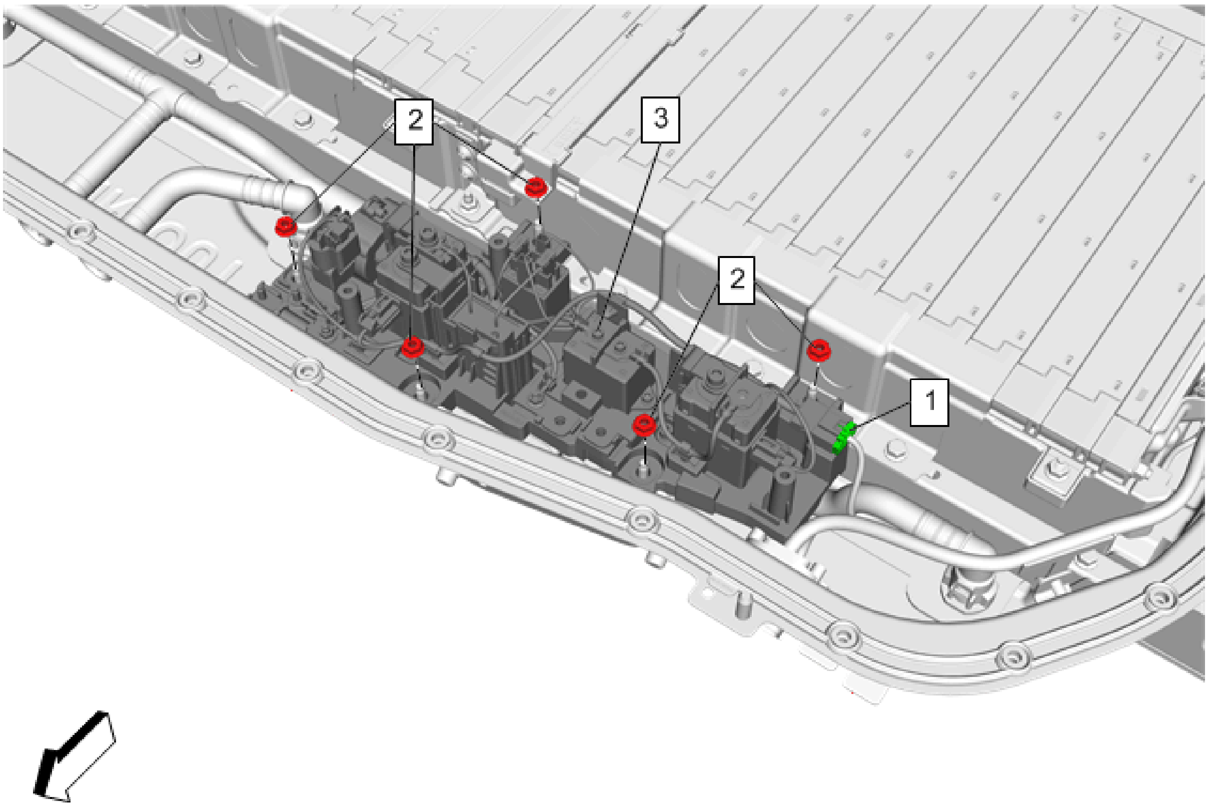


Fig. 231: High Voltage Battery Disconnect Relay Assembly
Courtesy of GENERAL MOTORS COMPANY

16. Install High Voltage Battery Disconnect Relay (3) High Voltage Battery Disconnect Relay Replacement
17. Install the battery upper cover. Battery Upper Cover Replacement
18. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (LEFT)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to**

servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

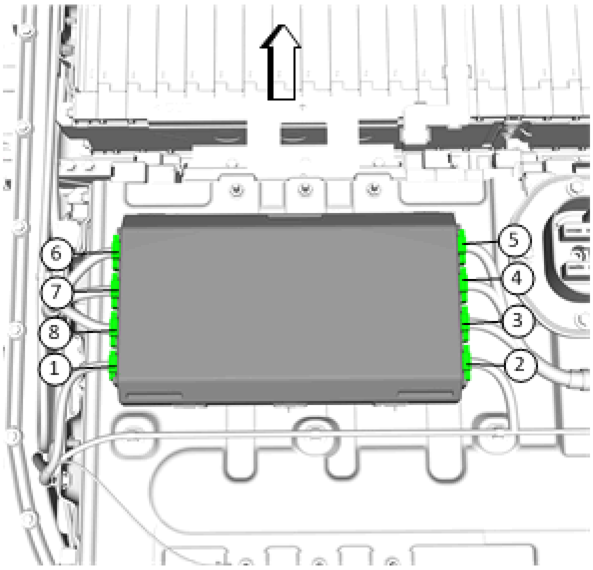


Fig. 232: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery**

section connector.

2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

3. Disconnect the battery energy control module connectors in the sequence shown.

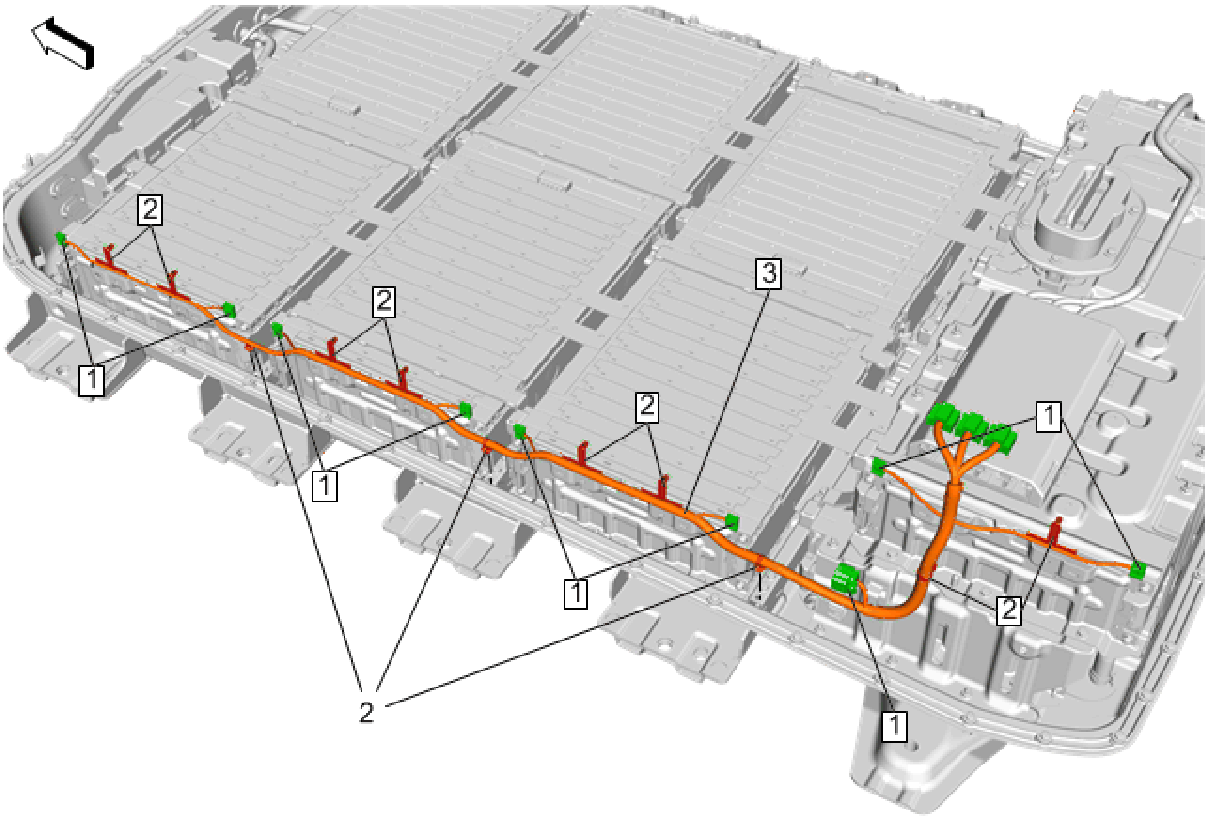


Fig. 233: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connectors (1)
5. Detach the wiring harness retainers (2)
6. Remove the drive motor battery sensor module wiring harness (3).

Installation Procedure

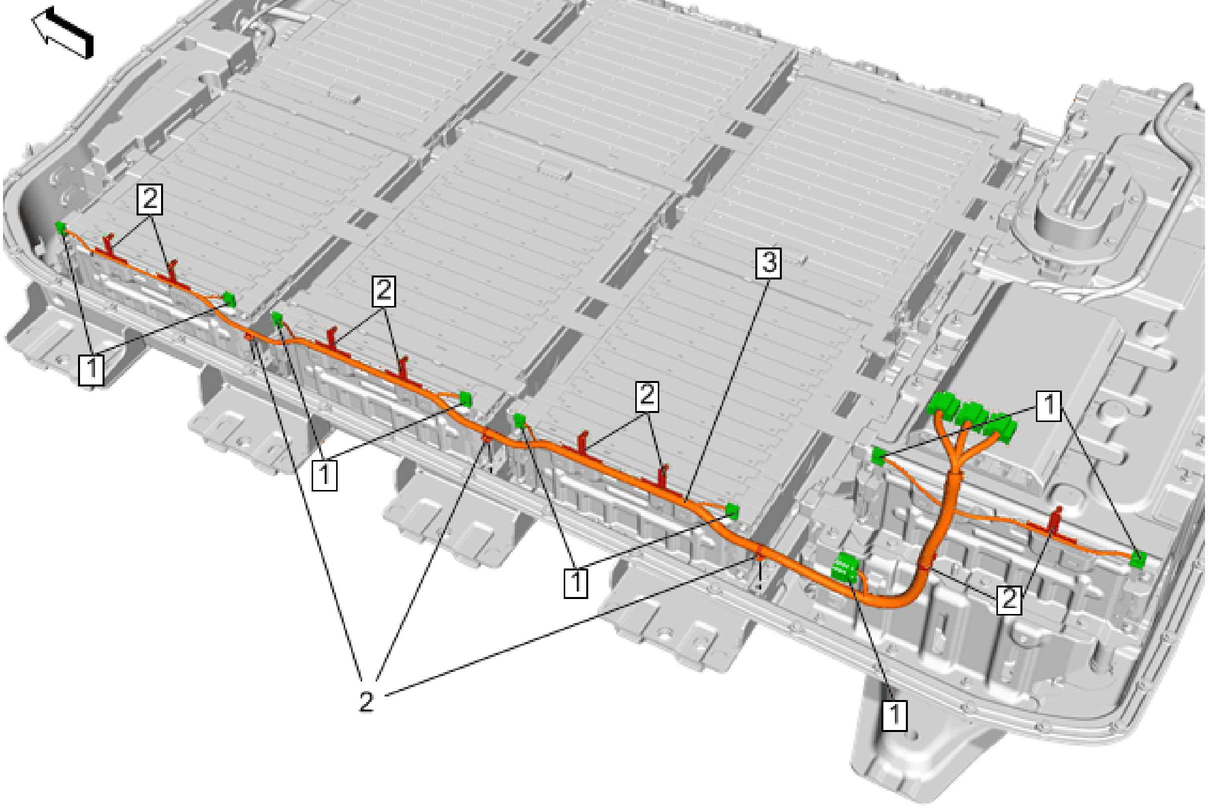


Fig. 234: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery sensor module wiring harness (3).
2. Attach the wiring harness retainers (2)
3. Connect the electrical connectors (1)

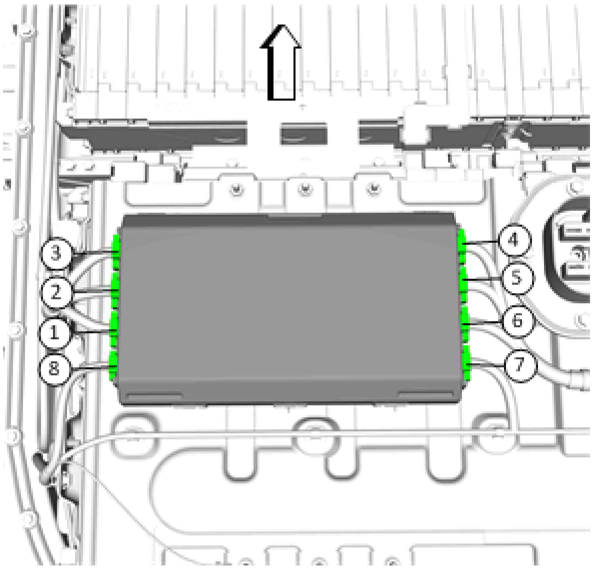


Fig. 235: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**

3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

4. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.
5. Install the battery upper cover. Battery Upper Cover Replacement
6. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (RIGHT)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

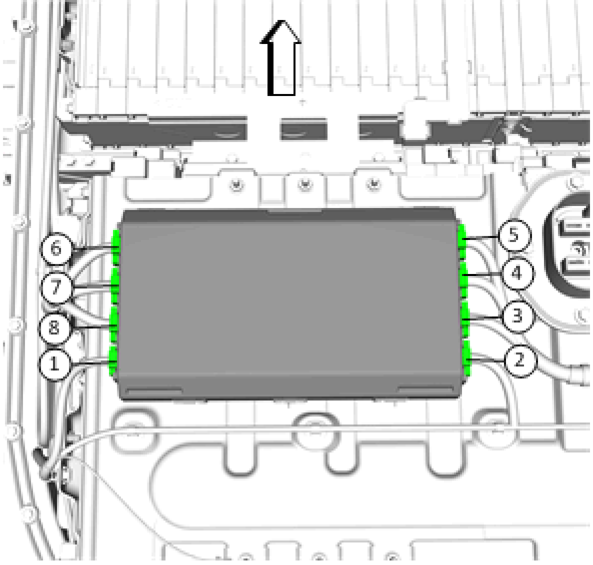


Fig. 236: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

3. Disconnect the battery energy control module connectors in the sequence shown.

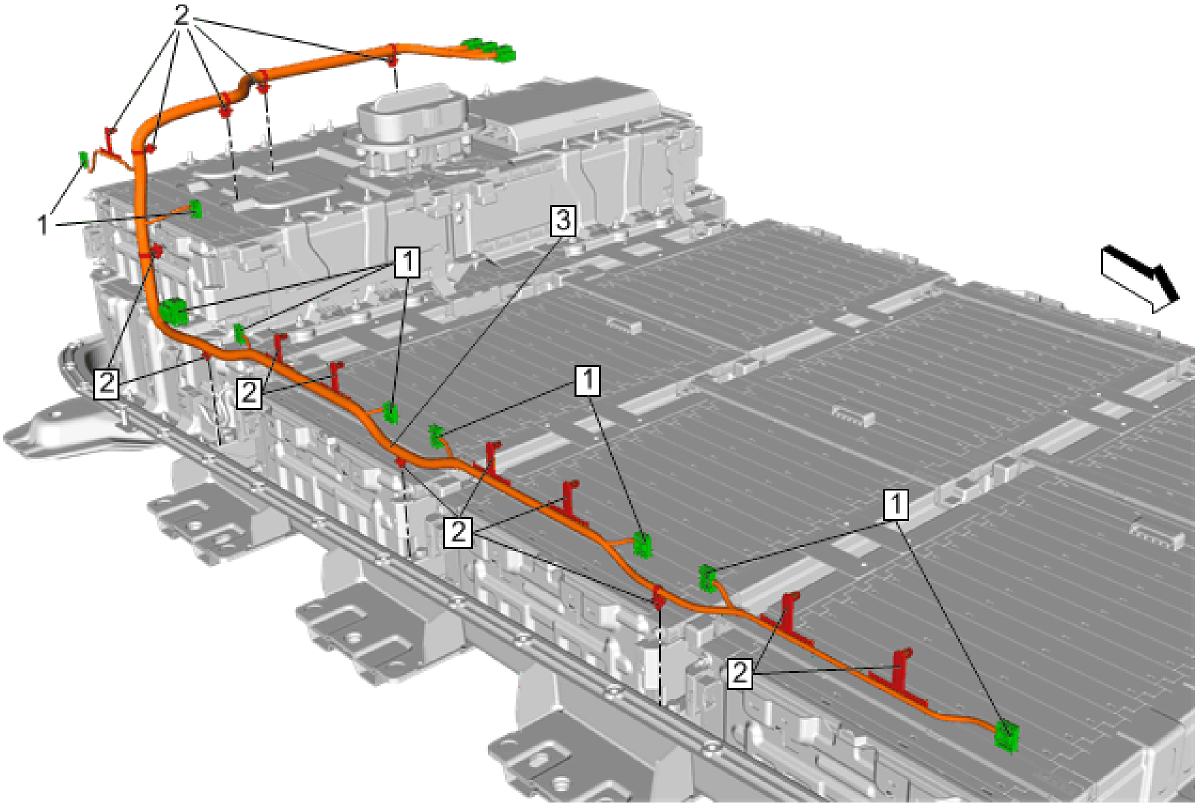


Fig. 237: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connectors (1)
5. Detach the wiring harness retainers (2)
6. Remove the drive motor battery sensor module wiring harness (3).

Installation Procedure

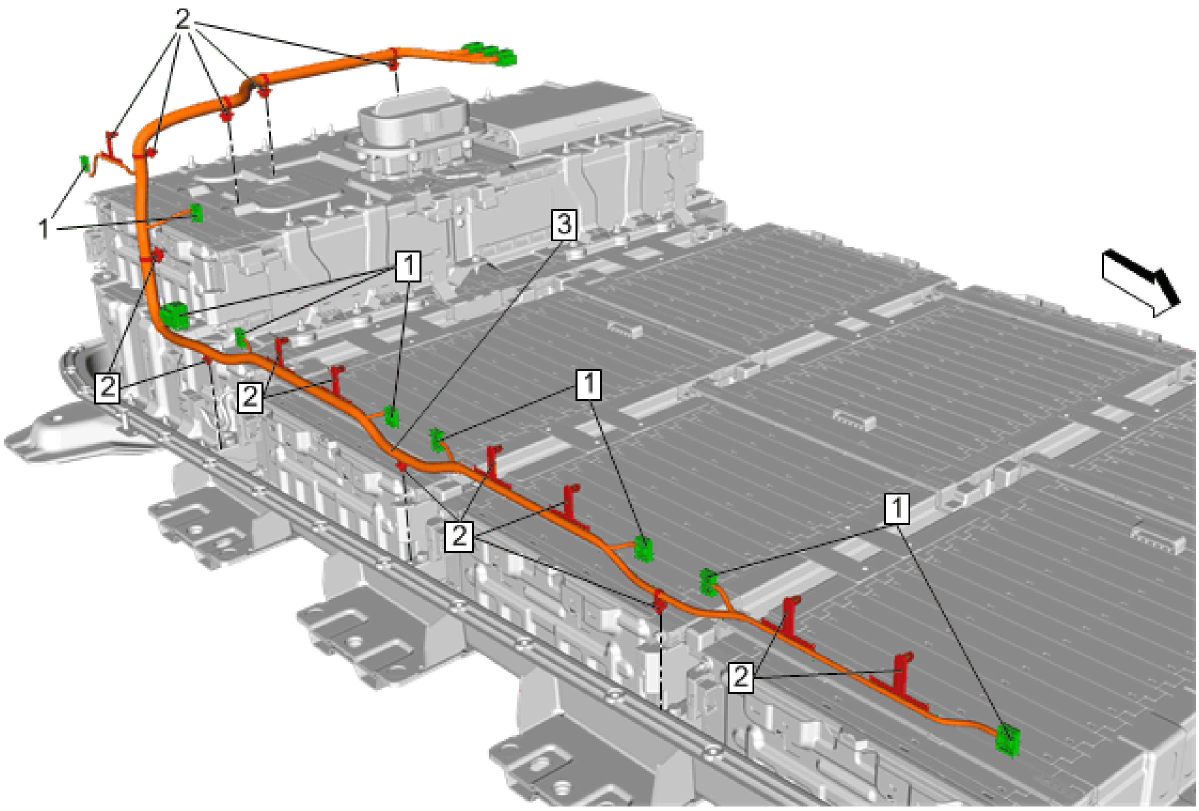


Fig. 238: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor battery sensor module wiring harness (3).
2. Attach the wiring harness retainers (2)
3. Connect the electrical connectors (1)

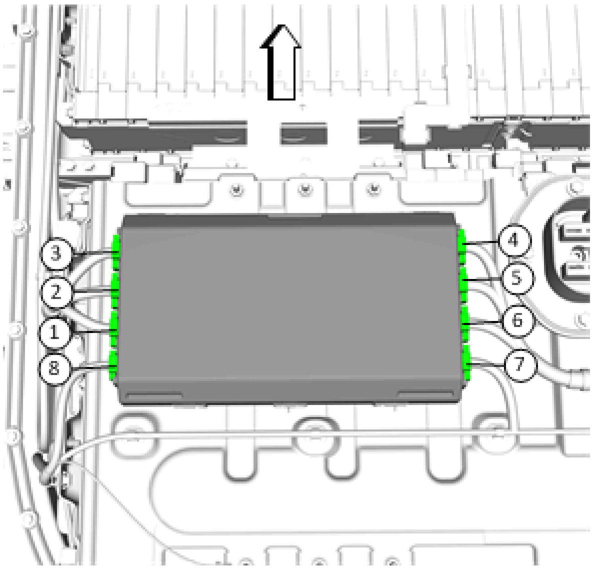


Fig. 239: Battery Energy Control Module Connectors In Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

4. Connect the battery energy control module connectors in the sequence shown to the battery energy control module.
5. Install the battery upper cover. Battery Upper Cover Replacement
6. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (LH, SUB)

Special Tools

- **BO-38185** Hose Clamp Pliers

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

2. Remove the battery upper cover. Battery Upper Cover Replacement

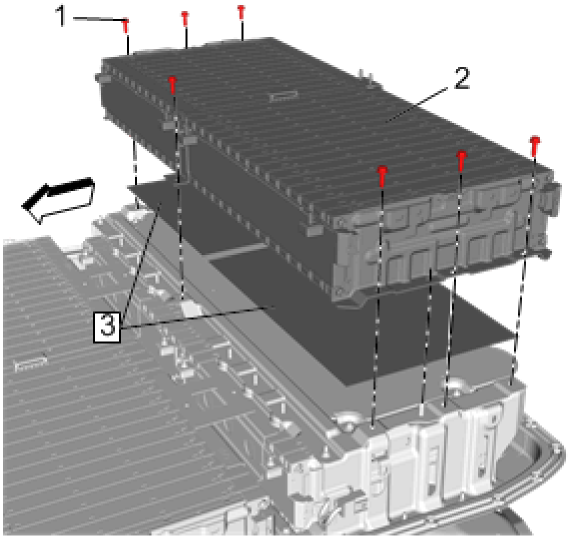


Fig. 240: Cell Battery Module
Courtesy of GENERAL MOTORS COMPANY

3. Remove row 5 cell battery module (2). Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 2)Cell Battery Module Replacement (Row 3)Cell Battery Module Replacement (Row 4)Cell Battery Module Replacement (Row 5)

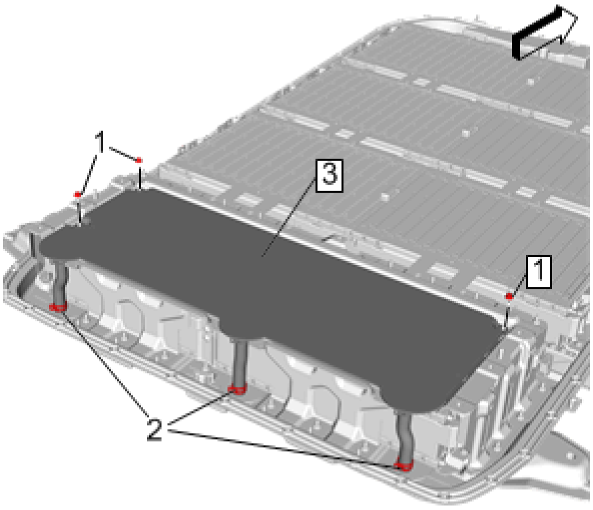


Fig. 241: Cell Battery Cooling Plate Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the cell battery cooling plate securing nuts (1).
5. Reposition the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
6. Remove the cell battery cooling plate (3).

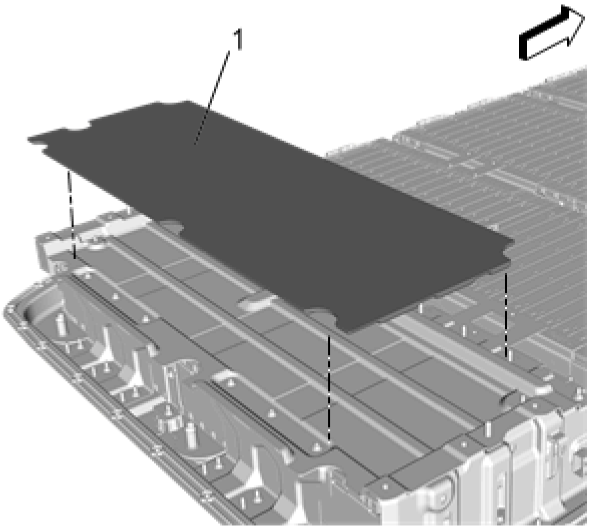


Fig. 242: Insulation Pad
Courtesy of GENERAL MOTORS COMPANY

7. Remove the insulation pad (1).

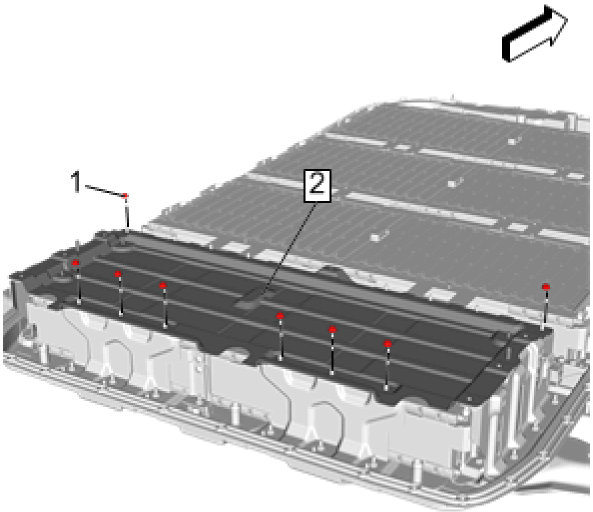


Fig. 243: Cell Battery Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery securing nuts (1) and the cell battery upper panel (2).

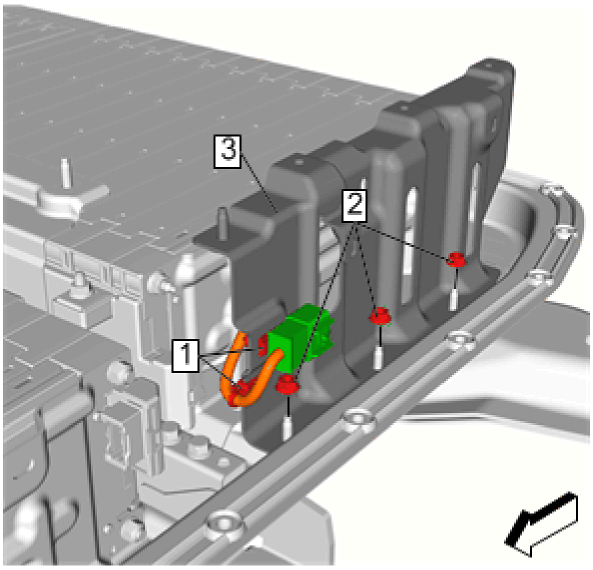


Fig. 244: Cell Battery Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

9. Detach the left subordinate drive motor sensor module wiring harness retainers (1).
10. Remove the cell battery securing nuts (2).
11. Remove the drive motor battery rear left side panel (3).

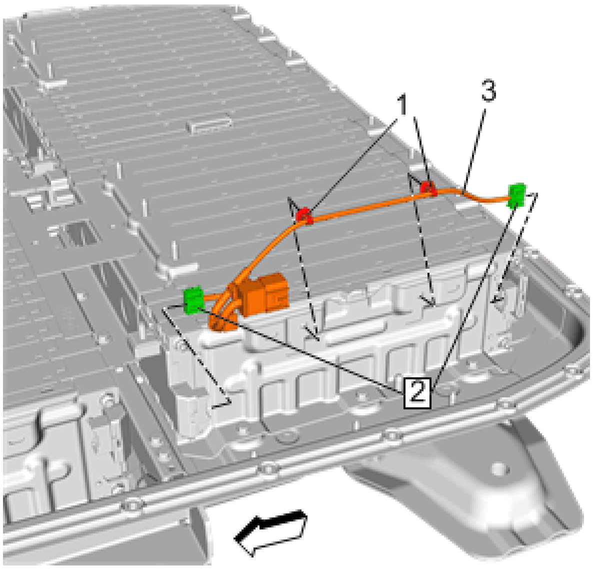


Fig. 245: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Detach the wiring harness retainers (1).
13. Disconnect the electrical connectors (2).
14. Remove the left subordinate drive motor sensor module wiring harness (3).

Installation Procedure

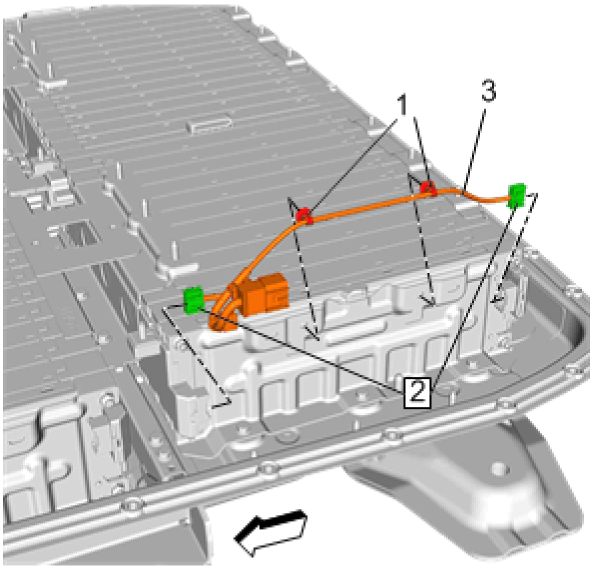


Fig. 246: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the left subordinate drive motor sensor module wiring harness (3).
2. Connect the electrical connectors (2)
3. Attach the wiring harness retainers (1)

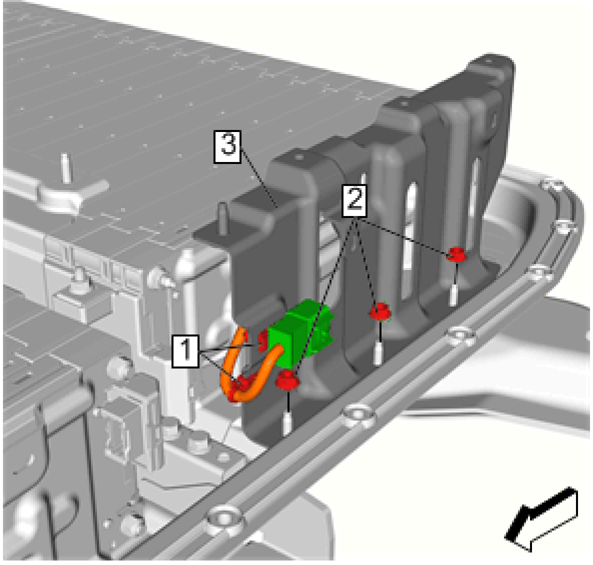


Fig. 247: Cell Battery Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Install the drive motor battery rear left side panel (3).
5. Tighten the cell battery securing nuts (2) 9 N.m (80 lb in).
6. Attach the left subordinate drive motor sensor module wiring harness retainers (1).

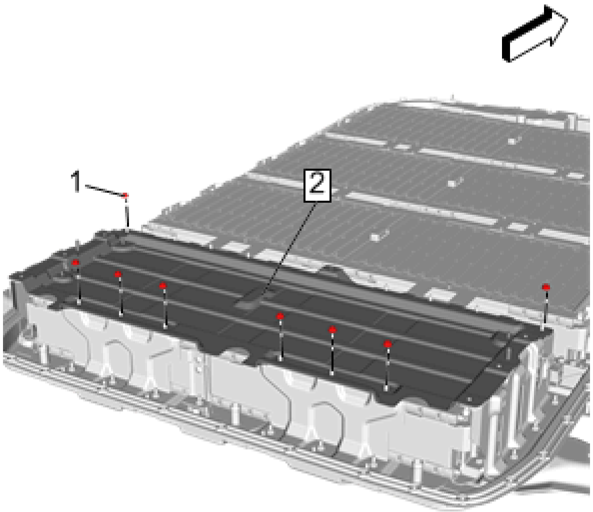
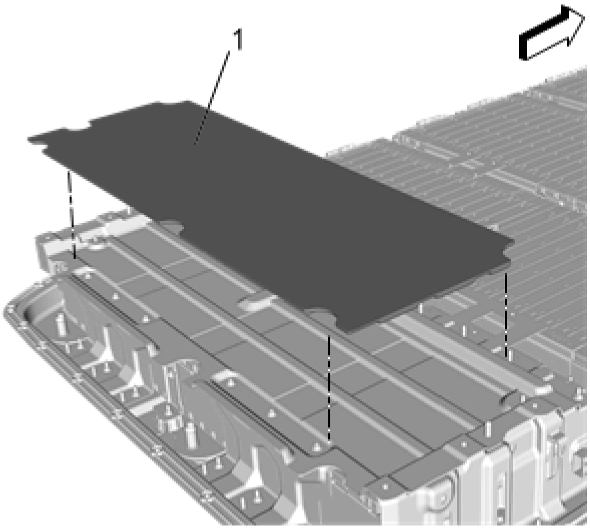


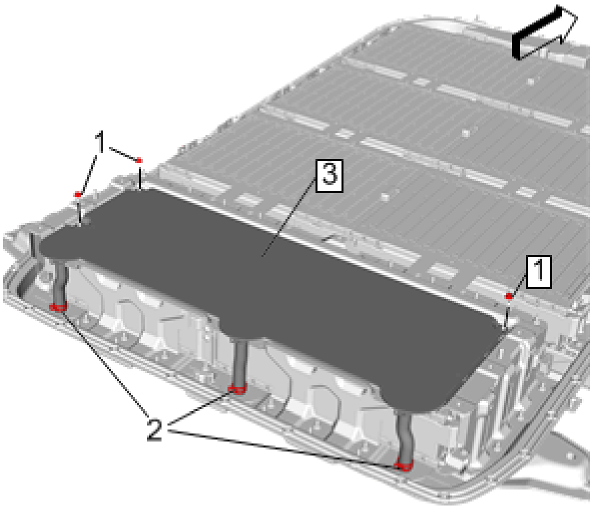
Fig. 248: Cell Battery Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Install the cell battery securing nuts (1) and the cell battery upper panel (2). Tighten the fasteners (1) to 9 N.m (80 lb in).



[Fig. 249: Insulation Pad]
Courtesy of GENERAL MOTORS COMPANY

8. Install the insulation pad (1).



[Fig. 250: Cell Battery Cooling Plate Securing Nuts]
Courtesy of GENERAL MOTORS COMPANY

9. Install the cell battery cooling plate (3).
10. Position the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
11. Tighten the cell battery cooling plate securing nuts (1) 9 N.m (80 lb in).

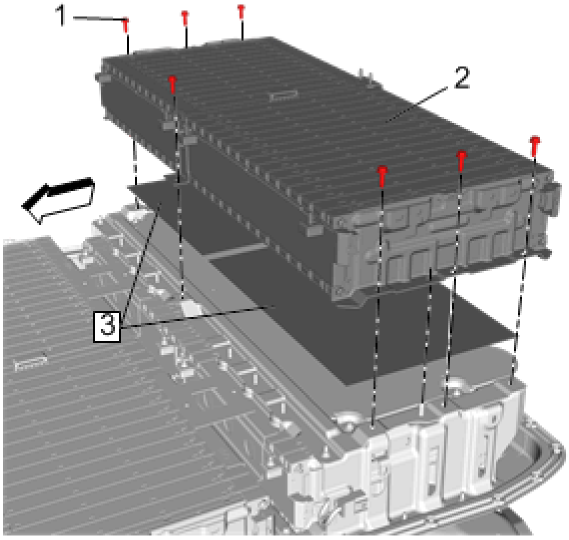


Fig. 251: Cell Battery Module
Courtesy of GENERAL MOTORS COMPANY

12. Install row 5 cell battery module (2). Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 2)Cell Battery Module Replacement (Row 3)Cell Battery Module Replacement (Row 4)Cell Battery Module Replacement (Row 5)
13. Perform the hybrid battery pack coolant passage leak test. Hybrid Battery Pack Coolant Passage Leak Test
14. Perform the cell battery balancing if replaced. Hybrid/EV Battery Cell Balancing
15. Install the battery upper cover. Battery Upper Cover Replacement
16. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

DRIVE MOTOR BATTERY SENSOR MODULE WIRING HARNESS REPLACEMENT (RH, SUB)

Special Tools

- **BO-38185** Hose Clamp Pliers

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Remove the battery upper cover. Battery Upper Cover Replacement

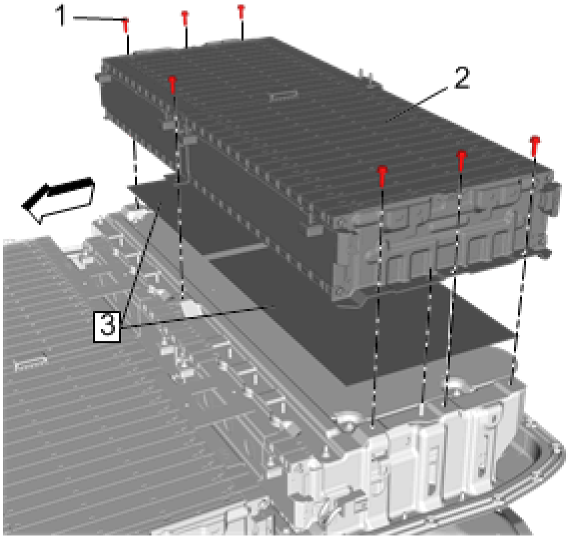


Fig. 252: Cell Battery Module
Courtesy of GENERAL MOTORS COMPANY

3. Remove row 5 cell battery module (2). Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 2)Cell Battery Module Replacement (Row 3)Cell Battery Module Replacement (Row 4)Cell Battery Module Replacement (Row 5)

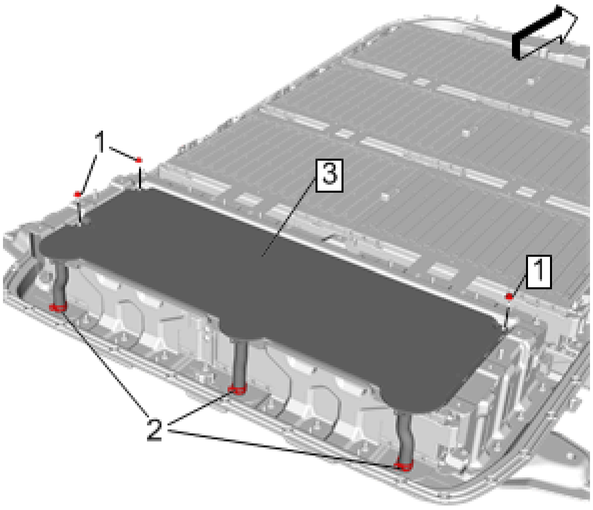
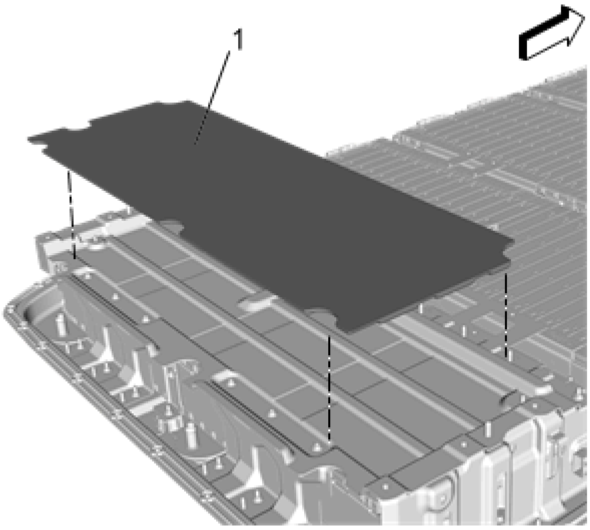


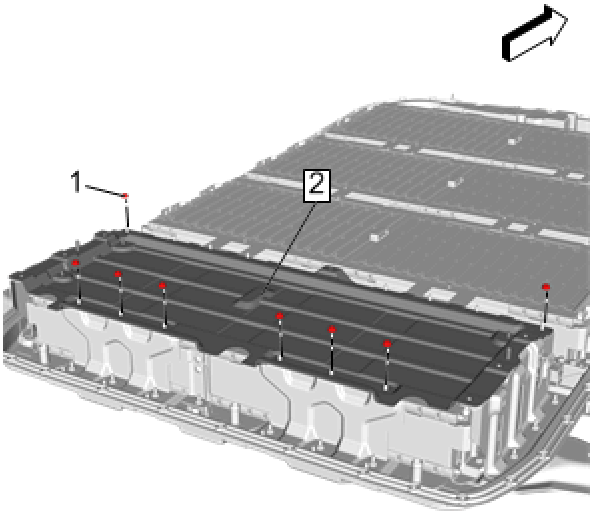
Fig. 253: Cell Battery Cooling Plate Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the cell battery cooling plate securing nuts (1)
5. Reposition the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
6. Remove the cell battery cooling plate (3).



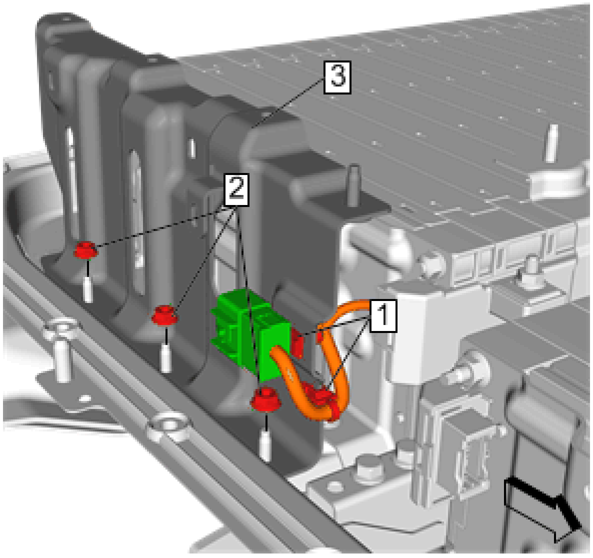
[Fig. 254: Insulation Pad](#)
Courtesy of GENERAL MOTORS COMPANY

7. Remove the insulation pad (1).



[Fig. 255: Cell Battery Securing Nuts](#)
Courtesy of GENERAL MOTORS COMPANY

8. Remove the cell battery securing nuts (1) and the cell battery upper panel (2).



[Fig. 256: Right Subordinate Drive Motor Sensor Module Wiring Harness Retainers](#)
Courtesy of GENERAL MOTORS COMPANY

9. Detach the right subordinate drive motor sensor module wiring harness retainers (1)
10. Remove the cell battery securing nuts (2)
11. Remove the drive motor battery rear right side panel (3).

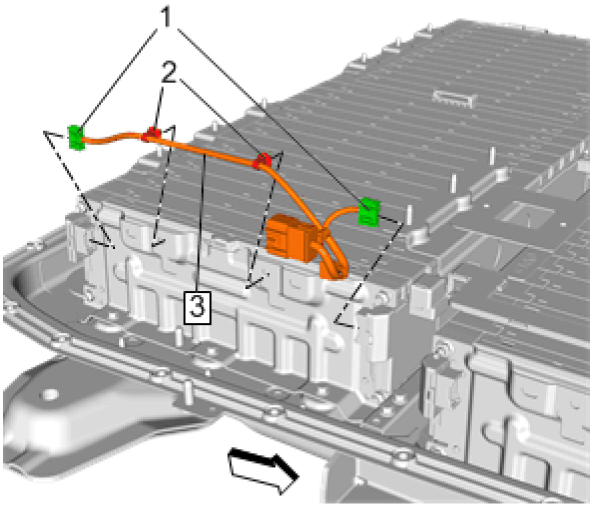


Fig. 257: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

12. Detach the wiring harness retainers (2)
13. Disconnect the electrical connectors (1)
14. Remove the left subordinate drive motor sensor module wiring harness (3).

Installation Procedure

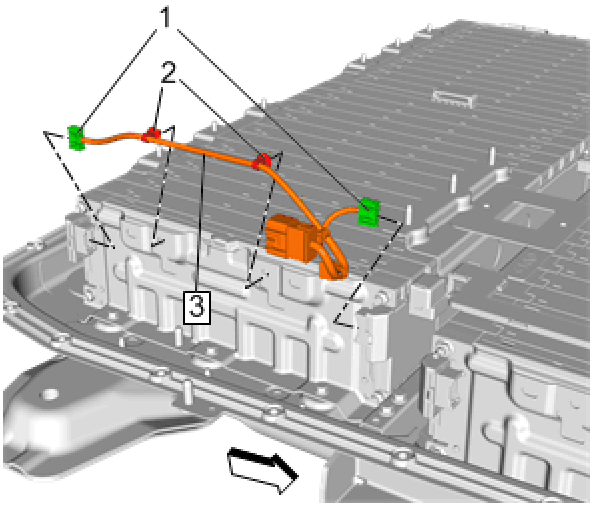


Fig. 258: Drive Motor Battery Sensor Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

1. Install the right subordinate drive motor sensor module wiring harness (3).
2. Connect the electrical connectors (1)
3. Attach the wiring harness retainers (2)

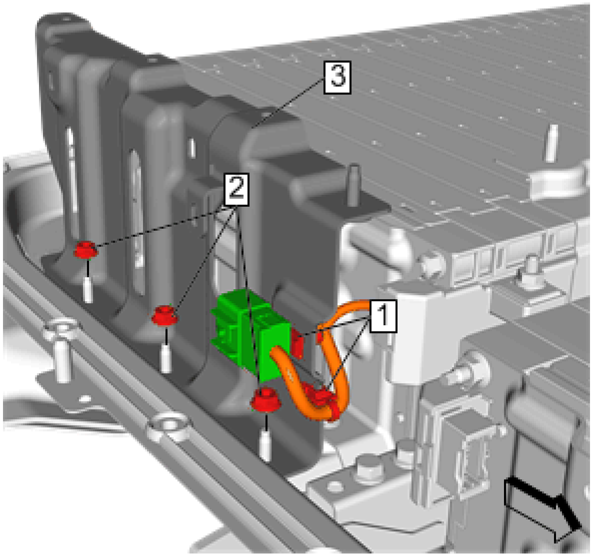


Fig. 259: Right Subordinate Drive Motor Sensor Module Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Install the drive motor battery rear left side panel (3).
5. Tighten the cell battery securing nuts (2) 9 N.m (80 lb in).
6. Attach the right subordinate drive motor sensor module wiring harness retainers (1)

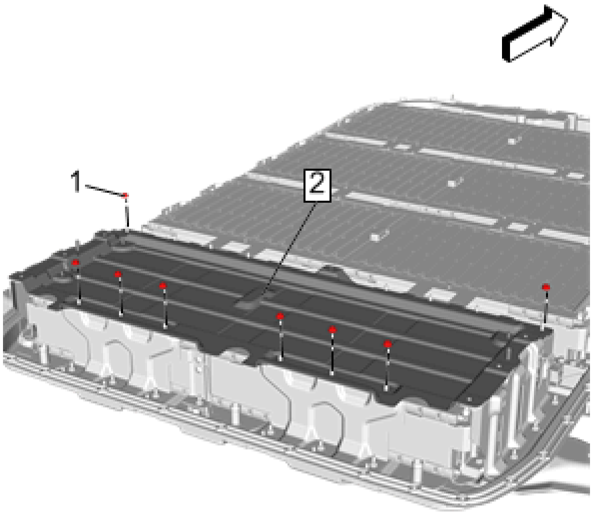


Fig. 260: Cell Battery Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

7. Install the cell battery securing nuts (1) and the cell battery upper panel (2). Tighten the fasteners (1) to 9 N.m (80 lb in).

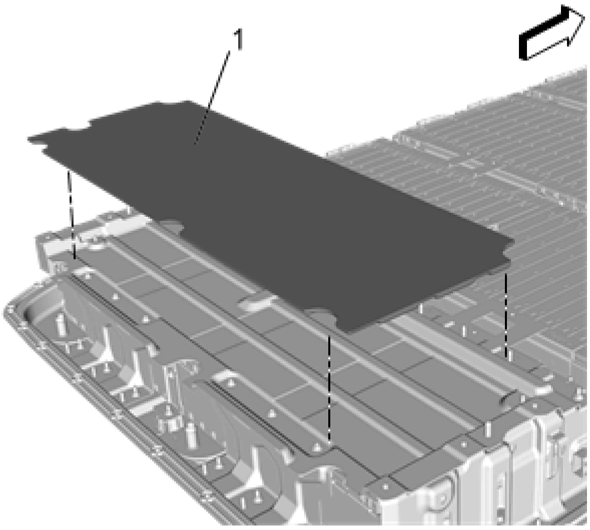


Fig. 261: Insulation Pad
Courtesy of GENERAL MOTORS COMPANY

8. Install the insulation pad (1).

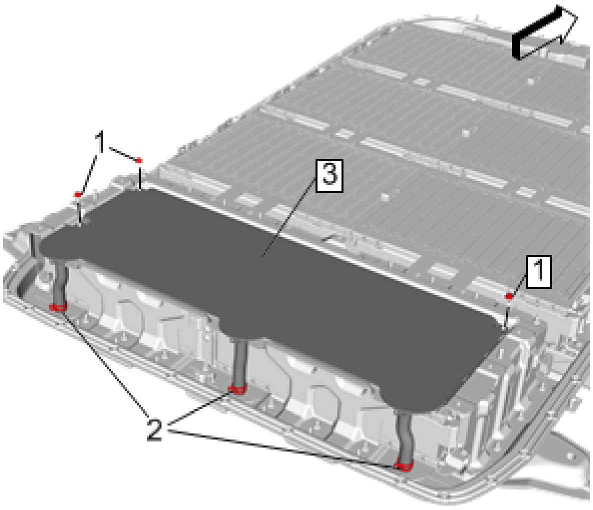


Fig. 262: Cell Battery Cooling Plate Securing Nuts
Courtesy of GENERAL MOTORS COMPANY

9. Install the cell battery cooling plate (3).
10. Position the cell battery cooling hose clamps (2), using **BO-38185** hose clamp pliers.
11. Tighten the cell battery cooling plate securing nuts (1) 9 N.m (80 lb in).

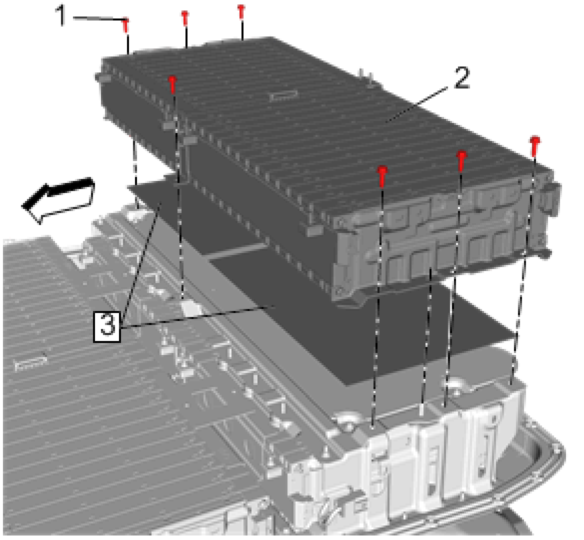


Fig. 263: Cell Battery Module
Courtesy of GENERAL MOTORS COMPANY

12. Install row 5 cell battery module (2). Cell Battery Module Replacement (Row 1)Cell Battery Module Replacement (Row 2)Cell Battery Module Replacement (Row 3)Cell Battery Module Replacement (Row 4)Cell Battery Module Replacement (Row 5)
13. Perform the hybrid battery pack coolant passage leak test. Hybrid Battery Pack Coolant Passage Leak Test
14. Perform the cell battery balancing if replaced. Hybrid/EV Battery Cell Balancing
15. Install the battery upper cover. Battery Upper Cover Replacement
16. Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY POSITIVE CABLE EXTENSION CABLE REPLACEMENT

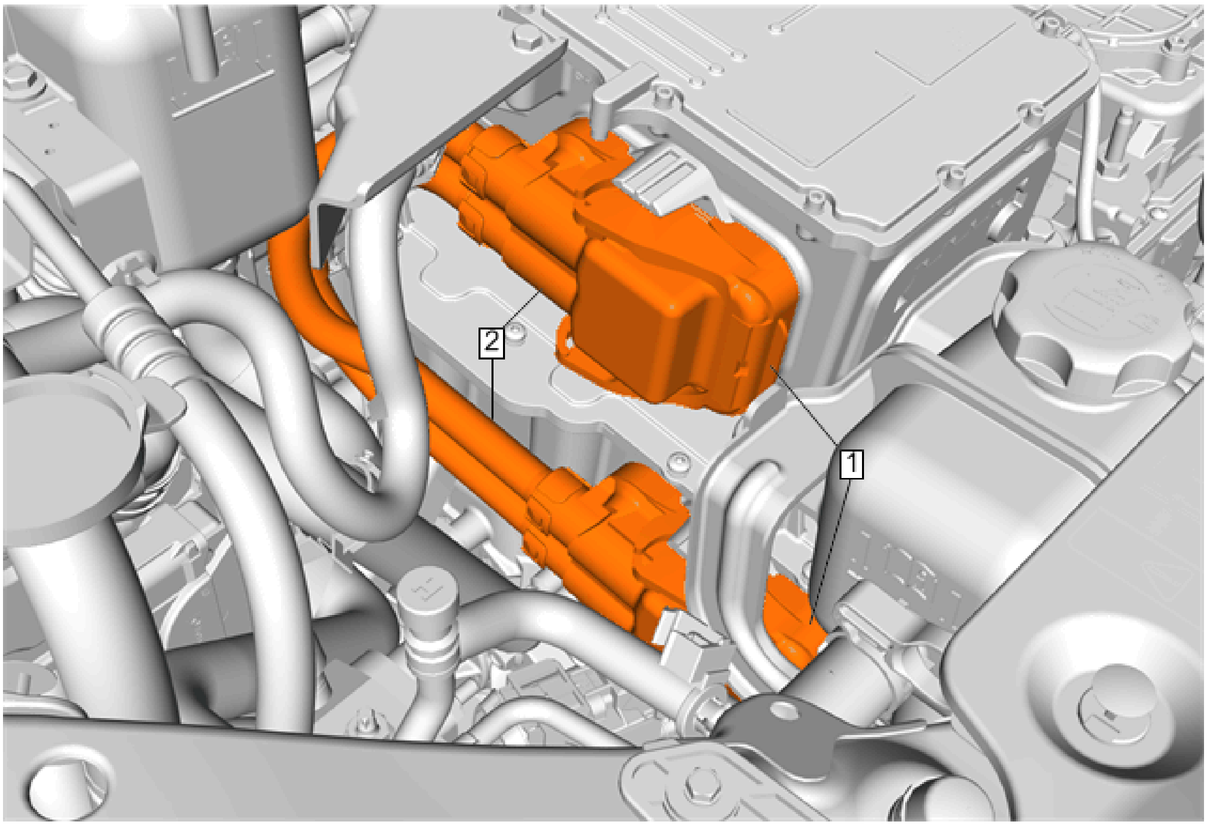


Fig. 264: Battery Positive Cable Extension Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

	WARNING:
	Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
	WARNING:
	Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
	• **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
	• **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
	  • **Visually and functionally inspect the gloves before use.**
	  • **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
	Failure to follow the procedure exactly as written may result in serious injury or death.
	Preliminary Procedures
	1. Disable the high voltage system. High Voltage Disabling

1	Battery Positive Cable Extension Cable Connector **Procedure** Insert Small, flat bladed tool, release tab and lift to disengage
2	Battery Positive Cable Extension Cable

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 3 TO CELL BATTERY MODULE 4)

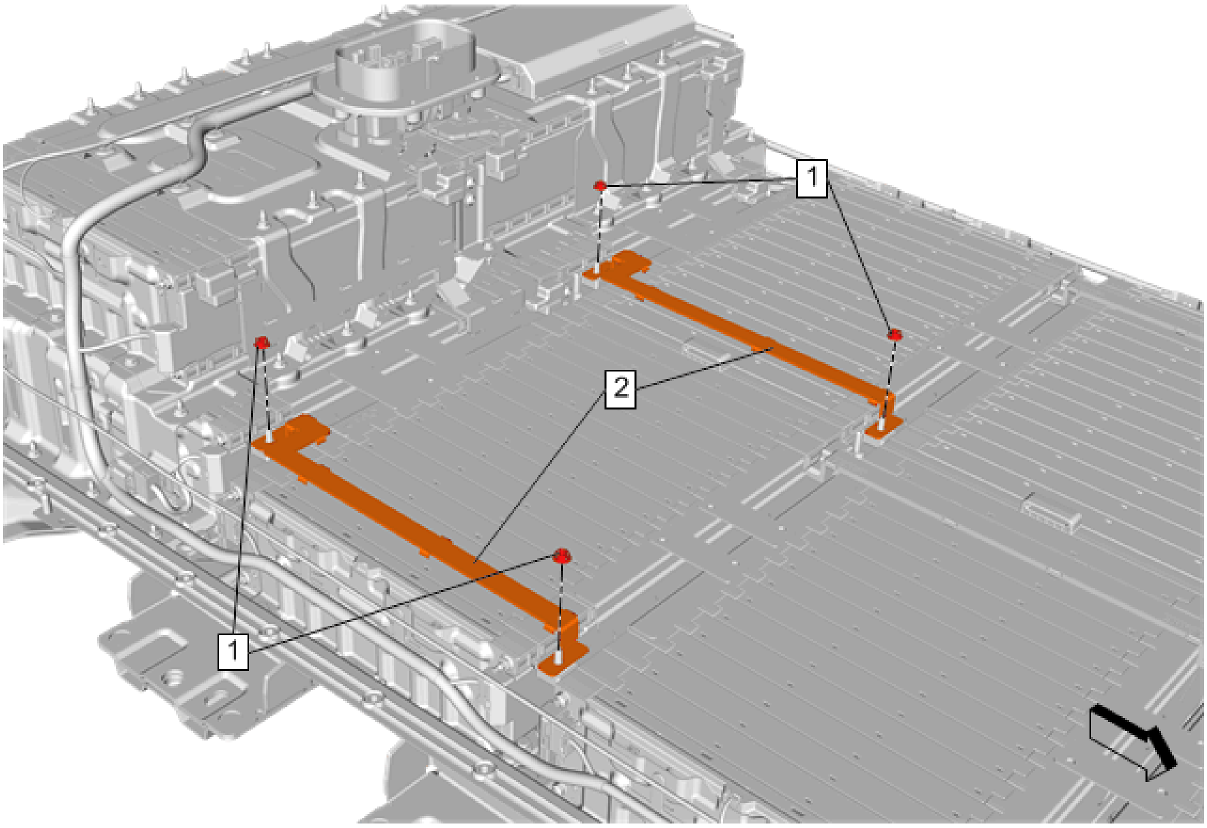


Fig. 265: Battery Cable (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

WARNING:
Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
WARNING:
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
Failure to follow the procedure exactly as written may result in serious injury or death.
Preliminary Procedures
1. Remove the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
2. **Battery Upper Cover Replacement**	

1	Battery Cable Nut (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **NOTE:** **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.** **Procedure** 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 3 to Cell Battery Module 4) (Qty: 2) **Procedure** Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 4 TO CELL BATTERY MODULE 5, LH)

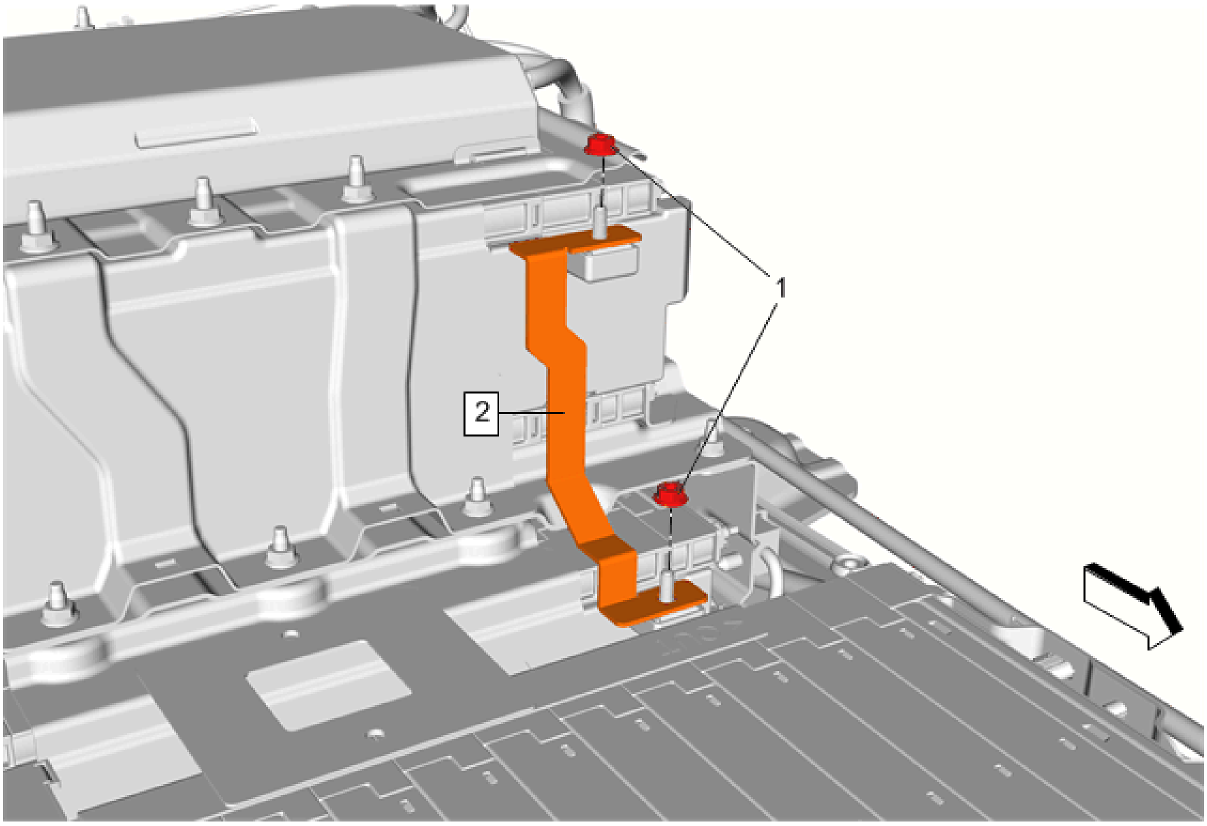


Fig. 266: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedures

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Battery Upper Cover Replacement

Callout	Component Name
1	Battery Cable Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **NOTE:** **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.** **Procedure** 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, LH) **Procedure** Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 4 TO CELL BATTERY MODULE 5, RH)

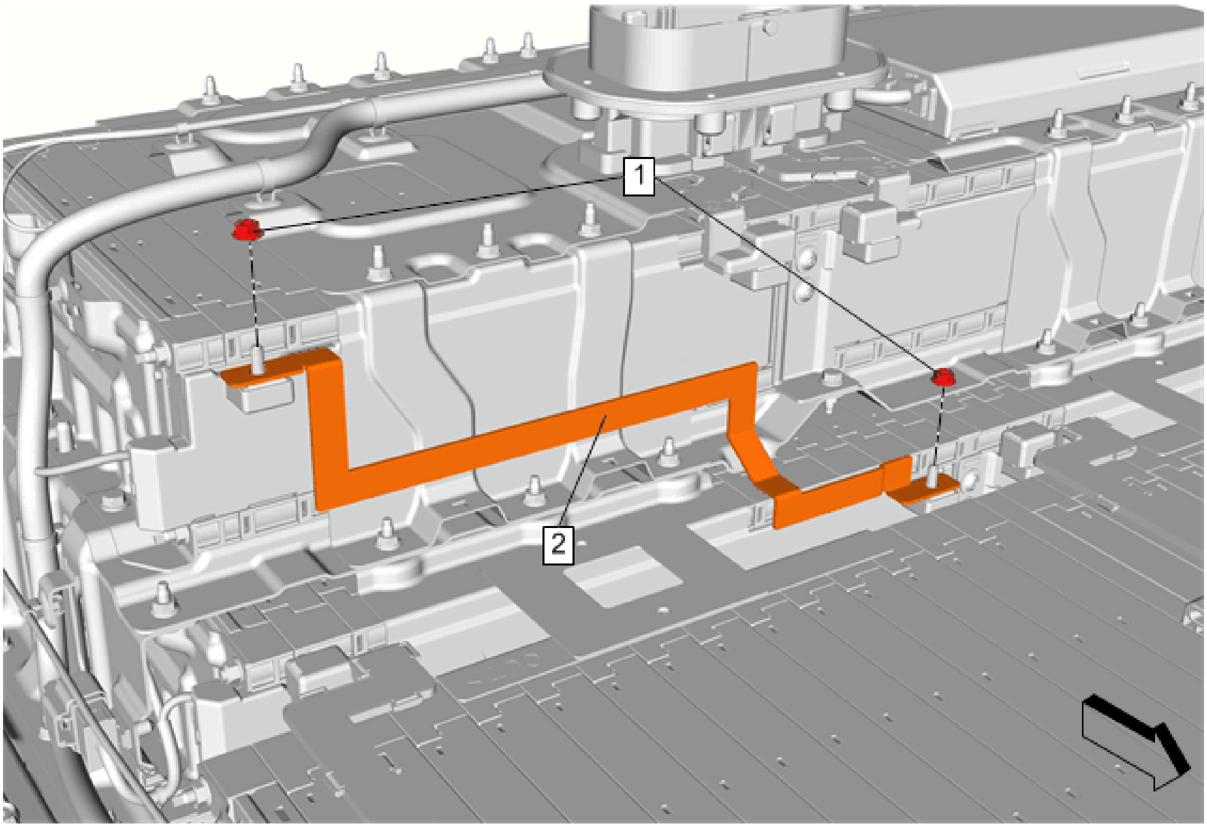


Fig. 267: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
• Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors
• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors
    • Visually and functionally inspect the gloves before use.
    • Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.
Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedures
1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Battery Upper Cover Replacement</td></tr>
<tr><td>1</td><td>Battery Cable Nut (Qty: 2)

CAUTION:
Refer to Fastener Caution .

NOTE:
Critical high voltage fastener. Perform second torque verification check following re-assembly.

NOTE:
Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.

Procedure
1. Tighten the nuts to 9 N.m (80 lb in).
2. Tighten the nuts again to 9 N.m (80 lb in).</td></tr>
<tr><td>2</td><td>Battery Cable (Bus Bar, Cell Battery Module 4 to Cell Battery Module 5, RH)
Procedure
Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)</td></tr>
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BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY DISCONNECT RELAY ASSEMBLY, NEGATIVE)

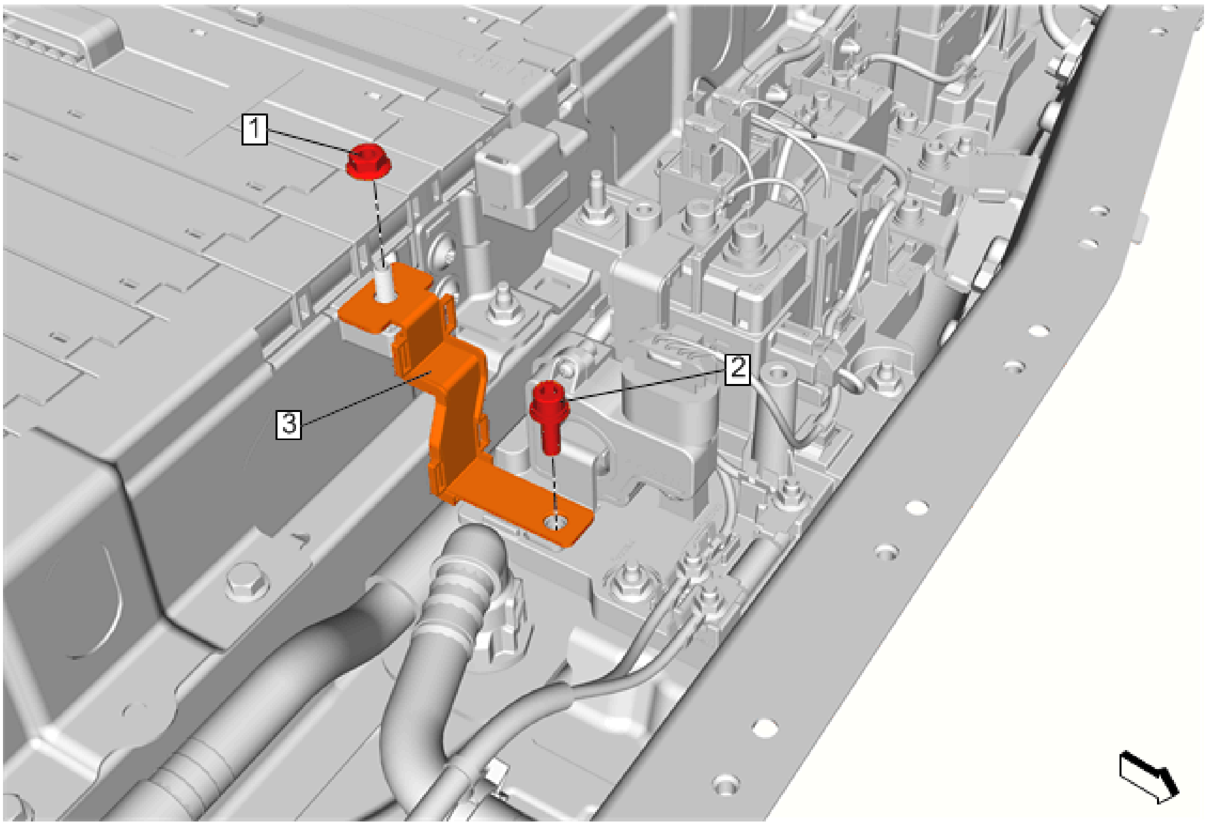


Fig. 268: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">**WARNING:**
Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedures
1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Battery Upper Cover Replacement
3. Remove the high voltage battery disconnect relay cover. High Voltage Battery Disconnect Relay Replacement</td></tr>
<tr><td>1</td><td>Battery Cable Nut

CAUTION:
Refer to Fastener Caution .

NOTE:
Critical high voltage fastener. Perform second torque verification check following re-assembly.

NOTE:
Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.

Procedure
1. Tighten the fastener to 9 N.m (80 lb in).
2. Tighten the fastener again to 9 N.m (80 lb in).</td></tr>
</table>

Callout	Component Name
2	Battery Cable Bolt **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **Procedure** 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Negative) **Procedure** Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY DISCONNECT RELAY ASSEMBLY, POSITIVE)

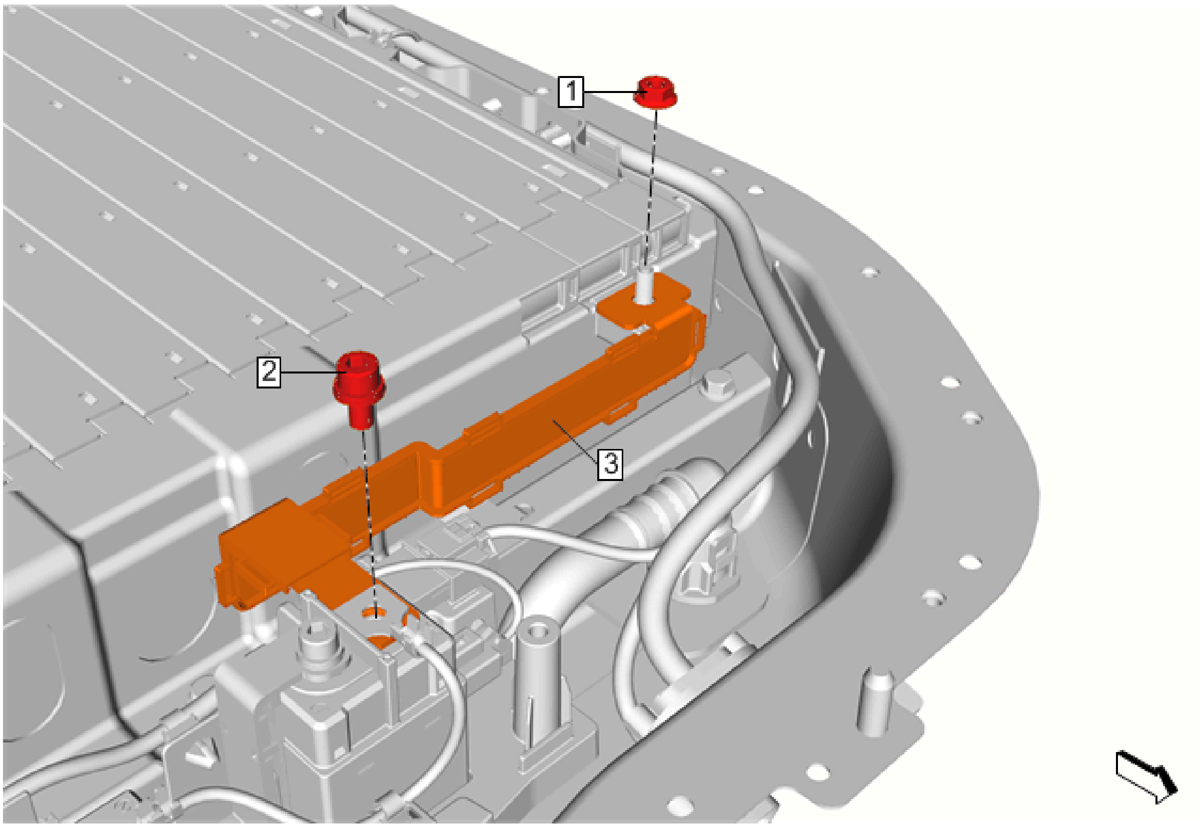


Fig. 269: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

WARNING:
Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
WARNING:
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
Failure to follow the procedure exactly as written may result in serious injury or death.
Preliminary Procedures
1. Remove the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
2. **Battery Upper Cover Replacement**
3. Remove the high voltage battery disconnect relay cover. **High Voltage Battery Disconnect Relay Replacement**	

1	Battery Cable Nut **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **NOTE:** **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.** **Procedure** 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).

Callout	Component Name
2	Battery Cable Bolt **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **Procedure** 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery Disconnect Relay Assembly, Positive) **Procedure** Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY HIGH VOLTAGE MANUAL DISCONNECT, NEGATIVE)

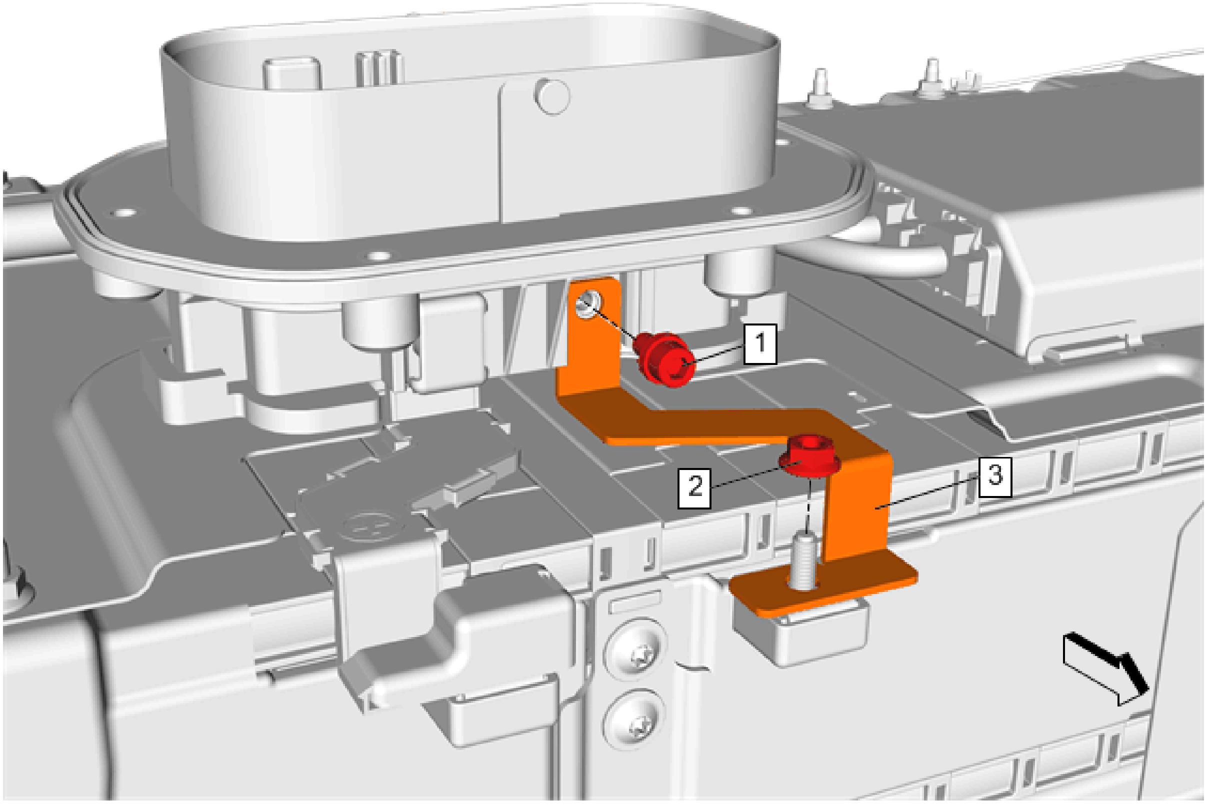


Fig. 270: Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

	WARNING:
	Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
	WARNING:
	Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
	• **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
	• **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
	  • **Visually and functionally inspect the gloves before use.**
	  • **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
	Failure to follow the procedure exactly as written may result in serious injury or death.
	Preliminary Procedures
	1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
	2. Battery Upper Cover Replacement

1	Battery Cable Bolt **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **Procedure** 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).

Callout	Component Name
2	Battery Cable Nut **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **NOTE:** **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.** **Procedure** 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Negative) **Procedure** Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

BATTERY CABLE REPLACEMENT (BUS BAR, BATTERY TO HIGH VOLTAGE BATTERY HIGH VOLTAGE MANUAL DISCONNECT, POSITIVE)

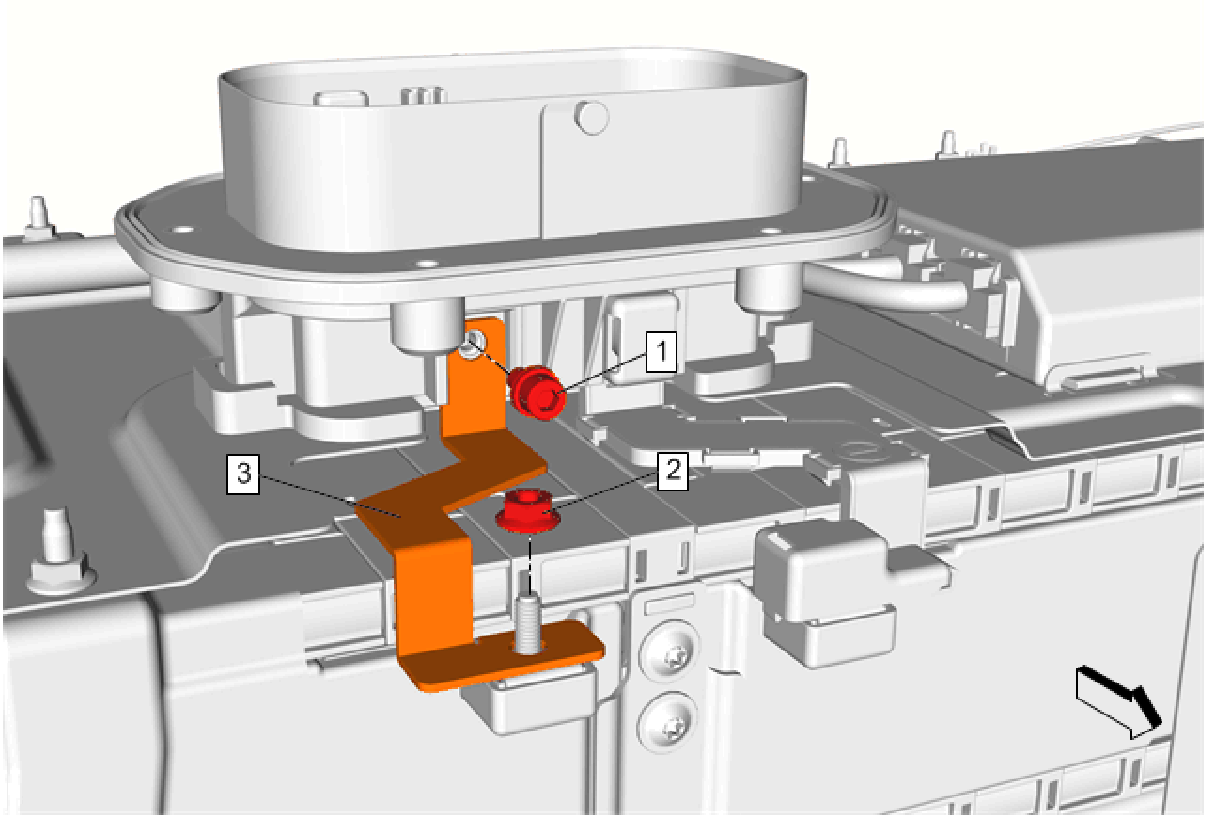


Fig. 271: Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

WARNING:
Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
WARNING:
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
Failure to follow the procedure exactly as written may result in serious injury or death.
Preliminary Procedures
1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Battery Upper Cover Replacement	

1	Battery Cable Bolt **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **Procedure** 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).

Callout	Component Name
2	Battery Cable Nut **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **NOTE:** **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.** **Procedure** 1. Tighten the fastener to 9 N.m (80 lb in). 2. Tighten the fastener again to 9 N.m (80 lb in).
3	Battery Cable (Bus Bar, Battery to High Voltage Battery High Voltage Manual Disconnect, Positive) **Procedure** Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 1 TO CELL BATTERY MODULE 2)

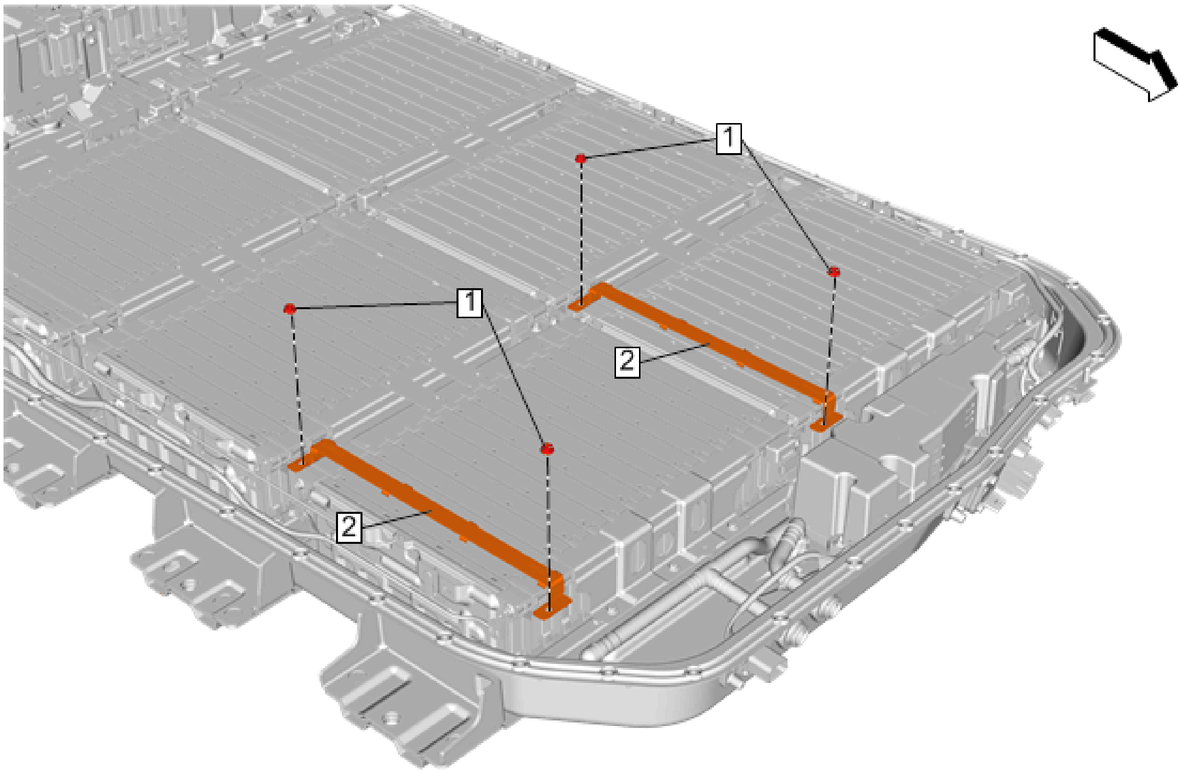


Fig. 272: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

	WARNING:
	Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
	WARNING:
	Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
	- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
	- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
	  - **Visually and functionally inspect the gloves before use.**
	  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
	Failure to follow the procedure exactly as written may result in serious injury or death.
	Preliminary Procedures
	1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
	2. Battery Upper Cover Replacement

1	Battery Cable Nut (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **NOTE:** **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.** **Procedure** 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 1 to Cell Battery Module 2) (Qty: 2) **Procedure** Install the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

BATTERY CABLE REPLACEMENT (BUS BAR, CELL BATTERY MODULE 2 TO CELL BATTERY MODULE 3)

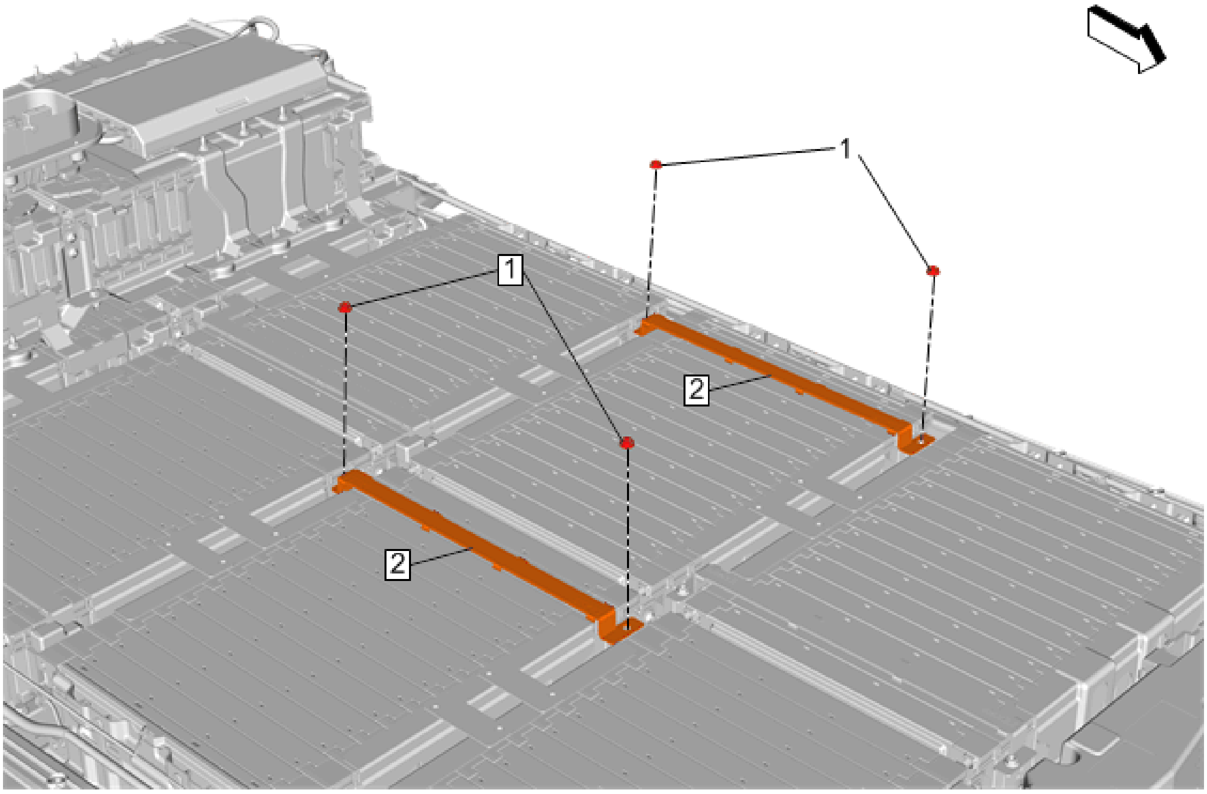


Fig. 273: Battery Cable
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedures

1. Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)
2. Battery Upper Cover Replacement

Callout	Component Name
1	Battery Cable Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Critical high voltage fastener. Perform second torque verification check following re-assembly.** **NOTE:** **Cover the battery cell stud with protective tape that is ULÂ® listed or insulation tape rated at a minimum of 600V.** **Procedure** 1. Tighten the nuts to 9 N.m (80 lb in). 2. Tighten the nuts again to 9 N.m (80 lb in).
2	Battery Cable (Bus Bar, Cell Battery Module 2 to Cell Battery Module 3) **Procedure** Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

BATTERY CABLE REPLACEMENT (BUS BAR, X3, POSITIVE & NEGATIVE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**

2. Remove Battery Upper Cover Battery Upper Cover Replacement

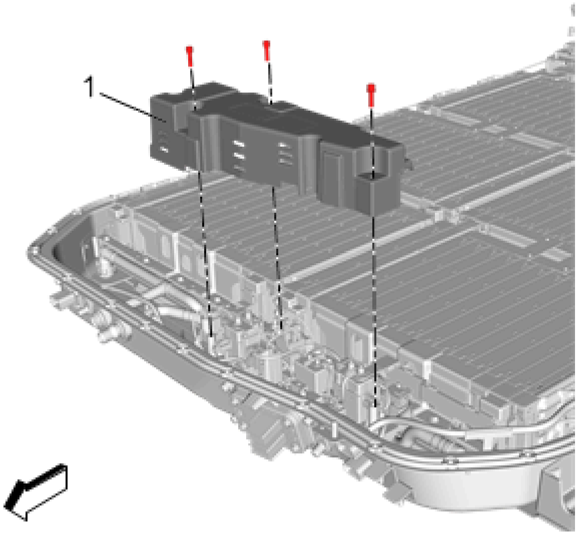


Fig. 274: High Voltage Battery Disconnect Relay Cover
Courtesy of GENERAL MOTORS COMPANY

3. Remove High Voltage Battery Disconnect Relay Cover (1)High Voltage Battery Disconnect Relay Replacement

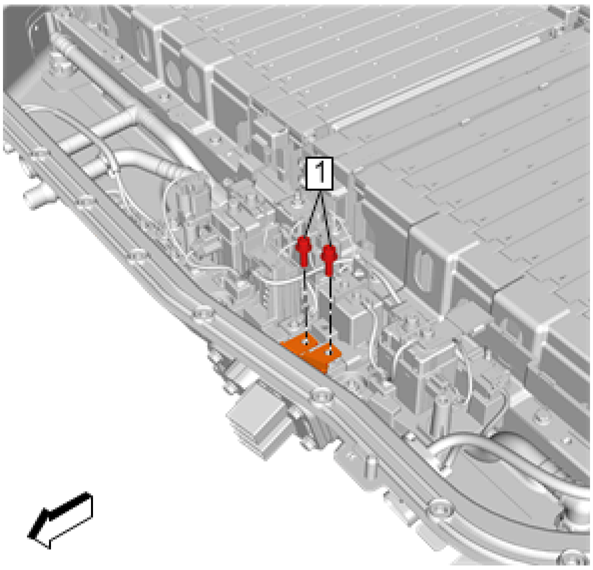


Fig. 275: Battery Cable Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Battery Cable Bolt (1)

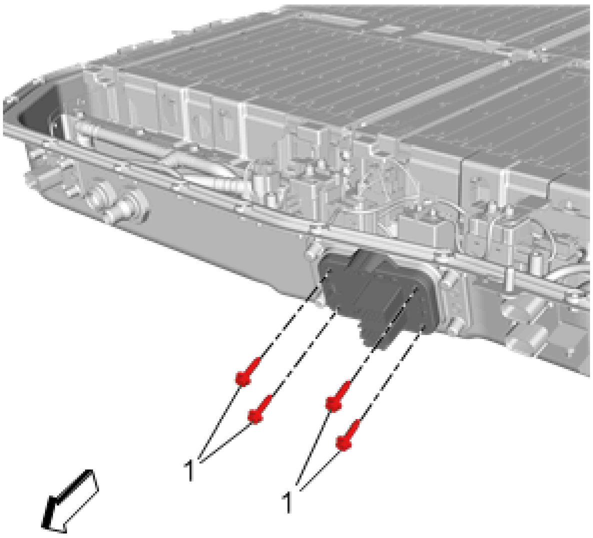


Fig. 276: High Voltage Battery X3 Connector Block Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove High Voltage Battery X3 Connector Block Bolt (1)

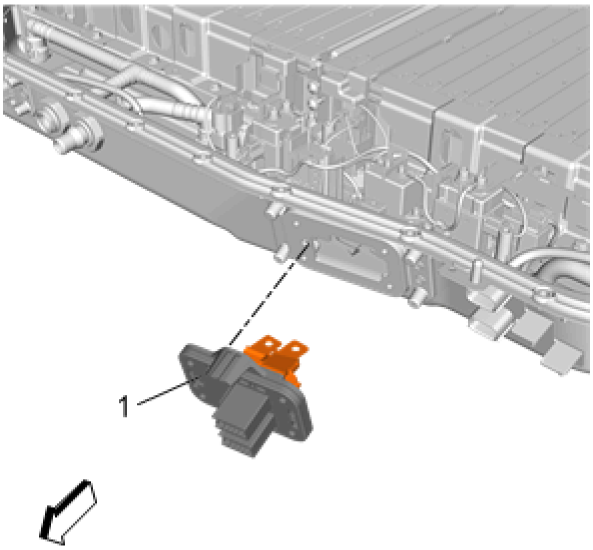


Fig. 277: High Voltage Battery X3 Connector With Battery Cables
Courtesy of GENERAL MOTORS COMPANY

6. Remove the high voltage battery X3 connector (1) with battery cables.

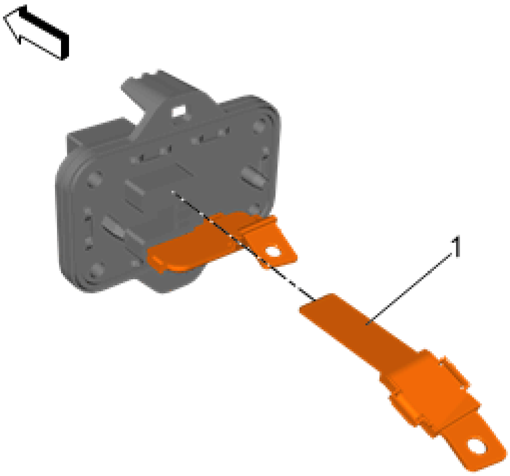


Fig. 278: Battery Cable - Bus Bar, X3, Positive
Courtesy of GENERAL MOTORS COMPANY

7. Remove the battery cable - Bus Bar, X3, Positive (1) from the high voltage battery X3 connector.

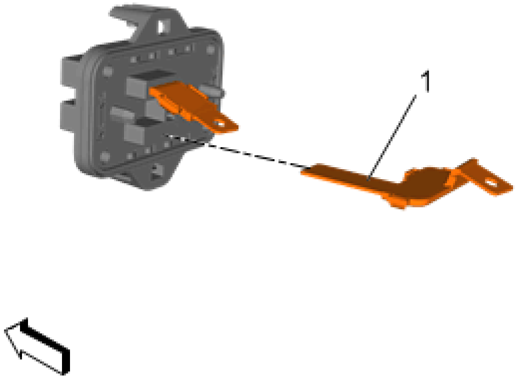


Fig. 279: Battery Cable - Bus Bar, X3, Negative
Courtesy of GENERAL MOTORS COMPANY

8. Remove the battery cable - Bus Bar, X3, Negative (1) from the high voltage battery X3 connector.

Installation Procedure

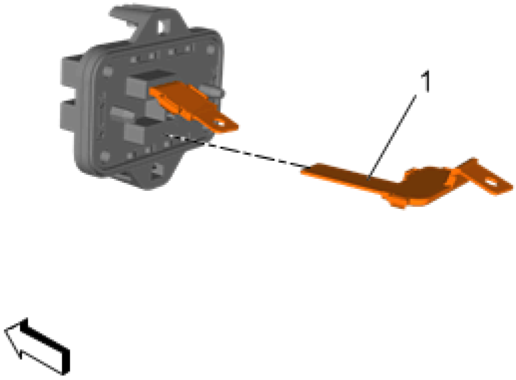


Fig. 280: Battery Cable - Bus Bar, X3, Negative
Courtesy of GENERAL MOTORS COMPANY

1. Install the battery cable - Bus Bar, X3, Negative (1) to the high voltage battery X3 connector.

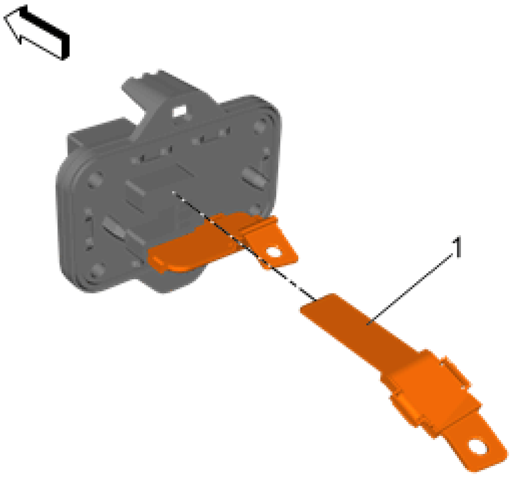


Fig. 281: Battery Cable - Bus Bar, X3, Positive
Courtesy of GENERAL MOTORS COMPANY

2. Install the battery cable - Bus Bar, X3, Positive (1) to the high voltage battery X3 connector.

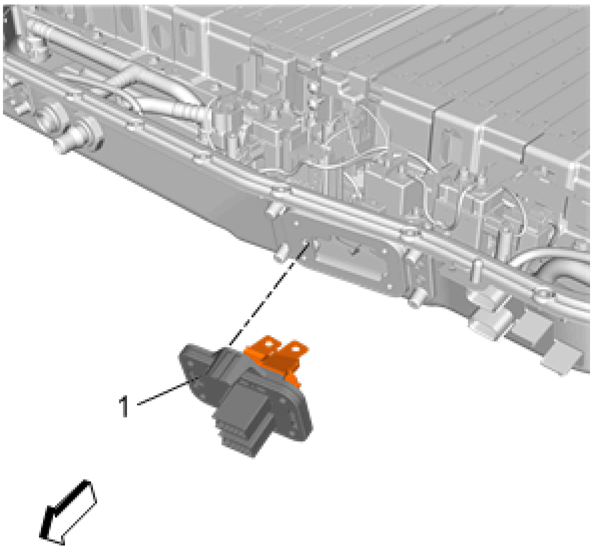


Fig. 282: High Voltage Battery X3 Connector With Battery Cables
Courtesy of GENERAL MOTORS COMPANY

3. Install the high voltage battery X3 connector (1) with battery cables.

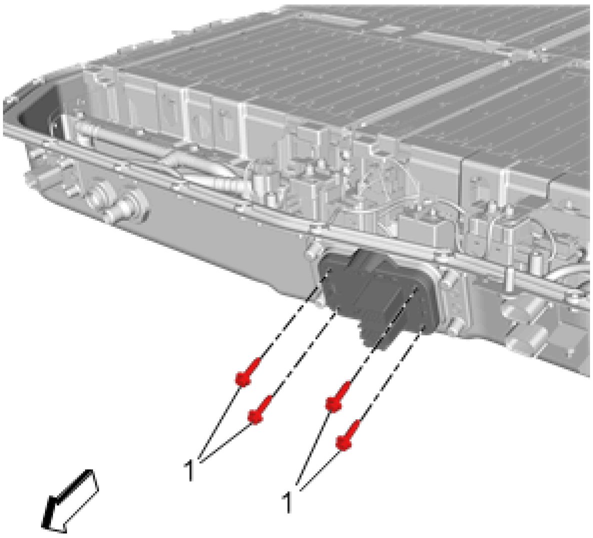
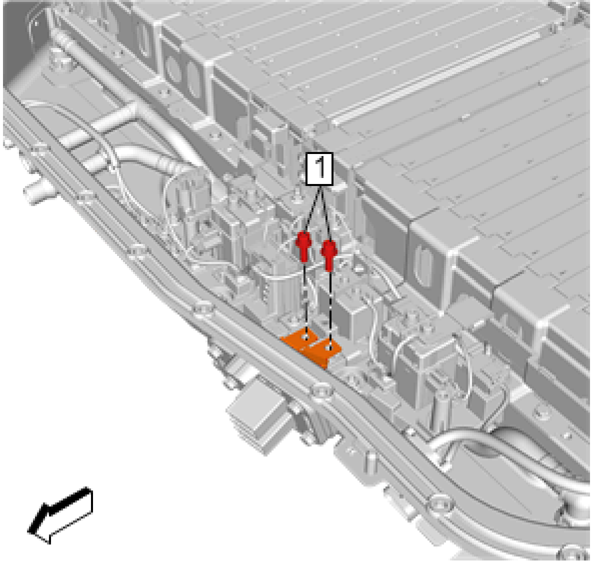


Fig. 283: High Voltage Battery X3 Connector Block Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

4. Install High Voltage Battery X3 Connector Block Bolt (1) and tighten 9 N.m (80 lb in)

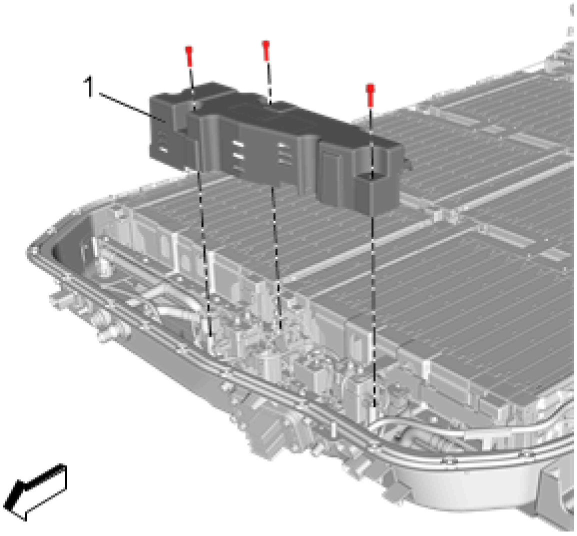


[Fig. 284: Battery Cable Bolt](#)
Courtesy of GENERAL MOTORS COMPANY

5. Install Battery Cable Bolt (1) and tighten

    4.1. First Pass: 9 N.m (80 lb in)

    4.2. Final Pass: 9 N.m (80 lb in)



[Fig. 285: High Voltage Battery Disconnect Relay Cover](#)
Courtesy of GENERAL MOTORS COMPANY

6. Install High Voltage Battery Disconnect Relay Cover (1) **High Voltage Battery Disconnect Relay Replacement**
7. Install Battery Upper Cover **Battery Upper Cover Replacement**
8. Enable the high voltage system. **High Voltage Enabling**

BATTERY UPPER COVER REPLACEMENT

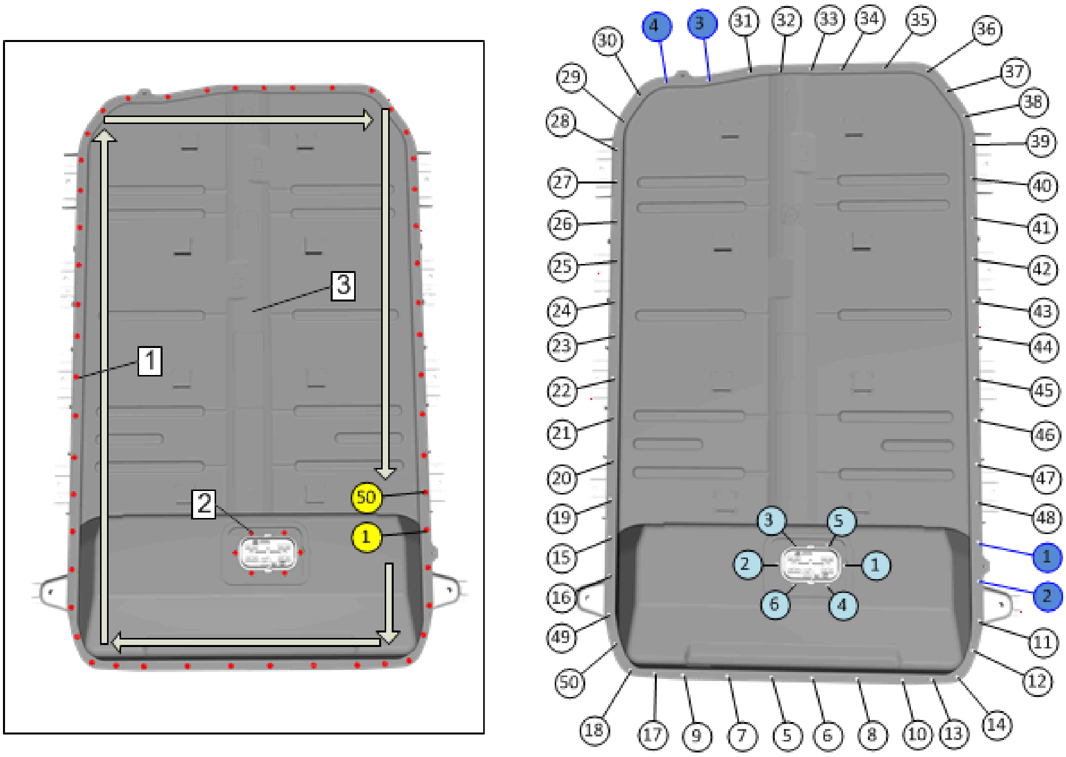


Fig. 286: Battery Upper Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedure Remove the drive motor battery. Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)

Callout	Component Name
1	Battery Upper Cover Fastener (Qty: 50) **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. When removing the bolts, follow the release sequence shown in the above left graphic. 2. Tighten the cover fasteners in the sequence shown in the above right graphic. 3. Loosely tighten the No. 1~4 bolts first. 4. Tighten the No. 1~50 bolts to 2.5 N.m (22 lb in). 5. Tighten the No. 1~50 bolts to 9 N.m (80 lb in)again.
2	High Voltage Disconnect Connector Fastener (Qty: 6) **Tighten** 9 N.m (80 lb in) **Procedure** Tighten the fasteners in the sequence shown in the above right graphic.
3	Battery Upper Cover **Procedure** 1. If needed, replace the battery upper cover. 2. If needed, replace the battery cover seal. **Battery Cover Seal Replacement** 3. Perform the rechargeable energy storage system smoke test. **Rechargeable Energy Storage System Smoke Test** 4. Perform the hybrid/EV battery system verification. **Hybrid/EV Battery System Verification** 5. Install the drive motor battery. **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**

DRIVE MOTOR BATTERY REPLACEMENT AND SHIPPING PREPARATION (OLD DESIGN BATTERY PACK IN VEHICLES BUILT BEFORE 1G1FX6S06H4163254)

Special Tools

- **GE-52418** Lifting Table
- **GE-52200** Lifting Table
- **EL-51102** High Voltage Battery Lift Bar Tilter
- **EL-51102 - 10** Hanging Bars and Shackles
- **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit
- **EL-51102 - 40** Battery Lifting Strap
- **EL-51102 - 50** Battery Lifting Strap

For equivalent regional tools, refer to **Special Tools** .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection**

Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Remove the front compartment air deflector. Front Compartment Air Deflector Replacement
3. Drain the drive motor battery cooling system. Drive Motor Battery Cooling System Draining and Filling

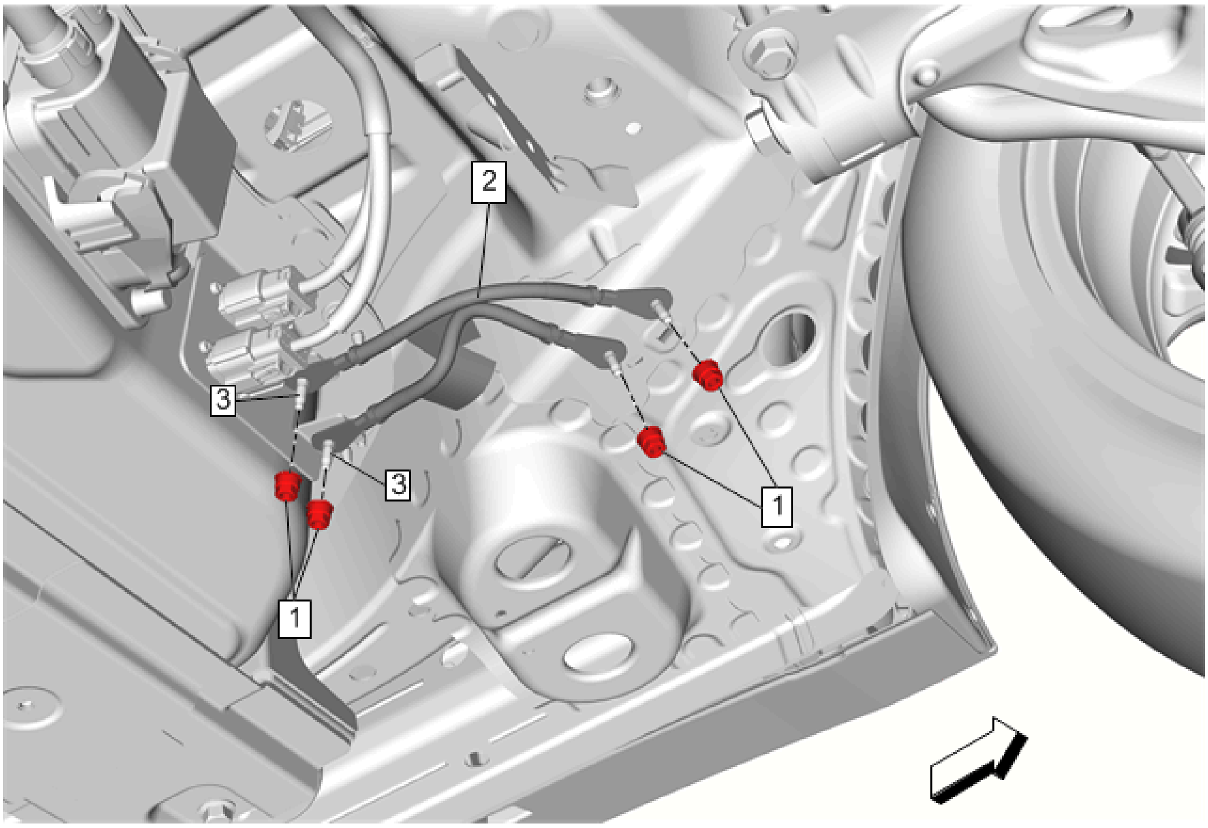


Fig. 287: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery negative cable (2) from the high voltage battery and body structure. Battery Negative Cable Replacement (High Voltage Battery to Body Structure) Battery Negative Cable Replacement (12V Battery to Body Structure)

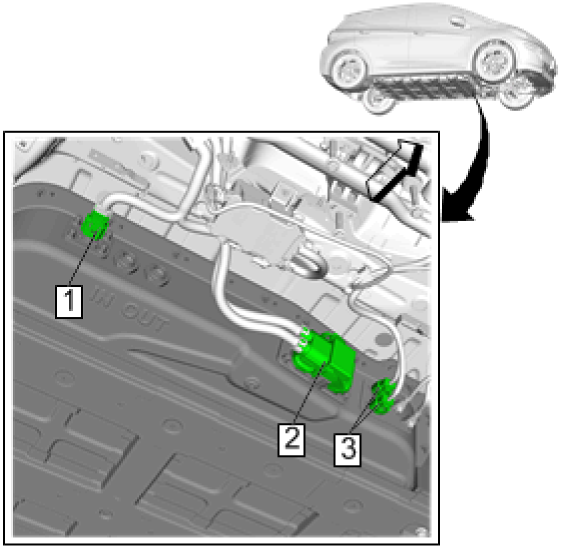


Fig. 288: High Voltage Battery Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the X4 high voltage battery connector (1) from the drive motor battery.
6. Disconnect the X3 high voltage battery connector (2) from the drive motor battery by rotating the connector handle until 90 degrees.
7. Disconnect the body wiring harness connectors (3) from the drive motor battery.

WARNING: **To avoid any vehicle damage, serious personal injury or death:**

- **When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.**
- **When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.**

CAUTION: **Perform the following steps before beginning any vehicle lifting or jacking procedure:**

- **Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.**
- **The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.**
- **The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.**
- **Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.**
- **Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.**

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

8. During drive motor battery removal, vehicle weight will be redistributed and may cause the vehicle to become unstable on the hoist. To avoid the vehicle potentially falling off secure the vehicle to lift/hoist arms with straps.

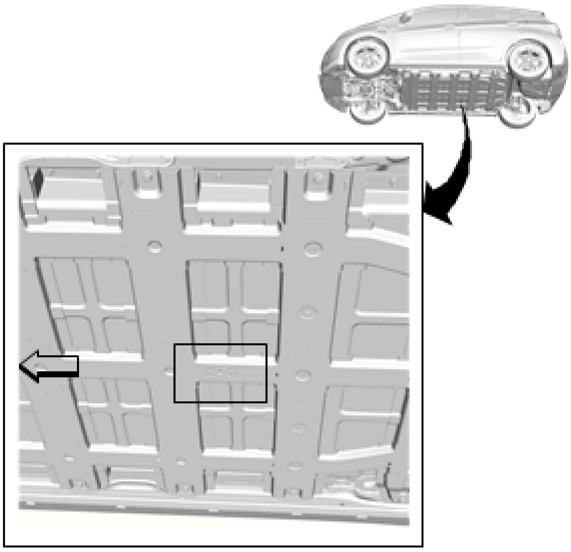


Fig. 289: Lifting Table
Courtesy of GENERAL MOTORS COMPANY

NOTE: **There is C.G (Center of Gravity) mark on the drive motor battery tray to locate your lift table.**

NOTE: **The high voltage battery mass is approximately 450 kg (1000 lbs)**

9. Position a **GE-52418** Lifting Table or **GE-52200** Lifting Table and raise the lifting table into position.

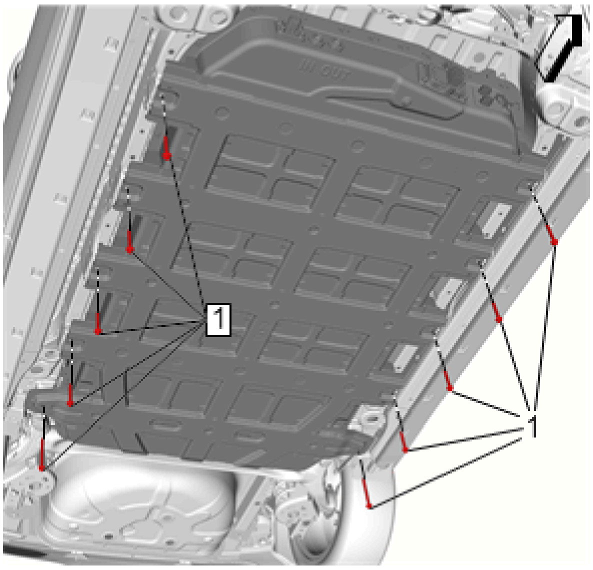


Fig. 290: Drive Motor Battery Mounting Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Verify ALL connectors are removed from the drive motor battery.**

NOTE: **Confirm the locking MSD cap/cover required in some regions will pass through the vehicle floor panel. If not, the MSD cap/cover should be removed during Battery Pack lowering from vehicle then reinstalled once the pack is out.**

NOTE: **Ensure all fasteners are removed before lowering the support table fixture with the drive motor battery.**

10. Remove the drive motor battery mounting fasteners (1).

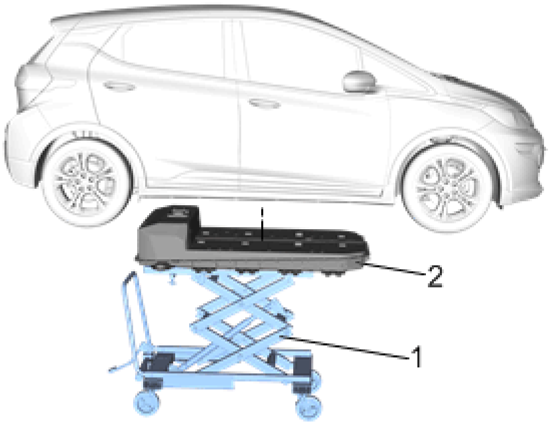


Fig. 291: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

WARNING: **When removing the high voltage battery, only use the recommended lift table with straps capable of holding 1000kg (2204.62 lbs). Failure to use the appropriate lift table and straps could cause the battery to fall and may result in personal injury or death.**

11. Slowly lower the lifting table (1) with the drive motor battery (2).
12. Secure the high voltage battery to the lifting table with straps.
13. Cover the manual disconnect tape.

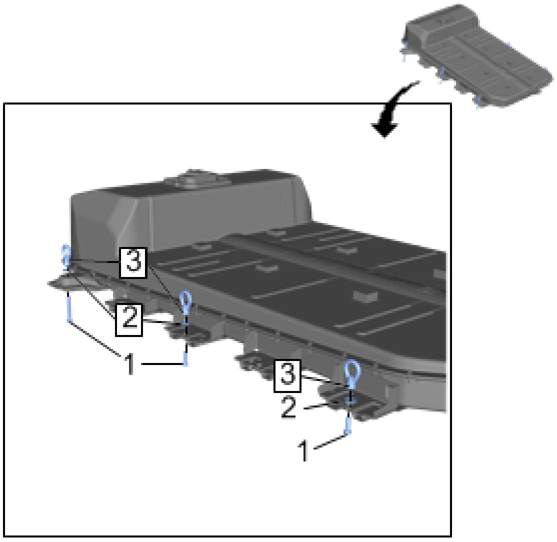


Fig. 292: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

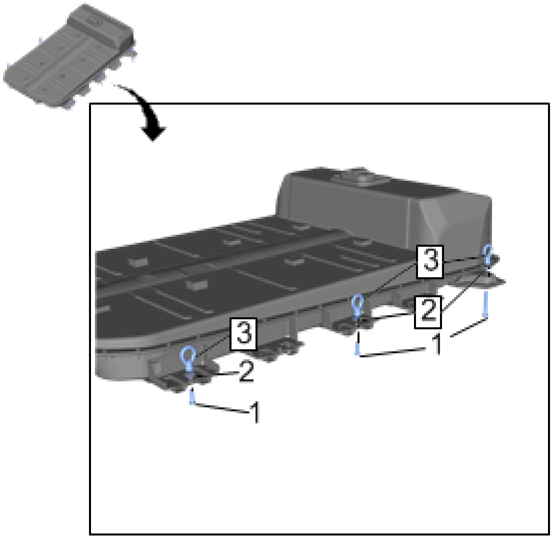


Fig. 293: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

15. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

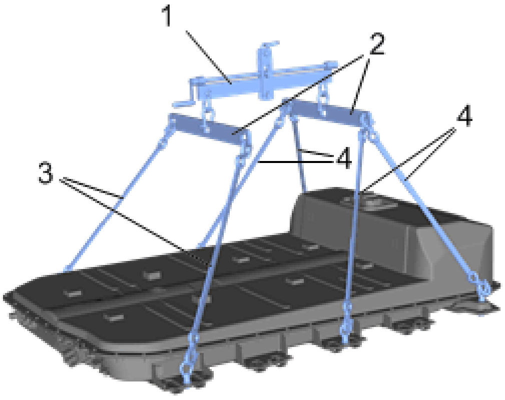


Fig. 294: High Voltage Battery Lift Bar Tilter
Courtesy of GENERAL MOTORS COMPANY

16. Attach the **EL-51102** High Voltage Battery Lift Bar Tilter (1) to a suitable lifting crane.
17. Position the **EL-51102** High Voltage Battery Lift Bar Tilter and **EL-51102 - 10** Hanging Bars and Shackles (2) over the high voltage battery as shown.
18. Install the **EL-51102 - 40** Battery Lifting Strap (3) and the **EL-51102 - 50** Battery Lifting Strap (4) to transport the drive motor battery to a secure area.

NOTE: **Make sure the drive motor battery is balanced when hung from the lifting straps before moving with a crane or chain block to a support table.**

NOTE: **As part of the battery removal process, all coolant should be drained from the battery pack.**

NOTE: **If internal repairs are being performed on the battery, all coolant should be drained from the battery pack to ensure coolant does not drain from the hoses during repairs.**

19. Install 2 coolant plugs into the coolant lines. Coolant plugs can be removed from the NEW service battery assembly.

Installation Procedure

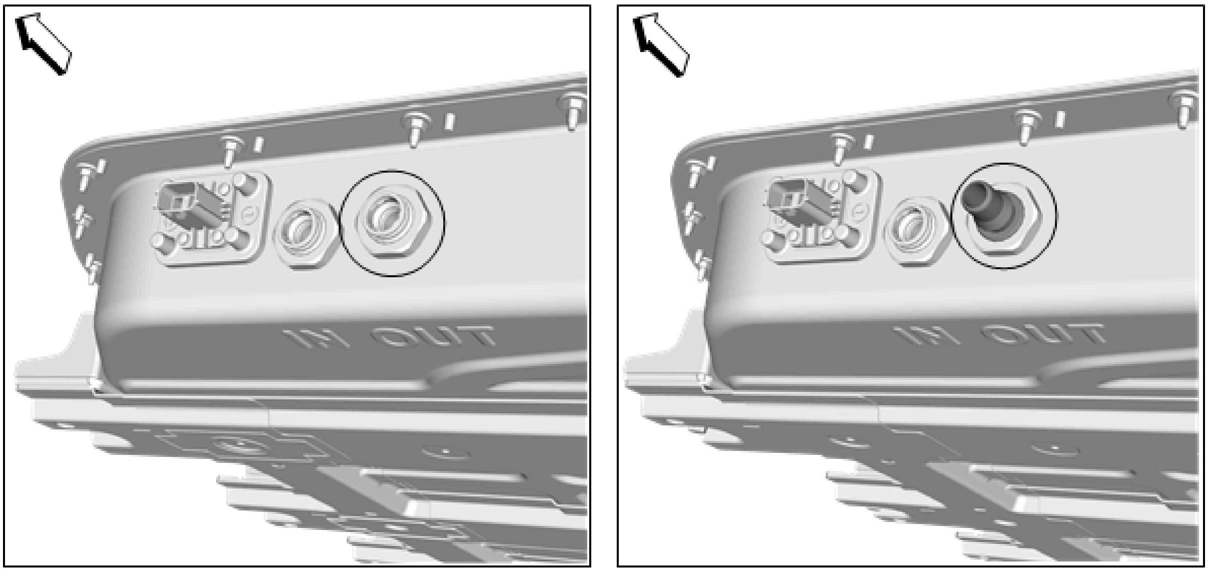


Fig. 295: New/ Old Battery Versions
Courtesy of GENERAL MOTORS COMPANY

1. Check if the drive motor battery pack is OLD version battery or NEW version battery.

    1.1 OLD version battery has a female type battery cooler outlet port like upper left picture.

    1.2 NEW version battery has a male type battery cooler outlet port like upper right picture.

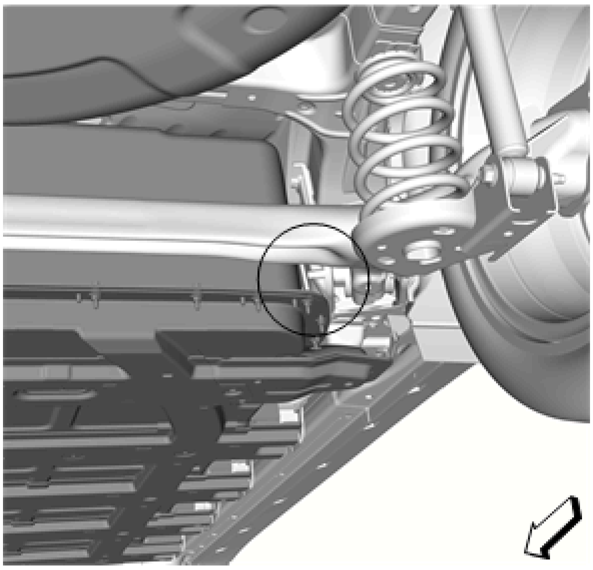


Fig. 296: Rear Of Drive Motor Battery And Rear Suspension Bushing Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Avoid making contact between the rear of the drive motor battery and the rear suspension bushing bolts.

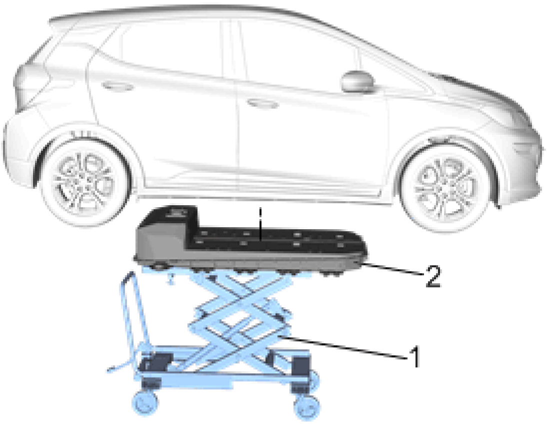


Fig. 297: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

3. Secure high voltage battery to the lifting table with straps.
4. With the drive motor battery (2) on the **GE-52418** Lifting Table or **GE-52200** Lifting Table (1), slowly raise the lifting table.
5. Release the straps.

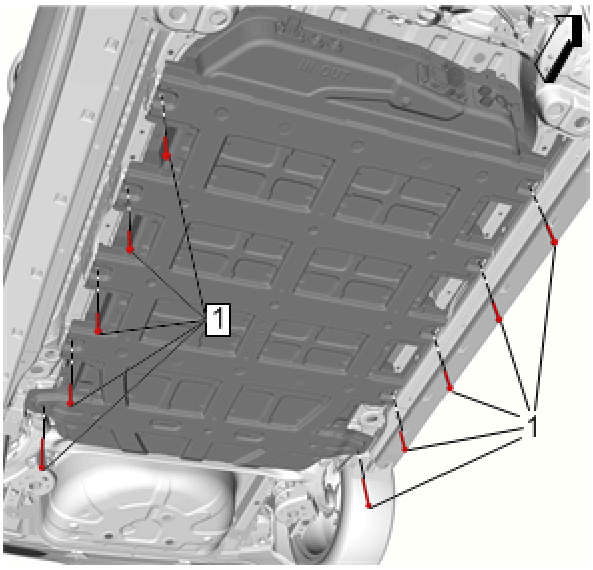


Fig. 298: Drive Motor Battery Mounting Fasteners
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

6. Snugly tighten the outside mounting fasteners (1).
7. Lower the lifting table.
8. Tighten the fasteners (1) to 56 N.m (41 lb ft).

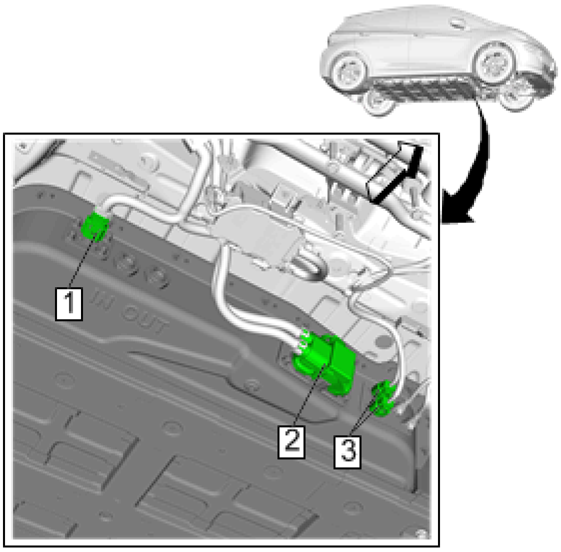


Fig. 299: High Voltage Battery Connector
Courtesy of GENERAL MOTORS COMPANY

9. Connect the body wiring harness connectors (3) to the drive motor battery.
10. Connect the X3 high voltage connector (2) to the drive motor battery.
11. Connect the X4 high voltage connector (1) to the drive motor battery.

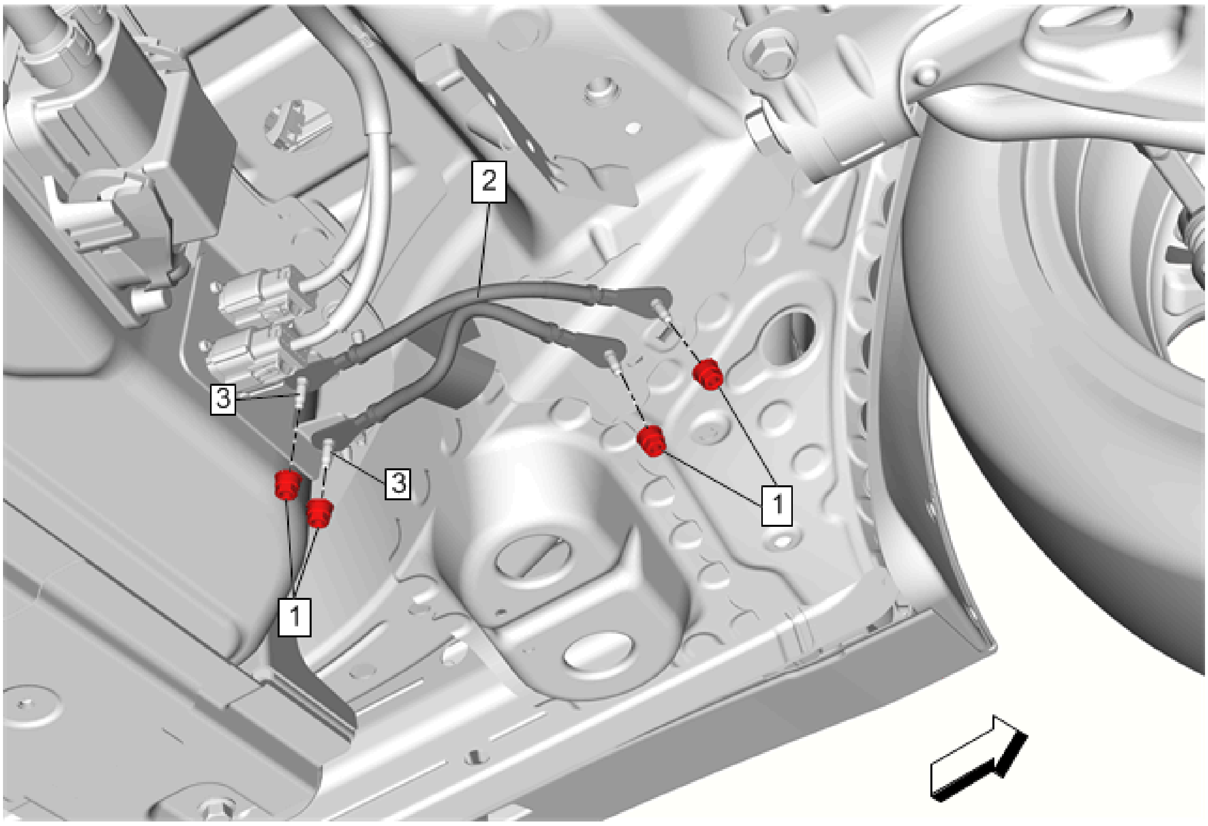


Fig. 300: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

12. Install the battery negative cable (2) to the high voltage battery and body structure. **Battery Negative Cable Replacement (High Voltage Battery to Body Structure) Battery Negative Cable Replacement (12V Battery to Body Structure)**
13. Untie the straps that is installed to avoid the vehicle potentially falling off from the lift/hoist.
14. Fill the drive motor battery cooling system. **Drive Motor Battery Cooling System Draining and Filling**
15. Check the cooling system for leaks. **Hybrid Cooling System Leak Test**
16. Install the front compartment air deflector. **Front Compartment Air Deflector Replacement**
17. Enable the high voltage system. **High Voltage Enabling**

18. Reprogram the battery energy control module. **Battery Energy Control Module Programming and Setup**
19. Program the hybrid powertrain control module 2. **Hybrid Powertrain Control Module 2 Programming and Setup**
20. Clear the secured high voltage DTCs. **Clear Secured High Voltage DTCs**
21. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. **Hybrid/EV Battery Pack Capacity Learn**

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

DRIVE MOTOR BATTERY REPLACEMENT AND SHIPPING PREPARATION (NEW DESIGN BATTERY PACK IN VEHICLES BUILT BEFORE 1G1FX6S06H4163254)

Special Tools

- **GE-52418** Lifting Table
- **GE-52200** Lifting Table
- **EL-51102** High Voltage Battery Lift Bar Tilter
- **EL-51102 - 10** Hanging Bars and Shackles
- **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit
- **EL-51102 - 40** Battery Lifting Strap
- **EL-51102 - 50** Battery Lifting Strap

For equivalent regional tools, refer to **Special Tools** .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

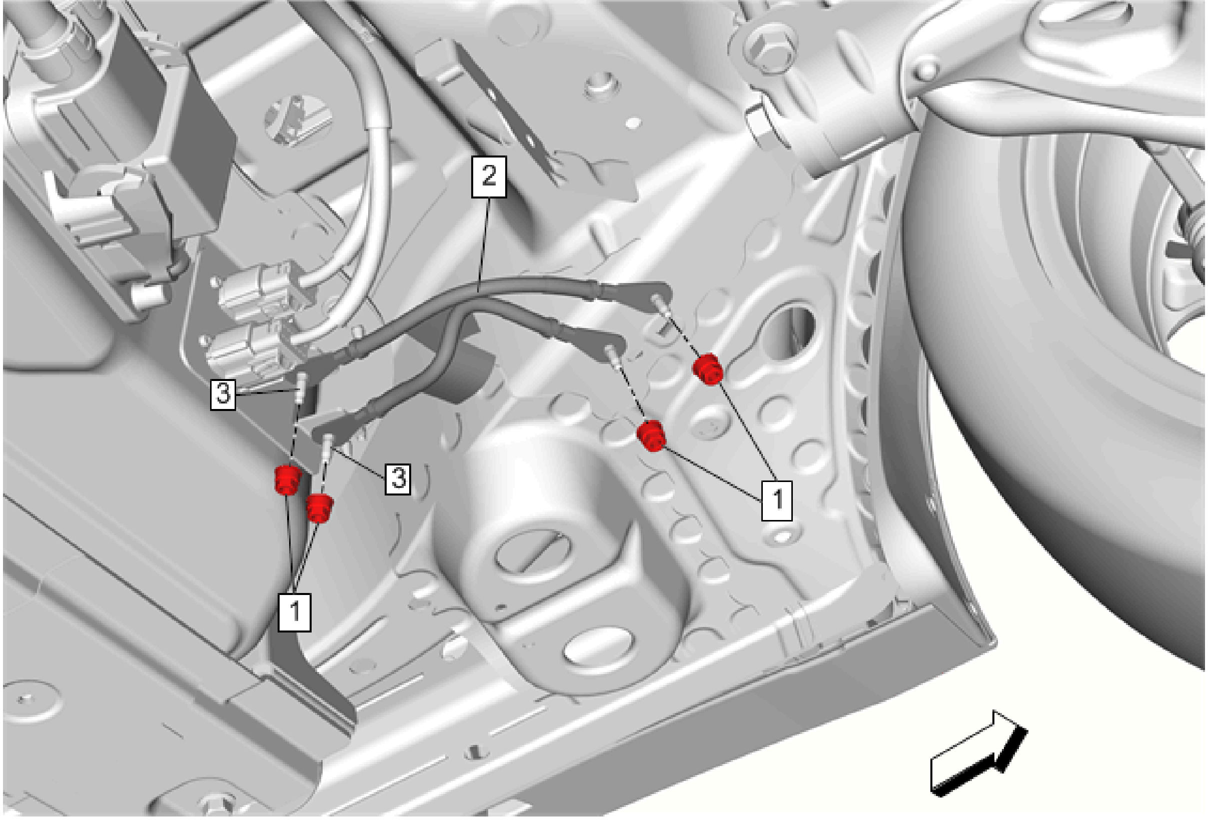
- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

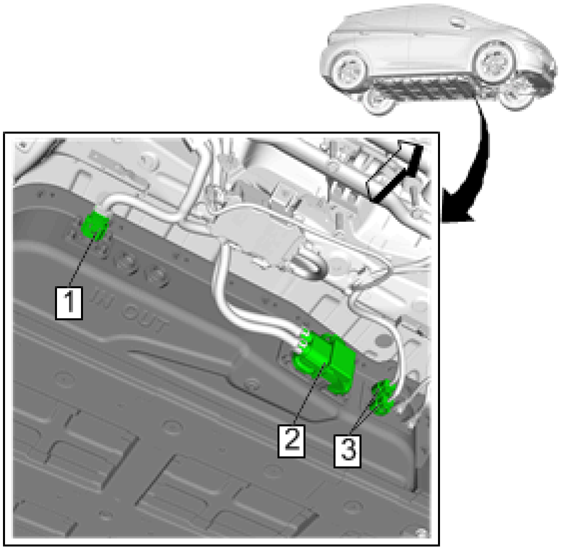
Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Remove the front compartment air deflector. **Front Compartment Air Deflector Replacement**
3. Drain the drive motor battery cooling system. **Drive Motor Battery Cooling System Draining and Filling**



[**Fig. 301: Battery Negative Cable**](#)
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery negative cable (2) from the high voltage battery and body structure. [**Battery Negative Cable Replacement (High Voltage Battery to Body Structure)**](#) [**Battery Negative Cable Replacement (12V Battery to Body Structure)**](#)



[**Fig. 302: High Voltage Battery Connector**](#)
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the X4 high voltage battery connector (1) from the drive motor battery.
6. Disconnect the X3 high voltage battery connector (2) from the drive motor battery by rotating the connector handle until 90 degrees.
7. Disconnect the body wiring harness connectors (3) from the drive motor battery.

WARNING: **To avoid any vehicle damage, serious personal injury or death:**

- **When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.**

- **When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.**

CAUTION: **Perform the following steps before beginning any vehicle lifting or jacking procedure:**

- **Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.**
- **The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.**
- **The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.**
- **Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.**
- **Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.**

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

8. During drive motor battery removal, vehicle weight will be redistributed and may cause the vehicle to become unstable on the hoist. To avoid the vehicle potentially falling off secure the vehicle to lift/hoist arms with straps.

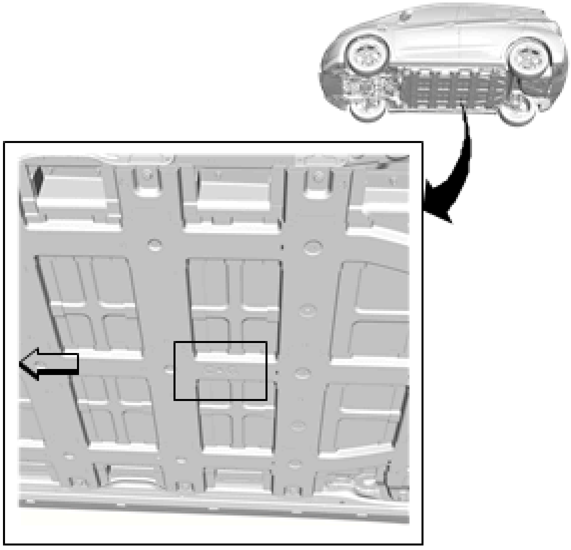


Fig. 303: Lifting Table
Courtesy of GENERAL MOTORS COMPANY

NOTE: **There is C.G (Center of Gravity) mark on the drive motor battery tray to locate your lift table.**

NOTE: **The high voltage battery mass is approximately 450 kg (1000 lbs)**

9. Position a **GE-52418** Lifting Table or **GE-52200** Lifting Table and raise the lifting table into position.

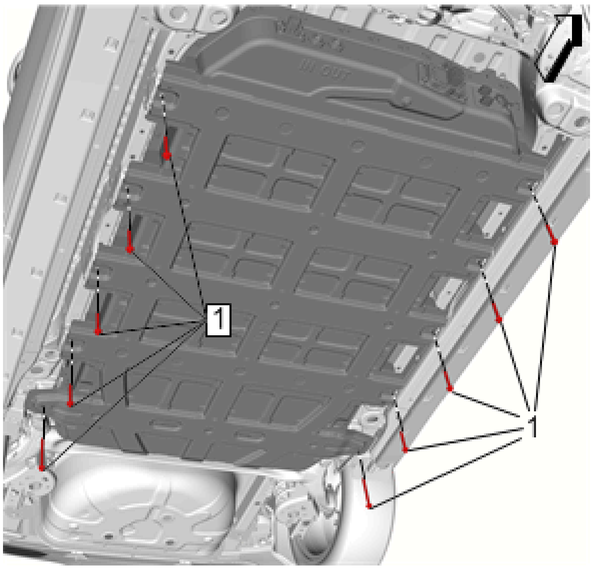


Fig. 304: Drive Motor Battery Mounting Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Verify ALL connectors are removed from the drive motor battery.**

NOTE: **Confirm the locking MSD cap/cover required in some regions will pass through the vehicle floor panel. If not, the MSD cap/cover should be removed during Battery Pack lowering from vehicle then reinstalled once the pack is out.**

NOTE: **Ensure all fasteners are removed before lowering the support table fixture with the drive motor battery.**

10. Remove the drive motor battery mounting fasteners (1).

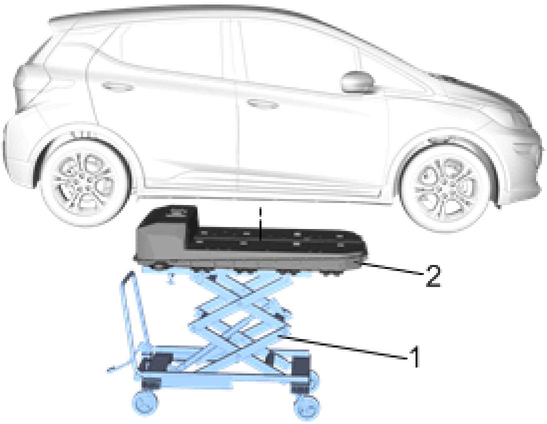


Fig. 305: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

WARNING: **When removing the high voltage battery, only use the recommended lift table with straps capable of holding 1000kg (2204.62 lbs). Failure to use the appropriate lift table and straps could cause the battery to fall and may result in personal injury or death.**

11. Slowly lower the lifting table (1) with the drive motor battery (2).
12. Secure the high voltage battery to the lifting table with straps.

13. Cover the manual disconnect tape.

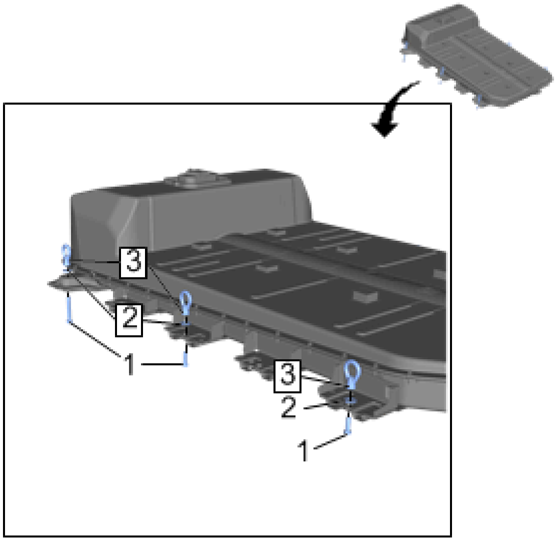


Fig. 306: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

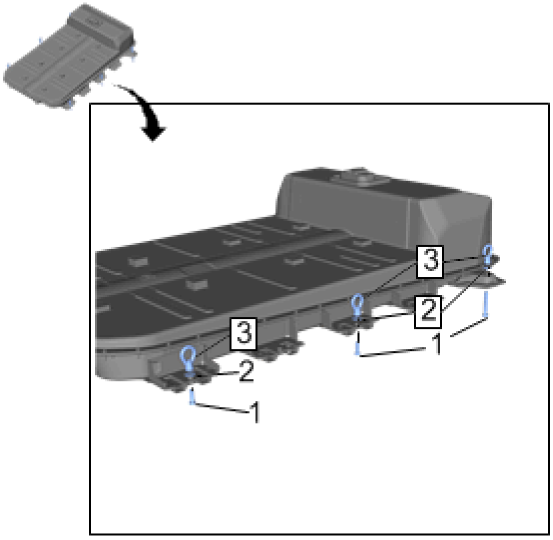


Fig. 307: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

15. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

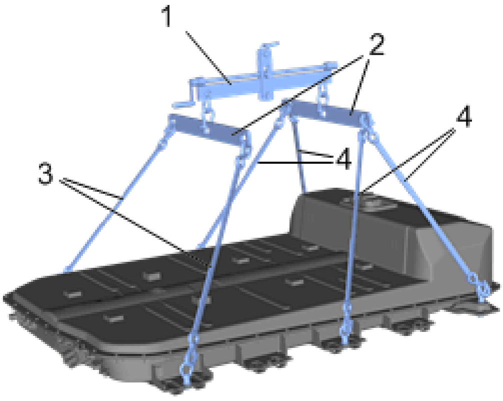


Fig. 308: High Voltage Battery Lift Bar Tilter
Courtesy of GENERAL MOTORS COMPANY

16. Attach the **EL-51102** High Voltage Battery Lift Bar Tilter (1) to a suitable lifting crane.
17. Position the **EL-51102** High Voltage Battery Lift Bar Tilter and **EL-51102 - 10** Hanging Bars and Shackles (2) over the high voltage battery as shown.
18. Install the **EL-51102 - 40** Battery Lifting Strap (3) and the **EL-51102 - 50** Battery Lifting Strap (4) to transport the drive motor battery to a secure area.

NOTE: **Make sure the drive motor battery is balanced when hung from the lifting straps before moving with a crane or chain block to a support table.**

NOTE: **As part of the battery removal process, all coolant should be drained from the battery pack.**

NOTE: **If internal repairs are being performed on the battery, all coolant should be drained from the battery pack to ensure coolant does not drain from the hoses during repairs.**

19. Install 2 coolant plugs into the coolant lines. Coolant plugs can be removed from the NEW service battery assembly.

Installation Procedure

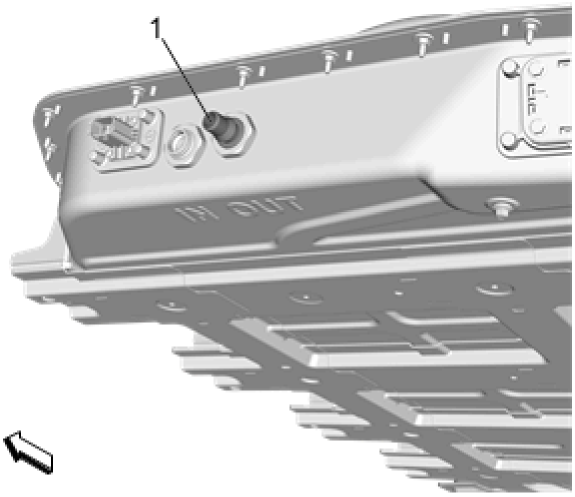


Fig. 309: Drive Motor Battery Coolant Cooler Outlet Port
Courtesy of GENERAL MOTORS COMPANY

NOTE: **NEW version battery pack has a male type battery coolant outlet port.**

1. Check if the drive motor battery coolant cooler outlet port (1) is male type.

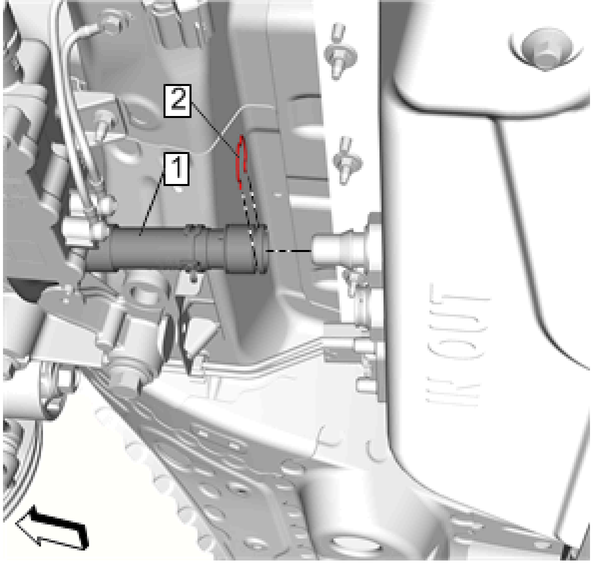


Fig. 310: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (2nd Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

2. If necessary, at the vehicle, replace the male type drive motor battery coolant cooler outlet hose with the female type outlet hose (1). **Drive Motor Battery Coolant Cooler Outlet Hose Replacement (CHILLER TO RESS)**

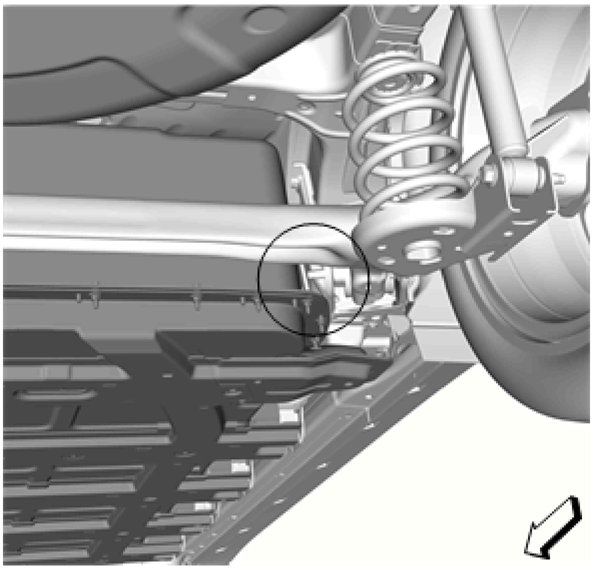


Fig. 311: Rear Of Drive Motor Battery And Rear Suspension Bushing Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Avoid making contact between the rear of the drive motor battery and the rear suspension bushing bolts.

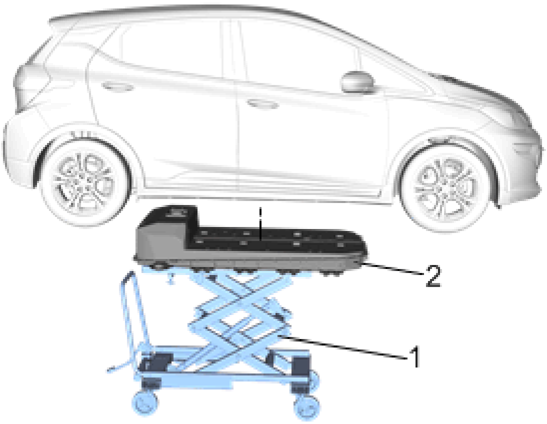


Fig. 312: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

4. Secure high voltage battery to the lifting table with straps.
5. With the drive motor battery (2) on the **GE-52418** Lifting Table or **GE-52200** Lifting Table (1), slowly raise the lifting table.
6. Release the straps.

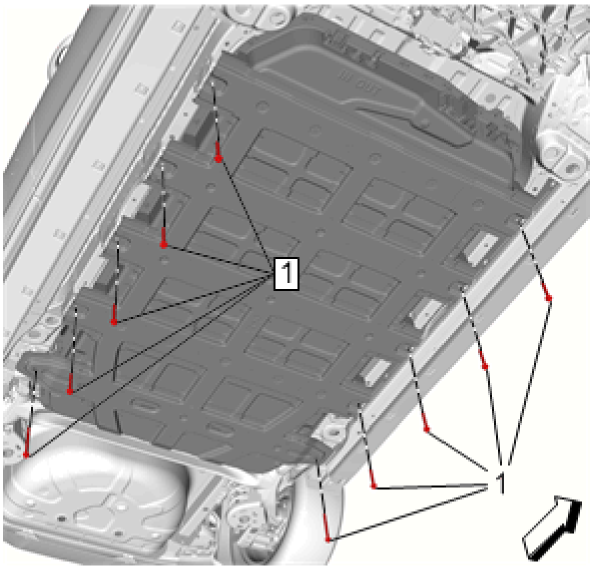


Fig. 313: Outside Mounting Fasteners
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

7. Snugly tighten the outside mounting fasteners (1).
8. Lower the lifting table.
9. Tighten the fasteners (1) to 56 N.m (41 lb ft).

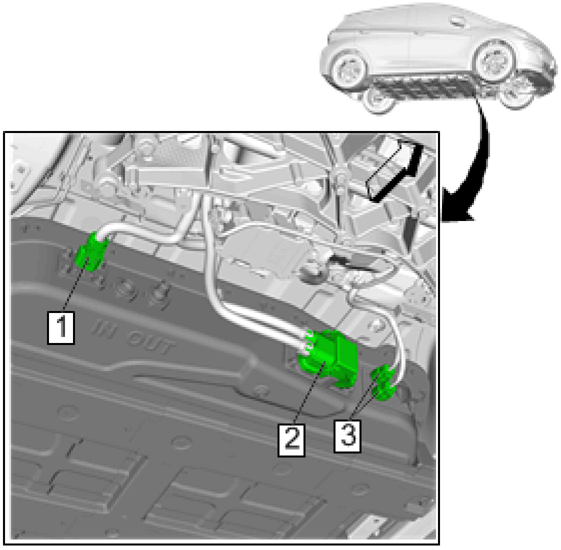


Fig. 314: Body Wiring Harness Connectors And High Voltage Connector
Courtesy of GENERAL MOTORS COMPANY

10. Connect the body wiring harness connectors (3) to the drive motor battery.
11. Connect the X3 high voltage connector (2) to the drive motor battery.
12. Connect the X4 high voltage connector (1) to the drive motor battery.

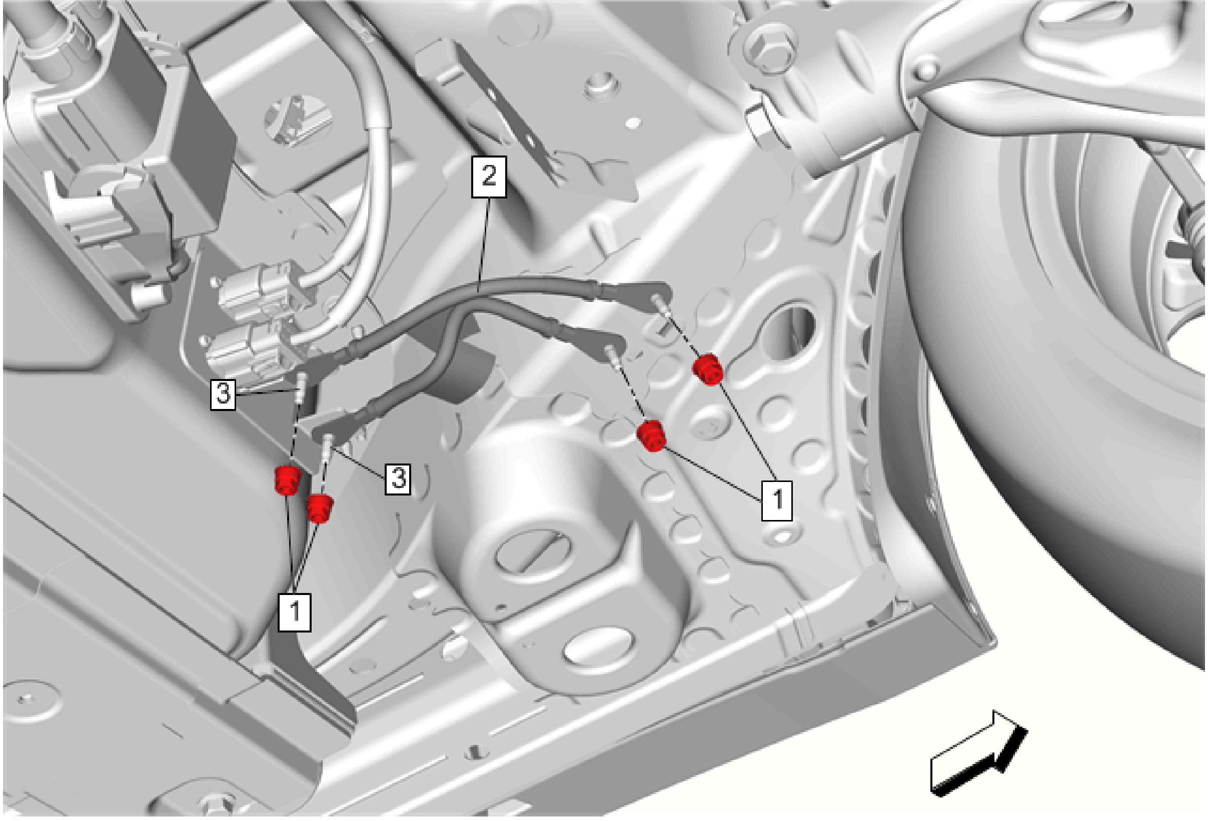


Fig. 315: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

13. Install the battery negative cable (2) to the high voltage battery and body structure. **Battery Negative Cable Replacement (High Voltage Battery to Body Structure)** **Battery Negative Cable Replacement (12V Battery to Body Structure)**
14. Untie the straps that is installed to avoid the vehicle potentially falling off from the lift/hoist.
15. Fill the drive motor battery cooling system. **Drive Motor Battery Cooling System Draining and Filling**
16. Check the cooling system for leaks. **Hybrid Cooling System Leak Test**
17. Install the front compartment air deflector. **Front Compartment Air Deflector Replacement**
18. Enable the high voltage system. **High Voltage Enabling**
19. Reprogram the battery energy control module. **Battery Energy Control Module Programming and Setup**
20. Program the hybrid powertrain control module 2. **Hybrid Powertrain Control Module 2 Programming and Setup**
21. Clear the secured high voltage DTCs. **Clear Secured High Voltage DTCs**
22. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. **Hybrid/EV Battery Pack Capacity Learn**

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

DRIVE MOTOR BATTERY REPLACEMENT AND SHIPPING PREPARATION (NEW DESIGN BATTERY PACK IN VEHICLES BUILT AFTER 1G1FX6S06H4163254)

Special Tools

- **GE-52418** Lifting Table
- **GE-52200** Lifting Table
- **EL-51102** High Voltage Battery Lift Bar Tilter
- **EL-51102 - 10** Hanging Bars and Shackles
- **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit
- **EL-51102 - 40** Battery Lifting Strap
- **EL-51102 - 50** Battery Lifting Strap

For equivalent regional tools, refer to Special Tools .

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Remove the front compartment air deflector. Front Compartment Air Deflector Replacement
3. Drain the drive motor battery cooling system. Drive Motor Battery Cooling System Draining and Filling

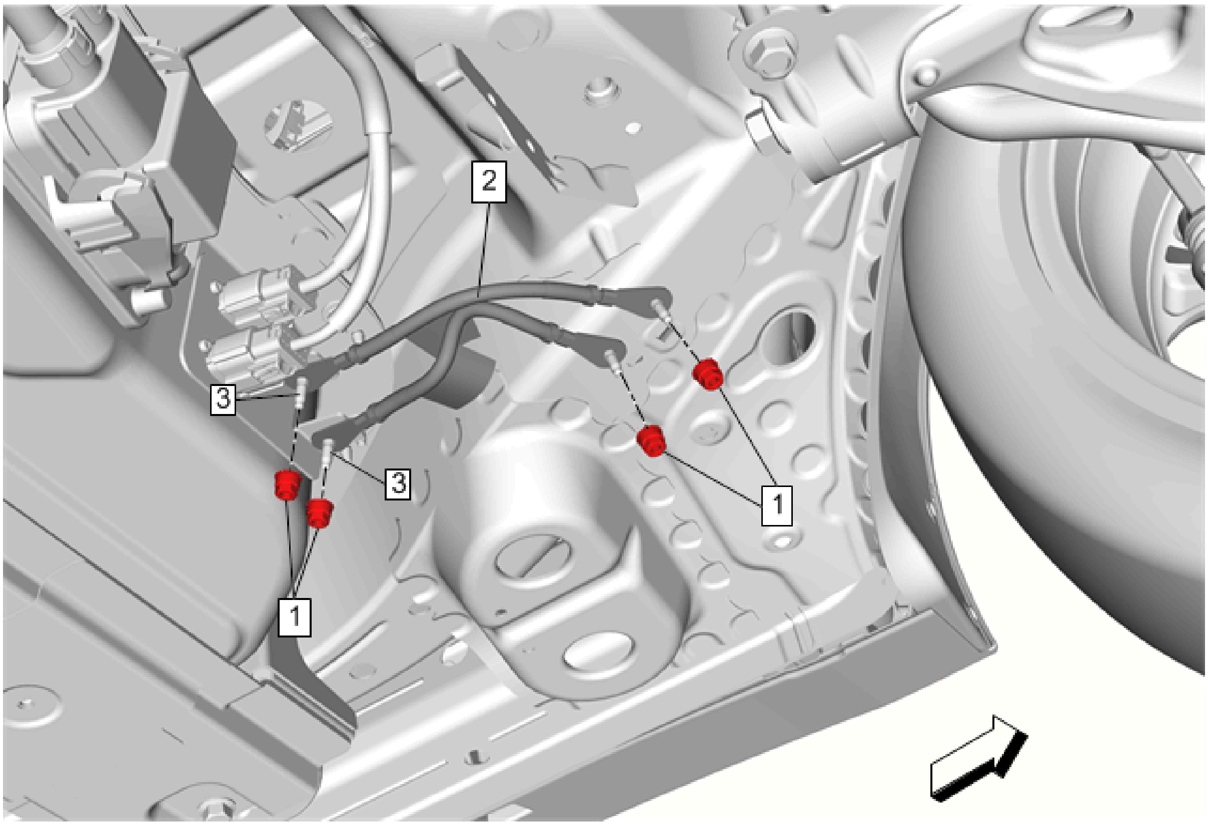


Fig. 316: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

4. Remove the battery negative cable (2) from the high voltage battery and body structure. Battery Negative Cable Replacement (High Voltage Battery to Body Structure) Battery Negative Cable Replacement (12V Battery to Body Structure)

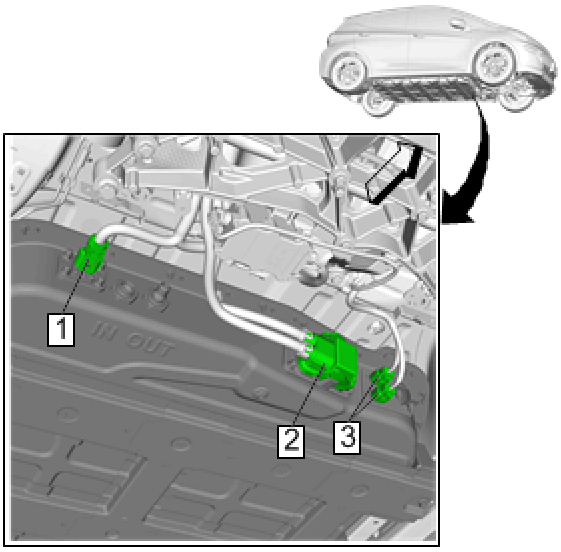


Fig. 317: Body Wiring Harness Connectors And High Voltage Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the X4 high voltage battery connector (1) from the drive motor battery.
6. Disconnect the X3 high voltage battery connector (2) from the drive motor battery by rotating the connector handle until 90 degrees.
7. Disconnect the body wiring harness connectors (3) from the drive motor battery.

WARNING: **To avoid any vehicle damage, serious personal injury or death:**

- **When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.**
- **When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.**

CAUTION: **Perform the following steps before beginning any vehicle lifting or jacking procedure:**

- **Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.**
- **The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.**
- **The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.**
- **Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.**

- **Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.**

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

8. During drive motor battery removal, vehicle weight will be redistributed and may cause the vehicle to become unstable on the hoist. To avoid the vehicle potentially falling off secure the vehicle to lift/hoist arms with straps.

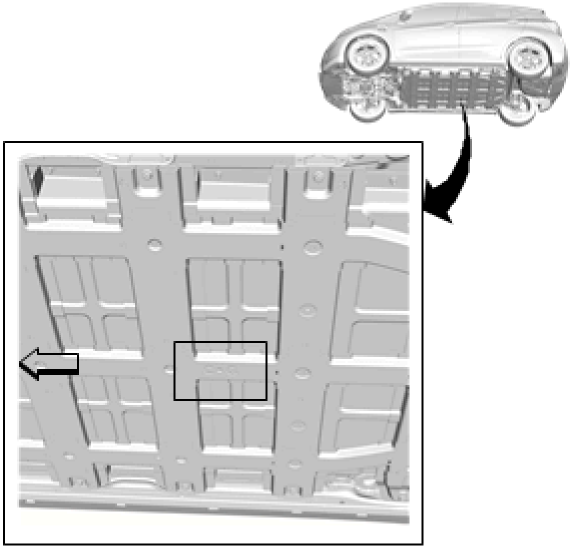


Fig. 318: Lifting Table
Courtesy of GENERAL MOTORS COMPANY

NOTE: **There is C.G (Center of Gravity) mark on the drive motor battery tray to locate your lift table.**

NOTE: **The high voltage battery mass is approximately 450 kg (1000 lbs)**

9. Position a **GE-52418** Lifting Table or **GE-52200** Lifting Table and raise the lifting table into position.

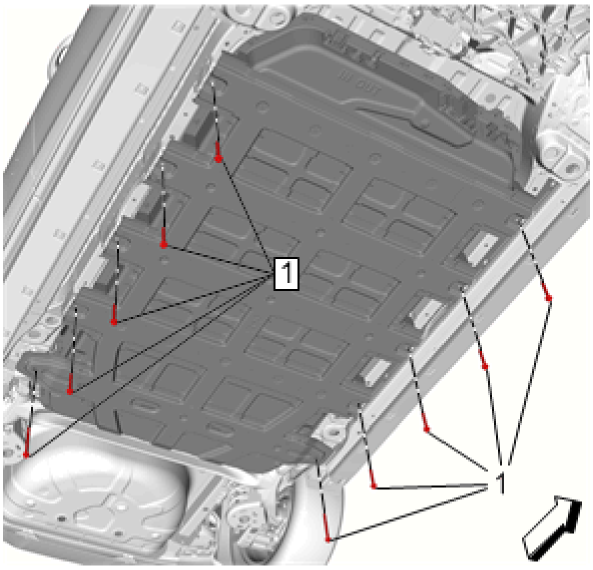


Fig. 319: Outside Mounting Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Verify ALL connectors are removed from the drive motor battery.**

NOTE: **Confirm the locking MSD cap/cover required in some regions will**

pass through the vehicle floor panel. If not, the MSD cap/cover should be removed during Battery Pack lowering from vehicle then reinstalled once the pack is out.

NOTE: **Ensure all fasteners are removed before lowering the support table fixture with the drive motor battery.**

10. Remove the drive motor battery mounting fasteners (1).

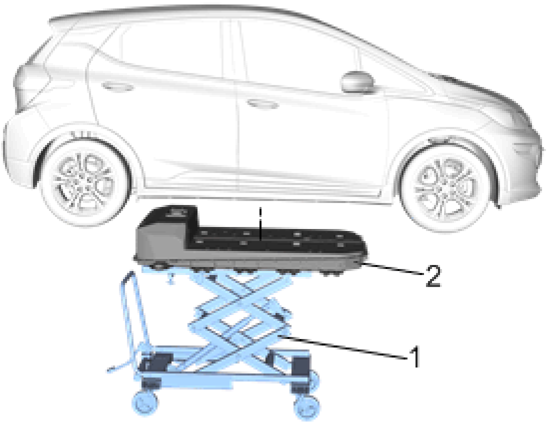


Fig. 320: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

WARNING: **When removing the high voltage battery, only use the recommended lift table with straps capable of holding 1000kg (2204.62 lbs). Failure to use the appropriate lift table and straps could cause the battery to fall and may result in personal injury or death.**

11. Slowly lower the lifting table (1) with the drive motor battery (2).
12. Secure the high voltage battery to the lifting table with straps.
13. Cover the manual disconnect tape.

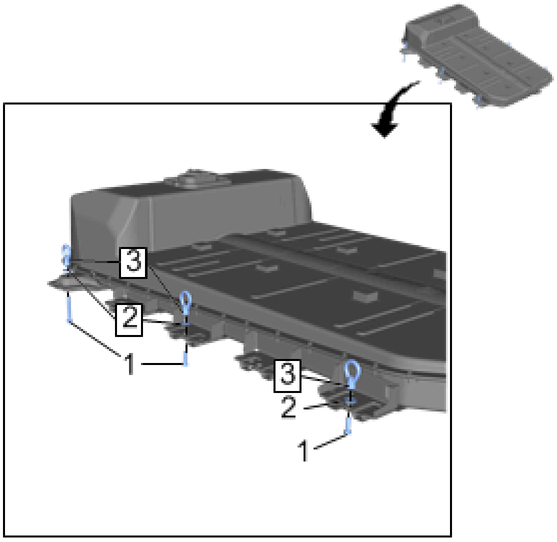


Fig. 321: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

14. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

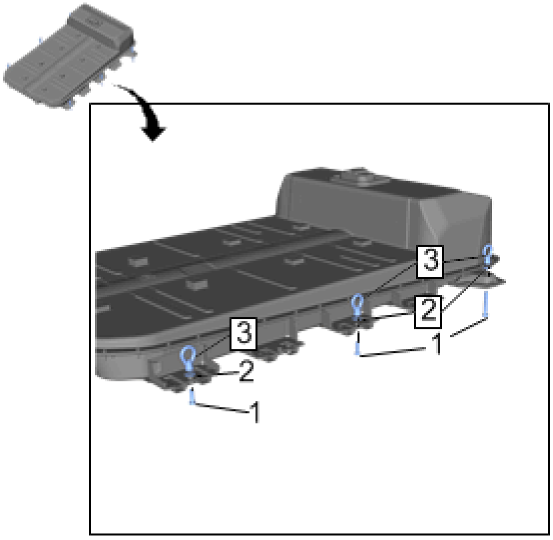


Fig. 322: 3 Eye-Nut, Washer And Bolts
Courtesy of GENERAL MOTORS COMPANY

15. Using the **EL-51102 - 20** High Voltage Battery Lift Bar Tilter Eye-Nut Kit install the 3 eye-nut (3), washers (2) and bolts (1). Tighten the bolts (1) to 9 N.m (80 lb in).

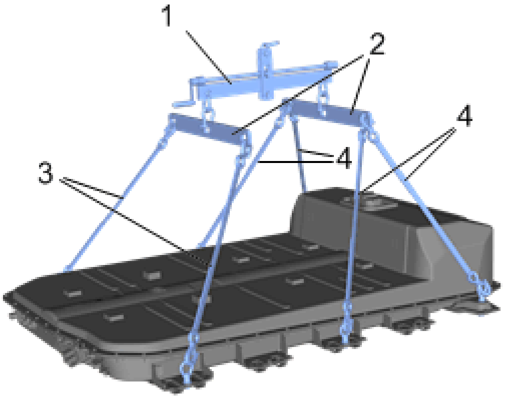


Fig. 323: High Voltage Battery Lift Bar Tilter
Courtesy of GENERAL MOTORS COMPANY

16. Attach the **EL-51102** High Voltage Battery Lift Bar Tilter (1) to a suitable lifting crane.
17. Position the **EL-51102** High Voltage Battery Lift Bar Tilter and **EL-51102 - 10** Hanging Bars and Shackles (2) over the high voltage battery as shown.
18. Install the **EL-51102 - 40** Battery Lifting Strap (3) and the **EL-51102 - 50** Battery Lifting Strap (4) to transport the drive motor battery to a secure area.

NOTE: **Make sure the drive motor battery is balanced when hung from the lifting straps before moving with a crane or chain block to a support table.**

NOTE: **As part of the battery removal process, all coolant should be drained from the battery pack.**

NOTE: **If internal repairs are being performed on the battery, all coolant should be drained from the battery pack to ensure coolant does not drain from the hoses during repairs.**

19. Install 2 coolant plugs into the coolant lines. Coolant plugs can be removed from the NEW service battery assembly.

Installation Procedure

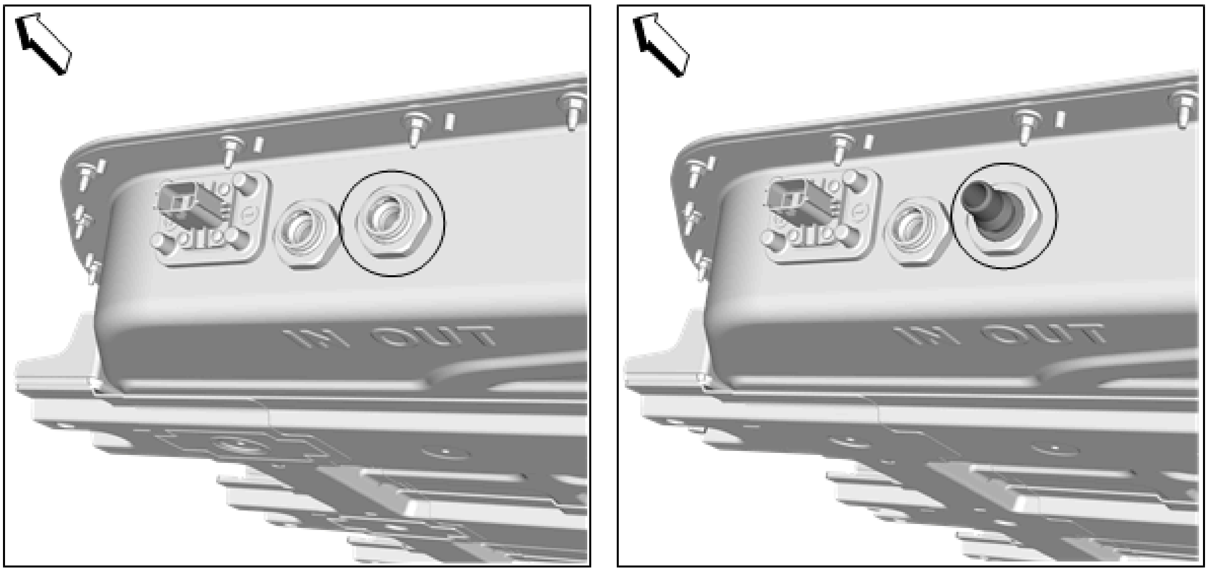


Fig. 324: New/ Old Battery Versions
Courtesy of GENERAL MOTORS COMPANY

1. Check if the drive motor battery pack is OLD version battery or NEW version battery.

   1.1 OLD version battery has a female type battery cooler outlet port like upper left picture.

   1.2 NEW version battery has a male type battery cooler outlet port like upper right picture.

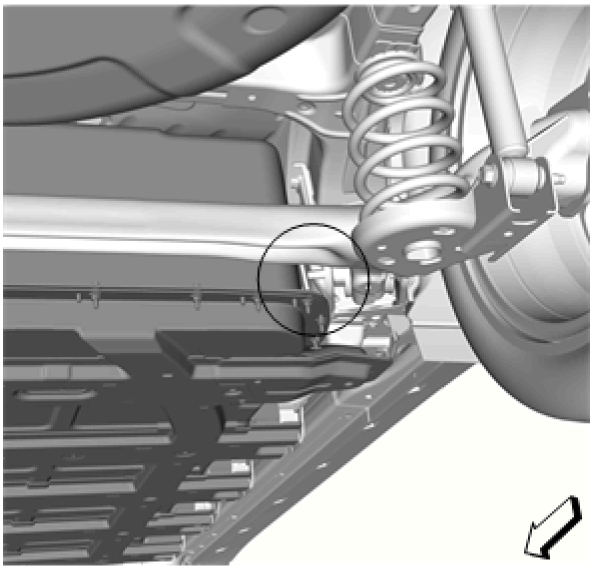


Fig. 325: Rear Of Drive Motor Battery And Rear Suspension Bushing Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Avoid making contact between the rear of the drive motor battery and the rear suspension bushing bolts.

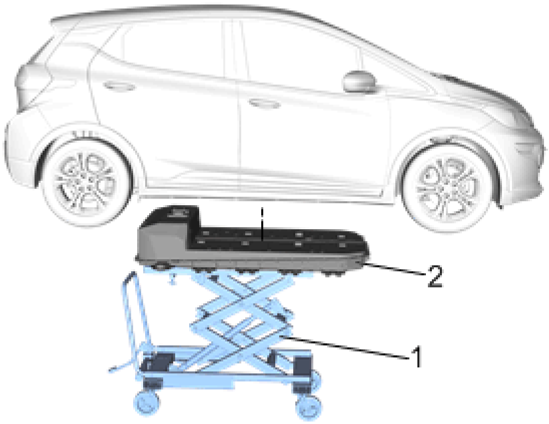


Fig. 326: Lifting Table With Drive Motor Battery
Courtesy of GENERAL MOTORS COMPANY

3. Secure high voltage battery to the lifting table with straps.
4. With the drive motor battery (2) on the **GE-52418** Lifting Table or **GE-52200** Lifting Table (1), slowly raise the lifting table.
5. Release the straps.

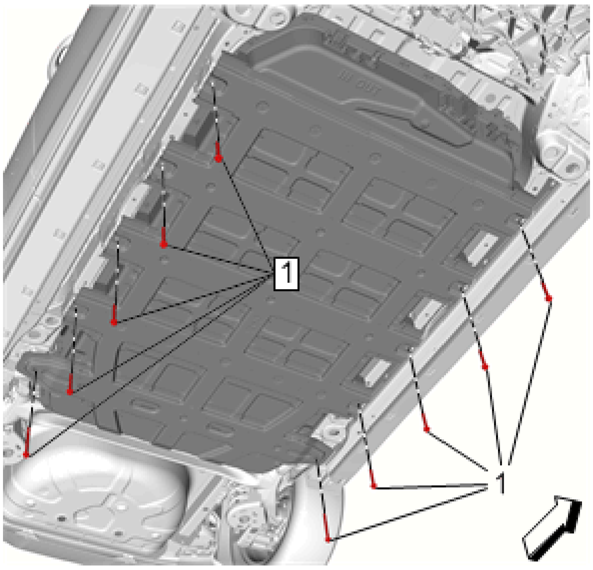


Fig. 327: Outside Mounting Fasteners
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

6. Snugly tighten the outside mounting fasteners (1).
7. Lower the lifting table.
8. Tighten the fasteners (1) to 56 N.m (41 lb ft).

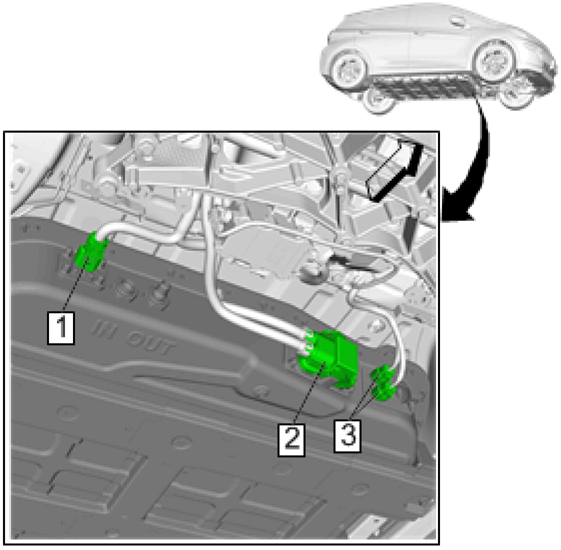


Fig. 328: Body Wiring Harness Connectors And High Voltage Connector
Courtesy of GENERAL MOTORS COMPANY

9. Connect the body wiring harness connectors (3) to the drive motor battery.
10. Connect the X3 high voltage connector (2) to the drive motor battery.
11. Connect the X4 high voltage connector (1) to the drive motor battery.

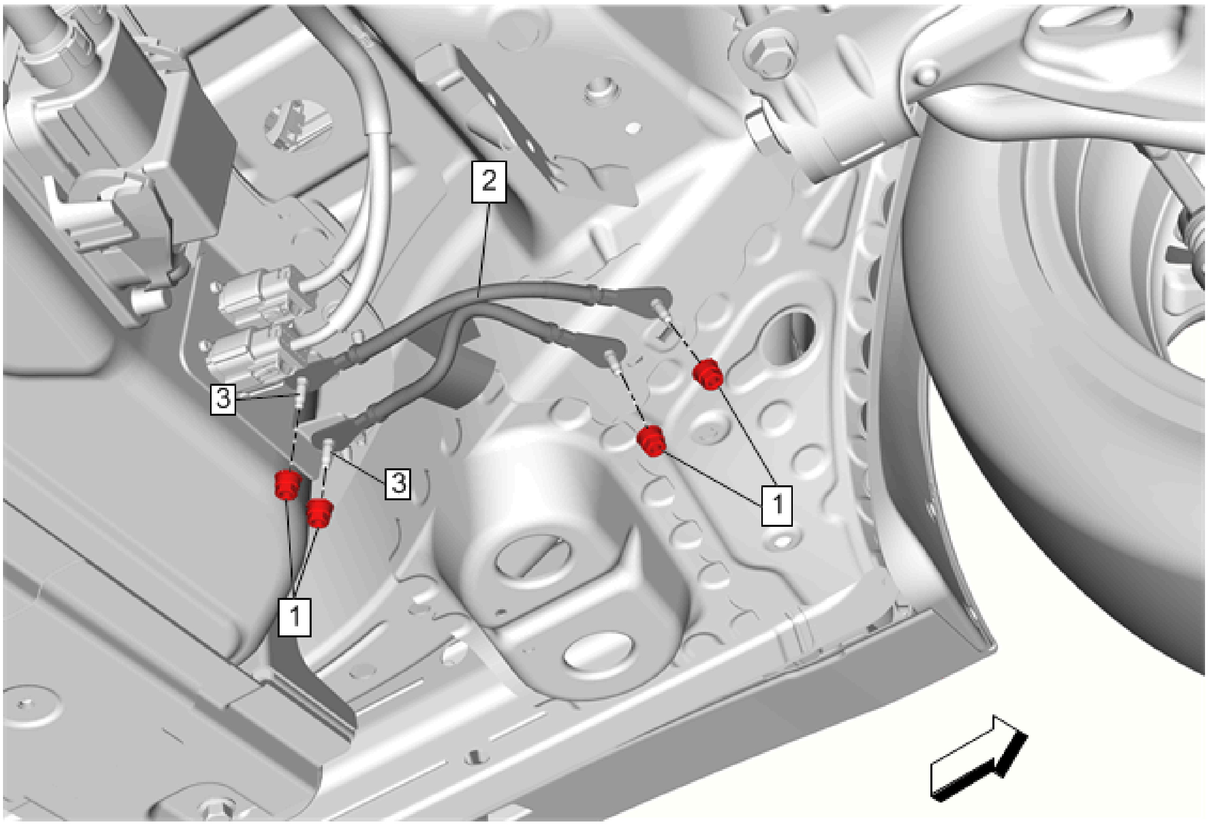


Fig. 329: Battery Negative Cable
Courtesy of GENERAL MOTORS COMPANY

12. Install the battery negative cable (2) to the high voltage battery and body structure. **Battery Negative Cable Replacement (High Voltage Battery to Body Structure)** **Battery Negative Cable Replacement (12V Battery to Body Structure)**
13. Untie the straps that is installed to avoid the vehicle potentially falling off from the lift/hoist.
14. Fill the drive motor battery cooling system. **Drive Motor Battery Cooling System Draining and Filling**
15. Check the cooling system for leaks. **Hybrid Cooling System Leak Test**
16. Install the front compartment air deflector. **Front Compartment Air Deflector Replacement**
17. Enable the high voltage system. **High Voltage Enabling**

18. Reprogram the battery energy control module. **Battery Energy Control Module Programming and Setup**
19. Program the hybrid powertrain control module 2. **Hybrid Powertrain Control Module 2 Programming and Setup**
20. Clear the secured high voltage DTCs. **Clear Secured High Voltage DTCs**
21. If required, perform the battery Hybrid/EV battery pack capacity learn procedure. **Hybrid/EV Battery Pack Capacity Learn**

NOTE: **Refer to Diagnostic Aids to determine when, if required procedure should be performed.**

CLEAR SECURED HIGH VOLTAGE DTCS

Circuit/System Description

The hybrid powertrain control modules 1 and 2 independently monitor for high voltage safety conditions such as airbag deploy events and certain high voltage system faults. When either module identifies one of these conditions, a DTC may set and the vehicle is placed into a 'high voltage lockout' state. While in the lockout state, the high voltage contactor relays are prevented from closing.

The purpose of the high voltage lockout state is to allow for high voltage system inspection prior to re-enabling. A complete inspection of the high voltage system and components must be performed if the vehicle has been involved in a collision. Perform the **High Voltage System Inspection** procedure, if necessary, prior to clearing a Secured High Voltage DTCs/lockout state.

Diagnostic Aids

- The following conditions may result in a HV lockout state without a corresponding DTC:
    - High voltage component replacement
    - Low 12 V battery event
    - SPS programming event
    - Airbag deployment/crash event detected: The Inflatable Restraint Sensing and Diagnostic Module may or may not set a DTC but will continue to broadcast a crash event status until reset.
- Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout.
- Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.
- The Clear Secured High Voltage DTCs procedure must be completed when the following components, as applicable, are replaced:
    - K16 Hybrid/EV Battery Energy Control Module
    - K112A - K112H Hybrid/EV Battery Interface Control Module
    - A4 Hybrid/EV Battery Pack
    - K114A Hybrid/EV Powertrain Control Module 1
    - K114B Hybrid/EV Powertrain Control Module 2

Contactor Open Reasons Reset

The hybrid/EV powertrain control module 2, Hybrid/EV Battery Contactor Open Reasons scan tool parameter list identifies all past events that commanded contactors open. The parameters can only be reset by either reprogramming the hybrid/EV powertrain control module 2 or by performing the scan tool Hybrid/EV Battery Contactor Open Reasons Reset function. To aid in possible future intermittent diagnosis, the parameters should be reset to NO once all diagnostic procedures are successfully completed.

Scan Tool Hybrid/EV Battery Contactor Open Reasons Reset Function

NOTE: **The hybrid/EV system must be able to enter a Propulsion Active state.**

1. Complete the Circuit System Verification and Testing as necessary.
2. Remove any chargers and as applicable, the charge cord.
3. Vehicle OFF, wait 5 minutes.

NOTE: **It is not necessary to completely remove the S15 Manual Service Disconnect.**

4. Disengage the S15 Manual Service Disconnect to the first position to open the high voltage interlock loop circuit.
5. Service Mode, enable the scan tool reset function.
6. Vehicle OFF, wait 5 minutes.
7. Fully engage the S15 Manual Service Disconnect.
8. Start the vehicle and Clear Vehicle DTCs.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle ON.
2. With a scan tool, verify the Hybrid/EV Powertrain Control Module 2 parameters Hybrid/EV Battery Positive Contactor Command and Hybrid/EV Battery Negative Contactor Command each indicate Closed.
    - **If the contactors are not commanded Closed**

      Refer to Circuit/System Testing.

    - **If the contactors are commanded Closed**
3. A Secured High Voltage DTC HV lockout state is not present. All OK.

Circuit/System Testing

The Clear Secured High Voltage DTCs reset process requires scan tool interaction with **two or three different control modules in sequence** and can be completed using the following steps:

1. Install **EL-49642** SPS programming support tool.
2. Vehicle in Service Mode. With a scan tool select the Hybrid/EV Powertrain Control Module 2, Hybrid Battery Pack Contactor Open Reasons data list. Verify if either the Crash Event Detected or Air Bag Deployed parameters indicate YES.
    - **If either parameter displays YES**
    1. Perform the **High Voltage System Inspection** procedure.
    2. If the results of the inspection procedure support enabling of the high voltage system, perform the Inflatable Restraint and Sensing Diagnostic Module function Reset High Voltage Disable Request After Crash Event Detected.
    3. Turn the vehicle OFF for 5 minutes.
    4. Proceed to next step.
    - **If BOTH parameters indicate NO**
3. Vehicle in Service Mode. With a scan tool, clear All DTCs.

NOTE: **A command reject may appear on the scan tool after the first Clear Secured High Voltage DTCs request. If this occurs, ignore this command reject and continue to the next step.**

4. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Control Functions list. Select Clear Secured High Voltage DTCs and follow the on-screen instructions waiting 45 seconds before exiting the screen.
5. With a scan tool, select Hybrid/EV Powertrain Control Module Control Functions list. Select Clear Secured High Voltage DTCs. Select Continue button waiting 45 seconds before exiting the screen.
6. With a scan tool, select Hybrid/EV Powertrain Control Module 2 Control Functions list. Select Clear Secured High Voltage DTCs and follow the on-screen instructions.
7. With a scan tool, clear All DTCs.
8. Allow the Hybrid/EV powertrain Control Modules to enter sleep mode by performing the following:
    1. Turn the vehicle OFF.
    2. Ensure the scan tool is not communicating with any control modules by returning to the Home screen.
    3. Ensure the scan tool is accessible without having to open doors or otherwise cause control module wake-up.
    4. Shut all doors. Do NOT depress the brake pedal or activate any vehicle controls such as the parking lights, fuel door release, etc.

       NOTE: **Sleep mode is usually entered within two minutes after shutting off the vehicle. However, activating vehicle features such as Refuel Mode may extend this time up to 30 minutes.**

    5. Wait 5 minutes with the vehicle in the prescribed condition so that the modules may enter sleep mode.
9. With a scan tool, verify the Hybrid/EV Powertrain Control Module 2 has gone to sleep by ensuring communication is not present.
    - **If communication is present**

      Repeat the previous step.

    - **If communication is not present**
10. Start the vehicle.
11. Verify that no DTCs are set.
    - **If any DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no DTCs are set**
12. All OK.

HYBRID/EV BATTERY PACK CAPACITY LEARN

Circuit/System Description

The Hybrid Powertrain Control Module 2 learns the battery capacity as the Hybrid/EV battery pack is discharged and charged. Once learned, the capacity value is allowed to change over a long period of time, as the battery ages.

Replacement of the battery pack, all battery sections or the Hybrid Powertrain Control Module 2 requires capacity learning at a faster rate than normal.

To enable hardware replacement, the Hybrid Powertrain Control Module 2 can be placed into a fast learn mode with the scan tool.

Activating the fast Capacity Learn mode will reset the battery capacity to a much lower value and subsequent charge/discharge cycles will then learn the capacity back up to the proper value. Initially this may have a noticeable effect on EV range until the capacity learning for the new hardware begins. It may take several battery pack depletions and charges for a maximum EV range to be learned/displayed.

Diagnostic Aids

The Hybrid/EV Battery Pack Capacity Learn procedure must be completed when the following components are replaced:

- Hybrid Powertrain Control Module 2
- Hybrid/EV Battery Pack
- All battery sections

Whenever the Hybrid/EV Battery Pack Capacity Learn is activated the vehicle needs to be operated in a normal manner in order to learn an accurate battery capacity value.

NEVER disconnect the 12V battery supply to the vehicle or the Hybrid Powertrain Control Module 2 after initially activating the Hybrid/EV Battery Pack Capacity Learn. Loss of 12V power will force the Hybrid Powertrain Control Module 2 to store the current capacity value as accurate and will also disable fast learning. The process needs to complete without 12V battery interruption for the best results. Repeat the Hybrid/EV Battery Pack Capacity Learn any time 12V battery interruption occurs prior to operating the vehicle by driving and/or charging. It is possible to observe whether an update has occurred by looking at the battery capacity after charging and/or driving the vehicle.

Hybrid/EV Battery Pack Capacity Learn

NOTE: **Hybrid/EV Battery Pack Capacity Learn should ONLY be activated when the battery pack, ALL battery sections or the Hybrid Powertrain Control Module 2 has been replaced.**

The Hybrid/EV Battery Pack Capacity Learn procedure can be activated with a scan tool using the following steps:

1. Vehicle On
2. With a scan tool, select Hybrid Powertrain Control Module 2 Configuration/Reset Functions. Select the Learn Functions -Hybrid/EV Battery Pack Capacity Learn and command a Learn.
3. Observe and record the alphanumeric value in the Hybrid/EV Battery Pack Capacity scan tool parameter.
4. Connect the vehicle charge cord and completely charge the hybrid/EV battery pack.
5. The vehicle is OK to return to the customer. Inform the customer that their EV range will continue to learn as the vehicle is operated normally. Longer drive trips followed by full charging will allow the fastest learn.
6. If the customer returns with an EV Range concern, contact technical assistance.

HYBRID/EV BATTERY CELL BALANCING

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

Hybrid/EV Battery Cell Balancing

The **EL-50332** Hybrid/EV Battery Service Tool is used to match the voltage level of a replacement battery section to the existing battery sections following a service event. The tool will charge or discharge the replacement section, as required, based on measured cell group voltage data. The **EL-50332** requires feedback from the battery energy control module during the balancing process. Communication is through the A4 Hybrid/EV Battery Pack connectors and a low voltage interface harness provided with the **EL-50332** Hybrid/EV Battery Service Tool. The charging and discharging is performed by direct alligator clamp connection to the replacement battery module positive and negative terminals.

Each battery section contains two battery cell modules. With the exception of section/row 5, the two battery cell modules are not electrically connected within their respective section/row and will need to be balanced individually and sequentially. Refer to Drive Motor Battery System Description .

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- COMPONENT CONNECTOR END VIEWS - INDEX
- INLINE HARNESS CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Special Tools

- **EL-50332** Hybrid/EV Battery Service Tool
- **EL-50332-105** Universal Fuse Box
- **EL-50332-120** High Voltage Interface Cable
- **EL-50332-125** Vehicle Interface Module Low Voltage 24-Pin Cable
- **EL-50332-145** Black Banana Jack Cable
- **EL-50332-150** Red Banana Jack Cable
- **EL-50332-155** Green Banana Jack Cable
- **EL-50332-170** High Voltage Alligator Clamps
- **EL-50332-175** 120 V Power Cable
- **EL-50332-180** 250 V Power Cable - AUS
- **EL-50332-185** 250 V Power Cable - EU/Korea
- **EL-50332-270** Vehicle Interface Module 2
- **EL-50332-325** Low Voltage Communication Harness

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

WARNING: **High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.**

WARNING: **This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test**

equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.

Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: **Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.**

Failure to follow these precautions could result in personal injury, death and property damage.

EL-50332 Configuration Procedure

NOTE: **Depending on the state of charge variation of the replacement section/row and the remaining battery pack sections, the balance process may take up to 40 hours to complete. You may stop or pause the process at any time. Regardless of your progress through the procedure, whenever restarting the EL-50332 you will always be required to connect to the first module, if only for a momentary voltage check.**

NOTE: **Before balancing a battery section, make sure all of the external EL-50332 components and cables are in good condition and working order.**

1. Connect the **EL-50332-145** black cable, **EL-50332-150** red cable, and **EL-50332-155** green cable to the **EL-50332-105** fuse box.
2. Connect the **EL-50332-120** cable to the **EL-50332-105** fuse box.
3. Connect the **EL-50332-120** cable to the **EL - 50332** service tool.
4. Connect the **EL-50332-325** harness to the **EL-50332-270** vehicle interface module 2.
5. Connect the **EL-50332-125** 24-pin cable to the **EL-50332-270** vehicle interface module 2.
6. Connect the **EL-50332-125** 24-pin cable to the **EL-50332** service tool.

Cell Balance Procedure

NOTE: **Refer to the Special Tools for the correct regional power cord.**

1. Connect the appropriate regional power cord to the **EL-50332** service tool.
2. Connect the appropriate regional power cord into a known good power outlet.
3. Turn ON the **EL - 50332** service tool using the power switch.
4. At the MAIN MENU, select SECTION BALANCE, press the SELECT soft key.
5. At the TYPE menu, select Bolt EV, press the NEXT soft key.
6. At the TARGET menu, select service replacement section (row) to be balanced, press the NEXT soft key.

Connection Procedure Module 1 of 2

1. Connect the **EL-50332-155** green cable to the A4 Hybrid/EV Battery Pack ground G350.

NOTE: **Observe the EL - 50332 screen to identify which module of the**

section/row to balance first.

2. Connect the **EL-50332-145** black cable to the module negative stud to be balanced. Refer to Hybrid/EV Energy Storage Schematics for Hybrid Battery Sections 1 - 5.
3. Connect the **EL-50332-150** red cable to the module positive stud to be balanced. Refer to Hybrid/EV Energy Storage Schematics for Hybrid Battery Sections 1 - 5.
4. Press the NEXT soft key.
5. Connect the **EL-50332-325** harness to the A4 Hybrid/EV Battery Pack.

Balancing Procedure Module 1 of 2

1. Press the NEXT soft key.

NOTE: **The EL - 50332 will now balance the selected module by charging/discharging, as appropriate. Target voltage will be based on measured pack cell group voltages. Initial balancing will be in a constant current mode - max 5 amp charge, 7.5 amp discharge. The tool will transition to a constant voltage mode - decreasing current near the end of the event.**

2. An audible tone will sound at the end of balancing or in the event of a fault condition.
   - If a fault condition was detected, refer to the **EL - 50332** Hybrid/EV Battery Service Tool Instruction Manual.
   - If a fault condition was not detected
3. Module balancing completed successfully and the second module will need to be balanced. Observe the **EL - 50332** screen to identify the next module to connect.

Connection Procedure Module 2 of 2

1. Connect the **EL-50332-155** green cable to the A4 Hybrid/EV Battery Pack ground G350.
2. Connect the **EL-50332-145** black cable to the second module negative stud to be balanced. Refer to Hybrid/EV Energy Storage Schematics for Hybrid Battery Sections 6 - 10.
3. Connect the **EL-50332-150** red cable to the second module positive stud to be balanced. Refer to Hybrid/EV Energy Storage Schematics for Hybrid Battery Sections 6 - 10.

Balancing Procedure Module 2 of 2

1. Press the NEXT soft key.

NOTE: **The EL - 50332 will now balance the selected module by charging/discharging, as appropriate. Target voltage will be based on measured pack cell group voltages. Initial balancing will be in a constant current mode - max 5 amp charge, 7.5 amp discharge. The tool will transition to a constant voltage mode - decreasing current near the end of the event. A warranty code and pack voltage current data will be displayed at the conclusion of the balancing event.**

2. An audible tone will sound at the end of balancing or in the event of a fault condition.
   - If a fault condition was detected, refer to the **EL - 50332** Hybrid/EV Battery Service Tool Instruction Manual.
   - If a fault condition was not detected
3. Section balancing completed successfully.

7. At the Completed menu, press the NEXT soft key. Record warranty code. Press the EXIT soft key.
8. All OK.

HYBRID/EV BATTERY SYSTEM VERIFICATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

Hybrid/EV Battery System Verification

The **EL-50332** Hybrid/EV Battery Service Tool communicates with the battery energy control module through the A4 Hybrid/EV Battery Pack X357 and X358 connectors. The tool displays battery cell group voltages along with the calculated voltage difference between the highest and lowest readings. The tool also displays the temperatures read by the thermistors located within the battery sections. By reviewing this data, technicians can verify circuit integrity within the A4 Hybrid/EV Battery Pack prior to attaching the Hybrid/EV Battery Cover.

Diagnostic Aids

Hybrid/EV Battery System Verification requires that the battery pack is removed from the vehicle and that the battery energy control module contains software. If you are installing a service replacement battery energy control module, connect the battery pack to the vehicle with the **EL-52014** Low Voltage Jumper Harness Extension and program the battery energy control module prior to performing Hybrid/EV Battery System Verification. Perform the **Clear Secured High Voltage DTCs** procedure after successfully programming the service replacement battery energy control module.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

Testing for Intermittent Conditions and Poor Connections

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL - 50332** Hybrid/EV Battery Service Tool
- **EL - 50332 - 125** Vehicle Interface Module Low Voltage 24-Pin Cable
- **EL - 50332 - 175** 120 V Power Cable
- **EL-50332-180** 250 V Power Cable - AUS
- **EL-50332-185** 250 V Power Cable - EU/Korea
- **EL - 50332 - 270** Vehicle Interface Module 2

- **EL - 50332 - 325** Low Voltage Communication Harness
- **EL-52014** Low Voltage Jumper Harness Extension

For equivalent regional tools, refer to **Special Tools**

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

WARNING: **High voltage circuits should only be tested using a digital multimeter (DMM) and test leads with at least a CAT III rating, such as the J 39200-A Digital Multimeter. Failure to follow the procedures may result in serious injury or death.**

WARNING: **This vehicle is equipped with a high voltage battery that is completely isolated from the chassis ground. Never utilize AC powered test equipment to probe the high voltage system. Serious injury, death and component damage could occur if the high voltage system is grounded through the electric utility.**

Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING: **Damage to a Lithium Ion hybrid/EV battery pack could result in fire, loss of electrical isolation or exposure to high voltage. Until the high voltage system inspection has been completed, store the vehicle with hybrid/EV battery pack installed outside in a secure area away from buildings and other vehicles and protected from rain, snow and other moisture. Remove the hybrid/EV battery pack high voltage manual disconnect lever and store it in a secure place outside the vehicle. Cover the exposed high voltage opening with ULÂ® listed, or equivalent, insulation tape rated at a minimum of 600 V.**

Failure to follow these precautions could result in personal injury, death and property damage.

NOTE: **Before performing the Hybrid/EV Battery System Verification, make sure all of the external EL-50332 components are in good condition and working order.**

1. Connect the **EL-50332-125** 24-pin cable to the **EL-50332-270** vehicle interface module 2.
2. Connect the **EL-50332-125** 24-pin cable to the **EL-50332** service tool.

NOTE: **Refer to the Special Tools for the correct regional power cord.**

3. Connect the appropriate regional power cord to the **EL-50332** service tool.
4. Connect the appropriate regional power cord into a known good power outlet.

5. Power ON the **EL-50332** service tool using the power switch.
6. At the MAIN MENU, select PACK INFO, press the SELECT soft key.

NOTE: **Selecting One-shot will take and display a single snapshot of the battery parameters, selecting Continuous will display live parameter values.**

7. At the PACK INFO TYPE, select ONE-SHOT, press the NEXT soft key.
8. At the MANUFACTURER menu, select correct BRAND, press the NEXT soft key.
9. At the MODEL menu, select correct MODEL, press the NEXT soft key.
10. At the COMM CONNECTION menu, select HYBRID BATTERY CONTACTOR ASSEMBLY, press the NEXT soft key.
11. Connect the **EL-50332-325** low voltage communication harness to the A4 Hybrid/EV Battery Pack.
12. Connect the **EL-50332-325** low voltage communication harness to the **EL-50332-270** vehicle interface module 2, press the NEXT soft key.
13. At the PACK INFO menu, scroll down to the DELTA VCELL parameter. Record and verify the DELTA VCELL is less than 0.1 V.
    - **If the DELTA VCELL is 0.1 V or greater**
    1. At the PACK INFO menu, press the EXIT soft key to end the Hybrid/EV Battery System Verification.
    2. Remove the **EL-50332-325** low voltage communication harness from the A4 Hybrid/EV Battery Pack.
    3. Verify any repairs performed are complete and that all connections are secure.

    NOTE: **Recheck the EL - 50332 cable connections by beginning at step 1 of the Hybrid/EV Battery System Verification.**

    4. Retest the Hybrid/EV Battery System Verification once all repairs have been rechecked.
    - **The DELTA VCELL is less than 0.1 V**
14. Record and verify all of the battery temperature sensor readings are within 6Â°C (10.8Â°F) of each other.
    - **If any of the battery temperature sensor readings are 6Â°C (10.8Â°F) or greater of each other**
    1. At the PACK INFO menu, press the EXIT soft key to end the Hybrid/EV Battery System Verification.
    2. Remove the **EL-50332-325** low voltage communication harness from the A4 Hybrid/EV Battery Pack.
    3. Verify any repairs performed are complete and that all connections are secure.

    NOTE: **Recheck the EL - 50332 cable connections by beginning at step 1 of the Hybrid/EV Battery System Verification.**

    4. Retest the Hybrid/EV Battery System Verification once all repairs have been rechecked.
    - **The battery temperature sensor readings are within 6Â°C (10.8Â°F) of each other**
15. All OK.

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2017 ELECTRICAL

Hybrid/EV Energy Storage - Schematic and Routing Diagrams - Hybrid/EV Energy Storage Schematics - Bolt EV

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV ENERGY STORAGE WIRING SCHEMATICS

Battery Energy and Interface Control Module Power, Ground, and Data Communication

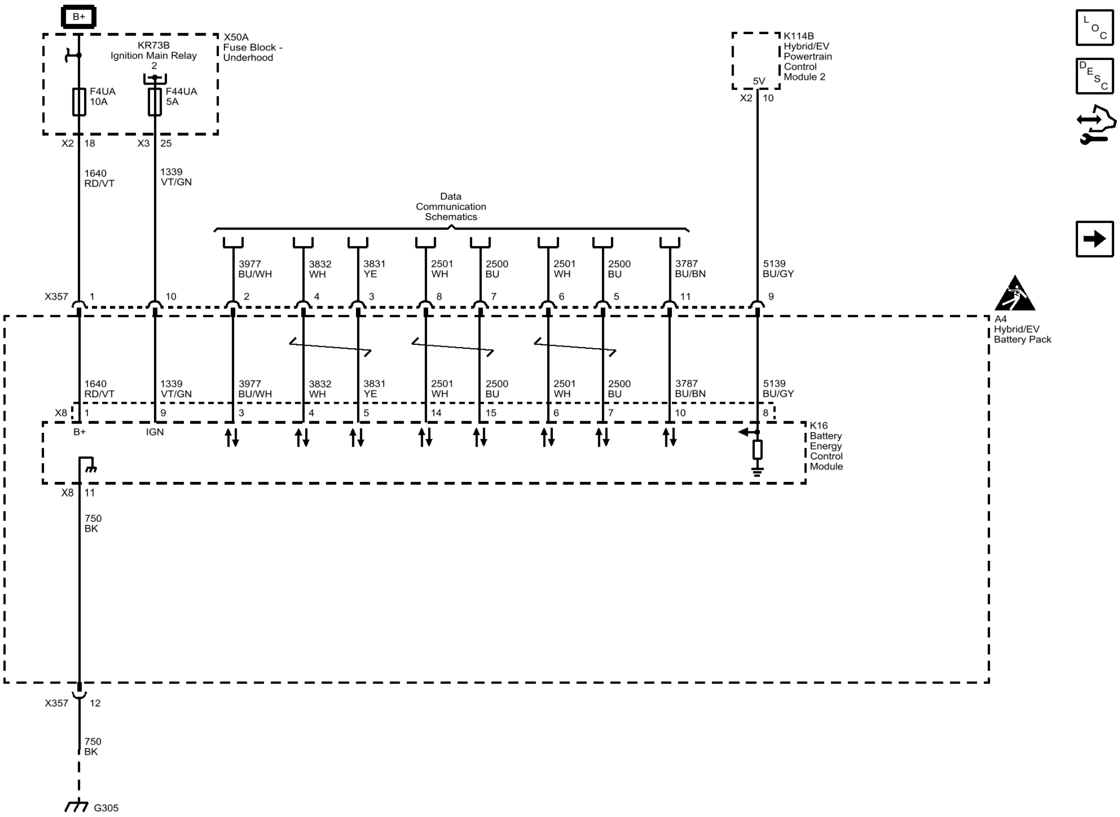

B+
KR73B
Ignition Main Relay
2
X50A
Fuse Block -
Underhood
F4UA
10A
F44UA
5A
X2
18
X3
25
1640
RD/VT
1339
VT/GN
K114B
Hybrid/EV
Powertrain
Control
Module 2
5V
X2
10
Data
Communication
Schematics
3977
BU/WH
3832
WH
3831
YE
2501
WH
2500
BU
2501
WH
2500
BU
3787
BU/BN
5139
BU/GY
X357
1
10
2
4
3
8
7
6
5
11
9
A4
Hybrid/EV
Battery Pack
1640
RD/VT
1339
VT/GN
3977
BU/WH
3832
WH
3831
YE
2501
WH
2500
BU
2501
WH
2500
BU
3787
BU/BN
5139
BU/GY
X8
1
9
3
4
5
14
15
6
7
10
8
B+
IGN
K16
Battery
Energy
Control
Module
X8
11
750
BK
X357
12
750
BK
G305
LOC
DESC

Fig. 1: Battery Energy and Interface Control Module Power, Ground, and Data Communication

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Module Powertrain Control Module 2 Power, Ground and Data Communication

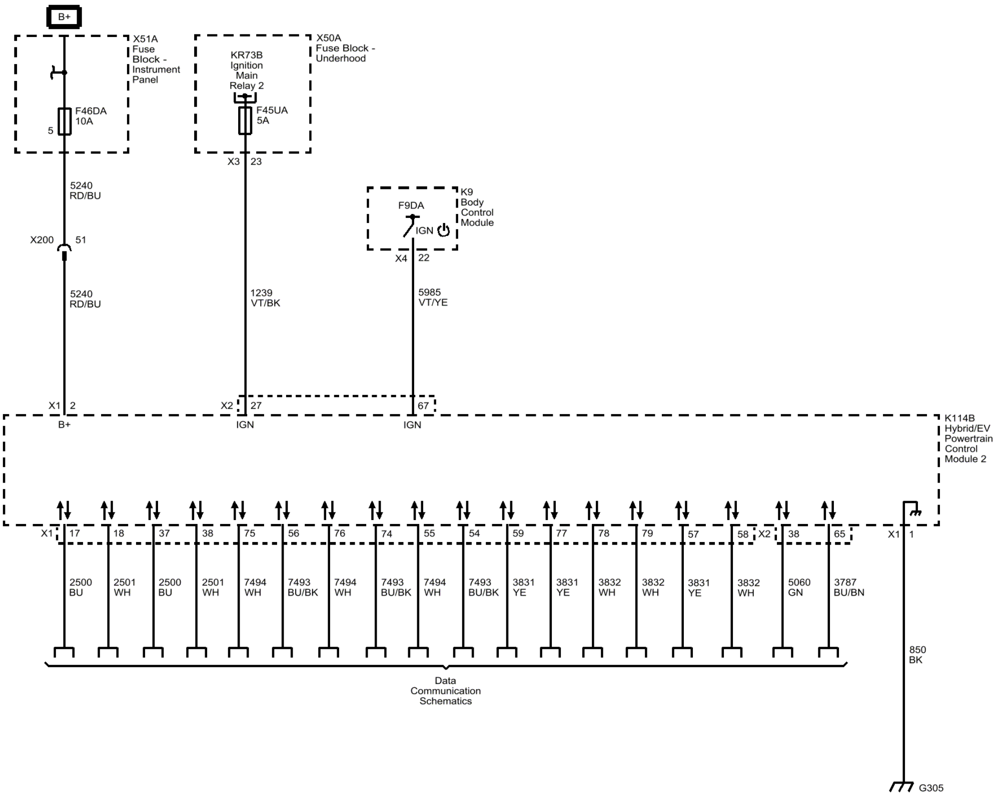

B+
X51A Fuse Block - Instrument Panel
F46DA 10A
5
X50A Fuse Block - Underhood
KR73B Ignition Main Relay 2
F45UA 5A
X3 23
5240 RD/BU
X200 51
5240 RD/BU
1239 VT/BK
K9 Body Control Module
F9DA
IGN
X4 22
5985 VT/YE
X1 2
B+
X2 27
IGN
67
IGN
K114B Hybrid/EV Powertrain Control Module 2
X1 17 18 37 38 75 56 76 74 55 54 59 77 78 79 57 58 X2 38 65
X1 1
2500 BU
2501 WH
2500 BU
2501 WH
7494 WH
7493 BU/BK
7494 WH
7493 BU/BK
7494 WH
7493 BU/BK
3831 YE
3831 YE
3832 WH
3832 WH
3831 YE
3832 WH
5060 GN
3787 BU/BN
850 BK
Data Communication Schematics
G305

Fig. 2: Hybrid/EV Module Powertrain Control Module 2 Power, Ground and Data Communication

Courtesy of GENERAL MOTORS COMPANY

High Voltage Interlock Loop

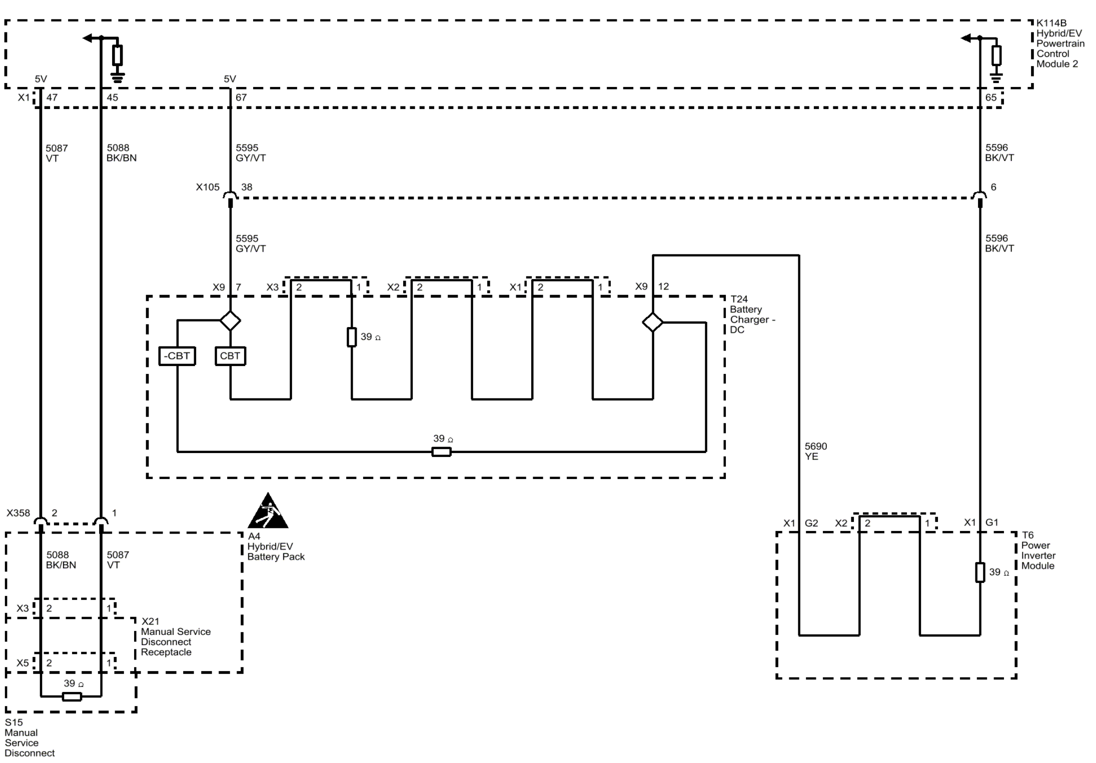

K114B Hybrid/EV Powertrain Control Module 2
5V
X1 47
45
5V
67
65
5087 VT
5088 BK/BN
5595 GY/VT
5596 BK/VT
X105 38
6
5595 GY/VT
5596 BK/VT
X9 7
X3 2 1
X2 2 1
X1 2 1
X9 12
T24 Battery Charger - DC
-CBT
CBT
39 Ω
39 Ω
5690 YE
X358 2
1
A4 Hybrid/EV Battery Pack
5088 BK/BN
5087 VT
X3 2 1
X21 Manual Service Disconnect Receptacle
X5 2 1
39 Ω
S15 Manual Service Disconnect
X1 G2
X2 2 1
X1 G1
T6 Power Inverter Module
39 Ω

Fig. 3: High Voltage Interlock Loop

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Bussing

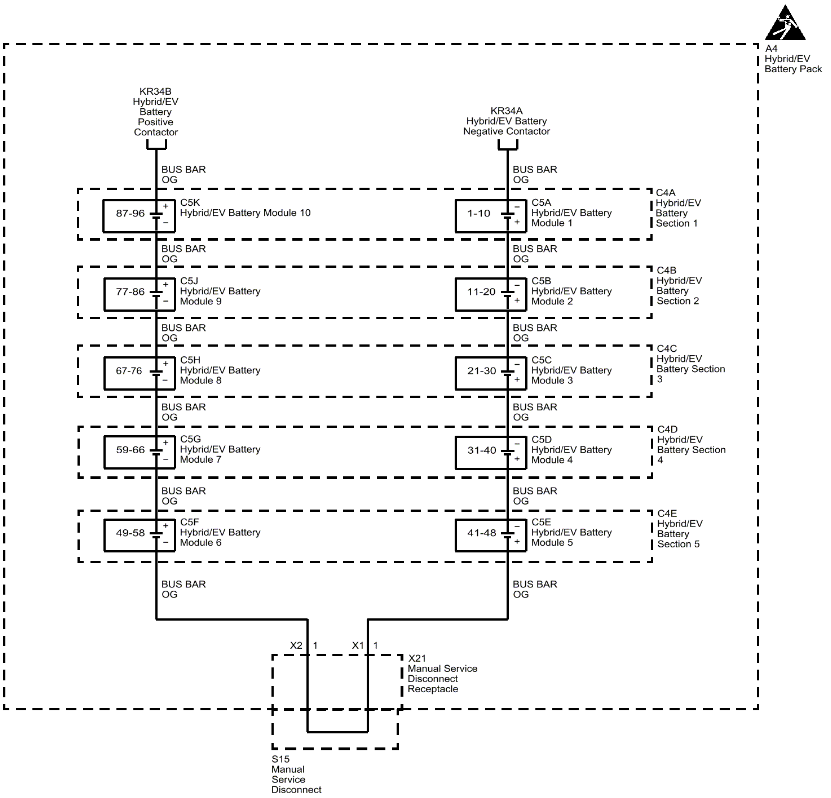

A4
Hybrid/EV
Battery Pack
KR34B
Hybrid/EV
Battery
Positive
Contactor
KR34A
Hybrid/EV Battery
Negative Contactor
BUS BAR
OG
87-96
C5K
Hybrid/EV Battery Module 10
1-10
C5A
Hybrid/EV Battery
Module 1
C4A
Hybrid/EV
Battery
Section 1
77-86
C5J
Hybrid/EV Battery
Module 9
11-20
C5B
Hybrid/EV Battery
Module 2
C4B
Hybrid/EV
Battery
Section 2
67-76
C5H
Hybrid/EV Battery
Module 8
21-30
C5C
Hybrid/EV Battery
Module 3
C4C
Hybrid/EV
Battery Section
3
59-66
C5G
Hybrid/EV Battery
Module 7
31-40
C5D
Hybrid/EV Battery
Module 4
C4D
Hybrid/EV
Battery Section
4
49-58
C5F
Hybrid/EV Battery
Module 6
41-48
C5E
Hybrid/EV Battery
Module 5
C4E
Hybrid/EV
Battery
Section 5
X2 1
X1 1
X21
Manual Service
Disconnect
Receptacle
S15
Manual
Service
Disconnect

Fig. 4: Hybrid/EV Battery Bussing

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 1

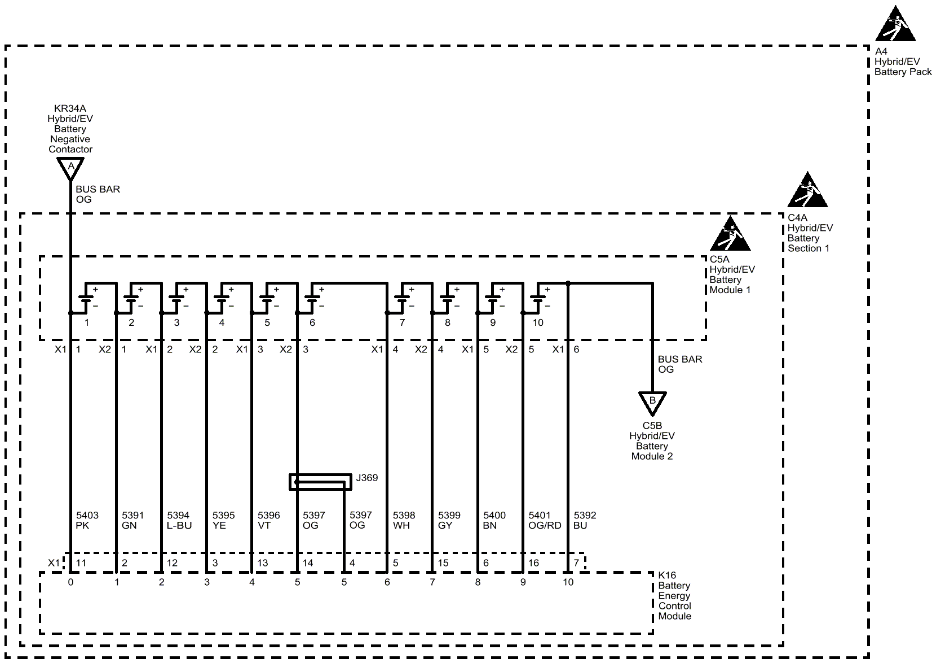

A4
Hybrid/EV
Battery Pack
KR34A
Hybrid/EV
Battery
Negative
Contactor
A
BUS BAR
OG
C4A
Hybrid/EV
Battery
Section 1
C5A
Hybrid/EV
Battery
Module 1
1
2
3
4
5
6
7
8
9
10
X1 1
X2 1
X1 2
X2 2
X1 3
X2 3
X1 4
X2 4
X1 5
X2 5
X1 6
BUS BAR
OG
B
C5B
Hybrid/EV
Battery
Module 2
J369
5403 PK
5391 GN
5394 L-BU
5395 YE
5396 VT
5397 OG
5397 OG
5398 WH
5399 GY
5400 BN
5401 OG/RD
5392 BU
X1 11
2
12
3
13
14
4
5
15
6
16
7
0
1
2
3
4
5
5
6
7
8
9
10
K16
Battery
Energy
Control
Module

Fig. 5: Hybrid/EV Battery Module 1

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 2

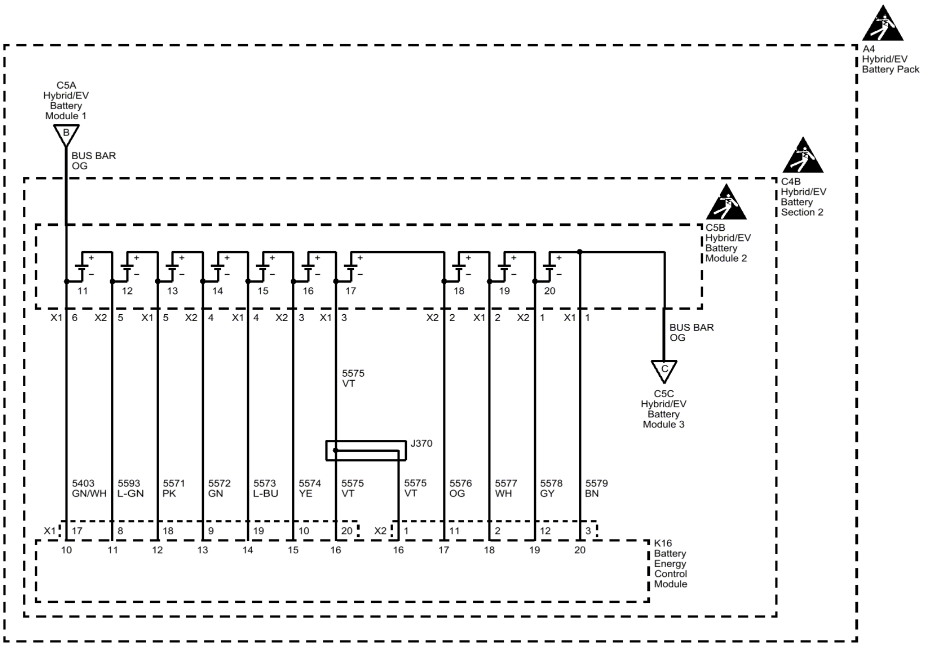

A4
Hybrid/EV
Battery Pack
C5A
Hybrid/EV
Battery
Module 1
B
BUS BAR
OG
C4B
Hybrid/EV
Battery
Section 2
C5B
Hybrid/EV
Battery
Module 2
11
12
13
14
15
16
17
18
19
20
X1 6 X2 5 X1 5 X2 4 X1 4 X2 3 X1 3
X2 2 X1 2 X2 1 X1 1
BUS BAR
OG
C
C5C
Hybrid/EV
Battery
Module 3
5575
VT
J370
5403
GN/WH
5593
L-GN
5571
PK
5572
GN
5573
L-BU
5574
YE
5575
VT
5575
VT
5576
OG
5577
WH
5578
GY
5579
BN
X1 17 8 18 9 19 10 20 X2 1 11 2 12 3
10 11 12 13 14 15 16 16 17 18 19 20
K16
Battery
Energy
Control
Module

Fig. 6: Hybrid/EV Battery Module 2

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 3

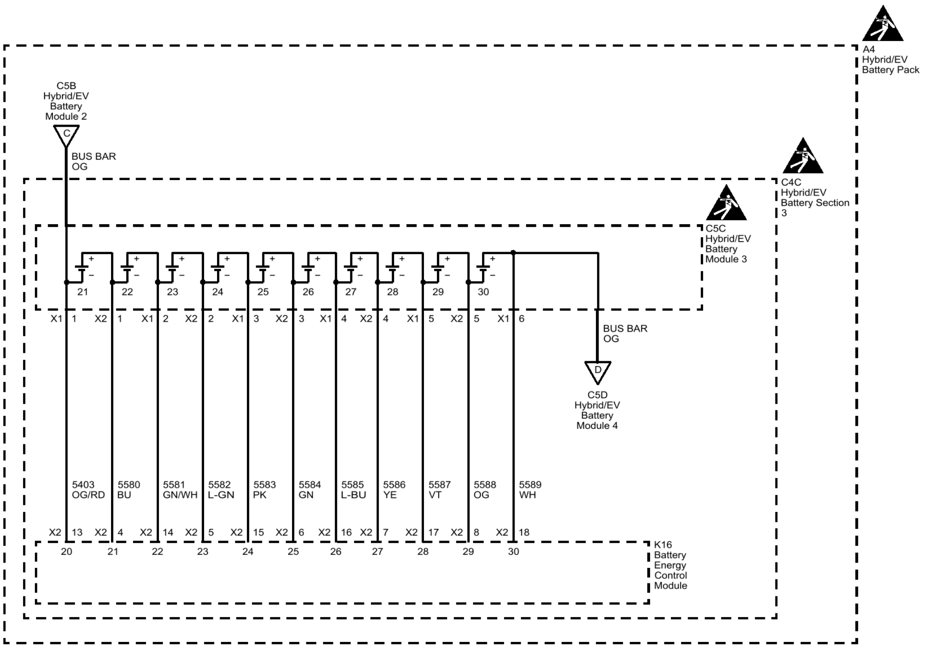

A4
Hybrid/EV
Battery Pack
C5B
Hybrid/EV
Battery
Module 2
C
BUS BAR
OG
C4C
Hybrid/EV
Battery Section
3
C5C
Hybrid/EV
Battery
Module 3
21
22
23
24
25
26
27
28
29
30
X1 1 X2 1 X1 2 X2 2 X1 3 X2 3 X1 4 X2 4 X1 5 X2 5 X1 6
BUS BAR
OG
D
C5D
Hybrid/EV
Battery
Module 4
5403
OG/RD
5580
BU
5581
GN/WH
5582
L-GN
5583
PK
5584
GN
5585
L-BU
5586
YE
5587
VT
5588
OG
5589
WH
X2 13 X2 4 X2 14 X2 5 X2 15 X2 6 X2 16 X2 7 X2 17 X2 8 X2 18
20 21 22 23 24 25 26 27 28 29 30
K16
Battery
Energy
Control
Module

Fig. 7: Hybrid/EV Battery Module 3

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 4

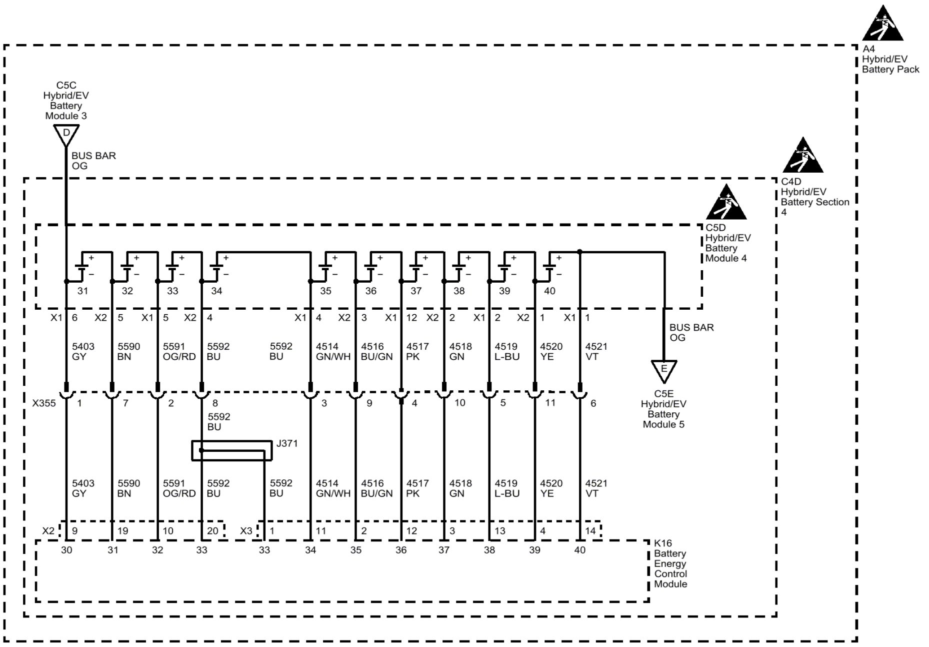

A4
Hybrid/EV
Battery Pack
C4D
Hybrid/EV
Battery Section
4
C5D
Hybrid/EV
Battery
Module 4
C5C
Hybrid/EV
Battery
Module 3
D
BUS BAR
OG
31
32
33
34
35
36
37
38
39
40
X1 6
X2 5
X1 5
X2 4
X1 4
X2 3
X1 12
X2 2
X1 2
X2 1
X1 1
5403 GY
5590 BN
5591 OG/RD
5592 BU
5592 BU
4514 GN/WH
4516 BU/GN
4517 PK
4518 GN
4519 L-BU
4520 YE
4521 VT
BUS BAR
OG
E
C5E
Hybrid/EV
Battery
Module 5
X355
1
7
2
8
3
9
4
10
5
11
6
5592
BU
J371
5403 GY
5590 BN
5591 OG/RD
5592 BU
5592 BU
4514 GN/WH
4516 BU/GN
4517 PK
4518 GN
4519 L-BU
4520 YE
4521 VT
X2 9
19
10
20
X3 1
11
2
12
3
13
4
14
30
31
32
33
33
34
35
36
37
38
39
40
K16
Battery
Energy
Control
Module

Fig. 8: Hybrid/EV Battery Module 4
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 5

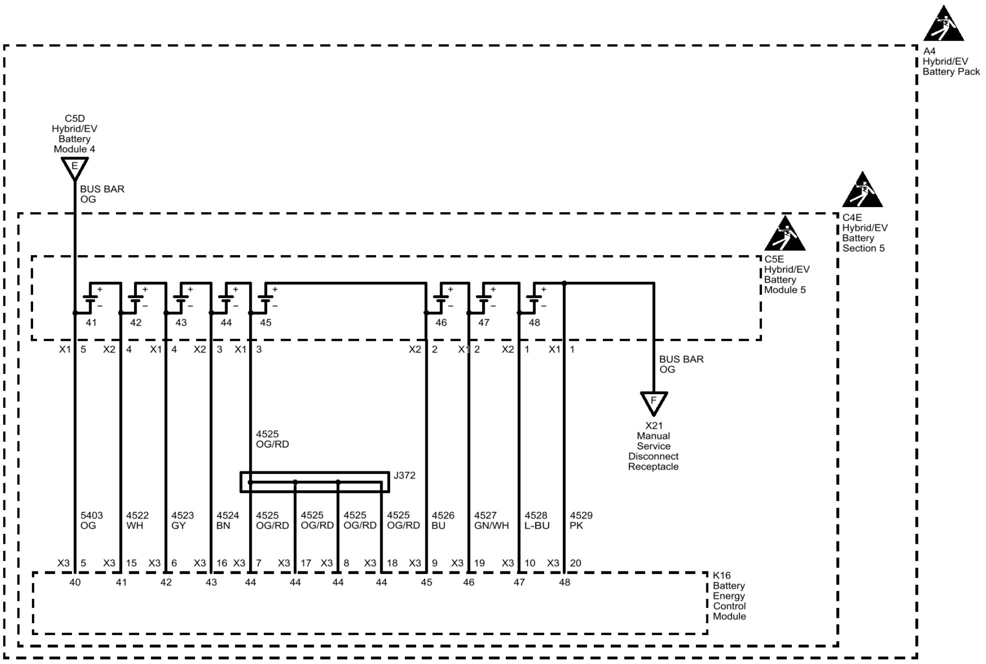

A4
Hybrid/EV
Battery Pack
C4E
Hybrid/EV
Battery
Section 5
C5E
Hybrid/EV
Battery
Module 5
C5D
Hybrid/EV
Battery
Module 4
E
BUS BAR
OG
41
42
43
44
45
46
47
48
X1 5
X2 4
X1 4
X2 3
X1 3
X2 2
X1 2
X2 1
X1 1
BUS BAR
OG
F
X21
Manual
Service
Disconnect
Receptacle
4525
OG/RD
J372
5403 OG
4522 WH
4523 GY
4524 BN
4525 OG/RD
4525 OG/RD
4525 OG/RD
4525 OG/RD
4526 BU
4527 GN/WH
4528 L-BU
4529 PK
X3 5
X3 15
X3 6
X3 16
X3 7
X3 17
X3 8
X3 18
X3 9
X3 19
X3 10
X3 20
40
41
42
43
44
44
44
44
45
46
47
48
K16
Battery
Energy
Control
Module

Fig. 9: Hybrid/EV Battery Module 5
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 6 and Manual Service Disconnect

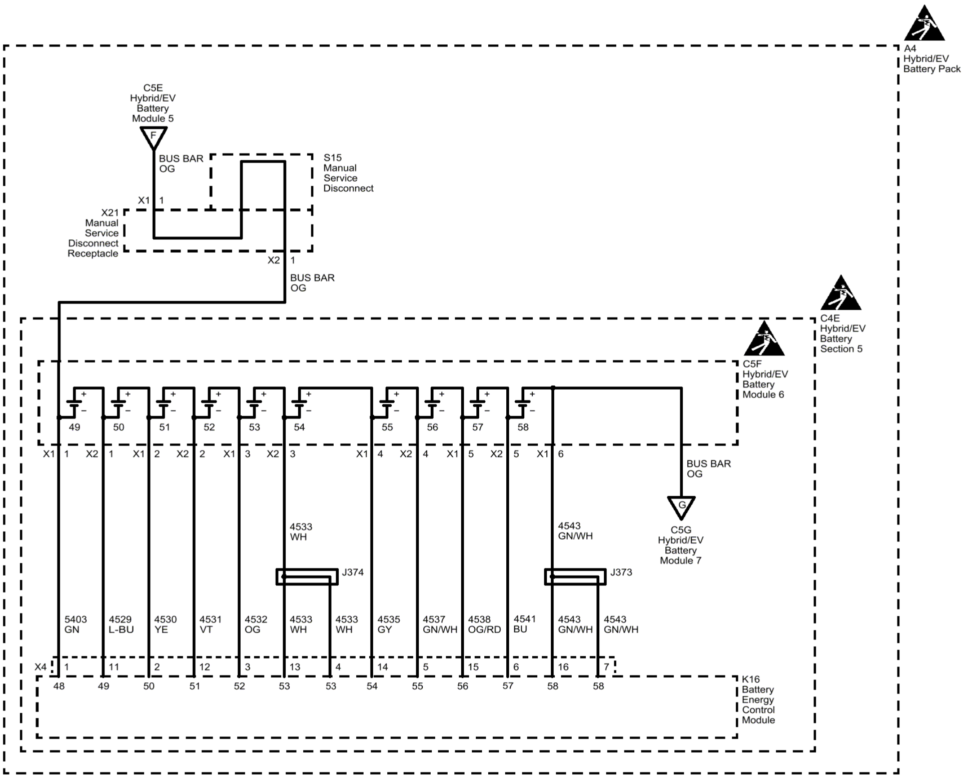

A4 Hybrid/EV Battery Pack
C5E Hybrid/EV Battery Module 5
F
BUS BAR OG
S15 Manual Service Disconnect
X1 1
X21 Manual Service Disconnect Receptacle
X2 1
BUS BAR OG
C4E Hybrid/EV Battery Section 5
C5F Hybrid/EV Battery Module 6
49
50
51
52
53
54
55
56
57
58
X1 1 X2 1 X1 2 X2 2 X1 3 X2 3 X1 4 X2 4 X1 5 X2 5 X1 6
BUS BAR OG
G
C5G Hybrid/EV Battery Module 7
4533 WH
4543 GN/WH
J374
J373
5403 GN
4529 L-BU
4530 YE
4531 VT
4532 OG
4533 WH
4533 WH
4535 GY
4537 GN/WH
4538 OG/RD
4541 BU
4543 GN/WH
4543 GN/WH
X4 1 11 2 12 3 13 4 14 5 15 6 16 7
48 49 50 51 52 53 53 54 55 56 57 58 58
K16 Battery Energy Control Module

Fig. 10: Hybrid/EV Battery Module 6 and Manual Service Disconnect
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 7

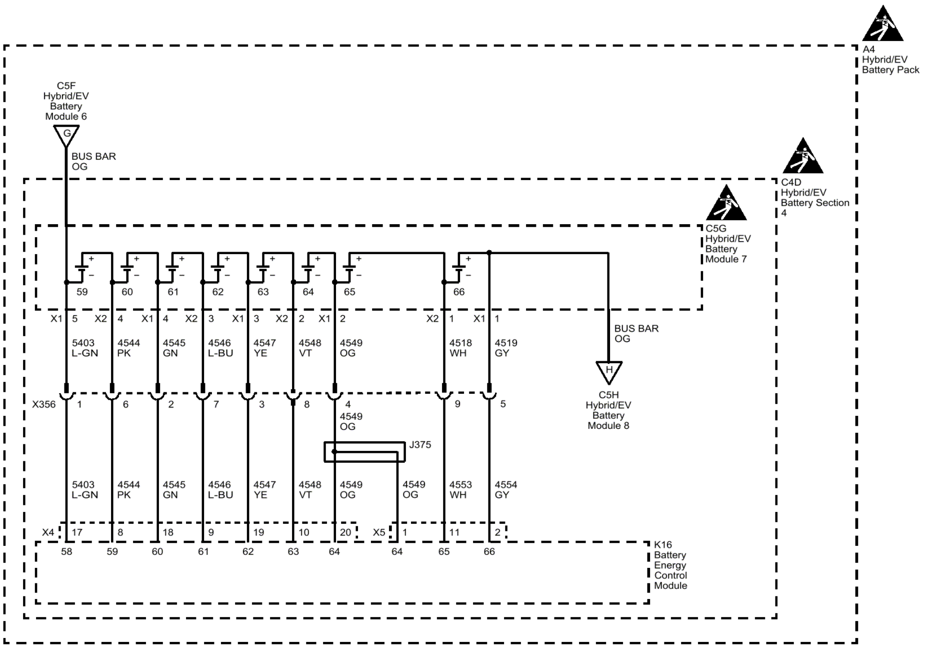

A4 Hybrid/EV Battery Pack
C5F Hybrid/EV Battery Module 6
G
BUS BAR OG
C4D Hybrid/EV Battery Section 4
C5G Hybrid/EV Battery Module 7
59
60
61
62
63
64
65
66
X1 5 X2 4 X1 4 X2 3 X1 3 X2 2 X1 2 X2 1 X1 1
5403 L-GN
4544 PK
4545 GN
4546 L-BU
4547 YE
4548 VT
4549 OG
4518 WH
4519 GY
BUS BAR OG
H
C5H Hybrid/EV Battery Module 8
X356 1 6 2 7 3 8 4 9 5
4549 OG
J375
5403 L-GN
4544 PK
4545 GN
4546 L-BU
4547 YE
4548 VT
4549 OG
4549 OG
4553 WH
4554 GY
X4 17 8 18 9 19 10 20 X5 1 11 2
58 59 60 61 62 63 64 64 65 66
K16 Battery Energy Control Module

Fig. 11: Hybrid/EV Battery Module 7
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 8

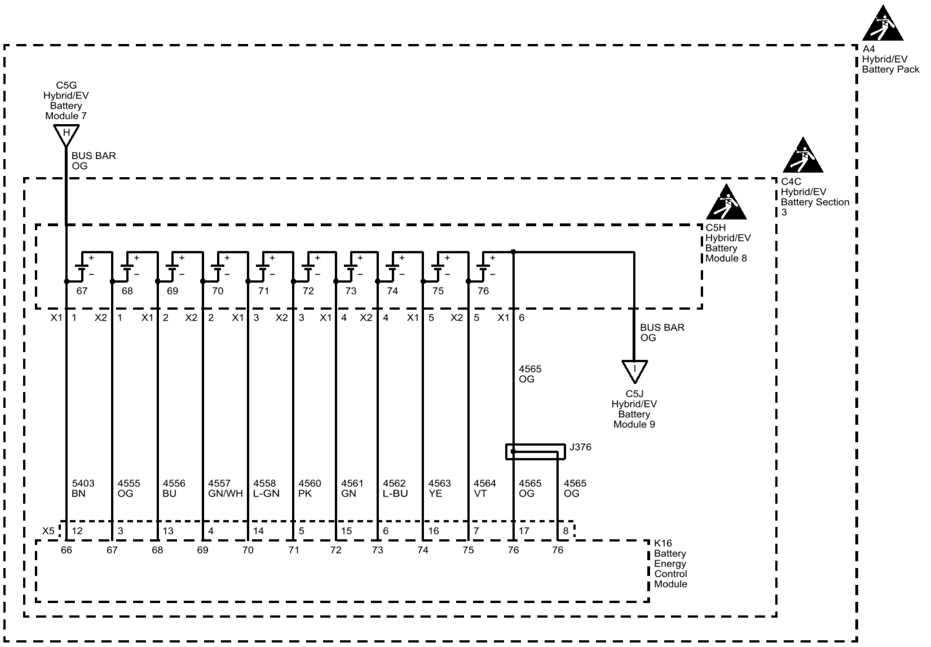

A4
Hybrid/EV
Battery Pack
C5G
Hybrid/EV
Battery
Module 7
H
BUS BAR
OG
C4C
Hybrid/EV
Battery Section
3
C5H
Hybrid/EV
Battery
Module 8
67
68
69
70
71
72
73
74
75
76
X1 1
X2 1
X1 2
X2 2
X1 3
X2 3
X1 4
X2 4
X1 5
X2 5
X1 6
BUS BAR
OG
I
C5J
Hybrid/EV
Battery
Module 9
4565
OG
J376
5403
BN
4555
OG
4556
BU
4557
GN/WH
4558
L-GN
4560
PK
4561
GN
4562
L-BU
4563
YE
4564
VT
4565
OG
4565
OG
X5
12
3
13
4
14
5
15
6
16
7
17
8
66
67
68
69
70
71
72
73
74
75
76
76
K16
Battery
Energy
Control
Module

Fig. 12: Hybrid/EV Battery Module 8

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 9

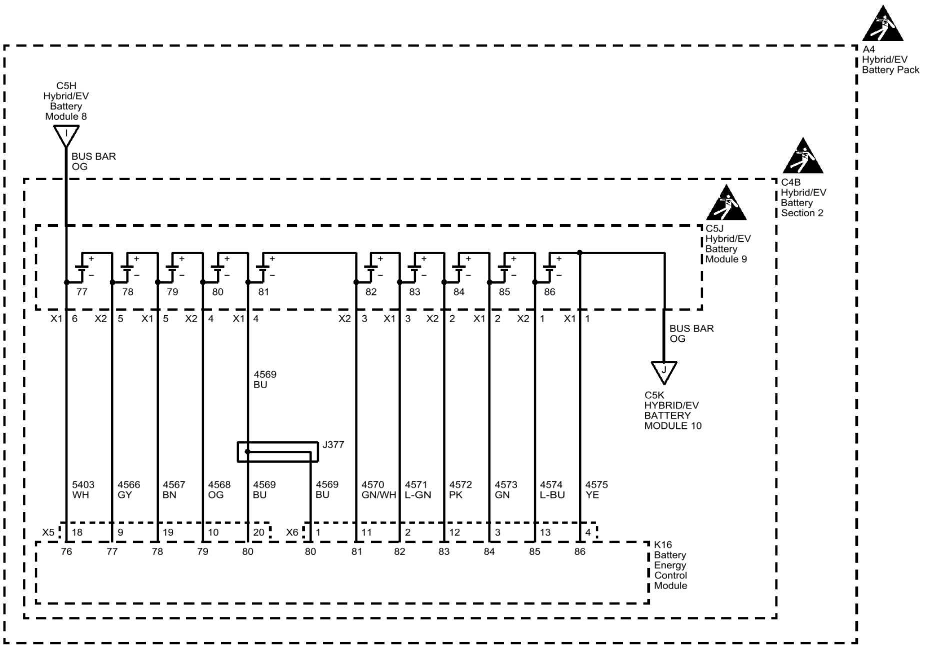

A4
Hybrid/EV
Battery Pack
C5H
Hybrid/EV
Battery
Module 8
I
BUS BAR
OG
C4B
Hybrid/EV
Battery
Section 2
C5J
Hybrid/EV
Battery
Module 9
77
78
79
80
81
82
83
84
85
86
X1 6
X2 5
X1 5
X2 4
X1 4
X2 3
X1 3
X2 2
X1 2
X2 1
X1 1
BUS BAR
OG
J
C5K
HYBRID/EV
BATTERY
MODULE 10
4569
BU
J377
5403
WH
4566
GY
4567
BN
4568
OG
4569
BU
4569
BU
4570
GN/WH
4571
L-GN
4572
PK
4573
GN
4574
L-BU
4575
YE
X5
18
9
19
10
20
X6
1
11
2
12
3
13
4
76
77
78
79
80
80
81
82
83
84
85
86
K16
Battery
Energy
Control
Module

Fig. 13: Hybrid/EV Battery Module 9

Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Module 10

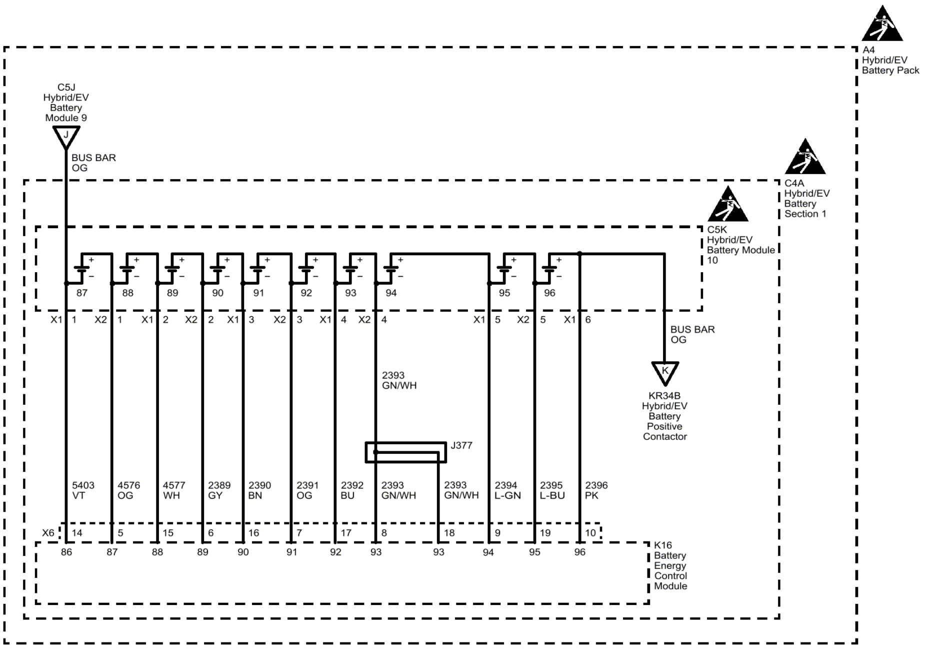

A4
Hybrid/EV
Battery Pack
C5J
Hybrid/EV
Battery
Module 9
J
BUS BAR
OG
C4A
Hybrid/EV
Battery
Section 1
C5K
Hybrid/EV
Battery Module
10
87
88
89
90
91
92
93
94
95
96
X1 1
X2 1
X1 2
X2 2
X1 3
X2 3
X1 4
X2 4
X1 5
X2 5
X1 6
BUS BAR
OG
K
KR34B
Hybrid/EV
Battery
Positive
Contactor
2393
GN/WH
J377
5403
VT
4576
OG
4577
WH
2389
GY
2390
BN
2391
OG
2392
BU
2393
GN/WH
2393
GN/WH
2394
L-GN
2395
L-BU
2396
PK
X6
14
5
15
6
16
7
17
8
18
9
19
10
86
87
88
89
90
91
92
93
93
94
95
96
K16
Battery
Energy
Control
Module

Fig. 14: Hybrid/EV Battery Module 10
Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors - High Voltage Positive

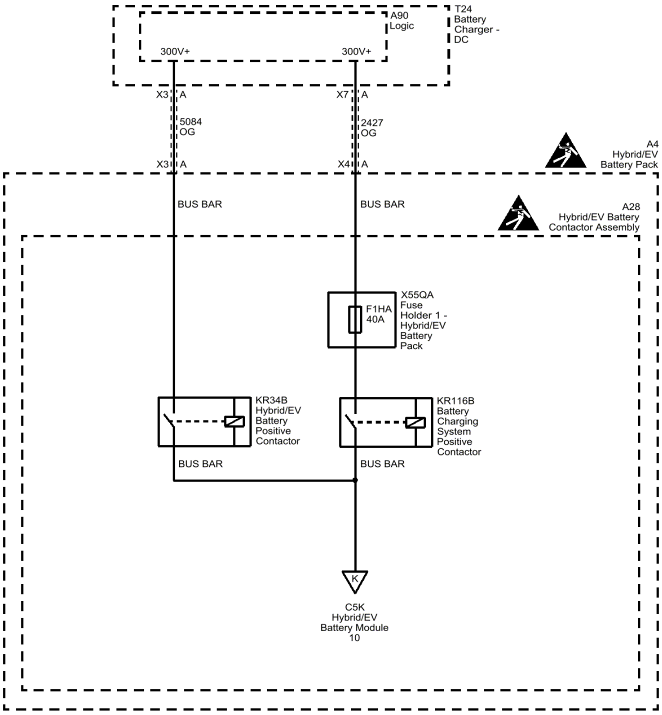

A90
Logic
T24
Battery
Charger -
DC
300V+
300V+
X3 A
X7 A
5084
OG
2427
OG
A4
Hybrid/EV
Battery Pack
X3 A
X4 A
BUS BAR
BUS BAR
A28
Hybrid/EV Battery
Contactor Assembly
X55QA
Fuse
Holder 1 -
Hybrid/EV
Battery
Pack
F1HA
40A
KR34B
Hybrid/EV
Battery
Positive
Contactor
KR116B
Battery
Charging
System
Positive
Contactor
BUS BAR
BUS BAR
K
C5K
Hybrid/EV
Battery Module
10

Fig. 15: High Voltage Contactors - High Voltage Positive
Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors - High Voltage Negative

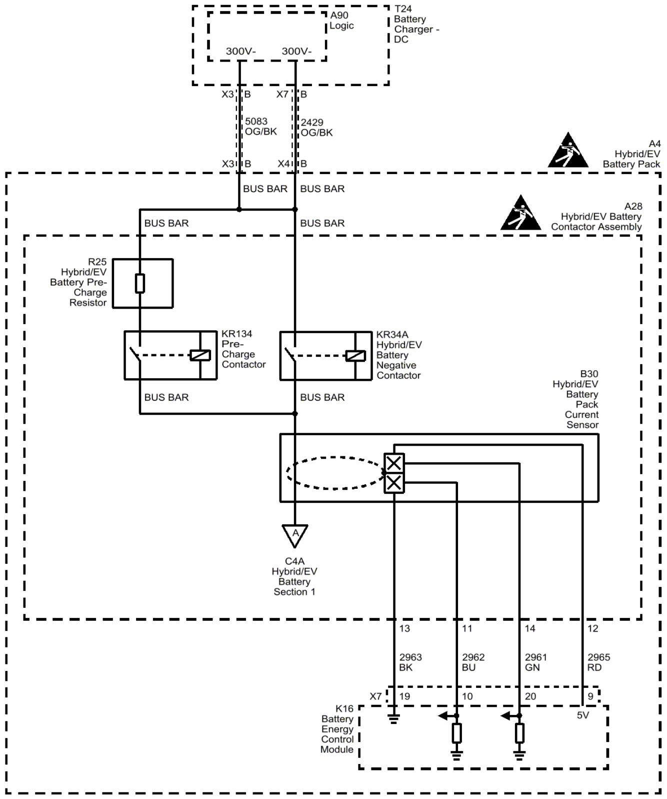

T24 Battery Charger - DC
A90 Logic
300V-
300V-
X3 B
X7 B
5083 OG/BK
2429 OG/BK
X3 B
X4 B
A4 Hybrid/EV Battery Pack
BUS BAR
BUS BAR
BUS BAR
BUS BAR
A28 Hybrid/EV Battery Contactor Assembly
R25 Hybrid/EV Battery Pre-Charge Resistor
KR134 Pre-Charge Contactor
KR34A Hybrid/EV Battery Negative Contactor
BUS BAR
BUS BAR
B30 Hybrid/EV Battery Pack Current Sensor
A
C4A Hybrid/EV Battery Section 1
13
11
14
12
2963 BK
2962 BU
2961 GN
2965 RD
X7
19
10
20
9
K16 Battery Energy Control Module
5V

Fig. 16: High Voltage Contactors - High Voltage Negative

Courtesy of GENERAL MOTORS COMPANY

High Voltage Contactors - Control

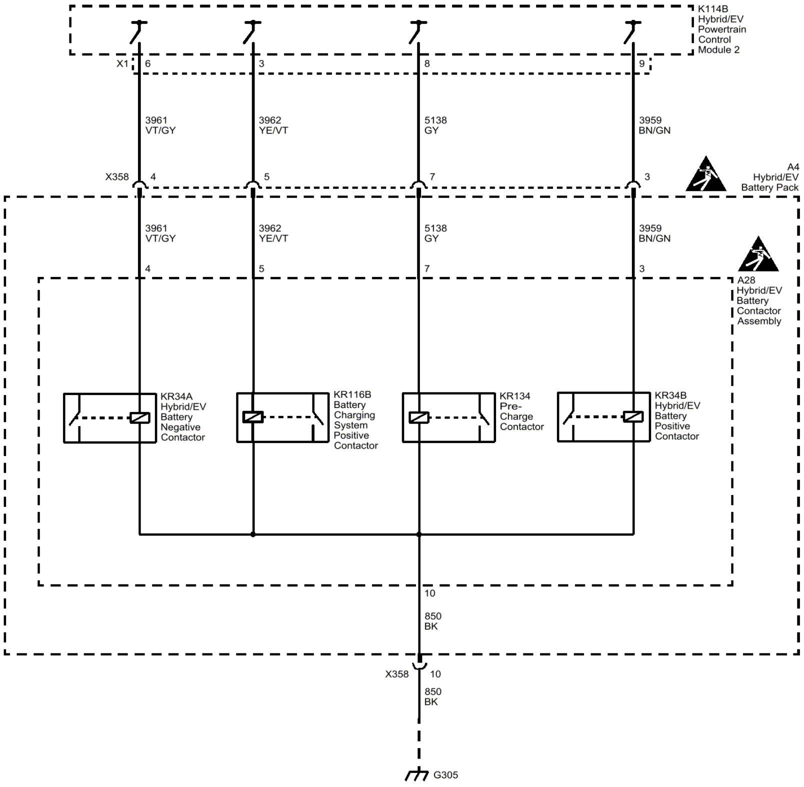

K114B Hybrid/EV Powertrain Control Module 2
X1
6
3
8
9
3961 VT/GY
3962 YE/VT
5138 GY
3959 BN/GN
X358
4
5
7
3
A4 Hybrid/EV Battery Pack
3961 VT/GY
3962 YE/VT
5138 GY
3959 BN/GN
4
5
7
3
A28 Hybrid/EV Battery Contactor Assembly
KR34A Hybrid/EV Battery Negative Contactor
KR116B Battery Charging System Positive Contactor
KR134 Pre-Charge Contactor
KR34B Hybrid/EV Battery Positive Contactor
10
850 BK
X358
10
850 BK
G305

Fig. 17: High Voltage Contactors - Control

Courtesy of GENERAL MOTORS COMPANY

High Voltage Cable Connections (Except CBT)

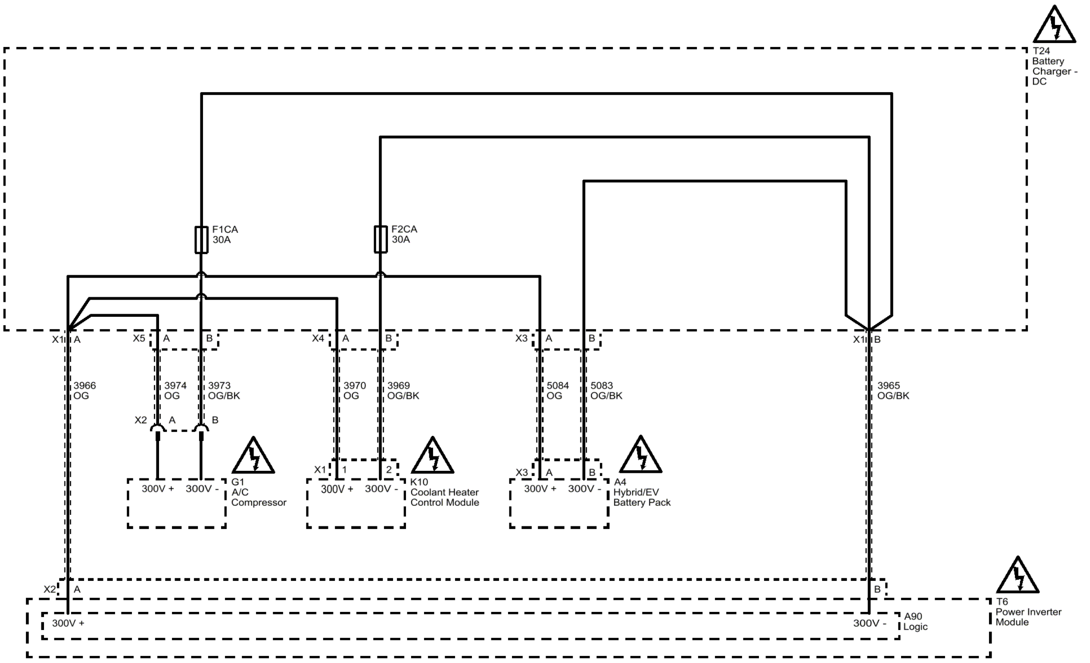

T24 Battery Charger - DC
F1CA 30A
F2CA 30A
X1 A
X5 A B
X4 A B
X3 A B
X1 B
3966 OG
3974 OG
3973 OG/BK
3970 OG
3969 OG/BK
5084 OG
5083 OG/BK
3965 OG/BK
X2 A B
X1 1 2
X3 A B
300V + 300V -
G1 A/C Compressor
300V + 300V -
K10 Coolant Heater Control Module
300V + 300V -
A4 Hybrid/EV Battery Pack
X2 A
B
300V +
300V -
A90 Logic
T6 Power Inverter Module

Fig. 18: High Voltage Cable Connections (Except CBT)
Courtesy of GENERAL MOTORS COMPANY

High Voltage Cable Connections (CBT)

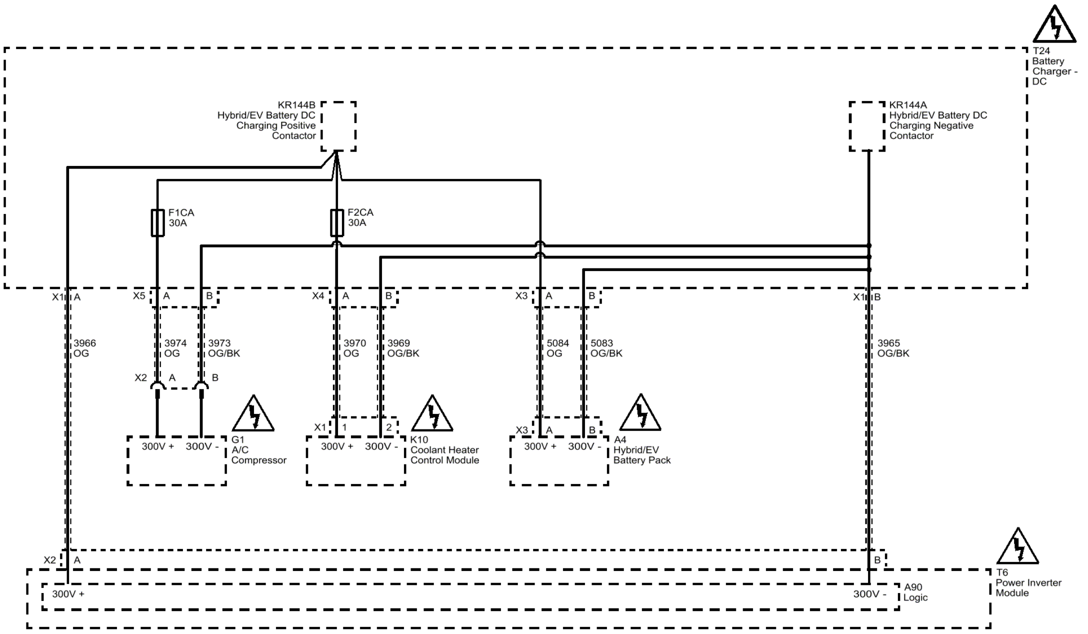

T24 Battery Charger - DC
KR144B Hybrid/EV Battery DC Charging Positive Contactor
KR144A Hybrid/EV Battery DC Charging Negative Contactor
F1CA 30A
F2CA 30A
X1 A
X5 A B
X4 A B
X3 A B
X1 B
3966 OG
3974 OG
3973 OG/BK
3970 OG
3969 OG/BK
5084 OG
5083 OG/BK
3965 OG/BK
X2 A B
X1 1 2
X3 A B
300V + 300V -
G1 A/C Compressor
300V + 300V -
K10 Coolant Heater Control Module
300V + 300V -
A4 Hybrid/EV Battery Pack
X2 A
B
300V +
300V -
A90 Logic
T6 Power Inverter Module

Fig. 19: High Voltage Cable Connections (CBT)
Courtesy of GENERAL MOTORS COMPANY

Back To Article

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

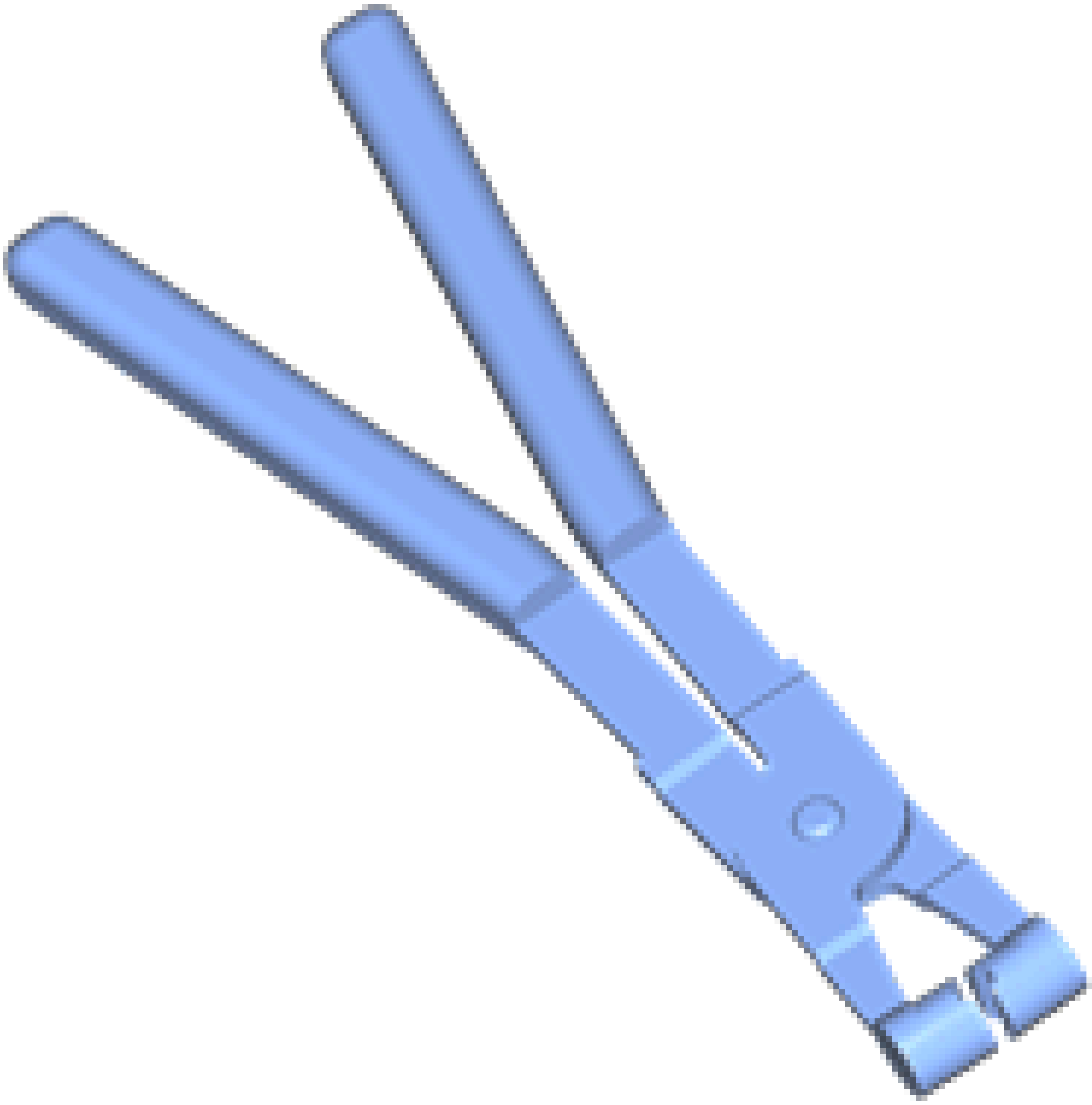
Illustration	Tool Number/ Description
	BO-38185 J 38185 Hose Clamp Pliers

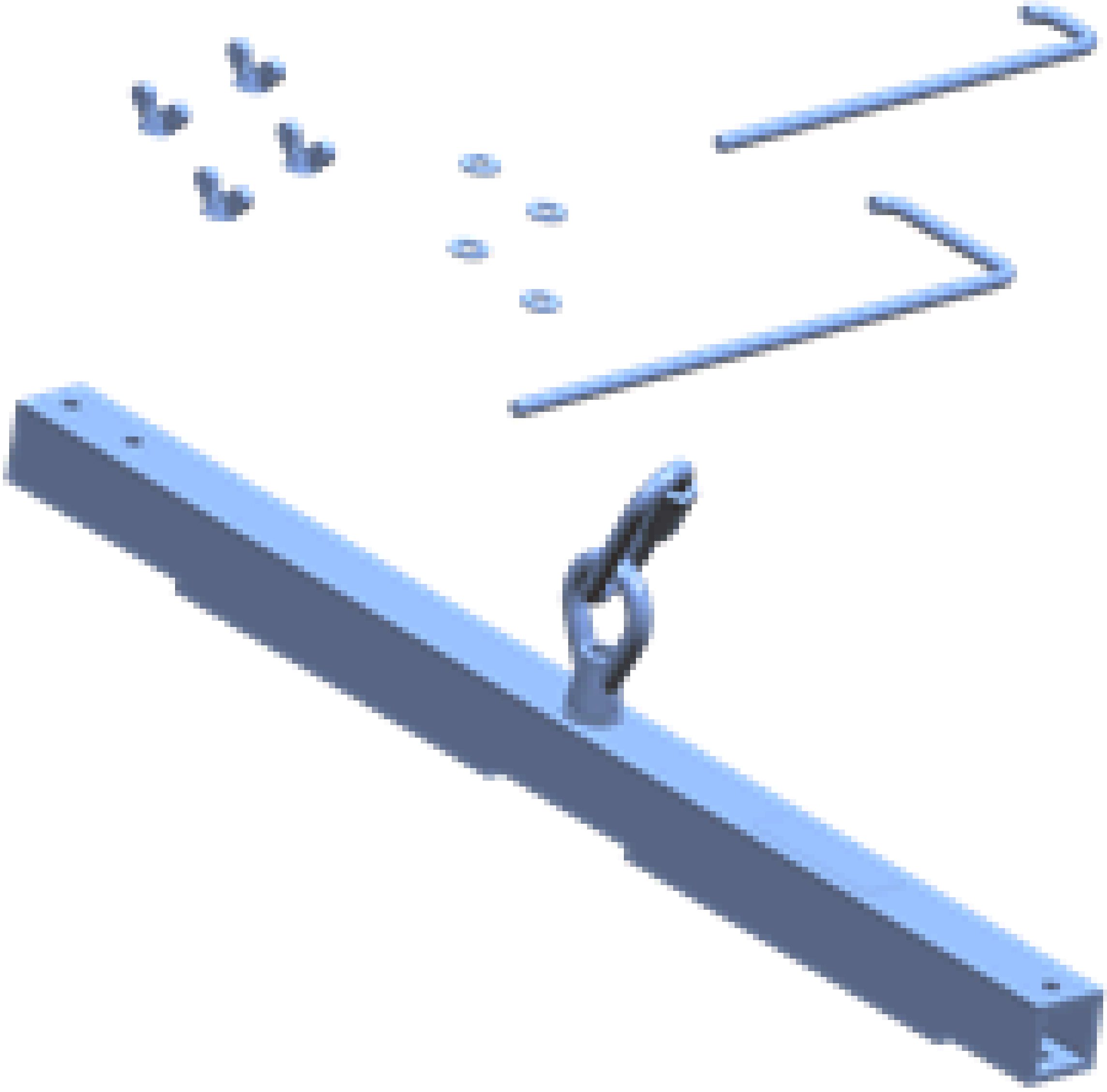
Illustration	Tool Number/ Description
	EL-48264 Battery Pack Lifting Adapter

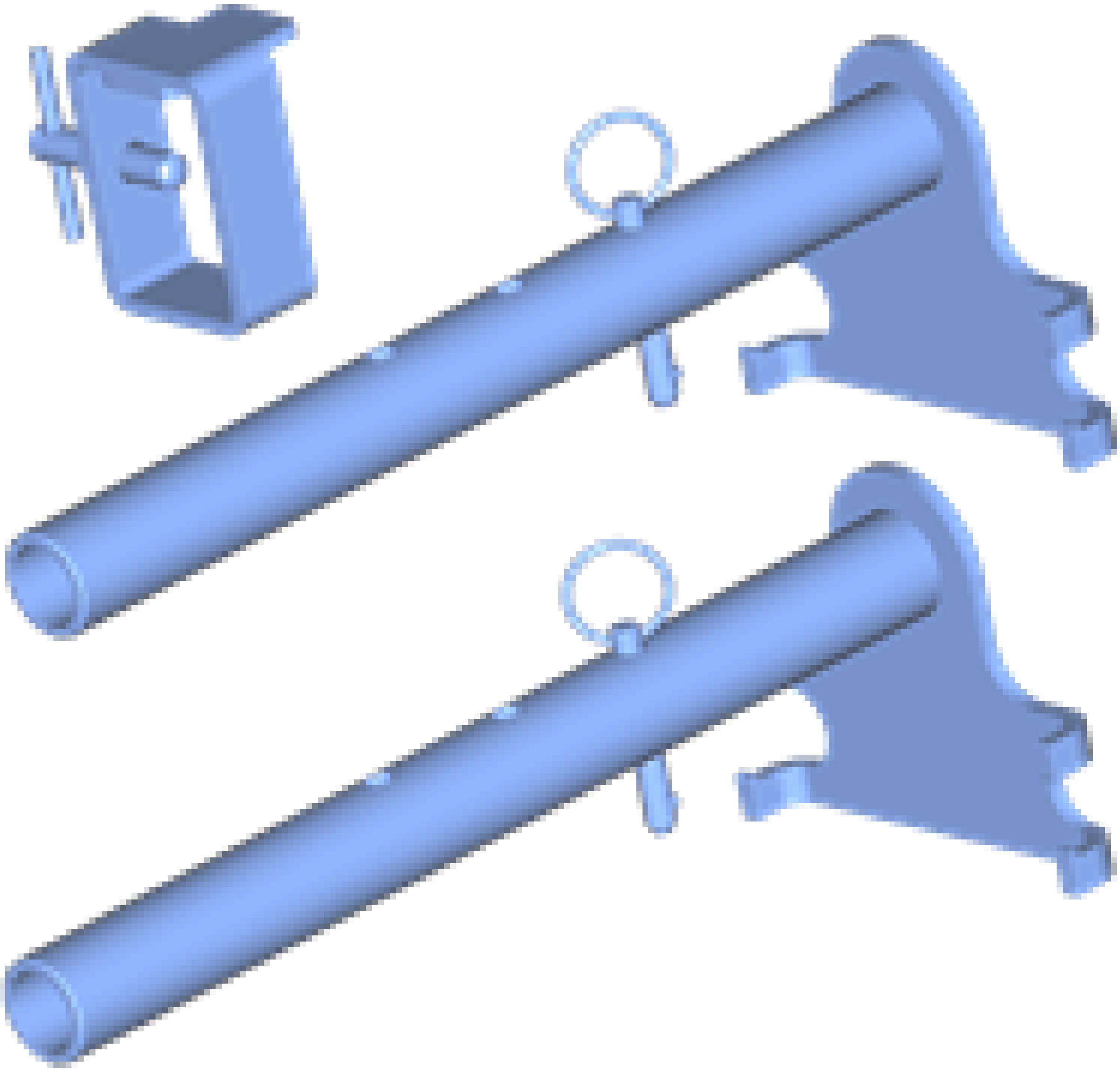
Illustration	Tool Number/ Description
	EL-48264-100 Battery Section Lifting Adapter

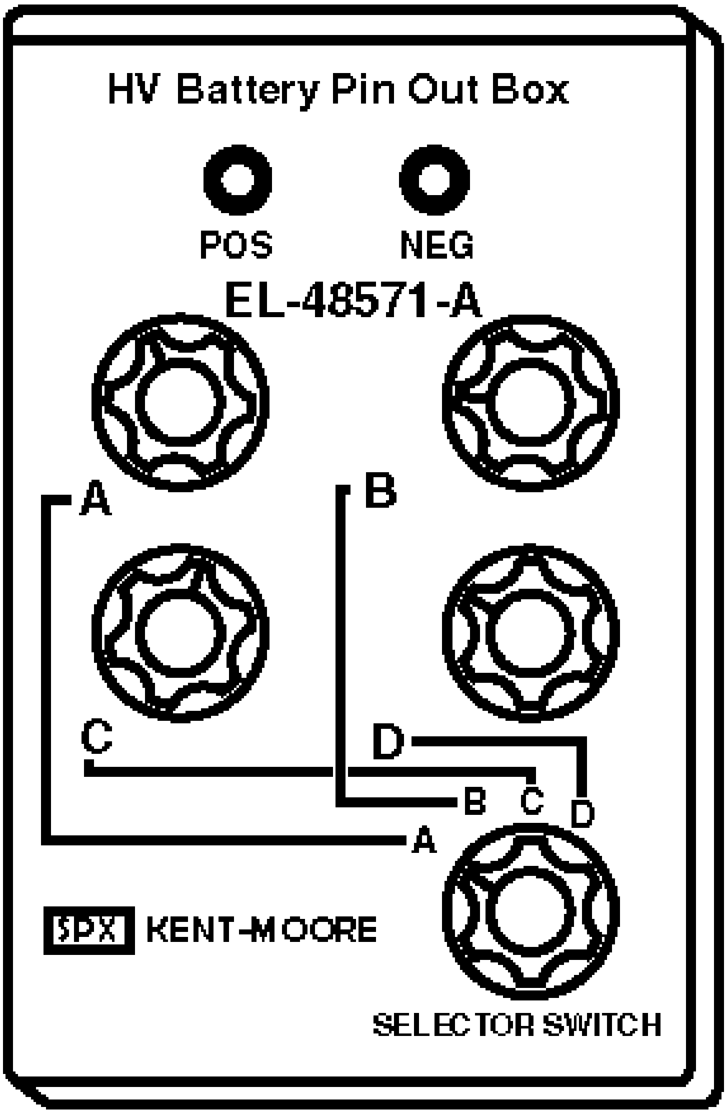
Illustration	Tool Number/ Description
 HV Battery Pin Out Box POS NEG EL-48571-A A B C D B C D A SPX KENT-MOORE SELECTOR SWITCH	EL-48571-A High Voltage Battery Pin Out Box

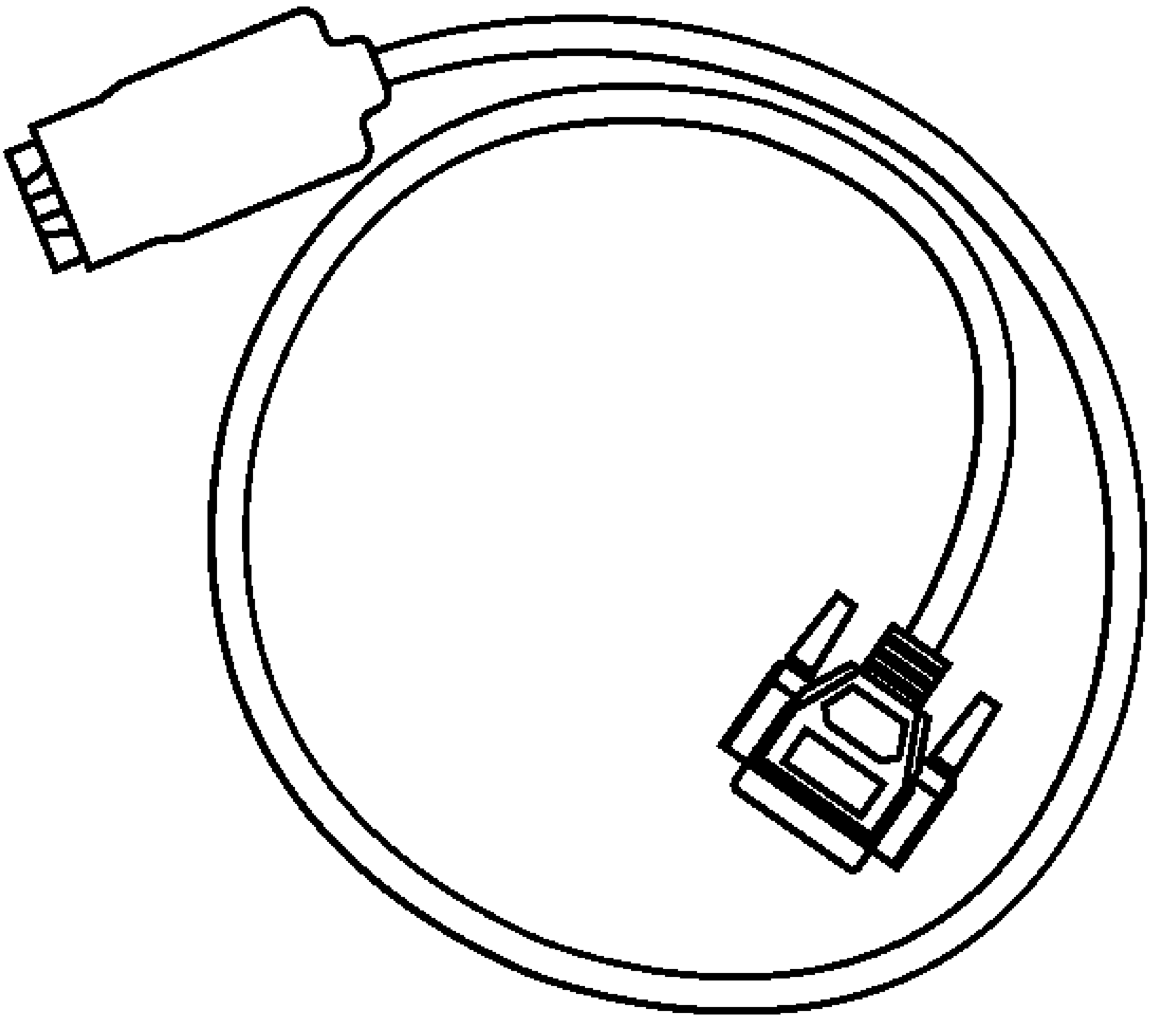
Illustration	Tool Number/ Description
	EL-48571-61 Pinout Box Adapter

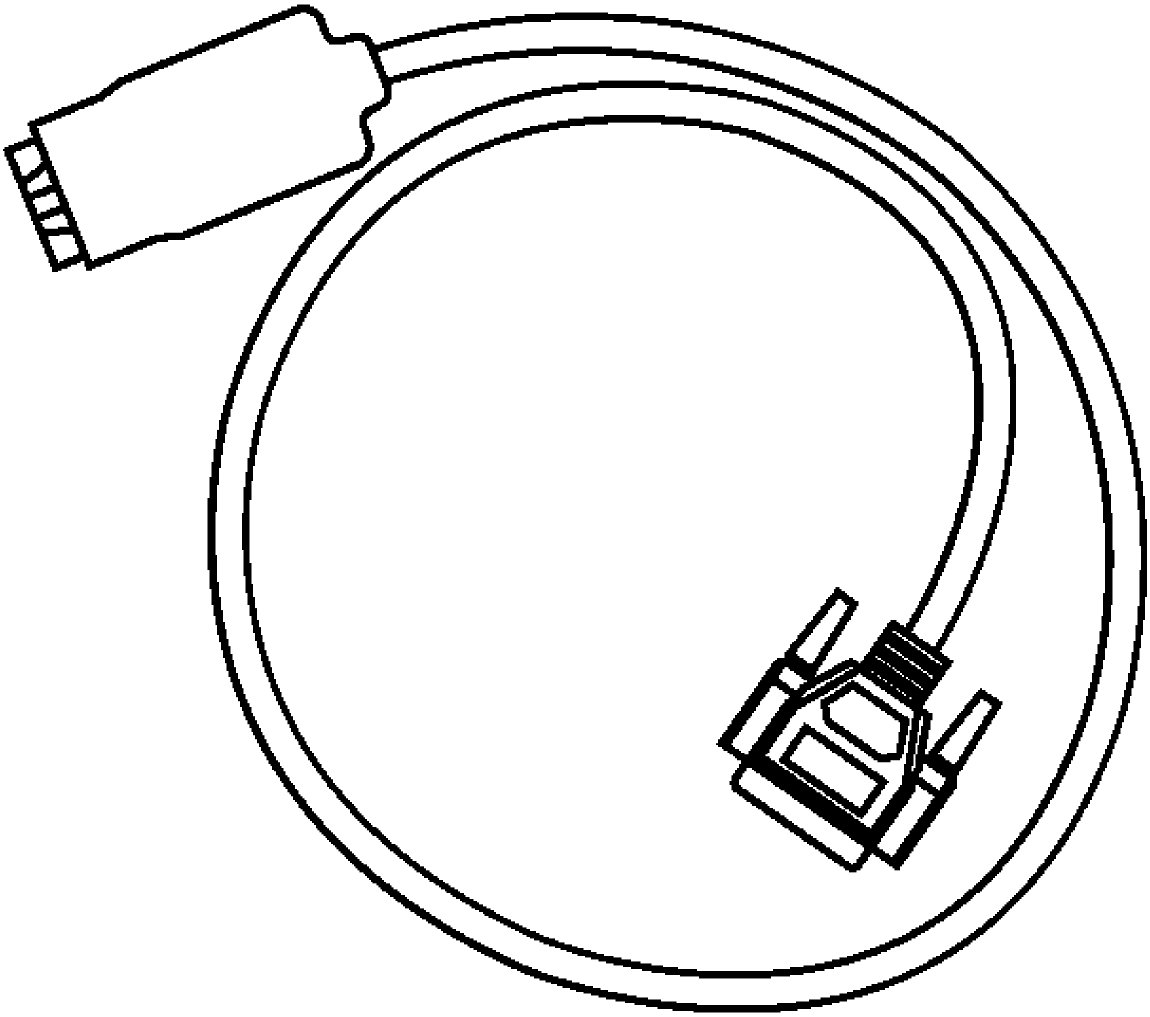
Illustration	Tool Number/ Description
	EL-48571-62 Pinout Box Adapter

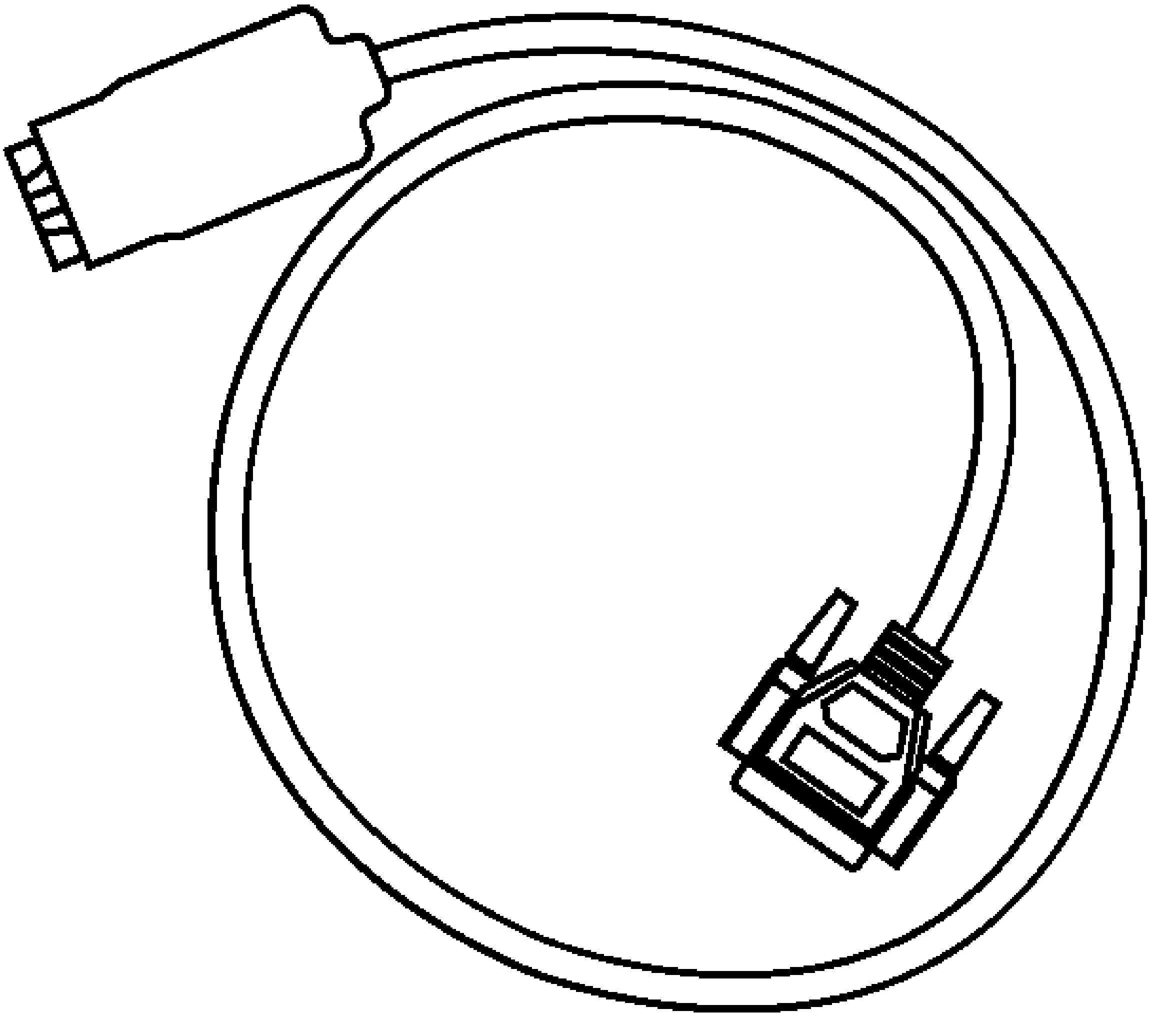
Illustration	Tool Number/ Description
	EL-48571-63 Pinout Box Adapter

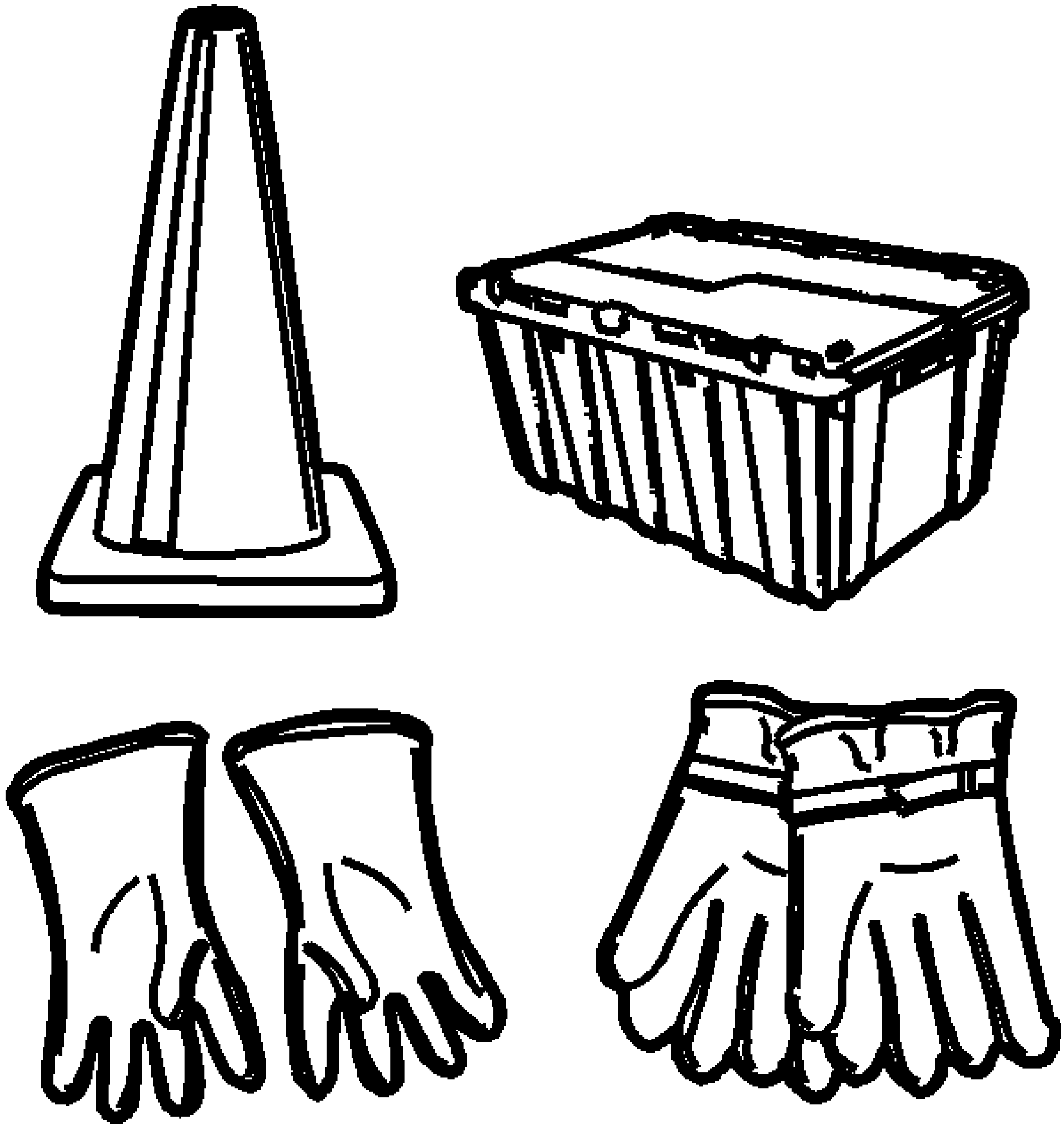
Illustration	Tool Number/ Description
	EL-48900 HEV Safety Kit

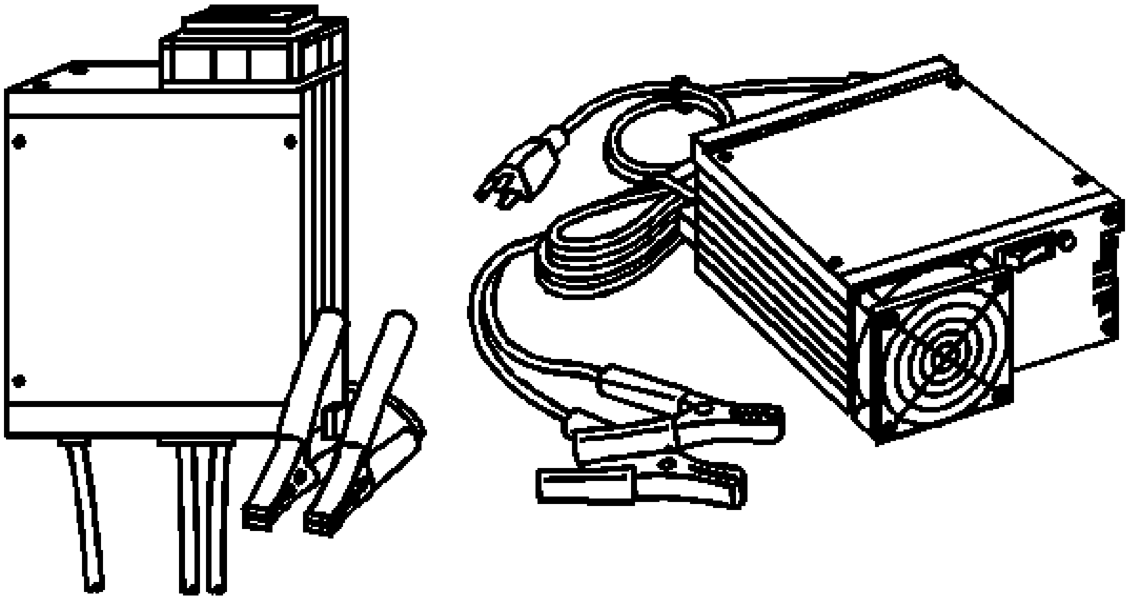
Illustration	Tool Number/ Description
	EL-49642 EL-50113 SPS Programming Support Tool

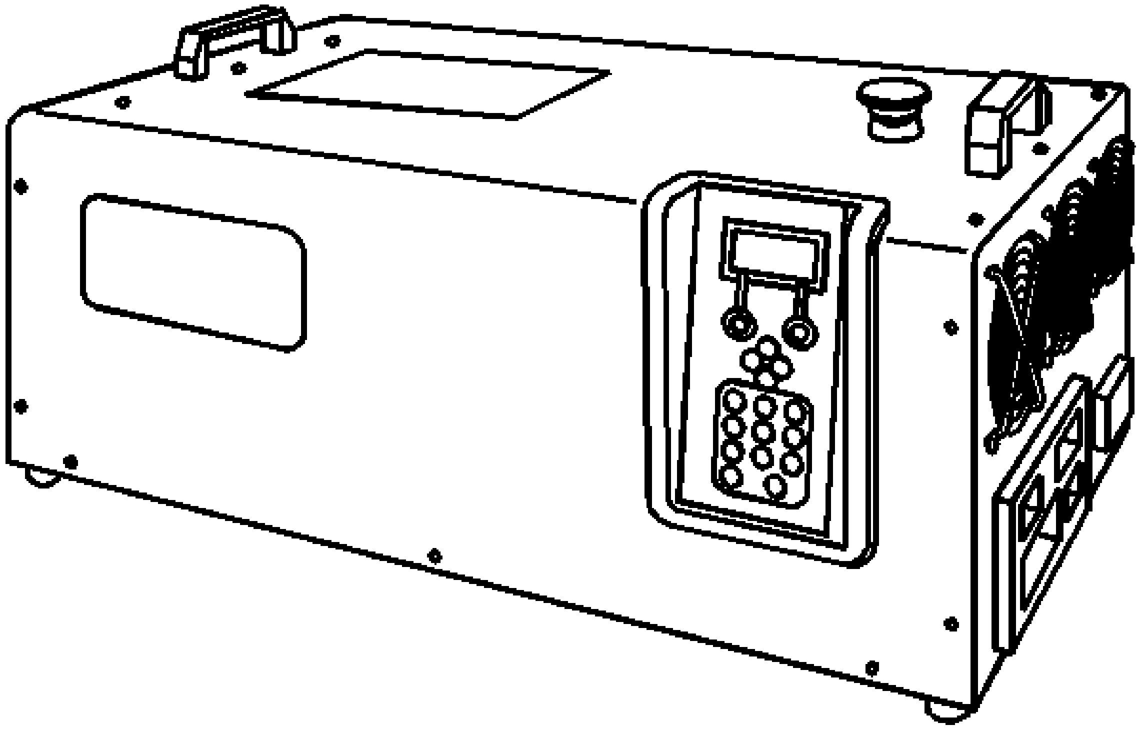
Illustration	Tool Number/ Description
	EL-50332 Hybrid/EV Battery Service Tool

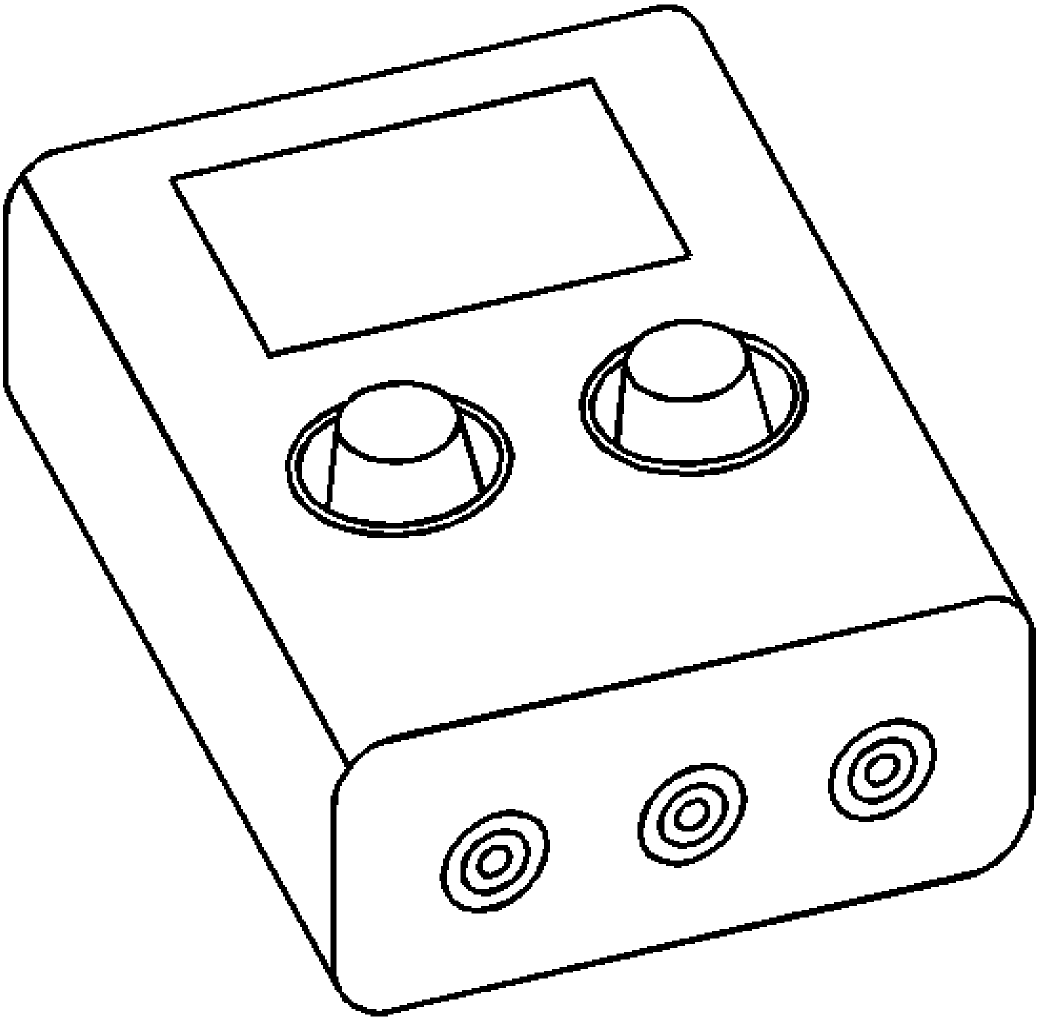
Illustration	Tool Number/ Description
	EL-50332-105 Universal Fuse Box

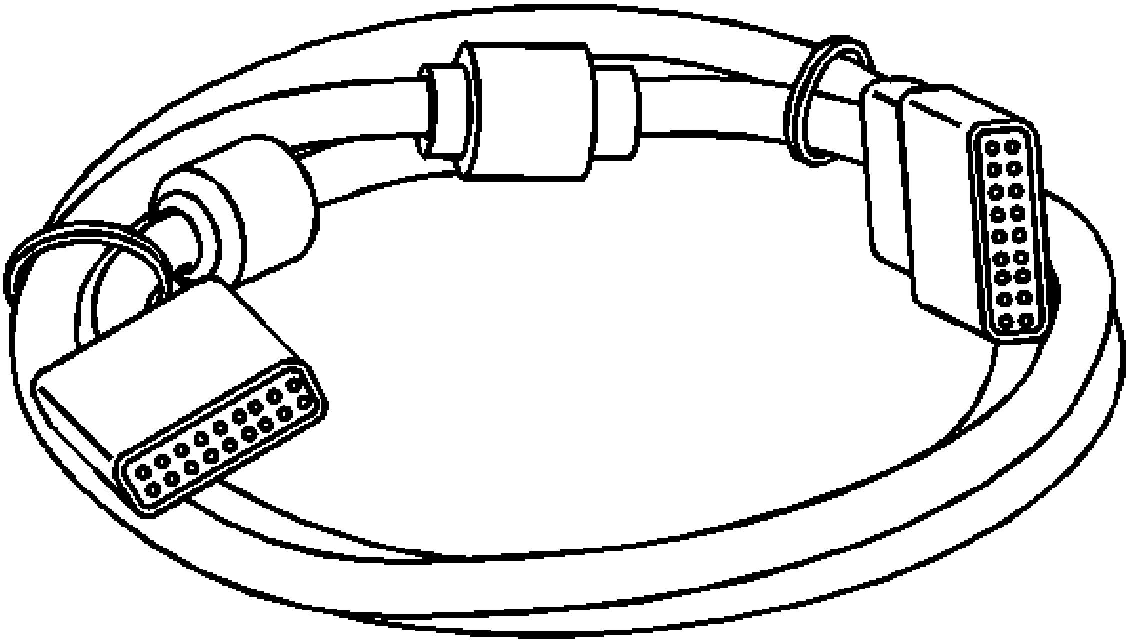
Illustration	Tool Number/ Description
	EL-50332-125 Vehicle Interface Module Low Voltage 24-Pin Cable

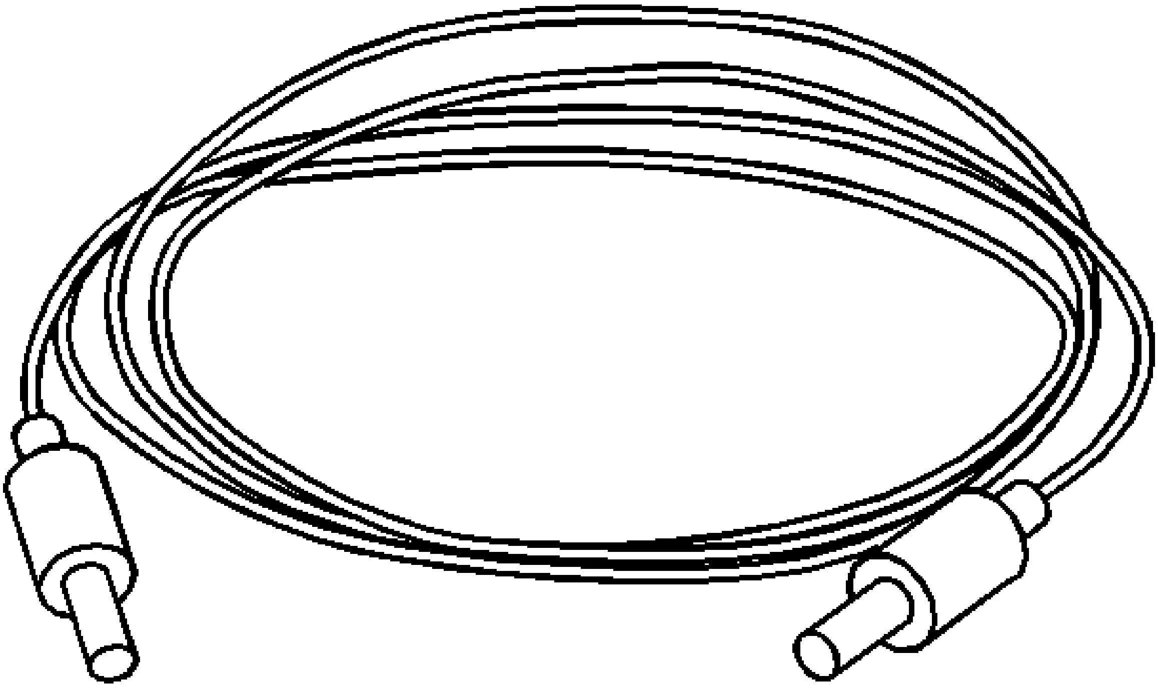
Illustration	Tool Number/ Description
	EL-50332-145 Black Banana Jack Cable

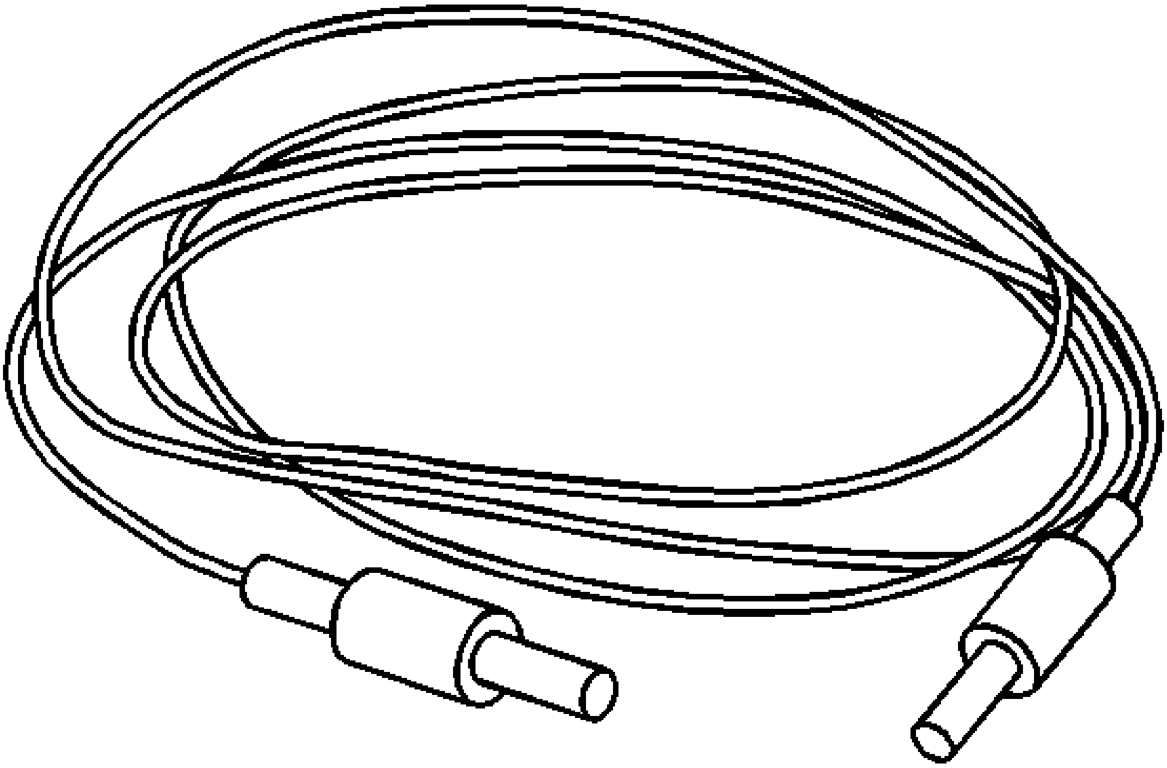
Illustration	Tool Number/ Description
	EL-50332-150 Red Banana Jack Cable

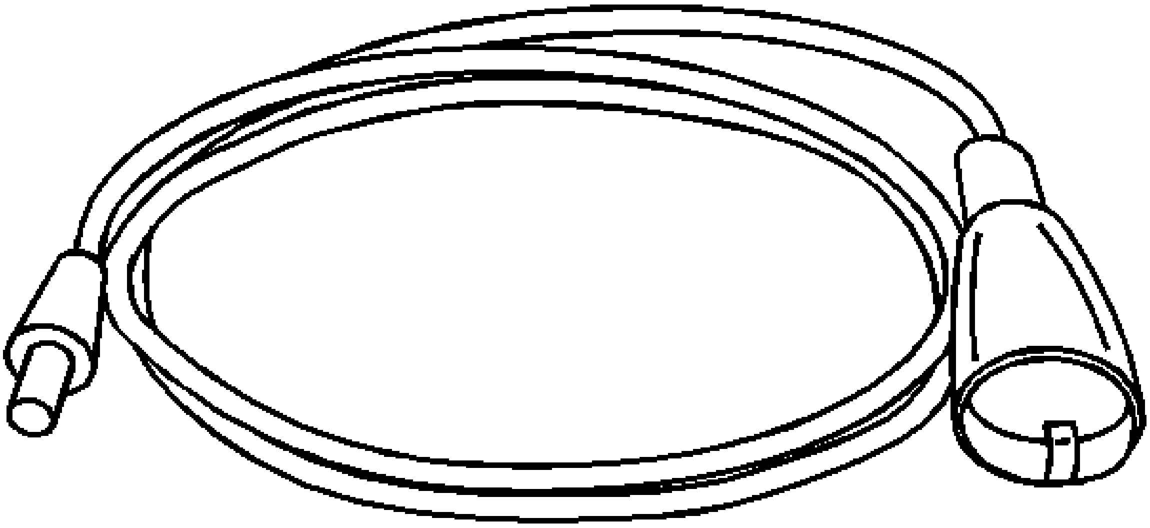
Illustration	Tool Number/ Description
	EL-50332-155 Green Banana Jack Cable

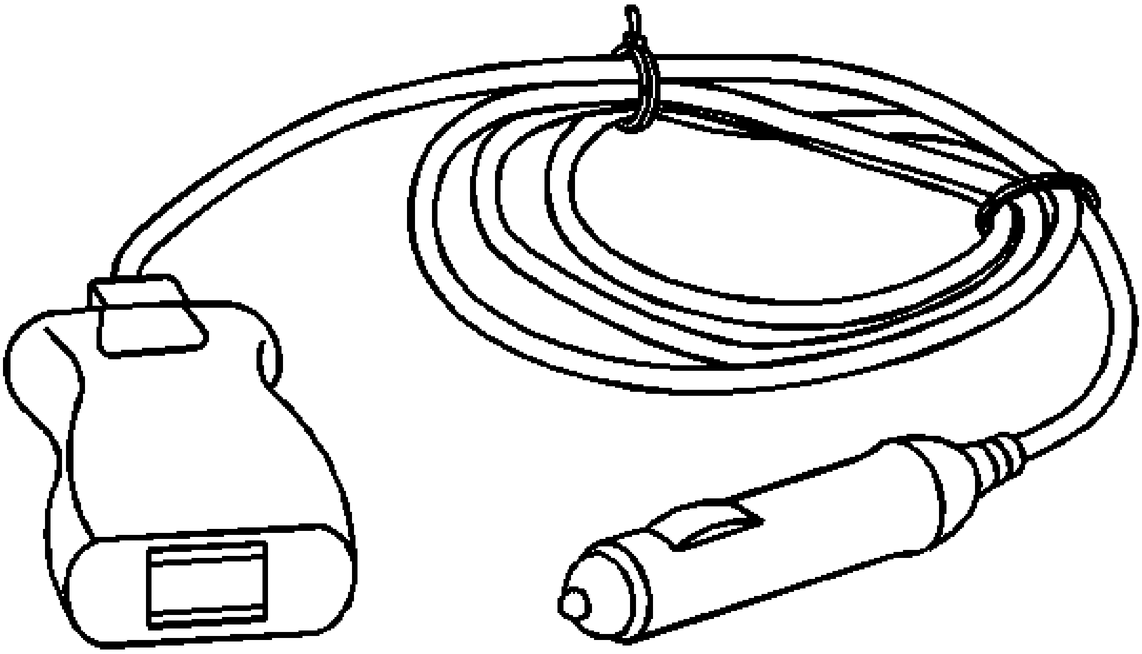
Illustration	Tool Number/ Description
	EL-50332-160 12 V Auxiliary Power Cable

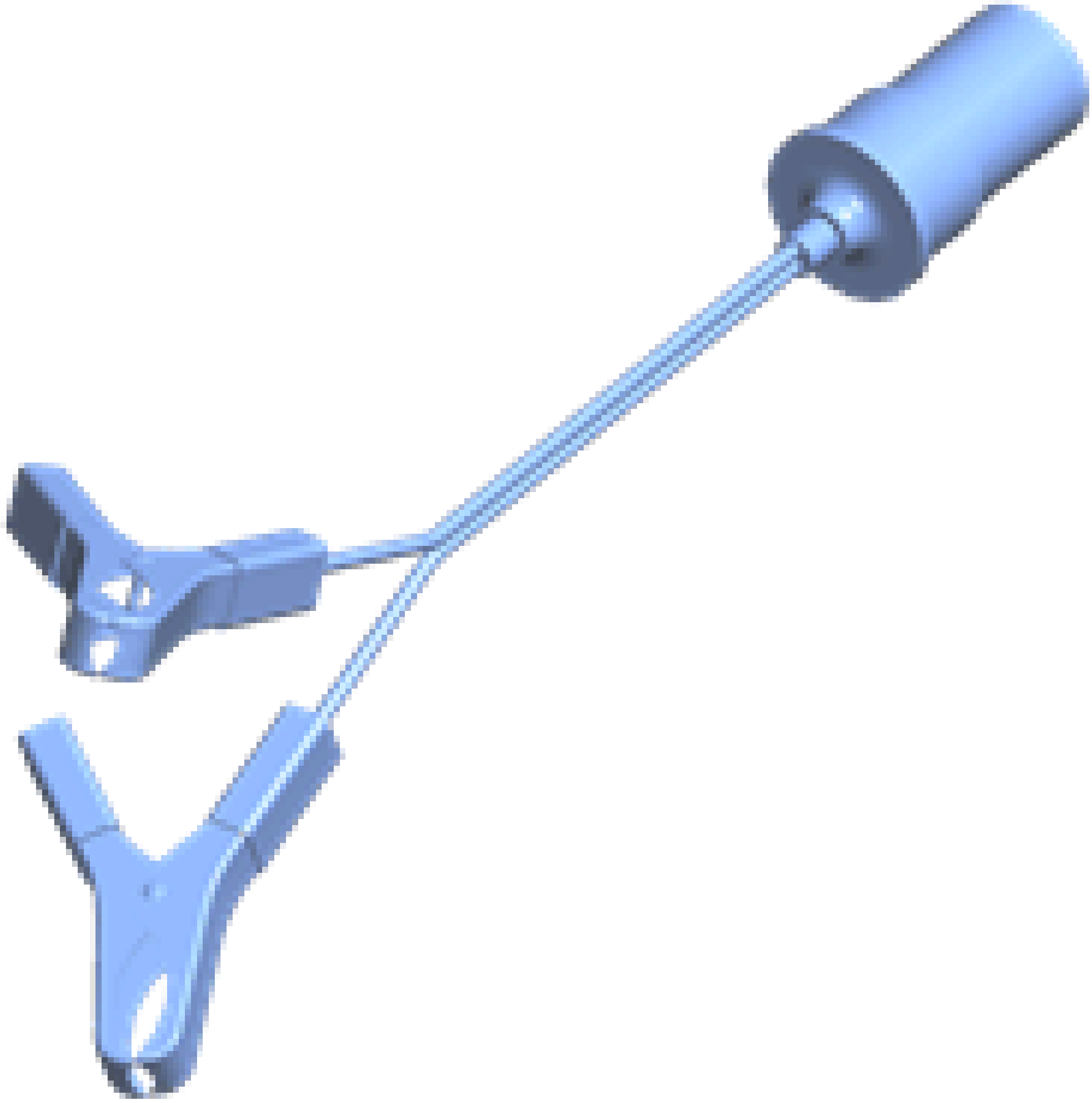
Illustration	Tool Number/ Description
	EL-50332-165 12 V Auxiliary Clamps Adapter Cable

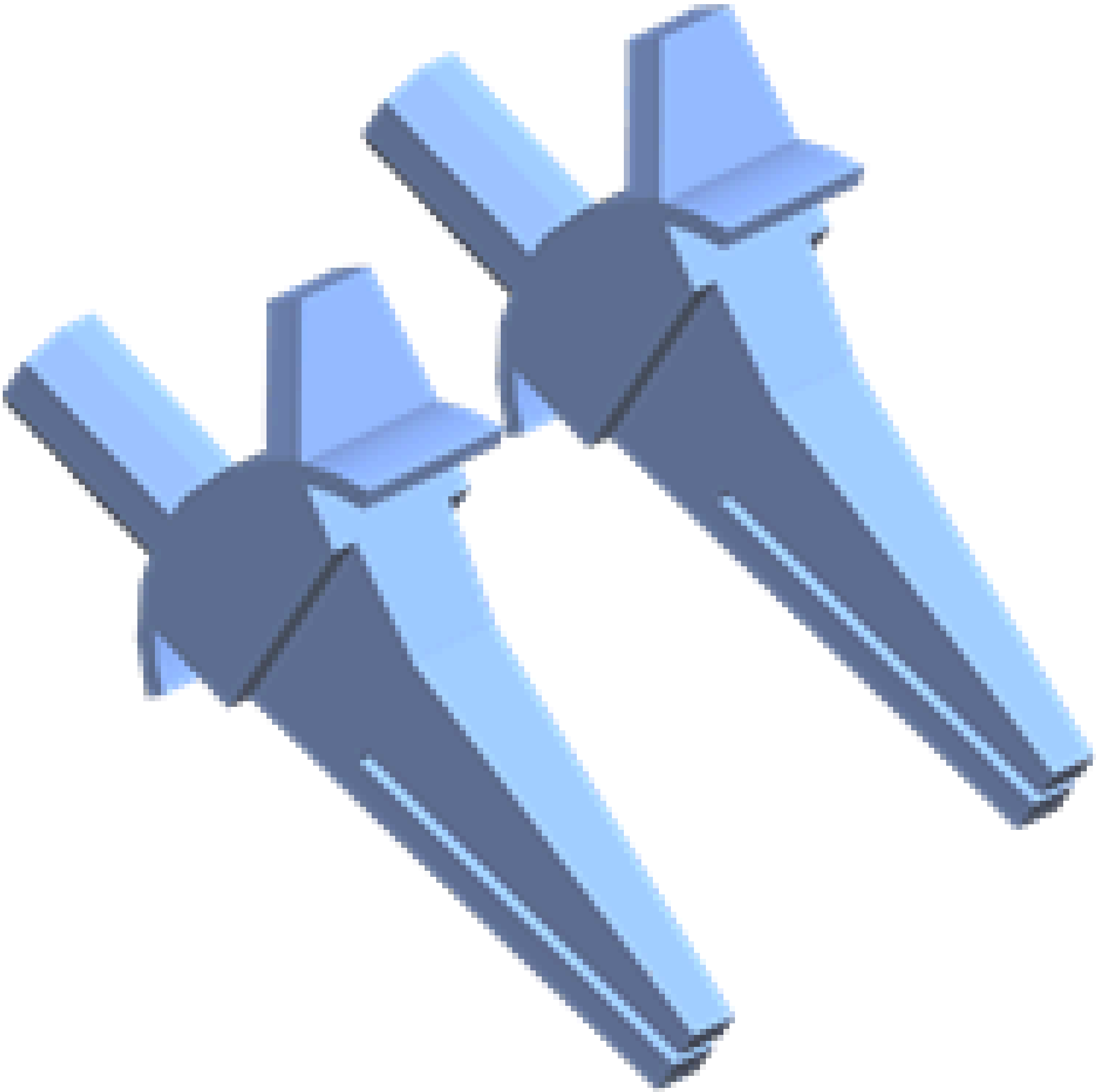
Illustration	Tool Number/ Description
	EL-50332-170 High Voltage Alligator Clamps

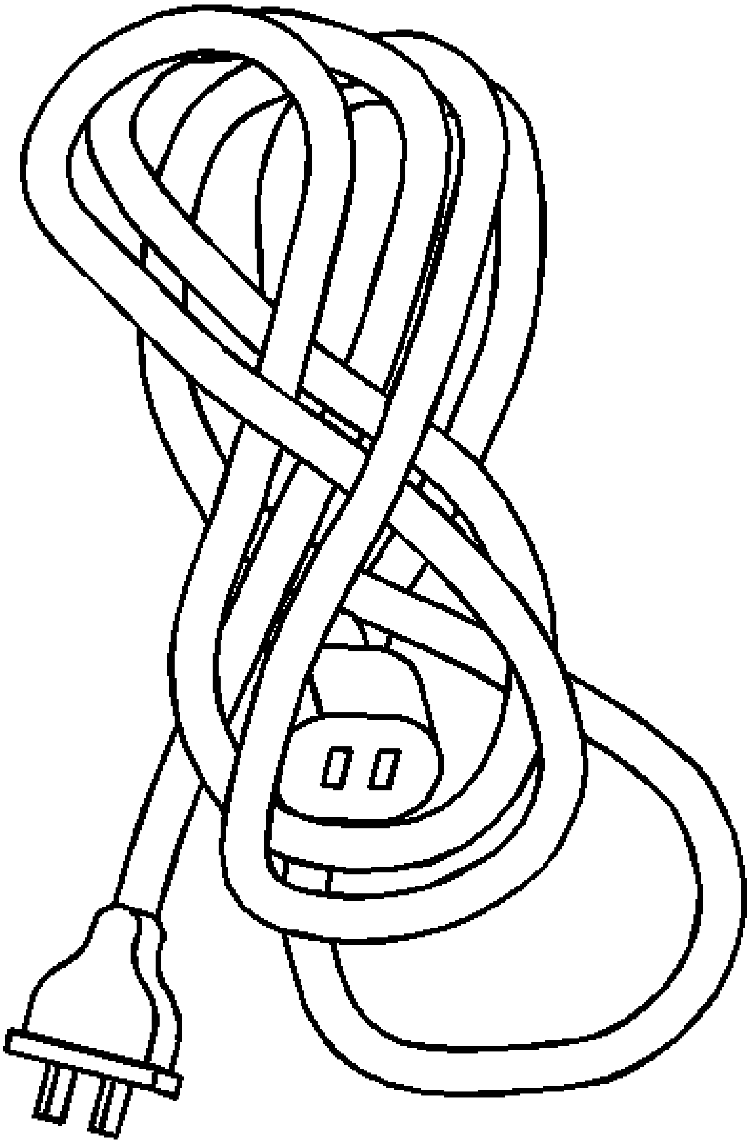
Illustration	Tool Number/ Description
	EL-50332-175 120 V Power Cable

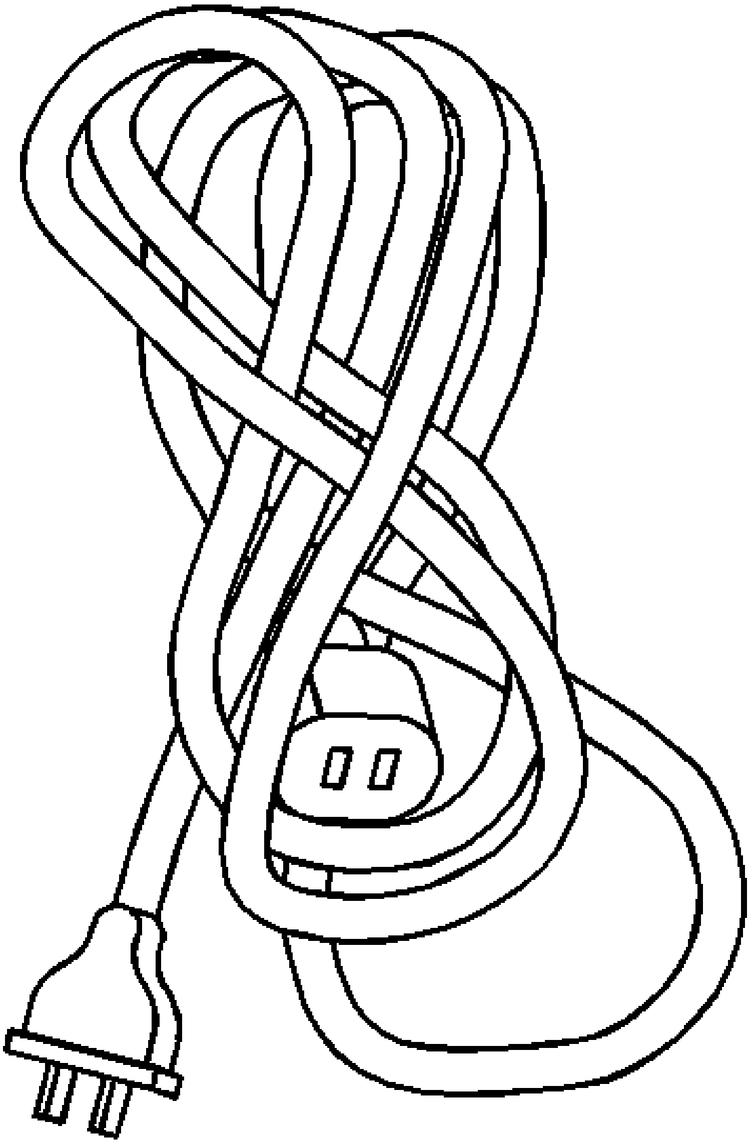
Illustration	Tool Number/ Description
	EL-50332-180 250 V Power Cable - AUS

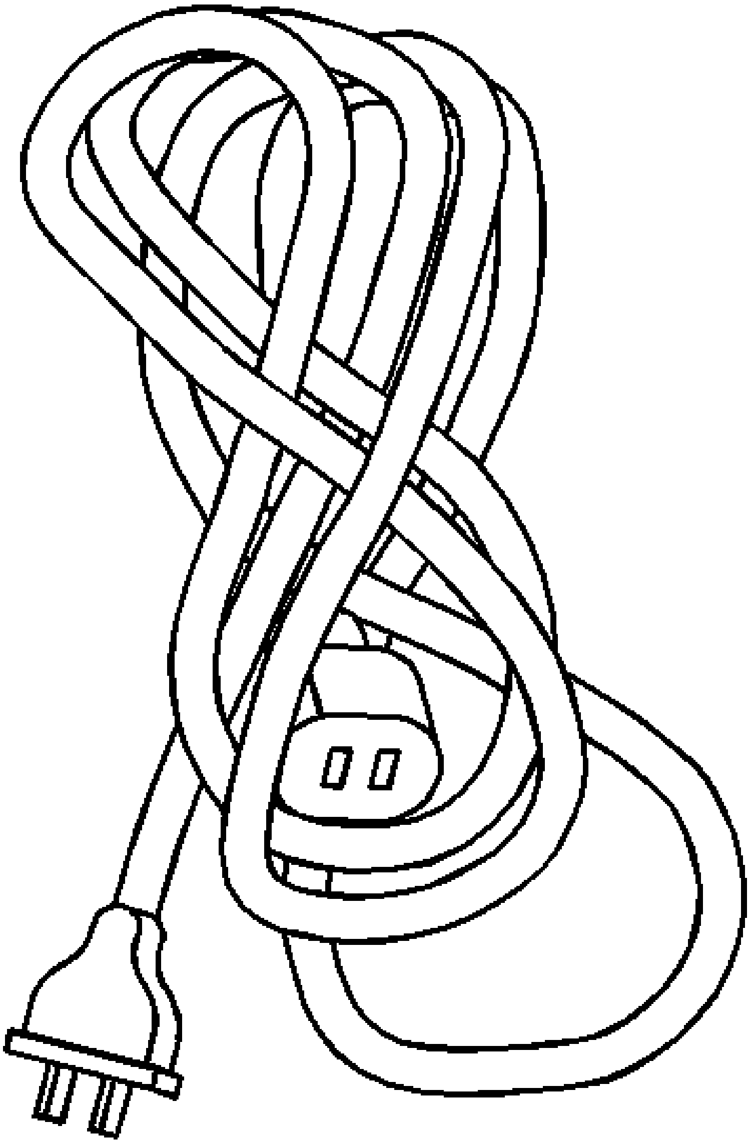
Illustration	Tool Number/ Description
	EL-50332-185 250 V Power Cable - EU/Korea

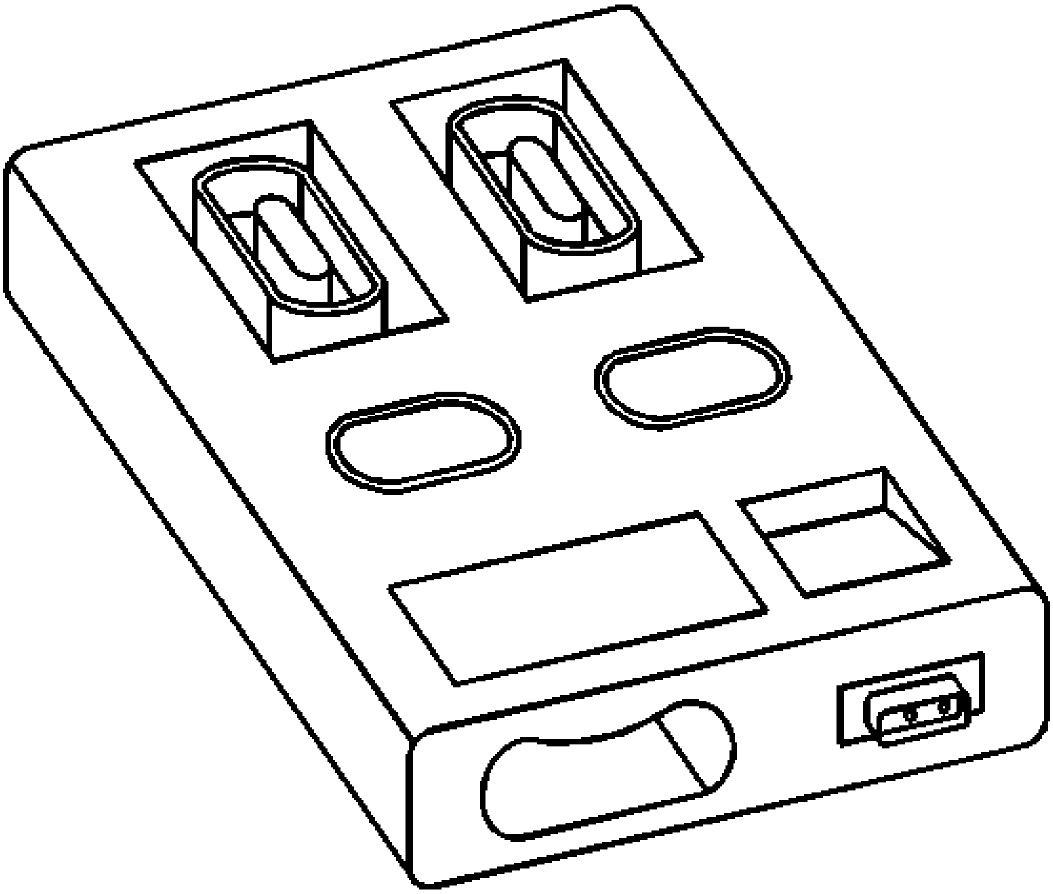
Illustration	Tool Number/ Description
	EL-50332-270 Vehicle Interface Module 2

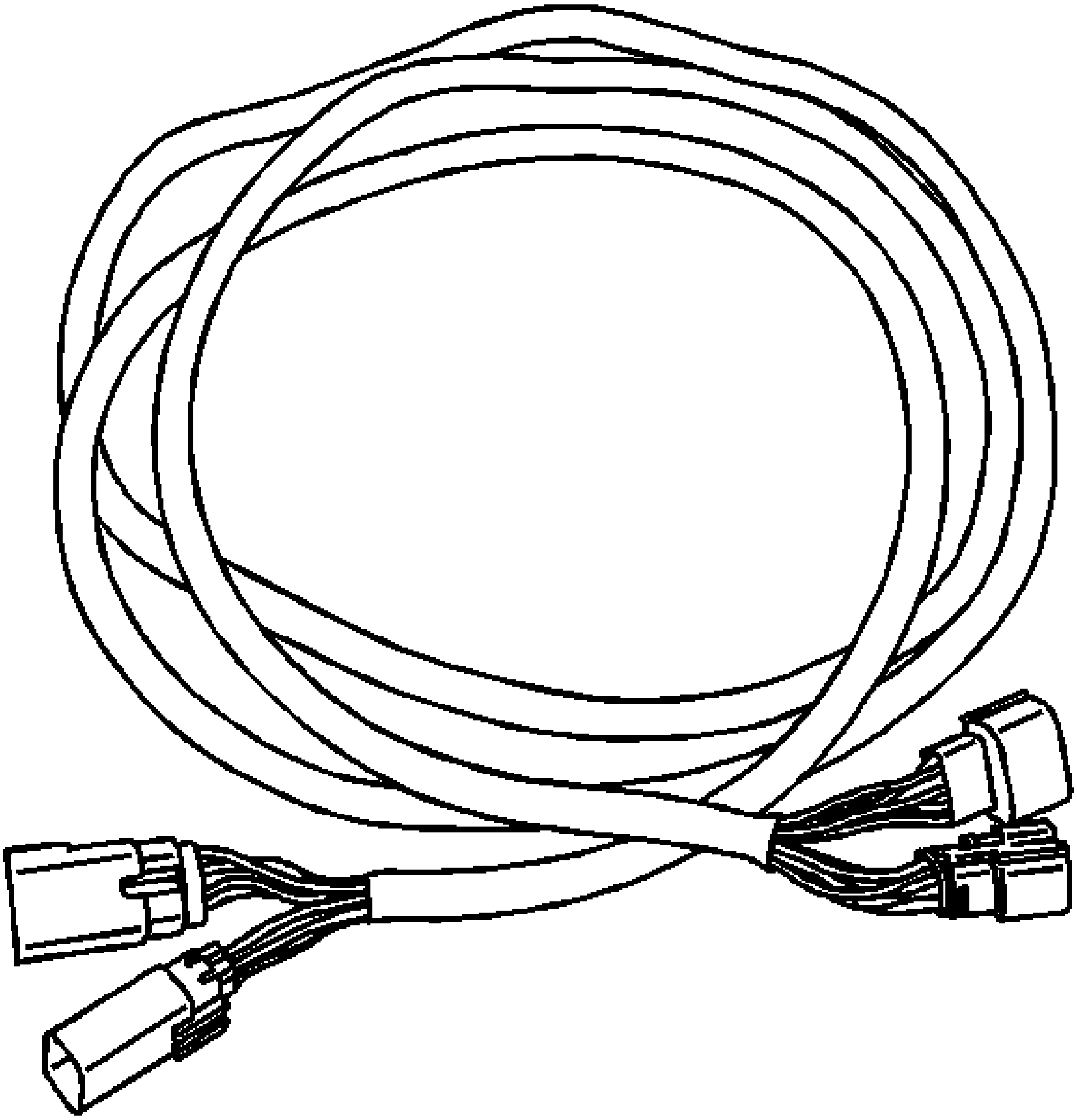
Illustration	Tool Number/ Description
	EL-50332-325 Low Voltage Adapter Harness

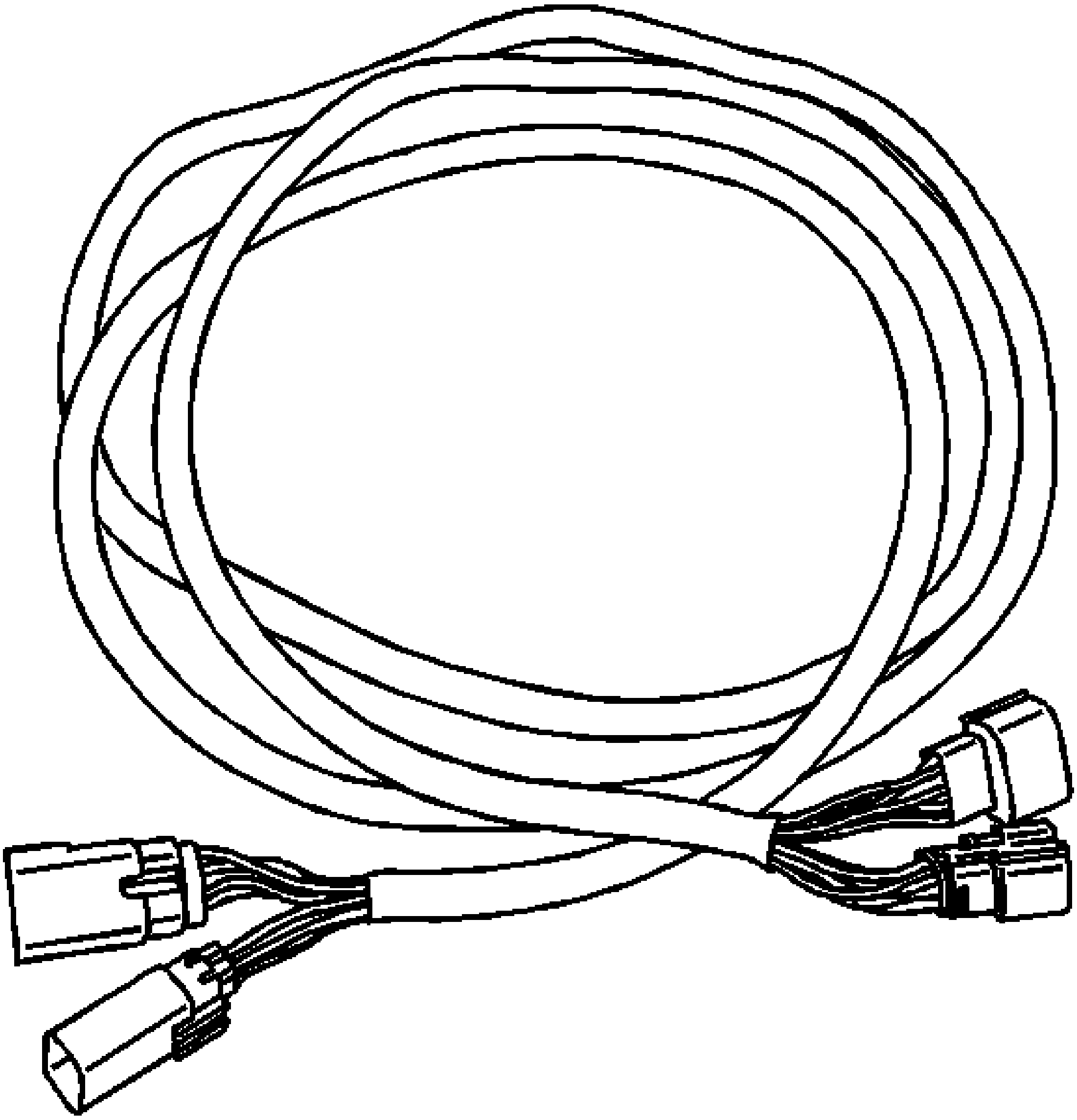
Illustration	Tool Number/ Description
	EL-50332-335 High Voltage Adapter Harness

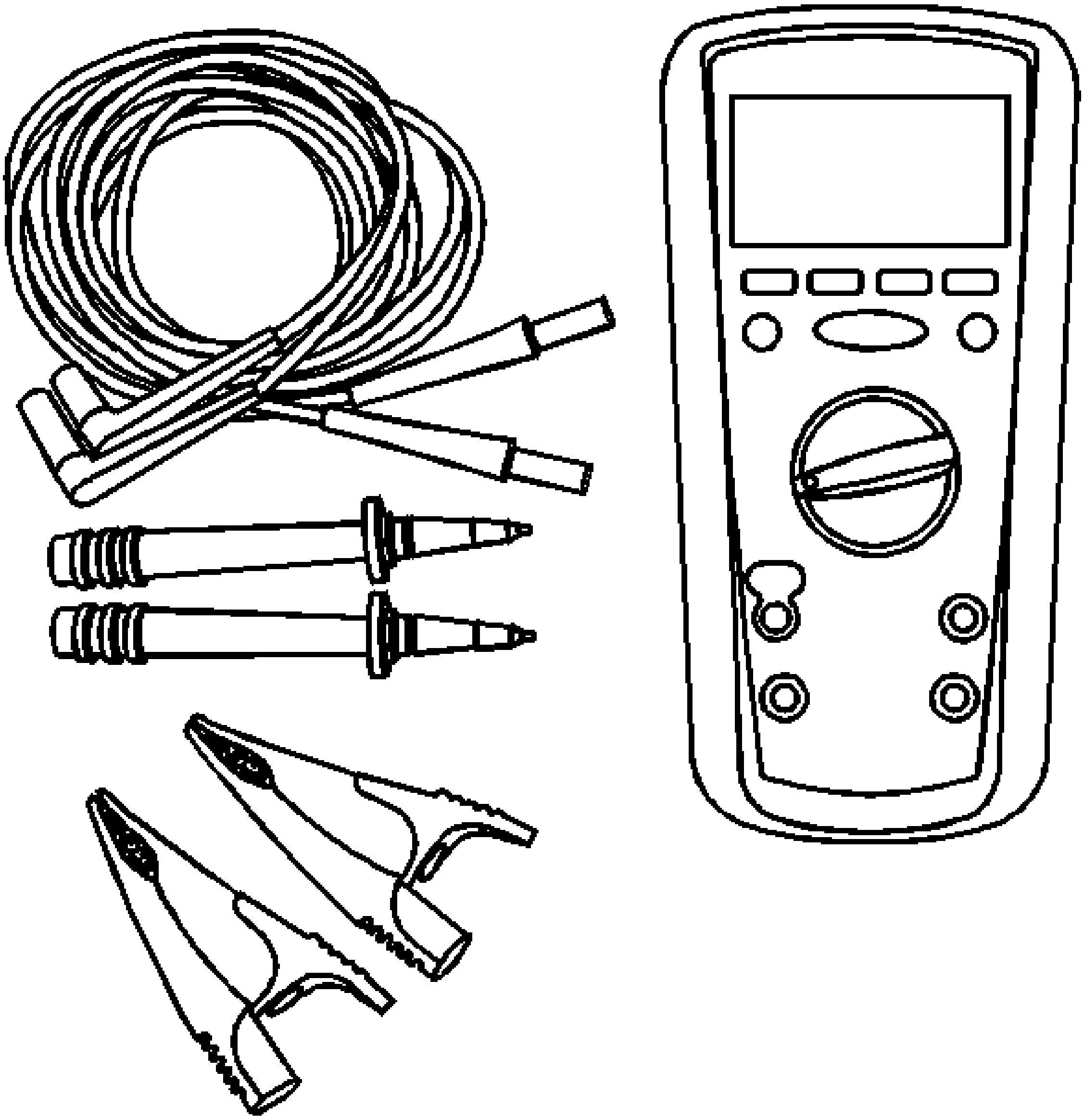
Illustration	Tool Number/ Description
	EL-50772 Insulation Multimeter

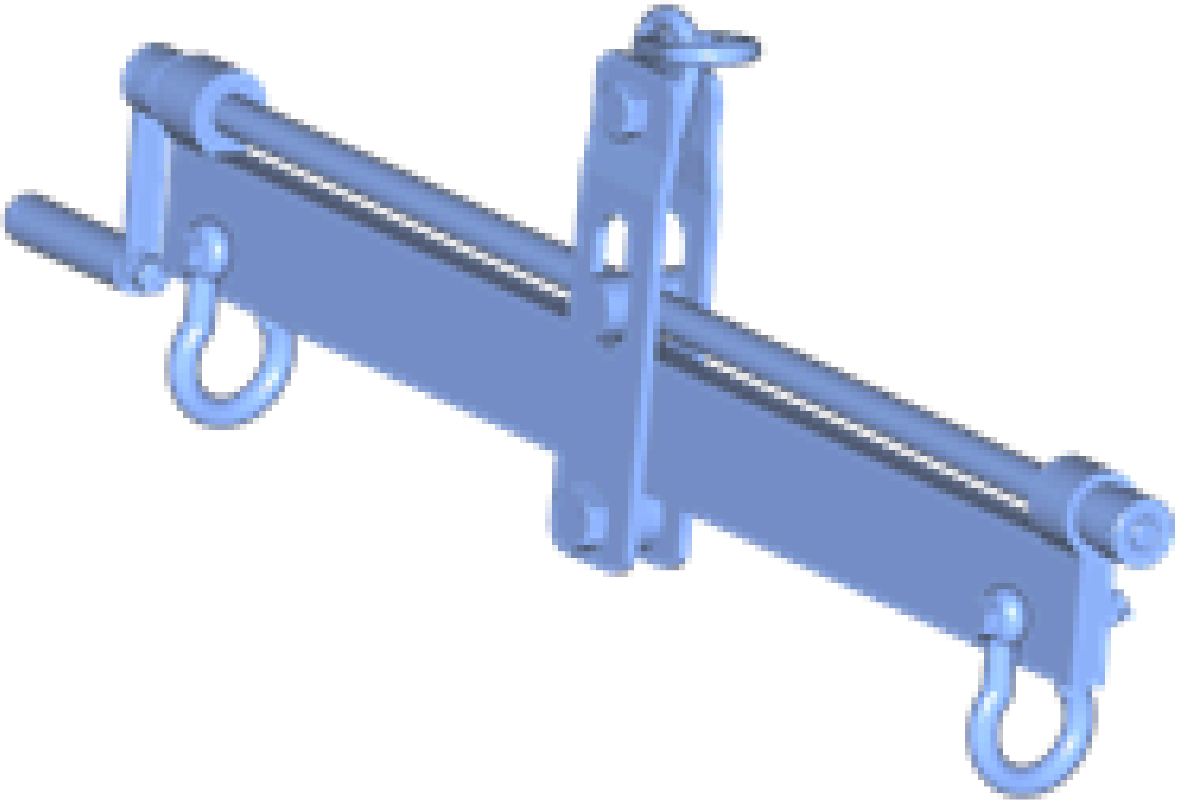
Illustration	Tool Number/ Description
	EL-51102 High Voltage Battery Lift Bar Tilter

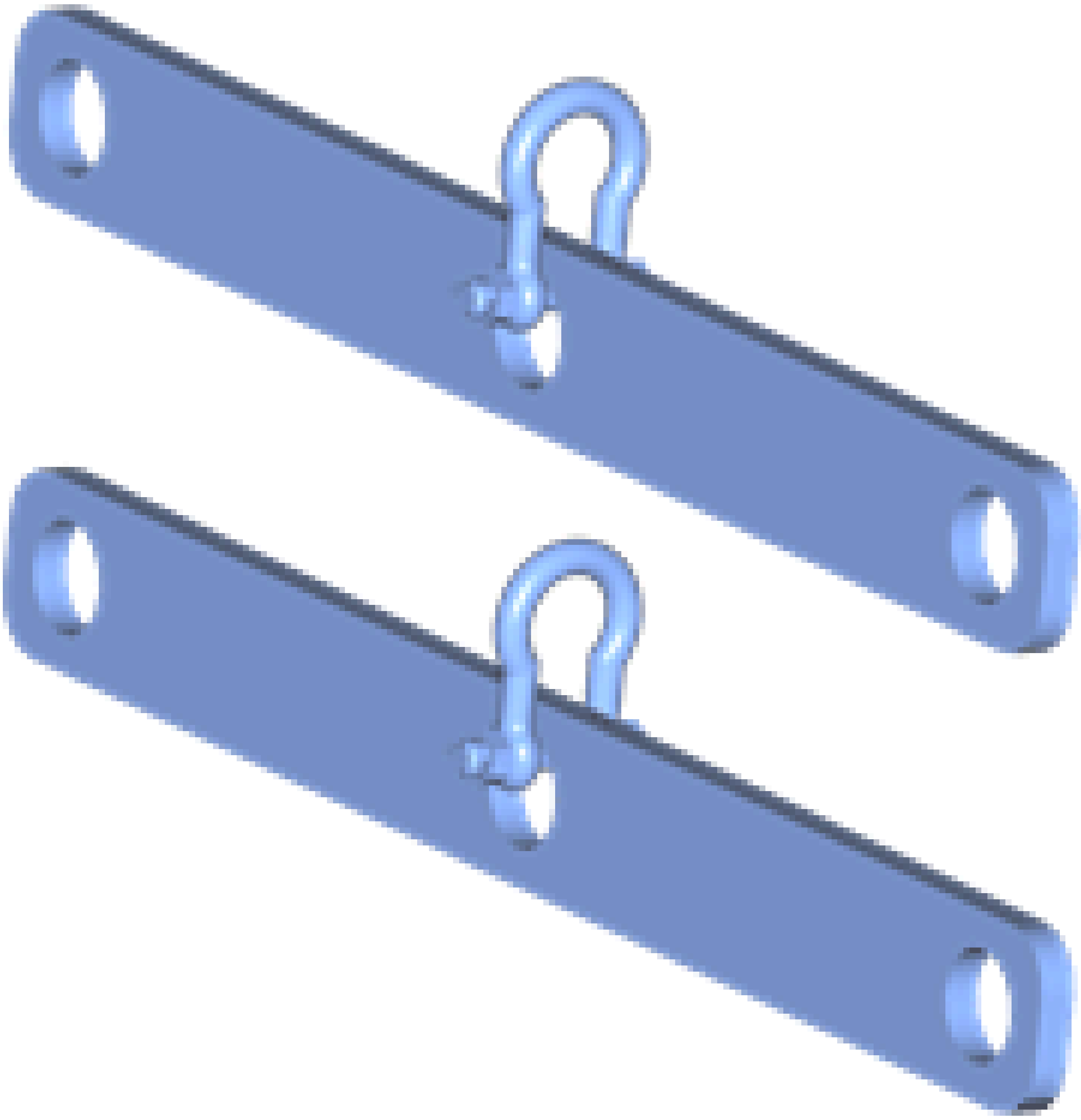
Illustration	Tool Number/ Description
	EL-51102-10 High Voltage Battery Lift Bar Hanging Bars and Shackles

Illustration	Tool Number/ Description
	EL-51102-20 High Voltage Battery Lift Bar Eye-Bolt Kit

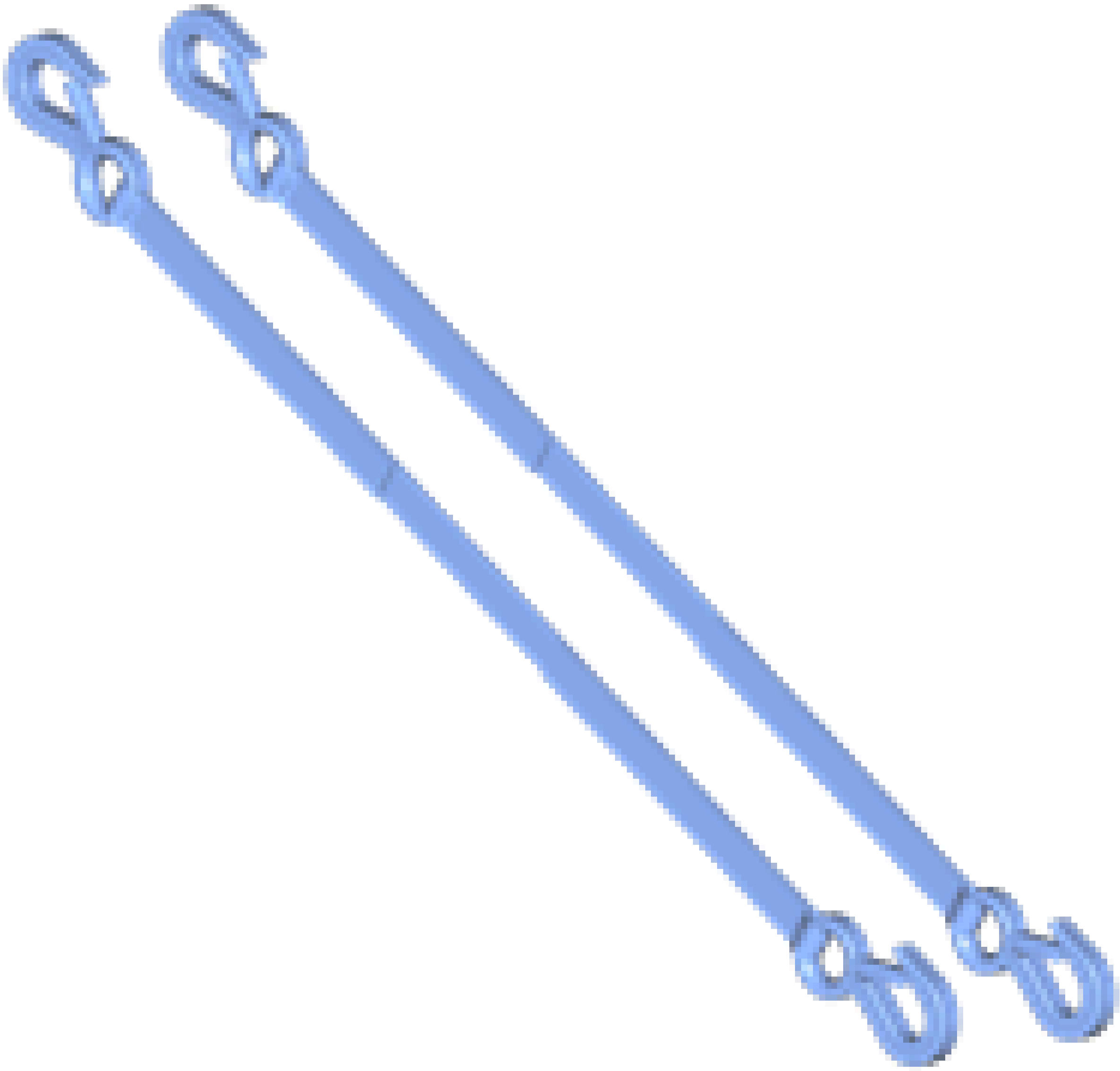
Illustration	Tool Number/ Description
	EL-51102-40 High Voltage Battery Lift Bar Straps

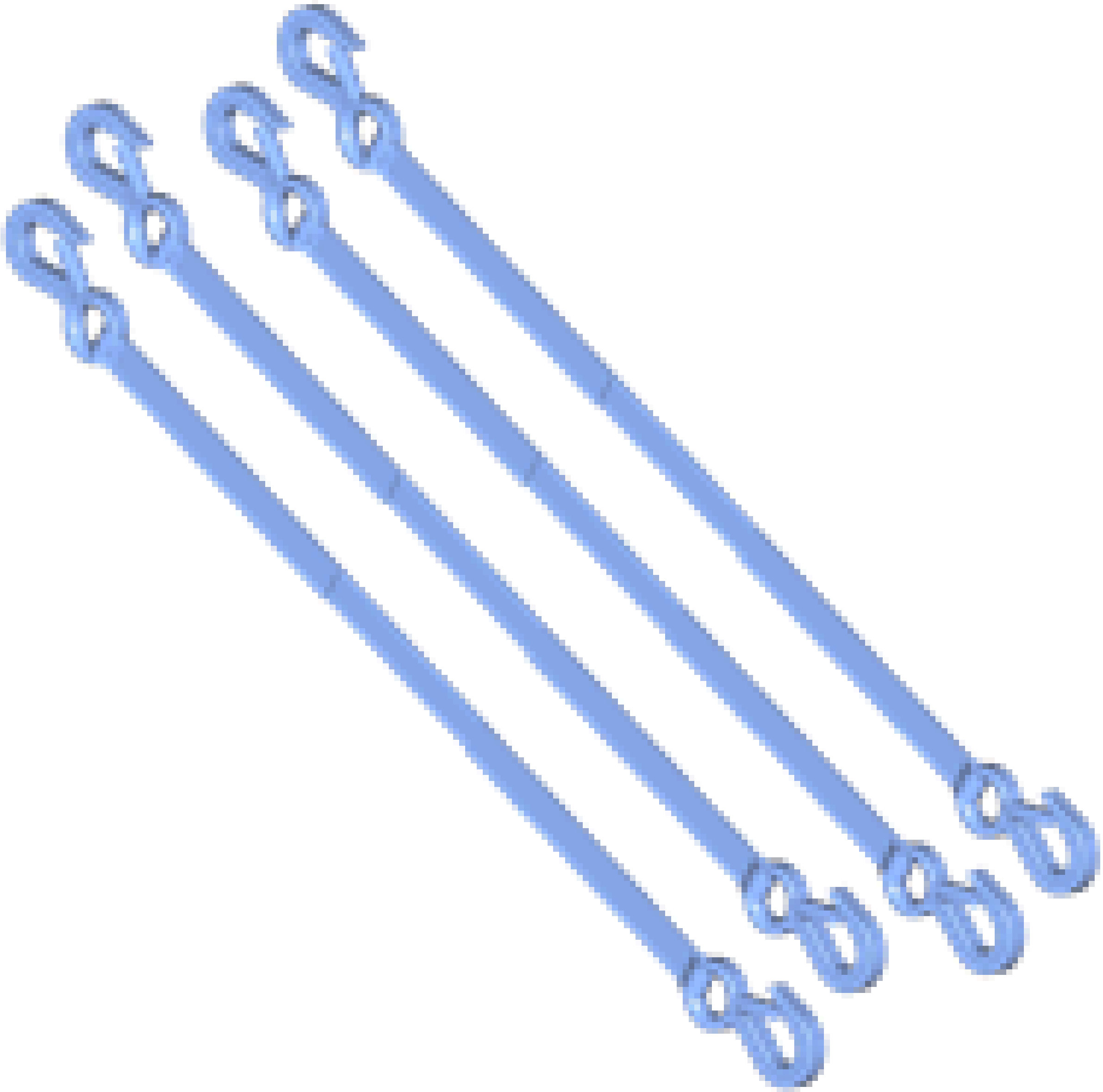
Illustration	Tool Number/ Description
	EL-51102-50 High Voltage Battery Lift Bar Straps

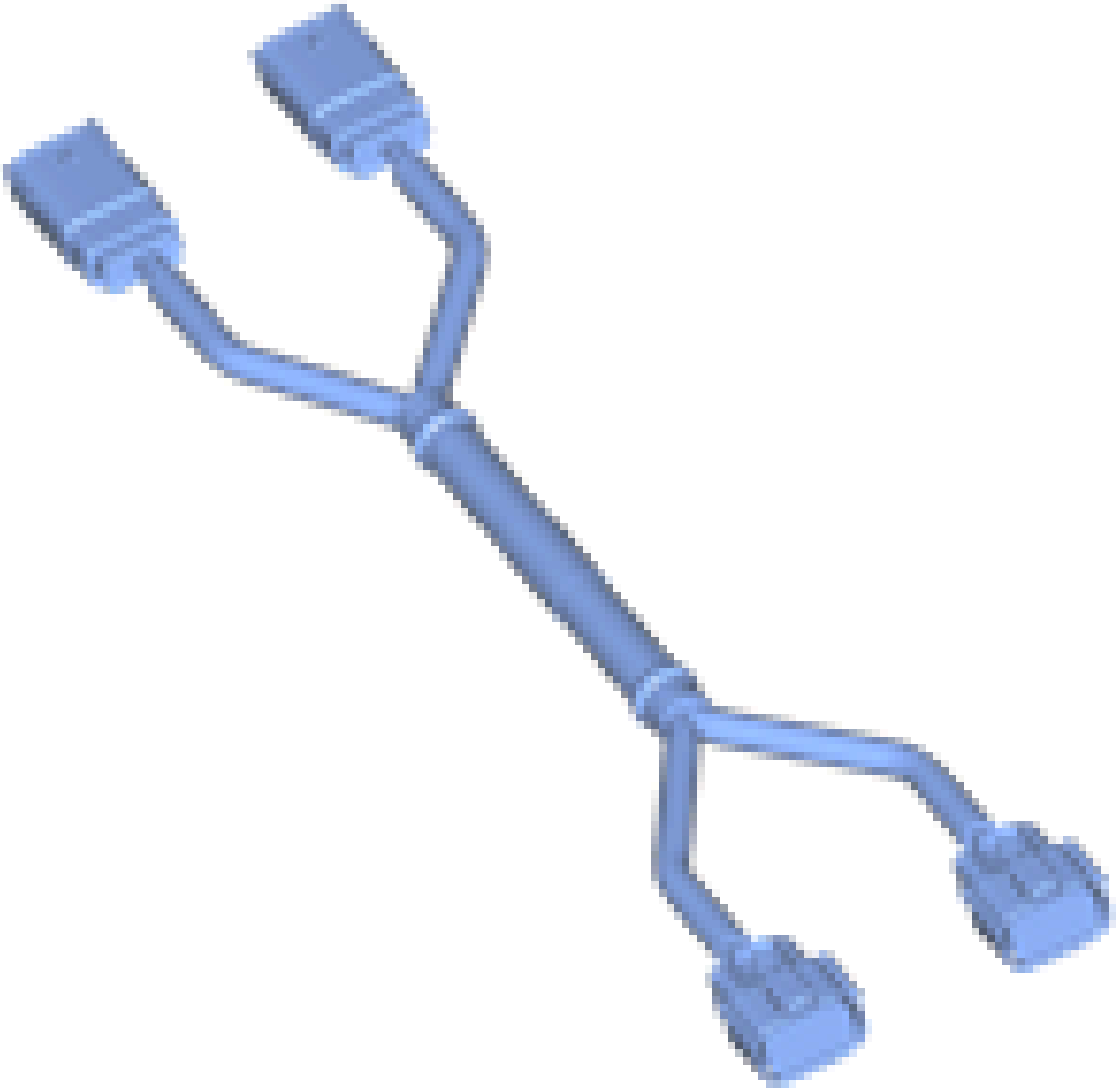
Illustration	Tool Number/ Description
	EL-52014 Low Voltage Test Harness

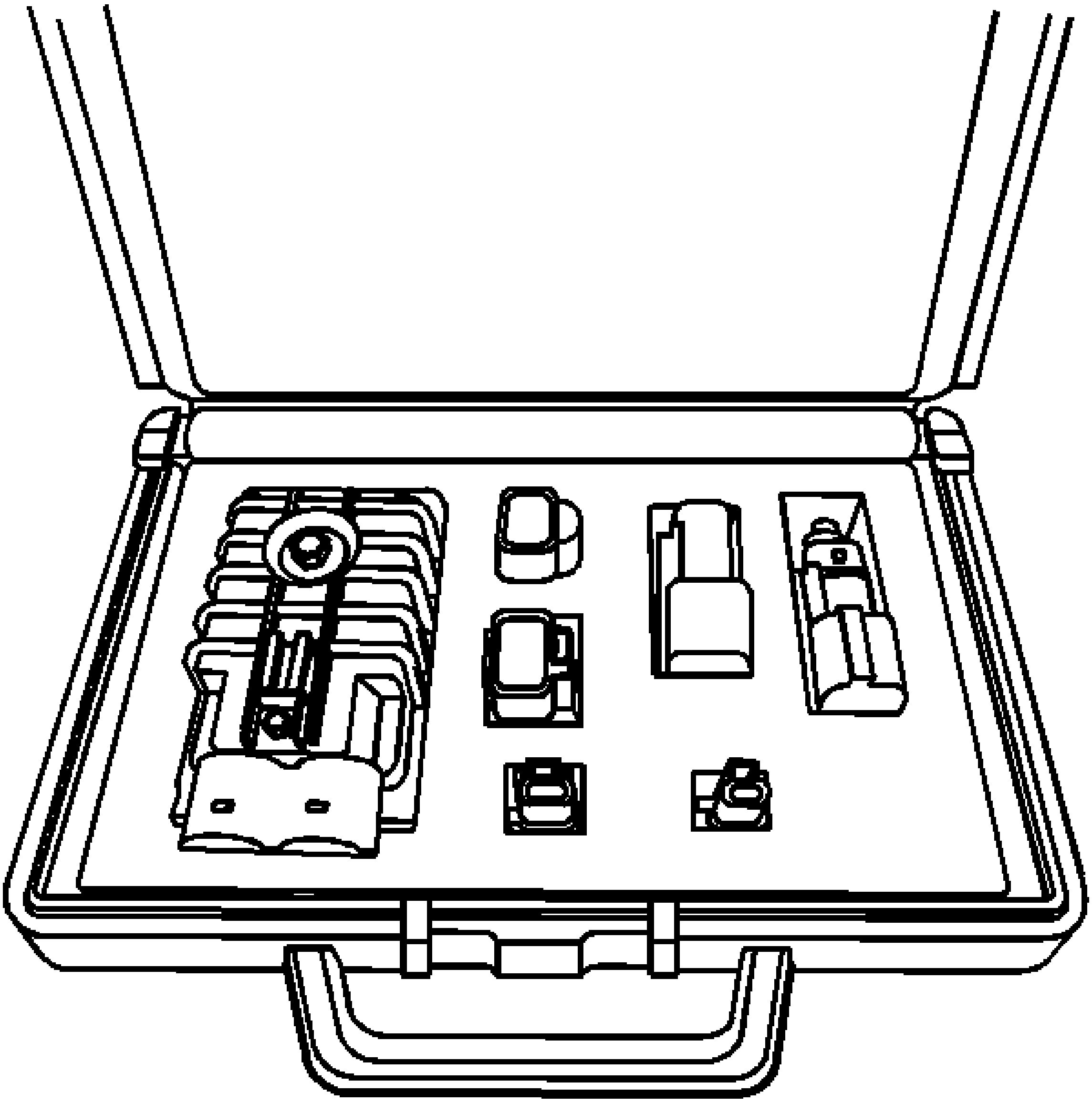
Illustration	Tool Number/ Description
	EL-52015 Battery Smoke Test Leak Adapters

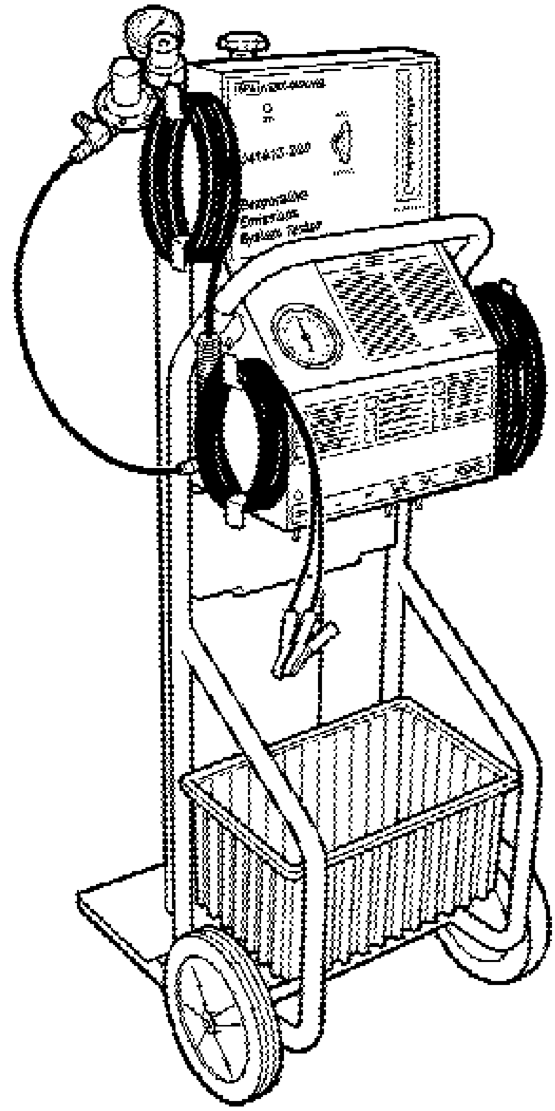
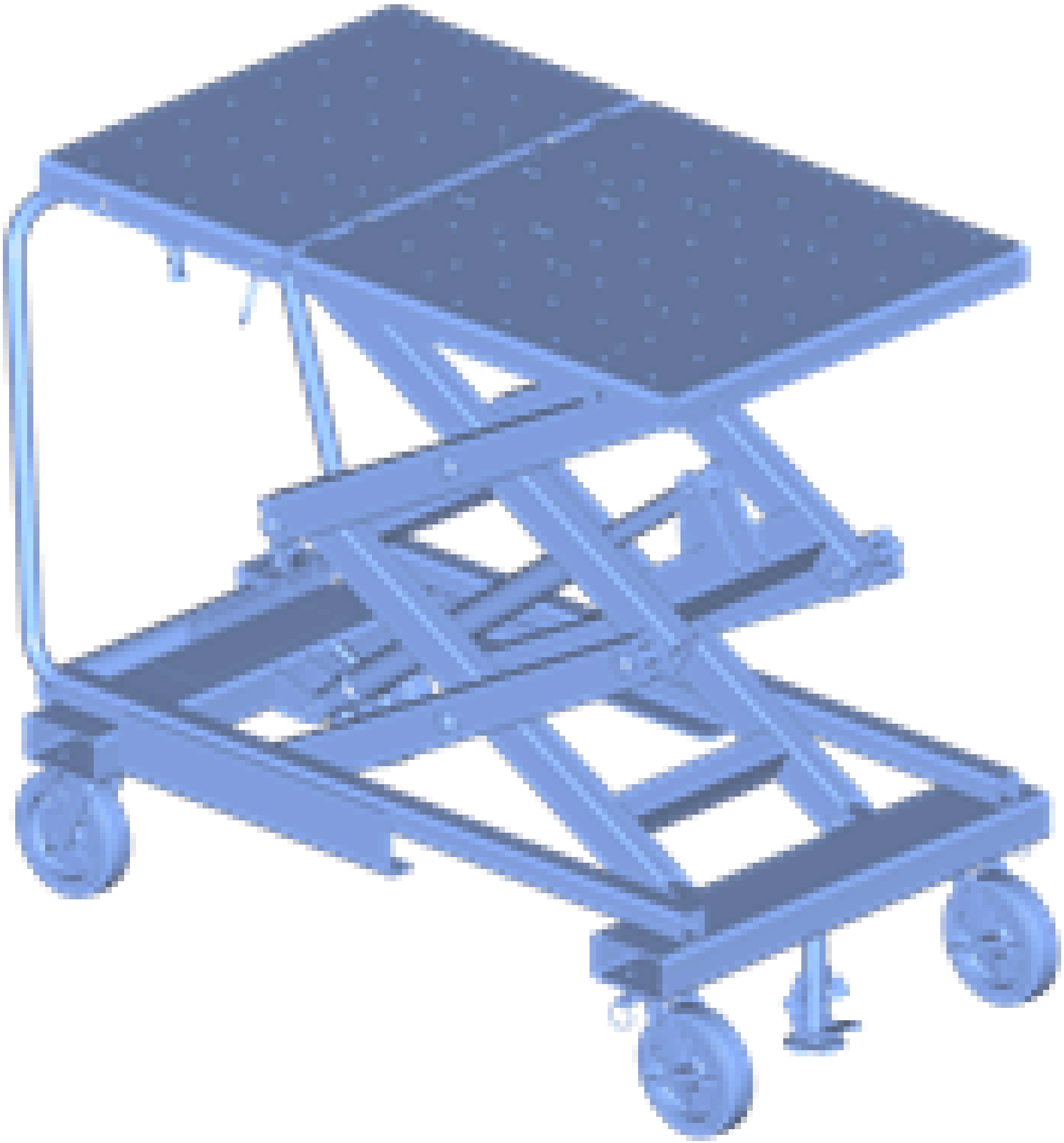
Illustration	Tool Number/ Description
	GE-41413-A J 41413-A Evaporative Emissions System Tester
	GE-52200 Lifting Table

Illustration	Tool Number/ Description

Illustration	Tool Number/ Description
	GE-52418 Lifting Table - Korea

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2017 ELECTRICAL

Hybrid/EV Energy Storage - Specifications - Fastener Specifications - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Accessory DC Power Control Module High Voltage Connector Protector Bolt	9 N.m (80 lb in)
Accessory DC Power Control Module High Voltage Connector Protector Bolt - Lower	9 N.m (80 lb in)
Accessory DC Power Control Module High Voltage Connector Protector Bolt - Upper	22 N.m (16 lb ft)
Accessory DC Power Control Module High Voltage Connector Protector Nut	9 N.m (80 lb in)
Battery Cable Bolt	9 N.m (80 lb in)
Battery Cable Nut	9 N.m (80 lb in)
Battery Upper Cover Fastener	9 N.m (80 lb in)
Cell Battery Cooling Plate Securing Nuts	9 N.m (80 lb in)
Cell Battery Module Bracket Bolt	9 N.m (80 lb in)
Cell Battery Module Securing Bolt	9 N.m (80 lb in)
Cell Battery Module Securing Nut	9 N.m (80 lb in)
Cell Battery Module Side Bolt	9 N.m (80 lb in)
Cooling Plate Nut	9 N.m (80 lb in)
Drive Motor Battery Bolt	56 N.m (41 lb ft)
Drive Motor Battery Control Module Wiring Harness Connector Screw	1.7 N.m (15 lb in)
Drive Motor Battery Control Module Wiring Harness Ground Terminal Fastener	6 N.m (53 lb in)
High Voltage Battery Connector X3 Die Casting Block Bolt	9 N.m (80 lb in)
High Voltage Battery Connector X4 Die Casting Block Bolt	9 N.m (80 lb in)
High Voltage Battery Connector X4 Harness Nut	4.5 N.m (40 lb in)
High Voltage Battery Connector X4 Head Screw	2.5 N.m (22 lb in)
High Voltage Battery Disconnect Relay Assembly Nuts	9 N.m (80 lb in)
High Voltage Battery Disconnect Relay Cover Bolt	4.5 N.m (40lb in)
High Voltage Battery Disconnect Relay Fuse Nut	5 N.m (44 lb in)
High Voltage Battery High Voltage Manual Disconnect Connector Bolt	9 N.m (80 lb in)
High Voltage Battery X3 Connector Block Bolt	9 N.m (80 lb in)
High Voltage Cable Channel Nut	9 N.m (80 lb in)
Tube Bolt	9 N.m (80 lb in)

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SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE

B204 Hybrid/EV Battery Pack Coolant Temperature Sensor*

Temperature Degrees C (Degrees F)	Resistance k ohm (typical)
-40Â°C (-40Â°F)	75.5
-20Â°C (-4Â°F)	21.6
0Â°C (32Â°F)	7.2
20Â°C (68Â°F)	2.7
40Â°C (104Â°F)	1.2
60Â°C (140Â°F)	0.550
80Â°C (176Â°F)	0.280
100Â°C (212Â°F)	0.155
140Â°C (284Â°F)	0.054
*Part # 55591401	

B32 Hybrid/EV Battery Temperature Sensor*

Temperature Degrees C (Degrees F)	Resistance k ohm (typical)
-40Â°C (-40Â°F)	202
-20Â°C (-4Â°F)	71.2
0Â°C (32Â°F)	27.8
20Â°C (68Â°F)	12.1
40Â°C (104Â°F)	5.8
60Â°C (140Â°F)	3
80Â°C (176Â°F)	1.7
90Â°C (194Â°F)	1.2
*Part # 23348948	

B202 Hybrid/EV Electronics Coolant Temperature Sensor*

Temperature Degrees C (Degrees F)	Resistance k ohm (typical)
-40Â°C (-40Â°F)	45
-20Â°C (-4Â°F)	15
0Â°C (32Â°F)	5.8
20Â°C (68Â°F)	2.5
40Â°C (104Â°F)	1.2
60Â°C (140Â°F)	0.595
80Â°C (176Â°F)	0.323
100Â°C (212Â°F)	0.187
150Â°C (302Â°F)	0.057
*Part # 12641072	

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Cooling Fan Bolt	5 N.m (44 lb in)
Drive Motor Battery Coolant Cooler Bracket Bolt	9 N.m (80 lb in)
Drive Motor Battery Coolant Inlet Hose Nut	5 N.m (44 lb in)
Drive Motor Battery Coolant Port Nut	40 N.m (30 lb ft)
Drive Motor Battery Coolant Pump Bracket Nut	9 N.m (80 lb in)
Drive Motor Battery Radiator Surge Tank Bracket Bolt	9 N.m (80 lb in)
Drive Motor Battery Radiator Surge Tank Bracket Nut	9 N.m (80 lb in)
Drive Motor Battery Coolant Cooler Bracket Nut	9 N.m (80 lb in)
Drive Motor Power Inverter Module Ground Cable Bolt	9 N.m (80 lb in)
Drive Motor Power Inverter Module Shield Bolt	25 N.m (18 lb ft)
High Voltage Battery Heater Bracket Nut	9 N.m (80 lb in)
High Voltage Battery Heater Bracket Bolt	9 N.m (80 lb in)
High Voltage Battery Heater Ground Cable Bolt	9 N.m (80 lb in)
Radiator Air Lower Baffle Bolt	9 N.m (80 lb in)
Radiator Surge Tank Bolt	4.5 N.m (40 lb in)
Radiator Surge Tank Support Bracket Bolt	9 N.m (80 lb in)
Radiator Surge Tank Support Bracket Nut	9 N.m (80 lb in)
Radiator Upper Bracket Fastener	22 N.m (16 lb ft)
Radiator Vent Valve	1.9 N.m (17 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	US English
Cooling System Filling		
• High Voltage Battery Pack Cooling	7.0 liters	7.39 Quarts
• Power Electronics Cooling	3.8 liters	4.01 Quarts

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS (NORTH AMERICA)

Application	Type of Material	GM Part Number	
		United States	Canada
DEX-COOLÂ® (Premix 50/50 with Deionized Water)	Fluid	12378390	10953456

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS (KOREA)

Application	Type of Material	GM Part Number
DEX-COOLÂ® (Premix 50/50 with Deionized Water)	Fluid	93746926

SCHEMATIC WIRING DIAGRAMS

HYBRID/EV COOLING WIRING SCHEMATICS

Hybrid/EV Electronics Cooling

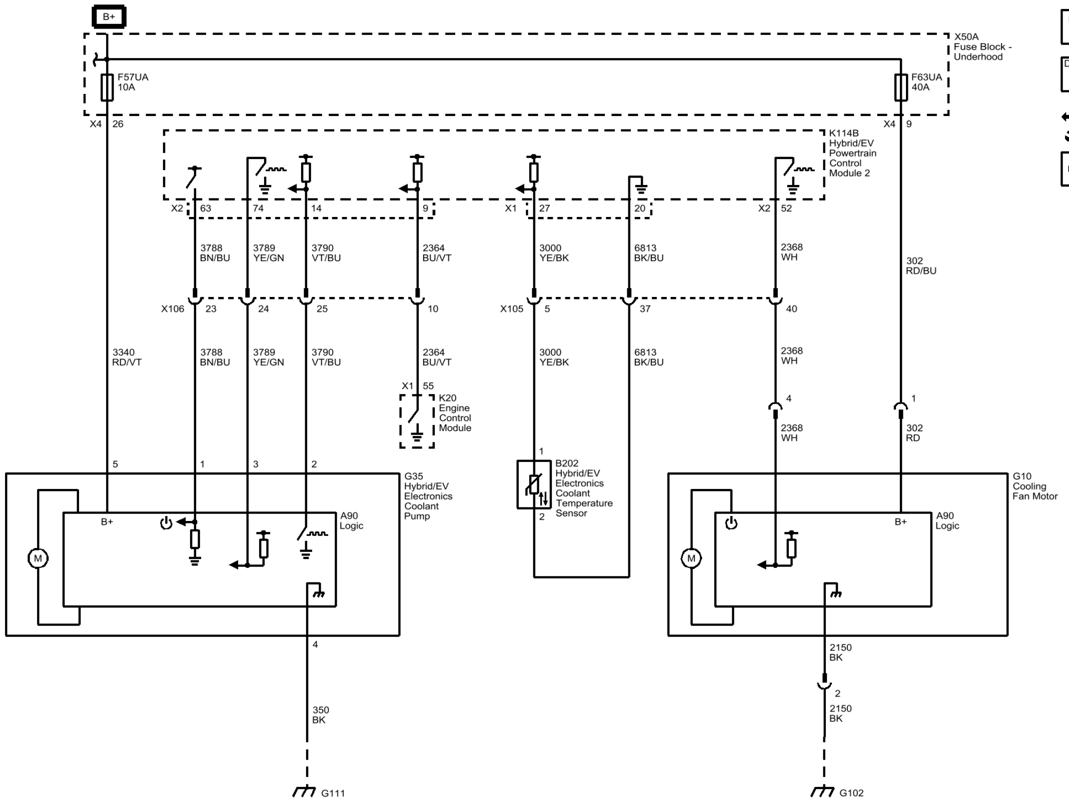
B+
X50A Fuse Block - Underhood
F57UA 10A
F63UA 40A
X4 26
X4 9
K114B Hybrid/EV Powertrain Control Module 2
X2 63
74
14
9
X1 27
20
X2 52
3788 BN/BU
3789 YE/GN
3790 VT/BU
2364 BU/VT
3000 YE/BK
6813 BK/BU
2368 WH
302 RD/BU
X106 23
24
25
10
X105 5
37
40
3340 RD/VT
3788 BN/BU
3789 YE/GN
3790 VT/BU
2364 BU/VT
3000 YE/BK
6813 BK/BU
2368 WH
X1 55
K20 Engine Control Module
4
1
2368 WH
302 RD
5
1
3
2
G35 Hybrid/EV Electronics Coolant Pump
B+
A90 Logic
M
1
B202 Hybrid/EV Electronics Coolant Temperature Sensor
2
G10 Cooling Fan Motor
B+
A90 Logic
M
4
350 BK
2150 BK
2
2150 BK
G111
G102

Fig. 1: Hybrid/EV Electronics Cooling
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Pack Cooling - Pump and Level Switch

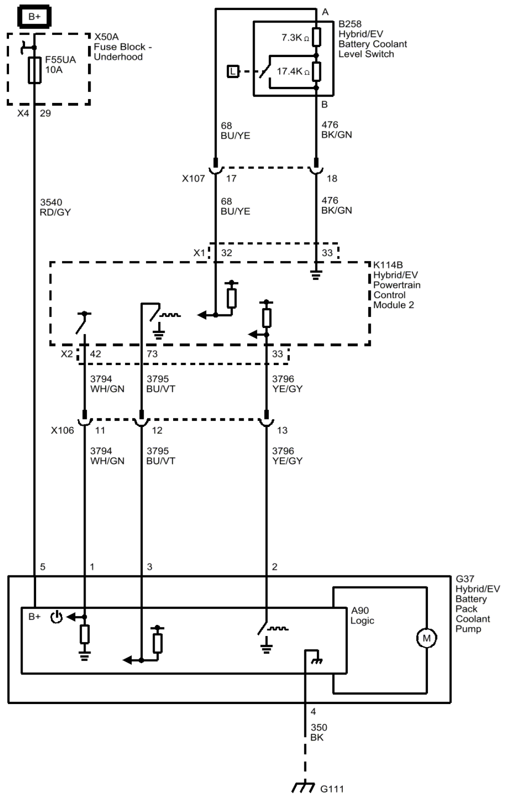
B+
X50A Fuse Block - Underhood
F55UA 10A
X4 29
A
B258 Hybrid/EV Battery Coolant Level Switch
7.3K Ω
17.4K Ω
L
B
68 BU/YE
476 BK/GN
X107 17
18
68 BU/YE
476 BK/GN
3540 RD/GY
X1 32
33
K114B Hybrid/EV Powertrain Control Module 2
X2 42
73
33
3794 WH/GN
3795 BU/VT
3796 YE/GY
X106 11
12
13
3794 WH/GN
3795 BU/VT
3796 YE/GY
5
1
3
2
G37 Hybrid/EV Battery Pack Coolant Pump
B+
A90 Logic
M
4
350 BK
G111

Fig. 2: Hybrid/EV Battery Pack Cooling - Pump and Level Switch
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Pack Cooling - Coolant Heater

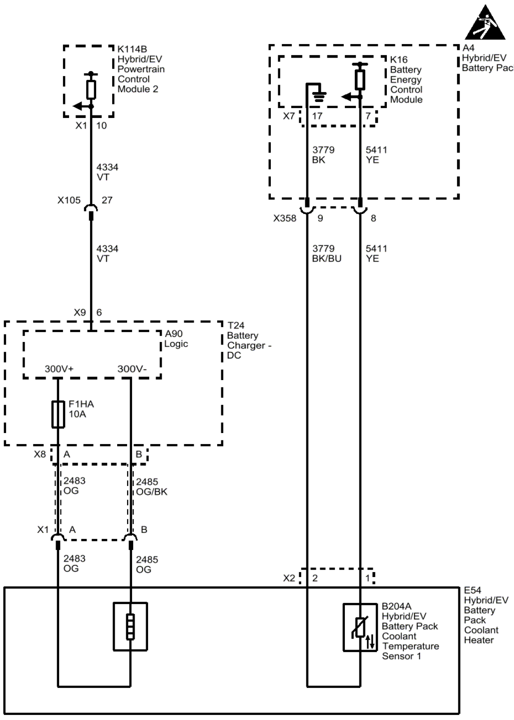
K114B
Hybrid/EV
Powertrain
Control
Module 2
X1
10
4334
VT
X105
27
4334
VT
X9
6
A90
Logic
T24
Battery
Charger -
DC
300V+
300V-
F1HA
10A
X8
A
B
2483
OG
2485
OG/BK
X1
A
B
2483
OG
2485
OG
A4
Hybrid/EV
Battery Pack
K16
Battery
Energy
Control
Module
X7
17
7
3779
BK
5411
YE
X358
9
8
3779
BK/BU
5411
YE
X2
2
1
B204A
Hybrid/EV
Battery Pack
Coolant
Temperature
Sensor 1
E54
Hybrid/EV
Battery
Pack
Coolant
Heater

Fig. 3: Hybrid/EV Battery Pack Cooling - Coolant Heater
Courtesy of GENERAL MOTORS COMPANY

Hybrid/EV Battery Temperature Sensors

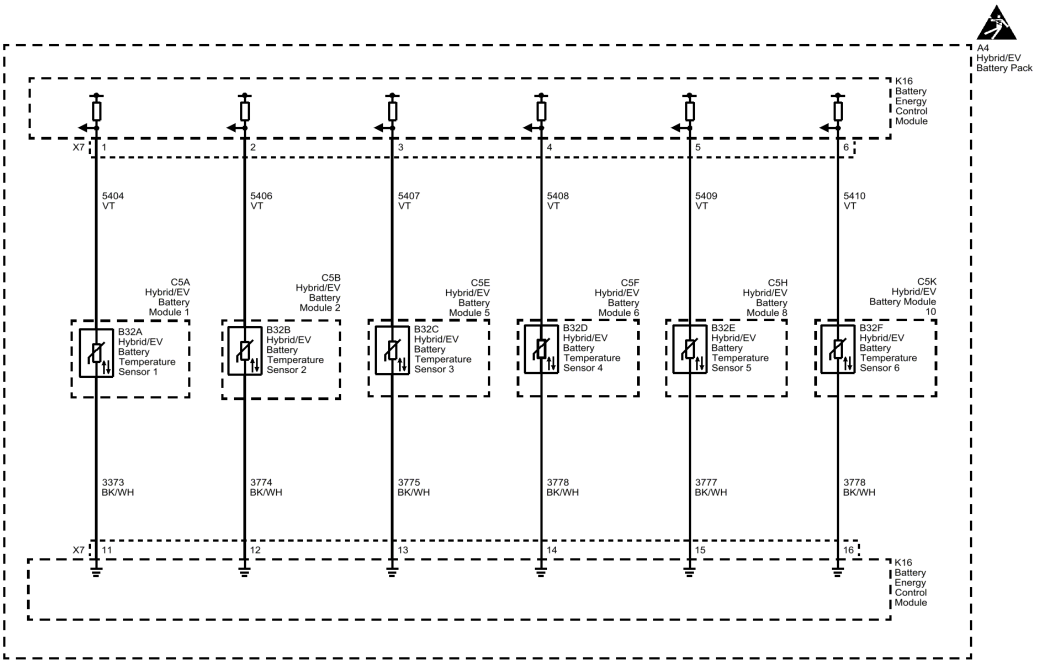
A4
Hybrid/EV
Battery Pack
K16
Battery
Energy
Control
Module
X7
1
2
3
4
5
6
5404
VT
5406
VT
5407
VT
5408
VT
5409
VT
5410
VT
C5A
Hybrid/EV
Battery
Module 1
C5B
Hybrid/EV
Battery
Module 2
C5E
Hybrid/EV
Battery
Module 5
C5F
Hybrid/EV
Battery
Module 6
C5H
Hybrid/EV
Battery
Module 8
C5K
Hybrid/EV
Battery Module
10
B32A
Hybrid/EV
Battery
Temperature
Sensor 1
B32B
Hybrid/EV
Battery
Temperature
Sensor 2
B32C
Hybrid/EV
Battery
Temperature
Sensor 3
B32D
Hybrid/EV
Battery
Temperature
Sensor 4
B32E
Hybrid/EV
Battery
Temperature
Sensor 5
B32F
Hybrid/EV
Battery
Temperature
Sensor 6
3373
BK/WH
3774
BK/WH
3775
BK/WH
3778
BK/WH
3777
BK/WH
3778
BK/WH
X7
11
12
13
14
15
16
K16
Battery
Energy
Control
Module

Fig. 4: Hybrid/EV Battery Temperature Sensors
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0480: COOLING FAN RELAY CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0480

Cooling Fan Relay Control Circuit

Circuit/System Description

The radiator cooling fan is controlled with a pulse width modulated (PWM) signal on the cooling fan control circuit from the hybrid/EV powertrain control module 2. Although the hybrid/EV powertrain control module 2 is directly connected to the cooling fan, the ECM is considered the master controller. The ECM sends a fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan signal hardwire circuit. The hybrid/EV powertrain control module 2 operates in a pass-through mode for any ECM-derived fan request. The higher the duty cycle the higher the cooling fan speed.

Conditions for Running the DTC

The 12 V battery voltage is greater than 10.2 V.

Conditions for Setting the DTC

The Hybrid/EV Powertrain Control Module 2 has detected an open, short to ground or short to voltage fault on the fan control circuit.

Action Taken When the DTC Sets

DTC P0480 is a type B DTC.

Conditions for Clearing the DTC

DTC P0480 is a type B DTC.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that the cooling fan is operating at high speed when commanding the Cooling Fan Motor Command to 90% with a scan tool.
    - **If the cooling fan is not operating at high speed**

      Refer to Circuit/System Testing

    - **If the cooling fan is operating as commanded**
3. Verify the cooling fan is operating at a low speed when commanding the Cooling Fan Motor Command to 10% with a scan tool.
    - **If the cooling fan is not operating at low speed**

      Refer to Circuit/System Testing

    - **If the cooling fan is operating as commanded**
4. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the appropriate G10 Cooling Fan Motor.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 10 Ω**
3. Connect a test lamp between the B+ circuit terminal 1 and ground.
4. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the G10 Cooling Fan Motor and the fuse.
    - **If the test lamp illuminates**
5. Connect a test lamp between the control circuit terminal 4 and the B+ circuit terminal 1.
6. Vehicle in service mode, verify the test lamp changes between dim (10%) and bright (90%) when commanding the Cooling Fan Motor Command ON between 10% and 90% with a scan tool.
    - **If the test lamp is always dim or does not illuminate**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is always bright**

   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp changes illumination between bright (90%) and dim (10%)**
7. Replace the G10 cooling fan motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Cooling Fan and Shroud Replacement** for G10 cooling fan motor replacement.
- Refer to **Control Module References** for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0A7E: HYBRID/EV BATTERY PACK HIGH TEMPERATURE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A7E

Hybrid/EV Battery Pack High Temperature

Circuit/System Description

The hybrid/EV battery pack has 6 hybrid/EV battery module temperature sensors. The hybrid/EV powertrain control module 2 uses the battery temperature sensors to determine the hybrid/EV battery module temperature to control the energy storage cooling system operation.

The energy storage system cooling system uses a 12 V hybrid/EV battery pack coolant pump, a refrigerant/coolant heat exchanger (chiller) and the electric A/C compressor motor control module assembly to cool down the high voltage hybrid/EV battery.

Conditions for Running the DTC

- The hybrid/EV powertrain control module 2 and hybrid/EV battery energy control module are awake and communicating.
- The 12 V battery voltage is greater than or equal to 10.2 V.
- None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36, or U179C.

Conditions for Setting the DTC

The maximum sensed temperature in the hybrid/EV battery is greater than 53Â°C (127Â°F).

Action Taken When the DTC Sets

- DTC P0A7E is a type A DTC.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

DTC P0A7E is a type A DTC.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0480, P0534, P0C47, P148A-P148C, P1EC6, P1E8C or P1E8D is not set.
    - **If any DTC is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If none of the DTCs are set**

WARNING: **Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.**

3. Test for proper coolant level and operation of the hybrid/EV battery coolant system, refrigerant system and coolant fan system. Refer to **Hybrid/EV Electronics Cooling Diagnostic (Drive Motor Generator Power Inverter Module Cooling System)Hybrid/EV Electronics Cooling Diagnostic (Drive Motor Battery Cooling System)**, for Drive Motor Battery Cooling System, **Hybrid/EV Battery Pack Coolant Pump Malfunction**, **Cooling Fan Malfunction**, **Hybrid Cooling System Loss of Coolant (Drive Motor Battery Cooling System)Hybrid Cooling System Loss of Coolant (Drive Motor Generator Power Inverter Module Cooling System)**, as appropriate.

DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, OR P0C34-P0C36: HYBRID/EV BATTERY TEMPERATURE SENSOR 1-6

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0A9C

Hybrid/EV Battery Temperature Sensor 1 Performance

DTC P0A9D

Hybrid/EV Battery Temperature Sensor 1 Circuit Low Voltage

DTC P0A9E

Hybrid/EV Battery Temperature Sensor 1 Circuit High Voltage

DTC P0AC6

Hybrid/EV Battery Temperature Sensor 2 Performance

DTC P0AC7

Hybrid/EV Battery Temperature Sensor 2 Circuit Low Voltage

DTC P0AC8

Hybrid/EV Battery Temperature Sensor 2 Circuit High Voltage

DTC P0ACB

Hybrid/EV Battery Temperature Sensor 3 Performance

DTC P0ACC

Hybrid/EV Battery Temperature Sensor 3 Circuit Low Voltage

DTC P0ACD

Hybrid/EV Battery Temperature Sensor 3 Circuit High Voltage

DTC P0AE9

Hybrid/EV Battery Temperature Sensor 4 Performance

DTC P0AEA

Hybrid/EV Battery Temperature Sensor 4 Circuit Low Voltage

DTC P0AEB

Hybrid/EV Battery Temperature Sensor 4 Circuit High Voltage

DTC P0BC3

Hybrid/EV Battery Temperature Sensor 5 Performance

DTC P0BC4

Hybrid/EV Battery Temperature Sensor 5 Circuit Low Voltage

DTC P0BC5

Hybrid/EV Battery Temperature Sensor 5 Circuit High Voltage

DTC P0C34

Hybrid/EV Battery Temperature Sensor 6 Performance

DTC P0C35

Hybrid/EV Battery Temperature Sensor 6 Circuit Low Voltage

DTC P0C36

Hybrid/EV Battery Temperature Sensor 6 Circuit High Voltage

Circuit/System Description

The hybrid/EV battery pack has 6 hybrid/EV battery temperature sensors. The temperature sensor is a variable resistor that measures the temperature of the hybrid/EV battery cell groups. The battery energy control module supplies 5 V to the signal circuit and a ground for the low reference circuit. The hybrid/EV battery temperature sensor resistance changes with battery temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The hybrid/EV powertrain control module 2 uses the battery temperature sensors to determine the hybrid/EV battery module temperature to control the battery cooling system operation.

Conditions for Running the DTC

P0A9C, P0AC6, P0ACB, P0AE9, P0BC3, and P0C34

None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35, P0C36, P0C89, P0C8A, P0C8B, P0C8E, P0C8F, P0C90, P0C93, P0C94, P0C95, P0C98, P0C99, P0C9A, P0CA9, P0CAA, P0CAB, P0CAE, P0CAF, P0CB0, P0CB3, P0CB4, P0CB5, P0CB8, P0CB9, P0CBA, P1E8E, P1E8F, P1E90, P1E91, P1E93, P1E94, P1E95, P1E96, P1E97, P1E99, P1E9A, P1E9B, P1E9C, P1E9D, P1E9F, P1EA0, P1EA1, P1EA2, P1EA3, P1EA5, P1EB1, P1EB2, P1EB3, P1EB4, P1EB5, U2401, U2603, U2604, U2605, or U2606.

P0A9D, P0A9E, P0AC7, P0AC8, P0ACC, P0ACD, P0AEA, P0AEB, P0BC4, P0BC5, P0C35, and P0C36

- Hybrid/EV Powertrain Control Module 2 and Battery Energy Control Module are awake and communicating
- None of the following DTCs are set: P1E8E, P1E94, P1E9A, P1EA0, P1FBD, P1FBE, P1FBF, P1FC0, U2603, U2604, U2605, U2606, U2617, U2618, U2619, or U2620.

Conditions for Setting the DTC

P0A9C, P0AC6, P0ACB, P0AE9, P0BC3, and P0C34

The difference between a hybrid/EV battery temperature sensor and the average of the other hybrid/EV battery temperature sensors is greater than a 20Â°C (36Â°F).

P0A9D, P0AC7, P0ACC, P0AEA, P0BC4, and P0C35

The hybrid/EV battery temperature sensor is greater than 87.5Â°C (189.5Â°F).

P0A9E, P0AC8, P0ACD, P0AEB, P0BC5, and P0C36

The hybrid/EV battery temperature sensor is -40Â°C (-40Â°F).

Action Taken When the DTC Sets

- DTCs P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35, and P0C36 are Type B DTCs.
- If six sensors fail, the vehicle will operate in a reduced power mode.

Conditions for Clearing the DTC

DTCs P0A9C, P0A9D, P0A9E, P0AC6, P0AC7, P0AC8, P0ACB, P0ACC, P0ACD, P0AE9, P0AEA, P0AEB, P0BC3, P0BC4, P0BC5, P0C34, P0C35, and P0C36 are Type B DTCs.

Diagnostic Aids

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

- Low or no coolant in the system may set a DTC P0A9D, P0AC7, P0ACC, P0AEA, P0BC4, or P0C35.
- The B32 Hybrid/EV Battery Temperature Sensors are non-serviceable components of the Hybrid/EV Battery Pack internal wiring harness.

Reference Information

Schematic Reference

- **Hybrid/EV Cooling Schematics**
- **Hybrid/EV Energy Storage Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Temperature Versus Resistance** for B32 Hybrid/EV Battery Temperature Sensor
- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0C47, P1E8C, or P1EC6 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

   - **If none of the DTCs are set**
3. Observe the scan tool Hybrid Battery 1 - 6 temperature parameters. The sensor readings should be between -39 and +87Â°C (-38.2 and +188.6Â°F) with less than a 15Â°C (27Â°F) difference between any of the temperature sensor readings.
   - **If not within the specified range**

     Refer to Circuit/System Testing.

   - **If within the specified range**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the A4 Hybrid/EV Battery Pack. Refer to **High Voltage Disabling** . Remove the A4 Hybrid/EV Battery Pack cover. Refer to **Battery Upper Cover Replacement** .

CAUTION: **The battery energy control modules internal cell balancing circuitry is powered by the cell group voltage sense circuits. In order to prevent an unrecoverable, unbalanced Hybrid/EV battery section or internal control module damage, always take the following actions:**

   1. **Disconnect ALL of the battery energy control module connectors prior to disconnecting any Hybrid/EV battery section connector.**
   2. **Reconnect all the Hybrid/EV battery section connectors prior to reconnecting the battery energy control module connectors.**
   3. **Disconnect and reconnect the battery energy control module connectors ONLY in the sequence provided in Repair Instructions.**

2. Disconnect all K16 battery energy control module connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
3. At the appropriate K16 battery energy control module connector, test for infinite resistance between the signal circuit terminal of the applicable B32 Hybrid/EV Battery Temperature Sensor and chassis ground of the A4 Hybrid/EV Battery Pack.
   - **If less than infinite resistance**

     Replace the Hybrid/EV Battery Pack internal wiring harness.

   - **If infinite resistance**
4. At the appropriate K16 battery energy control module connector, test for 9.9 - 13.4 k Ω at approximately 21.11Â°C (70Â°F) between the signal terminal and the low reference terminal. Refer to **Temperature Versus Resistance** for B32 Hybrid/EV Battery Temperature Sensor.
   - **If not within the specified range**

     Replace the Hybrid/EV Battery Pack internal wiring harness.

   - **If within the specified range**
5. Replace the K16 Battery Energy Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Control Module Wiring Harness Replacement** for B32 Hybrid/EV Battery Temperature Sensor replacement
- Refer to **Control Module References** for K16 battery energy control module replacement, programming and setup.

DTC P0C43-P0C46: HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR 1

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C43

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Performance

DTC P0C44

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit Low Voltage

DTC P0C45

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit High Voltage

DTC P0C46

Hybrid/EV Battery Pack Coolant Temperature Sensor 1 Circuit Erratic

Circuit/System Description

The hybrid/EV battery pack coolant temperature sensor is located in the coolant outlet of the hybrid/EV battery heater assembly. The temperature sensor is a variable resistor that measures the temperature of the hybrid/EV battery coolant. The hybrid/EV battery pack coolant temperature sensor resistance changes with battery coolant temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The battery energy control module uses the hybrid/EV battery temperature sensor to determine the hybrid/EV battery pack temperature to control the battery cooling and heating operations.

Conditions for Running the DTC

P0C43

- Vehicle ON after all high voltage contactor relays had been Open for at least 5 hours.
- The 12 V battery voltage is greater than or equal 10.2 V.
- None of the following DTCs are set: P0A9C, P0A9D, P0A9E, P0C44, P0C45, P0C46, P0C47, P1E8C, P1E8D, P19FD, P19FE, P19FF, or U0111.

P0C44 and P0C45

- The 12 V battery voltage is greater than or equal to 9 V.
- The Battery Energy Control Module is awake and communicating.

P0C46

- The 12 V battery voltage is greater than or equal 10.2 V.
- The Battery Energy Control Module is awake and communicating.
- None of the following DTCs are set: P0C44, P0C45, or U185A.

Conditions for Setting the DTC

P0C43

The hybrid/EV battery pack coolant temperature sensor reading is not within 25Â°C (45Â°F) of the Average Hybrid Battery Pack Temperature AND is not within 20Â°C (36Â°F) of the outside air temperature.

P0C44

The Hybrid/EV Battery Pack Coolant Temperature Sensor 1 is greater than or equal to 87.9Â°C (190.2Â°F).

P0C45

The Hybrid/EV Battery Pack Coolant Temperature Sensor 1 is less than -40Â°C (-40Â°F).

P0C46

The hybrid/EV battery pack coolant temperature sensor is intermittent or has changed by 60Â°C (108Â°F) or greater within 4 s.

Action Taken When the DTC Sets

- DTC P0C43-P0C46 are type B DTCs.
- The active heating mode is disabled.
- The hybrid/EV battery pack coolant pump is commanded to a fixed speed.

Conditions for Clearing the DTC

DTC P0C43-P0C46 are type B DTCs.

Diagnostic Aids

- Low or no coolant in the system may set a DTC P0C43.
- DTC P0C43-P0C46 will prevent battery heating and the vehicle will be unable to start in cold weather with battery temperatures below -25Â°C (-13Â°F).

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Temperature Versus Resistance** for Hybrid/EV Battery Pack Coolant Temperature Sensor
- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor 1 parameter is between -40 and +87.9Â°C (-40 and +190Â°F).
    - **If not within the specified range**

      Refer to Circuit/System Testing.

    - **If within the specified range**
3. Verify the Hybrid/EV Battery Pack Coolant Temperature Sensor 1 and Outside Air Temperature Sensor parameters are within 25Â°C (45Â°F) of each other after the vehicle has been OFF and not charging for 5 hours or greater.

   - **If not within the specified range**

     Refer to Circuit/System Testing.

   - **If within the specified range**

4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

NOTE: **Perform Component Testing of the temperature sensor first and if a sensor fault is found you do not need to perform Circuit/System Testing.**

1. Disconnect the harness X2 connector at the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1.
2. Vehicle in Service Mode. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect A4 Hybrid/EV Battery Pack connector X358.
   2. Test for less than 2 Ω in the low reference circuit from X358 terminal 9 to B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1 harness connector terminal 2.
      - If 2 Ω or greater, repair or replace the battery pack external wiring harness.
      - If less than 2 Ω

        Refer to Internal Hybrid/EV Battery Testing.

   - **If less than 10 Ω**
3. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor 1 is less than -40Â°C (-40Â°F).
   - **If -40Â°C (-40Â°F) or greater**
   1. Vehicle OFF, disconnect A4 Hybrid/EV Battery Pack connector X358.
   2. Test for infinite resistance between the signal circuit terminal 8 X358 and ground.
      - If less than infinite resistance, repair or replace the short to ground on the battery pack external wiring harness.
      - If infinite resistance

        Refer to Internal Hybrid/EV Battery Testing.

   - **If less than -40Â°C (-40Â°F)**
4. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor 1 is greater than 87.9Â°C (190Â°F).
   - **If less than 87.9Â°C (190Â°F)**
   1. Vehicle OFF, disconnect the A4 Hybrid/EV Battery Pack connector X358. Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair or replace the battery pack external wiring harness.
      - If less than 1 V
   3. Vehicle OFF.

    4. Test for less than 2 Ω in the signal circuit from X358 terminal 8 to B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1 harness connector terminal.
        - If 2 Ω or greater, repair or replace the battery pack external wiring harness.
        - If less than 2 Ω

          Refer to Internal Hybrid/EV Battery Testing

- **If 87.9Â°C (190Â°F) or greater**

5. Test or replace the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1.

Internal Hybrid/EV Battery Testing

1. Disable the high voltage. Refer to **High Voltage Disabling** . Remove the A4 Hybrid/EV Battery Pack cover. Refer to **Battery Upper Cover Replacement** .
2. Disconnect the harness X2 connector at the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1.

NOTE: **With the S15 manual service disconnect removed, the 12 V battery connected, and the Vehicle in Service Mode, additional DTCs may set. Continue with diagnostics and clear any additional DTCs when repairs are complete.**

3. Connect the **EL-50214** Low Voltage Jumper Harness Extension. Connect the 12 V battery.
4. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater

          Replace the Hybrid/EV Battery Pack internal wiring harness or repair the external wiring harness as necessary.

        - If less than 2 Ω
    2. Replace the K16 Battery Energy Control Module.
    - **If less than 10 Ω**
5. Vehicle in Service Mode.
6. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor 1 is less than -40Â°C (-40Â°F).
    - **If -40Â°C (-40Â°F) or greater**
    1. Vehicle OFF, test for infinite resistance between the signal circuit terminal 7 and ground.
        - If less than infinite resistance

          Replace the Hybrid/EV Battery Pack internal wiring harness or repair the short to ground on the external wiring harness as necessary.

        - If infinite resistance
    2. Replace the K16 Battery Energy Control Module.
    - **If less than -40Â°C (-40Â°F)**
7. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor 1 is greater than 87.9Â°C (190Â°F).
    - **If less than 87.9Â°C (190Â°F)**
    1. Vehicle OFF, disconnect the harness connector at the K16 Battery Energy Control Module. Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, replace the Hybrid/EV Battery Pack internal wiring harness or repair the external wiring harness as necessary.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, replace the Hybrid/EV Battery Pack internal wiring harness or repair the external wiring harness as necessary.

        - If less than 2 Ω

          Replace the K16 Battery Energy Control Module.

    - **If 87.9Â°C (190Â°F) or greater**

8. Test or replace the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1.
2. Test for 2.2 - 3.0k Ω at approximately 21.11Â°C (70Â°F) between the signal terminal and the low reference terminal. Refer to **Temperature Versus Resistance** for Hybrid/EV Battery Pack Coolant Temperature Sensor.
    - **If not within the specified range**

      Replace the B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1.

    - **If within the specified range**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **High Voltage Battery Heater Replacement** for B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1 replacement
- Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)**
- Refer to **Control Module References** for battery energy control module replacement, programming and setup.

DTC P0C47, P1E8C, OR P1E8D: HYBRID/EV BATTERY PACK COOLANT PUMP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0C47

Hybrid/EV Battery Pack Coolant Pump Control Circuit

DTC P1E8C

Hybrid/EV Battery Pack Coolant Pump Enable Circuit Low Voltage

DTC P1E8D

Hybrid/EV Battery Pack Coolant Pump Enable Circuit High Voltage

Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the hybrid/EV battery refrigerant/coolant heat exchanger, external high voltage battery heater assembly, and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack.

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P0C47

The 12 V battery voltage is greater than or equal to 10.2 V.

P1E8C

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The hybrid/EV battery pack coolant pump enable is commanded ON.

P1E8D

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The hybrid/EV battery pack coolant pump enable is OFF.

Conditions for Setting the DTC

P0C47

The hybrid/EV powertrain control module 2 detects the hybrid/EV battery pack coolant pump Control circuit is open, shorted to voltage or shorted to ground.

P1E8C

The hybrid/EV powertrain control module 2 detects the hybrid/EV battery pack coolant pump Enable circuit is shorted to ground.

P1E8D

The hybrid/EV powertrain control module 2 detects the hybrid/EV battery pack coolant pump Enable circuit is open or shorted to voltage.

Action Taken When the DTC Sets

- DTCs P0C47, P1E8C, and P1E8D are type B DTCs.
- DTC P1E8D Hybrid/EV battery pack active heating is disabled.

Conditions for Clearing the DTC

DTCs P0C47, P1E8C, and P1E8D are type B DTCs.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55 percent. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is in Service Mode*

Displayed PWM Value	Pump Self-Diagnostic Indication
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45 - 55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0C43, P0C44, P0C45, P0C46, P1FFB, P1FFC, P1FFD, P1FFE, U0111, U185B, or U2602 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If none of the DTCs are set**
2. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 80% with a scan tool.
    - Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
    - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
    - Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
    - **The scan tool parameters listed are not the specified values**

      Refer to Circuit/System Testing.

    - **The scan tool parameters listed are within the specified values**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.
    - **If 5 Ω or greater**

      Repair the open/high resistance on the ground circuit.

    - **If less than 5 Ω**
3. Vehicle ON.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
    - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω and the fuse is blown, replace the G37 Hybrid/EV Battery Pack Coolant Pump.
    - **If B+**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.
    - **If the test lamp is ON**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the pump enable circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is OFF**
7. Vehicle ON, verify the test lamp illuminates. Command the Hybrid Battery Pack Coolant Pump ON (20 - 80%) with a scan tool if necessary.
    - **If the test lamp is OFF**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the enable circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is ON**
8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify that a test lamp changes illumination between bright (20%) and dim (80%) when commanding the Hybrid Battery Pack Coolant Pump ON between 20% and 80% with a scan tool.
    - **If the test lamp is always dim or does not illuminate**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle ON.
    2. Test for less than 1 V between the control circuit terminal and ground
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

    - **If the test lamp is always bright**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **The test lamp changes illumination between bright (20%) and dim (80%)**

10. Remove the test lamp.
11. Verify the scan tool, Hybrid Battery Pack Coolant Pump Feedback parameter is 0%.
    - **If greater than 0%**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 0%**
12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is greater than 90%.
    - **If 90% or less**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the feedback circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the feedback circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 90%**
14. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)** (RESS Pump) for G37 Hybrid/EV Battery Pack Coolant Pump replacement.
- Refer to **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0CE9, P1F44, OR P1F45: HYBRID/EV ELECTRONICS COOLANT PUMP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0CE9

Hybrid/EV Electronics Coolant Pump Control Circuit

DTC P1F44

Hybrid/EV Electronics Coolant Pump Enable Circuit Low Voltage

DTC P1F45

Hybrid/EV Electronics Coolant Pump Enable Circuit High Voltage

Circuit/System Description

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump. When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P0CE9

The 12 V battery voltage is greater than 10.2 V.

P1F44

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV electronics coolant pump is enabled.

P1F45

- The 12 V battery voltage is greater than 10.2 V.
- The Hybrid/EV Electronics Coolant Pump is disabled.

Conditions for Setting the DTC

P0CE9

The Hybrid/EV Powertrain Control Module 2 has detected an open, short to voltage or short to ground on the Hybrid/EV electronics coolant pump control circuit.

P1F44

The Hybrid/EV Powertrain Control Module 2 has detected an open, or short to voltage on the Hybrid/EV electronics coolant pump enable circuit.

P1F45

The Hybrid/EV Powertrain Control Module 2 has detected an open or short to voltage on the Hybrid/EV electronics coolant pump enable circuit.

Action Taken When the DTC Sets

DTCs P0CE9, P1F44, and P1F45 are type B DTCs.

P0CE9

Hybrid/EV electronics coolant pump is commanded Off or to Maximum speed.

P1F44 and P1F45

Hybrid/EV electronics coolant pump is commanded Off.

Conditions for Clearing the DTC

DTCs P0CE9, P1F44, and P1F45 are type B DTCs.

Diagnostic Aids

- DTC P1F44 and P1F45 may cause DTC P0CE9 to set.
- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55 percent. Different PWM values will identify when a pump self-diagnostic has failed:

Hybrid/EV Electronics Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is in Service Mode*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45 - 55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

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Hybrid/EV Cooling Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 80% with a scan tool.
    - Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
    - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.

- Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
- **The scan tool parameters listed are not within the specified ranges**

  Refer to Circuit/System Testing.

- **The scan tool parameters listed are within the specified range**

2. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.
   - **If 5 Ω or greater**

     Repair the open/high resistance on the ground circuit.

   - **If less than 5 Ω**
3. Vehicle ON.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
   - **If less than B+**
   1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω and the fuse is blown, replace the G35 Hybrid/EV Electronics Coolant Pump.
   - **If B+**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.
   - **If the test lamp is ON**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle ON.
   2. Test for less than 1 V between the pump enable circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is OFF**
7. Vehicle ON. Verify the test lamp illuminates. Command the Hybrid/EV electronics coolant pump ON (20 - 80%) if necessary.
   - **If the test lamp is OFF**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the pump enable circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the pump enable circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is ON**
8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify the test lamp changes illumination between bright (20%) and dim (80%) when commanding the hybrid/EV electronics coolant pump ON between 20% and 80% with a scan tool.
   - **If the test lamp is always dim or does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle ON.

2. Test for less than 1 V between the control circuit terminal and ground
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp is always bright**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the control circuit and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **The test lamp changes illumination between bright (20%) and dim (80%)**

10. Remove the test lamp.
11. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.

- **If greater than 0%**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
    - If less than infinite resistance, repair the short to ground on the circuit.
    - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 0%**

12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool, Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.

- **If 90% or less**

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle ON.
2. Test for less than 1 V between the feedback circuit terminal and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the feedback circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit.
    - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 90%**

14. Replace the G35 Hybrid/EV Electronics Coolant Pump.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump) (PE Pump) for G35 Hybrid/EV Electronics Coolant Pump replacement.
- Refer to Control Module References for K114B Hybrid/EV Powertrain Control Module 2 replacement, programming and setup.

DTC P0CEF-P0CF2: HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0CEF

Hybrid/EV Electronics Coolant Temperature Sensor Performance

DTC P0CF0

Hybrid/EV Electronics Coolant Temperature Sensor Circuit Low Voltage

DTC P0CF1

Hybrid/EV Electronics Coolant Temperature Sensor Circuit High Voltage

DTC P0CF2

Hybrid/EV Electronics Coolant Temperature Sensor Circuit Erratic

Circuit/System Description

The hybrid/EV electronics coolant temperature sensor is located in the coolant radiator. The temperature sensor is a variable resistor that measures the temperature of the hybrid/EV electronics coolant. The hybrid/EV electronics coolant temperature sensor resistance changes with coolant temperature. The lower the temperature, the higher the resistance of the sensor. The higher the temperature, the lower the resistance of the sensor. The Hybrid/EV Powertrain Control Module 2 uses the hybrid/EV electronics coolant temperature sensor to determine the hybrid/EV electronics temperature to control the hybrid/EV electronics cooling operation.

Conditions for Running the DTC

P0CEF

- The 12 V battery voltage is greater than or equal to 10.2 V.
- Vehicle ON for less than 20 s.
- Propulsion system inactive time is greater than 2 hours.
- The hybrid/EV electronics coolant pump off soak time is greater than 2 hours.
- Air conditioning compressor off soak time is greater than 1 hour.
- The On Board Charger module off soak time is greater than 4 hours.
- None of the following DTCs are set; P0071-P0074, P0532, P0533, P0606, P0711-P0713, P0CE9, P0CF0, P0CF1, P0CF2, P1F44, or P1F45.

P0CF0, P0CF1 and P0CF2

- Vehicle ON.
- The 12 V battery voltage is greater than or equal to 10.2 V.

Conditions for Setting the DTC

P0CEF

- The hybrid/EV electronics coolant temperature does not fall within 23Â°C (41Â°F) of the outside air temperature.

  AND

- The hybrid/EV electronics coolant temperature does not fall within 23Â°C (41Â°F) of the transmission fluid temperature.

  AND

- The hybrid/EV electronics coolant temperature does not fall within 24Â°C (43Â°F) of the air conditioning high side pressure, converted to temperature.

P0CF0

The hybrid/EV electronics coolant temperature signal circuit voltage is less than 0.25 V.

P0CF1

The hybrid/EV electronics temperature signal circuit voltage is greater than 4.9 V.

P0CF2

- The hybrid/EV electronics coolant temperature is intermittent or has changed greater than 75Â°C (135Â°F).
- Condition exists for 4 seconds or more.

Action Taken When the DTC Sets

- DTC P0CEF-P0CF2 are type B DTCs.
- The Hybrid/EV Electronics Coolant Pump is commanded to a fixed speed.
- The radiator cooling fan is commanded to a fixed speed.

Conditions for Clearing the DTC

DTC P0CEF-P0CF2 are type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

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Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0CE9 is not set.
    - **If the DTC is set**

      Refer to **DTC P0CE9, P1F44, or P1F45**

    - **If the DTC is not set**
2. Observe the scan tool Hybrid/EV Powertrain Control Module 2 Hybrid Electronics Coolant Temperature parameter. The readings should be between -40Â° and +87.9Â°C (-40Â° and +190Â°F).
    - **The readings are not within the specified range**

      Refer to Circuit/System Testing

   - **The readings are within the specified range**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B202 Hybrid/EV Electronics Coolant Temperature Sensor.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Disconnect the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Verify the scan tool Hybrid Electronics Coolant Temperature is less than -40Â°C (-40Â°F).
   - **If -40Â°C (-40Â°F) or greater**
   1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than -40Â°C (-40Â°F)**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2. Verify the scan tool Hybrid Electronics Coolant Temperature parameter is greater than 87.9Â°C (190Â°F).
   - **If less than 87.9Â°C (190Â°F)**
   1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If 87.9Â°C (190Â°F) or greater**
6. Test or replace the B202 Hybrid/EV Electronics Coolant Temperature Sensor.

Component Testing

1. Vehicle OFF, disconnect the harness connector at the B202 Hybrid/EV Electronics Coolant Temperature Sensor.
2. Test for 2.2 - 3.0k Ω at approximately 21.11Â°C (70Â°F) between the signal terminal and the low reference terminal.
   - **If not within the specified range**

     Replace the B202 Hybrid/EV Electronics Coolant Temperature Sensor.

   - **If within the specified range**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Engine Coolant Temperature Sensor Replacement - Radiator Side**
- Refer to **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1485-P1487: COOLING FAN OUTPUT CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1485

Cooling Fan Output Circuit

DTC P1486

Cooling Fan Output Circuit Low Voltage

DTC P1487

Cooling Fan Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cooling Fan Speed Signal Circuit	P148B, P1486	P148A, P1485	P148C, P1487	-
Fans operate at 90% with all malfunctions				

Circuit/System Description

The hybrid/EV powertrain control module 2 indirectly controls the radiator fans. When propulsion is active, the engine control module (ECM) processes all requests for the cooling fans to be turned ON regardless of which module originates the request. The ECM decides if and at what speed the cooling fans should operate. The ECM sends the cooling fan command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the signal to the cooling fans to operate and at what speed. If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate and the ECM is not awake, the hybrid/EV powertrain control module 2 will control the cooling fans without ECM intervention.

The ECM communicates the fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan speed signal circuit/hardwire circuit and also sends a redundant serial data signal. Since the hardwire circuit is an output from the ECM but an input to the hybrid/EV powertrain control module 2, each module has unique DTCs to monitor the same circuit.

Conditions for Running the DTC

- DTC P2537 is not set.
- The 12 V battery voltage is equal to or greater than 11 V.
- The accessory circuit is active for greater than 5 s.
- The DTCs run continuously when the conditions above are met.

Conditions for Setting the DTC

The ECM detects that the commanded state of the driver and the actual state of the output circuit do not match for greater than 5 s.

Action Taken When the DTC Sets

DTCs P1485, P1486 and P1487 are Type B DTCs.

Conditions for Clearing the DTC

DTCs P1485, P1486 and P1487 are Type B DTCs.

Diagnostic Aids

DTCs P1485, P1486 and P1487 will not keep the cooling fan from operating. If one of these DTCs is set the hybrid/EV powertrain control module 2 will command the cooling fan to 90%. If the cooling fan does not operate, refer to **DTC P148A-P148C** for further diagnosis.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

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Electrical Information Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1485, P1486, P1487, P148A, P148B, or P148C is not set.
   - **If the DTC is set**

     Refer to Circuit/System Testing.

   - **If the DTC is not set**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.

   NOTE: **The cooling fan circuit is pulled up to a voltage within the ECM. 3 - 4 V measured on this circuit with the hybrid/EV powertrain control module 2 disconnected is normal.**

2. Test for 3 - 4 V between the cooling fan circuit terminal 9 and ground.
   - **If less than 3 V**
   1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
   2. Test for infinite resistance between the cooling fan circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.

        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If 4V or greater**
    1. Vehicle OFF. Disconnect the X1 harness connector at the K20 Engine Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the cooling fan circuit and ground.
        - If greater than 1 V, repair the short to voltage on the circuit.
        - If 1 V or less, replace the K20 Engine Control Module.
    - **If 3 - 4 V**
3. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
4. Reconnect the K114B Hybrid/EV Powertrain Control Module 2 connector X2.
5. Vehicle in Service Mode. Test for greater than 10 V between the signal circuit and ground.
    - **If 10 V or less**

      Replace the Hybrid/EV Powertrain Control Module 2.

    - **If greater than 10 V**
6. Replace the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K20 engine control module or K114B hybrid powertrain control module 2 replacement, programming and setup

DTC P19FA-P19FC: HYBRID/EV ELECTRONICS COOLANT PUMP FEEDBACK CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P19FA

Hybrid/EV Electronics Coolant Pump Feedback Circuit High Frequency

DTC P19FB

Hybrid/EV Electronics Coolant Pump Feedback Circuit Low Frequency

DTC P19FC

Hybrid/EV Electronics Coolant Pump Feedback Circuit Performance

Circuit/System Description

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV electronics coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV electronics coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P19FA and P19FB

- The 12 V battery voltage is greater than 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11 - 100%.
- The coolant pump On time is greater than 3 s.

P19FC

- The 12 V battery voltage is greater than 10.2 V.
- The coolant pump is disabled for at least 10 s.
- DTC P19FC has not already failed when coolant pump was enabled.
- None of the following DTCs are set: P0CE9, P0CEF, P0CF0, P0CF1, P0CF2, P1F44, or P1F45.

  OR

- The 12 V battery voltage is greater than 10.2 V.
- The coolant pump is enabled.
- The coolant pump PWM command is 10.5 - 90%.
- The coolant pump On delay time is greater than 10 s.
- Hybrid/EV electronics coolant temperature sensor is greater than -30Â°C (-22Â°F).
- All above conditions met for at least 5 seconds.
- None of the following DTCs are set: P0CE9, P0CEF, P0CF0, P0CF1, P0CF2, P1F44, or P1F45.

Conditions for Setting the DTC

P19FA

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is greater than 750 Hz.

P19FB

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is less than 8.6 Hz.

P19FC

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is greater than 215 RPM when the pump is not enabled.

OR

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is more than 800 RPM different than the expected pump speed when the pump is commanded between 11 - 90% PWM.

Action Taken When the DTC Sets

DTCs P19FA, P19FB and P19FC are type B DTCs.

Conditions for Clearing the DTC

DTCs P19FA, P19FB and P19FC are type B DTCs.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).

- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is in Service Mode*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

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Hybrid/EV Cooling Schematics

Connector End View Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0C43, P0C44, P0C45, P0C46, or P0C47 is not set.
   - **If any DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
   - **If none of the DTCs are set**
2. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV electronics coolant pump between 20% and 80% with a scan tool.
   - Hybrid/EV Electronics Coolant Pump Command to be 10% or greater.
   - Hybrid/EV Electronics Coolant Pump Feedback to be 50% +/-5%.
   - Hybrid/EV Electronics Coolant Pump Speed is greater than 500 RPM.
   - **The scan tool parameters listed are not within the specified ranges**

   Refer to Circuit/System Testing.

   - **The scan tool parameters listed are within the specified ranges**

3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.
   - **If 5 Ω or greater**

     Repair the open/high resistance on the ground circuit.

   - **If less than 5 Ω**
3. Vehicle ON.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
   - **If less than B+**
   1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω and the fuse is blown, replace the G35 Hybrid/EV Electronics Coolant Pump.
   - **If B+**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.
   - **If the test lamp is ON**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the pump enable circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.
   - **If the test lamp is OFF**
7. Vehicle ON. Verify the test lamp illuminates. Command the Hybrid/EV Electronics Coolant Pump ON (20 - 80%) with a scan tool if necessary.
   - **If the test lamp is OFF**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the pump enable circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the pump enable circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is ON**
8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify that a test lamp changes illumination between bright (20%) and dim (80%) when commanding the Hybrid/EV Electronics Coolant Pump ON between 20% and 80% with a scan tool.
   - **If the test lamp is always dim or does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.

        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is always bright**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **The test lamp changes illumination between bright (20%) and dim (80%)**
10. Remove the test lamp.
11. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is 0%.
    - **If greater than 0%**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 0%**
12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.
    - **If 90% or less**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the feedback circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 90%**
14. Replace the G35 Hybrid/EV Electronics Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)** (PE Pump) for G35 Hybrid/EV electronics coolant pump replacement.
- Refer to **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P19FD-P19FF: HYBRID/EV BATTERY PACK COOLANT PUMP FEEDBACK CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P19FD

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit High Frequency

DTC P19FE

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit Low Frequency

DTC P19FF

Hybrid/EV Battery Pack Coolant Pump Feedback Circuit Performance

Circuit/System Description

The Enable, Control and Feedback circuits connect the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump.

When the Enable circuit is high, the pump is allowed to operate as specified by the Control circuit signal. The pulse-width modulated Control circuit signal from the hybrid/EV powertrain control module 2 determines the hybrid/EV battery pack coolant pump speed. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump utilizes a pulse-width modulated signal on the Feedback circuit to the hybrid/EV powertrain control module 2. During normal operation, the feedback circuit provides pump speed information to the hybrid/EV powertrain control module 2. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on the same feedback circuit instead of pump speed information.

Conditions for Running the DTC

P19FD and P19FE

- The 12 V battery voltage is greater than 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 11 - 100%.
- All above conditions met for at least 3 s.

P19FF

- The 12 V battery voltage is greater than 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 10.5 - 90%.
- The coolant pump is disabled for at least 11 s.

OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The coolant pump is enabled.
- The coolant pump is commanded between 10.5 - 90%.
- Hybrid/EV battery pack coolant inlet temperature sensor is greater than -20Â°C (-4Â°F).
- All above conditions met for at least 5 seconds.
- None of the following DTCs are set: P0C43, P0C44, P0C45, P0C47, P1E8C, P1E8D, P19FD or P19FE.

Conditions for Setting the DTC

P19FD

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is greater than 750 Hz.

P19FE

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit frequency is less than 8.6 Hz.

P19FF

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is greater than 215 RPM when the pump is not enabled.

OR

The hybrid/EV powertrain control module 2 detects the Coolant Pump Feedback circuit indicated pump speed is more than 800 RPM different than the expected pump speed when the pump is commanded between 11 - 90% PWM.

Action Taken When the DTC Sets

DTCs P19FD, P19FE and P19FF are type B DTCs.

Conditions for Clearing the DTC

DTCs P19FD, P19FE and P19FF are type B DTCs.

Diagnostic Aids

- Always verify coolant freeze point protection if a fault occurs in cold climate conditions. An improper coolant to water ratio may result in slushy or frozen coolant, resulting in DTCs or overheating. Measure coolant concentration using the **J-26568** refractometer or equivalent to verify a 50/50 mix and freeze protection to -37Â°C (-34Â°F).
- The Coolant Pump Feedback parameter on the scan tool indicates the status of the pump. When the pump self-diagnostics indicate normal operation, the parameter will indicate a PWM between 45 and 55%. Different PWM values will identify when a pump self-diagnostic has failed:

Coolant Pump Feedback Parameter

Displayed PWM Value	Pump Self-Diagnostic Indication
0%	Pump has lost power/ground, feedback circuit open, or Vehicle is in Service Mode*
10%	Pump Under Voltage detected*
20%	Pump Under/Over Current detected*
30%	Blocked or Dry pump detected*
45-55%	Normal operation, actual pump speed provided by circuit frequency
80%	Pump Over Voltage detected*
90%	Pump Over Temperature detected*
100%	Feedback circuit shorted to ground*
*Coolant Pump Speed parameter defaults to 50 RPM, actual pump speed is 0 RPM.	

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0C43, P0C44, P0C45, P0C46, P1FFB, P1FFC, P1FFD, P1FFE, U0111, U185B, or U2602 is not set.
   - **If any DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
2. Verify the hybrid/EV powertrain control module 2 parameters listed below when commanding the hybrid/EV battery pack coolant pump between 20% and 80% with a scan tool.
   - Hybrid/EV Battery Pack Coolant Pump Command to be 10% or greater.
   - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
   - Hybrid/EV Battery Pack Coolant Pump Speed is greater than 500 RPM.
   - **The scan tool parameters listed are not within the specified ranges**

     Refer to Circuit/System Testing.

   - **The scan tool parameters listed are within the specified ranges**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 5 Ω between the ground circuit terminal 4 and ground.
   - **If 5 Ω or greater**

     Repair the open/high resistance on the ground circuit.

   - **If less than 5 Ω**
3. Vehicle ON.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
   - **If less than B+**
   1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   2. Test for less than 2 Ω in the B+ circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω and the fuse is blown, replace the G37 Hybrid/EV Battery Pack Coolant Pump.
   - **If B+**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Vehicle OFF, charge cord removed. Verify the test lamp is OFF.
   - **If the test lamp is ON**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the pump enable circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B hybrid/EV powertrain control module 2.
   - **If the test lamp is OFF**
7. Vehicle ON. Verify the test lamp illuminates. Command the Hybrid Battery Pack Coolant Pump ON (20 - 80%) with a scan tool if necessary.
   - **If the test lamp is OFF**

   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the pump enable circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the pump enable circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is ON**
8. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
9. Verify that a test lamp changes illumination between bright (20%) and dim (80%) when commanding the Hybrid Battery Pack Coolant Pump ON between 20% and 80% with a scan tool.
   - **If the test lamp is always dim or does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the control circuit terminal and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is always bright**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **The test lamp changes illumination between bright (20%) and dim (80%)**
10. Remove the test lamp.
11. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is 0%.
    - **If greater than 0%**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 0%**
12. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
13. Verify the scan tool Hybrid Battery Pack Coolant Pump Feedback parameter is greater than 90%.
    - **If 90% or less**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the feedback circuit terminal and ground.
       - If 1 V or greater, repair the short to voltage on the circuit.
       - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 90%**
14. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)** (RESS Pump) for G37 Hybrid/EV battery pack coolant pump replacement.
- Refer to **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P148A-P148C: COOLING FAN SIGNAL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P148A

Cooling Fan Signal Circuit Performance

DTC P148B

Cooling Fan Signal Circuit Low Voltage

DTC P148C

Cooling Fan Signal Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Cooling Fan Speed Signal Circuit	P148B, P1486	P148A, P1485	P148C, P1487	-
Fans operate at 90% with all malfunctions				

Circuit/System Description

The hybrid/EV powertrain control module 2 indirectly controls the radiator fans. When propulsion is active, the engine control module (ECM) processes all requests for the cooling fans to be turned ON regardless of which module originates the request. The ECM decides if and at what speed the cooling fans should operate. The ECM sends the cooling fan command to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 sends the signal to the cooling fans to operate and at what speed. If the vehicle is in Charge Mode and the hybrid/EV powertrain control module 2 requests the cooling fans to operate and the ECM is not awake, the hybrid/EV powertrain control module 2 will control the cooling fans without ECM intervention.

The ECM communicates the fan command PWM signal to the hybrid/EV powertrain control module 2 through the cooling fan speed signal circuit/hardwire circuit and also sends a redundant serial data signal. Since the hardwire circuit is an output from the ECM but an input to the hybrid/EV powertrain control module 2, each module has unique DTCs to monitor the same circuit.

Conditions for Running the DTC

P148A

- The 12 V battery voltage is greater than 10.2 V.
- The propulsion system is active for more than 44 s.
- The cooling fan speed has not changed by greater than 5%.
- None of the following DTCs are set: P148B, P148C, or U0293.

  OR

- The 12 V battery voltage is greater than or equal to 10.2 V.
- The propulsion system is inactive.
- The energy storage system thermal condition request is ActiveCool.
- The cooling fan is enabled for more than 49 s.
- The cooling fan speed has not changed by greater than 5%.
- None of the following DTCs are set: P148B, P148C, or U0293.

P148B

The 12 V battery voltage is greater than 10.2 V.

P148C

- The 12 V battery voltage is greater than 10.2 V.
- The propulsion system is active for more than 49 s.

  OR

- The 12 V battery voltage is greater 10.2 V.
- The propulsion system is inactive.
- The energy storage system thermal condition request is ActiveCool.
- The cooling fan is enabled for more than 49 s.

Conditions for Setting the DTC

P148A

The PWM cooling fan signal duty cycle request from Engine Control Module (Hardwire) is not within 25% of the redundant engine cooling fan speed sent to the hybrid/EV powertrain control module 2 via serial data.

P148B

The Hybrid/EV Powertrain Control Module 2 has detected a cooling fan signal circuit duty cycle of less than 3% from the engine control module.

P148C

The Hybrid/EV Powertrain Control Module 2 has detected a cooling fan signal circuit duty cycle of greater than 97% from the engine control module.

Action Taken When the DTC Sets

DTCs P148A, P148B and P148C are type B DTCs.

Conditions for Clearing the DTC

DTCs P148A, P148B and P148C are type B DTCs.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify DTC P1485, P1486, P1487, P148A, P148B, or P148C is not set.
    - **If the DTC is set**

      Refer to Circuit/System Testing.

    - **If the DTC is not set**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.

   NOTE: **The cooling fan circuit is pulled up to a voltage within the ECM. 3 - 4 V measured on this circuit with the hybrid/EV powertrain control module 2 disconnected is normal.**

2. Test for 3 - 4 V between the cooling fan circuit terminal 9 and ground.
    - **If less than 3 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
    2. Test for infinite resistance between the cooling fan circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If 4V or greater**
    1. Vehicle OFF. Disconnect the X1 harness connector at the K20 Engine Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the cooling fan circuit and ground.
        - If greater than 1 V, repair the short to voltage on the circuit.
        - If 1 V or less, replace the K20 Engine Control Module.
    - **If 3 - 4 V**
3. Vehicle OFF, disconnect the X1 harness connector at the K20 Engine Control Module.
4. Reconnect the K114B Hybrid/EV Powertrain Control Module 2 connector X2.
5. Vehicle in Service Mode. Test for greater than 10 V between the signal circuit and ground.
    - **If 10 V or less**

      Replace the Hybrid/EV Powertrain Control Module 2.

    - **If greater than 10 V**
6. Replace the K20 Engine Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for engine control module, hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1EC6: HYBRID/EV BATTERY PACK HEATER PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1EC6

Hybrid/EV Battery Pack Heater Performance

Circuit/System Description

The Hybrid/EV Battery Pack Coolant Heater is mounted to the coolant inlet external of the battery pack. The Hybrid/EV Battery Pack Coolant Heater uses high voltage as the power source. The T24 Battery Charger controls the Hybrid/EV Battery Pack Coolant Heater and contains a non-serviceable fuse to protect the high voltage circuits.

When the Conditions for Running the DTC are met, the Hybrid/EV Battery Pack Coolant Heater is commanded ON. The Hybrid/EV Powertrain Control Module 2 then monitors for a temperature change at the Hybrid/EV Battery Pack coolant temperature sensor 1 to determine if the Hybrid/EV Battery Pack Coolant Heater is functioning properly.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The hybrid/EV battery pack coolant temperature sensor is less than 21Â°C (70Â°F).
- Runs once per drive cycle, either in propulsion system active or in Charge Mode.
- Hybrid/EV battery pack Active Heating is requested.
- Hybrid/EV battery pack voltage is greater than 221 V.
- None of the following DTCs are set; P0C43, P0C44, P0C45, P0C47, P19FD, P19FE, P19FF, P1EC3, P1E8C, P1E8D, P1FFB, P1FFC, P1FFD, or P1FFE.

Conditions for Setting the DTC

- The hybrid/EV powertrain control module 2 commands the hybrid/EV battery pack coolant pump OFF and the battery heater ON to 100% for 5.5 seconds, then varies battery heater output in relation to battery voltage for a maximum of 2.5 minutes.
- The hybrid/EV powertrain control module 2 did not see the battery pack coolant temperature rise more than 2.75Â°C (4.9Â°F) within 85 seconds of commanding the battery heater OFF.

Action Taken When the DTC Sets

- DTC P1EC6 is a type B DTC.
- Hybrid/EV battery pack active heating is disabled.

Conditions for Clearing the DTC

DTC P1EC6 is a type B DTC.

Diagnostic Aids

P1EC6 will prevent battery heating and the vehicle will be unable to start in cold weather with battery temperatures below -25Â°C (-13Â°F).

Reference Information

Schematic Reference

- Hybrid/EV Cooling Schematics
- Hybrid/EV Energy Storage Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- **EL-50772** Insulation Multimeter

For equivalent regional tools, refer to Special Tools.

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE1, P0AE3, P0D0A, P0D09, P1EBD, P1EC0, or P1EC3 is not set.
   - **If any DTC is set**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
   - **If none of the DTCs are set**

   NOTE: **Other DTCs will set.**

3. Vehicle OFF. Remove the G37 Hybrid/EV Battery Pack Coolant Pump fuse. Set the vehicle Charge Mode to IMMEDIATE. Connect the charge cord set. With the vehicle in Charge Mode, Vehicle in Service Mode.
4. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor parameter increases 2.75Â°C (4.9Â°F) within 120 s when commanding the hybrid/EV battery pack coolant heater ON with a scan tool.
   - **If the Hybrid/EV Battery Pack Coolant Temperature Sensor did not increase 2.75Â°C (4.9Â°F) within 120 s**

     Refer to Circuit/System Testing.
   - **If the Hybrid/EV Battery Pack Coolant Temperature Sensor did increase 2.75Â°C (4.9Â°F) within 120 s**
5. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage. Refer to High Voltage Disabling . Disconnect the high voltage harness connector at the E54 Hybrid/EV Battery Pack Coolant Heater.
2. Test for 61 - 75 Ω between terminal A and terminal B at the E54 Hybrid/EV Battery Pack Coolant Heater.
   - **If not within the specified range**

     Replace the T24 Battery Charger and the E54 Hybrid/EV Battery Pack Coolant Heater.

   - **If within the specified range**

NOTE: **The following continuity tests must be performed using an EL-50772 Insulation Multimeter. Select the Isolation test setting, then select the 500 V range.**

3. With the **EL-50772** set on the Isolation test setting, test for 26 - 550M Ω between the E54 Hybrid/EV Battery Pack Coolant Heater terminals listed below and the coolant heater assembly ground:
   - Terminal A
   - Terminal B
   - **If less than the specified value**

     Replace the E54 Hybrid/EV Battery Pack Coolant Heater.

   - **If within the specified value**
4. Replace the T24 Battery Charger.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to High Voltage Battery Control Wiring Junction Block Replacement (With quick charge) High Voltage Battery Control Wiring Junction Block Replacement (Without quick charge) for T24 battery charger replacement.
- Refer to High Voltage Battery Heater Replacement for E54 Hybrid/EV battery pack coolant heater replacement.

DTC P1FFB-P1FFE: HYBRID/EV BATTERY PACK COOLANT LEVEL SENSOR CIRCUIT OR HYBRID/EV BATTERY PACK COOLANT LEVEL LOW

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1FFB

Hybrid/EV Battery Pack Coolant Level Sensor Circuit

DTC P1FFC

Hybrid/EV Battery Pack Coolant Level Sensor Circuit Low Voltage

DTC P1FFD

Hybrid/EV Battery Pack Coolant Level Sensor Circuit High Voltage

DTC P1FFE

Hybrid/EV Battery Pack Coolant Level Low

Circuit/System Description

The hybrid/EV battery pack coolant system has a level sensor. The hybrid/EV battery pack coolant level sensor is attached to the coolant surge tank. The level sensor is a 2-state bi-metallic reed switch which changes state when the switch reed is exposed to magnetism. The level of the hybrid/EV battery pack coolant in the surge tank causes a magnet-equipped float to move towards and away from the sensor as coolant level decreases or increases. The hybrid/EV powertrain control module 2 supplies 5 V to the signal circuit and a ground for the low reference circuit. The hybrid/EV battery pack coolant level sensor resistance decreases when the battery coolant level in the surge tank gets low. The hybrid/EV powertrain control module 2 uses the hybrid/EV battery pack coolant level sensor to determine if disabling the hybrid/EV battery pack because the coolant system is low on coolant.

Conditions for Running the DTC

P1FFB, P1FFC, and P1FFD

The 12 V battery voltage is greater than or equal to 10.2 V.

P1FFE

- The vehicle speed is zero for more than 40 s.

  AND

- The battery pack temperature is less than -7Â°C (+32Â°F) for greater than 30 s.
- None of the following DTCs are set: P0ABC, P0ABD, P0ABB, P0721, P077B, P1FFB, P1FFC, P1FFD, P1FFE, P215C, P2610, U0100, U0101, U0111, or U185A.

Conditions for Setting the DTC

P1FFB

The Hybrid/EV Battery Pack Coolant Level Sensor voltage is between 2.8 - 3.1 V

P1FFC

The Hybrid/EV Battery Pack Coolant Level Sensor voltage is below 1.37 V

P1FFD

The Hybrid/EV Battery Pack Coolant Level Sensor voltage is above 4.0 V

P1FFE

The Hybrid/EV Battery Pack Coolant Level Sensor voltage is between 1.38 - 2.84 V for more than 2 consecutive key cycles

Action Taken When the DTC Sets

- DTC P1FFB, P1FFC, P1FFD, and P1FFE are type A DTCs.
- Hybrid/EV Battery Pack charging is disabled.

Conditions for Clearing the DTC

DTC P1FFB, P1FFC, and P1FFD are type A DTCs.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that the vehicle hybrid/EV battery cooling system is full.
   - **If the hybrid/EV battery cooling system is low**

     WARNING: **Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.**

     Refer to **Hybrid Cooling System Loss of Coolant (Drive Motor Battery Cooling System)Hybrid Cooling System Loss of Coolant (Drive Motor Generator Power Inverter Module Cooling System)** for the Drive Motor Battery Cooling System

   - **The hybrid/EV battery cooling system is full**

     Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the harness connector at the B258 Hybrid/EV Battery Coolant Level Sensor.
2. Test for less than 10 Ω between the low reference circuit terminal B and ground.

- **If 10 Ω or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If less than 10 Ω**

3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V signal circuit terminal A and ground.
    - **If 5.2 V or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 4.8 V or less**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If within the specified range**
5. Vehicle OFF, remove the B258 Hybrid/EV Battery Coolant Level Sensor from the coolant surge tank
6. Test for 24 - 25.4k Ω between the signal terminal A and the low reference terminal B.
    - **If not within the specified range**

      Replace the B258 Hybrid/EV Battery Coolant Level Sensor.

    - **If within the specified range**

NOTE: **Moving the magnet slightly along the bottom of the sensor will assist closing the internal switch.**

7. Using a magnet, place the magnet off center of the sensor, opposite of the terminals on the epoxy side, test for 7.1 - 7.54k Ω between the signal terminal A and the low reference terminal B.
    - **If not within the specified range**

      Replace the B258 Hybrid/EV Battery Coolant Level Sensor.

    - **If within the specified range**
8. Replace the coolant surge tank.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Drive Motor Battery Coolant Level Sensor Replacement for B258 Hybrid/EV battery coolant level sensor replacement.
- Refer to Radiator Surge Tank Replacement
- Refer to Control Module References for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1FFF: SYSTEM ISOLATION/COOLANT LEVEL SENSOR FAULT - HYBRID/EV BATTERY CHARGING SYSTEM DISABLED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1FFF

System Isolation/Coolant Level Sensor Fault - Hybrid/EV Battery Charging System Disabled

Circuit/System Description

This diagnostic is an indicator that hybrid/EV battery pack charging is disabled because the hybrid/EV powertrain control module 2 detected one of the following conditions:

WARNING: **Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.**

- A loss of isolation between the hybrid/EV battery pack high voltage circuits and vehicle chassis
- A low coolant condition of the hybrid/EV battery pack coolant system
- A fault in the hybrid/EV battery pack coolant level sensor/circuit

Conditions for Running the DTC

- The hybrid powertrain control module 2 and battery energy control module are awake and communicating.
- Once set, the DTC will not run again until a scan tool clear code command is sent.

Conditions for Setting the DTC

NOTE: **DTC P1FFF will never set alone.**

When DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD, or P1FFE is set, DTC P1FFF will also be set.

Action Taken When the DTC Sets

- DTC P1FFF is a type A DTC.
- The driver information center displays the SERVICE HIGH VOLTAGE CHARGING SYSTEM message.
- Hybrid/EV battery pack charging will be reduced.

Conditions for Clearing the DTC

DTC P1FFF is a type A DTC but will only clear with a scan tool clear code command.

Diagnostic Aids

DTC P1FFF will not clear or go to history with ignition cycles once DTC is set. DTC P1FFF will only clear with a clear code command from the scan tool.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD or P1FFE is not set.
   - **If DTC P0AA6 or P1AE6 is set**

     Refer to **DTC P0AA6 or P1AE6** .

   - **If DTC P1FFB, P1FFC, P1FFD, or P1FFE is set**

     Refer to **DTC P1FFB-P1FFE**.

   - **If none of the DTCs are set**

NOTE: **If DTC P1FFF will not clear, the K114B Hybrid/EV Powertrain Control Module 2 may have to be programmed or replaced if the module contains the current calibration level.**

3. Clear codes.
4. Verify DTC P0AA6, P1AE6, P1FFB, P1FFC, P1FFD or P1FFE is not set.
   - **If any DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
5. All OK.

HYBRID/EV ELECTRONICS COOLING DIAGNOSTIC (DRIVE MOTOR GENERATOR POWER INVERTER MODULE COOLING SYSTEM)

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**

Step	Action	Yes	No
2	**WARNING:** **Refer to Moving Parts and Hot Surfaces Warning .** **WARNING:** **Wear safety glasses in order to avoid eye damage.** 1. Add coolant to the coolant surge tank as needed. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**. 2. Using GDS, turn on the hybrid electronics coolant pump and increase the RPM to 1000. 3. Quickly remove and instal the generator control module coolant tank hose from the automatic transmission. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)** Is there coolant flowing out of the automatic transmission?	Go to **Step 14**	Go to **Step 3**
3	Quickly remove and install the drive motor power inverter module cooling inlet hose from the automatic transmission. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** Is there coolant flowing out of the drive motor power inverter module cooling inlet hose?	Go to **Step 16**	Go to **Step 4**
4	Quickly remove and install the drive motor power inverter module cooling inlet hose from the drive motor battery charger. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** Is there coolant flowing out of the drive motor battery charger?	Go to **Step 18**	Go to **Step 5**
5	Quickly remove and install the electric differential drive motor power inverter module cooling hose from the drive motor battery charger. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** Is there coolant flowing out of the electric differential drive motor power inverter module cooling hose?	Go to **Step 19**	Go to **Step 6**
6	Quickly remove and install the electric differential drive motor power inverter module cooling hose from the accessory DC power control module. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** Is there coolant flowing out of the accessory DC power control module?	Go to **Step 21**	Go to **Step 7**
7	Quickly remove and install the drive motor generator control module cooling outlet hose from the accessory DC power control module. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** Is there coolant flowing out of the drive motor generator control module cooling outlet hose?	Go to **Step 22**	Go to **Step 8**

Step	Action	Yes	No
8	Quickly remove and install the drive motor generator control module cooling outlet hose from the drive motor power inverter module. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** Is there coolant flowing out of the drive motor power inverter module?	Go to **Step 24**	Go to **Step 9**
9	Quickly remove and install the drive motor generator control module radiator outlet hose from the drive motor power inverter module. Refer to **Drive Motor Generator Control Module Radiator Outlet Hose Replacement (Radiator To SPIM)** Is there coolant flowing out of the drive motor generator control module radiator outlet hose?	Go to **Step 25**	Go to **Step 10**
10	Quickly remove and install the drive motor generator control module radiator outlet hose from the radiator. Refer to **Drive Motor Generator Control Module Radiator Outlet Hose Replacement (Radiator To SPIM)** Is there coolant flowing out of the drive motor battery coolant radiator?	Go to **Step 27**	Go to **Step 11**
11	Quickly remove and install the drive motor generator control module radiator inlet hose from the radiator. Refer to **Drive Motor Generator Control Module Radiator Inlet Hose Replacement (Pump To Radiator)** Is there coolant flowing out of the drive motor generator control module radiator inlet hose?	Go to **Step 28**	Go to **Step 12**
12	Quickly remove and install the drive motor generator control module radiator inlet hose from the generator control module coolant pump. Refer to **Drive Motor Generator Control Module Radiator Inlet Hose Replacement (Pump To Radiator)** Is there coolant flowing out of the generator control module coolant pump?	Go to **Step 29**	Go to **Step 13**
13	Replace the drive motor battery coolant pump (PE Pump). Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**
14	Inspect for kinks or obstructions in the generator control module coolant tank hose or the drive motor generator control module coolant pump hose. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)**, or **Drive Motor Generator Control Module Coolant Pump Hose Replacement (Surge Tank To Pump)** Is there a kink or obstruction?	Go to **Step 15**	Go to **Step 1**
15	Replace the generator control module coolant tank hose or the drive motor generator control module coolant pump hose. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)**, or **Drive Motor Generator Control Module Coolant Pump Hose Replacement (Surge Tank To Pump)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**

Step	Action	Yes	No
16	1. Using GDS, turn off the hybrid electronics coolant pump. 2. Remove the generator control module coolant tank hose from the automatic transmission. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)** 3. Remove the drive motor power inverter module cooling inlet hose from the automatic transmission. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** 4. Back flush the automatic transmission cooling passages. 5. Install the generator control module coolant tank hose to the automatic transmission. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)** 6. Install the drive motor power inverter module cooling inlet hose to the automatic transmission. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** 7. Using GDS, turn on the hybrid electronics coolant pump and increase the RPM to 1000. 8. Quickly remove and install the generator control module coolant tank hose from the automatic transmission. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)** Is there coolant flowing out of the automatic transmission?	Go to **Step 30**	Go to **Step 17**
17	Replace the automatic transmission. Refer to **Transmission Replacement** . Is the repair complete?	Go to **Step 30**	Go to **Step 1**
18	Replace the drive motor power inverter module cooling inlet hose. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**

Step	Action	Yes	No
19	1. Using GDS, turn off the hybrid electronics coolant pump. 2. Remove the drive motor power inverter module cooling inlet hose from the drive motor battery charger. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** 3. Remove the electric differential drive motor power inverter module cooling hose from the drive motor battery charger. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** 4. Back flush the drive motor battery charger cooling passages. 5. Install the drive motor power inverter module cooling inlet hose to the drive motor battery charger. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** 6. Install the electric differential drive motor power inverter module cooling hose to the drive motor battery charger. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** 7. Using GDS, turn on the hybrid electronics coolant pump and increase the RPM to 1000. 8. Quickly remove and install the drive motor power inverter module cooling inlet hose from the drive motor battery charger. Refer to **Drive Motor Power Inverter Module Cooling Inlet Hose Replacement (OBCM To DU)** Is there coolant flowing out of the drive motor battery charger?	Go to **Step 30**	Go to **Step 20**
20	Replace the drive motor battery charger. Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**
21	Replace the electric differential drive motor power inverter module cooling hose. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**

Step	Action	Yes	No
22	1. Using GDS, turn off the hybrid electronics coolant pump. 2. Remove the electric differential drive motor power inverter module cooling hose from the accessory DC power control module. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** 3. Remove the drive motor generator control module cooling outlet hose from the accessory DC power control module. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** 4. Back flush the accessory DC power control module cooling passages. 5. Install the electric differential drive motor power inverter module cooling hose to the accessory DC power control module. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** 6. Install the drive motor generator control module cooling outlet hose to the accessory DC power control module. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** 7. Using GDS, turn on the hybrid electronics coolant pump and increase the RPM to 1000. 8. Quickly remove and install the electric differential drive motor power inverter module cooling hose. Refer to **Electric Differential Drive Motor Power Inverter Module Cooling Hose Replacement (APM To OBCM)** Is there coolant flowing out of the accessory DC power control module?	Go to **Step 30**	Go to **Step 23**
23	Replace the accessory DC power control module. Refer to **Accessory DC Power Control Module Replacement** Is the repair complete?	Go to **Step 30**	Go to **Step 1**
24	Replace the drive motor generator control module cooling outlet hose. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**

Step	Action	Yes	No
25	1. Using GDS, turn off the hybrid electronics coolant pump. 2. Remove the drive motor generator control module cooling outlet hose from the drive motor power inverter module. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** 3. Remove the drive motor generator control module radiator outlet hose from the drive motor power inverter module. Refer to **Drive Motor Generator Control Module Radiator Outlet Hose Replacement (Radiator To SPIM)** 4. Back flush the drive motor power inverter module cooling passages. 5. Install the drive motor generator control module cooling outlet hose to the drive motor power inverter module. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** 6. Install the drive motor generator control module radiator outlet hose to the drive motor power inverter module. Refer to **Drive Motor Generator Control Module Radiator Outlet Hose Replacement (Radiator To SPIM)** 7. Using GDS, turn on the hybrid electronics coolant pump and increase the RPM to 1000. 8. Quickly remove and install the drive motor generator control module cooling outlet hose. Refer to **Drive Motor Generator Control Module Cooling Outlet Hose Replacement (SPIM To APM)** Is there coolant flowing out of the drive motor power inverter module?	Go to **Step 30**	Go to **Step 26**
26	Replace the drive motor power inverter module. Refer to **Drive Motor Power Inverter Module Replacement** Is the repair complete?	Go to **Step 30**	Go to **Step 1**
27	Replace the drive motor generator control module radiator outlet hose. Refer to **Drive Motor Generator Control Module Radiator Outlet Hose Replacement (Radiator To SPIM)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**
28	Replace the radiator. Refer to **Radiator Replacement** Is the repair complete?	Go to **Step 30**	Go to **Step 1**
29	Replace the drive motor generator control module radiator outlet hose. Refer to **Drive Motor Generator Control Module Radiator Inlet Hose Replacement (Pump To Radiator)** Is the repair complete?	Go to **Step 30**	Go to **Step 1**
30	1. Add coolant to the coolant surge tank as needed. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**. 2. Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 1**

HYBRID/EV ELECTRONICS COOLING DIAGNOSTIC (DRIVE MOTOR BATTERY COOLING SYSTEM)

Step	Action	Yes	No
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Diagnostic System Check - Vehicle**
2	**WARNING:** **Refer to Moving Parts and Hot Surfaces Warning .** **WARNING:** **Wear safety glasses in order to avoid eye damage.** 1. Add coolant to the coolant surge tank as needed. Refer to **Drive Motor Battery Cooling System Draining and Filling** 2. Using GDS, turn on the hybrid electronics coolant pump and increase the RPM to 1000. 3. Quickly remove and install the drive motor battery coolant cooler inlet hose from the drive motor battery coolant pump. Refer to **Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump To RESS Heater)** Is there coolant flowing out of the drive motor battery coolant pump?	Go to **Step 3**	Go to **Step 1**
3	Quickly remove and install the drive motor battery coolant cooler inlet hose from the high voltage battery heater. Refer to **Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump To RESS Heater)** Is there coolant flowing out of the drive motor battery coolant cooler inlet hose?	Go to **Step 4**	Go to **Step 11**
4	Quickly remove and install the battery vent hose from the high voltage battery. Refer to **Battery Vent Hose Replacement (RESS HTR To RESS)** Is there coolant flowing out of the battery vent hose?	Go to **Step 6**	Go to **Step 12**
5	Quickly remove and install the battery vent hose from the high voltage battery. Refer to **Battery Vent Hose Replacement (RESS HTR To RESS)** Is there coolant flowing out of the battery vent hose?	Go to **Step 6**	Go to **Step 13**
6	Quickly remove and install the drive motor battery coolant cooler outlet hose from the drive motor battery. Refer to **Drive Motor Battery Coolant Cooler Outlet Hose Replacement (CHILLER TO RESS)** Is there coolant flowing out of the drive motor battery?	Go to **Step 7**	Go to **Step 14**
7	Quickly remove and install the drive motor battery coolant cooler outlet hose from the drive motor battery coolant cooler. Refer to **Drive Motor Battery Coolant Cooler Outlet Hose Replacement (CHILLER TO RESS)** Is there coolant flowing out of the drive motor battery coolant cooler outlet hose?	Go to **Step 8**	Go to **Step 15**
8	Quickly remove and install the drive motor battery radiator outlet hose from the drive motor battery coolant cooler. Refer to **Drive Motor Battery Radiator Outlet Hose Replacement (Surge Tank To Chiller)** Is there coolant flowing out of the drive motor battery coolant cooler?	Go to **Step 9**	Go to **Step 16**

Step	Action	Yes	No
9	Quickly remove and install the drive motor battery radiator outlet hose from the radiator surge tank. Refer to **Drive Motor Battery Radiator Outlet Hose Replacement (Surge Tank To Chiller)** Is there coolant flowing out of the drive motor battery radiator outlet hose?	Go to **Step 10**	Go to **Step 17**
10	Quickly remove and install the drive motor battery coolant pump inlet hose from the drive motor battery coolant pump. Refer to **Drive Motor Battery Coolant Pump Inlet Hose Replacement (Surge Tank To Pump)** Is there coolant flowing out of the drive motor battery coolant pump inlet hose?	Go to **Step 19**	Go to **Step 18**
11	Replace the drive motor battery coolant cooler inlet hose. Refer to **Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump To RESS Heater)** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
12	Replace the high voltage battery heater. Refer to **High Voltage Battery Heater Replacement** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
13	Replace the battery vent hose. Refer to **Battery Vent Hose Replacement (RESS HTR To RESS)** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
14	Replace the drive motor battery. Refer to **Drive Motor Battery Replacement and Shipping Preparation (Old Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built before 1G1FX6S06H4163254)** **Drive Motor Battery Replacement and Shipping Preparation (New Design Battery Pack in Vehicles built after 1G1FX6S06H4163254)** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
15	Refer to **Drive Motor Battery Coolant Cooler Outlet Hose Replacement (CHILLER TO RESS)** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
16	Replace the drive motor battery coolant cooler. Refer to **Drive Motor Battery Coolant Cooler Replacement** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
17	Replace the drive motor battery radiator outlet hose. Refer to **Drive Motor Battery Radiator Outlet Hose Replacement (Surge Tank To Chiller)** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
18	Replace the drive motor battery coolant pump inlet hose. Refer to **Drive Motor Battery Coolant Pump Inlet Hose Replacement (Surge Tank To Pump)** Is the repair complete?	Go to **Step 19**	Go to **Step 1**
19	1. Add coolant to the coolant surge tank as needed. Refer to **Drive Motor Battery Cooling System Draining and Filling** 2. Operate the system in order to verify the repair. Is there coolant flowing out of the drive motor battery coolant pump?	System OK	Go to **Step 1**

HYBRID/EV BATTERY PACK COOLANT PUMP MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The hybrid/EV battery pack coolant pump circulates coolant through the drive motor battery coolant radiator, drive motor battery coolant cooler, and the hybrid/EV battery pack to control the temperature of the hybrid/EV battery pack. An enable signal from the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump provides overall control of the pump. When this circuit is high, the pump can operate. The pump is controlled with a pulse-width modulated signal from the hybrid/EV powertrain control module 2 to the hybrid/EV battery pack coolant pump. The higher the duty cycle the higher the pump speed. The hybrid/EV battery pack coolant pump provides a hard-wired pulse-width modulated feedback signal to the hybrid/EV powertrain control module 2. During normal operation, this feedback signal provides pump speed information to the hybrid/EV powertrain control module 2. The hybrid/EV battery pack coolant pump has some self-diagnostic capability. If the hybrid/EV battery pack coolant pump determines there is an internal fault it provides this information on this same feedback circuit instead of pump speed information.

Diagnostic Aids

A malfunctioning coolant pump may cause a battery pack overheat condition.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify that DTC P0C43, P0C44, P0C45, P0CE0, P0CE2, P0CE3, P0D0A, P0D11, P1EBC, P1EC3, P1EC4, P1EC5, P1EC6, P1EC7, P1EC8, U0111, U185B, or U2602 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**
    - **If none of the DTCs are set**
3. With the Hybrid/Ev Battery Pack Coolant Pump disabled and not running, verify the scan tool parameters listed below:
    - Hybrid/EV Battery Pack Coolant Pump Command is less than 10%.

    - Hybrid/EV Battery Pack Coolant Pump Feedback is 0%.
    - Hybrid/EV Battery Pack Coolant Pump Speed is 25 RPM.
    - **The scan tool parameters listed are not the specified values**

      Refer to Circuit/System Testing.

    - **The scan tool parameters listed are within the specified values**
4. Set the vehicle Charge Mode to IMMEDIATE.
5. Vehicle OFF, connect the charge cord set.
6. With the vehicle charging, the hybrid/EV battery pack coolant pump enabled and not running, verify the scan tool parameters listed below:
    - Hybrid/EV Battery Pack Coolant Pump Command is 10%.
    - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
    - Hybrid/EV Battery Pack Coolant Pump Speed is 50 RPM.
    - **The scan tool parameters listed are not the specified values**

      Refer to Circuit/System Testing.

    - **The scan tool parameters listed are within the specified values**
7. Command the Hybrid/EV Battery Pack Coolant Pump to 90%, verify the scan tool parameters listed below:
    - Hybrid/EV Battery Pack Coolant Pump Command to be greater than 10%.
    - Hybrid/EV Battery Pack Coolant Pump Feedback to be 50% +/-5%.
    - Hybrid/EV Battery Pack Coolant Pump Speed is greater than 50 RPM.
    - **The scan tool parameters listed are not the specified values**

      Refer to Circuit/System Testing.

    - **The scan tool parameters listed are within the specified values**
8. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G37 Hybrid/EV Battery Pack Coolant Pump.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**

      Repair the open/high resistance on the ground circuit.

    - **If less than 10 Ω**
3. Vehicle On.
4. Test for greater than 11.5 V between the B+ circuit terminal 5 and the ground circuit terminal 4.
    - **If 11.5 V or less**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω and the fuse is blown, replace the G37 Hybrid/EV Battery Pack Coolant Pump.
    - **If greater than 11.5 V**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Command the Hybrid Battery Pack Coolant Pump Command OFF (10%) and ON (90%) with a scan tool. The test lamp should turn OFF and ON when changing between the commanded states.
    - **If the test lamp is always illuminated at 10%**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle On.
    2. Test for less than 1 V between the enable circuit terminal and ground.

      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp does not illuminate at 90%**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the enable circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the enable circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp turns OFF and ON when changing between the commanded states**
7. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
8. Command the Hybrid Battery Pack Coolant Pump Command ON between 20% and 90% with a scan tool. Verify that a test lamp changes illumination between bright (20%) and dim (90%) between the control circuit terminal 3 and the B+ circuit terminal 5.
   - **If the test lamp is always dim or does not illuminate**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle On.
   2. Test for less than 1 V between the control circuit terminal and ground
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Vehicle OFF.
   4. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is always bright**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **The test lamp changes illumination between bright (20%) and dim (90%)**
9. Command the Hybrid Battery Pack Coolant Pump Command OFF.
10. Verify the scan tool, Hybrid Battery Pack Coolant Pump Feedback parameter is less than 10%.
   - **If 10% or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10%**
11. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
12. Verify the scan tool, Hybrid Battery Pack Coolant Pump Feedback parameter is greater than 90%.
   - **If less than 90%**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the feedback circuit terminal and ground.

        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 90% or greater**

13. Replace the G37 Hybrid/EV Battery Pack Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)**
- Refer to **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

HYBRID/EV ELECTRONICS COOLANT PUMP MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The hybrid/EV electronics coolant pump circulates coolant through the power electronics coolant radiator, hybrid/EV powertrain control module 1, and the battery charger to control the temperature of the hybrid/EV powertrain control module 1 and the battery charger. An enable signal from the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump provides overall control of the pump. When this circuit is high, the pump can operate. The pump is controlled with a pulse-width modulated signal from the hybrid/EV powertrain control module 2 to the hybrid/EV electronics coolant pump. The higher the duty cycle the higher the pump speed. The hybrid/EV electronics coolant pump provides a hard-wired pulse-width modulated feedback signal to the hybrid/EV powertrain control module 2. During normal operation, this feedback signal provides pump speed information. The hybrid/EV electronics coolant pump has some self-diagnostic capability. If it determines there is an internal fault it provides this information on this same feedback circuit instead of pump speed information.

Diagnostic Aids

A malfunctioning coolant pump may cause an electronics overheat condition.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On
2. Verify that DTC P0C43, P0C44, P0C45, P0C47, or P1EC6 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If none of the DTCs are set**
3. Vehicle On.
4. With a scan tool, verify that the Hybrid/EV Electronics Coolant Pump Command is between 20%-90% and Hybrid Electronics Coolant Pump Feedback is 50% +/-5%.
    - **The readings are not within the specified range**

      Refer to Circuit/System Testing.

    - **The readings are within the specified range**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G35 Hybrid/EV Electronics Coolant Pump.
2. Test for less than 10 Ω between the ground circuit terminal 4 and ground.
    - **If 10 Ω or greater**

      Repair the open/high resistance on the ground circuit.

    - **If less than 10 Ω**
3. Vehicle On.
4. Test for B+ between the B+ circuit terminal 5 and the ground circuit terminal 4.
    - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit terminal 5 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω and the fuse is blown, replace the G35 Hybrid/EV Electronics Coolant Pump.
    - **If B+**
5. Connect a test lamp between the enable circuit terminal 1 and the ground circuit terminal 4.
6. Command the Hybrid/EV Electronics Coolant Pump OFF (10%) and ON (90%) with a scan tool. The test lamp should turn OFF and ON when changing between the commanded states.
    - **If the test lamp is always illuminated at 10%**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle On.
    2. Test for less than 1 V between the enable circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp does not illuminate at 90%**

    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the enable circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the pump enable circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp turns OFF and ON when changing between the commanded states**

7. Connect a test lamp between the control circuit terminal 3 and the B+ circuit terminal 5.
8. Command the Hybrid/EV Electronics Coolant Pump ON between 20% and 90% with a scan tool. Verify that a test lamp changes illumination between bright (20%) and dim (90%) between the control circuit terminal 3 and the B+ circuit terminal 5.
    - **If the test lamp is always dim or does not illuminate**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle On.
    2. Test for less than 1 V between the control circuit terminal and ground
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is always bright**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **The test lamp changes illumination between bright (20%) and dim (90%)**
9. Remove the test lamp.
10. Verify the scan tool, Hybrid/EV Electronics Coolant Pump Feedback parameter is less than 10%.
    - **If greater than 10%**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the feedback circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 10%**
11. Install a 3 A fused jumper wire between the feedback circuit terminal 2 and the ground circuit terminal 4.
12. Verify the scan tool, Hybrid/EV Electronics Coolant Pump Feedback parameter is greater than 90%.
    - **If less than 90%**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle On.
    2. Test for less than 1 V between the feedback circuit terminal and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If 90% or greater**

13. Replace the G35 Hybrid/EV Electronics Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)**
- Refer to **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

COOLING FAN MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 controls the radiator cooling fan. The cooling fan are controlled with a pulse width modulated signal. The Hybrid/EV Powertrain Control Module 2 diagnoses any faults with the hardwire circuit to the engine control module. The engine control module sends a fan request pulse width modulated signal to the Hybrid/EV Powertrain Control Module 2 through a hardwire circuit. The Hybrid/EV Powertrain Control Module 2 operates in a pass-through mode for the engine control module fan request. The higher the duty cycle the higher the cooling fan speed.

The Hybrid/EV Powertrain Control Module 2 sends a request to the engine control module for the cooling fan to be enabled. The engine control module uses this request and other vehicle inputs to decide if and what speed the cooling fan should operate. The engine control module sends the cooling fan command to the hybrid/EV powertrain control module 2. The Hybrid/EV Powertrain Control Module 2 sends the signal to the cooling fan to operate and at what speed.

If the vehicle is in Charge Mode and the Hybrid/EV Powertrain Control Module 2 requests the cooling fan to operate, if the engine control module is not awake, the Hybrid/EV Powertrain Control Module 2 will control the cooling fan. If active cooling is needed, the engine control module wakes up to operate the air conditioning control module and then the engine control module is the master controller for the fan.

Reference Information

Schematic Reference

Hybrid/EV Cooling Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Hybrid/EV Cooling System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Command the Cooling Fan Motor Command to 90% with a scan tool. Verify that the cooling fan is operating.
    - **The cooling fan is not operating**

      Refer to Circuit/System Testing

    - **The cooling fan is operating**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the G10 Cooling Fan Motor.
2. Test for less than 10 Ω between the ground circuit terminal 2 and ground.
    - **If 10 Ω or greater**

      Test the ground circuit for an open/high resistance.

    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for B+ between the B+ circuit terminal 1 and ground.
    - **If less than B+**
    1. Vehicle OFF, test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω and the fuse is blown, replace the G10 Cooling Fan Motor.
    - **If B+**
5. Connect a test lamp between the control circuit terminal 4 and the B+ circuit terminal 1.
6. Command the Cooling Fan Motor Command ON between 10% and 90% with a scan tool. Verify the test lamp changes between dim (10%) and bright (90%).
    - **If the test lamp is always dim or does not illuminate**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the control circuit and ground
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp is always bright**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **The test lamp changes illumination between bright (20%) and dim (90%)**
7. Replace the G10 Cooling Fan Motor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Cooling Fan and Shroud Replacement
- Refer to Control Module References for hybrid/EV powertrain control module 2 replacement, programming and setup.

HYBRID COOLING SYSTEM LOSS OF COOLANT (DRIVE MOTOR BATTERY COOLING SYSTEM)

Step	Action	Yes	No
DEFINITION: Perform this procedure in conjunction with a high-voltage battery overheating condition, low coolant in the high-voltage battery surge tank, or when instructed to by DTC P1AE6, or P0AA6 diagnostic procedures. **WARNING:** **Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:** **• Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors** **• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors** ** – Visually and functionally inspect the gloves before use.** ** – Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.** **Failure to follow the procedure exactly as written may result in serious injury or death.** **WARNING:** **Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.**			
1	Raise and support the hood with prop rod. Was the hood raised and supported with the prop rod?	Go to **Step 2**	Go to **Step 1**
2	Visually inspect the coolant level in the high-voltage battery surge tank. Is the coolant level at or above the seam on the side of the surge tank?	Go to **Step 3**	Go to **Step 4**
3	Are any of the following DTCs present? • P0AA6 (Hybrid/EV Battery Voltage System Isolation Lost) • P1AE6 (Battery Energy Control Module Hybrid/EV Battery Voltage Isolation Sensor Circuit)	Perform DTC Diagnostics.	Go to **Step 4**
4	Call the GM Technical Assistance Center (TAC) for further instructions. Refer to **DO NOT ATTEMPT TO REPAIR VEHICLE WITHOUT CALLING TAC.** Was TAC called?	Go to **Step 5**	Go to **Step 4**

Step	Action	Yes	No
5	Special Tools: • EN-24460-A cooling system pressure tester • GE-46143-2 radiator cap and surge tank test adapter Pressure test high-voltage battery cooling loop and pressure cap to 34.4 kPa (5 psi). Does the system hold pressure for at least 5 minutes?	Go to **Step 9**	Go to **Step 6**
6	**NOTE:** **When raising vehicle on hoist, vehicle must be level.** Visually inspect the following components. Also inspect their hoses, clamps, and hose connections for coolant leaks: • Coolant surge tank • HV battery coolant pump • HV battery chiller • HV battery assembly Was a coolant leak found?	Replace component(s), hose(s), or clamp(s) that is/are leaking. Refer to appropriate procedure(s). Validate repair with additional pressure test. Then Go to **Step 9**	Go to **Step 7**
7	If no external leaks are found ensure leak is not coming from test equipment. Is equipment faulty?	Repair Equipment. Go to **Step 6**	Go to **Step 8**
8	Visually inspect the following components internal to the drive motor battery. Also inspect their hoses, clamps, and hose connections for coolant leaks: • Battery Heater • Cell Battery Cooling Manifold Inlet Hose • Cell Battery Cooling Manifold Outlet Hose • Coolant Temperature Sensor Is leak repair complete?	Go to **Step 9**	Go to **Step 5**
9	Special Tools: • GE-26568 Coolant and Battery Tester • GE-47716-A Vac-N-Fill Coolant Refill Tool • GE-46143-2 Radiator Cap and Surge Tank Test Adapter Fill and adjust high-voltage battery cooling system level at the surge tank. Refer to **Drive Motor Battery Cooling System Draining and Filling**. Was a coolant leak found?	Go to **Step 10**	Go to **Step 6**
10	Verify the following before returning vehicle to customer: Coolant level is at the top of the seam of the high-voltage battery surge tank. Did you find and correct the condition?	System OK	Go to **Step 1**

HYBRID COOLING SYSTEM LOSS OF COOLANT (DRIVE MOTOR GENERATOR POWER INVERTER MODULE COOLING SYSTEM)

Step	Action	Yes	No
DEFINITION: The power inverter module (PIM) cooling system is losing coolant either internally or externally.			
1	Inspect the coolant level. Is the coolant at the proper level?	Go to **Step 13**	Go to **Step 2**
2	Fill the cooling system to the proper level. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**. Is the action complete?	Go to **Step 3**	-
3	Overheating can cause a loss of coolant. Is the PIM Cooling system overheating?	Go to **Step 11**	Go to **Step 4**
4	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to **Step 12**	Go to **Step 5**
5	Visually inspect the following components: • Coolant surge tank • Coolant pressure cap • Drive motor generator power inverter module • Accessory DC power control module • Automatic transmission • Radiator • Coolant pump • Coolant valves • Drive motor battery charger Are any of the listed components leaking?	Go to **Step 12**	Go to **Step 6**
6	1. Pressure test the cooling system. Refer to **Hybrid Cooling System Leak Test**. 2. With the cooling system pressurized, visually inspect the components listed in step 5. Are any leaks present?	Go to **Step 12**	Go to **Step 7**
7	Pressure test the coolant pressure cap. Refer to **Hybrid Cooling System Pressure Cap Testing**. Does the coolant pressure cap hold pressure?	Go to **Step 9**	Go to **Step 8**
8	Replace the coolant pressure cap. Is the repair complete?	Go to **Step 13**	-
9	1. Pressure test the cooling system. Refer to **Hybrid Cooling System Leak Test**. 2. With the cooling system pressurized, remove the engine cooling system pressure cap. Does the hybrid cooling system hold pressure?	-	Go to **Step 10**
10	Replace the surge tank. Refer to **Radiator Surge Tank Replacement**. Is the repair complete?	Go to **Step 13**	-
11	Repair the hybrid cooling system overheating condition. Is the repair complete?	Go to **Step 13**	-
12	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to **Step 13**	-

Step	Action	Yes	No
13	Operate the system in order to verify the repair. **NOTE:** **Do not use stop leak or any other chemicals. Only use premix Dexcool (50/50 mixture of Dexcool and deionized)** Did you find and correct the condition?	System OK	Go to **Step 2**

HYBRID COOLING SYSTEM PRESSURE CAP TESTING

Special Tools

- **GE-46143-2** Radiator Cap and Surge Tank Test Adapter
- **EN-24460-A** Cooling System Pressure Tester

For equivalent regional tools, Refer to Special Tools.

Pressure Cap Testing

WARNING: **To help avoid being burned, do not remove the hybrid cooling system pressure cap while the hybrid cooling system is hot. Scalding fluid and steam can be blown out under pressure if the cap is removed while the system is still hot.**

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.

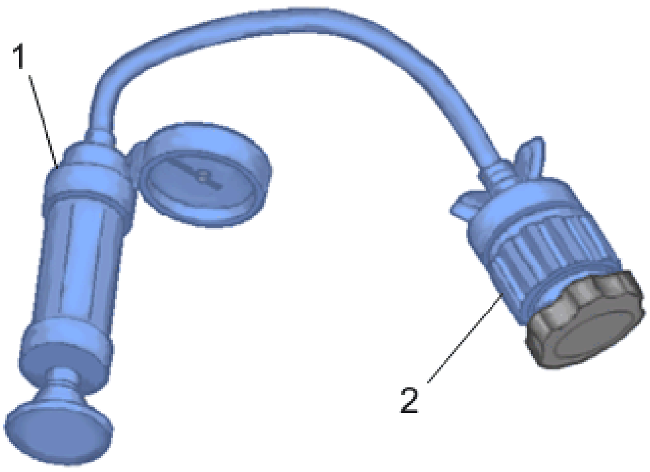


Fig. 5: Cooling System Pressure Tester & Radiator Cap/Surge Tank Test Adapter Kit
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Lubricate GE-46143-2 Radiator Cap and Surge Tank Test Adapter and pressure cap O-rings with coolant and press cap to seat O-ring on GE-46143-2 Radiator Cap and Surge Tank Test Adapter before turning to engage threads.**

3. Use the **EN-24460-A** Cooling System Pressure Tester (1) with **GE-46143-2** Radiator Cap and Surge Tank Test Adapter (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:

    - Pressure release when the **EN-24460-A** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
    - Maintain the rated pressure for at least 10 seconds.

      Note the rate of pressure loss.

5. Replace the pressure cap under the following conditions:
    - The pressure cap does not release pressure which exceeds the rated pressure of the cap.
    - The pressure cap does not hold the rated pressure.

HYBRID COOLING SYSTEM LEAK TEST

Special Tools

- **EN-24460-A** Cooling System Pressure Tester
- **GE-46143-2** Radiator Cap and Surge Tank Test Adapter

For equivalent regional tools, Refer to **Special Tools**.

WARNING: **Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.**

WARNING: **To help avoid being burned, do not remove the hybrid cooling system pressure cap while the hybrid cooling system is hot. Scalding fluid and steam can be blown out under pressure if the cap is removed while the system is still hot.**

WARNING: **In order to avoid personal injury, do not remove the cap or open the cooling system drains from a hot system. Allow the system to cool first.**

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Refer to **Hybrid Cooling System Pressure Cap Testing**.
3. Wash the pressure cap mating surface with water.

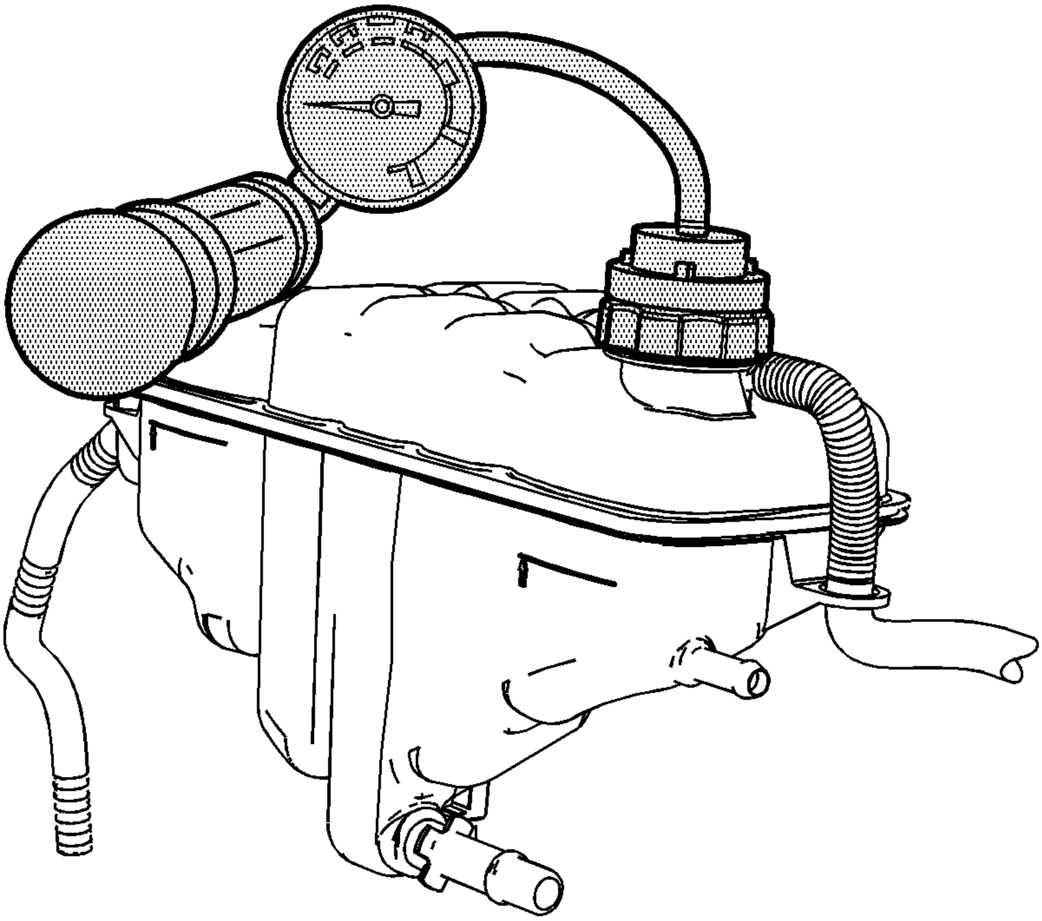


Fig. 6: Cooling System Pressure Tester Components
Courtesy of GENERAL MOTORS COMPANY

4. Use the **EN-24460-A** Cooling System Pressure Tester with the **GE-46143-2** Radiator Cap and Surge Tank Test Adapter in order to apply pressure to the cooling system.

   Do not exceed the pressure cap rating.

5. The cooling system should hold the rated pressure for at least 2 minutes.

   Observe the gauge for any pressure loss.

NOTE: **Do not use stop leak or any other chemicals. Only use premix Dexcool (50/50 mixture of Dexcool and deionized)**

6. Repair any leaks as required.

HYBRID BATTERY PACK COOLANT PASSAGE LEAK TEST

Special Tools

- **EN-24460-A** Cooling System Pressure Tester
- **GE-47716** Vac-N-Fill Coolant Refill Tool
- **EL-52016-A** Battery Pack Coolant Passage Pressure Test Adapter
- **GE-50389** Coolant Pressure Test Quick Connector

For equivalent regional tools, refer to Special Tools.

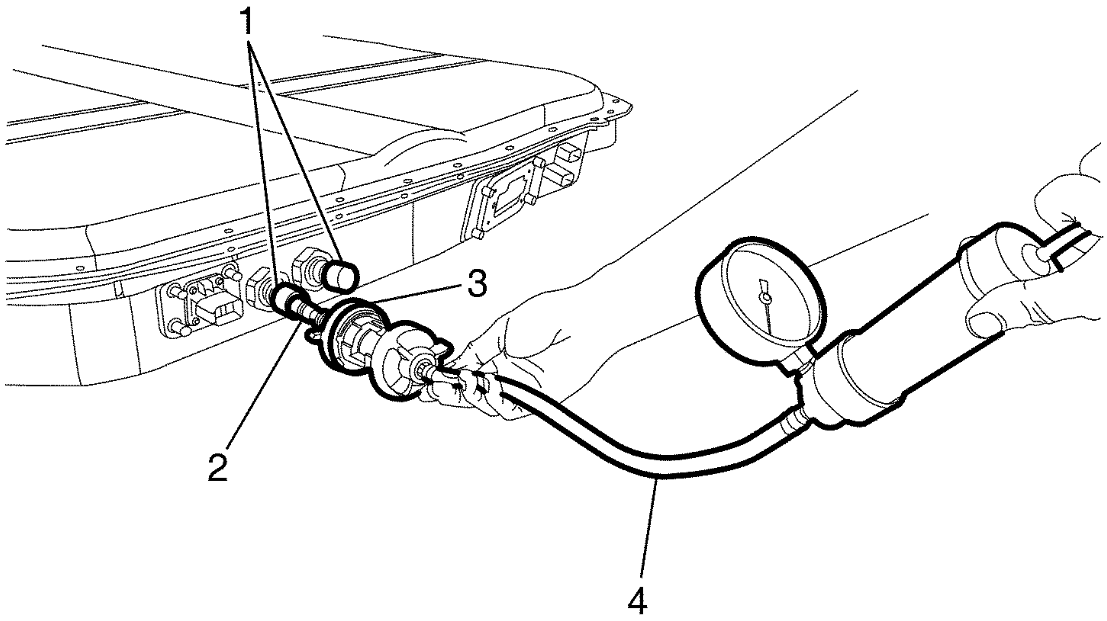


Fig. 7: Cooling System Pressure Tester And Components
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.**

WARNING: **To help avoid being burned, do not remove the hybrid cooling system pressure cap while the hybrid cooling system is hot. Scalding fluid and steam can be blown out under pressure if the cap is removed while the system is still hot.**

WARNING: **In order to avoid personal injury, do not remove the cap or open the cooling system drains from a hot system. Allow the system to cool first.**

1. Install Cooling System Pressure Tester Cap Adapter to **EN-24460-A** Cooling System Pressure Tester (4).
2. Install **GE-47716-8** Vac-N-Fill Cap (3) to Cooling System Pressure Tester Cap Adapter.
3. Install **GE-50389** Coolant Pressure Test Quick Connector (2) to **GE-47716-8** Vac-N-Fill Cap (3).
4. Install **EL-52016-1A** Coolant Pressure Tester Adapter (1) to **GE-50389** Quick Connector (2).
5. Install **EL-52016-1A** Coolant Pressure Tester Adapter (1) to battery pack inlet connector.
6. Install **EL-52016-2A** Coolant Pressure Tester Adapter (1) to battery pack outlet connector.
7. Apply pressure to the battery pack coolant passages.

   Do not exceed the pressure cap rating.

8. The cooling passages should hold the rated pressure for at least 2 minutes.

   Observe the gauge for any pressure loss.

9. Repair any leaks as required.

REPAIR INSTRUCTIONS

HOSE CLAMP REPLACEMENT GUIDELINES - SPRING TYPE

Special Tools

- **BO-38185** Hose Clamp Pliers
- **GE-47622** Hose Clamp Pliers.

Equivalent regional tools: **Special Tools**

Spring Type Hose Clamp Replacement Guidelines

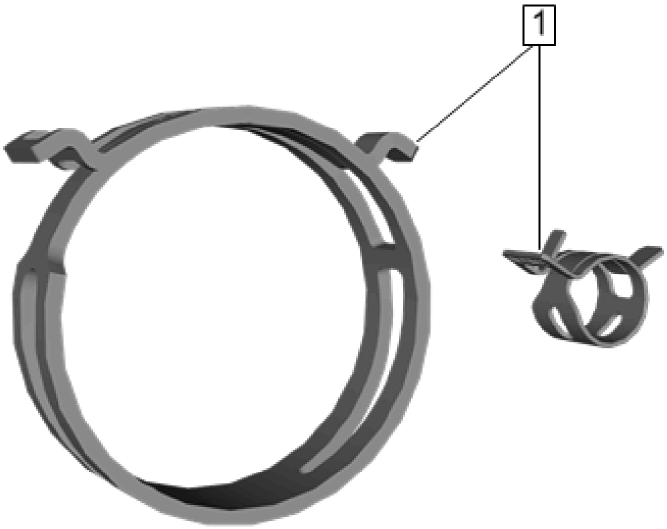


Fig. 8: Spring Type Hose Clamps
Courtesy of GENERAL MOTORS COMPANY

Vehicles utilize spring type hose clamps (1) to secure joints in which fluids, gases, or engine vacuum can travel to various vehicle systems. Spring type hose clamps are engineered to provide the proper amount of tension to maintain a leak & maintenance free joint for the life of the vehicle.

Spring type hose clamps have a special coating applied to the exterior of the clamp that is engineered to resist rust/corrosion, improve durability and increase the life of the hose clamp. If the coating is damaged, rust/corrosion could form resulting in the need to replace the hose clamp.

Many spring type hose clamps within GM utilize a small amount of adhesive placed directly on the hose clamp to secure the clamp to the mating hose for manufacturing purposes. Over time the strength of the adhesive will deteriorate. It is extremely important when a technician is attempting to service a joint or remove the hose clamp, that the clamp is not rotated or repositioned so that is tears and/or damages the hose. In this case, the hose and clamp must both be replaced.

When repairing a vehicle it is very important to observe the condition of both the hose and the spring type hose clamp as well as the orientation of the clamp to the hose.

If the spring type hose clamp(s) have any of the following conditions on any area of the clamp, replace the clamp(s) immediately.

- Rust/Corrosion
- Cracks
- Physical damage
- Leakage attributed to the retention of the clamp

Removing The Spring Type Hose Clamp

While keeping the hose stationary, use BO-38185 Hose Clamp Pliers or GE-47622 Hose Clamp Pliers and release the spring type hose clamp tension while attempting to separate the hose clamp from the hose.

- If the spring type hose clamp will not easily separate from the hose and/or the clamp tears or damages the hose, both the hose and hose clamp must be replaced
- If the spring type hose clamp is easily removed from the hose, the clamp can be reused provided that the clamp does not have any of the conditions as noted above.

If The Spring Type Hose Clamp Is Being Reused

It is extremely important that the spring type hose clamp is orientated to the hose in the exact same position as it was installed during vehicle assembly so that the hose clamp is not damaged or the hose clamp does not contact or damage any adjacent components. Do not use any type of adhesive on the hose clamp prior to installation.

When Reusing The Spring Type Hose Clamp and Replacing The Hose

- The inside and outside hose diameter must be identical between the new hose and the existing hose to guarantee proper hose clamp tension and joint integrity.
- Always place the existing spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The new hose might have a marking on the hose indicating the correct position of a hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

When Reusing The Spring Type Hose Clamp with an Existing Hose

Always place the existing spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The existing hose might have an indentation or compression mark on the hose from where the hose clamp was installed previously. The hose clamp should identically overlay this position. The existing hose might also have a marking on the hose indicating the correct position of the hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

If The Spring Type Hose Clamp Is Being Replaced

If the hose clamp needs to be replaced, always replace the hose as part of the service repair. It is extremely important that a new spring type hose clamp is orientated to the hose in the exact same position as it was installed during vehicle assembly so that the hose clamp is not damaged or the hose clamp does not contact or damage any adjacent components. Do not use any type of adhesive on the hose clamp prior to installation.

When Replacing The Spring Type Hose Clamp and Replacing The Hose

- The inside and outside hose diameter must be identical between the new hose and the existing hose to guarantee proper hose clamp tension and joint integrity.
- Always place the new spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The new hose might have a marking on the hose indicating the correct position of a hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

When Replacing The Spring Type Hose Clamp with an Existing Hose

Always place the new spring type hose clamp in the same orientation as it was positioned prior to separating the joint. The existing hose might have an indentation or compression mark on the hose from where a hose clamp was installed previously. The hose clamp should identically overlay this position. The existing hose might also have a marking on the hose indicating the correct position of the hose clamp, which should re-confirm the correct hose clamp position. The hose clamp should not contact any adjacent components after installation.

DRIVE MOTOR BATTERY COOLING SYSTEM DRAINING AND FILLING

Special Tools

- **GE-26568** Coolant and Battery Tester
- **GE-46143-2** Cooling System Adapter
- **GE-47716** Vac-N-Fill Coolant Refill Tool
- **EL-52016-1A** Battery Pack Coolant Passage Test Adapter

- **EL-52016 - 2A** Coolant Pressure Tester Adapter Plug

Equivalent regional tools: **Special Tools**

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

WARNING: **Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.**

WARNING: **Do NOT attempt to repair a Lithium Ion Hybrid/EV Battery Pack when an internal coolant leak is evident. The Hybrid/EV Battery Pack must always be replaced as an assembly. Failure to replace a coolant contaminated Hybrid/EV Battery Pack may result in fire, which can cause severe injury or death.**

WARNING: **To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.**

Draining Procedure

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Remove the radiator surge tank cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**

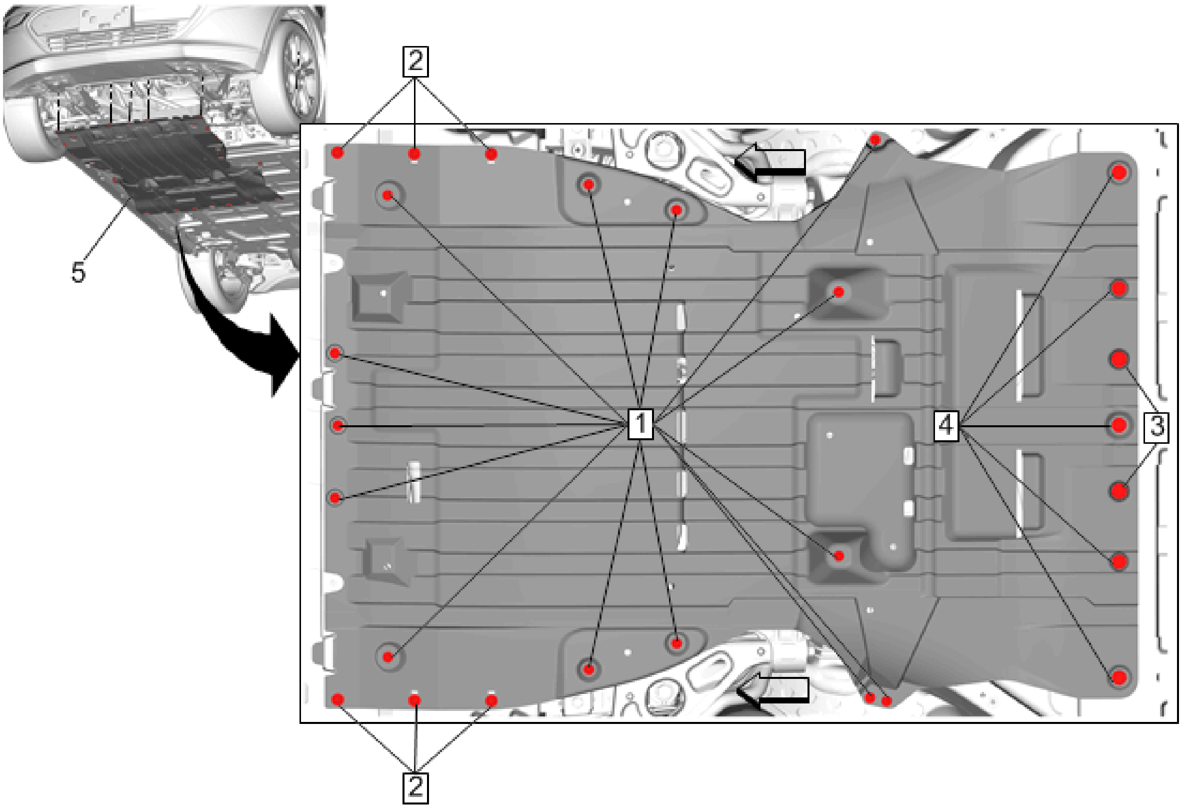


Fig. 9: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

4. Remove Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
5. Place a drain pan under the vehicle.

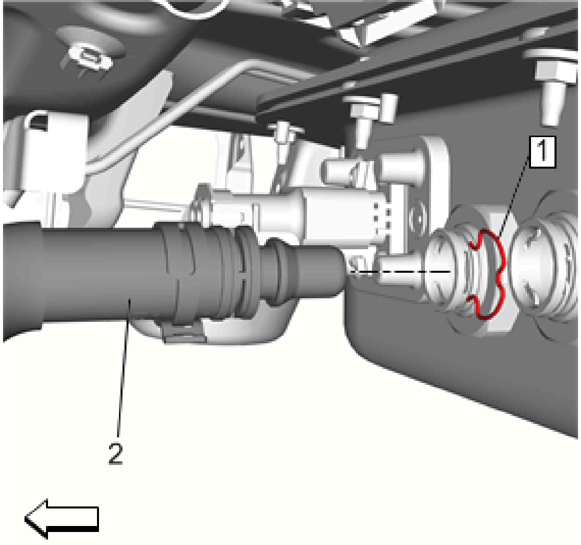


Fig. 10: Battery Vent Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

6. Remove Clip (1)
7. Remove Battery Vent Hose (2)

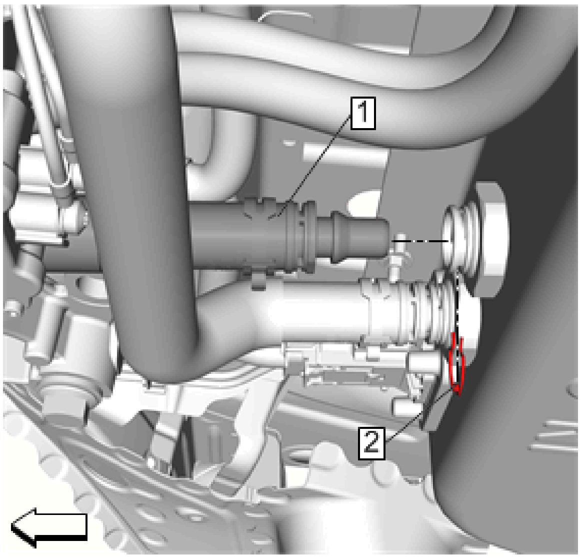


Fig. 11: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (1st Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

8. If equipped with the 1st design of battery pack having female inlet and female outlet port, remove the clip (2) and the drive motor battery coolant cooler outlet hose (1) from the RESS.

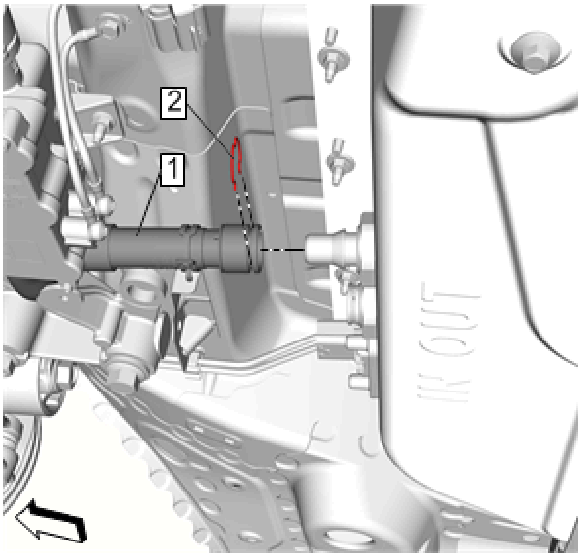


Fig. 12: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (2nd Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

9. If equipped with the 2nd design of battery pack having female inlet and male outlet port, remove the clip (2) and the drive motor battery coolant cooler outlet hose (1) from the RESS.
10. Remove the coolant from the drive motor battery cells.
11. Inspect the coolant.

Drive Motor Battery Cell Coolant Removal

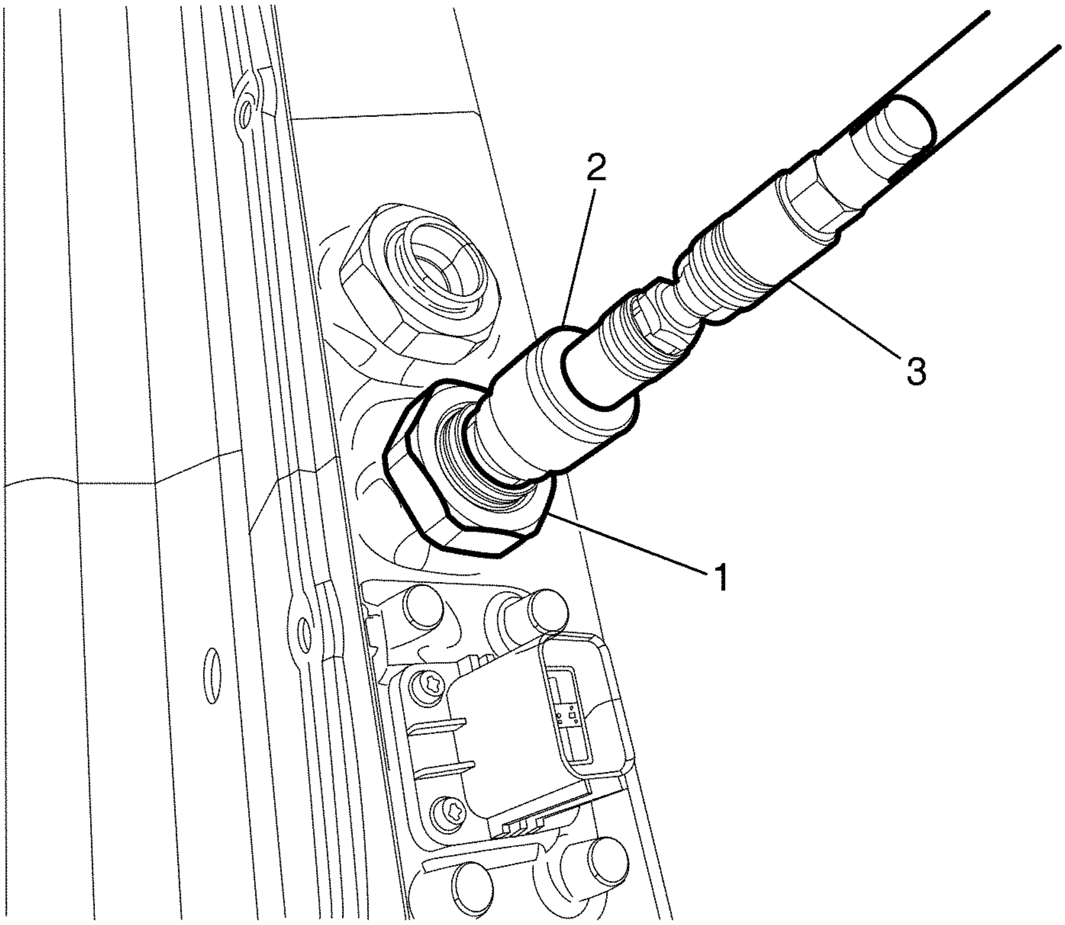


Fig. 13: Battery Pack Coolant Passage Test Adapter, Vac-N-Fill Vacuum Hose And Drive Motor Battery Coolant Inlet
Courtesy of GENERAL MOTORS COMPANY

1. Attach the **EL-52016-1A** Battery Pack Coolant Passage Test Adapter (2) to the drive motor battery coolant Inlet (1).
2. Attach the Vac-N-Fill Vacuum Hose (3) **GE-47716** Vac-N-Fill Coolant Refill Tool to the **EL-52016-1A** Battery Pack Coolant Passage Test Adapter (2).

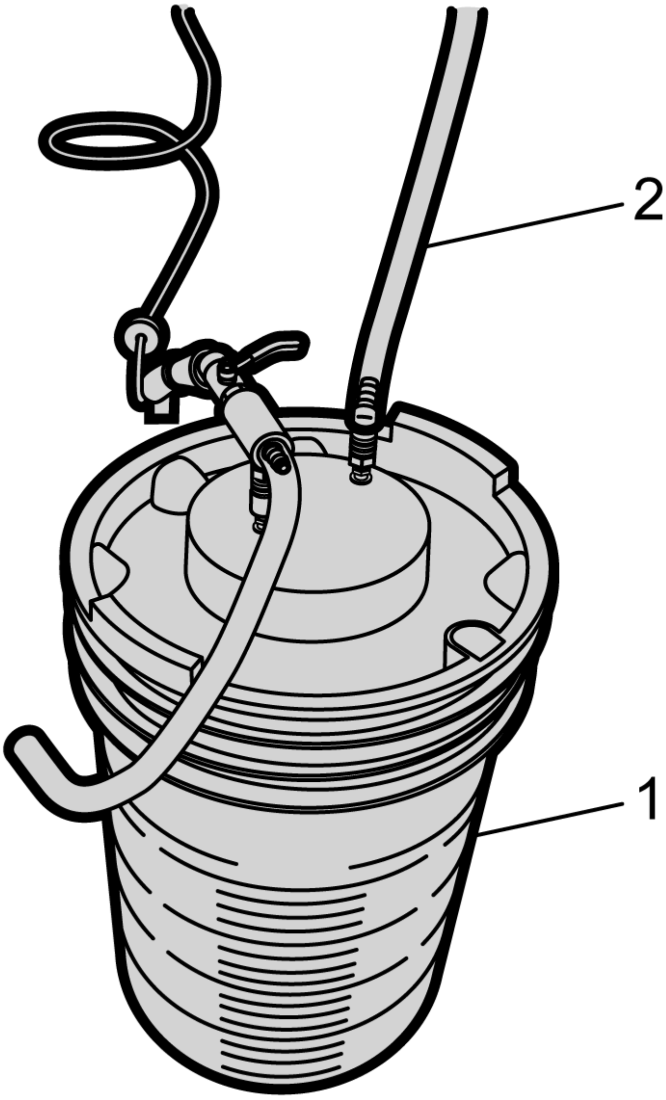


Fig. 14: Vac-N-Fill Vacuum Hose And Tank
Courtesy of GENERAL MOTORS COMPANY

3. Attach the Vac-N-Fill Vacuum Hose (2) to the Vac-N-Fill Vacuum Tank (1) **GE-47716** Vac-N-Fill Coolant Refill Tool.

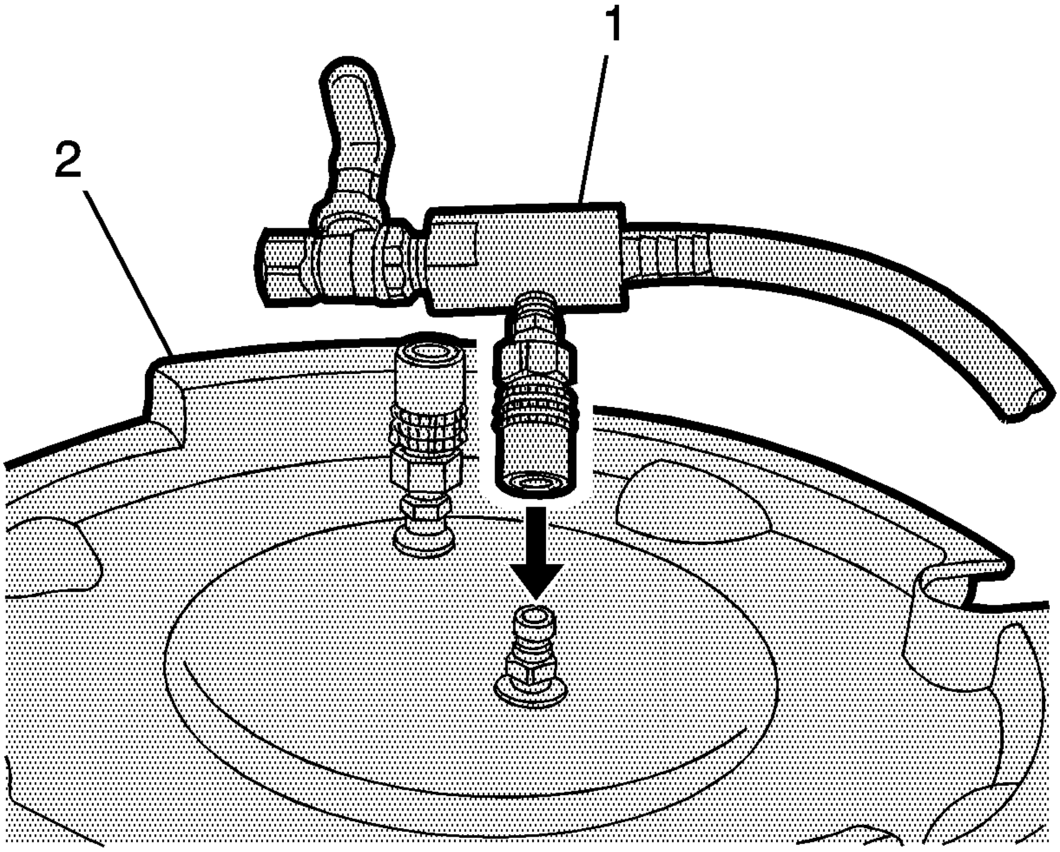


Fig. 15: Vacuum Tank & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Attach the venturi assembly (1) to the vacuum tank (2).

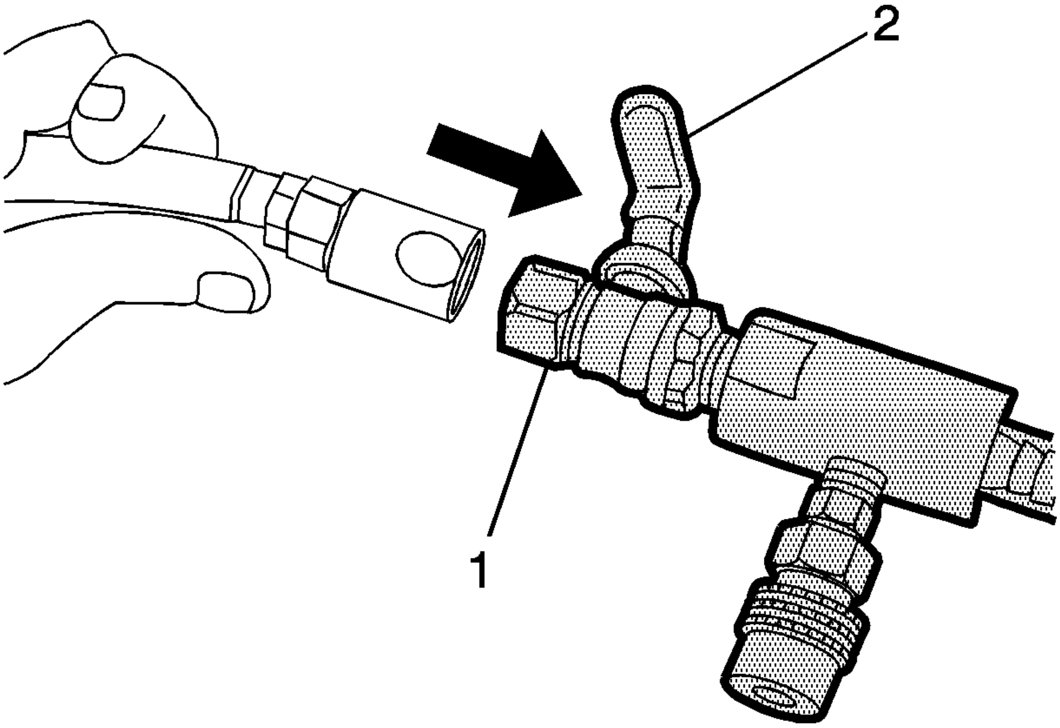


Fig. 16: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

5. Attach a shop air hose to the venturi assembly (1).
6. Ensure the valve (2) on the venturi assembly is closed.
7. Ensure the drain valve located on the bottom of the vacuum tank is closed.

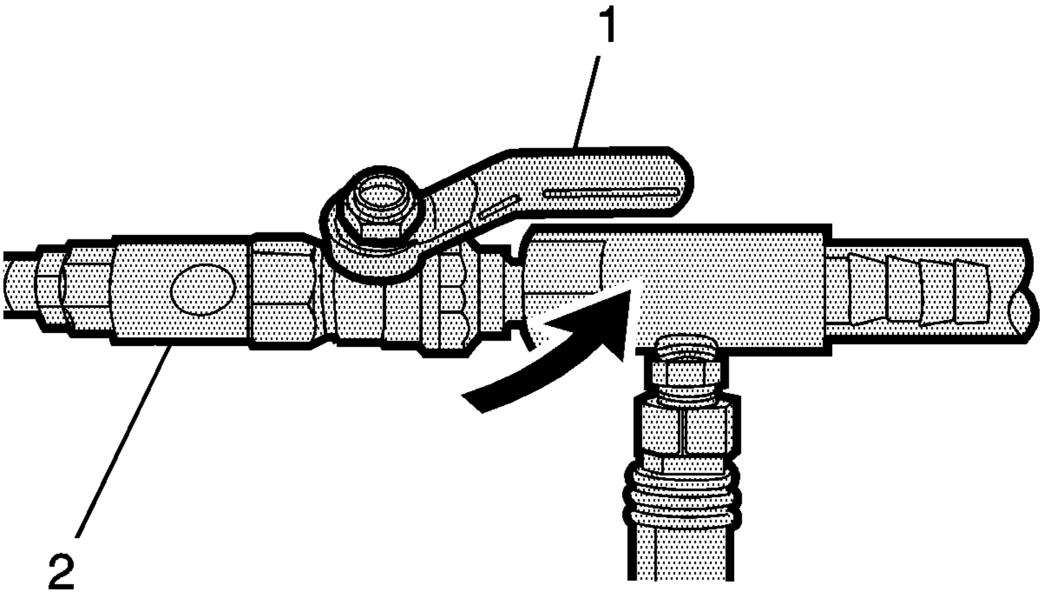


Fig. 17: Valve & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

   Coolant will be drawn from the drive motor battery through the vacuum hose and into the vacuum tank.

   Continue to draw coolant from the drive motor battery until there is a continuous mist through the vacuum hose.

9. Install the **EL52016-2A** Battery Pack Coolant Passage Test Adapter, shipping cap or equivalent into the drive motor battery coolant outlet fitting and allow vacuum to build in the drive motor battery for 15-20 seconds.
10. With a vacuum drawn on the drive motor battery cooling system, remove the **EL52016-2A** Battery Pack Coolant Passage Test Adapter, shipping cap or equivalent and allow air to enter the pack to extract additional coolant from the drive motor battery.
11. Repeat steps 7 and 8 until coolant stops draining from the drive motor battery.
12. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

Vac-N-Fill Procedure

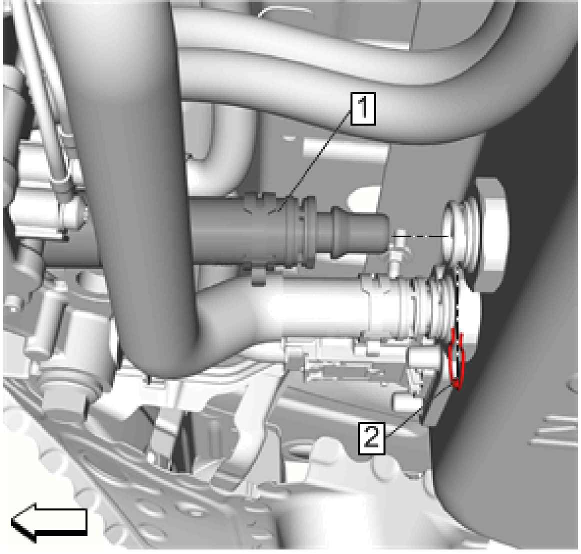


Fig. 18: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (1st Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing the inlet or outlet hose, be careful not to confuse the inlet port and outlet port.**

1. If equipped with the 1st design of battery pack having female inlet and female outlet port, install the clip (2) and the drive motor battery coolant cooler outlet hose (1) to the RESS.

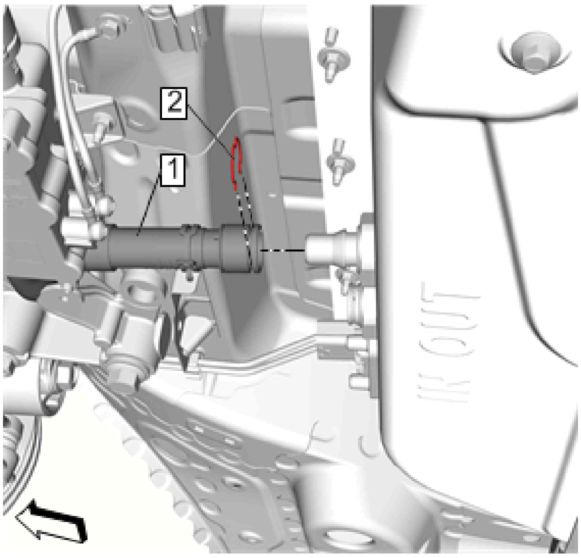


Fig. 19: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (2nd Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

2. If equipped with the 2nd design of battery pack having female inlet and male outlet port, install the clip (2) and the drive motor battery coolant cooler outlet hose (1) to the RESS.

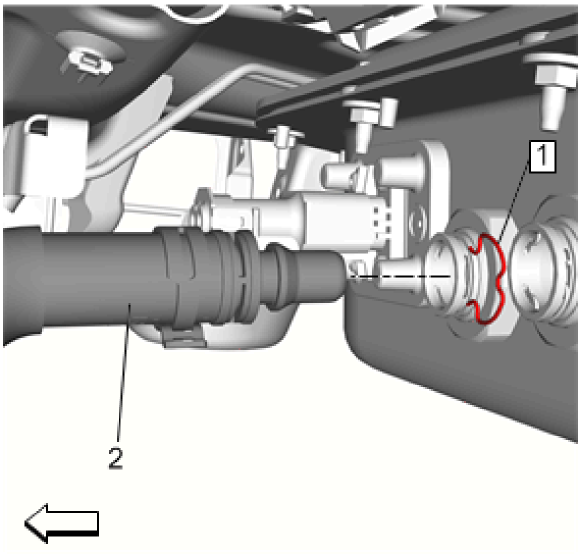


Fig. 20: Battery Vent Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

3. Install Battery Vent Hose (2)
4. Install Clip (1)

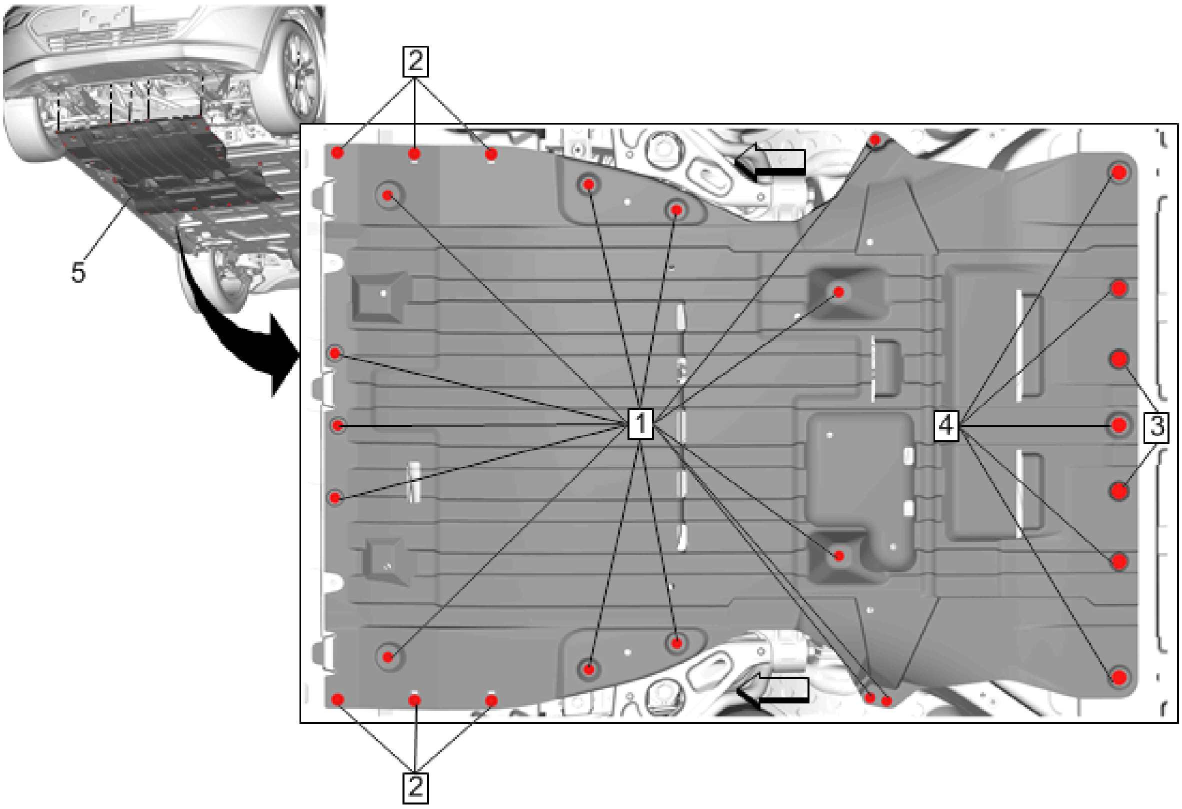


Fig. 21: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
6. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle**
7. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

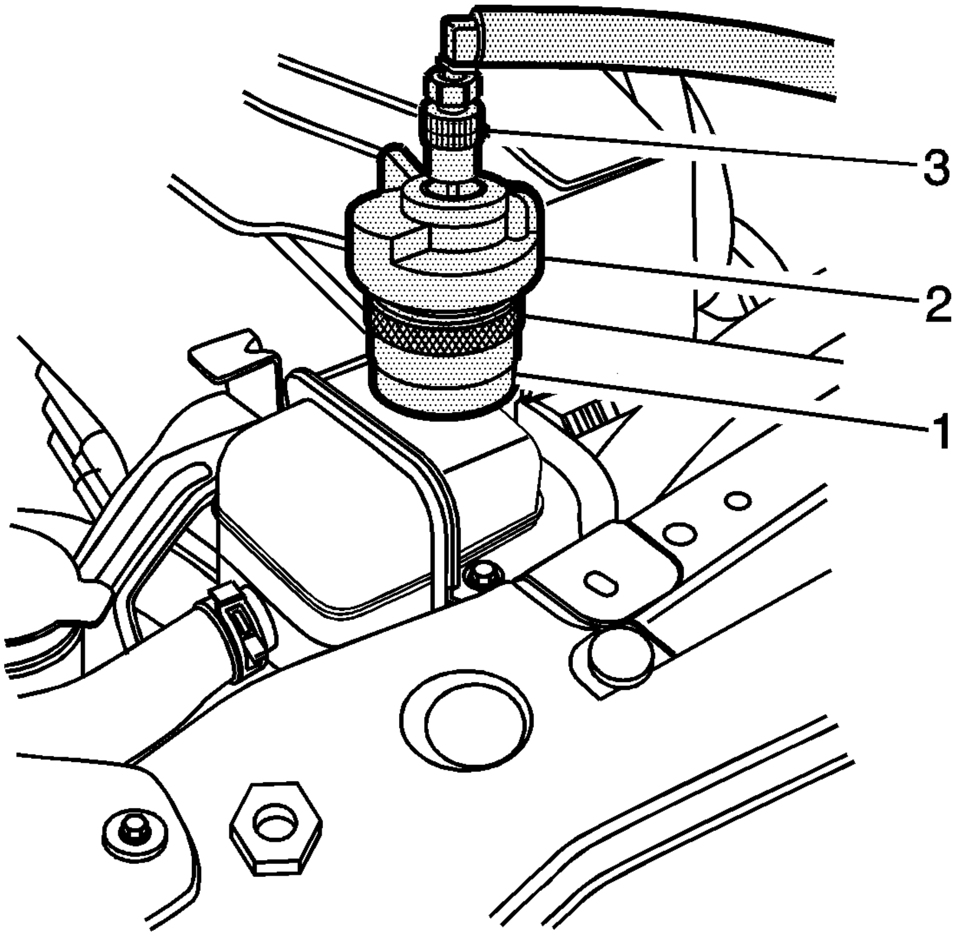


Fig. 22: Adapter, Vacuum Gauge Assembly And Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

NOTE: **To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49Â°C (120Â°F). The tool will not operate properly when the coolant is boiling.**

8. Install **GE-46143-2** adapter (1).
9. Attach the Vac-N-Fill cap (2) to **GE-46143-2** adapter (1).
10. Attach the vacuum gauge assembly (3) to the Vac-N-Fill cap (2).

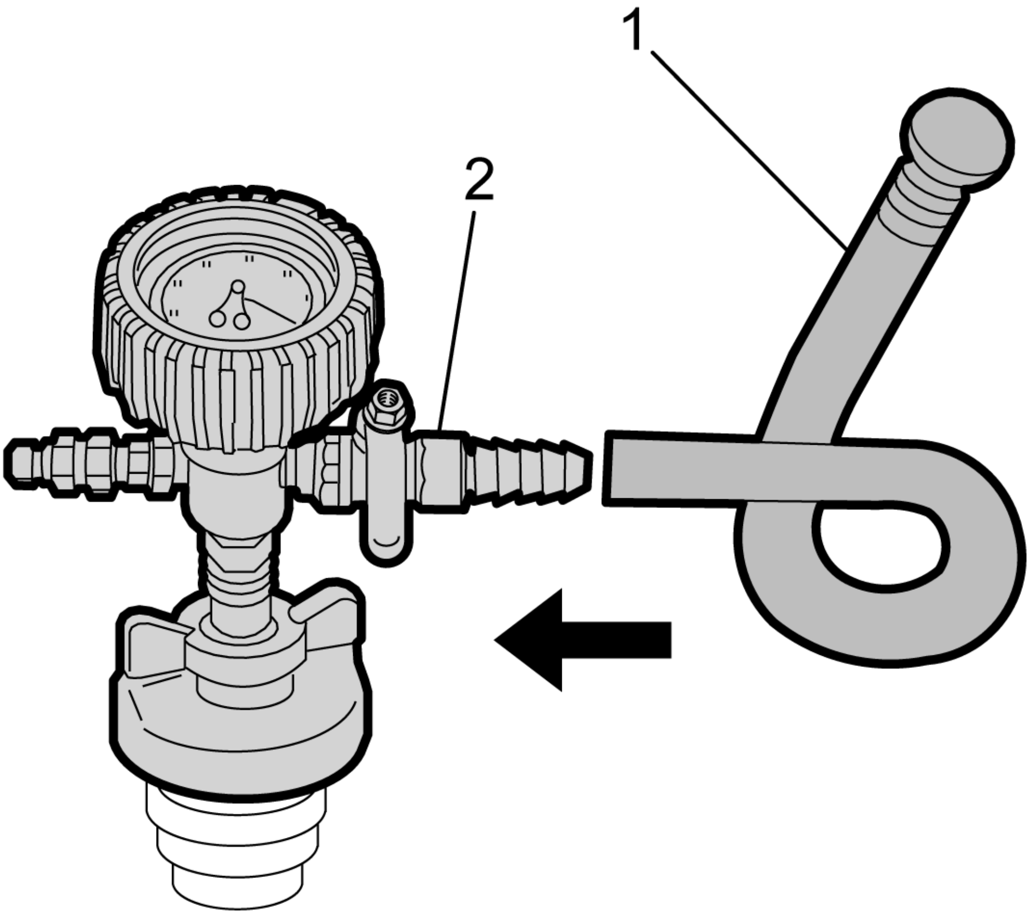


Fig. 23: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

11. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly.

    Ensure that the valve is closed.

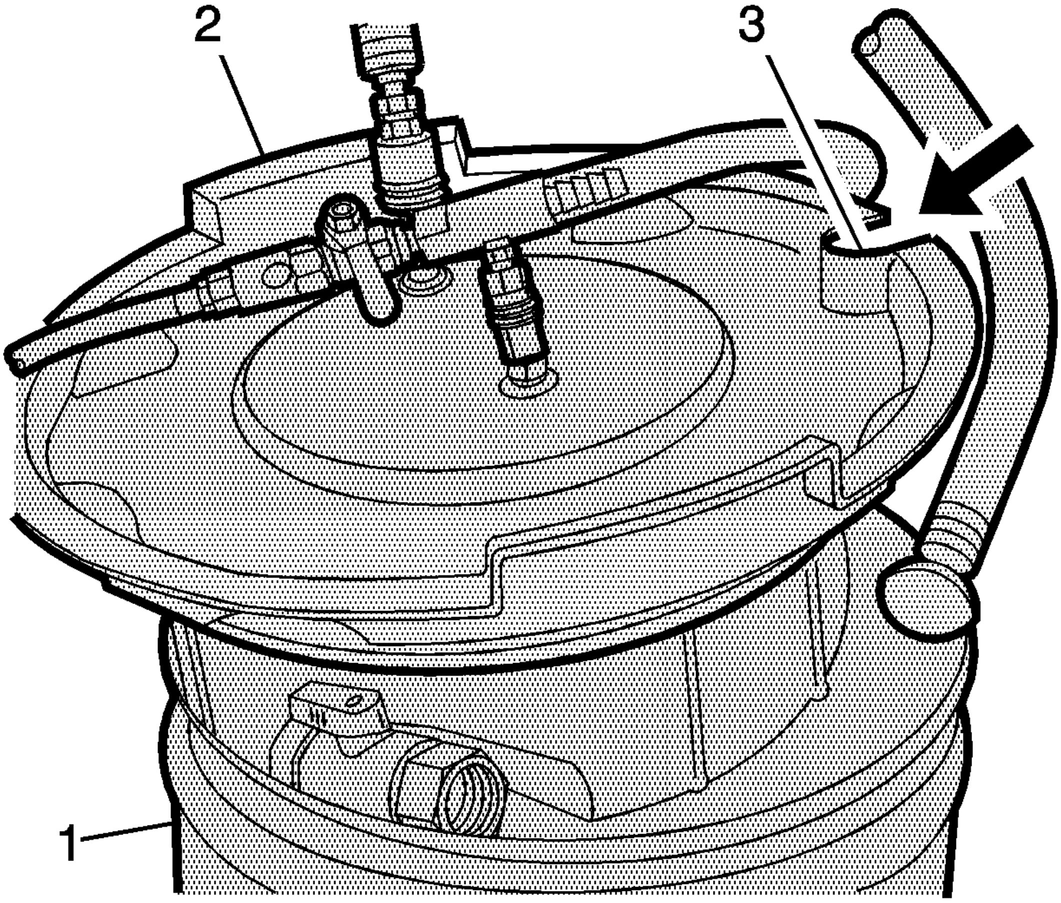


Fig. 24: Graduated Reservoir, Vacuum Tank & Cut-Out Area
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a Pre-mixed DEXCOOLÂ® (50/50 mixture of DEXCOOLÂ® and deionized water). Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.

12. Pour the coolant mixture into the graduated reservoir (1).
13. Place the fill hose in the graduated reservoir (1).

NOTE: Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.

14. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

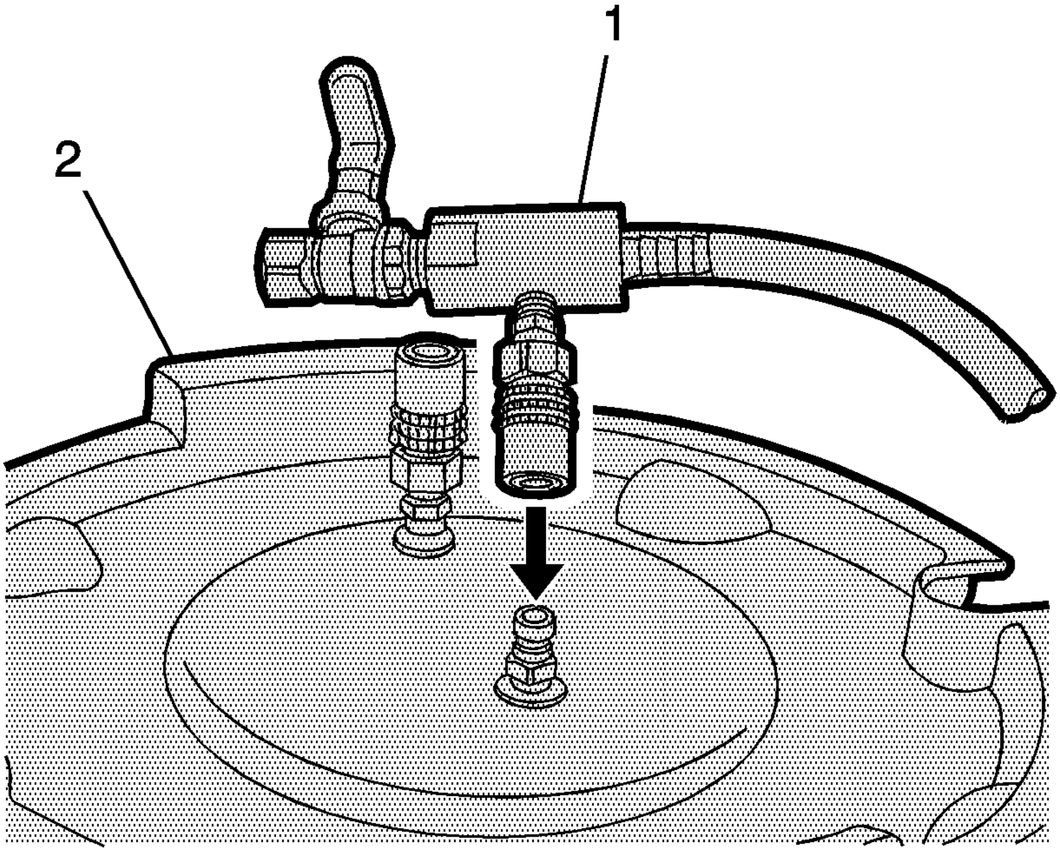


Fig. 25: Vacuum Tank & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

15. Attach the venturi assembly (1) to the vacuum tank (2).

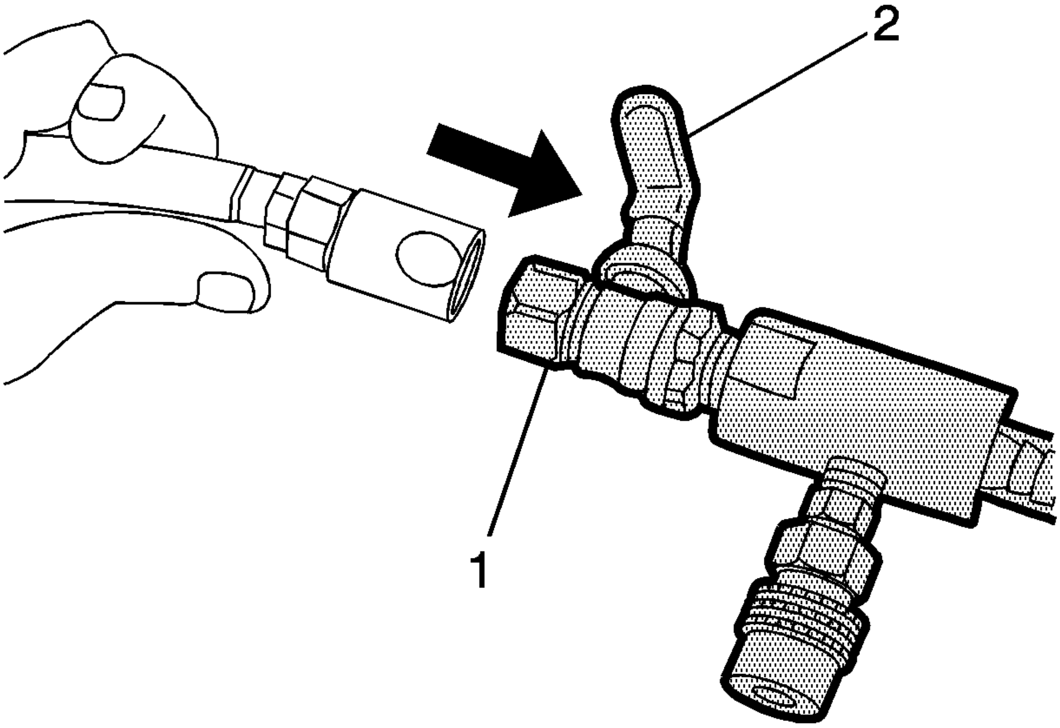


Fig. 26: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

16. Attach a shop air hose to the venturi assembly (1).

    Ensure the valve (2) on the venturi assembly is closed.

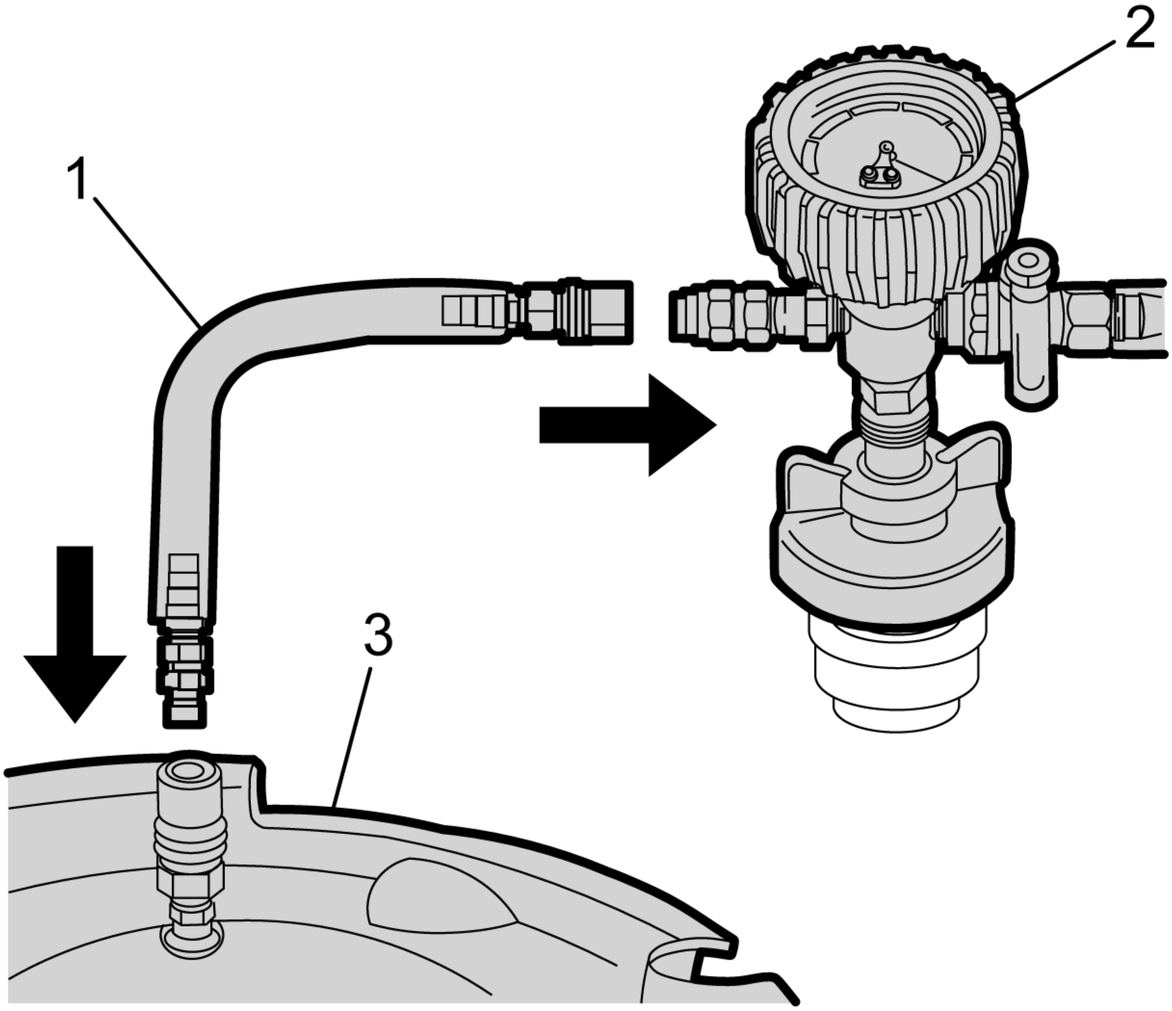


Fig. 27: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

17. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).

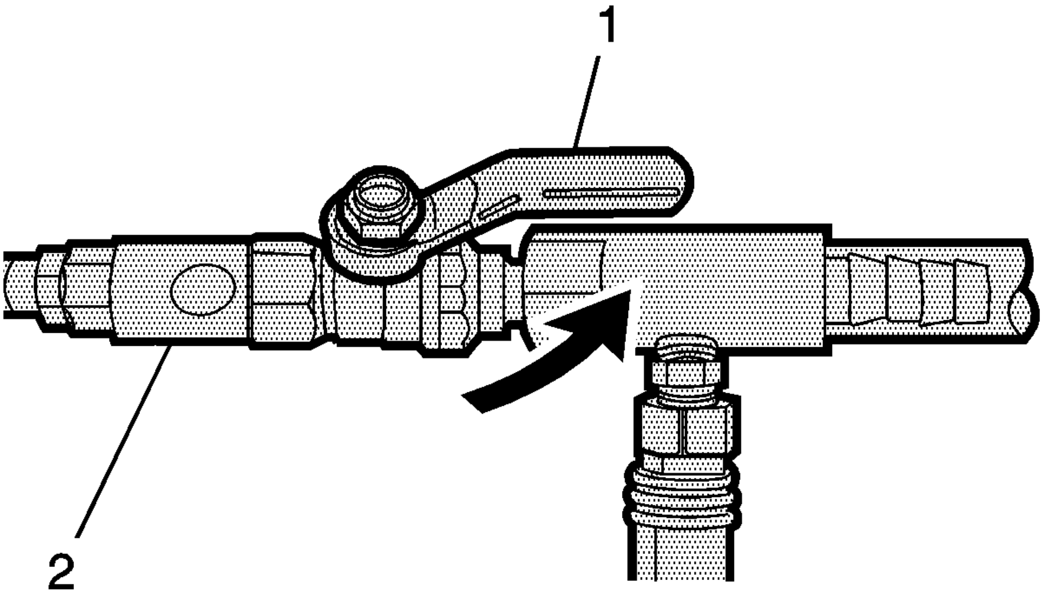


Fig. 28: Valve & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

18. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

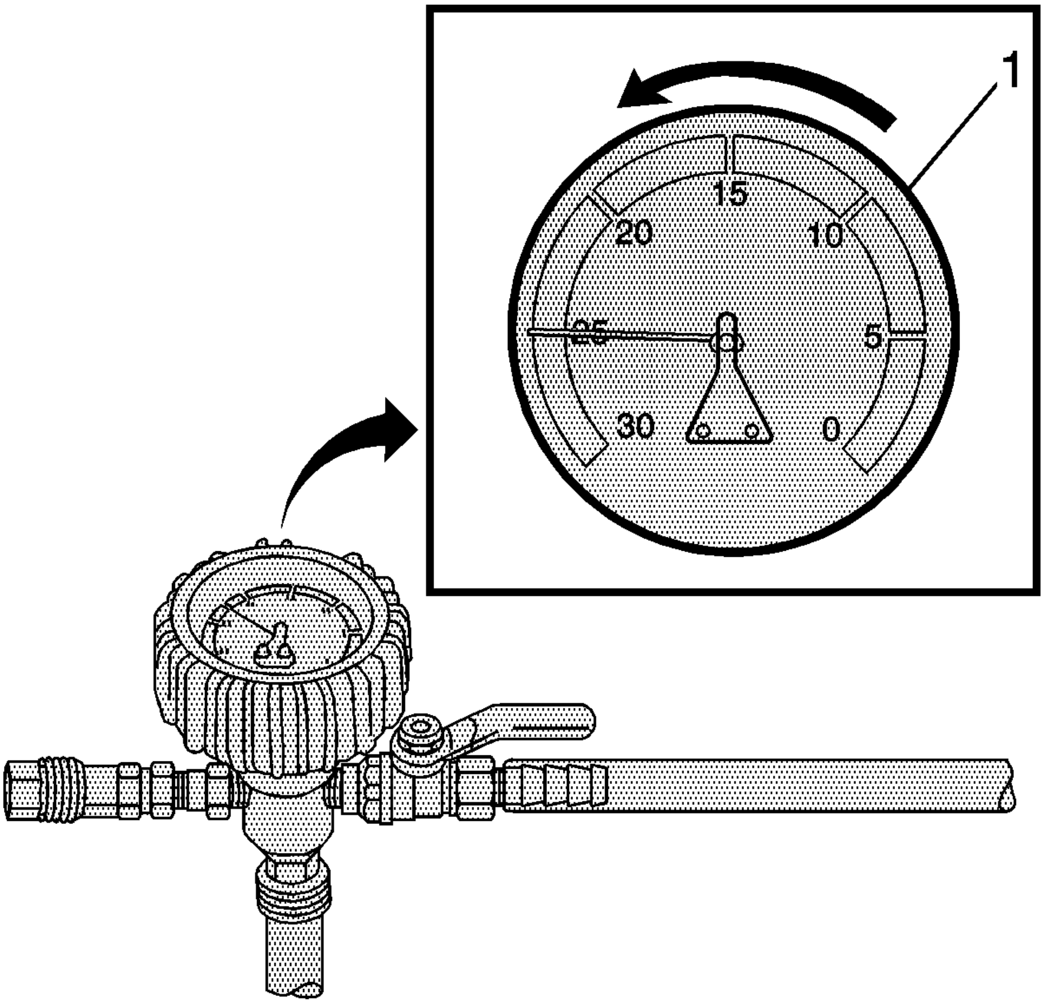


Fig. 29: Vacuum Gauge Needle
Courtesy of GENERAL MOTORS COMPANY

19. Continue to draw vacuum until the needle stops rising (1). This should be 610 - 660 mm Hg (24 - 26 in Hg).

    Cooling hoses may start to collapse. This is normal due to vacuum draw.

20. To aid in the fill process, position the graduated reservoir above the coolant fill port.

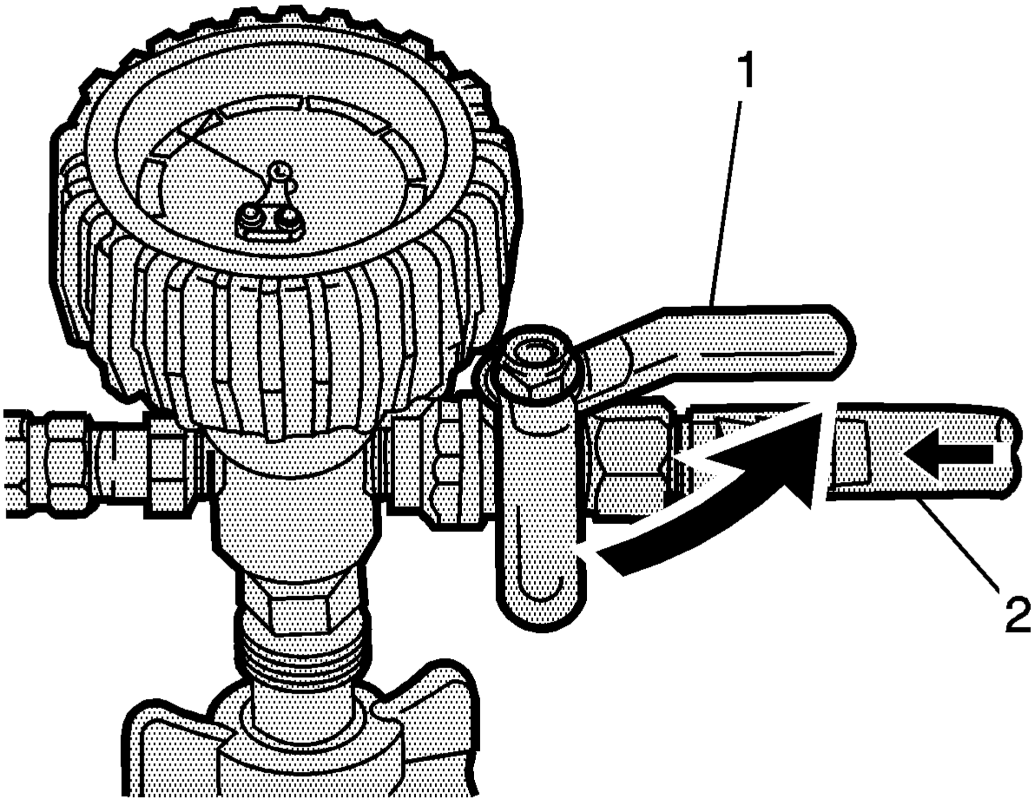


Fig. 30: Vacuum Gauge Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

21. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
22. Close the valve on the venturi assembly.
23. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

    If vacuum loss is observed, refer to **Hybrid Cooling System Loss of Coolant (Drive Motor Battery Cooling System)Hybrid Cooling System Loss of Coolant (Drive Motor Generator Power Inverter Module Cooling System)**.

24. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

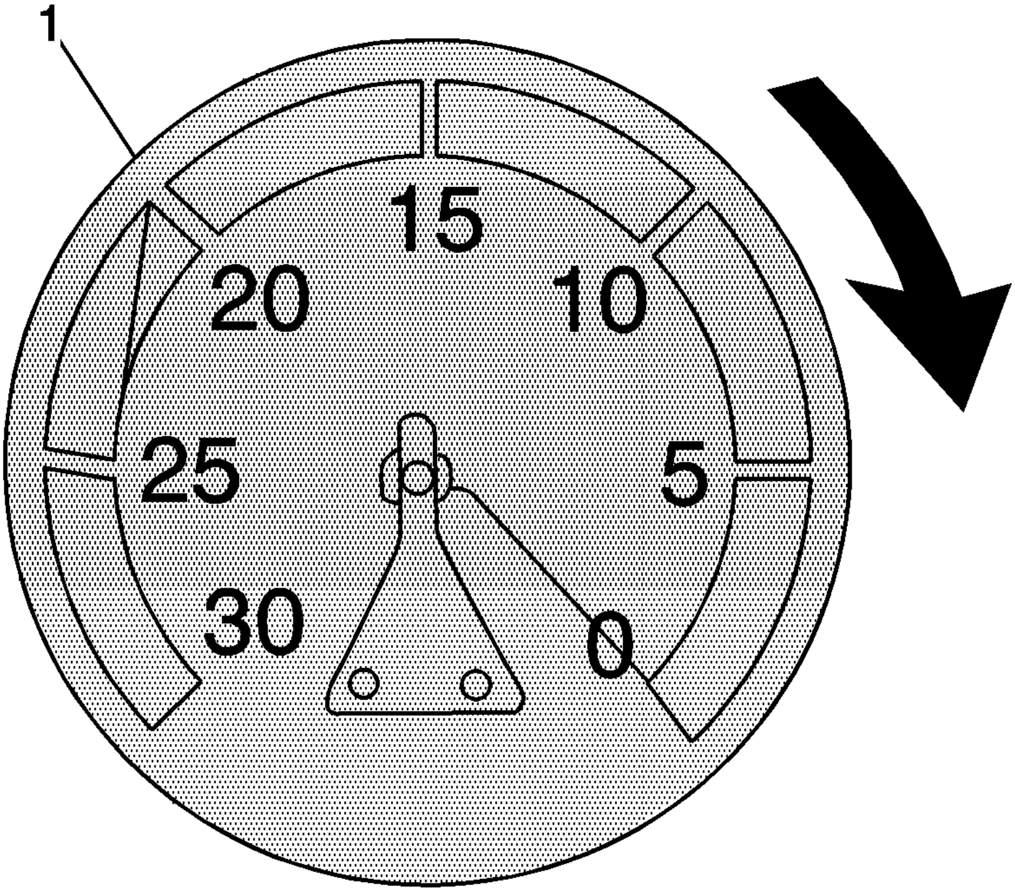


Fig. 31: Vacuum Gauge
Courtesy of GENERAL MOTORS COMPANY

25. Once the vacuum gauge (1) reaches zero, close the valve on the vacuum gauge assembly and repeat steps 15 - 21.
26. Ensure that the vehicle is in service mode. Refer to **Power Mode Description and Operation**
27. With the GDS scan tool, activate the hybrid/EV battery pack coolant pump for 5 minutes while maintaining 381 mm (15 in Hg) vacuum throughout the process.
28. Detach the Vac-N-Fill cap from the **GE-46143-2** adapter.
29. Remove **GE-46143-2** adapter from the surge tank fill neck.

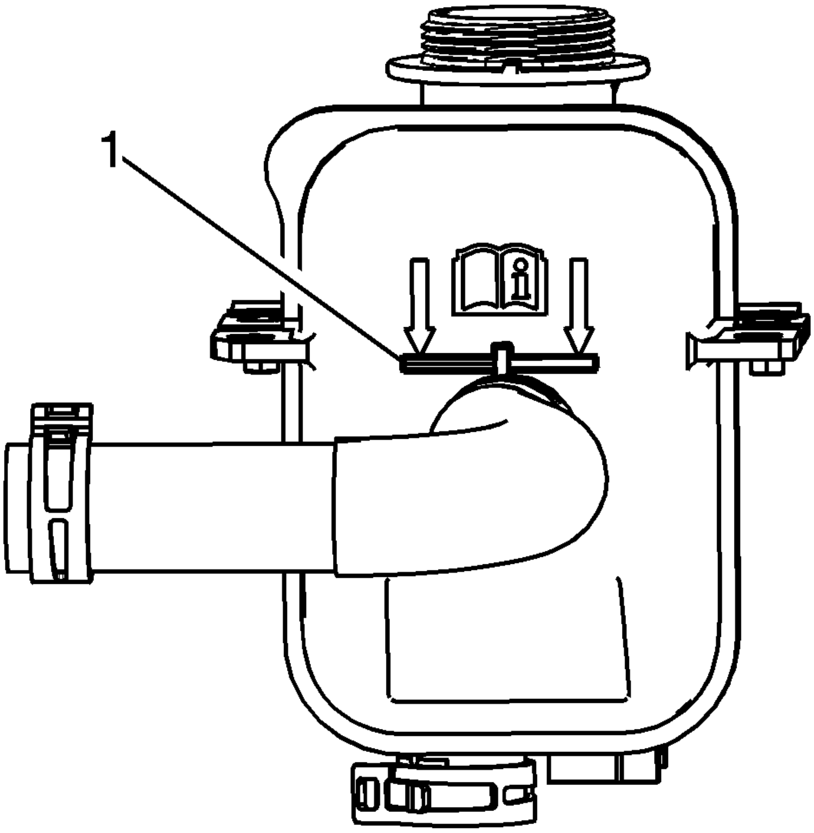


Fig. 32: Adjusting Surge Tank Coolant Level To Position Just Above Seam
Courtesy of GENERAL MOTORS COMPANY

30. Upon completion of the hybrid/EV battery pack coolant pump bleed procedure, adjust the surge tank coolant level to a position just above the seam (1).
31. Inspect the concentration of the coolant mixture using **GE-26568** tester.

REMOVING EXCESS COOLANT FROM SYSTEM

NOTE: **After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.**

1. Detach the vacuum hose from the vacuum gauge assembly.

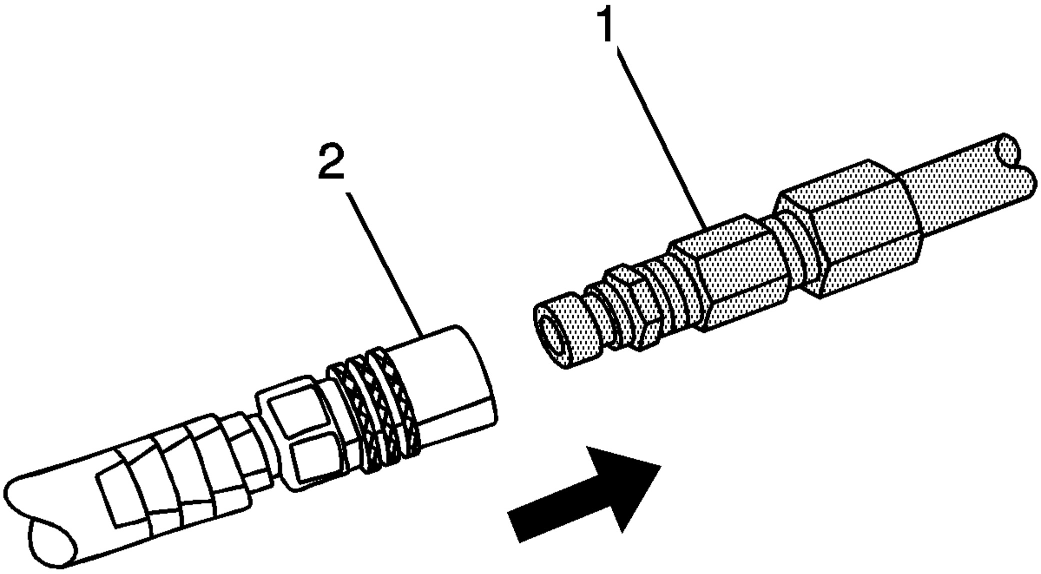


Fig. 33: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

2. Attach the extraction hose (1) to the vacuum hose (2).

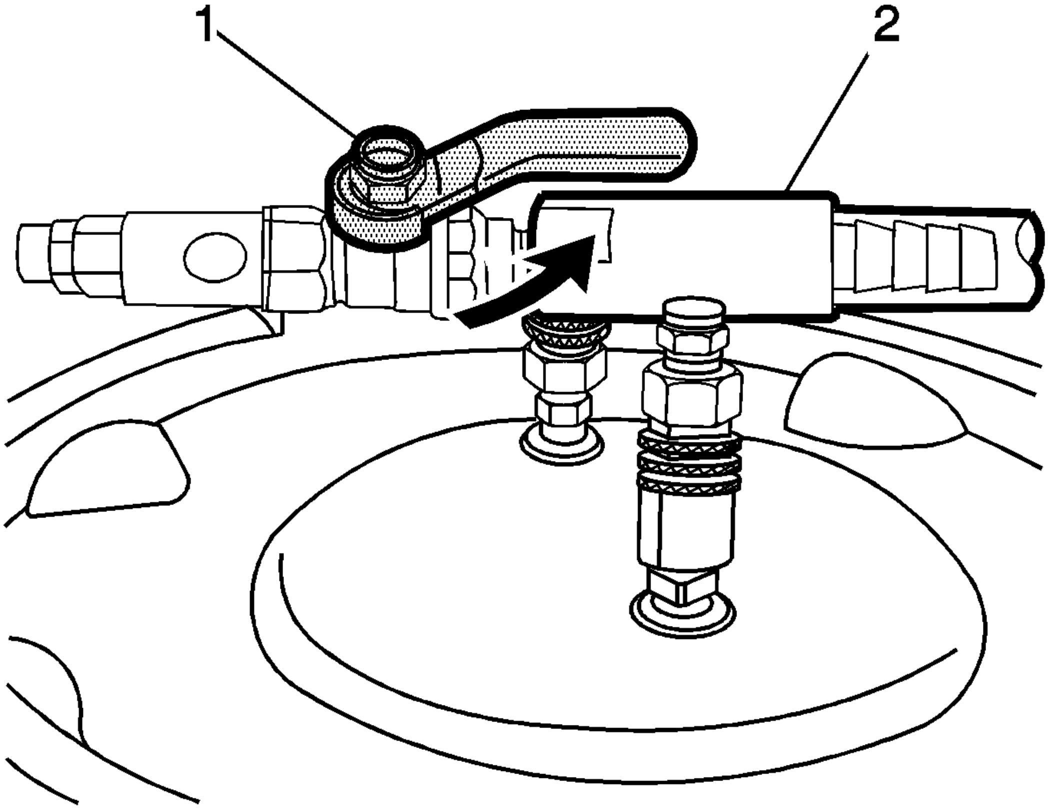


Fig. 34: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

3. Open the valve (1) on the venturi assembly (2) to start a vacuum draw.

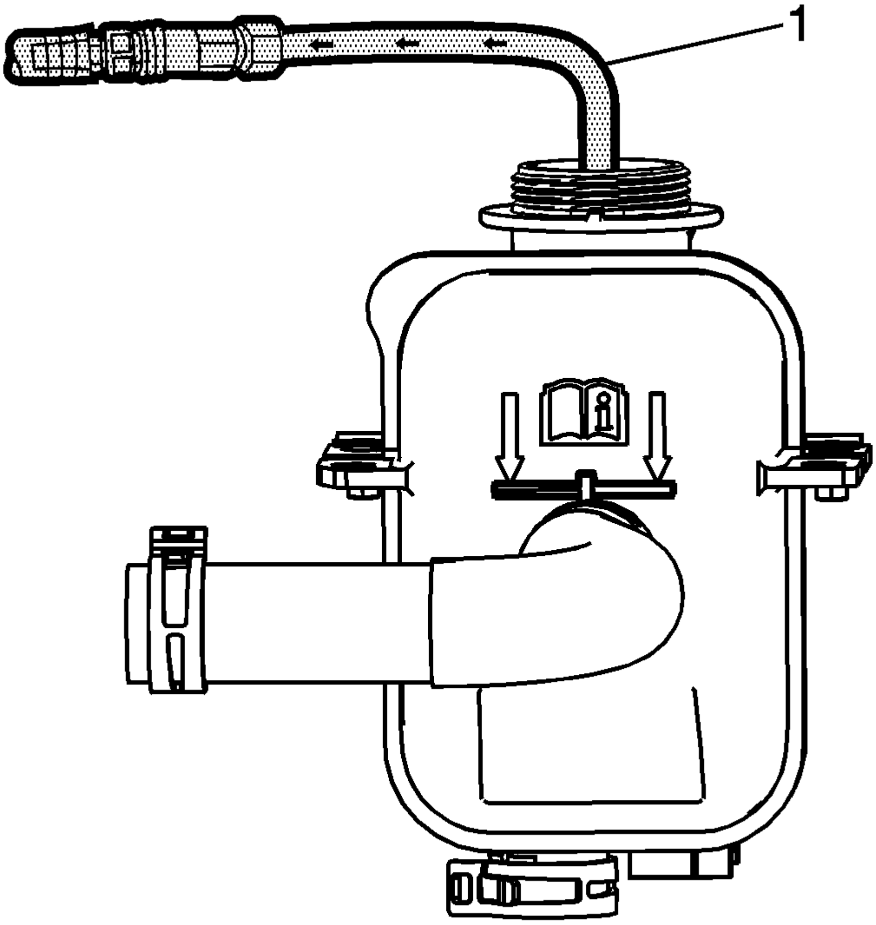


Fig. 35: Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

4. Assemble the extraction hose (1) and insert into the surge tank.

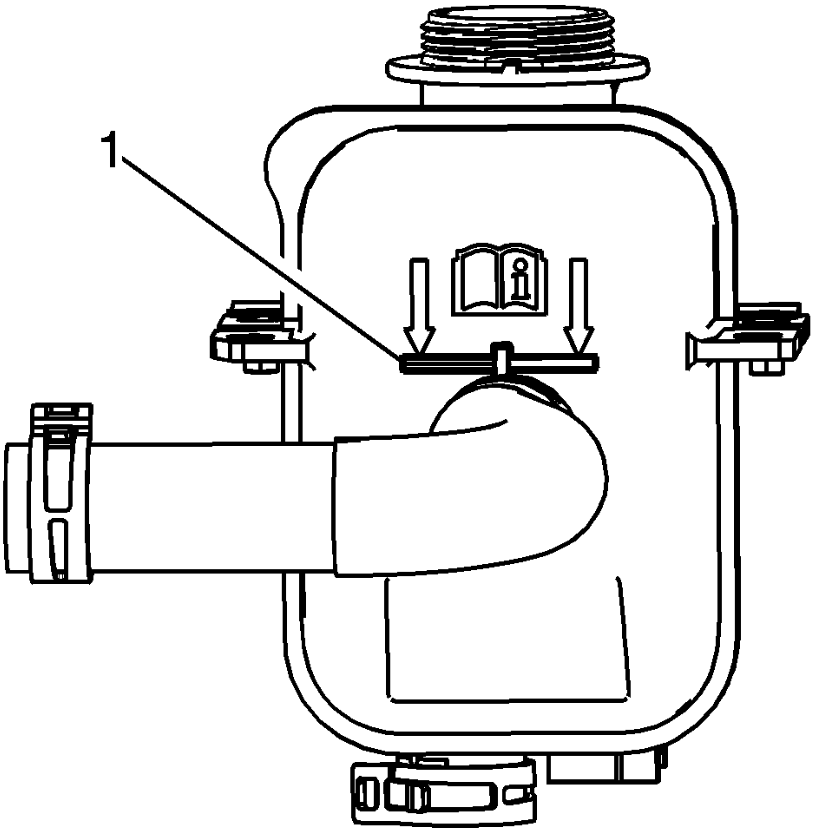


Fig. 36: Adjusting Surge Tank Coolant Level To Position Just Above Seam
Courtesy of GENERAL MOTORS COMPANY

5. Adjust the surge tank coolant level to a position just above the seam (1).
6. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

DRIVE MOTOR GENERATOR POWER INVERTER MODULE COOLING SYSTEM DRAINING AND FILLING

Special Tools

- **GE-26568** Coolant and Battery Tester
- **GE-46143 - 2** Cooling System Adapter
- **GE-47716** Vac-N-Fill Coolant Refill Tool

For equivalent regional tools, refer to Special Tools.

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

WARNING: **Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.**

WARNING: **To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.**

Draining Procedure

1. Turn Vehicle Power Off and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Remove the radiator surge tank cap.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
4. Place a drain pan under the vehicle.
5. Remove Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**

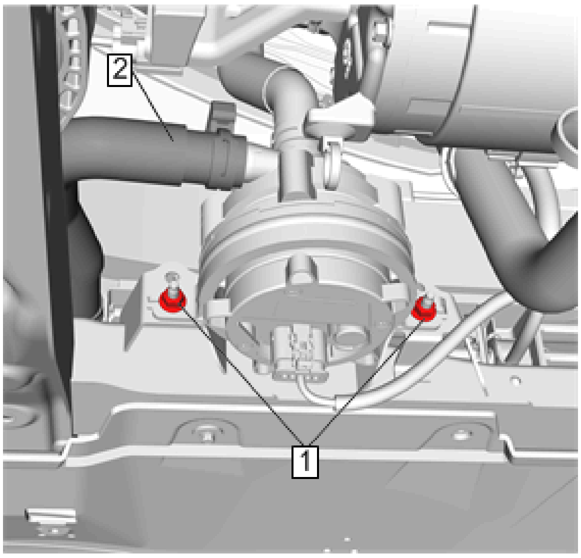


Fig. 37: Drive Motor Battery Coolant Pump Bracket Nuts And Drive Motor Generator Control Module Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Battery Coolant Pump Bracket Nuts (1) (Qty: 2)
7. Lower the drive motor battery coolant pump to secure the space to drain the coolant.
8. To drain the coolant, remove the drive motor generator control module radiator inlet hose (2) from the drive motor generator control module coolant pump. Refer to **Drive Motor Generator Control Module Radiator Inlet Hose Replacement (Pump To Radiator)**

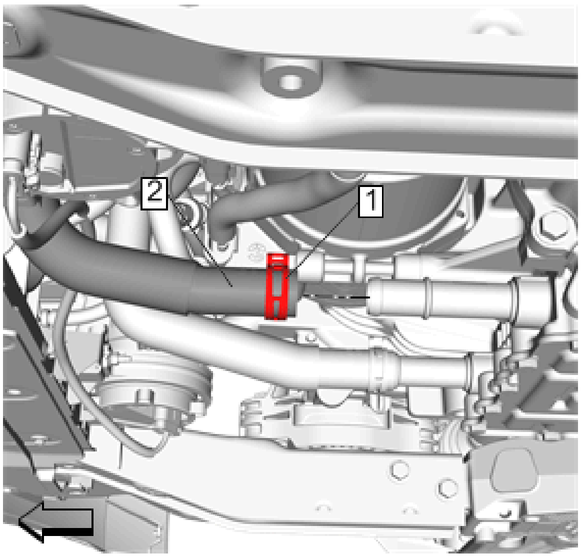


Fig. 38: Generator Control Module Coolant Tank Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

9. To drain the coolant, remove the generator control module coolant tank hose (2) from the drive motor. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)**
10. Inspect the coolant.

Vac-N-Fill Procedure

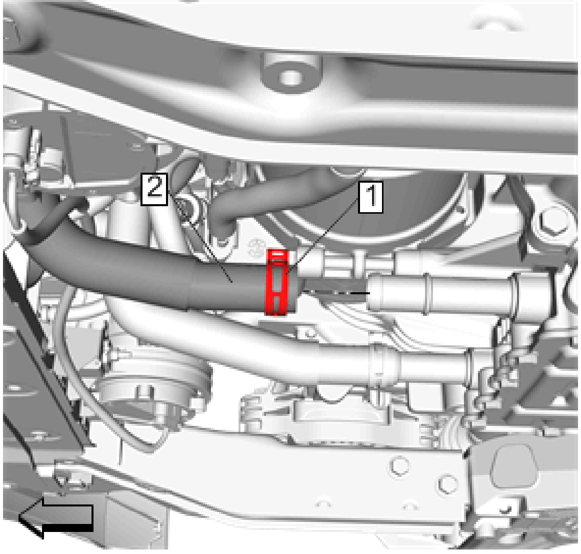


Fig. 39: Generator Control Module Coolant Tank Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install the generator control module coolant tank hose (2) to the drive motor. Refer to **Generator Control Module Coolant Tank Hose Replacement (DU To Surge Tank)**

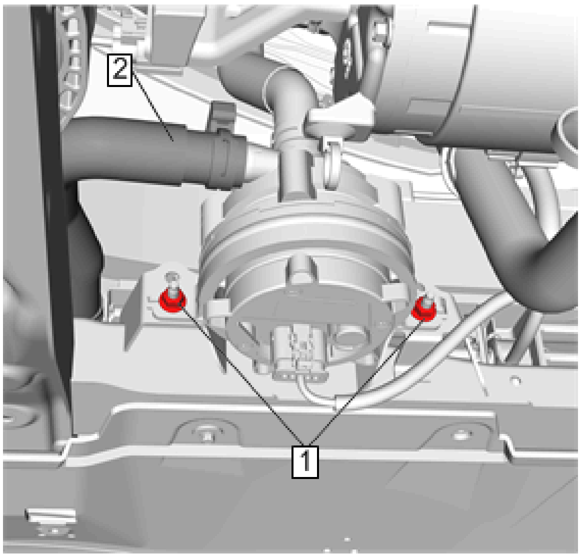


Fig. 40: Drive Motor Battery Coolant Pump Bracket Nuts And Drive Motor Generator Control Module Radiator Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

2. Install and tighten Drive Motor Battery Coolant Pump Bracket Nuts (1) (Qty: 2) to 9 N.m (80 lb in)
3. Install the drive motor generator control module radiator inlet hose (2) to the drive motor generator control module coolant pump. Refer to **Drive Motor Generator Control Module Radiator Inlet Hose Replacement (Pump To Radiator)**
4. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
5. Turn Vehicle Power Off and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

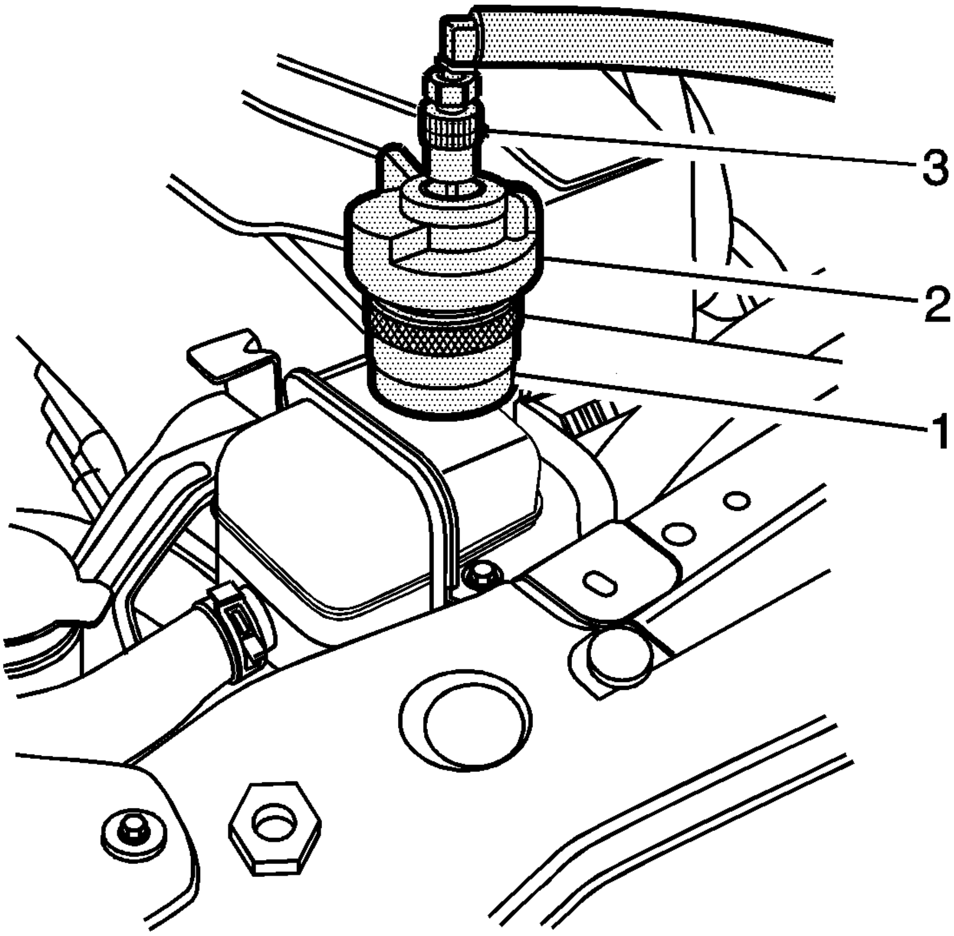


Fig. 41: Adapter, Vacuum Gauge Assembly And Vac-N-Fill Cap
Courtesy of GENERAL MOTORS COMPANY

NOTE: **To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49Â°C (120Â°F). The tool will not operate properly when the coolant is boiling.**

6. Install **GE-46143-2** adapter (1).
7. Attach the Van-N-Fill cap (2) to **GE-46143-2** adapter (1).
8. Attach the vacuum gauge assembly (3) to the Vac-N-Fill cap (2).

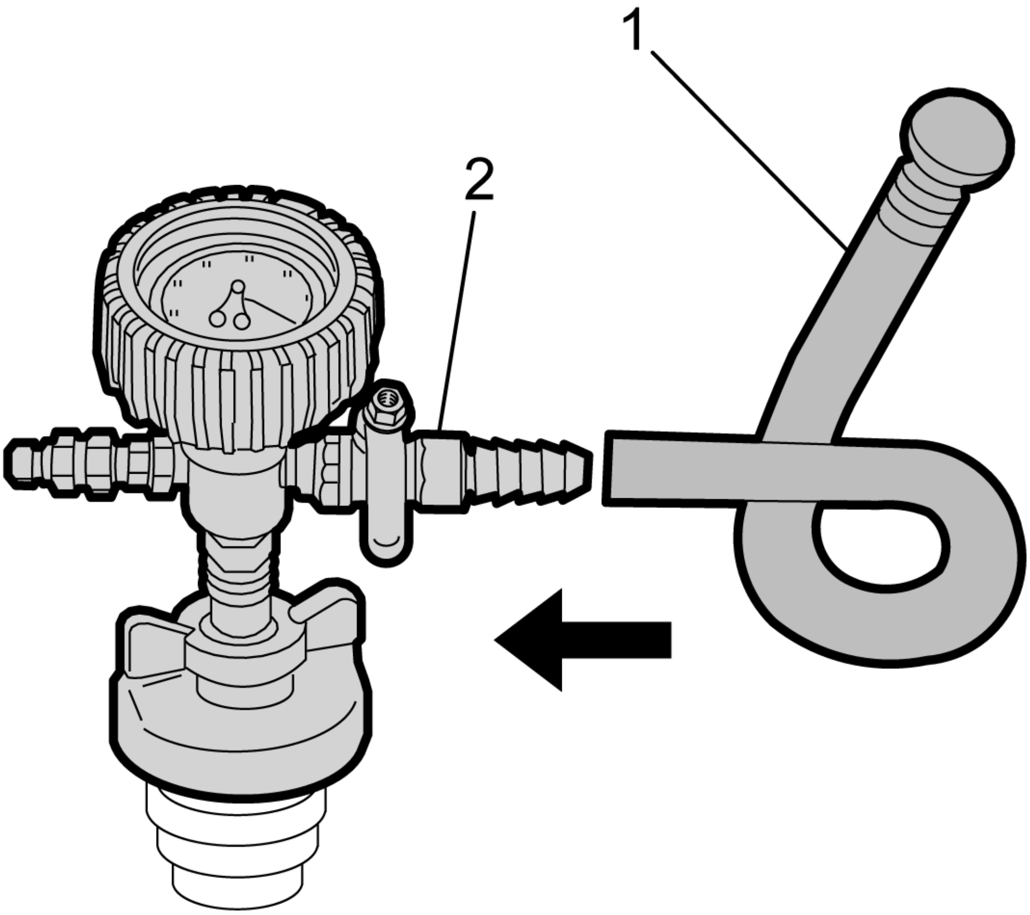


Fig. 42: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

9. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly.

   Ensure that the valve is closed.

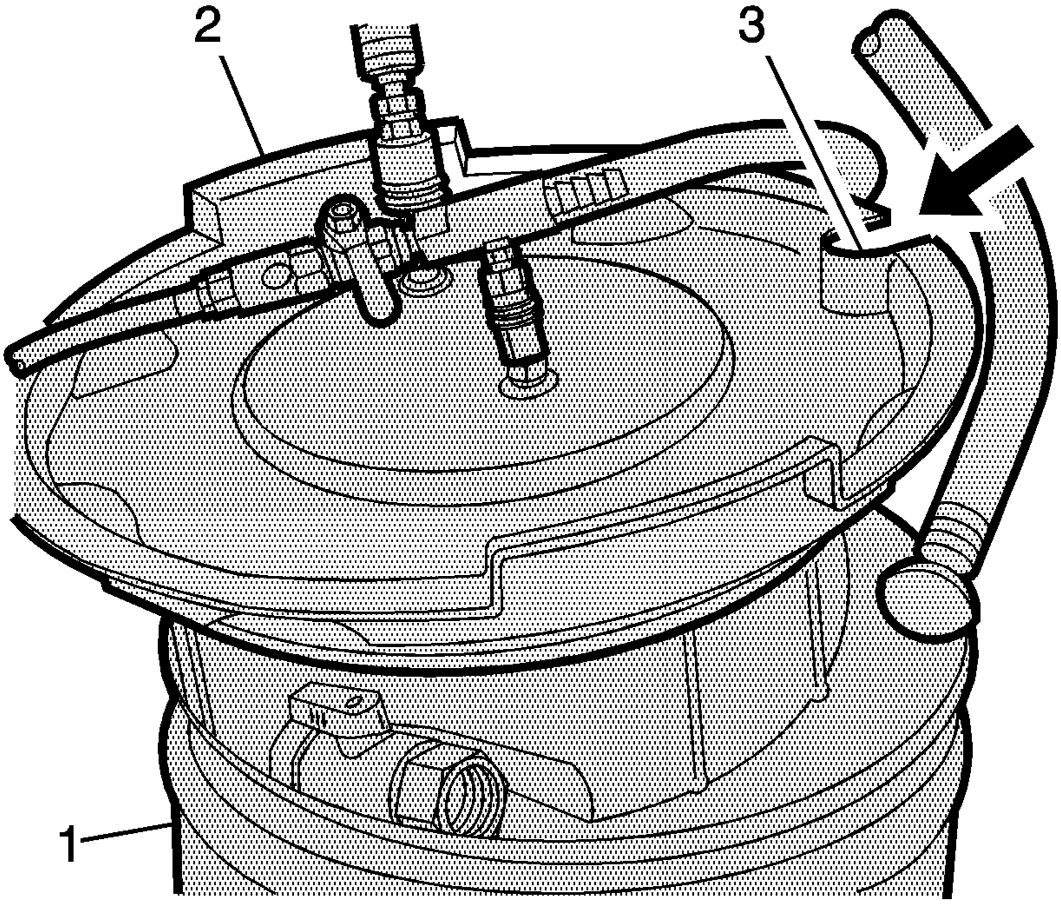


Fig. 43: Graduated Reservoir, Vacuum Tank & Cut-Out Area
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a Pre-mixed DEXCOOLÂ® (50/50 mixture of DEXCOOLÂ® and deionized water). Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.**

10. Pour the coolant mixture into the graduated reservoir (1).
11. Place the fill hose in the graduated reservoir (1).

NOTE: **Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.**

12. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

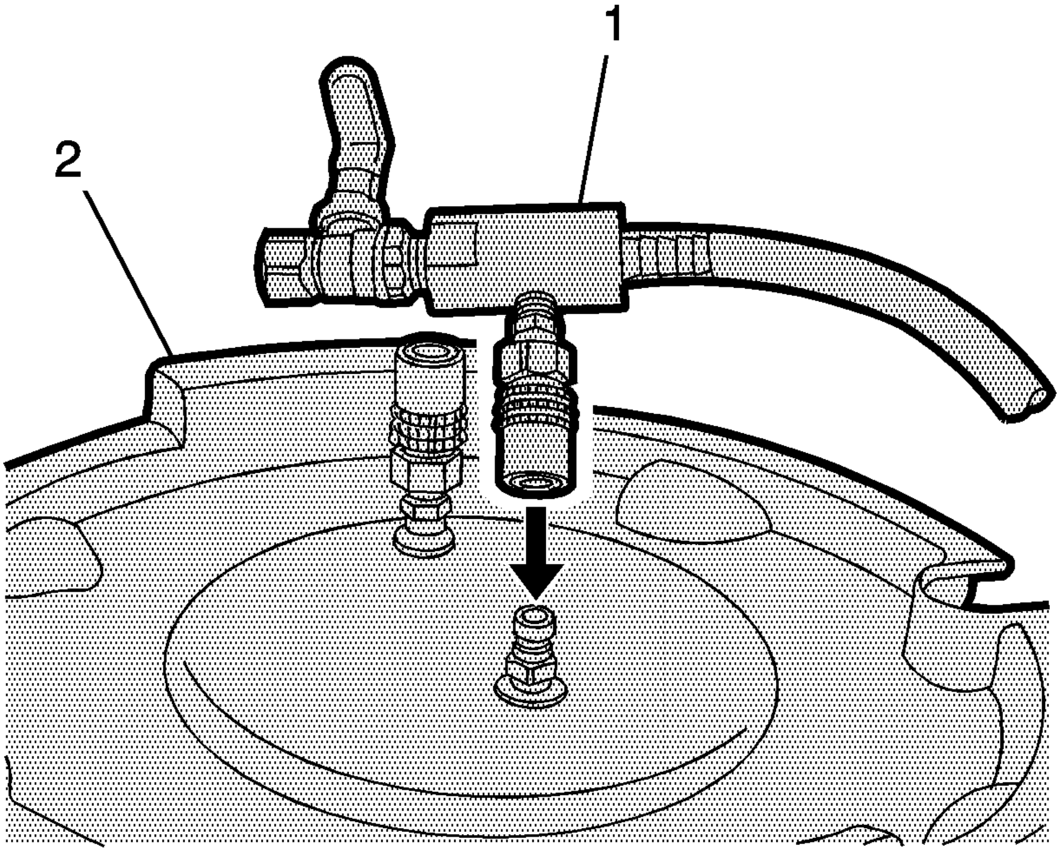


Fig. 44: Vacuum Tank & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

13. Attach the venturi assembly (1) to the vacuum tank (2).

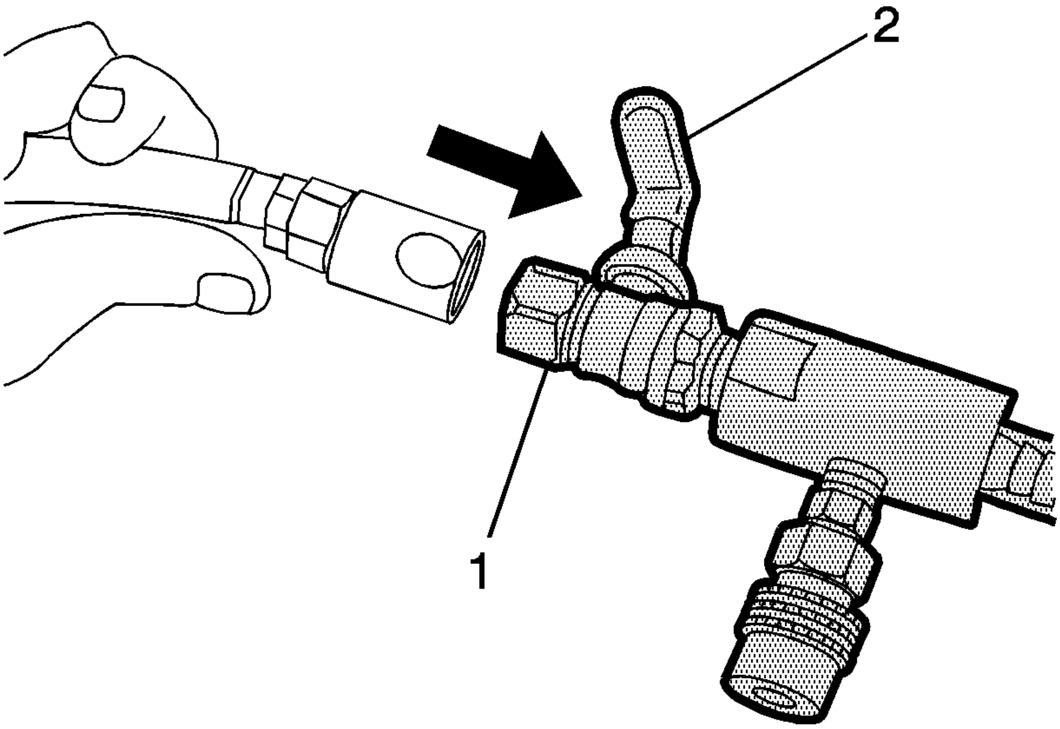


Fig. 45: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

14. Attach a shop air hose to the venturi assembly (1).

    Ensure the valve (2) on the venturi assembly is closed.

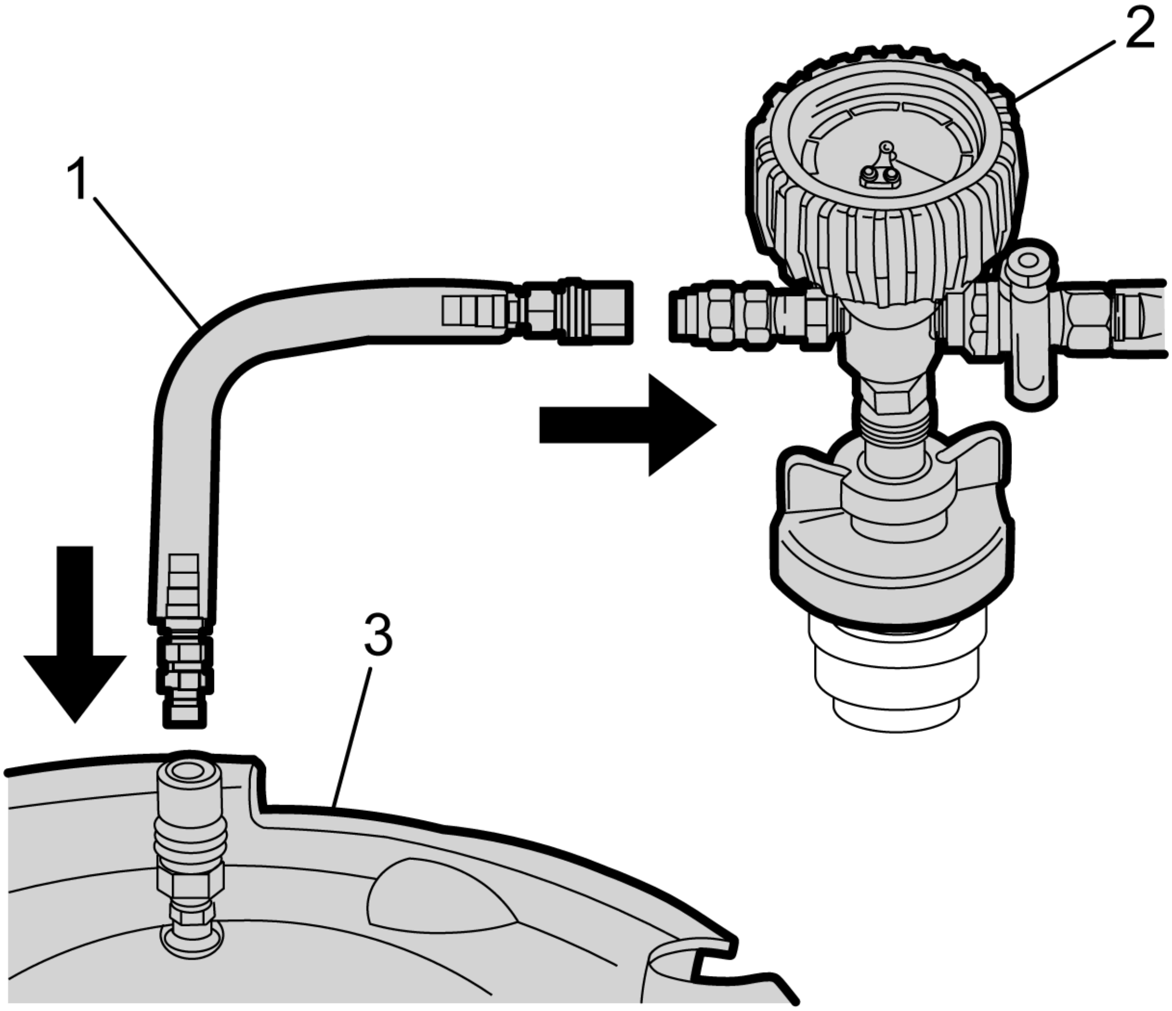


Fig. 46: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

15. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).

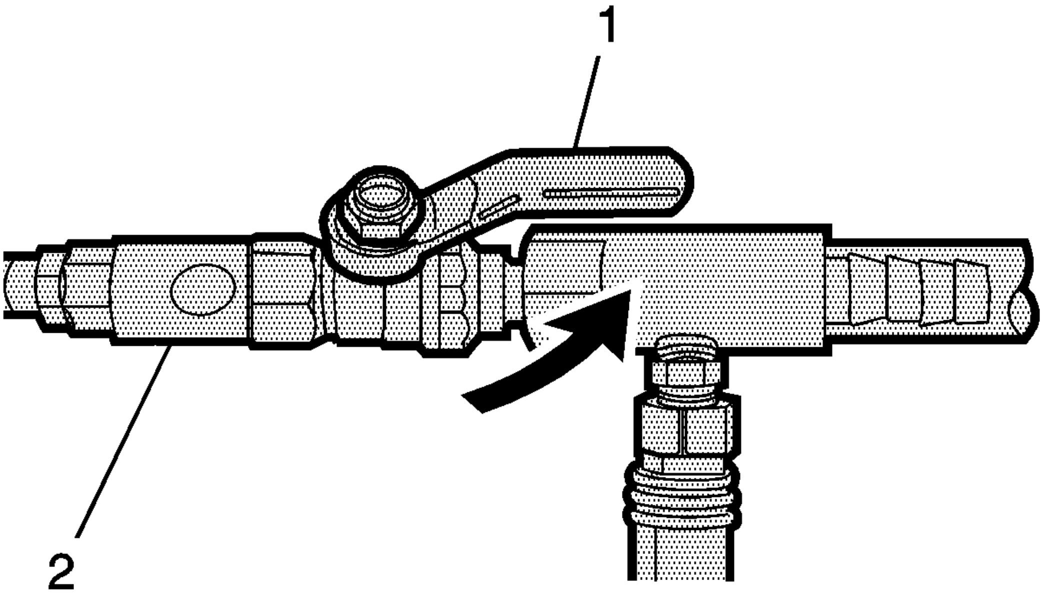


Fig. 47: Valve & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

16. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

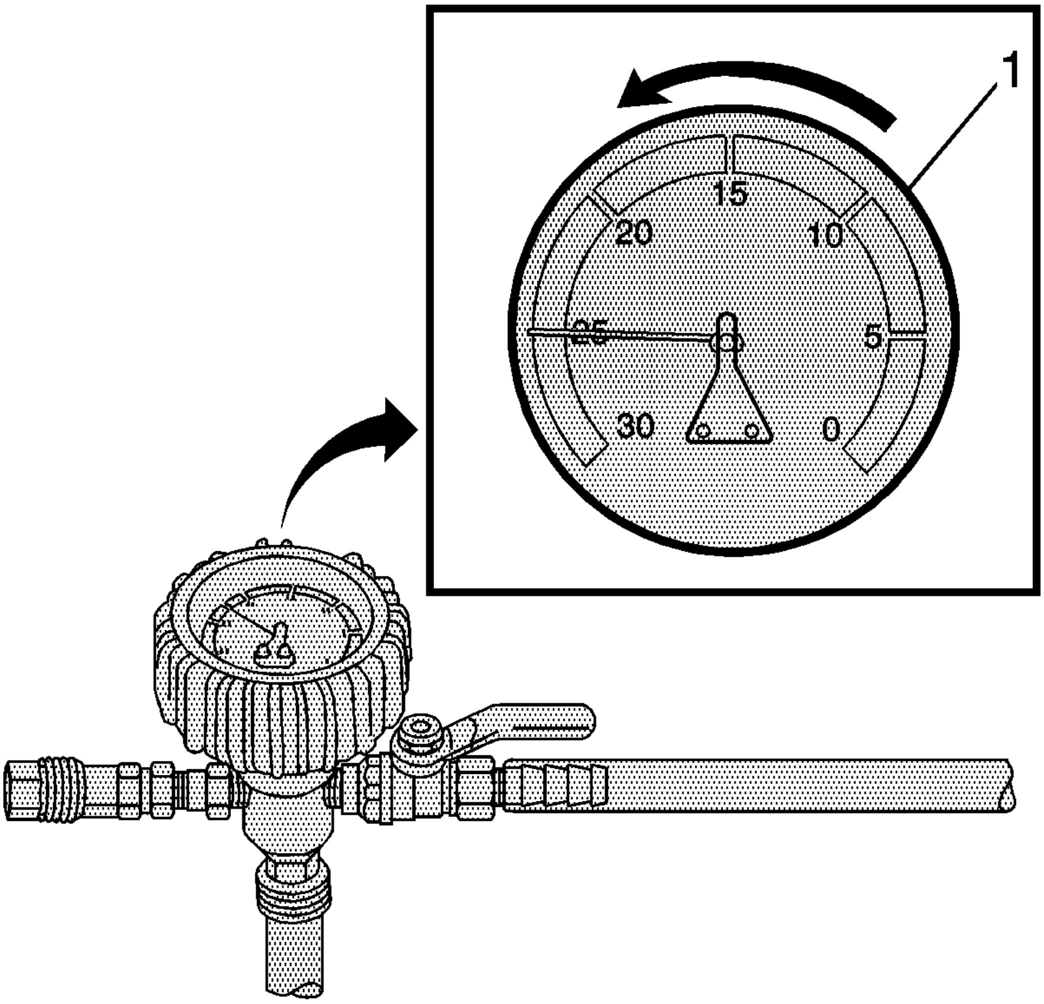


Fig. 48: Vacuum Gauge Needle
Courtesy of GENERAL MOTORS COMPANY

17. Continue to draw vacuum until the needle stops rising (1). This should be 610 - 660 mm Hg (24 - 26 in Hg).

    Cooling hoses may start to collapse. This is normal due to vacuum draw.

18. To aid in the fill process, position the graduated reservoir above the coolant fill port.

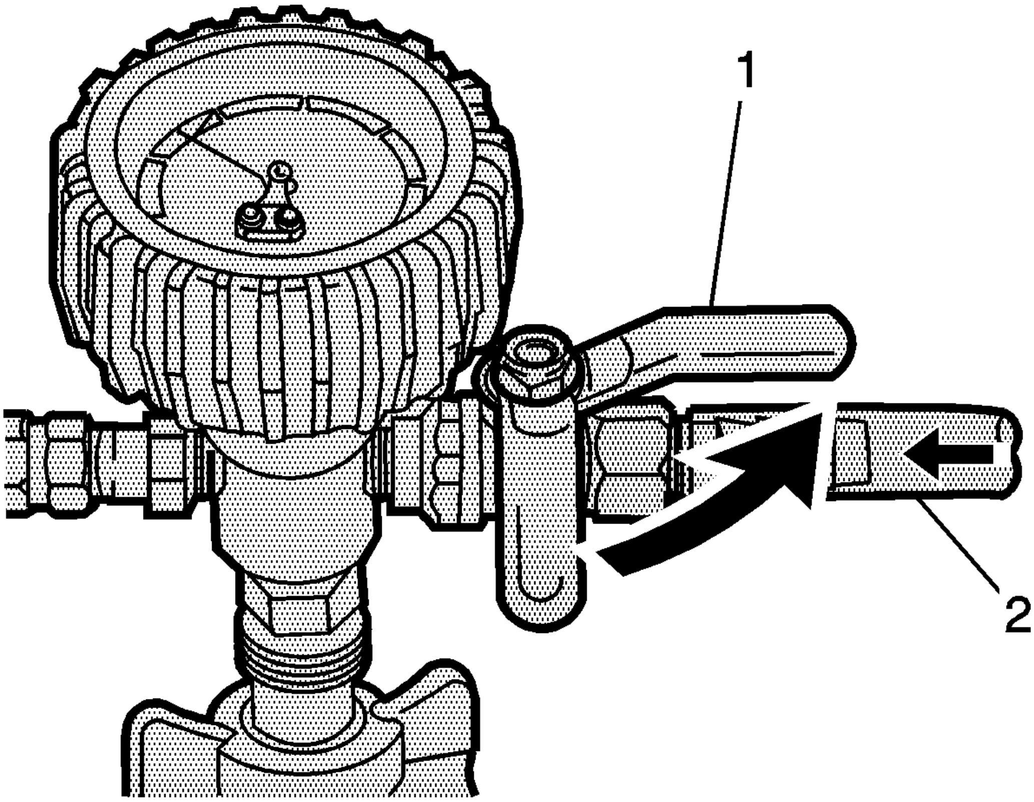


Fig. 49: Vacuum Gauge Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

19. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
20. Close the valve on the venturi assembly.
21. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

    If vacuum loss is observed, refer to **Hybrid Cooling System Loss of Coolant (Drive Motor Battery Cooling System)Hybrid Cooling System Loss of Coolant (Drive Motor Generator Power Inverter Module Cooling System)**.

22. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

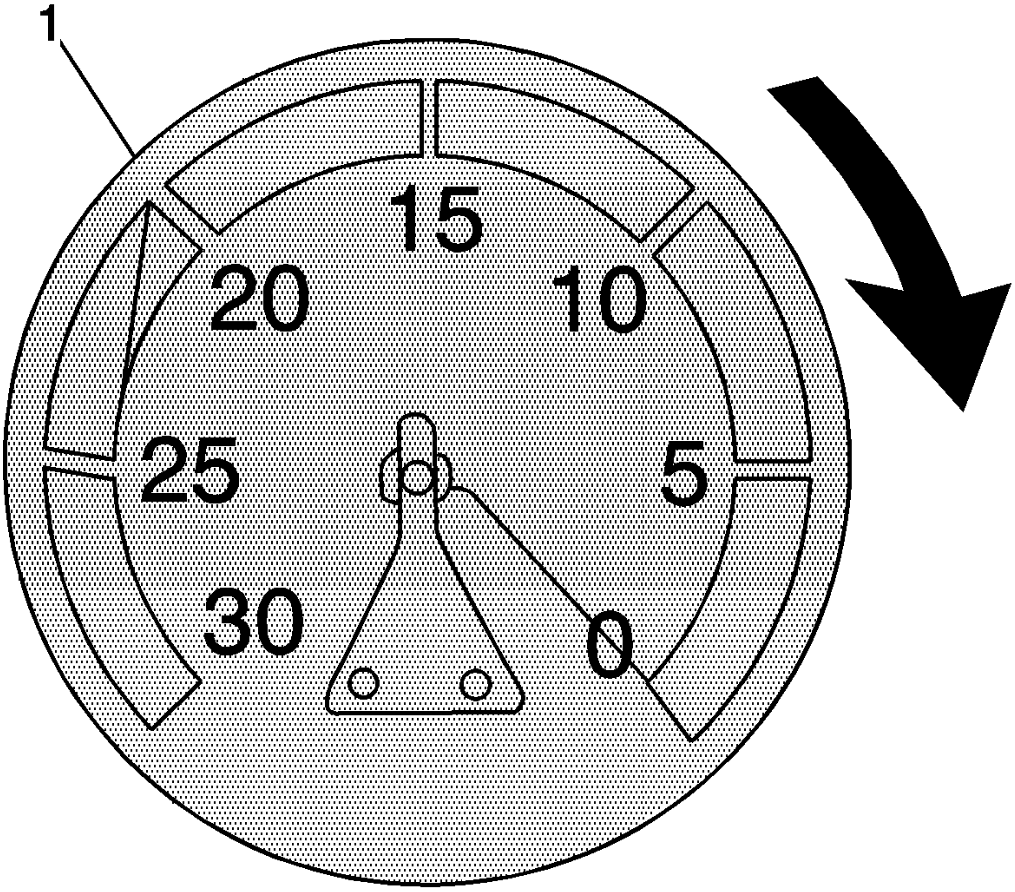


Fig. 50: Vacuum Gauge
Courtesy of GENERAL MOTORS COMPANY

23. Once the vacuum gauge (1) reaches zero, close the valve on the vacuum gauge assembly and repeat steps 15 - 21 one time.
24. Place vehicle in Service Mode. With the GDS scan tool, activate the drive motor generator control module coolant pump for 5 minutes while maintaining 381 mm (15 in Hg) vacuum throughout the process.
25. Detach the Vac-N-Fill cap from the **GE-46143-2** adapter.
26. Remove **GE-46143-2** adapter from the surge tank fill neck.

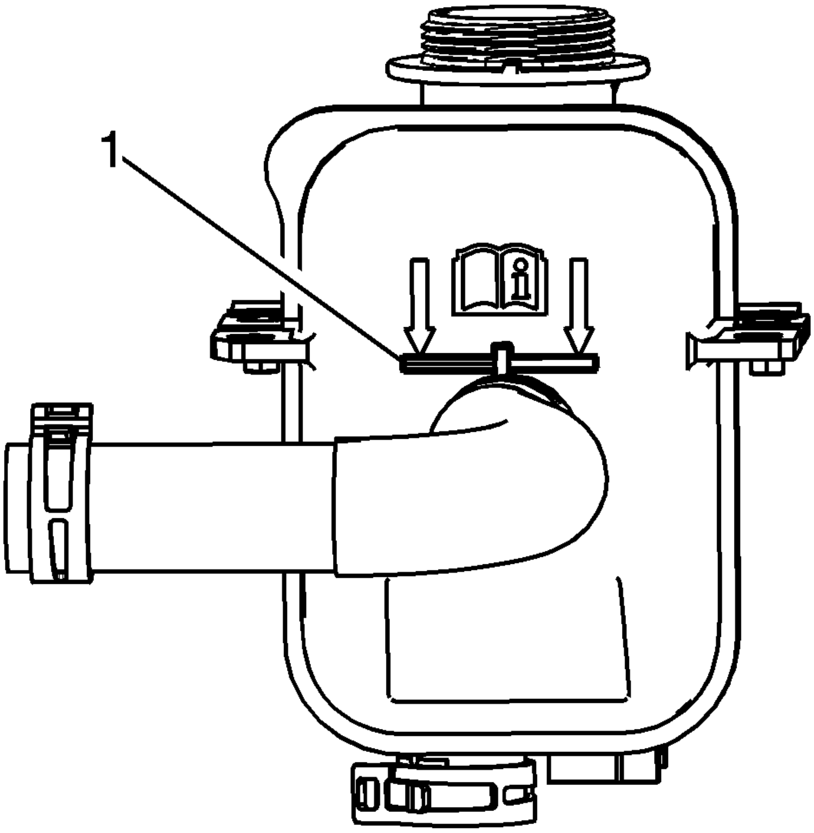


Fig. 51: Adjusting Surge Tank Coolant Level To Position Just Above Seam
Courtesy of GENERAL MOTORS COMPANY

27. Adjust the surge tank coolant level to a position just above the seam (1).
28. Inspect the concentration of the coolant mixture using **GE-26568** tester.

REMOVING EXCESS COOLANT FROM SYSTEM

NOTE: **After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.**

1. Detach the vacuum hose from the vacuum gauge assembly.

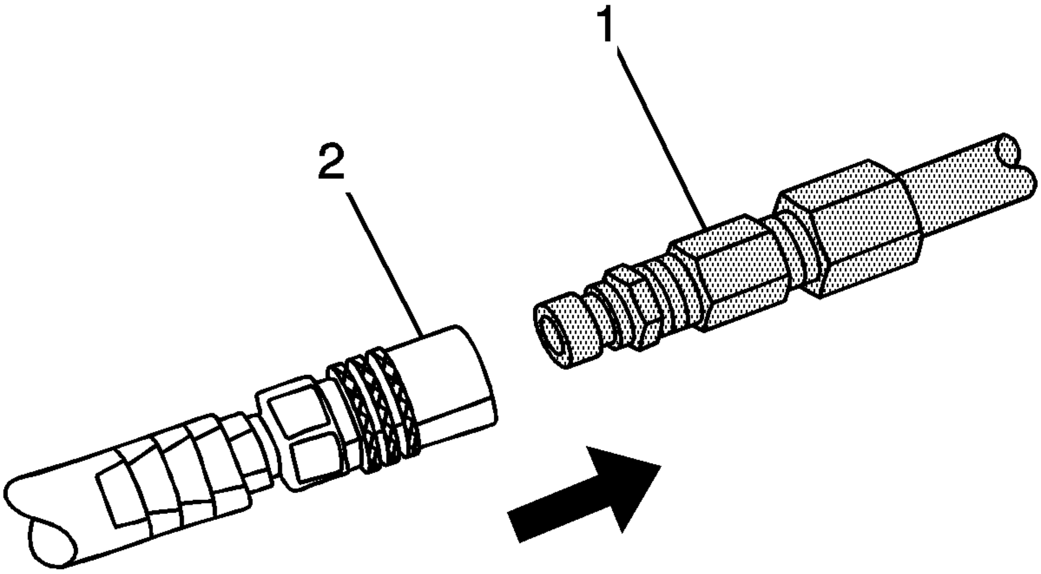


Fig. 52: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

2. Attach the extraction hose (1) to the vacuum hose (2).

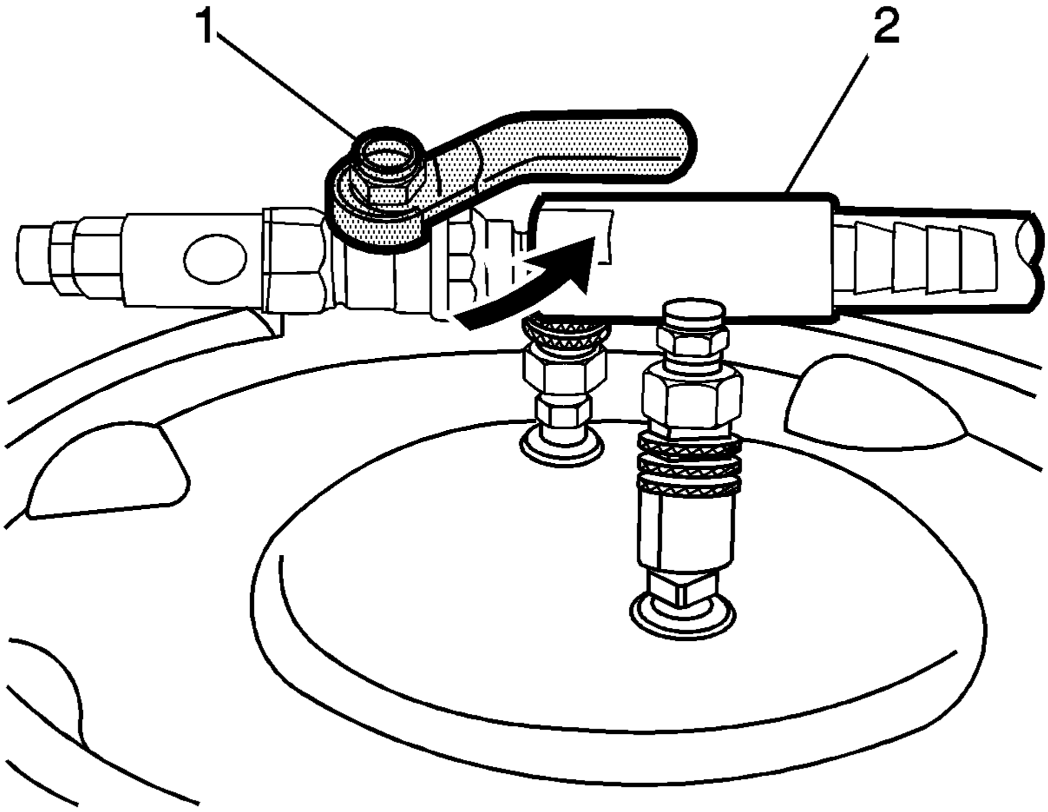


Fig. 53: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

3. Open the valve (1) on the venturi assembly (2) to start a vacuum draw.

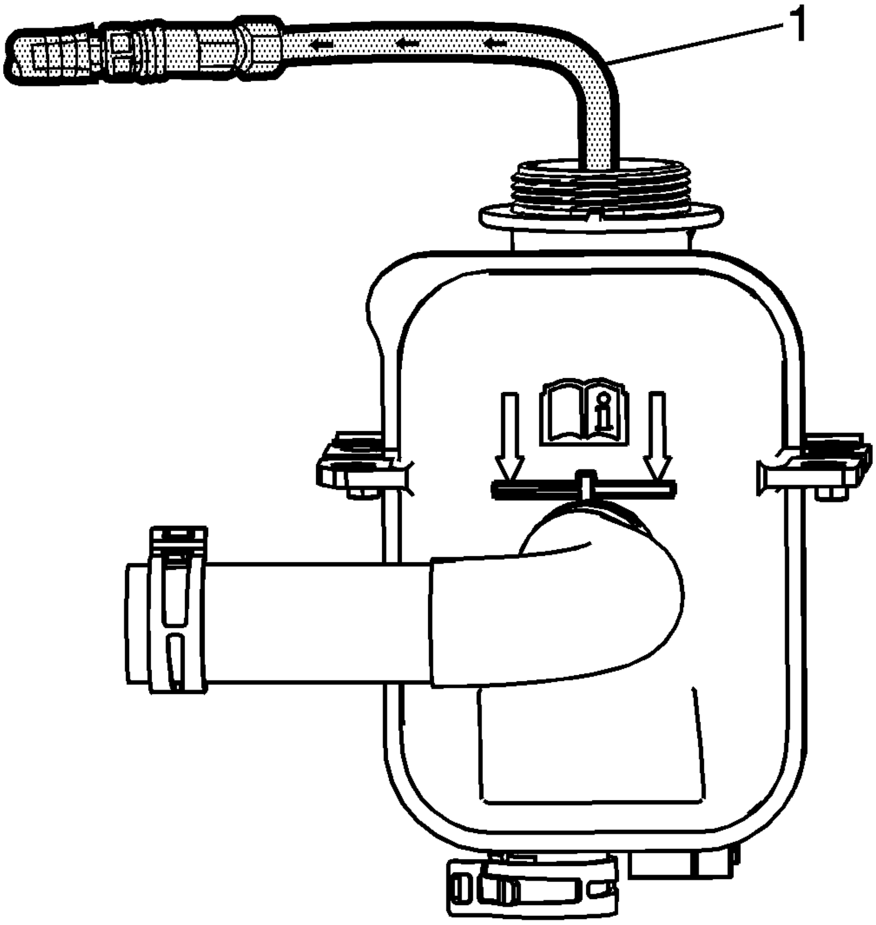


Fig. 54: Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

4. Assemble the extraction hose (1) and insert into the surge tank.

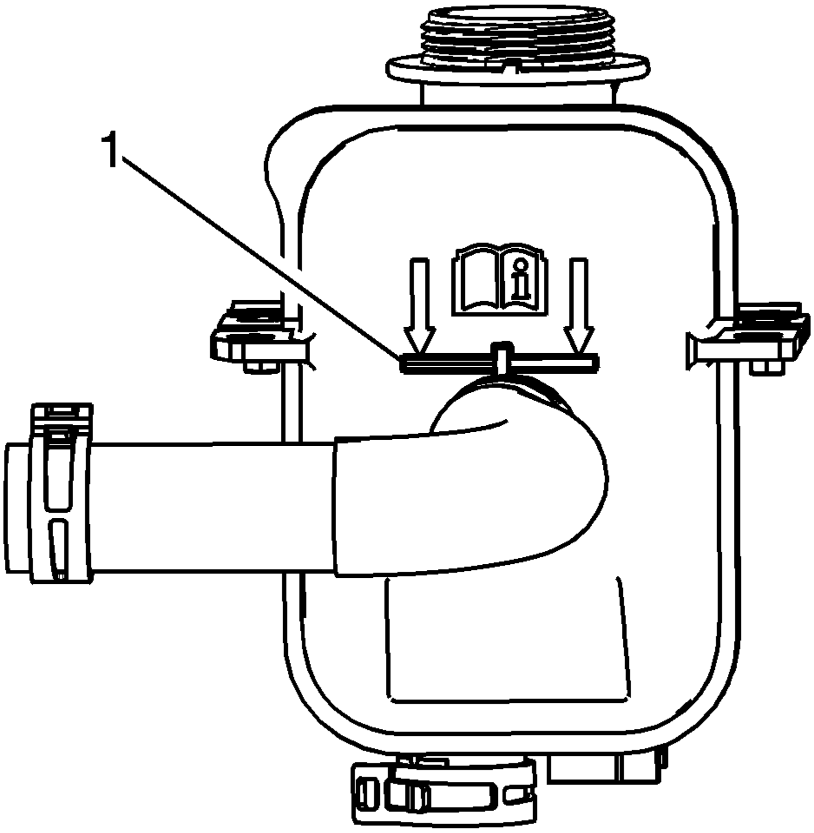


Fig. 55: Adjusting Surge Tank Coolant Level To Position Just Above Seam
Courtesy of GENERAL MOTORS COMPANY

5. Adjust the surge tank coolant level to a position just above the seam (1).
6. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

ELECTRIC DIFFERENTIAL DRIVE MOTOR POWER INVERTER MODULE COOLING HOSE REPLACEMENT (APM TO OBCM)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

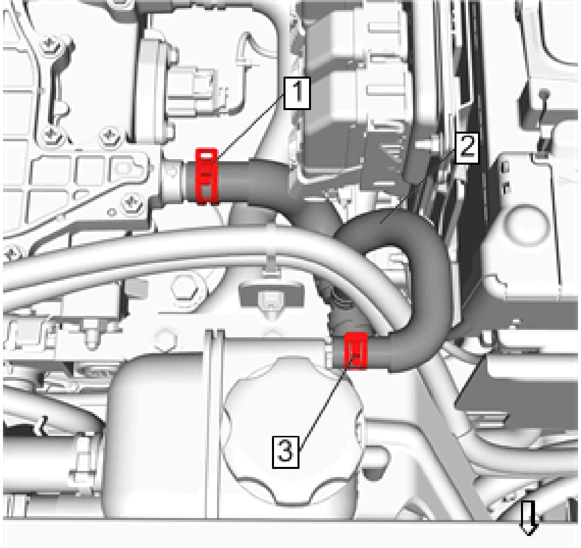


Fig. 56: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

3. Disengage Clamps (1, 3) (Qty: 2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
4. Remove the electric differential drive motor power inverter module cooling hose (2).

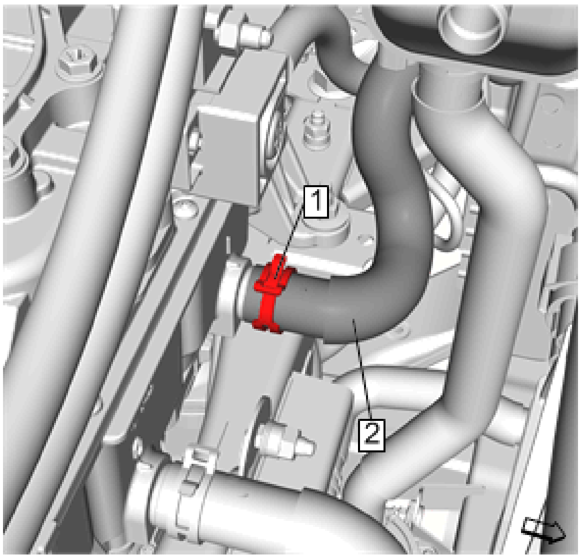


Fig. 57: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
6. Remove the electric differential drive motor power inverter module cooling hose (2).

Installation Procedure

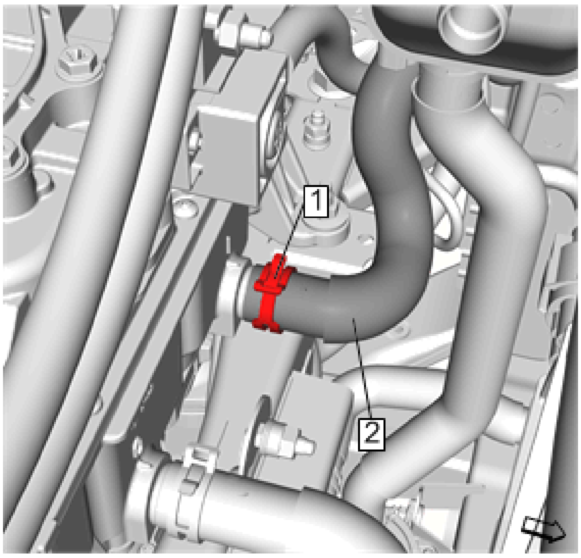


Fig. 58: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install the electric differential drive motor power inverter module cooling hose (2).
2. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

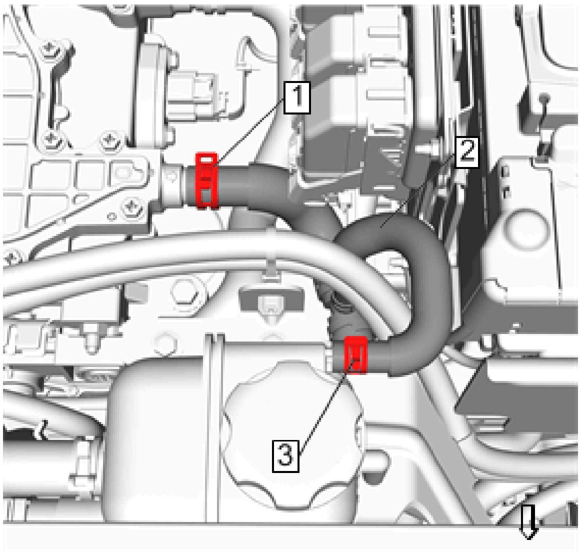


Fig. 59: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

3. Install the electric differential drive motor power inverter module cooling hose (2).
4. Engage Clamps (1, 3) (Qty: 2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
5. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
6. Check the cooling system for leaks.

DRIVE MOTOR BATTERY COOLANT LEVEL SENSOR REPLACEMENT

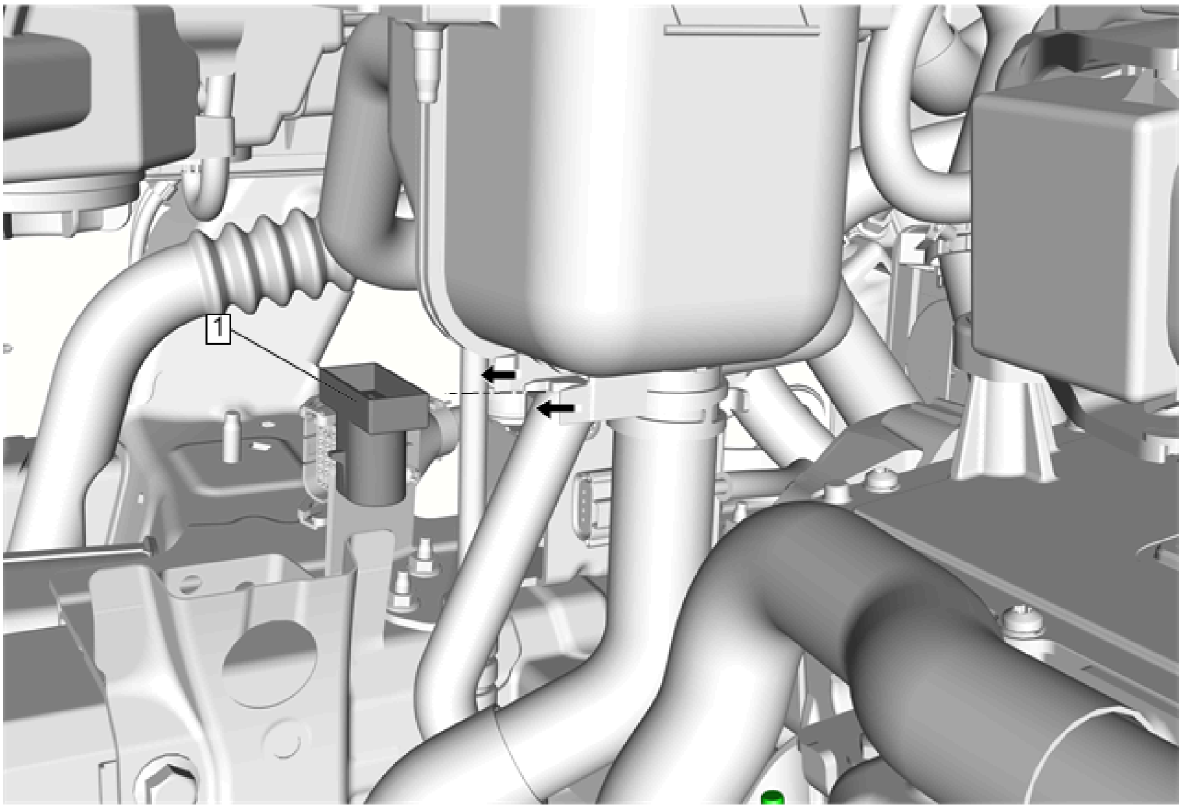


Fig. 60: Drive Motor Battery Coolant Level Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures Disconnect the electrical connector from the coolant level sensor.	
1	Drive Motor Battery Coolant Level Sensor

RADIATOR REPLACEMENT

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**
3. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**.
4. Recover the refrigerant. Refer to **Refrigerant Recovery and Recharging**

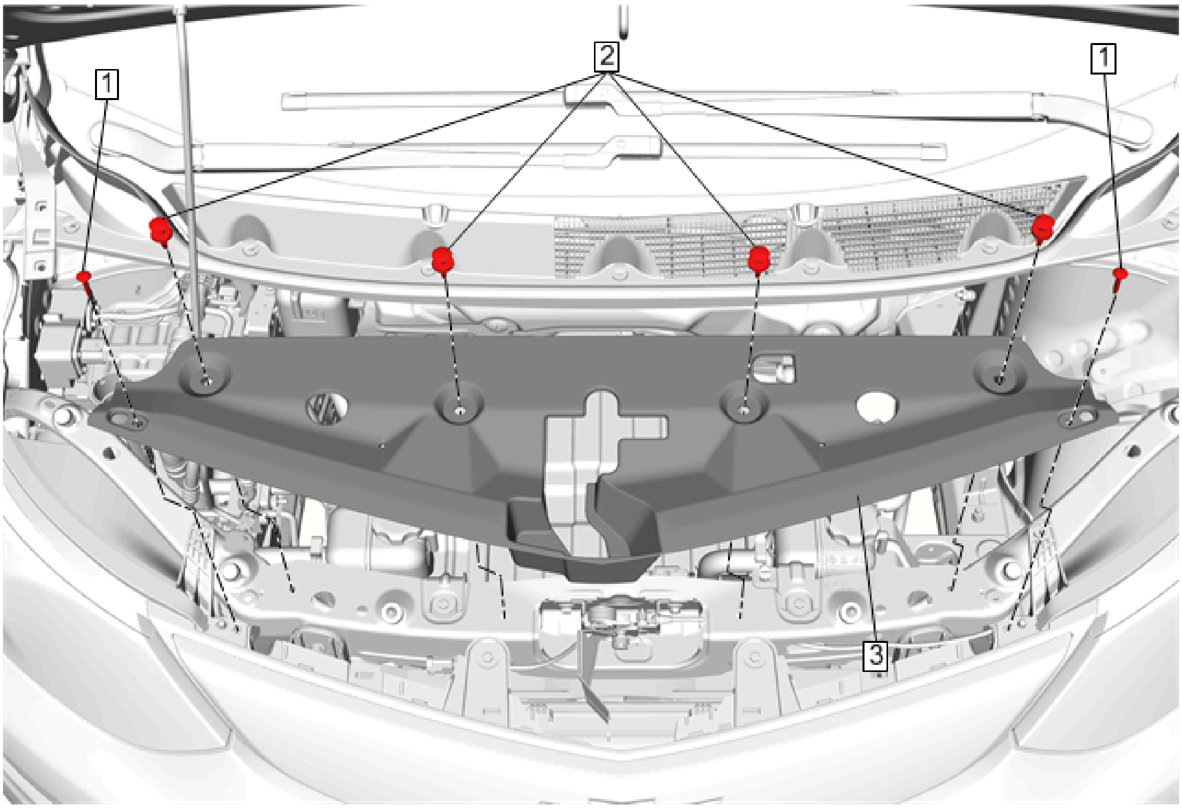


Fig. 61: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

5. Remove Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**

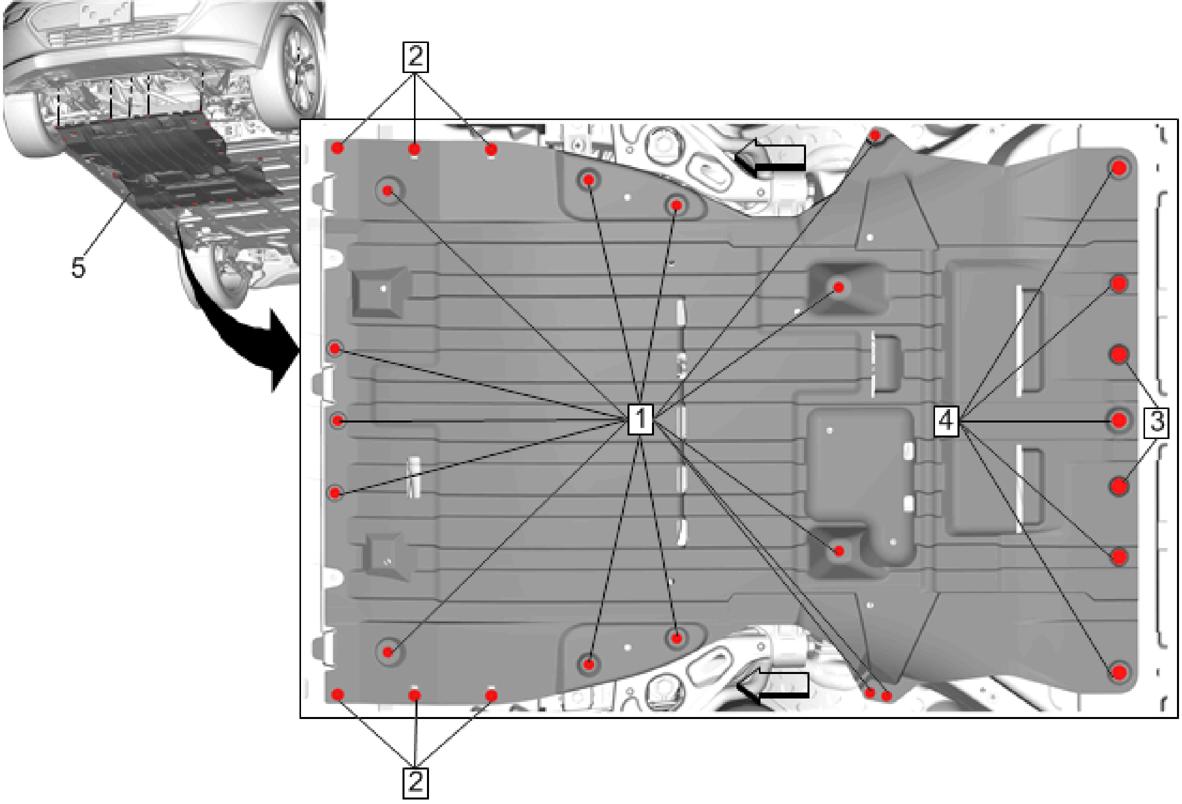


Fig. 62: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**

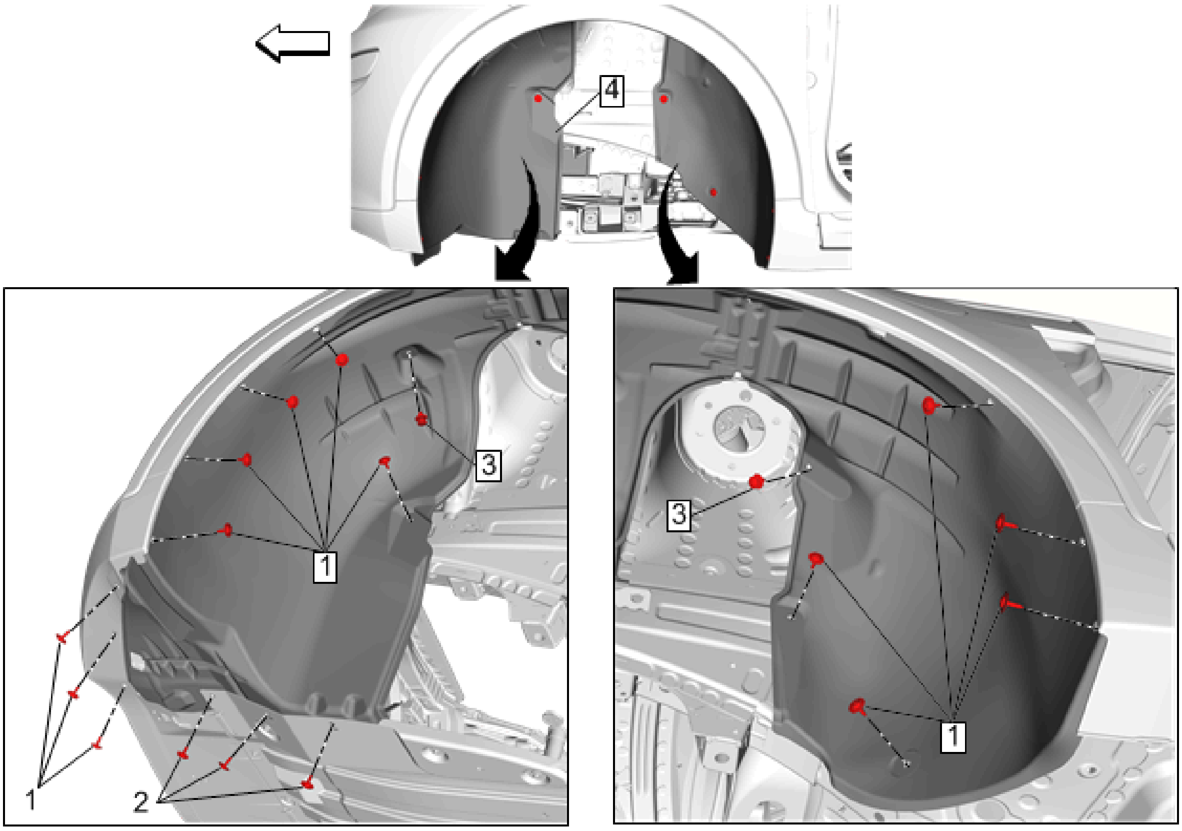


Fig. 63: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

7. Remove Front Wheelhouse Liner (4) (Qty: 2). Refer to **Front Wheelhouse Liner Replacement**
8. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**

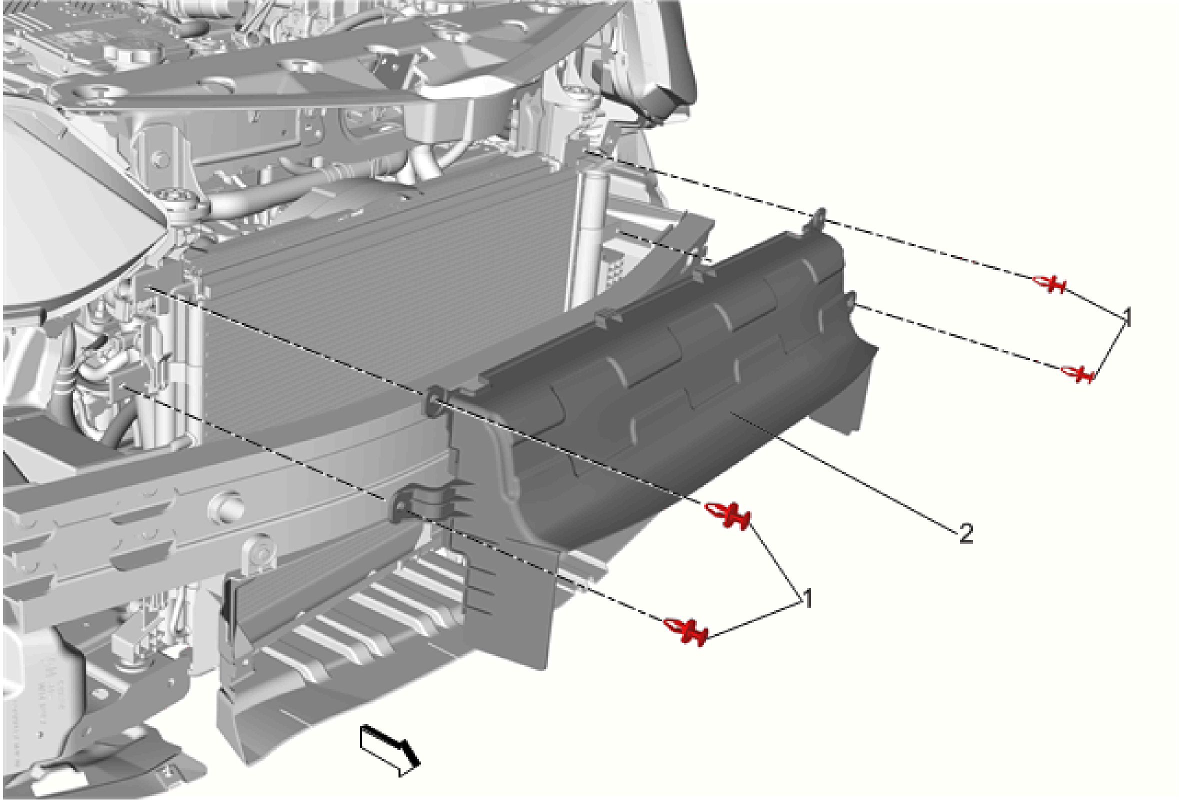


Fig. 64: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

9. Remove Radiator Air Upper Baffle and Deflector (2). Refer to **Radiator Air Upper Baffle and Deflector Replacement**

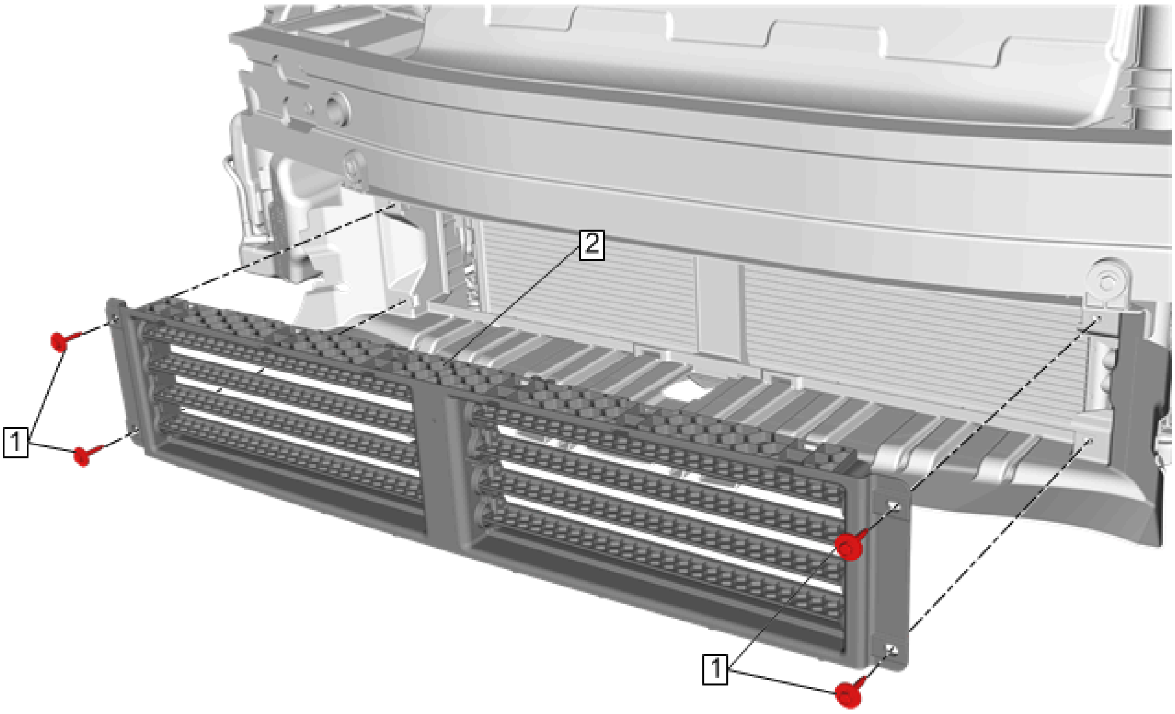


Fig. 65: Front Bumper Shutter
Courtesy of GENERAL MOTORS COMPANY

10. Remove Front Bumper Shutter (2). Refer to **Front Bumper Shutter Replacement**

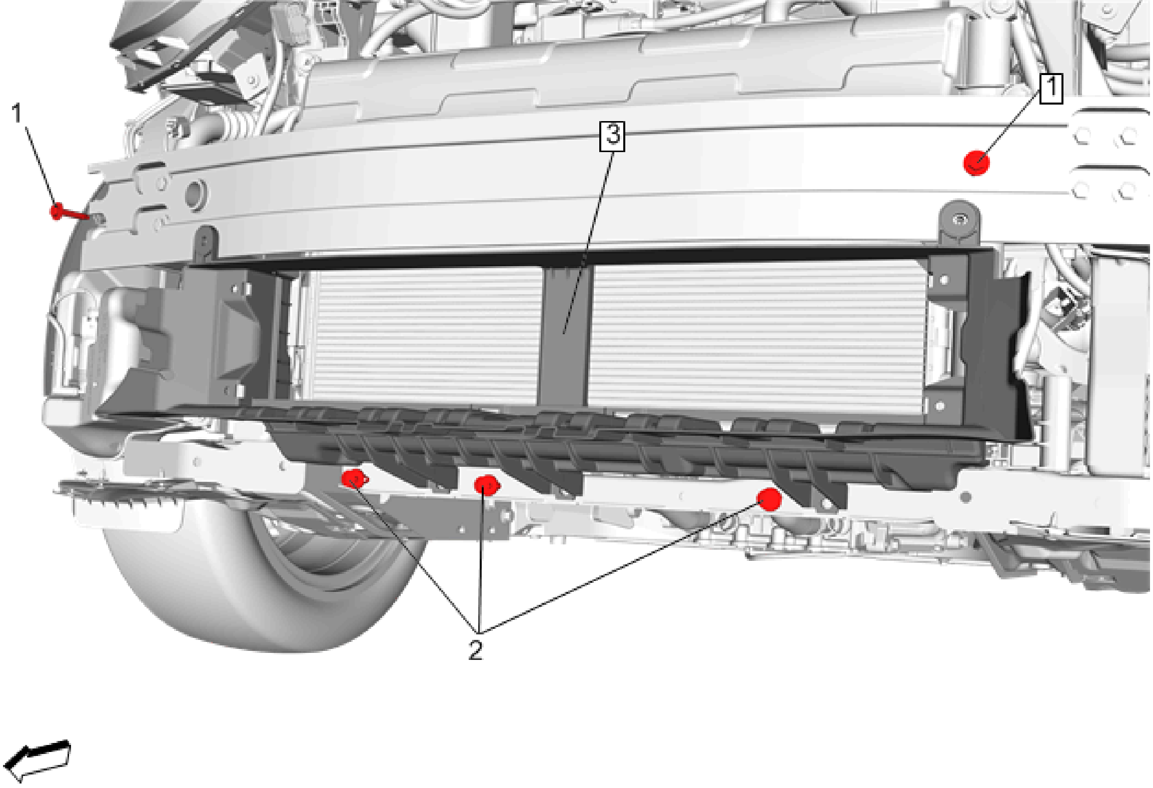


Fig. 66: Radiator Air Lower Baffle and Deflector Assembly
Courtesy of GENERAL MOTORS COMPANY

11. Remove Radiator Air Lower Baffle and Deflector Assembly (3). Refer to **Radiator Air Lower Baffle and Deflector Replacement**

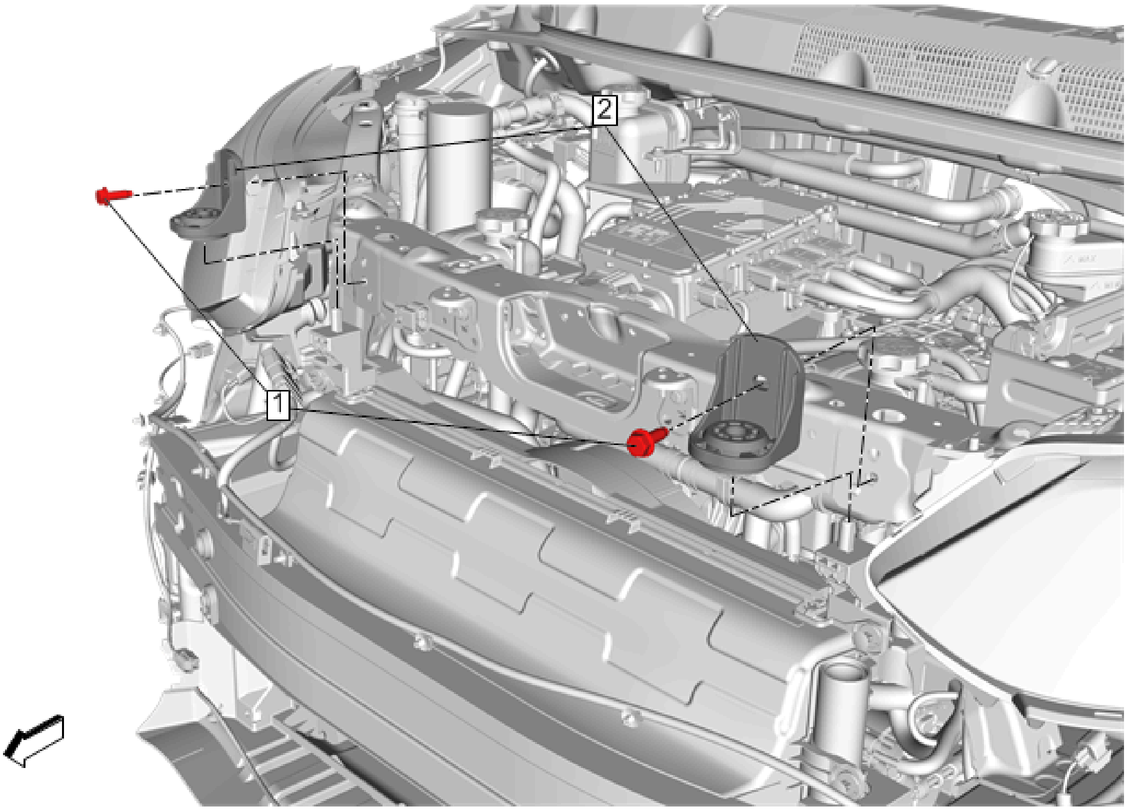


Fig. 67: Radiator Upper Brackets
Courtesy of GENERAL MOTORS COMPANY

12. Remove Radiator Upper Brackets (2) (Qty: 3). Refer to **Radiator Upper Bracket Replacement**

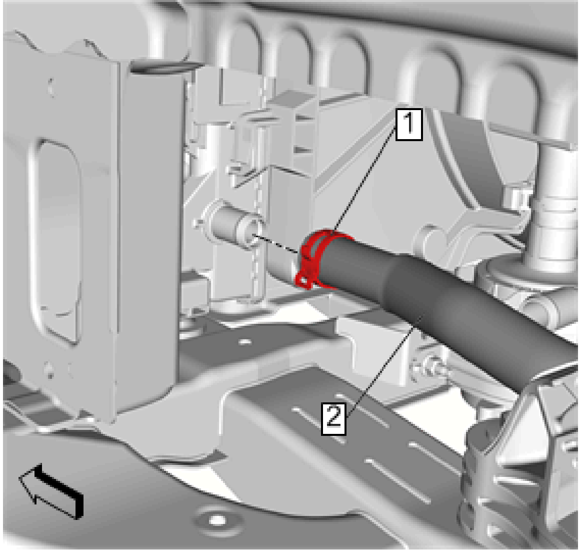


Fig. 68: Drive Motor Generator Control Module Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

13. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
14. Remove Drive Motor Generator Control Module Radiator Inlet Hose (2)

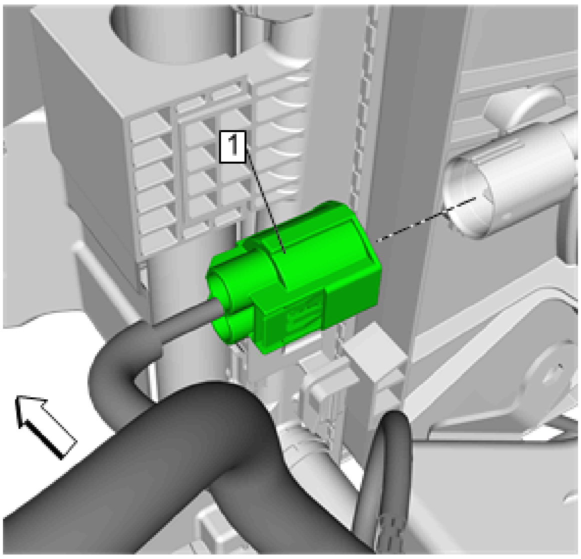


Fig. 69: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect Electrical Connector (1)

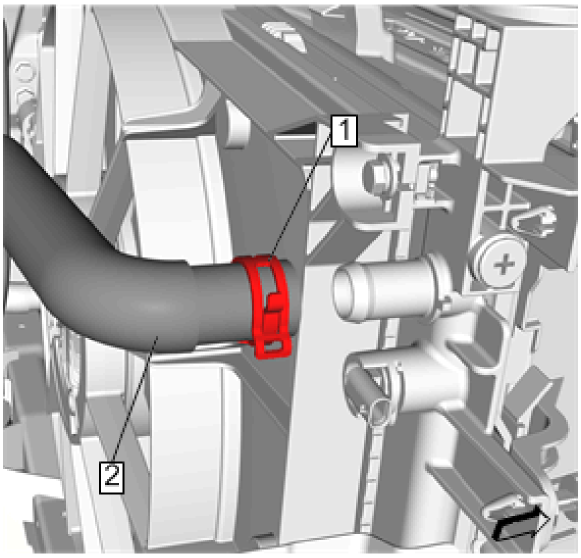


Fig. 70: Drive Motor Generator Control Module Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

16. Disengage Clamp (1). Refer to Hose Clamp Replacement Guidelines - Spring Type
17. Remove Drive Motor Generator Control Module Radiator Outlet Hose (2)

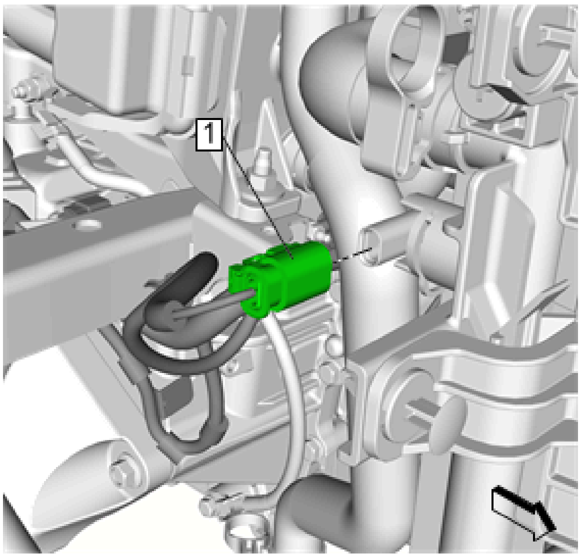


Fig. 71: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

18. Disconnect Electrical Connector (1)

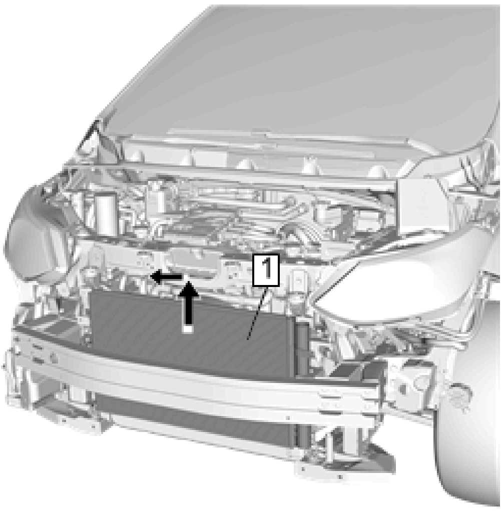


Fig. 72: Air Conditioning Condenser
Courtesy of GENERAL MOTORS COMPANY

19. Remove Air Conditioning Condenser (1). Refer to Air Conditioning Condenser Replacement

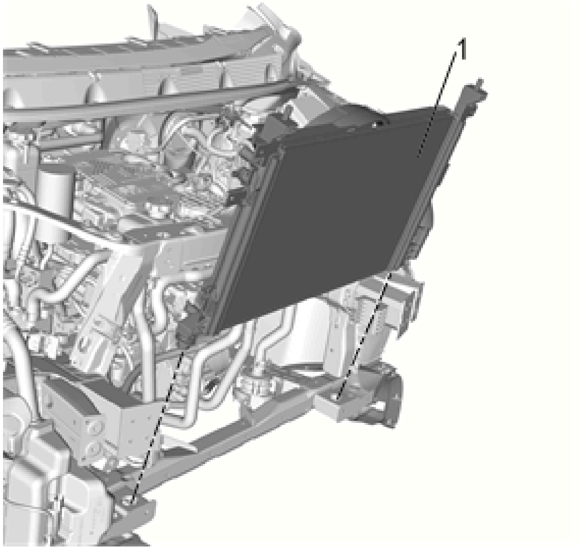


Fig. 73: Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

20. Remove Radiator Assembly (1)

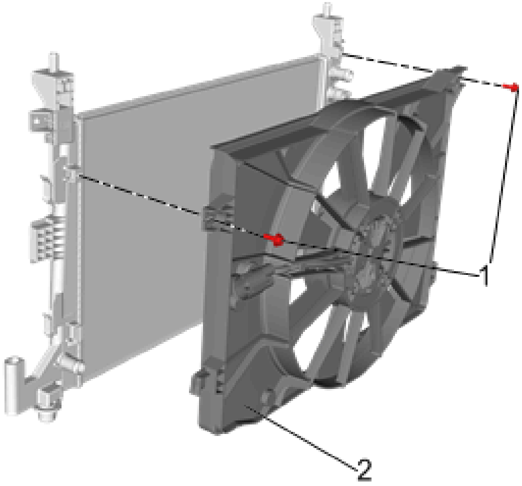


Fig. 74: Cooling Fan And Bolts
Courtesy of GENERAL MOTORS COMPANY

21. Remove the 2 cooling fan bolts (1).
22. Remove Cooling Fan (2)
23. Transfer components as necessary including rubber mounts.

Installation Procedure

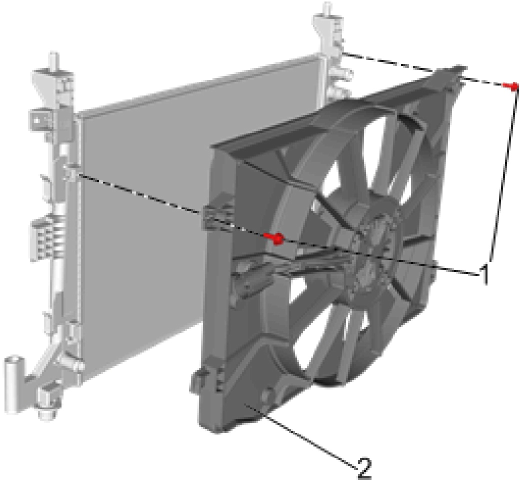


Fig. 75: Cooling Fan And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Cooling Fan (2)

CAUTION: **Refer to Fastener Caution .**

2. Install the 2 cooling fan bolts (1) and tighten to 5 N.m (44 lb in)

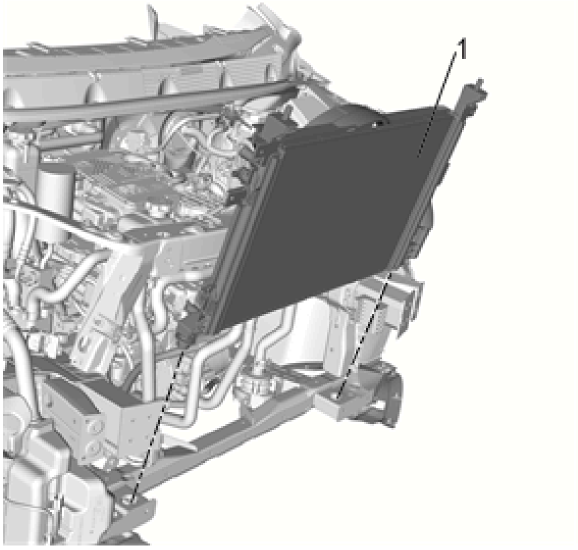


Fig. 76: Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install Radiator Assembly (1)

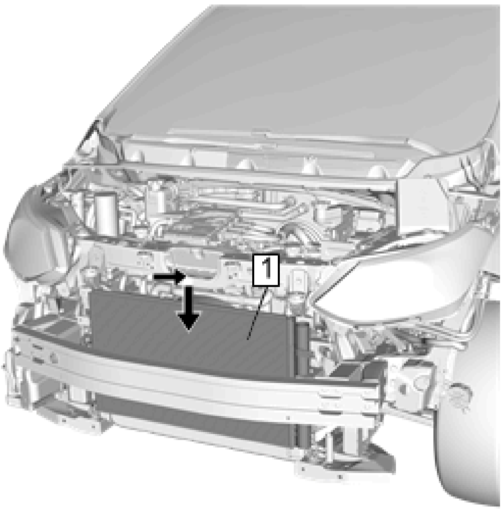


Fig. 77: Air Conditioning Condenser
Courtesy of GENERAL MOTORS COMPANY

4. Install Air Conditioning Condenser (1). Refer to **Air Conditioning Condenser Replacement**

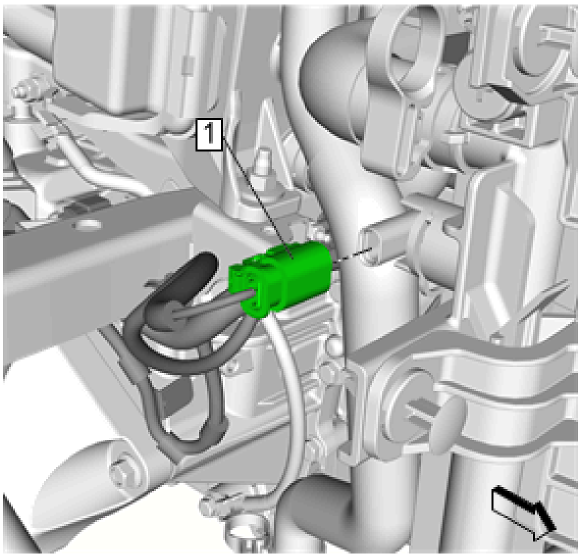


Fig. 78: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Connect Electrical Connector (1)

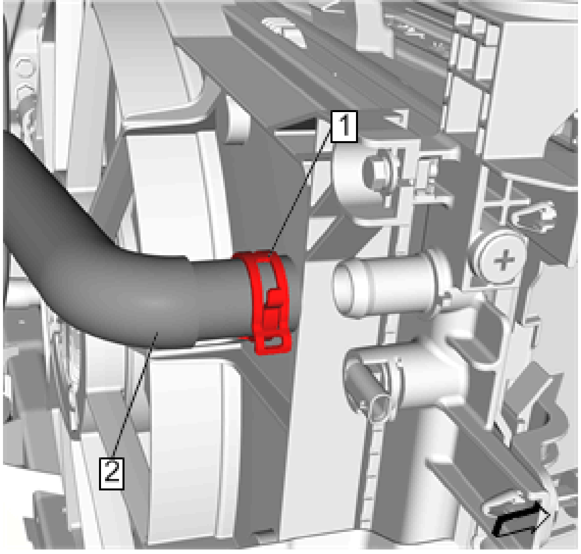


Fig. 79: Drive Motor Generator Control Module Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Install Drive Motor Generator Control Module Radiator Outlet Hose (2)
7. Engage Clamp (1). Refer to Hose Clamp Replacement Guidelines - Spring Type

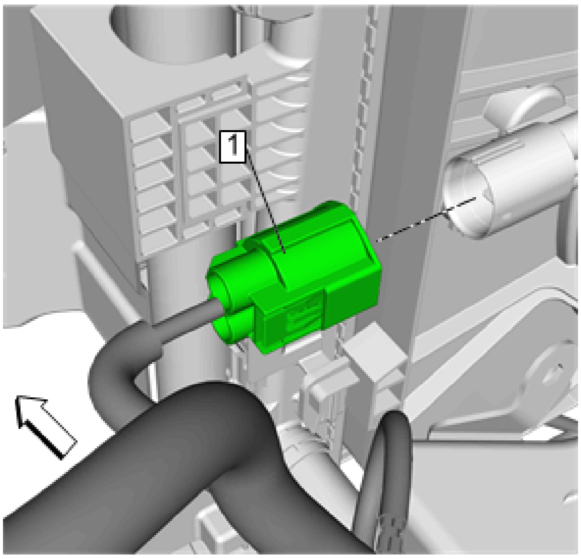


Fig. 80: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Connect Electrical Connector (1)

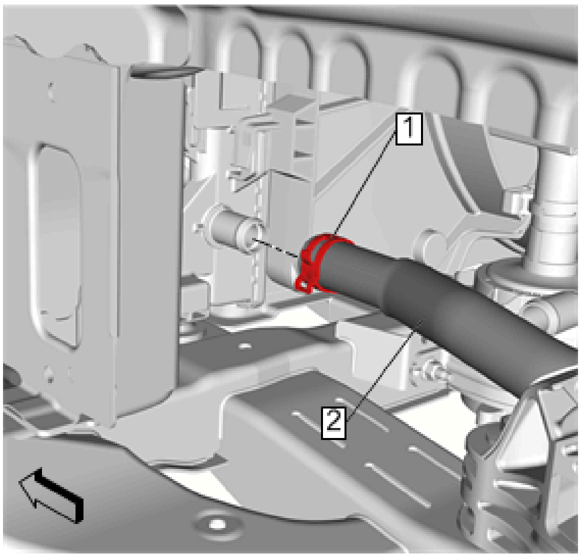


Fig. 81: Drive Motor Generator Control Module Radiator Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

9. Install Remove Drive Motor Generator Control Module Radiator Inlet Hose (2)
10. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

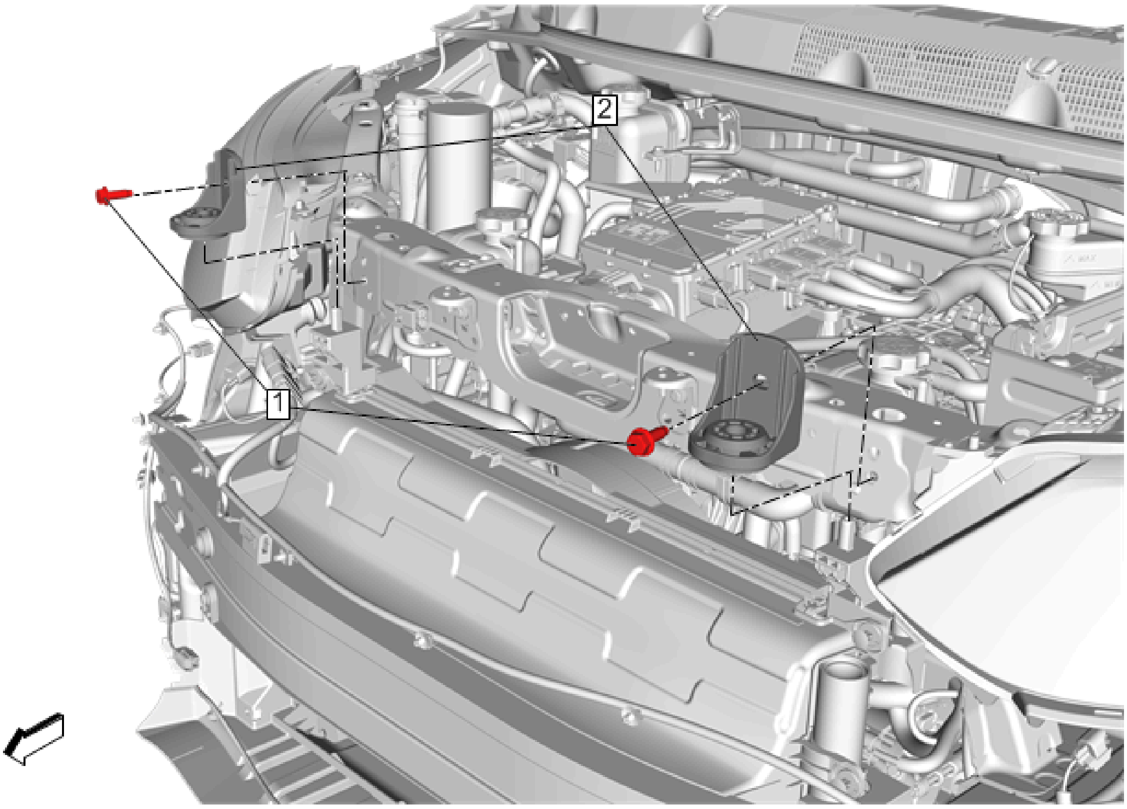


Fig. 82: Radiator Upper Brackets
Courtesy of GENERAL MOTORS COMPANY

11. Install Radiator Upper Brackets (2) (Qty: 3). Refer to **Radiator Upper Bracket Replacement**

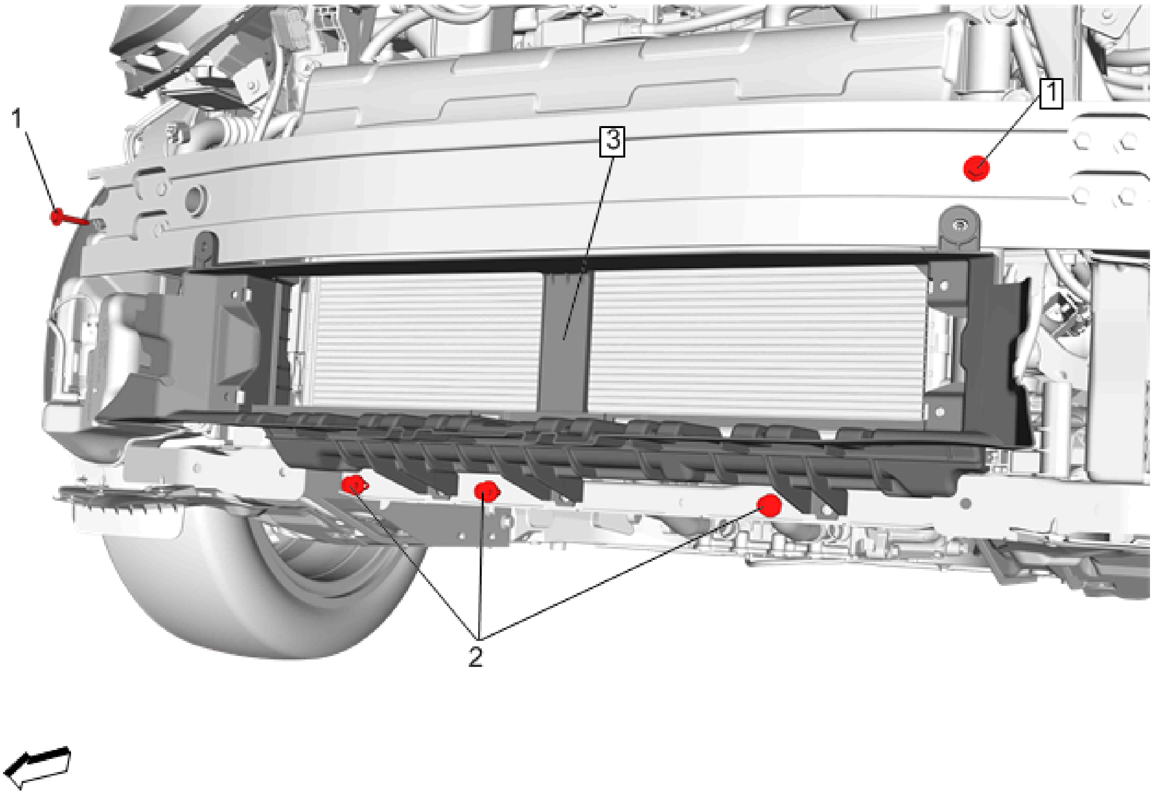
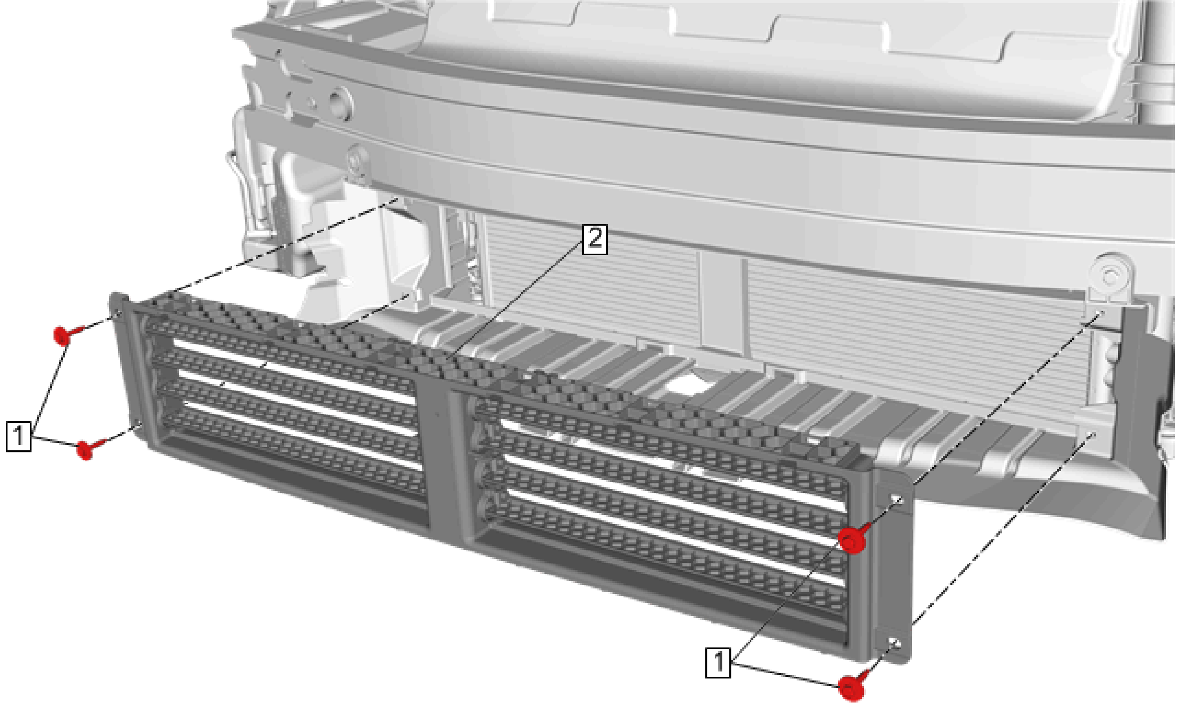


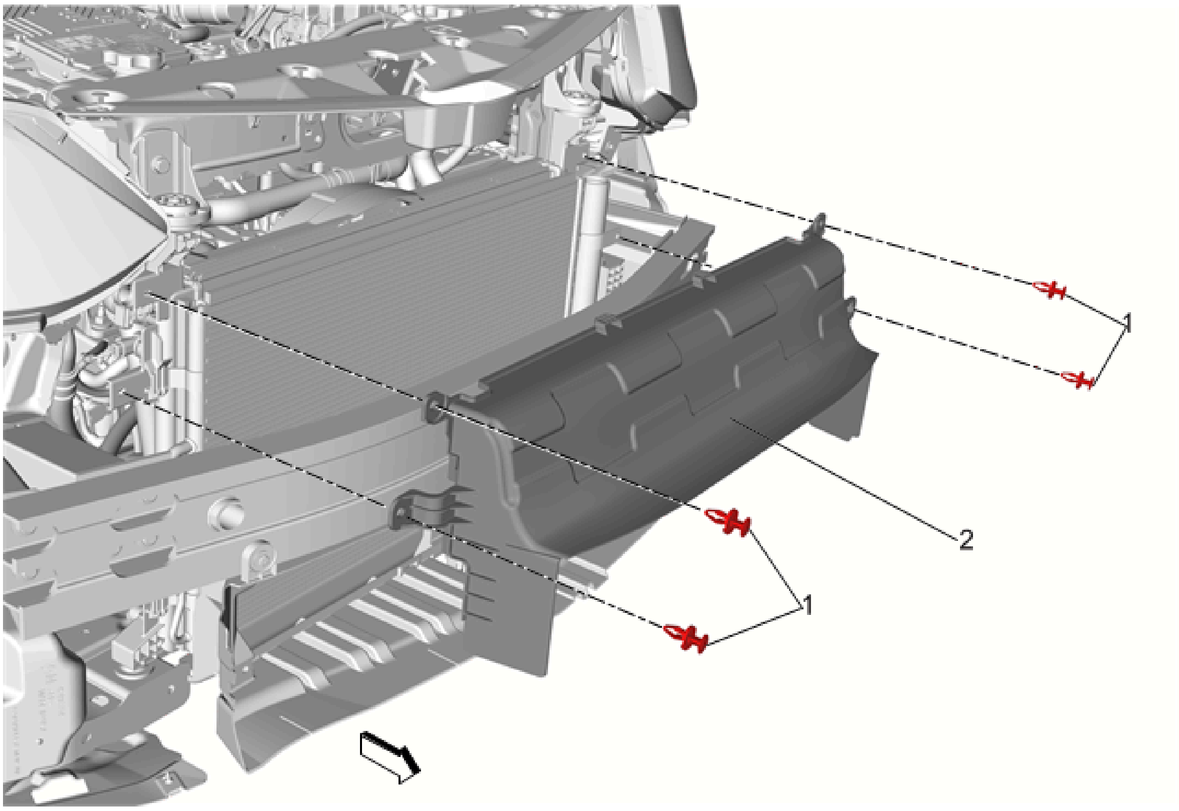
Fig. 83: Radiator Air Lower Baffle and Deflector Assembly
Courtesy of GENERAL MOTORS COMPANY

12. Install Radiator Air Lower Baffle and Deflector Assembly (3). Refer to **Radiator Air Lower Baffle and Deflector Replacement**



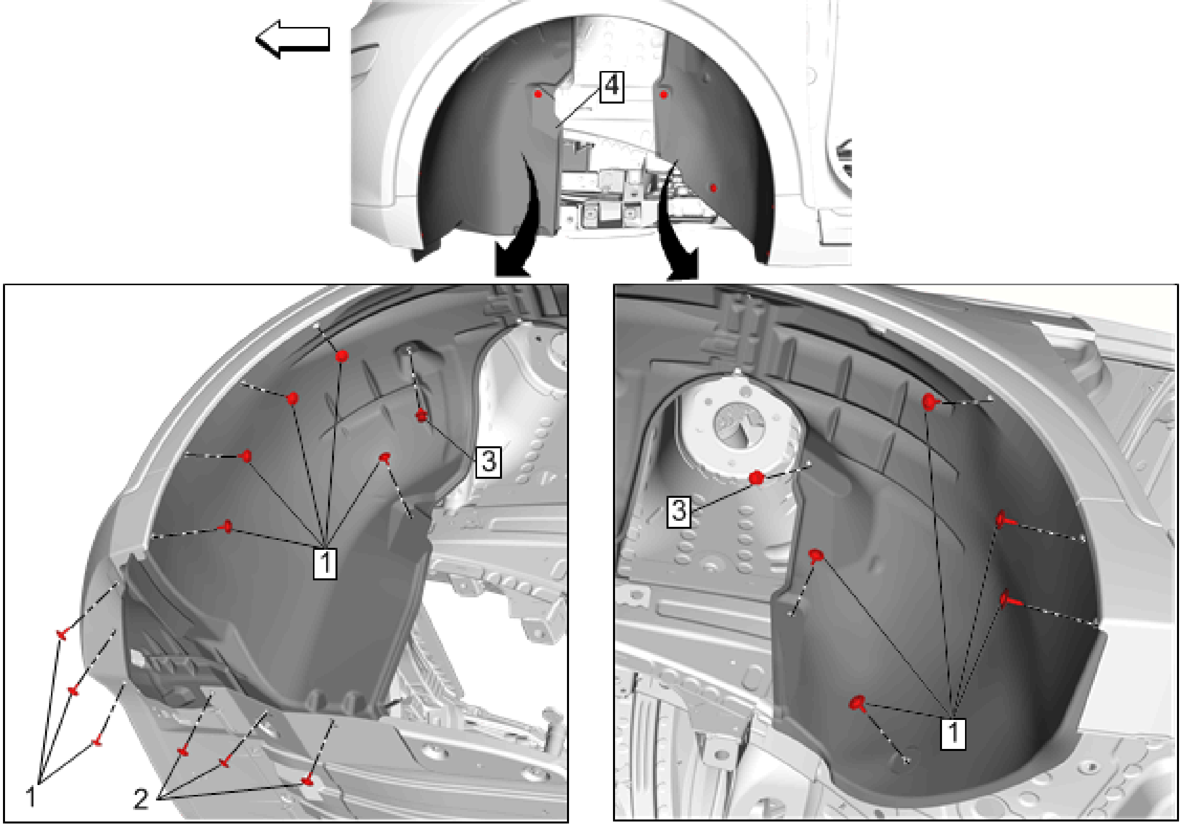
[Fig. 84: Front Bumper Shutter](#)
Courtesy of GENERAL MOTORS COMPANY

13. Install Front Bumper Shutter (2). Refer to **Front Bumper Shutter Replacement**



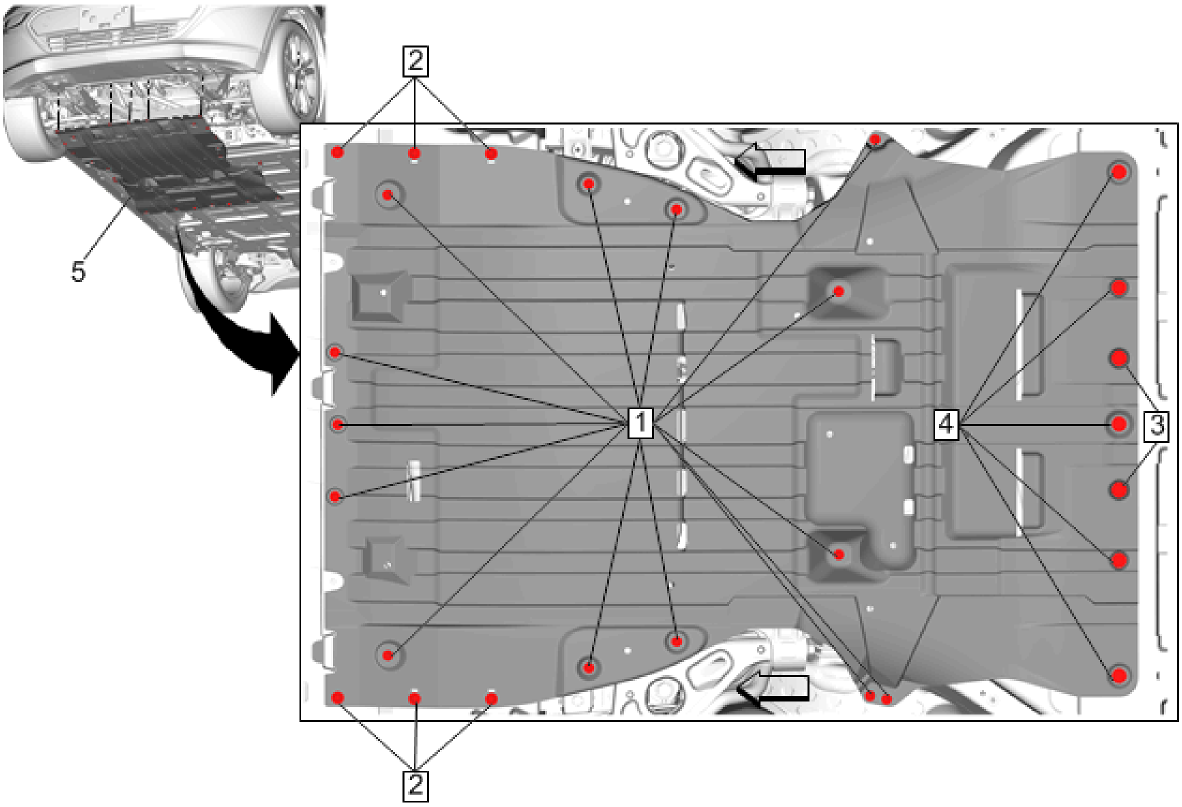
[Fig. 85: Radiator Air Upper Baffle And Deflector](#)
Courtesy of GENERAL MOTORS COMPANY

14. Install Radiator Air Upper Baffle and Deflector (2). Refer to **Radiator Air Upper Baffle and Deflector Replacement**
15. Install the front bumper fascia. Refer to **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**



[Fig. 86: Front Wheelhouse Liner](#)
Courtesy of GENERAL MOTORS COMPANY

16. Install Front Wheelhouse Liner (4) (Qty: 2). Refer to **Front Wheelhouse Liner Replacement**



[Fig. 87: Front Compartment Air Deflector And Fasteners](#)
Courtesy of GENERAL MOTORS COMPANY

17. Install Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**

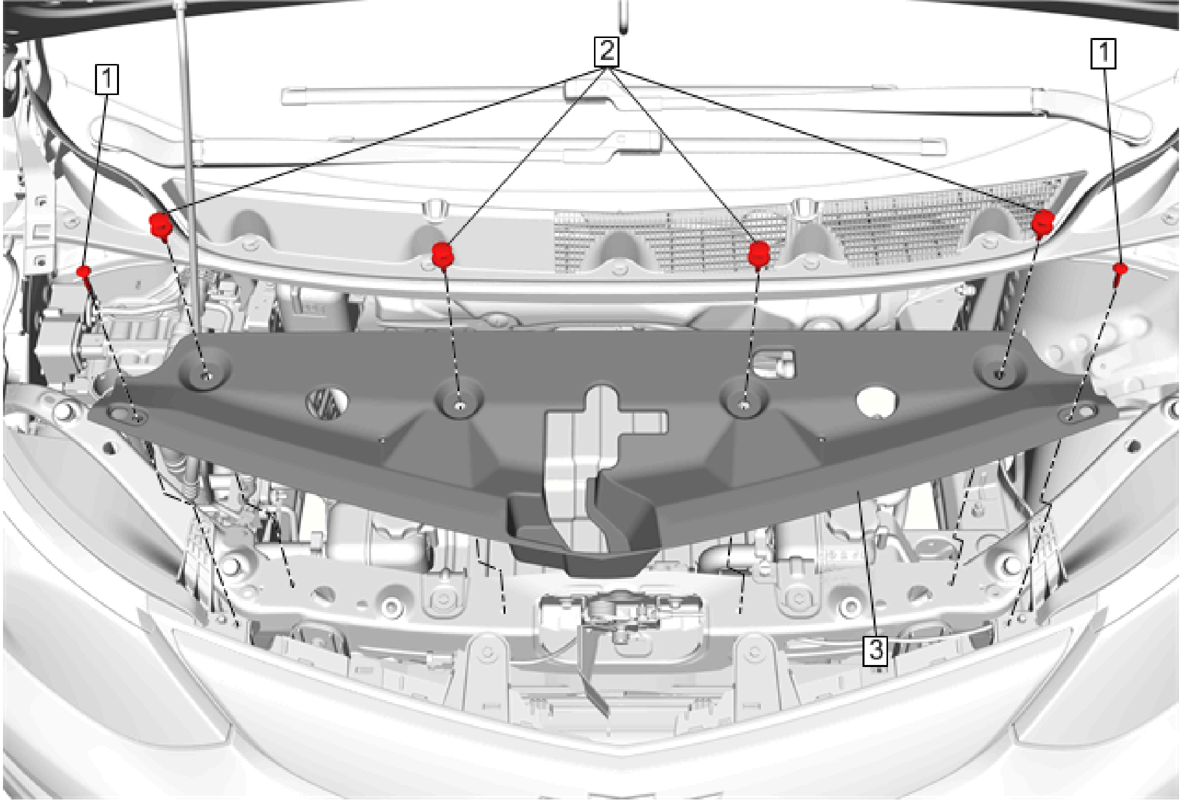


Fig. 88: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

18. Install Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**
19. Recharge the refrigerant. Refer to **Refrigerant Recovery and Recharging**
20. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**.
21. Check the cooling system for leaks.
22. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**

GENERATOR CONTROL MODULE COOLANT TANK HOSE REPLACEMENT (DU TO SURGE TANK)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

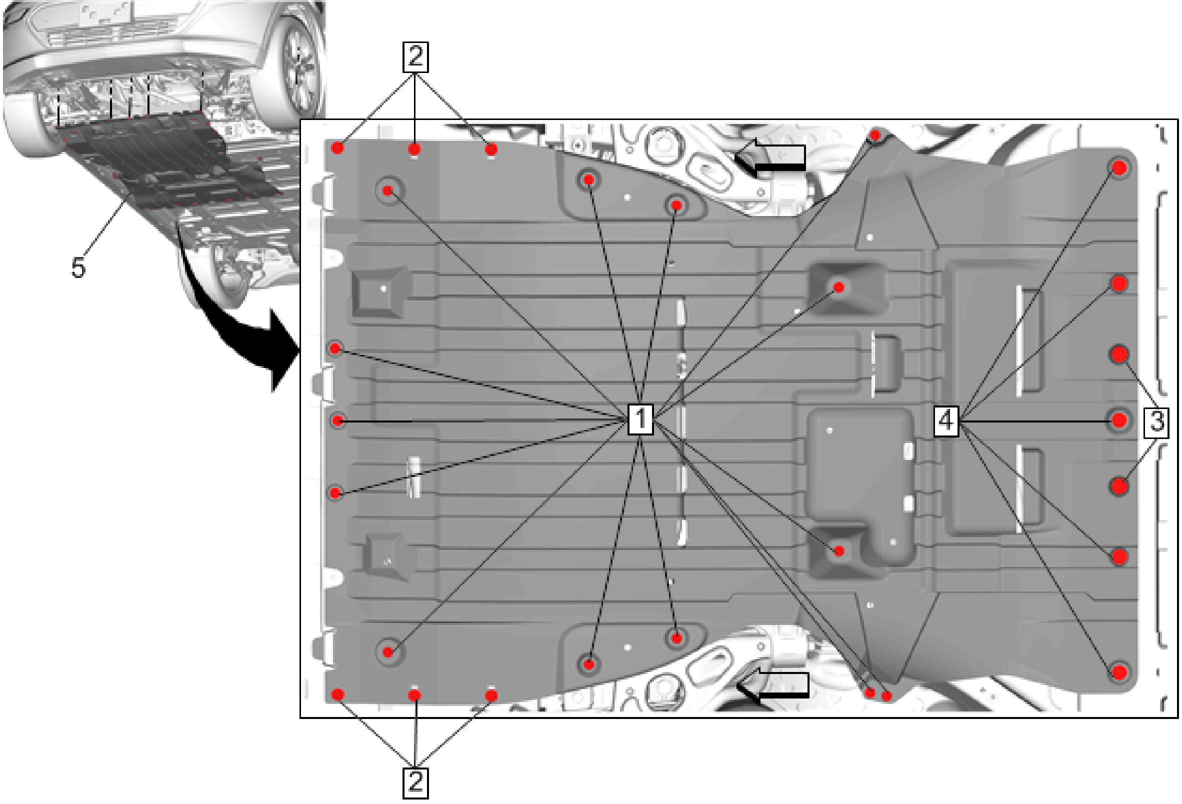


Fig. 89: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
3. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

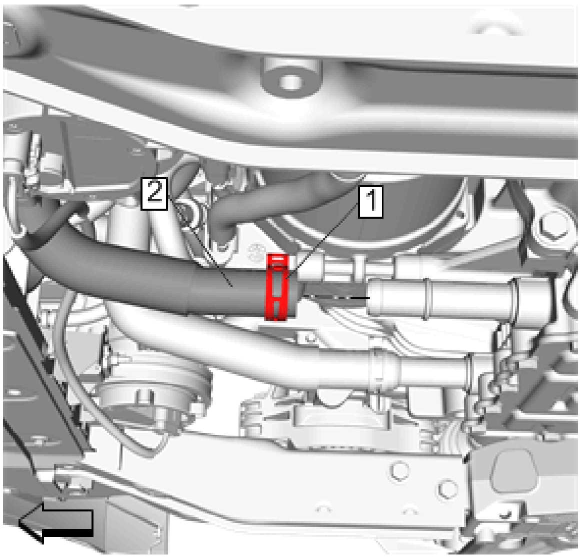


Fig. 90: Generator Control Module Coolant Tank Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
5. Remove Generator Control Module Coolant Tank Hose (2)

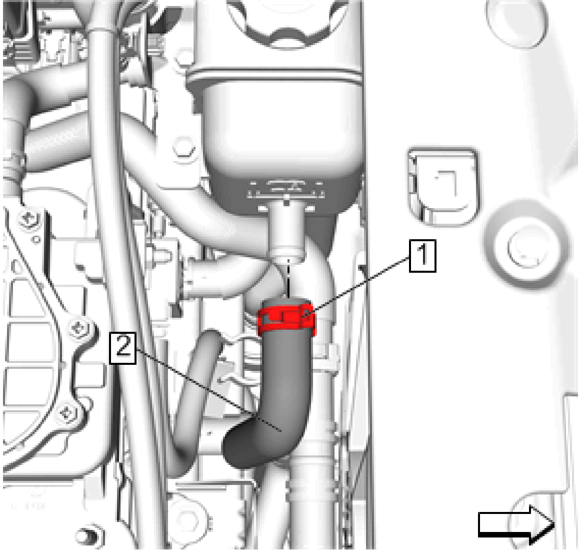


Fig. 91: Generator Control Module Coolant Tank Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
7. Remove Generator Control Module Coolant Tank Hose (2)

Installation Procedure

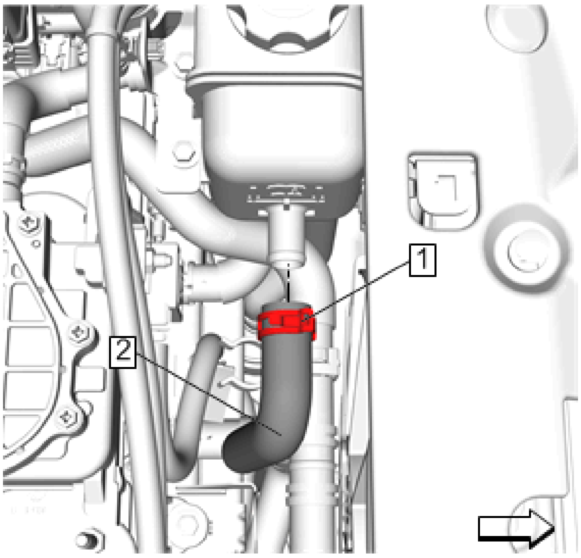


Fig. 92: Generator Control Module Coolant Tank Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install Generator Control Module Coolant Tank Hose (2)
2. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

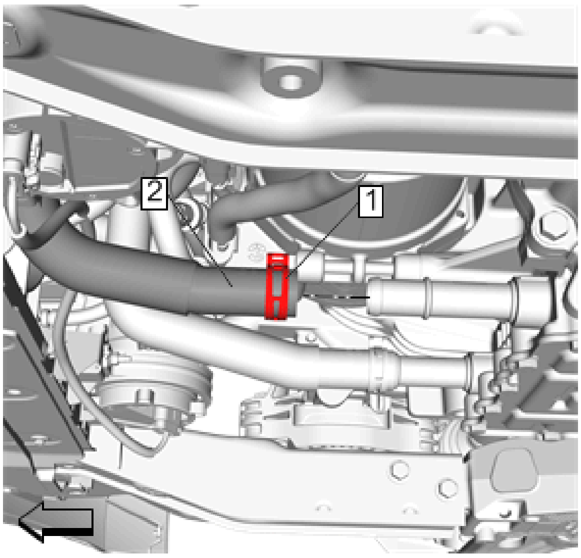


Fig. 93: Generator Control Module Coolant Tank Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Install Generator Control Module Coolant Tank Hose (2)
4. Engage Clamp (1). Refer to Hose Clamp Replacement Guidelines - Spring Type

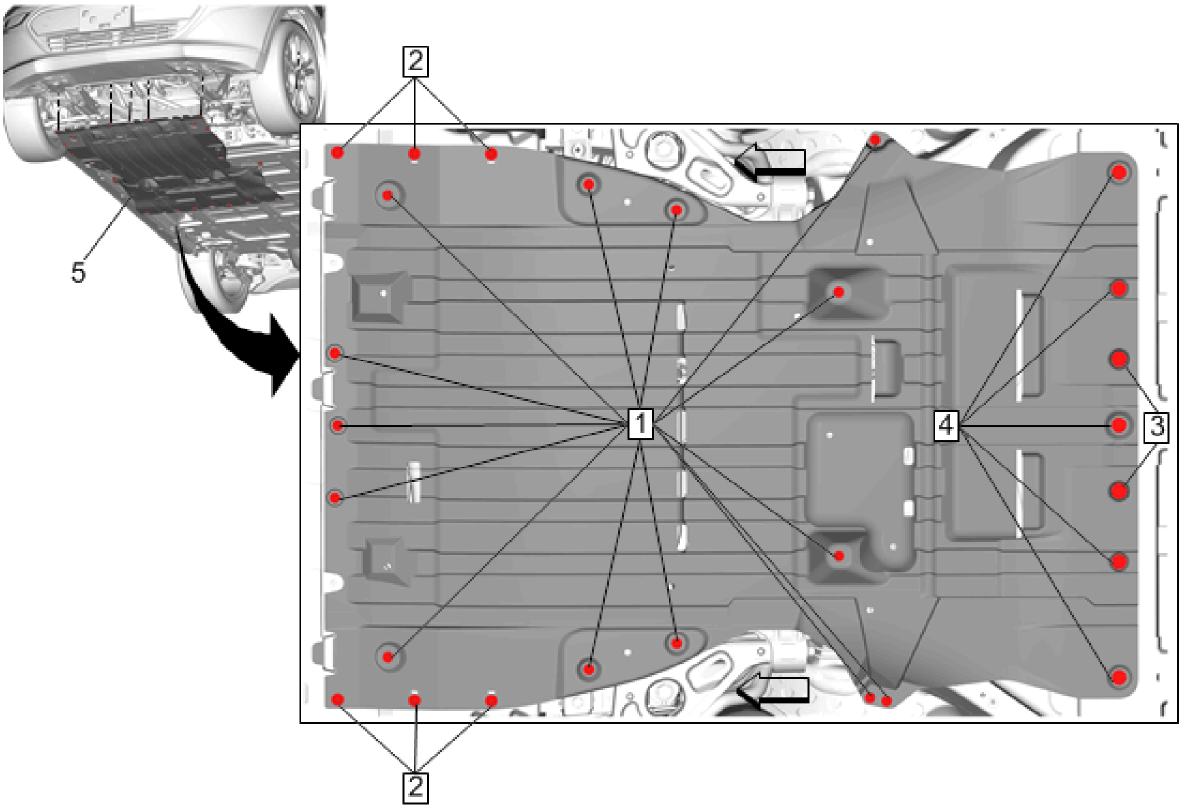


Fig. 94: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Compartment Air Deflector (3). Refer to Front Compartment Air Deflector Replacement
6. Fill the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling
7. Check the cooling system for leaks.

RADIATOR SURGE TANK REPLACEMENT

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling

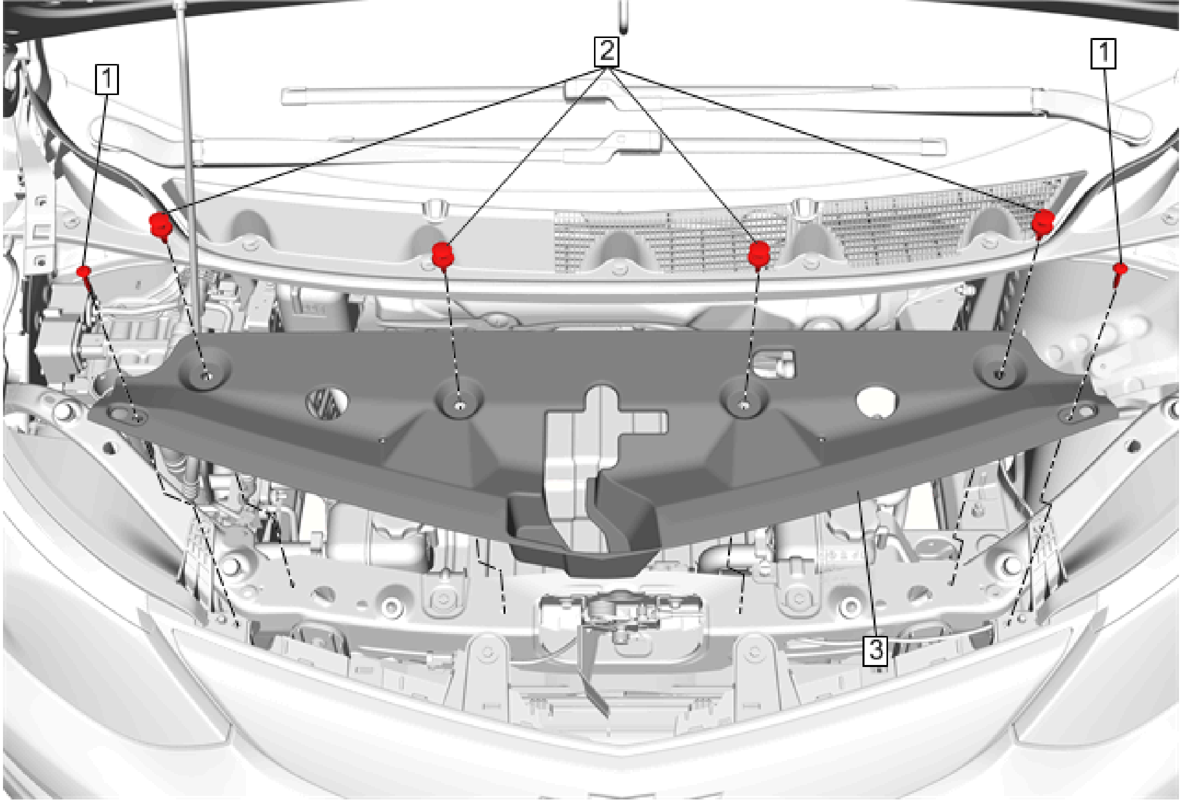


Fig. 95: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**

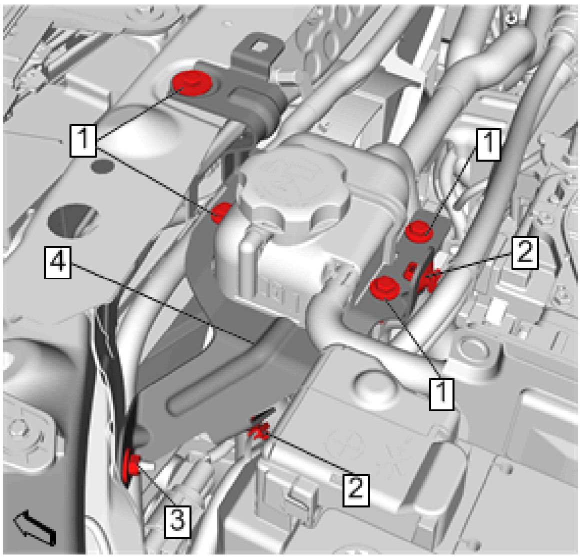
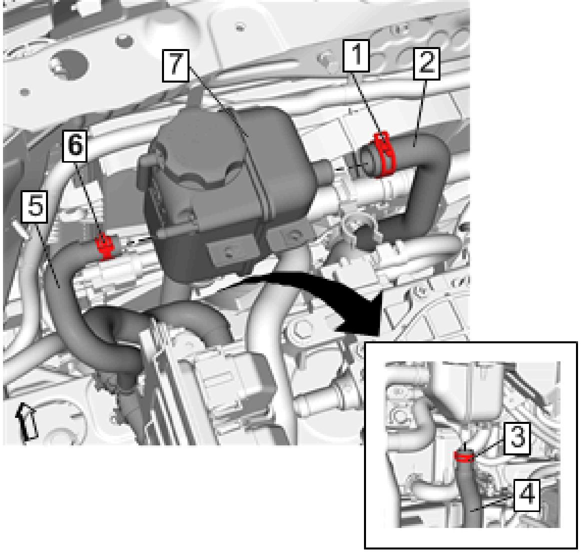


Fig. 96: Radiator Surge Tank Support Bracket And Fasteners (Left Front Side)
Courtesy of GENERAL MOTORS COMPANY

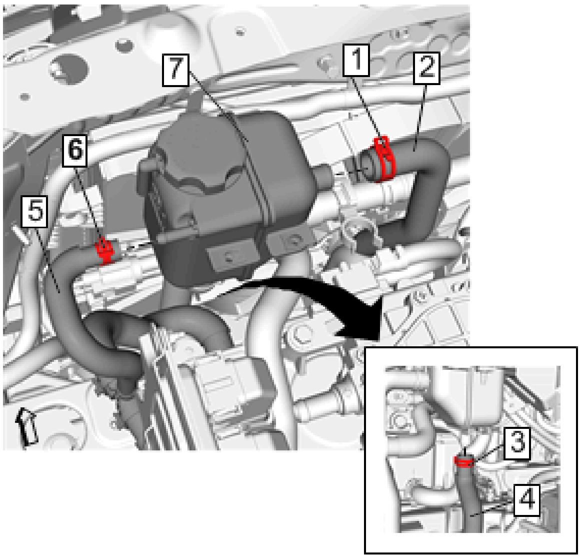
4. Remove the left front side of radiator surge tank support bracket (4). Refer to **Radiator Surge Tank Support Bracket Replacement (Radiator)**



[Fig. 97: Radiator Surge Tank And Connecting Components](#)
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Clamp (6). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
6. Remove the electric differential drive motor power inverter module cooling hose (5).
7. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
8. Remove Drive Motor Power Inverter Module Cooling Inlet Hose (2)
9. Disengage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
10. Remove Drive Motor Generator Control Module Coolant Pump Hose (4)
11. Remove Radiator Surge Tank (7)

Installation Procedure



[Fig. 98: Radiator Surge Tank And Connecting Components](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Surge Tank (7)
2. Install Drive Motor Generator Control Module Coolant Pump Hose (4)
3. Engage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
4. Install Drive Motor Power Inverter Module Cooling Inlet Hose (2)
5. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
6. Install the electric differential drive motor power inverter module cooling hose (5).
7. Engage Clamp (6). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

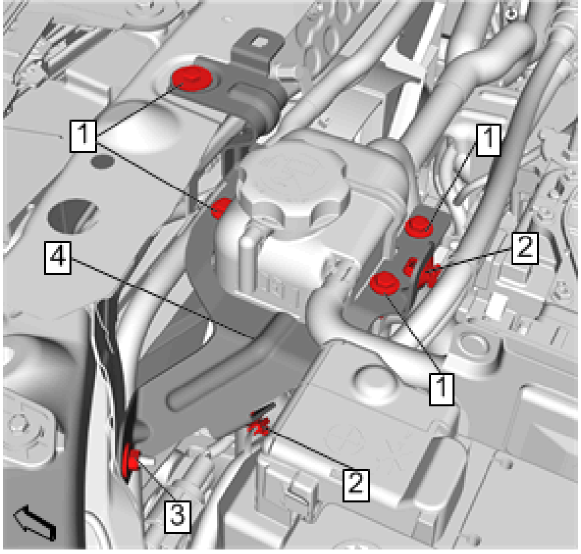


Fig. 99: Radiator Surge Tank Support Bracket And Fasteners (Left Front Side)
Courtesy of GENERAL MOTORS COMPANY

8. Install the left front side of radiator surge tank support bracket (4). Refer to Radiator Surge Tank Support Bracket Replacement (Radiator).

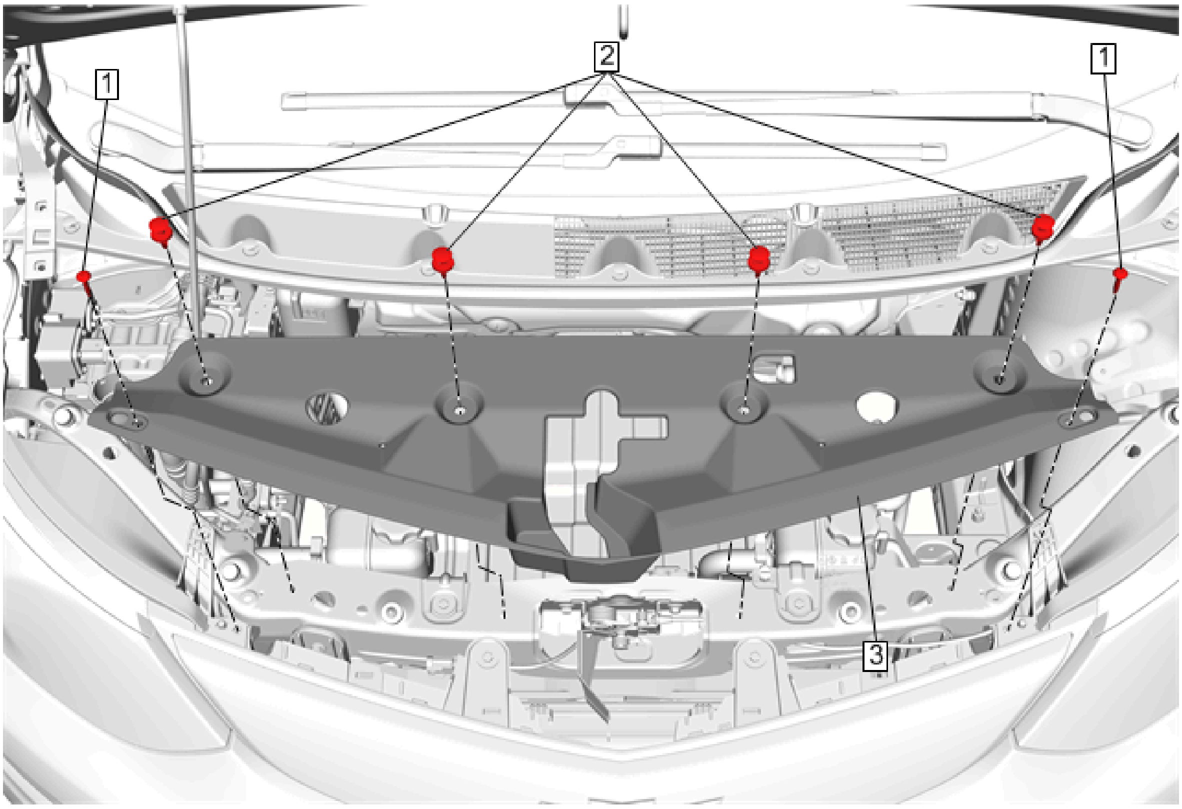


Fig. 100: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

9. Install Front Compartment Front Sight Shield (3). Refer to Front Compartment Front Sight Shield Replacement
10. Fill the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling
11. Check the cooling system for leaks.

RADIATOR SURGE TANK SUPPORT BRACKET REPLACEMENT (RADIATOR)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any**

cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

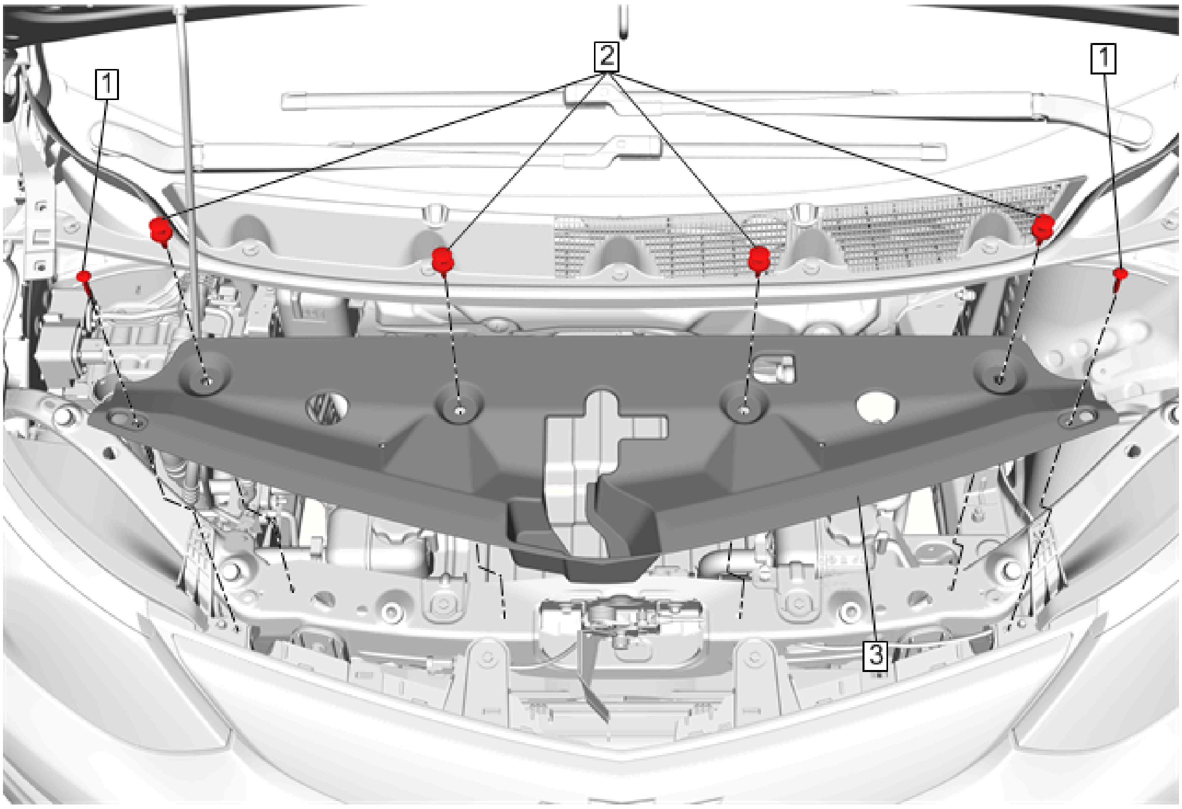


Fig. 101: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

1. Remove Front Compartment Front Sight Shield (3). Refer to Front Compartment Front Sight Shield Replacement

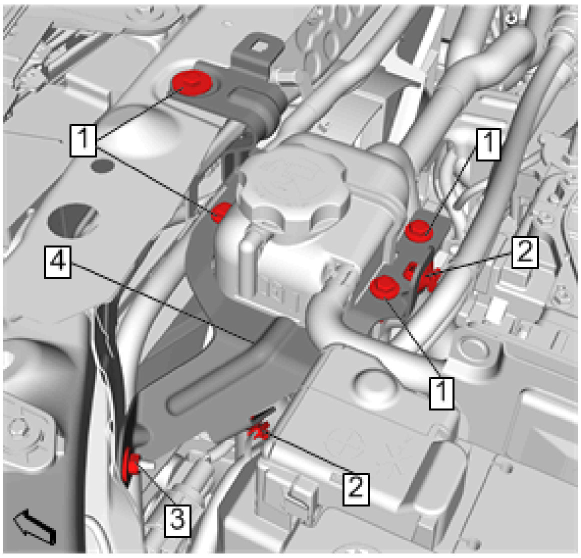
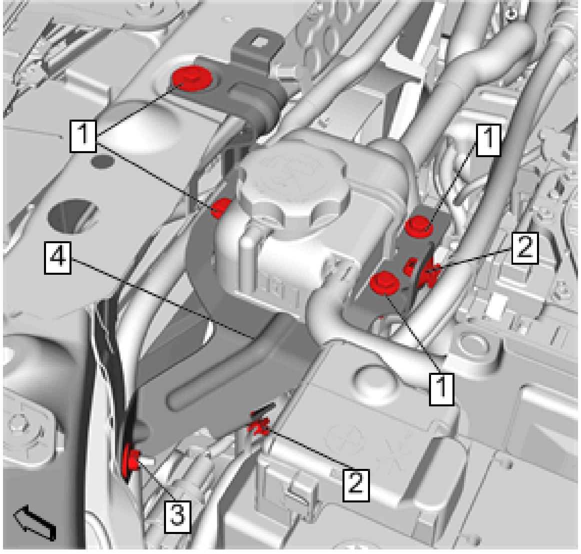


Fig. 102: Radiator Surge Tank Support Bracket And Fasteners (Left Front Side)
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not remove any coolant hoses from the surge tanks.**

2. Remove the 4 radiator surge tank support bracket bolts. (1)
3. Remove the radiator surge tank support bracket nut. (3)
4. {If equipped} Remove Retainers (2) (Qty: 2)
5. Remove the radiator surge tank support bracket. (4)

Installation Procedure

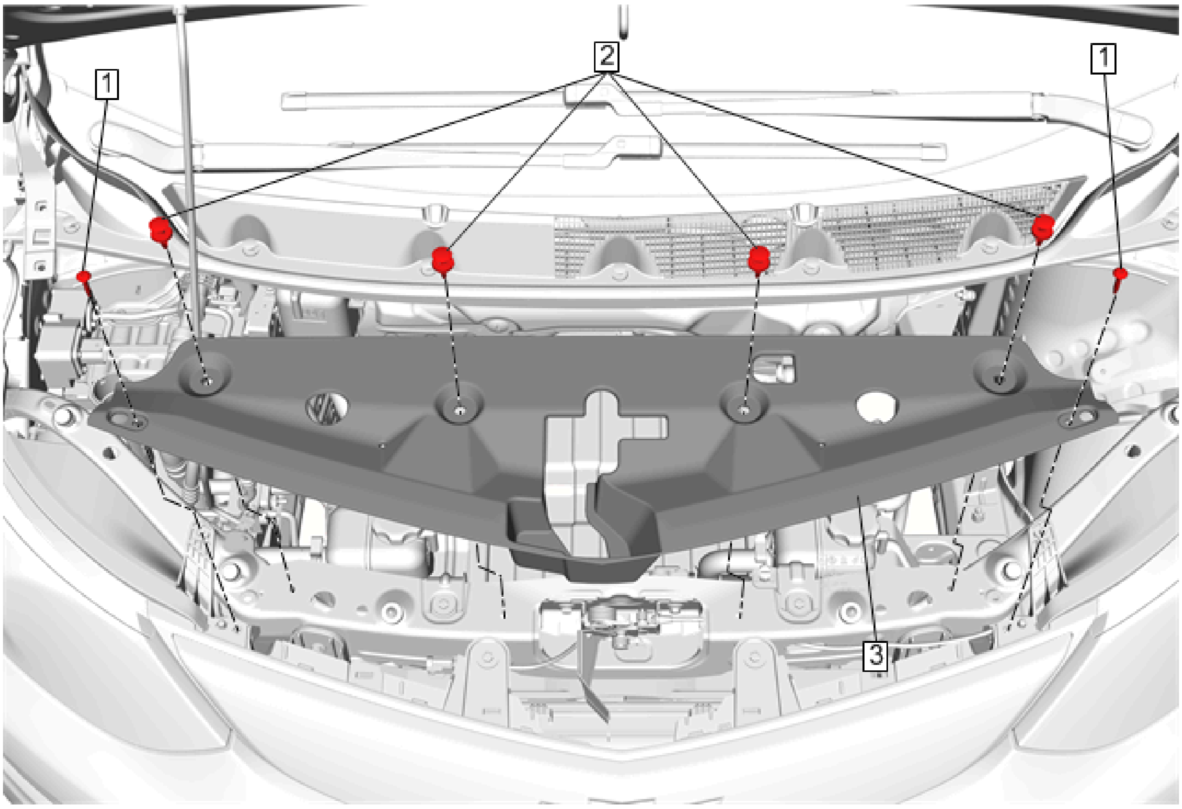


[Fig. 103: Radiator Surge Tank Support Bracket And Fasteners (Left Front Side)](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install the radiator surge tank support bracket. (4)

CAUTION: **Refer to [Fastener Caution](#)**

2. Install the radiator surge tank support bracket nut (3) and tighten to 9 N.m (80 lb in)
3. Install the 4 radiator surge tank support bracket bolts (1) and tighten to 9 N.m (80 lb in)
4. {If equipped} Install Retainers (2) (Qty: 2)



[Fig. 104: Front Compartment Front Sight Shield](#)
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Compartment Front Sight Shield (3). Refer to [Front Compartment Front Sight Shield Replacement](#)

RADIATOR SURGE TANK SUPPORT BRACKET REPLACEMENT (HEATER)

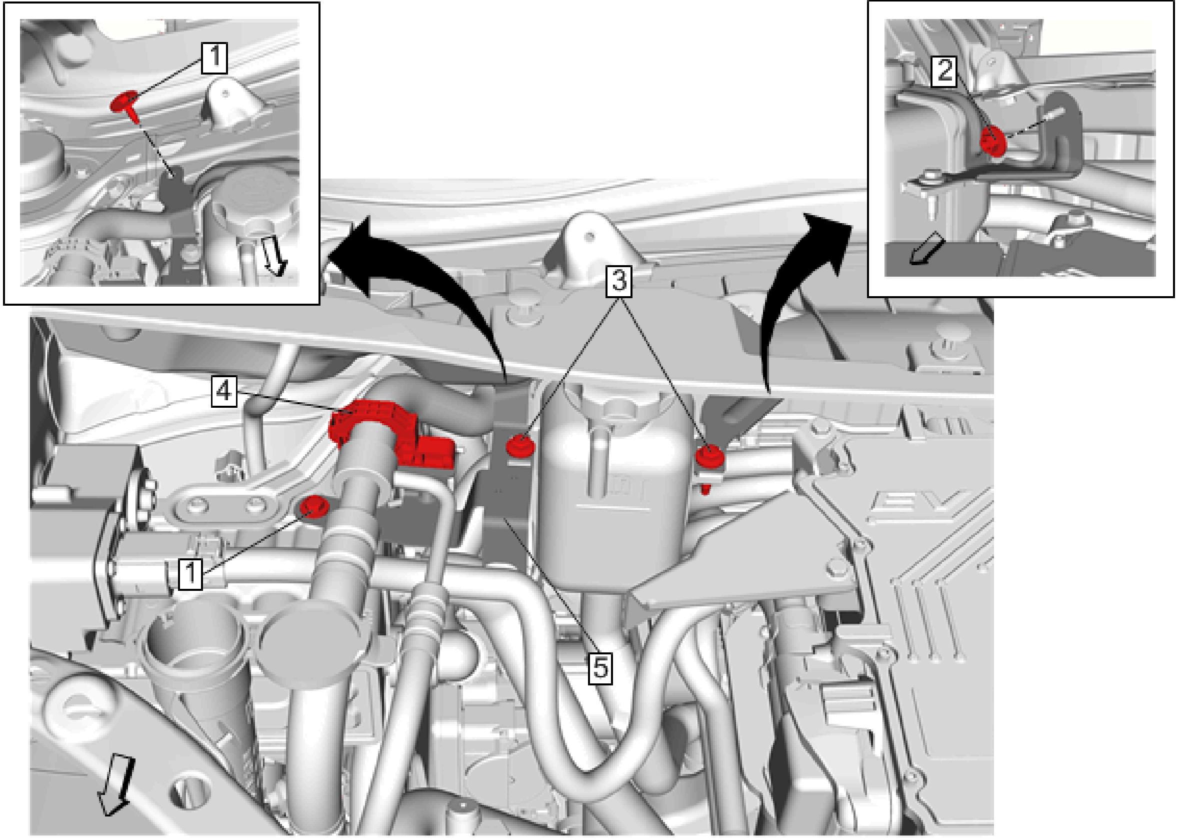


Fig. 105: Radiator Surge Tank Support Bracket (Heater)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**	
1	Radiator Surge Tank Support Bracket Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** 9 N.m (80 lb in)
2	Radiator Surge Tank Support Bracket Nut 9 N.m (80 lb in)
3	Radiator Surge Tank Bolt (Qty: 2) 4.5 N.m (40 lb in)
4	Retainer
5	Heater Surge Tank Bracket **Procedure** Unclip the high voltage heater harness from the bracket.

RADIATOR SURGE TANK SUPPORT BRACKET REPLACEMENT (RESS)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

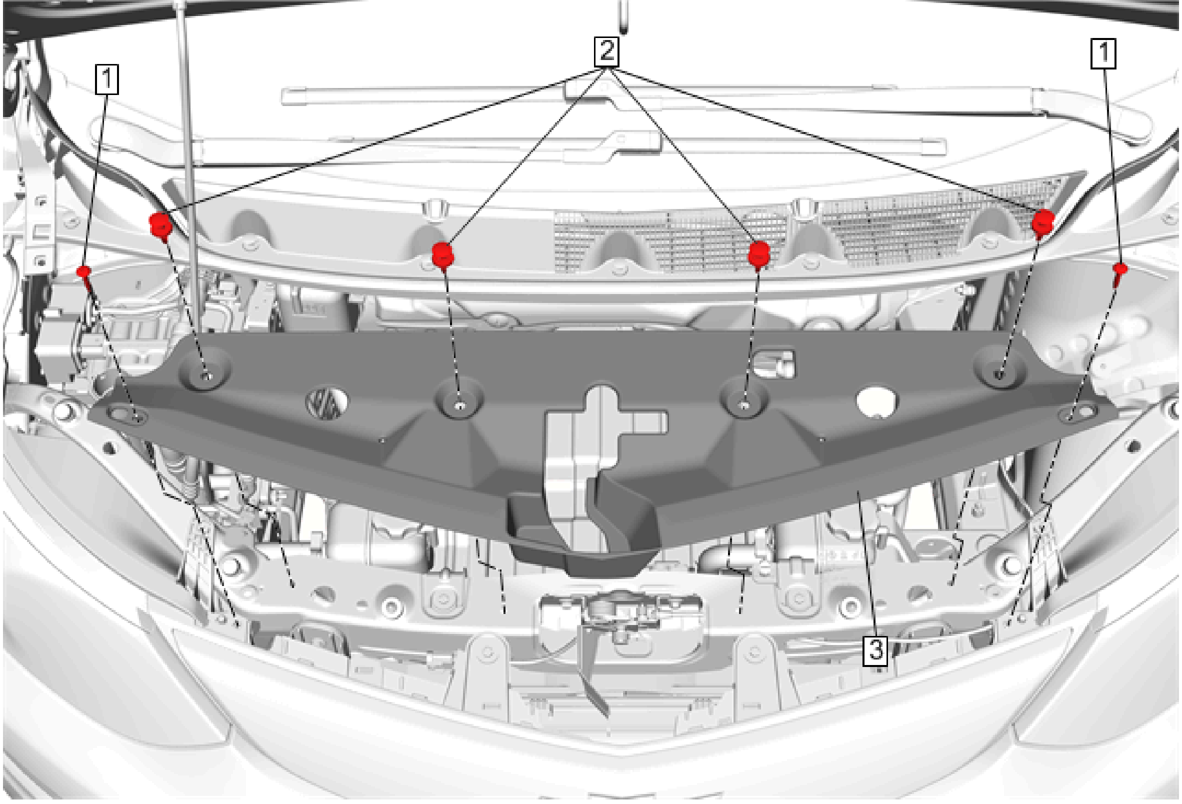


Fig. 106: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

1. Remove Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**

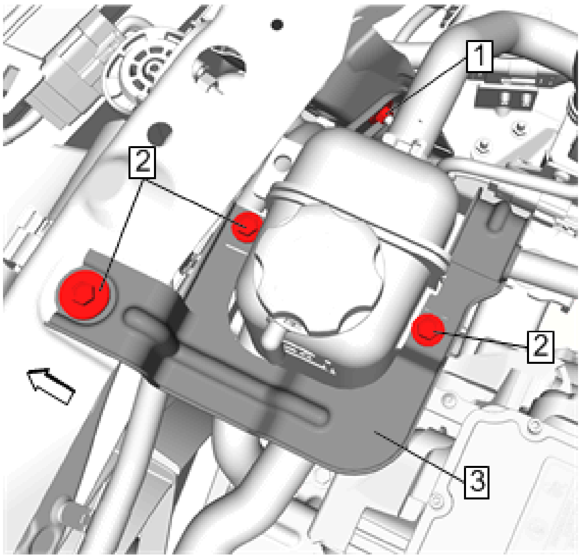


Fig. 107: Drive Motor Battery Radiator Surge Tank Bracket, Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not remove any coolant hoses from the surge tanks.**

2. Remove the 3 drive motor battery radiator surge tank bracket bolts (2).
3. Remove the drive motor battery radiator surge tank bracket nut (1).
4. Remove Radiator Surge Tank Bracket (3)

Installation Procedure

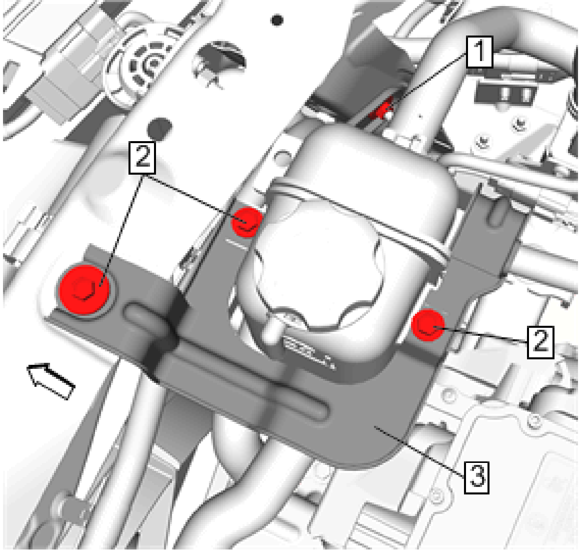


Fig. 108: Drive Motor Battery Radiator Surge Tank Bracket, Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install Radiator Surge Tank Bracket (3)

CAUTION: **Refer to Fastener Caution .**

2. Install the drive motor battery radiator surge tank bracket nut (1) and tighten to 9 N.m (80 lb in)
3. Install the 3 drive motor battery radiator surge tank bracket bolts (2) and tighten to 9 N.m (80 lb in)

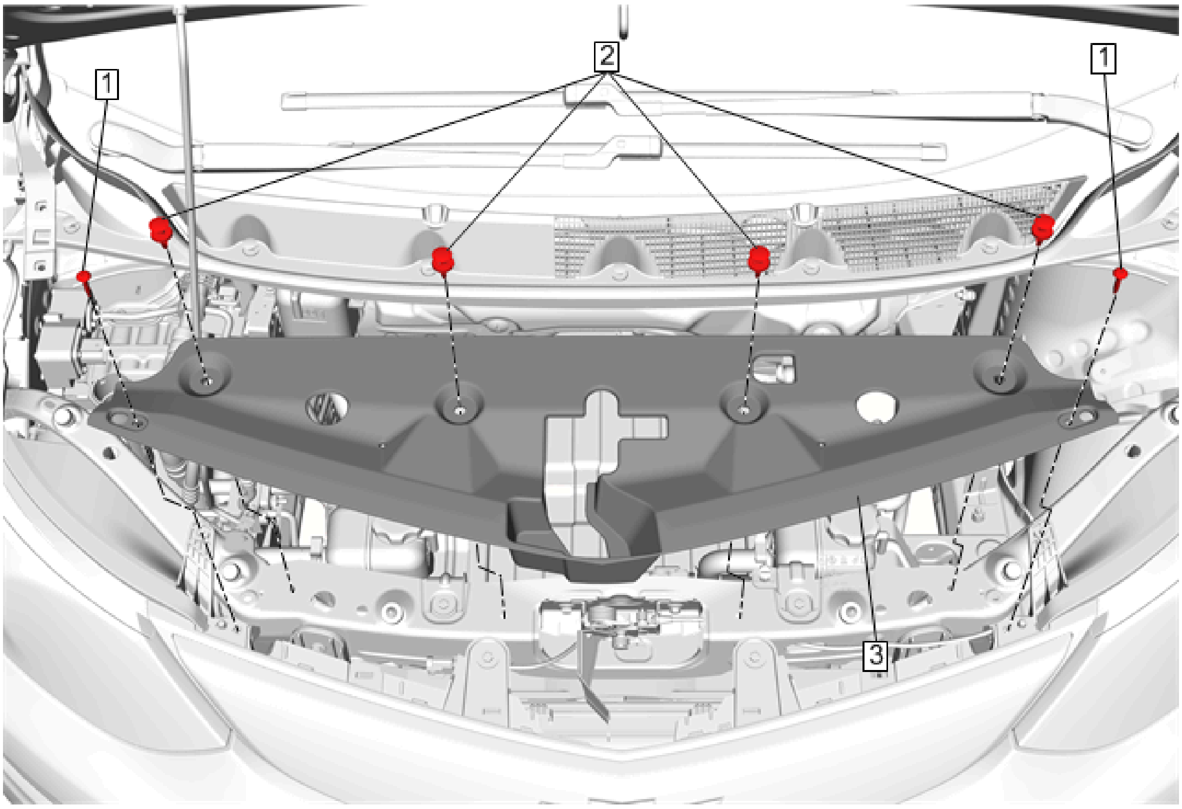


Fig. 109: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Compartment Front Sight Shield (3). Refer to Front Compartment Front Sight Shield Replacement

COOLING FAN AND SHROUD REPLACEMENT

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any**

cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**

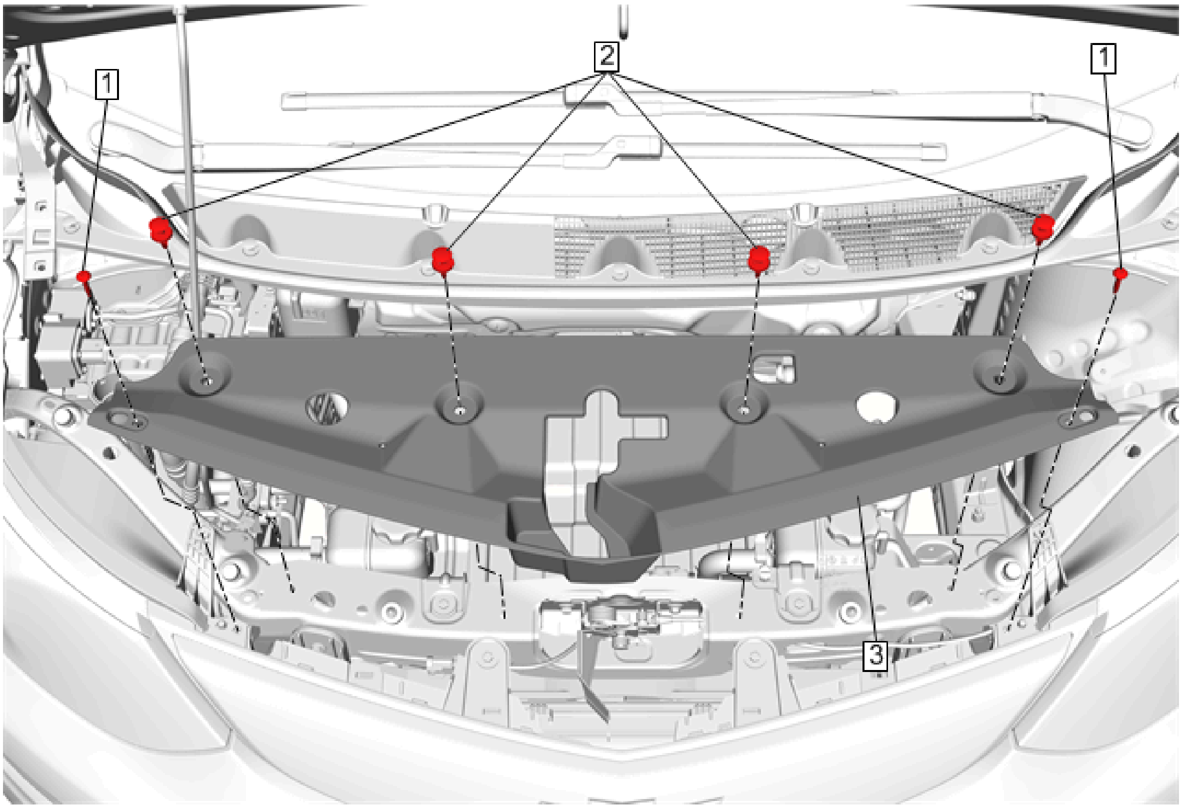


Fig. 110: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**

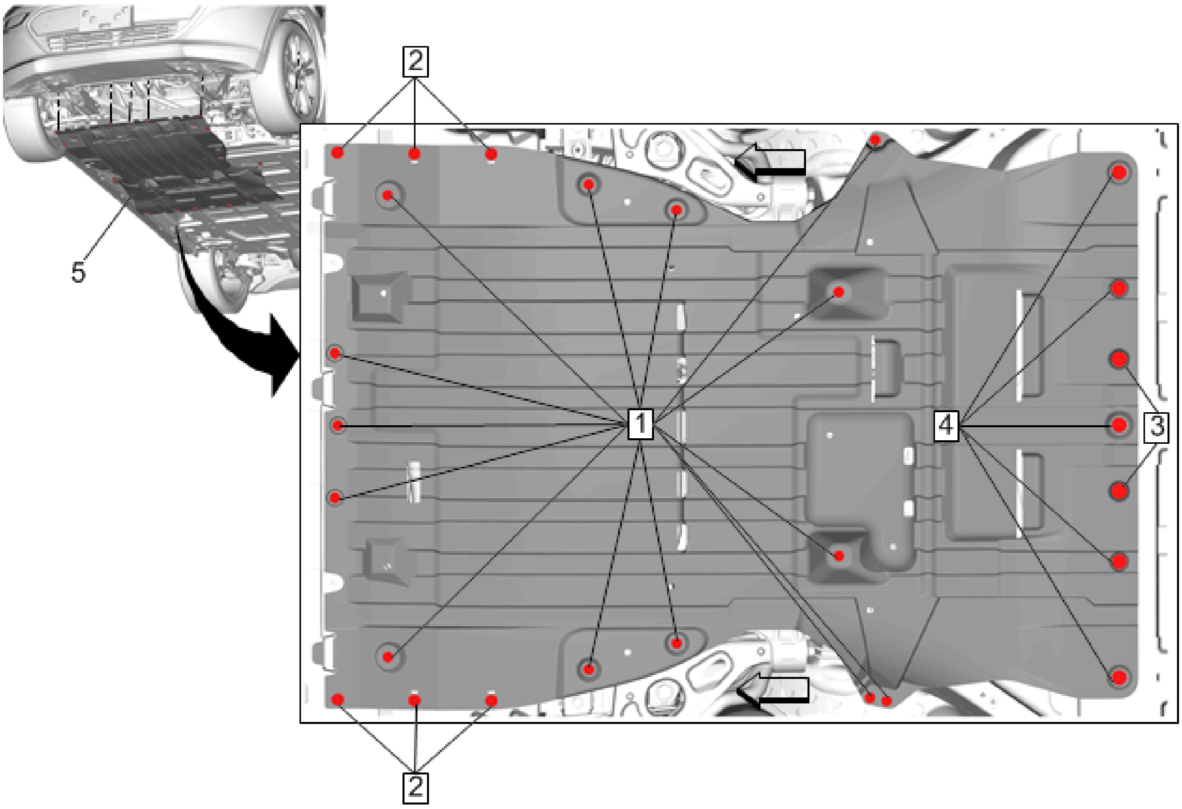


Fig. 111: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

4. Remove Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**

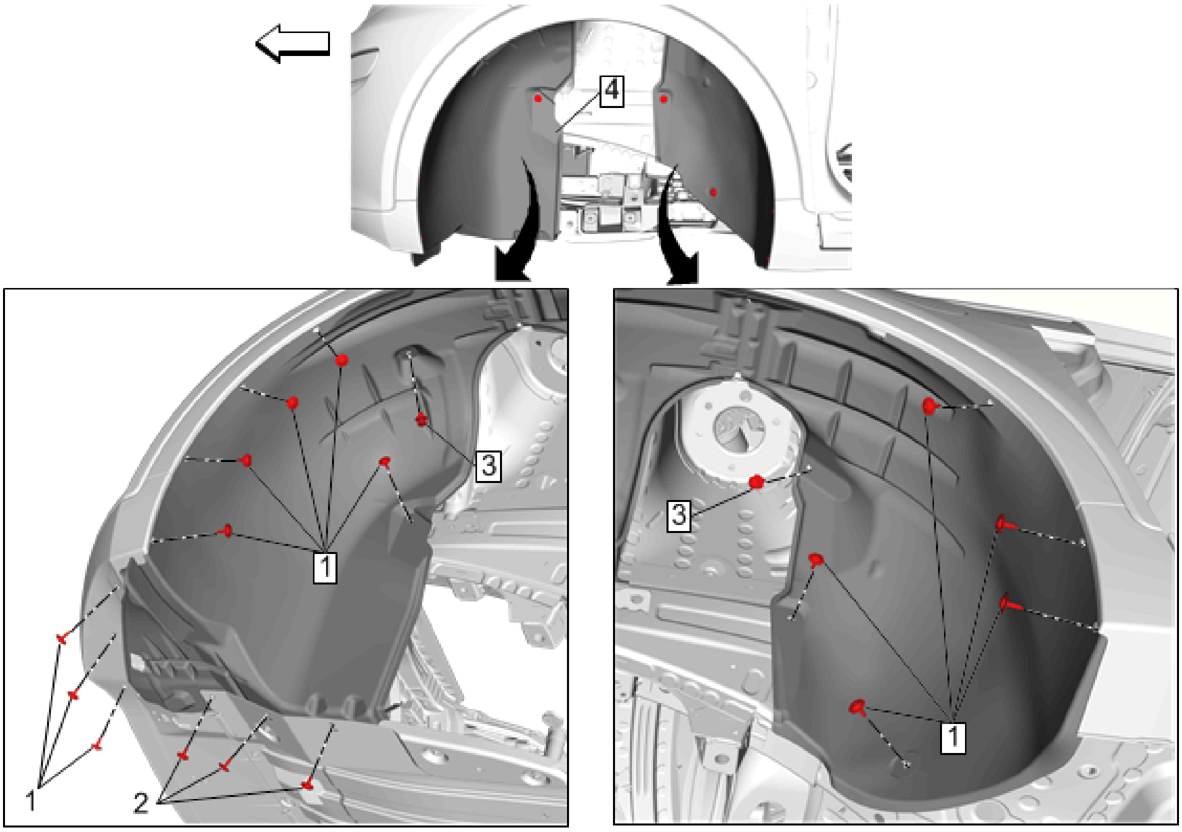


Fig. 112: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

5. Remove Front Wheelhouse Liner (4) (Qty: 2). Refer to **Front Wheelhouse Liner Replacement**
6. Remove the front bumper fascia. Refer to **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**

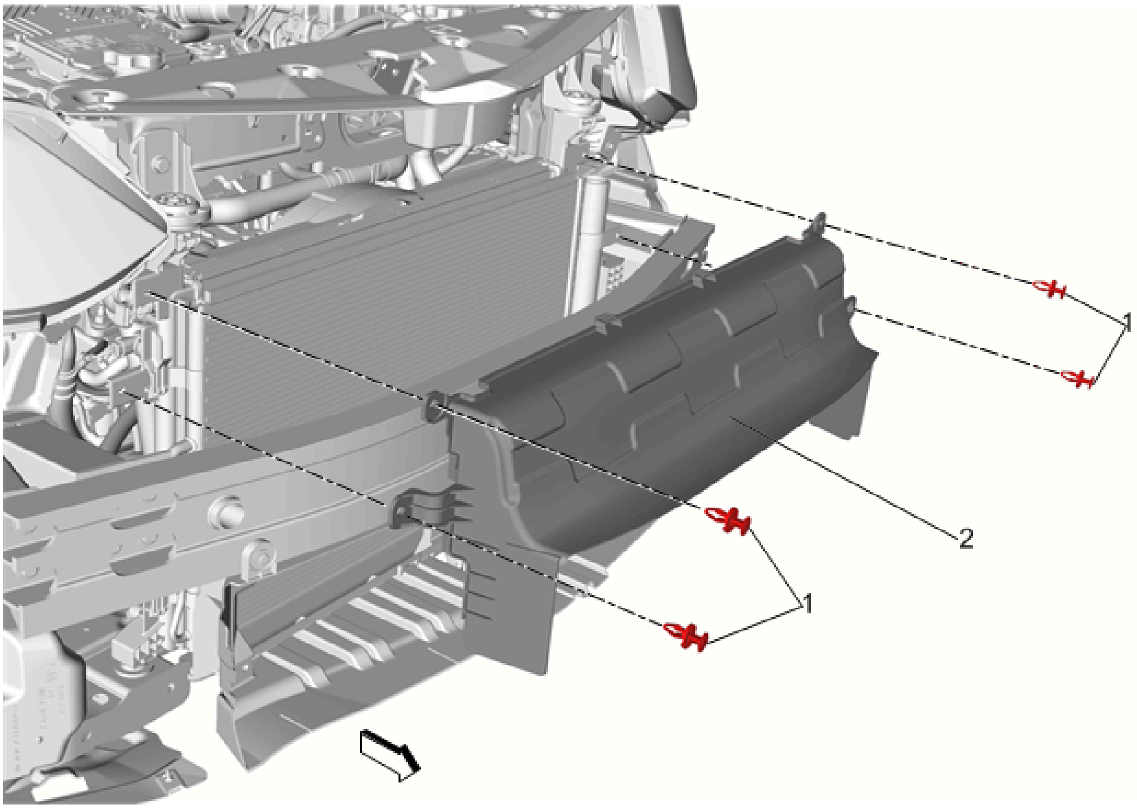


Fig. 113: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

7. Remove Radiator Air Upper Baffle and Deflector (2). Refer to **Radiator Air Upper Baffle and Deflector Replacement**

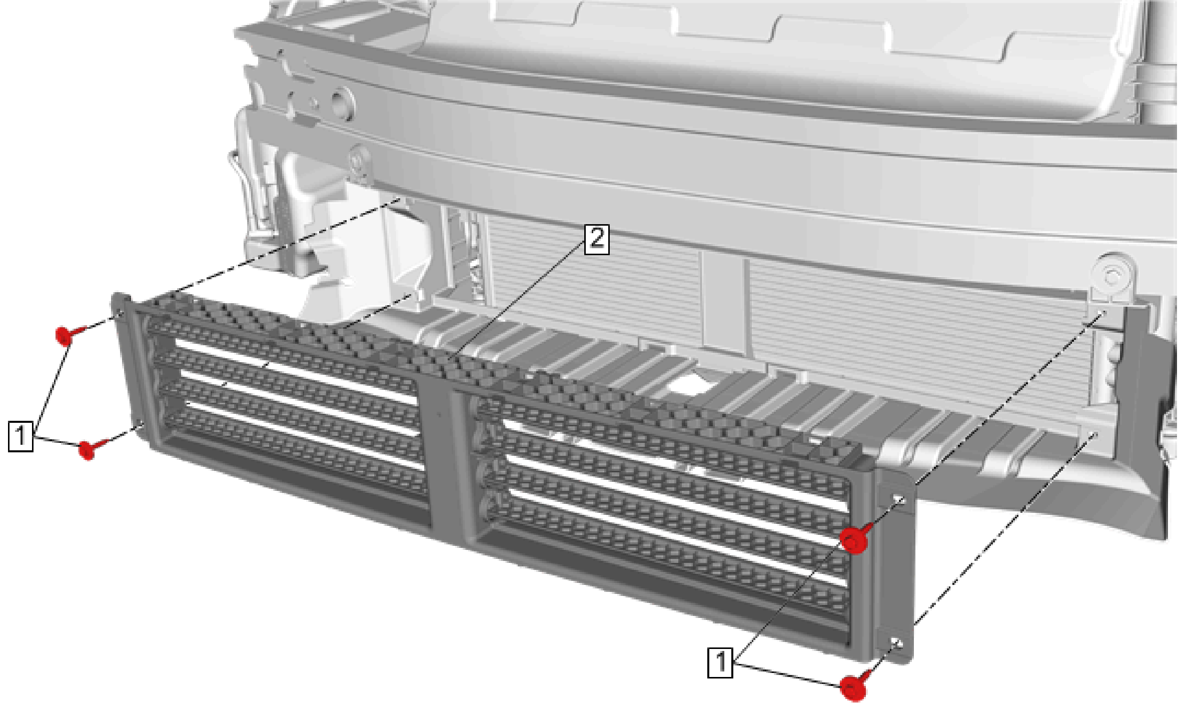


Fig. 114: Front Bumper Shutter
Courtesy of GENERAL MOTORS COMPANY

8. Remove Front Bumper Shutter (2). Refer to **Front Bumper Shutter Replacement**

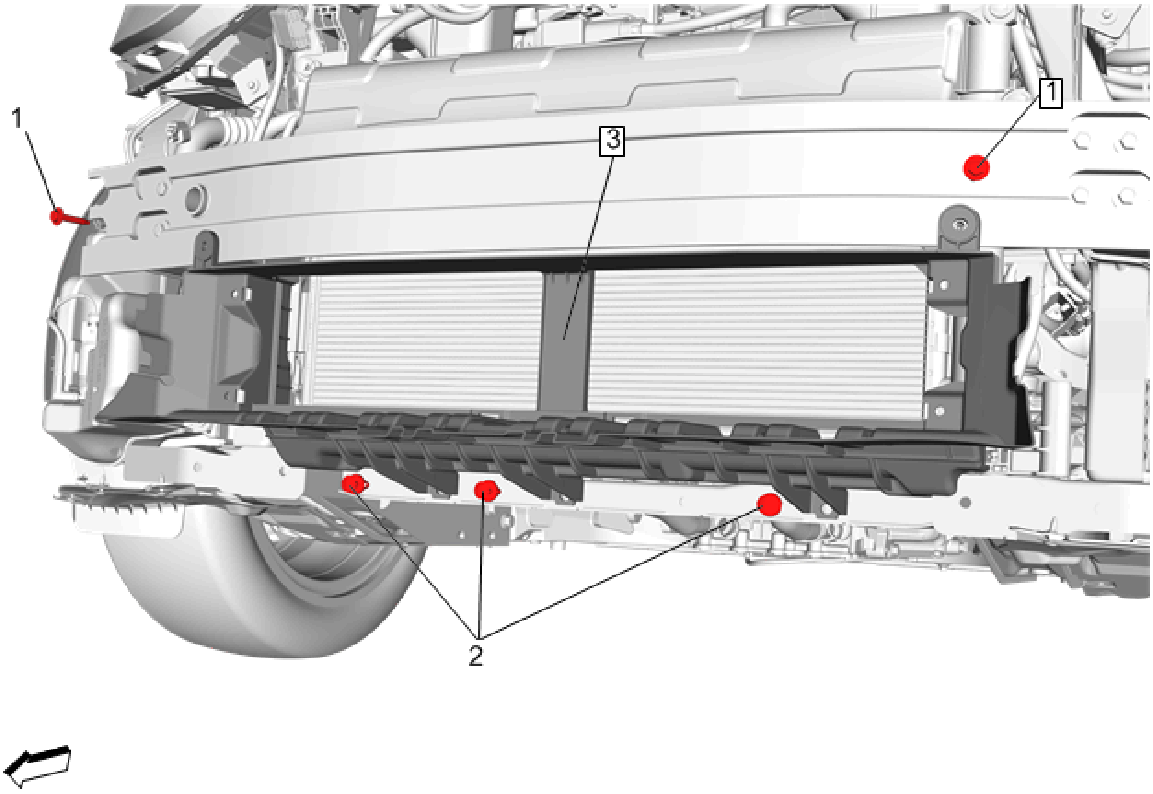


Fig. 115: Radiator Air Lower Baffle and Deflector Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Remove Radiator Air Lower Baffle and Deflector Assembly (3). Refer to **Radiator Air Lower Baffle and Deflector Replacement**

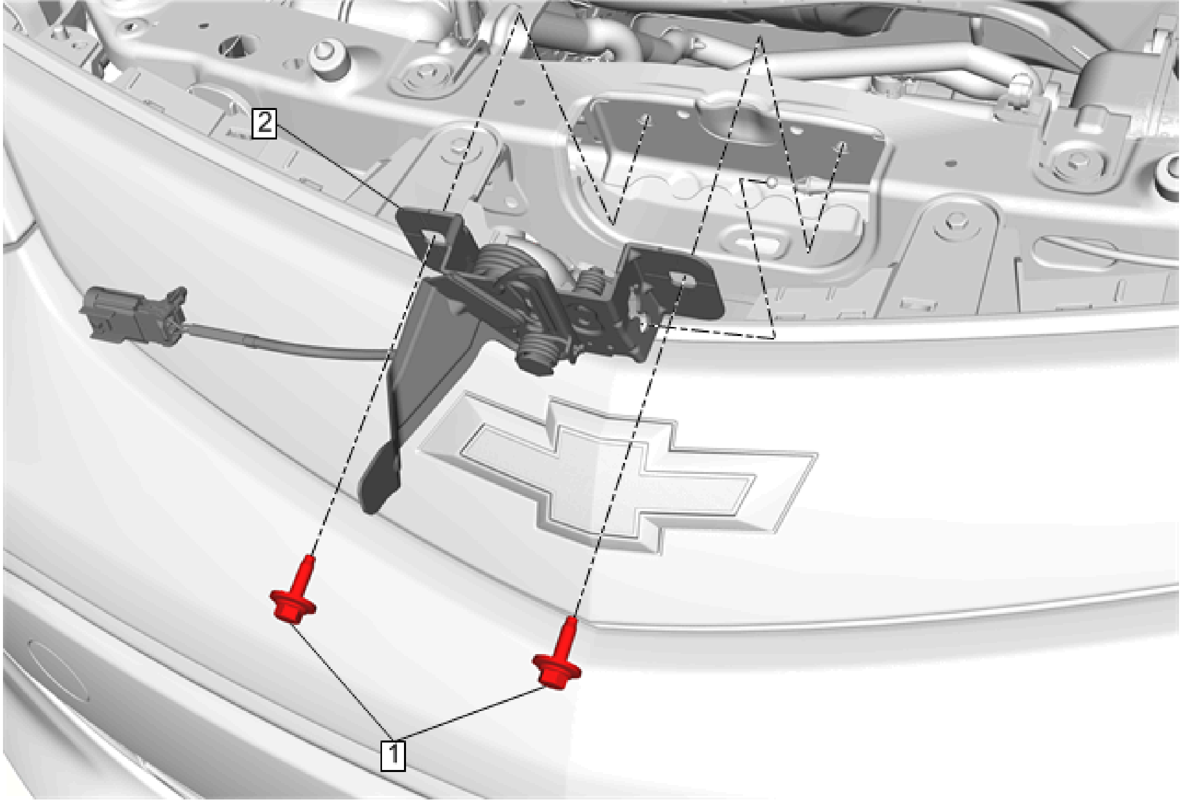


Fig. 116: Hood Primary and Secondary Latch
Courtesy of GENERAL MOTORS COMPANY

10. Reposition the hood primary and secondary latch (2). Refer to **Hood Primary and Secondary Latch Replacement**

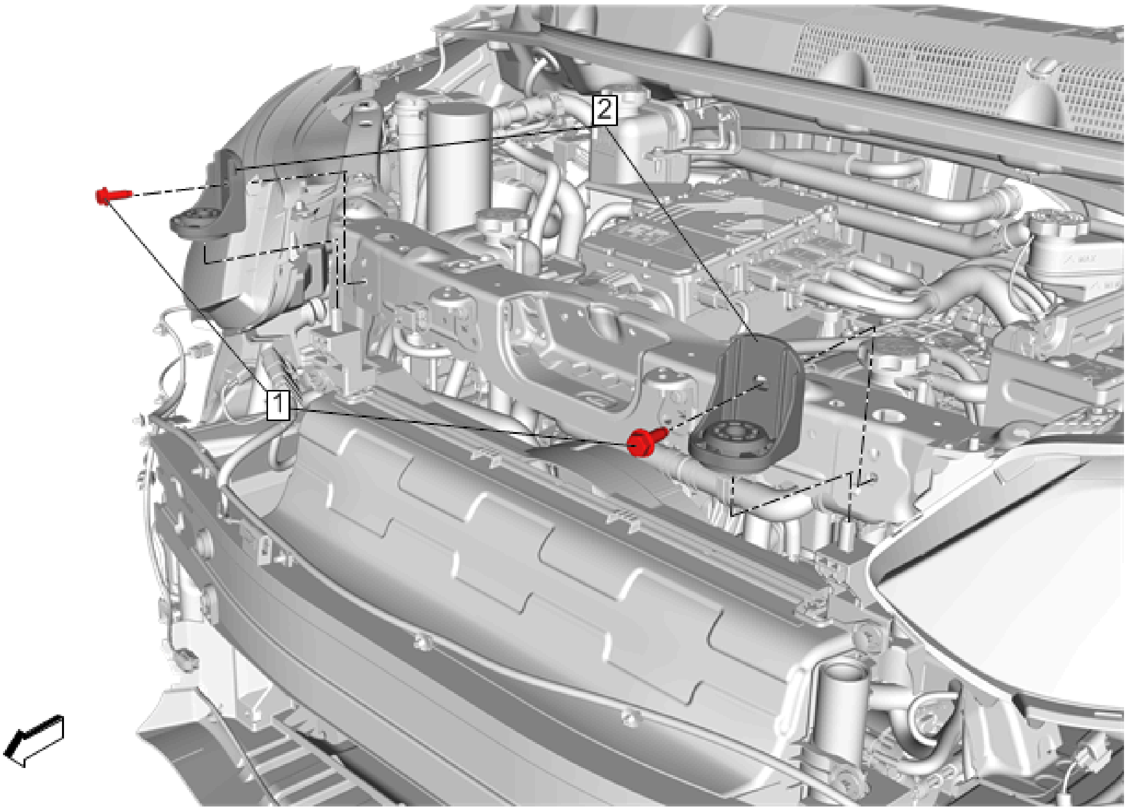


Fig. 117: Radiator Upper Brackets
Courtesy of GENERAL MOTORS COMPANY

11. Remove Radiator Upper Brackets (2) (Qty: 2). Refer to **Radiator Upper Bracket Replacement**

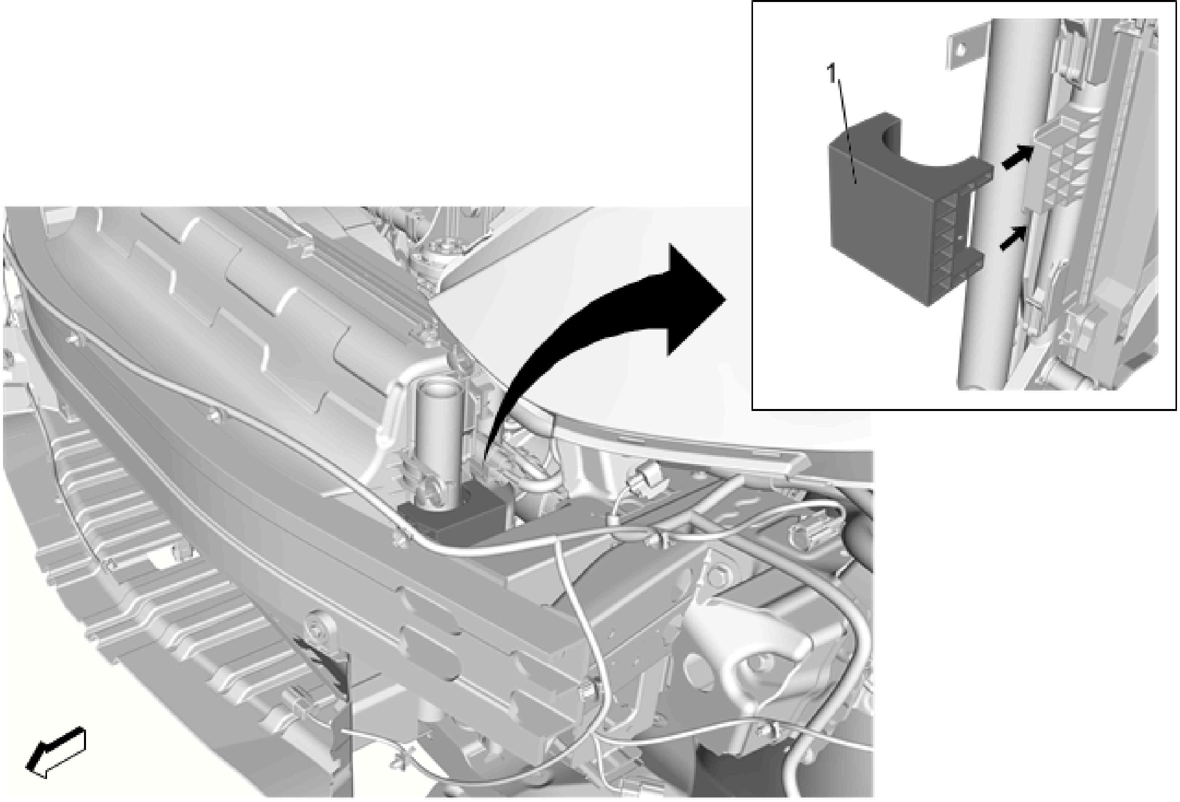


Fig. 118: Radiator Protector
Courtesy of GENERAL MOTORS COMPANY

12. Remove the radiator protector (1). Refer to **Radiator Protector Replacement**

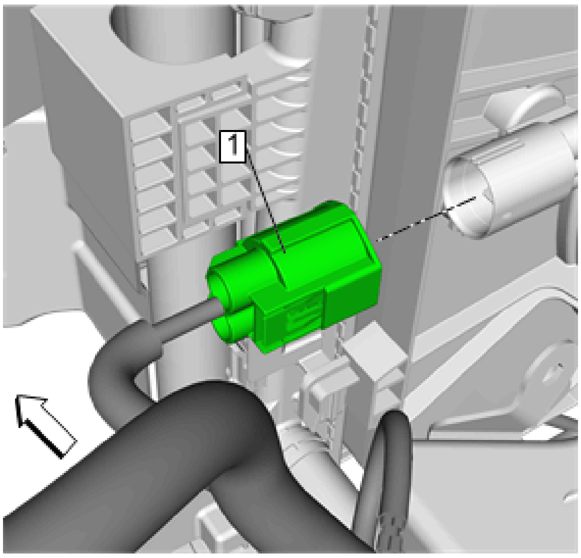


Fig. 119: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect Electrical Connector (1)

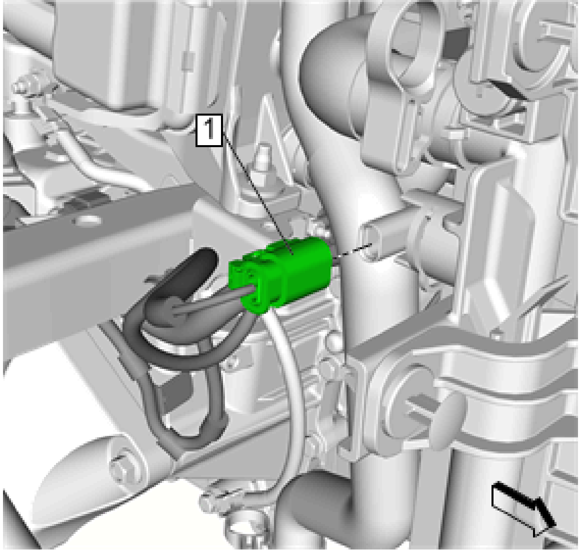


Fig. 120: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

14. Disconnect Electrical Connector (1)

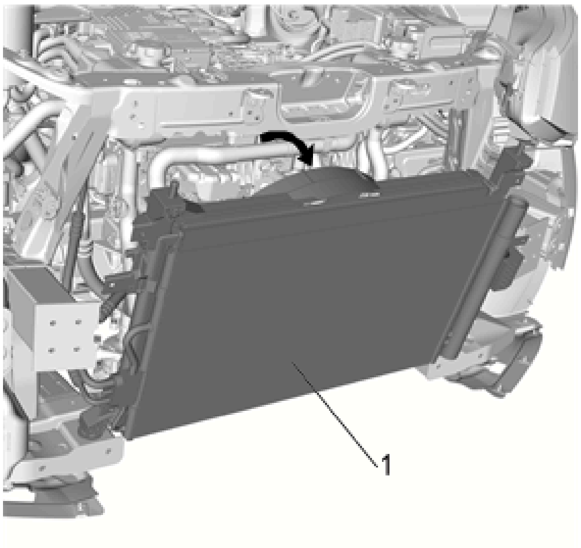


Fig. 121: Radiator Assembly
Courtesy of GENERAL MOTORS COMPANY

15. Pull the radiator assembly (1) with air conditioning condenser hoses forward to get the space.

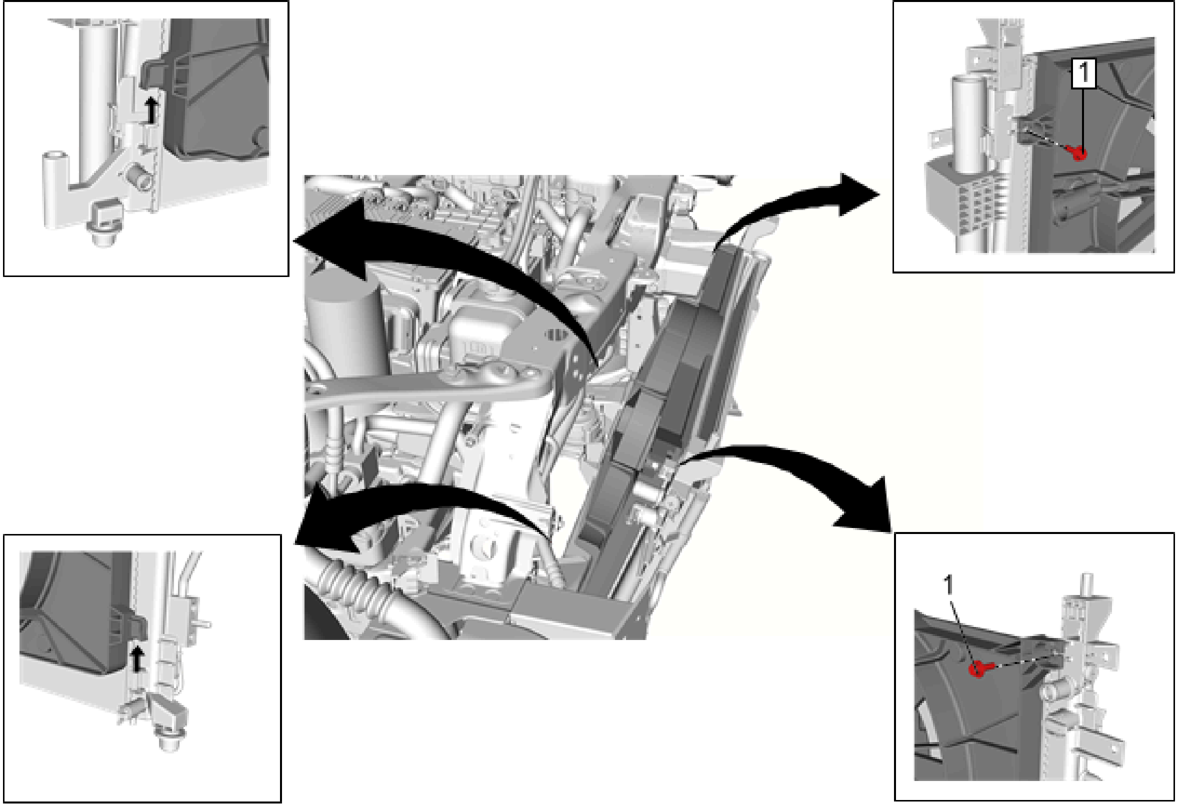


Fig. 122: Cooling Fan Bolts
Courtesy of GENERAL MOTORS COMPANY

16. Remove the 2 cooling fan bolts (1).
17. Pull up the lower cooling fan assembly until it can be put out of the retaining tabs.

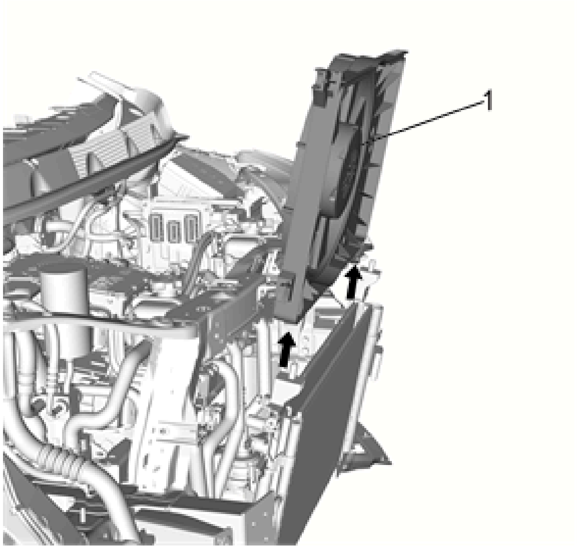


Fig. 123: Cooling Fan
Courtesy of GENERAL MOTORS COMPANY

18. Remove Cooling Fan (1)

Installation Procedure

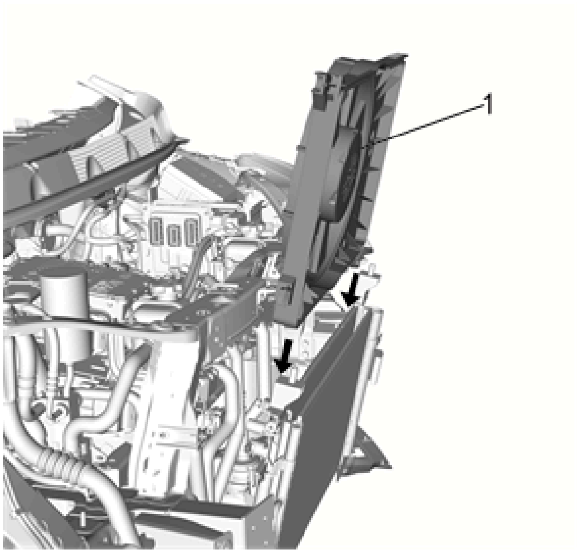


Fig. 124: Cooling Fan
Courtesy of GENERAL MOTORS COMPANY

1. Install Cooling Fan (1)

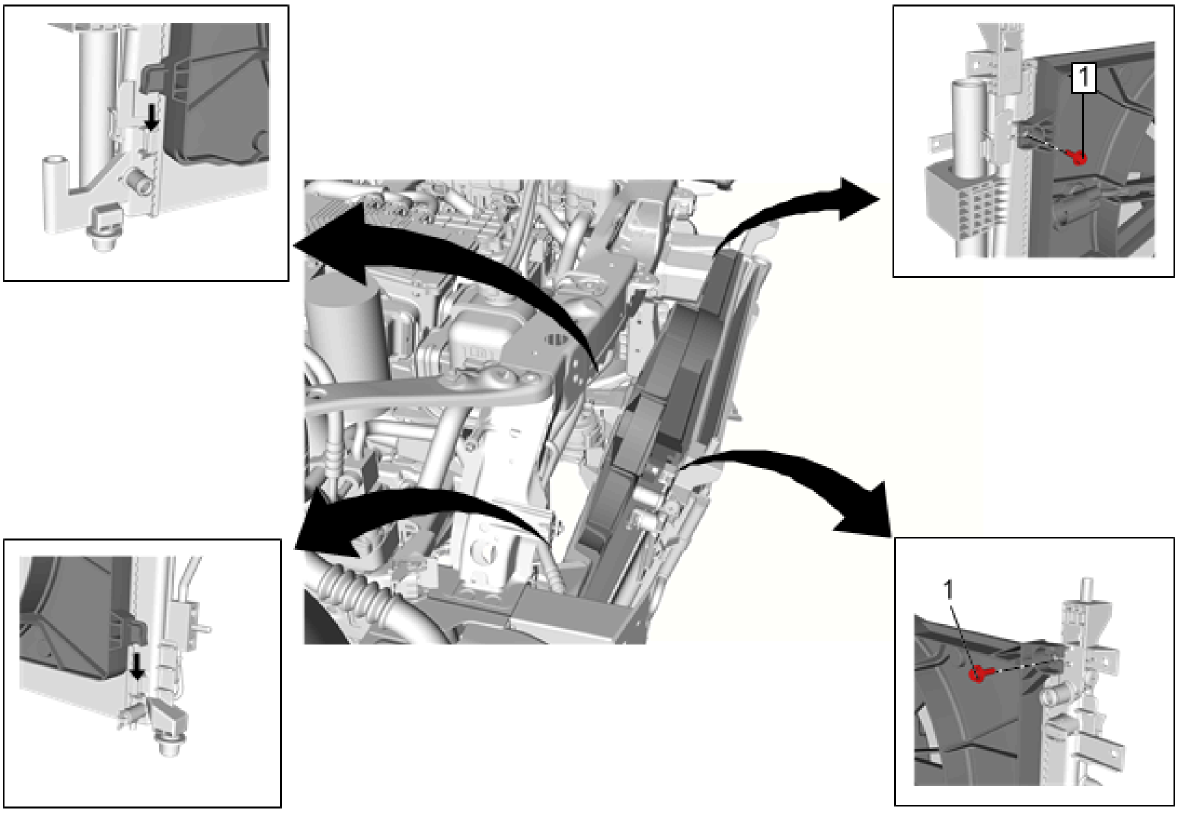


Fig. 125: Cooling Fan Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Install the lower cooling fan assembly into the retaining tabs.

CAUTION: **Refer to Fastener Caution .**

3. Install the 2 cooling fan bolts (1) and tighten to 5 N.m (44 lb in).

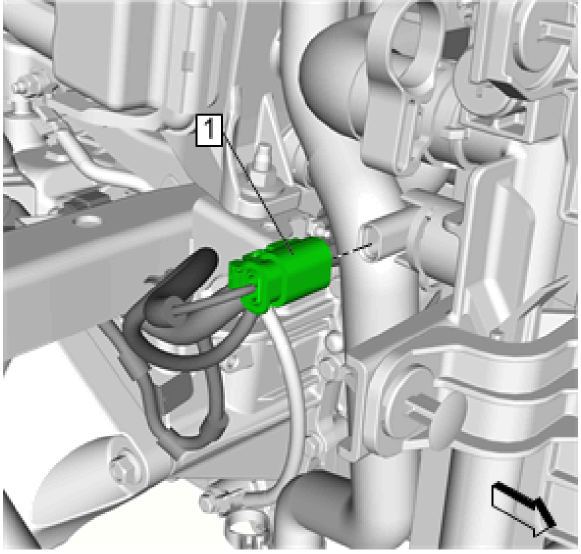


Fig. 126: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connector (1)

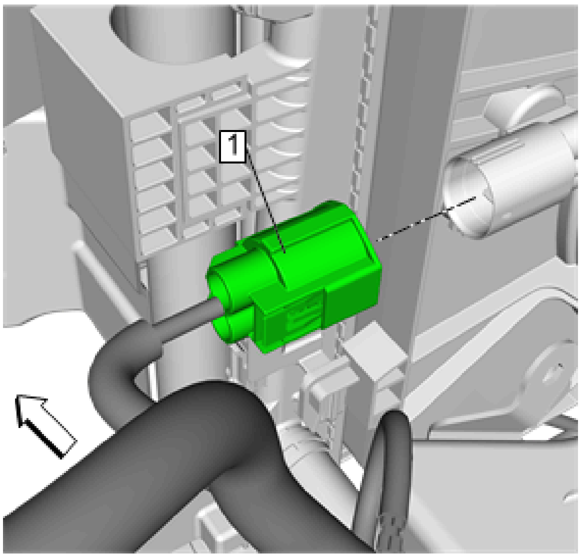


Fig. 127: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Connect Electrical Connector (1)

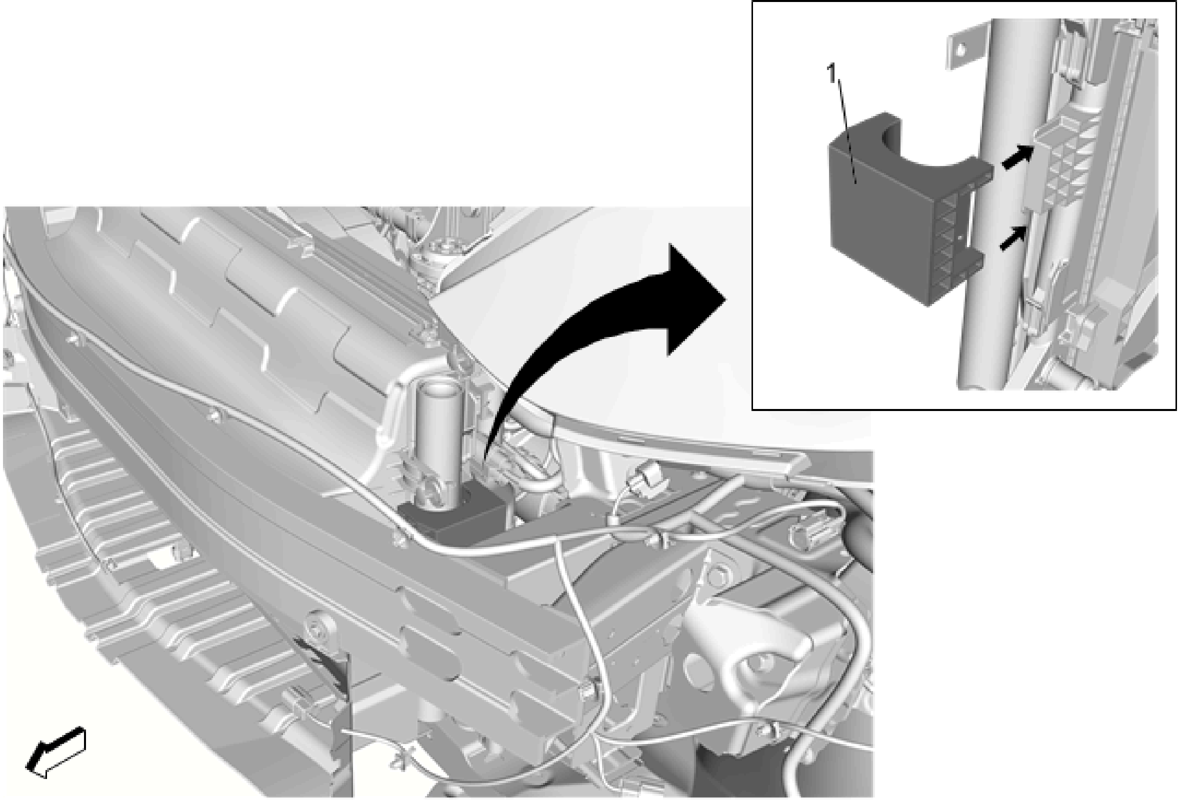


Fig. 128: Radiator Protector
Courtesy of GENERAL MOTORS COMPANY

6. Install the radiator protector (1). Refer to **Radiator Protector Replacement**

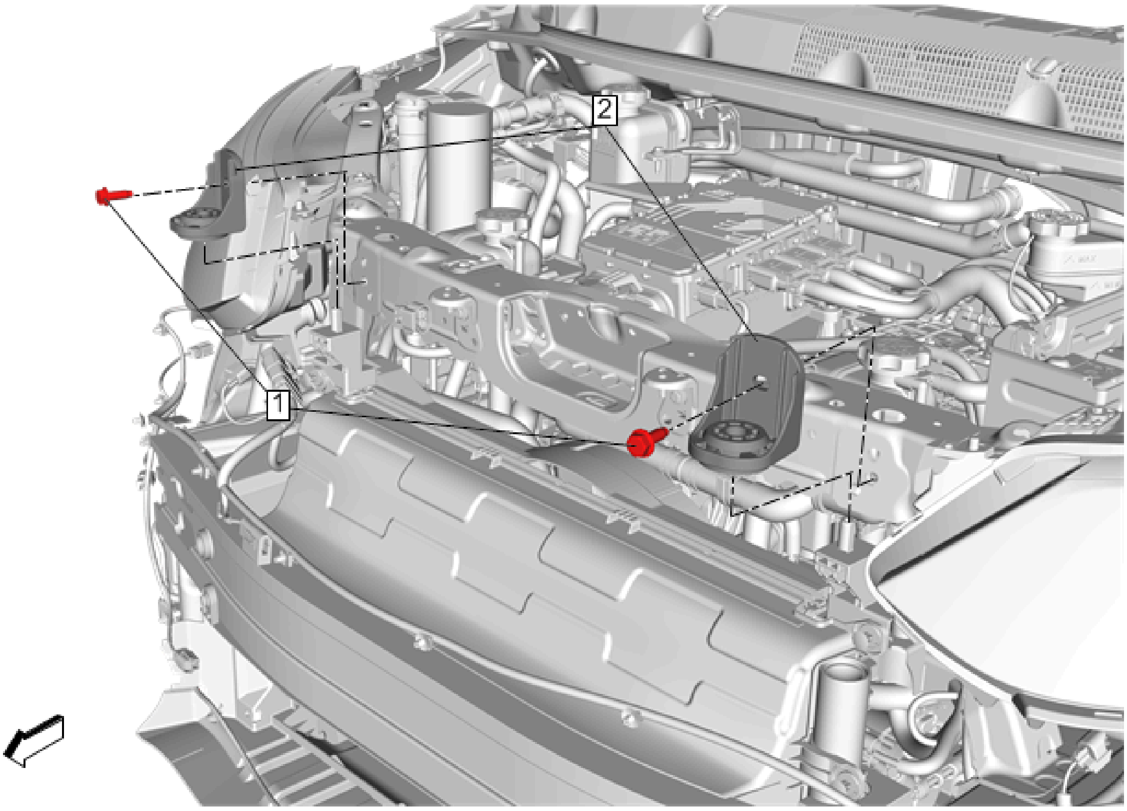


Fig. 129: Radiator Upper Brackets
Courtesy of GENERAL MOTORS COMPANY

7. Install Radiator Upper Brackets (2) (Qty: 2). Refer to **Radiator Upper Bracket Replacement**

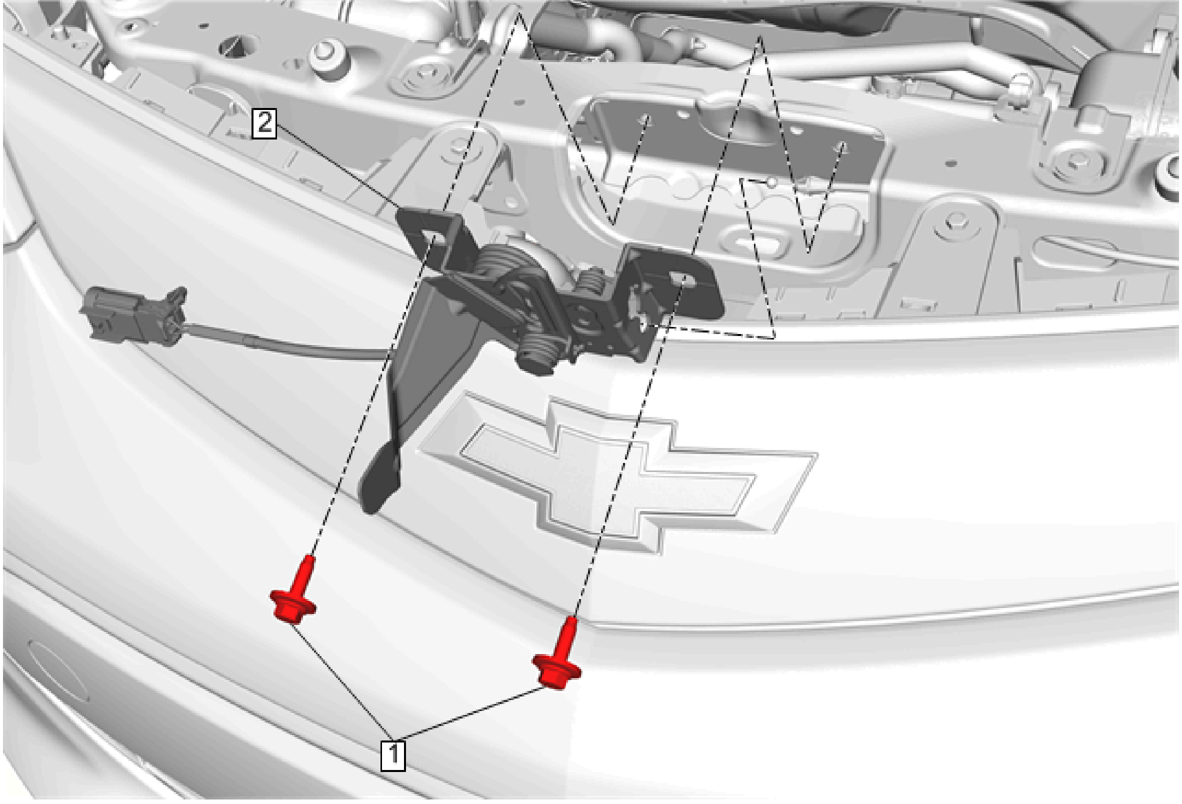


Fig. 130: Hood Primary and Secondary Latch
Courtesy of GENERAL MOTORS COMPANY

8. Install the hood primary and secondary latch (2). Refer to **Hood Primary and Secondary Latch Replacement**

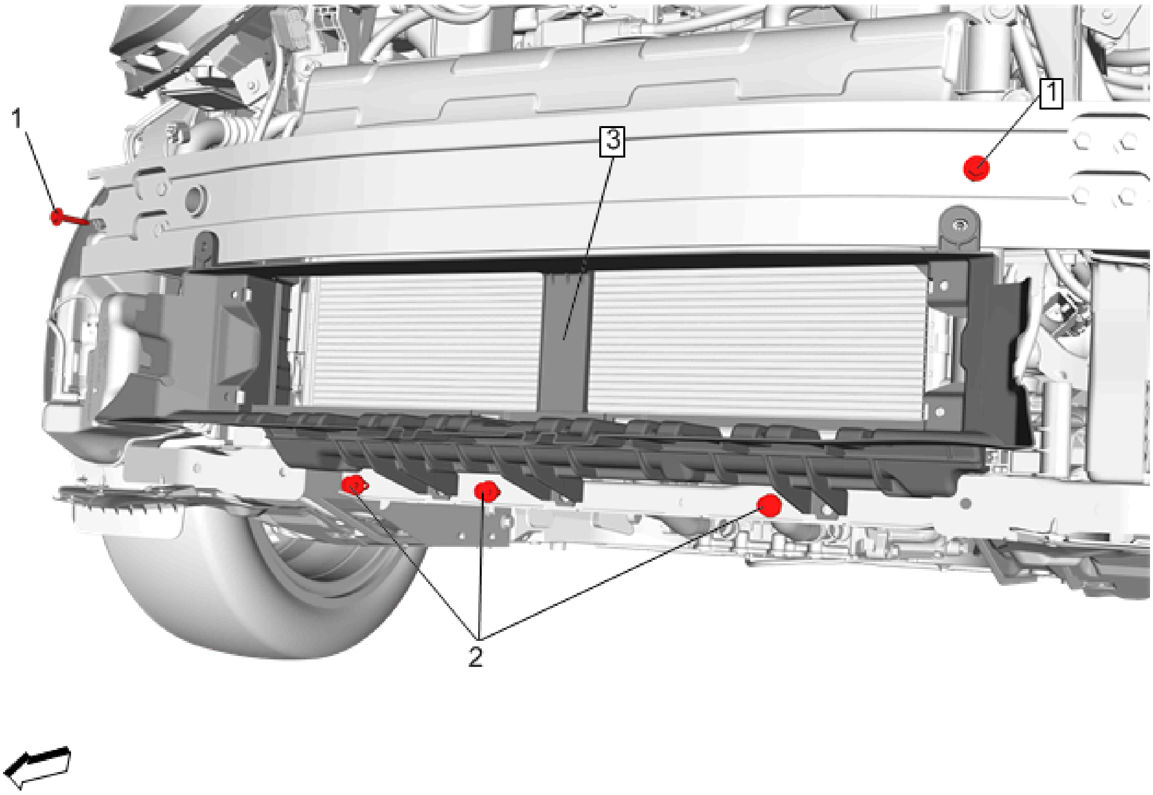


Fig. 131: Radiator Air Lower Baffle and Deflector Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Install Radiator Air Lower Baffle and Deflector Assembly (3). Refer to **Radiator Air Lower Baffle and Deflector Replacement**

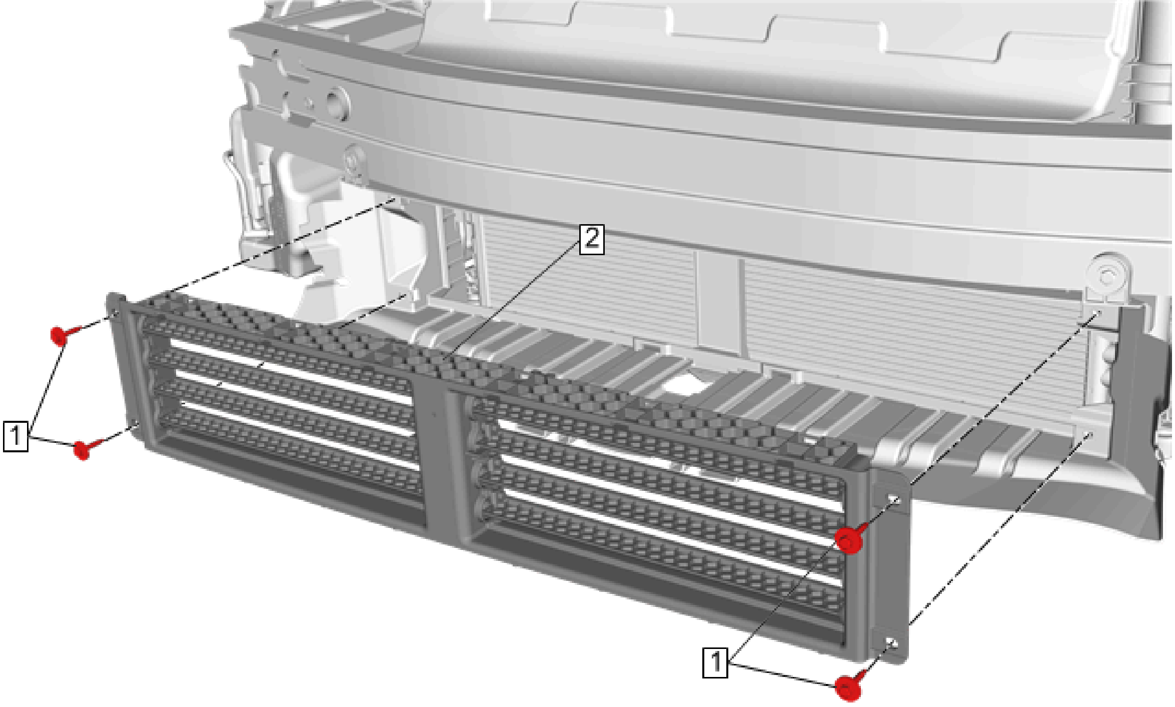


Fig. 132: Front Bumper Shutter
Courtesy of GENERAL MOTORS COMPANY

10. Install Front Bumper Shutter (2). Refer to **Front Bumper Shutter Replacement**

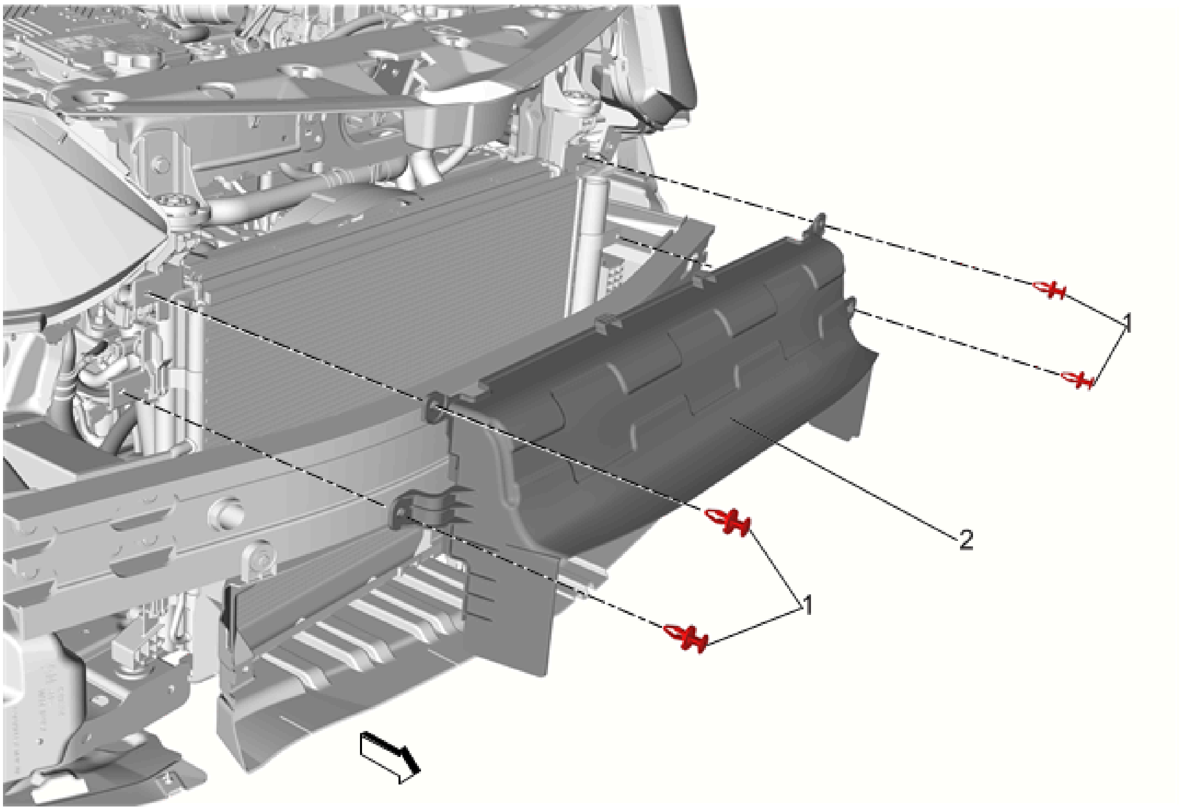


Fig. 133: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

11. Install Radiator Air Upper Baffle and Deflector (2). Refer to **Radiator Air Upper Baffle and Deflector Replacement**
12. Install Front Bumper Fascia. Refer to **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**

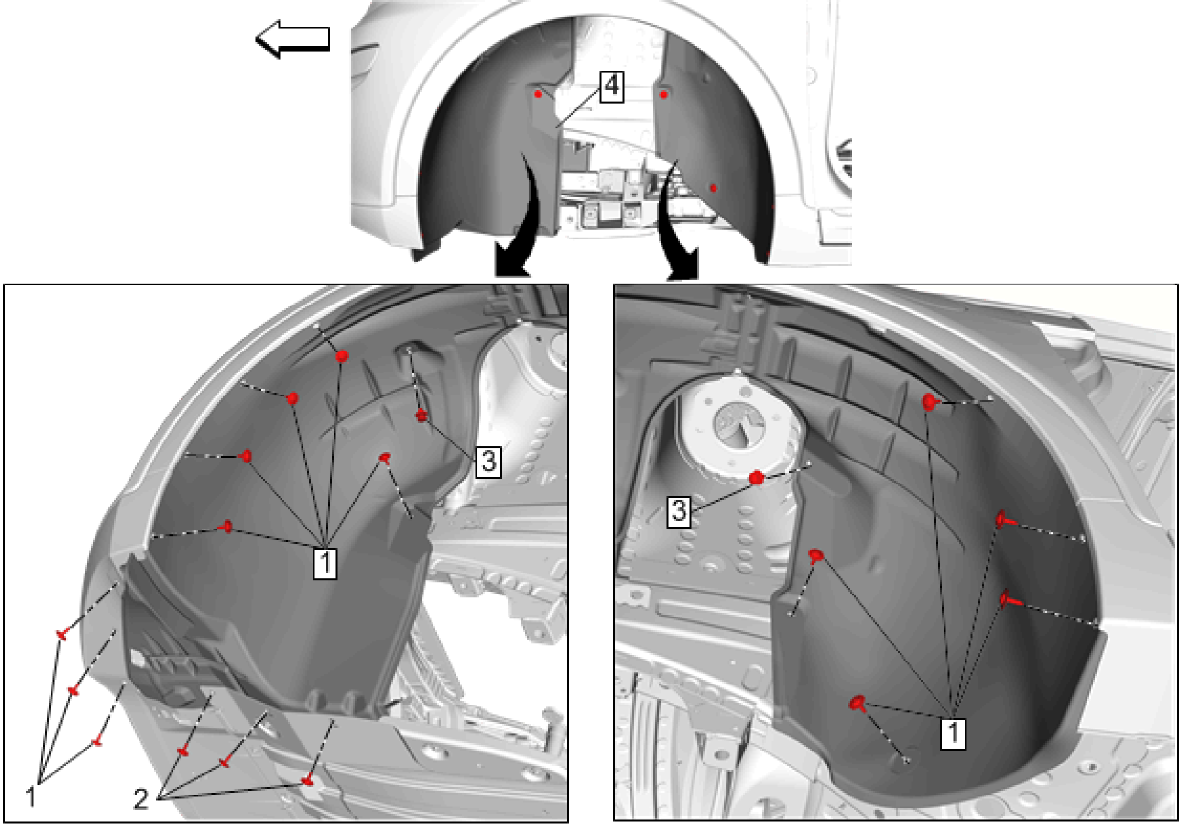


Fig. 134: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

13. Install Front Wheelhouse Liner (4) (Qty: 2). Refer to **Front Wheelhouse Liner Replacement**

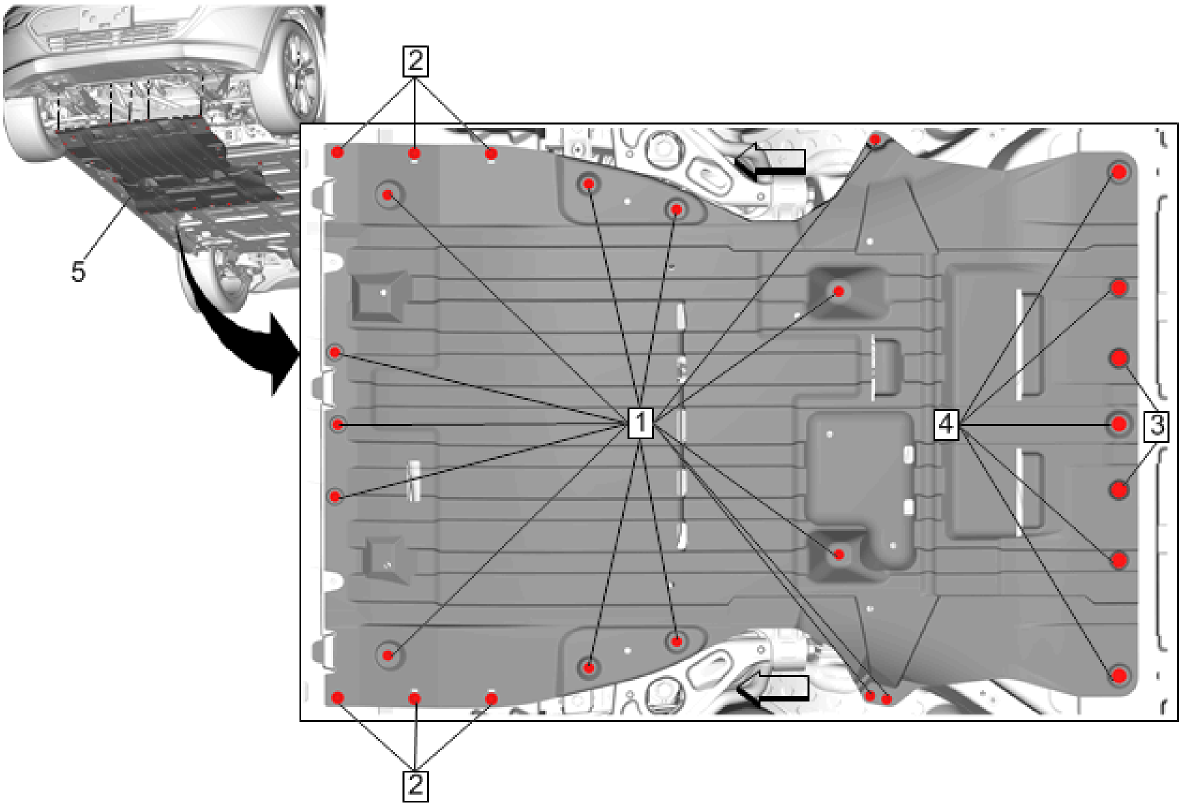


Fig. 135: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

14. Install Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**

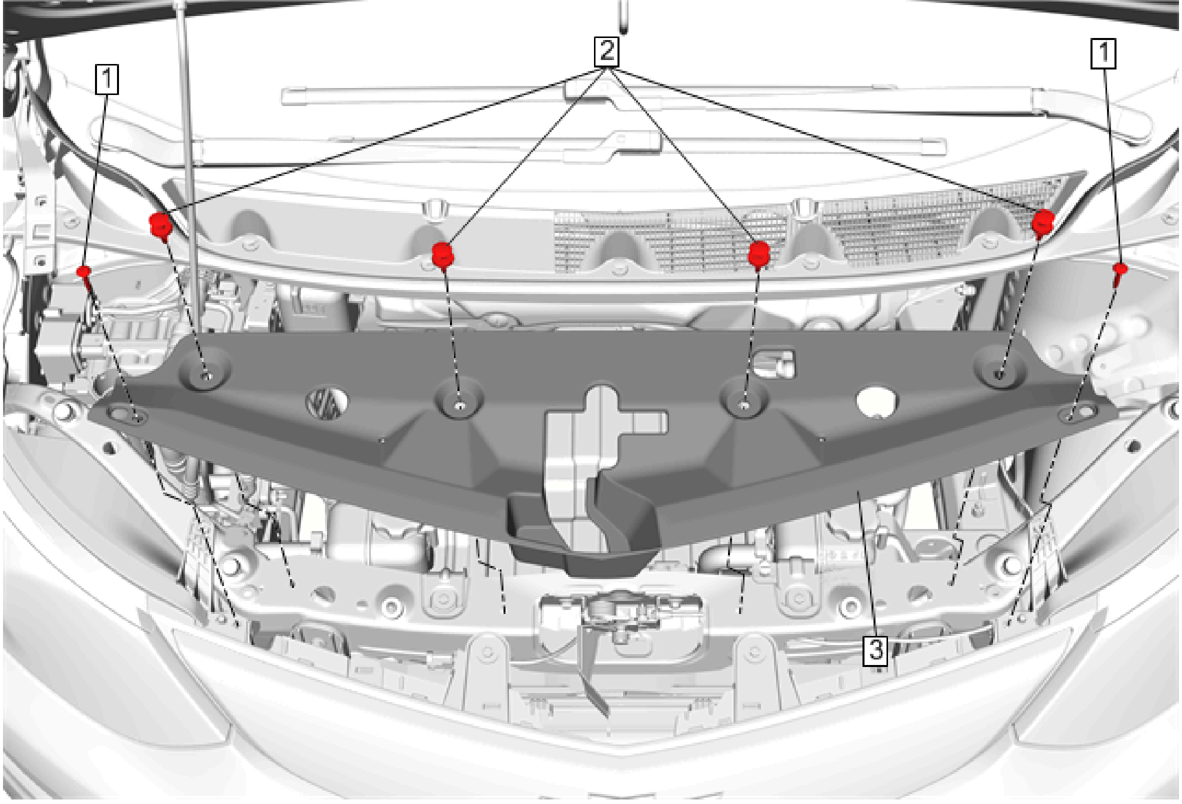


Fig. 136: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

15. Install Front Compartment Front Sight Shield (3). Refer to Front Compartment Front Sight Shield Replacement
16. Connect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT - RADIATOR SIDE

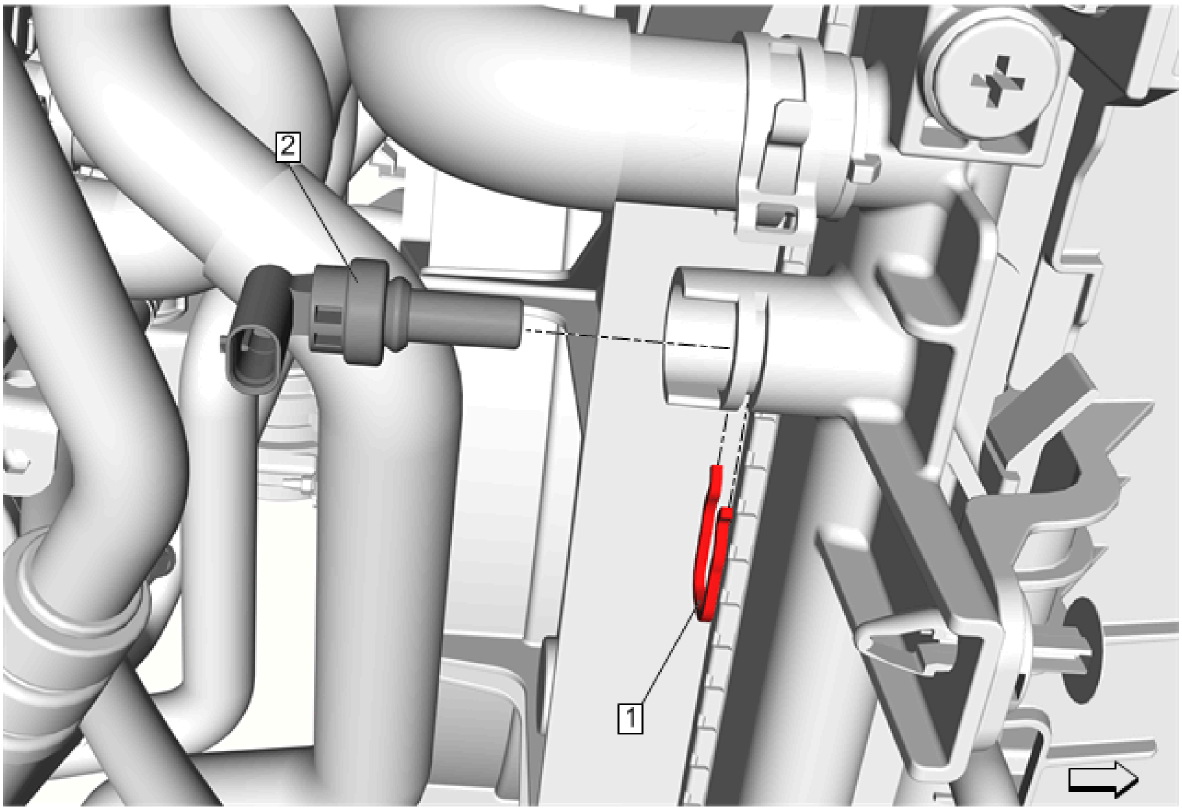


Fig. 137: Engine Coolant Temperature Sensor - Radiator Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** 2. Remove the RESS surge tank bracket. Refer to **Radiator Surge Tank Support Bracket Replacement (RESS)** 3. Disconnect the electrical connector from the engine coolant temperature sensor.	
1	Engine Coolant Temperature Sensor Retainer
2	Engine Coolant Temperature Sensor **Procedure** After replacement, connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**

RADIATOR DRAIN COCK REPLACEMENT

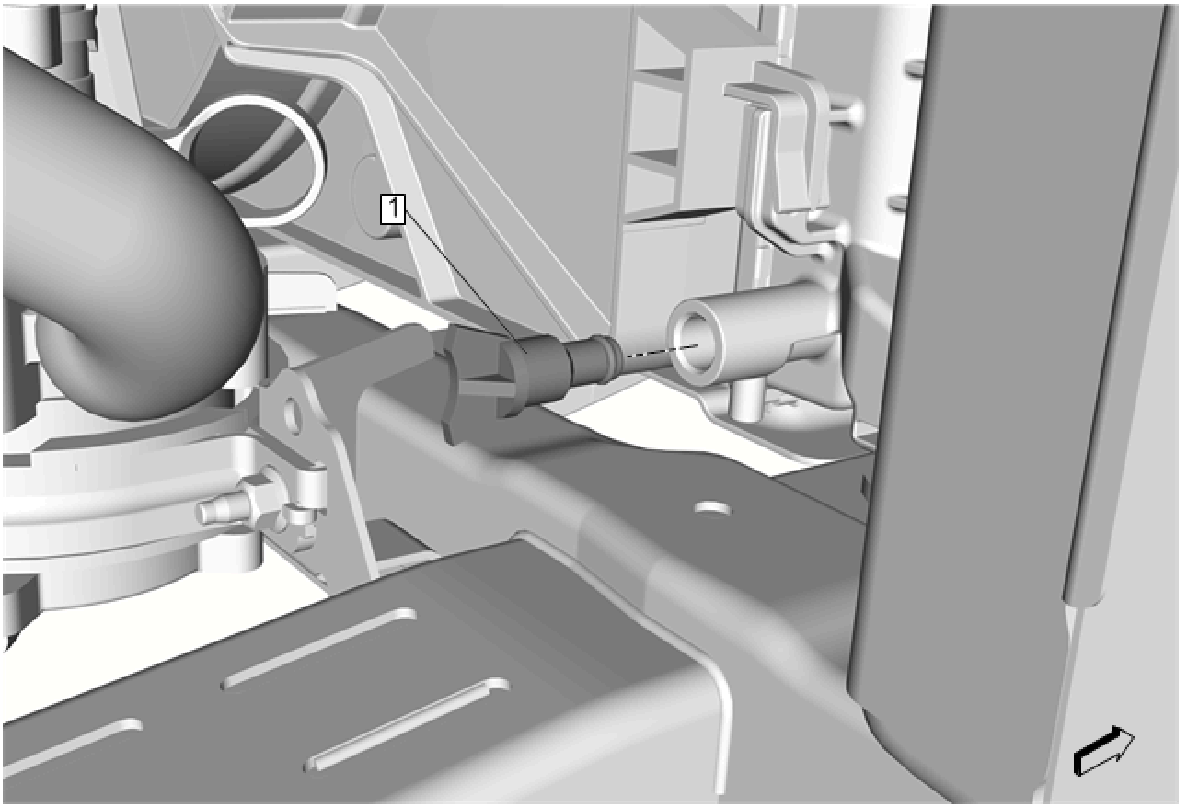


Fig. 138: Radiator Drain Cock
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.** **Preliminary Procedures** 1. Remove the right front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** 2. Remove the front compartment air deflector. Refer to **Front Compartment Air Deflector Replacement** 3. Drain the drive motor cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**	

Callout	Component Name
1	Radiator Drain Cock **CAUTION:** **Refer to Fastener Caution .** **Procedures** 1. Reposition the lower portion of the fascia to access the drain port. 2. Attach a rubber hose to the drive motor battery coolant radiator drain port. 3. Place a drain pan under the left side of the drive motor battery coolant radiator. 4. After installation, fill the coolant reservoir to the fill level. Refer to **Drive Motor Battery Cooling System Draining and Filling** 5. Inspect cooling system for leaks.

RADIATOR LOWER INSULATOR REPLACEMENT

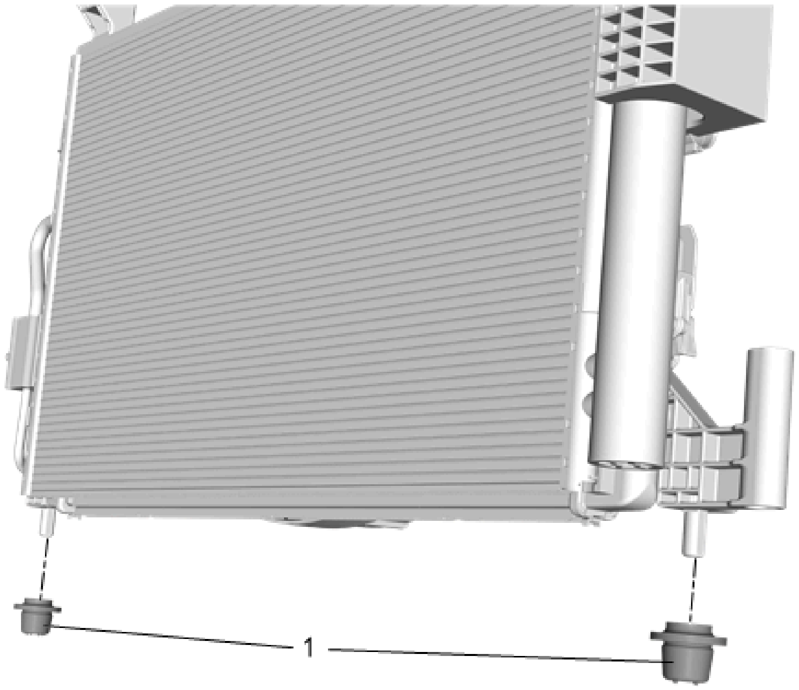


Fig. 139: Radiator Lower Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Front Bumper Fascia. Refer to **Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)** 2. Remove Radiator Upper Bracket. Refer to **Radiator Upper Bracket Replacement**	
1	Radiator Lower Insulator

RADIATOR UPPER BRACKET REPLACEMENT

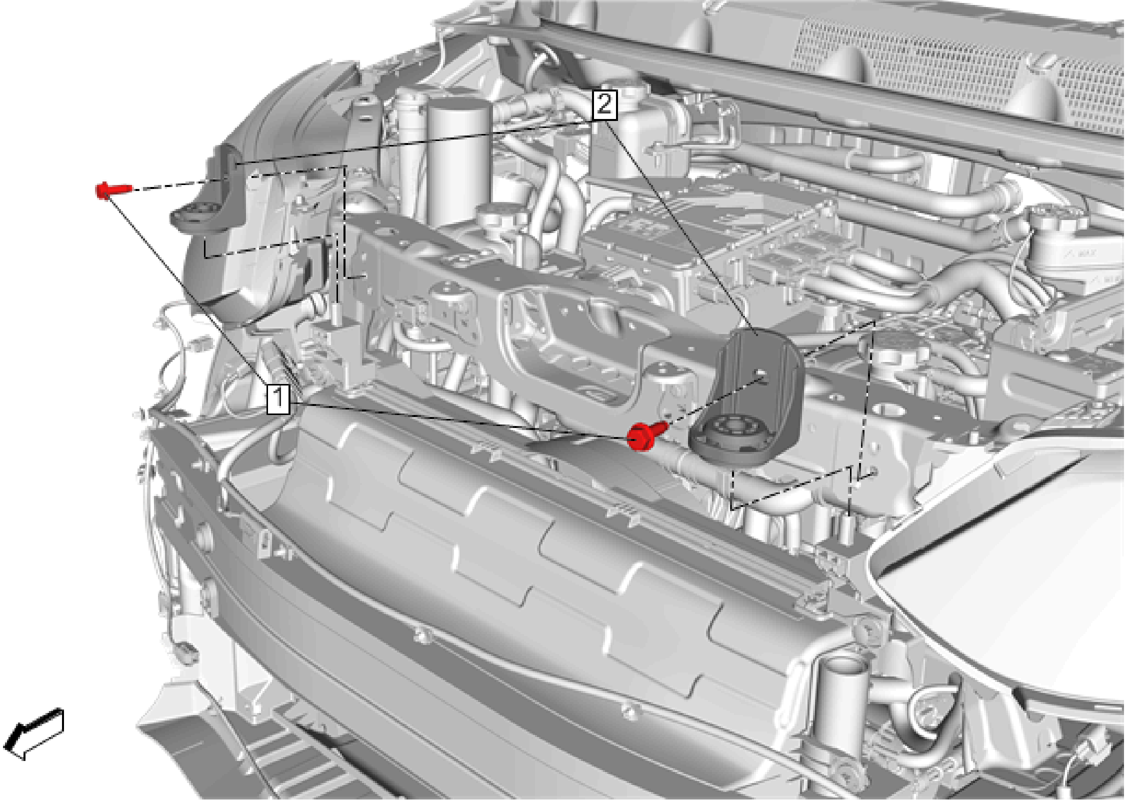


Fig. 140: Radiator Upper Brackets
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Compartment Front Sight Shield. Refer to **Front Compartment Front Sight Shield Replacement**	
1	Radiator Upper Bracket Fastener (Qty: 2) **CAUTION:** **Refer to Fastener Caution** 22 N.m (16 lb ft)
2	Radiator Upper Bracket

RADIATOR VENT VALVE REPLACEMENT

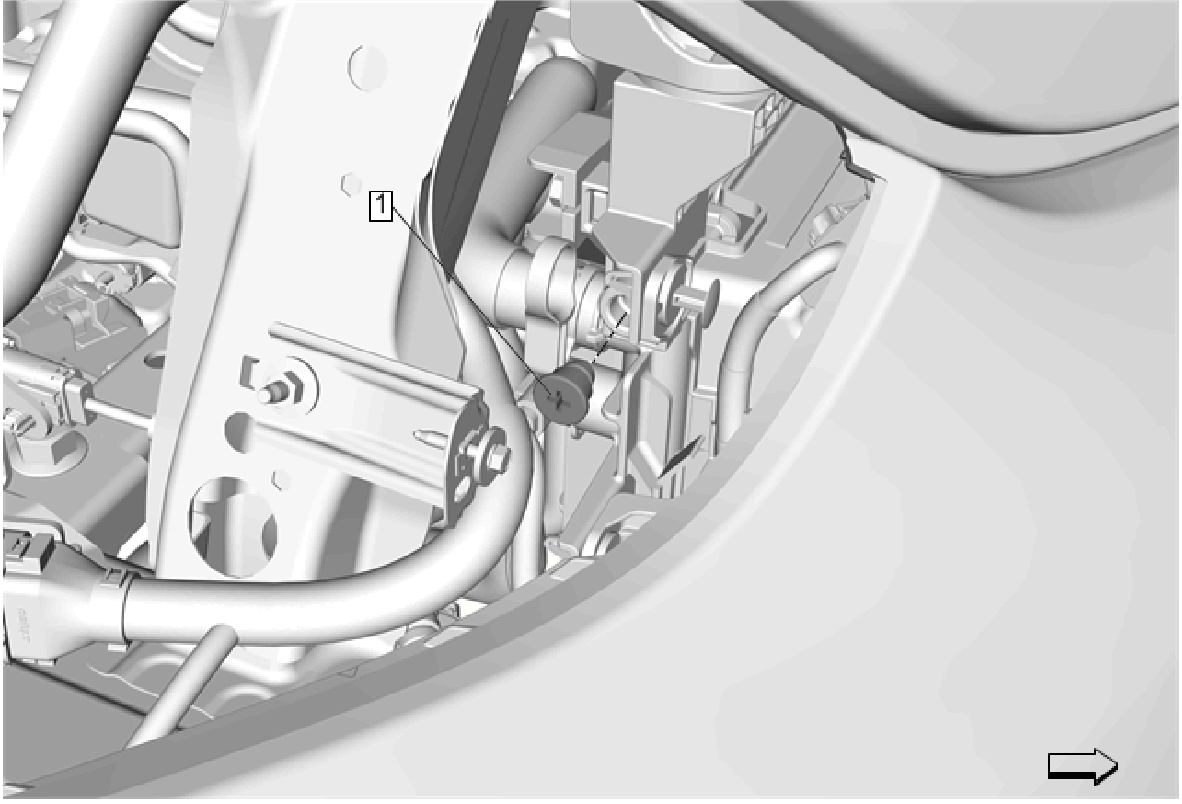


Fig. 141: Radiator Vent Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia. Refer to Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)	
1	Radiator Vent Valve **CAUTION:** **Refer to Fastener Caution** 1.9 N.m (17 lb in)

RADIATOR PROTECTOR REPLACEMENT

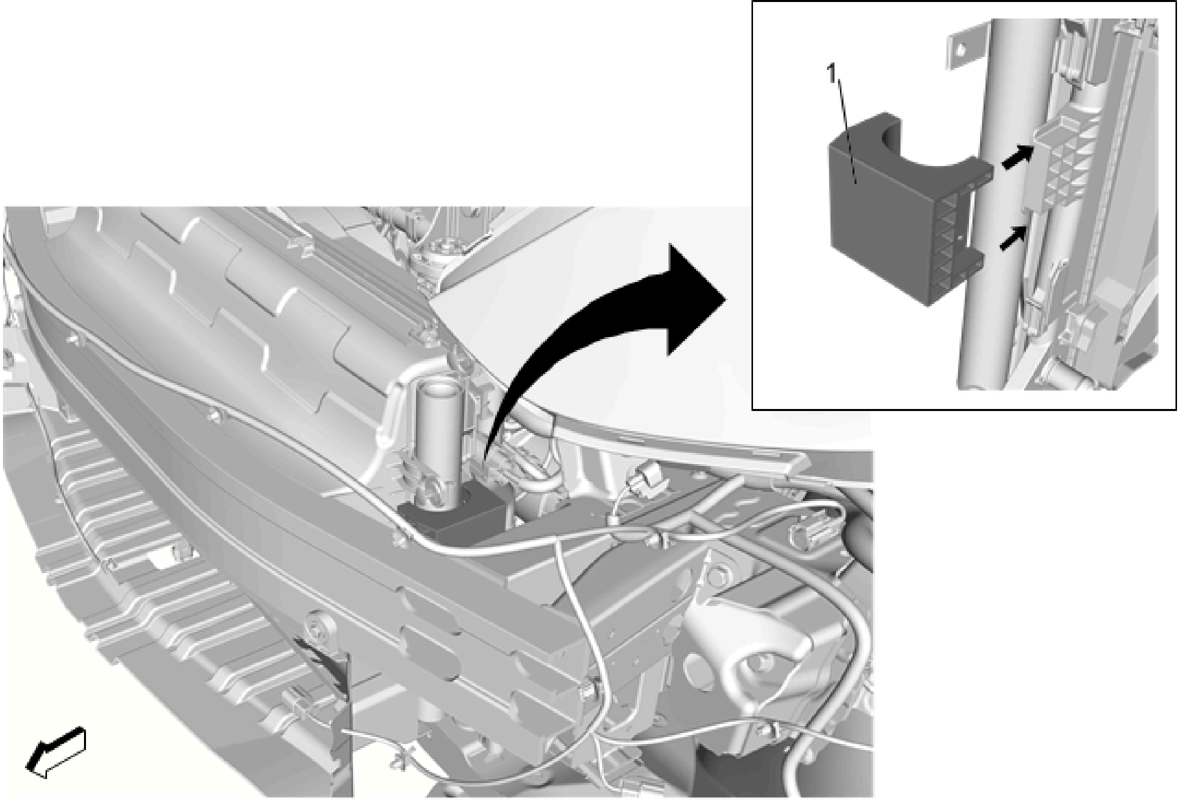


Fig. 142: Radiator Protector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia. Refer to Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)	
1	Radiator Protector **Procedure** Using a flat bladed tool, work the protector off of the radiator towards the drivers slide of the vehicle. Reposition the radiator as necessary.

DRIVE MOTOR GENERATOR CONTROL MODULE COOLANT PUMP HOSE REPLACEMENT (SURGE TANK TO PUMP)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling
3. Remove Front Compartment Front Sight Shield. Refer to Front Compartment Front Sight Shield Replacement

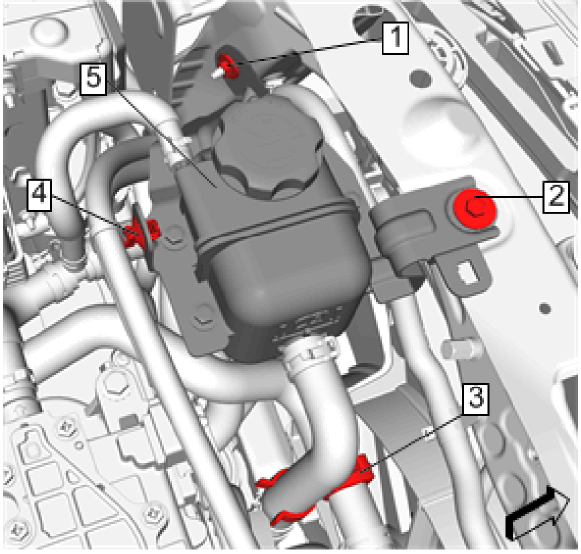


Fig. 143: Radiator Surge Tank Assembly And Fasteners
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not remove any coolant hoses from the surge tanks.**

4. Remove Radiator Surge Tank Bracket Bolt (2)
5. Remove Radiator Surge Tank Bracket Nut (1)
6. {If equipped} Remove Retainers (3, 4)
7. To gain access to the second radiator inlet hose clamp, lay the radiator surge tank assembly (5) aside.

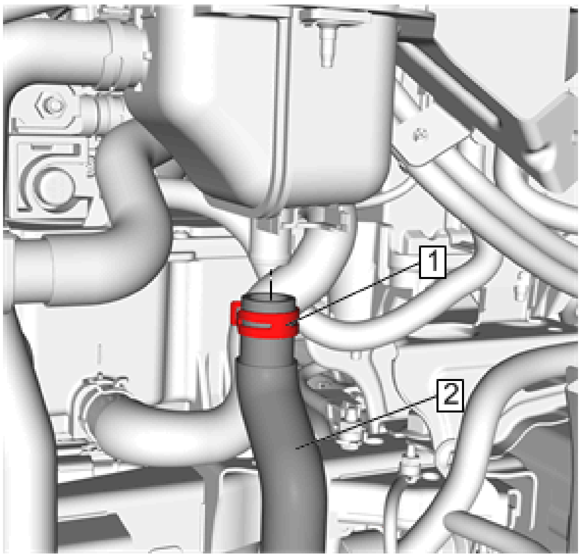


Fig. 144: Drive Motor Generator Control Module Coolant Pump Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
9. Remove Drive Motor Generator Control Module Coolant Pump Hose (2)
10. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
11. Disconnect the pump electrical connector.
12. Remove the pump/hose assembly from the vehicle. Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)**

NOTE: **The drain procedure has the technician remove the pump fasteners and one of the hoses. It is better to disconnect the pump electrical, and remove the pump/hose together.**

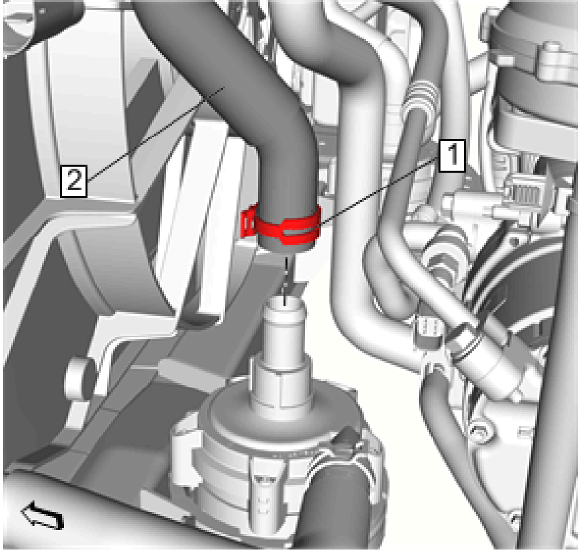


Fig. 145: Drive Motor Generator Control Module Coolant Pump Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

13. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
14. Remove Drive Motor Generator Control Module Coolant Pump Hose (2)

Installation Procedure

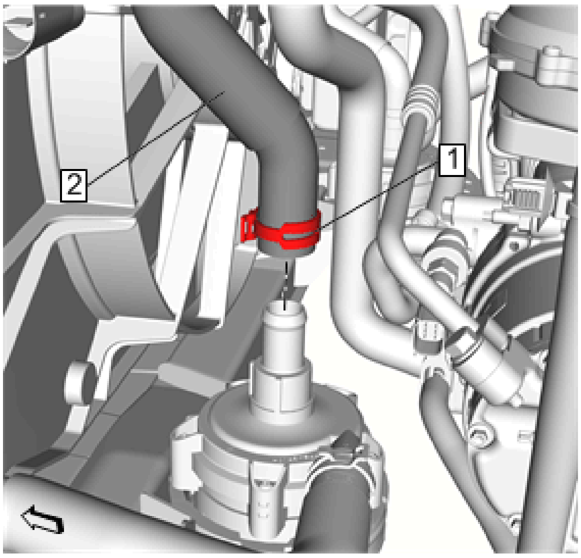


Fig. 146: Drive Motor Generator Control Module Coolant Pump Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Generator Control Module Coolant Pump Hose (2)
2. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
3. Install the pump/hose assembly to the vehicle. Refer to **Drive Motor Battery Coolant Pump Replacement (RESS Pump)Drive Motor Battery Coolant Pump Replacement (PE Pump)**
4. Connect the pump electrical connector.

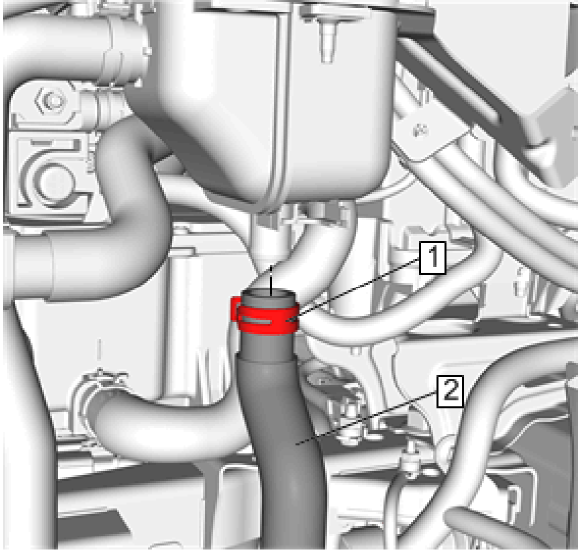


Fig. 147: Drive Motor Generator Control Module Coolant Pump Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install Drive Motor Generator Control Module Coolant Pump Hose (2)
6. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
7. Install Radiator Surge Tank (5)

CAUTION: **Refer to Fastener Caution**

8. Install and tighten Radiator Surge Tank Bracket Nut (1) to 9 N.m (80 lb in)
9. Install and tighten Radiator Surge Tank Bracket Bolt (2) to 9 N.m (80 lb in)
10. {If Equipped} Install Retainers (3, 4)
11. Install Front Compartment Front Sight Shield. Refer to **Front Compartment Front Sight Shield Replacement**
12. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
13. Check the cooling system for leaks.

DRIVE MOTOR GENERATOR CONTROL MODULE COOLING OUTLET HOSE REPLACEMENT (SPIM TO APM)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

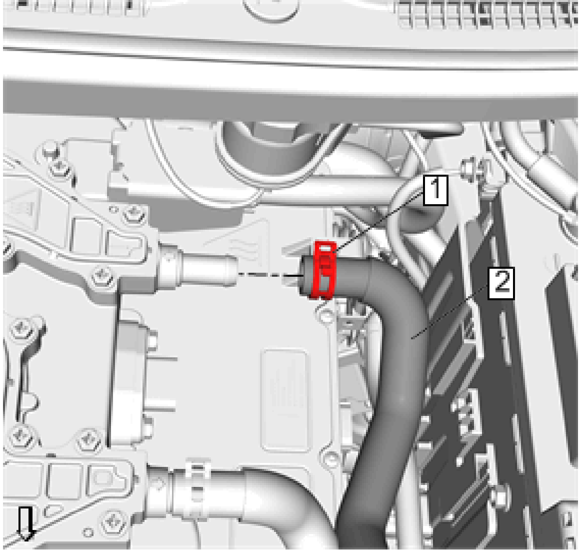


Fig. 148: Drive Motor Generator Control Module Cooling Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
4. Remove Drive Motor Generator Control Module Cooling Outlet Hose (2)

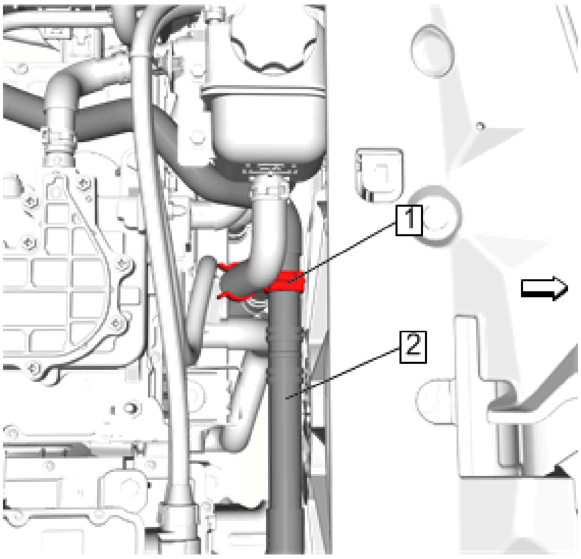


Fig. 149: Drive Motor Generator Control Module Cooling Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

5. Remove Retainer (1)
6. Remove Drive Motor Generator Control Module Cooling Outlet Hose (2)
7. Remove the RESS surge tank bracket and reposition the surge tank. Refer to **Radiator Surge Tank Support Bracket Replacement (RESS)**

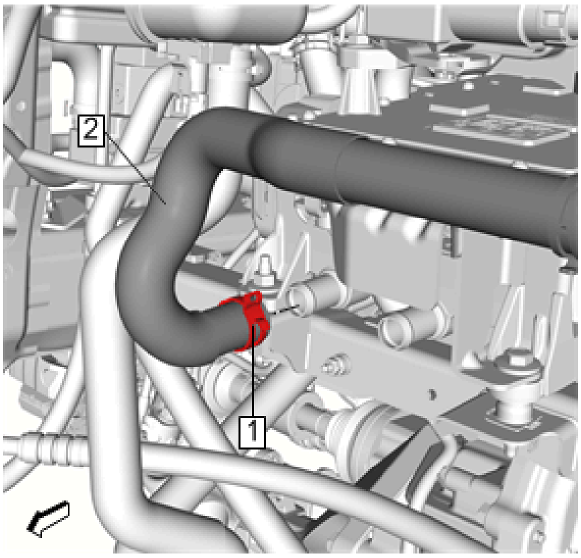


Fig. 150: Drive Motor Generator Control Module Cooling Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
9. Remove Drive Motor Generator Control Module Cooling Outlet Hose (2)

Installation Procedure

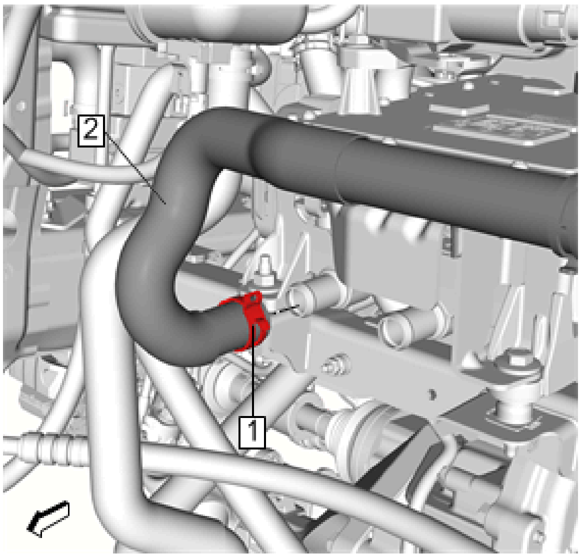


Fig. 151: Drive Motor Generator Control Module Cooling Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Generator Control Module Cooling Outlet Hose (2)
2. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
3. Position the surge tank and install the RESS surge tank bracket. Refer to **Radiator Surge Tank Support Bracket Replacement (RESS)**

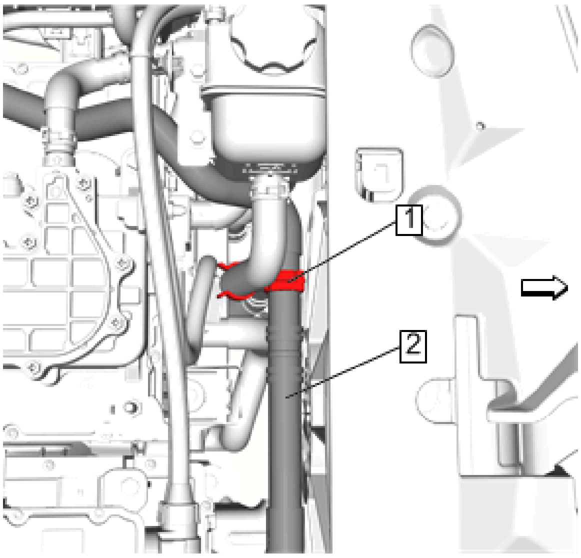


Fig. 152: Drive Motor Generator Control Module Cooling Outlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install Retainer (1)
5. Install Drive Motor Generator Control Module Cooling Outlet Hose (2)

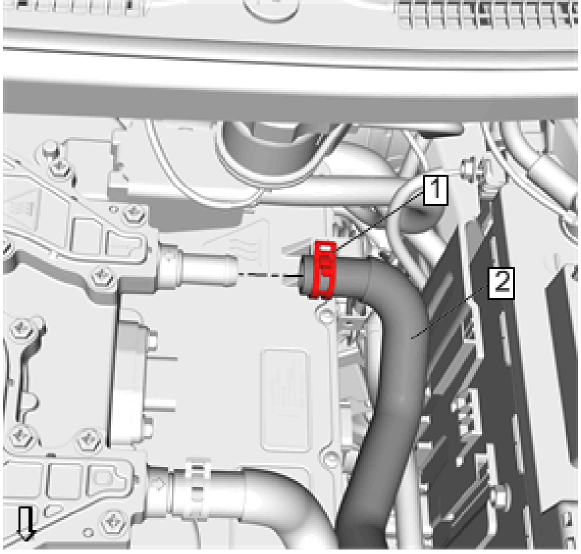


Fig. 153: Drive Motor Generator Control Module Cooling Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

6. Install Drive Motor Generator Control Module Cooling Outlet Hose (2)
7. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
8. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
9. Check the cooling system for leaks.

DRIVE MOTOR GENERATOR CONTROL MODULE RADIATOR INLET HOSE REPLACEMENT (PUMP TO RADIATOR)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Remove Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
3. Remove Front Wheelhouse Liner-Left Side. Refer to **Front Wheelhouse Liner Replacement**
4. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

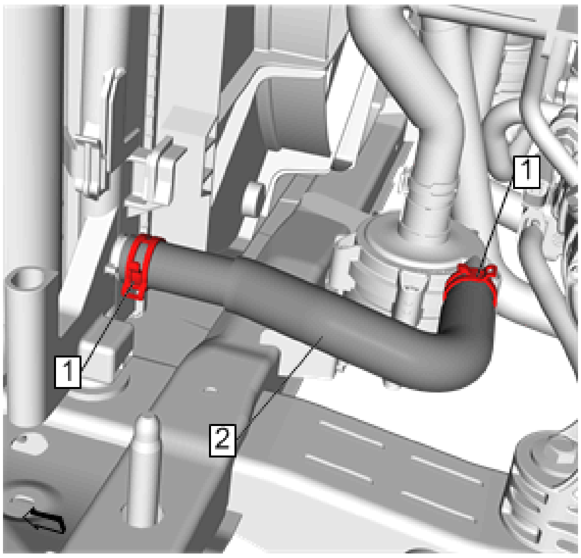


Fig. 154: Drive Motor Generator Control Module Radiator Inlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Clamps (1) (Qty: 2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
6. Remove Drive Motor Generator Control Module Radiator Inlet Hose (2)

Installation Procedure

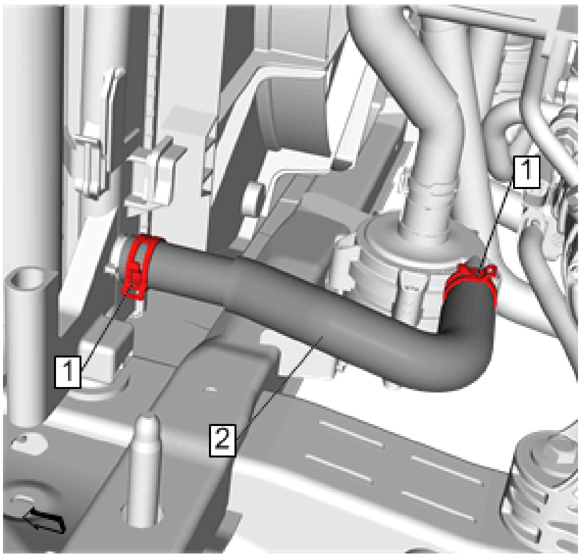


Fig. 155: Drive Motor Generator Control Module Radiator Inlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Generator Control Module Radiator Inlet Hose (2)
2. Engage Clamps (1) (Qty: 2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
3. Install Front Wheelhouse Liner-Left Side. Refer to **Front Wheelhouse Liner Replacement**
4. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
5. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
6. Check the cooling system for leaks.

DRIVE MOTOR GENERATOR CONTROL MODULE RADIATOR OUTLET HOSE REPLACEMENT (RADIATOR TO SPIM)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**
3. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
4. Remove Front Compartment Front Sight Shield. Refer to **Front Compartment Front Sight Shield Replacement**

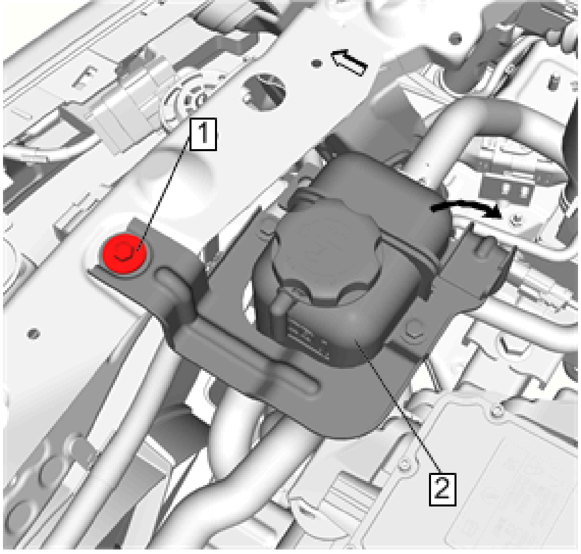


Fig. 156: Drive Motor Battery Radiator Surge Tank And Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove Drive Motor Battery Radiator Surge Tank Bracket Bolt (1)
6. Position aside drive motor battery radiator surge tank (2).

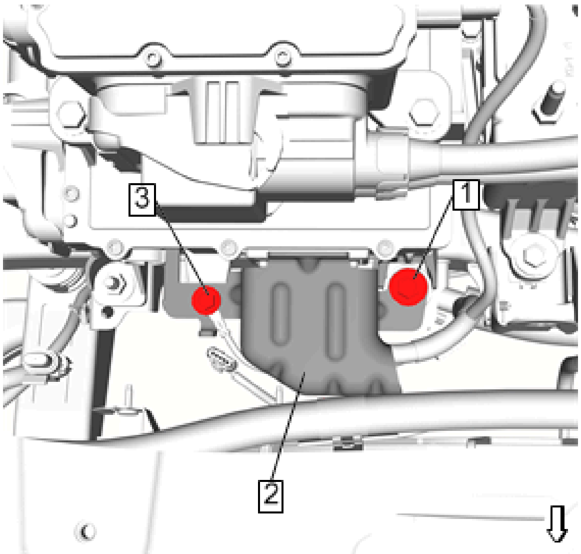


Fig. 157: Drive Motor Power Inverter Module Shield And Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove Drive Motor Power Inverter Module Shield Bolt (1)
8. Remove Ground Cable Bolt (3) @ Drive Motor Power Inverter Module
9. Remove Drive Motor Power Inverter Module Shield (2)

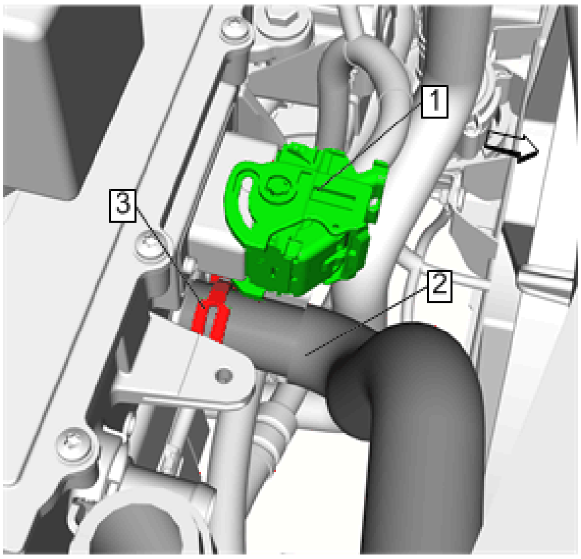


Fig. 158: Drive Motor Generator Control Module Radiator Outlet Hose, Clamp And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Electrical Connector (1)
11. Disengage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
12. Remove Drive Motor Generator Control Module Radiator Outlet Hose (2)

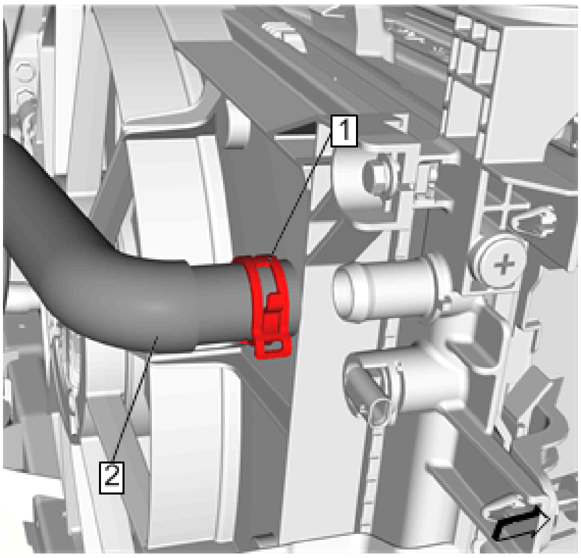


Fig. 159: Drive Motor Generator Control Module Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

13. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
14. Remove Drive Motor Generator Control Module Radiator Outlet Hose (2)

Installation Procedure

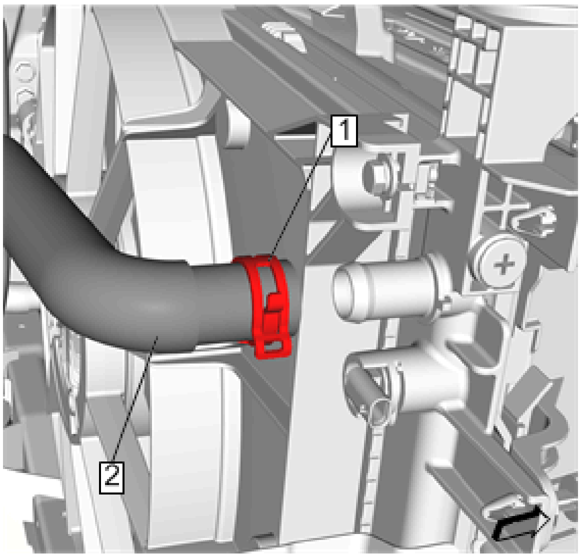


Fig. 160: Drive Motor Generator Control Module Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Generator Control Module Radiator Outlet Hose (2)
2. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

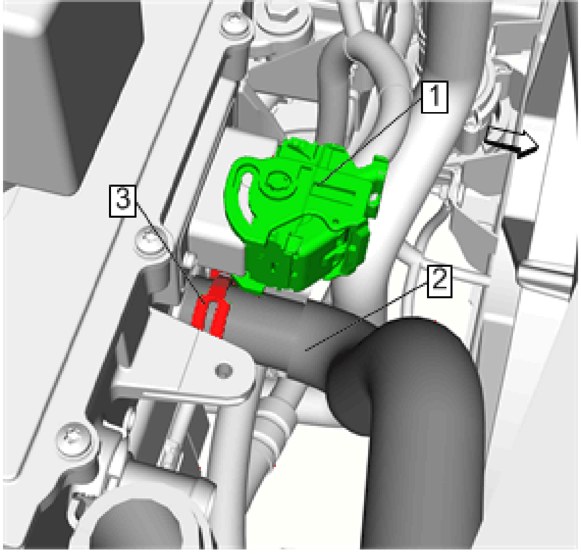


Fig. 161: Drive Motor Generator Control Module Radiator Outlet Hose, Clamp And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Install Drive Motor Generator Control Module Radiator Outlet Hose (2)
4. Engage Clamp (3). Refer to Hose Clamp Replacement Guidelines - Spring Type
5. Connect Electrical Connector (1)

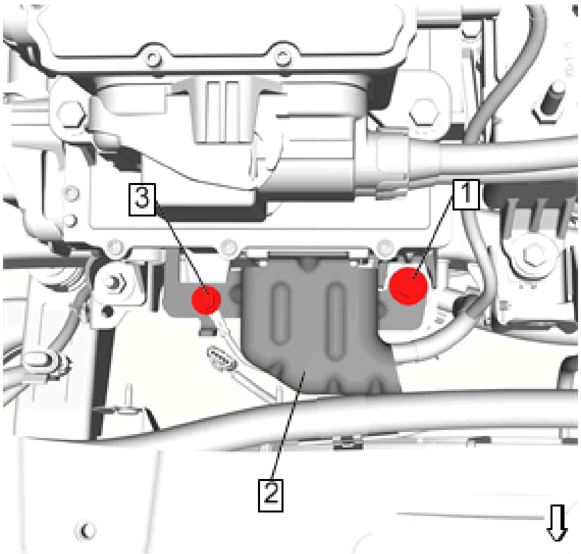


Fig. 162: Drive Motor Power Inverter Module Shield And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install Drive Motor Power Inverter Module Shield (2)

CAUTION: **Refer to Fastener Caution**

7. Install and tighten Ground Cable Bolt (3) @ Drive Motor Power Inverter Module to 9 N.m (80 lb in)
8. Install and tighten Drive Motor Power Inverter Module Shield Bolt (1) to 25 N.m (18 lb ft)

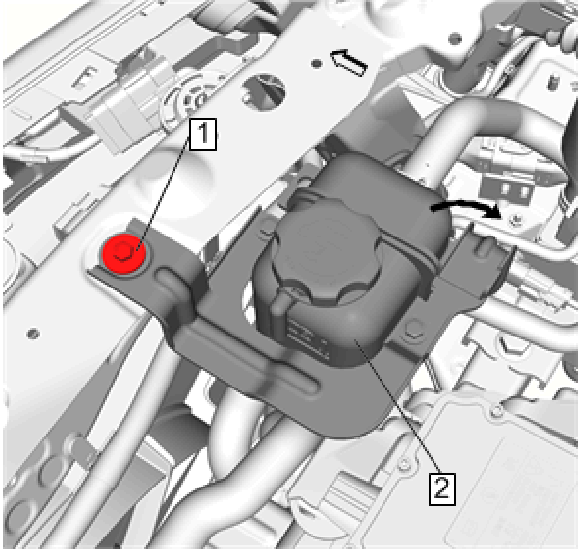


Fig. 163: Drive Motor Battery Radiator Surge Tank And Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Install Drive Motor Battery Radiator Surge Tank (2)
10. Install and tighten Drive Motor Battery Radiator Surge Tank Bracket Bolt (1) to 9 N.m (80 lb in)
11. Install Front Compartment Front Sight Shield. Refer to **Front Compartment Front Sight Shield Replacement**
12. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
13. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**

RADIATOR AIR LOWER BAFFLE AND DEFLECTOR REPLACEMENT

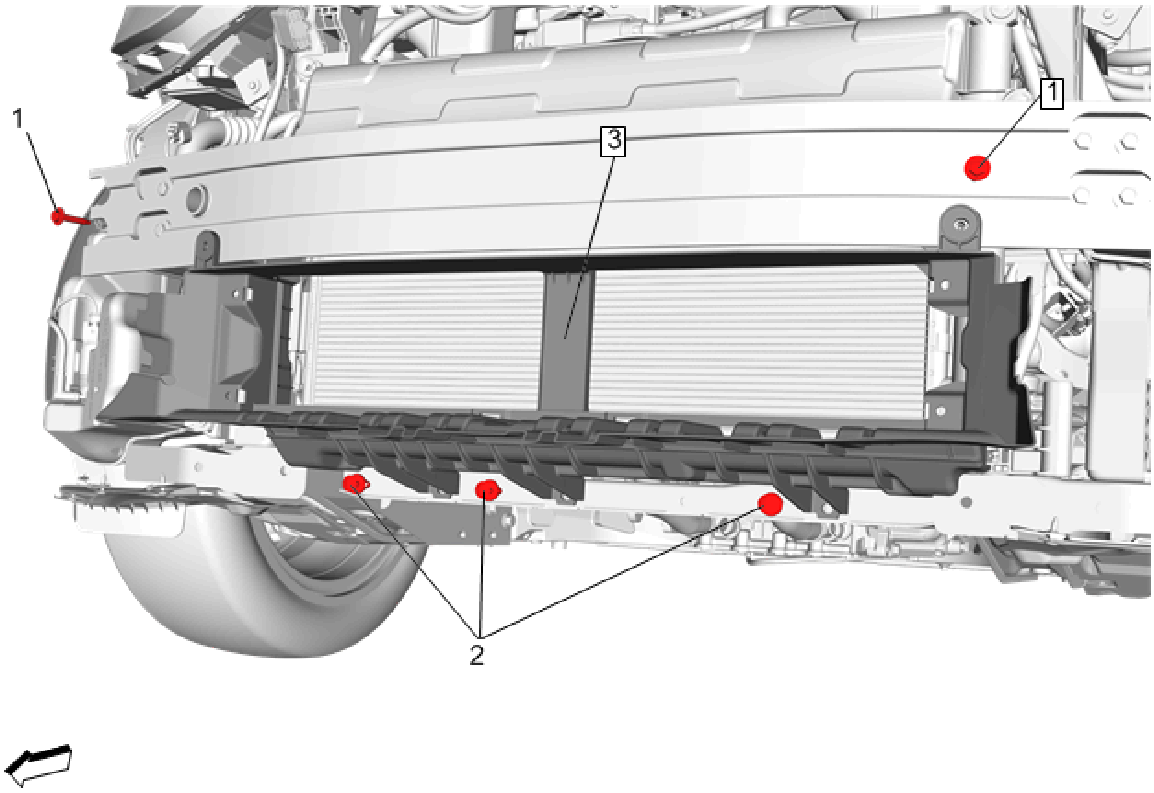


Fig. 164: Radiator Air Lower Baffle and Deflector Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Shutter. Refer to **Front Bumper Shutter Replacement**	

Callout	Component Name
1	Radiator Air Lower Baffle Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** 9 N.m (80 lb in)
2	Radiator Air Lower Baffle Retainer (Qty: 3)
3	Radiator Air Lower Baffle and Deflector Assembly **Procedure** Unclip the electrical harness.

RADIATOR AIR UPPER BAFFLE AND DEFLECTOR REPLACEMENT

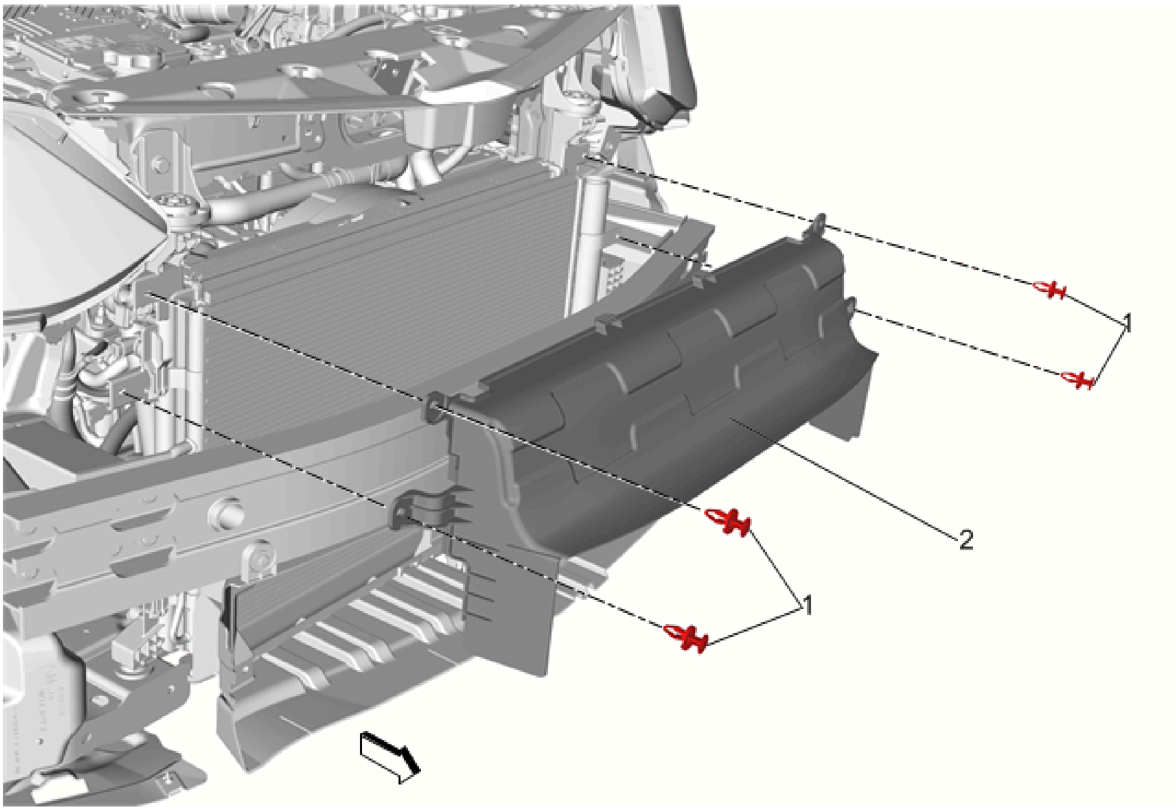


Fig. 165: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Front Bumper Fascia. Refer to Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)	
1	Radiator Air Upper Baffle Retainer (Qty: 4)
2	Radiator Air Upper Baffle and Deflector

HIGH VOLTAGE BATTERY HEATER REPLACEMENT

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to **High Voltage Disabling**
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
3. Drain the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**

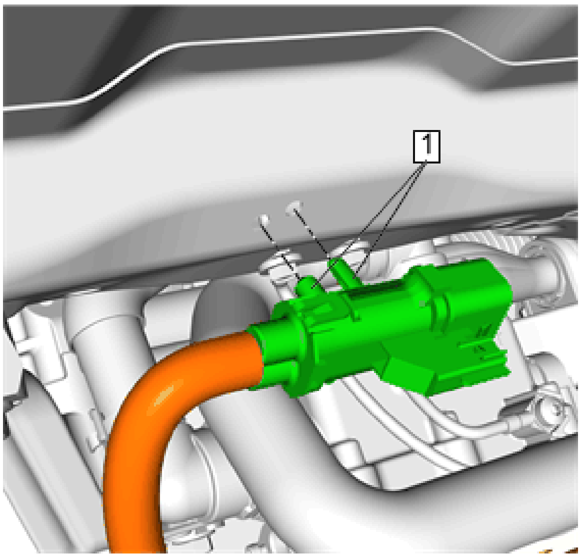


Fig. 166: Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Unclip Retainer (1)

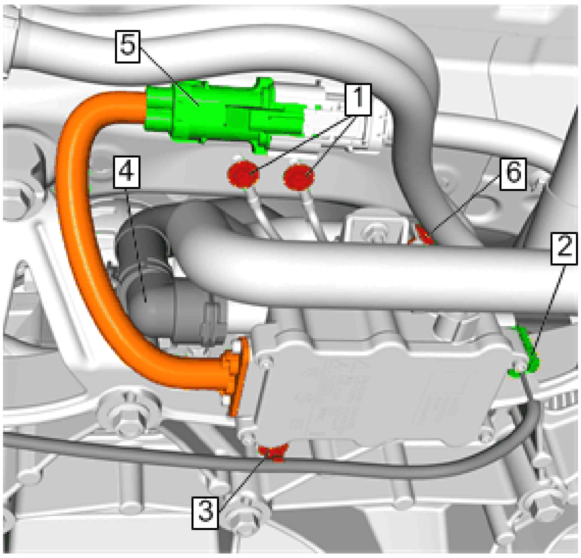


Fig. 167: Drive Motor Battery Coolant Cooler Inlet Hose, Electrical Connectors, Retainers And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connectors (2, 5)
6. Remove Retainers (3, 6)
7. Remove Ground Cable Bolts (1) (Qty: 2)
8. Remove Drive Motor Battery Coolant Cooler Inlet Hose (4) @ High Voltage Battery Heater. Refer to **Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump To RESS Heater)**

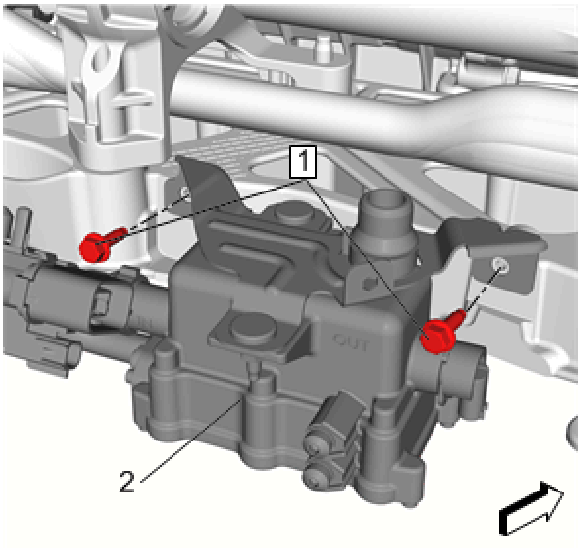


Fig. 168: High Voltage Battery Heater And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Remove Heater Bracket Bolts (1) (Qty: 2)
10. Lower the high voltage battery heater (2) to get the space to access to the battery vent hose.
11. Remove Battery Vent Hose @ High Voltage Battery Heater (2). Refer to **Battery Vent Hose Replacement (RESS HTR To RESS)**
12. Remove High Voltage Battery Heater (2)

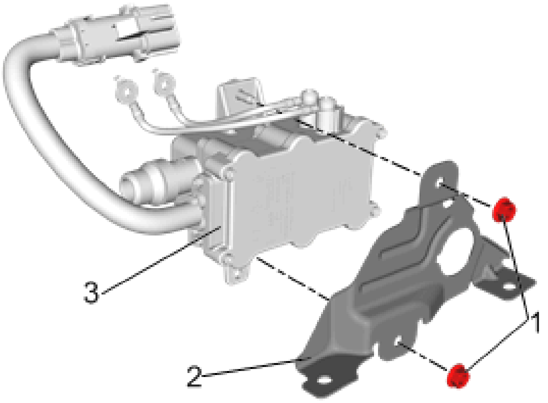


Fig. 169: High Voltage Battery Heater, Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

13. Remove the 2 heater bracket nuts (1).
14. Remove Heater Bracket (2) @ High Voltage Battery Heater (3)

Installation Procedure

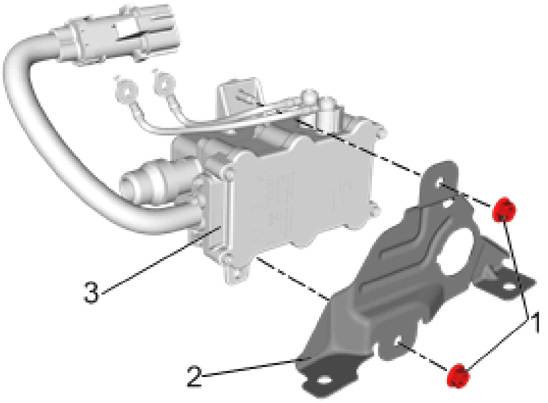


Fig. 170: High Voltage Battery Heater, Bracket And Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Install Heater Bracket (2) @ High Voltage Battery Heater (3)

CAUTION: **Refer to Fastener Caution .**

2. Install the 2 heater bracket nuts (1) and tighten to 9 N.m (80 lb in)

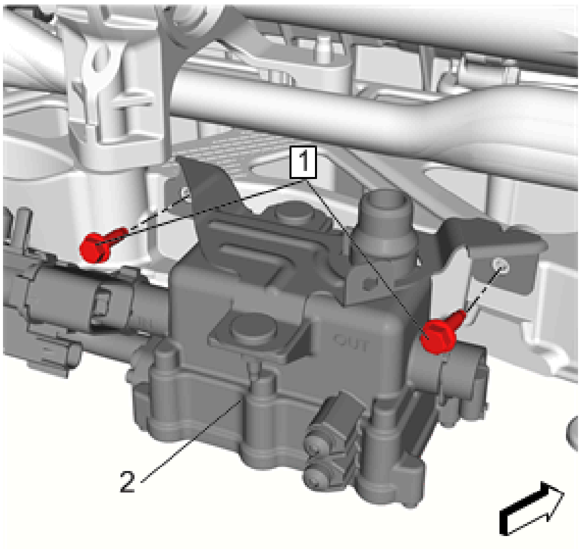


Fig. 171: High Voltage Battery Heater And Bracket Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install High Voltage Battery Heater (2)
4. Install Battery Vent Hose @ High Voltage Battery Heater (2). Refer to Battery Vent Hose Replacement (RESS HTR To RESS)
5. Install and tighten Heater Bracket Bolts (1) (Qty: 2) to 9 N.m (80 lb in)

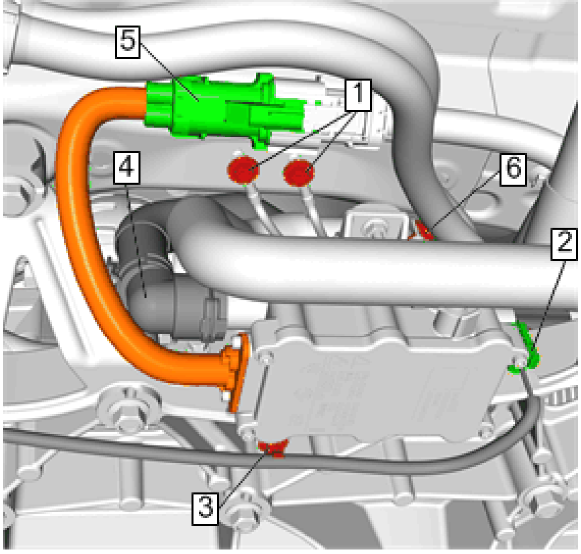


Fig. 172: Drive Motor Battery Coolant Cooler Inlet Hose, Electrical Connectors, Retainers And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Install Drive Motor Battery Coolant Cooler Inlet Hose (4) @ High Voltage Battery Heater. Refer to Drive Motor Battery Coolant Cooler Inlet Hose Replacement (Pump To RESS Heater)
7. Install and tighten Ground Cable Bolt (1) (Qty: 2) to 9 N.m (80 lb in)
8. Install Retainers (3, 6)
9. Connect Electrical Connectors (2, 5)

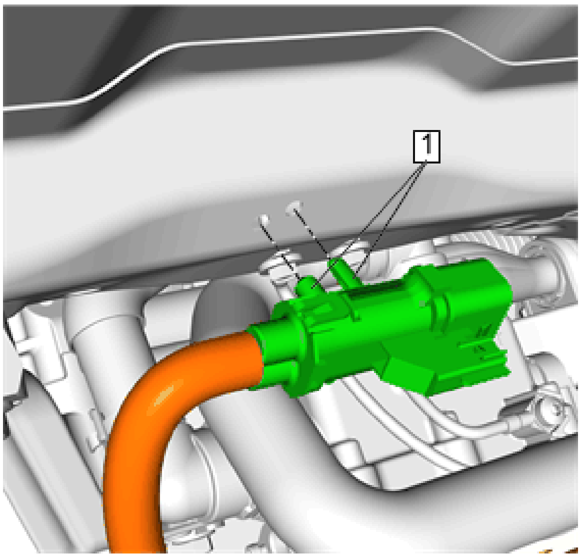


Fig. 173: Retainer
Courtesy of GENERAL MOTORS COMPANY

10. Install Retainer (1)
11. Fill the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling
12. Check the cooling system for leaks.
13. Enable the high voltage system. Refer to High Voltage Enabling

DRIVE MOTOR POWER INVERTER MODULE COOLING INLET HOSE REPLACEMENT (OBCM TO DU)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**

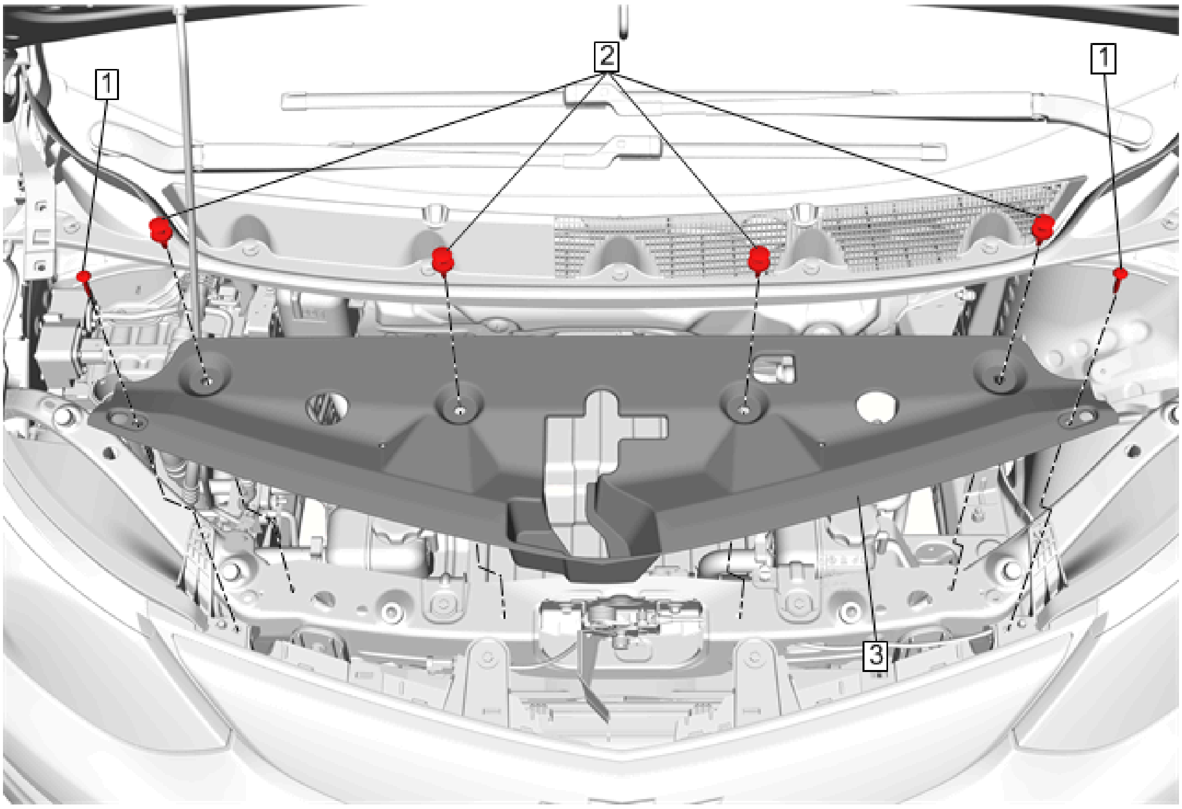


Fig. 174: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**

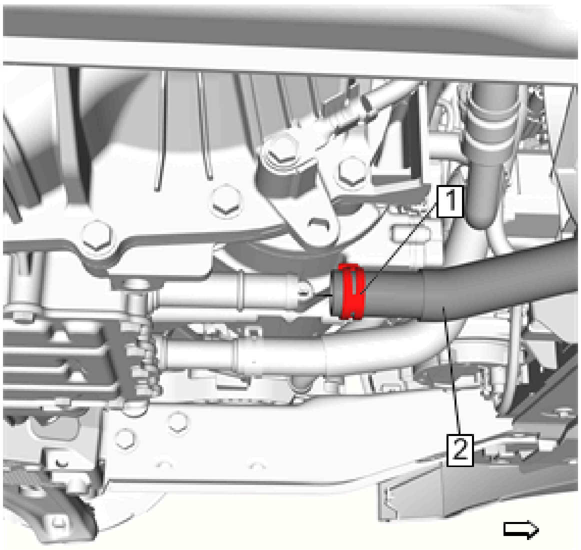


Fig. 175: Drive Motor Power Inverter Module Cooling Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
5. Remove the drive motor power inverter module cooling inlet hose (2) from the drive unit (DU).

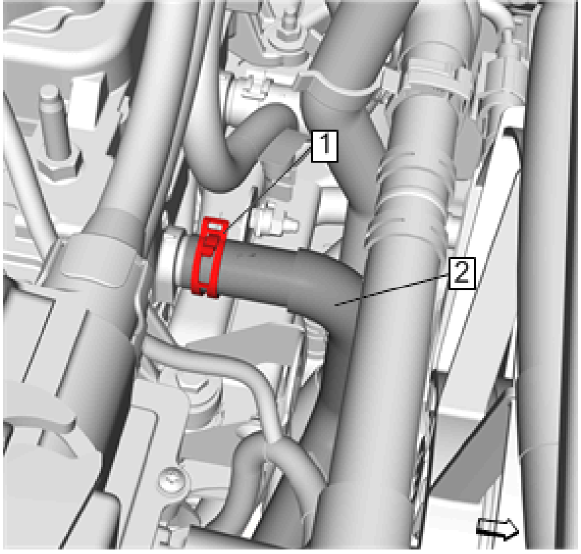


Fig. 176: Drive Motor Power Inverter Module Cooling Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
7. Remove the drive motor power inverter module cooling inlet hose (2) from the on board charging module (OBCM).

Installation Procedure

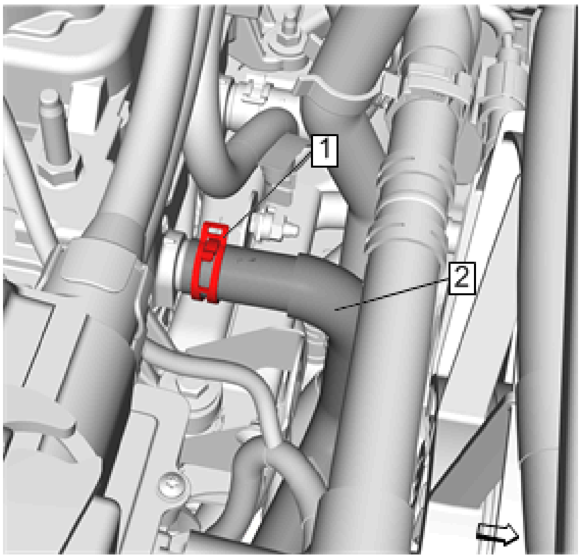


Fig. 177: Drive Motor Power Inverter Module Cooling Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install the drive motor power inverter module cooling inlet hose (2) to the on board charging module (OBCM).
2. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

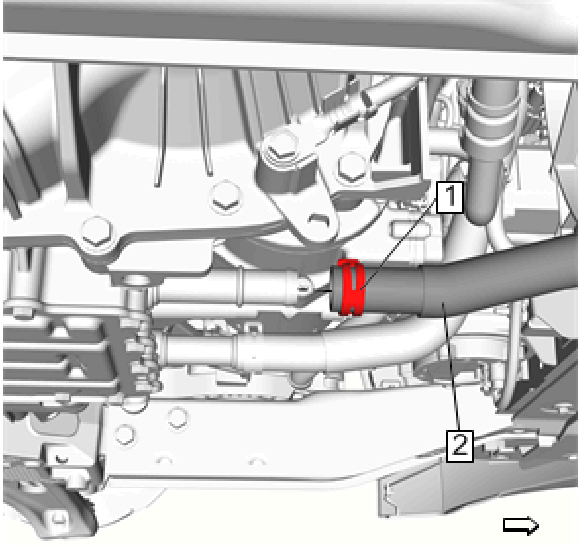


Fig. 178: Drive Motor Power Inverter Module Cooling Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Install the drive motor power inverter module cooling inlet hose (2) to the drive unit (DU).
4. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

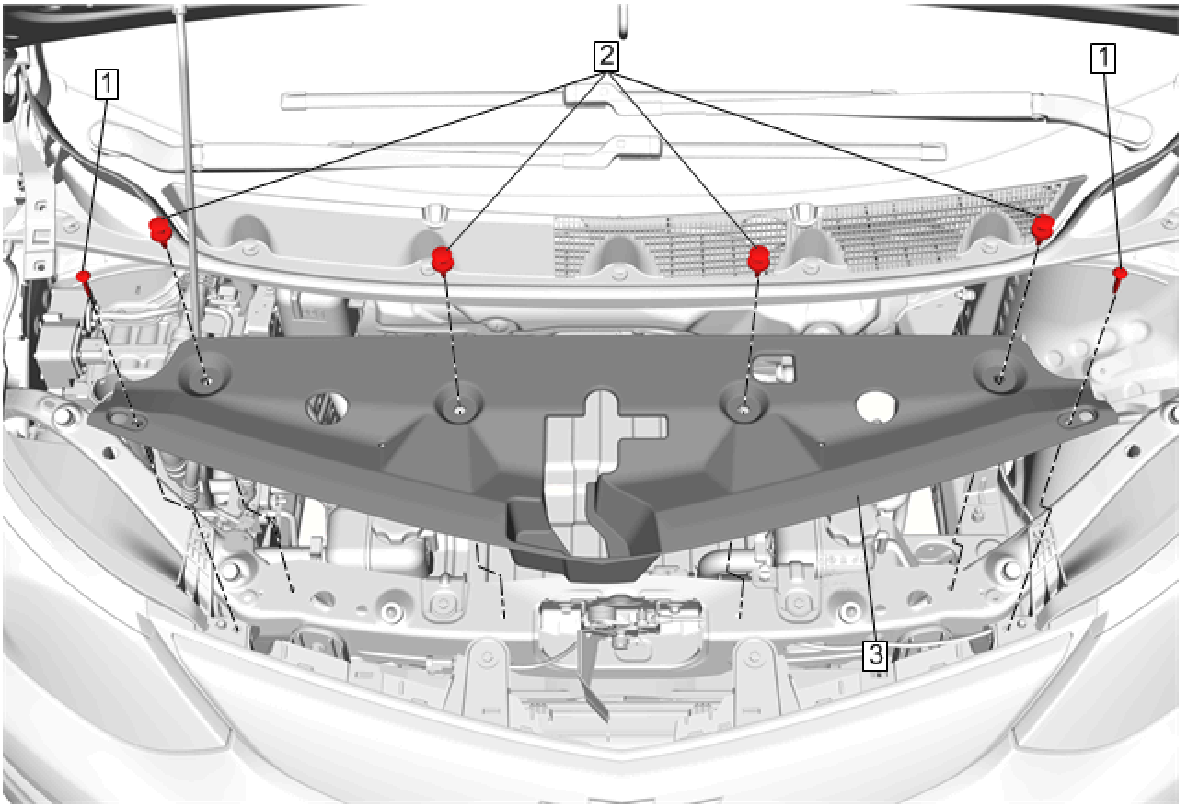


Fig. 179: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**
6. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
7. Check the cooling system for leaks.

DRIVE MOTOR BATTERY COOLANT COOLER REPLACEMENT

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any**

cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the drive motor battery cooling system draining and filling. Refer to **Drive Motor Battery Cooling System Draining and Filling**
3. Remove Air Conditioning Evaporator Hose Assembly @ Drive Motor Battery Coolant Cooler. Refer to **Air Conditioning Evaporator Hose Assembly Replacement**

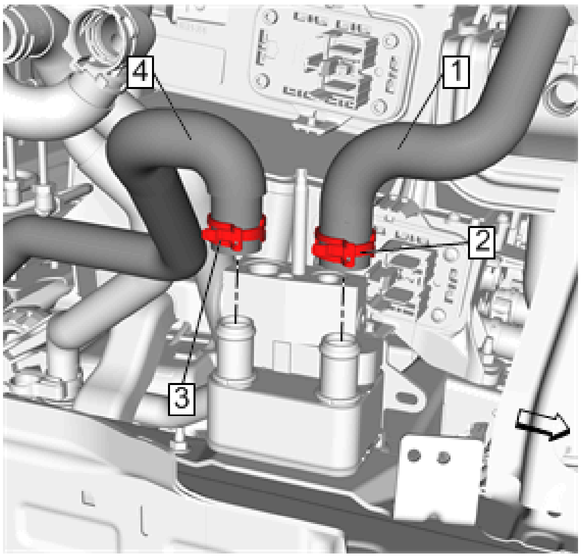


Fig. 180: Drive Motor Battery Coolant Cooler Outlet Hose, Drive Motor Battery Radiator Outlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Clamp (2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
5. Remove the drive motor battery radiator outlet hose (1).
6. Disengage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
7. Remove Drive Motor Battery Coolant Cooler Outlet Hose (4)

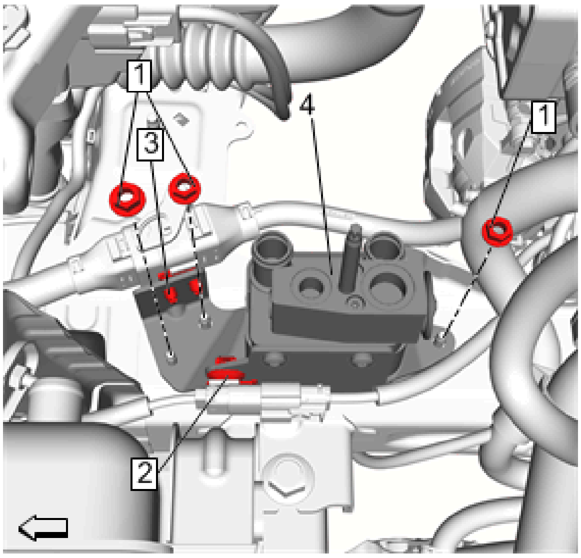


Fig. 181: Drive Motor Battery Coolant Cooler, Bracket Nuts And Retainers
Courtesy of GENERAL MOTORS COMPANY

8. Remove Drive Motor Battery Coolant Cooler Bracket Nuts (1) (Qty: 3)
9. Remove Retainers (2, 3)
10. Remove Drive Motor Battery Coolant Cooler (4)

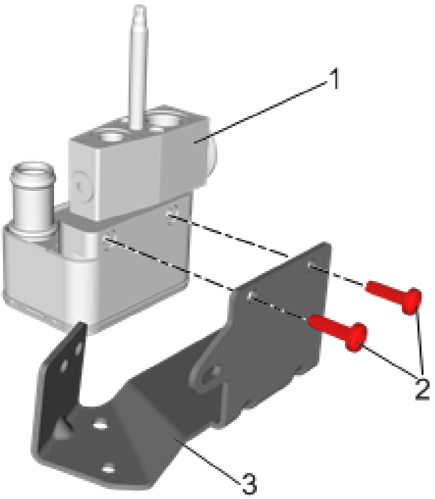


Fig. 182: Drive Motor Battery Coolant Cooler, Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

11. Remove the 2 drive motor battery coolant cooler bracket bolts (2).
12. Remove Drive Motor Battery Coolant Cooler Bracket (3) @ Drive Motor Battery Coolant Cooler (1)

Installation Procedure

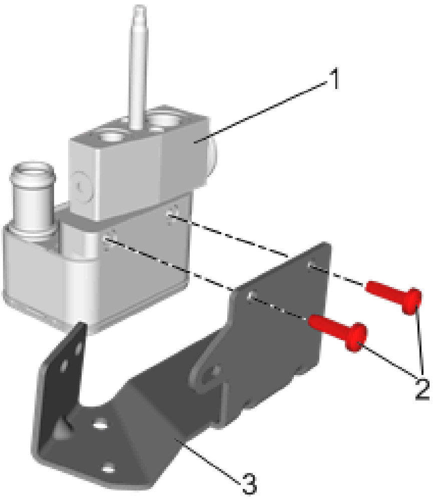


Fig. 183: Drive Motor Battery Coolant Cooler, Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Cooler Bracket (3) @ Drive Motor Battery Coolant Cooler (1)

CAUTION: **Refer to Fastener Caution .**

2. Install the 2 drive motor battery coolant cooler bracket bolts (2) and tighten to 9 N.m (80 lb in).

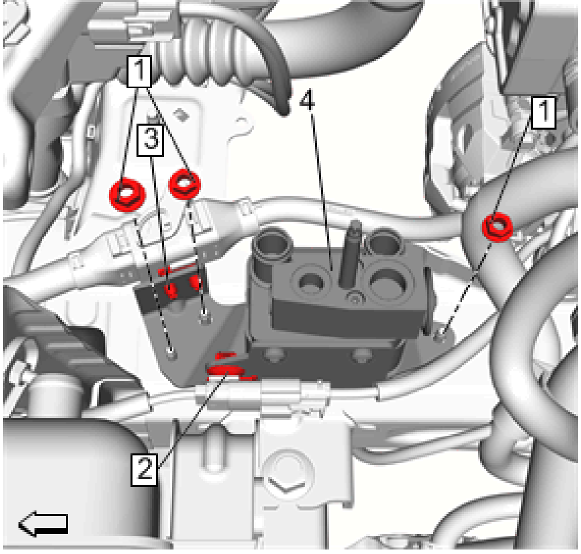


Fig. 184: Drive Motor Battery Coolant Cooler, Bracket Nuts And Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Install Drive Motor Battery Coolant Cooler (4)
4. Install Retainers (2, 3)
5. Install and tighten Drive Motor Battery Coolant Cooler Bracket Nuts (1) (Qty: 3) to 9 N.m (80 lb in)

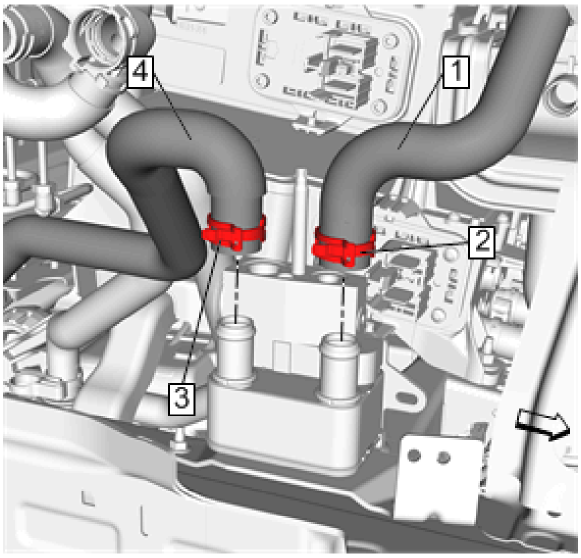


Fig. 185: Drive Motor Battery Coolant Cooler Outlet Hose, Drive Motor Battery Radiator Outlet Hose And Clamps
Courtesy of GENERAL MOTORS COMPANY

6. Install Drive Motor Battery Coolant Cooler Outlet Hose (4)
7. Engage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
8. Install the drive motor battery radiator outlet hose (1).
9. Engage Clamp (2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
10. Install Air Conditioning Evaporator Hose Assembly @ Drive Motor Battery Coolant Cooler. Refer to **Air Conditioning Evaporator Hose Assembly Replacement**
11. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
12. Check the cooling system for leaks.

DRIVE MOTOR BATTERY COOLANT PUMP REPLACEMENT (RESS PUMP)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any**

cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection

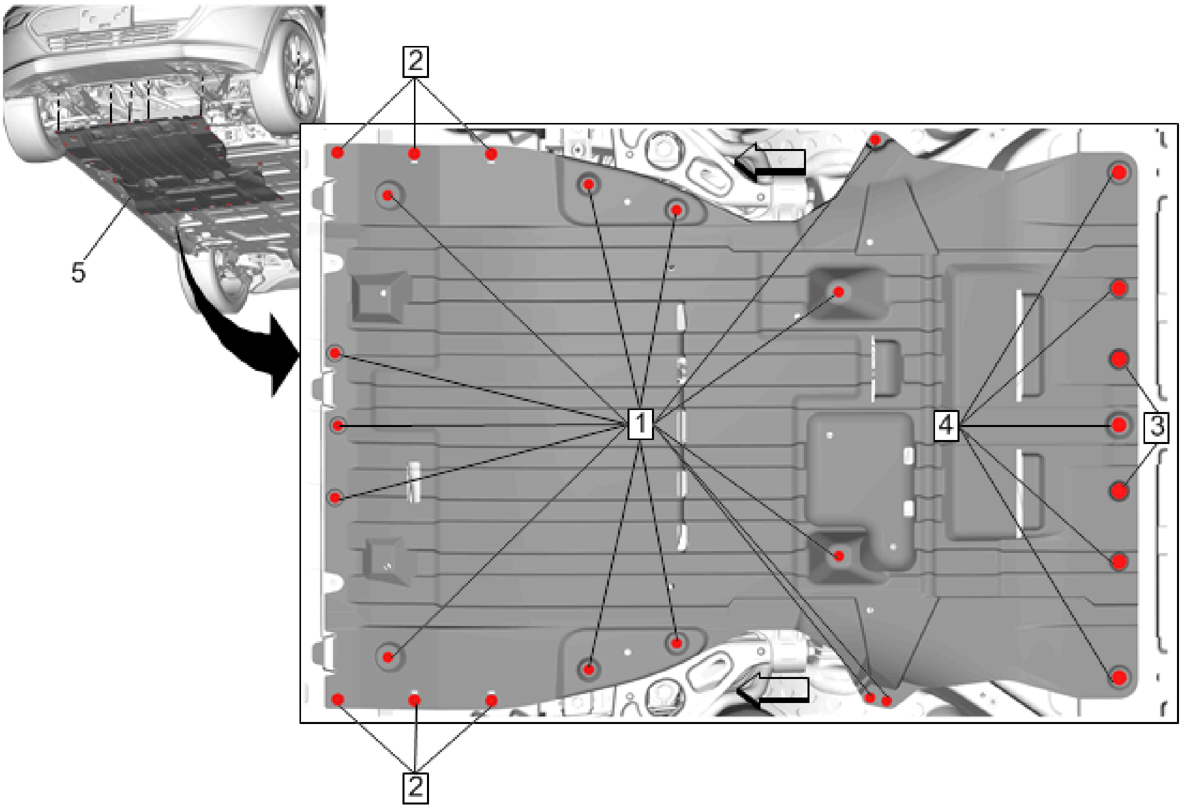


Fig. 186: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Compartment Air Deflector (5). Refer to Front Compartment Air Deflector Replacement
4. Drain the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling

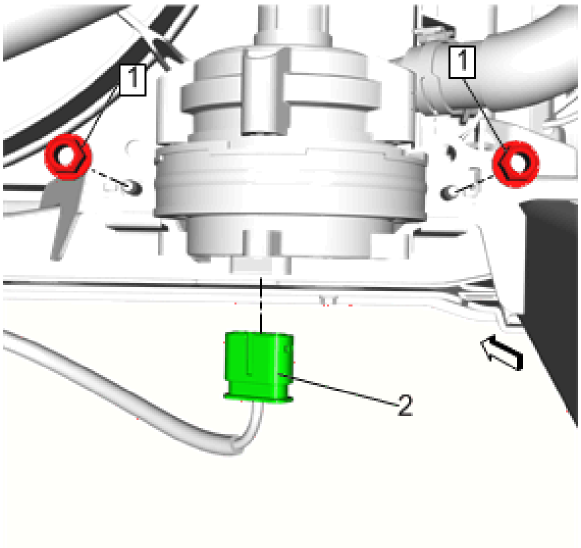


Fig. 187: Drive Motor Battery Coolant Pump Bracket Nuts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (2)
6. Remove the 2 drive motor battery coolant pump bracket nuts (1).

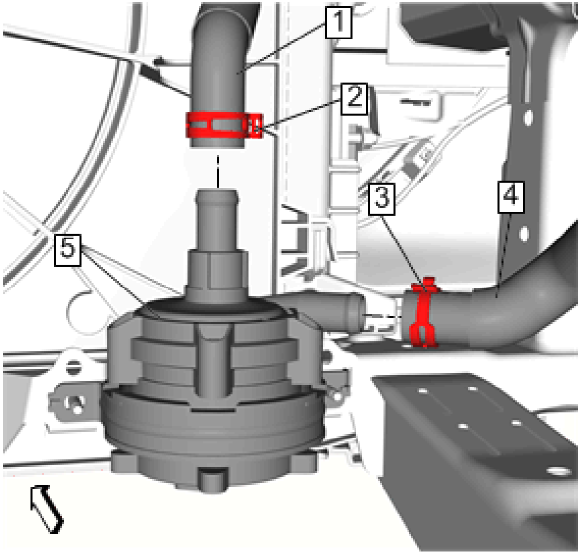


Fig. 188: Drive Motor Battery Coolant Pump And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

7. Disengage Clamp (2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
8. Remove Drive Motor Battery Coolant Pump Inlet Hose (1) @ Drive Motor Battery Coolant Pump (5)
9. Disengage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
10. Remove Drive Motor Battery Coolant Cooler Inlet Hose (4) @ Drive Motor Battery Coolant Pump (5)
11. Remove Drive Motor Battery Coolant Pump (5)

Installation Procedure

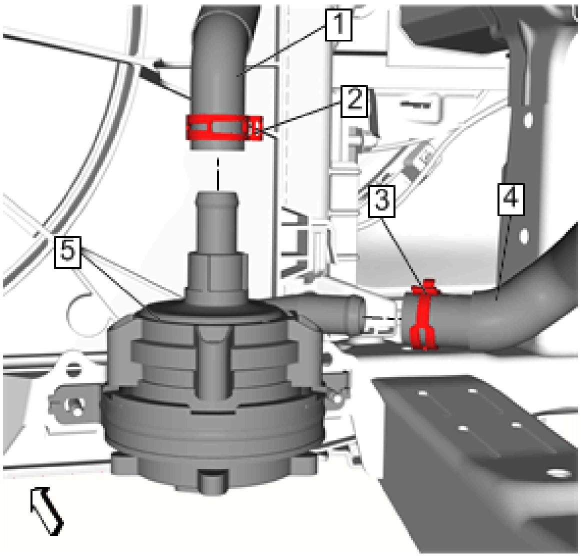


Fig. 189: Drive Motor Battery Coolant Pump And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Pump (5)
2. Install Drive Motor Battery Coolant Cooler Inlet Hose (4) @ Drive Motor Battery Coolant Pump (5)
3. Engage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
4. Install Drive Motor Battery Coolant Pump Inlet Hose (1) @ Drive Motor Battery Coolant Pump (5)
5. Engage Clamp (2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

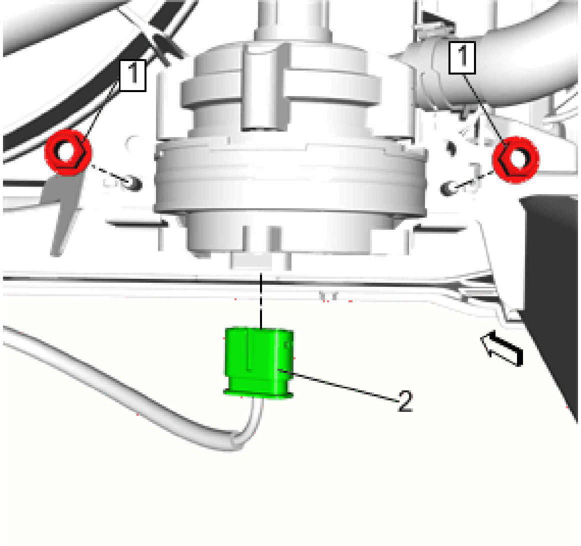


Fig. 190: Drive Motor Battery Coolant Pump Bracket Nuts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

6. Install the 2 drive motor battery coolant pump bracket nuts (1) and tighten to 9 N.m (80 lb in).
7. Connect Electrical Connector (2)

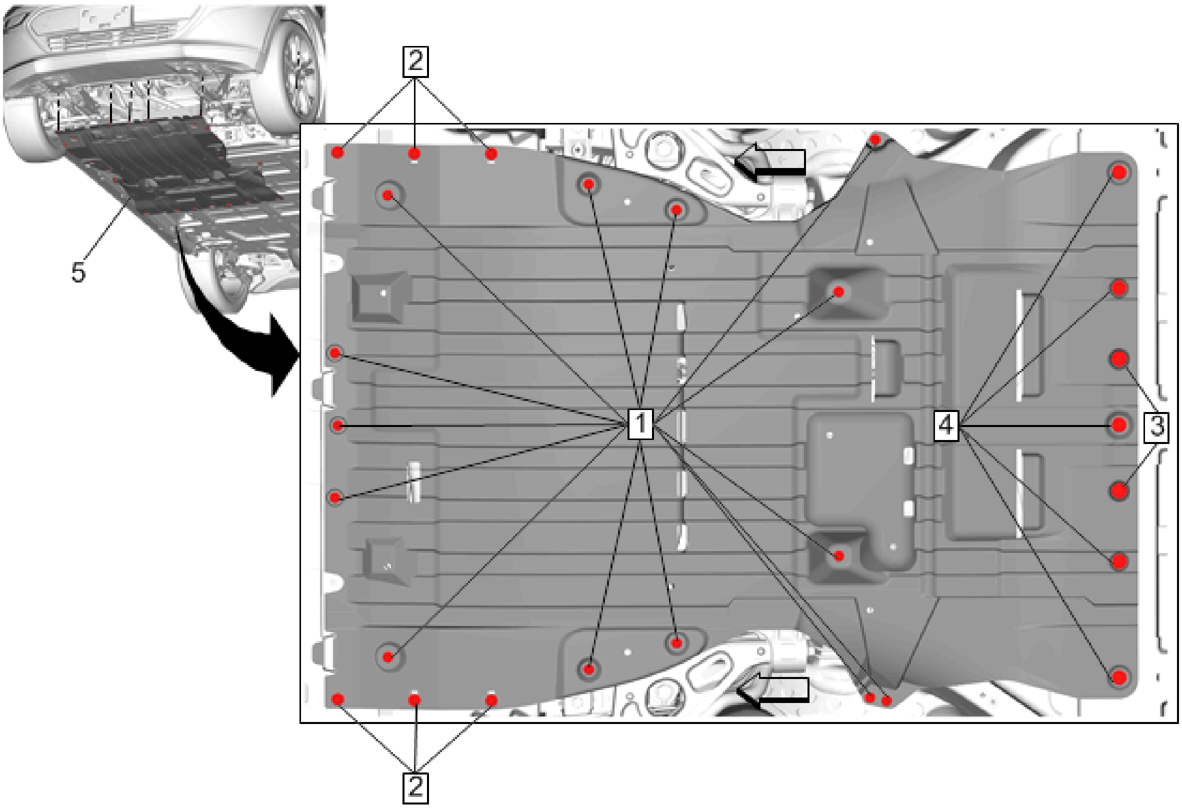


Fig. 191: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

8. Install Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
9. Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
10. Check the cooling system for leaks.
11. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**

DRIVE MOTOR BATTERY COOLANT PUMP REPLACEMENT (PE PUMP)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults**

exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Disconnect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection

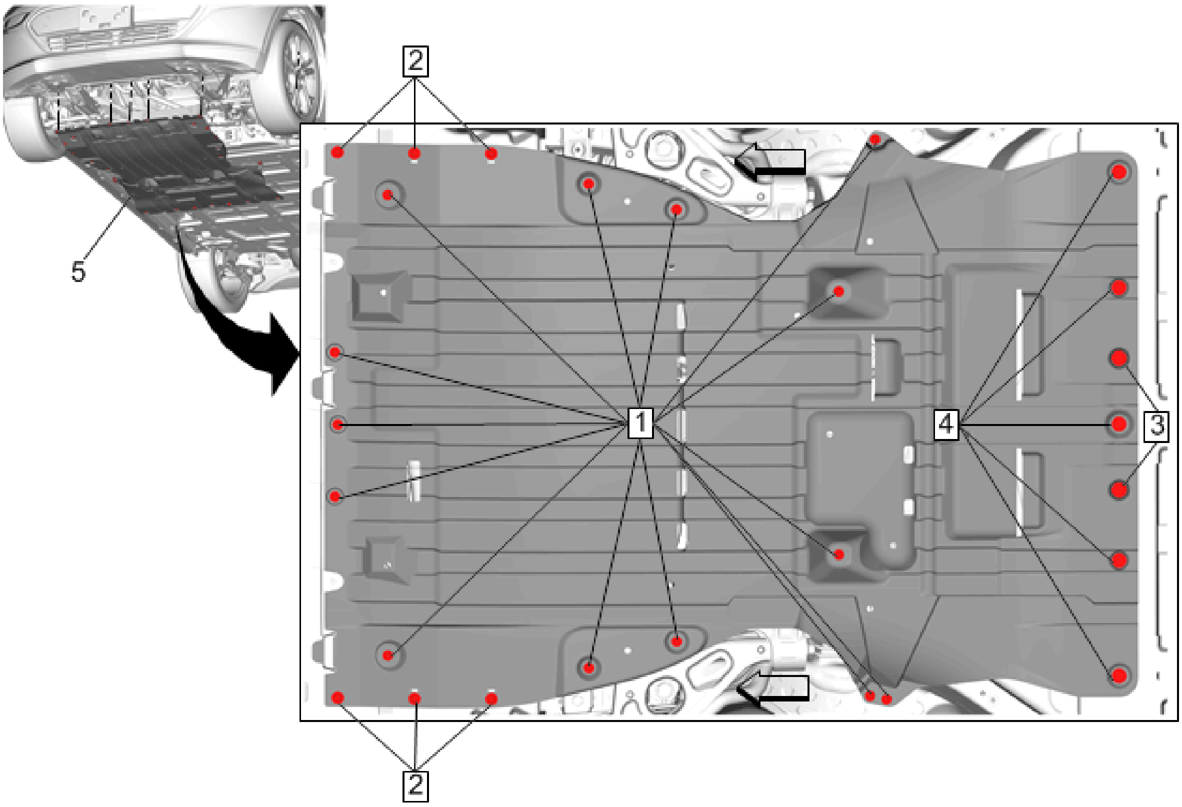


Fig. 192: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Compartment Air Deflector (5). Refer to Front Compartment Air Deflector Replacement
4. Drain the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling

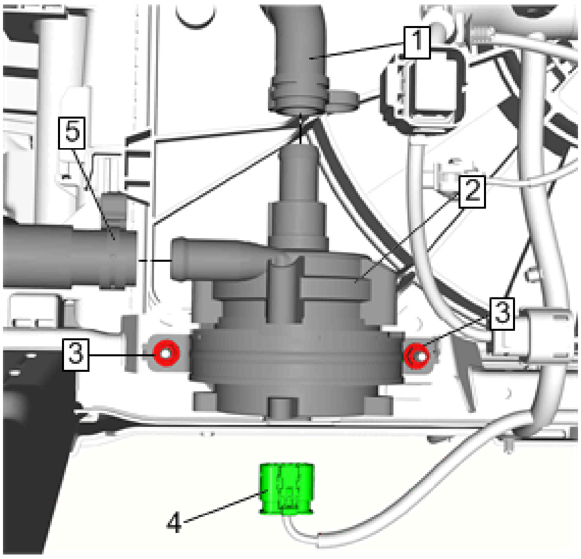


Fig. 193: Drive Motor Battery Coolant Pump And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Electrical Connector (4) @ Drive Motor Battery Coolant Pump (2)
6. Disengage Drive Motor Generator Control Module Coolant Pump Hose (1) @ Drive Motor Battery Coolant Pump (2). Refer to Hose Clamp Replacement Guidelines - Spring Type
7. Remove Drive Motor Battery Coolant Pump (2)

Installation Procedure

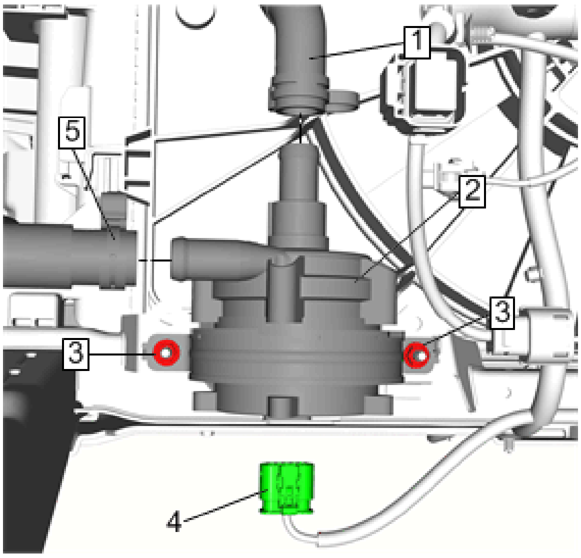


Fig. 194: Drive Motor Battery Coolant Pump And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Pump (2)
2. Engage Drive Motor Generator Control Module Coolant Pump Hose (1) @ Drive Motor Battery Coolant Pump (2). Refer to Hose Clamp Replacement Guidelines - Spring Type
3. Connect Electrical Connector (4) @ Drive Motor Battery Coolant Pump (2)

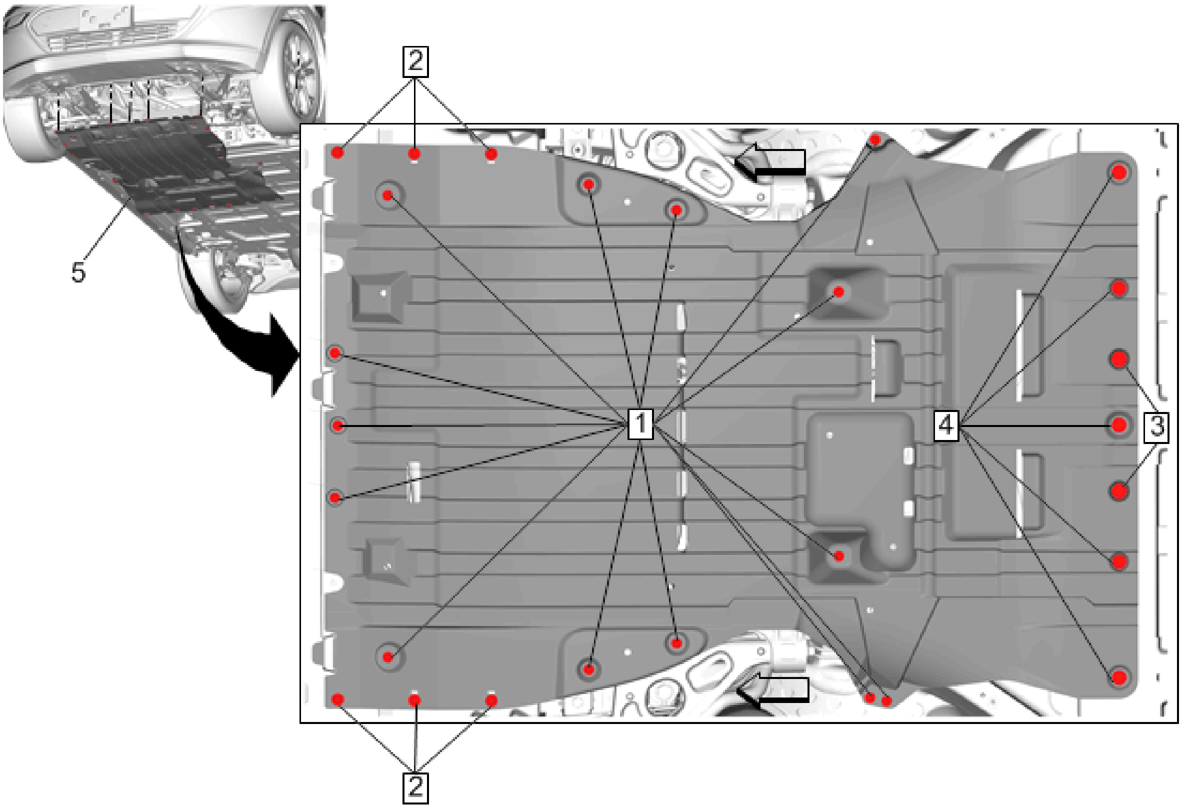


Fig. 195: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Compartment Air Deflector (5). Refer to Front Compartment Air Deflector Replacement
5. Fill the drive motor generator power inverter module cooling system. Refer to Drive Motor Generator Power Inverter Module Cooling System Draining and Filling
6. Check the cooling system for leaks.
7. Connect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection

DRIVE MOTOR BATTERY COOLANT PUMP INLET HOSE REPLACEMENT (SURGE TANK TO PUMP)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

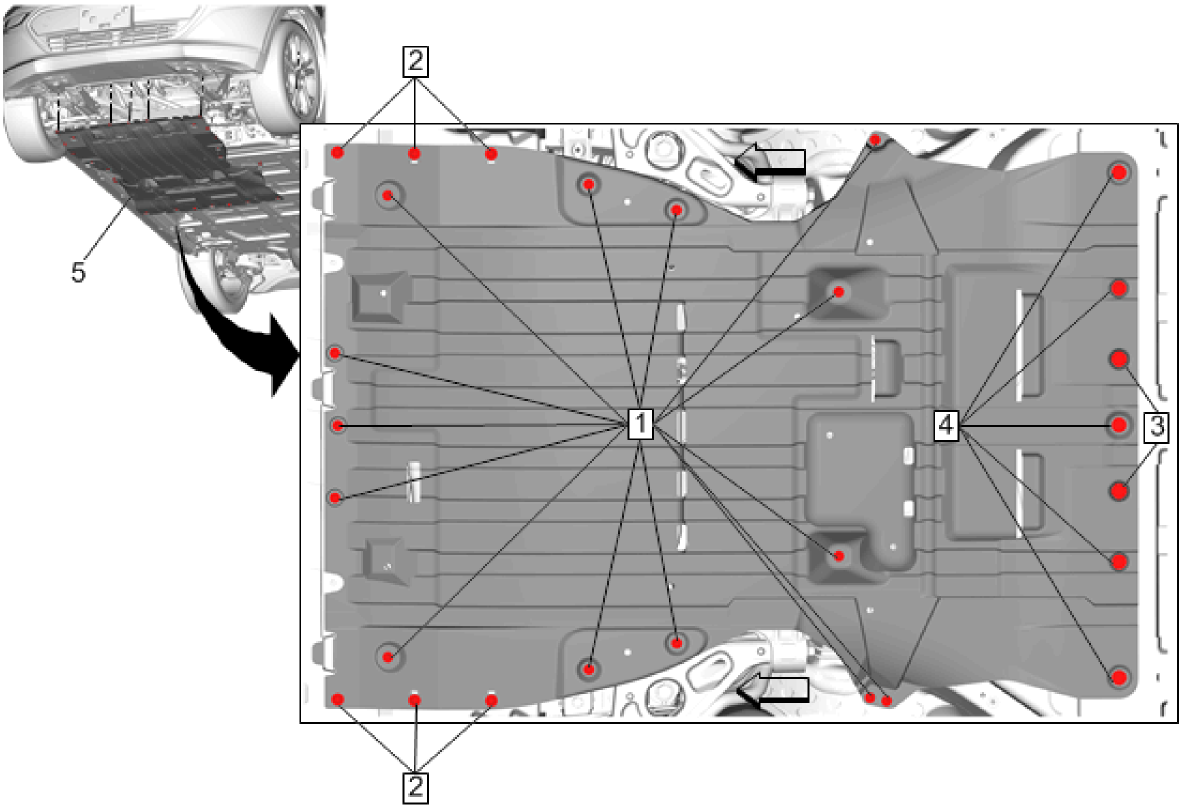


Fig. 196: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
3. Drain the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**

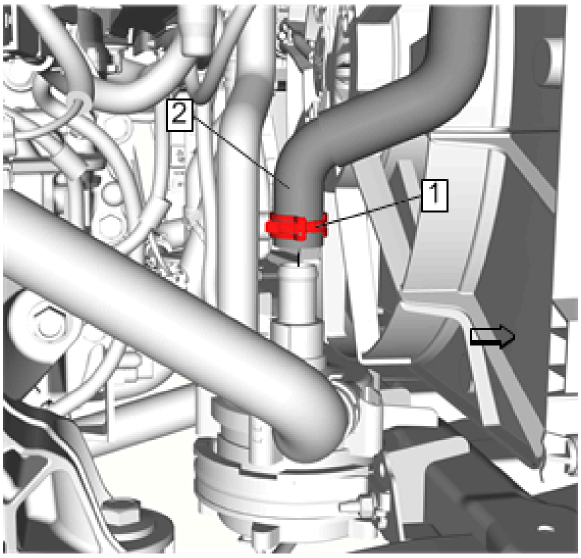


Fig. 197: Drive Motor Battery Coolant Pump Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
5. Remove Drive Motor Battery Coolant Pump Inlet Hose (2)

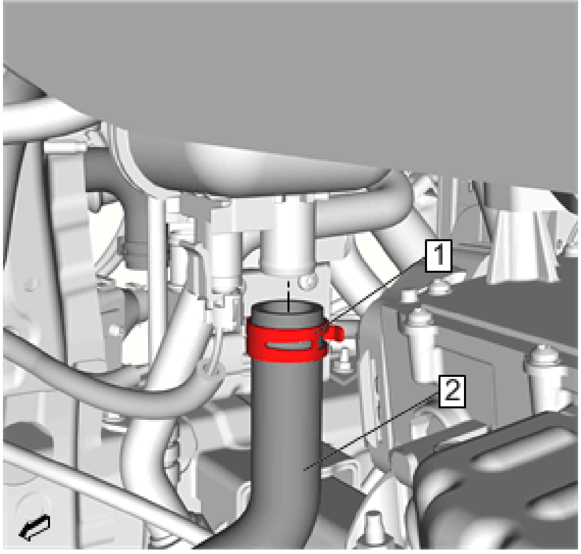


Fig. 198: Drive Motor Battery Coolant Pump Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
7. Remove Drive Motor Battery Coolant Pump Inlet Hose (2)

Installation Procedure

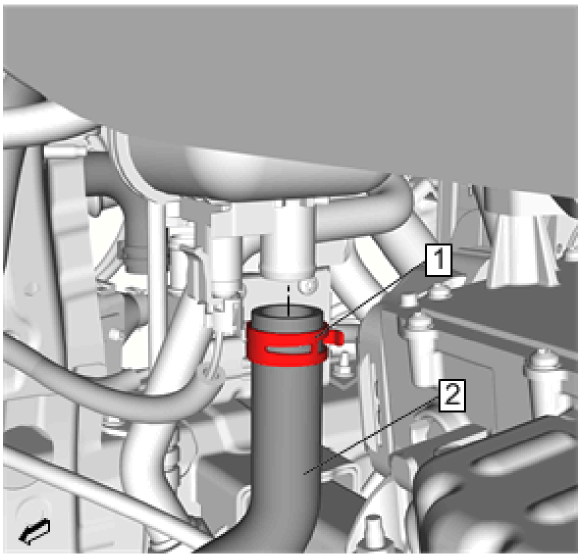


Fig. 199: Drive Motor Battery Coolant Pump Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Pump Inlet Hose (2)
2. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

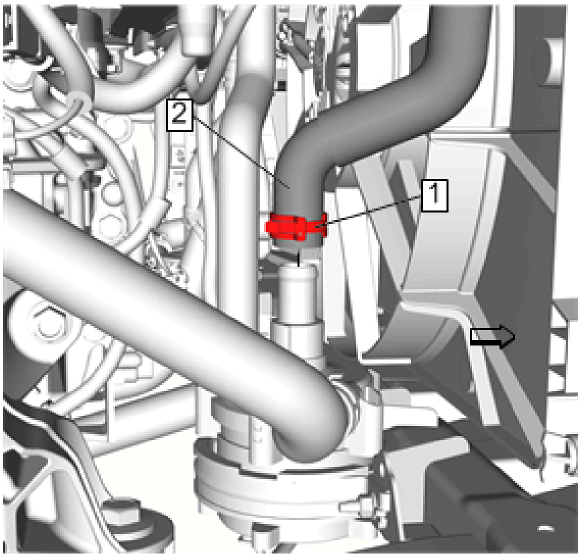


Fig. 200: Drive Motor Battery Coolant Pump Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Install Drive Motor Battery Coolant Pump Inlet Hose (2)
4. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

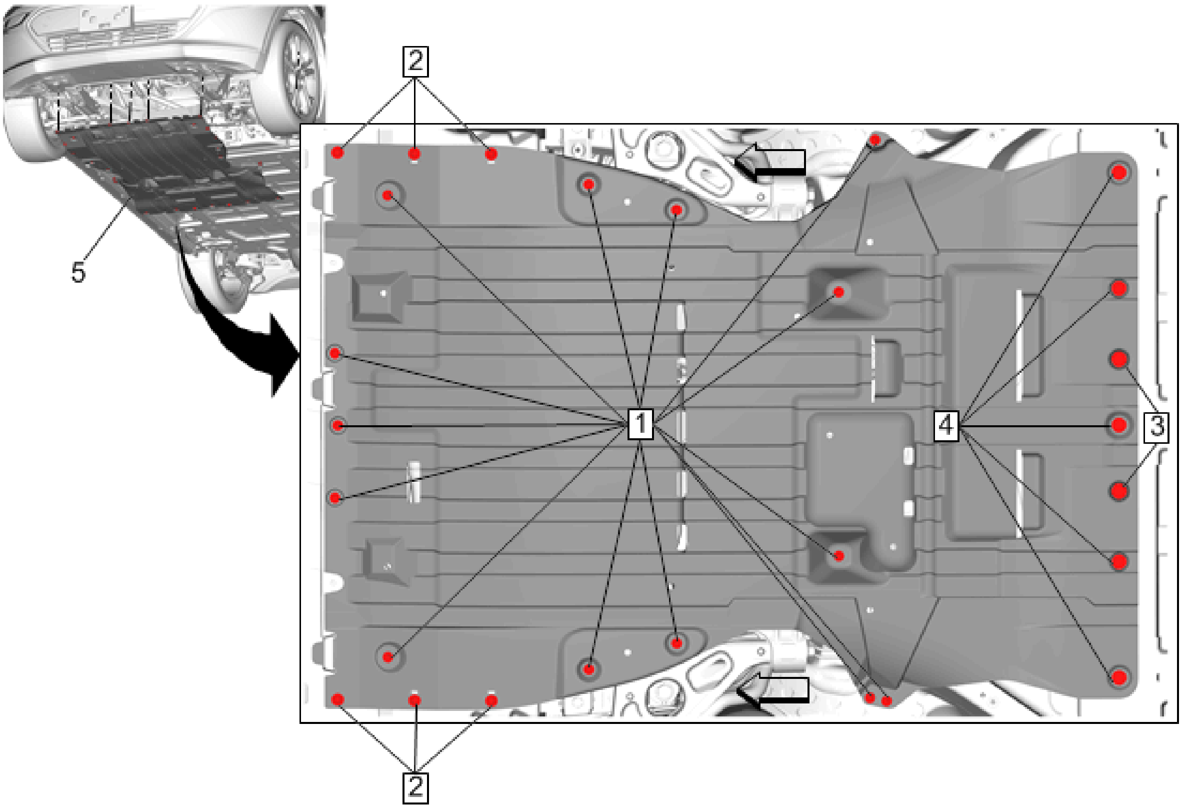


Fig. 201: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
6. Fill the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**
7. Check the cooling system for leaks.

DRIVE MOTOR BATTERY RADIATOR SURGE TANK REPLACEMENT

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**
3. Drain the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**

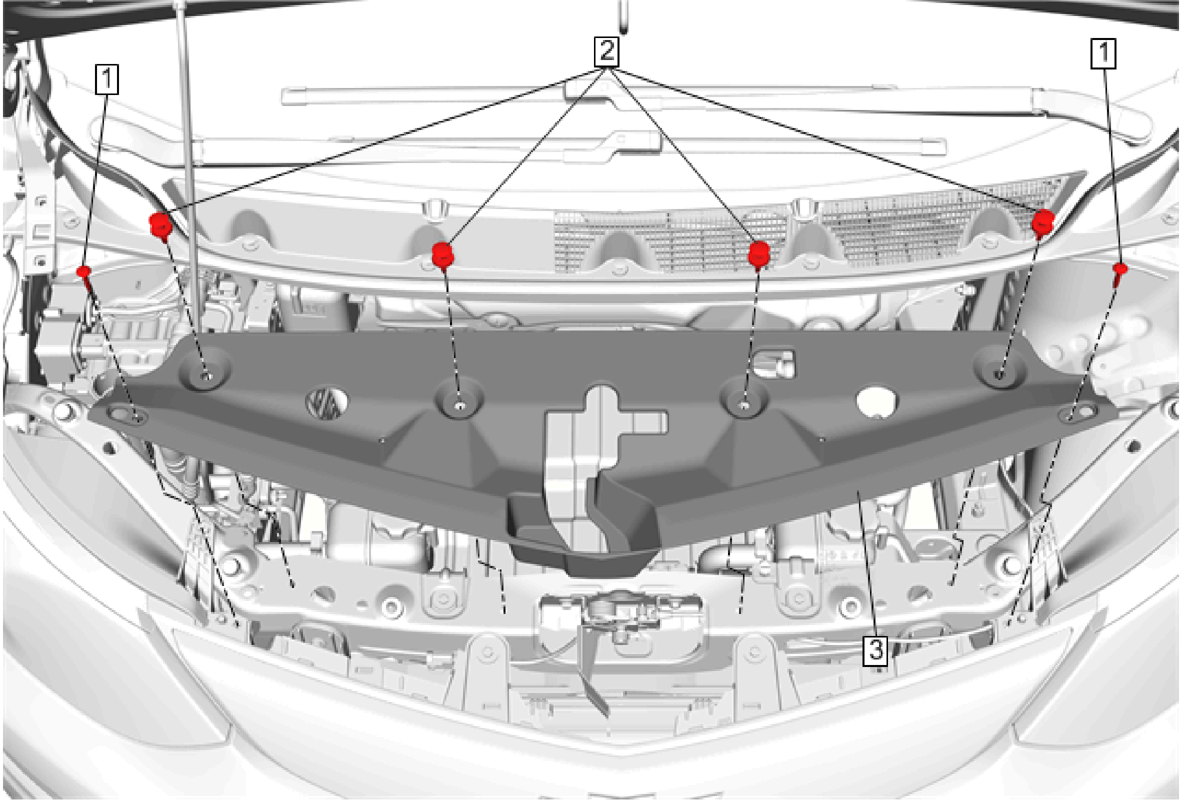


Fig. 202: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

4. Remove Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**

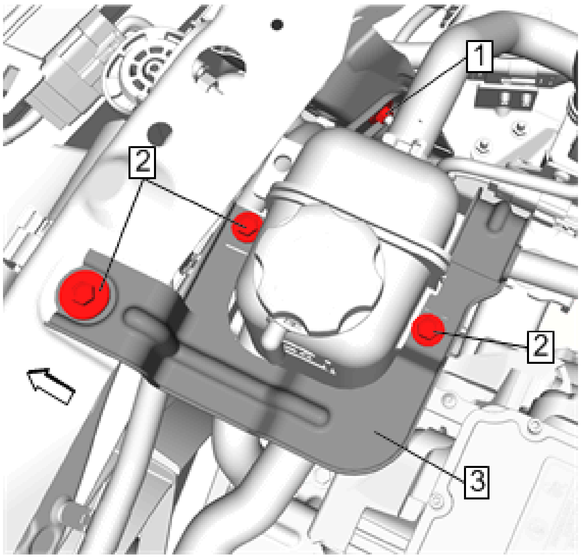


Fig. 203: Drive Motor Battery Radiator Surge Tank Bracket, Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

5. Remove Radiator Surge Tank Bracket (3). Refer to **Radiator Surge Tank Support Bracket Replacement (RESS)**

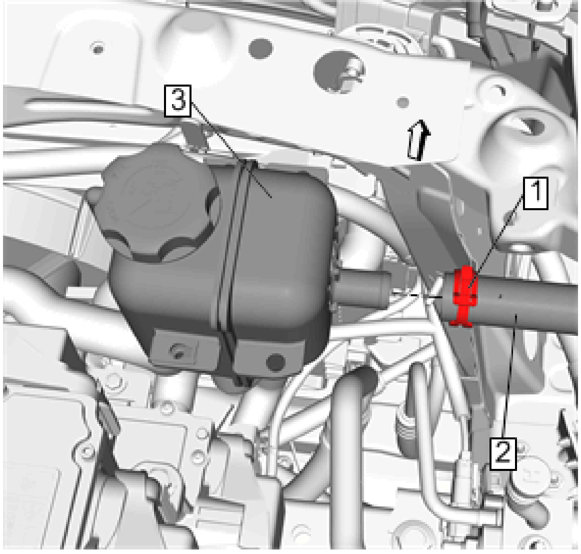


Fig. 204: Drive Motor Battery Radiator Surge Tank, Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Disengage Clamp (1). Refer to Hose Clamp Replacement Guidelines - Spring Type
7. Remove Drive Motor Battery Radiator Outlet Hose (2) @ Drive Motor Battery Radiator Surge Tank (3)

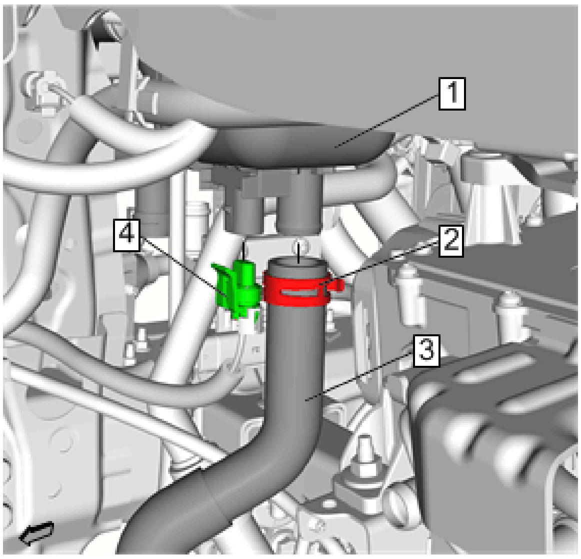


Fig. 205: Drive Motor Battery Radiator Surge Tank, Coolant Pump Inlet Hose, Clamp And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Electrical Connector (4)
9. Disengage Clamp (2). Refer to Hose Clamp Replacement Guidelines - Spring Type
10. Remove Drive Motor Battery Coolant Pump Inlet Hose (3)
11. Remove Drive Motor Battery Radiator Surge Tank (1)
12. Transfer components as necessary.

Installation Procedure

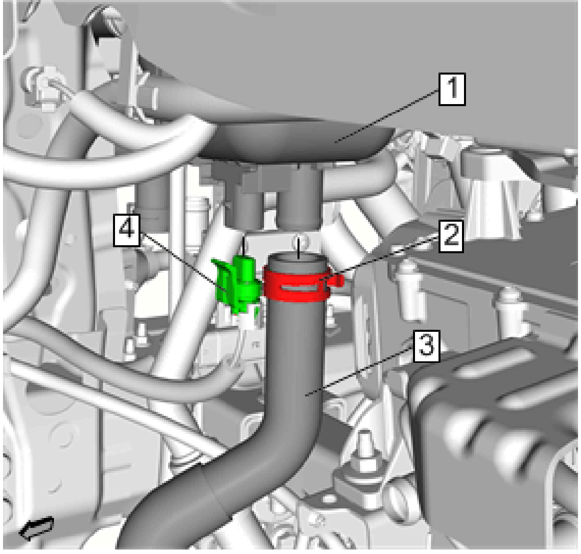


Fig. 206: Drive Motor Battery Radiator Surge Tank, Coolant Pump Inlet Hose, Clamp And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Radiator Surge Tank (1)
2. Install Drive Motor Battery Coolant Pump Inlet Hose (3)
3. Engage Clamp (2). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
4. Connect Electrical Connector (4)

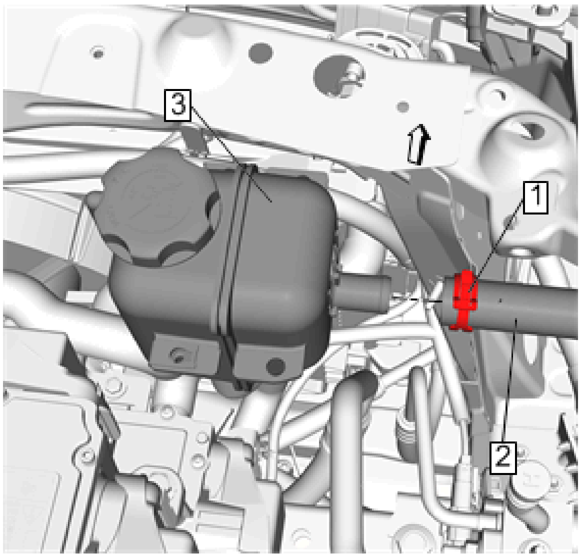


Fig. 207: Drive Motor Battery Radiator Surge Tank, Radiator Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install Drive Motor Battery Radiator Outlet Hose (2) @ Drive Motor Battery Radiator Surge Tank (3)
6. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

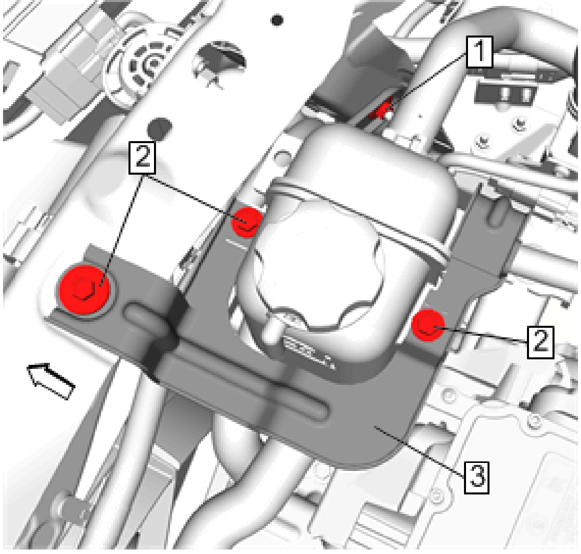


Fig. 208: Drive Motor Battery Radiator Surge Tank Bracket, Bolts And Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install Radiator Surge Tank Bracket (3). Refer to **Radiator Surge Tank Support Bracket Replacement (RESS)**

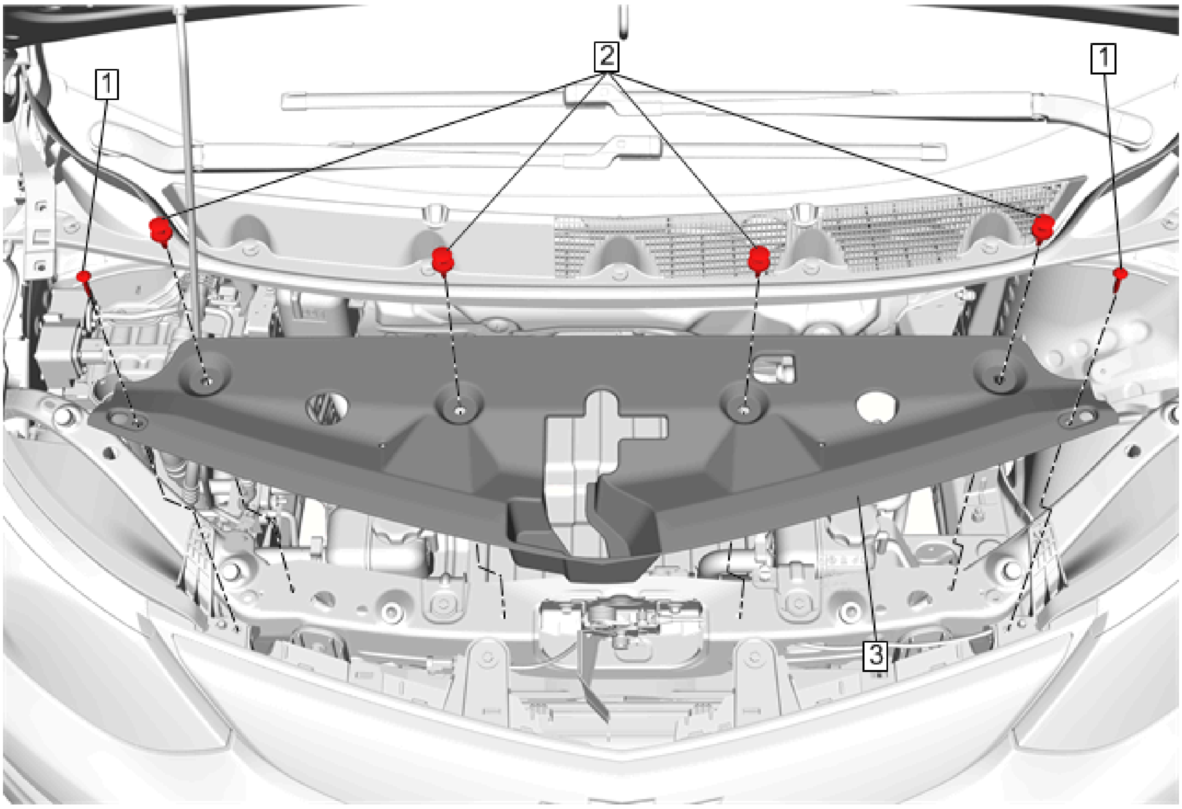


Fig. 209: Front Compartment Front Sight Shield
Courtesy of GENERAL MOTORS COMPANY

8. Install Front Compartment Front Sight Shield (3). Refer to **Front Compartment Front Sight Shield Replacement**
9. Fill the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**
10. Check the cooling system for leaks.
11. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection**

DRIVE MOTOR BATTERY COOLANT COOLER OUTLET HOSE REPLACEMENT (CHILLER TO RESS)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults**

exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

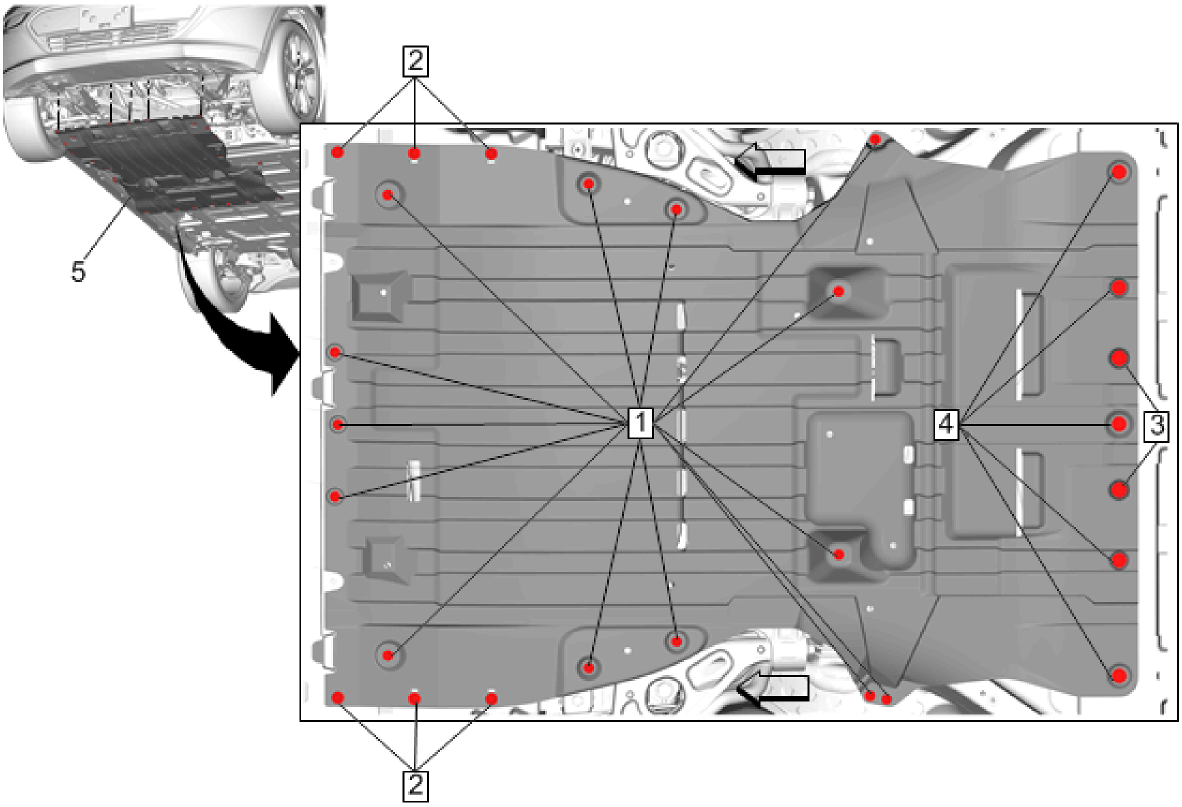


Fig. 210: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Compartment Air Deflector (5). Refer to Front Compartment Air Deflector Replacement

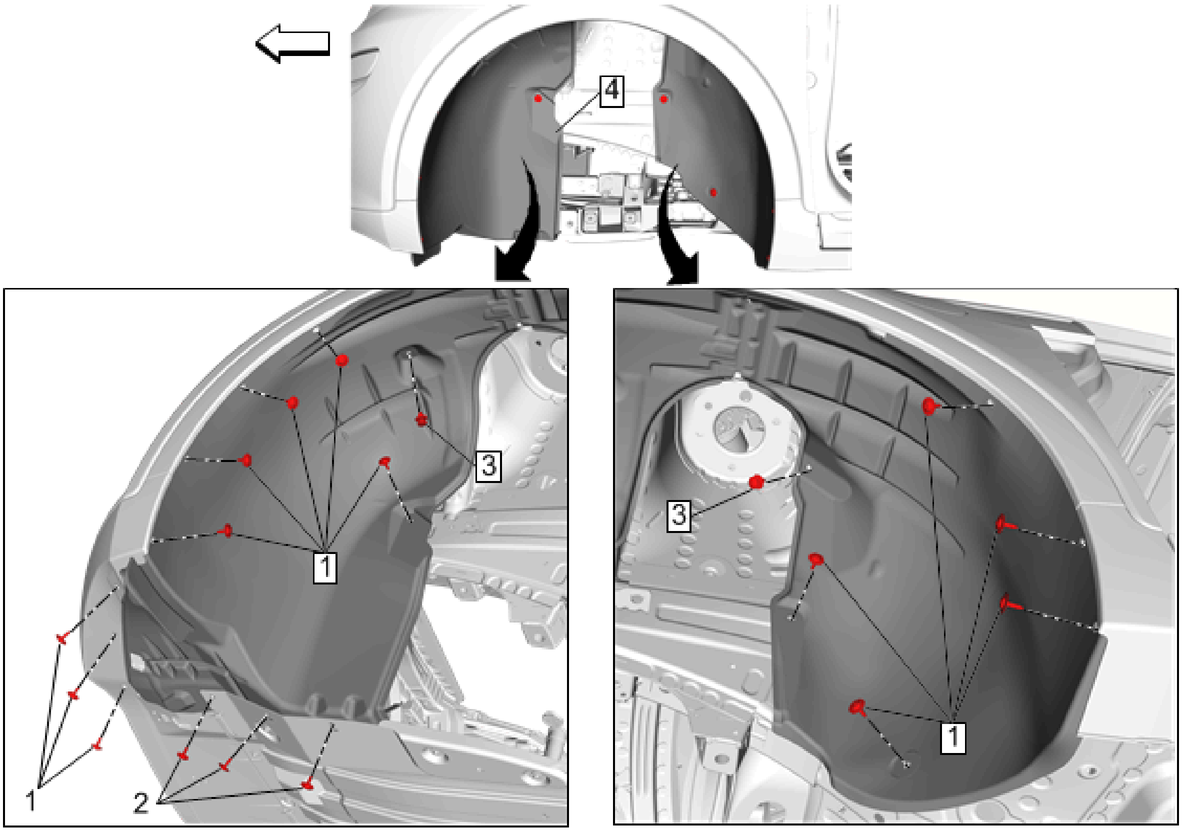


Fig. 211: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Wheelhouse Liner-Right Side (4) (Qty: 2). Refer to Front Wheelhouse Liner Replacement

4. Drain the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**

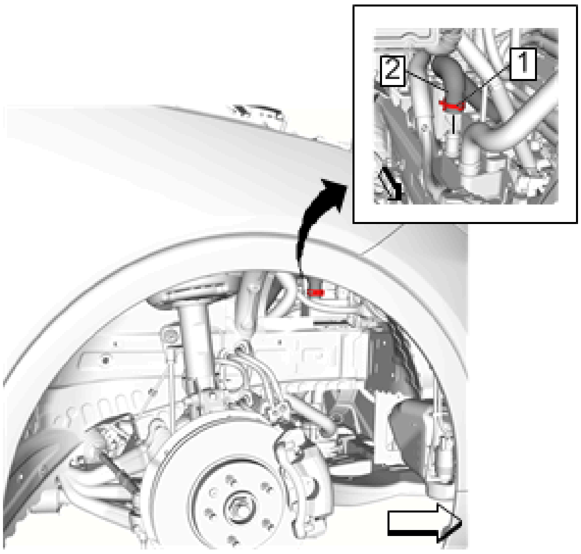


Fig. 212: Drive Motor Battery Coolant Cooler Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
6. Remove Drive Motor Battery Coolant Cooler Outlet Hose (2)

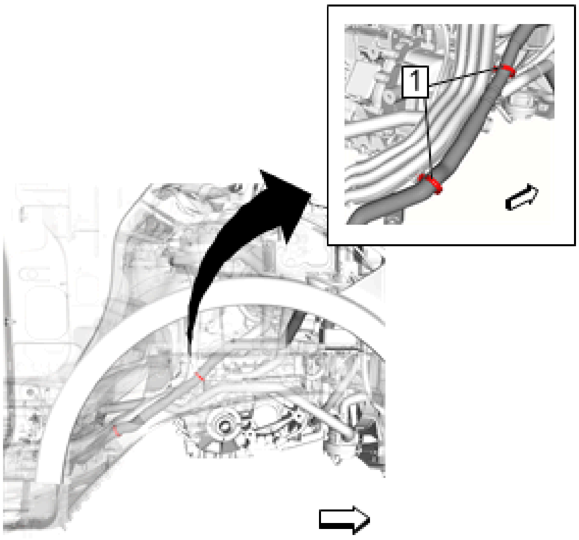


Fig. 213: Retainers
Courtesy of GENERAL MOTORS COMPANY

7. Remove Retainers (1) (Qty: 2)

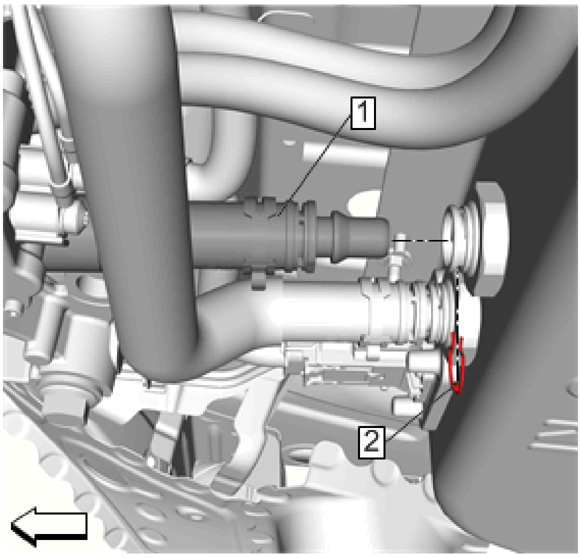


Fig. 214: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (1st Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

8. If equipped with the 1st design of battery pack having female inlet and female outlet port, remove the clip (2) and the drive motor battery coolant cooler outlet hose (1) from the RESS.

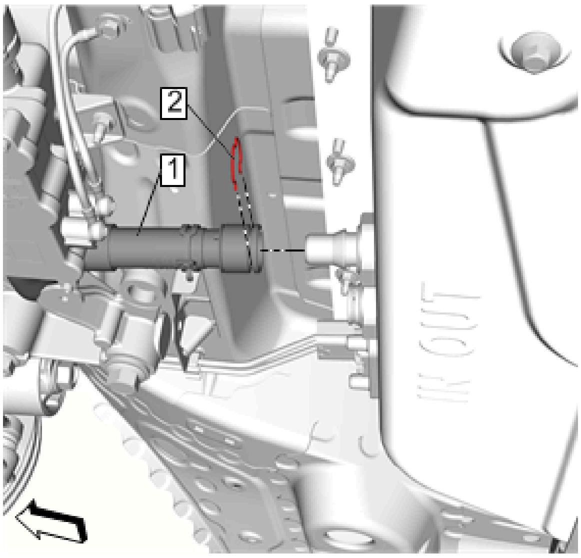


Fig. 215: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (2nd Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

9. If equipped with the 2nd design of battery pack having female inlet and male outlet port, remove the clip (2) and the drive motor battery coolant cooler outlet hose (1) from the RESS.

Installation Procedure

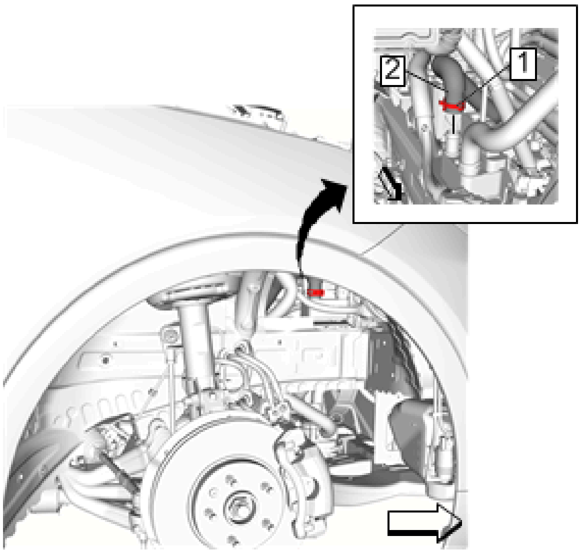


Fig. 216: Drive Motor Battery Coolant Cooler Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Cooler Outlet Hose (2)
2. Engage Clamp (1). Refer to Hose Clamp Replacement Guidelines - Spring Type

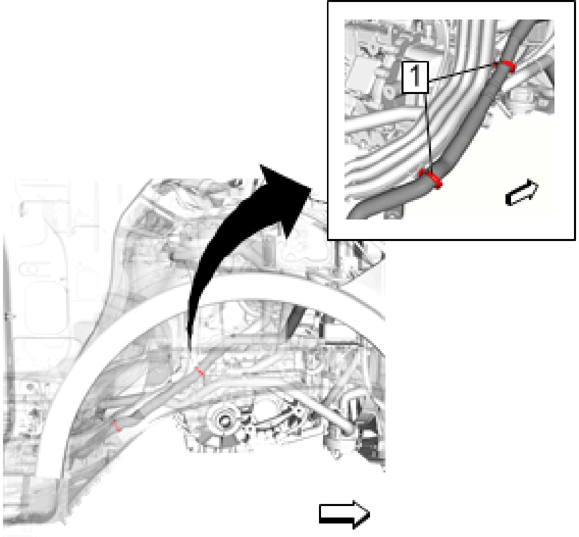


Fig. 217: Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Install Retainers (1) (Qty: 2)

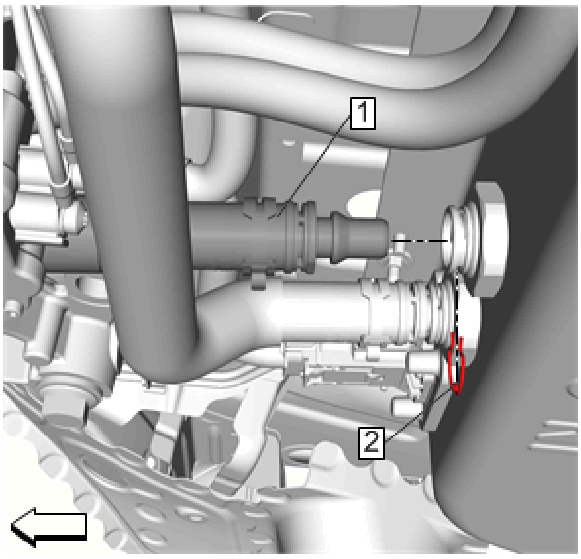


Fig. 218: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (1st Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing the inlet or outlet hose, be careful not to confuse the inlet port and outlet port.**

4. If equipped with the 1st design of battery pack having female inlet and female outlet port, install the clip (2) and the drive motor battery coolant cooler outlet hose (1) to the RESS.

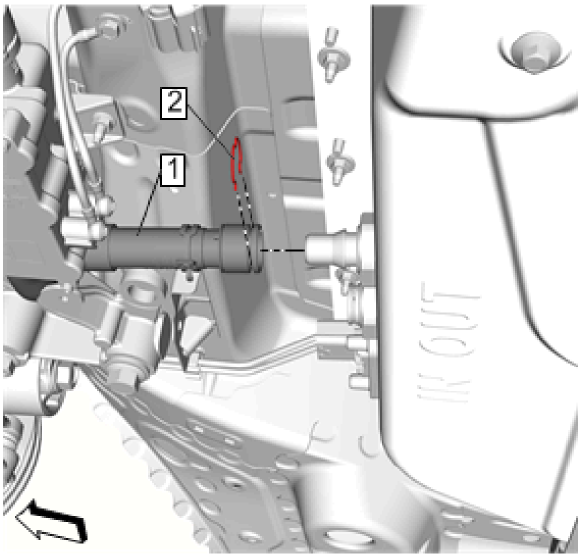


Fig. 219: Drive Motor Battery Coolant Cooler Outlet Hose And Clip (2nd Design Battery Pack)
Courtesy of GENERAL MOTORS COMPANY

5. If equipped with the 2nd design of battery pack having female inlet and male outlet port, install the clip (2) and the drive motor battery coolant cooler outlet hose (1) to the RESS.

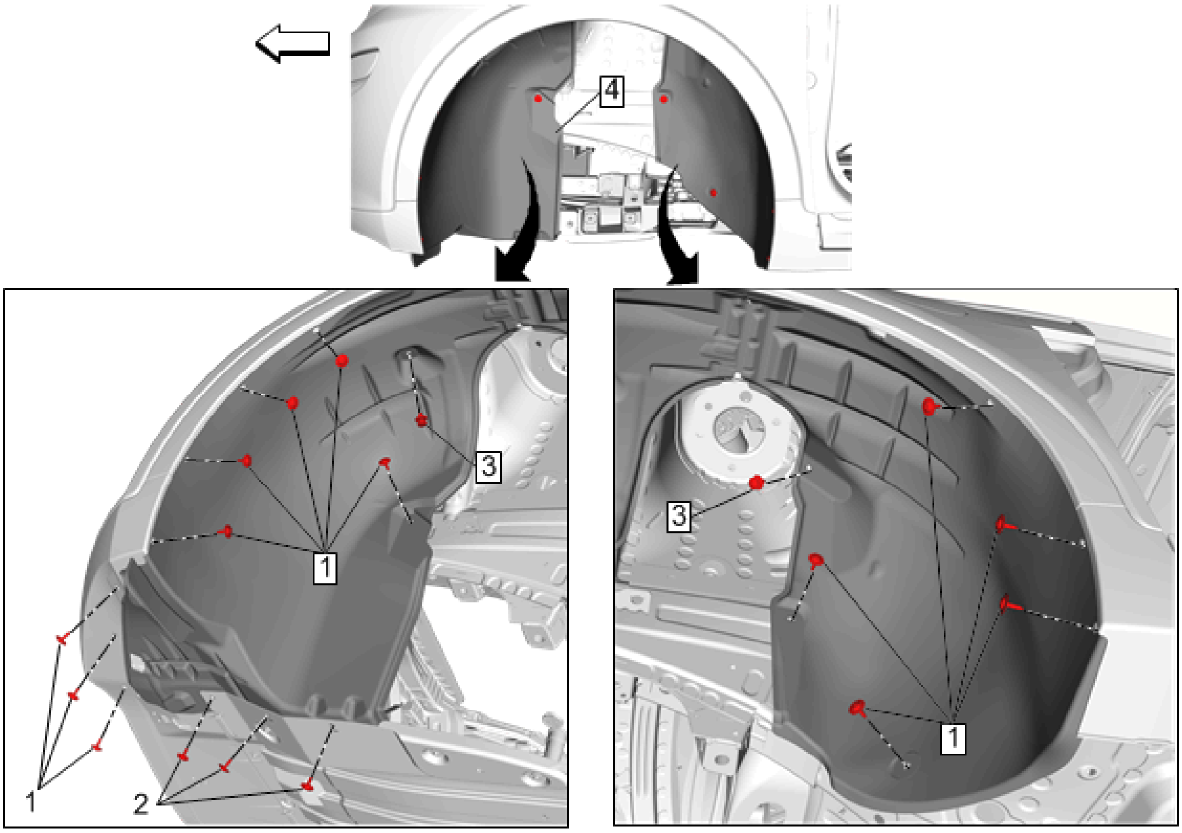


Fig. 220: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

6. Install Front Wheelhouse Liner-Right Side (4) (Qty: 2). Refer to Front Wheelhouse Liner Replacement

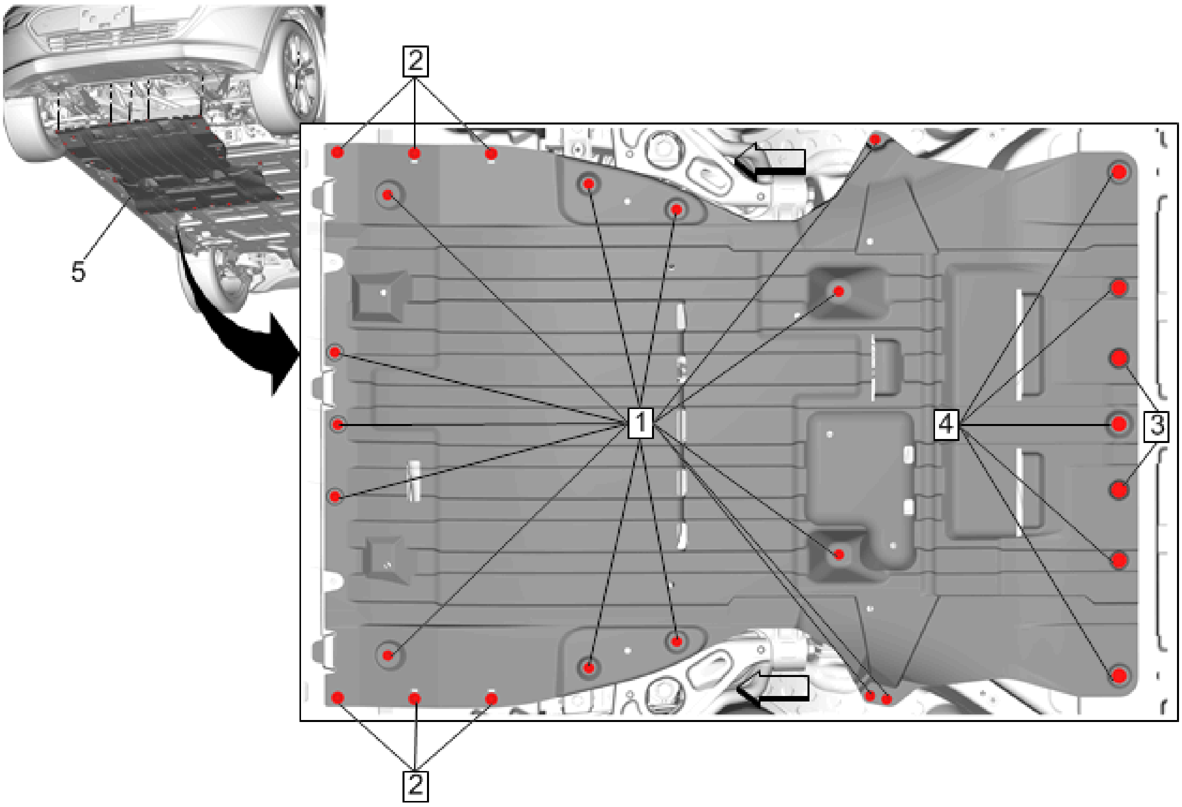


Fig. 221: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

7. Install Front Compartment Air Deflector (5). Refer to Front Compartment Air Deflector Replacement

8. Fill the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**
9. Check the cooling system for leaks.

DRIVE MOTOR BATTERY COOLANT INLET HOSE REPLACEMENT

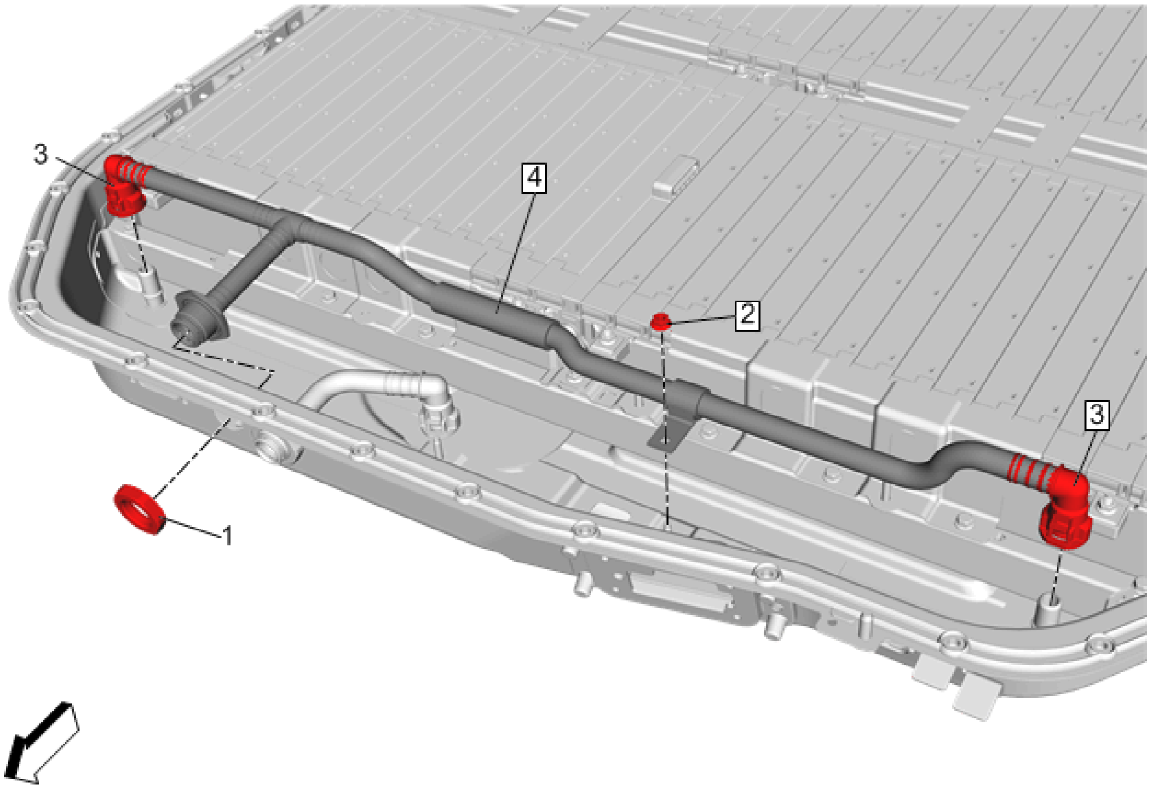


Fig. 222: Drive Motor Battery Coolant Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.

WARNING:

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedure exactly as written may result in serious injury or death.

Preliminary Procedure

1. Remove the high voltage battery disconnect relay. Refer to **High Voltage Battery Disconnect Relay Replacement**
2. Remove the high voltage connector X4 harness assembly. Refer to **High Voltage Connector Replacement (X4)**

Callout	Component Name
1	Drive Motor Battery Coolant Port Nut **CAUTION:** **Refer to Fastener Caution** **Tighten** 40 N.m (30 lb ft) **NOTE:** **Use a suitable tool to hold the backside fastener (inside nut).**
2	Drive Motor Battery Coolant Inlet Hose Nut **Tighten** 5 N.m (44 lb in)
3	Drive Motor Battery Coolant Inlet Hose Quick Connectors (Qty: 2) **NOTE:** **Place rags around the quick connectors. Residual coolant will leak out when quick connectors are disconnected and under no circumstances can coolant leak into the battery tray.** **CAUTION:** **The module must be drained of all residual coolant prior to disassembly. Failure to properly drain all residual coolant may cause electronic circuit damage to occur during disassembly.**
4	Drive Motor Battery Coolant Inlet Hose **Procedure** Check the battery pack cooling system for leaks before installing the battery pack to the vehicle. Refer to **Hybrid Battery Pack Coolant Passage Leak Test**

DRIVE MOTOR BATTERY COOLANT OUTLET HOSE REPLACEMENT

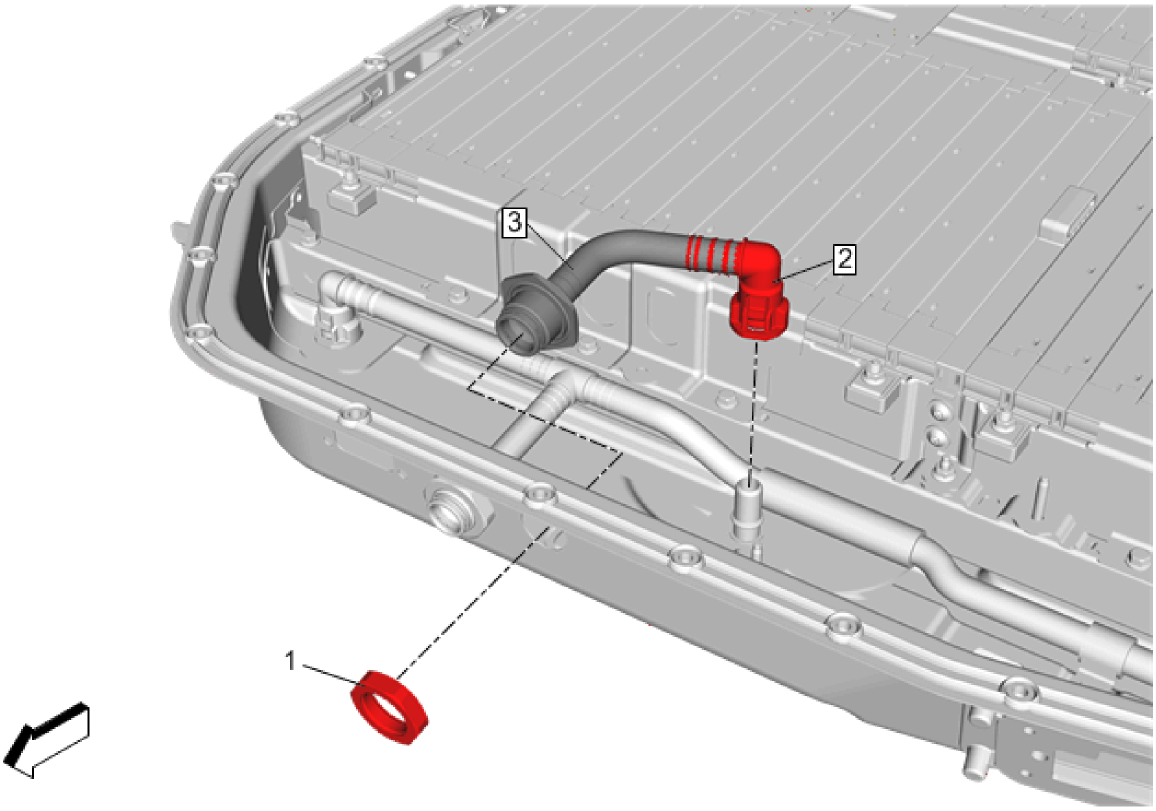


Fig. 223: Drive Motor Battery Coolant Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

	WARNING:
	Ensure all High Voltage safety procedures are followed. Failure to follow the procedure exactly as written may result in serious injury or death.
	WARNING:
	Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
	• **Safety glasses with appropriate side shields when within 50 feet of the vehicle, either indoors or outdoors**
	• **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors**
	  • **Visually and functionally inspect the gloves before use.**
	  • **Wear the Insulation gloves at all times when working with the high voltage battery assembly, whether the system is energized or not.**
	Failure to follow the procedure exactly as written may result in serious injury or death.
	Preliminary Procedure
	1. Remove the battery upper cover. Refer to **Battery Upper Cover Replacement**
	2. Detach the high voltage connector X4 harness retainer from the outlet hose. Refer to **High Voltage Connector Replacement (X4)**

1	Drive Motor Battery Coolant Port Nut (Qty: 1) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 40 N.m (30 lb ft) **NOTE:** **Use a suitable tool to hold the backside fastener (inside nut).**
2	Drive Motor Battery Coolant Outlet Hose Quick Connectors (Qty: 1)
3	Drive Motor Battery Coolant Outlet Hose **Procedure** Check the battery pack cooling system for leaks before installing the battery pack to the vehicle. Refer to **Hybrid Battery Pack Coolant Passage Leak Test**

DRIVE MOTOR BATTERY RADIATOR OUTLET HOSE REPLACEMENT (SURGE TANK TO CHILLER)

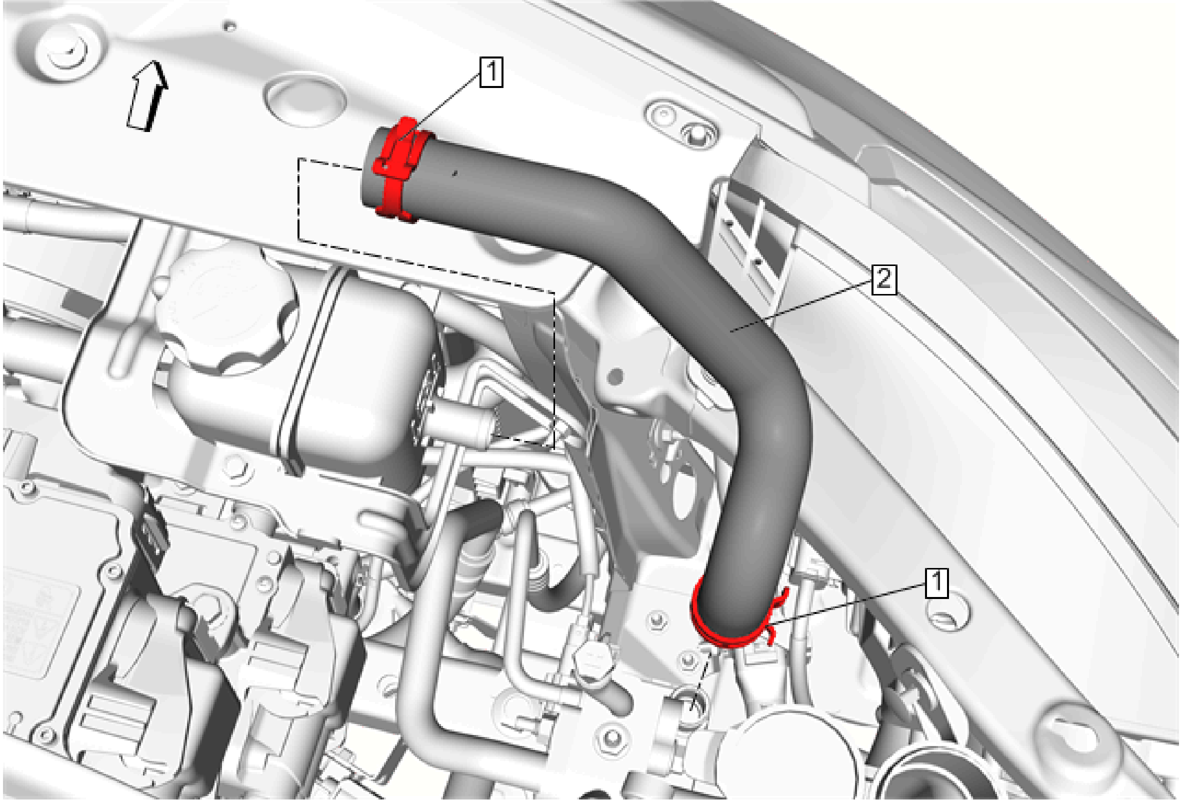


Fig. 224: Drive Motor Battery Radiator Outlet Hose (Surge Tank To Chiller)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.** **Preliminary Procedures** 1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle. 2. Drain the drive motor battery cooling system. Refer to Drive Motor Battery Cooling System Draining and Filling	
1	Clamp (Qty: 2) **Procedure** Reposition the drive motor battery radiator outlet hose clamps. Refer to Hose Clamp Replacement Guidelines - Spring Type
2	Drive Motor Battery Radiator Outlet Hose **Procedure** 1. Fill the coolant to the proper level. Refer to Drive Motor Battery Cooling System Draining and Filling 2. Check the cooling system for leaks.

DRIVE MOTOR BATTERY COOLANT COOLER INLET HOSE REPLACEMENT (PUMP TO RESS HEATER)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any**

cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

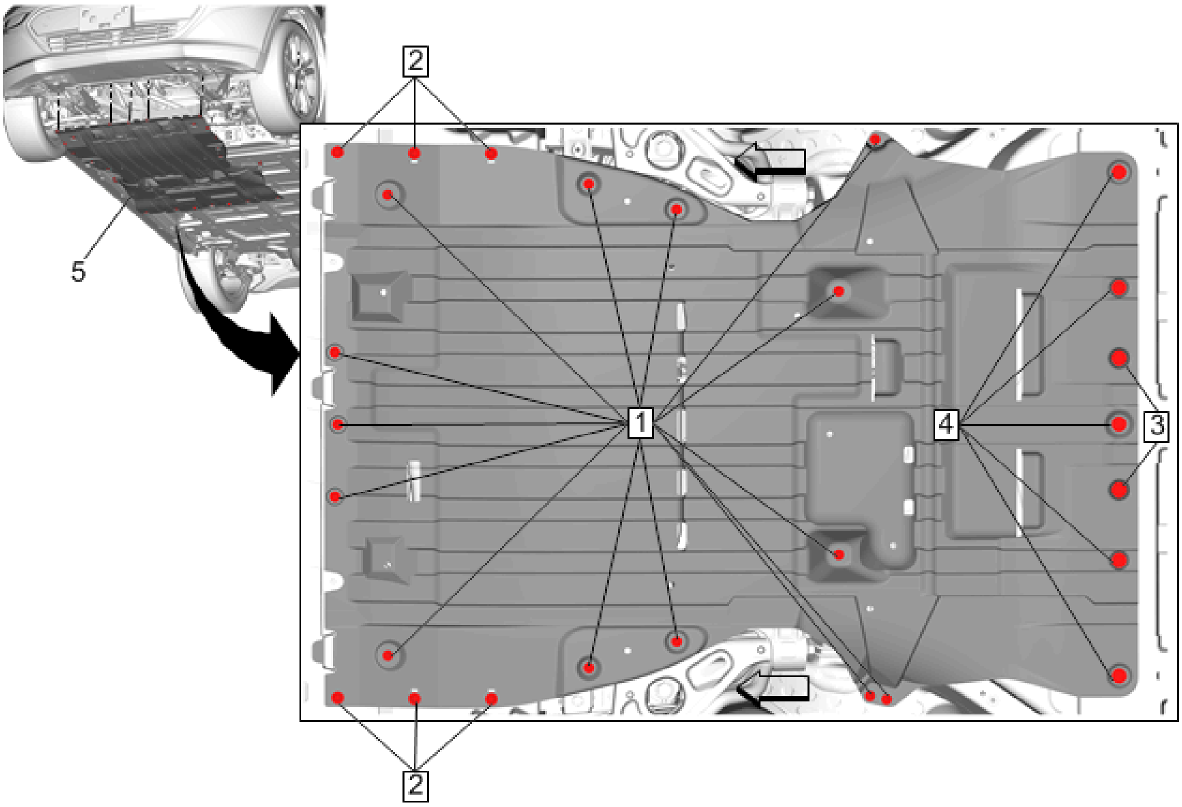


Fig. 225: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
3. Drain the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**

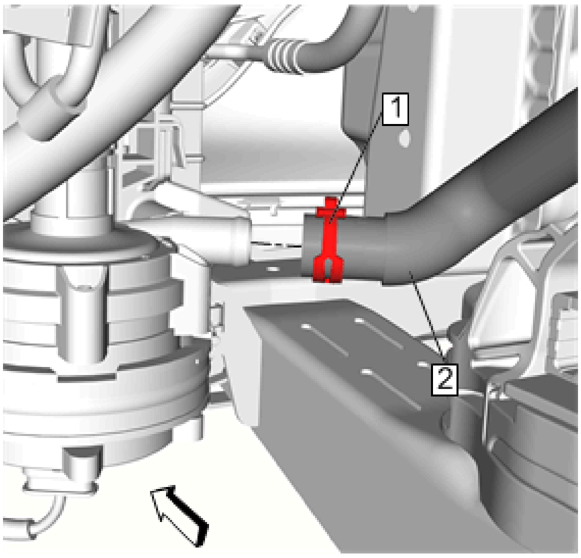


Fig. 226: Drive Motor Battery Coolant Cooler Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
5. Remove Drive Motor Battery Coolant Cooler Inlet Hose (2)

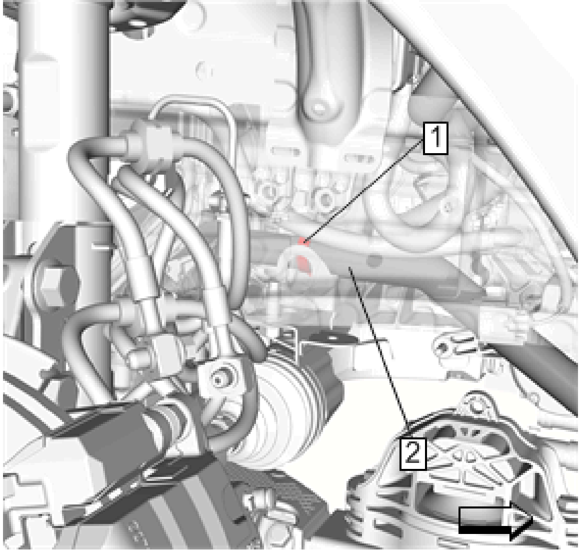


Fig. 227: Drive Motor Battery Coolant Cooler Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Remove Retainer (1)
7. Remove Drive Motor Battery Coolant Cooler Inlet Hose (2)

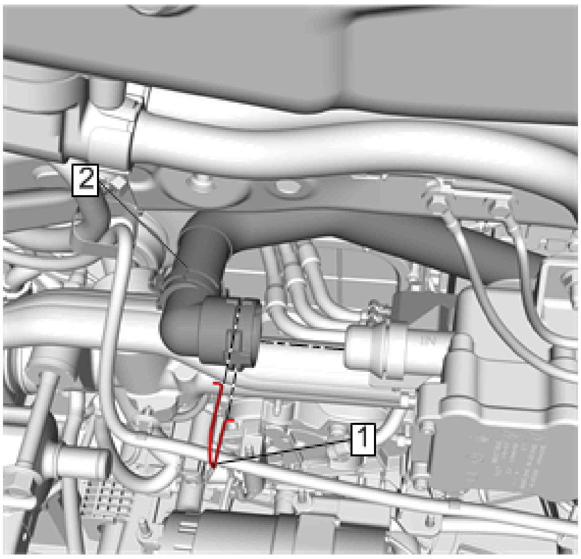


Fig. 228: Drive Motor Battery Coolant Cooler Inlet Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

8. Release Clip (1)
9. Remove Drive Motor Battery Coolant Cooler Inlet Hose (2)

Installation Procedure

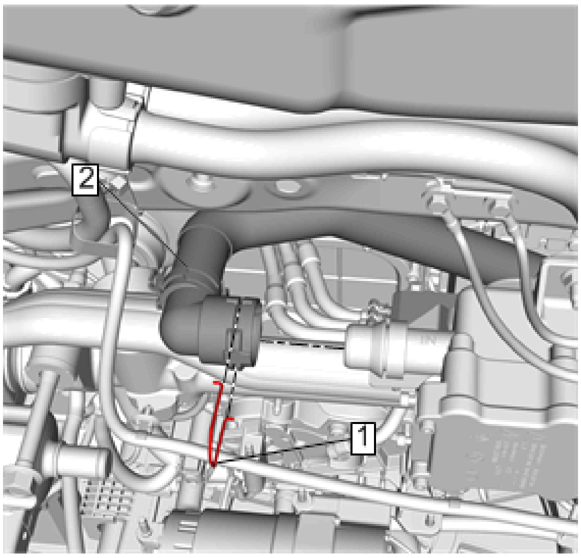


Fig. 229: Drive Motor Battery Coolant Cooler Inlet Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Coolant Cooler Inlet Hose (2)
2. Install Clip (1)

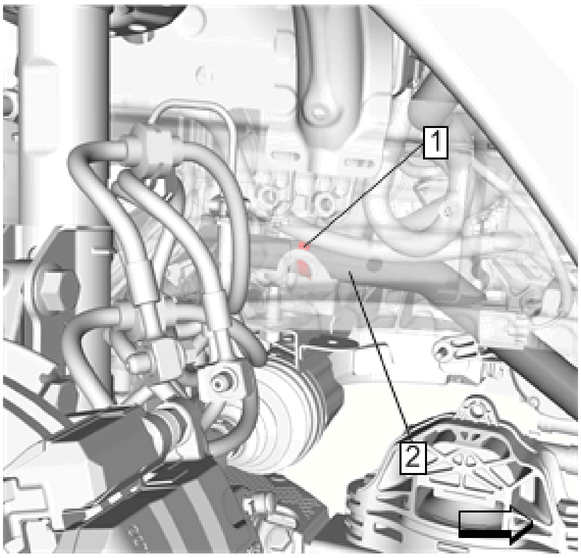


Fig. 230: Drive Motor Battery Coolant Cooler Inlet Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Install Drive Motor Battery Coolant Cooler Inlet Hose (2)
4. Install Retainer (1)

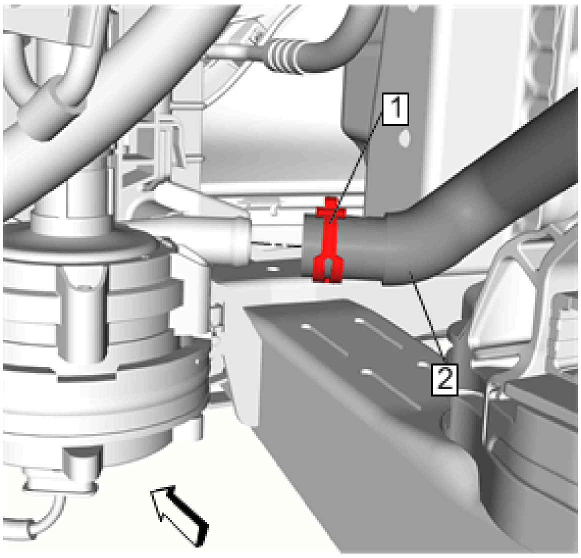


Fig. 231: Drive Motor Battery Coolant Cooler Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install Drive Motor Battery Coolant Cooler Inlet Hose (2)
6. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

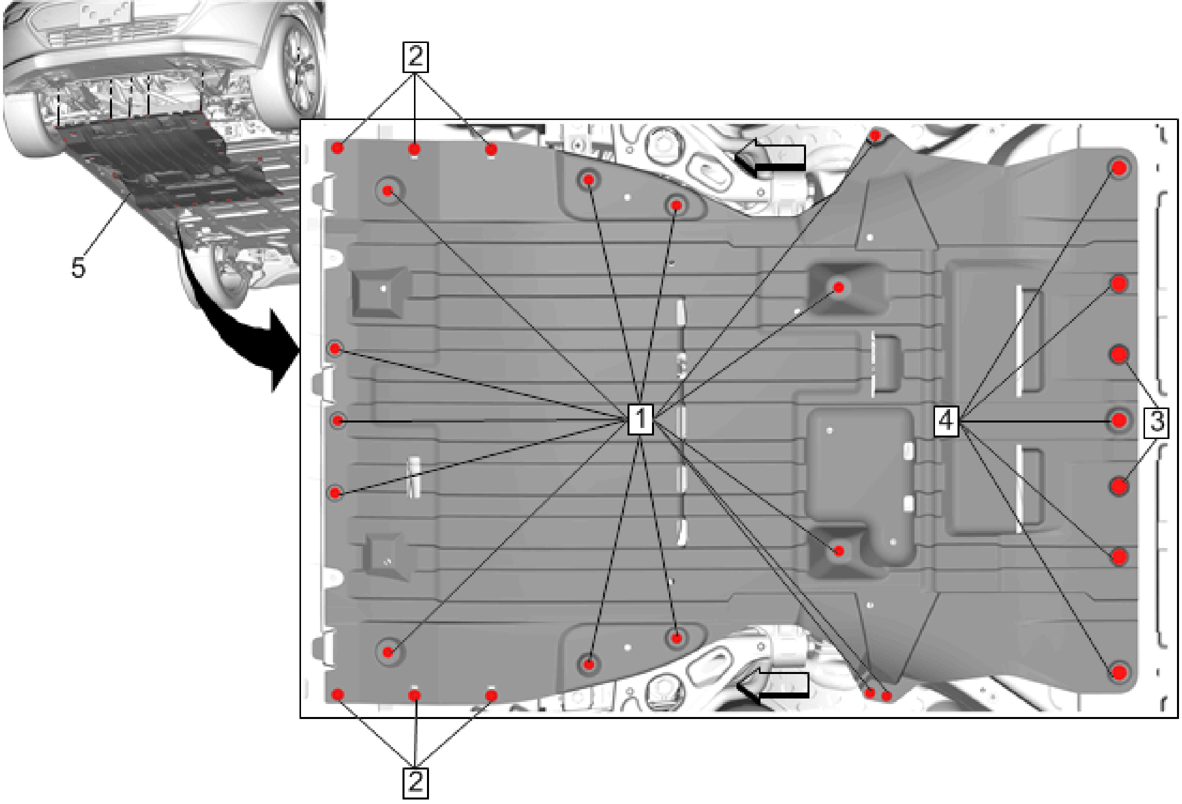


Fig. 232: Front Compartment Air Deflector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

7. Install Front Compartment Air Deflector (5). Refer to **Front Compartment Air Deflector Replacement**
8. Fill the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**
9. Check the cooling system for leaks.

BATTERY VENT HOSE REPLACEMENT (RESS HTR TO RESS)

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
3. Drain the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**

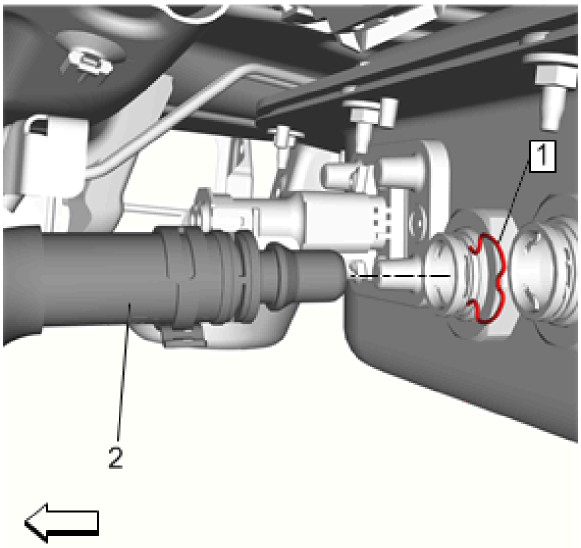


Fig. 233: Battery Vent Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

4. Remove Clip (1)
5. Remove Battery Vent Hose (2)

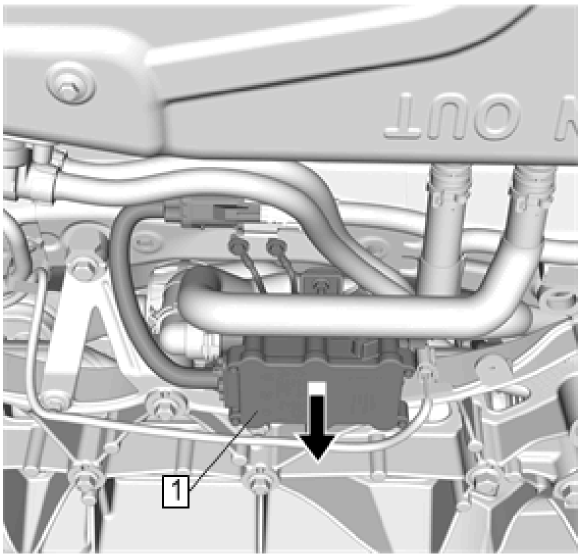


Fig. 234: High Voltage Battery Heater Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Lower the high voltage battery heater assembly (1) to get the space enough to access to the battery vent hose. Refer to High Voltage Battery Heater Replacement

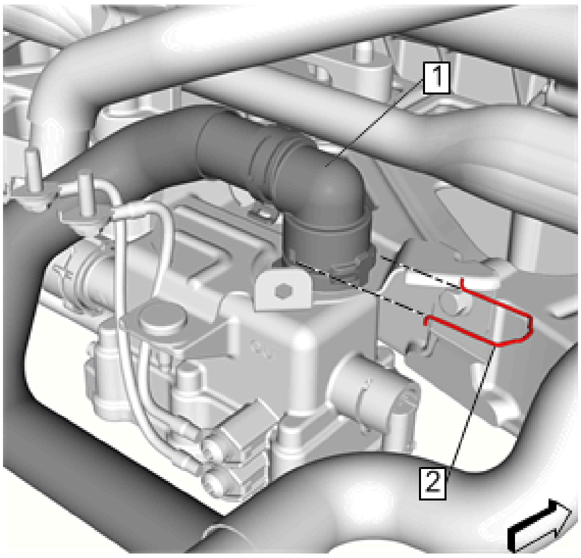


Fig. 235: Battery Vent Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

7. Release Clip (2)
8. Remove Battery Vent Hose (1)

Installation Procedure

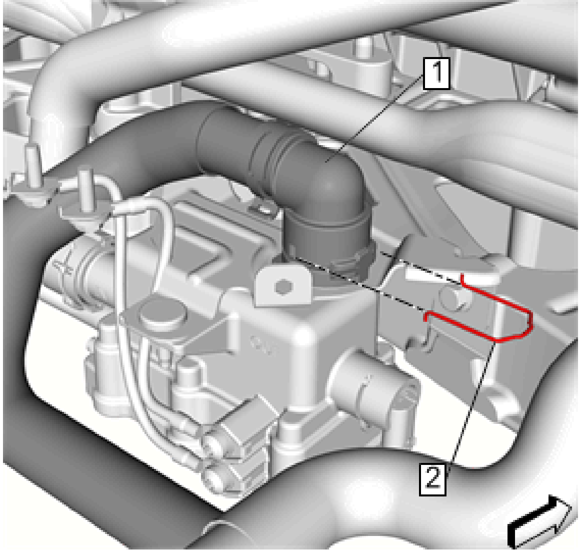


Fig. 236: Battery Vent Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

1. Install Battery Vent Hose (1)
2. Install Clip (2)

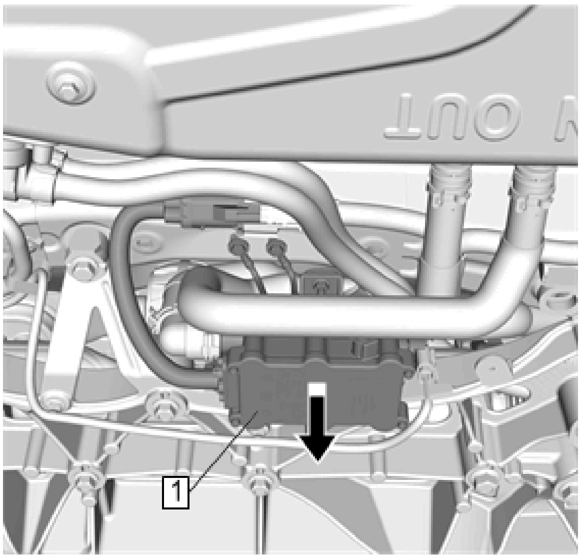


Fig. 237: High Voltage Battery Heater Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install High Voltage Battery Heater (1). Refer to **High Voltage Battery Heater Replacement**

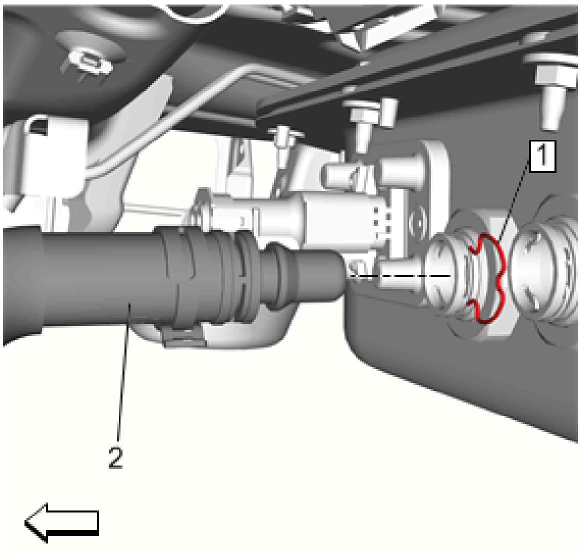


Fig. 238: Battery Vent Hose And Clip
Courtesy of GENERAL MOTORS COMPANY

4. Install Clip (1)

NOTE: **When installing the inlet or outlet hose, be careful not to confuse the inlet port and outlet port.**

5. Install Battery Vent Hose (2)
6. Fill the drive motor battery cooling system. Refer to **Drive Motor Battery Cooling System Draining and Filling**
7. Check the cooling system for leaks.

HEATER COOLANT SURGE TANK REPLACEMENT

Removal Procedure

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.
2. Drain the heater coolant heater system. Refer to **Heater Coolant Heater Draining and Filling**

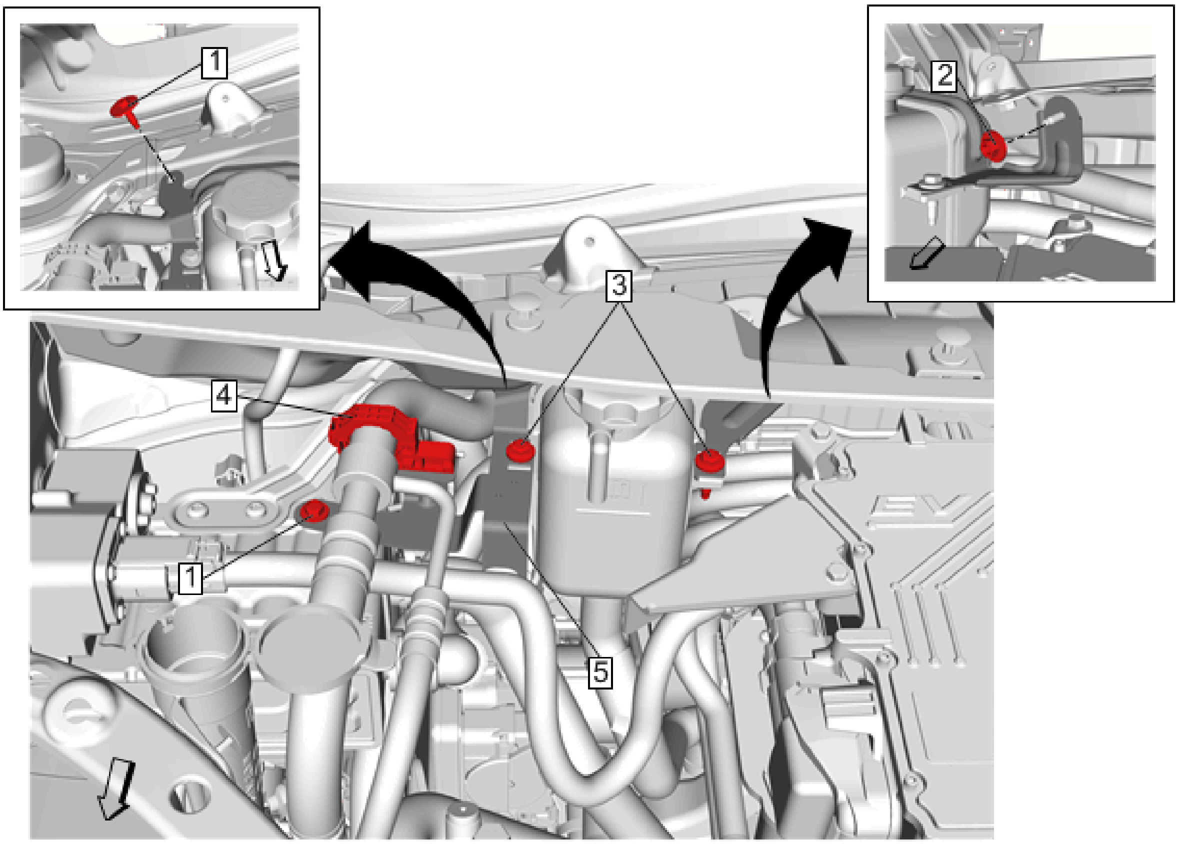


Fig. 239: Radiator Surge Tank Bracket-Heater Bracket
Courtesy of GENERAL MOTORS COMPANY

3. Remove Radiator Surge Tank Bracket-Heater Bracket (4). Refer to **Radiator Surge Tank Support Bracket Replacement (Heater)**

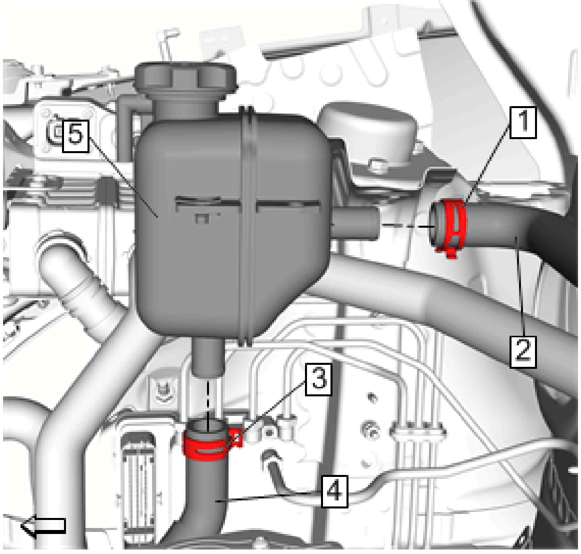


Fig. 240: Heater Coolant Surge Tank And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

4. Disengage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
5. Remove Heater Inlet Hose (2)
6. Disengage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
7. Remove Auxiliary Heater Inlet Hose (4)
8. Remove the heater coolant surge tank (5).
9. Transfer components as necessary.

Installation Procedure

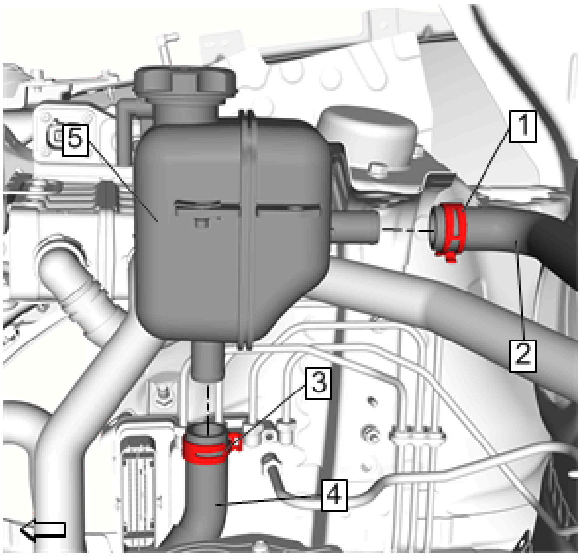


Fig. 241: Heater Coolant Surge Tank And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the heater coolant surge tank (5).
2. Auxiliary Heater Inlet Hose (4)
3. Engage Clamp (3). Refer to **Hose Clamp Replacement Guidelines - Spring Type**
4. Install Heater Inlet Hose (2)
5. Engage Clamp (1). Refer to **Hose Clamp Replacement Guidelines - Spring Type**

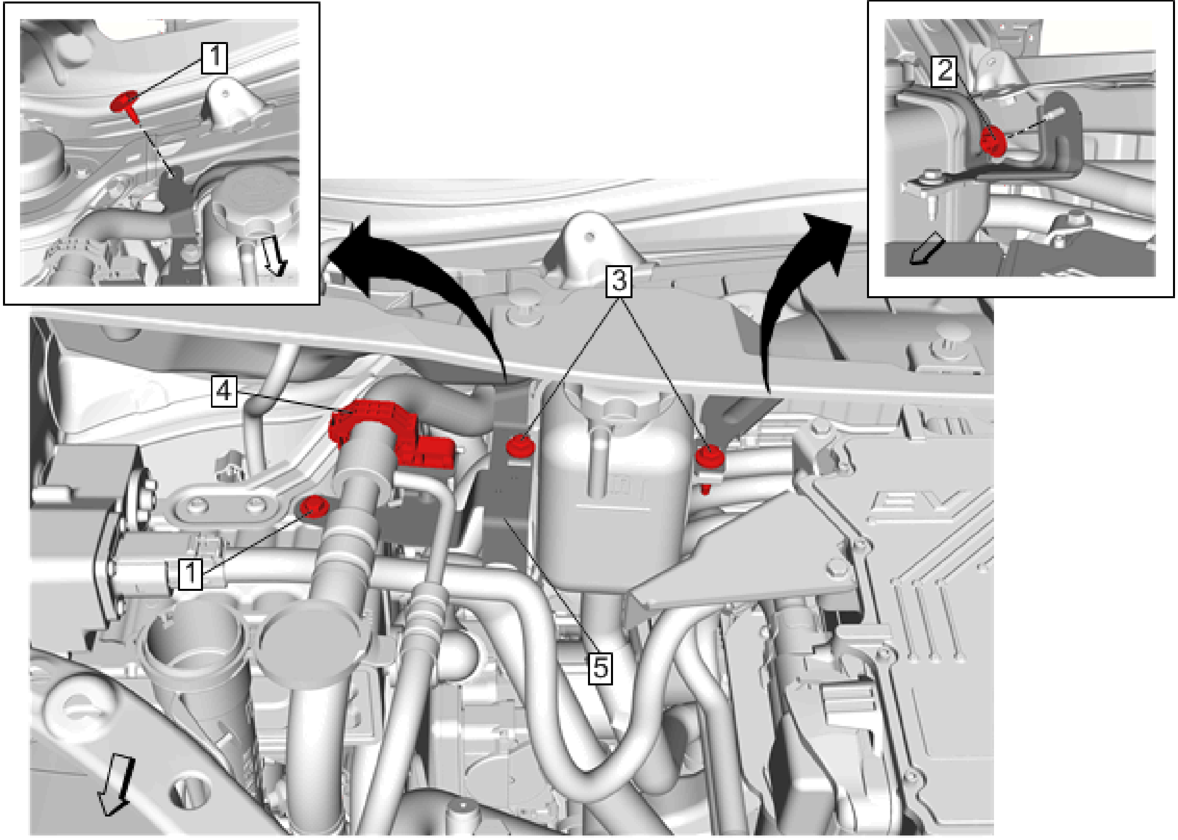


Fig. 242: Radiator Surge Tank Bracket-Heater Bracket
Courtesy of GENERAL MOTORS COMPANY

6. Install Radiator Surge Tank Bracket-Heater Bracket (4). Refer to **Radiator Surge Tank Support Bracket Replacement (Heater)**
7. Fill the heater coolant heater system. Refer to **Heater Coolant Heater Draining and Filling**
8. Check the cooling system for leaks.

DESCRIPTION AND OPERATION

HYBRID/EV COOLING SYSTEM DESCRIPTION AND OPERATION

This vehicle is equipped with three fully independent cooling systems.

1. The hybrid/EV electronics cooling system is dedicated to cooling the power electronics components.
2. The hybrid/EV battery pack cooling system is dedicated to cooling and heating the high voltage hybrid/EV battery.
3. The passenger compartment heater system is dedicated to providing heat to the passenger compartment.

Hybrid Electronics Cooling System Description and Operation

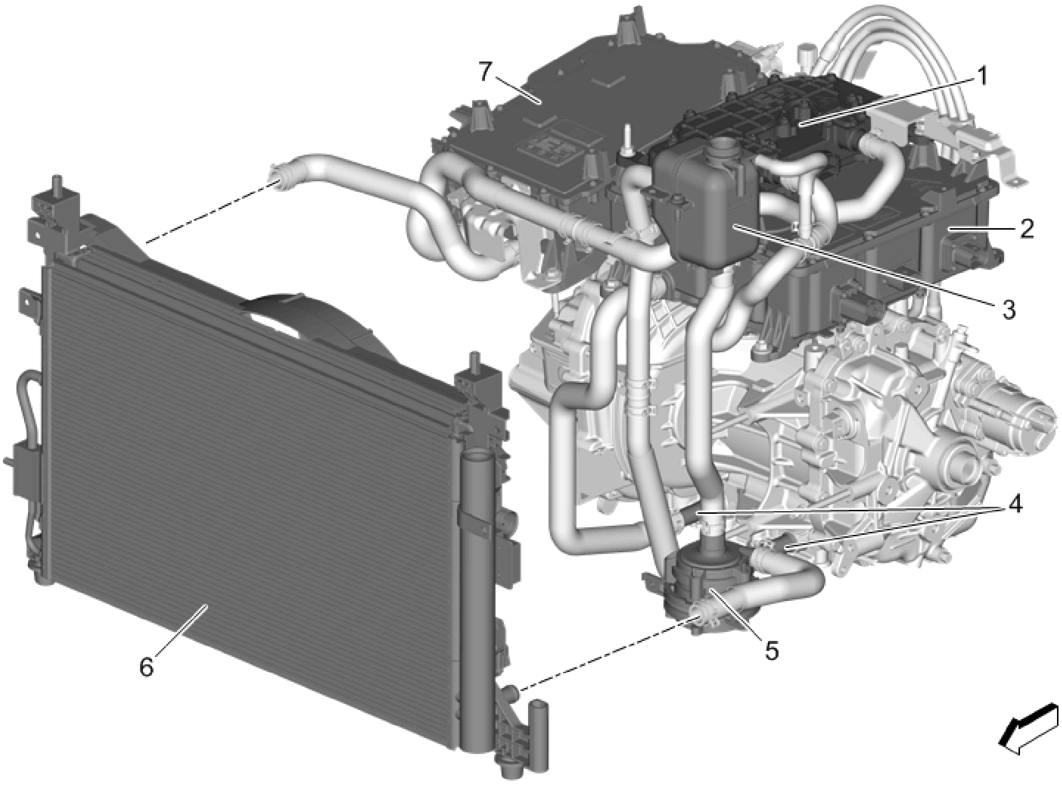


Fig. 243: Hybrid Electronics Cooling System Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name or Electronic Part Catalog Name
1	K1 14V Power Module	14V Power Module	Accessory DC Power Control Module
2	T18 Battery Charger	Battery Charger Control Module data list within Hybrid Powertrain Control Module 2	Drive Motor Battery Charger
3	Electronics Coolant Reservoir	Not Applicable	Drive Motor Battery Radiator Surge Tank
4	T12 Automatic Transmission Assembly coolant inlet and outlet ports	Not Applicable	Not Applicable
5	G35 Hybrid/EV Electronics Coolant Pump	Hybrid/EV Electronics Coolant Pump	Drive Motor Battery Coolant Pump
6	Power Electronics Coolant Radiator	Not Applicable	Engine Coolant Fan Module Radiator
7	T6 Power Inverter Module	• Hybrid Powertrain Control Module • Drive Motor Control Module 1	Drive Motor Power Inverter Module

The primary purpose of the hybrid/EV electronics cooling loop is to cool the T6 power inverter module, T18 battery charger, K1 14V power module and the transmission. The hybrid/EV electronics cooling system uses the hybrid/EV electronics radiator, engine control module inputs, a radiator fan and the 12 V G35 hybrid/EV electronics coolant pump to circulate coolant through the system. The K114B hybrid/EV powertrain control module 2 activates the G35 hybrid/EV electronics coolant pump and monitors the B202 hybrid/EV electronics coolant temperature sensor in the radiator. The coolant pump will be activated when the vehicle is on and during charging.

The hybrid/EV electronics cooling system circulates a pre-mixed DEX-COOLÂ® which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. De-ionized water is required for high voltage isolation and to prevent corrosion from effecting heat sink performance. Always use pre-mixed coolant and never use tap water in the hybrid/EV electronics coolant system.

Hybrid/EV Battery Pack Cooling System Description and Operation

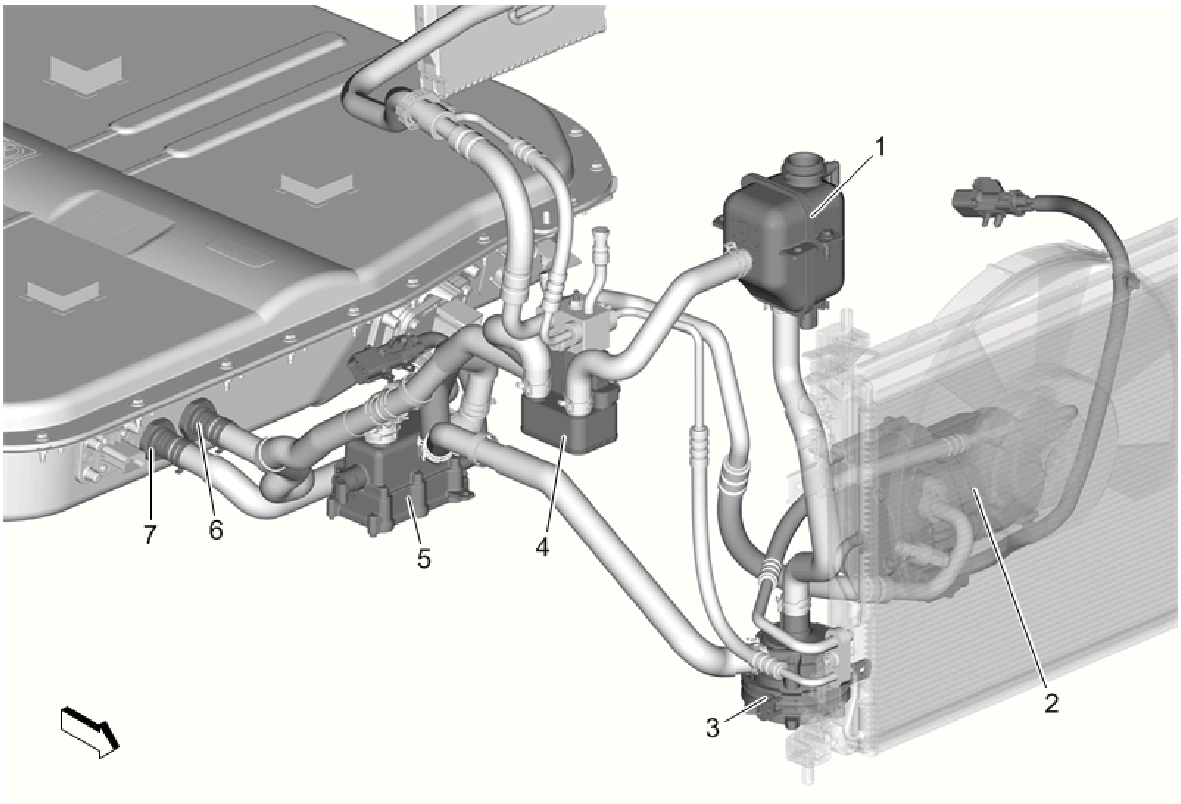


Fig. 244: Hybrid/EV Battery Pack Cooling System Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name or Electronic Part Catalog Name
1	Coolant Surge Tank	Not Applicable	Drive Motor Battery Radiator Surge Tank
2	G1 A/C Compressor	Electric A/C Compressor Control Module	Air Conditioning Compressor
3	G37 Hybrid/EV Battery Pack Coolant Pump	Hybrid/EV Battery Pack Coolant Pump	Drive Motor Battery Coolant Pump
4	Refrigerant/Coolant Heat Exchanger or Chiller	Not Applicable	Drive Motor Battery Coolant Cooler
5	E54 Hybrid/EV Battery Pack Coolant Heater	Hybrid/EV Battery Pack Heater	High Voltage Battery Heater
6	Hybrid/EV Battery Pack Coolant Outlet	Not Applicable	Cell Battery Cooling Manifold - Outlet
7	Hybrid/EV Battery Pack Coolant Inlet	Not Applicable	Cell Battery Cooling Manifold - Inlet

The Hybrid/EV battery pack cooling system uses a 12 V G37 hybrid/EV battery pack coolant pump, a refrigerant/coolant heat exchanger (chiller) and the G1 A/C compressor to cool down the high voltage hybrid/EV battery. There is also the high voltage E54 Hybrid/EV Battery Pack Coolant Heater external of the hybrid/EV battery to heat the coolant entering the hybrid/EV battery when needed. The K114B hybrid/EV powertrain control module 2 monitors the B204A hybrid/EV battery coolant temperature sensor 1, hybrid/EV battery cell temperature sensors, refrigerant temperature, refrigerant pressure, and the B258 hybrid/EV battery coolant level switch. The K114B hybrid/EV powertrain control module 2 determines how much hybrid/EV battery cooling or heating is required and turns on the G37 hybrid/EV battery pack coolant pump. Depending on what is required, it will operate the radiator fan and request the A/C Compressor Module to turn on the high voltage A/C compressor, or turn on the high voltage E54 hybrid/EV battery pack coolant heater. The hybrid/EV battery pack cooling system could be activated when the vehicle is operating, during charging, or when the vehicle is OFF and maintaining the hybrid/EV battery pack temperature. Refer to **Automatic HVAC Description and Operation** .

The B258 hybrid/EV battery pack coolant level switch is attached to the coolant surge tank. The level sensor is a 2 state switch which changes state when the level in the surge tank gets low. The K114B hybrid/EV powertrain control module 2 uses the coolant level switch to determine if disabling the hybrid/EV battery pack charging operation is necessary due to a loss of coolant.

The hybrid/EV battery pack cooling system circulates a pre-mixed DEX-COOLÂ® which is a 50/50 mixture of DEX-COOLÂ® and de-ionized water. De-ionized water is required for high voltage isolation and to prevent corrosion from effecting heat sink performance. Always use pre-mixed coolant and never use tap water in the battery coolant system.

Passenger Compartment Heater System Description and Operation

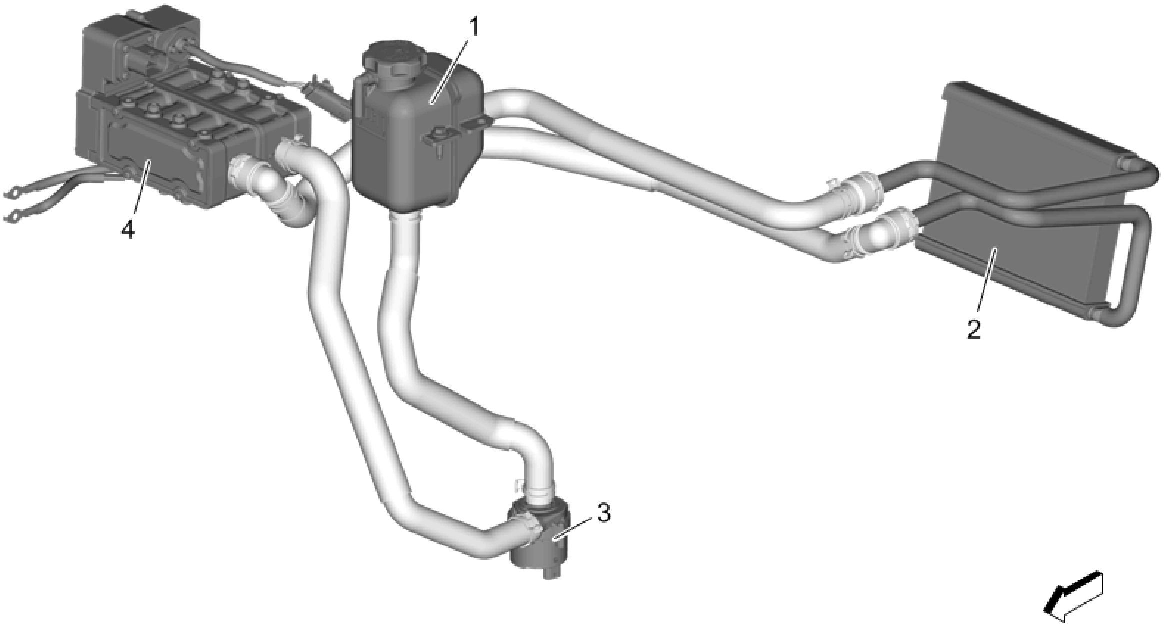


Fig. 245: Passenger Compartment Heater System Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Schematic Reference or Generic Name	Scan Tool Reference	Service Information Part Name or Electronic Part Catalog Name
1	Coolant Surge Tank	Not Applicable	Heater Coolant Surge Tank
2	Heater Core	Not Applicable	Heater Assembly
3	G17 Heater Coolant Pump	Not Applicable	Heater Coolant Pump
4	K10 Coolant Heater Control Module	Electric Passenger Compartment Heater	Heater Coolant Heater

The passenger compartment heater system uses the 12 V G17 heater coolant pump, high voltage K10 coolant heater control module and a heater core.

The K33 HVAC control module monitors the temperature sensors in the passenger compartment and coolant loop to determine if high voltage K10 coolant heater control module and G17 heater coolant pump operation is needed. Passenger compartment heat is provided by air flowing through the heater core. Refer to **Automatic HVAC Description and Operation** .

The passenger compartment heater cooling system circulates a 50/50 mixture of DEX-COOLÂ® and deionized water.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

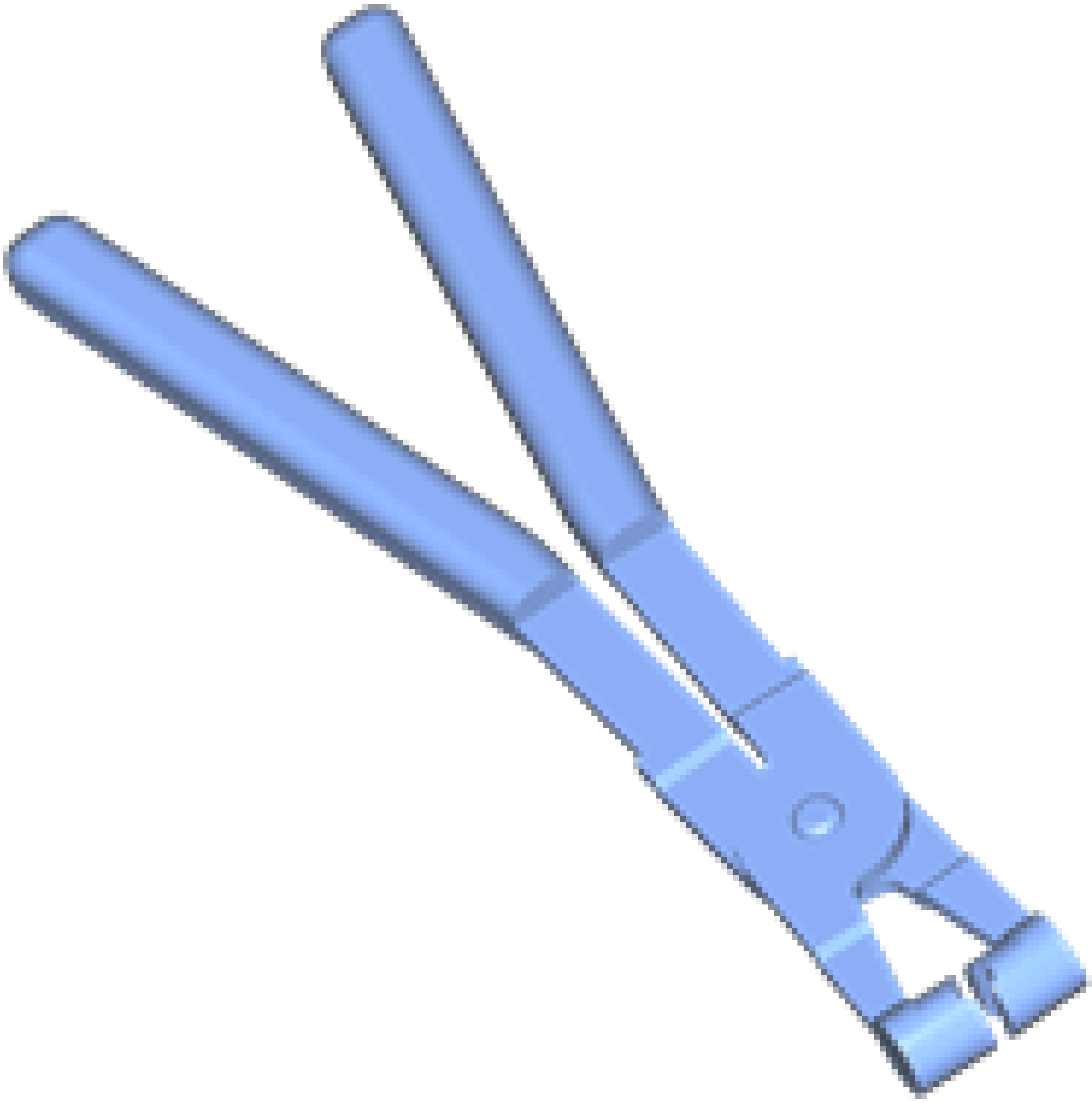
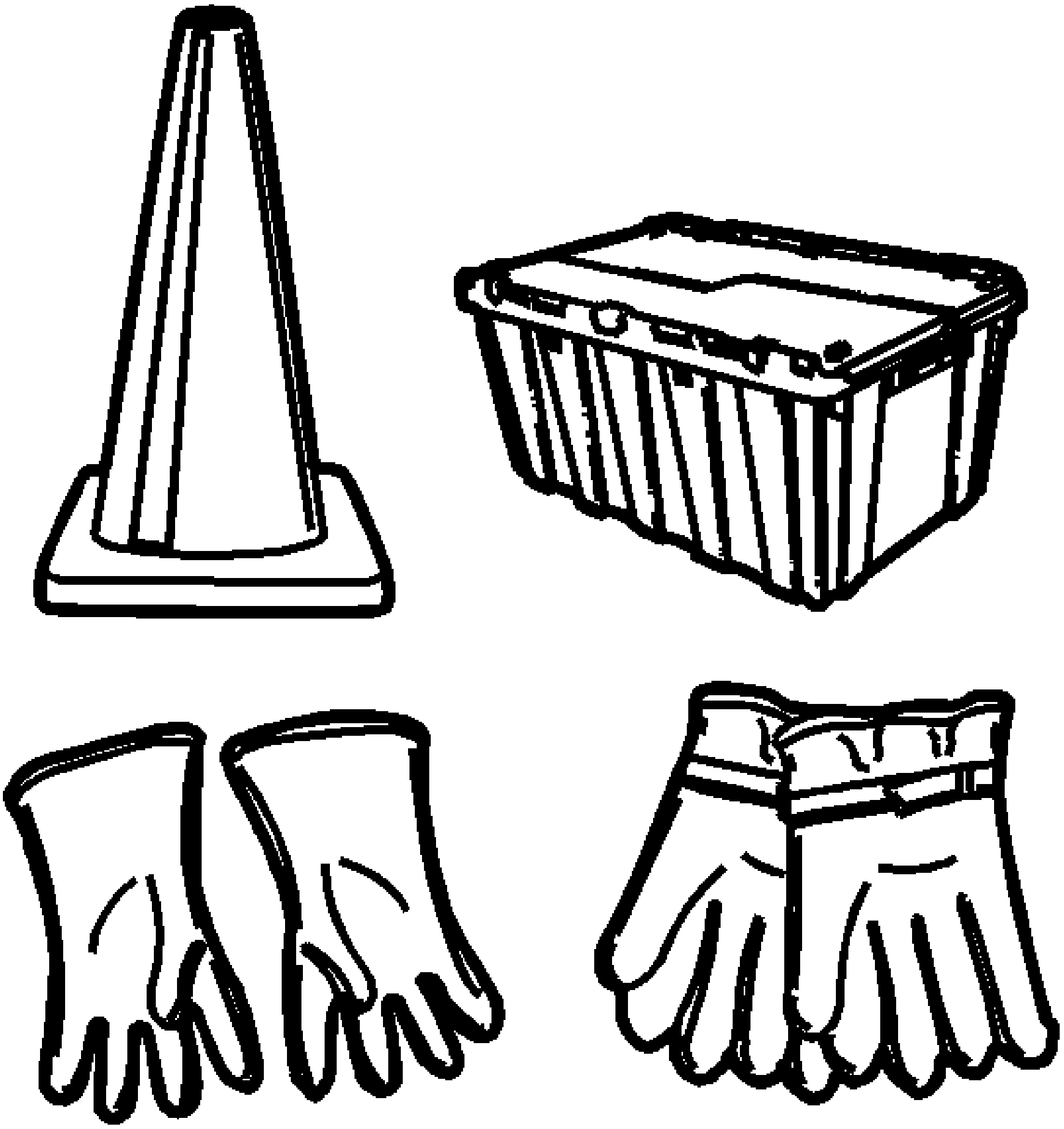
Illustration	Tool Number/Description
	BO 38185 J 38185 Hose Clamp Pliers

Illustration	Tool Number/Description
	EL 48900-A HEV Safety Kit

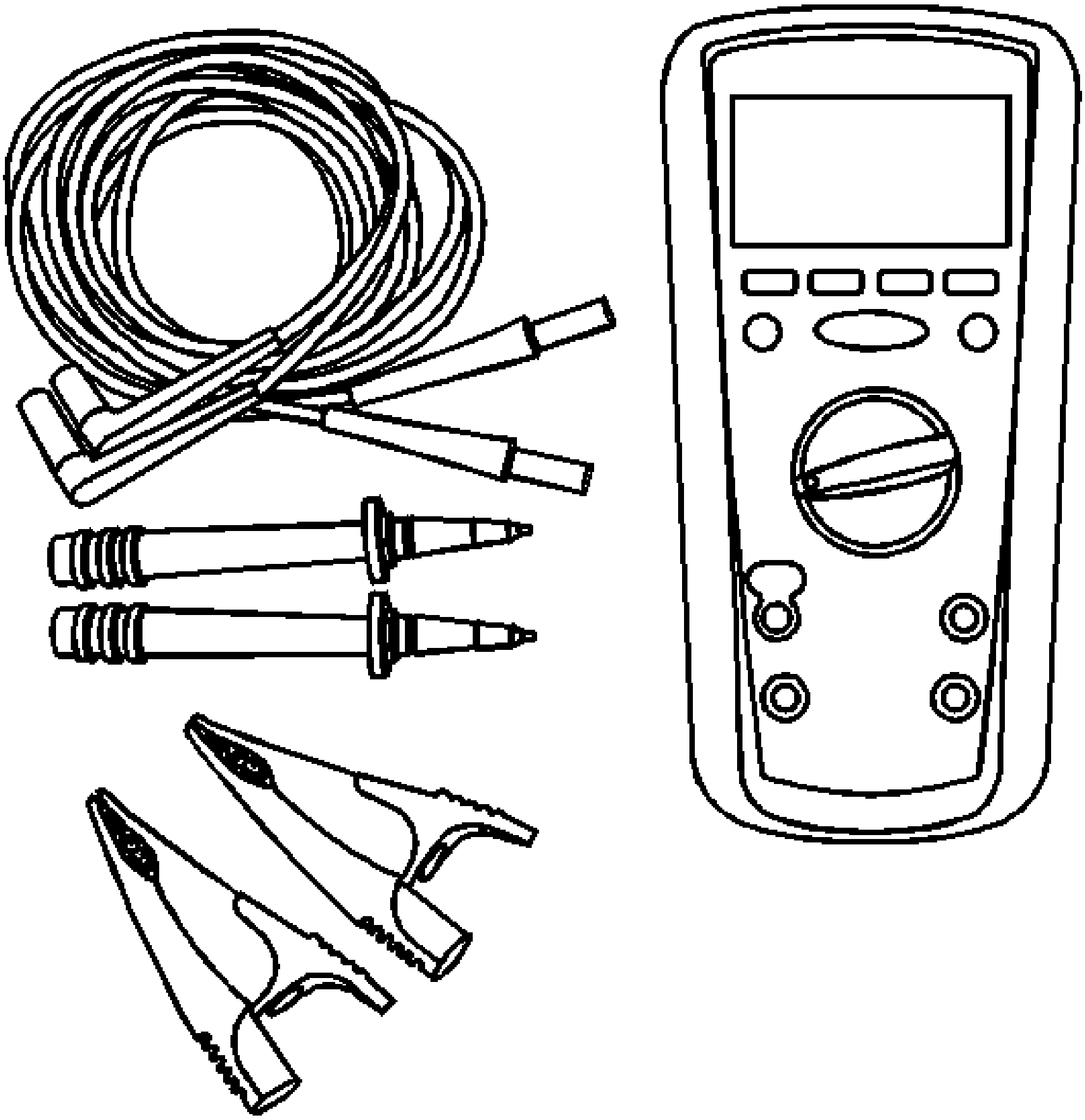
<table>
<tr><th>Illustration</th><th>Tool Number/Description</th></tr>
<tr><td></td><td>EL 50772
Insulation Multimeter</td></tr>
<tr><td></td><td>EN 24460-A
J 24460-A
Cooling System Pressure Tester</td></tr>
</table>

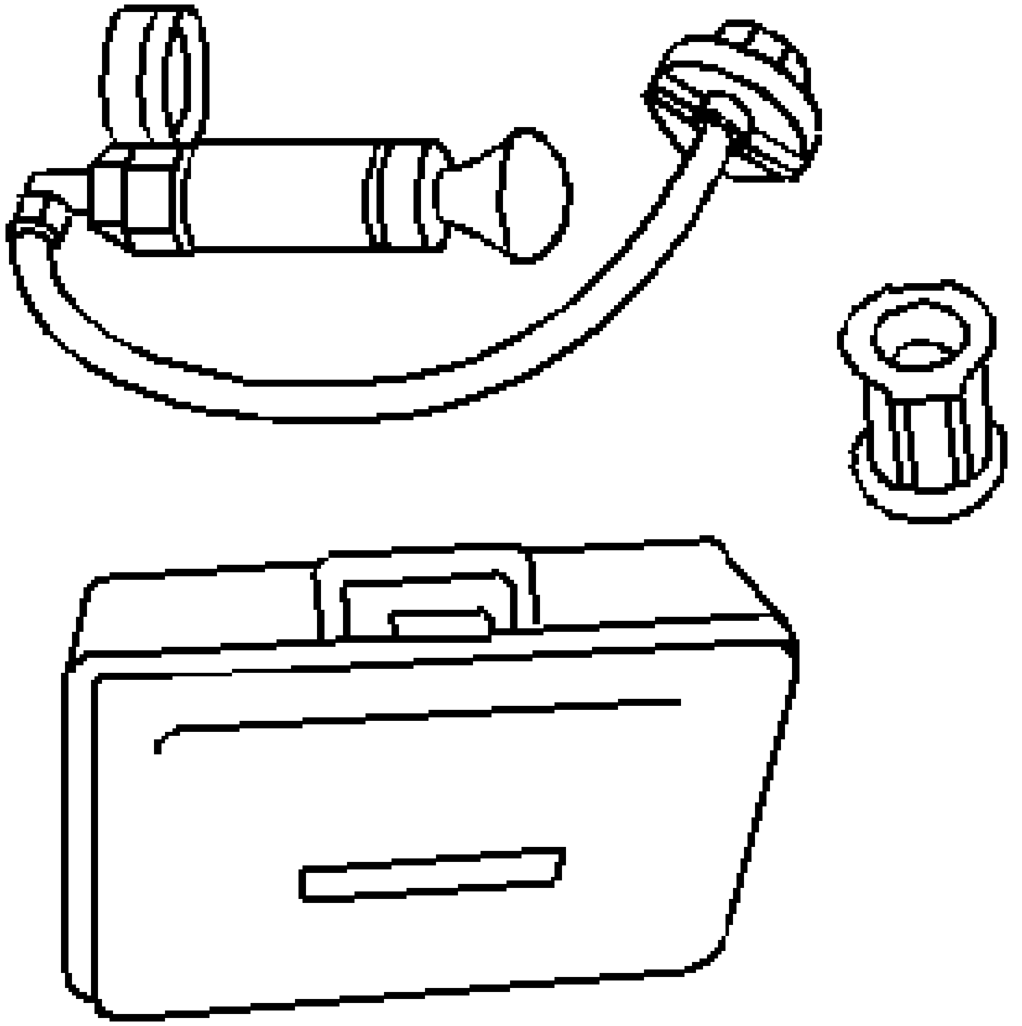
Illustration	Tool Number/Description
	

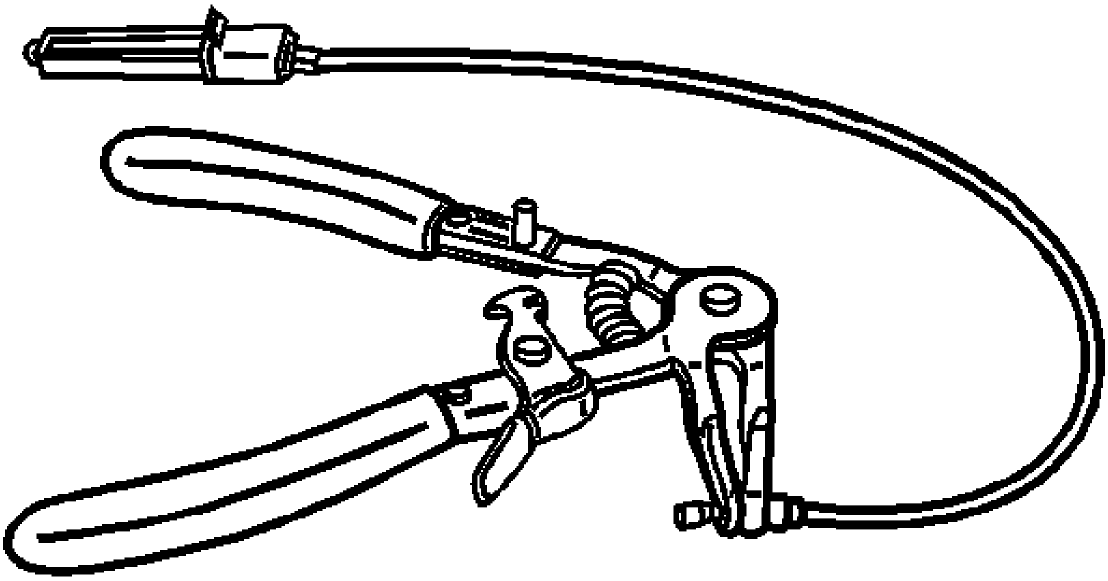
Illustration	Tool Number/Description
	EN 6182-3 GE 47622 GE 49731 Hose Clamp Pliers
	GE 26568 J 26568 Coolant and Battery Tester

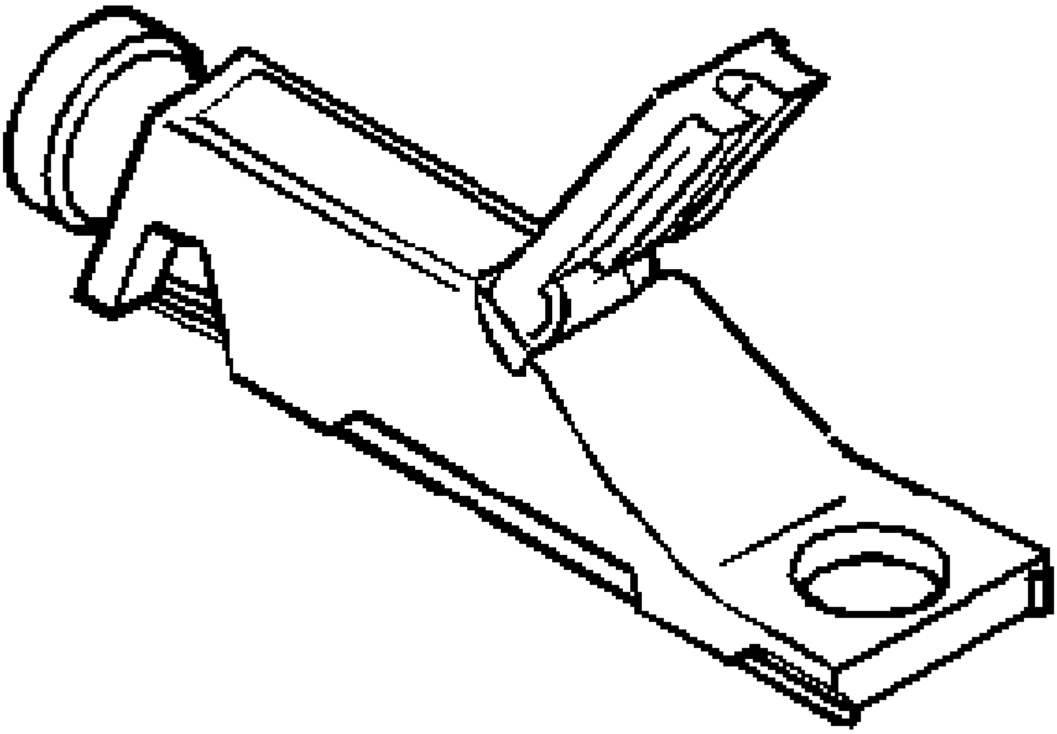
Illustration	Tool Number/Description
	

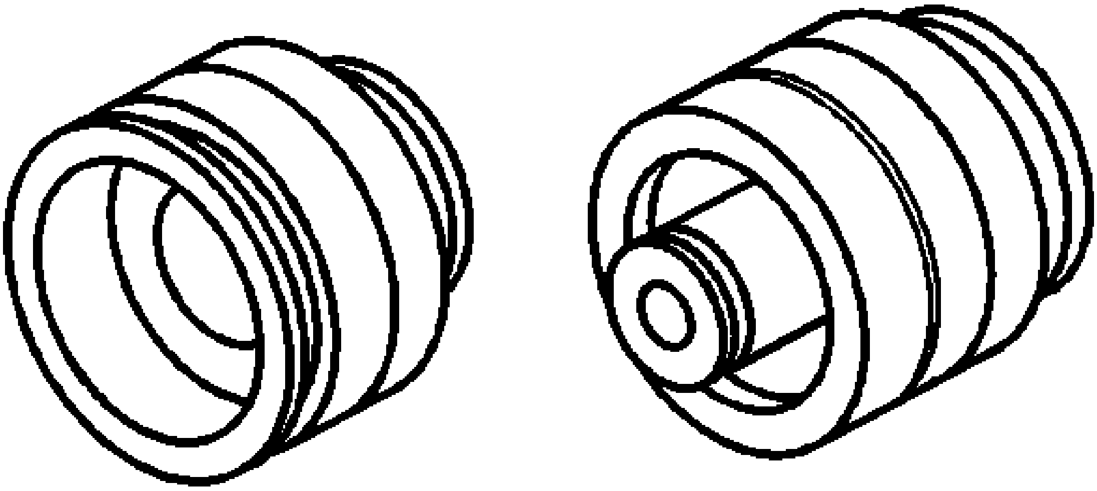
Illustration	Tool Number/Description
	GE 46143-2 J 46143-2 Cooling System Adapter

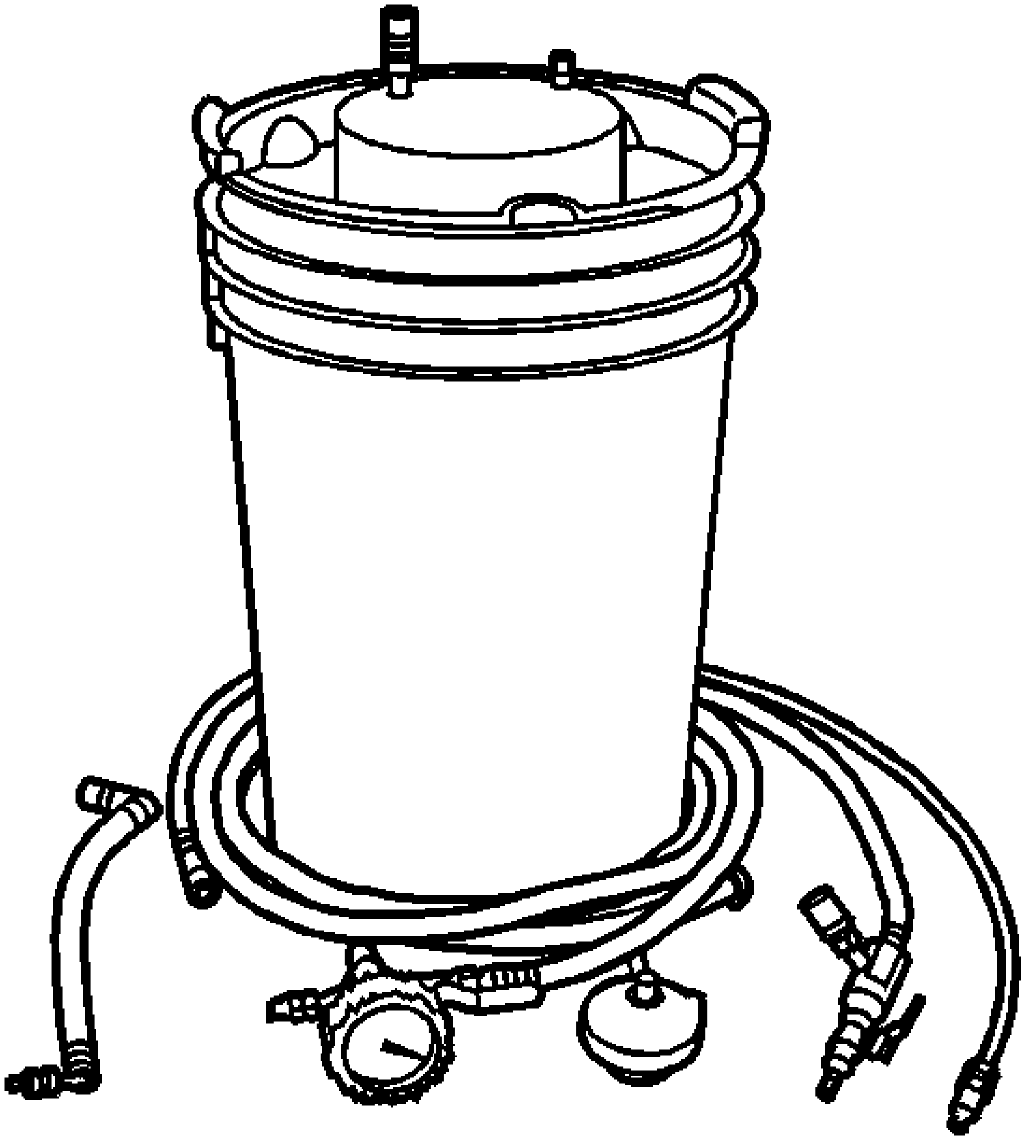
Illustration	Tool Number/Description
	GE 47716 Vac-N-Fill Coolant Refill Tool

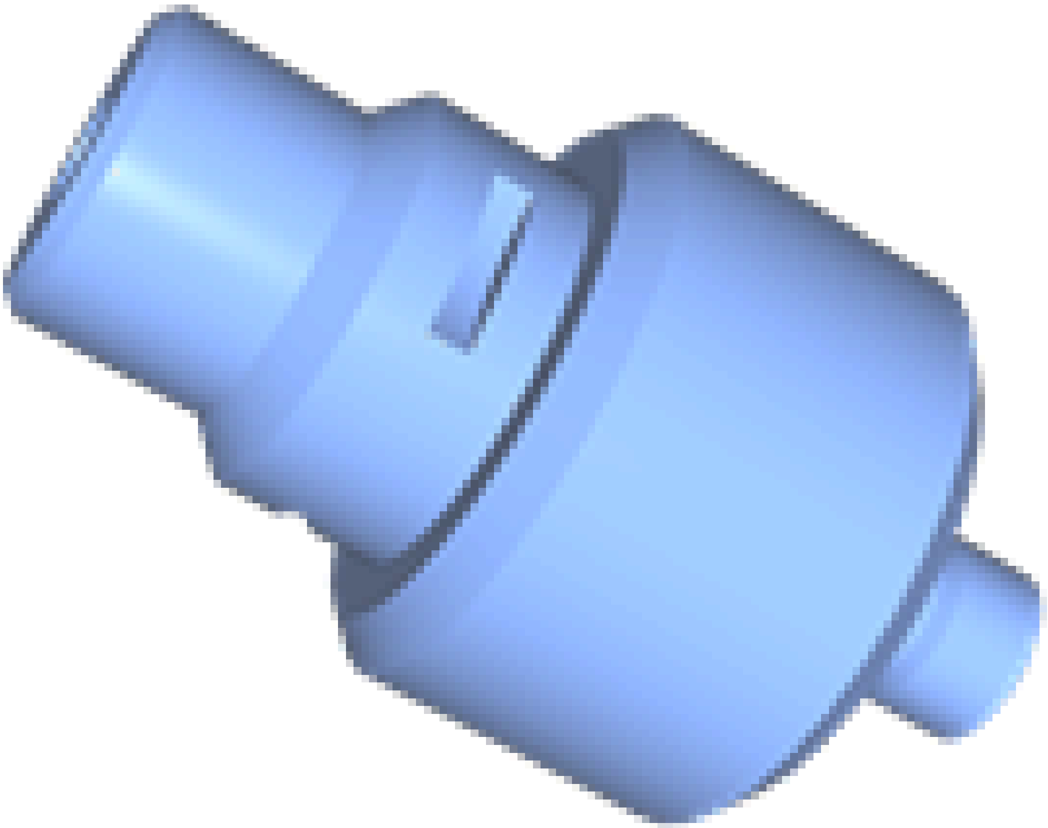
Illustration	Tool Number/Description
	EL-52016-1A Battery Pack Cooling Passage Test Adapter

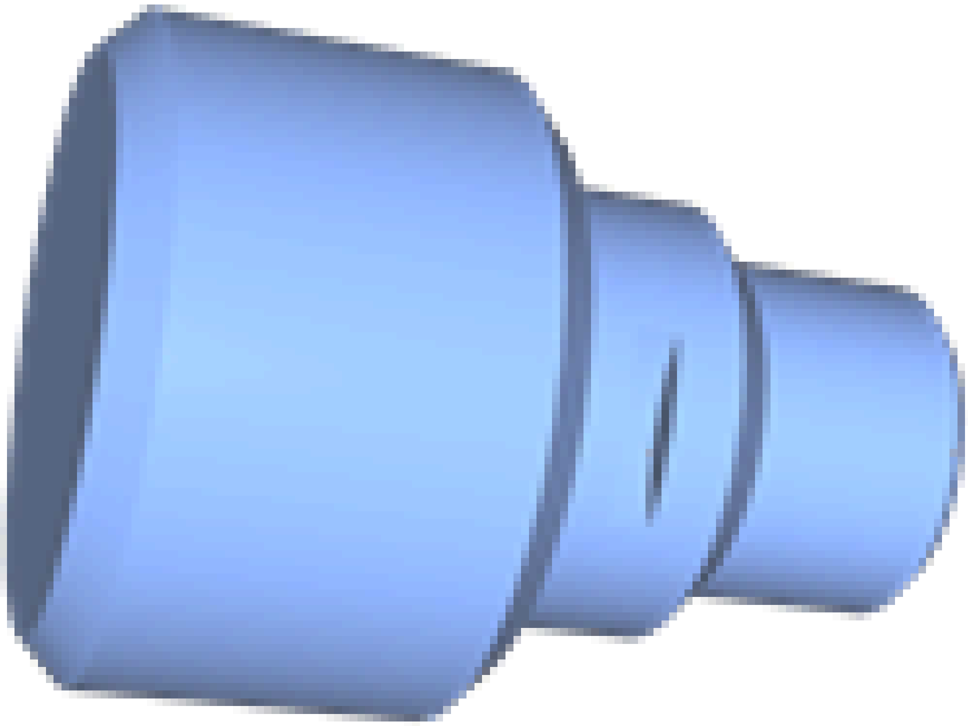
Illustration	Tool Number/Description
	EL-52016-2 Coolant Pressure Tester Adapter

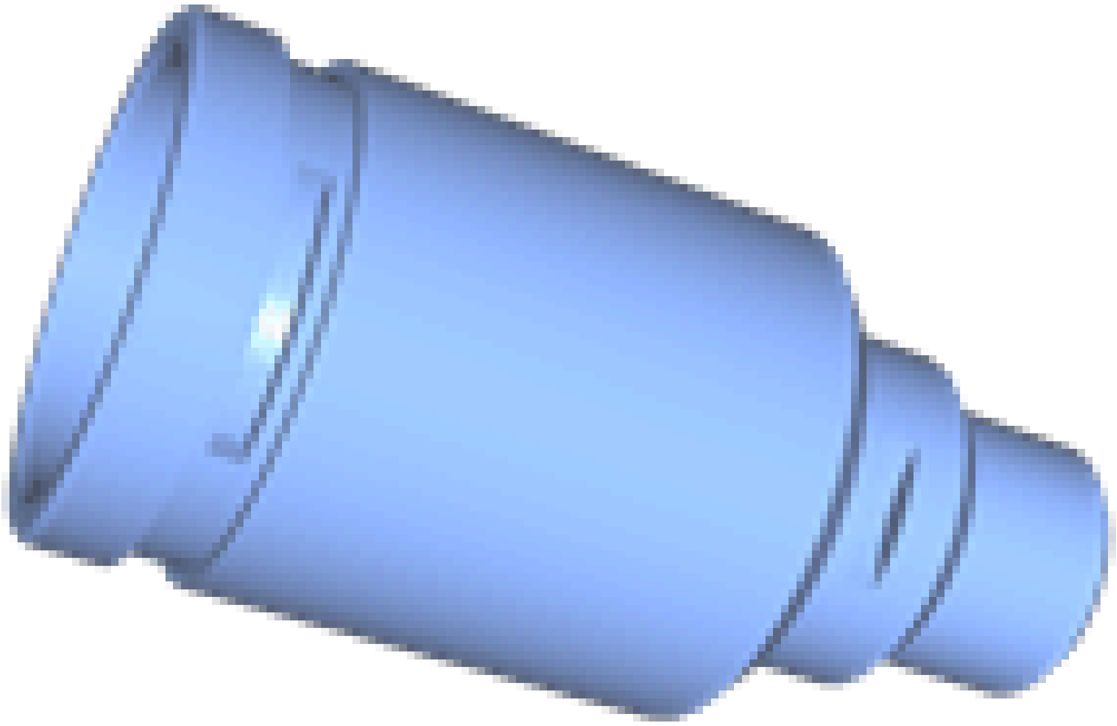
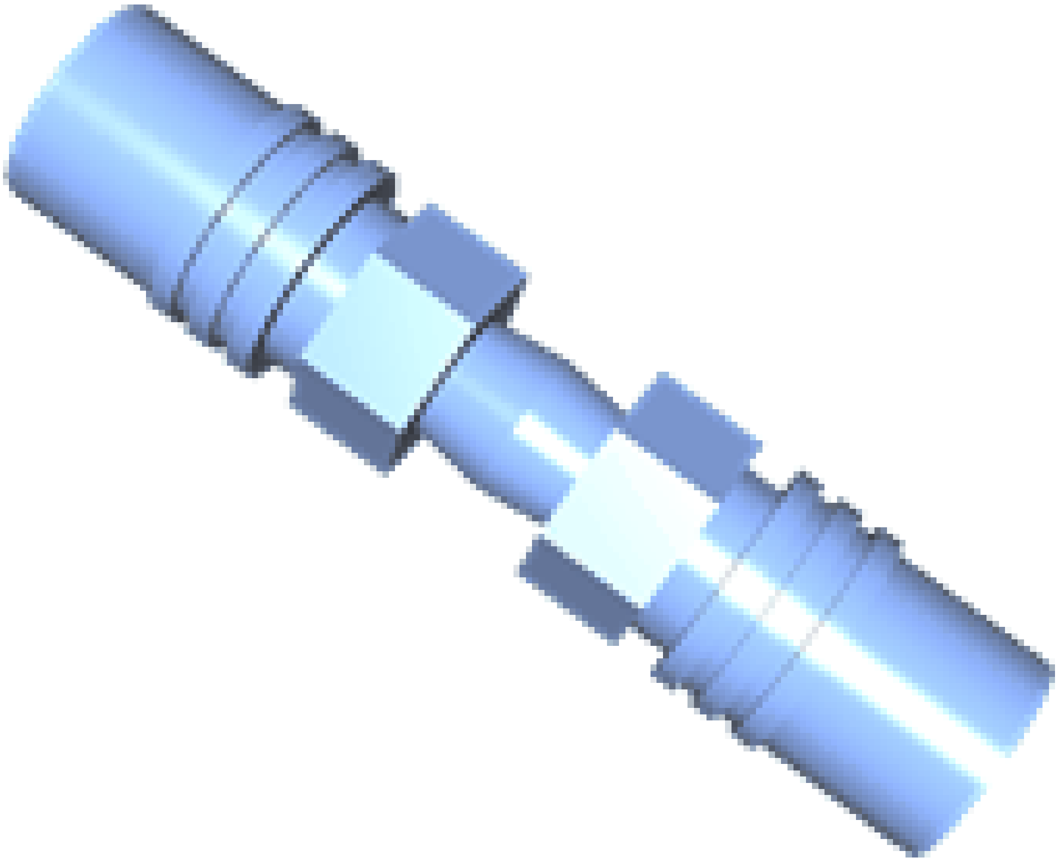
Illustration	Tool Number/Description
	EL-52016-2A Coolant Pressure Tester Adapter

Illustration	Tool Number/Description
	GE 50389 Coolant Pressure Test Quick Connector

Back To Article

2017 ELECTRICAL

Plug-In Charging - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Drive Motor Battery Charger Bolt	22 N.m (16 lb ft)
Drive Motor Battery Charger Bolt	25 N.m (18 lb ft)
Drive Motor Battery Charger Nut	22 N.m (16 lb ft)
Drive Motor Battery Charger Receptacle Bolt	9 N.m (80 lb in)
Engine Wiring Harness Bracket Bolt	9 N.m (80 lb in)
Ground Nut	9 N.m (80 lb in)
Power Line Communication Module Nut	9 N.m (80 lb in)

SCHEMATIC WIRING DIAGRAMS

PLUG-IN CHARGING WIRING SCHEMATICS

Battery State of Charge Indicators

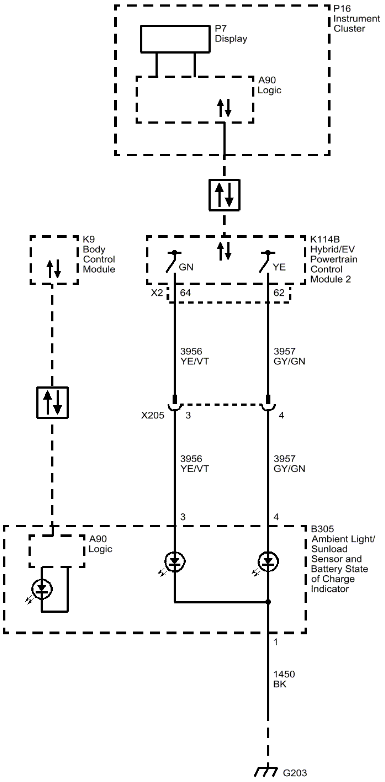

P16
Instrument
Cluster
P7
Display
A90
Logic
K9
Body
Control
Module
K114B
Hybrid/EV
Powertrain
Control
Module 2
GN
YE
X2
64
62
3956
YE/VT
3957
GY/GN
X205
3
4
3956
YE/VT
3957
GY/GN
3
4
A90
Logic
B305
Ambient Light/
Sunload
Sensor and
Battery State
of Charge
Indicator
1
1450
BK
G203

Fig. 1: Battery State of Charge Indicators
Courtesy of GENERAL MOTORS COMPANY

AC Battery Charging (EF7/Z49/CW1)

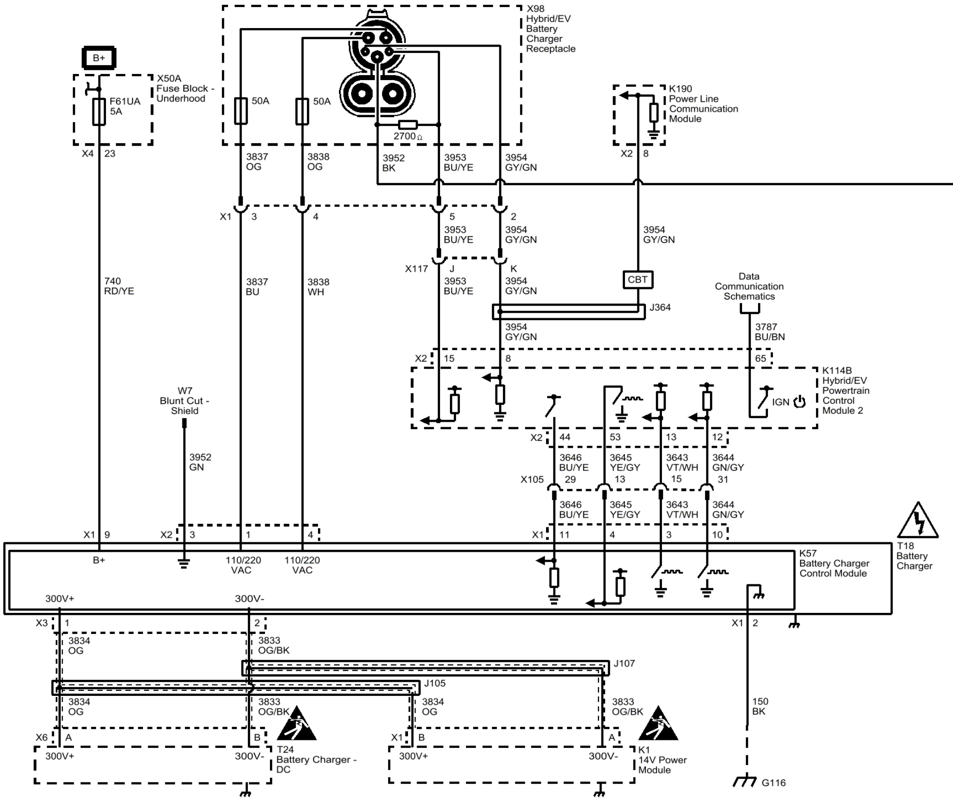

X98
Hybrid/EV
Battery
Charger
Receptacle
B+
X50A
Fuse Block -
Underhood
F61UA
5A
X4
23
50A
50A
2700 Ω
3837
OG
3838
OG
3952
BK
3953
BU/YE
3954
GY/GN
K190
Power Line
Communication
Module
X2
8
X1
3
4
5
2
3953
BU/YE
3954
GY/GN
X117
J
K
3953
BU/YE
3954
GY/GN
3954
GY/GN
CBT
J364
Data
Communication
Schematics
3787
BU/BN
740
RD/YE
3837
BU
3838
WH
3954
GY/GN
X2
15
8
65
K114B
Hybrid/EV
Powertrain
Control
Module 2
IGN
X2
44
53
13
12
3646
BU/YE
3645
YE/GY
3643
VT/WH
3644
GN/GY
X105
29
13
15
31
3646
BU/YE
3645
YE/GY
3643
VT/WH
3644
GN/GY
W7
Blunt Cut -
Shield
3952
GN
X1
9
X2
3
1
4
X1
11
4
3
10
T18
Battery
Charger
B+
110/220
VAC
110/220
VAC
K57
Battery Charger
Control Module
300V+
300V-
X3
1
2
X1
2
3834
OG
3833
OG/BK
J107
J105
3834
OG
3833
OG/BK
3834
OG
3833
OG/BK
150
BK
X6
A
B
X1
B
A
300V+
300V-
T24
Battery Charger -
DC
300V+
300V-
K1
14V Power
Module
G116
G108

Fig. 2: AC Battery Charging (EF7/Z49/CW1)
Courtesy of GENERAL MOTORS COMPANY

AC Battery Charging (MBM)

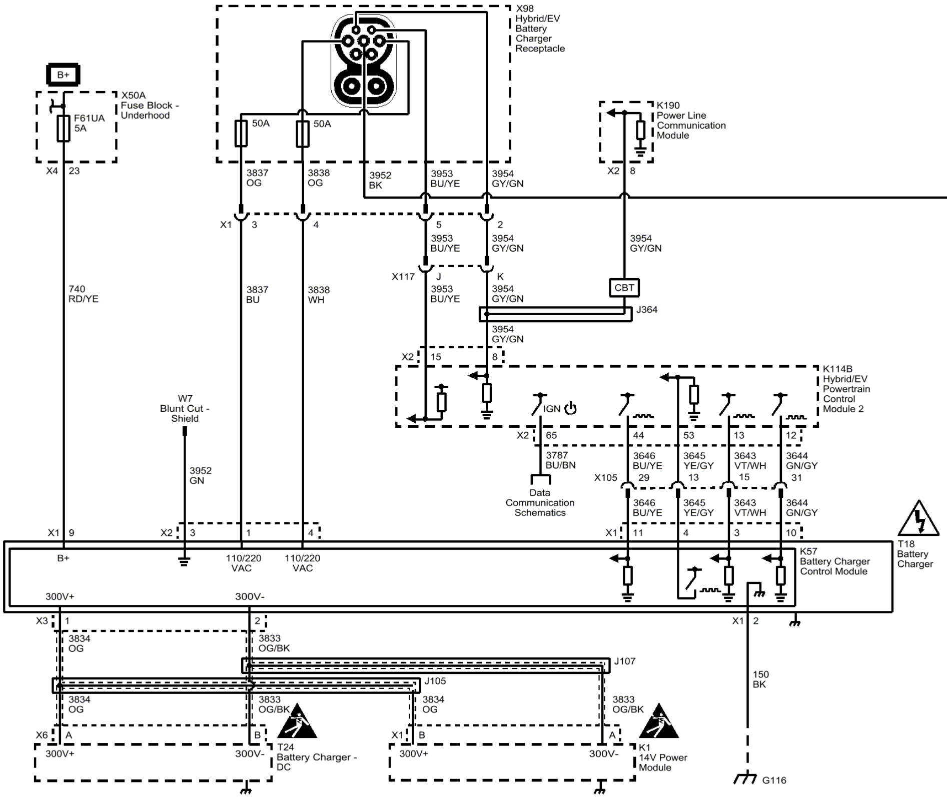

X98
Hybrid/EV
Battery
Charger
Receptacle
B+
X50A
Fuse Block -
Underhood
F61UA
5A
X4
23
50A
50A
3837
OG
3838
OG
3952
BK
3953
BU/YE
3954
GY/GN
K190
Power Line
Communication
Module
X2
8
X1
3
4
5
2
3953
BU/YE
3954
GY/GN
3954
GY/GN
X117
J
K
3953
BU/YE
3954
GY/GN
CBT
J364
740
RD/YE
3837
BU
3838
WH
3954
GY/GN
X2
15
8
K114B
Hybrid/EV
Powertrain
Control
Module 2
IGN
X2
65
44
53
13
12
3787
BU/BN
Data
Communication
Schematics
3646
BU/YE
3645
YE/GY
3643
VT/WH
3644
GN/GY
X105
29
13
15
31
3646
BU/YE
3645
YE/GY
3643
VT/WH
3644
GN/GY
W7
Blunt Cut -
Shield
3952
GN
X1
9
X2
3
1
4
X1
11
4
3
10
T18
Battery
Charger
B+
110/220
VAC
110/220
VAC
K57
Battery Charger
Control Module
300V+
300V-
X3
1
2
X1
2
3834
OG
3833
OG/BK
J107
J105
3834
OG
3833
OG/BK
3834
OG
3833
OG/BK
150
BK
X6
A
B
X1
B
A
300V+
300V-
T24
Battery Charger -
DC
300V+
300V-
K1
14V Power
Module
G116
G108

Fig. 3: AC Battery Charging (MBM)
Courtesy of GENERAL MOTORS COMPANY

DC Battery Charging - Power, Ground, Serial Data, and Receptacle Signals (CBT)

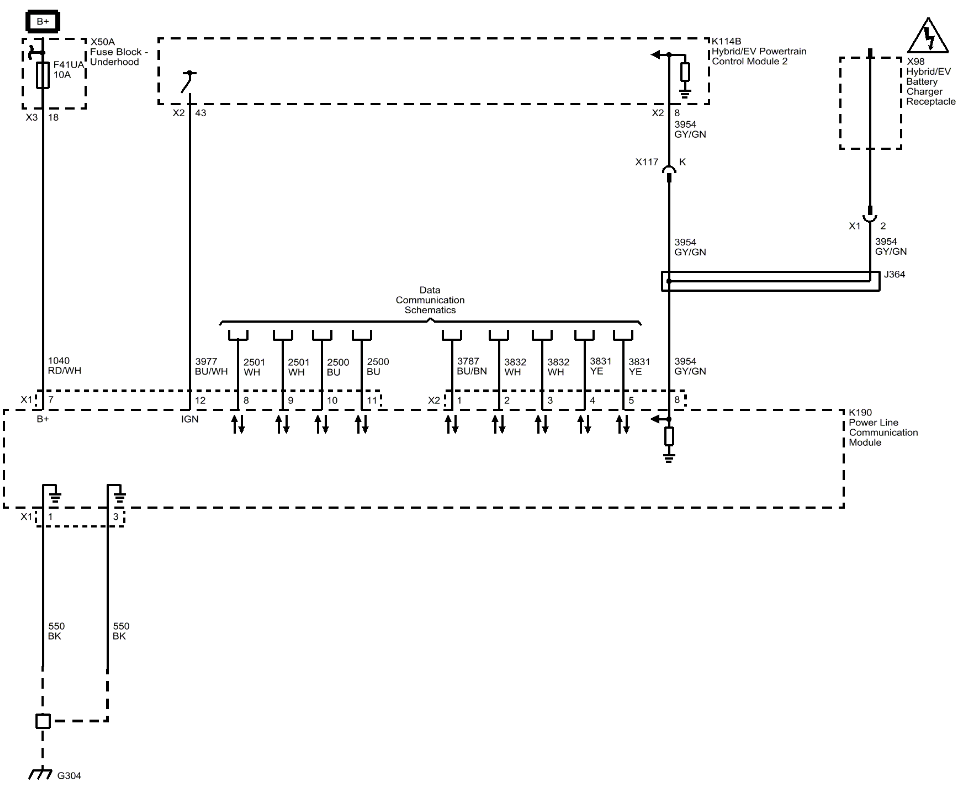

B+
X50A Fuse Block - Underhood
F41UA 10A
X3 18
X2 43
K114B Hybrid/EV Powertrain Control Module 2
X2 8
3954 GY/GN
X117 K
X98 Hybrid/EV Battery Charger Receptacle
X1 2
3954 GY/GN
3954 GY/GN
J364
Data Communication Schematics
1040 RD/WH
3977 BU/WH
2501 WH
2501 WH
2500 BU
2500 BU
3787 BU/BN
3832 WH
3832 WH
3831 YE
3831 YE
3954 GY/GN
X1 7
12
8
9
10
11
X2 1
2
3
4
5
8
B+
IGN
K190 Power Line Communication Module
X1 1
3
550 BK
550 BK
G304

Fig. 4: DC Battery Charging - Power, Ground, Serial Data, and Receptacle Signals (CBT)
Courtesy of GENERAL MOTORS COMPANY

DC Battery Charging - Sense Signals and Contactor Controls (CBT)

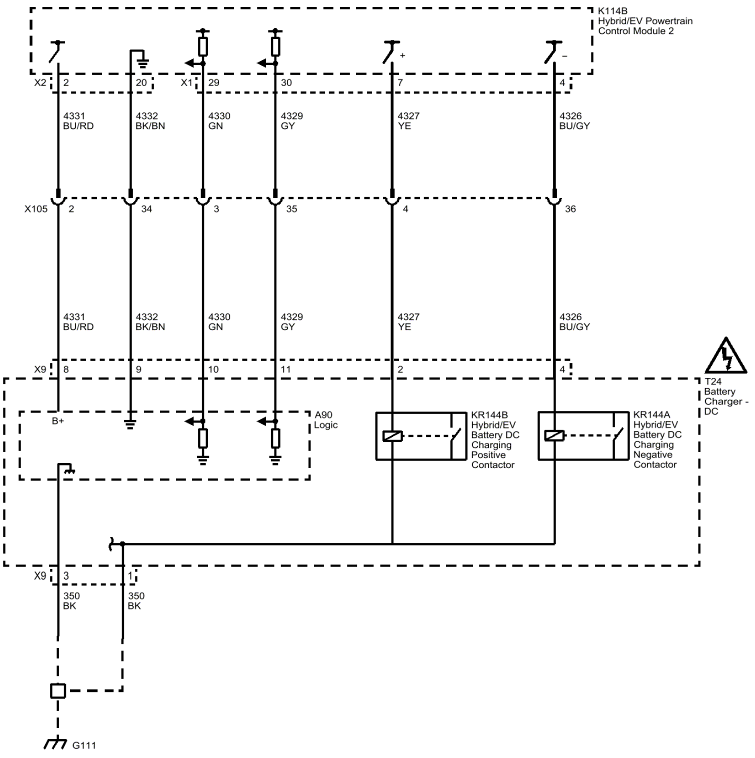

K114B Hybrid/EV Powertrain Control Module 2
+
-
X2 2
20
X1 29
30
7
4
4331 BU/RD
4332 BK/BN
4330 GN
4329 GY
4327 YE
4326 BU/GY
X105 2
34
3
35
4
36
4331 BU/RD
4332 BK/BN
4330 GN
4329 GY
4327 YE
4326 BU/GY
X9 8
9
10
11
2
4
T24 Battery Charger - DC
B+
A90 Logic
KR144B Hybrid/EV Battery DC Charging Positive Contactor
KR144A Hybrid/EV Battery DC Charging Negative Contactor
X9 3
1
350 BK
350 BK
G111

Fig. 5: DC Battery Charging - Sense Signals and Contactor Controls (CBT)
Courtesy of GENERAL MOTORS COMPANY

DC Battery Charging - Contactors and Receptacle (CBT) with (EF7/Z49/CW1)

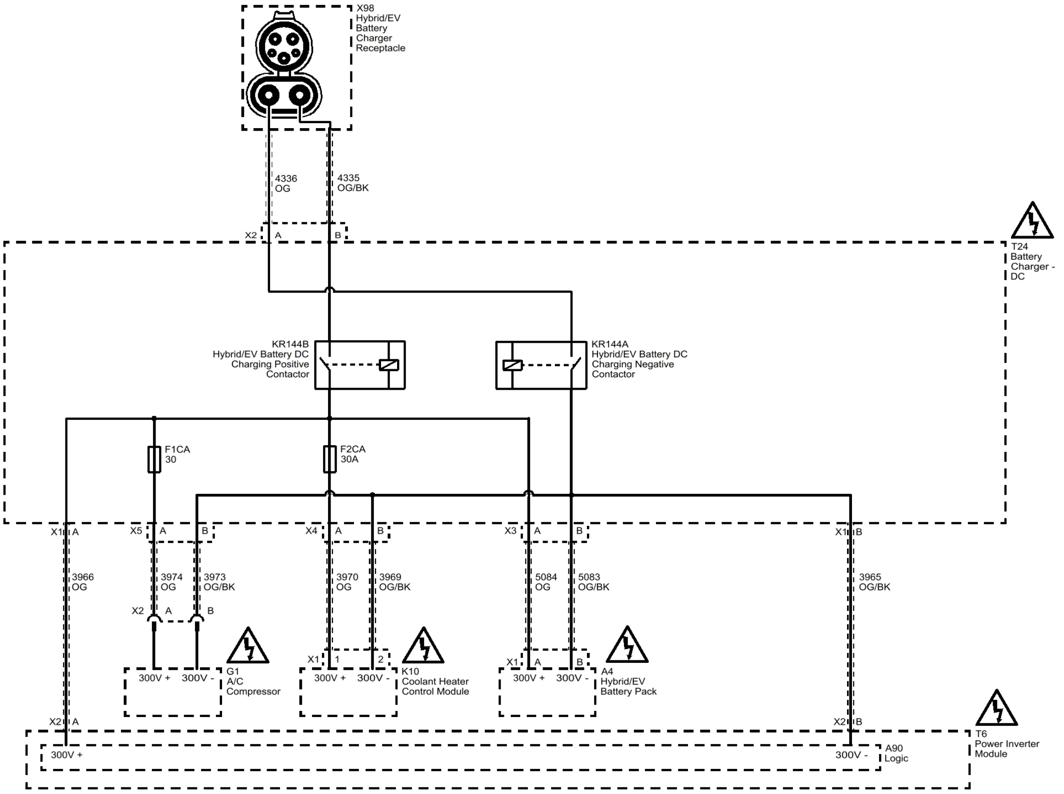

X98
Hybrid/EV
Battery
Charger
Receptacle
4336
OG
4335
OG/BK
X2
A
B
T24
Battery
Charger -
DC
KR144B
Hybrid/EV Battery DC
Charging Positive
Contactor
KR144A
Hybrid/EV Battery DC
Charging Negative
Contactor
F1CA
30
F2CA
30A
X1
A
X5
A
B
X4
A
B
X3
A
B
X1
B
3966
OG
3974
OG
3973
OG/BK
3970
OG
3969
OG/BK
5084
OG
5083
OG/BK
3965
OG/BK
X2
A
B
300V +
300V -
G1
A/C
Compressor
X1
1
2
300V +
300V -
K10
Coolant Heater
Control Module
X1
A
B
300V +
300V -
A4
Hybrid/EV
Battery Pack
X2
A
X2
B
300V +
300V -
A90
Logic
T6
Power Inverter
Module

Fig. 6: DC Battery Charging - Contactors and Receptacle (CBT) with (EF7/Z49/CW1)
Courtesy of GENERAL MOTORS COMPANY

DC Battery Charging - Contactors and Receptacle (CBT) with (MBM)

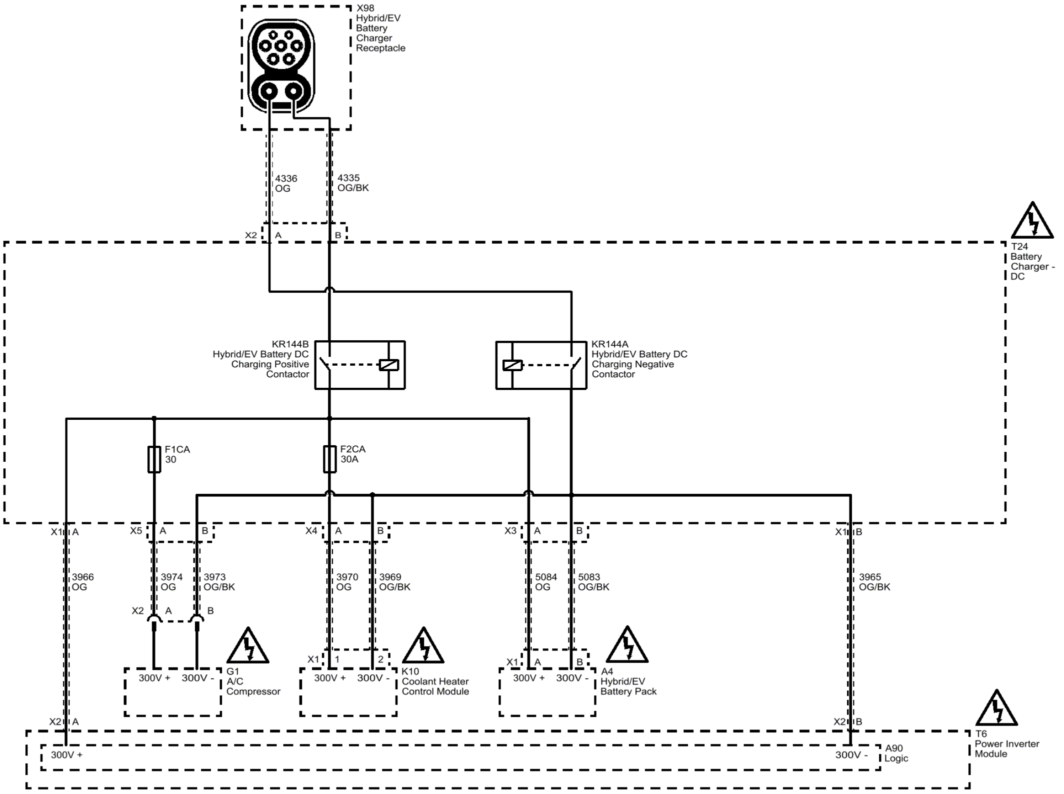

X98
Hybrid/EV
Battery
Charger
Receptacle
4336
OG
4335
OG/BK
X2
A
B
T24
Battery
Charger -
DC
KR144B
Hybrid/EV Battery DC
Charging Positive
Contactor
KR144A
Hybrid/EV Battery DC
Charging Negative
Contactor
F1CA
30
F2CA
30A
X1
A
X5
A
B
X4
A
B
X3
A
B
X1
B
3966
OG
3974
OG
3973
OG/BK
3970
OG
3969
OG/BK
5084
OG
5083
OG/BK
3965
OG/BK
X2
A
B
300V +
300V -
G1
A/C
Compressor
X1
1
2
300V +
300V -
K10
Coolant Heater
Control Module
X1
A
B
300V +
300V -
A4
Hybrid/EV
Battery Pack
X2
A
X2
B
300V +
300V -
A90
Logic
T6
Power Inverter
Module

Fig. 7: DC Battery Charging - Contactors and Receptacle (CBT) with (MBM)
Courtesy of GENERAL MOTORS COMPANY

Battery Charging Door/Receptacle (CBT)

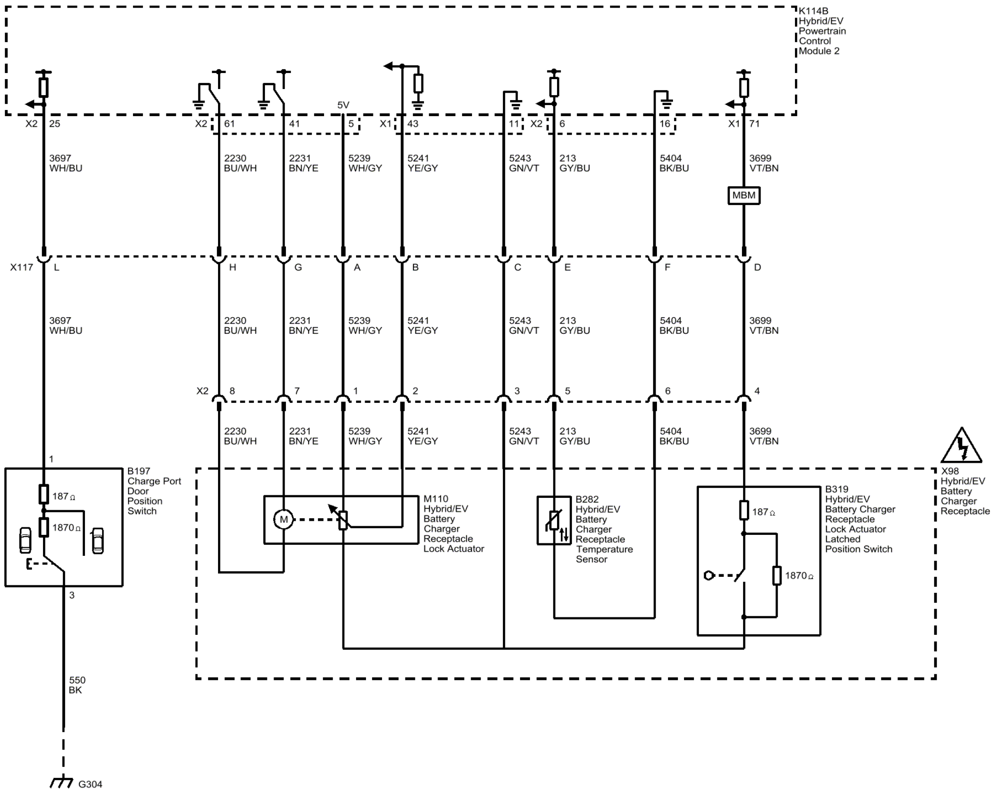

K114B Hybrid/EV Powertrain Control Module 2
5V
X2 25
X2 61
41
5
X1 43
11
X2 6
16
X1 71
3697 WH/BU
2230 BU/WH
2231 BN/YE
5239 WH/GY
5241 YE/GY
5243 GN/VT
213 GY/BU
5404 BK/BU
3699 VT/BN
MBM
X117 L
H
G
A
B
C
E
F
D
X2 8
7
1
2
3
5
6
4
1
B197 Charge Port Door Position Switch
187 Ω
1870 Ω
3
550 BK
G304
M
M110 Hybrid/EV Battery Charger Receptacle Lock Actuator
B282 Hybrid/EV Battery Charger Receptacle Temperature Sensor
B319 Hybrid/EV Battery Charger Receptacle Lock Actuator Latched Position Switch
187 Ω
1870 Ω
X98 Hybrid/EV Battery Charger Receptacle

Fig. 8: Battery Charging Door/Receptacle (CBT)
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0CF4-P0CF6: CONTROL PILOT CIRCUIT (NORTH AMERICA, KOREA)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

DTC Descriptor

DTC P0CF4

Control Pilot Circuit Performance

DTC P0CF5

Control Pilot Circuit Low Voltage

DTC P0CF6

Control Pilot Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Pilot Signal	P0CF4, P0CF5, P0CF6, P0CF9, P0D01, 1	P0CF4, P0CF5, P0CF6, 1	P0CF4, P0CF5, P0CF6, P0CF9, 1	P0CF4, P0CF5, P0CF6, 1
Proximity Status Signal	P0D58, 1	P0D59, 1	P0D59, 1	-
Voltage A/C Line 1	1	P0D3F, P1EE6	1	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Voltage A/C Neutral Line 2	1	P1EE6	1	-
Voltage A/C Ground	-	P0D59, 1	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors a control pilot signal from the drive motor battery charger cable. The hybrid/EV powertrain control module 2 utilizes this signal to manage the charging process between the drive motor battery charger cable and the hybrid/EV powertrain control module 2.

Under normal charging conditions the control pilot signal is generated by the drive motor battery charger cable. This diagnostic runs with the drive motor battery charger cable disconnected to verify the vehicle side circuit integrity. The diagnostic signal is generated internally by the hybrid/EV powertrain control module 2.

Conditions for Running the DTC

DTC P0CF4

- The vehicle 12 V battery system voltage needs to be above 10.2 V.
- The drive motor battery charger cable is disconnected and the charge port door is closed.
- The vehicle needs to be driven above 8 km/h (5 mph).

DTC P0CF5

- The vehicle 12 V battery system voltage needs to be above 10.2 V.
- The drive motor battery charger cable is disconnected and the charge port door is closed.

DTC P0CF6

- The vehicle 12 V battery system voltage needs to be above 10.2 V.
- The drive motor battery charger cable is disconnected and the charge port door is closed.
- Vehicle needs to be driven above 8 km/h (5 mph).

Conditions for Setting the DTC

DTC P0CF4

The control pilot circuit is not meeting its internal range requirements for 5 seconds. This can only be set internal to the hybrid/EV powertrain control module 2. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

DTC P0CF5

The control pilot circuit voltage divided by the system voltage is less than 0.03 V for 5 seconds. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

DTC P0CF6

The control pilot circuit voltage divided by the system voltage is greater than 0.55 V for 5 seconds. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

Actions Taken When the DTC Sets

- DTC P0CF4-P0CF6 are type A DTCs.
- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0CF4-P0CF6 are type A DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to **High Voltage Disabling** . Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

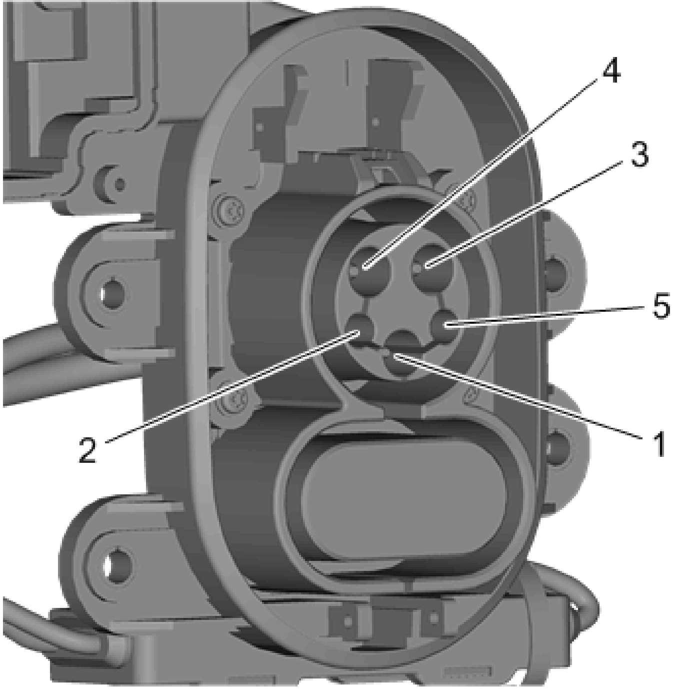


Fig. 9: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

2. Test for infinite resistance between the control pilot signal circuit terminal 2 of the X98 Hybrid/EV Battery Charger Receptacle and the terminals listed below:
   - Terminal 1
   - Terminal 3
   - Terminal 4
   - Terminal 5
   - **If less than infinite resistance**
   1. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.

      NOTE: **This test is performed on the vehicle side of the harness connector.**

   2. Test for infinite resistance between the harness connector control pilot signal circuit terminal 2 and the terminals listed below:
   - Terminal 1
   - Terminal 3
   - Terminal 4
   - Terminal 5
     - If less than infinite resistance, repair the short between the circuits.
     - If infinite resistance, replace the X98 Hybrid/EV Battery Charger Receptacle.
   - **If infinite resistance**
3. Test for less than 2 Ω in the control pilot signal circuit end to end.
   - **If 2 Ω or greater**
   1. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.

      NOTE: **This test is performed at the X98 Hybrid/EV Battery Charger Receptacle.**

   2. Test for less than 2 Ω in the control pilot signal circuit end to end.
     - If 2 Ω or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.
     - If less than 2 Ω, repair the open/high resistance in the circuit.
   - **If less than 2 Ω**

4. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)**
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0CF9 OR P0D01: CONTROL PILOT CHARGING SWITCH/VENTILATION SWITCH PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0CF9

Control Pilot Charging Switch Performance

DTC P0D01

Control Pilot Charging Ventilation Switch Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Pilot Signal	P0CF4, P0CF5, P0CF6, P0CF9, P0D01, 1	P0CF4, P0CF5, P0CF6, 1	P0CF4, P0CF5, P0CF6, P0CF9, 1	P0CF4, P0CF5, P0CF6, 1
Proximity Signal	P0D58, 1	P0D59, 1	P0D59, 1	-
Voltage A/C Line 1	1	P0D3F, P1EE6	1	-
Voltage A/C Neutral Line 2	1	P1EE6	1	-
Voltage A/C Ground	-	P0D59, 1	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The hybrid/EV powertrain control module 2 has two internal switches used to modify the control pilot signal. The first internal switch modifies the control pilot signal to indicate to the drive motor battery charger cable that the vehicle is either ready or not ready to accept energy. The second internal switch modifies the control pilot signal to indicate to some drive motor battery charger cables (currently not used) if indoor ventilation is required.

Conditions for Running the DTC

DTC P0CF9

- The 12 V battery voltage is greater than 10.2 V.
- The drive motor battery charger cable is disconnected and the charge port door is closed.
- The diagnostics for DTC P0CF4 - P0CF6 must have passed.

DTC P0D01

- The 12 V battery voltage is greater than 10.2 V.
- The drive motor battery charger cable is disconnected and the charge port door is closed.

- The diagnostics for DTC P0CF4 - P0CF6 and P0CF9 must have passed.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 2 measures the control pilot signal voltage out of range for 5 seconds. This is an internal circuit voltage in the hybrid/EV powertrain control module 2 and can not be measured.

Actions Taken When the DTC Sets

- DTC P0CF9 and P0D01 are type A DTCs
- Disables the high voltage battery charging.

Conditions for Clearing the DTC

DTC P0CF9 and P0D01 are type A DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON.
2. Verify that DTC P0CF9 or P0D01 is not set.
   - **If either of the DTCs are set**

     Replace the K114B Hybrid/EV Powertrain Control Module 2.

   - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0D1F: CONTROL MODULE DATE/TIME SYNCHRONIZATION PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D1F

Control Module Date/Time Synchronization Performance

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the date and time data it receives from the radio. This time information is used to ensure the module's internal clock is synchronized to the customer's local time. The Time of Day Charging feature utilizes this internal clock to keep track of time and alarms for delayed charging modes. If this radio time data is received during a drive cycle, the system is considered synchronized.

Conditions for Running the DTC

Vehicle in Service Mode.

Conditions for Setting the DTC

The vehicle is driven for more than 5 consecutive drive cycles where trip distance exceeds 15 Km (9.3 mi), and the date and time were unavailable from the radio.

Actions Taken When the DTC Sets

- DTC P0D1F is a type C DTC.
- On the Navigation screen "Default Charge Mode: Immediately" is displayed.
- The battery charger Time Of Day charging option is disabled, and charging mode is set to IMMEDIATE.

Conditions for Clearing the DTC

DTC P0D1F is a type C DTC.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode, verify no radio DTCs are set.
    - **If any radio DTC's are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
    - **If no radio DTC's are set**
2. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0D26: BATTERY CHARGER SYSTEM PRECHARGE TIME TOO LONG

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D26

Battery Charger System Precharge Time Too Long

Circuit/System Description

In order to prevent large in-rush current, battery charger bus high voltage is routed through a pre-charge resistor whenever high voltage charging is commanded ON. The hybrid/EV powertrain control module 2 monitors the time it takes the battery charger bus voltage to attain the same level as the battery pack voltage. If it takes too long, a DTC is set.

Conditions for Running the DTC

- Battery charger must go from disconnected to connected.
- Drive motor battery charger cable must be connected and vehicle receiving power.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 2 determines the battery charger does not reach its pre-charge voltage within 1 second.

Actions Taken When the DTC Sets

DTC P0D26 is a Type A DTC.

Conditions for Clearing the DTC

DTC P0D26 is a Type A DTC.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- **EL-48900** HEV Safety Kit
- For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Verify DTC P0C78 is not set.
   - **If the DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If the DTC is not set**
2. Verify DTC P0CF4, P0CF5, P0CF6, P0D4E, P0D4F, P0D58, or P0D59 is not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If none of the DTCs are set**
3. Connect the drive motor battery charger cable. Verify DTC P0D26 is not set and the vehicle will charge.
   - **If the DTC is set and the vehicle will not charge**

     Refer to Circuit/System Testing.

   - **If the DTC is not set and the vehicle charges**
4. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF. Remove the G37 Hybrid/EV Battery Pack Coolant Pump fuse. Set the vehicle Charge Mode to IMMEDIATE. Connect the charge cord set. Vehicle in Service Mode.

NOTE: **Do not command the heater ON any longer than is necessary to confirm the heater has high voltage and is functioning.**

2. Verify the scan tool Hybrid/EV Battery Pack Coolant Temperature Sensor parameter increases 2.75Ã‚Â°C (4.9Ã‚Â°F) within 120 s when commanding the hybrid/EV battery pack coolant heater ON with a scan tool.
   - **If the Hybrid/EV Battery Pack Coolant Temperature Sensor did not increase**
   1. Install the G37 Hybrid/EV Battery Pack Coolant Pump fuse. Disable the high voltage system for servicing the T24 Battery Charger and the A4 Battery Pack. Refer to **High Voltage Disabling** .
   2. Disconnect the T24 battery charger X7 connector and the A4 battery pack X4 connector.
   3. Inspect all connector ends for evidence of poor terminal contact and/or arc flash damage.
      - If a terminal concern is observed, replace all affected components.
      - If a terminal concern is not observed
   4. Test the following HV harness terminals for less than 2 Ω end to end:
      - X7-A to X4-A
      - X7-B to X4-B
      - If greater than 2 Ω, replace the HV Bat Pos & Neg (300V) Cable.
      - If less than 2 Ω
   5. Remove and open the A4 Battery Pack. Refer to **Battery Upper Cover Replacement** . Inspect for any of the following INTERNAL concerns:
      - Drive motor battery charger cable for loose/damaged terminal fasteners
      - High voltage battery disconnect relay fuse for loose/damaged fasteners or an open fuse condition
      - If a terminal concern is found, replace all affected components.
      - If an open fuse condition is found, replace the fuse, the T18 Battery Charger and the K1 14V Power Module.
      - If no internal concerns are observed, replace the A28 Hybrid/EV Battery Contactor Assembly.
   - **If the Hybrid/EV Battery Pack Coolant Temperature Sensor did increase**
3. Install the G37 Hybrid/EV Battery Pack Coolant Pump fuse. Disable the high voltage system for servicing the T18 Battery Charger, K1 14V Power Module and the T24 Battery Charger-DC. Refer to **High Voltage Disabling** .
4. Disconnect the X3 connector at the T18 Battery Charger, the X1 connector at the K1 14V Power Module and the X6 connector at the T24 Battery Charger-DC.
5. Verify that all HV harness connector and the mating module connector terminals are free from moisture, corrosion, and arc flash damage.
   - **If any terminals show signs of damage**

     Replace the HV wiring harness and affected modules as necessary.

   - **If no arc flash damage, moisture, or corrosion is found**
6. Test the following HV harness terminals for less than 2 Ω end to end:
   - X6-A to X1-A
   - X6-A to X3-A

  - X6-B to X1-B
  - X6-B to X3-B
  - **If greater than 2 Ω**

    Replace the HV wiring harness.

  - **If less than 2 Ω**

7. Replace the T18 Battery Charger.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **300-Volt Battery Positive and Negative Cable Replacement (Generator Battery Control Wiring Junction Block to Drive Motor Battery)** for T24 Battery Charger-DC to A4 Battery Pack cable
- **Battery to Battery Positive Cable Replacement** for K1 14V Power Module/T18 Battery Charger combination cable - includes G1 A/C compressor cable
- **High Voltage Battery Disconnect Relay Replacement** for A28 Hybrid/EV Battery Contactor Assembly
- **High Voltage Battery Disconnect Relay Fuse Replacement** for F1HA 40A charging system fuse
- **Control Module References** for T18 Battery Charger, T24 Battery Charger-DC, or K1 14V Power Module replacement, programming and setup

DTC P0D2B OR P0D2C: CONTROL PILOT INDICATOR CONTROL CIRCUIT/CHARGE STATUS INDICATOR CONTROL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D2B

Control Pilot Indicator Control Circuit

DTC P0D2C

Charge Status Indicator Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Charge Pilot Indicator Control	P0D2B	P0D2B	P0D2B	-
Charge Status Indicator Control	P0D2C	P0D2C, 1	P0D2C	-
Charge Complete Indicator Control	1	1	1	-
Low Reference	-	P0D2C, P0D2B	-	-
1. Plug In Charging Indicator Malfunction				

Circuit/System Description

The status of charging events (including delays) is communicated to the user through a charge status indicator and audio tones. The vehicle charge status indicator, located on the top middle of the instrument panel, contains a green LED (charge status indicator) and yellow LED (charge pilot indicator) controlled by the Hybrid Powertrain Control Module 2 and a second green LED (charge complete indicator) controlled by the BCM. The indicator will have a short flash green when the vehicle is charging under automatic control. The flash rate increases from one to four as the battery charges. It will have a long flash green if the charging is delayed and will begin later. It will be illumined solid green when charging is complete. A solid lit yellow indicator means the vehicle is not able to accept a charge.

And if there is no indicator lit it means the electronic vehicle supply equipment is not working properly or connected.

Conditions for Running the DTC

Both conditions need to run for diagnostic to pass.

Condition 1

The drive motor battery charger cable is disconnected (charge status indicator commanded OFF).

Condition 2

The vehicle is connected to an AC supply and the battery charger is charging the vehicle (charge status indicator commanded ON).

Conditions for Setting the DTC

- Charge status indicator Commanded OFF, The hybrid/EV powertrain control module 2 detects a short to battery for about 4 s.
- Charge status indicator Commanded ON, The hybrid/EV powertrain control module 2 detects a short to ground or an open/high resistance for 4 s.

Actions Taken When the DTC Sets

DTC P0D2B and P0D2C are type C DTCs.

Conditions for Clearing the DTC

DTC P0D2B and P0D2C are type C DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.
2. Test for less than 10 Ω between the low reference terminal 1 and ground.

- **If 10 Ω or greater**

  Repair the open/high resistance in the circuit.

- **If less than 10 Ω**

NOTE: **If the drive motor battery charger cable is connected. The drive motor battery charger cable must be disconnected for more than 10 seconds before performing the next step.**

3. Connect a test lamp between the control circuit terminal 4 and ground.
4. Verify the test lamp does not illuminate.
   - **If the test lamp does illuminate**
   1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp does not illuminate**
5. Connect the drive motor battery charger cable.
6. Verify that the test lamp illuminates within the first 5 seconds of connecting the drive motor battery charger cable.
   - **If the test lamp does not illuminate**
   1. Disconnect the drive motor battery charger cable. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the control circuit and ground
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp does illuminate**
7. Disconnect the drive motor battery charger cable for at least 10 seconds. Connect a test lamp between the control circuit terminal 3 and ground.
8. Verify the test lamp does not illuminate.
   - **If the test lamp does illuminate**
   1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp does not illuminate**
9. Connect the drive motor battery charger cable.
10. Verify that the test lamp illuminates within 25 seconds of connecting the drive motor battery charger cable.
    - **If the test lamp does not illuminate**
    1. Disconnect the drive motor battery charger cable. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit and ground
       - If less than infinite resistance, repair the short to ground on the circuit.
       - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp does illuminate**
11. Replace the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Sun Load, Ambient Light, and Charge Indicator Sensor Replacement** for B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator replacement.
- **Control Module References** for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0D3E-P0D40: BATTERY CHARGER INPUT VOLTAGE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D3E

Battery Charger Input Voltage Sensor Performance

DTC P0D3F

Battery Charger Input Voltage Sensor Circuit Low Voltage

DTC P0D40

Battery Charger Input Voltage Sensor Circuit High Voltage

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the AC voltage sensor inside the battery charger. The signal is pulse-width modulated and the duty cycle increases as the AC voltage increases. The duty cycle equals 10% when the AC voltage sensor reports less than 60 V. The duty cycle equals 90% when the AC voltage sensor reports more than 280 V. Therefore, during normal operation the duty cycle is between 10% and 90%.

Conditions for Running the DTC

P0D3E

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle is driven above 16 km/h (10 mph).

P0D3F and P0D40

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle is connected to an AC supply and the battery charger is charging the vehicle.

Conditions for Setting the DTC

DTC P0D3E

The battery charger AC input duty cycle is greater than 12% or less than 8%.

DTC P0D3F

The battery charger AC input duty cycle is between 1% and 8%.

OR

The battery charger AC input duty cycle equals 100%.

DTC P0D40

The battery charger AC input duty cycle is between 92% and 99%.

OR

The battery charger AC input duty cycle equals 0%.

Actions Taken When the DTC Sets

- DTC P0D3E, P0D3F and P0D40 are type B DTCs.
- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0D3E, P0D3F and P0D40 are type B DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Drive the vehicle above 16 km/h (10 mph).
2. Vehicle OFF. Connect the vehicle to an AC supply to begin charging.
3. Vehicle in Service Mode.
4. Verify that DTC P0D3E, P0D3F, or P0D40 is not set.
    - **If any of the DTCs are set**

      Refer to Circuit/System Testing.

    - **If none of the DTCs are set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the T18 Battery Charger. Vehicle in Service Mode.
2. Verify the scan tool Battery Charger AC Input Status Duty Cycle parameter is less than 10%.
    - **If 10% or greater**

    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the AC voltage sensor circuit terminal 10 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 10%**
3. Install a 3 A fused jumper wire between the AC voltage sensor circuit terminal 10 and the ground circuit terminal 2.
4. Verify the scan tool Battery Charger AC Input Status Duty Cycle parameter is greater than 90%.
    - **If 90% or less**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the AC voltage sensor circuit terminal 10 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the AC voltage sensor circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 90%**
5. Replace the T18 Battery Charger.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K114B Hybrid/EV Powertrain Control Module 2 or T18 Battery Charger replacement, programming and setup

DTC P0D4D-P0D4F: BATTERY CHARGER HYBRID/EV BATTERY OUTPUT VOLTAGE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D4D

Battery Charger Hybrid/EV Battery Output Voltage Sensor Performance

DTC P0D4E

Battery Charger Hybrid/EV Battery Output Voltage Sensor Circuit Low Voltage

DTC P0D4F

Battery Charger Hybrid/EV Battery Output Voltage Sensor Circuit High Voltage

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the DC voltage sensor inside the battery charger. The signal is pulse-width modulated and the duty cycle increases as the DC voltage increases. The duty cycle equals 10% when the DC voltage sensor reports less than 0 V. The duty cycle equals 90% when the DC voltage sensor reports more than 500 V. Therefore, during normal operation the duty cycle is between 10% and 90%.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle is connected to an AC supply and the battery charger is charging the vehicle.

Conditions for Setting the DTC

DTC P0D4D

The difference between the battery charger DC output voltage and hybrid/EV battery DC input voltage is greater than 30 V.

DTC P0D4E

The battery charger DC output duty cycle is between 1% and 8%.

OR

The battery charger DC output duty cycle equals 100%.

DTC P0D4F

The battery charger DC output duty cycle is between 92% and 99%.

OR

The battery charger DC output duty cycle equals 0%.

Actions Taken When the DTC Sets

- DTC P0D4D, P0D4E and P0D4F are type B DTCs.
- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0D4D, P0D4E and P0D4F are type B DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0D4E or P0D4F is not set.
   - **If any of the DTCs are set**

     Refer to Circuit/System Testing.

   - **If none of the DTCs are set**
2. Connect the vehicle to an AC supply to begin charging. Vehicle in Service Mode.
3. Verify that DTC P0D26 is not set.
   - **If the DTC is set**

     Refer to **DTC P0D26**.

   - **If the DTC is not set**
4. Verify that DTC P0D4D is not set.
   - **If the DTC is set**

     Refer to Circuit/System Testing.

   - **If the DTC is not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X1 harness connector at the T18 Battery Charger. Vehicle in Service Mode.
2. Verify the scan tool Battery Charger DC Output Status Duty Cycle parameter is less than 10%.
   - **If 10% or greater**
     1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
     2. Test for infinite resistance between the DC voltage sensor circuit terminal 3 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10%**
3. Install a 3 A fused jumper wire between the DC voltage sensor circuit terminal 3 and the ground circuit terminal 2.
4. Verify the scan tool Battery Charger DC Output Status Duty Cycle parameter is greater than 90%.
   - **If 90% or less**
     1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
     2. Test for less than 1 V between the DC voltage sensor circuit terminal 3 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
     3. Vehicle OFF.
     4. Test for less than 2 Ω in the DC voltage sensor circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If greater than 90%**
5. Replace the T18 Battery Charger.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for K114B Hybrid/EV Powertrain Control Module 2 or T18 Battery Charger replacement, programming and setup.

DTC P0D57-P0D59: PROXIMITY DETECTION CIRCUIT(NORTH AMERICA, KOREA)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D57

Proximity Detection Circuit Performance

DTC P0D58

Proximity Detection Circuit Low Voltage

DTC P0D59

Proximity Detection Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
AC Voltage Line 1	P1EE6	P1EE6	-	-
AC Voltage Line 2	P1EE6	P1EE6	-	-
AC Voltage Ground	1	P1EE6	1	-
Control Pilot Signal	1	1	1	-
Proximity Signal	P0D57, P0D58	P0D57, P0D59	P0D57, P0D59	P0D57
1. Plug In Charging Malfunction				

Circuit/System Description

The proximity detection circuit prevents movement of the vehicle while the drive motor battery charger cable is connected. This diagnostic runs with the drive motor battery charger cable disconnected to verify the vehicle side circuit integrity.

Conditions for Running the DTC

P0D57

- The 12 V battery voltage is greater than 10.2 V.
- DTC P0D58 and P0D59 are not set.

P0D58 and P0D59

- The 12 V battery voltage is greater than 10.2 V.
- The vehicle speed is greater than 20 km/h (15 mph).
- No vehicle speed DTCs are set.

Conditions for Setting the DTC

DTC P0D57

The hybrid/EV powertrain control module 2 measures a voltage less than 1.0 V or greater than 4.8 V on the Proximity Detection circuit.

OR

The hybrid/EV powertrain control module 2 measures a voltage between 2.0 V and 2.2 V on the Proximity Detection circuit.

OR

The hybrid/EV powertrain control module 2 measures a voltage between 3.4 V and 4.2 V on the Proximity Detection circuit.

DTC P0D58

The hybrid/EV powertrain control module 2 measures a voltage less than 4.2 V for 5 seconds.

DTC P0D59

The hybrid/EV powertrain control module 2 measures a voltage greater than 4.8 V for 5 seconds.

Actions Taken When the DTC Sets

- DTC P0D57 is a type B DTCs.
- DTC P0D58 and P0D59 are type A DTCs

Conditions for Clearing the DTC

- DTC P0D57 is a type B DTCs.
- DTC P0D58 and P0D59 are type A DTCs

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**

- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to High Voltage Disabling .

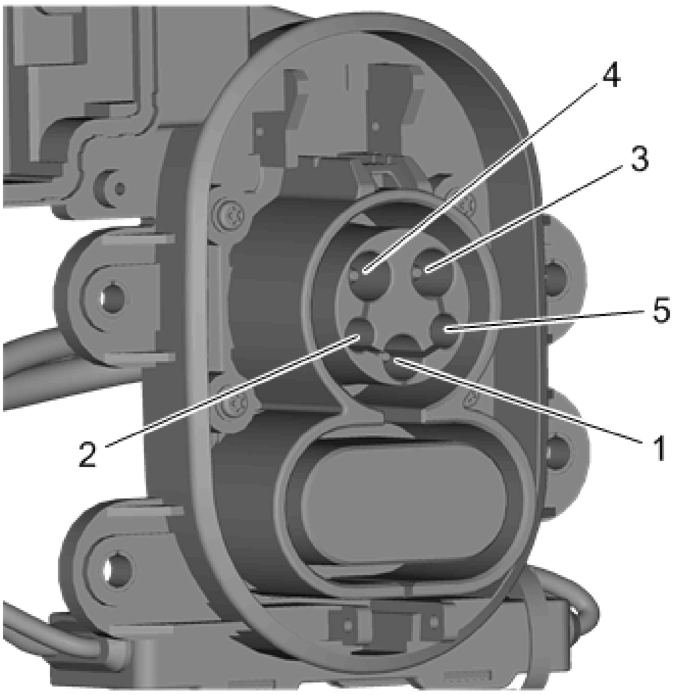


Fig. 10: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle face and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
   - **If 10 Ω or greater**

     NOTE: **G108 is located behind the front fender.**

     1. Disconnect the G108 ring terminal. Refer to Ground Nut removal in Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge).
     2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.
        - If less than 2 Ω, clean and reinstall the G108 ring terminal and ground nut.
   - **If less than 10 Ω**
3. Connect the 12 V battery. Vehicle in Service Mode.

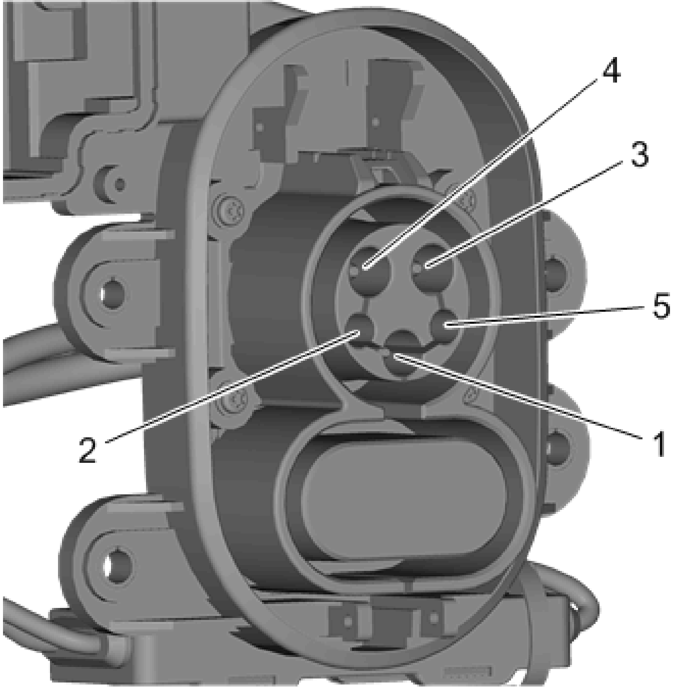


Fig. 11: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

4. Test for 4.2 - 4.8 V between the signal circuit terminal 5 and ground.
    - **If less than 4.2 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

    NOTE: **The following tests are performed at the vehicle harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

    2. Test for 4.8 V or greater between the signal circuit terminal 5 and ground.
        - If less than 4.8 V
        1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
        2. Test for infinite resistance between the signal circuit terminal 5 and ground.
            - If less than infinite resistance, repair the short to ground in the circuit.
            - If infinite resistance
        3. Test for less than 2 Ω in the signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
        - If 4.8 V or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.
    - **If greater than 4.8 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

    NOTE: **The following tests are performed at the vehicle harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

    2. Test for 4.8 - 5.2 V between the signal circuit terminal 5 and ground.
        - If greater than 5.2 V
        1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
        2. Vehicle in Service Mode. Test for less than 1 V between the signal circuit terminal 5 and ground.
            - If 1 V or greater, repair the short to voltage in the circuit.
            - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
        - If within 4.8 - 5.2 V

3. Test for 2.565 - 2.835K Ω between the signal circuit terminal 5 and the low reference circuit terminal 1 at the face of the X98 Hybrid/EV Battery Charger Receptacle.
    - If not within the specified range, replace the X98 Hybrid/EV Battery Charger Receptacle.
    - If within the specified range, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If within 4.2 - 4.8 V**

5. Test for infinite resistance between signal circuit terminal 5 of the X98 Hybrid/EV Battery Charger Receptacle and the terminals listed below:
    - Terminal 2
    - Terminal 3
    - Terminal 4
    - **If less than infinite resistance**
    1. Vehicle OFF, disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.
    2. Retest for infinite resistance between signal circuit terminal 5 of the X98 Hybrid/EV Battery Charger Receptacle and the terminals listed below:
        - Terminal 2
        - Terminal 3
        - Terminal 4
        - If less than infinite resistance replace the X98 Hybrid/EV Battery Charger Receptacle.
        - If infinite resistance, repair the short between the circuits in the vehicle wiring harness.
    - **If infinite resistance**
6. Replace the K114B Hybrid/EV Powertrain Control Module 2.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)** for X98 Hybrid/EV Battery Charger Receptacle.
- **Control Module References** for battery charger or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P0D5A: PROXIMITY DETECTION CIRCUIT ERRATIC

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D5A

Proximity Detection Circuit Erratic

Circuit/System Description

This diagnostic runs with the drive motor battery charger cable connected. The hybrid/EV powertrain control module 2 uses a 5 V regulated signal through a 2700 Ω resistor to a low reference circuit in the battery charger to detect if the drive motor battery charger cable is attached.

Conditions for Running the DTC

The drive motor battery charger cable is connected.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 2 determines the proximity signal voltage is erratic for 40 seconds.

Actions Taken When the DTC Sets

DTC P0D5A is a type C DTC.

Conditions for Clearing the DTC

DTC P0D5A is a type C DTC.

Diagnostic Aids

The proximity status circuit is susceptible to moisture intrusion. If signs of moisture intrusion are observed in the hybrid/EV battery charger receptacle harness connector, the hybrid/EV battery charger receptacle should be replaced. If moisture is detected on one connector, always be sure to inspect the mating connector as well.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Connect the drive motor battery charger cable.
2. Verify DTC P0D5A is not set.
    - **If the DTC is set**

      Replace the X98 Hybrid/EV Battery Charger Receptacle.

    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)

DTC P0D5E: BATTERY CHARGER SYSTEM HIGH VOLTAGE PRESENT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0D5E

Battery Charger System High Voltage Present

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or contain the high voltage DC within the hybrid/EV battery assembly. The 4 high voltage contactors are a main positive high voltage contactor, main negative high voltage contactor, charge positive high voltage contactor, and precharge high voltage contactor. These contactors close and open in sequence and are controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors. Ground is provided through the case ground.

Conditions for Running the DTC

- All contactors are commanded open.
- Runs once per charger contacts discharge event.
- None of the following DTCs are set: P0D4D, P0D4E or P0D4F.

Conditions for Setting the DTC

High voltage bus does not discharge to below 60 V within 4 seconds of the charger contactors being commanded open.

Actions Taken When the DTC Sets

- DTC P0D5E is a type A DTC.
- The hybrid/EV powertrain control module 2 opens the high voltage contactors.

Conditions for Clearing the DTC

- DTC P0D5E is a type A DTC.
- The **Clear Secured High Voltage DTCs** reset function must be performed with a scan tool before clear codes.

Reference Information

Schematic Reference

Hybrid/EV Energy Storage Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Drive Motor Battery System Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

[Powertrain Diagnostic Trouble Code (DTC) Type Definitions]

Scan Tool Reference

[Control Module References] for scan tool information

Circuit/System Verification

NOTE: **The following setup steps must be performed exactly in order to exercise the contactors.**

1. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
2. OPEN the driver door using outside door handle. Leave driver door OPEN.

NOTE: **The brake pedal must remain depressed throughout the remainder of the contactor steps.**

3. PRESS and HOLD the brake pedal.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode.**

4. Command the Hybrid/EV Battery Contactors ALL OPEN with a scan tool.
5. Disconnect the S15 Manual Service Disconnect.

NOTE: **DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning.**

6. Command the Battery Charging System Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open. The KR116B Battery Charging System Positive Contactor should be heard closing and opening.
   - **If the Battery Charging System Positive Contactor does not open and close**

     Refer to Circuit/System Testing.

   - **If the Battery Charging System Positive Contactor does open and close**
7. Replace the T18 Battery Charger.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**

- **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Vehicle OFF, disconnect the X358 harness connector at the A4 Hybrid/EV Battery Pack.
2. Test for less than 10 Ω between the ground circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Disconnect the X357 harness connector at the A4 Hybrid/EV Battery Pack.
4. Verify that a test lamp illuminates between the A4 Hybrid/EV Battery Pack harness B+ circuit terminal 1 X357 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF.
    2. Test for infinite resistance between the B+ circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the A28 Hybrid/EV Battery Contactor Assembly and K16 Battery Energy Control Module ensuring you reconnect the connectors in the sequence provided in Repair Instructions. Refer to **Battery Energy Control Module Replacement** .
    - **If the test lamp illuminates**
5. Vehicle in Service Mode.
6. Verify that a test lamp does not illuminate between the A4 Hybrid/EV Battery Pack harness control circuit terminal 5 X358 and ground.
    - **If the test lamp illuminates**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp does not illuminate**
7. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
8. Test for infinite resistance between the A4 Hybrid/EV Battery Pack harness control circuit terminal 5 X358 and ground.
    - **If less than infinite resistance**

      Repair the short to ground on the circuit.

    - **If infinite resistance**
9. Test for less than 2 Ω in the control circuit end to end.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**

10. Replace the K114B Hybrid/EV Powertrain Control Module 2.
11. Verify that DTC P0D5E does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If DTC P0D5E is set**

      Replace the A28 Hybrid/EV Battery Contactor Assembly.

    - **If DTC P0D5E is not set**
12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **High Voltage Battery Disconnect Relay Replacement** for A28 Hybrid/EV Battery Contactor Assembly.
- **Control Module References** for T18 Battery Charger, K16 Battery Energy Control Module, or K114B Hybrid/EV Powertrain Control Module 2 replacement, programming and setup.

DTC P0E61 OR P0E65: BATTERY CHARGER ENABLE/CONTROL CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P0E61

Battery Charger Enable Circuit

DTC P0E65

Battery Charger Control Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Charger Enable	P0E61	P0E61	P0E61	-
Battery Charger Control	P0E65	P0E65	P0E65	-

Circuit/System Description

The battery charger is controlled with a charger enable signal and a pulse width modulated (PWM) charger control circuit from the hybrid/EV powertrain control module 2. The charger enable signal is set to 12 V when the hybrid/EV powertrain control module 2 is awake. This allows the battery charger to operate while driving to allow DC voltage sensor operation.

Conditions for Running the DTC

DTC P0E61

The 12 V battery voltage is greater than 10.2 V.

DTC P0E65

- The 12 V battery voltage is greater than 10.2 V.
- Vehicle in Service Mode or the drive motor battery charger cable is connected.

Conditions for Setting the DTC

DTC P0E61

The hybrid/EV powertrain control module 2 detects an open, short to ground, or short to voltage on battery charger enable circuit for 1 second.

DTC P0E65

The hybrid/EV powertrain control module 2 detects an open, short to ground, or short to voltage on battery charger control circuit for 1 second.

Actions Taken When the DTC Sets

- DTC P0E61 and P0E65 are type B DTCs.
- Disables high voltage battery charging.

Conditions for Clearing the DTC

DTC P0E61 and P0E65 are type B DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Disconnect the X1 harness connector at the T18 Battery Charger.
2. Test for infinite resistance between the terminals listed below at the T18 Battery Charger X1 harness connector:
    - Battery charger enable terminal 11 and B+ terminal 9
    - Battery charger enable terminal 11 and ground terminal 2
    - Battery charger control terminal 4 and B+ terminal 9
    - Battery charger control terminal 4 and ground terminal 2
    - **If less than infinite resistance**

      Repair the short between the circuits.

    - **If infinite resistance**
3. Test for less than 2 Ω between the terminals listed below end to end:

    - T18 Battery Charger terminal 11 X1 and K114B Hybrid/EV Powertrain Control Module 2 terminal 44 X2
    - T18 Battery Charger terminal 4 X1 and K114B Hybrid/EV Powertrain Control Module 2 terminal 53 X2
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
5. Verify DTC P0E61 or P0E65 is not set.
    - **If any of the DTCs are set**

      Replace the T18 Battery Charger.

    - **If none of the DTCs are set**
6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for battery charger or hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P1ECE: BATTERY CHARGER TOTAL OUTPUT POWER PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1ECE

Battery Charger Total Output Power Performance

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the hybrid/EV battery pack voltage and current sensors to determine battery charger output power efficiency.

Conditions for Running the DTC

- The vehicle 12 V battery system voltage needs to be 10.2 V or greater.
- There cannot be any high voltage or current sensor faults present.
- Drive motor battery charger cable must be connected and vehicle receiving power.

Conditions for Setting the DTC

- Battery charger output power efficiency is less than 62% or greater than 167% for 80 minutes.
- Hybrid/EV electronics coolant temperature is between -12Ã‚Â°C (+10Ã‚Â°F) and +65Ã‚Â°C (+149Ã‚Â°F).

Actions Taken When the DTC Sets

- DTC P1ECE is a type A DTC.
- Disables the high voltage battery charging.

Conditions for Clearing the DTC

DTC P1ECE is a type A DTC.

Diagnostic Aids

The diagnostic consists of a passive efficiency test and active efficiency test. The passive test runs first, which takes a minimum of 80 minutes to mature. If the passive test fails, the active test is then run, which is intrusive. The DTC sets upon failure of the active test. The scan tool control function allows the active test to be run directly, eliminating the need to wait for the failure of the passive test.

The efficiency value is calculated by dividing the battery charger's output power by input power. A value less than 100% indicates power loss. A value more than 100% indicates an overcurrent condition and is less likely to occur.

Reference Information

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Plug-In Charging Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Connect the drive motor battery charger cable. Vehicle in Service Mode.
2. Perform the scan tool control function: Battery Charging System Efficiency Test (Active Test) @ K114B Hybrid/EV Powertrain Control Module 2 - On. Wait for test to complete.
3. Verify DTC P1ECE is not set.
    - **If the DTC is set**

      Replace the T18 Battery Charger.

    - **If the DTC is not set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T18 Battery Charger, often referred to as the Drive Motor Battery Charger, replacement, programming, and setup

DTC P1EE6 : BATTERY CHARGER AC VOLTAGE NOT PRESENT (NORTH AMERICA, KOREA)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P1EE6

Battery Charger AC Voltage Not Present

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Voltage AC Line 1	P1EE6	P1EE6	-	-
Voltage AC Neutral Line 2	P1EE6	P1EE6	-	-
Voltage AC Ground	-	P1EE6	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The hybrid battery charger receptacle is connected to the battery charger through two AC circuits and one ground circuit. When the battery charger has been enabled by the hybrid/EV powertrain control module 2, the battery charger will provide an AC voltage measurement to the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 allows charging to occur if proper AC voltage is present.

Conditions for Running the DTC

- The 12 V battery voltage is greater than 10.2 V.
- The drive motor battery charger cable is connected.
- DTCs P0D3E, P0D3F, P0D40, or P0D5C is not set.

Conditions for Setting the DTC

The battery charger AC input voltage is below 5 V.

Actions Taken When the DTC Sets

- DTC P1EE6 is a type C DTC.
- Disables the vehicle high voltage battery charging.

Conditions for Clearing the DTC

DTC P1EE6 is a type C DTC.

Diagnostic Aids

The hybrid/EV battery charger receptacle contains internal fuses on Voltage AC Line 1 and Voltage AC Neutral Line 2 circuits. A battery charger internal failure may cause these fuses to blow. If an open circuit is found in the hybrid/EV battery charger receptacle, the battery charger may also need to be replaced.

Reference Information

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Plug-In Charging Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Clear DTC, connect a known good drive motor battery charger cable to vehicle and household supply voltage.
2. Verify DTC P1EE6 is set.
   - **If DTC P1EE6 is not set**

     Replace customer's drive motor battery charger cable.

   - **If DTC P1EE6 is set**
3. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to **High Voltage Disabling**
4. Disconnect the X2 harness connector at the T18 Battery Charger.
5. Test into the harness for infinite resistance between the AC circuit terminals listed below and ground:
   - T18 Battery Charger terminal 1 X2

    - T18 Battery Charger terminal 4 X2
    - **If less than infinite resistance**
    1. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.
    2. Test into the harness for infinite resistance between the appropriate AC circuit terminal and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance
    3. Replace the X98 Hybrid/EV Battery Charger Receptacle.
    - **If infinite resistance**

6. Test into the harness for infinite resistance between all the AC circuit terminals listed below:
    - T18 Battery Charger terminal 1 X2
    - T18 Battery Charger terminal 3 X2
    - T18 Battery Charger terminal 4 X2
    - **If less than infinite resistance**
    1. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.
    2. Test into the harness for infinite resistance between the three AC circuit terminals.
        - If less than infinite resistance, repair the short between the circuits.
        - If infinite resistance
    3. Replace the X98 Hybrid/EV Battery Charger Receptacle.
    - **If infinite resistance**

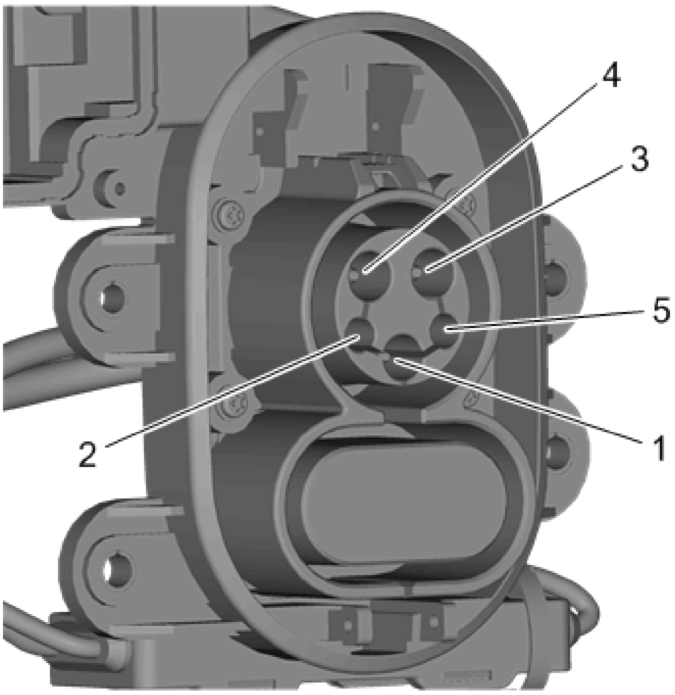

Fig. 12: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

7. Test for less than 10 Ω between the AC circuit terminals listed below:
    - T18 Battery Charger terminal 1 X2 and X98 Hybrid/EV Battery Charger Receptacle 3
    - T18 Battery Charger terminal 3 X2 and X98 Hybrid/EV Battery Charger Receptacle 1
    - T18 Battery Charger terminal 4 X2 and X98 Hybrid/EV Battery Charger Receptacle 4
    - **If 10 Ω or greater**
    1. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.
    2. Test for less than 2 Ω in the AC circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω
    3. Replace the X98 Hybrid/EV Battery Charger Receptacle.
    4. Verify the DTC does not set.

        - If the DTC sets, replace the T18 Battery Charger and X98 Hybrid/EV Battery Charger Receptacle.
        - If the DTC does not set

    5. All OK.

    - **If less than 10 Ω**

8. Replace the T18 Battery Charger.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**
- **Control Module References** for battery charger replacement, programming and setup.

DTC P3002, P3003, P301F, OR P3020: HYBRID/EV BATTERY DC CHARGING POSITIVE VOLTAGE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P3002

Hybrid/EV Battery DC Charging Positive Voltage Sensor Circuit Low Voltage

DTC P3003

Hybrid/EV Battery DC Charging Positive Voltage Sensor Circuit High Voltage

DTC P301F

Hybrid/EV Battery DC Charging Positive Voltage Sensor Stuck Low

DTC P3020

Hybrid/EV Battery DC Charging Positive Voltage Sensor Stuck High

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors for normal operation and regular (AC) charging, and 1 module. In vehicles with DC charging capability, there are two additional DC contactors that are housed in the battery charger - DC. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or safely contain the high voltage DC within the hybrid/EV battery assembly. The 6 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, AC charge positive high voltage contactor, precharge contactor, DC positive contactor, and DC negative contactor. The 1 module is the hybrid/EV battery pack coolant heater module. The contactors and module close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors/module. Ground is provided through the case ground and chassis.

The hybrid/EV powertrain control module 2 measures internal voltages, currents, and temperatures within the battery charger - DC and charge receptacle and verifies they are within the proper range.

Conditions for Running the DTC

P3002 and P3003

The vehicle 12 V battery system voltage is greater than 10.2 V.

P301F

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The vehicle is ready to be charged.
- The DC positive contactor is commanded OPEN.
- The charge control mode is precharge.
- The off board charger voltage limit command is greater than or equal to 201 V.
- DTC P3002 or P3003 is not set.

  OR

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The vehicle is ready to be charged.
- The DC positive contactor is commanded CLOSED.
- The charge control mode is constant current.
- DTC P3002 or P3003 is not set.

P3020

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The vehicle is ready to be charged.
- The DC positive contactor is commanded CLOSED.
- The charge control mode is constant current.
- DTC P3002 or P3003 is not set.

  OR

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- Vehicle in Service Mode or Vehicle ON.
- The DC charge cable is disconnected.
- The DC positive contactor is commanded OPEN.
- DTC P3002 or P3003 is not set.

Conditions for Setting the DTC

P3002

The hybrid/EV powertrain control module 2 detects the DC charging positive voltage sensor signal is out of range low. The signal percent is less than 5% for 1 s.

P3003

The hybrid/EV powertrain control module 2 detects the DC charging positive voltage sensor signal is out of range high. The signal percent is greater than 90% for 1 s.

P301F

- The DC Charging Positive Voltage Sensor bus voltage is less than or equal to 30 V.

  AND

- The DC Charging Negative Voltage Sensor bus voltage is greater than 30 V.

P3020

- The DC Charging Positive Voltage Sensor bus voltage is not within 20% of the hybrid/EV powertrain control module 1 bus voltage.

AND

- The DC Charging Positive Voltage Sensor bus voltage is greater than 20 V.

Action Taken When the DTC Sets

- DTC P3002, P3003, and P3020 are type A DTCs.
- DTC P301F is type B DTC.
- Disables DC high voltage battery charging.

Conditions for Clearing the DTC

- DTC P3002, P3003, and P3020 are type A DTCs.
- DTC P301F is type B DTC.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Observe the scan tool DC Positive Supply Isolation Voltage parameter. The reading should be 0 V.
    - **If greater than 0 V**

      Refer to Circuit/System Testing

    - **If 0 V**
3. Verify that DTC P3002, P3003, P301F, or P3020 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If any of the DTCs are set**

      Refer to Circuit/System Testing.

    - **If none of the DTCs are set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminal 9 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 8 and ground.
    - **If less than 4.8 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the 5 V reference circuit terminal 8 X9 and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for infinite resistance between the 5 V reference circuit terminal 5 X2 and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    4. Test for less than 2 Ω in the 5 V reference circuit terminal 8 X9 end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 5.2 V or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit terminal 8 X9 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 1 V between the 5 V reference circuit terminal 5 X2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If within the specified range**
5. Test for less than 1 V between the signal circuit terminal 10 X9 and ground.
    - **If 1 V or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If between 1 - 5 V, repair the short to voltage on the circuit.
        - If greater than 5 V, repair the short to voltage on the circuit and replace the T24 Battery Charger - DC.
        - If less than 1 V
    3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
    4. Verify that DTC P3002, P3003, P301F, or P3020 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If any of the DTCs are set, replace the T24 Battery Charger - DC.
        - If none of the DTCs are set
    5. All OK.
    - **If less than 1 V**

6. Vehicle OFF, install a 3 A fused jumper wire between the signal circuit terminal 10 and the 5 V reference circuit terminal 8. Vehicle in Service Mode.
7. Verify the scan tool DC Positive Supply Isolation Voltage parameter is greater than 500 V.
   - **If less than 500 V**
   1. Test for infinite resistance between the signal circuit and ground.
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   2. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If 500 V or greater**
8. Replace the T24 Battery Charger - DC.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for battery charger - DC and hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P3005, P3006, P3021, OR P3022: HYBRID/EV BATTERY DC CHARGING NEGATIVE VOLTAGE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P3005

Hybrid/EV Battery DC Charging Negative Voltage Sensor Circuit Low Voltage

DTC P3006

Hybrid/EV Battery DC Charging Negative Voltage Sensor Circuit High Voltage

DTC P3021

Hybrid/EV Battery DC Charging Negative Voltage Sensor Stuck Low

DTC P3022

Hybrid/EV Battery DC Charging Negative Voltage Sensor Stuck High

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors for normal operation and regular (AC) charging, and 1 module. In vehicles with DC charging capability, there are two additional DC contactors that are housed in the battery charger - DC. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or safely contain the high voltage DC within the hybrid/EV battery assembly. The 6 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, AC charge positive high voltage contactor, precharge contactor, DC positive contactor, and DC negative contactor. The 1 module is the hybrid/EV battery pack coolant heater module. The contactors and module close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors/module. Ground is provided through the case ground and chassis.

The hybrid/EV powertrain control module 2 measures internal voltages, currents, and temperatures within the battery charger - DC and charge receptacle and verifies they are within the proper range.

Conditions for Running the DTC

P3005 and P3006

The vehicle 12 V battery system voltage is greater than 10.2 V.

P3021

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The vehicle is ready to be charged.
- The DC negative contactor is commanded OPEN.
- The charge control mode is precharge.
- The off board charger voltage limit command is greater than or equal to 201 V.
- DTC P3005 or P3006 is not set.

  OR

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The vehicle is ready to be charged.
- The charge control mode is constant current.
- The DC negative contactor is commanded CLOSED.
- DTC P3005 or P3006 is not set.

P3022

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The DC negative contactor is commanded CLOSED.
- The charge control mode is constant current.
- DTC P3005 or P3006 is not set.

  OR

- Vehicle in Service Mode or Vehicle ON.
- The DC charge cable is disconnected.
- The DC negative contactor is commanded OPEN.

Conditions for Setting the DTC

P3005

The hybrid/EV powertrain control module 2 detects the DC charging negative voltage sensor signal is out of range low. The signal percent is less than 5% for 1 s.

P3006

The hybrid/EV powertrain control module 2 detects the DC charging negative voltage sensor signal is out of range high. The signal percent is greater than 90% for 1 s.

P3021

- The DC Charging Negative Voltage Sensor bus voltage is less than or equal to 30 V.

  AND

- The DC Charging Positive Voltage Sensor bus voltage is greater than 30 V.

P3022

- The DC Charging Negative Voltage Sensor bus voltage is greater than 20 V.

AND

- The DC Charging Negative Voltage Sensor bus voltage is not within 20% of the hybrid/EV powertrain control module 1 bus voltage.

Action Taken When the DTC Sets

- DTC P3005, P3006, and P3022 are type A DTCs.
- DTC P3021 is type B DTC.
- Disables DC high voltage battery charging.

Conditions for Clearing the DTC

- DTC P3005, P3006, and P3022 are type A DTCs.
- DTC P3021 is type B DTC.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Observe the scan tool DC Negative Supply Isolation Voltage parameter. The reading should be 0 V.
    - **If greater than 0 V**

      Refer to Circuit/System Testing.

    - **If 0 V**
3. Verify that DTC P3005, P3006, P3021, or P3022 does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If any of the DTCs are set**

      Refer to Circuit/System Testing.

    - **If none of the DTCs are set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminal 9 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 8 and ground.
    - **If less than 4.8 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the 5 V reference circuit terminal 8 X9 and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for infinite resistance between the 5 V reference circuit terminal 5 X2 and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    4. Test for less than 2 Ω in the 5 V reference circuit terminal 8 X9 end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 5.2 V or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit terminal 8 X9 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 1 V between the 5 V reference circuit terminal 5 X2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If within the specified range**
5. Test for less than 1 V between the signal circuit terminal 11 and ground.
    - **If 1 V or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If between 1 - 5 V, repair the short to voltage on the circuit.
        - If greater than 5 V, repair the short to voltage on the circuit and replace the T24 Battery Charger - DC.
        - If less than 1 V
    3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
    4. Verify that DTC P3002, P3003, P301F, or P3020 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If any of the DTCs are set, replace the T24 Battery Charger - DC.
        - If none of the DTCs are set
    5. All OK.
    - **If less than 1 V**

6. Vehicle OFF, install a 3 A fused jumper wire between the signal circuit terminal 11 and the 5 V reference circuit terminal 8. Vehicle in Service Mode.
7. Verify the scan tool DC Negative Supply Isolation Voltage parameter is greater than 500 V.
    - **If less than 500 V**
    1. Test for infinite resistance between the signal circuit and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 500 V or greater**
8. Replace the T24 Battery Charger - DC.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for battery charger - DC and hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P300B: HYBRID/EV BATTERY DC CHARGING OUTPUT CURRENT PERFORMANCE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P300B

Hybrid/EV Battery DC Charging Output Current Performance

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors for normal operation and regular (AC) charging, and 1 module. In vehicles with DC charging capability, there are two additional DC contactors that are housed in the battery charger - DC. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or safely contain the high voltage DC within the hybrid/EV battery assembly. The 6 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, AC charge positive high voltage contactor, precharge contactor, DC positive contactor, and DC negative contactor. The 1 module is the hybrid/EV battery pack coolant heater module. The contactors and module close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors/module. Ground is provided through the case ground and chassis.

The hybrid/EV powertrain control module 2 measures internal voltages, currents, and temperatures within the battery charger - DC and charge receptacle and verifies they are within the proper range.

Conditions for Running the DTC

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The Charge Control Mode is Constant current or Constant Voltage.
- The Battery Charger DC positive and negative contactors are closed.
- The Battery Pack main positive, main negative, and multifunction contactors are closed.
- The Charge Power Level is DC.
- DTCs P0AC1, P0AC2 and P1EBA are not set.

Conditions for Setting the DTC

The percent current deviation is greater than the fail threshold for 80% of the samples in a 10 s window. The fail thresholds are as follows:

- 100% current deviation when the commanded current is less than 5 A
- 60% current deviation when the commanded current is greater than or equal to 5 A and less than 20 A
- 50% current deviation when the commanded current is greater than or equal to 20 A and less than 40 A
- 30% current deviation when the commanded current is greater than or equal to 40 A

Action Taken When the DTC Sets

DTC P300B is a type C DTC.

Conditions for Clearing the DTC

DTC P300B is a type C DTC.

Diagnostic Aids

Current deviation is defined as actual current minus commanded current. Percent current deviation is defined as current deviation divided by commanded current multiplied by 100. For example, if commanded current is 10 A and actual current is 18 A, the current deviation is 8 A and the percent current deviation is 80%. An 80% current deviation is greater than the 60% fail threshold for the 5 A to 20 A commanded current range.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P300B does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If DTC P300B is set**

      Contact the GM Technical Assistance Center to report a DC Fast charge station problem.

    - **If DTC P300B is not set**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P300C, P300D, OR P300F: HYBRID/EV BATTERY DC CHARGING PORT TEMPERATURE SENSOR CIRCUIT LOW/HIGH/ERRATIC

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P300C

Hybrid/EV Battery DC Charging Port Temperature Sensor Circuit Low

DTC P300D

Hybrid/EV Battery DC Charging Port Temperature Sensor Circuit High

DTC P300F

Hybrid/EV Battery DC Charging Port Temperature Sensor Circuit Erratic

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the receptacle temperature any time the hybrid/EV powertrain control module 2 is awake. The hybrid/EV powertrain control module 2 verifies the temperature signal is within the proper range.

Conditions for Running the DTC

P300C and P300D

The vehicle 12 V battery system voltage is greater than 10.2 V.

P300F

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- DTC P300C or P300D is not set.

Conditions for Setting the DTC

P300C

The charging port temperature sensor signal percent is less than 2.5% in 1 s.

P300D

The charging port temperature sensor signal percent is greater than 99.0% in 1 s.

P300F

The hybrid/EV powertrain control module 2 detects the charging port temperature sensor signal is erratic for 10 seconds.

Action Taken When the DTC Sets

DTC P300C, P300D, and P300F are type A DTCs.

Conditions for Clearing the DTC

- DTC P300C, P300D, and P300F are type A DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Plug-In Charging System Description and Operation

Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

   NOTE: **The DC Charge Port Temperature should be close to ambient temperature without the cord set plugged in.**

2. Observe the scan tool DC Charge Port Temperature parameter. The reading should be between -40 and +125Ã‚Â° C (-40 and +257Ã‚Â° F).
   - **The reading is not within the specified range**

     Refer to Circuit/System Testing.

   - **The reading is within the specified range**
3. Verify that DTC P300C, P300D, or P300F does not set while operating the vehicle within the Conditions for Running the DTC.
   - **If any of the DTCs are set**

     Refer to Circuit/System Testing.

   - **If none of the DTCs are set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. Disconnect the X2 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference terminal 6 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.

4. Test for 4.8 - 4.95 V between the signal circuit terminal 5 and ground.
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the signal circuit and ground
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If greater than 4.95 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If between 1 - 5.2 V, repair the short to voltage on the circuit.
      - If greater than 5.2 V, repair the short to voltage on the circuit and replace the X98 Hybrid/EV Battery Charger Receptacle.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If between 4.8 - 4.95 V**
5. Replace the X98 Hybrid/EV Battery Charger Receptacle.

Component Testing

1. Vehicle OFF and all vehicle systems OFF. Disconnect the X2 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.
2. Test for 2.76 - 2.93k Ω at approximately 25Ã‚Â°C (77Ã‚Â°F) between the signal terminal 5 and the low reference terminal 6.
   - **If not within the specified range**

     Replace the X98 Hybrid/EV Battery Charger Receptacle.

   - **If within the specified range**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P3010, P3013, OR P3014: HYBRID/EV BATTERY DC CHARGING PORT LOCK

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P3010

Hybrid/EV Battery DC Charging Port Lock Control Circuit

DTC P3013

Hybrid/EV Battery DC Charging Port Lock Stuck Open

DTC P3014

Hybrid/EV Battery DC Charging Port Lock Stuck Closed

Circuit/System Description

The hybrid/EV powertrain control module 2 activates the charge port lock to prevent the DC charge cord from being disconnected during charging. The hybrid/EV powertrain control module 2 monitors the charge port lock any time the hybrid/EV powertrain control module 2 is awake. The hybrid/EV powertrain control module 2 monitors the command and the actuator position to verify proper operation.

Conditions for Running the DTC

P3010

The charge port lock actuator has been commanded to LOCK or UNLOCK.

P3013 and P3014

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The charge port lock actuator has not been commanded for more than 2 sec.
- DTC P302B, P302C, or P302D is not set.

Conditions for Setting the DTC

P3010

- The hybrid/EV powertrain control module 2 has detected a lock driver open circuit fault.

  OR

- The hybrid/EV powertrain control module 2 has detected a lock driver short circuit fault.

P3013

- The charge port lock actuator has been commanded to LOCK.
- The hybrid/EV powertrain control module 2 has determined a stuck open condition by comparing the charge port lock commanded lock position to the DC Charge Port Lock Actuator Engaged Position.

P3014

- The charge port lock actuator has been commanded to UNLOCK.
- The hybrid/EV powertrain control module 2 has determined a stuck closed condition by comparing the charge port lock commanded unlock position to the DC Charge Port Lock Actuator Disengaged Position.

Action Taken When the DTC Sets

DTC P3010, P3013, and P3014 are type C DTCs.

Conditions for Clearing the DTC

DTC P3010, P3013, and P3014 are type C DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Command the DC Charge Port Lock to LOCK and UNLOCK with a scan tool while listening for the DC Charge Port Lock to lock and unlock. The DC Charge Port Lock should lock and unlock and the scan tool DC Charge Port Lock Actuator Position Sensor parameter should change between 0.15 - 4.85 V.
    - **If the DC Charge Port Lock does not LOCK or UNLOCK or the DC Charge Port Lock Actuator Position Sensor parameter does not change**

      Refer to Circuit/System Testing.

    - **If the DC Charge Port Lock does LOCK and UNLOCK and the DC Charge Port Lock Actuator Position Sensor parameter changes**
3. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. Disconnect the X2 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Connect a test lamp between the control circuit terminal 7 and ground. Vehicle in Service Mode.
2. Verify the test lamp illuminates.
    - **If the test lamp does not illuminate or is very Dim**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit terminal 7 and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit terminal 7 end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp does illuminate**
3. Command the DC Charge Port Lock to LOCK and UNLOCK with a scan tool. Verify that the test lamp turns ON and OFF.
    - **If the test lamp does not turn OFF or Dims**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit terminal 7 and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If the test lamp turns ON and OFF**

4. Disconnect the test lamp. Connect a test lamp between the control circuit terminal 8 and ground.
   - **If the test lamp does not illuminate or is very Dim**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the control circuit terminal 8 and ground.
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp does illuminate**
5. Command the DC Charge Port Lock to UNLOCK and LOCK with a scan tool. Verify that the test lamp turns ON and OFF.
   - **If the test lamp does not turn OFF or Dims**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit terminal 8 and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp turns ON and OFF**
6. Replace the X98 Hybrid/EV Battery Charger Receptacle.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P3015, P3018, P301C, OR P301D: HYBRID/EV BATTERY DC CHARGING POSITIVE/NEGATIVE CONTACTOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P3015

Hybrid/EV Battery DC Charging Positive Contactor Control Circuit

DTC P3018

Hybrid/EV Battery DC Charging Negative Contactor Control Circuit

DTC P301C

Hybrid/EV Battery DC Charging Positive Contactor Stuck Closed

DTC P301D

Hybrid/EV Battery DC Charging Negative Contactor Stuck Closed

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Relay Coil Control	P3015, P3018, P301C, P301D	P3015, P3018, P301C, P301D	P3015, P3018, P301C, P301D	-

Circuit/System Description

In vehicles with quick charge DC charging capability, RPO: CBT, there are two high voltage contactors that are housed in the T24 battery charger - DC. These additional high voltage contactors allow the high voltage DC batteries to be connected to the X98 Hybrid/EV Battery Charger Receptacle DC charge terminals.

The hybrid/EV powertrain control module 2 measures internal voltages, currents, and temperatures within the T24 battery charger - DC and charge receptacle and verifies they are within the proper range.

Conditions for Running the DTC

P3015 and P3018

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The hybrid/EV battery current is less than 999 A.

P301C

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The main positive and negative contactors are CLOSED.
- The DC charging positive contactor is OPEN.

P301D

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The main positive and negative contactors are CLOSED.
- The DC charging negative contactor is OPEN.

Conditions for Setting the DTC

P3015

- The DC charging positive contactor is commanded OPEN and the output voltage is greater than battery voltage minus 0.4 V.

  OR

- The DC charging positive contactor is commanded CLOSED and the current sense feedback is less than 194 mA.

P3018

- The DC charging negative contactor is commanded OPEN and the output voltage is greater than battery voltage minus 0.4 V.

  OR

- The DC charging negative contactor is commanded CLOSED and the current sense feedback is less than 194 mA.

P301C

The DC charging positive bus voltage is within 80% to 120% of the hybrid/EV powertrain control module 1 positive bus voltage.

P301D

The DC charging negative bus voltage is within 80% to 120% of the hybrid/EV powertrain control module 1 negative bus voltage.

Action Taken When the DTC Sets

DTC P3015, P3018, P301C and P301D are type B DTCs.

Conditions for Clearing the DTC

DTC P3015, P3018, P301C and P301D are type B DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Plug-In Charging System Description and Operation

Electrical Information Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactors.**

1. Vehicle OFF. Turn ON the park lamps.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.**

NOTE: **There are two contactor control functions available on the scan tool. Make sure you select the DC charging contactor control and not the battery contactor control.**

2. Command the hybrid powertrain control module 2, Hybrid/EV Battery DC Charging Contactors ALL OPEN with a scan tool.

NOTE: **Ignore DTC P0ABC after pulling the S15 Manual Service Disconnect.**

3. Disconnect the S15 Manual Service Disconnect.

NOTE: **DO NOT use the scan tool Release Control button to turn OFF any of the**

contactors. Once the scan tool Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning, including reinstalling the S15 Manual Service Disconnect and clearing DTCs.

4. Command the Hybrid/EV Battery DC Charging Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to open.

NOTE: **It is normal for the charging contactors to only make noise while opening.**

5. Verify the Hybrid/EV Battery DC Charging Negative Contactor is heard opening.
   - **If the Hybrid/EV Battery DC Charging Negative Contactor operation cannot be heard**

     Refer to Hybrid/EV Battery DC Charging Negative Contactor.

   - **If the Hybrid/EV Battery DC Charging Negative Contactor operation can be heard**
6. Command the Hybrid/EV Battery DC Charging Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to open.
7. Verify the Hybrid/EV Battery DC Charging Positive Contactor is heard opening.
   - **If the Hybrid/EV Battery DC Charging Positive Contactor operation cannot be heard**

     Refer to Hybrid/EV Battery DC Charging Positive Contactor.

   - **If the Hybrid/EV Battery DC Charging Positive Contactor operation can be heard**

NOTE: **It is normal for the Hybrid/EV Battery DC Charging Negative Contactor to be slightly quieter than the positive contactor.**

8. Repeat opening and closing of both DC Charging contactors several times while comparing the sound made by each contactor.
   - **If either contactor intermittently stops working**

     Replace the T24 Battery Charger - DC

   - **If both contactors consistently generate sound**
9. All OK.

Circuit/System Testing

Hybrid/EV Battery DC Charging Negative Contactor

1. Vehicle OFF. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground.
   - Terminal 1
   - Terminal 3
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect the X9 harness connector at the T24 Battery Charger - DC.

NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactor.**

4. Vehicle OFF, turn ON the park lamps.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.**

5. Command the Hybrid/EV Battery DC Charging Contactors ALL OPEN with a scan tool.

NOTE: **Ignore P0ABC after pulling the S15 Manual Service Disconnect.**

6. Disconnect the S15 Manual Service Disconnect. Disconnect the X9 harness connector at the T24 Battery Charger - DC. Connect a test lamp between the control circuit terminal 4 and ground.
7. Verify that the test lamp is OFF.
   - **If the test lamp is ON**
   1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.
   - **If the test lamp is OFF**

NOTE: **DO NOT use the scan tool Release Control button to turn OFF the contactor. Once the scan tool Release Control button is pushed the setup steps will need to be restarted from the beginning.**

8. Command the Hybrid/EV Battery DC Charging Negative Contactor CLOSED and ALL OPEN with a scan tool. Verify that the test lamp turns ON and OFF.
   - **If the test lamp does not turn ON and OFF**
   1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
   2. Test for infinite resistance between control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid Powertrain Control Module 2.
   - **If the test lamp does turn ON and OFF**
9. Replace the T24 Battery Charger - DC.

Hybrid/EV Battery DC Charging Positive Contactor

1. Vehicle OFF. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground.
   - Terminal 1
   - Terminal 3
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Connect the X9 harness connector at the T24 Battery Charger - DC.

NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactor.**

4. Vehicle OFF, turn ON the park lamps.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.**

5. Command the Hybrid/EV Battery DC Charging Contactors ALL OPEN with a scan tool.

   NOTE: **Ignore P0ABC after pulling the S15 Manual Service Disconnect.**

6. Disconnect the S15 Manual Service Disconnect. Disconnect the X9 harness connector at the T24 Battery Charger - DC. Connect a test lamp between the control circuit terminal 2 and ground.

   NOTE: **DO NOT use the scan tool Release Control button to turn OFF the contactor. Once the scan tool Release Control button is pushed the setup steps will need to be restarted from the beginning.**

7. Verify that the test lamp is OFF.
   - **If the test lamp is ON**
   1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is OFF**
8. Command the Hybrid/EV Battery DC Charging Positive Contactor CLOSED and ALL OPEN with a scan tool.
9. Verify that the test lamp turns ON and OFF.
   - **If the test lamp does not turn ON and OFF**
   1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp does turn ON and OFF**
10. Replace the T24 Battery Charger - DC.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for T24 battery charger - DC and hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P301E: HYBRID/EV BATTERY DC CHARGING CONTACTORS OPENED UNDER LOAD - DC CHARGING DISABLED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P301E

Hybrid/EV Battery DC Charging Contactors Opened Under Load - DC Charging Disabled

Circuit/System Description

The hybrid/EV battery contains 4 high voltage contactors for normal operation and regular (AC) charging, and 1 module. In vehicles with DC charging capability, there are two additional DC contactors that are housed in the battery charger - DC. The high voltage contactors allow the high voltage DC batteries to be connected to the vehicle or safely contain the high voltage DC within the hybrid/EV battery assembly. The 6 high voltage contactors consist of a main positive high voltage contactor, main negative high voltage contactor, AC charge positive high voltage contactor, precharge contactor, DC positive contactor, and DC negative contactor. The 1 module is the hybrid/EV battery pack coolant heater module. The contactors and module close and open in a specific sequence controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 supplies voltage to the control circuit for the high voltage contactors/module. Ground is provided through the case ground and chassis.

The hybrid/EV powertrain control module 2 measures internal voltages, currents, and temperatures within the battery charger - DC and charge receptacle and verifies they are within the proper range. During DC charging the hybrid/EV powertrain control module 2 monitors for the charging cable being disconnected while under load during DC charging.

Conditions for Running the DTC

The charge current is greater than 5 A for 12.5 ms.

Conditions for Setting the DTC

The accumulated current when DC charging contactors are opened is greater than 30, 000 A.

Action Taken When the DTC Sets

DTC P301E is a type A DTC.

Conditions for Clearing the DTC

- DTC P301E is a type A DTC.
- The **DC Charging Disabled Reset** function must be performed with a scan tool before clear codes

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.

NOTE: **The DC Charge Port Temperature should be close to ambient temperature without the cord set plugged in.**

2. Observe the scan tool DC Charge Port Temperature parameter. The reading should be between -40 and +125Ã,Â° C (-40 and +257Ã,Â° F).
    - **The reading is not within the specified range**

      Refer to Circuit/System Testing.

    - **The reading is within the specified range**

NOTE: **Damage can include cracks, breaks, bent pins or missing parts.**

3. Vehicle OFF. Visually inspect the X98 Hybrid/EV Battery Charger Receptacle and high voltage cables for damage.
    - **The receptacle or cables are damaged**

      Replace the X98 Hybrid/EV Battery Charger Receptacle.

    - **The receptacle and cables are visually OK**
4. Verify that DTC P301F does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC is set**

      Contact the GM Technical Assistance Center to report a DC Charge Station problem.

    - **If the DTC is not set**
5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. Disconnect the X2 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference terminal 6 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 4.95 V between the signal circuit terminal 5 and ground.
    - **If less than 4.8 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the signal circuit and ground
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 4.95 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If between 1 - 5.2 V, repair the short to voltage on the circuit.

        - If greater than 5.2 V, repair the short to voltage on the circuit and replace the X98 Hybrid/EV Battery Charger Receptacle.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If between 4.8 - 4.95 V**
5. Replace the X98 Hybrid/EV Battery Charger Receptacle.

Component Testing

1. Vehicle OFF and all vehicle systems OFF. Disconnect the X2 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.
2. Test for 2.76 - 2.93k Ω at approximately 25Ã‚Â°C (77Ã‚Â°F) between the signal terminal 5 and the low reference terminal 6.
    - **If not within the specified range**

      Replace the X98 Hybrid/EV Battery Charger Receptacle.

    - **If within the specified range**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P3027-P302A: CHARGE PORT LOCK POSITION SENSOR (DUBAI)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P3027

Charge Port Lock Position Sensor Performance - Signal Low

DTC P3028

Charge Port Lock Position Sensor Performance - Signal High

DTC P3029

Charge Port Lock Position Sensor Performance

DTC P302A

Charge Port Lock Actuator Position Sensor Not Plausible

Circuit/System Description

The hybrid/EV powertrain control module 2 activates the charge port lock to prevent the DC charge cord from being disconnected during charging. The hybrid/EV powertrain control module 2 monitors the charge port lock any time the hybrid/EV powertrain control module 2 is awake. The hybrid/EV powertrain control module 2 monitors the command and the actuator position to verify proper operation.

Conditions for Running the DTC

P3027 and P3028

The vehicle 12 V battery system voltage is greater than 10.2 V.

P3029

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The charge port lock actuator has been commanded to LOCK for greater than 2 s.

P302A

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The charge port lock actuator has been commanded to LOCK for greater than 2 s.
- None of the following DTCs are set: P3027, P3028, P3029, P302B, P302C, P302D.

Conditions for Setting the DTC

P3027

The hybrid/EV powertrain control module 2 detects the charge port lock position sensor signal is out of range low. The signal is less than 22.94% of range for 4 s.

P3028

The hybrid/EV powertrain control module 2 detects the charge port lock position sensor signal is out of range high. The signal is greater than 94.50% of range for 4 s.

P3029

The hybrid/EV powertrain control module 2 detects the charge port lock position sensor signal is not within a valid range. The signal is within 65.80% to 81.56% of range for 4 s.

P302A

The hybrid/EV powertrain control module 2 detects the charge port lock actuator position sensor signal does not match the charge port lock position sensor signal for 8 s.

Action Taken When the DTC Sets

DTC P3027, P3028, P3029, and P302A are Type C DTCs.

Conditions for Clearing the DTC

DTC P3027, P3028, P3029, and P302A are Type C DTCs.

Reference Information

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Plug-In Charging Schematics

Connector End View Reference

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Plug-In Charging System Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode. With a scan tool command the DC Charge Port Lock between UNLOCK and LOCK.
2. Observe the scan tool DC Charge Port Lock Position Sensor parameter. The value should change between 4.08 - 4.73 V (UNLOCKED) and 1.15 - 3.29 V (LOCKED).
    - **The value is not within the specified ranges**

      Refer to Circuit/System Testing.

    - **The value is within the specified ranges**
3. Begin charging using a DC Fast Charge station. Wait 1 minute. Stop charging and remove plug. Verify that P3027 - P302A is not set.
    - **If any of the DTCs are set**

      Refer to Circuit/System Testing.

    - **If none of the DTCs are set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. Disconnect the X2 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.
2. Test for 1.15 V or greater between the signal circuit terminal 4 and ground.
    - **If less than 1.15 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the signal circuit terminal 4 and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit terminal 4 end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω
    4. Replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 1.15 V or greater**
3. Command the DC Charge Port Lock to LOCK with a scan tool. Test for 3.29 V or less between the signal circuit terminal 4 and ground.
    - **If greater than 3.29 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 4 and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.
        - If less than 1 V
    3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 3.29 V or less**
4. Replace the X98 Hybrid/EV Battery Charger Receptacle.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**
- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P302B-P302D: CHARGE PORT LOCK ACTUATOR POSITION SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P302B

Charge Port Lock Actuator Position Sensor Signal Out of Range Low

DTC P302C

Charge Port Lock Actuator Position Sensor Signal Out of Range High

DTC P302D

Charge Port Lock Actuator Position Sensor Circuit Performance

Circuit/System Description

The hybrid/EV powertrain control module 2 activates the charge port lock to prevent the DC charge cord from being disconnected during charging. The hybrid/EV powertrain control module 2 monitors the charge port lock any time the hybrid/EV powertrain control module 2 is awake. The hybrid/EV powertrain control module 2 monitors the command and the actuator position to verify proper operation.

Conditions for Running the DTC

P302B and P302C

The vehicle 12 V battery system voltage is greater than 10.2 V.

P302D

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The charge port lock actuator has been commanded to LOCK for greater than 2 s.

Conditions for Setting the DTC

P302B

The hybrid/EV powertrain control module 2 detects the charge port lock actuator position sensor signal is out of range low. The signal is less than 3% of range for 4 s.

P302C

The hybrid/EV powertrain control module 2 detects the charge port lock actuator position sensor signal is out of range high. The signal is greater than 97% of range for 4 s.

P302D

The hybrid/EV powertrain control module 2 detects the charge port lock actuator position sensor signal is not within a valid range. The signal is within 35% to 75% of range for 4 s.

Action Taken When the DTC Sets

DTC P302B, P302C, and P302D are type C DTCs.

Conditions for Clearing the DTC

DTC P302B, P302C, and P302D are type C DTCs.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Plug-In Charging System Description and Operation

Electrical Information Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode. Depress the receptacle switch with a small screw driver. With a scan command the DC Charge Port Lock between UNLOCK and LOCK.

   NOTE: **If the receptacle switch is not fully depressed the reading will remain below 2 V.**

2. Observe the scan tool DC Charge Port Lock Actuator Position Sensor parameter. The reading should change between 0.15 - 1.75 V (UNLOCKED) and 3.75 - 4.85 V (LOCKED).
   - **The reading are not within the specified ranges**

     Refer to Circuit/System Testing.

   - **The reading are within the specified ranges**
3. Verify that DTC P302B, P302C, or P302D is not set.
   - **If any of the DTCs are set**

     Refer to Circuit/System Testing.

   - **If none of the DTCs are set**
4. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF. Disconnect the X2 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference terminal 3 and ground.
   - **If 10 Ω or greater**

    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
    - **If less than 4.8 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 5.2 V**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If between 4.8 - 5.2 V**
5. Verify the scan tool DC Charge Port Lock Actuator Position Sensor parameter is less than 0.5 V.
    - **If 0.5 V or greater**
    1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 2 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 0.5 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 2 and the 5 V reference circuit terminal 1.
7. Verify the scan tool DC Charge Port Lock Actuator Position Sensor parameter is greater than 4.95 V.
    - **If 4.95 V or less**
    1. Vehicle OFF, remove the jumper wire. Disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If greater than 4.95 V**
8. Replace the X98 Hybrid/EV Battery Charger Receptacle.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**

- **Control Module References** for hybrid/EV powertrain control module 2 replacement, programming, and setup.

DTC P302F: HYBRID/EV BATTERY DC CHARGING SYSTEM ISOLATION FAULT (NORTH AMERICA, KOREA)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P302F

Hybrid/EV Battery DC Charging System Isolation Fault

Circuit/System Description

In vehicles with quick charge DC charging capability, RPO CBT, there are two high voltage contactors housed within the T24 battery charger - DC. These additional high voltage contactors allow the high voltage DC batteries to be connected to the X98 Hybrid/EV Battery Charger Receptacle DC charge terminals.

The hybrid/EV powertrain control module 2 measures a high impedance network within the T24 battery charger - DC to verify isolation between the DC high voltage positive and negative circuits and the vehicle chassis are within the proper range.

Conditions for Running the DTC

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The vehicle is charging.
- The battery charger - DC positive contactor is commanded CLOSED.
- The battery charger - DC negative contactor is commanded CLOSED.
- DTC P3002, P3003, P3005, P3006, P301F, P3020, P3021, or P3022 is not set.

OR

- The vehicle 12 V battery system voltage is greater than 10.2 V.
- The DC charge cable is connected.
- The charge mode is precharge.
- The battery charger - DC positive contactor is commanded OPEN.
- The battery charger - DC negative contactor is commanded OPEN.
- The difference between the sum of DC charger positive and negative voltage sensors and the battery voltage is less than 45 V for 2 s.
- DTC P3002, P3003, P3005, P3006, P301F, P3020, P3021, or P3022 is not set.

Conditions for Setting the DTC

The ratio between DC negative supply isolation voltage and DC positive supply isolation voltage is greater than 19.

Action Taken When the DTC Sets

DTC P302F is type A DTC.

Conditions for Clearing the DTC

DTC P302F is type A DTC.

Diagnostic Aids

- A single high voltage contactor stuck closed may set DTC P302F.

- Condensation or water intrusion into the battery charger - DC may cause DTC P302F to set.
- A vehicle-level loss of isolation concern may cause DTC P302F to set.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

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Plug-In Charging System Description and Operation

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE2, P0AE4, P0D0A, P0D11, P1EBC, P1EBE-P1EC0, P1EC3-P1EC5, P1AF0, P1AF4, P1AF5, P1E1B-P1E1F, P1E20-P1E22, P1B0B, P1B0C, P3002, P3003, P3005, P3006, P3015, P3018, P301B-P301F, P3020, P3021, or P3022 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
2. Remove all vehicle chargers.
3. Vehicle ON.
4. Observe the scan tool hybrid powertrain control module 2 DC Negative Supply Isolation Voltage parameter. The reading should be 0 V.
    - **If greater than 0 V**

      NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactors.**

      1. Vehicle OFF. Turn ON the park lamps.
      2. DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.

      NOTE: **There are two contactor control functions available on the scan tool. Make sure you select the DC charging contactor control and not the battery contactor control.**

      3. Command the Hybrid/EV Battery DC Charging Contactors ALL OPEN with a scan tool.

      NOTE: **Ignore P0ABC after pulling the S15 Manual Service Disconnect.**

4. Disconnect the S15 Manual Service Disconnect.
5. DO NOT use the scan tool Release Control button to turn OFF any of the contactors. Once the scan tool Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning including reinstalling the S15 Manual Service Disconnect and clearing DTCs.
6. Command the Hybrid/EV Battery DC Charging Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to open.

NOTE: **It is normal for the charging contactors to only make noise while opening.**

7. Verify the Hybrid/EV Battery DC Charging Positive Contactor is heard opening.
    - If the Hybrid/EV Battery DC Charging Positive Contactor operation cannot be heard, refer to Circuit/System Testing, Hybrid/EV Battery DC Charging Positive Contactor.
    - If the Hybrid/EV Battery DC Charging Positive Contactor operation is heard, refer to Circuit/System Testing, Hybrid/EV Battery DC Charging Negative Voltage Sensor.

- **If 0 V**

5. Observe the scan tool hybrid powertrain control module 2 DC Positive Supply Isolation Voltage parameter. The reading should be 0 V.
    - **If greater than 0 V**

    NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactors.**

    1. Vehicle OFF. Turn ON the park lamps.
    2. DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.

    NOTE: **There are two contactor control functions available on the scan tool. Make sure you select the DC charging contactor control and not the battery contactor control.**

    3. Command the Hybrid/EV Battery DC Charging Contactors ALL OPEN with a scan tool.

    NOTE: **Ignore P0ABC after pulling the S15 Manual Service Disconnect.**

    4. Disconnect the S15 Manual Service Disconnect.
    5. DO NOT use the scan tool Release Control button to turn OFF any of the contactors. Once the scan tool Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning including reinstalling the S15 Manual Service Disconnect and clearing DTCs.
    6. Command the Hybrid/EV Battery DC Charging Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to open.

    NOTE: **It is normal for the charging contactors to only make noise while opening.**

    7. Verify the Hybrid/EV Battery DC Charging Positive Contactor is heard opening.
        - If the Hybrid/EV Battery DC Charging Negative Contactor operation cannot be heard, refer to Circuit/System Testing, Hybrid/EV Battery DC Charging Negative Contactor.
        - If the Hybrid/EV Battery DC Charging Negative Contactor operation is heard, refer to Circuit/System Testing, Hybrid/EV Battery DC Charging Positive Voltage Sensor.

    - **If 0 V**

6. Refer to Circuit/System Testing, DC Charging System Isolation Fault.

Circuit/System Testing

Hybrid/EV Battery DC Charging Negative Voltage Sensor

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminal 9 and ground.

   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 8 and ground.
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the 5 V reference circuit terminal 8 X9 and ground.
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for infinite resistance between the 5 V reference circuit terminal 5 X2 and ground.
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   4. Test for less than 2 Ω in the 5 V reference circuit terminal 8 X9 end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If 5.2 V or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the 5 V reference circuit terminal 8 X9 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 1 V between the 5 V reference circuit terminal 5 X2 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If within the specified range**
5. Test for less than 1 V between the signal circuit terminal 11 X9 and ground.
   - **If 1 V or greater**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If between 1 - 5 V, repair the short to voltage on the circuit.
      - If greater than 5 V, repair the short to voltage on the circuit and replace the T24 Battery Charger - DC.
      - If less than 1 V
   3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
   4. Verify that DTC P3002, P3003, P301F, or P3020 does not set while operating the vehicle within the Conditions for Running the DTC.
      - If any of the DTCs are set, replace the T24 Battery Charger - DC.
      - If none of the DTCs are set
   5. All OK.
   - **If less than 1 V**
6. Vehicle OFF, install a 3 A fused jumper wire between the signal circuit terminal 11 and the 5 V reference circuit terminal 8. Vehicle in Service Mode.
7. Verify the scan tool DC Negative Supply Isolation Voltage parameter is greater than 500 V.
   - **If less than 500 V**

   1. Test for infinite resistance between the signal circuit and ground.
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   2. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If 500 V or greater**

8. Replace the T24 Battery Charger - DC.

Hybrid/EV Battery DC Charging Positive Voltage Sensor

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 min for all vehicle systems to power down. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminal 9 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 8 and ground.
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the 5 V reference circuit terminal 8 X9 and ground.
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for infinite resistance between the 5 V reference circuit terminal 5 X2 and ground.
      - If less infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   4. Test for less than 2 Ω in the 5 V reference circuit terminal 8 X9 end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If 5.2 V or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the 5 V reference circuit terminal 8 X9 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 1 V between the 5 V reference circuit terminal 5 X2 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If within the specified range**
5. Test for less than 1 V between the signal circuit terminal 10 X9 and ground.
   - **If 1 V or greater**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If between 1 - 5 V, repair the short to voltage on the circuit.

        - If greater than 5 V, repair the short to voltage on the circuit and replace the T24 Battery Charger - DC.
        - If less than 1 V
    3. Replace the K114B Hybrid/EV Powertrain Control Module 2.
    4. Verify that DTC P3002, P3003, P301F, or P3020 does not set while operating the vehicle within the Conditions for Running the DTC.
        - If any of the DTCs are set, replace the T24 Battery Charger - DC.
        - If none of the DTCs are set
    5. All OK.
    - **If less than 1 V**
6. Vehicle OFF, install a 3 A fused jumper wire between the signal circuit terminal 10 and the 5 V reference circuit terminal 8. Vehicle in Service Mode.
7. Verify the scan tool DC Positive Supply Isolation Voltage parameter is greater than 500 V.
    - **If less than 500 V**
    1. Test for infinite resistance between the signal circuit and ground.
        - If less infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    2. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If 500 V or greater**
8. Replace the T24 Battery Charger - DC.

Hybrid/EV Battery DC Charging Negative Contactor

1. Vehicle OFF. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground.
    - Terminal 1
    - Terminal 3
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect the X9 harness connector at the T24 Battery Charger - DC.

NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactor.**

4. Vehicle OFF, turn ON the park lamps.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.**

5. Command the Hybrid/EV Battery DC Charging Contactors ALL OPEN with a scan tool.

NOTE: **Ignore P0ABC after pulling the S15 Manual Service Disconnect.**

6. Disconnect the S15 Manual Service Disconnect. Disconnect the X9 harness connector at the T24 Battery Charger - DC. Connect a test lamp between the control circuit terminal 4 and ground.
7. Verify that the test lamp is OFF.
    - **If the test lamp is ON**

1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K114B Hybrid Powertrain Control Module 2.

- **If the test lamp is OFF**

NOTE: **DO NOT use the scan tool Release Control button to turn OFF the contactor. Once the scan tool Release Control button is pushed the setup steps will need to be restarted from the beginning.**

8. Command the Hybrid/EV Battery DC Charging Negative Contactor CLOSED and ALL OPEN with a scan tool. Verify that the test lamp turns ON and OFF.
    - **If the test lamp does not turn ON and OFF**
    1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2.
    2. Test for infinite resistance between control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid Powertrain Control Module 2.
    - **If the test lamp does turn ON and OFF**
9. Replace the T24 Battery Charger - DC.

Hybrid/EV Battery DC Charging Positive Contactor

1. Vehicle OFF. Disconnect the X9 harness connector at the T24 Battery Charger - DC.
2. Test for less than 10 Ω between the ground circuit terminals listed below and ground.
    - Terminal 1
    - Terminal 3
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect the X9 harness connector at the T24 Battery Charger - DC.

NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactor.**

4. Vehicle OFF, turn ON the park lamps.

NOTE: **DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.**

5. Command the Hybrid/EV Battery DC Charging Contactors ALL OPEN with a scan tool.

NOTE: **Ignore P0ABC after pulling the S15 Manual Service Disconnect.**

6. Disconnect the S15 Manual Service Disconnect. Disconnect the X9 harness connector at the T24 Battery Charger - DC. Connect a test lamp between the control circuit terminal 2 and ground.

NOTE: **DO NOT use the scan tool Release Control button to turn OFF the contactor. Once the scan tool Release Control button is pushed the setup steps will need**

to be restarted from the beginning.

7. Verify that the test lamp is OFF.
   - **If the test lamp is ON**
   1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp is OFF**
8. Command the Hybrid/EV Battery DC Charging Positive Contactor CLOSED and ALL OPEN with a scan tool.
9. Verify that the test lamp turns ON and OFF.
   - **If the test lamp does not turn ON and OFF**
   1. Vehicle OFF, turn OFF the park lamps. Remove the test lamp. Disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If the test lamp does turn ON and OFF**
10. Replace the T24 Battery Charger - DC.

DC Charging System Isolation Fault

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Perform the Circuit/System Verification steps of the Loss of Isolation on the High Voltage Main Bus procedure.
   - **If the Circuit/System Verification steps identify a vehicle-level loss of isolation concern**

Repair vehicle as applicable.

- **If the Circuit/System Verification steps do not identify a vehicle-level loss of isolation concern**

2. Vehicle OFF, disable the high voltage. Refer to High Voltage Disabling .

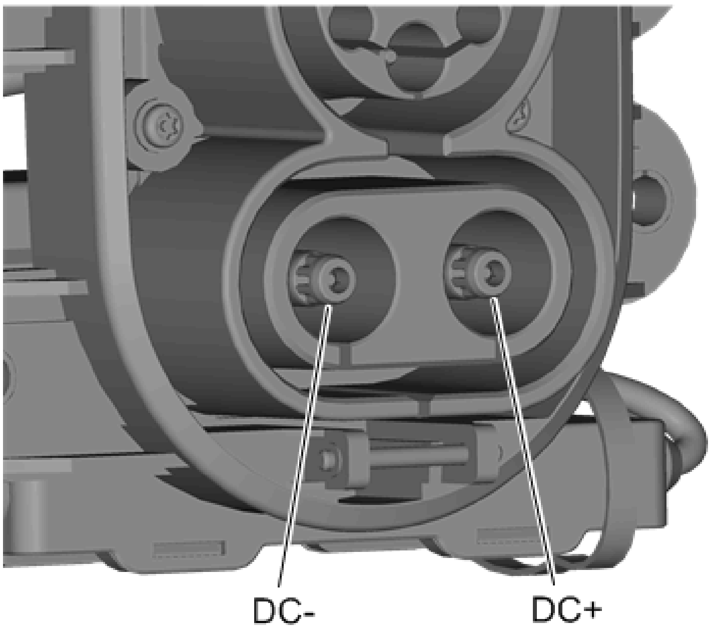


Fig. 13: Terminal DC- And DC+
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Only perform the following continuity tests using the EL-50772 Insulation Multimeter or equivalent.**

NOTE: **Unlike other HV components in the system, the DC charge terminals of the T24 Battery Charger - DC should not be tested at the 500 V range.**

3. Ensure only the **EL-50772** Insulation Multimeter or equivalent is used with this procedure. Select the Isolation Test setting, then select the 250 V range. Refer to Troubleshooting With an Insulation Multimeter for important usage instructions.

NOTE: **The following step assumes the X98 Hybrid/EV Battery Charger Receptacle high voltage DC cable is connected to the T24 Battery Charger - DC.**

4. Test for 15M Ω between the terminals listed below at the X98 Hybrid/EV Battery Charger Receptacle and chassis ground:
    - Terminal DC-
    - Terminal DC+
    - **If less than 15M Ω on either circuit**
    1. Disconnect the X2 harness connector at the T24 Battery Charger - DC.
    2. Select the Isolation Test setting, then change the voltage range from 250 V to the 500 V range.

    NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle.**

    3. Test for 550M Ω between the circuit terminals listed below and chassis ground:
        - Terminal DC-
        - Terminal DC+
        - If less than 550M Ω, replace the X98 Hybrid/EV Battery Charger Receptacle.
        - If 550M Ω replace the T24 Battery Charger - DC.
    - **If greater than 15M Ω on either circuit**

    Replace the T24 Battery Charger - DC and the X98 Hybrid/EV Battery Charger Receptacle.

- **If 15M Ω on both circuits**

5. Connect all disconnected components and connectors and enable high voltage.

NOTE: **It may be necessary to connect the vehicle to a DC Charge Station.**

6. Verify that DTC P302F does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If DTC P302F is set**

      Contact the GM Technical Assistance Center to report a DC Charge Station problem.

    - **If DTC P302F is not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)** for X98 Hybrid/EV Battery Charger Receptacle and harness replacement.
- **Control Module References** for the T24 battery charger - DC and hybrid/EV powertrain control module 2 replacement, programming and setup.

DTC P325C OR P325D: HYBRID/EV BATTERY DC CHARGING COMMUNICATION GATEWAY MODULE PROCESSOR PERFORMANCE

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P325C

Hybrid/EV Battery DC Charging Communication Gateway Module Processor Performance

DTC P325D

Hybrid/EV Battery DC Charging Communication Gateway Module Main Processor Performance

Circuit/System Description

This diagnostic runs when the vehicle is connected to a DC fast charge station. This is an internal fault detection of the power line communication module and no external circuits are involved.

Conditions for Running the DTC

Vehicle is connected to a DC fast charge station.

Conditions for Setting the DTC

The control module has detected an internal malfunction.

Actions Taken When the DTC Sets

DTC P325C or P325D is a type B DTC.

Conditions for Clearing the DTC

DTC P325C or P325D is a type B DTC.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Connect the vehicle to a DC fast charge station.
2. Verify DTC P325C or P325D is not set.
    - **If either of the DTCs are set**

      Replace the K190 Power Line Communication Module.

    - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Power Line Communication Module replacement, programming, and setup.

DTC P325F : HYBRID/EV BATTERY DC CHARGING COMMUNICATION GATEWAY MODULE - OFFBOARD DC CHARGER COMMUNICATION INTERRUPTED (NORTH AMERICA, KOREA)

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC P325F

Hybrid/EV Battery DC Charging Communication Gateway Module - Offboard DC Charger Communication Interrupted

Circuit/System Description

The hybrid/EV powertrain control module 2 monitors the control pilot signal from the DC fast station. When the hybrid/EV powertrain control module 2 detects a 5% duty cycle pulse width modulated (PWM) signal on the control pilot circuit, the hybrid/EV powertrain control module 2 commands the power line communication module to begin communication with the DC fast charge station.

The power line communication module communicates to the DC fast charge station using power line communication (PLC) over the control pilot circuit. The specific PLC technology used is HomePlug Green PHY to allow for digital communication over a single wire.

Conditions for Running the DTC

Vehicle is connected to a DC fast charge station and is charging.

Conditions for Setting the DTC

Communication between the power line communication module and the DC fast charge station is interrupted.

Actions Taken When the DTC Sets

DTC 325F is type C DTC.

Conditions for Clearing the DTC

DTC 325F is type C DTC.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Clear the DTC, connect the vehicle to a known good DC fast charge station.
2. Allow the vehicle to charge for at least 20 minutes.
3. Verify DTC P325F is set.
    - **If DTC P325F is not set**

      Contact the GM Technical Assistance Center to report a DC fast charge station problem.

    - **If DTC P325F is set**
4. Vehicle OFF, disable the high voltage at the T18 Battery Charger. Refer to High Voltage Disabling . Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Disconnect the X2 harness connector at the K190 Power Line Communication Module.

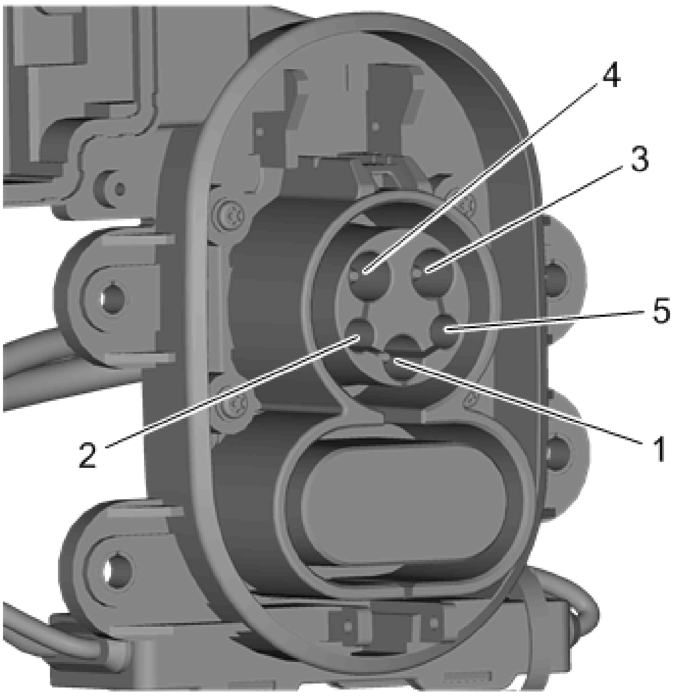


Fig. 14: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

5. Test for infinite resistance between the control pilot signal circuit terminal 2 of the X98 Hybrid/EV Battery Charger Receptacle and the terminals listed below:
    - Terminal 1

- Terminal 3
- Terminal 4
- Terminal 5
- DC+
- DC-
- **If less than infinite resistance**

1. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.

NOTE: **This test is performed on the vehicle side of the harness connector.**

2. Test for infinite resistance between the harness connector control pilot signal circuit terminal 2 and the terminals listed below:

- Terminal 4
- Terminal 1
- Terminal 5
- Terminal 3
- DC+
- DC-
  - If less than infinite resistance, repair the short between the circuits.
  - If infinite resistance, replace the X98 Hybrid/EV Battery Charger Receptacle.
- **If infinite resistance**

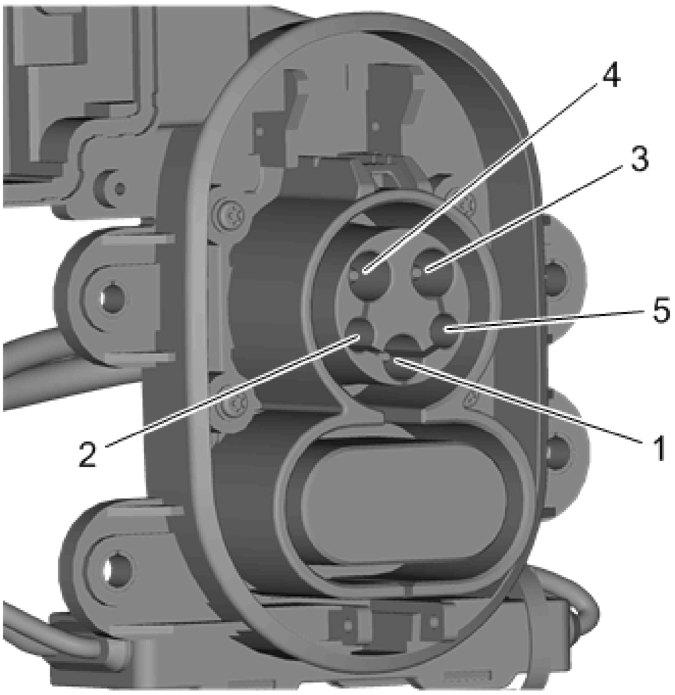


Fig. 15: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

6. Test for less than 2 Ω in the control pilot signal circuit end to end between the terminals listed below:
   - K190 Power Line Communication Module terminal 8 X2 and X98 Hybrid/EV Battery Charger Receptacle 2
   - K114B Hybrid/EV Powertrain Control Module 2 terminal 8 X2 and X98 Hybrid/EV Battery Charger Receptacle 2
   - **If 2 Ω or greater**

   1. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.

   NOTE: **This test is performed at the X98 Hybrid/EV Battery Charger Receptacle.**

   2. Test for less than 2 Ω in the control pilot signal circuit end to end.
      - If 2 Ω or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.

- If less than 2 Ω, repair the open/high resistance in the circuit.
- **If less than 2 Ω**

7. Replace the K190 Power Line Communication Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)**
- **Control Module References** for Power Line Communication Module replacement, programming and setup.

PLUG-IN CHARGING MALFUNCTION (AC CHARGING (NORTH AMERICA, KOREA))

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Pilot Signal	P0CF4, P0CF5, P0CF6, P0CF9, P0D01, 1	P0CF4, P0CF5, P0CF6, 1	P0CF4, P0CF5, P0CF6, P0CF9, 1	P0CF4, P0CF5, P0CF6, 1
Proximity Status Signal	P0D58, 1	P0D59, 1	P0D59, 1	-
Voltage AC Line 1	1	P0D3F, P1EE6	1	-
Voltage AC Neutral Line 2	1	P1EE6	1	-
Voltage AC Ground	-	P0D59, 1	1	-
1. Plug In Charging Malfunction				

Circuit/System Description

The drive motor battery charger cable allows the vehicle to be charged using a common household power outlet. The drive motor battery charger cable contains LEDs that indicate the status of the drive motor battery charger cable. The drive motor battery charger cable automatically prohibits voltage transfer to the hybrid/EV battery charger receptacle and the Fault Indicator is illuminated red if it senses internal faults or inadequate household voltage. If the drive motor battery charger cable senses no faults, the AC Present Indicator is illuminated solid green.

When the hybrid/EV powertrain control module 2 senses the drive motor battery charger cable is connected to the vehicle charge receptacle, it will communicate with the off-vehicle charge equipment to ensure compatibility and proper function. The hybrid/EV powertrain control module 2 will then indicate the status of charging events (including user-programmable delays) to the user via instrument panel mounted plug-in charging status indicator LEDs and audio tones.

Diagnostic Aids

- If the drive motor battery charger cable Fault Indicator is illuminated solid red or flashing red before plugging into the vehicle, the charger cable will need to be diagnosed first.
- Ensure delayed charging is not enabled. Delay charging can be programmed either in the vehicle or also in certain off-vehicle Charge Stations.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle ON, verify no DTCs are set.
    - **If DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
    - **If no DTCs are set**
2. Vehicle OFF. With the charge cord NOT connected to the vehicle battery charger receptacle, verify the vehicle plug-in charging status indicators are OFF.
    - **If the vehicle plug-in charging status indicators are not OFF with the charge cord disconnected from the vehicle**

      Refer to **Plug-In Charging Indicator Malfunction**.
    - **If the vehicle plug-in charging status indicators are OFF**
3. Vehicle OFF and connect the charge cord to the vehicle battery charger receptacle.
4. Verify the vehicle charge status indicator is operating properly.
    - **If the vehicle charge status indicator is solid yellow**

      Refer to Circuit/System Testing.
    - **If the vehicle charge status indicator is not illuminated**
    1. Vehicle ON.

       NOTE: **Vehicle must be ON and not in Service Mode for message operation.**
    2. Verify the Charge Cord Connected message is displayed in the instrument panel/message center.
        - If the Charge Cord Connected message is displayed, refer to **Plug-In Charging Indicator Malfunction**.
        - If the Charge Cord Connected message is NOT displayed
    3. Refer to Circuit/System Testing.
    - **If the vehicle charge indicator is operating properly**

NOTE: **The Charge History parameters record the conditions present during the last 5 charge events.**

5. Review the K114B Hybrid/EV Powertrain Control Module 2, Charge History Scan Tool Parameters. Inspect for any conditions that prohibited AC Charging.
    - **If an off-vehicle charge cord/station condition or delayed charging prohibited AC Charging**

      The vehicle is OK. Advise customer about delayed charging operation or charge cord/station condition.

    - **If an off-vehicle condition or delayed charging was not observed**
6. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Connect the customer's drive motor battery charger cable to household power outlet, but not the vehicle battery charger receptacle.
2. After 25 seconds, verify the drive motor battery charger cable AC Present Indicator illuminates solid green.
    - **If the drive motor battery charger cable AC Present Indicator does not illuminate solid green**
    1. Connect a known good drive motor battery charger cable to the same household power outlet.
    2. After 25 seconds, verify the known good drive motor battery charger cable AC Present Indicator illuminates solid green.
        - If the known good drive motor battery charger cable AC Present Indicator illuminates solid green, replace the customer's drive motor battery charger cable.
        - If the known good drive motor battery charger cable AC Present Indicator does not illuminate solid green, have the service provider inspect the household power outlet for insufficient voltage, high frequency noise, or open/high resistance.
    - **If the drive motor battery charger cable AC Present Indicator does illuminate solid green**

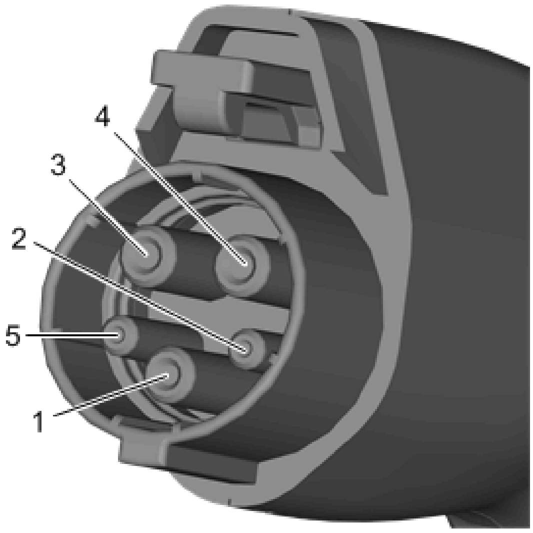


Fig. 16: Drive Motor Battery Charger Cable Terminals
Courtesy of GENERAL MOTORS COMPANY

3. Test for greater than 1 V between the low voltage circuits listed below on drive motor battery charger cable.
   - Control pilot signal circuit terminal 2
   - Proximity status signal circuit terminal 5
   - **If less than 1 V**

     Replace drive motor battery charger cable.
   - **If greater than 1 V**

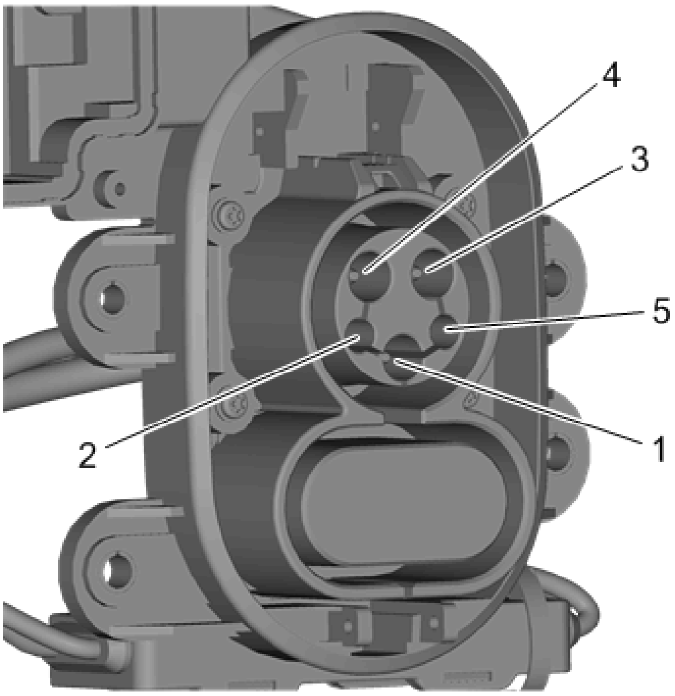


Fig. 17: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

NOTE: **When measuring resistance observe proper meter polarity by connecting the common/ground meter probe to ground/vehicle chassis.**

NOTE: **You must measure with a high-impedance Digital Multimeter (DMM) such as the EL-39200 or equivalent.**

4. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Test for 100k Ω - 4M Ω between the control pilot signal terminal 2 at the X98 Hybrid/EV Battery Charger Receptacle and ground.
   - **If 4M Ω greater**
   1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2
   2. Test for 2 Ω in the control pilot signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 100k Ω**
   1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2
   2. Test for infinite resistance between the control pilot signal circuit and ground.
      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If within the specified range**
5. Test for less than 10 Ω between the Voltage AC Ground terminal 1 at the X98 Hybrid/EV Battery Charger Receptacle and ground.
   - **If 10 Ω or greater**

   NOTE: **G108 is located behind the front fender.**

   1. Disconnect the G108 ring terminal. Refer to Ground Nut removal in **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)**.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.
      - If less than 2 Ω, clean and reinstall the G108 ring terminal and ground nut.
   - **If less than 10 Ω**
6. Vehicle in Service Mode.
7. Test for less than 1 V between the control pilot signal terminal 2 at the X98 Hybrid/EV Battery Charger Receptacle and ground.
   - **If 1 V or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
   2. Test for less than 1 V between the control pilot signal circuit and ground.
      - If greater than 1 V, repair the short to voltage in the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 1 V**

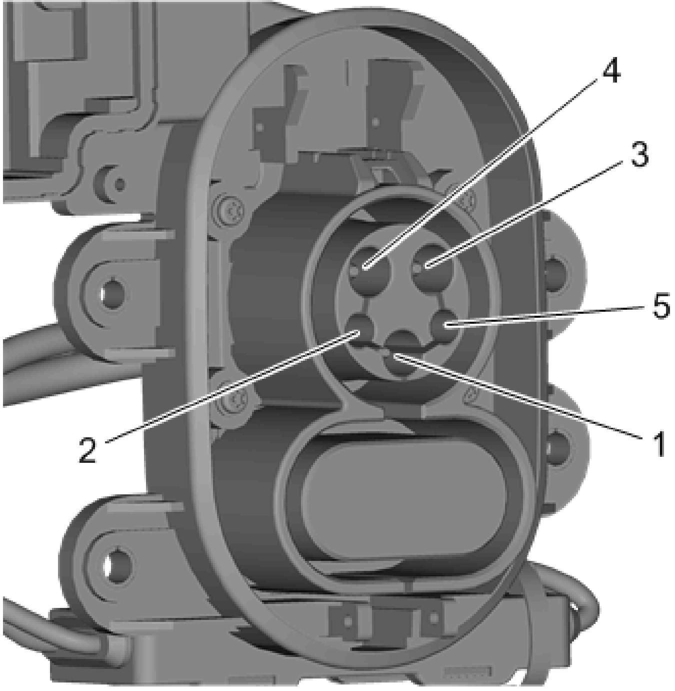


Fig. 18: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

8. Test for 4.2 - 4.8 V between the signal circuit terminal 5 and ground.
   - **If less than 4.2 V**
   1. Vehicle OFF, disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

      NOTE: **The following tests are performed at the vehicle harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

   2. Test for 4.8 V or greater between the signal circuit terminal 5 and ground.
      - If less than 4.8 V
      1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Test for infinite resistance between the signal circuit terminal 5 and ground.
         - If less than infinite resistance, repair the short to ground in the circuit.
         - If infinite resistance
      3. Test for less than 2 Ω in the signal circuit end to end.
         - If 2 Ω or greater, repair the open/high resistance in the circuit.
         - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
      - If 4.8 V or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.
   - **If greater than 4.8 V**
   1. Vehicle OFF, disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

      NOTE: **The following tests are performed at the vehicle harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

   2. Test for 4.8 - 5.2 V between the signal circuit terminal 5 and ground.
      - If greater than 5.2 V
      1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
      2. Vehicle in Service Mode. Test for less than 1 V between the signal circuit terminal 5 and ground.
         - If 1 V or greater, repair the short to voltage in the circuit.
         - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
      - If within 4.8 - 5.2 V

    3. Test for 2.565 - 2.835K Ω between the signal circuit terminal 5 and the low reference circuit terminal 1 at the face of the X98 Hybrid/EV Battery Charger Receptacle.
        - If not within the specified range, replace the X98 Hybrid/EV Battery Charger Receptacle.
        - If within the specified range, replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If within 4.2 - 4.8 V**

9. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Disconnect the X2 harness connector at the T18 Battery Charger, the X2 connector at the K114B Hybrid/EV Powertrain Control Module 2 and the X2 connector at the K190 Power Line Communication Module.

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

10. Test for infinite resistance between the terminals listed below at the X98 Hybrid/EV Battery Charger Receptacle:
    - Voltage AC Line 1 terminal 3 and Voltage AC Neutral Line 2 terminal 4
    - Voltage AC Line 1 terminal 3 and Voltage AC Ground terminal 1
    - Voltage AC Line 1 terminal 3 and Control pilot signal circuit terminal 2
    - Voltage AC Line 1 terminal 3 and Proximity status signal circuit terminal 5
    - Voltage AC Neutral Line 2 terminal 4 and Voltage AC Ground terminal 1
    - Voltage AC Neutral Line 2 terminal 4 and Control pilot signal circuit terminal 2
    - Voltage AC Neutral Line 2 terminal 4 and Proximity status signal circuit terminal 5
    - Voltage AC Ground terminal 1 and Control pilot signal circuit terminal 2
    - Control pilot signal circuit terminal 2 and Proximity status signal circuit terminal 5
    - **If less than infinite resistance**

      Repair the short between the circuits.

    - **If infinite resistance**

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

11. Test for less than 10 Ω between the terminals listed below:
    - Voltage AC Line 1 terminal 3 at the X98 Hybrid/EV Battery Charger Receptacle and T18 Battery Charger terminal 1 X2
    - Voltage AC Neutral Line 2 terminal 4 at the X98 Hybrid/EV Battery Charger Receptacle and T18 Battery Charger terminal 4 X2
    - **If 10 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 10 Ω**
    - **If infinite resistance**
12. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.
13. Test for 2.56 - 2.84k Ω between the Voltage AC Ground terminal 1 and Proximity status signal circuit terminal 5 at the face of the X98 Hybrid/EV Battery Charger Receptacle.
    - **If not within the specified range**

      Replace the X98 Hybrid/EV Battery Charger Receptacle.

    - **If within the specified range**

NOTE: **This test is performed on the vehicle side of the harness connector.**

14. Test for infinite resistance between the Proximity status signal circuit terminal 5 of the harness connector and ground.

- **If less than infinite resistance**

  Repair short to ground on the circuit.

- **If infinite resistance**

15. Replace and program the K114B Hybrid/EV Powertrain Control Module 2.
16. Repeat Circuit/System Verification and confirm vehicle is All OK.
    - **If Circuit/System Verification was not All OK**

      Replace the T18 Battery Charger.

    - **If Circuit/System Verification was All OK**
17. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only with quick charge)Drive Motor Battery Charger Receptacle Replacement (Dubai only without quick charge)**
- **Control Module References** for T18 battery charger or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

PLUG-IN CHARGING MALFUNCTION (DC CHARGING (NORTH AMERICA, KOREA))

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control Pilot Signal	P0CF4, P0CF5, P0CF6, P0CF9, P0D01, 1	P0CF4, P0CF5, P0CF6, 1	P0CF4, P0CF5, P0CF6, P0CF9, 1	P0CF4, P0CF5, P0CF6, 1
Proximity Status Signal	P0D58, 1	P0D59, 1	P0D59, 1	-
DC Negative Contactor	P3022, 1	P3015, P3020, 1	P3015, P301C, P1FF4**, 1	-
DC Positive Contactor	P0AA1*, P0AA4*, 1	P3018, 1	P3018, P301D, P1FF4**, 1	-
High Voltage DC+	1	1	1	-
High Voltage DC-	1	1	1	-
1. Plug In Charging Malfunction * DTCs set with Pass/Fail Status ** DTC set if 120/240 volt cordset is used				

Circuit/System Description

A direct current (DC) fast charge drive motor battery charger cable allows vehicles equipped with RPO CBT to be charged using a 480 V offboard DC charger. The hybrid/EV powertrain control module 2 and power line communication module automatically prohibit voltage transfer to the hybrid/EV battery charger receptacle if an internal fault or inadequate voltage is detected. If no faults are detected, voltage transfer to the hybrid/EV battery charger receptacle occurs.

Diagnostic Aids

- Most DC fast charge concerns, especially those without an accompanying DTC set, are the result of off-vehicle charge station or electrical infrastructure issues. Always verify a DC Fast charge concern by connecting to a known good charge station.
- Some off-vehicle DC Charge Stations allow for multiple vehicle connection and authorization yet they will only charge one vehicle at a time.
- DC charging requires positive locking of the charge cord to the vehicle charge receptacle. Ensure the customer is inserting the charge cord into the charge receptacle completely. Ease of insertion and locking may vary among DC Charge Stations.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-48900 HEV Safety Kit

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle in Service Mode, verify no additional DTCs are set in other control modules.
    - **If additional DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no additional DTCs are set**

NOTE: **Certain DTCs inhibit DC Charging, clearing the DTC alone will not clear the inhibit condition.**

2. Verify DTCs that disable DC Charging were not recently cleared.
    - **If DTCs were cleared**

      Perform the **DC Charging Disabled Reset**.

    - **If DTCs were not cleared or the DC Charging Disable Reset had been performed**

NOTE: **Loss of 12V or programming of the module will inhibit DC Charging.**

3. Verify that a low/no 12V condition was not present at the K114B Hybrid/EV Powertrain Control Module or that the module was not recently programmed.
    - **If the specified conditions occurred**

      The vehicle must be driven at a speed greater than 30 km/h (19 mph) to re-enable DC Charging.

    - **If the specified conditions had not occurred or the vehicle had been driven**
4. Connect a 120/220V AC charge cord and verify the vehicle will AC charge.
    - **If the vehicle will not AC Charge**

      Refer to the AC Charging document Plug-In Charging Malfunction (AC Charging (North America, Korea))Plug-In Charging Malfunction (DC Charging (North America, Korea)).

    - **If the vehicle will AC Charge**

NOTE: **The DC Charge History parameters record the conditions present during the last 5 charge events.**

5. Review the K114B Hybrid/EV Powertrain Control Module 2, DC Charge History Scan Tool Parameters (w/CBT). Inspect for any conditions that prohibited DC Charging.
    - **If an off-vehicle charge station condition prohibited DC Charging**

      The vehicle is OK. Contact the GM Technical Assistance Center to report a DC Charge Station problem.

    - **If an off-vehicle condition was not observed**

NOTE: **Review diagnostic aids.**

6. Verify with the customer whether the off-vehicle DC Charge Station had multiple charge cords, or they had difficulty in connecting the charge cord to the receptacle.
    - **If any of the conditions were observed**

      The vehicle is OK. Contact the GM Technical Assistance Center to report a DC Charge Station problem.

    - **If the conditions were not observed**

NOTE: **The following setup steps MUST BE PERFORMED EXACTLY in order to exercise the contactors.**

7. Vehicle OFF. Turn ON the park lamps.

NOTE:

- **DO NOT press the power button and enter Vehicle in Service Mode or Vehicle ON.**
- **Ignore P0ABC after pulling the S15 Manual Service Disconnect.**

NOTE: **There are two contactor control functions available on the scan tool from the Hybrid/EV Powertrain Control Module 2. Make sure you select the DC charging contactor control and not the battery contactor control.**

8. Command the Hybrid/EV DC Charging Contactors ALL OPEN with a scan tool.
9. Disconnect the S15 Manual Service Disconnect.

NOTE:

- **DO NOT use the Release Control button to turn OFF any of the contactors. Once the Release Control button is pushed the Circuit/System Verification will need to be restarted from the beginning including reinstalling the S15 Manual Service Disconnect and clearing DTCs.**
- **The following steps can be performed in any sequence or a single contactor can be exercised to verify a complaint.**

10. Command the Hybrid/EV Battery DC Charging Negative Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.

NOTE: **It is normal for the charging contactors to only make noise while opening.**

11. Verify the Hybrid/EV Battery DC Charging Negative Contactor is heard closing and opening.
    - **If the Hybrid/EV Battery DC Charging Negative Contactor does not open and close**

      Refer to Circuit/System Testing.

    - **If the Hybrid/EV Battery DC Charging Negative Contactor does open and close**
12. Command the Hybrid/EV Battery DC Charging Positive Contactor CLOSED and ALL OPEN with a scan tool while listening for the contactor to close and open.
13. Verify the Hybrid/EV Battery DC Charging Positive Contactor is heard closing and opening.
    - **If the Hybrid/EV Battery DC Charging Positive Contactor does not open and close**

      Refer to Circuit/System Testing.

    - **If the Hybrid/EV Battery DC Charging Positive Contactor does open and close**

NOTE: **It is normal for the Hybrid/EV Battery DC Negative Contactor to be slightly quieter than the positive contactor.**

14. Repeat opening and closing of both DC Charging contactors several times while comparing the sound made by each contactor.
    - **If either contactor intermittently stops working**

      Replace the T24 Battery Charger - DC.

    - **If both contactors consistently generate sound**
15. Connect to a known good DC Charge Station. Verify vehicle will fast charge and no DTCs are set.
    - **If the vehicle will not fast charge and DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If the vehicle will not fast charge and no DTCs are set**

      Refer to Circuit/System Testing.

    - **If the vehicle will fast charge**
16. All OK.

Circuit/System Testing

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**

- **Visually and functionally inspect the gloves before use.**
- **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

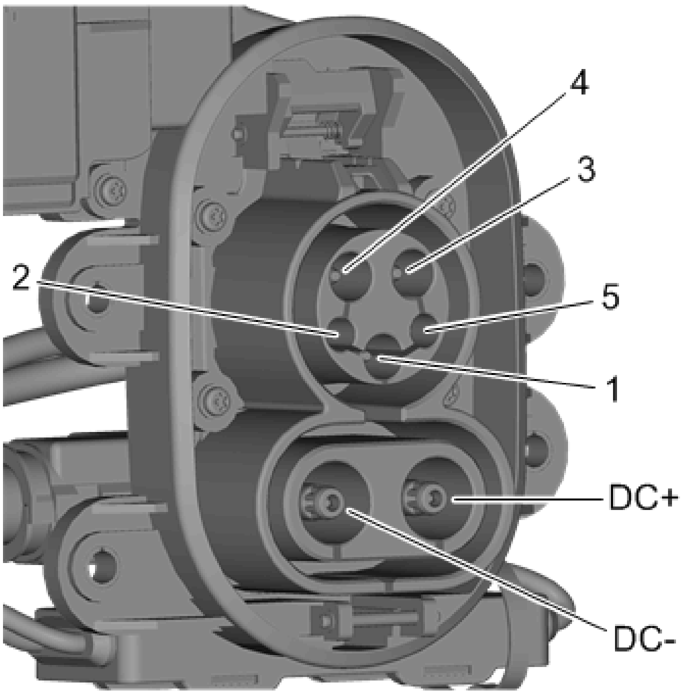


Fig. 19: X98 Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle face and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

NOTE: **When measuring resistance observe proper meter polarity by connecting the common/ground meter probe to ground/vehicle chassis.**

NOTE: **You must measure with a high-impedance Digital Multimeter (DMM) such as the EL-39200 or equivalent.**

1. Vehicle OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down. Test for 100k - 4M Ω between the control pilot signal terminal 2 at the X98 Hybrid/EV Battery Charger Receptacle and ground.
    - **If 4M Ω or greater**
    1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2
    2. Test for 2 Ω in the control pilot signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If less than 100k Ω**
    1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control pilot signal circuit and ground.
        - If infinite resistance, replace the K114B Hybrid/EV Powertrain Control Module 2.
        - If less than infinite resistance
    3. Vehicle OFF, disconnect the X9 harness connector at the T24 Battery Charger - DC.
    4. Test for infinite resistance between the control pilot signal circuit and ground.
        - If less than infinite resistance, repair the short to ground in the circuit.
        - If infinite resistance, replace the T24 Battery Charger - DC.
    - **If within the specified range**

2. Test for less than 10 Ω between the Voltage AC Ground terminal 1 at the X98 Hybrid/EV Battery Charger Receptacle and ground.
    - **If 10 Ω or greater**

      NOTE: G108 is located behind the front fender.

    1. Disconnect the G108 ring terminal. Refer to Ground Nut removal in Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge).
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.
        - If less than 2 Ω, clean and reinstall the G108 ring terminal and ground nut.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for less than 1 V between the control pilot signal terminal 2 at the X98 Hybrid/EV Battery Charger Receptacle and ground.
    - **If 1 V or greater**
    1. Vehicle OFF, disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2. Vehicle in Service Mode.
    2. Test for less than 1 V between the control pilot signal circuit and ground.
        - If greater than 1 V, repair the short to voltage in the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
        - If greater than 1 V
    3. Vehicle OFF, disconnect the X9 harness connector at the T24 Battery Charger - DC. Vehicle in Service Mode.
    4. Test for less than 1 V between the control pilot signal circuit and ground.
        - If greater than 1 V, repair the short to voltage in the circuit.
        - If less than 1 V, replace the T24 Battery Charger - DC.
    - **If less than 1 V**

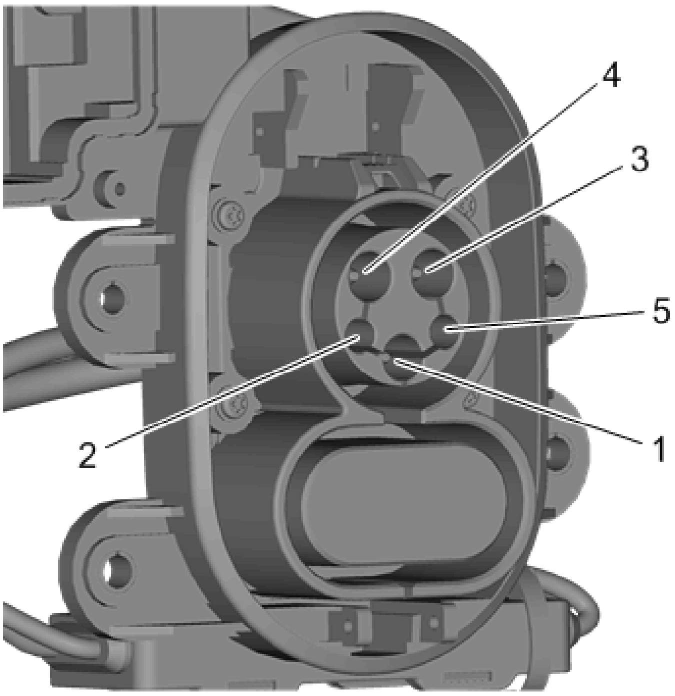


Fig. 20: Hybrid/EV Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

5. Test for 4.2 - 4.8 V between the signal circuit terminal 5 and ground.
    - **If less than 4.2 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

NOTE: **The following tests are performed at the vehicle harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

    2. Test for 4.8 V or greater between the signal circuit terminal 5 and ground.
        - If less than 4.8 V
        1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
        2. Test for infinite resistance between the signal circuit terminal 5 and ground.
            - If less than infinite resistance, repair the short to ground in the circuit.
            - If infinite resistance
        3. Test for less than 2 Ω in the signal circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
        - If 4.8 V or greater, replace the X98 Hybrid/EV Battery Charger Receptacle.
    - **If greater than 4.8 V**
    1. Vehicle OFF, disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle. Vehicle in Service Mode.

NOTE: **The following tests are performed at the vehicle harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

    2. Test for 4.8 - 5.2 V between the signal circuit terminal 5 and ground.
        - If greater than 5.2 V
        1. Vehicle OFF. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
        2. Vehicle in Service Mode. Test for less than 1 V between the signal circuit terminal 5 and ground.
            - If 1 V or greater, repair the short to voltage in the circuit.
            - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
        - If within 4.8 - 5.2 V
    3. Test for 2.565 - 2.835K Ω between the signal circuit terminal 5 and the low reference circuit terminal 1.
        - If not within the specified range, replace the X98 Hybrid/EV Battery Charger Receptacle.
        - If within the specified range, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If within 4.2 - 4.8 V**

6. Disable the high voltage for servicing at the T24 Battery Charger. Refer to High Voltage Disabling . Disconnect the X2 harness connector at the T24 Battery Charger DC.

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle face and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

7. Test for infinite resistance between the terminals listed below at the X98 Hybrid/EV Battery Charger Receptacle:
    - High Voltage DC Positive terminal DC+ and High Voltage DC Negative terminal DC-
    - Control pilot signal circuit terminal 2 and Proximity status signal circuit terminal 5
    - **If less than infinite resistance**

      Replace the X98 Hybrid/EV Battery Charger Receptacle.

    - **If infinite resistance**
8. Test for less than 10 Ω between the terminals listed below:
    - High Voltage DC Positive terminal DC+ at the X98 Hybrid/EV Battery Charger Receptacle and terminal A X2
    - High Voltage DC Negative terminal DC- at the X98 Hybrid/EV Battery Charger Receptacle and terminal B X2
    - **If 10 Ω or greater**

Replace the X98 Hybrid/EV Battery Charger Receptacle.

- **If less than 10 Ω**

9. Disconnect the X1 harness connector at the X98 Hybrid/EV Battery Charger Receptacle.

NOTE: **The following tests are performed at the X98 Hybrid/EV Battery Charger Receptacle face and not at the harness connector to the X98 Hybrid/EV Battery Charger Receptacle.**

10. Test for 2.56 - 2.84k Ω between the Voltage AC Ground terminal 1 and Proximity status signal circuit terminal 5 at the X98 Hybrid/EV Battery Charger Receptacle.
    - **If not within the specified range**

      Replace the X98 Hybrid/EV Battery Charger Receptacle.

    - **If within the specified range**
11. Replace the T24 Battery Charger - DC.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Drive Motor Battery Charger Receptacle Replacement (Except Dubai with quick charge)Drive Motor Battery Charger Receptacle Replacement (Except Dubai without quick charge)
- Control Module References for T24 battery charger - DC or K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

PLUG-IN CHARGING INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: Diagnostic System Check - Vehicle
- Review the description of Strategy Based Diagnosis: Strategy Based Diagnosis
- An overview of each diagnostic category can be found here: Diagnostic Procedure Instructions

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Charge Pilot Indicator Control	P0D2B	P0D2B	P0D2B	-
Charge Status Indicator Control	P0D2C	P0D2C, 1	P0D2C	-
Charge Complete Indicator Control	1	1	1	-
Low Reference	-	P0D2C, P0D2B	-	-
1. Plug In Charging Indicator Malfunction				

Circuit/System Description

The status of charging events (including delays) is communicated to the user through a vehicle plug-in charge status indicator and audio tones. The vehicle plug-in charge status indicator, located on the top middle of the instrument panel, contains a green LED (charge status indicator) and yellow LED (charge pilot indicator) controlled by the Hybrid Powertrain Control Module 2 and a second green LED (charge complete indicator) controlled by the BCM. The indicator will have a short flash green when the vehicle is charging under automatic control. The flash rate increases from one to four as the battery charges. It will have a long flash green if the charging is delayed and will begin later. It will be illumined solid green when charging is complete. A solid lit yellow indicator means the vehicle is not able to accept a charge.

Reference Information

Schematic Reference

Plug-In Charging Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Plug-In Charging System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC U135B is not set.
    - **If DTC U135B is set**

      Refer to **DTC U1340-U135F** .

    - **If DTC U135B is not set**
3. Verify no other hybrid/EV battery-related DTCs are set.
    - **If any hybrid/EV battery-related DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

    - **If no hybrid/EV battery-related DTCs are set**
4. Vehicle OFF. Ensure the charge cord is not connected to the vehicle.
5. Verify the vehicle charge indicator is OFF.
    - **If the vehicle charge indicator is not OFF**

      Refer to Circuit/System Testing.

    - **If the vehicle charge indicator is OFF**
6. Connect the charge cord.
7. Verify the vehicle charge indicator is operating properly.
    - **If the vehicle charge indicator is solid yellow**

      Refer to **Plug-In Charging Malfunction (AC Charging (North America, Korea))Plug-In Charging Malfunction (DC Charging (North America, Korea))**

    - **If the vehicle charge indicator is OFF**

    1. Vehicle ON.

       NOTE: **Vehicle must be ON and not in Service Mode for message operation.**

    2. Verify the Charge Cord Connected message is displayed in the instrument panel/message center.
        - If the Charge Cord Connected message is displayed, refer to Circuit/System Testing.
        - If the Charge Cord Connected message is NOT displayed

    3. Refer to **Plug-In Charging Malfunction (AC Charging (North America, Korea))Plug-In Charging Malfunction (DC Charging (North America, Korea))**.
  - **If the vehicle charge indicator is operating properly**

8. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the harness connector at the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.
2. Test for less than 10 Ω between the low reference terminal 1 and ground.
    - **If 10 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 10 Ω**

NOTE: **If the drive motor battery charger cable is connected. The drive motor battery charger cable must be disconnected for more than 10 s before performing the next step.**

3. Connect a test lamp between the yellow LED control circuit terminal 4 and ground.
4. Verify the test lamp does not illuminate.
    - **If the test lamp illuminates**
    1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp does not illuminate**
5. Connect the drive motor battery charger cable.
6. Verify that the test lamp illuminates or flashes in the first 5 s of connecting the drive motor battery charger cable.
    - **If the test lamp does not illuminate**
    1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit and ground
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
7. Disconnect the drive motor battery charger cable for at least 10 s. Connect a test lamp between the green LED control circuit terminal 3 and ground.
8. Verify test lamp does not illuminate.
    - **If the test lamp illuminates**
    1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage in the circuit.
        - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp does not illuminate**
9. Connect the drive motor battery charger cable.
10. Verify that the test lamp illuminates or flashes within 25 s of connecting the drive motor battery charger cable.
    - **If the test lamp does not illuminate**
    1. Disconnect the X2 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
    2. Test for infinite resistance between the control circuit and ground.

        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
    - **If the test lamp illuminates**
11. Replace the B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Sun Load, Ambient Light, and Charge Indicator Sensor Replacement** for B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator replacement.
- **Control Module References** for K114B hybrid/EV powertrain control module 2 replacement, programming and setup.

REPAIR INSTRUCTIONS

CHARGE PORT DOOR REPLACEMENT (EXCEPT DUBAI)

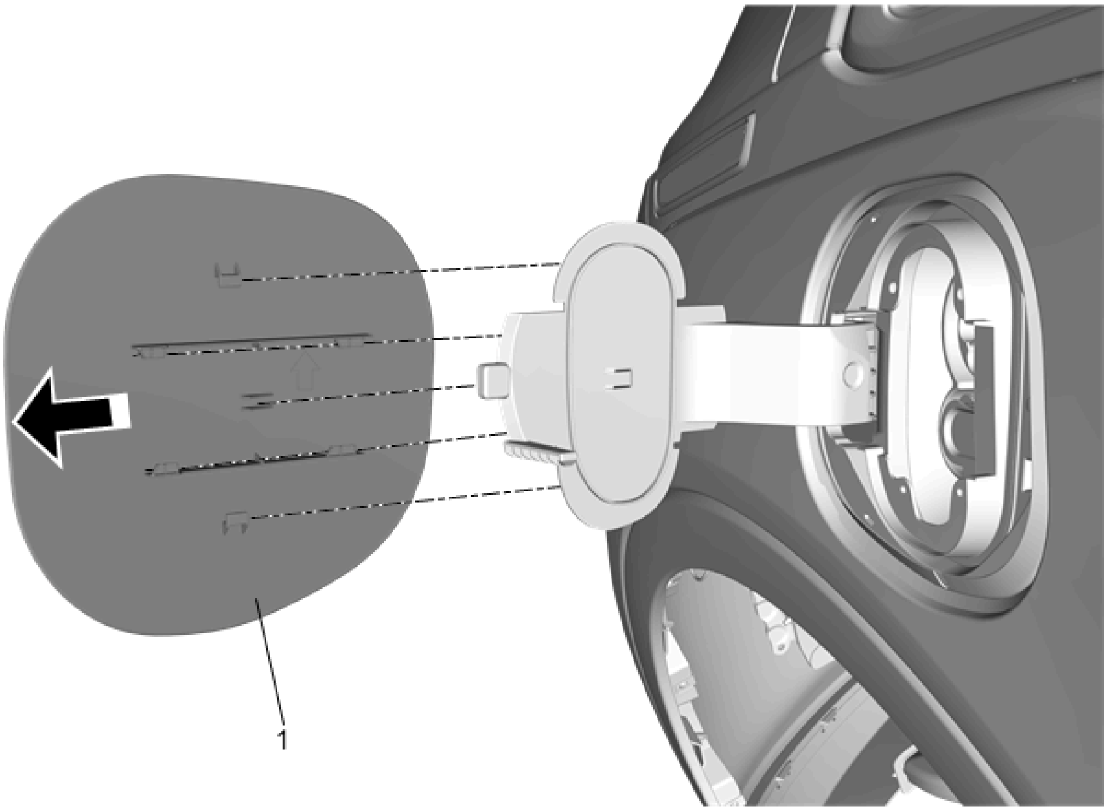


Fig. 21: Charge Port Door
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.
The High Voltage Disabling procedure includes the following steps:
• Identify how to disable high voltage.
• Identify how to test for the presence of high voltage.
• Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
• Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
• Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
  • Visually and functionally inspect the gloves before use.
  • Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.
Failure to follow the procedures may result in serious injury or death.
Preliminary Procedure
1. Open the charge port door.</td></tr>
<tr><td>1</td><td>Charge Port Door
Procedure
1. Using a flat-bladed driver, lift slightly upward on the tab at the center of the hinge in order to release the door from the hinge assembly.
2. Slide the door outward, away from the hinge and remove.</td></tr>
</table>

CHARGE PORT DOOR REPLACEMENT (DUBAI)

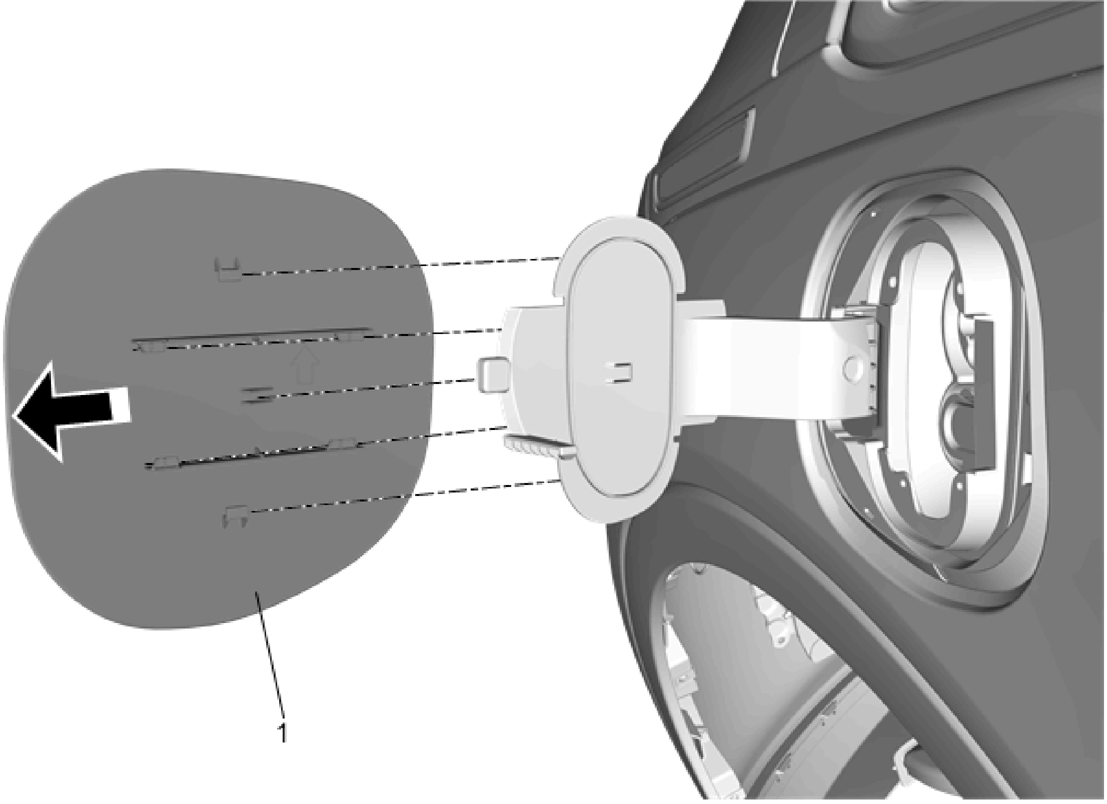


Fig. 22: Charge Port Door
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.** **The High Voltage Disabling procedure will perform the following tasks:** • **Identify how to disable high voltage.** • **Identify how to test for the presence of high voltage.** • **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.** **Failure to follow the procedures exactly as written may result in serious injury or death.** **Preliminary Procedure** 1. Open the charge port door.	
1	Charge Port Door **Procedure** 1. Using a flat-bladed driver, lift slightly upward on the tab at the center of the hinge in order to release the door from the hinge assembly. 2. Slide the door outward, away from the hinge and remove.

CHARGE PORT HOUSING REPLACEMENT (EXCEPT DUBAI)

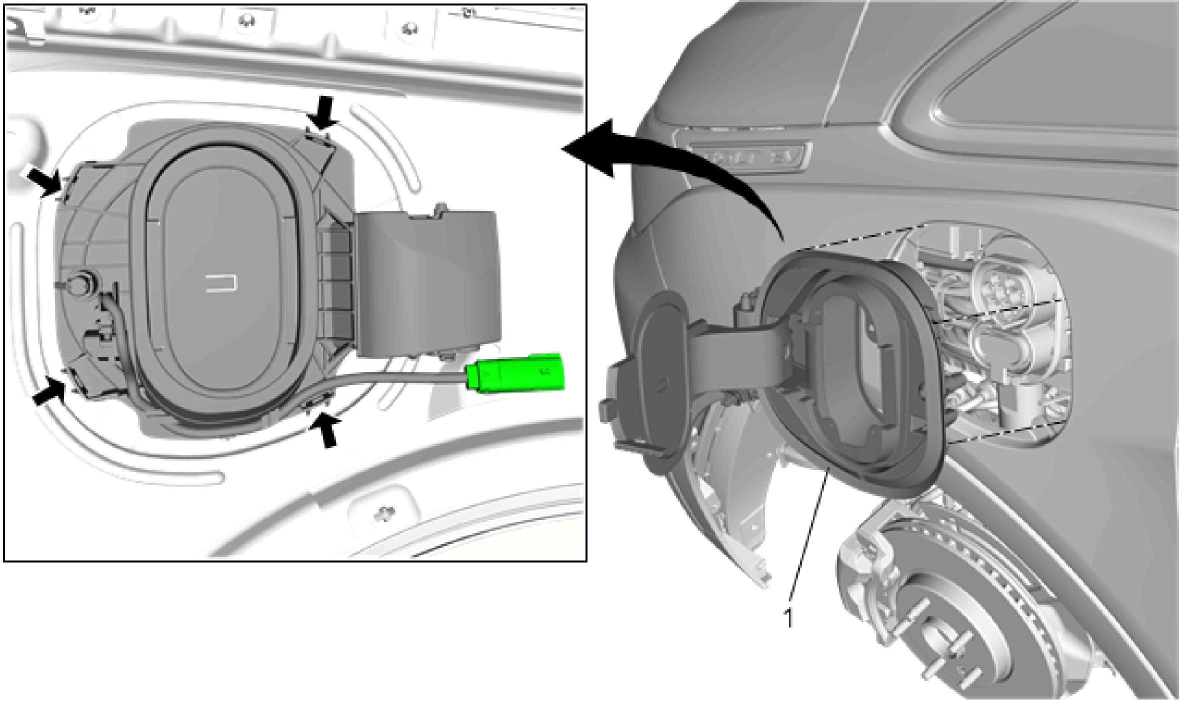


Fig. 23: Charge Port Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

Preliminary Procedures

1. Disable the high voltage system. High Voltage Disabling .
2. Remove Front Wheelhouse Liner&ndash;Left Side Front Wheelhouse Liner Replacement .
3. Charge Port Door Replacement (Except Dubai)Charge Port Door Replacement (Dubai).

Callout	Component Name
1	Charge Port Housing **Procedure** 1. Disconnect and unclip the electrical connector. 2. Using a plastic trim-type stick, release the tabs to the charge port housing assembly from inside the fender. 3. Push outward on the assembly housing. 4. Enable the high voltage system. **High Voltage Enabling** .

CHARGE PORT HOUSING REPLACEMENT (DUBAI)

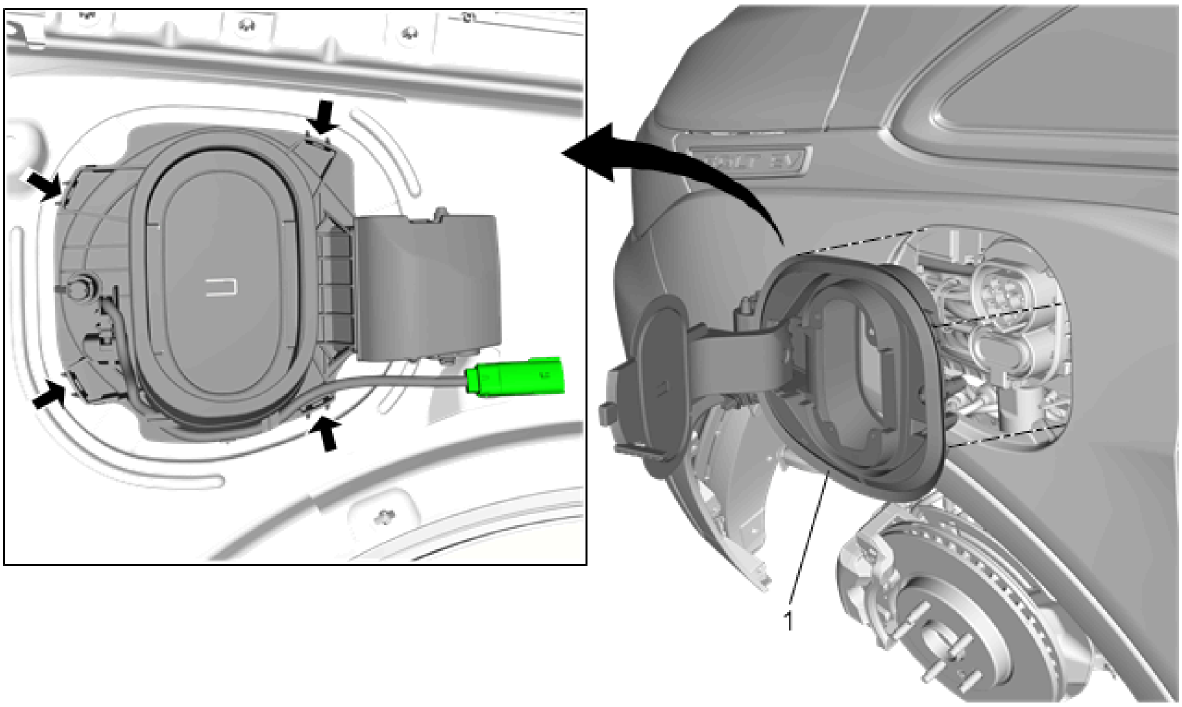


Fig. 24: Charge Port Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.** **The High Voltage Disabling procedure will perform the following tasks:** - **Identify how to disable high voltage.** - **Identify how to test for the presence of high voltage.** - **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.** **Failure to follow the procedures exactly as written may result in serious injury or death.** **Preliminary Procedures** 1. Disable the high voltage system. **High Voltage Disabling** . 2. Remove Front Wheelhouse Liner&ndash;Left Side **Front Wheelhouse Liner Replacement** . 3. **Charge Port Door Replacement (Dubai)**.	

Callout	Component Name
1	Charge Port Housing **Procedure** 1. Disconnect and unclip the electrical connector. 2. Using a plastic trim-type stick, release the tabs to the charge port housing assembly from inside the fender. 3. Push outward on the assembly housing. 4. Enable the high voltage system. **High Voltage Enabling** .

CHARGE PORT DOOR AJAR INDICATOR SWITCH REPLACEMENT (EXCEPT DUBAI)

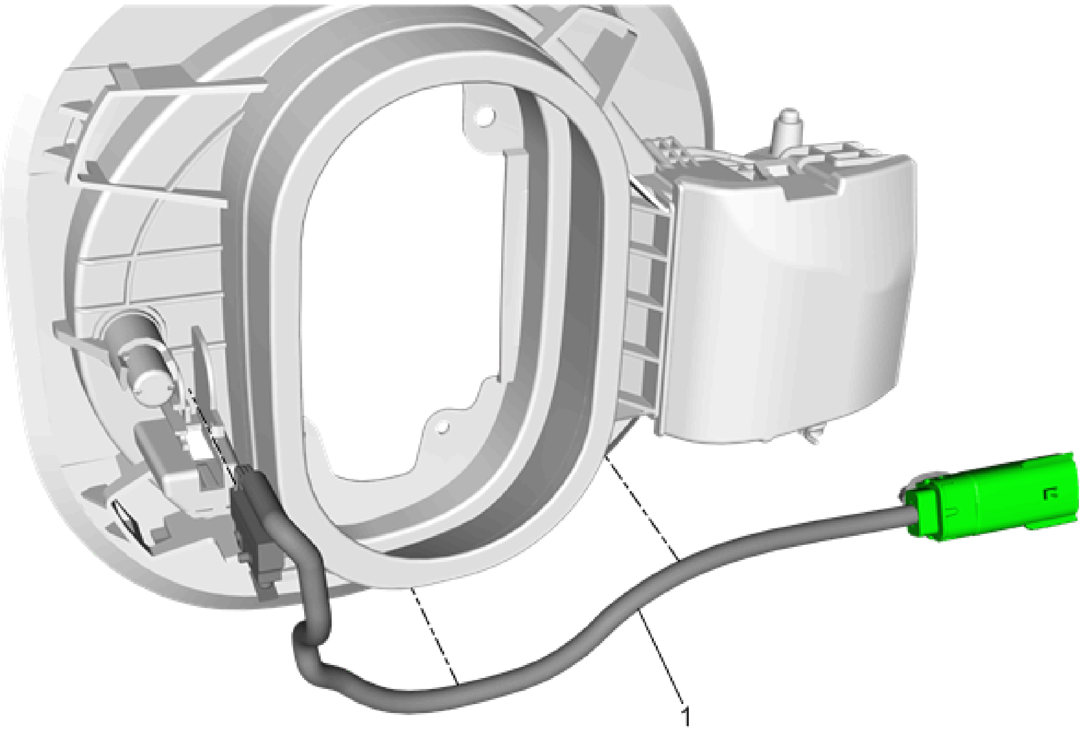


Fig. 25: Charge Port Door Ajar Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name

WARNING:
Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.
The High Voltage Disabling procedure includes the following steps:
- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**
Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:
- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**
Failure to follow the procedures may result in serious injury or death.
Preliminary Procedures
1. Disable the high voltage system. High Voltage Disabling
2. Charge Port Housing Replacement (Dubai)	

1	Charge Port Door Ajar Switch **Procedure** 1. Release the charge port door ajar indicator switch and connector from the charge port housing cavity. 2. Enable the high voltage system. High Voltage Enabling

CHARGE PORT DOOR AJAR INDICATOR SWITCH REPLACEMENT (DUBAI)

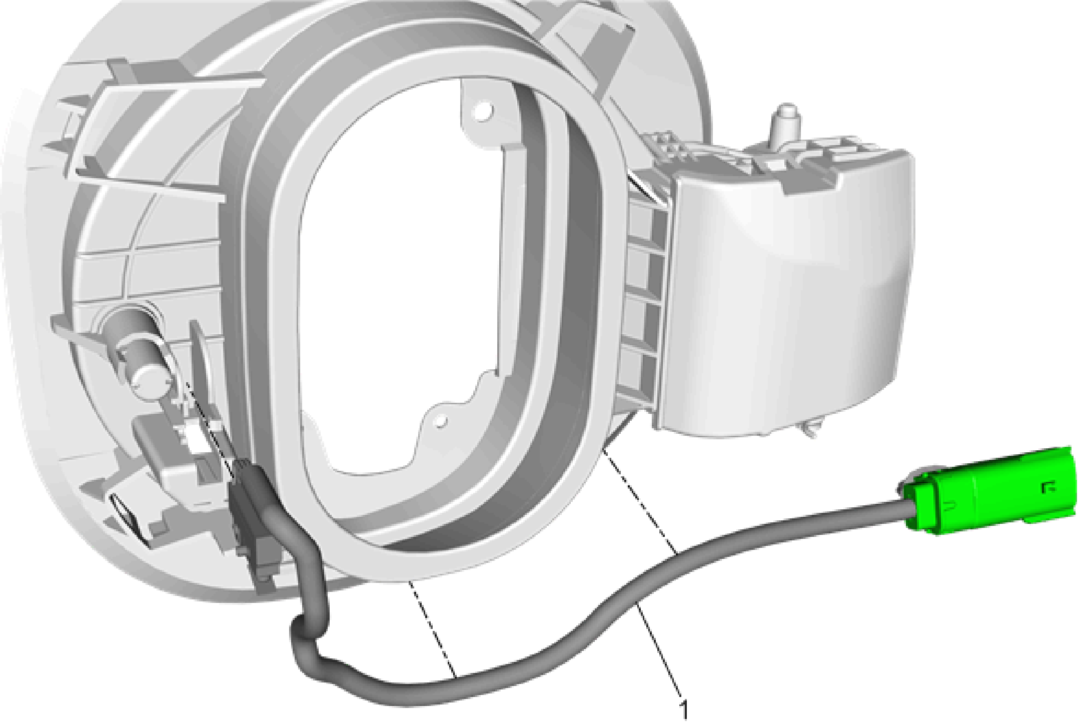


Fig. 26: Charge Port Door Ajar Indicator Switch
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:
Identify how to disable high voltage.
Identify how to test for the presence of high voltage.
Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.
Failure to follow the procedures exactly as written may result in serious injury or death.

Preliminary Procedures
Disable the high voltage system. High Voltage Disabling
Charge Port Housing Replacement (Dubai)</td></tr>
<tr><td>1</td><td>Charge Port Door Ajar Switch

Procedure
Release the charge port door ajar indicator switch and connector from the charge port housing cavity.
Enable the high voltage system. High Voltage Enabling</td></tr>
</table>

DRIVE MOTOR BATTERY CHARGER REPLACEMENT (EXCEPT DUBAI)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Drain the drive motor generator power inverter module cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
3. Remove Battery Tray **Battery Tray Replacement**
4. Remove Radiator Surge Tank **Radiator Surge Tank Replacement**
5. Remove Accessory DC Power Control Module **Accessory DC Power Control Module Replacement**

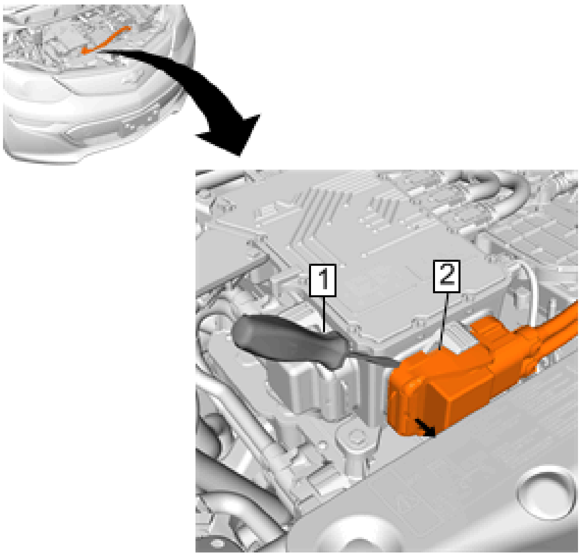


Fig. 27: Flat Bladed Screwdriver And Connector Handle Lock
Courtesy of GENERAL MOTORS COMPANY

6. {If Equipped} Using a flat bladed screwdriver (1), pry the edge of the connector handle lock (2) from the holding tab.
7. {If Equipped} Release the connector handle lock by rotating the connector handle forward.
8. {If Equipped} With the connector handle in the release position, disconnect the high voltage charger connector from the high power distribution module.

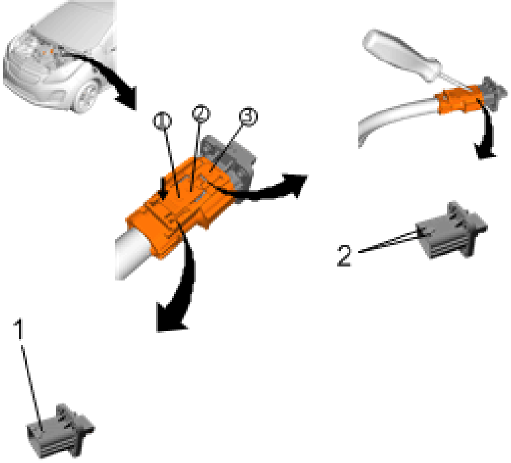


Fig. 28: First Stage Connector Tab And Connector Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the high voltage connectors in the following sequence:
    - Release the CPA. Push down on the connector tab, and release the connector.

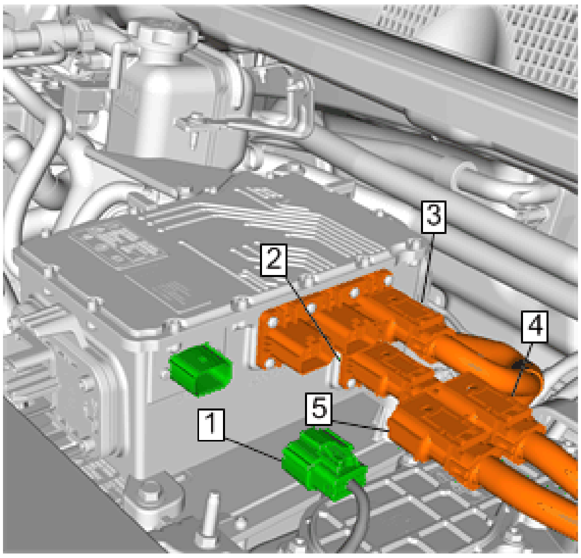


Fig. 29: Low Voltage Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Low Voltage Electrical Connector (1) @Generator Battery Control Wiring Junction Block
11. After releasing the 2-stage safety connectors, remove the A/C control module electrical connector (5)and the drive motor battery charger & auxiliary power module connector (4)from the generator battery control wiring junction block.
12. Remove the RESS heater electrical connector (3) and the drive motor battery charger & auxiliary power module to RESS electrical connector (2)from the generator battery control wiring junction block.

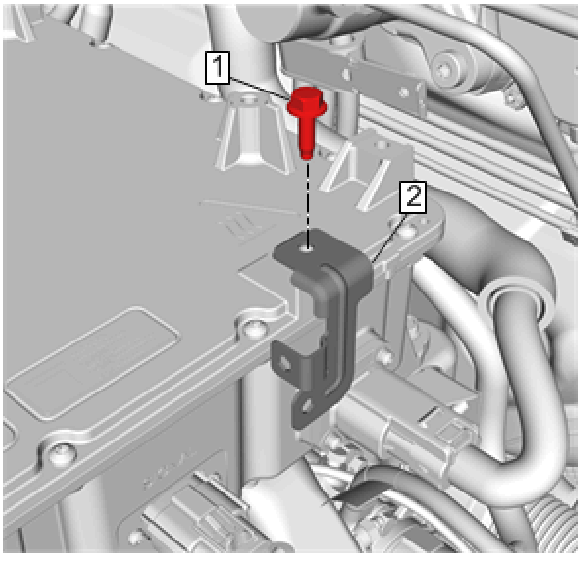


Fig. 30: Engine Wiring Harness Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Remove Engine Wiring Harness Bracket Bolt (1)
14. Remove Engine Wiring Harness Bracket(2)

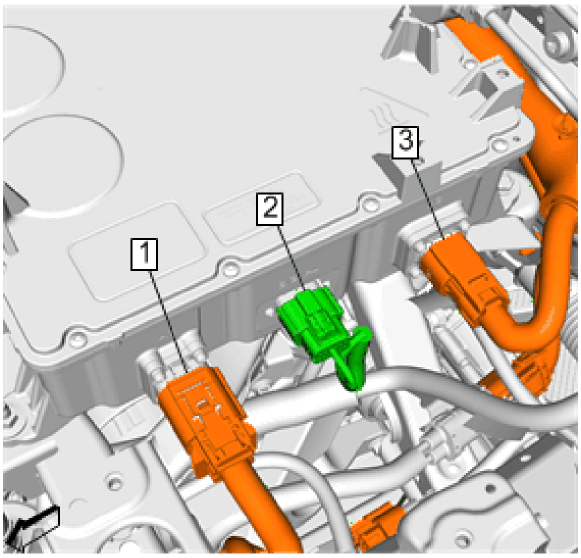


Fig. 31: Drive Motor Battery Charger Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect Drive Motor Battery Charger Electrical Connector (1) (3)
16. Disconnect Signal & AC Electrical Connector (2)

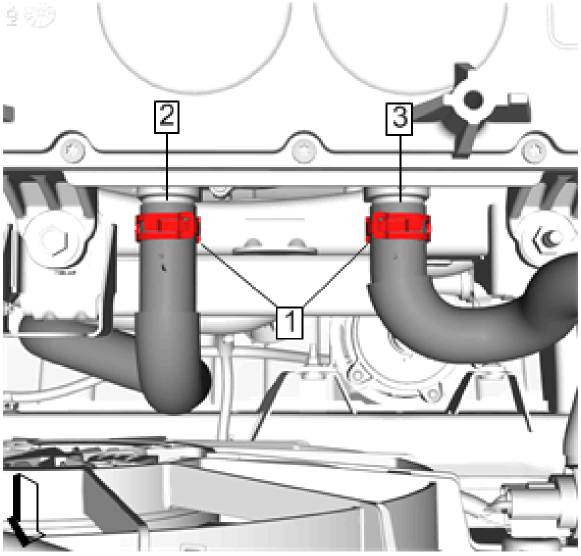
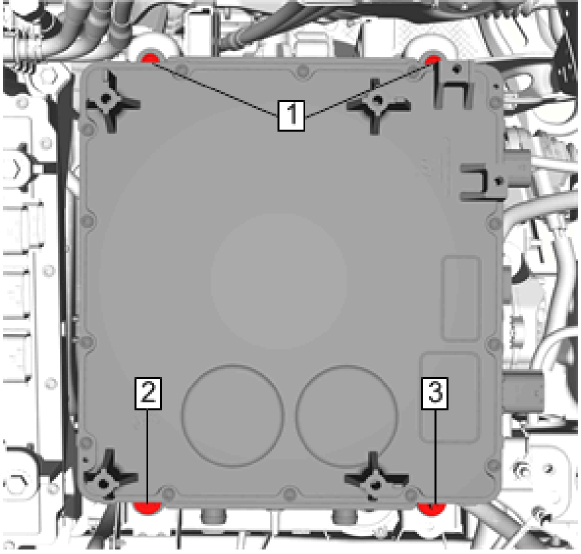


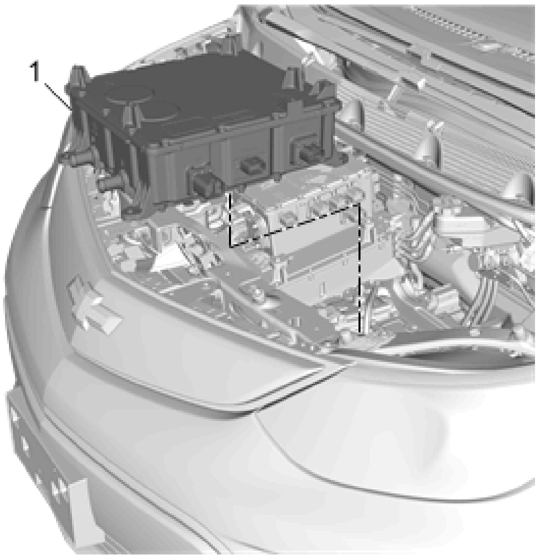
Fig. 32: Drive Motor Power Inverter Module Cooling Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

17. Drive Motor Power Inverter Module Cooling Inlet Hose(2) - Release Clamp (1) and Remove the Hose
18. Electric Differential Drive Motor Power Inverter Module Cooling Hose (3) - Release Clamp (1) and Remove the Hose



[Fig. 33: Drive Motor Battery Charger Nut](#)
Courtesy of GENERAL MOTORS COMPANY

19. Remove Drive Motor Battery Charger Bolt(1, 2)
20. Remove Drive Motor Battery Charger Nut(3)



[Fig. 34: Drive Motor Battery Charger](#)
Courtesy of GENERAL MOTORS COMPANY

21. Remove Drive Motor Battery Charger (1)

Installation Procedure

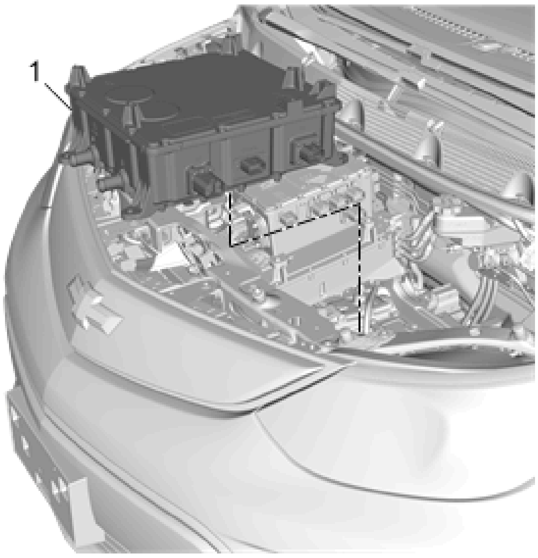


Fig. 35: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Charger(1)

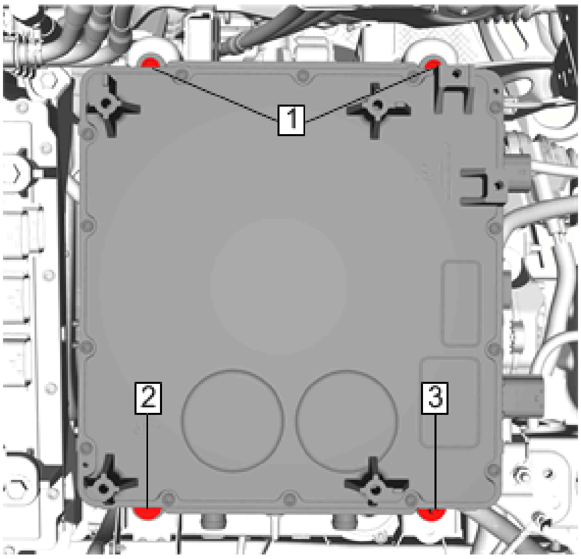


Fig. 36: Drive Motor Battery Charger Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Drive Motor Battery Charger Bolt(1) 22 N.m (16 lb ft)
3. Install Drive Motor Battery Charger Bolt(2) 25 N.m (18 lb ft)
4. Install Drive Motor Battery Charger Nut(3) 25 N.m (18 lb ft)

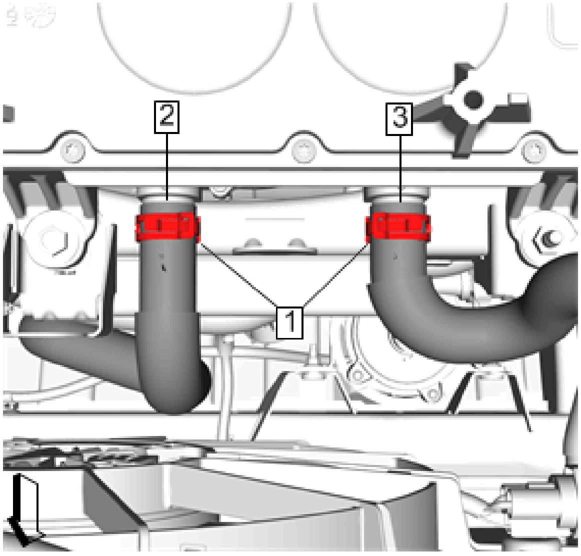


Fig. 37: Drive Motor Power Inverter Module Cooling Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Install Drive Motor Power Inverter Module Cooling Inlet Hose(2) @ the Hose and Engage the Clamp (1)
6. Electric Differential Drive Motor Power Inverter Module Cooling Hose (3) @ the Hose and Engage the Clamp (1)

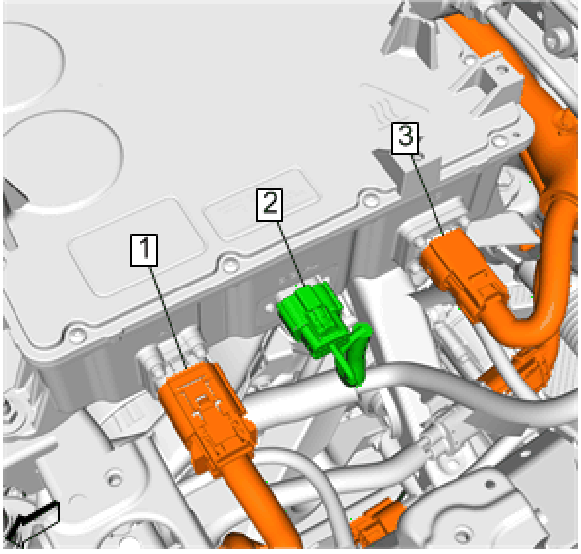


Fig. 38: Drive Motor Battery Charger Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Connect Drive Motor Battery Charger Electrical Connector (1, 3)
8. Connect Signal & AC Electrical Connector (2)

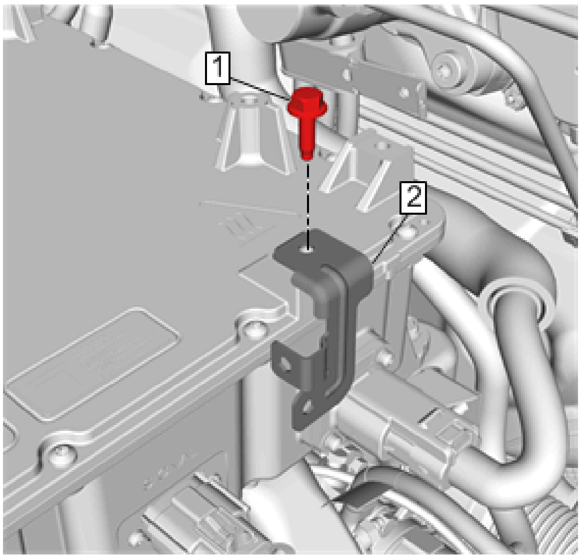


Fig. 39: Engine Wiring Harness Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Install Engine Wiring Harness Bracket(2)
10. Install Engine Wiring Harness Bracket Bolt(1) 9 N.m (80 lb in)

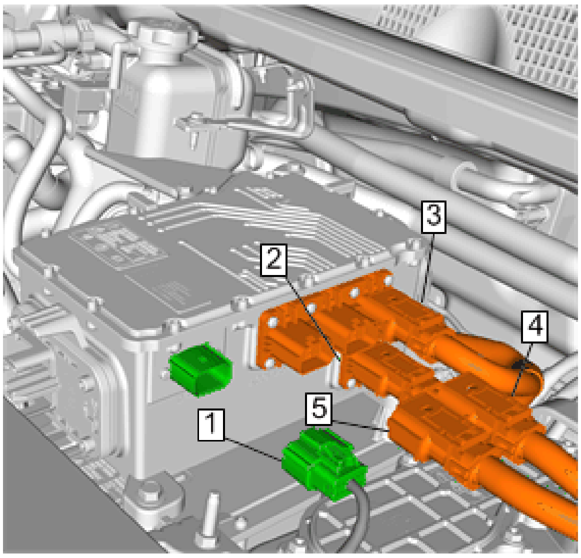


Fig. 40: Low Voltage Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

11. Install the RESS heater electrical connector (3) and the drive motor battery charger & auxiliary power module to RESS connector (2)to the generator battery control wiring junction block.
12. Install the A/C control module electrical connector (5)and the drive motor battery charger & auxiliary power module connector (4)to the generator battery control wiring junction block.
13. Connect Low Voltage Electrical Connector (1) @Generator Battery Control Wiring Junction Block

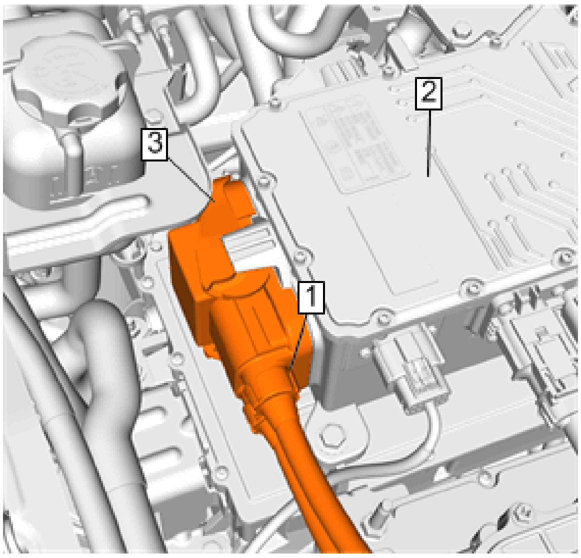


Fig. 41: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

14. {If Equipped} Install the drive motor battery charger receptacle electrical connector (1) to the generator battery control wiring junction block (2) and lock the handle (3) into the lock position.
15. Install Accessory DC Power Control Module **Accessory DC Power Control Module Replacement**
16. Install Radiator Surge Tank **Radiator Surge Tank Replacement**
17. Install Battery Tray **Battery Tray Replacement**
18. Fill the drive motor generator power inverter module cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
19. Enable the high voltage system. **High Voltage Enabling**
20. Program the drive motor battery charger. **Control Module References**

DRIVE MOTOR BATTERY CHARGER REPLACEMENT (DUBAI)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Drain the drive motor generator power inverter module cooling system. **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
3. Remove Battery Tray **Battery Tray Replacement**
4. Remove Radiator Surge Tank **Radiator Surge Tank Replacement**
5. Remove Accessory DC Power Control Module **Accessory DC Power Control Module Replacement**

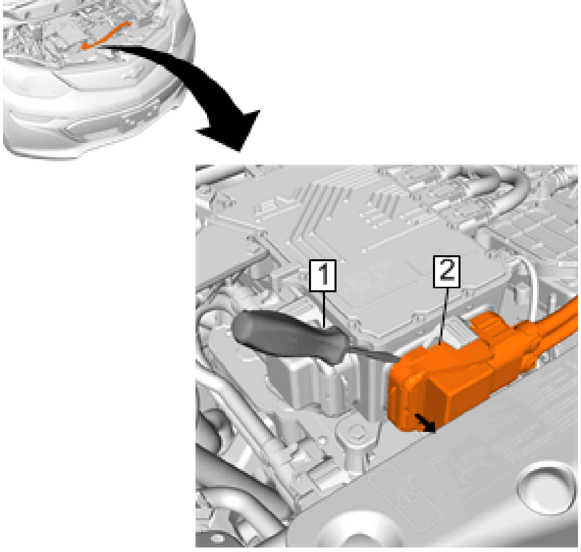


Fig. 42: Flat Bladed Screwdriver And Connector Handle Lock
Courtesy of GENERAL MOTORS COMPANY

6. {If Equipped} Using a flat bladed screwdriver (1), pry the edge of the connector handle lock (2) from the holding tab.
7. {If Equipped} Release the connector handle lock by rotating the connector handle forward.
8. {If Equipped} With the connector handle in the release position, disconnect the high voltage charger connector from the high power distribution module.

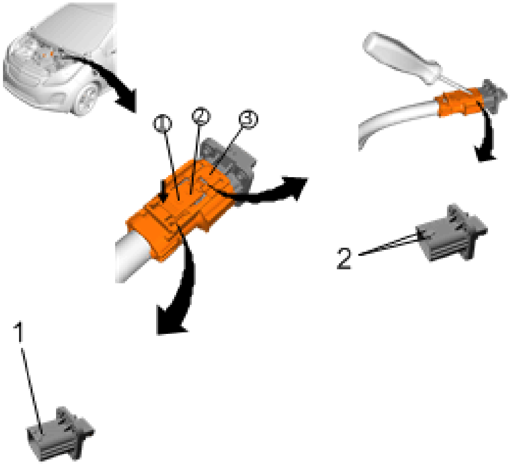


Fig. 43: First Stage Connector Tab And Connector Retaining Tabs
Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the high voltage connectors in the following sequence:
    - Release the CPA. Push down on the connector tab, and release the connector.

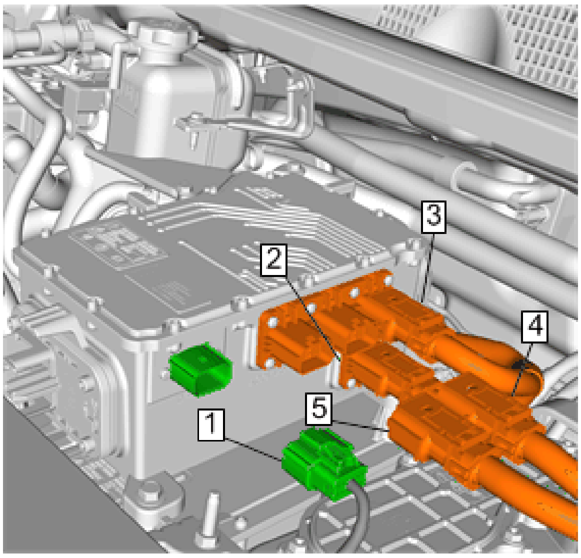


Fig. 44: Low Voltage Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Low Voltage Electrical Connector (1) @Generator Battery Control Wiring Junction Block
11. After releasing the 2-stage safety connectors, remove the A/C control module electrical connector (5)and the drive motor battery charger & auxiliary power module connector (4)from the generator battery control wiring junction block.
12. Remove the RESS heater electrical connector (3) and the drive motor battery charger & auxiliary power module to RESS electrical connector (2)from the generator battery control wiring junction block.

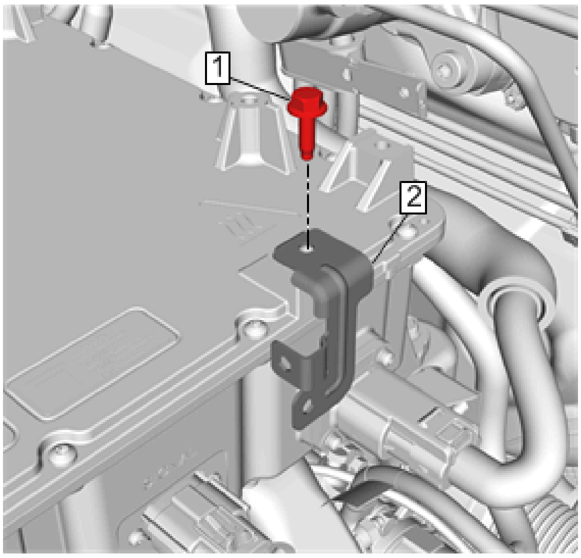


Fig. 45: Engine Wiring Harness Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Remove Engine Wiring Harness Bracket Bolt(1)
14. Remove Engine Wiring Harness Bracket(2)

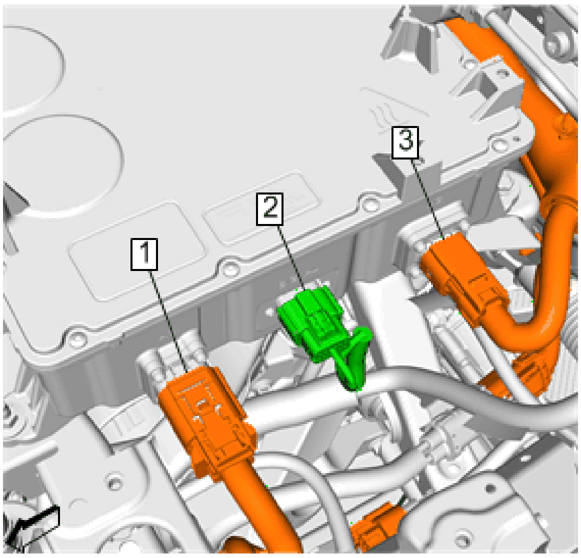


Fig. 46: Drive Motor Battery Charger Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect Drive Motor Battery Charger Electrical Connector (1) (3)
16. Disconnect Signal & AC Electrical Connector (2)

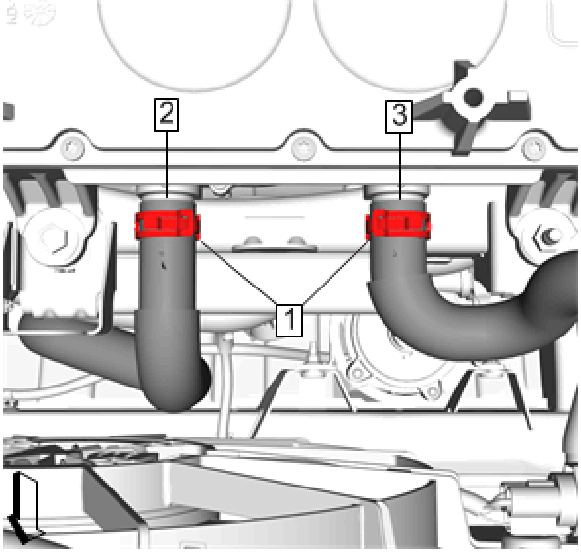


Fig. 47: Drive Motor Power Inverter Module Cooling Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

17. Drive Motor Power Inverter Module Cooling Inlet Hose(2) - Release Clamp (1) and Remove the Hose
18. Electric Differential Drive Motor Power Inverter Module Cooling Hose (3) - Release Clamp (1) and Remove the Hose

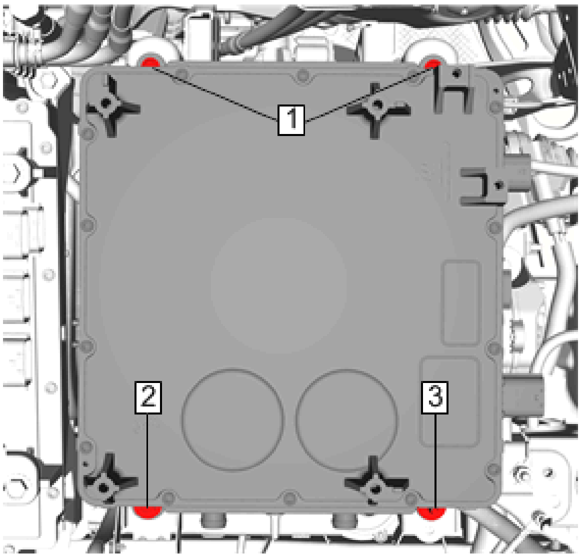


Fig. 48: Drive Motor Battery Charger Nut
Courtesy of GENERAL MOTORS COMPANY

19. Remove Drive Motor Battery Charger Bolt(1, 2)
20. Remove Drive Motor Battery Charger Nut(3)

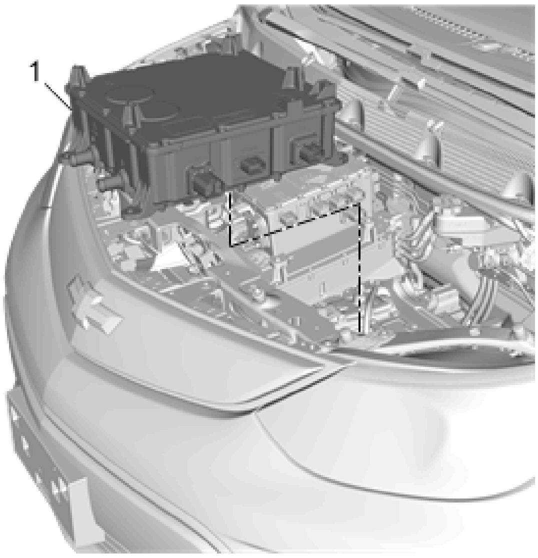


Fig. 49: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

21. Remove Drive Motor Battery Charger(1)

Installation Procedure

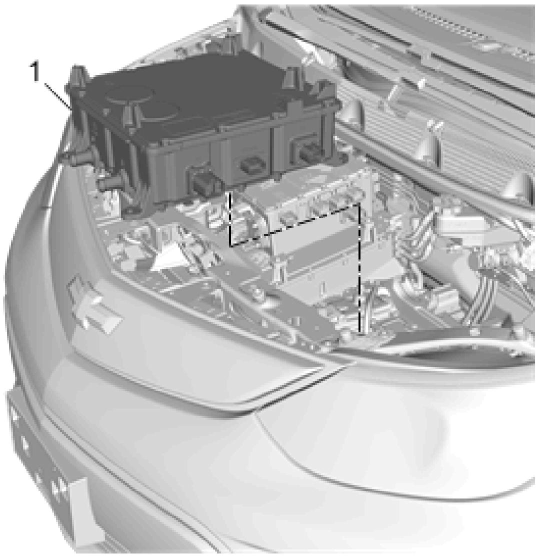


Fig. 50: Drive Motor Battery Charger
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Charger(1)

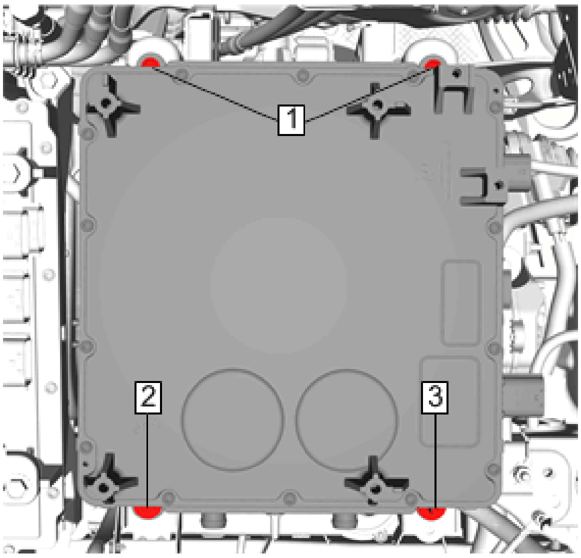


Fig. 51: Drive Motor Battery Charger Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Drive Motor Battery Charger Bolt(1) 22 N.m (16 lb ft)
3. Install Drive Motor Battery Charger Bolt(2) 25 N.m (18 lb ft)
4. Install Drive Motor Battery Charger Nut(3) 22 N.m (16 lb ft)

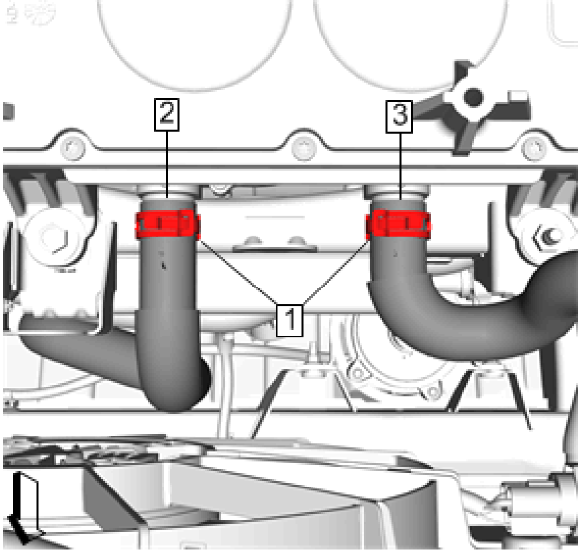


Fig. 52: Drive Motor Power Inverter Module Cooling Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

5. Install Drive Motor Power Inverter Module Cooling Inlet Hose(2) @ the Hose and Engage the Clamp (1)
6. Install Electric Differential Drive Motor Power Inverter Module Cooling Hose (3) @ the Hose and Engage the Clamp (1)

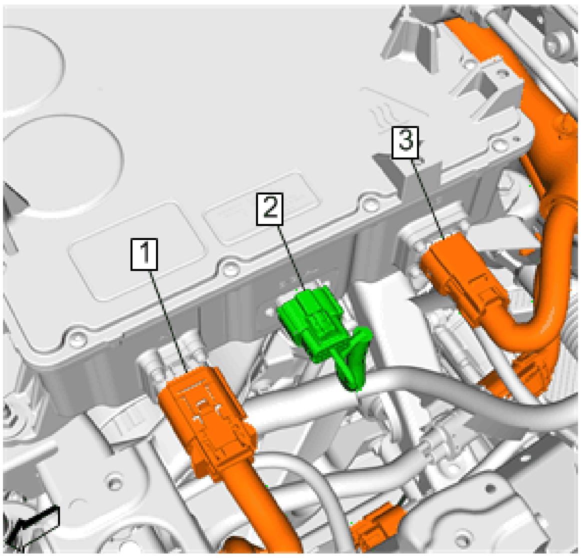


Fig. 53: Drive Motor Battery Charger Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Connect Drive Motor Battery Charger Electrical Connector (1, 3)
8. Connect Signal & AC Electrical Connector (2)

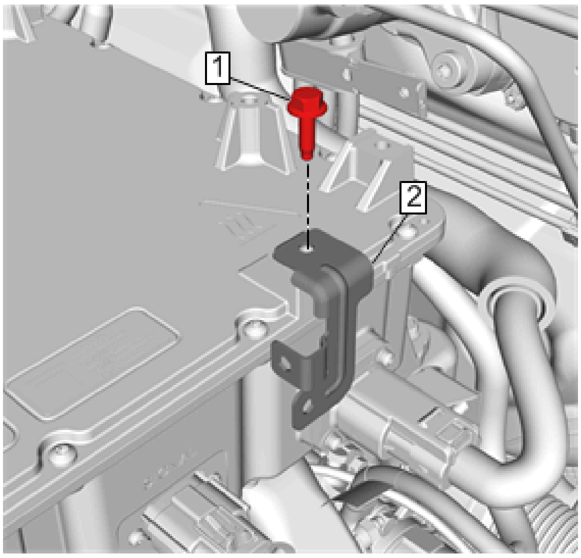


Fig. 54: Engine Wiring Harness Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Install Engine Wiring Harness Bracket(2)
10. Install Engine Wiring Harness Bracket Bolt(1) 9 N.m (80 lb in)

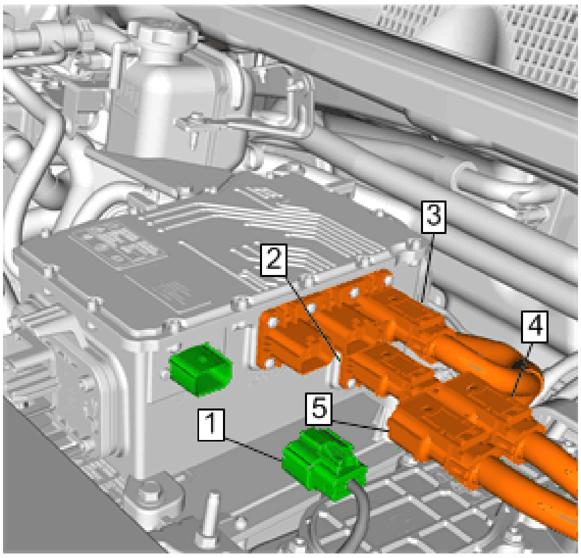


Fig. 55: Low Voltage Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

11. Install the RESS heater electrical connector (3) and the drive motor battery charger & auxiliary power module to RESS connector (2)to the generator battery control wiring junction block.
12. Install the A/C control module electrical connector (5)and the drive motor battery charger & auxiliary power module connector (4)to the generator battery control wiring junction block.
13. Connect Low Voltage Electrical Connector (1) @Generator Battery Control Wiring Junction Block

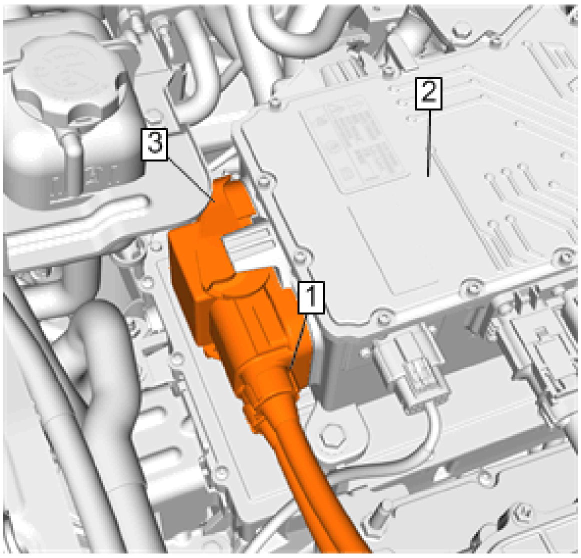


Fig. 56: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

14. {If Equipped} Install the drive motor battery charger receptacle electrical connector (1) to the generator battery control wiring junction block (2) and lock the handle (3)into the lock position.
15. Install Accessory DC Power Control Module Accessory DC Power Control Module Replacement
16. Install Radiator Surge Tank Radiator Surge Tank Replacement
17. Install Battery Tray Battery Tray Replacement
18. Fill the drive motor generator power inverter module cooling system. Drive Motor Generator Power Inverter Module Cooling System Draining and Filling
19. Enable the high voltage system. High Voltage Enabling
20. Program the drive motor battery charger. Control Module References

DRIVE MOTOR BATTERY CHARGER RECEPTACLE REPLACEMENT (EXCEPT DUBAI WITH QUICK CHARGE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Remove Charge Port Housing Charge Port Housing Replacement (Except Dubai)
3. Remove Headlamp Headlamp Replacement

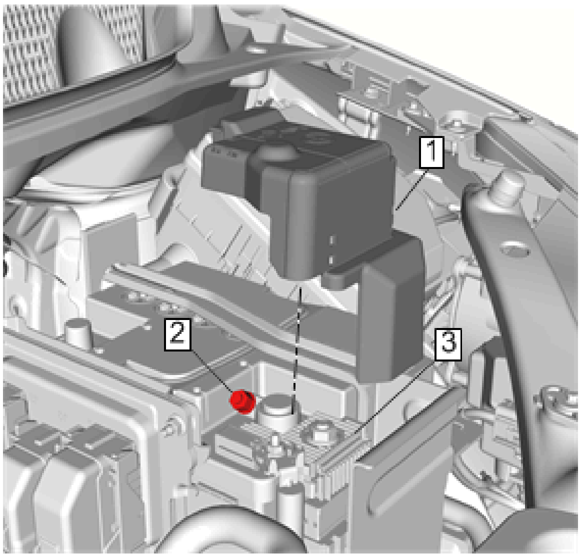
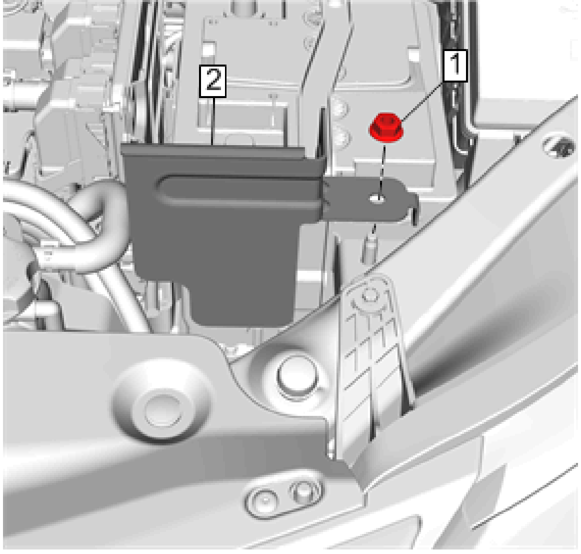


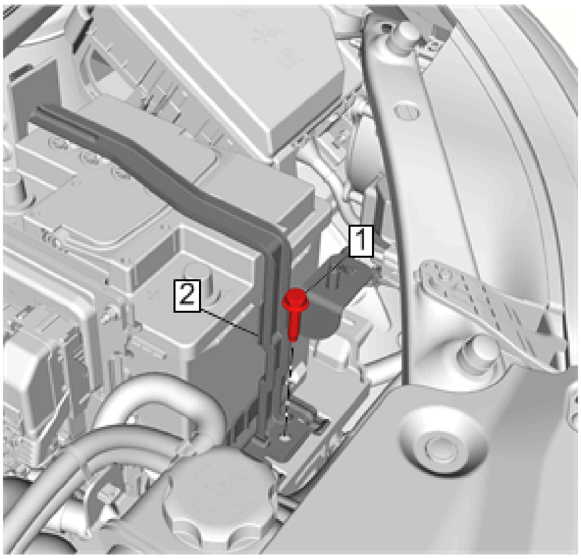
Fig. 57: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

4. Remove Battery Positive Cable Protective Cover (1)
5. Loosen Battery Positive Cable Clamp Fastener
6. Remove Battery Positive Cable (3) @ Battery Post



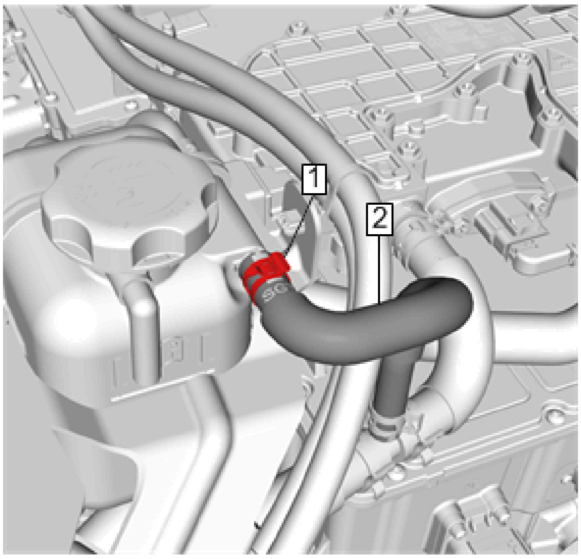
[Fig. 58: Battery Tray Support Nut]
Courtesy of GENERAL MOTORS COMPANY

7. Remove Battery Tray Support Nut (1)
8. Remove Battery Tray Support (2)



[Fig. 59: Battery Retainer Assembly Bolt And Assembly]
Courtesy of GENERAL MOTORS COMPANY

9. Remove Battery Retainer Assembly Bolt (1)
10. Remove Battery Retainer Assembly (2)



[Fig. 60: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamp]
Courtesy of GENERAL MOTORS COMPANY

11. Reposition Electric Differential Drive Motor Power Inverter Module Cooling Hose Clamp (2)
12. Position aside Electric Differential Drive Motor Power Inverter Module Cooling Hose @Radiator Surge Tank(1)

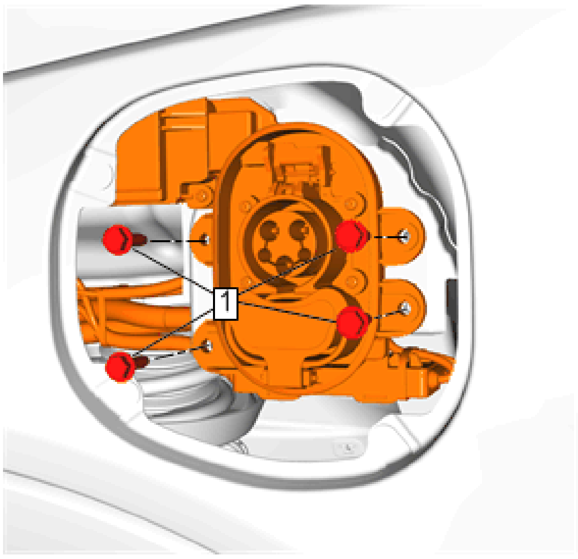


Fig. 61: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Remove Drive Motor Battery Charger Receptacle Bolt(1)

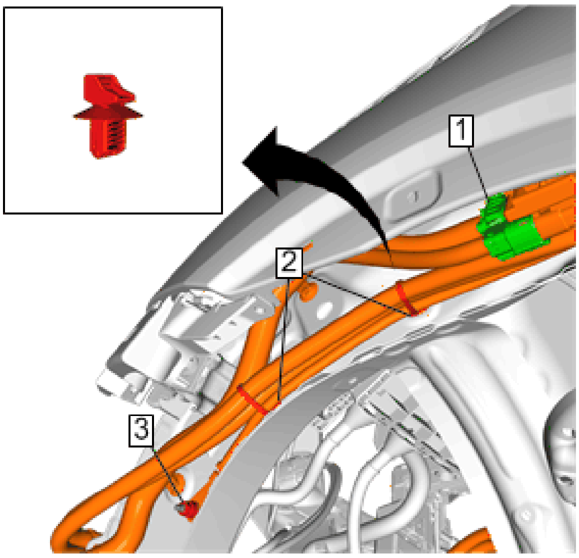


Fig. 62: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

14. Disconnect Drive Motor Battery Charger Receptacle Electrical Connector (1)
15. Detach Drive Motor Battery Charger Receptacle Retainer(2)
16. Remove Ground Nut(3)@Stud

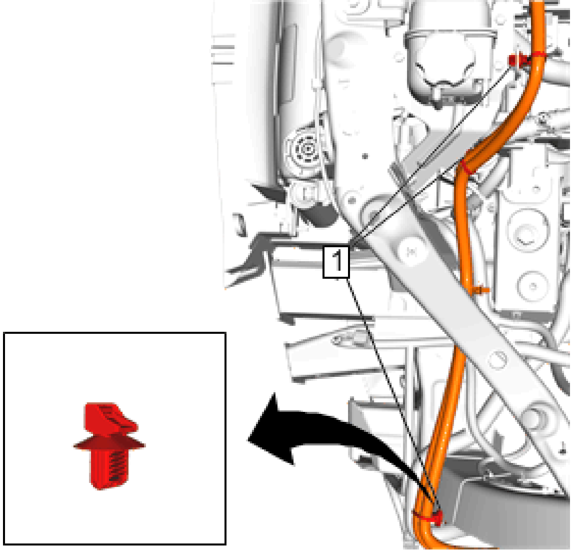


Fig. 63: Drive Motor Battery Charger Receptacle Retainer
Courtesy of GENERAL MOTORS COMPANY

17. Detach Drive Motor Battery Charger Receptacle Retainer(1)

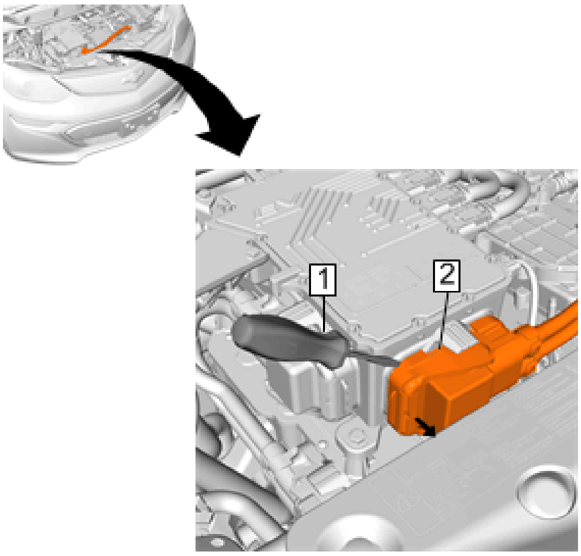


Fig. 64: Flat Bladed Screwdriver And Connector Handle Lock
Courtesy of GENERAL MOTORS COMPANY

18. Using a flat bladed screwdriver (1), pry the edge of the electrical connector handle lock (2) from the holding tab.
19. Release the electrical connector handle lock by rotating the electrical connector handle forward.
20. With the electrical connector handle in the release position, disconnect the high voltage charger electrical connector from the high power distribution module.

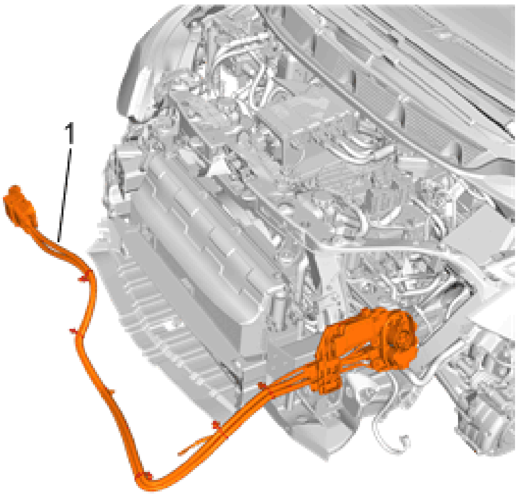


Fig. 65: Drive Motor Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

21. Remove Drive Motor Battery Charger Receptacle(1)

Installation Procedure

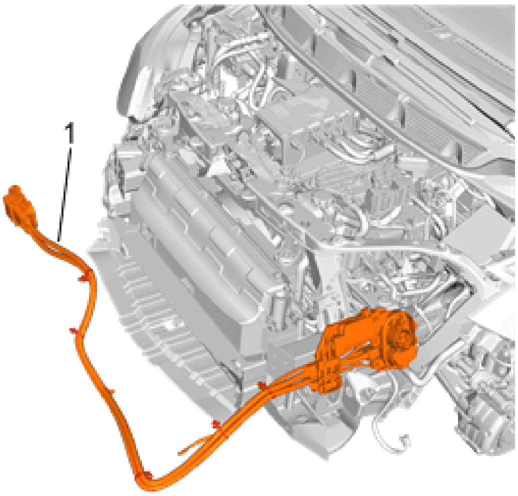


Fig. 66: Drive Motor Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Charger Receptacle(1)

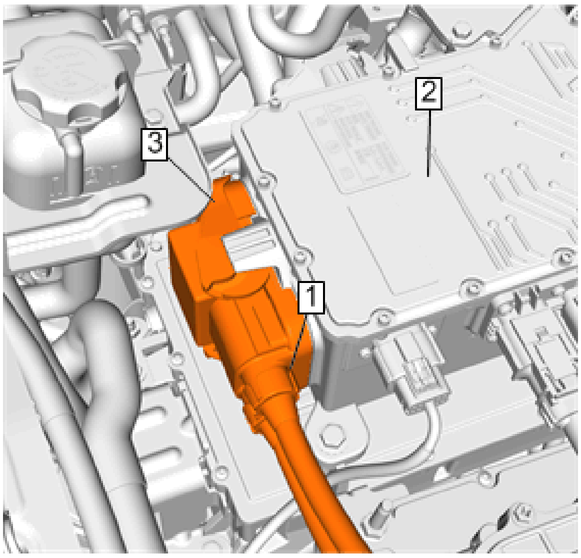


Fig. 67: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Install the drive motor battery charger receptacle electrical connector (1) to the generator battery control wiring junction block (2)and lock the handle (3) into the lock position.

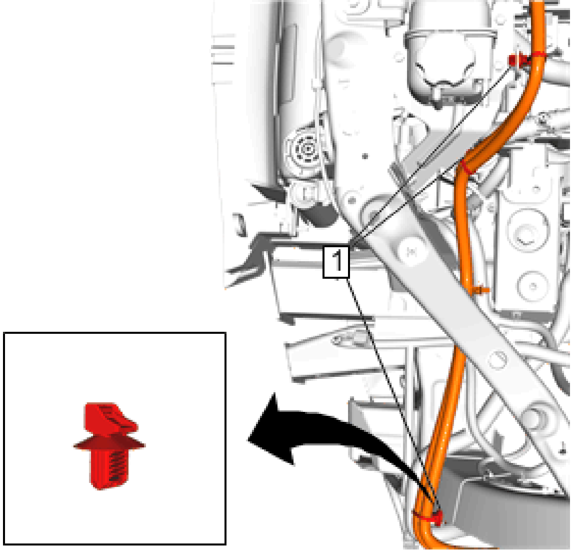


Fig. 68: Drive Motor Battery Charger Receptacle Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Install Drive Motor Battery Charger Receptacle Retainer(1)

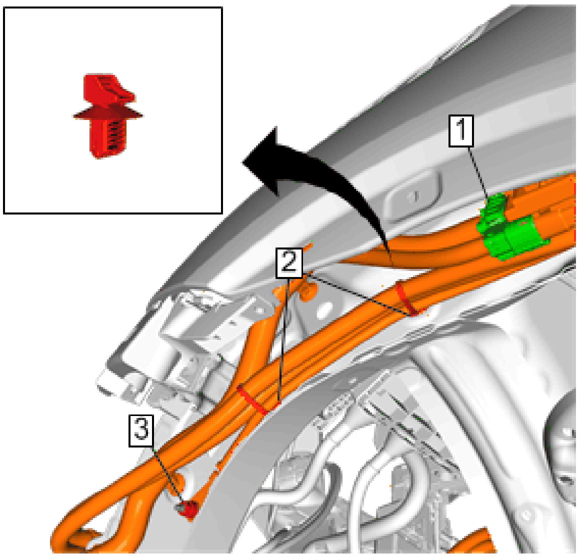


Fig. 69: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

4. Install Ground Nut(3)@Stud 9 N.m (80 lb in)
5. Install Drive Motor Battery Charger Receptacle Retainer(2)
6. Connect Drive Motor Battery Charger Receptacle Electrical Connector (1)

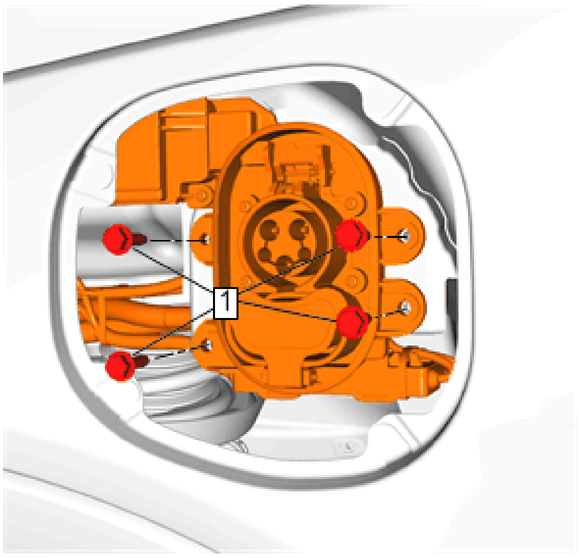


Fig. 70: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Install Drive Motor Battery Charger Receptacle Bolt(1) 9 N.m (80 lb in)

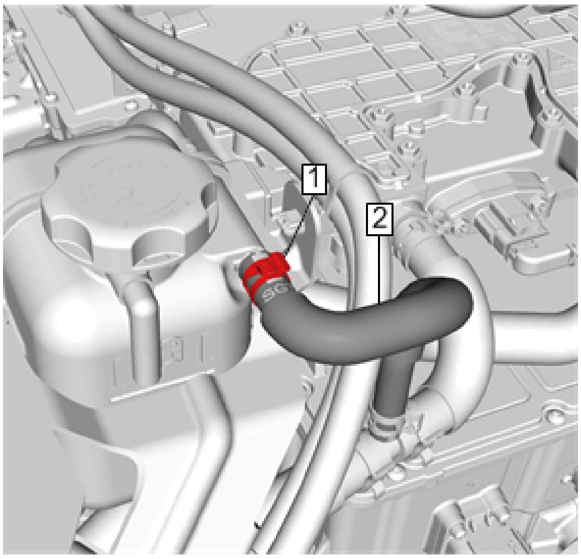


Fig. 71: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Install Electric Differential Drive Motor Power Inverter Module Cooling Hose (1)
9. Install Electric Differential Drive Motor Power Inverter Module Cooling Hose Clamp (2)

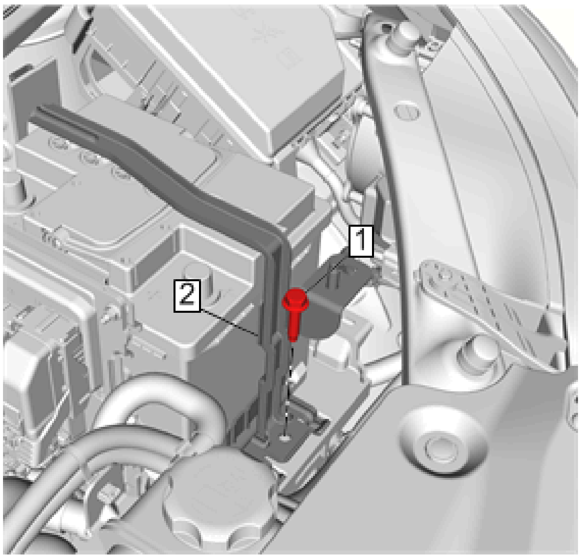


Fig. 72: Battery Retainer Assembly Bolt And Assembly
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

10. Install Battery Retainer Assembly (2)
11. Install Battery Retainer Assembly Bolt (1) and tighten 8 N.m (71 lb in)

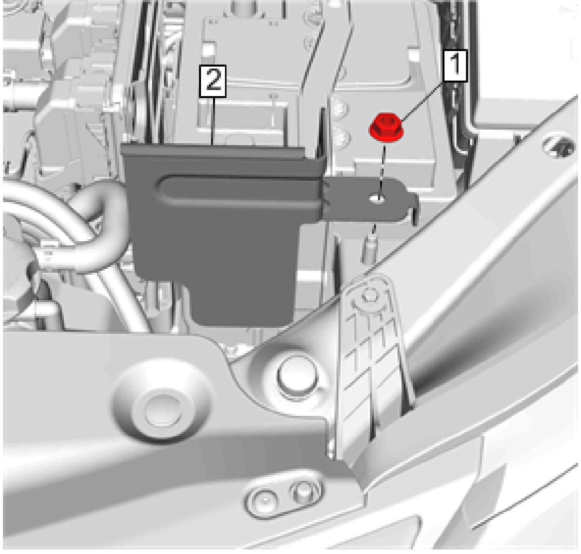


Fig. 73: Battery Tray Support Nut
Courtesy of GENERAL MOTORS COMPANY

12. Install Battery Tray Support (2)
13. Install Battery Tray Support Nut (1) and tighten 9 N.m (80 lb in)

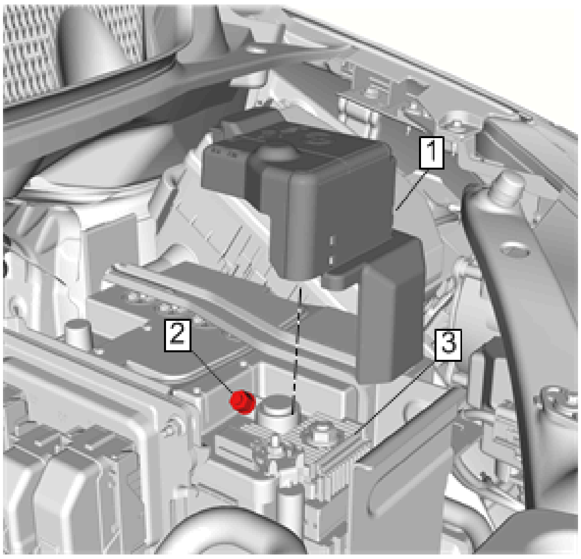


Fig. 74: Battery Positive Cable Protective Cover
Courtesy of GENERAL MOTORS COMPANY

14. Install Battery Positive Cable (3) @ Battery Post
15. Install Battery Positive Cable Clamp Fastener and tighten 5 N.m (44 lb in)
16. Install Battery Positive Cable Protective Cover (1)
17. Install Headlamp **Headlamp Replacement**
18. Install Charge Port Housing **Charge Port Housing Replacement (Except Dubai)**
19. Enable the high voltage system. **High Voltage Enabling**

DRIVE MOTOR BATTERY CHARGER RECEPTACLE REPLACEMENT (EXCEPT DUBAI WITHOUT QUICK CHARGE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Remove Charge Port Housing **Charge Port Housing Replacement (Except Dubai)**

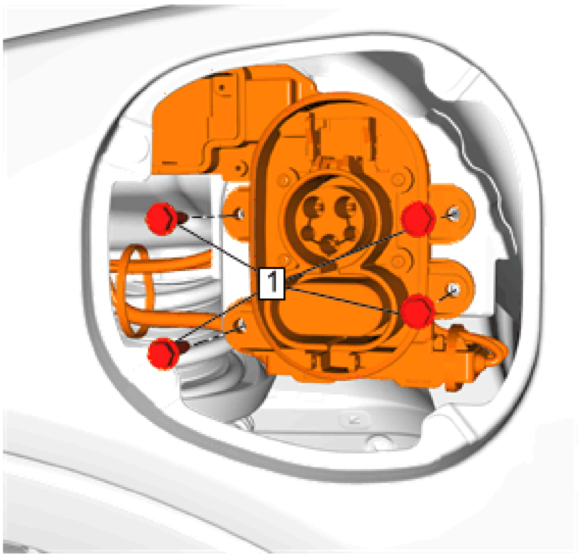


Fig. 75: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove Drive Motor Battery Charger Receptacle Bolt(1)

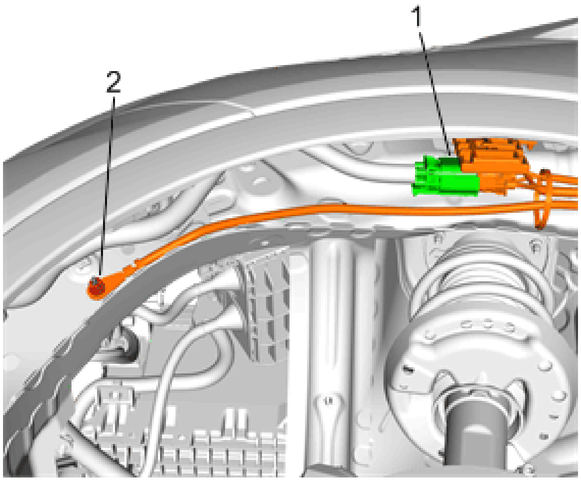


Fig. 76: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Drive Motor Battery Charger Receptacle Electrical Connector (1)
5. Remove Ground Nut(3)@Stud

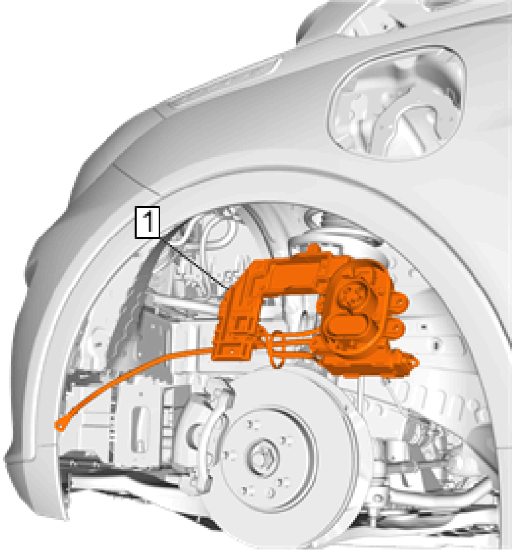


Fig. 77: Drive Motor Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Battery Charger Receptacle(1)

Installation Procedure

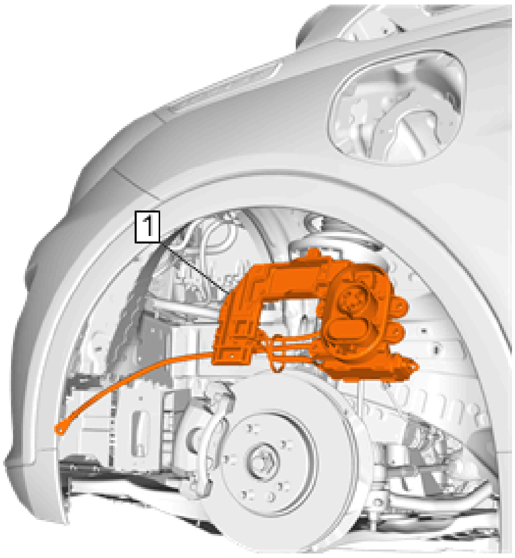


Fig. 78: Drive Motor Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Charger Receptacle(1)

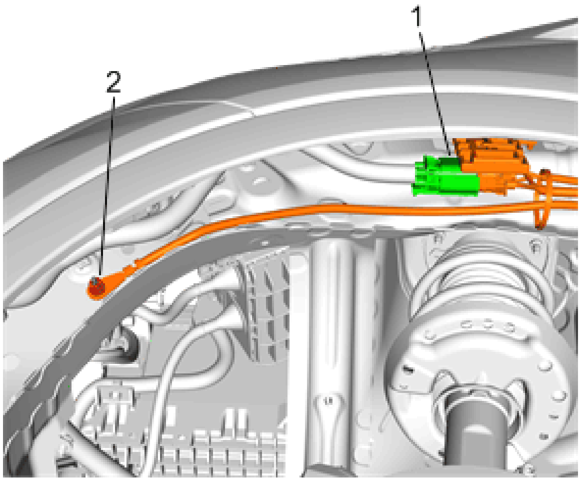


Fig. 79: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

2. Install Ground Nut(1)@Stud 9 N.m (80 lb in)
3. Connect Drive Motor Battery Charger Receptacle Electrical Connector (1)

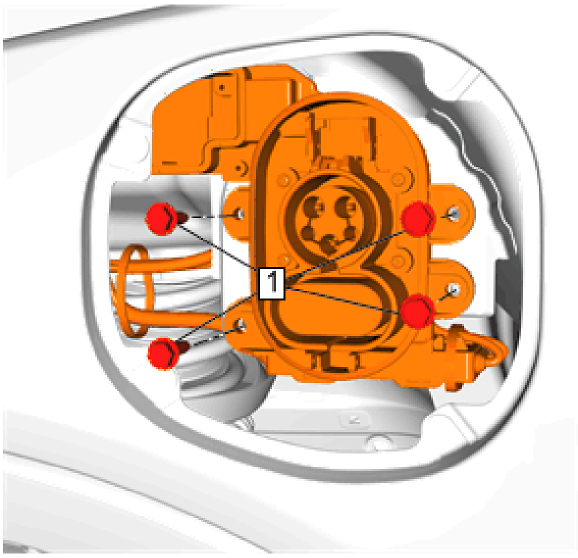


Fig. 80: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install Drive Motor Battery Charger Receptacle Bolt(1) 9 N.m (80 lb in)
5. Install Charge Port Housing **Charge Port Housing Replacement (Except Dubai)**
6. Enable the high voltage system. **High Voltage Enabling**

DRIVE MOTOR BATTERY CHARGER RECEPTACLE REPLACEMENT (DUBAI ONLY WITH QUICK CHARGE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Remove Charge Port Housing **Charge Port Housing Replacement (Dubai)**
3. Remove Headlamp **Headlamp Replacement**
4. Remove Battery Tray **Battery Tray Replacement**

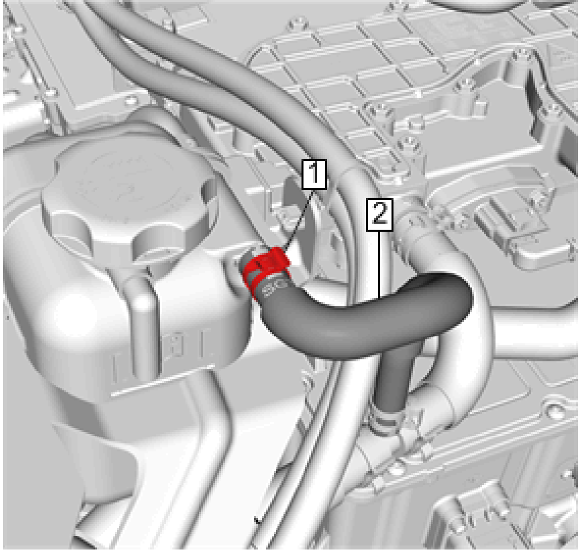


Fig. 81: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Reposition Electric Differential Drive Motor Power Inverter Module Cooling Hose Clamp (2)
6. Position aside Electric Differential Drive Motor Power Inverter Module Cooling Hose @Radiator Surge Tank(1)

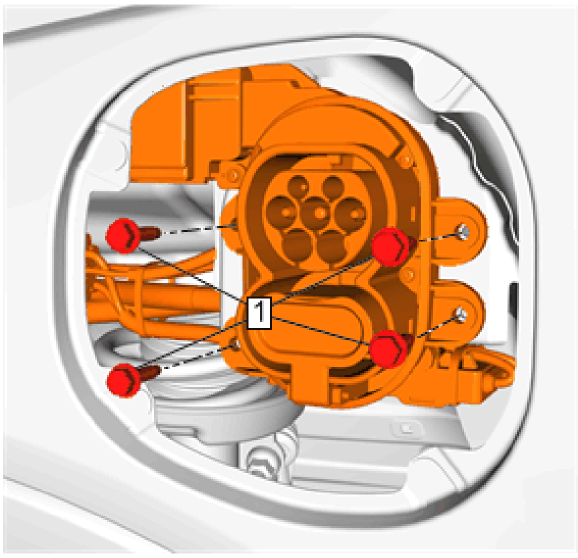


Fig. 82: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Remove Drive Motor Battery Charger Receptacle Bolt(1)

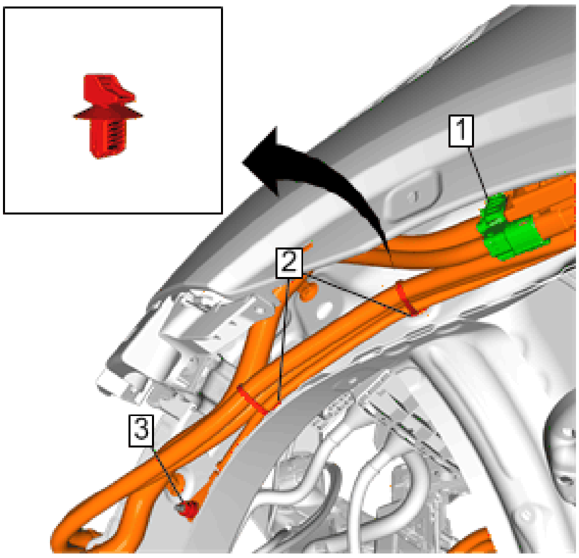


Fig. 83: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Drive Motor Battery Charger Receptacle Electrical Connector (1)
9. Detach Drive Motor Battery Charger Receptacle Retainer(2)
10. Remove Ground Nut(3)@Stud

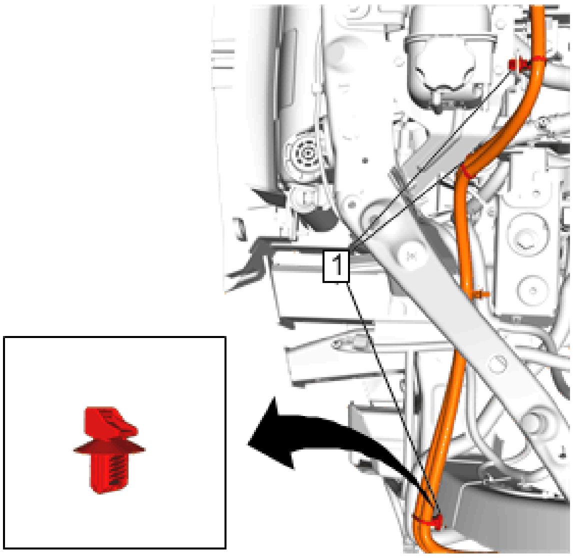


Fig. 84: Drive Motor Battery Charger Receptacle Retainer
Courtesy of GENERAL MOTORS COMPANY

11. Detach Drive Motor Battery Charger Receptacle Retainer(1)

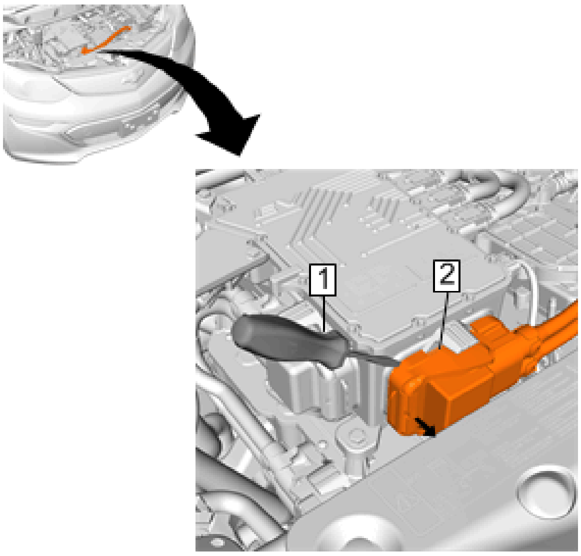
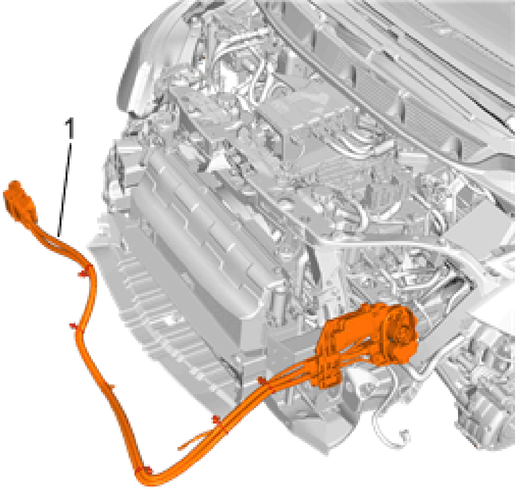


Fig. 85: Flat Bladed Screwdriver And Connector Handle Lock
Courtesy of GENERAL MOTORS COMPANY

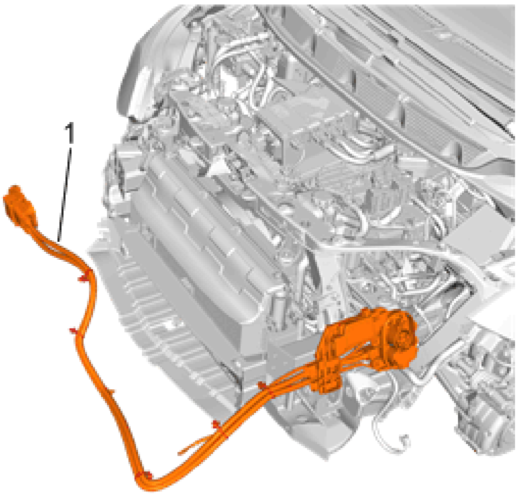
12. Using a flat bladed screwdriver (1), pry the edge of the electrical connector handle lock (2) from the holding tab.
13. Release the electrical connector handle lock by rotating the electrical connector handle forward.
14. With the electrical connector handle in the release position, disconnect the high voltage charger electrical connector from the high power distribution module.



[Fig. 86: Drive Motor Battery Charger Receptacle](#)
Courtesy of GENERAL MOTORS COMPANY

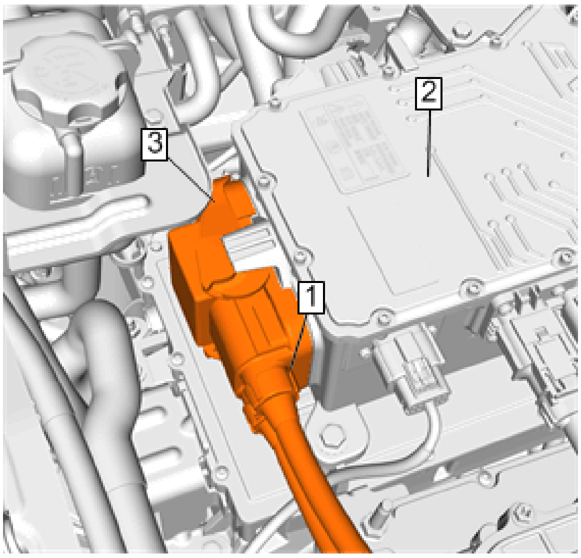
15. Remove Drive Motor Battery Charger Receptacle(1)

Installation Procedure



[Fig. 87: Drive Motor Battery Charger Receptacle](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Charger Receptacle(1)



[Fig. 88: Drive Motor Battery Charger Receptacle Electrical Connector](#)
Courtesy of GENERAL MOTORS COMPANY

2. Install the drive motor battery charger receptacle electrical connector (1) to the generator battery control wiring junction block (2)and lock the handle (3) into the lock position.

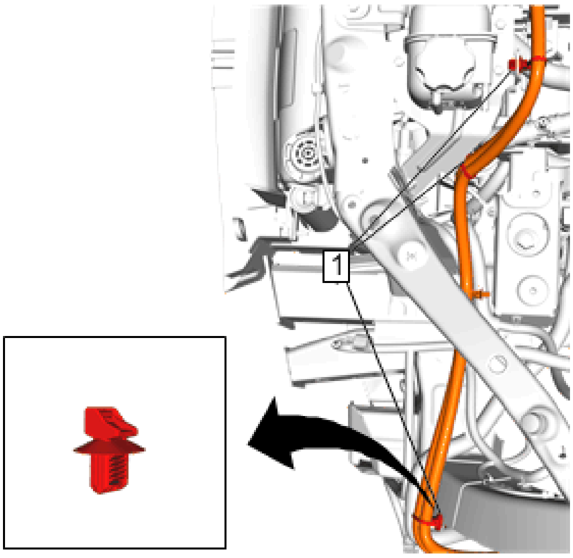


Fig. 89: Drive Motor Battery Charger Receptacle Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Install Drive Motor Battery Charger Receptacle Retainer(1)

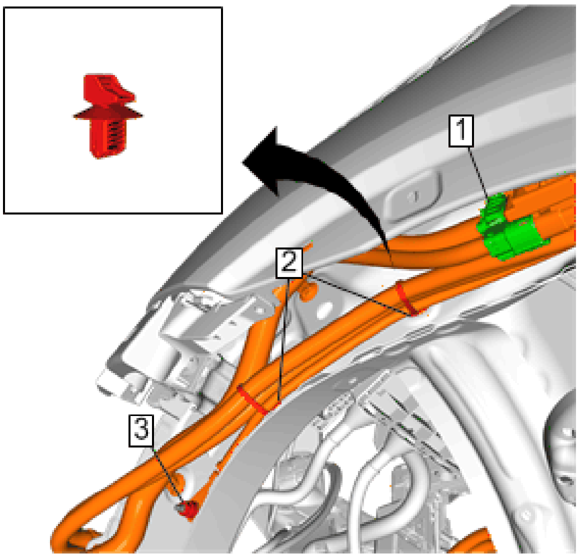


Fig. 90: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution .**

4. Install Ground Nut(3)@Stud 9 N.m (80 lb in)
5. Install Drive Motor Battery Charger Receptacle Retainer(2)
6. Connect Drive Motor Battery Charger Receptacle Electrical Connector (3)

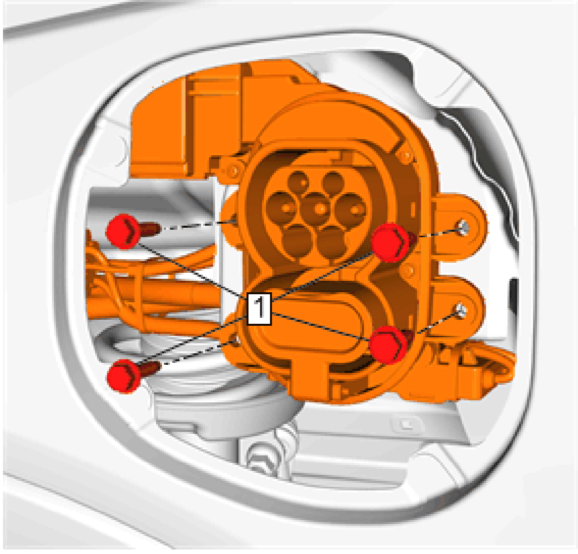


Fig. 91: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Install Drive Motor Battery Charger Receptacle Bolt(1) 9 N.m (80 lb in)

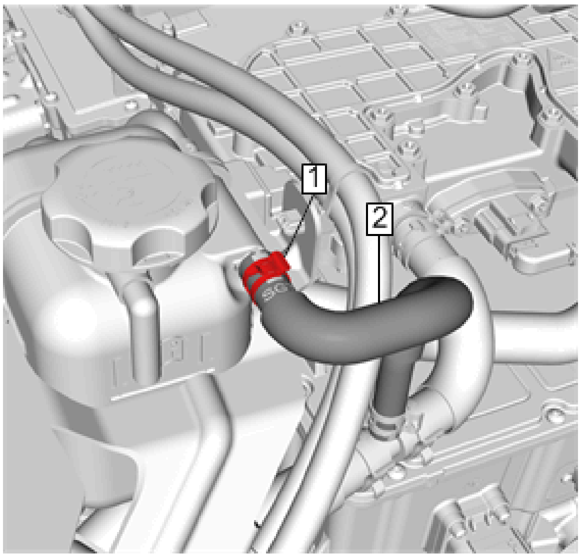


Fig. 92: Electric Differential Drive Motor Power Inverter Module Cooling Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Install Electric Differential Drive Motor Power Inverter Module Cooling Hose (1)
9. Electric Differential Drive Motor Power Inverter Module Cooling Hose Clamp (2
10. Install Battery Tray **Battery Tray Replacement**
11. Install Headlamp **Headlamp Replacement**
12. Install Charge Port Housing **Charge Port Housing Replacement (Dubai)**
13. Enable the high voltage system. **High Voltage Enabling**

DRIVE MOTOR BATTERY CHARGER RECEPTACLE REPLACEMENT (DUBAI ONLY WITHOUT QUICK CHARGE)

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**

- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Remove Charge Port Housing **Charge Port Housing Replacement (Dubai)**

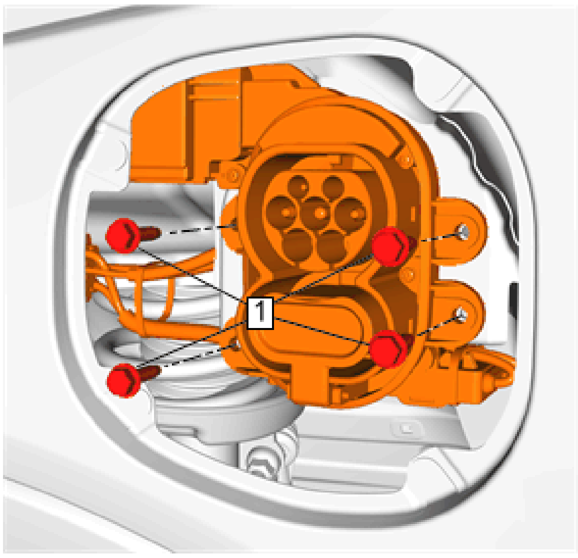


Fig. 93: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove Drive Motor Battery Charger Receptacle Bolt(1)

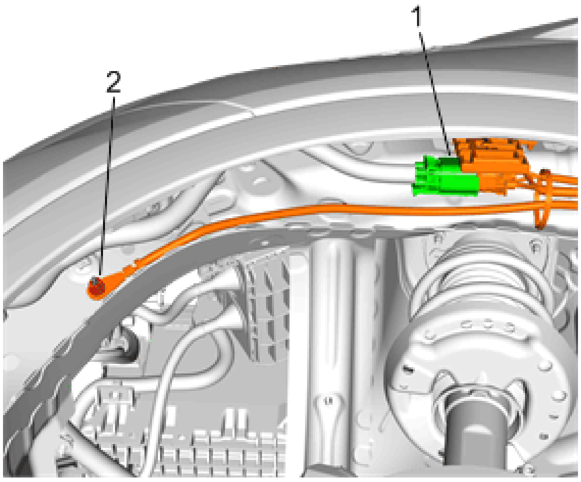


Fig. 94: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Drive Motor Battery Charger Receptacle Electrical Connector (1)
5. Remove Ground Nut(3)@Stud

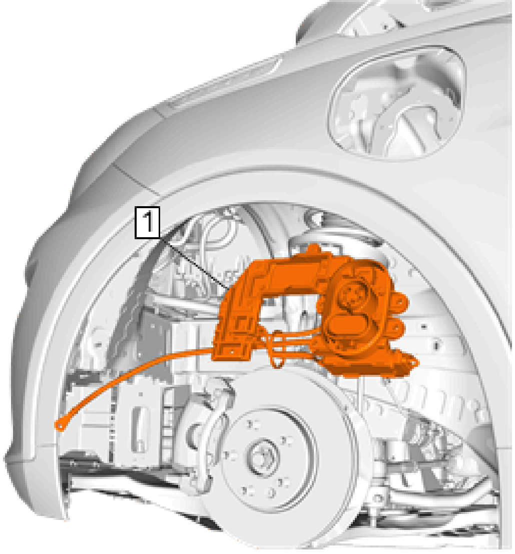


Fig. 95: Drive Motor Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Battery Charger Receptacle(1)

Installation Procedure

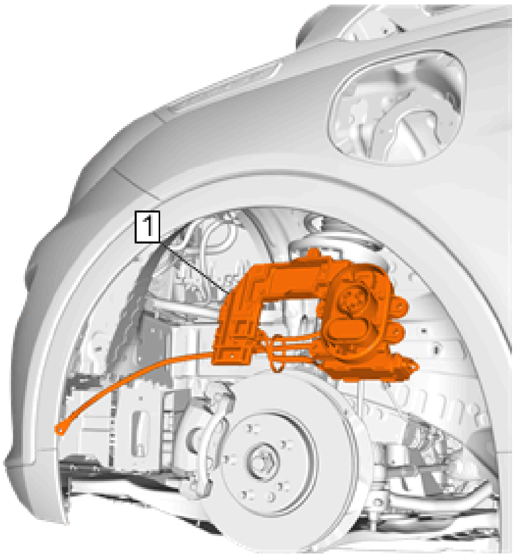


Fig. 96: Drive Motor Battery Charger Receptacle
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Battery Charger Receptacle(1) -

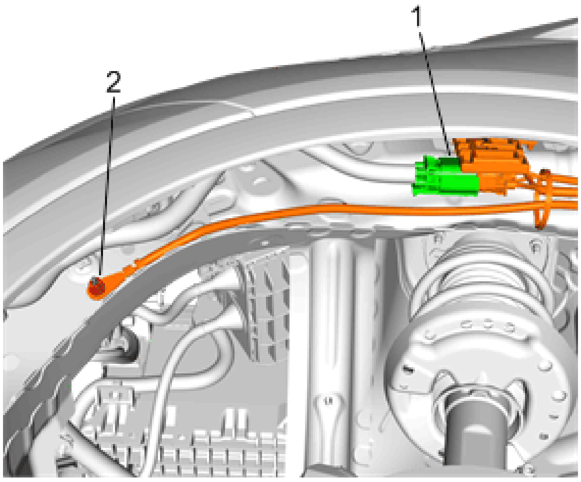


Fig. 97: Drive Motor Battery Charger Receptacle Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution .

2. Install Ground Nut(3)@Stud 9 N.m (80 lb in)
3. Connect Drive Motor Battery Charger Receptacle Electrical Connector (1)

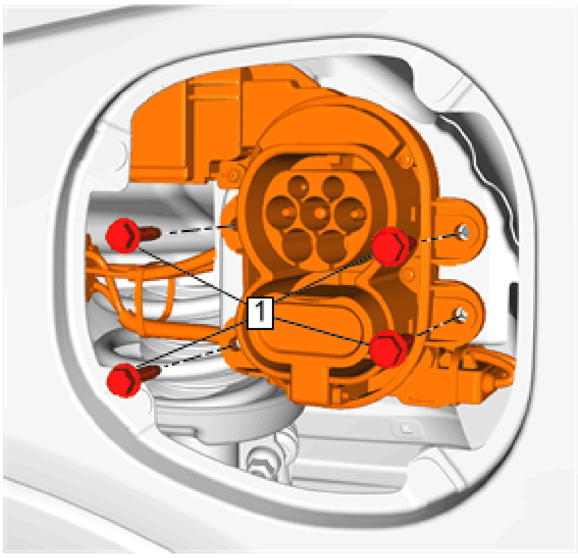


Fig. 98: Drive Motor Battery Charger Receptacle Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install Drive Motor Battery Charger Receptacle Bolt(1) 9 N.m (80 lb in)
5. Install Charge Port Housing Charge Port Housing Replacement (Except Dubai)Charge Port Housing Replacement (Dubai)
6. Enable the high voltage system. High Voltage Enabling

DC CHARGING DISABLED RESET

The DC Charging Disabled Reset procedure must be completed after Isolation Faults have been repaired.

The DC Charging Disabled Reset procedure requires a scan tool sequence and can be completed using the following steps:

1. Vehicle in Service Mode.
2. With a scan tool, select DC Charging Disabled Reset in the Hybrid/EV Powertrain Control Module 2 Configuration/Reset Functions, Reset Functions list.
3. Follow the scan tool directions to complete the procedure.
4. With a scan tool, clear any DTCs that may be set.
5. Vehicle OFF.

POWER LINE COMMUNICATION MODULE REPLACEMENT

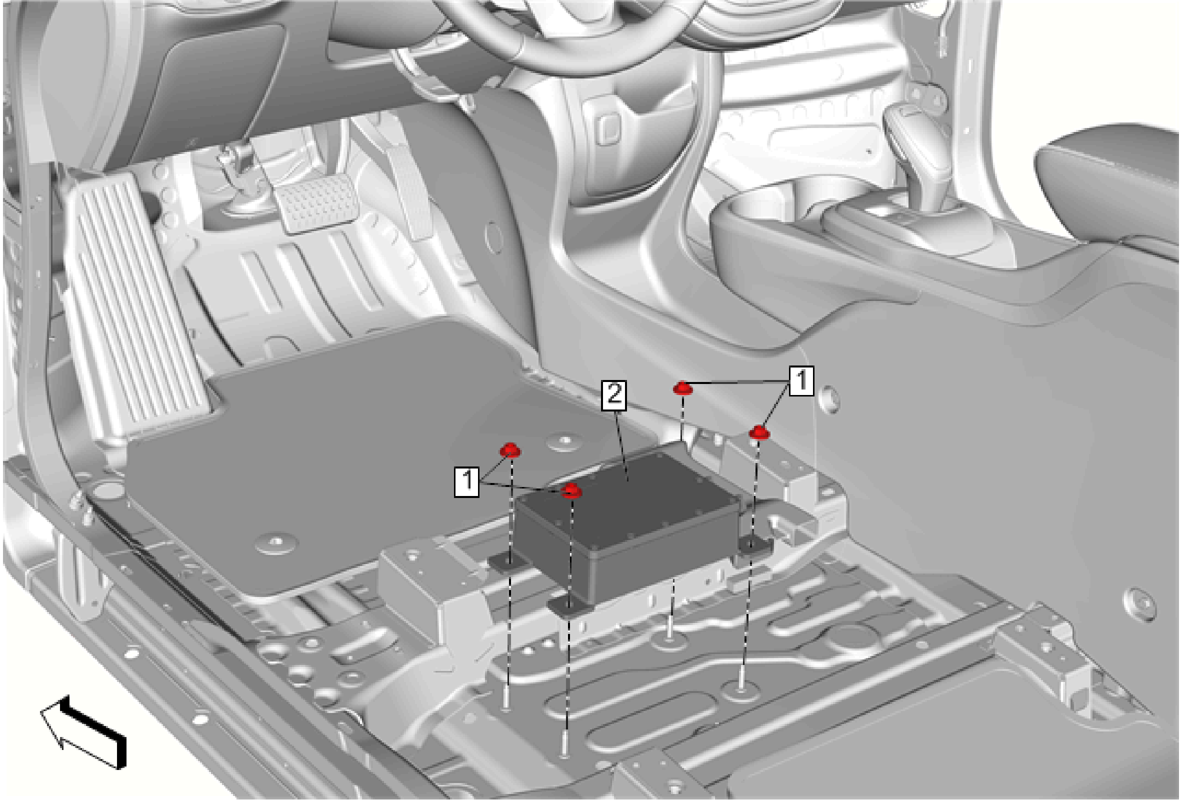


Fig. 99: Power Line Communication Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures **WARNING:** Battery Disconnect Warning 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection 2. Remove the driver seat. Driver or Passenger Seat Removal and Installation	
1	Power Line Communication Module Nut **CAUTION:** Fastener Caution **Tighten** 9 N.m (80 lb in)
2	Power Line Communication Module **Procedure** 1. To access the module, open up the floor carpet along the cut line. 2. Disconnect the electrical connectors. 3. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection 4. For programming and set up, refer to Control Module References .

DESCRIPTION AND OPERATION

PLUG-IN CHARGING SYSTEM DESCRIPTION AND OPERATION

Plug-In Charging System Components

The high voltage battery charging system consists of four main components:

1. The off-vehicle charging equipment:
    - Drive motor battery charger cable, often referred to as the travel cord set
    - Optional, permanent 220 - 240 V charge station
2. The hybrid/EV battery charger receptacle, often referred to as the drive motor battery charger receptacle.
3. The battery charger, often referred to as the drive motor battery charger.
4. The hybrid/EV battery pack.

A variety of mechanical, visual, and audio indicators/devices are used to communicate with the user of the charging equipment.

Drive Motor Battery Charger Cable/Charge Station

The drive motor battery charger cable provided with the vehicle features a standard household electrical plug on one end and a plug designed to interface with the vehicles hybrid/EV battery charger receptacle on the other end. The drive motor battery charger cable features a charge current interrupt device with AC power and fault indicators, and it is stored in the vehicle's cargo area. An optional charge station is available for customers who want to reduce the amount of time needed to recharge. The optional charge station, if available, is hard-wired to a 220 - 240 V power supply and must be permanently mounted at the customer's location. The optional charge station features the same plug on the vehicle end as the drive motor battery charger cable.

The Drive Motor Battery Charger Cable Indicators and the Vehicle Indicators

The drive motor battery charger cable has two indicators, the AC Present Indicator and the Fault Indicator, which display its status.

- Solid green AC Present Indicator means AC voltage is present at the wall plug and there are no faults.
- Flashing green AC Present Indicator and solid red Fault Indicator means the electrical outlet or plug is faulty or overheated.
- Solid red Fault Indicator means the AC outlet does not have a proper ground and charging is not permitted for safety reasons.
- Flashing red Fault Indicator means there is a vehicle fault and the charger cable ground-fault circuit interrupter (GFCI) has tripped.
- Solid green AC Present Indicator and flashing red Fault Indicator means the charger cable has failed self-check.

The off-vehicle battery charging equipment is supervised and controlled by the hybrid/EV powertrain control module 2. The hybrid/EV powertrain control module 2 is the primary controller, and all diagnostic trouble codes will set in that module even though some of the diagnostics are actually run within the battery charger. Charging events can be delayed based on electric rates and departure time. The status of charging events, including delays, is communicated to the user through visual indications, instrument panel mounted charge status indicator, and audio tones. The vehicle charge status indicator, located on the top middle of the instrument panel, will be short flashing green when the vehicle is charging under automatic control. The flash rate increases from one to four as the battery charges. It will be long flashing green if the charging is delayed and will begin later. It will be solid green when charging is complete. A solid yellow indicator means the vehicle is not able to accept a charge. If there is no indicator, the drive motor battery charger cable is not working properly or not connected.

Vehicle Receptacle

The vehicle receptacle, or hybrid/EV battery charger receptacle, is located behind the charging port door on the driver's side rear quarter panel. The receptacle is accessed by depressing and opening the receptacle door.

Battery Charger

The battery charger is a serviceable assembly containing several micro-processors and two separate high voltage chargers. The battery charger is mounted beneath the vehicle under the hybrid/EV battery pack. DEX-COOLÃ‚Â® coolant is used to ensure that the charger does not exceed its maximum designed operating temperature. The battery charger, along with the 14 V power module and the drive motor generator power inverter module, are cooled by a power electronics cooling loop, which is separate from other cooling systems.

12 V Battery Maintenance Mode

Battery Maintenance Mode is an automatic function that prevents deep discharge of the 12 V battery in specific circumstances. It is not dependent on the drive motor battery charger cable being plugged into the hybrid/EV battery charger receptacle. It functions either when the drive motor battery charger cable is plugged in or unplugged. Operation differs depending on whether the power mode is Vehicle Off or Vehicle in Service Mode.

With Vehicle Off, the 12 V battery is monitored at periodic intervals up to a maximum of 30 days. With Vehicle in Service Mode, the 12 V battery is monitored at periodic intervals up to a maximum of 60 hours. If voltage is low, the 12 V battery is charged by the 14 V power module using external power for up to four hours. This function is only intended to prevent a dead 12 V battery and does not provide a full charge. This is more efficient than continuously trickle charging, thus minimizing the usage of external power.

Under normal circumstances, with a 12 V battery that is charged when the vehicle is parked, Battery Maintenance Mode will simply monitor the voltage level, and no charging will be necessary. With Vehicle Off, Battery Maintenance Mode will maintain the 12 V battery for up to 30 days. For longer periods, refer to Owner Manual for instructions.

DC Fast Charging System (if equipped)

The DC high power fast charge system consists of the stationary DC fast charge station, the DC combo plug, the hybrid/EV battery charger receptacle, the battery charger - DC, and the hybrid/EV battery pack. The high voltage DC current is directly supplied to the hybrid/EV battery pack through the battery charger -DC, bypassing the battery charger, often referred to as the drive motor battery charger. The receptacle has a locking mechanism that locks the DC combo plug while power is being transferred to the hybrid/EV battery pack. The mechanical lock is a safety system that is controlled by the hybrid/EV powertrain control module 2. This locking mechanism will disengage once the charging process is completed or terminated and high voltage DC is reduced to a safe voltage level at the DC combo plug.

The hybrid/EV powertrain control module 2 monitors and verifies the following conditions before the charging process can begin:

- The stationary charge station is capable of providing high voltage DC power to the hybrid/EV battery pack.
- The hybrid/EV battery pack temperature can be maintained within the normal operating range.
- No high voltage electrical safety faults are present.
- The receptacle locking mechanism is operating properly.
- Vehicle immobilization is successful, if equipped.

If any of these conditions fail during the charging process, then the charging process will be terminated.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

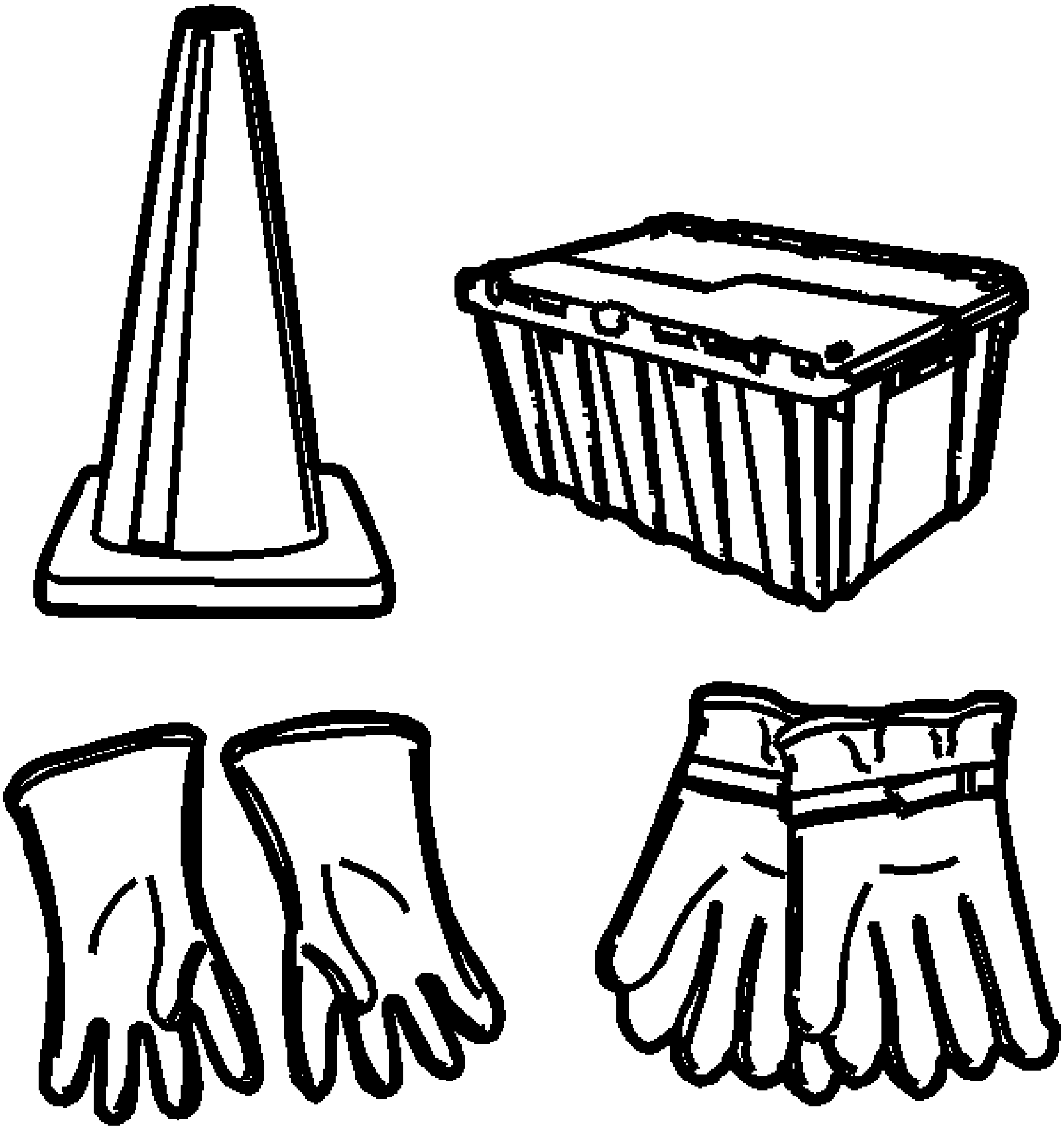
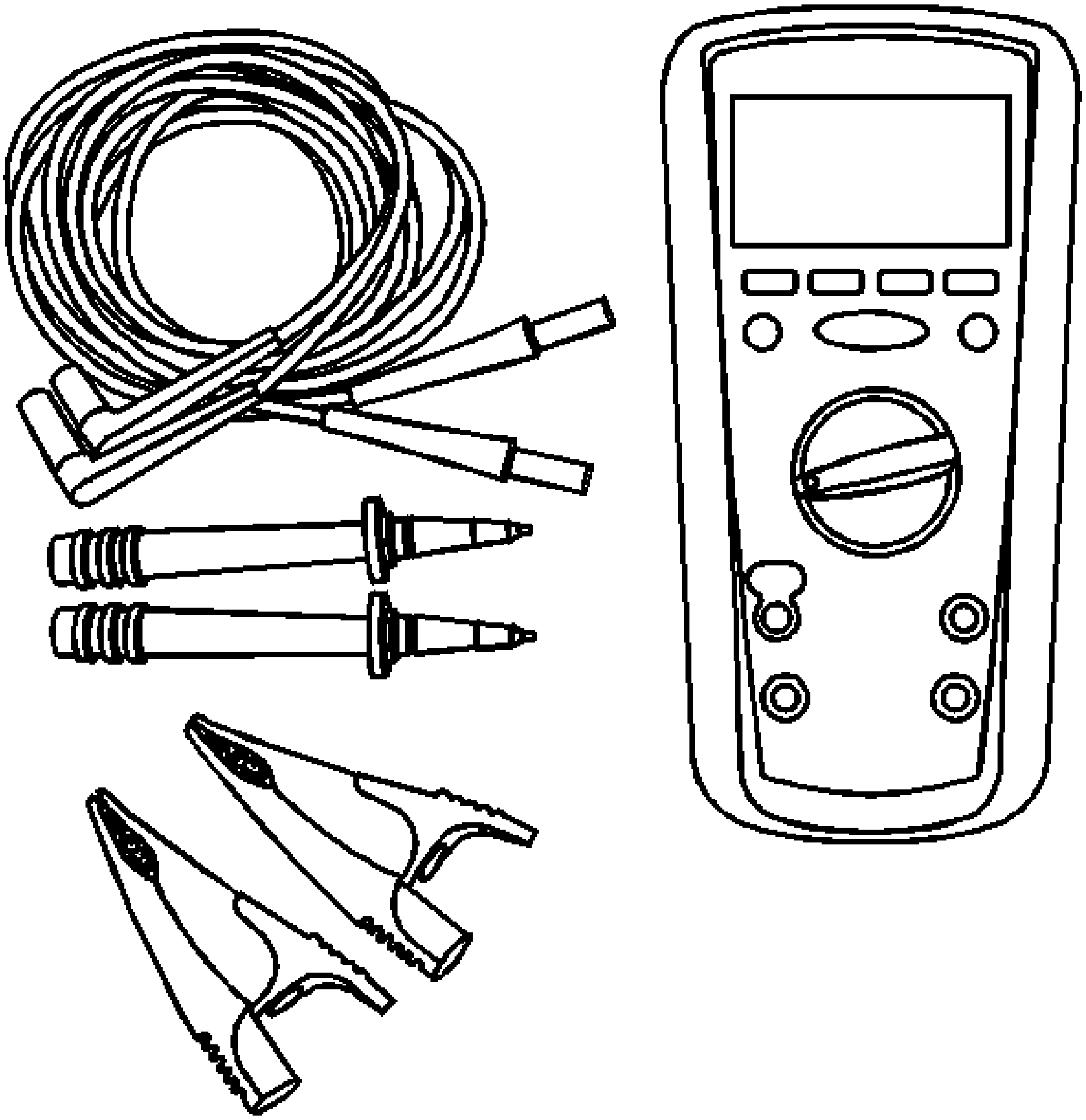
Illustration	Tool Number/Description
	EL-48900 HEV Safety Kit or equivalent Dealer Equipment

Illustration	Tool Number/Description
	EL-50772 Insulation Multimeter

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2017 ELECTRICAL

Wiring Systems And Power Management - Component Connector End Views - Index - Bolt EV

COMPONENT CONNECTOR END VIEWS - INDEX

Component Connector End Views Index

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C5C Hybrid/EV Battery Module 3 X1
C5C Hybrid/EV Battery Module 3 X2
C5D Hybrid/EV Battery Module 4 X1
C5D Hybrid/EV Battery Module 4 X2
C5E Hybrid/EV Battery Module 5 X1
C5E Hybrid/EV Battery Module 5 X2
C5F Hybrid/EV Battery Module 6 X1
C5F Hybrid/EV Battery Module 6 X2
C5G Hybrid/EV Battery Module 7 X1
C5G Hybrid/EV Battery Module 7 X2
C5H Hybrid/EV Battery Module 8 X1
C5H Hybrid/EV Battery Module 8 X2
C5J Hybrid/EV Battery Module 9 X1
C5J Hybrid/EV Battery Module 9 X2
C5K Hybrid/EV Battery Module 10 X1
C5K Hybrid/EV Battery Module 10 X2
E1G Accent Lamp - Left Instrument Panel
E1H Accent Lamp - Right Instrument Panel
E2LR Side Marker Lamp - Left Rear (TW5)
E2RR Side Marker Lamp - Right Rear (TW5)
E4LF Turn Signal Lamp - Left Front (KA6)
E4RF Turn Signal Lamp - Right Front
E6 Center High Mounted Stop Lamp
E7L License Plate Lamp - Left
E7R License Plate Lamp - Right
E8S Rear Compartment Courtesy Lamp
E14C Seat Heating Element - Passenger Back (KA1)
E14D Seat Heating Element - Passenger Cushion
E14F Seat Heating Element - Left Rear Cushion (KA6)
E14H Seat Heating Element - Right Rear Cushion
E15 Steering Wheel Heater
E18 Rear Defogger Grid X1
E18 Rear Defogger Grid X2
E37D Dome/Reading Lamps - Overhead Console
E37R Dome/Reading Lamps - Rear
E54 Hybrid/EV Battery Pack Coolant Heater X1
E54 Hybrid/EV Battery Pack Coolant Heater X2
F101 Passenger Instrument Panel Air Bag X1
F101 Passenger Instrument Panel Air Bag X2
F105L Roof Rail Air Bag - Left (AYF/AY0)
F105R Roof Rail Air Bag - Right (AYF/AY0)

Description
F106LR Seat Side Air Bag - Left Rear (AYF)
F106P Seat Side Air Bag - Passenger (AY0/AYF)
F106RR Seat Side Air Bag - Right Rear (AYF)
F107 Steering Wheel Air Bag X1
F107 Steering Wheel Air Bag X2
F112D Seat Belt Retractor Pretensioner - Driver (AY0)
F112LR Seat Belt Retractor Pretensioner - Left Rear (SBK)
F112P Seat Belt Retractor Pretensioner - Passenger (AY0)
F112RR Seat Belt Retractor Pretensioner - Right Rear (SBK)
F113D Seat Belt Anchor Pretensioner - Driver (AY0)
F113P Seat Belt Anchor Pretensioner - Passenger (AY0)
F114D Knee Air Bag - Driver (AYF)
F114P Knee Air Bag - Passenger (AYF)
G1 A/C Compressor X1
G1 A/C Compressor X2
G5 Transmission Fluid Pump - Electric/Auxiliary
G10 Cooling Fan Motor
G19 Rear Window Washer Pump
G24 Windshield Washer Pump
G35 Hybrid/EV Electronics Coolant Pump
G36 Auxiliary Heater Coolant Pump
G37 Hybrid/EV Battery Pack Coolant Pump
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K16 Battery Energy Control Module X1
K16 Battery Energy Control Module X2
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K16 Battery Energy Control Module X5
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K16 Battery Energy Control Module X8
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K20 Engine Control Module X1
K20 Engine Control Module X2
K20 Engine Control Module X3
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K29F Seat Heating Control Module - Front X2 (KA1)
K29R Seat Heating Control Module - Rear X1 (KA6)
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K32 Steering Wheel Heating Control Module
K33 HVAC Control Module X1
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K33 HVAC Control Module X3
K36 Inflatable Restraint Sensing and Diagnostic Module X1
K36 Inflatable Restraint Sensing and Diagnostic Module X2 (AY0/AYF)
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K38 Chassis Control Module
M38 Power Steering Motor X1
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K56 Serial Data Gateway Module X1
K56 Serial Data Gateway Module X2
K57 Battery Charger Control Module X1
K60 Steering Column Lock Module (NO6)
K68 Trailer Lighting Control Module X1 (MBM)
K68 Trailer Lighting Control Module X2 (MBM)
K73 Telematics Communication Interface Control Module X7
K73 Telematics Communication Interface Control Module X1 (UE1)
K73 Telematics Communication Interface Control Module X2 (UE1)
K73 Telematics Communication Interface Control Module X5
K77 Remote Control Door Lock Receiver
K84 Keyless Entry Control Module X1
K84 Keyless Entry Control Module X2
K85 Passenger Presence Module
K89 Immobilizer Control Module
K101 Trailer Interface Control Module X1
K101 Trailer Interface Control Module X2
K114B Hybrid/EV Powertrain Control Module 2 X1
K114B Hybrid/EV Powertrain Control Module 2 X2
K132 Pedestrian Alert Sound Control Module
K157 Video Processing Control Module X1 (UVH)
K157 Video Processing Control Module X2 (UVH)
K173 Transmission Range Control Module
K177 Brake Booster Control Module
K182 Parking Assist Control Module X1
K182 Parking Assist Control Module X2
K182 Parking Assist Control Module X3
K183 Short Range Remote Control Transceiver
K190 Power Line Communication Module X1 (CBT)
K190 Power Line Communication Module X2 (CBT)
M6 Air Temperature Door Actuator
M8 Blower Motor
M29L Headlamp Leveling Actuator - Left (TR6)
M29R Headlamp Leveling Actuator - Right (TR6)
M37 Mode Door Actuator
M45 Rear Wiper Motor
M46 Air Recirculation Door Actuator
M74D Window Motor - Driver
M74LR Window Motor - Left Rear
M74P Window Motor - Passenger
M74RR Window Motor - Right Rear
M75L Windshield Wiper Motor Module - Left

Description
M75R Windshield Wiper Motor Module - Right
M96 Active Grille Air Shutter Actuator
M104L Park Brake Actuator - Left
M104R Park Brake Actuator - Right
P12L Horn - Left
P12R Horn - Right
P14 Passenger Air Bag Disabled Indicator
P16 Instrument Cluster
P17 Info Display Module X1
P19AC Speaker - Subwoofer (UQA)
P19AG Speaker - Left Front Door (UQ3)
P19AG Speaker - Left Front Door (UQA)
P19AH Speaker - Right Front Door (UQ3)
P19AH Speaker - Right Front Door (UQA)
P19AL Speaker - Left Rear Door (UQ3)
P19AL Speaker - Left Rear Door (UQA)
P19AM Speaker - Right Rear Door (UQ3)
P19AM Speaker - Right Rear Door (UQA)
P19H Speaker - Left Front Tweeter (UQA)
P19V Speaker - Right Front Tweeter (UQA)
P43 Collision Alert Indicators (UEU/UHX/UHY/UVX)
P48 Pedestrian Alert Sound Speaker
S3 Transmission Shift Lever
S13D Door Lock Switch - Driver
S13P Door Lock Switch - Passenger
S30 Headlamp Switch
S32LR Seat Heating Switch - Left Rear (KA6)
S32RR Seat Heating Switch - Right Rear
S33 Horn Switch
S40 Passenger Air Bag Disable Switch (C99)
S46B Liftgate Unlatch Switch
S48C Multifunction Switch 1 - Instrument Panel
S48D Multifunction Switch 2 - Instrument Panel
S51 Telematics Button Assembly (UE1)
S70E Steering Wheel Controls Switch - Radio Presets
S70F Steering Wheel Controls Switch - Radio Volume
S70L Steering Wheel Controls Switch - Left
S70R Steering Wheel Controls Switch - Right
S78 Turn Signal/Multifunction Switch
S79D Window Switch - Driver
S79LR Window Switch - Left Rear
S79P Window Switch - Passenger
S79RR Window Switch - Right Rear
S82 Windshield Wiper/Washer Switch
S83 Vehicle On/Off Switch
S91 Park Brake Control Switch
S151 Regenerative Braking On-Demand Switch
T2RR Antenna - Roof Rear X1
T2RR Antenna - Roof Rear X2
T2RR Antenna - Roof Rear X5
T2RR Antenna - Roof Rear X6
T3 Audio Amplifier X1 (UQA)

Description
T3 Audio Amplifier X2 (UQA)
T3 Audio Amplifier X3 (UQA)
T6 Power Inverter Module X1
T6 Power Inverter Module X2
T6 Power Inverter Module X3
T10E Keyless Entry Antenna - Rear Compartment
T10G Keyless Entry Antenna - Rear Fascia
T10J Keyless Entry Antenna - Center Console Front
T12 Automatic Transmission Assembly X1
T12 Automatic Transmission Assembly X2
T12 Automatic Transmission Assembly X3
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T23 Radio Antenna Amplifier X2
T23 Radio Antenna Amplifier X3
T24 Battery Charger - DC X2
T24 Battery Charger - DC X3
T24 Battery Charger - DC X4
T24 Battery Charger - DC X5
T24 Battery Charger - DC X6
T24 Battery Charger - DC X7
T24 Battery Charger - DC X8
T24 Battery Charger - DC X1
T24 Battery Charger - DC X9 (-CBT)
X21 Manual Service Disconnect Receptacle X1
X21 Manual Service Disconnect Receptacle X2
X21 Manual Service Disconnect Receptacle X3
X80 Accessory Power Receptacle
X83 Auxiliary Audio Input X1
X83 Auxiliary Audio Input X2
X84B Auxiliary Data Connector X2
X84 Data Link Connector
X85 Steering Wheel Air Bag Coil X1
X85 Steering Wheel Air Bag Coil X2
X92 USB Receptacle (USS)
X98 Hybrid/EV Battery Charger Receptacle X1
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COMPONENT CONNECTOR END VIEWS

C5B HYBRID/EV BATTERY MODULE 2 X2

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Connector Part Information - Harness Type: Hybrid/EV Battery - OEM Connector: Not Available - Service Connector: Service by Harness - See Part Catalog - Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GY	5578	Battery Voltage Signal 19	I	-
2	-	OG	5576	Battery Voltage Signal 17	I	-
3	-	YE	5574	Battery Voltage Signal 15	I	-
4	-	GN	5572	Battery Voltage Signal 13	I	-
5	-	L-GN	5593	Module Temperature Low Reference 2	I	-

C5C HYBRID/EV BATTERY MODULE 3 X1

-
Connector Part Information - Harness Type: Hybrid/EV Battery - OEM Connector: Not Available - Service Connector: Service by Harness - See Part Catalog - Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG/RD	5403	Battery Pack Monitor Low Reference	I	-
2	-	GN/WH	5581	Battery Voltage Signal 22	I	-
3	-	PK	5583	Battery Voltage Signal 24	I	-
4	-	L-BU	5585	Battery Voltage Signal 26	I	-
5	-	VT	5587	Battery Voltage Signal 28	I	-
6	-	WH	5589	Battery Voltage Signal 30	I	-

C5C HYBRID/EV BATTERY MODULE 3 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BU	5580	Battery Voltage Signal 21	I	-
2	-	L-GN	5582	Battery Voltage Signal 23	I	-
3	-	GN	5584	Battery Voltage Signal 25	I	-
4	-	YE	5586	Battery Voltage Signal 27	I	-
5	-	OG	5588	Battery Voltage Signal 29	I	-

C5D HYBRID/EV BATTERY MODULE 4 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT	4521	Battery Cell Voltage Signal 40	I	-
2	-	L-BU	4519	Battery Cell Voltage Signal 38	I	-
4	-	GN/WH	4514	Battery Cell Voltage Signal 34	I	-
5	-	OG/RD	5591	Battery Voltage Signal 32	I	-
6	-	GY	5403	Battery Pack Monitor Low Reference	I	-
12	-	PK	4517	Battery Cell Voltage Signal 36	I	-

C5D HYBRID/EV BATTERY MODULE 4 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	YE	4520	Battery Cell Voltage Signal 39	I	-
2	-	GN	4518	Battery Cell Voltage Signal 37	I	-
3	-	BU/GN	4516	Battery Cell Voltage Signal 35	I	-
4	-	BU	5592	Battery Voltage Signal 33	I	-
5	-	BN	5590	Battery Voltage Signal 31	I	-

C5E HYBRID/EV BATTERY MODULE 5 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	PK	4529	Battery Cell Voltage Signal 48	I	-
2	-	GN/WH	4527	Battery Cell Voltage Signal 46	I	-
3	-	OG/RD	4525	Battery Cell Voltage Signal 44	I	-
4	-	GY	4523	Battery Cell Voltage Signal 42	I	-
5	-	OG	5403	Battery Pack Monitor Low Reference	I	-

C5E HYBRID/EV BATTERY MODULE 5 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	L-BU	4528	Battery Cell Voltage Signal 47	I	-
2	-	BU	4526	Battery Cell Voltage Signal 45	I	-
3	-	BN	4524	Battery Cell Voltage Signal 43	I	-
4	-	WH	4522	Battery Cell Voltage Signal 41	I	-

C5F HYBRID/EV BATTERY MODULE 6 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GN	5403	Battery Pack Monitor Low Reference	I	-
2	-	YE	4530	Battery Cell Voltage Signal 49	I	-
3	-	OG	4532	Battery Cell Voltage Signal 51	I	-
4	-	GY	4535	Battery Cell Voltage Signal 53	I	-
5	-	OG/RD	4538	Battery Cell Voltage Signal 56	I	-
6	-	GN/WH	4543	Battery Cell Voltage Signal 58	I	-

C5F HYBRID/EV BATTERY MODULE 6 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	L-BU	4529	Battery Cell Voltage Signal 48	I	-
2	-	VT	4531	Battery Cell Voltage Signal 50	I	-
3	-	WH	4533	Battery Cell Voltage Signal 52	I	-
4	-	GN/WH	4537	Battery Cell Voltage Signal 55	I	-
5	-	BU	4541	Battery Cell Voltage Signal 57	I	-

C5G HYBRID/EV BATTERY MODULE 7 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GY	4519	Battery Cell Voltage Signal 38	I	-
2	-	OG	4549	Battery Cell Voltage Signal 64	I	-
3	-	YE	4547	Battery Cell Voltage Signal 62	I	-
4	-	GN	4545	Battery Cell Voltage Signal 60	I	-
5	-	L-GN	5403	Battery Pack Monitor Low Reference	I	-

C5G HYBRID/EV BATTERY MODULE 7 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	WH	4518	Battery Cell Voltage Signal 37	I	-
2	-	VT	4548	Battery Cell Voltage Signal 63	I	-
3	-	L-BU	4546	Battery Cell Voltage Signal 61	I	-
4	-	PK	4544	Battery Cell Voltage Signal 59	I	-

C5H HYBRID/EV BATTERY MODULE 8 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery

- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BN	5403	Battery Pack Monitor Low Reference	I	-
2	-	BU	4556	Battery Cell Voltage Signal 68	I	-
3	-	L-GN	4558	Battery Cell Voltage Signal 70	I	-
4	-	GN	4561	Battery Cell Voltage Signal 72	I	-
5	-	YE	4563	Battery Cell Voltage Signal 74	I	-
6	-	OG	4565	Battery Cell Voltage Signal 76	I	-

C5H HYBRID/EV BATTERY MODULE 8 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG	4555	Battery Cell Voltage Signal 67	I	-
2	-	GN/WH	4557	Battery Cell Voltage Signal 69	I	-
3	-	PK	4560	Battery Cell Voltage Signal 71	I	-
4	-	L-BU	4562	Battery Cell Voltage Signal 73	I	-
5	-	VT	4564	Battery Cell Voltage Signal 75	I	-

C5J HYBRID/EV BATTERY MODULE 9 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	YE	4575	Battery Cell Voltage Signal 86	I	-
2	-	GN	4573	Battery Cell Voltage Signal 84	I	-
3	-	L-GN	4571	Battery Cell Voltage Signal 82	I	-
4	-	BU	4569	Battery Cell Voltage Signal 80	I	-
5	-	BN	4567	Battery Cell Voltage Signal 78	I	-
6	-	WH	5403	Battery Pack Monitor Low Reference	I	-

C5J HYBRID/EV BATTERY MODULE 9 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	L-BU	4574	Battery Cell Voltage Signal 85	I	-
2	-	PK	4572	Battery Cell Voltage Signal 83	I	-
3	-	GN/WH	4570	Battery Cell Voltage Signal 81	I	-
4	-	OG	4568	Battery Cell Voltage Signal 79	I	-
5	-	GY	4566	Battery Cell Voltage Signal 77	I	-

C5K HYBRID/EV BATTERY MODULE 10 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT	5403	Battery Pack Monitor Low Reference	I	-
2	-	WH	4577	Battery Cell Voltage Signal 88	I	-
3	-	BN	2390	Battery Cell Voltage Signal 90	I	-
4	-	BU	2392	Battery Cell Voltage Signal 92	I	-
5	-	L-GN	2394	Battery Cell Voltage Signal 94	I	-
6	-	PK	2396	Battery Cell Voltage Signal 96	I	-

C5K HYBRID/EV BATTERY MODULE 10 X2

-

Connector Part Information

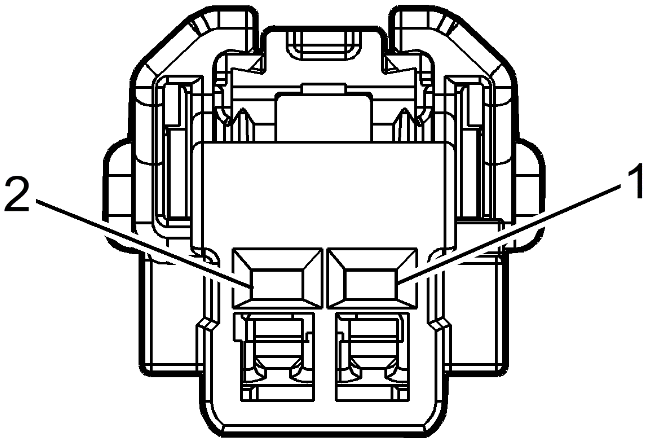
- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

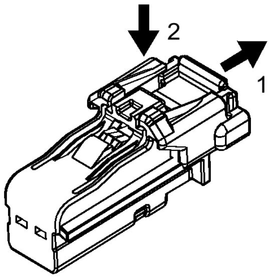
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG	4576	Battery Cell Voltage Signal 87	I	-
2	-	GY	2389	Battery Cell Voltage Signal 89	I	-
3	-	OG	2391	Battery Cell Voltage Signal 91	I	-
4	-	GN/WH	2393	Battery Cell Voltage Signal 93	I	-
5	-	L-BU	2395	Battery Cell Voltage Signal 95	I	-

E1G ACCENT LAMP - LEFT INSTRUMENT PANEL





Connector Part Information

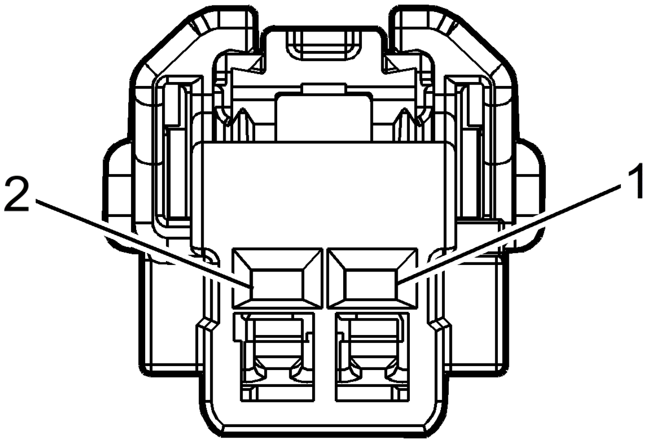
- Harness Type: Instrument Panel
- OEM Connector: 9956-1789
- Service Connector: 19352066
- Description: 2-Way F 1.2 Series (BK)

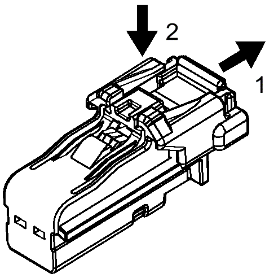
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1250	Ground	I	C9J
2	0.35	WH/YE	7557	LED Ambient Lighting Control 1	I	C9J

E1H ACCENT LAMP - RIGHT INSTRUMENT PANEL





Connector Part Information

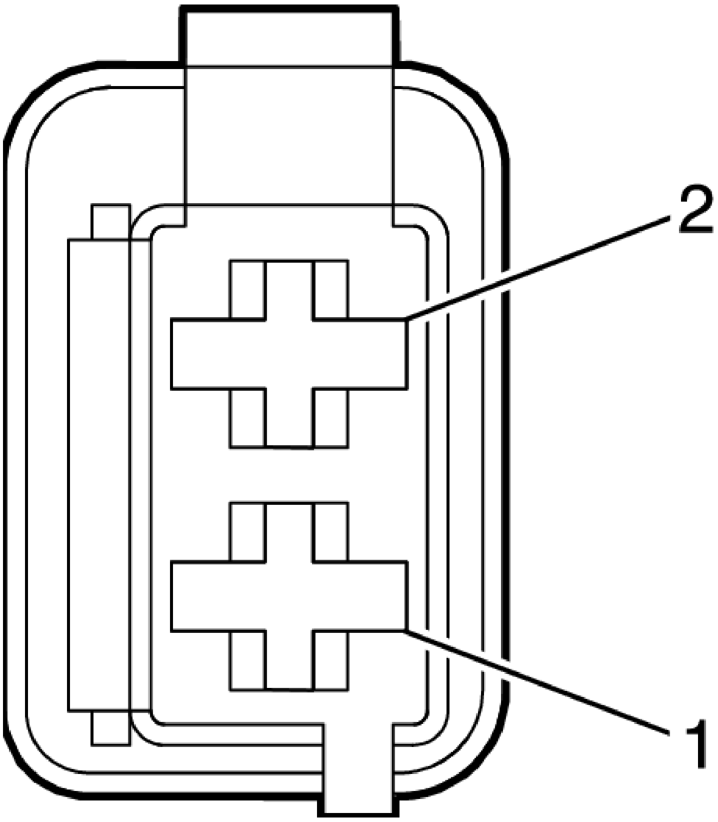
- Harness Type: Instrument Panel
- OEM Connector: 9956-1789
- Service Connector: 19352066
- Description: 2-Way F 1.2 Series (BK)

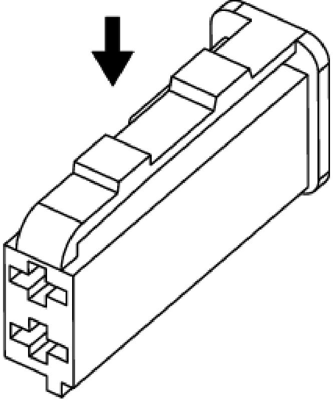
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1250	Ground	I	C9J
2	0.35	WH/YE	7557	LED Ambient Lighting Control 1	I	C9J

E2LR SIDE MARKER LAMP - LEFT REAR (TW5)





Connector Part Information

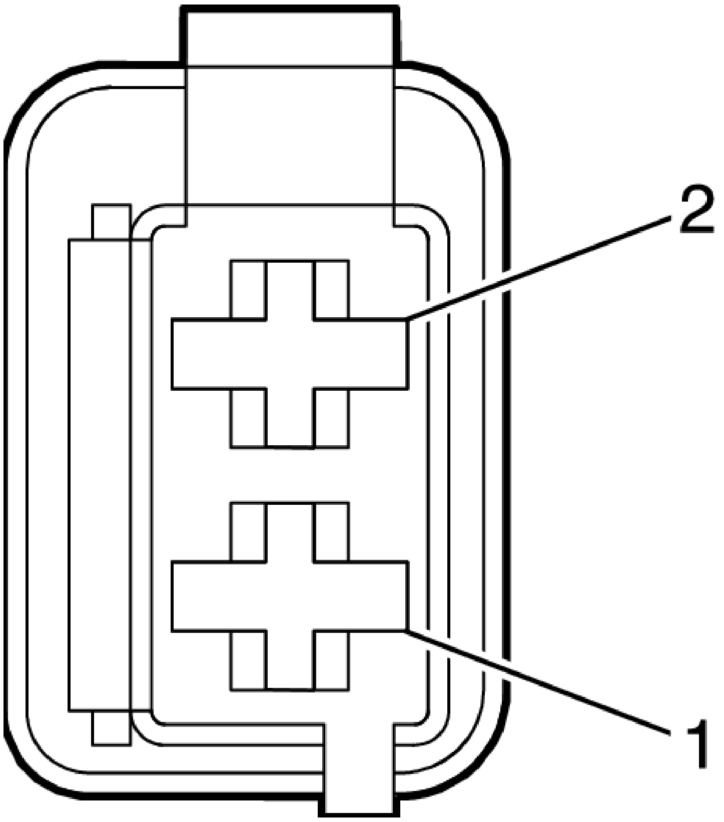
- Harness Type: Body
- OEM Connector: 1563189-1
- Service Connector: 13580951
- Description: 2-Way F 1.6 Timer Series (BK)

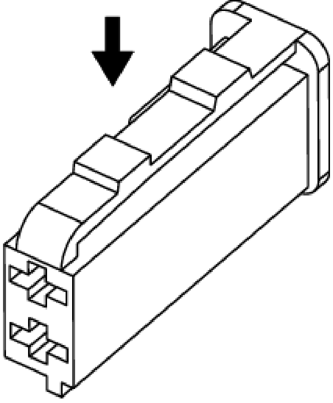
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/GY	709	Left Park Lamp Control	I	TW5
2	0.5	BK	1150	Ground	I	TW5

E2RR SIDE MARKER LAMP - RIGHT REAR (TW5)





Connector Part Information

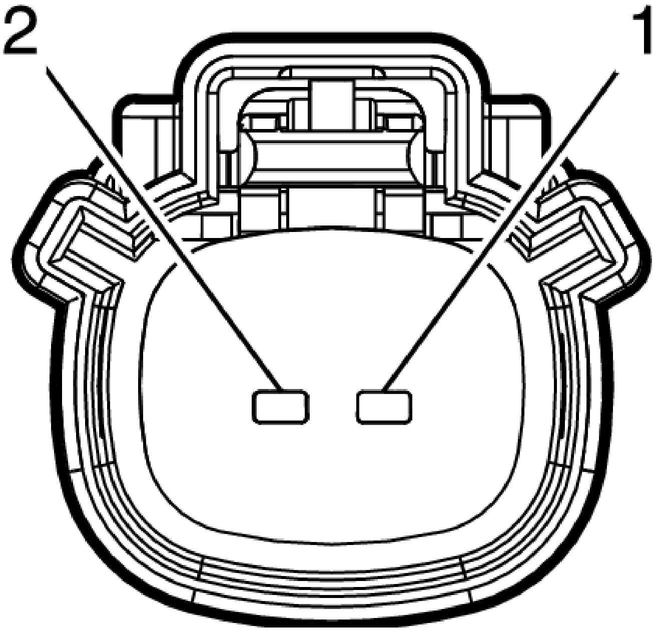
- Harness Type: Body
- OEM Connector: 1563189-1
- Service Connector: 13580951
- Description: 2-Way F 1.6 Timer Series (BK)

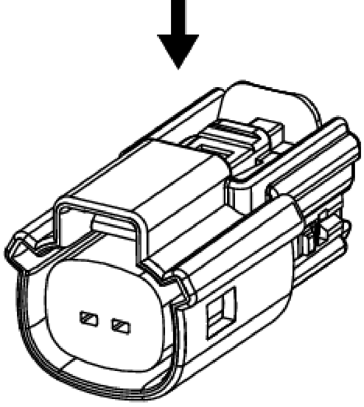
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BN	309	Right Park Lamp Control	I	TW5
2	0.75	BK	1550	Ground	I	TW5-UKC

E4LF TURN SIGNAL LAMP - LEFT FRONT (KA6)





Connector Part Information

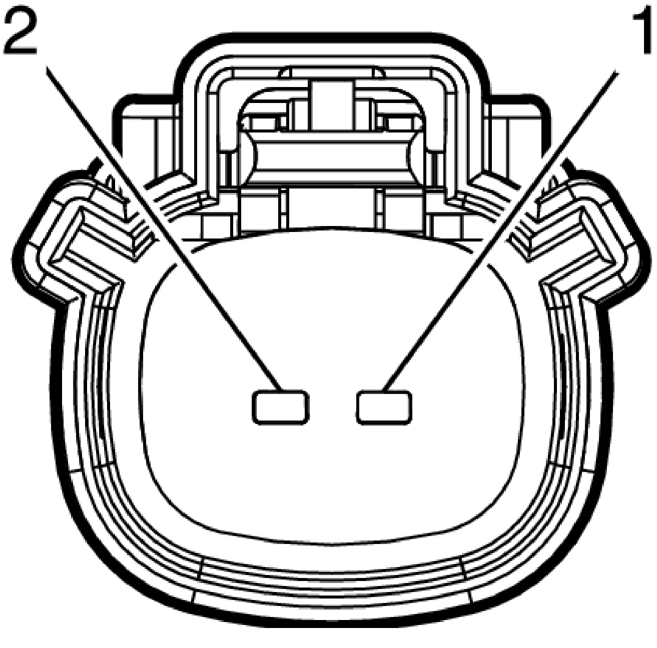
- Harness Type: Left Front Trun Signal Pigtail
- OEM Connector: 13503499
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 150 MX Series, Sealed (BK)

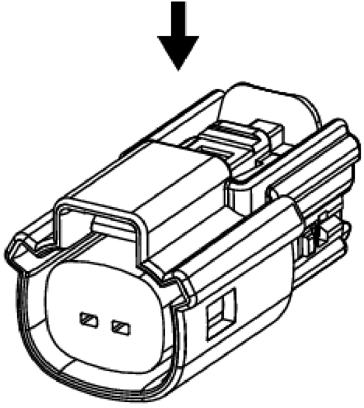
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BU/WH	1314	Left Front Turn Signal Lamp Control	I	-
2	-	BK	750	Ground	I	-

E4RF TURN SIGNAL LAMP - RIGHT FRONT





Connector Part Information

- Harness Type: Right Front Turn Signal Pigtail
- OEM Connector: 13503499
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GN/VT	1315	Right Front Turn Signal Lamp Control	I	-
2	-	BK	250	Ground	I	-

E6 CENTER HIGH MOUNTED STOP LAMP

-

Connector Part Information

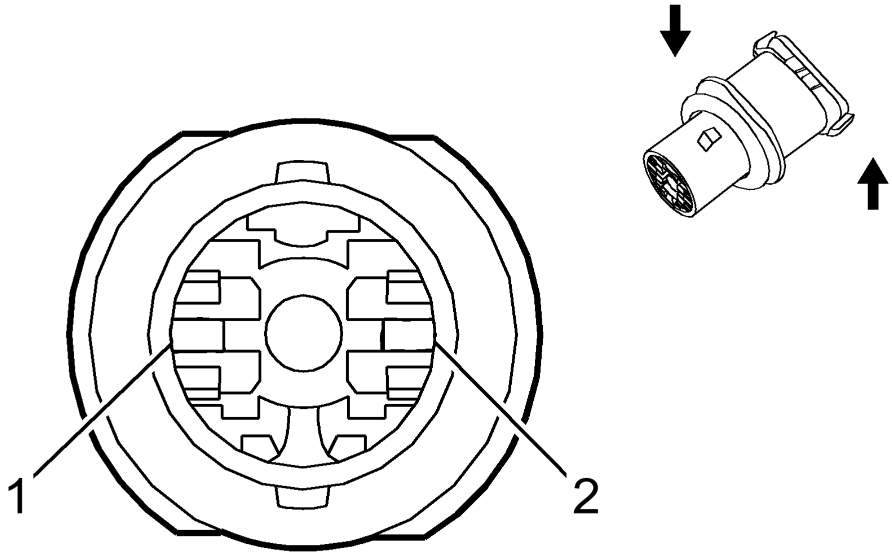
- Harness Type: Center High Mounted Stop Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BK	2350	Ground	I	-
2	-	BK	1050	Ground	I	-
3	-	BN/YE	820	CHMSL Control	I	-

E7L LICENSE PLATE LAMP - LEFT



Connector Part Information

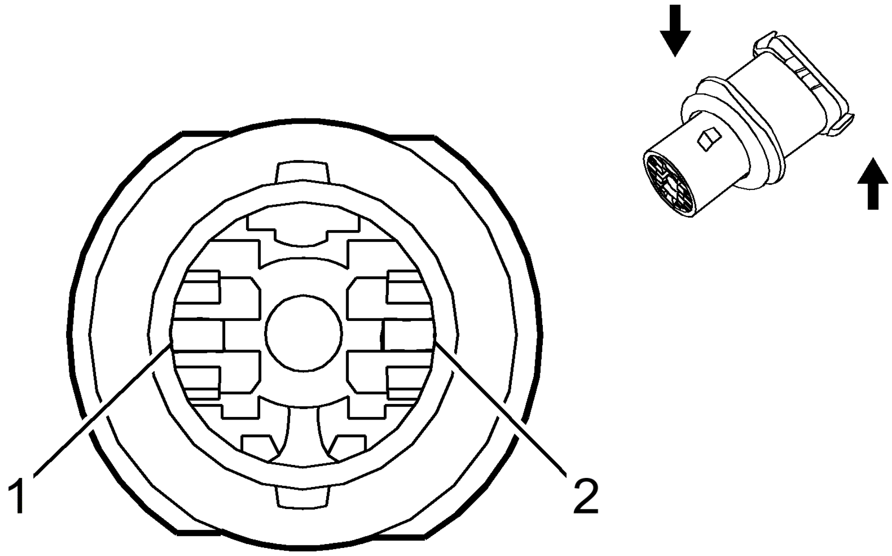
- Harness Type: License Plate Lamp
- OEM Connector: 13698133
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Lamp Socket Wedge Base, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/YE	6846	Rear License Lamp Control	I	-
2	0.35	BK	1050	Ground	I	-

E7R LICENSE PLATE LAMP - RIGHT



Connector Part Information

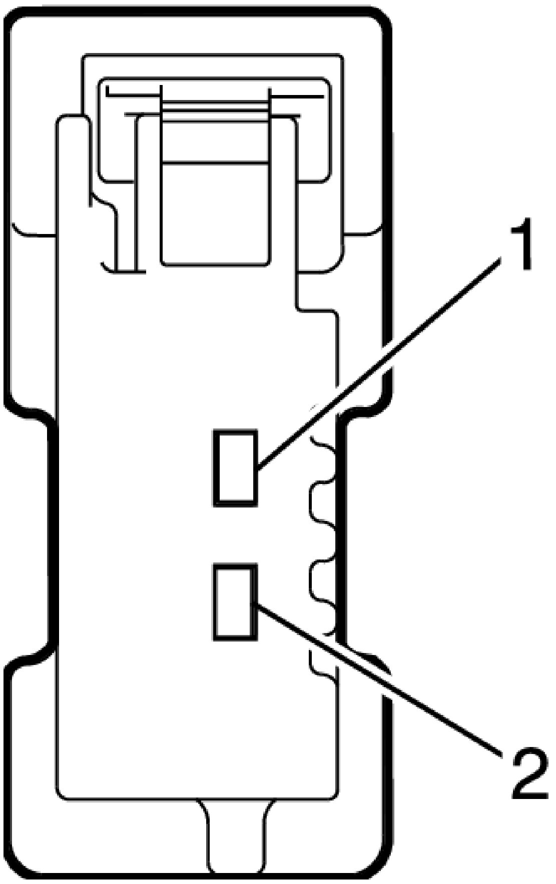
- Harness Type: License Plate Lamp
- OEM Connector: 13698133
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Lamp Socket Wedge Base, Sealed (BK)

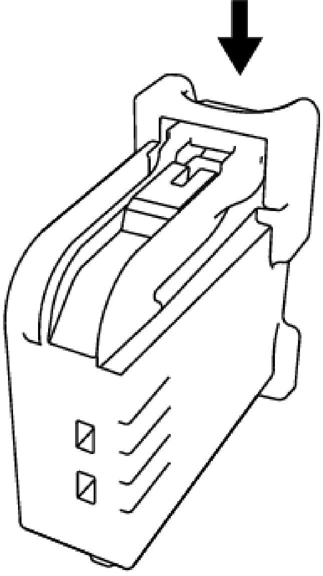
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/YE	6846	Rear License Lamp Control	I	-
2	0.35	BK	1050	Ground	I	-

E8S REAR COMPARTMENT COURTESY LAMP





Connector Part Information

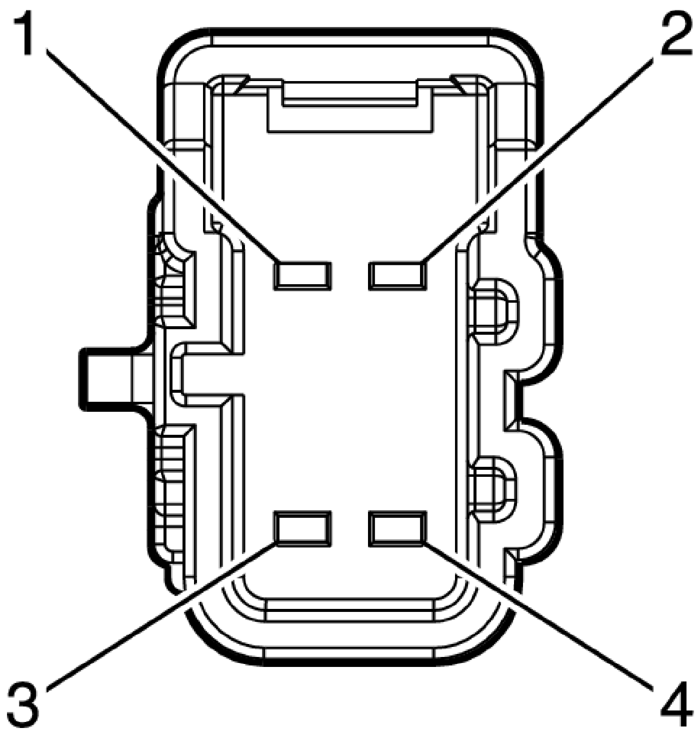
- Harness Type: Body
- OEM Connector: 6098-5510
- Service Connector: 13584097
- Description: 2-Way F 1.5 Series (BK)

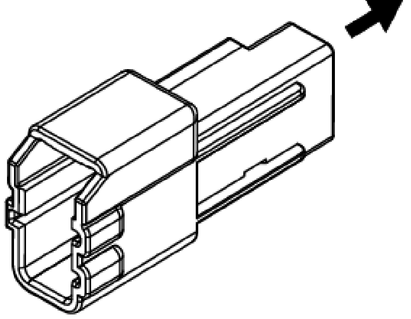
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/GY	737	Rear Compartment Lid Lamp Control	I	-
2	0.5	BK	1150	Ground	I	-

E14C SEAT HEATING ELEMENT - PASSENGER BACK (KA1)





Connector Part Information

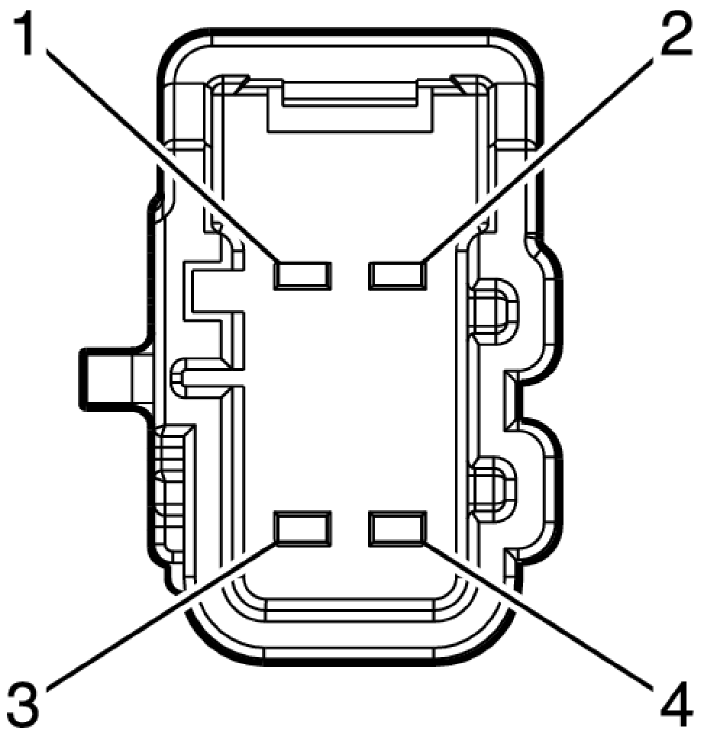
- Harness Type: Passenger Seat
- OEM Connector: 6098-7781
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (GY)

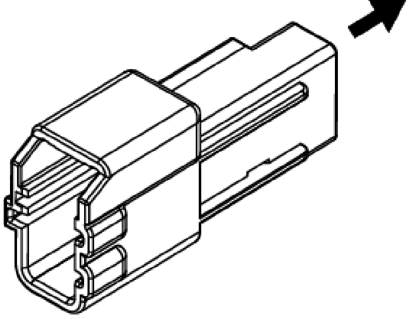
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/BU	2479	Passenger Heated Seat Element Control	I	-
2	0.5	WH/BU	2436	Passenger Heated Back NTC Signal	I	-
3	0.5	BK/GY	2435	Passenger Heated Seat NTC Low Reference	I	-
4	0.75	GY/BK	2480	Passenger Heated Seat Element Low Reference	I	-

E14D SEAT HEATING ELEMENT - PASSENGER CUSHION





Connector Part Information

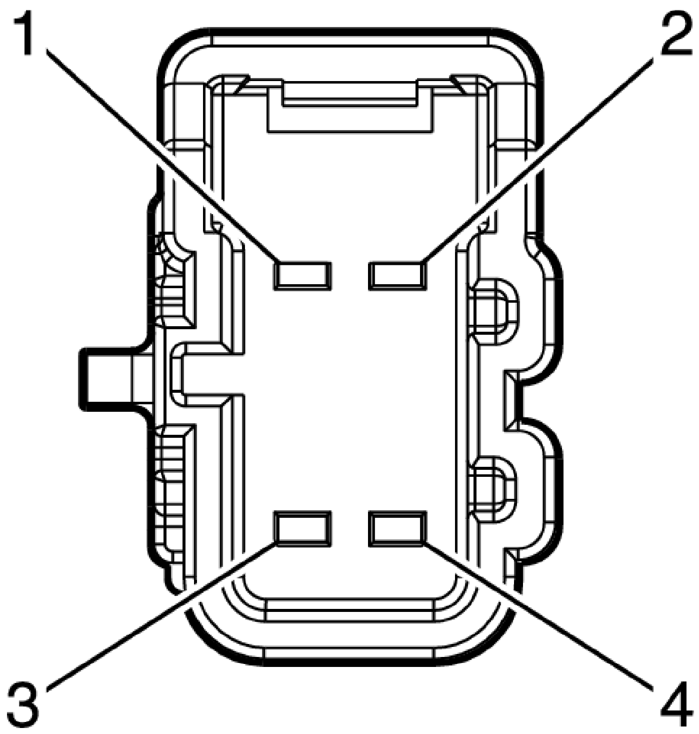
- Harness Type: Passenger Seat
- OEM Connector: 6098-7779
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (BK)

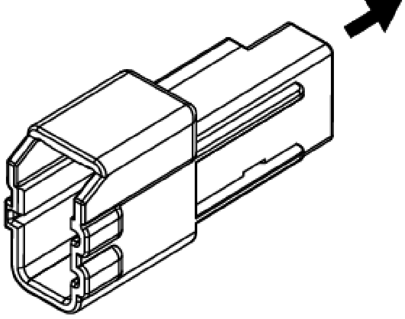
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/BU	2479	Passenger Heated Seat Element Control	I	-
2	0.5	WH/GY	2434	Passenger Heated Seat NTC Signal	I	-
3	0.5	BK/GY	2435	Passenger Heated Seat NTC Low Reference	I	-
4	0.75	GY/BK	2480	Passenger Heated Seat Element Low Reference	I	-

E14F SEAT HEATING ELEMENT - LEFT REAR CUSHION (KA6)





Connector Part Information

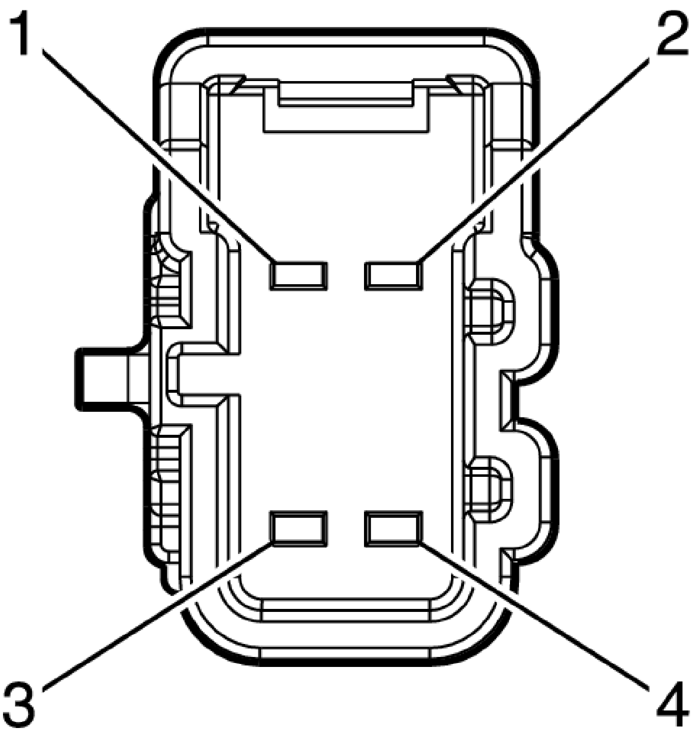
- Harness Type: Rear Heated Seat Harness
- OEM Connector: 13588644
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (BK)

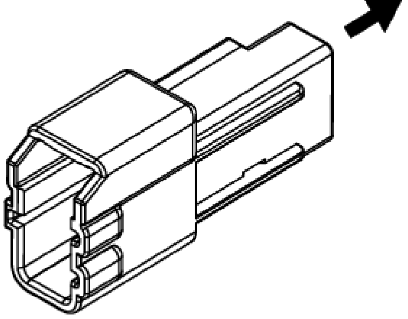
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	- -	GY BN/BK	2294 2295	Left Rear Heated Seat Cushion Element Control Left Rear Heated Seat Cushion Element Low Reference	I I	- -
2	-	GY	7663	Left Rear Heated Seat NTC Signal	I	-
3	-	VT/RD	7662	Left Rear Heated Seat NTC Low Reference	I	-
4	-	BN/BK	2295	Left Rear Heated Seat Cushion Element Low Reference	I	-

E14H SEAT HEATING ELEMENT - RIGHT REAR CUSHION





Connector Part Information

- Harness Type: Rear Heated Seat Harness
- OEM Connector: 13588644
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GN/BN	2296	Right Rear Heated Seat Cushion Element Control	I	-
2	-	YE/WH	7053	Right Rear Cushion NTC Signal	I	-
3	-	WH/BK	7054	Right Rear Cushion NTC Low Reference	I	-
4	-	GN/BK	2297	Right Rear Heated Seat Cushion Element Low Reference	I	-

E15 STEERING WHEEL HEATER

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Connector Part Information

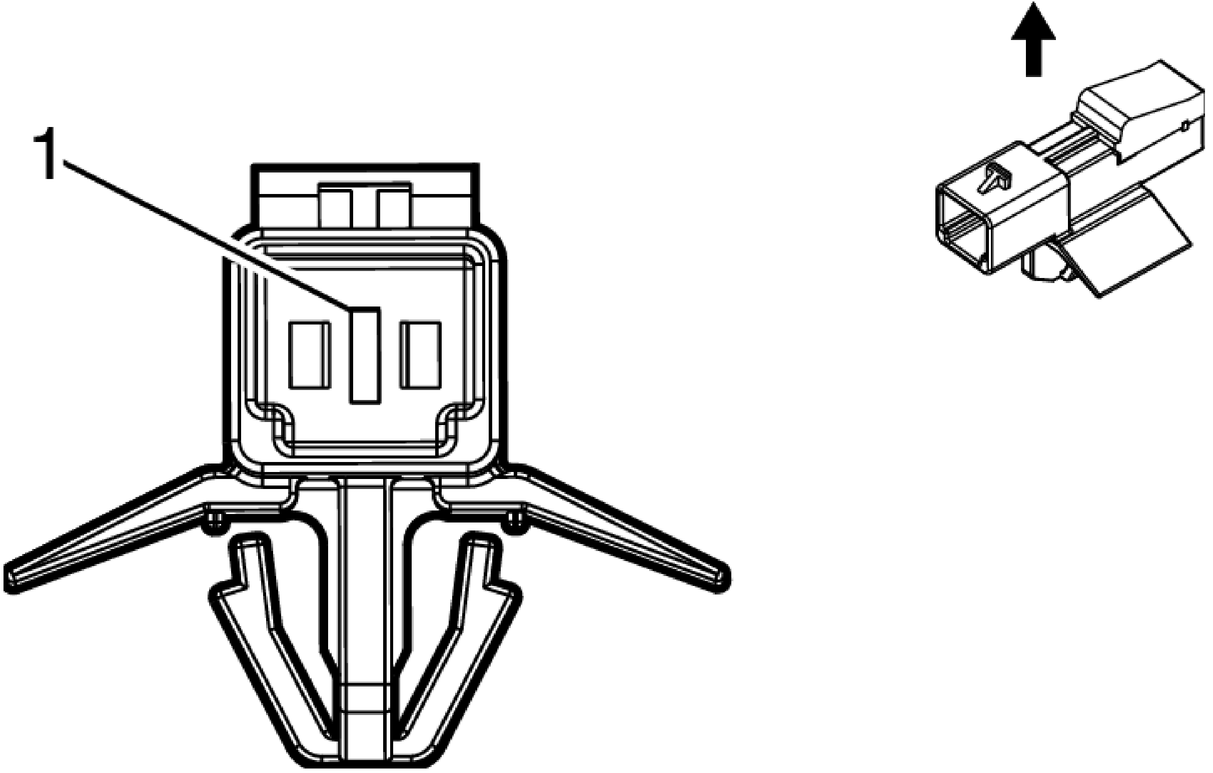
- Harness Type: Steering Wheel Harness
- OEM Connector: 31068-1040
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BN	1650	Ground	I	-
2	-	GY	5885	Heated Steering Wheel Voltage Reference	I	-
3	-	WH	5888	Heated Steering Wheel High Control	I	-
4	-	BK	1150	Ground	I	-

E18 REAR DEFOGGER GRID X1



Connector Part Information

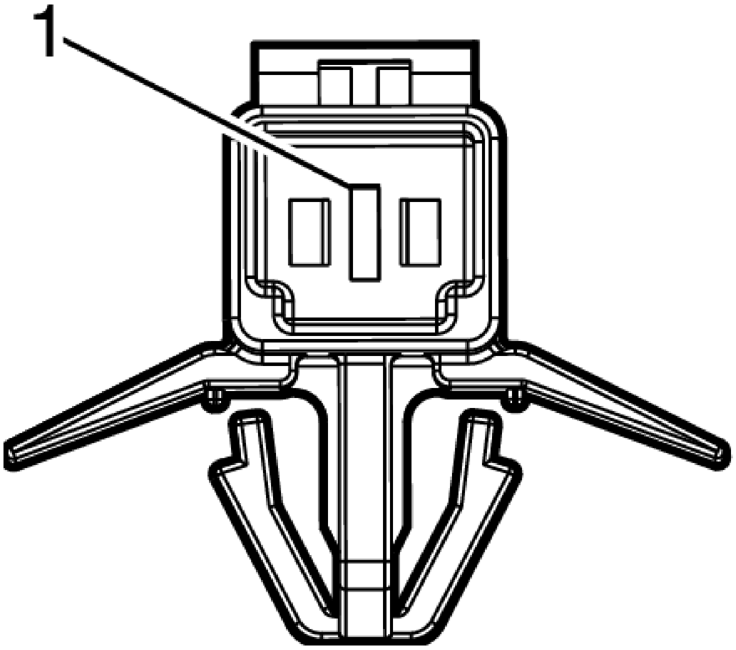
- Harness Type: Liftgate
- OEM Connector: 2109209-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F (BK)

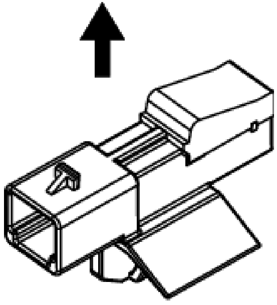
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-5 (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2	BN/VT	293	Rear Defog Element Control	I	-

E18 REAR DEFOGGER GRID X2





Connector Part Information

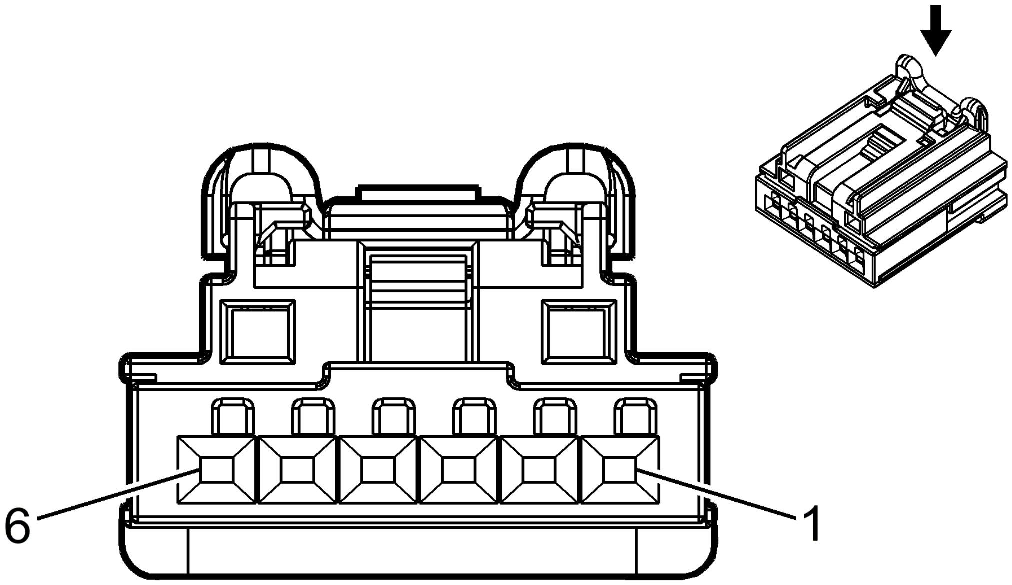
- Harness Type: Liftgate
- OEM Connector: 2109209-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-5 (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2	BK	1950	Ground	I	-

E37D DOME/READING LAMPS - OVERHEAD CONSOLE



Connector Part Information

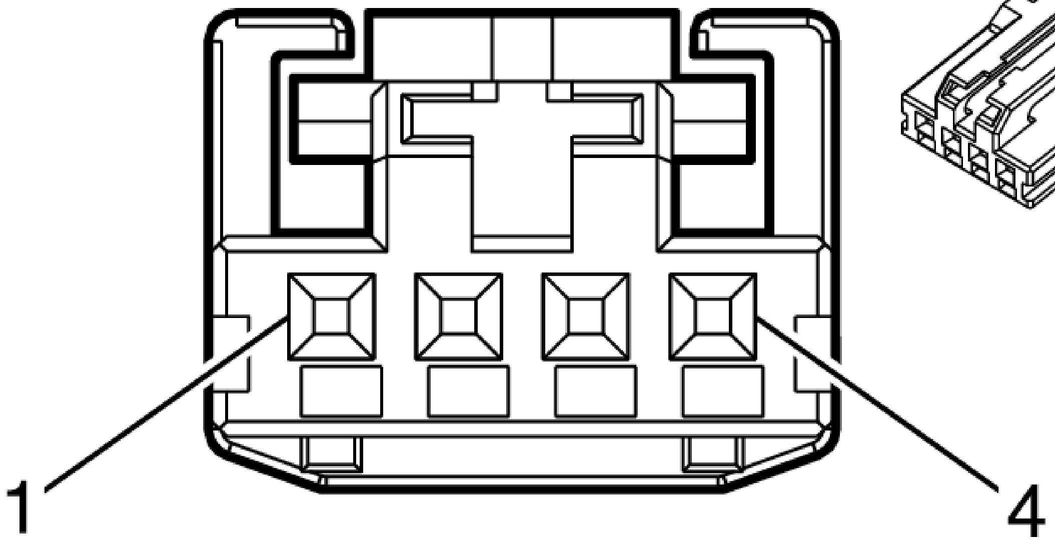
- Harness Type: Headliner
- OEM Connector: 2035363-2
- Service Connector: 19356359
- Description: 6-Way F 0.64 Generation Y Series (BK)

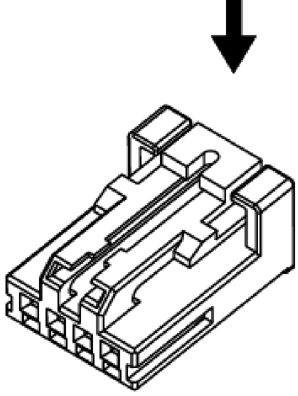
Terminal Part Information

Terminal Type ID	**Terminated Lead**	**Diagnostic Test Probe**	**Terminal Removal Tool**	**Service Terminal**	**Tray Name**	**Core Crimp**	**Insulation Crimp**
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	**Size**	**Color**	**Circuit**	**Function**	**Terminal Type ID**	**Option**
1	-	-	-	Not Occupied	-	-
2	0.5	WH/BN	6815	Inadvertent Power Control	I	-
3	0.5	GY	157	Interior Lamp Control	I	-
4	0.5	BK	650	Ground	I	-
5	0.5	GY	156	Courtesy Lamp Switch Signal	I	-
6	0.5	GY/GN	328	Interior Lamp Defeat Switch Signal	I	-

E37R DOME/READING LAMPS - REAR





Connector Part Information

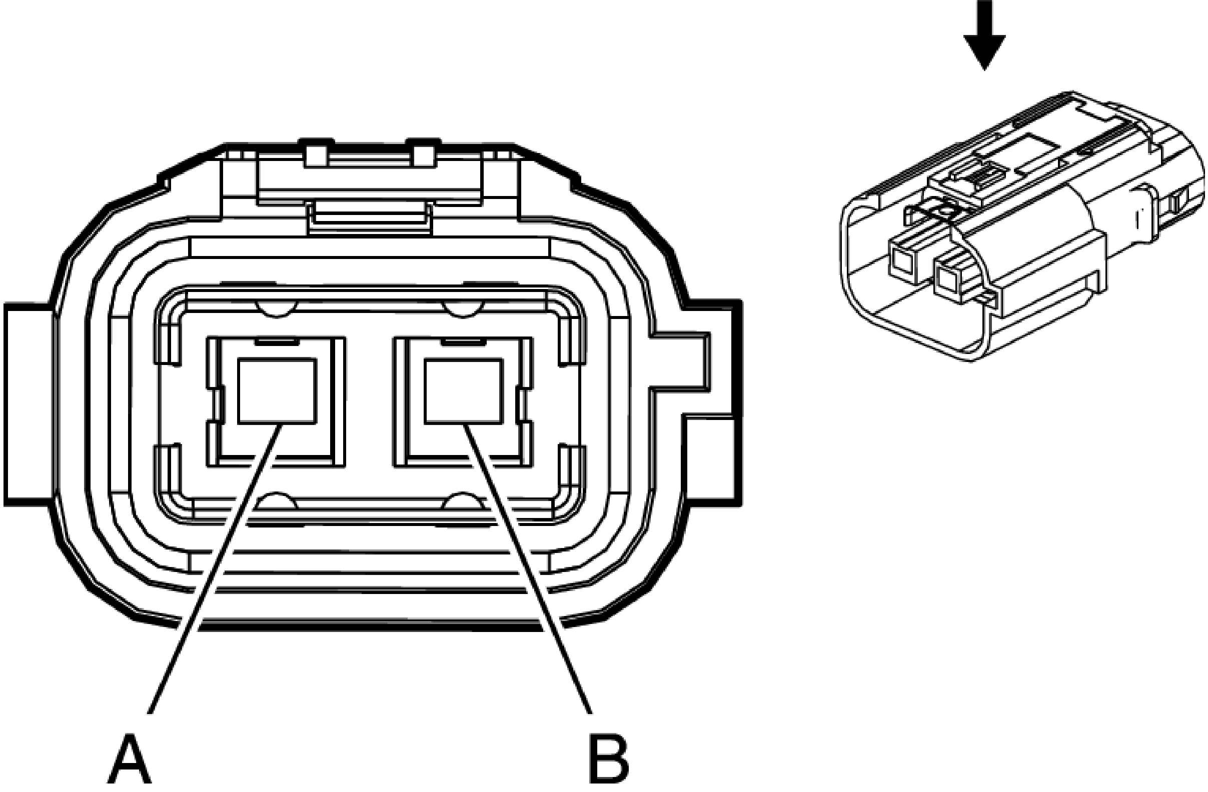
- Harness Type: Headliner
- OEM Connector: 936119-1
- Service Connector: 13587297
- Description: 4-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/BN	6815	Inadvertent Power Control	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	BK	650	Ground	I	-
4	0.5	GY	157	Interior Lamp Control	I	-

E54 HYBRID/EV BATTERY PACK COOLANT HEATER X1



Connector Part Information

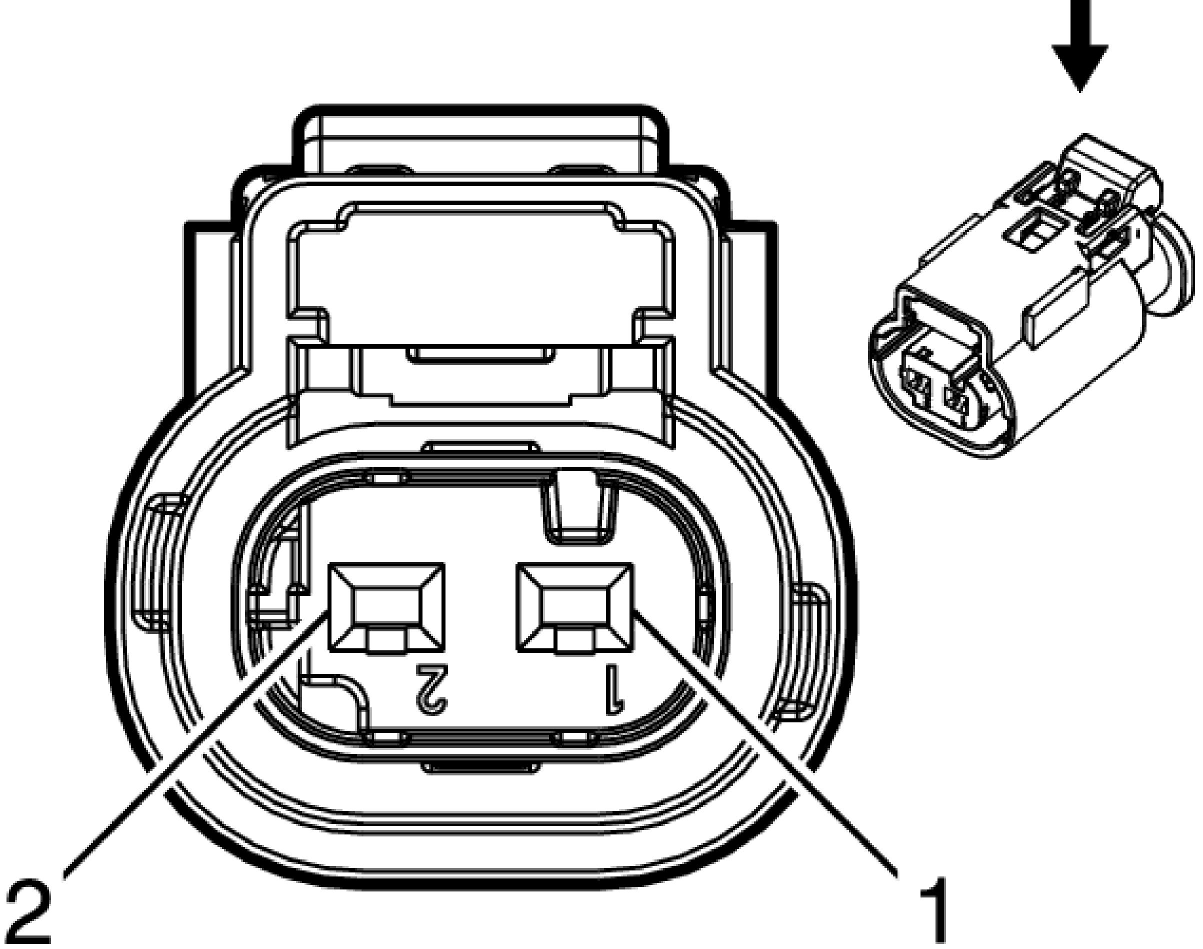
- Harness Type: High Voltage
- OEM Connector: 33278201
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Mertic-Pack Series, Sealed (OG) (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	2483	High Voltage Battery 7 (+)	I	-
B	-	OG/BK	2485	High Voltage Battery 7 (-)	I	-

E54 HYBRID/EV BATTERY PACK COOLANT HEATER X2



Connector Part Information

- Harness Type: High Voltage
- OEM Connector: 13503566
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	YE	5411	Battery Module Temperature Signal 7	I	-
2	-	BK/BU	3779	Battery Module Temperature Sensor Low Reference 7	I	-

F101 PASSENGER INSTRUMENT PANEL AIR BAG X1

-

Connector Part Information

- Harness Type: Passenger Instrument Panel Air Bag
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	YE/OG	3025	Passenger IP Module Stage 1 High Control	I	-
2	-	OG/WH	3024	Passenger IP Module Stage 1 Low Control	I	-

F101 PASSENGER INSTRUMENT PANEL AIR BAG X2

-

Connector Part Information

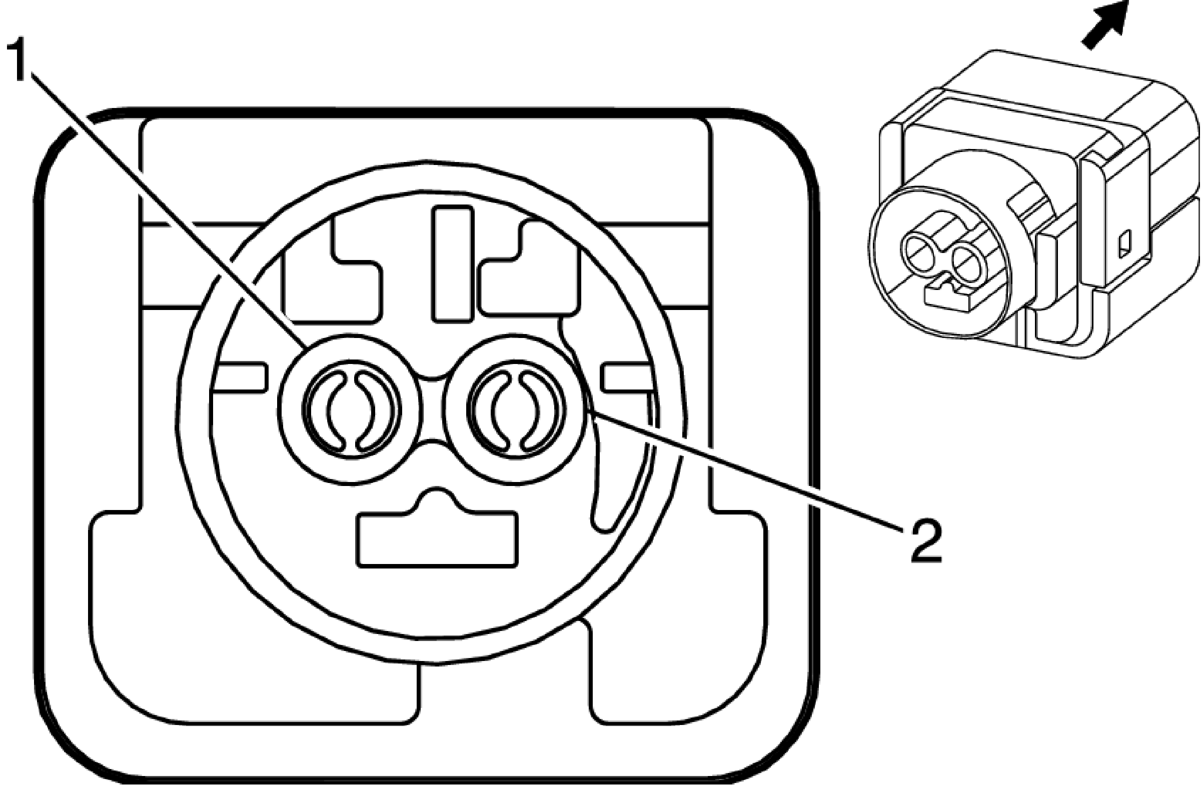
- Harness Type: Passenger Instrument Panel Air Bag
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GY/OG	3027	Passenger IP Module Stage 2 High Control	I	-
2	-	OG/VT	3026	Passenger IP Module Stage 2 Low Control	I	-

F105L ROOF RAIL AIR BAG - LEFT (AYF/AY0)



Connector Part Information

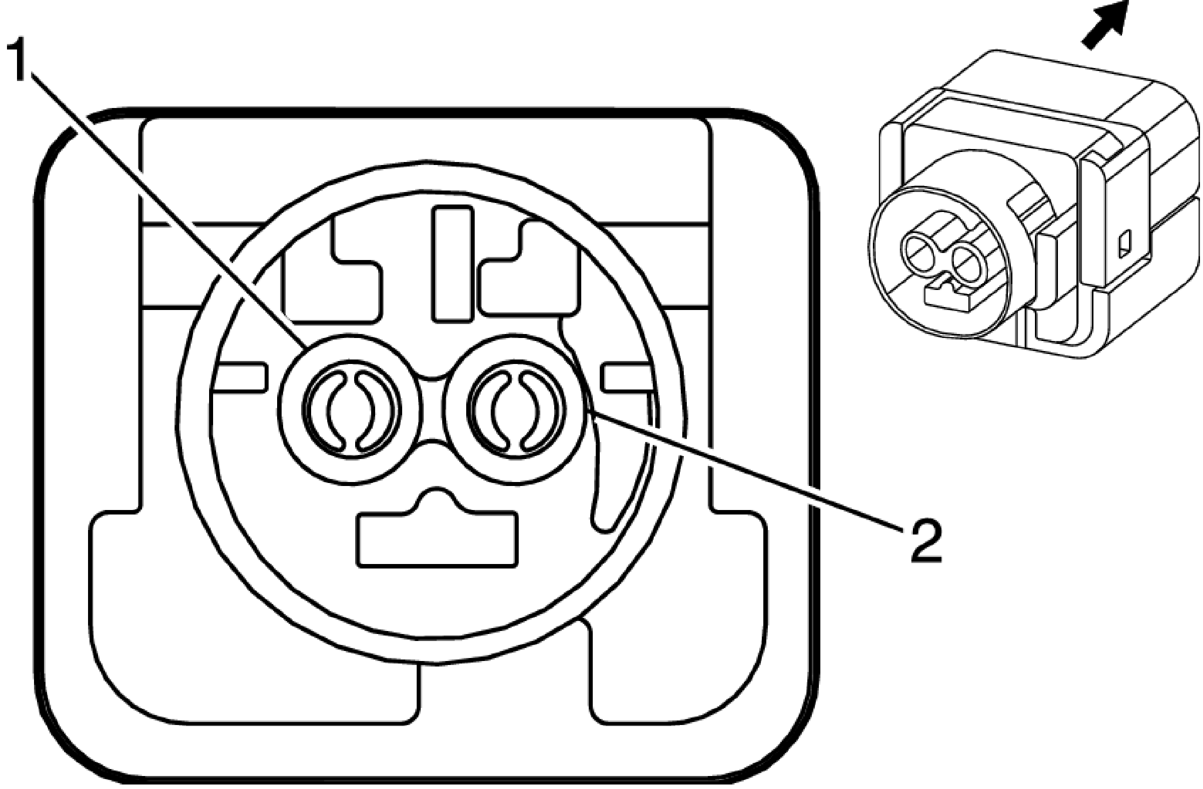
- Harness Type: Body
- OEM Connector: PPI0001142
- Service Connector: 19355495
- Description: 2-Way F FPB 180-1 Series (BK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GN	5019	Left Front Head Curtain Module High Control	I	-
2	0.5	VT/OG	5020	Left Front Head Curtain Module Low Control	I	-

F105R ROOF RAIL AIR BAG - RIGHT (AYF/AY0)



Connector Part Information

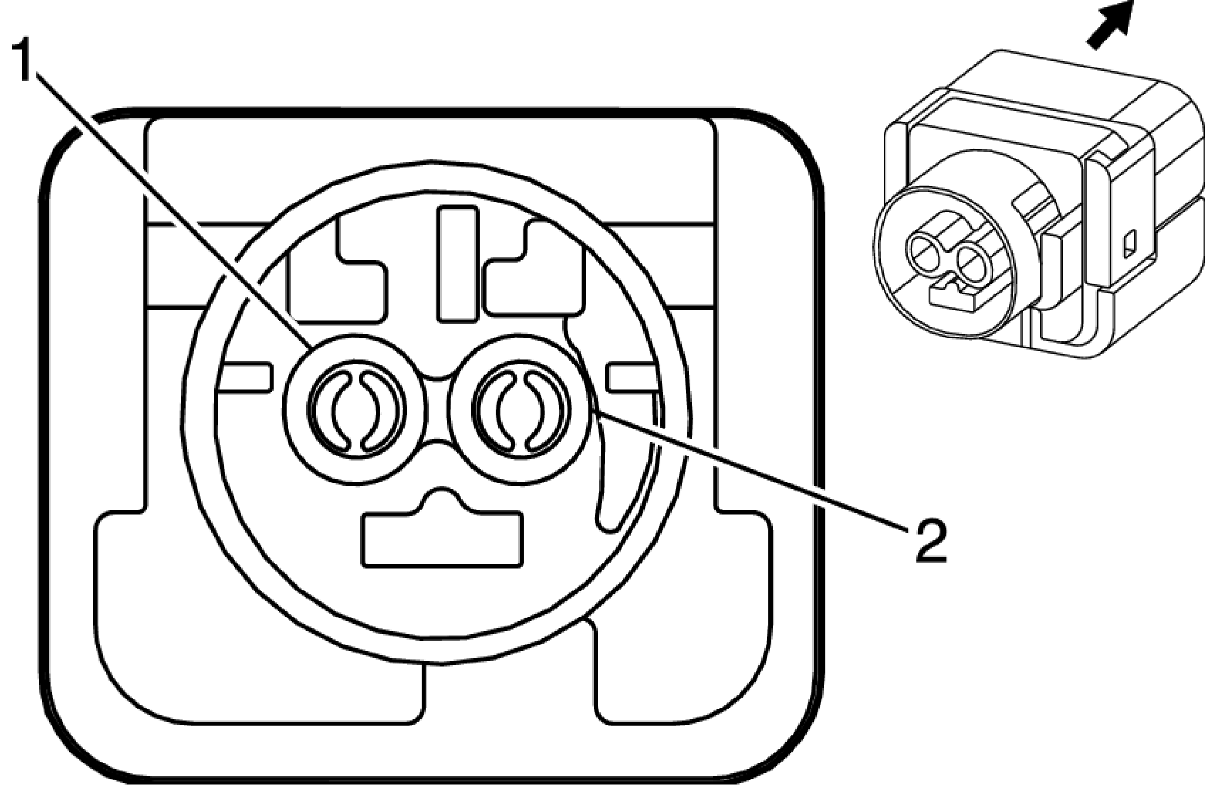
- Harness Type: Body
- OEM Connector: PPI0001142
- Service Connector: 19355495
- Description: 2-Way F FPB 180-1 Series (BK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GY	5021	Right Front Head Curtain Module High Control	I	-
2	0.5	WH/OG	5022	Right Front Head Curtain Module Low Control	I	-

F106LR SEAT SIDE AIR BAG - LEFT REAR (AYF)



Connector Part Information

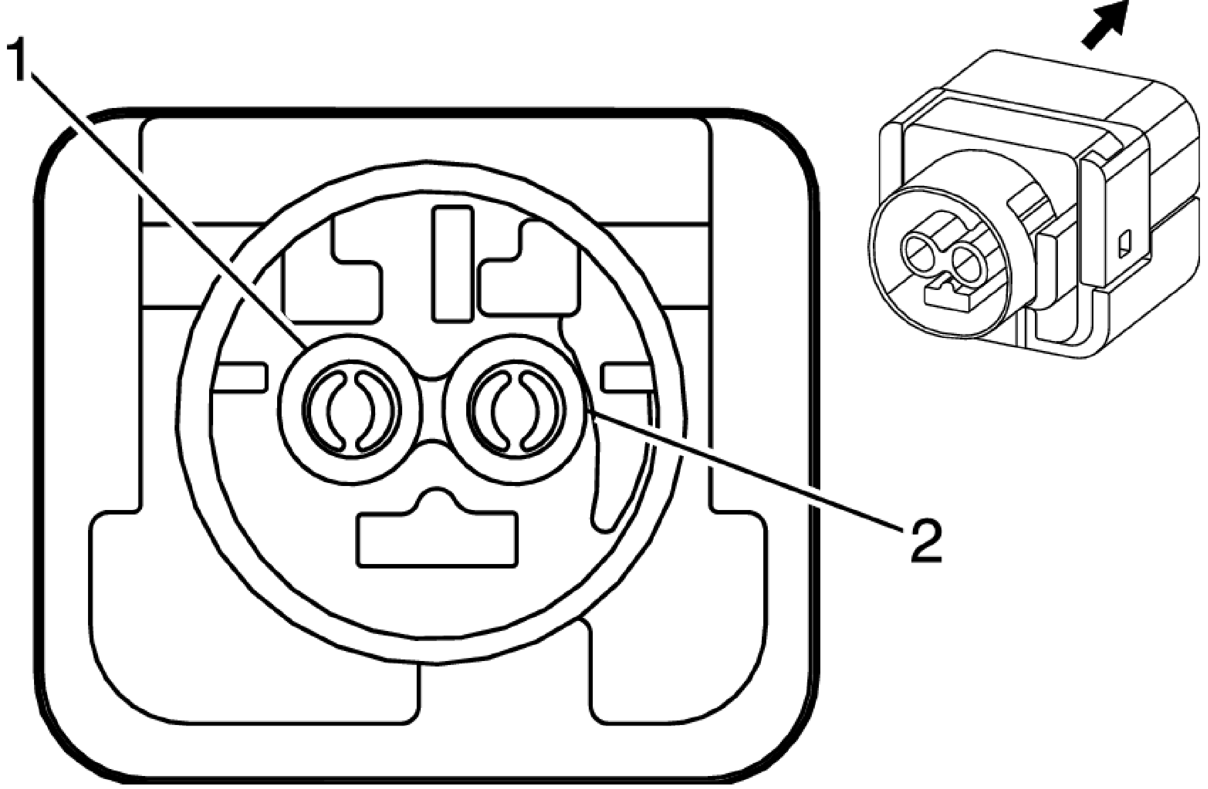
- Harness Type: Body
- OEM Connector: PPI0001142
- Service Connector: 19355495
- Description: 2-Way F FPB 180-1 Series (BK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GY	5223	Left Rear Side Impact SIR Inflator Control	I	AYF
2	0.5	BN/OG	5224	Left Rear Side Impact SIR Inflator Control	I	AYF

F106P SEAT SIDE AIR BAG - PASSENGER (AY0/AYF)



Connector Part Information

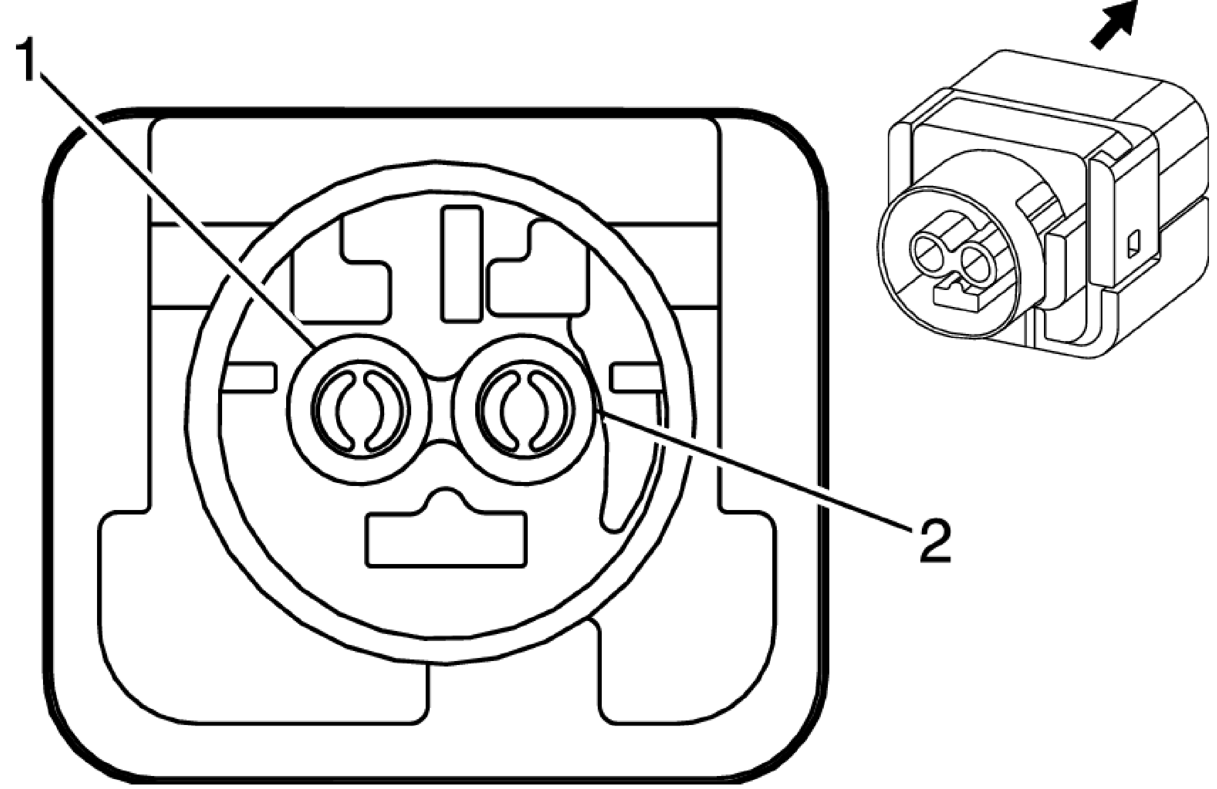
- Harness Type: Passenger Seat
- OEM Connector: 19178108
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F FPB 180-1 Series (BK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GY	3066	Passenger Side Impact Module High Control	I	-
2	0.5	BU/OG	3067	Passenger Side Impact Module Low Control	I	-

F106RR SEAT SIDE AIR BAG - RIGHT REAR (AYF)



Connector Part Information

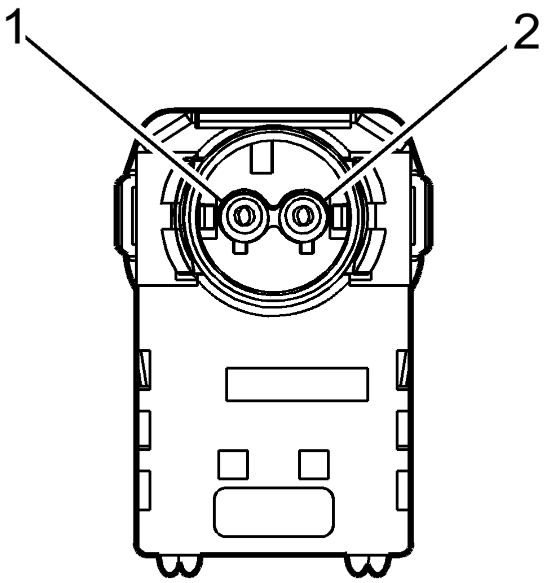
- Harness Type: Body
- OEM Connector: PPI0001142
- Service Connector: 19355495
- Description: 2-Way F FPB 180-1 Series (BK with YE Cover)

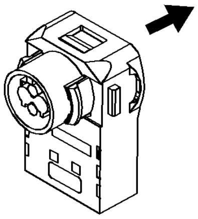
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/OG	5225	Right Rear Side Impact SIR Inflator Control	I	AYF
2	0.5	OG/GY	5226	Right Rear Side Impact SIR Inflator Control	I	AYF

F107 STEERING WHEEL AIR BAG X1





Connector Part Information

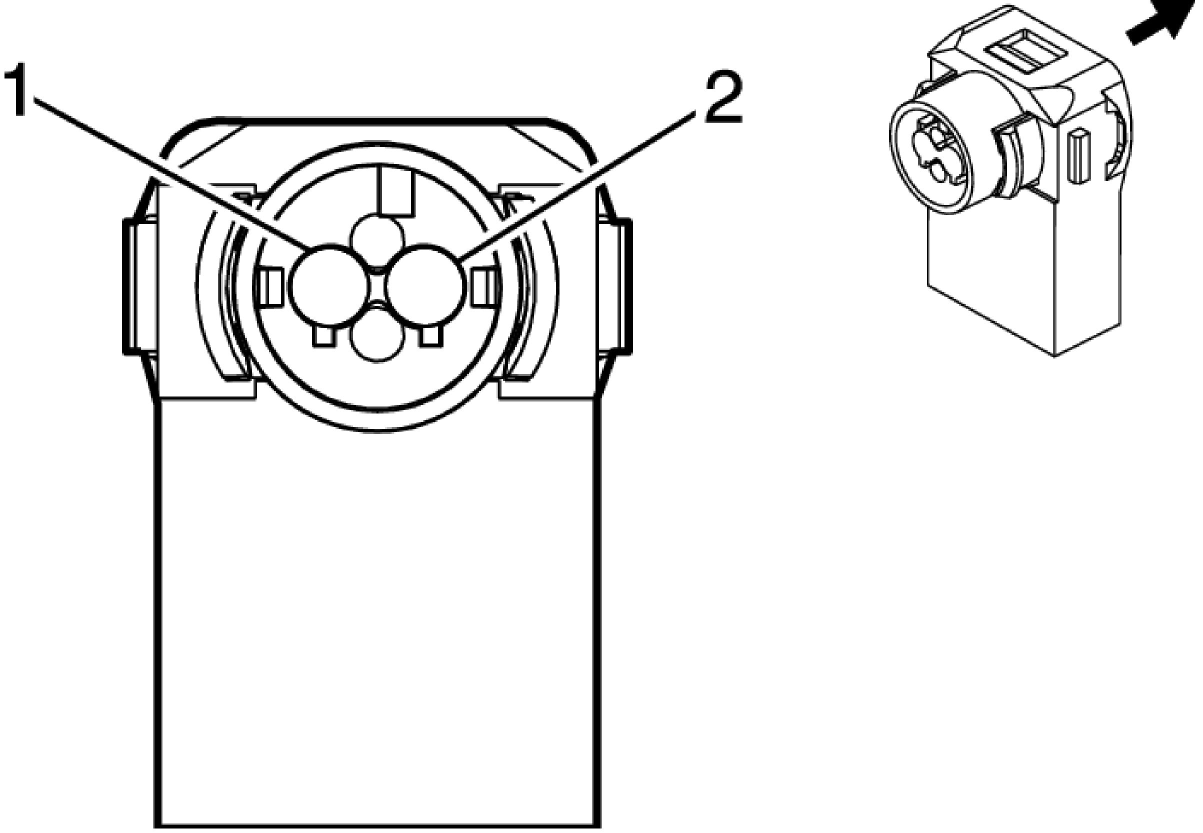
- Harness Type: Steering Wheel
- OEM Connector: 13596550
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.0 MAC Series (PK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	TN	3021	Steering Wheel Module Stage 1 High Control	I	-
2	-	BN	3020	Steering Wheel Module Stage 1 Low Control	I	-

F107 STEERING WHEEL AIR BAG X2



Connector Part Information

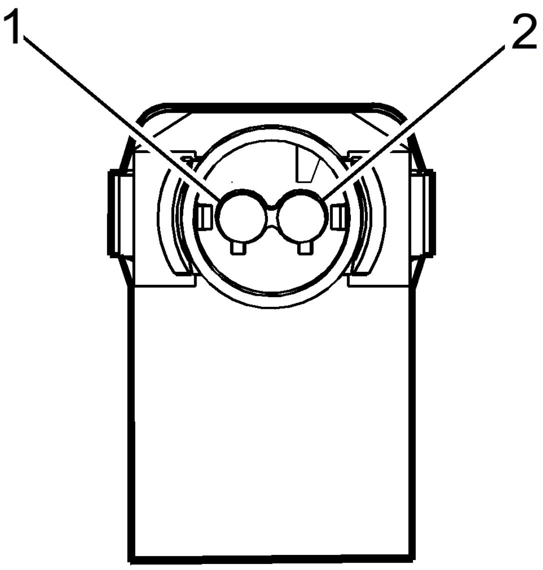
- Harness Type: Steering Wheel
- OEM Connector: 13596551
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

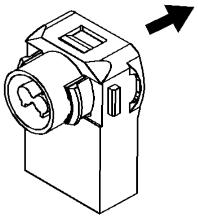
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	WH	3023	Steering Wheel Module Stage 2 High Control	I	-
2	-	PK	3022	Steering Wheel Module Stage 2 Low Control	I	-

F112D SEAT BELT RETRACTOR PRETENSIONER - DRIVER (AY0)





Connector Part Information

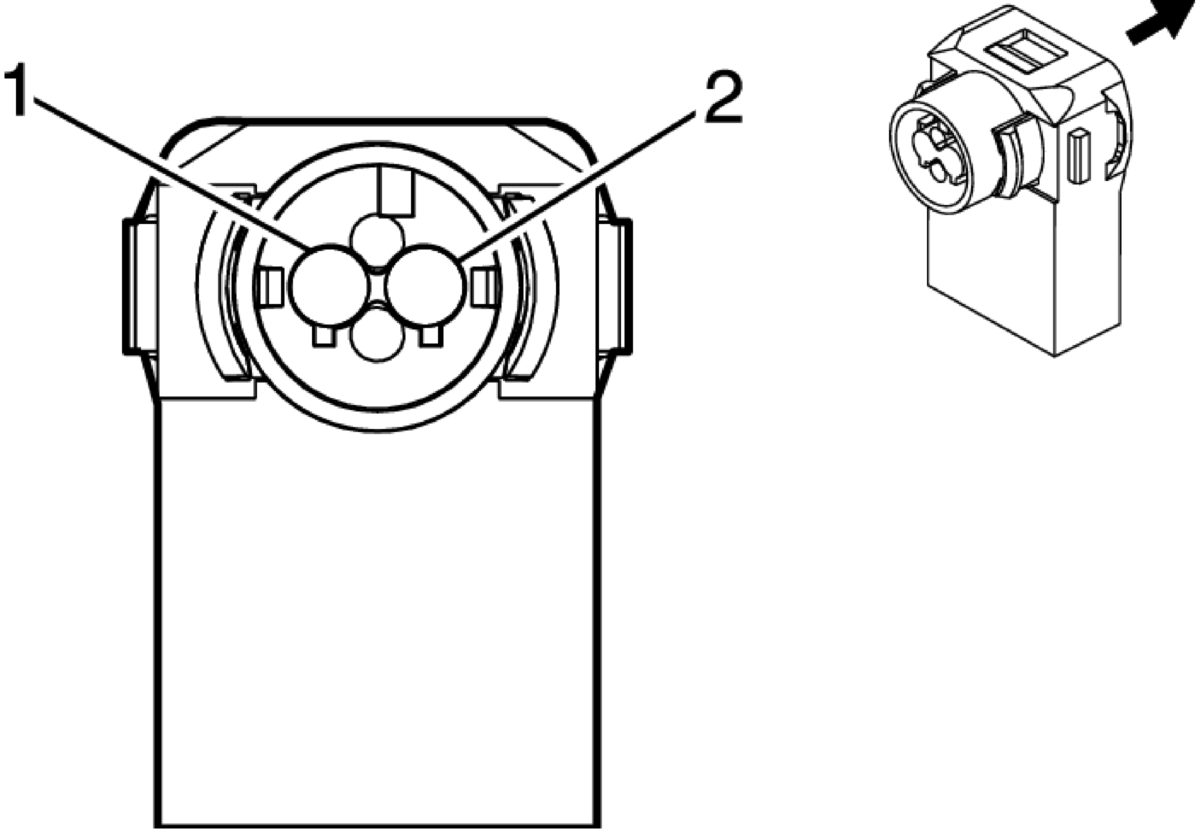
- Harness Type: Body
- OEM Connector: 13596557
- Service Connector: 19355416
- Description: 2-Way F 1.0 MAC Series (GN with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/WH	3477	Driver Seat Belt Retractor Pretensioner High Control	I	-
2	0.5	GY/OG	3478	Driver Seat Belt Retractor Pretensioner Low Control	I	-

F112LR SEAT BELT RETRACTOR PRETENSIONER - LEFT REAR (SBK)



Connector Part Information

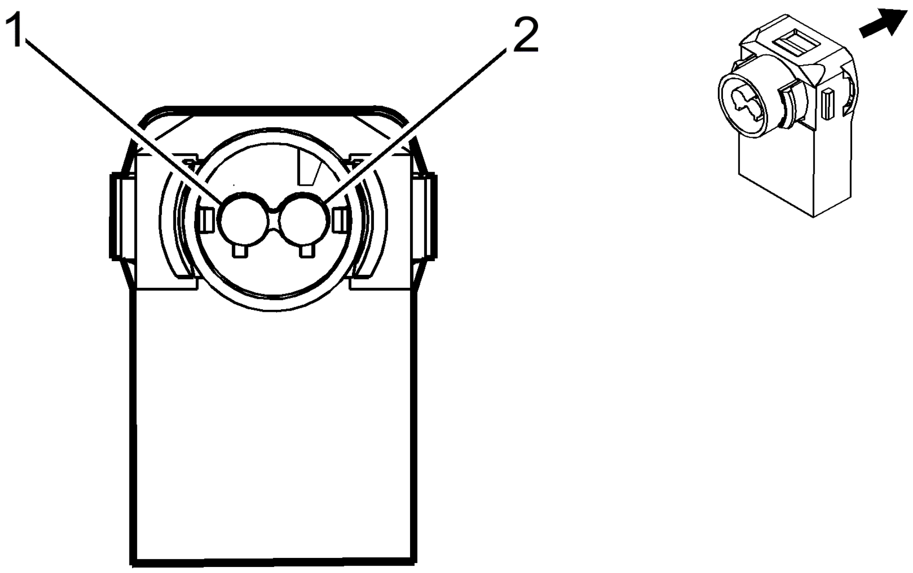
- Harness Type: Body
- OEM Connector: 33154433
- Service Connector: 19355490
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/VT	5155	Left Rear Seat Belt Pretensioner Control	I	SBK
2	0.5	BK/OG	5156	Left Rear Seat Belt Pretensioner Low Reference	I	SBK

F112P SEAT BELT RETRACTOR PRETENSIONER - PASSENGER (AY0)



Connector Part Information

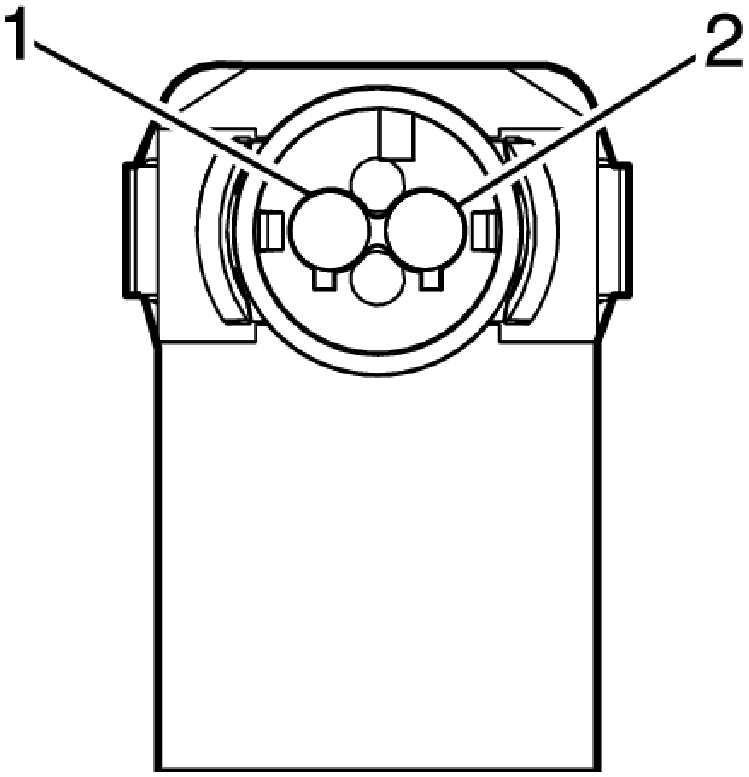
- Harness Type: Body
- OEM Connector: 13596557
- Service Connector: 19355416
- Description: 2-Way F 1.0 MAC Series (GN with YE Cover)

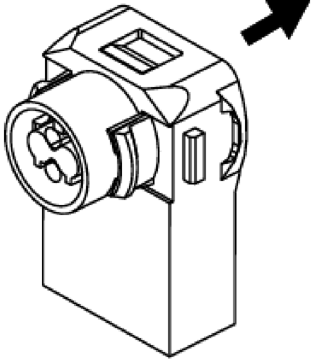
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GN	3475	Passenger Seat Belt Retractor Pretensioner High Control	I	-
2	0.5	WH/OG	3476	Passenger Seat Belt Retractor Pretensioner Low Control	I	-

F112RR SEAT BELT RETRACTOR PRETENSIONER - RIGHT REAR (SBK)





Connector Part Information

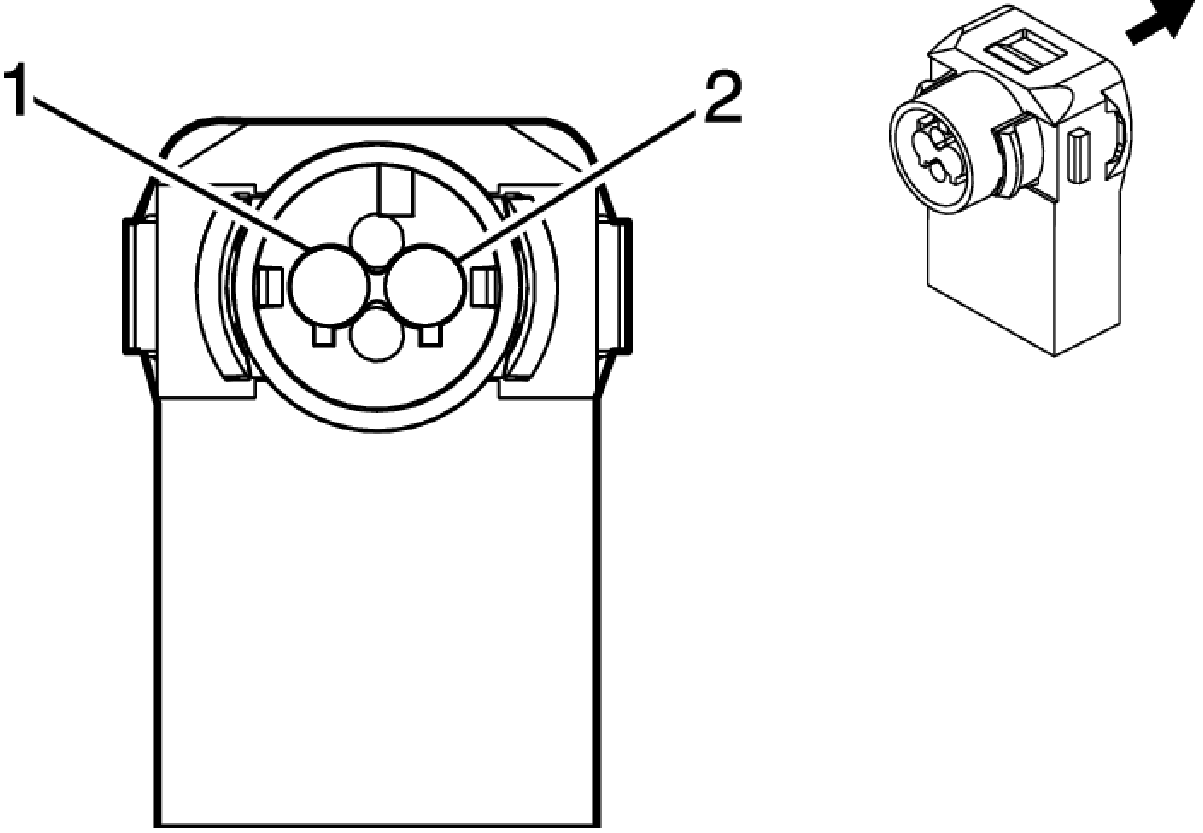
- Harness Type: Body
- OEM Connector: 33154433
- Service Connector: 19355490
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/WH	5157	Right Rear Seat Belt Pretensioner Control	I	SBK
2	0.5	BK/OG	5158	Right Rear Seat Belt Pretensioner Low Reference	I	SBK

F113D SEAT BELT ANCHOR PRETENSIONER - DRIVER (AY0)



Connector Part Information

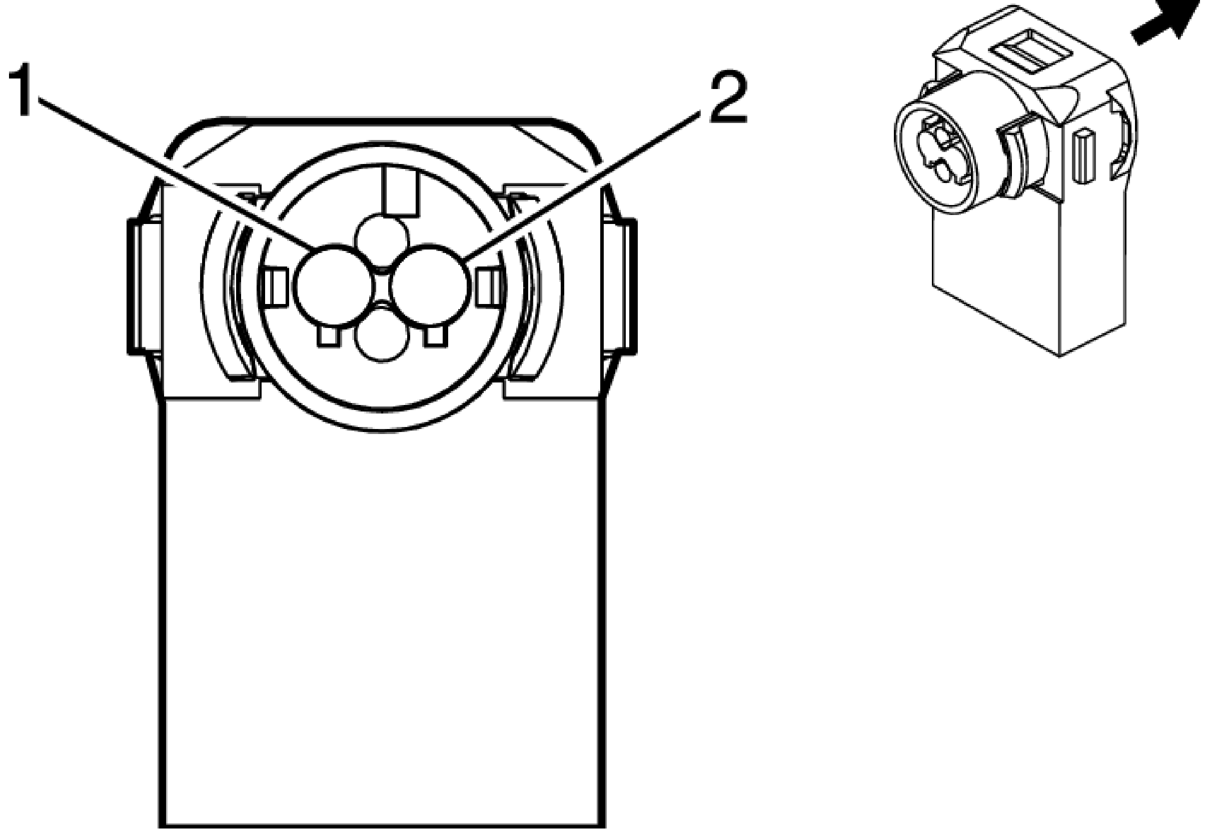
- Harness Type: Body
- OEM Connector: 33154433
- Service Connector: 19355490
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/YE	3481	Driver Seat Belt Anchor Pretensioner High Control	I	-
2	0.5	WH/OG	3482	Driver Seat Belt Anchor Pretensioner Low Control	I	-

F113P SEAT BELT ANCHOR PRETENSIONER - PASSENGER (AY0)



Connector Part Information

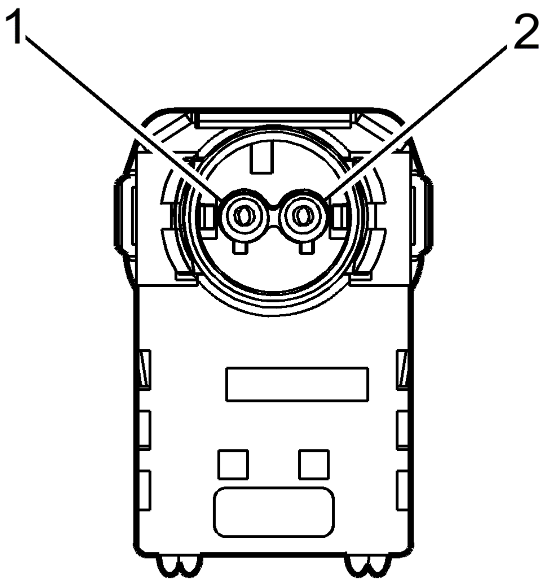
- Harness Type: Body
- OEM Connector: 33154433
- Service Connector: 19355490
- Description: 2-Way F 1.0 MAC Series (PU with YE Cover)

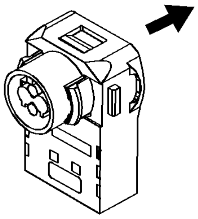
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BN	3479	Passenger Seat Belt Anchor Pretensioner High Control	I	-
2	0.5	GY/OG	3480	Passenger Seat Belt Anchor Pretensioner Low Control	I	-

F114D KNEE AIR BAG - DRIVER (AYF)





Connector Part Information

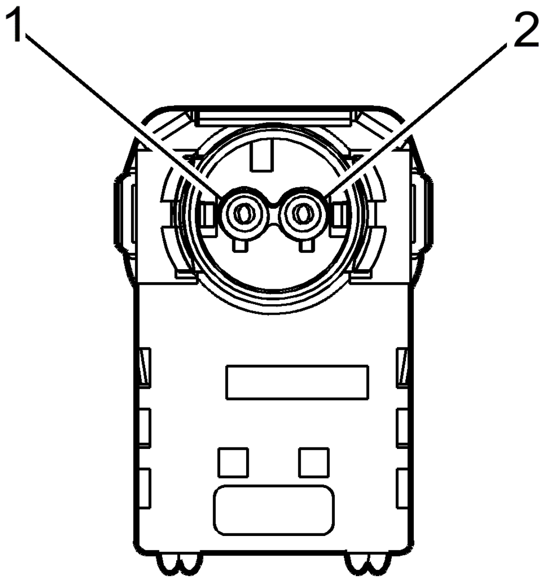
- Harness Type: Instrument Panel
- OEM Connector: 33154418
- Service Connector: 19355489
- Description: 2-Way F 1.0 MAC Series (PK with YE Cover)

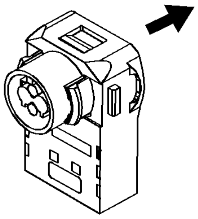
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BU	3078	Driver Knee Module High Control	I	AYF
2	0.5	GY/OG	3079	Driver Knee Module Low Control	I	AYF

F114P KNEE AIR BAG - PASSENGER (AYF)





Connector Part Information

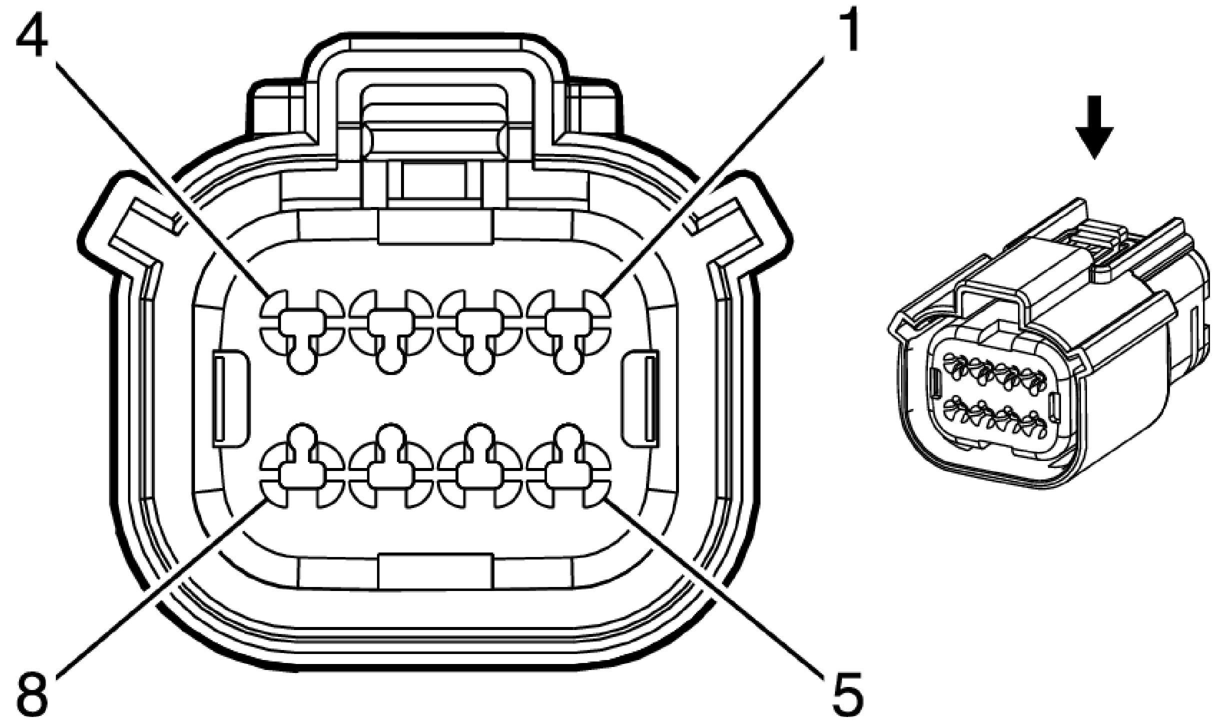
- Harness Type: Instrument Panel
- OEM Connector: 33154418
- Service Connector: 19355489
- Description: 2-Way F 1.0 MAC Series (PK with YE Cover)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BU	3076	Passenger Knee Module High Control	I	AYF
2	0.5	WH/OG	3077	Passenger Knee Module Low Control	I	AYF

G1 A/C COMPRESSOR X1



Connector Part Information

- Harness Type: Engine
- OEM Connector: 33472-0806
- Service Connector: 13577527
- Description: 8-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	150	Ground	I	-
2	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
3	0.5	VT/WH	1139	Run/Crank Ignition 1 Voltage	I	-
4	0.5	RD/GY	2140	Battery Positive Voltage	I	-
5	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
6	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
7	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
8	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-

G1 A/C COMPRESSOR X2

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Connector Part Information

- Harness Type: High Voltage
- OEM Connector: 135050435

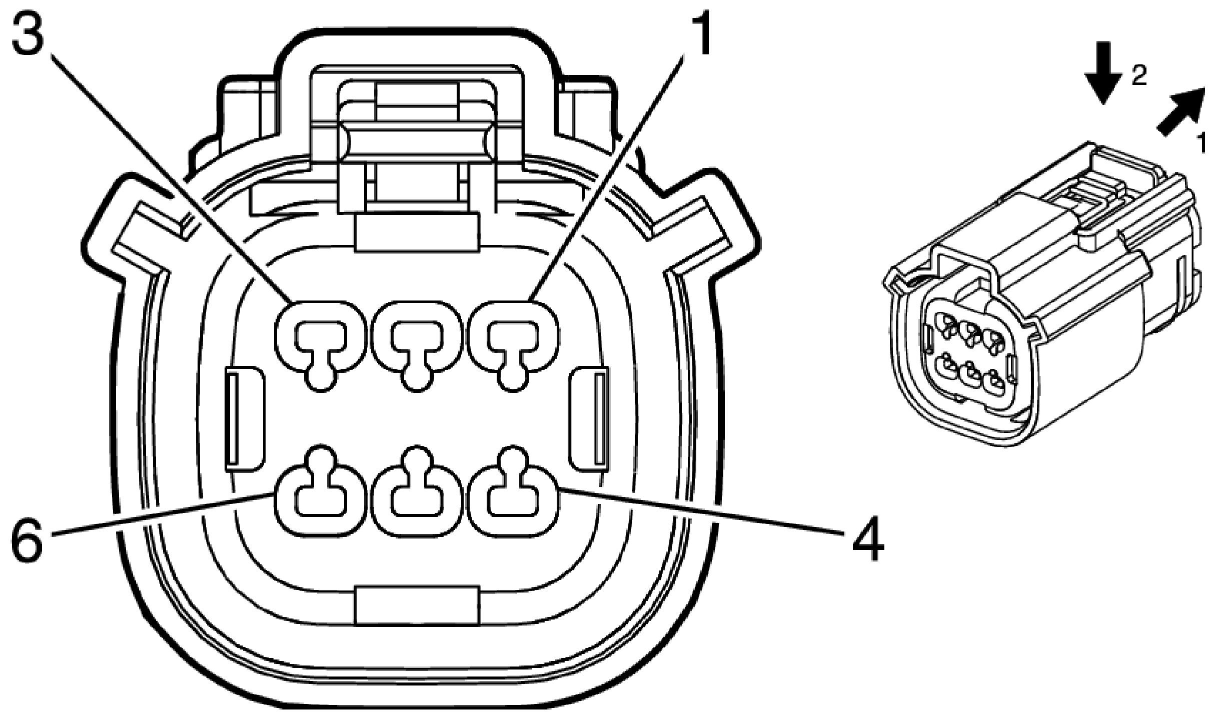
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	3974	High Voltage Battery 5 (+)	I	-
B	-	OG/BK	3973	High Voltage Battery 5 (-)	I	-

G5 TRANSMISSION FLUID PUMP - ELECTRIC/AUXILIARY



Connector Part Information

- Harness Type: Engine
- OEM Connector: 33472-0681
- Service Connector: 13585853
- Description: 6-Way F 150 MX Series, Sealed (BK)

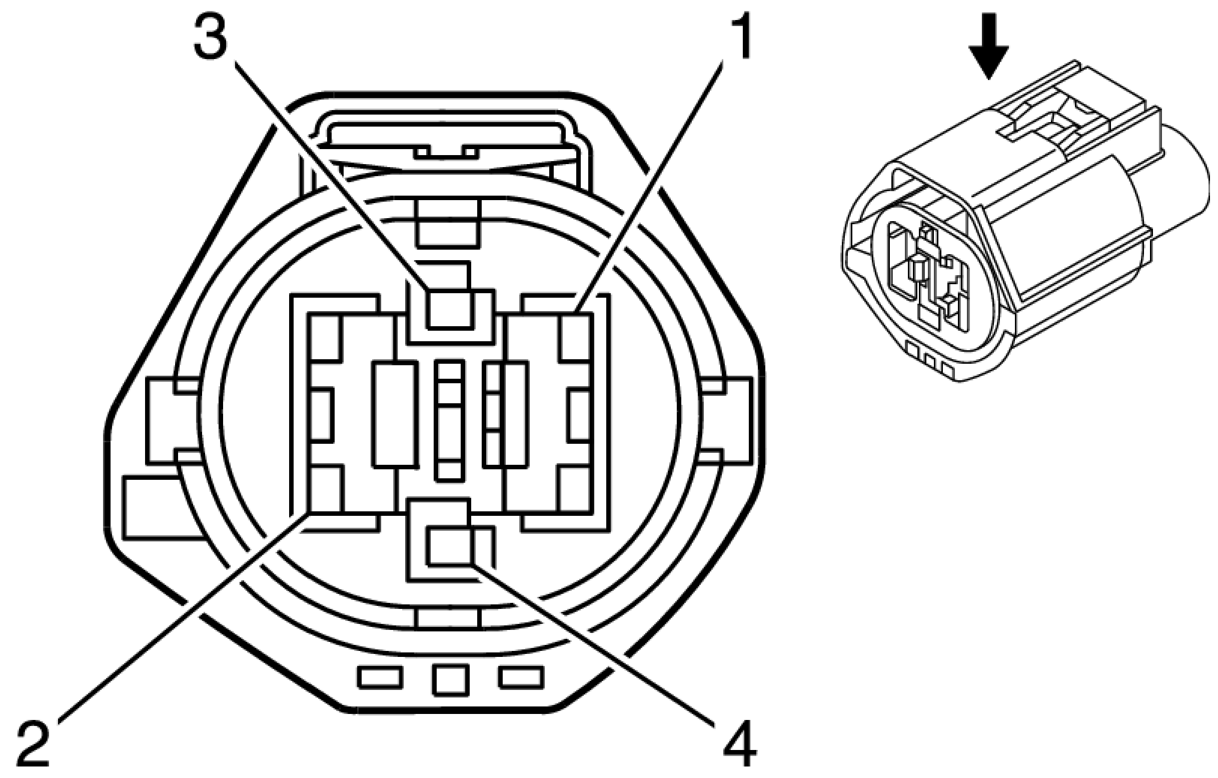
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	RD/BU	3240	Battery Positive Voltage	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	VT/BU	5290	Powertrain Main Relay Fused Supply 1	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
4	0.5	GY/BK	2967	Transmission Auxiliary Oil Pump Relay Control	I	-
5	0.5	GY/BU	4324	Transmission Auxiliary Pump Feedback Signal	I	-
6	1	BK	350	Ground	I	-

G10 COOLING FAN MOTOR



Connector Part Information

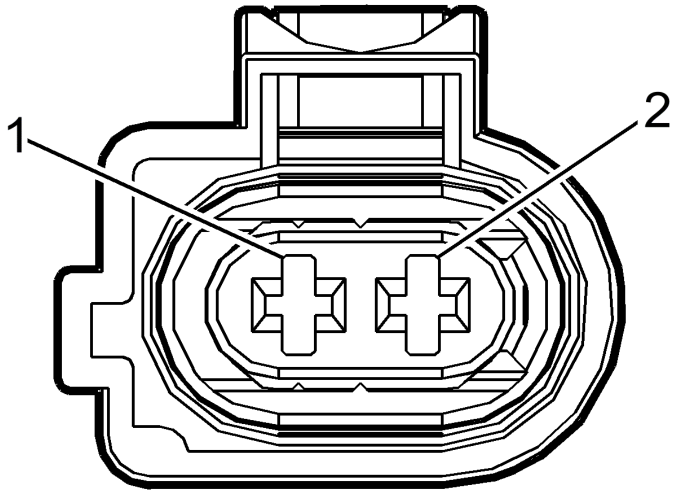
- Harness Type: Engine
- OEM Connector: 7283-8496-30
- Service Connector: 19115593
- Description: 4-Way F 1.5, 9.5 Series, Sealed (BK)

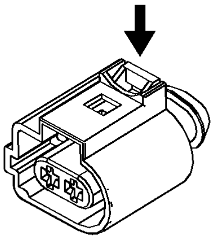
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-22 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	4	RD/BU	302	Battery Positive Voltage	I	-
2	4	BK	2150	Ground	I	-
3	-	-	-	Not Occupied	-	-
4	0.75	WH	2368	Cooling Fan Control Signal	II	-

G19 REAR WINDOW WASHER PUMP





Connector Part Information

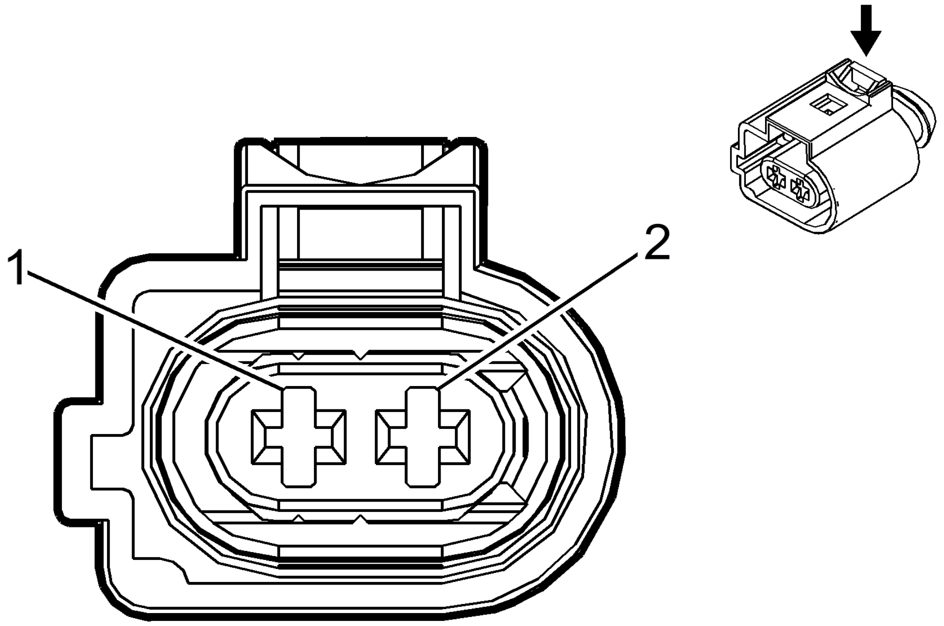
- Harness Type: Forward Lamp
- OEM Connector: 3-1355200-1
- Service Connector: 19301746
- Description: 2-Way F 2.8 MCP Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/VT	392	Rear Window Washer Pump Control	I	-
2	0.5	BK	250	Ground	I	-

G24 WINDSHIELD WASHER PUMP



Connector Part Information

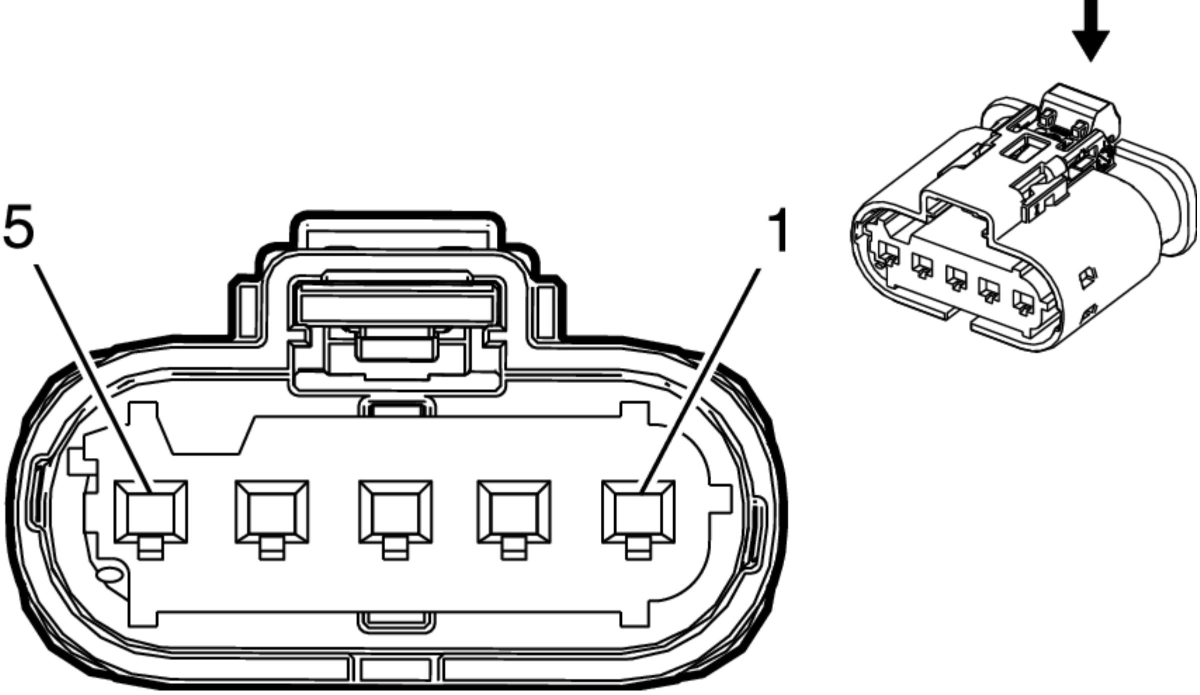
- Harness Type: Forward Lamp
- OEM Connector: 3-1355200-1
- Service Connector: 19301746
- Description: 2-Way F 2.8 MCP Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/VT	228	Windshield Washer Pump Control	I	-
2	0.5	BK	250	Ground	I	-

G35 HYBRID/EV ELECTRONICS COOLANT PUMP



Connector Part Information

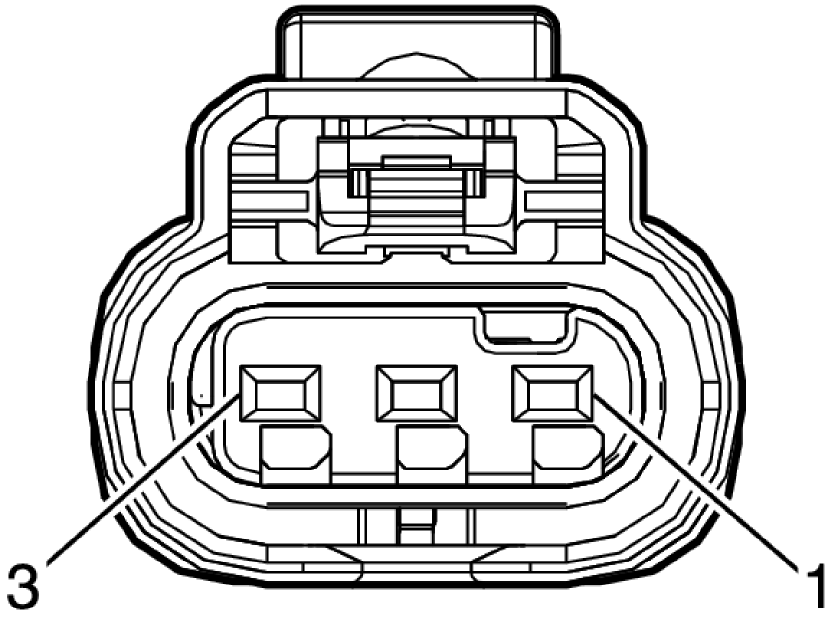
- Harness Type: Engine
- OEM Connector: 9408621
- Service Connector: 19300589
- Description: 5-Way F 1.2 Multilock Series, Sealed (BK)

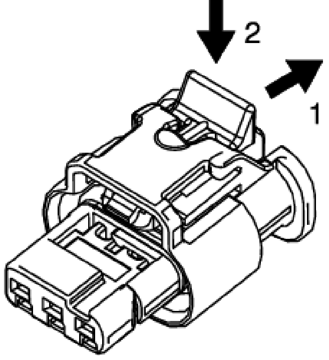
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/BU	3788	Electric Coolant Motor Control	I	-
2	0.5	VT/BU	3790	Electric Coolant Motor Feedback Signal	I	-
3	0.5	YE/GN	3789	Electric Coolant Motor Control	I	-
4	0.5	BK	350	Ground	I	-
5	0.5	RD/VT	3340	Battery Positive Voltage	I	-

G36 AUXILIARY HEATER COOLANT PUMP





Connector Part Information

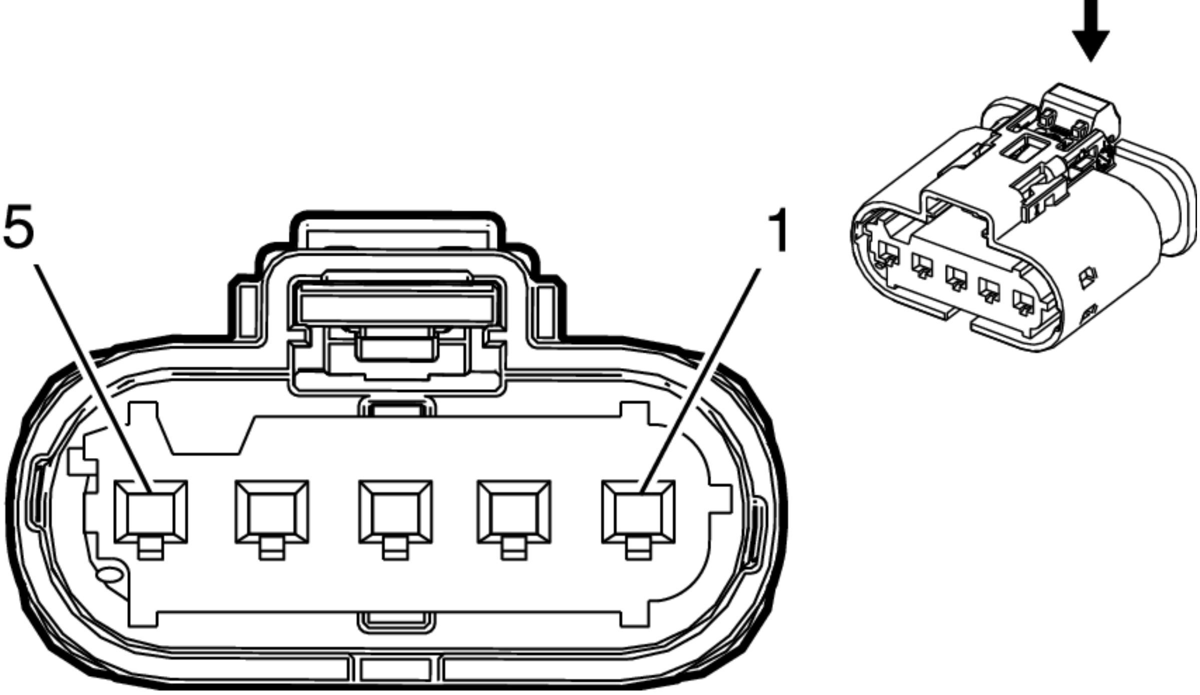
- Harness Type: Engine
- OEM Connector: 4-2272004-1
- Service Connector: 19352065
- Description: 3-Way F 1.2 MCP Series, Sealed (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	350	Ground	I	-
2	0.5	RD/WH	3440	Battery Positive Voltage	I	-
3	-	-	-	Not Occupied	-	-

G37 HYBRID/EV BATTERY PACK COOLANT PUMP



Connector Part Information

- Harness Type: Engine
- OEM Connector: 9408621
- Service Connector: 19300589
- Description: 5-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/GN	3794	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-
2	0.5	YE/GY	3796	Rechargeable Energy Storage System 1 Coolant Motor Feedback Signal	I	-
3	0.5	BU/VT	3795	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-
4	0.5	BK	350	Ground	I	-
5	0.5	RD/GY	3540	Battery Positive Voltage	I	-

K1 14V POWER MODULE X1

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Connector Part Information

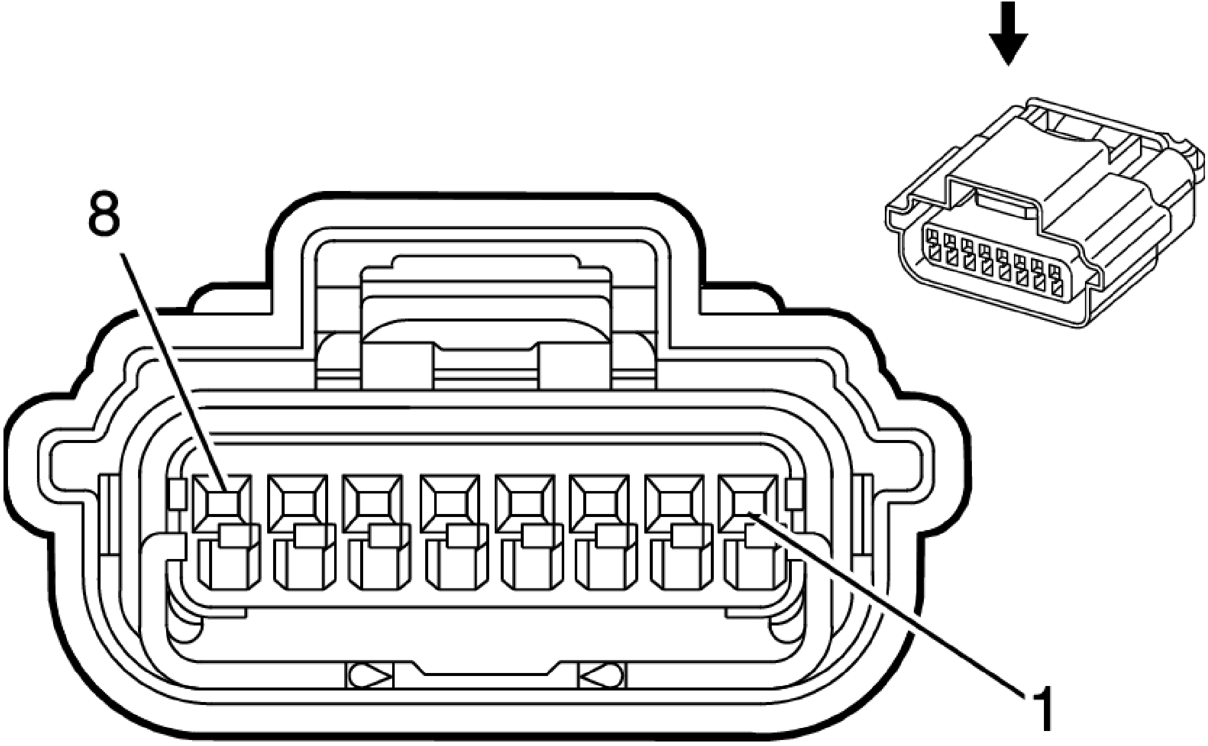
- Harness Type: Engine
- OEM Connector: 13511583
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG/BK	3833	High Voltage Battery 2 (-)	I	-
B	-	OG	3834	High Voltage Battery 2 (+)	I	-

K1 14V POWER MODULE X2



Connector Part Information

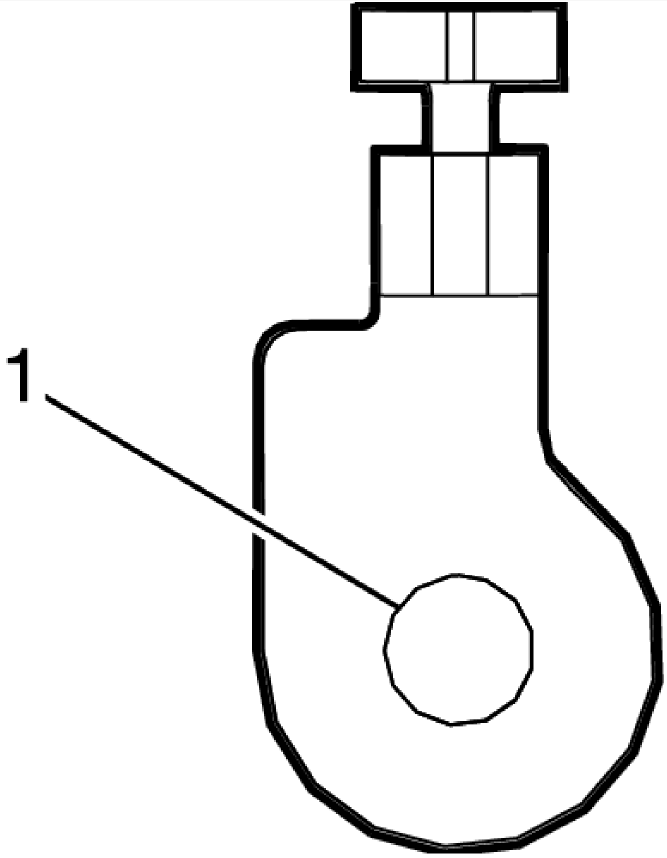
- Harness Type: Engine
- OEM Connector: ATSSPB-C0802Y-1AK
- Service Connector: 19352910
- Description: 8-Way F 0.64 Series, Sealed (BK)

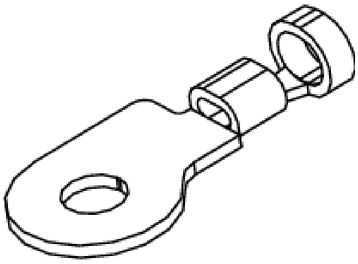
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN	25	Charge Indicator Control	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	GY	23	Generator Field Duty Cycle Signal	I	-
4 - 8	-	-	-	Not Occupied	-	-

K1 14V POWER MODULE X3





Connector Part Information

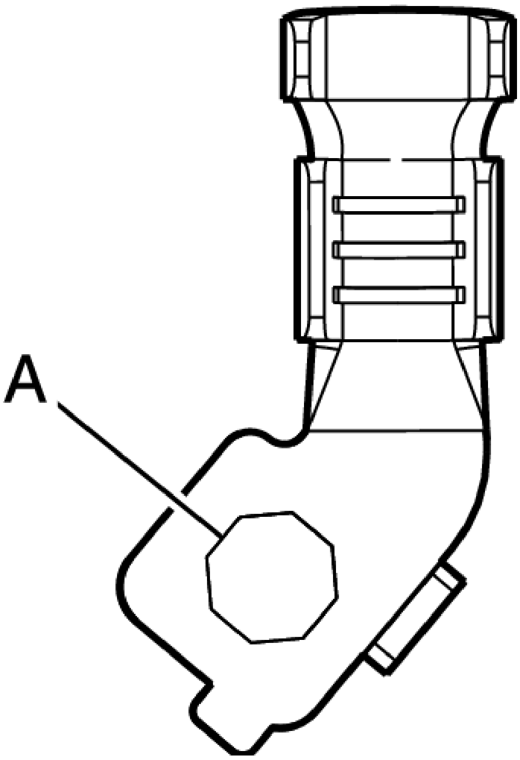
- Harness Type: Battery Cable
- OEM Connector: 33194395
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

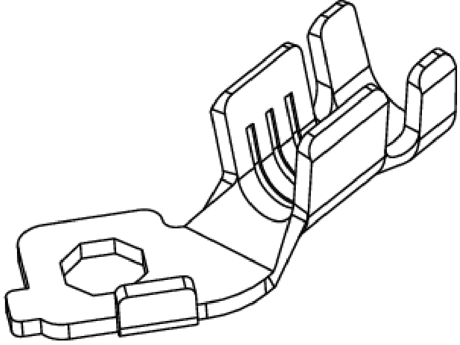
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	25	RD/YE	2	Battery Positive Voltage	I	-

K1 14V POWER MODULE X4





Connector Part Information

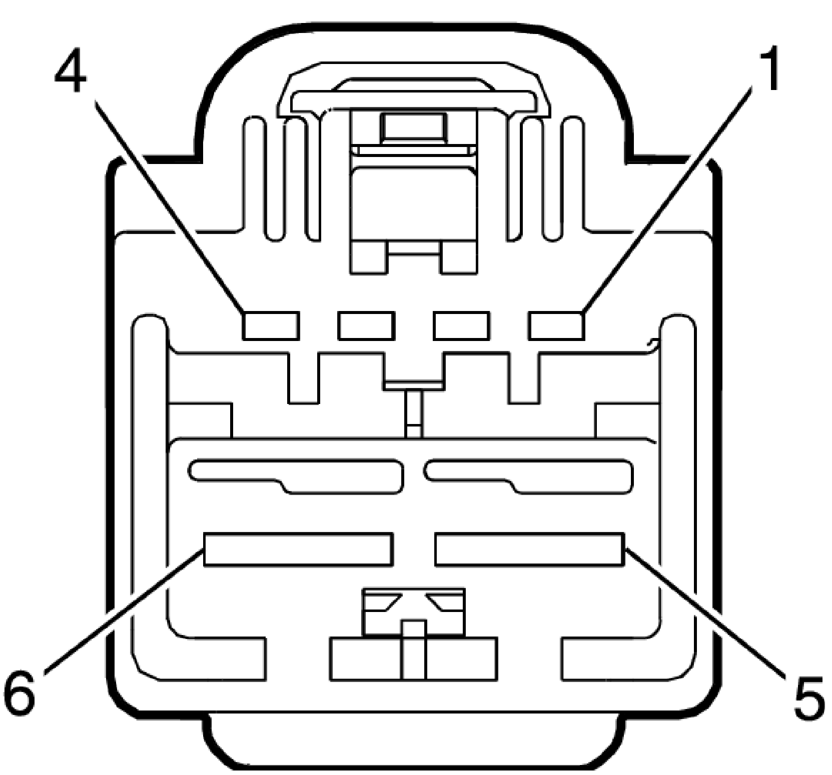
- Harness Type: Battery Cable
- OEM Connector: CBR669-012
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

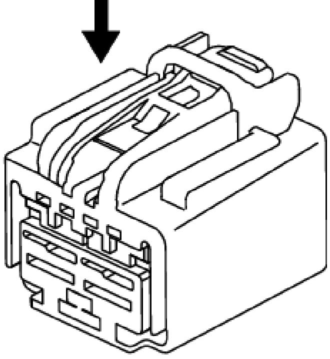
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	25	BK	750	Ground	I	-

K8 BLOWER MOTOR CONTROL MODULE





Connector Part Information

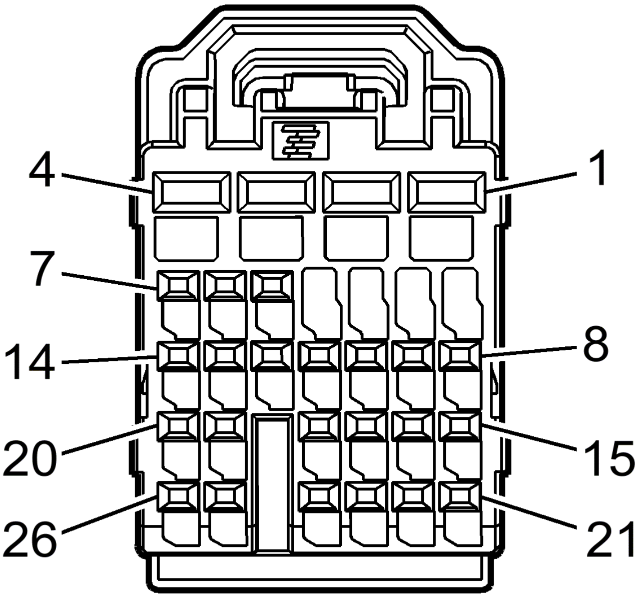
- Harness Type: Instrument Panel
- OEM Connector: 7283-9749-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F YESC Kaizen Series (BK)

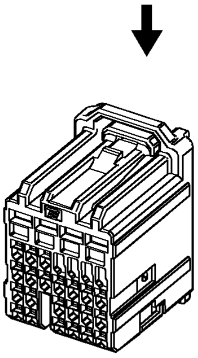
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.35	BU/GY	754	Blower Motor Speed Control	I	-
4	-	-	-	Not Occupied	-	-
5	2.5	BK	1350	Ground	II	-
6	2.5	RD/BU	840	Battery Positive Voltage	II	-

K9 BODY CONTROL MODULE X1





Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2098067-1
- Service Connector: 13576031
- Description: 26-Way F 0.64, 2.8 Series (NA)

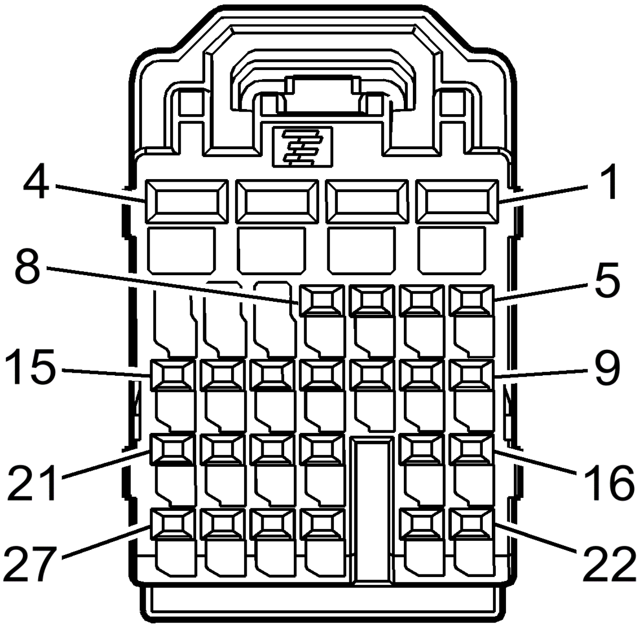
Terminal Part Information

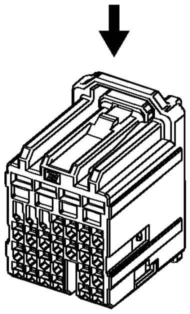
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
II	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	1350	Ground	II	-
2	0.75	RD/YE	4340	Battery Positive Voltage	II	-
3	0.75	RD/BN	4240	Battery Positive Voltage	II	-
4	0.75	RD/GY	4140	Battery Positive Voltage	II	-
5	0.35	WH	6816	Indicator Dimming Control	I	-
6	0.35	GN/WH	2270	Rear Window Washer Relay Control	I	-
7	0.35	BK/YE	5005	Instrument Panel Lamp Dimmer Switch Low Reference	I	-
8 - 10	-	-	-	Not Occupied	-	-
11	0.35	GN/BN	306	Headlamp Switch Headlamps Off Signal Control	I	-
12	0.35	BU/GY	187	Rear Fog Lamp Switch Signal	I	-
13	0.35	BU/RD	1688	5V Reference	I	-
14	0.35	BN/VT	245	Passenger Door Lock Switch Unlock Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
15	0.35	GN	4512	Wireless Charging System Charge Indicator Control	I	K4C
16	0.35	WH/VT	103	Headlamp Switch On Signal	I	-
17	0.35	GY/YE	7543	Hazard LED Dimming Signal	I	-
18	0.35	BU/VT	5904	Steering Column Lock Status Signal	I	N06
19	0.5	BK/BN	5360	Brake Apply Sensor Low Reference	I	-
20	0.13	BU	5719	Ignition Mode Switch Start LED Signal	I	-
21	-	-	-	Not Occupied	-	-
22	0.35	GN/GY	13	Headlamp Switch Park Lamp Signal	I	-
23	0.13	GN	5721	Ignition Mode Switch Off LED Signal	I	-
24	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
25	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
26	0.35	BU/WH	3275	Remote Function Actuator Receive Signal	I	-

K9 BODY CONTROL MODULE X2





Connector Part Information

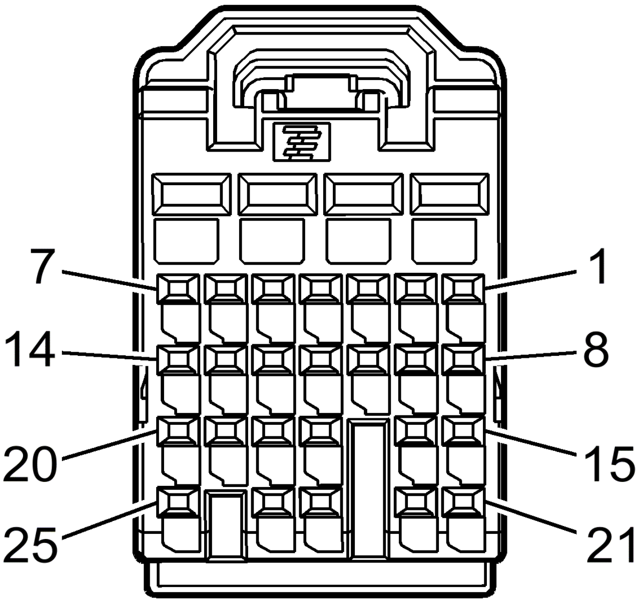
- Harness Type: Instrument Panel
- OEM Connector: 2098067-2
- Service Connector: 13576032
- Description: 27-Way F 0.64, 2.8 Series (BU)

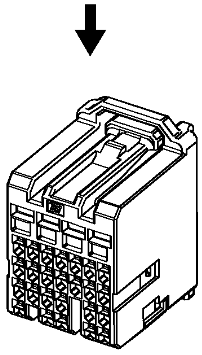
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575578	J-35616-35 (VT)	J-38125-553	8100-4445	Sumitomo 22	4	4
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	RD/VT	4040	Battery Positive Voltage	III	-
2	0.75	BK	1350	Ground	III	-
3	0.75	RD/GN	4440	Battery Positive Voltage	III	-
4	2	RD/WH	4740	Battery Positive Voltage	I	-
5 - 6	-	-	-	Not Occupied	-	-
7	0.5	BU/YE	5361	Brake Apply Sensor Signal	II	-
8	0.35	YE	6817	LED Backlight Dimming Control	II	-
9	0.35	YE/GY	44	Instrument Panel Lamp Dimmer Switch Signal	II	-
10 - 11	-	-	-	Not Occupied	-	-
12	0.35	BN/BU	391	Rear Window Wiper Switch Signal	II	-
13	0.5	WH	5359	Brake Apply Sensor Control	II	-
14	0.5 0.35	BARE BU/VT	1782 1788	Low Reference Traction Control Switch Signal 1	II II	UE1 -UE1
15	0.35	BN/WH	781	Driver Door Lock Switch Unlock Signal	II	-
16	0.35	GY	3273	Remote Function Actuator Low Reference	II	-
17	0.13	BU	5723	Ignition Mode Switch Mode Voltage	II	-
18	0.35	BU	6856	Headlamp Automatic High Beam Dim Control	II	-
19	0.35	BN/YE	780	Driver Door Lock Switch Lock Signal	II	-
20	-	-	-	Not Occupied	-	-
21	0.35	GN/GY	6135	Local Interconnect Network Serial Data Bus 4	II	-
22	0.35	GN	5060	Low Speed GMLAN Serial Data	II	-
23	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-
24	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
25	0.35	GY/WH	3272	Remote Function Actuator Control	II	-
26	0.35	GN/WH	111	Hazard Switch Signal	II	-
27	0.35	YE/GN	3274	Remote Function Actuator Transmit Signal	II	-

K9 BODY CONTROL MODULE X3





Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2098067-7
- Service Connector: 13576037
- Description: 25-Way F 0.64, 2.8 Series (GN)

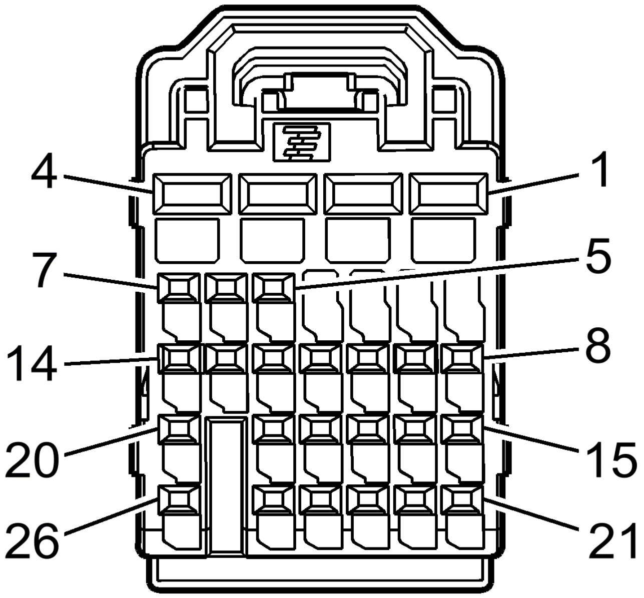
Terminal Part Information

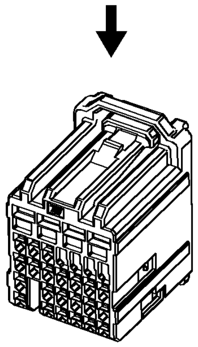
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/GY	3277	Vehicle Anti-Theft System Immobilizer Low Reference	I	-
2	0.35	GN/VT	7533	Local Interconnect Network Serial Data Bus 11	I	-
3	0.35	GY/BK	3276	Vehicle Anti-Theft System Immobilizer Control	I	-
4	0.35	YE	7556	Lighting Control Switch Reference	I	-
5	0.13	GY	4	Accessory Ignition Voltage	I	-
6	0.13	VT	3	Run/Crank Ignition 1 Voltage	I	-
7 - 8	-	-	-	Not Occupied	-	-
9	0.35	BN/GN	1884	Cruise Control Set/Coast/Resume/Accelerate Switch Signal	I	-
10	0.35	BK/GY	6009	Windshield Wiper Switch Low Reference	I	-
11	0.35	WH	524	Headlamp Dimmer Switch High Beam Signal	I	-
12	0.35	WH/GN	663	Hazard Switch Left Turn Signal	I	-
13	0.35	YE/BU	1714	Windshield Wiper Switch Low Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
14 - 16	-	-	-	Not Occupied	-	-
17	0.35	YE/BN	307	Headlamp Switch Flash To Pass Signal	I	-
18	0.35	GN/WH	3287	Horn Switch Signal	I	-
19	0.35	GN/WH	4115	Local Interconnect Network Serial Data Bus 15	I	-
20	0.35	GY	1715	Windshield Wiper Switch High Signal	I	-
21	0.5	VT/YE	5526	Tap Up/Tap Down Switch Signal	I	-
22 - 23	-	-	-	Not Occupied	-	-
24	0.35	VT/BU	664	Hazard Switch Right Turn Signal	I	-
25	0.35	WH/BK	94	Windshield Washer Switch Signal	I	-

K9 BODY CONTROL MODULE X4





Connector Part Information

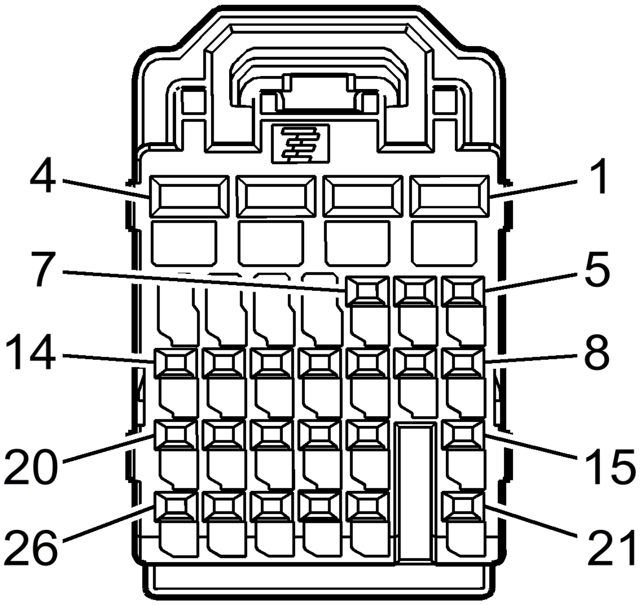
- Harness Type: Body
- OEM Connector: 2098067-3
- Service Connector: 13576033
- Description: 26-Way F 0.64, 2.8 Series (BK)

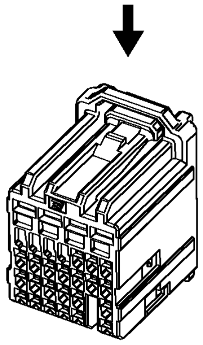
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575577	J-35616-35 (VT)	J-38125-553	8100-4443	Sumitomo 22	E	A
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE	312	Right Headlamp Low Beam Control	I	-
2	0.5	YE	712	Left Headlamp Low Beam Control	I	-
3	0.75	GN/VT	1315	Right Front Turn Signal Lamp Control	III	-
4	0.5	BU/VT	1335	Right Rear Turn Signal Lamp Control	I	-
5	0.5	GY/BN	309	Right Park Lamp Control	II	-
6	0.5	VT/GY	709	Left Park Lamp Control	II	-
7 - 8	-	-	-	Not Occupied	-	-
9	0.35	GY/VT	3264	Logistic Mode Relay Close Control	II	-
10	0.35	YE	5420	Rear Wiper Motor Relay Coil Control	II	-
11	0.5	BN/YE	820	CHMSL Control	II	-
12	0.35	GN/VT	4759	Remote PRNDL Enable	II	-
13	0.35	GN/YE	6846	Rear License Lamp Control	II	-
14	0.35	BN/GY	2268	Windshield Washer Relay Control	II	-
15	0.35	GN/VT	5199	Run/Crank Relay Coil Control	II	-
16	0.5	GY	91	Windshield Wiper Motor Relay Coil Control	II	-
17	-	-	-	Not Occupied	-	-
18	0.5	WH/YE	5075	Current Sensor Signal	II	-
19	-	-	-	Not Occupied	-	-
20	0.35	RD/GN	40	Battery Positive Voltage	II	-
21	0.5	BU/VT	5076	Current Sensor Control	II	-
22	0.5	VT/YE	5985	Accessory Wakeup Serial Data	II	-
23	0.5	WH/BU	5986	Serial Data Communication Enable	II	-
24	0.5	BN/GN	109	Hood Ajar Switch Signal	II	-
25	0.5	YE/BU	4086	Pushbutton Start Challenge Active Signal	II	-
26	0.5	BK/WH	51	Signal Ground	II	-

K9 BODY CONTROL MODULE X5





Connector Part Information

- Harness Type: Body
- OEM Connector: 2098067-4
- Service Connector: 13576034
- Description: 26-Way F 0.64, 2.8 Series (BN)

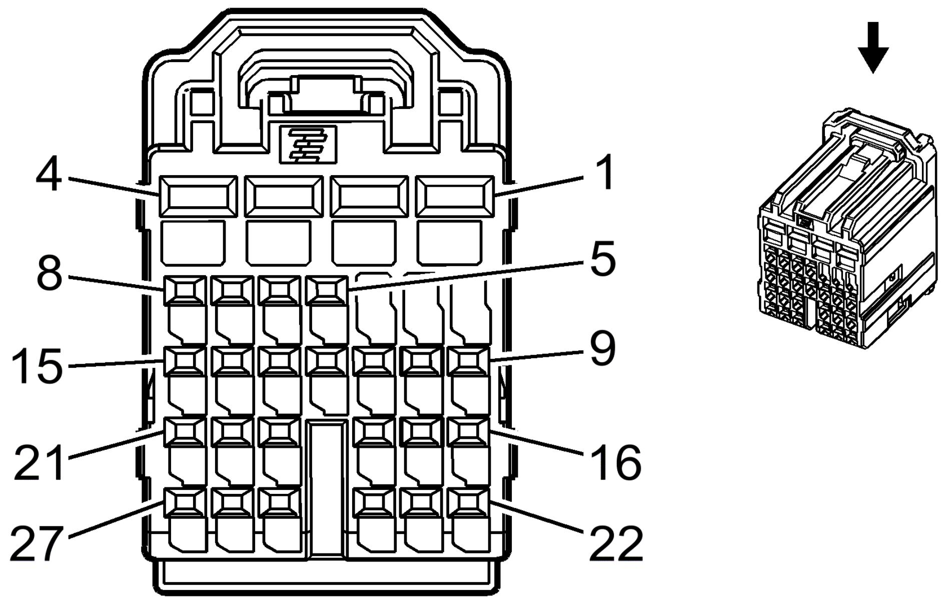
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575577	J-35616-35 (VT)	J-38125-553	8100-4443	Sumitomo 22	E	A
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
III	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/WH	1334	Left Rear Turn Signal Lamp Control	I	-
2	0.75	BU/WH	1314	Left Front Turn Signal Lamp Control	III	-
3	0.5	RD/VT	4640	Battery Positive Voltage	I	-
4	0.5	RD/BU	4540	Battery Positive Voltage	I	-
5	0.5	BN/BU	1977	Rear Fog Lamp Relay Control	II	VD1
6	0.5	BK/VT	5077	Current Sensor Low Reference	II	-
7 - 10	-	-	-	Not Occupied	-	-
11	0.35	GN/BN	5706	Endgate Latch Relay Control	II	-
12	0.5	WH/BU	6311	Cruise/ETC/TCC Brake Signal	II	-
13	0.35	BN/YE	1970	Headlamp Low Beam Relay Control	II	-
14	0.35	VT/BN	541	Run Ignition 3 Voltage	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
15	0.5	BN/WH	1635	Right Rear Heated Seat High Indicator Control	II	KA6
16 - 17	-	-	-	Not Occupied	-	-
18	0.35	BN/VT	1969	Headlamp High Beam Relay Control	II	-
19	0.35	BN/WH	28	Horn Relay Control	II	-
20	0.35	YE	5704	Endgate Latch Relay Coil Control	II	-
21	0.5	WH	1638	Left Rear Heated Seat High Indicator Control	II	KA6
22 - 26	-	-	-	Not Occupied	-	-

K9 BODY CONTROL MODULE X6



Connector Part Information

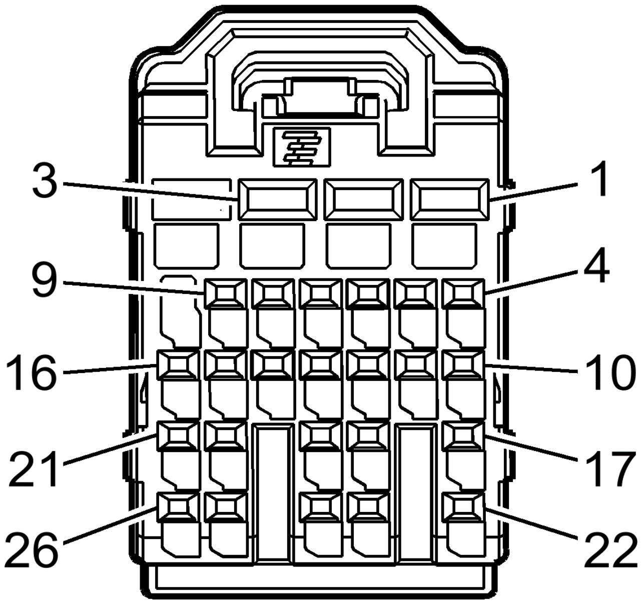
- Harness Type: Body
- OEM Connector: 2098067-5
- Service Connector: 13576035
- Description: 27-Way F 0.64, 2.8 Series (PK)

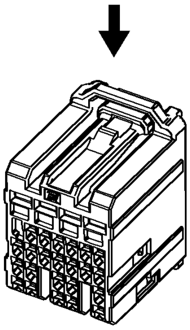
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575578	J-35616-35 (VT)	J-38125-553	8100-4445	Sumitomo 22	4	4
II	13575578	J-35616-35 (VT)	J-38125-553	Not Available	Not Available	Not Available	Not Available
III	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available
IV	13582326	J-35616-35 (VT)	J-38125-553	8100-4444	Sumitomo 22	2	A

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GY	5911	Door Lock Actuator Lock Control 2	IV	-
2	1.5	GY	295	Door Lock Actuator Lock Control	II	-
3	2	BK	650	Ground	I	-
4	1.5	BN/YE	294	Door Lock Actuator Unlock Control	II	-
5	0.5	VT/GY	1303	Lift Gate Ajar Switch Signal 1	III	-
6	-	-	-	Not Occupied	-	-
7	0.35	WH/YE	7557	LED Ambient Lighting Control 1	III	-
8	-	-	-	Not Occupied	-	-
9	0.5 0.35	GN/BU GN/BU	6133 6133	Local Interconnect Network Serial Data Bus 2 Local Interconnect Network Serial Data Bus 2	III III	KA1+KA6 KA1-KA6
10	0.35	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	III	-
11 - 14	-	-	-	Not Occupied	-	-
15	0.5	YE/BU	5797	Rear Closure Handle Switch Open Signal	III	-
16	0.35	GN/BN	6132	Local Interconnect Network Serial Data Bus 1	III	-
17 - 21	-	-	-	Not Occupied	-	-
22	0.35	GY	5054	Sport Mode Switch Signal	III	-
23	-	-	-	Not Occupied	-	-
24	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	III	-
25	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	III	-
26	-	-	-	Not Occupied	-	-
27	0.5	BN/WH	1637	Left Rear Heated Seat Switch Signal	III	KA6

K9 BODY CONTROL MODULE X7





Connector Part Information

- Harness Type: Body
- OEM Connector: 2098067-6
- Service Connector: 13576036
- Description: 26-Way F 0.64, 2.8 Series (GY)

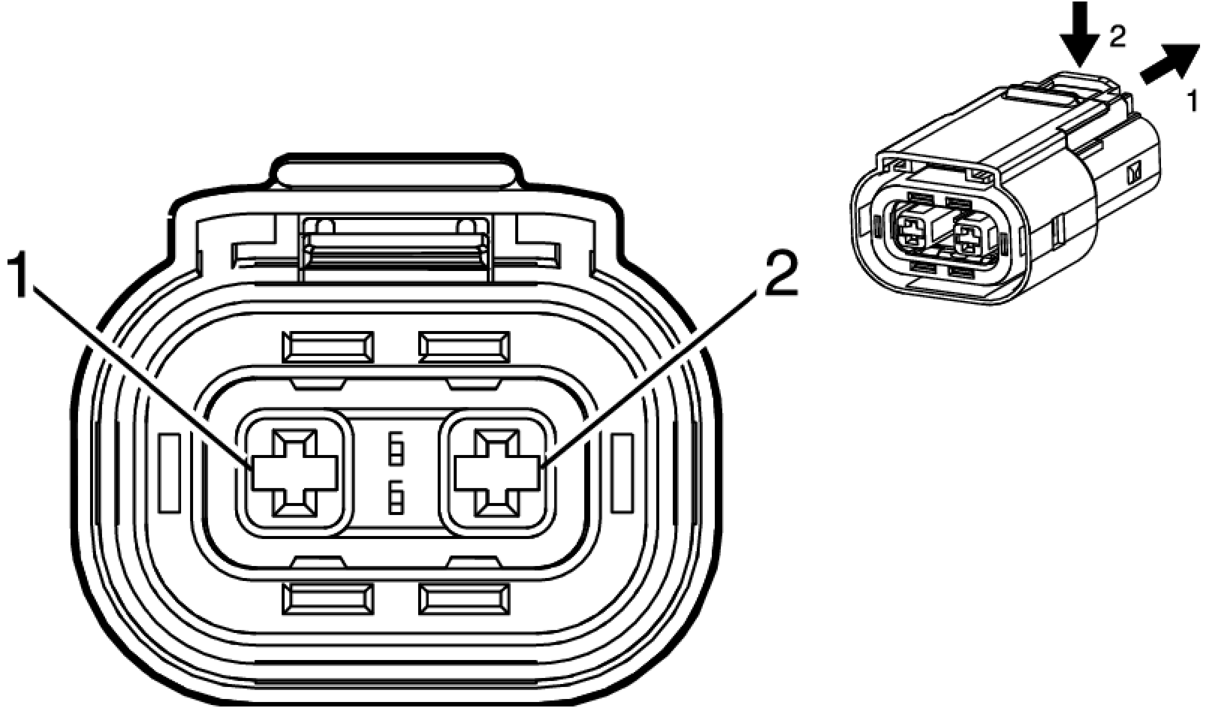
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575577	J-35616-35 (VT)	J-38125-553	8100-4443	Sumitomo 22	E	A
II	13582297	J-35616-64B (LT BU)	J-38125-22	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY	157	Interior Lamp Control	I	-
2	0.5	WH/BN	6815	Inadvertent Power Control	I	-
3	0.5	GN/WH	24	Backup Lamp Control	I	-
4 - 6	-	-	-	Not Occupied	-	-
7	0.5	GN/GY	737	Rear Compartment Lid Lamp Control	II	-
8	-	-	-	Not Occupied	-	-
9	0.35	YE	6817	LED Backlight Dimming Control	II	-
10	-	-	-	Not Occupied	-	-
11	0.5	BN/GN	1634	Right Rear Heated Seat Switch Signal	II	KA6
12 - 13	-	-	-	Not Occupied	-	-
14	0.35	YE/VT	244	Passenger Door Lock Switch Lock Control	II	-
15	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
16	0.35	VT/BU	3263	Logistic Mode Relay Open Control	II	-
17 - 18	-	-	-	Not Occupied	-	-
19	0.5	GY	156	Courtesy Lamp Switch Signal	II	-
20 - 23	-	-	-	Not Occupied	-	-
24	0.5	GY/GN	328	Interior Lamp Defeat Switch Signal	II	-
25 - 26	-	-	-	Not Occupied	-	-

K10 COOLANT HEATER CONTROL MODULE X1



Connector Part Information

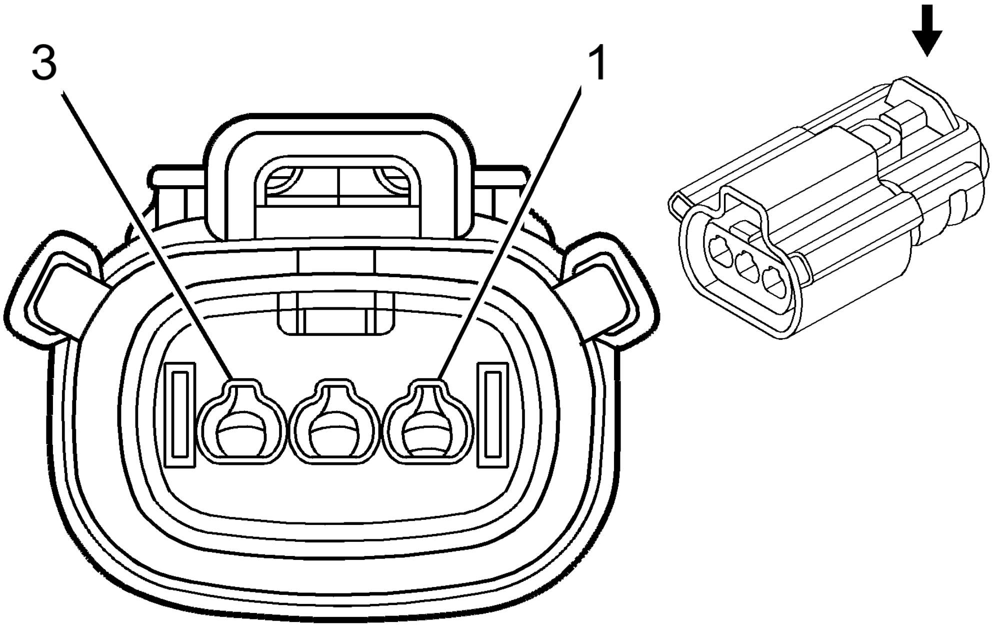
- Harness Type: High Voltage
- OEM Connector: 13589514
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F HVA280-2PHI Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG	3970	High Voltage Battery 4 (+)	I	-
2	-	OG/BK	3969	High Voltage Battery 4 (-)	I	-

K10 COOLANT HEATER CONTROL MODULE X2



Connector Part Information

- Harness Type: Body
- OEM Connector: 33471-0306
- Service Connector: 19301648
- Description: 3-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/BU	4119	Local Interconnect Network Serial Data Bus 19	I	-
2	0.5	RD/WH	2740	Battery Positive Voltage	I	-
3	0.5	BK	750	Ground	I	-

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Wiring Systems and Power Management - Component Locator - Component Connector End Views - Bolt EV

COMPONENT CONNECTOR END VIEWS

K16 BATTERY ENERGY CONTROL MODULE X1

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Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	RD/VT	1640	Battery Positive Voltage	I	-
2	-	GN	5391	Battery Voltage Signal 1	I	-
3	-	YE	5395	Battery Voltage Signal 3	I	-
4	-	OG	5397	Battery Voltage Signal 5	I	-
5	-	WH	5398	Battery Voltage Signal 6	I	-
6	-	BN	5400	Battery Voltage Signal 8	I	-
7	-	BU	5392	Battery Voltage Signal 10	I	-
8	-	L-GN/	5593	Module Temperature Low Reference 2	I	-
9	-	GN	5572	Battery Voltage Signal 13	I	-
10	- -	VT/GN YE	1339 5574	Run/Crank Ignition 1 Voltage Battery Voltage Signal 15	I I	- -
11	-	PK	5403	Battery Pack Monitor Low Reference	I	-
12	- -	L-BU/ BK	5394 750	Battery Voltage Signal 2 Ground	I I	- -
13	-	VT	5396	Battery Voltage Signal 4	I	-
14	-	OG	5397	Battery Voltage Signal 5	I	-
15	-	GY	5399	Battery Voltage Signal 7	I	-
16	-	OG/RD	5401	Battery Voltage Signal 9	I	-
17	-	GN/WH	5403	Battery Pack Monitor Low Reference	I	-
18	-	PK	5571	Battery Voltage Signal 12	I	-
19	-	L-BU/	5573	Battery Voltage Signal 14	I	-
20	-	VT	5575	Battery Voltage Signal 16	I	-

K16 BATTERY ENERGY CONTROL MODULE X2

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Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT	5575	Battery Voltage Signal 16	I	-
2	-	WH	5577	Battery Voltage Signal 18	I	-
3	-	BN	5579	Battery Voltage Signal 20	I	-
4	-	BU	5580	Battery Voltage Signal 21	I	-
5	-	L-GN/	5582	Battery Voltage Signal 23	I	-
6	-	GN	5584	Battery Voltage Signal 25	I	-
7	-	YE	5586	Battery Voltage Signal 27	I	-
8	-	OG	5588	Battery Voltage Signal 29	I	-
9	-	GY	5403	Battery Pack Monitor Low Reference	I	-
10	-	OG/RD	5591	Battery Voltage Signal 32	I	-
11	-	OG	5576	Battery Voltage Signal 17	I	-
12	-	GY	5578	Battery Voltage Signal 19	I	-
13	-	OG/RD	5403	Battery Pack Monitor Low Reference	I	-
14	-	GN/WH	5581	Battery Voltage Signal 22	I	-
15	-	PK	5583	Battery Voltage Signal 24	I	-
16	-	L-BU/	5585	Battery Voltage Signal 26	I	-
17	-	VT	5587	Battery Voltage Signal 28	I	-
18	-	WH	5589	Battery Voltage Signal 30	I	-
19	-	BN	5590	Battery Voltage Signal 31	I	-
20	-	BU	5592	Battery Voltage Signal 33	I	-

K16 BATTERY ENERGY CONTROL MODULE X3

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Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BU	5592	Battery Voltage Signal 33	I	-
2	-	BU/GN	4516	Battery Cell Voltage Signal 35	I	-
3	-	GN	4518	Battery Cell Voltage Signal 37	I	-
4	-	YE	4520	Battery Cell Voltage Signal 39	I	-
5	-	OG	5403	Battery Pack Monitor Low Reference	I	-
6	-	GY	4523	Battery Cell Voltage Signal 42	I	-
7	-	OG/RD	4525	Battery Cell Voltage Signal 44	I	-
8	-	OG/RD	4525	Battery Cell Voltage Signal 44	I	-
9	-	BU	4526	Battery Cell Voltage Signal 45	I	-
10	-	L-BU/	4528	Battery Cell Voltage Signal 47	I	-
11	-	GN/WH	4514	Battery Cell Voltage Signal 34	I	-
12	-	PK	4517	Battery Cell Voltage Signal 36	I	-
13	-	L-BU/	4519	Battery Cell Voltage Signal 38	I	-
14	-	VT	4521	Battery Cell Voltage Signal 40	I	-
15	-	WH	4522	Battery Cell Voltage Signal 41	I	-
16	-	BN	4524	Battery Cell Voltage Signal 43	I	-
17	-	OG/RD	4525	Battery Cell Voltage Signal 44	I	-
18	-	OG/RD	4525	Battery Cell Voltage Signal 44	I	-
19	-	GN/WH	4527	Battery Cell Voltage Signal 46	I	-
20	-	PK	4529	Battery Cell Voltage Signal 48	I	-

K16 BATTERY ENERGY CONTROL MODULE X4

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Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GN	5403	Battery Pack Monitor Low Reference	I	-
2	-	YE	4530	Battery Cell Voltage Signal 49	I	-
3	-	OG	4532	Battery Cell Voltage Signal 51	I	-
4	-	WH	4533	Battery Cell Voltage Signal 52	I	-
5	-	GN/WH	4537	Battery Cell Voltage Signal 55	I	-
6	-	BU	4541	Battery Cell Voltage Signal 57	I	-
7	-	GN/WH	4543	Battery Cell Voltage Signal 58	I	-
8	-	PK	4544	Battery Cell Voltage Signal 59	I	-
9	-	L-BU/	4546	Battery Cell Voltage Signal 61	I	-
10	-	VT	4548	Battery Cell Voltage Signal 63	I	-
11	-	L-BU/	4529	Battery Cell Voltage Signal 48	I	-
12	-	VT	4531	Battery Cell Voltage Signal 50	I	-
13	-	WH	4533	Battery Cell Voltage Signal 52	I	-
14	-	GY	4535	Battery Cell Voltage Signal 53	I	-
15	-	OG/RD	4538	Battery Cell Voltage Signal 56	I	-
16	-	GN/WH	4543	Battery Cell Voltage Signal 58	I	-
17	-	L-GN/	5403	Battery Pack Monitor Low Reference	I	-
18	-	GN	4545	Battery Cell Voltage Signal 60	I	-
19	-	YE	4547	Battery Cell Voltage Signal 62	I	-
20	-	OG	4549	Battery Cell Voltage Signal 64	I	-

K16 BATTERY ENERGY CONTROL MODULE X5

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Connector Part Information

- Harness Type: Hybrid/EV Battery

- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG	4549	Battery Cell Voltage Signal 64	I	-
2	-	GY	4554	Battery Cell Voltage Signal 66	I	-
3	-	OG	4555	Battery Cell Voltage Signal 67	I	-
4	-	GN/WH	4557	Battery Cell Voltage Signal 69	I	-
5	-	PK	4560	Battery Cell Voltage Signal 71	I	-
6	-	L-BU/	4562	Battery Cell Voltage Signal 73	I	-
7	-	VT	4564	Battery Cell Voltage Signal 75	I	-
8	-	OG	4565	Battery Cell Voltage Signal 76	I	-
9	-	GY	4566	Battery Cell Voltage Signal 77	I	-
10	-	OG	4568	Battery Cell Voltage Signal 79	I	-
11	-	WH	4553	Battery Cell Voltage Signal 65	I	-
12	-	BN	5403	Battery Pack Monitor Low Reference	I	-
13	-	BU	4556	Battery Cell Voltage Signal 68	I	-
14	-	L-GN/	4558	Battery Cell Voltage Signal 70	I	-
15	-	GN	4561	Battery Cell Voltage Signal 72	I	-
16	-	YE	4563	Battery Cell Voltage Signal 74	I	-
17	-	OG	4565	Battery Cell Voltage Signal 76	I	-
18	-	WH	5403	Battery Pack Monitor Low Reference	I	-
19	-	BN	4567	Battery Cell Voltage Signal 78	I	-
20	-	BU	4569	Battery Cell Voltage Signal 80	I	-

K16 BATTERY ENERGY CONTROL MODULE X6

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Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BU	4569	Battery Cell Voltage Signal 80	I	-
2	-	L-GN/	4571	Battery Cell Voltage Signal 82	I	-
3	-	GN	4573	Battery Cell Voltage Signal 84	I	-
4	-	YE	4575	Battery Cell Voltage Signal 86	I	-
5	-	OG	4576	Battery Cell Voltage Signal 87	I	-
6	-	GY	2389	Battery Cell Voltage Signal 89	I	-
7	-	OG	2391	Battery Cell Voltage Signal 91	I	-
8	-	GN/WH	2393	Battery Cell Voltage Signal 93	I	-
9	-	L-GN/	2394	Battery Cell Voltage Signal 94	I	-
10	-	PK	2396	Battery Cell Voltage Signal 96	I	-
11	-	GN/WH	4570	Battery Cell Voltage Signal 81	I	-
12	-	PK	4572	Battery Cell Voltage Signal 83	I	-
13	-	L-BU/	4574	Battery Cell Voltage Signal 85	I	-
14	-	VT	5403	Battery Pack Monitor Low Reference	I	-
15	-	WH	4577	Battery Cell Voltage Signal 88	I	-
16	-	BN	2390	Battery Cell Voltage Signal 90	I	-
17	-	BU	2392	Battery Cell Voltage Signal 92	I	-
18	-	GN/WH	2393	Battery Cell Voltage Signal 93	I	-
19	-	L-BU/	2395	Battery Cell Voltage Signal 95	I	-

K16 BATTERY ENERGY CONTROL MODULE X7

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Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT	5404	Charge Port Paddle Temperature Sensor Low Reference	I	-
2	-	VT	5406	Battery Module Temperature Signal 2	I	-
3	-	VT	5407	Battery Module Temperature Signal 3	I	-
4	-	VT	5408	Battery Module Temperature Signal 4	I	-
5	-	VT	5409	Battery Module Temperature Signal 5	I	-
6	-	VT	5410	Battery Module Temperature Signal 6	I	-
7	-	YE	5411	Battery Module Temperature Signal 7	I	-
9	-	RD	2965	High Voltage Battery Current Sensor Voltage Reference	I	-
10	-	BU	2962	High Voltage Battery Current Sensor Course Signal	I	-
11	-	BK/WH	3373	Auxiliary Video High Signal 2	I	-
12	-	BK/WH	3774	Battery Module Temperature Sensor Low Reference 2	I	-
13	-	BK/WH	3775	Battery Module Temperature Sensor Low Reference 3	I	-
14	-	BK/WH	3778	Battery Module Temperature Sensor Low Reference 6	I	-
15	-	BK/WH	3777	Battery Module Temperature Sensor Low Reference 5	I	-
16	-	BK/WH	3778	Battery Module Temperature Sensor Low Reference 6	I	-
17	-	BK	3779	Battery Module Temperature Sensor Low Reference 7	I	-
19	-	BK	2963	High Voltage Battery Current Sensor Low Reference	I	-
20	-	GN	2961	High Voltage Battery Current Sensor Fine Signal	I	-

K16 BATTERY ENERGY CONTROL MODULE X8

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Connector Part Information

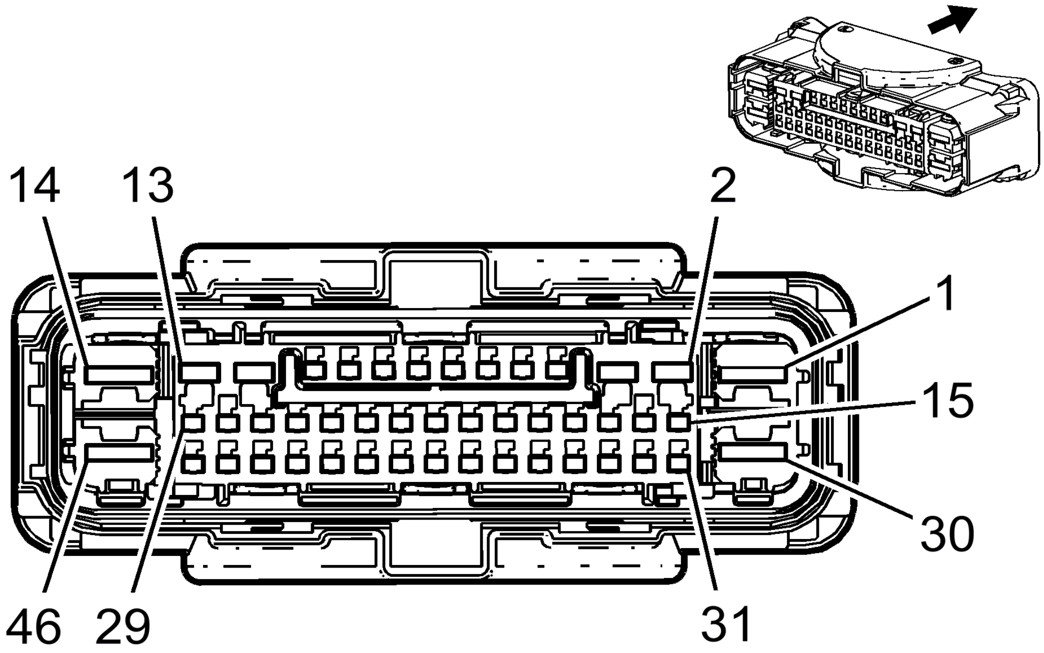
- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	RD/VT	1640	Battery Positive Voltage	I	-
3	-	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
4	-	WH	3832	High Speed GMLAN Serial Data (-) 6	I	-
5	-	BU/GN	3831	High Speed GMLAN Serial Data (+) 6	I	-
6	-	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
7	-	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
8	-	BU/GY	5139	High Voltage Fault Signal	I	-
9	-	RD/GY	1339	Run/Crank Ignition 1 Voltage	I	-
10	- -	BU/BN YE/BN	3787 3787	High Voltage Energy Management Communication Control High Voltage Energy Management Communication Control	I I	- -
11	-	BK	750	Ground	I	-
14	-	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
15	-	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-

K17 ELECTRONIC BRAKE CONTROL MODULE



Connector Part Information

- Harness Type: Body
- OEM Connector: 1928405782
- Service Connector: 19333357
- Description: 46-Way F 1.5, 2.8, 5.8 Series, Sealed (BK)

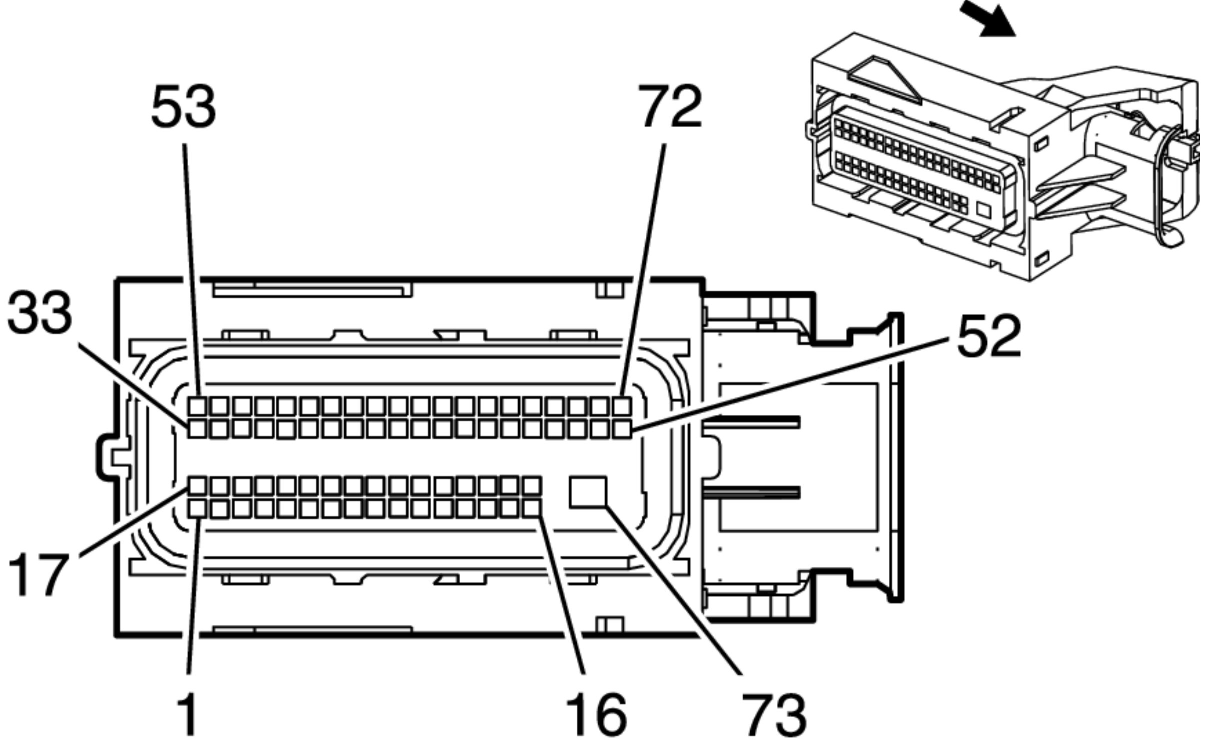
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19330700	J-35616-35 (VT)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
II	19333305	J-35616-40 (BU)	J-38125-556	Not Available	Not Available	Not Available	Not Available
III	19333312	J-35616-4A (PU)	J-38125-553	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	4	RD/BN	3142	Battery Positive Voltage	II	-
2	2.5	GN/VT	1988	Park Brake Motor Apply Right Rear Control	I	-
3	2.5	GY	4368	Park Brake Motor Low Reference Right Rear	I	-
4	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	III	-
5	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	III	-
6	-	-	-	Not Occupied	-	-
7	0.5	GY	830	Wheel Speed Sensor Signal Left Front	III	-
8	0.35	YE/RD	7683	Park Brake Release Switch Voltage Reference	III	-
9	0.35	BU/VT	1134	Park Brake Switch Signal	III	-
10	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	III	-
12	2.5	GY/BK	4369	Park Brake Motor Low Reference Left Rear	I	-
13	2.5	WH	2001	Park Brake Motor Apply Left Rear Control	I	-
14	4	BK	1650	Ground	II	-
15	0.35	BU/BK	6108	Park Brake Release Switch Signal	III	-
16	0.35	YE	1492	Park Brake Switch Supply Voltage	III	-
17	-	-	-	Not Occupied	-	-
18	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	III	-
19	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	III	-
20	-	-	-	Not Occupied	-	-
21	0.5	GY/BN	7065	Wheel Speed Sensor Control Right Front	III	-
22	0.5	GY/YE	7128	Wheel Speed Sensor Control Right Rear	III	-
23	0.5	BU	884	Wheel Speed Sensor Signal Left Rear	III	-
24	0.5	GY/WH	7064	Wheel Speed Sensor Control Left Front	III	-
25	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	III	-
26	0.5	YE	872	Wheel Speed Sensor Signal Right Front	III	-
27 - 29	-	-	-	Not Occupied	-	-
30	2.5	RD/BU	3242	Battery Positive Voltage	II	-
31	0.35	BN	6107	Park Brake Apply Switch Signal	III	-
32	0.35	GY/RD	7684	Park Brake Apply Switch Voltage Reference	III	-
33 - 35	-	-	-	Not Occupied	-	-
36	0.5	WH/BU	5986	Serial Data Communication Enable	III	-
37	0.5	VT	882	Wheel Speed Sensor Signal Right Rear	III	-
38	-	-	-	Not Occupied	-	-
39	0.5	GY/BK	7127	Wheel Speed Sensor Control Left Rear	III	-
40 - 41	-	-	-	Not Occupied	-	-
42	0.5	GN/GY	333	Brake Fluid Level Sensor Signal	III	-
43 - 45	-	-	-	Not Occupied	-	-
46	2.5	BK	1650	Ground	II	-

K20 ENGINE CONTROL MODULE X1



Connector Part Information

- Harness Type: Engine
- OEM Connector: 34566-7593
- Service Connector: 13574947
- Description: 73-Way F 0.64, 2.8 Series, Sealed (BK with BK Terminal Position Assurance)

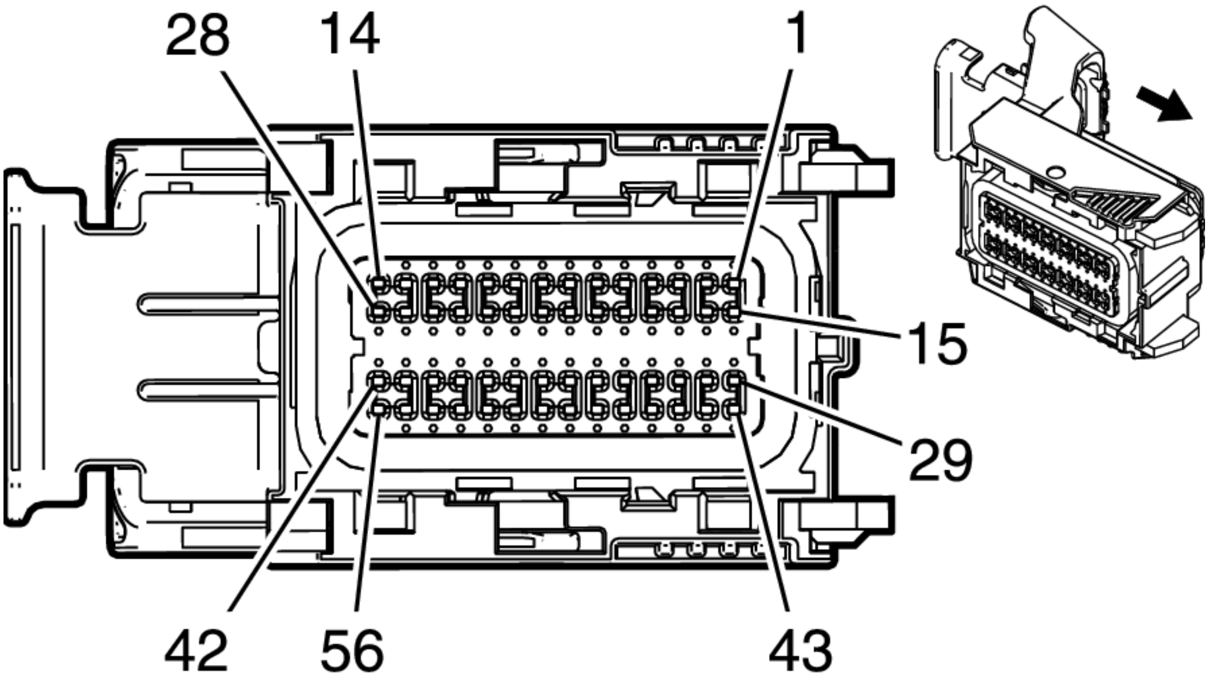
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575812	J-35616-64B (LT BU)	J-38125-213	Not Available	Not Available	Not Available	Not Available
II	13576392	J-35616-4A (PU)	J-38125-11A	7116-4152-02	Yazaki 9	2	5

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 8	-	-	-	Not Occupied	-	-
9	0.5	GN	380	A/C Refrigerant Pressure Sensor Signal	I	-
10	0.5	BK/BN	5514	A/C Refrigerant Pressure Sensor Low Reference	I	-
11	0.5	VT/GY	139	Run/Crank Ignition 1 Voltage	I	-
12	0.5	BN/WH	419	Check Engine Indicator Control	I	-
13 - 14	-	-	-	Not Occupied	-	-
15	0.5	RD/WH	140	Battery Positive Voltage	I	-
16	0.5	VT/BU	5292	Powertrain Main Relay Fused Supply 3	I	-
17 - 19	-	-	-	Not Occupied	-	-
20	0.5	WH/BU	6311	Cruise/ETC/TCC Brake Signal	I	-
21 - 24	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
25	0.5	GN/WH	1162	Accelerator Pedal Position Signal 2	I	-
26 - 28	-	-	-	Not Occupied	-	-
29	0.5	YE	5991	Powertrain Relay Coil Control	I	-
30 - 31	-	-	-	Not Occupied	-	-
32	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
33 - 36	-	-	-	Not Occupied	-	-
37	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
38 - 39	-	-	-	Not Occupied	-	-
40	0.5	BK/VT	1272	Accelerator Pedal Position Low Reference 2	I	-
41 - 50	-	-	-	Not Occupied	-	-
51	0.5	BN/RD	1274	Accelerator Pedal Position 5V Reference 2	I	-
52	0.5	WH/RD	1164	Accelerator Pedal Position 5V Reference 1	I	-
53 - 54	-	-	-	Not Occupied	-	-
55	0.5	BU/VT	2364	Cooling Fan Speed Signal	I	-
56	-	-	-	Not Occupied	-	-
57	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
58	-	-	-	Not Occupied	-	-
59	0.5	GN/VT	4621	Local Interconnect Network Serial Data Bus 21	I	-
60	-	-	-	Not Occupied	-	-
61	0.5	BK/BU	1271	Accelerator Pedal Position Low Reference 1	I	-
62	0.5	YE/WH	1161	Accelerator Pedal Position Signal 1	I	-
63 - 71	-	-	-	Not Occupied	-	-
72	0.5	BN/RD	2700	A/C Pressure Sensor 5V Reference	I	-
73	2	BK	150	Ground	II	-

K20 ENGINE CONTROL MODULE X2



Connector Part Information

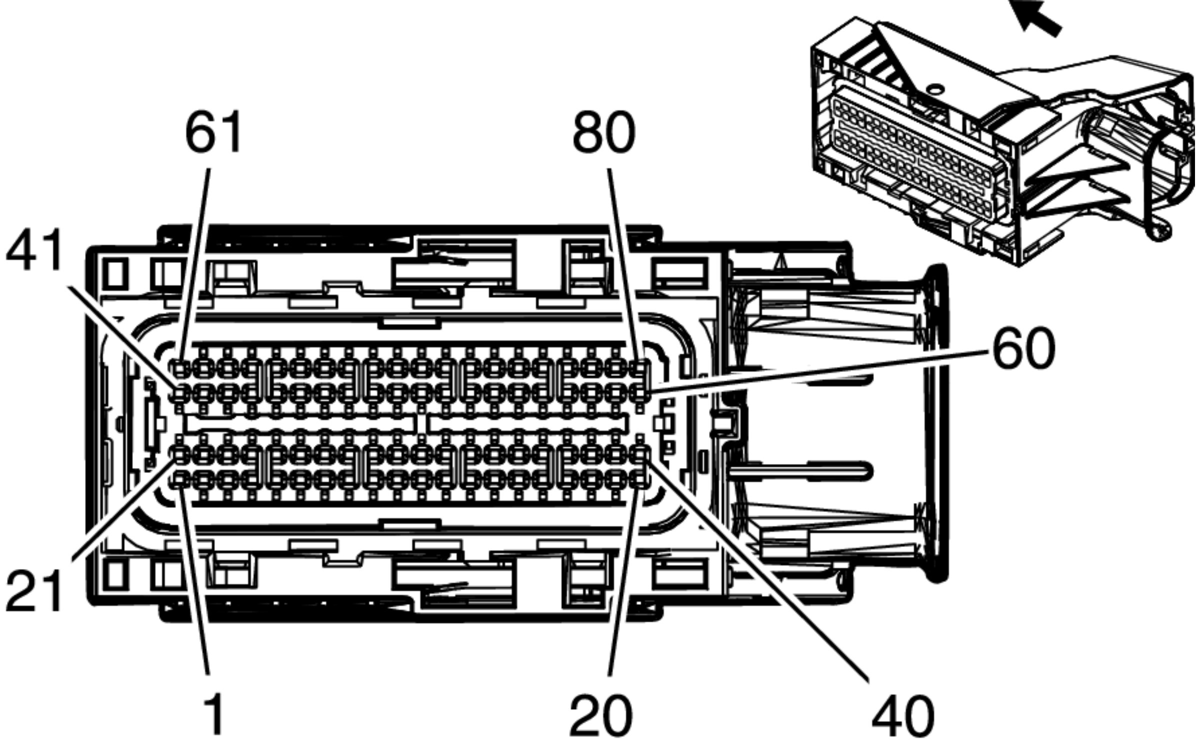
- Harness Type: Engine
- OEM Connector: 34576-1903
- Service Connector: 13395411
- Description: 56-Way F 0.64 Series, Sealed (BU with BU Terminal Position Assurance)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575812	J-35616-64B (LT BU)	J-38125-213	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 6	-	-	-	Not Occupied	-	-
7	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	I	-
8 - 19	-	-	-	Not Occupied	-	-
20	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	I	-
21 - 23	-	-	-	Not Occupied	-	-
24	0.5	WH/GN	5380	Brake Position Sensor Signal	I	-
25 - 35	-	-	-	Not Occupied	-	-
36	0.5	BK/YE	5382	Brake Position Sensor Low Reference	I	-
37	0.5	WH/RD	5381	Brake Position Sensor 5V Reference	I	-
38 - 56	-	-	-	Not Occupied	-	-

K20 ENGINE CONTROL MODULE X3



Connector Part Information

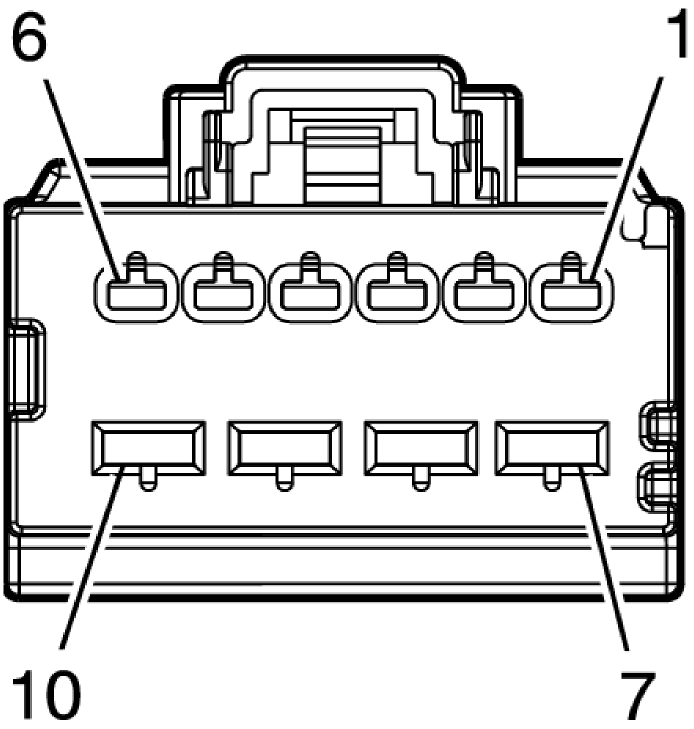
- Harness Type: Engine
- OEM Connector: 34566-2003
- Service Connector: 13579724
- Description: 80-Way F 0.64 Series, Sealed (BK with GY Terminal Position Assurance)

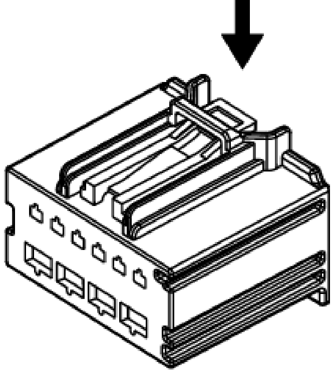
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575812	J-35616-64B (LT BU)	J-38125-213	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 48	-	-	-	Not Occupied	-	-
49	0.5	BN	25	Charge Indicator Control	I	-
50 - 70	-	-	-	Not Occupied	-	-
71	0.5	GY	23	Generator Field Duty Cycle Signal	I	-
72 - 80	-	-	-	Not Occupied	-	-

K29F SEAT HEATING CONTROL MODULE - FRONT X1 (KA1)





Connector Part Information

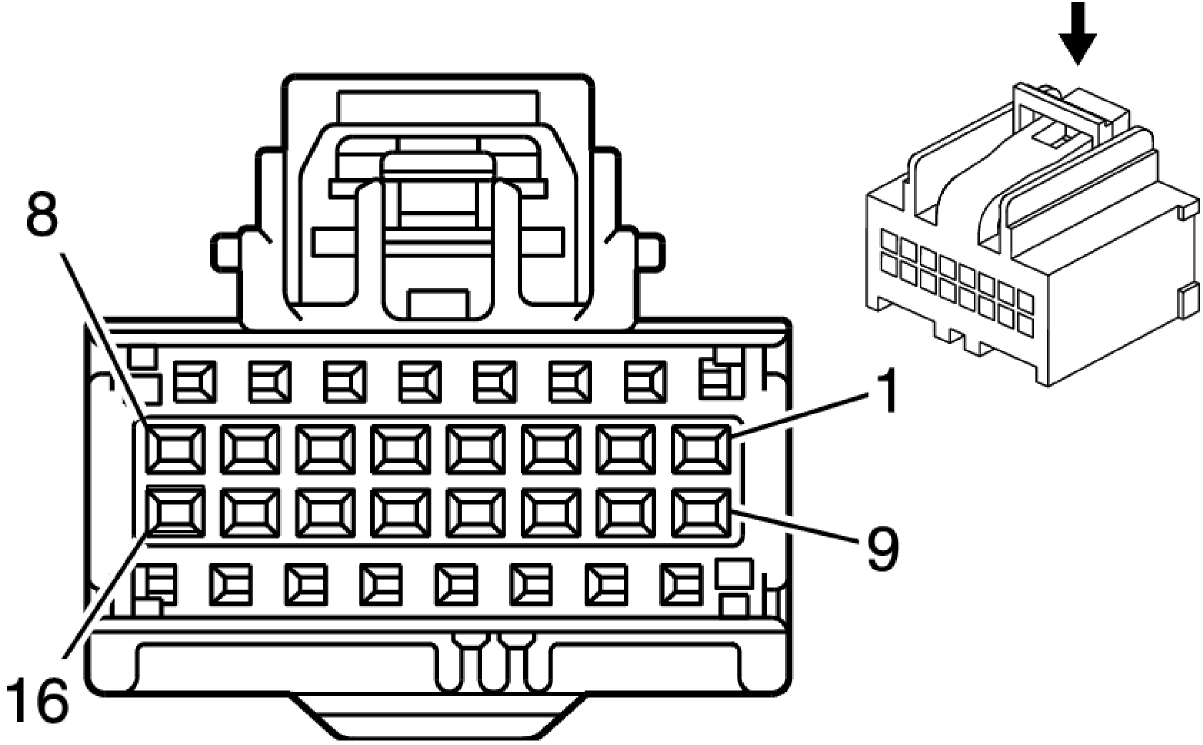
- Harness Type: Passenger Seat
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.75	BN/BU	2479	Passenger Heated Seat Element Control	I	-
3	0.75	GY/BK	2480	Passenger Heated Seat Element Low Reference	I	-
4	0.75	VT/BK	2424	Driver Heated Back Element Low Reference	I	-
5	-	-	-	Not Occupied	-	-
6	0.75	BN/VT	2077	Driver Heated Seat Element Control	I	-
7	1.5	RD/BU	540	Battery Positive Voltage	II	-
8	2	BK	850	Ground	II	-
9	-	-	-	Not Occupied	-	-
10	2	RD/BU	540	Battery Positive Voltage	II	-

K29F SEAT HEATING CONTROL MODULE - FRONT X2 (KA1)



Connector Part Information

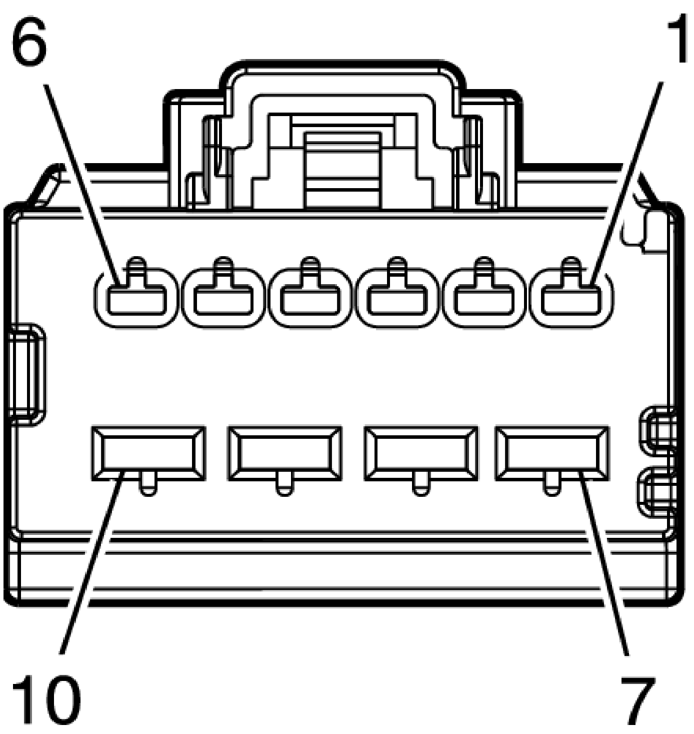
- Harness Type: Passenger Seat
- OEM Connector: 15136073
- Service Connector: Service by Harness - See Part Catalog
- Description: 16-Way F 0.64 Kaizen Series (BK)

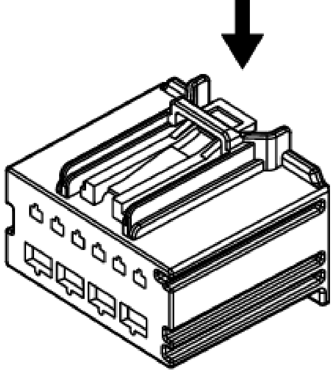
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/YE	2080	Driver Heated Seat NTC Low Reference	I	-
2	0.5	BK/GY	2435	Passenger Heated Seat NTC Low Reference	I	-
3	0.5	BU	2425	Driver Heated Back NTC Signal	I	-
4	0.5	WH/BU	2436	Passenger Heated Back NTC Signal	I	-
5	0.5	WH/GY	2434	Passenger Heated Seat NTC Signal	I	-
6	0.5	YE/GY	2079	Driver Heated Seat NTC Signal	I	-
7	-	-	-	Not Occupied	-	-
8	0.5	GN/BU	6133	Local Interconnect Network Serial Data Bus 2	I	-
9 - 16	-	-	-	Not Occupied	-	-

K29R SEAT HEATING CONTROL MODULE - REAR X1 (KA6)





Connector Part Information

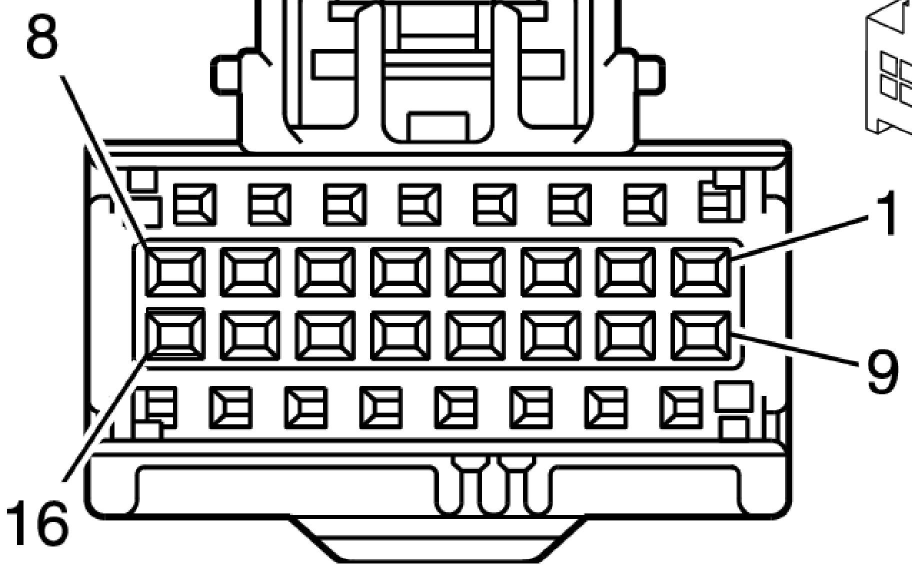
- Harness Type: Rear Seat Harness
- OEM Connector: 13582823
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

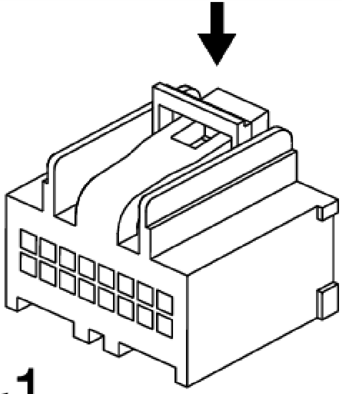
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	-	GN/BN	2296	Right Rear Heated Seat Cushion Element Control	I	-
3	-	GN/BK	2297	Right Rear Heated Seat Cushion Element Low Reference	I	-
4	-	BN/BK	2295	Left Rear Heated Seat Cushion Element Low Reference	I	-
5	-	-	-	Not Occupied	-	-
6	-	GY	2294	Left Rear Heated Seat Cushion Element Control	I	-
7	-	RD/BU	540	Battery Positive Voltage	I	-
8	-	BK	2250	Ground	I	-
9	-	-	-	Not Occupied	-	-
10	-	RD/BU	540	Battery Positive Voltage	I	-

K29R SEAT HEATING CONTROL MODULE - REAR X2 (KA6)





Connector Part Information

- Harness Type: Rear Seat Harness
- OEM Connector: 15136073
- Service Connector: Service by Harness - See Part Catalog
- Description: 16-Way F 0.64 Kaizen Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT/RD	7662	Left Rear Heated Seat NTC Low Reference	I	-
2	-	WH/BK	7054	Right Rear Cushion NTC Low Reference	I	-
3 - 4	-	-	-	Not Occupied	-	-
5	-	YE/WH	7053	Right Rear Cushion NTC Signal	I	-
6	-	GY	7663	Left Rear Heated Seat NTC Signal	I	-
7	-	BK	2250	Ground	I	-
8	-	GN/BU	6133	Local Interconnect Network Serial Data Bus 2	I	-
9 - 16	-	-	-	Not Occupied	-	-

K32 STEERING WHEEL HEATING CONTROL MODULE

-

Connector Part Information

- Harness Type: Steering Wheel Harness
- OEM Connector: 31068-1040

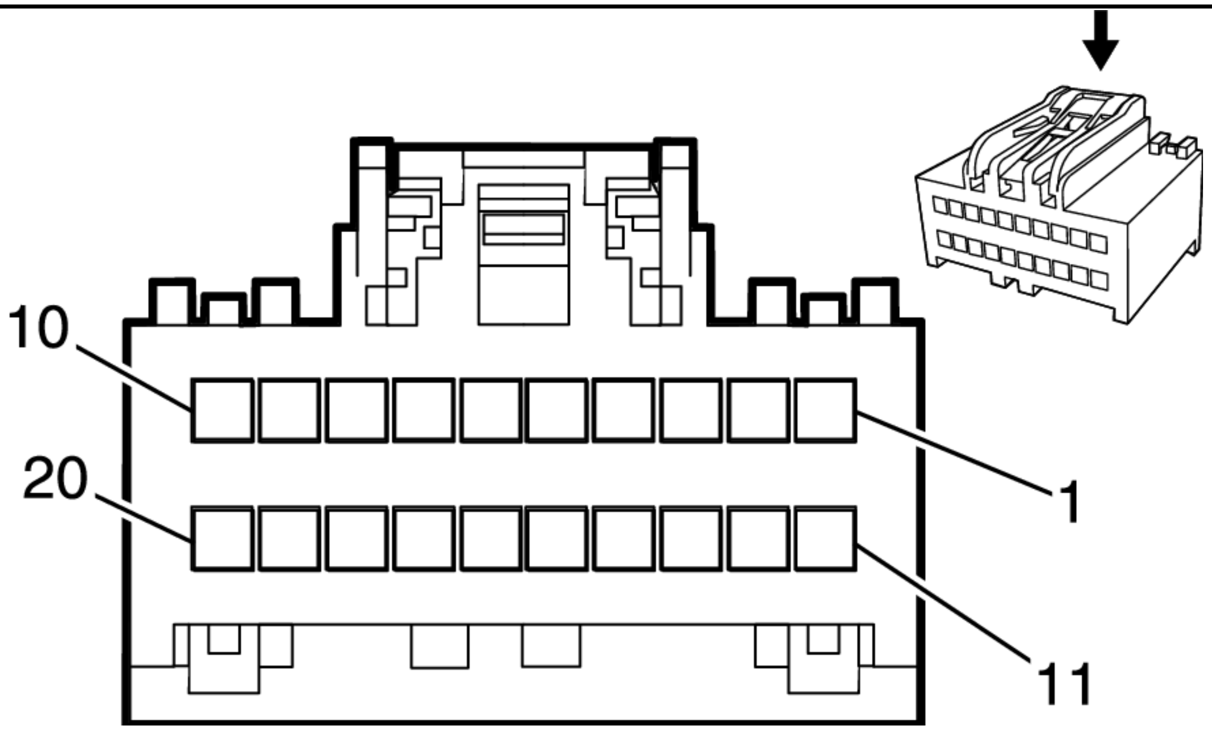
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	YE/GN	5883	Heated Steering Wheel Switch Signal	I	-
2	-	BN/WH	5884	Heated Steering Wheel Switch LED Control	I	-
3	-	VT/GN	2239	Run/Crank Ignition 1 Voltage	I	-
5	-	BK	1650	Ground	I	-

K33 HVAC CONTROL MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-1203
- Service Connector: 13576644
- Description: 20-Way F 0.64 Series (GN)

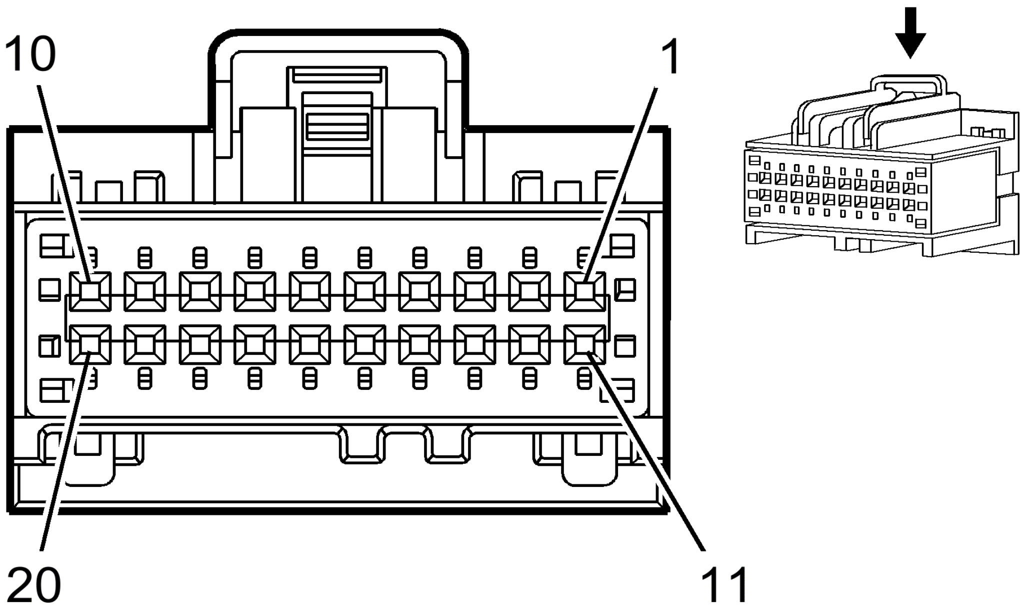
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.35	GY/GN	7565	Windscreen Temp Sensor Signal	I	-CE1
3 - 4	-	-	-	Not Occupied	-	-
5	0.35	YE/BU	3197	Humidity Temperature Sensor Signal	I	-CE1
6	0.35	YE/RD	597	5V Reference	I	-CE1
7	0.35	BK/BU	7566	Humidity/Windscreen Temp Sensor Low Reference	I	-CE1
8 - 11	-	-	-	Not Occupied	-	-
12	0.35	GY/BU	7564	Humidity Sensor Signal	I	-CE1
13 - 17	-	-	-	Not Occupied	-	-
18	0.5	BN	518	Lower Left Air Temperature Sensor Signal	I	-
19 - 20	-	-	-	Not Occupied	-	-

K33 HVAC CONTROL MODULE X2



Connector Part Information

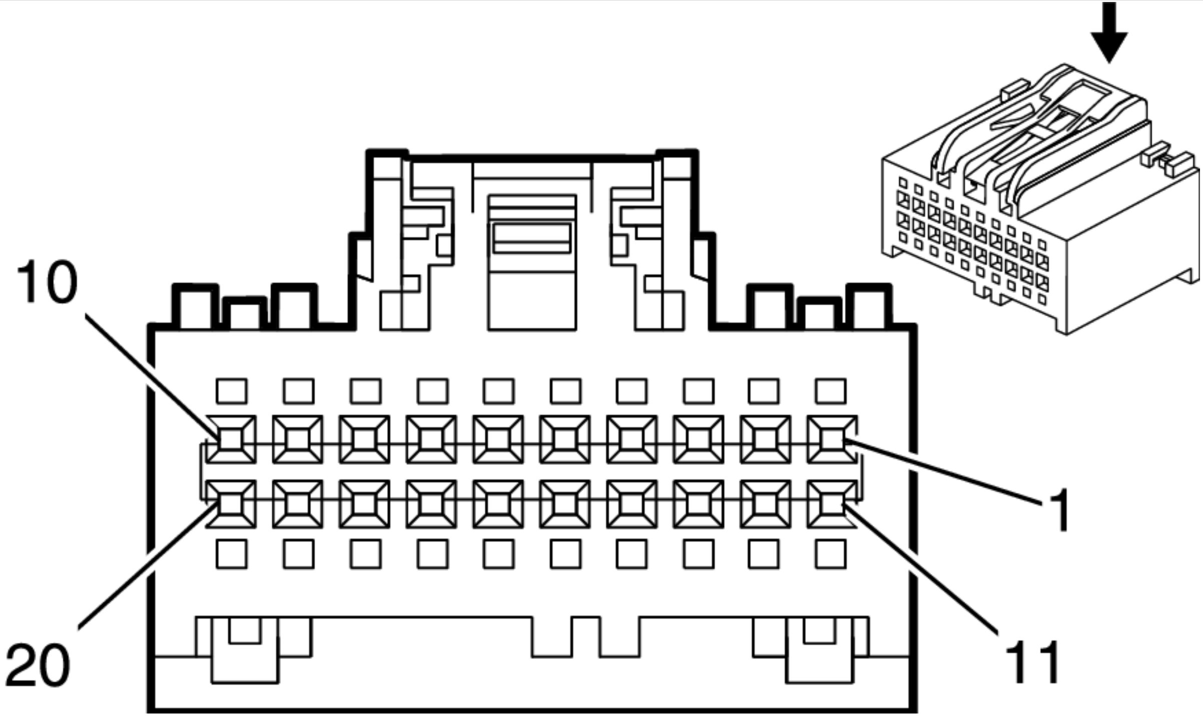
- Harness Type: Instrument Panel
- OEM Connector: 31410-1202
- Service Connector: 15126709
- Description: 20-Way F 64 Series, Sealed (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	RD/BN	6640	Battery Positive Voltage	I	-
2	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
3	-	-	-	Not Occupied	-	-
4	0.35	GN/WH	7530	Local Interconnect Network Serial Data Bus 8	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	GN/BU	4119	Local Interconnect Network Serial Data Bus 19	I	-
7	-	-	-	Not Occupied	-	-
8	0.5	BK	1250	Ground	I	-
9	0.35	VT/BN	541	Run Ignition 3 Voltage	I	-
10 - 12	-	-	-	Not Occupied	-	-
13	0.5	GY	5127	After Boil Heater Relay Control	I	-
14	-	-	-	Not Occupied	-	-
15	0.35	BU/GY	754	Blower Motor Speed Control	I	-
16 - 18	-	-	-	Not Occupied	-	-
19	0.35	BN/VT	193	Rear Defog Relay Control	I	-
20	-	-	-	Not Occupied	-	-

K33 HVAC CONTROL MODULE X3



Connector Part Information

- Harness Type: HVAC Harness
- OEM Connector: 15126711
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 0.64 Series (BK)

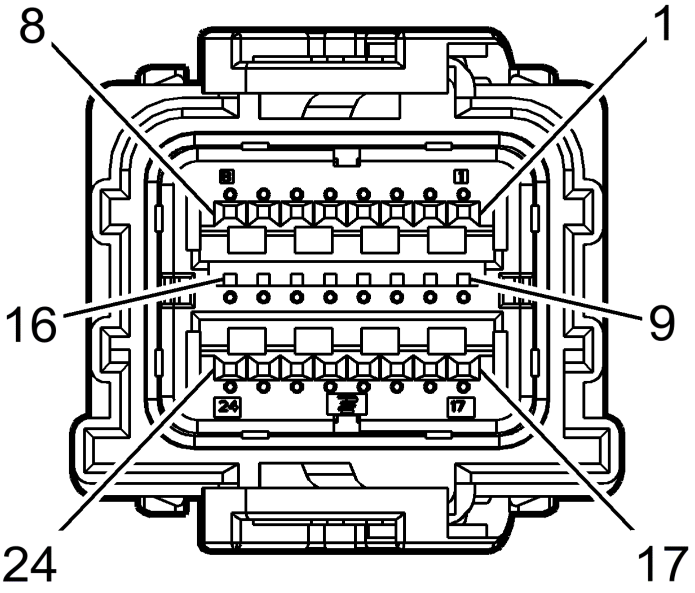
Terminal Part Information

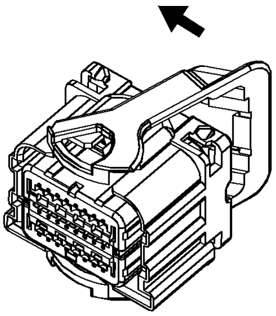
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GY/GN	516	Upper Left Air Temperature Sensor Signal	I	-
2	-	BU/BN	3167	Mode Door Stepper Motor Control 3	I	-
3	-	GY	3165	Mode Door Stepper Motor Control 1	I	-
4	-	BN	3168	Mode Door Stepper Motor Control 4	I	-
5	-	BN/GN	3166	Mode Door Stepper Motor Control 2	I	-
6 - 8	-	-	-	Not Occupied	-	-
9	-	BK/YE	407	Sensor Low Reference	I	-
10	-	-	-	Not Occupied	-	-
11	-	WH/BK	3169	Temp Door Stepper Motor Control 1	I	-
12	-	VT/GN	3170	Temp Door Stepper Motor Control 2	I	-
13	-	YE/GN	3171	Temp Door Stepper Motor Control 3	I	-
14	-	GY/BU	3172	Temp Door Stepper Motor Control 4	I	-
15	-	BN/VT	7572	HVAC Motor Control	I	-
16	-	BU/GY	3173	Air Inlet Door Stepper Motor Control 1	I	-
17	-	BN/WH	3174	Air Inlet Door Stepper Motor Control 2	I	-
18	-	YE	3175	Air Inlet Door Stepper Motor Control 3	I	-
19	-	WH	3176	Air Inlet Door Stepper Motor Control 4	I	-
20	-	-	-	Not Occupied	-	-

K36 INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE X1





Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2098923-1
- Service Connector: 19299778
- Description: 24-Way F 0.64 Series, Sealed (YE)

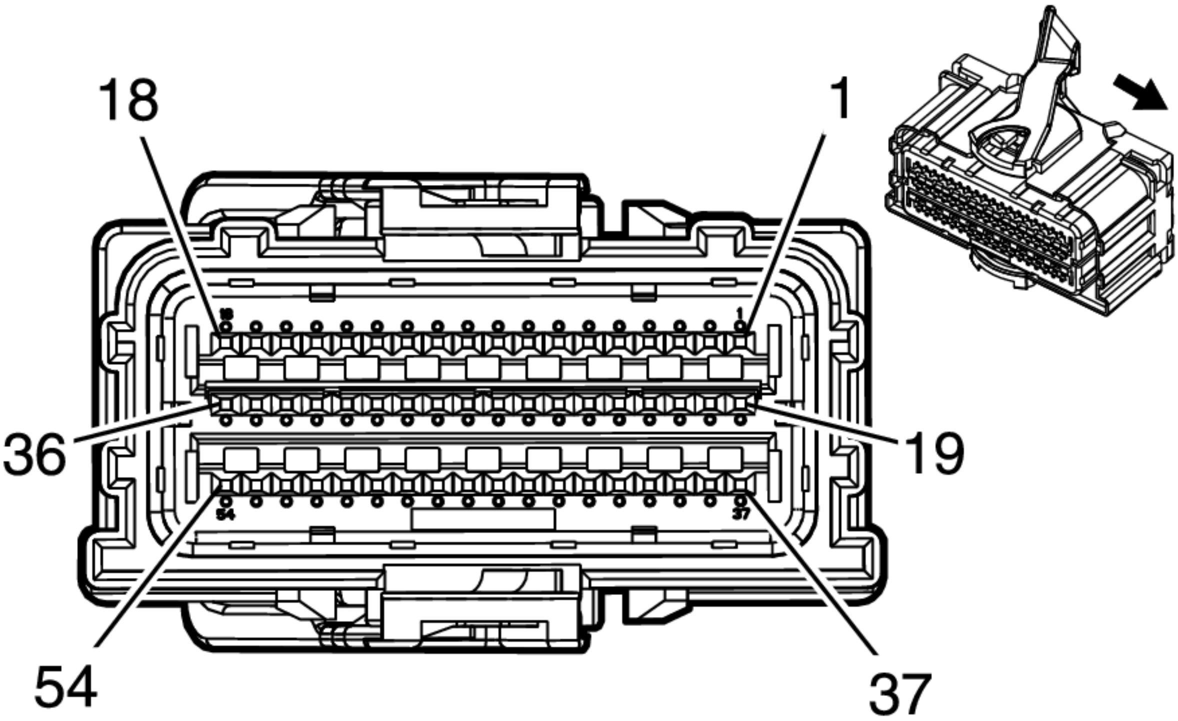
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19328872	J-35616-64B (LT BU)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/GN	3023	Steering Wheel Module Stage 2 High Control	I	AY0/AYF
2	0.35	WH/OG	3022	Steering Wheel Module Stage 2 Low Control	I	AY0/AYF
3	0.35	BN/OG	3020	Steering Wheel Module Stage 1 Low Control	I	AY0/AYF
4	0.35	OG/VT	3021	Steering Wheel Module Stage 1 High Control	I	AY0/AYF
5	0.5	YE/OG	3025	Passenger IP Module Stage 1 High Control	I	AY0/AYF
6	0.5	OG/WH	3024	Passenger IP Module Stage 1 Low Control	I	AY0/AYF
7	0.5	OG/VT	3026	Passenger IP Module Stage 2 Low Control	I	AY0/AYF
8	0.5	GY/OG	3027	Passenger IP Module Stage 2 High Control	I	AY0/AYF
9	0.35	RD/GN	6140	Battery Positive Voltage	I	AY0/AYF
10	0.35	VT/WH	5234	Passenger Seat Belt Indicator Control	I	AY0/AYF

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.35	BU	2307	Passenger Air Bag On Indicator Control	I	-
12	0.35	GN	2308	Passenger Air Bag Off Indicator Control	I	-
13	0.35	VT/OG	371	Passenger IP Module Disable Switch Signal	I	C99
14	0.35	BU/OG	7328	Passenger IP Module Disable Switch Low Reference	I	C99
15	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
16	-	-	-	Not Occupied	-	-
17	0.5	WH/BU	5986	Serial Data Communication Enable	I	-
18	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
19	0.5	BK/WH	1751	Signal Ground	I	-
20	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
21	0.5	OG/BU	3078	Driver Knee Module High Control	I	AYF
22	0.5	GY/OG	3079	Driver Knee Module Low Control	I	AYF
23	0.5	WH/OG	3077	Passenger Knee Module Low Control	I	AYF
24	0.5	OG/BU	3076	Passenger Knee Module High Control	I	AYF

K36 INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE X2 (AY0/AYF)



Connector Part Information

- Harness Type: Body
- OEM Connector: 2098922-4
- Service Connector: 19301193
- Description: 54-Way F 0.64 Series, Sealed (YE)

Terminal Part Information

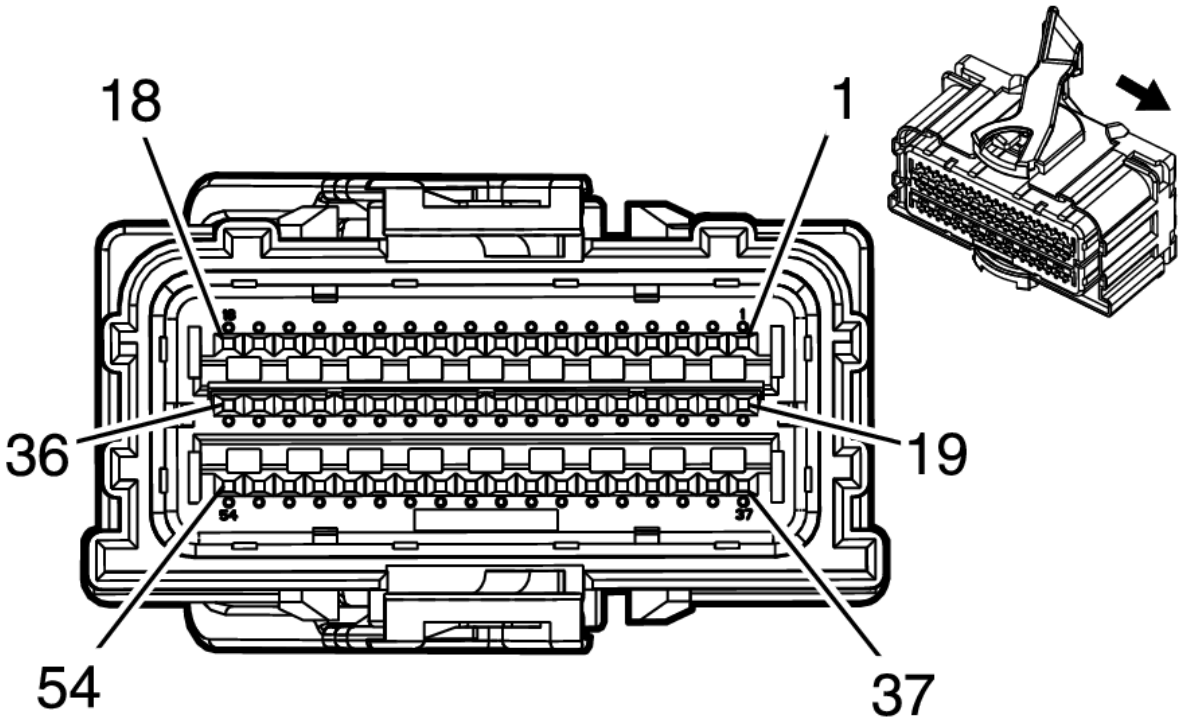
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19328872	J-35616-64B (LT BU)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/VT	5155	Left Rear Seat Belt Pretensioner Control	I	SBK
2	0.5	BK/OG	5156	Left Rear Seat Belt Pretensioner Low Reference	I	SBK
3	0.5	BK/OG	5158	Right Rear Seat Belt Pretensioner Low Reference	I	SBK
4	0.5	OG/WH	5157	Right Rear Seat Belt Pretensioner Control	I	SBK
5	0.5	OG/GY	5223	Left Rear Side Impact SIR Inflator Control	I	AYF
6	0.5	BN/OG	5224	Left Rear Side Impact SIR Inflator Control	I	AYF
7	0.5	OG/GY	5226	Right Rear Side Impact SIR Inflator Control	I	AYF
8	0.5	VT/OG	5225	Right Rear Side Impact SIR Inflator Control	I	AYF
9	0.5	OG/YE	3481	Driver Seat Belt Anchor Pretensioner High Control	I	-
10	0.5	WH/OG	3482	Driver Seat Belt Anchor Pretensioner Low Control	I	-
11	0.5	GY/OG	3480	Passenger Seat Belt Anchor Pretensioner Low Control	I	-
12	0.5	OG/BN	3479	Passenger Seat Belt Anchor Pretensioner High Control	I	-
13	0.5	OG/BU	3068	Driver Side Impact Module High Control	I	-
14	0.5	BK/OG	3069	Driver Side Impact Module Low Control	I	-
15	0.5	BU/OG	3067	Passenger Side Impact Module Low Control	I	-
16	0.5	OG/GY	3066	Passenger Side Impact Module High Control	I	-
17	0.5	OG/GN	5019	Left Front Head Curtain Module High Control	I	-
18	0.5	VT/OG	5020	Left Front Head Curtain Module Low Control	I	-
19	0.5	OG/GN	2132	Left Front Side Impact Sensing Module Signal	I	AYF
20	0.5	BK/OG	6628	Left Front Side Impact Sensing Module Low Reference	I	AYF
21	0.5	BK/OG	6629	Right Front Side Impact Sensing Module Low Reference	I	AYF
22	0.5	BN/OG	2134	Right Front Side Impact Sensing Module Signal	I	AYF

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
23	0.5 0.5	OG/YE OG/GY	354 6618	Left Front Discriminating Sensor Signal Middle Front Discriminating Sensor Signal	I I	AYF AYF+MBM
24	0.5 0.5	BK/OG BK/OG	5045 6619	Left Front Discriminating Sensor Low Reference Middle Front Discriminating Sensor Low Reference	I I	AYF AYF+MBM
25	0.5	BK/OG	5600	Right Front Discriminating Sensor Low Reference	I	AYF
26	0.5	OG/GN	1409	Right Front Discriminating Sensor Signal	I	AYF
27	0.5 0.5	OG/BU OG/BU	6620 6622	Left Middle Side Impact Sensing Module Signal Left Rear Side Impact Sensing Module Signal	I I	AYF AYF+MBM
28	0.5 0.5	BK/OG BK/OG	6621 6623	Left Middle Side Impact Sensing Module Low Reference Left Rear Side Impact Sensing Module Low Reference	I I	AYF AYF+MBM
29	0.5 0.5	BK/OG BK/OG	6625 6627	Right Middle Side Impact Sensing Module Low Reference Right Rear Side Impact Sensing Module Low Reference	I I	AYF AYF+MBM
30	0.5 0.5	OG/VT OG/WH	6624 6626	Right Middle Side Impact Sensing Module Signal Right Rear Side Impact Sensing Module Signal	I I	AYF AYF+MBM
31 - 36	-	-	-	Not Occupied	-	-
37	0.5	OG/WH	3477	Driver Seat Belt Retractor Pretensioner High Control	I	-
38	0.5	GY/OG	3478	Driver Seat Belt Retractor Pretensioner Low Control	I	-
39	0.5	WH/OG	3476	Passenger Seat Belt Retractor Pretensioner Low Control	I	-
40	0.5	OG/GN	3475	Passenger Seat Belt Retractor Pretensioner High Control	I	-
41	0.5	OG/BN	238	Driver Seat Belt Switch Signal	I	-
42	-	-	-	Not Occupied	-	-
43	0.5	BK/OG	1363	Driver Seat Belt Switch Low Reference	I	-
44	0.5	BK/OG	1361	Passenger Seat Belt Switch Low Reference	I	-
45	0.5	OG/VT	1362	Passenger Seat Belt Switch Signal	I	-
46	-	-	-	Not Occupied	-	-
47	0.5	OG/BN	7571	Passenger Seat Belt Reminder Signal	I	-
48 - 52	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
53	0.5	OG/GY	5021	Right Front Head Curtain Module High Control	I	-
54	0.5	WH/OG	5022	Right Front Head Curtain Module Low Control	I	-

K36 INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE X2 (AY0+MAW)



Connector Part Information

- Harness Type: Body
- OEM Connector: 3-2098922-7
- Service Connector: 19303770
- Description: 54-Way F 0.64 Series, Sealed (YE)

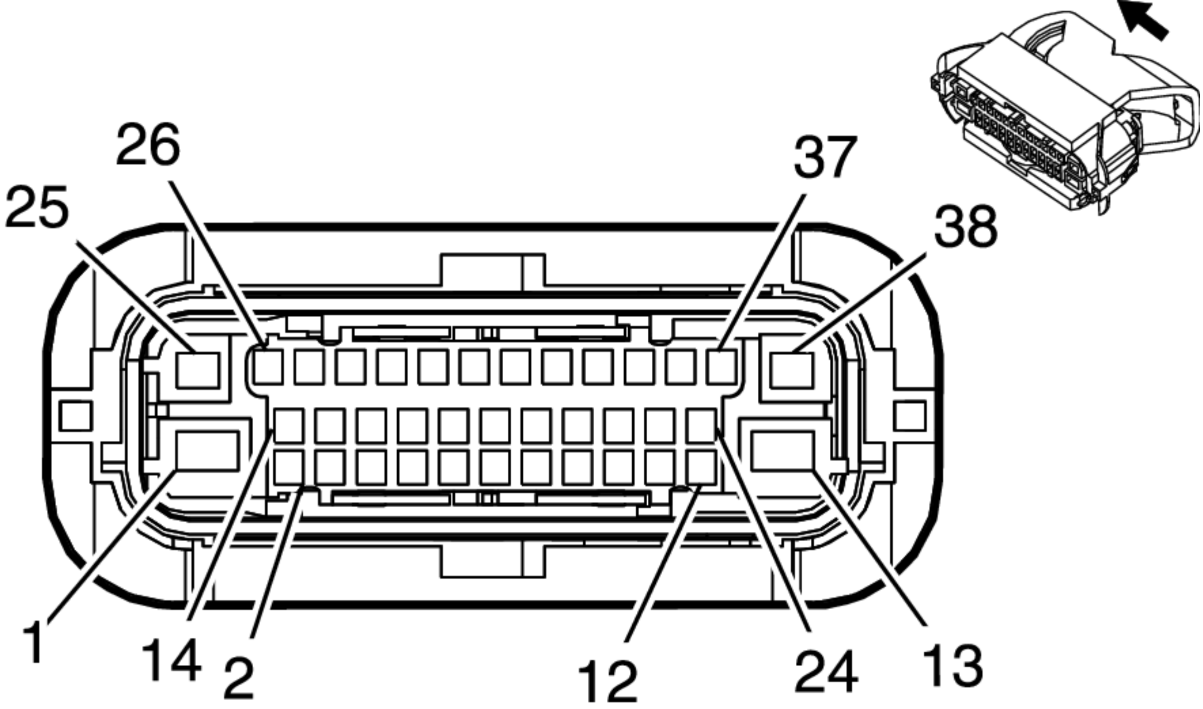
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19328872	J-35616-64B (LT BU)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 8	-	-	-	Not Occupied	-	-
9	0.5	OG/YE	3481	Driver Seat Belt Anchor Pretensioner High Control	I	-
10	0.5	WH/OG	3482	Driver Seat Belt Anchor Pretensioner Low Control	I	-
11	0.5	GY/OG	3480	Passenger Seat Belt Anchor Pretensioner Low Control	I	-
12	0.5	OG/BN	3479	Passenger Seat Belt Anchor Pretensioner High Control	I	-
13	0.5	OG/BU	3068	Driver Side Impact Module High Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
14	0.5	BK/OG	3069	Driver Side Impact Module Low Control	I	-
15	0.5	BU/OG	3067	Passenger Side Impact Module Low Control	I	-
16	0.5	OG/GY	3066	Passenger Side Impact Module High Control	I	-
17	0.5	OG/GN	5019	Left Front Head Curtain Module High Control	I	-
18	0.5	VT/OG	5020	Left Front Head Curtain Module Low Control	I	-
19 - 22	-	-	-	Not Occupied	-	-
23	0.5	OG/GY	6618	Middle Front Discriminating Sensor Signal	I	-
24	0.5	BK/OG	6619	Middle Front Discriminating Sensor Low Reference	I	-
25 - 26	-	-	-	Not Occupied	-	-
27	0.5	OG/BU	6622	Left Rear Side Impact Sensing Module Signal	I	-
28	0.5	BK/OG	6623	Left Rear Side Impact Sensing Module Low Reference	I	-
29	0.5	BK/OG	6627	Right Rear Side Impact Sensing Module Low Reference	I	-
30	0.5	OG/WH	6626	Right Rear Side Impact Sensing Module Signal	I	-
31 - 36	-	-	-	Not Occupied	-	-
37	0.5	OG/WH	3477	Driver Seat Belt Retractor Pretensioner High Control	I	-
38	0.5	GY/OG	3478	Driver Seat Belt Retractor Pretensioner Low Control	I	-
39	0.5	WH/OG	3476	Passenger Seat Belt Retractor Pretensioner Low Control	I	-
40	0.5	OG/GN	3475	Passenger Seat Belt Retractor Pretensioner High Control	I	-
41	0.5	OG/BN	238	Driver Seat Belt Switch Signal	I	-
42	-	-	-	Not Occupied	-	-
43	0.5	BK/OG	1363	Driver Seat Belt Switch Low Reference	I	-
44	0.5	BK/OG	1361	Passenger Seat Belt Switch Low Reference	I	-
45	0.5	OG/VT	1362	Passenger Seat Belt Switch Signal	I	-
46	-	-	-	Not Occupied	-	-
47	0.5	OG/BN	7571	Passenger Seat Belt Reminder Signal	I	-
48 - 52	-	-	-	Not Occupied	-	-
53	0.5	OG/GY	5021	Right Front Head Curtain Module High Control	I	-
54	0.5	WH/OG	5022	Right Front Head Curtain Module Low Control	I	-

K38 CHASSIS CONTROL MODULE



Connector Part Information

- Harness Type: Body
- OEM Connector: 33110415
- Service Connector: 19353395
- Description: 38-Way F 1.5 CTS, 2.8 MCP, 4.8 MCP Series, Sealed (BK)

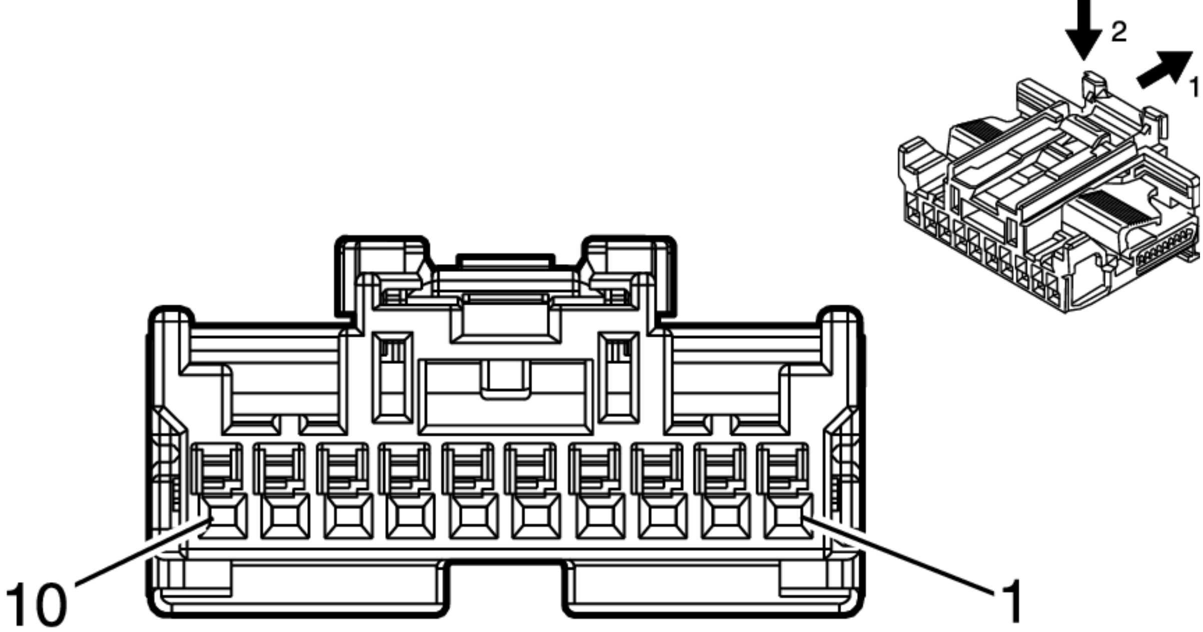
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19119381	J-35616-14 (GN)	J-38125-215A	Not Available	Not Available	Not Available	Not Available
II	19333088	J-35616-35 (VT)	J-38125-36	Not Available	Not Available	Not Available	Not Available
III	19353349	J-35616-40 (BU)	J-38125-556	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/RD	2635	Transmission Shifter Position Sensor 2 Voltage Reference	III	-
2	0.35	YE/BU	2633	Transmission Shifter Position Sensor 2 Alpha Signal	I	-
3	0.35	BK/BU	2647	Transmission Shifter Position Sensor 1 Low Reference	I	-
4	0.35	BK/VT	2632	Transmission Shifter Park Position Switch 2 Return	I	-
5	0.35	BK/GN	2636	Transmission Shifter Position Sensor 2 Low Reference	I	-
6	0.35	BK/BN	2649	Transmission Shift Interlock Switch 1 Return	I	-
7	0.35	BK/GY	2630	Transmission Shifter Park Position Switch 1 Return	I	-
8	0.35	BK/GN	2655	Transmission Shift Interlock Switch 2 Return	I	-
9 - 12	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
13	0.5	BK	750	Ground	III	-
14	0.35	VT/BU	2634	Transmission Shifter Position Sensor 2 Beta Signal	I	-
15	0.35	WH/GY	2631	Transmission Shifter Park Position Switch 2 Signal	I	-
16	0.35	WH/GN	2654	Transmission Shift Interlock Switch 2 Signal	I	-
17	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
18	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
19	-	-	-	Not Occupied	-	-
20	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
21	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
22 - 24	-	-	-	Not Occupied	-	-
25	0.35	BU/RD	2646	Transmission Shifter Position Sensor 1 Voltage Reference	II	-
26	0.35	YE/BN	2644	Transmission Shifter Position Sensor 1 Alpha Signal	I	-
27	0.35	VT/GN	2629	Transmission Shifter Park Position Switch 1 Signal	I	-
28	0.35	VT/BN	2645	Transmission Shifter Position Sensor 1 Beta Signal	I	-
29	0.35	WH	2648	Transmission Shift Interlock Switch 1 Signal	I	-
30	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
31	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
32	-	-	-	Not Occupied	-	-
33	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
34	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
35	0.5	GN/BU	4626	Local Interconnect Network Serial Data Bus 26	I	-
36	0.35	VT/WH	639	Run/Crank Ignition 1 Voltage	I	-
37	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
38	0.35	RD/BN	440	Battery Positive Voltage	II	-

M38 POWER STEERING MOTOR X1



Connector Part Information

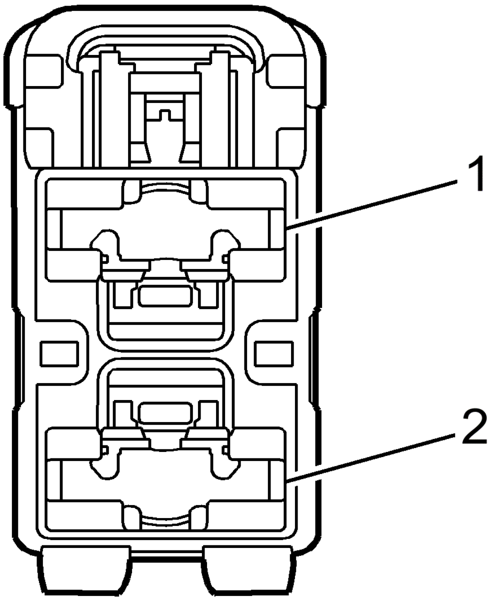
- Harness Type: Instrument Panel
- OEM Connector: 2138504-1
- Service Connector: 13580917
- Description: 10-Way F 0.64 Generation Y Series (BN)

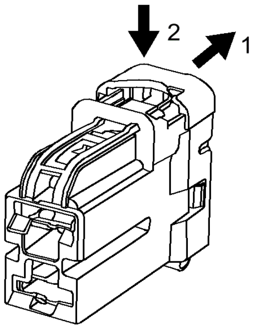
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300631	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
3	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
4	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
5	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
6	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
7	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
8	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
9	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
10	0.5	WH/BU	5986	Serial Data Communication Enable	I	-

M38 POWER STEERING MOTOR X2





Connector Part Information

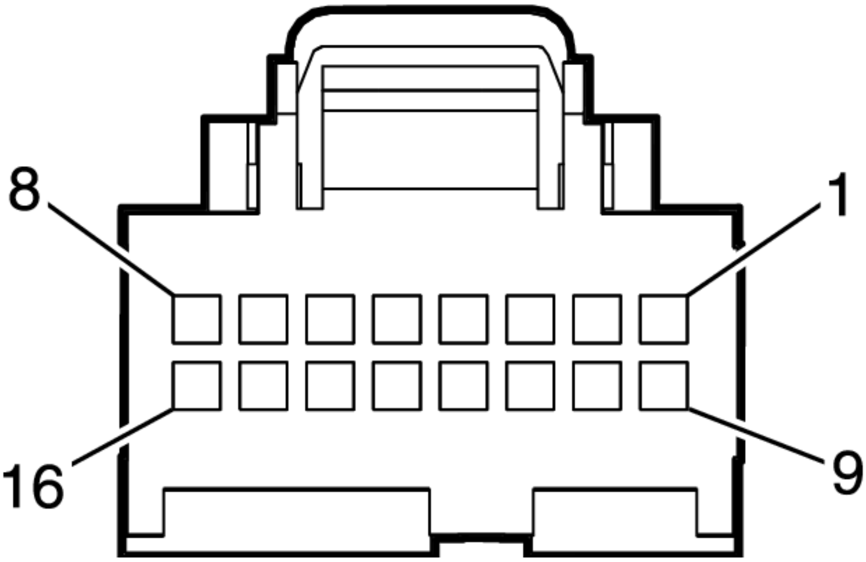
- Harness Type: Instrument Panel
- OEM Connector: 7283-0724-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 9.5 Series (BK)

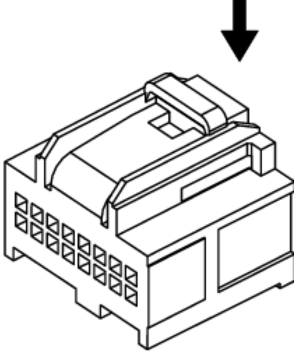
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-22 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	8	RD/GN	40	Battery Positive Voltage	I	-
2	8	BK	1750	Ground	I	-

K56 SERIAL DATA GATEWAY MODULE X1





Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 33104224
- Service Connector: 13594065
- Description: 16-Way F 0.64 OCS Series (BK)

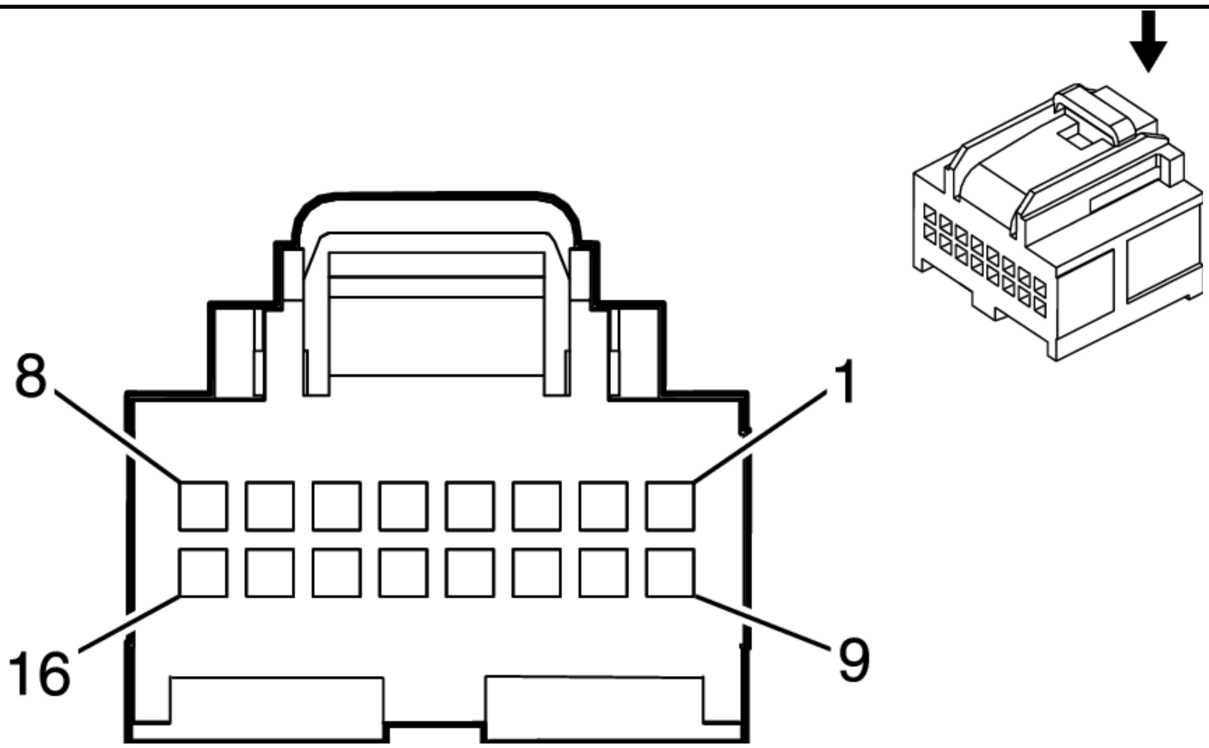
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13587581	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GN/YE	6840	Auxiliary Device 2 Switched Voltage	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	BU/GN	1304	High Speed GMLAN Serial Data (+) 9	I	UE1
4	0.5	WH/GN	1305	High Speed GMLAN Serial Data (-) 9	I	UE1
5	-	-	-	Not Occupied	-	-
6	0.75	BK	1250	Ground	I	-
7	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
8	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
9	-	-	-	Not Occupied	-	-
10	0.5	WH/BU	5986	Serial Data Communication Enable	I	-
11	0.5	BU/GN	1304	High Speed GMLAN Serial Data (+) 9	I	UE1
12	0.5	WH/GN	1305	High Speed GMLAN Serial Data (-) 9	I	UE1

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
13	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
14	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
15	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
16	-	-	-	Not Occupied	-	-

K56 SERIAL DATA GATEWAY MODULE X2



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 33104225
- Service Connector: 13594066
- Description: 16-Way F 0.64 OCS Series (GY)

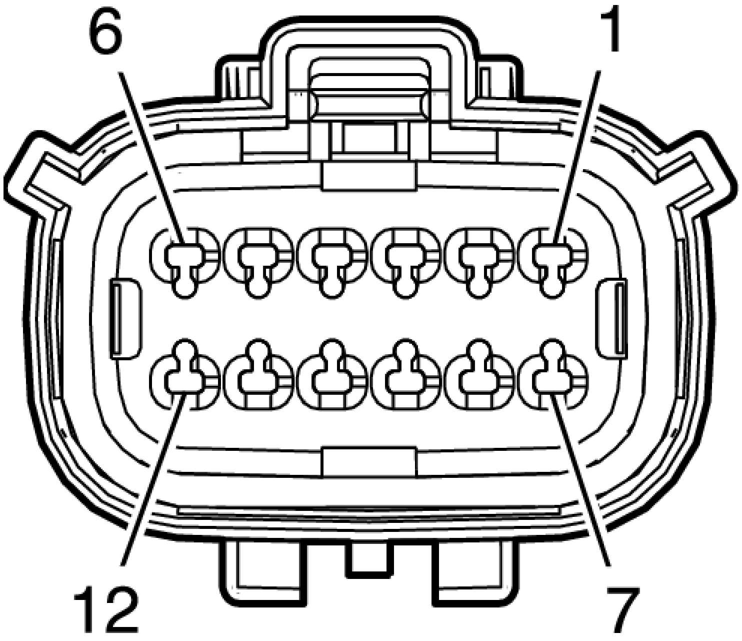
Terminal Part Information

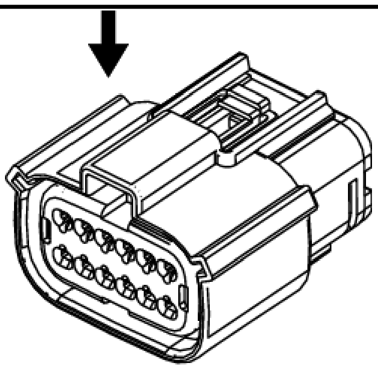
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13587581	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
2	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
3	0.5	BU/GN	1304	High Speed GMLAN Serial Data (+) 9	I	UE1
4	0.5	WH/GN	1305	High Speed GMLAN Serial Data (-) 9	I	UE1

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5 - 9	-	-	-	Not Occupied	-	-
10	0.35	GY/GN	1102	Low Speed GMLAN Serial Data #2	I	-
11	0.5	BU/GN	1304	High Speed GMLAN Serial Data (+) 9	I	UE1
12	0.5	WH/GN	1305	High Speed GMLAN Serial Data (-) 9	I	UE1
13 - 16	-	-	-	Not Occupied	-	-

K57 BATTERY CHARGER CONTROL MODULE X1





Connector Part Information

- Harness Type: Engine
- OEM Connector: 33472-1291
- Service Connector: 19352908
- Description: 12-Way F 150 MX Series, Sealed (BK)

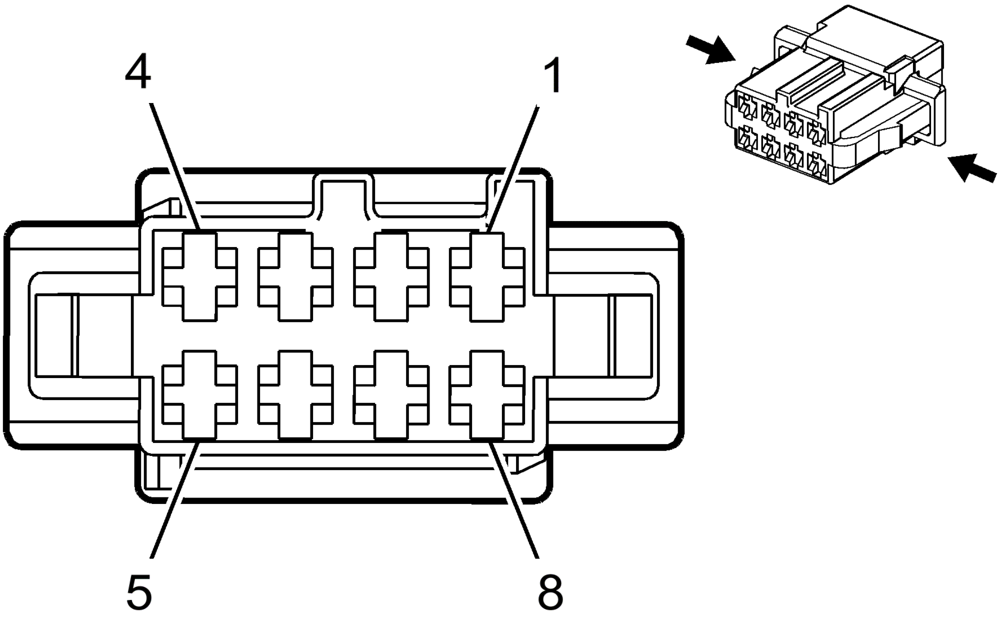
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BK	150	Ground	I	-
3	0.5	VT/WH	3643	High Voltage Onboard Charging DC Voltage Sense Signal	I	-
4	0.5	YE/GY	3645	High Voltage Onboard Charging Control	I	-
5 - 8	-	-	-	Not Occupied	-	-
9	0.5	RD/YE	740	Battery Positive Voltage	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
10	0.5	GN/GY	3644	High Voltage Onboard Charging AC Voltage Sense Signal	I	-
11	0.5	BU/YE	3646	High Voltage Onboard Charging Enable	I	-
12	-	-	-	Not Occupied	-	-

K60 STEERING COLUMN LOCK MODULE (NO6)



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 10718780
- Service Connector: 13576545
- Description: 8-Way F 1.6 Micro-Timer Series (BK)

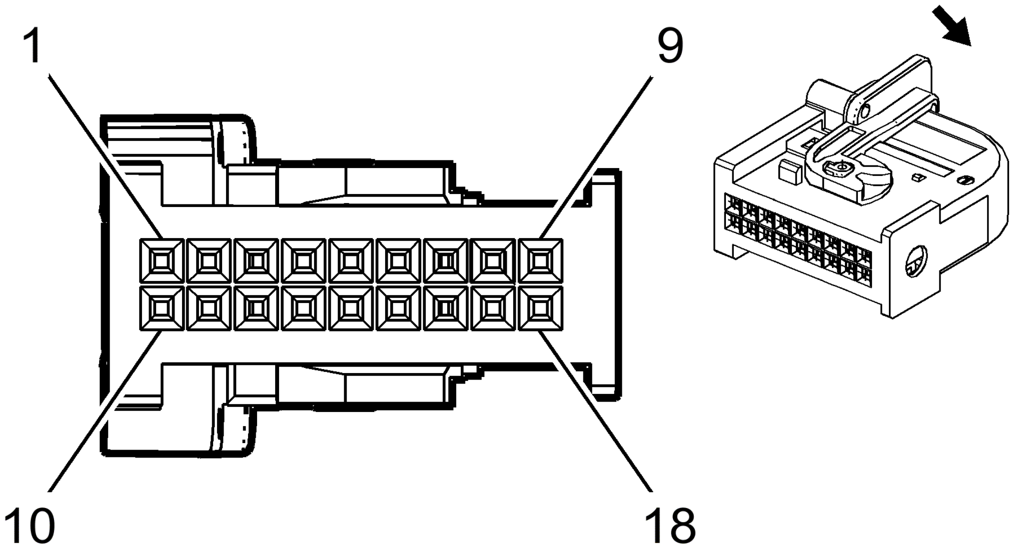
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.35	BU/VT	5904	Steering Column Lock Status Signal	I	N06
3	0.75	BU/VT	807	OFF/Accessory Ignition Voltage	I	N06
4	0.35	GN/VT	1601	Steering Column Lock Signal	I	N06
5	0.35	RD/GN	5140	Battery Positive Voltage	I	N06
6	0.75	BK	1250	Ground	I	N06
7	0.35	BK	1250	Ground	I	N06

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.35	GN	5060	Low Speed GMLAN Serial Data	I	N06

K68 TRAILER LIGHTING CONTROL MODULE X1 (MBM)



Connector Part Information

- Harness Type: Body
- OEM Connector: PPI0000498
- Service Connector: 13587947
- Description: 18-Way F 0.64 Series (BK)

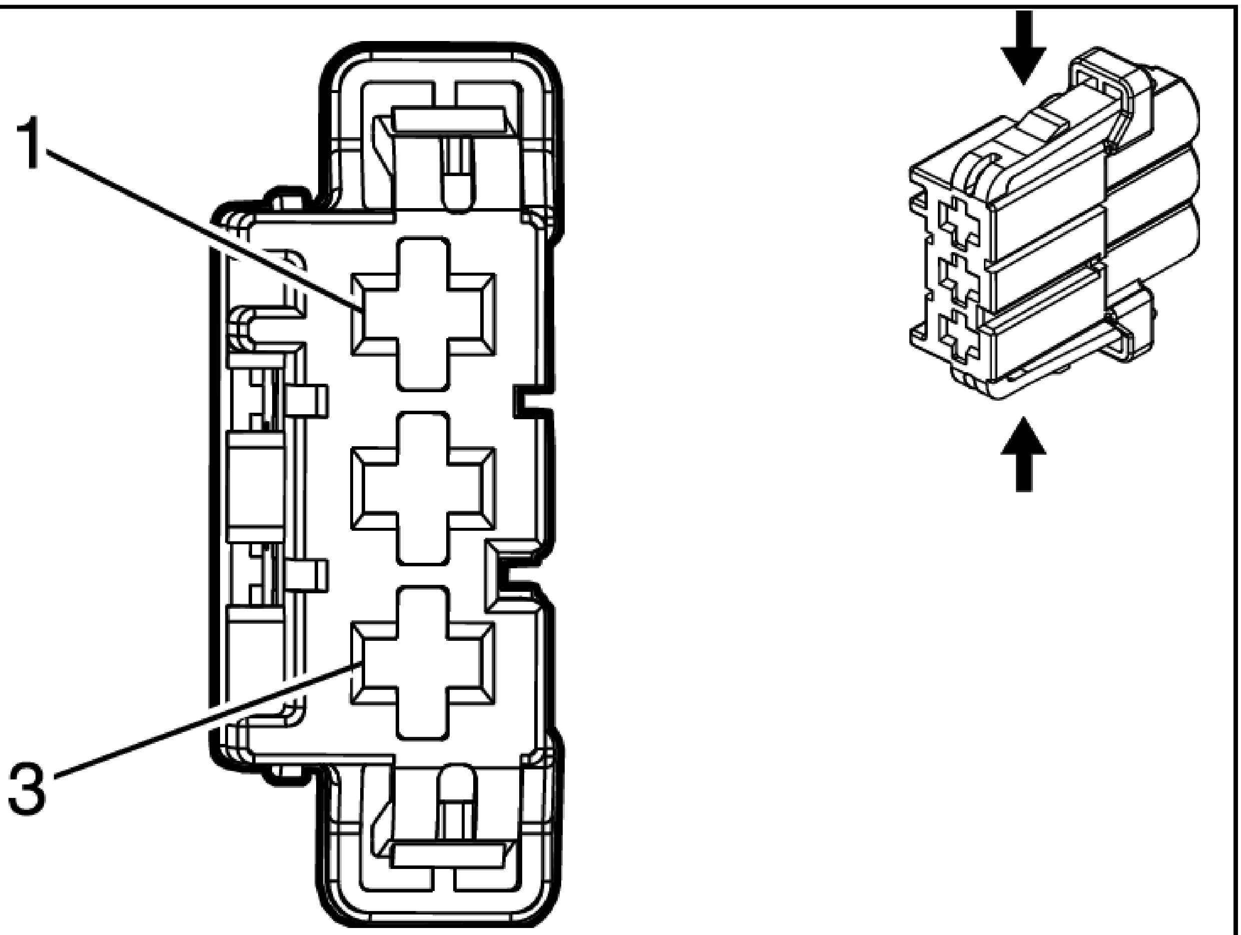
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13579917	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
II	13579918	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN	5060	Low Speed GMLAN Serial Data	II	-
2	-	-	-	Not Occupied	-	-
3	0.5	GY/BN	309	Right Park Lamp Control	II	-
4 - 5	-	-	-	Not Occupied	-	-
6	0.5	WH/YE	3688	Right Rear Supplemental Stop Lamp Control	II	-
7	0.5	WH/YE	7541	Right Rear Stop Lamp Control	II	-
8	0.5	GY/YE	7542	Left Rear Stop Lamp Control	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
9	0.5	GY/YE	3687	Left Rear Supplemental Stop Lamp Control	II	-
10	-	-	-	Not Occupied	-	-
11	0.5	VT/GY	709	Left Park Lamp Control	II	-
12	-	-	-	Not Occupied	-	-
13	0.35	VT/BK	2539	Run/Crank Ignition 1 Voltage	II	-
14	0.75	VT/WH	5065	Stop Lamp Relay Coil Control	I	-
15 - 18	-	-	-	Not Occupied	-	-

K68 TRAILER LIGHTING CONTROL MODULE X2 (MBM)



Connector Part Information

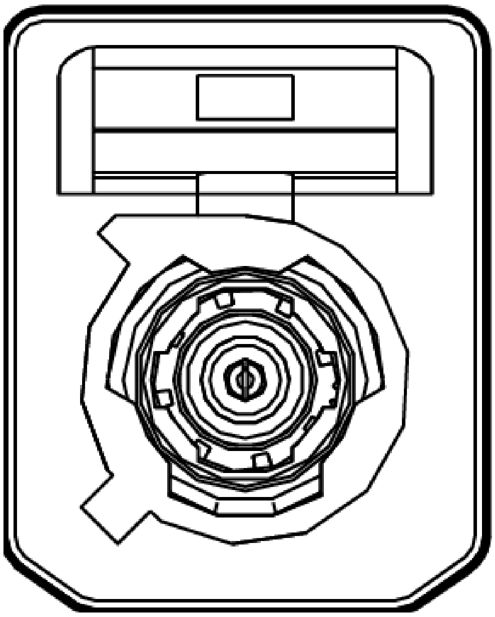
- Harness Type: Body
- OEM Connector: 1-968976-9
- Service Connector: 13314094
- Description: 3-Way F 2.8 MCP Series, Sealed (BK)

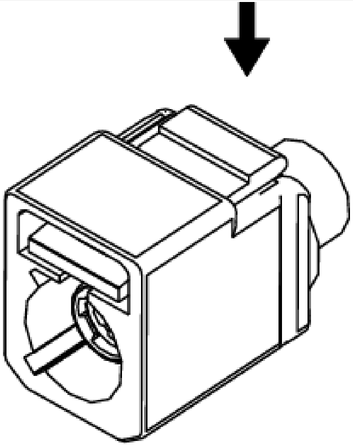
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	BK	1050	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	1	RD/GY	5540	Battery Positive Voltage	I	-

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X7





Connector Part Information

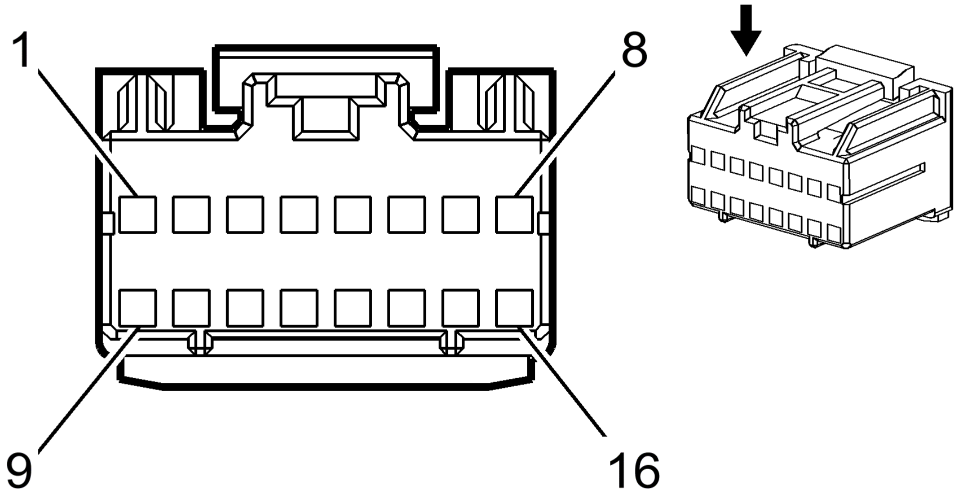
- Harness Type: Instrument Panel
- OEM Connector: 13581969
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(GPS/Cell) Coaxial Antenna Cell/GPS combined Signal	I	-

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X1 (UE1)



Connector Part Information

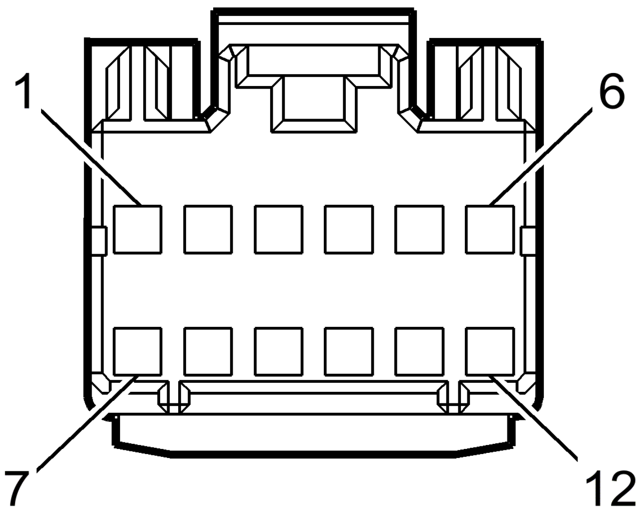
- Harness Type: Instrument Panel
- OEM Connector: 1456601-1
- Service Connector: 19153138
- Description: 16-Way F 040 Multilock II Series (WH)

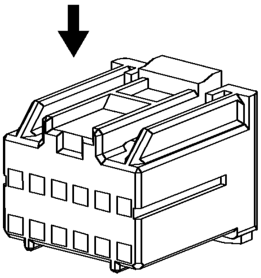
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575740	J-35616-16 (LT GN)	J-38125-559	15445905	Delphi 23	J	J

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/GN	1102	Low Speed GMLAN Serial Data #2	I	UE1
2	0.35	BN/WH	2517	Keypad Red LED Control	I	UE1
3	0.35	YE/VT	2516	Keypad Green LED Control	I	UE1
4 - 5	-	-	-	Not Occupied	-	-
6	0.35	GN/BK	2515	Keypad Control	I	UE1
7	0.5	BK	1850	Ground	I	UE1
8 - 9	-	-	-	Not Occupied	-	-
10	0.5	BU/GN	1304	High Speed GMLAN Serial Data (+) 9	I	UE1
11	0.35	GN/WH	2514	Keypad Signal	I	UE1
12	0.5	WH/GN	1305	High Speed GMLAN Serial Data (-) 9	I	UE1
13	0.35	BK/VT	5167	Battery Backup Low Reference	I	UE1
14	0.35	YE/VT	5235	Battery Backup Control	I	UE1
15	0.35	RD/GY	7040	Battery Positive Voltage	I	UE1
16	-	-	-	Not Occupied	-	-

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X2 (UE1)





Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1456599-1
- Service Connector: 88952886
- Description: 12-Way F 040 Multilock II Series (WH)

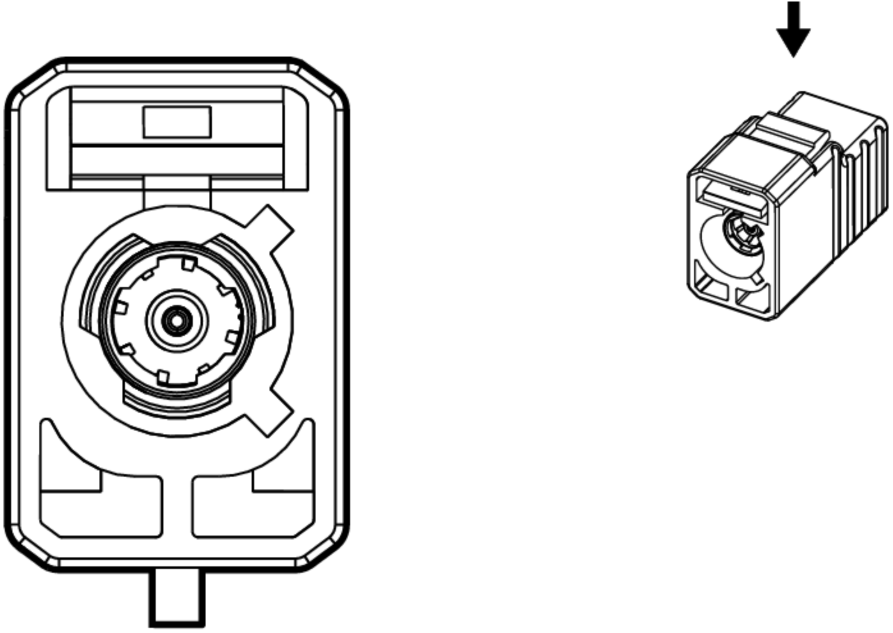
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575740	J-35616-16 (LT GN)	J-38125-559	15445905	Delphi 23	J	J

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE	658	Cellular Telephone Voice Signal	I	UE1
2	0.5	BK/YE	659	Cellular Telephone Voice Low Reference	I	UE1
3	0.5	BU/GN	1304	High Speed GMLAN Serial Data (+) 9	I	UE1
4	0.5	WH/GN	1305	High Speed GMLAN Serial Data (-) 9	I	UE1
5	0.5	BK/WH	551	Signal Ground	I	UE1
6	0.5	GY/YE	5149	Voice Recognition Audio Signal	I	UE1
7	0.5	WH/BU	5986	Serial Data Communication Enable	I	UE1
8	0.35	BK/WH	751	Signal Ground	I	UE1
9	0.35	BU	655	Cellular Telephone Microphone Signal	I	UE1
10	0.35	BK/BN	654	Cellular Telephone Microphone Low Reference	I	UE1
11	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.5	BK/GY	5152	Voice Recognition Audio Low Reference	I	UE1

K73 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE X5



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 13581693
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (VT)

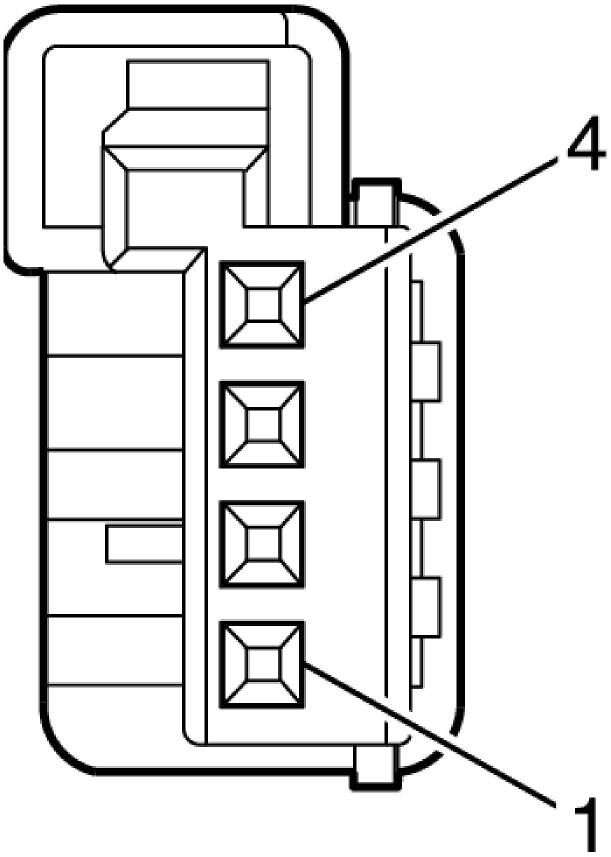
Terminal Part Information

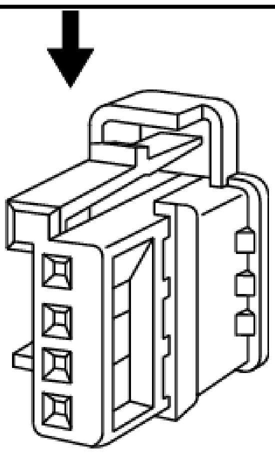
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(Cell only) Coaxial Antenna Cell Phone Signal	I	-

COMPONENT CONNECTOR END VIEWS

K77 REMOTE CONTROL DOOR LOCK RECEIVER





Connector Part Information

- Harness Type: Body
- OEM Connector: 1379029-3
- Service Connector: 13316147
- Description: 4-Way F 0.64 Micro-Quadlock Series (BU)

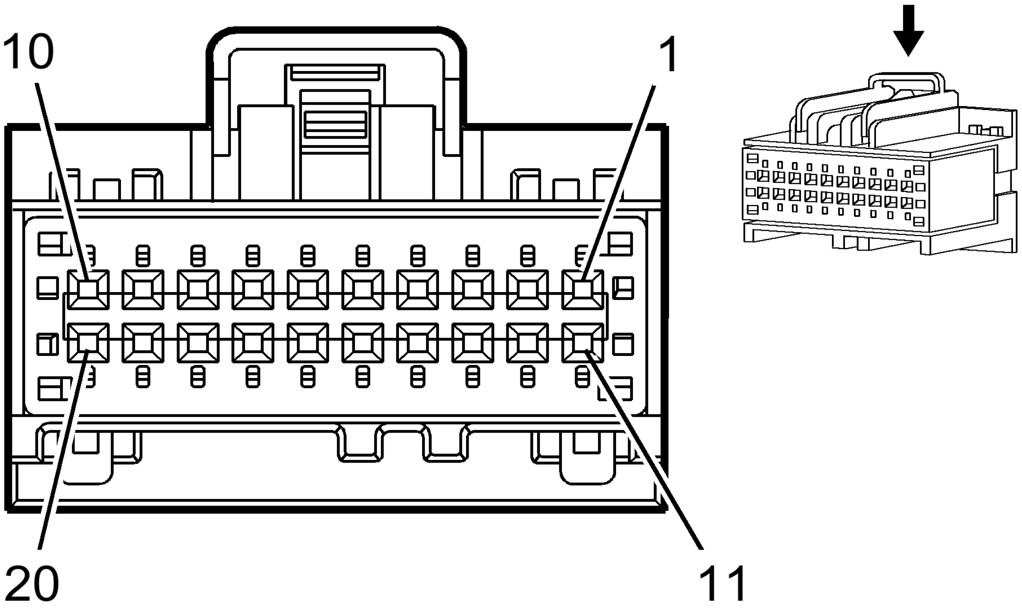
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY	3273	Remote Function Actuator Low Reference	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.35	YE/GN	3274	Remote Function Actuator Transmit Signal	I	-
3	0.35	BU/WH	3275	Remote Function Actuator Receive Signal	I	-
4	0.35	GY/WH	3272	Remote Function Actuator Control	I	-

K84 KEYLESS ENTRY CONTROL MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-1202
- Service Connector: 15126709
- Description: 20-Way F 64 Series, Sealed (BN)

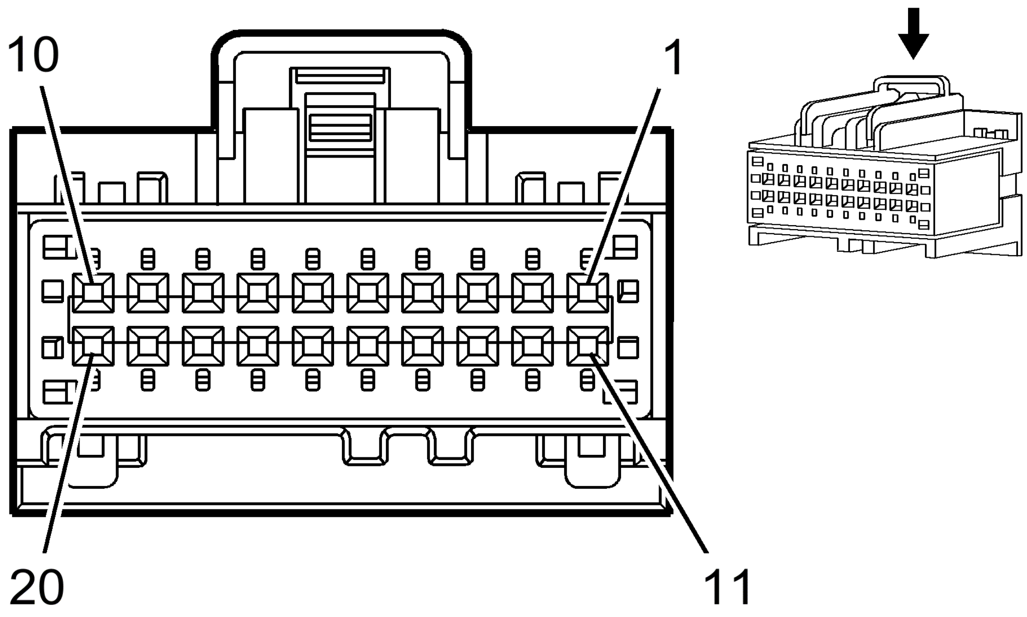
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	Not Available	Not Available	Not Available	Not Available
II	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/VT	1601	Steering Column Lock Signal	II	N06
2	0.35	RD/WH	5740	Battery Positive Voltage	II	-
3	0.35	GN	5060	Low Speed GMLAN Serial Data	II	-
4	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	0.13	GY	4	Accessory Ignition Voltage	I	-
6	-	-	-	Not Occupied	-	-
7	0.5	GY/GN	4083	RAP Relay 2 Coil Control	II	-
8	-	-	-	Not Occupied	-	-
9	0.5	WH/YE	3574	Driver Door Open Switch Signal	II	-
10	0.5	YE/BU	4086	Pushbutton Start Challenge Active Signal	II	-
11	0.13	GN	3558	Passive Start Switch Signal 2	I	-
12	0.13	BK	3559	Passive Start Switch 2 Low Reference	I	-
13	0.13	VT	3	Run/Crank Ignition 1 Voltage	I	-
14	0.5	BK	1250	Ground	II	-
15	0.5	GY/BK	3555	Passive Start Interior Antenna 2 Signal Lo	II	-
16	0.5	BN/BK	3552	Passive Start Interior Antenna 1 Signal Hi	II	-
17	0.5	WH	3553	Passive Start Interior Antenna 1 Signal Lo	II	-
18	0.5	WH/GN	3556	Passive Start Interior Antenna 3 Signal Hi	II	-
19	0.5	GN	3557	Passive Start Interior Antenna 3 Signal Lo	II	-
20	0.5	BU	3554	Passive Start Interior Antenna 2 Signal Hi	II	-

K84 KEYLESS ENTRY CONTROL MODULE X2



Connector Part Information

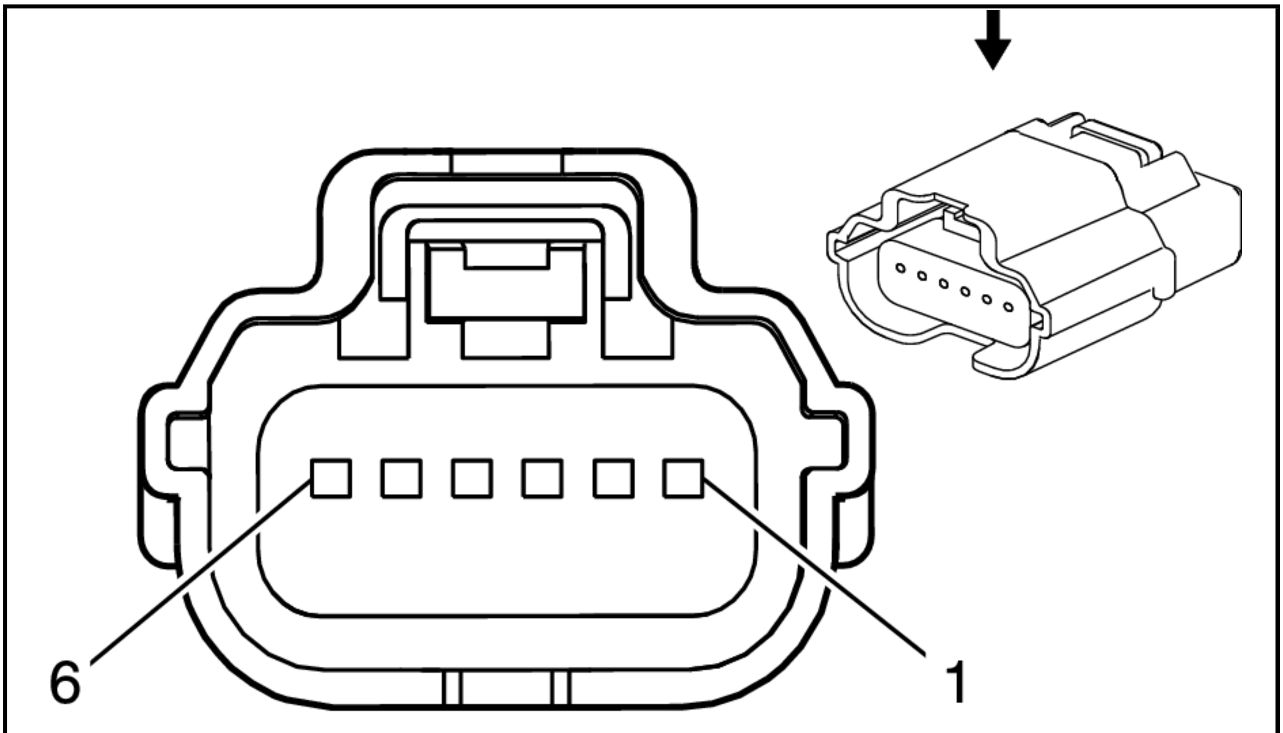
- Harness Type: Instrument Panel
- OEM Connector: 31410-1202
- Service Connector: 15126709
- Description: 20-Way F 64 Series, Sealed (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/GY	6158	Right Rear Door Handle Switch Signal	I	-
2	0.5	BN/YE	6157	Left Rear Door Handle Switch Signal	I	-
3 - 5	-	-	-	Not Occupied	-	-
6	0.5	VT	3560	Passive Entry Driver Door Antenna Signal Hi	I	-
7	0.5	VT/GY	3561	Passive Entry Driver Door Antenna Signal Lo	I	-
8	-	-	-	Not Occupied	-	-
9	0.5	GN/BK	3563	Passive Entry Passenger Door Antenna Signal Lo	I	-
10	-	-	-	Not Occupied	-	-
11	0.5	VT/WH	3571	Passenger Door Handle Switch Signal	I	-
12	0.5	GN/WH	3570	Driver Door Handle Switch Signal	I	-
13 - 15	-	-	-	Not Occupied	-	-
16	0.5	BN/GN	3568	Passive Entry Rear Closure Antenna Signal Hi	I	-
17	-	-	-	Not Occupied	-	-
18	0.5	GN/GY	3569	Passive Entry Rear Closure Antenna Signal Lo	I	-
19	-	-	-	Not Occupied	-	-
20	0.5	GN/YE	3562	Passive Entry Passenger Door Antenna Signal Hi	I	-

K85 PASSENGER PRESENCE MODULE (AL0)



Connector Part Information

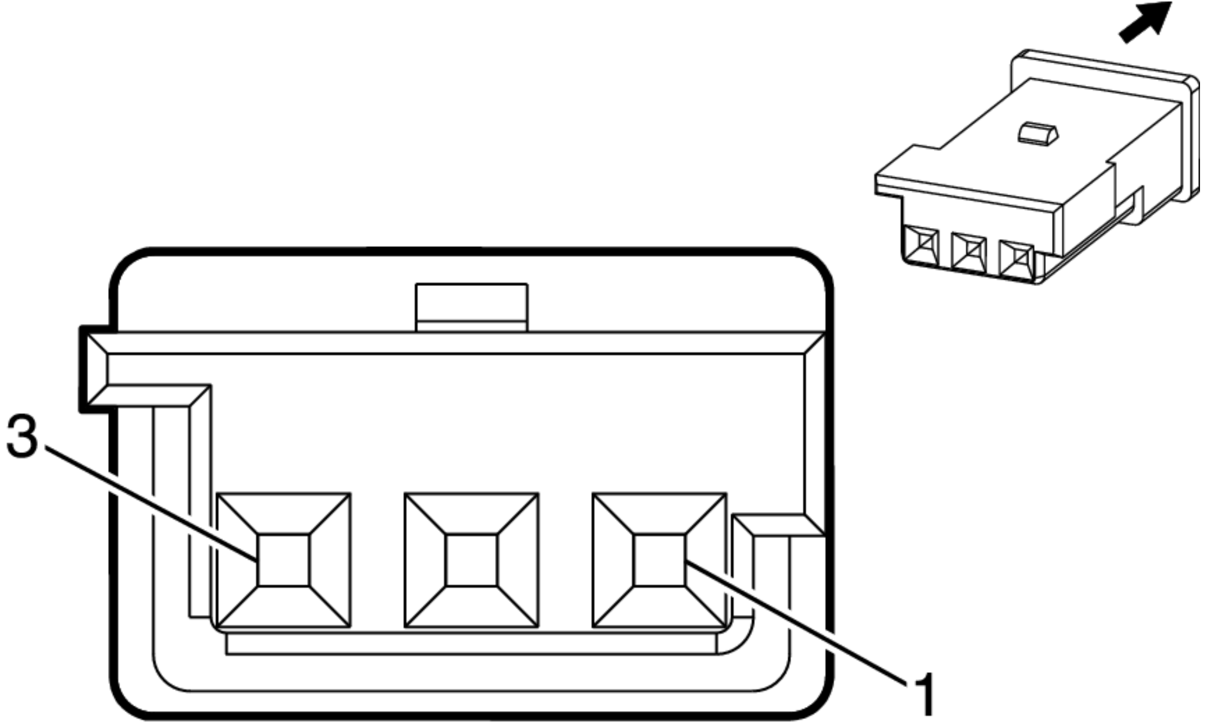
- Harness Type: Passenger Seat
- OEM Connector: 31404-6132
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	RD/GN	2440	Battery Positive Voltage	I	-
2	0.5	GN	5060	Low Speed GMLAN Serial Data	I	-
3	-	-	-	Not Occupied	-	-
4	0.35	BK	750	Ground	I	-
5	0.5	GY/OG	3946	Automatic Locking Retractor Switch Low Reference	I	-
6	0.5	OG/BN	3947	Automatic Locking Retractor Switch Signal	I	-

K89 IMMOBILIZER CONTROL MODULE



Connector Part Information

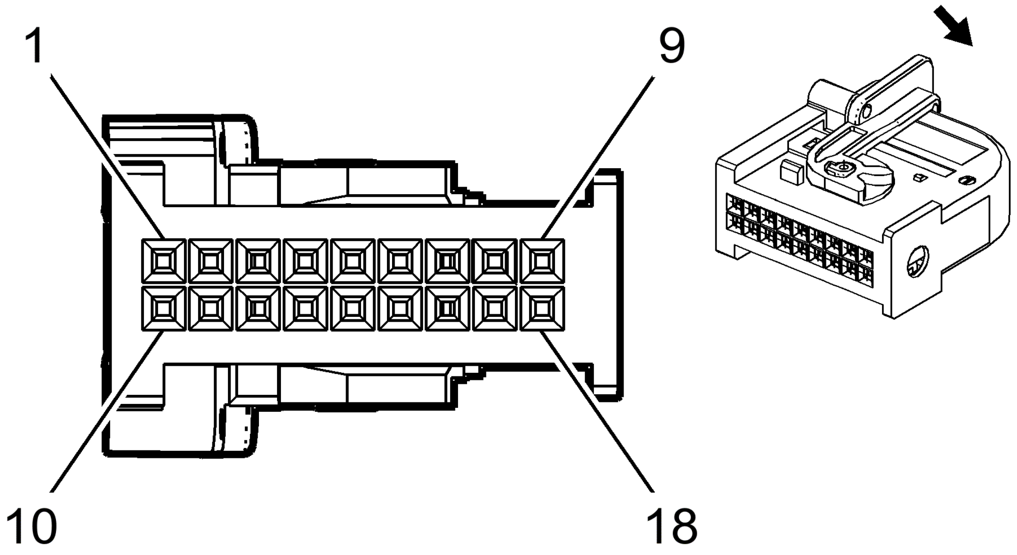
- Harness Type: Floor Console
- OEM Connector: 4-1718346-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Micro-Quadlock Series (PU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/GY	3277	Vehicle Anti-Theft System Immobilizer Low Reference	I	-
2	0.35	GN/VT	7533	Local Interconnect Network Serial Data Bus 11	I	-
3	0.35	GY/BK	3276	Vehicle Anti-Theft System Immobilizer Control	I	-

K101 TRAILER INTERFACE CONTROL MODULE X1 (MAH/MBC/MAW/MCX)



Connector Part Information

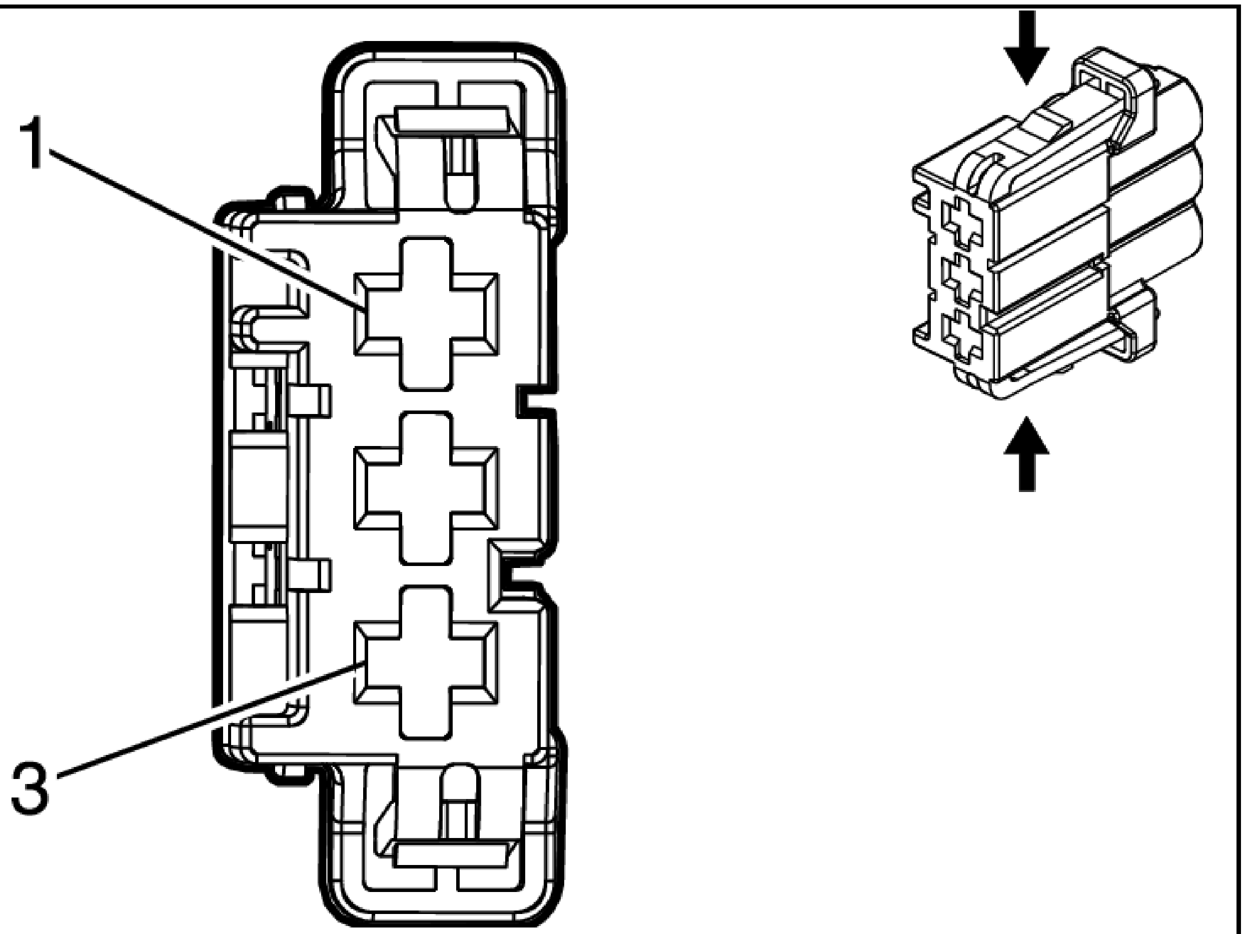
- Harness Type: Body
- OEM Connector: PPI0000498
- Service Connector: 13587947
- Description: 18-Way F 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13579917	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
II	13579918	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN	5060	Low Speed GMLAN Serial Data	II	-
2	-	-	-	Not Occupied	-	-
3	0.5	GY/BN	309	Right Park Lamp Control	II	-
4 - 5	-	-	-	Not Occupied	-	-
6	0.5	WH/YE	3688	Right Rear Supplemental Stop Lamp Control	II	-
7	0.5	WH/YE	7541	Right Rear Stop Lamp Control	II	-
8	0.5	GY/YE	7542	Left Rear Stop Lamp Control	II	-
9	0.5	GY/YE	3687	Left Rear Supplemental Stop Lamp Control	II	-
10	-	-	-	Not Occupied	-	-
11	0.5	VT/GY	709	Left Park Lamp Control	II	-
12	-	-	-	Not Occupied	-	-
13	0.35	VT/BK	2539	Run/Crank Ignition 1 Voltage	II	-
14	0.75	VT/WH	5065	Stop Lamp Relay Coil Control	I	-
15 - 18	-	-	-	Not Occupied	-	-

K101 TRAILER INTERFACE CONTROL MODULE X2 (MAH/MBC/MAW/MCX)



Connector Part Information

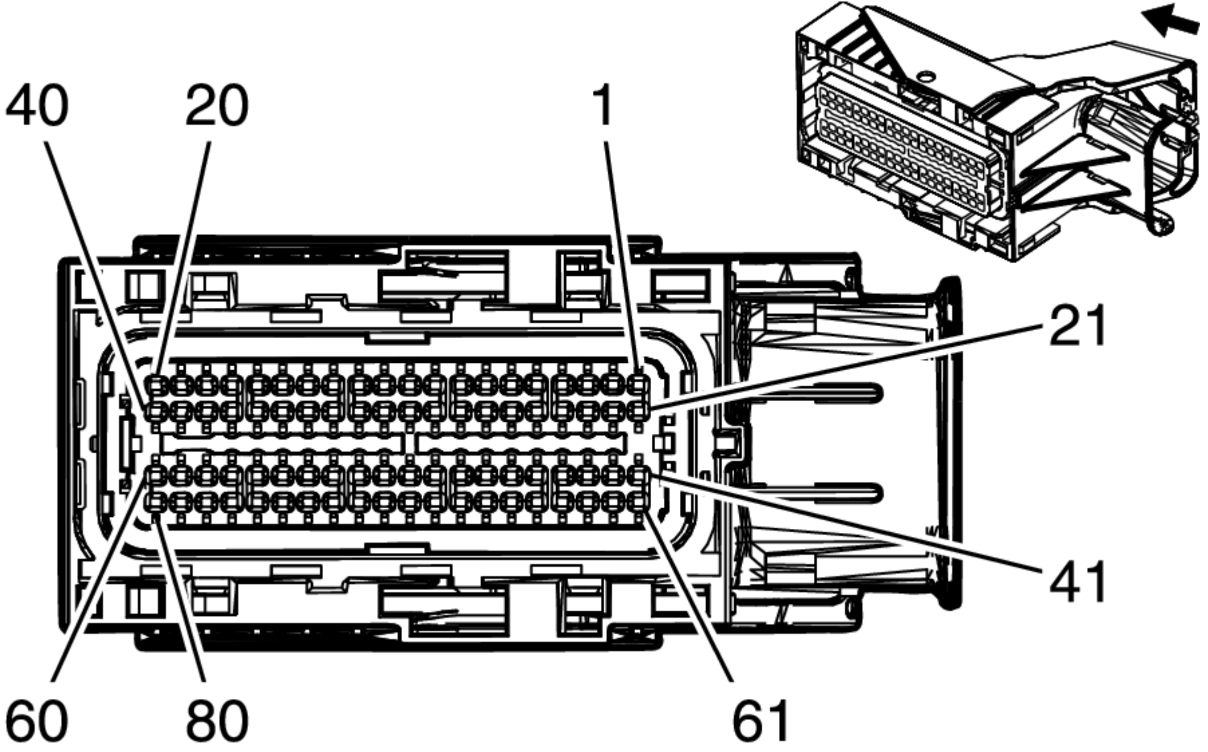
- Harness Type: Body
- OEM Connector: 1-968976-9
- Service Connector: 13314094
- Description: 3-Way F 2.8 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	1	RD/GY	5540	Battery Positive Voltage	I	-

K114B HYBRID/EV POWERTRAIN CONTROL MODULE 2 X1



Connector Part Information

- Harness Type: Body
- OEM Connector: 34566-0703
- Service Connector: 13577545
- Description: 80-Way F MX123 Series, Sealed (BK with BU Terminal Position Assurance)

Terminal Part Information

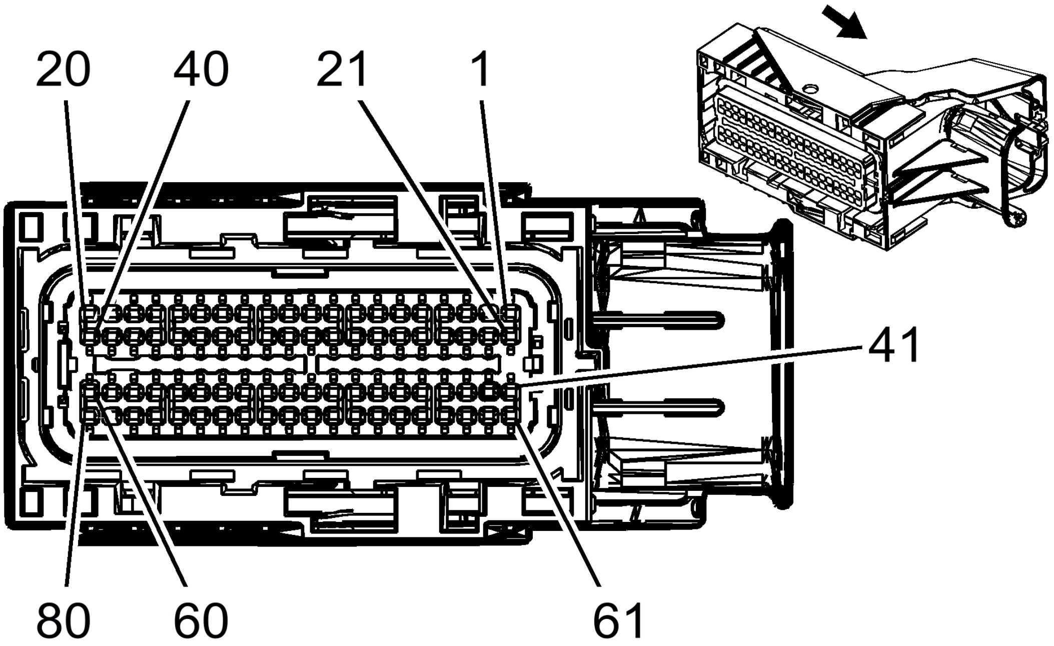
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575813	J-35616-64B (LT BU)	J-38125-213	33468-0003	Delphi 23	J	J
II	13575813	J-35616-64B (LT BU)	J-38125-213	33468-0003	Delphi 23	K	K

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	750	Ground	II	-
2	0.75	RD/BU	5240	Battery Positive Voltage	II	-
3	0.5	YE/VT	3962	High Voltage Battery 3 (+) Relay Control	I	-
4	0.5	BU/GY	4326	High Power Contactor Ground Relay Control	I	CBT

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	0.5	WH/VT	2246	Driver Illumination Lamp #1 Control	I	-
6	0.5	VT/GY	3961	High Voltage Battery (-) Relay Control	I	-
7	0.5	YE	4327	High Power Contactor Positive Relay Control	I	CBT
8	0.5	GY	5138	Precharge Relay	I	-
9	0.5	BN/GN	3959	High Voltage Battery 1 (+) Relay Control	I	-
10	0.5	VT	4334	Battery Pack Coolant Heater Control	I	-
11	0.5	GN/VT	5243	Inside Rear View Mirror Potentiometer Ground	I	CBT
12 - 16	-	-	-	Not Occupied	-	-
17	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
18	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
19	-	-	-	Not Occupied	-	-
20	0.5	BK/BU	6813	Coolant Temperature Sensor 2 Low Reference	I	-
21 - 25	-	-	-	Not Occupied	-	-
26	0.5	BU/GY	636	Outside Ambient Air Temperature Sensor Signal	I	-
27	0.5	YE/BK	3000	Coolant Temperature Sensor 2 Signal	I	-
28	-	-	-	Not Occupied	-	-
29	0.5	GN	4330	High Power Contactor Positive Voltage Sense Signal	I	CBT
30	0.5	GY	4329	High Power Contactor Ground Voltage Sense Signal	I	CBT
31	0.5	BU	204	A/C Low Pressure Sensor Signal	I	-
32	0.5	BU/YE	68	Low Coolant Level Indicator Control	I	-
33	0.5	BK/GN	476	Sensor Low Reference	I	-
34 - 36	-	-	-	Not Occupied	-	-
37	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
38	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
39	-	-	-	Not Occupied	-	-
40	0.5	BK/BU	61	Outside Ambient Temperature Sensor Low Reference	I	-
41 - 42	-	-	-	Not Occupied	-	-
43	0.5	YE/GY	5241	Inside Rear View Mirror Horizontal Potentiometer	I	CBT
44	-	-	-	Not Occupied	-	-
45	0.5	BK/BN	5088	High Voltage Interlock Loop Low Reference 1	I	-
46	-	-	-	Not Occupied	-	-
47	0.5	VT	5087	High Voltage Interlock Loop Signal 1	I	-
48 - 51	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
52	0.5	YE	5530	Hood Open Switch Signal	I	-
53	-	-	-	Not Occupied	-	-
54	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	I	-
55	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	I	-
56	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	I	-
57	0.5	YE	3831	High Speed GMLAN Serial Data (+) 6	I	-
58	0.5	WH	3832	High Speed GMLAN Serial Data (-) 6	I	-
59	0.5	YE	3831	High Speed GMLAN Serial Data (+) 6	I	-
60	0.5	BK/GN	3800	A/C Refrigerant Sensor Low Reference	I	-
61 - 62	-	-	-	Not Occupied	-	-
63	0.5	BU/RD	474	5V Reference	I	-
64	-	-	-	Not Occupied	-	-
65	0.5	BK/VT	5596	High Voltage Interlock Loop Low Reference 2	I	-
66	-	-	-	Not Occupied	-	-
67	0.5	GY/VT	5595	High Voltage Interlock Loop Signal 2	I	-
68 - 70	-	-	-	Not Occupied	-	-
71	0.5	VT/BN	3699	Charge Port Door Switch Signal	I	CBT
72 - 73	-	-	-	Not Occupied	-	-
74	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+) 3	I	-
75	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	I	-
76	0.5	WH	7494	High Speed GMLAN Serial Data (-) 3	I	-
77	0.5	YE	3831	High Speed GMLAN Serial Data (+) 6	I	-
78	0.5	WH	3832	High Speed GMLAN Serial Data (-) 6	I	-
79	0.5	WH	3832	High Speed GMLAN Serial Data (-) 6	I	-
80	-	-	-	Not Occupied	-	-

K114B HYBRID/EV POWERTRAIN CONTROL MODULE 2 X2



Connector Part Information

- Harness Type: Body
- OEM Connector: 34566-0803
- Service Connector: 19115670
- Description: 80-Way F 0.64 Series, Sealed (BK with GY Terminal Position Assurance)

Terminal Part Information

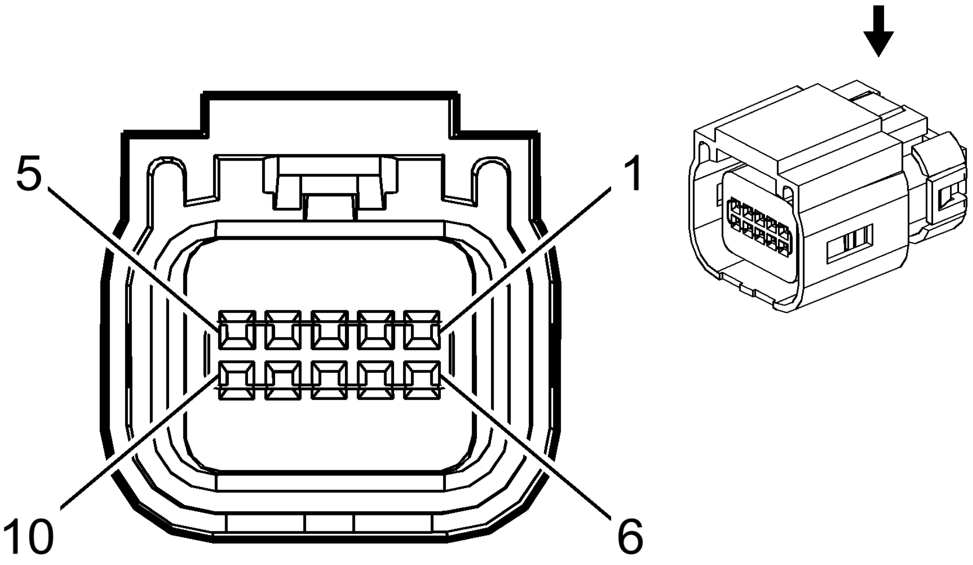
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575813	J-35616-64B (LT BU)	J-38125-213	33468-0003	Delphi 23	J	J
II	13575813	J-35616-64B (LT BU)	J-38125-213	33468-0003	Delphi 23	K	K
III	13582310	J-35616-64B (LT BU)	J-38125-12A	33468-0001	Delphi 23	H	H

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BU/RD	4331	High Power Contactor Signal Conditioner Voltage Reference	I	CBT
3 - 4	-	-	-	Not Occupied	-	-
5	0.5	WH/GY	5239	Inside Rear View Mirror Vertical Potentiometer	I	CBT
6	0.5	GY/BU	213	Charge Port Paddle Temperature Sensor Signal	I	CBT
7	-	-	-	Not Occupied	-	-
8	0.75	GY/GN	3954	Control Pilot Signal 1	II	-
9	0.5	BU/VT	2364	Cooling Fan Speed Signal	I	-
10	0.5	BU/GY	5139	High Voltage Fault Signal	I	-
11	-	-	-	Not Occupied	-	-
12	0.5	GN/GY	3644	High Voltage Onboard Charging AC Voltage Sense Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
13	0.5	VT/WH	3643	High Voltage Onboard Charging DC Voltage Sense Signal	I	-
14	0.5	VT/BU	3790	Electric Coolant Motor Feedback Signal	I	-
15	0.75	BU/YE	3953	Proximity Status Signal 1	II	-
16	0.5	BK/BU	5404	Charge Port Paddle Temperature Sensor Low Reference	I	CBT
17 - 19	-	-	-	Not Occupied	-	-
20	0.5	BK/BN	4332	High Power Contactor Signal Conditioner Low Reference	I	CBT
21 - 24	-	-	-	Not Occupied	-	-
25	0.5	WH/BU	3697	Charge Port Door Sensor Signal	I	-
26	-	-	-	Not Occupied	-	-
27	0.5	VT/BK	1239	Run/Crank Ignition 1 Voltage	I	-
28 - 32	-	-	-	Not Occupied	-	-
33	0.5	YE/GY	3796	Rechargeable Energy Storage System 1 Coolant Motor Feedback Signal	I	-
34 - 37	-	-	-	Not Occupied	-	-
38	0.35	GN	5060	Low Speed GMLAN Serial Data	III	-
39 - 40	-	-	-	Not Occupied	-	-
41	0.5	BN/YE	2231	Charge Port Valve Motor Close Control	I	CBT
42	0.5	WH/GN	3794	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-
43	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
44	0.5	BU/YE	3646	High Voltage Onboard Charging Enable	I	-
45 - 51	-	-	-	Not Occupied	-	-
52	0.75	WH	2368	Cooling Fan Control Signal	II	-
53	0.5	YE/GY	3645	High Voltage Onboard Charging Control	I	-
54 - 60	-	-	-	Not Occupied	-	-
61	0.5	BU/WH	2230	Charge Port Valve Motor Open Control	I	CBT
62	0.5	GY/GN	3957	Charging Pilot Signal Indicator Control	I	-
63	0.5	BN/BU	3788	Electric Coolant Motor Control	I	-
64	0.5	YE/VT	3956	Charging Status Indicator Control	I	-
65	0.5	BU/BN	3787	High Voltage Energy Management Communication Control	I	-
66	-	-	-	Not Occupied	-	-
67	0.5	VT/YE	5985	Accessory Wakeup Serial Data	I	-
68 - 72	-	-	-	Not Occupied	-	-
73	0.5	BU/VT	3795	Rechargeable Energy Storage System 1 Coolant Motor Control	I	-
74	0.5	YE/GN	3789	Electric Coolant Motor Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
75 - 80	-	-	-	Not Occupied	-	-

K132 PEDESTRIAN ALERT SOUND CONTROL MODULE



Connector Part Information

- Harness Type: Body
- OEM Connector: 13569289
- Service Connector: 19178082
- Description: 10-Way F 0.64 Series, Sealed (BK)

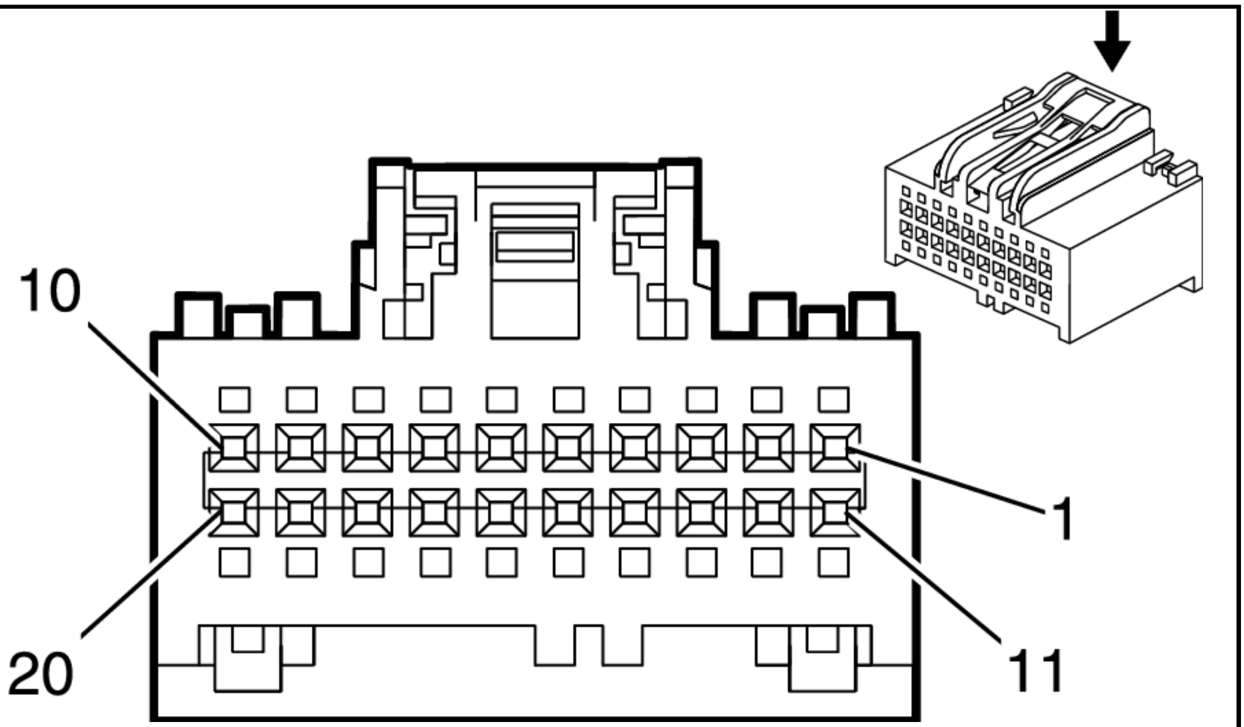
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13579944	J-35616-64B (LT BU)	J-38125-215A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
2	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
3	0.5	BK	550	Ground	I	-
4	0.5	WH/BU	5986	Serial Data Communication Enable	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
7	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	VT/BN	4337	Pedestrian Friendly Alert Speaker Control (-)	I	-
9	0.5	GY/GN	4338	Pedestrian Friendly Alert Speaker Control (+)	I	-
10	0.5	RD/BU	6040	Battery Positive Voltage	I	-

K157 VIDEO PROCESSING CONTROL MODULE X1 (UVH)



Connector Part Information

- Harness Type: Body
- OEM Connector: 31410-1200
- Service Connector: 15126711
- Description: 20-Way F 64 Series, Sealed (BK)

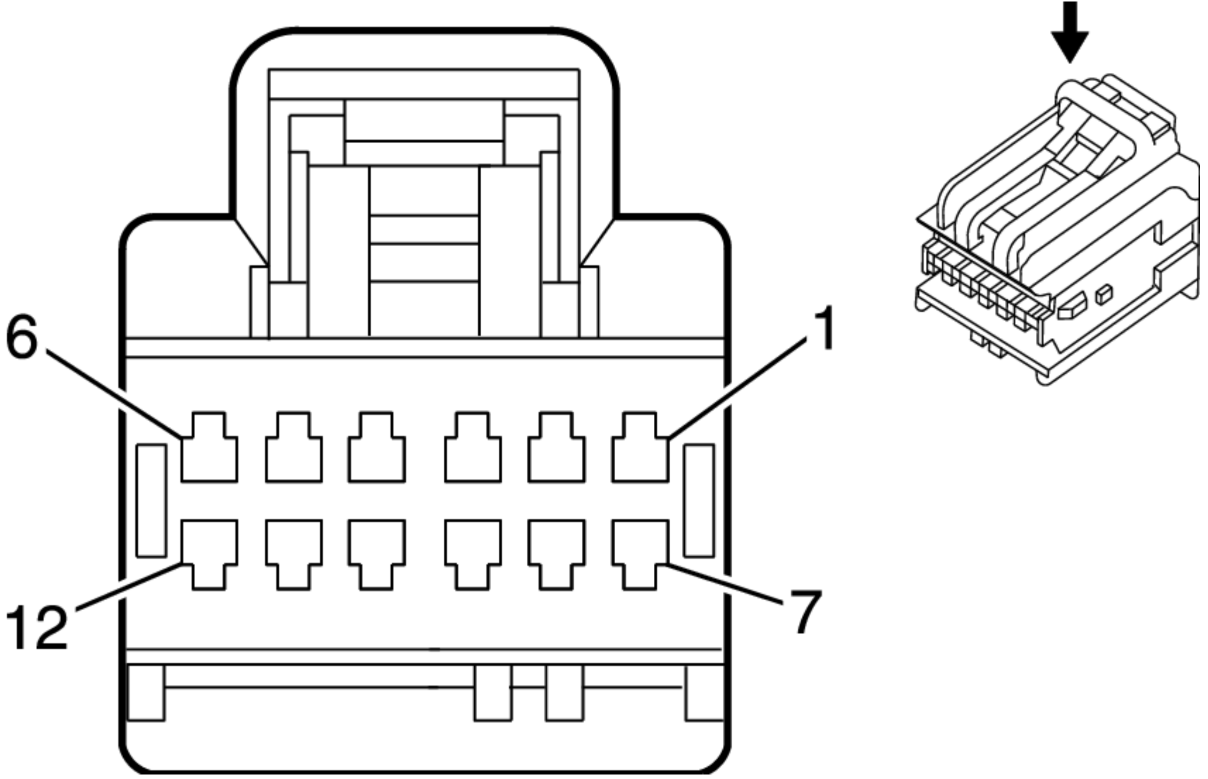
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH	2397	Front Vision Camera #1 Signal (+)	I	UVH
2	0.35	BN/BK	6202	Camera Ground	I	UVH
3	0.35	BK/YE	4670	Rear Camera Return	I	UVH
4	0.35	GY/YE	6972	Camera Signal 2 +	I	UVH
5	0.35	WH/GN	2628	Left Side Vision Camera Video Signal (+)	I	UVH
6	0.35	BK/GN	4664	Left Side Camera Return	I	UVH
7	0.35	BK/BU	4667	Right Side Camera Return	I	UVH
8	0.35	WH/BU	2627	Right Side Vision Camera Video Signal (+)	I	UVH
9 - 10	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.35	BU	2398	Front Vision Camera #1 Signal (-)	I	UVH
12	0.35	WH/BN	6201	Camera Control	I	UVH
13	0.35	VT/BN	4669	Rear Camera Control	I	UVH
14	0.35	WH/BU	6973	Camera Signal 2	I	UVH
15	0.35	GY/GN	2625	Left Side Vision Camera Video Signal (-)	I	UVH
16	0.35	VT/GN	4663	Left Side Camera Control	I	UVH
17	0.35	VT/BU	4666	Right Side Camera Control	I	UVH
18	0.35	GY/BU	2626	Right Side Vision Camera Video Signal (-)	I	UVH
19 - 20	-	-	-	Not Occupied	-	-

K157 VIDEO PROCESSING CONTROL MODULE X2 (UVH)



Connector Part Information

- Harness Type: Body
- OEM Connector: 31410-1120
- Service Connector: 89047364
- Description: 12-Way F 0.64 Series, Sealed (BK)

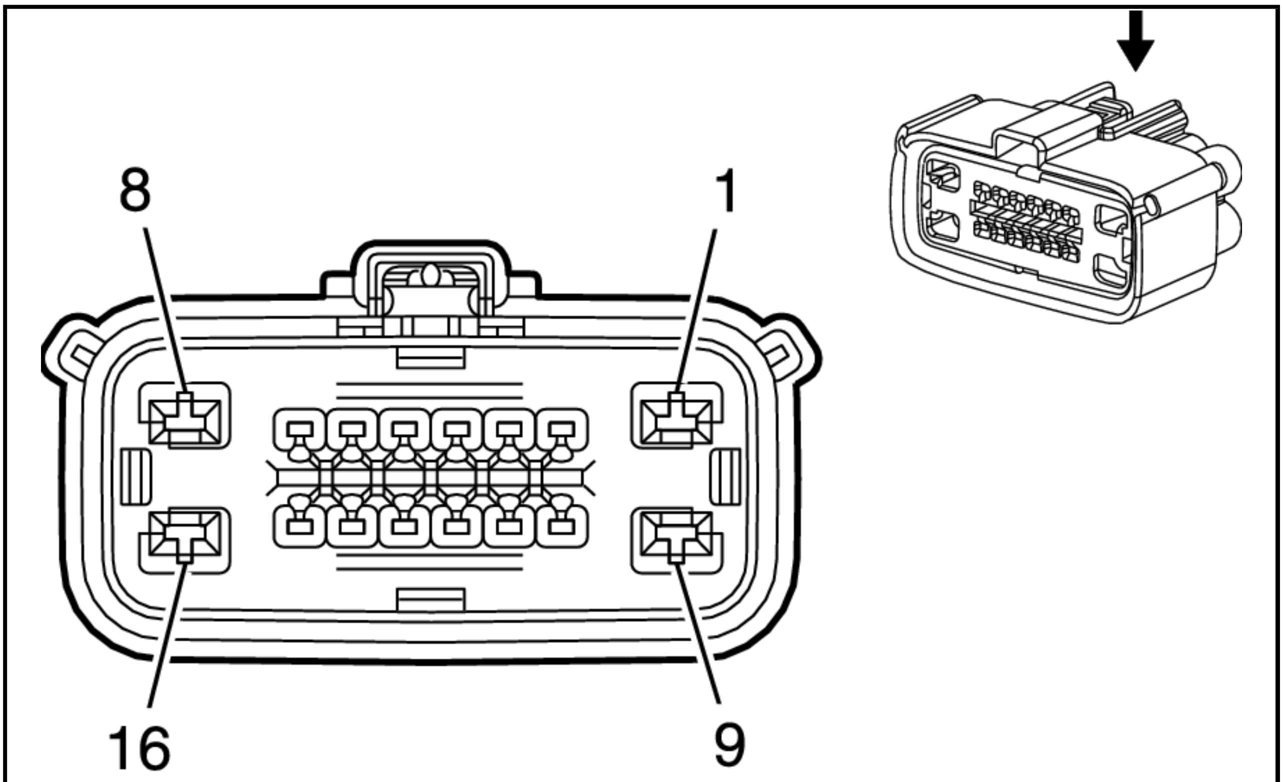
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/BU	7340	Camshaft W 2 Low Reference	I	UVH
2	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	0.35	GY/GN	1102	Low Speed GMLAN Serial Data #2	I	UVH
4 - 5	-	-	-	Not Occupied	-	-
6	0.35	WH/VT	4660	Combined Camera Video Signal (+)	I	UVH
7	0.5	BK	2250	Ground	I	UVH
8 - 10	-	-	-	Not Occupied	-	-
11	0.35	BK/WH	2651	Signal Ground	I	UVH
12	0.35	GN/WH	4661	Combined Camera Video Signal (-)	I	UVH

K173 TRANSMISSION RANGE CONTROL MODULE



Connector Part Information

- Harness Type: Engine
- OEM Connector: 34985-1606
- Service Connector: 19352906
- Description: 16-Way F 1.5, 2.8 Series, Sealed (BK)

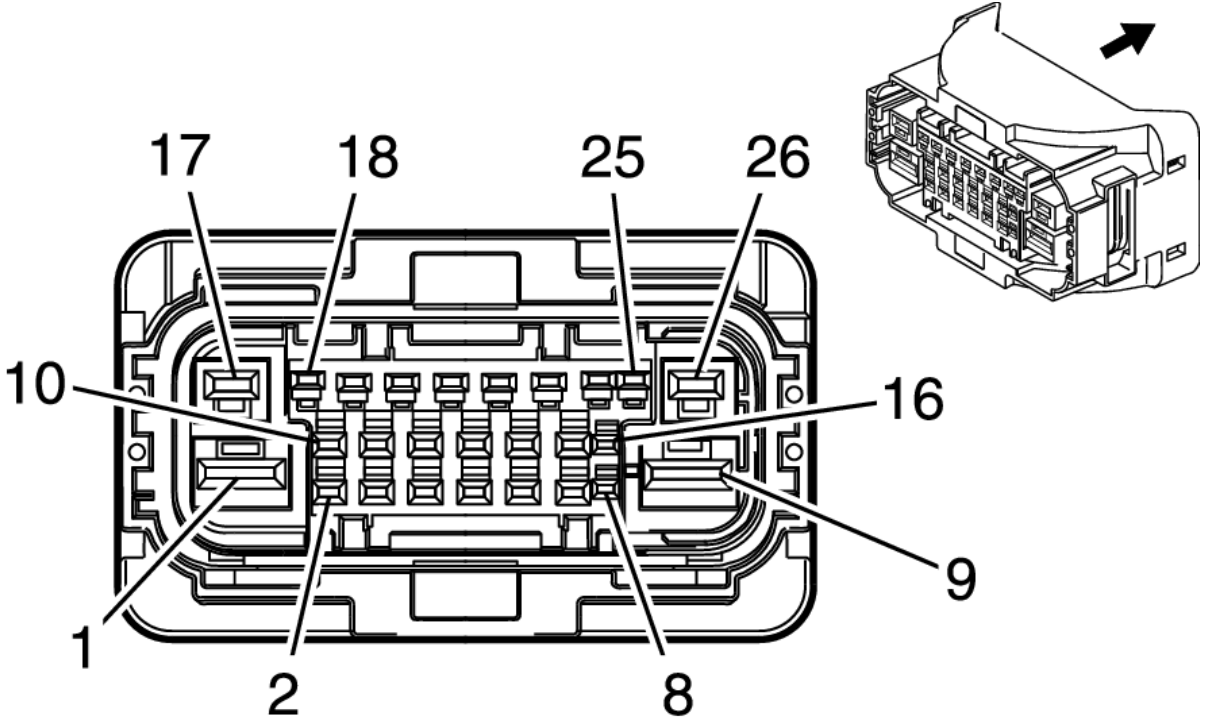
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576376	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	A	4
II	13579750	J-35616-35 (VT)	J-38125-12A	1326030-8	Lear 17	4	D
III	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	I	-
2	0.5	VT/WH	1539	Run/Crank Ignition 1 Voltage	III	-
3	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	III	-
4	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	III	-
5	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	III	-
6	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	III	-
7	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	III	-
8	2.5	BK	350	Ground	II	-
9 - 10	-	-	-	Not Occupied	-	-
11	0.5	GN/BU	4626	Local Interconnect Network Serial Data Bus 26	III	-
12	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	III	-
13	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	III	-
14	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	III	-
15	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	III	-
16	2.5	RD/GY	642	Battery Positive Voltage	II	-

K177 BRAKE BOOSTER CONTROL MODULE



Connector Part Information

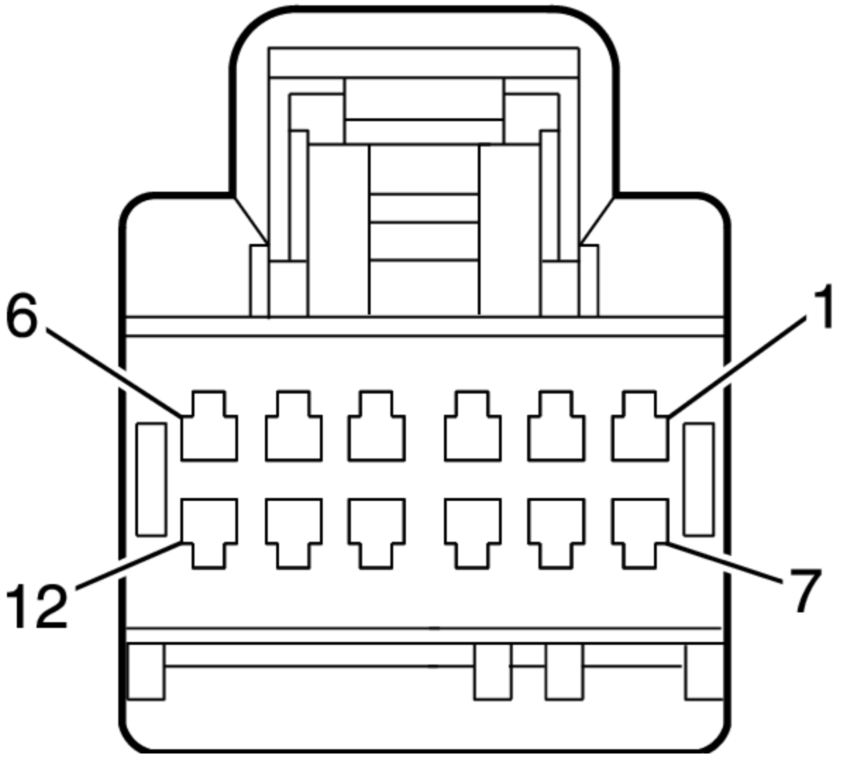
- Harness Type: Body
- OEM Connector: 1928405762
- Service Connector: 19332378
- Description: 26-Way F 1.5, 2.8, 4.8 Series, Sealed (BK)

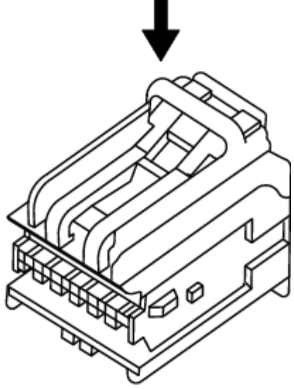
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13584537	J-35616-35 (VT)	J-38125-561	Not Available	Not Available	Not Available	Not Available
II	19330700	J-35616-35 (VT)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
III	19333305	J-35616-40 (BU)	J-38125-556	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	RD/YE	3042	Battery Positive Voltage	III	-
2	0.5	BU/RD	3335	Brake Pedal Travel Sensor 1 High Reference	I	-
3 - 7	-	-	-	Not Occupied	-	-
8	0.5	BK/GY	3417	Brake Pedal Travel Sensor 1 Low Reference	I	-
9	2.5	BK	650	Ground	III	-
10	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
11	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
12 - 14	-	-	-	Not Occupied	-	-
15	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
16	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
17	1	RD/YE	3040	Battery Positive Voltage	II	-
18	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
19	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
20	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	-
21	0.35	VT/GY	539	Run/Crank Ignition 1 Voltage	I	-
22	0.35	BU/YE	3334	Brake Pedal Travel Sensor 1 Signal	I	-
23	0.35	VT/BN	3333	Brake Pedal Travel Sensor 2 Signal	I	-
24	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
25	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
26	-	-	-	Not Occupied	-	-

K182 PARKING ASSIST CONTROL MODULE X1





Connector Part Information

- Harness Type: Body
- OEM Connector: 31410-1120
- Service Connector: 89047364
- Description: 12-Way F 0.64 Series, Sealed (BK)

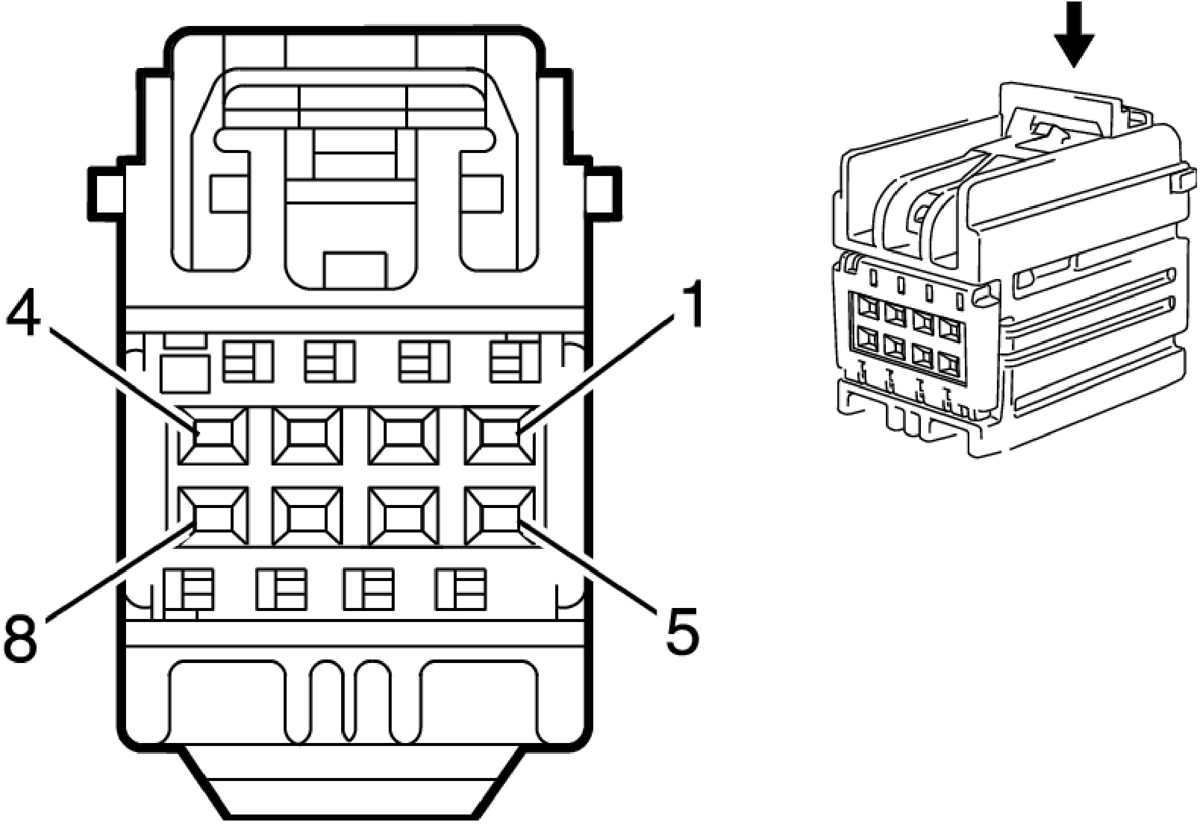
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	RD/WH	5440	Battery Positive Voltage	I	UD5/UD7/UFQ
2	0.5	WH/BU	5986	Serial Data Communication Enable	I	UD5/UD7/UFQ
3	0.5	GN/BN	5852	Rear Park Assist LED Disable Signal	I	UD5/UFQ
4	-	-	-	Not Occupied	-	-
5	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
6	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
7	0.5	BK	1050	Ground	I	-
8	0.5	GY/GN	2555	Rear Park Assist Disable Signal	I	UD5/UFQ
9	0.35	GN	5060	Low Speed GMLAN Serial Data	I	UD5/UD7/UFQ
10	0.35	BU/BN	3161	Parallel Park Assist Disable Switch Signal	I	UFQ
11	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-

K182 PARKING ASSIST CONTROL MODULE X2



Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-9029-40
- Service Connector: 19115653
- Description: 8-Way F YESC Kaizen Series (L-GY)

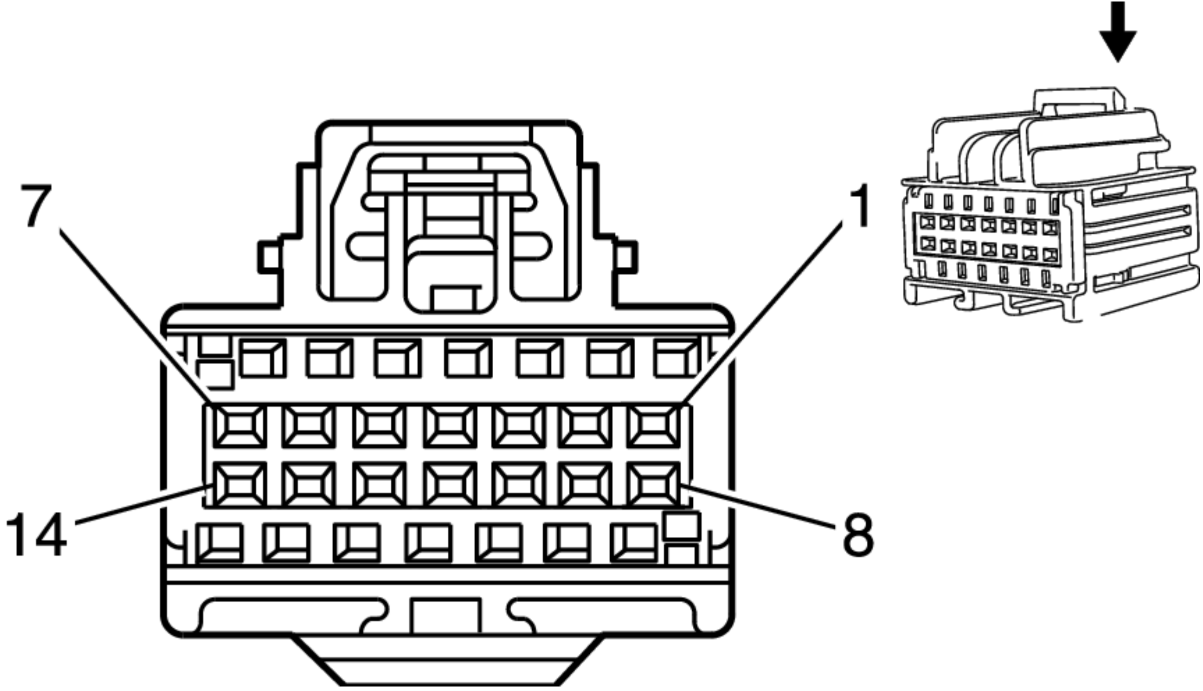
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE	2375	Left Rear Corner Object Sensor Signal	I	-
2	0.35	BU	3157	Right Rear Supplemental Object Sensor Signal	I	UFQ
3	-	-	-	Not Occupied	-	-
4	0.35	BN/WH	2374	Object Sensor Control	I	-
5	0.35	YE/VT	2378	Right Rear Corner Object Sensor Signal	I	-
6	0.35	GN	3156	Left Rear Supplemental Object Sensor Signal	I	UFQ

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
7	0.35	YE/WH	2377	Right Rear Middle Object Sensor Signal	I	-
8	0.35	BK/GY	2379	Object Sensor Low Reference	I	-

K182 PARKING ASSIST CONTROL MODULE X3



Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-9068-90
- Service Connector: 15127038
- Description: 14-Way F 0.64 Kaizen Series (BU)

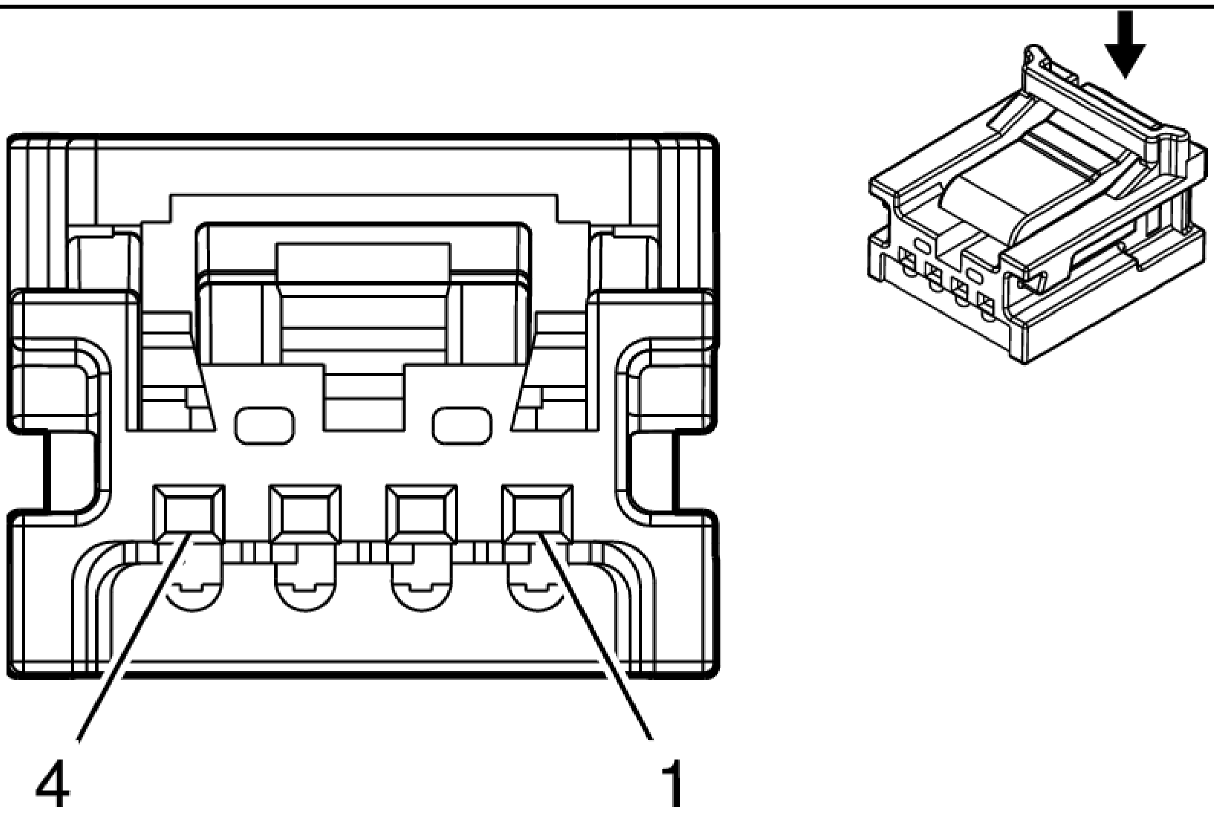
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	6581	Front Parking Aid Display Control	I	UD5/UFQ
2	-	-	-	Not Occupied	-	-
3	0.35	GY	3154	Left Front Supplemental Object Sensor Signal	I	UFQ
4	0.35	VT/WH	5215	Front Parking Left Corner Sensor	I	UD5/UFQ
5	0.35	YE/GY	5216	Front Parking Left Mid Sensor	I	UD5/UFQ
6 - 7	-	-	-	Not Occupied	-	-
8	0.35	BK/BU	5214	Front Parking Sensor Low Reference	I	UD5/UFQ
9	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
10	0.35	GN	3155	Right Front Supplemental Object Sensor Signal	I	UFQ
11	0.35	WH/GY	5217	Front Parking Right Corner Sensor	I	UD5/UFQ
12	0.35	VT/GY	5218	Front Parking Right Mid Sensor	I	UD5/UFQ
13 - 14	-	-	-	Not Occupied	-	-

K183 UHF SHORT RANGE LOW ENERGY REMOTE CONTROL ACCESS TRANSCEIVER



Connector Part Information

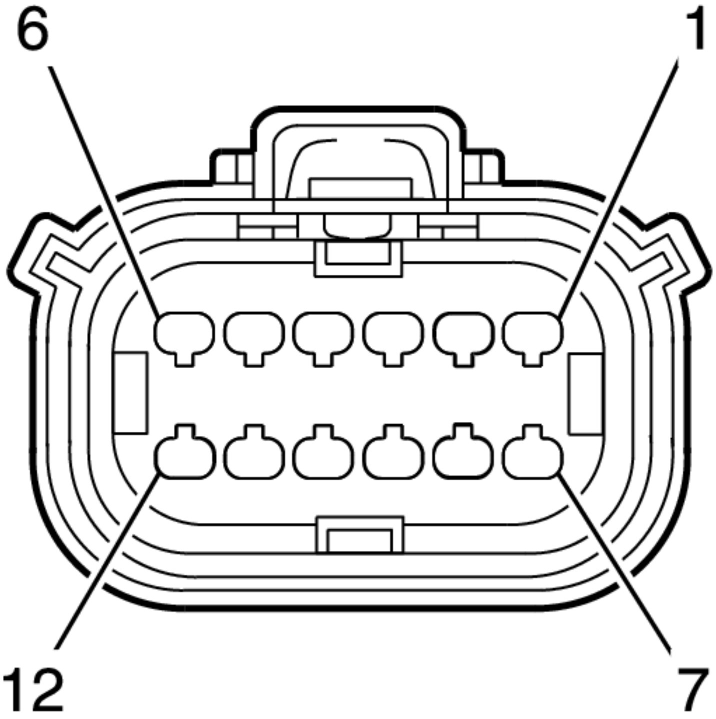
- Harness Type: Body
- OEM Connector: 34791-5140
- Service Connector: 19354840
- Description: 4-Way F Mini 50 Series (BK)

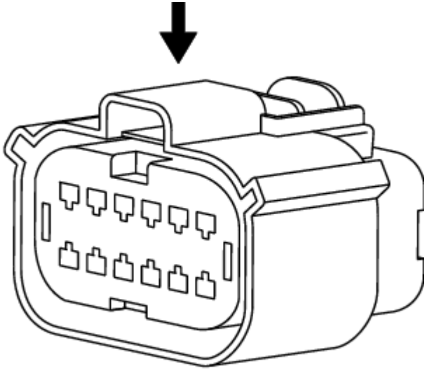
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	EL-35616-58 (BK)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	RD/BN	5940	Battery Positive Voltage	I	-
2	0.35	GN/WH	4115	Local Interconnect Network Serial Data Bus 15	I	-
3	-	-	-	Not Occupied	-	-
4	0.35	BK	2250	Ground	I	-

K190 POWER LINE COMMUNICATION MODULE X1 (CBT)





Connector Part Information

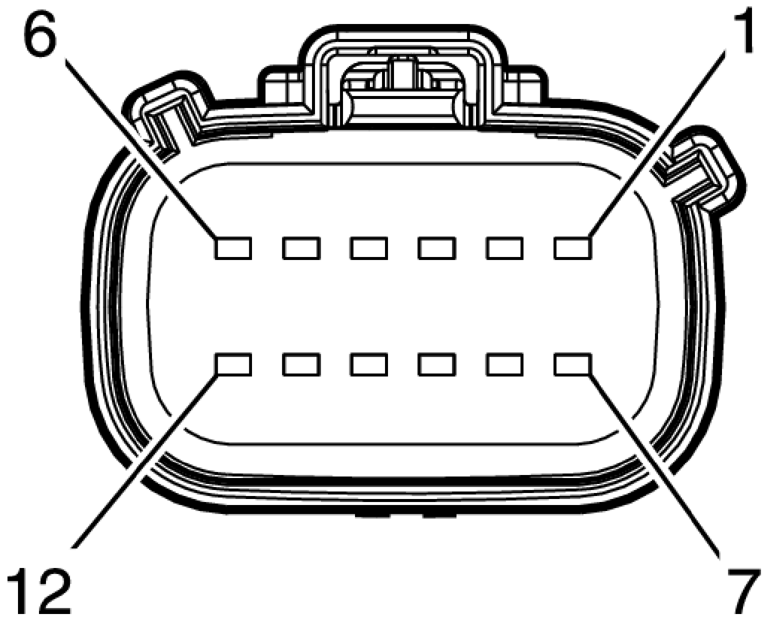
- Harness Type: Body
- OEM Connector: 33472-1216
- Service Connector: 19150019
- Description: 12-Way F 150 MX Series, Sealed (BK)

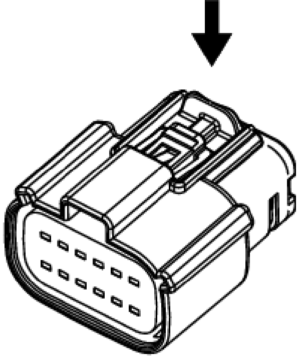
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	550	Ground	I	CBT
2	-	-	-	Not Occupied	-	-
3	0.5	BK	550	Ground	I	CBT
4 - 6	-	-	-	Not Occupied	-	-
7	0.5	RD/WH	1040	Battery Positive Voltage	I	CBT
8	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	CBT
9	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	CBT
10	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	CBT
11	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	CBT
12	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	I	CBT

K190 POWER LINE COMMUNICATION MODULE X2 (CBT)





Connector Part Information

- Harness Type: Body
- OEM Connector: 33472-1259
- Service Connector: 19333239
- Description: 12-Way F 150 MX Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/BN	3787	High Voltage Energy Management Communication Control	I	CBT
2	0.5	WH	3832	High Speed GMLAN Serial Data (-) 6	I	CBT
3	0.5	WH	3832	High Speed GMLAN Serial Data (-) 6	I	CBT
4	0.5	YE	3831	High Speed GMLAN Serial Data (+) 6	I	CBT
5	0.5	YE	3831	High Speed GMLAN Serial Data (+) 6	I	CBT
6 - 7	-	-	-	Not Occupied	-	-
8	0.5	GY/GN	3954	Control Pilot Signal 1	I	CBT
9 - 12	-	-	-	Not Occupied	-	-

M6 AIR TEMPERATURE DOOR ACTUATOR

-

Connector Part Information

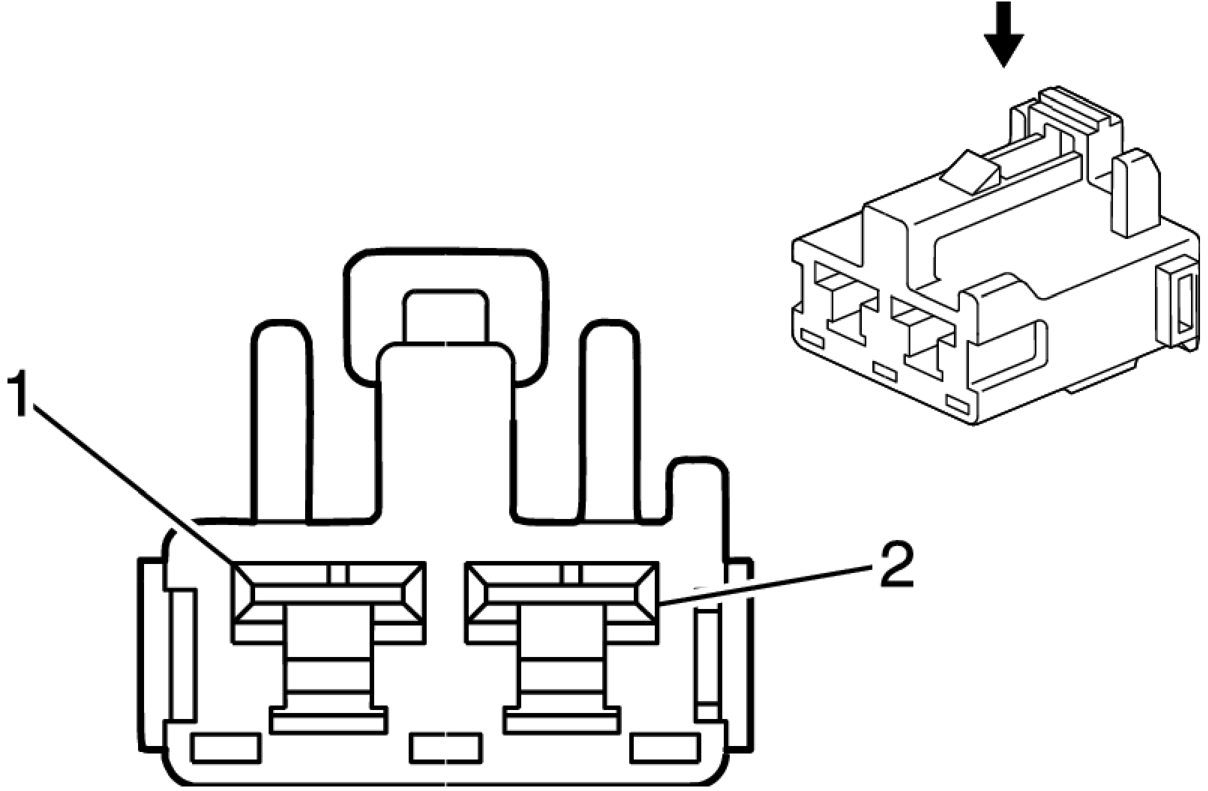
- Harness Type: HVAC
- OEM Connector: 1355881
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	- -	WH/BK BU/GY	3169 3173	Temp Door Stepper Motor Control 1 Air Inlet Door Stepper Motor Control 1	I I	- -
2	-	BN/VT	7572	HVAC Motor Control	I	-
3	- -	VT/GN BN/WH	3170 3174	Temp Door Stepper Motor Control 2 Air Inlet Door Stepper Motor Control 2	I I	- -
4	- -	YE/GN YE	3171 3175	Temp Door Stepper Motor Control 3 Air Inlet Door Stepper Motor Control 3	I I	- -
6	- -	GY/BU WH	3172 3176	Temp Door Stepper Motor Control 4 Air Inlet Door Stepper Motor Control 4	I I	- -

M8 BLOWER MOTOR



Connector Part Information

- Harness Type: HVAC Harness

- OEM Connector: 6098-0325
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F TS 187 Series (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT	65	Blower Motor Control	I	-
2	-	VT/BK	5987	Front Blower Motor Low Reference	I	-

M29L HEADLAMP LEVELING ACTUATOR - LEFT (TR6)

-

Connector Part Information

- Harness Type: Left Headlamp
- OEM Connector: 13580662
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT/WH	239	Run/Crank Ignition 1 Voltage	I	-

M29R HEADLAMP LEVELING ACTUATOR - RIGHT (TR6)

-

Connector Part Information

- Harness Type: Right Headlamp
- OEM Connector: 13580662
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT/WH	239	Run/Crank Ignition 1 Voltage	I	-

M37 MODE DOOR ACTUATOR

-

Connector Part Information

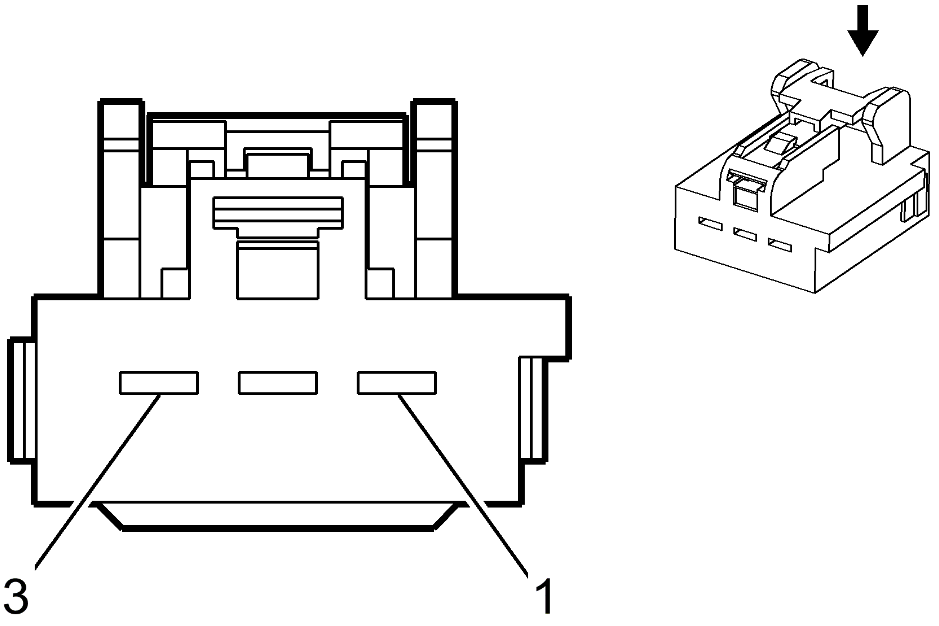
- Harness Type: HVAC
- OEM Connector: 1355881
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BU/BN	3167	Mode Door Stepper Motor Control 3	I	-
2	-	BN/VT	7572	HVAC Motor Control	I	-
3	-	GY	3165	Mode Door Stepper Motor Control 1	I	-
4	-	BN	3168	Mode Door Stepper Motor Control 4	I	-
6	-	BN/GN	3166	Mode Door Stepper Motor Control 2	I	-

M45 REAR WIPER MOTOR



Connector Part Information

- Harness Type: Liftgate
- OEM Connector: 7283-5563-40
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 2.8 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	GY/VT	5780	Windshield Wiper Motor Park Switch Fused Signal	I	-
2	1	BK	1950	Ground	I	-
3	1	BU	393	Rear Window Wiper Motor Control	I	-

M46 AIR RECIRCULATION DOOR ACTUATOR

-

Connector Part Information

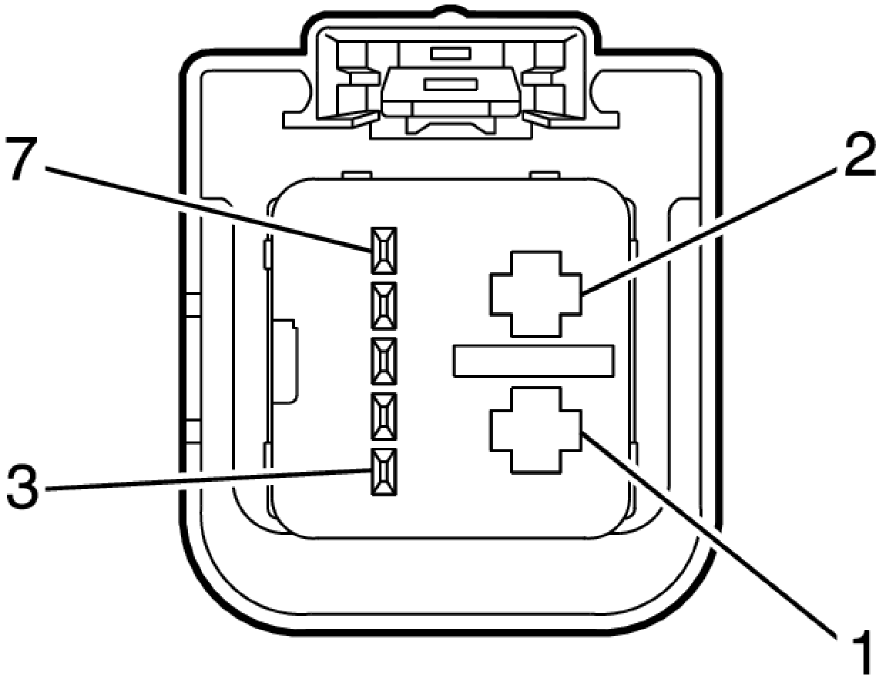
- Harness Type: HVAC
- OEM Connector: 1355881
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way

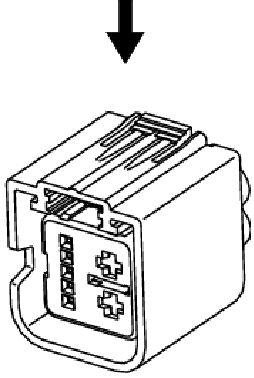
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BU/GY	3173	Air Inlet Door Stepper Motor Control 1	I	-
2	-	BN/VT	7572	HVAC Motor Control	I	-
3	-	BN/WH	3174	Air Inlet Door Stepper Motor Control 2	I	-
4	-	YE	3175	Air Inlet Door Stepper Motor Control 3	I	-
6	-	WH	3176	Air Inlet Door Stepper Motor Control 4	I	-

M74D WINDOW MOTOR - DRIVER





Connector Part Information

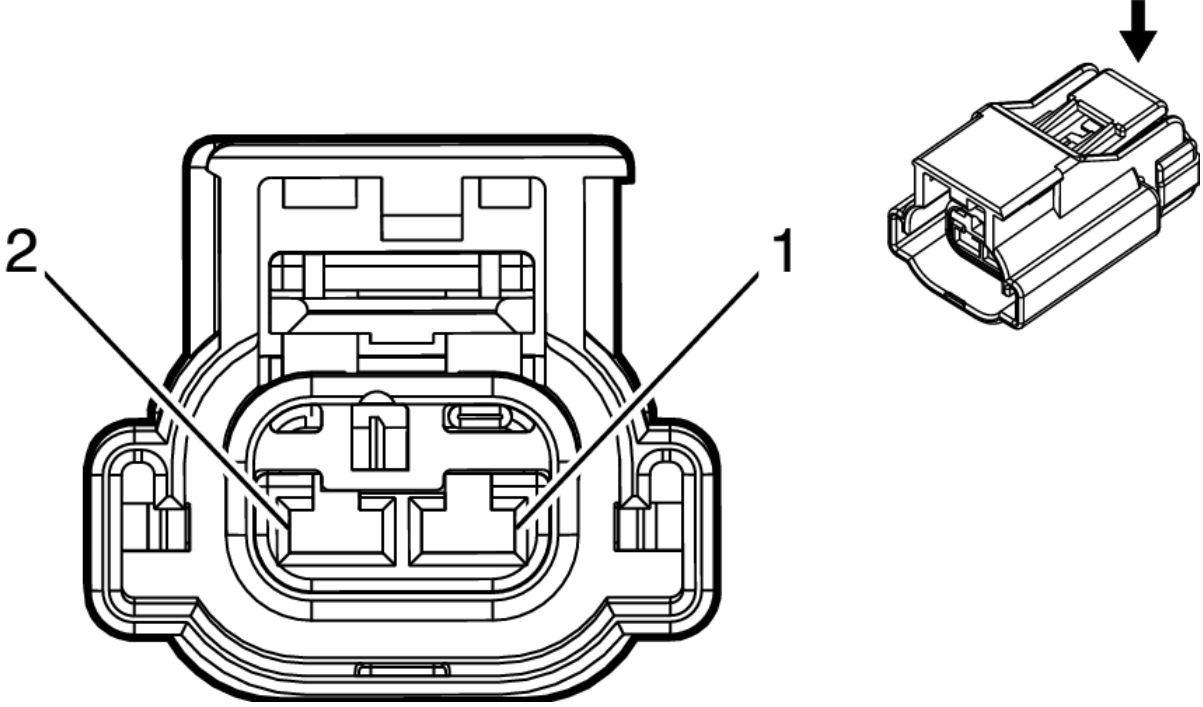
- Harness Type: Driver Door
- OEM Connector: 1-1732115-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 7-Way F 0.64, 2.8 Kaizen Timer Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2	BK	650	Ground	I	-
2	2	RD/GN	1540	Battery Positive Voltage	I	-
3	0.5	GN/WH	3379	Power Window Switch Driver Up Signal	II	-
4	0.5	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	II	-
5	0.5	GN	3381	Power Window Switch Driver Express Signal	II	-
6	0.35	GY	745	Left Front Door Ajar Switch Signal	II	-
7	0.5	GY	3380	Power Window Switch Driver Down Signal	II	-

M74LR WINDOW MOTOR - LEFT REAR



Connector Part Information

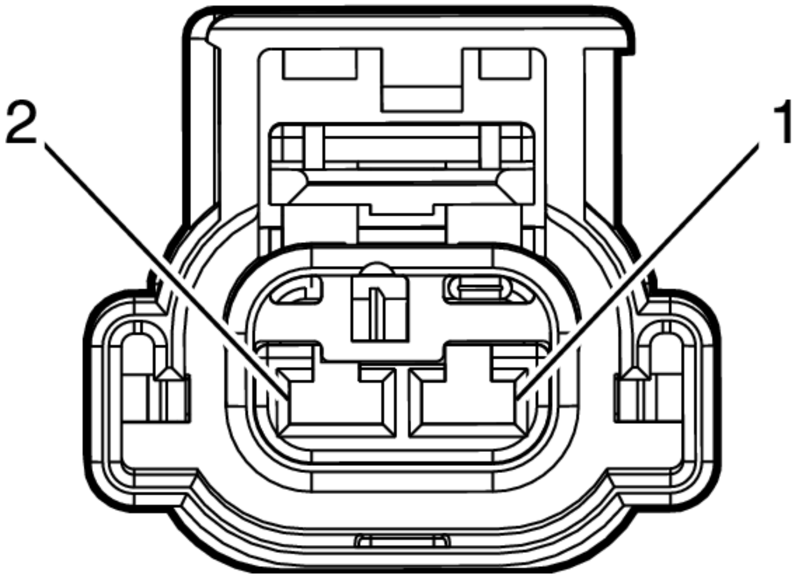
- Harness Type: Left Rear Door
- OEM Connector: 54200220N
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 2.8 Series, Sealed (BK)

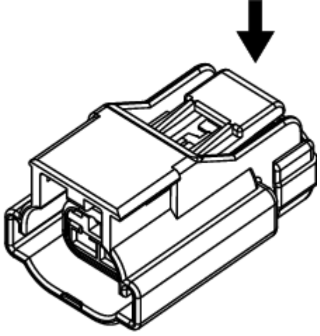
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1.5	BU/VT	668	Power Window Motor Left Rear Up Control	I	-
2	1.5	YE/BU	669	Power Window Motor Left Rear Down Control	I	-

M74P WINDOW MOTOR - PASSENGER





Connector Part Information

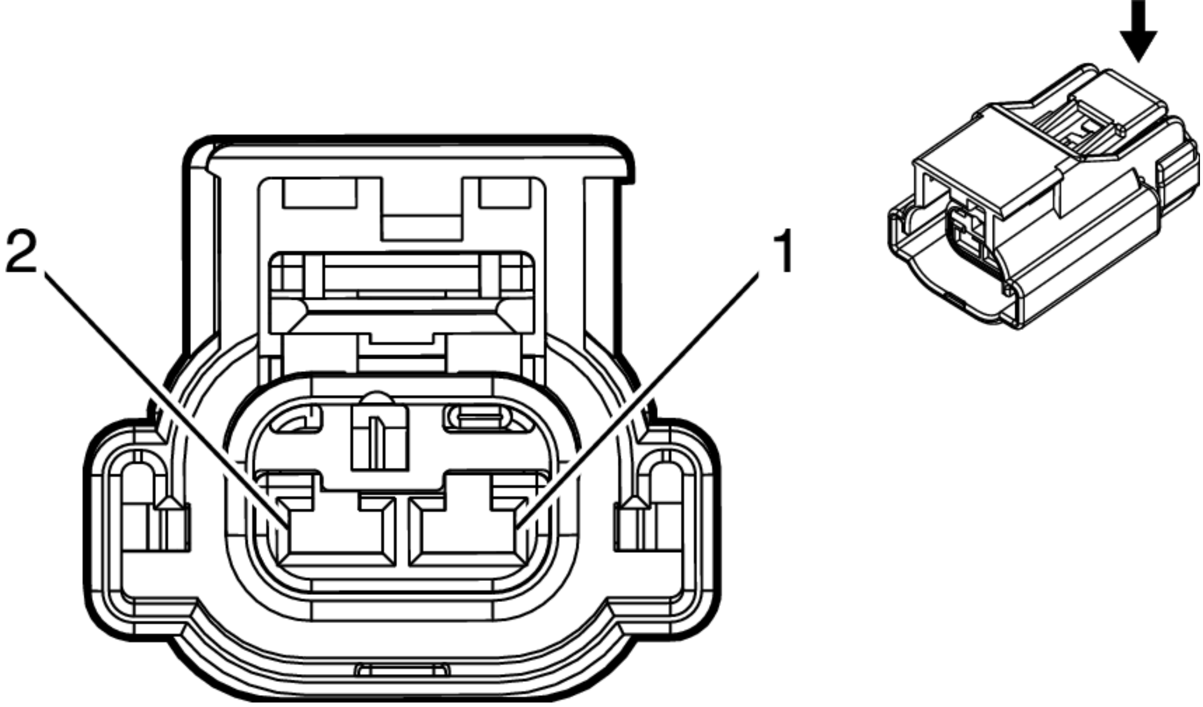
- Harness Type: Passenger Door
- OEM Connector: 54200220N
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 2.8 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1.5	GN/GY	3387	Power Window Motor Passenger Up Control	I	-
2	1.5	YE/BU	3388	Power Window Motor Passenger Down Control	I	-

M74RR WINDOW MOTOR - RIGHT REAR



Connector Part Information

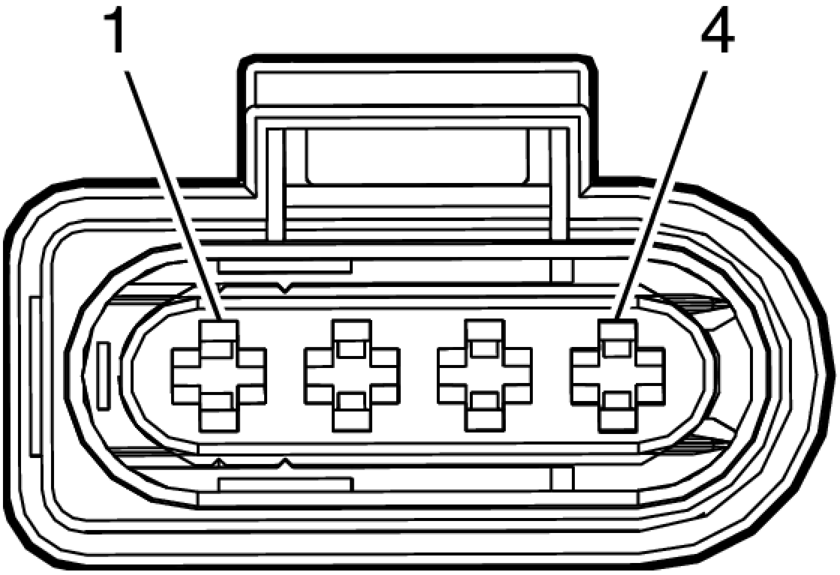
- Harness Type: Right Rear Door
- OEM Connector: 54200220N
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 2.8 Series, Sealed (BK)

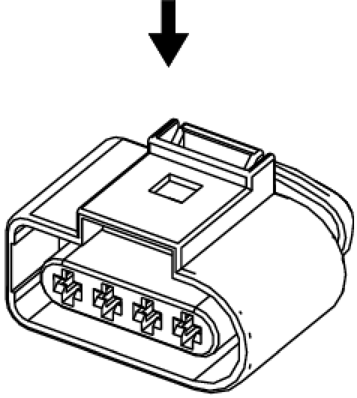
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1.5	BU/GY	670	Power Window Motor Right Rear Up Control	I	-
2	1.5	GN/BK	671	Power Window Motor Right Rear Down Control	I	-

M75L WINDSHIELD WIPER MOTOR MODULE - LEFT





Connector Part Information

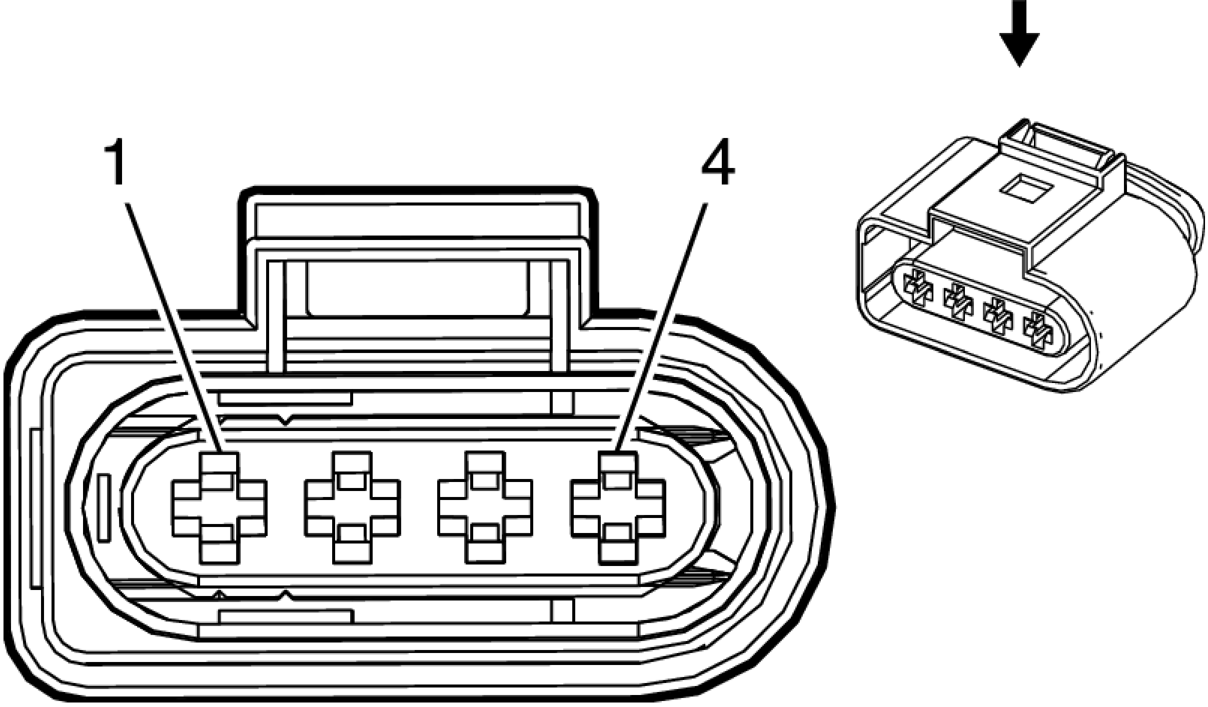
- Harness Type: Body
- OEM Connector: 638245-2
- Service Connector: 88987987
- Description: 4-Way F Junior Power Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35 2.5	GN/BN RD/WH	6132 640	Local Interconnect Network Serial Data Bus 1 Battery Positive Voltage	I I	CE1 -CE1
2	0.5 2.5	GY BK	9199 350	- Ground	I I	CE1 -CE1
3	2.5 0.5	BK GY	350 9199	Ground -	I I	CE1 -CE1
4	2.5 0.35	RD/WH GN/BN	640 6132	Battery Positive Voltage Local Interconnect Network Serial Data Bus 1	I I	CE1 -CE1

M75R WINDSHIELD WIPER MOTOR MODULE - RIGHT



Connector Part Information

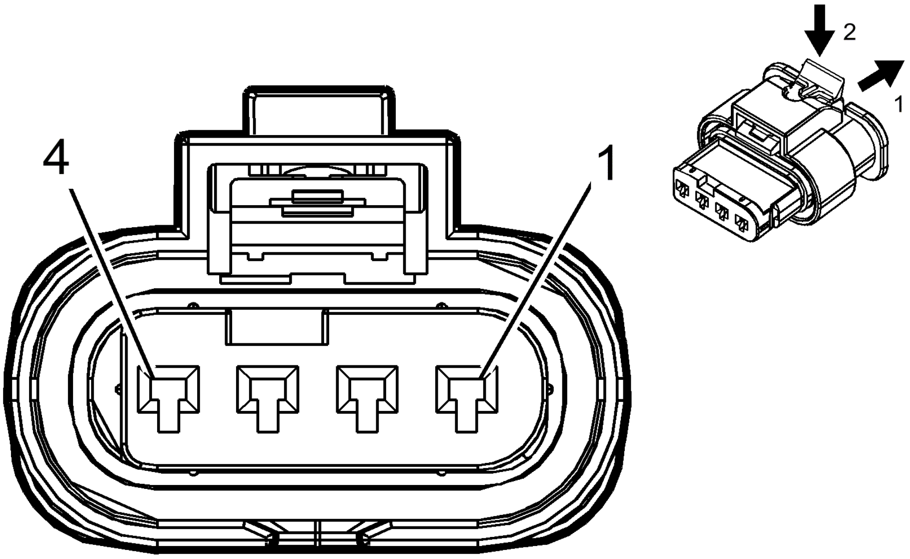
- Harness Type: Body
- OEM Connector: 638245-2
- Service Connector: 88987987
- Description: 4-Way F Junior Power Timer Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY	9199	-	I	-
2	0.5	GY	91	Windshield Wiper Motor Relay Coil Control	I	-
3	2.5	BK	450	Ground	I	-
4	2.5	RD/WH	640	Battery Positive Voltage	I	-

M96 ACTIVE GRILLE AIR SHUTTER ACTUATOR



Connector Part Information

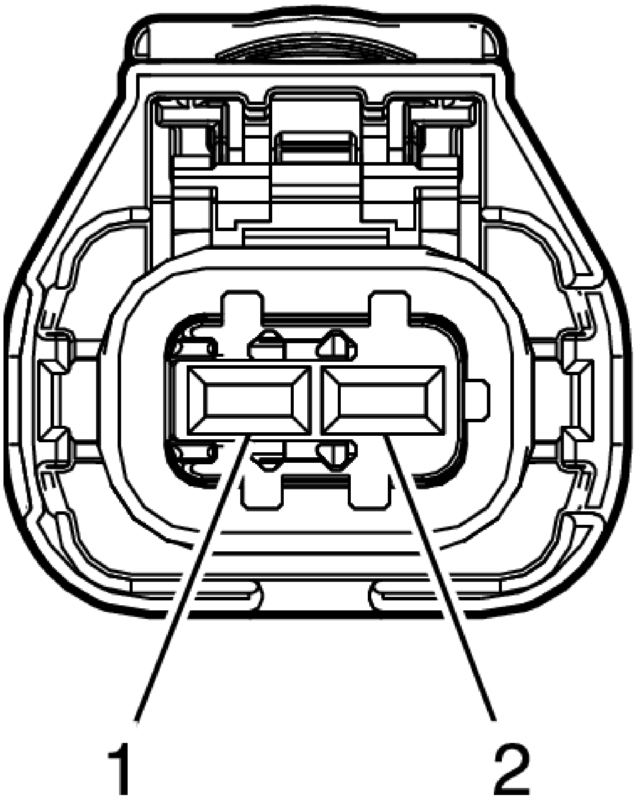
- Harness Type: Engine
- OEM Connector: 4-2272005-2
- Service Connector: 19352416
- Description: 4-Way F 1.2 MCON Series (BK)

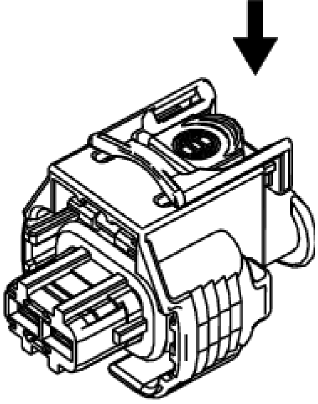
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	5705	Powertrain Main Relay Fused Control 6	I	-
2	0.5	GN/VT	4621	Local Interconnect Network Serial Data Bus 21	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	BK	350	Ground	I	-

M104L PARK BRAKE ACTUATOR - LEFT





Connector Part Information

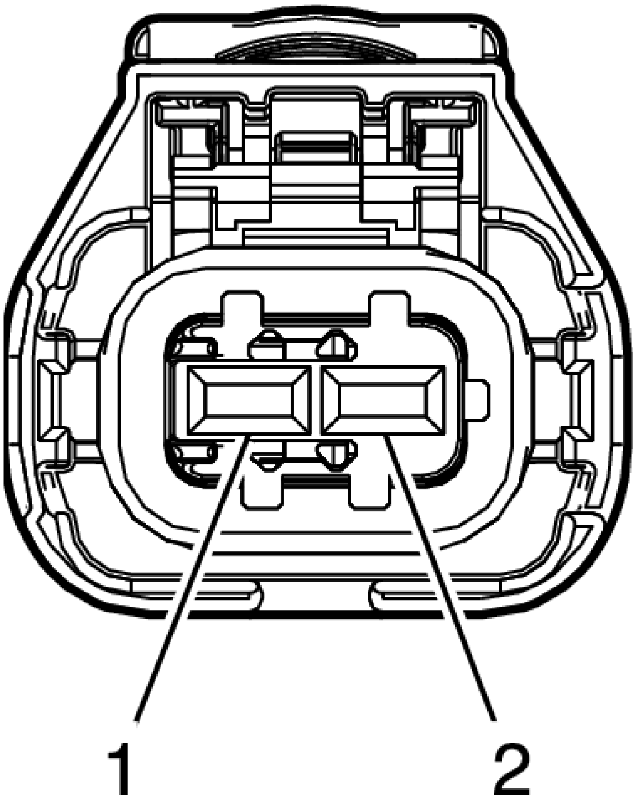
- Harness Type: Body
- OEM Connector: 1928405715
- Service Connector: 19299882
- Description: 2-Way F 2.8 Series, Sealed (BK)

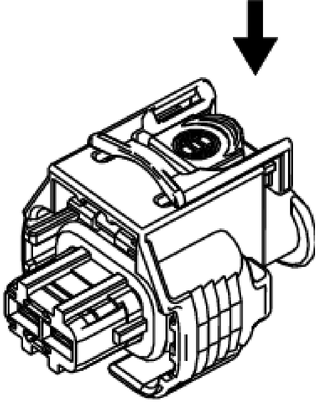
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	WH	2001	Park Brake Motor Apply Left Rear Control	I	-
2	2.5	GY/BK	4369	Park Brake Motor Low Reference Left Rear	I	-

M104R PARK BRAKE ACTUATOR - RIGHT





Connector Part Information

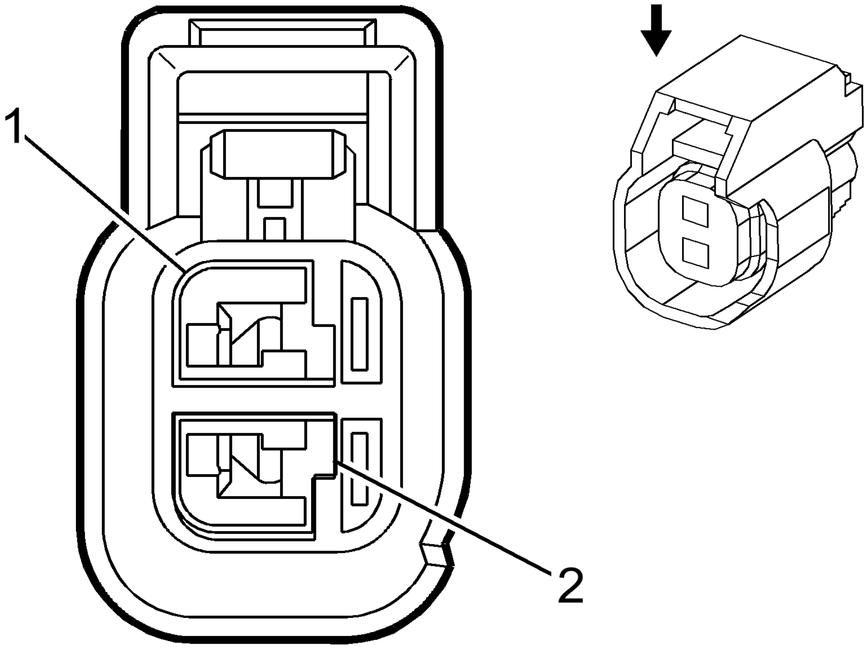
- Harness Type: Body
- OEM Connector: 1928405715
- Service Connector: 19299882
- Description: 2-Way F 2.8 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2.5	GN/VT	1988	Park Brake Motor Apply Right Rear Control	I	-
2	2.5	GY	4368	Park Brake Motor Low Reference Right Rear	I	-

P12L HORN - LEFT



Connector Part Information

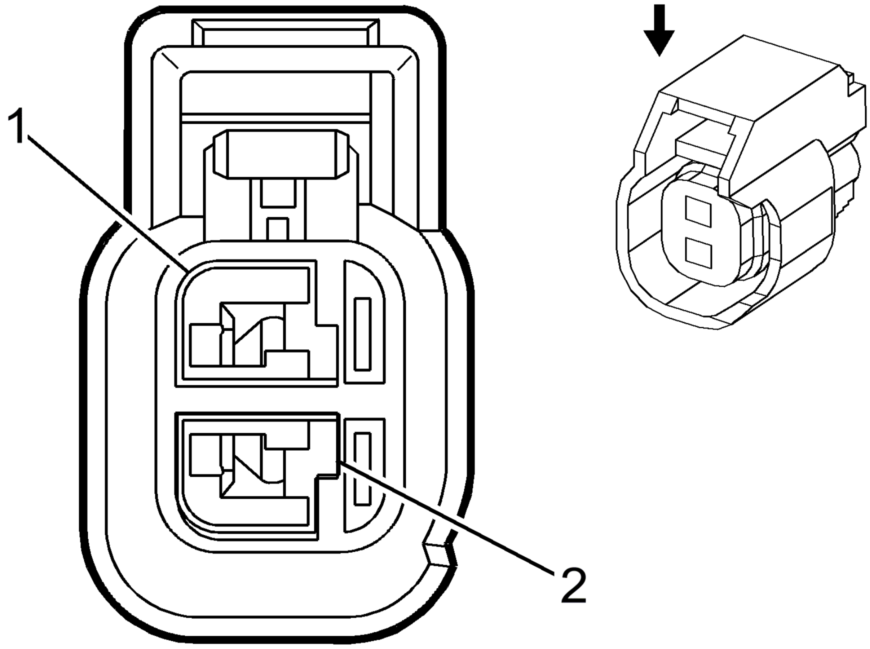
- Harness Type: Forward Lamp
- OEM Connector: E-6171-001
- Service Connector: 13585854
- Description: 2-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	50	Ground	I	-
2	0.75	BN/GY	29	Horn Control	I	-

P12R HORN - RIGHT



Connector Part Information

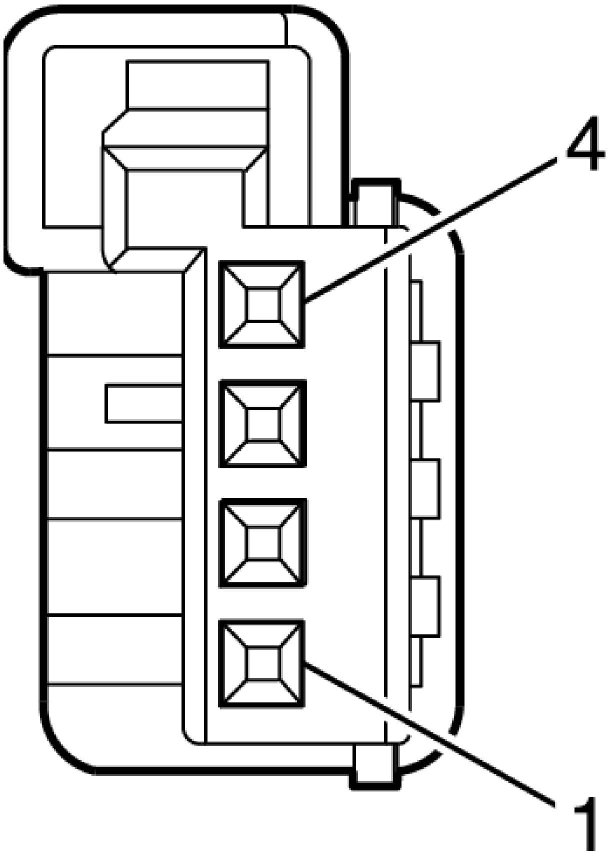
- Harness Type: Forward Lamp
- OEM Connector: E-6171-001
- Service Connector: 13585854
- Description: 2-Way F 150 GT Series, Sealed (BK)

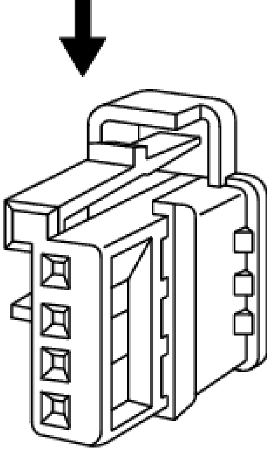
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	BK	250	Ground	I	-
2	1	BN/GY	29	Horn Control	I	-

P14 PASSENGER AIR BAG DISABLED INDICATOR





Connector Part Information

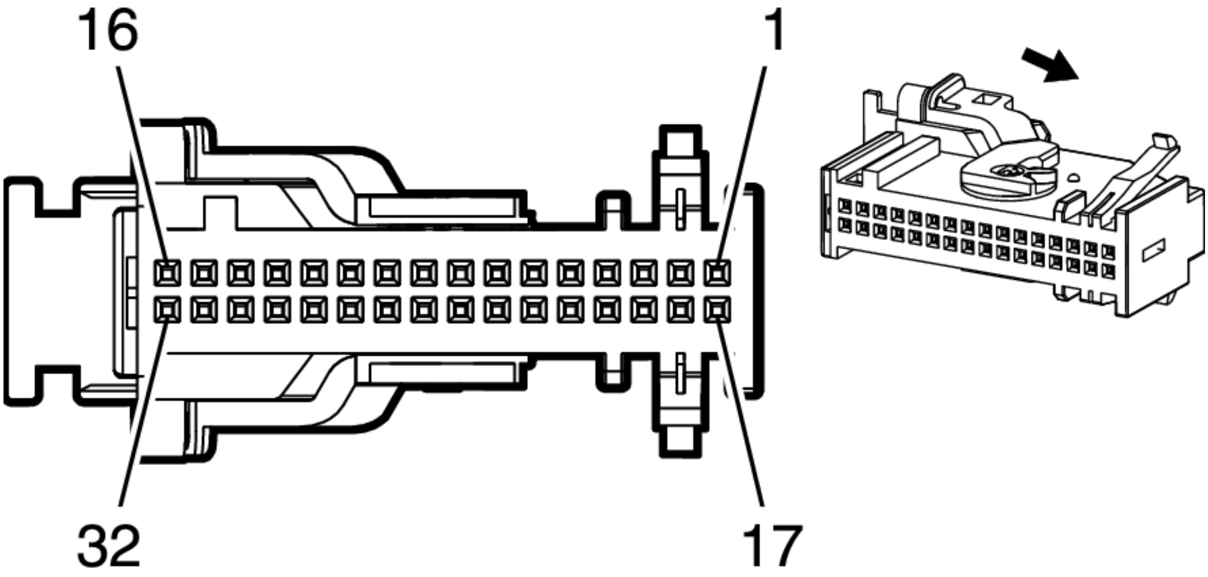
- Harness Type: Headliner
- OEM Connector: 1379029-5
- Service Connector: 19119349
- Description: 4-Way F 0.64 Micro-Quadlock Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	550	Ground	I	AY0/AYF
2	0.35	BU	2307	Passenger Air Bag On Indicator Control	I	-
3	0.35	GN	2308	Passenger Air Bag Off Indicator Control	I	-
4	0.35	VT/WH	5234	Passenger Seat Belt Indicator Control	I	AY0/AYF

P16 INSTRUMENT CLUSTER



Connector Part Information

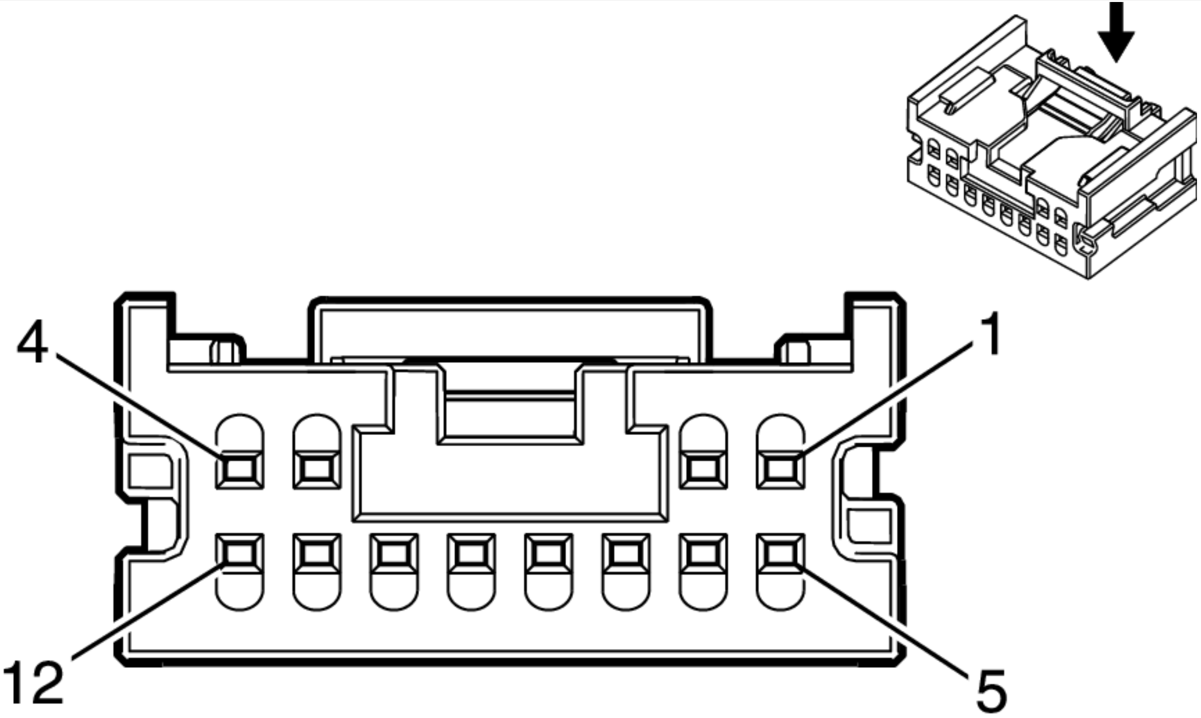
- Harness Type: Instrument Panel
- OEM Connector: 968265-1
- Service Connector: 88988405
- Description: 32-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575859	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN	7217	Ethernet Bus 7 (+)	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	GY/GN	1102	Low Speed GMLAN Serial Data #2	I	-
4 - 6	-	-	-	Not Occupied	-	-
7	0.35	RD/VT	6340	Battery Positive Voltage	I	-
8	0.35	VT/WH	2439	Run/Crank Ignition 1 Voltage	I	-
9 - 11	-	-	-	Not Occupied	-	-
12	0.35	GY/YE	3885	Forward Collision Alert LED Control	I	-
13 - 15	-	-	-	Not Occupied	-	-
16	0.35	BN/WH	419	Check Engine Indicator Control	I	-
17	0.35	WH	7216	Ethernet Bus 7 (-)	I	-
18	-	-	-	Not Occupied	-	-
19	0.35	BK	1250	Ground	I	-
20	0.5	GN/BK	3894	Local Interconnect Network Serial Data Bus 12	I	-
21 - 29	-	-	-	Not Occupied	-	-
30	0.35	WH/GN	3535	Reflected LED Display Dimming Control	I	-
31 - 32	-	-	-	Not Occupied	-	-

P17 INFO DISPLAY MODULE X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 34824-5124
- Service Connector: 13507121
- Description: 12-Way F Mini 50 Series (BK)

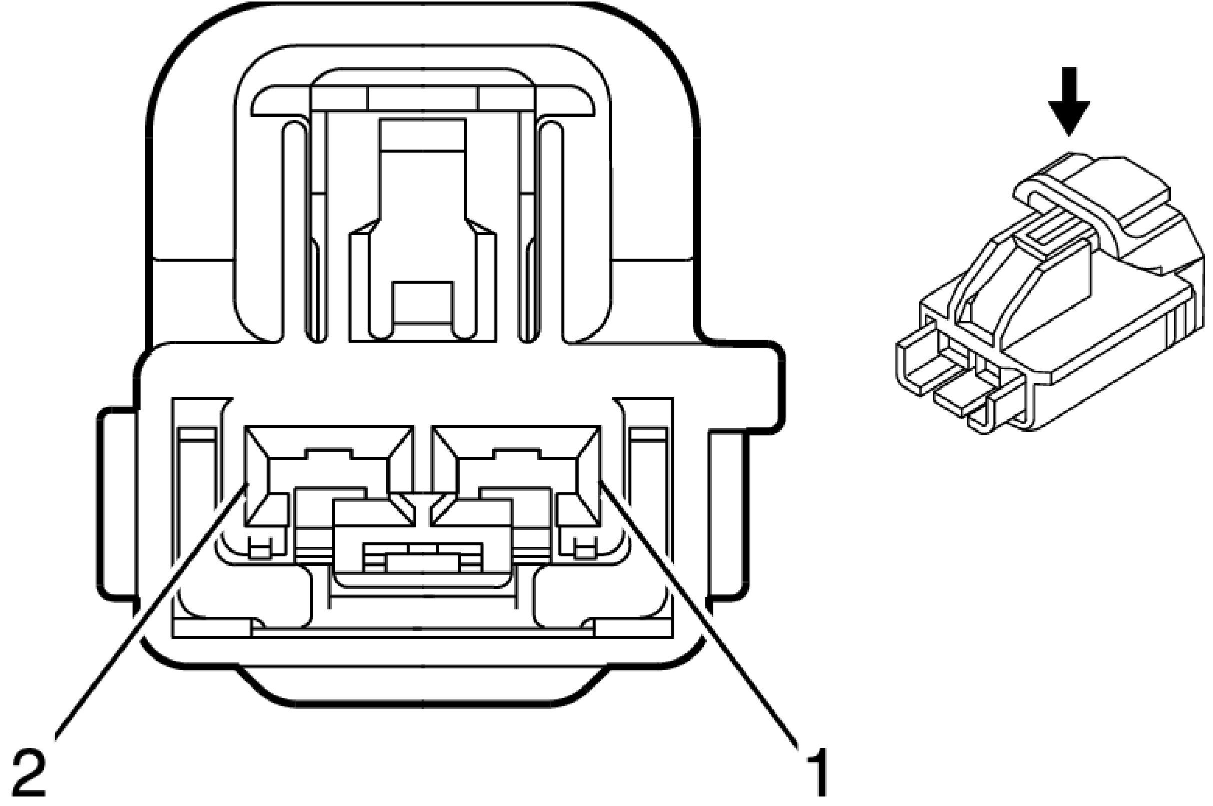
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575568	EL-35616-58 (BK)	No Tool Required	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU/GN	2813	Radio Display Backlight Dimming Control	I	-
2	0.35	WH	2811	Radio Display Diagnostic Signal	I	-
3	0.35	GN/BK	2805	Radio Keypad Ground Return	I	-
4	0.35	BU/RD	2807	Radio Keypad Voltage Reference	I	-
5	0.35	BN	2814	Radio Display Low Voltage Differential Signaling Lock Signal	I	-
6	0.35	GY/VT	2812	Radio Display Low Voltage Differential Signaling Error Signal	I	-
7	0.35	GY/BU	2803	Radio Display Touch Interrupt Request Signal	I	-
8	0.35	BK/GN	2804	Radio Display Backlight Low Reference	I	-
9	0.35	BK/WH	351	Signal Ground	I	-
10	0.35	BK/WH	451	Signal Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.35	BK/YE	2806	Radio Keypad Low Reference	I	-
12	0.35	BU/GY	2808	Radio Keypad Dimming Control	I	-

P19AC SPEAKER - SUBWOOFER (UQA)



Connector Part Information

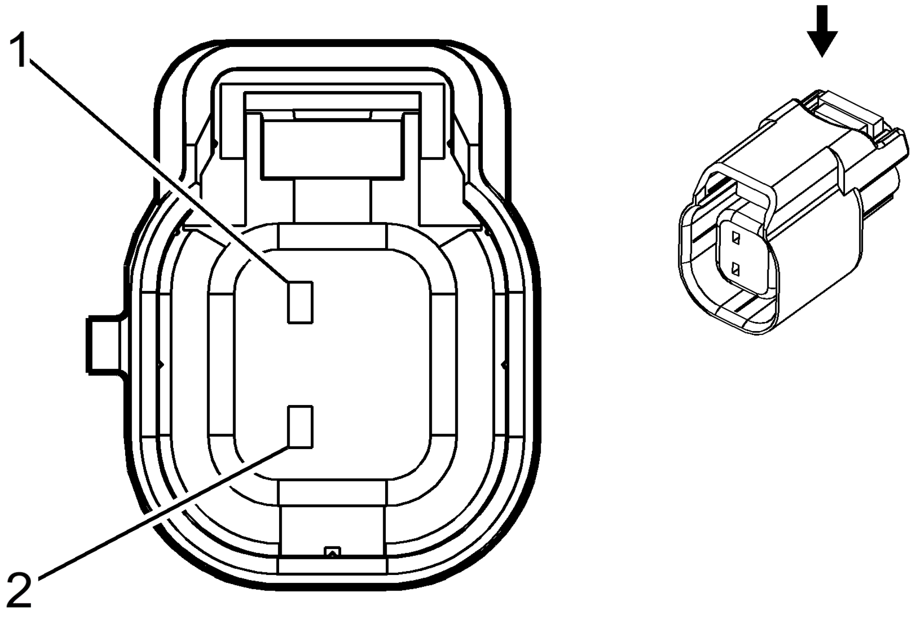
- Harness Type: Body
- OEM Connector: 7283-6445-40
- Service Connector: 19301720
- Description: 2-Way F YESC Kaizen Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	2	GN/BK	1794	Left/Rear Subwoofer Speaker (-) Low Reference	I	UQA
2	2	BU/GY	346	Left/Rear Subwoofer Speaker Control (+)	I	UQA

P19AG SPEAKER - LEFT FRONT DOOR (UQ3)



Connector Part Information

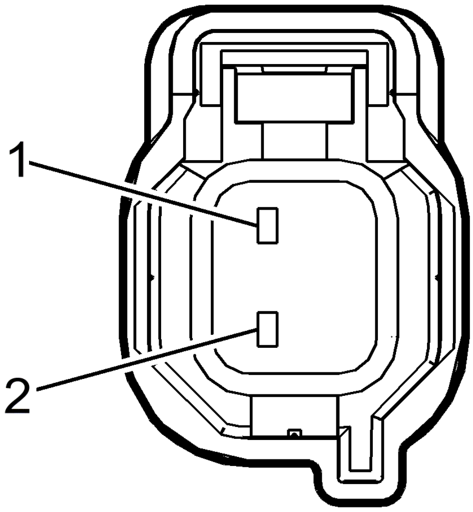
- Harness Type: Driver Door
- OEM Connector: 34062-0046
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

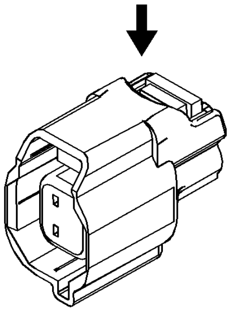
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/BU	118	Left Front Speaker Signal (-) 1	I	UQ3
2	0.75	BU	201	Left Front Speaker Control (+) 1	I	UQ3

P19AG SPEAKER - LEFT FRONT DOOR (UQA)





Connector Part Information

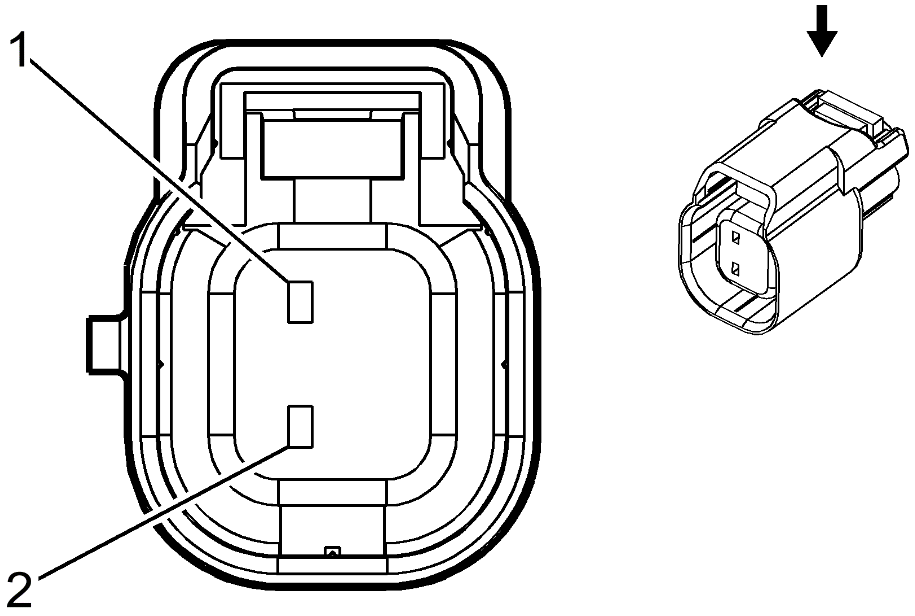
- Harness Type: Driver Door
- OEM Connector: 34062-0022
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/BU	118	Left Front Speaker Signal (-) 1	I	UQA
2	0.75	BU	201	Left Front Speaker Control (+) 1	I	UQA

P19AH SPEAKER - RIGHT FRONT DOOR (UQ3)



Connector Part Information

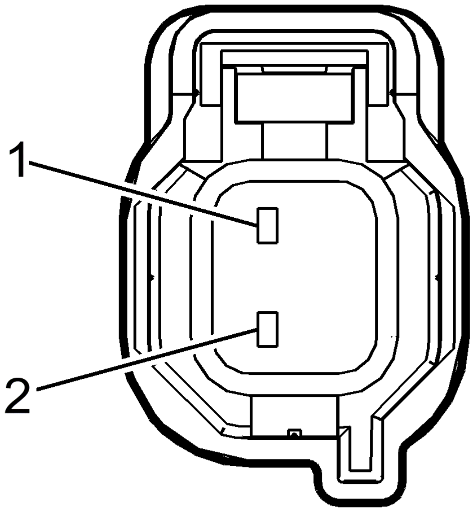
- Harness Type: Passenger Door
- OEM Connector: 34062-0046
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

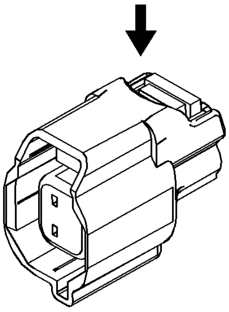
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	YE/BK	117	Right Front Speaker Signal (-) 1	I	UQ3
2	0.75	YE	200	Right Front Speaker Control (+) 1	I	UQ3

P19AH SPEAKER - RIGHT FRONT DOOR (UQA)





Connector Part Information

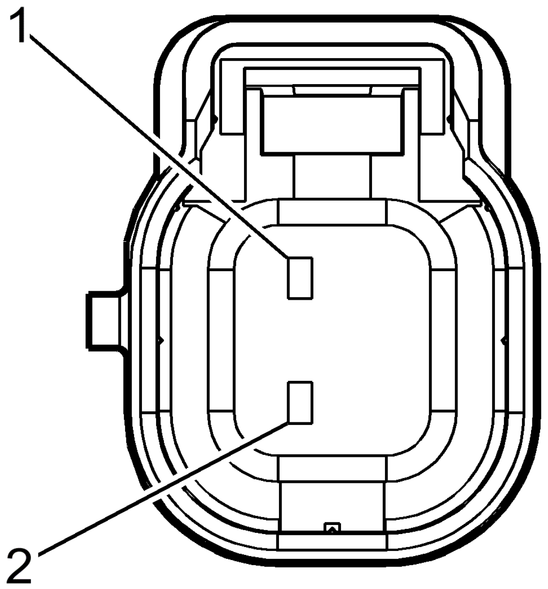
- Harness Type: Passenger Door
- OEM Connector: 34062-0022
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

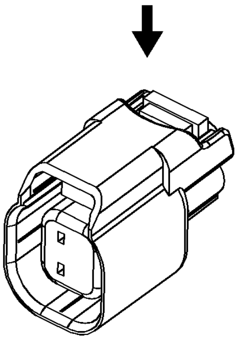
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	YE/BK	117	Right Front Speaker Signal (-) 1	I	UQA
2	0.75	YE	200	Right Front Speaker Control (+) 1	I	UQA

P19AL SPEAKER - LEFT REAR DOOR (UQ3)





Connector Part Information

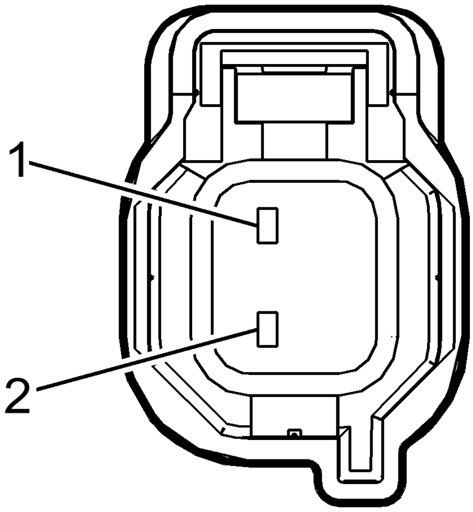
- Harness Type: Left Rear Door
- OEM Connector: 34062-0046
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

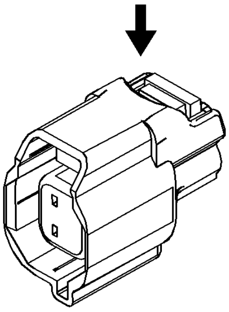
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GN/BK	116	Left Rear Speaker Signal (-)	I	UQ3
2	0.75	GN	199	Left Rear Speaker Control (+)	I	UQ3

P19AL SPEAKER - LEFT REAR DOOR (UQA)





Connector Part Information

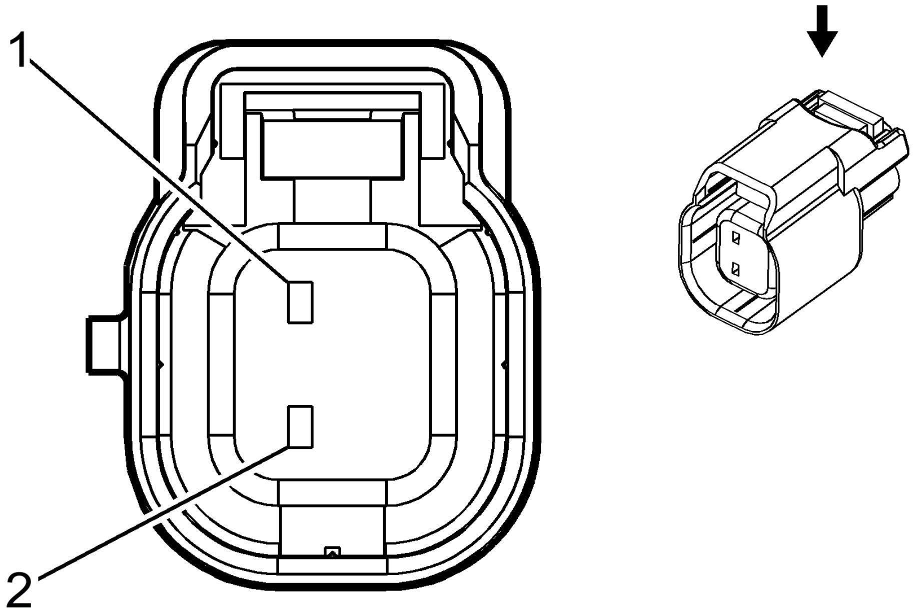
- Harness Type: Left Rear Door
- OEM Connector: 34062-0022
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	GN/BK	116	Left Rear Speaker Signal (-)	I	UQA
2	0.75	GN	199	Left Rear Speaker Control (+)	I	UQA

P19AM SPEAKER - RIGHT REAR DOOR (UQ3)



Connector Part Information

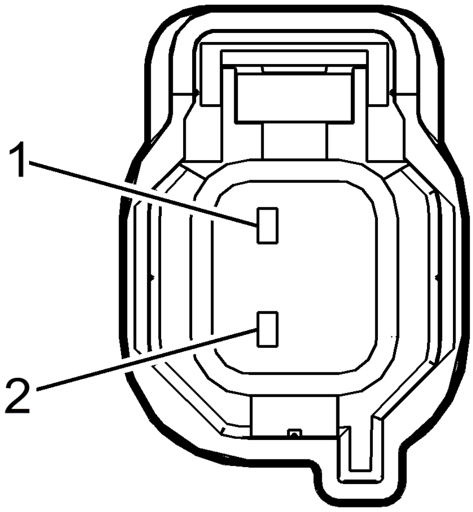
- Harness Type: Right Rear Door
- OEM Connector: 34062-0046
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)

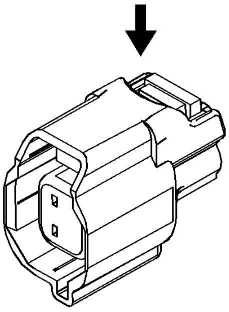
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BU/BK	115	Right Rear Speaker Signal (-)	I	UQ3
2	0.75	WH	46	Right Rear Speaker Control (+)	I	UQ3

P19AM SPEAKER - RIGHT REAR DOOR (UQA)





Connector Part Information

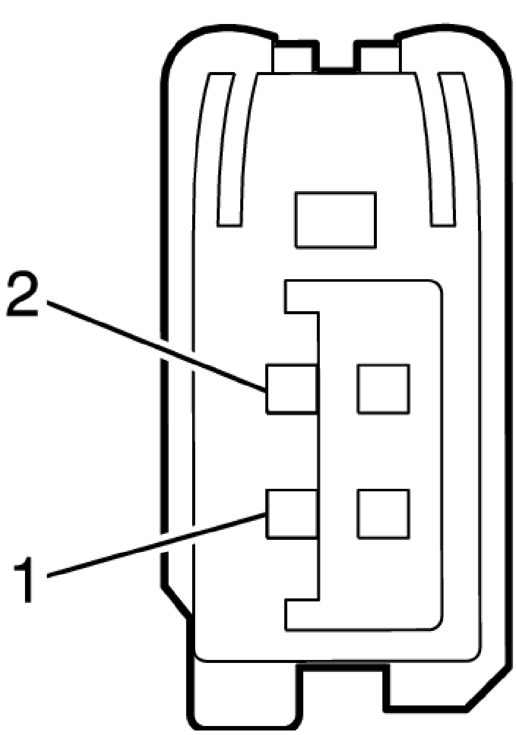
- Harness Type: Right Rear Door
- OEM Connector: 34062-0022
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (L-GY)

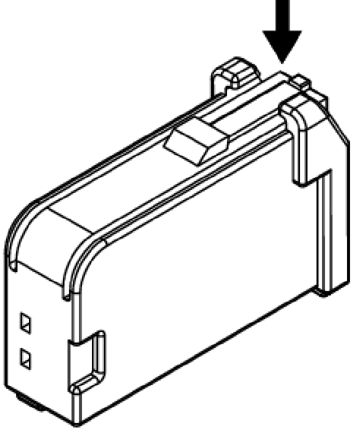
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BU/BK	115	Right Rear Speaker Signal (-)	I	UQA
2	0.75	WH	46	Right Rear Speaker Control (+)	I	UQA

P19H SPEAKER - LEFT FRONT TWEETER (UQA)





Connector Part Information

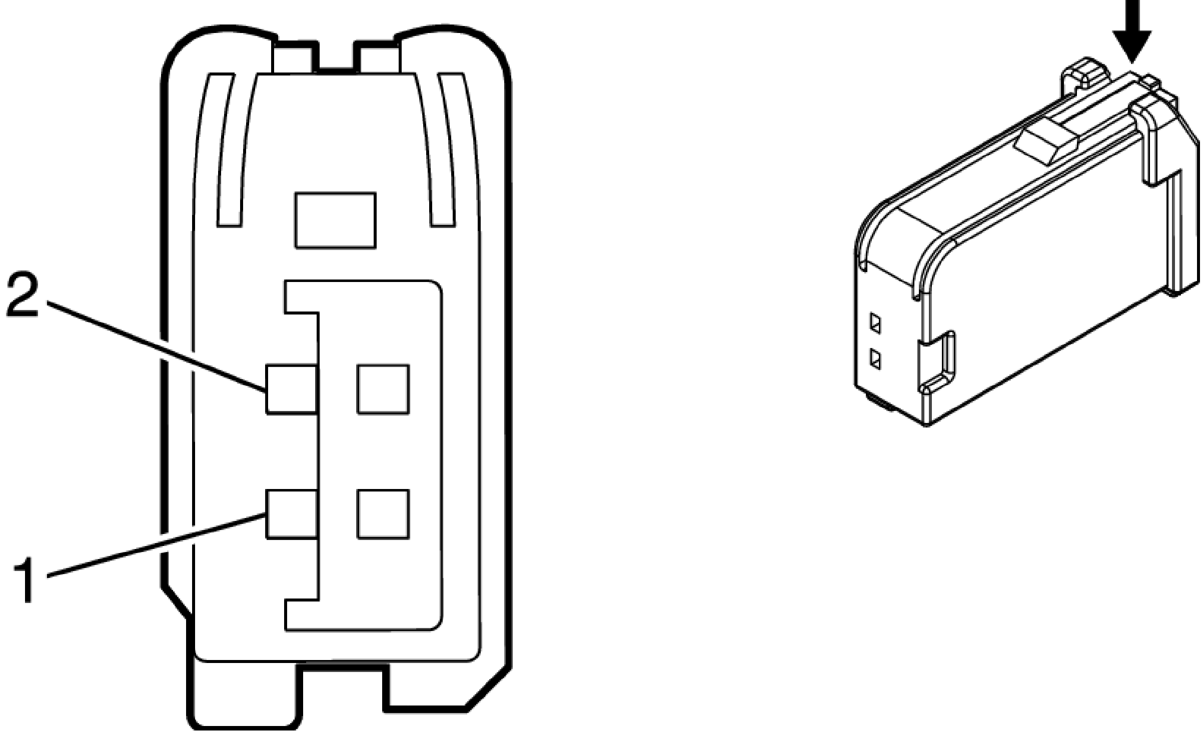
- Harness Type: Instrument Panel
- OEM Connector: AIT2PB-02G-1AK
- Service Connector: 13585901
- Description: 2-Way F 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BN/BU	118	Left Front Speaker Signal (-) 1	I	-
2	0.75	BU	201	Left Front Speaker Control (+) 1	I	-

P19V SPEAKER - RIGHT FRONT TWEETER (UQA)



Connector Part Information

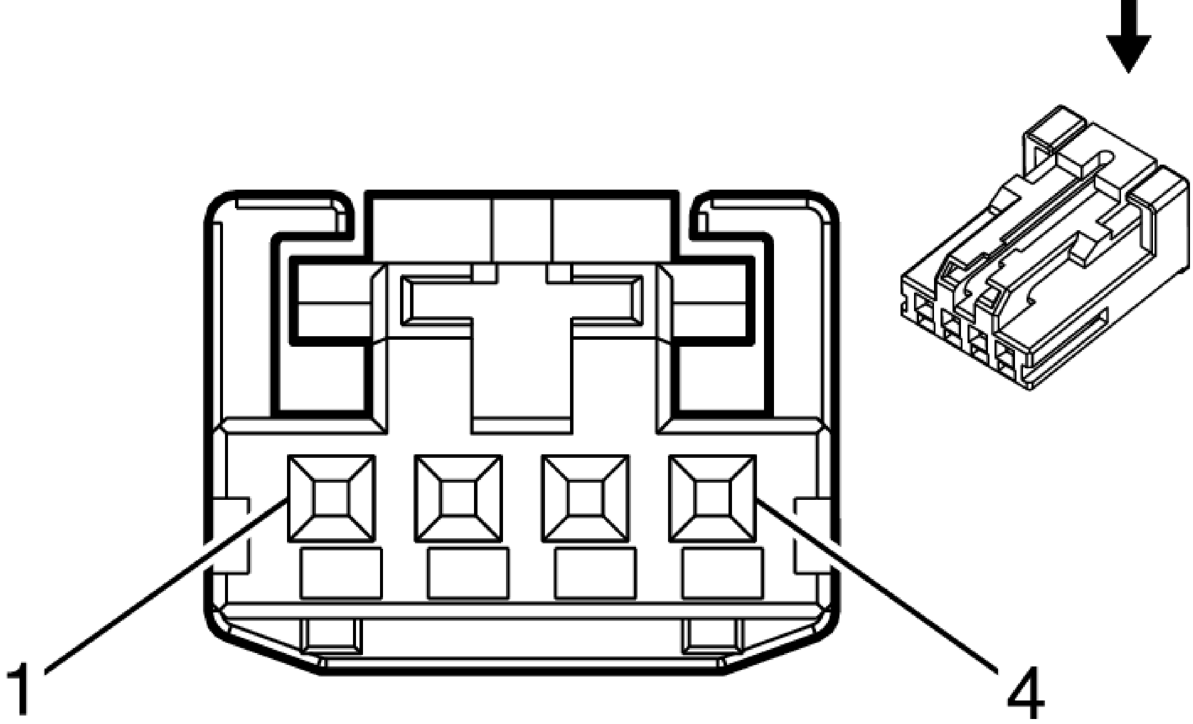
- Harness Type: Instrument Panel
- OEM Connector: AIT2PB-02G-1AK
- Service Connector: 13585901
- Description: 2-Way F 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	YE/BK	117	Right Front Speaker Signal (-) 1	I	-
2	0.75	YE	200	Right Front Speaker Control (+) 1	I	-

P43 COLLISION ALERT INDICATORS (UEU/UHX/UHY/UVX)



Connector Part Information

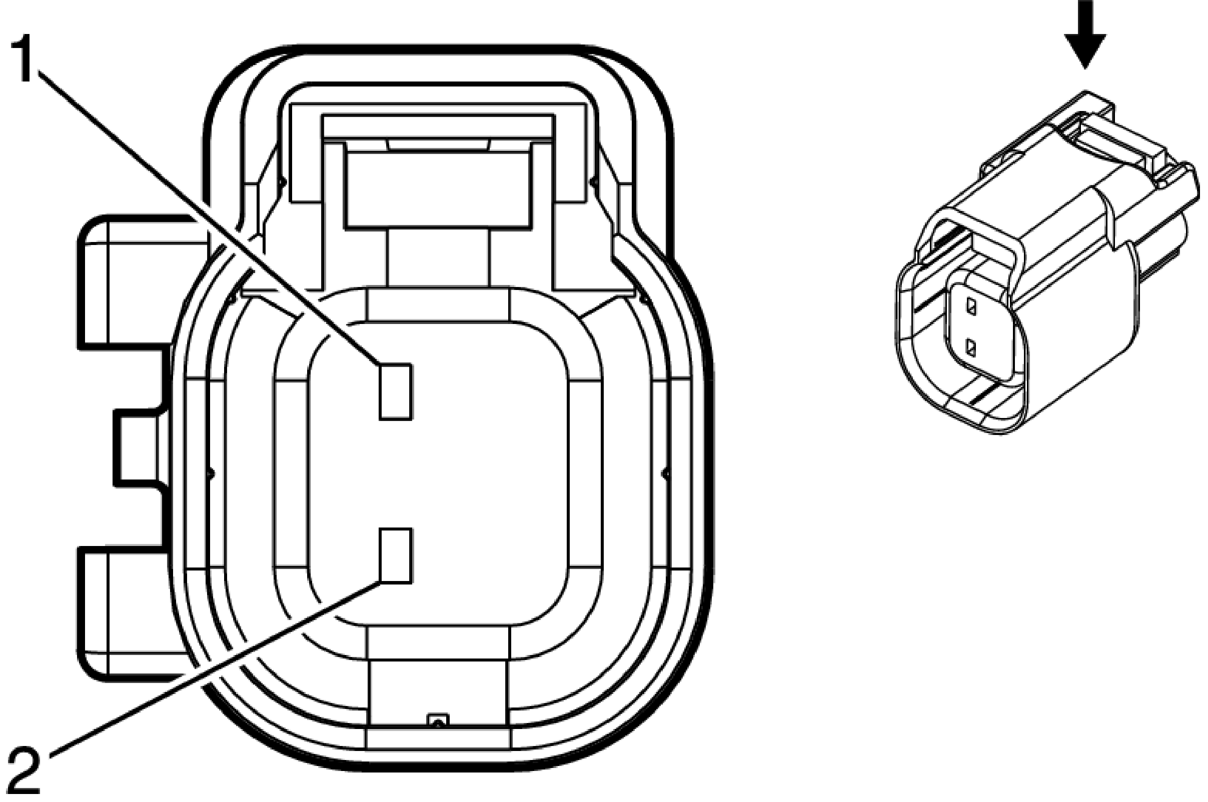
- Harness Type: Instrument Panel
- OEM Connector: 936119-1
- Service Connector: 13587297
- Description: 4-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT/BK	2139	Run/Crank Ignition 1 Voltage	I	-
2	0.35	GY/YE	3885	Forward Collision Alert LED Control	I	-
3	0.35	WH/GN	3535	Reflected LED Display Dimming Control	I	-
4	0.5	BK	1250	Ground	I	-

P48 PEDESTRIAN ALERT SOUND SPEAKER



Connector Part Information

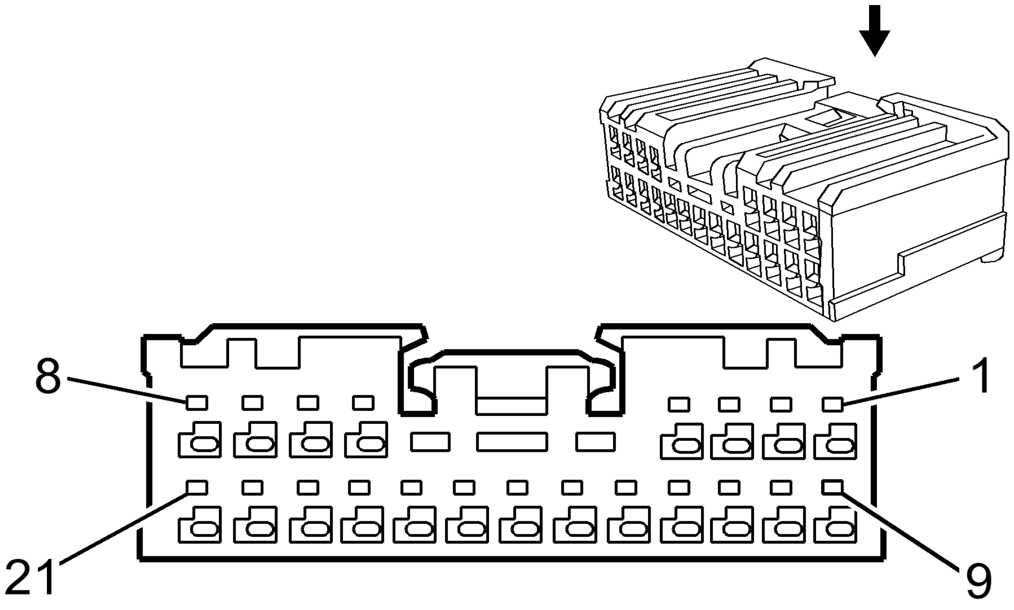
- Harness Type: Forward Lamp
- OEM Connector: 34062-0033
- Service Connector: 19332516
- Description: 2-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/GN	4338	Pedestrian Friendly Alert Speaker Control (+)	I	-
2	0.5	VT/BN	4337	Pedestrian Friendly Alert Speaker Control (-)	I	-

S3 TRANSMISSION SHIFT LEVER



Connector Part Information

- Harness Type: Floor Console
- OEM Connector: ATLCPB-21-2BH
- Service Connector: Service by Harness - See Part Catalog
- Description: 21-Way F 0.64 Series (GY)

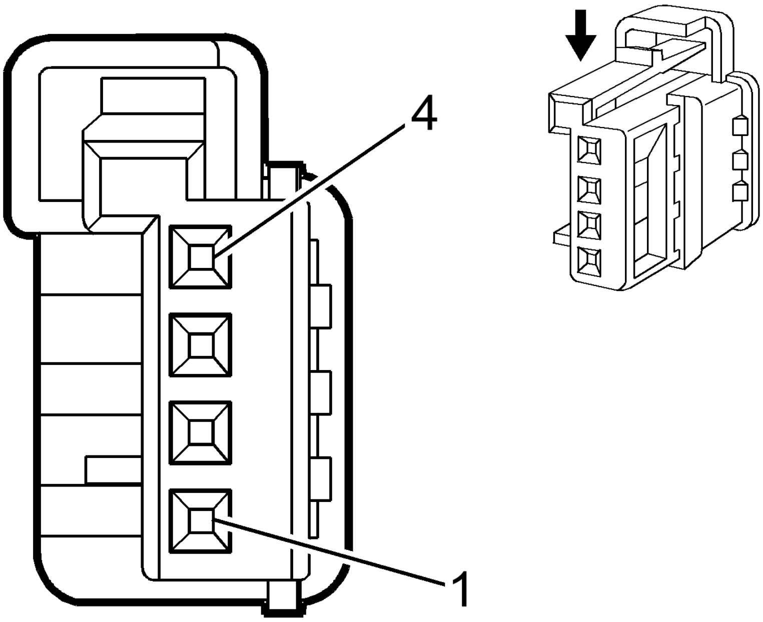
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/BU	2633	Transmission Shifter Position Sensor 2 Alpha Signal	I	-
2	0.5	BK/GN	2636	Transmission Shifter Position Sensor 2 Low Reference	I	-
3	0.5	PU/BU	2634	Transmission Shifter Position Sensor 2 Beta Signal	I	-
4	0.5	GN/RD	2635	Transmission Shifter Position Sensor 2 Voltage Reference	I	-
5	-	-	-	Not Occupied	-	-
6	0.5	RD/GN	1840	Battery Positive Voltage	I	-
7	0.5	GN/GY	4120	Local Interconnect Network Serial Data Bus 20	I	-
8	0.35	BK	1650	Ground	I	-
9	0.5	PU/GN	2629	Transmission Shifter Park Position Switch 1 Signal	I	-
10	0.5	BK/GY	2630	Transmission Shifter Park Position Switch 1 Return	I	-
11	0.5	WH/GY	2631	Transmission Shifter Park Position Switch 2 Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.5	BK/PU	2632	Transmission Shifter Park Position Switch 2 Return	I	-
13	0.5	BU/RD	2646	Transmission Shifter Position Sensor 1 Voltage Reference	I	-
14	0.5	YE/BN	2644	Transmission Shifter Position Sensor 1 Alpha Signal	I	-
15	0.5	BK/BU	2647	Transmission Shifter Position Sensor 1 Low Reference	I	-
16	0.5	PU/BN	2645	Transmission Shifter Position Sensor 1 Beta Signal	I	-
17	-	-	-	Not Occupied	-	-
18	0.5	BK/BN	2649	Transmission Shift Interlock Switch 1 Return	I	-
19	0.5	WH	2648	Transmission Shift Interlock Switch 1 Signal	I	-
20	0.5	BK/GN	2655	Transmission Shift Interlock Switch 2 Return	I	-
21	0.5	WH/GN	2654	Transmission Shift Interlock Switch 2 Signal	I	-

S13D DOOR LOCK SWITCH - DRIVER



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: 1379029-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 Micro-Quadlock Series (WH)

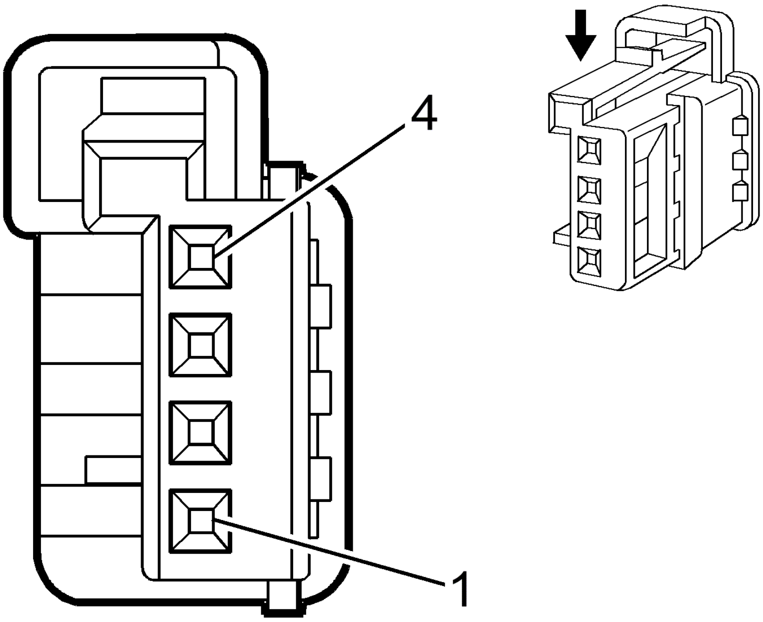
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE	6817	LED Backlight Dimming Control	I	-
2	0.5	BN/YE	780	Driver Door Lock Switch Lock Signal	I	-
3	0.5	BN/WH	781	Driver Door Lock Switch Unlock Signal	I	-
4	0.5	BK	550	Ground	I	-

S13P DOOR LOCK SWITCH - PASSENGER



Connector Part Information

- Harness Type: Passenger Door
- OEM Connector: 1379029-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 Micro-Quadlock Series (WH)

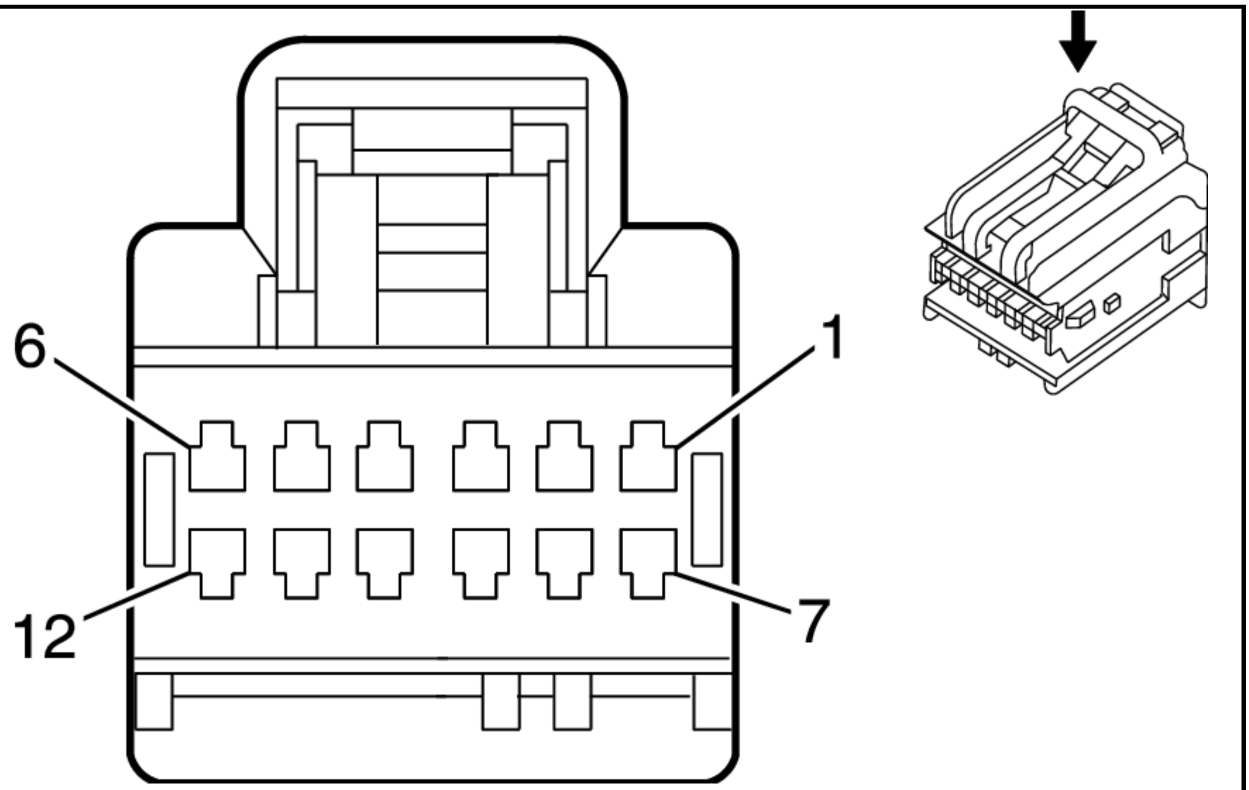
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE	6817	LED Backlight Dimming Control	I	-
2	0.5	YE/VT	244	Passenger Door Lock Switch Lock Control	I	-
3	0.5	BN/VT	245	Passenger Door Lock Switch Unlock Control	I	-
4	0.5	BK	750	Ground	I	-

S30 HEADLAMP SWITCH



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-1120
- Service Connector: 89047364
- Description: 12-Way F 0.64 Series, Sealed (BK)

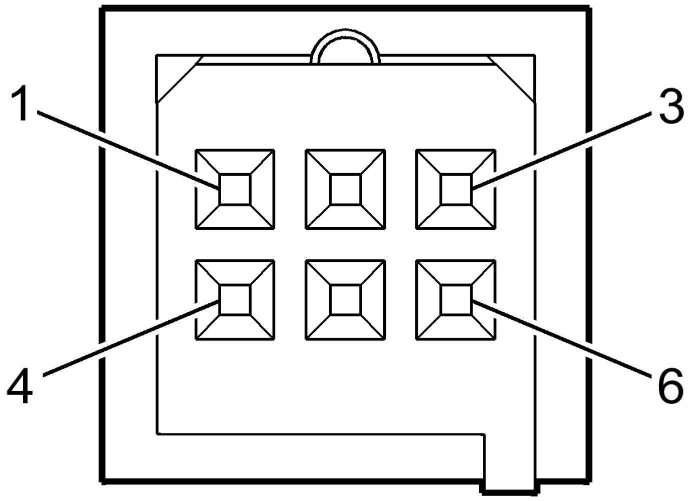
Terminal Part Information

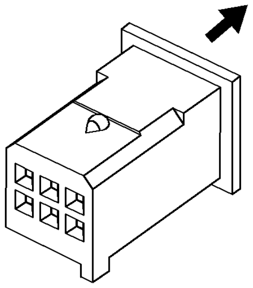
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH/VT	103	Headlamp Switch On Signal	I	-
2	0.35	YE	6817	LED Backlight Dimming Control	I	-
3	0.35	GN/BN	306	Headlamp Switch Headlamps Off Signal Control	I	-
4	0.5 0.35	VT/GN VT/GN	2639 2639	Run/Crank Ignition 1 Voltage Run/Crank Ignition 1 Voltage	I I	TR6 -TR6

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	0.35	GN/GY	13	Headlamp Switch Park Lamp Signal	I	-
6	0.35	BU/GY	187	Rear Fog Lamp Switch Signal	I	-
7	0.35	BK/YE	5005	Instrument Panel Lamp Dimmer Switch Low Reference	I	-
8	0.5	BK	1250	Ground	I	-
9	0.5	BN/YE	189	Headlamp Leveling Motor Control	I	TR6
10	-	-	-	Not Occupied	-	-
11	0.35	YE/GY	44	Instrument Panel Lamp Dimmer Switch Signal	I	-
12	0.35	BU/RD	1688	5V Reference	I	-

S32LR SEAT HEATING SWITCH - LEFT REAR (KA6)





Connector Part Information

- Harness Type: Left Rear Door
- OEM Connector: 1-968291-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	550	Ground	I	KA6

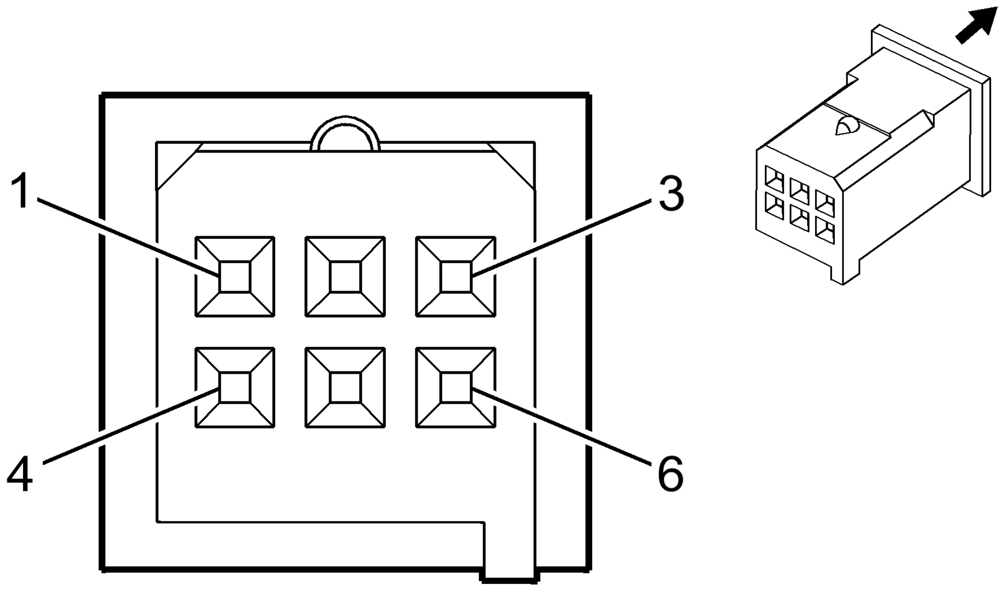
Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.5	YE	6817	LED Backlight Dimming Control	I	KA6
3	0.5	BN/WH	1637	Left Rear Heated Seat Switch Signal	I	KA6
4	0.5	WH	1638	Left Rear Heated Seat High Indicator Control	I	KA6
5	-	-	-	Not Occupied	-	-
6	0.5	WH	6816	Indicator Dimming Control	I	KA6

Back To Article

Wiring Systems and Power Management - Component Locator - Component Connector End Views - Bolt EV

COMPONENT CONNECTOR END VIEWS

S32RR SEAT HEATING SWITCH - RIGHT REAR



Connector Part Information

- Harness Type: Right Rear Door
- OEM Connector: 1-968291-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	750	Ground	I	KA6
2	0.5	YE	6817	LED Backlight Dimming Control	I	-
3	0.5	BN/GN	1634	Right Rear Heated Seat Switch Signal	I	KA6
4	0.5	BN/WH	1635	Right Rear Heated Seat High Indicator Control	I	KA6

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	-	-	-	Not Occupied	-	-
6	0.5	WH	6816	Indicator Dimming Control	I	-

S33 HORN SWITCH

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Connector Part Information

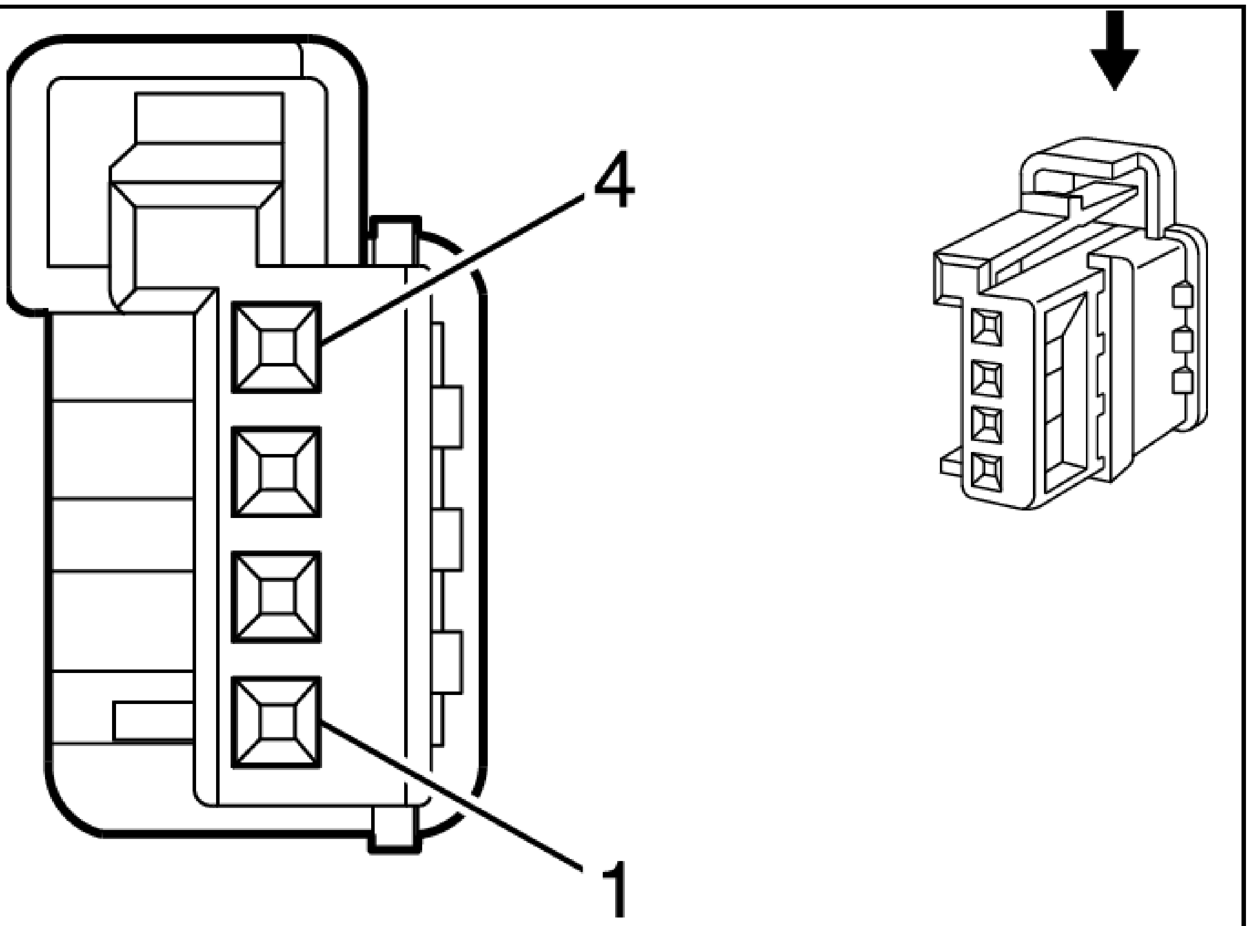
- Harness Type: Steering Wheel Harness
- OEM Connector: 19179817
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	RD	3287	Horn Switch Signal	I	-
2	-	BK	1650	Ground	I	-

S40 PASSENGER AIR BAG DISABLE SWITCH (C99)



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 1379029-1

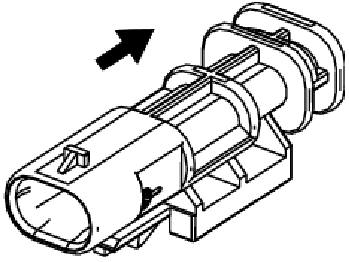
- Service Connector: 13584096
- Description: 4-Way F 0.64 Micro-Quadlock Series (BK)

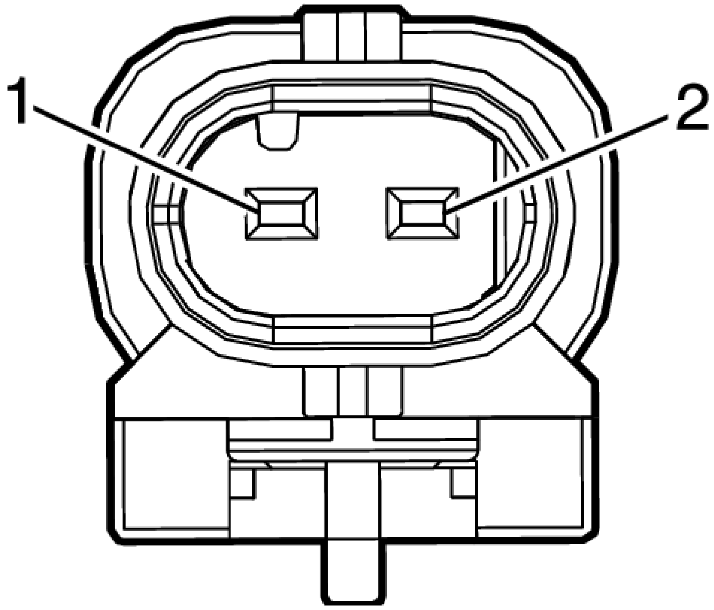
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT/OG	371	Passenger IP Module Disable Switch Signal	I	C99
2	-	-	-	Not Occupied	-	-
3	0.35	BU/OG	7328	Passenger IP Module Disable Switch Low Reference	I	C99
4	-	-	-	Not Occupied	-	-

S46B LIFTGATE UNLATCH SWITCH





Connector Part Information

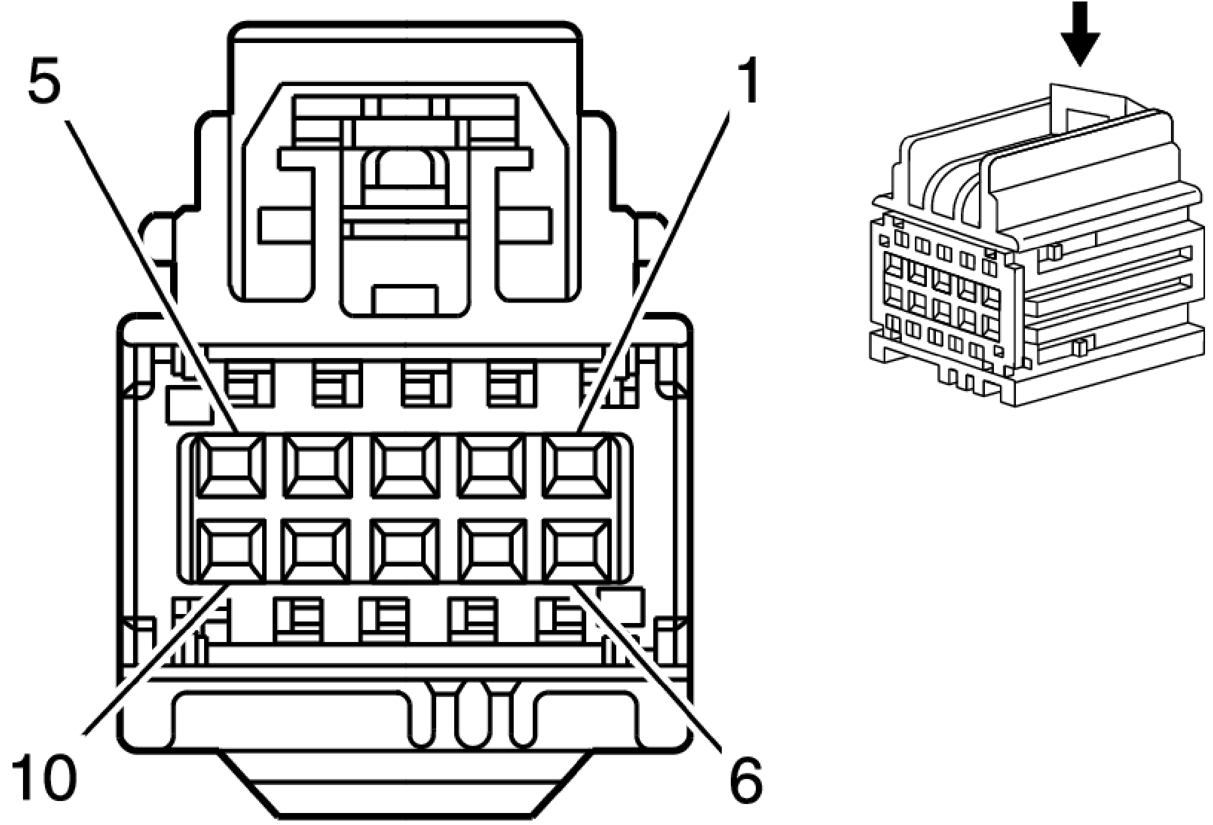
- Harness Type: Liftgate Pigtail
- OEM Connector: 13505427
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way M 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	YE/BU	5797	Rear Closure Handle Switch Open Signal	I	-
2	-	BK	1050	Ground	I	-

S48C MULTIFUNCTION SWITCH 1 - INSTRUMENT PANEL



Connector Part Information

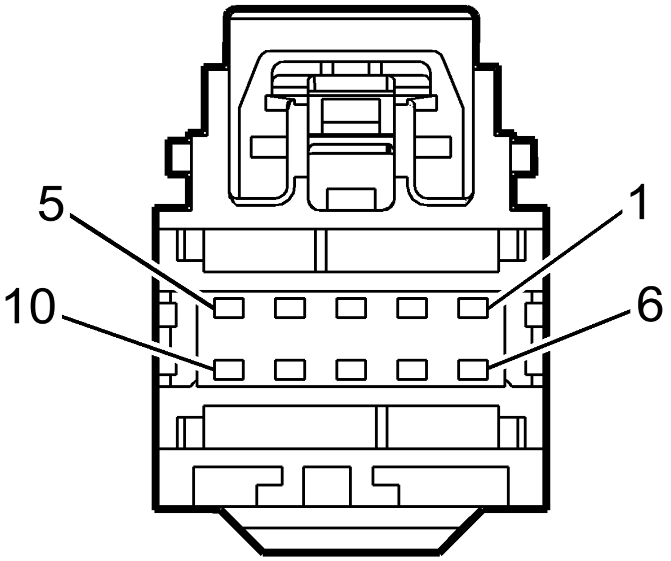
- Harness Type: Instrument Panel
- OEM Connector: 7283-9040-30
- Service Connector: 15127042
- Description: 10-Way F 0.64 YESC Kaizen Series (BK)

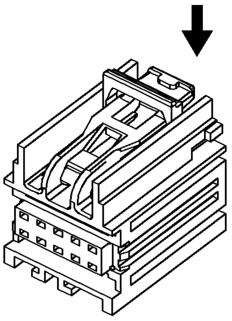
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/WH	111	Hazard Switch Signal	I	-
2	0.35	GY	5054	Sport Mode Switch Signal	I	-
3	0.35	BU/VT	1788	Traction Control Switch Signal 1	I	-
4	0.35	GY/YE	7543	Hazard LED Dimming Signal	I	-
5	0.35	YE	6817	LED Backlight Dimming Control	I	-
6 - 9	-	-	-	Not Occupied	-	-
10	0.5	BK	1450	Ground	I	-

S48D MULTIFUNCTION SWITCH 2 - INSTRUMENT PANEL





Connector Part Information

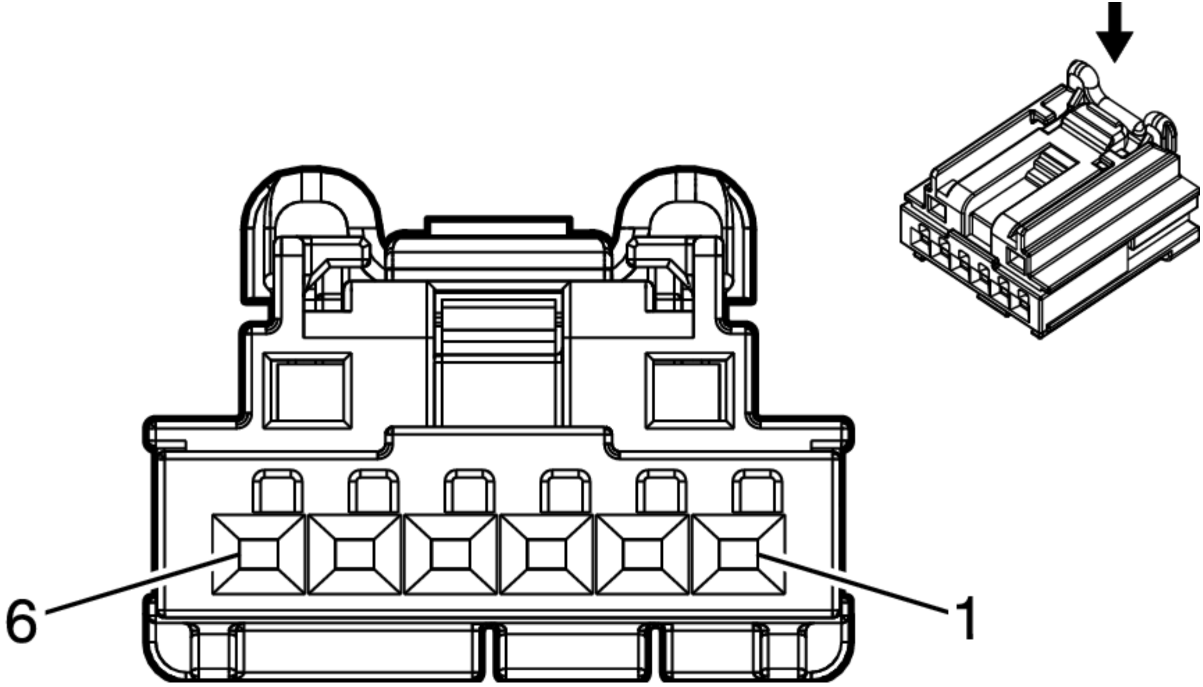
- Harness Type: Instrument Panel
- OEM Connector: 7283-9043-60
- Service Connector: 15127041
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BU/BN	3161	Parallel Park Assist Disable Switch Signal	I	UFQ
2	0.35	GY/GN	2555	Rear Park Assist Disable Signal	I	UD5/UFQ
3	0.35	GY/WH	3153	Lane Departure Warning Disable Switch Signal	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	YE	6817	LED Backlight Dimming Control	I	-
6	0.35	WH	6816	Indicator Dimming Control	I	-
7	0.5	GN/BN	5852	Rear Park Assist LED Disable Signal	I	UD5/UFQ
8	0.35	WH	3152	Lane Departure Warning Indicator Control	I	-
9	-	-	-	Not Occupied	-	-
10	0.5	BK	1450	Ground	I	-

S51 TELEMATICS BUTTON ASSEMBLY (UE1)



Connector Part Information

- Harness Type: Headliner
- OEM Connector: 2035363-4
- Service Connector: 19332786
- Description: 6-Way F 0.64 Generation Y Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/BK	2515	Keypad Control	I	UE1
2	-	-	-	Not Occupied	-	-
3	0.35	GN/WH	2514	Keypad Signal	I	UE1
4	0.35	YE/VT	2516	Keypad Green LED Control	I	UE1
5	0.35	BN/WH	2517	Keypad Red LED Control	I	UE1
6	0.5	BK	550	Ground	I	UE1

S70E STEERING WHEEL CONTROLS SWITCH - RADIO PRESETS

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Connector Part Information

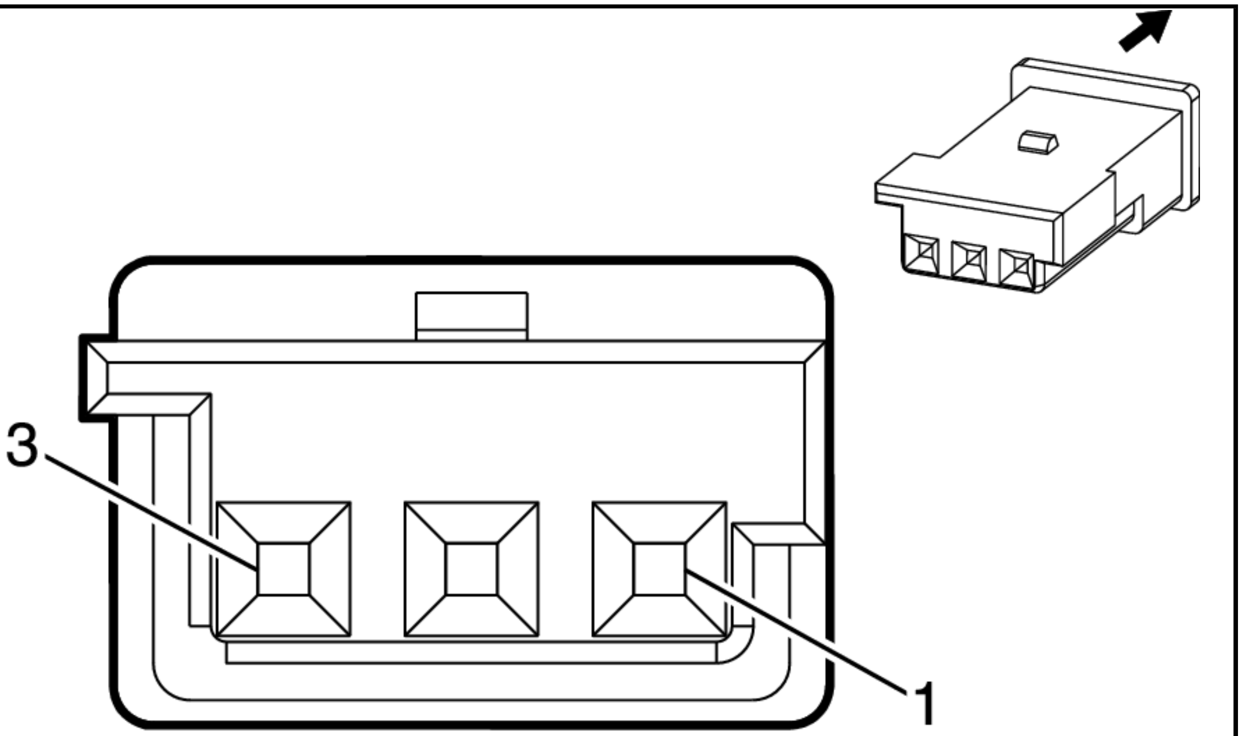
- Harness Type: Steering Wheel Harness
- OEM Connector: 5057-9404
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	- -	BK GN/OG	1650 4313	Ground Radio Favorite Forward Signal	I I	- -
2	-	GY/OG	4312	Radio Favorite Back Signal	I	-
3	-	BK	1650	Ground	I	-
4	-	YE	6817	LED Backlight Dimming Control	I	-

S70F STEERING WHEEL CONTROLS SWITCH - RADIO VOLUME



Connector Part Information

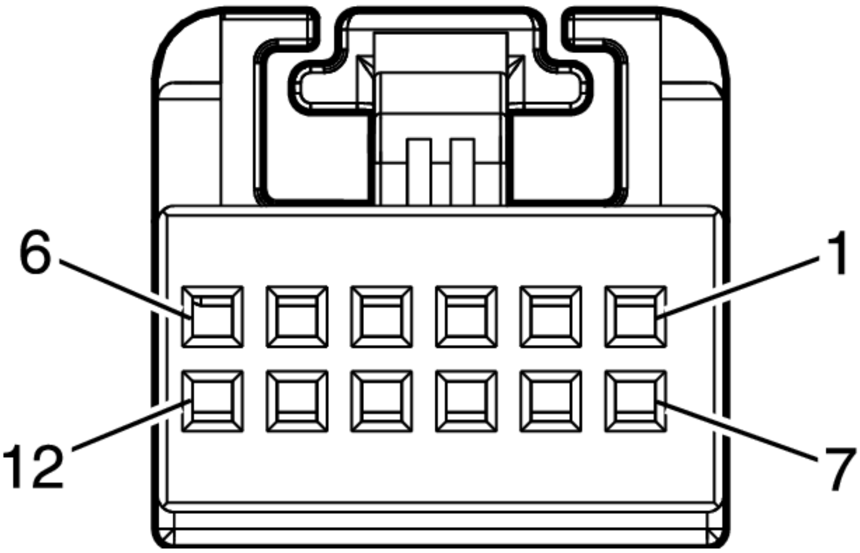
- Harness Type: Steering Wheel Harness
- OEM Connector: 19153569
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F Micro-Quadlock Series (PU)

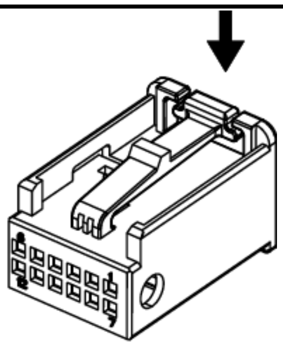
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BK/BU	4315	Radio Volume Up Signal	I	-
2	-	BU/RD	4314	Radio Volume Down Signal	I	-
3	-	BK	1650	Ground	I	-

S70L STEERING WHEEL CONTROLS SWITCH - LEFT





Connector Part Information

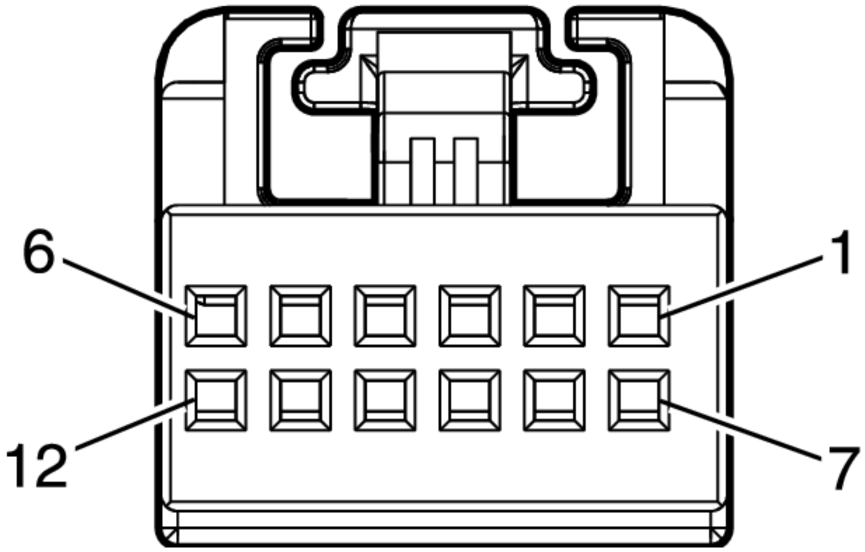
- Harness Type: Steering Wheel Harness
- OEM Connector: 13578796
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F 0.64 GET Series (BK with BK Case)

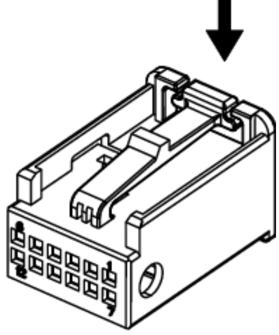
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	1650	Ground	I	-
2	0.35	GY/WH	3153	Lane Departure Warning Disable Switch Signal	I	-
3	0.35	YE/BK	3893	LED Backlight Dimming Control 2	I	-
4	0.35	WH	6816	Indicator Dimming Control	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	RD/YE	5040	Battery Positive Voltage	I	-
7	0.35	BN/WH	5884	Heated Steering Wheel Switch LED Control	I	-
8	0.35	YE/GN	5883	Heated Steering Wheel Switch Signal	I	-
9	0.35	BN/GN	1884	Cruise Control Set/Coast/Resume/Accelerate Switch Signal	I	-
10	-	-	-	Not Occupied	-	-
11	0.35	WH	3152	Lane Departure Warning Indicator Control	I	-
12	0.35	YE	7556	Lighting Control Switch Reference	I	-

S70R STEERING WHEEL CONTROLS SWITCH - RIGHT





Connector Part Information

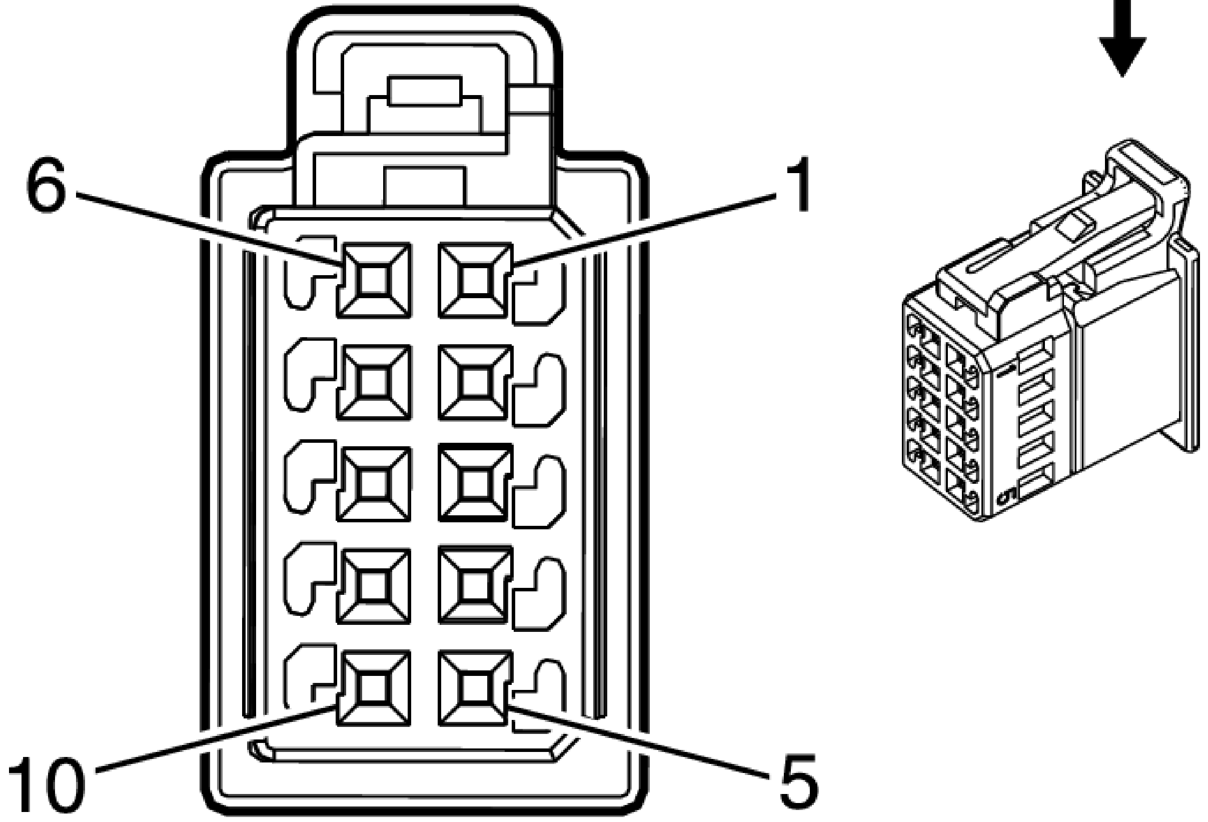
- Harness Type: Steering Wheel Harness
- OEM Connector: 13578796
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F 0.64 GET Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BK	1650	Ground	I	-
2	-	GN/BK	3894	Local Interconnect Network Serial Data Bus 12	I	-
3	-	YE/BK	3893	LED Backlight Dimming Control 2	I	-
4	-	WH	6816	Indicator Dimming Control	I	-
7	-	GN/OG	4313	Radio Favorite Forward Signal	I	-
8	-	GY/OG	4312	Radio Favorite Back Signal	I	-
9	-	BU/RD	4314	Radio Volume Down Signal	I	-
10	-	BK/BU	4315	Radio Volume Up Signal	I	-
12	-	RD/YE	5040	Battery Positive Voltage	I	-

S78 TURN SIGNAL/MULTIFUNCTION SWITCH



Connector Part Information

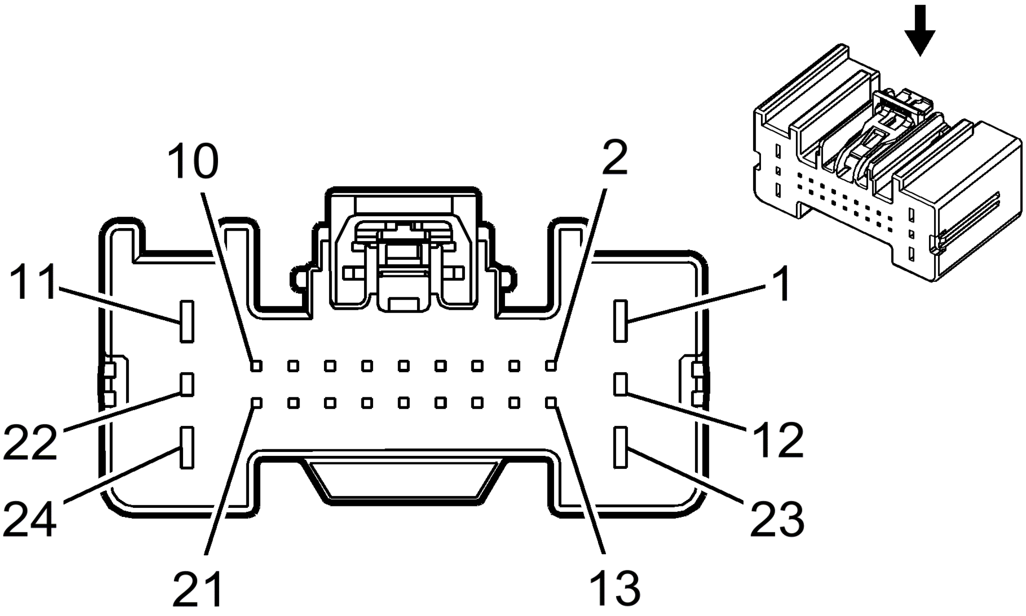
- Harness Type: Instrument Panel
- OEM Connector: 1488973-1
- Service Connector: 19299776
- Description: 10-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575859	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	WH/GN	663	Hazard Switch Left Turn Signal	I	-
2	0.35	VT/BU	664	Hazard Switch Right Turn Signal	I	-
3	0.75	BK	1250	Ground	I	-
4	0.35	BU	6856	Headlamp Automatic High Beam Dim Control	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	YE/BN	307	Headlamp Switch Flash To Pass Signal	I	-
7	0.35	WH	524	Headlamp Dimmer Switch High Beam Signal	I	-
8 - 10	-	-	-	Not Occupied	-	-

S79D WINDOW SWITCH - DRIVER



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: 7287-3260-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 24-Way F 0.64, 1.5, 2.8 Series (BK)

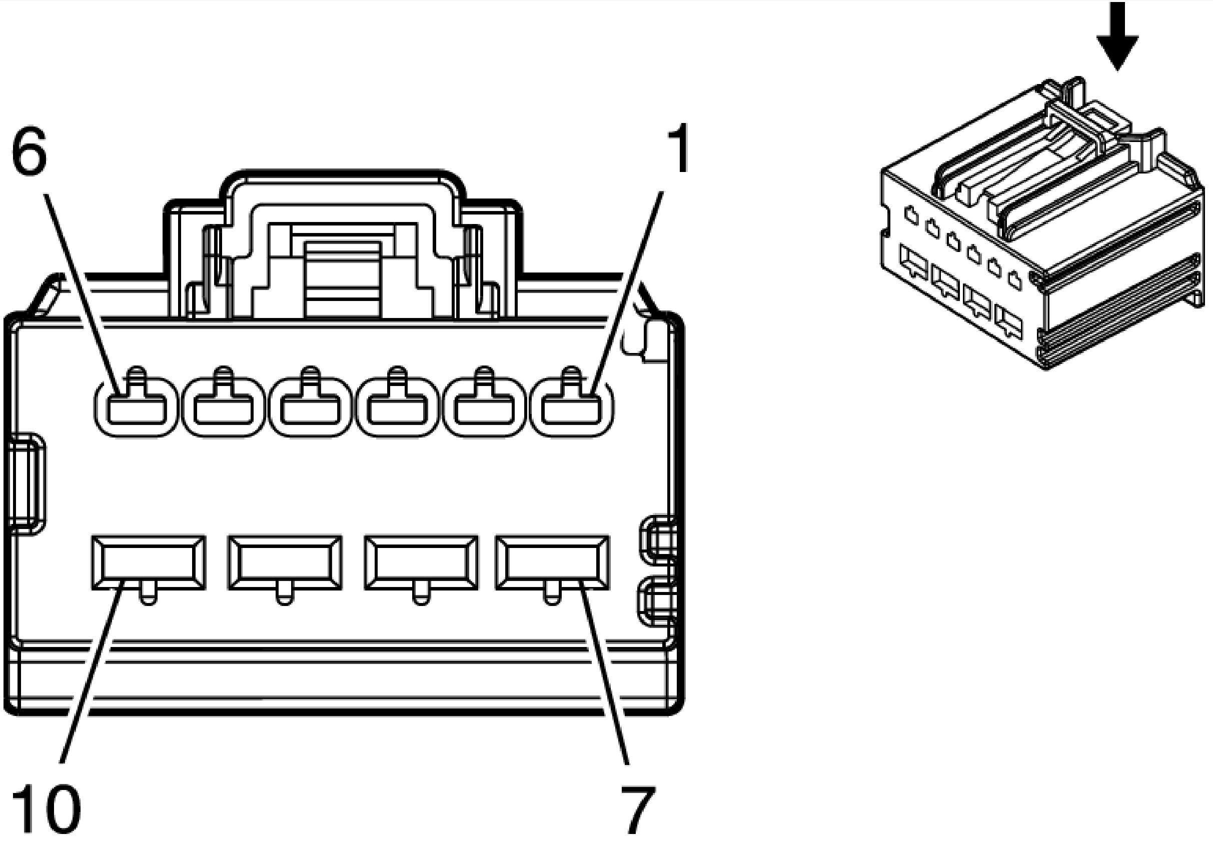
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY	3380	Power Window Switch Driver Down Signal	II	-
2	0.5	YE/VT	3397	Passenger Mirror Motor Up (+) Down (-) Control	III	-
3	0.5	WH	3398	Passenger Mirror Motor Common Control	III	-
4	0.5	GN/BK	3396	Passenger Mirror Motor Right (+) Left (-) Control	III	-
5	0.5	GN	3381	Power Window Switch Driver Express Signal	III	-
6	0.5	BN/BK	3389	Driver Mirror Motor Right (+) Left (-) Control	III	-
7	0.5	VT/BU	3390	Driver Mirror Motor Up (+) Down (-) Control	III	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.5	YE/BN	3391	Driver Mirror Motor Common Control	III	-
9	0.5	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	III	-
10	-	-	-	Not Occupied	-	-
11	0.5	GN/WH	3379	Power Window Switch Driver Up Signal	II	-
12	0.5	WH/BN	3410	Mirror Motor Fold In Control	I	DLR
13	-	-	-	Not Occupied	-	-
14	0.35	WH/VT	3270	Driver Door Lock Motor Status Signal	III	-
15	0.35	BU/VT	1124	Door Lock Key Switch Unlock Signal	III	-
16 - 21	-	-	-	Not Occupied	-	-
22	0.5	VT/YE	3409	Mirror Motor Fold Out Control	I	DLR
23	0.5	RD/GN	1540	Battery Positive Voltage	II	-
24	0.5	BK	550	Ground	II	-

S79LR WINDOW SWITCH - LEFT REAR



Connector Part Information

- Harness Type: Left Rear Door
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

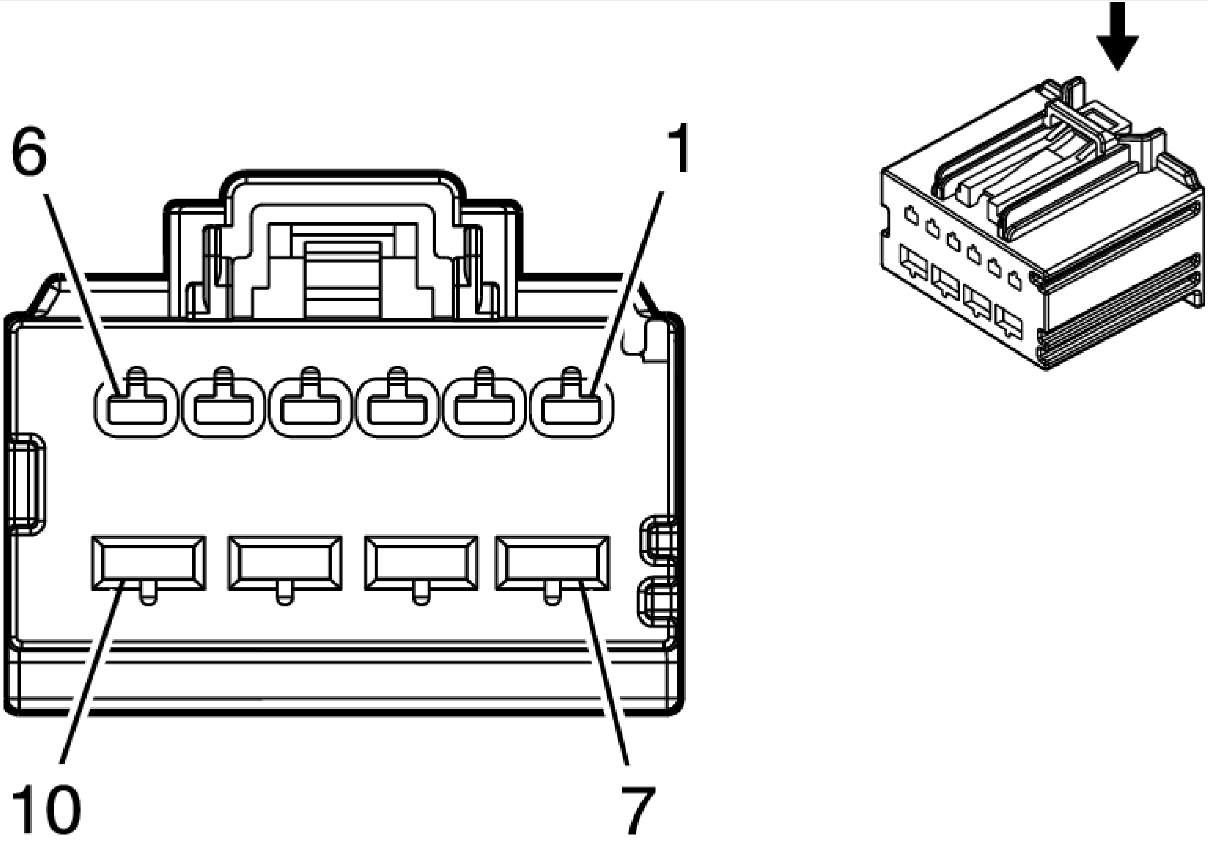
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/GY	6135	Local Interconnect Network Serial Data Bus 4	I	-
2	0.35	GY	747	Left Rear Door Ajar Switch Signal	I	-
3	0.5	BK	550	Ground	I	-
4 - 6	-	-	-	Not Occupied	-	-
7	2	BK	650	Ground	II	-
8	2	RD/BN	2940	Battery Positive Voltage	II	-
9	1.5	BU/VT	668	Power Window Motor Left Rear Up Control	II	-
10	1.5	YE/BU	669	Power Window Motor Left Rear Down Control	II	-

S79P WINDOW SWITCH - PASSENGER



Connector Part Information

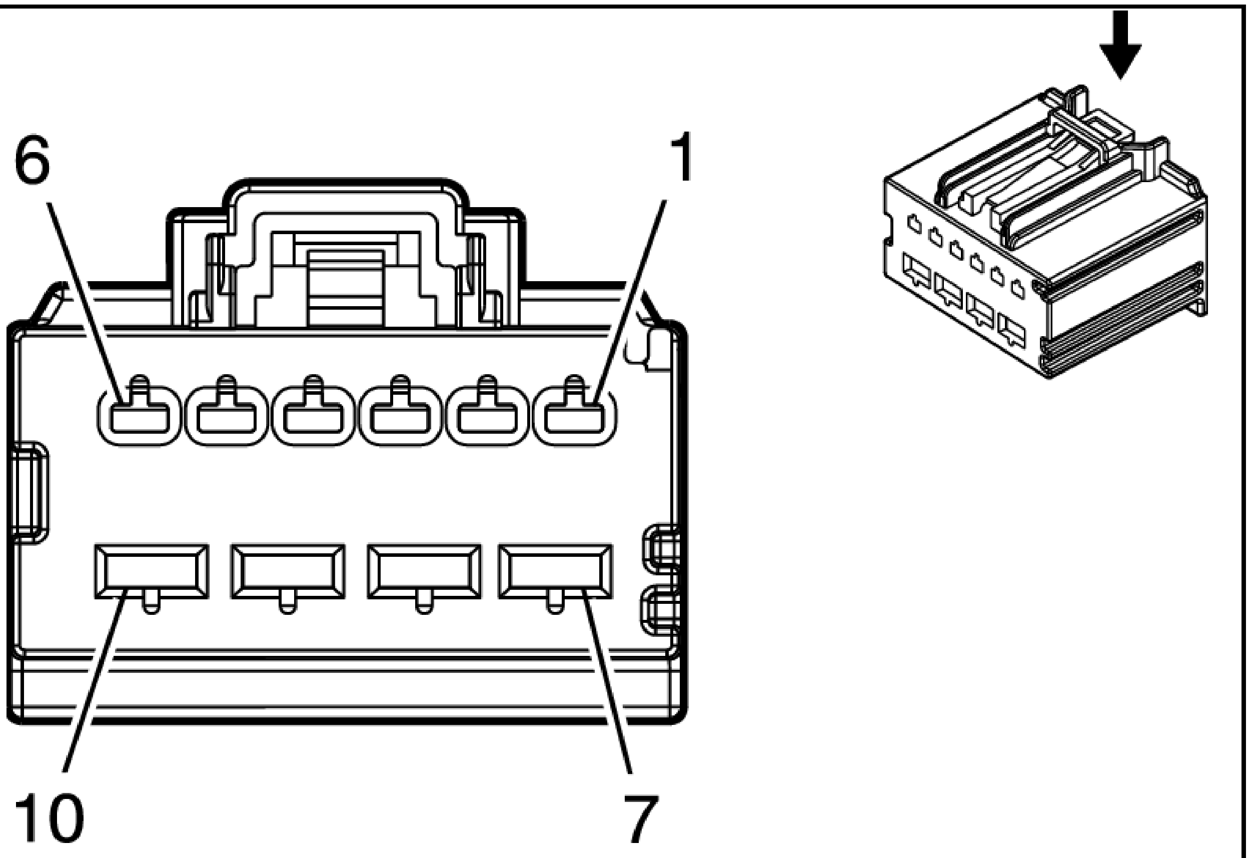
- Harness Type: Passenger Door
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/YE	6134	Local Interconnect Network Serial Data Bus 3	I	-
2	0.35	GY	746	Right Front Door Ajar Switch Signal	I	-
3 - 6	-	-	-	Not Occupied	-	-
7	2	BK	850	Ground	II	-
8	2	RD/GN	1540	Battery Positive Voltage	II	-
9	1.5	GN/GY	3387	Power Window Motor Passenger Up Control	II	-
10	1.5	YE/BU	3388	Power Window Motor Passenger Down Control	II	-

S79RR WINDOW SWITCH - RIGHT REAR



Connector Part Information

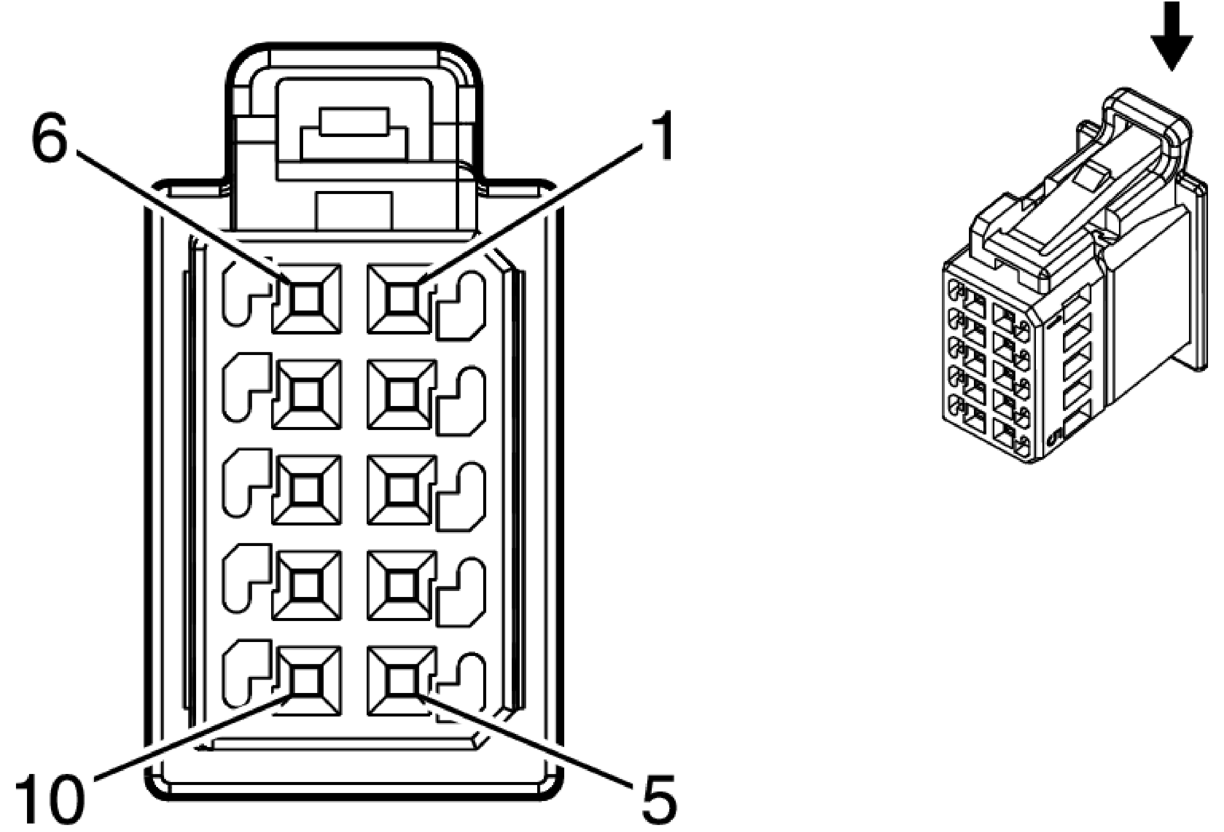
- Harness Type: Right Rear Door
- OEM Connector: 31372-1000
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 1.5, 2.8 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5 2	GN/GY RD/BN	6135 2940	Local Interconnect Network Serial Data Bus 4 Battery Positive Voltage	I II	- -
2	0.35	GY	748	Right Rear Door Ajar Switch Signal	I	-
3 - 4	-	-	-	Not Occupied	-	-
5	0.5	GN/GY	6135	Local Interconnect Network Serial Data Bus 4	I	-
6	-	-	-	Not Occupied	-	-
7	2	BK	850	Ground	II	-
8	-	-	-	Not Occupied	-	-
9	1.5	BU/GY	670	Power Window Motor Right Rear Up Control	II	-
10	1.5	GN/BK	671	Power Window Motor Right Rear Down Control	II	-

S82 WINDSHIELD WIPER/WASHER SWITCH



Connector Part Information

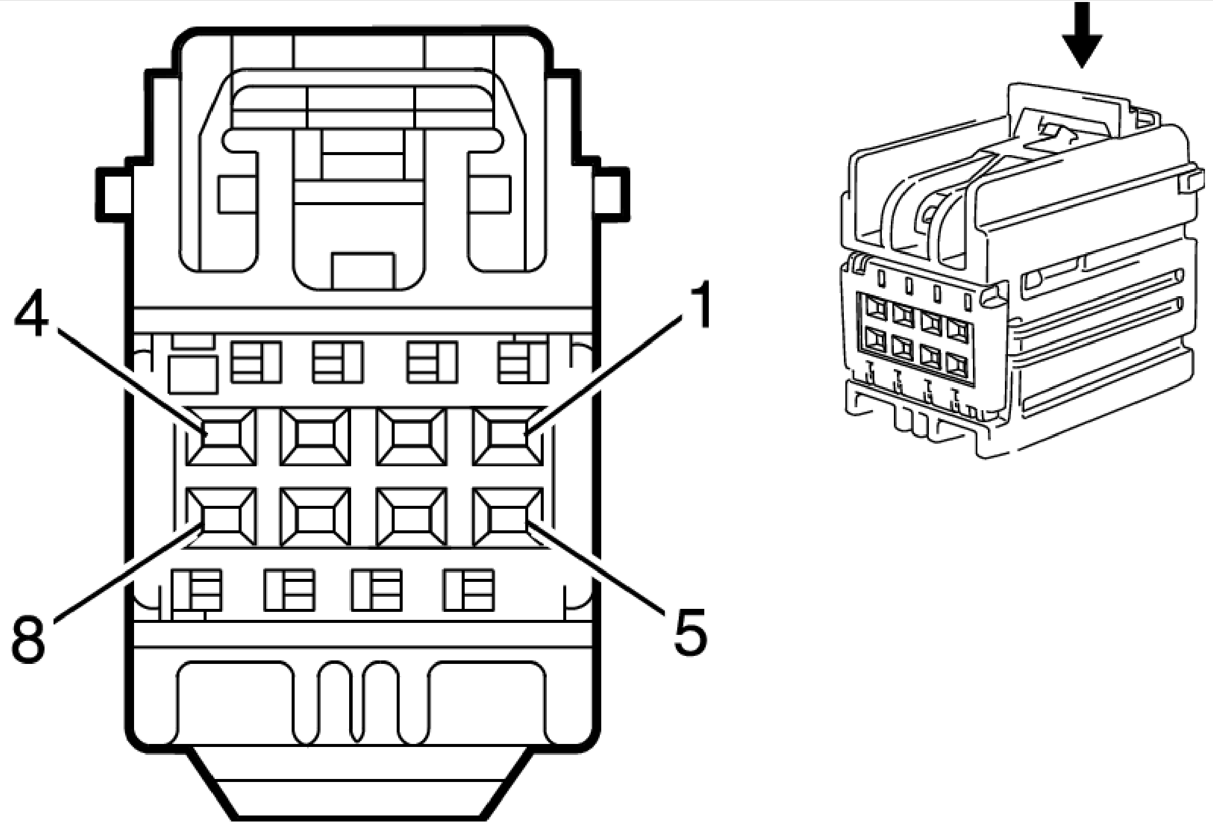
- Harness Type: Instrument Panel
- OEM Connector: 1488973-2
- Service Connector: 19330677
- Description: 10-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575859	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK/GY	6009	Windshield Wiper Switch Low Reference	I	-
2	0.35	GY	1715	Windshield Wiper Switch High Signal	I	-
3	0.35	YE/BU	1714	Windshield Wiper Switch Low Signal	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	BN/BU	391	Rear Window Wiper Switch Signal	I	-
6	-	-	-	Not Occupied	-	-
7	0.35	WH/BK	94	Windshield Washer Switch Signal	I	-
8 - 10	-	-	-	Not Occupied	-	-

S83 VEHICLE ON/OFF SWITCH



Connector Part Information

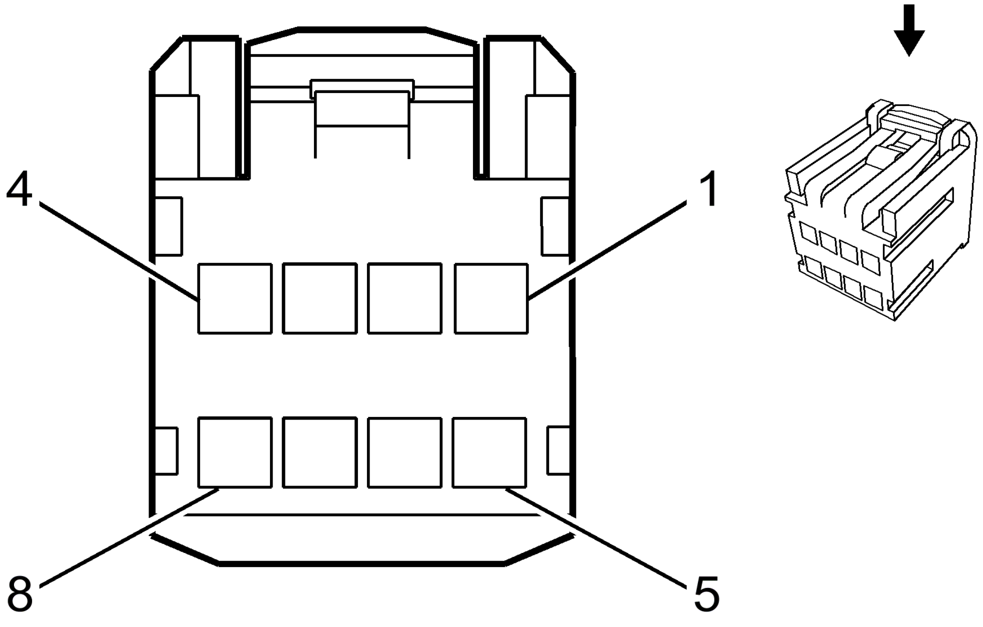
- Harness Type: Instrument Panel
- OEM Connector: 7283-9029-40
- Service Connector: 19115653
- Description: 8-Way F YESC Kaizen Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.13	GN	3558	Passive Start Switch Signal 2	I	-
4	0.5	BK	1250	Ground	I	-
5	0.13	BU	5719	Ignition Mode Switch Start LED Signal	I	-
6	0.13	BU	5723	Ignition Mode Switch Mode Voltage	I	-
7	0.13	BK	3559	Passive Start Switch 2 Low Reference	I	-
8	0.13	GN	5721	Ignition Mode Switch Off LED Signal	I	-

S91 PARK BRAKE CONTROL SWITCH



Connector Part Information

- Harness Type: Floor Console
- OEM Connector: HCMDPB-08-K
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 1.2 HCM Series (BK)

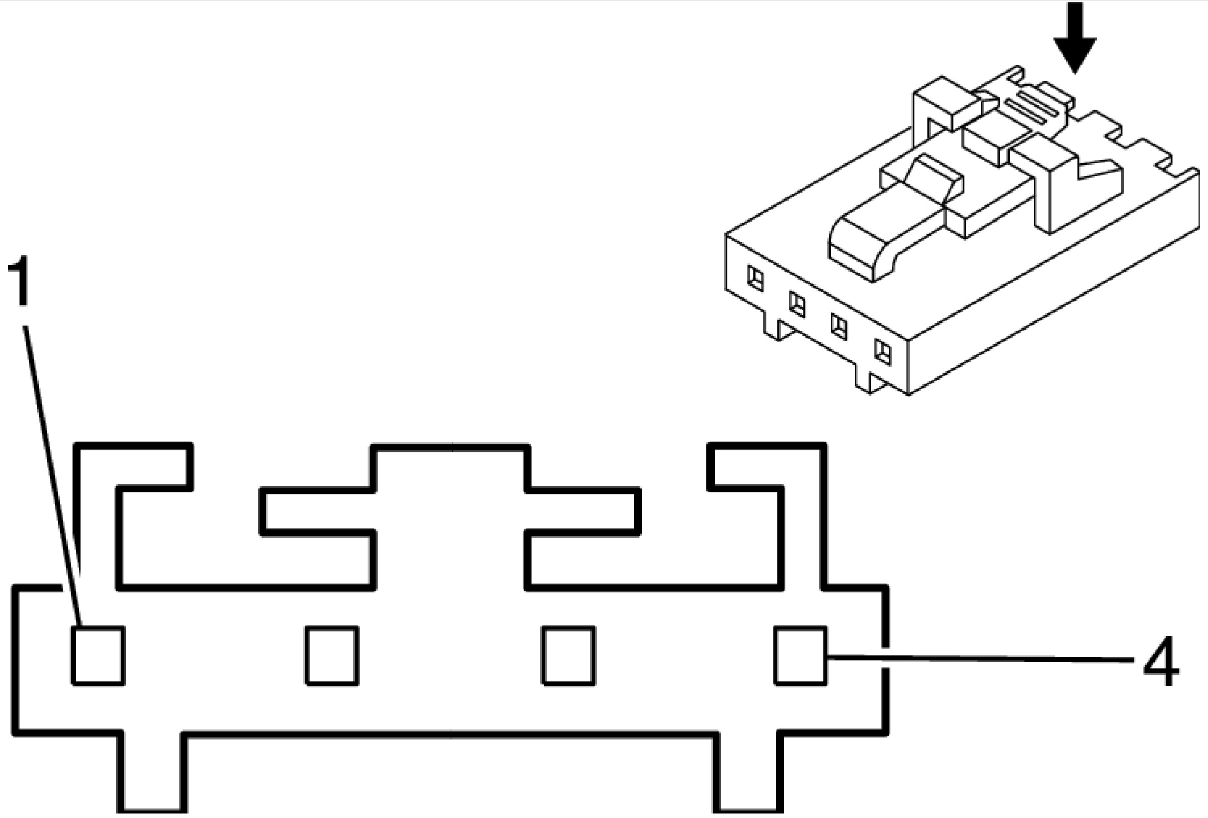
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE	1492	Park Brake Switch Supply Voltage	I	-
2	0.35	BU/VT	1134	Park Brake Switch Signal	I	-
3	0.35	YE/RD	7683	Park Brake Release Switch Voltage Reference	I	-
4	0.35	BN	6107	Park Brake Apply Switch Signal	I	-
5	0.35	BU/BK	6108	Park Brake Release Switch Signal	I	-
6	0.35	YE	6817	LED Backlight Dimming Control	I	-
7	0.35	GY/RD	7684	Park Brake Apply Switch Voltage Reference	I	-
8	0.5	BK	750	Ground	I	-

S151 REGENERATIVE BRAKING ON-DEMAND SWITCH



Connector Part Information

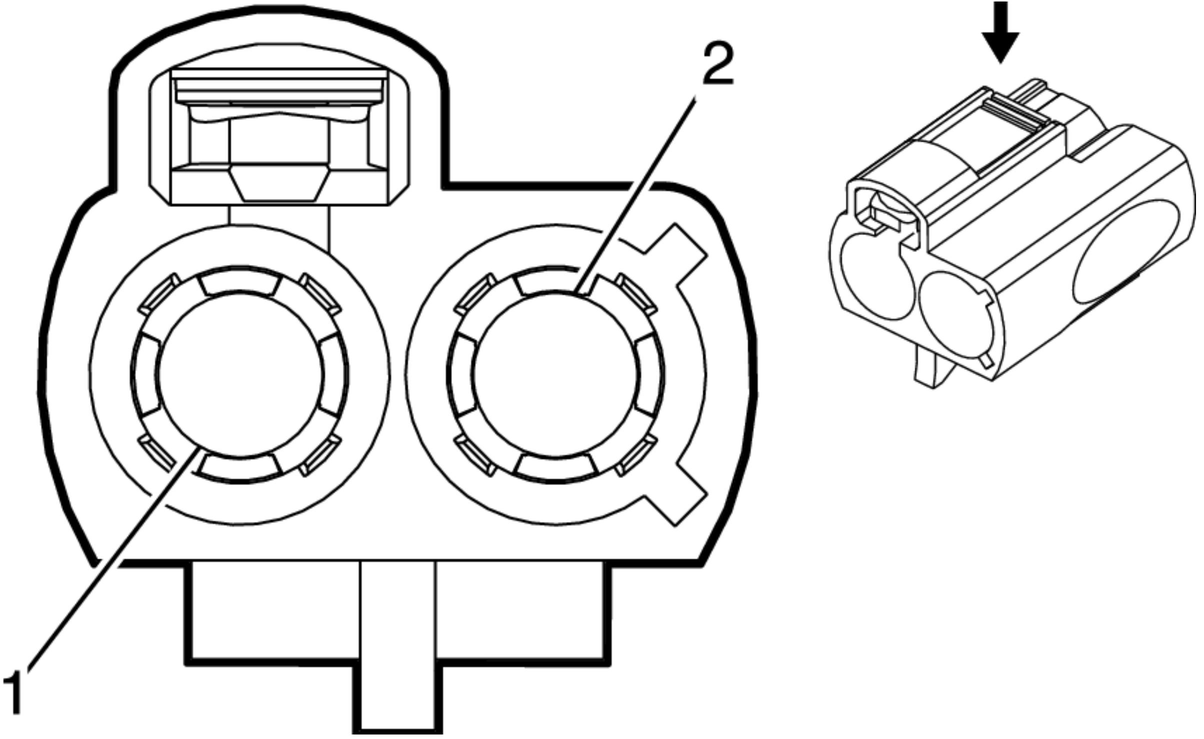
- Harness Type: Steering Wheel
- OEM Connector: 50-57-9404
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 0.64 SL Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BK	1650	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	-	VT/YE	5526	Tap Up/Tap Down Switch Signal	I	-
4	-	YE/BK	3893	LED Backlight Dimming Control 2	I	-

T2RR ANTENNA - ROOF REAR X1



Connector Part Information

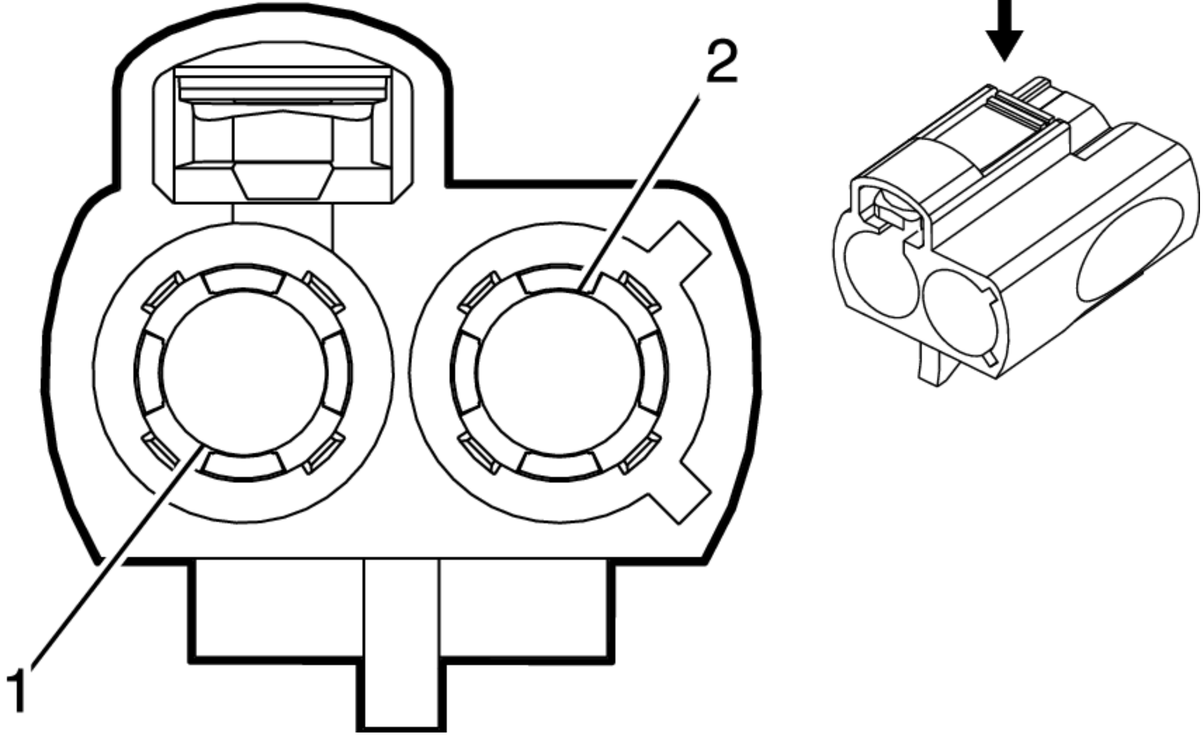
- Harness Type: Antenna Pig Tail
- OEM Connector: 13583911
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 2-Way F Coax Type (PU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
BU	-	-	COAX	Coax Cable	I	-

T2RR ANTENNA - ROOF REAR X2



Connector Part Information

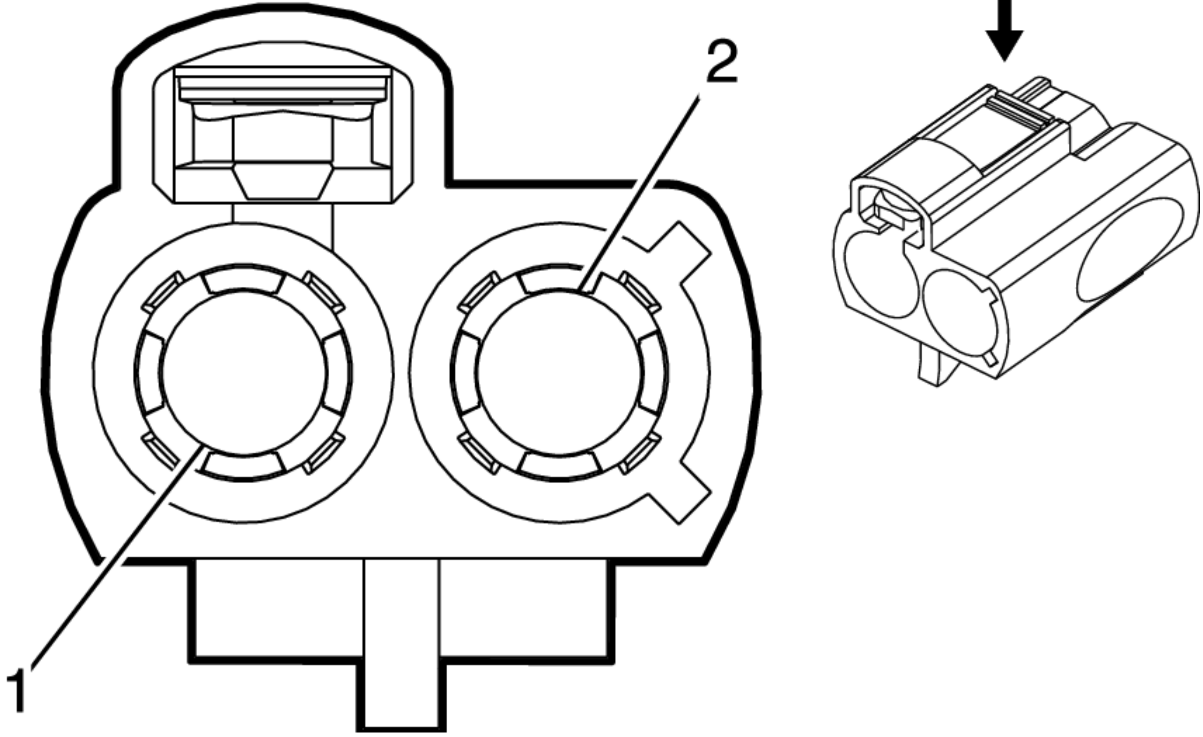
- Harness Type: Antenna Pig Tail
- OEM Connector: 13583911
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 2-Way F Coax Type (PU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
PU	-	-	COAX	Coax Cable	I	-

T2RR ANTENNA - ROOF REAR X5



Connector Part Information

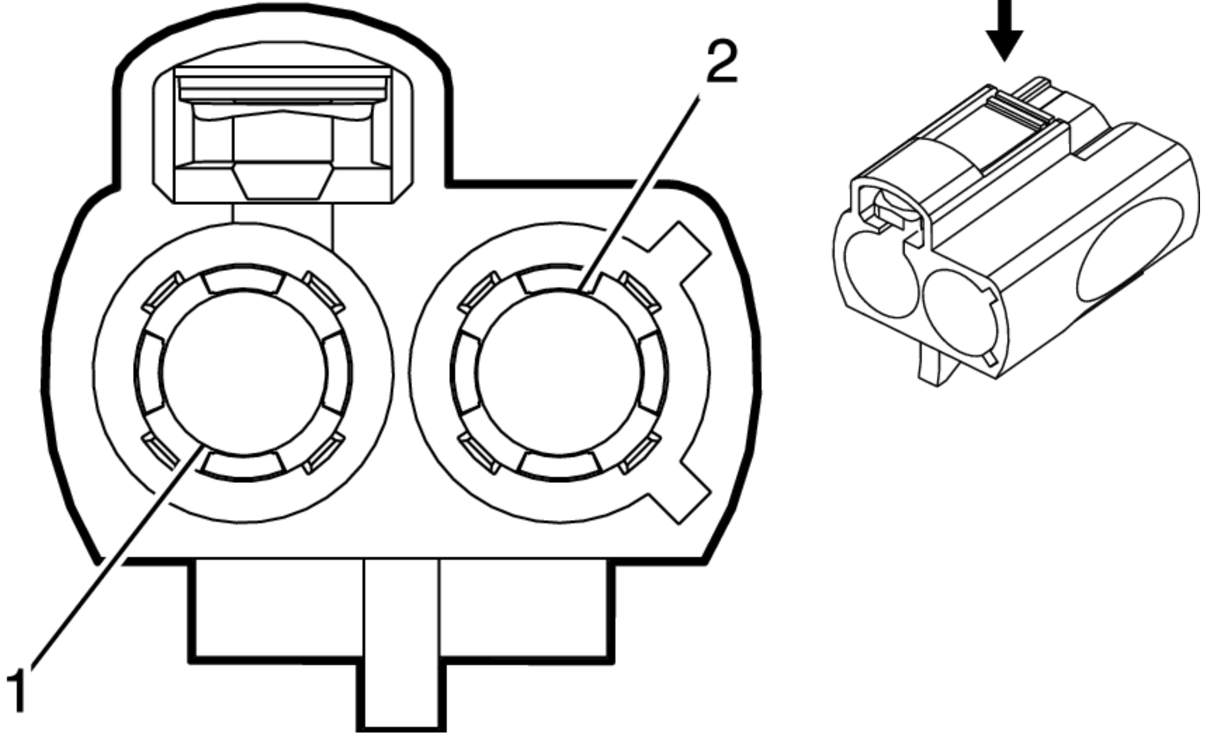
- Harness Type: Antenna Pig Tail
- OEM Connector: 13583911
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 2-Way F Coax Type (PU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
1_VT	-	-	COAX	Coax Cable	I	-
2_VT	-	-	COAX	Coax Cable	I	-

T2RR ANTENNA - ROOF REAR X6



Connector Part Information

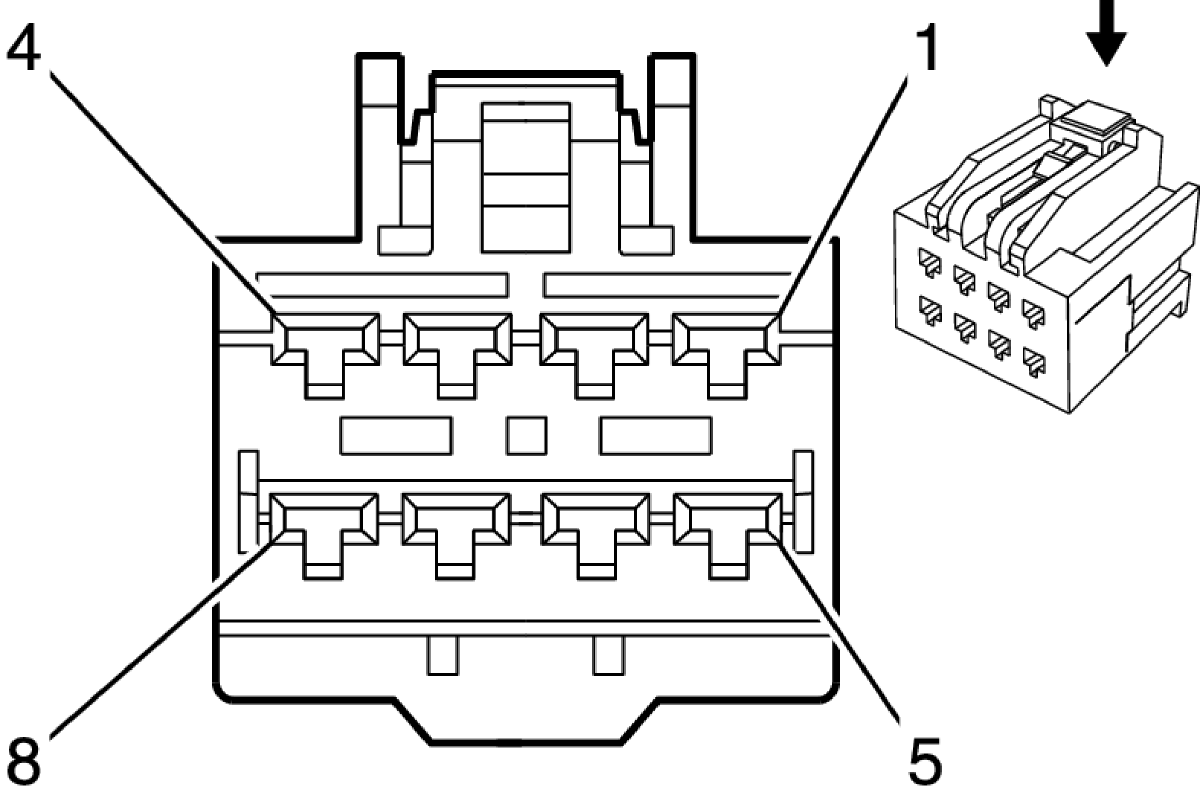
- Harness Type: Antenna Pig Tail
- OEM Connector: 13583911
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 2-Way F Coax Type (PU)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
CU	-	-	COAX	Coax Cable	I	-

T3 AUDIO AMPLIFIER X1 (UQA)



Connector Part Information

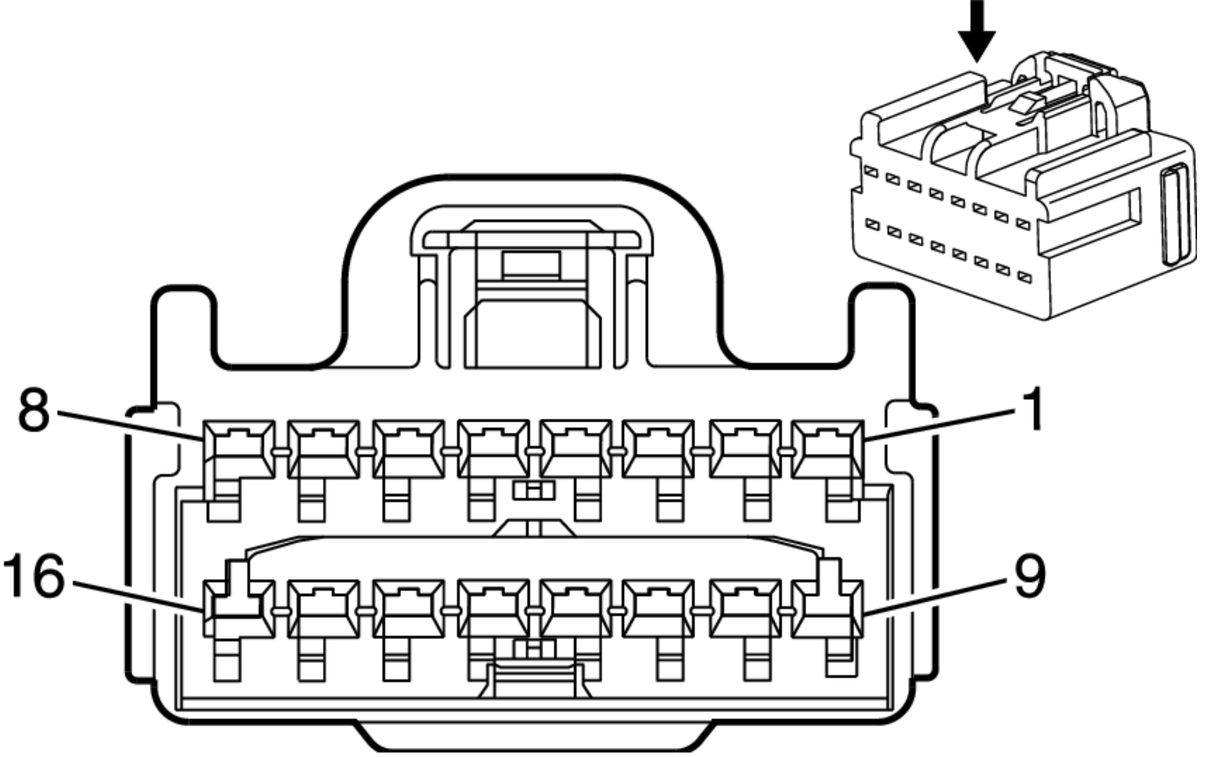
- Harness Type: Body
- OEM Connector: 6098-4798
- Service Connector: 19115652
- Description: 8-Way F 2.8 Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	2	GN/BK	1794	Left/Rear Subwoofer Speaker (-) Low Reference	I	UQA
4	2	RD/VT	5640	Battery Positive Voltage	I	UQA
5 - 6	-	-	-	Not Occupied	-	-
7	2	BU/GY	346	Left/Rear Subwoofer Speaker Control (+)	I	UQA
8	2	BK	2050	Ground	I	UQA

T3 AUDIO AMPLIFIER X2 (UQA)



Connector Part Information

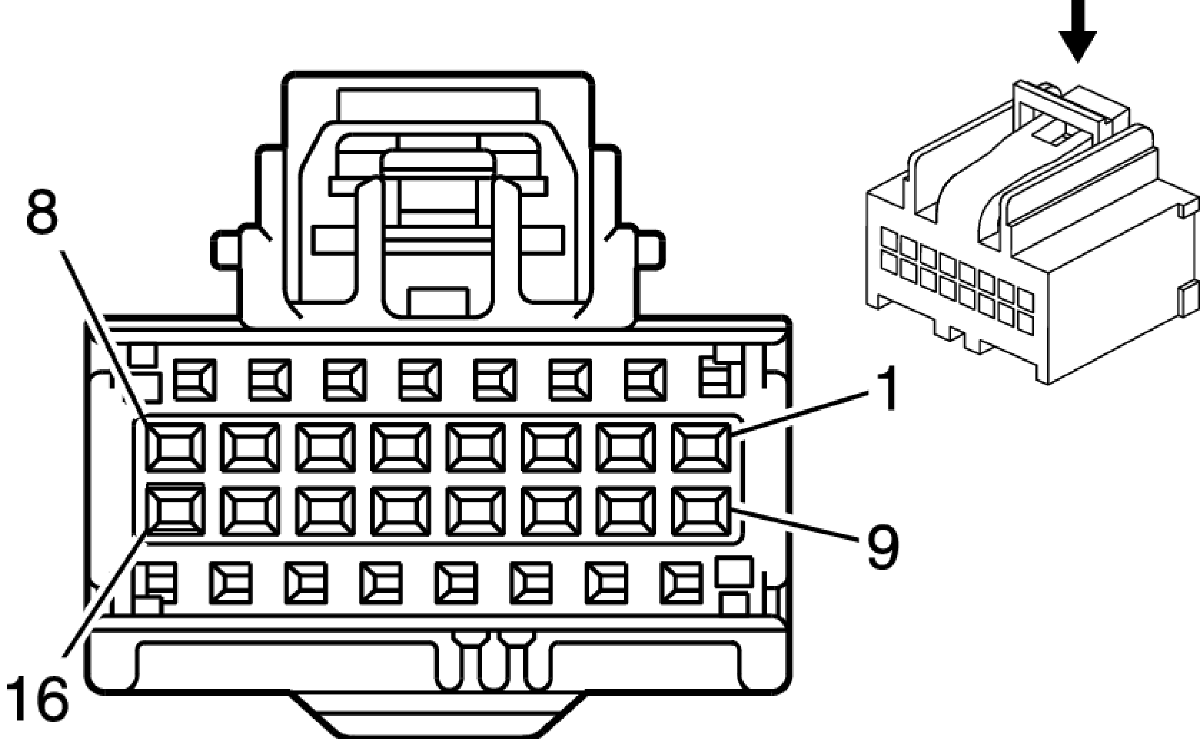
- Harness Type: Body
- OEM Connector: 7283-6453-60
- Service Connector: 89047090
- Description: 16-Way F 1.5 Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575850	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
II	13578892	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1.5	YE/BK	117	Right Front Speaker Signal (-) 1	II	UQA
2	1.5	YE	200	Right Front Speaker Control (+) 1	II	UQA
3	1.5	BN/BU	118	Left Front Speaker Signal (-) 1	II	UQA
4	1.5	BU	201	Left Front Speaker Control (+) 1	II	UQA
5	0.75	BU/BK	115	Right Rear Speaker Signal (-)	I	UQA
6	0.75	WH	46	Right Rear Speaker Control (+)	I	UQA
7	0.75	GN/BK	116	Left Rear Speaker Signal (-)	I	UQA
8	0.75	GN	199	Left Rear Speaker Control (+)	I	UQA
9 - 16	-	-	-	Not Occupied	-	-

T3 AUDIO AMPLIFIER X3 (UQA)



Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-9076-30
- Service Connector: 15136073
- Description: 16-Way F 0.64 Kaizen Series (BK)

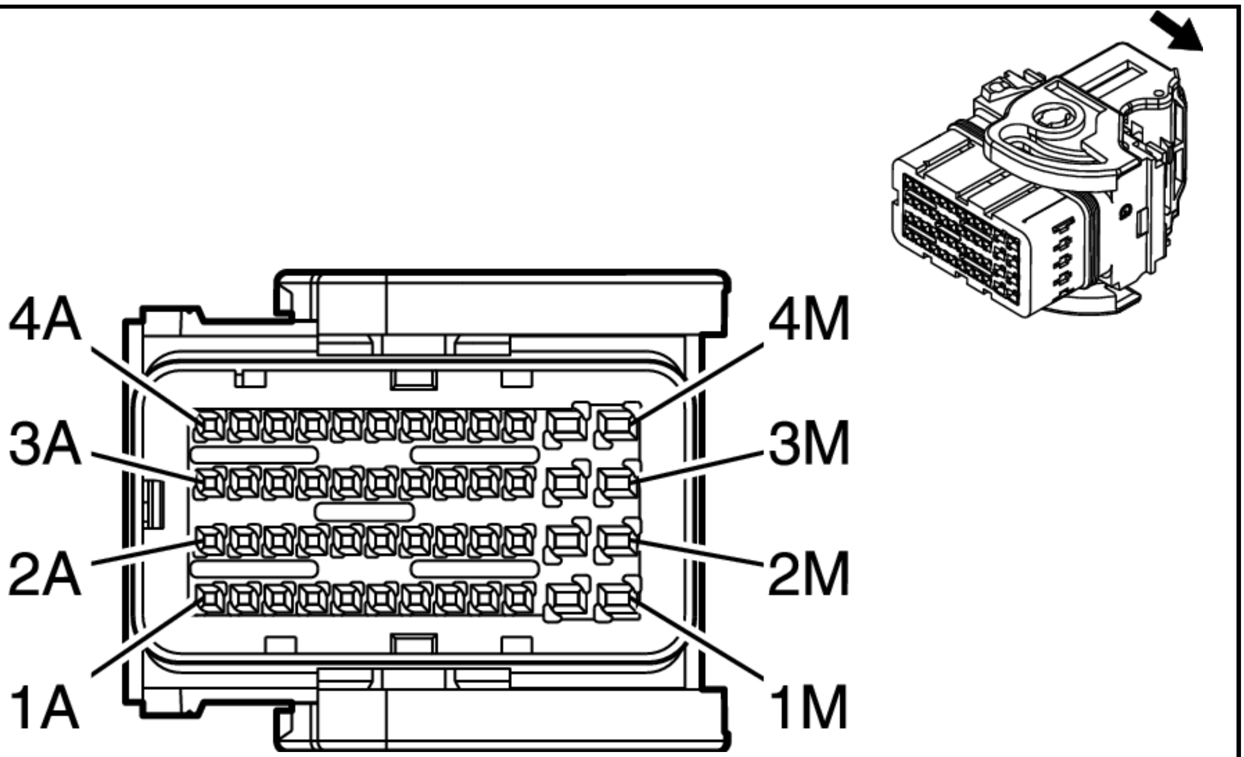
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 3	-	-	-	Not Occupied	-	-
4	0.75	BU/BK	1946	Right Rear Low Level Audio (-) Low Reference	I	UQA
5	0.75	BN/VT	1999	Left Rear Low Level Audio (-) Low Reference	I	UQA
6	0.75	BU/BN	1546	Front Low Level Audio (-) Low Reference	I	UQA
7	0.75	BN/BU	1947	Left Front Low Level Audio (-) Low Reference	I	UQA
8	0.5	GN/YE	7066	Entertainment Remote Enable Signal	I	UQA
9 - 10	-	-	-	Not Occupied	-	-
11	0.5	VT/BU	6978	Amplifier Control	I	UQA
12	0.75	BN/WH	546	Right Rear Low Level Audio Signal	I	UQA
13	0.75	GN/BK	599	Left Rear Low Level Audio Signal	I	UQA
14	0.75	YE	512	Right Front Low Level Audio Signal	I	UQA
15	0.75	BU	511	Left Front Low Level Audio Signal	I	UQA

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
16	-	-	-	Not Occupied	-	-

T6 POWER INVERTER MODULE X1



Connector Part Information

- Harness Type: Engine
- OEM Connector: 98993-5021
- Service Connector: 19354859
- Description: 48-Way F 0.6, 1.5 Sealed, Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19354833	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
II	19354834	J-35616-64B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
III	19354835	J-35616-2A (GY)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1A - 4M	-	-	-	Not Occupied	-	-
B1	0.75	WH/GN	7648	Traction Power Inverter Module Traction Power Inverter Module Resolver 1 Excitation Signal Negative	I	-
B2	0.75	BU	7645	Traction Power Inverter Module Resolver 1 Excitation Signal Positive	I	-
B4	0.5	VT/WH	5981	PRNDL A Signal	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
C1	0.75	BN	7652	Traction Power Inverter Module Resolver 1 S3 Signal	I	-
C2	0.75	YE	7649	Traction Power Inverter Module Resolver 1 S1 Signal	I	-
C3	0.5	GY/BN	5982	PRNDL B Signal	II	-
C4	0.5	GY/WH	4168	PRNDL P Signal	II	-
D1	0.75	GY	7646	Transmission Traction Power Inverter Module Resolver 1 S4 Signal	I	-
D2	0.75	VT/GN	7647	Transmission Traction Power Inverter Module Resolver 1 S2 Signal	I	-
D3	0.5	WH/BK	5983	PRNDL C Signal	II	-
D4	0.5	GY/YE	4169	PRNDL S Signal	II	-
E3	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-
E4	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
F1	0.5	GY/BK	2967	Transmission Auxiliary Oil Pump Relay Control	II	-
F2	0.5	GY/BU	4324	Transmission Auxiliary Pump Feedback Signal	II	-
F3	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	II	-
F4	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	II	-
G1	0.5	BK/VT	5596	High Voltage Interlock Loop Low Reference 2	II	-
G2	0.5	YE	5690	High Voltage Interlock Loop Signal 3	II	-
G3	0.5	WH	7494	High Speed GMLAN Serial Data (-)3	II	-
G4	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+)3	II	-
H1	0.5	BN/WH	585	Transmission Oil Temperature Sensor Signal	II	-
H2	0.5	BK/BN	586	Transmission Oil Temperature Sensor Low Reference	II	-
H3	0.5	WH	7494	High Speed GMLAN Serial Data (-)3	II	-
H4	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+)3	II	-
J1	0.5	WH/BU	7653	Traction Power Inverter Motor 1 Temperature Sensor Signal	II	-
J2	0.5	GN	7654	Traction Power Inverter Motor 1 Temperature Sensor Low Reference	II	-
J3	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	II	-
J4	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	II	-
K2	0.5	BK	150	Ground	II	-
L1	0.5	YE/BU	3992	Internal Mode Switch Voltage Supply A	III	-
L3	0.5	VT/GY	1439	Run/Crank Ignition 1 Voltage	III	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
L4	0.5	VT/BU	3991	Internal Mode Switch Voltage Supply B	III	-
M1	0.5	RD/VT	340	Battery Positive Voltage	III	-
M2	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	III	-
M4	0.5	RD/YE	240	Battery Positive Voltage	III	-

T6 POWER INVERTER MODULE X2

-

Connector Part Information

- Harness Type: High Voltage
- OEM Connector: 13598848
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	- -	OG OG	3832 3966	High Speed GMLAN Serial Data (-) 6 High Voltage Battery 3 (+)	I I	- -
B	- -	OG/BK OG/BK	3826 3965	Rechargeable Energy Storage System Coolant Temperature Sensor Low Reference 2 High Voltage Battery 3 (-)	I I	- -

T6 POWER INVERTER MODULE X3

-

Connector Part Information

- Harness Type: High Voltage
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

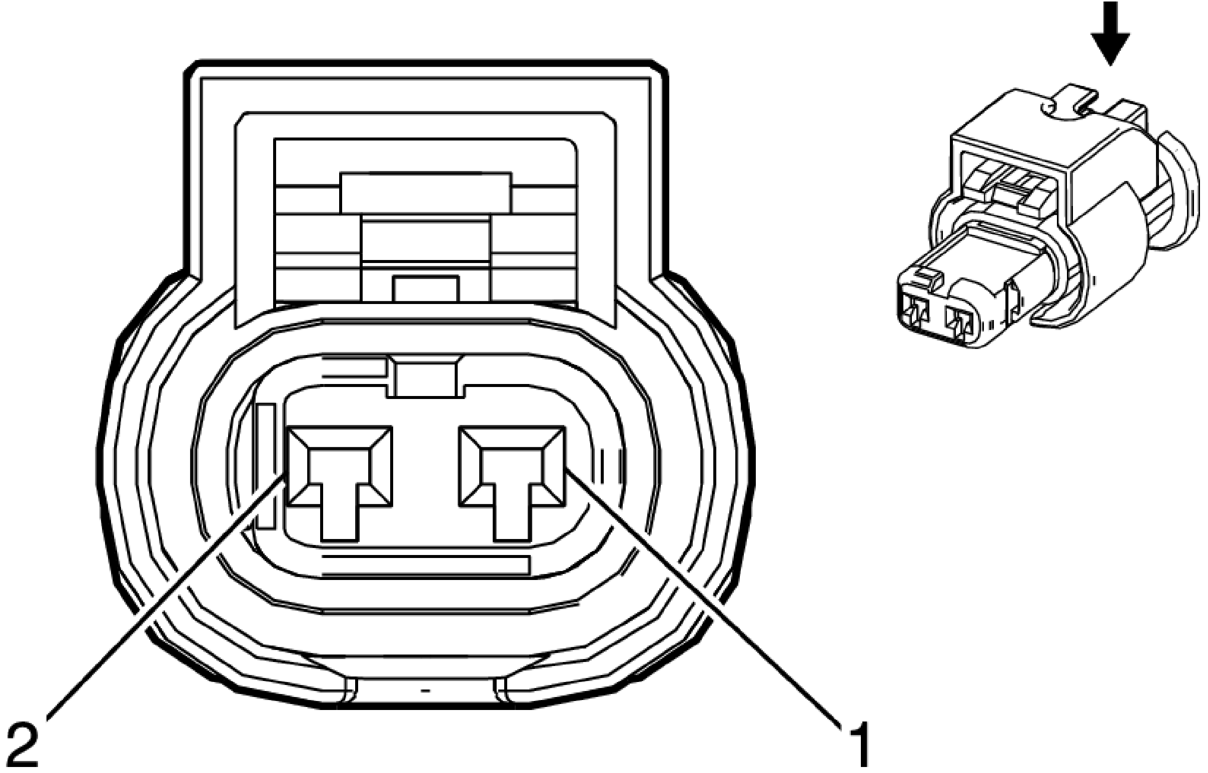
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG	3770	MGU Phase W Control	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	-	OG	3771	MGU Phase V Control	I	-
3	-	OG	3772	MGU Phase U Control	I	-

T10E KEYLESS ENTRY ANTENNA - REAR COMPARTMENT



Connector Part Information

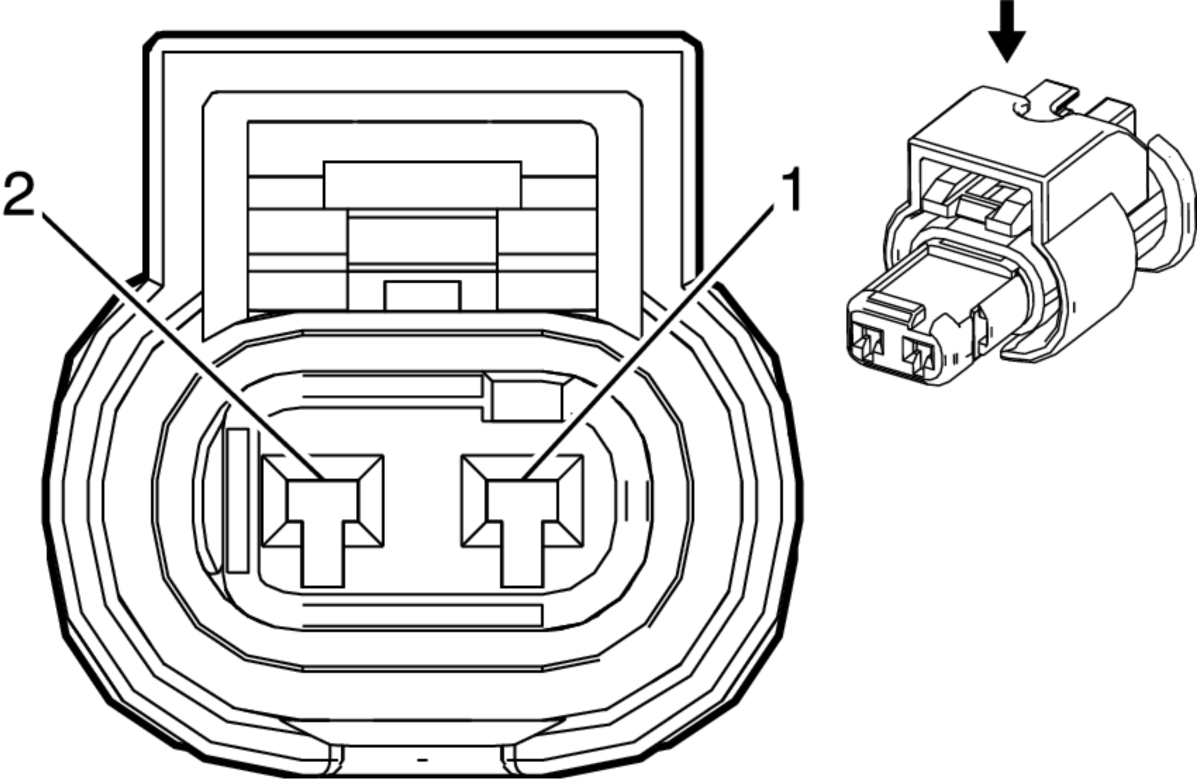
- Harness Type: Body
- OEM Connector: 2-1823608-5
- Service Connector: 19299928
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH/GN	3556	Passive Start Interior Antenna 3 Signal Hi	I	-
2	0.5	GN	3557	Passive Start Interior Antenna 3 Signal Lo	I	-

T10G KEYLESS ENTRY ANTENNA - REAR FASCIA



Connector Part Information

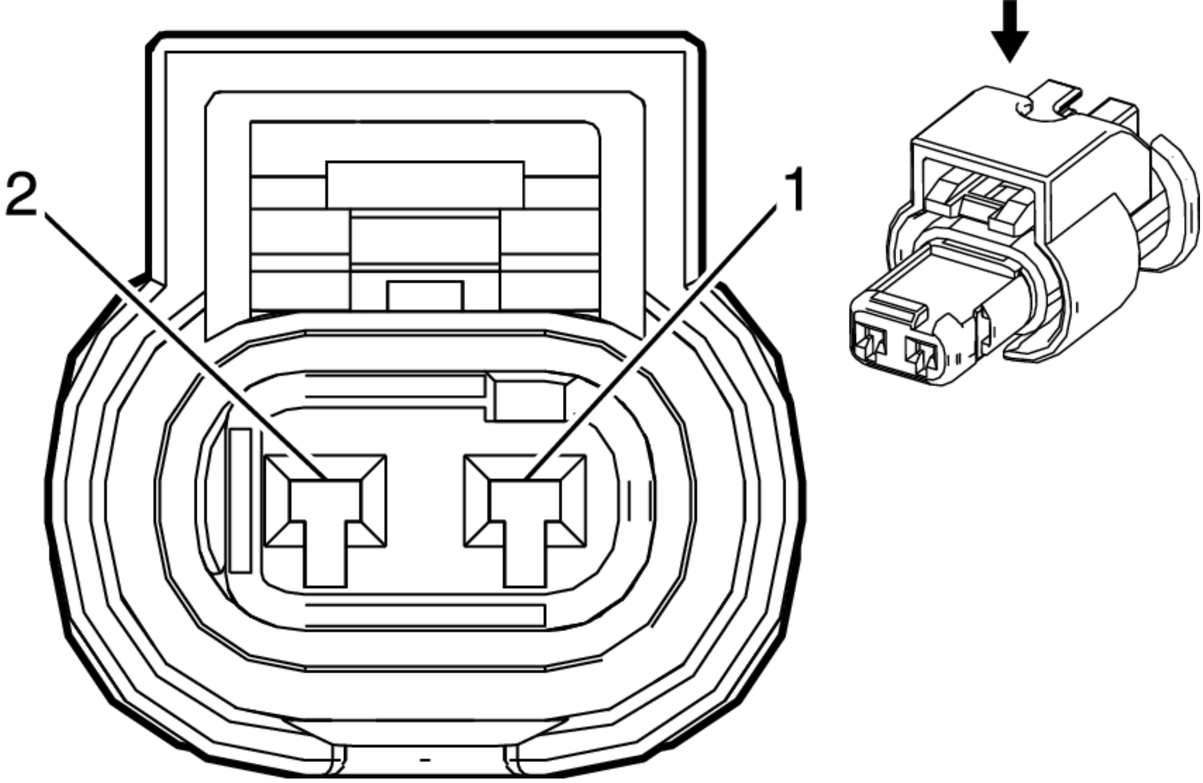
- Harness Type: Rear Fascia
- OEM Connector: 1-1823608-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/GN	3568	Passive Entry Rear Closure Antenna Signal Hi	I	-
2	0.5	GN/GY	3569	Passive Entry Rear Closure Antenna Signal Lo	I	-

T10J KEYLESS ENTRY ANTENNA - CENTER CONSOLE FRONT



Connector Part Information

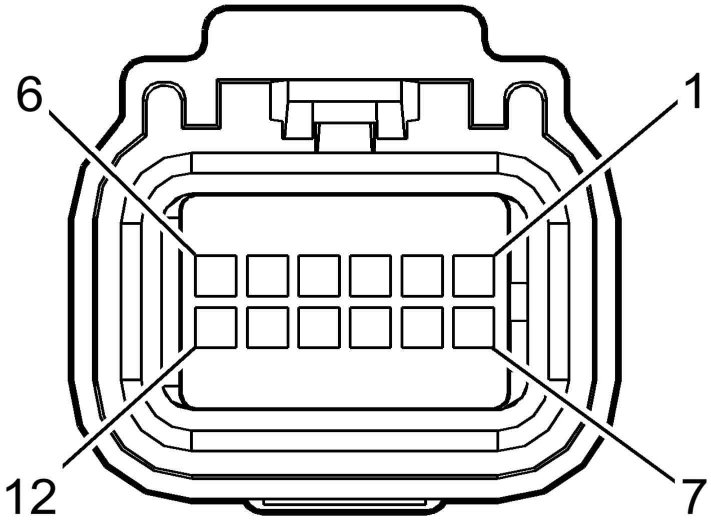
- Harness Type: Instrument Panel
- OEM Connector: 1-1823608-5
- Service Connector: 19300402
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

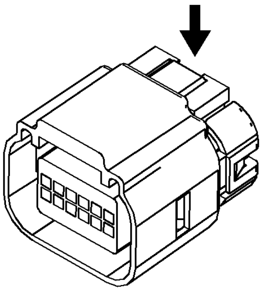
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/BK	3552	Passive Start Interior Antenna 1 Signal Hi	I	-
2	0.5	WH	3553	Passive Start Interior Antenna 1 Signal Lo	I	-

T12 AUTOMATIC TRANSMISSION ASSEMBLY X1





Connector Part Information

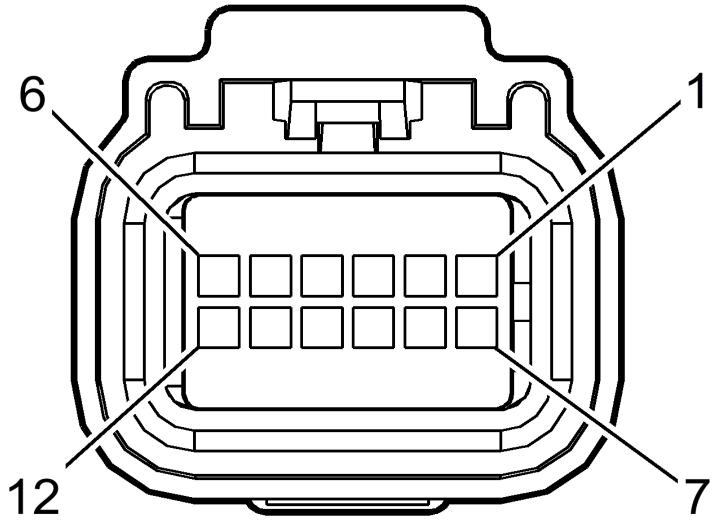
- Harness Type: Engine
- OEM Connector: 33269315
- Service Connector: 19354851
- Description: 12-Way F 1.2 OCS Series, Sealed (BK)

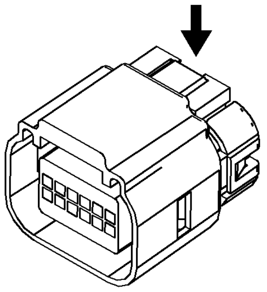
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300649	J-35616-64B (LT BU)	J-38125-553	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BK/GY	9005	-	I	-
3	0.5	VT	9005	-	I	-
4	0.5	YE/BU	3992	Internal Mode Switch Voltage Supply A	I	-
5	0.5	VT/WH	5981	PRNDL A Signal	I	-
6	0.5	WH/BK	5983	PRNDL C Signal	I	-
7	0.5	GY/YE	4169	PRNDL S Signal	I	-
8	0.5	GY/BN	5982	PRNDL B Signal	I	-
9	0.5	GY/WH	4168	PRNDL P Signal	I	-
10	0.5	VT/BU	3991	Internal Mode Switch Voltage Supply B	I	-
11	0.5	BN	9005	-	I	-
12	0.5	YE/BK	9005	-	I	-

T12 AUTOMATIC TRANSMISSION ASSEMBLY X2





Connector Part Information

- Harness Type: Engine
- OEM Connector: 33269315
- Service Connector: 19354851
- Description: 12-Way F 1.2 OCS Series, Sealed (BK)

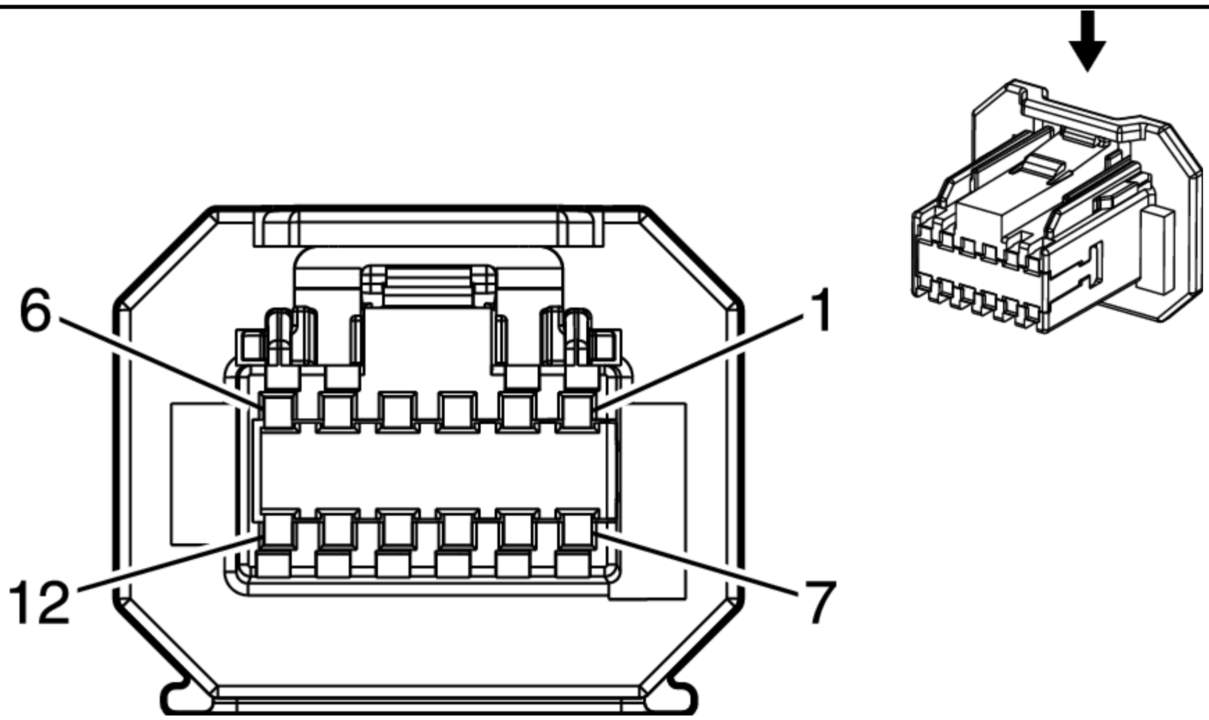
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300649	J-35616-64B (LT BU)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
II	19300649	J-35616-64B (LT BU)	J-38125-553	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BN/WH	585	Transmission Oil Temperature Sensor Signal	II	-
3	0.5	BK/BN	586	Transmission Oil Temperature Sensor Low Reference	II	-
4	0.75	BN	7652	Traction Power Inverter Module Resolver 1 S3 Signal	I	-
5	0.75	YE	7649	Traction Power Inverter Module Resolver 1 S1 Signal	I	-
6	0.75	BU	7645	Traction Power Inverter Module Resolver 1 Excitation Signal Positive	I	-
7	0.75	WH/GN	7648	Traction Power Inverter Module Traction Power Inverter Module Resolver 1 Excitation Signal Negative	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
8	0.75	VT/GN	7647	Transmission Traction Power Inverter Module Resolver 1 S2 Signal	I	-
9	0.75	GY	7646	Transmission Traction Power Inverter Module Resolver 1 S4 Signal	I	-
10	0.5	GN	7654	Traction Power Inverter Motor 1 Temperature Sensor Low Reference	II	-
11	0.5	WH/BU	7653	Traction Power Inverter Motor 1 Temperature Sensor Signal	II	-
12	0.5	BU	9005	-	II	-

T12 AUTOMATIC TRANSMISSION ASSEMBLY X3



Connector Part Information

- Harness Type: -
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way

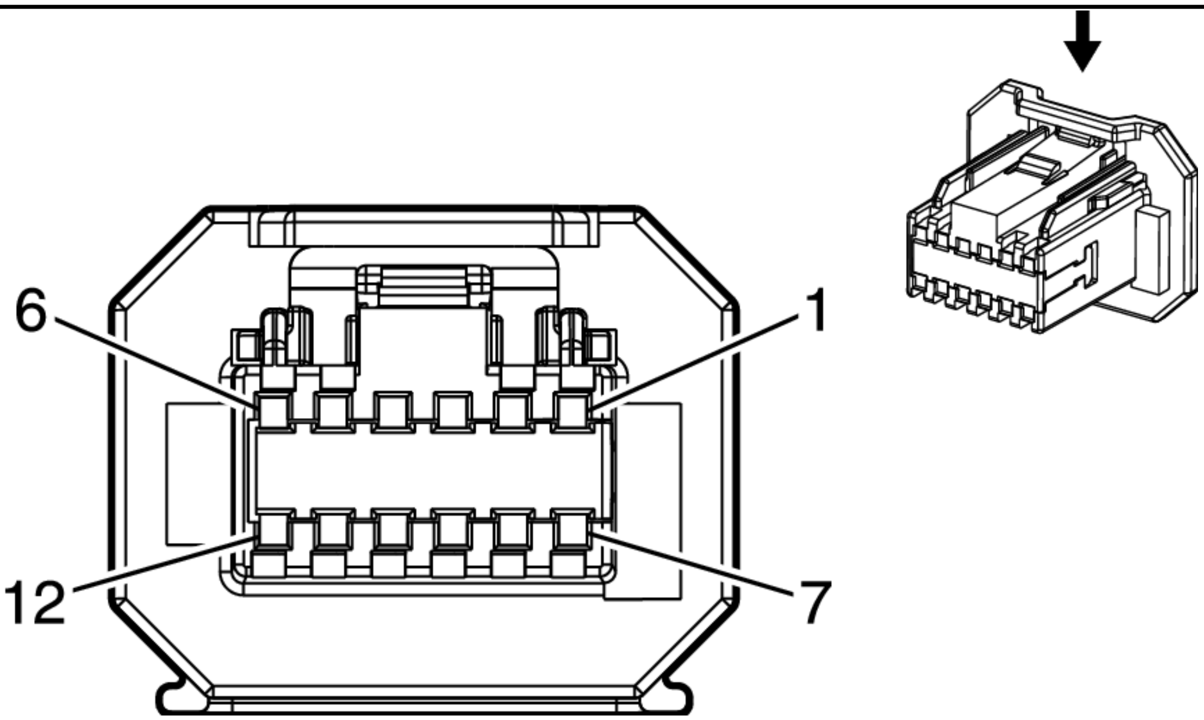
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BK	9005	-	I	-
3	0.5	BK	9005	-	I	-
4	0.5	BK	3992	Internal Mode Switch Voltage Supply A	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	0.5	BK	5981	PRNDL A Signal	I	-
6	0.5	BK	5983	PRNDL C Signal	I	-
7	0.5	BK	4169	PRNDL S Signal	I	-
8	0.5	BK	5982	PRNDL B Signal	I	-
9	0.5	BK	4168	PRNDL P Signal	I	-
10	0.5	BK	3991	Internal Mode Switch Voltage Supply B	I	-
11	0.5	BK	9005	-	I	-
12	0.5	BK	9005	-	I	-

T12 AUTOMATIC TRANSMISSION ASSEMBLY X4



Connector Part Information

- Harness Type: Transmission Case
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way M

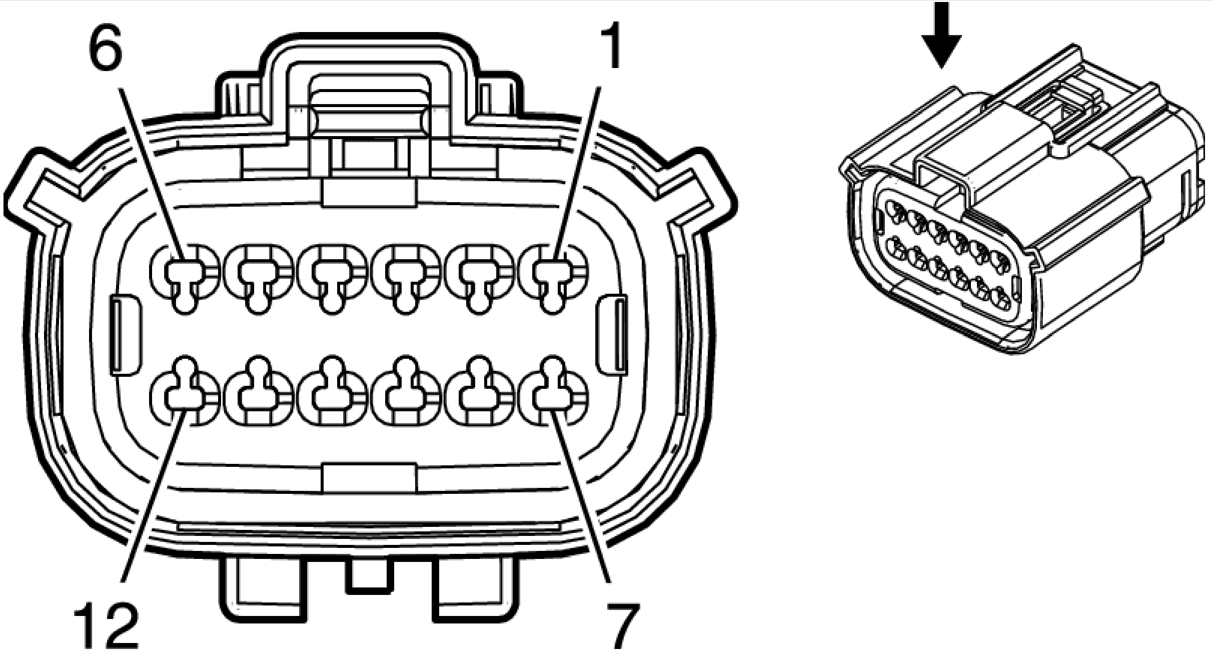
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BK	585	Transmission Oil Temperature Sensor Signal	I	-
3	0.5	BK	586	Transmission Oil Temperature Sensor Low Reference	I	-
4	0.75	BK	7652	Traction Power Inverter Module Resolver 1 S3 Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	0.75	BK	7649	Traction Power Inverter Module Resolver 1 S1 Signal	I	-
6	0.75	BK	7645	Traction Power Inverter Module Resolver 1 Excitation Signal Positive	I	-
7	0.75	BK	7648	Traction Power Inverter Module Traction Power Inverter Module Resolver 1 Excitation Signal Negative	I	-
8	0.75	BK	7647	Transmission Traction Power Inverter Module Resolver 1 S2 Signal	I	-
9	0.75	BK	7646	Transmission Traction Power Inverter Module Resolver 1 S4 Signal	I	-
10	0.5	BK	7654	Traction Power Inverter Motor 1 Temperature Sensor Low Reference	I	-
11	0.5	BK	7653	Traction Power Inverter Motor 1 Temperature Sensor Signal	I	-
12	0.5	BK	9005	-	I	-

T18 BATTERY CHARGER X1



Connector Part Information

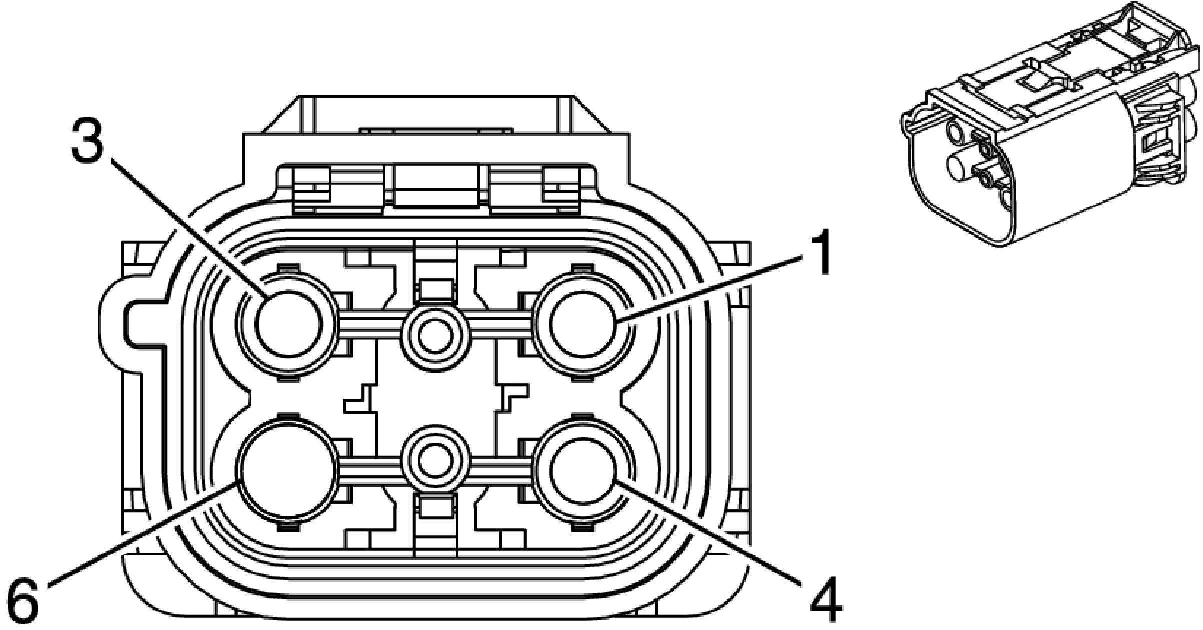
- Harness Type: Engine
- OEM Connector: 33472-1291
- Service Connector: 19352908
- Description: 12-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.5	BK	150	Ground	I	-
3	0.5	VT/WH	3643	High Voltage Onboard Charging DC Voltage Sense Signal	I	-
4	0.5	YE/GY	3645	High Voltage Onboard Charging Control	I	-
5 - 8	-	-	-	Not Occupied	-	-
9	0.5	RD/YE	740	Battery Positive Voltage	I	-
10	0.5	GN/GY	3644	High Voltage Onboard Charging AC Voltage Sense Signal	I	-
11	0.5	BU/YE	3646	High Voltage Onboard Charging Enable	I	-
12	-	-	-	Not Occupied	-	-

T18 BATTERY CHARGER X2



Connector Part Information

- Harness Type: High Voltage
- OEM Connector: 13590889
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 1.0, 2.4 HES Sealed (OG)

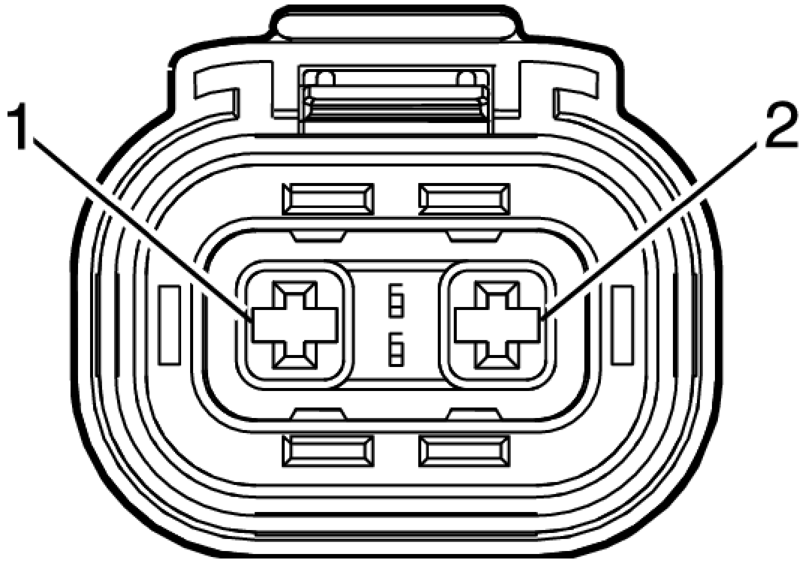
Terminal Part Information

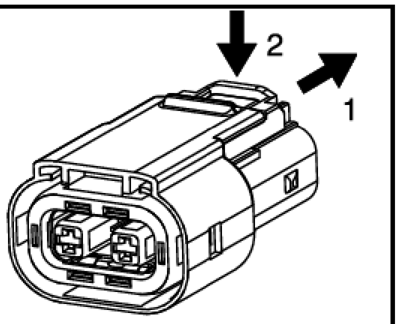
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BU	3837	Voltage AC Line 1	I	-
2	-	-	-	Not Occupied	-	-
3	-	GN	3952	Voltage AC Ground	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
4	-	WH	3838	Voltage AC Neutral Line 2	I	-
5 - 6	-	-	-	Not Occupied	-	-

T18 BATTERY CHARGER X3





Connector Part Information

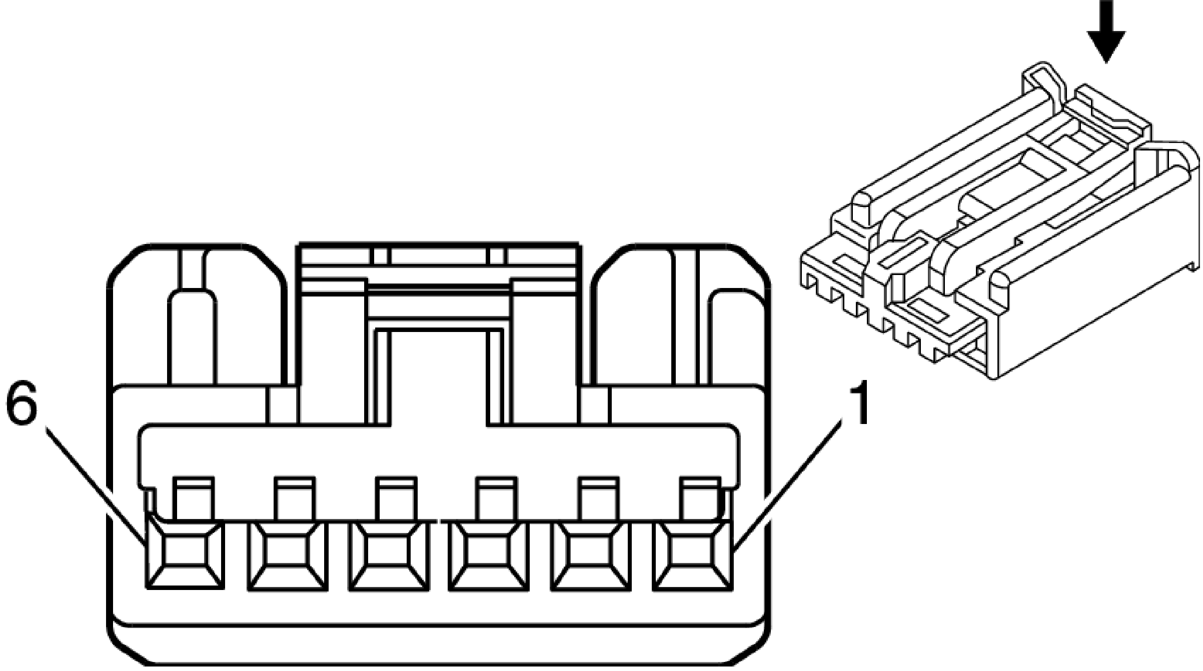
- Harness Type: High Voltage
- OEM Connector: 13583853
- Service Connector: Service by Harness - See Part Catlog
- Description: 2-Way F HVA280-2PHI Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	-	Not Available	No Tool Required	-	-	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	5	OG	3834	High Voltage Battery 2 (+)	I	-
2	5	OG/BK	3833	High Voltage Battery 2 (-)	I	-

T22 MOBILE DEVICE WIRELESS CHARGER MODULE (K4C)



Connector Part Information

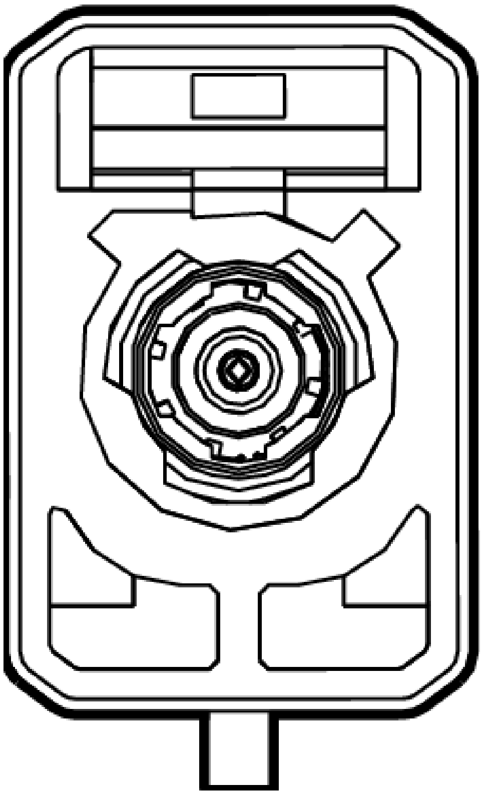
- Harness Type: Floor Console
- OEM Connector: AIT2PB-06-1FS
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Series (NA)

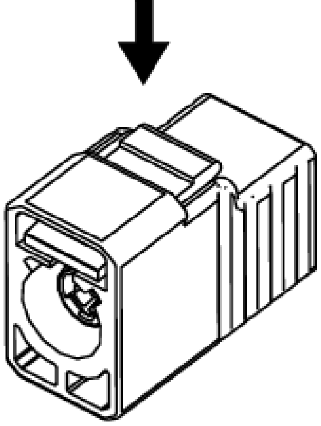
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT	4601	Retained Accessory Power Fused Control	I	K4C
2	0.5	BK	550	Ground	I	K4C
3	0.35	GN	4512	Wireless Charging System Charge Indicator Control	I	K4C
4 - 6	-	-	-	Not Occupied	-	-

T23 RADIO ANTENNA AMPLIFIER X1





Connector Part Information

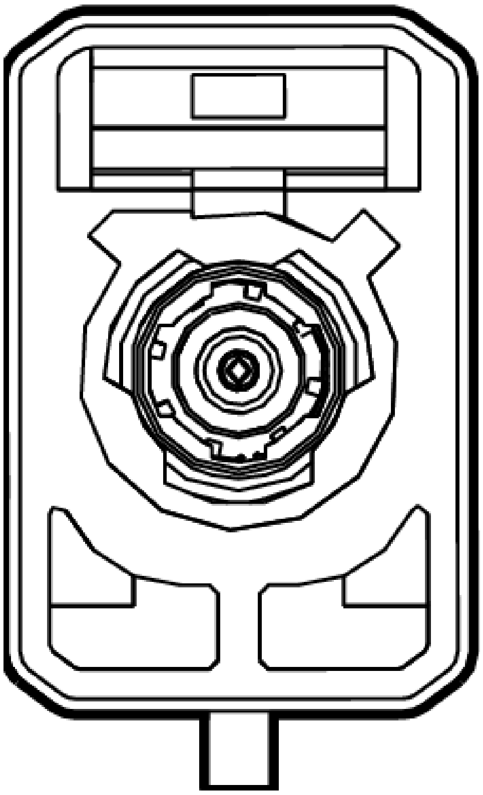
- Harness Type: Radio Antenna Amplifier
- OEM Connector: 13581684
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BK)

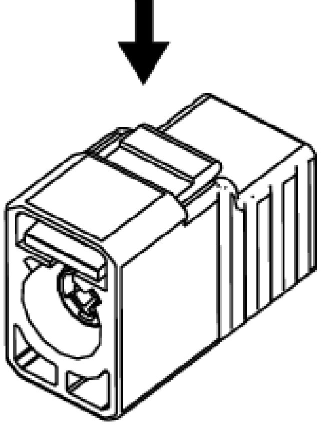
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(AM/FM) Antenna RF Signal	I	-

T23 RADIO ANTENNA AMPLIFIER X2





Connector Part Information

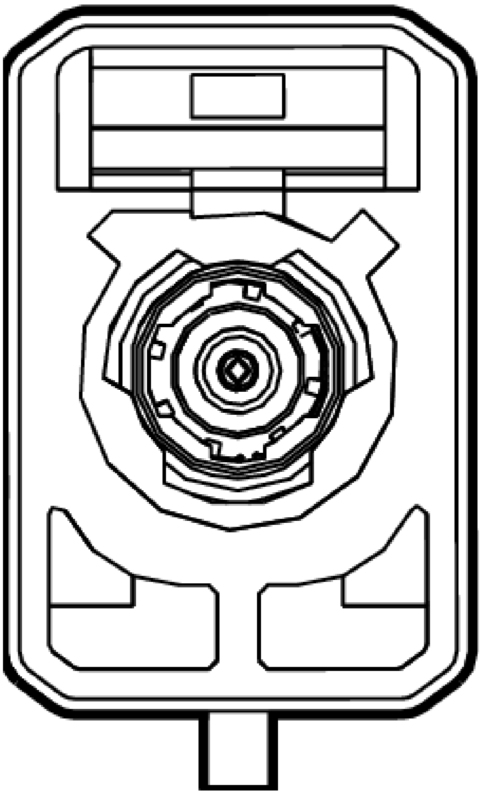
- Harness Type: Radio Antenna Amplifier
- OEM Connector: 13581684
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BK)

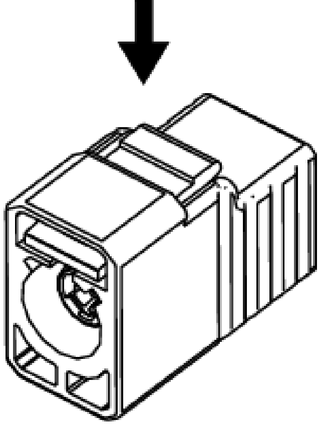
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(AM/FM) Antenna RF Signal	I	-

T23 RADIO ANTENNA AMPLIFIER X3





Connector Part Information

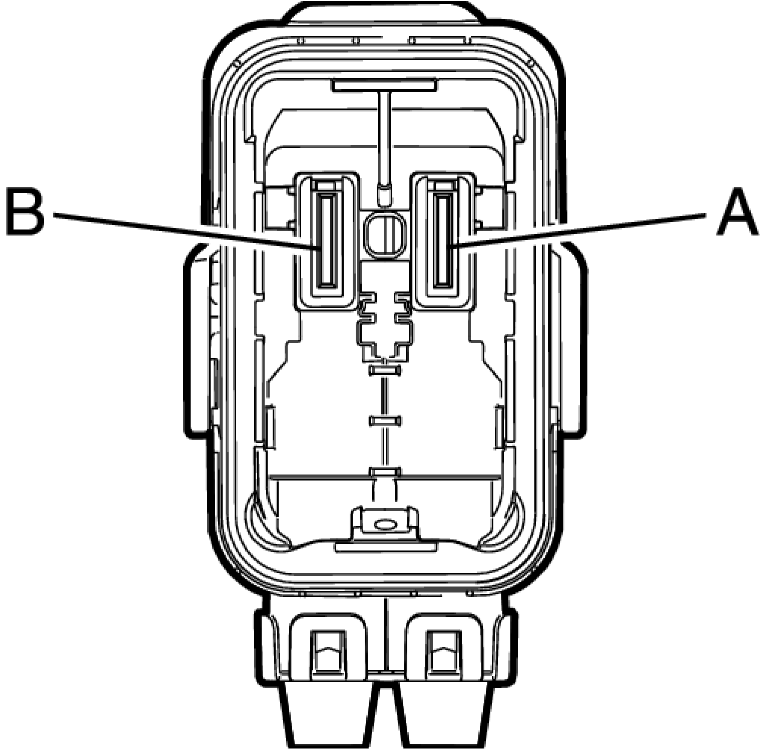
- Harness Type: Radio Antenna Amplifier
- OEM Connector: 13581684
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BK)

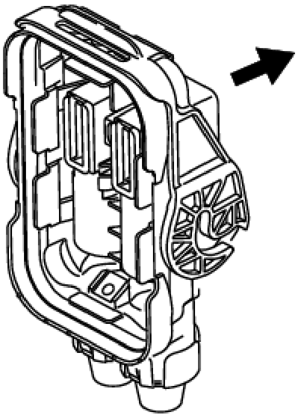
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(DAB/DMB) Coaxial Antenna DAB Signal	I	-

T24 BATTERY CHARGER - DC X2





Connector Part Information

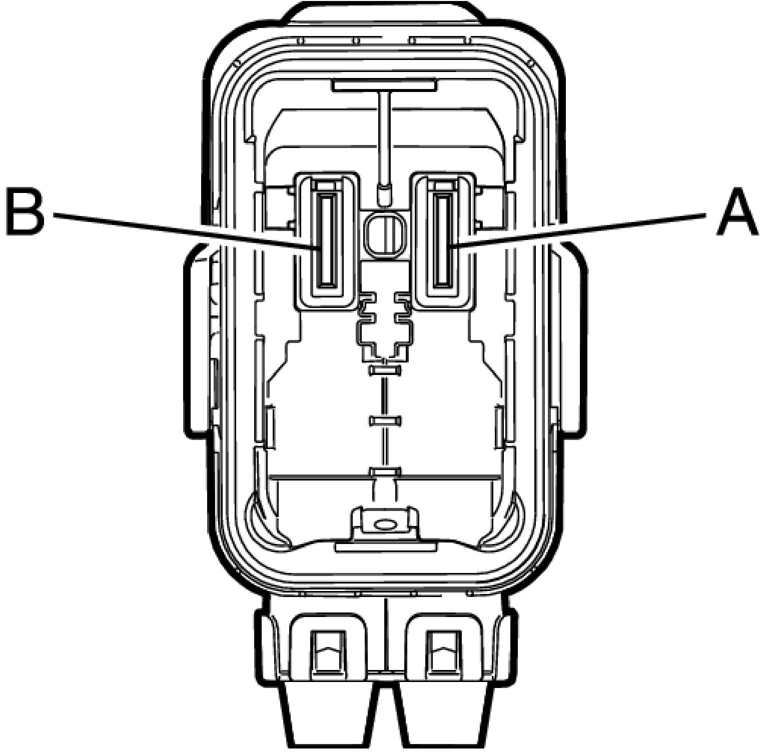
- Harness Type: Engine
- OEM Connector: 13598848
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Power Pack 2000, Sealed (OG)

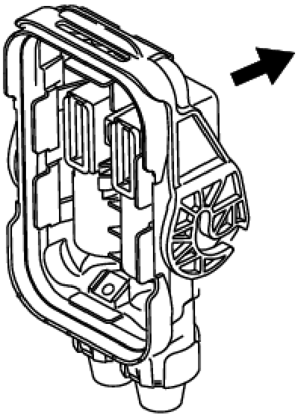
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	4336	B+ (360 V)	I	-
B	-	OG/BK	4335	360 VDC Ground	I	-

T24 BATTERY CHARGER - DC X3





Connector Part Information

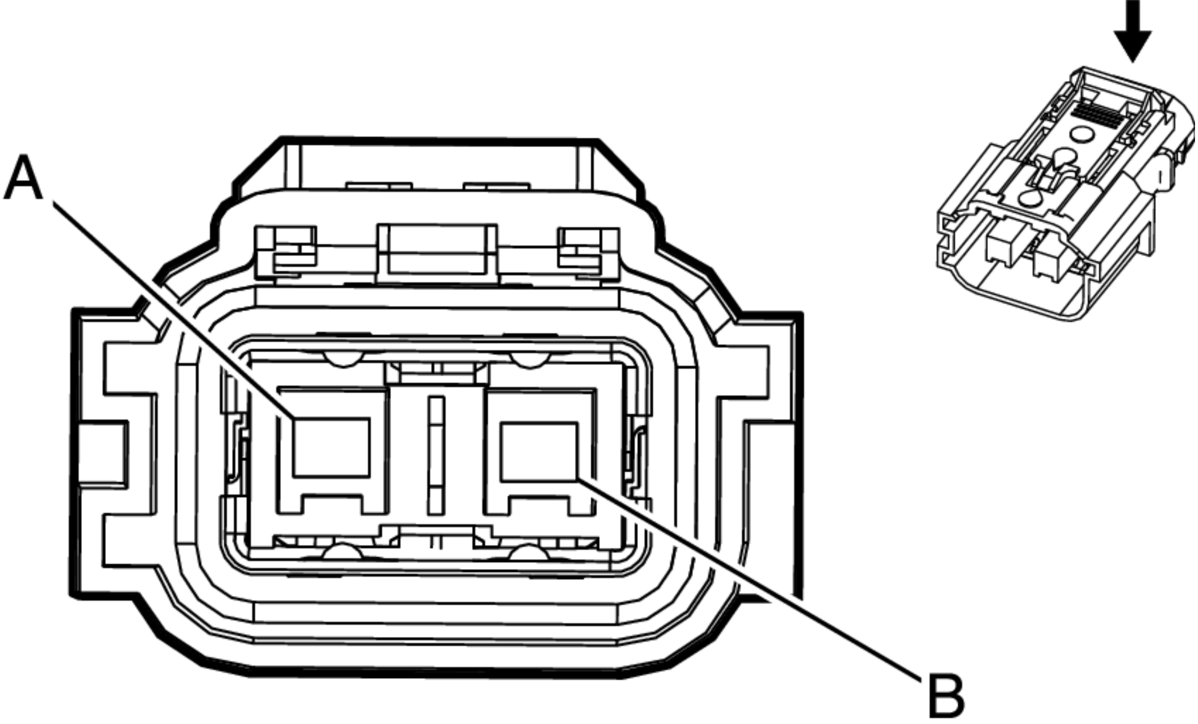
- Harness Type: Engine
- OEM Connector: 13598848
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Power Pack 2000, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	5084	High Voltage Battery (+)	I	-
B	-	OG/BK	5083	High Voltage Battery (-)	I	-

T24 BATTERY CHARGER - DC X4



Connector Part Information

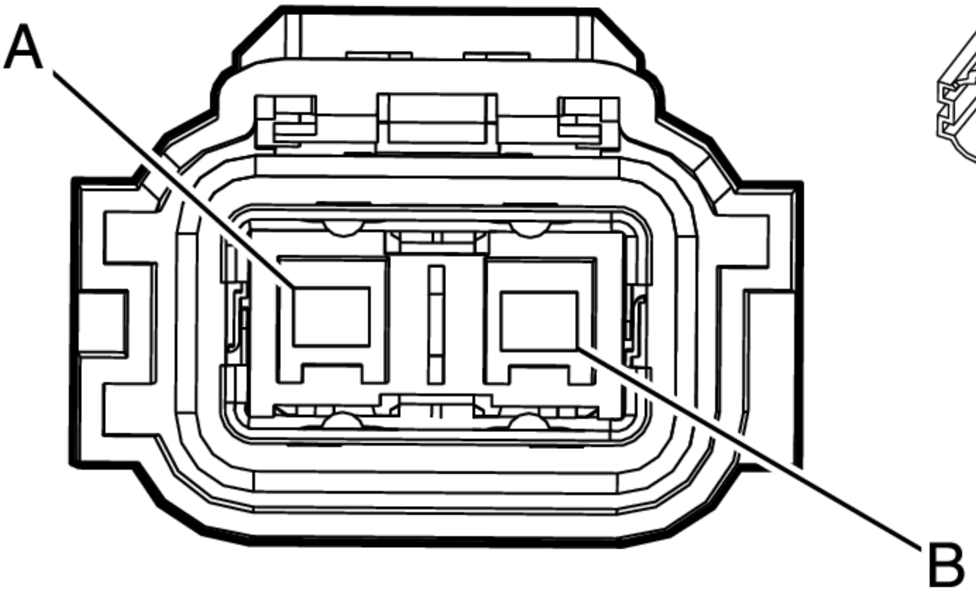
- Harness Type: Engine
- OEM Connector: 13511582
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (OG)

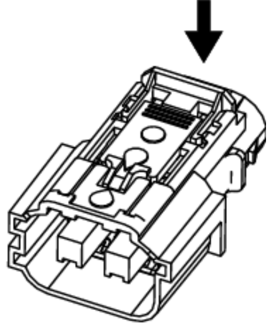
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	3970	High Voltage Battery 4 (+)	I	-
B	-	OG/BK	3969	High Voltage Battery 4 (-)	I	-

T24 BATTERY CHARGER - DC X5





Connector Part Information

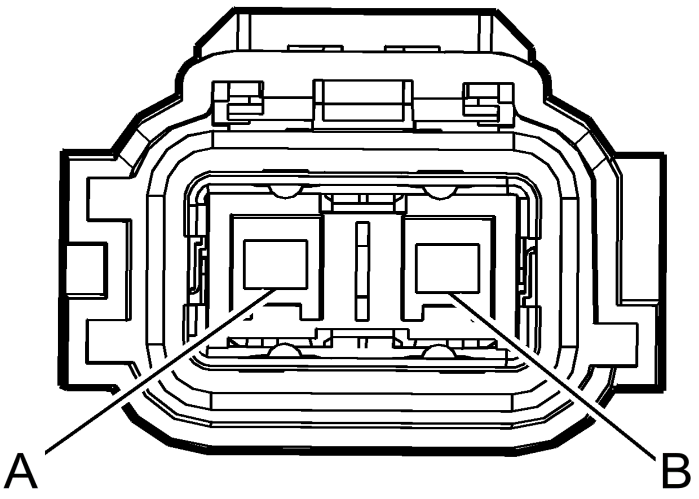
- Harness Type: Engine
- OEM Connector: 13511584
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (OG)

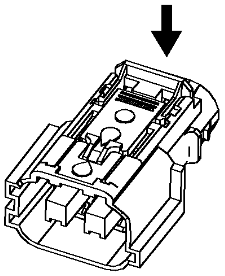
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	3974	High Voltage Battery 5 (+)	I	-
B	-	OG/BK	3973	High Voltage Battery 5 (-)	I	-

T24 BATTERY CHARGER - DC X6





Connector Part Information

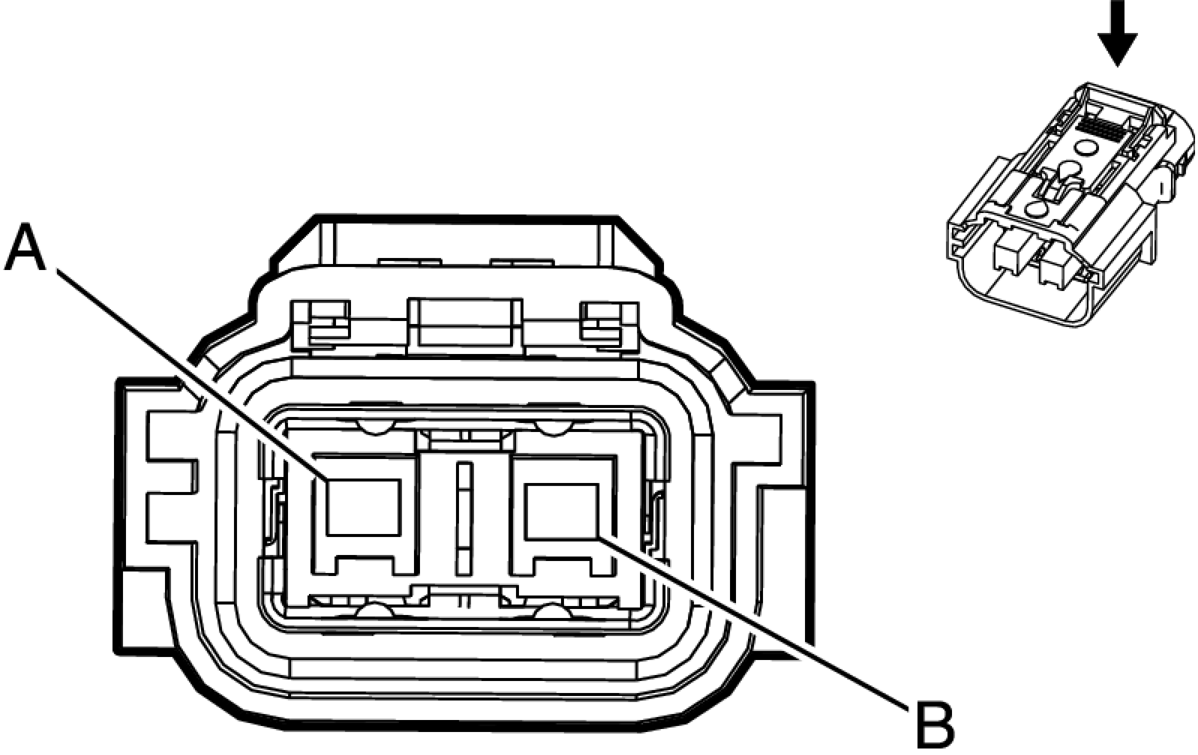
- Harness Type: Engine
- OEM Connector: 13511585
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	3834	High Voltage Battery 2 (+)	I	-
B	-	OG/BK	3833	High Voltage Battery 2 (-)	I	-

T24 BATTERY CHARGER - DC X7



Connector Part Information

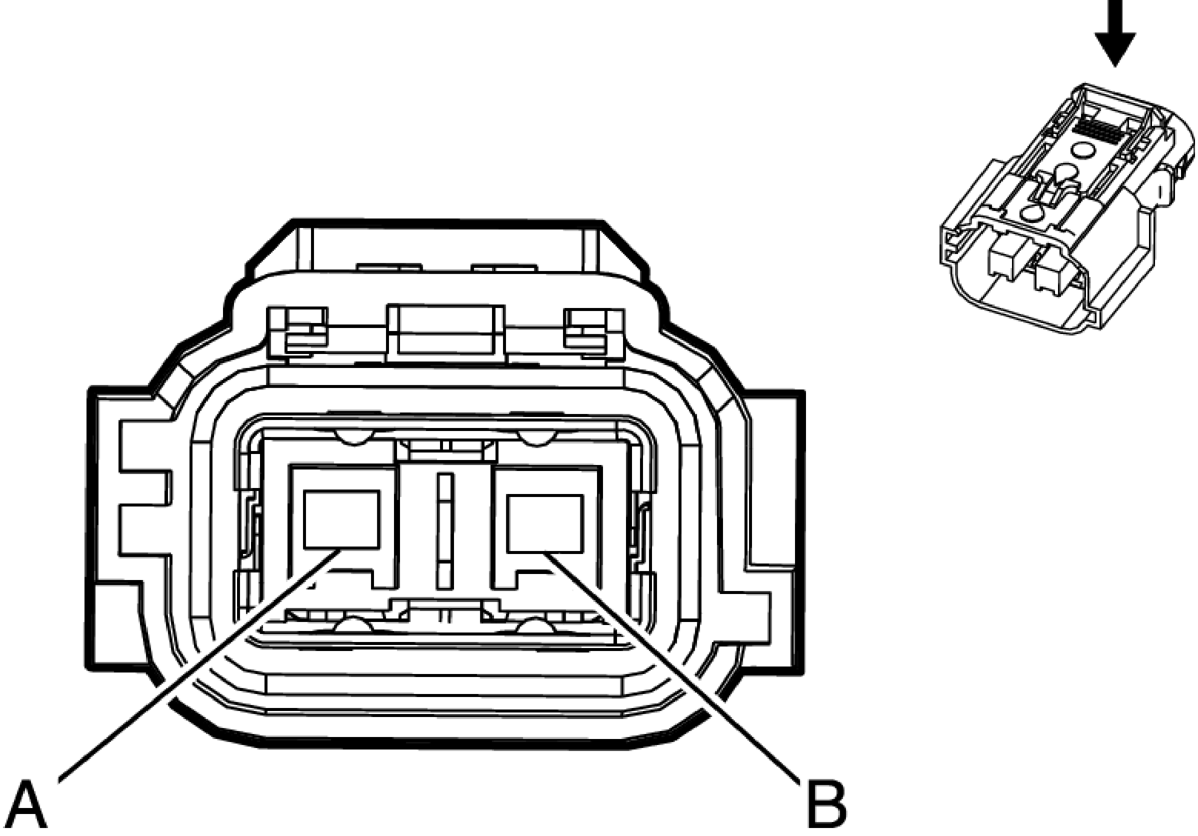
- Harness Type: Engine
- OEM Connector: 13511583
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	2427	High Voltage Battery 6 (+)	I	-
B	-	OG/BK	2429	High Voltage Battery 6 (-)	I	-

T24 BATTERY CHARGER - DC X8



Connector Part Information

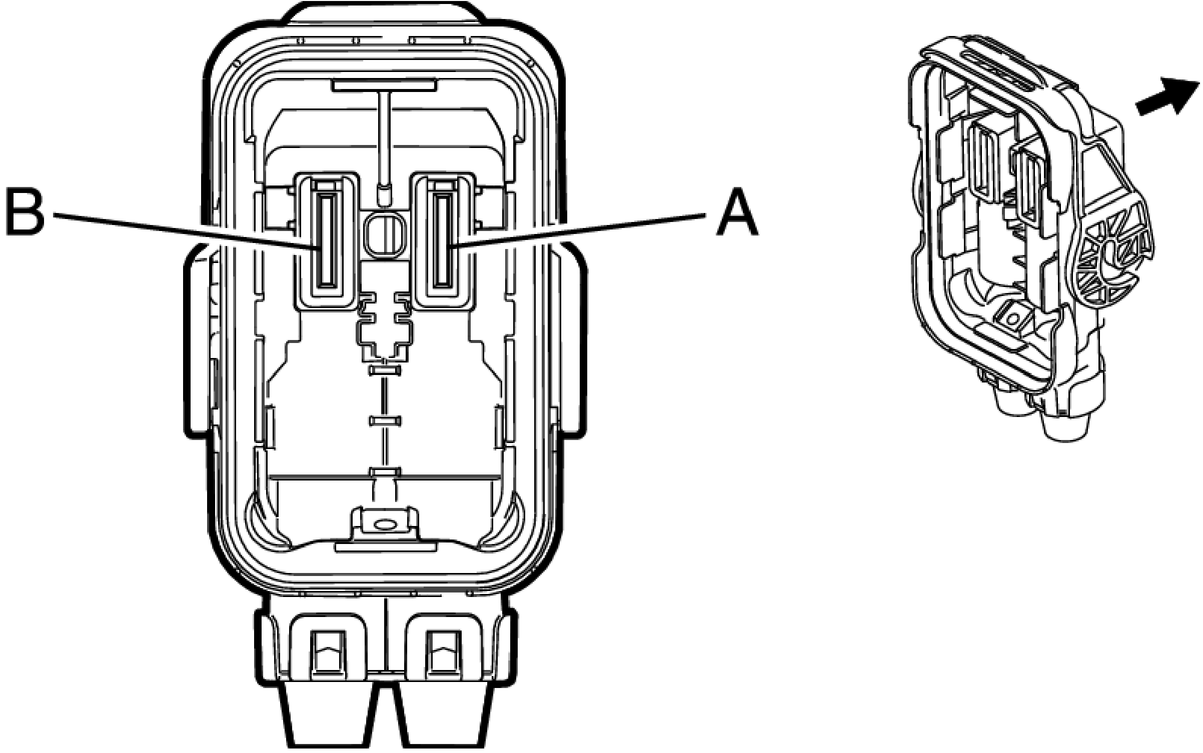
- Harness Type: Engine
- OEM Connector: 13511586
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	2483	High Voltage Battery 7 (+)	I	-
B	-	OG/BK	2485	High Voltage Battery 7 (-)	I	-

T24 BATTERY CHARGER - DC X1



Connector Part Information

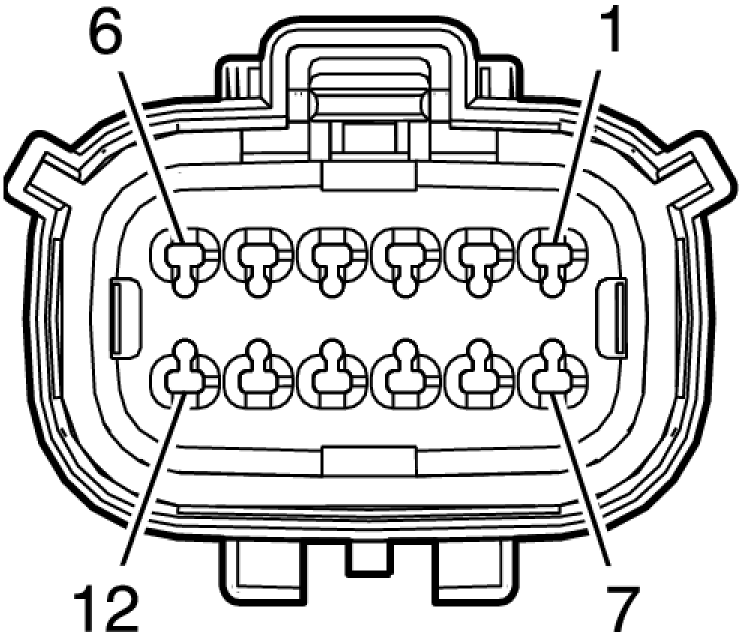
- Harness Type: Engine
- OEM Connector: 13598848
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Power Pack 2000, Sealed (OG)

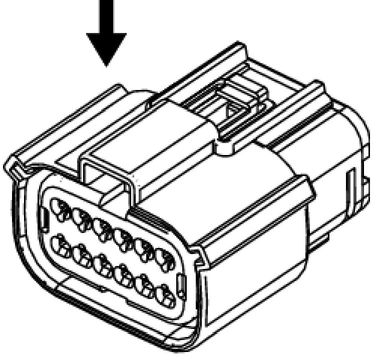
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	3966	High Voltage Battery 3 (+)	I	-
B	-	OG/BK	3965	High Voltage Battery 3 (-)	I	-

T24 BATTERY CHARGER - DC X9 (-CBT)





Connector Part Information

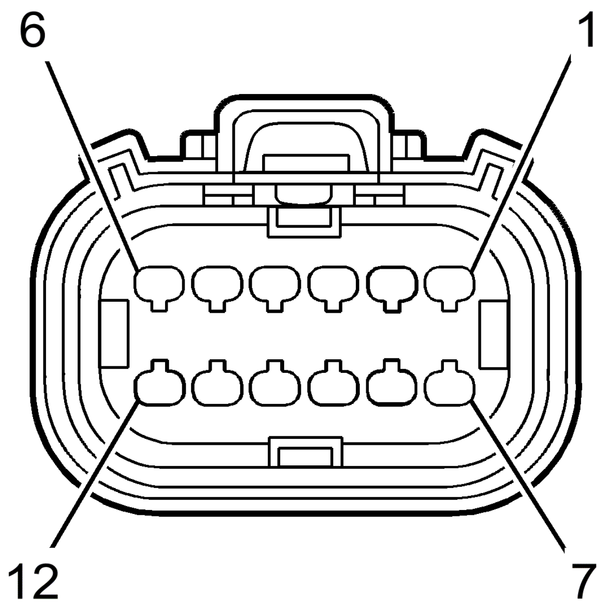
- Harness Type: Engine
- OEM Connector: 33472-1296
- Service Connector: 13503528
- Description: 12-Way F 150 MX Series, Sealed (BK)

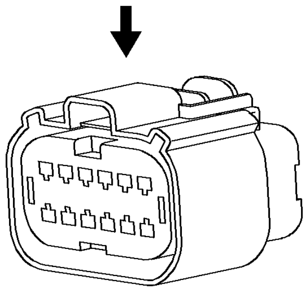
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	350	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	0.5	BK	350	Ground	I	-
4 - 5	-	-	-	Not Occupied	-	-
6	0.5	VT	4334	Battery Pack Coolant Heater Control	I	-
7	0.5	GY/VT	5595	High Voltage Interlock Loop Signal 2	I	-
8 - 11	-	-	-	Not Occupied	-	-
12	0.5	YE	5690	High Voltage Interlock Loop Signal 3	I	-

X21 MANUAL SERVICE DISCONNECT RECEPTACLE X1





Connector Part Information

- Harness Type: Battery Disconnect
- OEM Connector: 13586052
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F 150 MX Series, Sealed (D-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	BUS	-	I	-
2 - 12	-	-	-	Not Occupied	-	-

X21 MANUAL SERVICE DISCONNECT RECEPTACLE X2

-

Connector Part Information

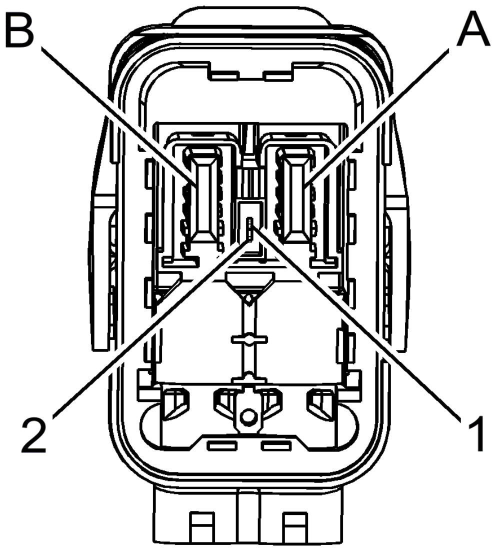
- Harness Type: Battery Disconnect
- OEM Connector: 13589660
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

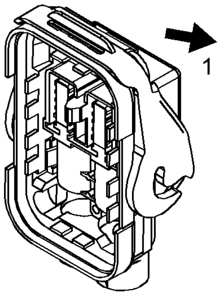
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	BUS	-	I	-

X21 MANUAL SERVICE DISCONNECT RECEPTACLE X3





Connector Part Information

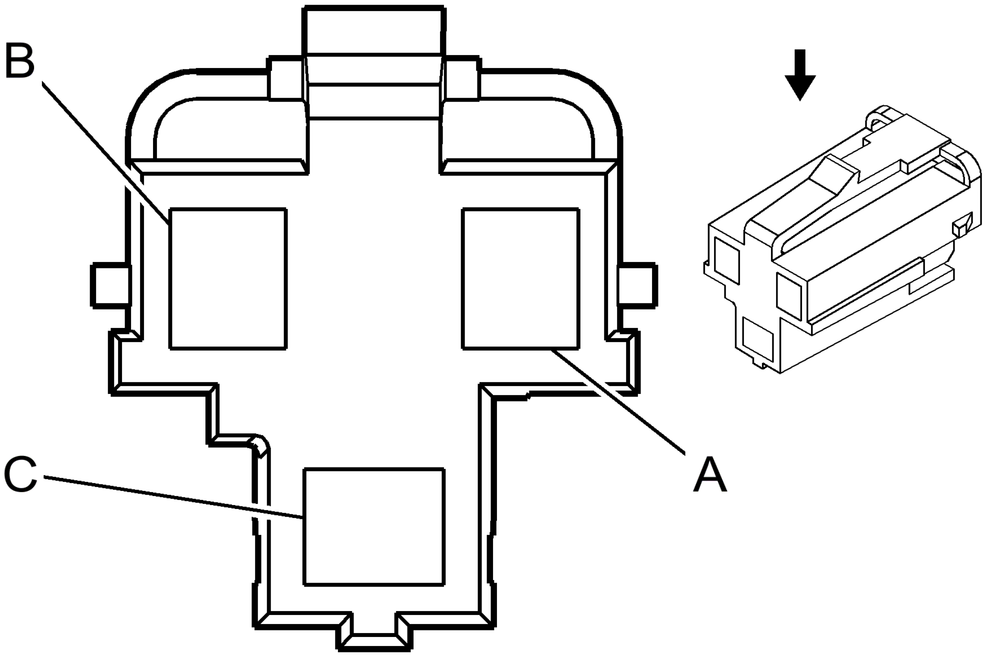
- Harness Type: Battery Disconnect
- OEM Connector: 13584040
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F Power Pack 2000 Series, Sealed

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT	5087	High Voltage Interlock Loop Signal 1	I	-
2	-	BK/BN	5088	High Voltage Interlock Loop Low Reference 1	I	-
A - B	-	-	-	Not Occupied	-	-

X80 ACCESSORY POWER RECEPTACLE



Connector Part Information

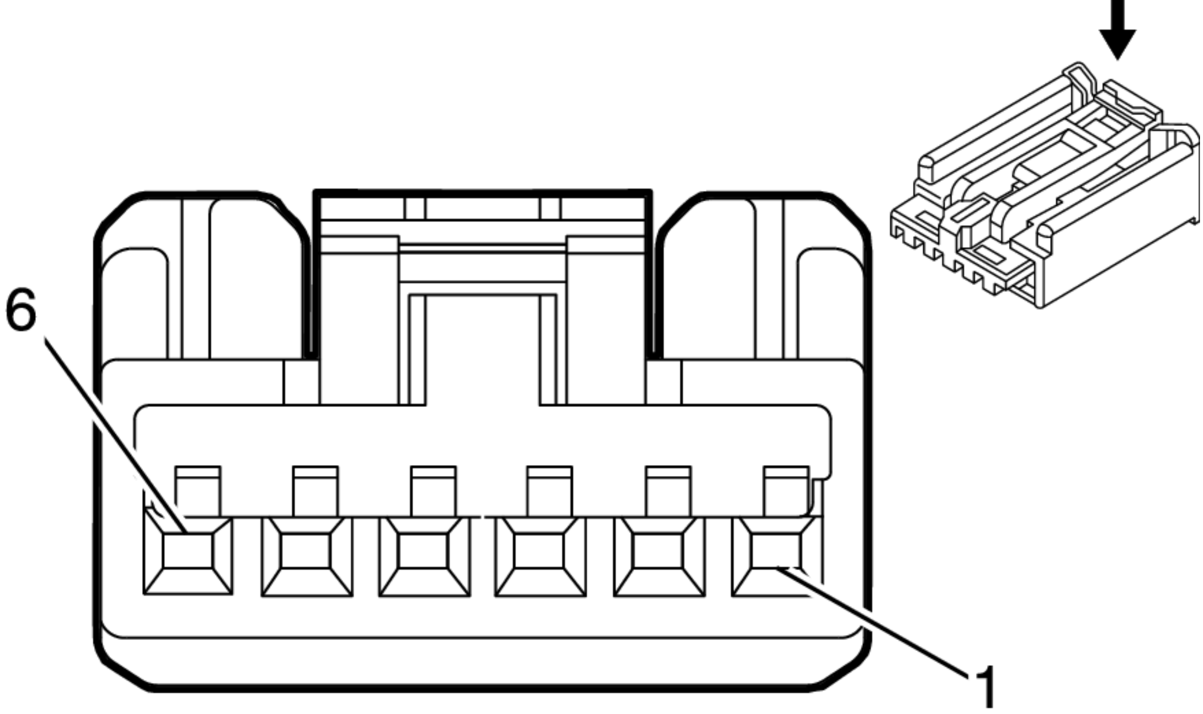
- Harness Type: Instrument Panel
- OEM Connector: 12176446
- Service Connector: 19257374
- Description: 3-Way F 280 Metri-Pack Flexlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	1	VT	1701	Retained Accessory Power Ignition	I	-
B	-	-	-	Not Occupied	-	-
C	1	BK	1350	Ground	I	-

X83 AUXILIARY AUDIO INPUT X1



Connector Part Information

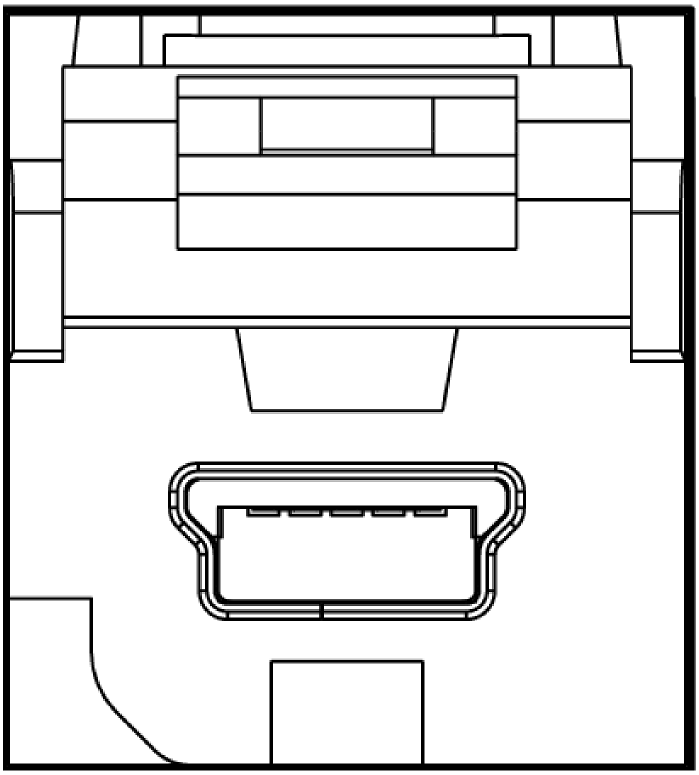
- Harness Type: Floor Console
- OEM Connector: AIT2PB-06-1AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Kaizen Series (BK)

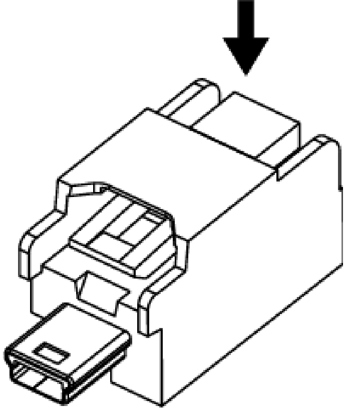
Terminal Part Information

Terminal Type ID	**Terminated Lead**	**Diagnostic Test Probe**	**Terminal Removal Tool**	**Service Terminal**	**Tray Name**	**Core Crimp**	**Insulation Crimp**
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	**Size**	**Color**	**Circuit**	**Function**	**Terminal Type ID**	**Option**
1 - 3	-	-	-	Not Occupied	-	-
4	0.35	BK	2050	Ground	I	-
5	-	-	-	Not Occupied	-	-
6	0.35	RD/GN	6940	Battery Positive Voltage	I	-

X83 AUXILIARY AUDIO INPUT X2





Connector Part Information

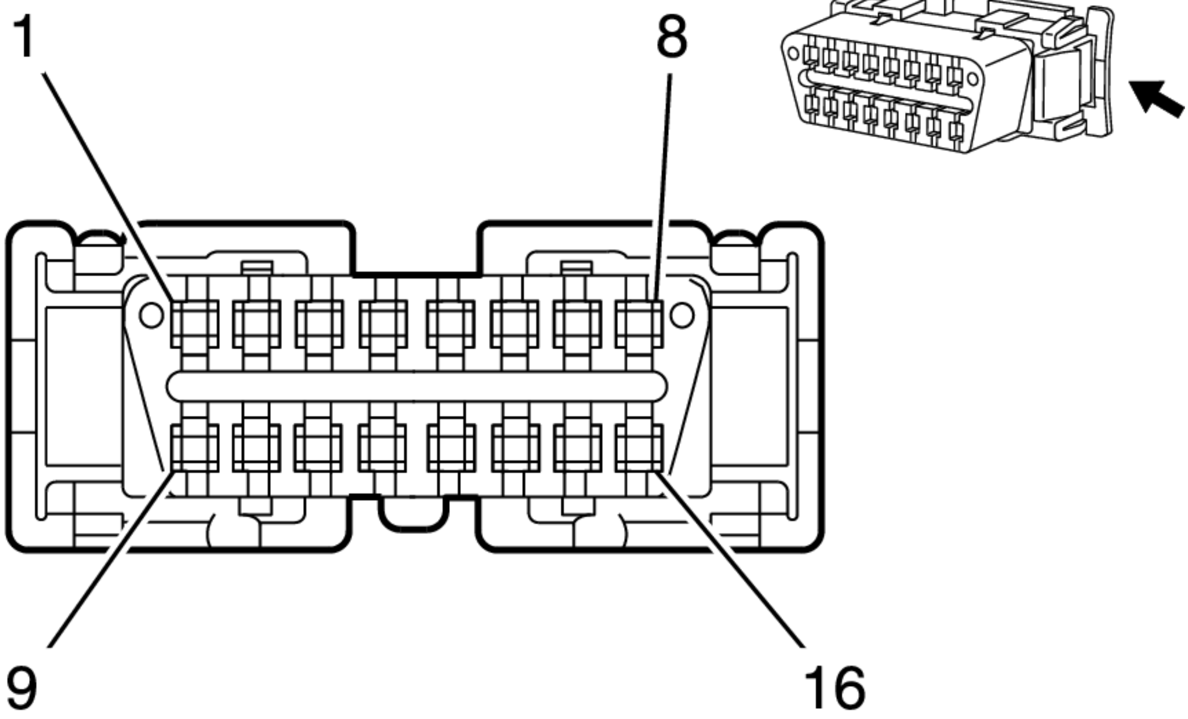
- Harness Type: Floor Console
- OEM Connector: 13868840
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 5-Way M 2.0 Mini-B USB Type (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	USB	-	USB Serial Data	I	-

X84B AUXILIARY DATA CONNECTOR X2



Connector Part Information

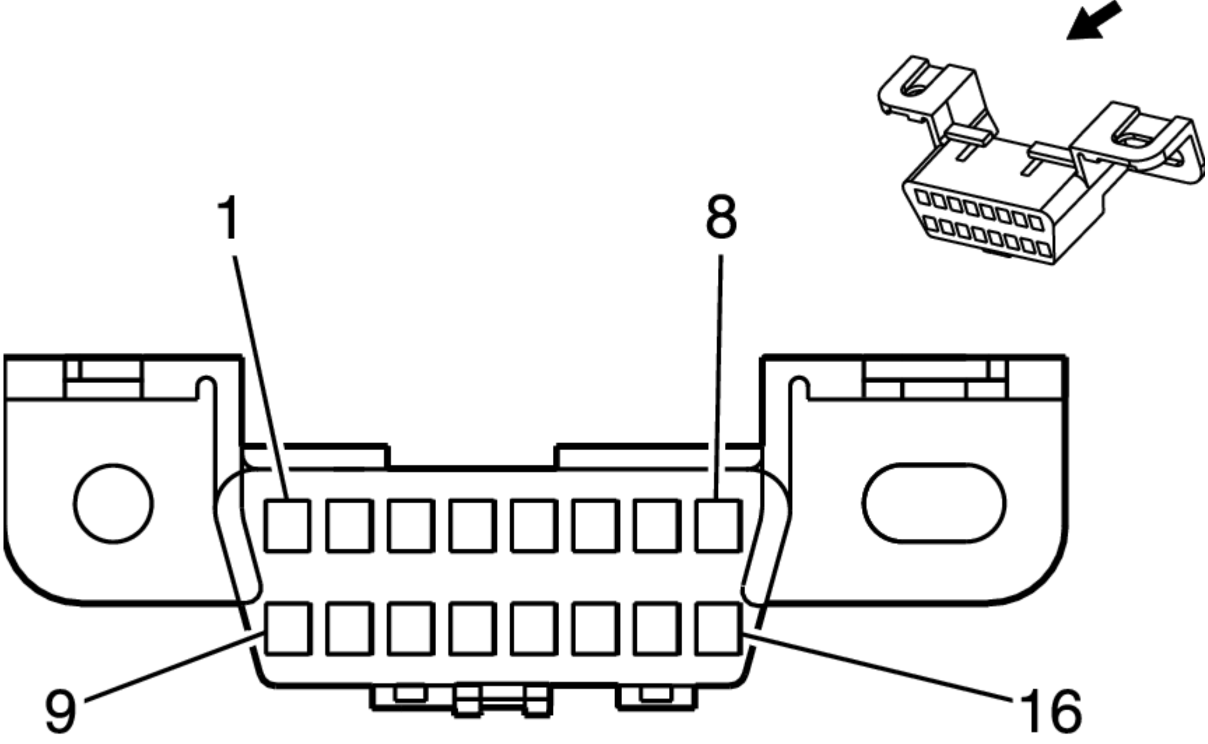
- Harness Type: Instrument Panel
- OEM Connector: 51115-1621
- Service Connector: 13584381
- Description: 16-Way F 51115 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575534	J-35616-2A (GY)	J-38125-12A	50420-8000	Yazaki 15	H	H

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.5	YE	3831	High Speed GMLAN Serial Data (+) 6	I	-
4	0.5	BK	1450	Ground	I	-
5	0.5	BK	1450	Ground	I	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.5	BK	1450	Ground	I	-
9 - 10	-	-	-	Not Occupied	-	-
11	0.5	WH	3832	High Speed GMLAN Serial Data (-) 6	I	-
12	0.5	BU/BK	7493	High Speed GMLAN Serial Data (+)3	I	-
13	0.5	WH	7494	High Speed GMLAN Serial Data (-)3	I	-
14 - 15	-	-	-	Not Occupied	-	-
16	0.5	RD/BN	4940	Battery Positive Voltage	I	-

X84 DATA LINK CONNECTOR



Connector Part Information

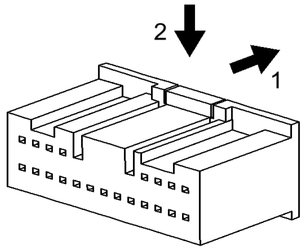
- Harness Type: Instrument Panel
- OEM Connector: 12110250
- Service Connector: 12110250
- Description: 16-Way F 150 Metri-Pack Series (BK)

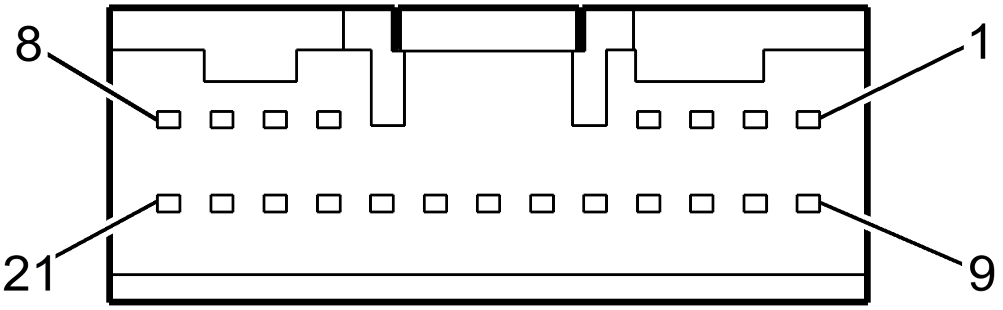
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575725	J-35616-14 (GN)	J-38125-12A	12129484	Delphi 19	E	C

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
2 - 3	-	-	-	Not Occupied	-	-
4	0.5	BK	1350	Ground	I	-
5	0.5	BK	1250	Ground	I	-
6	0.5	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
7 - 11	-	-	-	Not Occupied	-	-
12	0.5	BU/YE	6105	High Speed GMLAN Serial Data (+) 2	I	-
13	0.5	WH	6106	High Speed GMLAN Serial Data (-) 2	I	-
14	0.5	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
15	-	-	-	Not Occupied	-	-
16	0.35	RD/GY	4840	Battery Positive Voltage	I	-

X85 STEERING WHEEL AIR BAG COIL X1





Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: ATLCPB-21B-2AY
- Service Connector: 13510218
- Description: 21-Way F 0.64 Series, Sealed (YE)

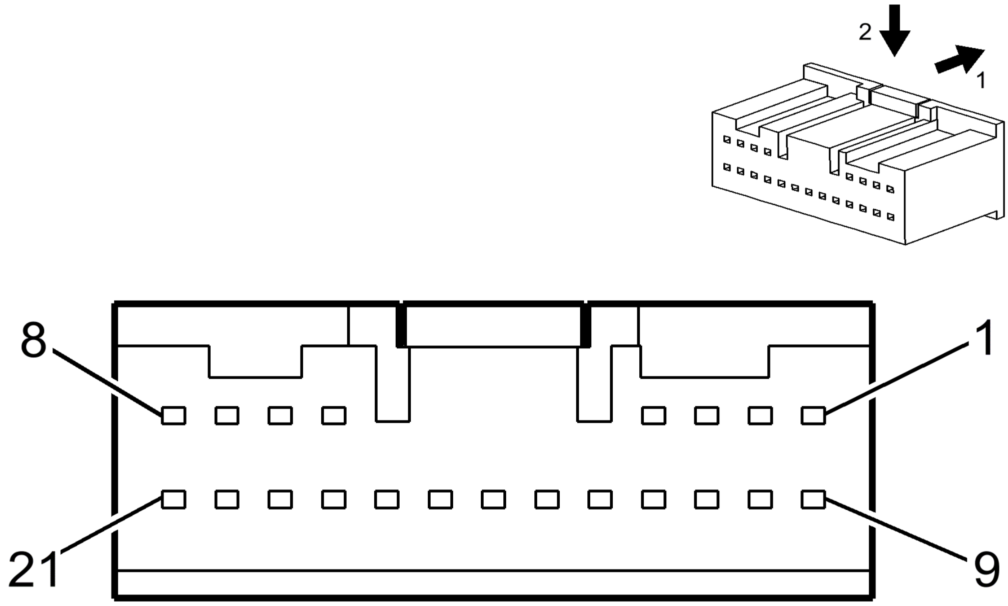
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575864	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03GF-M064	Yazaki 27	P	P
II	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	OG/VT	3021	Steering Wheel Module Stage 1 High Control	I	AY0/AYF
2	0.35	BN/OG	3020	Steering Wheel Module Stage 1 Low Control	I	AY0/AYF
3	0.35	WH/OG	3022	Steering Wheel Module Stage 2 Low Control	I	AY0/AYF
4	0.35	OG/GN	3023	Steering Wheel Module Stage 2 High Control	I	AY0/AYF
5	0.35	GN/WH	3287	Horn Switch Signal	II	-
6	0.5	BK	1350	Ground	II	-
7	-	-	-	Not Occupied	-	-
8	0.5	BK	1350	Ground	II	-
9	0.5	GN/BK	3894	Local Interconnect Network Serial Data Bus 12	II	-
10	0.35	YE	6817	LED Backlight Dimming Control	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.35	BN/GN	1884	Cruise Control Set/Coast/Resume/Accelerate Switch Signal	II	-
12	0.35	WH	3152	Lane Departure Warning Indicator Control	II	-
13	0.35	YE	7556	Lighting Control Switch Reference	II	-
14	-	-	-	Not Occupied	-	-
15	0.35	GY/WH	3153	Lane Departure Warning Disable Switch Signal	II	-
16	0.5	VT/YE	5526	Tap Up/Tap Down Switch Signal	II	-
17	-	-	-	Not Occupied	-	-
18	0.35	RD/YE	5040	Battery Positive Voltage	II	-
19 - 20	-	-	-	Not Occupied	-	-
21	0.35	VT/GN	2239	Run/Crank Ignition 1 Voltage	II	-

X85 STEERING WHEEL AIR BAG COIL X2



Connector Part Information

- Harness Type: Steering Wheel Harness
- OEM Connector: 13510218
- Service Connector: Service by Harness - See Part Catalog
- Description: 21-Way F 0.64 Series, Sealed (YE)

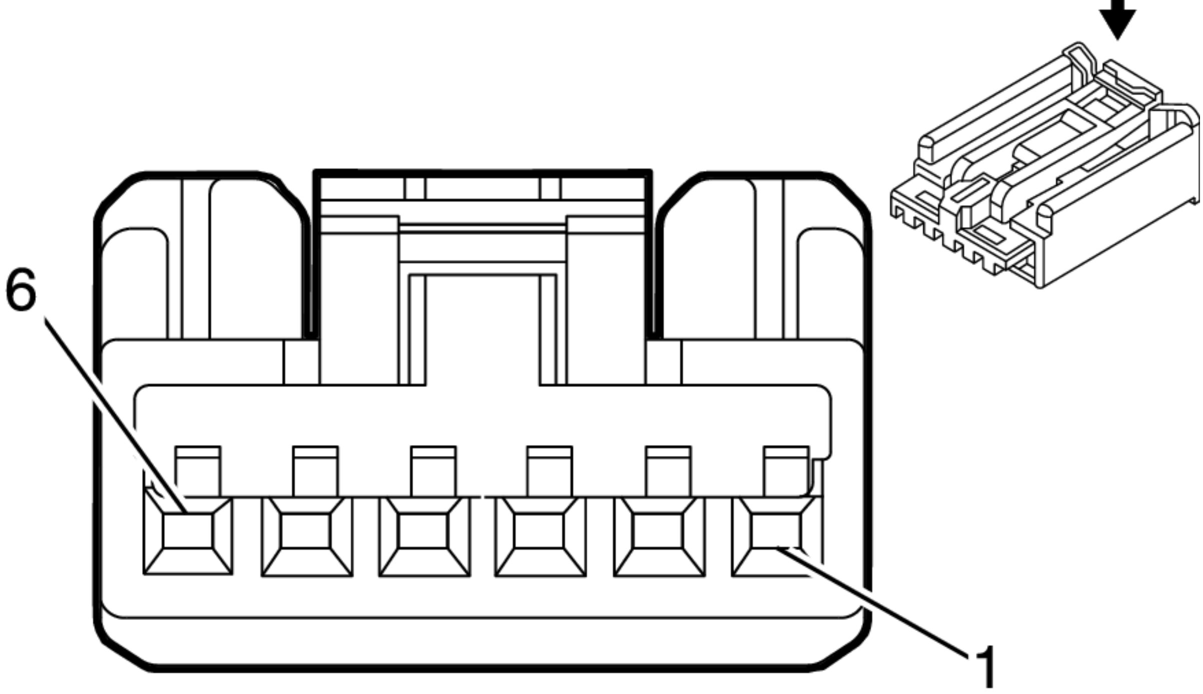
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BK	1150	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	-	BK	1650	Ground	I	-
4	-	RD	3287	Horn Switch Signal	I	-
5	-	WH	3023	Steering Wheel Module Stage 2 High Control	I	-
6	-	PK	3022	Steering Wheel Module Stage 2 Low Control	I	-
7	-	BN	3020	Steering Wheel Module Stage 1 Low Control	I	-
8	-	TN	3021	Steering Wheel Module Stage 1 High Control	I	-
9	-	VT/GN	2239	Run/Crank Ignition 1 Voltage	I	-
10 - 11	-	-	-	Not Occupied	-	-
12	- -	RD/YE RD/YE	5040 5440	Battery Positive Voltage Battery Positive Voltage	I I	- -
13	-	-	-	Not Occupied	-	-
14	-	VT/YE	5526	Tap Up/Tap Down Switch Signal	I	-
15	-	GY/WH	3153	Lane Departure Warning Disable Switch Signal	I	-
16	-	-	-	Not Occupied	-	-
17	-	YE	7556	Lighting Control Switch Reference	I	-
18	-	WH	3152	Lane Departure Warning Indicator Control	I	-
19	-	BN/GN	1884	Cruise Control Set/Coast/Resume/Accelerate Switch Signal	I	-
20	-	YE	6817	LED Backlight Dimming Control	I	-
21	-	GN/BK	3894	Local Interconnect Network Serial Data Bus 12	I	-

X92 USB RECEPTACLE (USS)



Connector Part Information

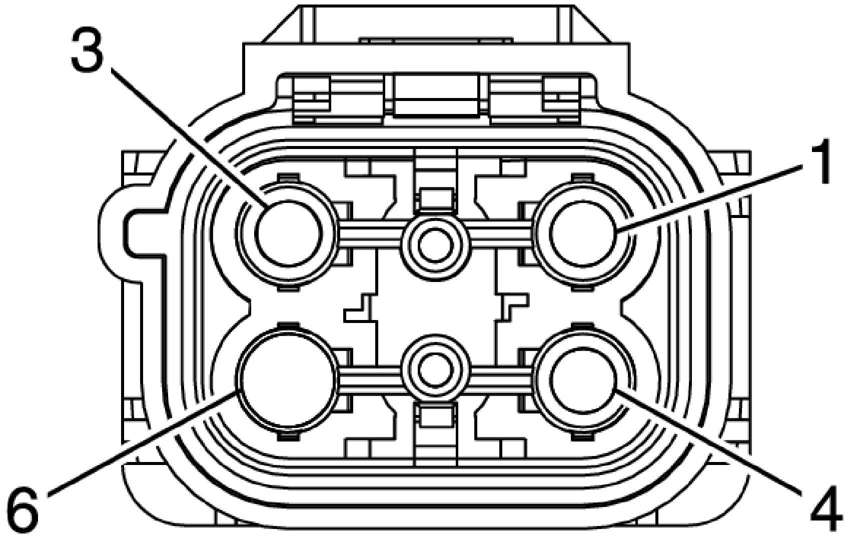
- Harness Type: Floor Console
- OEM Connector: AIT2PB-06-1AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 0.64 Kaizen Series (BK)

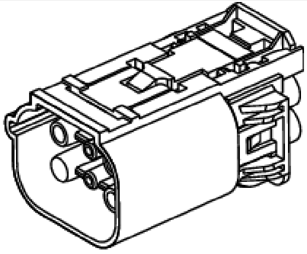
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 3	-	-	-	Not Occupied	-	-
4	0.35	BK	550	Ground	I	USS
5	-	-	-	Not Occupied	-	-
6	0.35	VT	2801	Retained Accessory Power Fuse Ignition	I	USS

X98 HYBRID/EV BATTERY CHARGER RECEPTACLE X1





Connector Part Information

- Harness Type: Battery Charger Receptacle
- OEM Connector: 13593533
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 1.0, 2.4 HES Sealed (OG)

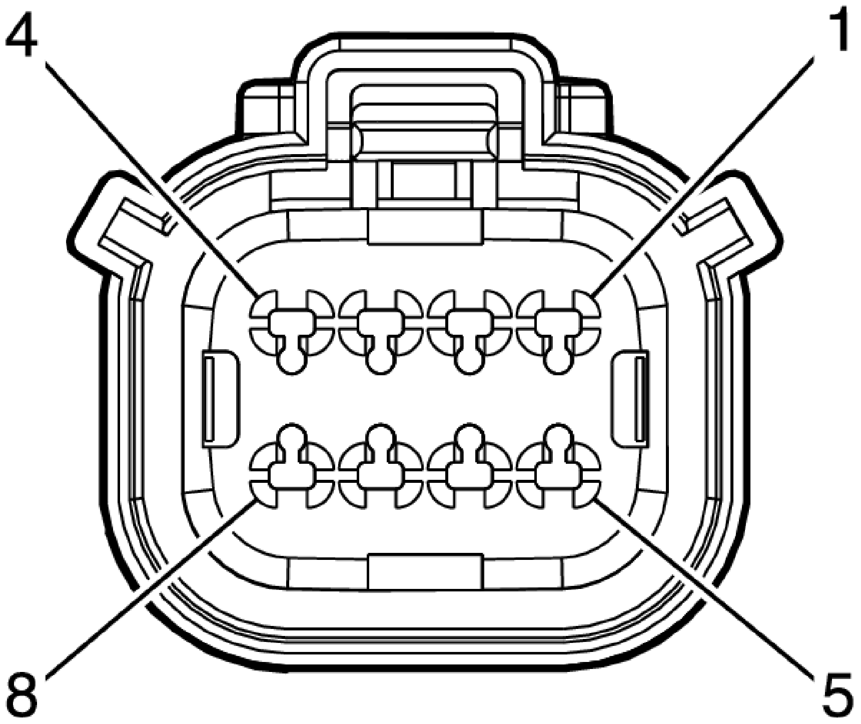
Terminal Part Information

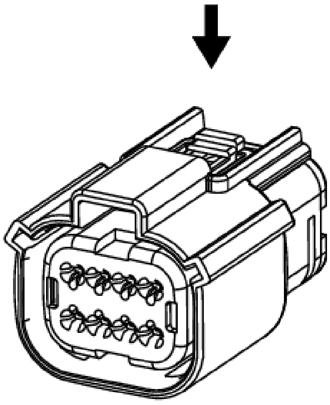
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	-	GY/GN	3954	Control Pilot Signal 1	I	-
3	-	BU	3837	Voltage AC Line 1	I	-
4	-	WH	3838	Voltage AC Neutral Line 2	I	-
5	-	BU/YE	3953	Proximity Status Signal 1	I	-
6	-	-	-	Not Occupied	-	-

X98 HYBRID/EV BATTERY CHARGER RECEPTACLE X2 (CBT)





Connector Part Information

- Harness Type: Drive Motor Battery Recharger Receptacle
- OEM Connector: 13503524
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	WH/GY	5239	Battery Charger Receptacle Lock Actuator Position Sensor 5 Volt Reference	I	-
2	-	YE/GY	5241	Battery Charger Receptacle Lock Actuator Position Sensor Low Reference	I	-
3	-	GN/VT	5243	Battery Charger Receptacle Lock Actuator Position Sensor Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
4	-	VT/BN	3699	Charge Port Door Switch Signal	I	-
5	-	GY/BU	213	Charge Port Paddle Temperature Sensor Signal	I	-
6	-	BK/BU	5404	Charge Port Paddle Temperature Sensor Low Reference	I	-
7	-	BN/YE	2231	Charge Port Valve Motor Close Control	I	-
8	-	BU/WH	2230	Charge Port Valve Motor Open Control	I	-

COMPONENT CONNECTOR END VIEWS

A4 HYBRID/EV BATTERY PACK X1

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Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	5084	High Voltage Battery (+)	I	-
B	-	OG/BK	5083	High Voltage Battery (-)	I	-

A4 HYBRID/EV BATTERY PACK X3

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Connector Part Information

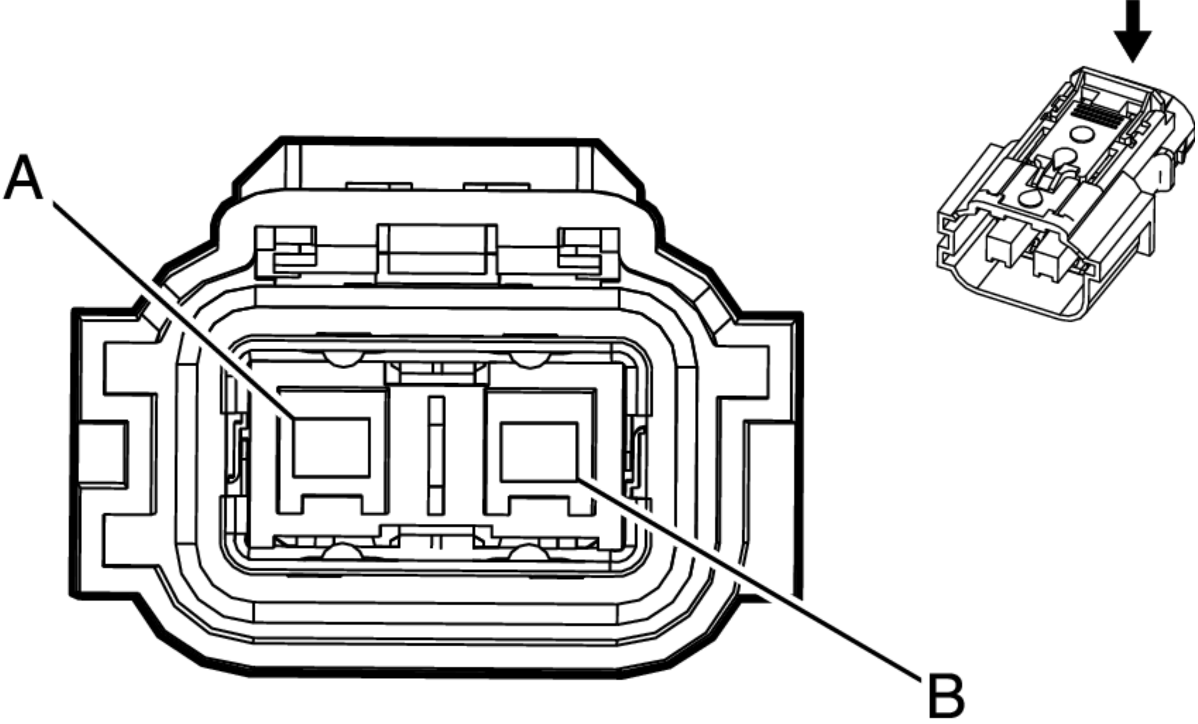
- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	5084	High Voltage Battery (+)	I	-
B	-	OG/BK	5083	High Voltage Battery (-)	I	-

A4 HYBRID/EV BATTERY PACK X4



Connector Part Information

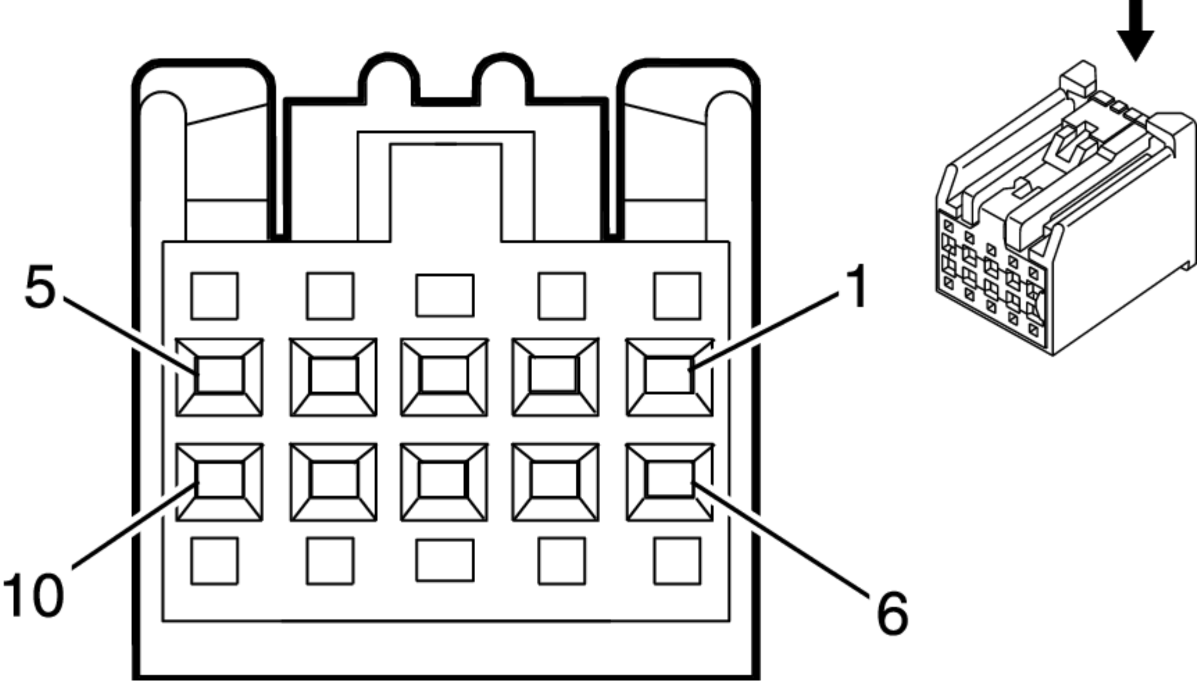
- Harness Type: Hybrid/EV Battery
- OEM Connector: 13511582
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 280 Metri-Pack Series, Sealed (OG)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	OG	2427	High Voltage Battery 6 (+)	I	-
B	-	OG/BK	2429	High Voltage Battery 6 (-)	I	-

A10 INSIDE REARVIEW MIRROR X1



Connector Part Information

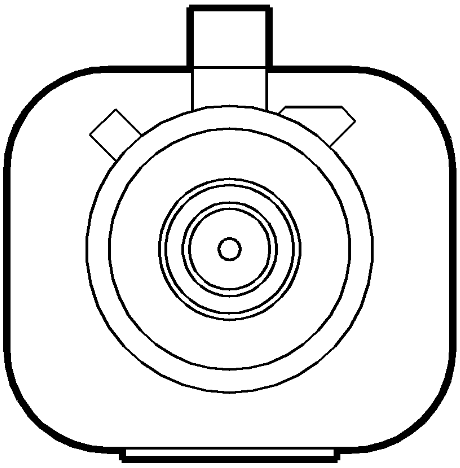
- Harness Type: Headliner
- OEM Connector: AIT2PB-10P-2AK
- Service Connector: 13577390
- Description: 10-Way F 0.64 Kaizen Series (BK)

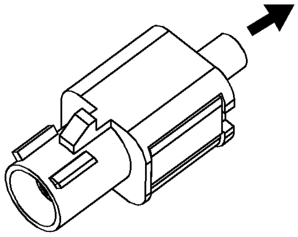
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/WH	24	Backup Lamp Control	I	-
2	0.5	VT/BK	339	Run/Crank Ignition 1 Voltage	I	-
3 - 4	-	-	-	Not Occupied	-	-
5	0.5	BK	550	Ground	I	-
6 - 10	-	-	-	Not Occupied	-	-

A10 INSIDE REARVIEW MIRROR X2 (DRZ)





Connector Part Information

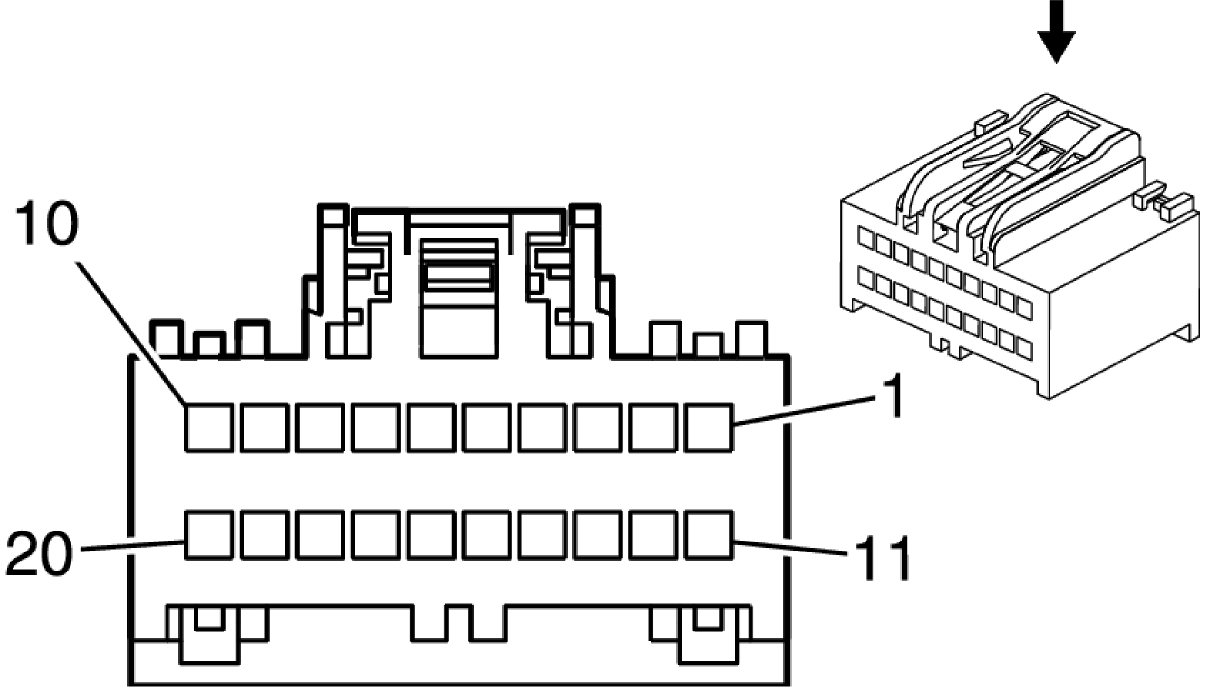
- Harness Type: Headliner Harness
- OEM Connector: 13594293
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way M Coax Type (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	LVDS	-	(Infotainment) Infotainment Display Signal	I	-

A11 RADIO X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-0201
- Service Connector: 13593932
- Description: 20-Way F USCAR 64 Series (GY)

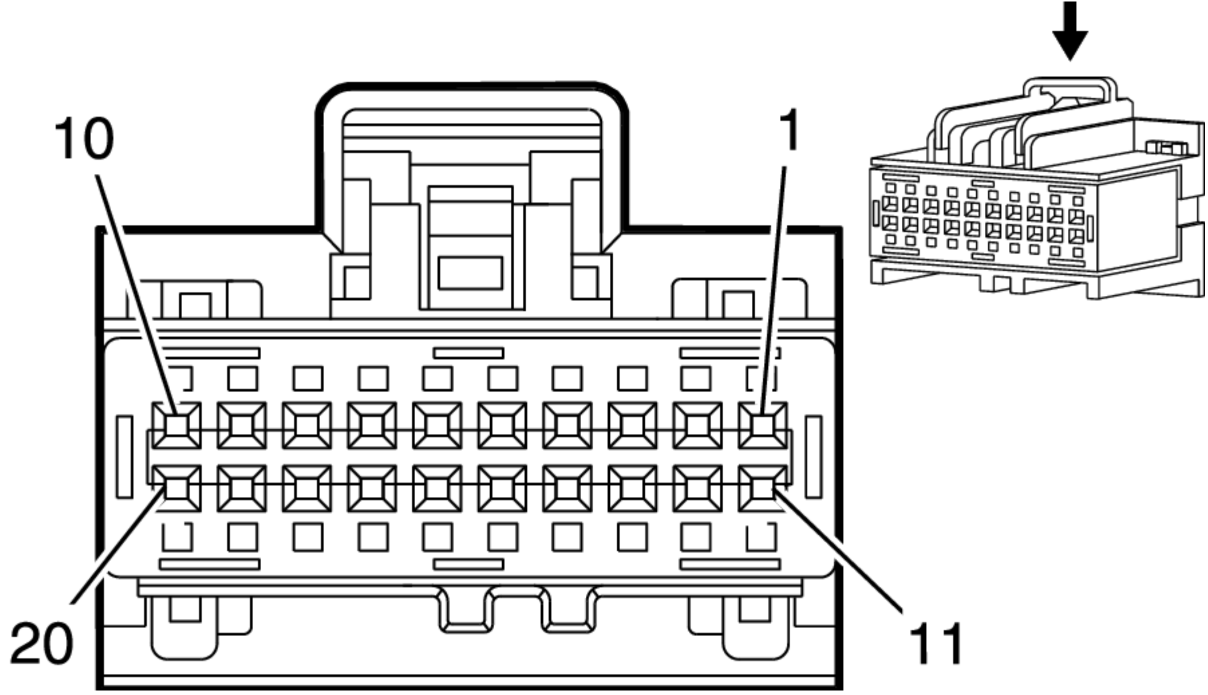
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK/WH	151	Signal Ground	I	-
2	0.35	BK/GN	2804	Radio Display Backlight Low Reference	I	-
3	0.35	BU/GN	2813	Radio Display Backlight Dimming Control	I	-
4	0.35	GY/GN	1102	Low Speed GMLAN Serial Data #2	I	-
5	-	-	-	Not Occupied	-	-
6	0.5 0.5	BK/GY BK/BN	5152 654	Voice Recognition Audio Low Reference Cellular Telephone Microphone Low Reference	I I	UE1 -UE1
7	0.5 0.5	GY/YE BU	5149 655	Voice Recognition Audio Signal Cellular Telephone Microphone Signal	I I	UE1 -UE1
8	0.35	VT/WH	2810	Radio Keypad Button Signal	I	-
9	0.5	BK/YE	659	Cellular Telephone Voice Low Reference	I	UE1
10	0.5	YE	658	Cellular Telephone Voice Signal	I	UE1
11	0.75	RD/WH	6440	Battery Positive Voltage	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
12	0.5	GN/YE	7066	Entertainment Remote Enable Signal	I	UQA
13	-	-	-	Not Occupied	-	-
14	0.35 0.35	WH/BU GN/WH	6973 4661	Camera Signal 2 Combined Camera Video Signal (-)	I I	UVC UVH
15	0.35 0.35	GY/YE WH/VT	6972 4660	Camera Signal 2 + Combined Camera Video Signal (+)	I I	UVC UVH
16 - 20	-	-	-	Not Occupied	-	-

A11 RADIO X2



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 31410-0202
- Service Connector: 13593933
- Description: 20-Way F USCAR 64 Series (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575867	J-35616-64B (LT BU)	J-38125-215A	SAIT-A03T-M064	Yazaki 14	P	P

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	2550	Ground	I	UQA
2	0.5	VT/BU	6978	Amplifier Control	I	UQA
3	0.35	BN/WH	2809	Radio Keypad Power Signal	I	-
4	0.35	BN	2814	Radio Display Low Voltage Differential Signaling Lock Signal	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
5	0.35	GY/VT	2812	Radio Display Low Voltage Differential Signaling Error Signal	I	-
6	0.35	GY/BU	2803	Radio Display Touch Interrupt Request Signal	I	-
7	0.35	WH	2811	Radio Display Diagnostic Signal	I	-
8	0.35	BU	4315	Radio Volume Up Signal	I	-
9	0.35	GY/BN	4314	Radio Volume Down Signal	I	-
10	0.75	BK/WH	251	Signal Ground	I	-
11	0.75 0.75	WH BN/WH	46 546	Right Rear Speaker Control (+) Right Rear Low Level Audio Signal	I I	UQ3 UQA
12	0.75 0.75	BU/BK BU/BK	115 1946	Right Rear Speaker Signal (-) Right Rear Low Level Audio (-) Low Reference	I I	UQ3 UQA
13	0.75 0.75	GN GN/BK	199 599	Left Rear Speaker Control (+) Left Rear Low Level Audio Signal	I I	UQ3 UQA
14	0.75 0.75	GN/BK BN/VT	116 1999	Left Rear Speaker Signal (-) Left Rear Low Level Audio (-) Low Reference	I I	UQ3 UQA
15	0.75 0.75	YE/BK BU/BN	117 1546	Right Front Speaker Signal (-) 1 Front Low Level Audio (-) Low Reference	I I	UQ3 UQA
16	0.75 0.75	YE YE	200 512	Right Front Speaker Control (+) 1 Right Front Low Level Audio Signal	I I	UQ3 UQA
17	0.75 0.75	BN/BU BN/BU	118 1947	Left Front Speaker Signal (-) 1 Left Front Low Level Audio (-) Low Reference	I I	UQ3 UQA
18	0.75 0.75	BU BU	201 511	Left Front Speaker Control (+) 1 Left Front Low Level Audio Signal	I I	UQ3 UQA
19	0.5	BK	2550	Ground	I	UQA
20	0.75	RD/WH	6440	Battery Positive Voltage	I	-

A11 RADIO X3

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Connector Part Information

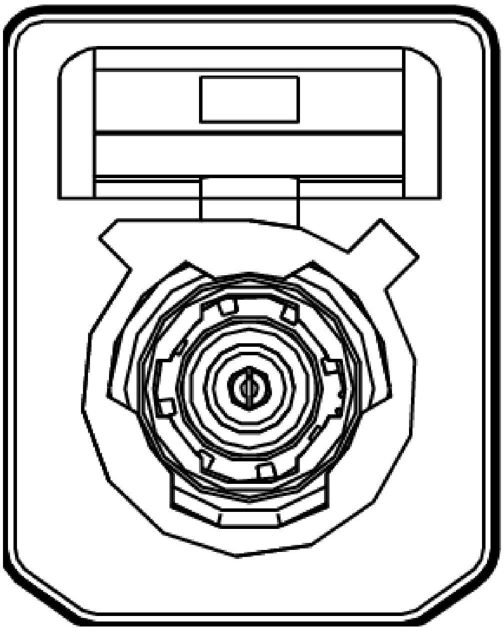
- Harness Type: USB Cable
- OEM Connector: SH3145B
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

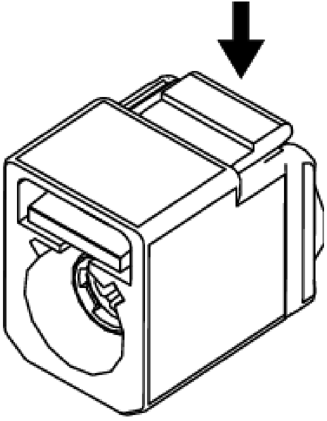
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
GY	-	-	USB	USB Cable	I	-

A11 RADIO X4





Connector Part Information

- Harness Type: Instrument Panel COAX
- OEM Connector: 13591267
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	Coax	-	(AM/FM) Antenna RF Signal	I	-

A11 RADIO X5

-

Connector Part Information

- Harness Type: Instrument Panel COAX

- OEM Connector: 13591282
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
CU	-	-	COAX	Coax Cable	I	-

A11 RADIO X6

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Connector Part Information

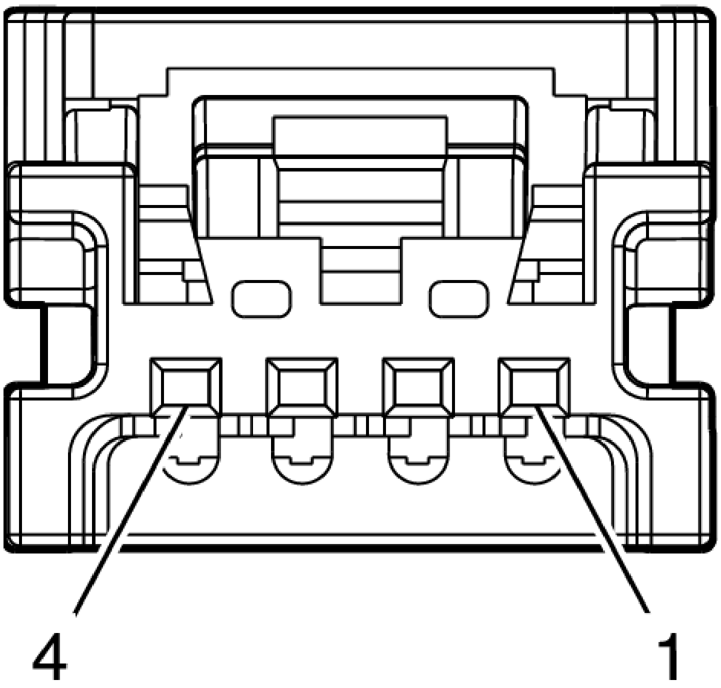
- Harness Type: Instrument Panel COAX
- OEM Connector: 13591274
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

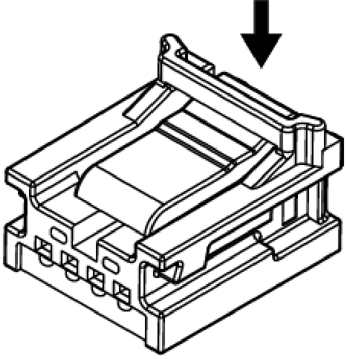
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
GN	-	-	COAX	Coax Cable	I	-

A11 RADIO X8





Connector Part Information

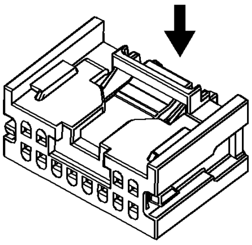
- Harness Type: Instrument Panel
- OEM Connector: 34791-5140
- Service Connector: 19354840
- Description: 4-Way F Mini 50 Series (BK)

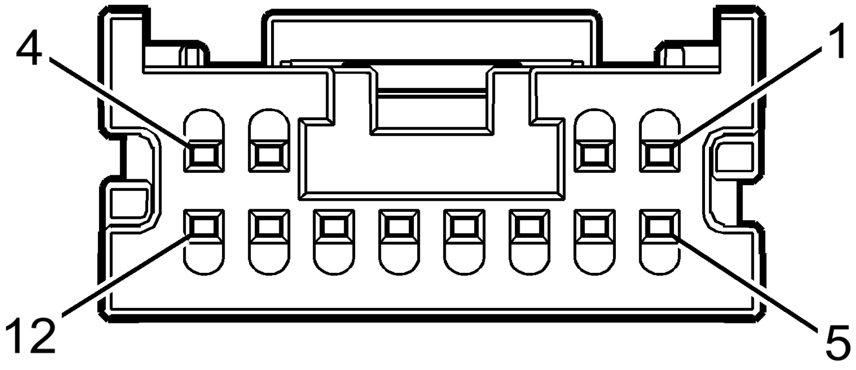
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	EL-35616-58 (BK)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	-	-	Not Occupied	-	-
2	0.35	GN	7217	Ethernet Bus 7 (+)	I	-
3	0.35	WH	7216	Ethernet Bus 7 (-)	I	-
4	-	-	-	Not Occupied	-	-

A20 RADIO/HVAC CONTROLS





Connector Part Information

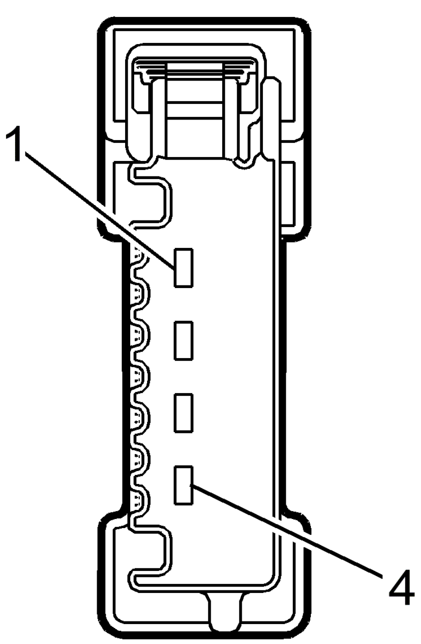
- Harness Type: Instrument Panel
- OEM Connector: 34824-5125
- Service Connector: 13507122
- Description: 12-Way F Mini 50 Series (GY)

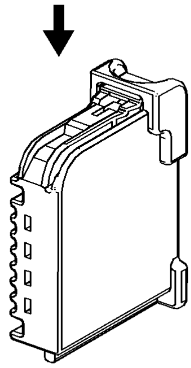
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575568	J35616-65B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN/BK	2805	Radio Keypad Ground Return	I	-
2	0.35	BU/GY	2808	Radio Keypad Dimming Control	I	-
3	-	-	-	Not Occupied	-	-
4	0.35	GN/WH	7530	Local Interconnect Network Serial Data Bus 8	I	-
5	0.35	BN/WH	2809	Radio Keypad Power Signal	I	-
6	0.35	VT/WH	2810	Radio Keypad Button Signal	I	-
7	0.35	BU	4315	Radio Volume Up Signal	I	-
8	0.35	GY/BN	4314	Radio Volume Down Signal	I	-
9	0.35	BU/RD	2807	Radio Keypad Voltage Reference	I	-
10	0.35	BK/YE	2806	Radio Keypad Low Reference	I	-
11	0.35	BK/WH	551	Signal Ground	I	-
12	-	-	-	Not Occupied	-	-

A23C LIFTGATE LATCH ASSEMBLY





Connector Part Information

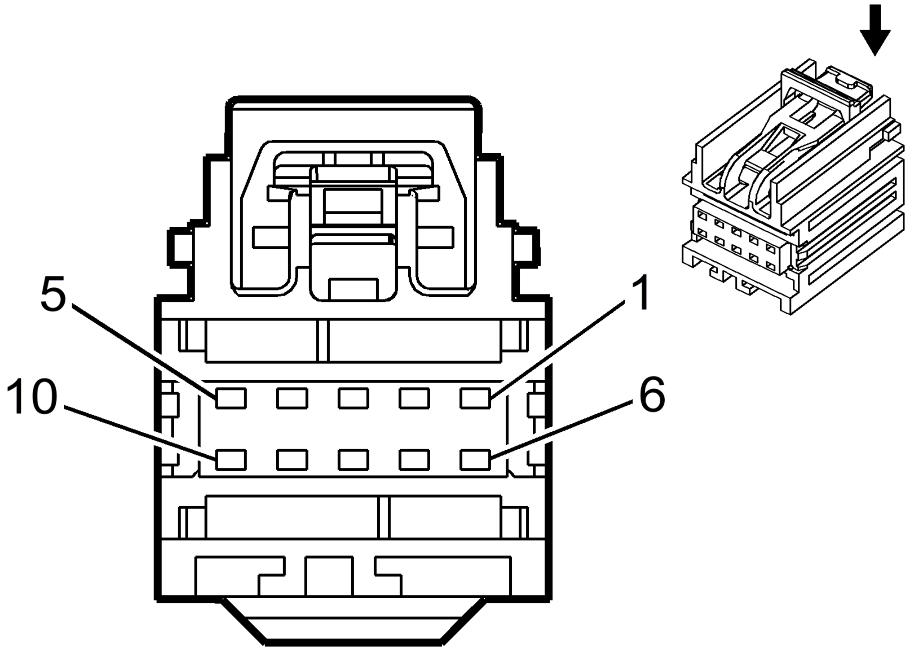
- Harness Type: Liftgate
- OEM Connector: 6098-5516
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.5 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	1950	Ground	I	-
2	0.5	VT/GY	1303	Lift Gate Ajar Switch Signal 1	I	-
3	0.5	BU/WH	6128	Rear Closure Unlatch Motor Unlatch Control	I	-
4	-	-	-	Not Occupied	-	-

A23D DOOR LATCH ASSEMBLY - DRIVER



Connector Part Information

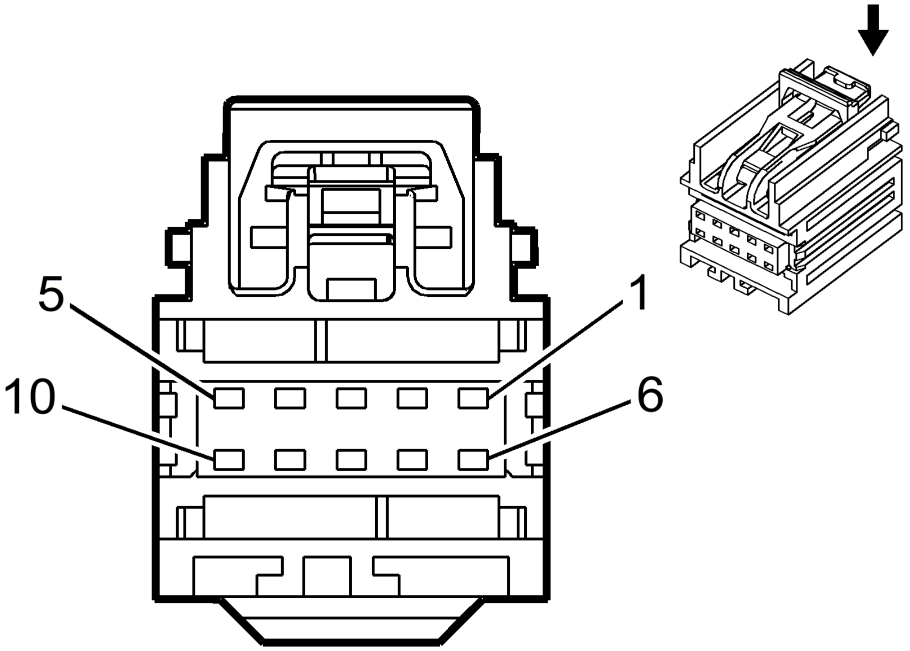
- Harness Type: Driver Door
- OEM Connector: 7283-9043-60
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY	745	Left Front Door Ajar Switch Signal	I	-
2	0.5	WH/YE	3574	Driver Door Open Switch Signal	I	-
3	0.5 0.5	BK BK	650 550	Ground Ground	I I	DG6/DLS/DLR -DG6/-DLS/-DLR
4	0.35	WH/VT	3270	Driver Door Lock Motor Status Signal	I	-
5	0.35	BU/VT	1124	Door Lock Key Switch Unlock Signal	I	-
6	-	-	-	Not Occupied	-	-
7	0.75	GY	5911	Door Lock Actuator Lock Control 2	I	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9 - 10	-	-	-	Not Occupied	-	-

A23LR DOOR LATCH ASSEMBLY - LEFT REAR



Connector Part Information

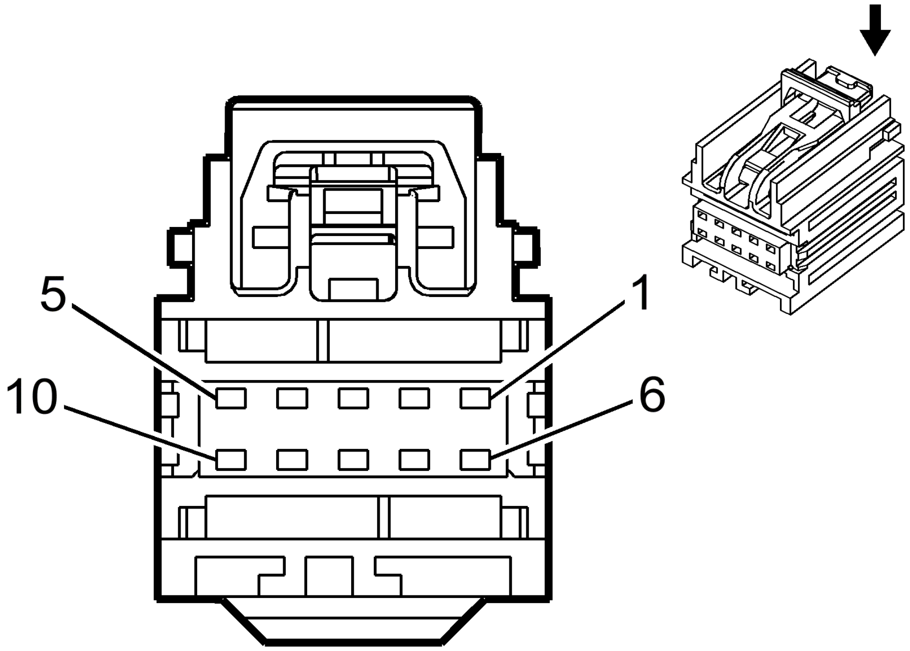
- Harness Type: Left Rear Door
- OEM Connector: 7283-9043-60
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY	747	Left Rear Door Ajar Switch Signal	I	-
2	-	-	-	Not Occupied	-	-
3	0.5 0.5	BK BK	650 550	Ground Ground	I I	DG6/DLS/DLR -DG6/-DLS/-DLR
4 - 6	-	-	-	Not Occupied	-	-
7	0.75	GY	295	Door Lock Actuator Lock Control	I	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9 - 10	-	-	-	Not Occupied	-	-

A23P DOOR LATCH ASSEMBLY - PASSENGER



Connector Part Information

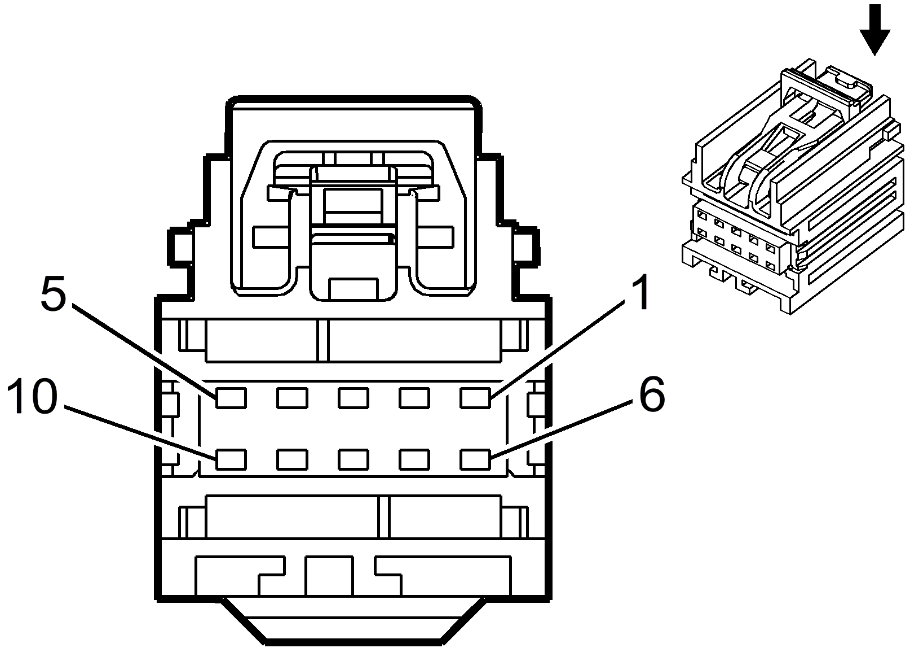
- Harness Type: Passenger Door
- OEM Connector: 7283-9043-60
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.5	BK	750	Ground	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	GY	746	Right Front Door Ajar Switch Signal	I	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9	0.75	GY	295	Door Lock Actuator Lock Control	I	-
10	-	-	-	Not Occupied	-	-

A23RR DOOR LATCH ASSEMBLY - RIGHT REAR



Connector Part Information

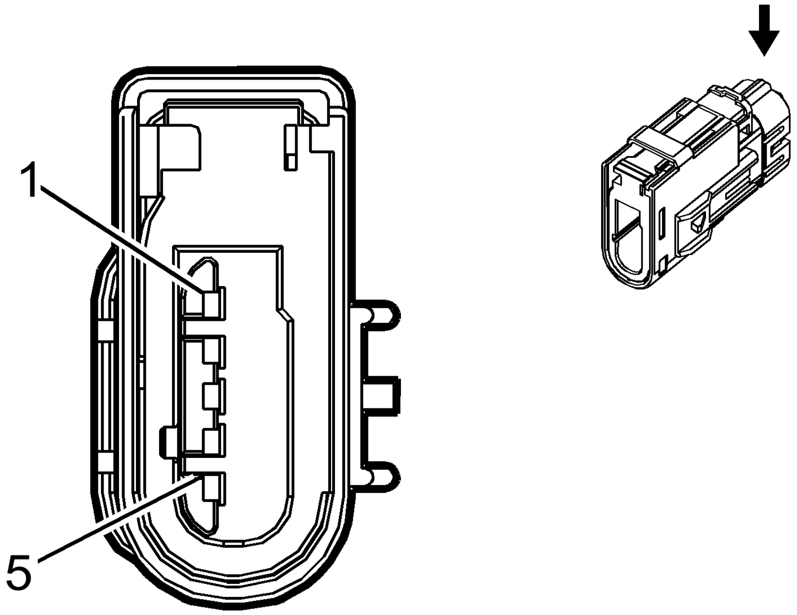
- Harness Type: Right Rear Door
- OEM Connector: 7283-9043-60
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 0.64 YESC Kaizen Series (GN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1 - 2	-	-	-	Not Occupied	-	-
3	0.5	BK	750	Ground	I	-
4	-	-	-	Not Occupied	-	-
5	0.35	GY	748	Right Rear Door Ajar Switch Signal	I	-
6 - 7	-	-	-	Not Occupied	-	-
8	0.75	BN/YE	294	Door Lock Actuator Unlock Control	I	-
9	0.75	GY	295	Door Lock Actuator Lock Control	I	-
10	-	-	-	Not Occupied	-	-

A24D DOOR HANDLE ASSEMBLY - DRIVER EXTERIOR



Connector Part Information

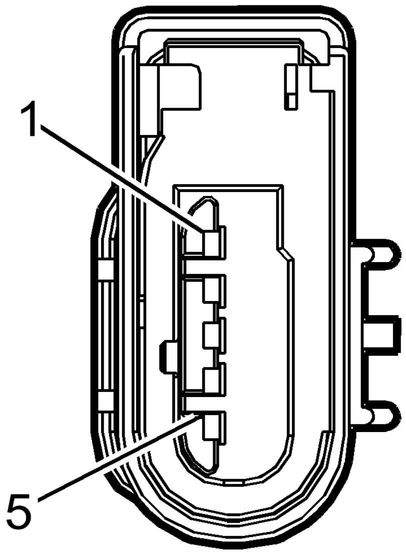
- Harness Type: Driver Door Harness
- OEM Connector: 13582039
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (NA)

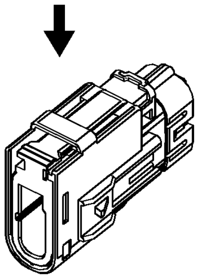
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GN/WH	3570	Driver Door Handle Switch Signal	I	-
2	-	YE	3560	Passive Entry Driver Door Antenna Signal Hi	I	-
3	-	-	-	Not Occupied	-	-
4	-	GN	3561	Passive Entry Driver Door Antenna Signal Lo	I	-
5	-	BK	550	Ground	I	-

A24LR DOOR HANDLE ASSEMBLY - LEFT REAR EXTERIOR





Connector Part Information

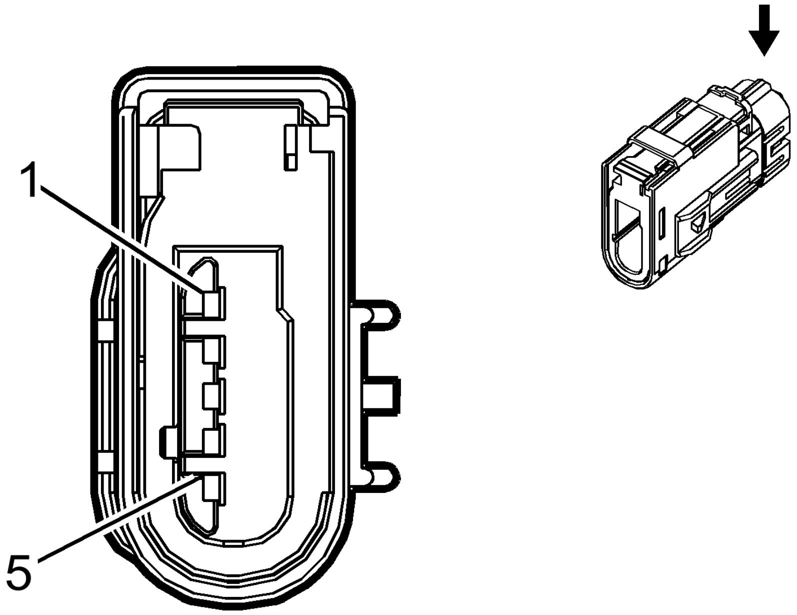
- Harness Type: Left Rear Door Harness
- OEM Connector: 13582040
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BN/YE	6157	Left Rear Door Handle Switch Signal	I	-
2 - 4	-	-	-	Not Occupied	-	-
5	-	BK/	550	Ground	I	-

A24P DOOR HANDLE ASSEMBLY - PASSENGER EXTERIOR



Connector Part Information

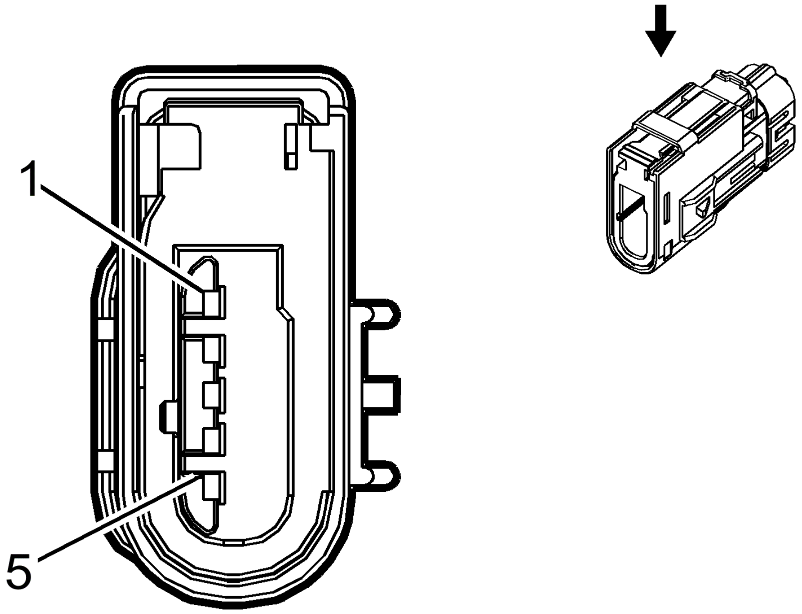
- Harness Type: Passenger Door Harness
- OEM Connector: 13582039
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	VT/WH	3571	Passenger Door Handle Switch Signal	I	-
2	-	YE	3562	Passive Entry Passenger Door Antenna Signal Hi	I	-
3	-	-	-	Not Occupied	-	-
4	-	GN	3563	Passive Entry Passenger Door Antenna Signal Lo	I	-
5	-	BK	750	Ground	I	-

A24RR DOOR HANDLE ASSEMBLY - RIGHT REAR EXTERIOR



Connector Part Information

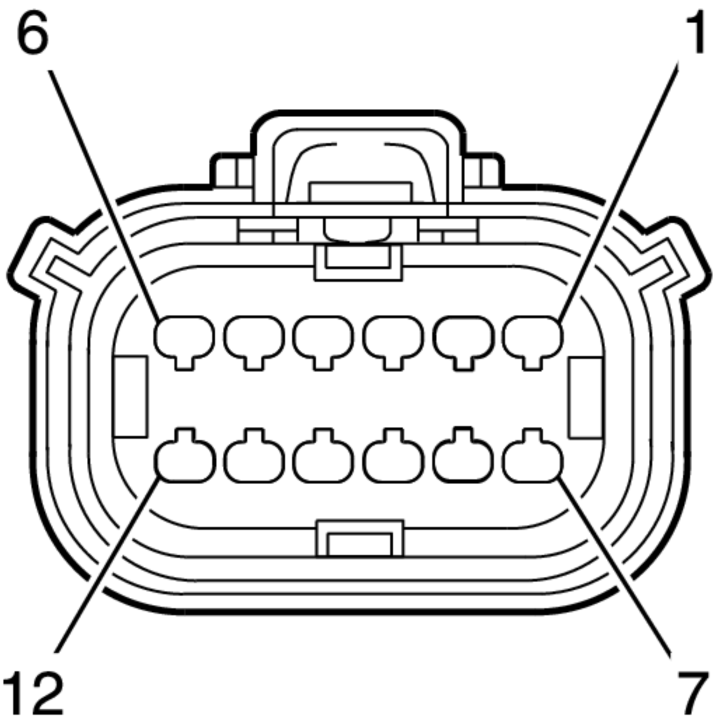
- Harness Type: Right Rear Door Harness
- OEM Connector: 13582040
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (BK)

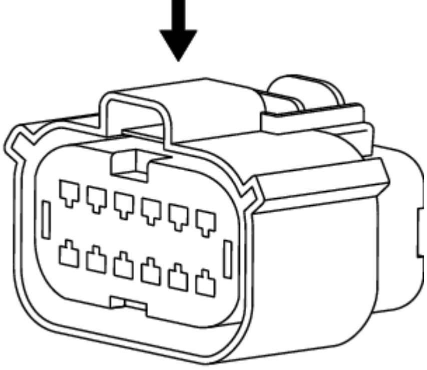
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	YE/GY	6158	Right Rear Door Handle Switch Signal	I	-
2 - 4	-	-	-	Not Occupied	-	-
5	-	BK	750	Ground	I	-

A28 HYBRID/EV BATTERY CONTACTOR ASSEMBLY X2





Connector Part Information

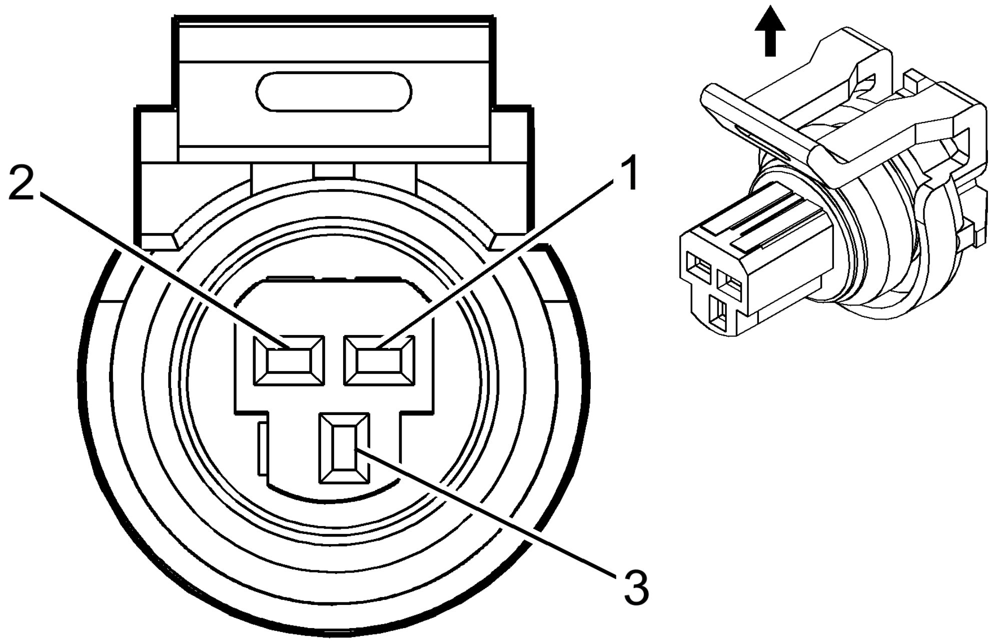
- Harness Type: Body
- OEM Connector: 33472-1274
- Service Connector: 13503528
- Description: 12-Way F 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT	5087	High Voltage Interlock Loop Signal 1	I	-
2	0.5	BK/BN	5088	High Voltage Interlock Loop Low Reference 1	I	-
3	0.5	BN/GN	3959	High Voltage Battery 1 (+) Relay Control	I	-
4	0.5	VT/GY	3961	High Voltage Battery (-) Relay Control	I	-
5	0.5	YE/VT	3962	High Voltage Battery 3 (+) Relay Control	I	-
6	-	-	-	Not Occupied	-	-
7	0.5	GY	5138	Precharge Relay	I	-
8	0.5	YE	5411	Battery Module Temperature Signal 7	I	-
9	0.5	BK/BU	3779	Battery Module Temperature Sensor Low Reference 7	I	-
10	0.5	BK	850	Ground	I	-
11 - 12	-	-	-	Not Occupied	-	-

B1C A/C LOW SIDE PRESSURE SENSOR



Connector Part Information

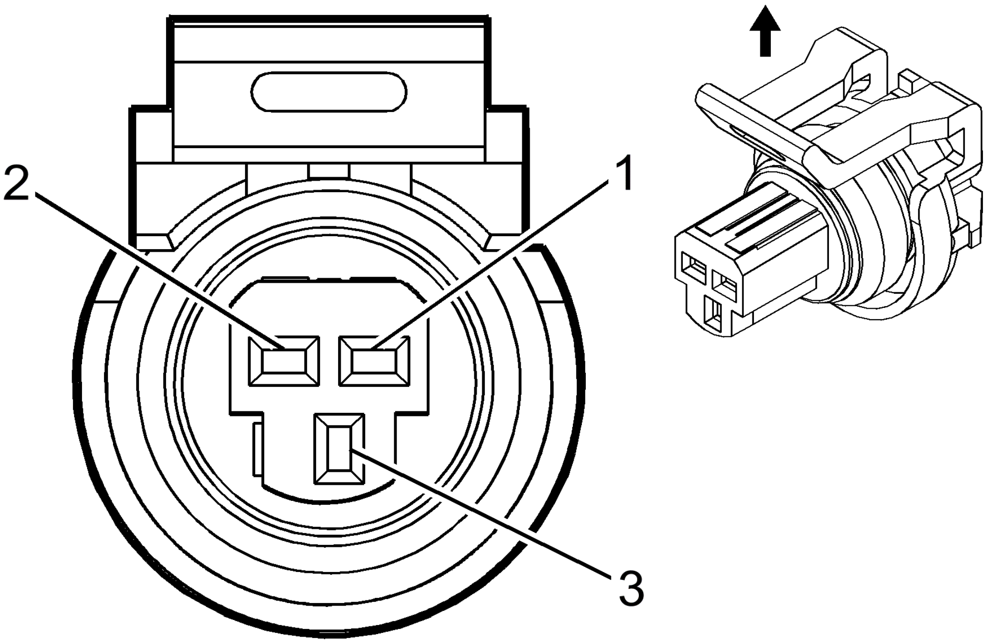
- Harness Type: Engine
- OEM Connector: 13532244
- Service Connector: 88988301
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/GN	3800	A/C Refrigerant Sensor Low Reference	I	-
2	0.5	BU/RD	474	5V Reference	I	-
3	0.5	BU	204	A/C Low Pressure Sensor Signal	I	-

B1 A/C REFRIGERANT PRESSURE SENSOR



Connector Part Information

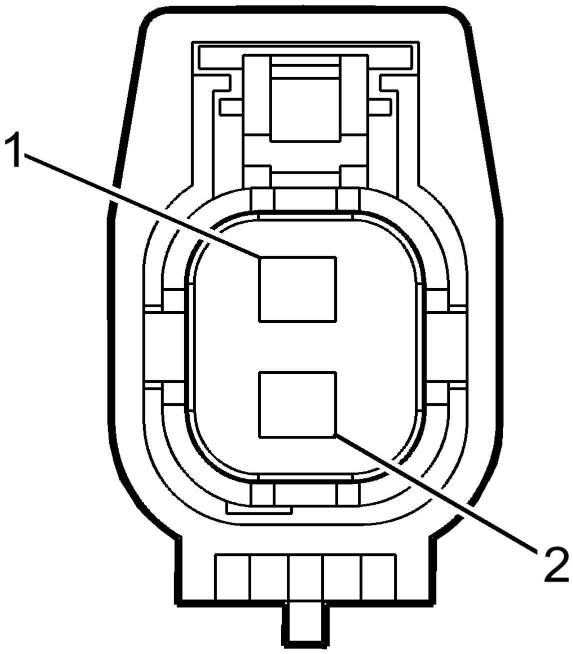
- Harness Type: Engine Harness
- OEM Connector: 13532244
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 150 GT Series, Sealed (BK)

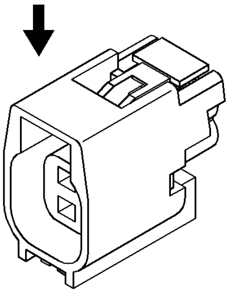
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BK/BN	5514	A/C Refrigerant Pressure Sensor Low Reference	I	-
2	-	BN/RD	2700	A/C Pressure Sensor 5V Reference	I	-
3	-	GN	380	A/C Refrigerant Pressure Sensor Signal	I	-

B5LF WHEEL SPEED SENSOR - LEFT FRONT





Connector Part Information

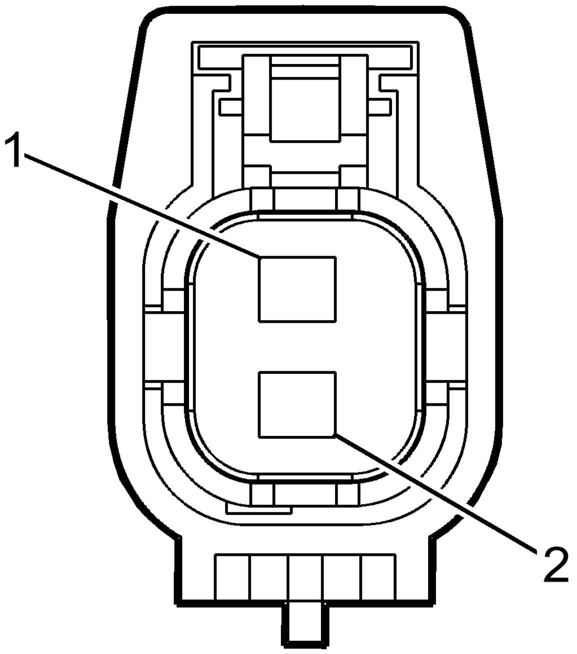
- Harness Type: Forward Lamp
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

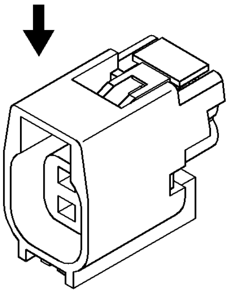
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/WH	7064	Wheel Speed Sensor Control Left Front	I	-
2	0.5	GY	830	Wheel Speed Sensor Signal Left Front	I	-

B5LR WHEEL SPEED SENSOR - LEFT REAR





Connector Part Information

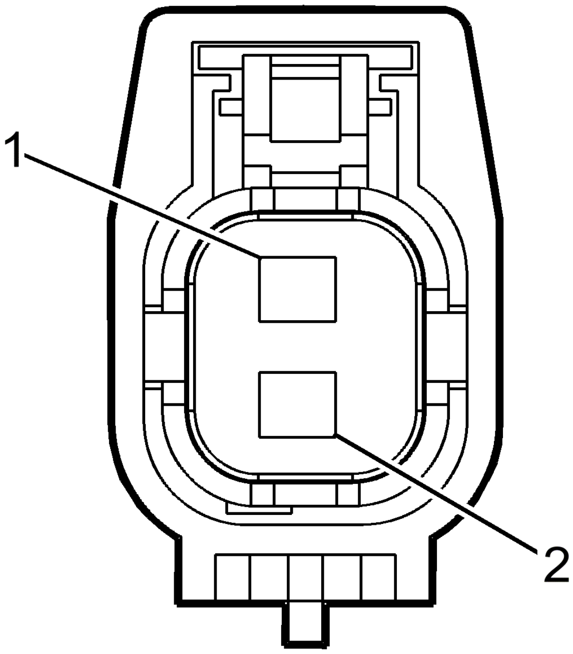
- Harness Type: Body
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

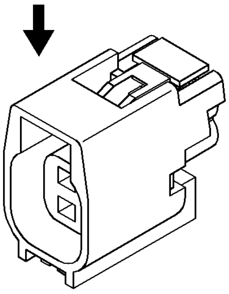
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BK	7127	Wheel Speed Sensor Control Left Rear	I	-
2	0.5	BU	884	Wheel Speed Sensor Signal Left Rear	I	-

B5RF WHEEL SPEED SENSOR - RIGHT FRONT





Connector Part Information

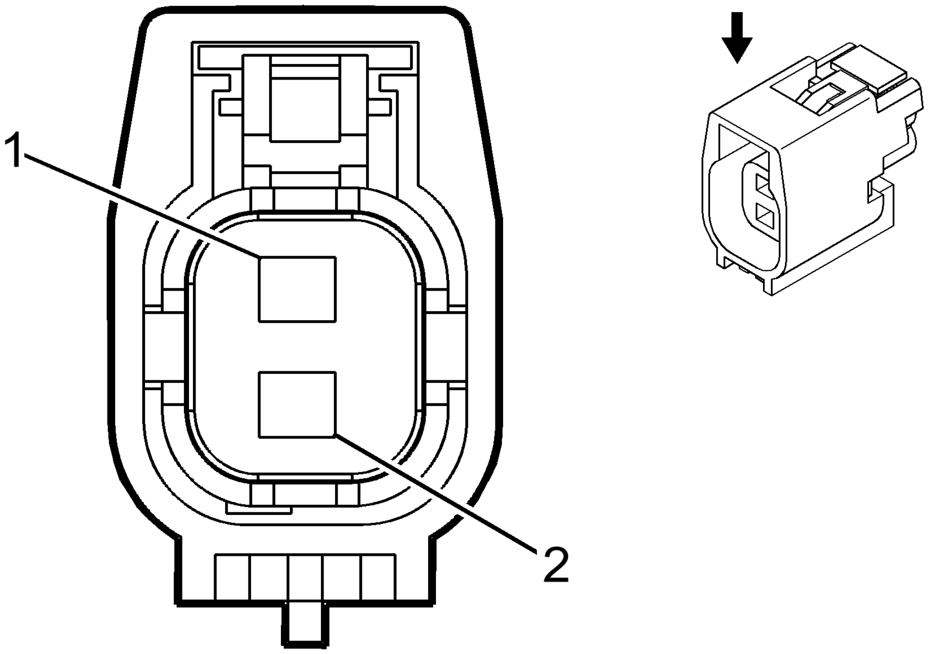
- Harness Type: Body
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/BN	7065	Wheel Speed Sensor Control Right Front	I	-
2	0.5	YE	872	Wheel Speed Sensor Signal Right Front	I	-

B5RR WHEEL SPEED SENSOR - RIGHT REAR



Connector Part Information

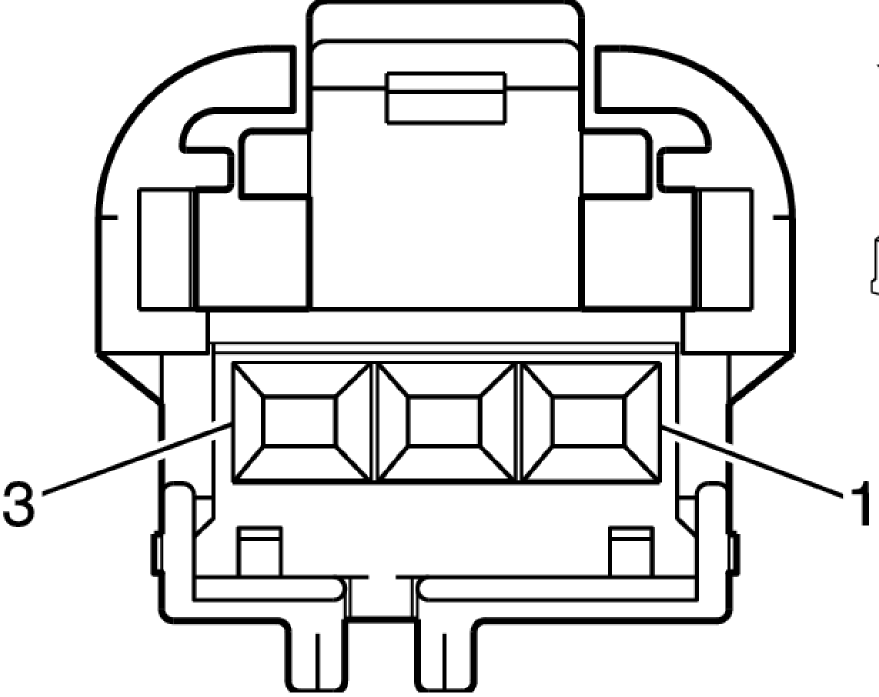
- Harness Type: Body
- OEM Connector: 7287-0973-30
- Service Connector: 13586115
- Description: 2-Way F 1.5 GT Series, Sealed (BK)

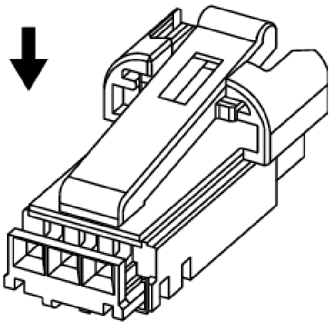
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/YE	7128	Wheel Speed Sensor Control Right Rear	I	-
2	0.5	VT	882	Wheel Speed Sensor Signal Right Rear	I	-

B7B AIR TEMPERATURE SENSOR - DUCT LOWER





Connector Part Information

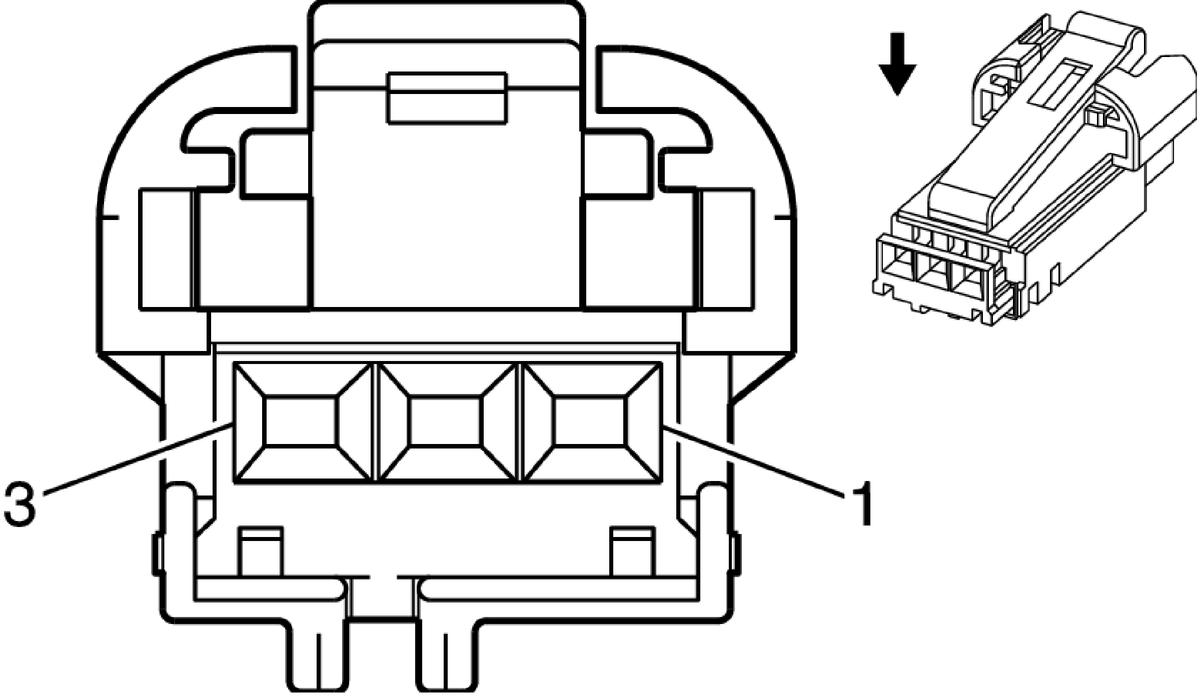
- Harness Type: Air Duct Harness
- OEM Connector: 31067-1010
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 GET Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BN	518	Lower Left Air Temperature Sensor Signal	I	-
2	-	-	-	Not Occupied	-	-
3	-	BK/YE	407	Sensor Low Reference	I	-

B7F AIR TEMPERATURE SENSOR - DUCT UPPER



Connector Part Information

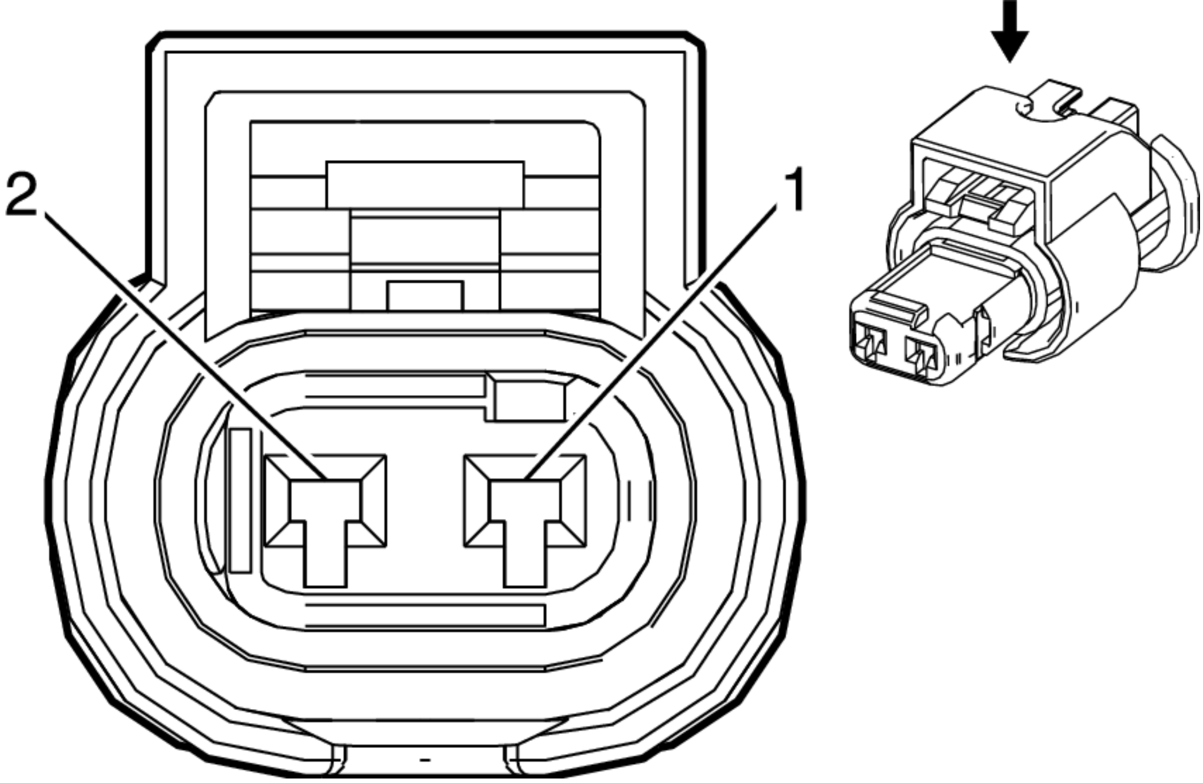
- Harness Type: HVAC
- OEM Connector: 31067-1010
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 GET Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BK/YE	407	Sensor Low Reference	I	-
2	-	-	-	Not Occupied	-	-
3	-	GY/GN	516	Upper Left Air Temperature Sensor Signal	I	-

B9 AMBIENT AIR TEMPERATURE SENSOR



Connector Part Information

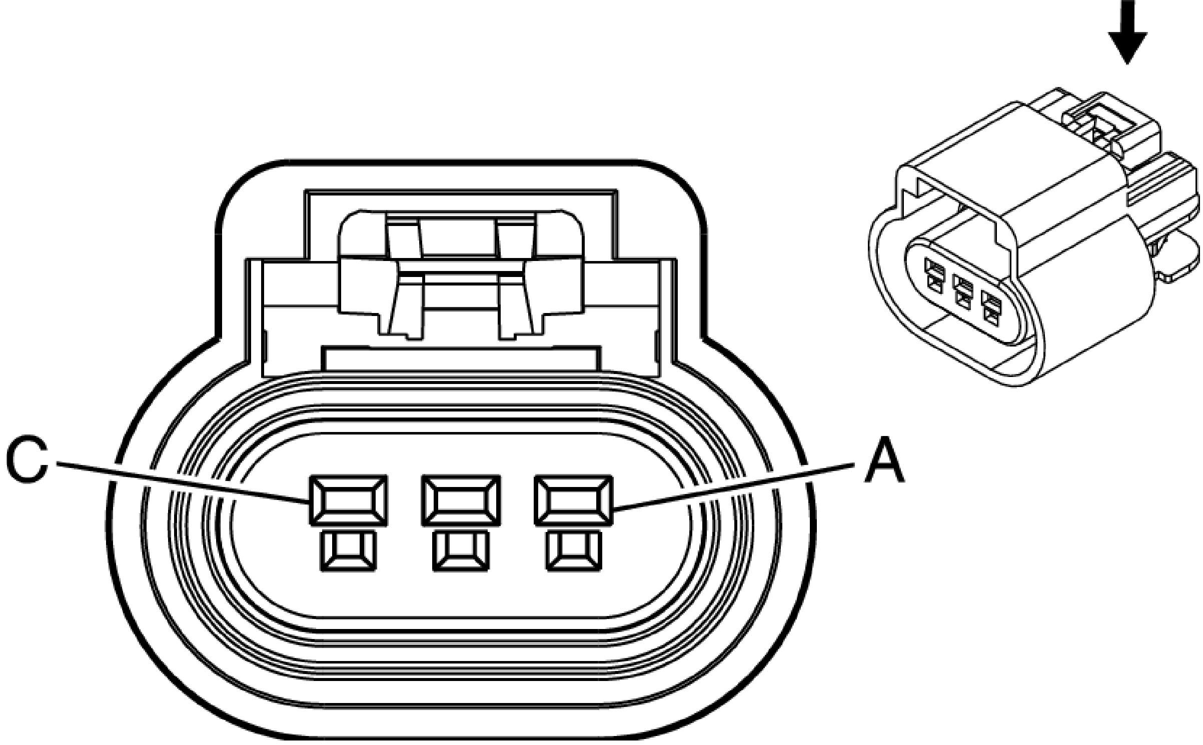
- Harness Type: Front Fascia
- OEM Connector: 1-1823608-5
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 MCP Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/GY	636	Outside Ambient Air Temperature Sensor Signal	I	-
2	0.5	BK/BU	61	Outside Ambient Temperature Sensor Low Reference	I	-

B18 BATTERY CURRENT SENSOR



Connector Part Information

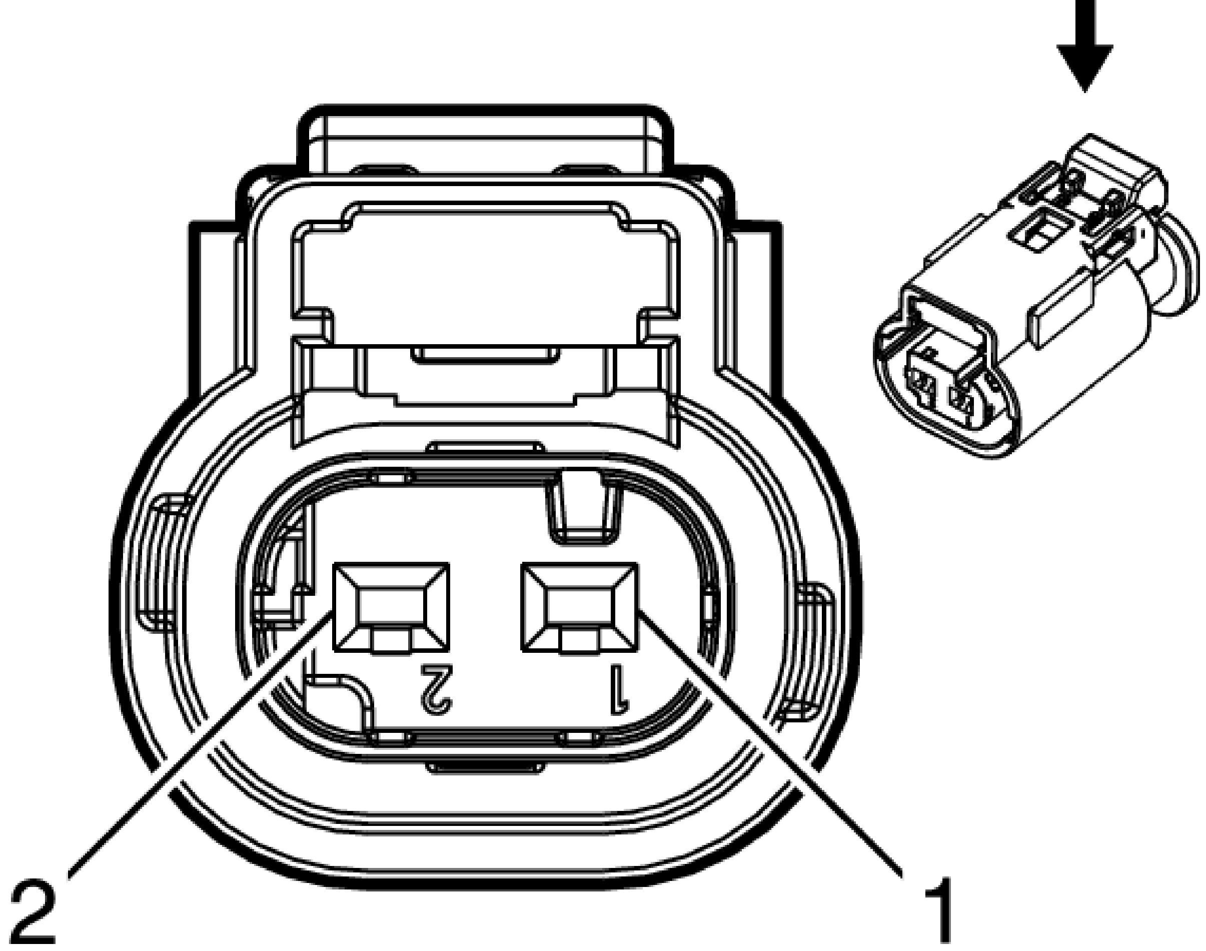
- Harness Type: Body
- OEM Connector: 13519047
- Service Connector: 13580871
- Description: 3-Way F 150 GT Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	BU/VT	5076	Current Sensor Control	I	-
B	0.5	BK/VT	5077	Current Sensor Low Reference	I	-
C	0.5	WH/YE	5075	Current Sensor Signal	I	-

B20 BRAKE FLUID LEVEL SWITCH



Connector Part Information

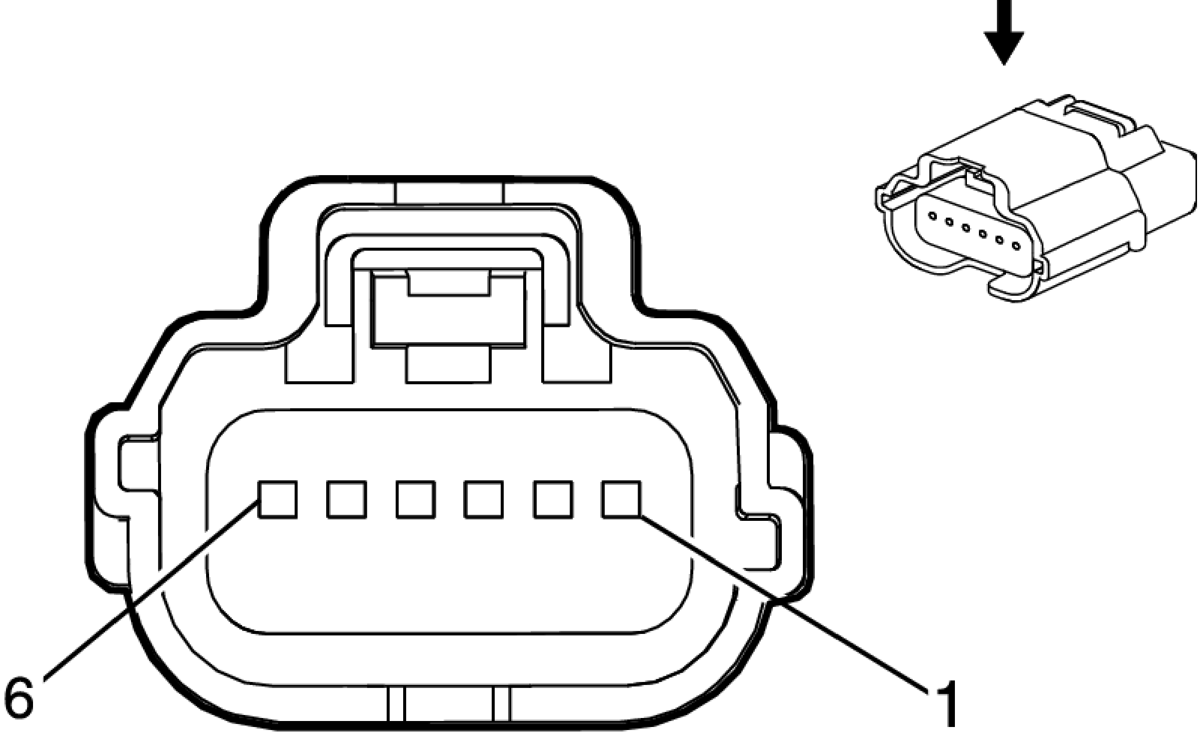
- Harness Type: Body
- OEM Connector: 10010337
- Service Connector: 13587326
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/GY	333	Brake Fluid Level Sensor Signal	I	-
2	0.5	BK	550	Ground	I	-

B22 BRAKE PEDAL POSITION SENSOR



Connector Part Information

- Harness Type: Body
- OEM Connector: 31404-6810
- Service Connector: 19304011
- Description: 6-Way F 64 Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH	5359	Brake Apply Sensor Control	I	-
2	0.5	BK/BN	5360	Brake Apply Sensor Low Reference	I	-
3	0.5	BU/YE	5361	Brake Apply Sensor Signal	I	-
4	0.5	WH/GN	5380	Brake Position Sensor Signal	I	-
5	0.5	WH/RD	5381	Brake Position Sensor 5V Reference	I	-
6	0.5	BK/YE	5382	Brake Position Sensor Low Reference	I	-

B24 MOBILE TELEPHONE MICROPHONE (UE1)

-

Connector Part Information

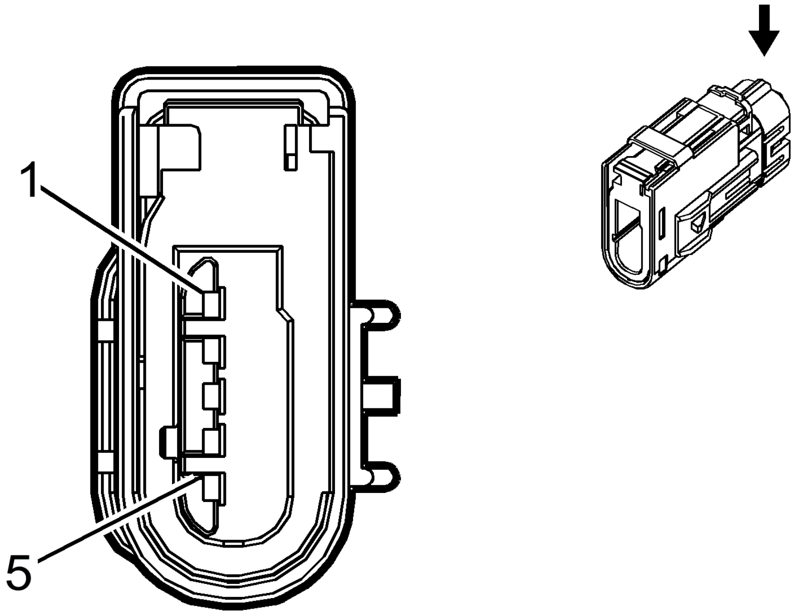
- Harness Type: Cellular Phone Microphone Pigtail
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	-	BK/BN	654	Cellular Telephone Microphone Low Reference	I	-
B	-	BU	655	Cellular Telephone Microphone Signal	I	-

B27D DOOR HANDLE SWITCH - DRIVER EXTERIOR



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: SRVWSB-04-BS
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (NA)

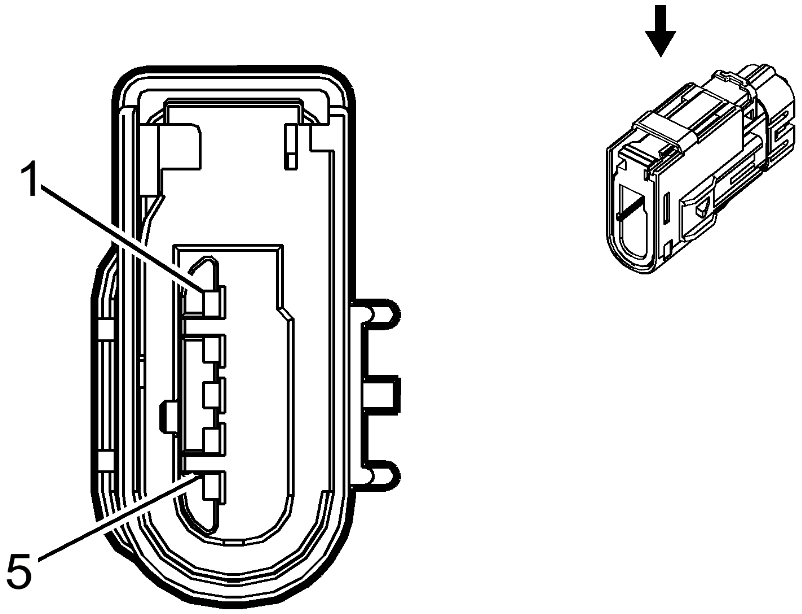
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GN/WH	3570	Driver Door Handle Switch Signal	I	-
2	0.5	VT	3560	Passive Entry Driver Door Antenna Signal Hi	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
3	-	-	-	Not Occupied	-	-
4	0.5	VT/GY	3561	Passive Entry Driver Door Antenna Signal Lo	I	-
5	0.5	BK	550	Ground	I	-

B27LR DOOR HANDLE SWITCH - LEFT REAR EXTERIOR



Connector Part Information

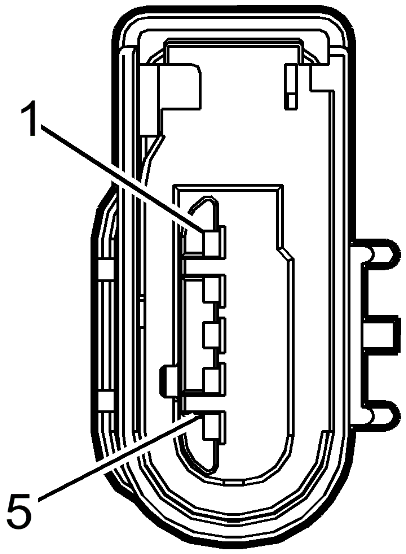
- Harness Type: Left Rear Door
- OEM Connector: SRVWSB-02-DK
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (BK)

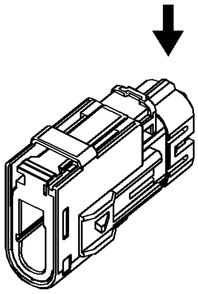
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/YE	6157	Left Rear Door Handle Switch Signal	I	-
2 - 4	-	-	-	Not Occupied	-	-
5	0.5	BK	550	Ground	I	-

B27P DOOR HANDLE SWITCH - PASSENGER EXTERIOR





Connector Part Information

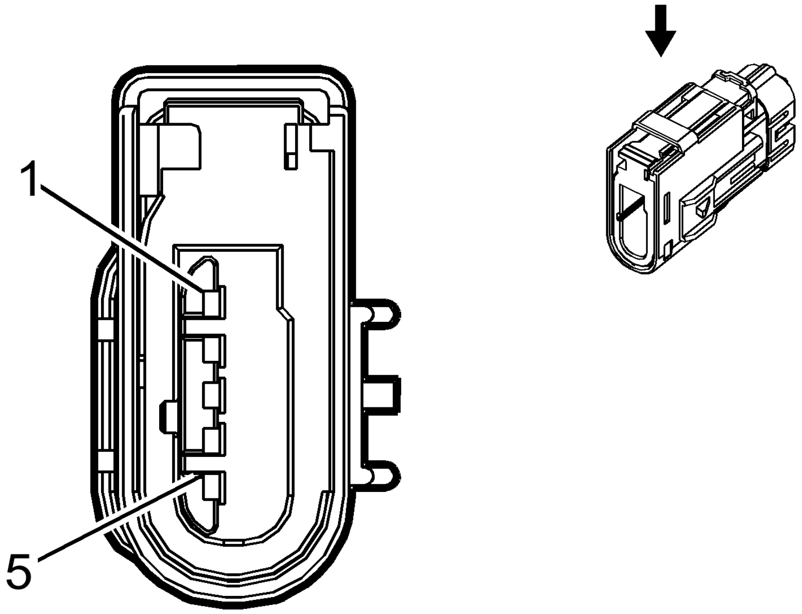
- Harness Type: Passenger Door
- OEM Connector: SRVWSB-04-BS
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/WH	3571	Passenger Door Handle Switch Signal	I	-
2	0.5	GN/YE	3562	Passive Entry Passenger Door Antenna Signal Hi	I	-
3	-	-	-	Not Occupied	-	-
4	0.5	GN/BK	3563	Passive Entry Passenger Door Antenna Signal Lo	I	-
5	0.5	BK	750	Ground	I	-

B27RR DOOR HANDLE SWITCH - RIGHT REAR EXTERIOR



Connector Part Information

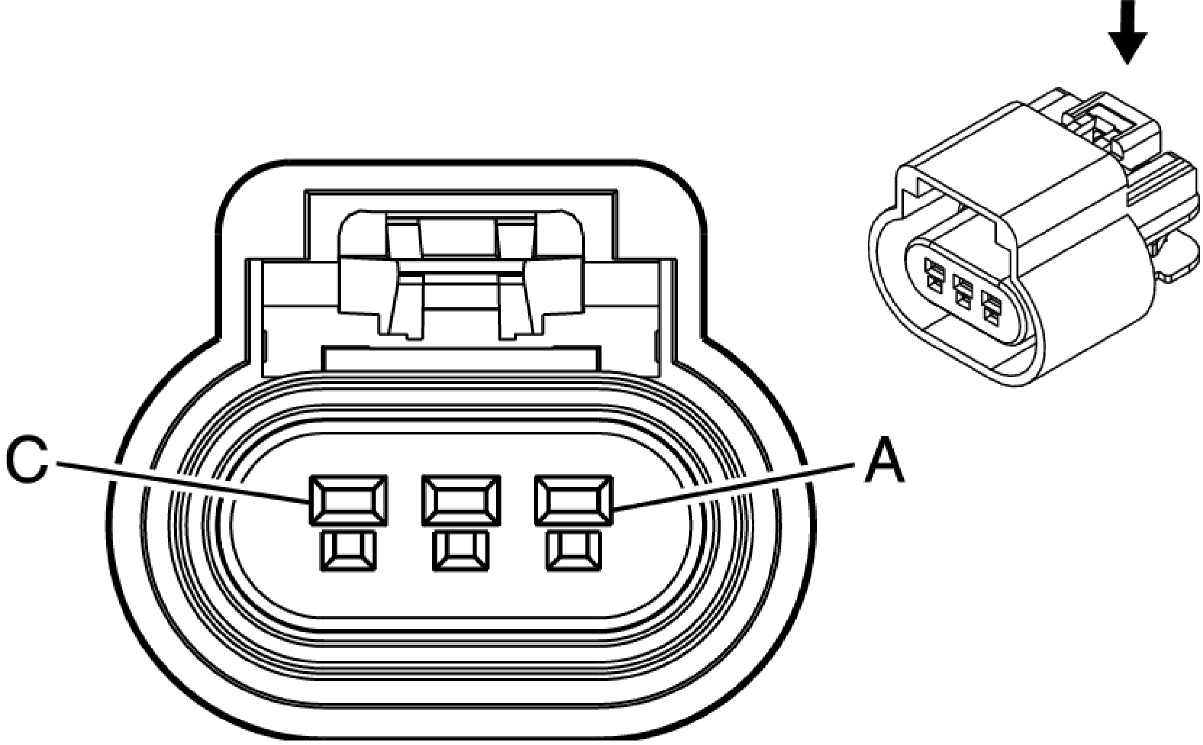
- Harness Type: Right Rear Door
- OEM Connector: SRVWSB-02-DK
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/GY	6158	Right Rear Door Handle Switch Signal	I	-
2 - 4	-	-	-	Not Occupied	-	-
5	0.5	BK	750	Ground	I	-

B55 ENGINE HOOD SWITCH



Connector Part Information

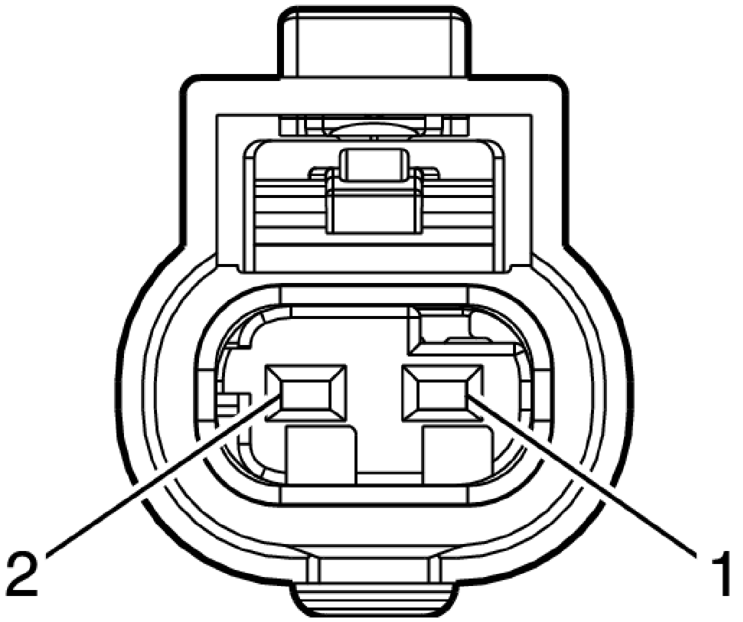
- Harness Type: Forward Lamp
- OEM Connector: 13519047
- Service Connector: 13580871
- Description: 3-Way F 150 GT Series, Sealed (BK)

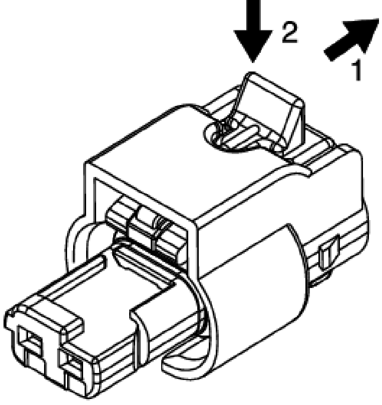
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.5	YE	5530	Hood Open Switch Signal	I	-
B	0.5	BN/GN	109	Hood Ajar Switch Signal	I	-
C	0.5	BK	250	Ground	I	-

B59L FRONT IMPACT SENSOR - LEFT (AYF)





Connector Part Information

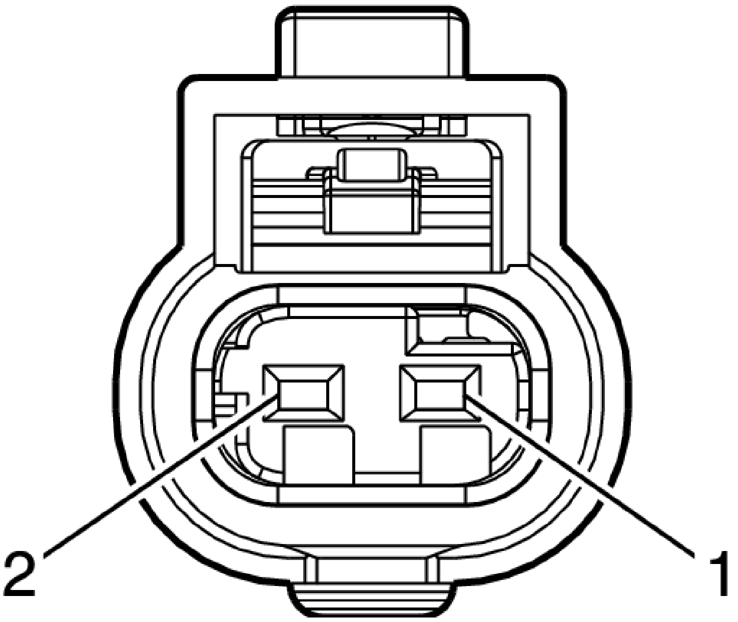
- Harness Type: Forward Lamp
- OEM Connector: 4-2272003-4
- Service Connector: 19354841
- Description: 2-Way F 1.2 MCON-CB Series, Sealed (BN)

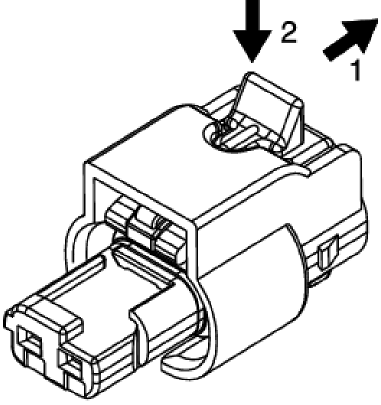
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5 0.5	OG/GY OG/YE	6618 354	Middle Front Discriminating Sensor Signal Left Front Discriminating Sensor Signal	I I	AY0 AYF
2	0.5 0.5	BK/OG BK/OG	6619 5045	Middle Front Discriminating Sensor Low Reference Left Front Discriminating Sensor Low Reference	I I	AY0 AYF

B59R FRONT IMPACT SENSOR - RIGHT (AYF)





Connector Part Information

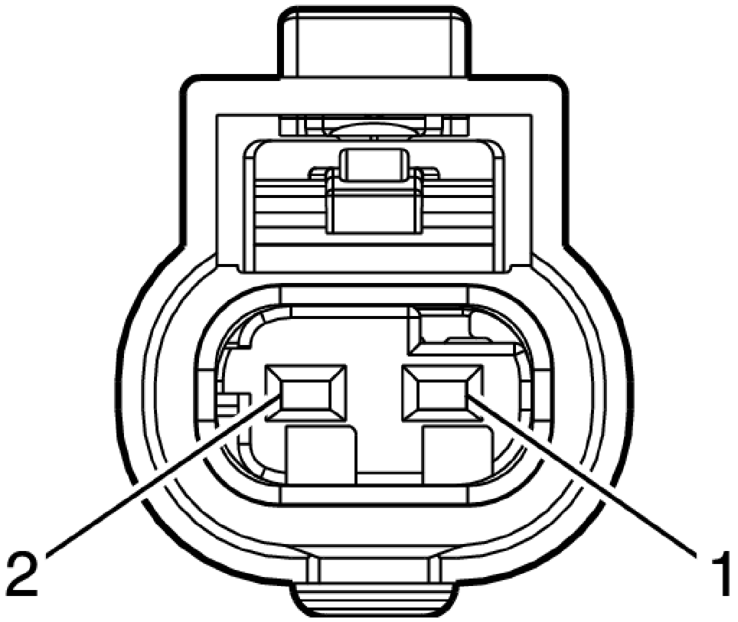
- Harness Type: Forward Lamp
- OEM Connector: 4-2272003-4
- Service Connector: 19354841
- Description: 2-Way F 1.2 MCON-CB Series, Sealed (BN)

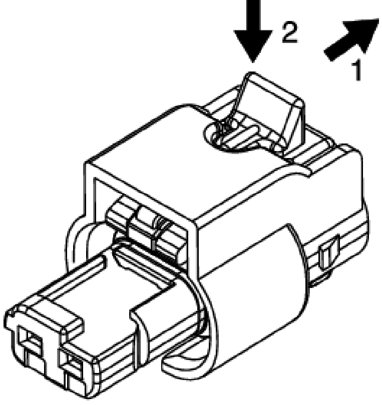
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GN	1409	Right Front Discriminating Sensor Signal	I	AYF
2	0.5	BK/OG	5600	Right Front Discriminating Sensor Low Reference	I	AYF

B59 FRONT IMPACT SENSOR (AY0)





Connector Part Information

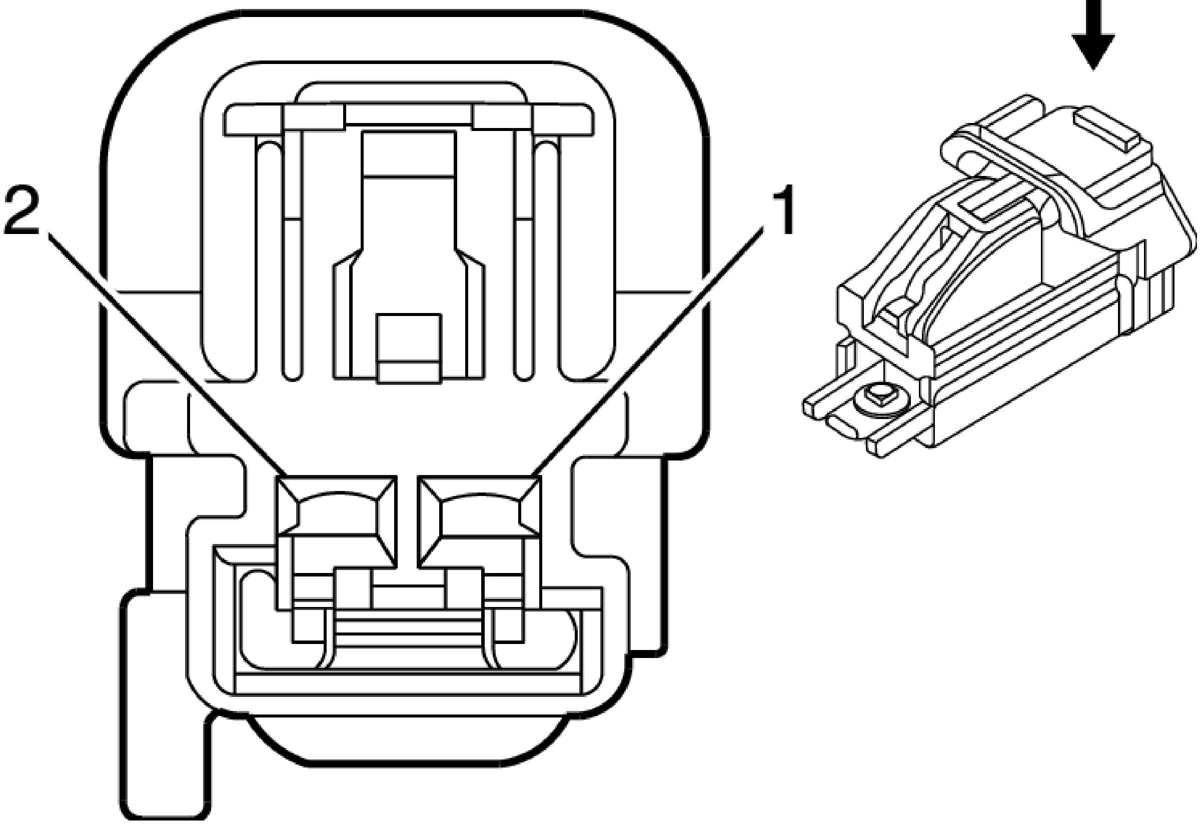
- Harness Type: Forward Lamp
- OEM Connector: 13510975
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 MCON-CB Series, Sealed (BN)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG/GY	6618	Middle Front Discriminating Sensor Signal	I	-
2	-	BK/OG	6619	Middle Front Discriminating Sensor Low Reference	I	-

B60 PASSENGER PRESENCE SENSOR (-AL0+MAW)



Connector Part Information

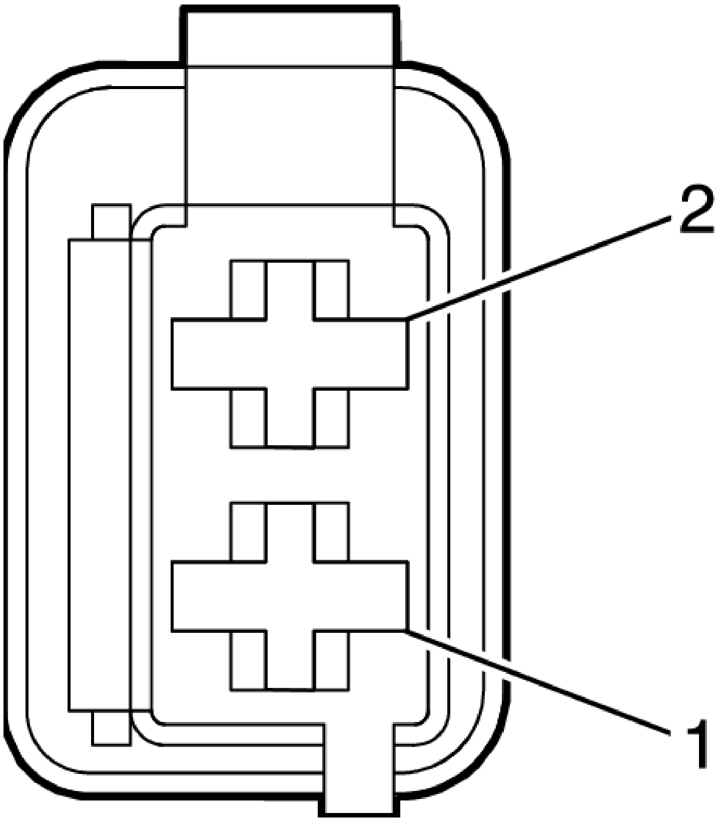
- Harness Type: Passenger Seat
- OEM Connector: 7283-6443-40
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 YESC Series (L-GY)

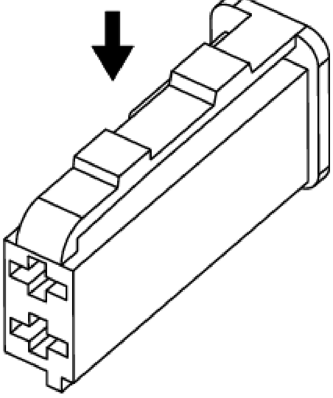
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BN	7571	Passenger Seat Belt Reminder Signal	I	-
2	0.5	BK/OG	1361	Passenger Seat Belt Switch Low Reference	I	-

B61P SEAT BELT TENSION SENSOR - PASSENGER (AL0)





Connector Part Information

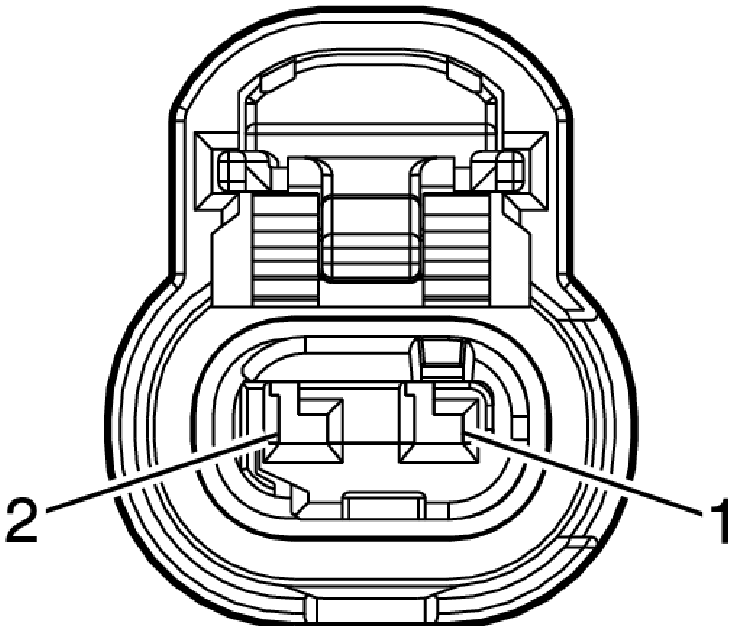
- Harness Type: Body
- OEM Connector: 1563189-1
- Service Connector: 13580951
- Description: 2-Way F 1.6 Timer Series (BK)

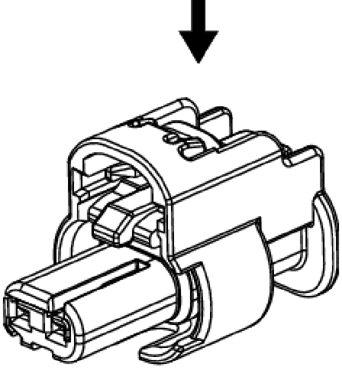
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY/OG	3946	Automatic Locking Retractor Switch Low Reference	I	AL0
2	0.5	OG/BN	3947	Automatic Locking Retractor Switch Signal	I	AL0

B63L SIDE IMPACT SENSOR - LEFT (AY0)





Connector Part Information

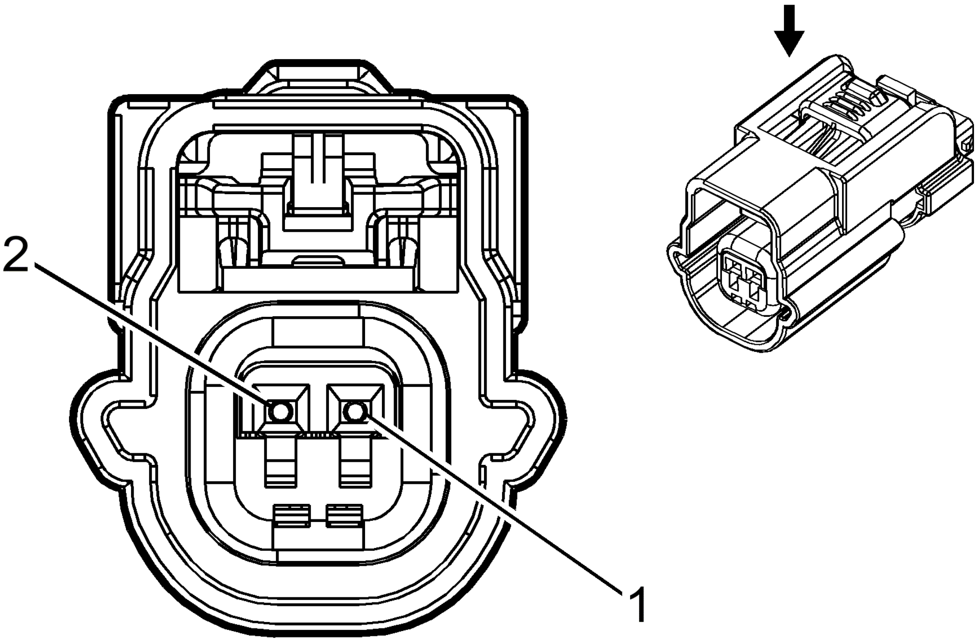
- Harness Type: Body
- OEM Connector: 1-2203312-1
- Service Connector: 19330898
- Description: 2-Way F 1.2 MCON Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BU	6622	Left Rear Side Impact Sensing Module Signal	I	-
2	0.5	BK/OG	6623	Left Rear Side Impact Sensing Module Low Reference	I	-

B63LF SIDE IMPACT SENSOR - LEFT FRONT (AYF)



Connector Part Information

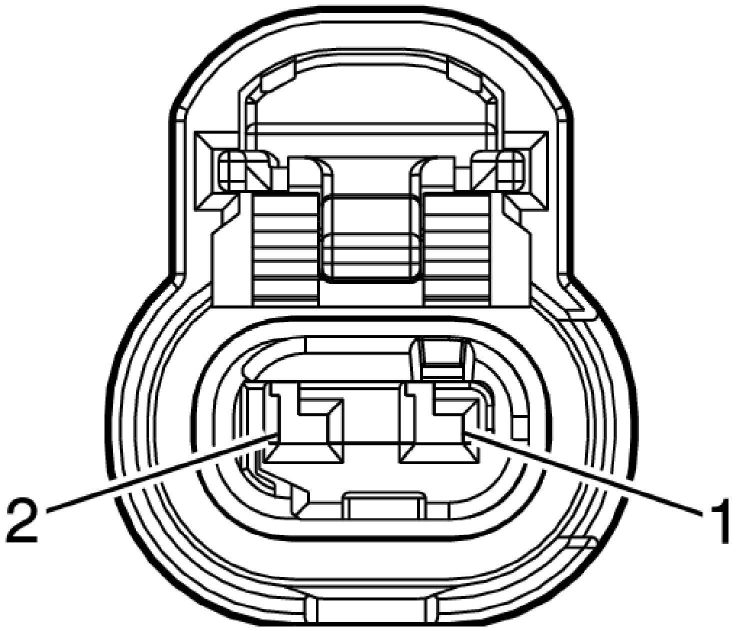
- Harness Type: Driver Door
- OEM Connector: 54390240
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 0.64 Series, Sealed (L-GY)

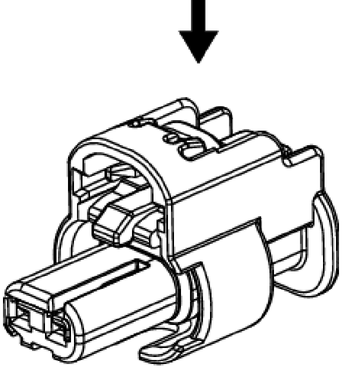
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/GN	2132	Left Front Side Impact Sensing Module Signal	I	AYF
2	0.5	BK/OG	6628	Left Front Side Impact Sensing Module Low Reference	I	AYF

B63LR SIDE IMPACT SENSOR - LEFT REAR (AYF)





Connector Part Information

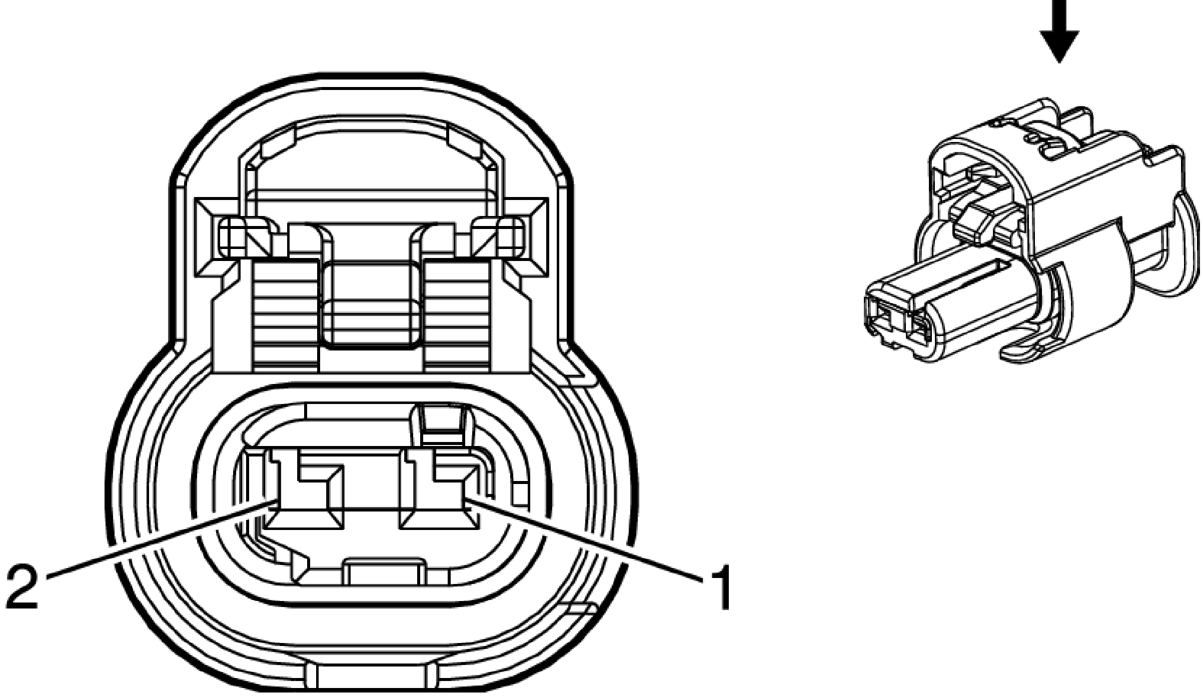
- Harness Type: Body
- OEM Connector: 1-2203312-1
- Service Connector: 19330898
- Description: 2-Way F 1.2 MCON Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/BU	6620	Left Middle Side Impact Sensing Module Signal	I	AYF
2	0.5	BK/OG	6621	Left Middle Side Impact Sensing Module Low Reference	I	AYF

B63R SIDE IMPACT SENSOR - RIGHT (AY0)



Connector Part Information

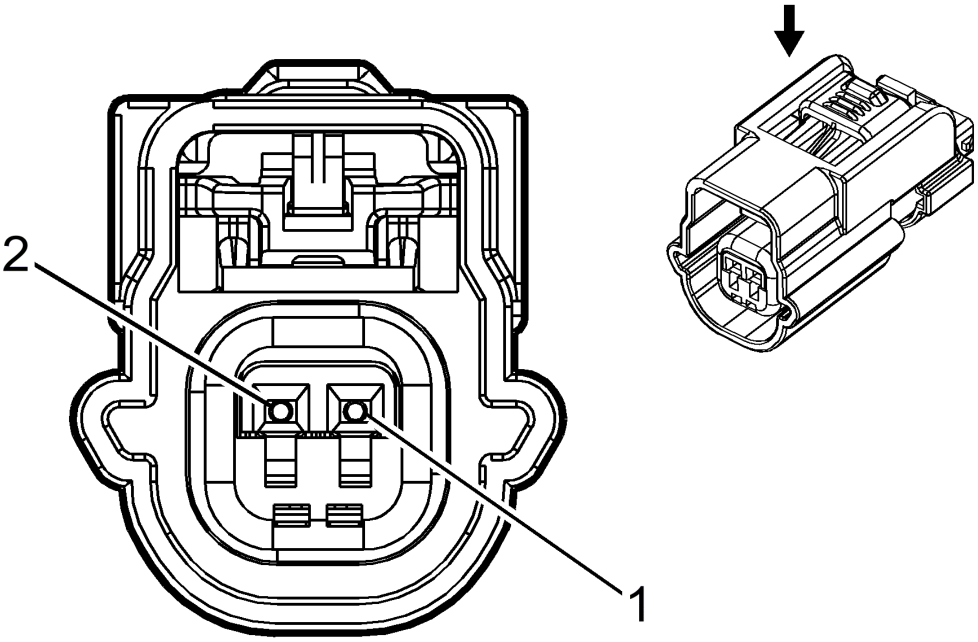
- Harness Type: Body
- OEM Connector: 1-2203312-1
- Service Connector: 19330898
- Description: 2-Way F 1.2 MCON Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/WH	6626	Right Rear Side Impact Sensing Module Signal	I	-
2	0.5	BK/OG	6627	Right Rear Side Impact Sensing Module Low Reference	I	-

B63RF SIDE IMPACT SENSOR - RIGHT FRONT (AYF)



Connector Part Information

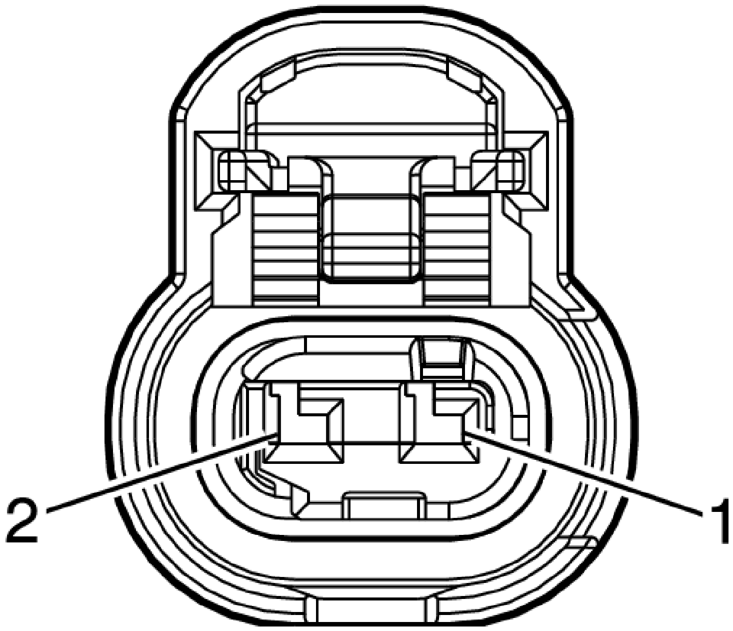
- Harness Type: Passenger Door
- OEM Connector: 54390240
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 0.64 Series, Sealed (L-GY)

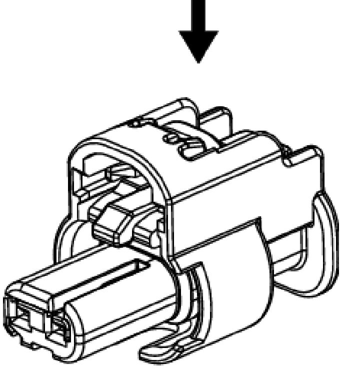
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/OG	2134	Right Front Side Impact Sensing Module Signal	I	AYF
2	0.5	BK/OG	6629	Right Front Side Impact Sensing Module Low Reference	I	AYF

B63RR SIDE IMPACT SENSOR - RIGHT REAR (AYF)





Connector Part Information

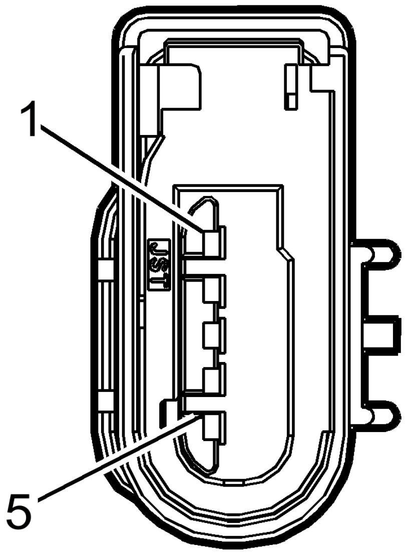
- Harness Type: Body
- OEM Connector: 1-2203312-1
- Service Connector: 19330898
- Description: 2-Way F 1.2 MCON Series, Sealed (BK)

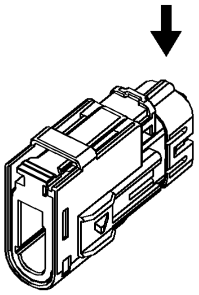
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/VT	6624	Right Middle Side Impact Sensing Module Signal	I	AYF
2	0.5	BK/OG	6625	Right Middle Side Impact Sensing Module Low Reference	I	AYF

B87 REARVIEW CAMERA X1 (UVC)





Connector Part Information

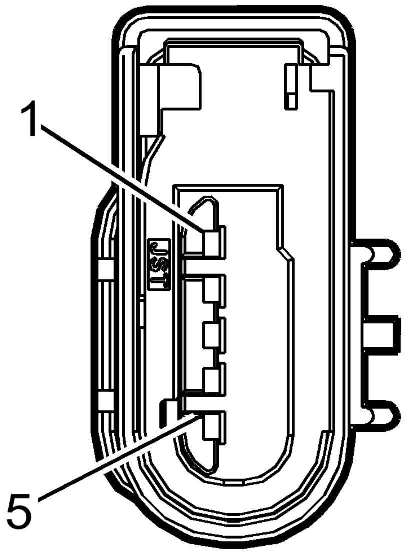
- Harness Type: License Plate Lamp
- OEM Connector: SRVWSB-05-AH
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (L-GY)

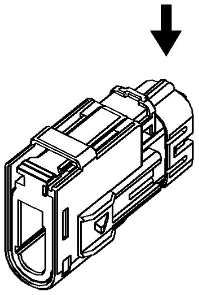
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/YE	6972	Camera Signal 2 +	I	UVC
2	0.35	WH/BU	6973	Camera Signal 2	I	UVC
3	0.35	GY	7069	Camera Shield Ground Extension	I	UVC
4	0.35	BK	2050	Ground	I	UVC
5	0.35	VT/BK	739	Run/Crank Ignition 1 Voltage	I	UVC

B87 REARVIEW CAMERA X1 (UVH)





Connector Part Information

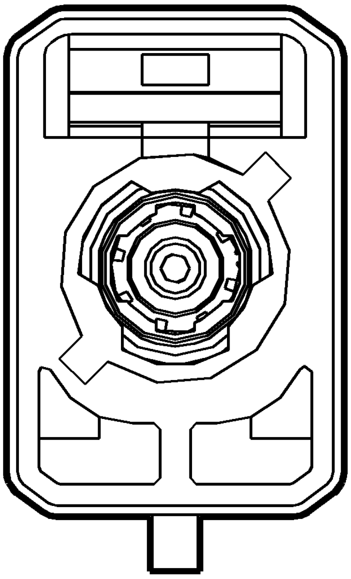
- Harness Type: License Plate Lamp
- OEM Connector: SRVWSB-05-DK
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (L-GY)

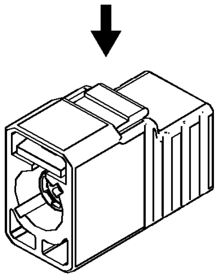
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GY/YE	6972	Camera Signal 2 +	I	UVH
2	0.35	GY	7069	Camera Shield Ground Extension	I	UVH
3	0.35	WH/BU	6973	Camera Signal 2	I	UVH
4	0.35	BK/YE	4670	Rear Camera Return	I	UVH
5	0.35	VT/BN	4669	Rear Camera Control	I	UVH

B87 REARVIEW CAMERA X2 (DRZ)





Connector Part Information

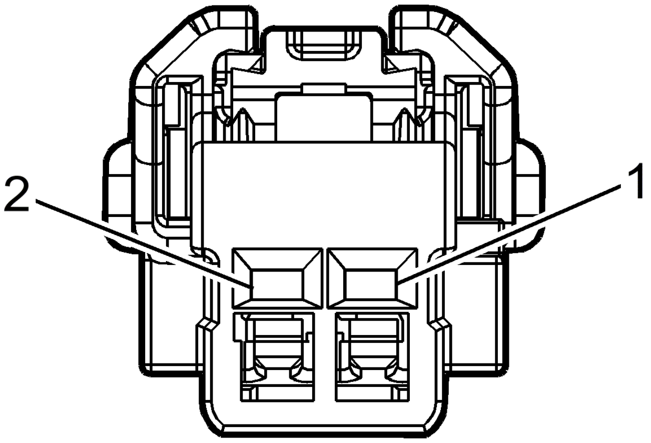
- Harness Type: Liftgate Harness
- OEM Connector: 13581690
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way F Coax Type (BU)

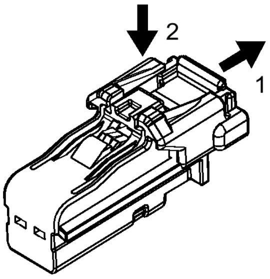
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
-	-	LVDS	-	Navigation Display Signal	I	-

B88P SEAT BELT SWITCH - PASSENGER (AL0+AY0/AYF)





Connector Part Information

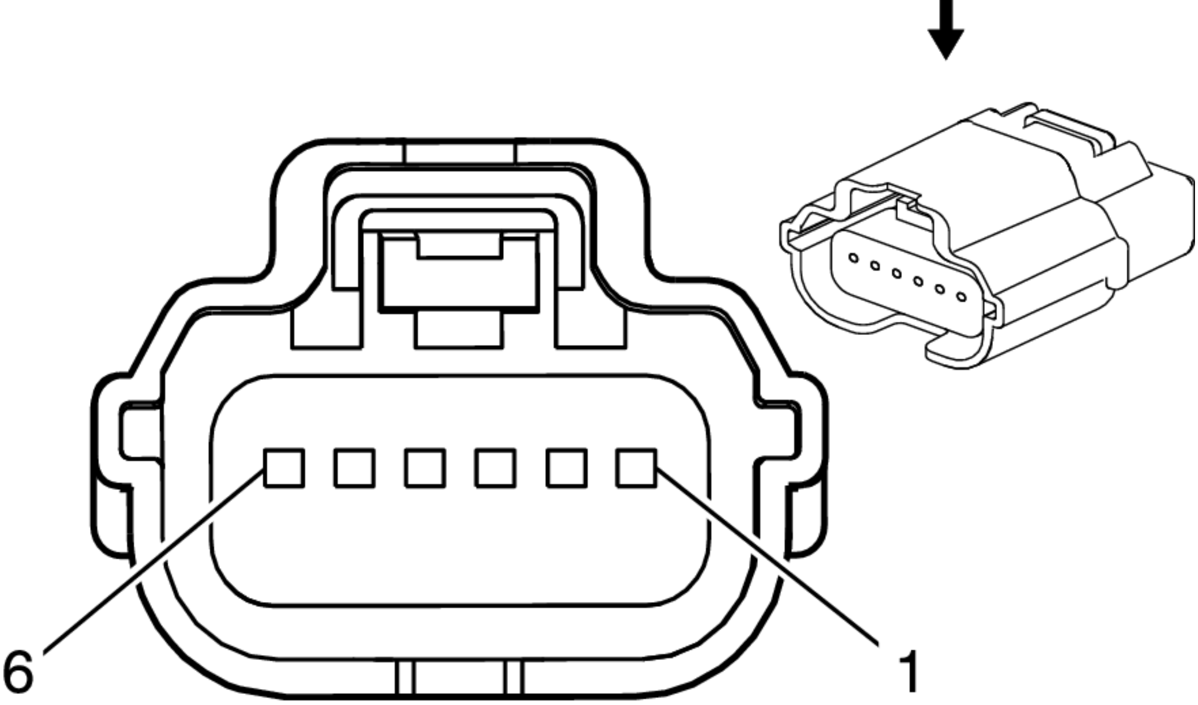
- Harness Type: Passenger Seat
- OEM Connector: 6098-7685
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.2 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	OG/VT	1362	Passenger Seat Belt Switch Signal	I	-
2	0.5	BK/OG	1361	Passenger Seat Belt Switch Low Reference	I	-

B107 ACCELERATOR PEDAL POSITION SENSOR



Connector Part Information

- Harness Type: Body
- OEM Connector: 31404-6110
- Service Connector: 19356496
- Description: 6-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/RD	1274	Accelerator Pedal Position 5V Reference 2	I	-
2	0.5	GN/WH	1162	Accelerator Pedal Position Signal 2	I	-
3	0.5	BK/VT	1272	Accelerator Pedal Position Low Reference 2	I	-
4	0.5	BK/BU	1271	Accelerator Pedal Position Low Reference 1	I	-
5	0.5	YE/WH	1161	Accelerator Pedal Position Signal 1	I	-
6	0.5	WH/RD	1164	Accelerator Pedal Position 5V Reference 1	I	-

B153D SEAT BELT BUCKLE - DRIVER

-

Connector Part Information

- Harness Type: Driver Seat Harness
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog

- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG/BN	238	Driver Seat Belt Switch Signal	I	-
2	-	BK/BN	1363	Driver Seat Belt Switch Low Reference	I	-

B153P SEAT BELT BUCKLE - PASSENGER

-

Connector Part Information

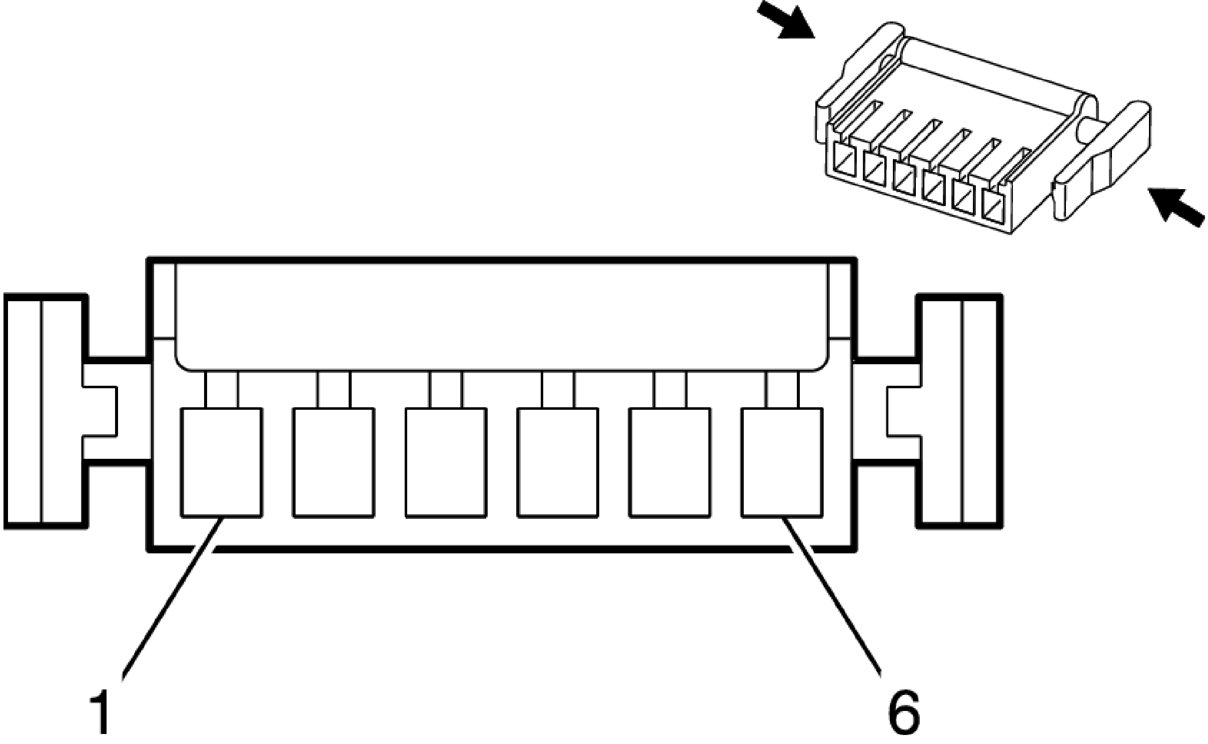
- Harness Type: Passenger Seat Harness
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Available	No Tool Required	Not Available	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	OG/VT	1362	Passenger Seat Belt Switch Signal	I	-
2	-	BK/OG	1361	Passenger Seat Belt Switch Low Reference	II	-

B160 WINDSHIELD TEMPERATURE AND INSIDE MOISTURE SENSOR



Connector Part Information

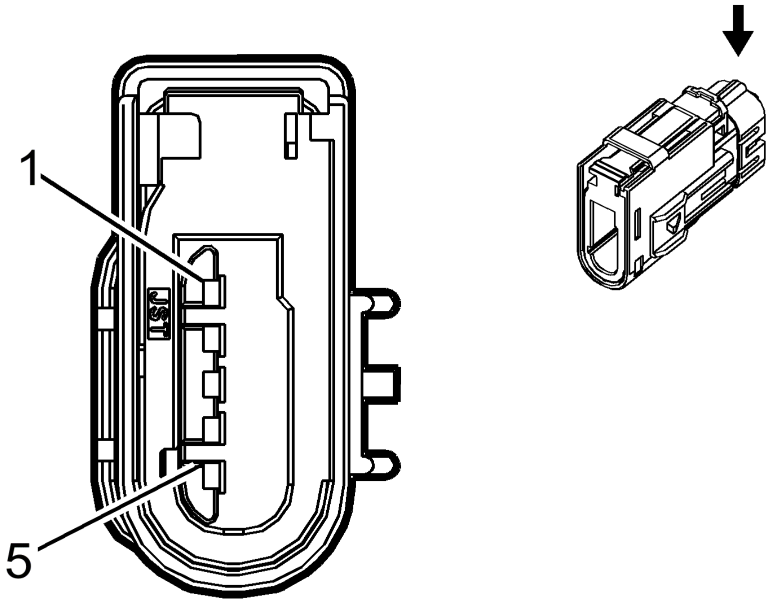
- Harness Type: Headliner
- OEM Connector: 13726957
- Service Connector: 13576539
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	YE/RD	597	5V Reference	I	-
2	0.35	GY/BU	7564	Humidity Sensor Signal	I	-
3	0.35	BK/BU	7566	Humidity/Windscreen Temp Sensor Low Reference	I	-
4	0.35	GY/GN	7565	Windscreen Temp Sensor Signal	I	-
5	0.35	YE/BU	3197	Humidity Temperature Sensor Signal	I	-
6	-	-	-	Not Occupied	-	-

B174G FRONTVIEW CAMERA - GRILLE (UVH)



Connector Part Information

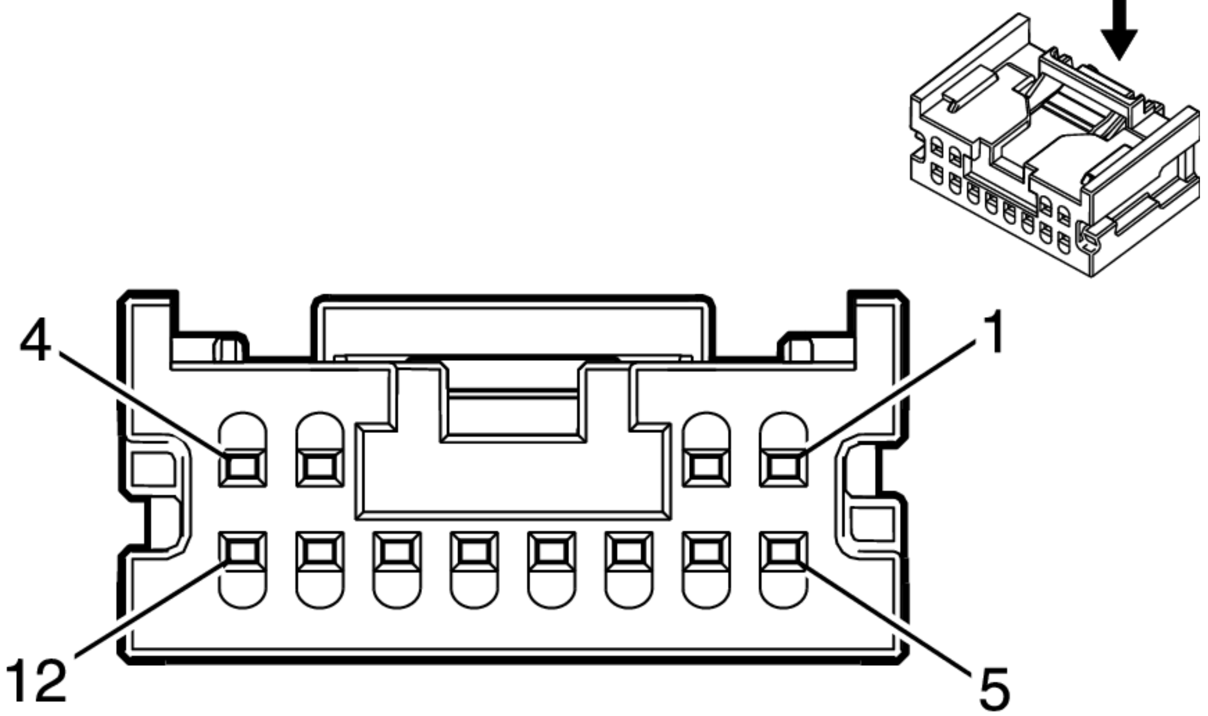
- Harness Type: Front Fascia
- OEM Connector: SRVWSB-05-DK
- Service Connector: Service by Harness - See Part Catalog
- Description: 5-Way M 1.2 Series, Sealed (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	WH	2397	Front Vision Camera #1 Signal (+)	I	UVH
2	0.35	BK/WH	2351	Signal Ground	I	UVH
3	0.5	BU	2398	Front Vision Camera #1 Signal (-)	I	UVH
4	0.5	BN/BK	6202	Camera Ground	I	UVH
5	0.5	WH/BN	6201	Camera Control	I	UVH

B174W FRONTVIEW CAMERA - WINDSHIELD (UGN/UHX)



Connector Part Information

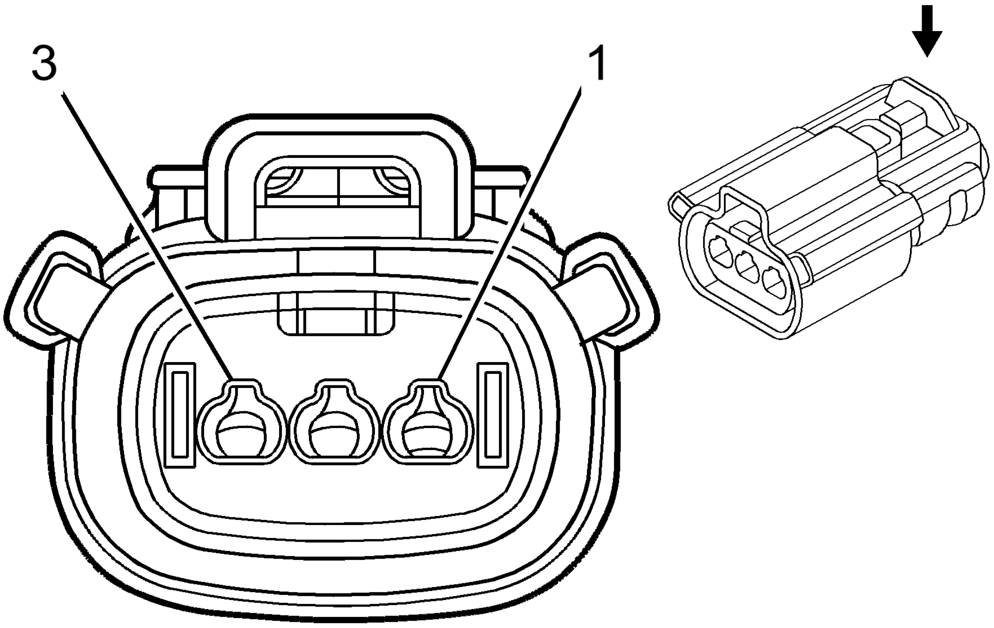
- Harness Type: Headliner
- OEM Connector: 34824-5124
- Service Connector: 13507121
- Description: 12-Way F Mini 50 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19333221	EL-35616-58 (BK)	J-38125-553	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BK	550	Ground	I	-
2	-	-	-	Not Occupied	-	-
3	0.35	RD/GY	6240	Battery Positive Voltage	I	-
4	0.35	WH	3152	Lane Departure Warning Indicator Control	I	-
5	0.35	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
6	0.35	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
7	0.35	BU	2500	High Speed GMLAN Serial Data (+) 1	I	-
8	0.35	WH	2501	High Speed GMLAN Serial Data (-) 1	I	-
9	0.35	WH/BU	5986	Serial Data Communication Enable	I	-
10	0.35	GY/WH	3153	Lane Departure Warning Disable Switch Signal	I	-
11	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
12	-	-	-	Not Occupied	-	-

B197 CHARGE PORT DOOR POSITION SWITCH



Connector Part Information

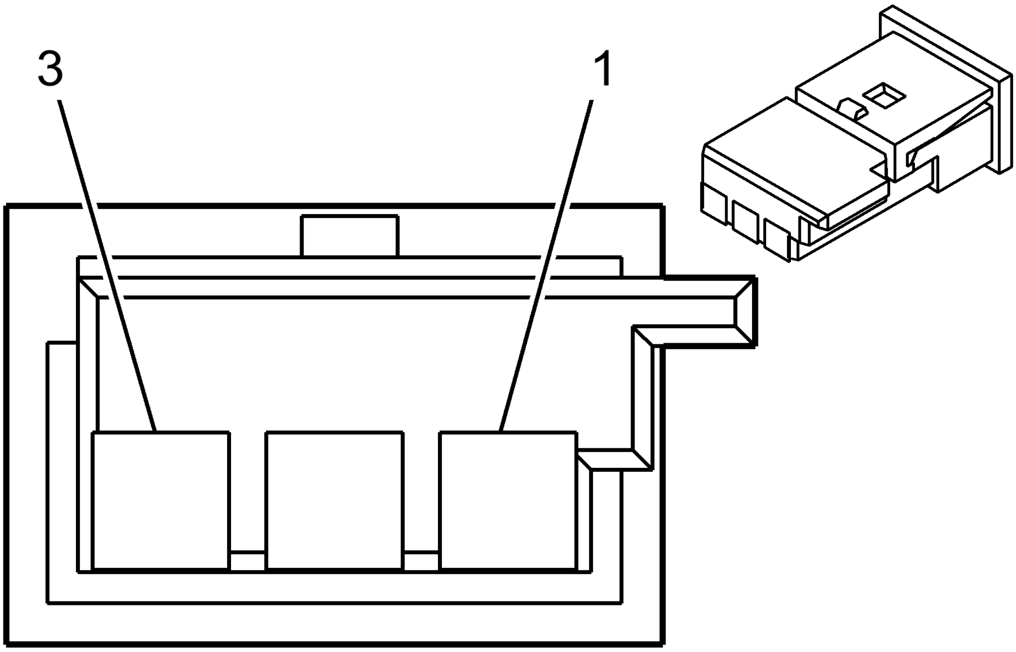
- Harness Type: High Voltage
- OEM Connector: 13503225
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 150 MX Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	WH/BU	3697	Charge Port Door Sensor Signal	I	-
2	-	-	-	Not Occupied	-	-
3	-	BK	550	Ground	I	-

B200 RAIN SENSOR MODULE (CE1)



Connector Part Information

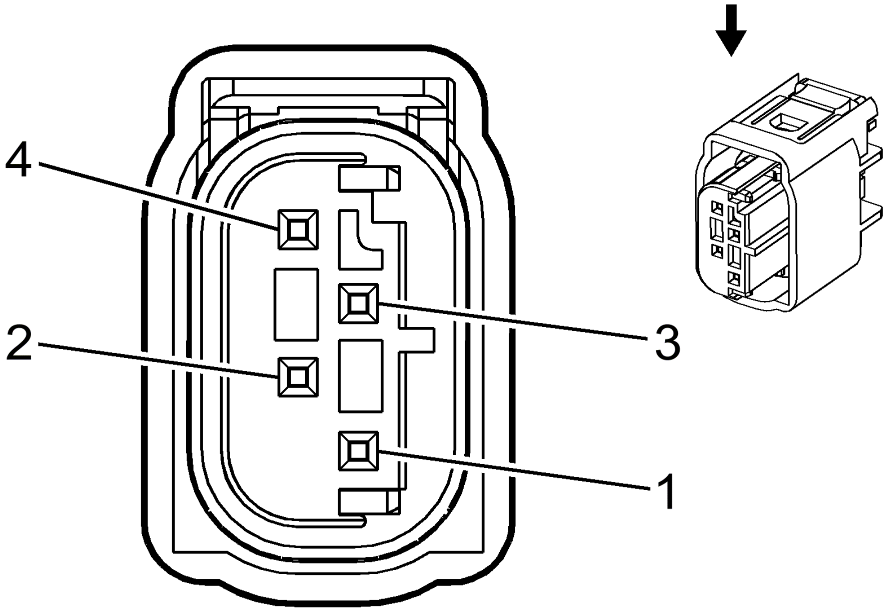
- Harness Type: Headliner
- OEM Connector: 1-1718346-1
- Service Connector: 13314078
- Description: 3-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	RD/YE	3740	Battery Positive Voltage	I	CE1
2	0.35	GN/BN	6132	Local Interconnect Network Serial Data Bus 1	I	CE1
3	0.5	BK	550	Ground	I	CE1

B201 BRAKE CONTROL BRAKE PEDAL POSITION SENSOR



Connector Part Information

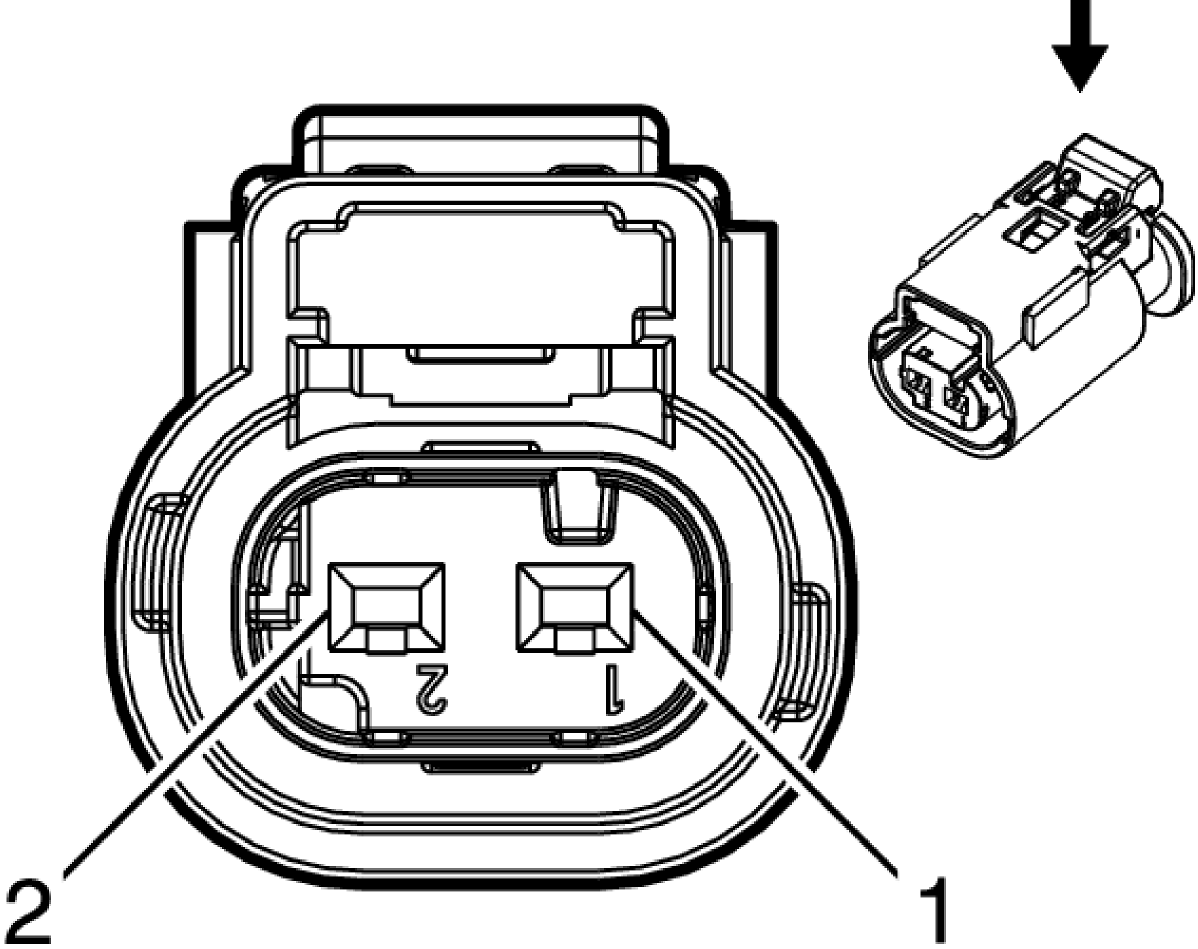
- Harness Type: Body
- OEM Connector: 1563215-1
- Service Connector: 13314098
- Description: 4-Way F 0.64 Micro-Quadlock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BU/RD	3335	Brake Pedal Travel Sensor 1 High Reference	I	-
2	0.35	BU/YE	3334	Brake Pedal Travel Sensor 1 Signal	I	-
3	0.5	BK/GY	3417	Brake Pedal Travel Sensor 1 Low Reference	I	-
4	0.35	VT/BN	3333	Brake Pedal Travel Sensor 2 Signal	I	-

B202 HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR



Connector Part Information

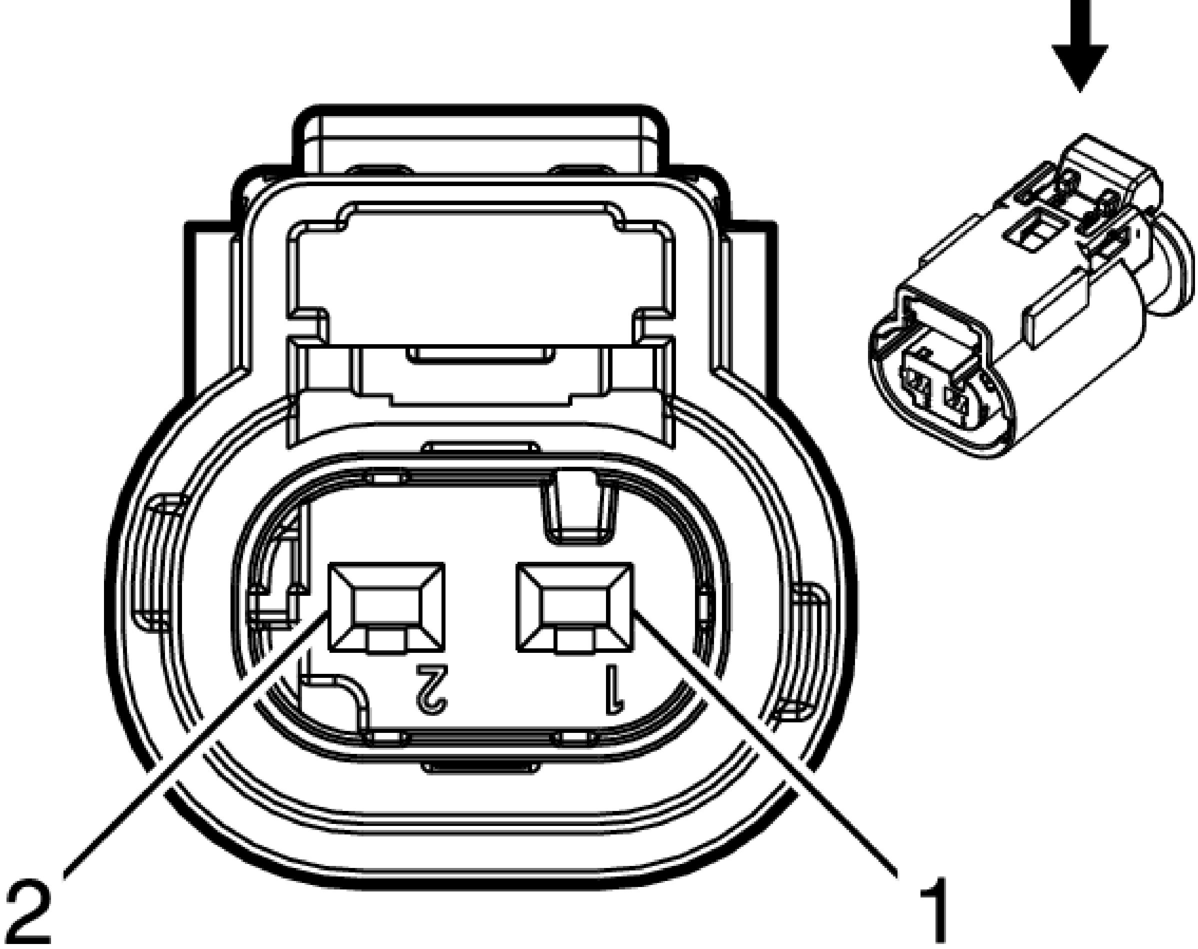
- Harness Type: Engine
- OEM Connector: 10010337
- Service Connector: 13587326
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE/BK	3000	Coolant Temperature Sensor 2 Signal	I	-
2	0.5	BK/BU	6813	Coolant Temperature Sensor 2 Low Reference	I	-

B204A HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR 1



Connector Part Information

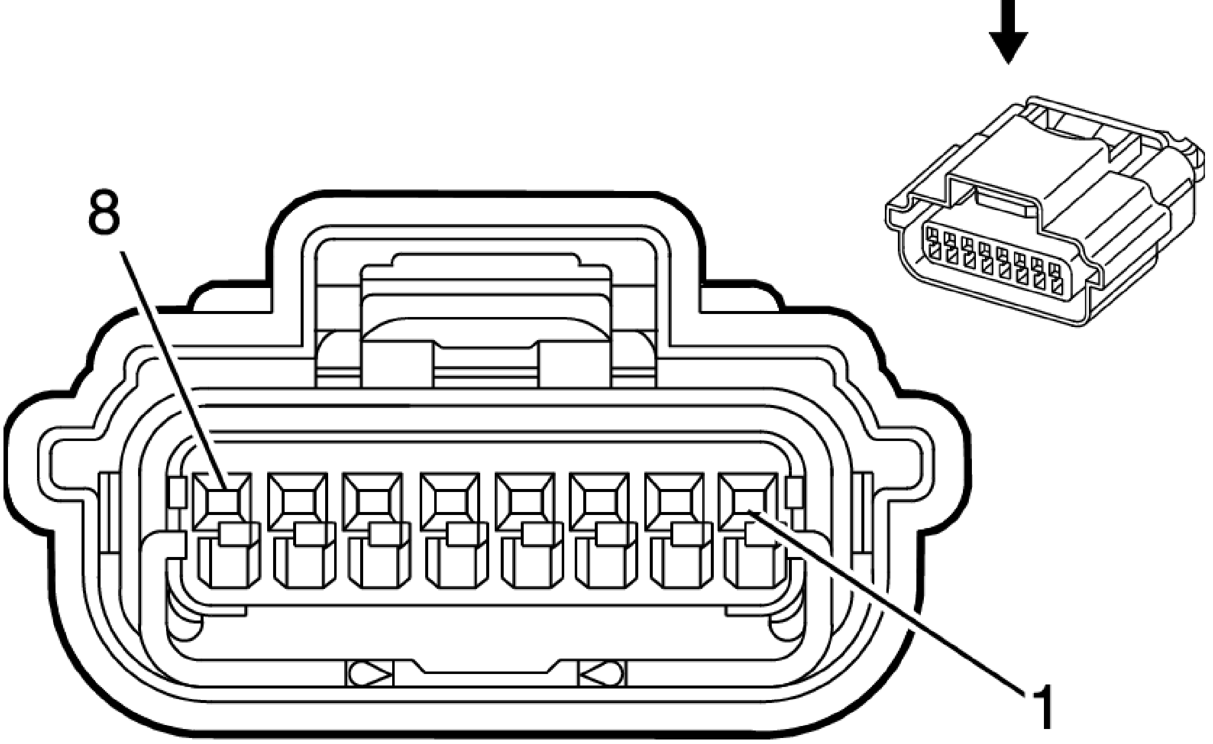
- Harness Type: Body
- OEM Connector: 10010337
- Service Connector: 13587326
- Description: 2-Way F 1.2 Multilock Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	YE	5411	Battery Module Temperature Signal 7	I	-
2	0.5	BK/BU	3779	Battery Module Temperature Sensor Low Reference 7	I	-

B218L SIDE OBJECT SENSOR MODULE - LEFT (UKC)



Connector Part Information

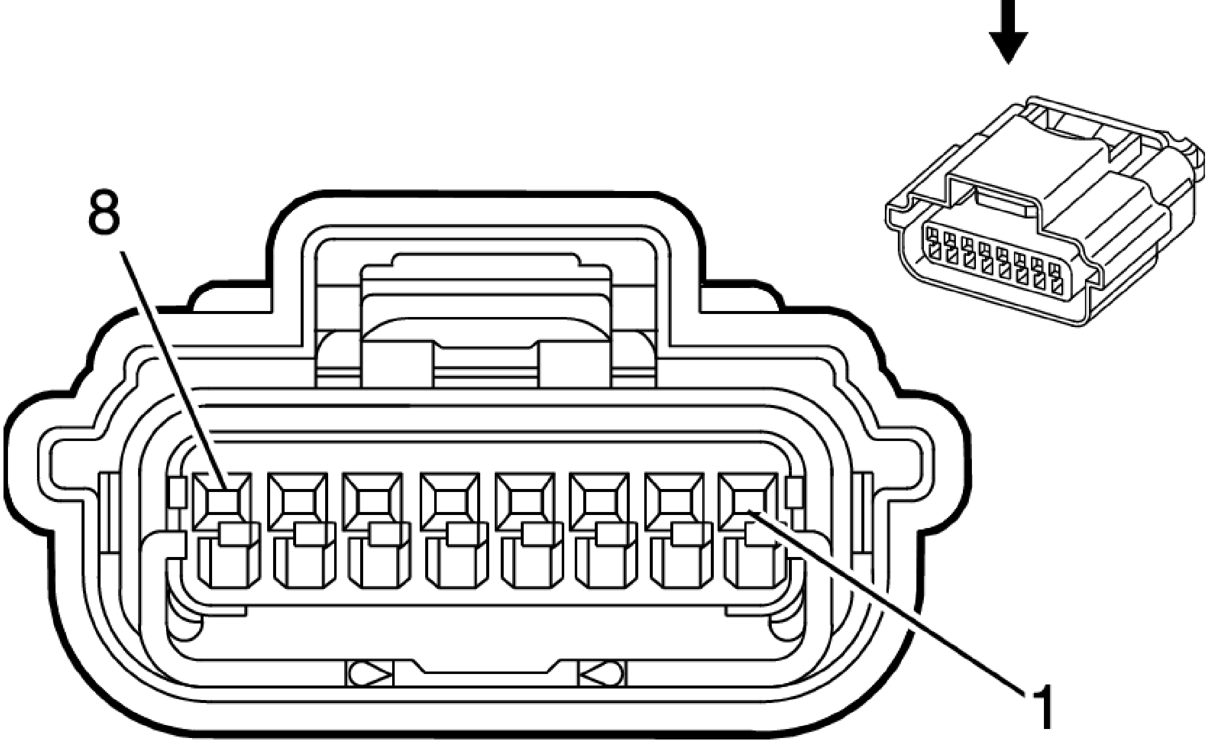
- Harness Type: Rear Fascia
- OEM Connector: ATSSPB-C0805J-1AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	GN	5060	Low Speed GMLAN Serial Data	I	UKC
2 - 3	-	-	-	Not Occupied	-	-
4	0.5	BU/WH	3812	High Speed GMLAN Serial Data (+) 5	I	UKC
5	0.5	BU/YE	3810	High Speed GMLAN Serial Data (-) 5	I	UKC
6	-	-	-	Not Occupied	-	-
7	0.5	BK	1550	Ground	I	UKC
8	0.35	RD/YE	5840	Battery Positive Voltage	I	UKC

B218R SIDE OBJECT SENSOR MODULE - RIGHT (UKC)



Connector Part Information

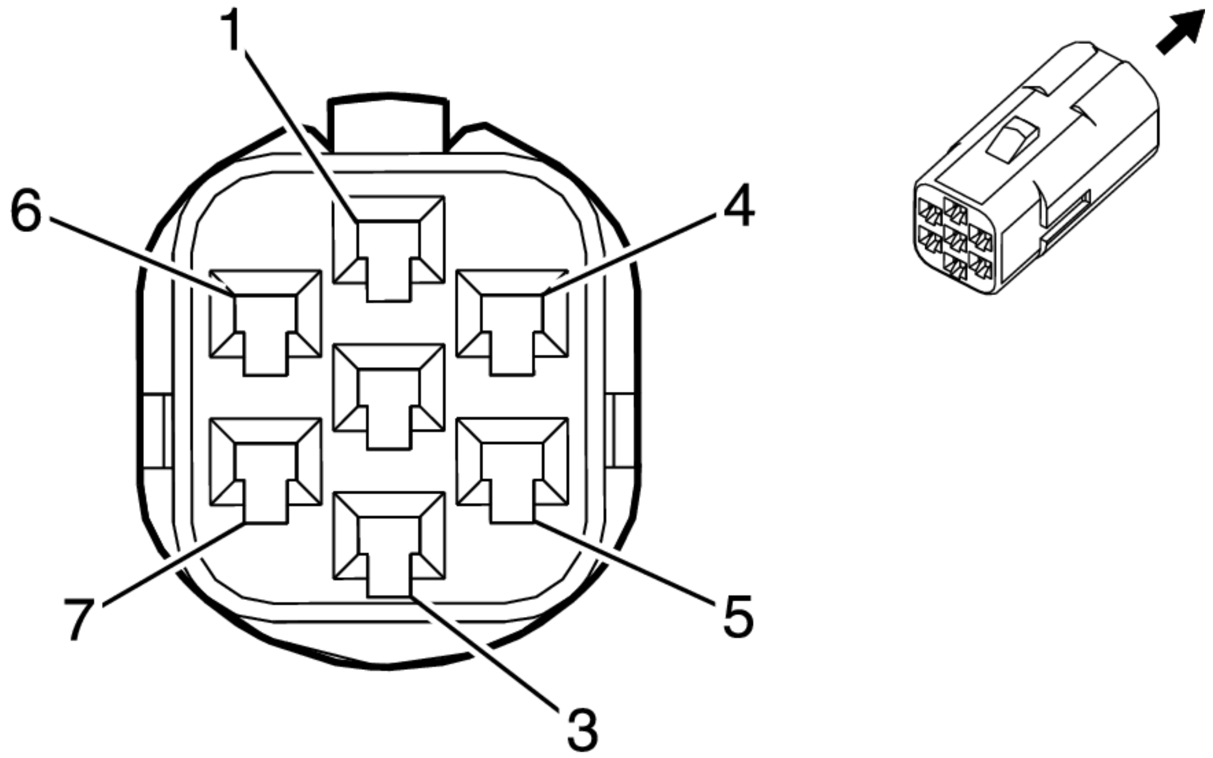
- Harness Type: Rear Fascia
- OEM Connector: ATSSPB-C0806L-1AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	GY	1761	Right Side Object Detection LED Control	I	UKC
2	0.5	GY/YE	1760	Left Side Object Detection LED Control	I	UKC
3	-	-	-	Not Occupied	-	-
4	0.5	BU/WH	3812	High Speed GMLAN Serial Data (+) 5	I	UKC
5	0.5	BU/YE	3810	High Speed GMLAN Serial Data (-) 5	I	UKC
6	-	-	-	Not Occupied	-	-
7	0.5	BK	1550	Ground	I	UKC
8	0.35	RD/YE	5840	Battery Positive Voltage	I	UKC

B225L SIDEVIEW CAMERA - LEFT (UVH)



Connector Part Information

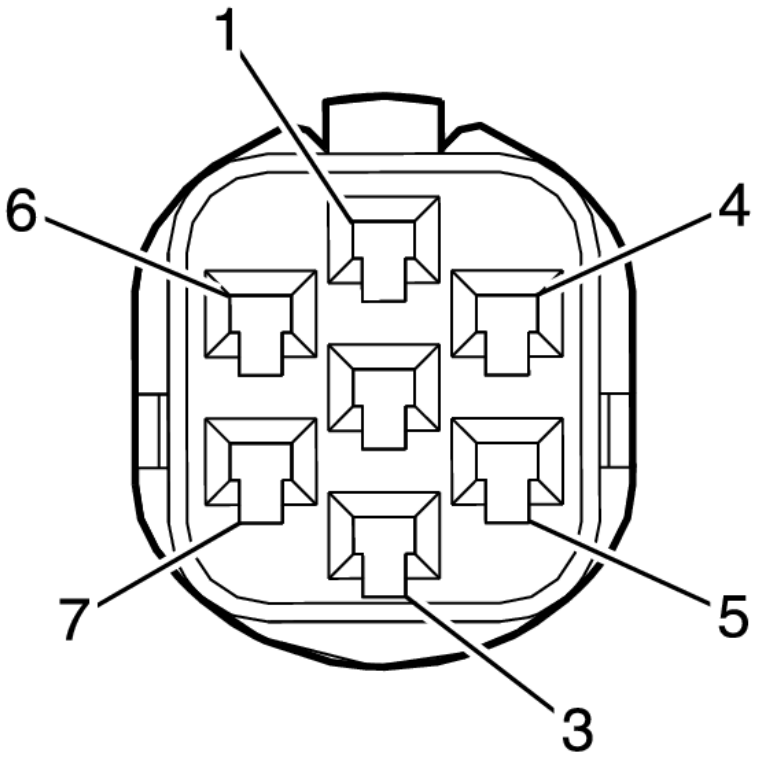
- Harness Type: Driver Outside Rearview Mirror
- OEM Connector: 13576423
- Service Connector: Service by Harness - See Part Catalog
- Description: 7-Way F Multilock Series (GN)

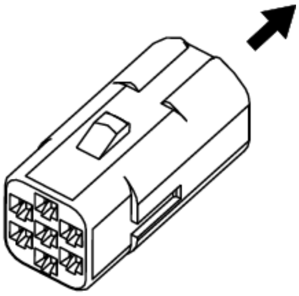
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	WH/GN	2628	Left Side Vision Camera Video Signal (+)	I	-
2 - 3	-	-	-	Not Occupied	-	-
4	-	GY/GN	2625	Left Side Vision Camera Video Signal (-)	I	-
5	-	BK/GN	4664	Left Side Camera Return	I	-
6	-	VT/GN	4663	Left Side Camera Control	I	-
7	-	-	-	Not Occupied	-	-

B225R SIDEVIEW CAMERA - RIGHT (UVH)





Connector Part Information

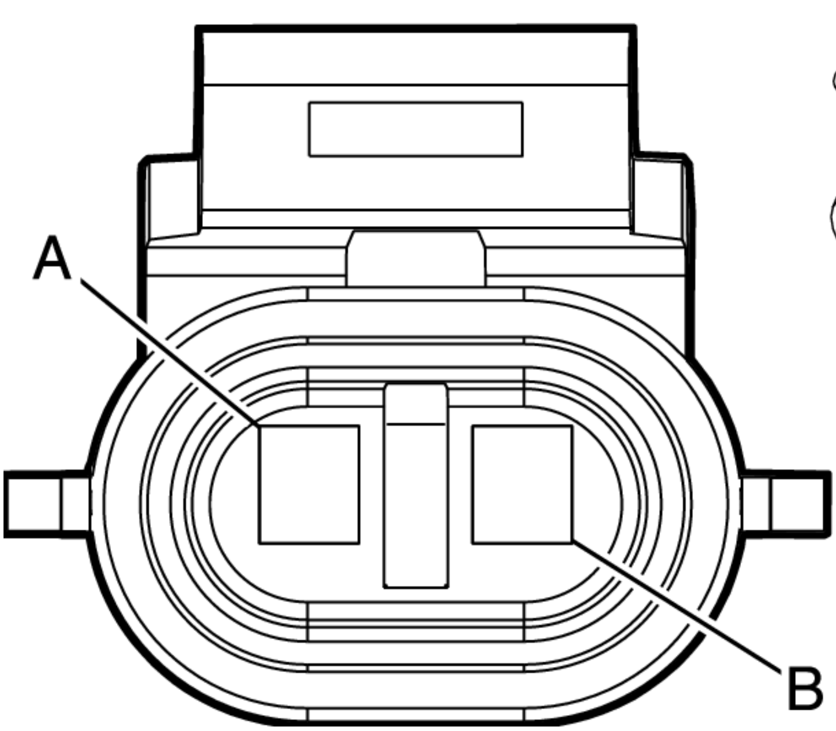
- Harness Type: Passenger Outside Rearview Mirror
- OEM Connector: 13576423
- Service Connector: Service by Harness - See Part Catalog
- Description: 7-Way F Multilock Series (GN)

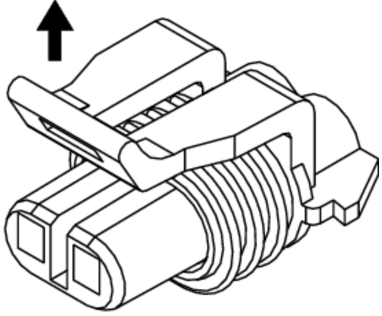
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	WH/BU	2627	Right Side Vision Camera Video Signal (+)	I	-
2 - 3	-	-	-	Not Occupied	-	-
4	-	GY/BU	2626	Right Side Vision Camera Video Signal (-)	I	-
5	-	BK/BU	4667	Right Side Camera Return	I	-
6	-	VT/BU	4666	Right Side Camera Control	I	-
7	-	-	-	Not Occupied	-	-

B258 HYBRID/EV BATTERY COOLANT LEVEL SWITCH





Connector Part Information

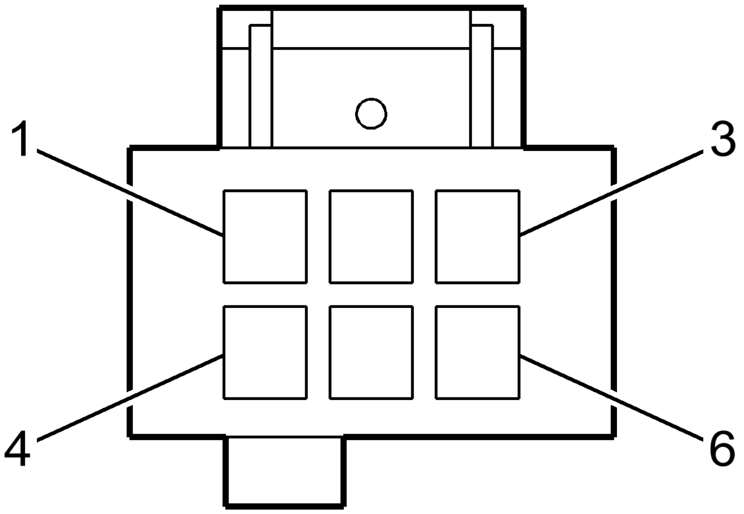
- Harness Type: Forward Lamp
- OEM Connector: 12052641
- Service Connector: 13586114
- Description: 2-Way F 150 Metri-Pack Series (BK)

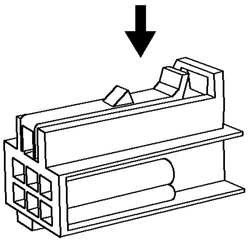
Terminal Part Information

Terminal Type ID	**Terminated Lead**	**Diagnostic Test Probe**	**Terminal Removal Tool**	**Service Terminal**	**Tray Name**	**Core Crimp**	**Insulation Crimp**
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	**Size**	**Color**	**Circuit**	**Function**	**Terminal Type ID**	**Option**
A	0.5	BU/YE	68	Low Coolant Level Indicator Control	I	-
B	0.5	BK/GN	476	Sensor Low Reference	I	-

P36 BATTERY STATE OF CHARGE INDICATOR





Connector Part Information

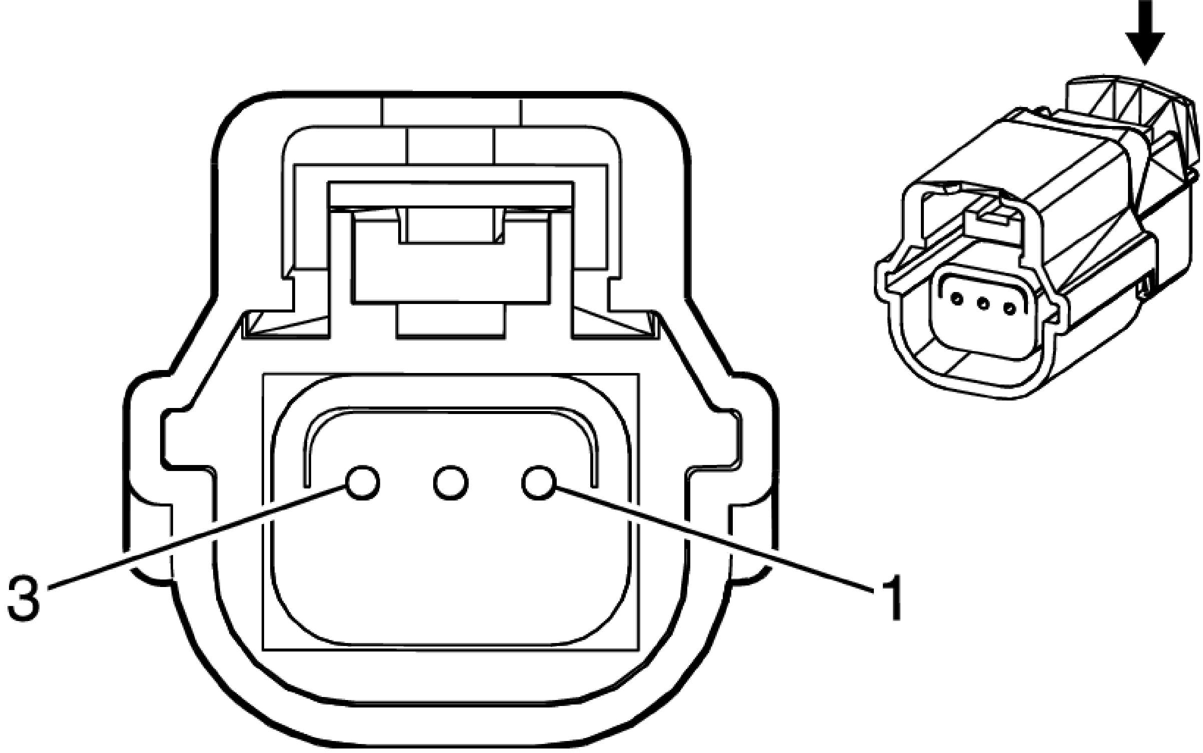
- Harness Type: Instrument Panel
- OEM Connector: 965413-1
- Service Connector: 19333315
- Description: 6-Way F 0.64 Micro-Quadlock Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK	1450	Ground	I	-
2	0.35	GN/WH	4115	Local Interconnect Network Serial Data Bus 15	I	-
3	0.5	YE/VT	3956	Charging Status Indicator Control	I	-
4	0.5	GY/GN	3957	Charging Pilot Signal Indicator Control	I	-
5	0.35	RD/BU	6740	Battery Positive Voltage	I	-
6	0.5	BK	1450	Ground	I	-

B306A PARKING ASSIST SENSOR - FRONT LEFT OUTER (UD5/UFQ)



Connector Part Information

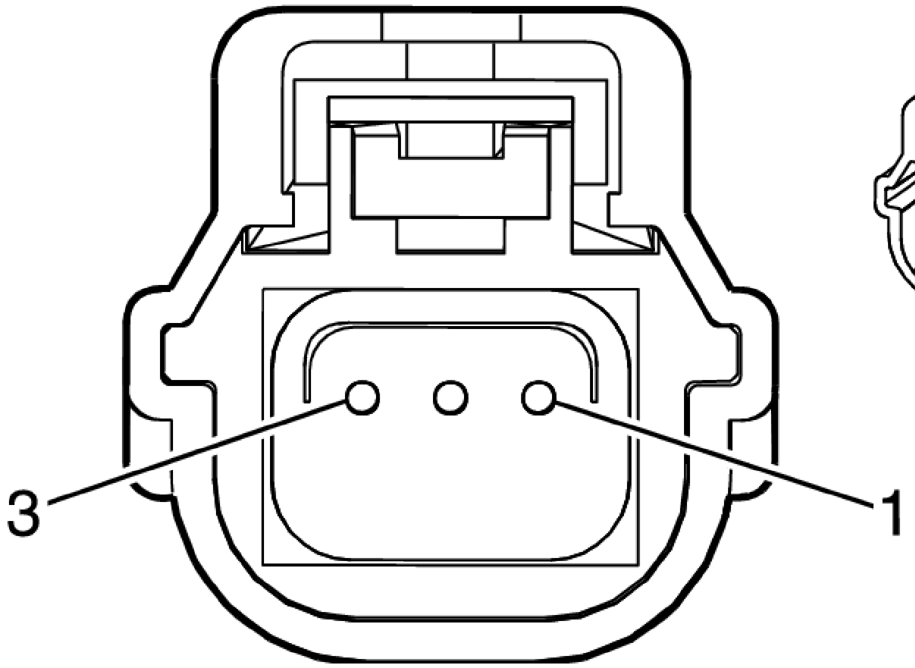
- Harness Type: Front Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

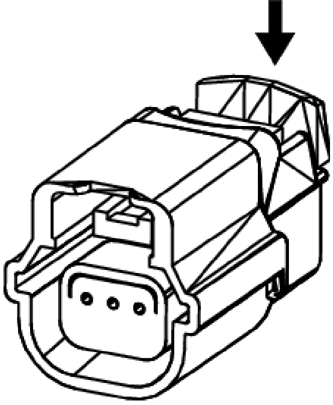
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	6581	Front Parking Aid Display Control	I	UD5/UFQ
2	0.5	VT/WH	5215	Front Parking Left Corner Sensor	I	UD5/UFQ
3	0.35	BK/BU	5214	Front Parking Sensor Low Reference	I	UD5/UFQ

B306B PARKING ASSIST SENSOR - FRONT LEFT MIDDLE





Connector Part Information

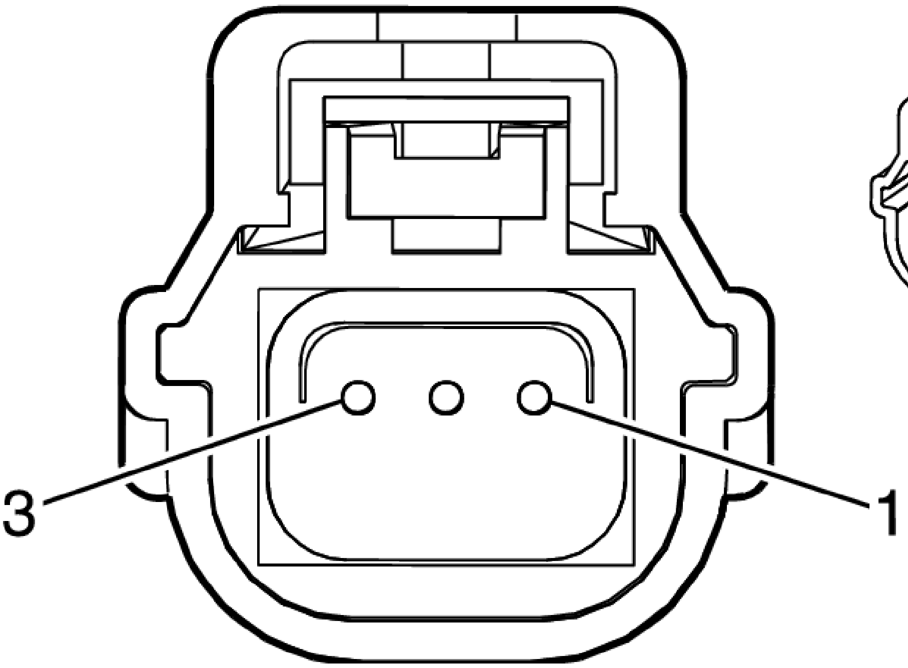
- Harness Type: Front Fascia
- OEM Connector: 19115171
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

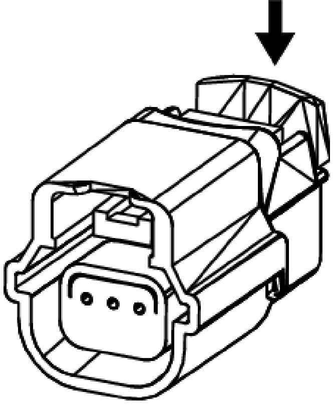
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BN	6581	Front Parking Aid Display Control	I	-
2	-	YE/GY	5216	Front Parking Left Mid Sensor	I	-
3	-	BK/BU	5214	Front Parking Sensor Low Reference	I	-

B306C PARKING ASSIST SENSOR - FRONT RIGHT MIDDLE (UD5/UFQ)





Connector Part Information

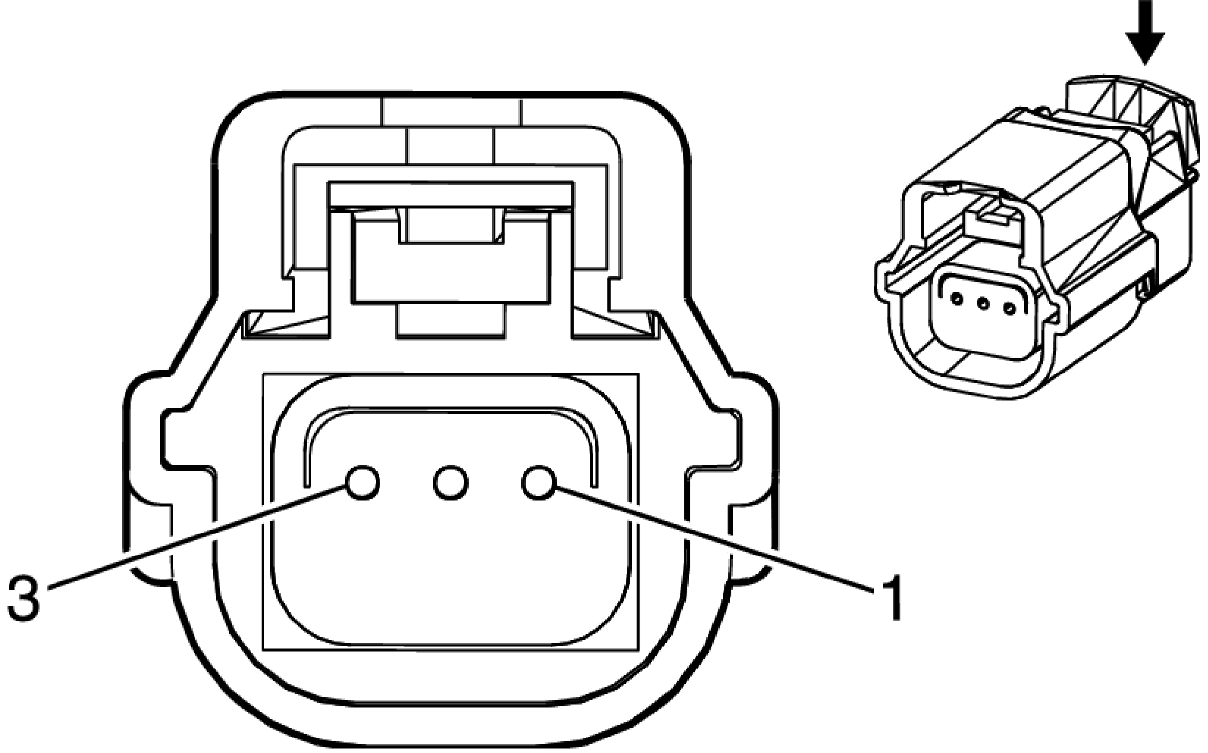
- Harness Type: Front Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	6581	Front Parking Aid Display Control	I	UD5/UFQ
2	0.5	VT/GY	5218	Front Parking Right Mid Sensor	I	UD5/UFQ
3	0.35	BK/BU	5214	Front Parking Sensor Low Reference	I	UD5/UFQ

B306D PARKING ASSIST SENSOR - FRONT RIGHT OUTER (UD5/UFQ)



Connector Part Information

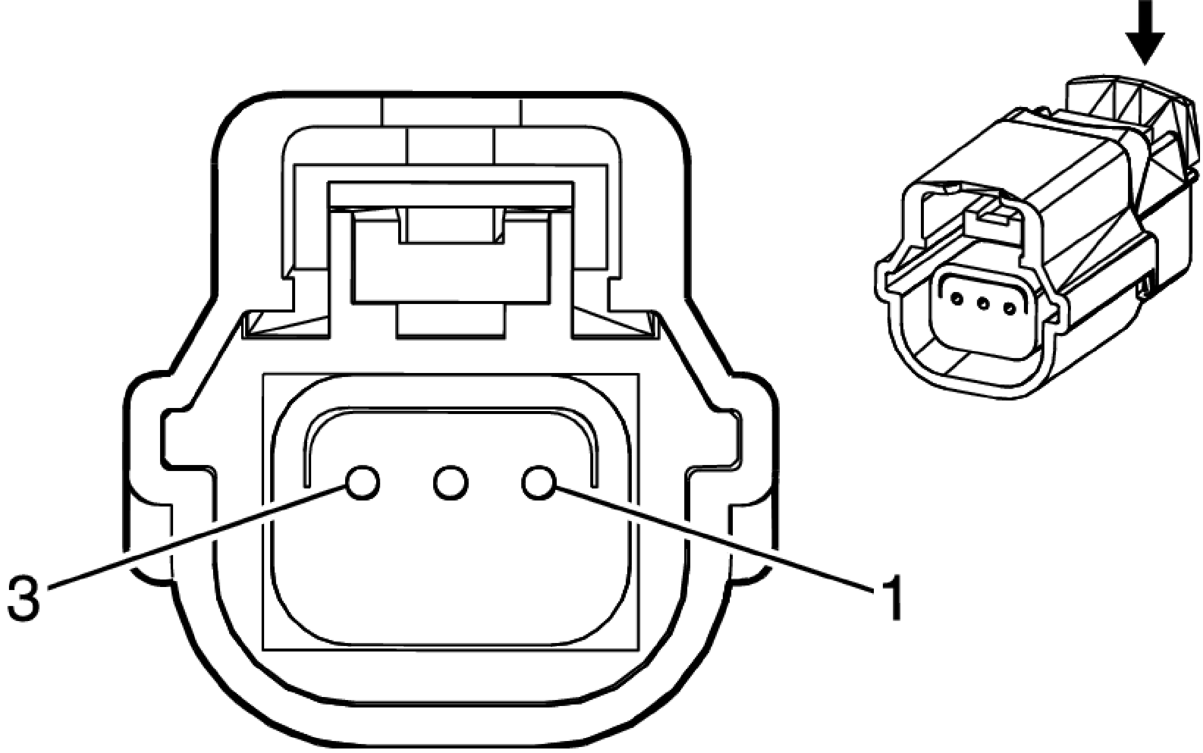
- Harness Type: Front Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	6581	Front Parking Aid Display Control	I	UD5/UFQ
2	0.5	WH/GY	5217	Front Parking Right Corner Sensor	I	UD5/UFQ
3	0.35	BK/BU	5214	Front Parking Sensor Low Reference	I	UD5/UFQ

B306E PARKING ASSIST SENSOR - REAR LEFT OUTER (UD5/UD7/UFQ)



Connector Part Information

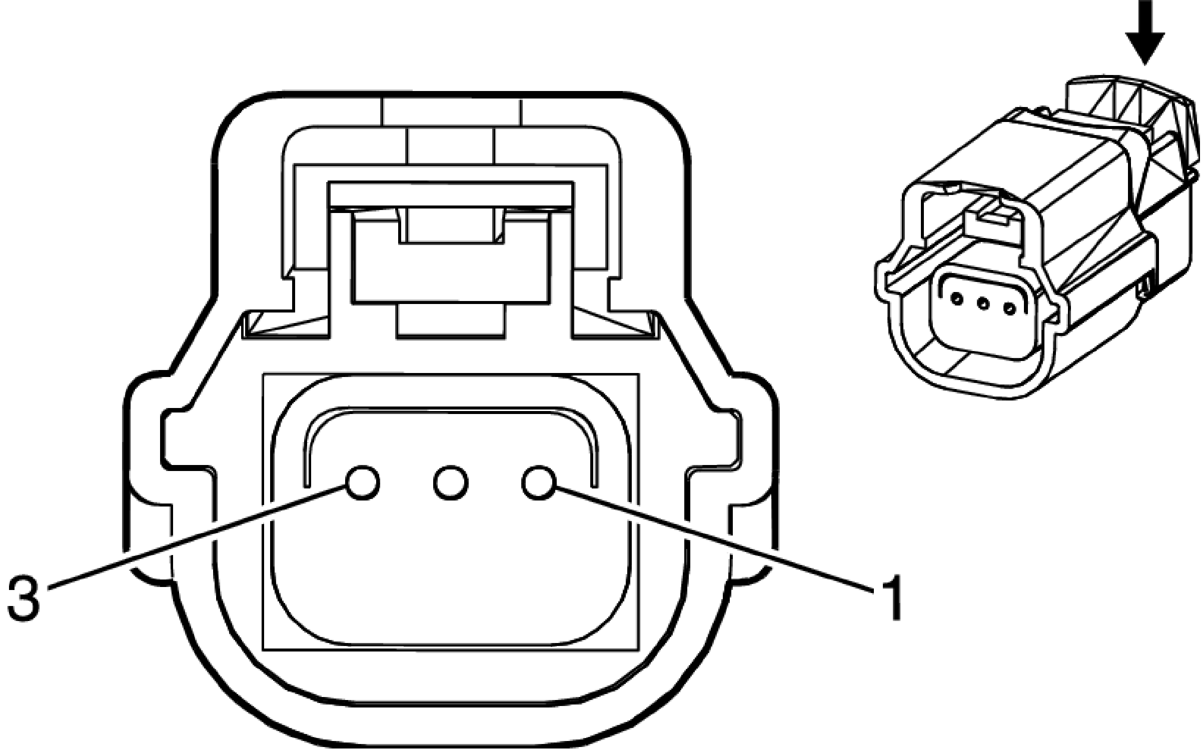
- Harness Type: Rear Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/WH	2374	Object Sensor Control	I	-
2	0.35	YE	2375	Left Rear Corner Object Sensor Signal	I	UD5/UFQ/UD7
3	0.35	BK/GY	2379	Object Sensor Low Reference	I	-

B306H PARKING ASSIST SENSOR - REAR RIGHT OUTER (UD5/UD7/UFQ)



Connector Part Information

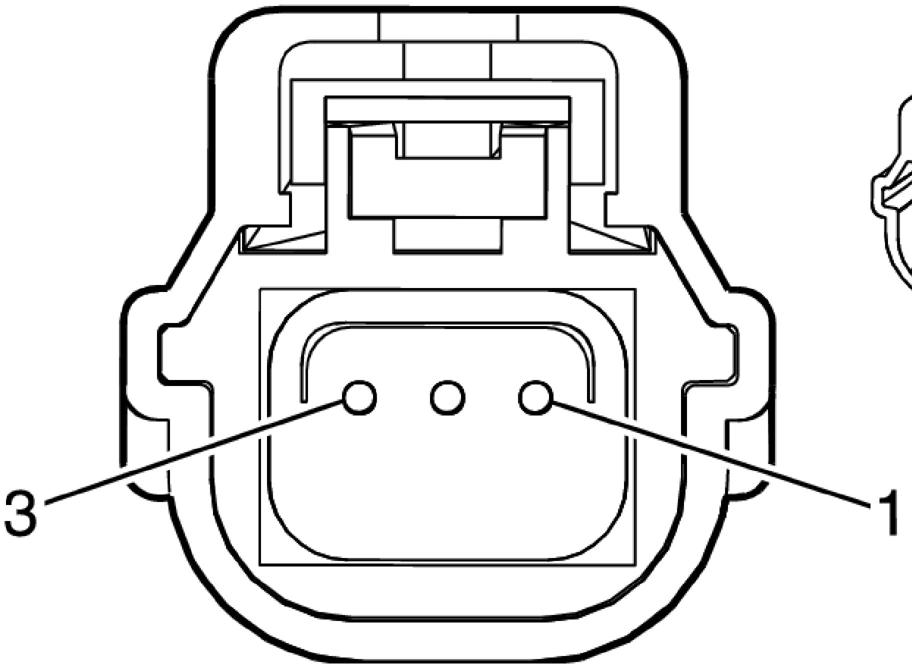
- Harness Type: Rear Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

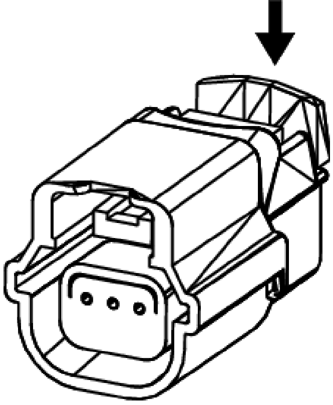
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/WH	2374	Object Sensor Control	I	-
2	0.35	YE/VT	2378	Right Rear Corner Object Sensor Signal	I	-
3	0.35	BK/GY	2379	Object Sensor Low Reference	I	-

B306J PARKING ASSIST SENSOR - REAR MIDDLE





Connector Part Information

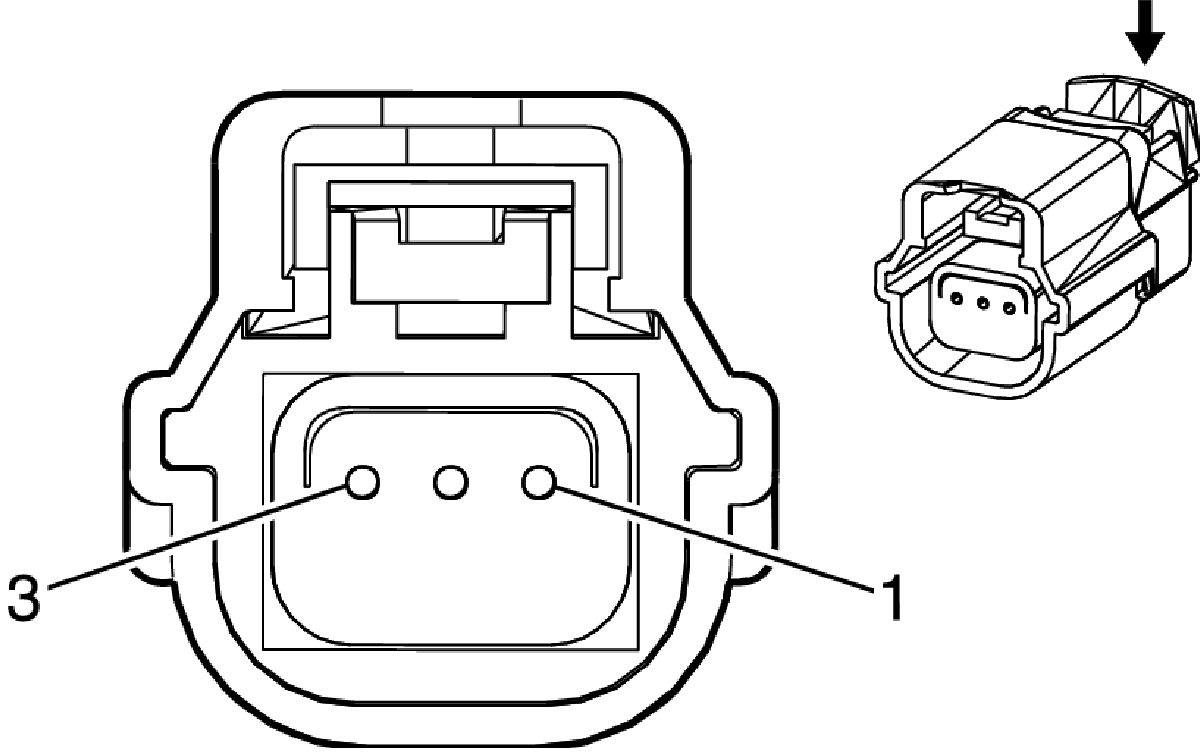
- Harness Type: Rear Fascia Harness
- OEM Connector: 19115171
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BN/WH	2374	Object Sensor Control	I	-
2	-	WH/YE	2377	Right Rear Middle Object Sensor Signal	I	-
3	-	BK/GY	2379	Object Sensor Low Reference	I	-

B306K PARKING ASSIST SENSOR - SIDE LEFT FRONT (UFQ)



Connector Part Information

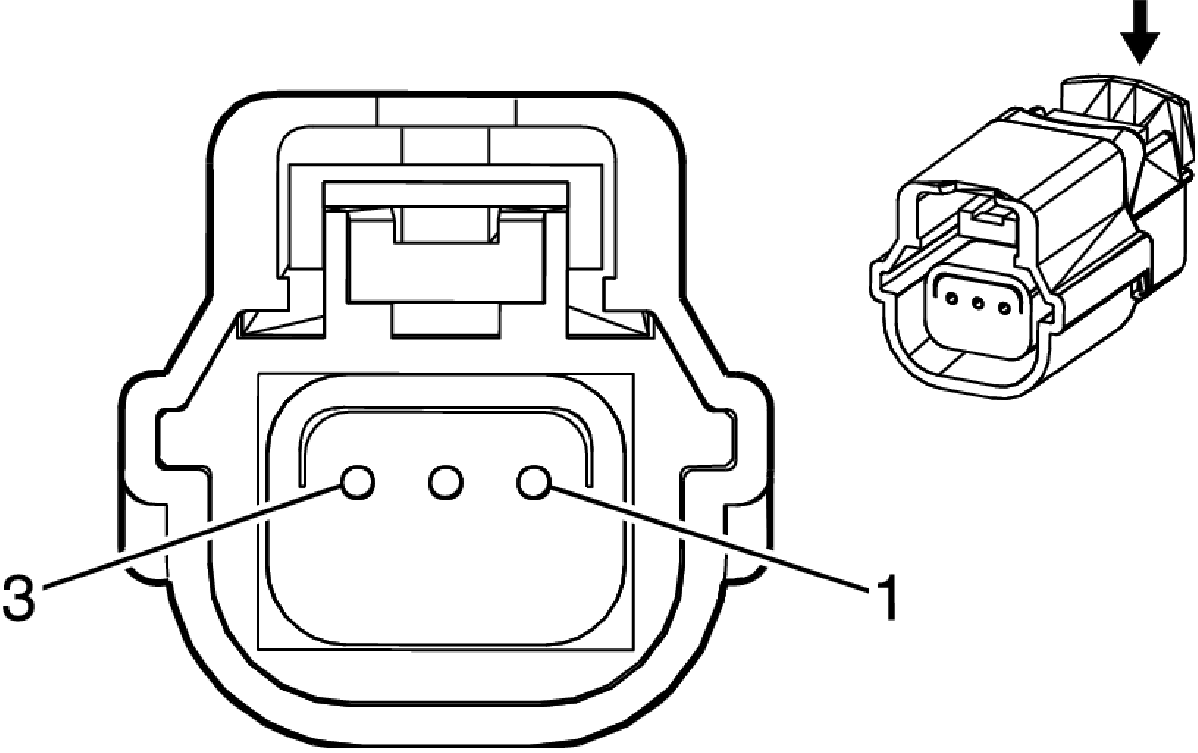
- Harness Type: Front Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	6581	Front Parking Aid Display Control	I	UFQ
2	0.5	GY	3154	Left Front Supplemental Object Sensor Signal	I	UFQ
3	0.35	BK/BU	5214	Front Parking Sensor Low Reference	I	UFQ

B306L PARKING ASSIST SENSOR - SIDE RIGHT FRONT (UFQ)



Connector Part Information

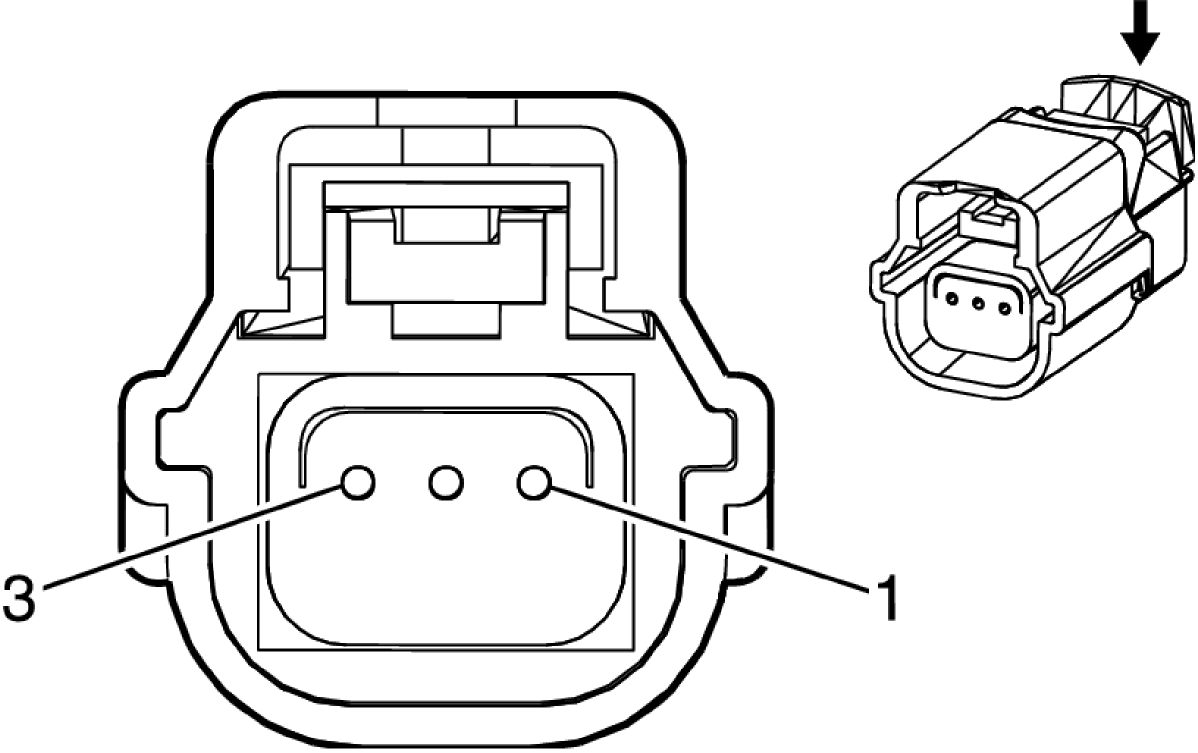
- Harness Type: Front Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN	6581	Front Parking Aid Display Control	I	UFQ
2	0.5	GN	3155	Right Front Supplemental Object Sensor Signal	I	UFQ
3	0.35	BK/BU	5214	Front Parking Sensor Low Reference	I	UFQ

B306M PARKING ASSIST SENSOR - SIDE LEFT REAR (UFQ)



Connector Part Information

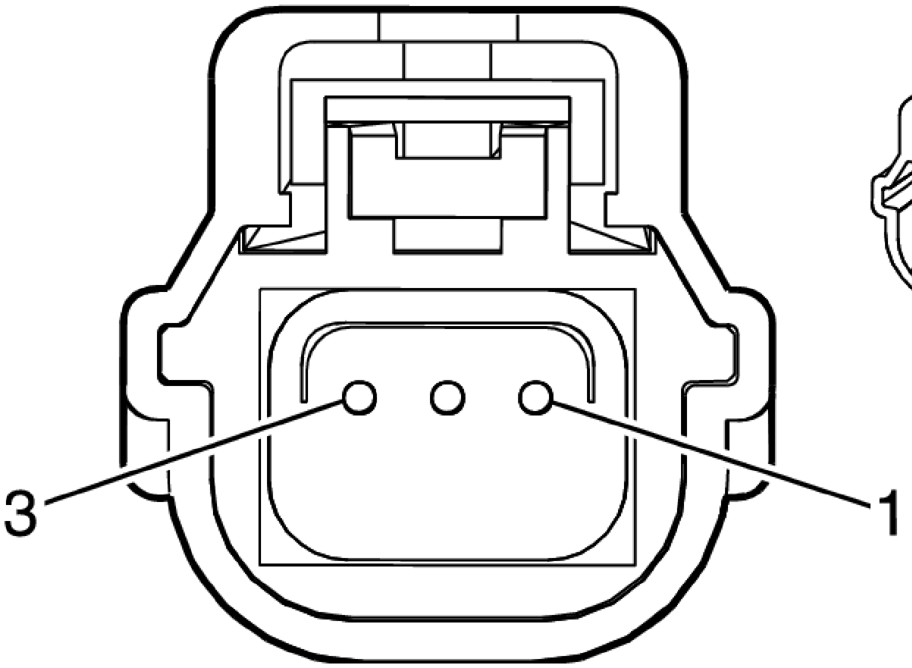
- Harness Type: Rear Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

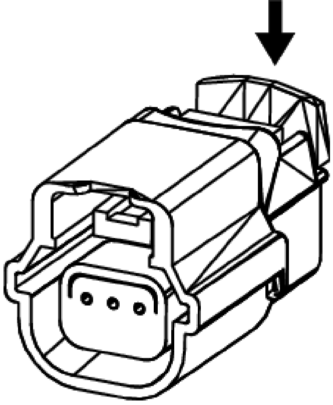
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/WH	2374	Object Sensor Control	I	UFQ
2	0.35	GN	3156	Left Rear Supplemental Object Sensor Signal	I	UFQ
3	0.35	BK/GY	2379	Object Sensor Low Reference	I	UFQ

B306N PARKING ASSIST SENSOR - SIDE RIGHT REAR (UFQ)





Connector Part Information

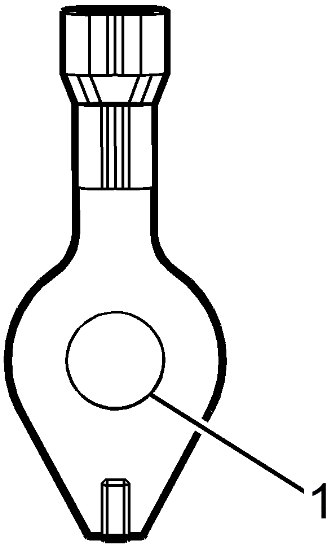
- Harness Type: Rear Fascia
- OEM Connector: 31404-3110
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F 0.64 Series, Sealed (BK)

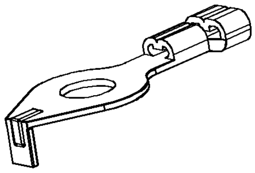
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	BN/WH	2374	Object Sensor Control	I	UFQ
2	0.35	BU	3157	Right Rear Supplemental Object Sensor Signal	I	UFQ
3	0.35	BK/GY	2379	Object Sensor Low Reference	I	UFQ

C1 BATTERY ((-) BODY)





Connector Part Information

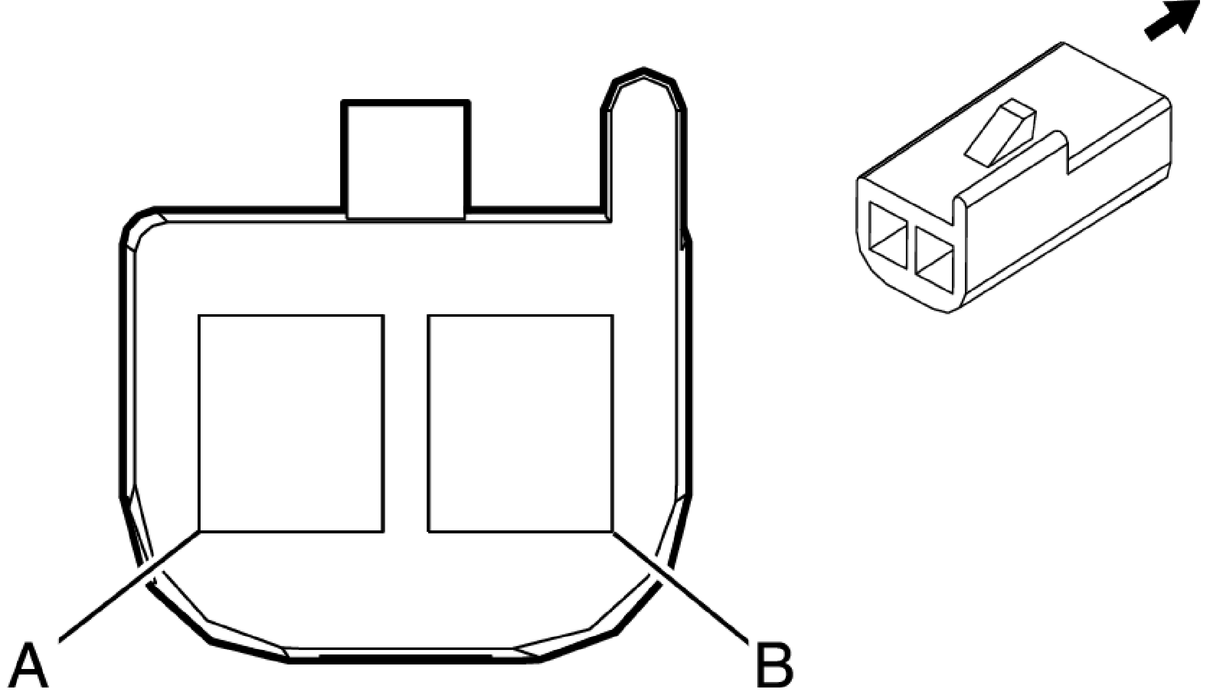
- Harness Type: Body
- OEM Connector: ST711059-3
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BK/WH	51	Signal Ground	I	-

C3 TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE BATTERY (UE1)



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 12047662
- Service Connector: 12085535
- Description: 2-Way F 150 Metri-Pack Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.35	YE/VT	5235	Battery Backup Control	I	UE1
B	0.35	BK/VT	5167	Battery Backup Low Reference	I	UE1

C5A HYBRID/EV BATTERY MODULE 1 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	PK	5403	Battery Pack Monitor Low Reference	I	-
2	-	L-BU	5394	Battery Voltage Signal 2	I	-
3	-	VT	5396	Battery Voltage Signal 4	I	-
4	-	WH	5398	Battery Voltage Signal 6	I	-
5	-	BN	5400	Battery Voltage Signal 8	I	-
6	-	BU	5392	Battery Voltage Signal 10	I	-

C5A HYBRID/EV BATTERY MODULE 1 X2

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	GN	5391	Battery Voltage Signal 1	I	-
2	-	YE	5395	Battery Voltage Signal 3	I	-
3	-	OG	5397	Battery Voltage Signal 5	I	-
4	-	GY	5399	Battery Voltage Signal 7	I	-
5	-	OG/RD	5401	Battery Voltage Signal 9	I	-

C5B HYBRID/EV BATTERY MODULE 2 X1

-

Connector Part Information

- Harness Type: Hybrid/EV Battery
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	-	BN	5579	Battery Voltage Signal 20	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	-	WH	5577	Battery Voltage Signal 18	I	-
3	-	VT	5575	Battery Voltage Signal 16	I	-
4	-	L-BU	5573	Battery Voltage Signal 14	I	-
5	-	PK	5571	Battery Voltage Signal 12	I	-
6	-	GN/WH	5403	Battery Pack Monitor Low Reference	I	-

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DOOR COMPONENT VIEWS

DRIVER DOOR COMPONENTS

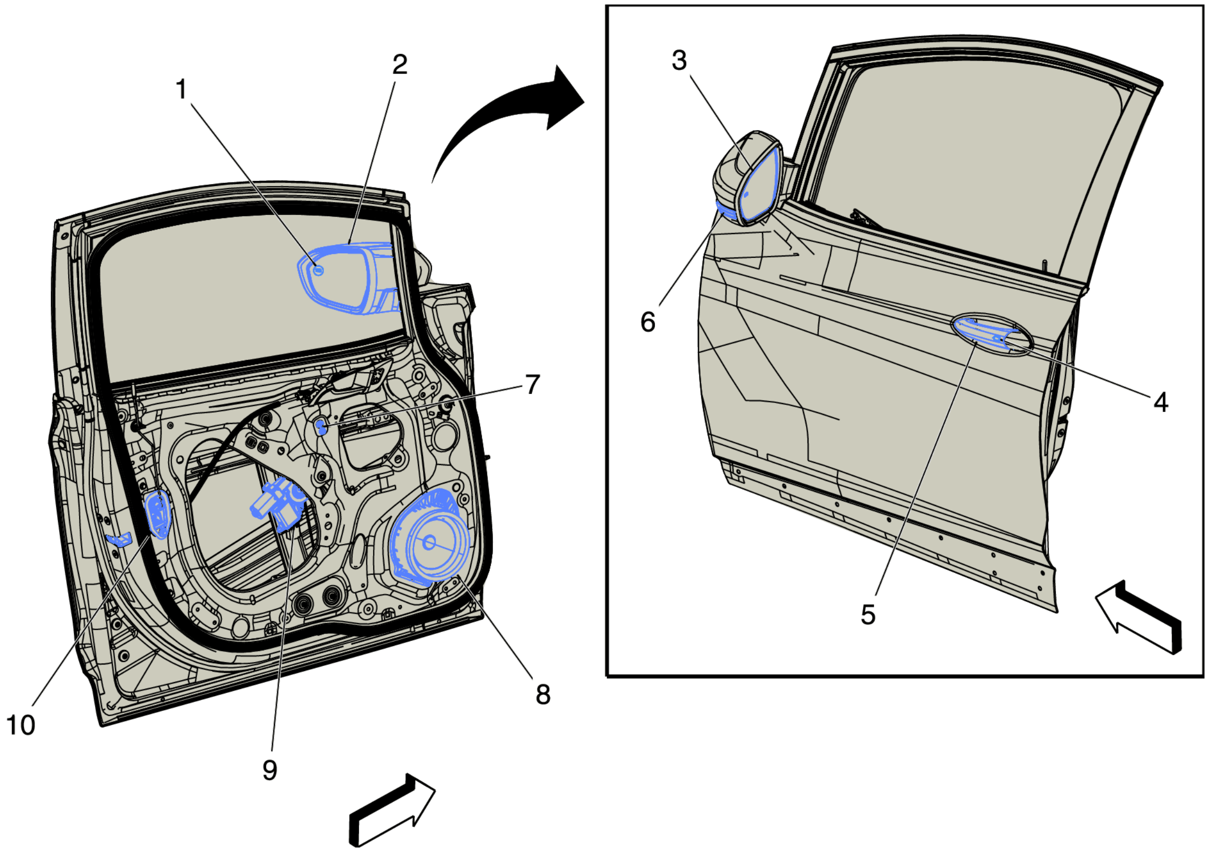

Fig. 1: Driver Door Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: P34D Side Object Detection Indicator - Driver
2: A9A Outside Rearview Mirror - Driver
3: E17D Outside Rearview Mirror Glass - Driver
4: B27D Door Handle Switch - Driver Exterior B27D Door Handle Switch - Driver Exterior
5: A24D Door Handle Assembly - Driver Exterior A24D Door Handle Assembly - Driver Exterior
6: E4Y Turn Signal Repeater Lamp - Left
7: B63LF Side Impact Sensor - Left Front (AYF) B63LF Side Impact Sensor - Left Front (AYF)
8: P19AG Speaker - Left Front Door P19AG Speaker - Left Front Door (UQ3) P19AG Speaker - Left Front Door (UQA)
9: M74D Window Motor - Driver M74D Window Motor - Driver
10: A23D Door Latch Assembly - Driver A23D Door Latch Assembly - Driver

DRIVER DOOR TRIM COMPONENTS

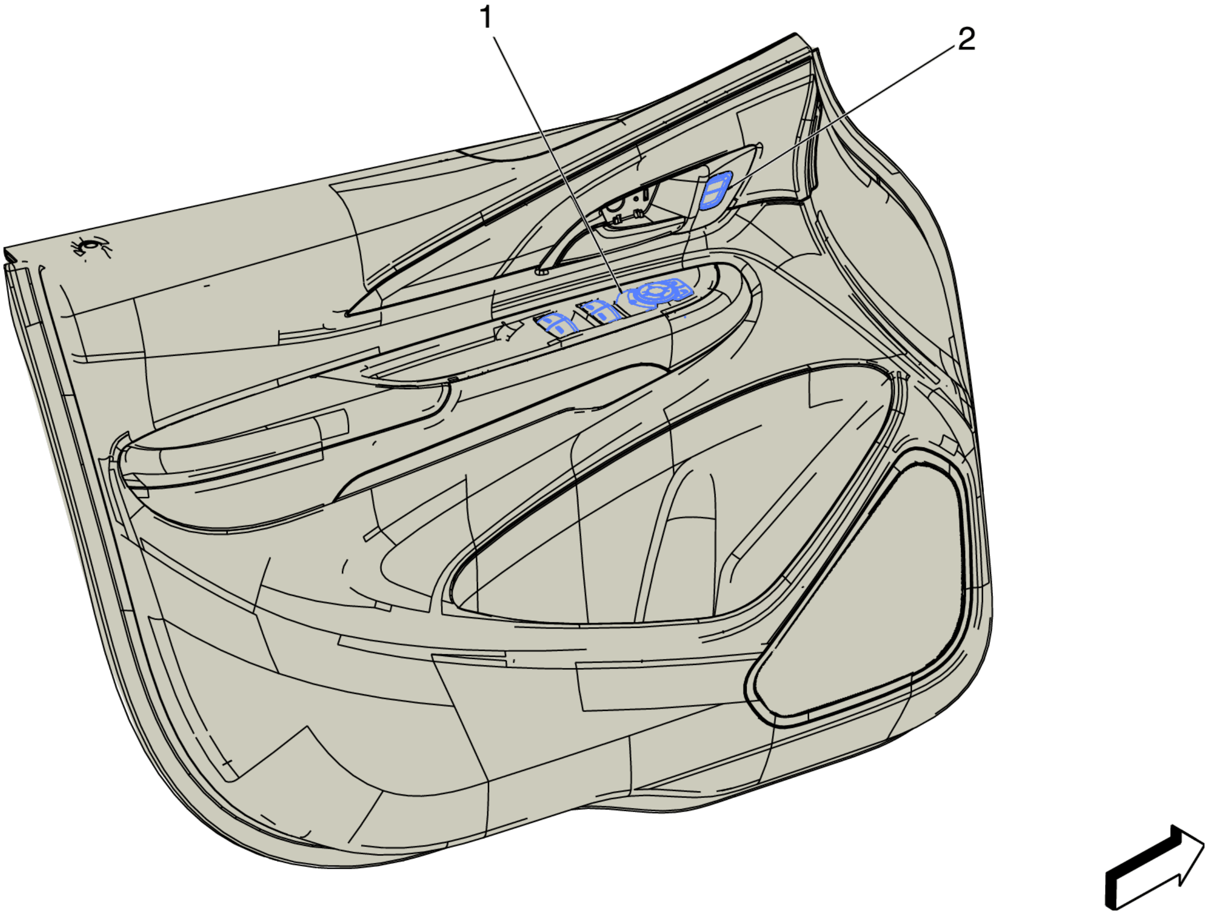

Fig. 2: Driver Door Trim Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: S146 Window/Outside Rearview Mirror Switch - Driver **S79D Window Switch - Driver**
2: S13D Door Lock Switch - Driver **S13D Door Lock Switch - Driver**

PASSENGER DOOR COMPONENTS

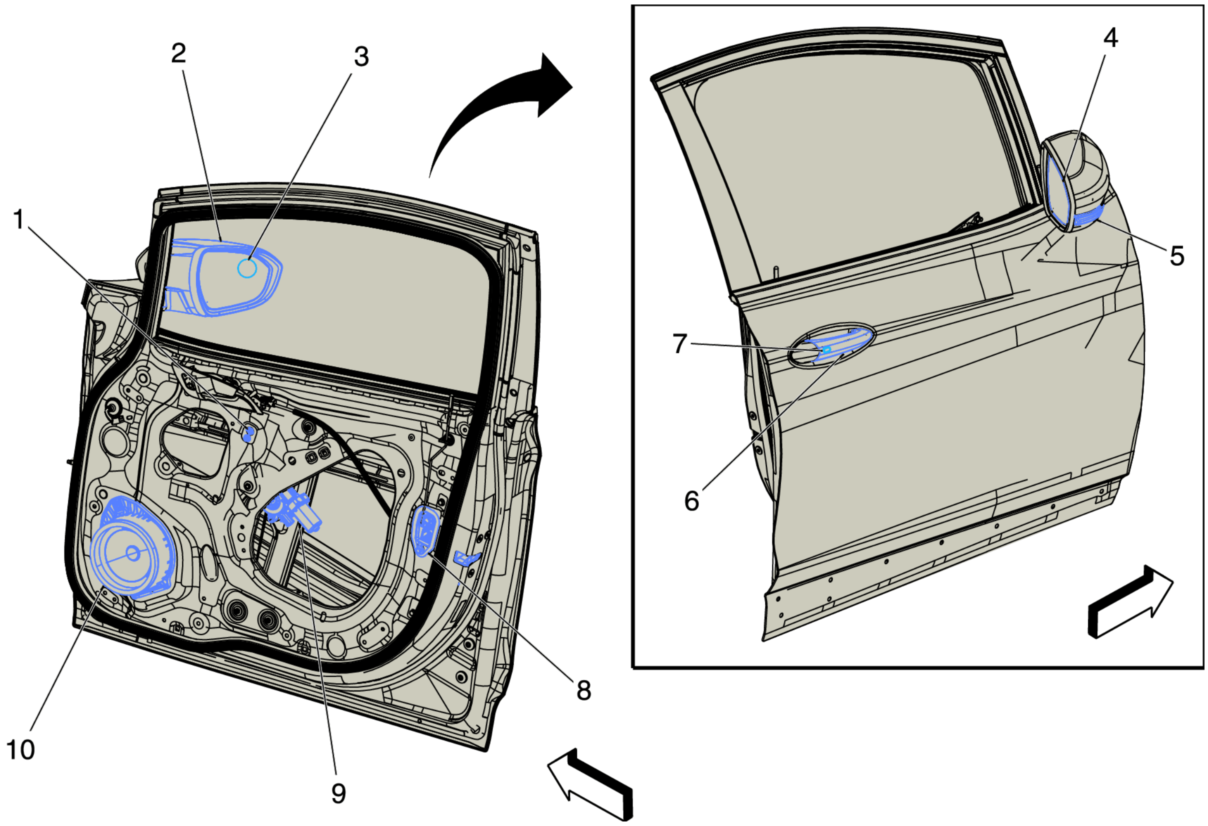

Fig. 3: Passenger Door Components
Courtesy of GENERAL MOTORS COMPANY

Items

1: B63RF Side Impact Sensor - Right Front (AYF) **B63RF Side Impact Sensor - Right Front (AYF)**
2: A9B Outside Rearview Mirror - Passenger
3: P34P Side Object Detection Indicator - Passenger
4: E17P Outside Rearview Mirror Glass - Passenger
5: E4Z Turn Signal Repeater Lamp - Right
6: A24P Door Handle Assembly - Passenger Exterior **A24P Door Handle Assembly - Passenger Exterior**
7: B27P Door Handle Switch - Passenger Exterior **B27P Door Handle Switch - Passenger Exterior**
8: A23P Door Latch Assembly - Passenger **A23P Door Latch Assembly - Passenger**
9: M74P Window Motor - Passenger **M74P Window Motor - Passenger**
10: P19AH Speaker - Right Front Door **P19AH Speaker - Right Front Door (UQ3)** **P19AH Speaker - Right Front Door (UQA)**

PASSENGER DOOR TRIM COMPONENTS

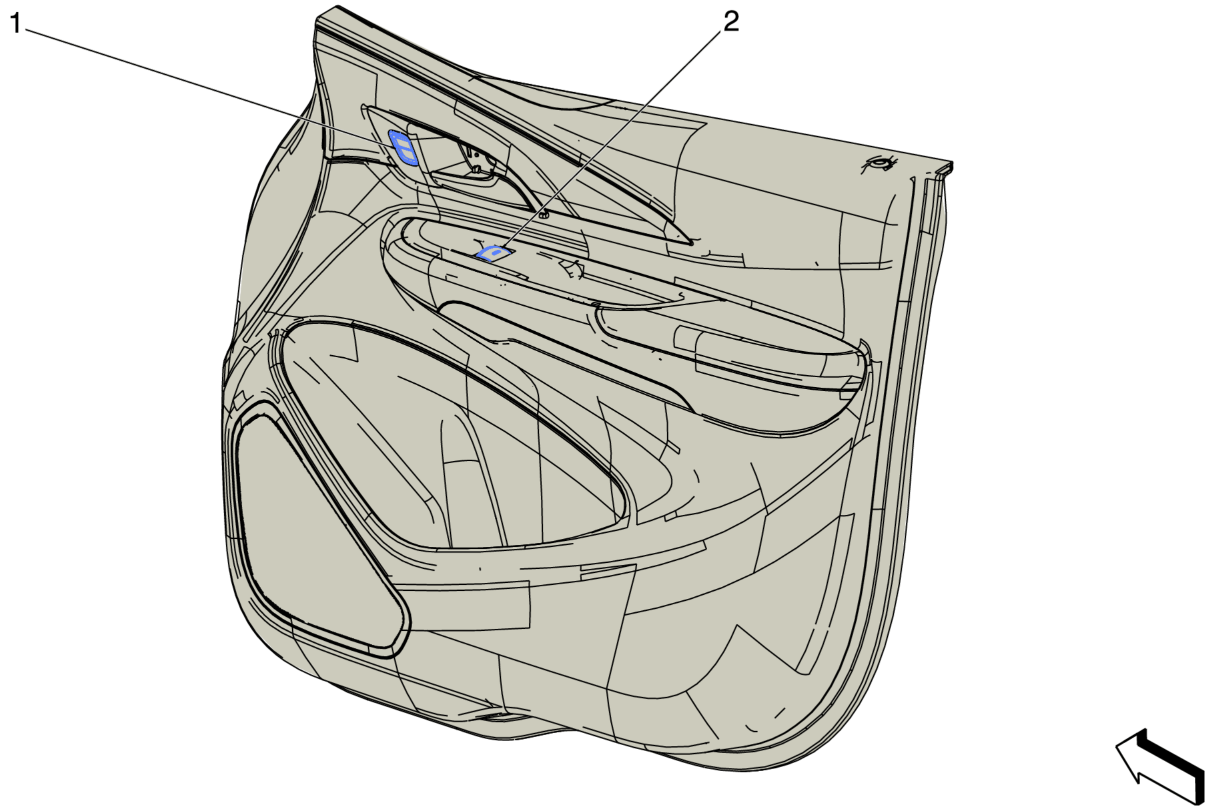

Fig. 4: Passenger Door Trim Components
Courtesy of GENERAL MOTORS COMPANY

Items

1: S13P Door Lock Switch - Passenger **S13P Door Lock Switch - Passenger**
2: S79P Window Switch - Passenger **S79P Window Switch - Passenger**

LEFT REAR DOOR COMPONENTS

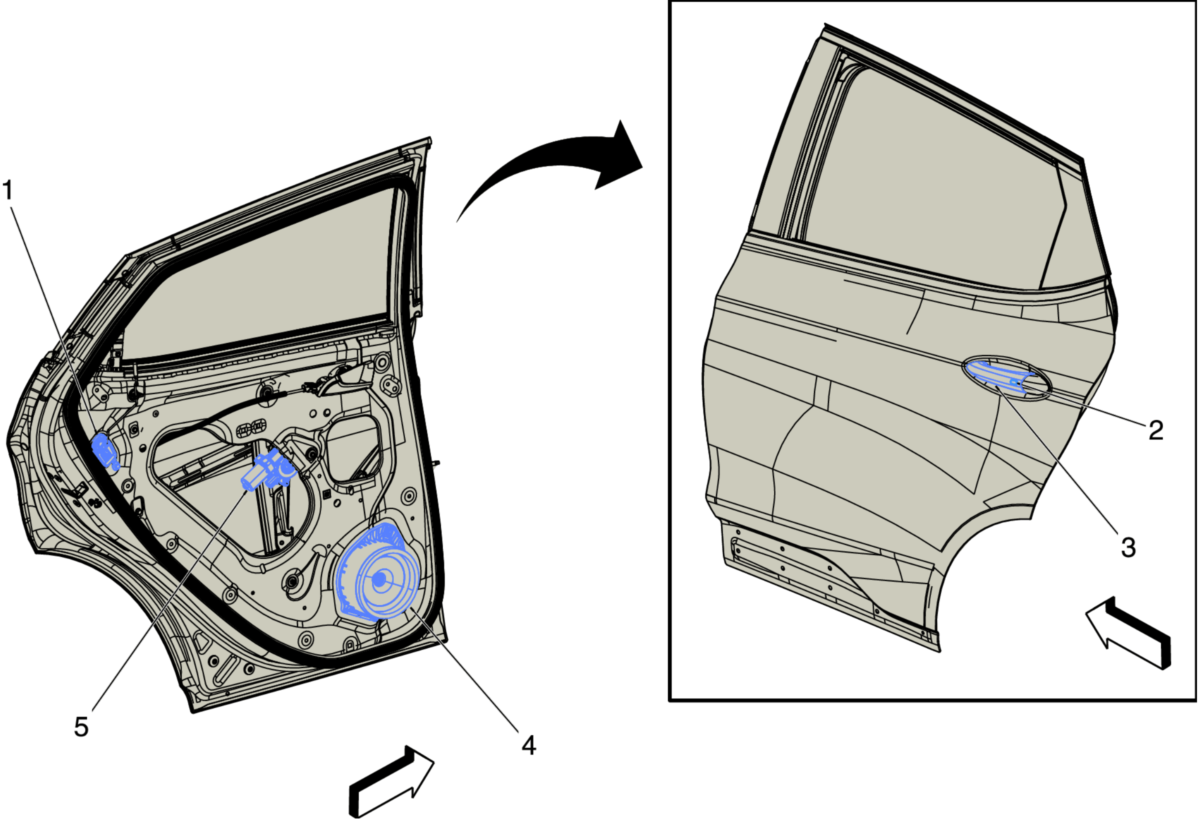

Fig. 5: Left Rear Door Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: A23LR Door Latch Assembly - Left Rear **A23LR Door Latch Assembly - Left Rear**
2: B27LR Door Handle Switch - Left Rear Exterior **B27LR Door Handle Switch - Left Rear Exterior**
3: A24LR Door Handle Assembly - Left Rear Exterior **A24LR Door Handle Assembly - Left Rear Exterior**
4: P19AL Speaker - Left Rear Door **P19AL Speaker - Left Rear Door (UQ3)** **P19AL Speaker - Left Rear Door (UQA)**
5: M74LR Window Motor - Left Rear **M74LR Window Motor - Left Rear**

LEFT REAR DOOR TRIM COMPONENTS

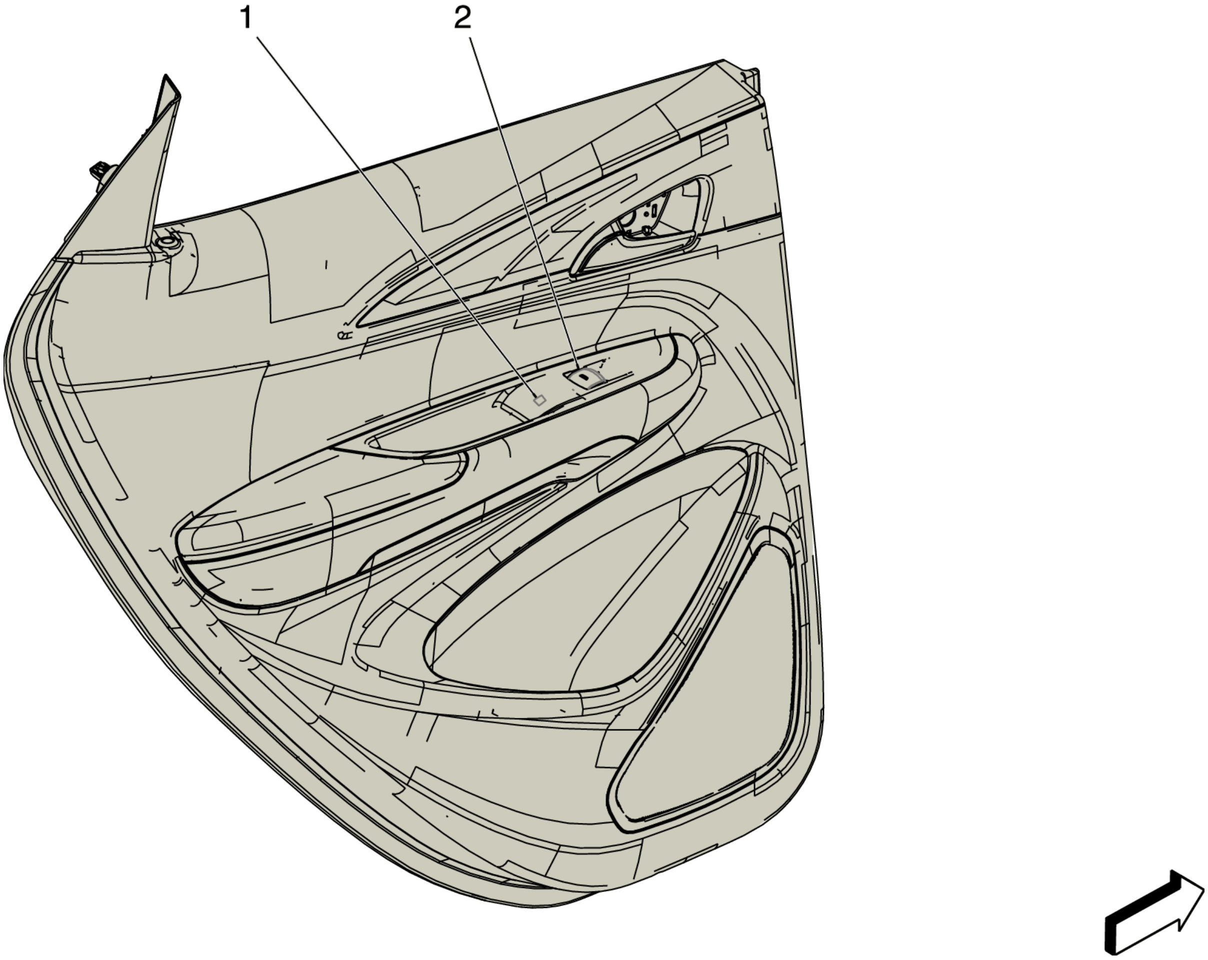

Fig. 6: Left Rear Door Trim Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: S32LR Seat Heating Switch - Left Rear (KA6) S32LR Seat Heating Switch - Left Rear (KA6)
2: S79LR Window Switch - Left Rear S79LR Window Switch - Left Rear

RIGHT REAR DOOR COMPONENTS

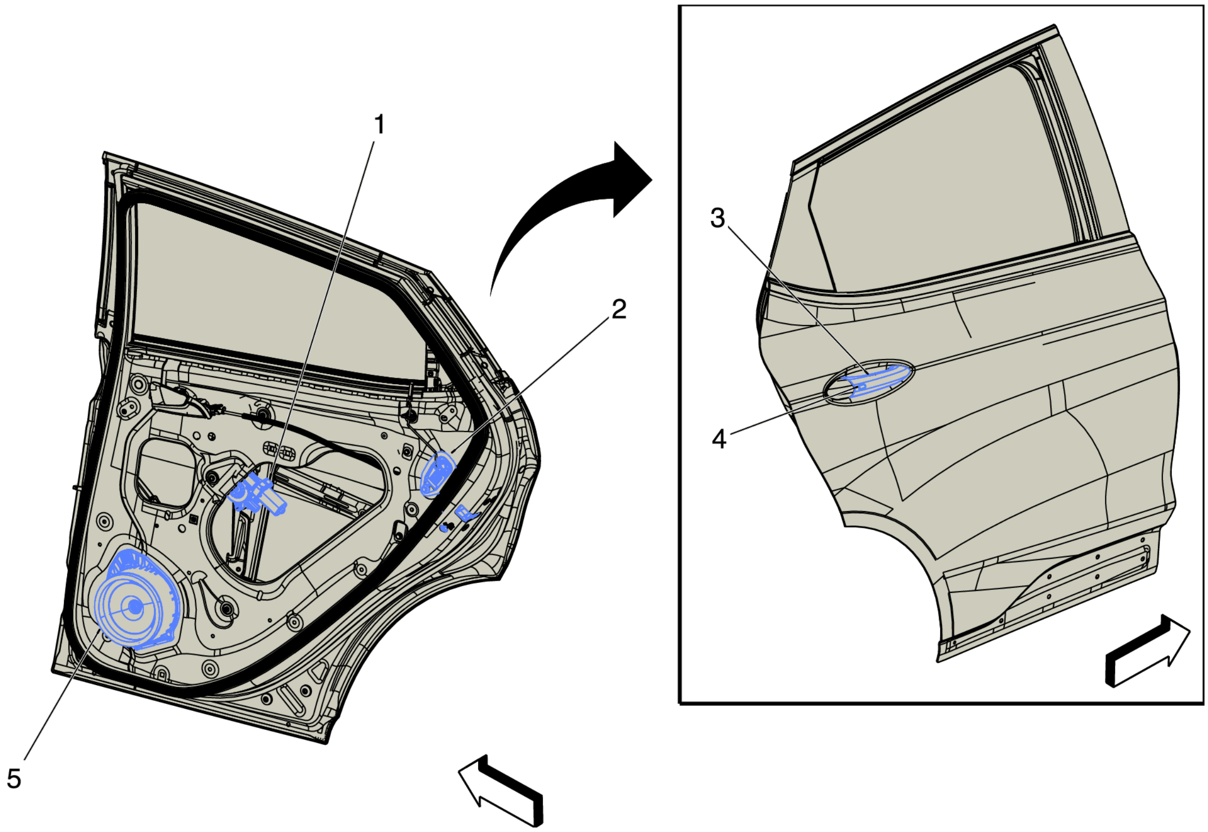

Fig. 7: Right Rear Door Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: M74RR Window Motor - Right Rear M74RR Window Motor - Right Rear
2: A23RR Door Latch Assembly - Right Rear A23RR Door Latch Assembly - Right Rear
3: A24RR Door Handle Assembly - Right Rear Exterior A24RR Door Handle Assembly - Right Rear Exterior
4: B27RR Door Handle Switch - Right Rear Exterior B27RR Door Handle Switch - Right Rear Exterior
5: P19AM Speaker - Right Rear Door P19AM Speaker - Right Rear Door (UQ3) P19AM Speaker - Right Rear Door (UQA)

RIGHT REAR DOOR TRIM COMPONENTS

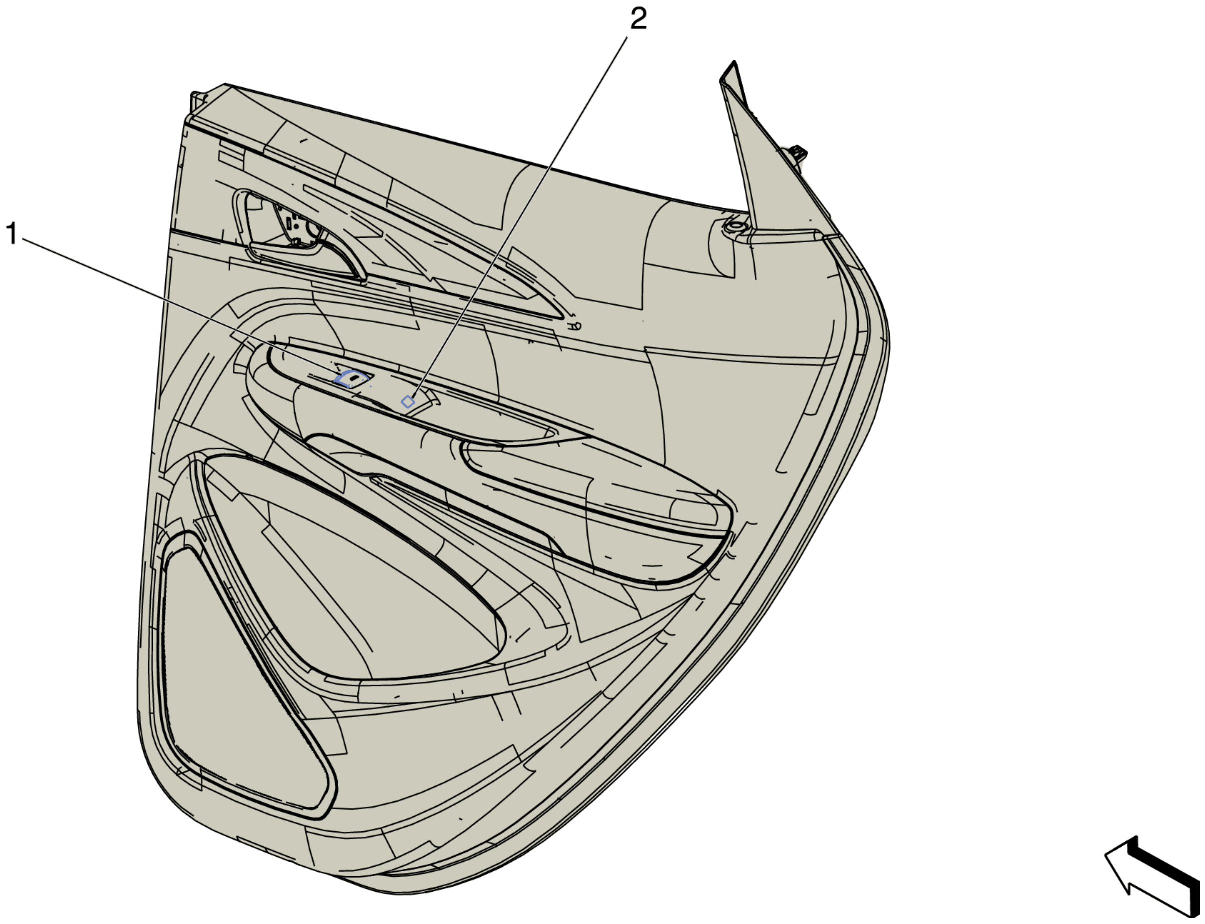

Fig. 8: Right Rear Door Trim Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: S79RR Window Switch - Right Rear S79RR Window Switch - Right Rear
2: S32RR Seat Heating Switch - Right Rear (KA6) S32RR Seat Heating Switch - Right Rear

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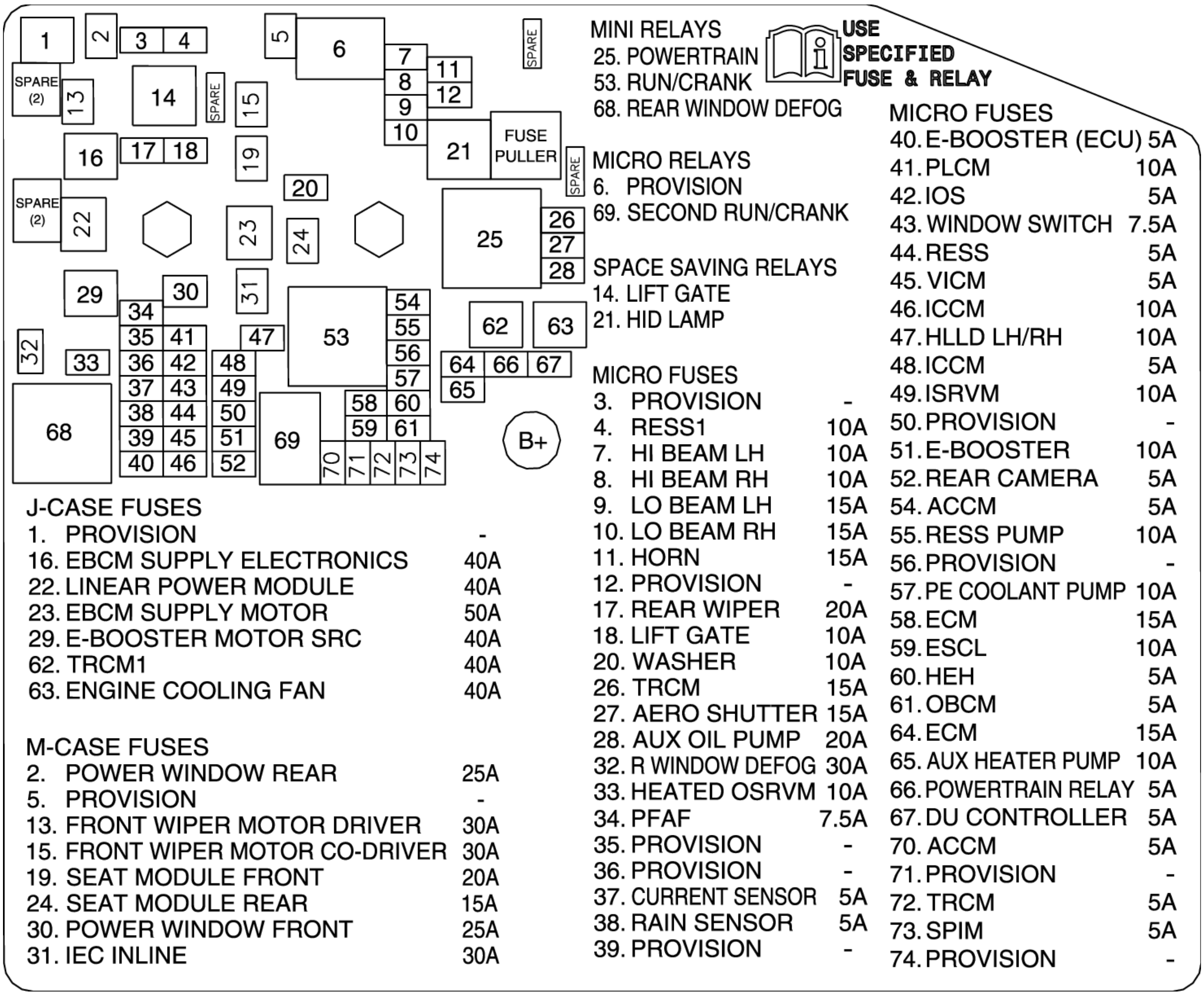
ELECTRICAL CENTER IDENTIFICATION VIEWS

X50A FUSE BLOCK - UNDERHOOD LABEL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USE SPECIFIED FUSE & RELAY

MINI RELAYS
25. POWERTRAIN
53. RUN/CRANK
68. REAR WINDOW DEFOG

MICRO RELAYS
6. PROVISION
69. SECOND RUN/CRANK

SPACE SAVING RELAYS
14. LIFT GATE
21. HID LAMP

J-CASE FUSES	
1. PROVISION	-
16. EBCM SUPPLY ELECTRONICS	40A
22. LINEAR POWER MODULE	40A
23. EBCM SUPPLY MOTOR	50A
29. E-BOOSTER MOTOR SRC	40A
62. TRCM1	40A
63. ENGINE COOLING FAN	40A

M-CASE FUSES	
2. POWER WINDOW REAR	25A
5. PROVISION	-
13. FRONT WIPER MOTOR DRIVER	30A
15. FRONT WIPER MOTOR CO-DRIVER	30A
19. SEAT MODULE FRONT	20A
24. SEAT MODULE REAR	15A
30. POWER WINDOW FRONT	25A
31. IEC INLINE	30A

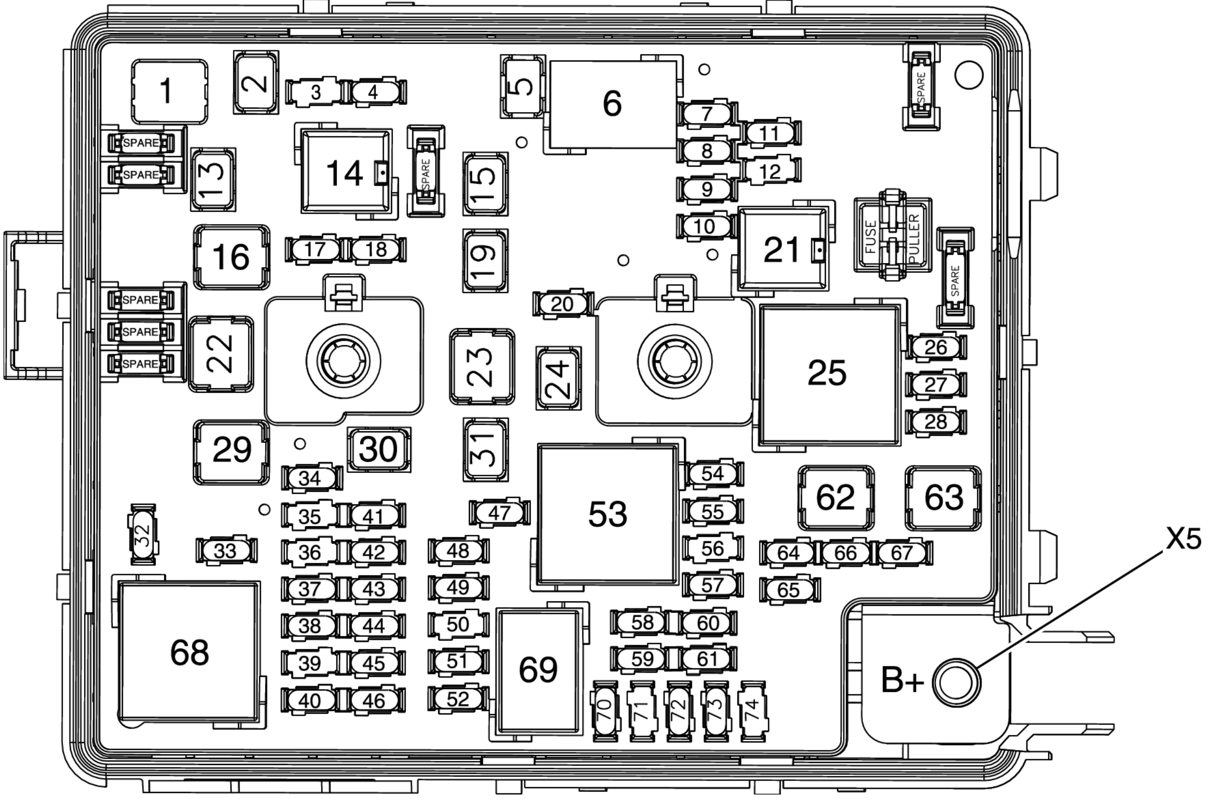
MICRO FUSES	
3. PROVISION	-
4. RESS1	10A
7. HI BEAM LH	10A
8. HI BEAM RH	10A
9. LO BEAM LH	15A
10. LO BEAM RH	15A
11. HORN	15A
12. PROVISION	-
17. REAR WIPER	20A
18. LIFT GATE	10A
20. WASHER	10A
26. TRCM	15A
27. AERO SHUTTER	15A
28. AUX OIL PUMP	20A
32. R WINDOW DEFOG	30A
33. HEATED OSRVM	10A
34. PFAF	7.5A
35. PROVISION	-
36. PROVISION	-
37. CURRENT SENSOR	5A
38. RAIN SENSOR	5A
39. PROVISION	-

MICRO FUSES	
40. E-BOOSTER (ECU)	5A
41. PLCM	10A
42. IOS	5A
43. WINDOW SWITCH	7.5A
44. RESS	5A
45. VICM	5A
46. ICCM	10A
47. HLLD LH/RH	10A
48. ICCM	5A
49. ISRVM	10A
50. PROVISION	-
51. E-BOOSTER	10A
52. REAR CAMERA	5A
54. ACCM	5A
55. RESS PUMP	10A
56. PROVISION	-
57. PE COOLANT PUMP	10A
58. ECM	15A
59. ESCL	10A
60. HEH	5A
61. OBCM	5A
64. ECM	15A
65. AUX HEATER PUMP	10A
66. POWERTRAIN RELAY	5A
67. DU CONTROLLER	5A
70. ACCM	5A
71. PROVISION	-
72. TRCM	5A
73. SPIM	5A
74. PROVISION	-

Fig. 1: X50A Fuse Block - Underhood Label

Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD TOP VIEW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[Fig. 2: X50A Fuse Block - Underhood Top View]

Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD FUSE AND RELAY IDENTIFICATION LEGEND

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
1	PROVISION	-	-	- Not Used
2	POWER WINDOW REAR	F2UA	25A	- S79LR Window Switch - Left Rear - S79RR Window Switch - Right Rear
3	PROVISION	-	-	- Not Used
4	RESS1	F4UA	10A	- K16 Battery Energy Control Module
5	PROVISION	-	-	- Not Used
7	HI BEAM LH	F7UA	10A	- M28L High Beam Solenoid Actuator - Left
8	HI BEAM RH	F8UA	10A	- M28R High Beam Solenoid Actuator - Right
9	LO BEAM LH	F9UA	15A	- E4G Headlamp - Left Low Beam

No.	Device Label Name	Device Assigned Name	Rating	Description
10	LO BEAM RH	F10UA	15A	• E4H Headlamp - Right Low Beam
11	HORN	F11UA	15A	• P12L Horn - Left • P12R Horn - Right
12	PROVISION	-	-	• Not Used
13	FRONT WIPER MOTOR DRIVER	F13UA	30A	• M75L Windshield Wiper Motor Module - Left
15	FRONT WIPER MOTOR CO-DRIVER	F15UA	30A	• M75R Windshield Wiper Motor Module - Right
16	EBCM SUPPLY ELECTRONICS	F16UA	40A	• K17 Electronic Brake Control Module
17	REAR WIPER	F17UA	20A	• KR7 Rear Wiper Relay
18	REAR LIFT GATE	F18UA	10A	• KR95A Liftgate Unlatch Relay
19	SEAT MODULE FRONT	F19UA	20A	• K29F Seat Heating Control Module - Front
20	WASHER	F20UA	10A	• KR11 Windshield Washer Pump Relay • KR6 Rear Window Washer Pump Relay
22	LINEAR POWER MOTOR	F22UA	40A	• K8 Blower Motor Control Module
23	EBCM SUPPLY MOTOR	F23UA	50A	• K17 Electronic Brake Control Module
24	SEAT MODULE REAR	F24DA	15A	• K29R Seat Heating Control Module - Rear
26	TRCM	F26UA	15A	• K173 Transmission Range Control Module
27	AERO SHUTTER	F27UA	15A	• M96 Active Grille Air Shutter Actuator

No.	Device Label Name	Device Assigned Name	Rating	Description
28	AUX OIL PUMP	F28UA	20A	• G5 Transmission Fluid Pump - Electric/ Auxiliary
29	E-BOOSTER MOTOR SRC	F29UA	40A	• K177 Brake Booster Control Module
30	POWER WINDOW FRONT	F30UA	25A	• M74D Window Motor - Driver • S79P Window Switch - Passenger
31	IEC INLINE	F31UA	30A	• F25DA • F26DA • F27DA • F28DA • F29DA • F30DA
32	R WINDOW DEFOG	F32UA	30A	• E18 Rear Defogger Grid
33	HEATED OSRVM	F33UA	10A	• E17D Outside Rearview Mirror Glass - Driver • E17P Outside Rearview Mirror Glass - Passenger
34	PFAF	F34UA	7.5A	• K132 Pedestrian Alert Sound Control Module
35	PROVISION	-	-	• Not Used
36	PROVISION	-	-	• Not Used
37	CURRENT SENSOR	F37UA	5A	• K9 Body Control Module
38	RAIN SENSOR	F38UA	5A	• B200 Rain Sensor Module (CE1)
39	PROVISION	-	-	• Not Used
40	E-BOOSTER (ECU)	F40UA	5A	• K177 Brake Booster Control Module
41	PLCM	F41UA	10A	• K190 Power Line Communication Module (CBT)

No.	Device Label Name	Device Assigned Name	Rating	Description
42	IOS	F42UA	5A	• K85 Passenger Presence Module (AL0)
43	WINDOW SWITCH	F43UA	7.5A	• S79D Window Switch - Driver
44	RESS	F44UA	5A	• K16 Battery Energy Control Module
45	VICM	F45UA	5A	• K114B Hybrid/EV Powertrain Control Module 2
46	ICCM	F46UA	10A	• K38 Chassis Control Module
47	HLLD LH/RH	F47UA	10A	• M29L Headlamp Leveling Actuator - Left (TR6) • M29R Headlamp Leveling Actuator - Right (TR6)
48	ICCM	F48UA	5A	• K38 Chassis Control Module
49	ISRVM	F49UA	40A	• A10 Inside Rearview Mirror (DD8/DRZ/UEV)
50	PROVISION	-	-	• Not Used
51	E-BOOSTER	F51UA	10A	• K177 Brake Booster Control Module
52	REAR CAMERA	F52UA	5A	• B87 Rearview Camera (UVC/UVH)
54	ACCM	F54UA	5A	• G1 A/C Compressor
55	RESS PUMP	F55UA	10A	• G37 Hybrid/EV Battery Pack Coolant Pump
56	PROVISION	-	-	• Not Used
57	PE COOLANT PUMP	F57UA	10A	• G35 Hybrid/EV Electronics Coolant Pump
58	ECM	F58UA	15A	• K20 Engine Control Module

No.	Device Label Name	Device Assigned Name	Rating	Description
59	ESCL	F59UA	10A	- K60 Steering Column Lock Module (N06)
60	HEH	F60UA	5A	- K10 Coolant Heater Control Module
61	OBCM	F61UA	5A	- T18 Battery Charger
62	TRCM1	F62UA	40A	- K173 Transmission Range Control Module
63	ENGINE COOLING FAN	F63UA	40A	- G10 Cooling Fan Motor
64	ECM	F64UA	15A	- K20 Engine Control Module
65	AUX HEATER PUMP	F65UA	10A	- G36 Auxiliary Heater Coolant Pump
66	POWERTRAIN RELAY	F66UA	5A	- K20 Engine Control Module
67	DU CONTROLER	F67UA	5A	- G5 Transmission Fluid Pump - Electric/ Auxiliary
70	ACCM	F70UA	5A	- G1 A/C Compressor
71	PROVISION	-	-	- Not Used
72	TRCM	F72UA	5A	- K173 Transmission Range Control Module
73	SPIM	F73UA	5A	- T6 Power Inverter Module
74	PROVISION	-	-	- Not Used
Relays				
6	PROVISION	-	-	- Not Used
14	LIFT GATE	KR95A Liftgate Unlatch Relay	-	- A23C Liftgate Latch Assembly
21	HID LAMP	KR49 Headlamp Low Beam Relay	-	- F9UA

No.	Device Label Name	Device Assigned Name	Rating	Description
25	POWERTRAIN	KR75 Engine Controls Ignition Relay	-	• F26UA • F27UA • F66UA • F67UA
53	RUN/CRANK	KR73A Ignition Main Relay 1	-	• F31UA • F47UA • F48UA • F49UA • F51UA • F52UA • F59UA • F64UA • F71UA
68	REAR WINDOW DEFOG	KR5 Rear Defogger Relay	-	• F32UA • F33UA
69	SECOND RUN/CRANK	KR73B Ignition Main Relay 2	-	• F36UA • F39UA • F44UA • F45UA • F54UA • F72UA • F73UA
Important: Relays listed below are non-serviceable Printed Circuit Board (PCB) relays and are internal to the block				
-	-	KR3 Horn Relay	-	• F11UA
-	-	KR7 Rear Wiper Relay	-	• M45 Rear Wiper Motor
-	-	KR6 Rear Window Washer Pump Relay	-	• G19 Rear Window Washer Pump
-	-	KR11 Windshield Washer Pump Relay	-	• G24 Windshield Washer Pump Relay
-	-	KR48 Headlamp High Beam Relay	-	• F7UA • F8UA
-	-	KR31 Coolant Pump Relay - Auxillary	-	• F65UA

X50A FUSE BLOCK - UNDERHOOD BOTTOM VIEW

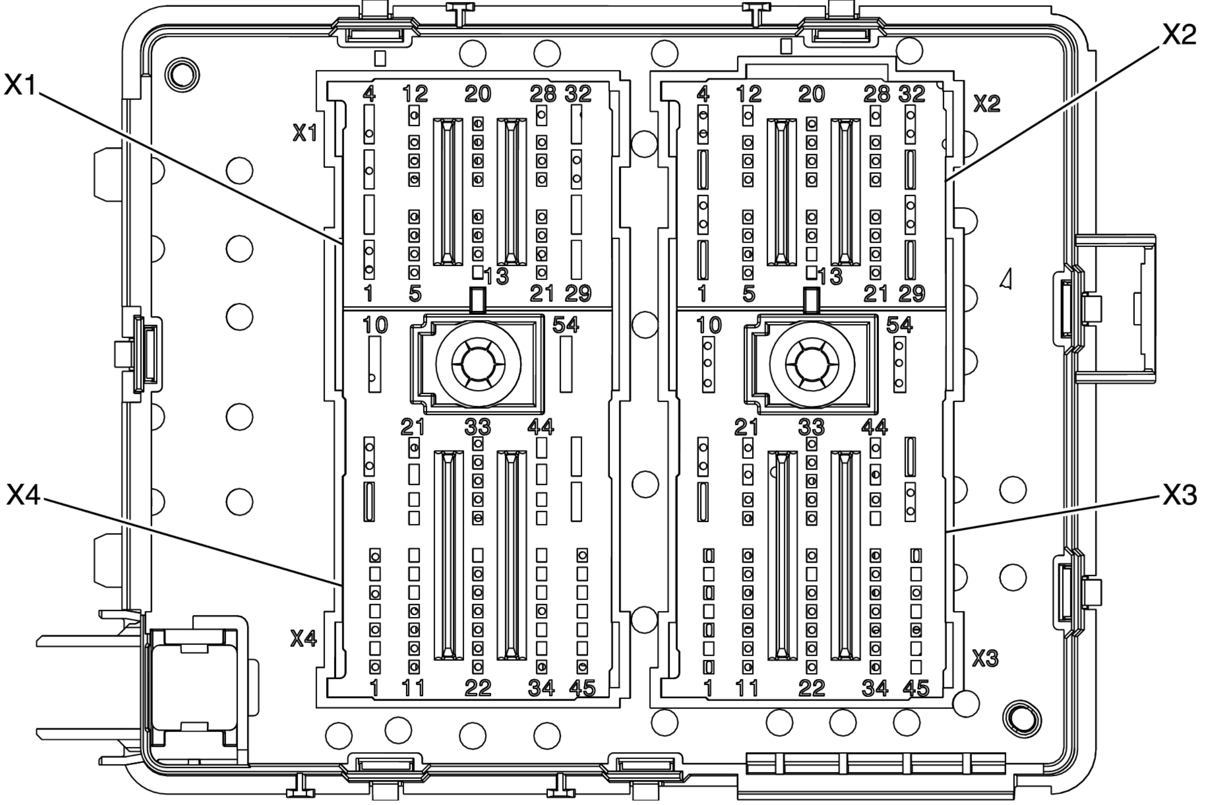
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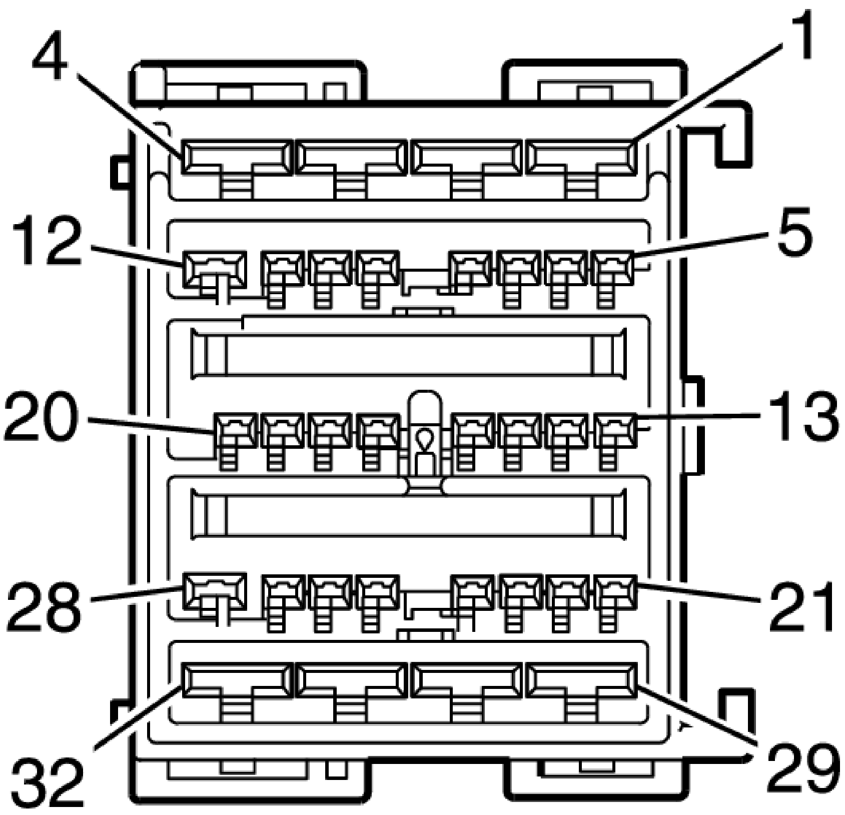
Fig. 3: X50A Fuse Block - Underhood Bottom View

Courtesy of GENERAL MOTORS COMPANY

X50A FUSE BLOCK - UNDERHOOD X1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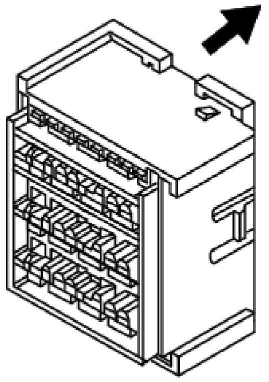


Connector Part Information

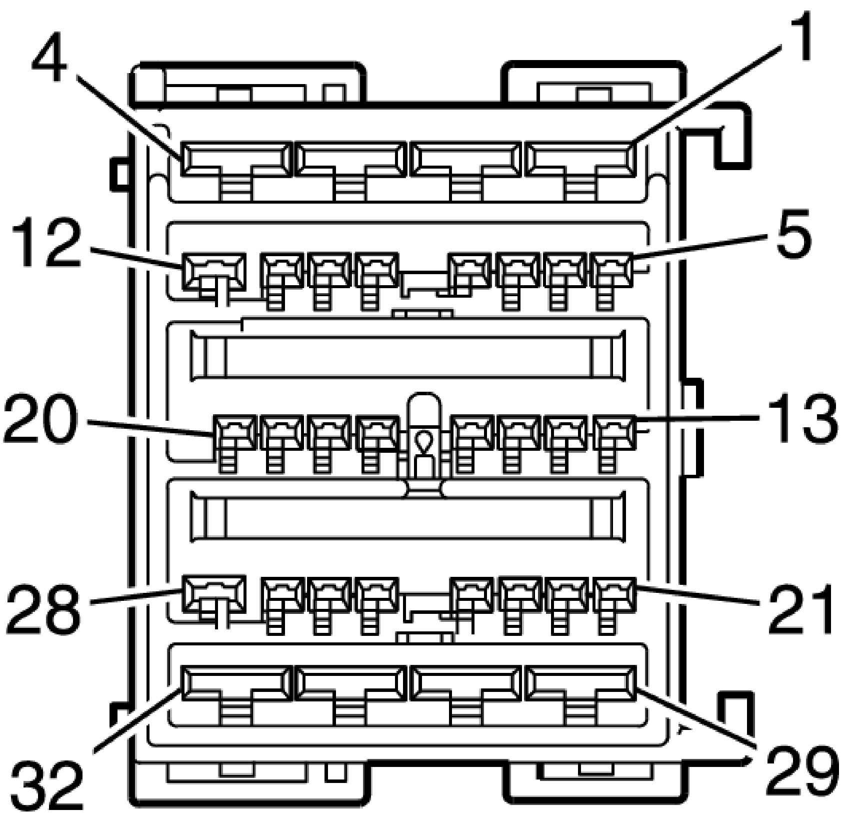
- Harness Type: Forward Lamp
- OEM Connector: 7283-9458-30
- Service Connector: 19153183
- Description: 32-Way F YESC Kaizen Series (BK)

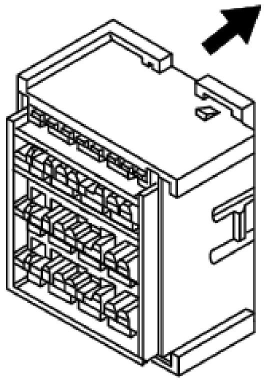
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575833	J-35616-42 (RD)	J-38125-11A	7116-4120-02	Yazaki 9	E	A
II	13575839	J-35616-35 (VT)	J-38125-11A	7116-4112-02	Yazaki 9	C	D
III	13575850	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	BN/YE	189	Headlamp Leveling Motor Control	I	TR6
2 - 4	-	-	-	Not Occupied	-	-
5	0.5	GN/VT	1315	Right Front Turn Signal Lamp Control	III	-
6	0.5	BU/WH	1314	Left Front Turn Signal Lamp Control	III	-
7 - 9	-	-	-	Not Occupied	-	-
10	0.75	BN/GY	29	Horn Control	III	-
11	1	BN/GY	29	Horn Control	III	-
12	2.5	BK	50	Ground	II	-
13 - 15	-	-	-	Not Occupied	-	-
16	0.75	YE	312	Right Headlamp Low Beam Control	III	-
17	0.75	YE	712	Left Headlamp Low Beam Control	III	-
18	-	-	-	Not Occupied	-	-
19	0.5	WH	311	Right Headlamp High Beam Control	III	-
20	0.5	WH	711	Left Headlamp High Beam Control	III	-
21	0.5	VT/WH	239	Run/Crank Ignition 1 Voltage	III	TR6
22	0.5	VT/GY	709	Left Park Lamp Control	III	-
23	0.5	GY/VT	228	Windshield Washer Pump Control	III	-
24	0.5	BU/VT	392	Rear Window Washer Pump Control	III	-
25	0.5	GY/BN	309	Right Park Lamp Control	III	-
26	0.5	GY/GN	4338	Pedestrian Friendly Alert Speaker Control (+)	III	-
27	0.5	VT/BN	4337	Pedestrian Friendly Alert Speaker Control (-)	III	-
28 - 32	-	-	-	Not Occupied	-	-

X50A FUSE BLOCK - UNDERHOOD X2





Connector Part Information

- Harness Type: Body
- OEM Connector: 7283-9458-30
- Service Connector: 19153183
- Description: 32-Way F YESC Kaizen Series (BK)

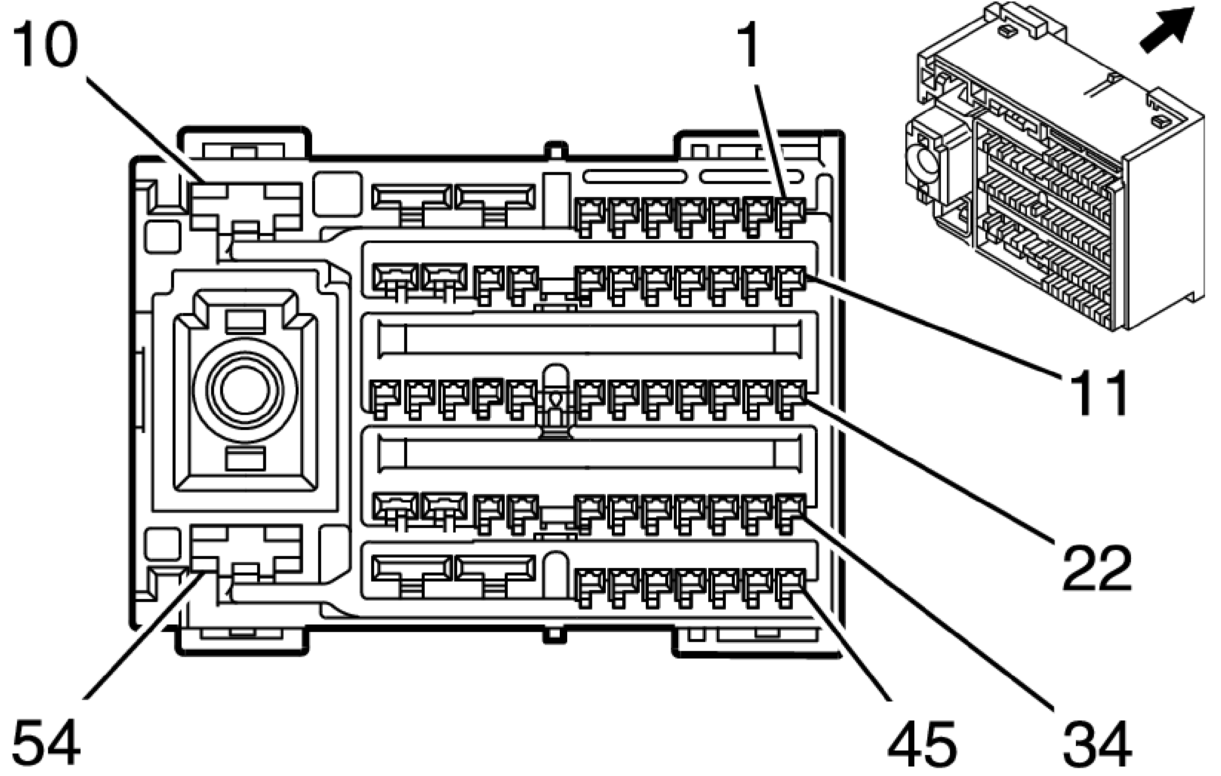
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575833	J-35616-42 (RD)	J-38125-11A	7116-4120-02	Yazaki 9	E	B
II	13575838	J-35616-35 (VT)	J-38125-11A	7116-4110-02	Yazaki 9	E	C
III	13575839	J-35616-35 (VT)	J-38125-11A	7116-4112-02	Yazaki 9	C	D
IV	13575850	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
V	13578928	J-35616-42 (RD)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	1	RD/BU	540	Battery Positive Voltage	I	KA1
2	-	-	-	Not Occupied	-	-
3	2.5	RD/WH	640	Battery Positive Voltage	V	-
4	-	-	-	Not Occupied	-	-
5	0.5	VT/GY	709	Left Park Lamp Control	IV	-
6	0.75	BU/WH	1314	Left Front Turn Signal Lamp Control	IV	-
7 - 9	-	-	-	Not Occupied	-	-
10	0.5	GY/GN	4338	Pedestrian Friendly Alert Speaker Control (+)	IV	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
11	0.5	VT/BN	4337	Pedestrian Friendly Alert Speaker Control (-)	IV	-
12	0.5	GY/BN	309	Right Park Lamp Control	II	-
13 - 14	-	-	-	Not Occupied	-	-
15	0.35	GN/WH	2270	Rear Window Washer Relay Control	IV	-
16	0.35	BN/VT	1969	Headlamp High Beam Relay Control	IV	-
17	-	-	-	Not Occupied	-	-
18	0.5	RD/VT	1640	Battery Positive Voltage	IV	-
19	0.5	BN/YE	189	Headlamp Leveling Motor Control	IV	TR6
20 - 21	-	-	-	Not Occupied	-	-
22	0.35	YE	5420	Rear Wiper Motor Relay Coil Control	IV	-
23	0.35	BN/GY	2268	Windshield Washer Relay Control	IV	-
24	0.35	BN/WH	28	Horn Relay Control	IV	-
25	0.35	YE	5704	Endgate Latch Relay Coil Control	IV	-
26	0.5	BU/WH	6128	Rear Closure Unlatch Motor Unlatch Control	IV	-
27	0.35	GN/BN	5706	Endgate Latch Relay Control	IV	-
28	2	RD/BN	2940	Battery Positive Voltage	III	-
29	2.5	RD/BU	3242	Battery Positive Voltage	V	-
30	1	GY/VT	5780	Windshield Wiper Motor Park Switch Fused Signal	I	-
31	2.5	RD/WH	640	Battery Positive Voltage	V	-
32	-	-	-	Not Occupied	-	-

X50A FUSE BLOCK - UNDERHOOD X3



Connector Part Information

- Harness Type: Body

- OEM Connector: 7283-9457-3W
- Service Connector: 19153182
- Description: 54-Way F YESC Kaizen Series (BK)

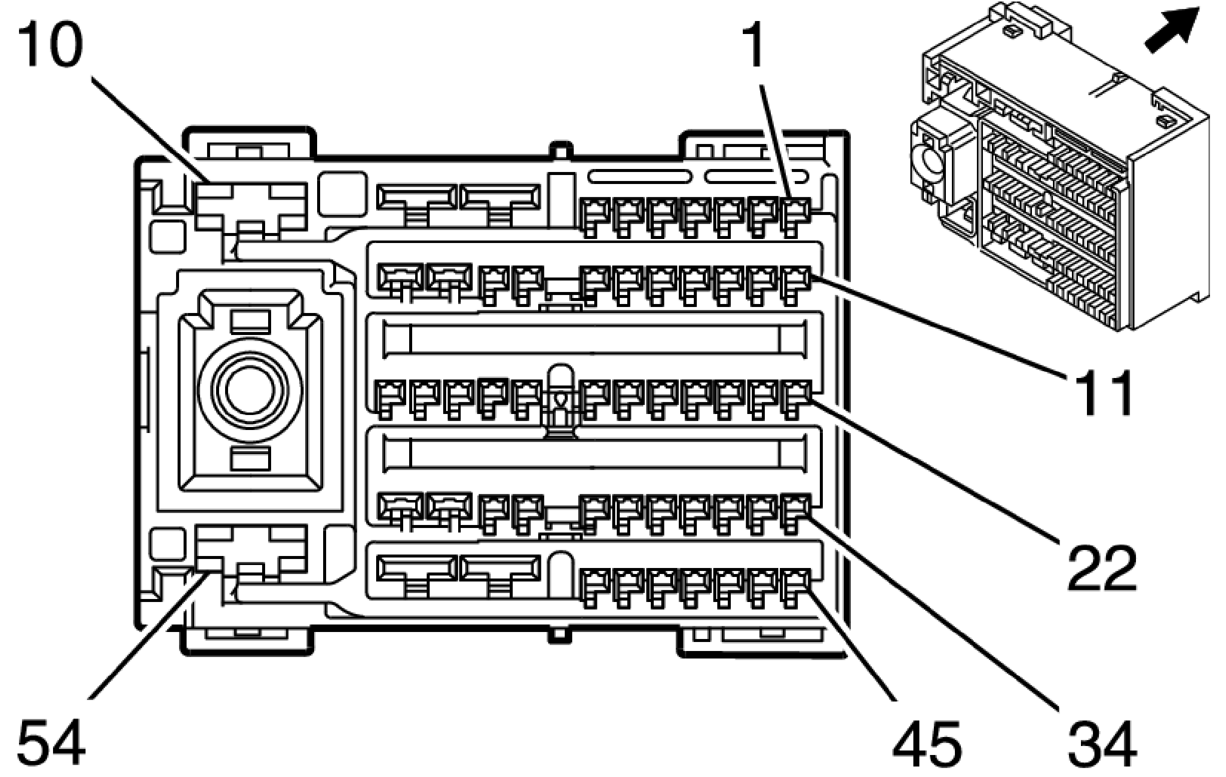
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575833	J-35616-42 (RD)	J-38125-11A	7116-4120-02	Yazaki 9	E	B
II	13575838	J-35616-35 (VT)	J-38125-11A	7116-4111-02	Yazaki 9	C	A
III	13575839	J-35616-35 (VT)	J-38125-11A	7116-4112-02	Yazaki 9	C	D
IV	13575850	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
V	13578927	J-35616-22 (RD)	J-38125-11A	7116-3251	Yazaki 10	G	3
VI	13578927	J-35616-22 (RD)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
VII	13578928	J-35616-42 (RD)	J-38125-11A	7116-4121-02	Yazaki 10	C	B
VIII	13578928	J-35616-42 (RD)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.35	VT/GY	539	Run/Crank Ignition 1 Voltage	IV	-
2 - 4	-	-	-	Not Occupied	-	-
5	0.35	VT/BK	339	Run/Crank Ignition 1 Voltage	IV	-
6	-	-	-	Not Occupied	-	-
7	0.35	VT/WH	639	Run/Crank Ignition 1 Voltage	IV	-
8	2	VT/GN	39	Run/Crank Ignition 1 Voltage	VII	-
9	0.75	RD/BU	540	Battery Positive Voltage	I	KA6
10	4	RD/BN	3142	Battery Positive Voltage	V	-
11	0.35	VT/BK	739	Run/Crank Ignition 1 Voltage	IV	UVC
12	0.35	BN/WH	419	Check Engine Indicator Control	IV	-
13	-	-	-	Not Occupied	-	-
14	0.75	BU/VT	807	OFF /Accessory Ignition Voltage	IV	N06
15	0.35	RD/GN	1540	Battery Positive Voltage	IV	-
16	0.35	GN/VT	5199	Run/Crank Relay Coil Control	IV	-
17	0.5	RD/GN	2440	Battery Positive Voltage	IV	AL0
18	0.5	RD/WH	1040	Battery Positive Voltage	IV	CBT
19	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	IV	-
20	1	BK	350	Ground	II	-
21	2	RD/GN	1540	Battery Positive Voltage	III	-
22	0.35	RD/BN	440	Battery Positive Voltage	IV	-
23	0.5	VT/BK	1239	Run/Crank Ignition 1 Voltage	IV	-
24	0.35	RD/YE	3740	Battery Positive Voltage	IV	-
25	0.5	VT/GN	1339	Run/Crank Ignition 1 Voltage	IV	-
26	0.35	RD/GN	40	Battery Positive Voltage	IV	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
27 - 30	-	-	-	Not Occupied	-	-
31	0.5	RD/BU	6040	Battery Positive Voltage	IV	-
32	-	-	-	Not Occupied	-	-
33	0.75	GN/VT	1315	Right Front Turn Signal Lamp Control	IV	-
34 - 35	-	-	-	Not Occupied	-	-
36	1	RD/YE	3040	Battery Positive Voltage	IV	-
37	-	-	-	Not Occupied	-	-
38	0.35	GN/VT	5199	Run/Crank Relay Coil Control	IV	-
39	0.35	BN/YE	2267	Mirror Heating Element Control	IV	-
40	0.35	BN/YE	2267	Mirror Heating Element Control	IV	-
41	-	-	-	Not Occupied	-	-
42	0.35	BN/YE	1970	Headlamp Low Beam Relay Control	IV	-
43	-	-	-	Not Occupied	-	-
44	1	BU	393	Rear Window Wiper Motor Control	II	-
45 - 47	-	-	-	Not Occupied	-	-
48	0.35	BN/VT	193	Rear Defog Relay Control	IV	-
49	0.35	GY	5127	After Boil Heater Relay Control	IV	-
50 - 51	-	-	-	Not Occupied	-	-
52	2	BN/VT	293	Rear Defog Element Control	VII	-
53	2.5	RD/YE	3042	Battery Positive Voltage	VIII	-
54	2.5	RD/BU	840	Battery Positive Voltage	VI	-

X50A FUSE BLOCK - UNDERHOOD X4



Connector Part Information

- Harness Type: Engine

- OEM Connector: 7283-9457-3W
- Service Connector: 19153182
- Description: 54-Way F YESC Kaizen Series (BK)

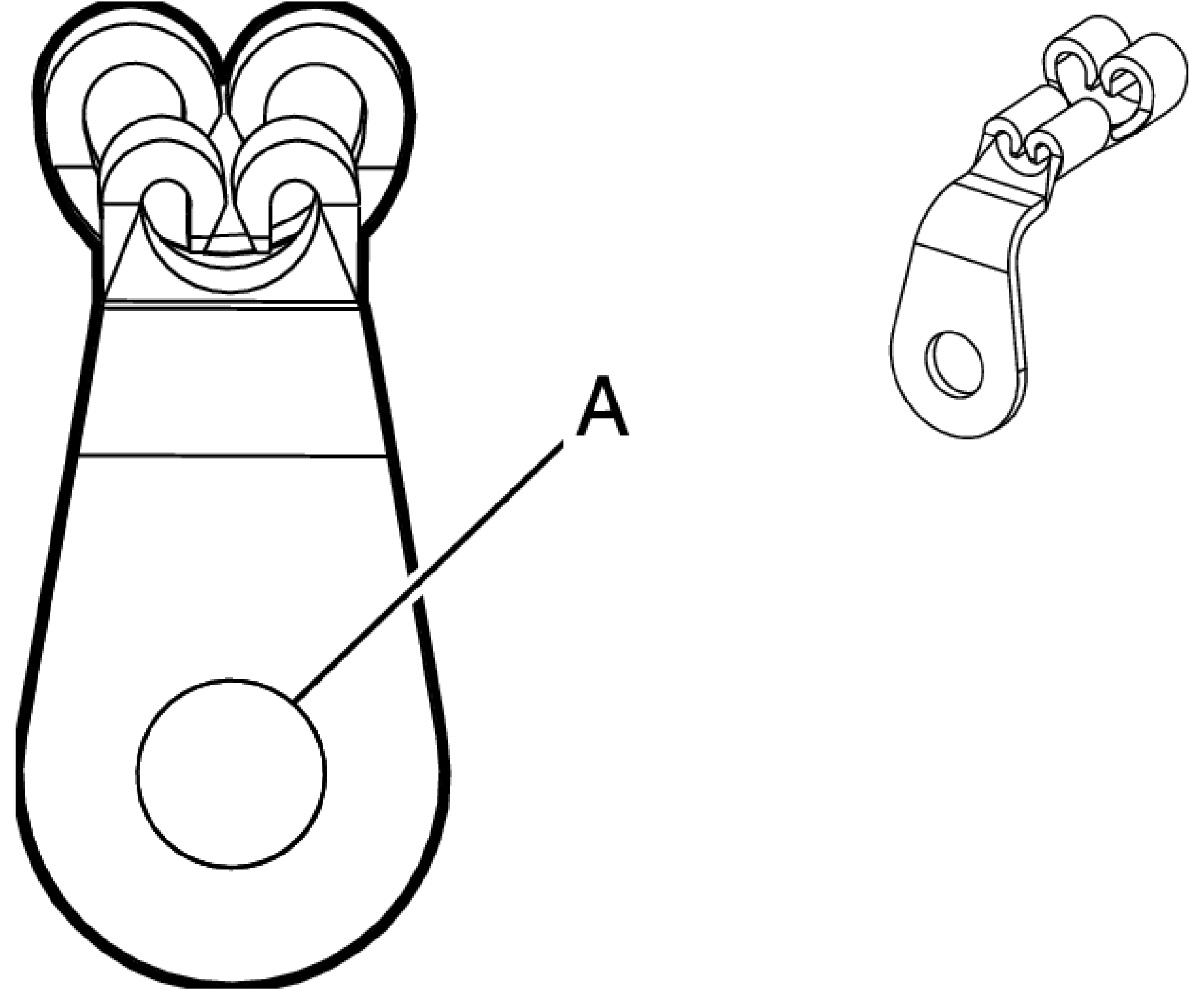
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575835	J-35616-42 (RD)	J-38125-11A	7116-4122-02	Yazaki 10	D	G
II	13575838	J-35616-35 (VT)	J-38125-11A	7116-4111-02	Yazaki 9	C	A
III	13575850	J-35616-2A (GY)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
IV	13578928	J-35616-42 (RD)	J-38125-11A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.5	VT/BU	5290	Powertrain Main Relay Fused Supply 1	III	-
2	-	-	-	Not Occupied	-	-
3	0.5	VT/BU	5292	Powertrain Main Relay Fused Supply 3	III	-
4 - 7	-	-	-	Not Occupied	-	-
8	2.5	RD/GY	642	Battery Positive Voltage	IV	-
9	4	RD/BU	302	Battery Positive Voltage	I	-
10 - 11	-	-	-	Not Occupied	-	-
12	0.5	VT/GY	1439	Run/Crank Ignition 1 Voltage	III	-
13	0.5	RD/WH	3440	Battery Positive Voltage	III	-
14	0.5	RD/WH	140	Battery Positive Voltage	III	-
15 - 20	-	-	-	Not Occupied	-	-
21	1	RD/BU	3240	Battery Positive Voltage	II	-
22	0.5	VT/WH	1539	Run/Crank Ignition 1 Voltage	III	-
23	0.5	RD/YE	740	Battery Positive Voltage	III	-
24	0.5	RD/WH	2740	Battery Positive Voltage	III	-
25	0.5	VT/GY	139	Run/Crank Ignition 1 Voltage	III	-
26	0.5	RD/VT	3340	Battery Positive Voltage	III	-
27 - 28	-	-	-	Not Occupied	-	-
29	0.5	RD/GY	3540	Battery Positive Voltage	III	-
30	0.5	YE	5991	Powertrain Relay Coil Control	III	-
31	0.5	RD/GY	2140	Battery Positive Voltage	III	-
32	0.5	VT/BU	5705	Powertrain Main Relay Fused Control 6	III	-
33	0.5	VT/BU	5293	Powertrain Main Relay Fused Supply 4	III	-
34 - 36	-	-	-	Not Occupied	-	-
37	0.5	BN/WH	419	Check Engine Indicator Control	III	-
38 - 44	-	-	-	Not Occupied	-	-
45	0.5	VT/WH	1139	Run/Crank Ignition 1 Voltage	III	-
46 - 50	-	-	-	Not Occupied	-	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
51	0.5	BU/WH	3977	Accessory Wakeup Serial Data 2	III	-
52 - 54	-	-	-	Not Occupied	-	-

X50A FUSE BLOCK - UNDERHOOD X5



Connector Part Information

- Harness Type: Battery Cable
- OEM Connector: CBR514-012
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	25	RD/WH	4042	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY TOP VIEW

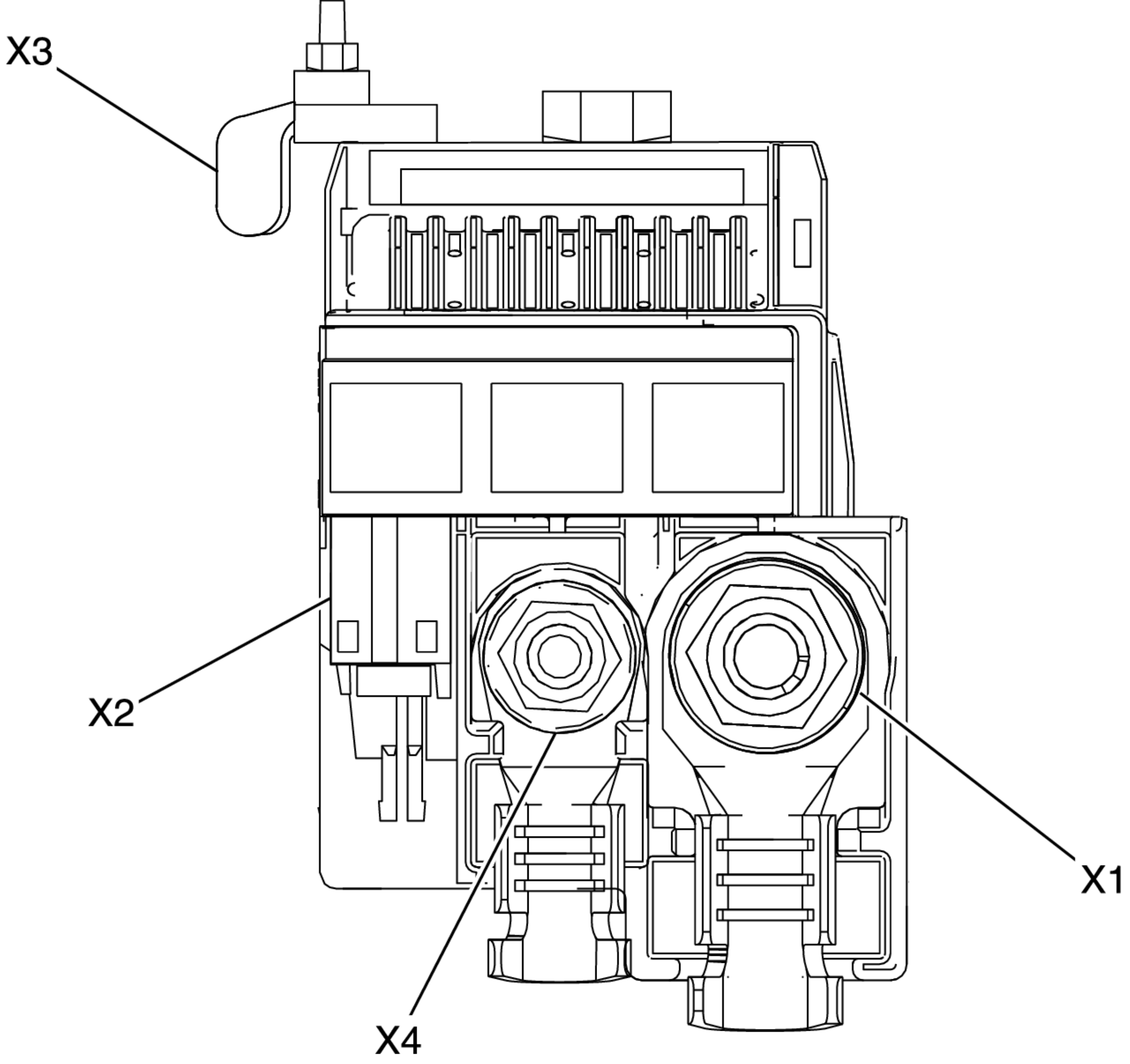
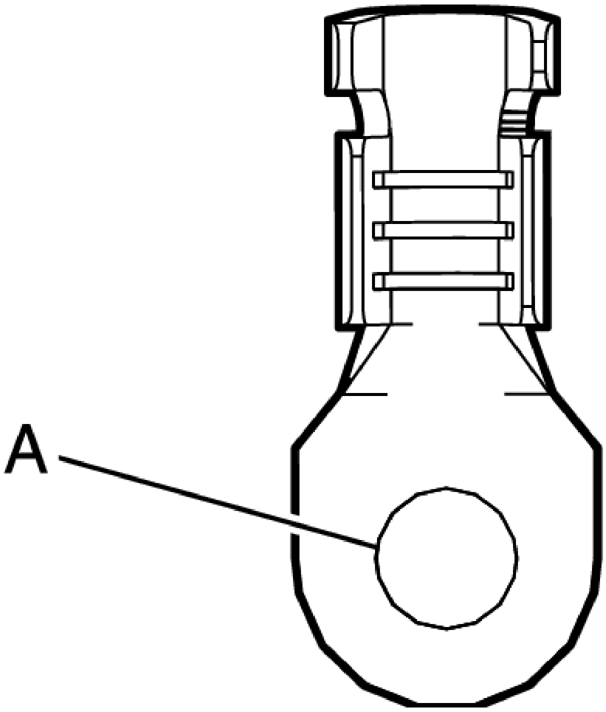


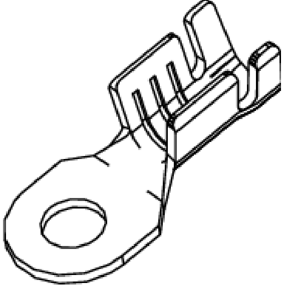
Fig. 4: X50D Fuse Block - Battery Top View
Courtesy of GENERAL MOTORS COMPANY

X50D FUSE BLOCK - BATTERY FUSE IDENTIFICATION

No.	Device Label Name	Device Assigned Name	Rating	Description
Fuses				
1	APM	F1BA	200A	• APM Fuse
2	UEC	F2BA	160A	• X51 Fuse Block - Underhood
3	REC	F3BA	100A	• X51 Fuse Block - Instrument Pane
4	EPS	F4BA	80A	• K43 Power Steering Control Module

X50D FUSE BLOCK - BATTERY X1





Connector Part Information

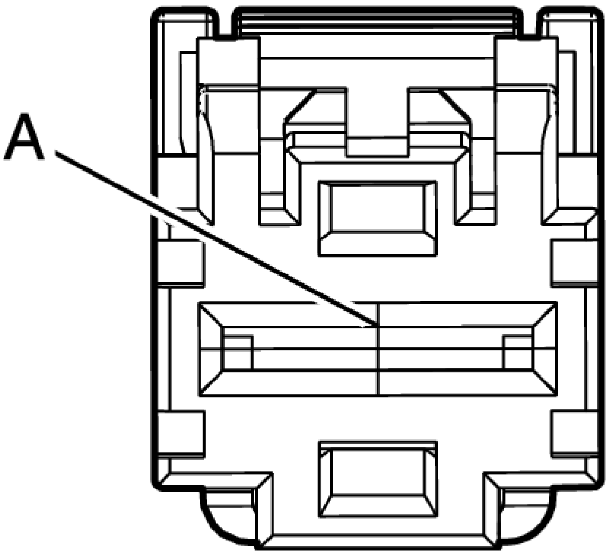
- Harness Type: Battery Cable
- OEM Connector: CBR742-012
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

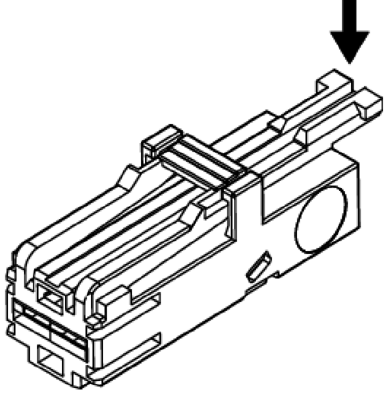
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	25	RD/WH	4042	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X2





Connector Part Information

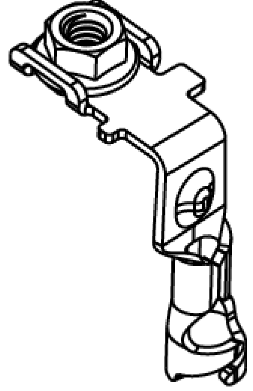
- Harness Type: Body
- OEM Connector: 1718446-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F 8.0 Timer (BK)

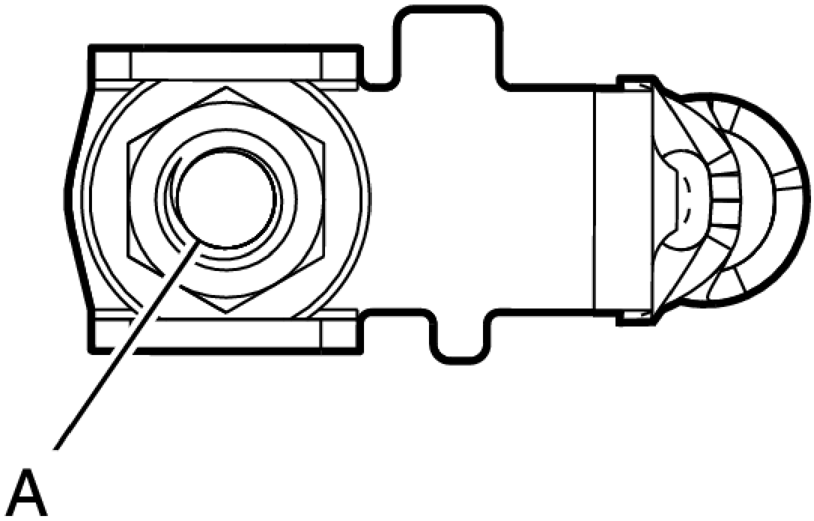
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-22 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	8	RD/GN	40	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X3





Connector Part Information

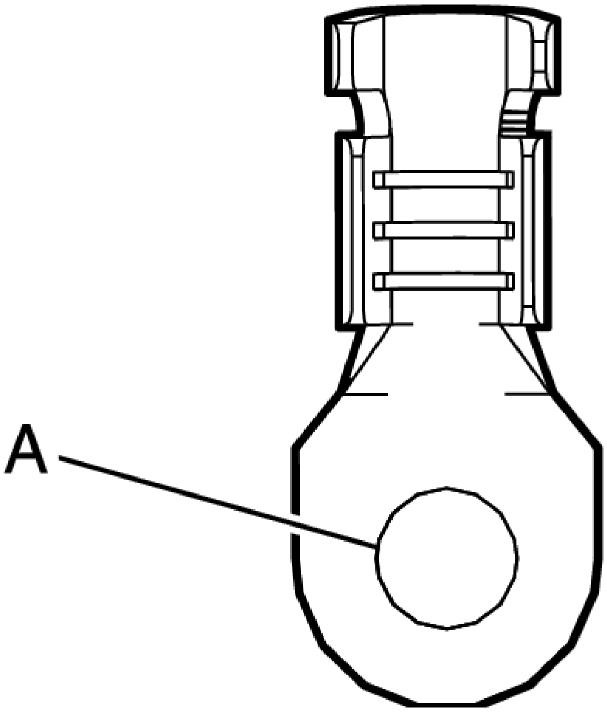
- Harness Type: Body
- OEM Connector: 13869290
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

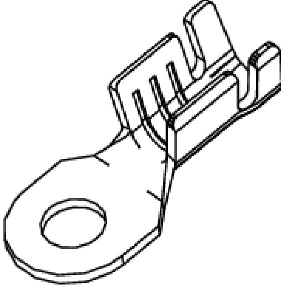
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	8	RD/BU	42	Battery Positive Voltage	I	-

X50D FUSE BLOCK - BATTERY X4





Connector Part Information

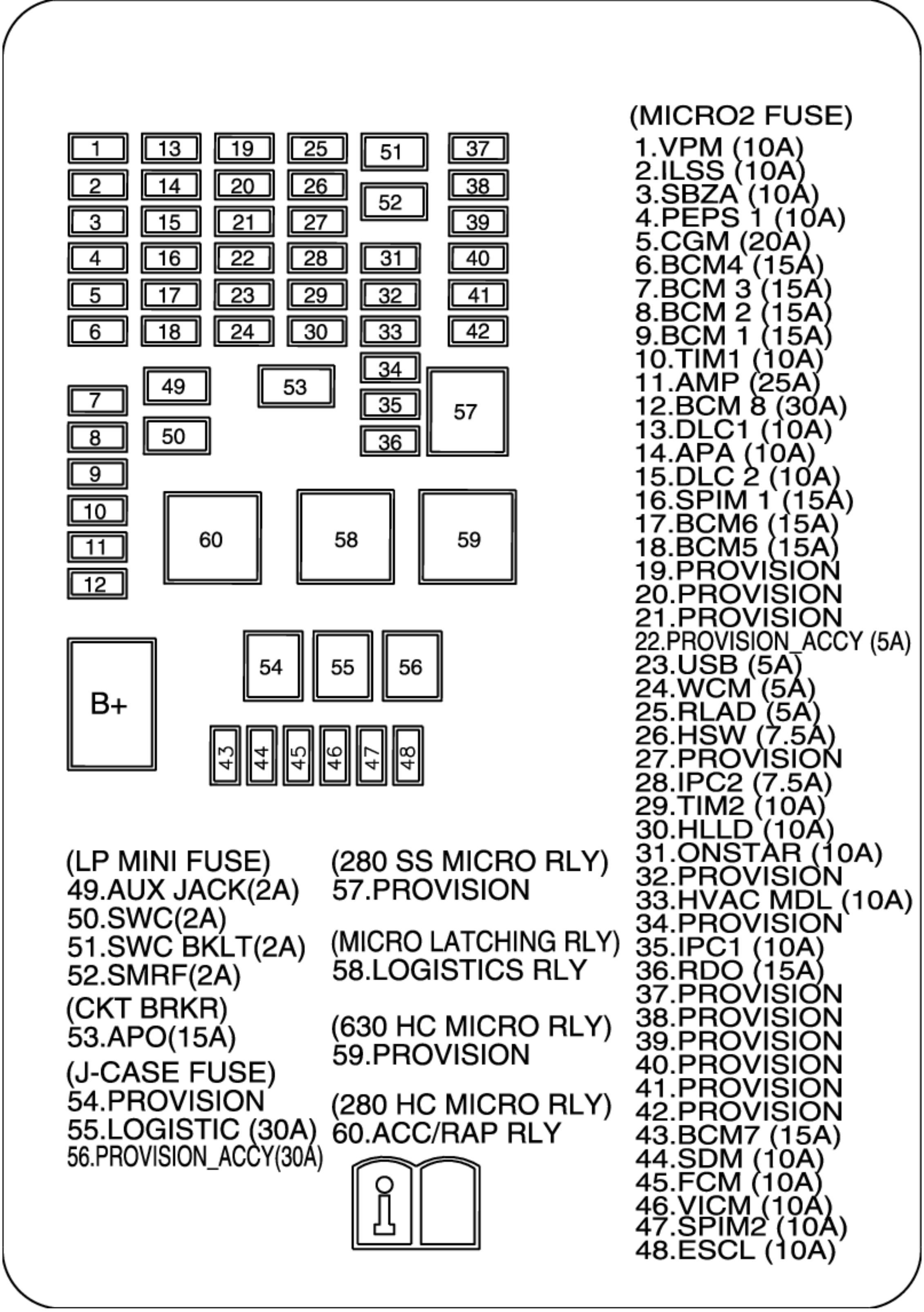
- Harness Type: Battery Cable
- OEM Connector: CBR742-012
- Service Connector: Service by Cable Assembly - See Part Catalog
- Description: 1-Way Ring Terminal

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	No Tool Required	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	25	RD/YE	2	Battery Positive Voltage	I	-

X51A FUSE BLOCK - INSTRUMENT PANEL LABEL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(MICRO2 FUSE)
1.VPM (10A)
2.ILSS (10A)
3.SBZA (10A)
4.PEPS 1 (10A)
5.CGM (20A)
6.BCM4 (15A)
7.BCM 3 (15A)
8.BCM 2 (15A)
9.BCM 1 (15A)
10.TIM1 (10A)
11.AMP (25A)
12.BCM 8 (30A)
13.DLC1 (10A)
14.APA (10A)
15.DLC 2 (10A)
16.SPIM 1 (15A)
17.BCM6 (15A)
18.BCM5 (15A)
19.PROVISION
20.PROVISION
21.PROVISION
22.PROVISION_ACCY (5A)
23.USB (5A)
24.WCM (5A)
25.RLAD (5A)
26.HSW (7.5A)
27.PROVISION
28.IPC2 (7.5A)
29.TIM2 (10A)
30.HLLD (10A)
31.ONSTAR (10A)
32.PROVISION
33.HVAC MDL (10A)
34.PROVISION
35.IPC1 (10A)
36.RDO (15A)
37.PROVISION
38.PROVISION
39.PROVISION
40.PROVISION
41.PROVISION
42.PROVISION
43.BCM7 (15A)
44.SDM (10A)
45.FCM (10A)
46.VICM (10A)
47.SPIM2 (10A)
48.ESCL (10A)

(LP MINI FUSE)
49.AUX JACK(2A)
50.SWC(2A)
51.SWC BKLT(2A)
52.SMRF(2A)

(CKT BRKR)
53.APO(15A)

(J-CASE FUSE)
54.PROVISION
55.LOGISTIC (30A)
56.PROVISION_ACCY(30A)

(280 SS MICRO RLY)
57.PROVISION

(MICRO LATCHING RLY)
58.LOGISTICS RLY

(630 HC MICRO RLY)
59.PROVISION

(280 HC MICRO RLY)
60.ACC/RAP RLY

Fig. 5: X51A Fuse Block - Instrument Panel Label
Courtesy of GENERAL MOTORS COMPANY

X51A FUSE BLOCK - INSTRUMENT PANEL TOP VIEW

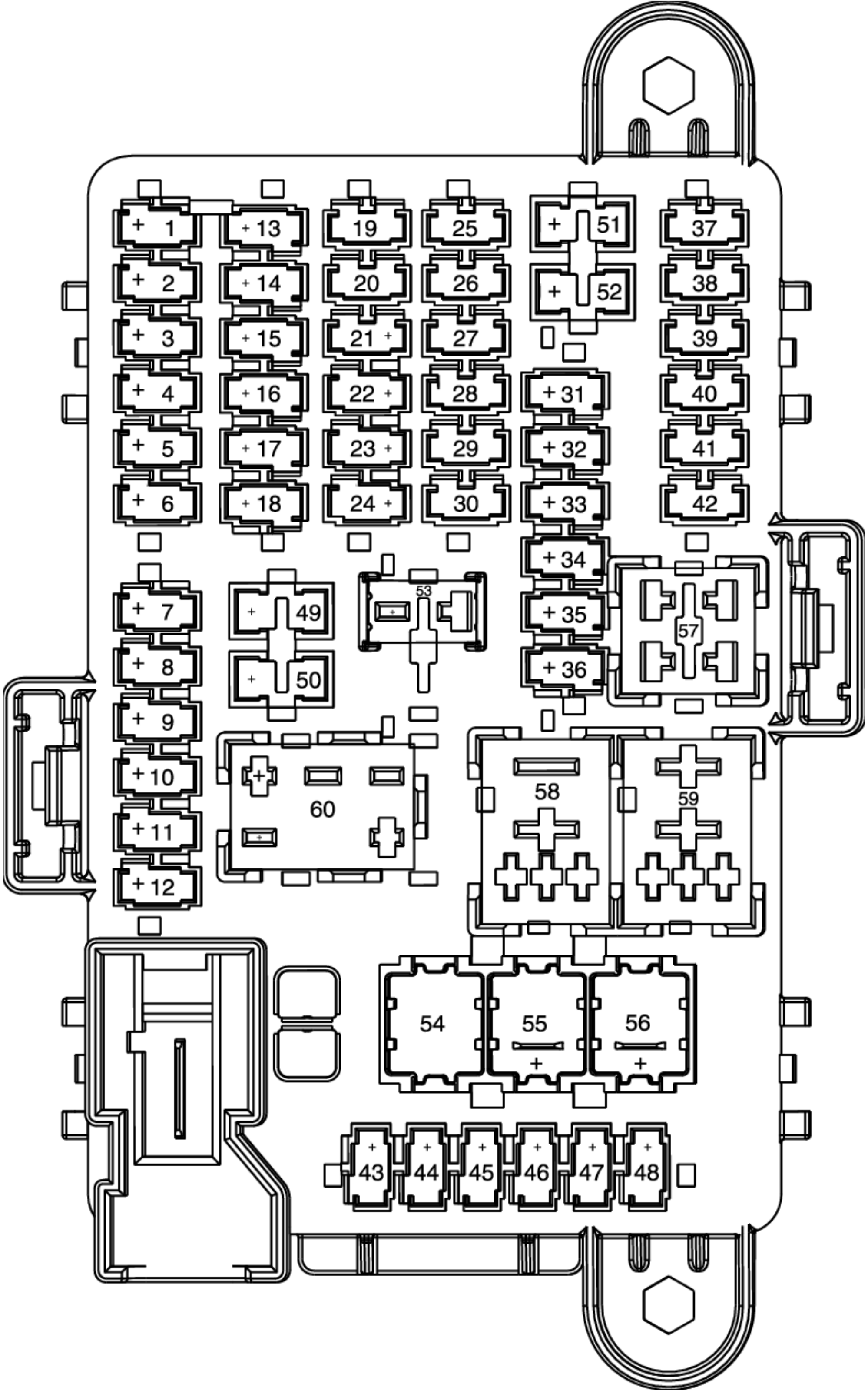
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Fig. 6: X51A Fuse Block - Instrument Panel Top View
Courtesy of GENERAL MOTORS COMPANY

X51A FUSE BLOCK - INSTRUMENT PANEL FUSE AND RELAY IDENTIFICATION LEGEND

No.	Device Label Name	Device Assigned Name	Rating	Description
1	VPM	F1DA	10A	- K157 Video Processing Control Module (UVH)
2	ILSS	F2DA	10A	- B10B Ambient Light/ Sunload Sensor

No.	Device Label Name	Device Assigned Name	Rating	Description
3	SBZA	F3DA	10A	• B94L Side Object Sensor - Left (UKH) • B94R Side Object Sensor - Right (UKH)
4	PEPS	F4DA	10A	• K84 Keyless Entry Control Module
5	CGM	F5DA	20A	• K56 Serial Data Gateway Module
6	BCM4	F6DA	15A	• K9 Body Control Module
7	BCM3	F7DA	15A	• K9 Body Control Module
8	BCM2	F8DA	15A	• K9 Body Control Module
9	BCM1	F9DA	15A	• K9 Body Control Module
10	TIM1	F10DA	10A	• K101 Trailer Interface Control Module
11	AMP	F11DA	25A	• T3 Audio Amplifier (AMP)
12	BCM8	F12DA	30A	• K9 Body Control Module
13	DLC1	F13DA	10A	• X84 Data Link Connector
14	APA	F14DA	10A	• K182 Parking Assist Control Module (UD5/UD7/UFQ)
15	DLC2	F15DA	10A	• X84B Auxiliary Data Connector
16	SPIM1	F16DA	15A	• T6 Power Inverter Module
17	BCM6	F17DA	15A	• K9 Body Control Module
18	BCM5	F18DA	15A	• K9 Body Control Module
19	PROVISION	F19DA	-	• Not Used

No.	Device Label Name	Device Assigned Name	Rating	Description
20	PROVISION	F20DA	-	- Not Used
21	PROVISION	F21DA	-	- Not Used
22	PROVISION_ACCY	F22DA	5A	- Not Used
23	USB	F23DA	5A	- X92 USB Receptacle
24	WCM	F24DA	5A	- T22 Mobile Device Wireless Charger Module (K4C)
25	RLAD	F25DA	5A	- P43 Collision Alert Indicators (UEU/UHX/UHY)
26	HSW	F26DA	7.5A	- K32 Steering Wheel Heating Control Module
27	PROVISION	F27DA	-	- Not Used
28	IPC2	F28DA	7.5A	- P16 Instrument Cluster
29	TIM2	F29DA	10A	- K101 Trailer Interface Control Module
30	HLLD	F30DA	10A	- S30 Headlamp Switch (TR6)
31	ONSTAR	F31DA	10A	- K73 Telematics Communication Interface Control Module (UE1)
32	PROVISION	F32DA	-	- Not Used
33	HAVC MDL	F33DA	10A	- K33 HVAC Control Module
34	PROVISION	F34DA	-	- Not Used
35	IPC1	F35DA	10A	- P16 Instrument Cluster
36	RDO	F36DA	15A	- A11 Radio
37	PROVISION	F37DA	-	- Not Used

No.	Device Label Name	Device Assigned Name	Rating	Description
38	PROVISION	F38DA	-	• Not Used
39	PROVISION	F39DA	-	• Not Used
40	PROVISION	F40DA	-	• Not Used
41	PROVISION	F41DA	-	• Not Used
42	PROVISION	F42DA	-	• Not Used
43	BCM7	F43DA	15A	• K9 Body Control Module
44	SDM	F44DA	10A	• K36 Inflatable Restraint Sensing and Diagnostic Module
45	FCM	F45DA	10A	• B174W Frontview Camera - Windshield (UEU/UHX/UHY)
46	VICM	F46DA	10A	• K114B Hybrid/EV Powertrain Control Module 2
47	SPIM2	F47DA	10A	• T6 Power Inverter Module
48	ESCL	F48DA	10A	• K60 Steering Column Lock Module (N06)
49	AUX JACK	F49DA	2A	• X83 Auxiliary Audio Input
50	SWC	F50DA	2A	• S70R Steering Wheel Controls Switch - Right
51	SWC BKLT	F51DA	2A	• S70E Steering Wheel Controls Switch - Radio Presets
52	SMRF	F52DA	2A	• K183 Short Range Remote Control Transceiver
53	APO	F53DA	15A	• X80 Accessory Power Receptacle
54	PROVISION	F54DA	-	• Not Used

No.	Device Label Name	Device Assigned Name	Rating	Description
55	LOGISTIC	F55DA	30A	- KR104A Battery Saver Relay 1
56	PROVISION_ACCY	F56DA	30A	- Not Used
Ã‚Â	Ã‚Â	Ã‚Â	Ã‚Â	Ã‚Â
Relays				
57	PROVISION	-	-	- -
58	LOGIC MODE RELAY	KR104A Battery Saver Relay 1	-	- F31DA - F32DA - F33DA - F34DA - F35DA - F36DA - F52DA
59	PROVISION	-	-	- -
60	ACC/RAP/RLY	KR76 Retained Accessory Power Relay	-	- F22DA - F23DA - F24DA - F53DA

X51A FUSE BLOCK - INSTRUMENT PANEL X0

-

Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 7171-1068-30
- Service Connector: Service by Component Assembly - See Part Catalog
- Description: -Way Wire Entry Fuse Block

Terminal Part Information

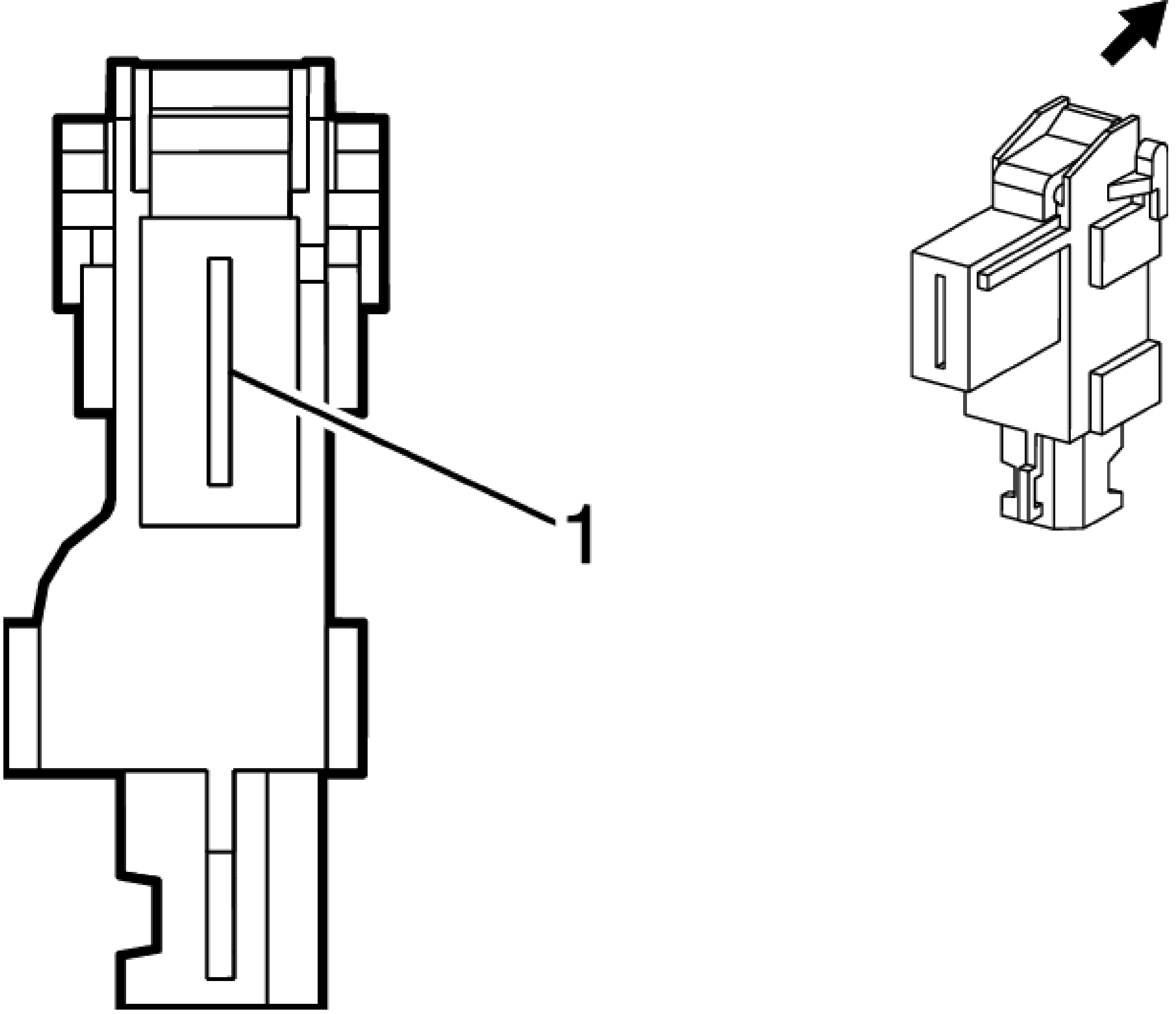
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575838	J-35616-35 (VT)	J-38125-11A	Not Required	Not Required	Not Required	Not Required
II	13575839	J-35616-35 (VT)	J-38125-11A	Not Required	Not Required	Not Required	Not Required
III	13578858	J-35616-4A (PU)	J-38125-36	Not Required	Not Required	Not Required	Not Required
IV	13578860	J-35616-4A (PU)	J-38125-36	Not Required	Not Required	Not Required	Not Required

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
V	13579921	J-35616-40 (BU)	J-38125-556	Not Required	Not Required	Not Required	Not Required
VI	19354836	J-35616-19 (BK)	J-38125-560	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
2	0.75	RD/VT	4640	Battery Positive Voltage	I	-
3	0.35	RD/GN	6140	Battery Positive Voltage	I	-
4	0.35	RD/GY	6240	Battery Positive Voltage	I	-
5	0.75	RD/BU	5240	Battery Positive Voltage	I	-
6	0.5	RD/YE	240	Battery Positive Voltage	I	-
7	0.35	RD/GN	5140	Battery Positive Voltage	I	N06
18	2.5	RD/VT	7140	Battery Positive Voltage	VI	-
21	0.5	BK	1250	Ground	III	-
22	0.5	GY/GN	4083	RAP Relay 2 Coil Control	III	-
25	0.35	GY/VT	3264	Logistic Mode Relay Close Control	III	-
26	0.35	BK	1250	Ground	III	-
27	0.35	VT/BU	3263	Logistic Mode Relay Open Control	III	-
28	2.5	RD/VT	7140	Battery Positive Voltage	V	-
35	2	RD/WH	4740	Battery Positive Voltage	II	-
36	2	RD/VT	5640	Battery Positive Voltage	II	UQA
37	1	RD/GY	5540	Battery Positive Voltage	I	-
38	0.75	RD/VT	4040	Battery Positive Voltage	I	-
39	0.75	RD/GY	4140	Battery Positive Voltage	I	-
40	0.75	RD/BN	4240	Battery Positive Voltage	I	-
47	0.75	RD/YE	4340	Battery Positive Voltage	I	-
48	0.75	GN/YE	6840	Auxiliary Device 2 Switched Voltage	I	-
49	0.35	RD/WH	5740	Battery Positive Voltage	I	-
50	0.35	RD/YE	5840	Battery Positive Voltage	I	-
51	0.35	RD/BU	6740	Battery Positive Voltage	I	-
52	0.35	BK/BU	7340	Camshaft W 2 Low Reference	I	UVH
60	0.35	RD/YE	5040	Battery Positive Voltage	III	-
62	0.35	RD/GN	6940	Battery Positive Voltage	III	-
69	0.75	RD/GN	4440	Battery Positive Voltage	I	-
70	0.75	RD/BU	4540	Battery Positive Voltage	I	-
71	0.5	RD/VT	340	Battery Positive Voltage	I	-
72	0.5	RD/BN	4940	Battery Positive Voltage	I	-
73	0.35	RD/WH	5440	Battery Positive Voltage	I	UD5/UD7/UFQ
74	0.35	RD/GY	4840	Battery Positive Voltage	I	-
78	1	VT	1701	Retained Accessory Power Ignition	IV	-
79	0.35	VT	4601	Retained Accessory Power Fused Control	I	K4C
80	0.35	VT	2801	Retained Accessory Power Fuse Ignition	I	-
91	2	VT/GN	39	Run/Crank Ignition 1 Voltage	II	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
92	2	VT/GN	39	Run/Crank Ignition 1 Voltage	II	-
93	2	VT/GN	39	Run/Crank Ignition 1 Voltage	II	-
94	2	VT/GN	39	Run/Crank Ignition 1 Voltage	II	-
95	2	VT/GN	39	Run/Crank Ignition 1 Voltage	II	-
96	2	VT/GN	39	Run/Crank Ignition 1 Voltage	II	-
97	0.5 0.35	VT/GN VT/GN	2639 2639	Run/Crank Ignition 1 Voltage Run/Crank Ignition 1 Voltage	I I	TR6 -TR6
98	0.35	VT/BK	2539	Run/Crank Ignition 1 Voltage	I	-
99	0.35	VT/WH	2439	Run/Crank Ignition 1 Voltage	I	-
101	0.35	VT/GN	2239	Run/Crank Ignition 1 Voltage	I	-
102	0.35	VT/BK	2139	Run/Crank Ignition 1 Voltage	I	-
109	1.5	RD/WH	6440	Battery Positive Voltage	II	-
110	0.35	RD/VT	6340	Battery Positive Voltage	I	-
112	0.35	RD/BN	6640	Battery Positive Voltage	I	-
114	0.35	RD/GY	7040	Battery Positive Voltage	I	UE1
116	0.35	RD/BN	5940	Battery Positive Voltage	III	-
117	0.35	YE	6817	LED Backlight Dimming Control	III	-
118	0.35	YE	6817	LED Backlight Dimming Control	III	-

X51A FUSE BLOCK - INSTRUMENT PANEL X1



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 21083000001
- Service Connector: Service by Harness - See Part Catalog
- Description: 1-Way F 120 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	8	RD/BU	42	Battery Positive Voltage	I	-

Back To Article

2017 ELECTRICAL

Wiring Systems and Power Management - Component Locator - Front of Vehicle/Engine Compartment Component Views - Bolt EV

FRONT OF VEHICLE/ENGINE COMPARTMENT COMPONENT VIEWS

FRONT OF VEHICLE

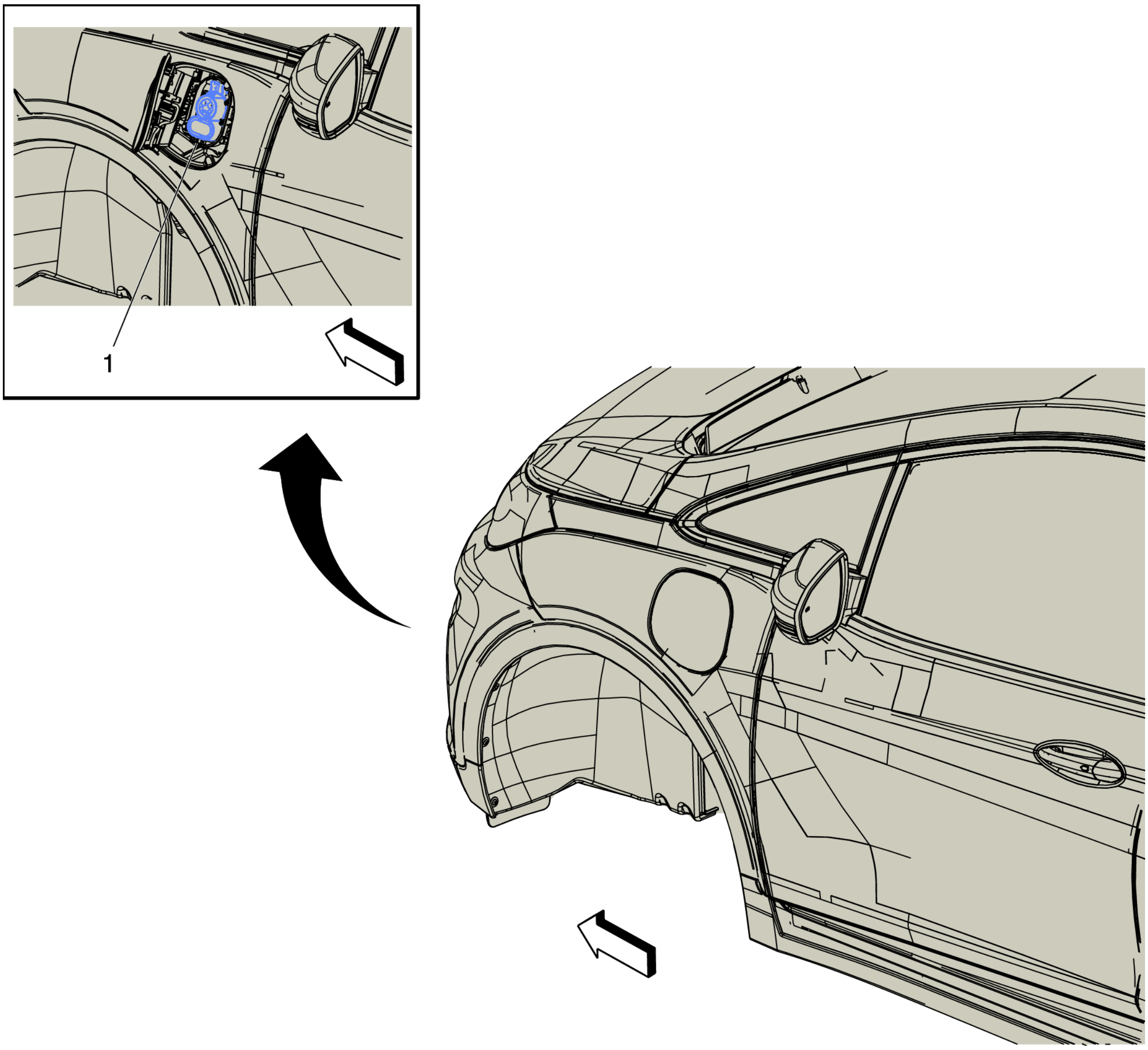


Fig. 1: Front of Vehicle
Courtesy of GENERAL MOTORS COMPANY

Items
1: X98 Hybrid/EV Battery Charger Receptacle X98 Hybrid/EV Battery Charger Receptacle X1 X98 Hybrid/EV Battery Charger Receptacle X2 (CBT)

FRONT FASCIA COMPONENTS

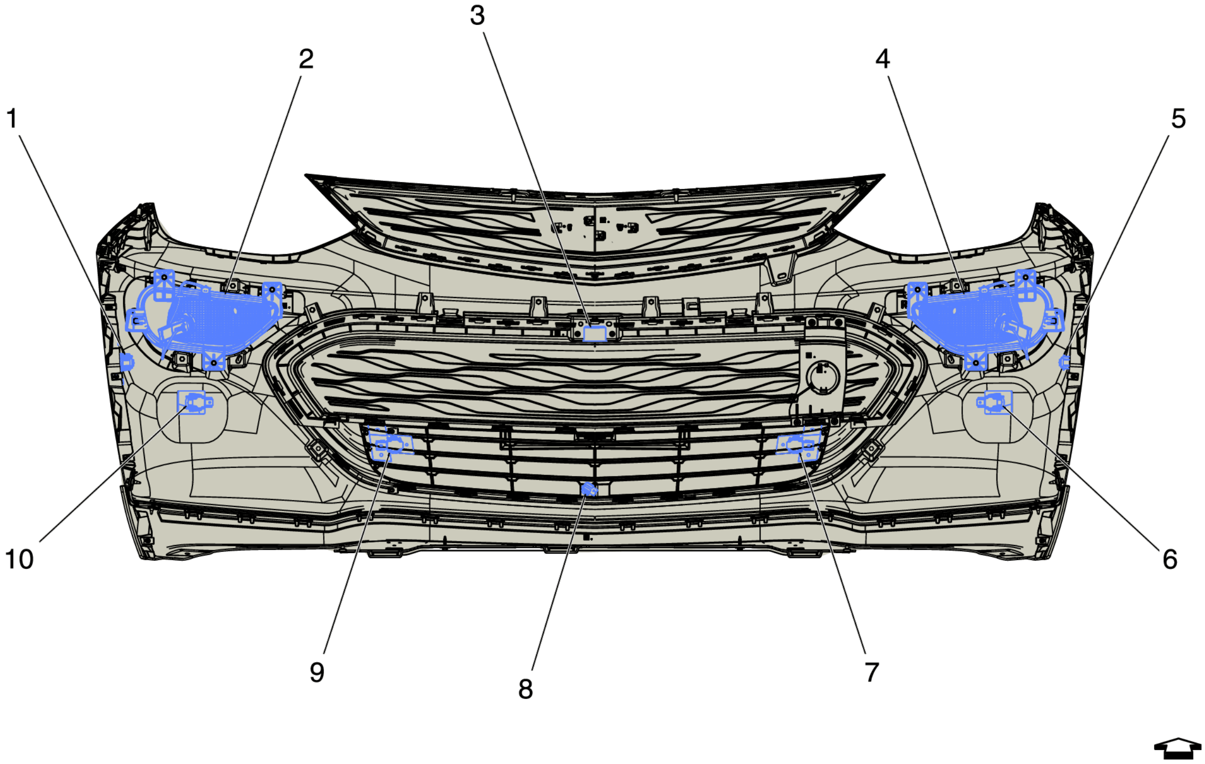


Fig. 2: Front Fascia Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: B306A Parking Assist Sensor - Front Left Outer (UD5/UFQ) **B306A Parking Assist Sensor - Front Left Outer (UD5/UFQ)**
2: E4LF Turn Signal Lamp - Left Front **E4LF Turn Signal Lamp - Left Front (KA6)**
3: B174G Frontview Camera - Grille (UVH) **B174G Frontview Camera - Grille (UVH)**
4: E4RF Turn Signal Lamp - Right Front **E4RF Turn Signal Lamp - Right Front**
5: B306D Parking Assist Sensor - Front Right Outer (UD5/UFQ) **B306D Parking Assist Sensor - Front Right Outer (UD5/UFQ)**
6: B306L Parking Assist Sensor - Side Right Front (UFQ) **B306L Parking Assist Sensor - Side Right Front (UFQ)**
7: B306C Parking Assist Sensor - Front Right Middle (UD5/UFQ) **B306C Parking Assist Sensor - Front Right Middle (UD5/UFQ)**
8: B9 Ambient Air Temperature Sensor **B9 Ambient Air Temperature Sensor**
9: B306A Parking Assist Sensor - Front Left Outer (UD5/UFQ) **B306A Parking Assist Sensor - Front Left Outer (UD5/UFQ)**
10: B306K Parking Assist Sensor - Side Left Front (UFQ) **B306K Parking Assist Sensor - Side Left Front (UFQ)**

LEFT SIDE ENGINE COMPARTMENT

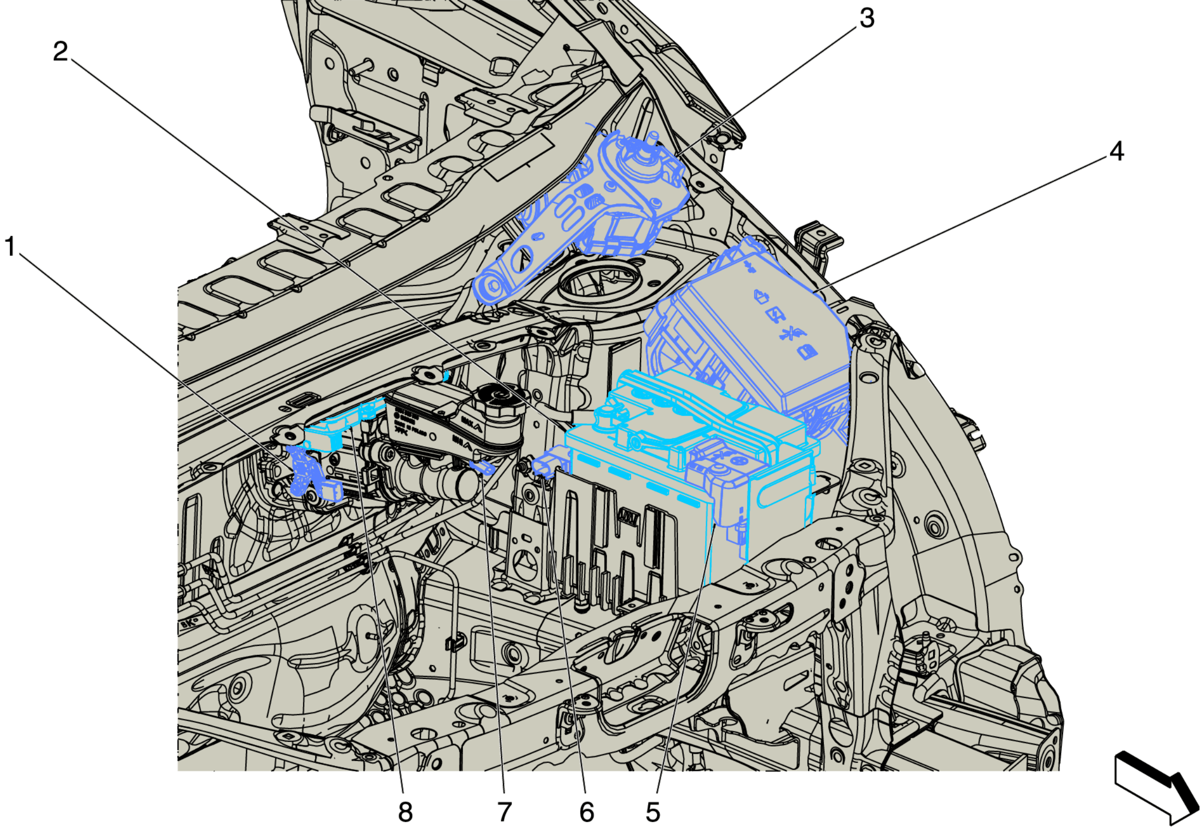


Fig. 3: Left Side Engine Compartment
Courtesy of GENERAL MOTORS COMPANY

Items
1: B201 Brake Control Brake Pedal Position Sensor **B201 Brake Control Brake Pedal Position Sensor**
2: C1 Battery **C1 Battery ((-) Body)**
3: M75L Windshield Wiper Motor Module - Left **M75L Windshield Wiper Motor Module - Left**
4: X50A Fuse Block - Underhood **X50A Fuse Block - Underhood X1** **X50A Fuse Block - Underhood X2** **X50A Fuse Block - Underhood X3** **X50A Fuse Block - Underhood X4** **X50A Fuse Block - Underhood X5**
5: X50D Fuse Block - Battery **X50D Fuse Block - Battery X1** **X50D Fuse Block - Battery X2** **X50D Fuse Block - Battery X3** **X50D Fuse Block - Battery X4**
6: B18 Battery Current Sensor **B18 Battery Current Sensor**
7: B20 Brake Fluid Level Switch **B20 Brake Fluid Level Switch**
8: K177 Brake Booster Control Module **K177 Brake Booster Control Module**

RIGHT SIDE ENGINE COMPARTMENT

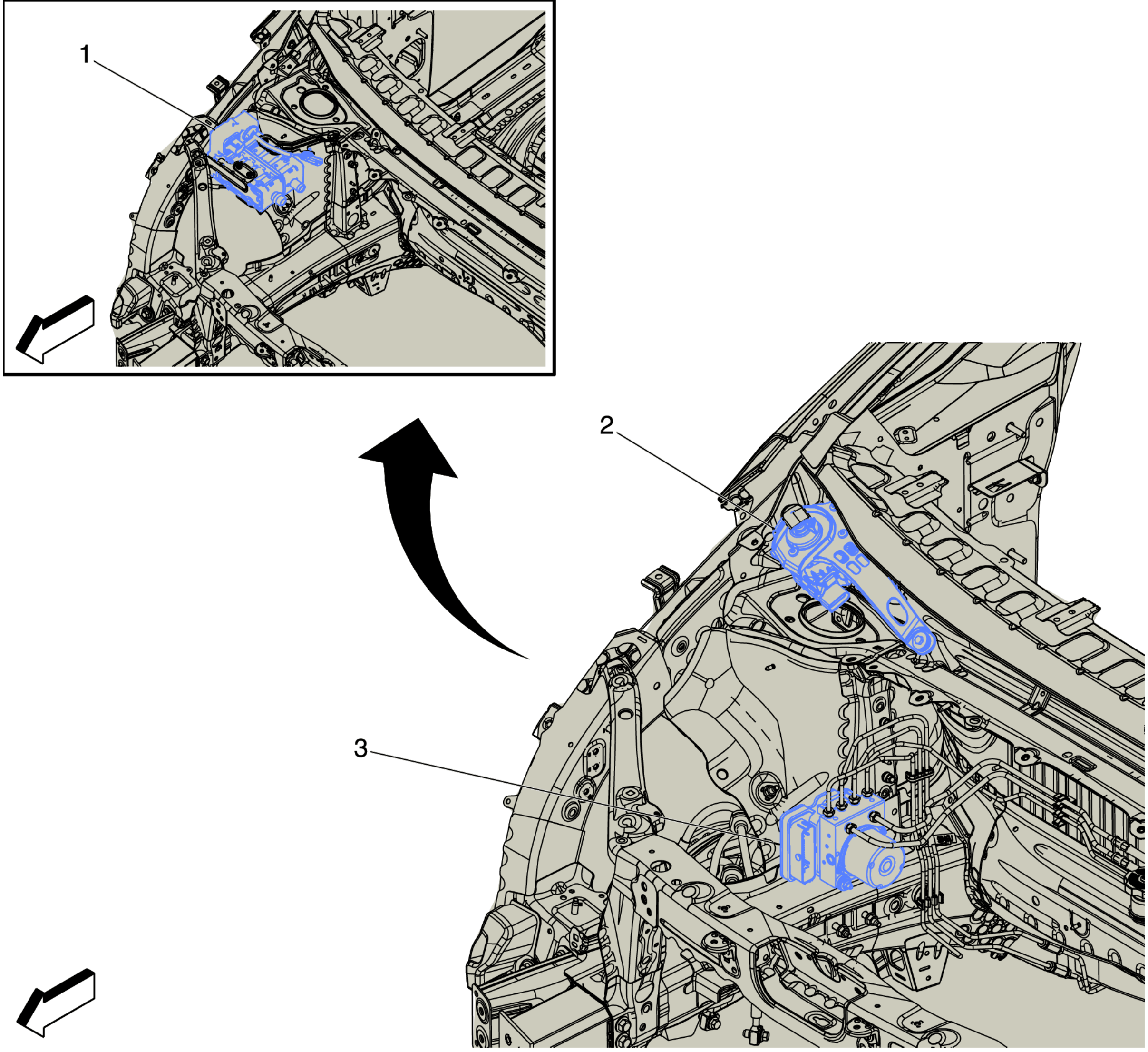


Fig. 4: Right Side Engine Compartment
Courtesy of GENERAL MOTORS COMPANY

Items

1: K10 Coolant Heater Control Module K10 Coolant Heater Control Module X1 K10 Coolant Heater Control Module X2

2: M75R Windshield Wiper Motor Module - Right M75R Windshield Wiper Motor Module - Right

3: K17 Electronic Brake Control Module K17 Electronic Brake Control Module

ENGINE COMPARTMENT TOP

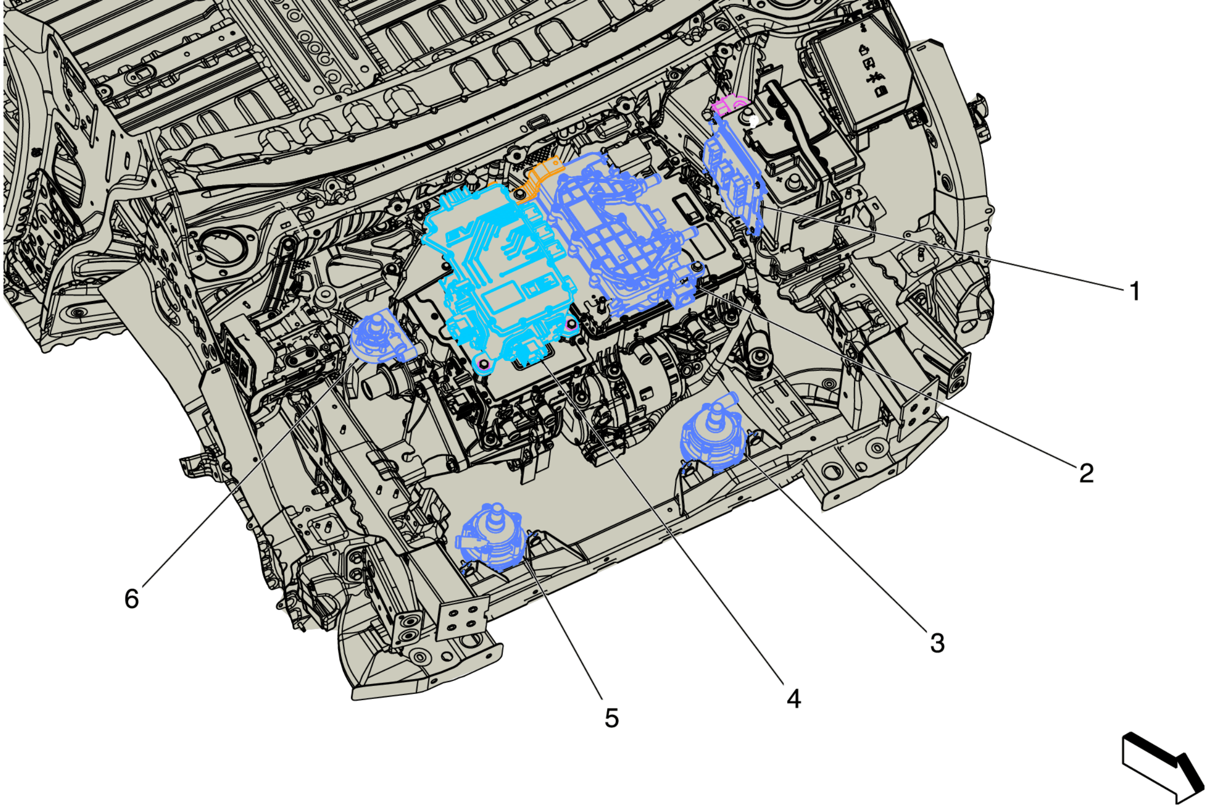


Fig. 5: Engine Compartment Top

Courtesy of GENERAL MOTORS COMPANY

Items
1: K20 Engine Control Module **K20 Engine Control Module X1** **K20 Engine Control Module X2** **K20 Engine Control Module X3**
2: K1 14V Power Module **K1 14V Power Module X1** **K1 14V Power Module X2** **K1 14V Power Module X3** **K1 14V Power Module X4**
3: G35 Hybrid/EV Electronics Coolant Pump **G35 Hybrid/EV Electronics Coolant Pump**
4: T24 Battery Charger - DC **T24 Battery Charger - DC X1** **T24 Battery Charger - DC X2** **T24 Battery Charger - DC X3** **T24 Battery Charger - DC X4** **T24 Battery Charger - DC X5** **T24 Battery Charger - DC X6** **T24 Battery Charger - DC X7** **T24 Battery Charger - DC X8** **T24 Battery Charger - DC X9 (-CBT)**
5: G37 Hybrid/EV Battery Pack Coolant Pump **G37 Hybrid/EV Battery Pack Coolant Pump**
6: G36 Auxiliary Heater Coolant Pump **G36 Auxiliary Heater Coolant Pump**

FRONT OF ENGINE COMPARTMENT

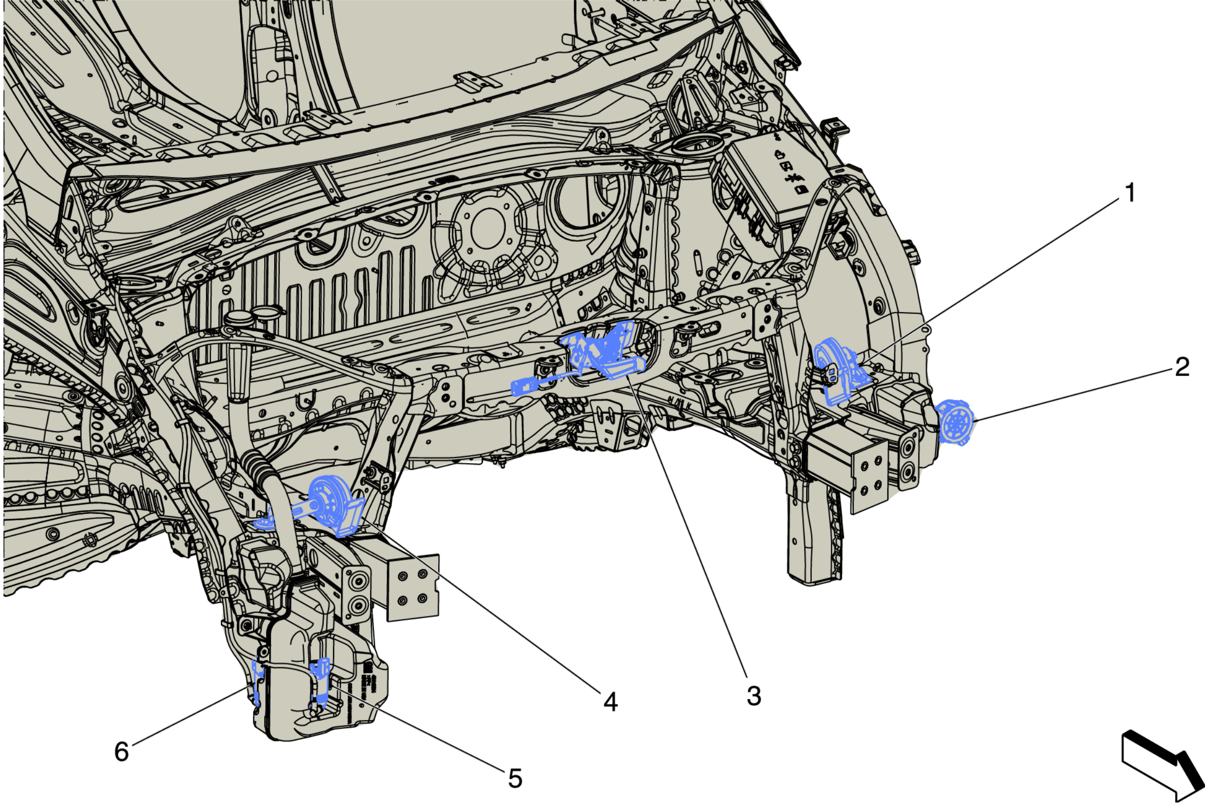


Fig. 6: Front of Engine Compartment
Courtesy of GENERAL MOTORS COMPANY

Items

1: P12L Horn - Left **P12L Horn - Left**
2: P48 Pedestrian Alert Sound Speaker **P48 Pedestrian Alert Sound Speaker**
3: B55 Hood Ajar Switch **B55 Engine Hood Switch**
4: P12R Horn - Right **P12R Horn - Right**
5: G19 Rear Window Washer Pump **G19 Rear Window Washer Pump**
6: G24 Windshield Washer Pump **G24 Windshield Washer Pump**

Back To Article

Wiring Systems and Power Management - Component Locator - Ground Views - Bolt EV

GROUND VIEWS

G100

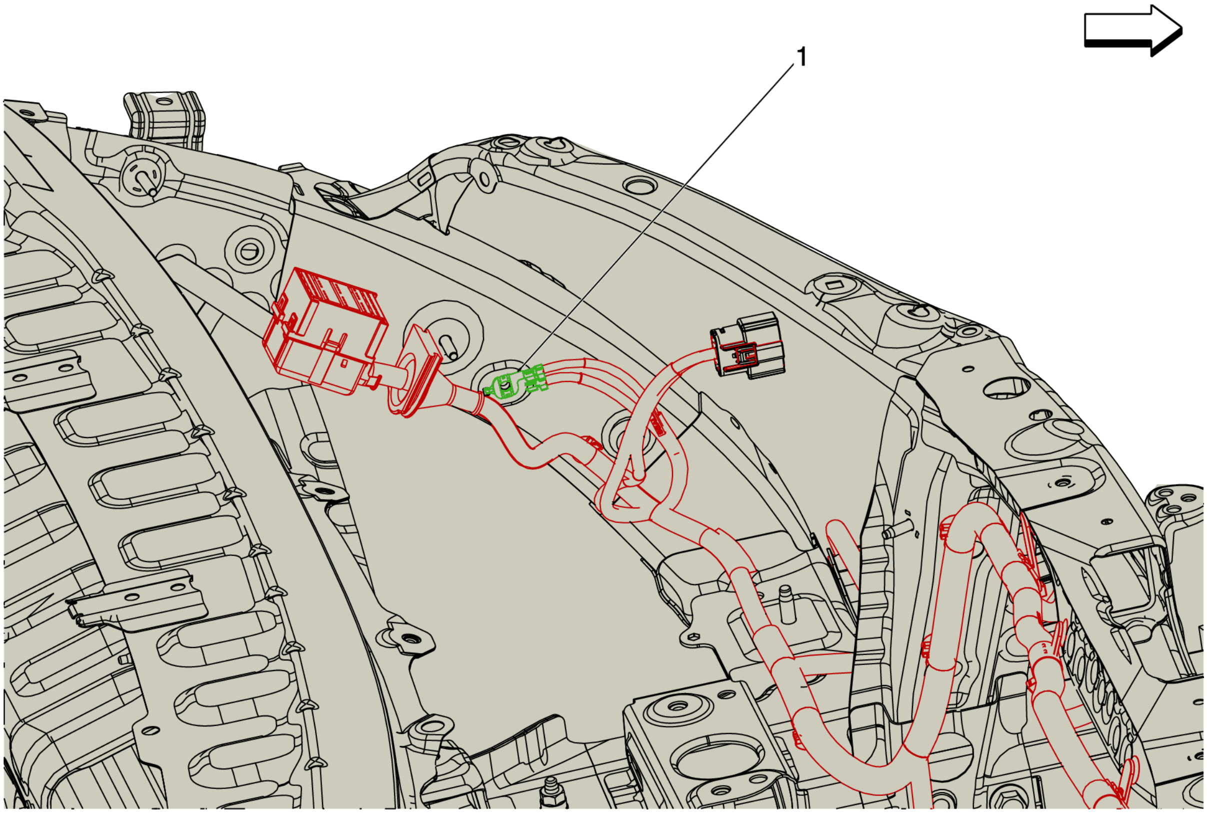
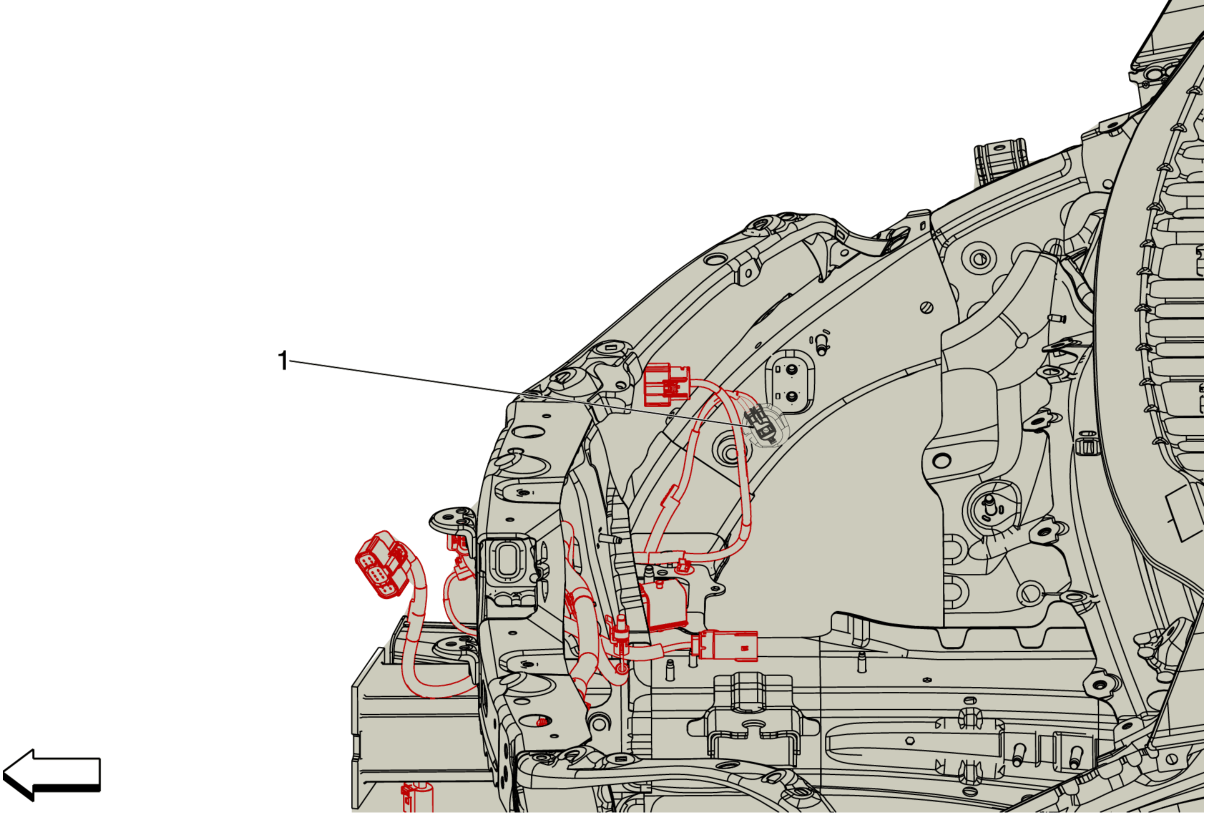


Fig. 1: G100
Courtesy of GENERAL MOTORS COMPANY

Items
1: G100 Forward Lamp Harness

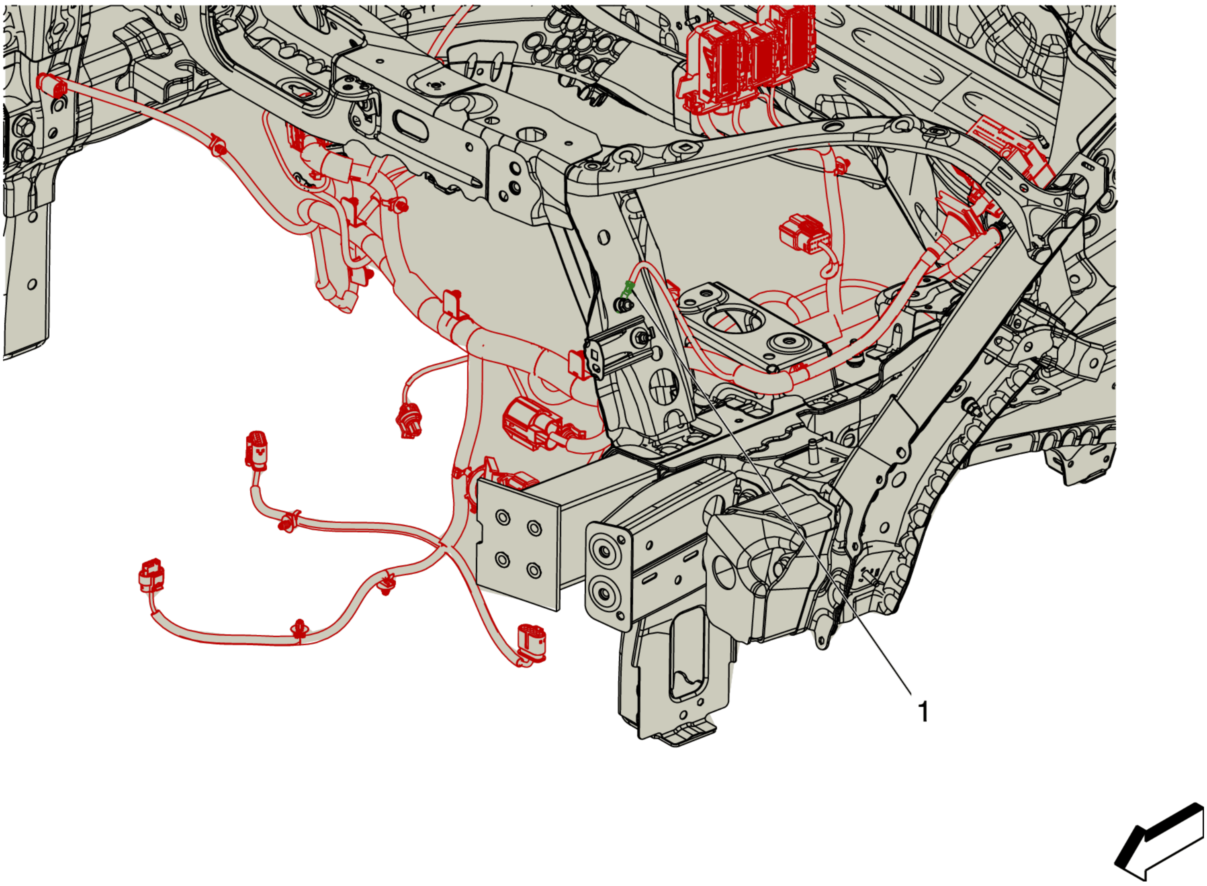
G101



[Fig. 2: G101](#)
Courtesy of GENERAL MOTORS COMPANY

Items
1: G101 Forward Lamp Harness

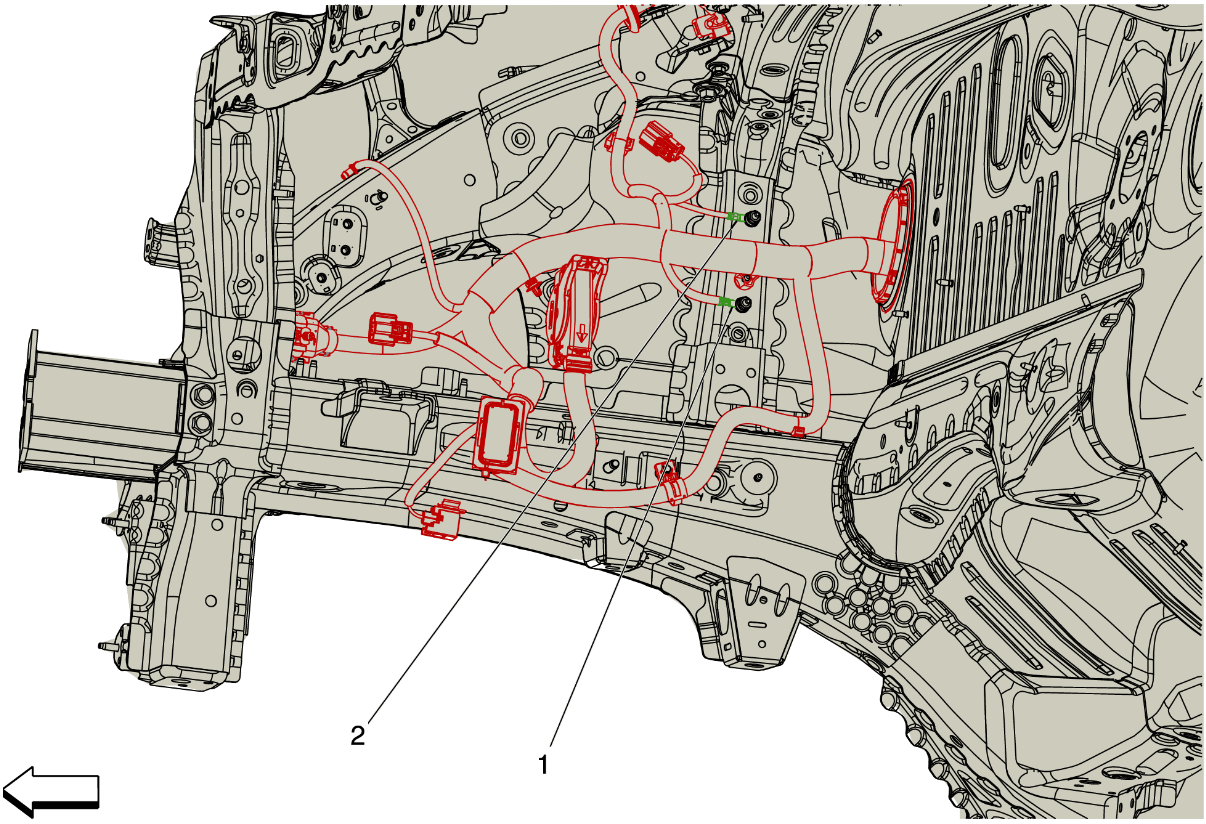
G102



[Fig. 3: G102](#)
Courtesy of GENERAL MOTORS COMPANY

Items
1: G102 Engine Harness

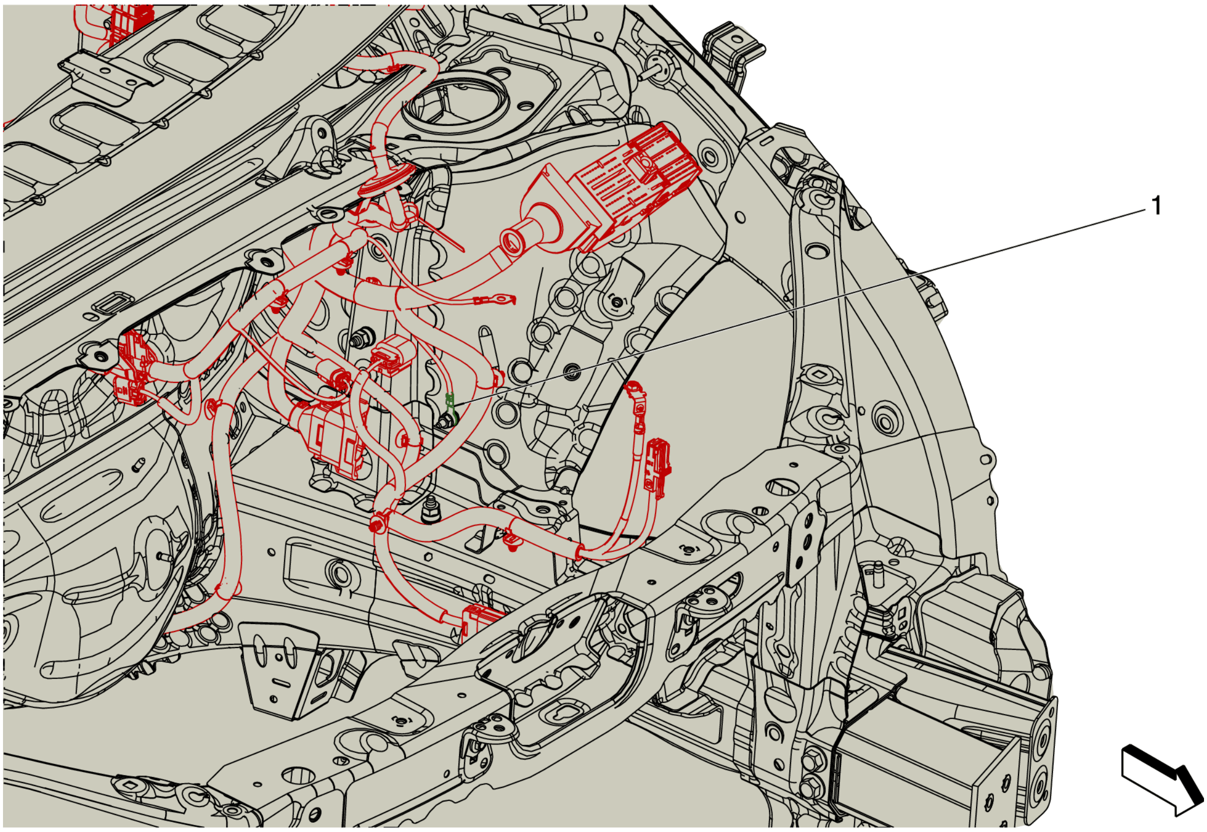
G103 AND G105



[Fig. 4: G103 and G105](#)
Courtesy of GENERAL MOTORS COMPANY

Items
1: G103 Body Harness
2: G105 Body Harness

G104



[Fig. 5: G104](#)
Courtesy of GENERAL MOTORS COMPANY

Items
1: G104 Body Harness

G107

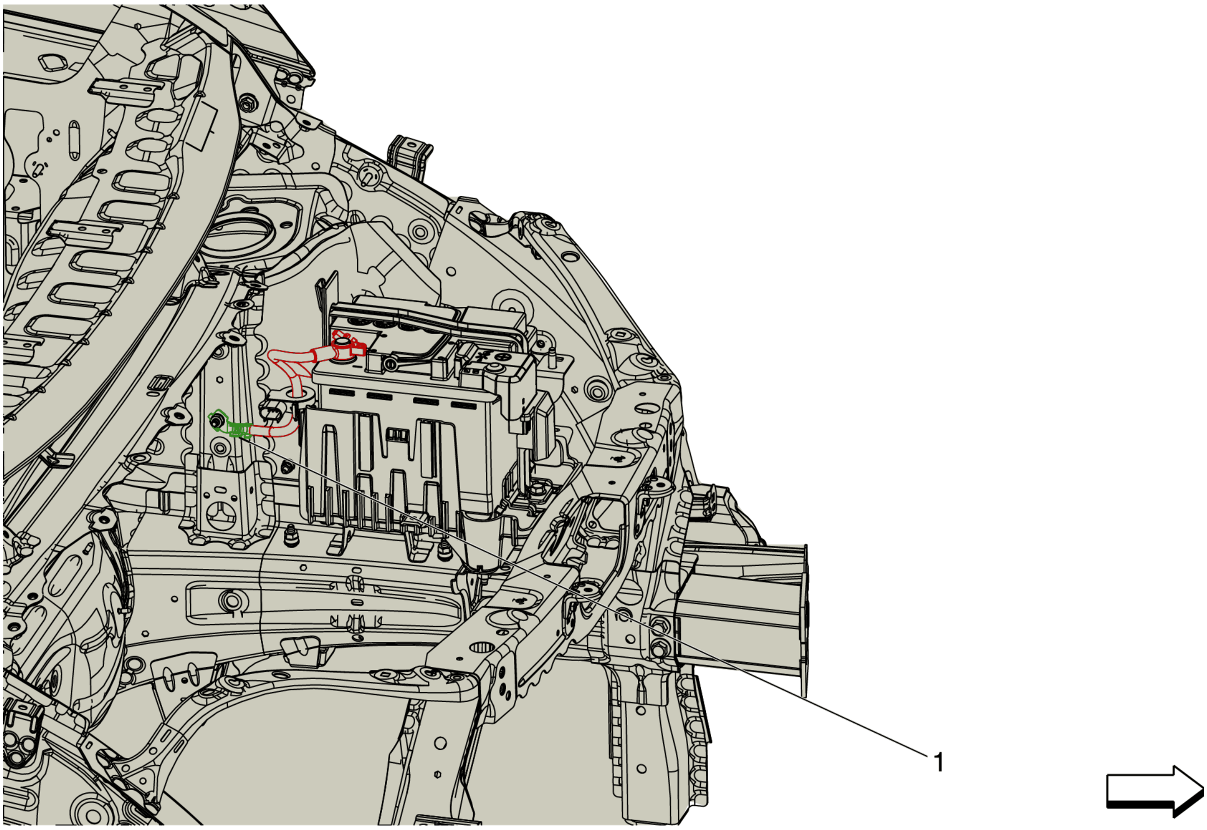


Fig. 6: G107
Courtesy of GENERAL MOTORS COMPANY

Items
1: G107 Battery Negative Harness

G111

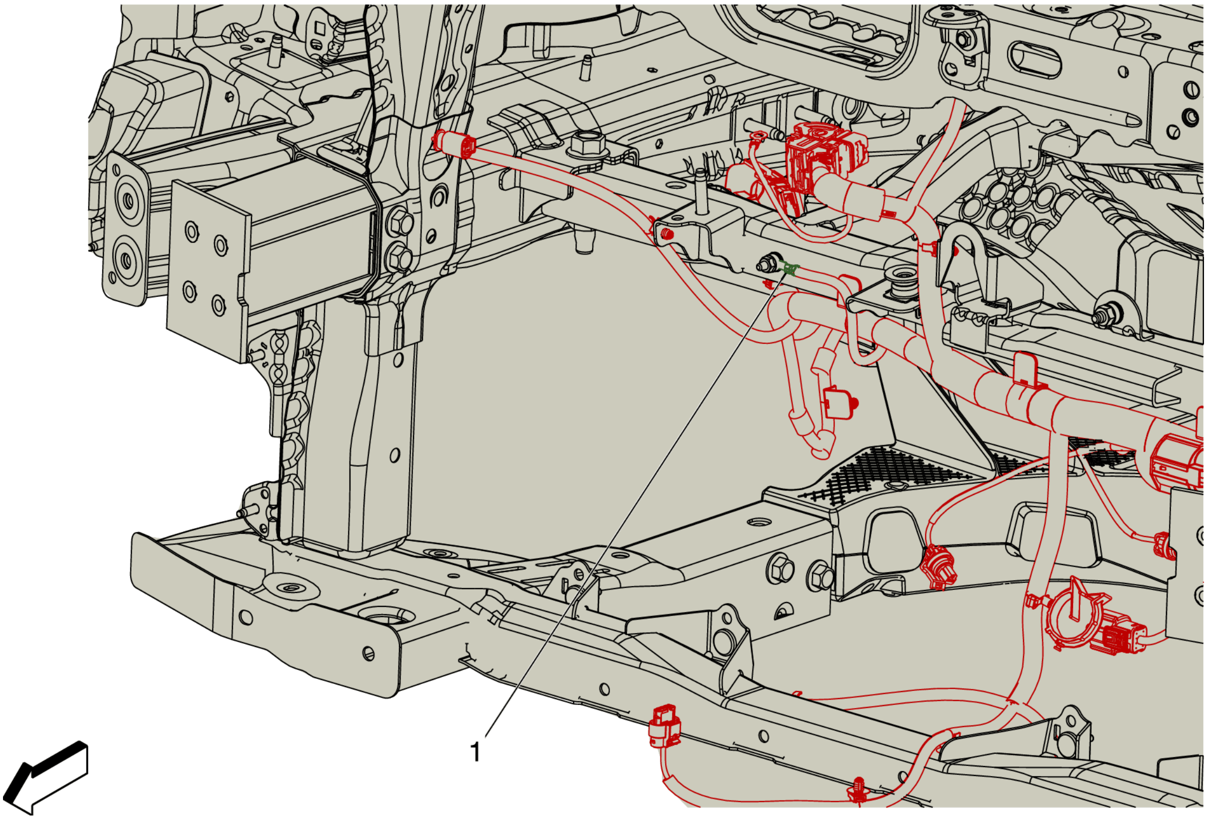


Fig. 7: G111
Courtesy of GENERAL MOTORS COMPANY

Items
1: G111 Engine Harness

G112

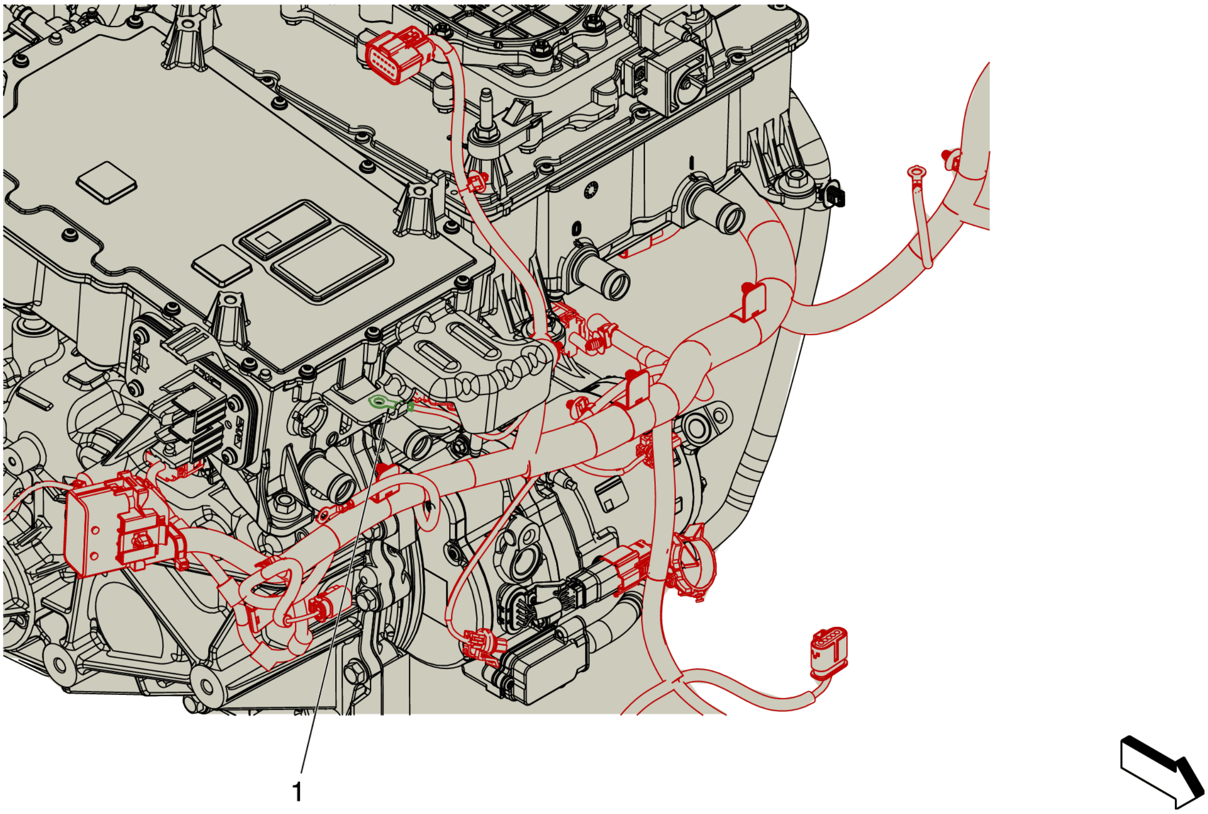


Fig. 8: G112
Courtesy of GENERAL MOTORS COMPANY

Items
1: G112 Engine Harness

G116

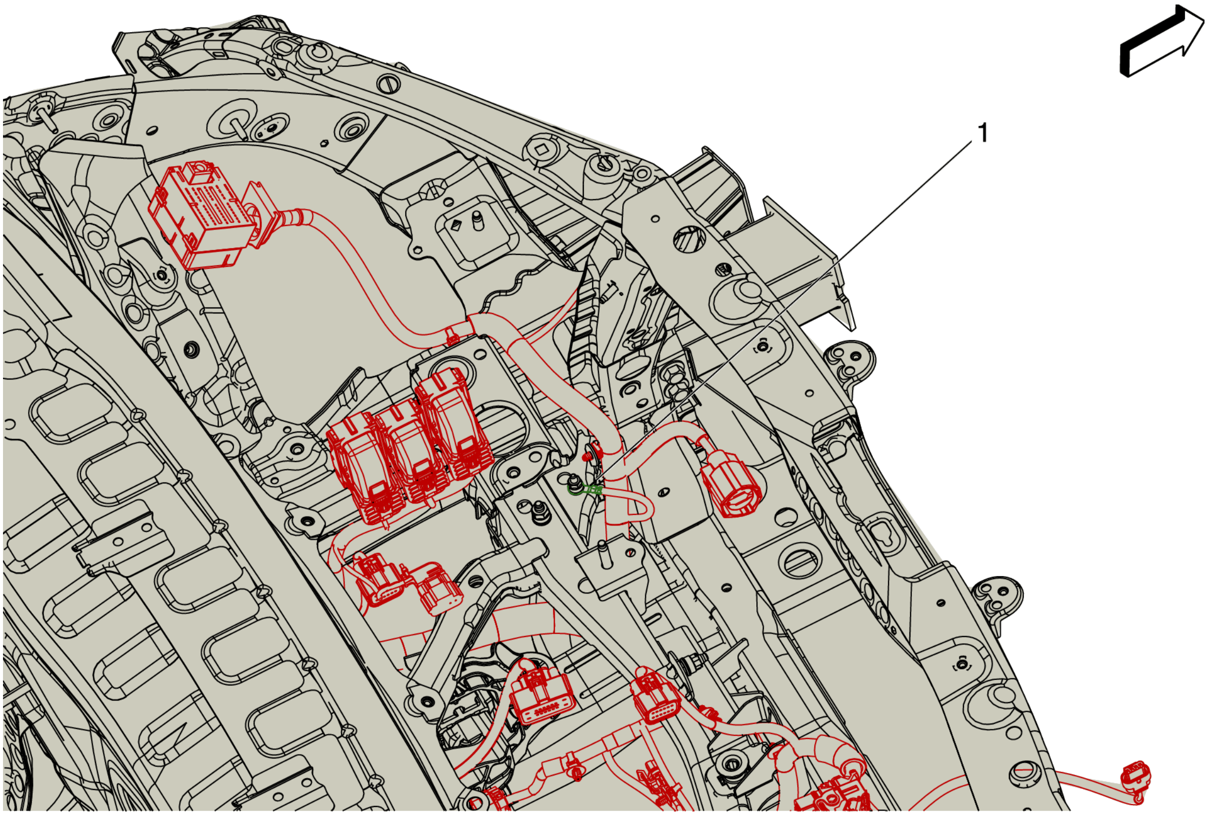


Fig. 9: G116
Courtesy of GENERAL MOTORS COMPANY

Items
1: G116 Engine Harness

G150, G151, G153 AND G154

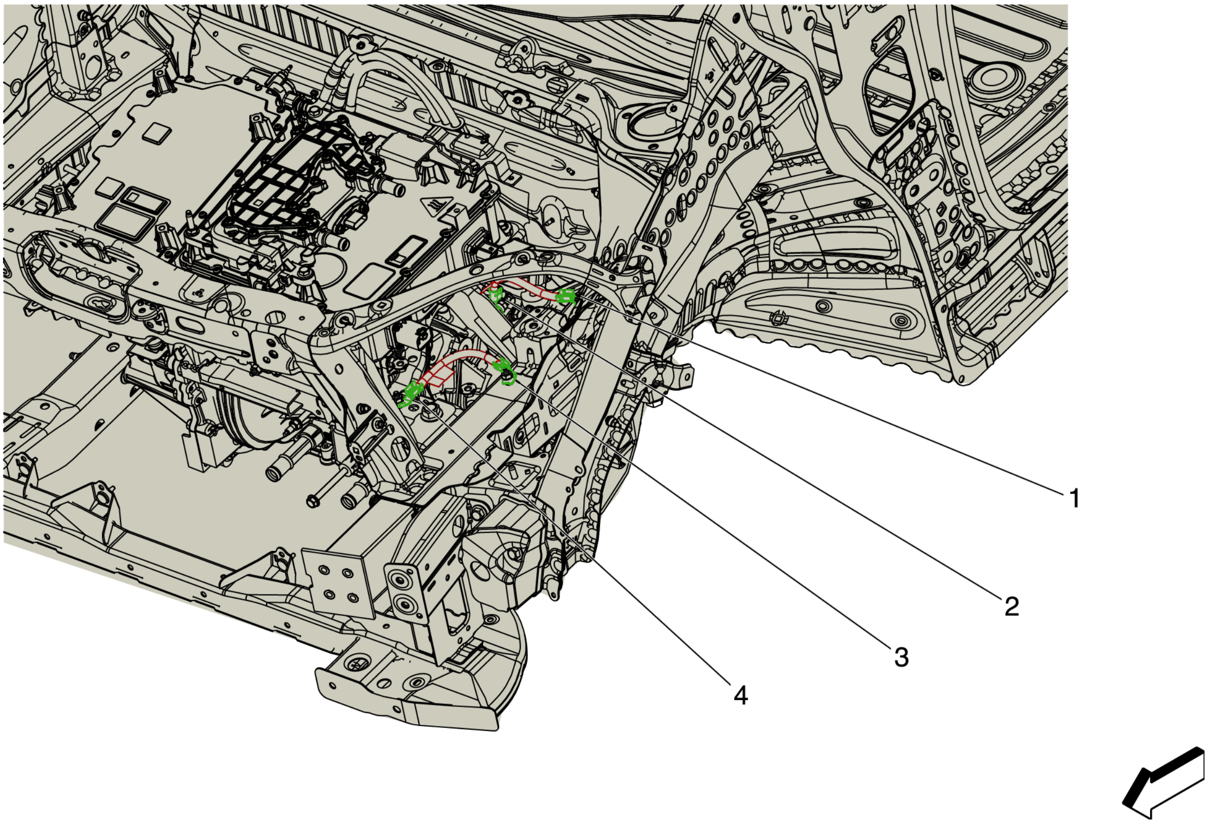


Fig. 10: G150, G151, G153 and G154
Courtesy of GENERAL MOTORS COMPANY

Items
1: G154 Ground Jumper Harness
2: G153 Ground Jumper Harness
3: G151 Ground Jumper Harness
4: G150 Ground Jumper Harness

G155 AND G156

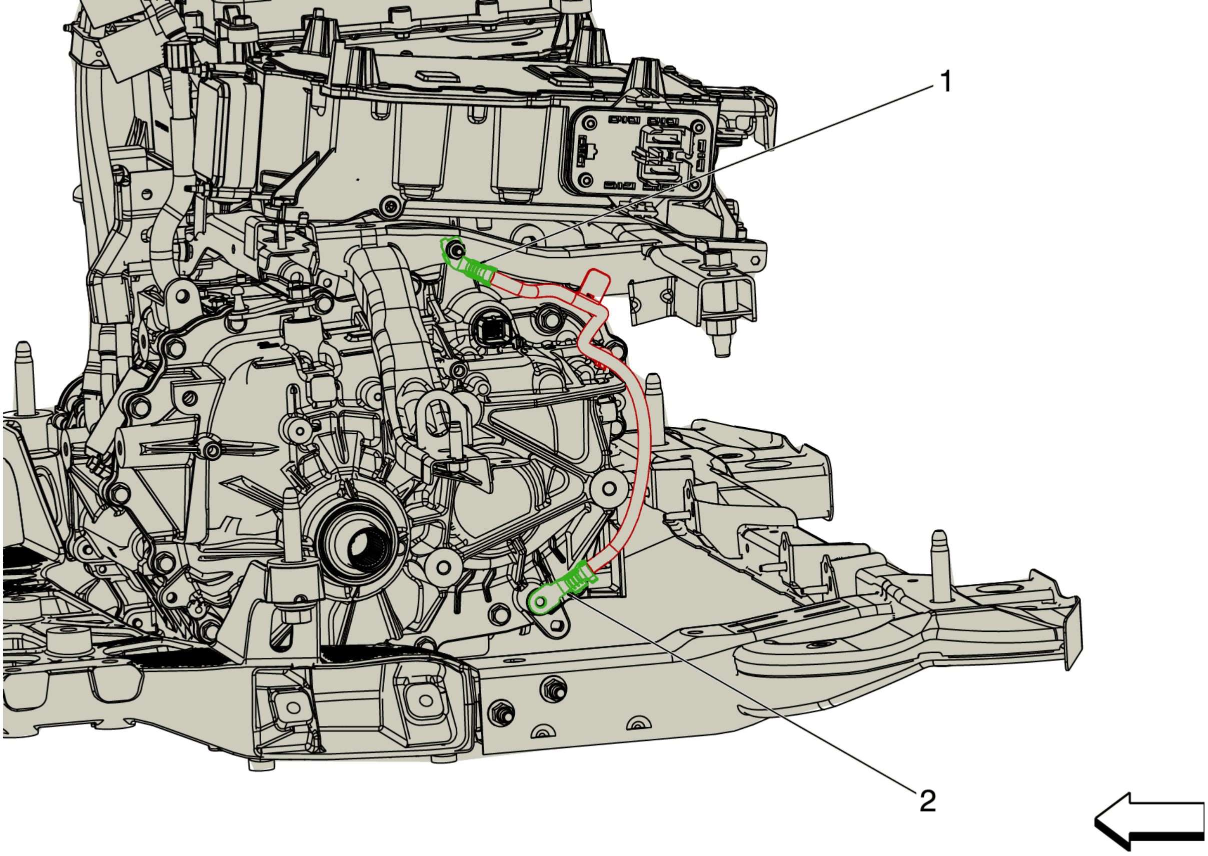


Fig. 11: G155 and G156
Courtesy of GENERAL MOTORS COMPANY

Items
1: G155 Ground Jumper Harness
2: G156 Ground Jumper Harness

G157 AND G158

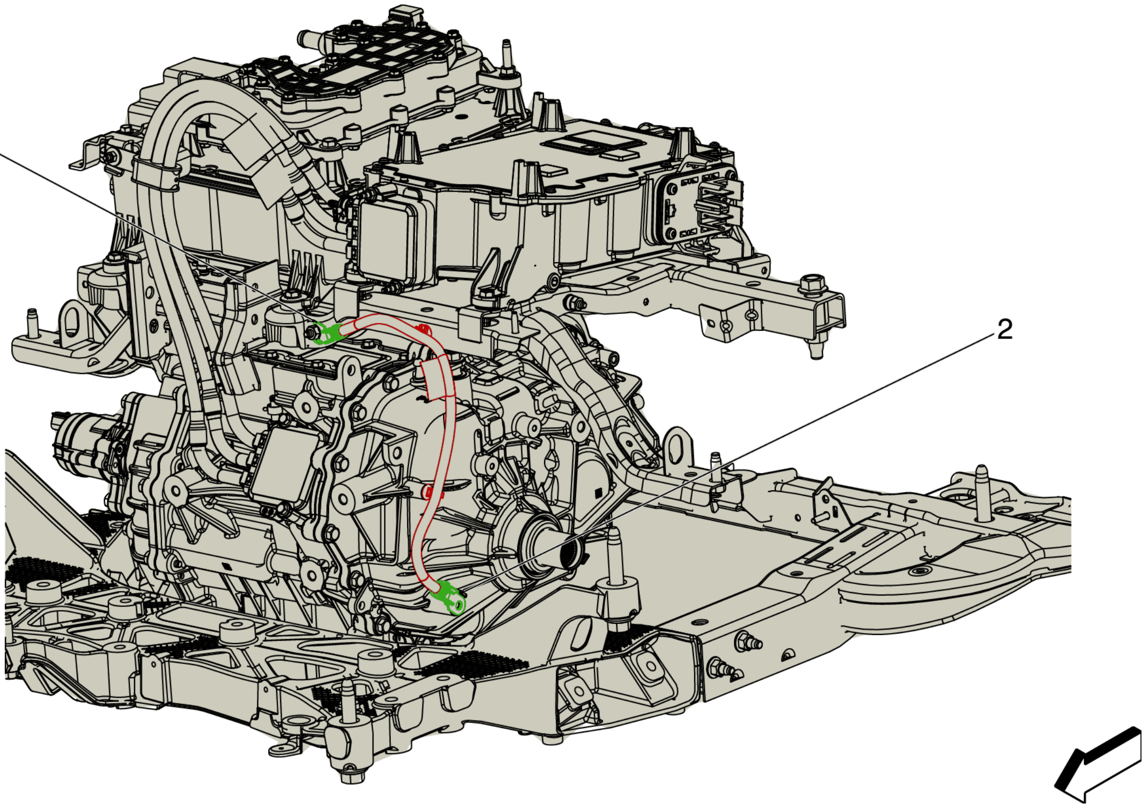


Fig. 12: G157 and G158
Courtesy of GENERAL MOTORS COMPANY

Items
1: G157 Ground Jumper Harness

Items
2: G158 Ground Jumper Harness

G200

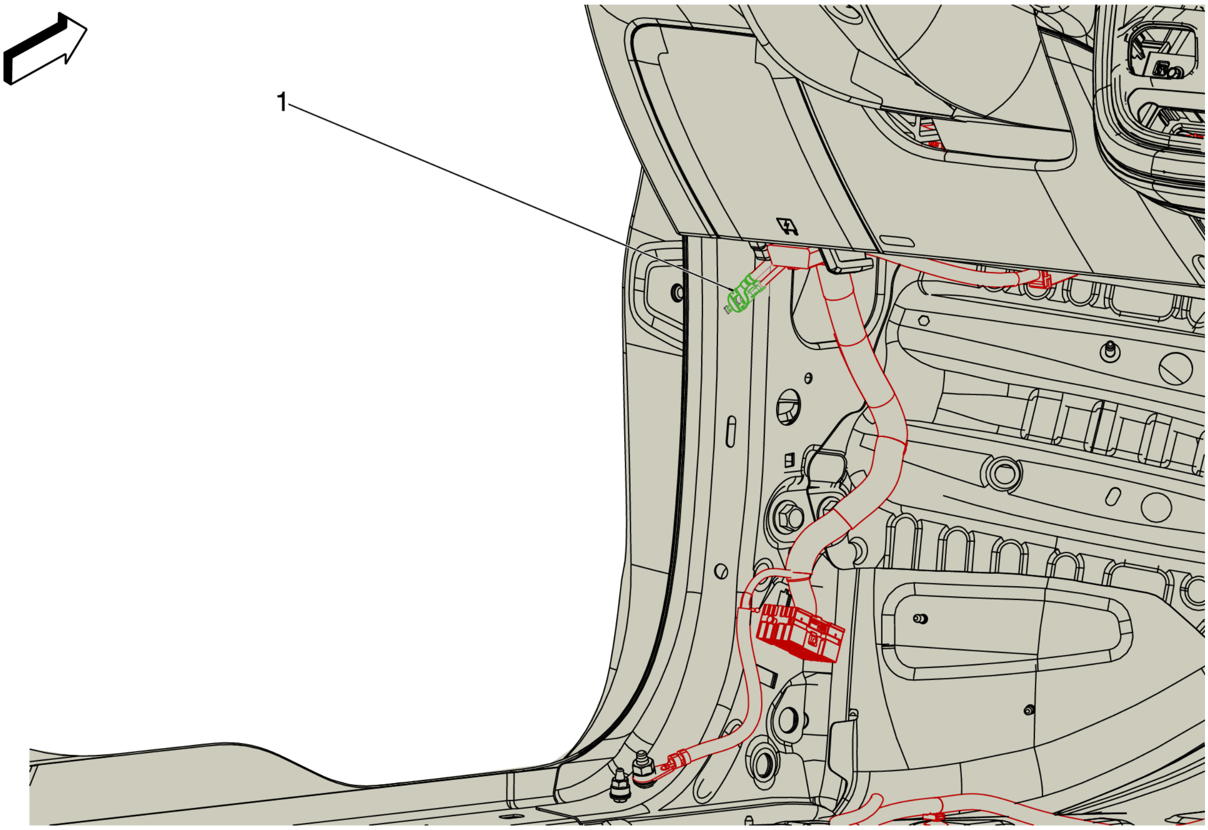


Fig. 13: G200
Courtesy of GENERAL MOTORS COMPANY

Items
1: G200 Instrument Panel Harness

G201 AND G304

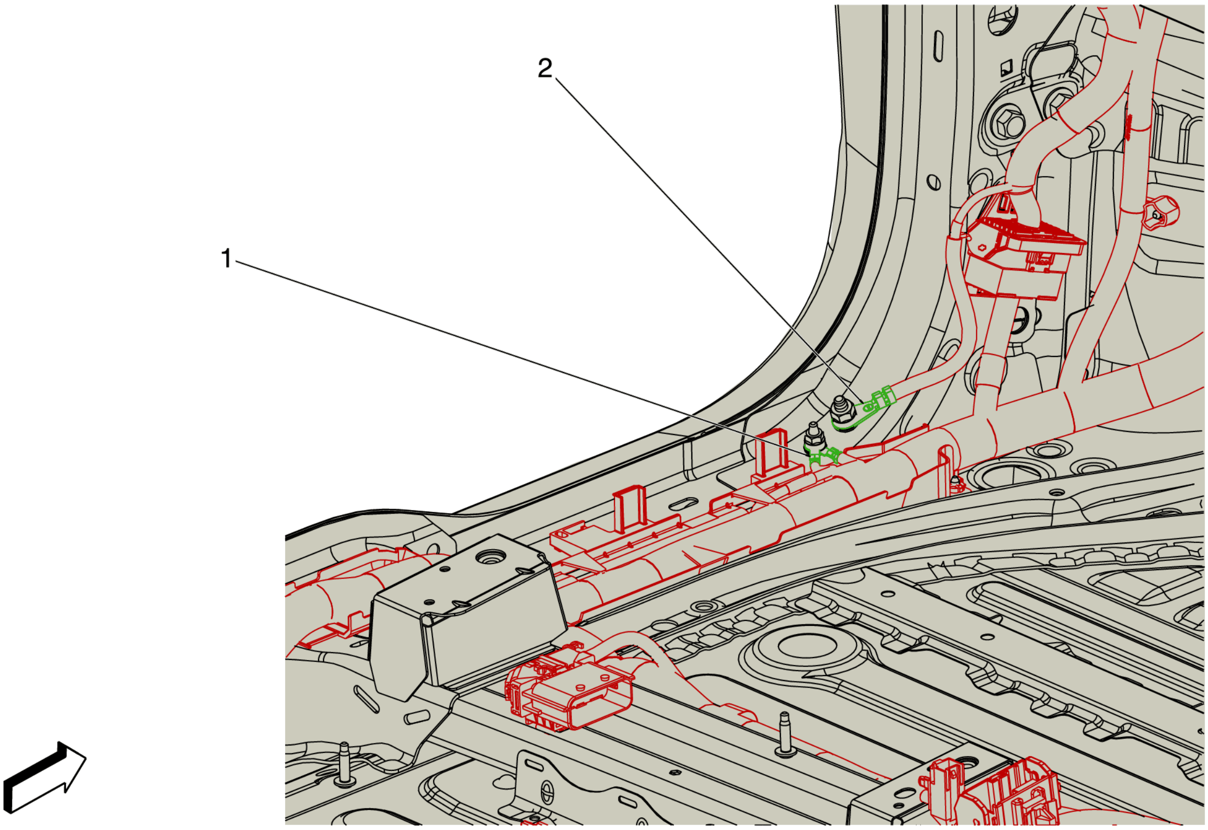


Fig. 14: G201 and G304
Courtesy of GENERAL MOTORS COMPANY

Items
1: G304 Body Harness
2: G201 Instrument Panel Harness

G202 AND G305

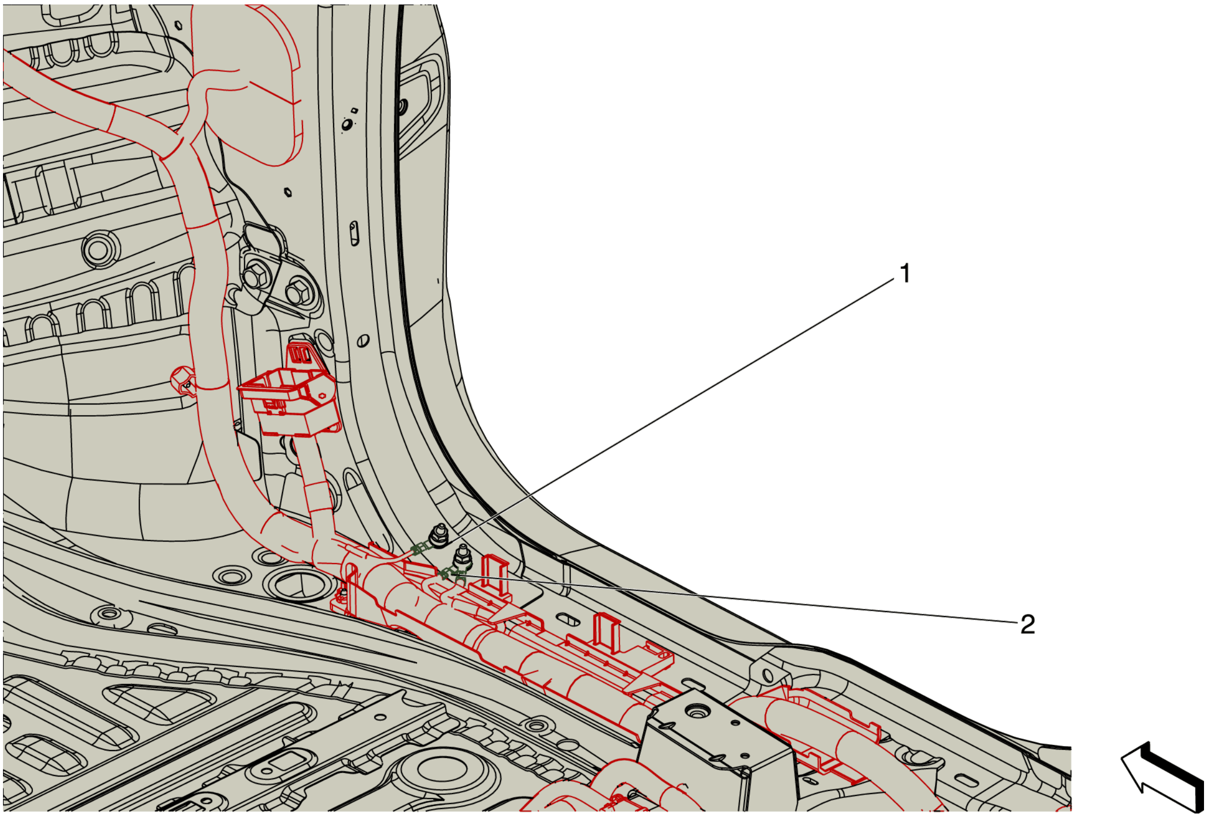


Fig. 15: G202 and G305
Courtesy of GENERAL MOTORS COMPANY

Items
1: G202 Instrument Panel Harness
2: G305 Body Harness

G310

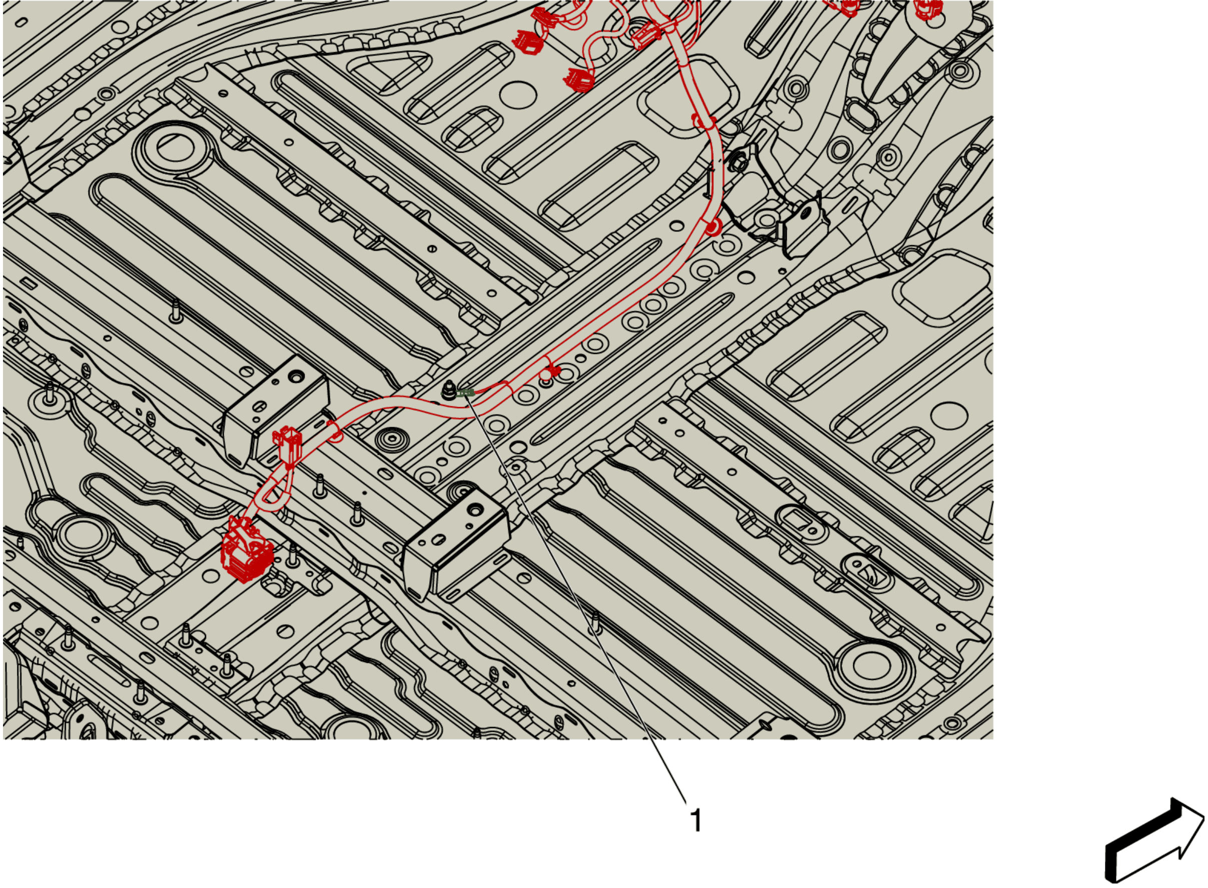


Fig. 16: G310

Courtesy of GENERAL MOTORS COMPANY

Items
1: G310 Instrument Panel Harness

G355, G356, G357 AND G358

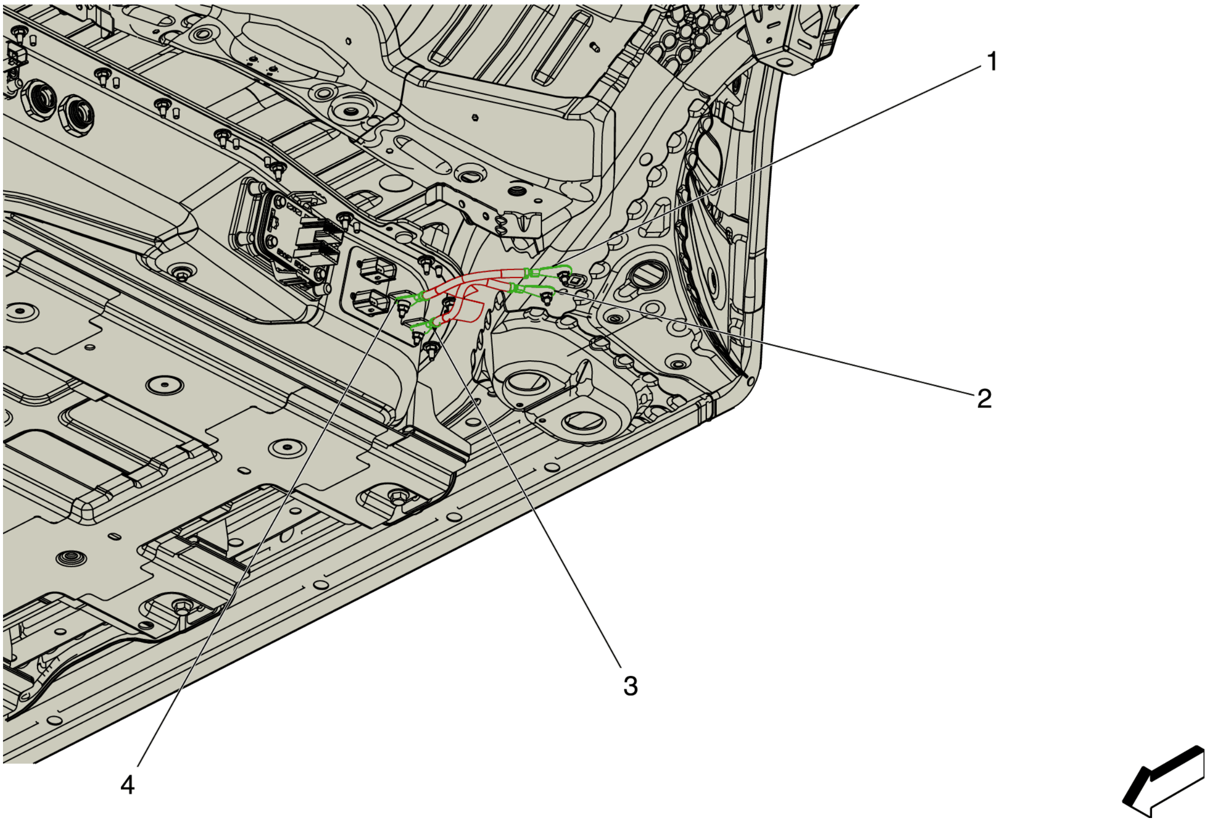


Fig. 17: G355, G356, G357 and G358

Courtesy of GENERAL MOTORS COMPANY

Items
1: G357 Ground Jumper Harness

Items
2: G355 Ground Jumper Harness
3: G356 Ground Jumper Harness
4: G358 Ground Jumper Harness

G401 AND G404

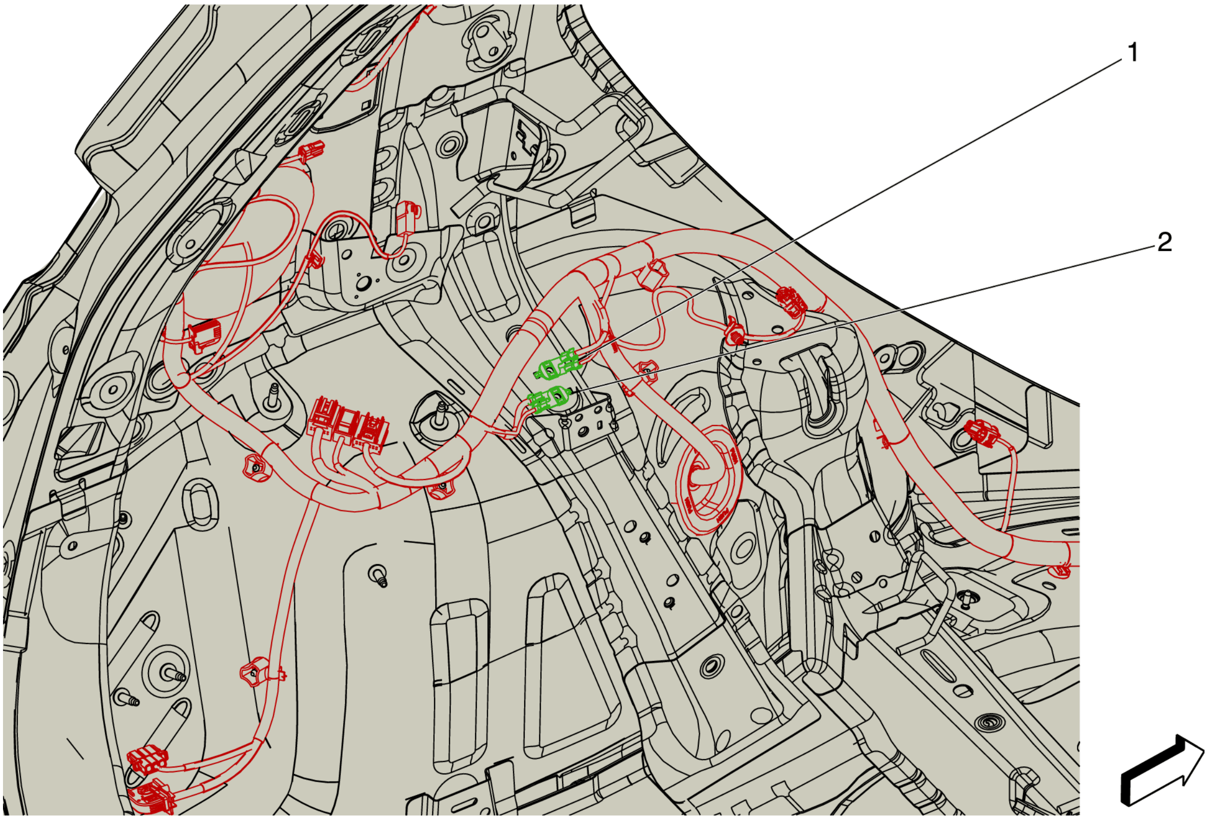


Fig. 18: G401 and G404
Courtesy of GENERAL MOTORS COMPANY

Items
1: G404 Body Harness
2: G401 Body Harness

G405

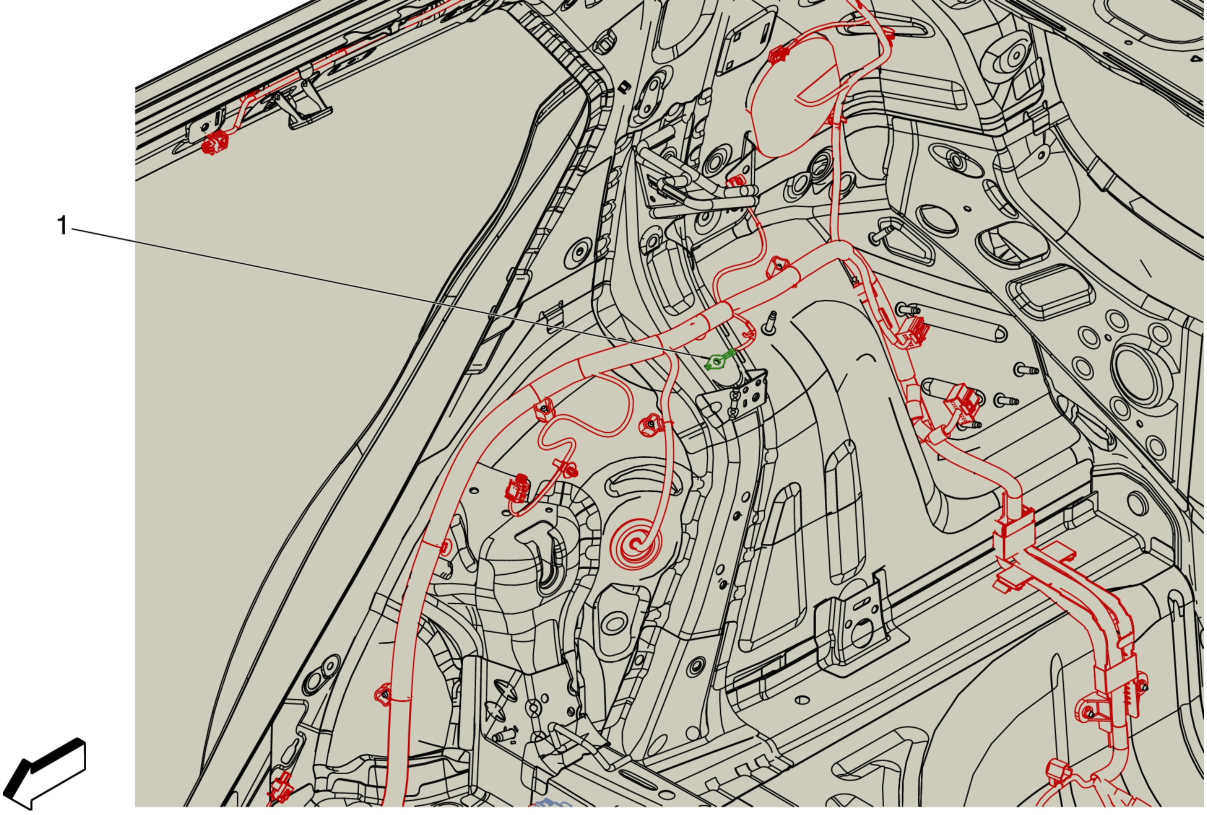


Fig. 19: G405
Courtesy of GENERAL MOTORS COMPANY

Items
1: G405 Body Harness

G900

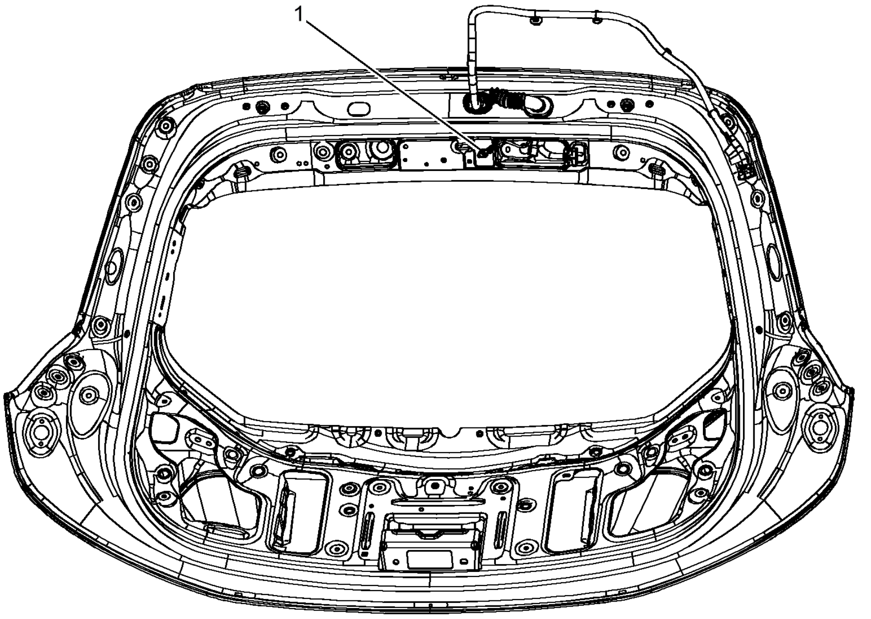
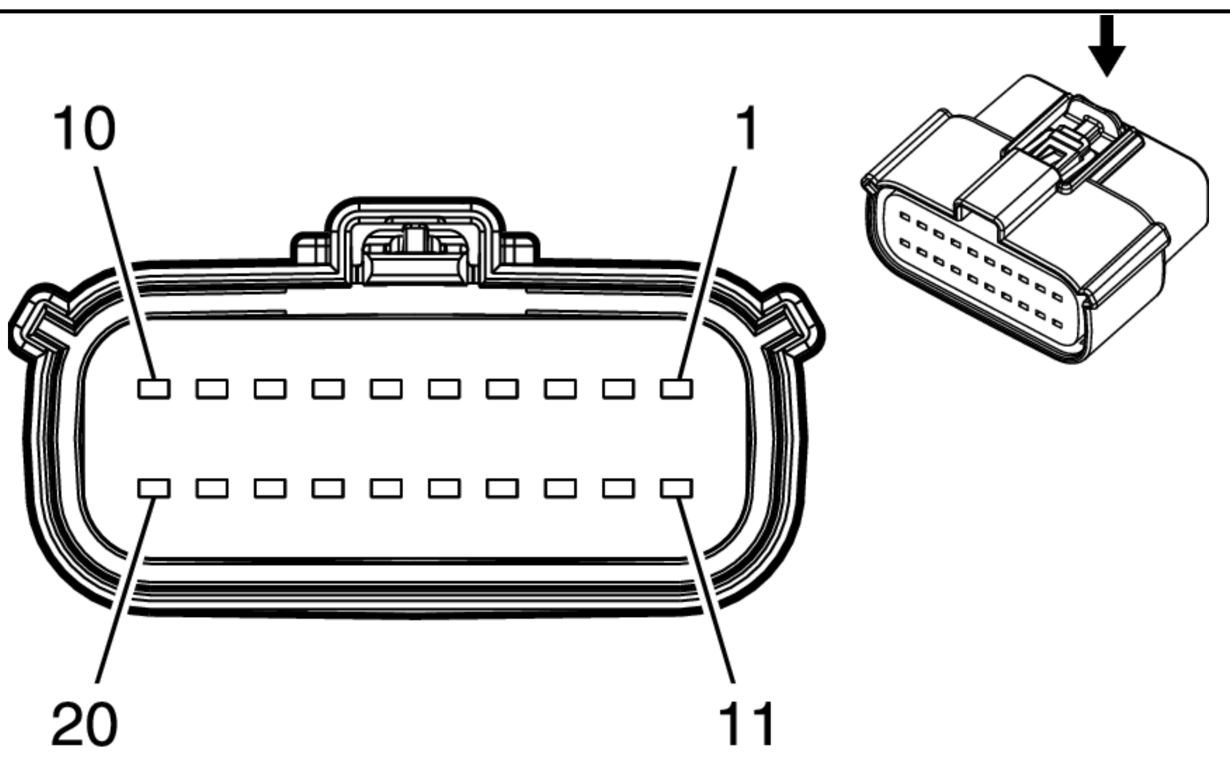


Fig. 20: G900
Courtesy of GENERAL MOTORS COMPANY

Items
1: G900 Liftgate Extention Harness

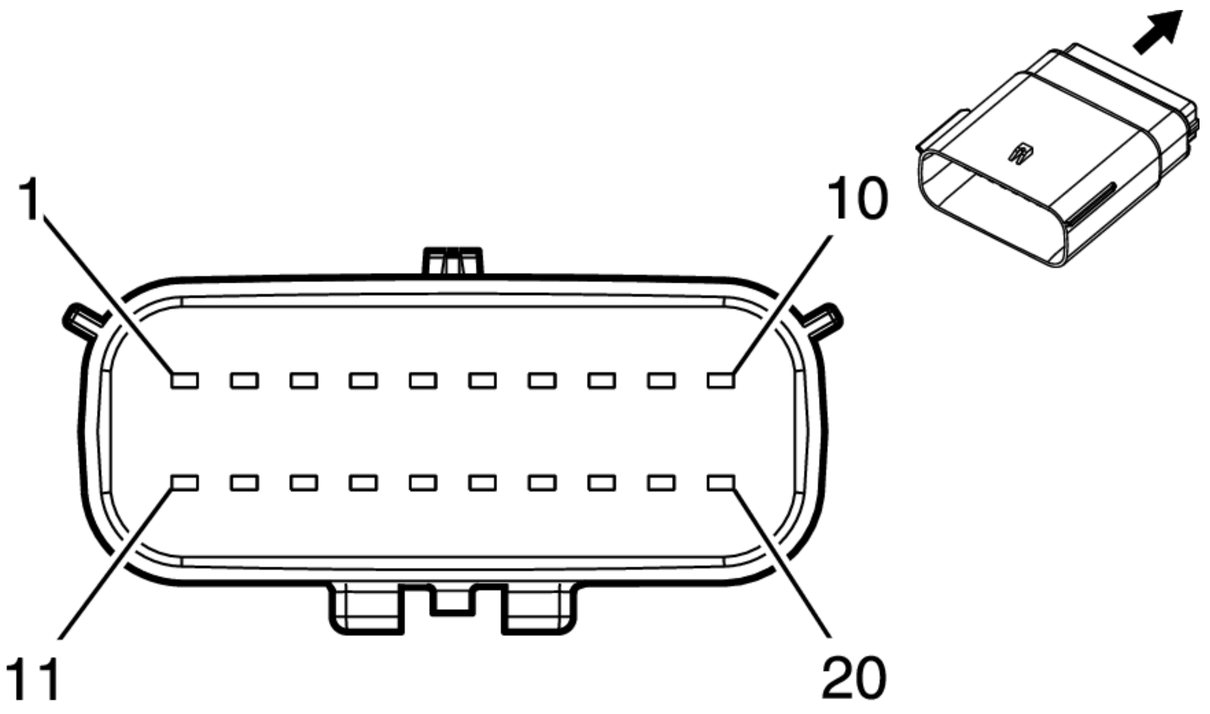
INLINE HARNESS CONNECTOR END VIEWS

X101 FORWARD LAMP HARNESS TO FRONT FASCIA HARNESS (UD5/UFQ/UVH)



Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 33472-2006
- Service Connector: 19300557
- Description: 20-Way F 150 MX Series, Sealed (BK)



Connector Part Information

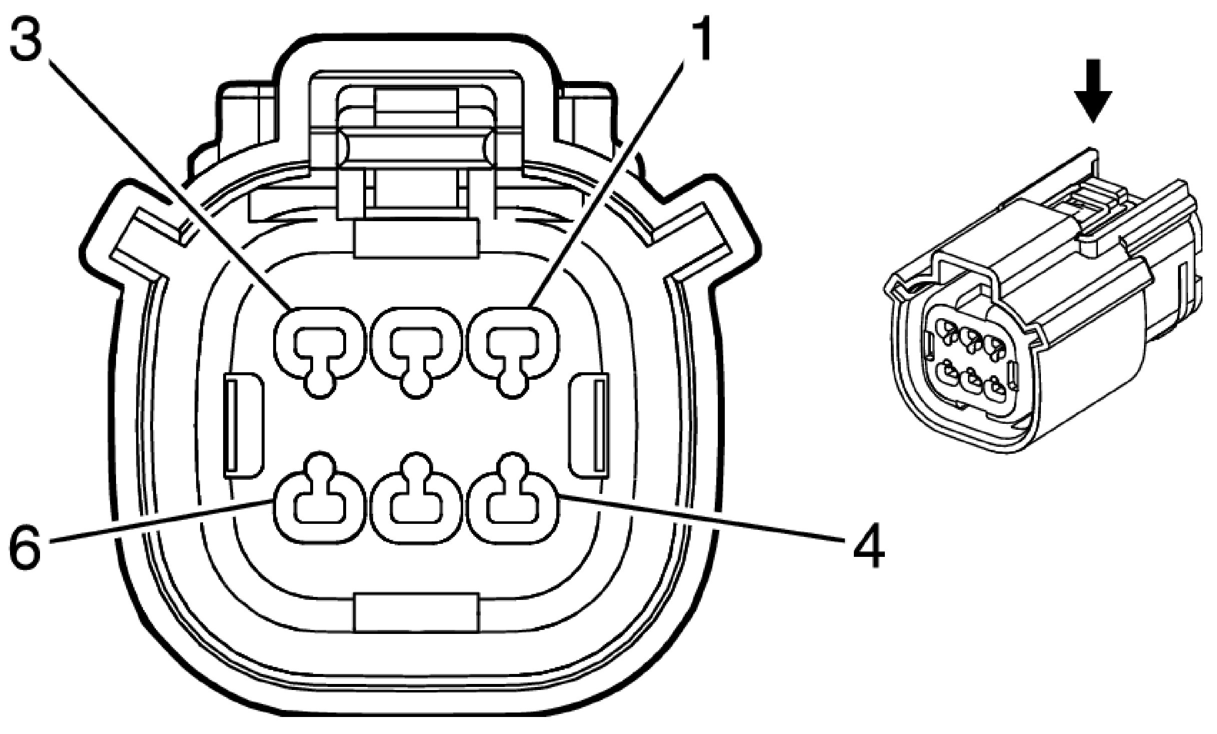
- Harness Type: Front Fascia
- OEM Connector: 33482-2101
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way M 1.5 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

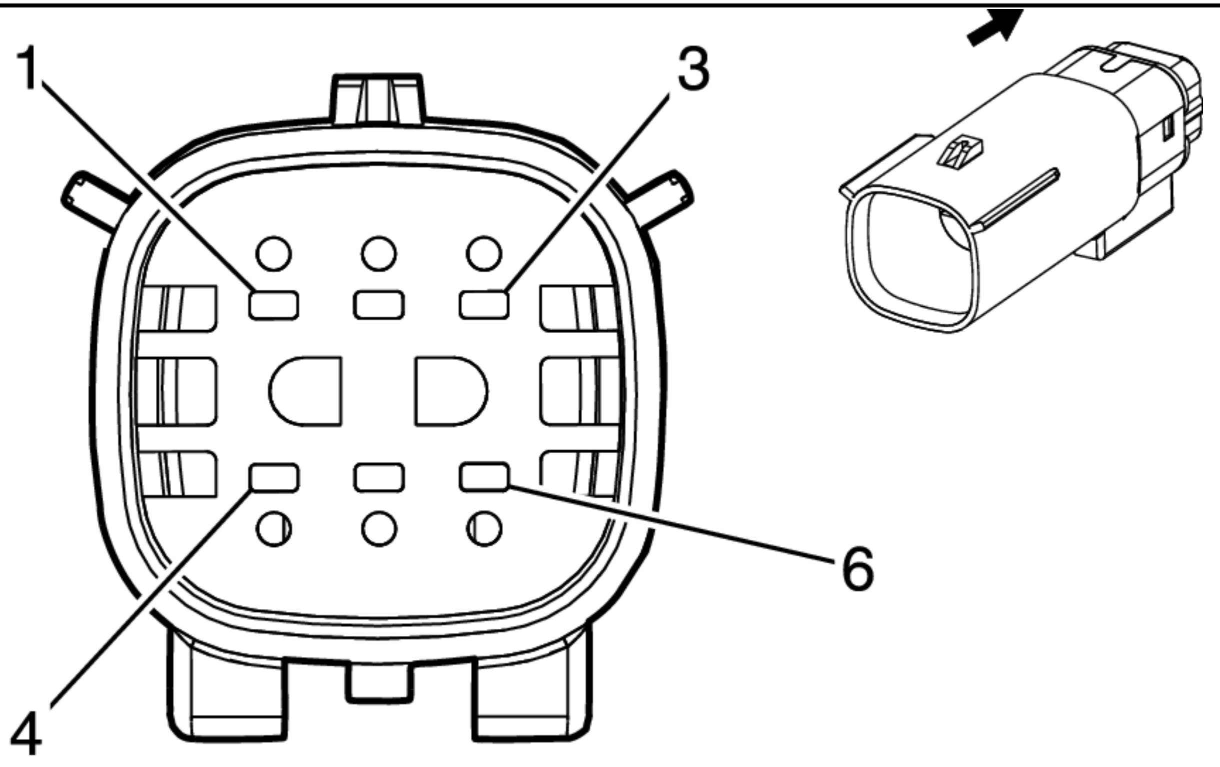
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Left Front Turn Signal Lamp Control	1	0.5	BU/WH	1314	II	UD5/UFQ/UVH
2	-	-	-	-	-	Ground	2	0.5	BK	50	II	UD5/UFQ/UVH
3	0.5	GN/VT	1315	I	-	Right Front Turn Signal Lamp Control	3	0.5	GN/VT	1315	II	UD5/UFQ/UVH
4	0.5	BK	250	I	-	Ground	4	0.5	BK	250	II	UD5/UFQ/UVH
5	-	-	-	-	-	Not Occupied	5	-	-	-	-	-
6	0.5	WH/BN	6201	I	UVH	Camera Control	6	0.5	WH/BN	6201	II	UVH
7	0.5	VT/GY	5218	I	UD5/UFQ	Front Parking Right Mid Sensor	7	0.5	VT/GY	5218	II	UD5/UFQ
8	0.5	WH/GY	5217	I	UD5/UFQ	Front Parking Right Corner Sensor	8	0.5	WH/GY	5217	II	UD5/UFQ
9	0.5	GN	3155	I	UFQ	Right Front Supplemental Object Sensor Signal	9	0.5	GN	3155	II	UFQ
10	0.5	BK/BU	5214	I	UD5/UFQ	Front Parking Sensor Low Reference	10	0.5	BK/BU	5214	II	UD5/UFQ
11	0.5	BK/BU	61	I	-	Outside Ambient Temperature Sensor Low Reference	11	0.5	BK/BU	61	II	UD5/UFQ/UVH
12	0.5	BU/GY	636	I	-	Outside Ambient Air Temperature Sensor Signal	12	0.5	BU/GY	636	II	UD5/UFQ/UVH
13	0.5	BN/BK	6202	I	UVH	Camera Ground	13	0.5	BN/BK	6202	II	UVH
14	0.5	BK/WH	2351	I	UVH	Signal Ground	14	0.5	BK/WH	2351	II	UVH
15	0.5	WH	2397	I	UVH	Front Vision Camera #1 Signal (+)	15	0.5	WH	2397	II	UVH
16	0.5	BU	2398	I	UVH	Front Vision Camera #1 Signal (-)	16	0.5	BU	2398	II	UVH
17	0.5	GY	3154	I	UFQ	Left Front Supplemental Object Sensor Signal	17	0.5	GY	3154	II	UFQ
18	0.5	VT/WH	5215	I	UD5/UFQ	Front Parking Left Corner Sensor	18	0.5	VT/WH	5215	II	UD5/UFQ
19	0.5	YE	5216	I	UD5/UFQ	Front Parking Left Mid Sensor	19	0.5	YE/GY	5216	II	UD5/UFQ
20	0.5	BN	6581	I	UD5/UFQ	Front Parking Aid Display Control	20	0.5	BN	6581	II	UD5/UFQ

X101 FORWARD LAMP HARNESS TO FRONT FASCIA HARNESS (-UD5/UFQ/UVH)



Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 33472-0606
- Service Connector: 13585853
- Description: 6-Way F 150 MX Series, Sealed (BK)



Connector Part Information

- Harness Type: Front Fascia
- OEM Connector: 33482-0601
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way M 150 MX Series, Sealed (BK)

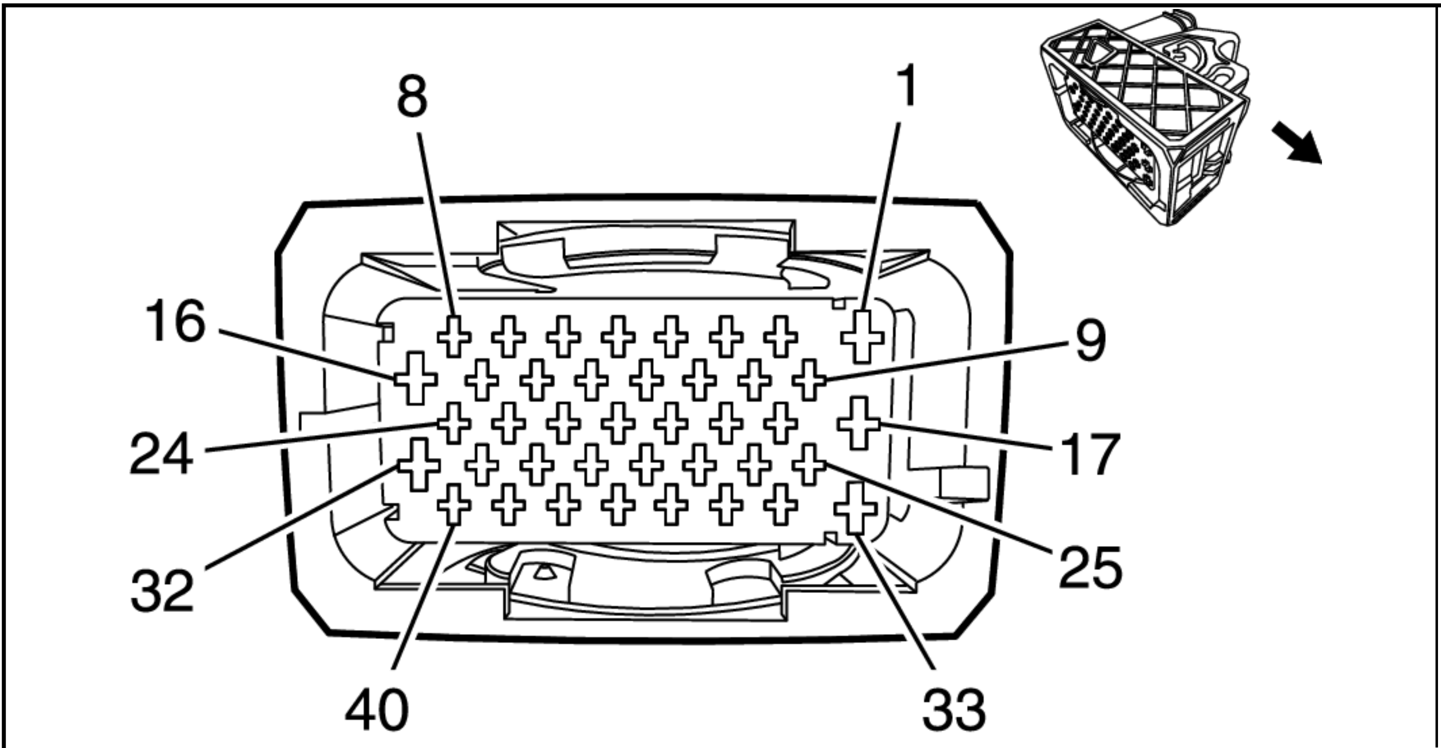
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

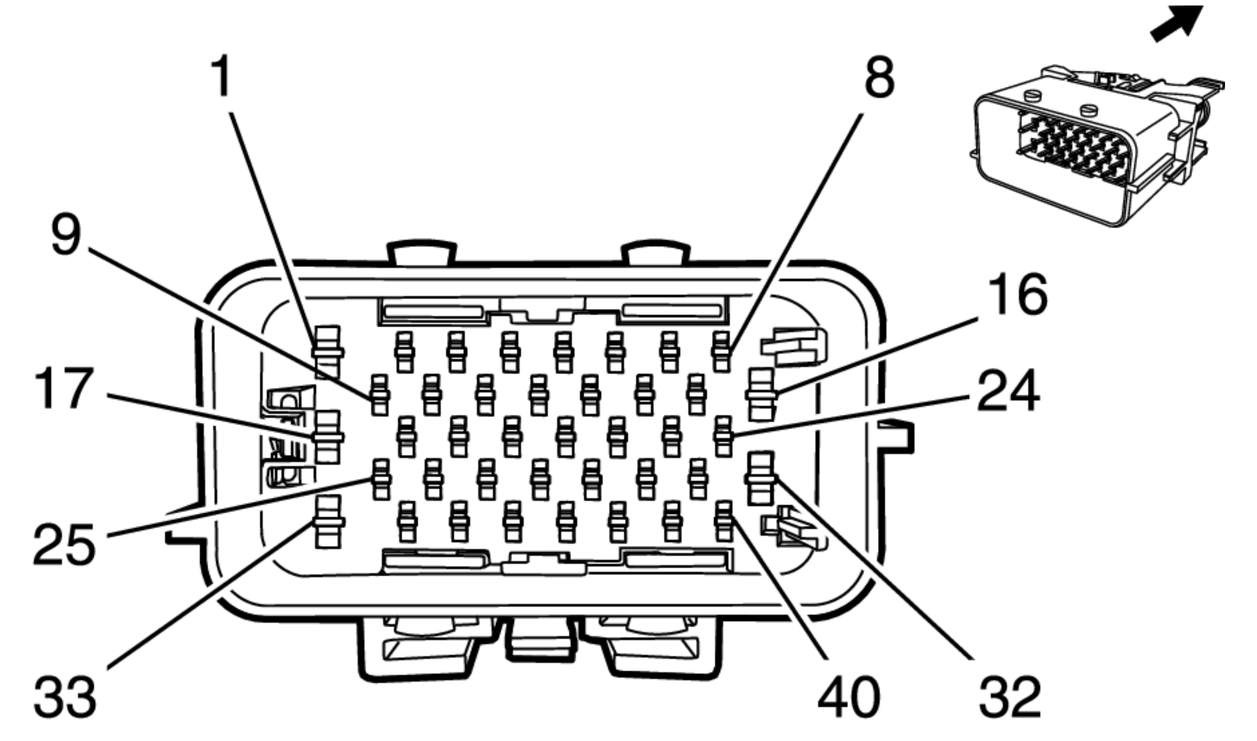
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BU/WH	1314	I	-	Left Front Turn Signal Lamp Control	1	0.5	BU/WH	1314	II	-
2	0.5	BK	50	I	-	Ground	2	0.5	BK	50	II	-
3	0.5	BK/BU	61	I	-	Outside Ambient Temperature Sensor Low Reference	3	0.5	BK/BU	61	II	-
4	0.5	GN/VT	1315	I	-	Right Front Turn Signal Lamp Control	4	0.5	GN/VT	1315	II	-
5	0.5	BK	250	I	-	Ground	5	0.5	BK	250	II	-
6	0.5	BU/GY	636	I	-	Outside Ambient Air Temperature Sensor Signal	6	0.5	BU/GY	636	II	-

X105 BODY HARNESS TO ENGINE HARNESS



Connector Part Information

- Harness Type: Body
- OEM Connector: 13603185
- Service Connector: 13576549
- Description: 40-Way F 1.5, 2.8 Series, Sealed (BK)



Connector Part Information

- Harness Type: Engine
- OEM Connector: 13603208
- Service Connector: 13576551
- Description: 40-Way M 1.5 DSQ, 2.8 ATS Series, Sealed (BK)

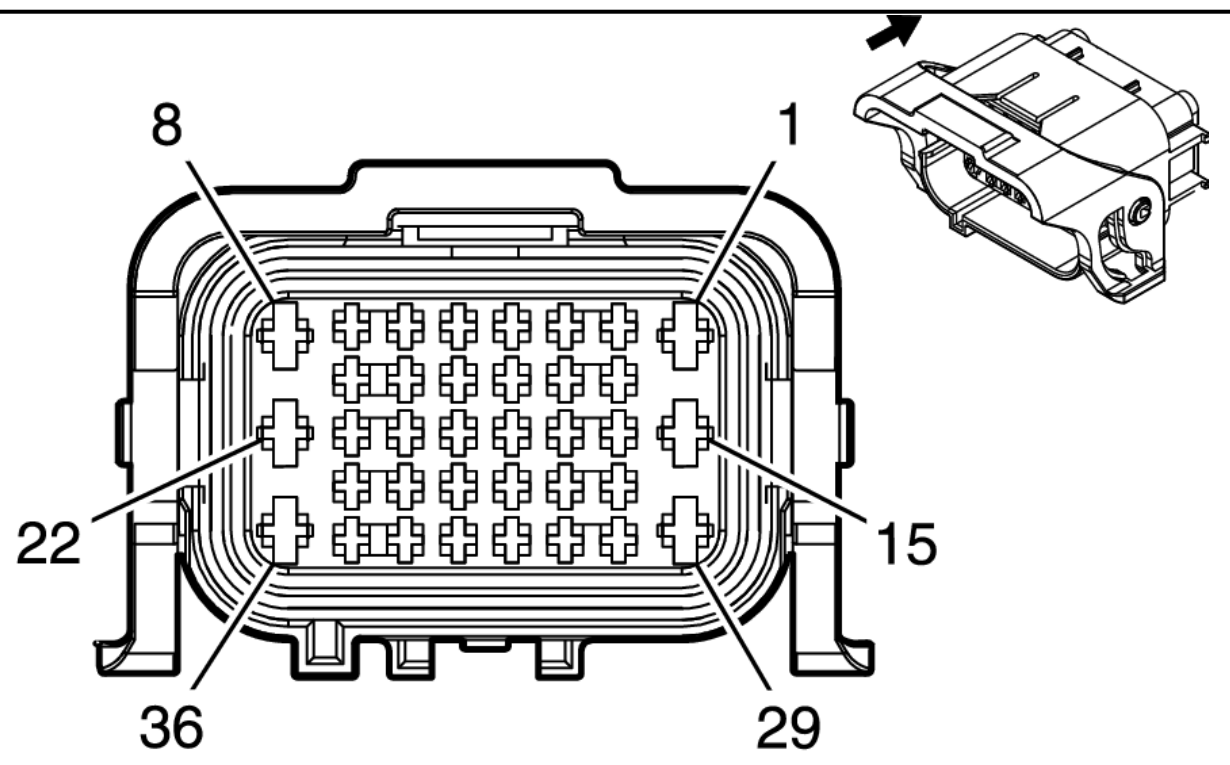
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576369	J-35616-14 (GN)	J-38125-560	Not Available	Not Available	Not Available	Not Available
II	13580834	J-35616-14 (GN)	J-38125-560	Not Available	Not Available	Not Available	Not Available
III	13575380	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	BU/RD	4331	I	CBT	High Power Contactor Signal Conditioner Voltage Reference	2	0.5	BU/RD	4331	III	CBT
3	0.5	GN	4330	I	CBT	High Power Contactor Positive Voltage Sense Signal	3	0.5	GN	4330	III	CBT
4	0.5	YE	4327	I	CBT	High Power Contactor Positive Relay Control	4	0.5	YE	4327	III	CBT
5	0.5	YE/BK	3000	I	-	Coolant Temperature Sensor 2 Signal	5	0.5	YE/BK	3000	III	-
6	0.5	BK/VT	5596	I	-	High Voltage Interlock Loop Low Reference 2	6	0.5	BK/VT	5596	III	-
7	0.5	BU/RD	474	I	-	5V Reference	7	0.5	BU/RD	474	III	-
8	-	-	-	-	-	Not Occupied	8	-	-	-	-	-
9	0.5	RD/YE	240	I	-	Battery Positive Voltage	9	0.5	RD/YE	240	III	-
10	0.5	BU/BK	7493	I	-	High Speed GMLAN Serial Data (+)3	10	0.5	BU/BK	7493	III	-
11	-	-	-	-	-	Not Occupied	11	-	-	-	-	-
12	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	12	0.5	BU	2500	III	-
13	0.5	YE/GY	3645	I	-	High Voltage Onboard Charging Control	13	0.5	YE/GY	3645	III	-
14	0.5	BU/YE	6105	I	-	High Speed GMLAN Serial Data (+) 2	14	0.5	BU/YE	6105	III	-
15	0.5	VT/WH	3643	I	-	High Voltage Onboard Charging DC Voltage Sense Signal	15	0.5	VT/WH	3643	III	-
16 - 18	-	-	-	-	-	Not Occupied	16 - 18	-	-	-	-	-
19	0.5	WH	7494	I	-	High Speed GMLAN Serial Data (-)3	19	0.5	WH	7494	III	-
20	0.5	GN/BU	4626	I	-	Local Interconnect Network Serial Data Bus 26	20	0.5	GN/BU	4626	III	-
21	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	21	0.5	WH	2501	III	-
22	-	-	-	-	-	Not Occupied	22	-	-	-	-	-
23	0.5	WH	6106	I	-	High Speed GMLAN Serial Data (-) 2	23	0.5	WH	6106	III	-
24	0.5	BU	204	I	-	A/C Low Pressure Sensor Signal	24	0.5	BU	204	III	-
25	0.5	RD/VT	340	I	-	Battery Positive Voltage	25	0.5	RD/VT	340	III	-
26	-	-	-	-	-	Not Occupied	26	-	-	-	-	-
27	0.5	VT	4334	I	-	Battery Pack Coolant Heater Control	27	0.5	VT	4334	III	-
28	-	-	-	-	-	Not Occupied	28	-	-	-	-	-
29	0.5	BU/YE	3646	I	-	High Voltage Onboard Charging Enable	29	0.5	BU/YE	3646	III	-
30	-	-	-	-	-	Not Occupied	30	-	-	-	-	-
31	0.5	GN/GY	3644	I	-	High Voltage Onboard Charging AC Voltage Sense Signal	31	0.5	GN/GY	3644	III	-
32 - 33	-	-	-	-	-	Not Occupied	32 - 33	-	-	-	-	-
34	0.5	BK/BN	4332	I	CBT	High Power Contactor Signal Conditioner Low Reference	34	0.5	BK/BN	4332	III	CBT

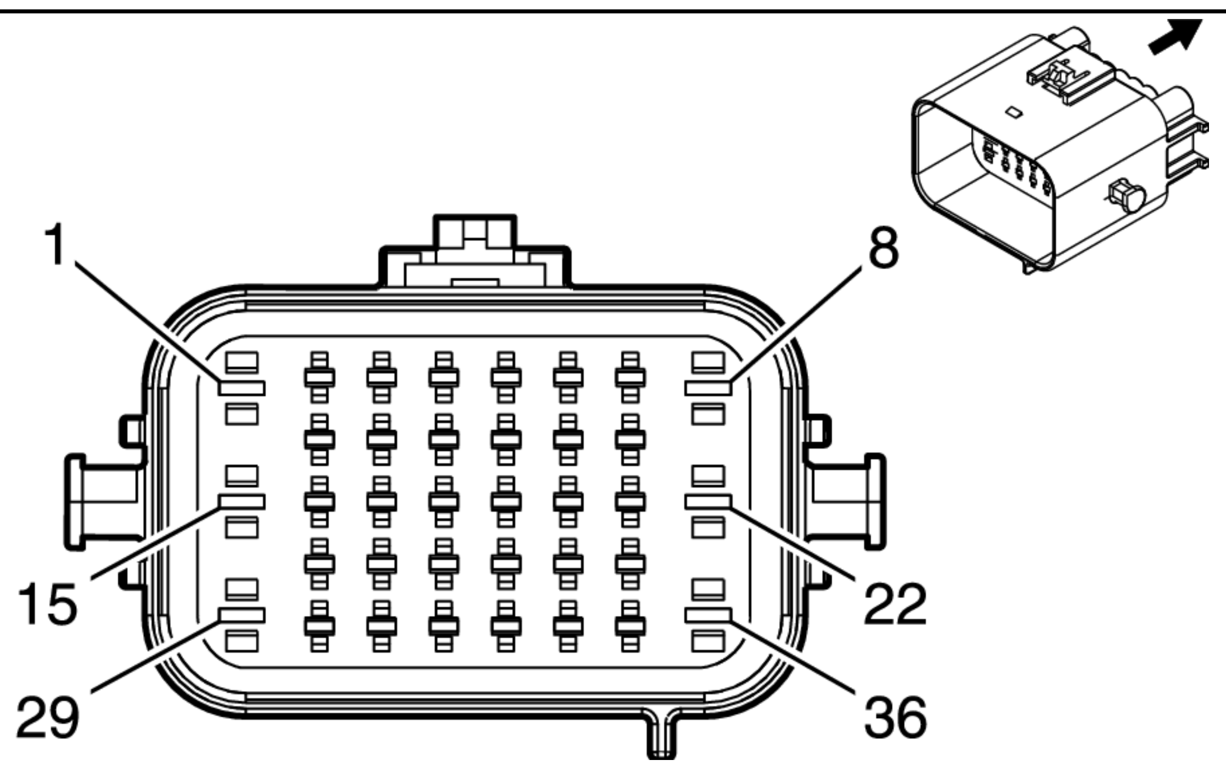
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
35	0.5	GY	4329	I	CBT	High Power Contactor Ground Voltage Sense Signal	35	0.5	GY	4329	III	CBT
36	0.5	BU/GY	4326	I	CBT	High Power Contactor Ground Relay Control	36	0.5	BU/GY	4326	III	CBT
37	0.5	BK/BU	6813	I	-	Coolant Temperature Sensor 2 Low Reference	37	0.5	BK/BU	6813	III	-
38	0.5	GY/VT	5595	I	-	High Voltage Interlock Loop Signal 2	38	0.5	GY/VT	5595	III	-
39	0.5	BK/GN	3800	I	-	A/C Refrigerant Sensor Low Reference	39	0.5	BK/GN	3800	III	-
40	0.75	WH	2368	II	-	Cooling Fan Control Signal	40	0.75	WH	2368	III	-

X106 BODY HARNESS TO ENGINE HARNESS



Connector Part Information

- Harness Type: Body
- OEM Connector: 1743059-2
- Service Connector: 13580088
- Description: 36-Way F Micro-Timer II, Junior Power Timer Series (BK)



Connector Part Information

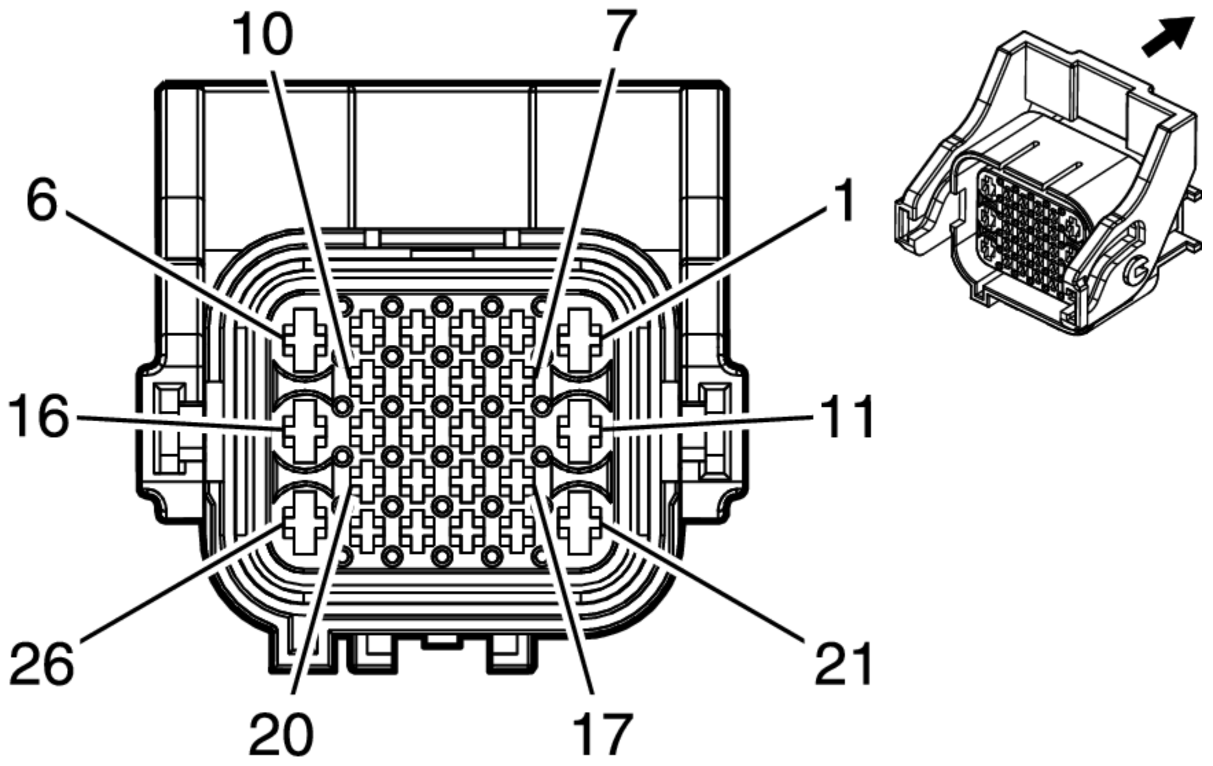
- Harness Type: Engine
- OEM Connector: 1743062-2
- Service Connector: 13580089
- Description: 36-Way M Micro-Timer II, Junior Power Timer Hybrid Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576368	J-35616-14 (GN)	J-38125-560	4-969005-1	Lear 16	E	1
II	13581378	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2

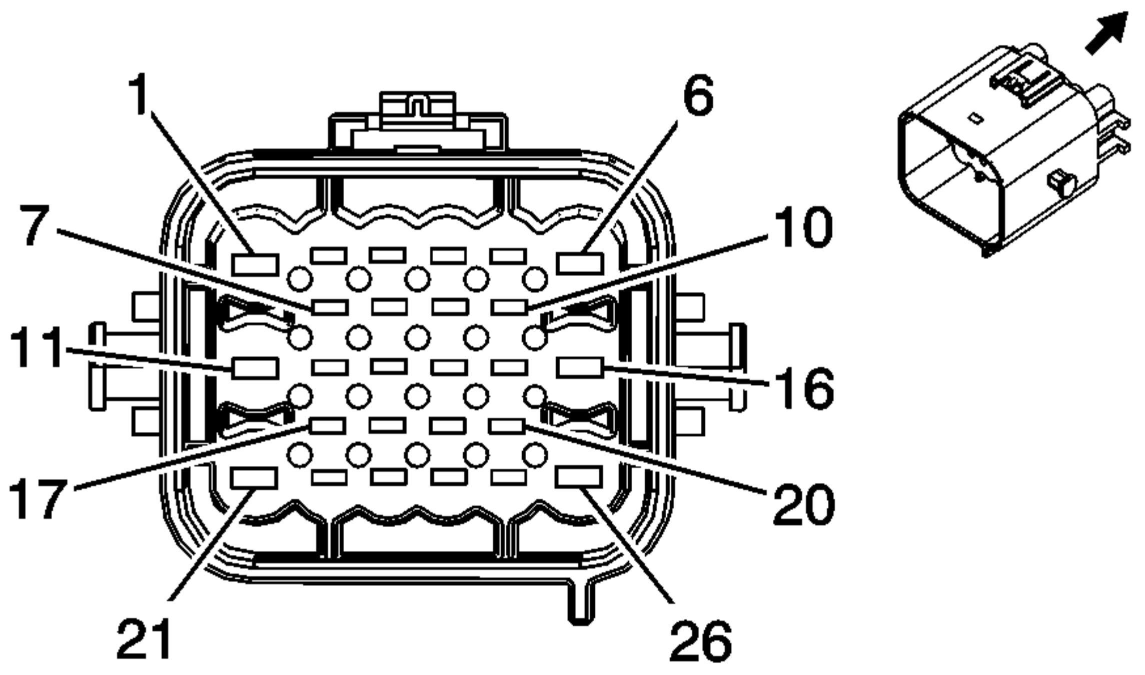
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	WH/GN	5380	I	-	Brake Position Sensor Signal	2	0.5	WH/GN	5380	II	-
3	0.5	WH/RD	5381	I	-	Brake Position Sensor 5V Reference	3	0.5	WH/RD	5381	II	-
4	0.5	BK/YE	5382	I	-	Brake Position Sensor Low Reference	4	0.5	BK/YE	5382	II	-
5	0.5	WH/BU	6311	I	-	Cruise/ETC/TCC Brake Signal	5	0.5	WH/BU	6311	II	-
6 - 9	-	-	-	-	-	Not Occupied	6 - 9	-	-	-	-	-
10	0.5	BU/VT	2364	I	-	Cooling Fan Speed Signal	10	0.5	BU/VT	2364	II	-
11	0.5	WH/GN	3794	I	-	Rechargeable Energy Storage System 1 Coolant Motor Control	11	0.5	WH/GN	3794	II	-
12	0.5	BU/VT	3795	I	-	Rechargeable Energy Storage System 1 Coolant Motor Control	12	0.5	BU/VT	3795	II	-
13	0.5	YE/GY	3796	I	-	Rechargeable Energy Storage System 1 Coolant Motor Feedback Signal	13	0.5	YE/GY	3796	II	-
14	0.5	RD/WH	2740	I	-	Battery Positive Voltage	14	0.5	RD/WH	2740	II	-
15	-	-	-	-	-	Not Occupied	15	-	-	-	-	-
16	0.5	YE/WH	1161	I	-	Accelerator Pedal Position Signal 1	16	0.5	YE/WH	1161	II	-
17	0.5	GN/WH	1162	I	-	Accelerator Pedal Position Signal 2	17	0.5	GN/WH	1162	II	-
18	0.5	WH/RD	1164	I	-	Accelerator Pedal Position 5V Reference 1	18	0.5	WH/RD	1164	II	-
19	0.5	BK/BU	1271	I	-	Accelerator Pedal Position Low Reference 1	19	0.5	BK/BU	1271	II	-
20	0.5	BK/VT	1272	I	-	Accelerator Pedal Position Low Reference 2	20	0.5	BK/VT	1272	II	-
21	0.5	BN/RD	1274	I	-	Accelerator Pedal Position 5V Reference 2	21	0.5	BN/RD	1274	II	-
22	-	-	-	-	-	Not Occupied	22	-	-	-	-	-
23	0.5	BN/BU	3788	I	-	Electric Coolant Motor Control	23	0.5	BN/BU	3788	II	-
24	0.5	YE/GN	3789	I	-	Electric Coolant Motor Control	24	0.5	YE/GN	3789	II	-
25	0.5	VT/BU	3790	I	-	Electric Coolant Motor Feedback Signal	25	0.5	VT/BU	3790	II	-
26	0.5	BU/YE	6105	I	-	High Speed GMLAN Serial Data (+) 2	26	0.5	BU/YE	6105	II	-
27	0.5	WH	6106	I	-	High Speed GMLAN Serial Data (-) 2	27	0.5	WH	6106	II	-
28	0.5	BK	650	I	-	Ground	28	-	-	-	-	-
29	-	-	-	-	-	Not Occupied	29	-	-	-	-	-
30	0.5	WH/VT	2246	I	-	Driver Illumination Lamp #1 Control	30	-	-	-	-	-
31 - 36	-	-	-	-	-	Not Occupied	31 - 36	-	-	-	-	-

X107 BODY HARNESS TO FORWARD LAMP HARNESS



Connector Part Information

- Harness Type: Body
- OEM Connector: 1897009-2
- Service Connector: 13579377
- Description: 26-Way F 1.5 Micro-Timer 2, 2.8 Junior Power Timer Series, Sealed (BK)



Connector Part Information

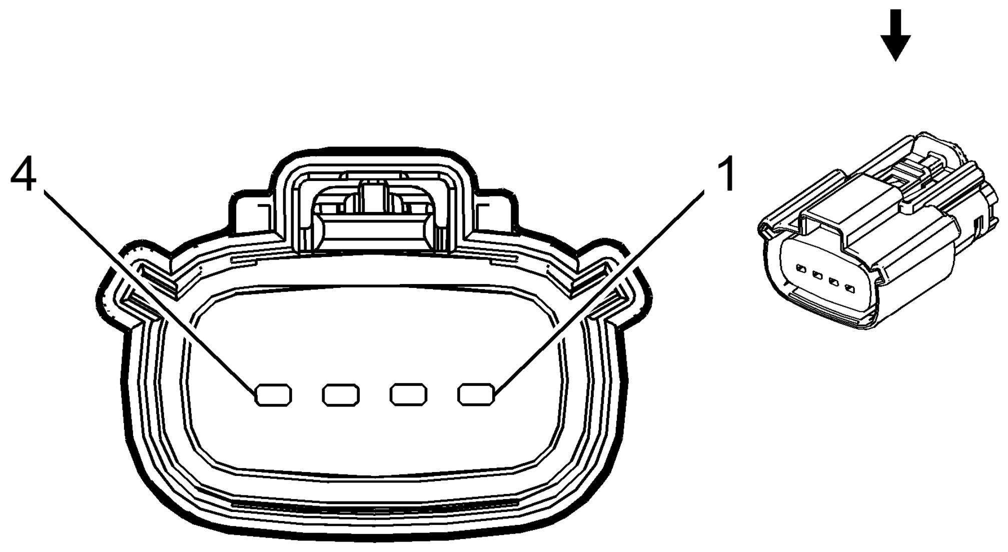
- Harness Type: Forward Lamp
- OEM Connector: 1897013-2
- Service Connector: 13579378
- Description: 26-Way M Micro-Timer II, Junior Power Timer Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576368	J-35616-14 (GN)	J-38125-560	4-969005-1	Lear 16	E	1
II	19301414	J-35616-35 (VT)	J-38125-36	4-964286-1	Lear 16	E	1
III	13575350	J-35616-5 (PU)	J-38125-36	1-962915-3	Yazaki 15	E	1
IV	13581378	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2

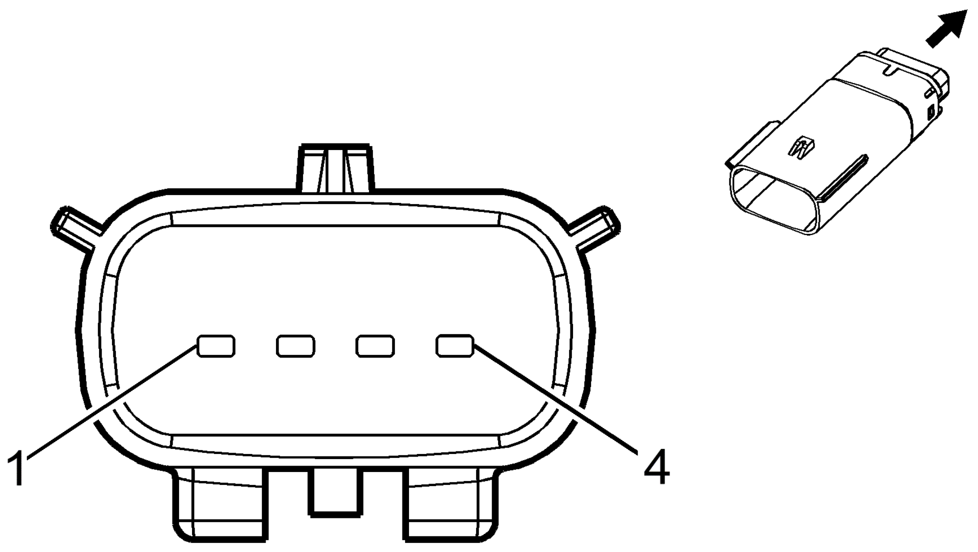
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	YE	712	II	-	Left Headlamp Low Beam Control	1	0.5	YE	712	III	-
2	0.35	BN	6581	I	UD5/UFQ	Front Parking Aid Display Control	2	0.5	BN	6581	IV	UD5/UFQ
3	0.35	GY	3154	I	UFQ	Left Front Supplemental Object Sensor Signal	3	0.5	GY	3154	IV	UFQ
4	0.35	VT/WH	5215	I	UD5/UFQ	Front Parking Left Corner Sensor	4	0.5	VT/WH	5215	IV	UD5/UFQ
5	0.35	YE/GY	5216	I	UD5/UFQ	Front Parking Left Mid Sensor	5	0.5	YE	5216	IV	UD5/UFQ
6	0.5	YE	312	II	-	Right Headlamp Low Beam Control	6	0.5	YE	312	III	-
7	0.35	VT/GY	5218	I	UD5/UFQ	Front Parking Right Mid Sensor	7	0.5	VT/GY	5218	IV	UD5/UFQ
8	0.35	WH/GY	5217	I	UD5/UFQ	Front Parking Right Corner Sensor	8	0.5	WH/GY	5217	IV	UD5/UFQ
9	0.35	GN	3155	I	UFQ	Right Front Supplemental Object Sensor Signal	9	0.5	GN	3155	IV	UFQ
10	0.35	BK/BU	5214	I	UD5/UFQ	Front Parking Sensor Low Reference	10	0.5	BK/BU	5214	IV	UD5/UFQ
11	0.5	BK/BU	61	II	-	Outside Ambient Temperature Sensor Low Reference	11	0.5	BK/BU	61	III	-
12	0.5	GY/WH	7064	I	-	Wheel Speed Sensor Control Left Front	12	0.5	GY/WH	7064	IV	-
13	0.5	GY	830	I	-	Wheel Speed Sensor Signal Left Front	13	0.5	GY	830	IV	-
14	0.5	YE	5530	I	-	Hood Open Switch Signal	14	0.5	YE	5530	IV	-
15	0.5	BN/GN	109	I	-	Hood Ajar Switch Signal	15	0.5	BN/GN	109	IV	-
16	0.5	BU/GY	636	II	-	Outside Ambient Air Temperature Sensor Signal	16	0.5	BU/GY	636	III	-
17	0.5	BU/YE	68	I	-	Low Coolant Level Indicator Control	17	0.5	BU/YE	68	IV	-
18	0.5	BK/GN	476	I	-	Sensor Low Reference	18	0.5	BK/GN	476	IV	-
19	-	-	-	-	-	Not Occupied	19	-	-	-	-	-
20	0.35	BK/WH	2351	I	UVH	Signal Ground	20	0.35	BK/WH	2351	IV	UVH
21	-	-	-	-	-	Not Occupied	21	-	-	-	-	-
22	0.35	WH/BN	6201	I	UVH	Camera Control	22	0.5	WH/BN	6201	IV	UVH
23	0.35	BN/BK	6202	I	UVH	Camera Ground	23	0.5	BN/BK	6202	IV	UVH
24	0.35	BU	2398	I	UVH	Front Vision Camera #1 Signal (-)	24	0.5	BU	2398	IV	UVH
25	0.35	WH	2397	I	UVH	Front Vision Camera #1 Signal (+)	25	0.5	WH	2397	IV	UVH
26	-	-	-	-	-	Not Occupied	26	-	-	-	-	-

X108 BODY HARNESS TO FORWARD LAMP HARNESS



Connector Part Information

- Harness Type: Body
- OEM Connector: 33471-0406
- Service Connector: 13577535
- Description: 4-Way F 1.5 Series, Sealed (BK)



Connector Part Information

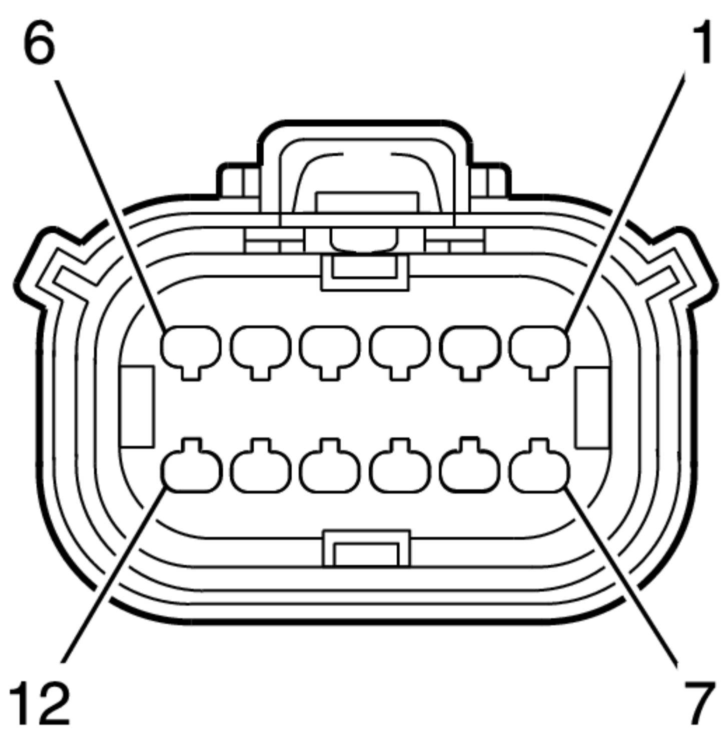
- Harness Type: Forward Lamp
- OEM Connector: 33481-0401
- Service Connector: 19330690
- Description: 4-Way M 1.5 Series, Sealed (BK)

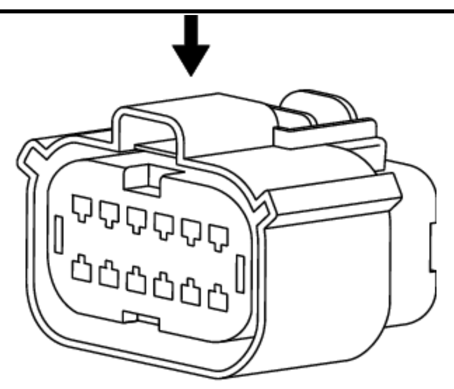
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	OG/YE	354	I	AYF	Left Front Discriminating Sensor Signal	1	0.5	OG/YE	354	II	AYF
2	0.5 0.5	OG/GY BK/OG	6618 5045	I I	AY0+MBM AYF	Middle Front Discriminating Sensor Signal Left Front Discriminating Sensor Low Reference	2	0.5 0.5	OG/GY BK/OG	6618 5045	II II	AY0 AYF
3	0.5 0.5	BK/OG OG/GN	6619 1409	I I	AY0+MBM AYF	Middle Front Discriminating Sensor Low Reference Right Front Discriminating Sensor Signal	3	0.5 0.5	BK/OG OG/GN	6619 1409	II II	AY0 AYF
4	0.5	BK/OG	5600	I	AYF	Right Front Discriminating Sensor Low Reference	4	0.5	BK/OG	5600	II	AYF

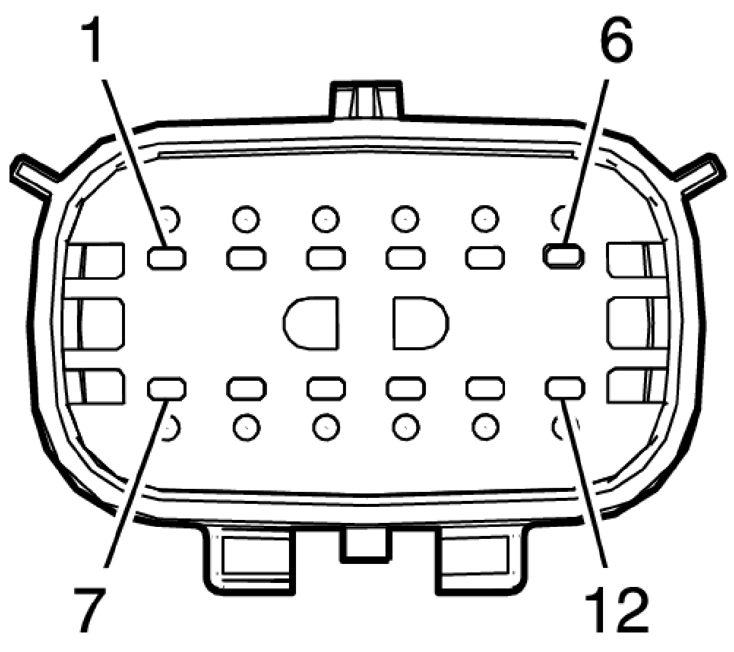
X110 FORWARD LAMP HARNESS TO LEFT HEADLAMP HARNESS (TR6)

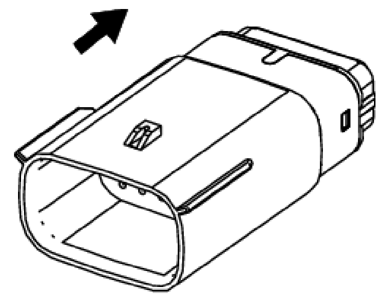




Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 33472-1251
- Service Connector: 13503528
- Description: 12-Way F 150 MX Series, Sealed (BK)





Connector Part Information

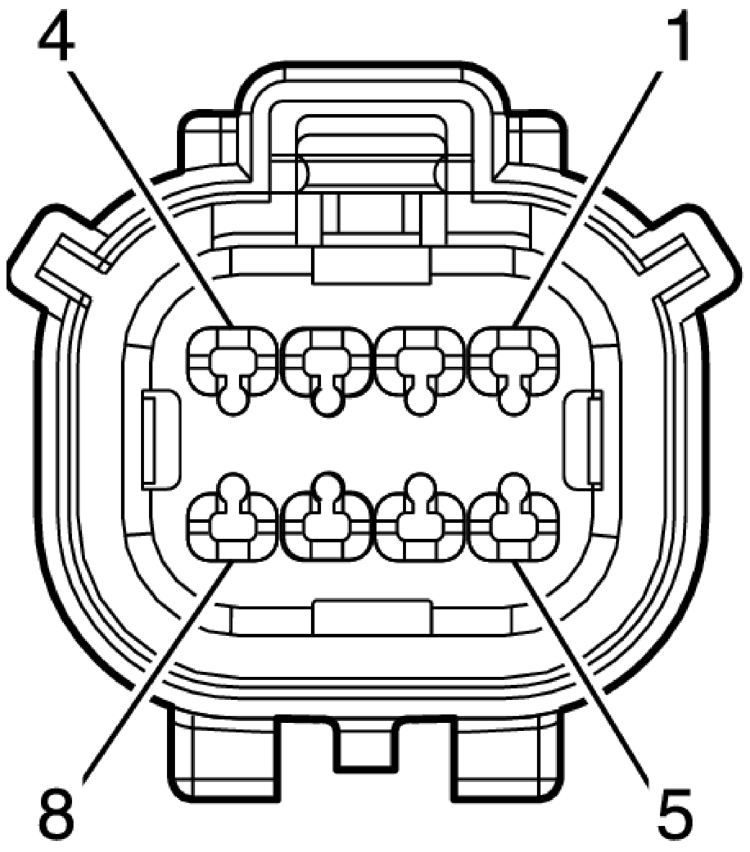
- Harness Type: Left Headlamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way M

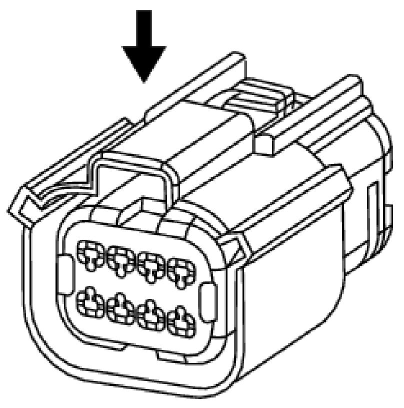
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575808	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
III	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	YE	712	I	TR6	Left Headlamp Low Beam Control	1	0.75	YE	712	III	TR6
2	0.5	WH	711	II	TR6	Left Headlamp High Beam Control	2	0.5	WH	711	III	TR6
3	0.5	YE	712	II	TR6	Left Headlamp Low Beam Control	3	0.5	YE	712	III	TR6
4	0.5	VT/GY	709	II	TR6	Left Park Lamp Control	4	0.5	VT/GY	709	III	TR6
5	0.5	VT/WH	239	II	TR6	Run/Crank Ignition 1 Voltage	5	0.5	VT/WH	239	III	TR6
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-
7	0.75	BK	50	I	TR6	Ground	7	0.75	BK	50	III	TR6
8	0.5	BK	50	II	TR6	Ground	8	0.5	BK	50	III	TR6
9	0.5	BK	50	II	TR6	Ground	9	0.5	BK	50	III	TR6
10	0.5	BK	50	II	TR6	Ground	10	0.5	BK	250	III	TR6
11	0.5	BN/YE	189	II	TR6	Headlamp Leveling Motor Control	11	0.5	BN/YE	189	III	TR6
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-

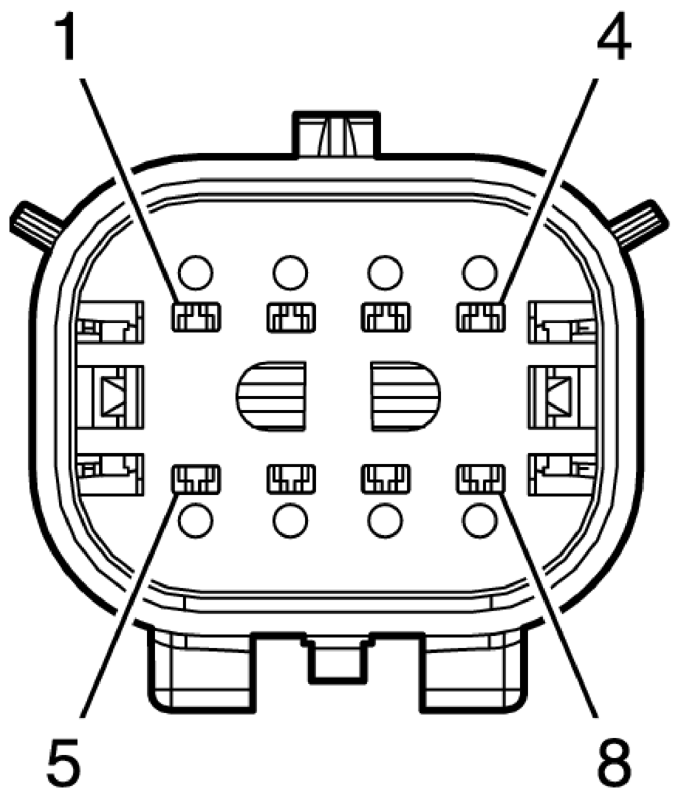
X110 FORWARD LAMP HARNESS TO LEFT HEADLAMP HARNESS (-TR6)

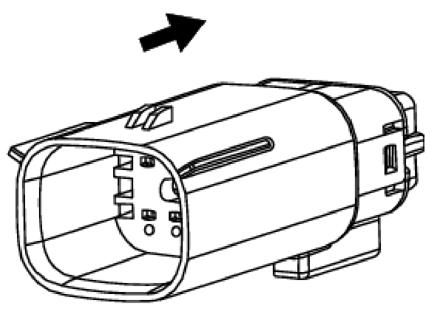




Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 33472-0901
- Service Connector: 13587959
- Description: 8-Way F 150 MX Series, Sealed (BK)





Connector Part Information

- Harness Type: Left Headlamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way M

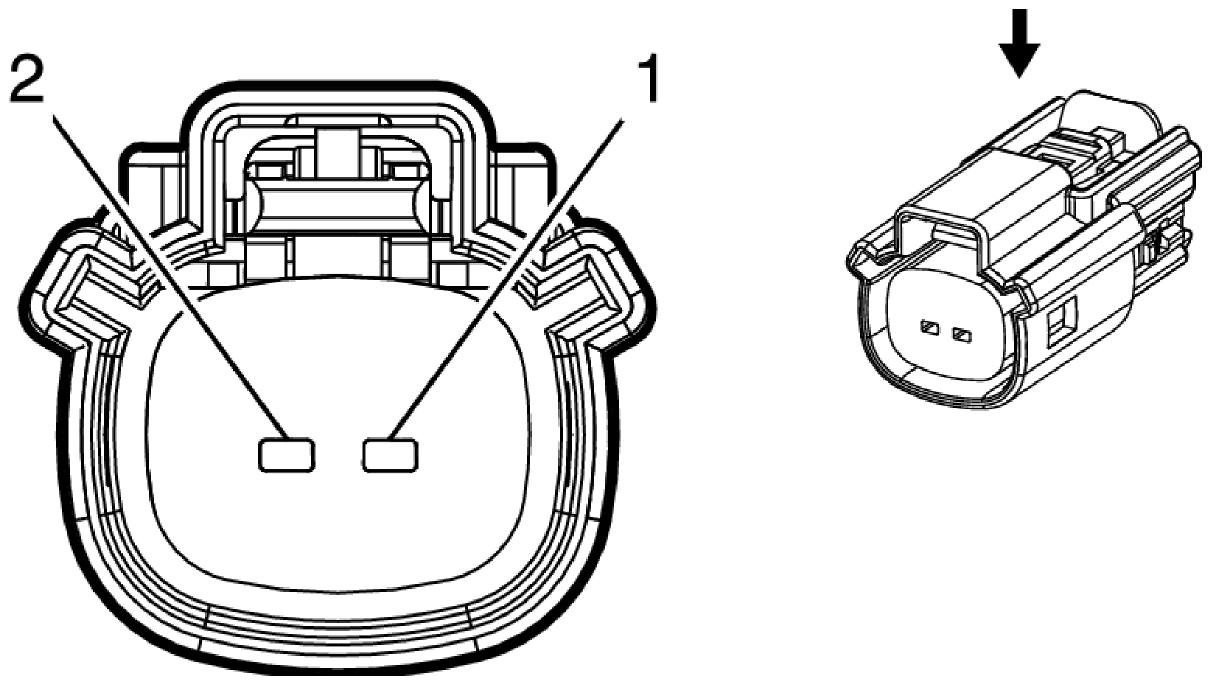
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

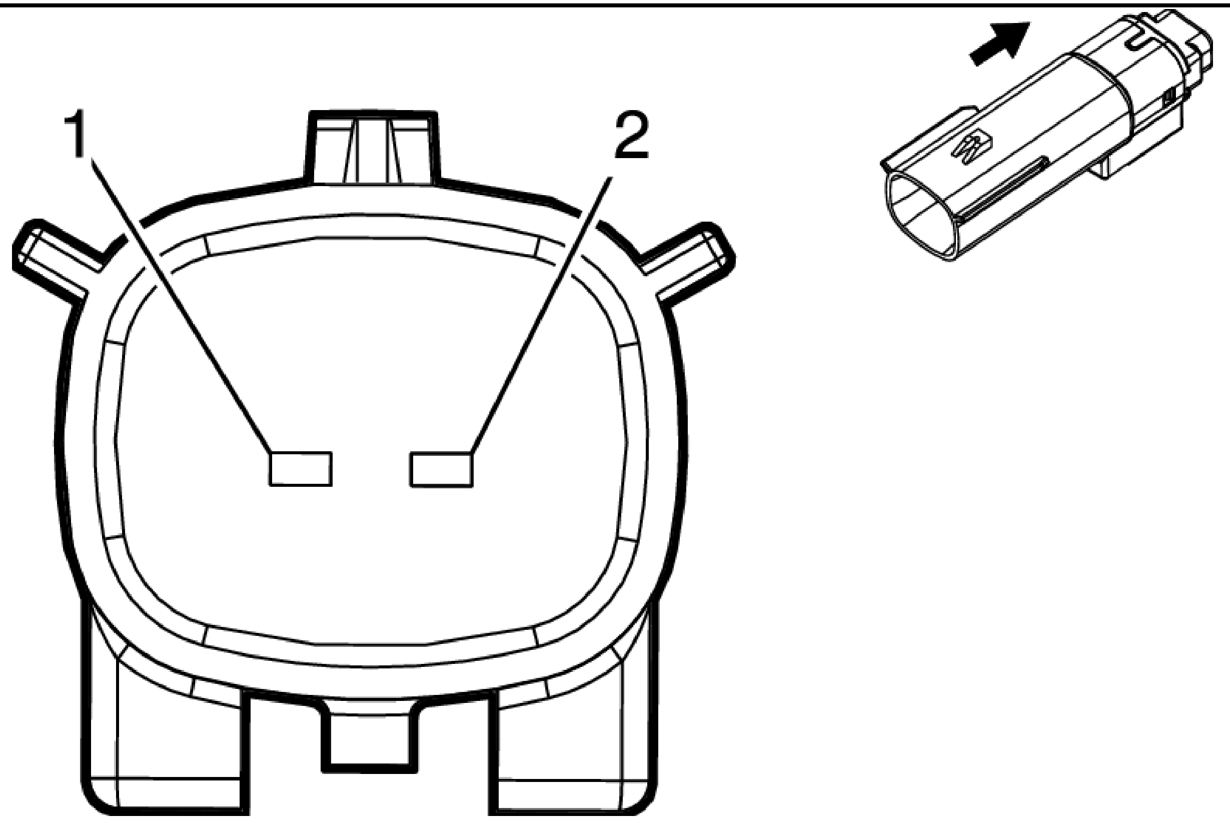
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	YE	712	I	-TR6	Left Headlamp Low Beam Control	1	0.75	YE	712	II	-TR6
2	0.5	WH	711	I	-TR6	Left Headlamp High Beam Control	2	0.5	WH	711	II	-TR6
3	0.5	YE	712	I	-TR6	Left Headlamp Low Beam Control	3	0.5	YE	712	II	-TR6
4	0.5	VT/GY	709	I	-TR6	Left Park Lamp Control	4	0.5	VT/GY	709	II	-TR6
5	0.75	BK	50	I	-TR6	Ground	5	0.75	BK	50	II	-TR6
6	0.5	BK	50	I	-TR6	Ground	6	0.5	BK	250	II	-TR6
7	0.5	VT/GY	709	I	-TR6	Left Park Lamp Control	7	0.5	VT/GY	709	II	-TR6
8	0.5	BK	50	I	-TR6	Ground	8	0.5	BK	50	II	-TR6

X111 FRONT FASCIA HARNESS TO LEFT TURN SIGNAL HARNESS



Connector Part Information

- Harness Type: Front Fascia
- OEM Connector: 33471-0201
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)



Connector Part Information

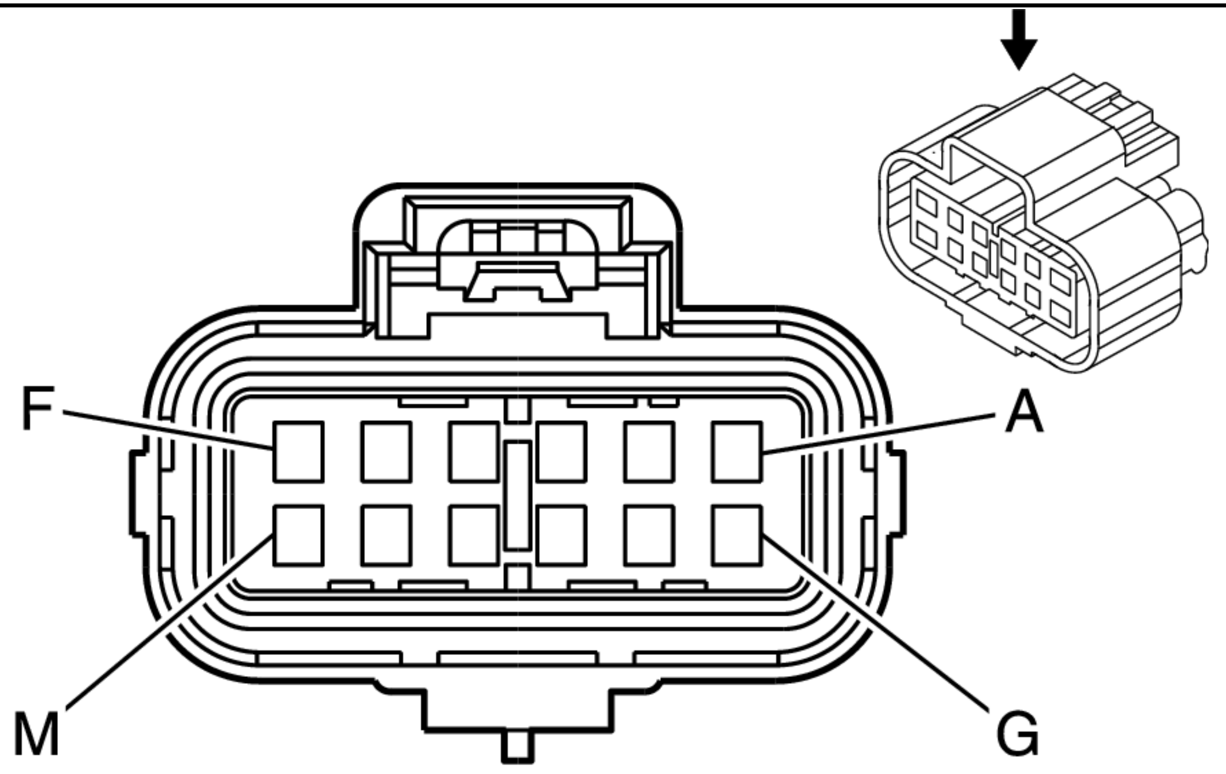
- Harness Type: Left Turn Signal
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

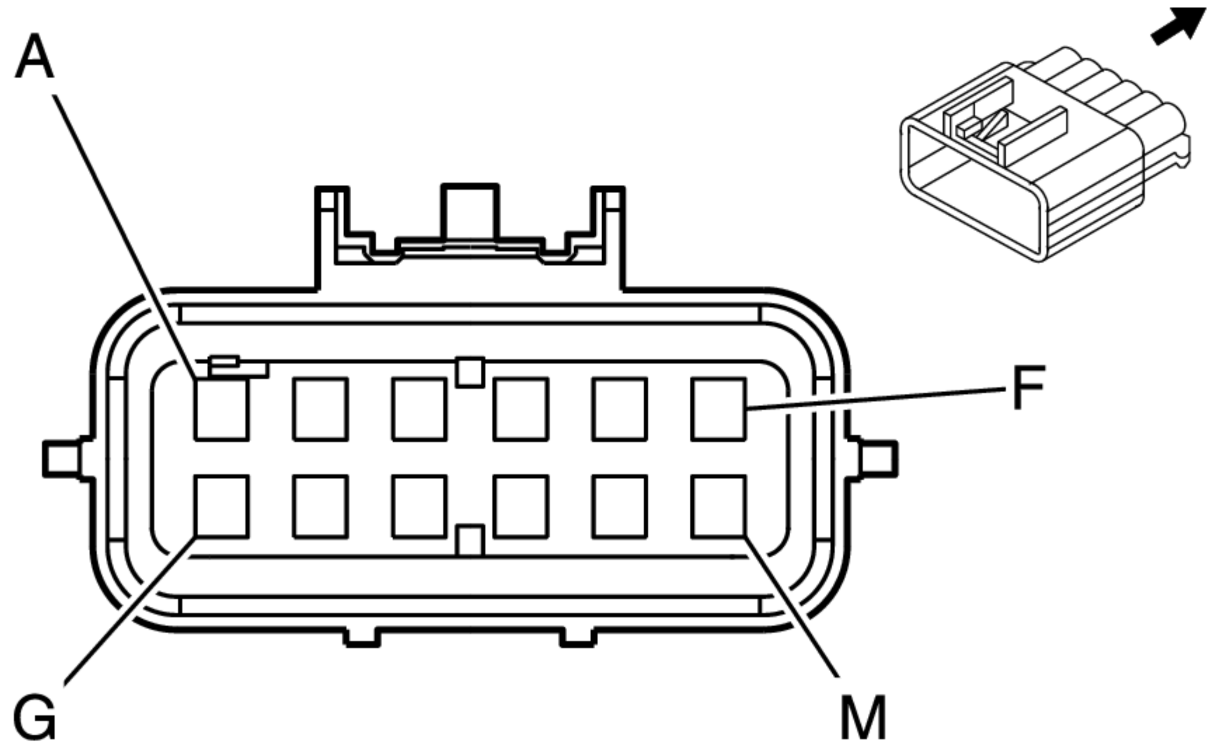
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BU/WH	1314	I	-	Left Front Turn Signal Lamp Control	1	0.5	BU/WH	1314	II	-
2	0.5	BK	50	I	-	Ground	2	0.5	BK	50	II	-

X117 CHARGE RECEPTACLE HARNESS TO BODY HARNESS (CBT)



Connector Part Information

- Harness Type: Charge Receptacle
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F



Connector Part Information

- Harness Type: Body
- OEM Connector: 15326854
- Service Connector: 88986252
- Description: 12-Way M 150 GT Series, Sealed (BK)

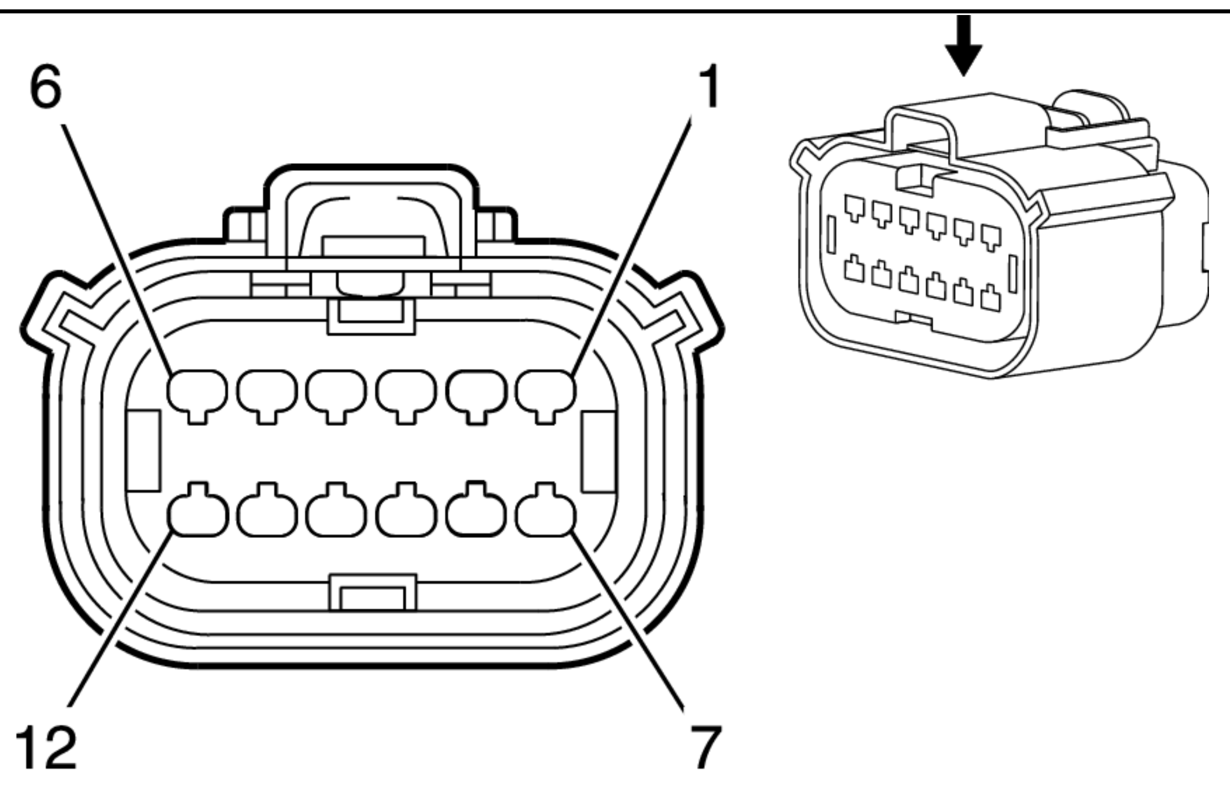
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	13575397	J-35616-3 (GY)	J-38125-553	15326269	Delphi 19	E	4
III	13576364	J-35616-3 (GY)	J-38125-553	15326269	Delphi 19	E	1

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
A	0.5	WH/GY	5239	I	CBT	Inside Rear View Mirror Vertical Potentiometer	A	0.5	WH/GY	5239	II	CBT
B	0.5	YE/GY	5241	I	CBT	Inside Rear View Mirror Horizontal Potentiometer	B	0.5	YE/GY	5241	II	CBT
C	0.5	GN/VT	5243	I	CBT	Inside Rear View Mirror Potentiometer Ground	C	0.5	GN/VT	5243	II	CBT
D	0.5	VT/BN	3699	I	CBT	Charge Port Door Switch Signal	D	0.5	VT/BN	3699	II	CBT
E	0.5	GY/BU	213	I	CBT	Charge Port Paddle Temperature Sensor Signal	E	0.5	GY/BU	213	II	CBT
F	0.5	BK/BU	5404	I	CBT	Charge Port Paddle Temperature Sensor Low Reference	F	0.5	BK/BU	5404	II	CBT
G	0.5	BN/YE	2231	I	CBT	Charge Port Valve Motor Close Control	G	0.5	BN/YE	2231	II	CBT

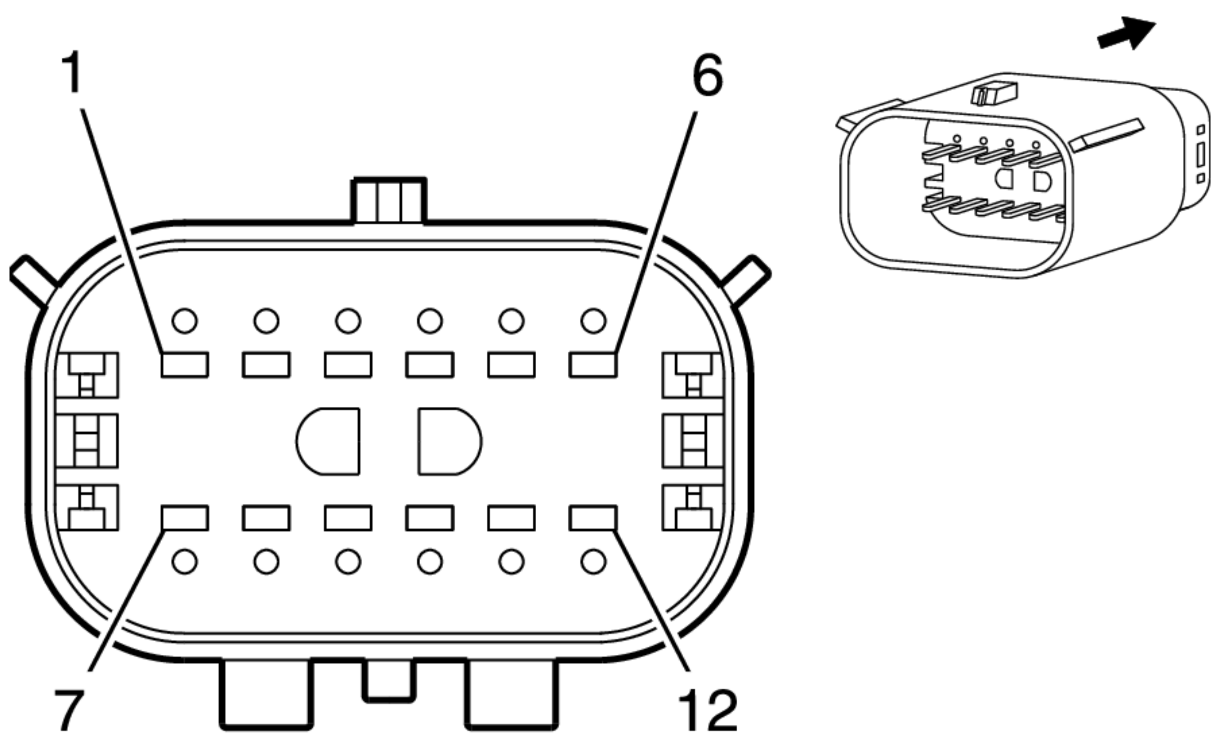
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
H	0.5	BU/WH	2230	I	CBT	Charge Port Valve Motor Open Control	H	0.5	BU/WH	2230	II	CBT
J	0.75	BU/YE	3953	I	-	Proximity Status Signal 1	J	0.75	BU/YE	3953	III	-
K	0.75	GY/GN	3954	I	-	Control Pilot Signal 1	K	0.75	GY/GN	3954	III	-
L	0.5	WH/BU	3697	I	-	Charge Port Door Sensor Signal	L	0.5	WH/BU	3697	II	-
M	0.5	BK	650	I	-	Ground	M	0.5	BK	550	II	-

X120 FORWARD LAMP HARNESS TO RIGHT HEADLAMP HARNESS (TR6)



Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 33472-1251
- Service Connector: 13503528
- Description: 12-Way F 150 MX Series, Sealed (BK)



Connector Part Information

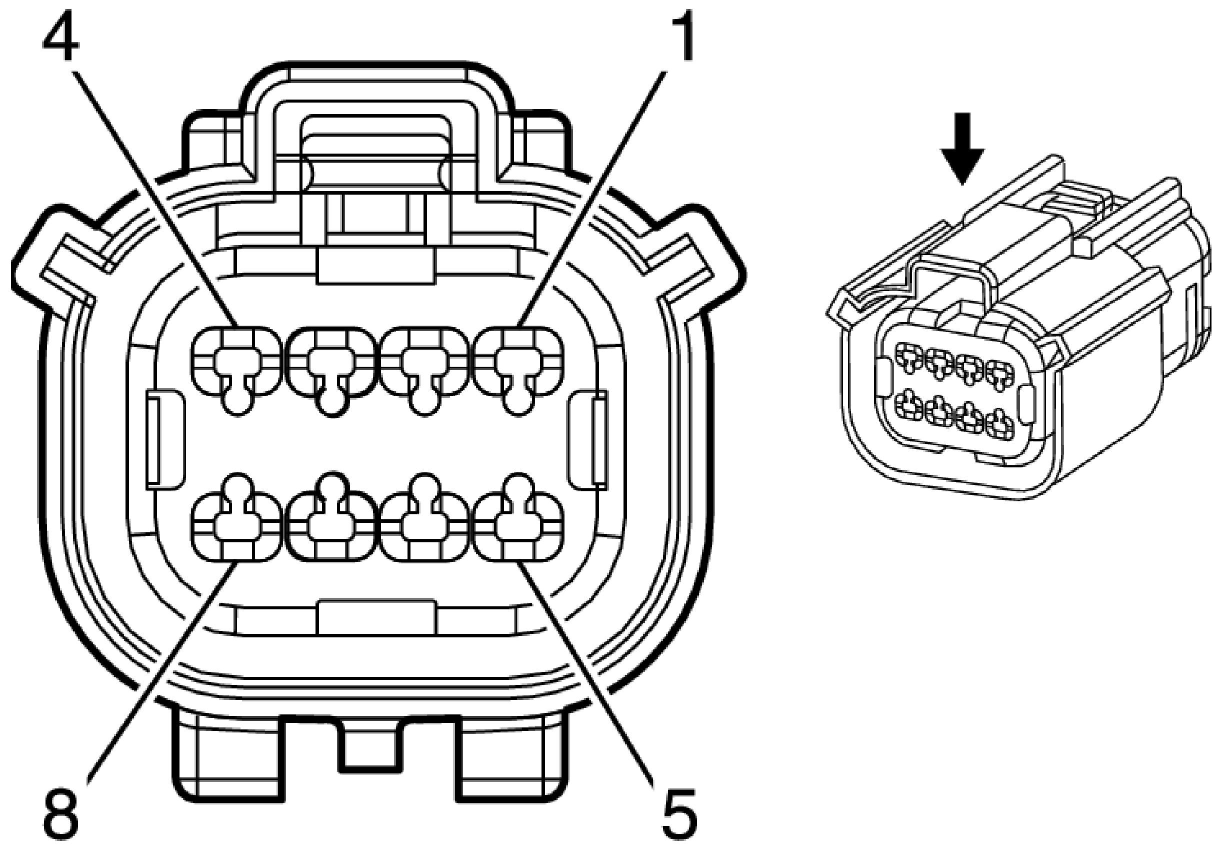
- Harness Type: Right Headlamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575808	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
III	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

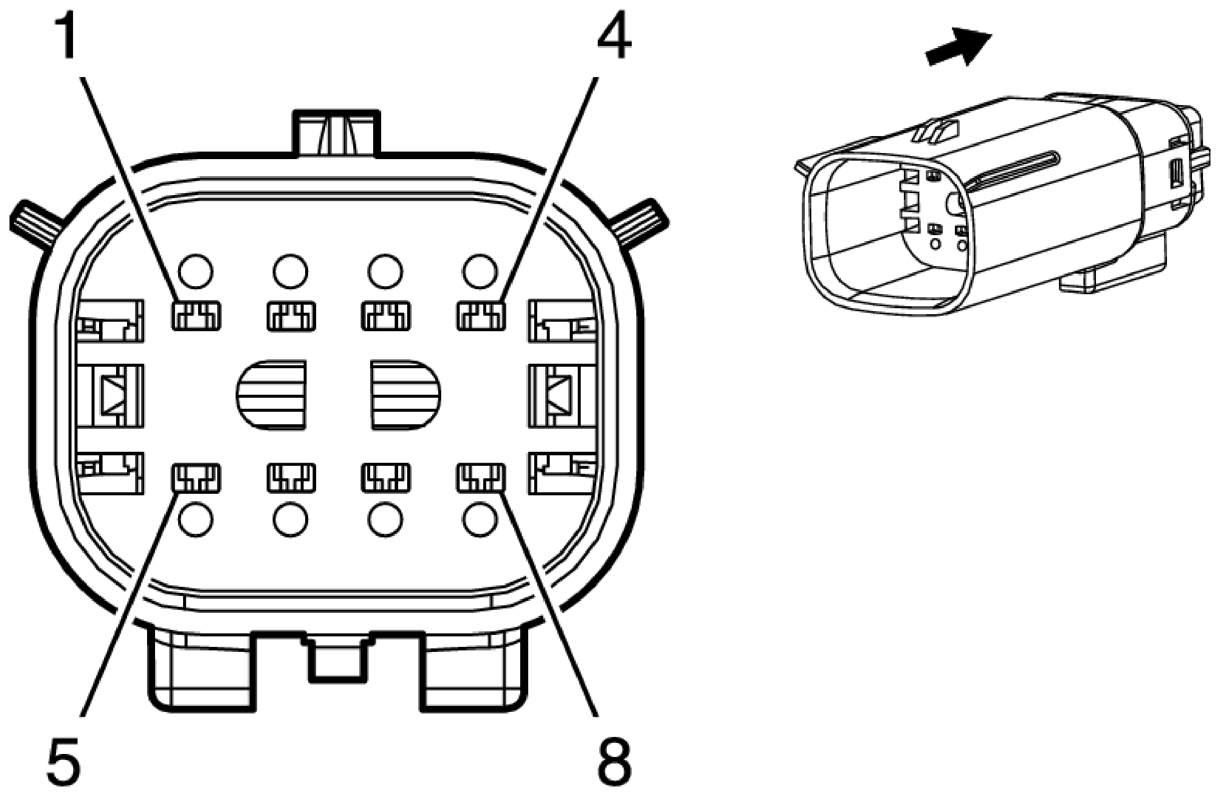
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	YE	312	I	TR6	Right Headlamp Low Beam Control	1	0.75	YE	312	III	TR6
2	0.5	WH	311	II	TR6	Right Headlamp High Beam Control	2	0.5	WH	311	III	TR6
3	0.5	YE	312	II	TR6	Right Headlamp Low Beam Control	3	0.5	YE	312	III	TR6
4	0.5	GY/BN	309	II	TR6	Right Park Lamp Control	4	0.5	GY/BN	309	III	TR6
5	0.5	VT/WH	239	II	TR6	Run/Crank Ignition 1 Voltage	5	0.5	VT/WH	239	III	TR6
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-
7	0.75	BK	250	I	TR6	Ground	7	0.75	BK	250	III	TR6
8	0.5	BK	250	II	TR6	Ground	8	0.5	BK	250	III	TR6
9	0.5	BK	250	II	TR6	Ground	9	0.5	BK	250	III	TR6
10	0.5	BK	250	II	TR6	Ground	10	0.5	BK	250	III	TR6
11	0.5	BN/YE	189	II	TR6	Headlamp Leveling Motor Control	11	0.5	BN/YE	189	III	TR6
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-

X120 FORWARD LAMP HARNESS TO RIGHT HEADLAMP HARNESS (-TR6)



Connector Part Information

- Harness Type: Forward Lamp
- OEM Connector: 33472-0901
- Service Connector: 13587959
- Description: 8-Way F 150 MX Series, Sealed (BK)



Connector Part Information

- Harness Type: Right Headlamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 8-Way M

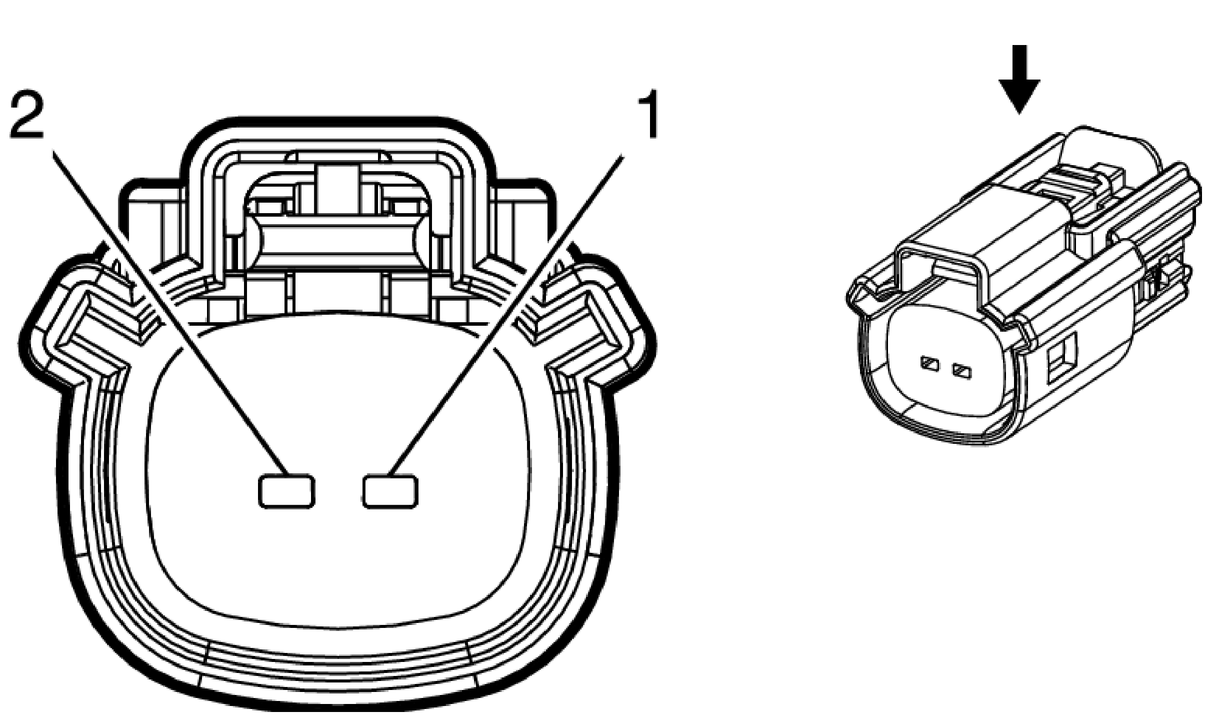
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	YE	312	I	-TR6	Right Headlamp Low Beam Control	1	0.75	YE	312	II	-TR6
2	0.5	WH	311	I	-TR6	Right Headlamp High Beam Control	2	0.5	WH	311	II	-TR6
3	0.5	YE	312	I	-TR6	Right Headlamp Low Beam Control	3	0.5	YE	312	II	-TR6
4	0.5	GY/BN	309	I	-TR6	Right Park Lamp Control	4	0.5	GY/BN	309	II	-TR6
5	1	BK	250	I	-TR6	Ground	5	1	BK	250	II	-TR6

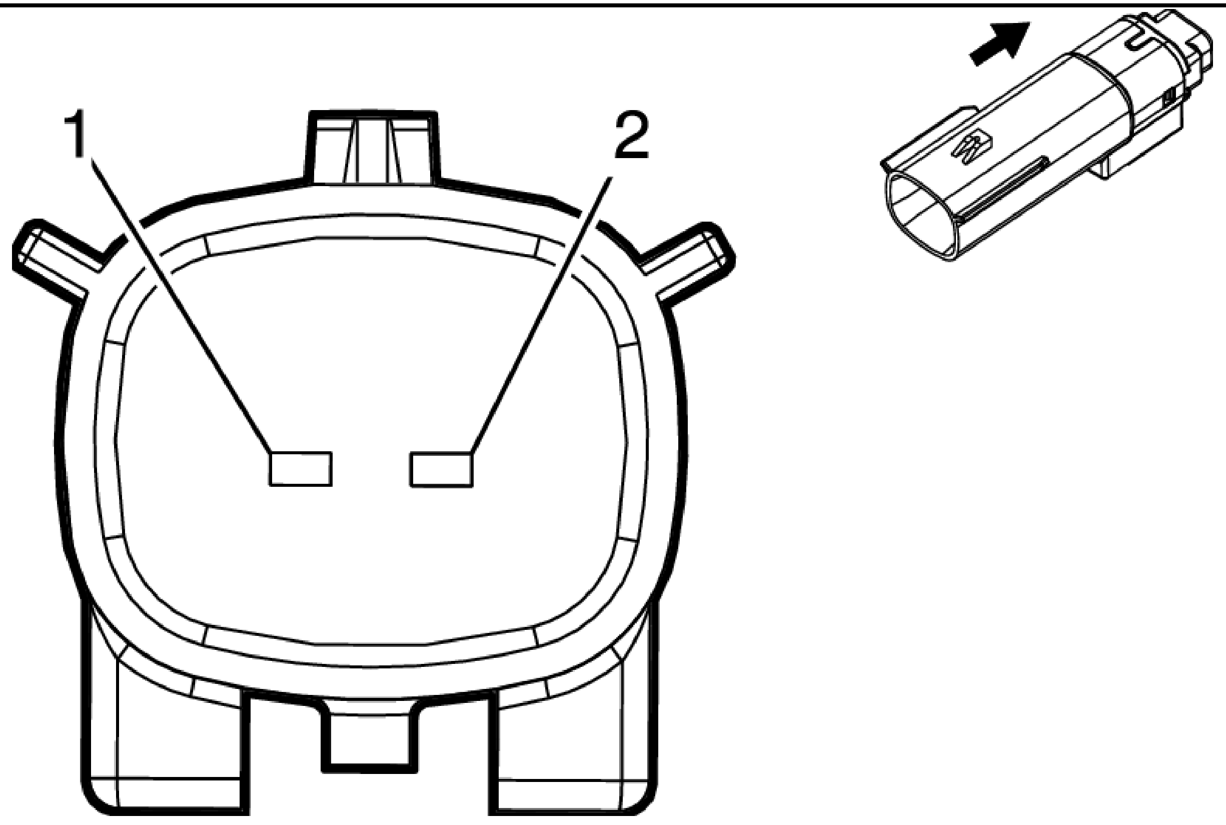
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
6	0.5	BK	250	I	-TR6	Ground	6	0.5	BK	250	II	-TR6
7	0.5	GY/BN	309	I	-TR6	Right Park Lamp Control	7	0.5	GY/BN	309	II	-TR6
8	0.5	BK	250	I	-TR6	Ground	8	0.5	BK	250	II	-TR6

X121 FRONT FASCIA HARNESS TO RIGHT TURN SIGNAL HARNESS



Connector Part Information

- Harness Type: Front Fascia
- OEM Connector: 33471-0201
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F 1.5 Series, Sealed (BK)



Connector Part Information

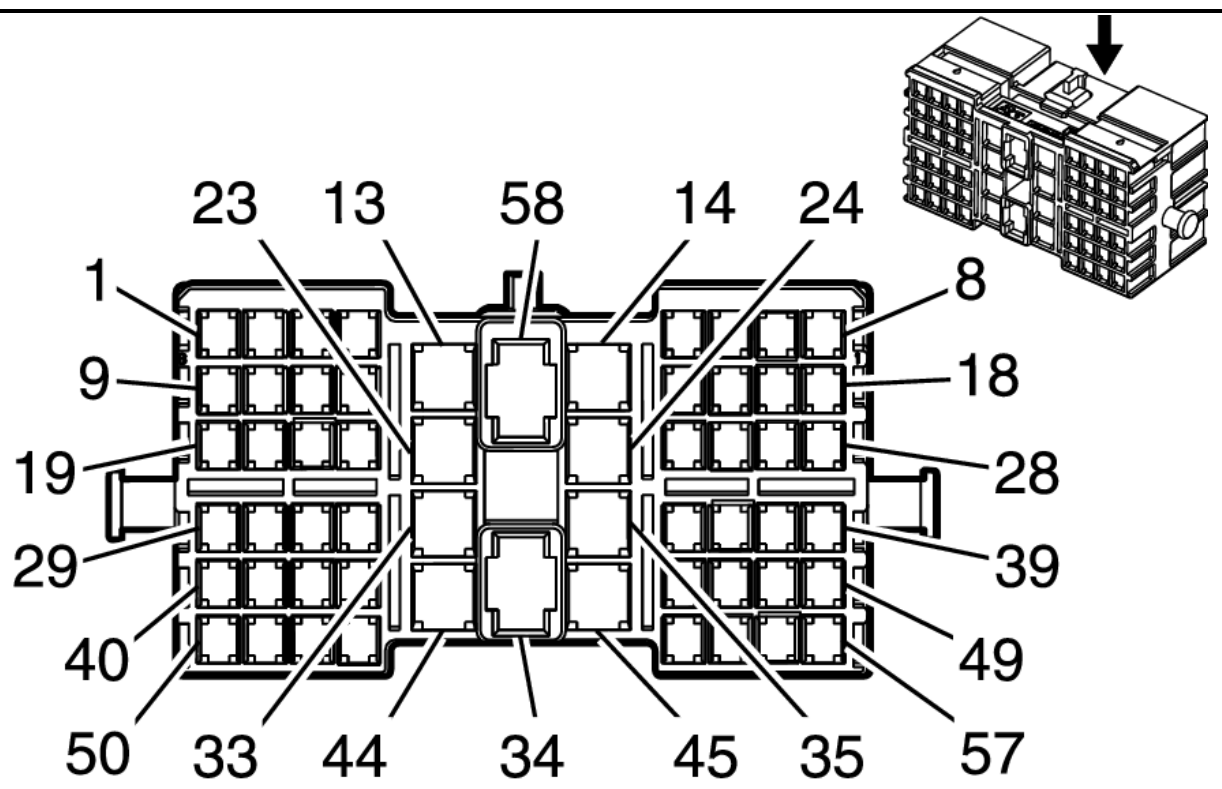
- Harness Type: Right Turn Signal
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

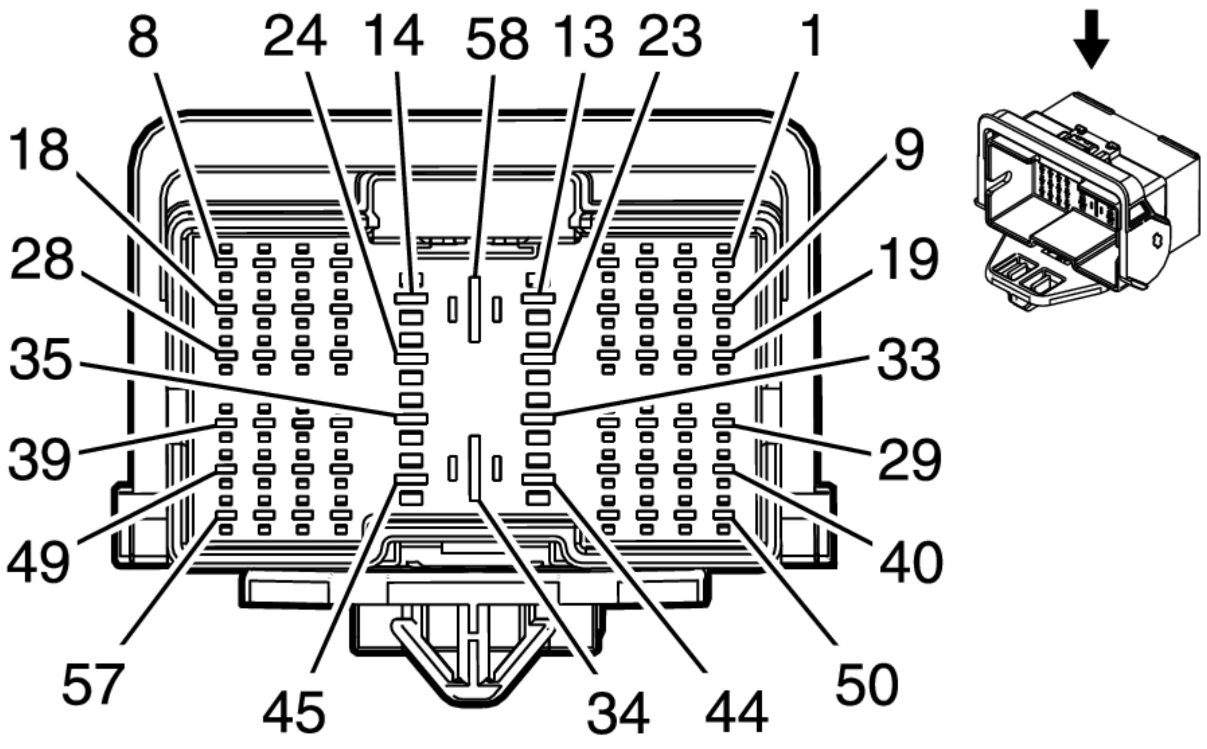
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	GN/VT	1315	I	-	Right Front Turn Signal Lamp Control	1	0.5	GN/VT	1315	II	-
2	0.5	BK	250	I	-	Ground	2	0.5	BK	250	II	-

X200 INSTRUMENT PANEL HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2005281-3
- Service Connector: 13395410
- Description: 58-Way F 1.6, 2.8, 4.8 Timer Series (GY)



Connector Part Information

- Harness Type: Body
- OEM Connector: 2005275-3
- Service Connector: 13395409
- Description: 58-Way M 1.6, 2.8, 5.8 Timer Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575471	J-35616-14 (GN)	J-38125-560	964274-2	Lear 16	E	1
II	13575856	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	2
III	13575856	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	C
IV	13575858	J-35616-42 (RD)	J-38125-36	927837-1	Lear 25	A	D
V	13575858	J-35616-42 (RD)	J-38125-36	927837-1	Lear 25	C	A
VI	13578858	J-35616-4A (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
VII	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
VIII	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
IX	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
X	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.35	RD/GN	6940	I	-	Battery Positive Voltage	1	0.35	RD/GN	6940	VIII	-
2	0.35	BN/WH	419	I	-	Check Engine Indicator Control	2	0.35	BN/WH	419	VIII	-
3	0.35	VT/BN	541	I	-	Run Ignition 3 Voltage	3	0.35	VT/BN	541	VIII	-
4	0.35	GN/WH	2514	I	UE1	Keypad Signal	4	0.35	GN/WH	2514	VIII	UE1
5	0.35	GN/BK	2515	I	UE1	Keypad Control	5	0.35	GN/BK	2515	VIII	UE1
6	0.35	YE/VT	2516	I	UE1	Keypad Green LED Control	6	0.35	YE/VT	2516	VIII	UE1
7	0.35	BN/WH	2517	I	UE1	Keypad Red LED Control	7	0.35	BN/WH	2517	VIII	UE1
8	0.35	BN/VT	193	I	-	Rear Defog Relay Control	8	0.35	BN/VT	193	VIII	-
9	0.35	GN/GY	3277	I	-	Vehicle Anti-Theft System Immobilizer Low Reference	9	0.35	GN/GY	3277	VIII	-
10	0.35	GN/VT	7533	I	-	Local Interconnect Network Serial Data Bus 11	10	0.35	GN/VT	7533	VIII	-
11	0.35	GY/BK	3276	I	-	Vehicle Anti-Theft System Immobilizer Control	11	0.35	GY/BK	3276	VIII	-
12	0.35	BN/YE	780	I	-	Driver Door Lock Switch Lock Signal	12	0.35	BN/YE	780	VIII	-
13	1	RD/GY	5540	VI	-	Battery Positive Voltage	13	1	RD/GY	5540	VII	-

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
14	0.75	BU/VT	807	VI	N06	OFF /Accessory Ignition Voltage	14	0.75	BU/VT	807	VII	N06
15	0.75	RD/BU	4540	I	-	Battery Positive Voltage	15	0.5	RD/BU	4540	VIII	-
16	0.75	RD/VT	4640	I	-	Battery Positive Voltage	16	0.5	RD/VT	4640	VIII	-
17	0.35	WH/YE	7557	I	C9J	LED Ambient Lighting Control 1	17	0.35	WH/YE	7557	VIII	-
18	0.35	BN/WH	781	I	-	Driver Door Lock Switch Unlock Signal	18	0.35	BN/WH	781	VIII	-
19	0.5	GY	5127	I	-	After Boil Heater Relay Control	19	0.35	GY	5127	VIII	-
20	0.5	VT	3560	I	-	Passive Entry Driver Door Antenna Signal Hi	20	0.5	VT	3560	VIII	-
21	0.5	VT/GY	3561	I	-	Passive Entry Driver Door Antenna Signal Lo	21	0.5	VT/GY	3561	VIII	-
22	0.35	GN	4512	I	K4C	Wireless Charging System Charge Indicator Control	22	0.35	GN	4512	VIII	K4C
23	0.5	BN/YE	189	III	TR6	Headlamp Leveling Motor Control	23	0.5	BN/YE	189	VII	TR6
24	0.5	BN/YE	6157	III	-	Left Rear Door Handle Switch Signal	24	0.5	BN/YE	6157	VII	-
25	0.35	VT	2801	I	-	Retained Accessory Power Fuse Ignition	25	0.35	VT	2801	VIII	USS
26	0.5	YE/BU	4086	I	-	Pushbutton Start Challenge Active Signal	26	0.5	YE/BU	4086	VIII	-
27	0.35	GY/WH	3153	I	-	Lane Departure Warning Disable Switch Signal	27	0.35	GY/WH	3153	VIII	-
28	0.35	WH	3152	I	-	Lane Departure Warning Indicator Control	28	0.35	WH	3152	VIII	-
29	0.35	VT/BU	3263	I	-	Logistic Mode Relay Open Control	29	0.35	VT/BU	3263	VIII	-
30	0.5	GN/BN	5852	I	UD5/UFQ	Rear Park Assist LED Disable Signal	30	0.5	GN/BN	5852	VIII	UD5/UFQ
31	0.35	BU/BN	3161	I	UFQ	Parallel Park Assist Disable Switch Signal	31	0.35	BU/BN	3161	VIII	UFQ
32	0.35	GY/VT	3264	I	-	Logistic Mode Relay Close Control	32	0.35	GY/VT	3264	VIII	-
33	0.35	RD/GN	6140	II	-	Battery Positive Voltage	33	0.35	RD/GN	6140	VII	-
34	2	VT/GN	39	V	-	Run/Crank Ignition 1 Voltage	34	2	VT/GN	39	X	-
35	0.35	RD/GN	6140	II	AY0/AYF	Battery Positive Voltage	35	0.35	RD/GN	6140	VII	-
36	0.35 0.5	BK/BN BK/BN	654 654	I I	UE1 -UE1	Cellular Telephone Microphone Low Reference Cellular Telephone Microphone Low Reference	36	0.35	BK/BN	654	VIII	-
37	0.35 0.5	BU BU	655 655	I I	UE1 -UE1	Cellular Telephone Microphone Signal Cellular Telephone Microphone Signal	37	0.35	BU	655	VIII	-
38	0.5	BU/YE	6105	I	-	High Speed GMLAN Serial Data (+) 2	38	0.5	BU/YE	6105	VIII	-
39	0.5	WH	6106	I	-	High Speed GMLAN Serial Data (-) 2	39	0.5	WH	6106	VIII	-
40	0.5	BK/BN	5360	I	-	Brake Apply Sensor Low Reference	40	0.5	BK/BN	5360	VIII	-
41	0.5	BU/YE	5361	I	-	Brake Apply Sensor Signal	41	0.5	BU/YE	5361	VIII	-
42	0.5	WH	5359	I	-	Brake Apply Sensor Control	42	0.5	WH	5359	VIII	-
43	0.35	VT	4601	I	K4C	Retained Accessory Power Fused Control	43	0.5	VT	4601	VIII	K4C
44	0.35	RD/YE	5840	II	-	Battery Positive Voltage	44	0.35	RD/YE	5840	VII	UKC
45	0.35	GY/GN	2555	II	UD5/UFQ	Rear Park Assist Disable Signal	45	0.5	GY/GN	2555	VII	UD5/UFQ
46	0.35	GN/WH	2270	I	-	Rear Window Washer Relay Control	46	0.35	GN/WH	2270	VIII	-
47	0.35	GY/WH	3272	I	-	Remote Function Actuator Control	47	0.35	GY/WH	3272	VIII	-
48	0.35	GY	3273	I	-	Remote Function Actuator Low Reference	48	0.35	GY	3273	VIII	-
49	0.35	YE/GN	3274	I	-	Remote Function Actuator Transmit Signal	49	0.35	YE/GN	3274	VIII	-
50	0.35	BU/WH	3275	I	-	Remote Function Actuator Receive Signal	50	0.35	BU/WH	3275	VIII	-
51	0.75	RD/BU	5240	I	-	Battery Positive Voltage	51	0.75	RD/BU	5240	IX	-
52	0.5	WH/BU	5986	I	-	Serial Data Communication Enable	52	0.5	WH/BU	5986	VIII	-
53	0.35	RD/GY	6240	I	-	Battery Positive Voltage	53	0.35	RD/GY	6240	VIII	-
54	0.35	RD/WH	5440	I	UD5/UD7/UFQ	Battery Positive Voltage	54	0.35	RD/WH	5440	VIII	UD5/UD7/UFQ
55	0.35	VT/BK	2539	I	-	Run/Crank Ignition 1 Voltage	55	0.35	VT/BK	2539	VIII	-
56	0.35	GY/GN	1102	I	UVH	Low Speed GMLAN Serial Data #2	56	0.35	GY/GN	1102	VIII	UVH
57	0.35	GY	5054	I	-	Sport Mode Switch Signal	57	0.35	GY	5054	VIII	-
58	2.5	RD/BU	840	IV	-	Battery Positive Voltage	58	2.5	RD/BU	840	X	-

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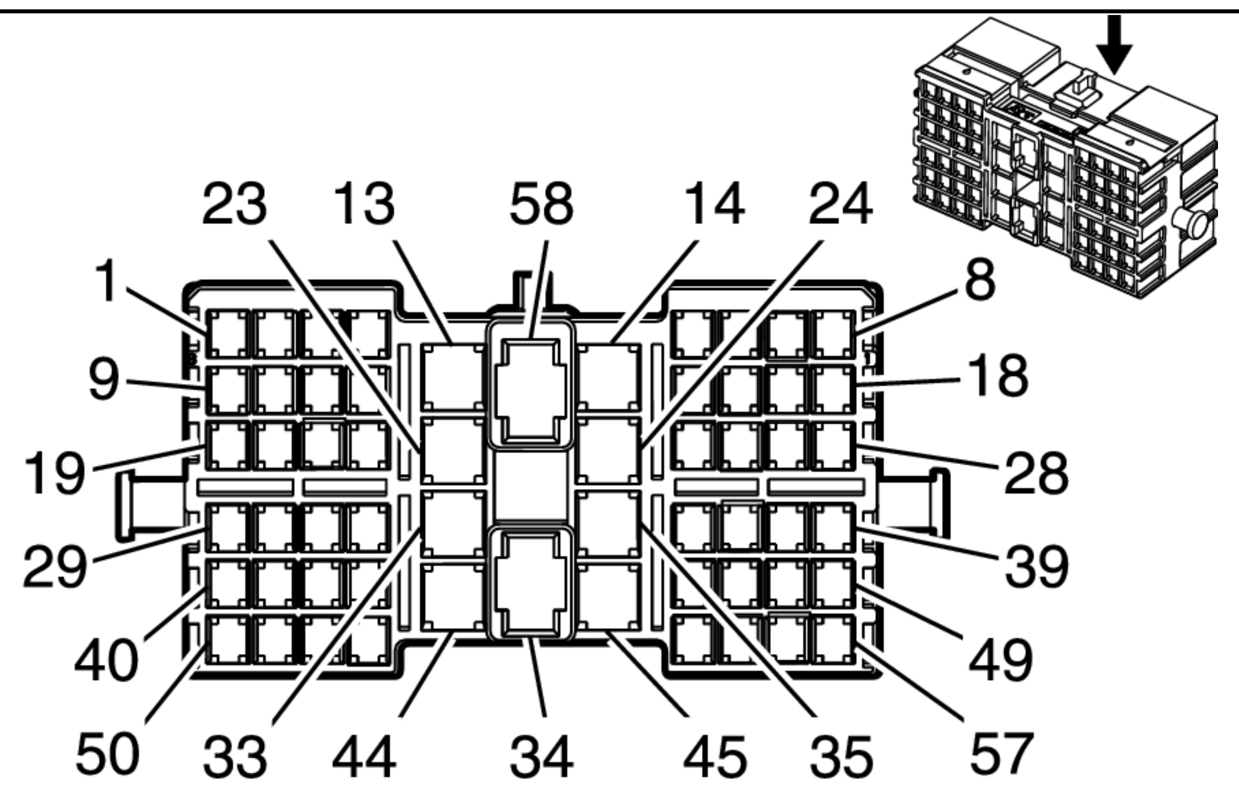
2017 ELECTRICAL

Wiring Systems and Power Management - Component Locator - Inline Harness Connector End Views - Bolt EV

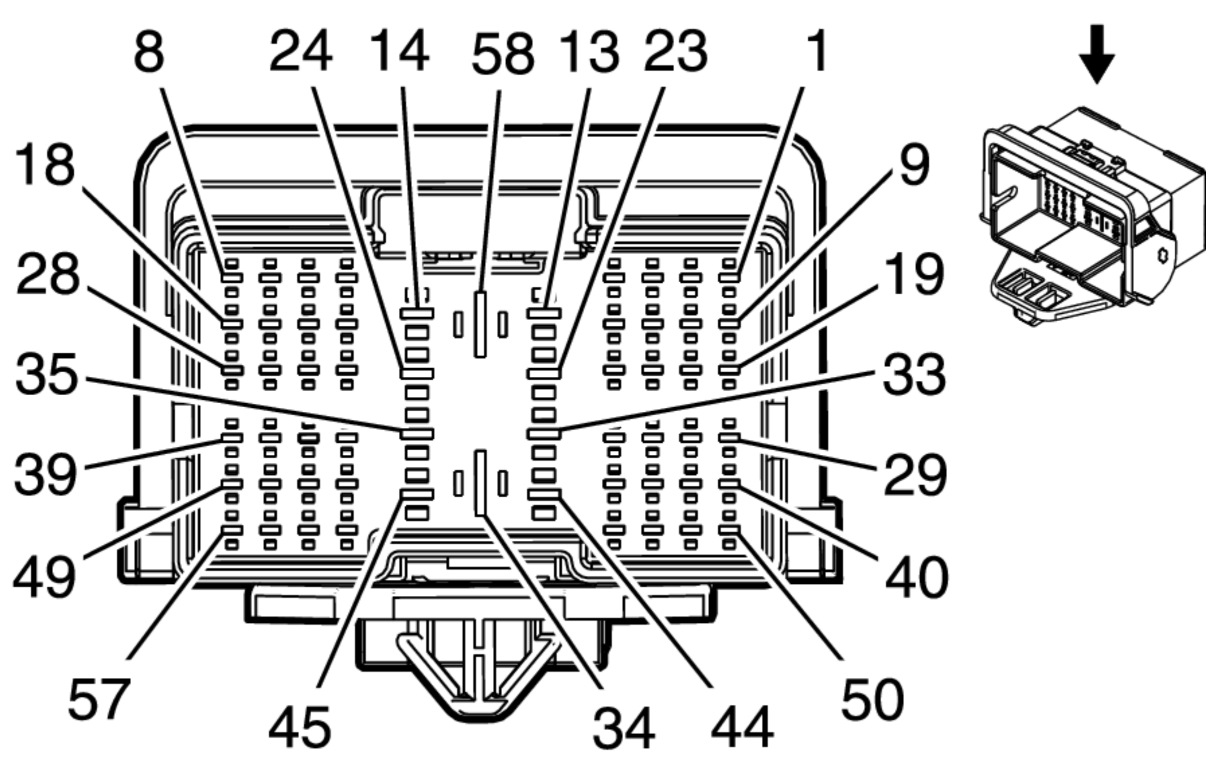
INLINE HARNESS CONNECTOR END VIEWS

X205 INSTRUMENT PANEL HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2005281-3
- Service Connector: 13395410
- Description: 58-Way F 1.6, 2.8, 4.8 Timer Series (GY)



Connector Part Information

- Harness Type: Body
- OEM Connector: 2005275-3
- Service Connector: 13395409
- Description: 58-Way M 1.6, 2.8, 5.8 Timer Series (GY)

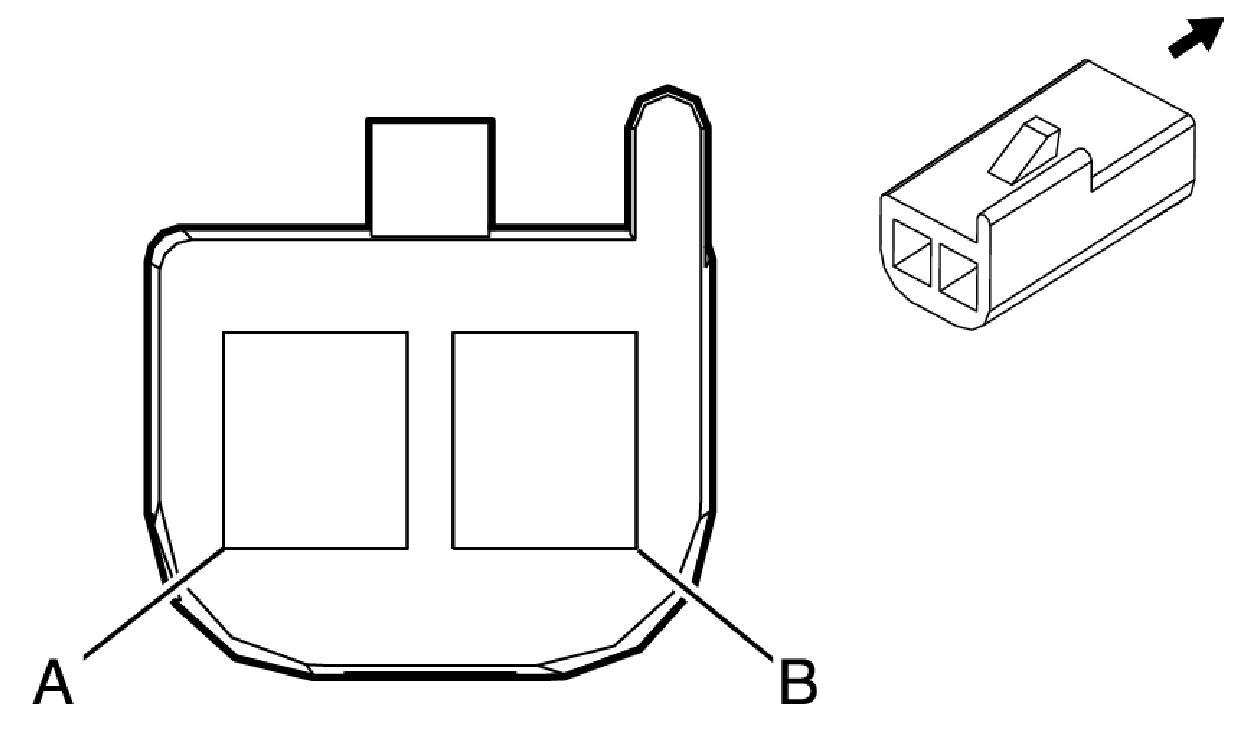
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575471	J-35616-14 (GN)	J-38125-560	964274-2	Lear 16	E	1
II	13575856	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	2
III	13575856	J-35616-4A (PU)	J-38125-36	964280-2	Yazaki 15	E	C
IV	13578858	J-35616-4A (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
V	13582335	J-35616-40 (BU)	J-38125-11A	Not Available	Not Available	Not Available	Not Available
VI	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
VII	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
VIII	13575593	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
IX	19331719	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BN/GN	3568	I	-	Passive Entry Rear Closure Antenna Signal Hi	1	0.5	BN/GN	3568	VII	-
2	0.5	GN/GY	3569	I	-	Passive Entry Rear Closure Antenna Signal Lo	2	0.5	GN/GY	3569	VII	-
3	0.5	YE/VT	3956	I	-	Charging Status Indicator Control	3	0.5	YE/VT	3956	VII	-
4	0.5	GY/GN	3957	I	-	Charging Pilot Signal Indicator Control	4	0.5	GY/GN	3957	VII	-
5	0.35	VT/WH	5234	I	AY0/AYF	Passenger Seat Belt Indicator Control	5	0.35	VT/WH	5234	VII	AY0/AYF
6	0.35	BU	2307	I	-	Passenger Air Bag On Indicator Control	6	0.35	BU	2307	VII	-
7	0.35	GN	2308	I	-	Passenger Air Bag Off Indicator Control	7	0.35	GN	2308	VII	-
8	0.35	GN/WH	4115	I	-	Local Interconnect Network Serial Data Bus 15	8	0.35	GN/WH	4115	VII	-
9	0.75	BN/BU	118	I	UQA	Left Front Speaker Signal (-) 1	9	0.75	BN/BU	118	VIII	UQA
10	0.75	BU	201	I	UQA	Left Front Speaker Control (+) 1	10	0.75	BU	201	VIII	UQA
11	0.75	YE/BK	117	I	UQA	Right Front Speaker Signal (-) 1	11	0.75	YE/BK	117	VIII	UQA
12	0.75	YE	200	I	UQA	Right Front Speaker Control (+) 1	12	0.75	YE	200	VIII	UQA
13	0.5	YE	3831	III	-	High Speed GMLAN Serial Data (+) 6	13	0.5	YE	3831	VI	-
14	0.5	WH	3832	III	-	High Speed GMLAN Serial Data (-) 6	14	0.5	WH	3832	VI	-
15	0.5	BU/BK	7493	I	-	High Speed GMLAN Serial Data (+)3	15	0.5	BU/BK	7493	VII	-
16	0.5	WH	7494	I	-	High Speed GMLAN Serial Data (-)3	16	0.5	WH	7494	VII	-
17	0.5	GN/BU	4119	I	-	Local Interconnect Network Serial Data Bus 19	17	0.5	GN/BU	4119	VII	-
18	0.5	GN/WH	3570	I	-	Driver Door Handle Switch Signal	18	0.5	GN/WH	3570	VII	-
19	0.5	VT/WH	3571	I	-	Passenger Door Handle Switch Signal	19	0.5	VT/WH	3571	VII	-
20	0.35	GN	5060	I	-	Low Speed GMLAN Serial Data	20	0.35	GN	5060	VII	-
21	0.35	GN/GY	6135	I	-	Local Interconnect Network Serial Data Bus 4	21	0.35	GN/GY	6135	VII	-
22	0.35	WH	6816	I	-	Indicator Dimming Control	22	0.35	WH	6816	VII	KA6
23	0.5	YE/GY	6158	III	-	Right Rear Door Handle Switch Signal	23	0.5	YE/GY	6158	VI	-
24	0.35	BK/BU	7340	II	UVH	Camshaft W 2 Low Reference	24	0.35	BK/BU	7340	VI	UVH
25	0.35 0.35	GY BK/WH	7069 2651	I I	UVC UVH	Camera Shield Ground Extension Signal Ground	25	0.35 0.35	GY BK/WH	7069 2651	VII VII	UVC UVH
26	0.35 0.35	GY/YE WH/VT	6972 4660	I I	UVC UVH	Camera Signal 2 + Combined Camera Video Signal (+)	26	0.35 0.35	GY/YE WH/VT	6972 4660	VII VII	UVC UVH
27	0.35 0.35	WH/BU GN/WH	6973 4661	I I	UVC UVH	Camera Signal 2 Combined Camera Video Signal (-)	27	0.35 0.35	WH/BU GN/WH	6973 4661	VII VII	UVC UVH
28	0.5	GN/YE	7066	I	UQA	Entertainment Remote Enable Signal	28	0.5	GN/YE	7066	VII	UQA
29	0.5	VT/BU	6978	I	UQA	Amplifier Control	29	0.5	VT/BU	6978	VII	UQA
30	0.5	WH/YE	3574	I	-	Driver Door Open Switch Signal	30	0.5	WH/YE	3574	VII	-
31	0.35	BK/BU	7566	I	-CE1	Humidity/Windscreen Temp Sensor Low Reference	31	0.35	BK/BU	7566	VII	-CE1
32	0.35	GY/GN	7565	I	-CE1	Windscreen Temp Sensor Signal	32	0.35	GY/GN	7565	VII	-CE1
33	0.35	GY/BU	7564	II	-CE1	Humidity Sensor Signal	33	0.35	GY/BU	7564	VI	-CE1
34	0.35	YE/BU	3197	V	-CE1	Humidity Temperature Sensor Signal	34	0.35	YE/BU	3197	IX	-CE1
35	0.35	YE/RD	597	II	-CE1	5V Reference	35	0.35	YE/RD	597	VI	-CE1

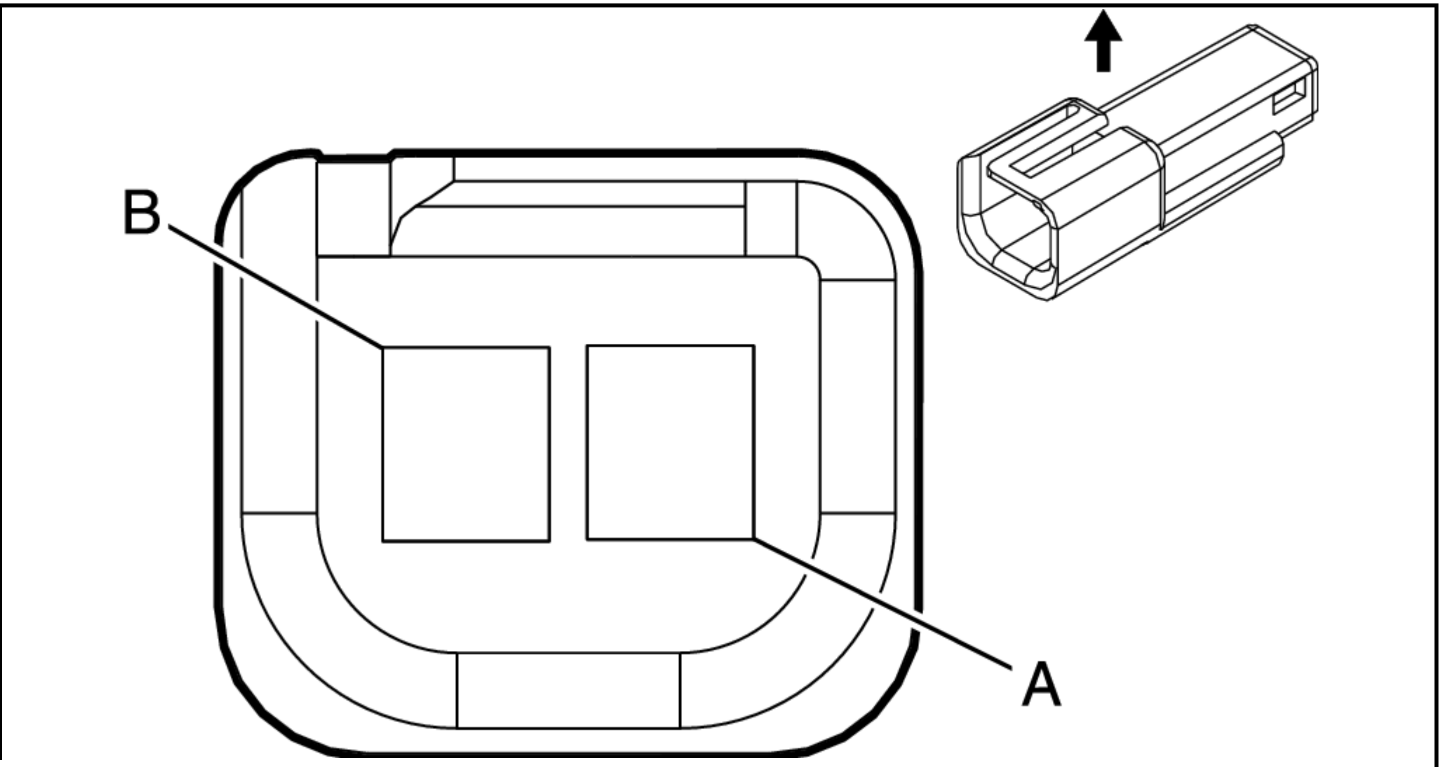
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
36	0.35	BN/VT	245	I	-	Passenger Door Lock Switch Unlock Control	36	0.35	BN/VT	245	VII	-
37	0.35	RD/BN	5940	I	-	Battery Positive Voltage	37	0.35	RD/BN	5940	VII	-
38	0.5	GN/YE	3562	I	-	Passive Entry Passenger Door Antenna Signal Hi	38	0.5	GN/YE	3562	VII	-
39	0.5	GN/BK	3563	I	-	Passive Entry Passenger Door Antenna Signal Lo	39	0.5	GN/BK	3563	VII	-
40	0.75 0.75	WH BN/WH	46 546	I I	UQ3 UQA	Right Rear Speaker Control (+) Right Rear Low Level Audio Signal	40	0.75 0.75	WH BN/WH	46 546	VIII VIII	UQ3 UQA
41	0.75 0.75	BU/BK BU/BK	115 1946	I I	UQ3 UQA	Right Rear Speaker Signal (-) Right Rear Low Level Audio (-) Low Reference	41	0.75 0.75	BU/BK BU/BK	115 1946	VIII VIII	UQ3 UQA
42	0.75 0.75	GN/BK BN/VT	116 1999	I I	UQ3 UQA	Left Rear Speaker Signal (-) Left Rear Low Level Audio (-) Low Reference	42	0.75 0.75	GN/BK BN/VT	116 1999	VIII VIII	UQ3 UQA
43	0.75 0.75	GN GN/BK	199 599	I I	UQ3 UQA	Left Rear Speaker Control (+) Left Rear Low Level Audio Signal	43	0.75 0.75	GN GN/BK	199 599	VIII VIII	UQ3 UQA
44	2	RD/VT	5640	IV	UQA	Battery Positive Voltage	44	2	RD/VT	5640	VI	UQA
45	-	-	-	-	-	Not Occupied	45	-	-	-	-	-
46	0.75 0.75	YE/BK BU/BN	117 1546	I I	UQ3 UQA	Right Front Speaker Signal (-) 1 Front Low Level Audio (-) Low Reference	46	0.75 0.75	YE/BK BU/BN	117 1546	VIII VIII	UQ3 UQA
47	0.75 0.75	YE YE	200 512	I I	UQ3 UQA	Right Front Speaker Control (+) 1 Right Front Low Level Audio Signal	47	0.75 0.75	YE YE	200 512	VIII VIII	UQ3 UQA
48	0.75 0.75	BN/BU BN/BU	118 1947	I I	UQ3 UQA	Left Front Speaker Signal (-) 1 Left Front Low Level Audio (-) Low Reference	48	0.75 0.75	BN/BU BN/BU	118 1947	VIII VIII	UQ3 UQA
49	0.75 0.75	BU BU	201 511	I I	UQ3 UQA	Left Front Speaker Control (+) 1 Left Front Low Level Audio Signal	49	0.75 0.75	BU BU	201 511	VIII VIII	UQ3 UQA
50	0.5	BU	3554	I	-	Passive Start Interior Antenna 2 Signal Hi	50	0.5	BU	3554	VII	-
51	0.5	GY/BK	3555	I	-	Passive Start Interior Antenna 2 Signal Lo	51	0.5	GY/BK	3555	VII	-
52	0.5	RD/VT	340	I	-	Battery Positive Voltage	52	0.5	RD/VT	340	VII	-
53	0.5	BK	2550	I	UQA	Ground	53	0.5	BK	2550	VII	UQA
54	0.5	RD/YE	240	I	-	Battery Positive Voltage	54	0.5	RD/YE	240	VII	-
55	0.5	WH/GN	3556	I	-	Passive Start Interior Antenna 3 Signal Hi	55	0.5	WH/GN	3556	VII	-
56	0.5	GN	3557	I	-	Passive Start Interior Antenna 3 Signal Lo	56	0.5	GN	3557	VII	-
57	0.5	BK	2550	I	UQA	Ground	57	0.5	BK	2550	VII	UQA
58	-	-	-	-	-	Not Occupied	58	-	-	-	-	-

X207 CELLULAR PHONE MICROPHONE HARNESS TO HEADLINER HARNESS



Connector Part Information

- Harness Type: Cellular Phone Microphone
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F



Connector Part Information

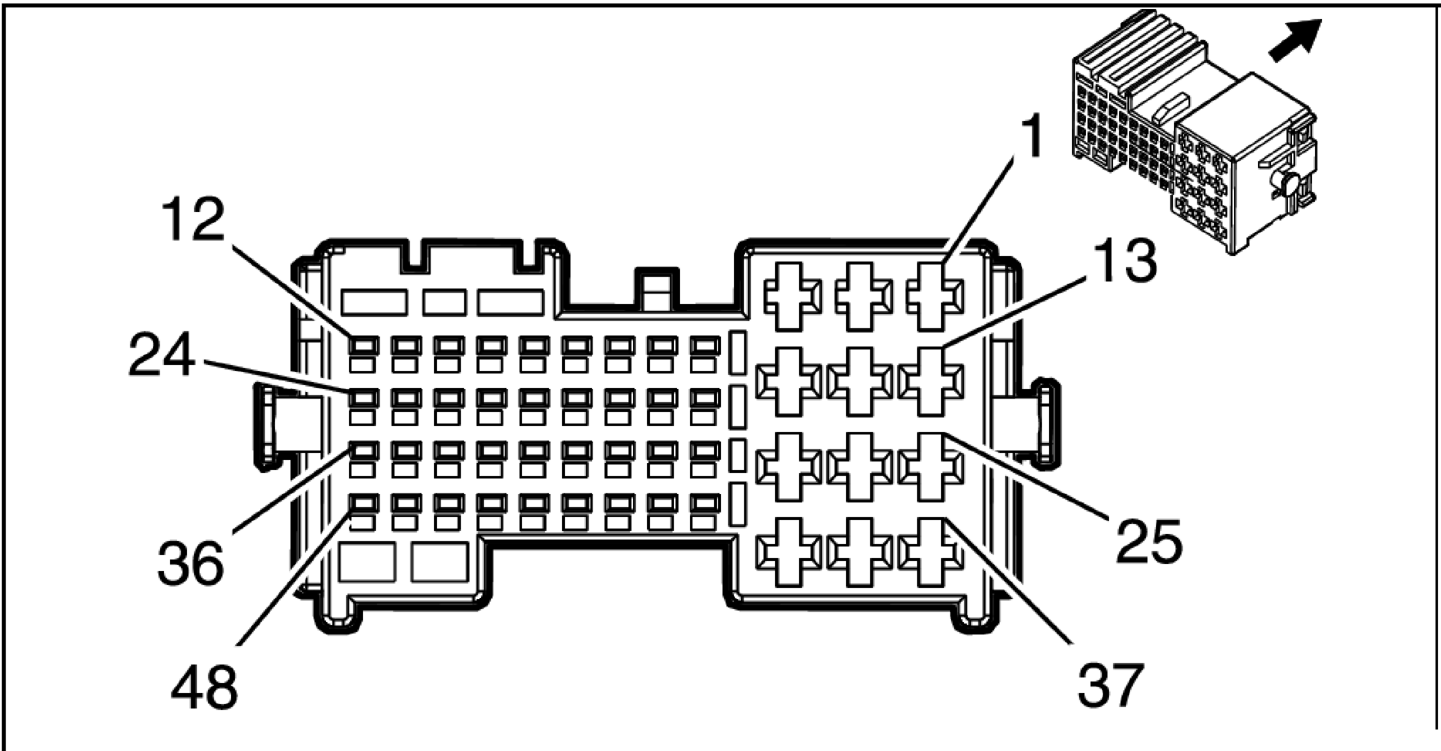
- Harness Type: Headliner
- OEM Connector: 12047663
- Service Connector: 13584278
- Description: 2-Way M 150 Metri-Pack Series (BK)

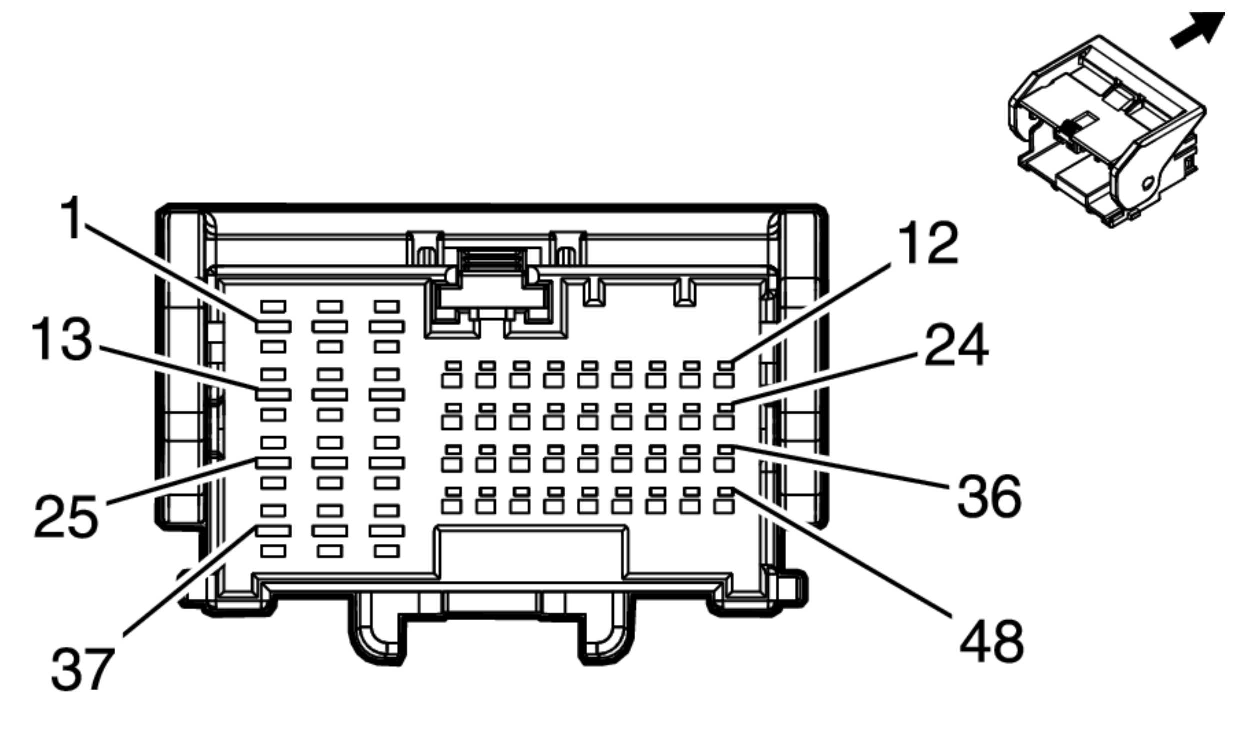
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
A	0.35	BK/BN	654	I	-	Cellular Telephone Microphone Low Reference	A	0.35	BK/BN	654	II	-
B	0.35	BU	655	I	-	Cellular Telephone Microphone Signal	B	0.35	BU	655	II	-

X208 HEADLINER HARNESS TO BODY HARNESS





Connector Part Information

- Harness Type: Headliner
- OEM Connector: 2109452-2
- Service Connector: 19329739
- Description: 48-Way F 1.2 MCON, 2.8 MCP Series (BK)

Connector Part Information

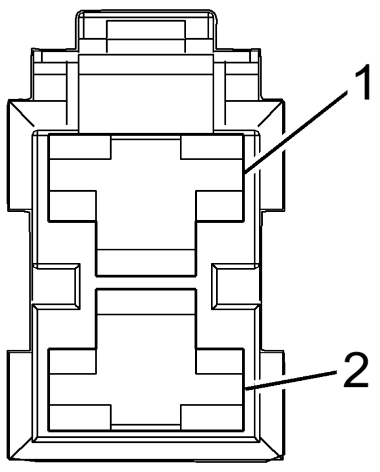
- Harness Type: Body
- OEM Connector: 5-2109455-2
- Service Connector: 19329740
- Description: 48-Way M 1.2 MCON, 2.8 MCP Series (BK)

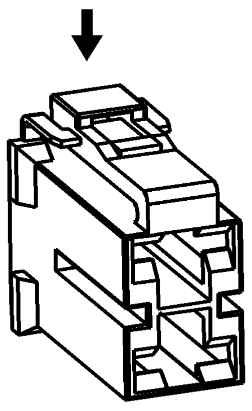
Terminal Part Information

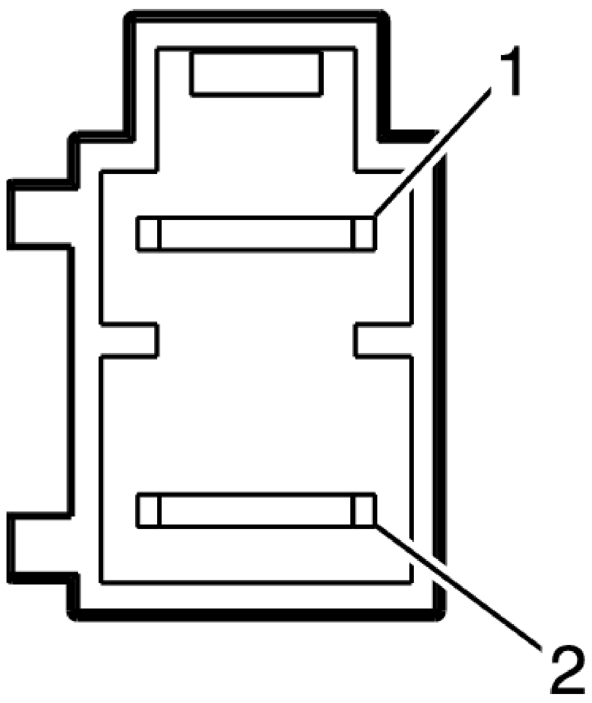
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19119592	J-35616-35 (VT)	J-38125-557	Not Available	Not Available	Not Available	Not Available
II	19329758	J-35616-16 (LT GN)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
III	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
IV	19329749	J-35616-13 (BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

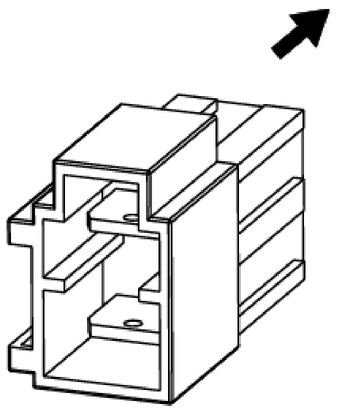
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	GN/WH	24	I	-	Backup Lamp Control	1	0.5	GN/WH	24	III	-
2	0.5	BK	550	I	-	Ground	2	0.5	BK	550	III	-
3	0.5	VT/BK	339	I	-	Run/Crank Ignition 1 Voltage	3	0.35	VT/BK	339	III	-
4	0.35	RD/GY	6240	II	-	Battery Positive Voltage	4	0.35	RD/GY	6240	IV	-
5	0.35	WH/BU	5986	II	-	Serial Data Communication Enable	5	0.35	WH/BU	5986	IV	-
6	0.35	WH	3152	II	-	Lane Departure Warning Indicator Control	6	0.35	WH	3152	IV	-
7	0.35	GY/WH	3153	II	-	Lane Departure Warning Disable Switch Signal	7	0.35	GY/WH	3153	IV	-
8	0.35	BK	550	II	-	Ground	8	0.5	BK	550	IV	-
9	0.35	BK/BN	654	II	-	Cellular Telephone Microphone Low Reference	9	0.35	BK/BN	654	IV	-
10	0.35	BU	655	II	-	Cellular Telephone Microphone Signal	10	0.35	BU	655	IV	-
11	0.35	YE/RD	597	II	-	5V Reference	11	0.35	YE/RD	597	IV	-CE1
12	0.35	BK/BU	7566	II	-	Humidity/Windscreen Temp Sensor Low Reference	12	0.35	BK/BU	7566	IV	-CE1
13 - 15	-	-	-	-	-	Not Occupied	13 - 15	-	-	-	-	-
16	0.35	GN/WH	2514	II	UE1	Keypad Signal	16	0.35	GN/WH	2514	IV	UE1
17	0.35	GN/BK	2515	II	UE1	Keypad Control	17	0.35	GN/BK	2515	IV	UE1
18	0.35	YE/VT	2516	II	UE1	Keypad Green LED Control	18	0.35	YE/VT	2516	IV	UE1
19	0.35	BN/WH	2517	II	UE1	Keypad Red LED Control	19	0.35	BN/WH	2517	IV	UE1
20	0.5	BK	550	II	UE1	Ground	20	0.5	BK	550	IV	-
21	-	-	-	-	-	Not Occupied	21	-	-	-	-	-
22	0.5	WH/BN	6815	II	-	Inadvertent Power Control	22	0.5	WH/BN	6815	IV	-
23	0.5	GY	157	II	-	Interior Lamp Control	23	0.5	GY	157	IV	-
24	0.35	BK	550	II	AY0/AYF	Ground	24	0.5	BK	550	IV	-
25	-	-	-	-	-	Not Occupied	25	-	-	-	-	-
26	0.35	GN	5060	I	-	Low Speed GMLAN Serial Data	26	0.35	GN	5060	III	-
27	0.5	BK	650	I	-	Ground	27	0.5	BK	650	III	-
28	0.35	GN	2308	II	-	Passenger Air Bag Off Indicator Control	28	0.35	GN	2308	IV	-
29	0.35	VT/WH	5234	II	AY0/AYF	Passenger Seat Belt Indicator Control	29	0.35	VT/WH	5234	IV	AY0/AYF
30	0.35	BU	2307	II	-	Passenger Air Bag On Indicator Control	30	0.35	BU	2307	IV	-
31	0.35	GY/GN	7565	II	-	Windscreen Temp Sensor Signal	31	0.35	GY/GN	7565	IV	-CE1
32	0.35	GY/BU	7564	II	-	Humidity Sensor Signal	32	0.35	GY/BU	7564	IV	-CE1
33	0.35	YE/BU	3197	II	-	Humidity Temperature Sensor Signal	33	0.35	YE/BU	3197	IV	-CE1
34	0.35 0.5	BU BU	2500 2500	II II	UVX/UHY/UHX/UEU -UVX/UHY/UHX/UEU	High Speed GMLAN Serial Data (+) 1 High Speed GMLAN Serial Data (+) 1	34	0.5	BU	2500	IV	-
35	0.35 0.5	WH WH	2501 2501	II II	UVX/UHY/UHX/UEU -UVX/UHY/UHX/UEU	High Speed GMLAN Serial Data (-) 1 High Speed GMLAN Serial Data (-) 1	35	0.5	WH	2501	IV	-
36	-	-	-	-	-	Not Occupied	36	-	-	-	-	-
37	0.5	GY/GN	328	I	-	Interior Lamp Defeat Switch Signal	37	0.5	GY/GN	328	III	-
38	0.5	GY	156	I	-	Courtesy Lamp Switch Signal	38	0.5	GY	156	III	-
39	-	-	-	-	-	Not Occupied	39	-	-	-	-	-
40	0.35	RD/YE	3740	II	CE1	Battery Positive Voltage	40	0.35	RD/YE	3740	IV	-
41	0.5	BK	550	II	CE1	Ground	41	0.5	BK	550	IV	CE1
42 - 43	-	-	-	-	-	Not Occupied	42 - 43	-	-	-	-	-
44	0.35	GN/BN	6132	II	CE1	Local Interconnect Network Serial Data Bus 1	44	0.35	GN/BN	6132	IV	CE1
45	-	-	-	-	-	Not Occupied	45	-	-	-	-	-
46	0.35 0.5	BU BU	2500 2500	II II	UVX/UHY/UHX/UEU -UVX/UHY/UHX/UEU	High Speed GMLAN Serial Data (+) 1 High Speed GMLAN Serial Data (+) 1	46	0.5	BU	2500	IV	-
47	0.35 0.5	WH WH	2501 2501	II II	UVX/UHY/UHX/UEU -UVX/UHY/UHX/UEU	High Speed GMLAN Serial Data (-) 1 High Speed GMLAN Serial Data (-) 1	47	0.5	WH	2501	IV	-
48	-	-	-	-	-	Not Occupied	48	-	-	-	-	-

X210 INSTRUMENT PANEL HARNESS TO BODY HARNESS









Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: -
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F

Connector Part Information

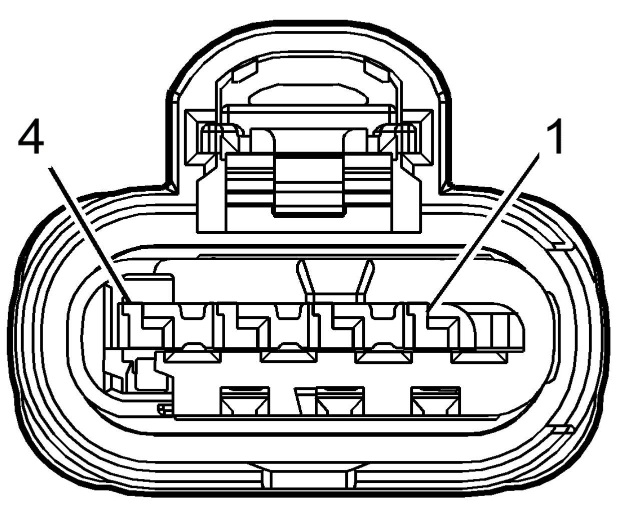
- Harness Type: Body
- OEM Connector: 7122-4123-30
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way M 375 Series (BK)

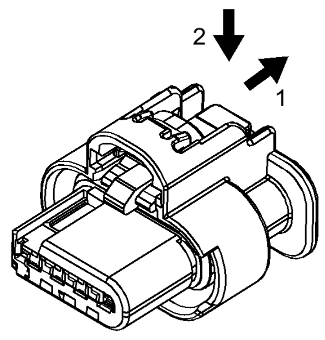
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-22 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-21 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	8	RD/GN	40	I	-	Battery Positive Voltage	1	8	RD/GN	40	II	-
2	8	RD/BU	42	I	-	Battery Positive Voltage	2	8	RD/BU	42	II	-

X215 INSTRUMENT PANEL HARNESS TO PASSENGER INSTRUMENT PANEL AIR BAG HARNESS





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Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 2138042-6
- Service Connector: 13586575
- Description: 4-Way F 1.2 MCON Series, Sealed (YE)

Connector Part Information

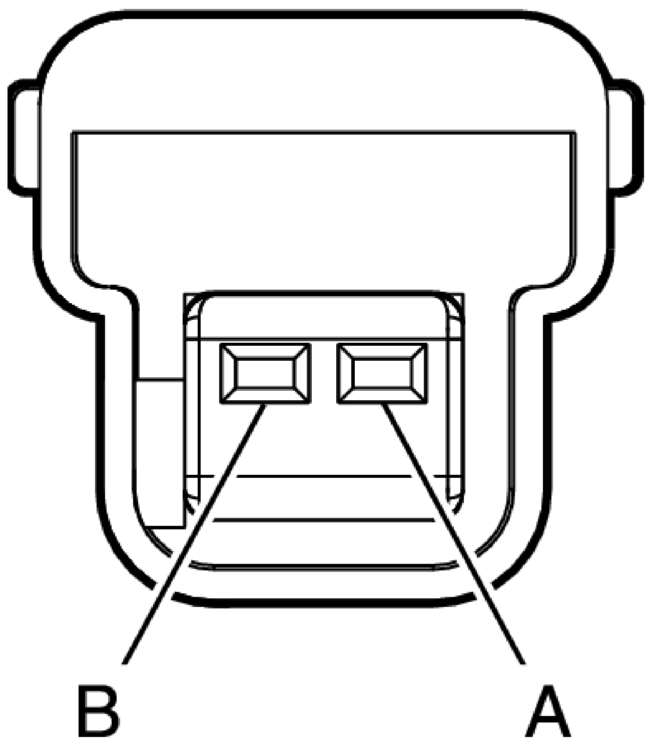
- Harness Type: Passenger Instrument Panel Air Bag
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M

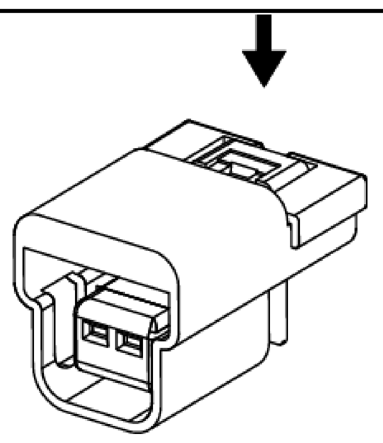
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-17 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	OG/WH	3024	I	AY0/AYF	Passenger IP Module Stage 1 Low Control	1	0.5	OG/WH	3024	II	AY0/AYF
2	0.5	YE/OG	3025	I	AY0/AYF	Passenger IP Module Stage 1 High Control	2	0.5	YE/OG	3025	II	AY0/AYF
3	0.5	OG/VT	3026	I	AY0/AYF	Passenger IP Module Stage 2 Low Control	3	0.5	OG/VT	3026	II	AY0/AYF
4	0.5	GY/OG	3027	I	AY0/AYF	Passenger IP Module Stage 2 High Control	4	0.5	GY/OG	3027	II	AY0/AYF

X236 INSTRUMENT PANEL HARNESS TO AIR DUCT JUMPER HARNESS





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Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 15332128

Connector Part Information

- Harness Type: Air Duct Jumper
- OEM Connector: Not Available

- Service Connector: 19354839
- Description: 2-Way F 150 GT Series (BK)

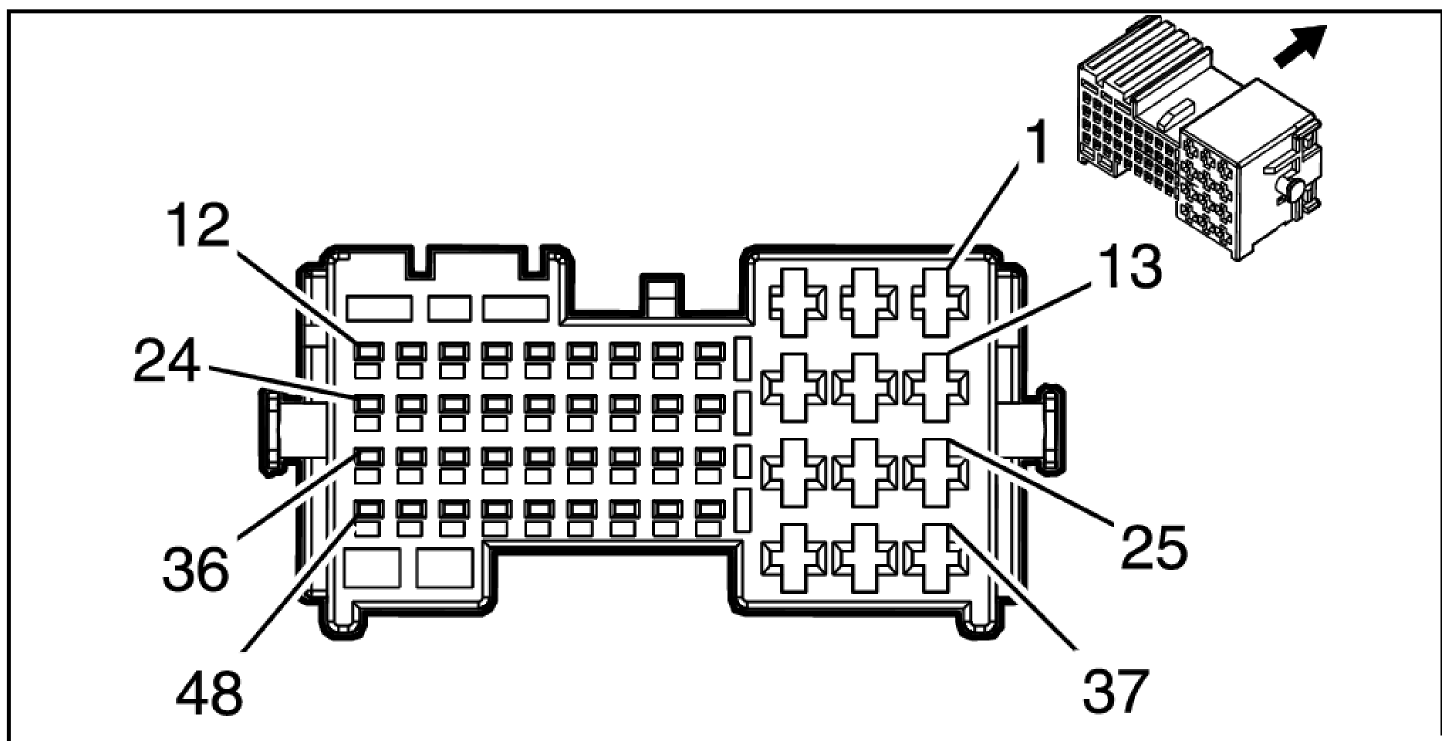
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

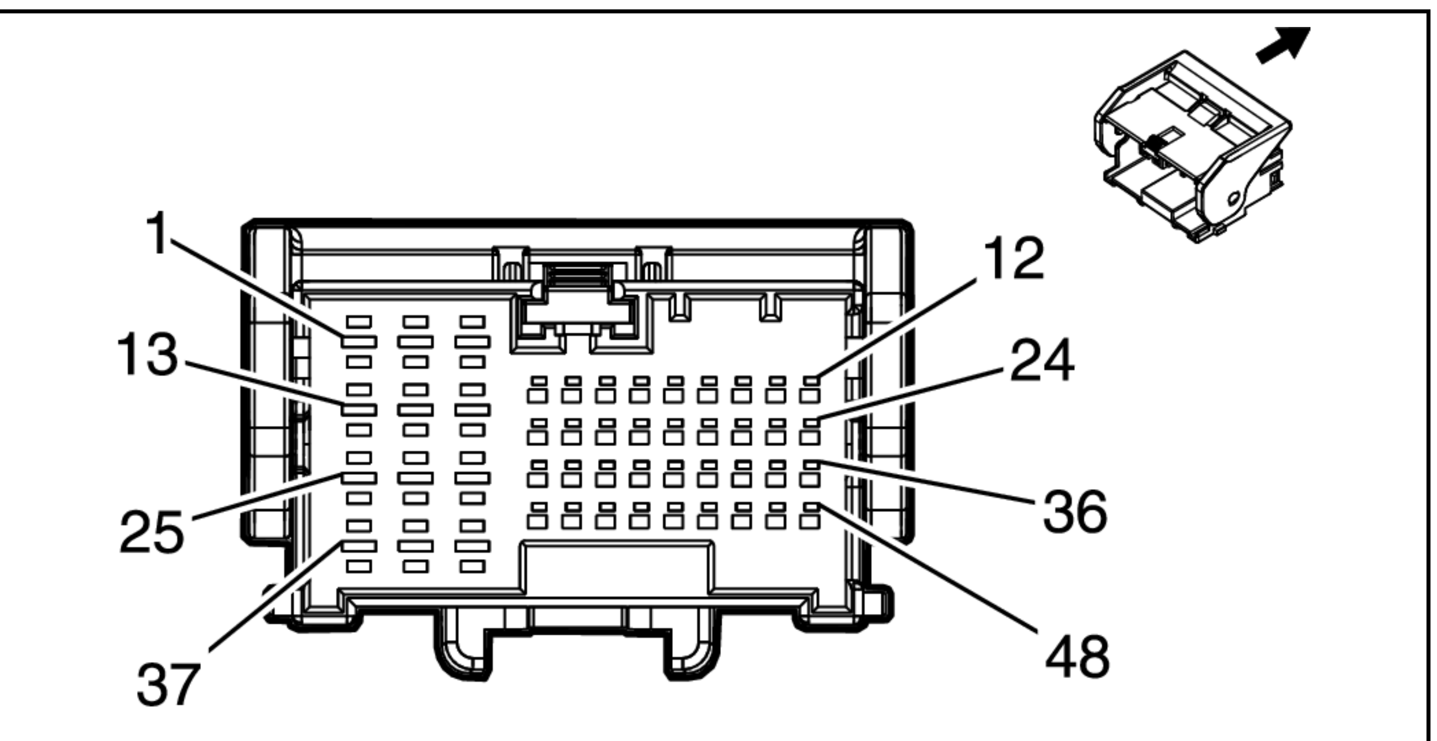
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
A	-	-	-	-	-	Not Occupied	A	-	-	-	-	-
B	0.5	BN	518	I	-	Lower Left Air Temperature Sensor Signal	B	0.5	BN	518	II	-

X300 FLOOR CONSOLE HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Floor Console
- OEM Connector: 2109452-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 48-Way F 1.2 MCON, 2.8 MCP Series (BK)



Connector Part Information

- Harness Type: Body
- OEM Connector: 5-2109455-2
- Service Connector: 19329740
- Description: 48-Way M 1.2 MCON, 2.8 MCP Series (BK)

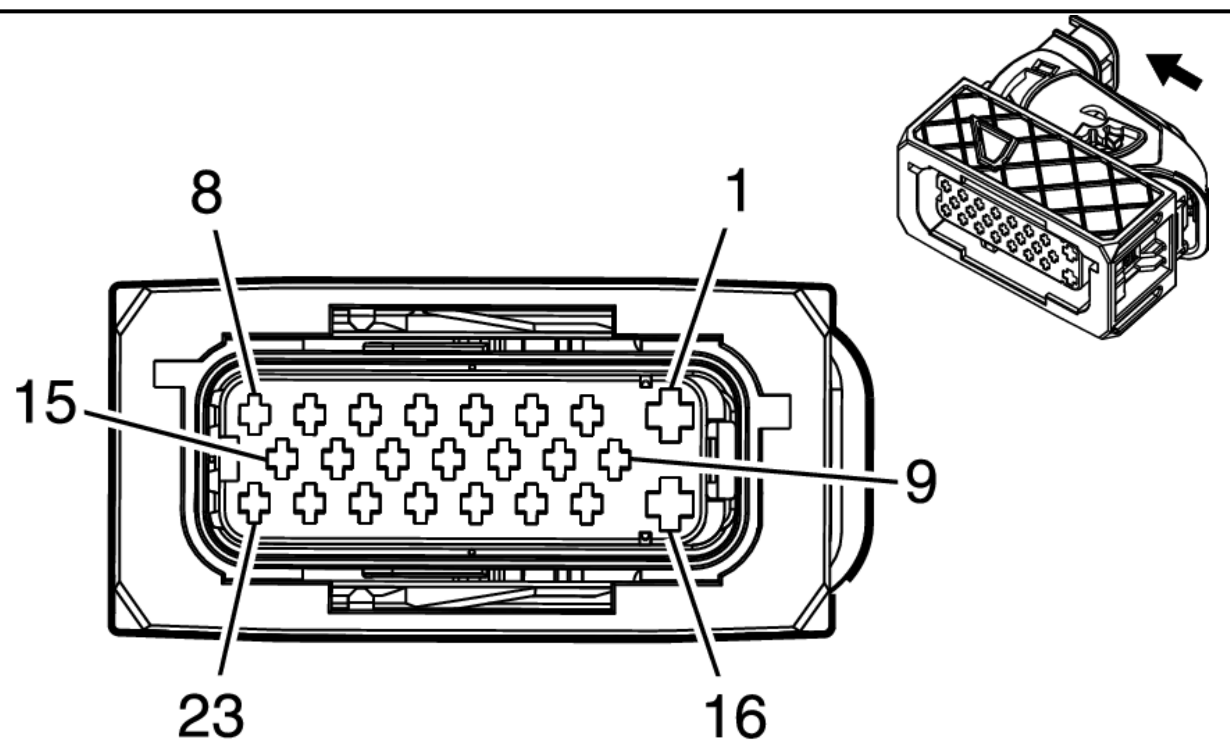
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available
IV	19329749	J-35616-13 (BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	VT	4601	II	K4C	Retained Accessory Power Fused Control	1	0.5	VT	4601	III	K4C
2 - 3	-	-	-	-	-	Not Occupied	2 - 3	-	-	-	-	-
4	0.35	BK	550	I	USS	Ground	4	0.35	BK	550	IV	USS
5	0.35	VT	2801	I	USS	Retained Accessory Power Fuse Ignition	5	0.35	VT	2801	IV	USS
6	0.5	BK	550	I	K4C	Ground	6	0.5	BK	550	IV	K4C
7	0.35	GN	4512	I	K4C	Wireless Charging System Charge Indicator Control	7	0.35	GN	4512	IV	K4C
8	0.5	BK	750	I	-	Ground	8	0.35	BK	750	IV	-
9	0.35	RD/GN	6940	I	-	Battery Positive Voltage	9	0.35	RD/GN	6940	IV	-
10	0.35	GN/VT	4759	I	-	Remote PRNDL Enable	10	0.35	GN/VT	4759	IV	-
11	0.35	VT/GN	2629	I	-	Transmission Shifter Park Position Switch 1 Signal	11	0.35	VT/GN	2629	IV	-
12	0.35	BK/GY	2630	I	-	Transmission Shifter Park Position Switch 1 Return	12	0.35	BK/GY	2630	IV	-
13 - 15	-	-	-	-	-	Not Occupied	13 - 15	-	-	-	-	-
16	0.35	WH/GY	2631	I	-	Transmission Shifter Park Position Switch 2 Signal	16	0.35	WH/GY	2631	IV	-
17	0.35	BK/VT	2632	I	-	Transmission Shifter Park Position Switch 2 Return	17	0.35	BK/VT	2632	IV	-
18	0.35	YE/BU	2633	I	-	Transmission Shifter Position Sensor 2 Alpha Signal	18	0.35	YE/BU	2633	IV	-
19	0.35	VT/BU	2634	I	-	Transmission Shifter Position Sensor 2 Beta Signal	19	0.35	VT/BU	2634	IV	-
20	0.35	GN/RD	2635	I	-	Transmission Shifter Position Sensor 2 Voltage Reference	20	0.35	GN/RD	2635	IV	-
21	0.35	BK/GN	2636	I	-	Transmission Shifter Position Sensor 2 Low Reference	21	0.35	BK/GN	2636	IV	-
22	0.35	YE/BN	2644	I	-	Transmission Shifter Position Sensor 1 Alpha Signal	22	0.35	YE/BN	2644	IV	-
23	0.35	VT/BN	2645	I	-	Transmission Shifter Position Sensor 1 Beta Signal	23	0.35	VT/BN	2645	IV	-
24	0.35	BU/RD	2646	I	-	Transmission Shifter Position Sensor 1 Voltage Reference	24	0.35	BU/RD	2646	IV	-
25 - 26	-	-	-	-	-	Not Occupied	25 - 26	-	-	-	-	-
27	0.5	BK	750	II	-	Ground	27	0.5	BK	750	III	-
28	0.35	BK/BU	2647	I	-	Transmission Shifter Position Sensor 1 Low Reference	28	0.35	BK/BU	2647	IV	-
29	0.35	WH	2648	I	-	Transmission Shift Interlock Switch 1 Signal	29	0.35	WH	2648	IV	-
30	0.35	BK/BN	2649	I	-	Transmission Shift Interlock Switch 1 Return	30	0.35	BK/BN	2649	IV	-
31	0.35	WH/GN	2654	I	-	Transmission Shift Interlock Switch 2 Signal	31	0.35	WH/GN	2654	IV	-
32	0.35	BK/GN	2655	I	-	Transmission Shift Interlock Switch 2 Return	32	0.35	BK/GN	2655	IV	-
33	0.35	GY/BK	3276	I	-	Vehicle Anti-Theft System Immobilizer Control	33	0.35	GY/BK	3276	IV	-
34	0.35	GN/GY	3277	I	-	Vehicle Anti-Theft System Immobilizer Low Reference	34	0.35	GN/GY	3277	IV	-

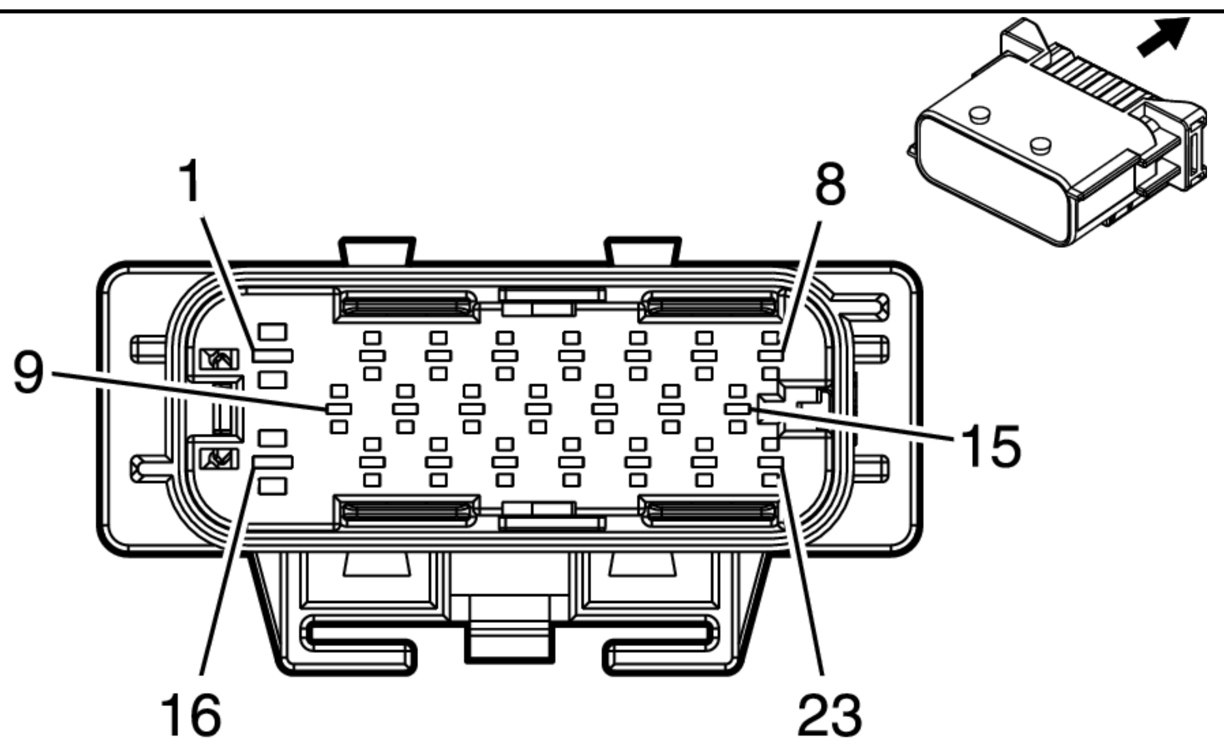
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
35	0.35	GN/VT	7533	I	-	Local Interconnect Network Serial Data Bus 11	35	0.35	GN/VT	7533	IV	-
36	-	-	-	-	-	Not Occupied	36	-	-	-	-	-
37	0.5	BU	3554	II	-	Passive Start Interior Antenna 2 Signal Hi	37	0.5	BU	3554	III	-
38	0.5	GY/BK	3555	II	-	Passive Start Interior Antenna 2 Signal Lo	38	0.5	GY/BK	3555	III	-
39	-	-	-	-	-	Not Occupied	39	-	-	-	-	-
40	0.5	GN/BU	4626	I	-	Local Interconnect Network Serial Data Bus 26	40	0.5	GN/BU	4626	IV	-
41	0.35	BU/VT	1134	I	-	Park Brake Switch Signal	41	0.35	BU/VT	1134	IV	-
42	0.35	GY/RD	7684	I	-	Park Brake Apply Switch Voltage Reference	42	0.35	GY/RD	7684	IV	-
43	0.35	BN	6107	I	-	Park Brake Apply Switch Signal	43	0.35	BN	6107	IV	-
44	0.35	BU/BK	6108	I	-	Park Brake Release Switch Signal	44	0.35	BU/BK	6108	IV	-
45	0.35	YE/RD	7683	I	-	Park Brake Release Switch Voltage Reference	45	0.35	YE/RD	7683	IV	-
46	0.35	YE	1492	I	-	Park Brake Switch Supply Voltage	46	0.35	YE	1492	IV	-
47	0.35	BK	2050	I	-	Ground	47	0.35	BK	2050	IV	-
48	0.35	YE	6817	I	-	LED Backlight Dimming Control	48	0.35	YE	6817	IV	-

X310 DRIVER SEAT HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Driver Seat
- OEM Connector: 13674806
- Service Connector: Service by Harness - See Part Catalog
- Description: 23-Way F 1.5 DSQ, 2.8 AST Series, Sealed (BK)



Connector Part Information

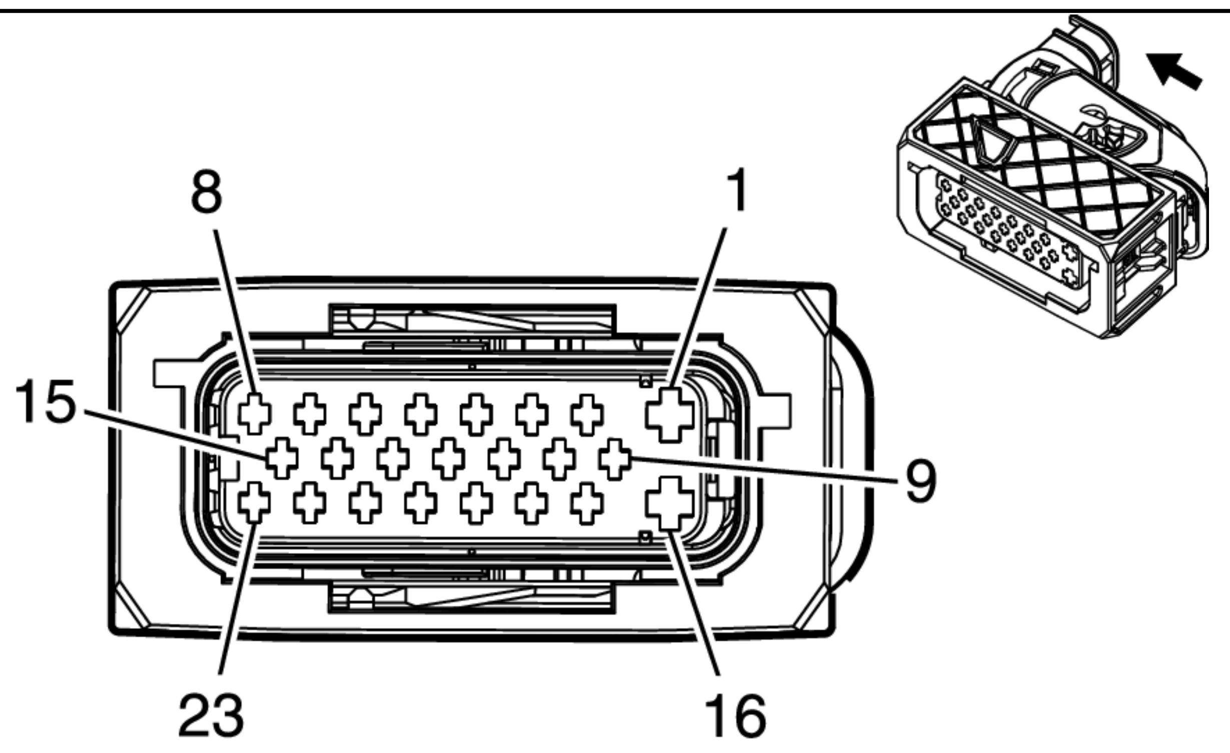
- Harness Type: Body
- OEM Connector: 13750010
- Service Connector: 19332380
- Description: 23-Way M 1.5 DSQ, 2.8 AST Series, Sealed (BK)

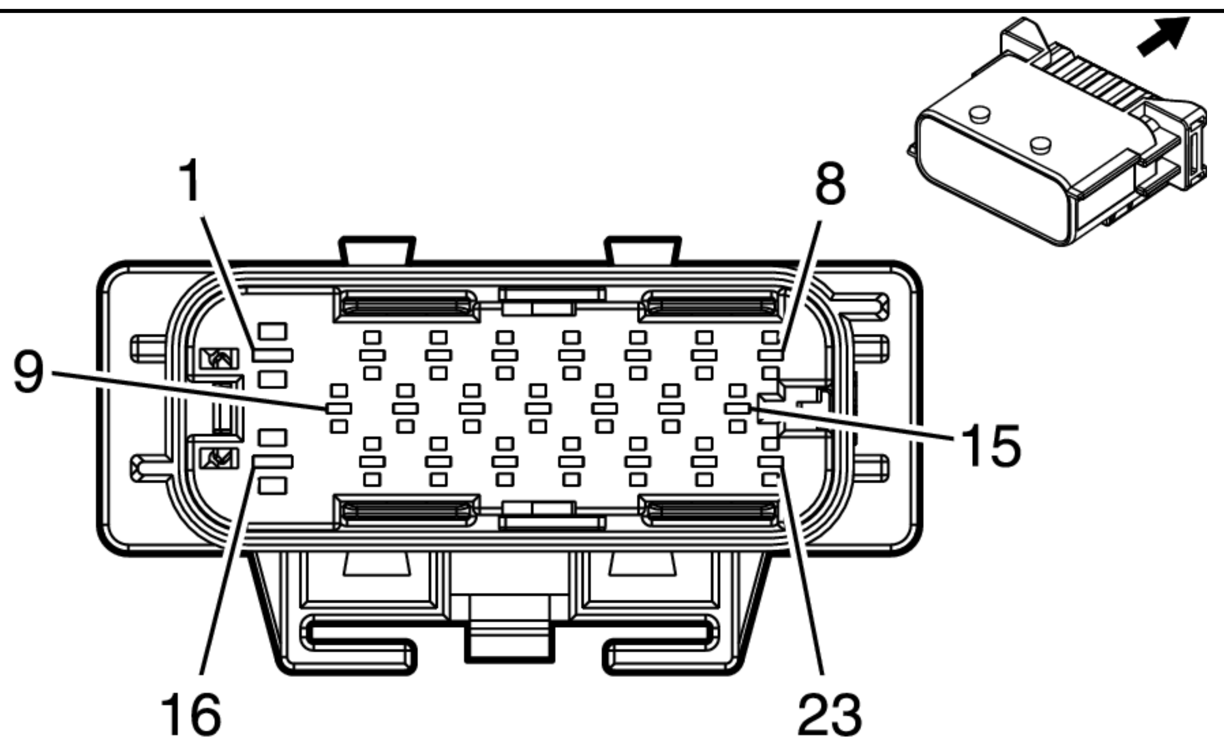
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13505800	J-35616-5 (PU)	J-38125-557	Not Available	Not Available	Not Available	Not Available
IV	13575380	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
V	13579756	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BN/VT	2077	II	-	Driver Heated Seat Element Control	1	0.75	BN/VT	2077	III	KA1
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.5	OG/BN	238	I	-	Driver Seat Belt Switch Signal	3	0.5	OG/BN	238	IV	-
4	0.5	BK/OG	1363	I	-	Driver Seat Belt Switch Low Reference	4	0.5	BK/OG	1363	IV	-
5	0.5	BK/YE	2080	I	-	Driver Heated Seat NTC Low Reference	5	0.5	BK/YE	2080	IV	KA1
6	0.5	YE/GY	2079	I	-	Driver Heated Seat NTC Signal	6	0.5	YE/GY	2079	IV	KA1
7	0.5	BU	2425	I	-	Driver Heated Back NTC Signal	7	0.5	BU	2425	IV	KA1
8 - 9	-	-	-	-	-	Not Occupied	8 - 9	-	-	-	-	-
10	0.5	OG/BU	3068	I	-	Driver Side Impact Module High Control	10	0.5	OG/BU	3068	V	-
11	0.5	BK/OG	3069	I	-	Driver Side Impact Module Low Control	11	0.5	BK/OG	3069	V	-
12 - 15	-	-	-	-	-	Not Occupied	12 - 15	-	-	-	-	-
16	0.75	VT/BK	2424	II	-	Driver Heated Back Element Low Reference	16	0.75	VT/BK	2424	III	KA1
17 - 23	-	-	-	-	-	Not Occupied	17 - 23	-	-	-	-	-

X320 PASSENGER SEAT HARNESS TO BODY HARNESS





Connector Part Information

- Harness Type: Passenger Seat
- OEM Connector: 13674806
- Service Connector: Service by Harness - See Part Catalog
- Description: 23-Way F 1.5 DSQ, 2.8 AST Series, Sealed (BK)

Connector Part Information

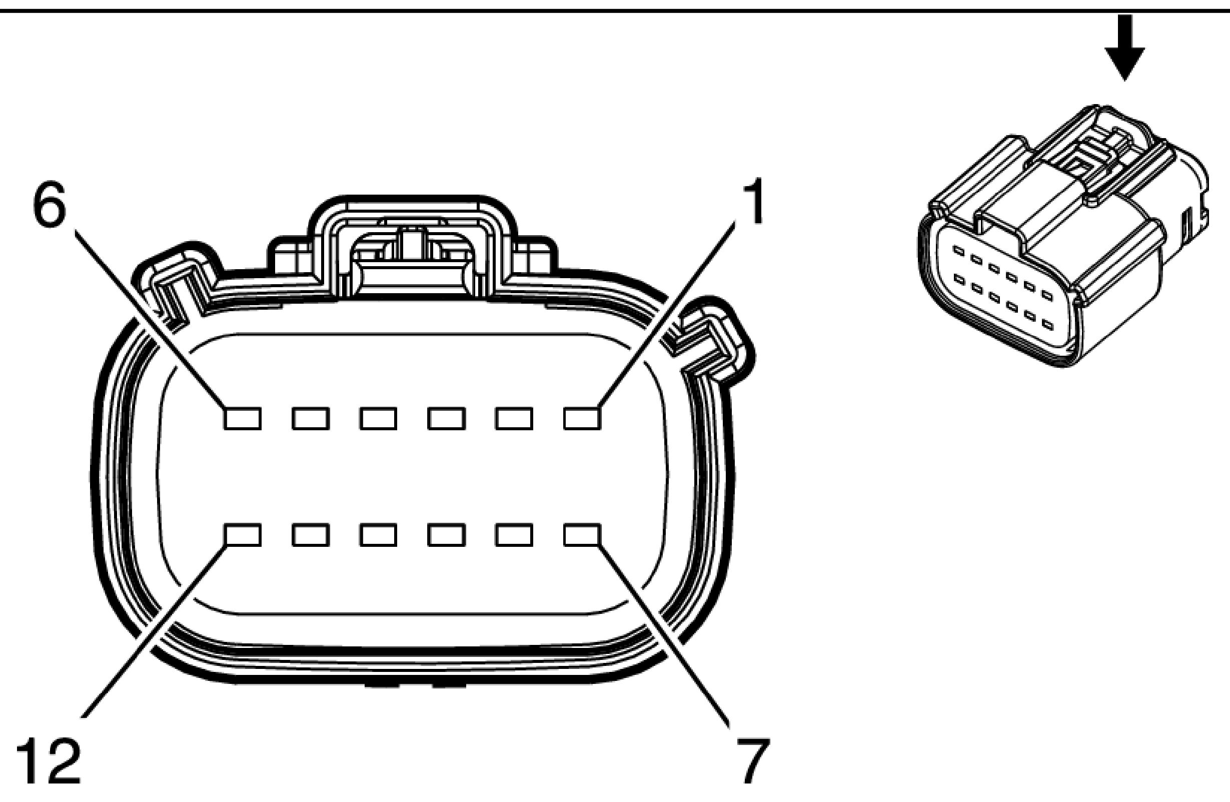
- Harness Type: Body
- OEM Connector: 13750010
- Service Connector: 19332380
- Description: 23-Way M 1.5 DSQ, 2.8 AST Series, Sealed (BK)

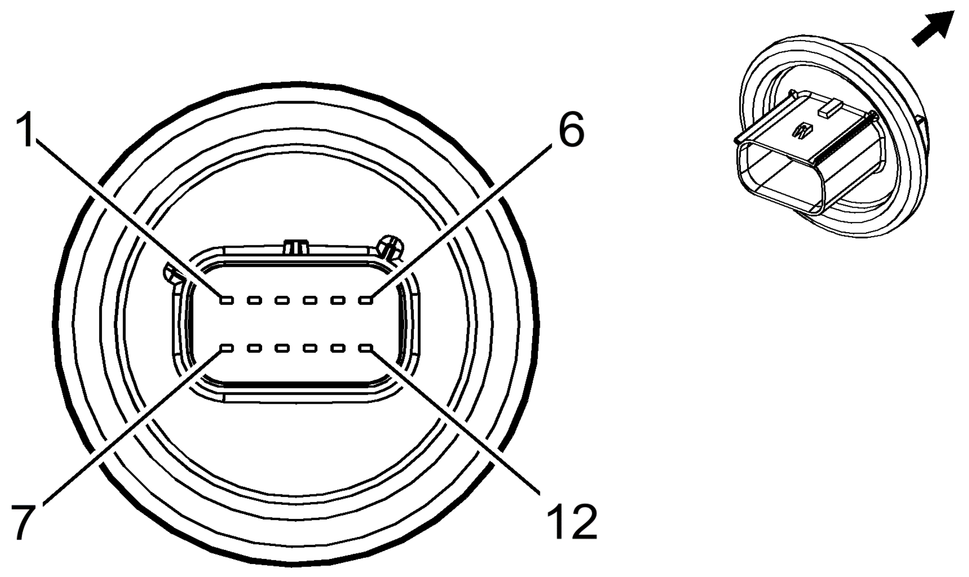
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13505800	J-35616-5 (PU)	J-38125-557	Not Available	Not Available	Not Available	Not Available
IV	13505813	J-35616-5 (PU)	J-38125-557	Not Available	Not Available	Not Available	Not Available
V	13575380	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available
VI	13579756	J-35616-3 (GY)	J-38125-560	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2	RD/BU	540	II	-	Battery Positive Voltage	1	1	RD/BU	540	III	KA1
2	0.5	OG/BN	7571	I	-	Passenger Seat Belt Reminder Signal	2	0.5	OG/BN	7571	V	-
3	0.5	OG/VT	1362	I	-	Passenger Seat Belt Switch Signal	3	0.5	OG/VT	1362	V	-
4	0.5	BK/OG	1361	I	-	Passenger Seat Belt Switch Low Reference	4	0.5	BK/OG	1361	V	-
5	0.75	VT/BK	2424	I	-	Driver Heated Back Element Low Reference	5	0.75	VT/BK	2424	V	KA1
6	0.5	BK/YE	2080	I	-	Driver Heated Seat NTC Low Reference	6	0.5	BK/YE	2080	V	KA1
7	0.5	YE/GY	2079	I	-	Driver Heated Seat NTC Signal	7	0.5	YE/GY	2079	V	KA1
8	0.75	BN/VT	2077	I	-	Driver Heated Seat Element Control	8	0.75	BN/VT	2077	V	KA1
9	0.5	GN/BU	6133	I	-	Local Interconnect Network Serial Data Bus 2	9	0.5	GN/BU	6133	V	-
10	0.5	OG/GY	3066	I	-	Passenger Side Impact Module High Control	10	0.5	OG/GY	3066	VI	-
11	0.5	BU/OG	3067	I	-	Passenger Side Impact Module Low Control	11	0.5	BU/OG	3067	VI	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-
13	0.5	RD/GN	2440	I	-	Battery Positive Voltage	13	0.5	RD/GN	2440	V	AL0
14	0.5	GN	5060	I	-	Low Speed GMLAN Serial Data	14	0.5	GN	5060	V	AL0
15	0.5	BK	750	I	-	Ground	15	0.5	BK	750	V	AL0
16	2	BK	850	II	-	Ground	16	2	BK	850	IV	KA1
17	-	-	-	-	-	Not Occupied	17	-	-	-	-	-
18	0.5	OG/BN	3947	I	-	Automatic Locking Retractor Switch Signal	18	0.5	OG/BN	3947	V	AL0
19	0.5	GY/OG	3946	I	-	Automatic Locking Retractor Switch Low Reference	19	0.5	GY/OG	3946	V	AL0
20	-	-	-	-	-	Not Occupied	20	-	-	-	-	-
21	1.5	RD/BU	540	I	-	Battery Positive Voltage	21	1	RD/BU	540	V	KA1
22	-	-	-	-	-	Not Occupied	22	-	-	-	-	-
23	0.5	BU	2425	I	-	Driver Heated Back NTC Signal	23	0.5	BU	2425	V	KA1

X357 BODY HARNESS TO BATTERY CABLE HARNESS





Connector Part Information

- Harness Type: Body
- OEM Connector: 33472-1259
- Service Connector: 19333239
- Description: 12-Way F 150 MX Series, Sealed (D-GY)

Connector Part Information

- Harness Type: Battery Cable
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way M

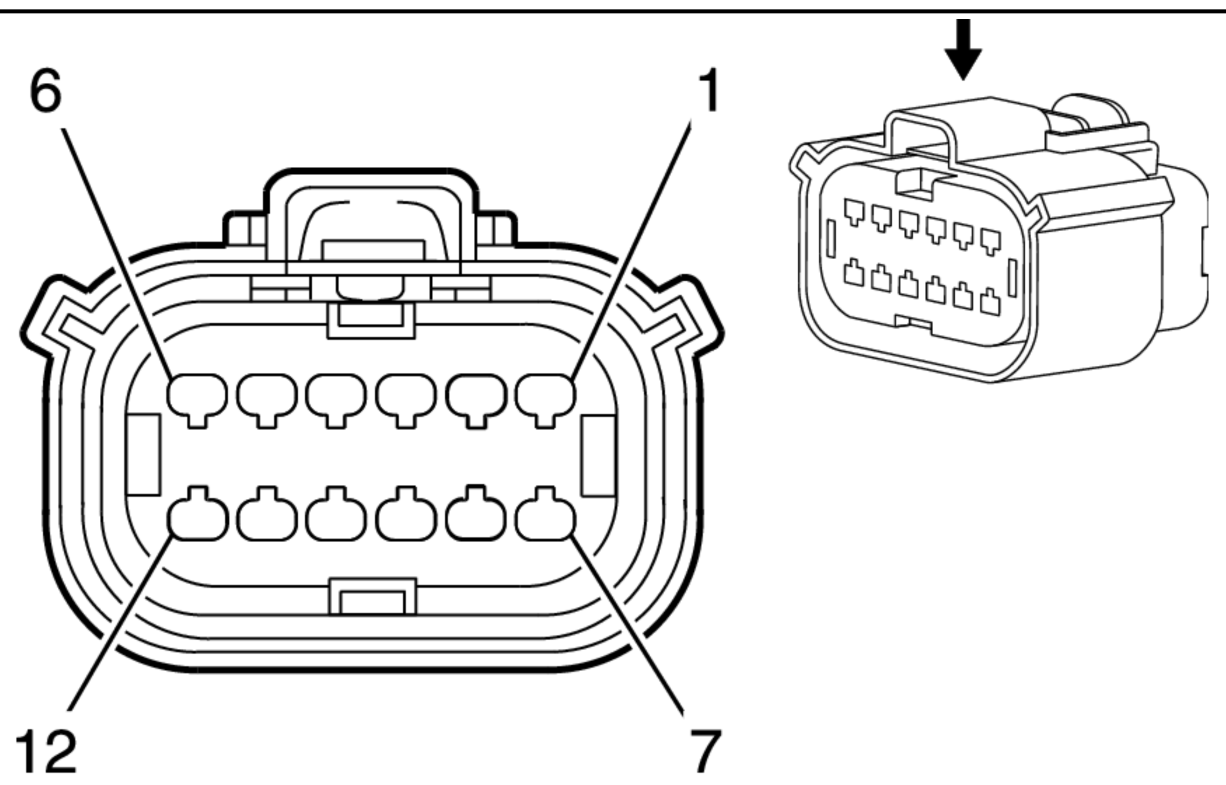
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	19300635	J-35616-2A (GY)	J-38125-217	Not Available	Not Available	Not Available	Not Available
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	RD/VT	1640	I	-	Battery Positive Voltage	1	0.5	RD/VT	1640	II	-
2	0.5	BU/WH	3977	I	-	Accessory Wakeup Serial Data 2	2	0.5	BU/WH	3977	II	-
3	0.5	YE	3831	I	-	High Speed GMLAN Serial Data (+) 6	3	0.5	YE	3831	II	-
4	0.5	WH	3832	I	-	High Speed GMLAN Serial Data (-) 6	4	0.5	WH	3832	II	-
5	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	5	0.5	BU	2500	II	-
6	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	6	0.5	WH	2501	II	-
7	0.5	BU	2500	I	-	High Speed GMLAN Serial Data (+) 1	7	0.5	BU	2500	II	-
8	0.5	WH	2501	I	-	High Speed GMLAN Serial Data (-) 1	8	0.5	WH	2501	II	-
9	0.5	BU/GY	5139	I	-	High Voltage Fault Signal	9	0.5	BU/GY	5139	II	-

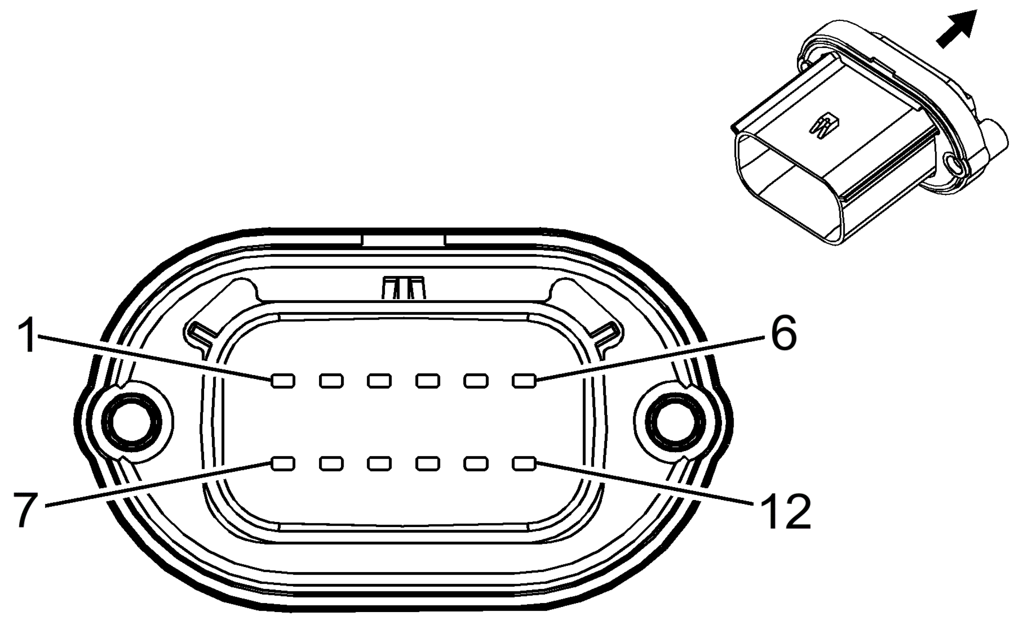
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
10	0.5	VT/GN	1339	I	-	Run/Crank Ignition 1 Voltage	10	0.5	VT/GN	1339	II	-
11	0.5	BU/BN	3787	I	-	High Voltage Energy Management Communication Control	11	0.5	BU/BN	3787	II	-
12	-	-	-	-	-	Not Occupied	12	-	-	-	-	-

X358 BODY HARNESS TO BATTERY HARNESS



Connector Part Information

- Harness Type: Body
- OEM Connector: 33472-1274
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F 1.5 Series, Sealed (BK)



Connector Part Information

- Harness Type: Battery
- OEM Connector: 44725-2010
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way M MX150 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	Not Available	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	BK/BN	5087	I	-	High Voltage Interlock Loop Signal 1	1	-	VT	5087	II	-
2	-	VT	5088	I	-	High Voltage Interlock Loop Low Reference 1	2	-	BK/BN	5088	II	-
3	-	BN/GN	3959	I	-	High Voltage Battery 1 (+) Relay Control	3	-	BN/GN	3959	II	-
4	-	VT/GY	3961	I	-	High Voltage Battery (-) Relay Control	4	-	VT/GY	3961	II	-
5	-	YE/VT	3962	I	-	High Voltage Battery 3 (+) Relay Control	5	-	YE/VT	3962	II	-
6	-	-	-	-	-	Not Occupied	6	-	-	-	-	-
7	-	GY	5138	I	-	Precharge Relay	7	-	GY	5138	II	-
8	-	YE	5411	I	-	Battery Module Temperature Signal 7	8	-	YE	5411	II	-
9	-	BK/BU	3779	I	-	Battery Module Temperature Sensor Low Reference 7	9	-	BK	3779	II	-
10	-	BK	850	I	-	Ground	10	-	BK	850	II	-
11 - 12	-	-	-	-	-	Not Occupied	11 - 12	-	-	-	-	-

X360 RIGHT REAR SEAT HARNESS TO BODY HARNESS (KA6)

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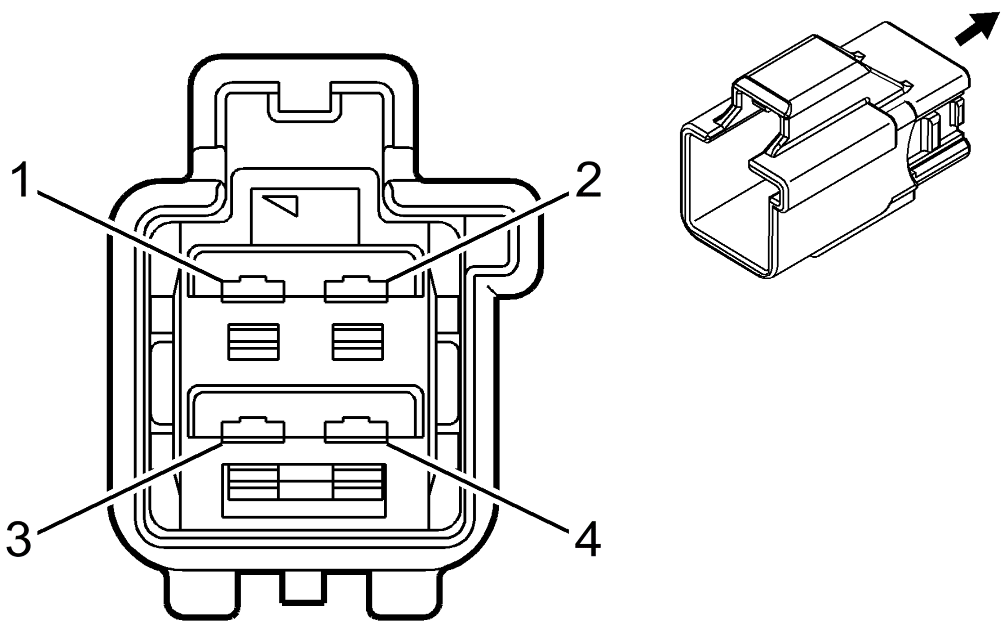


Connector Part Information

- Harness Type: Right Rear Seat
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F

Connector Part Information

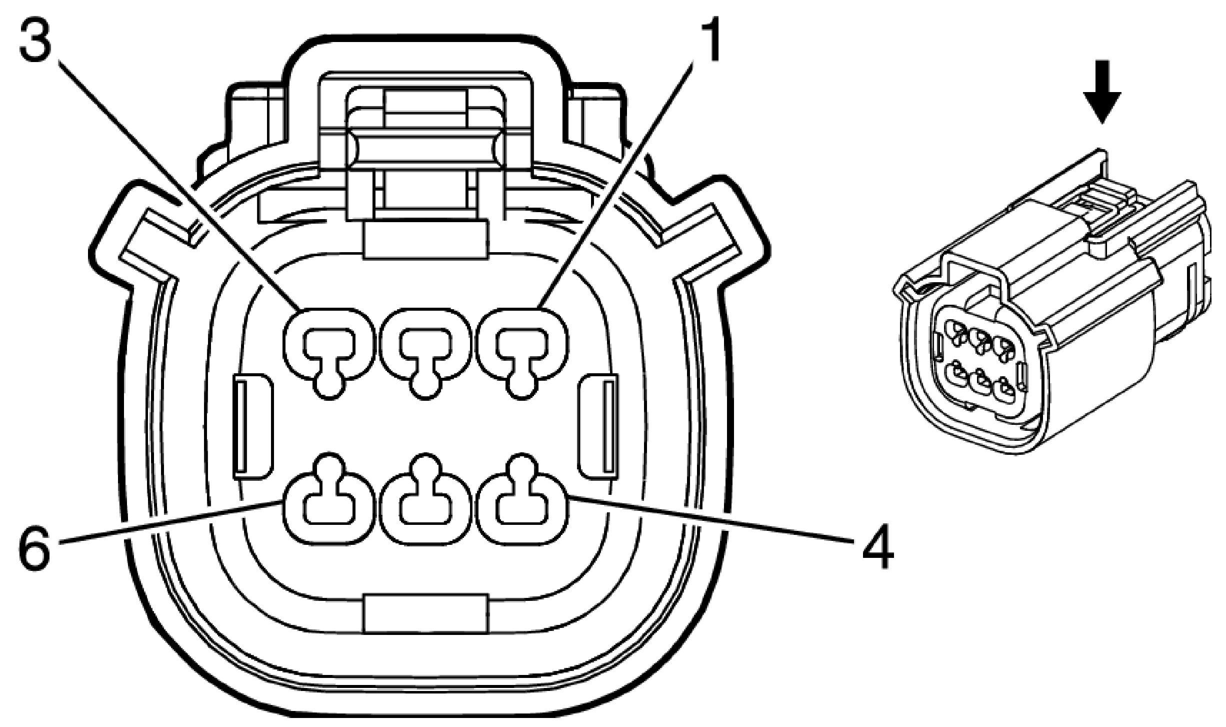
- Harness Type: Body
- OEM Connector: 7282-6446-40
- Service Connector: 89046843
- Description: 4-Way M 2.8 YESC Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-4A (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-5 (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

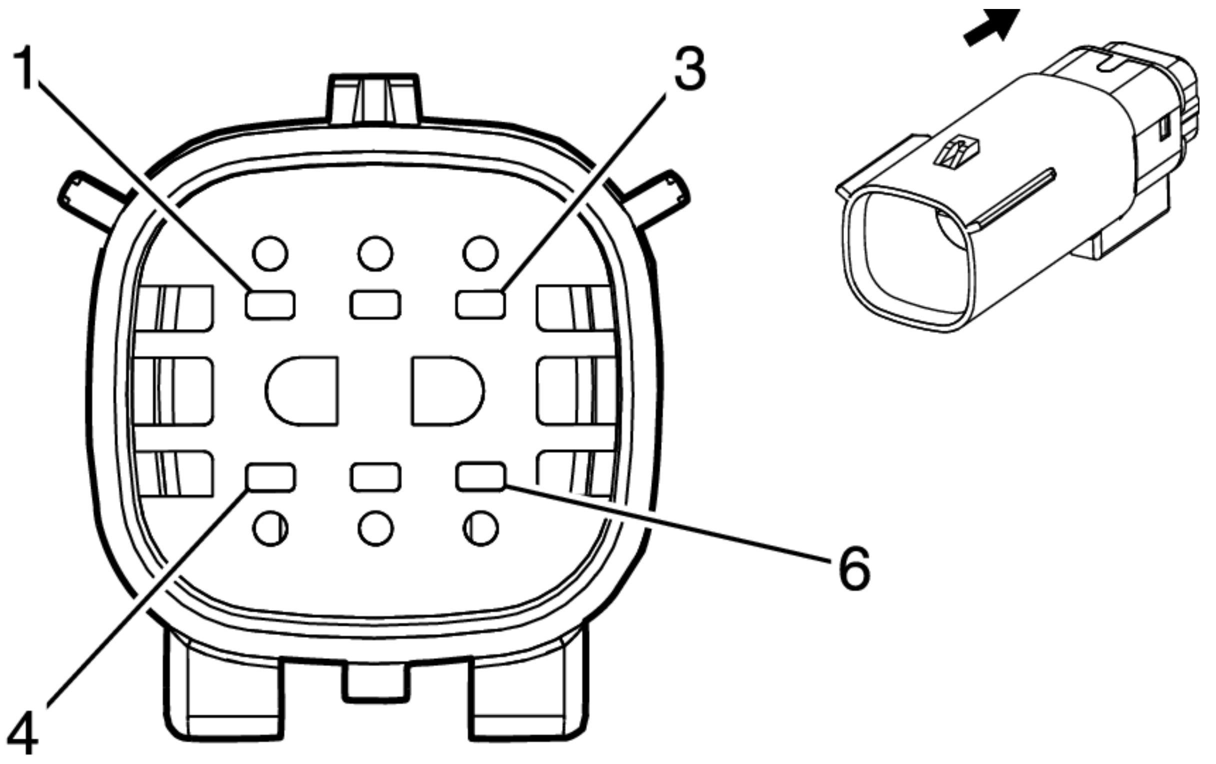
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	RD/BU	540	I	KA6	Battery Positive Voltage	1	0.75	RD/BU	540	II	KA6
3	0.75	BK	1050	I	KA6	Ground	3	0.75	BK	2250	II	KA6
4	0.5	GN/BU	6133	I	-	Local Interconnect Network Serial Data Bus 2	4	0.5	GN/BU	6133	II	KA1+KA6

X410 REAR FASCIA HARNESS TO LEFT LAMP JUMPER HARNESS (TW5)



Connector Part Information

- Harness Type: Rear Fascia
- OEM Connector: 33472-0665
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 150 MX Series, Sealed (BK)



Connector Part Information

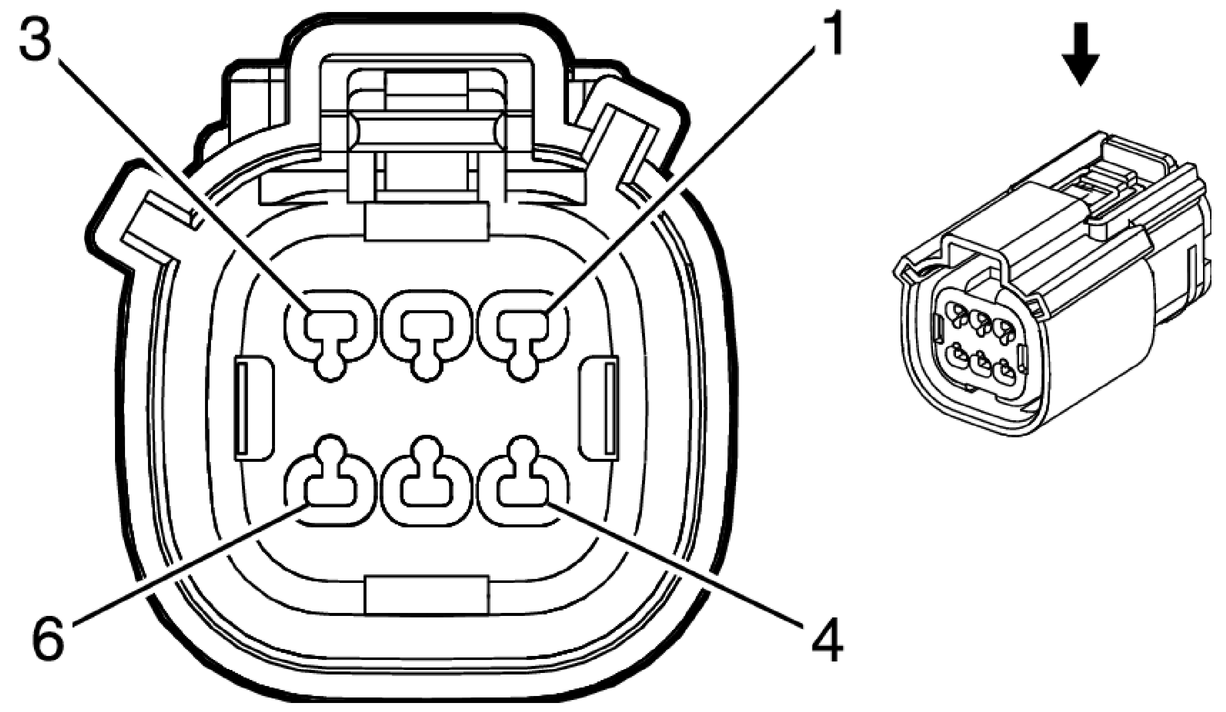
- Harness Type: Left Lamp Jumper
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

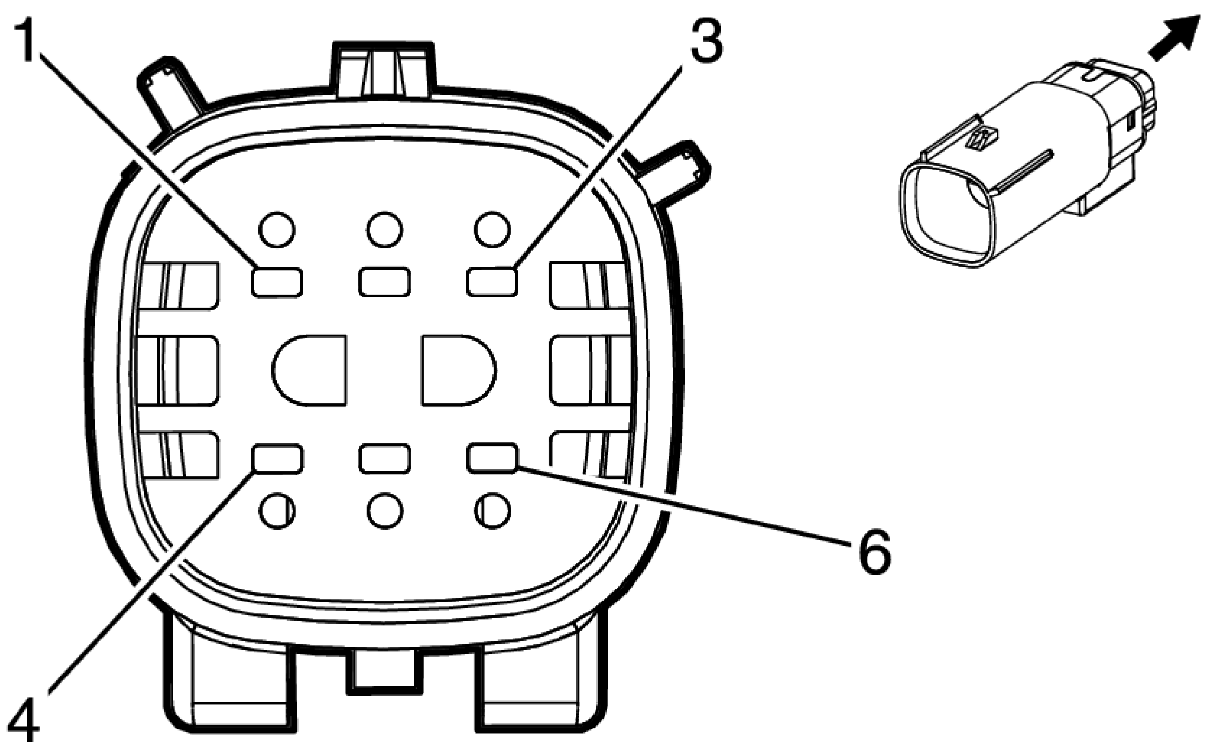
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	GY/YE	3687	I	TW5	Left Rear Supplemental Stop Lamp Control	2	0.5	GY/YE	3687	II	TW5
3	0.5	BU/WH	1334	I	TW5	Left Rear Turn Signal Lamp Control	3	0.5	BU/WH	1334	II	TW5
4	0.5	GN/WH	24	I	TW5	Backup Lamp Control	4	0.5	GN/WH	24	II	TW5
5	0.5	BK	1150	I	TW5	Ground	5	0.5	BK	1150	II	TW5
6	0.5	BK	1150	I	TW5	Ground	6	0.5	BK	1150	II	TW5

X410 REAR FASCIA HARNESS TO LEFT LAMP JUMPER HARNESS (VD1)



Connector Part Information

- Harness Type: Rear Fascia
- OEM Connector: 33472-0602
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 1.5 Series, Sealed (GY)



Connector Part Information

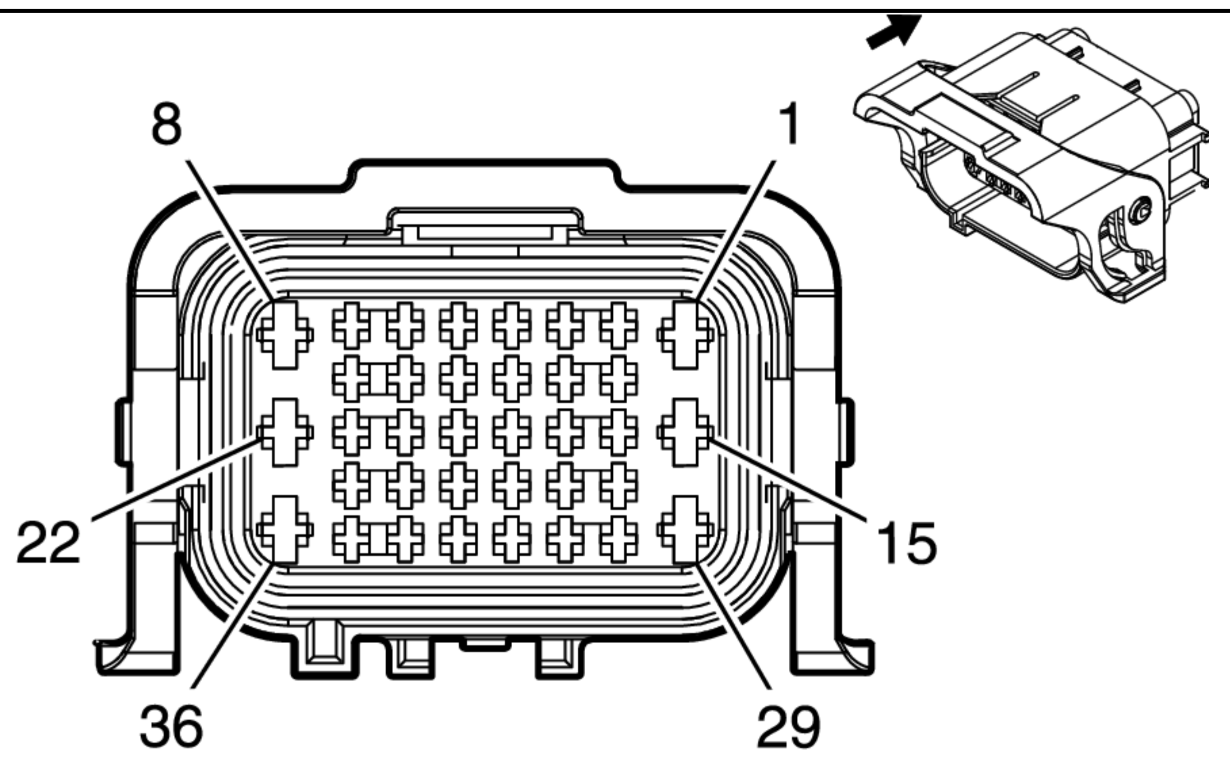
- Harness Type: Left Lamp Jumper
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way M

Terminal Part Information

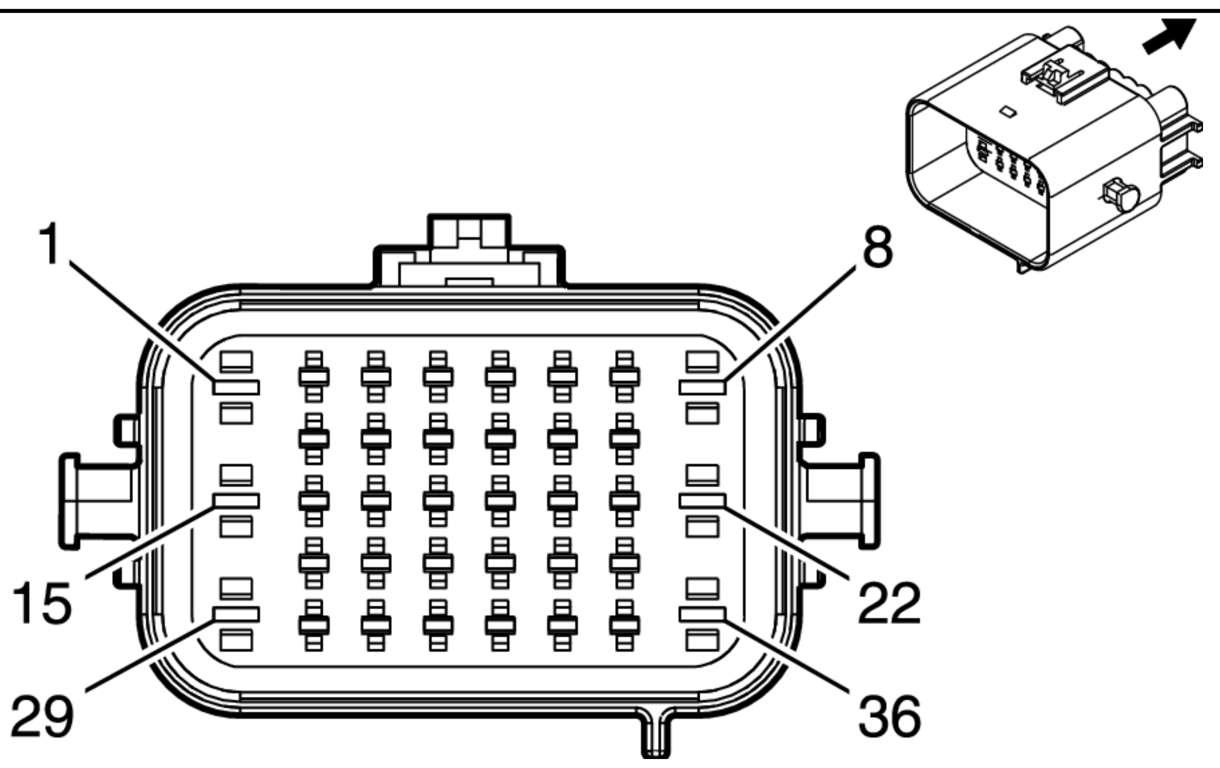
Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	GY/YE	3687	I	VD1	Left Rear Supplemental Stop Lamp Control	2	0.5	GY/YE	3687	II	VD1
3	0.5	BU/WH	1334	I	VD1	Left Rear Turn Signal Lamp Control	3	0.5	BU/WH	1334	II	VD1
4	0.5	BN/BU	1977	I	VD1	Rear Fog Lamp Relay Control	4	0.5	BN/BU	1977	II	VD1
5	0.5	BK	1150	I	VD1	Ground	5	0.5	BK	1150	II	VD1
6	0.5	BK	1150	I	VD1	Ground	6	0.5	BK	1150	II	VD1

X415 BODY HARNESS TO REAR FASCIA HARNESS



Connector Part Information



Connector Part Information

- Harness Type: Body
- OEM Connector: 1743059-2
- Service Connector: 13580088
- Description: 36-Way F Micro-Timer II, Junior Power Timer Series (BK)

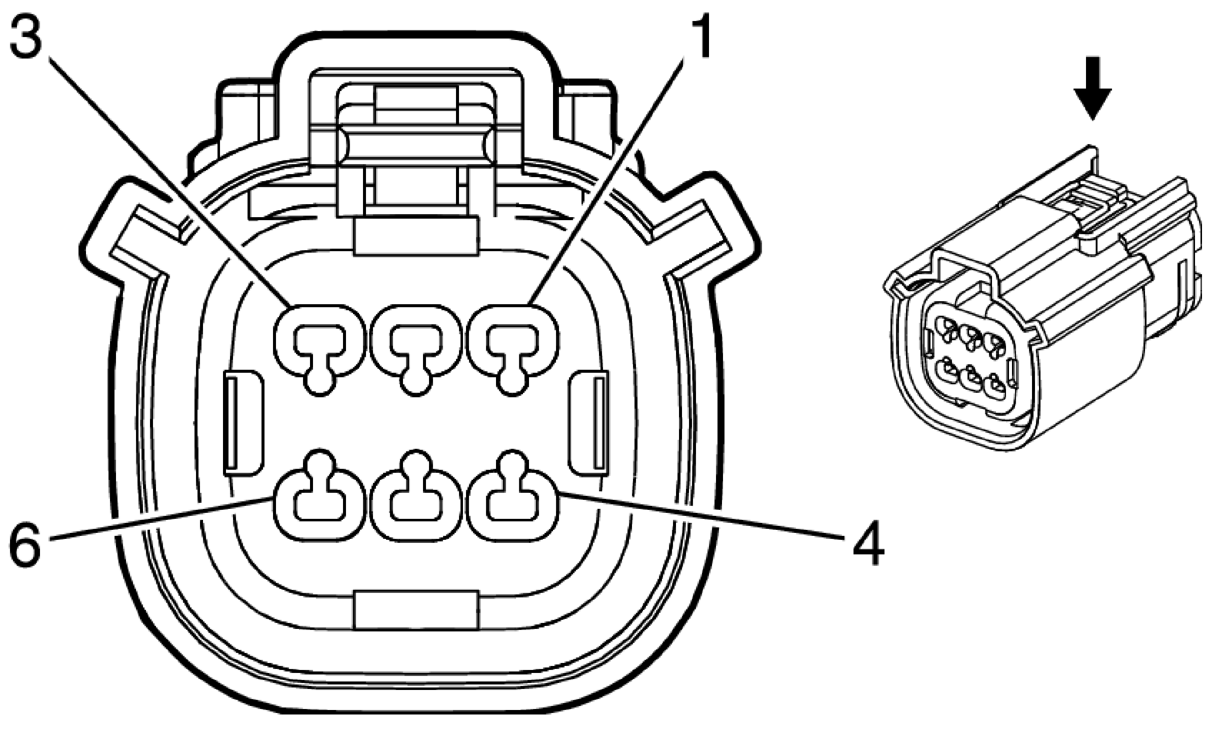
- Harness Type: Rear Fascia
- OEM Connector: 1743062-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 36-Way M Micro-Timer II, Junior Power Timer Hybrid Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13576368	J-35616-14 (GN)	J-38125-560	4-969005-1	Lear 16	E	1
II	13576368	J-35616-14 (GN)	J-38125-560	Not Available	Not Available	Not Available	Not Available
III	Not Required	J-35616-34 (YE)	No Tool Required	Not Required	Not Required	Not Required	Not Required

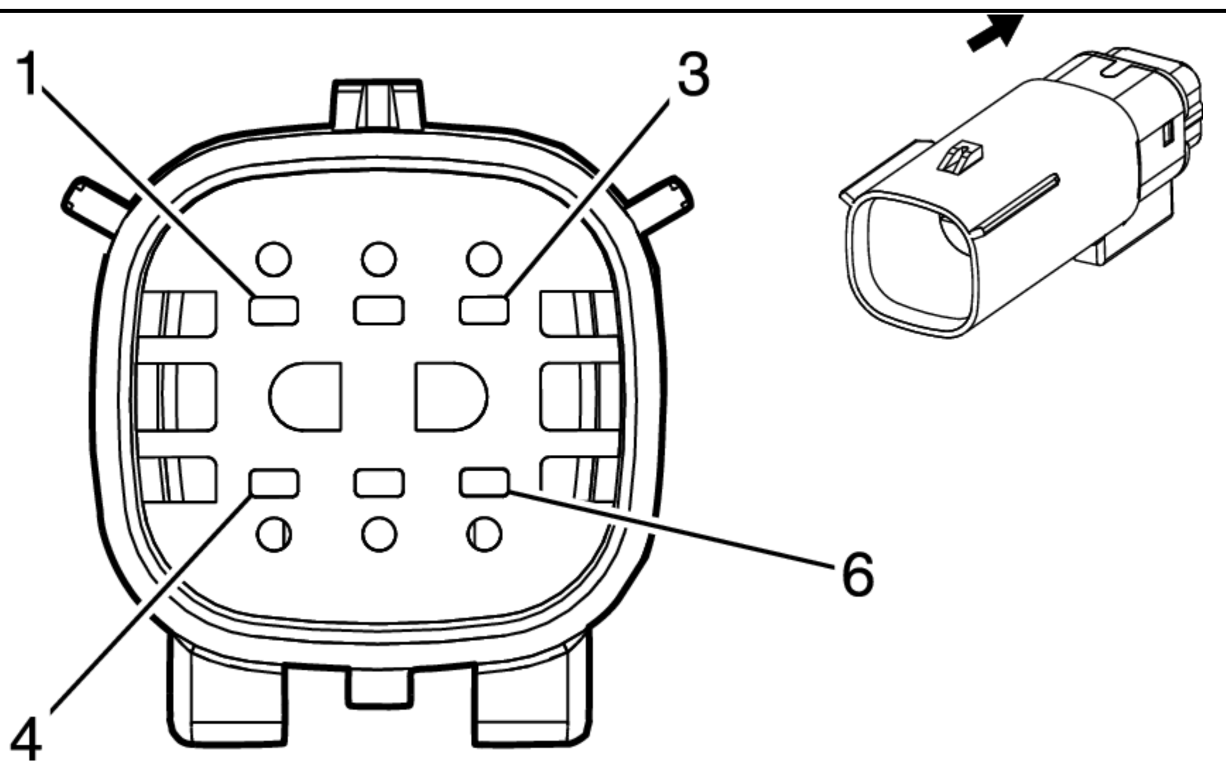
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1 - 2	-	-	-	-	-	Not Occupied	1 - 2	-	-	-	-	-
3	0.5	GY/YE	3687	I	-	Left Rear Supplemental Stop Lamp Control	3	0.5	GY/YE	3687	III	-
4	0.5	BU/WH	1334	I	-	Left Rear Turn Signal Lamp Control	4	0.5	BU/WH	1334	III	-
5	0.5 0.5	GN/WH BN/BU	24 1977	I I	TW5 VD1	Backup Lamp Control Rear Fog Lamp Relay Control	5	0.5 0.5	GN/WH BN/BU	24 1977	III III	TW5 VD1
6	0.5 0.75	BK BK	1550 1550	I II	UKC UKC-TW5	Ground Ground	6	0.5	BK	1550	III	-
7	0.35	BN/WH	2374	I	-	Object Sensor Control	7	0.35	BN/WH	2374	III	-
8	-	-	-	-	-	Not Occupied	8	-	-	-	-	-
9	0.5	BK	1150	I	-	Ground	9	0.5	BK	1150	III	-
10	0.5	BK	1150	I	-	Ground	10	0.5	BK	1150	III	-
11 - 12	-	-	-	-	-	Not Occupied	11 - 12	-	-	-	-	-
13	0.35	YE	2375	I	-	Left Rear Corner Object Sensor Signal	13	0.35	YE	2375	III	-
14	0.35	GN	3156	I	UFQ	Left Rear Supplemental Object Sensor Signal	14	0.35	GN	3156	III	UFQ
15	-	-	-	-	-	Not Occupied	15	-	-	-	-	-
16	0.5	BN/GN	3568	I	-	Passive Entry Rear Closure Antenna Signal Hi	16	0.5	BN/GN	3568	III	-
17	0.5	GN/GY	3569	I	-	Passive Entry Rear Closure Antenna Signal Lo	17	0.5	GN/GY	3569	III	-
18	0.5	GY/YE	1760	I	UKC	Left Side Object Detection LED Control	18	0.5	GY/YE	1760	III	UKC
19	0.5	GY	1761	I	UKC	Right Side Object Detection LED Control	19	0.5	GY	1761	III	UKC
20	0.35	YE/VT	2378	I	-	Right Rear Corner Object Sensor Signal	20	0.35	YE/VT	2378	III	-
21	0.35	YE/WH	2377	I	-	Right Rear Middle Object Sensor Signal	21	0.35	YE/WH	2377	III	-
22	-	-	-	-	-	Not Occupied	22	-	-	-	-	-
23	0.5	BK	1950	I	-	Ground	23	0.5	BK	1950	III	-
24	0.5	BK	1950	I	-	Ground	24	0.5	BK	1950	III	-
25	-	-	-	-	-	Not Occupied	25	-	-	-	-	-
26	0.35	GN	5060	I	UKC	Low Speed GMLAN Serial Data	26	0.35	GN	5060	III	UKC
27	-	-	-	-	-	Not Occupied	27	-	-	-	-	-
28	0.35	BU	3157	I	UFQ	Right Rear Supplemental Object Sensor Signal	28	0.35	BU	3157	III	UFQ
29 - 30	-	-	-	-	-	Not Occupied	29 - 30	-	-	-	-	-
31	0.5	WH/YE	3688	I	-	Right Rear Supplemental Stop Lamp Control	31	0.5	WH/YE	3688	III	-
32	0.5	BU/VT	1335	I	-	Right Rear Turn Signal Lamp Control	32	0.5	BU/VT	1335	III	-
33	0.5	GN/WH	24	I	-	Backup Lamp Control	33	0.5	GN/WH	24	III	-
34	0.35	RD/YE	5840	I	UKC	Battery Positive Voltage	34	0.35	RD/YE	5840	III	UKC
35	0.35	BK/GY	2379	I	-	Object Sensor Low Reference	35	0.35	BK/GY	2379	III	-
36	-	-	-	-	-	Not Occupied	36	-	-	-	-	-

X420 REAR FASCIA HARNESS TO RIGHT LAMP JUMPER HARNESS (TW5)



Connector Part Information

- Harness Type: Rear Fascia
- OEM Connector: 33472-0665
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 150 MX Series, Sealed (BK)



Connector Part Information

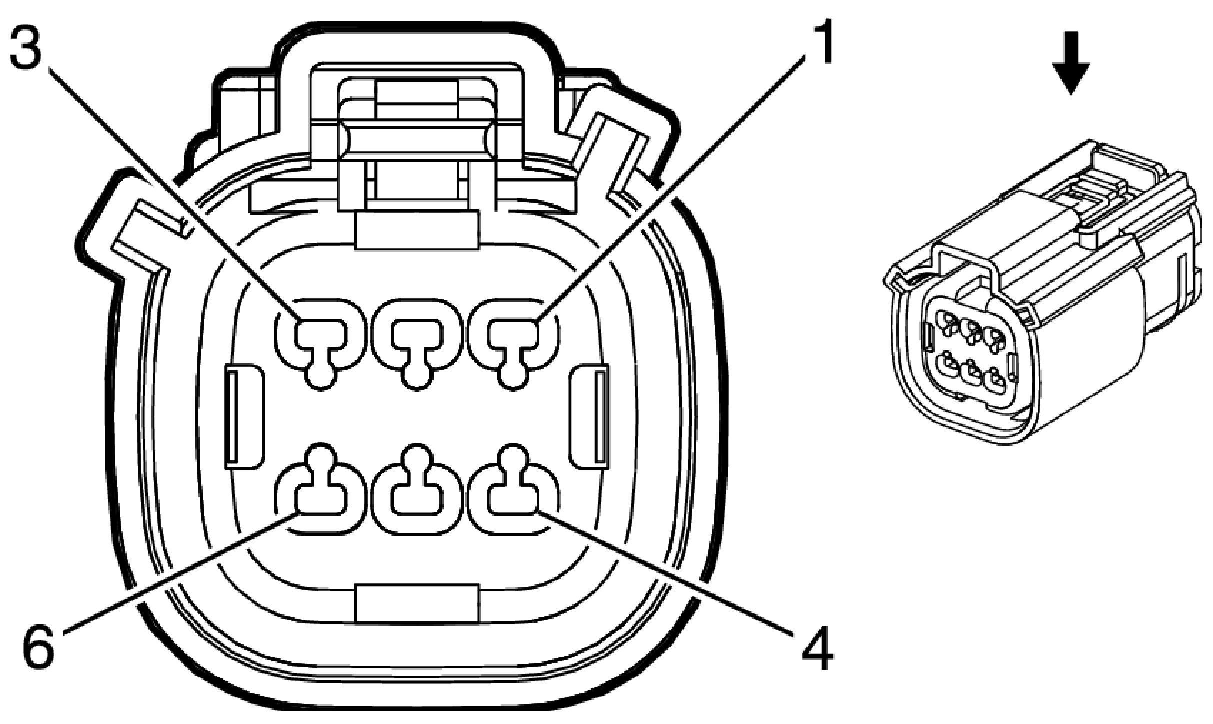
- Harness Type: Right Lamp Jumper
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

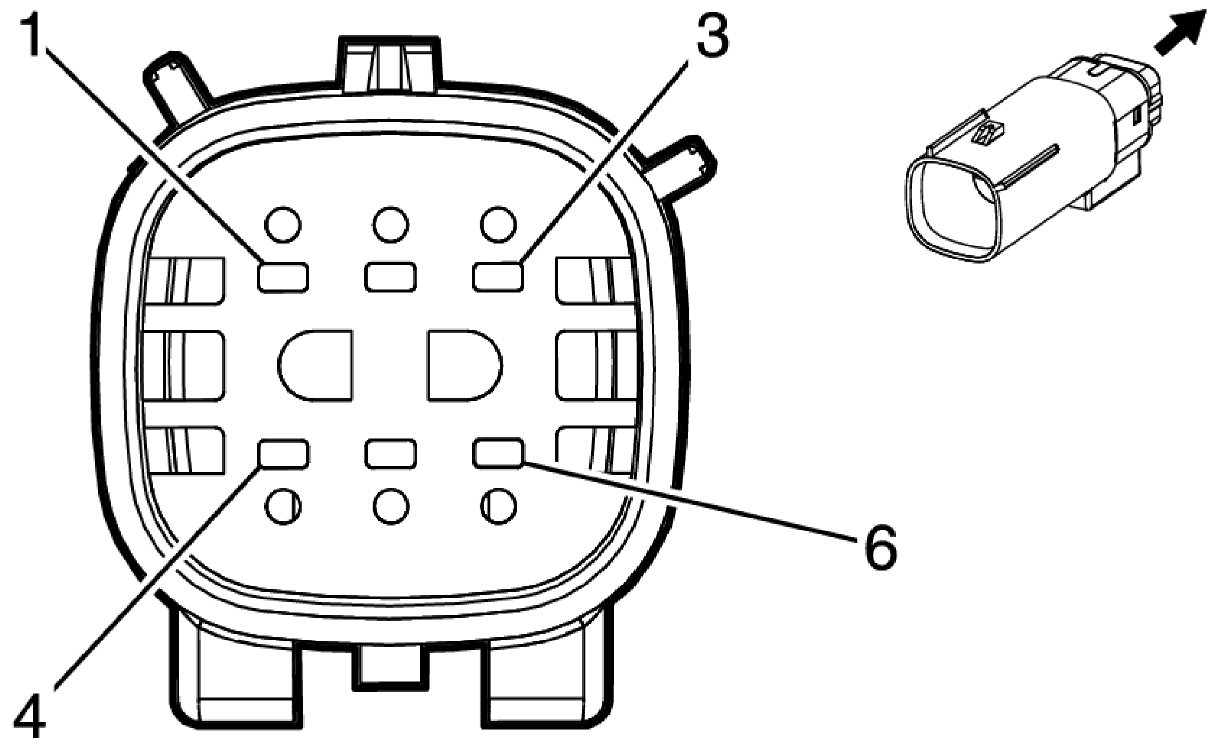
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	WH/YE	3688	I	TW5	Right Rear Supplemental Stop Lamp Control	2	0.5	WH/YE	3688	II	TW5
3	0.5	BU/VT	1335	I	TW5	Right Rear Turn Signal Lamp Control	3	0.5	BU/VT	1335	II	TW5
4	0.5	GN/WH	24	I	TW5	Backup Lamp Control	4	0.5	GN/WH	24	II	TW5
5	0.5	BK	1950	I	-	Ground	5	0.5	BK	1950	II	TW5
6	0.5	BK	1950	I	-	Ground	6	0.5	BK	1950	II	TW5

X420 REAR FASCIA HARNESS TO RIGHT LAMP JUMPER HARNESS (VD1)



Connector Part Information

- Harness Type: Rear Fascia
- OEM Connector: 33472-0602
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way F 1.5 Series, Sealed (GY)



Connector Part Information

- Harness Type: Right Lamp Jumper
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 6-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-2A (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-3 (GY)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.5	WH/YE	3688	I	VD1	Right Rear Supplemental Stop Lamp Control	2	0.5	WH/YE	3688	II	VD1
3	0.5	BU/VT	1335	I	VD1	Right Rear Turn Signal Lamp Control	3	0.5	BU/VT	1335	II	VD1
4	0.5	GN/WH	24	I	VD1	Backup Lamp Control	4	0.5	GN/WH	24	II	VD1
5	-	-	-	-	-	Ground	5	0.5	BK	1950	II	VD1
6	-	-	-	-	-	Ground	6	0.5	BK	1950	II	VD1

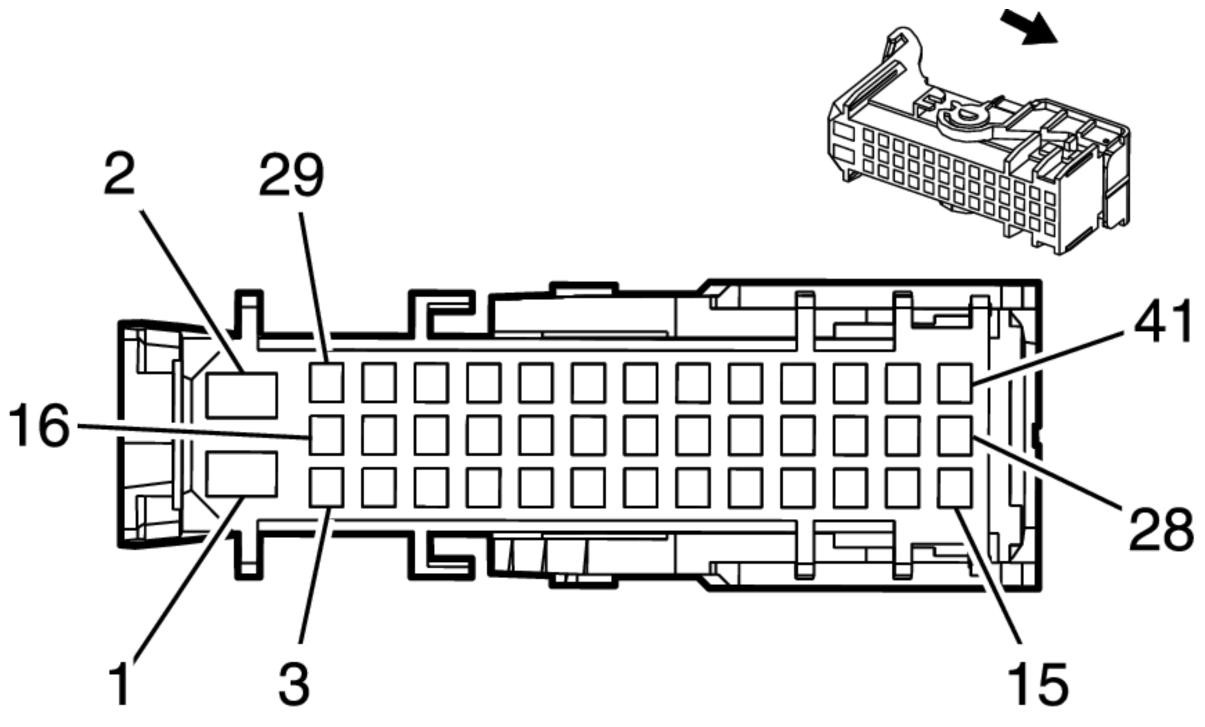
Article GUID: A00890037

2017 ELECTRICAL

Wiring Systems and Power Management - Component Locator - Inline Harness Connector End Views - Bolt EV

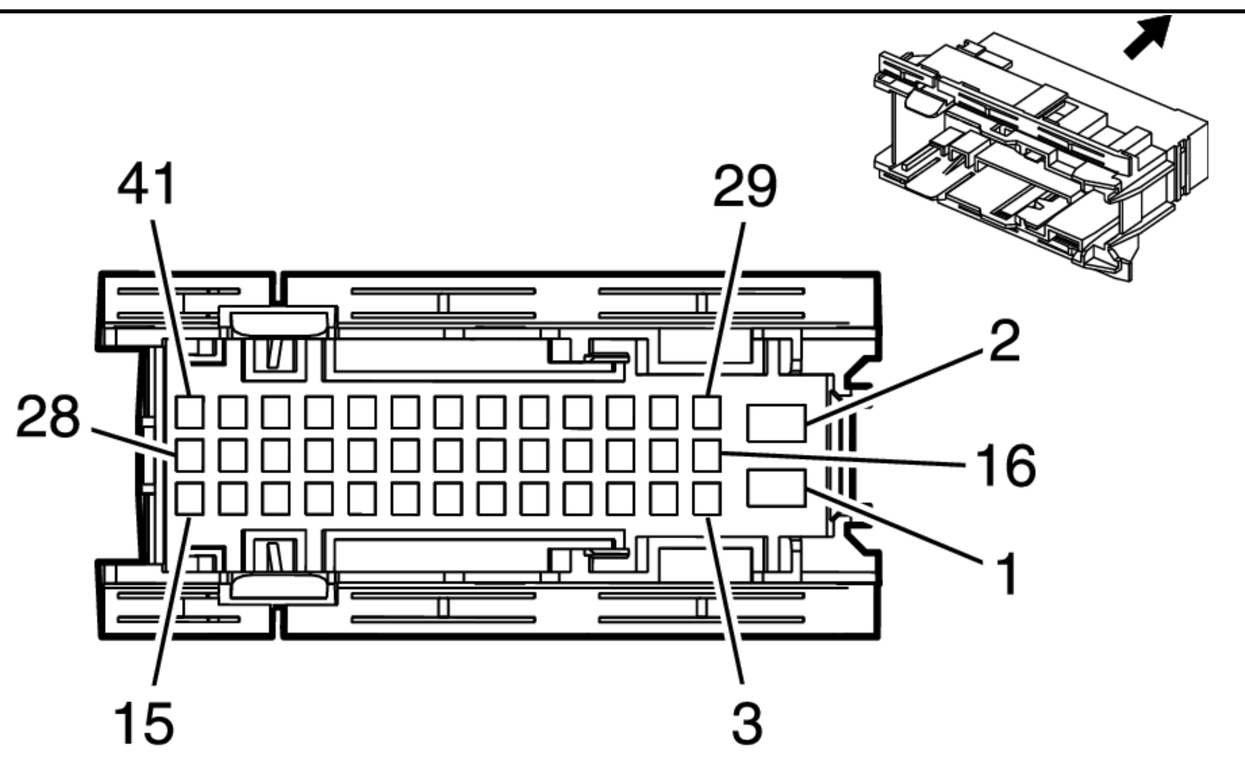
INLINE HARNESS CONNECTOR END VIEWS

X500 DRIVER DOOR HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Driver Door
- OEM Connector: 13678795
- Service Connector: Service by Harness - See Part Catalog
- Description: 41-Way F 4.8 Timer, 1.5 DSQ Series (GY)



Connector Part Information

- Harness Type: Body
- OEM Connector: 13946876
- Service Connector: 13587760
- Description: 41-Way M 1.5, 2.8 Series (GY)

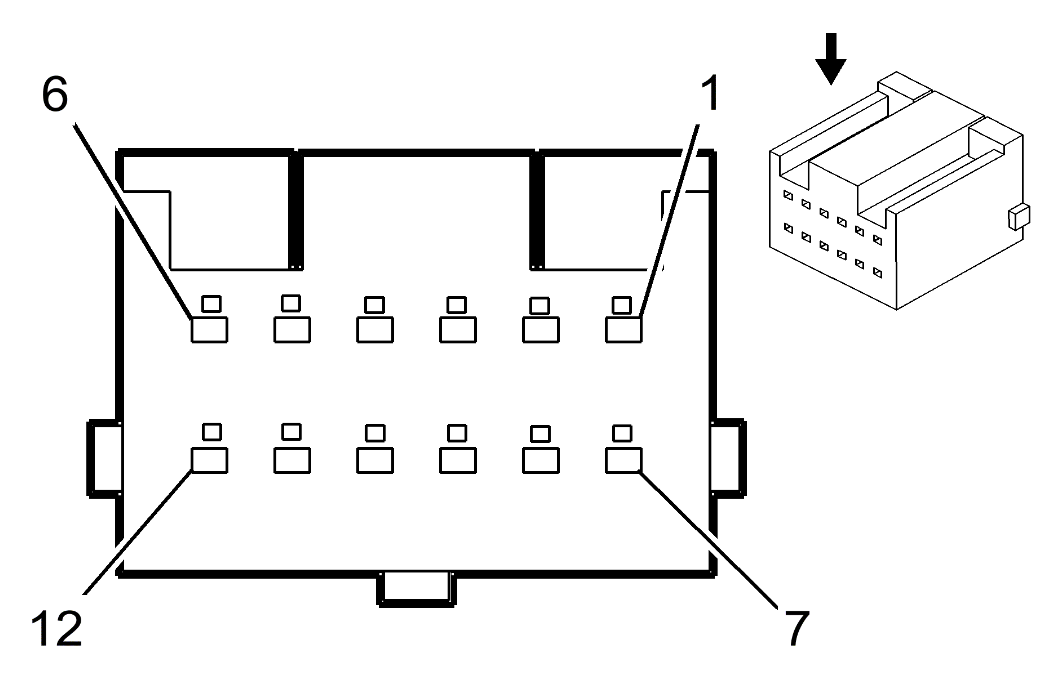
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575556	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
VI	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
VII	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2	RD/GN	1540	II	-	Battery Positive Voltage	1	2	RD/GN	1540	VII	-
2	2	BK	650	II	-	Ground	2	2	BK	650	VII	-
3	-	-	-	-	-	Not Occupied	3	-	-	-	-	-
4	0.75	BN/BU	118	I	-	Left Front Speaker Signal (-) 1	4	0.75 1.5	BN/BU BN/BU	118 118	VI III	UQ3 UQA
5	0.75	BU	201	I	-	Left Front Speaker Control (+) 1	5	0.75 1.5	BU BU	201 201	VI III	UQ3 UQA
6 - 7	-	-	-	-	-	Not Occupied	6 - 7	-	-	-	-	-
8	0.5	BK	550	I	-	Ground	8	0.5	BK	550	V	-
9	0.5	BN/WH	781	I	-	Driver Door Lock Switch Unlock Signal	9	0.35	BN/WH	781	IV	-
10	0.5	BN/YE	780	I	-	Driver Door Lock Switch Lock Signal	10	0.35	BN/YE	780	IV	-
11	0.5	YE	6817	I	-	LED Backlight Dimming Control	11	0.35	YE	6817	IV	-
12	0.5	BK	550	I	-	Ground	12	0.5	BK	550	V	-
13	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	13	0.75	BN/YE	294	VI	-
14	0.75	GY	5911	I	-	Door Lock Actuator Lock Control 2	14	0.75	GY	5911	VI	-
15	0.5	VT/GN	4663	I	UVH	Left Side Camera Control	15	0.35	VT/GN	4663	IV	UVH
16	0.5	BK/GN	4664	I	UVH	Left Side Camera Return	16	0.35	BK/GN	4664	IV	UVH
17	0.5	BK/WH	2451	I	UVH	Signal Ground	17	0.35	BK/WH	2451	IV	UVH
18	0.5	WH/GN	2628	I	UVH	Left Side Vision Camera Video Signal (+)	18	0.35	WH/GN	2628	IV	UVH
19	0.5	GY/GN	2625	I	UVH	Left Side Vision Camera Video Signal (-)	19	0.35	GY/GN	2625	IV	UVH
20	0.5	BK	550	I	DG6/DLR/DLS	Ground Ground	20	0.5 0.5	BK BK	650 550	V V	DG6/DLS/DLR DG6/DLR/DLS
21	0.5	BN/YE	2267	I	-	Mirror Heating Element Control	21	0.35	BN/YE	2267	IV	-
22	0.5	BK	550	I	-	Ground	22	0.5	BK	550	V	-
23	0.5	RD/GN	1540	I	-	Battery Positive Voltage	23	0.35	RD/GN	1540	IV	-
24	0.5	BK	650	I	-	Ground	24	0.5	BK	650	V	UKC
25	0.5	VT/GY	3561	I	-	Passive Entry Driver Door Antenna Signal Lo	25	0.5	VT/GY	3561	V	-
26	0.5	VT	3560	I	-	Passive Entry Driver Door Antenna Signal Hi	26	0.5	VT	3560	V	-
27	0.5	GN/WH	3570	I	-	Driver Door Handle Switch Signal	27	0.5	GN/WH	3570	V	-
28	0.5	BK	550	I	-	Ground	28	0.5	BK	550	V	-
29	0.5	WH/YE	3574	I	-	Driver Door Open Switch Signal	29	0.5	WH/YE	3574	V	-
30	-	-	-	-	-	Not Occupied	30	-	-	-	-	-
31	0.5	GN/YE	6134	I	-	Local Interconnect Network Serial Data Bus 3	31	0.35	GN/YE	6134	IV	-
32	-	-	-	-	-	Not Occupied	32	-	-	-	-	-
33	0.5	OG/GN	2132	I	AYF	Left Front Side Impact Sensing Module Signal	33	0.5	OG/GN	2132	V	AYF
34	0.5	BK/OG	6628	I	AYF	Left Front Side Impact Sensing Module Low Reference	34	0.5	BK/OG	6628	V	AYF
35	0.5	BU/WH	1314	I	-	Left Front Turn Signal Lamp Control	35	0.5	BU/WH	1314	V	-
36	0.5	VT/YE	3409	I	DLR	Mirror Motor Fold Out Control	36	0.5	VT/YE	3409	V	DLR
37	0.5	WH/BN	3410	I	DLR	Mirror Motor Fold In Control	37	0.5	WH/BN	3410	V	DLR
38	0.5	GY/YE	1760	I	UKC	Left Side Object Detection LED Control	38	0.5	GY/YE	1760	V	UKC

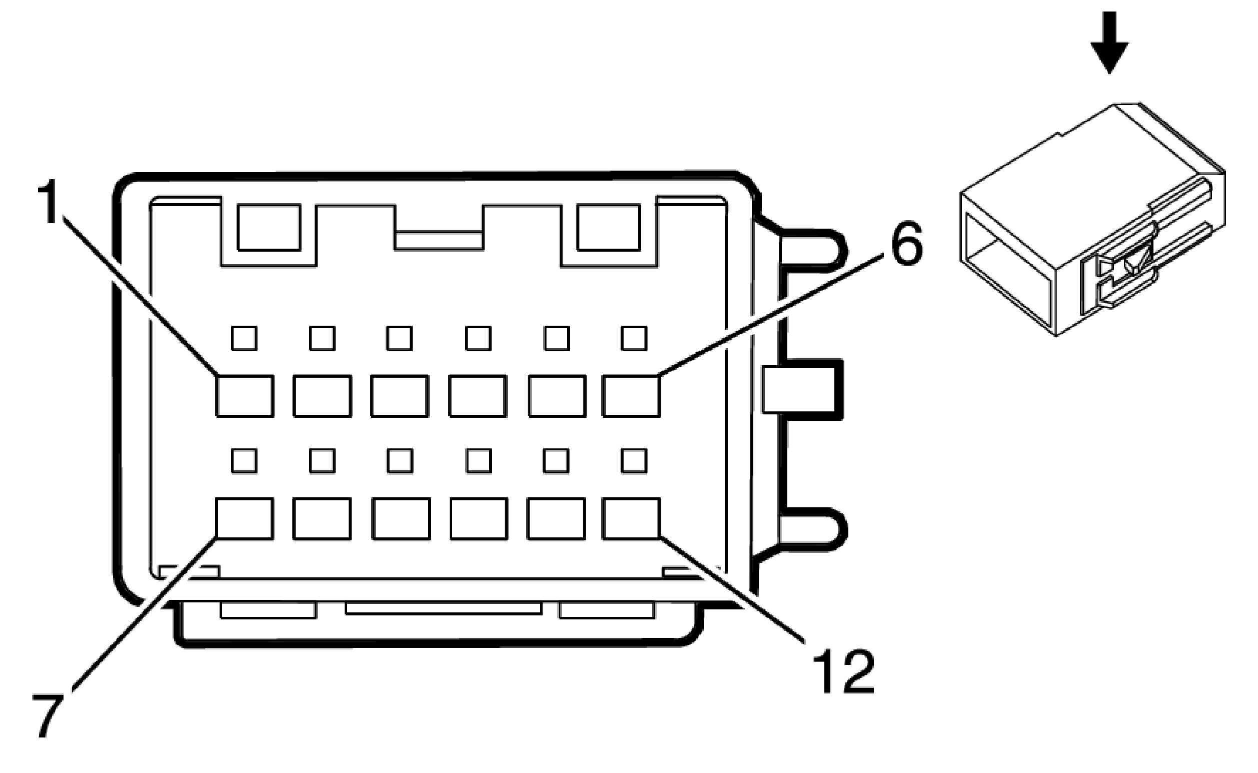
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
39	0.5	GN/BK	3396	I	-	Passenger Mirror Motor Right (+) Left (-) Control	39	0.5	GN/BK	3396	V	-
40	0.5	YE/VT	3397	I	-	Passenger Mirror Motor Up (+) Down (-) Control	40	0.5	YE/VT	3397	V	-
41	0.5	WH	3398	I	-	Passenger Mirror Motor Common Control	41	0.5	WH	3398	V	-

X510 DRIVER OUTSIDE REARVIEW MIRROR HARNESS TO DRIVER DOOR HARNESS



Connector Part Information

- Harness Type: Driver Outside Rearview Mirror
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F



Connector Part Information

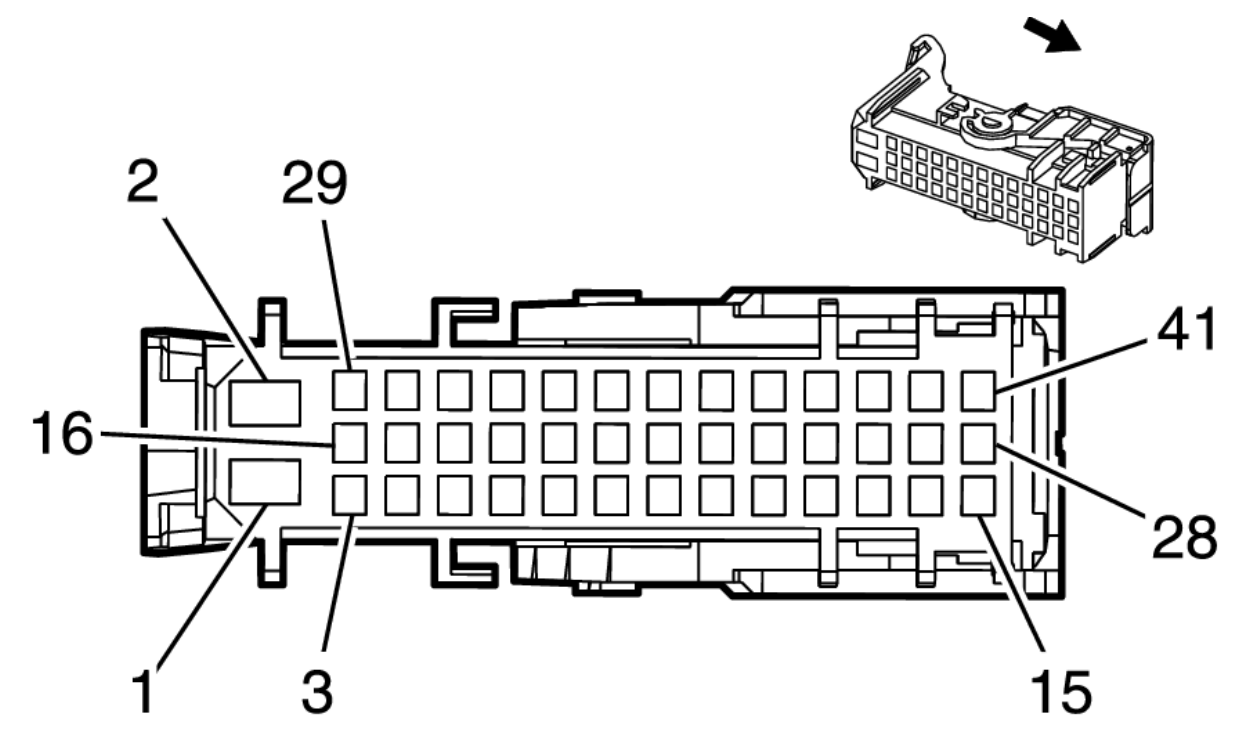
- Harness Type: Driver Door
- OEM Connector: ARVWSB-12BC-2AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way M 0.64 Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-65B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

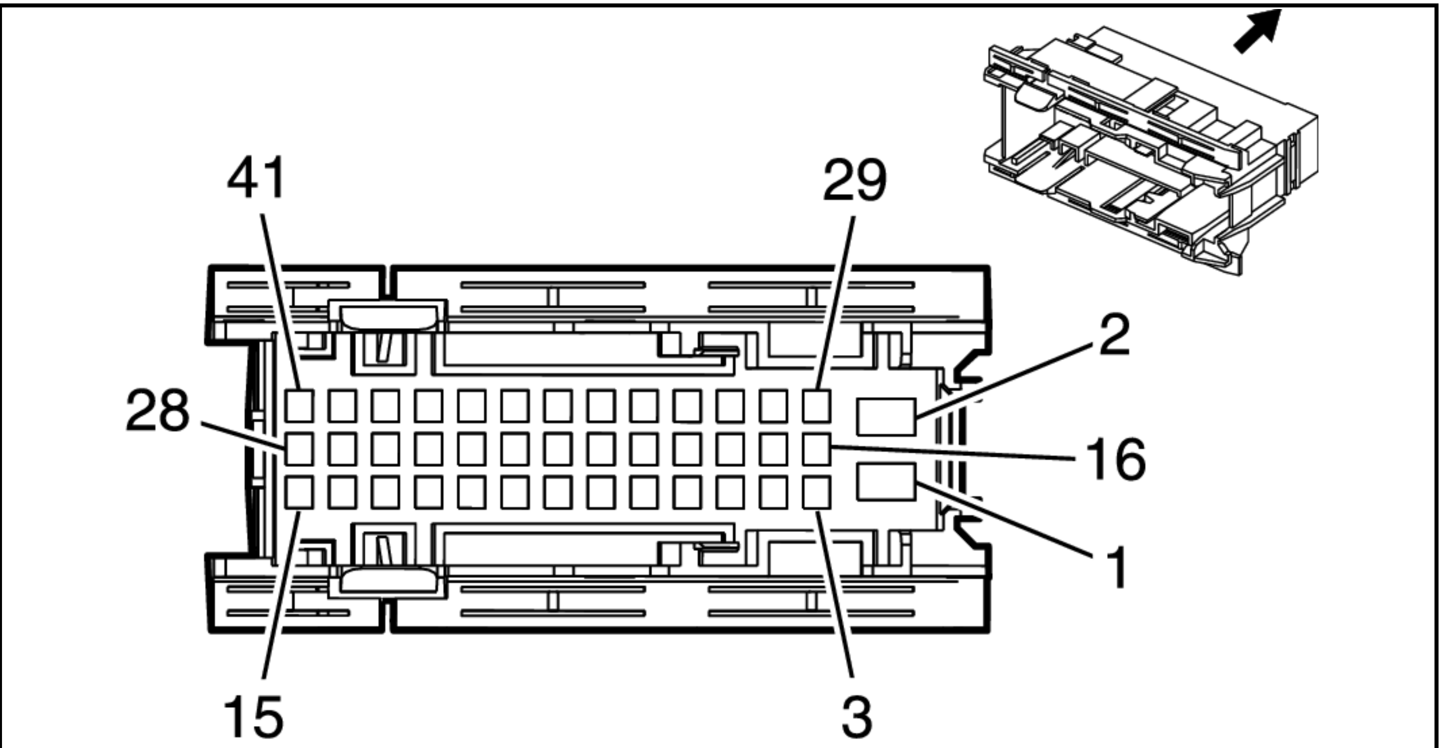
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	YE/BN	3391	I	DG6/DLR/DLS	Driver Mirror Motor Common Control	1	0.5	YE/BN	3391	II	-
2	0.5	VT/BU	3390	I	DG6/DLR/DLS	Driver Mirror Motor Up (+) Down (-) Control	2	0.5	VT/BU	3390	II	-
3	0.5	BN/BK	3389	I	DG6/DLR/DLS	Driver Mirror Motor Right (+) Left (-) Control	3	0.5	BN/BK	3389	II	-
4	0.5	BN/YE	2267	I	DG6/DLR/DLS	Mirror Heating Element Control	4	0.5	BN/YE	2267	II	-
5	0.5	BK	650	I	DG6/DLR/DLS	Ground	5	0.5	BK	650	II	-
6	0.5	BU/WH	1314	I	DLR/DLS	Left Front Turn Signal Lamp Control	6	0.5	BU/WH	1314	II	-
7	0.5	GY/YE	1760	I	UKC	Left Side Object Detection LED Control	7	0.5	GY/YE	1760	II	UKC
8	0.5	BK	650	I	UKC	Ground	8	0.5	BK	650	II	UKC
9	0.5 0.5	WH/BN WH/GN	3410 2628	I I	DLR UVH	Mirror Motor Fold In Control Left Side Vision Camera Video Signal (+)	9	0.5 0.5	WH/BN WH/GN	3410 2628	II II	DLR UVH
10	0.5 0.5	VT/YE GY/GN	3409 2625	I I	DLR UVH	Mirror Motor Fold Out Control Left Side Vision Camera Video Signal (-)	10	0.5 0.5	VT/YE GY/GN	3409 2625	II II	DLR UVH
11	0.5	BK/GN	4664	I	UVH	Left Side Camera Return	11	0.5	BK/GN	4664	II	UVH
12	0.5	VT/GN	4663	I	UVH	Left Side Camera Control	12	0.5	VT/GN	4663	II	UVH

X600 PASSENGER DOOR HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Passenger Door
- OEM Connector: 13678795
- Service Connector: Service by Harness - See Part Catalog
- Description: 41-Way F 4.8 Timer, 1.5 DSQ Series (GY)



Connector Part Information

- Harness Type: Body
- OEM Connector: 13946876
- Service Connector: 13587760
- Description: 41-Way M 1.5, 2.8 Series (GY)

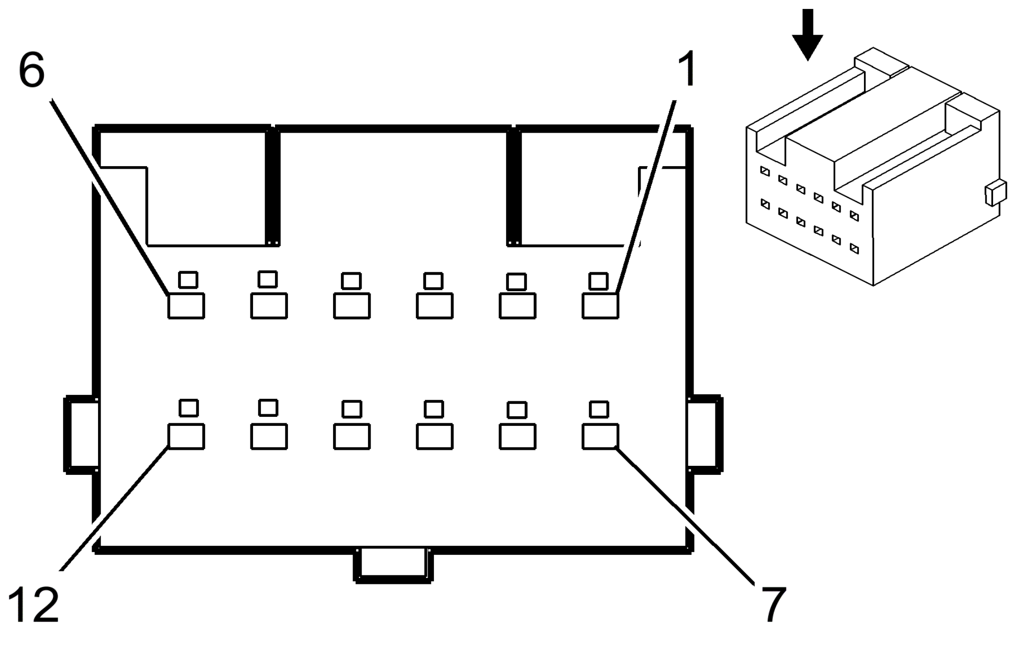
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575556	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
VI	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
VII	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

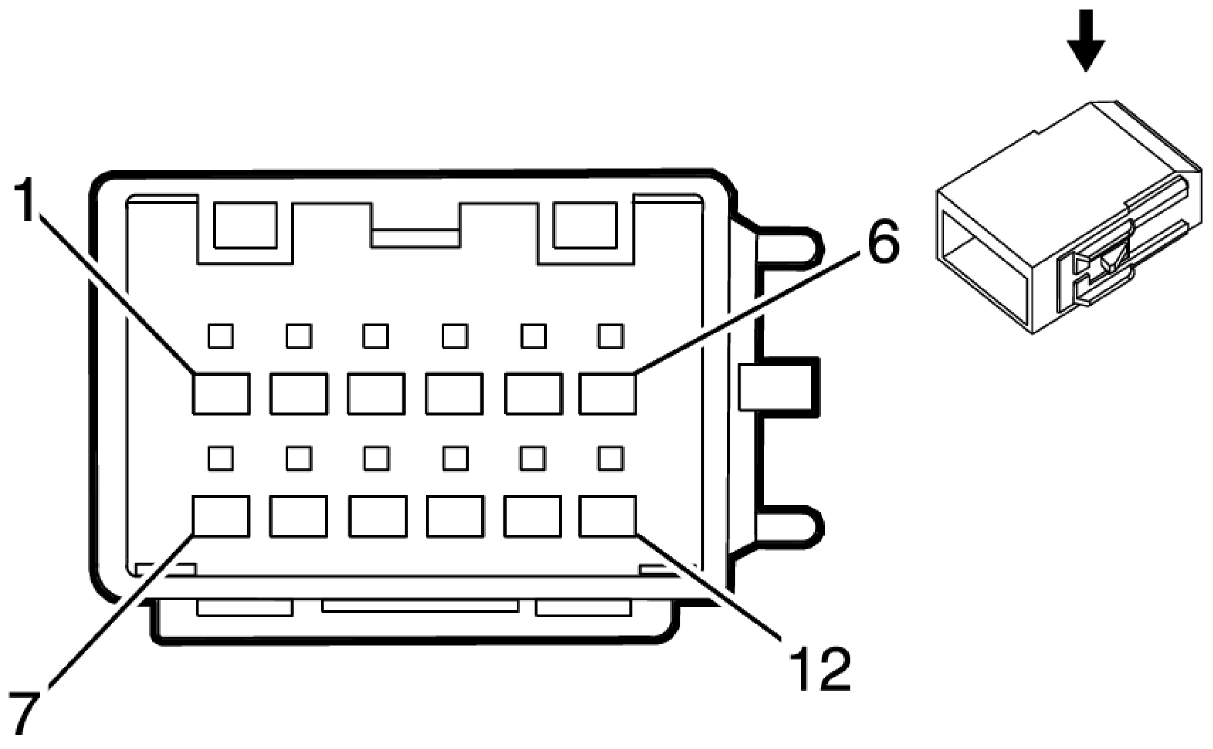
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2	RD/GN	1540	II	-	Battery Positive Voltage	1	2	RD/GN	1540	VII	-
2	2	BK	850	II	-	Ground	2	2	BK	850	VII	-
3	-	-	-	-	-	Not Occupied	3	-	-	-	-	-
4	0.75	YE/BK	117	I	-	Right Front Speaker Signal (-) 1	4	0.75 1.5	YE/BK YE/BK	117 117	VI III	UQ3 UQA
5	0.75	YE	200	I	-	Right Front Speaker Control (+) 1	5	0.75 1.5	YE YE	200 200	VI III	UQ3 UQA
6 - 7	-	-	-	-	-	Not Occupied	6 - 7	-	-	-	-	-
8	0.5	BK	750	I	-	Ground	8	0.5	BK	750	V	-
9	0.5	BN/VT	245	I	-	Passenger Door Lock Switch Unlock Control	9	0.35	BN/VT	245	IV	-
10	0.5	YE/VT	244	I	-	Passenger Door Lock Switch Lock Control	10	0.35	YE/VT	244	IV	-
11	0.5	YE	6817	I	-	LED Backlight Dimming Control	11	0.35	YE	6817	IV	-
12	0.5	BK	750	I	-	Ground	12	0.5	BK	750	V	-
13	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	13	1	BN/YE	294	III	-
14	0.75	GY	295	I	-	Door Lock Actuator Lock Control	14	1	GY	295	III	-
15	0.5	VT/BU	4666	I	UVH	Right Side Camera Control	15	0.35	VT/BU	4666	IV	UVH
16	0.5	BK/BU	4667	I	UVH	Right Side Camera Return	16	0.35	BK/BU	4667	IV	UVH
17	0.5	BK/WH	2551	I	UVH	Signal Ground	17	0.35	BK/WH	2551	IV	UVH
18	0.5	WH/BU	2627	I	UVH	Right Side Vision Camera Video Signal (+)	18	0.35	WH/BU	2627	IV	UVH
19	0.5	GY/BU	2626	I	UVH	Right Side Vision Camera Video Signal (-)	19	0.35	GY/BU	2626	IV	UVH
20	0.5	BK	750	I	DG6/DLR/DLS	Ground Ground	20	0.5 0.5	BK BK	850 750	V V	DG6/DLS/DLR DG6/DLR/DLS
21	0.5	BN/YE	2267	I	-	Mirror Heating Element Control	21	0.35	BN/YE	2267	IV	-
22 - 23	-	-	-	-	-	Not Occupied	22 - 23	-	-	-	-	-
24	0.5	BK	750	I	UKC	Ground	24	0.5	BK	750	V	UKC
25	0.5	GN/YE	3562	I	-	Passive Entry Passenger Door Antenna Signal Hi	25	0.5	GN/YE	3562	V	-
26	0.5	GN/BK	3563	I	-	Passive Entry Passenger Door Antenna Signal Lo	26	0.5	GN/BK	3563	V	-
27	0.5	VT/WH	3571	I	-	Passenger Door Handle Switch Signal	27	0.5	VT/WH	3571	V	-
28	0.5	BK	750	I	-	Ground	28	0.5	BK	750	V	-
29 - 30	-	-	-	-	-	Not Occupied	29 - 30	-	-	-	-	-
31	0.5	GN/YE	6134	I	-	Local Interconnect Network Serial Data Bus 3	31	0.35	GN/YE	6134	IV	-
32	-	-	-	-	-	Not Occupied	32	-	-	-	-	-
33	0.5	BN/OG	2134	I	AYF	Right Front Side Impact Sensing Module Signal	33	0.5	BN/OG	2134	V	AYF
34	0.5	BK/OG	6629	I	AYF	Right Front Side Impact Sensing Module Low Reference	34	0.5	BK/OG	6629	V	AYF
35	0.5	GN/VT	1315	I	-	Right Front Turn Signal Lamp Control	35	0.5	GN/VT	1315	V	-
36	0.5	VT/YE	3409	I	DLR	Mirror Motor Fold Out Control	36	0.5	VT/YE	3409	V	DLR
37	0.5	WH/BN	3410	I	DLR	Mirror Motor Fold In Control	37	0.5	WH/BN	3410	V	DLR
38	0.5	GY	1761	I	UKC	Right Side Object Detection LED Control	38	0.5	GY	1761	V	UKC
39	0.5	GN/BK	3396	I	-	Passenger Mirror Motor Right (+) Left (-) Control	39	0.5	GN/BK	3396	V	-
40	0.5	YE/VT	3397	I	-	Passenger Mirror Motor Up (+) Down (-) Control	40	0.5	YE/VT	3397	V	-
41	0.5	WH	3398	I	-	Passenger Mirror Motor Common Control	41	0.5	WH	3398	V	-

X610 PASSENGER OUTSIDE REARVIEW MIRROR HARNESS TO PASSENGER DOOR HARNESS



Connector Part Information

- Harness Type: Passenger Outside Rearview Mirror
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way F



Connector Part Information

- Harness Type: Passenger Door
- OEM Connector: ARVWSB-12BC-2AK
- Service Connector: Service by Harness - See Part Catalog
- Description: 12-Way M 0.64 Series (BK)

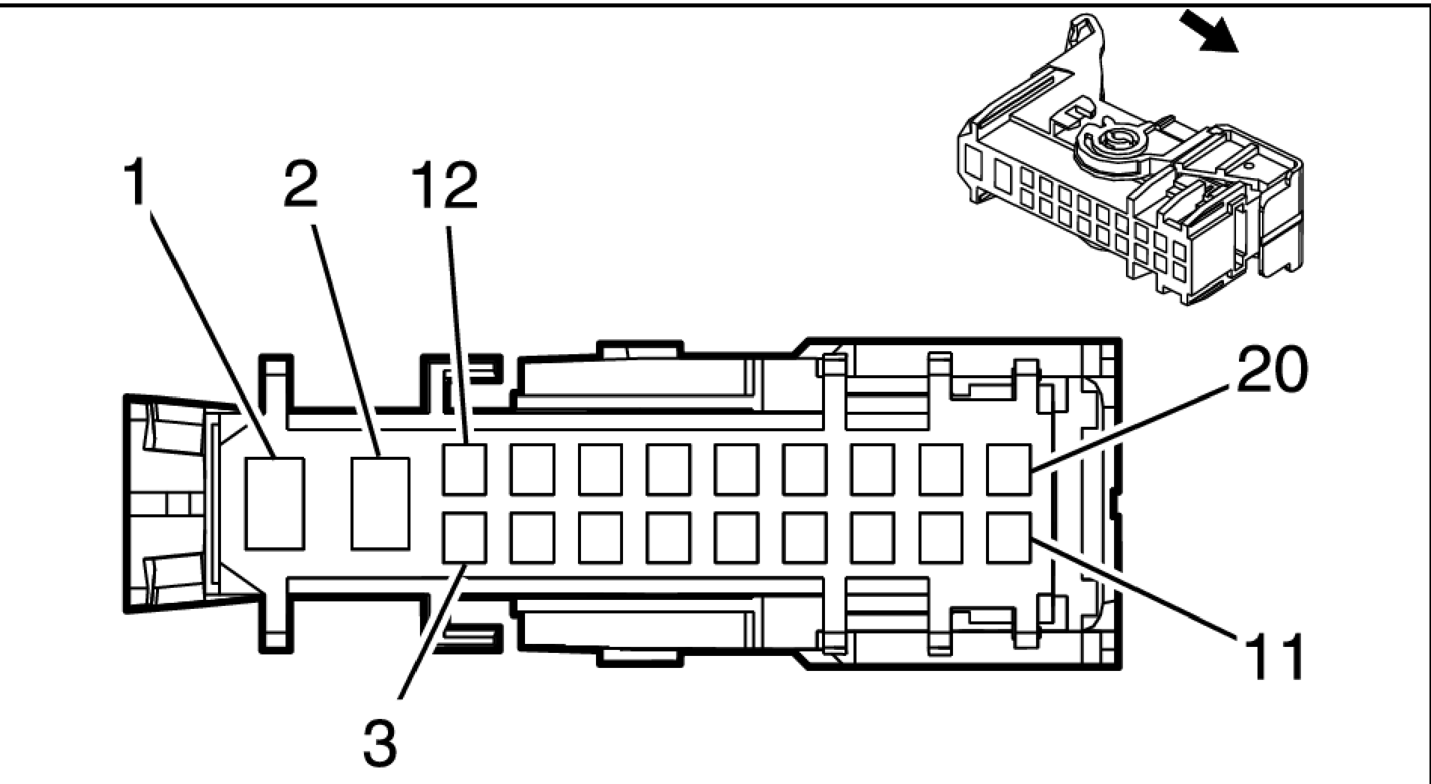
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-65B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	WH	3398	I	DG6/DLR/DLS	Passenger Mirror Motor Common Control	1	0.5	WH	3398	II	-

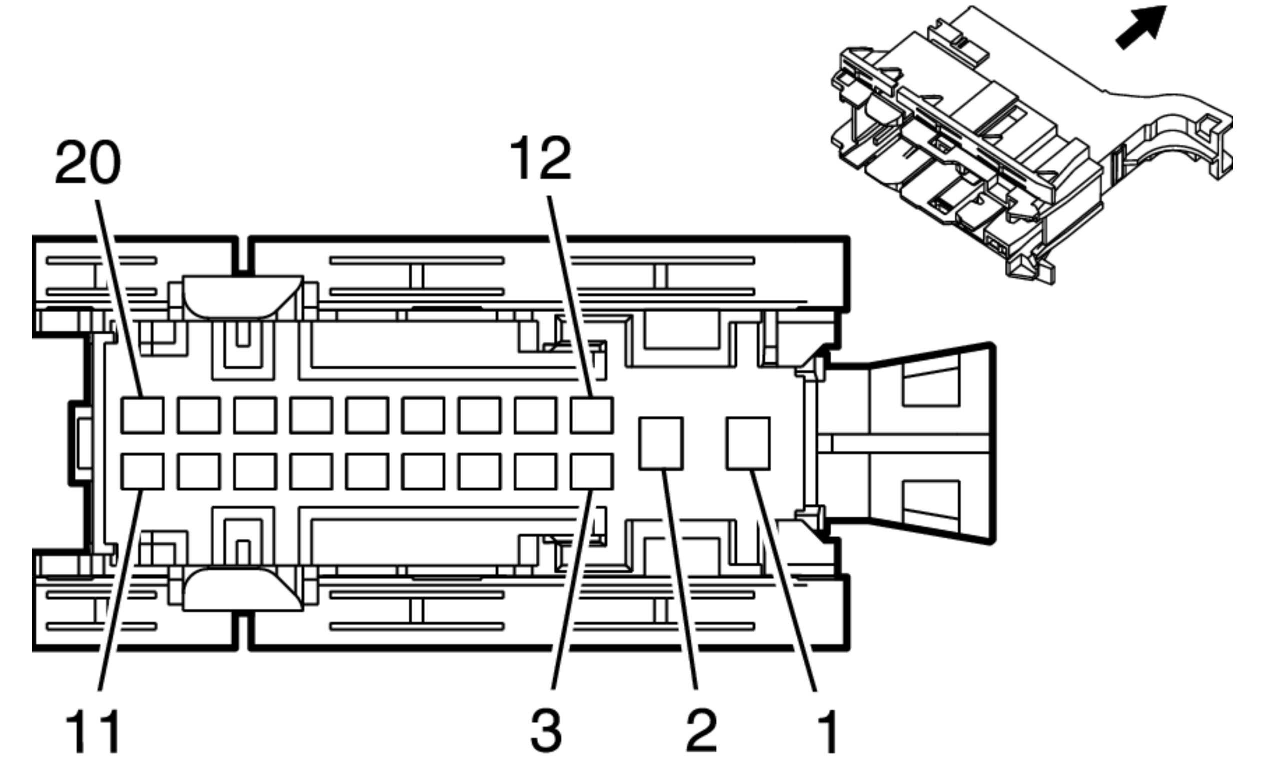
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
2	0.5	YE/VT	3397	I	DG6/DLR/DLS	Passenger Mirror Motor Up (+) Down (-) Control	2	0.5	YE/VT	3397	II	-
3	0.5	GN/BK	3396	I	DG6/DLR/DLS	Passenger Mirror Motor Right (+) Left (-) Control	3	0.5	GN/BK	3396	II	-
4	-	-	-	-	-	Not Occupied	4	-	-	-	-	-
5	0.5	BK	750	I	DG6/DLR/DLS	Ground Ground	5	0.5 0.5	BK BK	850 750	II II	DG6/DLS/DLR DG6/DLR/DLS
6	0.5	GN/VT	1315	I	DLR/DLS	Right Front Turn Signal Lamp Control	6	0.5	GN/VT	1315	II	-
7	0.5	GY	1761	I	UKC	Right Side Object Detection LED Control	7	0.5	GY	1761	II	UKC
8	0.5	BK	750	I	UKC	Ground	8	0.5	BK	750	II	UKC
9	0.5 0.5	WH/BN WH/BU	3410 2627	I I	DLR UVH	Mirror Motor Fold In Control Right Side Vision Camera Video Signal (+)	9	0.5 0.5	WH/BN WH/BU	3410 2627	II II	DLR UVH
10	0.5 0.5	VT/YE GY/BU	3409 2626	I I	DLR UVH	Mirror Motor Fold Out Control Right Side Vision Camera Video Signal (-)	10	0.5 0.5	VT/YE GY/BU	3409 2626	II II	DLR UVH
11	0.5	BK/BU	4667	I	UVH	Right Side Camera Return	11	0.5	BK/BU	4667	II	UVH
12	0.5	VT/BU	4666	I	UVH	Right Side Camera Control	12	0.5	VT/BU	4666	II	UVH

X700 LEFT REAR DOOR HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Left Rear Door
- OEM Connector: 13678789
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 4.8 Timer, 1.5 DSQ Series (GY)



Connector Part Information

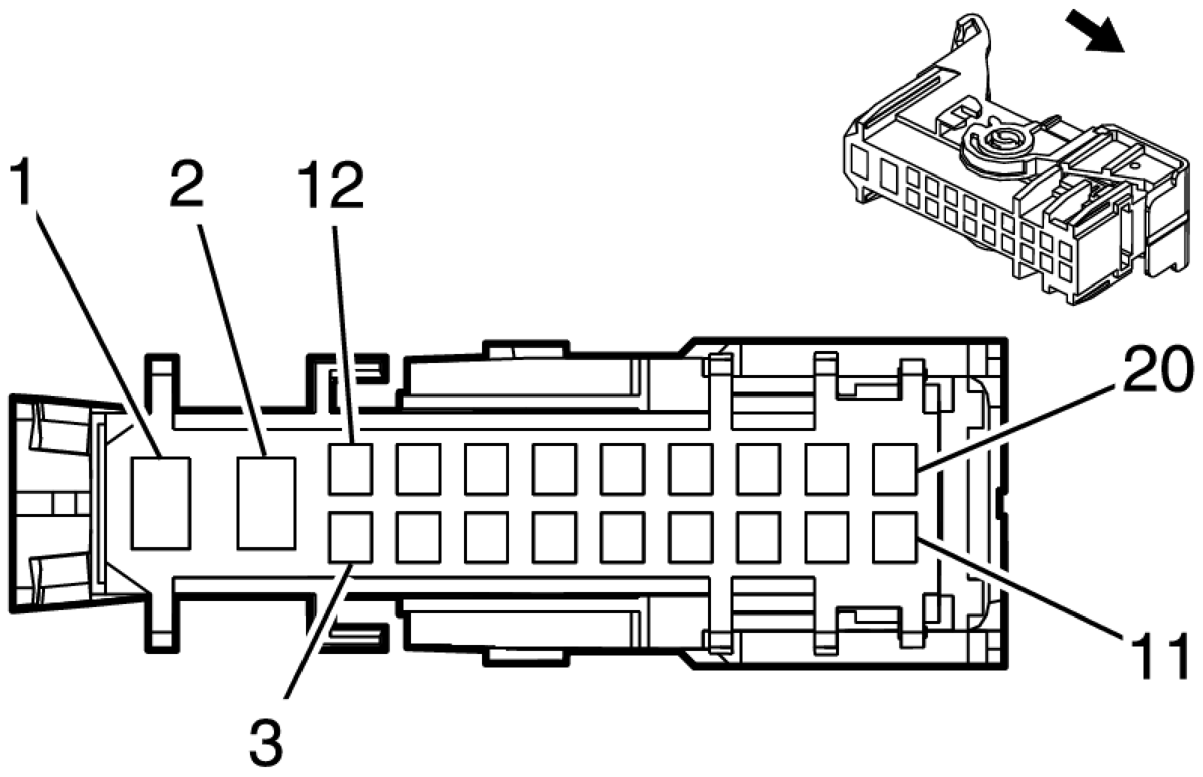
- Harness Type: Body
- OEM Connector: 13680032
- Service Connector: 13577518
- Description: 20-Way M 1.5, 5.8 TTS Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
VI	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

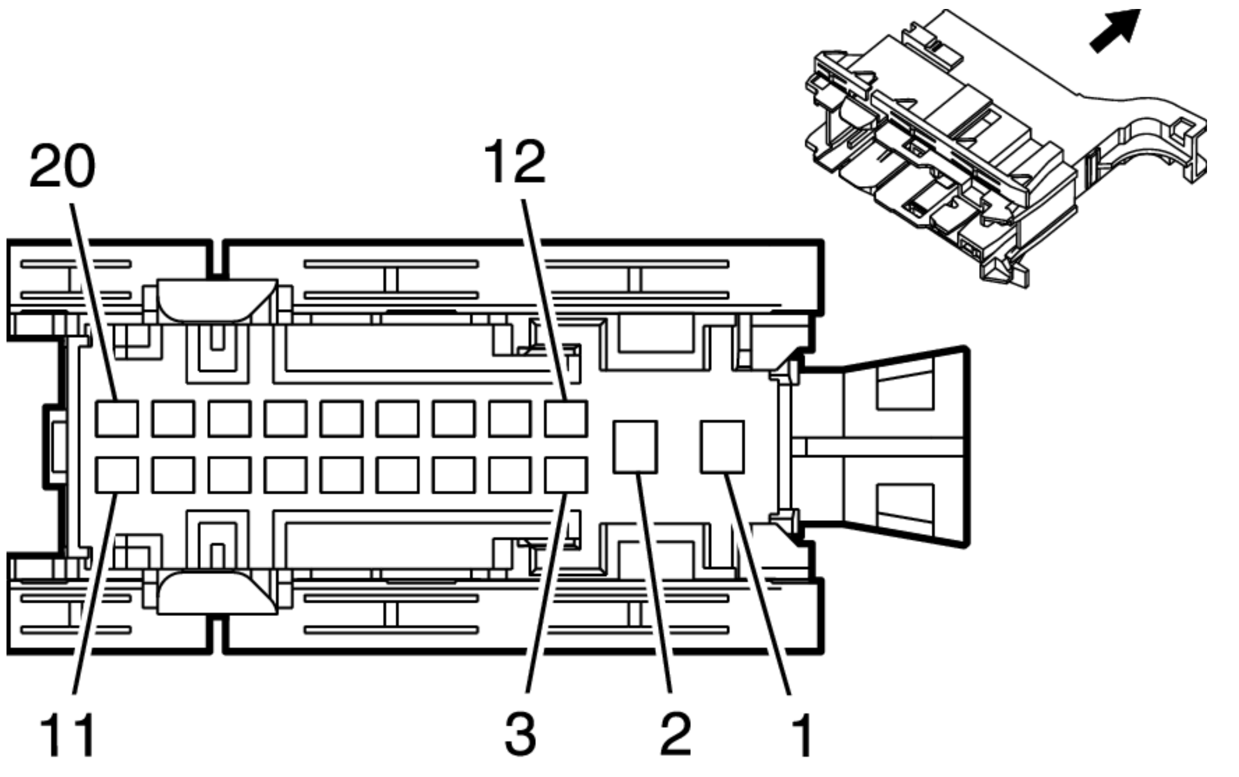
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2	RD/BN	2940	II	-	Battery Positive Voltage	1	2	RD/BN	2940	VI	-
2	2	BK	650	II	-	Ground	2	2	BK	650	VI	-
3	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	3	0.75	BN/YE	294	V	-
4	0.75	GY	295	I	-	Door Lock Actuator Lock Control	4	0.75	GY	295	V	-
5	0.5	GN/GY	6135	I	-	Local Interconnect Network Serial Data Bus 4	5	0.35	GN/GY	6135	III	-
6	0.5	BK	550	I	-	Ground	6	0.5	BK	550	IV	-
7 - 8	-	-	-	-	-	Not Occupied	7 - 8	-	-	-	-	-
9	0.5	WH	6816	I	KA6	Indicator Dimming Control	9	0.35	WH	6816	III	KA6
10	0.5	BN/YE	6157	I	-	Left Rear Door Handle Switch Signal	10	0.5	BN/YE	6157	IV	-
11	0.5	BK	550	I	-	Ground	11	0.5	BK	550	IV	-
12 - 13	-	-	-	-	-	Not Occupied	12 - 13	-	-	-	-	-
14	0.75	GN/BK	116	I	-	Left Rear Speaker Signal (-)	14	0.75	GN/BK	116	V	-
15	0.75	GN	199	I	-	Left Rear Speaker Control (+)	15	0.75	GN	199	V	-
16	-	-	-	-	-	Not Occupied	16	-	-	-	-	-
17	0.5	YE	6817	I	KA6	LED Backlight Dimming Control	17	0.35	YE	6817	III	KA6
18	0.5	BN/WH	1637	I	KA6	Left Rear Heated Seat Switch Signal	18	0.5	BN/WH	1637	IV	KA6
19	0.5	WH	1638	I	KA6	Left Rear Heated Seat High Indicator Control	19	0.5	WH	1638	IV	KA6
20	0.5	BK	550	I	-	Ground	20	0.5	BK	550	IV	KA6

X800 RIGHT REAR DOOR HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Right Rear Door
- OEM Connector: 13678789
- Service Connector: Service by Harness - See Part Catalog
- Description: 20-Way F 4.8 Timer, 1.5 DSQ Series (GY)



Connector Part Information

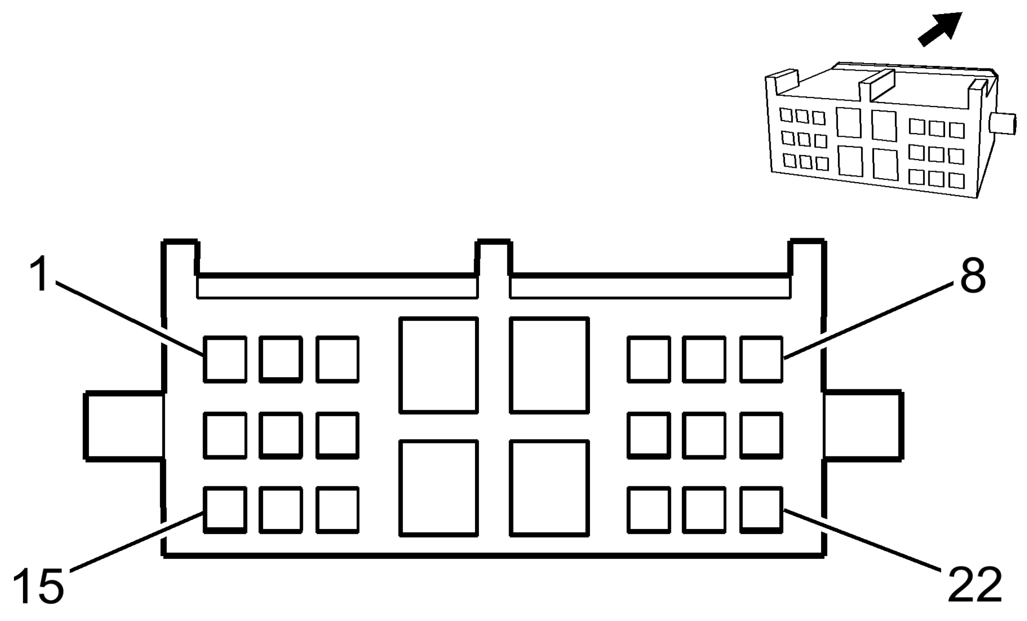
- Harness Type: Body
- OEM Connector: 13680032
- Service Connector: 13577518
- Description: 20-Way M 1.5, 5.8 TTS Series (GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-14 (GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-42 (RD)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575556	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
IV	13575775	J-35616-34 (YE)	J-38125-560	Not Available	Not Available	Not Available	Not Available
V	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	2
VI	13575776	J-35616-34 (YE)	J-38125-560	964265-2	Lear 28	E	C
VII	13575857	J-35616-32 (OR)	J-38125-36	Not Available	Not Available	Not Available	Not Available

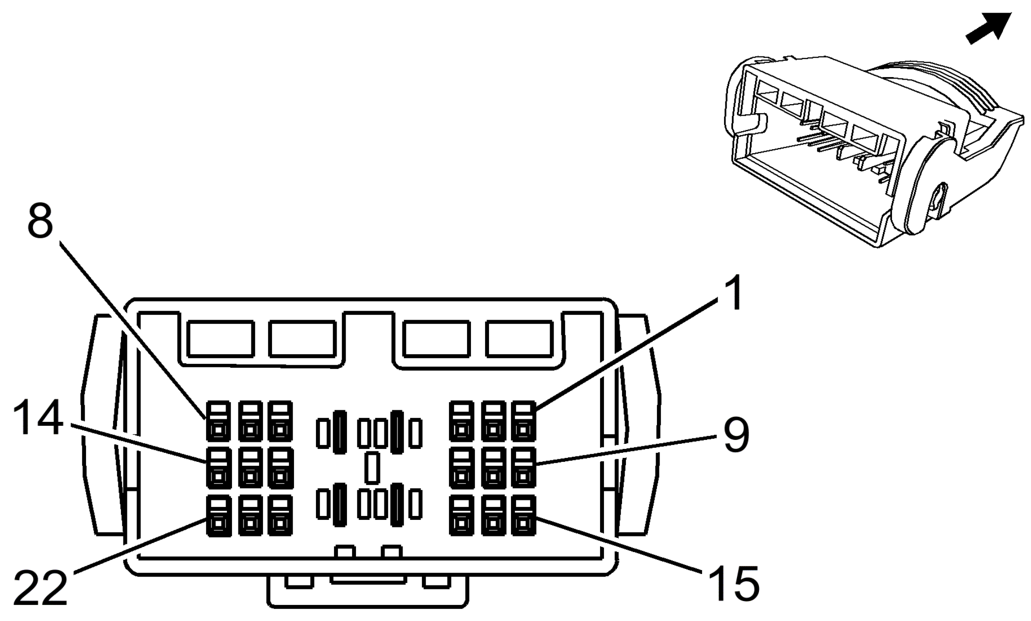
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	2	RD/BN	2940	II	-	Battery Positive Voltage	1	2	RD/BN	2940	VII	-
2	2	BK	850	I	-	Ground	2	2	BK	850	VII	-
3	0.75	BN/YE	294	I	-	Door Lock Actuator Unlock Control	3	1	BN/YE	294	III	-
4	0.75	GY	295	I	-	Door Lock Actuator Lock Control	4	1	GY	295	III	-
5	0.5	GN/GY	6135	I	-	Local Interconnect Network Serial Data Bus 4	5	0.35	GN/GY	6135	IV	-
6	0.5	BK	750	I	-	Ground	6	0.5	BK	750	V	-
7	-	-	-	-	-	Not Occupied	7	-	-	-	-	-
8	2	RD/BN	2940	II	-	Battery Positive Voltage	8	-	-	-	-	-
9	0.5	WH	6816	I	KA6	Indicator Dimming Control	9	0.35	WH	6816	IV	KA6
10	0.5	YE/GY	6158	I	-	Right Rear Door Handle Switch Signal	10	0.5	YE/GY	6158	V	-
11	0.5	BK	750	I	-	Ground	11	0.5	BK	750	V	-
12 - 13	-	-	-	-	-	Not Occupied	12 - 13	-	-	-	-	-
14	0.75	BU/BK	115	I	-	Right Rear Speaker Signal (-)	14	0.75	BU/BK	115	VI	-
15	0.75	WH	46	I	-	Right Rear Speaker Control (+)	15	0.75	WH	46	VI	-
16	-	-	-	-	-	Not Occupied	16	-	-	-	-	-
17	0.5	YE	6817	I	KA6	LED Backlight Dimming Control	17	0.35	YE	6817	IV	KA6
18	0.5	BN/GN	1634	I	-	Right Rear Heated Seat Switch Signal	18	0.5	BN/GN	1634	V	KA6
19	0.5	BN/WH	1635	I	-	Right Rear Heated Seat High Indicator Control	19	0.5	BN/WH	1635	V	KA6
20	0.5	BK	750	I	-	Ground	20	0.5	BK	750	V	KA6

X900 LIFTGATE EXTENSION HARNESS TO BODY HARNESS



Connector Part Information

- Harness Type: Liftgate Extension
- OEM Connector: 1897543-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 22-Way F 0.64 Micro-Quadlock, 2.8 Micro-Power Series (BK)



Connector Part Information

- Harness Type: Body
- OEM Connector: 1897540-2
- Service Connector: 13580994
- Description: 22-Way M 0.64 MQS, 2.8 MCP Series (BK)

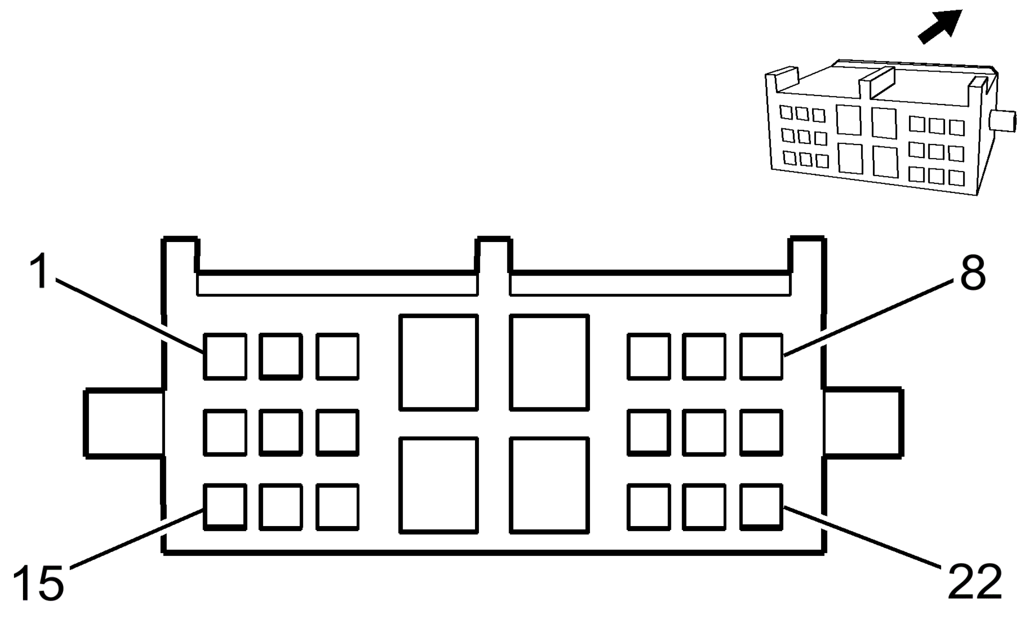
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	13575569	J-35616-65B (LT BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available
IV	13575574	J-35616-5 (PU)	J-38125-36	Not Available	Not Available	Not Available	Not Available

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	WH/YE	7541	II	-	Right Rear Stop Lamp Control	1	0.5	WH/YE	7541	III	-

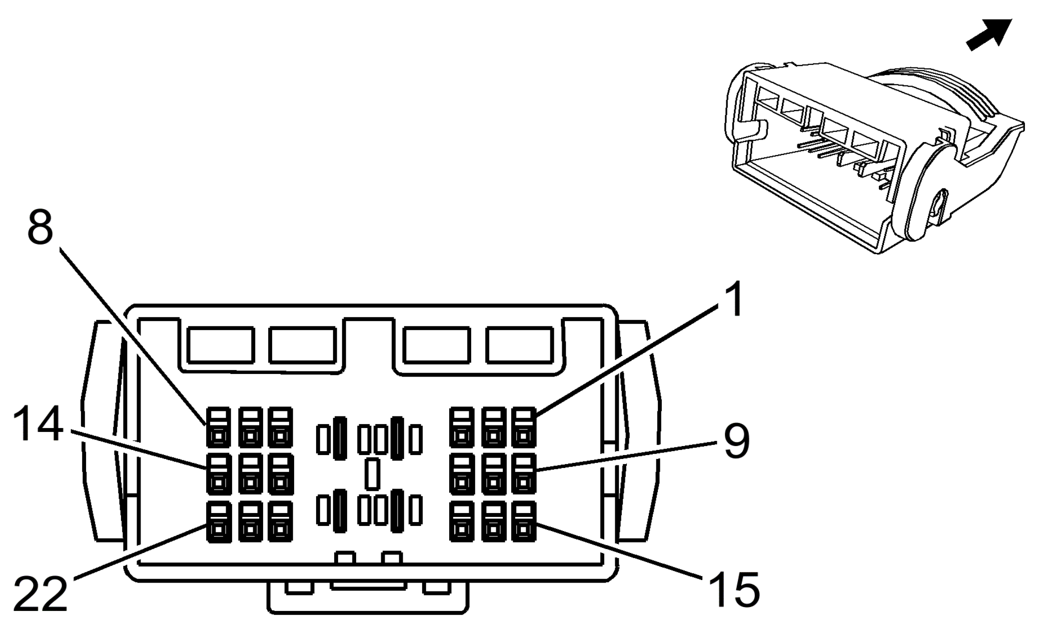
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
2	0.5	GY/YE	7542	II	-	Left Rear Stop Lamp Control	2	0.5	GY/YE	7542	III	-
3	0.5	BK	1050	II	-	Ground	3	0.5	BK	1050	III	-
4	2	BN/VT	293	I	-	Rear Defog Element Control	4	2	BN/VT	293	IV	-
5	2.5	BK	1950	I	-	Ground	5	2.5	BK	1950	IV	-
6	Â	Â	Â	Â	Â	Run/Crank Ignition 1 Voltage	6	0.35 0.35	VT/BK VT/BN	739 4669	III III	UVC UVH
7	0.5	GN/YE	6846	II	-	Rear License Lamp Control	7	0.35	GN/YE	6846	III	-
8	0.5	BN/YE	820	II	-	CHMSL Control	8	0.5	BN/YE	820	III	-
9	-	-	-	-	-	Camera Signal 2 +	9	0.35	GY/YE	6972	III	-
10	-	-	-	-	-	Camera Signal 2	10	0.35	WH/BU	6973	III	-
11	-	-	-	-	-	Camera Shield Ground Extension	11	0.35	GY	7069	III	-
12	0.5	VT/GY	1303	II	-	Lift Gate Ajar Switch Signal 1	12	0.5	VT/GY	1303	III	-
13	0.5	BK	1150	II	-	Ground	13	0.5	BK	1150	III	-
14	0.5	BU/WH	6128	II	-	Rear Closure Unlatch Motor Unlatch Control	14	0.5	BU/WH	6128	III	-
15	0.5	BK	1950	II	-	Ground	15	0.5	BK	1950	III	-
16	0.5	BK	1050	II	-	Ground	16	0.5	BK	1050	III	-
17	0.5	YE/BU	5797	II	-	Rear Closure Handle Switch Open Signal	17	0.5	YE/BU	5797	III	-
18	1	BU	393	I	-	Rear Window Wiper Motor Control	18	1	BU	393	IV	-
19	1	GY/VT	5780	I	-	Windshield Wiper Motor Park Switch Fused Signal	19	1	GY/VT	5780	IV	-
20	0.5	BK	2050	II	-	Ground	20	0.35 0.5	BK/YE BK	4670 2050	III III	UVH UVC
21	0.5	GY/BN	309	II	-	Right Park Lamp Control	21	0.5	GY/BN	309	III	-
22	0.5	VT/GY	709	II	-	Left Park Lamp Control	22	0.5	VT/GY	709	III	-

X901 LIFTGATE EXTENSION HARNESS TO LIFTGATE HARNESS



Connector Part Information

- Harness Type: Liftgate Extension
- OEM Connector: 1897543-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 22-Way F 0.64 Micro-Quadlock, 2.8 Micro-Power Series (BK)



Connector Part Information

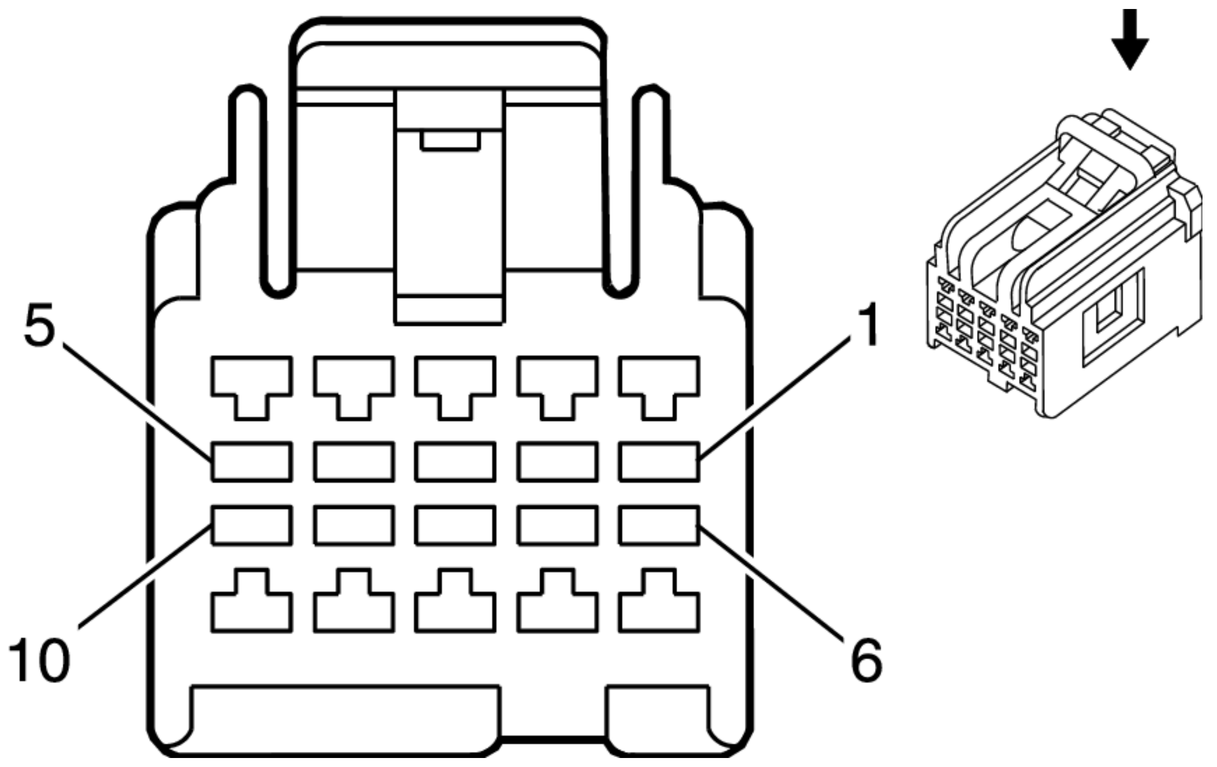
- Harness Type: Liftgate
- OEM Connector: 1897540-2
- Service Connector: Service by Harness - See Part Catalog
- Description: 22-Way M 0.64 MQS, 2.8 MCP Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-35 (VT)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-64B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
III	Not Required	J-35616-5 (PU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
IV	Not Required	J-35616-65B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

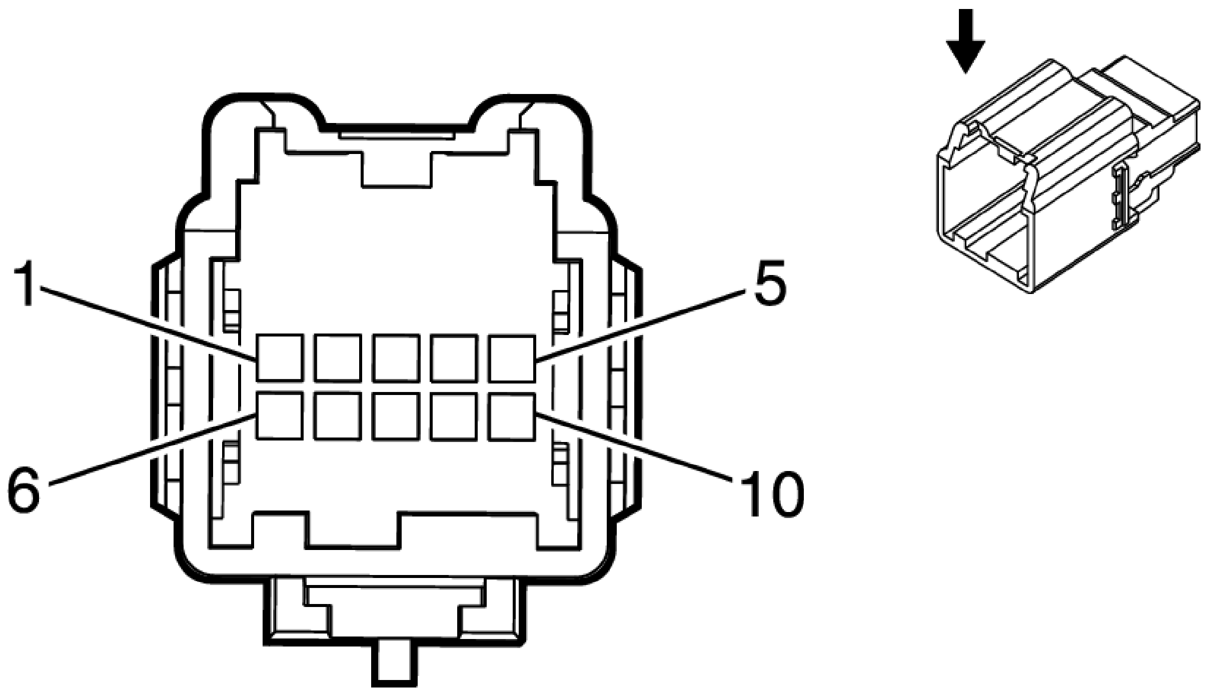
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	WH/YE	7541	II	-	Right Rear Stop Lamp Control	1	0.5	WH/YE	7541	IV	-
2	0.5	GY/YE	7542	II	-	Left Rear Stop Lamp Control	2	0.5	GY/YE	7542	IV	-
3	0.5	BK	1050	II	-	Ground	3	0.5	BK	1050	IV	-
4	2	BN/VT	293	I	-	Rear Defog Element Control	4	2	BN/VT	293	III	-
5	2.5	BK	1950	I	-	Ground	5	2.5	BK	1950	III	-
6	0.5	VT/BK	739	II	UVC/UVH	Run/Crank Ignition 1 Voltage	6	0.35	VT/BK	739	IV	UVC/UVH
7	0.5	GN/YE	6846	II	-	Rear License Lamp Control	7	0.35	GN/YE	6846	IV	-
8	-	-	-	-	-	Not Occupied	8	-	-	-	-	-
9	0.5	GN/YE	6972	II	UVC/UVH	Camera Signal 2 +	9	0.35	GY/YE	6972	IV	UVC/UVH
10	0.5	WH/BU	6973	II	UVC/UVH	Camera Signal 2	10	0.35	WH/BU	6973	IV	UVC/UVH
11	0.5	GY	7069	II	UVC/UVH	Camera Shield Ground Extension	11	0.35	GY	7069	IV	UVC/UVH
12	0.5	VT/GY	1303	II	-	Lift Gate Ajar Switch Signal 1	12	0.5	VT/GY	1303	IV	-
13	0.5	BK	1150	II	-	Ground	13	0.5	BK	1150	IV	-
14	0.5	BU/WH	6128	II	-	Rear Closure Unlatch Motor Unlatch Control	14	0.5	BU/WH	6128	IV	-
15	0.5	BK	1950	II	-	Ground	15	0.5	BK	1950	IV	-
16	0.5	BK	1050	II	-	Ground	16	0.35	BK	1050	IV	-
17	0.5	YE/BU	5797	II	-	Rear Closure Handle Switch Open Signal	17	0.5	YE/BU	5797	IV	-
18	1	BU	393	I	-	Rear Window Wiper Motor Control	18	1	BU	393	III	-
19	1	GY/VT	5780	I	-	Windshield Wiper Motor Park Switch Fused Signal	19	1	GY/VT	5780	III	-
20	0.5 0.5	BK BK	2050 1050	II II	UVC UVH	Ground Ground	20	0.35 0.35	BK BK	2050 1050	IV IV	UVC UVH
21	0.5	GY/BN	309	II	-	Right Park Lamp Control	21	0.5	GY/BN	309	IV	-
22	0.5	VT/GY	709	II	-	Left Park Lamp Control	22	0.5	VT/GY	709	IV	-

X902 LICENSE PLATE LAMP HARNESS TO LIFTGATE HARNESS



Connector Part Information

- Harness Type: License Plate Lamp
- OEM Connector: 15486854
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way F 64 Micro-HVT Series (BK)



Connector Part Information

- Harness Type: Liftgate
- OEM Connector: 13624101
- Service Connector: Service by Harness - See Part Catalog
- Description: 10-Way M 0.64 Micro-HVT Series (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-65B (LT BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

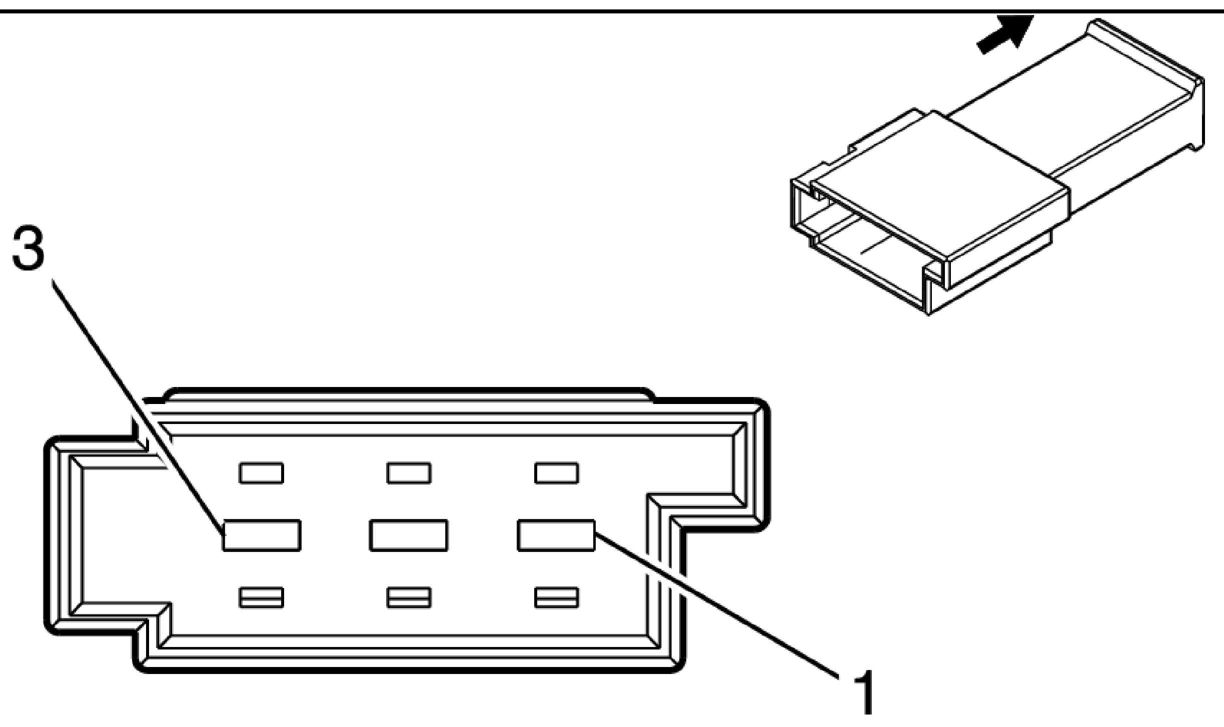
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	-	-	-	-	-	Not Occupied	1	-	-	-	-	-
2	0.35 0.35	VT/BK VT/BN	739 4669	I I	UVC UVH	Run/Crank Ignition 1 Voltage Rear Camera Control	2	0.35	VT/BK	739	II	UVC/UVH
3	0.35	GN/YE	6846	I	-	Rear License Lamp Control	3	0.35	GN/YE	6846	II	-
4	0.35	GY/YE	6972	I	-	Camera Signal 2 +	4	0.35	GY/YE	6972	II	UVC/UVH
5	0.35	WH/BU	6973	I	-	Camera Signal 2	5	0.35	WH/BU	6973	II	UVC/UVH
6	0.35 0.35	BK BK	1150 1050	I I	UVC/UVH VD1	Ground Ground	6	0.35 0.35	BK BK	1150 1050	II II	UVC/UVH VD1
7	0.5	YE/BU	5797	I	-	Rear Closure Handle Switch Open Signal	7	0.5	YE/BU	5797	II	-
8	0.5	BK	1050	I	-	Ground	8	0.5	BK	1050	II	-
9	0.35	GY	7069	I	-	Camera Shield Ground Extension	9	0.35	GY	7069	II	UVC/UVH
10	0.35 0.35	BK BK	1050 2050	I I	UVC/UVH VD1	Ground Ground	10	0.35 0.35	BK BK	1050 2050	II II	UVC/UVH VD1

X903 CENTER HIGH MOUNT STOP LIGHT HARNESS TO LIFTGATE EXTENSION HARNESS

-

Connector Part Information

- Harness Type: Center High Mount Stop Light
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way F



Connector Part Information

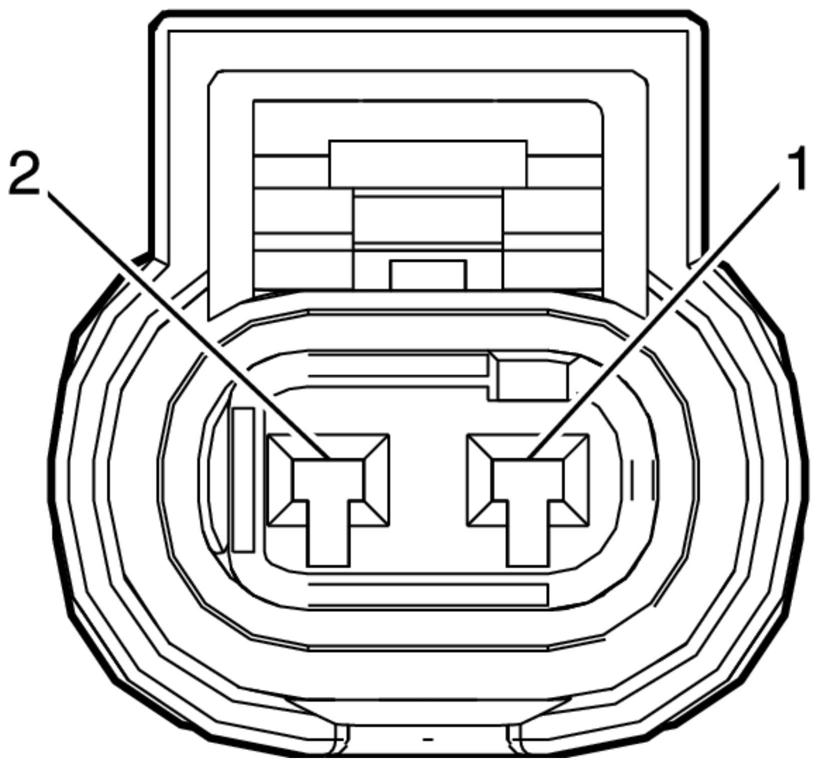
- Harness Type: Liftgate Extension
- OEM Connector: 1-962342-1
- Service Connector: Service by Harness - See Part Catalog
- Description: 3-Way M 1.6 Micro-Timer Series (BK)

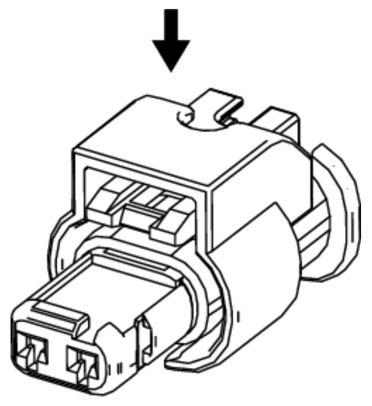
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-33 (YE)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-34 (YE)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	BK	2350	I	-	Ground	1	0.5	BK	2350	II	-
2	0.5	BK	1150	I	-	Ground Ground	2	0.5 0.5	BK BK	1150 1050	II II	VD1 UVC/UVH
3	0.5	BN/YE	820	I	-	CHMSL Control	3	0.5	BN/YE	820	II	-

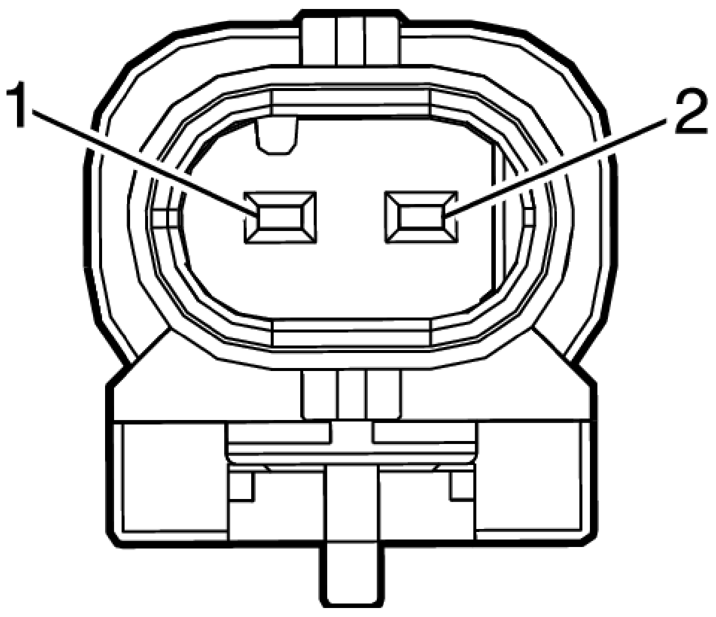
X907 LIFTGATE SWITCH HARNESS TO LICENSE PLATE LAMP HARNESS

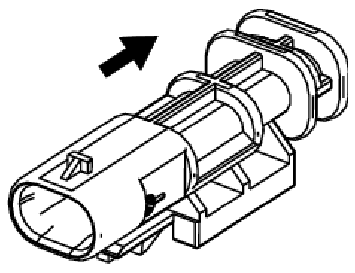




Connector Part Information

- Harness Type: Liftgate Switch
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way F





Connector Part Information

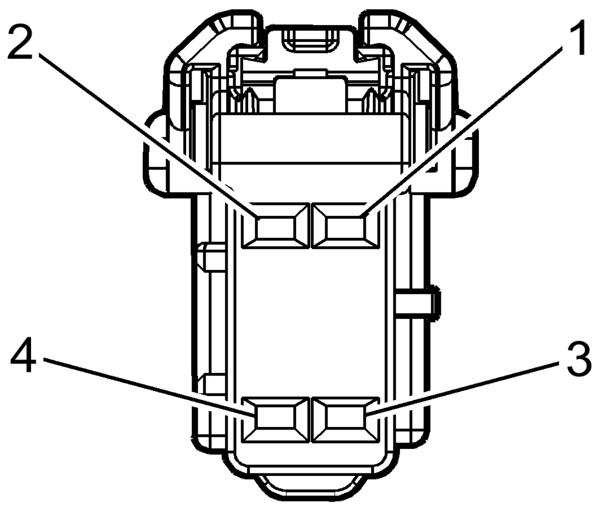
- Harness Type: License Plate Lamp
- OEM Connector: 1-1703498-3
- Service Connector: Service by Harness - See Part Catalog
- Description: 2-Way M 1.2 Multilock Series, Sealed (BK)

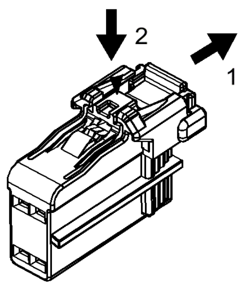
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-12 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-13 (BU)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	YE/BU	5797	I	-	Rear Closure Handle Switch Open Signal	1	0.5	YE/BU	5797	II	-
2	0.5	BK	1050	I	-	Ground	2	0.5	BK	1050	II	-

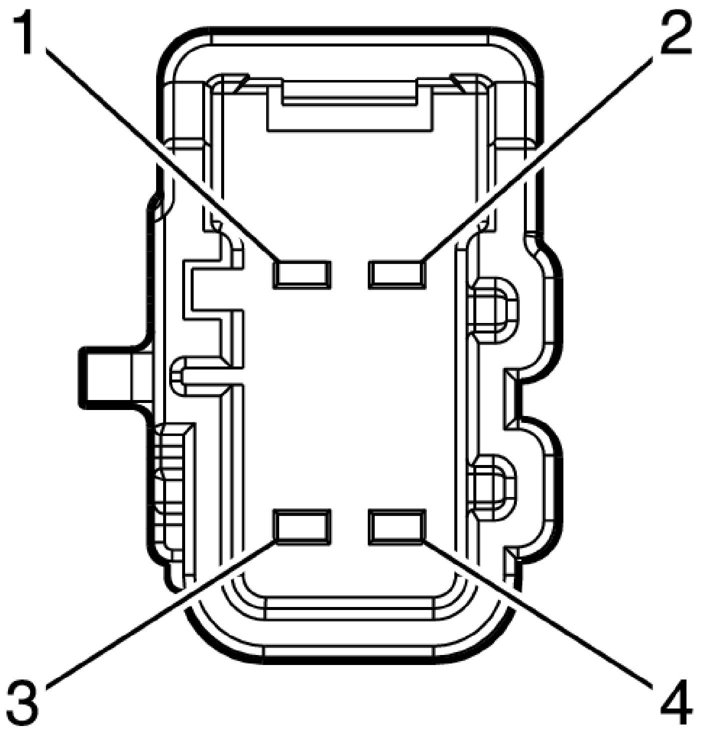
X910 LIFTGATE HARNESS TO LEFT TAIL STOP LAMP HARNESS (TW5)

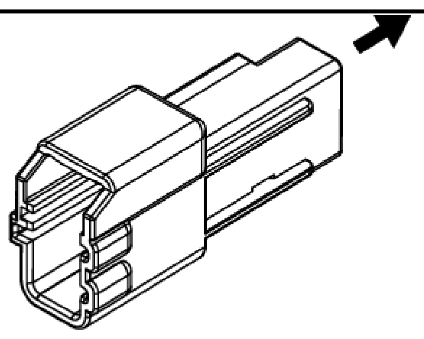




Connector Part Information

- Harness Type: Liftgate
- OEM Connector: 6098-7787
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.2 Series (BK)





Connector Part Information

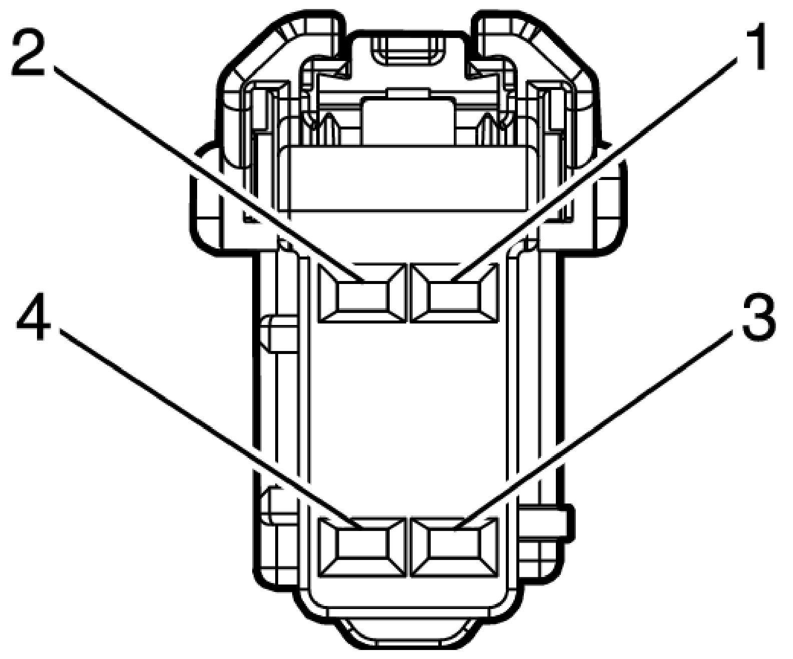
- Harness Type: Left Tail Stop Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M

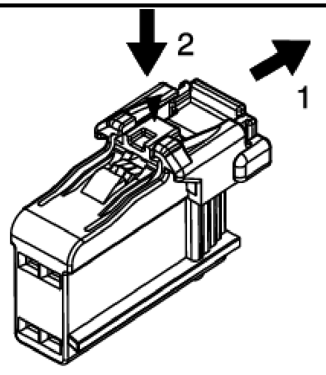
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-17 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	VT/GY	709	I	TW5	Left Park Lamp Control	1	0.5	VT/GY	709	II	TW5
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.5	GY/YE	7542	I	TW5	Left Rear Stop Lamp Control	3	0.5	GY/YE	7542	II	TW5
4	0.5	BK	1150	I	TW5	Ground	4	0.5	BK	1150	II	TW5

X910 LIFTGATE HARNESS TO LEFT TAIL STOP LAMP HARNESS (VD1)





Connector Part Information

- Harness Type: Liftgate
- OEM Connector: 6098-7789
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.2 Series (GY)

-

Connector Part Information

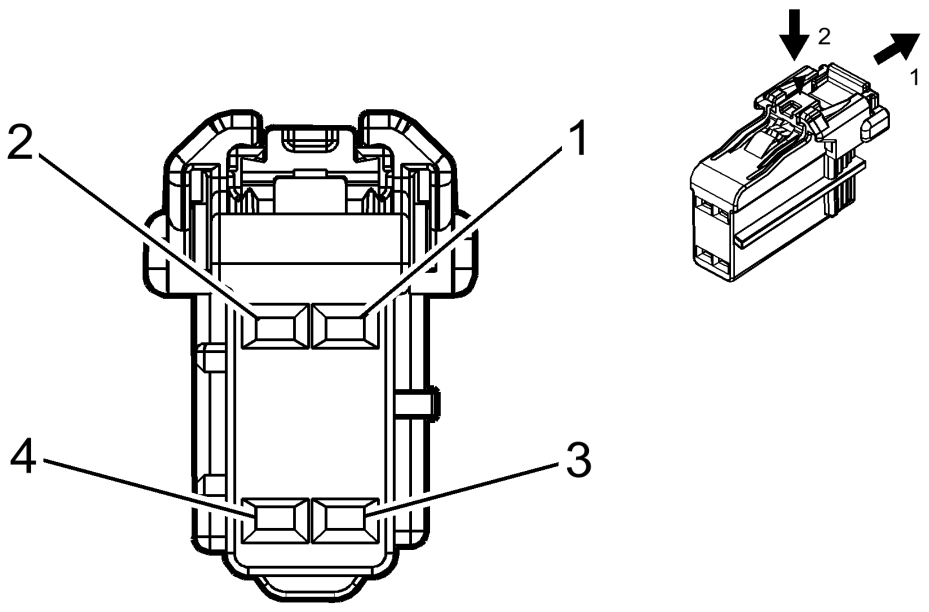
- Harness Type: Left Tail Stop Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M

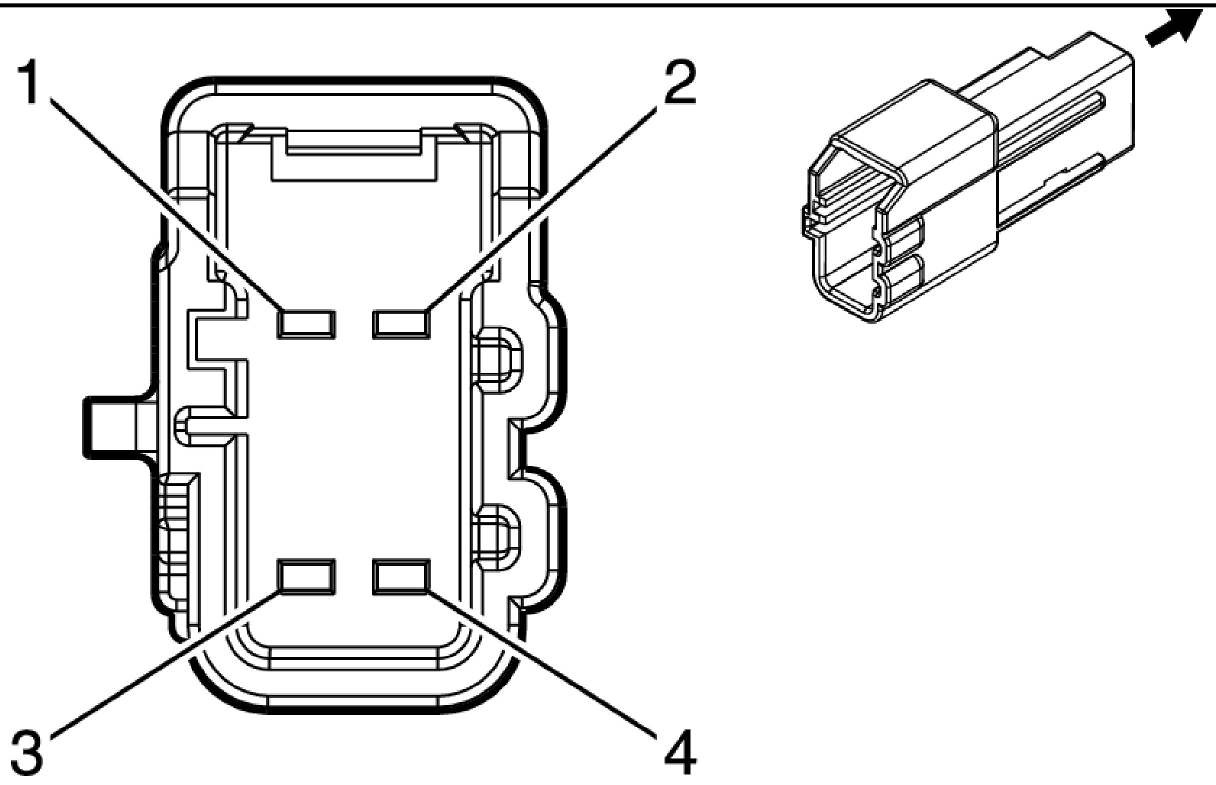
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-17 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	VT/GY	709	I	VD1	Left Park Lamp Control	1	0.5	VT/GY	709	II	VD1
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.5	GY/YE	7542	I	VD1	Left Rear Stop Lamp Control	3	0.5	GY/YE	7542	II	VD1
4	0.5	BK	1150	I	VD1	Ground	4	0.5	BK	1150	II	VD1

X920 LIFTGATE HARNESS TO RIGHT TAIL STOP LAMP HARNESS (TW5)





Connector Part Information

- Harness Type: Liftgate
- OEM Connector: 6098-7787
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.2 Series (BK)

Connector Part Information

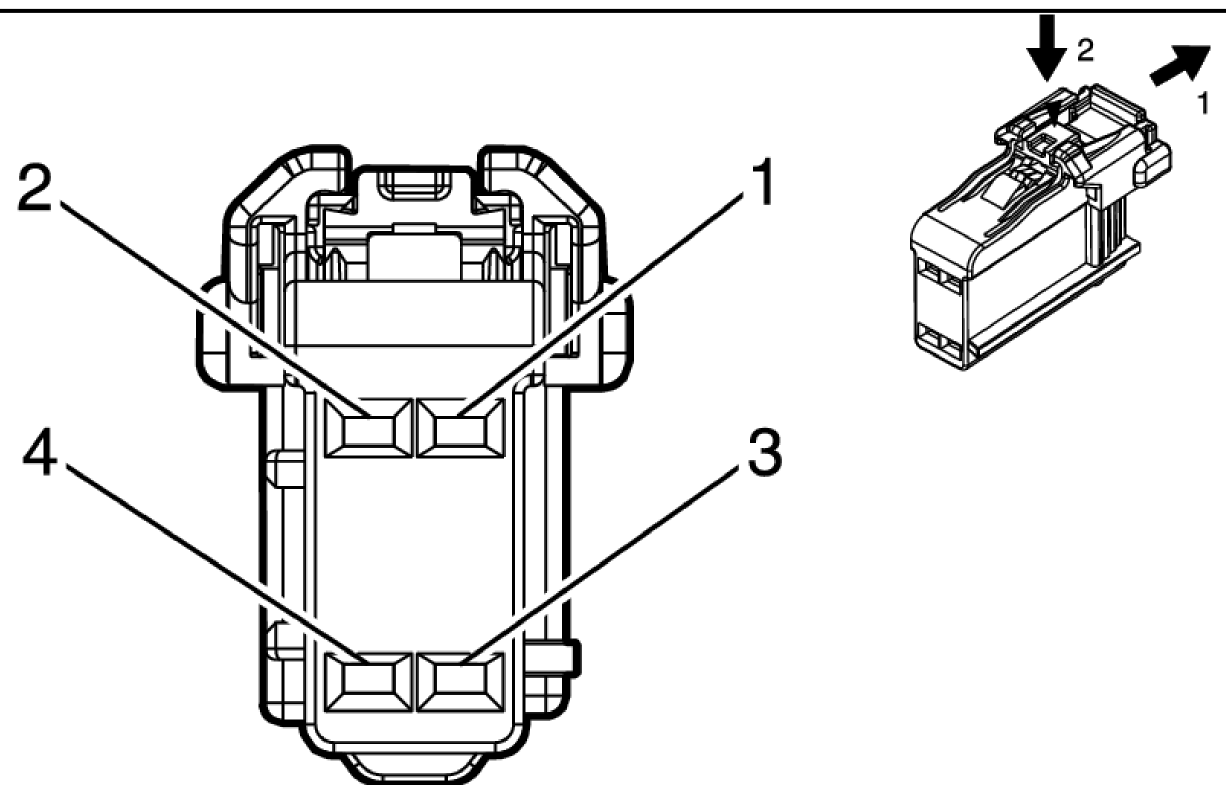
- Harness Type: Right Tail Stop Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-17 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	GY/BN	309	I	TW5	Right Park Lamp Control	1	0.5	GY/BN	309	II	TW5
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.5	WH/YE	7541	I	TW5	Right Rear Stop Lamp Control	3	0.5	WH/YE	7541	II	TW5
4	0.5 0.5	BK BK	1550 1950	I I	TW5 VD1	Ground Ground	4	0.5	BK	1550	II	TW5

X920 LIFTGATE HARNESS TO RIGHT TAIL STOP LAMP HARNESS (VD1)



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Connector Part Information

- Harness Type: Liftgate
- OEM Connector: 6098-7789
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way F 1.2 Series (GY)

Connector Part Information

- Harness Type: Right Tail Stop Lamp
- OEM Connector: Not Available
- Service Connector: Service by Harness - See Part Catalog
- Description: 4-Way M

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	Not Required	J-35616-16 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required
II	Not Required	J-35616-17 (LT GN)	No Tool Required	Not Required	Not Required	Not Required	Not Required

Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.5	GY/BN	309	I	VD1	Right Park Lamp Control	1	0.5	GY/BN	309	II	VD1
2	-	-	-	-	-	Not Occupied	2	-	-	-	-	-
3	0.5	WH/YE	7541	I	VD1	Right Rear Stop Lamp Control	3	0.5	WH/YE	7541	II	VD1
4	0.5 0.5	BK BK	1950 1550	I I	TW5 VD1	Ground Ground	4	0.5	BK	1550	II	VD1

Article GUID: A00889995

2017 ELECTRICAL

Wiring Systems and Power Management - Component Locator - Instrument Panel/Center Console Component Views - Bolt EV

INSTRUMENT PANEL/CENTER CONSOLE COMPONENT VIEWS

CENTER CONSOLE COMPONENTS TOP

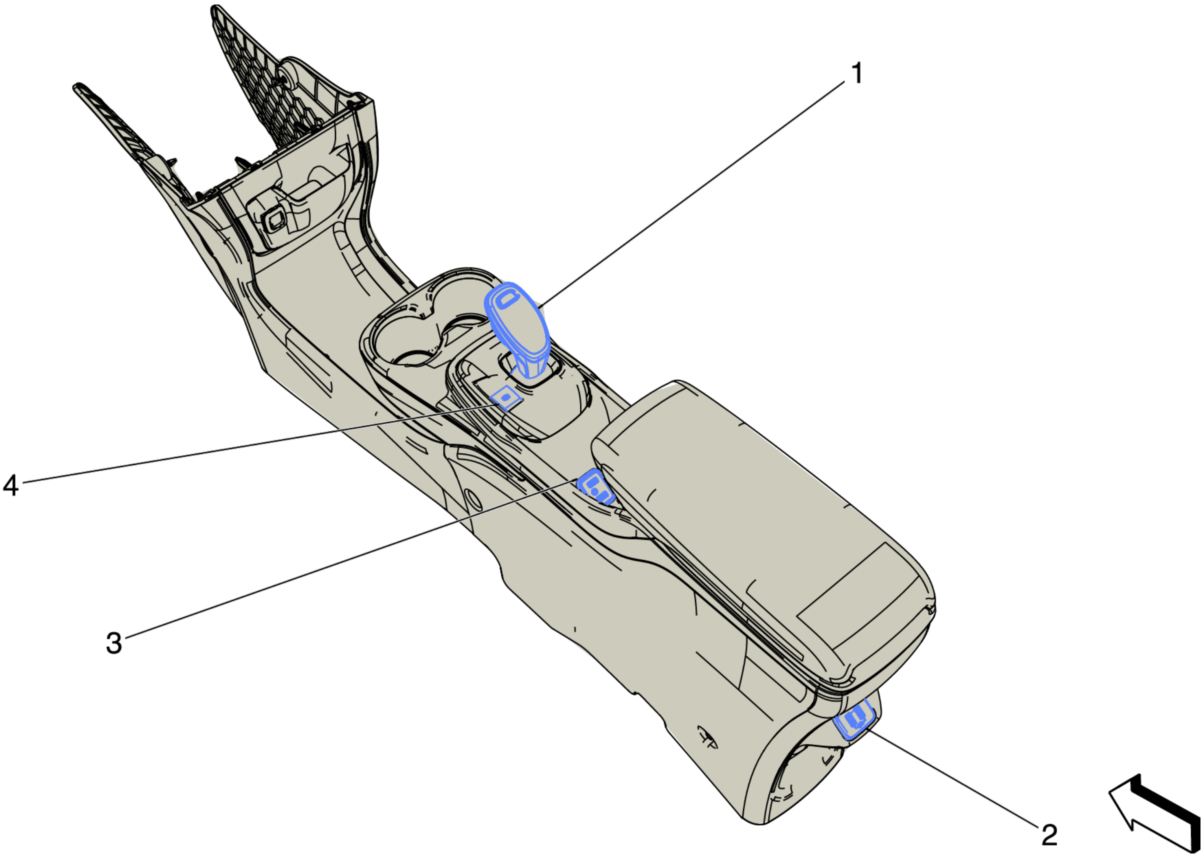

Fig. 1: Center Console Components Top
Courtesy of GENERAL MOTORS COMPANY

Items
1: P2 Transmission Shift Lever Position Indicator
2: X92 USB Receptacle X92 USB Receptacle (USS)
3: X83 Auxiliary Audio Input X83 Auxiliary Audio Input X1 X83 Auxiliary Audio Input X2
4: S91 Park Brake Control Switch S91 Park Brake Control Switch

CENTER CONSOLE COMPONENTS BOTTOM

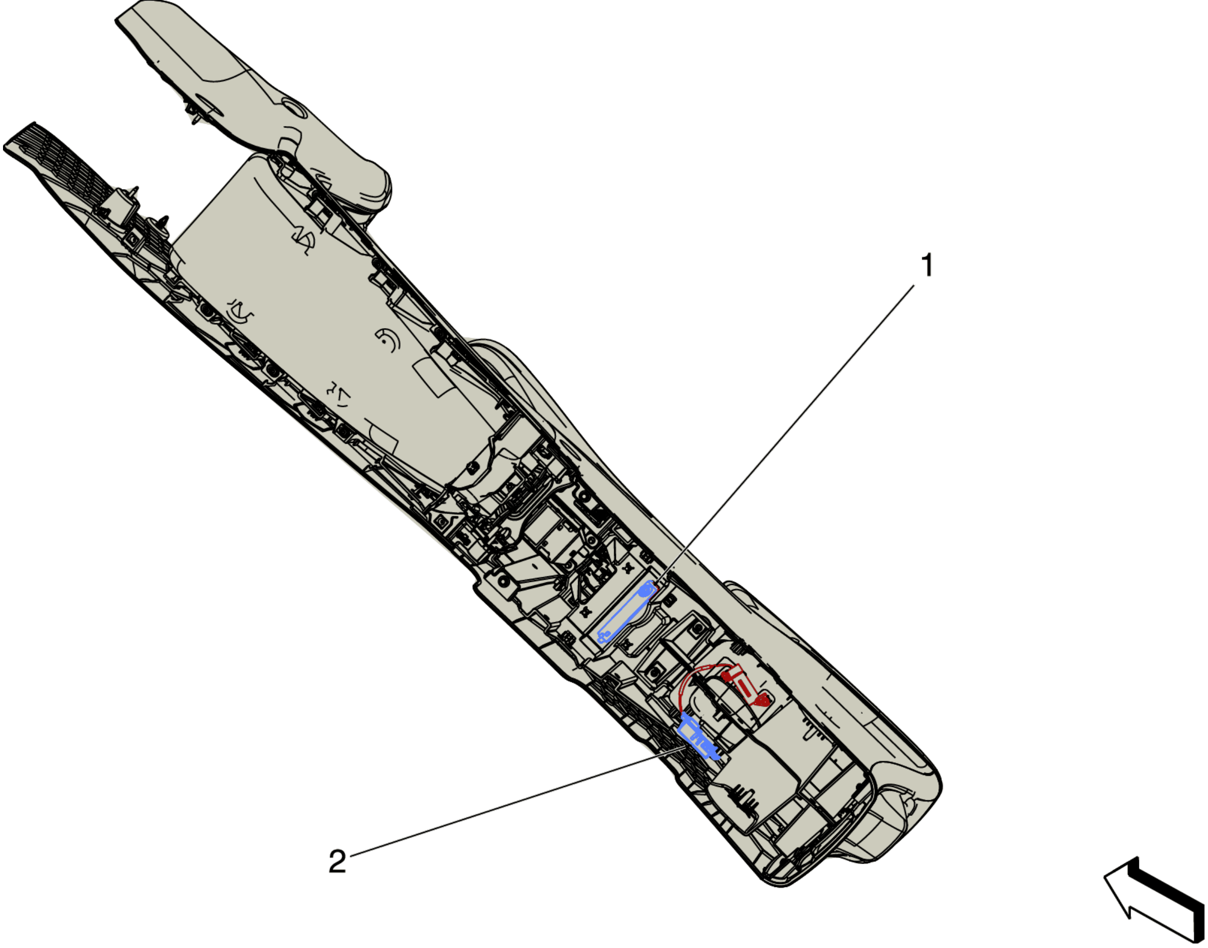

Fig. 2: Center Console Components Bottom
Courtesy of GENERAL MOTORS COMPANY

Items
1: T10K Keyless Entry Antenna - Center Console Rear
2: K89 Immobilizer Control Module K89 Immobilizer Control Module

CENTER CONSOLE COMPONENTS INTERNAL

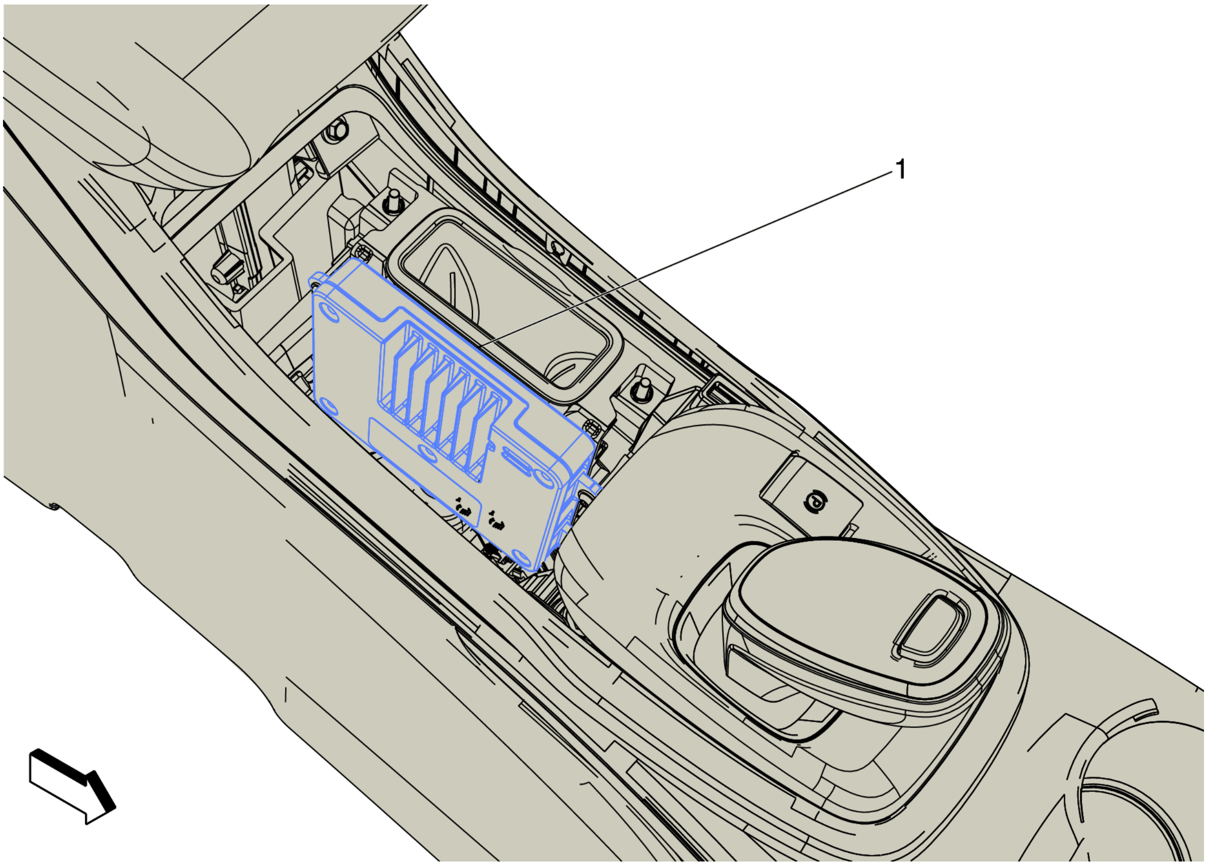

Fig. 3: Center Console Components Internal
Courtesy of GENERAL MOTORS COMPANY

Items
1: T22 Mobile Device Wireless Charger Module (K4C) **T22 Mobile Device Wireless Charger Module (K4C)**

FRONT OF INSTRUMENT PANEL COMPONENTS

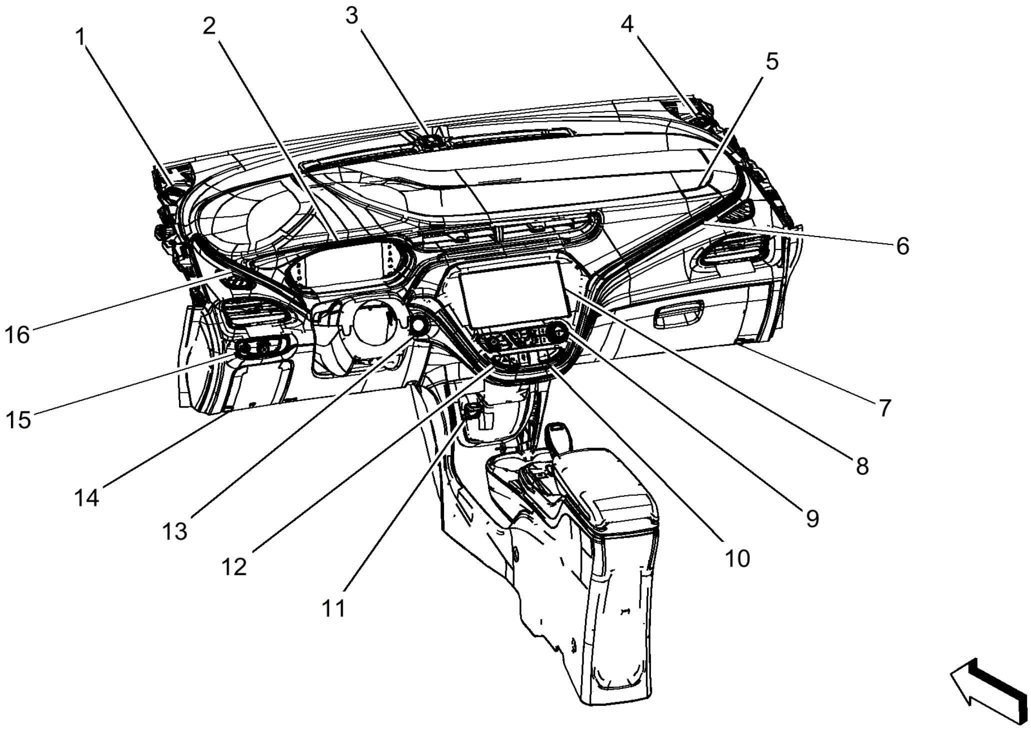

Fig. 4: Front of Instrument Panel Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: P19H Speaker - Left Front Tweeter **P19H Speaker - Left Front Tweeter (UQA)**
2: P16 Instrument Cluster **P16 Instrument Cluster**
3: B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator **P36 Battery State of Charge Indicator**
4: P19AH Speaker - Right Front Door **P19AH Speaker - Right Front Door (UQ3)** **P19AH Speaker - Right Front Door (UQA)**
5: F101 Passenger Instrument Panel Air Bag **F101 Passenger Instrument Panel Air Bag X1** **F101 Passenger Instrument Panel Air Bag X2**
6: E1H Accent Lamp - Right Instrument Panel **E1H Accent Lamp - Right Instrument Panel**
7: X84B Auxiliary Data Connector **X84B Auxiliary Data Connector X2**
8: A11 Radio **A11 Radio X1** **A11 Radio X2** **A11 Radio X3** **A11 Radio X4** **A11 Radio X5** **A11 Radio X6** **A11 Radio X8**
9: A20 Radio/HVAC Controls **A20 Radio/HVAC Controls**
10: S48D Multifunction Switch 2 - Instrument Panel **S48D Multifunction Switch 2 - Instrument Panel**
11: X80 Accessory Power Receptacle **X80 Accessory Power Receptacle**
12: S48C Multifunction Switch 1 - Instrument Panel **S48C Multifunction Switch 1 - Instrument Panel**
13: S83 Vehicle On/Off Switch **S83 Vehicle On/Off Switch**
14: X84 Data Link Connector **X84 Data Link Connector**
15: S30 Headlamp Switch **S30 Headlamp Switch**
16: E1G Accent Lamp - Left Instrument Panel **E1G Accent Lamp - Left Instrument Panel**

HVAC ASSEMBLY COMPONENTS

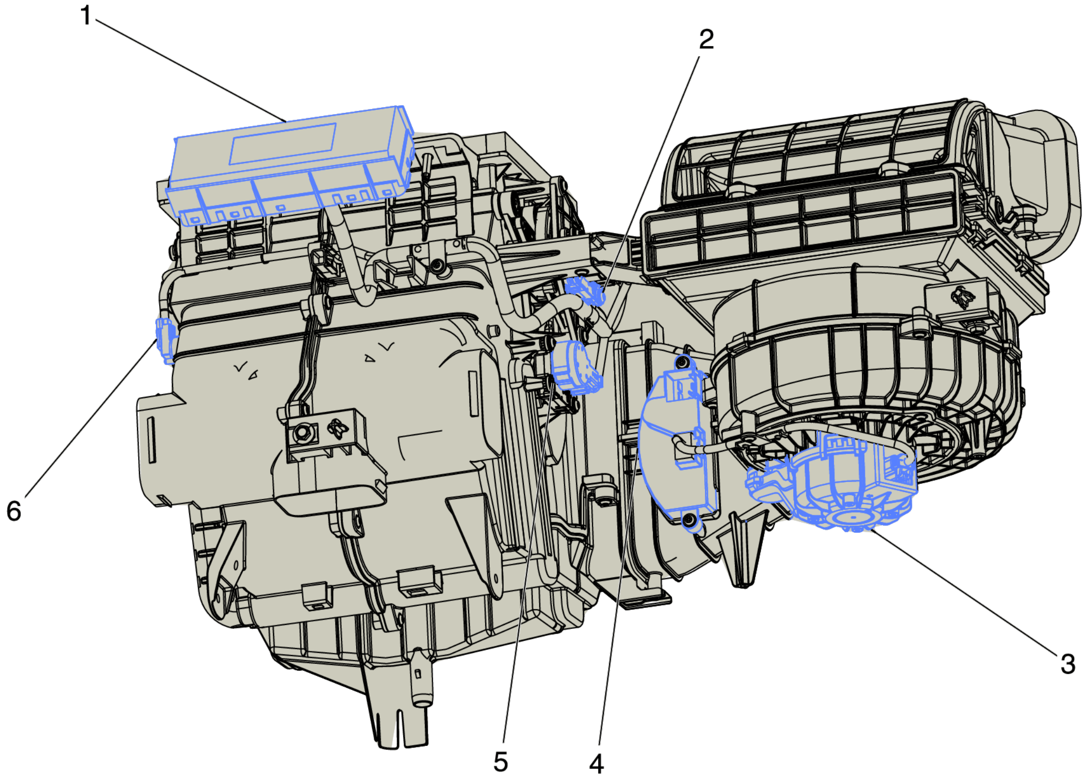

Fig. 5: HVAC Assembly Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: K33 HVAC Control Module **K33 HVAC Control Module X1** **K33 HVAC Control Module X2** **K33 HVAC Control Module X3**
2: M37 Mode Door Actuator **M37 Mode Door Actuator**
3: M8 Blower Motor **M8 Blower Motor**
4: K8 Blower Motor Control Module **K8 Blower Motor Control Module**
5: M6 Air Temperature Door Actuator **M6 Air Temperature Door Actuator**
6: B7F Air Temperature Sensor - Duct Upper **B7F Air Temperature Sensor - Duct Upper**

REAR OF INSTRUMENT PANEL COMPONENTS

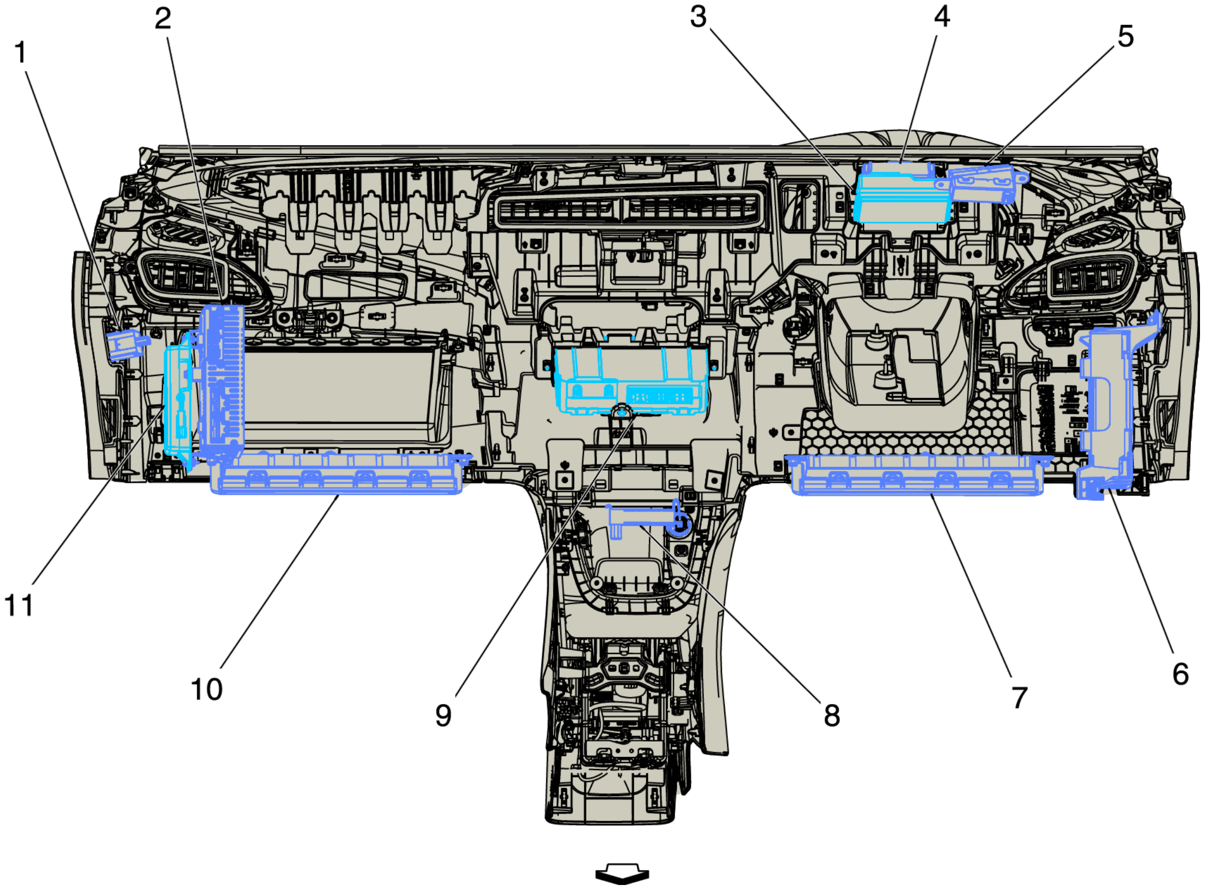

Fig. 6: Rear of Instrument Panel Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: S40 Passenger Air Bag Disable Switch **S40 Passenger Air Bag Disable Switch (C99)**
2: A11 Radio **A11 Radio X1** **A11 Radio X2** **A11 Radio X3** **A11 Radio X4** **A11 Radio X5** **A11 Radio X6** **A11 Radio X8**
3: K84 Keyless Entry Control Module **K84 Keyless Entry Control Module X1** **K84 Keyless Entry Control Module X2**
4: K56 Serial Data Gateway Module **K56 Serial Data Gateway Module X1** **K56 Serial Data Gateway Module X2**
5: P43 Collision Alert Indicators **P43 Collision Alert Indicators (UEU/UHX/UHY/UVX)**
6: K9 Body Control Module **K9 Body Control Module X1** **K9 Body Control Module X2** **K9 Body Control Module X3** **K9 Body Control Module X4** **K9 Body Control Module X5** **K9 Body Control Module X6** **K9 Body Control Module X7**
7: F114D Knee Air Bag - Driver **F114D Knee Air Bag - Driver (AYF)**
8: T10J Keyless Entry Antenna - Center Console Front **T10J Keyless Entry Antenna - Center Console Front**
9: K73 Telematics Communication Interface Control Module **K73 Telematics Communication Interface Control Module X1 (UE1)** **K73 Telematics Communication Interface Control Module X2 (UE1)** **K73 Telematics Communication Interface Control Module X5** **K73 Telematics Communication Interface Control Module X7**
10: F114P Knee Air Bag - Passenger **F114P Knee Air Bag - Passenger (AYF)**
11: C3 Telematics Communication Interface Control Module Battery (UE1) **C3 Telematics Communication Interface Control Module Battery (UE1)**

STEERING COLUMN COMPONENTS

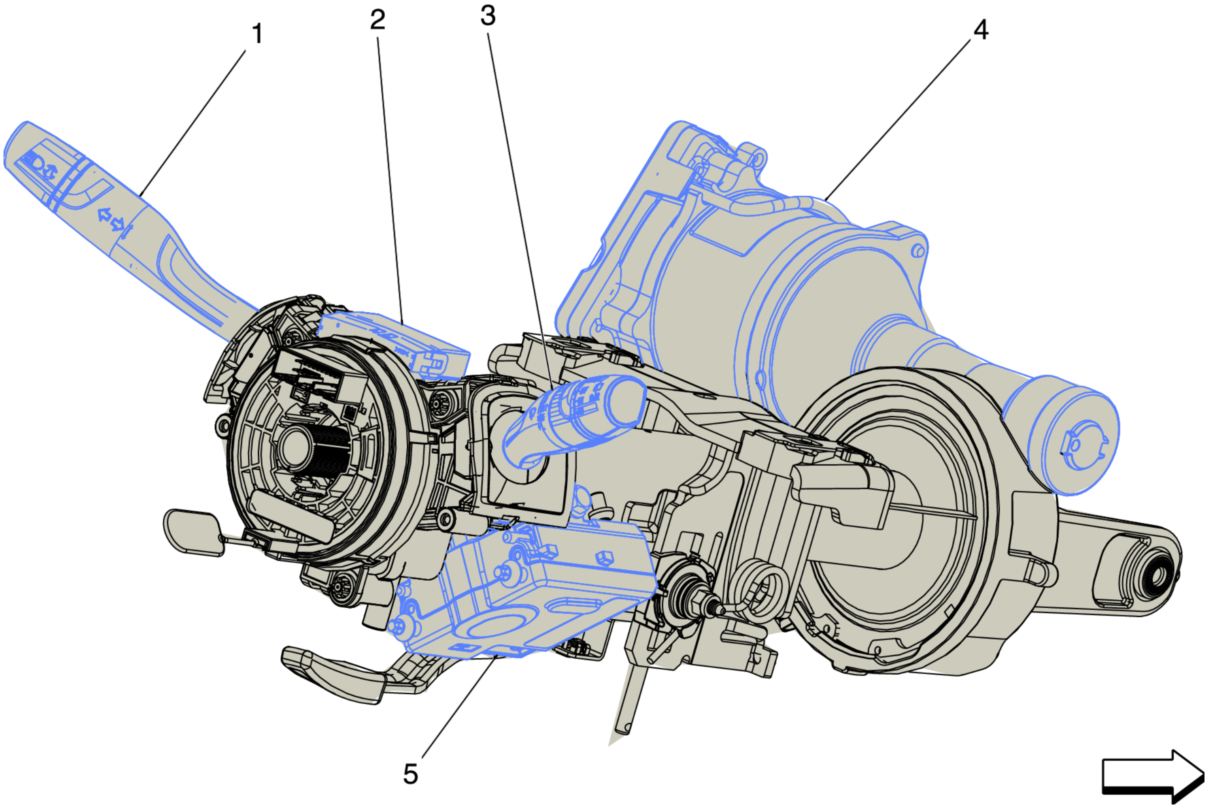

Fig. 7: Steering Column Components
Courtesy of GENERAL MOTORS COMPANY

Items

1: S78 Turn Signal/Multifunction Switch **S78 Turn Signal/Multifunction Switch**
2: X85 Steering Wheel Air Bag Coil **X85 Steering Wheel Air Bag Coil X1** **X85 Steering Wheel Air Bag Coil X2**
3: S82 Windshield Wiper/Washer Switch **S82 Windshield Wiper/Washer Switch**
4: K43 Power Steering Control Module X210 Instrument Panel Harness to Body Harness
5: K60 Steering Column Lock Module (N06) **K60 Steering Column Lock Module (NO6)**

Back To Article

Wiring Systems and Power Management - Component Locator - Luggage Compartment/Rear of Vehicle Component Views - Bolt EV

LUGGAGE COMPARTMENT/REAR OF VEHICLE COMPONENT VIEWS

LEFT SIDE LUGGAGE COMPARTMENT COMPONENTS

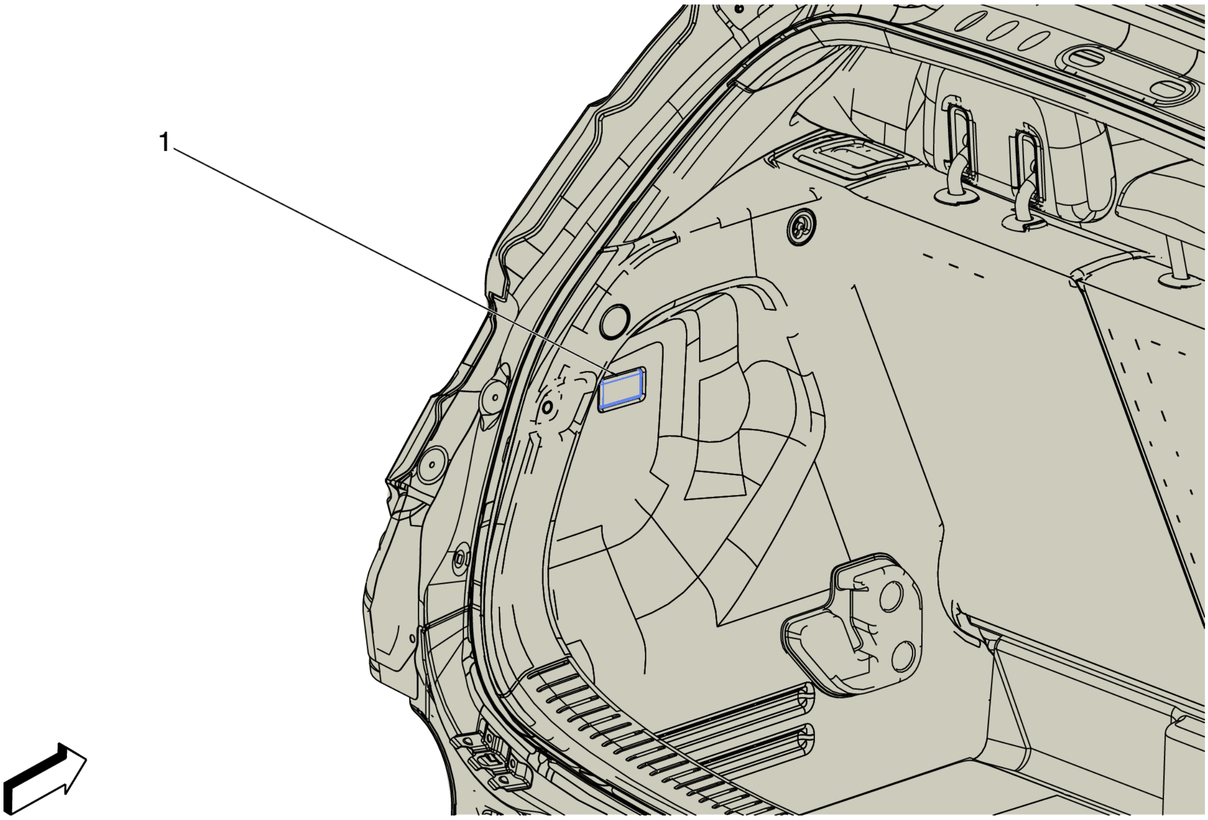

Fig. 1: Left Side Luggage Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: E8S Rear Compartment Courtesy Lamp E8S Rear Compartment Courtesy Lamp

BOTTOM OF LUGGAGE COMPARTMENT COMPONENTS

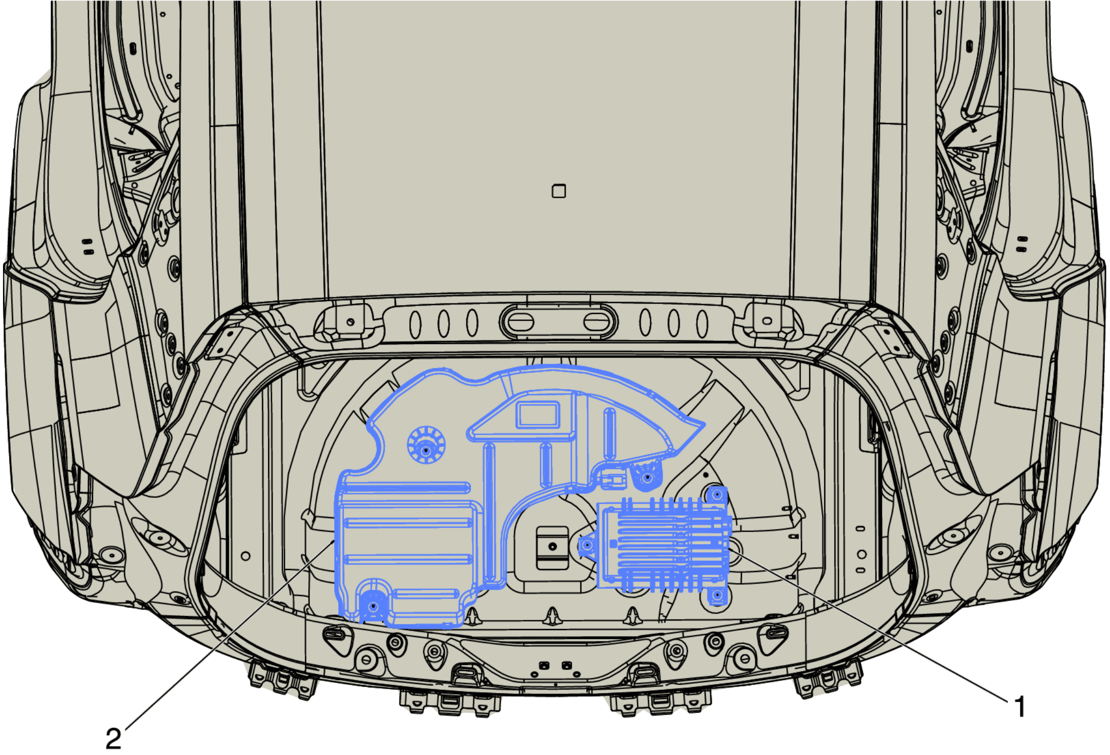

Fig. 2: Bottom of Luggage Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: T3 Audio Amplifier (UQA) T3 Audio Amplifier X1 (UQA) T3 Audio Amplifier X2 (UQA) T3 Audio Amplifier X3 (UQA)
1: P19AC Speaker - Subwoofer P19AC Speaker - Subwoofer (UQA)

LIFTGATE COMPONENTS

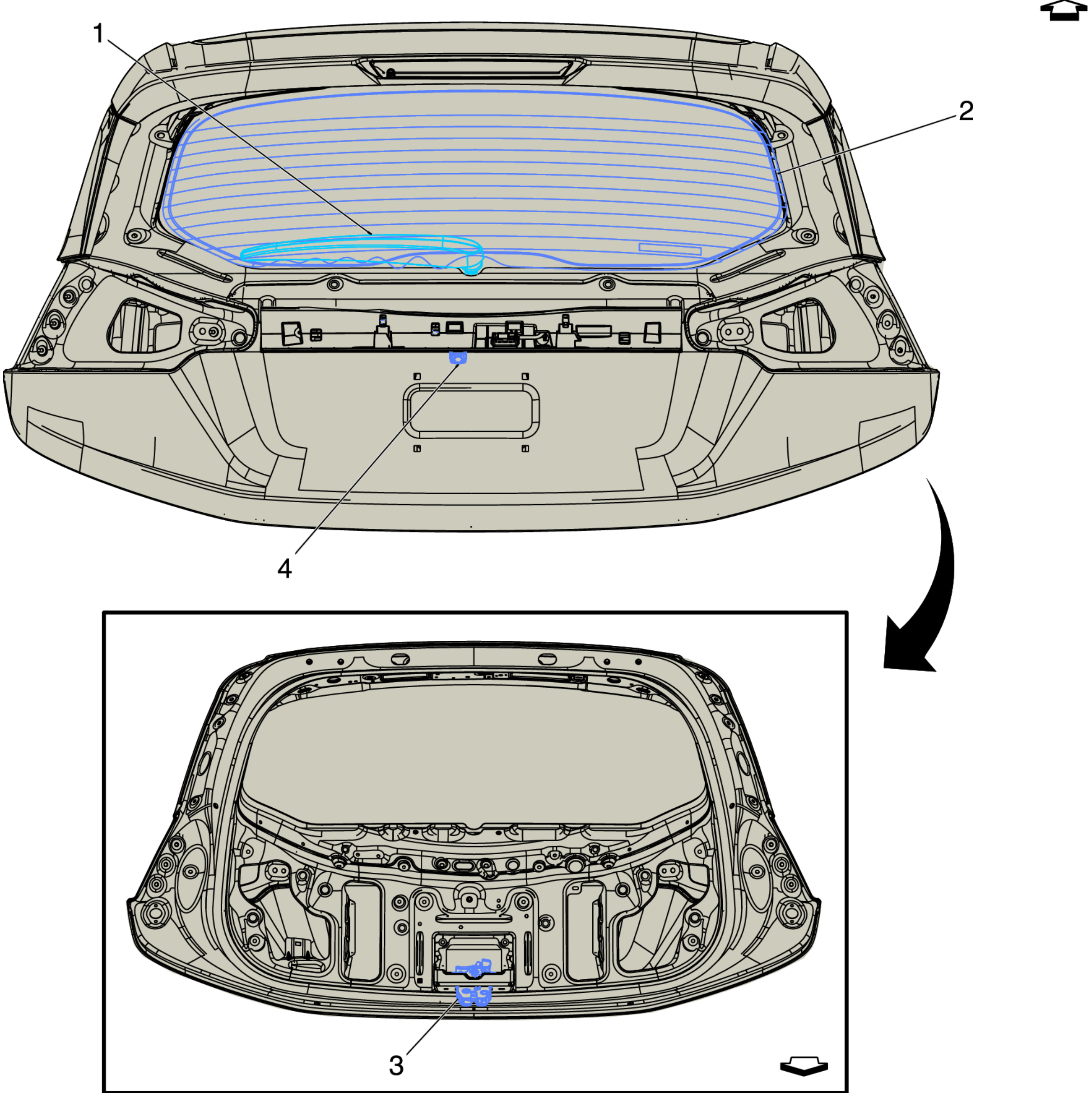

Fig. 3: Liftgate Components

Courtesy of GENERAL MOTORS COMPANY

Items

1: M45 Rear Wiper Motor **M45 Rear Wiper Motor**

2: E18 Rear Defogger Grid **E18 Rear Defogger Grid X1** **E18 Rear Defogger Grid X2**

3: A23C Liftgate Latch Assembly **A23C Liftgate Latch Assembly**

4: B87 Rearview Camera **B87 Rearview Camera X1 (UVC)** **B87 Rearview Camera X1 (UVH)** **B87 Rearview Camera X2 (DRZ)**

LEFT AND RIGHT REAR VEHICLE COMPONENTS

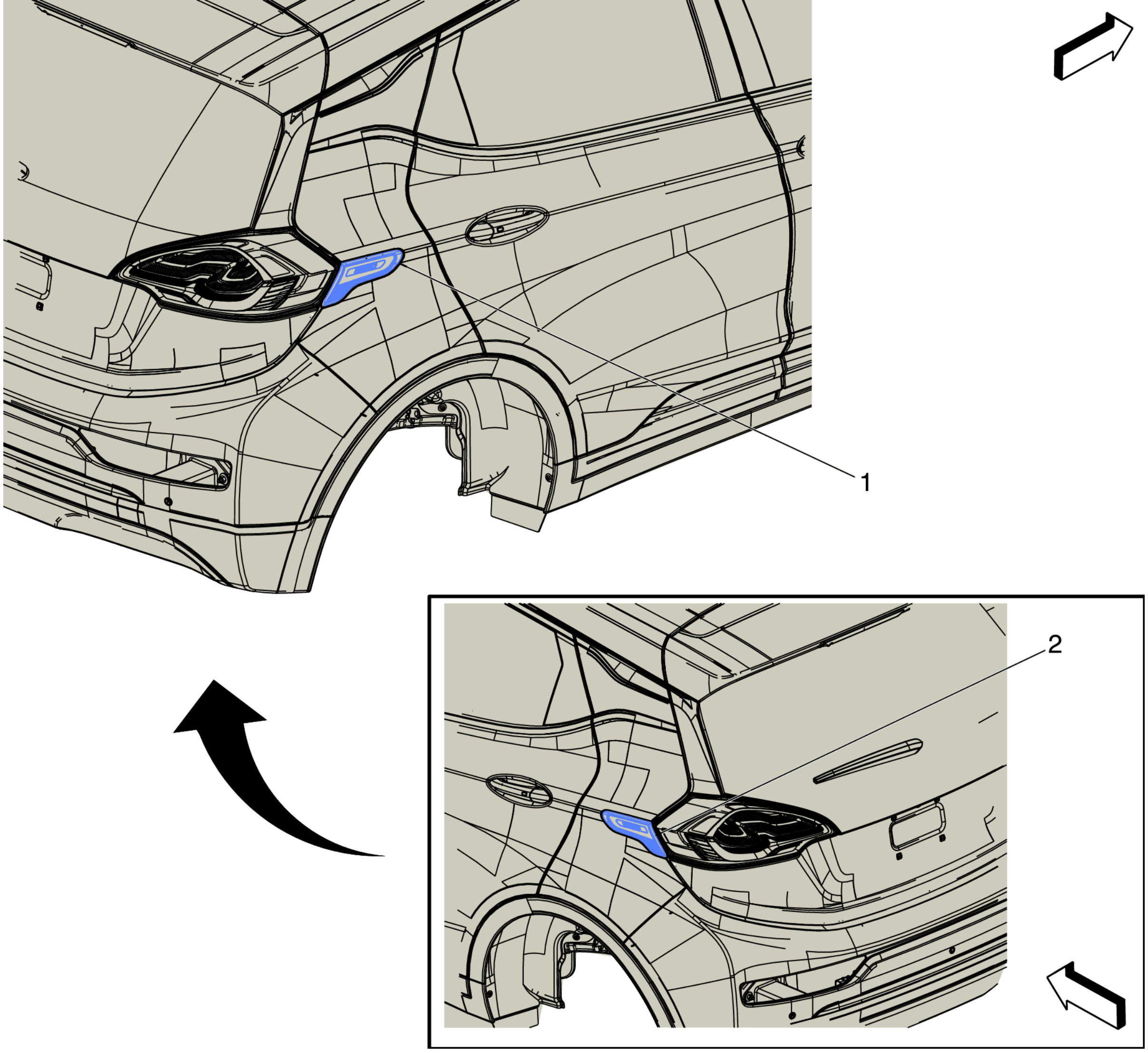

Fig. 4: Left and Right Rear Vehicle Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: E2RR Side Marker Lamp - Right Rear **E2RR Side Marker Lamp - Right Rear (TW5)**
2: E2LR Side Marker Lamp - Left Rear **E2LR Side Marker Lamp - Left Rear (TW5)**

REAR FASCIA COMPONENTS

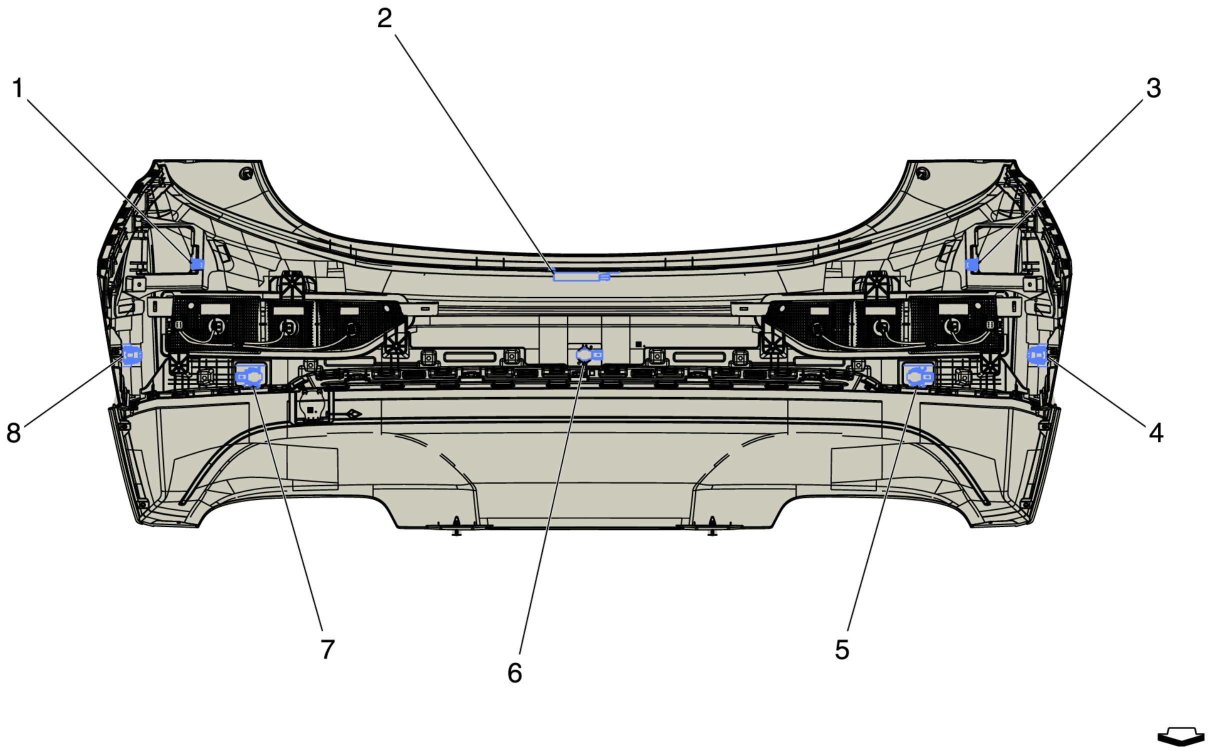

Fig. 5: Rear Fascia Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: B218R Side Object Sensor Module - Right (UKC) **B218R Side Object Sensor Module - Right (UKC)**
2: T10G Keyless Entry Antenna - Rear Fascia **T10G Keyless Entry Antenna - Rear Fascia**
3: B218L Side Object Sensor Module - Left (UKC) **B218L Side Object Sensor Module - Left (UKC)**
4: B306M Parking Assist Sensor - Side Left Rear (UFQ) **B306M Parking Assist Sensor - Side Left Rear (UFQ)**
5: B306E Parking Assist Sensor - Rear Left Outer (UD5/UD7/UFQ) **B306E Parking Assist Sensor - Rear Left Outer (UD5/UD7/UFQ)**
6: B306J Parking Assist Sensor - Rear Middle **B306J Parking Assist Sensor - Rear Middle**
7: B306H Parking Assist Sensor - Rear Right Outer (UD5/UD7/UFQ) **B306H Parking Assist Sensor - Rear Right Outer (UD5/UD7/UFQ)**
8: B306N Parking Assist Sensor - Side Right Rear (UFQ) **B306N Parking Assist Sensor - Side Right Rear (UFQ)**

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2017 ELECTRICAL

Wiring Systems and Power Management - Component Locator - Master Electrical Component List - Bolt EV

MASTER ELECTRICAL COMPONENT LIST

Code	Name	Option	Location	Locator View	Connector End View
A4	Hybrid/EV Battery Pack	-	Underbody in rear of vehicle mounted above the rear axle.	-	A4 Hybrid/EV Battery Pack X1 A4 Hybrid/EV Battery Pack X3 A4 Hybrid/EV Battery Pack X4
A9A	Outside Rearview Mirror - Driver	-	On the outside of the driver door, near the front of the door	Driver Door Components	-
A9B	Outside Rearview Mirror - Passenger	-	On the outside of the front passenger door, near the front of the door	Passenger Door Components	-
A10	Inside Rearview Mirror	-	In the passenger compartment, front center, at top of windshield, at center	Headliner Components	A10 Inside Rearview Mirror X1 A10 Inside Rearview Mirror X2 (DRZ)
A11	Radio	-	In the passenger compartment, in the center of the instrument panel	Front of Instrument Panel Components	A11 Radio X1 A11 Radio X2 A11 Radio X3 A11 Radio X4 A11 Radio X5 A11 Radio X6 A11 Radio X8
A20	Radio/HVAC Controls	-	In the passenger compartment, front at center, part of the info display module	Front of Instrument Panel Components	A20 Radio/HVAC Controls

Code	Name	Option	Location	Locator View	Connector End View
A23C	Liftgate Latch Assembly	-	In the passenger compartment, at the bottom middle of the liftgate	Liftgate Components	A23C Liftgate Latch Assembly
A23D	Door Latch Assembly - Driver	-	Inside the driver door, at rear below middle	Driver Door Components	A23D Door Latch Assembly - Driver
A23LR	Door Latch Assembly - Left Rear	-	Inside the left rear door, at rear below middle	Left Rear Door Components	A23LR Door Latch Assembly - Left Rear
A23P	Door Latch Assembly - Passenger	-	Inside the passenger door, at rear below middle	Passenger Door Components	A23P Door Latch Assembly - Passenger
A23RR	Door Latch Assembly - Right Rear	-	Inside the right rear door, at rear below middle	Right Rear Door Components	A23RR Door Latch Assembly - Right Rear
A24D	Door Handle Assembly - Driver Exterior	-	On outside of driver door, at rear	-	A24D Door Handle Assembly - Driver Exterior
A24LR	Door Handle Assembly - Left Rear Exterior	-	On outside of left rear door, at rear	-	A24LR Door Handle Assembly - Left Rear Exterior
A24P	Door Handle Assembly - Passenger Exterior	-	On outside of passenger door, at rear	-	A24P Door Handle Assembly - Passenger Exterior
A24RR	Door Handle Assembly - Right Rear Exterior	-	On outside of right rear door, at rear	-	A24RR Door Handle Assembly - Right Rear Exterior
A28	Hybrid/EV Battery Contactor Assembly	-	Inside battery pack assembly in front of battery sections	Underbody - Hybrid/EV Battery Pack Components	A28 Hybrid/EV Battery Contactor Assembly X2
B1	A/C Refrigerant Pressure Sensor	-	In the engine compartment in the high pressure line	-	B1 A/C Refrigerant Pressure Sensor
B1C	A/C Low Side Pressure Sensor	-	In the engine compartment, attached to the A/C line	-	B1C A/C Low Side Pressure Sensor
B5LF	Wheel Speed Sensor - Left Front	-	Near the left front wheel, to the rear of the knuckle	Wheel Well Components - Front	B5LF Wheel Speed Sensor - Left Front
B5LR	Wheel Speed Sensor - Left Rear	-	Near the left rear wheel, inside the hub	-	B5LR Wheel Speed Sensor - Left Rear
B5RF	Wheel Speed Sensor - Right Front	-	Near the right front wheel, to the rear of the knuckle	Wheel Well Components - Front	B5RF Wheel Speed Sensor - Right Front

Code	Name	Option	Location	Locator View	Connector End View
B5RR	Wheel Speed Sensor - Right Rear	-	Near the right rear wheel, inside the hub	**Wheel Well Components - Rear**	**B5RR Wheel Speed Sensor - Right Rear**
B7B	Air Temperature Sensor - Duct Lower	-	In the passenger compartment, behind the instrument panel, attached to the left lower HVAC duct	-	**B7B Air Temperature Sensor - Duct Lower**
B7F	Air Temperature Sensor - Duct Upper	-	In the passenger compartment, behind the instrument panel, attached to the left upper HVAC duct	**HVAC Assembly Components**	**B7F Air Temperature Sensor - Duct Upper**
B9	Ambient Air Temperature Sensor	-	On the front of the vehicle, to the right of the A/C condenser, mounted in the grill	**Front Fascia Components**	**B9 Ambient Air Temperature Sensor**
B10B	Ambient Light/Sunload Sensor	-	In the passenger compartment, at the top center of the instrument panel	-	-
B13	Transmission Fluid Temperature Sensor	-	In the engine compartment, internal to the automatic transmission assembly	-	-
B15	Transmission Internal Mode Switch	-	In the engine compartment, internal to the automatic transmission assembly	-	-
B18	Battery Current Sensor	-	In the engine compartment, left front, forward of battery, mounted to battery negative cable	**Left Side Engine Compartment**	**B18 Battery Current Sensor**
B20	Brake Fluid Level Switch	-	In the left rear of the engine compartment, at the bottom of the brake fluid reservoir	**Left Side Engine Compartment**	**B20 Brake Fluid Level Switch**

Code	Name	Option	Location	Locator View	Connector End View
B22	Brake Pedal Position Sensor	-	In the passenger compartment, left front, left of accelerator pedal, mounted to bracket on lower bulkhead	**Left Front of Passenger Compartment Components**	**B22 Brake Pedal Position Sensor**
B24	Cellular Phone Microphone	-	In the passenger compartment, at the front of the headliner, next to the dome lamp	-	**B24 Mobile Telephone Microphone (UE1)**
B27D	Door Handle Switch - Driver Exterior	-	On outside of driver door, at rear, part of door handle assembly	**Driver Door Components**	**B27D Door Handle Switch - Driver Exterior**
B27LR	Door Handle Switch - Left Rear Exterior	-	On outside of left rear door, at rear, part of door handle assembly	**Left Rear Door Components**	**B27LR Door Handle Switch - Left Rear Exterior**
B27P	Door Handle Switch - Passenger Exterior	-	On outside of passenger door, at rear, part of door handle assembly	**Passenger Door Components**	**B27P Door Handle Switch - Passenger Exterior**
B27RR	Door Handle Switch - Right Rear Exterior	-	On outside of right rear door, at rear, part of door handle assembly	**Right Rear Door Components**	**B27RR Door Handle Switch - Right Rear Exterior**
B30	Hybrid/EV Battery Pack Current Sensor	-	Internal component to Hybrid/EV battery pack	-	-
B32A	Hybrid/EV Battery Temperature Sensor 1	-	Under the vehicle, in the Hybrid/EV battery part of Hybrid/EV battery module 1	-	-
B32B	Hybrid/EV Battery Temperature Sensor 2	-	Under the vehicle, in the Hybrid/EV battery part of Hybrid/EV battery module 2	-	-

Code	Name	Option	Location	Locator View	Connector End View
B32C	Hybrid/EV Battery Temperature Sensor 3	-	Under the vehicle, in the Hybrid/EV battery part of Hybrid/EV battery module 3	-	-
B32D	Hybrid/EV Battery Temperature Sensor 4	-	Under the vehicle, in the Hybrid/EV battery part of Hybrid/EV battery module 4	-	-
B32E	Hybrid/EV Battery Temperature Sensor 5	-	Under the vehicle, in the Hybrid/EV battery part of Hybrid/EV battery module 5	-	-
B32F	Hybrid/EV Battery Temperature Sensor 6	-	Under the vehicle, in the Hybrid/EV battery part of Hybrid/EV battery module 6	-	-
B55	Hood Ajar Switch	-	In the engine compartment, to the left of the hood latch	**Front of Engine Compartment**	**B55 Engine Hood Switch**
B59L	Front Impact Sensor - Left	AYF	In the engine compartment, left of the hood latch	-	**B59L Front Impact Sensor - Left (AYF)**
B59R	Front Impact Sensor - Right	AYF	In the engine compartment, right of the hood latch	-	**B59R Front Impact Sensor - Right (AYF)**
B59	Front Impact Sensor	AY0	In the engine compartment, center of the hood latch	-	**B59 Front Impact Sensor (AY0)**
B60	Passenger Presence Sensor	-	In the passenger compartment, right forward of center, under the passenger seat.	-	**B60 Passenger Presence Sensor (-AL0+MAW)**
B61P	Seat Belt Tension Sensor - Passenger	-	Part of Passenger Seat Belt Buckle	**Right Front of Passenger Compartment Components**	**B61P Seat Belt Tension Sensor - Passenger (AL0)**

Code	Name	Option	Location	Locator View	Connector End View
B63L	Side Impact Sensor - Left	AY0	In the passenger compartment, at the bottom of the left B-pillar, behind the trim panel	Left Front of Passenger Compartment Components	B63L Side Impact Sensor - Left (AY0)
B63LF	Side Impact Sensor - Left Front	AYF	In the driver door, near middle, mounted to door beam	Driver Door Components	B63LF Side Impact Sensor - Left Front (AYF)
B63LR	Side Impact Sensor - Left Rear	AYF	In the passenger compartment, left rear, near outboard seat belt anchor bolt	Left Rear of Passenger Compartment Components	B63LR Side Impact Sensor - Left Rear (AYF)
B63R	Side Impact Sensor - Right	AY0	In the passenger compartment, at the bottom of the right B-pillar, behind the trim panel	Right Front of Passenger Compartment Components	B63R Side Impact Sensor - Right (AY0)
B63RF	Side Impact Sensor - Right Front	AYF	In the passenger door, near middle, mounted to door beam	Passenger Door Components	B63RF Side Impact Sensor - Right Front (AYF)
B63RR	Side Impact Sensor - Right Rear	AYF	In the passenger compartment, right rear, near outboard seat belt anchor bolt	Right Rear of Passenger Compartment Components	B63RR Side Impact Sensor - Right Rear (AYF)
B87	Rearview Camera	-	At the rear of vehicle, mounted to liftgate above license plate, left of center	Liftgate Components	• B87 Rearview Camera X1 (UVC) • B87 Rearview Camera X1 (UVH) • B87 Rearview Camera X2 (DRZ)
B88D	Seat Belt Switch - Driver	-	In the passenger compartment, in the driver seat belt buckle	-	B88D Seat Belt Switch - Driver
B88P	Seat Belt Switch - Passenger	-	In the passenger compartment, in the passenger seat belt buckle	Passenger Seat Components	B88P Seat Belt Switch - Passenger (AL0+AY0/AYF)

Code	Name	Option	Location	Locator View	Connector End View
B107	Accelerator Pedal Position Sensor	-	In the passenger compartment, under the instrument panel near the accelerator pedal	**Left Front of Passenger Compartment Components**	**B107 Accelerator Pedal Position Sensor**
B153D	Seat Belt Buckle - Driver	-	In the passenger compartment mounted to the inboard side of the driver seat	-	**B153D Seat Belt Buckle - Driver**
B153P	Seat Belt Buckle - Passenger	-	In the passenger compartment mounted to the inboard side of the passenger seat	-	**B153P Seat Belt Buckle - Passenger**
B160	Windshield Temperature and Inside Moisture Sensor	-	In the passenger compartment, front center, mounted to top of windshield, near inside rearview mirror	**Headliner Components**	**B160 Windshield Temperature and Inside Moisture Sensor**
B174G	Frontview Camera - Grille	UVH	On the front of the vehicle, on the center of the grille	**Front Fascia Components**	**B174G Frontview Camera - Grille (UVH)**
B197	Charge Port Door Position Switch	-	Left front of the vehicle, behind the rear of the left front fender	-	**B197 Charge Port Door Position Switch**
B200	Rain Sensor Module	CE1	In the passenger compartment, in front of the inside rearview	-	**B200 Rain Sensor Module (CE1)**
B201	Brake Control Brake Pedal Position Sensor	-	In the passenger compartment, under the driver side of the instrument panel, mounted to the brake pedal	**Left Side Engine Compartment**	**B201 Brake Control Brake Pedal Position Sensor**

Code	Name	Option	Location	Locator View	Connector End View
B202	Hybrid/EV Electronics Coolant Temperature Sensor	-	Right front of the engine compartment, mounted in the Hybrid/EV electronics radiator	-	**B202 Hybrid/EV Electronics Coolant Temperature Sensor**
B204A	Hybrid/EV Battery Pack Coolant Temperature Sensor 1	-	Rear of engine compartment, mounted within E54 Hybrid/EV Battery Pack Coolant Heater	**Underbody - Hybrid/EV Battery Pack Components**	**B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1**
B218L	Side Object Sensor Module - Left	UKC	Left rear of vehicle, mounted to back side of rear fascia	**Rear Fascia Components**	**B218L Side Object Sensor Module - Left (UKC)**
B218R	Side Object Sensor Module - Right	UKC	Right rear of vehicle, mounted to back side of rear fascia	**Rear Fascia Components**	**B218R Side Object Sensor Module - Right (UKC)**
B225L	Sideview Camera - Left	UVH	Outside of vehicle, left front, mounted to left outside rearview mirror	-	**B225L Sideview Camera - Left (UVH)**
B225R	Sideview Camera - Right	UVH	Outside of vehicle, right front, mounted to right outside rearview mirror	-	**B225R Sideview Camera - Right (UVH)**
B228	Drive Motor Position Sensor	-	In the engine compartment, internal to the automatic transmission assembly	-	-
B258	Hybrid/EV Battery Coolant Level Switch	-	In the engine compartment, right side front mounted battery coolant bottle	-	**B258 Hybrid/EV Battery Coolant Level Switch**
B282	Hybrid/EV Battery Charger Receptacle Temperature Sensor	-	At the left front of the vehicle, behind the rear of the left front fender	-	-

Code	Name	Option	Location	Locator View	Connector End View
B305	Ambient Light/Sunload Sensor and Battery State of Charge Indicator	-	In passenger compartment, front of center, mounted in the instrument panel at base of windshield	Front of Instrument Panel Components	P36 Battery State of Charge Indicator
B306A	Parking Assist Sensor - Front Left Outer	UD5/UFQ	At the front of the vehicle, On the front fascia, near the left front corner.	- Front Fascia Components - Front Fascia Components	B306A Parking Assist Sensor - Front Left Outer (UD5/UFQ)
B306B	Parking Assist Sensor - Front Left Middle	UD5/UFQ	At the front of the vehicle, On the front fascia, near the left front middle.	-	B306B Parking Assist Sensor - Front Left Middle
B306C	Parking Assist Sensor - Front Right Middle	UD5/UFQ	At the front of the vehicle, On the front fascia, near the right front middle.	Front Fascia Components	B306C Parking Assist Sensor - Front Right Middle (UD5/UFQ)
B306D	Parking Assist Sensor - Front Right Outer	UD5/UFQ	At the front of the vehicle, On the front fascia, near the right front corner.	Front Fascia Components	B306D Parking Assist Sensor - Front Right Outer (UD5/UFQ)
B306E	Parking Assist Sensor - Rear Left Outer	UD5/UD7/UFQ	At the rear of the vehicle, on the rear fascia, near the left rear corner	Rear Fascia Components	B306E Parking Assist Sensor - Rear Left Outer (UD5/UD7/UFQ)
B306H	Parking Assist Sensor - Rear Right Outer	UD5/UD7/UFQ	At the rear of the vehicle, on the rear fascia, near the right rear corner	Rear Fascia Components	B306H Parking Assist Sensor - Rear Right Outer (UD5/UD7/UFQ)
B306J	Parking Assist Sensor - Rear Middle	-	At the rear of the vehicle, on the rear fascia, in the right center of the rear fascia	Rear Fascia Components	B306J Parking Assist Sensor - Rear Middle
B306K	Parking Assist Sensor - Side Left Front	UFQ	At the front of the vehicle, on the front fascia, near the left front corner	Front Fascia Components	B306K Parking Assist Sensor - Side Left Front (UFQ)
B306L	Parking Assist Sensor - Side Right Front	UFQ	At the front of the vehicle, on the front fascia, near the right front corner	Front Fascia Components	B306L Parking Assist Sensor - Side Right Front (UFQ)

Code	Name	Option	Location	Locator View	Connector End View
B306M	Parking Assist Sensor - Side Left Rear	UFQ	In rear of vehicle, mounted to left rear fascia	Rear Fascia Components	B306M Parking Assist Sensor - Side Left Rear (UFQ)
B306N	Parking Assist Sensor - Side Right Rear	UFQ	At the rear of the vehicle, on the rear fascia, on the passenger side	Rear Fascia Components	B306N Parking Assist Sensor - Side Right Rear (UFQ)
C1	Battery	-	In the engine compartment, left side, near front, mounted to battery tray, below battery cover	Left Side Engine Compartment	• C1 Battery ((-) Body) • C1 Battery ((-) Battery)
C3	Telematics Communication Interface Control Module Battery	UE1	In the passenger compartment, behind the center of the instrument panel	Rear of Instrument Panel Components	C3 Telematics Communication Interface Control Module Battery (UE1)
C4A	Hybrid/EV Battery Section 1	-	Internal component to Hybrid/EV battery pack	-	-
C4B	Hybrid/EV Battery Section 2	-	Internal component to Hybrid/EV battery pack	-	-
C4C	Hybrid/EV Battery Section 3	-	Internal component to Hybrid/EV battery pack	-	-
C4D	Hybrid/EV Battery Section 4	-	Internal component to Hybrid/EV battery pack	-	-
C4E	Hybrid/EV Battery Section 5	-	Internal component to Hybrid/EV battery pack	-	-
C5A	Hybrid/EV Battery Module 1	-	Internal component to Hybrid/EV battery pack	-	• C5A Hybrid/EV Battery Module 1 X1 • C5A Hybrid/EV Battery Module 1 X2
C5B	Hybrid/EV Battery Module 2	-	Internal component to Hybrid/EV battery pack	-	• C5B Hybrid/EV Battery Module 2 X1 • C5B Hybrid/EV Battery Module 2 X2

Code	Name	Option	Location	Locator View	Connector End View
C5C	Hybrid/EV Battery Module 3	-	Internal component to Hybrid/EV battery pack	-	- **C5C Hybrid/EV Battery Module 3 X1** - **C5C Hybrid/EV Battery Module 3 X2**
C5D	Hybrid/EV Battery Module 4	-	Internal component to Hybrid/EV battery pack	-	- **C5D Hybrid/EV Battery Module 4 X1** - **C5D Hybrid/EV Battery Module 4 X2**
C5E	Hybrid/EV Battery Module 5	-	Internal component to Hybrid/EV battery pack	-	- **C5E Hybrid/EV Battery Module 5 X1** - **C5E Hybrid/EV Battery Module 5 X2**
C5F	Hybrid/EV Battery Module 6	-	Internal component to Hybrid/EV battery pack	-	- **C5F Hybrid/EV Battery Module 6 X1** - **C5F Hybrid/EV Battery Module 6 X2**
C5G	Hybrid/EV Battery Module 7	-	Internal component to Hybrid/EV battery pack	-	- **C5G Hybrid/EV Battery Module 7 X1** - **C5G Hybrid/EV Battery Module 7 X2**
C5H	Hybrid/EV Battery Module 8	-	Internal component to Hybrid/EV battery pack	-	- **C5H Hybrid/EV Battery Module 8 X1** - **C5H Hybrid/EV Battery Module 8 X2**
C5J	Hybrid/EV Battery Module 9	-	Internal component to Hybrid/EV battery pack	-	- **C5J Hybrid/EV Battery Module 9 X1** - **C5J Hybrid/EV Battery Module 9 X2**

Code	Name	Option	Location	Locator View	Connector End View
C5K	Hybrid/EV Battery Module 10	-	Internal component to Hybrid/EV battery pack	-	- C5K Hybrid/EV Battery Module 10 X1 - C5K Hybrid/EV Battery Module 10 X2
E1G	Accent Lamp - Left Instrument Panel	-	In the passenger compartment, left front, in the instrument panel, below left outboard vent	Front of Instrument Panel Components	E1G Accent Lamp - Left Instrument Panel
E1H	Accent Lamp - Right Instrument Panel	-	In the passenger compartment, right front, in the instrument panel, below right outboard vent	Front of Instrument Panel Components	E1H Accent Lamp - Right Instrument Panel
E2LF	Side Marker Lamp - Left Front	-	At left side, front of vehicle forward of left front wheel well	-	-
E2LR	Side Marker Lamp - Left Rear	-	At left rear corner of vehicle, within the tail lamp assembly, outboard lamp	Left and Right Rear Vehicle Components	E2LR Side Marker Lamp - Left Rear (TW5)
E2RF	Side Marker Lamp - Right Front	-	At right side, front of vehicle forward of right front wheel well	-	-
E2RR	Side Marker Lamp - Right Rear	-	At right rear corner of vehicle, within the tail lamp assembly, outboard lamp	Left and Right Rear Vehicle Components	E2RR Side Marker Lamp - Right Rear (TW5)
E4C	Daytime Running Lamp - Left	-	LED within the left front head lamp assembly	-	-
E4D	Daytime Running Lamp - Right	-	LED within the right front headlamp assembly	-	-

Code	Name	Option	Location	Locator View	Connector End View
E4G	Headlamp - Left Low Beam	-	At the front of vehicle, left side, within headlamp assembly	-	-
E4H	Headlamp - Right Low Beam	-	At the front of vehicle, right side, within headlamp assembly	-	-
E4J	Park Lamp - Left Front	-	At the front of vehicle, left side, within headlamp assembly, outboard bottom position	-	-
E4K	Park Lamp - Right Front	-	At the front of vehicle, right side, within headlamp assembly, outboard bottom position	-	-
E4LF	Turn Signal Lamp - Left Front	-	At the front of vehicle, left side, within headlamp assembly, bottom inboard position	**Front Fascia Components**	**E4LF Turn Signal Lamp - Left Front (KA6)**
E4LR	Turn Signal Lamp - Left Rear	-	At the rear of vehicle, left side, within tail lamp assembly, center position	-	-
E4RF	Turn Signal Lamp - Right Front	-	At the front of vehicle, right side, within headlamp assembly, bottom inboard position	**Front Fascia Components**	**E4RF Turn Signal Lamp - Right Front**
E4RR	Turn Signal Lamp - Right Rear	-	At the rear of vehicle, right side, within tail lamp assembly, center position	-	-
E4Y	Turn Signal Repeater Lamp - Left	-	In outside rearview mirror	**Driver Door Components**	-
E4Z	Turn Signal Repeater Lamp - Right	-	In outside rearview mirror	**Passenger Door Components**	-

Code	Name	Option	Location	Locator View	Connector End View
E5A	Backup Lamp - Left	-	In the left rear corner of the vehicle, in the left rear lamp assembly	-	-
E5AA	Tail/Stop Lamp - Left	-	In the left rear corner of the vehicle, in the left rear lamp assembly	-	-
E5AB	Tail/Stop Lamp - Right	-	In the right rear corner of the vehicle, in the right rear lamp assembly	-	-
E5B	Backup Lamp - Right	-	In the right rear corner of the vehicle, in the right rear lamp assembly	-	-
E5LC	Tail/Stop Lamp - Auxiliary Left	-	On the vehicle exterior, at the left rear corner of the vehicle, part of E51L Tail Lamp Assembly - Auxiliary Left	-	-
E5RC	Tail/Stop Lamp - Auxiliary Right	-	On the vehicle exterior, at the right rear corner of the vehicle, part of E51R Tail Lamp Assembly - Auxiliary Right	-	-
E6	Center High Mounted Stop Lamp	-	In the passenger compartment, at the top of the liftgate	-	**E6 Center High Mounted Stop Lamp**
E7L	License Plate Lamp - Left	-	On the outside of the liftgate, near the outside handle	-	**E7L License Plate Lamp - Left**
E7R	License Plate Lamp - Right	-	On the outside of the liftgate, near the outside handle	-	**E7R License Plate Lamp - Right**

Code	Name	Option	Location	Locator View	Connector End View
E8S	Rear Compartment Courtesy Lamp	-	Inside luggage compartment in the left rear quarter trim	**Left Side Luggage Compartment Components**	**E8S Rear Compartment Courtesy Lamp**
E13LA	Headlamp Assembly - Left	-	On the outside of the vehicle, at the left front corner of the vehicle	-	-
E13RA	Headlamp Assembly - Right	-	On the outside of the vehicle, at the right front corner of the vehicle	-	-
E14A	Seat Heating Element - Driver Back	KA1	In the passenger compartment, inside the driver seat back	-	E14A Seat Heating Element - Driver Back (KA1)
E14B	Seat Heating Element - Driver Cushion	KA1	In the passenger compartment, inside the driver seat cushion	-	E14B Seat Heating Element - Driver Cushion (KA1)
E14C	Seat Heating Element - Passenger Back	KA1	In the passenger compartment, inside the front passenger seat back	**Passenger Seat Components**	**E14C Seat Heating Element - Passenger Back (KA1)**
E14D	Seat Heating Element - Passenger Cushion	KA1	In the passenger compartment, inside the front passenger seat cushion	**Passenger Seat Components**	**E14D Seat Heating Element - Passenger Cushion**
E14F	Seat Heating Element - Left Rear Cushion	KA6	In the passenger compartment, inside the left rear seat cushion	-	**E14F Seat Heating Element - Left Rear Cushion (KA6)**
E14H	Seat Heating Element - Right Rear Cushion	KA6	In the passenger compartment, inside the right rear seat cushion	-	**E14H Seat Heating Element - Right Rear Cushion**
E15	Steering Wheel Heater	UVD	In the passenger compartment, left front, within the steering wheel rim	-	**E15 Steering Wheel Heater**

Code	Name	Option	Location	Locator View	Connector End View
E17D	Outside Rearview Mirror Glass - Driver	-	On the outside of the driver door, part of the outside rearview mirror - driver, at front	**Driver Door Components**	-
E17P	Outside Rearview Mirror Glass - Passenger	-	On the outside of the passenger door, part of the outside rearview mirror - passenger, at front	**Passenger Door Components**	-
E18	Rear Defogger Grid	-	Inside the passenger compartment, attached to the rear window	**Liftgate Components**	• **E18 Rear Defogger Grid X1** • **E18 Rear Defogger Grid X2**
E29R	Fog Lamp - Rear	-	At rear of vehicle, lower Left, in lamp assembly	-	-
E37D	Dome/Reading Lamps - Overhead Console	-	In the passenger compartment, front center of the headliner between the sunshades	**Headliner Components**	**E37D Dome/Reading Lamps - Overhead Console**
E37R	Dome/Reading Lamps - Rear	-	In the passenger compartment, center of the headliner	**Headliner Components**	**E37R Dome/Reading Lamps - Rear**
E42L	Tail Lamp Assembly - Left	-	At the left rear corner of the vehicle	-	-
E42R	Tail Lamp Assembly - Right	-	At the right rear corner of the vehicle	-	-
E51L	Tail Lamp Assembly - Auxiliary Left	-	On the vehicle exterior, at the left rear of the vehicle	-	-
E51R	Tail Lamp Assembly - Auxiliary Right	-	On the vehicle exterior, at the right rear of the vehicle	-	-
E54	Hybrid/EV Battery Pack Coolant Heater	-	Rear of engine compartment, mounter by Hybrid/EV battery pack	**Underbody - Hybrid/EV Battery Pack Components**	**Underbody - Hybrid/EV Battery Pack Components**

Code	Name	Option	Location	Locator View	Connector End View
F101	Passenger Instrument Panel Air Bag	-	In the passenger compartment, in the passenger side of the instrument panel	Front of Instrument Panel Components	- F101 Passenger Instrument Panel Air Bag X1 - F101 Passenger Instrument Panel Air Bag X2
F105L	Roof Rail Air Bag - Left	-	In the passenger compartment, on the left side of the roof	Left Front of Passenger Compartment Components	F105L Roof Rail Air Bag - Left (AYF/AY0)
F105R	Roof Rail Air Bag - Right	-	In the passenger compartment, on the right side of the roof	Right Front of Passenger Compartment Components	F105R Roof Rail Air Bag - Right (AYF/AY0)
F106LF	Seat Side Air Bag - Left Front	-	In the passenger compartment, in the left front seat back	-	F106LF Seat Side Air Bag - Left Front
F106LR	Seat Side Air Bag - Left Rear	-	In the passenger compartment, on the left side of the rear seat back	Left Rear of Passenger Compartment Components	F106LR Seat Side Air Bag - Left Rear (AYF)
F106RF	Seat Side Air Bag - Right Front	-	In the passenger compartment, in the right front seat back	-	F106P Seat Side Air Bag - Passenger (AY0/AYF)
F106RR	Seat Side Air Bag - Right Rear	-	In the passenger compartment, on the right side of the rear seat back	Right Rear of Passenger Compartment Components	F106RR Seat Side Air Bag - Right Rear (AYF)
F107	Steering Wheel Air Bag	-	In the passenger compartment, in the steering wheel	-	- F107 Steering Wheel Air Bag X1 - F107 Steering Wheel Air Bag X2
F112D	Seat Belt Retractor Pretensioner - Driver	-	In the passenger compartment, at the bottom of the left B-pillar	Left Front of Passenger Compartment Components	F112D Seat Belt Retractor Pretensioner - Driver (AY0)

Code	Name	Option	Location	Locator View	Connector End View
F112LR	Seat Belt Retractor Pretensioner - Left Rear	-	In the passenger compartment, mounted at top left of C-pillar	**Left Rear of Passenger Compartment Components**	**F112LR Seat Belt Retractor Pretensioner - Left Rear (SBK)**
F112P	Seat Belt Retractor Pretensioner - Passenger	-	In the passenger compartment, at the bottom of the right B-pillar	**Right Front of Passenger Compartment Components**	**F112P Seat Belt Retractor Pretensioner - Passenger (AY0)**
F112RR	Seat Belt Retractor Pretensioner - Right Rear	-	In the passenger compartment, mounted at top right of C-pillar	**Right Rear of Passenger Compartment Components**	**F112RR Seat Belt Retractor Pretensioner - Right Rear (SBK)**
F113D	Seat Belt Anchor Pretensioner - Driver	-	In the passenger compartment, on the lower outside of the driver seat, mounted to the floor	**Left Front of Passenger Compartment Components**	**F113D Seat Belt Anchor Pretensioner - Driver (AY0)**
F113P	Seat Belt Anchor Pretensioner - Passenger	-	In the passenger compartment, on the lower outside of the passenger seat, mounted to the floor	**Right Front of Passenger Compartment Components**	**F113P Seat Belt Anchor Pretensioner - Passenger (AY0)**
F114D	Knee Air Bag - Driver	-	In the passenger compartment, at the bottom of the driver side of the instrument panel	**Rear of Instrument Panel Components**	**F114D Knee Air Bag - Driver (AYF)**
F114P	Knee Air Bag - Passenger	-	In the passenger compartment, at the bottom of the passenger side of the instrument panel	**Rear of Instrument Panel Components**	**F114P Knee Air Bag - Passenger (AYF)**
G1	A/C Compressor	-	In the engine compartment, at the bottom, front center of drive motor.	**Front of Hybrid/EV Drive Unit**	• **G1 A/C Compressor X1** • **G1 A/C Compressor X2**
G5	Transmission Fluid Pump - Electric/Auxiliary	-	In the engine compartment, internal to the transmission assembly	**Hybrid/EV Tranmission Drive Unit**	**G5 Transmission Fluid Pump - Electric/Auxiliary**

Code	Name	Option	Location	Locator View	Connector End View
G10	Cooling Fan Motor	-	In the engine compartment, attached to the radiator shroud	-	G10 Cooling Fan Motor
G17	Heater Coolant Pump	-	In the engine compartment, right front, mounted to inside of right frame rail	-	-
G19	Rear Window Washer Pump	-	In the front of vehicle, behind front fascia in the right front corner, in the washer fluid reservoir	Front of Engine Compartment	G19 Rear Window Washer Pump
G24	Windshield Washer Pump	-	In the front of vehicle, behind front fascia in the right front corner, in the washer fluid reservoir	Front of Engine Compartment	G24 Windshield Washer Pump
G35	Hybrid/EV Electronics Coolant Pump	-	In the engine compartment, right front lower	Engine Compartment Top	G35 Hybrid/EV Electronics Coolant Pump
G36	Auxiliary Heater Coolant Pump	-	At the right side of the engine compartment, mounted to the suspension cradle	Engine Compartment Top	G36 Auxiliary Heater Coolant Pump
G37	Hybrid/EV Battery Pack Coolant Pump	-	At the front of the engine compartment, mounted to the center of the lower core support	Engine Compartment Top	G37 Hybrid/EV Battery Pack Coolant Pump
K1	14V Power Module	-	In the engine compartment on top of drive motor and under the power inverter module	Engine Compartment Top	• K1 14V Power Module X1 • K1 14V Power Module X2 • K1 14V Power Module X3 • K1 14V Power Module X4

Code	Name	Option	Location	Locator View	Connector End View
K6	Transmission Fluid Pump Control Module - Electric/Auxiliary	-	In the left side of the engine compartment, part of the power inverter module assembly	-	-
K8	Blower Motor Control Module	-	In the passenger compartment, under the passenger side of the instrument panel, mounted to the HVAC module assembly	**HVAC Assembly Components**	**K8 Blower Motor Control Module**
K9	Body Control Module	-	In the passenger compartment, instrument panel	• **Left Front of Passenger Compartment Components** • **Rear of Instrument Panel Components**	• **K9 Body Control Module X1** • **K9 Body Control Module X2** • **K9 Body Control Module X3** • **K9 Body Control Module X4** • **K9 Body Control Module X5** • **K9 Body Control Module X6** • **K9 Body Control Module X7**
K10	Coolant Heater Control Module	-	At the center rear of the engine compartment, mounted to the bulkhead	**Right Side Engine Compartment**	• **K10 Coolant Heater Control Module X1** • **K10 Coolant Heater Control Module X2**

Code	Name	Option	Location	Locator View	Connector End View
K16	Battery Energy Control Module	-	Underbody Integrated to the Hybrid/EV Battery Pack.	-	- K16 Battery Energy Control Module X1 - K16 Battery Energy Control Module X2 - K16 Battery Energy Control Module X3 - K16 Battery Energy Control Module X4 - K16 Battery Energy Control Module X5 - K16 Battery Energy Control Module X6 - K16 Battery Energy Control Module X7 - K16 Battery Energy Control Module X8
K17	Electronic Brake Control Module	-	In the engine compartment, behind the right headlamp	Right Side Engine Compartment	K17 Electronic Brake Control Module
K20	Engine Control Module	-	In the engine compartment, Mounted on top of the on board charging module	Engine Compartment Top	- K20 Engine Control Module X1 - K20 Engine Control Module X2 - K20 Engine Control Module X3
K29F	Seat Heating Control Module - Front	KA1	In the passenger compartment, under the passenger seat cushion	Passenger Seat Components	- K29F Seat Heating Control Module - Front X1 (KA1) - K29F Seat Heating Control Module - Front X2 (KA1)
K29R	Seat Heating Control Module - Rear	KA6	In the passenger compartment, center rear, underneath center of rear seat cushion	-	Ã,Â

Code	Name	Option	Location	Locator View	Connector End View
K32	Steering Wheel Heating Control Module	UVD	In the passenger compartment, left front, attached to front steering wheel cover left of center	-	K32 Steering Wheel Heating Control Module
K33	HVAC Control Module	-	In the passenger compartment, in the center of the instrument panel, behind the HVAC controls	HVAC Assembly Components	• K33 HVAC Control Module X1 • K33 HVAC Control Module X2 • K33 HVAC Control Module X3
K36	Inflatable Restraint Sensing and Diagnostic Module	-	In the passenger compartment, under center console	Left Front of Passenger Compartment Components	• K36 Inflatable Restraint Sensing and Diagnostic Module X1 • K36 Inflatable Restraint Sensing and Diagnostic Module X2 (AY0/AYF) • K36 Inflatable Restraint Sensing and Diagnostic Module X2 (AY0+MAW)
K38	Chassis Control Module	-	In the passenger compartment, near the floor under the front of the center console on top of the body control module.	Left Front of Passenger Compartment Components	K38 Chassis Control Module
K43	Power Steering Control Module	-	In the passenger compartment, behind the instrument panel	Steering Column Components	• M38 Power Steering Motor X1 • M38 Power Steering Motor X2

Code	Name	Option	Location	Locator View	Connector End View
K56	Serial Data Gateway Module	-	In the passenger compartment, driver side front, in the instrument panel, outboard of steering column, near the Body Control Module	Rear of Instrument Panel Components	- K56 Serial Data Gateway Module X1 - K56 Serial Data Gateway Module X2
K57	Battery Charger Control Module	-	Underhood, Internal component of battery charger	-	K57 Battery Charger Control Module X1
K60	Steering Column Lock Module	N06	In the passenger compartment, left front, attached to steering column, lower	Steering Column Components	K60 Steering Column Lock Module (NO6)
K68	Tralier Lighting Control Moduel	MBM	In the luggage compartment, mounted at base of left C-pillar	Left Rear of Passenger Compartment Components	- K68 Trailer Lighting Control Module X1 (MBM) - K68 Trailer Lighting Control Module X2 (MBM)
K73	Telematics Communication Interface Control Module	-	In the passenger compartment, mounted under passenger seat	Rear of Instrument Panel Components	- K73 Telematics Communication Interface Control Module X1 (UE1) - K73 Telematics Communication Interface Control Module X2 (UE1) - K73 Telematics Communication Interface Control Module X5 - K73 Telematics Communication Interface Control Module X7
K77	Remote Control Door Lock Receiver	-	In the passenger compartment, mounted at top rear left of C-pillar	Left Rear of Passenger Compartment Components	K77 Remote Control Door Lock Receiver

Code	Name	Option	Location	Locator View	Connector End View
K83	Park Brake Control Module	-	Mounted under vehicle on right side, between the hybrid battery pack and rear bumper	-	-
K84	Keyless Entry Control Module	-	In the luggage compartment on the right side behind quarter panel trim	**Rear of Instrument Panel Components**	- **K84 Keyless Entry Control Module X1** - **K84 Keyless Entry Control Module X2**
K85	Passenger Presence Module	-	Under passenger seat mounted to seat frame	**Passenger Seat Components**	**K85 Passenger Presence Module**
K89	Immobilizer Control Module	-	In the passenger compartment, behind the instrument panel near the steering column	**Center Console Components Bottom**	**K89 Immobilizer Control Module**
K101	Trailer Interface Control Module	MAH/MBC/MAW/MCX	In the luggage compartment, mounted at base of left C-pillar	**Left Rear of Passenger Compartment Components**	- **K101 Trailer Interface Control Module X1** - **K101 Trailer Interface Control Module X2**
K107	Drive Motor Control Module	-	In the engine compartment, internal component of the power inverter module	-	-
K109	Frontview Camera Module	UEU	In the passenger compartment, at the top center of the windshield.	**Headliner Components**	**B174W Frontview Camera - Windshield (UEU/UHX/UHY/UVX)**
K114A	Hybrid/EV Powertrain Control Module 1	-	In the engine compartment internal component of the power inverter module.	-	-

Code	Name	Option	Location	Locator View	Connector End View
K114B	Hybrid/EV Powertrain Control Module 2	-	In the passenger compartment, under the right front seat	Right Front of Passenger Compartment Components	• K114B Hybrid/EV Powertrain Control Module 2 X1 • K114B Hybrid/EV Powertrain Control Module 2 X2
K132	Pedestrian Alert Sound Control Module	-	In the passenger compartment, under center console	Left Front of Passenger Compartment Components	K132 Pedestrian Alert Sound Control Module
K157	Video Processing Control Module	-	I the passenger compartment, mounted under center console	Right Rear of Passenger Compartment Components	• K157 Video Processing Control Module X1 (UVH) • K157 Video Processing Control Module X2 (UVH)
K173	Transmission Range Control Module	-	In the left side of the engine compartment, mounted on the top front of the transmission.	Hybrid/EV Tranmission Drive Unit	K173 Transmission Range Control Module
K177	Brake Booster Control Module	-	In the engine compartment, mounted behind the brake master cylinder	Left Side Engine Compartment	K177 Brake Booster Control Module
K182	Parking Assist Control Module	-	In the luggage compartment, mounted at the base of the C-pillar	Left Rear of Passenger Compartment Components	• K182 Parking Assist Control Module X1 • K182 Parking Assist Control Module X2 • K182 Parking Assist Control Module X3
K183	Short Range Remote Control Transceiver	-	In the passenger compartment, mounted in the middle of the left C-pillar	Right Rear of Passenger Compartment Components	K183 Short Range Remote Control Transceiver

Code	Name	Option	Location	Locator View	Connector End View
K190	Power Line Communication Module	-	I the passenger compartment, mounted under drivers seat	Left Front of Passenger Compartment Components	- K190 Power Line Communication Module X1 (CBT) - K190 Power Line Communication Module X2 (CBT)
M6	Air Temperature Door Actuator	-	In the passenger compartment, behind the center of the instrument panel	HVAC Assembly Components	M6 Air Temperature Door Actuator
M8	Blower Motor	-	In the passenger compartment, behind the passenger side of the instrument panel	HVAC Assembly Components	M8 Blower Motor
M15	Drive Motor	-	In the engine compartment	-	-
M28L	High Beam Solenoid Actuator - Left	-	At the front of vehicle, left side, inside of headlamp assembly, outboard side of projector	-	-
M28R	High Beam Solenoid Actuator - Right	-	At the front of vehicle, right side, inside of headlamp assembly, outboard side of projector	-	-
M29L	Headlamp Leveling Actuator - Left	TR6	At the front of vehicle, left side, back side of headlamp assembly, inboard center position	-	M29L Headlamp Leveling Actuator - Left (TR6)
M29R	Headlamp Leveling Actuator - Right	TR6	At the front of vehicle, right side, back side of headlamp assembly, inboard center position	-	M29R Headlamp Leveling Actuator - Right (TR6)

Code	Name	Option	Location	Locator View	Connector End View
M37	Mode Door Actuator	-	In the passenger compartment, left front, within the instrument panel, mounted to left of HVAC assembly	HVAC Assembly Components	M37 Mode Door Actuator
M45	Rear Wiper Motor	-	In the vehicle interior, inside the liftgate	Liftgate Components	M45 Rear Wiper Motor
M46	Air Recirculation Door Actuator	-	In the passenger compartment, left front, within the instrument panel, mounted to right of HVAC assembly	-	M46 Air Recirculation Door Actuator
M74D	Window Motor - Driver	-	In the passenger compartment, inside the driver door	Driver Door Components	M74D Window Motor - Driver
M74LR	Window Motor - Left Rear	-	In the passenger compartment, inside the left rear door	Left Rear Door Components	M74LR Window Motor - Left Rear
M74P	Window Motor - Passenger	-	In the passenger compartment, inside the passenger door	Passenger Door Components	M74P Window Motor - Passenger
M74RR	Window Motor - Right Rear	-	In the passenger compartment, inside the right rear door	Right Rear Door Components	M74RR Window Motor - Right Rear
M75L	Windshield Wiper Motor Module - Left	-	In the cowl panel, at the base of the windshield left side	Left Side Engine Compartment	M75L Windshield Wiper Motor Module - Left
M75R	Windshield Wiper Motor Module - Right	-	In the cowl panel, at the base of the windshield, right side	Right Side Engine Compartment	M75R Windshield Wiper Motor Module - Right
M77D	Outside Rearview Mirror Motor - Driver	-	In the passenger compartment, behind the driver door panel	-	-

Code	Name	Option	Location	Locator View	Connector End View
M77P	Outside Rearview Mirror Motor - Passenger	-	In the passenger compartment, behind the passenger door panel	-	-
M78D	Outside Rearview Mirror Folding Motor - Driver	DLR	On outside of driver door, front middle, forward of window opening, part of outside rearview mirror assembly	-	-
M78P	Outside Rearview Mirror Folding Motor - Passenger	DLR	On outside of passenger door, front middle, forward of window opening, part of outside rearview mirror assembly	-	-
M96	Active Grille Air Shutter Actuator	-	At front of vehicle, at center, rear of lower center grille opening	-	**M96 Active Grille Air Shutter Actuator**
M104L	Park Brake Actuator - Left	-	In the vehicle underbody, left rear, mounted to the left rear caliper bracket	**Wheel Well Components - Rear**	**M104L Park Brake Actuator - Left**
M104R	Park Brake Actuator - Right	-	In the vehicle underbody, right rear, mounted to the right rear caliper bracket	**Wheel Well Components - Rear**	**M104R Park Brake Actuator - Right**
M110	Hybrid/EV Battery Charger Receptacle Lock Actuator	-	In the charging port, on left front of vehicle	-	-
P2	Transmission Shift Lever Position Indicator	-	In the passenger compartment, on the center console, in the automatic transmission shift lever	**Center Console Components Top**	P2 Transmission Shift Lever Position Indicator

Code	Name	Option	Location	Locator View	Connector End View
P9	Driver Information Center Display	-	In the passenger compartment, part of the instrument cluster assembly	-	-
P12L	Horn - Left	-	In the left front of the engine compartment, at the frame rail just behind the radiator.	**Front of Engine Compartment**	**P12L Horn - Left**
P12R	Horn - Right	-	In the right front of the engine compartment, at the frame rail just behind the radiator.	**Front of Engine Compartment**	**P12R Horn - Right**
P14	Passenger Air Bag Disabled Indicator	-	in the passenger compartment, mounted in the headliner, part of over head console assembly	**Headliner Components**	**P14 Passenger Air Bag Disabled Indicator**
P16	Instrument Cluster	-	In the passenger compartment, in the driver side of the instrument panel	**Front of Instrument Panel Components**	**P16 Instrument Cluster**
P17	Info Display Module	-	In the passenger compartment, in the Center of the instrument panel, above radio	-	**P17 Info Display Module X1**
P19AC	Speaker - Subwoofer	-	In the passenger compartment, in the center of the rear well	**Bottom of Luggage Compartment Components**	**P19AC Speaker - Subwoofer (UQA)**
P19AG	Speaker - Left Front Door	-	On the left front door, front lower, behind door trim	**Driver Door Components**	• **P19AG Speaker - Left Front Door (UQ3)** • **P19AG Speaker - Left Front Door (UQA)**

Code	Name	Option	Location	Locator View	Connector End View
P19AH	Speaker - Right Front Door	-	On the right front door, front lower, behind door trim	- Front of Instrument Panel Components - Passenger Door Components	- P19AH Speaker - Right Front Door (UQ3) - P19AH Speaker - Right Front Door (UQA)
P19AL	Speaker - Left Rear Door	-	On the left rear door, front lower, behind door trim	Left Rear Door Components	- P19AL Speaker - Left Rear Door (UQ3) - P19AL Speaker - Left Rear Door (UQA)
P19AM	Speaker - Right Rear Door	-	On the right rear door, front lower, behind door trim	Right Rear Door Components	- P19AM Speaker - Right Rear Door (UQ3) - P19AM Speaker - Right Rear Door (UQA)
P19H	Speaker - Left Front Tweeter	-	In the passenger compartment, left front, mounted to rear of A-pillar trim	Front of Instrument Panel Components	P19H Speaker - Left Front Tweeter (UQA)
P19V	Speaker - Right Front Tweeter	-	In the passenger compartment, right front, mounted to rear of A-pillar trim	-	P19V Speaker - Right Front Tweeter (UQA)
P34D	Side Object Detection Indicator - Driver	-	On outside of driver door, front middle, forward of window opening, part of outside rearview mirror glass	Driver Door Components	-
P34P	Side Object Detection Indicator - Passenger	-	On outside of passenger door, front middle, forward of window opening, part of outside rearview mirror glass	Passenger Door Components	-

Code	Name	Option	Location	Locator View	Connector End View
P43	Collision Alert Indicators	-	In the passenger compartment, left front, mounted to instrument panel, forward of instrument cluster	**Rear of Instrument Panel Components**	**P43 Collision Alert Indicators (UEU/UHX/UHY/UVX)**
P48	Pedestrian Alert Sound Speaker	-	Front of vehicle left side behind fascia. below headlamp - left	**Front of Engine Compartment**	**P48 Pedestrian Alert Sound Speaker**
Q5	Brake Pressure Modulator	-	At the rear of the engine compartment, driver side, mounted to the electronic brake control module	-	-
R25	Hybrid/EV Battery Pre-Charge Resistor	-	Inside hybrid/ev battery pack.	-	-
S2	Transmission Manual Shift Switch	-	In the passenger compartment, in the center of the center console, part of the shift lever assembly	-	-
S3	Transmission Shift Lever	-	In the passenger compartment, in the center console	-	**S3 Transmission Shift Lever**
S13D	Door Lock Switch - Driver	-	In the passenger compartment, inside the driver door	**Driver Door Trim Components**	**S13D Door Lock Switch - Driver**
S13P	Door Lock Switch - Passenger	-	In the passenger compartment, inside the passenger door	**Passenger Door Trim Components**	**S13P Door Lock Switch - Passenger**
S15	Manual Service Disconnect	-	In the passenger compartment under rear seat lower cushion	-	-

Code	Name	Option	Location	Locator View	Connector End View
S26	Hazard Warning Switch	-	In the passenger compartment, in the center of the instrument panel	-	-
S30	Headlamp Switch	-	In the passenger compartment, on the left side of the instrument panel, between the steering column, and the driver door	**Front of Instrument Panel Components**	**S30 Headlamp Switch**
S32LR	Seat Heating Switch - Left Rear	KA6	In the left rear door trim panel, mounted to left rear door trim plate	**Left Rear Door Trim Components**	**S32LR Seat Heating Switch - Left Rear (KA6)**
S32RR	Seat Heating Switch - Right Rear	KA6	In the right rear door trim panel, mounted to right rear door trim plate	**Right Rear Door Trim Components**	**S32RR Seat Heating Switch - Right Rear**
S33	Horn Switch	-	In the passenger compartment, within the steering wheel, forward of the air bag.	-	**S33 Horn Switch**
S40	Passenger Air Bag Disable Switch	-	In the passenger compartment, on the instrument panel	**Rear of Instrument Panel Components**	**S40 Passenger Air Bag Disable Switch (C99)**
S46B	Liftgate Unlatch Switch	-	In the passenger compartment, on the instrument panel left of steering column	-	**S46B Liftgate Unlatch Switch**
S48C	Multifunction Switch 1 - Instrument Panel	-	In the passenger compartment, left side of the steering column on instrument panel, left of center	**Front of Instrument Panel Components**	**S48C Multifunction Switch 1 - Instrument Panel**

Code	Name	Option	Location	Locator View	Connector End View
S48D	Multifunction Switch 2 - Instrument Panel	-	In the passenger compartment, left side of the steering column on instrument panel, right of center	Front of Instrument Panel Components	S48D Multifunction Switch 2 - Instrument Panel
S51	Telematics Button Assembly	-	In the passenger compartment, front center, within the overhead console, at front left	Headliner Components	S51 Telematics Button Assembly (UE1)
S70E	Steering Wheel Controls Switch - Radio Presets	-	In the passenger compartment, left front, on steering wheel, left spoke facing driver	-	S70E Steering Wheel Controls Switch - Radio Presets
S70F	Steering Wheel Controls Switch - Radio Volume	-	In the passenger compartment, left front, on steering wheel, right spoke facing driver	-	S70F Steering Wheel Controls Switch - Radio Volume
S70L	Steering Wheel Controls Switch - Left	-	In the passenger compartment, left front, on steering wheel, left spoke facing driver	-	S70L Steering Wheel Controls Switch - Left
S70R	Steering Wheel Controls Switch - Right	-	In the passenger compartment, left front, on steering wheel, right spoke facing driver	-	S70R Steering Wheel Controls Switch - Right
S78	Turn Signal/Multifunction Switch	-	In the passenger compartment, on the steering column	Steering Column Components	S78 Turn Signal/Multifunction Switch
S79LR	Window Switch - Left Rear	-	In the passenger compartment, in the left rear door	Left Rear Door Trim Components	S79LR Window Switch - Left Rear

Code	Name	Option	Location	Locator View	Connector End View
S79P	Window Switch - Passenger	-	In the passenger compartment, in the passenger door	Passenger Door Trim Components	S79P Window Switch - Passenger
S79RR	Window Switch - Right Rear	-	In the passenger compartment, in the right rear door	Right Rear Door Trim Components	S79RR Window Switch - Right Rear
S82	Windshield Wiper/Washer Switch	-	In the passenger compartment, left front, within the steering column, forward of the steering wheel, on right side	Steering Column Components	S82 Windshield Wiper/Washer Switch
S83	Vehicle On/Off Switch	-	In the passenger compartment, in the center of the instrument panel left of HVAC controls	Front of Instrument Panel Components	S83 Vehicle On/Off Switch
S91	Park Brake Control Switch	-	In the passenger compartment, in the center console below shift lever	Center Console Components Top	S91 Park Brake Control Switch
S146	Window/Outside Rearview Mirror Switch - Driver	-	In the driver door trim panel, forward of the arm rest.	Driver Door Trim Components	S79D Window Switch - Driver
S156	Transmission Shift Lever Knob	-	In the passenger compartment, in the center console	-	-
S151	Regenerative Braking On-Demand Switch	-	In passenger compartment, drivers side, mounted on the instrument panel	-	S151 Regenerative Braking On-Demand Switch
T2E	Antenna - Rear End Spoiler	-	In the passenger compartment, mounted behind the trim of the rear liftgate	-	-

Code	Name	Option	Location	Locator View	Connector End View
T2RR	Antenna - Roof Rear	-	In passenger compartment, rear of vehicle, mounted to the roof	-	- T2RR Antenna - Roof Rear X1 - T2RR Antenna - Roof Rear X2 - T2RR Antenna - Roof Rear X5 - T2RR Antenna - Roof Rear X6
T3	Audio Amplifier	UQA	In the luggage compartment, in the center of the rear well	Bottom of Luggage Compartment Components	- T3 Audio Amplifier X1 (UQA) - T3 Audio Amplifier X2 (UQA) - T3 Audio Amplifier X3 (UQA)
T4S	Wireless Communication Antenna - Bluetooth	UE1	In the passenger compartment, attached to the telematics control module	-	-
T6	Power Inverter Module	-	In the engine compartment, under the power inverter module assembly cable cover	Front of Hybrid/EV Drive Unit	- T6 Power Inverter Module X1 - T6 Power Inverter Module X2 - T6 Power Inverter Module X3
T10E	Keyless Entry Antenna - Rear Compartment	-	In the luggage compartment, left front, behind trim on liftgate opening	Left Rear of Passenger Compartment Components	T10E Keyless Entry Antenna - Rear Compartment
T10G	Keyless Entry Antenna - Rear Fascia	-	At the rear of vehicle, near center, above bumper behind fascia	Rear Fascia Components	T10G Keyless Entry Antenna - Rear Fascia
T10J	Keyless Entry Antenna - Center Console Front	-	Inside the passenger compartment, mounted to the front of shift lever	Rear of Instrument Panel Components	T10J Keyless Entry Antenna - Center Console Front

Code	Name	Option	Location	Locator View	Connector End View
T10K	Keyless Entry Antenna - Center Console Rear	-	Inside the passenger compartment, mounted to the rear of shift lever	**Center Console Components Bottom**	T10K Keyless Entry Antenna - Center Console Rear
T10M	Keyless Entry Antenna - Driver Door Handle	-	On outside of driver door, at rear, part of door handle assembly	-	-
T10N	Keyless Entry Antenna - Passenger Door Handle	-	On outside of driver door, at rear, part of passenger handle assembly	-	-
T12	Automatic Transmission Assembly	-	In the engine compartment, mounted to the left side of the drive motor	**Front of Hybrid/EV Drive Unit**	- **T12 Automatic Transmission Assembly X1** - **T12 Automatic Transmission Assembly X2** - **T12 Automatic Transmission Assembly X3** - **T12 Automatic Transmission Assembly X4**
T18	Battery Charger	-	In the engine compartment mounted above transmission assembly and below engine control module	**Front of Hybrid/EV Drive Unit**	- **T18 Battery Charger X1** - **T18 Battery Charger X2** - **T18 Battery Charger X3**
T22	Mobile Device Wireless Charger Module	K4C	In the passenger compartment, middle center, mounted to center console, in front of center console compartment	**Center Console Components Internal**	**T22 Mobile Device Wireless Charger Module (K4C)**
T23	Radio Antenna Amplifier	-	In the rear compartment, under the center rear of the headliner, just forward of the liftgate.	-	- **T23 Radio Antenna Amplifier X1** - **T23 Radio Antenna Amplifier X2** - **T23 Radio Antenna Amplifier X3**

Code	Name	Option	Location	Locator View	Connector End View
T24	Battery Charger - DC	-	In the engine compartment mounted above the power inverter module	Engine Compartment Top	- T24 Battery Charger - DC X1 - T24 Battery Charger - DC X2 - T24 Battery Charger - DC X3 - T24 Battery Charger - DC X4 - T24 Battery Charger - DC X5 - T24 Battery Charger - DC X6 - T24 Battery Charger - DC X7 - T24 Battery Charger - DC X8 - T24 Battery Charger - DC X9 (-CBT) - T24 Battery Charger - DC X9 (CBT)
X21	Manual Service Disconnect Receptacle	-	Under the vehicle at the top of the Hybrid/EV battery, under the battery cover at the top rear of section 2	-	- X21 Manual Service Disconnect Receptacle X1 - X21 Manual Service Disconnect Receptacle X2 - X21 Manual Service Disconnect Receptacle X3
X50A	Fuse Block - Underhood	-	In the engine compartment, in the left rear corner of the engine compartment	Left Side Engine Compartment	-
X50D	Fuse Block - Battery	-	In the engine compartment, on the left side of the engine compartment	Left Side Engine Compartment	-
X51A	Fuse Block - Instrument Panel	-	In the passenger compartment, on the driver side of the instrument panel	-	-

Code	Name	Option	Location	Locator View	Connector End View
X55QA	Fuse Holder 1 - Hybrid/EV Battery Pack	-	Internal component to Hybrid/EV battery pack	-	-
X80	Accessory Power Receptacle	-	In the passenger compartment, mounted under hvac controls, left center in instrument panel	**Front of Instrument Panel Components**	**X80 Accessory Power Receptacle**
X83	Auxiliary Audio Input	-	In the passenger compartment, center middle, Instrument panel under HVAC control head	**Center Console Components Top**	• **X83 Auxiliary Audio Input X1** • **X83 Auxiliary Audio Input X2**
X84	Data Link Connector	-	In the passenger compartment, on the driver side of the instrument panel	**Front of Instrument Panel Components**	**X84 Data Link Connector**
X84B	Auxiliary Data Connector	-	In the passenger compartment, near the right side of the center stack on the lower instrument panel.	**Front of Instrument Panel Components**	**X84B Auxiliary Data Connector X2**
X85	Steering Wheel Air Bag Coil	-	In the passenger compartment, behind the steering wheel, on the steering column	**Steering Column Components**	• **X85 Steering Wheel Air Bag Coil X1** • **X85 Steering Wheel Air Bag Coil X2**
X92	USB Receptacle	-	in the passenger compartment, mounted in rear of center console	**Center Console Components Top**	**X92 USB Receptacle (USS)**
X98	Hybrid/EV Battery Charger Receptacle	-	Hybrid/EV Battery Charger Receptacle	-	• **X98 Hybrid/EV Battery Charger Receptacle X1** • **X98 Hybrid/EV Battery Charger Receptacle X2 (CBT)**

Code	Name	Option	Location	Locator View	Connector End View
X101	Forward Lamp Harness to Front Fascia	-	In the engine compartment, front center, between front fascia and core support	- Front Fascia Harness Routing - Forward Lamp Harness Routing	- X101 Forward Lamp Harness to Front Fascia Harness (UD5/UFQ/UVH) - X101 Forward Lamp Harness to Front Fascia Harness (-UD5/UFQ/UVH)
X105	Body Harness to Engine Harness (36 Cavities)	-	In the engine compartment, left rear, near battery	- Front of Drive Motor Harness Routing - Right Side Engine Compartment Harness Routing	X105 Body Harness to Engine Harness
X106	Body Harness to Engine Harness (36 Cavities)	-	In the engine compartment, right rear, near top of right strut tower	- Left Front of Engine Compartment Harness Routing - Front of Drive Motor Harness Routing	X106 Body Harness to Engine Harness
X107	Body Harness to Forward Lamp Harness	-	In the engine compartment, right front, mounted on the front frame rail	- Right Side Engine Compartment Harness Routing - Forward Lamp Harness Routing	X107 Body Harness to Forward Lamp Harness
X108	Body Harness to Forward Lamp Harness	-	In the engine compartment, right front, mounted on the front frame rail	- Right Side Engine Compartment Harness Routing - Forward Lamp Harness Routing	X108 Body Harness to Forward Lamp Harness

Code	Name	Option	Location	Locator View	Connector End View
X110	Forward Lamp Harness to Left Headlight Assembly (4 Cavities)	-	At the front of vehicle, at the bottom of headlamp assembly - left	**Forward Lamp Harness Routing**	- **X110 Forward Lamp Harness to Left Headlamp Harness (TR6)** - **X110 Forward Lamp Harness to Left Headlamp Harness (-TR6)**
X111	Left Turn Signal Harness to Front Fascia Harness	-	At the front of vehicle, mounted on left side of vehicle, between	-	**X111 Front Fascia Harness to Left Turn Signal Harness**
X117	Charge Receptacle Harness to Body Harness (12 Cavities)	-	At the front of vehicle, at the bottom of headlamp assembly - left	**Left Front of Engine Compartment Harness Routing**	**X117 Charge Receptacle Harness to Body Harness (CBT)**
X120	Forward Lamp Harness to Right Headlight Assembly (4 Cavities)	-	At the front of vehicle, at the bottom of headlamp assembly - Right	-	- **X120 Forward Lamp Harness to Right Headlamp Harness (TR6)** - **X120 Forward Lamp Harness to Right Headlamp Harness (-TR6)**
X121	Right Turn Signal Harness to Front Fascia Harness	-	At the front of vehicle, mounted behind front bumper	-	**X121 Front Fascia Harness to Right Turn Signal Harness**
X126	Forward Lamp Harness to Right Front Impact Sensor Extension Harness	-	In the engine compartment, mounted on the lower right corner of the core support	-	-
X200	Instrument Panel Harness to Body Harness	-	In the passenger compartment, at the base of the left A-pillar, behind the kick panel	- **Instrument Panel Harness Routing** - **Left Front of Passenger Compartment Harness Routing**	**X200 Instrument Panel Harness to Body Harness**

Code	Name	Option	Location	Locator View	Connector End View
X205	Instrument Panel Harness to Body Harness	-	In the passenger compartment, at the base of the right A-pillar, behind the kick panel	- Instrument Panel Harness Routing - Right Front of Passenger Compartment Harness Routing	X205 Instrument Panel Harness to Body Harness
X208	Headliner Harness to Body Harness	-	In the passenger compartment, mounted on the left side of instrument panel	- Left Front of Passenger Compartment Harness Routing - Headliner Harness Routing	X208 Headliner Harness to Body Harness
X209	Instrument Panel Harness to Headliner Harness	-	In the passenger compartment, at base of the right A-pillar, behind the kick panel	- Instrument Panel Harness Routing - Instrument Panel Harness Routing	-
X210	Instrument Panel Harness to Body Harness	-	In the passenger compartment, behind the left side of the instrument panel	- Left Front of Passenger Compartment Harness Routing - Instrument Panel Harness Routing	X210 Instrument Panel Harness to Body Harness
X211	Instrument Panel Harness to Headliner Harness	-	In the passenger compartment, behind the left side of the instrument panel	Instrument Panel Harness Routing	-
X212	Instrument Panel Harness to Floor Console Harness	-	In the passenger compartment, under the center console	- Center Console Harness Routing - Instrument Panel Harness Routing	X212 Instrument Panel Harness to Floor Console Harness

Code	Name	Option	Location	Locator View	Connector End View
X215	Body Harness to Instrument Panel Harness	-	In the passenger compartment, at the base of the left A-pillar, above the kick panel	**Instrument Panel Harness Routing**	**X215 Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness**
X236	Instrument Panel Harness to Air Duct Jumper	-	In the passenger compartment, behind the right side of the instrument panel	-	**X236 Instrument Panel Harness to Air Duct Jumper Harness**
X300	Body Harness to Floor Console Harness	-	In the passenger compartment, under the center console	- **Center Console Harness Routing** - **Left Front of Passenger Compartment Harness Routing**	**X300 Floor Console Harness to Body Harness**
X310	Body Harness to Instrument Panel Harness	-	In the passenger compartment, under the center console	**Left Front of Passenger Compartment Harness Routing**	**X310 Driver Seat Harness to Body Harness**
X320	Passenger Seat Harness to Body Harness	-	In the passenger compartment, under the passenger seat	- **Passenger Seat Harness Routing** - **Right Front of Passenger Compartment Harness Routing**	**X320 Passenger Seat Harness to Body Harness**
X355	Low Voltage Battery Harness to Battery Module 4 Jumper Harness	-	Internal to Hybrid/EV Battery Pack	-	-
X356	Low Voltage Battery Harness to Battery Module 7 Jumper Harness	-	Internal to Hybrid/EV Battery Pack	-	-
X357	Body Harness to Battery Harness	-	Underbody in rear of vehicle, connected to front of Hybrid/EV battery pack	**Left Front of Engine Compartment Harness Routing**	**X357 Body Harness to Battery Cable Harness**
X358	Body Harness to Battery Harness	-	Underbody in rear of vehicle, connected to left side of Hybrid/EV battery pack	**Left Front of Engine Compartment Harness Routing**	**X358 Body Harness to Battery Harness**

Code	Name	Option	Location	Locator View	Connector End View
X360	Right Rear Seat Harness to Body Harness	-	In the passenger compartment, mounted under the rear seat, on right side	Right Rear of Passenger Compartment Harness Routing	X360 Right Rear Seat Harness to Body Harness (KA6)
X410	Left Auxillary Tail Lamp Harness to Left Lamp Jumper Harness	-	In the luggage compartment, near the left tail lamp, behind the trim panel	Rear Fascia Harness Routing	- X410 Rear Fascia Harness to Left Lamp Jumper Harness (TW5) - X410 Rear Fascia Harness to Left Lamp Jumper Harness (VD1)
X411	Rear Fascia Harness to Left Stop Turn Lamp Harness	-	In the luggage compartment, near left stop turn lamp	-	-
X415	Body Harness to Rear Fascia Harness	-	In the rear of vehicle, on left side, under the rear fasica	Rear Fascia Harness Routing	X415 Body Harness to Rear Fascia Harness
X420	Right Auxillary Tail Lamp Harness to Right Lamp Jumper Harness	-	In the luggage compartment, near the right tail lamp, behind the trim panel	Rear Fascia Harness Routing	- X420 Rear Fascia Harness to Right Lamp Jumper Harness (TW5) - X420 Rear Fascia Harness to Right Lamp Jumper Harness (VD1)
X421	Rear Fascia Harness to Right Lamp Jumper Harness	-	In the rear of vehicle	-	-
X500	Driver Door Harness to Body Harness	-	In the passenger compartment, at the left front A-pillar	- Driver Door Harness Routing - Left Front of Passenger Compartment Harness Routing	X500 Driver Door Harness to Body Harness
X510	Driver Door Harness to Driver Outside Rearview Mirror Harness	-	In the driver door,	Driver Door Harness Routing	X510 Driver Outside Rearview Mirror Harness to Driver Door Harness

Code	Name	Option	Location	Locator View	Connector End View
X600	Passenger Door Harness to Body Harness	-	In the passenger compartment, at the right front A-pillar	- Passenger Door Harness Routing - Right Front of Passenger Compartment Harness Routing	X600 Passenger Door Harness to Body Harness
X610	Passenger Door Harness to Passenger Outside Rearview Mirror Harness	-	In the passenger door, behind passenger door trim	Passenger Door Harness Routing	X610 Passenger Outside Rearview Mirror Harness to Passenger Door Harness
X700	Left Rear Door Harness to Body Harness	-	In the passenger compartment, in the left B-pillar	- Left Rear Door Harness Routing - Left Front of Passenger Compartment Harness Routing	X700 Left Rear Door Harness to Body Harness
X800	Right Rear Door Harness to Body Harness	-	In the passenger compartment, in the right B-pillar	- Right Rear Door Harness Routing - Right Front of Passenger Compartment Harness Routing	X800 Right Rear Door Harness to Body Harness
X900	Liftgate Extension Harness to Body Harness	-	In the cargo area, on the left side, behind the trim panel	Left Rear of Passenger Compartment Harness Routing	X900 Liftgate Extension Harness to Body Harness
X901	Liftgate Extension Harness to Liftgate Harness	-	In the cargo area, on the left side, behind the trim panel	- Liftgate Harness Routing - Liftgate Extension Harness Routing	X901 Liftgate Extension Harness to Liftgate Harness
X902	Liftgate Harness to License Plate Lamp Harness	-	In the rear of the vehicle, behind the liftgate trim panel, below the middle of the rear window	Liftgate Harness Routing	X902 License Plate Lamp Harness to Liftgate Harness
X903	Center High Mount Stop Light Harness to Liftgate Harness	-	In the liftgate, behind the center high mount stop lamp	Liftgate Extension Harness Routing	X903 Center High Mount Stop Light Harness to Liftgate Extension Harness

Code	Name	Option	Location	Locator View	Connector End View
X904	Headliner Harness to Liftgate Harness	-	In the passenger compartment, rear of vehicle, behind headliner	-	-
X905	Liftgate Harness to Liftgate Extention Harness	-	In the rear of the vehicle, behind the liftgate trim panel, below the middle of the rear window above the license plate lights	**Liftgate Harness Routing**	-
X906	Liftgate Extention Harness to Headliner Harness	-	In the passenger compartment, rear of vehicle, behind headliner	-	-
X907	Liftgate Switch to License Plate Lamp Harness	-	In the liftgate, center of liftgate, behind the liftgate trim panel	-	**X907 Liftgate Switch Harness to License Plate Lamp Harness**
X910	Liftgate Harness to Left Tail Stop Lamp Harness	-	In the liftgate, left side, behind liftgate trim panel	**Liftgate Harness Routing**	• **X910 Liftgate Harness to Left Tail Stop Lamp Harness (TW5)** • **X910 Liftgate Harness to Left Tail Stop Lamp Harness (VD1)**
X920	Liftgate Harness to Right Tail Stop Lamp Harness	-	In the liftgate, left side, behind liftgate trim panel	**Liftgate Harness Routing**	• **X920 Liftgate Harness to Right Tail Stop Lamp Harness (TW5)** • **X920 Liftgate Harness to Right Tail Stop Lamp Harness (VD1)**
G100	Forward Lamp Harness	-	In the engine compartment, front left of center, on frame rail forward of battery	**G100**	-

Code	Name	Option	Location	Locator View	Connector End View
G101	Forward Lamp Harness	-	In the engine compartment, front left of center, on core support under Left headlamp assembly.	**G101**	-
G102	Engine Harness	-	In the engine compartment, front right of center, on core support under right headlamp assembly.	**G102**	-
G103	Body Harness	-	In the engine compartment, rear center, on frame.	**G103 and G105**	-
G104	Body Harness	-	In the engine compartment, front right of center, on frame.	**G104**	-
G105	Body Harness	-	In the engine compartment, rear of front frame right of center.	**G103 and G105**	-
G107	Battery Negative Harness	-	In the engine compartment, attached to the center of the left strut tower	**G107**	-
G108	Battery Charger Receptacle Harness	-	In the charging port receptacle	-	-
G111	Engine Harness	-	In the engine compartment, lift front, mouthed support member	**G111**	-
G112	Engine Harness	-	In the engine compartment, attached to left side of coolant heater control module	**G112**	-
G116	Engine Harness	-	In the engine compartment, left front, mounted to support member	**G116**	-

Code	Name	Option	Location	Locator View	Connector End View
G150	Ground Jumper Harness	-	In the engine compartment, left front, attached to left frame rail, before left front strut tower	**G150, G151, G153 and G154**	-
G151	Ground Jumper Harness	-	In the engine compartment, attached to right side front of rear frame	**G150, G151, G153 and G154**	-
G152	Ground Jumper Harness	-	In the engine compartment, attached to right side or drive motor	-	-
G153	Ground Jumper Harness	-	In the engine compartment, mounted to front center of frame	**G150, G151, G153 and G154**	-
G154	Ground Jumper Harness	-	In the engine compartment, mounted to left front corner of power inverter module	**G150, G151, G153 and G154**	-
G155	Ground Jumper Harness	-	In the engine compartment, attached to left upper frame rail, above electric drive motor	**G155 and G156**	-
G156	Ground Jumper Harness	-	In the engine compartment, attached to base of electric drive motor	**G155 and G156**	-
G157	Ground Jumper Harness	-	In the engine compartment, attached to frame rail, above electric drive motor	**G157 and G158**	-
G158	Ground Jumper Harness	-	In the engine compartment, attached to electric drive motor, on right side at base of electric drive motor	**G157 and G158**	-

Code	Name	Option	Location	Locator View	Connector End View
G200	Instrument Panel Harness	-	In the passenger compartment, attached to the A-pillar, blow instrument panel, behind trim panel	G200	-
G201	Instrument Panel Harness	-	In the passenger compartment, left front, at base of left A-pillar	G201 and G304	-
G202	Instrument Panel Harness	-	In the passenger compartment, right front, at base of left A-pillar	G202 and G305	-
G203	Instrument Panel Harness	-	In the passenger compartment, mounted behind the center of the instrument panel	-	-
G260	Ground Jumper Harness	-	In the engine compartment	-	-
G261	Ground Jumper Harness	-	In the engine compartment	-	-
G262	Ground Jumper Harness	-	In the engine compartment	-	-
G263	Ground Jumper Harness	-	In the engine compartment	-	-
G304	Body Harness	-	In the passenger compartment, attache to the base of the left A-pillar, behind trim panel	G201 and G304	-
G305	Body Harness	-	In the passenger compartment, right of center rear of middle, on floor below left front seat.	G202 and G305	-
G310	Instrument Panel Harness	-	At the left rear of the luggage compartment	G310	-

Code	Name	Option	Location	Locator View	Connector End View
G355	Ground Jumper Harness	-	Outside under body left of center mounted on body frame rail next to G357	**G355, G356, G357 and G358**	-
G356	Ground Jumper Harness	-	Outside under body left of center mounted to battery pack next to G358	**G355, G356, G357 and G358**	-
G357	Ground Jumper Harness	-	Outside under body left of center mounted on Body frame rail next to G355	**G355, G356, G357 and G358**	-
G358	Ground Jumper Harness	-	Outside under body left of center mounted on body frame rail next to G356	**G355, G356, G357 and G358**	-
G401	Body Harness	-	In the luggage compartment, attached to the upper portion of the left rear wheel well	**G401 and G404**	-
G404	Body Harness	-	In the luggage compartment, attached to the upper portion of the left rear wheel well	**G401 and G404**	-
G405	Body Harness	-	In the luggage compartment, attached to the upper portion of the right rear wheel well	**G405**	-
G900	Liftgate Extention Harness	-	In the liftgate, in center of liftgate, just above the rear glass	**G900**	-
J100	Engine Harness	-	In the engine harness approximately 4 cm (1.57 in) before the brake out to G111	**Front of Drive Motor Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J101	Engine Harness	-	In the body harness approximately 5 cm (1.97 in) before the breakout leading to G116 and G10 cooling fan motor	**Front of Drive Motor Harness Routing**	-
J102	Forward Lamp Harness	-	In the engine harness approximately 13 cm (5.12 in) from breakout to G100	**Forward Lamp Harness Routing**	-
J103	Forward Lamp Harness	-	In the engine harness approximately 7.5 cm (2.95 in) from breakout to G101	**Forward Lamp Harness Routing**	-
J105	High Voltage Harness	-	In the engine harness approximately 11 cm (4.33 in) from the Power Inverter Module branch breakout	-	-
J107	High Voltage Harness	-	In the engine harness main bundle approximately 4.5 cm (1.77 in) from the G109 branch breakout	-	-
J108	Engine Harness	-	In the engine harness approximately 2cm (0.80 in) from the G112 breakout	**Front of Drive Motor Harness Routing**	-
J109	Forward Lamp Harness	-	In the forward lamp harness approximately 14.5 cm (5.70 in) from the X110 breakout	**Forward Lamp Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J110	Forward Lamp Harness	-	In the forward lamp harness approximately 20 cm (7.87 in) from the X120 breakout	**Forward Lamp Harness Routing**	-
J111	Forward Lamp Harness	-	In the forward lamp harness approximately 5 cm (1.97 in) from the left front impact senor	**Forward Lamp Harness Routing**	-
J112	Forward Lamp Harness	-	In the forward lamp harness approximately 4 cm (1.57 in) from the breakout to left front impact sensor	**Forward Lamp Harness Routing**	-
J113	Front Fascia Harness	-	In the front fascia harness approximately 8 cm (3.15 in) from splice J124	**Front Fascia Harness Routing**	-
J122	Engine Harness	-	In the engine harness approximately 5 cm (1.96 in) from breakout to G112	**Front of Drive Motor Harness Routing**	-
J123	Engine Harness	-	In the engine harness approximately 2 cm (0.80 in) from breakout to hybrid battery pack coolant pump	**Front of Drive Motor Harness Routing**	-
J124	Front Fascia Harness	-	In the front fascia harness approximately 8 cm (3.15 in) from breakout to X101	**Front Fascia Harness Routing**	-
J126	Left Headlamp Harness	-	In the left headlamp harness, internal to the left headlamp assembly	-	-
J127	Right Headlamp Harness	-	In the right headlamp harness, internal to the right headlamp assembly	-	-

Code	Name	Option	Location	Locator View	Connector End View
J128	Body Harness	-	In the body harness approximately 8.5 cm (3.35 in) from pass through leading to the instrument panel	**Left Front of Engine Compartment Harness Routing**	-
J129	Body Harness	-	In the body harness approximately 5 cm (2 in) from branch to X107	-	-
J200	Instrument Panel Harness	-	In the body harness approximately 4 cm (2.17 in) from breakout to X51A	**Instrument Panel Harness Routing**	-
J201	Instrument Panel Harness	-	In the body harness approximately 2.5 cm (1 in) from splice J203	**Instrument Panel Harness Routing**	-
J202	Instrument Panel Harness	-	In the body harness approximately 17.5 cm (6.89 in) from X210	**Instrument Panel Harness Routing**	-
J203	Instrument Panel Harness	-	In the body harness approximately 2.5 cm (1 in) from splice J201	**Instrument Panel Harness Routing**	-
J204	Instrument Panel Harness	-	In the instrument Panel harness approximately 2.5 cm (0.98 in) from splice pack JX200 branch	**Instrument Panel Harness Routing**	-
J205	Instrument Panel Harness	-	In the instrument Panel harness approximately 2.5 cm (0.98 in) from splice J252	**Instrument Panel Harness Routing**	-
J206	HVAC Harness	-	In the HVAC harness	-	-
J207	HVAC Harness	-	In the HVAC harness	-	-

Code	Name	Option	Location	Locator View	Connector End View
J217	Instrument Panel Harness	-	In the instrument Panel harness approximately 12 cm (4.72 in) from splice J225	**Instrument Panel Harness Routing**	-
J219	Instrument Panel Harness	-	In the instrument Panel harness approximately 14 cm (5.5 in) from splice J217	**Instrument Panel Harness Routing**	-
J221	Instrument Panel Harness	-	In the instrument Panel harness approximately 2.5 cm (0.98 in) from breakout to G203	**Instrument Panel Harness Routing**	-
J222	Steering Wheel Harness	-	In the steering wheel harness	-	-
J223	Instrument Panel Harness	-	In the instrument Panel harness on branch leading, approximately 8 cm (3.15 in) from X200	-	-
J224	Instrument Panel Harness	-	In the instrument Panel harness approximately 12 cm (4.72 in) from branch leading to radio	**Instrument Panel Harness Routing**	-
J225	Instrument Panel Harness	-	In the instrument Panel harness approximately 3 cm (1.18 in) in center of instrument panel	**Instrument Panel Harness Routing**	-
J226	Instrument Panel Harness	-	In the instrument Panel harness near center inside main bundle approximately 7 cm (2.8 in) from splice J218	**Instrument Panel Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J227	Instrument Panel Harness	-	In the instrument Panel harness approximately 4 cm (1.5 in) from splice J228	**Instrument Panel Harness Routing**	-
J228	Instrument Panel Harness	-	In the instrument Panel harness approximately 4 cm (1.5 in) from splice J227	**Instrument Panel Harness Routing**	-
J229	Instrument Panel Harness	-	In the instrument Panel harness approximately 44.5 cm (17.5 in) on branch leading to ambient light/sunload sensor	**Instrument Panel Harness Routing**	-
J230	Steering Wheel Harness	-	In the steering wheel harness	-	-
J231	Steering Wheel Harness	-	In the steering wheel harness	-	-
J232	Steering Wheel Harness	-	In the steering wheel harness	-	-
J233	Steering Wheel Harness	-	In the steering wheel harness	-	-
J236	Body Harness	-	In the body harness approximately 5 cm (2 in) from branch leading to body control module	-	-
J237	Body Harness	-	In the body harness approximately 9 cm (3.5 in) after breakout for splice pack JX210	-	-
J238	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J239 in the main harness bundle	**Left Front of Passenger Compartment Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J239	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J238 in the main harness bundle	**Left Front of Passenger Compartment Harness Routing**	-
J240	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J239 in the main harness bundle	-	-
J241	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J239 in the main harness bundle	**Left Front of Passenger Compartment Harness Routing**	-
J242	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J243 in the main harness bundle	**Left Front of Passenger Compartment Harness Routing**	-
J243	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J242 in the main harness bundle	**Left Front of Passenger Compartment Harness Routing**	-
J244	Body Harness	-	In the body harness approximately 22.5 cm (8.8 in) from pass through, on the branch leading to X500	**Left Front of Passenger Compartment Harness Routing**	-
J245	Body Harness	-	In the body harness approximately 8 cm (3.1 in) from X500, before the pass through into the vehicle	-	-

Code	Name	Option	Location	Locator View	Connector End View
J246	Body Harness	-	In the body harness approximately 10 cm (3.9 in) from the breakout to G304	-	-
J247	Body Harness	-	In the body harness approximately 8 cm (3.1 in) on branch leading to X600, between pass through and X600	-	-
J248	Instrument Panel Harness	-	In the instrument panel harness approximately 3cm (1 in) from splice J226, in main harness bundle	**Instrument Panel Harness Routing**	-
J249	Instrument Panel Harness	-	In the instrument panel harness approximately 5 cm (2 in) from splice J250, in main harness bundle	**Instrument Panel Harness Routing**	-
J250	Instrument Panel Harness	-	In the instrument panel harness approximately 5 cm (2 in) from splice J249, in main harness bundle	**Instrument Panel Harness Routing**	-
J251	Instrument Panel Harness	-	In the instrument panel harness approximately 2.5 cm (1 in) from branch leading to splice pack JX200	**Instrument Panel Harness Routing**	-
J252	Instrument Panel Harness	-	In the instrument panel harness approximately 2.5 (1 in) from splice J251	**Instrument Panel Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J301	Body Harness	-	In the body harness approximately 11 cm (4.3 in) from splice J349, in main harness bundle	Left Front of Passenger Compartment Harness Routing	-
J302	Body Harness	-	In the body harness approximately 13.5 cm (5.3 in) from breakout to X310	-	-
J303	Body Harness	-	In the body harness approximately 15 cm (5.90 in) forward of plastic harness channel	-	-
J304	Body Harness	-	In the body harness approximately 3 cm (1 in) from splice J313, in main harness bundle	Right Front of Passenger Compartment Harness Routing	-
J305	Body Harness	-	In the body harness approximately 5 cm (1.9 in) from branch leading to hybrid/ev powertrain control module	Right Front of Passenger Compartment Harness Routing	-
J306	Body Harness	-	In the body harness approximately 5 cm (1.9 in) from branch leading to right side impact sensor	Right Front of Passenger Compartment Harness Routing	-
J307	Body Harness	-	In the body harness approximately 5 cm (1.9 in) from branch leading to G202 and X205	Right Front of Passenger Compartment Harness Routing	-

Code	Name	Option	Location	Locator View	Connector End View
J308	Body Harness	-	In the body harness approximately 3 cm (1.1 in) from the breakout to G404	Left Rear of Passenger Compartment Harness Routing	-
J309	Body Harness	-	In the body harness approximately 5 cm (2 in) from breakout to G404	Left Rear of Passenger Compartment Harness Routing	-
J310	Body Harness	-	In the body harness approximately 5 cm (2 in) from breakout to G404	-	-
J314	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J315, in main harness bundle	-	-
J315	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J314, in main harness bundle	-	-
J316	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J317, in main harness bundle	-	-
J317	Body Harness	-	In the body harness approximately 5 cm (2 in) from splice J316, in main harness bundle	Right Front of Passenger Compartment Harness Routing	-
J320	Body Harness	-	In the body harness approximately 13.5 cm (5.3 in) from splice J321, in main harness bundle	Left Rear of Passenger Compartment Harness Routing	-

Code	Name	Option	Location	Locator View	Connector End View
J321	Body Harness	-	In the body harness approximately 13.5 cm (5.3 in) from splice J321, in main harness bundle	**Left Rear of Passenger Compartment Harness Routing**	-
J322	Body Harness	-	In the body harness approximately 6 cm (2.3 in) from splice J305, in main harness bundle	**Right Front of Passenger Compartment Harness Routing**	-
J323	Headliner Harness	-	In the headliner harness approximately 5 cm (1.9 in) from breakout for rear dome/reading lamps, in main harness bundle	**Headliner Harness Routing**	-
J324	Headliner Harness	-	In the headliner harness approximately 5 cm (1.9 in) from breakout for rear dome/reading lamps, in main harness bundle	**Headliner Harness Routing**	-
J325	Headliner Harness	-	In the headliner harness approximately 15 cm (5.9 in) from breakout for rear dome/reading lamps, in main harness bundle	**Headliner Harness Routing**	-
J326	Body Harness	-	In the body harness approximately 8.5 cm (3.5 in) from breakout to X300	**Left Front of Passenger Compartment Harness Routing**	-
J337	Drivers Seat Harness	KA1	In the driver seat harness approximately 2 cm (0.7 in) from breakout to X310	-	-

Code	Name	Option	Location	Locator View	Connector End View
J338	Drivers Seat Harness	KA1	In the driver seat harness approximately 17 cm (6.6 in) from splice J337, in main harness bundle	-	-
J339	Drivers Seat Harness	KA1	In the driver seat harness approximately 3 cm (1.1 in) from breakout to X310	-	-
J340	Passenger Seat Harness	KA1	In the passenger seat harness approximately 4 cm (1.5 in) from breakout to passenger seat cushion heating element	-	-
J341	Passenger Seat Harness	KA1	In the passenger seat harness approximately 2.5 cm (1 in) from breakout to passenger presence module	**Passenger Seat Harness Routing**	-
J342	Passenger Seat Harness	KA1	In the passenger seat harness approximately 2.5 cm (1 in) from splice J341, in main harness bundle	**Passenger Seat Harness Routing**	-
J343	Rear Seat Harness	KA6	In the rear seat harness	-	-
J344	Rear Seat Harness	KA6	In the rear seat harness	-	-
J346	Body Harness	-	In the body harness approximately 6 cm (2.3 in) from splice J356	**Left Front of Passenger Compartment Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J347	Passenger Seat Harness	-	In the passenger seat harness on branch going to passenger seat belt switch, approximately 3 cm (1.1 in) from branch breakout	**Passenger Seat Harness Routing**	-
J349	Body Harness	-	In the body harness approximately 4 cm (1.5 in) from splice J368	**Left Front of Passenger Compartment Harness Routing**	-
J351	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	**Right Front of Passenger Compartment Harness Routing**	-
J352	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	**Right Front of Passenger Compartment Harness Routing**	-
J353	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	**Left Front of Passenger Compartment Harness Routing**	-
J354	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	**Left Front of Passenger Compartment Harness Routing**	-
J355	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J356	Body Harness	-	In the body harness approximately 6 cm (2.3 in) from splice J346	-	-
J359	Body Hanress	-	in the body harness approximately 5 cm (1.9 in) from the breakout to X300	**Right Front of Passenger Compartment Harness Routing**	-
J364	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	• **Left Front of Passenger Compartment Harness Routing** • **Instrument Panel Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J367	Body Harness	-	In the body harness approximately 6 cm (2.3 in) from splice J359	Ã‚Â	Ã‚Â
J368	Body Harness	-	In the body harness approximately 4 cm (1.5 in) from splice J349	**Left Front of Passenger Compartment Harness Routing**	-
J369	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	**Right Front of Passenger Compartment Harness Routing**	-
J370	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J371	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J372	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J373	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J374	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J375	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J376	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J377	Hybrid/EV Battery Pack Low Voltage Harness	-	Internal to Hybrid/EV Battery Pack	-	-
J400	Body Harness	-	In the body harness approximately 5.5 cm (2.16 in) from X405 branch breakout	-	-
J401	Ã‚Â	-	Ã‚Â	-	-
J402	Rear Fascia Harness	-	In the rear fascia harness approximately 5 cm (1.9 in) from breakout to rear keyless entry antenna	**Rear Fascia Harness Routing**	-

Code	Name	Option	Location	Locator View	Connector End View
J403	Rear Fascia Harness	-	In the rear fascia harness approximately 5 cm (1.9 in) from splice J402, in main harness bundle	Rear Fascia Harness Routing	-
J406	Rear Fascia Harness	-	In the rear fascia harness approximately 5 cm (1.9 in) from splice J403, in main harness bundle	Rear Fascia Harness Routing	-
J407	Rear Fascia Harness	-	In the rear fascia harness approximately 4.5 (1.7 in) from breakout for X415	• Left Rear of Passenger Compartment Harness Routing • Rear Fascia Harness Routing	-
J410	Left Tail Lamp Auxiliary Assembly	-	Internal to left auxiliary tail lamp assembly	-	-
J420	Right Tail Lamp Auxiliary Assembly	-	Internal to right auxiliary tail lamp assembly	-	-
J500	Driver Door Harness	-	In the driver door harness 5 cm (2 in) from splice J501, in main harness bundle	Driver Door Harness Routing	-
J501	Driver Door Harness	-	In the driver door harness 5 cm (2 in) from splice J500, in main harness bundle	Driver Door Harness Routing	-
J502	Driver Door Harness	-	In the driver door harness approximately 5 cm (2 in) from X510, on branch leading to X510	Driver Door Harness Routing	-
J503	Driver Door Harness	-	In the driver door harness approximately 3 cm (1 in) from X500	-	-

Code	Name	Option	Location	Locator View	Connector End View
J504	Driver Door Harness	-	In the driver door harness approximately 7.5 cm (3 in) from breakout to X510	**Driver Door Harness Routing**	-
J600	Passenger Door Harness	-	In the driver door harness approximately 5 cm (2 in) from X610	**Passenger Door Harness Routing**	-
J700	Left Rear Door Harness	-	In the left rear door harness approximately 18.5 cm (7.2 in) from X700, in main harness bundle	**Left Rear Door Harness Routing**	-
J900	License Plate Lamp Harness	-	In the license plate lamp harness approximately 8 cm (3.1 in) from breakout to rearview camera	-	-
J901	Liftgate Harness	-	In the license plate lamp harness approximately 18.5 (7.2 in) from breakout to right license plate lamp	-	-
J902	Liftgate Extension Harness	-	In the liftgate extension harness approximately 14 cm (5.51 in) from the body to liftgate pass through	-	-
J903	Liftgate Harness	-	In the liftgate harness approximately 12 cm (4.1 in) from breakout X905	**Liftgate Harness Routing**	-
JX200	Instrument Panel Harness	-	In the passenger compartment, right front of passenger compartment, behind A-pillar kick panel	**Instrument Panel Harness Routing**	**JX200 Splice Pack**

Code	Name	Option	Location	Locator View	Connector End View
JX210	Body Harness	-	In the passenger compartment, left front, near inline connector X208, on left side of instrument panel	**Left Front of Passenger Compartment Harness Routing**	**JX210 Splice Pack**

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Wiring Systems and Power Management - Component Locator - Passenger Compartment/Roof Component Views - Bolt EV

PASSENGER COMPARTMENT/ROOF COMPONENT VIEWS

LEFT FRONT OF PASSENGER COMPARTMENT COMPONENTS

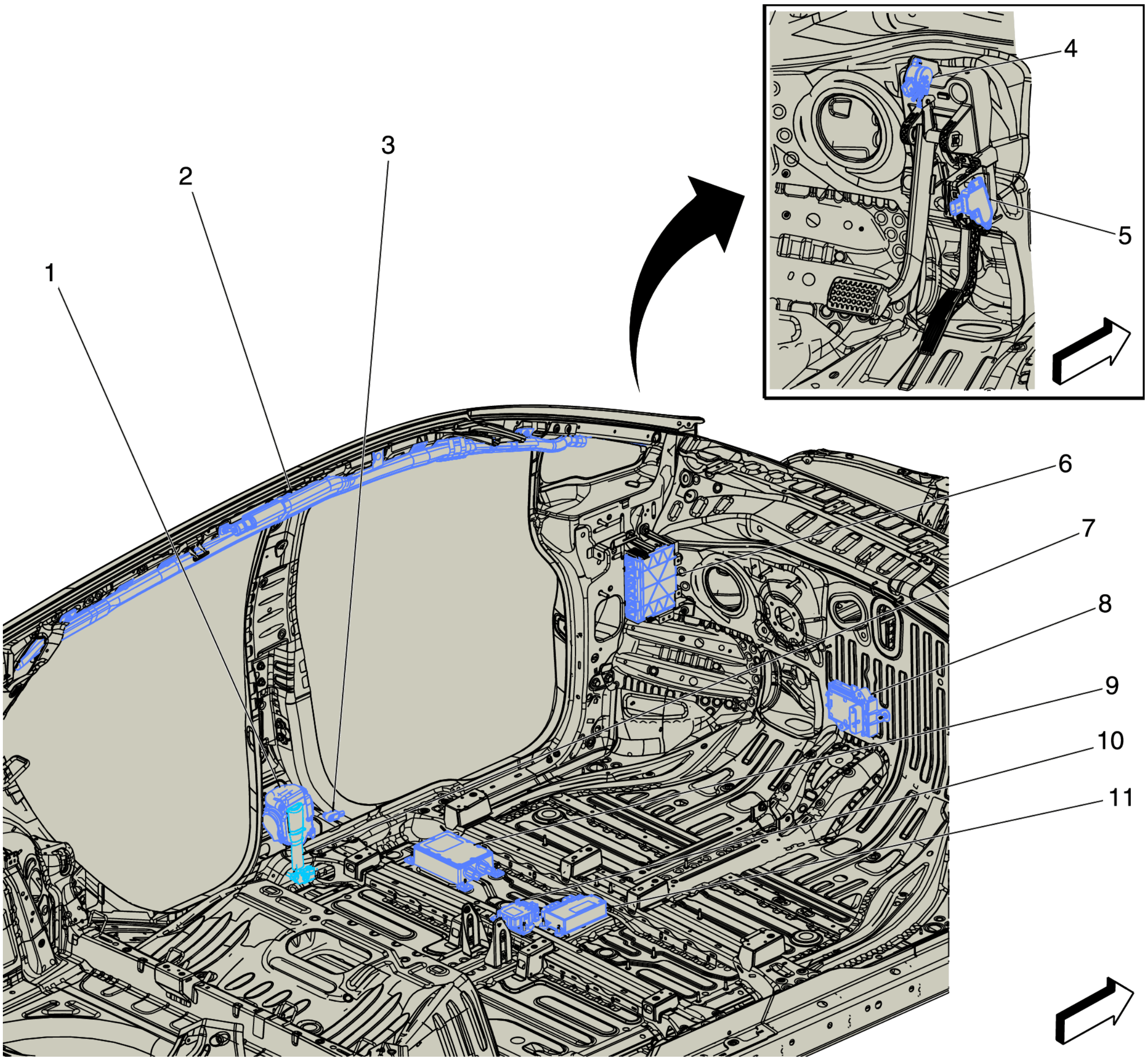

Fig. 1: Left Front of Passenger Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: F112D Seat Belt Retractor Pretensioner - Driver F112D Seat Belt Retractor Pretensioner - Driver (AY0)
2: F105L Roof Rail Air Bag - Left F105L Roof Rail Air Bag - Left (AYF/AY0)
3: B63L Side Impact Sensor - Left (AY0) B63L Side Impact Sensor - Left (AY0)
4: B22 Brake Pedal Position Sensor B22 Brake Pedal Position Sensor
5: B107 Accelerator Pedal Position Sensor B107 Accelerator Pedal Position Sensor
6: K9 Body Control Module K9 Body Control Module X1 K9 Body Control Module X2 K9 Body Control Module X3 K9 Body Control Module X4 K9 Body Control Module X5 K9 Body Control Module X6 K9 Body Control Module X7
7: F113D Seat Belt Anchor Pretensioner - Driver F113D Seat Belt Anchor Pretensioner - Driver (AY0)
8: K38 Chassis Control Module K38 Chassis Control Module

Items
9: K190 Power Line CommunicationModule K190 Power Line Communication Module X1 (CBT) K190 Power Line Communication Module X2 (CBT)
10: K132 Pedestrian Alert Sound Control Module K132 Pedestrian Alert Sound Control Module
11: K36 Inflatable Restraint Sensing and Diagnostic Module K36 Inflatable Restraint Sensing and Diagnostic Module X1 K36 Inflatable Restraint Sensing and Diagnostic Module X2 (AY0+MAW) K36 Inflatable Restraint Sensing and Diagnostic Module X2 (AY0/AYF)

RIGHT FRONT OF PASSENGER COMPARTMENT COMPONENTS

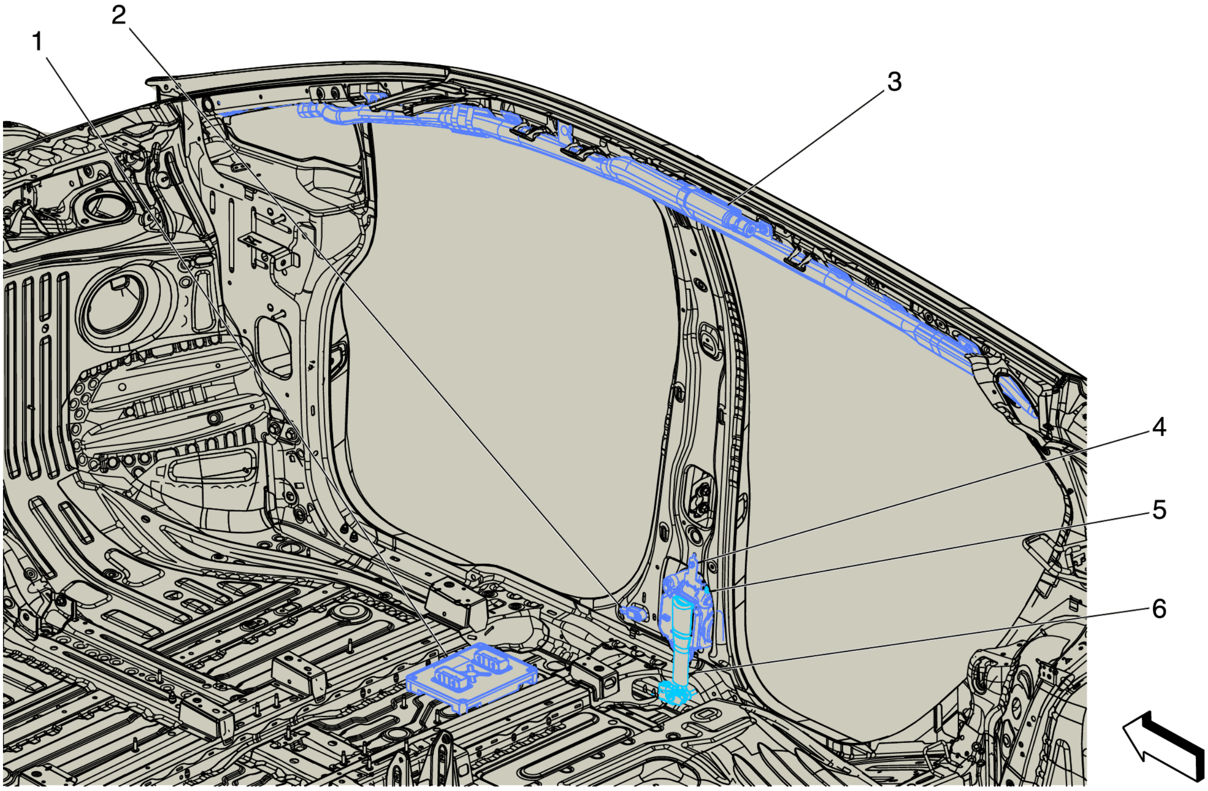

Fig. 2: Right Front of Passenger Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: K114B Hybrid/EV Powertrain Control Module 2 K114B Hybrid/EV Powertrain Control Module 2 X1 K114B Hybrid/EV Powertrain Control Module 2 X2
2: B63R Side Impact Sensor - Right (AY0) B63R Side Impact Sensor - Right (AY0)
3: F105R Roof Rail Air Bag - Right F105R Roof Rail Air Bag - Right (AYF/AY0)
4: F112P Seat Belt Retractor Pretensioner - Passenger F112P Seat Belt Retractor Pretensioner - Passenger (AY0)
5: B61P Seat Belt Tension Sensor - Passenger B61P Seat Belt Tension Sensor - Passenger (AL0)
6: F113P Seat Belt Anchor Pretensioner - Passenger F113P Seat Belt Anchor Pretensioner - Passenger (AY0)

LEFT REAR OF PASSENGER COMPARTMENT COMPONENTS

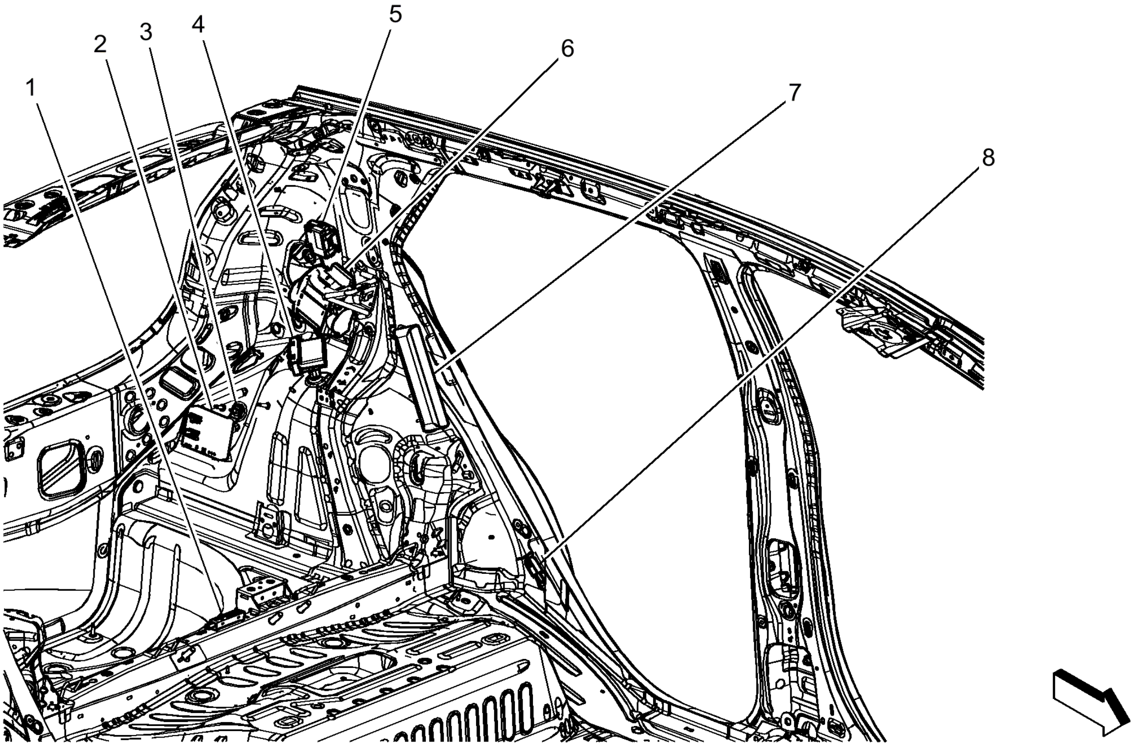

Fig. 3: Left Rear of Passenger Compartment Components

Courtesy of GENERAL MOTORS COMPANY

Items
1: T10E Keyless Entry Antenna - Rear Compartment T10E Keyless Entry Antenna - Rear Compartment
2: K101 Trailer Interface Control Module (MAH/MBC/MAW/MCX) K101 Trailer Interface Control Module X1 K101 Trailer Interface Control Module X2
3: K68 Tralier Lighting Control Moduel (MBM) K68 Trailer Lighting Control Module X1 (MBM) K68 Trailer Lighting Control Module X2 (MBM)
4: K182 Parking Assist Control Module K182 Parking Assist Control Module X1 K182 Parking Assist Control Module X2 K182 Parking Assist Control Module X3
5: K77 Remote Control Door Lock Receiver K77 Remote Control Door Lock Receiver
6: F112LR Seat Belt Retractor Pretensioner - Left Rear F112LR Seat Belt Retractor Pretensioner - Left Rear (SBK)
7: F106LR Seat Side Air Bag - Left Rear F106LR Seat Side Air Bag - Left Rear (AYF)
8: B63LR Side Impact Sensor - Left Rear (AYF) B63LR Side Impact Sensor - Left Rear (AYF)

RIGHT REAR OF PASSENGER COMPARTMENT COMPONENTS

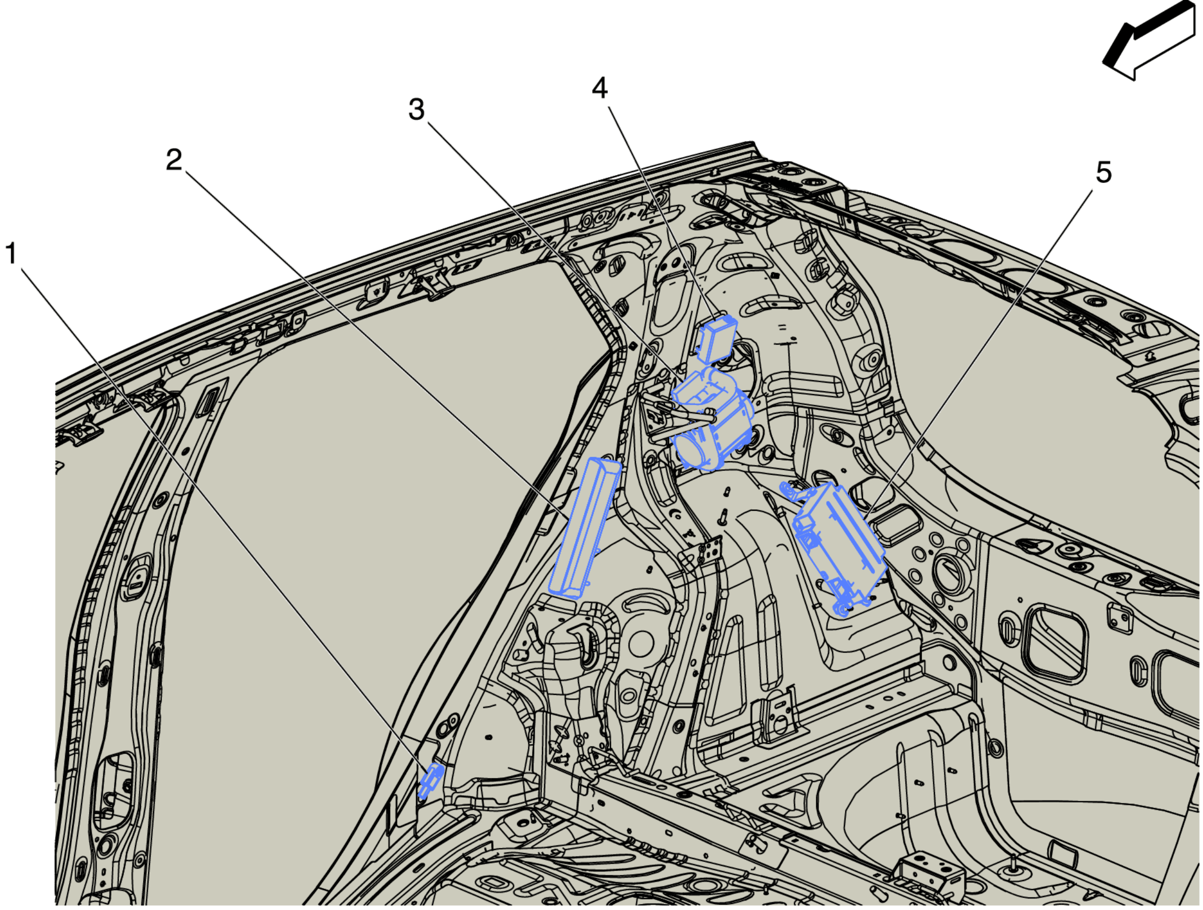

Fig. 4: Right Rear of Passenger Compartment Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: B63RR Side Impact Sensor - Right Rear (AYF) B63RR Side Impact Sensor - Right Rear (AYF)
2: F106RR Seat Side Air Bag - Right Rear F106RR Seat Side Air Bag - Right Rear (AYF)
3: F112RR Seat Belt Retractor Pretensioner - Right Rear F112RR Seat Belt Retractor Pretensioner - Right Rear (SBK)
4: K183 UHF Short Range Low Energy Remote Control Access Transceiver K183 Short Range Remote Control Transceiver
5: K157 Video Processing Control Module K157 Video Processing Control Module X1 (UVH) K157 Video Processing Control Module X2 (UVH)

PASSENGER SEAT COMPONENTS

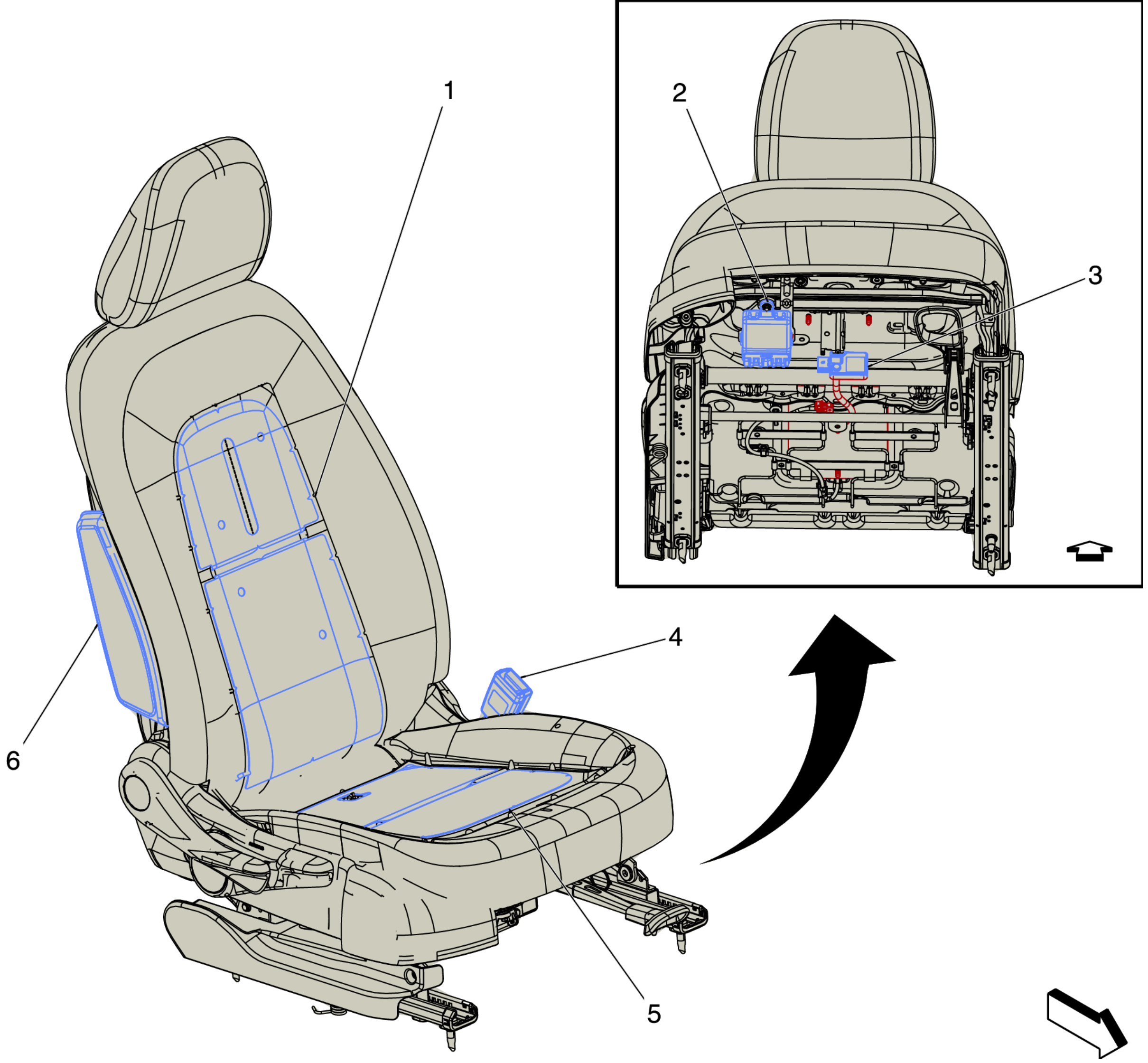

Fig. 5: Passenger Seat Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: E14C Seat Heating Element - Passenger Back (KA1) **E14C Seat Heating Element - Passenger Back (KA1)**
2: K29F Seat Heating Control Module - Front (KA1) **K29F Seat Heating Control Module - Front X1 (KA1)** **K29F Seat Heating Control Module - Front X2 (KA1)**
3: K85 Passenger Presence Module **K85 Passenger Presence Module**
4: B88P Seat Belt Switch - Passenger **B88P Seat Belt Switch - Passenger (AL0+AY0/AYF)**
5: E14D Seat Heating Element - Passenger Cushion (KA1) **E14D Seat Heating Element - Passenger Cushion**
6: F106RF Seat Side Air Bag - Right Front **F106P Seat Side Air Bag - Passenger (AY0/AYF)**

HEADLINER COMPONENTS

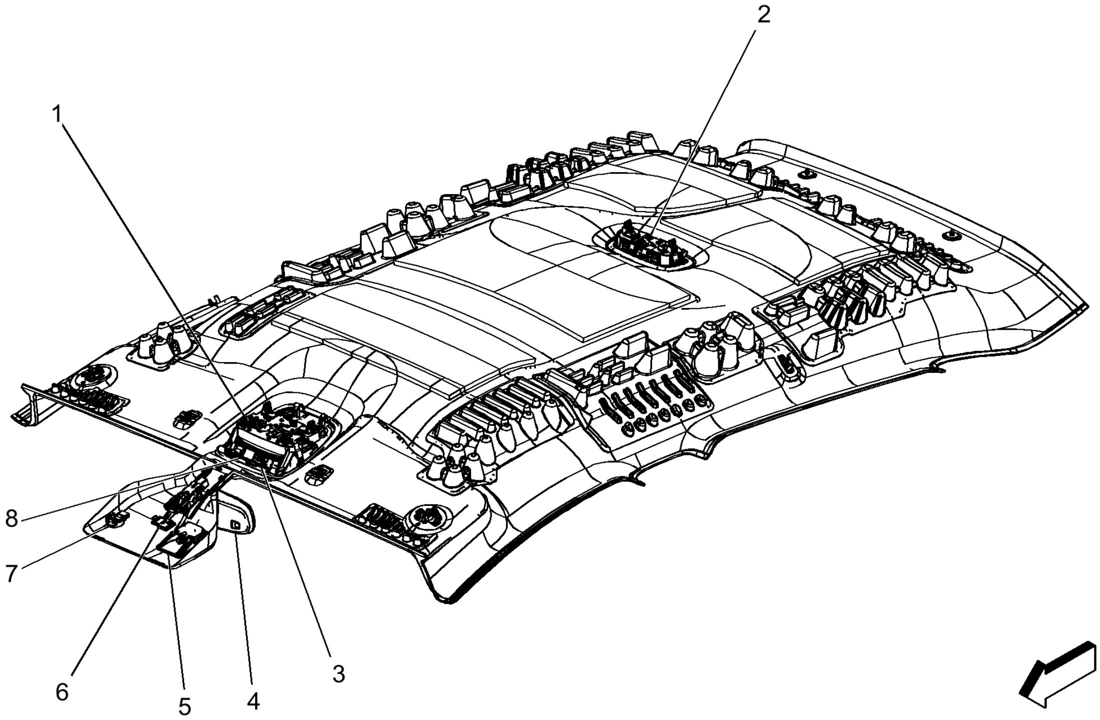

Fig. 6: Headliner Components
Courtesy of GENERAL MOTORS COMPANY

Items
1: E37D Dome/Reading Lamps - Overhead Console **E37D Dome/Reading Lamps - Overhead Console**
2: E37R Dome/Reading Lamps - Rear **E37R Dome/Reading Lamps - Rear**
3: S51 Telematics Button Assembly **S51 Telematics Button Assembly (UE1)**
4: A10 Inside Rearview Mirror **A10 Inside Rearview Mirror X1** **A10 Inside Rearview Mirror X2 (DRZ)**
5: K109 Frontview Camera Module (UEU) **B174W Frontview Camera - Windshield (UEU/UHX/UHY/UVX)**
6: B160 Windshield Temperature and Inside Moisture Sensor **B160 Windshield Temperature and Inside Moisture Sensor**
7: B200 Rain Sensor Module (CE1) **B200 Rain Sensor Module (CE1)**
8: P14 Passenger Air Bag Disabled Indicator **P14 Passenger Air Bag Disabled Indicator**

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2017 ELECTRICAL

Wiring Systems and Power Management - Component Locator - Powertrain Component Views - Bolt EV

POWERTRAIN COMPONENT VIEWS

FRONT OF HYBRID/EV DRIVE UNIT

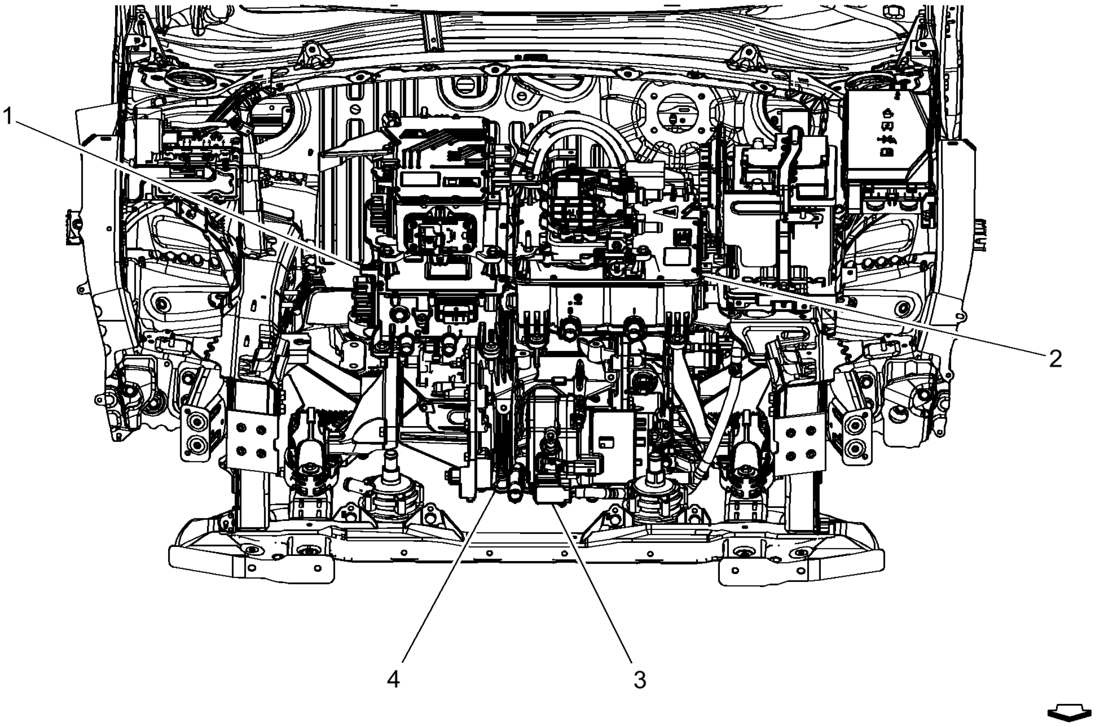

Fig. 1: Front of Hybrid/EV Drive Unit
Courtesy of GENERAL MOTORS COMPANY

Items
1. T6 Power Inverter Module T6 Power Inverter Module X1 T6 Power Inverter Module X2 T6 Power Inverter Module X3
2. T18 Battery Charger T18 Battery Charger X1 T18 Battery Charger X2 T18 Battery Charger X3
3. G1 A/C Compressor G1 A/C Compressor X1 G1 A/C Compressor X2
4. T12 Automatic Transmission Assembly

HYBRID/EV TRANMISSION DRIVE UNIT

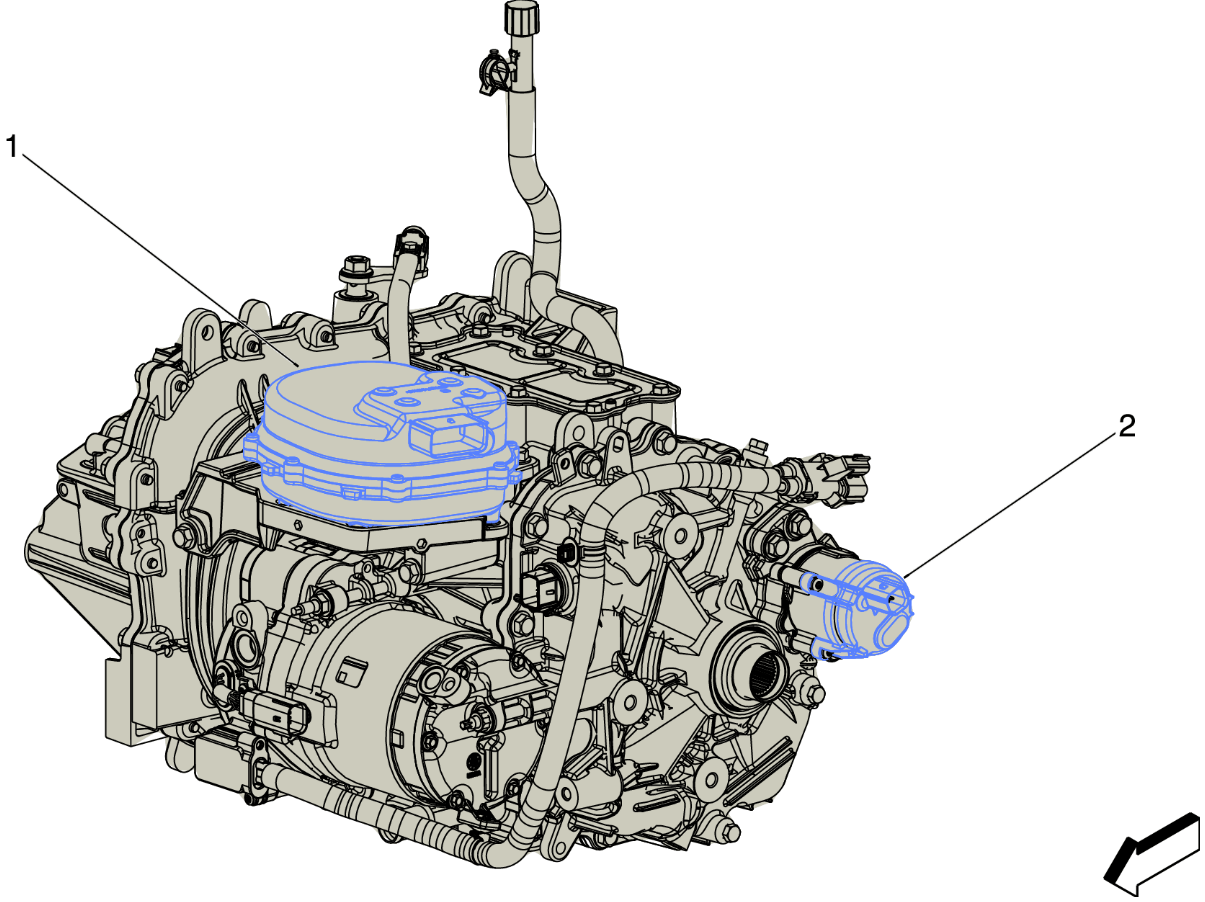

Fig. 2: Hybrid/EV Tranmission Drive Unit
Courtesy of GENERAL MOTORS COMPANY

Items
1. K173 Transmission Range Control Module **K173 Transmission Range Control Module**
2. G5 Transmission Fluid Pump - Electric/Auxiliary **G5 Transmission Fluid Pump - Electric/Auxiliary**

TRANSMISSION COMPONENTS

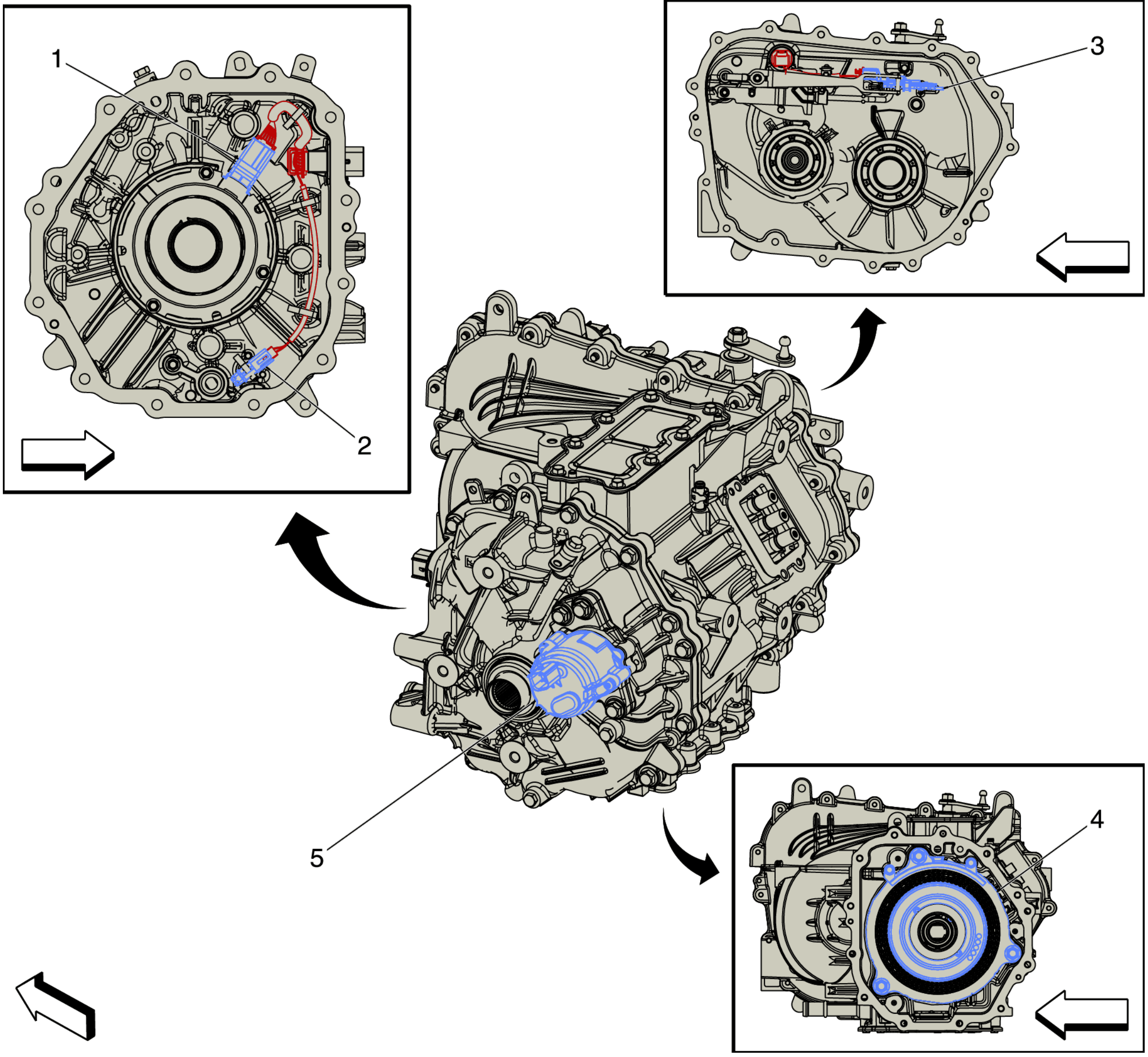

Fig. 3: Transmission Components
Courtesy of GENERAL MOTORS COMPANY

Items
1. B228 Drive Motor Position Sensor
2. B13 Transmission Fluid Temperature Sensor
3. B15 Transmission Internal Mode Switch
4. M15 Drive Motor
5. G5 Transmission Fluid Pump - Electric/Auxiliary **G5 Transmission Fluid Pump - Electric/Auxiliary**

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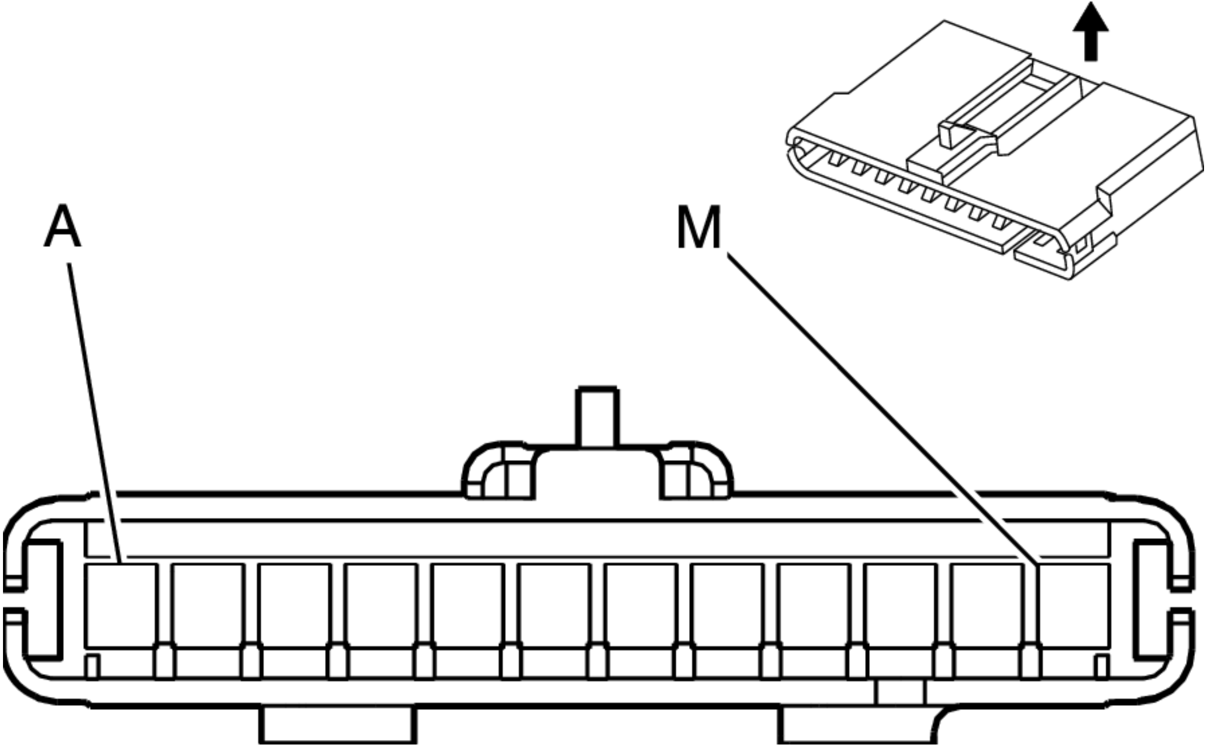
Wiring Systems and Power Management - Component Locator - Splice Pack Connector End Views - Bolt EV

SPLICE PACK CONNECTOR END VIEWS

JX200 SPLICE PACK



Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 12191216
- Service Connector: 15305914
- Description: 12-Way F 150 GT Series (L-GY)

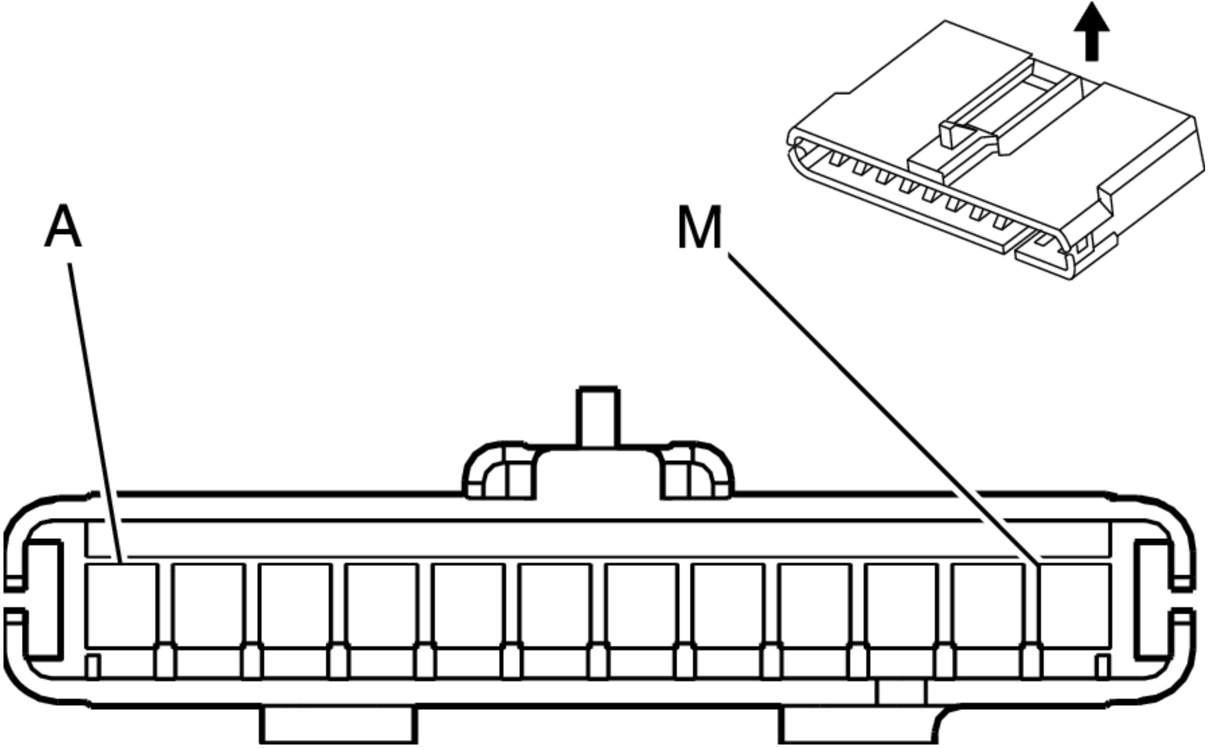
Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575735	J-35616-14 (GN)	J-38125-553	12191812	Delphi 19	E	C

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
B	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
C	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
D	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
E	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
F	-	-	-	Not Occupied	-	-
G	0.35	GN	5060	Low Speed GMLAN Serial Data	I	N06
H - K	-	-	-	Not Occupied	-	-
L	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
M	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-

JX210 SPLICE PACK



Connector Part Information

- Harness Type: Body
- OEM Connector: 12191216
- Service Connector: 15305914
- Description: 12-Way F 150 GT Series (L-GY)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray Name	Core Crimp	Insulation Crimp
I	13575735	J-35616-14 (GN)	J-38125-553	12191812	Delphi 19	E	C

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
A - E	-	-	-	Not Occupied	-	-
F	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
G	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-

Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
H	0.35	GN	5060	Low Speed GMLAN Serial Data	I	UKC
J	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-
K	0.5	GN	5060	Low Speed GMLAN Serial Data	I	AL0
L	0.35	GN	5060	Low Speed GMLAN Serial Data	I	UD5/UD7/UFQ
M	0.35	GN	5060	Low Speed GMLAN Serial Data	I	-

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Wiring Systems and Power Management - Component Locator - Wheels/Vehicle Underbody Component Views - Bolt EV

WHEELS/VEHICLE UNDERBODY COMPONENT VIEWS

UNDERBODY - HYBRID/EV BATTERY PACK COMPONENTS

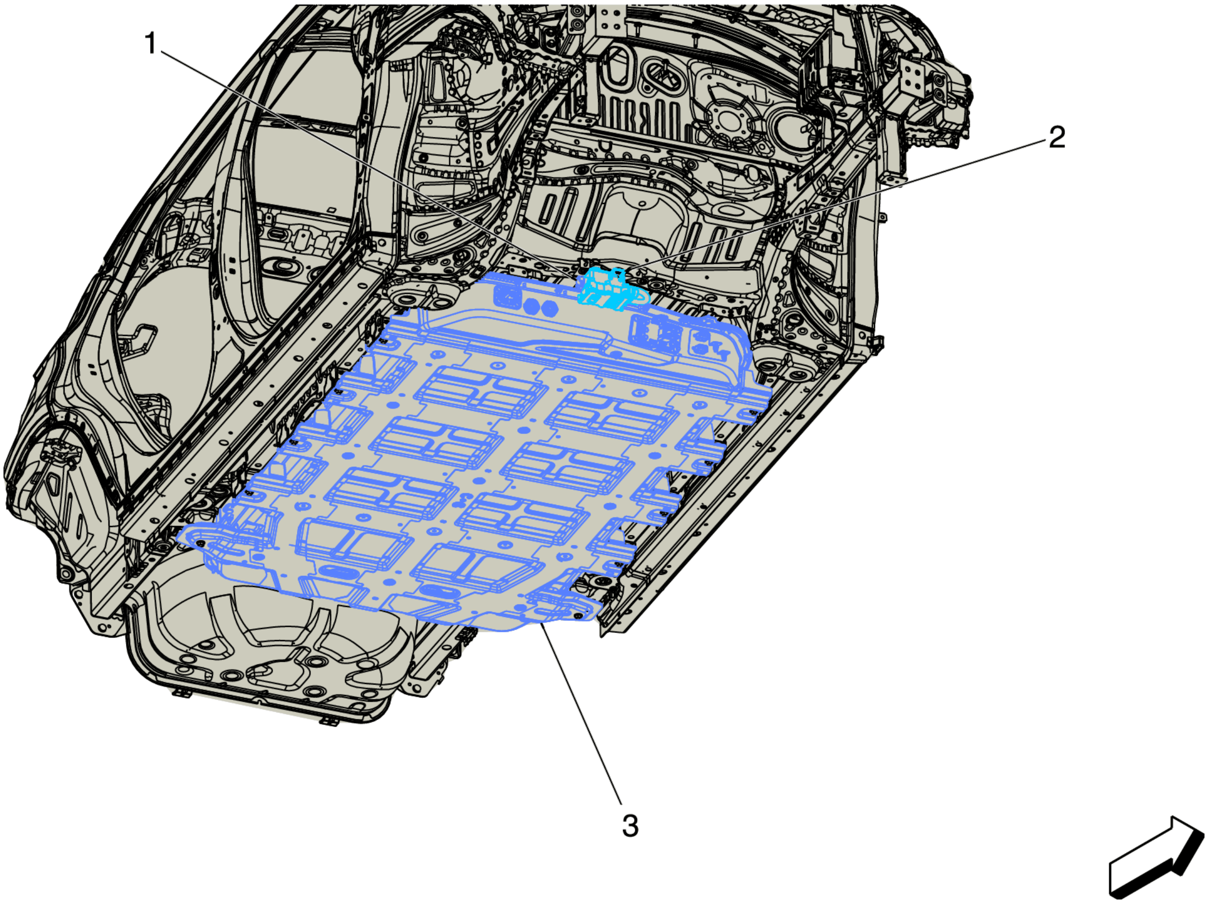


Fig. 1: Underbody - Hybrid/EV Battery Pack Components
Courtesy of GENERAL MOTORS COMPANY

Items
1. B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1 **B204A Hybrid/EV Battery Pack Coolant Temperature Sensor 1**
2. E54 Hybrid/EV Battery Pack Coolant Heater **E54 Hybrid/EV Battery Pack Coolant Heater X1** **E54 Hybrid/EV Battery Pack Coolant Heater X2**
3. A4 Hybrid/EV Battery Pack **A4 Hybrid/EV Battery Pack X1** **A4 Hybrid/EV Battery Pack X3** **A4 Hybrid/EV Battery Pack X4**

WHEEL WELL COMPONENTS - FRONT

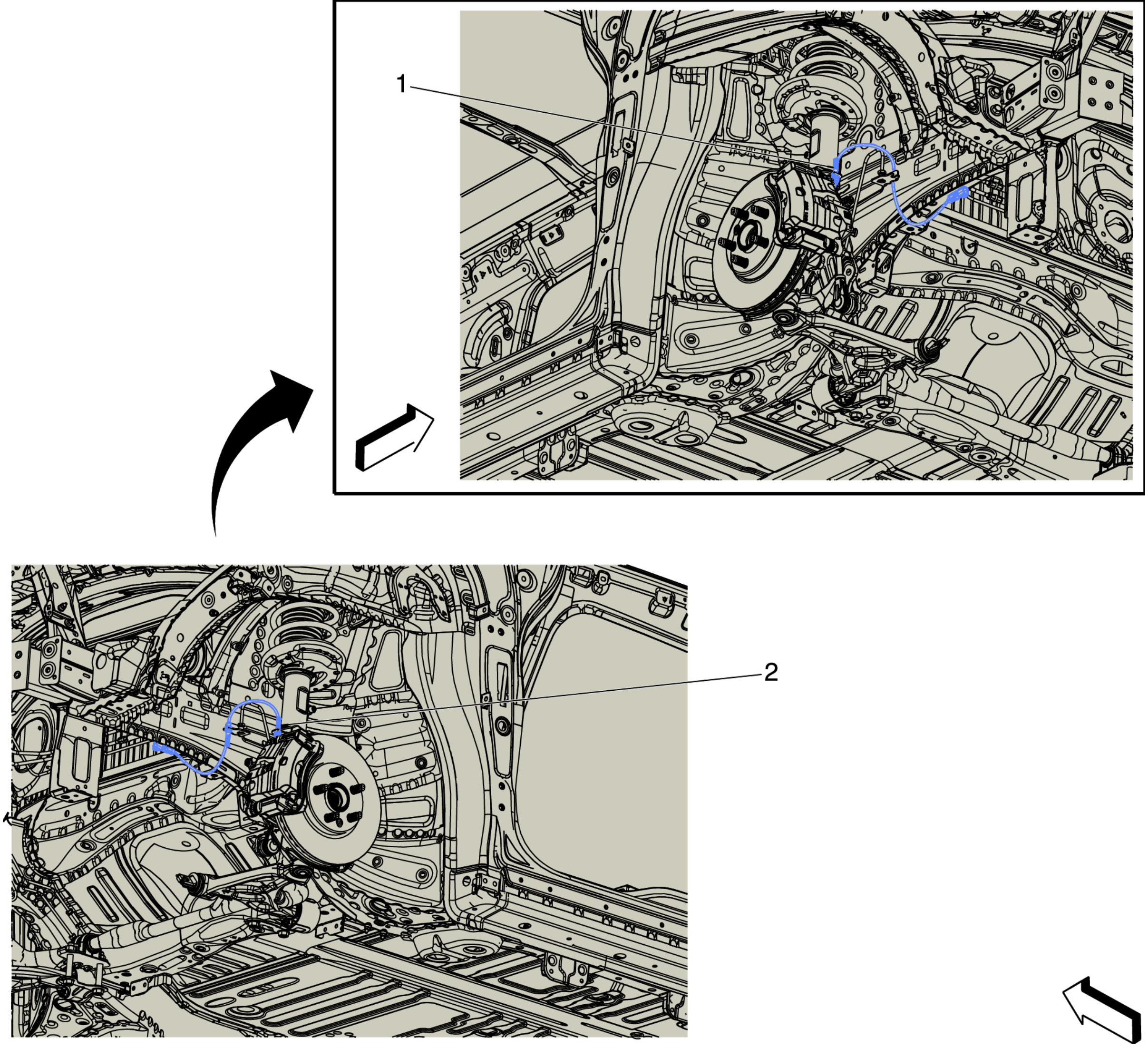
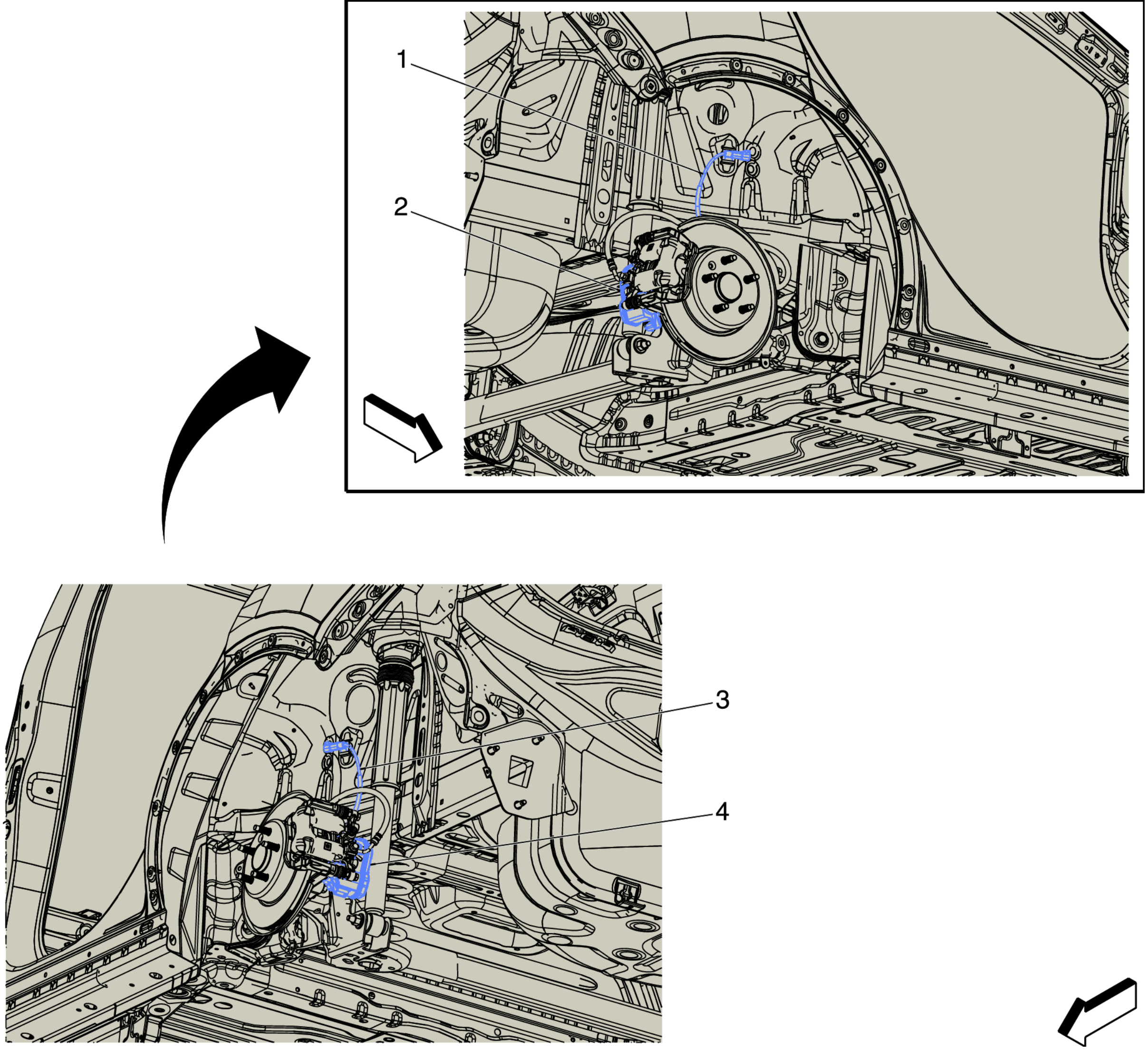


Fig. 2: Wheel Well Components - Front
Courtesy of GENERAL MOTORS COMPANY

Items
1. B5RF Wheel Speed Sensor - Right Front **B5RF Wheel Speed Sensor - Right Front**
2. B5LF Wheel Speed Sensor - Left Front **B5LF Wheel Speed Sensor - Left Front**

WHEEL WELL COMPONENTS - REAR



[Fig. 3: Wheel Well Components - Rear]

Courtesy of GENERAL MOTORS COMPANY

Items
1. B5RR Wheel Speed Sensor - Right Rear **B5RR Wheel Speed Sensor - Right Rear**
2. M104R Park Brake Actuator - Right **M104R Park Brake Actuator - Right**
3. B5LR Wheel Speed Sensor - Left Rear **B5LR Wheel Speed Sensor - Left Rear**
4. M104L Park Brake Actuator - Left **M104L Park Brake Actuator - Left**

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Wiring Systems and Power Management - Description and Operation - Bolt EV

DESCRIPTION AND OPERATION

ELECTRONIC PARK LOCK DESCRIPTION AND OPERATION

If the vehicle is equipped with automatic transmission and a floor mounted console gear shift, it has an electronic park lock system. The electronic park lock system purpose is to prevent the ignition from being switched to the Vehicle OFF position when the transmission is in any position other than PARK and the vehicle may still be moving. The electronic park lock system incorporates the park position switch that located in the A/T shift lock control switch. When the transmission shift selector is in PARK, the park position switch closes and the BCM allows the ignition to be turned Vehicle OFF.

If the vehicle is not in PARK, the ignition will return to ACC/ACCESSORY and display the message SHIFT TO PARK in the Driver Information Center. When the vehicle is shifted into PARK, the ignition system will switch to Vehicle OFF.

POWER MODE DESCRIPTION AND OPERATION

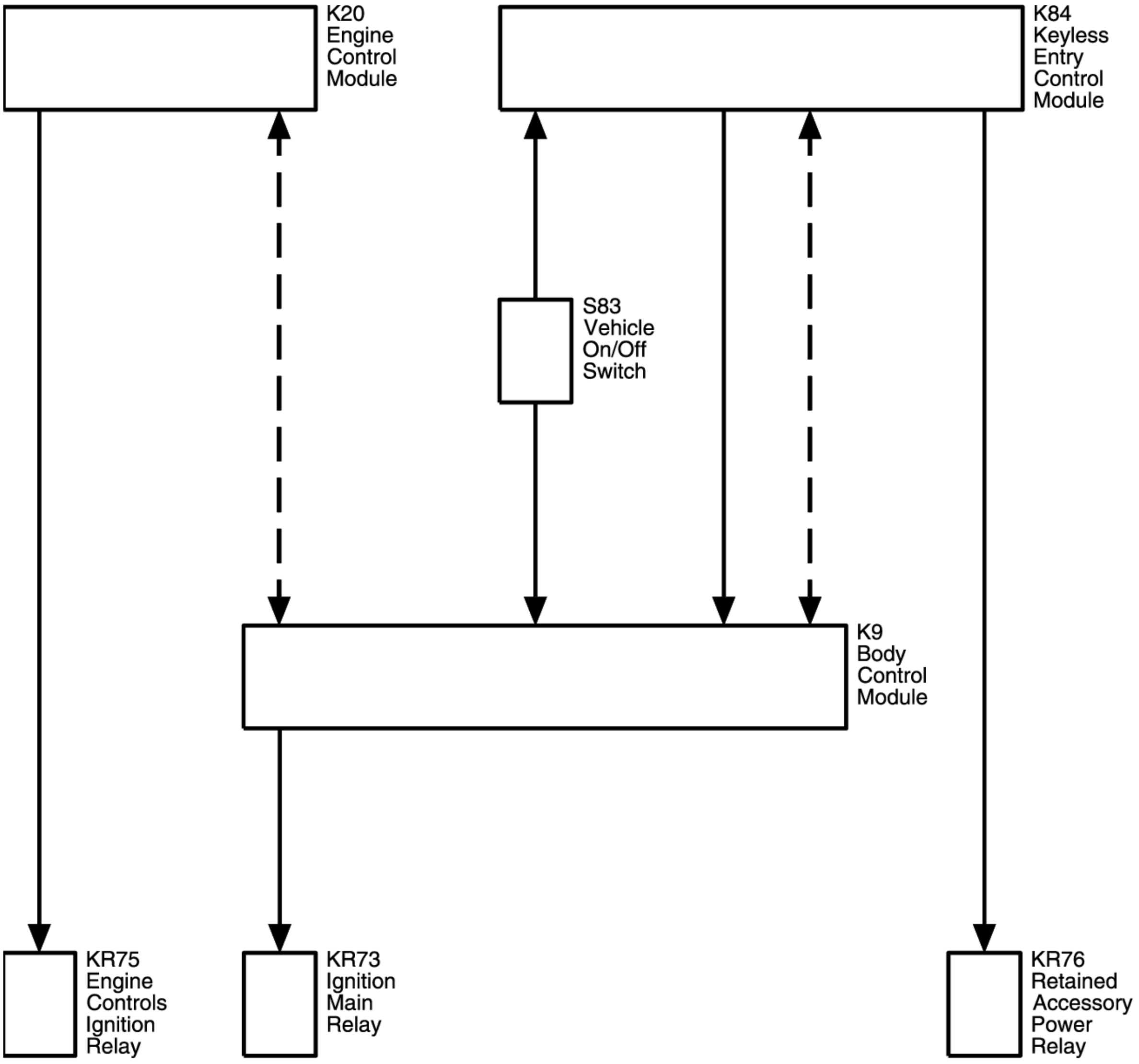
K20
Engine
Control
Module
K84
Keyless
Entry
Control
Module
S83
Vehicle
On/Off
Switch
K9
Body
Control
Module
KR75
Engine
Controls
Ignition
Relay
KR73
Ignition
Main
Relay
KR76
Retained
Accessory
Power
Relay

Fig. 1: Power Mode System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K20	K20 Engine Control Module
KR73	KR73 Ignition Main Relay
KR75	KR75 Engine Controls Ignition Relay
K9	K9 Body Control Module
K84	K84 Keyless Entry Control Module
S83	S83 Vehicle On/Off Switch
KR76	KR76 Retained Accessory Power Relay

Serial Data Power Mode Master

Power to many of this vehicles circuits is controlled by the module that is designated the power mode master. This vehicles power mode master is the body control module (BCM). The BCM has multiple B+ circuits that feed into it. Each of those circuits are partitioned within the controller to drive certain outputs of the vehicle's body functions. An open or short in any one of the B+ circuits may induce multiple codes/or a section of non-functionality within the BCM with the rest of the BCM functioning normally. In this case it is useful to refer to the power distribution schematics to determine if the non-functional partition of the controller shares a common B+ circuit. The power button switch is a low current push button switch with discrete power button switch signals to the power mode master for determination of the power mode that will be sent over the serial data circuits to the other modules that need this information. The power mode master will also activate relays and other direct outputs of the power mode master as needed. The power mode master determines which power mode (Vehicle Off, Vehicle On, Vehicle in Service Mode) is required, and reports this information to other modules via serial data. Modules which have switched voltage inputs may operate in a default mode if the power mode serial data message does not match what the individual module can see from its own connections.

The power mode master receives power button switch signals and transmitter in range signals to identify the operators desired power mode. The Power Mode Parameters table below illustrates the correct state of these input parameters (circuits) in correspondence to the power button switch position and the transmitter to vehicle range:

Power Mode Parameters

Power Mode	Power Mode Transmitted	Push Button Ignition Switch (Power Button Switch Circuit Input to the BCM)	Push Button Ignition Switch Voltage Push Button Ignition Switch Voltage Input to the BCM	Key in Cylinder Switch/Key Fob in Vehicle (Transmitter in Range to the BCM Signal)
Transmitter in Range	Vehicle Off	Inactive	9 V	Yes
Transmitter out of Range	Vehicle Off	Inactive	9 V	No
Vehicle On Power Mode, then Press the Power Button Switch (Foot on or off the Brake Pedal); Transmitter in Vehicle	Vehicle Off	Active (pushed) / Inactive (not pushed)	6 V (pressed)	Yes
Vehicle Off Power Mode, then Press the Power Button Switch with foot on the Brake Pedal; Transmitter in Vehicle	Vehicle On	Active (pushed) / Inactive (not pushed)	6 V (pressed)	Yes

Power Mode	Power Mode Transmitted	Push Button Ignition Switch (Power Button Switch Circuit Input to the BCM)	Push Button Ignition Switch Voltage Push Button Ignition Switch Voltage Input to the BCM	Key in Cylinder Switch/Key Fob in Vehicle (Transmitter in Range to the BCM Signal)
Vehicle Off Power Mode, then Press and Hold the Power Button Switch for 5 s with foot off the Brake Pedal; Transmitter in Vehicle	Vehicle in Service Mode	Active (pushed) / Inactive (not pushed)	6 V (pressed)	Yes
Vehicle Off Power Mode, then Press and Hold the Power Button Switch for over 10 s with foot off the Brake Pedal; Transmitter in Vehicle	Vehicle in Service Mode	Active (pushed) / Inactive (not pushed)	6 V (pressed)	Yes

Relay Controlled Power Mode

The BCM uses the discrete power button switch inputs, transmitter in range status, current power mode state, and the brake pedal position state to distinguish the correct power mode (Vehicle Off, Vehicle On, and Vehicle in Service Mode). The BCM, after determining the desired power mode, will activate the appropriate relays for that power mode and send the power mode message out to other modules in a serial data message.

The retained accessory power relay remains on for a timed period after the power mode transitions to Vehicle Off. Refer to **Retained Accessory Power Description and Operation** for more information on the retained accessory power function.

Push Button Start

The vehicle has an electronic push button start switch. The power button switch is equipped with two LED's, one for backlighting and one for Vehicle On indication or Vehicle In Service Mode indication. The power button switch light flashes when the driver door is open and the vehicle is not on. The flashing light will eventually time out. The power button switch light is on steady when in Vehicle On or Vehicle In Service Mode. When the vehicle is turned off, the power button switch light will turn off.

Vehicle On

This position is for driving and starting. The Vehicle On mode will be used for service (including maintenance and lubrication) and diagnostics on the electronic propulsion system or the gas engine. With the vehicle off, transmitter in the vehicle and the brake pedal applied, pressing the power button switch once will place the vehicle in Vehicle On mode. The instrument cluster displays an active fuel or battery gauge, along with an audio startup cue, when the vehicle is ready to be driven. This could take up to 15 s at extremely cold temperatures. The gas engine will only start if needed. If the vehicle did not start, the instrument cluster will display a screen with inactive fuel and battery gauges. The electric propulsion system is active in this power mode. The gas engine will start if the hood is opened while in this power mode. The vehicle can be charged while in this power mode. If the vehicle is left in PARK while in Vehicle On mode and the transmitter is removed from the vehicle, the vehicle will automatically turn off after 1.5 hours. If the vehicle is left in PARK while in Vehicle On mode and the transmitter is in the vehicle, the vehicle will automatically turn OFF after 3 hours. The timer will stop when the vehicle is shifted out of PARK and the timer will reset after the vehicle is placed back in PARK while in Vehicle On mode.

Vehicle In Service Mode

NOTE: **The vehicle will not charge if the charging cable is attached to the vehicle after being placed into the Vehicle In Service Mode. Attach the charging cable to the vehicle before entering the Vehicle In Service Mode to charge the vehicle.**

This power mode is available for service and diagnostics, and to verify the proper operation of the MIL as may be required for emission inspection purposes. The Vehicle In Service Mode will be used for service and diagnostics for items not requiring the electronic propulsion to be active or the operation of the gas engine. With the vehicle off, and the brake pedal not applied, pressing and holding the power button switch for 5 s will place the vehicle in Vehicle In Service Mode for approximately 3 hours. After being in Vehicle In Service Mode for 1.5 hours, the vehicle will look to see if the transmitter in still present. If the transmitter is not present in the vehicle, it will power down instead of staying powered up for the full 3 hours. Pressing and holding the power button switch for at least 10 s will place the vehicle in Vehicle In Service Mode until the vehicle is manually turned OFF. The instruments and audio systems will operate as they do in Vehicle On mode, but the vehicle will not be able to be driven. The electric propulsion system is inactive in this power mode. The gas engine will not start if the hood is opened while in this power mode. The vehicle can only be charged in this power mode if the charging cable is attached before this power mode is enabled.

Vehicle Off

To turn the vehicle off, push the power button switch with the vehicle in P (Park). Retained Accessory Power (RAP) will remain active until the driver door is opened. Refer to **Retained Accessory Power Description and Operation** for more information on the retained accessory power function. When turning off the vehicle, if the vehicle is not in P (Park), the SHIFT TO PARK message is displayed in the Driver Information Center (DIC). The electric propulsion system is inactive in this power mode. The gas engine will not start if the hood is opened in this power mode. The vehicle can be charged while in this power mode.

Battery Saver Mode (Transport Mode) (If Equipped)

The battery saver mode (transport mode) reduces the parasitic load of some modules during overseas shipment or during vehicle storage conditions. This improves the drain time on the battery (up to 70 days without the battery going dead). When the vehicle is in transport/storage, some features may have reduced functionality while in the battery saver mode (transport mode), such as disabling the Remote Function Actuator or content theft features.

The battery saver mode (transport mode) incorporates a latching relay that when enabled disconnects some modules from their ignition power or memory power sources. Battery saver mode (transport mode) is initiated by turning on the hazard flashers, applying the brake pedal, and then pushing the power button switch for greater than 15 s. The mode is disengaged by repeating the previous process causing the relay to latch in the other direction. Once the vehicle is in Vehicle On mode and the hazard flashers are on, pushing the power button switch for greater than 15 s will latch the relay in the other direction. This feature can be used as many times as necessary if the vehicle is to be stored for an extended period of time.

BCM Awake/Sleep States

The BCM is able to control or perform all of the BCM functions in the awake state. The BCM enters the sleep state when active control or normal monitoring of system functions has stopped and a time limit has passed. The BCM must detect certain wake-up inputs before entering the awake state. The BCM monitors for these inputs during the sleep state.

The BCM will enter the awake state if any of the following wake-up inputs are detected:

- Activity on the serial data line (including wake-up circuits)
- Detection of a battery reconnect
- Any door open signal
- Headlamps ON
- Vehicle On
- Vehicle In Service Mode

- Park lamps ON
- Keyless entry or remote start message

The BCM will enter a sleep state when all of the following conditions exist:

- Vehicle Off, transmitter is out of range
- No activity exists on the serial data line (including wake-up circuits)
- No outputs are commanded.
- No delay timers are actively counting.
- No wake-up inputs are present.

If all these conditions are met, the BCM will enter a low power or sleep condition.

Serial Data Wake-Up

Control modules on the serial data wake-up circuit enable or disable communication based on the voltage level of this circuit.

RETAINED ACCESSORY POWER DESCRIPTION AND OPERATION

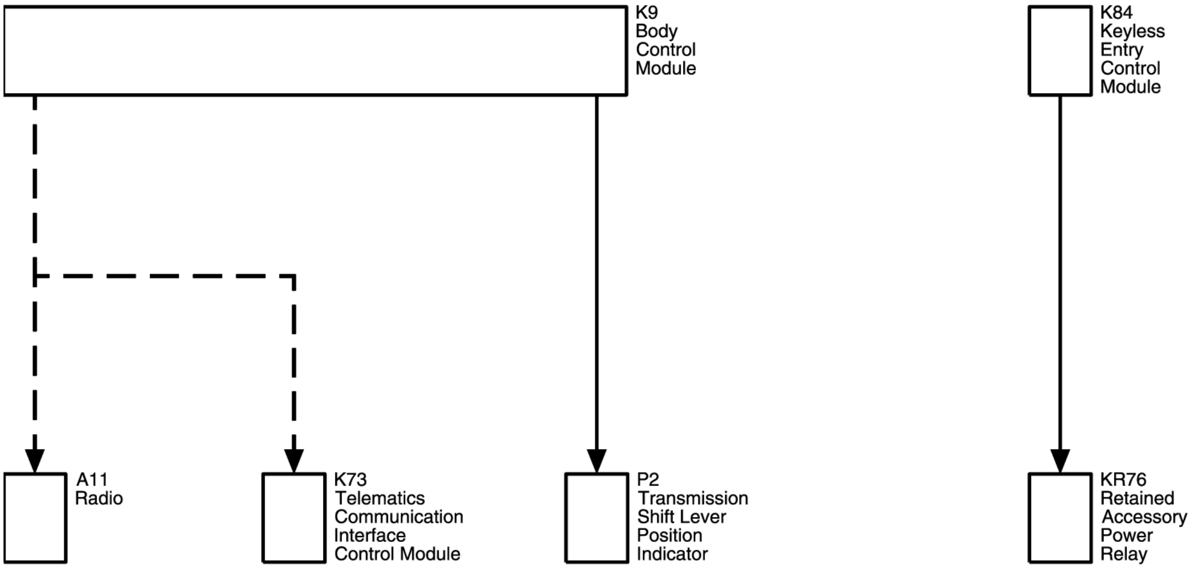
K9
Body
Control
Module
K84
Keyless
Entry
Control
Module
A11
Radio
K73
Telematics
Communication
Interface
Control Module
P2
Transmission
Shift Lever
Position
Indicator
KR76
Retained
Accessory
Power
Relay

Fig. 2: Retained Accessory Power System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K9	K9 Body Control Module
A11	A11 Radio
K73	K73 Telematics Communication Interface Control Module
P2	P2 Transmission Shift Lever Position Indicator
K84	K84 Keyless Entry Control Module
KR76	KR76 Retained Accessory Power Relay

Retained Accessory Power

The body control module (BCM) monitors the vehicle power modes, battery condition, and each door ajar/open switch status to determine whether the retained accessory power should be initiated or terminated. Retained accessory power is controlled by two different methods; relay control and serial data. Some modules receive a retained accessory power message from the BCM over the serial data circuits. Serial data controlled retained accessory power is deactivated as required by their modules retained accessory power mode operation. Other subsystems are activated directly. Components and systems that are active in retained accessory power are also activated anytime the vehicle power mode is any state other than Vehicle OFF regardless of the door switch signals.

Interruptible Retained Accessory Power Relay Controlled Retained Accessory Power

The Keyless entry control module keeps the relay energized during all power modes, except Vehicle Off. The relay is also energized for approximately 10 minutes after moving to the Vehicle OFF state and moving the transmitter out of range, providing no door is opened. The keyless entry control module controls components in the same manner as BCM direct controlled retained accessory power with one exception; interruptible retained accessory power is deactivated during transmitter authentication. The keyless entry control module will deactivate components that may cause radio frequency (RF) interference when the vehicle On/Off switch is pressed which may result in "NO REMOTE DETECTED" displayed on the driver information center.

Relay controlled retained accessory power will end when one of the following conditions is met:

- The keyless entry control module receives a message that any door ajar or open switch indicating the opening of any door after entering the Vehicle Off state and the transmitter is out of range.

  NOTE: **If the keyless entry control module is receiving any door ajar or open signal from those switches when the Vehicle Off state is entered and the transmitter is out of range, retained accessory power will not initiate.**

-
- The keyless entry control module detects a decrease in battery capacity below a prescribed limit.

Systems powered by the retained accessory power relay during the retained accessory power mode are as follows:

- Accessory Power Receptacle
- Cigarette Lighter Receptacle

Serial Data Controlled Retained Accessory Power

Retained accessory power systems controlled by serial data are as follows:

Radio

Radio retained accessory power activation / termination is the same as relay operation with one exception; the only door switch that will turn off the radio during retained accessory power is the driver door open switch.

Vehicle Communication Interface Module (VCIM) (OnstarÂ®) (If Equipped)

VCIM RAP activation/termination is the same as radio operation with 1 exception; if there is an active call when the ignition key is turned off the VCIM will remain in RAP mode, and keep the radio in RAP mode until the call is terminated.

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INLINE HARNESS CONNECTOR END VIEWS - INDEX

Inline Harness Connector End Views Index

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X101 Forward Lamp Harness to Front Fascia Harness (-UD5/UFQ/UVH)
X105 Body Harness to Engine Harness
X106 Body Harness to Engine Harness
X107 Body Harness to Forward Lamp Harness
X108 Body Harness to Forward Lamp Harness ()
X110 Forward Lamp Harness to Left Headlamp Harness (TR6)
X110 Forward Lamp Harness to Left Headlamp Harness (-TR6)
X111 Front Fascia Harness to Left Turn Signal Harness
X117 Charge Receptacle Harness to Body Harness (CBT)
X120 Forward Lamp Harness to Right Headlamp Harness (TR6)
X120 Forward Lamp Harness to Right Headlamp Harness (-TR6)
X121 Front Fascia Harness to Right Turn Signal Harness
X200 Instrument Panel Harness to Body Harness
X205 Instrument Panel Harness to Body Harness
X207 Cellular Phone Microphone Harness to Headliner Harness
X208 Headliner Harness to Body Harness ()
X210 Instrument Panel Harness to Body Harness
X215 Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness
X236 Instrument Panel Harness to Air Duct Jumper Harness ()
X300 Floor Console Harness to Body Harness
X310 Driver Seat Harness to Body Harness
X320 Passenger Seat Harness to Body Harness ()
X357 Body Harness to Battery Cable Harness ()
X358 Body Harness to Battery Harness ()
X360 Right Rear Seat Harness to Body Harness (KA6)
X410 Rear Fascia Harness to Left Lamp Jumper Harness (TW5)
X410 Rear Fascia Harness to Left Lamp Jumper Harness (VD1)
X415 Body Harness to Rear Fascia Harness ()
X420 Rear Fascia Harness to Right Lamp Jumper Harness (TW5)
X420 Rear Fascia Harness to Right Lamp Jumper Harness (VD1)
X500 Driver Door Harness to Body Harness ()
X510 Driver Outside Rearview Mirror Harness to Driver Door Harness
X600 Passenger Door Harness to Body Harness ()
X610 Passenger Outside Rearview Mirror Harness to Passenger Door Harness
X700 Left Rear Door Harness to Body Harness
X800 Right Rear Door Harness to Body Harness ()
X900 Liftgate Extension Harness to Body Harness
X901 Liftgate Extension Harness to Liftgate Harness ()
X902 License Plate Lamp Harness to Liftgate Harness ()
X903 Center High Mount Stop Light Harness to Liftgate Extension Harness ()
X907 Liftgate Switch Harness to License Plate Lamp Harness

Description
X910 Liftgate Harness to Left Tail Stop Lamp Harness (TW5)
X910 Liftgate Harness to Left Tail Stop Lamp Harness (VD1)
X920 Liftgate Harness to Right Tail Stop Lamp Harness (TW5)
X920 Liftgate Harness to Right Tail Stop Lamp Harness (VD1)

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SCHEMATIC WIRING DIAGRAMS

HARNESS ROUTING VIEWS

Driver Door Harness Routing

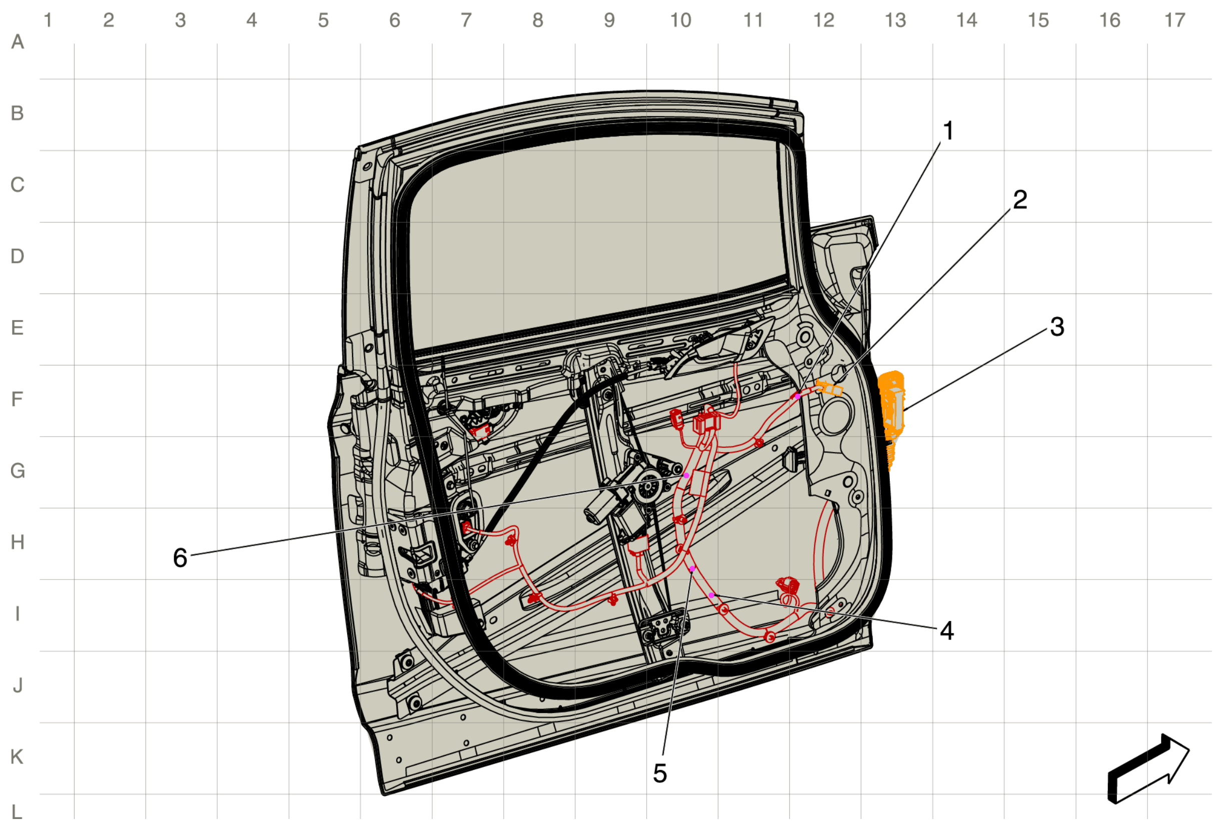
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Fig. 1: Driver Door Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: J502 Driver Door Harness
2: X510 Driver Door Harness to Driver Outside Rearview Mirror Harness X510 Driver Outside Rearview Mirror Harness to Driver Door Harness
3: X500 Driver Door Harness to Body Harness X500 Driver Door Harness to Body Harness ()
4: J501 Driver Door Harness
5: J500 Driver Door Harness
6: J504 Driver Door Harness

Passenger Door Harness Routing

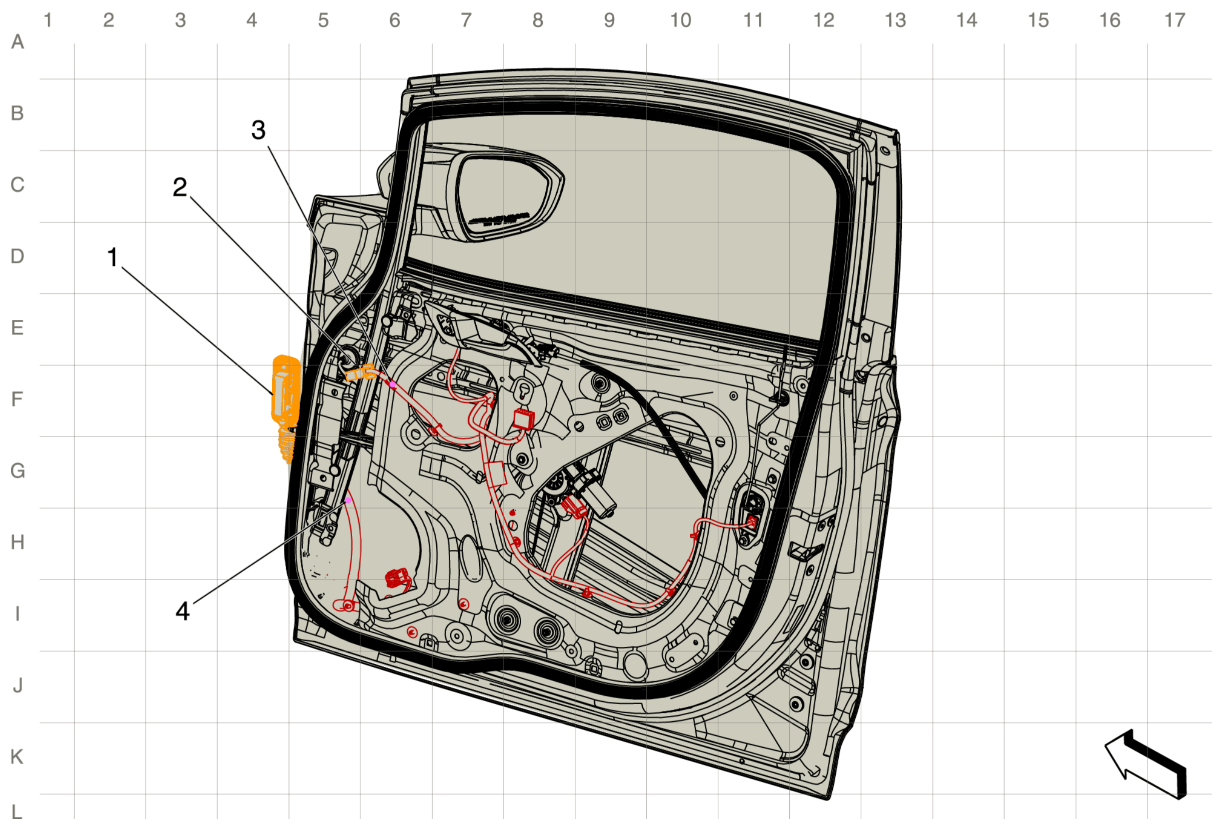
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Fig. 2: Passenger Door Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X600 Passenger Door Harness to Body Harness X600 Passenger Door Harness to Body Harness ()
2: X610 Passenger Door Harness to Passenger Outside Rearview Mirror Harness X610 Passenger Outside Rearview Mirror Harness to Passenger Door Harness
3: J600 Passenger Door Harness
4: J247 Body Harness

Left Rear Door Harness Routing

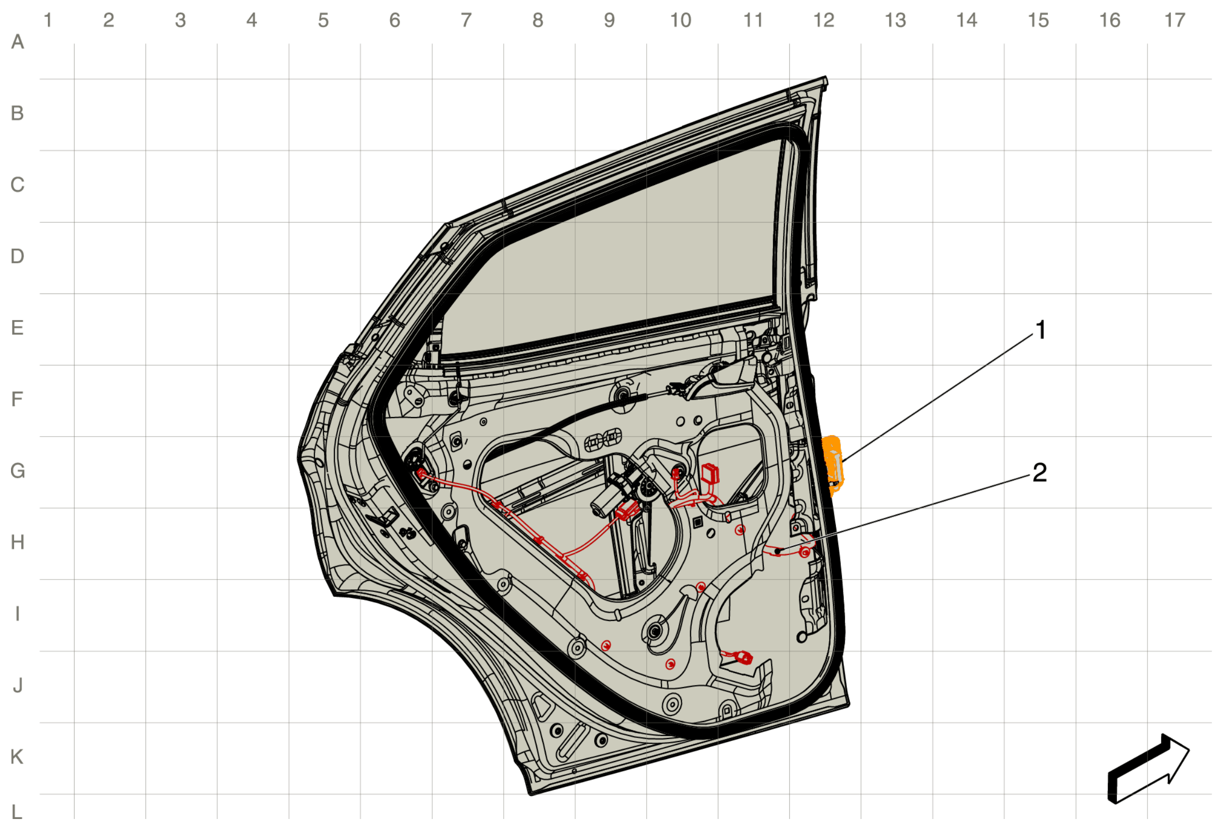
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Fig. 3: Left Rear Door Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X700 Left Rear Door Harness to Body Harness X700 Left Rear Door Harness to Body Harness
2: J700 Left Rear Door Harness

Right Rear Door Harness Routing

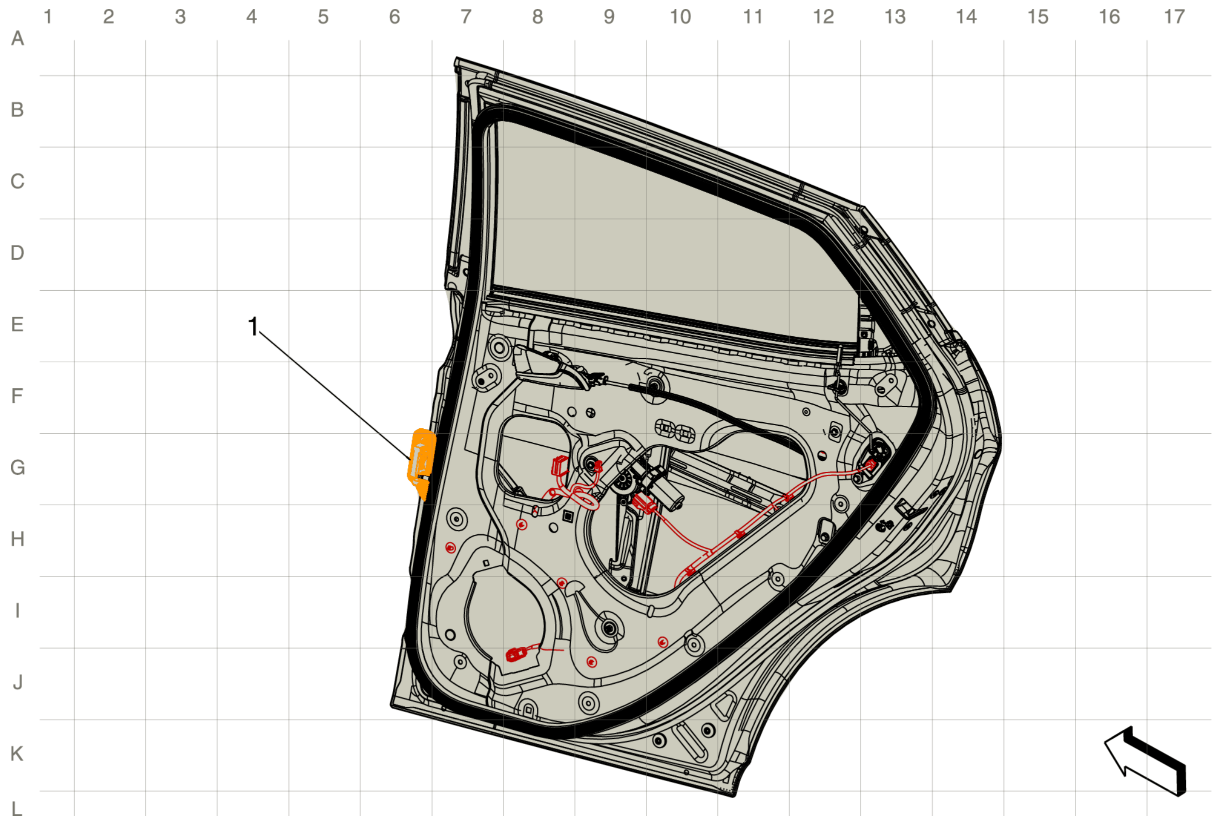

Fig. 4: Right Rear Door Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X800 Right Rear Door Harness to Body Harness **X800 Right Rear Door Harness to Body Harness ()**

Passenger Seat Harness Routing

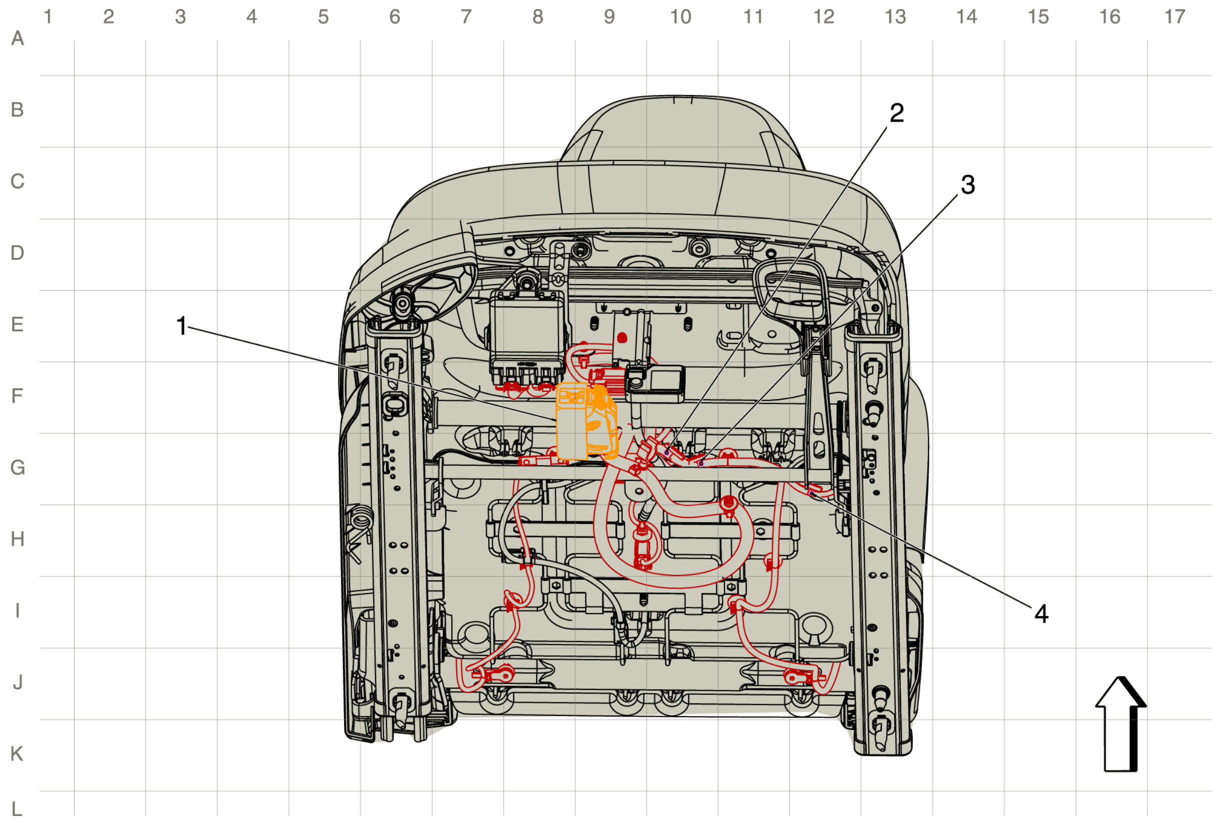

Fig. 5: Passenger Seat Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X320 Passenger Seat Harness to Body Harness **X320 Passenger Seat Harness to Body Harness ()**
2: J341 Passenger Seat Harness (KA1)
3: J342 Passenger Seat Harness (KA1)
4: J347 Passenger Seat Harness

Right Side Engine Compartment Harness Routing

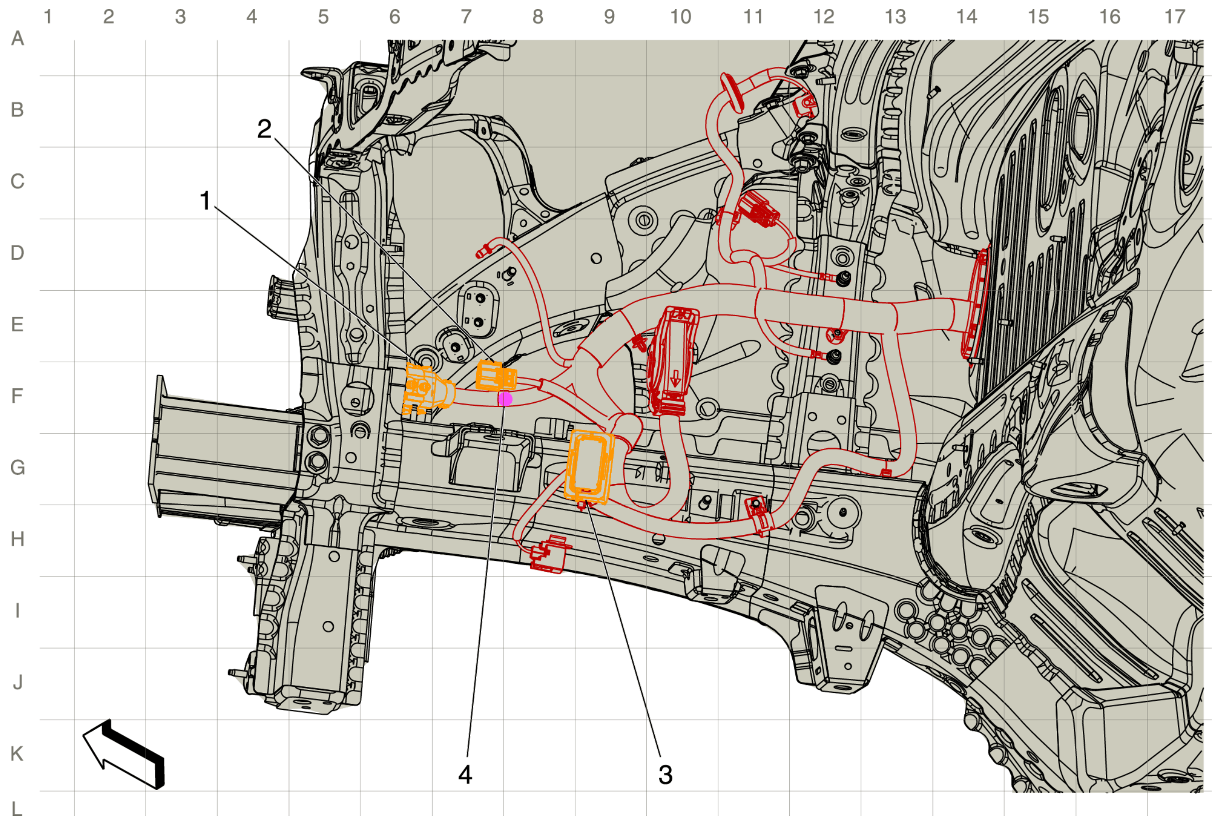

Fig. 6: Right Side Engine Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X107 Body Harness to Forward Lamp Harness **X107 Body Harness to Forward Lamp Harness**
2: X108 Body Harness to Forward Lamp Harness **X108 Body Harness to Forward Lamp Harness ()**
3: X105 Body Harness to Engine Harness (36 Cavities) **X105 Body Harness to Engine Harness**
4: J129 Body Harness

Left Front of Engine Compartment Harness Routing

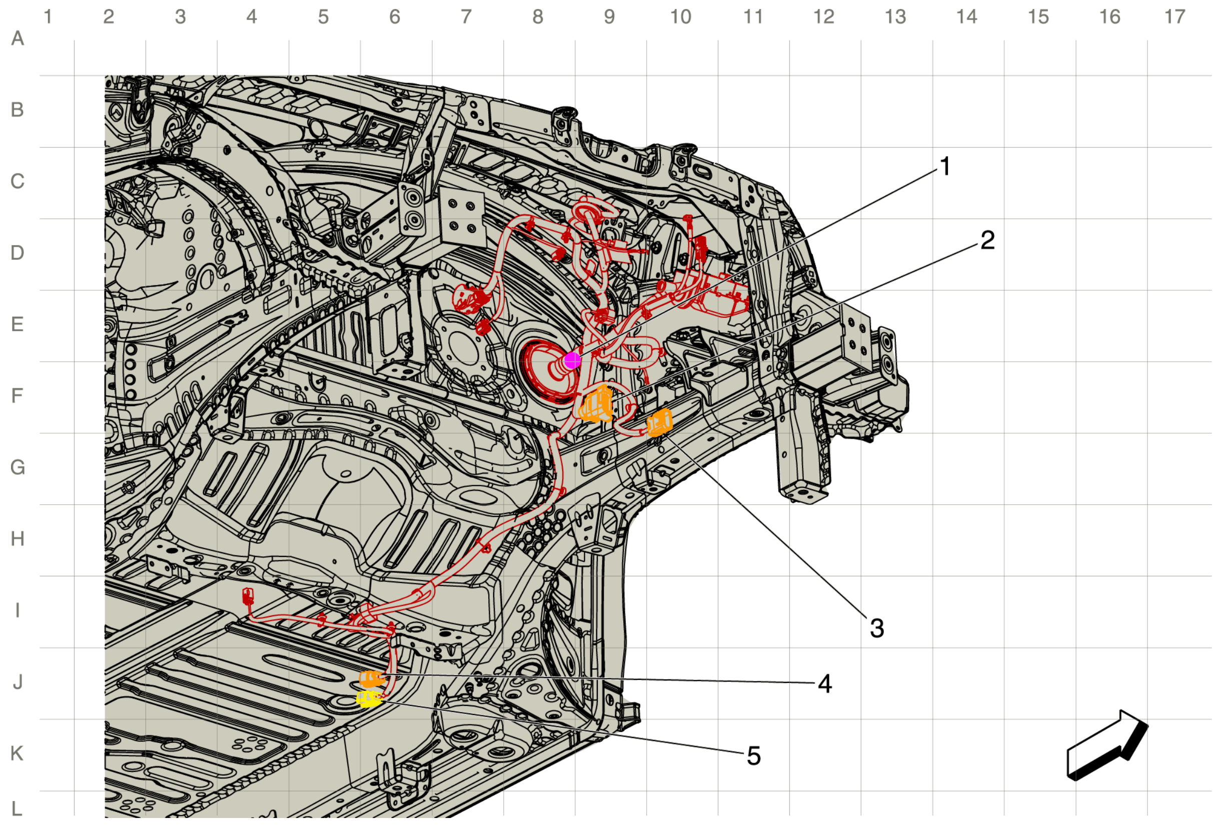

Fig. 7: Left Front of Engine Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items

1: J128 Body Harness
2: X106 Body Harness to Engine Harness (36 Cavities) X106 Body Harness to Engine Harness
3: X117 Charge Receptacle Harness to Body Harness (12 Cavities) X117 Charge Receptacle Harness to Body Harness (CBT)
4: X357 Body Harness to Battery Harness X357 Body Harness to Battery Cable Harness ()
5: X358 Body Harness to Battery Harness X358 Body Harness to Battery Harness ()

Forward Lamp Harness Routing

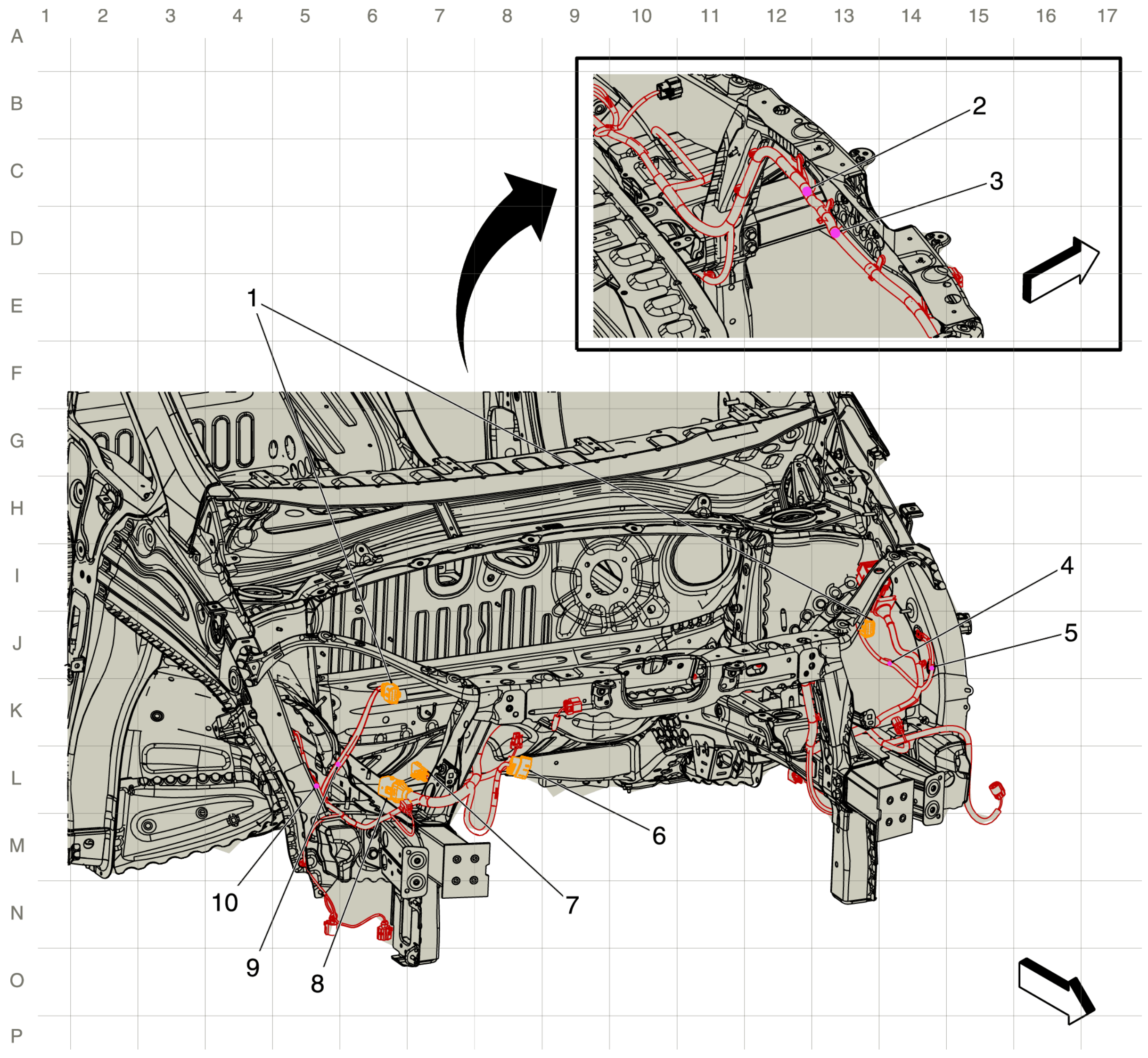

Fig. 8: Forward Lamp Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items

1: X110 Forward Lamp Harness to Left Headlight Assembly (4 Cavities) X110 Forward Lamp Harness to Left Headlamp Harness (-TR6)
2: J111 Forward Lamp Harness
3: J112 Forward Lamp Harness
4: J109 Forward Lamp Harness
5: J102 Forward Lamp Harness
6: X101 Forward Lamp Harness to Front Fascia X101 Forward Lamp Harness to Front Fascia Harness (-UD5/UFQ/UVH) X101 Forward Lamp Harness to Front Fascia Harness (UD5/UFQ/UVH)
7: X108 Body Harness to Forward Lamp Harness X108 Body Harness to Forward Lamp Harness ()
8: X107 Body Harness to Forward Lamp Harness X107 Body Harness to Forward Lamp Harness
9: J110 Forward Lamp Harness
10: J103 Forward Lamp Harness

Front of Drive Motor Harness Routing

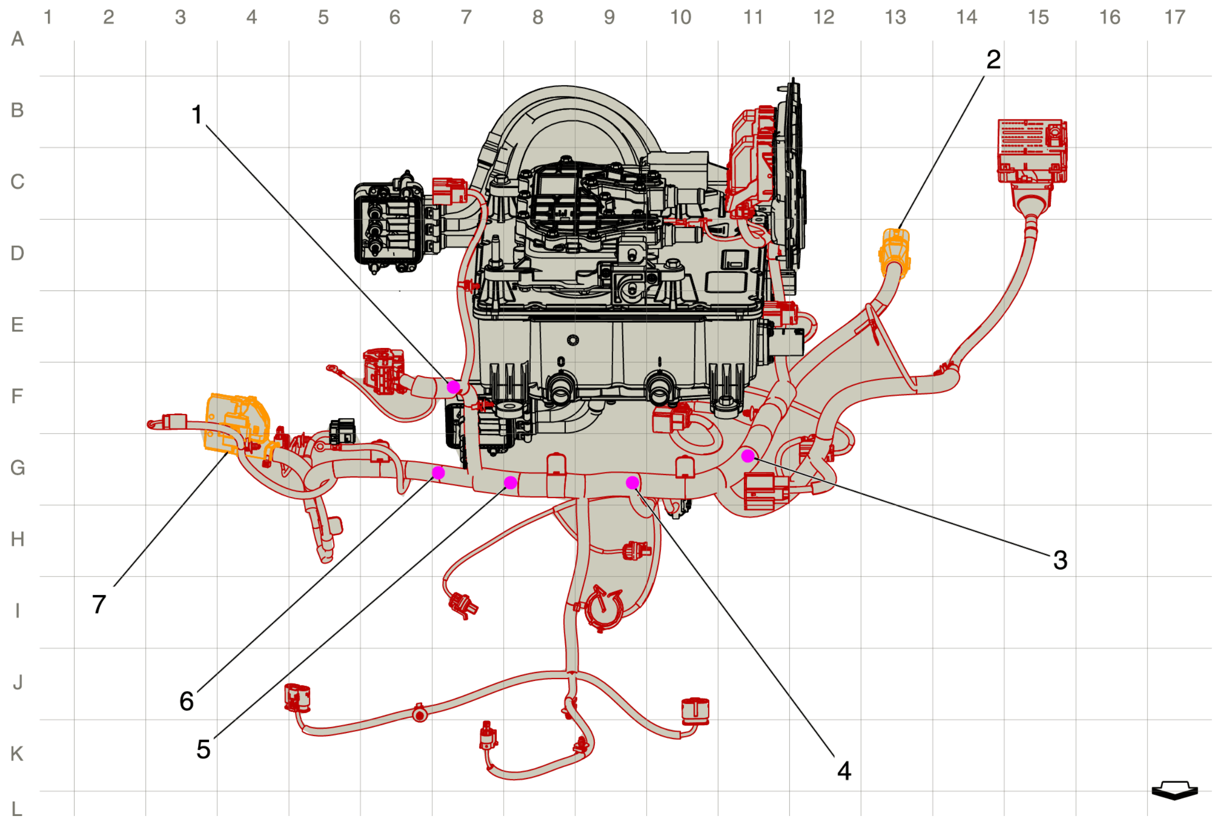

Fig. 9: Front of Drive Motor Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items

1: J108 Engine Harness
2: X106 Body Harness to Engine Harness (36 Cavities) X106 Body Harness to Engine Harness
3: J101 Engine Harness
4: J123 Engine Harness
5: J122 Engine Harness
6: J100 Engine Harness

Items
7: X105 Body Harness to Engine Harness (36 Cavities) **X105 Body Harness to Engine Harness**

Front Fascia Harness Routing

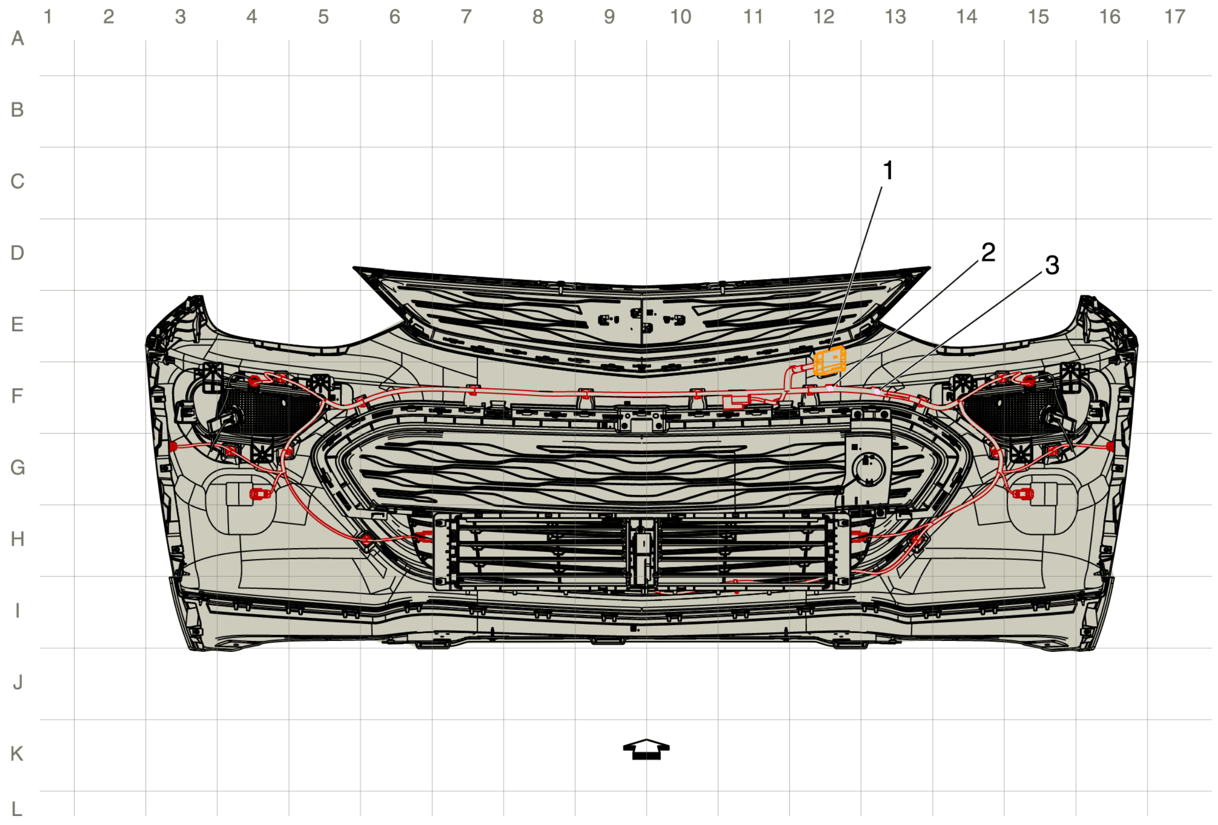
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Fig. 10: Front Fascia Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X101 Forward Lamp Harness to Front Fascia **X101 Forward Lamp Harness to Front Fascia Harness (-UD5/UFQ/UVH)** **X101 Forward Lamp Harness to Front Fascia Harness (UD5/UFQ/UVH)**
2: J124 Front Fascia Harness
3: J113 Front Fascia Harness

Rear Fascia Harness Routing

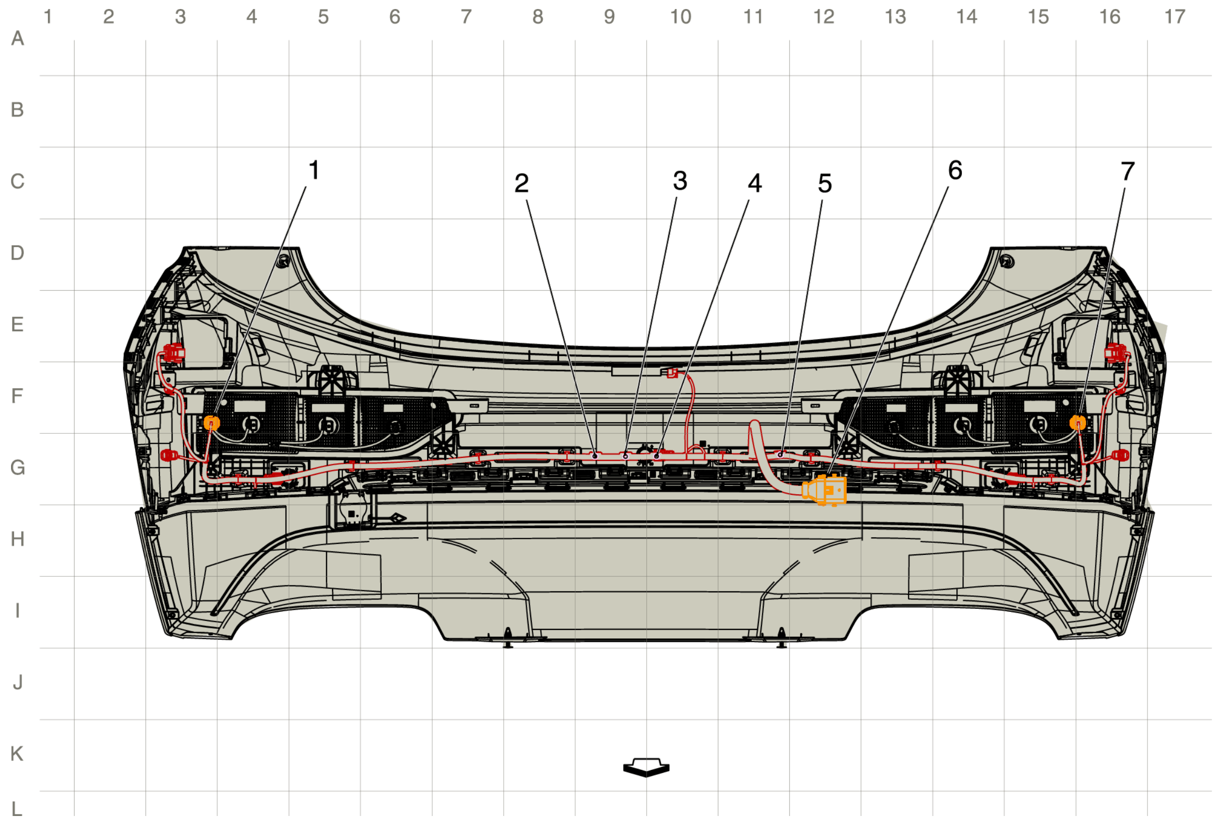
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Fig. 11: Rear Fascia Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X420 Right Auxillary Tail Lamp Harness to Right Lamp Jumper Harness **X420 Rear Fascia Harness to Right Lamp Jumper Harness (TW5)** **X420 Rear Fascia Harness to Right Lamp Jumper Harness (VD1)**
2: J406 Rear Fascia Harness
3: J403 Rear Fascia Harness
4: J402 Rear Fascia Harness
5: J407 Rear Fascia Harness
6: X415 Body Harness to Rear Fascia Harness **X415 Body Harness to Rear Fascia Harness ()**
7: X410 Left Auxillary Tail Lamp Harness to Left Lamp Jumper Harness **X410 Rear Fascia Harness to Left Lamp Jumper Harness (TW5)** **X410 Rear Fascia Harness to Left Lamp Jumper Harness (VD1)**

Instrument Panel Harness Routing

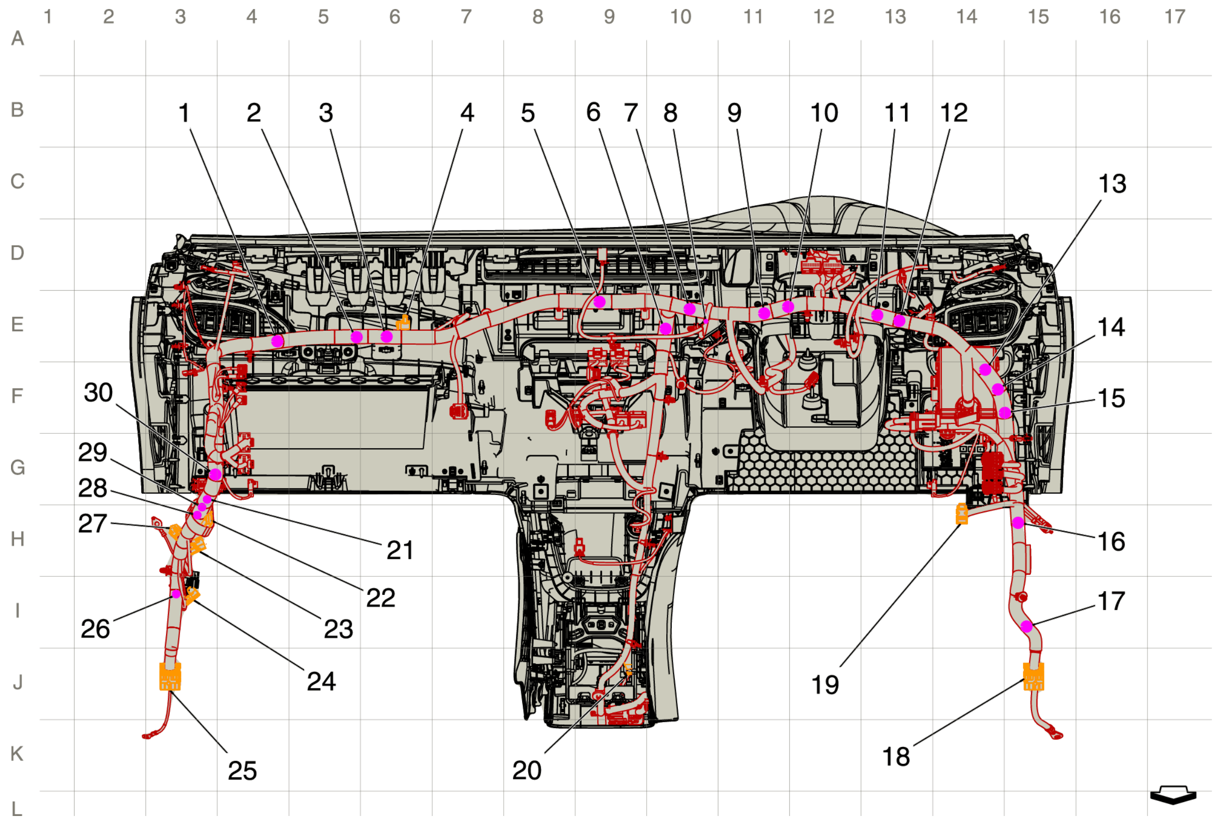
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Fig. 12: Instrument Panel Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: J224 Instrument Panel Harness
2: J250 Instrument Panel Harness
3: J249 Instrument Panel Harness
4: X215 Body Harness to Instrument Panel Harness **X215 Instrument Panel Harness to Passenger Instrument Panel Air Bag Harness**
5: J217 Instrument Panel Harness
6: J219 Instrument Panel Harness
7: J225 Instrument Panel Harness
8: J229 Instrument Panel Harness
9: J203 Instrument Panel Harness
10: J201 Instrument Panel Harness
11: J248 Instrument Panel Harness
12: J226 Instrument Panel Harness
13: J228 Instrument Panel Harness
14: J200 Instrument Panel Harness

Items
15: J227 Instrument Panel Harness
16: J202 Instrument Panel Harness
17: J364 Hybrid/EV Battery Pack Low Voltage Harness
18: X200 Instrument Panel Harness to Body Harness **X200 Instrument Panel Harness to Body Harness**
19: X210 Instrument Panel Harness to Body Harness **X210 Instrument Panel Harness to Body Harness**
20: X212 Instrument Panel Harness to Floor Console Harness
21: J251 Instrument Panel Harness
22: JX200 Instrument Panel Harness **JX200 Splice Pack**
23: X209 Instrument Panel Harness to Headliner Harness
24: X211 Instrument Panel Harness to Headliner Harness
25: X205 Instrument Panel Harness to Body Harness **X205 Instrument Panel Harness to Body Harness**
26: J221 Instrument Panel Harness
27: X209 Instrument Panel Harness to Headliner Harness
28: J205 Instrument Panel Harness
29: J252 Instrument Panel Harness
30: J204 Instrument Panel Harness

Center Console Harness Routing

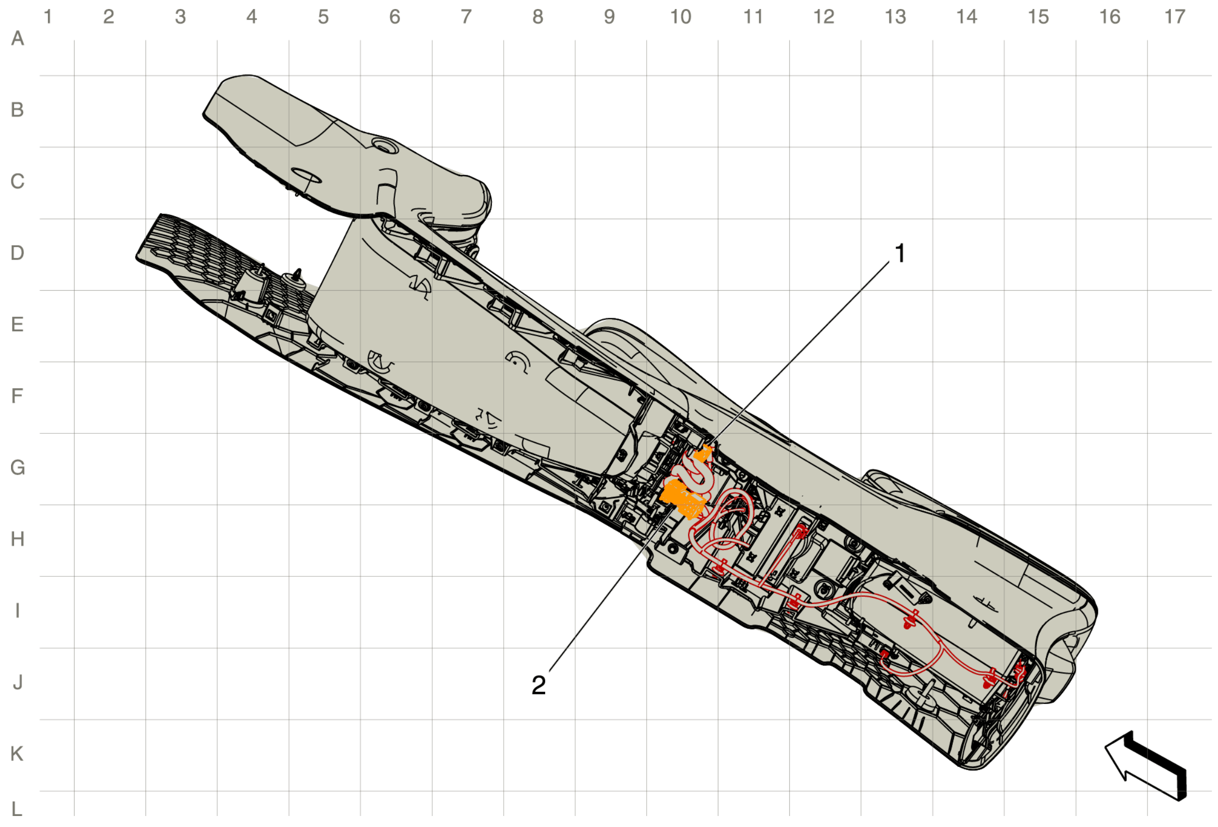
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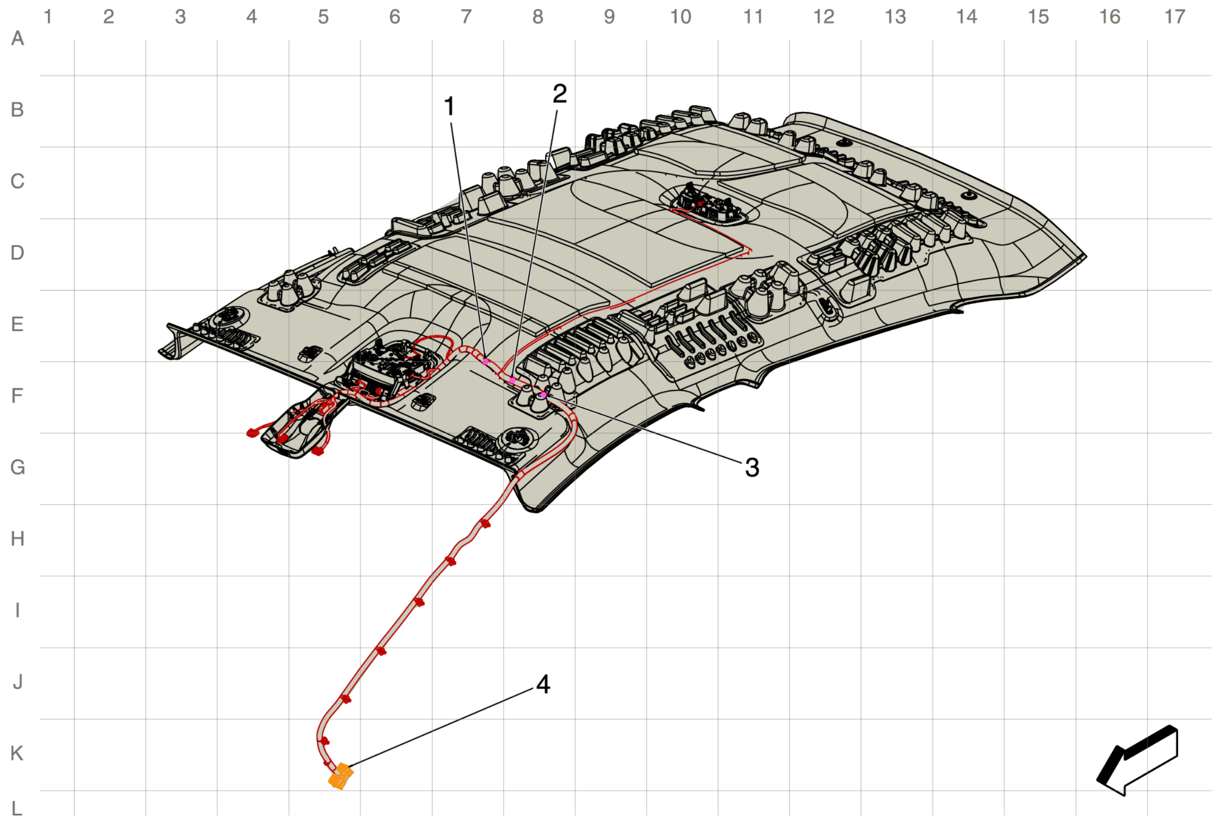
Fig. 13: Center Console Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X212 Instrument Panel Harness to Floor Console Harness
2: X300 Body Harness to Floor Console Harness **X300 Floor Console Harness to Body Harness**

Headliner Harness Routing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J
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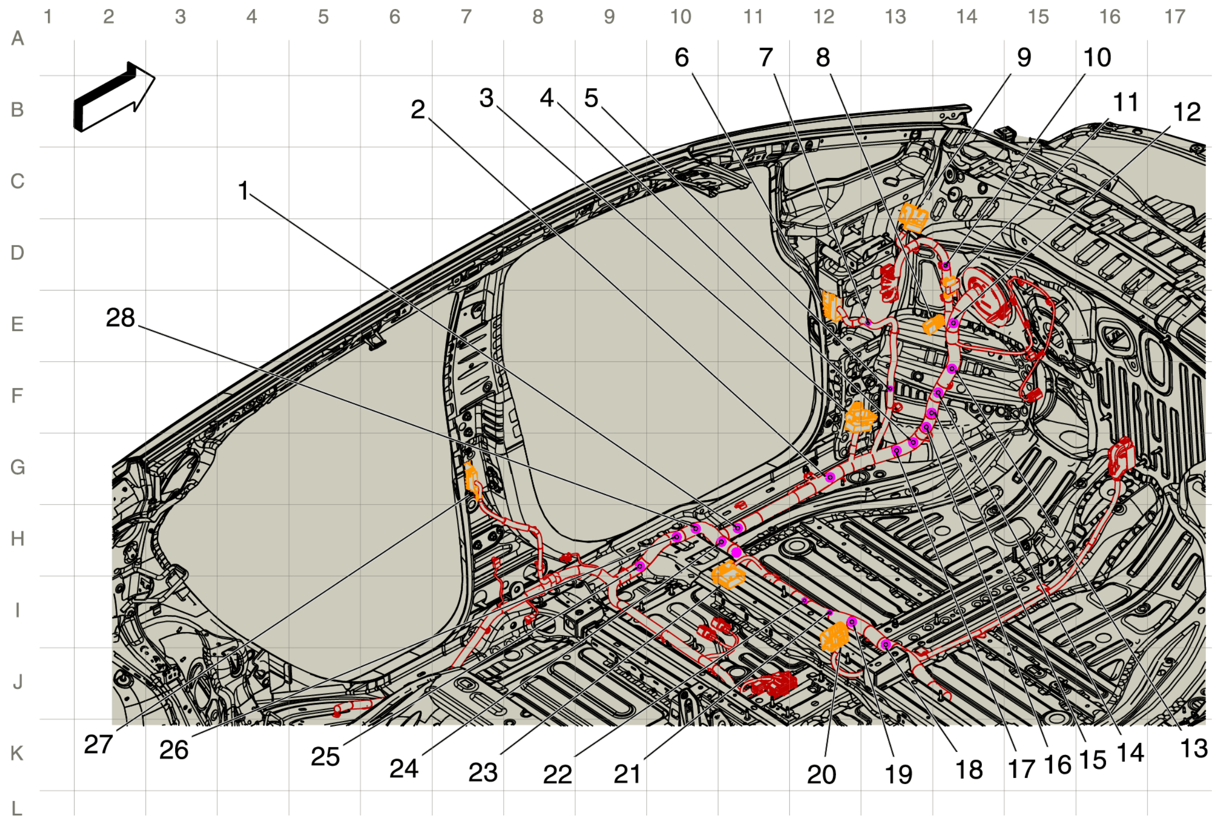
Fig. 14: Headliner Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: J324 Headliner Harness
2: J323 Headliner Harness
3: J325 Headliner Harness
4: X208 Headliner Harness to Body Harness **X208 Headliner Harness to Body Harness ()**

Left Front of Passenger Compartment Harness Routing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D
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J
K
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6
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10
2
3
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Fig. 15: Left Front of Passenger Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: J364 Hybrid/EV Battery Pack Low Voltage Harness
2: J246 Body Harness
3: X200 Instrument Panel Harness to Body Harness **X200 Instrument Panel Harness to Body Harness**

Items
4: J242 Body Harness
5: J244 Body Harness
6: X500 Driver Door Harness to Body Harness **X500 Driver Door Harness to Body Harness ()**
7: J245 Body Harness
8: X210 Instrument Panel Harness to Body Harness **X210 Instrument Panel Harness to Body Harness**
9: X208 Headliner Harness to Body Harness **X208 Headliner Harness to Body Harness ()**
10: J237 Body Harness
11: JX210 Body Harness **JX210 Splice Pack ()**
12: J236 Body Harness
13: J241 Body Harness
14: J238 Body Harness
15: J239 Body Harness
16: J240 Body Harness
17: J243 Body Harness
18: J326 Body Harness
19: J346 Body Harness
20: X300 Body Harness to Floor Console Harness **X300 Floor Console Harness to Body Harness**
21: J356 Body Harness
22: J353 Hybrid/EV Battery Pack Low Voltage Harness
23: X310 Body Harness to Instrument Panel Harness **X310 Driver Seat Harness to Body Harness**
24: J354 Hybrid/EV Battery Pack Low Voltage Harness
25: J301 Body Harness
26: J349 Body Harness
27: X700 Left Rear Door Harness to Body Harness **X700 Left Rear Door Harness to Body Harness**
28: J368 Body Harness

Left Rear of Passenger Compartment Harness Routing

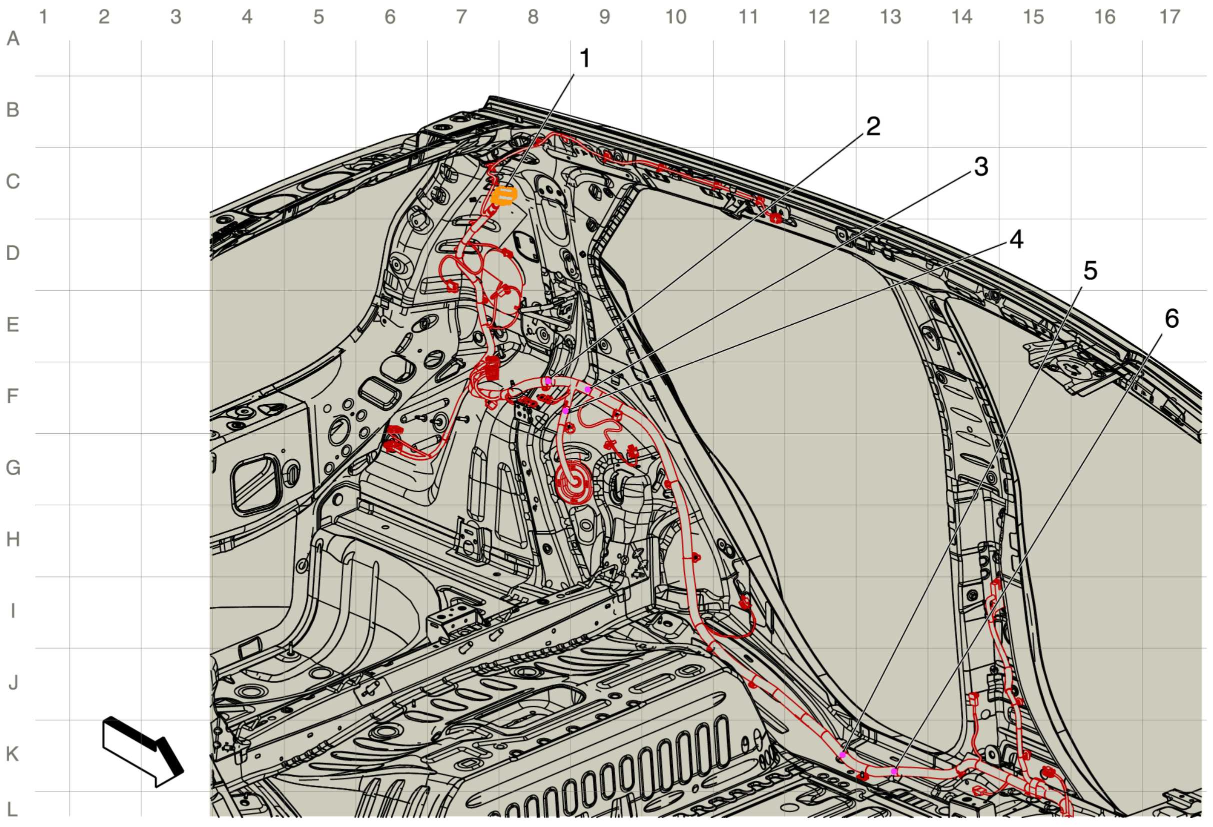


Fig. 16: Left Rear of Passenger Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X900 Liftgate Extension Harness to Body Harness **X900 Liftgate Extension Harness to Body Harness**
2: J407 Rear Fascia Harness
3: J308 Body Harness
4: J309 Body Harness
5: J321 Body Harness
6: J320 Body Harness

Right Front of Passenger Compartment Harness Routing

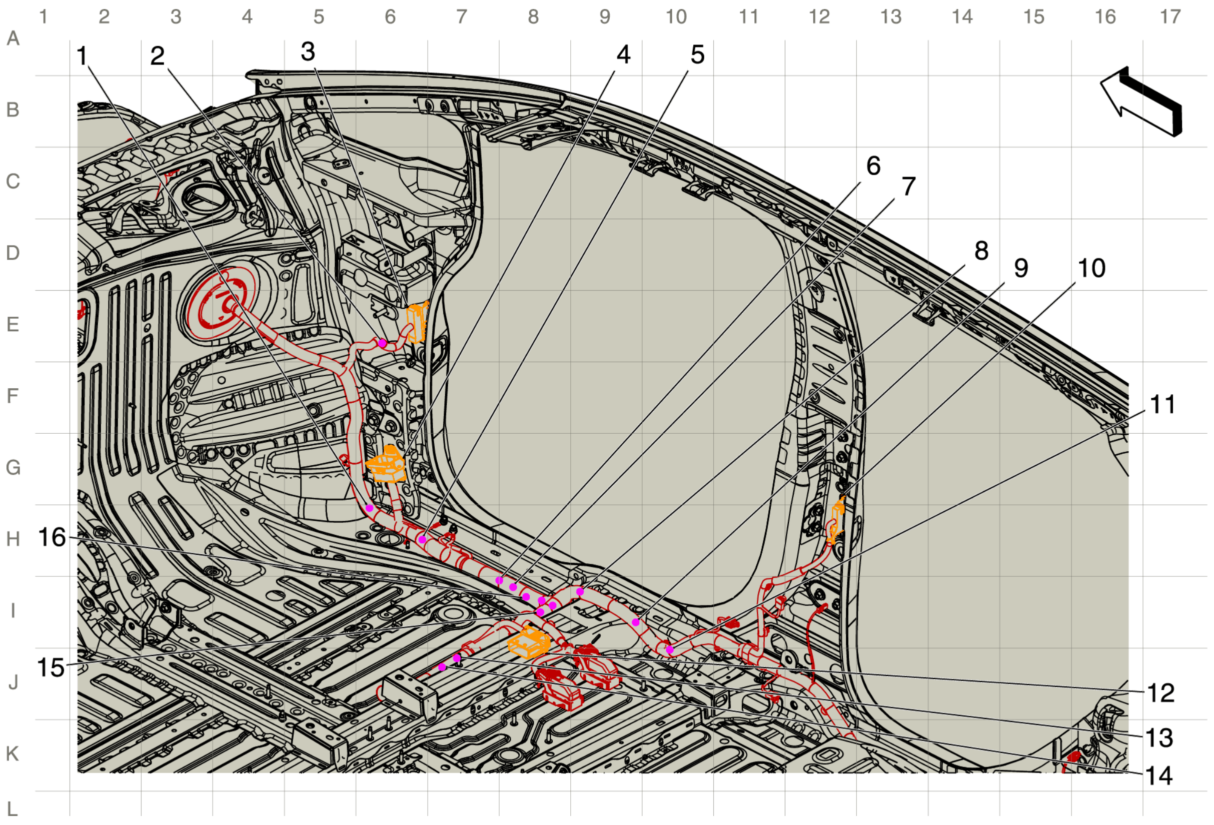


Fig. 17: Right Front of Passenger Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: J307 Body Harness
2: J247 Body Harness
3: X600 Passenger Door Harness to Body Harness **X600 Passenger Door Harness to Body Harness ()**
4: X205 Instrument Panel Harness to Body Harness **X205 Instrument Panel Harness to Body Harness**
5: J304 Body Harness
6: J317 Body Harness
7: J352 Hybrid/EV Battery Pack Low Voltage Harness
8: J322 Body Harness
9: J369 Hybrid/EV Battery Pack Low Voltage Harness
10: X800 Right Rear Door Harness to Body Harness **X800 Right Rear Door Harness to Body Harness ()**
11: J306 Body Harness
12: X320 Passenger Seat Harness to Body Harness **X320 Passenger Seat Harness to Body Harness ()**
13: J367 Body Harness
14: J359 Body Hanress
15: J305 Body Harness
16: J351 Hybrid/EV Battery Pack Low Voltage Harness

Right Rear of Passenger Compartment Harness Routing

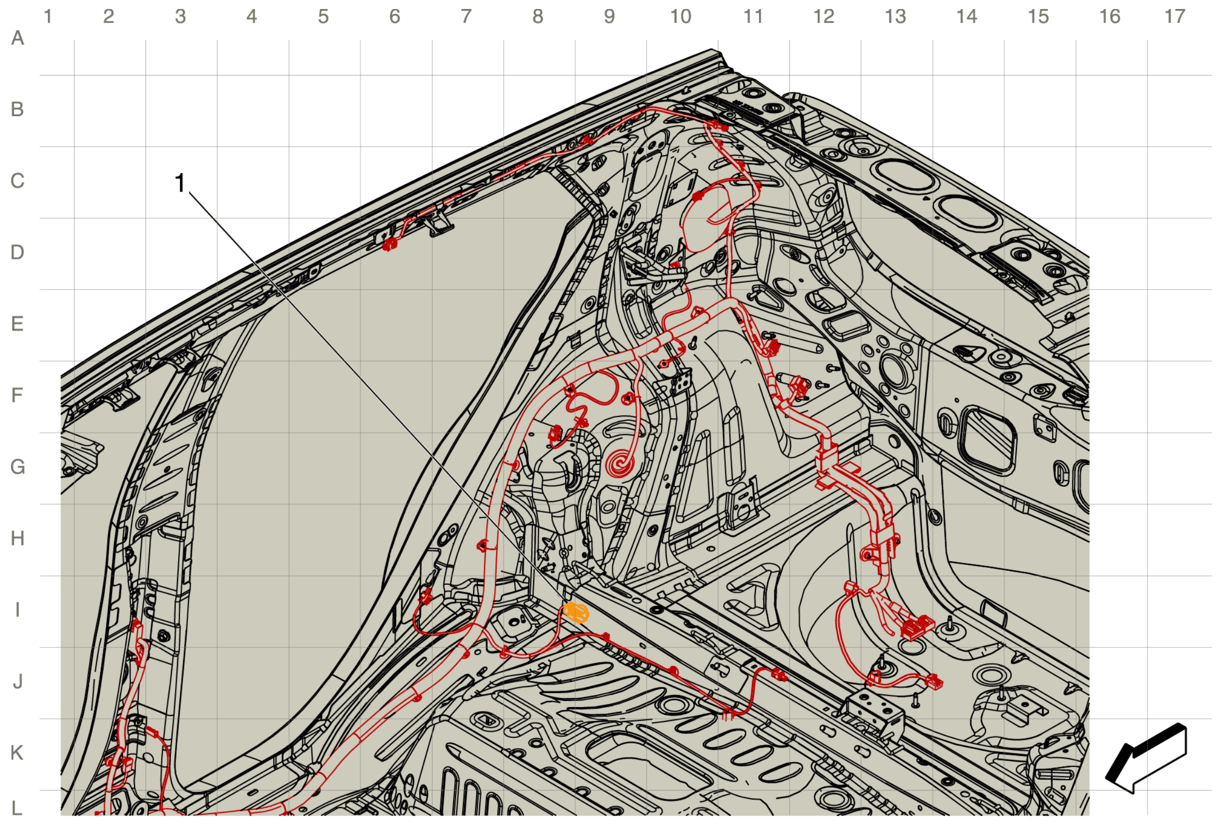


Fig. 18: Right Rear of Passenger Compartment Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X360 Right Rear Seat Harness to Body Harness **X360 Right Rear Seat Harness to Body Harness (KA6)**

Liftgate Harness Routing

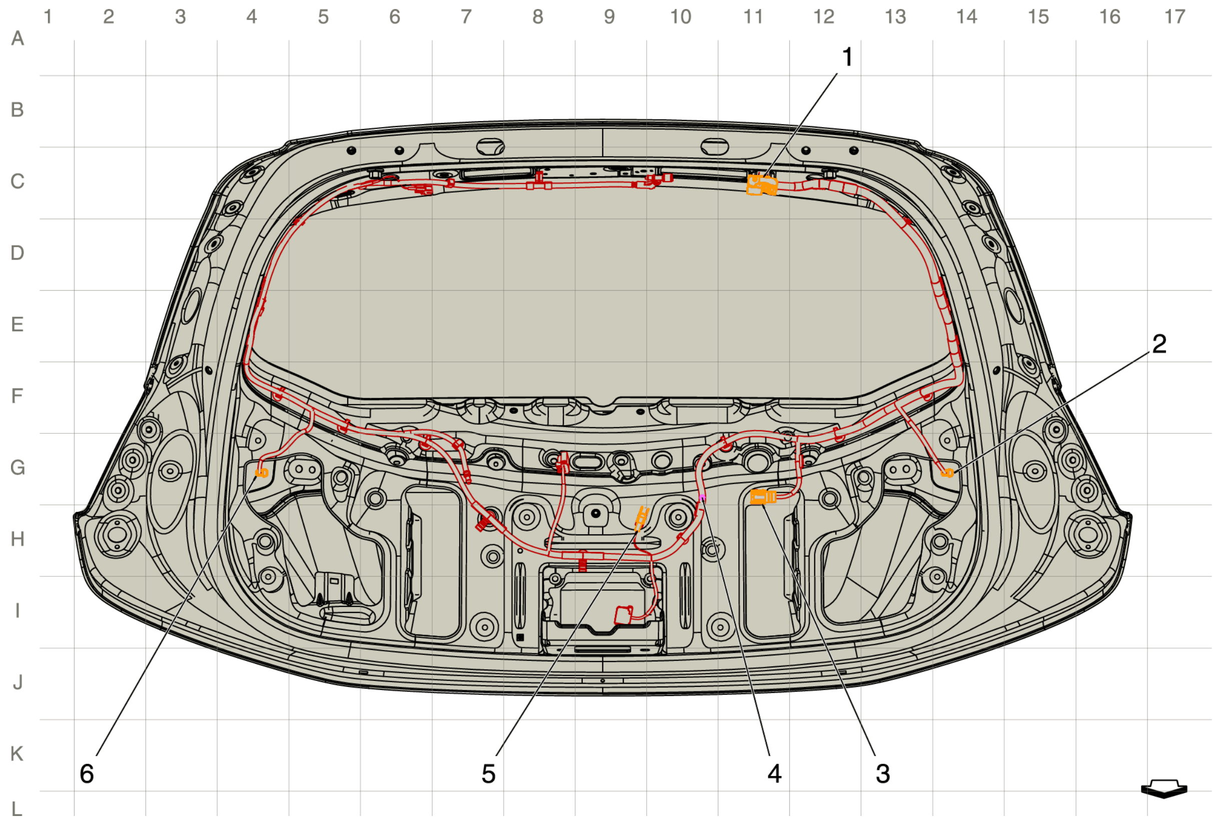


Fig. 19: Liftgate Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: X901 Liftgate Extension Harness to Liftgate Harness **X901 Liftgate Extension Harness to Liftgate Harness ()**
2: X910 Liftgate Harness to Left Tail Stop Lamp Harness **X910 Liftgate Harness to Left Tail Stop Lamp Harness (TW5)** **X910 Liftgate Harness to Left Tail Stop Lamp Harness (VD1)**
3: X902 Liftgate Harness to License Plate Lamp Harness **X902 License Plate Lamp Harness to Liftgate Harness ()**
4: J903 Liftgate Harness
5: X905 Liftgate Harness to Liftgate Extention Harness
6: X920 Liftgate Harness to Right Tail Stop Lamp Harness **X920 Liftgate Harness to Right Tail Stop Lamp Harness (TW5)** **X920 Liftgate Harness to Right Tail Stop Lamp Harness (VD1)**

Liftgate Extension Harness Routing

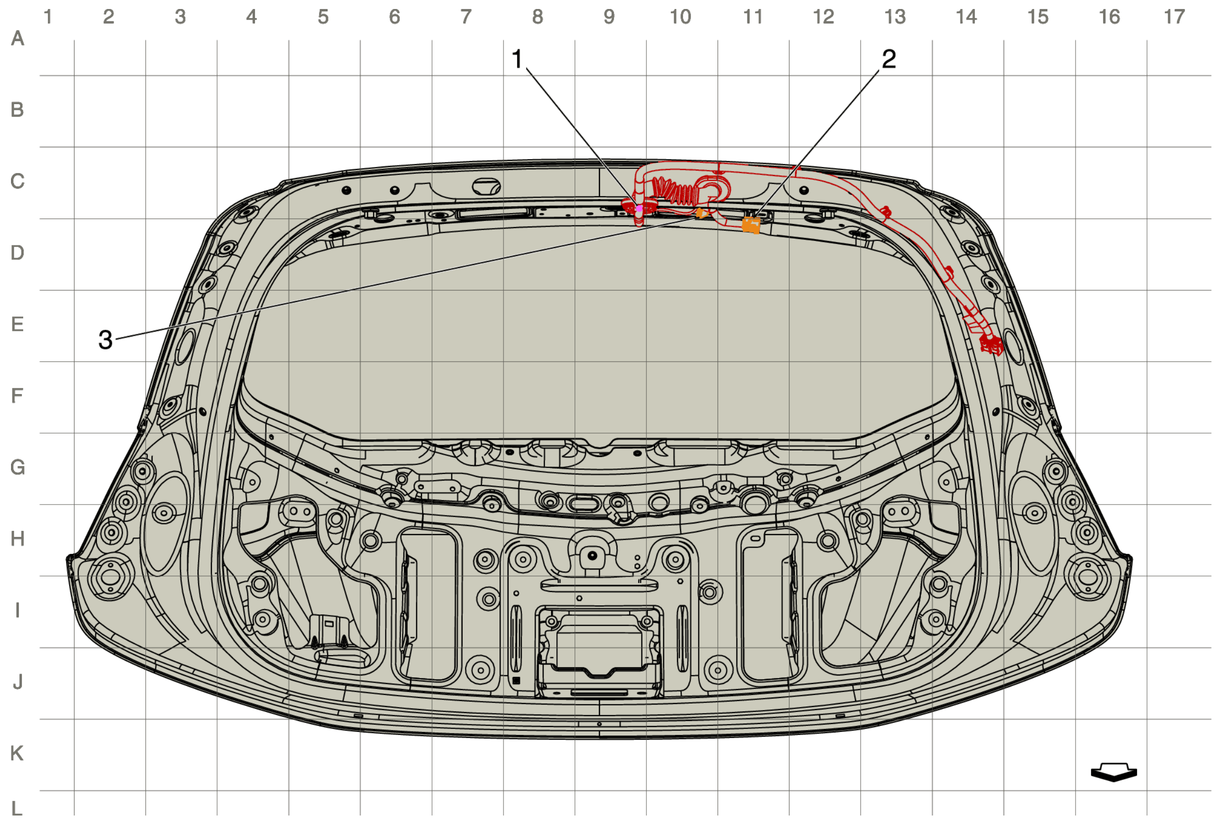


Fig. 20: Liftgate Extension Harness Routing
Courtesy of GENERAL MOTORS COMPANY

Items
1: J902 Liftgate Extension Harness
2: X901 Liftgate Extension Harness to Liftgate Harness **X901 Liftgate Extension Harness to Liftgate Harness ()**
3: X903 Center High Mount Stop Light Harness to Liftgate Harness **X903 Center High Mount Stop Light Harness to Liftgate Extension Harness ()**

HOW TO USE ELECTRICAL SCHEMATICS

Information Overview

The following explains some of the key parts of the GM wiring diagrams. Included are:

- Color Abbreviations
- Electronic Delivery Navigation Features

Color Abbreviations

The following sequence is used when depicting wire colors:

1. Color modifier of the wire, such as light or dark (if applicable)
2. Primary color of the wire
3. Secondary color of the wire (tracer/stripe)

Wire insulation and connector body colors in schematic information are abbreviated with a two character code as listed below.

Abbreviation	Color	Abbreviation	Color

Abbreviation	Color	Abbreviation	Color
AM	Amber	OG	Orange
BARE	Bare	PK	Pink
BG	Beige	PU	Purple
BK	Black	RD	Red
BN	Brown	RU	Rust
BU	Blue	SR	Silver
CL	Clear	TL	Teal
CR	Cream	TN	Tan
CU	Curry	TQ	Turquoise
GD	Gold	VT	Violet
GN	Green	WH	White
GY	Gray	YE	Yellow
NA	Natural	-	-
Color Modifiers			
L	Light	D	Dark

Additionally, industry standard cable types are not identified by color, but are listed by cable type as follows:

Abbreviation	Cable Type
COAX	Coax Cable
ENET	Ethernet
FW	Flat Wire
HDMI	High Definition Multimedia Interface
LDVS	Low-voltage Differential Signaling
TWINAX	Twinax Cable
USB	Universal Serial Bus

Electronic Delivery Navigation Features

The schematics information has been enhanced for electronic delivery and the following explains the features that are now available.

The enhanced features are categorized into three types:

- Mouse-overs, which are active when the mouse pointer is placed over the activated area
- Hotspots (links to other information), which are active by placing the mouse pointer over the activated area and clicking the left mouse button
- Hotspot Target Highlighting, which is when linking from one graphic to another graphic, the point of interest will be highlighted in red. This feature is available only when linking from a schematic graphic to a component locator/harness routing view, or when linking from a schematic to an electrical center identification view

Depending on the amount of information that is linked to from a hotspot, the mouse pointer changes shape.

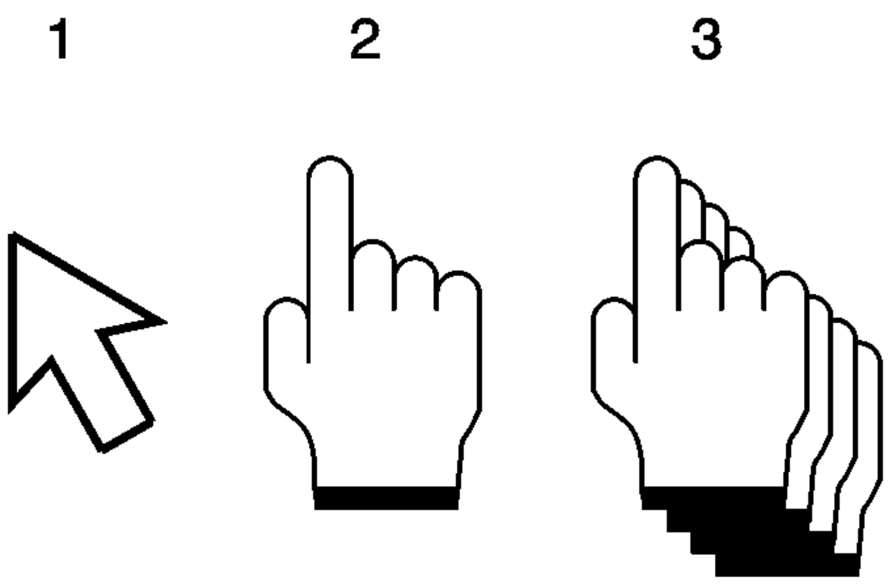


Fig. 21: Mouse Pointer Changes Shape
Courtesy of GENERAL MOTORS COMPANY

1. Basic mouse pointer - this means there are no hotspots available, but there may be a mouse-over available.
2. Single hand pointer - this means there is a mouse-over and hotspot link to a single document. Clicking on these areas will automatically take you to the target link.
3. Multiple hand pointer - this means there is a mouse-over and hotspot link to a multiple document. Clicking on these areas will bring up a pop-up menu that will display all available links. You may then select one of the available links clicking on one of the displayed links.

To see which areas of the schematic information have an available hotspot and/or a mouse-over, select and hold down the highlight hotspots button of the cgm viewer. This will highlight all areas of the graphic that have an available hotspot and/or a mouse-over in red. Once the button is released, the areas of the graphic will no longer be highlighted.

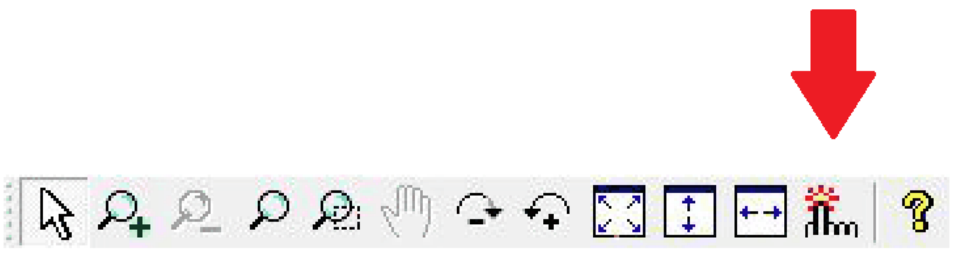


Fig. 22: Available Hotspot And/Or A Mouse-Over In Red
Courtesy of GENERAL MOTORS COMPANY

Each type of schematic related information has some level of these features. The schematic related information consists of the following information types:

- Schematics
- Connector End Views
- Component Locator Views
- Harness Routing Views
- Electrical Center Identification Views
- Master Electrical Component List
- Master Electrical Schematic Icons
- Schematics RPO Code List
- Circuit Number/Wire Colors
- Wire Lines
- Connector Cavities

Schematics

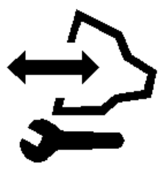
An electrical schematic hotspot is an activated icon or area in the schematic that can be cursor selected to link to additional information. Additionally, each of the hotspots in schematics has a mouse-over.

Hotspots in schematics are categorized into three types:

- Schematic Navigational Icon Hotspots
- Schematic Informational Icon Hotspots
- Schematic Navigational Hotspots

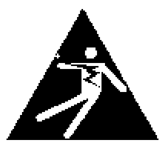
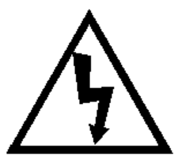
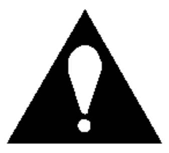
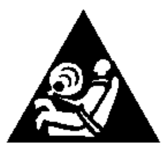
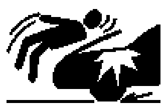
Schematic Navigational Icon Hotspots

The following lists icons that may appear on the upper right corner of a schematic that have an available mouse-over and hotspot.

Icon	Mouse-Over	Hotspot Link to Information
LOC	Master Electrical Component List	Links to the vehicle Master Electrical Component List that shows all electrical components and harness items on the vehicle and has links to any available views
DESC	Title of the subsystem description and operation	Links to the System Description and Operation
	Control Module References	Links to the Control Module References table
➡	Title of the next schematic page	Links to the next schematic of the subsystem schematics
⬅	Title of the previous schematic page	Links to the previous schematic of the subsystem schematics

Schematic Informational Icon Hotspots

The following lists the icons that may appear anywhere on a schematic that have an available mouse-over and hotspot.

Icon	Mouse-Over	Hotspot Link to Information
 Danger	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.
 High Voltage	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.
 Caution	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.
Supplemental Restraint 	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.
Pedestrian Impact 	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.

Icon	Mouse-Over	Hotspot Link to Information
Additional Information ℹ	Master Electrical Schematic Icons	Links to the vehicle Master Electrical Schematic Icons list that describes the message for the icon.

Schematic Navigational Hotspots

In addition to the navigational icons, schematics have other active hotspots that link to supporting information such as related schematics, component locator views, harness routing views, and connector end views.

These hotspots can be either text based or symbol based. The following are the items that will have a mouse-over and hotspot.

Schematic Title Circuit References

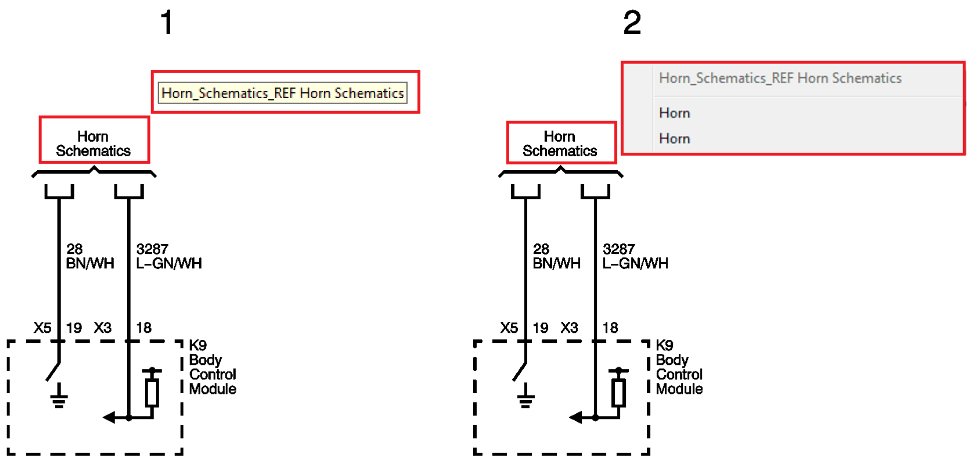

1
2
Horn_Schematics_REF Horn Schematics
Horn Schematics
Horn_Schematics_REF Horn Schematics
Horn
Horn
Horn Schematics
28 BN/WH
3287 L-GN/WH
X5
19
X3
18
K9 Body Control Module
28 BN/WH
3287 L-GN/WH
X5
19
X3
18
K9 Body Control Module

Fig. 23: Schematic Title Circuit References
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the title of the schematic page linked to.
2. **Hotspot Link to Information:** Links to the individual subsystem schematic page(s) that shows the circuit in detail. If multiple circuits are included, or if the circuit is shown in multiple schematics, a menu will appear when the link is selected. This menu includes links to all schematics that contain the same circuit number as the circuit being referenced. Additionally, when the target schematic is opened, the referenced circuit will be highlighted to draw visual attention. Note that when there are multiple target links, the links may appear to be duplicate in the menu, however, they are not. The exact same title is repeated for each circuit number that is pointing to the same target schematic. A future update will include the circuit number before the link description to further assist in link selection.

Serial Data Functional Circuit Icon

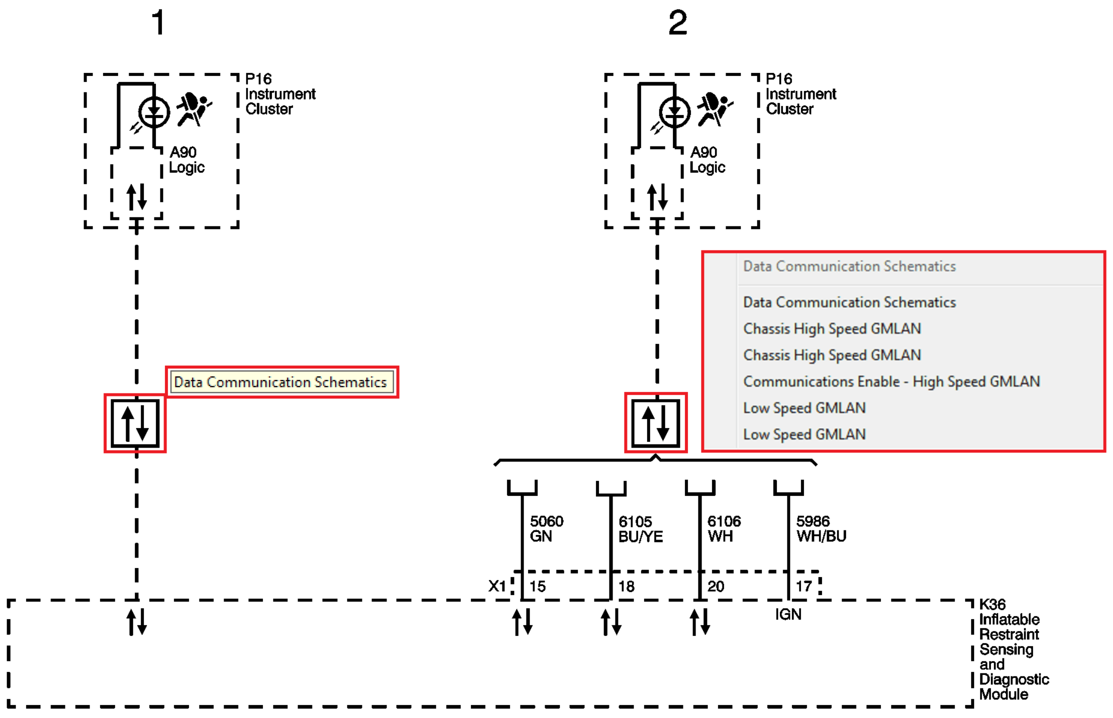

1
2
P16 Instrument Cluster
A90 Logic
Data Communication Schematics
P16 Instrument Cluster
A90 Logic
Data Communication Schematics
Data Communication Schematics
Chassis High Speed GMLAN
Chassis High Speed GMLAN
Communications Enable - High Speed GMLAN
Low Speed GMLAN
Low Speed GMLAN
5060 GN
6105 BU/YE
6106 WH
5986 WH/BU
X1
15
18
20
17
IGN
K36 Inflatable Restraint Sensing and Diagnostic Module

Fig. 24: Serial Data Functional Circuit Icon
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the schematic title Data Communication Schematics.
2. **Hotspot Link to Information:**
    - When a dashed serial data wire and icon are shown without any circuit numbers, the serial data circuit icon will link to the complete list of Data Communication schematic pages, and not a specific schematic. This is due to no circuit numbers are shown.
    - When a circuit wire(s) are shown with circuit numbers, a menu will appear when the link is selected. This menu includes links to the list of Data Communication schematic pages as well as links to the individual schematics that contain the same circuit number as the circuit being referenced. Additionally, when the target schematic is opened, the referenced circuit will be highlighted to draw visual attention. Note that when there are multiple target links, the links may appear to be duplicate in the menu, however, they are not. The exact same title is repeated for each circuit number that is pointing to the same target schematic. A future update will include the circuit number before the link description to further assist in link selection.

Fuse/Circuit Breaker Symbol and Name within Subsystem Schematics

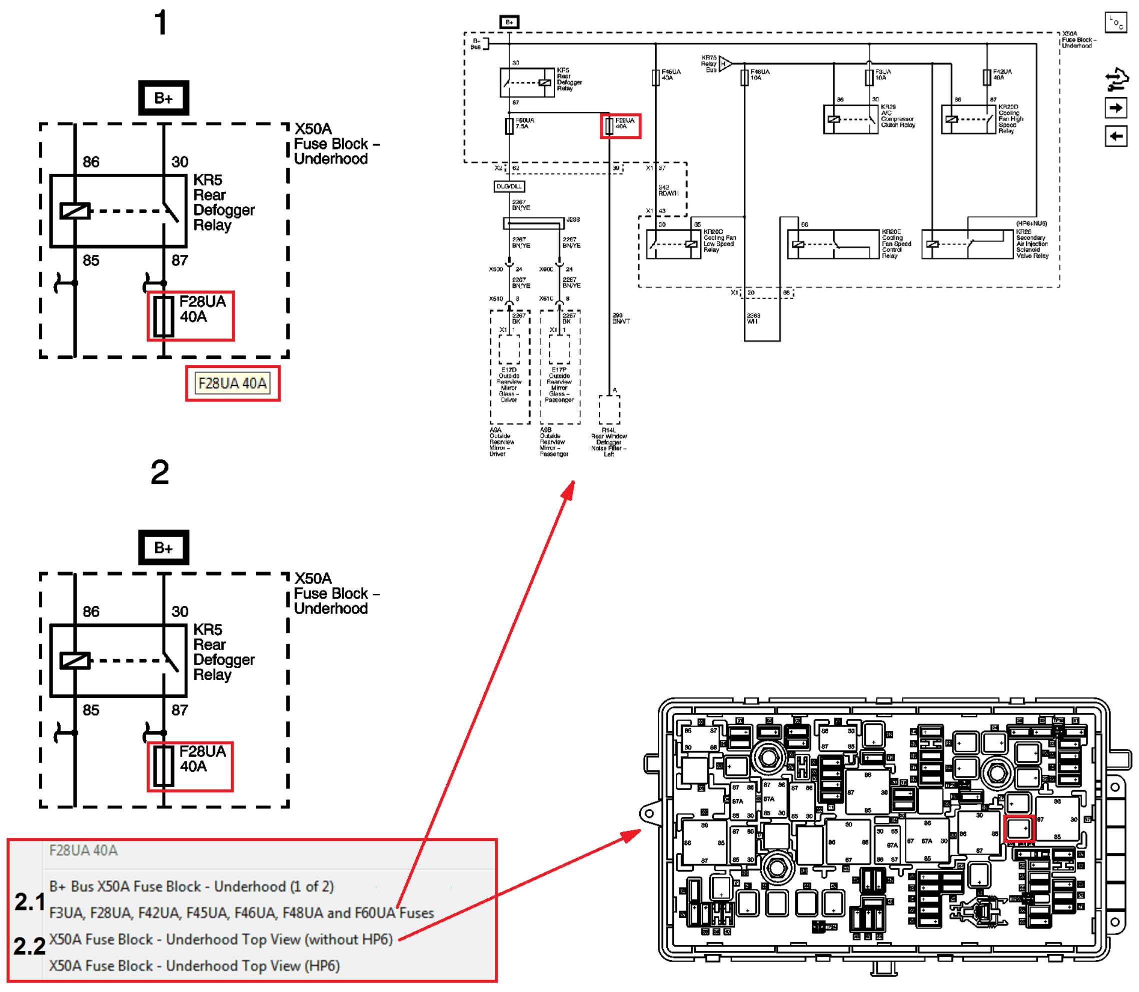

1
B+
X50A
Fuse Block – Underhood
86
30
KR5
Rear
Defogger
Relay
85
87
F28UA
40A
F28UA 40A
2
B+
X50A
Fuse Block – Underhood
86
30
KR5
Rear
Defogger
Relay
85
87
F28UA
40A
F28UA 40A
2.1
B+ Bus X50A Fuse Block - Underhood (1 of 2)
F3UA, F28UA, F42UA, F45UA, F46UA, F48UA and F60UA Fuses
2.2
X50A Fuse Block - Underhood Top View (without HP6)
X50A Fuse Block - Underhood Top View (HP6)

Fig. 25: Fuse/Circuit Breaker Symbol And Name Within Subsystem Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code and the amperage of the protection device.
2. **Hotspot Link to Information:**
    - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
    1. Links to the individual schematic page(s) within the Power Distribution Schematics where the circuits are shown in detail. Additionally, when the target schematic is opened, the circuit protection device will be highlighted to draw visual attention.
    2. Links to individual fuse block top or bottom view(s) within the Electrical Center Identification Views and will show where the device is located in the fuse block. Additionally, when the target view is opened, the device outline will be highlighted for visual attention.

Ground Symbol/Name in Subsystem Schematics

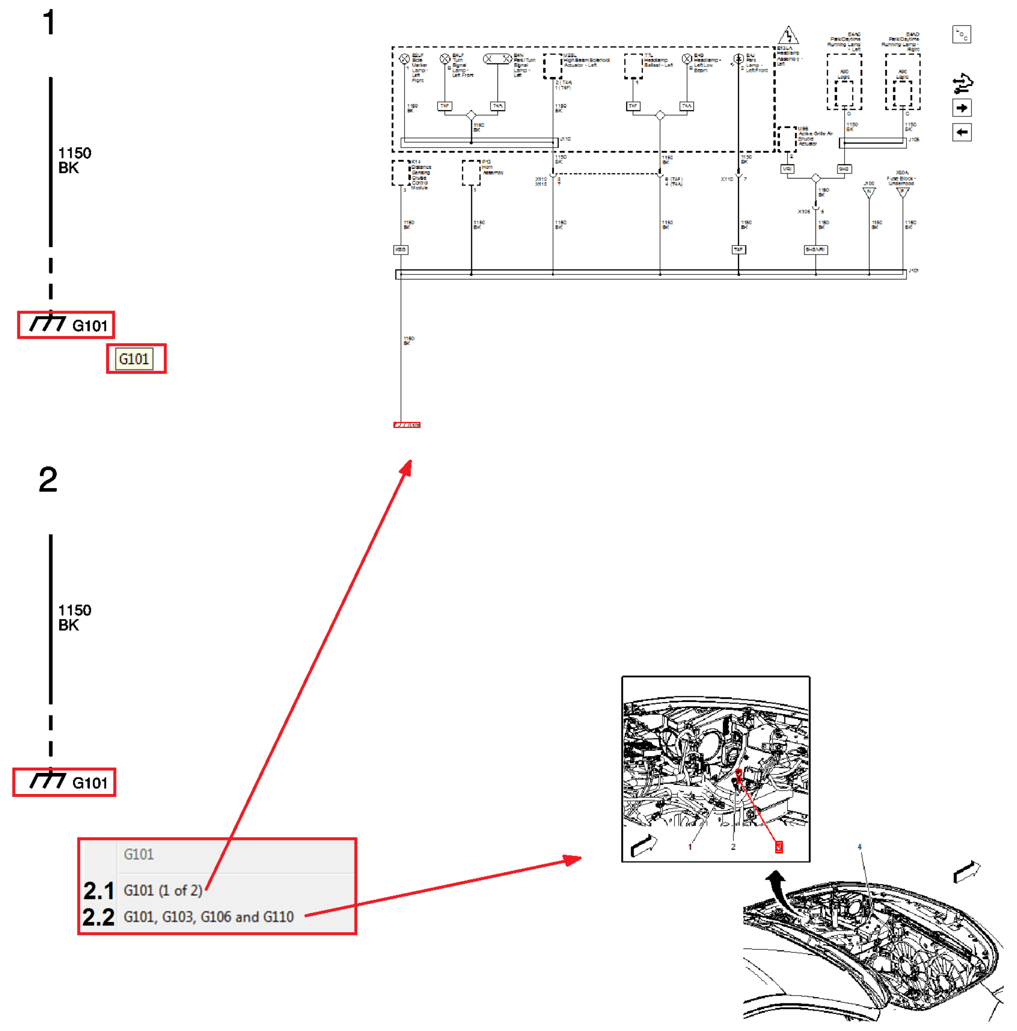
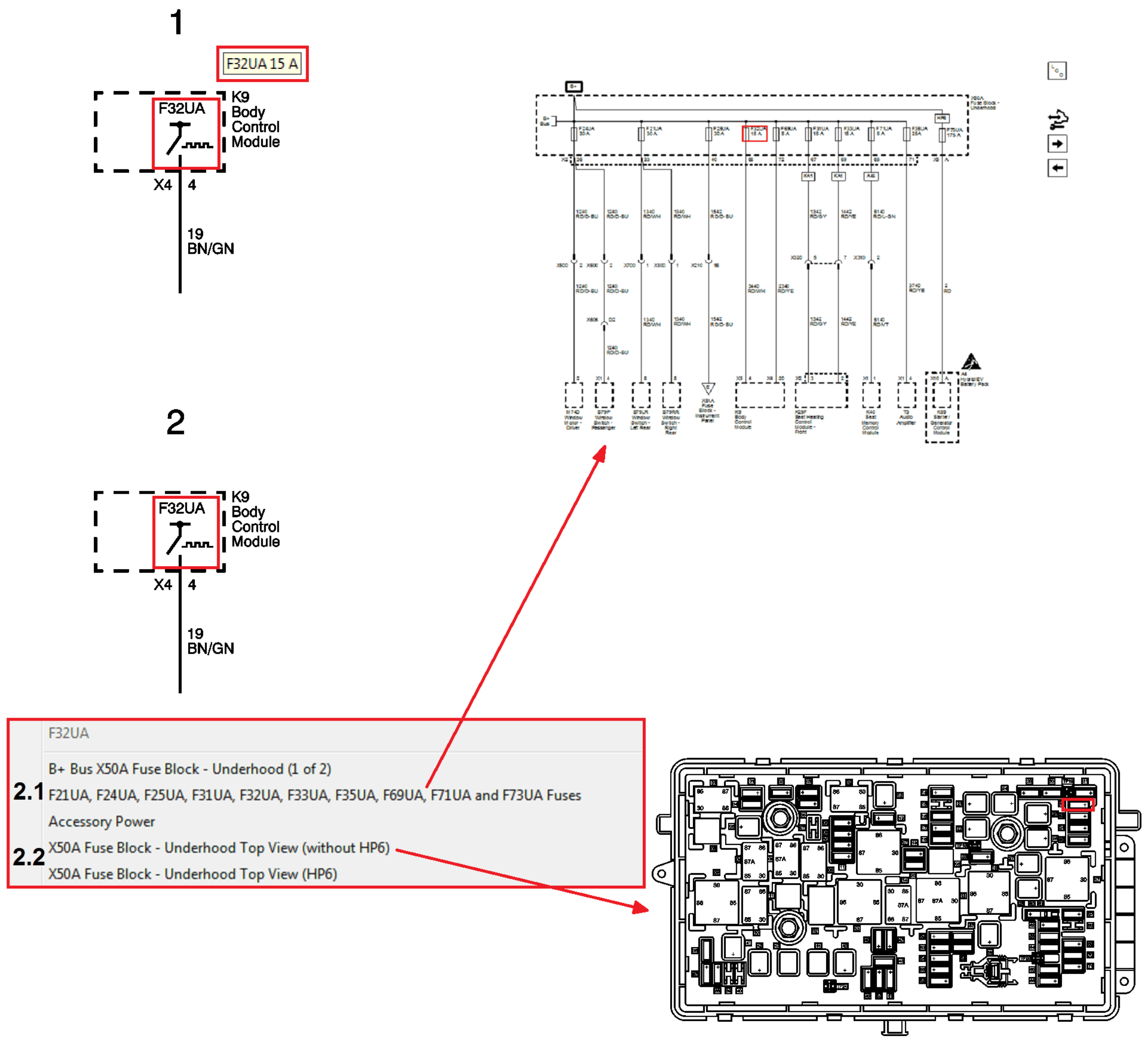

1
1150
BK
G101
G101
2
1150
BK
G101
G101
2.1
G101 (1 of 2)
2.2
G101, G103, G106 and G110

Fig. 26: Ground Symbol/Name In Subsystem Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the ground number.
2. **Hotspot Link to Information:**
    - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
    1. Links to the individual schematic page(s) within the Ground Distribution Schematics where the circuits are shown in detail. Additionally, when the target schematic is opened, the ground will be highlighted to draw visual attention.
    2. Links to the individual locator view(s) within the Ground Views and will show where the ground is located on the vehicle. Additionally, when the target view is opened, the ground and callout leader line/number will be highlighted to draw visual attention.

Body Control Module High-Side Driver Output Symbol/Driver Source Fuse Name in Subsystem Schematics

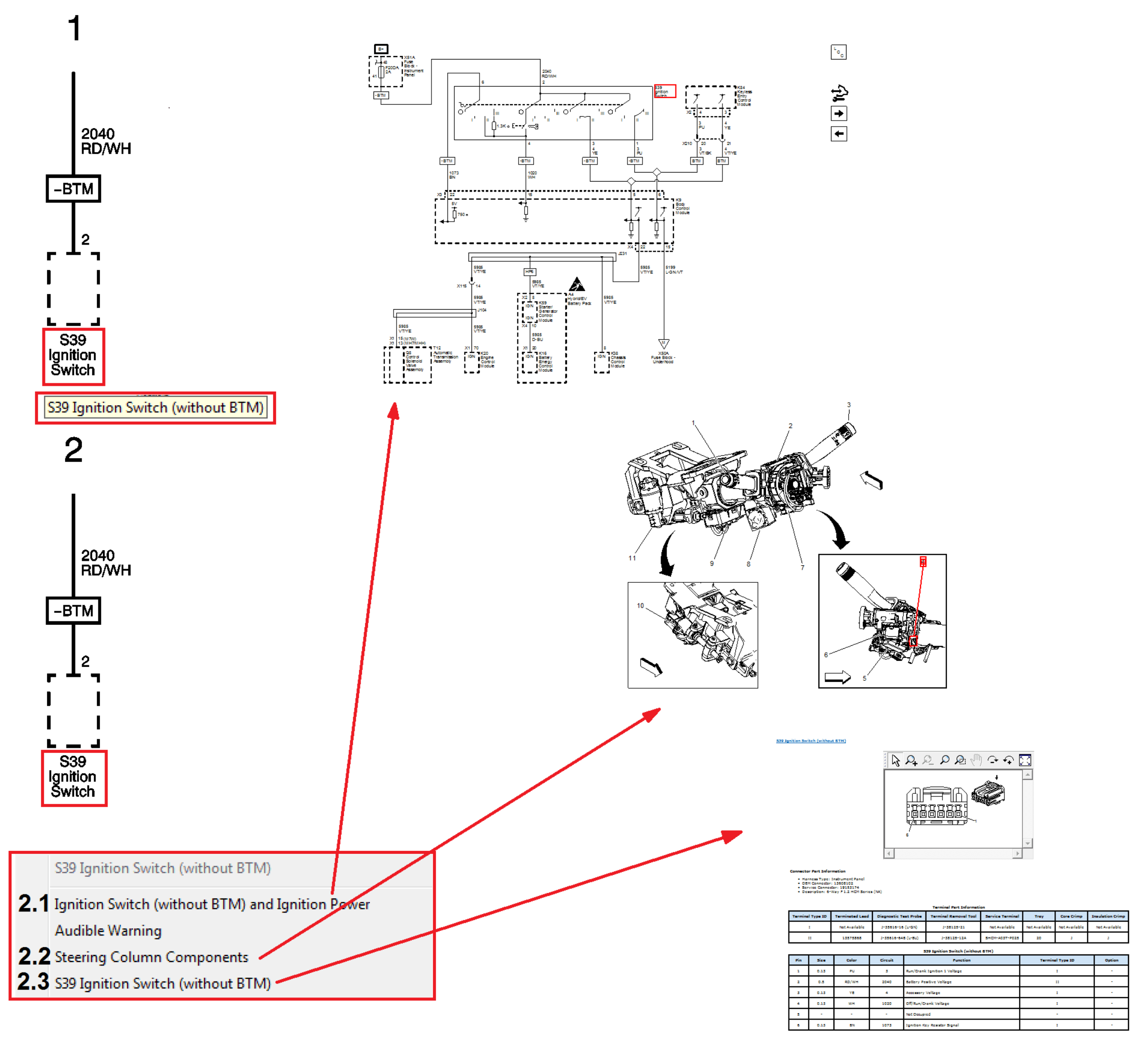

1
F32UA 15 A
F32UA
K9 Body Control Module
X4 4
19 BN/GN
2
F32UA
K9 Body Control Module
X4 4
19 BN/GN
F32UA
B+ Bus X50A Fuse Block - Underhood (1 of 2)
2.1 F21UA, F24UA, F25UA, F31UA, F32UA, F33UA, F35UA, F69UA, F71UA and F73UA Fuses
Accessory Power
2.2 X50A Fuse Block - Underhood Top View (without HP6)
X50A Fuse Block - Underhood Top View (HP6)

[Fig. 27: Body Control Module High-Side Driver Output Symbol/Driver Source Fuse Name in Subsystem Wiring Schematics]()

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the protection device that supplies the high-side driver output circuit.
2. **Hotspot Link to Information:**
   - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
   1. Links to the individual schematic page(s) within the Power Distribution Schematics where the circuits are shown in detail. Additionally, when the target schematic is opened, the circuit protection device will be highlighted to draw visual attention.
   2. Links to individual fuse block top or bottom view(s) within the Electrical Center Identification Views and will show where the device is located in the fuse block. Additionally, when the target view is opened, the device outline will be highlighted for visual attention.

Component Name in Power and Ground Distribution Schematics


1
2040 RD/WH
-BTM
2
S39 Ignition Switch
S39 Ignition Switch (without BTM)
2
2040 RD/WH
-BTM
2
S39 Ignition Switch
S39 Ignition Switch (without BTM)
2.1 Ignition Switch (without BTM) and Ignition Power
Audible Warning
2.2 Steering Column Components
2.3 S39 Ignition Switch (without BTM)

[Fig. 28: Component Name in Power and Ground Distribution Wiring Schematics]()

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code and name of the component.
2. **Hotspot Link to Information:**
   - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
   1. Links to the individual schematic page(s) within the Subsystem Schematic(s) where the circuits are shown in detail. Additionally, when the target schematic is opened, the component code and name will be highlighted to draw visual attention.
   2. Links to the individual locator view(s) within the applicable component view category and will show where the component is located on the vehicle. Additionally, when the target view is opened, the component and callout leader line/number will be highlighted to draw visual attention.
   3. Links to individual connector end view(s) within the Component Connector End Views.

Twisted Pair Symbols

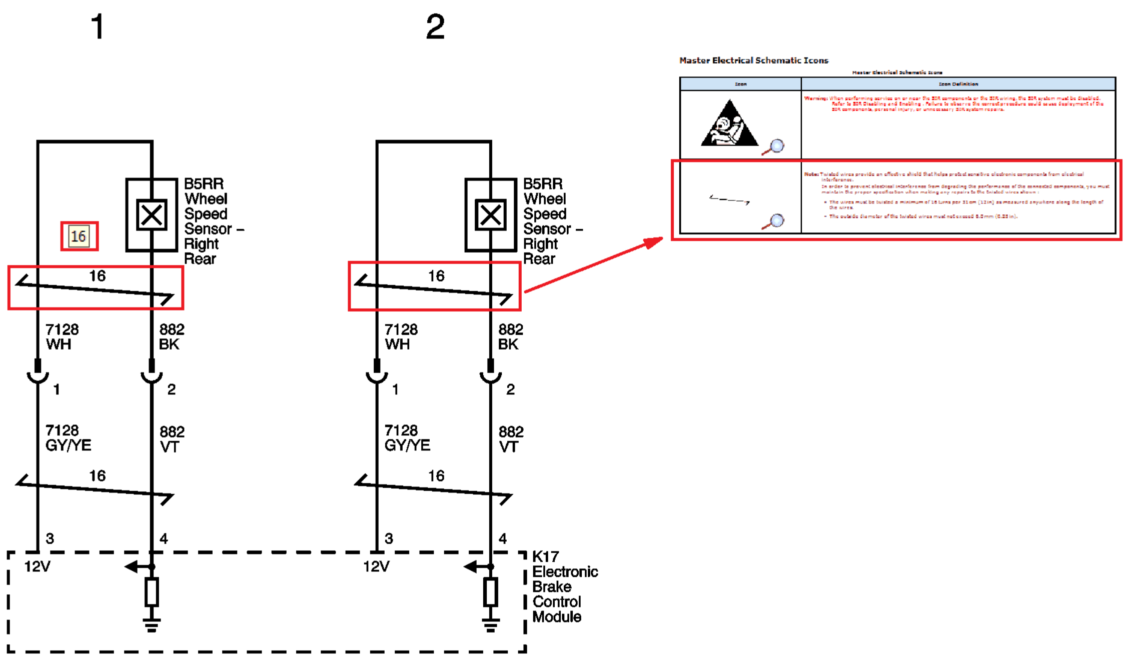

1
2
Master Electrical Schematic Icons
B5RR Wheel Speed Sensor – Right Rear
16
16
7128 WH
882 BK
1
2
7128 GY/YE
882 VT
16
3
4
12V
B5RR Wheel Speed Sensor – Right Rear
16
7128 WH
882 BK
1
2
7128 GY/YE
882 VT
16
3
4
12V
K17 Electronic Brake Control Module

Fig. 29: Twisted Pair Symbols
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the repair specification for the number of twists of the wire within the specified distance.
2. **Hotspot Link to Information:** Links to the Master Electrical Schematic Icons list that shows the icon along with the repair specification details for the wire.

Relay Name (located within a block)

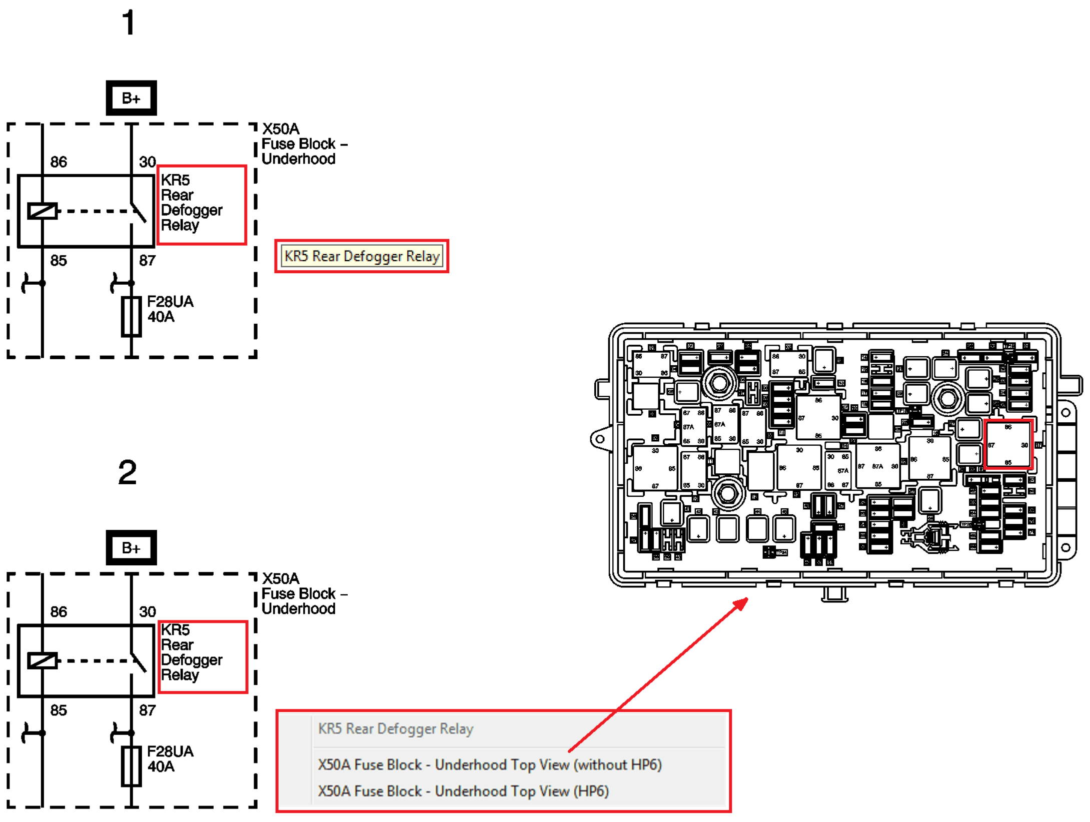

1
B+
X50A
Fuse Block – Underhood
86
30
KR5
Rear
Defogger
Relay
KR5 Rear Defogger Relay
85
87
F28UA
40A
2
B+
X50A
Fuse Block – Underhood
86
30
KR5
Rear
Defogger
Relay
85
87
F28UA
40A
KR5 Rear Defogger Relay
X50A Fuse Block - Underhood Top View (without HP6)
X50A Fuse Block - Underhood Top View (HP6)

Fig. 30: Relay Name (Located Within A Block)
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the relay code and name.
2. **Hotspot Link to Information:** Links to individual fuse block top or bottom view(s) within the Electrical Center Identification Views and will show where the device is located in the fuse block. Additionally, when the target view is opened, the device outline will be highlighted for visual attention.

Component Name in Subsystem Schematics

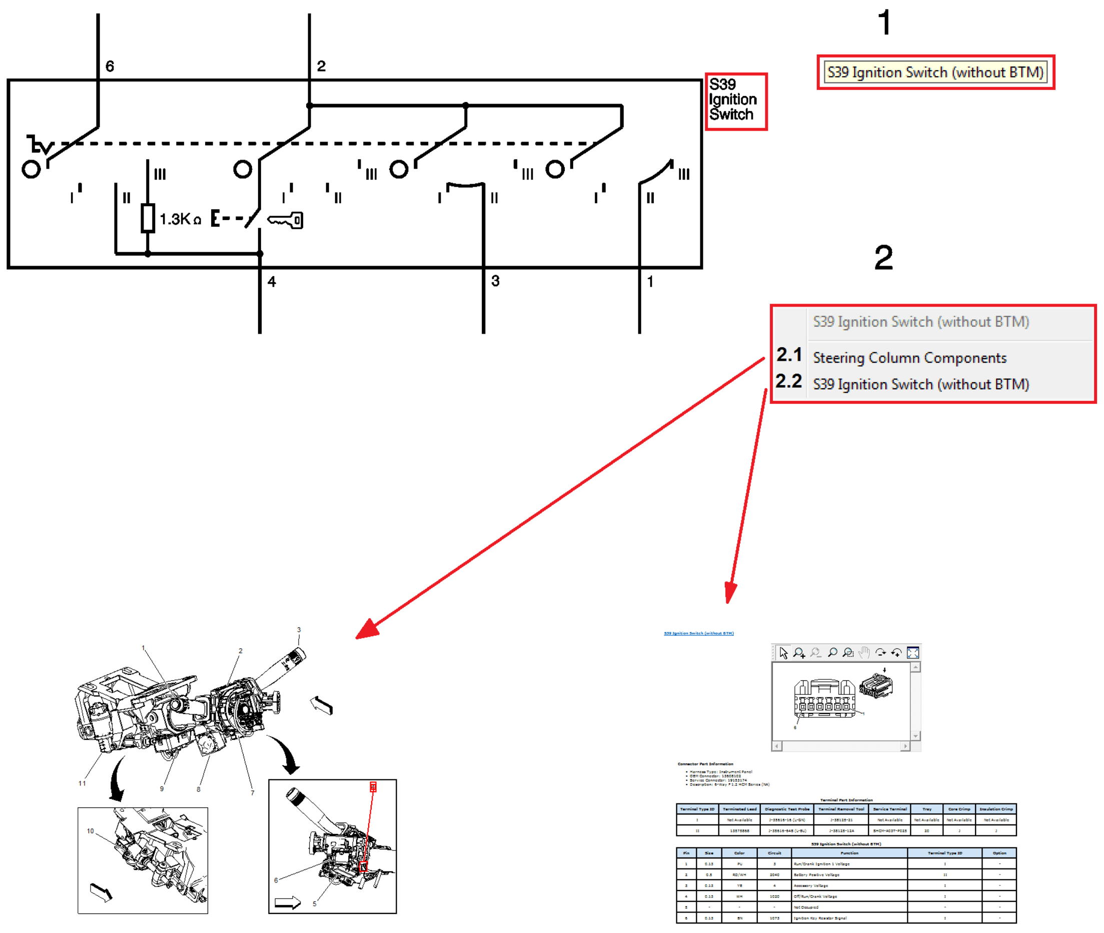

6
2
S39
Ignition
Switch
1
S39 Ignition Switch (without BTM)
1.3K Ω
4
3
1
2
S39 Ignition Switch (without BTM)
2.1 Steering Column Components
2.2 S39 Ignition Switch (without BTM)

Fig. 31: Component Name In Subsystem Wiring Schematics
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code and name of the component.
2. **Hotspot Link to Information:**
   - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
   1. Links to the individual locator view(s) within the applicable component view category and will show where the component is located on the vehicle. Additionally, when the target view is opened, the component and callout leader line/number will be highlighted to draw visual attention.
   2. Links to individual connector end view(s) within the Component Connector End Views.

Splice Names

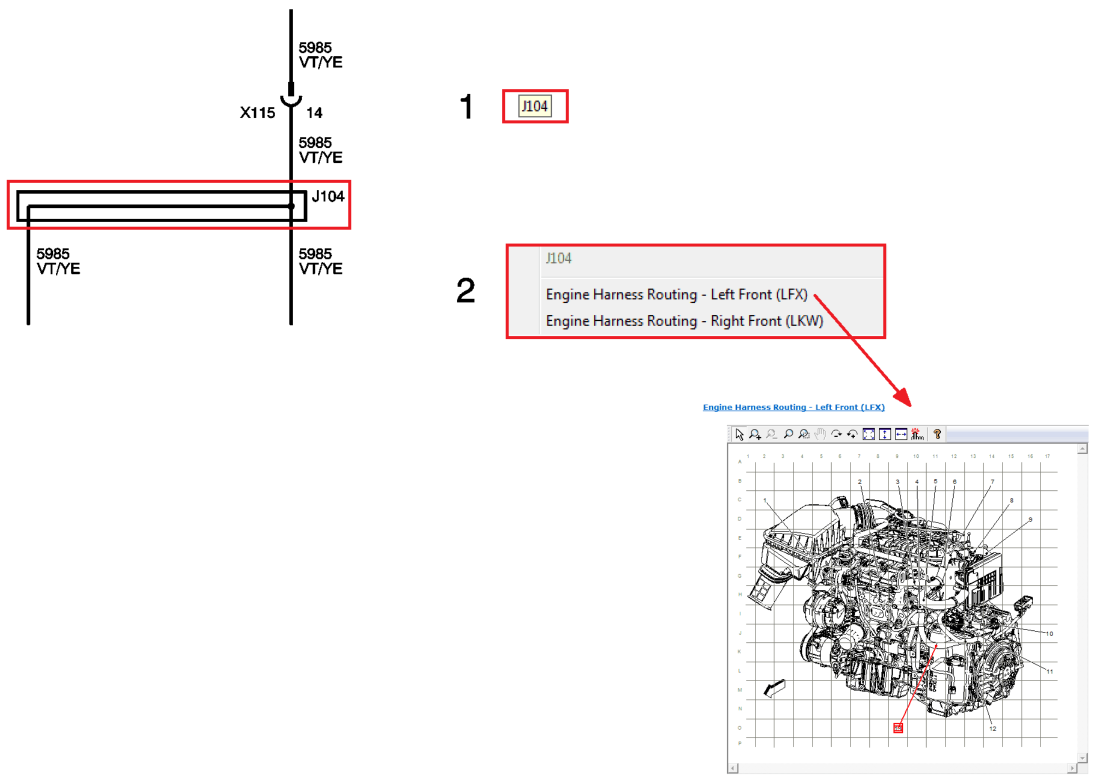
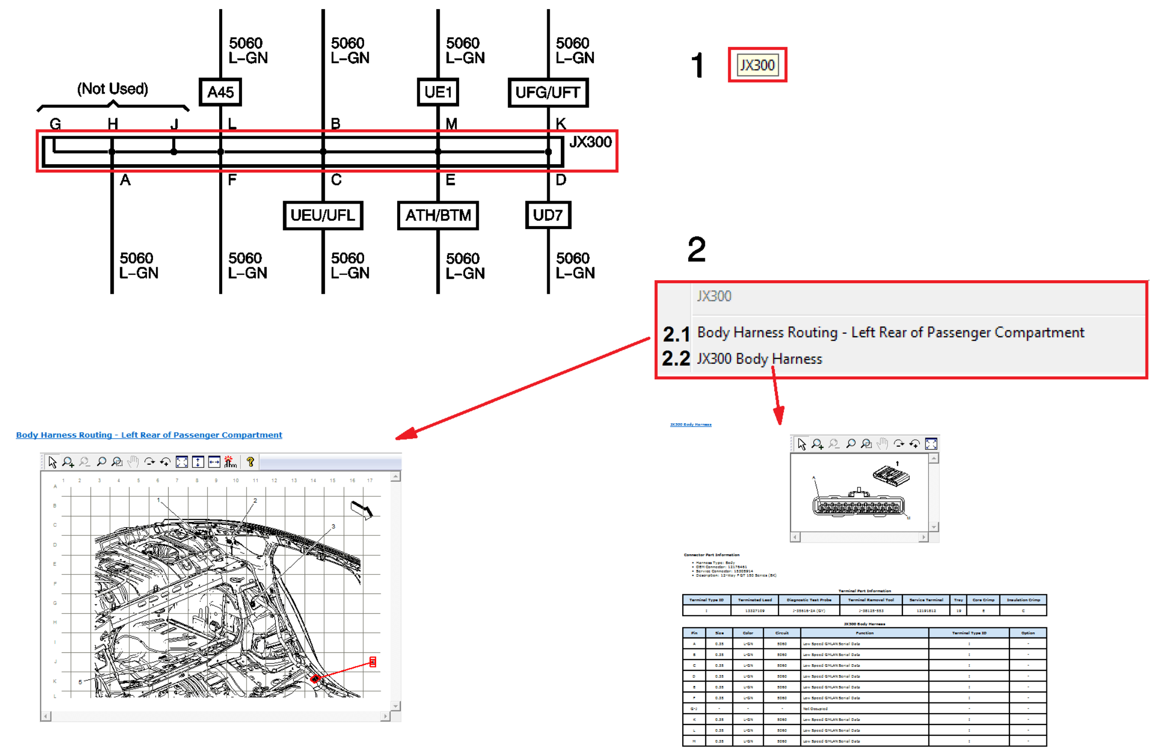

5985
VT/YE
X115
14
5985
VT/YE
J104
5985
VT/YE
5985
VT/YE
1
J104
2
J104
Engine Harness Routing - Left Front (LFX)
Engine Harness Routing - Right Front (LKW)
Engine Harness Routing - Left Front (LFX)

Fig. 32: Splice Names
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the harness splice.
2. **Hotspot Link to Information:** Links to the individual harness routing view(s) within the Harness Routing Views and will show where the harness item is located on the vehicle harness. Additionally, when the target view is opened, the harness item and callout leader line/number will be highlighted to draw visual attention.

Splice Pack Names

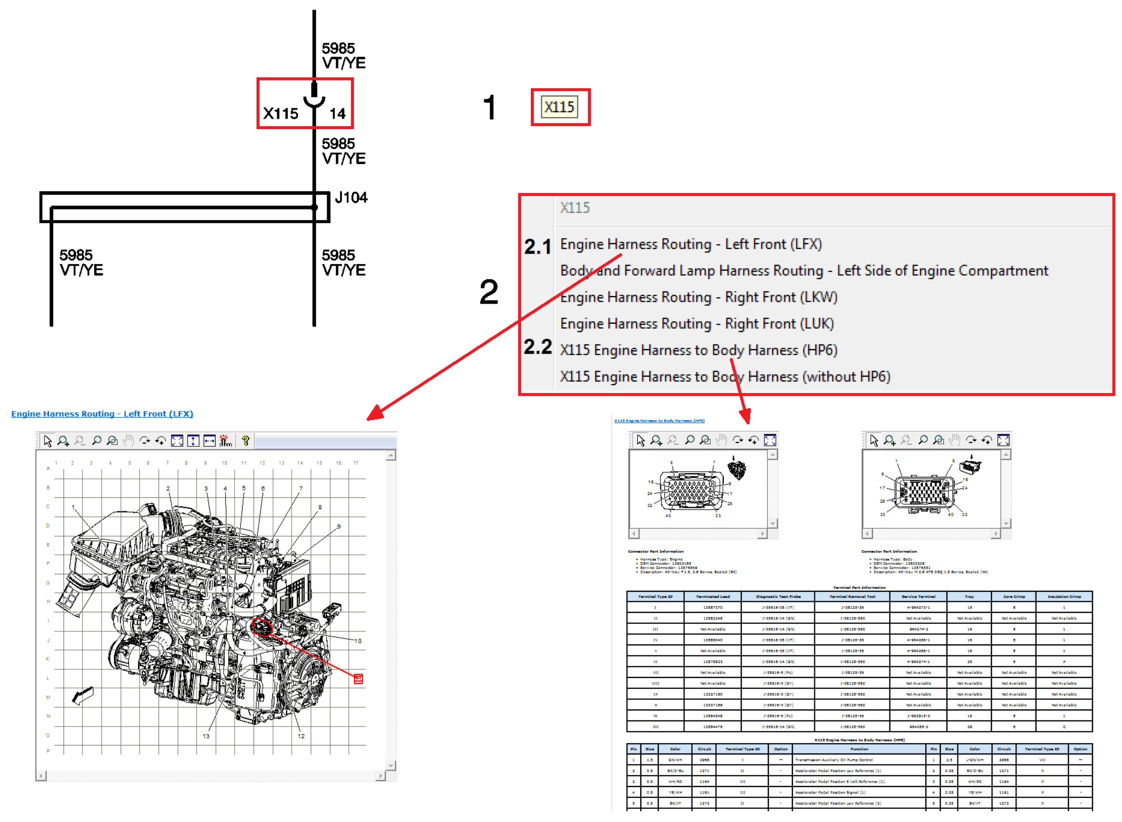

5060 L-GN
(Not Used)
A45
UE1
UFG/UFT
G
H
J
L
B
M
K
JX300
A
F
C
E
D
UEU/UFL
ATH/BTM
UD7
1
JX300
2
JX300
2.1 Body Harness Routing - Left Rear of Passenger Compartment
2.2 JX300 Body Harness
Body Harness Routing - Left Rear of Passenger Compartment

[Fig. 33: Splice Pack Names](#)

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the harness splice pack.
2. **Hotspot Link to Information:**
   - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
   1. Links to the individual harness routing view(s) within the Harness Routing Views and will show where the harness item is located on the vehicle harness. Additionally, when the target view is opened, the harness item and callout leader line/number will be highlighted to draw visual attention.
   2. Links to individual connector end view(s) within the Splice Pack Connector End Views.

Inline Harness Connector Names

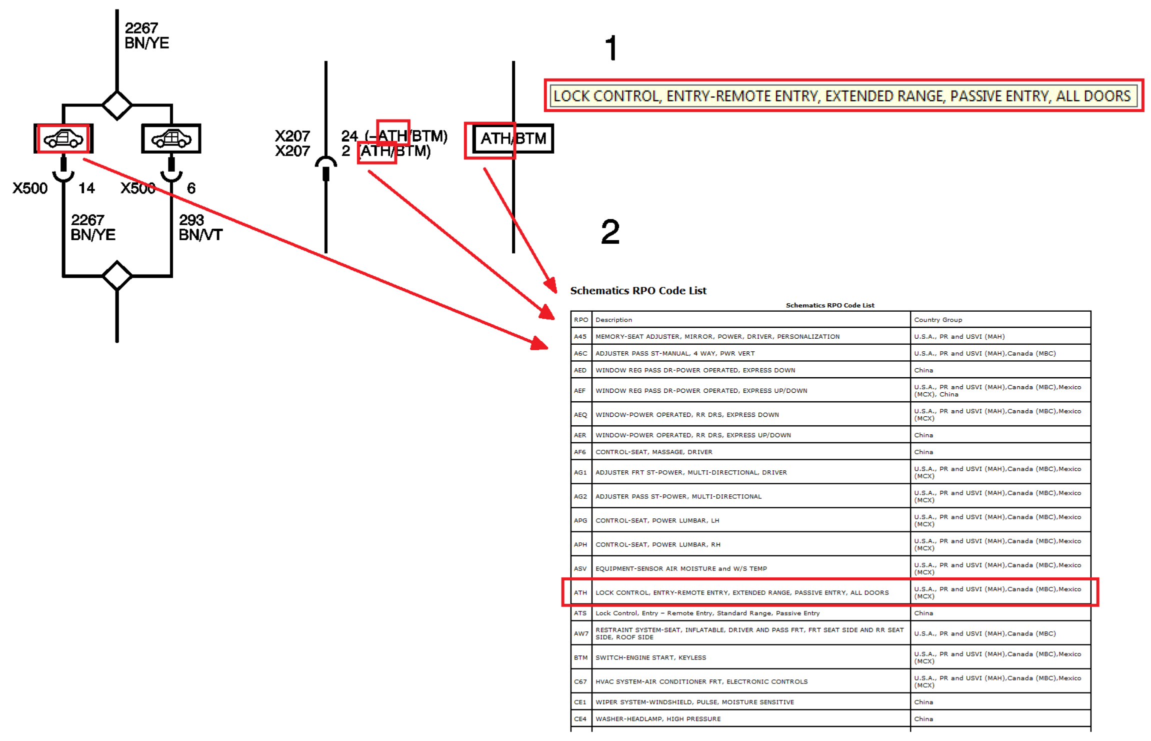

5985 VT/YE
X115
14
J104
1
X115
2
X115
2.1 Engine Harness Routing - Left Front (LFX)
Body and Forward Lamp Harness Routing - Left Side of Engine Compartment
Engine Harness Routing - Right Front (LKW)
Engine Harness Routing - Right Front (LUK)
2.2 X115 Engine Harness to Body Harness (HP6)
X115 Engine Harness to Body Harness (without HP6)
Engine Harness Routing - Left Front (LFX)

[Fig. 34: Inline Harness Connector Names](#)

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the inline harness connector.
2. **Hotspot Link to Information:**
   - When multiple links are available, a menu will appear when the link is selected. This menu includes all available links in a structured sequence.
   1. Links to the individual harness routing view(s) within the Harness Routing Views and will show where the harness item is located on the vehicle harness. Additionally, when the target view is opened, the harness item and callout leader line/number will be highlighted to draw visual attention.
   2. Links to individual connector end view(s) within the Inline Harness Connector End Views.

Regular Production Option (RPO) Codes/Icons


2267 BN/YE
X500
14
X500
6
2267 BN/YE
293 BN/VT
X207
X207
24 (−ATH/BTM)
2 ATH/BTM
ATH/BTM
1
LOCK CONTROL, ENTRY-REMOTE ENTRY, EXTENDED RANGE, PASSIVE ENTRY, ALL DOORS
2
Schematics RPO Code List

[Fig. 35: Regular Production Option (RPO) Codes/Icons](#)

Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the description of the RPO code as well as the country group names where the option is possible to order. Note that each RPO shown will have its own mouse-over and description. Also note that the mouse-over does not include any symbols indicating with (shown as a + sign if combined option) or without (shown as a - sign to mean without/except).
2. **Hotspot Link to Information:** Links to the Schematics RPO Code List that shows the RPO, the description of the option, and the country group names where the option is possible to order.

Circuit Number/Wire Colors

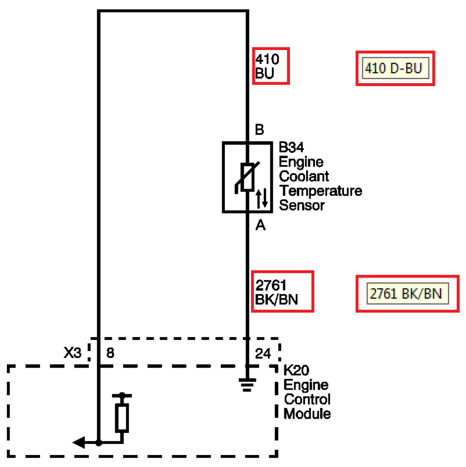


Fig. 36: Circuit Number/Wire Colors
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the circuit number (if shown) and the color abbreviation of the wire insulation. Refer to Color Abbreviations for an explanation of each wire color abbreviation. A future update may spell out the wire colors in all languages.
2. **Hotspot Link to Information:** None at this time.

Wire Lines

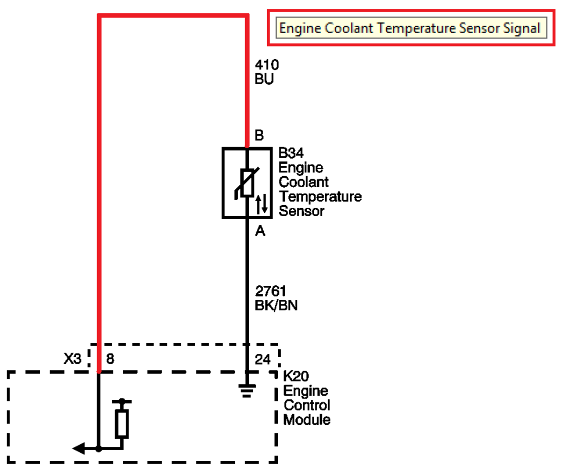


Fig. 37: Wire Lines
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the circuit function of the wire as used on the vehicle. This same function is shown in the connector end view pinout table for the component the wire connects. Note if there is no circuit number shown, the circuit will not have an associated mouse-over.
2. **Hotspot Link to Information:** None at this time. A future update may include links to harness routing views to show the routing of the circuit within the vehicle harness.

Connector Identifiers and Cavities

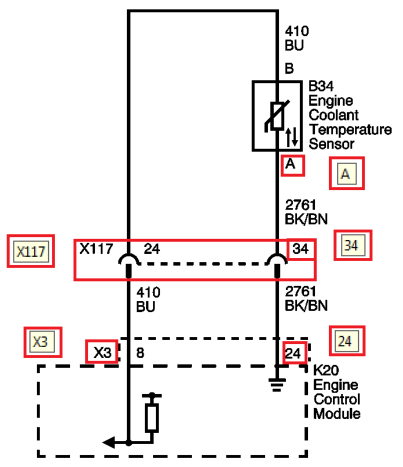
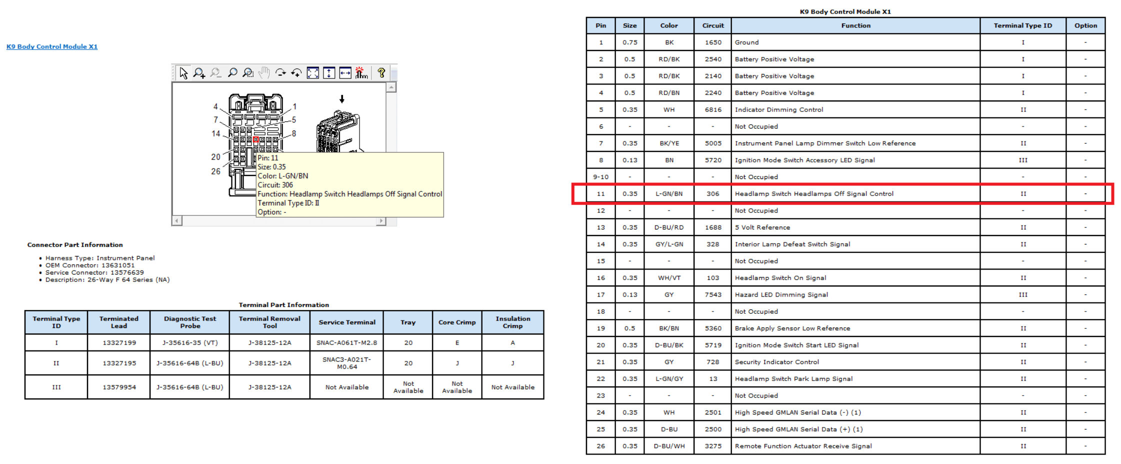


Fig. 38: Connector Identifiers And Cavities
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the cavity (pin) identifier (letter/number) for the connection at the component or inline harness connection.
2. **Hotspot Link to Information:** None at this time.

Connector End Views

Connector end view graphics now have mouse-overs to show the wire details of each of the populated cavities. Additionally, the terminal part information has been restructured into an easier to read table.



Pin: 11
Size: 0.35
Color: L-GN/BN
Circuit: 306
Function: Headlamp Switch Headlamps Off Signal Control
Terminal Type ID: II
Option: -

Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 13631051
- Service Connector: 13576639
- Description: 26-Way F 64 Series (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	13327199	J-35616-35 (VT)	J-38125-12A	SNAC-A061T-M2.8	20	E	A
II	13327195	J-35616-64B (L-BU)	J-38125-12A	SNAC3-A021T-M0.64	20	J	J
III	13579954	J-35616-64B (L-BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

K9 Body Control Module X1

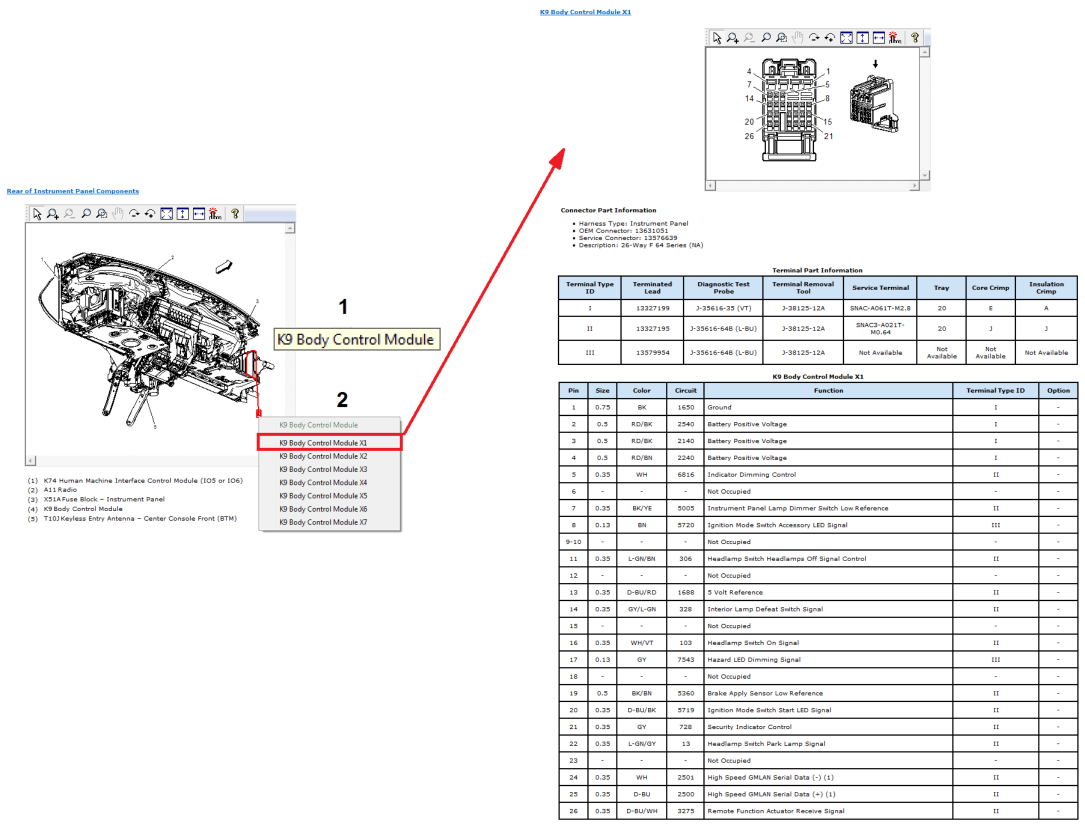
Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	1650	Ground	I	-
2	0.5	RD/BK	2540	Battery Positive Voltage	I	-
3	0.5	RD/BK	2140	Battery Positive Voltage	I	-
4	0.5	RD/BN	2240	Battery Positive Voltage	I	-
5	0.35	WH	6816	Indicator Dimming Control	II	-
6	-	-	-	Not Occupied	-	-
7	0.35	BK/YE	5005	Instrument Panel Lamp Dimmer Switch Low Reference	II	-
8	0.13	BN	5720	Ignition Mode Switch Accessory LED Signal	III	-
9-10	-	-	-	Not Occupied	-	-
11	0.35	L-GN/BN	306	Headlamp Switch Headlamps Off Signal Control	II	-
12	-	-	-	Not Occupied	-	-
13	0.35	D-BU/RD	1688	5 Volt Reference	II	-
14	0.35	GY/L-GN	328	Interior Lamp Defeat Switch Signal	II	-
15	-	-	-	Not Occupied	-	-
16	0.35	WH/VT	103	Headlamp Switch On Signal	II	-
17	0.13	GY	7543	Hazard LED Dimming Signal	III	-
18	-	-	-	Not Occupied	-	-
19	0.5	BK/BN	5360	Brake Apply Sensor Low Reference	II	-
20	0.35	D-BU/BK	5719	Ignition Mode Switch Start LED Signal	II	-
21	0.35	GY	728	Security Indicator Control	II	-
22	0.35	L-GN/GY	13	Headlamp Switch Park Lamp Signal	II	-
23	-	-	-	Not Occupied	-	-
24	0.35	WH	2501	High Speed GMLAN Serial Data (-) (1)	II	-
25	0.35	D-BU	2500	High Speed GMLAN Serial Data (+) (1)	II	-
26	0.35	D-BU/WH	3275	Remote Function Actuator Receive Signal	II	-

Fig. 39: Connector End View Graphics Table Information
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays all of the pinout table information for each column including Pin, Size, Color, Circuit, Function, Terminal Type ID, and Option. Note, that not used/not occupied cavities will not have a mouse-over at all. For not used/not occupied cavities, the connector graphic will appear to have a mouse-over, but no information will be displayed in a pop-up menu.
2. **Hotspot Link to Information:** None at this time. A future update may include links to individual subsystem schematic(s) for each circuit.

Component Locator Views

Component locator views now have links to component connector end views.


Rear of Instrument Panel Components
1
2
3
4
5
1
K9 Body Control Module
2
K9 Body Control Module
K9 Body Control Module X1
K9 Body Control Module X2
K9 Body Control Module X3
K9 Body Control Module X4
K9 Body Control Module X5
K9 Body Control Module X6
K9 Body Control Module X7
K9 Body Control Module X1
4
1
7
5
14
8
20
15
26
21

(1) K74 Human Machine Interface Control Module (IO5 or IO6)
(2) A11 Radio
(3) X51A Fuse Block - Instrument Panel
(4) K9 Body Control Module
(5) T10J Keyless Entry Antenna - Center Console Front (BTM)

Connector Part Information

- Harness Type: Instrument Panel
- OEM Connector: 13631051
- Service Connector: 13576639
- Description: 26-Way F 64 Series (NA)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	13327199	J-35616-35 (VT)	J-38125-12A	SNAC-A061T-M2.8	20	E	A
II	13327195	J-35616-64B (L-BU)	J-38125-12A	SNAC3-A021T-M0.64	20	J	J
III	13579954	J-35616-64B (L-BU)	J-38125-12A	Not Available	Not Available	Not Available	Not Available

K9 Body Control Module X1

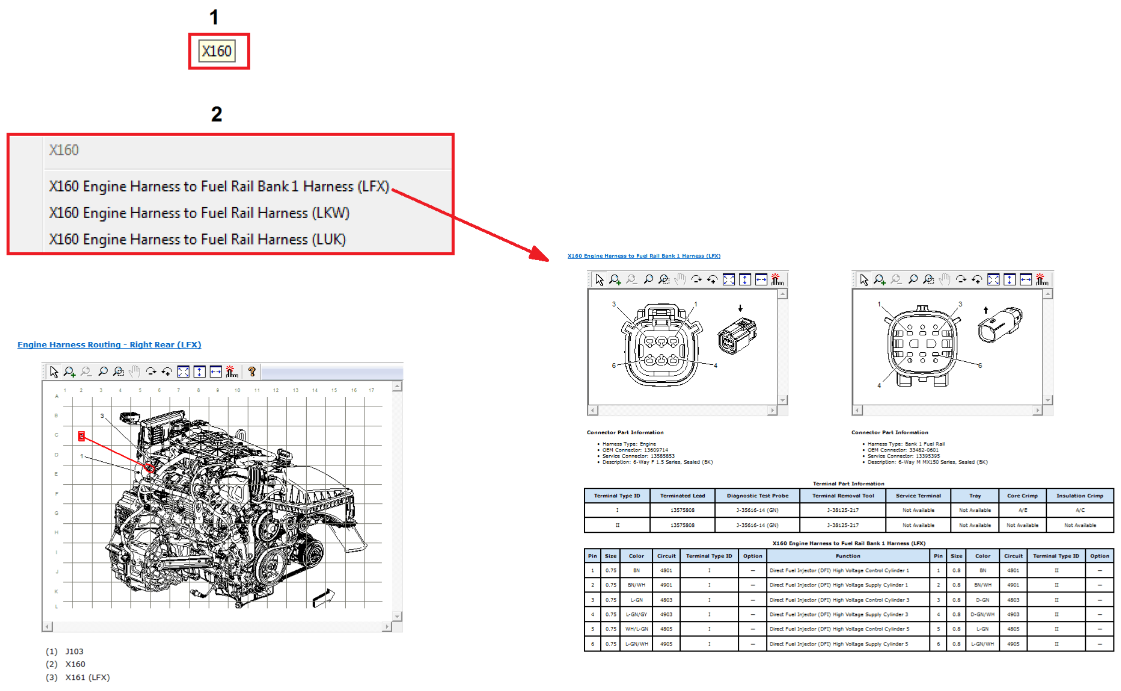
Pin	Size	Color	Circuit	Function	Terminal Type ID	Option
1	0.75	BK	1650	Ground	I	-
2	0.5	RD/BK	2540	Battery Positive Voltage	I	-
3	0.5	RD/BK	2140	Battery Positive Voltage	I	-
4	0.5	RD/BN	2240	Battery Positive Voltage	I	-
5	0.35	WH	6816	Indicator Dimming Control	II	-
6	-	-	-	Not Occupied	-	-
7	0.35	BK/YE	5005	Instrument Panel Lamp Dimmer Switch Low Reference	II	-
8	0.13	BN	5720	Ignition Mode Switch Accessory LED Signal	III	-
9-10	-	-	-	Not Occupied	-	-
11	0.35	L-GN/BN	306	Headlamp Switch Headlamps Off Signal Control	II	-
12	-	-	-	Not Occupied	-	-
13	0.35	D-BU/RD	1688	5 Volt Reference	II	-
14	0.35	GY/L-GN	328	Interior Lamp Defeat Switch Signal	II	-
15	-	-	-	Not Occupied	-	-
16	0.35	WH/VT	103	Headlamp Switch On Signal	II	-
17	0.13	GY	7543	Hazard LED Dimming Signal	III	-
18	-	-	-	Not Occupied	-	-
19	0.5	BK/BN	5360	Brake Apply Sensor Low Reference	II	-
20	0.35	D-BU/BK	5719	Ignition Mode Switch Start LED Signal	II	-
21	0.35	GY	728	Security Indicator Control	II	-
22	0.35	L-GN/GY	13	Headlamp Switch Park Lamp Signal	II	-
23	-	-	-	Not Occupied	-	-
24	0.35	WH	2501	High Speed GMLAN Serial Data (-) (1)	II	-
25	0.35	D-BU	2500	High Speed GMLAN Serial Data (+) (1)	II	-
26	0.35	D-BU/WH	3275	Remote Function Actuator Receive Signal	II	-

Fig. 40: Component Locator Views Have Links To Component Connector End Views
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code and name of the component.
2. **Hotspot Link to Information:** Links to individual connector end view(s) within Component Connector End Views.

Harness Routing Views

Harness routing views now have links to splice pack and inline harness connector end views.


1
X160
2
X160
X160 Engine Harness to Fuel Rail Bank 1 Harness (LFX)
X160 Engine Harness to Fuel Rail Harness (LKW)
X160 Engine Harness to Fuel Rail Harness (LUK)
Engine Harness Routing - Right Rear (LFX)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
A
B
C
D
E
F
G
H
I
J
K
L
3
1
X160 Engine Harness to Fuel Rail Bank 1 Harness (LFX)
3
1
6
4
1
3
6
4

(1) J103
(2) X160
(3) X161 (LFX)

Connector Part Information

- Harness Type: Engine
- OEM Connector: 13609714
- Service Connector: 13585853
- Description: 6-Way F 1.5 Series, Sealed (BK)

Connector Part Information

- Harness Type: Bank 1 Fuel Rail
- OEM Connector: 33482-0601
- Service Connector: 13395395
- Description: 6-Way M MX150 Series, Sealed (BK)

Terminal Part Information

Terminal Type ID	Terminated Lead	Diagnostic Test Probe	Terminal Removal Tool	Service Terminal	Tray	Core Crimp	Insulation Crimp
I	13575808	J-35616-14 (GN)	J-38125-217	Not Available	Not Available	A/E	A/C
II	13575808	J-35616-14 (GN)	J-38125-217	Not Available	Not Available	Not Available	Not Available

X160 Engine Harness to Fuel Rail Bank 1 Harness (LFX)

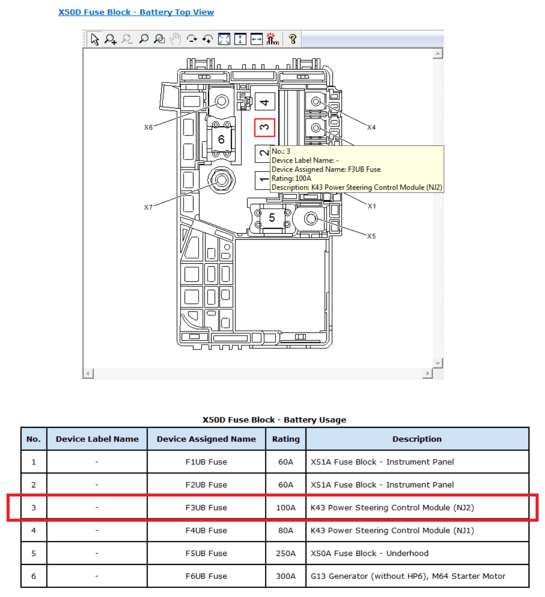
Pin	Size	Color	Circuit	Terminal Type ID	Option	Function	Pin	Size	Color	Circuit	Terminal Type ID	Option
1	0.75	BN	4801	I	–	Direct Fuel Injector (DFI) High Voltage Control Cylinder 1	1	0.8	BN	4801	II	–
2	0.75	BN/WH	4901	I	–	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 1	2	0.8	BN/WH	4901	II	–
3	0.75	L-GN	4803	I	–	Direct Fuel Injector (DFI) High Voltage Control Cylinder 3	3	0.8	D-GN	4803	II	–
4	0.75	L-GN/GY	4903	I	–	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 3	4	0.8	D-GN/WH	4903	II	–
5	0.75	WH/L-GN	4805	I	–	Direct Fuel Injector (DFI) High Voltage Control Cylinder 5	5	0.8	L-GN	4805	II	–
6	0.75	L-GN/WH	4905	I	–	Direct Fuel Injector (DFI) High Voltage Supply Cylinder 5	6	0.8	L-GN/WH	4905	II	–

Fig. 41: Harness Routing Views Have Links To Splice Pack And Inline Harness Connector End Views
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays the code of the harness item.
2. **Hotspot Link to Information:** Links to individual splice pack connector end view(s) within Splice Pack Connector End Views for splice packs and to the individual inline harness connector end view(s) within Inline Harness Connector End Views for inline harness connectors.

Electrical Center Identification Views

Electrical center identification views (top and bottom/front and back) graphics now have mouse-overs to show the function details of each of utilized devices. Note that the label view will not have any mouse-overs or links at all.


X50D Fuse Block - Battery Top View
4
3
2
1
6
5
X6
X4
X7
X1
X5

No.: 3
Device Label Name: -
Device Assigned Name: F3UB Fuse
Rating: 100A
Description: K43 Power Steering Control Module (NJ2)

X50D Fuse Block - Battery Usage

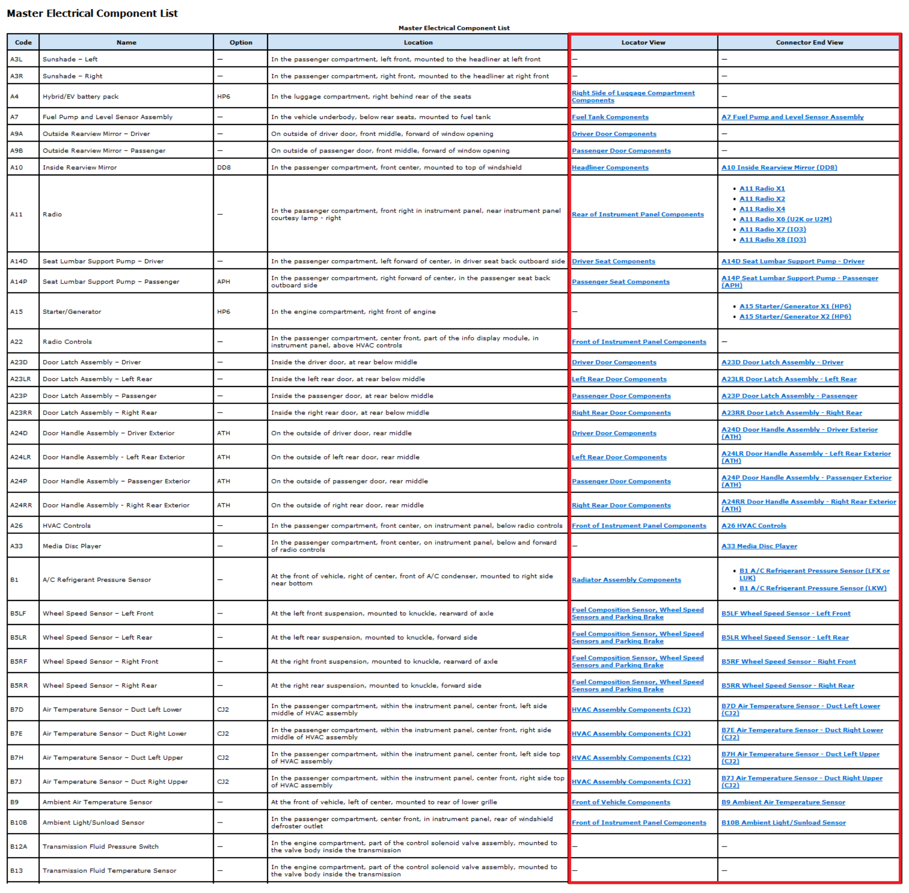
No.	Device Label Name	Device Assigned Name	Rating	Description
1	-	F1UB Fuse	60A	X51A Fuse Block - Instrument Panel
2	-	F2UB Fuse	60A	X51A Fuse Block - Instrument Panel
3	-	F3UB Fuse	100A	K43 Power Steering Control Module (NJ2)
4	-	F4UB Fuse	80A	K43 Power Steering Control Module (NJ1)
5	-	F5UB Fuse	250A	X50A Fuse Block - Underhood
6	-	F6UB Fuse	300A	G13 Generator (without HP6), M64 Starter Motor

Fig. 42: Electrical Center Identification Views Graphics Have Mouse-Overs To Show Function Details
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** Displays all of the usage table information for each column including No., Device Label Name, Device Assigned Name, Rating, and Description. Note, that not used/not occupied devices will not have a mouse-over at all. For not used/not occupied devices, the device graphic may appear to have a mouse-over, but no information will be displayed in a pop-up screen.
2. **Hotspot Link to Information:** None at this time.

Master Electrical Component List

While the master electrical component list format has not changed, it will continue to have links to component locator, harness routing, and connector end views for each of the available electrical devices within the vehicle.



Master Electrical Component List

Master Electrical Component List

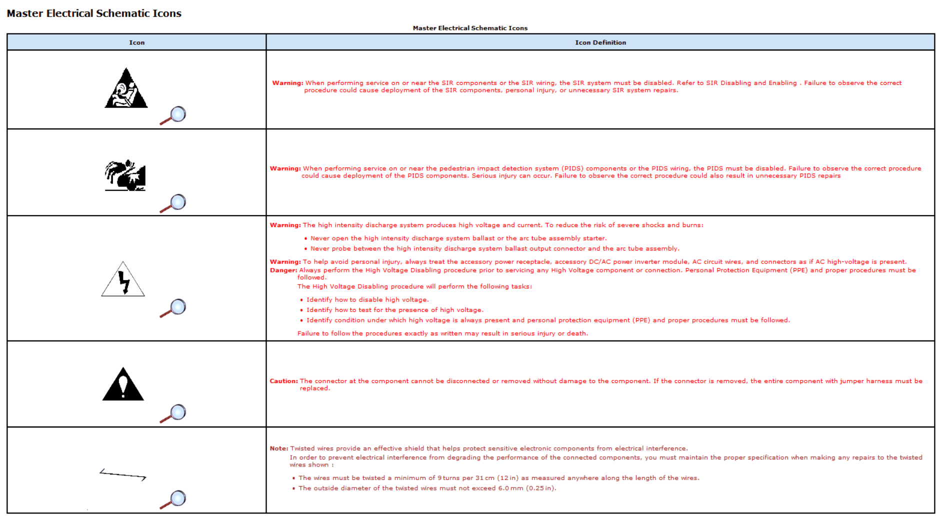
Code	Name	Option	Location	Locator View	Connector End View
A3L	Sunshade – Left	–	In the passenger compartment, left front, mounted to the headliner at left front	–	–
A3R	Sunshade – Right	–	In the passenger compartment, right front, mounted to the headliner at right front	–	–
A4	Hybrid/EV battery pack	HP6	In the luggage compartment, right behind rear of the seats	Right Side of Luggage Compartment Components	–
A7	Fuel Pump and Level Sensor Assembly	–	In the vehicle underbody, below rear seats, mounted to fuel tank	Fuel Tank Components	A7 Fuel Pump and Level Sensor Assembly
A9A	Outside Rearview Mirror – Driver	–	On outside of driver door, front middle, forward of window opening	Driver Door Components	–
A9B	Outside Rearview Mirror – Passenger	–	On outside of passenger door, front middle, forward of window opening	Passenger Door Components	–
A10	Inside Rearview Mirror	DD8	In the passenger compartment, front center, mounted to top of windshield	Headliner Components	A10 Inside Rearview Mirror (DD8)
A11	Radio	–	In the passenger compartment, front right in instrument panel, near instrument panel courtesy lamp - right	Rear of Instrument Panel Components	• A11 Radio X1 • A11 Radio X2 • A11 Radio X4 • A11 Radio X6 (U2K or U2M) • A11 Radio X7 (IO3) • A11 Radio X8 (IO3)
A14D	Seat Lumbar Support Pump – Driver	–	In the passenger compartment, left forward of center, in driver seat back outboard side	Driver Seat Components	A14D Seat Lumbar Support Pump - Driver
A14P	Seat Lumbar Support Pump – Passenger	APH	In the passenger compartment, right forward of center, in the passenger seat back outboard side	Passenger Seat Components	A14P Seat Lumbar Support Pump - Passenger (APH)
A15	Starter/Generator	HP6	In the engine compartment, right front of engine	–	• A15 Starter/Generator X1 (HP6) • A15 Starter/Generator X2 (HP6)
A22	Radio Controls	–	In the passenger compartment, center front, part of the info display module, in instrument panel, above HVAC controls	Front of Instrument Panel Components	–
A23D	Door Latch Assembly – Driver	–	Inside the driver door, at rear below middle	Driver Door Components	A23D Door Latch Assembly - Driver
A23LR	Door Latch Assembly – Left Rear	–	Inside the left rear door, at rear below middle	Left Rear Door Components	A23LR Door Latch Assembly - Left Rear
A23P	Door Latch Assembly – Passenger	–	Inside the passenger door, at rear below middle	Passenger Door Components	A23P Door Latch Assembly - Passenger
A23RR	Door Latch Assembly – Right Rear	–	Inside the right rear door, at rear below middle	Right Rear Door Components	A23RR Door Latch Assembly - Right Rear
A24D	Door Handle Assembly – Driver Exterior	ATH	On the outside of driver door, rear middle	Driver Door Components	A24D Door Handle Assembly - Driver Exterior (ATH)
A24LR	Door Handle Assembly - Left Rear Exterior	ATH	On the outside of left rear door, rear middle	Left Rear Door Components	A24LR Door Handle Assembly - Left Rear Exterior (ATH)
A24P	Door Handle Assembly – Passenger Exterior	ATH	On the outside of passenger door, rear middle	Passenger Door Components	A24P Door Handle Assembly - Passenger Exterior (ATH)
A24RR	Door Handle Assembly - Right Rear Exterior	ATH	On the outside of right rear door, rear middle	Right Rear Door Components	A24RR Door Handle Assembly - Right Rear Exterior (ATH)
A26	HVAC Controls	–	In the passenger compartment, front center, on instrument panel, below radio controls	Front of Instrument Panel Components	A26 HVAC Controls
A33	Media Disc Player	–	In the passenger compartment, front center, on instrument panel, below and forward of radio controls	–	A33 Media Disc Player
B1	A/C Refrigerant Pressure Sensor	–	At the front of vehicle, right of center, front of A/C condenser, mounted to right side near bottom	Radiator Assembly Components	• B1 A/C Refrigerant Pressure Sensor (LFX or LUK) • B1 A/C Refrigerant Pressure Sensor (LKW)
B5LF	Wheel Speed Sensor – Left Front	–	At the left front suspension, mounted to knuckle, rearward of axle	Fuel Composition Sensor, Wheel Speed Sensors and Parking Brake	B5LF Wheel Speed Sensor - Left Front
B5LR	Wheel Speed Sensor – Left Rear	–	At the left rear suspension, mounted to knuckle, forward side	Fuel Composition Sensor, Wheel Speed Sensors and Parking Brake	B5LR Wheel Speed Sensor - Left Rear
B5RF	Wheel Speed Sensor – Right Front	–	At the right front suspension, mounted to knuckle, rearward of axle	Fuel Composition Sensor, Wheel Speed Sensors and Parking Brake	B5RF Wheel Speed Sensor - Right Front
B5RR	Wheel Speed Sensor – Right Rear	–	At the right rear suspension, mounted to knuckle, forward side	Fuel Composition Sensor, Wheel Speed Sensors and Parking Brake	B5RR Wheel Speed Sensor - Right Rear
B7D	Air Temperature Sensor – Duct Left Lower	CJ2	In the passenger compartment, within the instrument panel, center front, left side middle of HVAC assembly	HVAC Assembly Components (CJ2)	B7D Air Temperature Sensor - Duct Left Lower (CJ2)
B7E	Air Temperature Sensor – Duct Right Lower	CJ2	In the passenger compartment, within the instrument panel, center front, right side middle of HVAC assembly	HVAC Assembly Components (CJ2)	B7E Air Temperature Sensor - Duct Right Lower (CJ2)
B7H	Air Temperature Sensor – Duct Left Upper	CJ2	In the passenger compartment, within the instrument panel, center front, left side top of HVAC assembly	HVAC Assembly Components (CJ2)	B7H Air Temperature Sensor - Duct Left Upper (CJ2)
B7J	Air Temperature Sensor – Duct Right Upper	CJ2	In the passenger compartment, within the instrument panel, center front, right side top of HVAC assembly	HVAC Assembly Components (CJ2)	B7J Air Temperature Sensor - Duct Right Upper (CJ2)
B9	Ambient Air Temperature Sensor	–	At the front of vehicle, left of center, mounted to rear of lower grille	Front of Vehicle Components	B9 Ambient Air Temperature Sensor
B10B	Ambient Light/Sunload Sensor	–	In the passenger compartment, center front, in instrument panel, rear of windshield defroster outlet	Front of Instrument Panel Components	B10B Ambient Light/Sunload Sensor
B12A	Transmission Fluid Pressure Switch	–	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	–	–
B13	Transmission Fluid Temperature Sensor	–	In the engine compartment, part of the control solenoid valve assembly, mounted to the valve body inside the transmission	–	–

Fig. 43: Master Electrical Component List Format
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** None at this time.
2. **Hotspot Link to Information:**
    - A future update may include links to individual subsystem schematic(s) for each component/harness item.
    - **Components**
    - Links to individual locator view within one of the eight component view categories and will show where the component is located in the vehicle.
    - Links to individual connector end view(s) within Component Connector End Views.
    - **Electrical Centers (Fuse Blocks)**
    - Links to individual locator view within one of the eight component view categories and will show where the component is located in the vehicle.
    - Links to individual connector end view(s) within Electrical Center Identification Views.
    - **Inline Harness Connectors**
    - Links to individual harness routing view(s) within Harness Routing Views and will show where the harness item is located on the vehicle harness.
    - Links to individual connector end view(s) within Inline Harness Connector End Views.
    - **Grounds**
    - Links to individual locator view within Ground Views component view and will show where the ground is located in the vehicle.
    - **Splices**
    - Links to individual harness routing view(s) within Harness Routing Views and will show where the harness item is located on the vehicle harness.
    - **Splice Packs**
    - Links to individual harness routing view(s) within Harness Routing Views and will show where the harness item is located on the vehicle harness.
    - Links to individual connector end view(s) within Splice Pack Connector End Views.

Master Electrical Schematic Icons

While the master electrical schematic icons list format has not changed, it will continue to include icons used in the vehicle schematics along with the message for the icon.



Master Electrical Schematic Icons

Master Electrical Schematic Icons

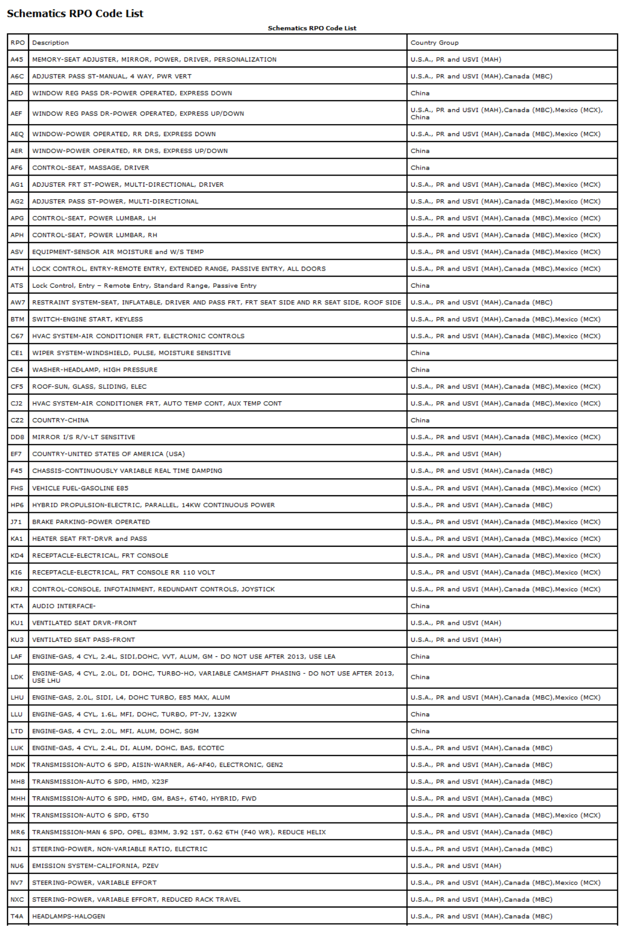
Icon	Icon Definition
	Warning: When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling . Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.
	Warning: When performing service on or near the pedestrian impact detection system (PIDS) components or the PIDS wiring, the PIDS must be disabled. Failure to observe the correct procedure could cause deployment of the PIDS components. Serious injury can occur. Failure to observe the correct procedure could also result in unnecessary PIDS repairs
⚡	**Warning:** The high intensity discharge system produces high voltage and current. To reduce the risk of severe shocks and burns: • Never open the high intensity discharge system ballast or the arc tube assembly starter. • Never probe between the high intensity discharge system ballast output connector and the arc tube assembly. **Warning:** To help avoid personal injury, always treat the accessory power receptacle, accessory DC/AC power inverter module, AC circuit wires, and connectors as if AC high-voltage is present. **Danger:** Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed. The High Voltage Disabling procedure will perform the following tasks: • Identify how to disable high voltage. • Identify how to test for the presence of high voltage. • Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed. Failure to follow the procedures exactly as written may result in serious injury or death.
⚠	**Caution:** The connector at the component cannot be disconnected or removed without damage to the component. If the connector is removed, the entire component with jumper harness must be replaced.
	Note: Twisted wires provide an effective shield that helps protect sensitive electronic components from electrical interference. In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted wires shown : • The wires must be twisted a minimum of 9 turns per 31 cm (12 in) as measured anywhere along the length of the wires. • The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in).

Fig. 44: Master Electrical Wiring Schematic Icons List Format
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** None at this time.
2. **Hotspot Link to Information:** None at this time.

Schematic RPO Code List

The schematic RPO code list only includes RPOs shown in schematics and also includes the country groupings for the options. This list is in addition to the vehicle RPO Code List that is included in General Information.



Schematics RPO Code List

Schematics RPO Code List

RPO	Description	Country Group
A45	MEMORY-SEAT ADJUSTER, MIRROR, POWER, DRIVER, PERSONALIZATION	U.S.A., PR and USVI (MAH)
A6C	ADJUSTER PASS ST-MANUAL, 4 WAY, PWR VERT	U.S.A., PR and USVI (MAH),Canada (MBC)
AED	WINDOW REG PASS DR-POWER OPERATED, EXPRESS DOWN	China
AEF	WINDOW REG PASS DR-POWER OPERATED, EXPRESS UP/DOWN	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX), China
AEQ	WINDOW-POWER OPERATED, RR DRS, EXPRESS DOWN	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
AER	WINDOW-POWER OPERATED, RR DRS, EXPRESS UP/DOWN	China
AF6	CONTROL-SEAT, MASSAGE, DRIVER	China
AG1	ADJUSTER FRT ST-POWER, MULTI-DIRECTIONAL, DRIVER	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
AG2	ADJUSTER PASS ST-POWER, MULTI-DIRECTIONAL	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
APG	CONTROL-SEAT, POWER LUMBAR, LH	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
APH	CONTROL-SEAT, POWER LUMBAR, RH	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
ASV	EQUIPMENT-SENSOR AIR MOISTURE and W/S TEMP	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
ATH	LOCK CONTROL, ENTRY-REMOTE ENTRY, EXTENDED RANGE, PASSIVE ENTRY, ALL DOORS	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
ATS	Lock Control, Entry – Remote Entry, Standard Range, Passive Entry	China
AW7	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER AND PASS FRT, FRT SEAT SIDE AND RR SEAT SIDE, ROOF SIDE	U.S.A., PR and USVI (MAH),Canada (MBC)
BTM	SWITCH-ENGINE START, KEYLESS	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
C67	HVAC SYSTEM-AIR CONDITIONER FRT, ELECTRONIC CONTROLS	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
CE1	WIPER SYSTEM-WINDSHIELD, PULSE, MOISTURE SENSITIVE	China
CE4	WASHER-HEADLAMP, HIGH PRESSURE	China
CF5	ROOF-SUN, GLASS, SLIDING, ELEC	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
CJ2	HVAC SYSTEM-AIR CONDITIONER FRT, AUTO TEMP CONT, AUX TEMP CONT	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
CZ2	COUNTRY-CHINA	China
DD8	MIRROR I/S R/V-LT SENSITIVE	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
EF7	COUNTRY-UNITED STATES OF AMERICA (USA)	U.S.A., PR and USVI (MAH)
F45	CHASSIS-CONTINUOUSLY VARIABLE REAL TIME DAMPING	U.S.A., PR and USVI (MAH),Canada (MBC)
FHS	VEHICLE FUEL-GASOLINE E85	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
HP6	HYBRID PROPULSION-ELECTRIC, PARALLEL, 14KW CONTINUOUS POWER	U.S.A., PR and USVI (MAH),Canada (MBC)
J71	BRAKE PARKING-POWER OPERATED	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
KA1	HEATER SEAT FRT-DRVR and PASS	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
KD4	RECEPTACLE-ELECTRICAL, FRT CONSOLE	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
KI6	RECEPTACLE-ELECTRICAL, FRT CONSOLE RR 110 VOLT	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
KRJ	CONTROL-CONSOLE, INFOTAINMENT, REDUNDANT CONTROLS, JOYSTICK	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
KTA	AUDIO INTERFACE-	China
KU1	VENTILATED SEAT DRVR-FRONT	U.S.A., PR and USVI (MAH)
KU3	VENTILATED SEAT PASS-FRONT	U.S.A., PR and USVI (MAH)
LAF	ENGINE-GAS, 4 CYL, 2.4L, SIDI,DOHC, VVT, ALUM, GM - DO NOT USE AFTER 2013, USE LEA	China
LDK	ENGINE-GAS, 4 CYL, 2.0L, DI, DOHC, TURBO-HO, VARIABLE CAMSHAFT PHASING - DO NOT USE AFTER 2013, USE LHU	China
LHU	ENGINE-GAS, 2.0L, SIDI, L4, DOHC TURBO, E85 MAX, ALUM	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
LLU	ENGINE-GAS, 4 CYL, 1.6L, MFI, DOHC, TURBO, PT-JV, 132KW	China
LTD	ENGINE-GAS, 4 CYL, 2.0L, MFI, ALUM, DOHC, SGM	China
LUK	ENGINE-GAS, 4 CYL, 2.4L, DI, ALUM, DOHC, BAS, ECOTEC	U.S.A., PR and USVI (MAH),Canada (MBC)
MDK	TRANSMISSION-AUTO 6 SPD, AISIN-WARNER, A6-AF40, ELECTRONIC, GEN2	U.S.A., PR and USVI (MAH),Canada (MBC)
MH8	TRANSMISSION-AUTO 6 SPD, HMD, X23F	U.S.A., PR and USVI (MAH),Canada (MBC)
MHH	TRANSMISSION-AUTO 6 SPD, HMD, GM, BAS+, 6T40, HYBRID, FWD	U.S.A., PR and USVI (MAH),Canada (MBC)
MHK	TRANSMISSION-AUTO 6 SPD, 6T50	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
MR6	TRANSMISSION-MAN 6 SPD, OPEL, 83MM, 3.92 1ST, 0.62 6TH (F40 WR), REDUCE HELIX	U.S.A., PR and USVI (MAH),Canada (MBC)
NJ1	STEERING-POWER, NON-VARIABLE RATIO, ELECTRIC	U.S.A., PR and USVI (MAH),Canada (MBC)
NU6	EMISSION SYSTEM-CALIFORNIA, PZEV	U.S.A., PR and USVI (MAH)
NV7	STEERING-POWER, VARIABLE EFFORT	U.S.A., PR and USVI (MAH),Canada (MBC),Mexico (MCX)
NXC	STEERING-POWER, VARIABLE EFFORT, REDUCED RACK TRAVEL	U.S.A., PR and USVI (MAH),Canada (MBC)
T4A	HEADLAMPS-HALOGEN	U.S.A., PR and USVI (MAH),Canada (MBC)

[Fig. 45: Schematic RPO Code List](#)
Courtesy of GENERAL MOTORS COMPANY

1. **Mouse-over:** None at this time.
2. **Hotspot Link to Information:** None at this time.

ELECTRICAL SCHEMATIC SYMBOLS

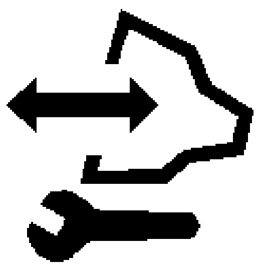
Voltage Indicators

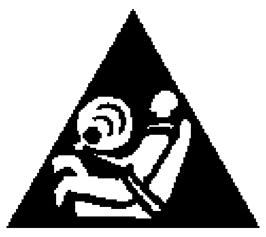
Symbol	Description
B+	Battery Voltage
IGN 0	Ignition Switch - Off Position

Symbol	Description
IGN I	Ignition Switch - Accessory Position
IGN II	Ignition Switch - Run Position
IGN III	Ignition Switch - Start Position

General Icons

Symbol	Description

Symbol	Description
LOC	Master Component List Icon This icon is used on the schematic to link to the Master Electrical Component List.
DESC	Description and Operation Icon This icon is used on the schematic to link to the Description and Operation of that particular system.
	Computer Programming Icon This icon is used on the schematic to link to Control Module References, which identifies which components need programming upon replacement.

Symbol	Description
➡	Next Schematic Page Icon This icon is used on the schematic to navigate to the next schematic in the subsystem.
⬅	Previous Schematic Page Icon This icon is used on the schematic to navigate to the previous schematic in the subsystem.
	Supplemental Inflatable Restraint (SIR) or Supplemental Restraint System (SRS) Icon This icon is used to alert the technician that the system contains SIR/SRS components that require certain precautions before servicing.

Symbol	Description
ℹ	Information Icon This icon is used to alert the technician that there is additional information that will aid in servicing a system.
⚠	Danger Icon This icon is intended to alert the technician that a component within the system contains labeling with the same icon. This icon is used when a source component has potential for 60 volts DC or greater or has potential for 42 volts AC or greater.
⚡	High Voltage Icon This icon is intended to alert the technician that a component within the system contains labeling with the same icon. This icon is used when a component/circuit has potential for 60 volts DC or greater or has potential for 42 volts AC or greater.

Symbol	Description
⚠	Caution Icon This icon is used to advise the technician to use caution when servicing this component. This icon may be used when a component/circuit has a voltage range potential between 30-60 volts DC or 15-42 volts AC.
⇅	Functional Serial Data Communication This icon is used to show the technician that the serial data circuit detail is shown incomplete. It also provides an active link to the Data Communication Schematics were the circuit is shown complete.

Switch Position Icons

Symbol	Description
↑ ∧ △	Generic Up Arrows

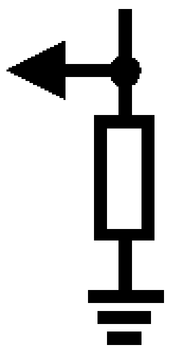
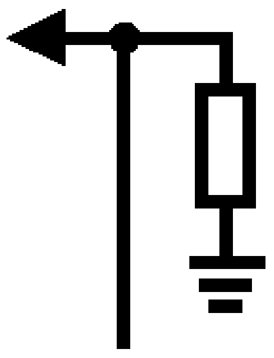
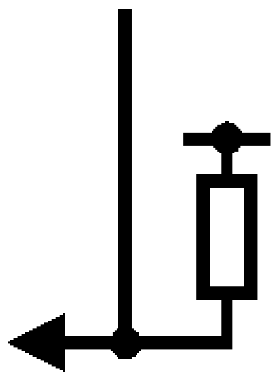
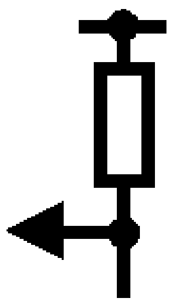
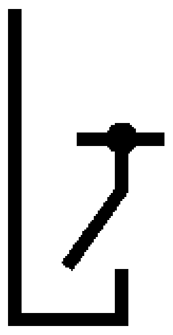
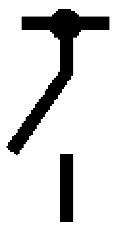
Symbol	Description
↓ ∨ ▽	Generic Down Arrows
← < ◁	Generic Left Arrows
→ > ▷	Generic Right Arrows

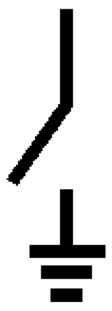
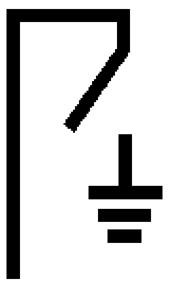
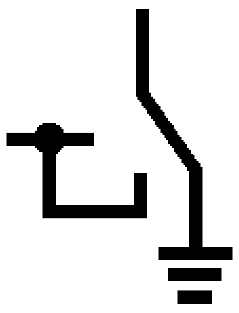
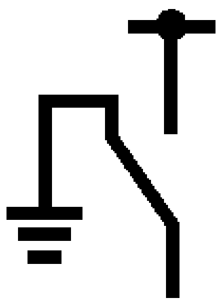
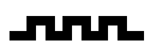
Symbol	Description
⇊	Generic Express Down Arrows
⏻	On/Off Icon
🔒	Generic Lock Icon

Symbol	Description
🔓	Generic Unlock Icon
▛ ▜ ▙ ▟	Generic Window Switch Positions - 4 Door
◧ ◨	Generic Window Switch Positions - 2 Door

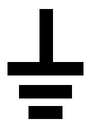
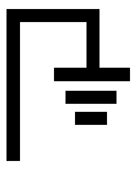
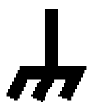
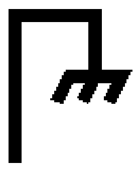
Module Circuit Function Icons

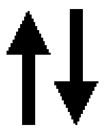
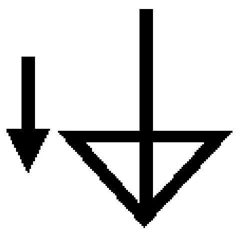
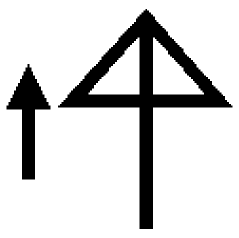
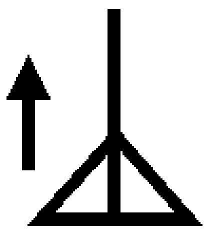
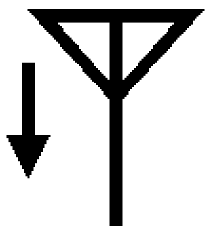
Symbol	Description

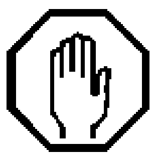
Symbol	Description
 	I/O Pull-Down Resistors (-)
 	I/O Pull-Up Resistors (+)
 	I/O High-Side Drive Switch (+)

Symbol	Description
 	I/O Low-Side Drive Switch (+)
 	I/O Bidirectional Switch (+/-)
	Pulse-Width Modulation Symbol

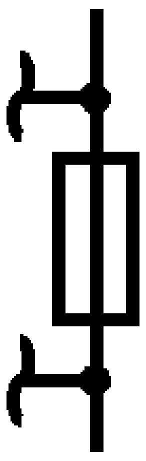
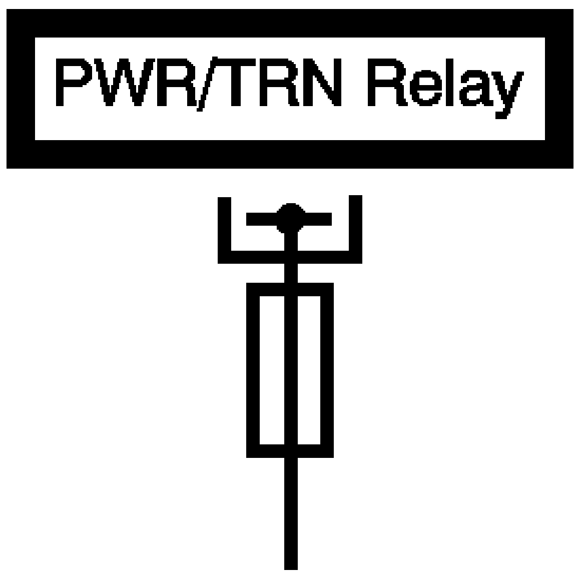
Symbol	Description
B+	Battery Voltage
IGN	Ignition Voltage
5V	Voltage Reference

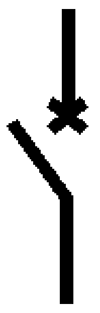
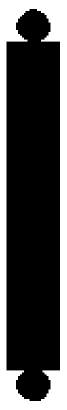
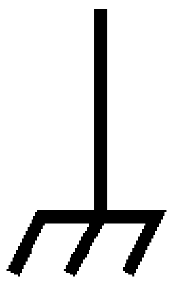
Symbol	Description
5V AC	A/C Voltage
 	Low Reference
 	Ground

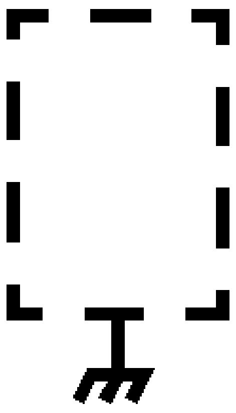
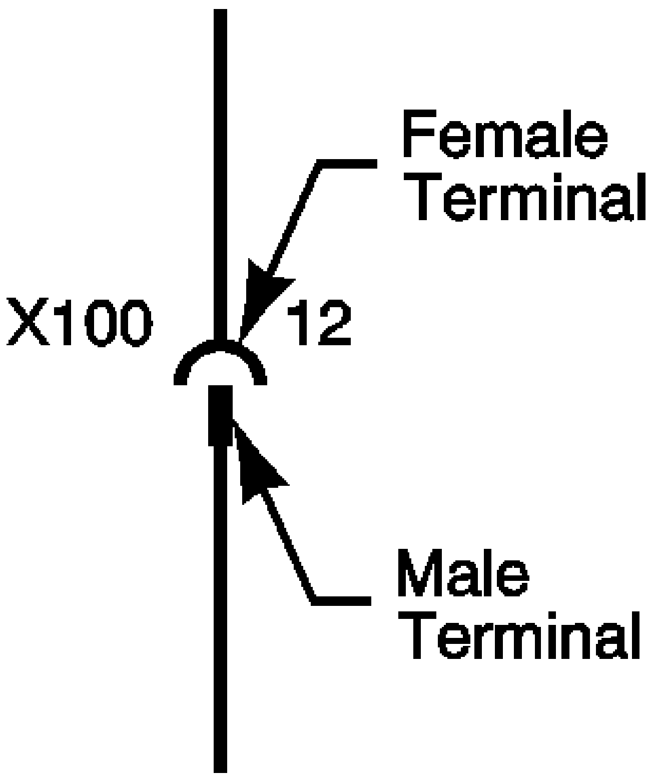
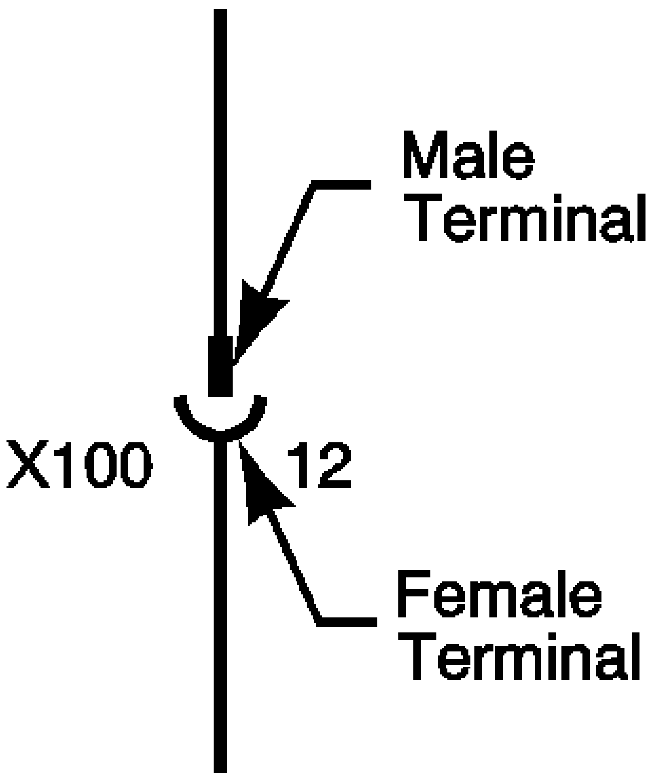
Symbol	Description
	Serial Data
 	Antenna Signal - In
 	Antenna Signal - Out

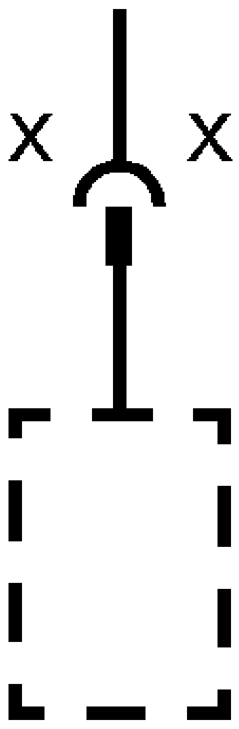
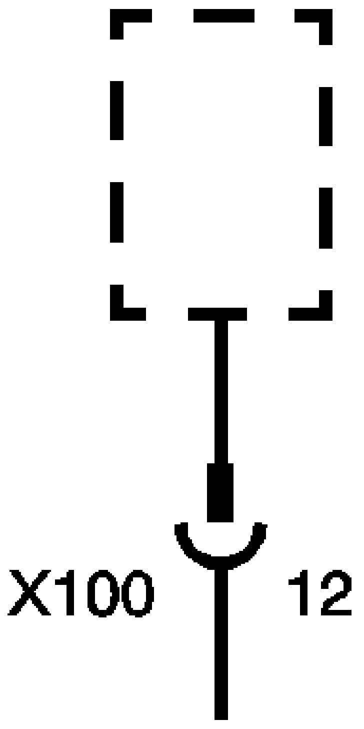
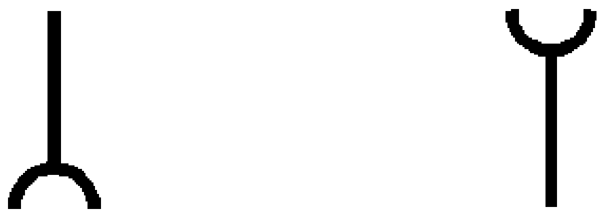
Symbol	Description
	Brake Apply

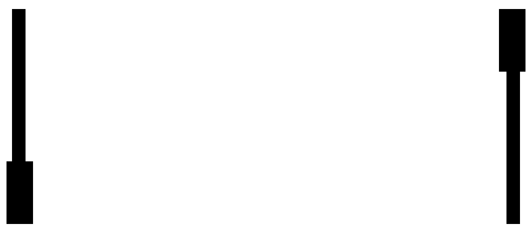
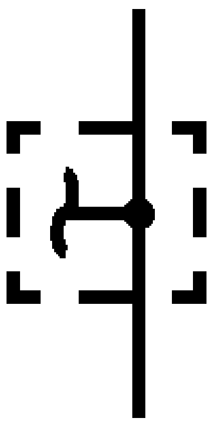
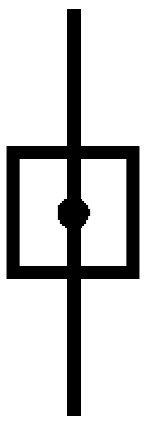
Harness Components

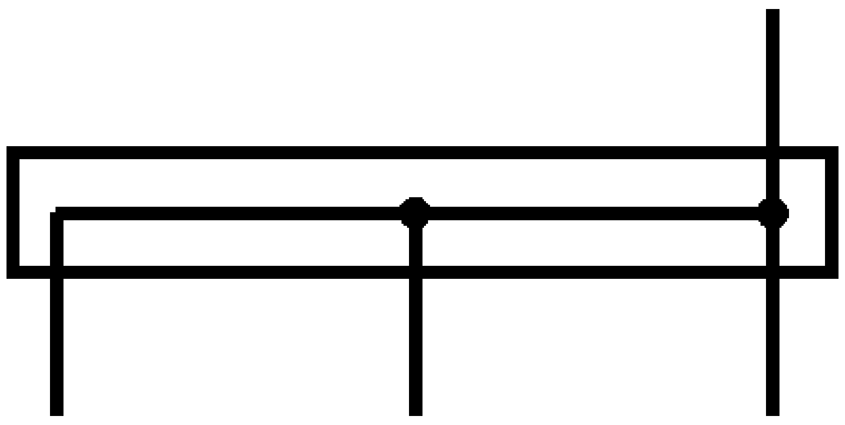
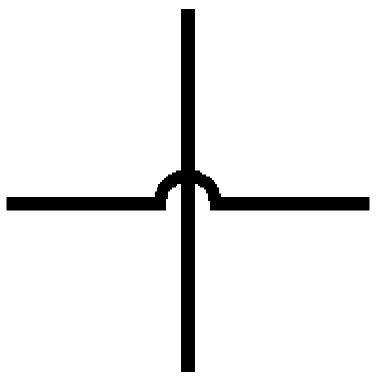
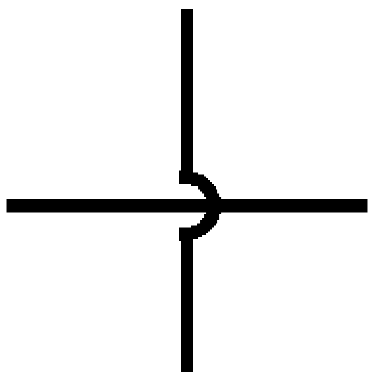
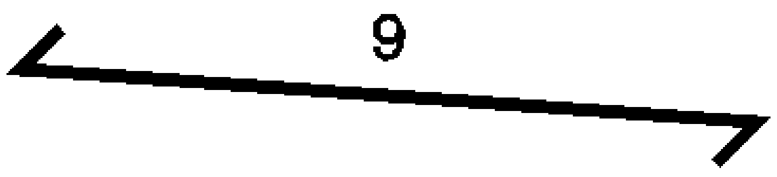
Symbol	Description
	Fuse
 PWR/TRN Relay	Fuse Supplied by a Relay

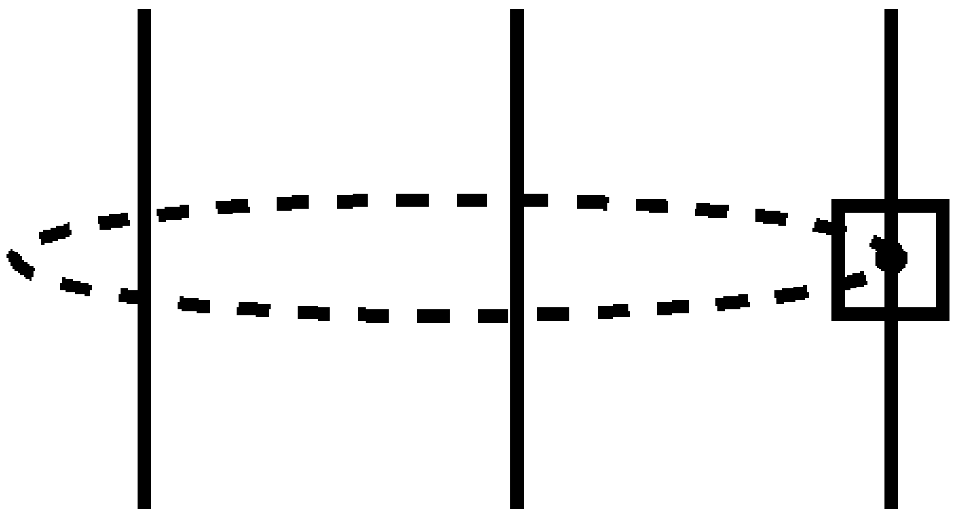
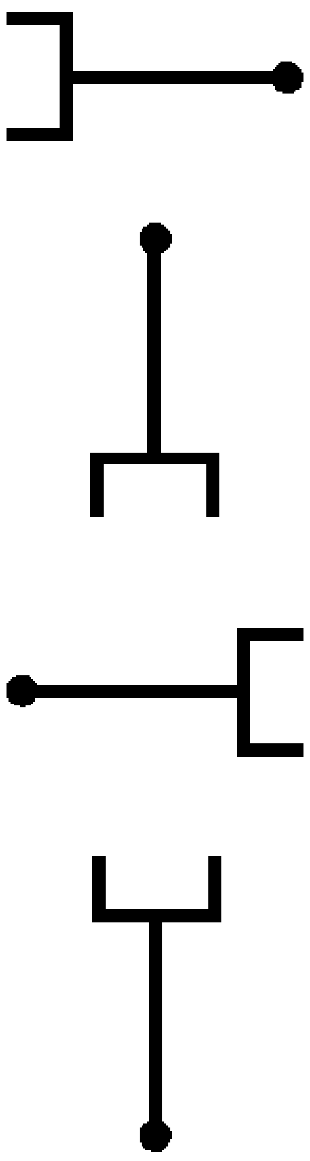
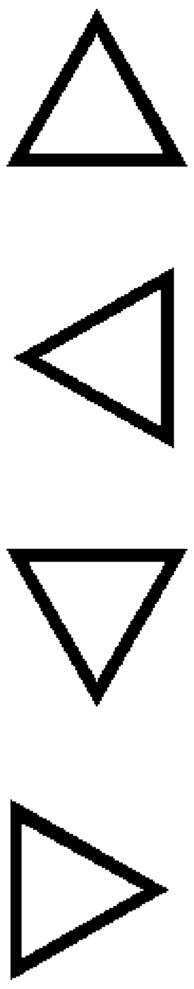
Symbol	Description
	Circuit Breaker
	Fusible Link
	Ground

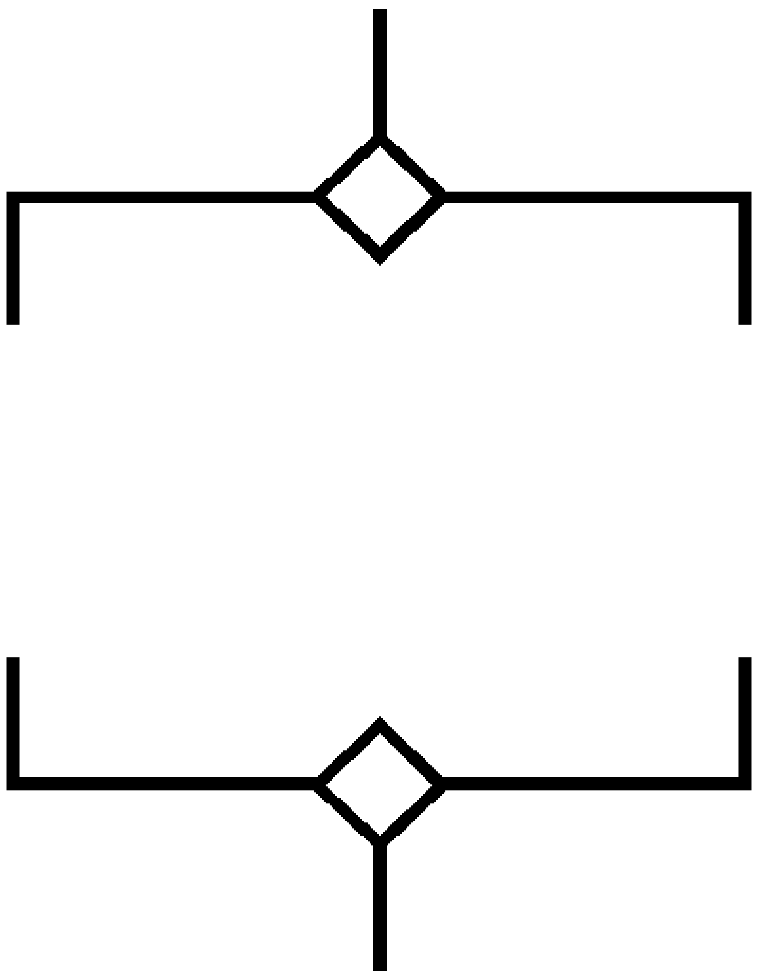
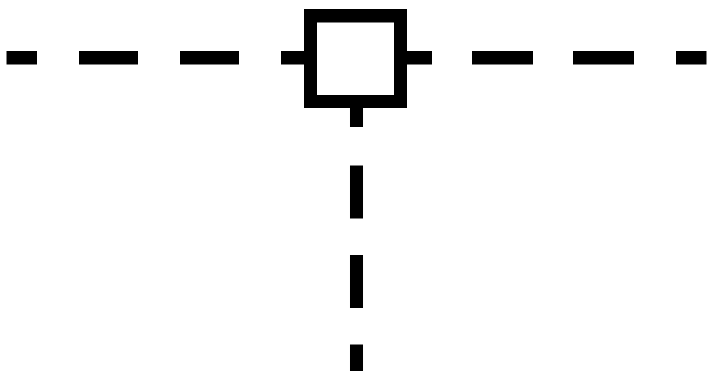
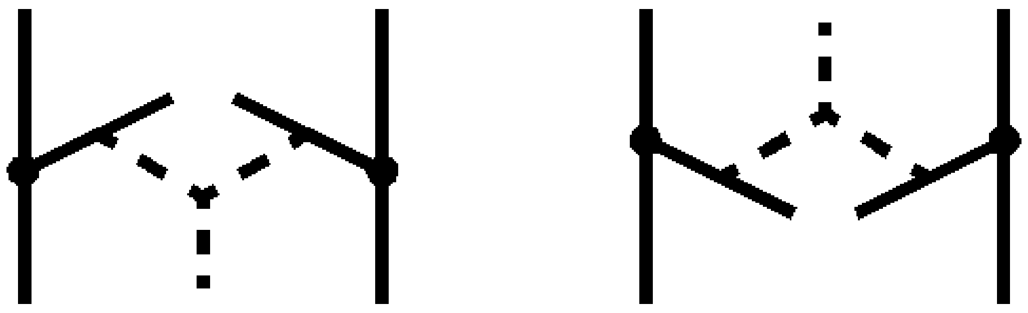
Symbol	Description
	Case Ground
 Female Terminal X100 12 Male Terminal	Inline Harness Connector
 Male Terminal X100 12 Female Terminal	Inline Harness Connector

Symbol	Description
	Pigtail Connection
	Pigtail Connection
	Provisional or Diagnostic Connector

Symbol	Description
	Blunt Cut Wire
	Incomplete Physical Splice
	Complete Physical Splice - 2 Wires

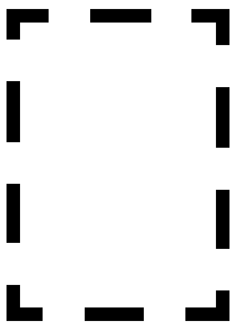
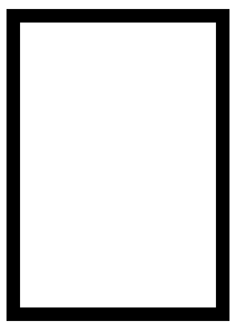
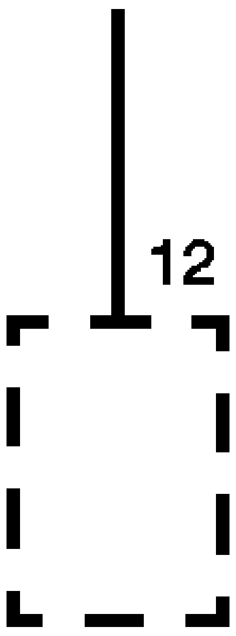
Symbol	Description
	Complete Physical Splice - 3 or more wires
 	Wire Crosses
	Twisted Wires

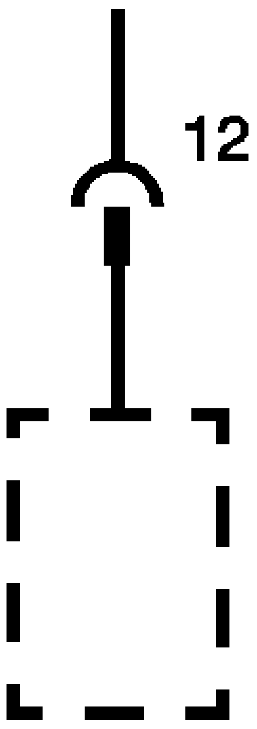
Symbol	Description
	Shield
	Circuit References
	Circuit Continuation Arrowheads

Symbol	Description
	Option Breakpoint
	Ground Circuit Connection
	Connector Shorting Clip

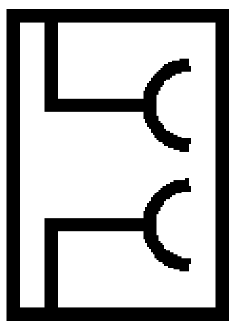
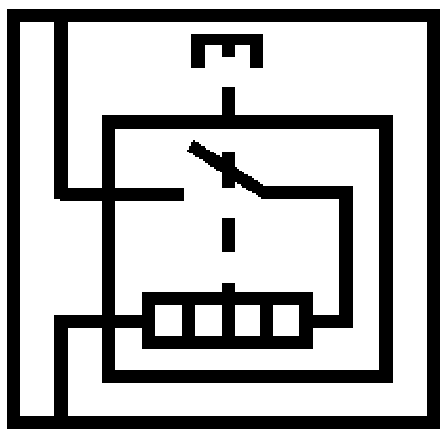
Component Parts

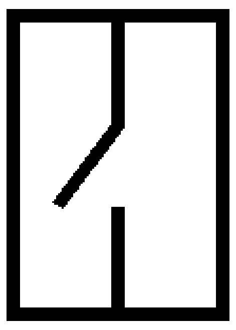
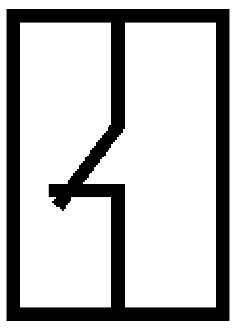
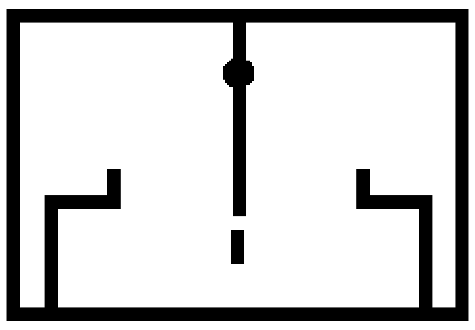
Symbol	Description

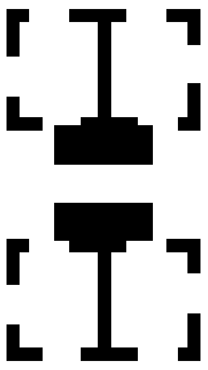
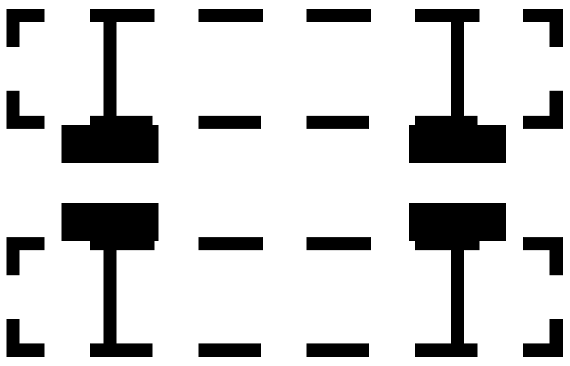
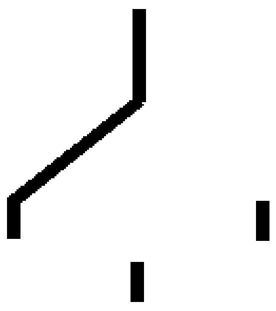
Symbol	Description
	Partial Component When a component is represented in a dashed box, the component or its wiring is not shown in its entirety.
	Entire Component When a component is represented in a solid box the component or its wiring is shown in its entirety.
	Connector Directly Attached to Component

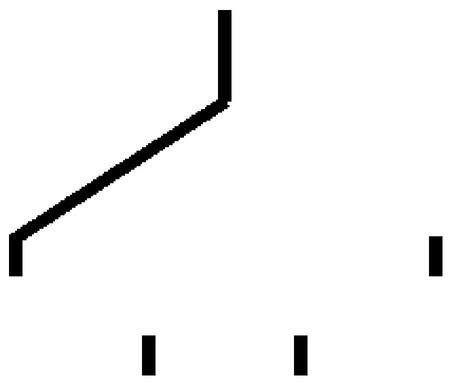
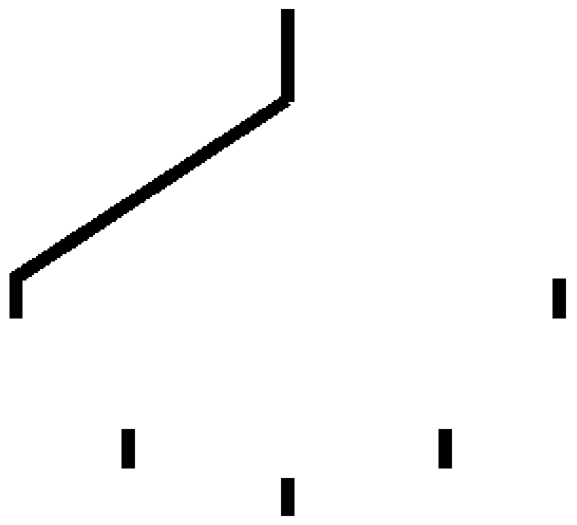
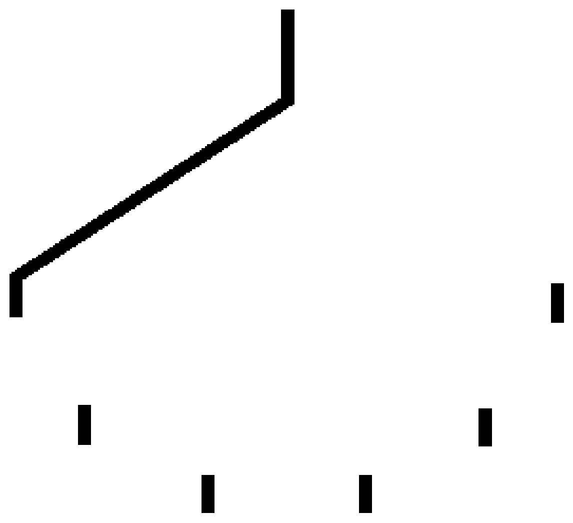
Symbol	Description
	Pigtail Connector

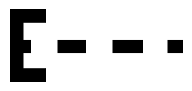
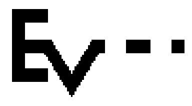
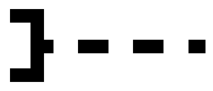
Switches and Relays

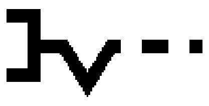
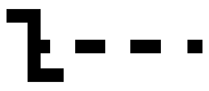
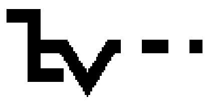
Symbol	Description
	Accessory Power Outlet
	Cigar Lighter

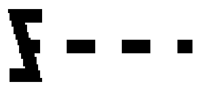
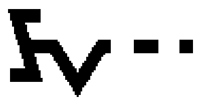
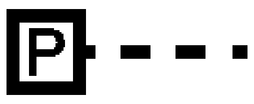
Symbol	Description
	Switch - 2 Position Normally Open
	Switch - 2 Position Normally Closed
	Switch - Rocker

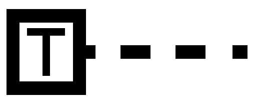
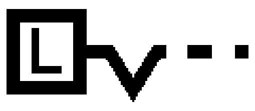
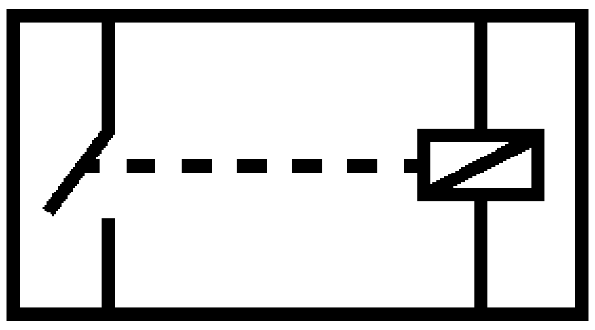
Symbol	Description
	Switch - Contact Plate (1 Wire)
	Switch - Contact Plate (2 Wire)
	Switch - 3 Position

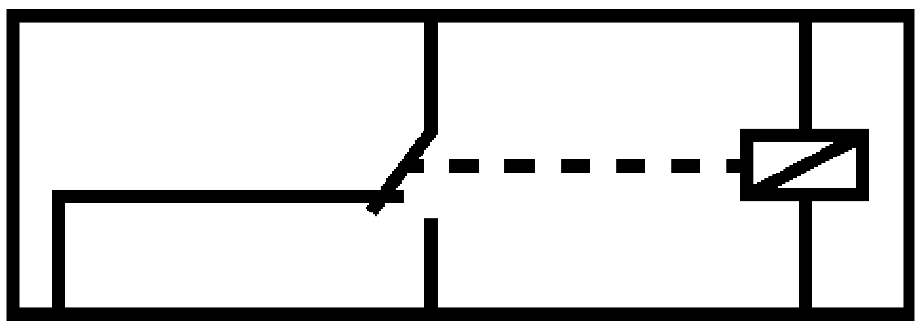
Symbol	Description
	Switch - 4 Position
	Switch - 5 Position
	Switch - 6 Position

Symbol	Description
	Switch Actuator - Push (Momentary)
	Switch Actuator - Push (Latching)
	Switch Actuator - Pull (Momentary)

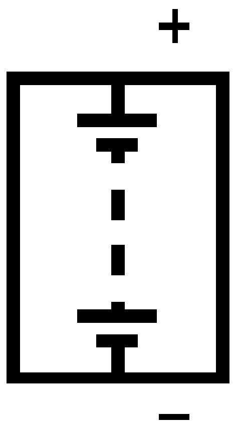
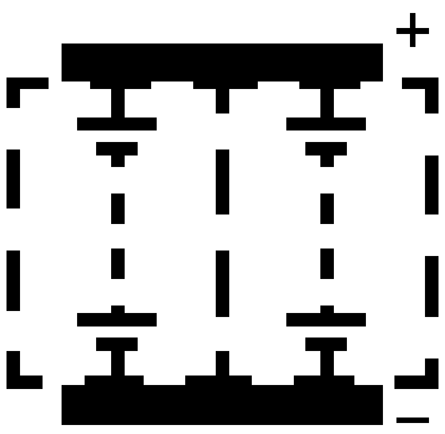
Symbol	Description
	Switch Actuator - Pull (Latching)
	Switch Actuator - Rotate (Momentary)
	Switch Actuator - Rotate (Latching)

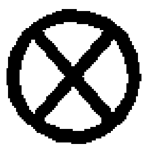
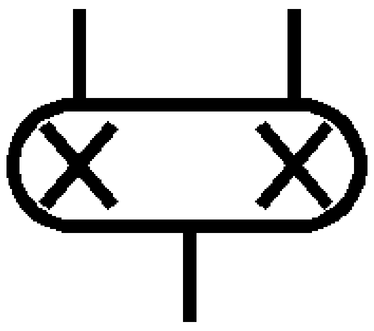
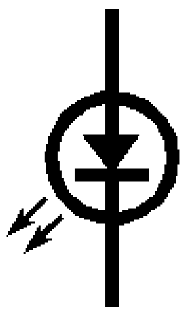
Symbol	Description
	Switch Actuator - Slide (Momentary)
	Switch Actuator - Slide (Latching)
	Switch Actuator - Pressure (Momentary)

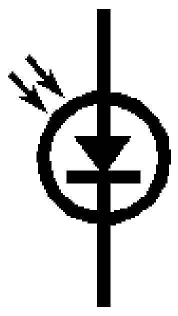
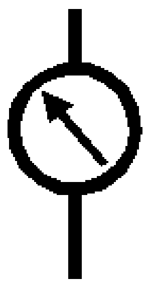
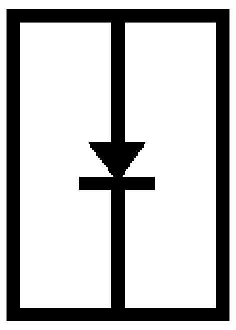
Symbol	Description
	Switch Actuator - Temperature (Momentary)
	Switch Actuator - Volume (Latching)
	4-Pin Single Pole/Throw Relay - Normally Open

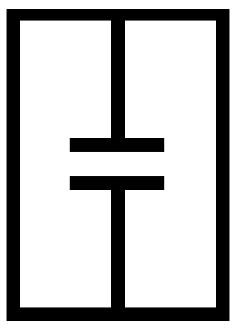
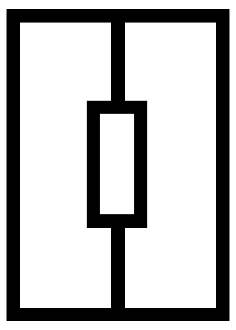
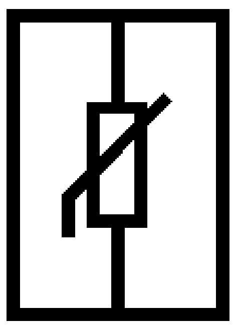
Symbol	Description
	5-Pin Relay - Normally Closed

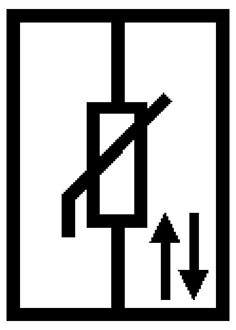
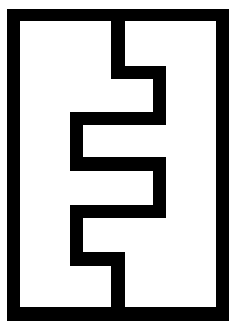
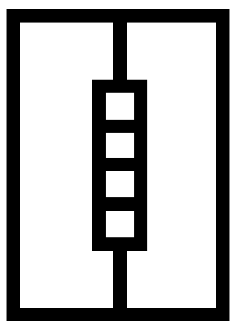
Devices and Sensors

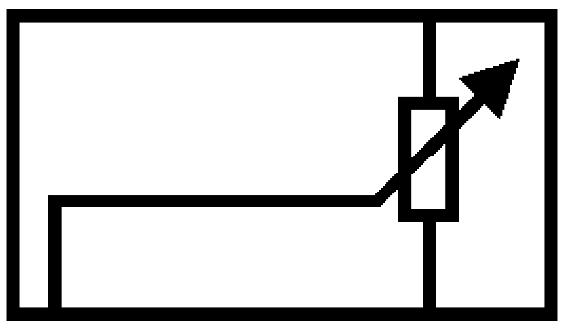
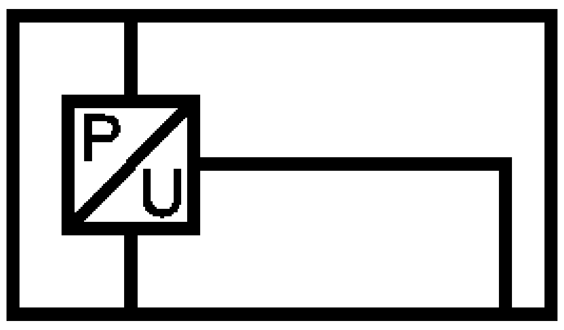
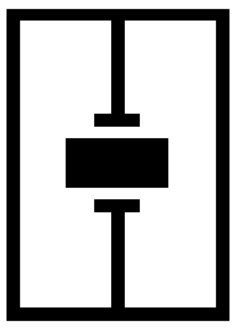
Symbol	Description
	Battery
	Battery Assembly - Hybrid

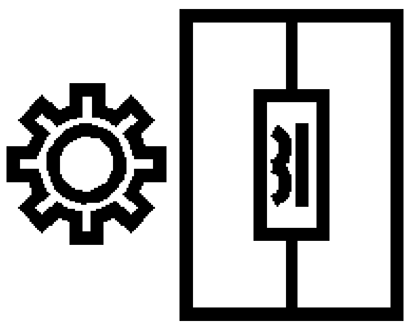
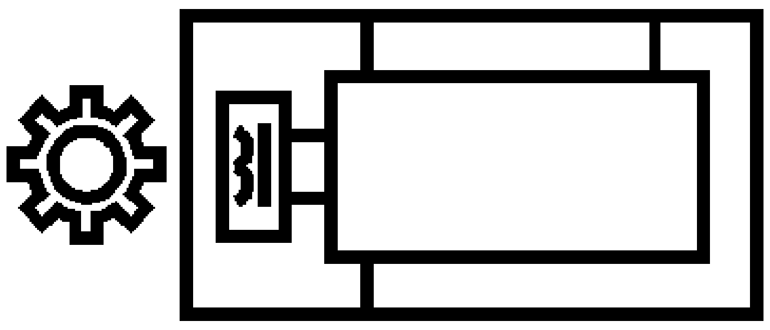
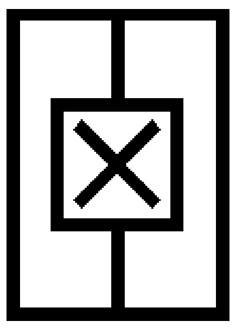
Symbol	**Description**
	Single Filament Light Bulb
	Double Filament Light Bulb
	Light Emitting Diode (LED)

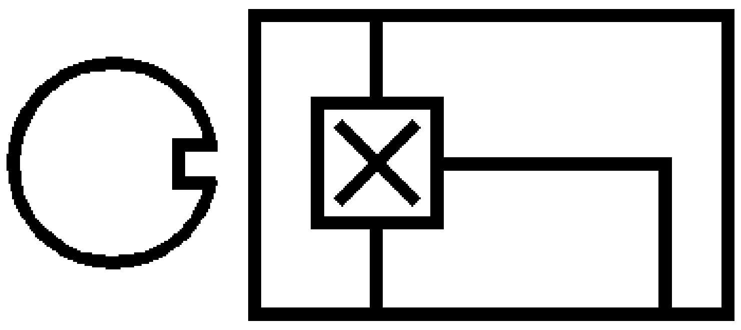
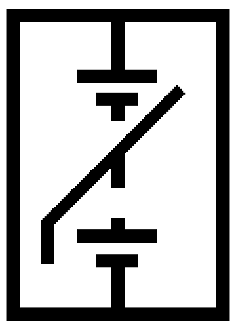
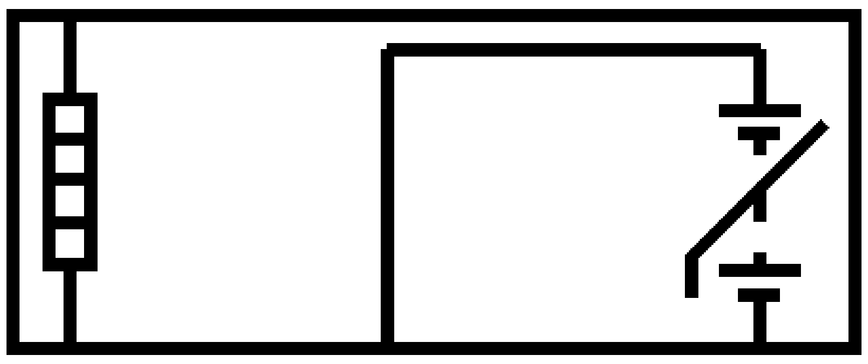
Symbol	Description
	Photo Sensor
	Gauge
	Diode

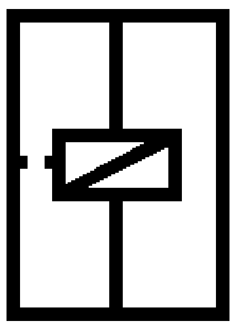
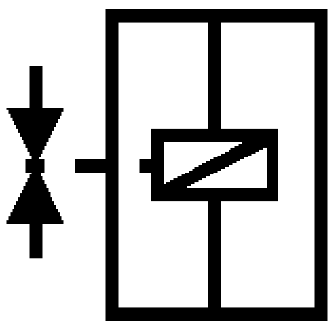
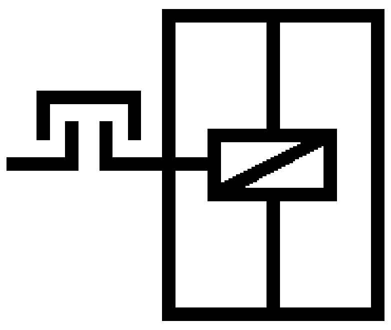
Symbol	Description
	Capacitor
	Resistor
	Variable Resistor

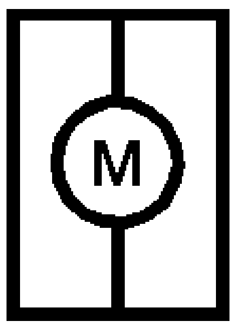
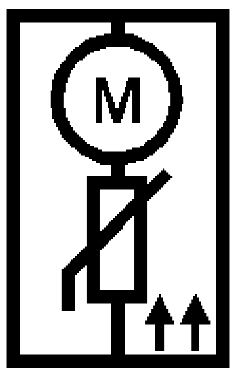
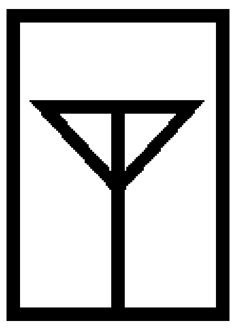
Symbol	Description
	Variable Resistor - NTC
	Breakable Wire
	Heating Element

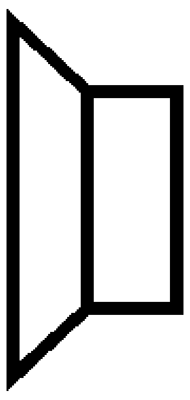
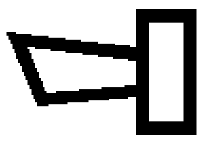
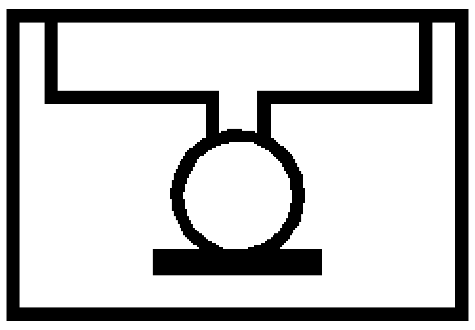
Symbol	Description
	Position Sensor
	Pressure Sensor
	Knock Sensor

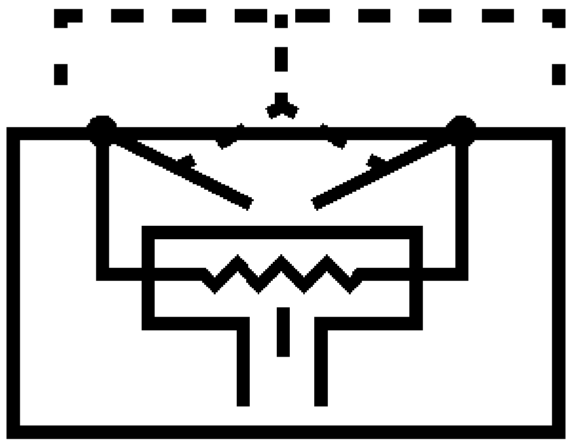
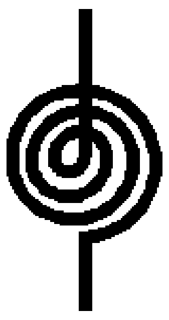
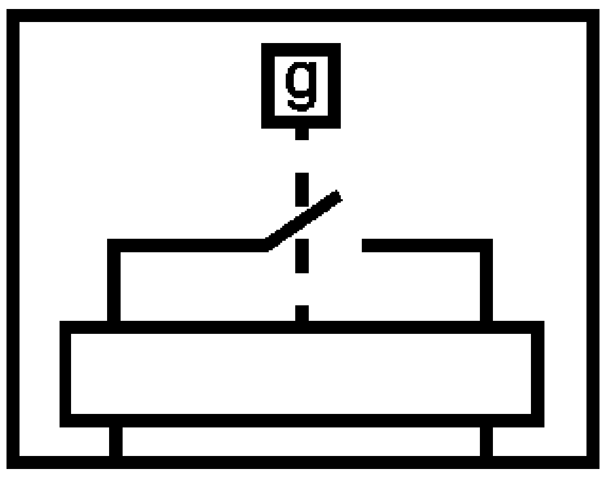
Symbol	Description
	Inductive Type Sensor - 2-Wire
	Inductive Type Sensor - 3-Wire
	Hall Effect Sensor - 2-Wire

Symbol	Description
	Hall Effect Sensor - 3-Wire
	Oxygen Sensor - 2-Wire
	Heated Oxygen Sensor - 4-Wire

Symbol	Description
	Solenoid - Actuator
	Solenoid - Valve
	Clutch

Symbol	Description
	Motor
	Motor with PTC
	Antenna

Symbol	Description
	Speaker
	Horn
	Microphone

Symbol	Description
	Airbag
	SIR Coil
	SIR Impact Sensor

VEHICLE ZONING STRATEGY

All grounds, in-line connectors, and splices have identifying numbers that correspond to where they are located in the vehicle. The following table explains the numbering system.

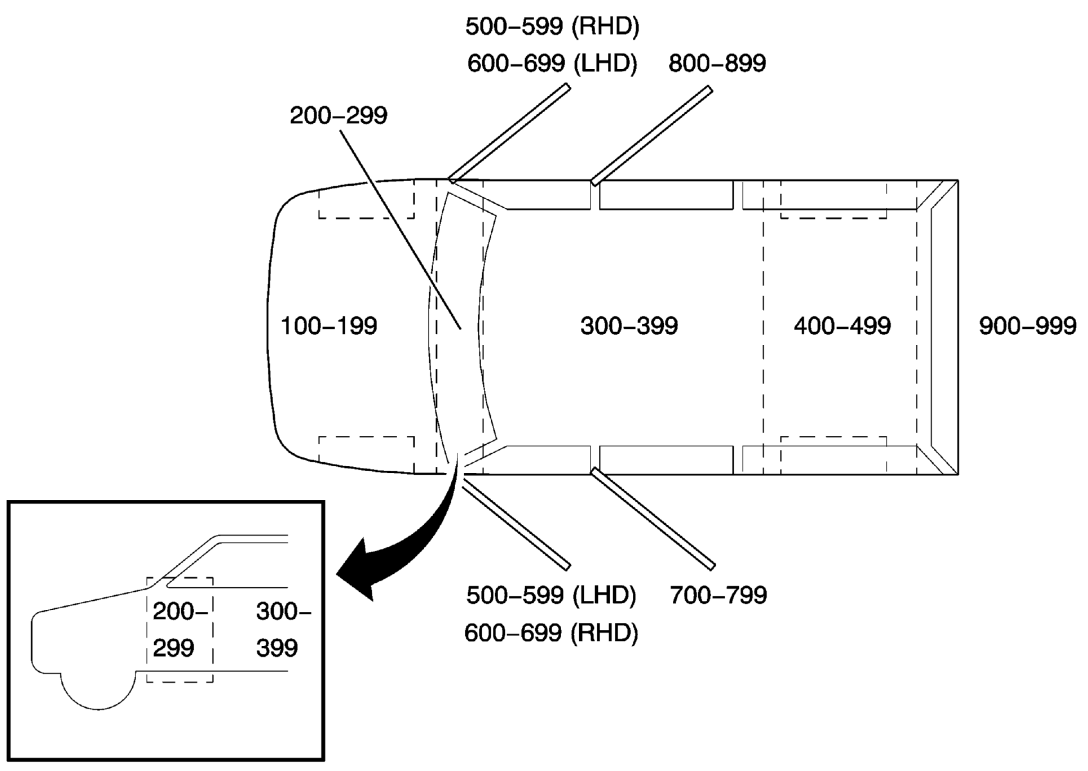


Fig. 46: Utility/Van Zoning
Courtesy of GENERAL MOTORS COMPANY

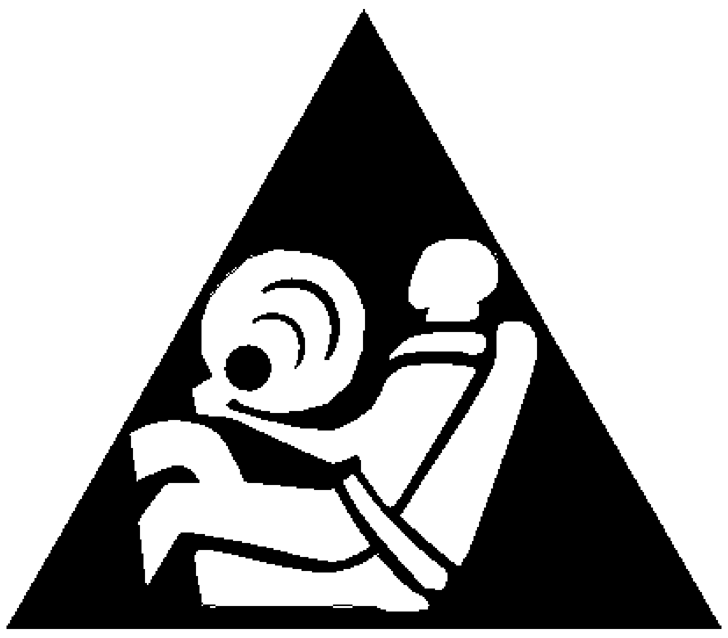
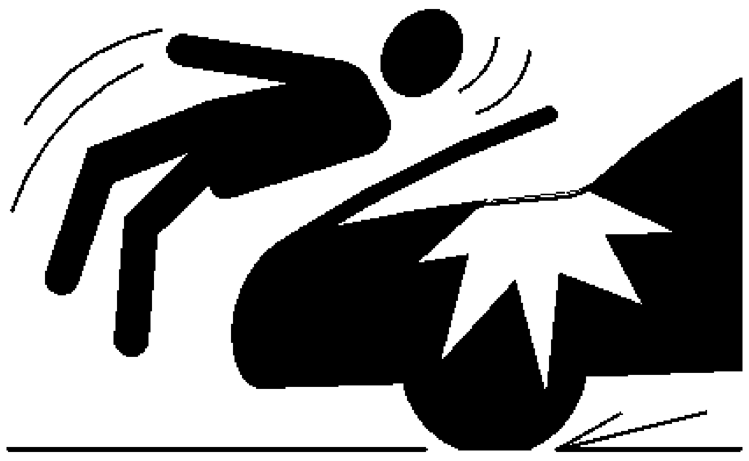
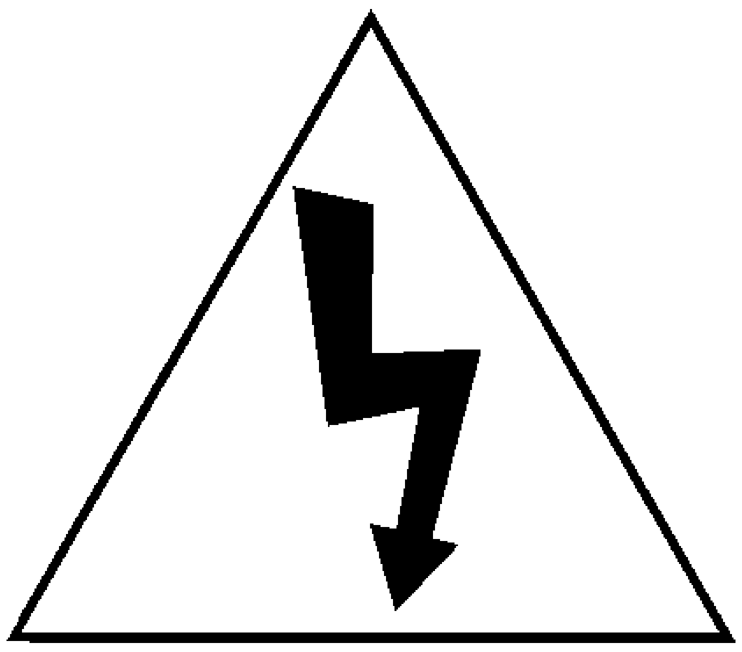
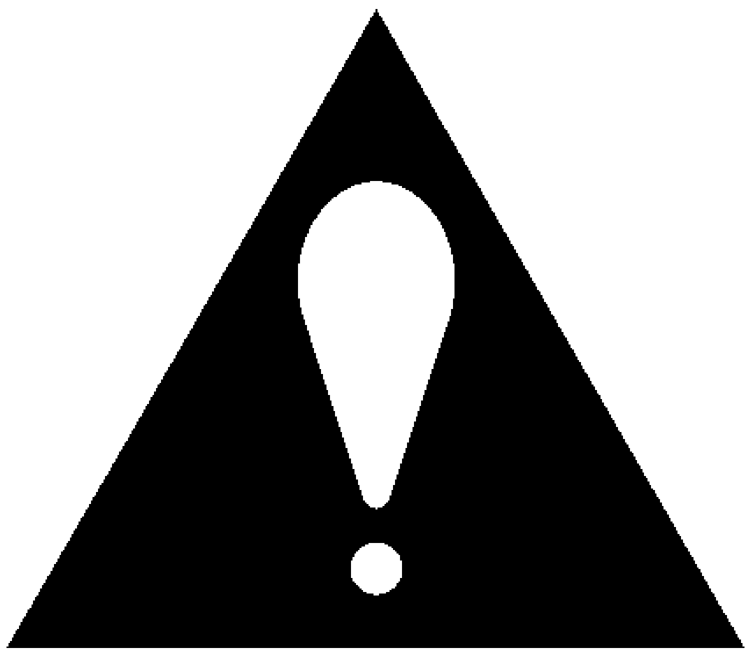
Callout Numbers	Zone Description
100-199	Engine compartment (all forward of the instrument panel)
200-299	Within the instrument panel area (between the bulkhead and the front plane of the instrument panel)
300-399	Passenger compartment (from instrument panel to the back of the 2nd row seats)
400-499	Luggage compartment (from the back of the 2nd row seats to the rear of the vehicle, including any additional rows of seating rear of the 2nd row seats)
500-599	Inline harness connectors to or within the driver door
600-699	Inline harness connectors to or within the front passenger door
700-799	Inline harness connectors to or within the left rear door
800-899	Inline harness connectors to or within the right rear door
900-999	Inline harness connectors to or within the liftgate, lift window, endgate, or rear doors

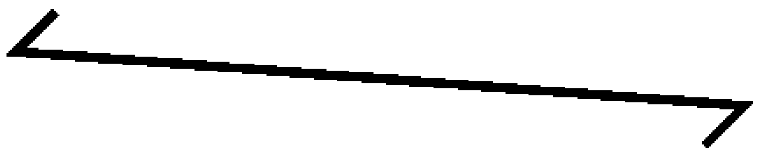
SCHEMATICS RPO CODE LIST

RPO	Option Name	Country Group
AL0	SENSOR INDICATOR-INFLATABLE RESTRAINT, FRT PASS/CHILD PRESENCE DETECTOR	U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX)
AY0	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER and PASS FRT, SEAT SIDE, ROOF SIDE	Korea (MAW)
AYF	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER and PASS FRT, FRT SEAT SIDE and RR SEAT SIDE, ROOF SIDE, KNEE	U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX)
C9J	LAMP-INTR, AMBIENT, I/P	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
CBT	PROVISIONS-FAST CHARGING ACCOMMODATIONS	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW), Mexico (MCX)
CE1	WIPER SYS WINDSHIELD-PULSE, MOISTURE SENSITIVE	Korea (MAW)
CV3	COUNTRY-MEXICO	Mexico (MCX)
CW1	COUNTRY-KOREA	Korea (MAW)
DD8	MIRROR I/S R/V-LT SENSITIVE	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
DLR	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, HEATED, POWER FOLDING, COLOR, TURN SIGNAL	Korea (MAW)
DLS	MIRROR O/S-LH and RH, REMOTE CONTROL, ELECTRIC, HEATED, MANUAL FOLDING, COLOR, TURN SIG IND	U.S.A., PR and USVI (MAH), Canada (MBC)
DRZ	MIRROR I/S R/V-LT SENSITIVE, FULL VIDEO DISPLAY	U.S.A., PR and USVI (MAH), Canada (MBC)
EF7	COUNTRY-UNITED STATES	United States (MAH)
K34	CRUISE CONTROL-AUTOMATIC, ELECTRONIC	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW), Mexico (MCX)
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
KA1	HEATER SEAT FRT-DRVR and PASS	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
KA6	HEATER SEAT-REAR	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
TQ5	HEADLAMP HIGH BEAM-AUTO CONTROL	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL	Korea (MAW)
UD5	PARK ASSIST-FRONT AND REAR	Korea (MAW)
UD7	PARK ASSIST-REAR	U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX)
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR	U.S.A., PR and USVI (MAH), Canada (MBC), Mexico (MCX)
UE4	SENSOR INDICATOR-FOLLOWING DISTANCE	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
UFG	SENSOR INDICATOR-REAR CROSS TRAFFIC ALERT	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW), Mexico (MCX)
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)	Korea (MAW)
UHX	LANE ACTIVE SAFETY-KEEP ASSIST	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW), Mexico (MCX)
UKJ	PED DETECTION FRT-BASIC, PEDESTRIANS	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
UQ3	SPEAKER SYSTEM-ENHANCED AUDIO	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW), Mexico (MCX)
UQA	SPEAKER SYSTEM-PREMIUM AUDIO, BRANDED AMPLIFIER	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
USS	RECEPTACLE-USB CHARGE PORT	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
UVC	VISION-REAR VIEW, MONO, ANALOG	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW), Mexico (MCX)
UVD	STEERING WHEEL HEAT-MANUAL	U.S.A., PR and USVI (MAH), Canada (MBC), Korea (MAW)
UVH	VISION-360 VIEW, MONO, ANALOG	U.S.A., PR and USVI (MAH), Canada (MBC)
Z49	COUNTRY-CANADA	Canada (MBC)

MASTER ELECTRICAL SCHEMATIC ICONS

Icon	Icon Definition

Icon	Icon Definition
	WARNING: **When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.**
	WARNING: **When performing service on or near the pedestrian impact detection system (PIDS) components or the PIDS wiring, the PIDS must be disabled. Failure to observe the correct procedure could cause deployment of the PIDS components. Serious injury can occur. Failure to observe the correct procedure could also result in unnecessary PIDS repairs**
	WARNING: **The high intensity discharge system produces high voltage and current. To reduce the risk of severe shocks and burns:** • **Never open the high intensity discharge system ballast or the arc tube assembly starter.** • **Never probe between the high intensity discharge system ballast output connector and the arc tube assembly.** WARNING: **To help avoid personal injury, always treat the accessory power receptacle, accessory DC/AC power inverter module, AC circuit wires, and connectors as if AC high-voltage is present.** WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.** **The High Voltage Disabling procedure will perform the following tasks:** • **Identify how to disable high voltage.** • **Identify how to test for the presence of high voltage.** • **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.** **Failure to follow the procedures exactly as written may result in serious injury or death.**
	**CAUTION:** **The connector at the component cannot be disconnected or removed without damage to the component. If the connector is removed, the entire component with jumper harness must be replaced.**

Icon	Icon Definition
	**NOTE:** **Twisted wires provide an effective shield that helps protect sensitive electronic components from electrical interference.** **In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted wires shown :** • **The wires must be twisted a minimum of 9 turns per 31 cm (12 in) as measured anywhere along the length of the wires.** • **The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in).**

POWER DISTRIBUTION SCHEMATICS

B+ Bus (1 of 2)

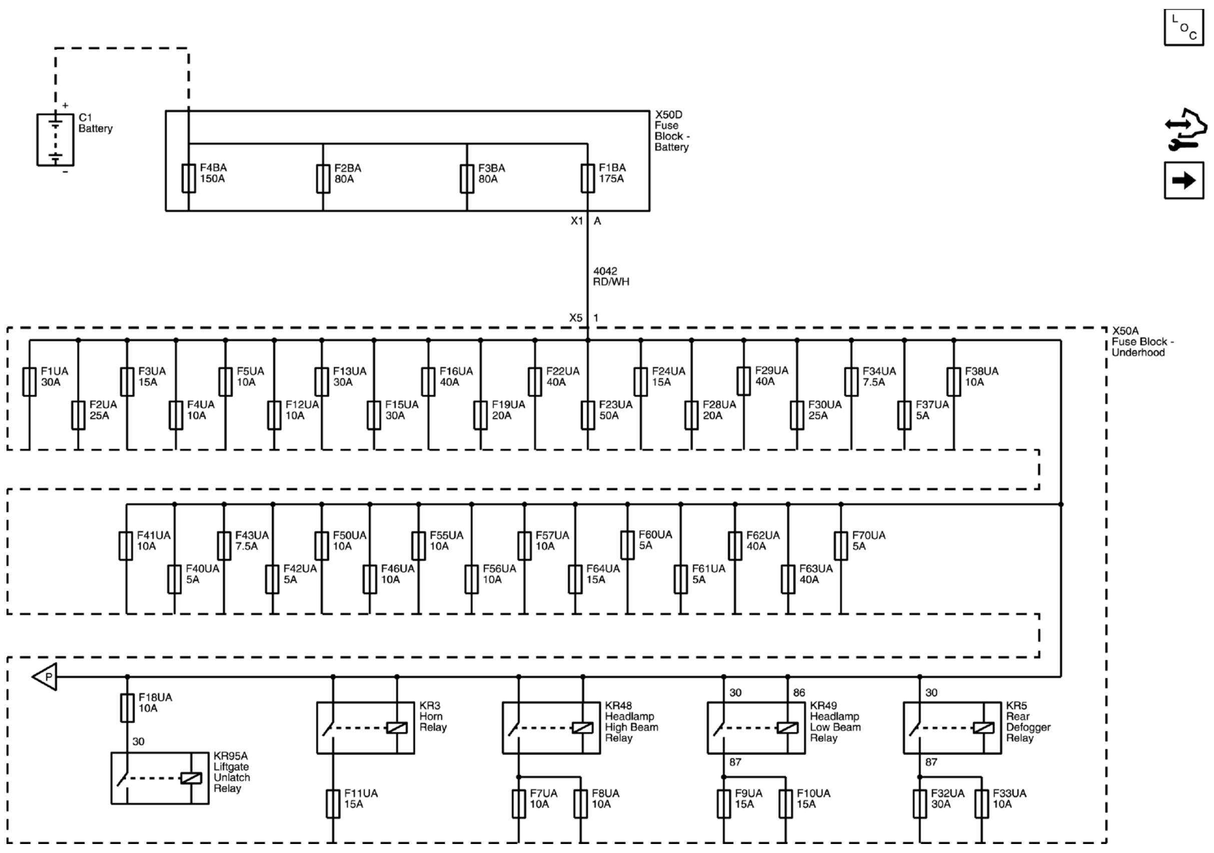

C1 Battery
X50D Fuse Block - Battery
F4BA 150A
F2BA 80A
F3BA 80A
F1BA 175A
X1 A
4042 RD/WH
X5 1
X50A Fuse Block - Underhood
F1UA 30A
F2UA 25A
F3UA 15A
F4UA 10A
F5UA 10A
F12UA 10A
F13UA 30A
F15UA 30A
F16UA 40A
F19UA 20A
F22UA 40A
F23UA 50A
F24UA 15A
F28UA 20A
F29UA 40A
F30UA 25A
F34UA 7.5A
F37UA 5A
F38UA 10A
F41UA 10A
F40UA 5A
F43UA 7.5A
F42UA 5A
F50UA 10A
F46UA 10A
F55UA 10A
F56UA 10A
F57UA 10A
F64UA 15A
F60UA 5A
F61UA 5A
F62UA 40A
F63UA 40A
F70UA 5A
P
F18UA 10A
30
KR95A Liftgate Unlatch Relay
KR3 Horn Relay
F11UA 15A
KR48 Headlamp High Beam Relay
F7UA 10A
F8UA 10A
30
86
KR49 Headlamp Low Beam Relay
87
F9UA 15A
F10UA 15A
30
KR5 Rear Defogger Relay
87
F32UA 30A
F33UA 10A
LOC

Fig. 47: B+ Bus (1 of 2)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_1	1
CONN_X5	X5
4042	Battery Positive Voltage
CAV_A	A
CONN_X1	X1
4042_RD/WH	4042 RD/WH
CAV_30	30
CAV_87	87
CAV_30	30
CAV_87	87
CAV_86	86
CAV_30	30
F4BA	F4BA 150A
F1BA	F1BA 175A
F11UA	F11UA 15A
F7UA	F7UA 10A
F8UA	F8UA 10A
F24UA	F24UA 15A
F22UA	F22UA 40A
F19UA	F19UA 20A
F16UA	F16UA 40A
F13UA	F13UA 30A
F5UA	F5UA 10A
F3UA	F3UA 15A
F1UA	F1UA 30A
F15UA	F15UA 30A
F12UA	F12UA 10A
F4UA	F4UA 10A
F2UA	F2UA 25A
F2BA	F2BA 80A
F3BA	F3BA 80A
F23UA	F23UA 50A
F28UA	F28UA 20A
F29UA	F29UA 40A
P_REF	P
F38UA	F38UA 10A
F34UA	F34UA 7.5A
F30UA	F30UA 25A
F37UA	F37UA 5A
F57UA	F57UA 10A
F55UA	F55UA 10A
F50UA	F50UA 10A
F43UA	F43UA 7.5A
F41UA	F41UA 10A
F46UA	F46UA 10A
F42UA	F42UA 5A
F40UA	F40UA 5A
F56UA	F56UA 10A
F58UA	F58UA 15A
F60UA	F60UA 5A
F70UA	F70UA 5A
F62UA	F62UA 40A
F61UA	F61UA 5A
F63UA	F63UA 40A

Callout	Component Name
F32UA	F32UA 30A
F33UA	F33UA 10A
F9UA	F9UA 15A
F10UA	F10UA 15A
F18UA	F18UA 10A
C1	C1 Battery
KR3	KR3 Horn Relay
KR48	KR48 Headlamp High Beam Relay
X50D	X50D Fuse Block - Battery
KR5	KR5 Rear Defogger Relay
KR49	KR49 Headlamp Low Beam Relay
KR95A	KR95A Liftgate Unlatch Relay
X50A	X50A Fuse Block - Underhood

B+ Bus (2 of 2)

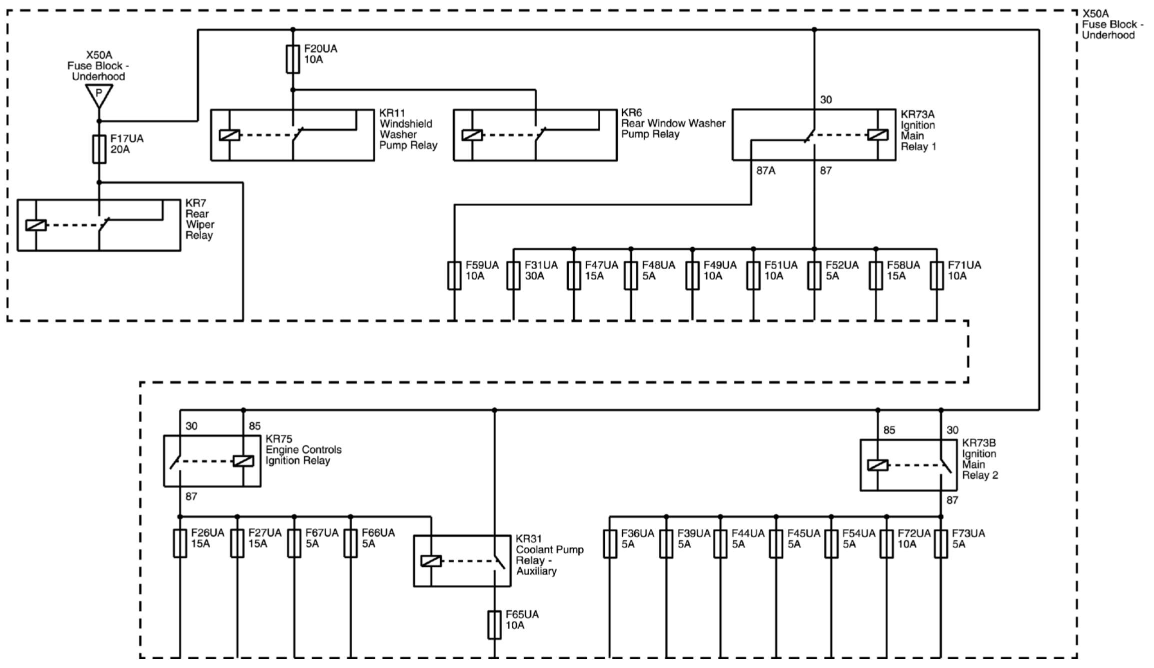

X50A
Fuse Block -
Underhood
P
F17UA
20A
KR7
Rear
Wiper
Relay
F20UA
10A
KR11
Windshield
Washer
Pump Relay
KR6
Rear Window Washer
Pump Relay
30
KR73A
Ignition
Main
Relay 1
87A
87
X50A
Fuse Block -
Underhood
F59UA
10A
F31UA
30A
F47UA
15A
F48UA
5A
F49UA
10A
F51UA
10A
F52UA
5A
F58UA
15A
F71UA
10A
30
85
KR75
Engine Controls
Ignition Relay
87
F26UA
15A
F27UA
15A
F67UA
5A
F66UA
5A
KR31
Coolant Pump
Relay -
Auxiliary
F65UA
10A
85
30
KR73B
Ignition
Main
Relay 2
87
F36UA
5A
F39UA
5A
F44UA
5A
F45UA
5A
F54UA
5A
F72UA
10A
F73UA
5A

Fig. 48: B+ Bus (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_87A	87A
CAV_30	30
CAV_87	87
CAV_30	30
CAV_87	87
CAV_85	85
CAV_87	87
CAV_85	85
CAV_30	30
F17UA	F17UA 20A
F20UA	F20UA 10A
F48UA	F48UA 5A
F49UA	F49UA 10A
F51UA	F51UA 10A
F52UA	F52UA 5A
F64UA	F64UA 15A
F71UA	F71UA 10A
F36UA	F36UA 5A
F39UA	F39UA 5A
F44UA	F44UA 5A
F45UA	F45UA 5A
F72UA	F72UA 10A
F54UA	F54UA 5A
P_REF	P
F47UA	F47UA 15A
F31UA	F31UA 30A
F59UA	F59UA 10A
F73UA	F73UA 5A
F65UA	F65UA 10A
F26UA	F26UA 15A
F67UA	F67UA 5A
F27UA	F27UA 15A
F66UA	F66UA 5A
X50A	X50A Fuse Block - Underhood
X50A	X50A Fuse Block - Underhood
KR6	KR6 Rear Window Washer Pump Relay
KR73B	KR73B Ignition Main Relay 2
KR7	KR7 Rear Wiper Relay
KR11	KR11 Windshield Washer Pump Relay
KR73A	KR73A Ignition Main Relay 1
KR31	KR31 Coolant Pump Relay - Auxiliary
KR75	KR75 Engine Controls Ignition Relay

F1BA, F2BA, F3BA, and F4BA Fuses

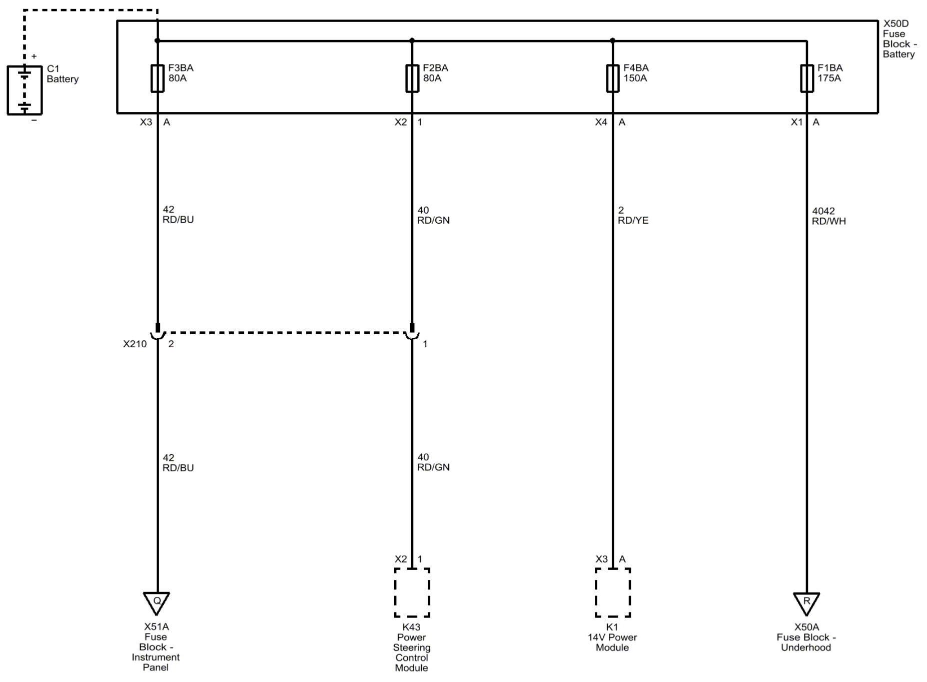

C1
Battery
+
–
F3BA
80A
F2BA
80A
F4BA
150A
F1BA
175A
X50D
Fuse
Block -
Battery
X3
A
X2
1
X4
A
X1
A
42
RD/BU
40
RD/GN
2
RD/YE
4042
RD/WH
X210
2
1
42
RD/BU
40
RD/GN
X2
1
X3
A
Q
R
X51A
Fuse
Block -
Instrument
Panel
K43
Power
Steering
Control
Module
K1
14V Power
Module
X50A
Fuse Block -
Underhood

Fig. 49: F1BA, F2BA, F3BA, and F4BA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
42	Battery Positive Voltage
42_RD/BU	42 RD/BU
40	Battery Positive Voltage
CAV_1	1
CONN_X2	X2
2_RD/YE	2 RD/YE
CAV_A	A
CONN_X3	X3
CAV_A	A
CONN_X2	X2
CAV_A	A
CONN_X4	X4
CAV_A	A
CONN_X1	X1
40_RD/GN	40 RD/GN
40_RD/GN	40 RD/GN
4042_RD/WH	4042 RD/WH
4042	Battery Positive Voltage
2	Battery Positive Voltage
42_RD/BU	42 RD/BU
CAV_A	A
CONN_X3	X3
X210	X210
CAV_2	2
CAV_1	1
F3BA	F3BA 80A
F2BA	F2BA 80A
F4BA	F4BA 150A
F1BA	F1BA 175A
Q_REF	Q
R_REF	R
X210	X210
K43	K43 Power Steering Control Module
X51A	X51A Fuse Block - Instrument Panel
X50A	X50A Fuse Block - Underhood
X50D	X50D Fuse Block - Battery
C1	C1 Battery
K1	K1 14V Power Module

F1UA, F2UA, F3UA, F4UA, F5UA, F12UA, F13UA, F15UA, F16UA, F19UA, F22UA and F23UA Fuses

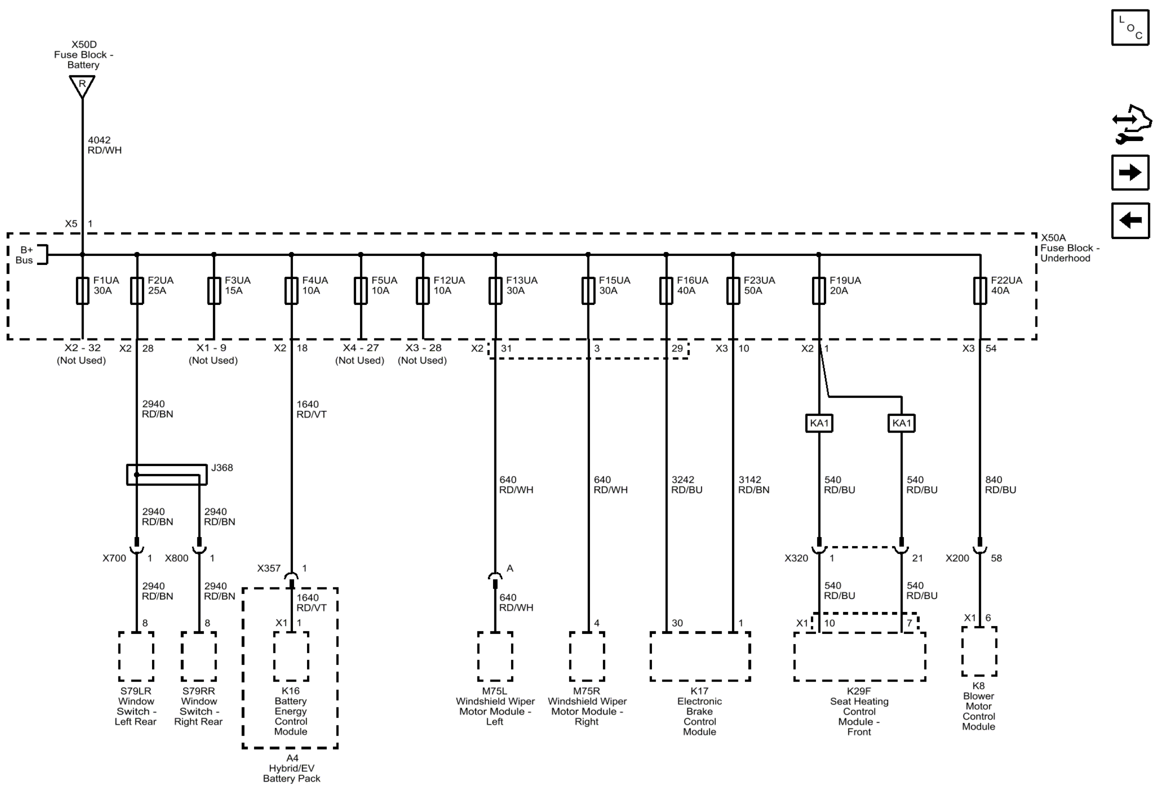

X50D
Fuse Block -
Battery
R
4042
RD/WH
X5
1
B+
Bus
F1UA
30A
F2UA
25A
F3UA
15A
F4UA
10A
F5UA
10A
F12UA
10A
F13UA
30A
F15UA
30A
F16UA
40A
F23UA
50A
F19UA
20A
F22UA
40A
X50A
Fuse Block -
Underhood
X2 - 32
(Not Used)
X2
28
X1 - 9
(Not Used)
X2
18
X4 - 27
(Not Used)
X3 - 28
(Not Used)
X2
31
3
29
X3
10
X2
1
X3
54
2940
RD/BN
1640
RD/VT
J368
KA1
KA1
640
RD/WH
640
RD/WH
3242
RD/BU
3142
RD/BN
540
RD/BU
540
RD/BU
840
RD/BU
2940
RD/BN
2940
RD/BN
X700
1
X800
1
X357
1
A
X320
1
21
X200
58
2940
RD/BN
2940
RD/BN
1640
RD/VT
640
RD/WH
540
RD/BU
540
RD/BU
8
8
X1
1
4
30
1
X1
10
7
X1
6
S79LR
Window
Switch -
Left Rear
S79RR
Window
Switch -
Right Rear
K16
Battery
Energy
Control
Module
A4
Hybrid/EV
Battery Pack
M75L
Windshield Wiper
Motor Module -
Left
M75R
Windshield Wiper
Motor Module -
Right
K17
Electronic
Brake
Control
Module
K29F
Seat Heating
Control
Module -
Front
K8
Blower
Motor
Control
Module
L O C

Fig. 50: F1UA, F2UA, F3UA, F4UA, F5UA, F12UA, F13UA, F15UA, F16UA, F19UA, F22UA and F23UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
4042	Battery Positive Voltage
4042_RD/WH	4042 RD/WH
CAV_1	1
CONN_X5	X5
2940	Battery Positive Voltage
2940_RD/BN	2940 RD/BN
CAV_28	28
CONN_X2	X2
1640	Battery Positive Voltage
CAV_18	18
640	Battery Positive Voltage
640_RD/WH	640 RD/WH
CAV_4	4
840	Battery Positive Voltage
840_RD/BU	840 RD/BU
CAV_6	6
CONN_X1	X1
3242	Battery Positive Voltage
3242_RD/BU	3242 RD/BU
CAV_30	30
3142	Battery Positive Voltage
3142_RD/BN	3142 RD/BN
CAV_1	1
2940	Battery Positive Voltage
CAV_1	1
CAV_1	1
2940_RD/BN	2940 RD/BN
2940_RD/BN	2940 RD/BN
2940_RD/BN	2940 RD/BN
2940_RD/BN	2940 RD/BN
CONN_X2	X2
CAV_1	1
CONN_X1	X1

Callout	Component Name
1640_RD/VT	1640 RD/VT
CAV_31	31
CONN_X2	X2
CAV_3	3
640_RD/WH	640 RD/WH
CAV_A	A
640_RD/WH	640 RD/WH
CAV_29	29
CAV_10	10
CONN_X3	X3
540	Battery Positive Voltage
540_RD/BU	540 RD/BU
540_RD/BU	540 RD/BU
CAV_7	7
CAV_10	10
CONN_X1	X1
CAV_1	1
CONN_X2	X2
1040	Battery Positive Voltage
KA1	HEATER SEAT FRT-DRVR and PASS
KA1	HEATER SEAT FRT-DRVR and PASS
540_RD/BU	540 RD/BU
540_RD/BU	540 RD/BU
CAV_58	58
CAV_54	54
CONN_X3	X3
1640_RD/VT	1640 RD/VT
CAV_1	1
CAV_8	8
CAV_8	8
X320	X320
CAV_1	1
CAV_21	21
F1UA	F1UA 30A
F2UA	F2UA 25A
F3UA	F3UA 15A
F4UA	F4UA 10A
F5UA	F5UA 10A
F12UA	F12UA 10A
F15UA	F15UA 30A
F16UA	F16UA 40A
F23UA	F23UA 50A
F13UA	F13UA 30A
F22UA	F22UA 40A
R_REF	R
J368	J368
X700	X700
X800	X800
F19UA	F19UA 20A
X200	X200
X357	X357
X320	X320
X50D	X50D Fuse Block - Battery
X50A	X50A Fuse Block - Underhood
S79LR	S79LR Window Switch - Left Rear
S79RR	S79RR Window Switch - Right Rear
K16	K16 Battery Energy Control Module
A4	A4 Hybrid/EV Battery Pack
M75L	M75L Windshield Wiper Motor Module - Left
M75R	M75R Windshield Wiper Motor Module - Right
K17	K17 Electronic Brake Control Module
K29F	K29F Seat Heating Control Module - Front (KA1)
K8	K8 Blower Motor Control Module

F7UA, F8UA, F9UA, F10UA, F11UA, F32UA, and F33UA Fuses

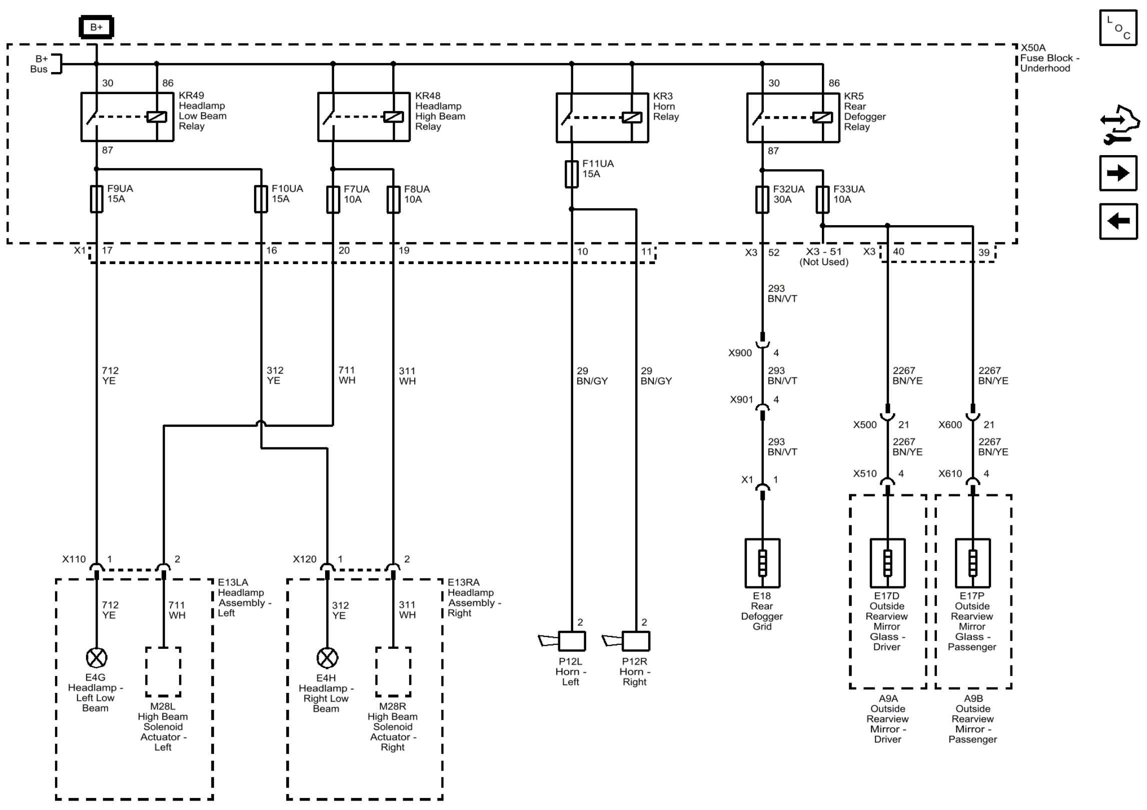

B+
B+ Bus
X50A Fuse Block - Underhood
30
86
KR49 Headlamp Low Beam Relay
KR48 Headlamp High Beam Relay
KR3 Horn Relay
KR5 Rear Defogger Relay
87
F9UA 15A
F10UA 15A
F7UA 10A
F8UA 10A
F11UA 15A
F32UA 30A
F33UA 10A
X1 17
16
20
19
10
11
X3 52
X3 - 51 (Not Used)
X3 40
39
712 YE
312 YE
711 WH
311 WH
29 BN/GY
293 BN/VT
X900 4
X901 4
X1 1
2267 BN/YE
X500 21
X600 21
X510 4
X610 4
X110 1 2
X120 1 2
E13LA Headlamp Assembly - Left
E13RA Headlamp Assembly - Right
E4G Headlamp - Left Low Beam
M28L High Beam Solenoid Actuator - Left
E4H Headlamp - Right Low Beam
M28R High Beam Solenoid Actuator - Right
P12L Horn - Left
P12R Horn - Right
E18 Rear Defogger Grid
E17D Outside Rearview Mirror Glass - Driver
E17P Outside Rearview Mirror Glass - Passenger
A9A Outside Rearview Mirror - Driver
A9B Outside Rearview Mirror - Passenger
L O C

Fig. 51: F7UA, F8UA, F9UA, F10UA, F11UA, F32UA, and F33UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
712	Left Headlamp Low Beam Control
CAV_17	17
CONN_X1	X1
312	Right Headlamp Low Beam Control
312_YE	312 YE
CAV_16	16
711	Left Headlamp High Beam Control
CAV_20	20
712_YE	712 YE
711_WH	711 WH
311	Right Headlamp High Beam Control

Callout	Component Name
311_WH	311 WH
CAV_19	19
CAV_30	30
CAV_86	86
CAV_87	87
712_YE	712 YE
312_YE	312 YE
311_WH	311 WH
711_WH	711 WH
29	Horn Control
CAV_10	10
29_BN/GY	29 BN/GY
2267	Mirror Heating Element Control
2267_BN/YE	2267 BN/YE
2267_BN/YE	2267 BN/YE
2267_BN/YE	2267 BN/YE
2267_BN/YE	2267 BN/YE
CAV_21	21
CAV_21	21
CAV_2	2
CAV_11	11
29_BN/GY	29 BN/GY
CAV_2	2
CAV_39	39
CAV_40	40
293	Rear Defog Element Control
293_BN/VT	293 BN/VT
CAV_4	4
CAV_4	4
293_BN/VT	293 BN/VT
CAV_52	52
CONN_X3	X3
CONN_X3	X3
CAV_87	87
CAV_30	30
CAV_86	86
293_BN/VT	293 BN/VT
CAV_4	4
CAV_4	4
CAV_1	1
X110	X110
CAV_1	1
CAV_2	2
X120	X120
CAV_1	1
CAV_2	2
F9UA	F9UA 15A
F10UA	F10UA 15A
F7UA	F7UA 10A
F8UA	F8UA 10A
F11UA	F11UA 15A
X500	X500
X600	X600
F32UA	F32UA 30A
F33UA	F33UA 10A
X901	X901
X900	X900
X510	X510
X610	X610
X1	X1
X110	X110
X120	X120
E13LA	E13LA Headlamp Assembly - Left
E13RA	E13RA Headlamp Assembly - Right
M28R	M28R High Beam Solenoid Actuator - Right
M28L	M28L High Beam Solenoid Actuator - Left
X50A	X50A Fuse Block - Underhood
KR49	KR49 Headlamp Low Beam Relay
KR48	KR48 Headlamp High Beam Relay
E4G	E4G Headlamp - Left Low Beam
E4H	E4H Headlamp - Right Low Beam
KR3	KR3 Horn Relay
E17P	E17P Outside Rearview Mirror Glass - Passenger
E17D	E17D Outside Rearview Mirror Glass - Driver
P12R	P12R Horn - Right
P12L	P12L Horn - Left
KR5	KR5 Rear Defogger Relay
A9A	A9A Outside Rearview Mirror - Driver
A9B	A9B Outside Rearview Mirror - Passenger
E18	E18 Rear Defogger Grid

F17UA, F18UA, and F20UA Fuses

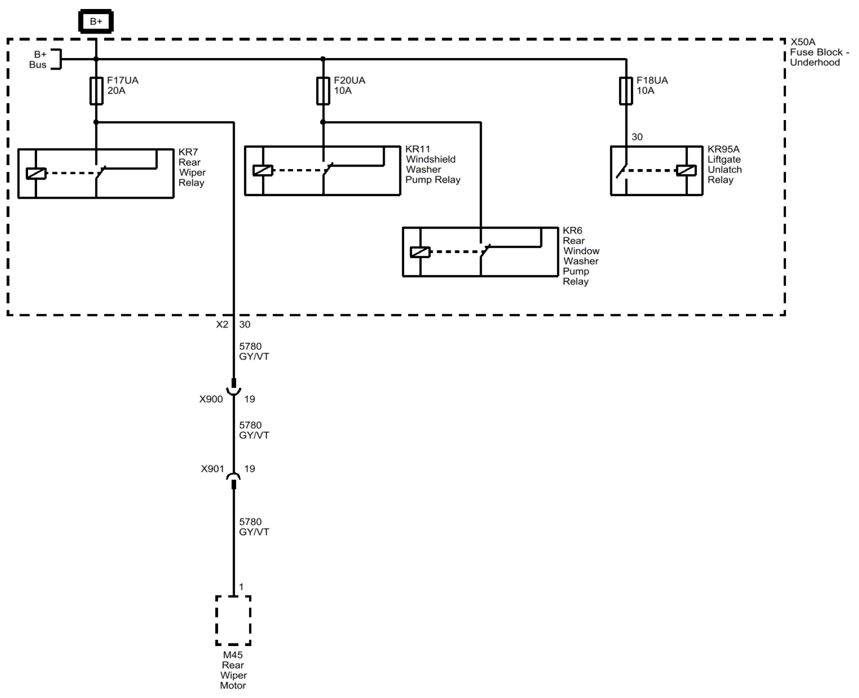

B+
B+ Bus
F17UA 20A
F20UA 10A
F18UA 10A
X50A Fuse Block - Underhood
30
KR7 Rear Wiper Relay
KR11 Windshield Washer Pump Relay
KR95A Liftgate Unlatch Relay
KR6 Rear Window Washer Pump Relay
X2 30
5780 GY/VT
X900 19
5780 GY/VT
X901 19
5780 GY/VT
1
M45 Rear Wiper Motor

Fig. 52: F17UA, F18UA, and F20UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5780	Windshield Wiper Motor Park Switch Fused Signal
5780_GY/VT	5780 GY/VT
CAV_1	1
5780_GY/VT	5780 GY/VT
CAV_19	19
CAV_30	30
CAV_30	30
CONN_X2	X2
CAV_19	19
5780_GY/VT	5780 GY/VT
F17UA	F17UA 20A
F20UA	F20UA 10A
X900	X900
F18UA	F18UA 10A
X901	X901
KR7	KR7 Rear Wiper Relay
KR11	KR11 Windshield Washer Pump Relay
KR6	KR6 Rear Window Washer Pump Relay
M45	M45 Rear Wiper Motor
KR95A	KR95A Liftgate Unlatch Relay
X50A	X50A Fuse Block - Underhood

F24UA, F28UA, F29UA, F30UA, F34UA, F38UA, F40UA, F41UA, F42UA, F43UA, F50UA, and F56UA Fuses

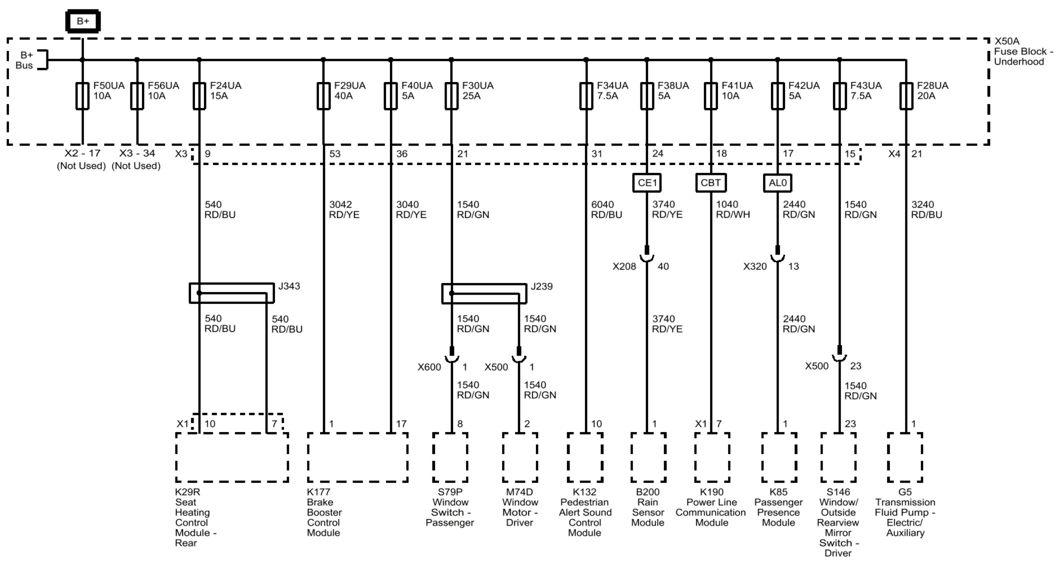

B+
B+ Bus
F50UA 10A
F56UA 10A
F24UA 15A
F29UA 40A
F40UA 5A
F30UA 25A
F34UA 7.5A
F38UA 5A
F41UA 10A
F42UA 5A
F43UA 7.5A
F28UA 20A
X50A Fuse Block - Underhood
X2 - 17 (Not Used)
X3 - 34 (Not Used)
X3 9
53
36
21
31
24
18
17
15
X4 21
CE1
CBT
AL0
540 RD/BU
3042 RD/YE
3040 RD/YE
1540 RD/GN
6040 RD/BU
3740 RD/YE
1040 RD/WH
2440 RD/GN
1540 RD/GN
3240 RD/BU
X208 40
X320 13
J343
J239
540 RD/BU
540 RD/BU
1540 RD/GN
1540 RD/GN
3740 RD/YE
2440 RD/GN
X600 1
X500 1
X500 23
1540 RD/GN
1540 RD/GN
1540 RD/GN
X1 10
7
1
17
8
2
10
1
X1 7
1
23
1
K29R Seat Heating Control Module - Rear
K177 Brake Booster Control Module
S79P Window Switch - Passenger
M74D Window Motor - Driver
K132 Pedestrian Alert Sound Control Module
B200 Rain Sensor Module
K190 Power Line Communication Module
K85 Passenger Presence Module
S146 Window/ Outside Rearview Mirror Switch - Driver
G5 Transmission Fluid Pump - Electric/ Auxiliary

Fig. 53: F24UA, F28UA, F29UA, F30UA, F34UA, F38UA, F40UA, F41UA, F42UA, F43UA, F50UA, and F56UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1540	Battery Positive Voltage
1540_RD/GN	1540 RD/GN
CAV_8	8
CAV_2	2
6040	Battery Positive Voltage
6040_RD/BU	6040 RD/BU
CAV_10	10
CAV_31	31
CAV_21	21
1040	Battery Positive Voltage
1040_RD/WH	1040 RD/WH
CAV_7	7
CAV_18	18
3042	Battery Positive Voltage
3042_RD/YE	3042 RD/YE
CAV_1	1
CAV_53	53
3040	Battery Positive Voltage
3040_RD/YE	3040 RD/YE
CAV_17	17
CAV_36	36
540	Battery Positive Voltage
540_RD/BU	540 RD/BU
CAV_10	10
CONN_X1	X1
540_RD/BU	540 RD/BU
CAV_7	7
CAV_9	9

Callout	Component Name
CONN_X3	X3
CAV_1	1
CAV_1	1
1540_RD/GN	1540 RD/GN
1540_RD/GN	1540 RD/GN
1540_RD/GN	1540 RD/GN
1540_RD/GN	1540 RD/GN
540_RD/BU	540 RD/BU
3740	Battery Positive Voltage
3740_RD/YE	3740 RD/YE
CAV_1	1
CAV_24	24
CE1	WIPER SYS WINDSHIELD-PULSE, MOISTURE SENSITIVE
CAV_40	40
3740_RD/YE	3740 RD/YE
CBT	PROVISIONS-FAST CHARGING ACCOMMODATIONS
2440	Battery Positive Voltage
2440_RD/GN	2440 RD/GN
CAV_1	1
CAV_17	17
CAV_13	13
2440_RD/GN	2440 RD/GN
AL0	SENSOR INDICATOR-INFLATABLE RESTRAINT, FRT PASS/CHILD PRESENCE DETECTOR
1540_RD/GN	1540 RD/GN
CAV_23	23
CAV_15	15
3240	Battery Positive Voltage
3240_RD/BU	3240 RD/BU
CAV_1	1
CAV_21	21
CONN_X4	X4
CONN_X3	X3
CAV_23	23
1540_RD/GN	1540 RD/GN
CONN_X1	X1
F50UA	F50UA 10A
F56UA	F56UA 10A
F24UA	F24UA 15A
F29UA	F29UA 40A
F30UA	F30UA 25A
F40UA	F40UA 5A
F34UA	F34UA 7.5A
F41UA	F41UA 10A
X600	X600
X500	X500
J343	J343
J239	J239
F38UA	F38UA 5A
X208	X208
F42UA	F42UA 5A
X320	X320
F43UA	F43UA 7.5A
F28UA	F28UA 20A
X500	X500
X50A	X50A Fuse Block - Underhood
S79P	S79P Window Switch - Passenger
M74D	M74D Window Motor - Driver
K132	K132 Pedestrian Alert Sound Control Module
B200	B200 Rain Sensor Module (CE1)
K85	K85 Passenger Presence Module
G5	G5 Transmission Fluid Pump - Electric/Auxiliary
K29R	K29R Seat Heating Control Module - Rear (KA6)
K177	K177 Brake Booster Control Module
K190	K190 Power Line CommunicationModule
S146	S146 Window/Outside Rearview Mirror Switch - Driver

F26UA, F27UA, F36UA, F38UA, F39UA, F44UA, F45UA, F54UA, F65UA, F66UA, F67UA, F70UA, F72UA and F73UA

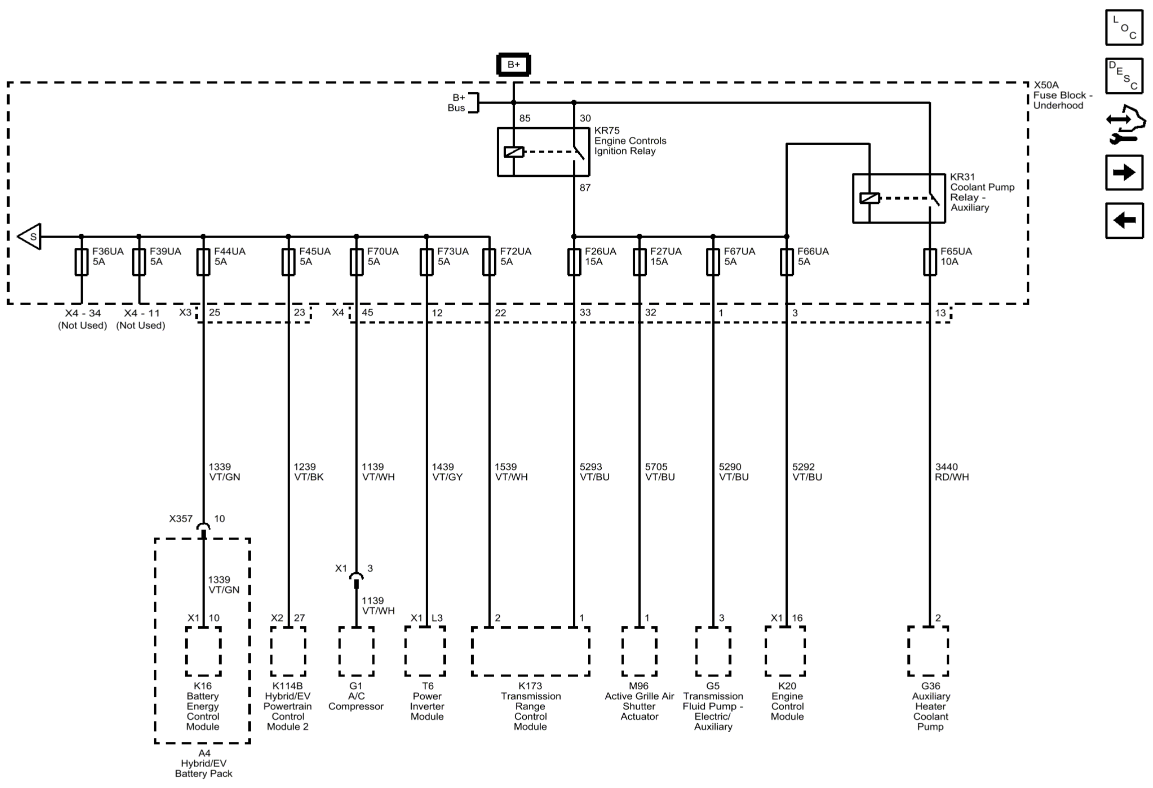

B+
B+ Bus
85
30
KR75 Engine Controls Ignition Relay
87
KR31 Coolant Pump Relay - Auxiliary
X50A Fuse Block - Underhood
S
F36UA 5A
F39UA 5A
F44UA 5A
F45UA 5A
F70UA 5A
F73UA 5A
F72UA 5A
F26UA 15A
F27UA 15A
F67UA 5A
F66UA 5A
F65UA 10A
X4 - 34 (Not Used)
X4 - 11 (Not Used)
X3
25
23
X4
45
12
22
33
32
1
3
13
1339 VT/GN
1239 VT/BK
1139 VT/WH
1439 VT/GY
1539 VT/WH
5293 VT/BU
5705 VT/BU
5290 VT/BU
5292 VT/BU
3440 RD/WH
X357
10
1339 VT/GN
X1
3
1139 VT/WH
X1 10
X2 27
X1 L3
2
1
1
3
X1 16
2
K16 Battery Energy Control Module
A4 Hybrid/EV Battery Pack
K114B Hybrid/EV Powertrain Control Module 2
G1 A/C Compressor
T6 Power Inverter Module
K173 Transmission Range Control Module
M96 Active Grille Air Shutter Actuator
G5 Transmission Fluid Pump - Electric/ Auxiliary
K20 Engine Control Module
G36 Auxiliary Heater Coolant Pump
LOC
DESC

Fig. 54: F26UA, F27UA, F36UA, F38UA, F39UA, F44UA, F45UA, F54UA, F65UA, F66UA, F67UA, F70UA, F72UA and F73UA
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1439	Run/Crank Ignition 1 Voltage
1239	Run/Crank Ignition 1 Voltage
CAV_27	27
CONN_X2	X2
1339	Run/Crank Ignition 1 Voltage
1539	Run/Crank Ignition 1 Voltage
CAV_2	2
CAV_23	23
CAV_25	25

Callout	Component Name
1239_VT/BK	1239 VT/BK
1339_VT/GN	1339 VT/GN
CAV_22	22
1539_VT/WH	1539 VT/WH
CAV_12	12
CAV_L3	L3
CONN_X1	X1
1439_VT/GY	1439 VT/GY
CAV_10	10
CONN_X1	X1
CAV_10	10
1339_VT/GN	1339 VT/GN
CONN_X3	X3
1139	Run/Crank Ignition 1 Voltage
CAV_45	45
1139_VT/WH	1139 VT/WH
1139_VT/WH	1139 VT/WH
CAV_30	30
CAV_87	87
CAV_85	85
5292	Powertrain Main Relay Fused Supply 3
5293	Powertrain Main Relay Fused Supply 4
5290	Powertrain Main Relay Fused Supply 1
CAV_3	3
CONN_X3	X3
CAV_33	33
5293_VT/BU	5293 VT/BU
CAV_1	1
5290_VT/BU	5290 VT/BU
CAV_3	3
CAV_16	16
CONN_X1	X1
5292_VT/BU	5292 VT/BU
5705	Powertrain Main Relay Fused Control 6
CAV_32	32
5705_VT/BU	5705 VT/BU
3440	Battery Positive Voltage
CAV_13	13
CAV_2	2
3440_RD/WH	3440 RD/WH
CAV_1	1
CAV_1	1
CONN_X4	X4
CAV_3	3
F36UA	F36UA 5A
F39UA	F39UA 5A
F45UA	F45UA 5A
F44UA	F44UA 5A
F73UA	F73UA 5A
F72UA	F72UA 5A
S_REF	S
X357	X357
F70UA	F70UA 5A
F26UA	F26UA 15A
F66UA	F66UA 5A
F67UA	F67UA 5A
F27UA	F27UA 15A
F65UA	F65UA 10A
X1	X1
K114B	K114B Hybrid/EV Powertrain Control Module 2
K16	K16 Battery Energy Control Module
A4	A4 Hybrid/EV Battery Pack
G1	G1 A/C Compressor
T6	T6 Power Inverter Module
KR75	KR75 Engine Controls Ignition Relay
KR31	KR31 Coolant Pump Relay - Auxiliary
X50A	X50A Fuse Block - Underhood
M96	M96 Active Grille Air Shutter Actuator
G36	G36 Auxiliary Heater Coolant Pump
K20	K20 Engine Control Module
G5	G5 Transmission Fluid Pump - Electric/Auxiliary
K173	K173 Transmission Range Control Module

F31UA, F47UA, F48UA, F49UA, F51UA, F52UA, F59UA, F64UA, and F71UA Fuses

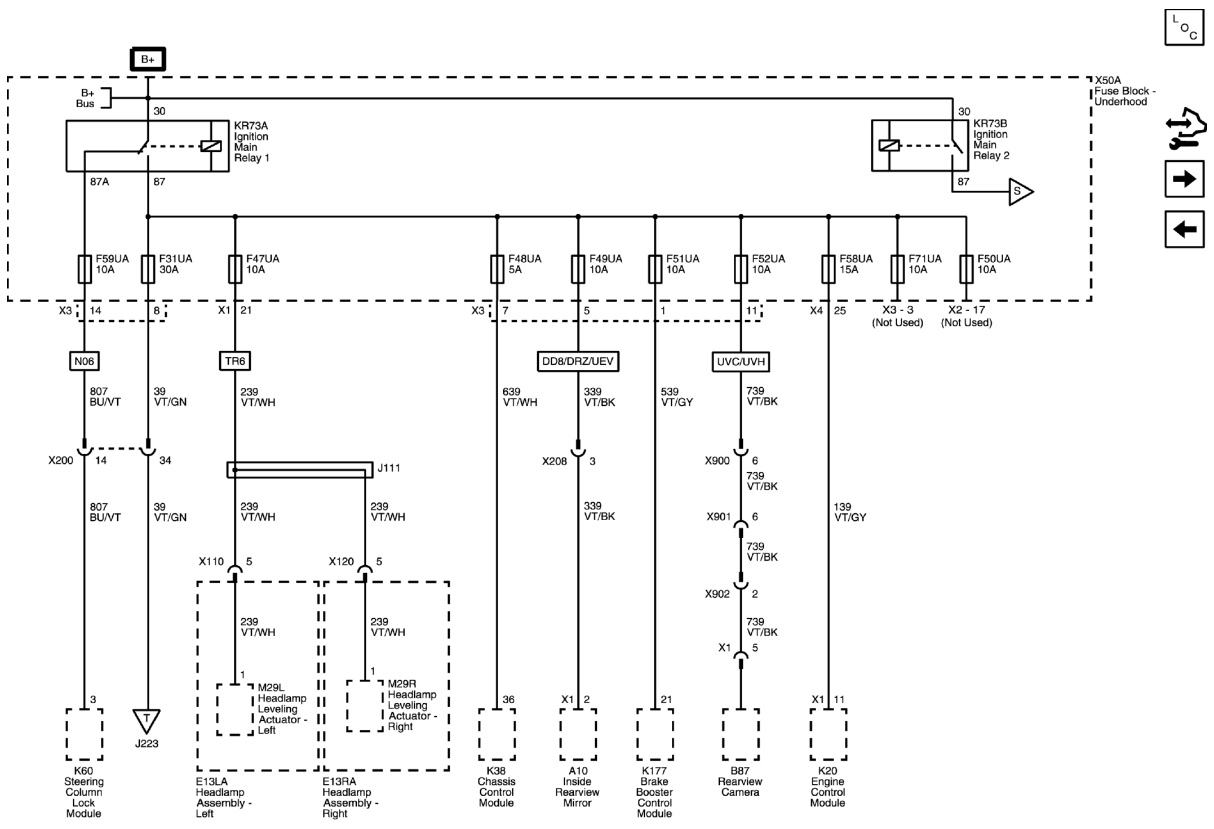

B+
B+ Bus
30
KR73A Ignition Main Relay 1
87A
87
30
KR73B Ignition Main Relay 2
87
S
X50A Fuse Block - Underhood
F59UA 10A
F31UA 30A
F47UA 10A
F48UA 5A
F49UA 10A
F51UA 10A
F52UA 10A
F58UA 15A
F71UA 10A
F50UA 10A
X3 14
8
X1 21
X3 7
5
1
11
X4 25
X3 - 3 (Not Used)
X2 - 17 (Not Used)
N06
TR6
DD8/DRZ/UEV
UVC/UVH
807 BU/VT
39 VT/GN
239 VT/WH
639 VT/WH
339 VT/BK
539 VT/GY
739 VT/BK
X200 14
34
J111
X208 3
X900 6
X901 6
X902 2
X1 5
139 VT/GY
X110 5
X120 5
1
M29L Headlamp Leveling Actuator - Left
M29R Headlamp Leveling Actuator - Right
3
J223
36
X1 2
21
X1 11
K60 Steering Column Lock Module
E13LA Headlamp Assembly - Left
E13RA Headlamp Assembly - Right
K38 Chassis Control Module
A10 Inside Rearview Mirror
K177 Brake Booster Control Module
B87 Rearview Camera
K20 Engine Control Module

Fig. 55: F31UA, F47UA, F48UA, F49UA, F51UA, F52UA, F59UA, F64UA, and F71UA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
339	Run/Crank Ignition 1 Voltage
639	Run/Crank Ignition 1 Voltage
739	Run/Crank Ignition 1 Voltage
639_VT/WH	639 VT/WH

Callout	Component Name
339_VT/BK	339 VT/BK
739_VT/BK	739 VT/BK
739_VT/BK	739 VT/BK
CAV_87A	87A
CAV_30	30
CAV_87	87
39	Run/Crank Ignition 1 Voltage
39_VT/GN	39 VT/GN
CAV_8	8
39_VT/GN	39 VT/GN
CAV_30	30
CAV_87	87
539	Run/Crank Ignition 1 Voltage
539_VT/GY	539 VT/GY
21	Roof Clearance Lamp Switch Signal
239_VT/WH	239 VT/WH
239_VT/WH	239 VT/WH
CAV_1	1
239_VT/WH	239 VT/WH
CAV_5	5
CAV_5	5
CAV_1	1
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
239_VT/WH	239 VT/WH
239_VT/WH	239 VT/WH
CAV_21	21
CONN_X1	X1
CAV_36	36
CAV_7	7
CONN_X3	X3
DD8	MIRROR I/S R/V-LT SENSITIVE
DRZ	MIRROR I/S R/V-LT SENSITIVE, FULL VIDEO DISPLAY
UEV	COMMUNICATION EQUIP-AUTOMATIC TOLL COLLECTION
CAV_5	5
CAV_3	3
339_VT/BK	339 VT/BK
CAV_1	1
CAV_21	21
UVC	VISION-REAR VIEW, MONO, ANALOG
UVH	VISION-360 VIEW, MONO, ANALOG
CAV_6	6
CAV_6	6
CAV_2	2
739_VT/BK	739 VT/BK
739_VT/BK	739 VT/BK
CAV_11	11
139	Run/Crank Ignition 1 Voltage
139_VT/GY	139 VT/GY
CAV_25	25
CONN_X4	X4
CAV_11	11
CONN_X1	X1
807	OFF /Accessory Ignition Voltage
807_BU/VT	807 BU/VT
CAV_14	14
CONN_X3	X3
807_BU/VT	807 BU/VT
CAV_3	3
N06	STEERING COLUMN LOCK-ELECTRICAL
CAV_2	2
CONN_X1	X1
CAV_5	5
X200	X200
CAV_14	14
CAV_34	34
F59UA	F59UA 10A
F48UA	F48UA 5A
F52UA	F52UA 10A
F49UA	F49UA 10A
F71UA	F71UA 10A
S_REF	S
F31UA	F31UA 30A
F47UA	F47UA 10A
J111	J111
X110	X110
X120	X120
X208	X208
F51UA	F51UA 10A
X900	X900
X901	X901
X902	X902
F64UA	F64UA 15A
X1	X1
X200	X200
X50A	X50A Fuse Block - Underhood
KR73A	KR73A Ignition Main Relay 1
KR73B	KR73B Ignition Main Relay 2
M29L	M29L Headlamp Leveling Actuator - Left (TR6)
E13LA	E13LA Headlamp Assembly - Left
M29R	M29R Headlamp Leveling Actuator - Right (TR6)
E13RA	E13RA Headlamp Assembly - Right
K38	K38 Chassis Control Module
A10	A10 Inside Rearview Mirror
K177	K177 Brake Booster Control Module
B87	B87 Rearview Camera
K20	K20 Engine Control Module
K60	K60 Steering Column Lock Module (N06)

F35UA, F46UA, F54UA, F55UA, F57UA, F58UA, F60UA, F62UA and F63UA

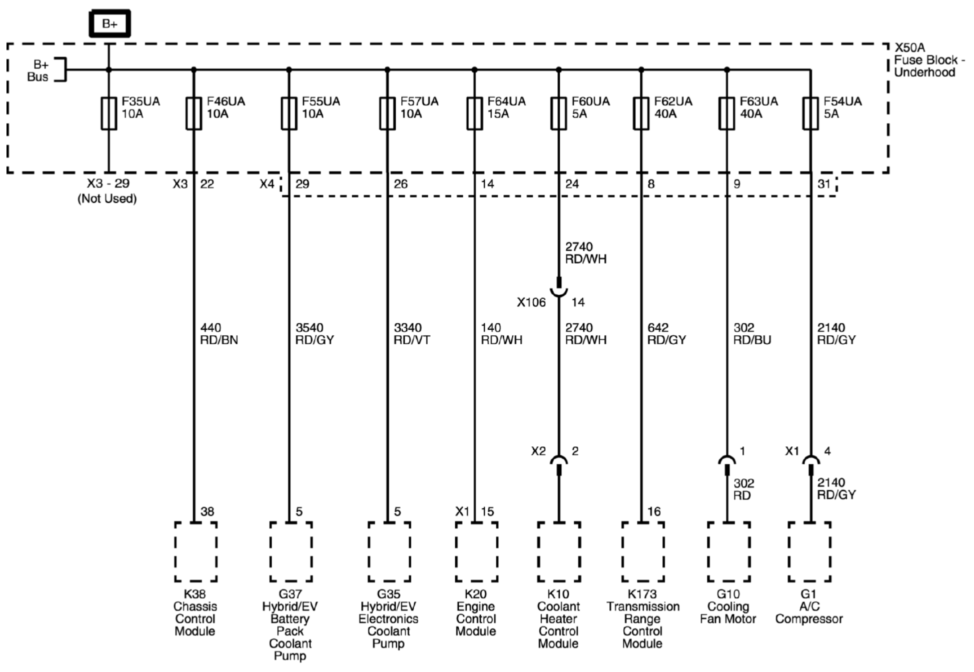

B+
B+ Bus
X50A Fuse Block - Underhood
F35UA 10A
F46UA 10A
F55UA 10A
F57UA 10A
F64UA 15A
F60UA 5A
F62UA 40A
F63UA 40A
F54UA 5A
X3 - 29 (Not Used)
X3 22
X4 29
26
14
24
8
9
31
2740 RD/WH
X106 14
440 RD/BN
3540 RD/GY
3340 RD/VT
140 RD/WH
2740 RD/WH
642 RD/GY
302 RD/BU
2140 RD/GY
X2 2
1
X1 4
302 RD
2140 RD/GY
38
5
5
X1 15
16
K38 Chassis Control Module
G37 Hybrid/EV Battery Pack Coolant Pump
G35 Hybrid/EV Electronics Coolant Pump
K20 Engine Control Module
K10 Coolant Heater Control Module
K173 Transmission Range Control Module
G10 Cooling Fan Motor
G1 A/C Compressor

Fig. 56: F35UA, F46UA, F54UA, F55UA, F57UA, F58UA, F60UA, F62UA and F63UA
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
440	Battery Positive Voltage
440_RD/BN	440 RD/BN
CAV_38	38
2140	Battery Positive Voltage
2140_RD/GY	2140 RD/GY
CAV_31	31
CAV_22	22
CONN_X3	X3
3540	Battery Positive Voltage
3540_RD/GY	3540 RD/GY
CAV_5	5
CAV_29	29
CONN_X4	X4
3340	Battery Positive Voltage
3340_RD/VT	3340 RD/VT
CAV_5	5
CAV_26	26
140	Battery Positive Voltage
140_RD/WH	140 RD/WH
CAV_15	15
CAV_14	14
CONN_X1	X1
2740	Battery Positive Voltage
2740_RD/WH	2740 RD/WH
CAV_24	24
CAV_14	14
2740_RD/WH	2740 RD/WH
642	Battery Positive Voltage
642_RD/GY	642 RD/GY
CAV_16	16
CAV_8	8
302	Battery Positive Voltage
302_RD/BU	302 RD/BU
CAV_9	9
CAV_1	1
302_RD	302 RD
2140_RD/GY	2140 RD/GY
CAV_4	4
CAV_2	2
F35UA	F35UA 10A
F46UA	F46UA 10A
F54UA	F54UA 5A
F55UA	F55UA 10A
F57UA	F57UA 10A
F58UA	F58UA 15A
F60UA	F60UA 5A
X106	X106
F62UA	F62UA 40A
F63UA	F63UA 40A
X1	X1
X2	X2
K38	K38 Chassis Control Module
G37	G37 Hybrid/EV Battery Pack Coolant Pump
G35	G35 Hybrid/EV Electronics Coolant Pump
K20	K20 Engine Control Module
K10	K10 Coolant Heater Control Module
K173	K173 Transmission Range Control Module
G10	G10 Cooling Fan Motor
G1	G1 A/C Compressor
X50A	X50A Fuse Block - Underhood

F1DA, F2DA, F3DA, F4DA, F5DA, F16DA, F44DA, F45DA, F46DA, F47DA, F48DA, F49DA, F50DA, F55DA, and F56DA Fuses

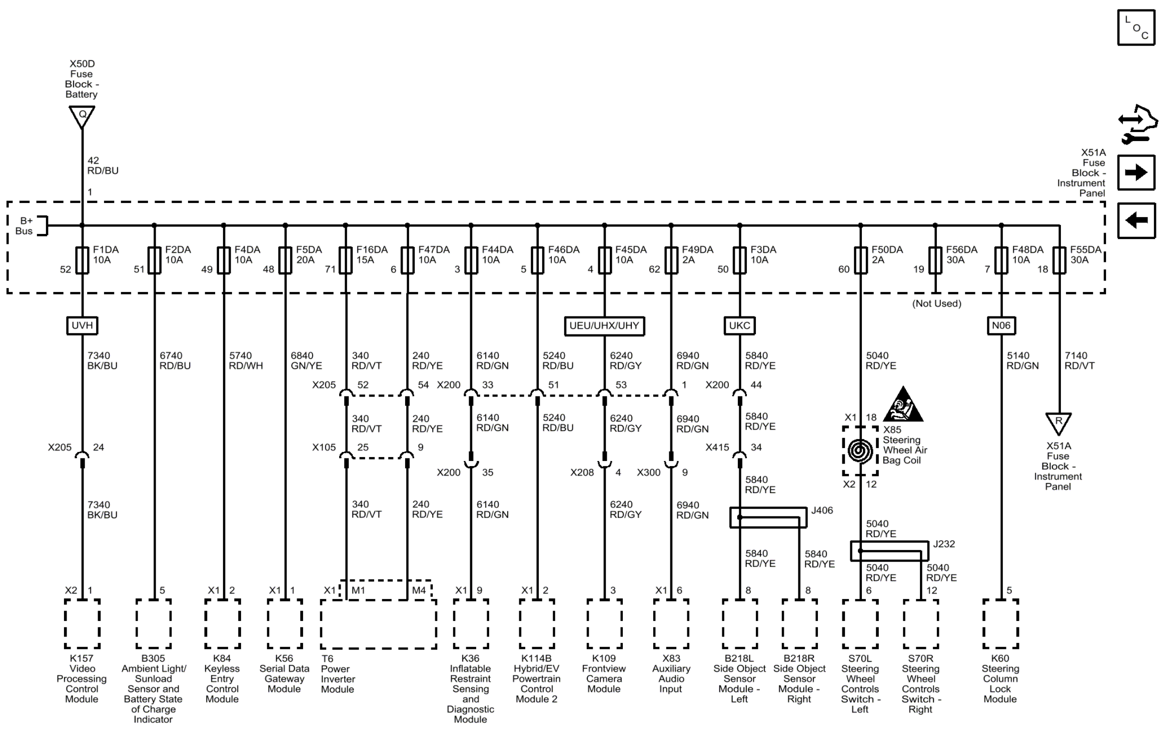

X50D Fuse Block - Battery
Q
42 RD/BU
1
B+ Bus
F1DA 10A
52
F2DA 10A
51
F4DA 10A
49
F5DA 20A
48
F16DA 15A
71
F47DA 10A
6
F44DA 10A
3
F46DA 10A
5
F45DA 10A
4
F49DA 2A
62
F3DA 10A
50
F50DA 2A
60
F56DA 30A
19
(Not Used)
F48DA 10A
7
F55DA 30A
18
X51A Fuse Block - Instrument Panel
UVH
UEU/UHX/UHY
UKC
N06
7340 BK/BU
6740 RD/BU
5740 RD/WH
6840 GN/YE
340 RD/VT
240 RD/YE
6140 RD/GN
5240 RD/BU
6240 RD/GY
6940 RD/GN
5840 RD/YE
5040 RD/YE
5140 RD/GN
7140 RD/VT
X205
24
52
54
X200
33
51
53
1
44
X105
25
9
35
X208
4
X300
X415
34
J406
J232
X1
18
X2
12
X85 Steering Wheel Air Bag Coil
R
X1
M1
M4
2
5
6
8
3
K157 Video Processing Control Module
B305 Ambient Light/ Sunload Sensor and Battery State of Charge Indicator
K84 Keyless Entry Control Module
K56 Serial Data Gateway Module
T6 Power Inverter Module
K36 Inflatable Restraint Sensing and Diagnostic Module
K114B Hybrid/EV Powertrain Control Module 2
K109 Frontview Camera Module
X83 Auxiliary Audio Input
B218L Side Object Sensor Module - Left
B218R Side Object Sensor Module - Right
S70L Steering Wheel Controls Switch - Left
S70R Steering Wheel Controls Switch - Right
K60 Steering Column Lock Module
L O C

Fig. 57: F1DA, F2DA, F3DA, F4DA, F5DA, F16DA, F44DA, F45DA, F46DA, F47DA, F48DA, F49DA, F50DA, F55DA, and F56DA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
6740	Battery Positive Voltage
6740_RD/BU	6740 RD/BU
7340	Camshaft W 2 Low Reference
7340_BK/BU	7340 BK/BU
5840	Battery Positive Voltage
5840_RD/YE	5840 RD/YE
6840	Auxiliary Device 2 Switched Voltage
6840_GN/YE	6840 GN/YE
5740	Battery Positive Voltage
5740_RD/WH	5740 RD/WH
6140	Battery Positive Voltage
6140_RD/GN	6140 RD/GN
6940	Battery Positive Voltage
6940_RD/GN	6940 RD/GN
CAV_51	51
CAV_52	52
CAV_50	50
CAV_48	48
CAV_71	71
CAV_6	6
CAV_49	49
CAV_3	3
CAV_5	5
CAV_4	4
CAV_62	62
340	Battery Positive Voltage
240	Battery Positive Voltage
5240	Battery Positive Voltage
5240_RD/BU	5240 RD/BU
6240	Battery Positive Voltage
6240_RD/GY	6240 RD/GY
CAV_3	3
340_RD/VT	340 RD/VT
240_RD/YE	240 RD/YE
340_RD/VT	340 RD/VT
240_RD/YE	240 RD/YE
6140_RD/GN	6140 RD/GN
CAV_60	60
CAV_8	8
CAV_8	8
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
5840_RD/YE	5840 RD/YE
5840_RD/YE	5840 RD/YE
CAV_34	34
CAV_44	44
5840_RD/YE	5840 RD/YE
5840_RD/YE	5840 RD/YE
CAV_5	5
CAV_1	1
CONN_X2	X2
CAV_24	24
UVH	VISION-360 VIEW, MONO, ANALOG
CAV_1	1
CONN_X1	X1
CAV_M1	M1
CONN_X1	X1
CAV_M4	M4
340_RD/VT	340 RD/VT
240_RD/YE	240 RD/YE
CAV_4	4
6240_RD/GY	6240 RD/GY
6240_RD/GY	6240 RD/GY
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
CAV_9	9
6940_RD/GN	6940 RD/GN
6940_RD/GN	6940 RD/GN
5040	Battery Positive Voltage
CAV_18	18
CONN_X1	X1
CAV_6	6
CAV_12	12
CONN_X2	X2
CAV_12	12
5040_RD/YE	5040 RD/YE
5040_RD/YE	5040 RD/YE

Callout	Component Name
5040_RD/YE	5040 RD/YE
5040_RD/YE	5040 RD/YE
CAV_35	35
6140_RD/GN	6140 RD/GN
5240_RD/BU	5240 RD/BU
CAV_9	9
CONN_X1	X1
CAV_2	2
CONN_X1	X1
CAV_19	19
2740	Battery Positive Voltage
42_RD/BU	42 RD/BU
CAV_1	1
7140	Battery Positive Voltage
7140_RD/VT	7140 RD/VT
CAV_18	18
5140	Battery Positive Voltage
5140_RD/GN	5140 RD/GN
CAV_7	7
CAV_5	5
N06	STEERING COLUMN LOCK-ELECTRICAL
7340_BK/BU	7340 BK/BU
CAV_6	6
CONN_X1	X1
CAV_2	2
CONN_X1	X1
X205	X205
CAV_52	52
CAV_54	54
X105	X105
CAV_25	25
CAV_9	9
X200	X200
CAV_51	51
CAV_33	33
CAV_53	53
CAV_1	1
F2DA	F2DA 10A
F1DA	F1DA 10A
F3DA	F3DA 10A
F5DA	F5DA 20A
F16DA	F16DA 15A
F47DA	F47DA 10A
F4DA	F4DA 10A
F44DA	F44DA 10A
F46DA	F46DA 10A
F45DA	F45DA 10A
F49DA	F49DA 2A
F50DA	F50DA 2A
X415	X415
X200	X200
X205	X205
X208	X208
X300	X300
J232	J232
X200	X200
F55DA	F55DA 30A
F56DA	F56DA 30A
Q_REF	Q
F48DA	F48DA 10A
J406	J406
X205	X205
X105	X105
X200	X200
K84	K84 Keyless Entry Control Module
K157	K157 Video Processing Control Module
K56	K56 Serial Data Gateway Module
T6	T6 Power Inverter Module
B174W	B174W Frontview Camera - Windshield (UEU)
X83	X83 Auxiliary Audio Input
S70L	S70L Steering Wheel Controls Switch - Left
S70R	S70R Steering Wheel Controls Switch - Right
X85	X85 Steering Wheel Air Bag Coil
K36	K36 Inflatable Restraint Sensing and Diagnostic Module
K114B	K114B Hybrid/EV Powertrain Control Module 2
X50D	X50D Fuse Block - Battery
X51A	X51A Fuse Block - Instrument Panel
K60	K60 Steering Column Lock Module (N06)
X51A	X51A Fuse Block - Instrument Panel
B218L	B218L Side Object Sensor Module - Left (UKC)
B218R	B218R Side Object Sensor Module - Right (UKC)
B305	B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator

F6DA, F7DA, F8DA, F9DA, F10DA, F11DA, F12DA, F13DA, F14DA, F15DA, F17DA, F18DA, and F43DA Fuses

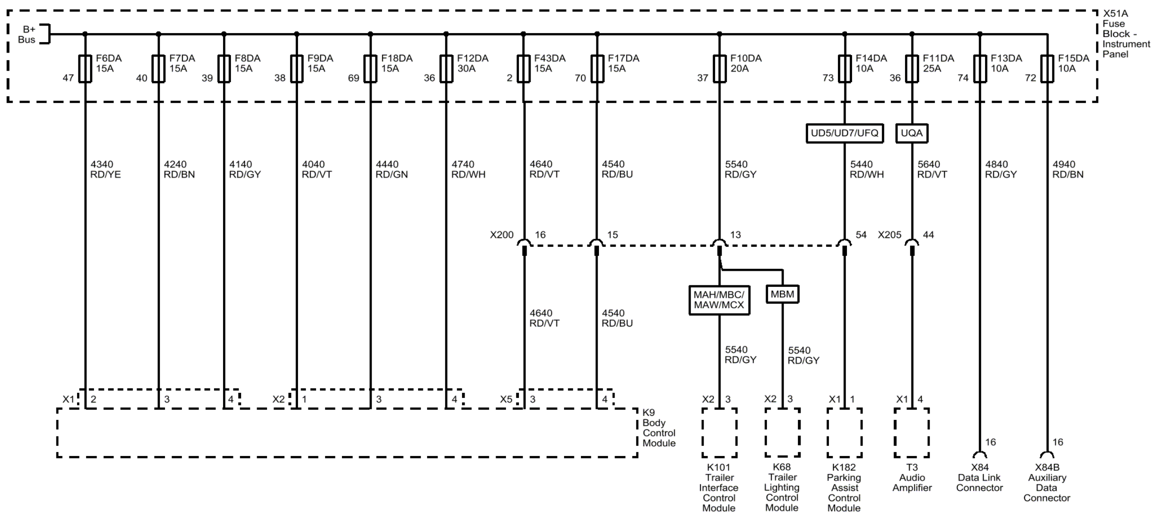

B+
Bus
F6DA
15A
47
F7DA
15A
40
F8DA
15A
39
F9DA
15A
38
F18DA
15A
69
F12DA
30A
36
F43DA
15A
2
F17DA
15A
70
F10DA
20A
37
F14DA
10A
73
F11DA
25A
36
F13DA
10A
74
F15DA
10A
72
X51A
Fuse
Block -
Instrument
Panel
UD5/UD7/UFQ
UQA
4340
RD/YE
4240
RD/BN
4140
RD/GY
4040
RD/VT
4440
RD/GN
4740
RD/WH
4640
RD/VT
4540
RD/BU
5540
RD/GY
5440
RD/WH
5640
RD/VT
4840
RD/GY
4940
RD/BN
X200
16
15
13
54
X205
44
MAH/MBC/
MAW/MCX
MBM
4640
RD/VT
4540
RD/BU
5540
RD/GY
5540
RD/GY
X1
2
3
4
X2
1
3
4
X5
3
4
K9
Body
Control
Module
X2
3
X2
3
X1
1
X1
4
16
16
K101
Trailer
Interface
Control
Module
K68
Trailer
Lighting
Control
Module
K182
Parking
Assist
Control
Module
T3
Audio
Amplifier
X84
Data Link
Connector
X84B
Auxiliary
Data
Connector

Fig. 58: F6DA, F7DA, F8DA, F9DA, F10DA, F11DA, F12DA, F13DA, F14DA, F15DA, F17DA, F18DA, and F43DA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
4040	Battery Positive Voltage
4040_RD/VT	4040 RD/VT
CAV_1	1
CONN_X2	X2
4440	Battery Positive Voltage
4440_RD/GN	4440 RD/GN
4340	Battery Positive Voltage
4340_RD/YE	4340 RD/YE
4240	Battery Positive Voltage
4240_RD/BN	4240 RD/BN
4740	Battery Positive Voltage
4740_RD/WH	4740 RD/WH
4140	Battery Positive Voltage
4140_RD/GY	4140 RD/GY
CAV_4	4
5540	Battery Positive Voltage
5540_RD/GY	5540 RD/GY
CAV_3	3
4840	Battery Positive Voltage
4840_RD/GY	4840 RD/GY
CAV_16	16
CAV_38	38
CAV_69	69
CAV_47	47
CAV_40	40
CAV_36	36
CAV_2	2
CAV_70	70
CAV_39	39
CAV_37	37
CAV_73	73
CAV_36	36
CAV_74	74
4640	Battery Positive Voltage
4540	Battery Positive Voltage
5440	Battery Positive Voltage
5440_RD/WH	5440 RD/WH
5640	Battery Positive Voltage
5640_RD/VT	5640 RD/VT
CAV_4	4
4940	Battery Positive Voltage
4940_RD/BN	4940 RD/BN
CAV_16	16
CAV_3	3
CAV_2	2
CONN_X1	X1
CAV_3	3
CAV_4	4
CAV_3	3
CONN_X5	X5
CAV_4	4
4640_RD/VT	4640 RD/VT
4540_RD/BU	4540 RD/BU
4640_RD/VT	4640 RD/VT
4540_RD/BU	4540 RD/BU
CONN_X2	X2
5540_RD/GY	5540 RD/GY
UD5	PARK ASSIST-FRONT AND REAR
UD7	PARK ASSIST-REAR
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
CAV_1	1
CONN_X1	X1
UQA	SPEAKER SYSTEM-PREMIUM AUDIO, BRANDED AMPLIFIER
CONN_X1	X1
CAV_72	72
CAV_44	44
MAH	Â
MBC	Â
MAW	Â
MCX	Â
CAV_3	3
CONN_X2	X2
5540_RD/GY	5540 RD/GY
MBM	Â
X200	X200
CAV_16	16
CAV_15	15

Callout	Component Name
CAV_13	13
CAV_54	54
F9DA	F9DA 15A
F18DA	F18DA 15A
F6DA	F6DA 15A
F7DA	F7DA 15A
F12DA	F12DA 30A
F43DA	F43DA 15A
F17DA	F17DA 15A
F8DA	F8DA 15A
F10DA	F10DA 20A
F14DA	F14DA 10A
F11DA	F11DA 25A
F13DA	F13DA 10A
F15DA	F15DA 10A
X205	X205
X200	X200
K9	K9 Body Control Module
X84	X84 Data Link Connector
X84B	X84B Auxiliary Data Connector
K101	K101 Trailer Interface Control Module (MAH/MBC/MAW/MCX)
K182	K182 Parking Assist Control Module
T3	T3 Audio Amplifier (UQA)
K68	K68 Tralier Lighting Control Moduel (MBM)
X51A	X51A Fuse Block - Instrument Panel

F22DA, F23DA, F24DA, F51DA and F53DA Fuses

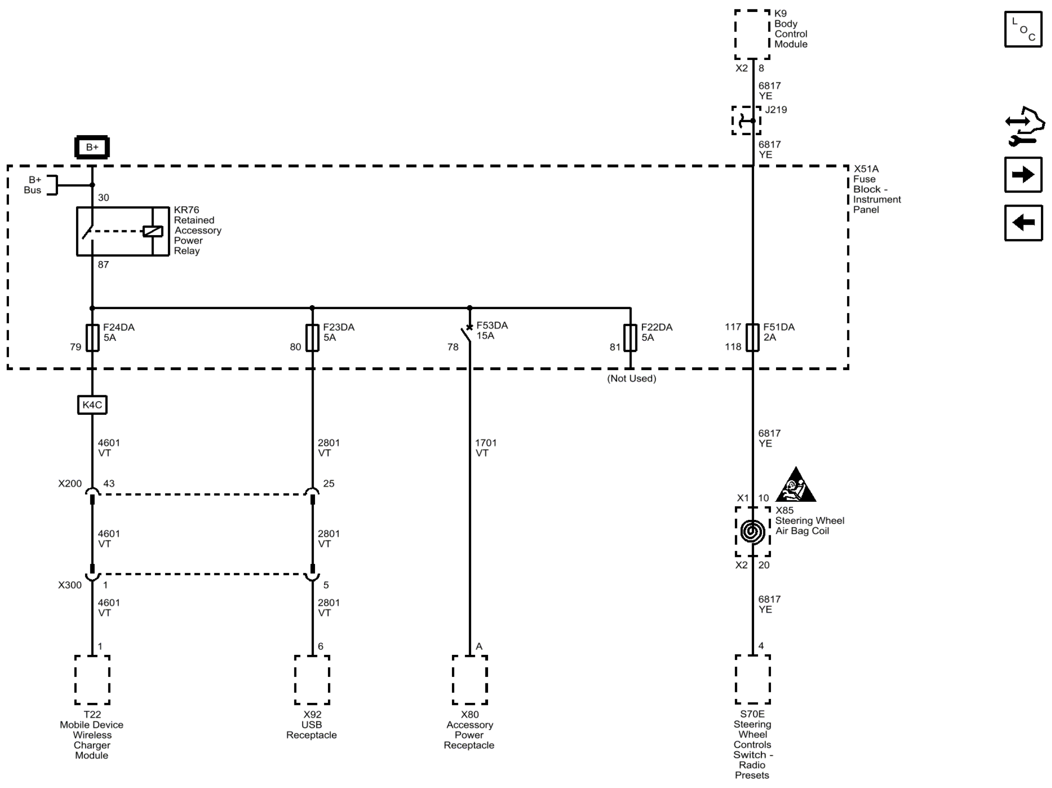

K9
Body
Control
Module
X2 8
6817
YE
J219
6817
YE
B+
B+
Bus
30
KR76
Retained
Accessory
Power
Relay
87
X51A
Fuse
Block -
Instrument
Panel
F24DA
5A
79
F23DA
5A
80
F53DA
15A
78
F22DA
5A
81
(Not Used)
117
118
F51DA
2A
K4C
4601
VT
2801
VT
1701
VT
6817
YE
X200
43
25
X1 10
X85
Steering Wheel
Air Bag Coil
X2 20
X300
1
5
1
6
A
4
T22
Mobile Device
Wireless
Charger
Module
X92
USB
Receptacle
X80
Accessory
Power
Receptacle
S70E
Steering
Wheel
Controls
Switch -
Radio
Presets
L O C

Fig. 59: F22DA, F23DA, F24DA, F51DA and F53DA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_78	78
CAV_81	81
CAV_80	80
CAV_79	79
CAV_1	1
2801	Retained Accessory Power Fuse Ignition
2801_VT	2801 VT
4601_VT	4601 VT
2801_VT	2801 VT
4601_VT	4601 VT
2801_VT	2801 VT
4601_VT	4601 VT
4601	Retained Accessory Power Fused Control
1701	Retained Accessory Power Ignition
CAV_A	A
CAV_87	87
CAV_30	30
1701_VT	1701 VT
CAV_6	6
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
2239	Run/Crank Ignition 1 Voltage
6817_YE	6817 YE
6817_YE	6817 YE
CAV_10	10
CONN_X1	X1
CAV_20	20
CONN_X2	X2
CAV_117	117
CAV_118	118
CAV_4	4
6817	LED Backlight Dimming Control 1
6817_YE	6817 YE
CAV_8	8
CONN_X2	X2
6817_YE	6817 YE
X200	X200
CAV_43	43
CAV_25	25
X300	X300
CAV_5	5
CAV_1	1
F24DA	F24DA 5A
F23DA	F23DA 5A
F22DA	F22DA 5A
F51DA	F51DA 2A
J219	J219
F53DA	F53DA 15A
X200	X200
X300	X300

Callout	Component Name
KR76	KR76 Retained Accessory Power Relay
T22	T22 Mobile Device Wireless Charger Module (K4C)
X92	X92 USB Receptacle
X80	X80 Accessory Power Receptacle
X85	X85 Steering Wheel Air Bag Coil
S70E	S70E Steering Wheel Controls Switch - Radio Presets
K9	K9 Body Control Module
X51A	X51A Fuse Block - Instrument Panel

F25DA, F26DA, F27DA, F28DA, F29DA, and F30DA Fuses

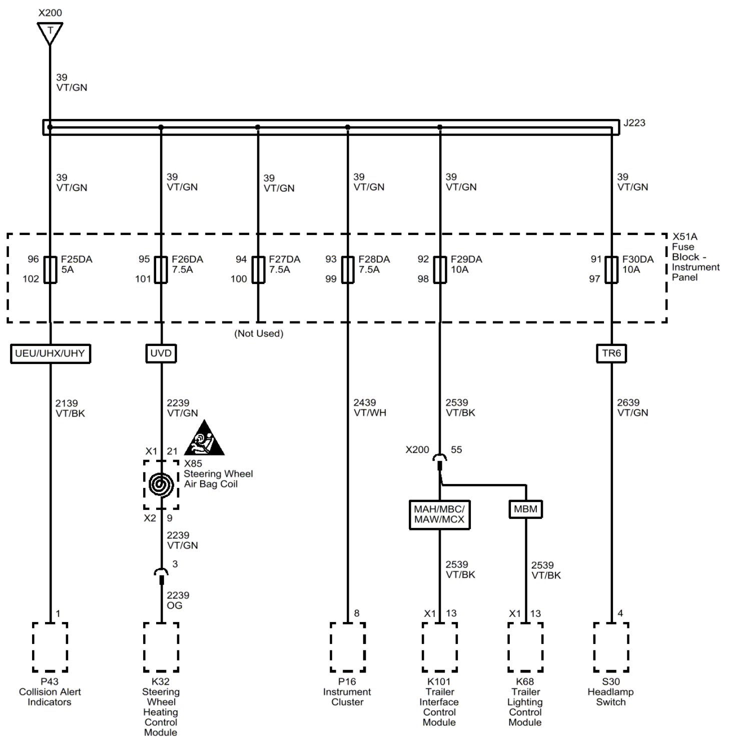

X200
39
VT/GN
J223
39
VT/GN
39
VT/GN
39
VT/GN
39
VT/GN
39
VT/GN
39
VT/GN
X51A
Fuse
Block -
Instrument
Panel
96
102
F25DA
5A
95
101
F26DA
7.5A
94
100
F27DA
7.5A
93
99
F28DA
7.5A
92
98
F29DA
10A
91
97
F30DA
10A
(Not Used)
UEU/UHX/UHY
UVD
TR6
2139
VT/BK
2239
VT/GN
X1
21
X85
Steering Wheel
Air Bag Coil
X2
9
2239
VT/GN
3
2239
OG
2439
VT/WH
2539
VT/BK
X200
55
MAH/MBC/
MAW/MCX
MBM
2539
VT/BK
2539
VT/BK
2639
VT/GN
1
8
X1
13
X1
13
4
P43
Collision Alert
Indicators
K32
Steering
Wheel
Heating
Control
Module
P16
Instrument
Cluster
K101
Trailer
Interface
Control
Module
K68
Trailer
Lighting
Control
Module
S30
Headlamp
Switch

Fig. 60: F25DA, F26DA, F27DA, F28DA, F29DA, and F30DA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
39	Run/Crank Ignition 1 Voltage
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
39_VT/GN	39 VT/GN
2439	Run/Crank Ignition 1 Voltage
2439_VT/WH	2439 VT/WH
CAV_8	8
2139	Run/Crank Ignition 1 Voltage
CAV_1	1
2139_VT/BK	2139 VT/BK
CAV_94	94
CAV_100	100
39_VT/GN	39 VT/GN
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
2239	Run/Crank Ignition 1 Voltage
2239_OG	2239 OG
2239_VT/GN	2239 VT/GN
2239_VT/GN	2239 VT/GN
UVD	STEERING WHEEL HEAT-MANUAL
CAV_21	21
CONN_X1	X1
CAV_9	9
CONN_X2	X2
CAV_3	3
2539	Run/Crank Ignition 1 Voltage
2539_VT/BK	2539 VT/BK
CAV_13	13
2639	Run/Crank Ignition 1 Voltage
2639_VT/GN	2639 VT/GN
CAV_4	4
2539_VT/BK	2539 VT/BK
CAV_91	91
CAV_97	97
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
CAV_93	93
CAV_99	99
CAV_96	96
CAV_102	102
CAV_95	95
CAV_101	101
CAV_92	92
CAV_98	98
CONN_X1	X1
CAV_13	13
CONN_X1	X1
2539_VT/BK	2539 VT/BK
MAH	Â
MBC	Â
MAW	Â
MCX	Â
MBM	Â
CAV_55	55
F27DA	F27DA 7.5A
F25DA	F25DA 5A
F28DA	F28DA 7.5A
F29DA	F29DA 10A
F30DA	F30DA 10A
F26DA	F26DA 7.5A
X200	X200
J223	J223
X51A	X51A Fuse Block - Instrument Panel

Callout	Component Name
P43	P43 Collision Alert Indicators
X85	X85 Steering Wheel Air Bag Coil
P16	P16 Instrument Cluster
K101	K101 Trailer Interface Control Module (MAH/MBC/MAW/MCX)
S30	S30 Headlamp Switch
K32	K32 Steering Wheel Heating Control Module (UVD)
K68	K68 Tralier Lighting Control Moduel (MBM)

F31DA, F32DA, F33DA, F34DA, F35DA, F36DA, and F52DA Fuses

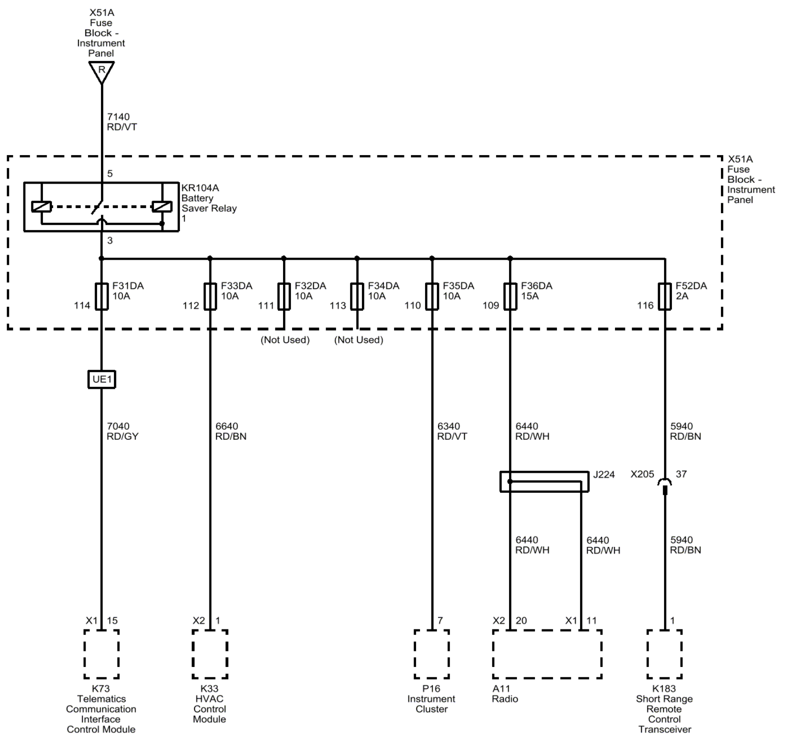

X51A
Fuse
Block -
Instrument
Panel
R
7140
RD/VT
5
KR104A
Battery
Saver Relay
1
3
X51A
Fuse
Block -
Instrument
Panel
F31DA
10A
114
F33DA
10A
112
F32DA
10A
111
F34DA
10A
113
F35DA
10A
110
F36DA
15A
109
F52DA
2A
116
(Not Used)
(Not Used)
UE1
7040
RD/GY
6640
RD/BN
6340
RD/VT
6440
RD/WH
5940
RD/BN
J224
X205
37
6440
RD/WH
6440
RD/WH
5940
RD/BN
X1 15
X2 1
7
X2 20
X1 11
1
K73
Telematics
Communication
Interface
Control Module
K33
HVAC
Control
Module
P16
Instrument
Cluster
A11
Radio
K183
Short Range
Remote
Control
Transceiver

Fig. 61: F31DA, F32DA, F33DA, F34DA, F35DA, F36DA, and F52DA Fuses
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_114	114
CAV_112	112
CAV_109	109
7040	Battery Positive Voltage
7040_RD/GY	7040 RD/GY
CAV_15	15
CONN_X1	X1
6640	Battery Positive Voltage
6640_RD/BN	6640 RD/BN
CAV_1	1
6440	Battery Positive Voltage
6440_RD/WH	6440 RD/WH
CAV_20	20
CONN_X2	X2
CONN_X2	X2
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR
CAV_111	111
CAV_113	113
CAV_110	110
6340	Battery Positive Voltage
6340_RD/VT	6340 RD/VT
CAV_7	7
CAV_116	116
5940	Battery Positive Voltage
5940_RD/BN	5940 RD/BN
CAV_1	1
CAV_37	37
5940_RD/BN	5940 RD/BN
6440_RD/WH	6440 RD/WH
CAV_11	11
CONN_X1	X1
6440_RD/WH	6440 RD/WH
7140	Battery Positive Voltage
7140_RD/VT	7140 RD/VT
F31DA	F31DA 10A
F33DA	F33DA 10A
F36DA	F36DA 15A
F32DA	F32DA 10A
F34DA	F34DA 10A
F35DA	F35DA 10A
F52DA	F52DA 2A
X205	X205
J224	J224
R_REF	R
X51A	X51A Fuse Block - Instrument Panel
K33	K33 HVAC Control Module
K73	K73 Telematics Communication Interface Control Module
KR104A	KR104A Battery Saver Relay 1
P16	P16 Instrument Cluster
A11	A11 Radio
X51A	X51A Fuse Block - Instrument Panel
K183	K183 UHF Short Range Low Energy Remote Control Access Transceiver

POWER MODING SCHEMATICS

Ignition Mode Switch

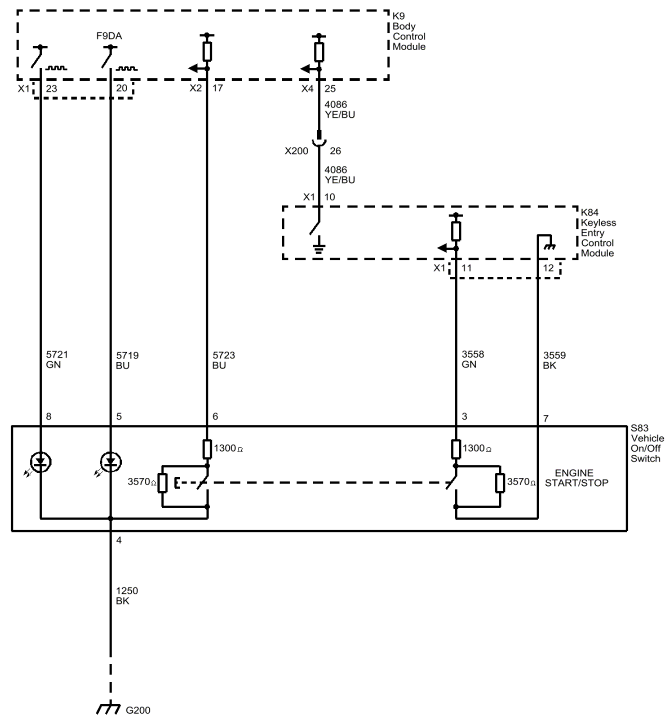

K9
Body
Control
Module
F9DA
X1
23
20
X2
17
X4
25
4086
YE/BU
X200
26
4086
YE/BU
X1
10
K84
Keyless
Entry
Control
Module
X1
11
12
5721
GN
5719
BU
5723
BU
3558
GN
3559
BK
8
5
6
3
7
S83
Vehicle
On/Off
Switch
1300Ω
1300Ω
3570Ω
3570Ω
ENGINE
START/STOP
4
1250
BK
G200

Fig. 62: Ignition Mode Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5721	Ignition Mode Switch Off LED Signal
CAV_8	8
5719	Ignition Mode Switch Start LED Signal
5719_BU	5719 BU
CAV_5	5
CAV_20	20
5723	Ignition Mode Switch Mode Voltage
5723_BU	5723 BU
CAV_6	6
CAV_17	17
CONN_X2	X2
1250	Ground
1250_BK	1250 BK
CAV_4	4
5721_GN	5721 GN
3558	Passive Start Switch Signal 2
CAV_3	3
CAV_11	11
CONN_X1	X1
3559	Passive Start Switch 2 Low Reference
CAV_7	7
CAV_12	12
3558_GN	3558 GN
3559_BK	3559 BK
CAV_23	23
CONN_X1	X1
4086	Pushbutton Start Challenge Active Signal
4086_YE/BU	4086 YE/BU
CAV_25	25
CONN_X4	X4
4086_YE/BU	4086 YE/BU
CAV_26	26
CAV_10	10
CONN_X1	X1
G200	G200
F9DA	F9DA
X200	X200
K9	K9 Body Control Module
K84	K84 Keyless Entry Control Module
S83	S83 Vehicle On/Off Switch

Ignition Power and Ignition Main Relay 1

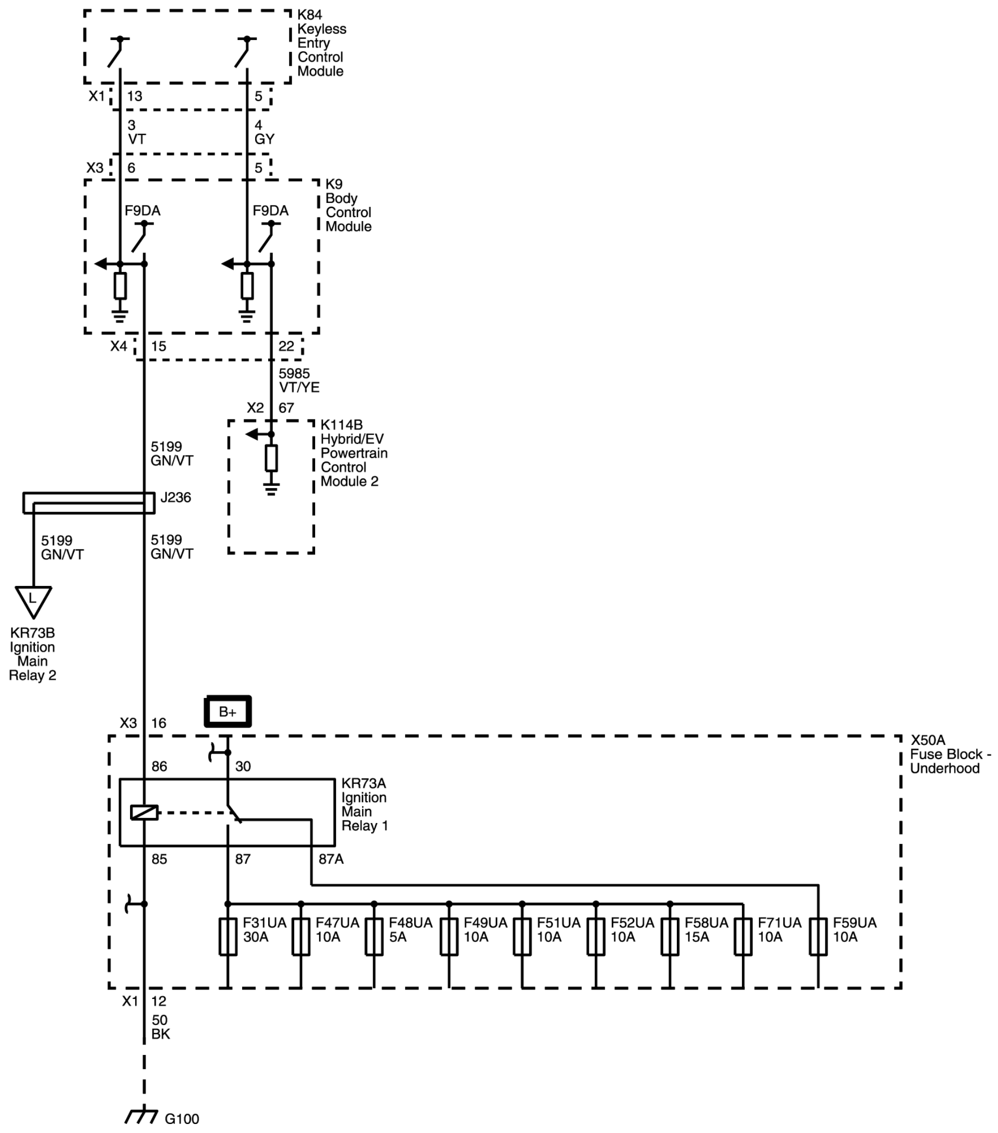

K84
Keyless
Entry
Control
Module
X1
13
5
3
VT
4
GY
X3
6
5
K9
Body
Control
Module
F9DA
F9DA
X4
15
22
5985
VT/YE
X2
67
K114B
Hybrid/EV
Powertrain
Control
Module 2
5199
GN/VT
J236
5199
GN/VT
5199
GN/VT
L
KR73B
Ignition
Main
Relay 2
B+
X3
16
X50A
Fuse Block -
Underhood
86
30
KR73A
Ignition
Main
Relay 1
85
87
87A
F31UA
30A
F47UA
10A
F48UA
5A
F49UA
10A
F51UA
10A
F52UA
10A
F58UA
15A
F71UA
10A
F59UA
10A
X1
12
50
BK
G100

Fig. 63: Ignition Power and Ignition Main Relay 1
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CONN_X3	X3
CAV_5	5
5199	Run/Crank Relay Coil Control
5199_GN/VT	5199 GN/VT

Callout	Component Name
CAV_15	15
CONN_X4	X4
4	Accessory Ignition Voltage
CAV_86	86
CAV_30	30
CAV_85	85
CAV_87	87
50	Ground
50_BK	50 BK
CAV_87A	87A
CAV_6	6
CAV_22	22
3	Run/Crank Ignition 1 Voltage
5985	Accessory Wakeup Serial Data
5985_VT/YE	5985 VT/YE
CAV_5	5
CONN_X1	X1
CAV_13	13
CAV_12	12
CAV_16	16
4_GY	4 GY
3_VT	3 VT
CAV_67	67
CONN_X2	X2
CONN_X3	X3
CONN_X1	X1
5199_GN/VT	5199 GN/VT
5199_GN/VT	5199 GN/VT
G100	G100
F59UA	F59UA 10A
F47UA	F47UA 10A
F48UA	F48UA 5A
F49UA	F49UA 10A
F51UA	F51UA 10A
F52UA	F52UA 10A
F64UA	F64UA 15A
F71UA	F71UA 10A
F9DA	F9DA
F9DA	F9DA
F31UA	F31UA 30A
L_REF	L
J236	J236
X50A	X50A Fuse Block - Underhood
K114B	K114B Hybrid/EV Powertrain Control Module 2
K84	K84 Keyless Entry Control Module
KR73A	KR73A Ignition Main Relay 1
KR73B	KR73B Ignition Main Relay 2
K9	K9 Body Control Module

Ignition Main Relay 2

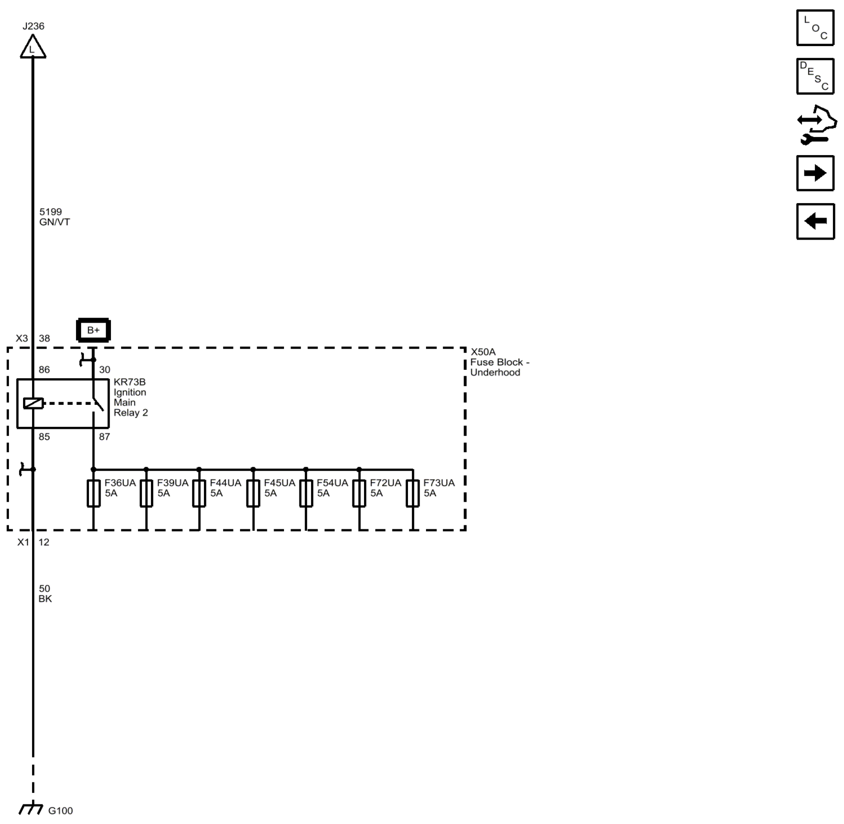

J236
L
5199
GN/VT
B+
X3 38
86
30
KR73B
Ignition
Main
Relay 2
X50A
Fuse Block -
Underhood
85
87
F36UA
5A
F39UA
5A
F44UA
5A
F45UA
5A
F54UA
5A
F72UA
5A
F73UA
5A
X1 12
50
BK
G100

Fig. 64: Ignition Main Relay 2
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5199	Run/Crank Relay Coil Control
CAV_86	86
CAV_30	30
CAV_85	85
CAV_87	87
50	Ground
50_BK	50 BK
CAV_12	12
CAV_38	38
CONN_X3	X3
CONN_X1	X1
5199_GN/VT	5199 GN/VT
G100	G100
F39UA	F39UA 5A
F44UA	F44UA 5A
F45UA	F45UA 5A
F54UA	F54UA 5A
F72UA	F72UA 5A
F73UA	F73UA 5A
F36UA	F36UA 5A
L_REF	L
J236	J236
X50A	X50A Fuse Block - Underhood
KR73B	KR73B Ignition Main Relay 2

Accessory Power and Retained Accessory Power Relay

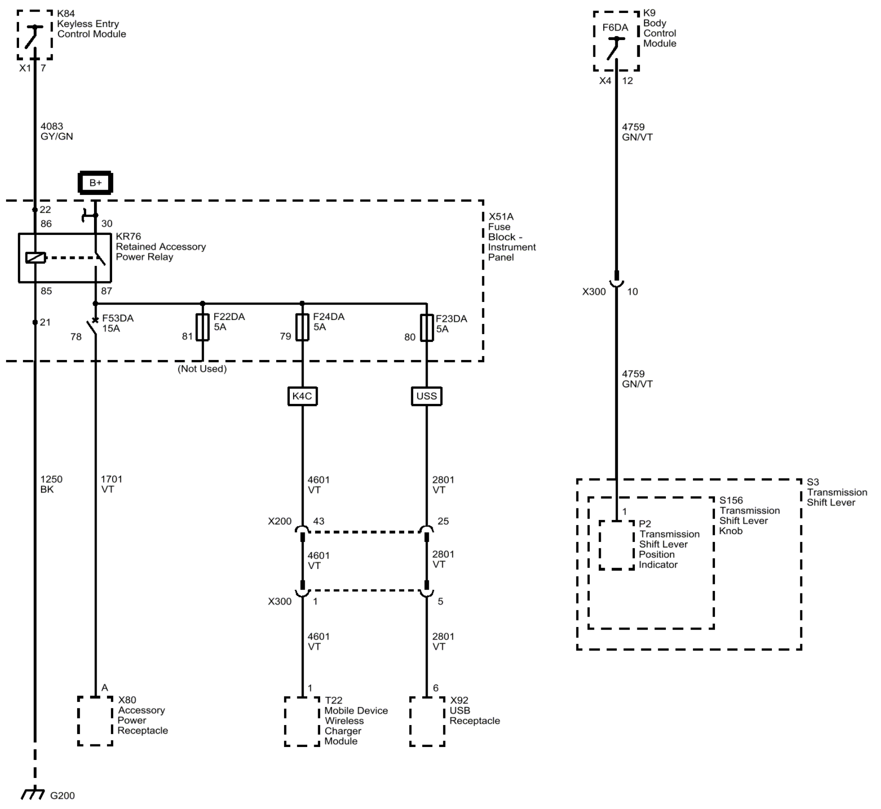

K84
Keyless Entry
Control Module
X1 7
4083
GY/GN
B+
22
86
30
KR76
Retained Accessory
Power Relay
85
87
21
F53DA
15A
78
F22DA
5A
81
(Not Used)
F24DA
5A
79
F23DA
5A
80
X51A
Fuse
Block -
Instrument
Panel
K4C
USS
1250
BK
1701
VT
4601
VT
2801
VT
X200
43
25
X300
1
5
A
X80
Accessory
Power
Receptacle
T22
Mobile Device
Wireless
Charger
Module
6
X92
USB
Receptacle
G200
K9
Body
Control
Module
F6DA
X4 12
4759
GN/VT
X300
10
S3
Transmission
Shift Lever
S156
Transmission
Shift Lever
Knob
P2
Transmission
Shift Lever
Position
Indicator

Fig. 65: Accessory Power and Retained Accessory Power Relay
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_1	1
CAV_12	12
CONN_X4	X4
CAV_6	6
CAV_1	1
1250_BK	1250 BK
1250	Ground
CAV_7	7
CONN_X1	X1
4083_GY/GN	4083 GY/GN
4083	RAP Relay 2 Coil Control
4759	Transmission Shift Lever Position Indicator 2 Control
CAV_86	86
CAV_30	30
CAV_22	22
1701_VT	1701 VT
1701	Retained Accessory Power Ignition
CAV_80	80
CAV_78	78
CAV_87	87
CAV_85	85
CAV_21	21
2801	Retained Accessory Power Fuse Ignition
2801_VT	2801 VT
4601	Retained Accessory Power Fused Control
4601_VT	4601 VT
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
4601_VT	4601 VT
4601_VT	4601 VT
2801_VT	2801 VT
2801_VT	2801 VT
USS	RECEPTACLE-USB CHARGE PORT
CAV_79	79
CAV_81	81
CAV_A	A
4759_GN/VT	4759 GN/VT
CAV_10	10
4759_GN/VT	4759 GN/VT
X200	X200
CAV_25	25
CAV_43	43
X300	X300
CAV_5	5
CAV_1	1
G200	G200
F6DA	F6DA
F23DA	F23DA 5A
F53DA	F53DA 15A
F24DA	F24DA 5A
F22DA	F22DA 5A
X300	X300
X200	X200
X300	X300
K9	K9 Body Control Module
T22	T22 Mobile Device Wireless Charger Module (K4C)
X92	X92 USB Receptacle
K84	K84 Keyless Entry Control Module
X51A	X51A Fuse Block - Instrument Panel
KR76	KR76 Retained Accessory Power Relay
X80	X80 Accessory Power Receptacle
P2	P2 Transmission Shift Lever Position Indicator
S156	S156 Transmission Shift Lever Knob
S3	S3 Transmission Shift Lever

Battery Saver Relay

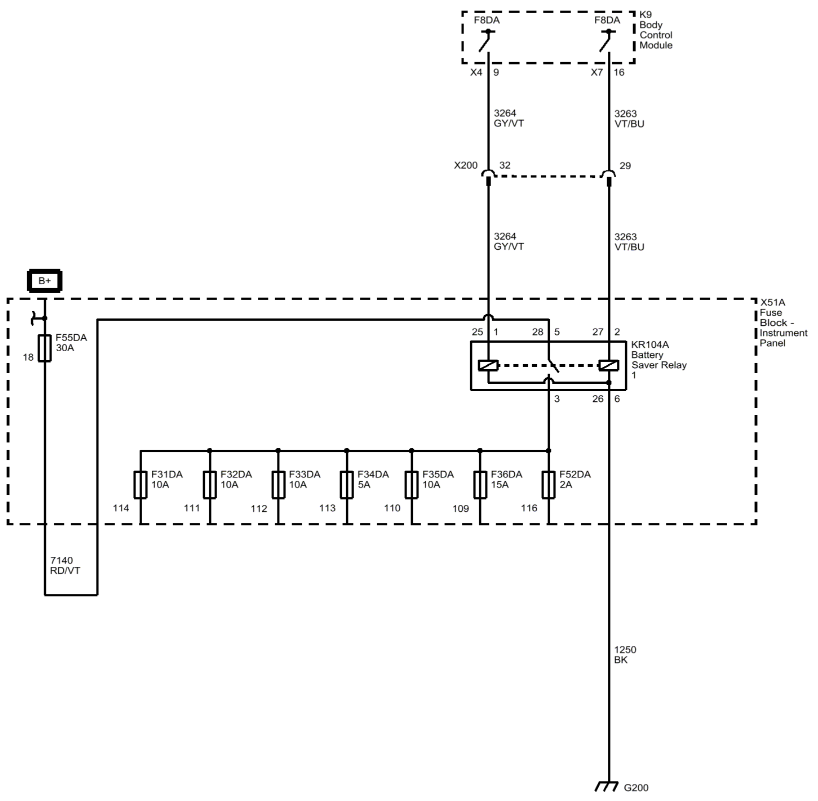

F8DA
F8DA
K9 Body Control Module
X4
9
X7
16
3264 GY/VT
3263 VT/BU
X200
32
29
3264 GY/VT
3263 VT/BU
B+
X51A Fuse Block - Instrument Panel
F55DA 30A
18
25
1
28
5
27
2
KR104A Battery Saver Relay 1
3
26
6
F31DA 10A
F32DA 10A
F33DA 10A
F34DA 5A
F35DA 10A
F36DA 15A
F52DA 2A
114
111
112
113
110
109
116
7140 RD/VT
1250 BK
G200

Fig. 66: Battery Saver Relay
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAV_9	9
CONN_X4	X4
CAV_16	16
CONN_X7	X7
CAV_110	110
CAV_109	109
CAV_116	116
1250	Ground
1250_BK	1250 BK
3264	Logistic Mode Relay Close Control
3264_GY/VT	3264 GY/VT
3263	Logistic Mode Relay Open Control
3263_VT/BU	3263 VT/BU
3264_GY/VT	3264 GY/VT
3263_VT/BU	3263 VT/BU
7140	Battery Positive Voltage
7140_RD/VT	7140 RD/VT
CAV_18	18
CAV_1	1
CONN_25	25
CAV_5	5
CONN_28	28
CAV_2	2
CONN_27	27
CAV_6	6
CONN_26	26
CAV_3	3
CAV_111	111
CAV_112	112
CAV_113	113
CAV_114	114
X200	X200
CAV_32	32
CAV_29	29
G200	G200
F35DA	F35DA 10A
F36DA	F36DA 15A
F52DA	F52DA 2A
F55DA	F55DA 30A
F32DA	F32DA 10A
F33DA	F33DA 10A
F34DA	F34DA 5A
F31DA	F31DA 10A
F8DA	F8DA
F8DA	F8DA
X200	X200
K9	K9 Body Control Module
KR104A	KR104A Battery Saver Relay 1
X51A	X51A Fuse Block - Instrument Panel

GROUND DISTRIBUTION SCHEMATICS

G100 and G104

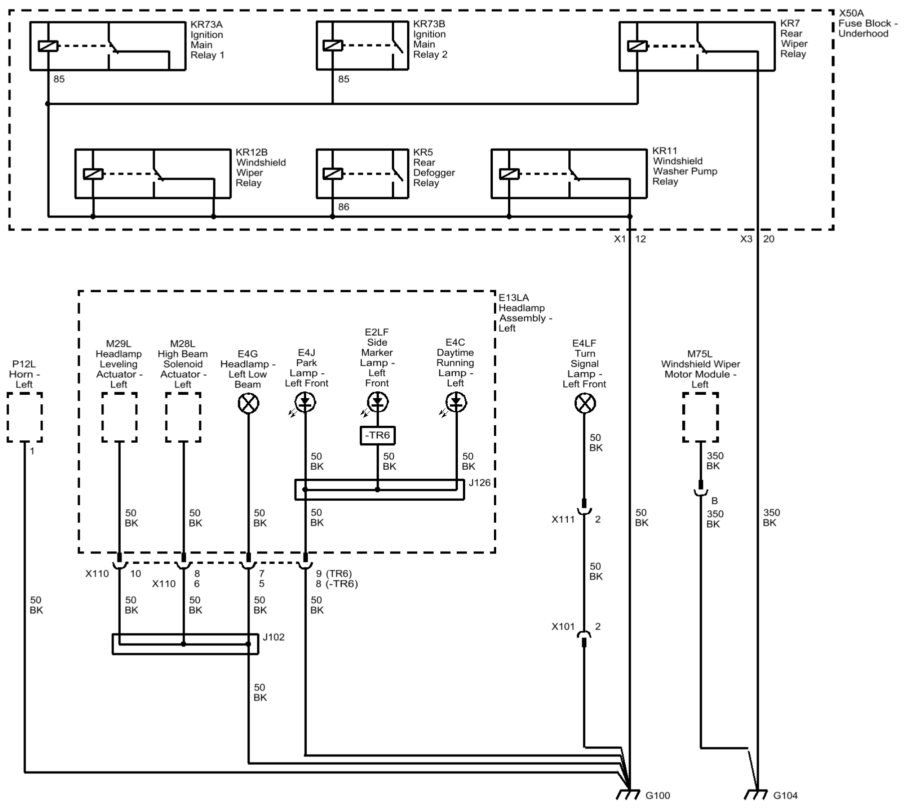

KR73A Ignition Main Relay 1
KR73B Ignition Main Relay 2
KR7 Rear Wiper Relay
X50A Fuse Block - Underhood
85
85
KR12B Windshield Wiper Relay
KR5 Rear Defogger Relay
KR11 Windshield Washer Pump Relay
86
X1
12
X3
20
E13LA Headlamp Assembly - Left
P12L Horn - Left
M29L Headlamp Leveling Actuator - Left
M28L High Beam Solenoid Actuator - Left
E4G Headlamp - Left Low Beam
E4J Park Lamp - Left Front
E2LF Side Marker Lamp - Left Front
E4C Daytime Running Lamp - Left
E4LF Turn Signal Lamp - Left Front
M75L Windshield Wiper Motor Module - Left
-TR6
1
50 BK
350 BK
J126
B
X111
2
X110
10
X110
8
6
7
5
9 (TR6)
8 (-TR6)
J102
X101
2
G100
G104

Fig. 67: G100 and G104
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
50	Ground
50_BK	50 BK
CAV_85	85
CAV_86	86
50_BK	50 BK
50_BK	50 BK
50_BK	50 BK
50_BK	50 BK
50_BK	50 BK
CAV_2	2
CAV_2	2
50_BK	50 BK
50_BK	50 BK
50_BK	50 BK
50_BK	50 BK
50_BK	50 BK
50_BK	50 BK
CAV_85	85
850	Ground
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
CAV_8	8
CAV_5	5
CAV_6	6
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
350	Ground
350_BK	350 BK
350_BK	350 BK
CAV_B	B
350_BK	350 BK
50_BK	50 BK
50_BK	50 BK
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
50_BK	50 BK
CAV_1	1
50_BK	50 BK
CAV_20	20
CONN_X3	X3
CAV_12	12
CONN_X1	X1
X110	X110
CAV_8	8
CAV_9	9
CAV_7	7
CAV_10	10
J126	J126
J102	J102
X111	X111
X101	X101
G100	G100
G104	G104
X110	X110
KR12B	KR12B Windshield Wiper Relay
KR5	KR5 Rear Defogger Relay
E13LA	E13LA Headlamp Assembly - Left
KR11	KR11 Windshield Washer Pump Relay
E4G	E4G Headlamp - Left Low Beam
E4J	E4J Park Lamp - Left Front
E2LF	E2LF Side Marker Lamp - Left Front
E4C	E4C Daytime Running Lamp - Left
M28L	M28L High Beam Solenoid Actuator - Left
M29L	M29L Headlamp Leveling Actuator - Left (TR6)
E4LF	E4LF Turn Signal Lamp - Left Front
KR73A	KR73A Ignition Main Relay 1
KR73B	KR73B Ignition Main Relay 2
KR7	KR7 Rear Wiper Relay
M75L	M75L Windshield Wiper Motor Module - Left
P12L	P12L Horn - Left
X50A	X50A Fuse Block - Underhood

G101 and G102

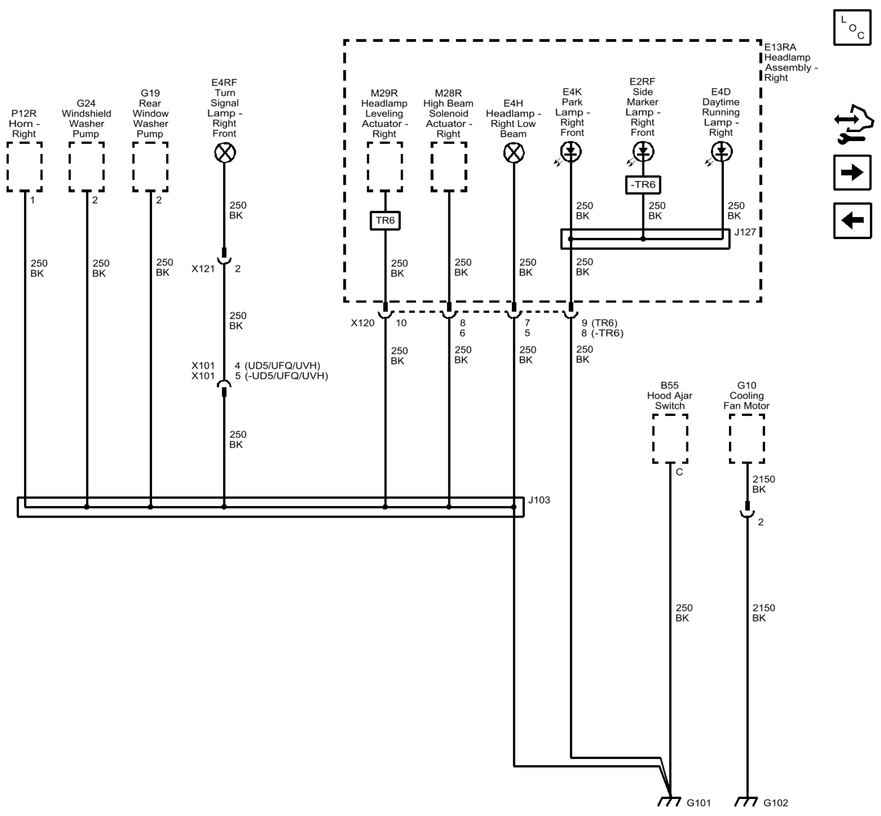
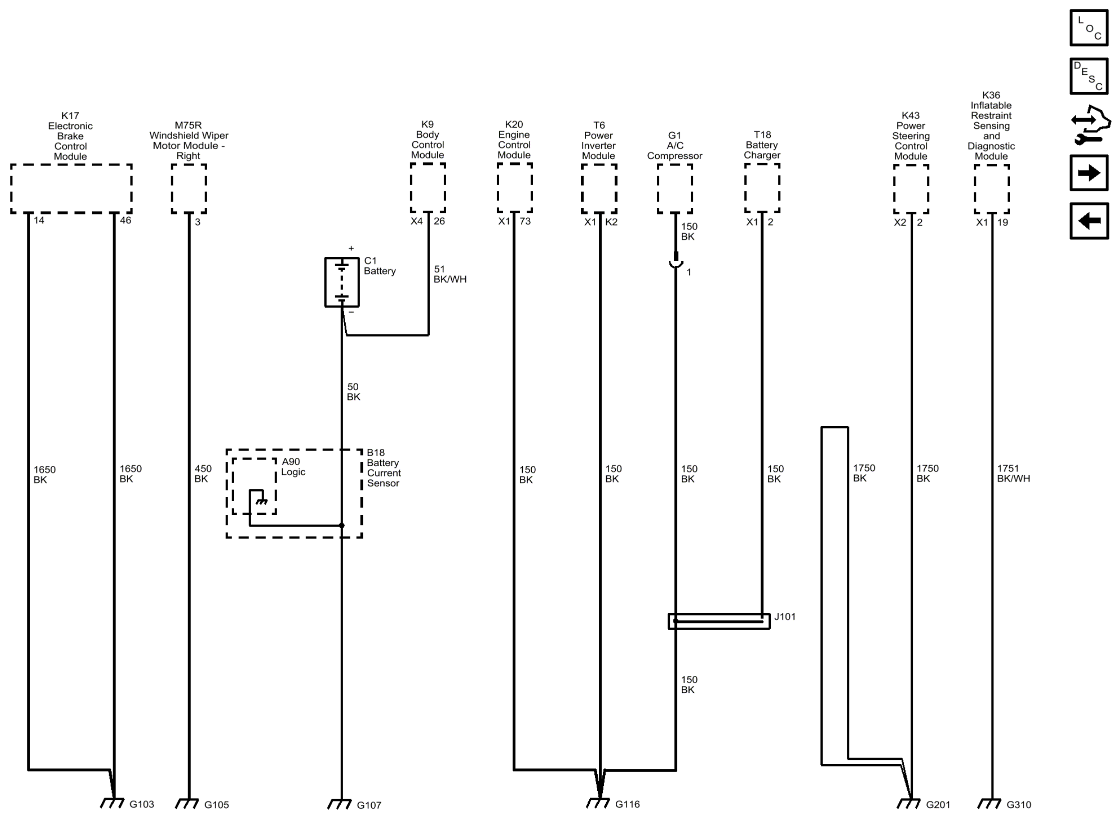

P12R Horn - Right
G24 Windshield Washer Pump
G19 Rear Window Washer Pump
E4RF Turn Signal Lamp - Right Front
M29R Headlamp Leveling Actuator - Right
M28R High Beam Solenoid Actuator - Right
E4H Headlamp - Right Low Beam
E4K Park Lamp - Right Front
E2RF Side Marker Lamp - Right Front
E4D Daytime Running Lamp - Right
E13RA Headlamp Assembly - Right
TR6
-TR6
250 BK
2150 BK
X121
X120
X101
4 (UD5/UFQ/UVH)
5 (-UD5/UFQ/UVH)
9 (TR6)
8 (-TR6)
J127
J103
B55 Hood Ajar Switch
G10 Cooling Fan Motor
G101
G102

Fig. 68: G101 and G102
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
250	Ground
250_BK	250 BK
250_BK	250 BK
Â	Â
250_BK	250 BK
250_BK	250 BK

Callout	Component Name
250_BK	250 BK
250_BK	250 BK
250_BK	250 BK
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
CAV_2	2
CAV_5	5
250_BK	250 BK
250_BK	250 BK
250_BK	250 BK
250_BK	250 BK
250_BK	250 BK
250_BK	250 BK
CAV_8	8
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
CAV_5	5
CAV_6	6
CAV_4	4
UD5	PARK ASSIST-FRONT AND REAR
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UVH	VISION-360 VIEW, MONO, ANALOG
UD5	PARK ASSIST-FRONT AND REAR
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UVH	VISION-360 VIEW, MONO, ANALOG
250_BK	250 BK
250_BK	250 BK
250_BK	250 BK
250_BK	250 BK
CAV_C	C
CAV_2	2
CAV_2	2
CAV_1	1
250_BK	250 BK
850	Ground
2150	Ground
2150_BK	2150 BK
CAV_2	2
2150_BK	2150 BK
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
X120	X120
CAV_10	10
CAV_8	8
CAV_9	9
CAV_7	7
J127	J127
X121	X121
X101	X101
J103	J103
G101	G101
G102	G102
X120	X120
M29R	M29R Headlamp Leveling Actuator - Right (TR6)
M28R	M28R High Beam Solenoid Actuator - Right
E4H	E4H Headlamp - Right Low Beam
E4K	E4K Park Lamp - Right Front
E2RF	E2RF Side Marker Lamp - Right Front
E4D	E4D Daytime Running Lamp - Right
E13RA	E13RA Headlamp Assembly - Right
E4RF	E4RF Turn Signal Lamp - Right Front
P12R	P12R Horn - Right
G24	G24 Windshield Washer Pump
G19	G19 Rear Window Washer Pump
B55	B55 Hood Ajar Switch
G10	G10 Cooling Fan Motor

G103, G105, G107, G116, G201 and G310


K17 Electronic Brake Control Module
M75R Windshield Wiper Motor Module - Right
K9 Body Control Module
K20 Engine Control Module
T6 Power Inverter Module
G1 A/C Compressor
T18 Battery Charger
K43 Power Steering Control Module
K36 Inflatable Restraint Sensing and Diagnostic Module
14
46
3
X4 26
X1 73
X1 K2
X1 2
X2 2
X1 19
C1 Battery
51 BK/WH
150 BK
1
50 BK
A90 Logic
B18 Battery Current Sensor
1650 BK
1650 BK
450 BK
150 BK
150 BK
150 BK
150 BK
1750 BK
1750 BK
1751 BK/WH
J101
150 BK
G103
G105
G107
G116
G201
G310

[Fig. 69: G103, G105, G107, G116, G201 and G310](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1650	Ground
1650_BK	1650 BK
CAV_46	46
1650_BK	1650 BK
CAV_14	14
150	Ground
150_BK	150 BK
150_BK	150 BK
150_BK	150 BK
150_BK	150 BK

Callout	Component Name
150_BK	150 BK
450	Ground
450_BK	450 BK
CAV_3	3
CAV_1	1
150_BK	150 BK
CAV_2	2
CONN_X1	X1
CAV_K2	K2
CONN_X1	X1
CAV_73	73
CONN_X1	X1
1750	Ground
1750_BK	1750 BK
1750_BK	1750 BK
350	Ground
CAV_2	2
CONN_X2	X2
1751	Signal Ground
1751_BK/WH	1751 BK/WH
CAV_19	19
CONN_X1	X1
CAV_26	26
CONN_X4	X4
50_BK	50 BK
50	Ground
51	Signal Ground
51_BK/WH	51 BK/WH
G103	G103
G116	G116
J101	J101
G105	G105
G201	G201
G310	G310
G107	G107
K17	K17 Electronic Brake Control Module
G1	G1 A/C Compressor
M75R	M75R Windshield Wiper Motor Module - Right
T18	T18 Battery Charger
T6	T6 Power Inverter Module
K20	K20 Engine Control Module
K43	K43 Power Steering Control Module
K36	K36 Inflatable Restraint Sensing and Diagnostic Module
C1	C1 Battery
A90	A90 Logic
B18	B18 Battery Current Sensor
K9	K9 Body Control Module

G111, G150, G151, G153, G154, G155, G156, G157 and G158

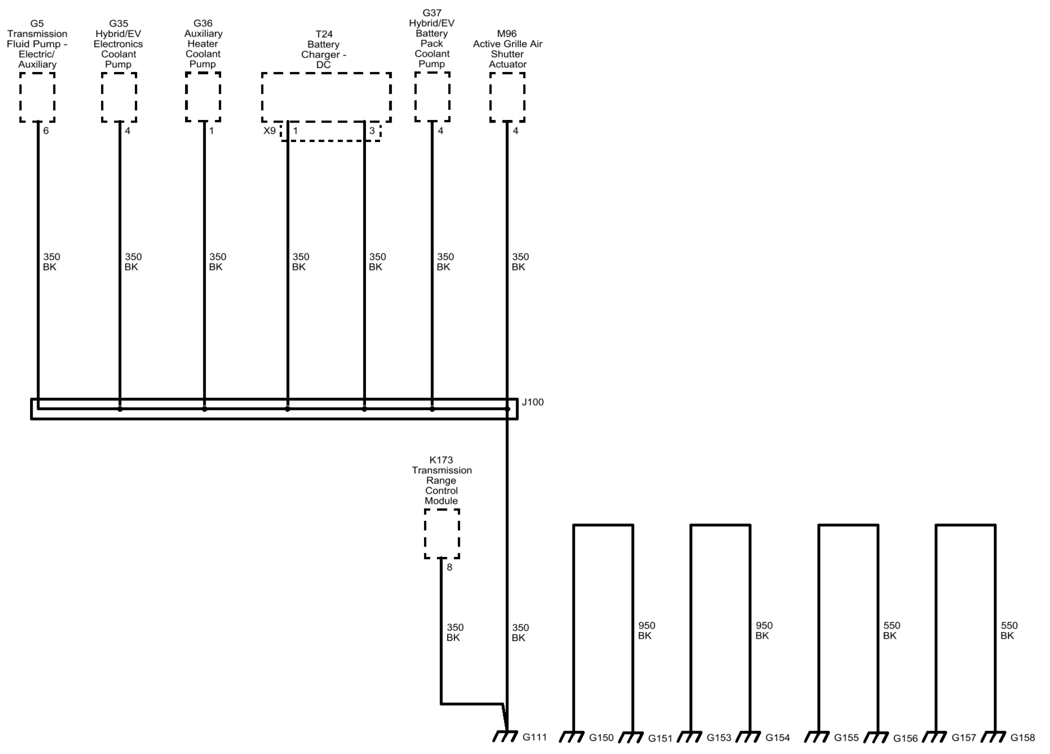

G5
Transmission Fluid Pump - Electric/ Auxiliary
G35
Hybrid/EV Electronics Coolant Pump
G36
Auxiliary Heater Coolant Pump
T24
Battery Charger - DC
G37
Hybrid/EV Battery Pack Coolant Pump
M96
Active Grille Air Shutter Actuator
6
4
1
X9
1
3
4
4
350 BK
350 BK
350 BK
350 BK
350 BK
350 BK
350 BK
J100
K173
Transmission Range Control Module
8
350 BK
350 BK
950 BK
950 BK
550 BK
550 BK
G111
G150
G151
G153
G154
G155
G156
G157
G158

Fig. 70: G111, G150, G151, G153, G154, G155, G156, G157 and G158
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
350_BK	350 BK
CAV_6	6
350	Ground
350_BK	350 BK
350_BK	350 BK
CAV_3	3
350_BK	350 BK
350_BK	350 BK
350_BK	350 BK
CAV_4	4
350_BK	350 BK
CAV_1	1
350_BK	350 BK
350	Ground
350_BK	350 BK
CAV_8	8
CAV_4	4
CAV_4	4
CAV_1	1
CONN_X9	X9
CONN_X3	X3
950_BK	950 BK
950_BK	950 BK
550	Ground
550_BK	550 BK
550_BK	550 BK
G111	G111

Callout	Component Name
G150	G150
G151	G151
G153	G153
G154	G154
G155	G155
G156	G156
G157	G157
G158	G158
J100	J100
K173	K173 Transmission Range Control Module
M96	M96 Active Grille Air Shutter Actuator
T24	T24 Battery Charger - DC
G37	G37 Hybrid/EV Battery Pack Coolant Pump
G36	G36 Auxiliary Heater Coolant Pump
G35	G35 Hybrid/EV Electronics Coolant Pump
G5	G5 Transmission Fluid Pump - Electric/Auxiliary

G200 (1 of 2)

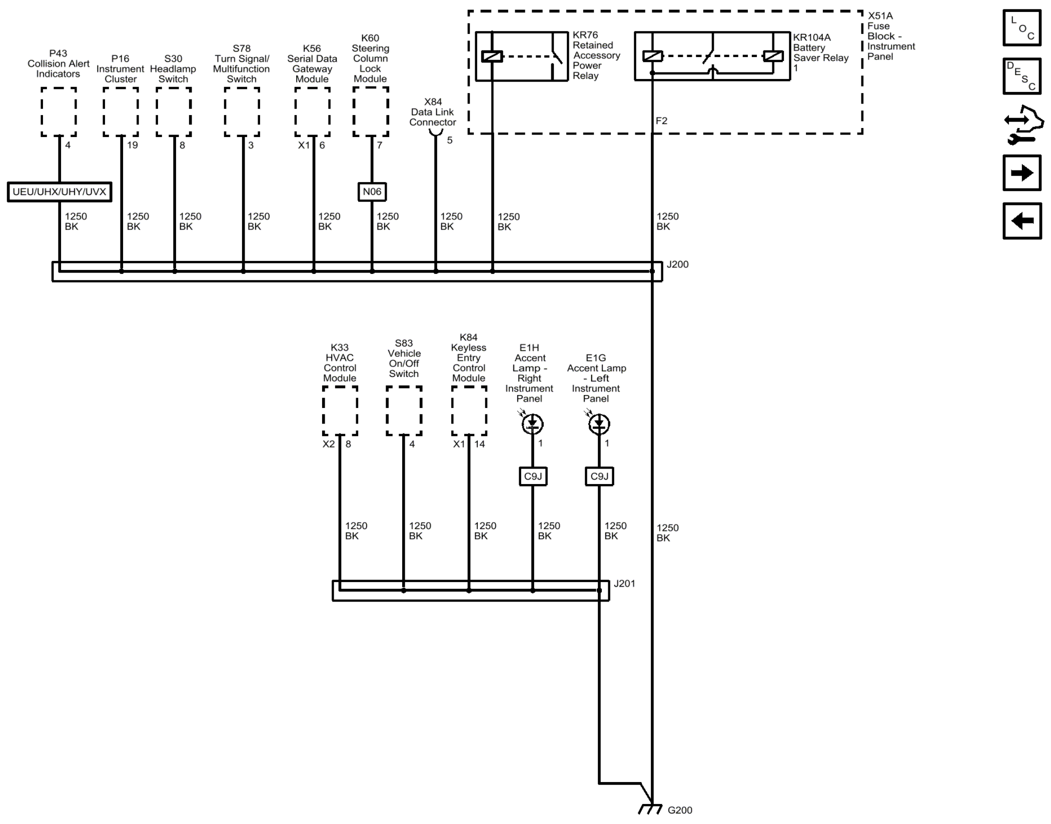

P43 Collision Alert Indicators
P16 Instrument Cluster
S30 Headlamp Switch
S78 Turn Signal/ Multifunction Switch
K56 Serial Data Gateway Module
K60 Steering Column Lock Module
X84 Data Link Connector
KR76 Retained Accessory Power Relay
KR104A Battery Saver Relay 1
X51A Fuse Block - Instrument Panel
4
19
8
3
X1
6
7
5
F2
UEU/UHX/UHY/UVX
N06
1250 BK
J200
K33 HVAC Control Module
S83 Vehicle On/Off Switch
K84 Keyless Entry Control Module
E1H Accent Lamp - Right Instrument Panel
E1G Accent Lamp - Left Instrument Panel
X2
8
4
X1
14
1
1
C9J
C9J
J201
G200
L O C
D E S C

Fig. 71: G200 (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1250	Ground
1250_BK	1250 BK
1250_BK	1250 BK
CAV_8	8
CAV_19	19
1250_BK	1250 BK
CAV_3	3
1250_BK	1250 BK
1250_BK	1250 BK
1250_BK	1250 BK
1250_BK	1250 BK
CAV_7	7
1250_BK	1250 BK
1250_BK	1250 BK
CAV_4	4
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UVX	SENSOR INDICATOR-TRAFFIC SIGN RECOGNITION ENHANCED
CAV_6	6
CONN_X1	X1
CAV_F2	F2
CAV_5	5
1250_BK	1250 BK
N06	STEERING COLUMN LOCK-ELECTRICAL
1250_BK	1250 BK
CAV_4	4
1250_BK	1250 BK
CAV_8	8
1250_BK	1250 BK
1250_BK	1250 BK
CAV_14	14
1250_BK	1250 BK
CONN_X2	X2
CONN_X1	X1
CAV_1	1
CAV_1	1
CAV_1	1
C9J	LAMP-INTR, AMBIENT, I/P
C9J	LAMP-INTR, AMBIENT, I/P
J200	J200
J201	J201
G200	G200
P43	P43 Collision Alert Indicators
P16	P16 Instrument Cluster
S30	S30 Headlamp Switch
S78	S78 Turn Signal/Multifunction Switch
K56	K56 Serial Data Gateway Module
K60	K60 Steering Column Lock Module (N06)
X51A	X51A Fuse Block - Instrument Panel
KR76	KR76 Retained Accessory Power Relay
KR104A	KR104A Battery Saver Relay 1
X84	X84 Data Link Connector
K33	K33 HVAC Control Module
S83	S83 Vehicle On/Off Switch
K84	K84 Keyless Entry Control Module
E1H	E1H Accent Lamp - Right Instrument Panel
E1G	E1G Accent Lamp - Left Instrument Panel

G200 (2 of 2)

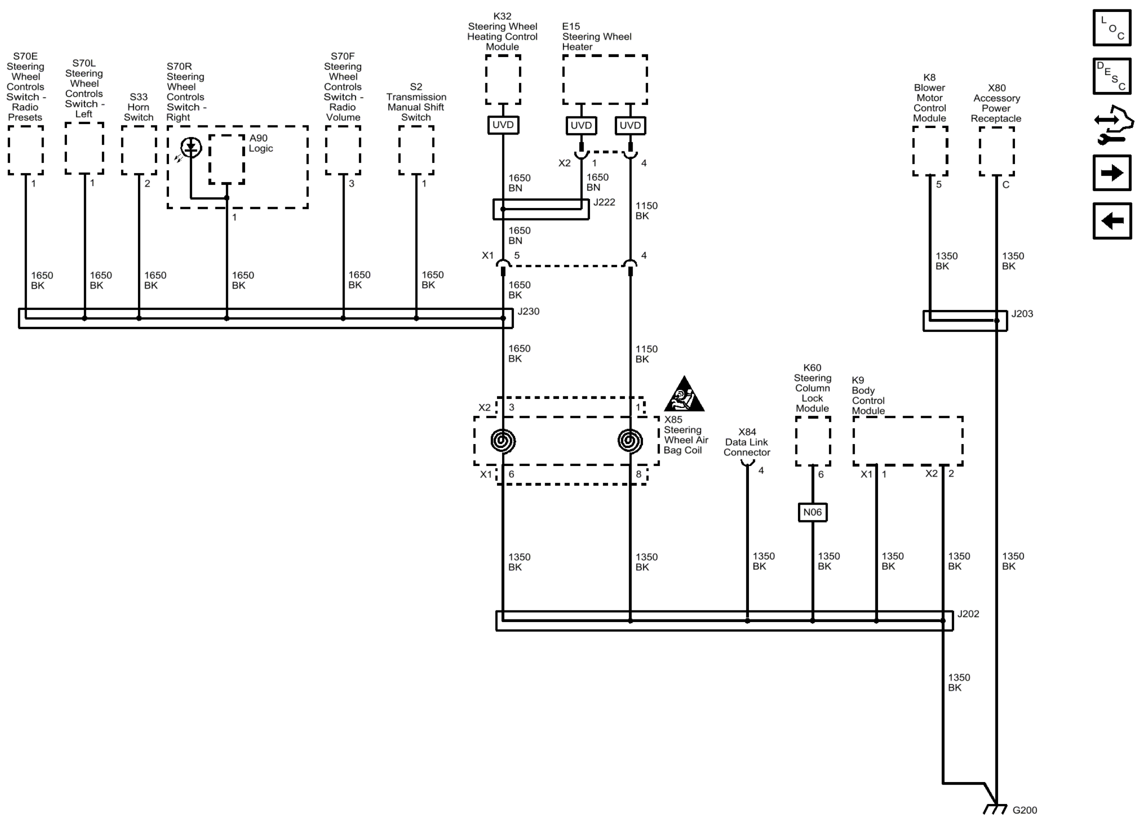

S70E Steering Wheel Controls Switch - Radio Presets
S70L Steering Wheel Controls Switch - Left
S33 Horn Switch
S70R Steering Wheel Controls Switch - Right
A90 Logic
S70F Steering Wheel Controls Switch - Radio Volume
S2 Transmission Manual Shift Switch
K32 Steering Wheel Heating Control Module
E15 Steering Wheel Heater
UVD
UVD
UVD
X2
1
4
1650 BN
1650 BN
J222
1150 BK
1650 BN
X1
5
4
1
1
2
1
3
1
1650 BK
1650 BK
1650 BK
1650 BK
1650 BK
1650 BK
1650 BK
J230
1650 BK
1150 BK
X2
3
1
X85 Steering Wheel Air Bag Coil
X1
6
8
X84 Data Link Connector
4
K60 Steering Column Lock Module
6
N06
K9 Body Control Module
X1
1
X2
2
K8 Blower Motor Control Module
5
X80 Accessory Power Receptacle
C
1350 BK
1350 BK
J203
1350 BK
1350 BK
1350 BK
1350 BK
1350 BK
1350 BK
1350 BK
J202
1350 BK
G200
LOC
DESC

Fig. 72: G200 (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1350_BK	1350 BK
1350	Ground
1350_BK	1350 BK
1350_BK	1350 BK
1350_BK	1350 BK
CAV_6	6
1350_BK	1350 BK
1350_BK	1350 BK
1350_BK	1350 BK
CAV_5	5
CAV_C	C
CAV_6	6
CONN_X1	X1
1350_BK	1350 BK
1350_BK	1350 BK
1650	Ground
1650_BK	1650 BK
1650_BK	1650 BK
1650_BK	1650 BK
CAV_1	1
CAV_3	3
1650_BK	1650 BK
CAV_3	3
CONN_X2	X2
1650_BK	1650 BK
CAV_1	1
1150	Ground
1150_BK	1150 BK
1650_BK	1650 BK
CAV_2	2
Â	Â
CAV_1	1
1650_BK	1650 BK
CAV_1	1
CAV_8	8
1150_BK	1150 BK
Â	Â
1650_BN	1650 BN
1650_BN	1650 BN
1650_BN	1650 BN
CAV_1	1
CONN_X1	X1
CAV_2	2
CONN_X2	X2
CAV_4	4
N06	STEERING COLUMN LOCK-ELECTRICAL
1650_BK	1650 BK
CAV_1	1
UVD	STEERING WHEEL HEAT-MANUAL
UVD	STEERING WHEEL HEAT-MANUAL
UVD	STEERING WHEEL HEAT-MANUAL
1350_BK	1350 BK
X2	X2
CAV_4	4
CAV_1	1
X1	X1
CAV_4	4
CAV_5	5
G200	G200
J203	J203
J222	J222
J202	J202
J230	J230
X2	X2
X1	X1
X80	X80 Accessory Power Receptacle
K8	K8 Blower Motor Control Module
X85	X85 Steering Wheel Air Bag Coil
A90	A90 Logic
S70E	S70E Steering Wheel Controls Switch - Radio Presets
S70L	S70L Steering Wheel Controls Switch - Left
S33	S33 Horn Switch
S70R	S70R Steering Wheel Controls Switch - Right
S70F	S70F Steering Wheel Controls Switch - Radio Volume
K32	K32 Steering Wheel Heating Control Module (UVD)
E15	E15 Steering Wheel Heater (UVD)

Callout	Component Name
K9	K9 Body Control Module
X84	X84 Data Link Connector
S2	S2 Transmission Manual Shift Switch
K60	K60 Steering Column Lock Module (N06)

G202, G203, G260, G261, G262 and G263

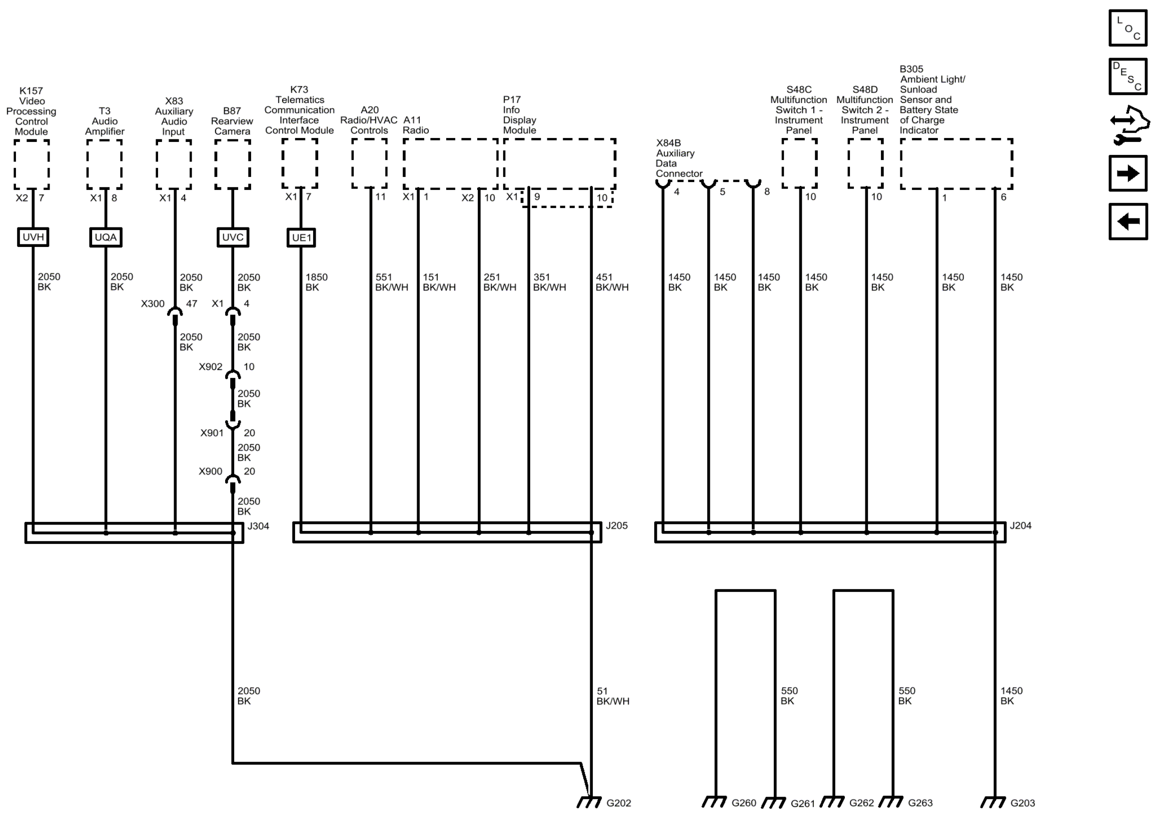

K157 Video Processing Control Module
T3 Audio Amplifier
X83 Auxiliary Audio Input
B87 Rearview Camera
K73 Telematics Communication Interface Control Module
A20 Radio/HVAC Controls
A11 Radio
P17 Info Display Module
X84B Auxiliary Data Connector
S48C Multifunction Switch 1 - Instrument Panel
S48D Multifunction Switch 2 - Instrument Panel
B305 Ambient Light/ Sunload Sensor and Battery State of Charge Indicator
X2 7
X1 8
X1 4
X1 7
11
X1 1
X2 10
X1 9
10
4
5
8
10
10
1
6
UVH
UQA
UVC
UE1
2050 BK
1850 BK
551 BK/WH
151 BK/WH
251 BK/WH
351 BK/WH
451 BK/WH
1450 BK
X300 47
X1 4
X902 10
X901 20
X900 20
J304
J205
J204
51 BK/WH
550 BK
G202
G260
G261
G262
G263
G203

Fig. 73: G202, G203, G260, G261, G262 and G263
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1450	Ground
1450_BK	1450 BK
1450_BK	1450 BK
1450_BK	1450 BK
1450_BK	1450 BK
CAV_10	10
1450_BK	1450 BK
CAV_10	10
1850_BK	1850 BK
CAV_7	7
1850	Ground
451_BK/WH	451 BK/WH
451	Signal Ground
551_BK/WH	551 BK/WH
CAV_11	11
551	Signal Ground
351_BK/WH	351 BK/WH
351	Signal Ground
151_BK/WH	151 BK/WH
151	Signal Ground
251_BK/WH	251 BK/WH
251	Signal Ground
CAV_10	10
CAV_9	9
CAV_10	10
CONN_X2	X2
CAV_1	1
CONN_X1	X1
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR
550	Ground
550_BK	550 BK
550_BK	550 BK
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
CAV_7	7
CONN_X2	X2
UVH	VISION-360 VIEW, MONO, ANALOG
CAV_4	4
CONN_X1	X1
CAV_47	47
2050_BK	2050 BK
2050_BK	2050 BK
CAV_8	8
CONN_X1	X1
UQA	SPEAKER SYSTEM-PREMIUM AUDIO, BRANDED AMPLIFIER
UVC	VISION-REAR VIEW, MONO, ANALOG
CAV_10	10
CAV_20	20
CAV_20	20
2050_BK	2050 BK
2050_BK	2050 BK
2050_BK	2050 BK
350	Ground
2050	Ground
51	Signal Ground
51_BK/WH	51 BK/WH
CONN_X1	X1
1450_BK	1450 BK
1450_BK	1450 BK
1450_BK	1450 BK
CAV_1	1
CAV_6	6
CAV_5	5
CAV_4	4
CAV_8	8
CAV_4	4
CONN_X1	X1

Callout	Component Name
G203	G203
J204	J204
G202	G202
J205	J205
G260	G260
G261	G261
G262	G262
G263	G263
X300	X300
X902	X902
X901	X901
X900	X900
J304	J304
X1	X1
X84B	X84B Auxiliary Data Connector
K73	K73 Telematics Communication Interface Control Module
K157	K157 Video Processing Control Module
X83	X83 Auxiliary Audio Input
B87	B87 Rearview Camera
T3	T3 Audio Amplifier (UQA)
A11	A11 Radio
P17	P17 Info Display Module
A20	A20 Radio/HVAC Controls
S48D	S48D Multifunction Switch 2 - Instrument Panel
S48C	S48C Multifunction Switch 1 - Instrument Panel
B305	B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator

G304

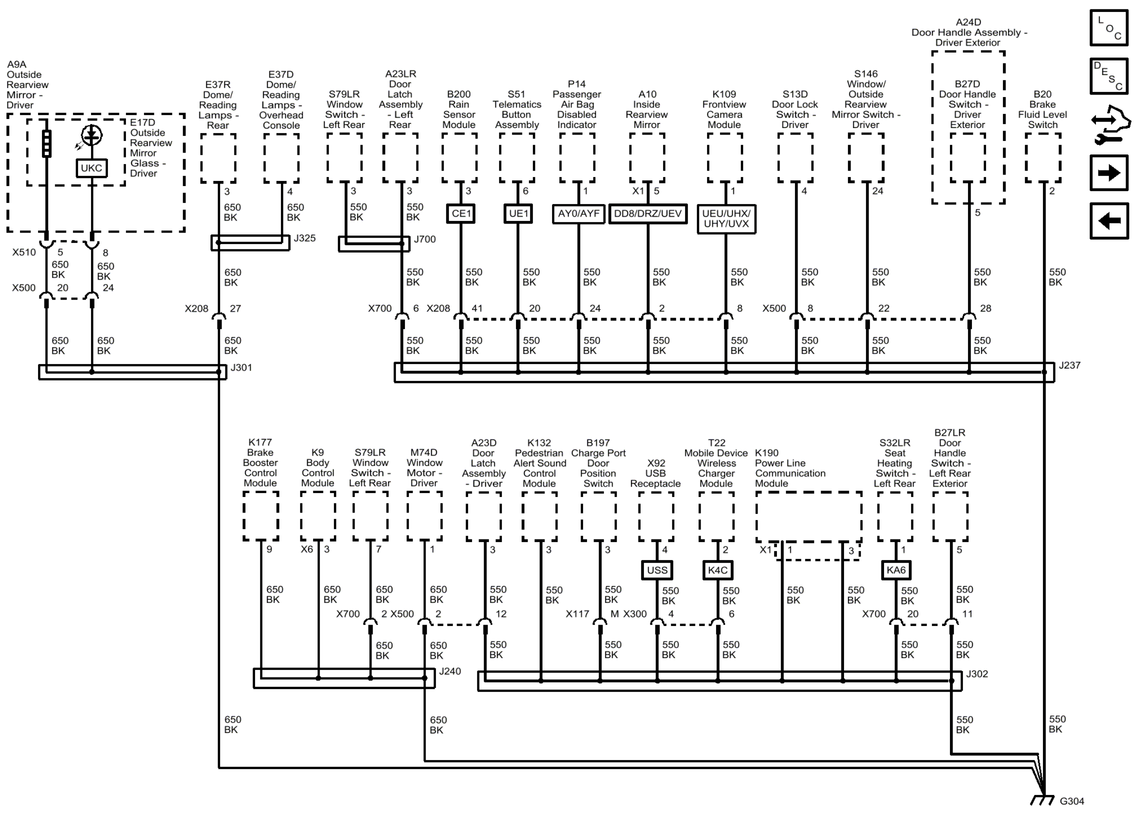

A9A Outside Rearview Mirror - Driver
E17D Outside Rearview Mirror Glass - Driver
UKC
E37R Dome/ Reading Lamps - Rear
E37D Dome/ Reading Lamps - Overhead Console
S79LR Window Switch - Left Rear
A23LR Door Latch Assembly - Left Rear
B200 Rain Sensor Module
S51 Telematics Button Assembly
P14 Passenger Air Bag Disabled Indicator
A10 Inside Rearview Mirror
K109 Frontview Camera Module
S13D Door Lock Switch - Driver
S146 Window/ Outside Rearview Mirror Switch - Driver
A24D Door Handle Assembly - Driver Exterior
B27D Door Handle Switch - Driver Exterior
B20 Brake Fluid Level Switch
CE1
UE1
AY0/AYF
DD8/DRZ/UEV
UEU/UHX/ UHY/UVX
650 BK
550 BK
X510
X500
X208
X700
X1
J325
J700
J301
J237
K177 Brake Booster Control Module
K9 Body Control Module
S79LR Window Switch - Left Rear
M74D Window Motor - Driver
A23D Door Latch Assembly - Driver
K132 Pedestrian Alert Sound Control Module
B197 Charge Port Door Position Switch
X92 USB Receptacle
T22 Mobile Device Wireless Charger Module
K190 Power Line Communication Module
S32LR Seat Heating Switch - Left Rear
B27LR Door Handle Switch - Left Rear Exterior
USS
K4C
KA6
X6
X117
X300
J240
J302
G304

Fig. 74: G304
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
550	Ground
550_BK	550 BK
CAV_4	4
550_BK	550 BK
550_BK	550 BK
CAV_2	2
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
CAV_3	3
CAV_1	1
CONN_X1	X1
USS	RECEPTACLE-USB CHARGE PORT
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
CAV_1	1
CAV_5	5
KA6	HEATER SEAT-REAR
550_BK	550 BK
CAV_3	3
550_BK	550 BK
CAV_3	3
CAV_M	M
550_BK	550 BK
CAV_3	3
550_BK	550 BK
CAV_6	6
550_BK	550 BK
550_BK	550 BK
CAV_1	1
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
CAV_4	4
CAV_24	24
550_BK	550 BK
CAV_3	3
CAV_3	3
550_BK	550 BK
CAV_3	3
CAV_1	1
CAV_6	6
CE1	WIPER SYS WINDSHIELD-PULSE, MOISTURE SENSITIVE
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR
DD8	MIRROR I/S R/V-LT SENSITIVE
DRZ	MIRROR I/S R/V-LT SENSITIVE, FULL VIDEO DISPLAY
UEV	COMMUNICATION EQUIP-AUTOMATIC TOLL COLLECTION
550_BK	550 BK

Callout	Component Name
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
CAV_2	2
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
550_BK	550 BK
650	Ground
650_BK	650 BK
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
650_BK	650 BK
650_BK	650 BK
CAV_3	3
CAV_4	4
650	Ground
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
CAV_27	27
650_BK	650 BK
CAV_1	1
650_BK	650 BK
CAV_7	7
650_BK	650 BK
650_BK	650 BK
CAV_9	9
CAV_3	3
CONN_X6	X6
CAV_2	2
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
650_BK	650 BK
550_BK	550 BK
650_BK	650 BK
550_BK	550 BK
AY0	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER and PASS FRT, SEAT SIDE, ROOF SIDE
AYF	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER and PASS FRT, FRT SEAT SIDE and RR SEAT SIDE, ROOF SIDE, KNEE
CAV_5	5
CONN_X1	X1
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UVX	SENSOR INDICATOR-TRAFFIC SIGN RECOGNITION ENHANCED
CAV_5	5
X300	X300
CAV_4	4
CAV_6	6
X700	X700
CAV_20	20
CAV_11	11
X500	X500
CAV_8	8
CAV_22	22
CAV_28	28
X208	X208
CAV_20	20
CAV_41	41
CAV_24	24
CAV_8	8
X500	X500
CAV_20	20
CAV_24	24
X500	X500
CAV_2	2
CAV_12	12
X510	X510
CAV_5	5
CAV_8	8
G304	G304
X117	X117
X700	X700
J700	J700
J325	J325
X208	X208
X700	X700
J240	J240
J301	J301
J302	J302
J237	J237
X300	X300
X700	X700
X500	X500
X208	X208
X500	X500
X500	X500
X510	X510
X92	X92 USB Receptacle
T22	T22 Mobile Device Wireless Charger Module (K4C)
S32LR	S32LR Seat Heating Switch - Left Rear (KA6)

Callout	Component Name
B27LR	B27LR Door Handle Switch - Left Rear Exterior
A23D	A23D Door Latch Assembly - Driver
B197	B197 Charge Port Door Position Switch
K132	K132 Pedestrian Alert Sound Control Module
S79LR	S79LR Window Switch - Left Rear
A23LR	A23LR Door Latch Assembly - Left Rear
B200	B200 Rain Sensor Module (CE1)
S51	S51 Telematics Button Assembly
P14	P14 Passenger Air Bag Disabled Indicator
A10	A10 Inside Rearview Mirror
B174W	B174W Frontview Camera - Windshield (UEU)
S13D	S13D Door Lock Switch - Driver
B20	B20 Brake Fluid Level Switch
E17D	E17D Outside Rearview Mirror Glass - Driver
E37R	E37R Dome/Reading Lamps - Rear
E37D	E37D Dome/Reading Lamps - Overhead Console
A9A	A9A Outside Rearview Mirror - Driver
K177	K177 Brake Booster Control Module
K9	K9 Body Control Module
S79LR	S79LR Window Switch - Left Rear
M74D	M74D Window Motor - Driver
K190	K190 Power Line CommunicationModule
S146	S146 Window/Outside Rearview Mirror Switch - Driver
B27D	B27D Door Handle Switch - Driver Exterior
A24D	A24D Door Handle Assembly - Driver Exterior

G305

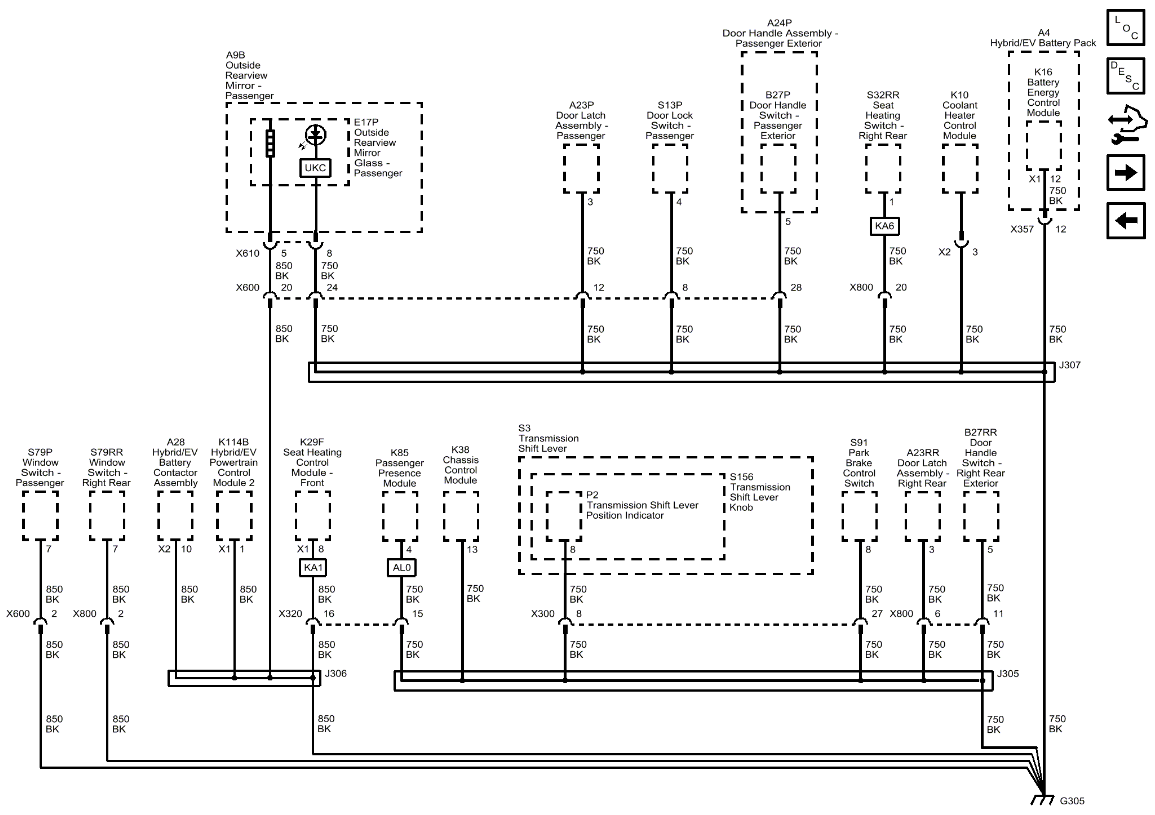

A9B Outside Rearview Mirror - Passenger
E17P Outside Rearview Mirror Glass - Passenger
UKC
A23P Door Latch Assembly - Passenger
S13P Door Lock Switch - Passenger
A24P Door Handle Assembly - Passenger Exterior
B27P Door Handle Switch - Passenger Exterior
S32RR Seat Heating Switch - Right Rear
K10 Coolant Heater Control Module
A4 Hybrid/EV Battery Pack
K16 Battery Energy Control Module
LOC
DESC
KA6
X610
X600
X800
X2
X357
X1
750 BK
850 BK
J307
S79P Window Switch - Passenger
S79RR Window Switch - Right Rear
A28 Hybrid/EV Battery Contactor Assembly
K114B Hybrid/EV Powertrain Control Module 2
K29F Seat Heating Control Module - Front
K85 Passenger Presence Module
K38 Chassis Control Module
S3 Transmission Shift Lever
S156 Transmission Shift Lever Knob
P2 Transmission Shift Lever Position Indicator
S91 Park Brake Control Switch
A23RR Door Latch Assembly - Right Rear
B27RR Door Handle Switch - Right Rear Exterior
KA1
AL0
X320
X300
J306
J305
G305

Fig. 75: G305
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
750	Ground
750_BK	750 BK
CAV_8	8
750_BK	750 BK
750_BK	750 BK
CAV_8	8
750_BK	750 BK
750_BK	750 BK
CAV_3	3
CAV_5	5
750_BK	750 BK
CAV_4	4
750_BK	750 BK
CAV_13	13
750_BK	750 BK
CAV_1	1
750_BK	750 BK
CAV_3	3
750_BK	750 BK
CAV_4	4
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
750_BK	750 BK
850	Ground
850_BK	850 BK
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
750_BK	750 BK
850_BK	850 BK
750_BK	750 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
CAV_8	8
CONN_X1	X1
750_BK	750 BK
CAV_20	20
KA6	HEATER SEAT-REAR
AL0	SENSOR INDICATOR-INFLATABLE RESTRAINT, FRT PASS/CHILD PRESENCE DETECTOR
CAV_1	1
CONN_X1	X1

Callout	Component Name
CAV_10	10
CONN_X2	X2
850_BK	850 BK
CAV_7	7
CAV_2	2
850_BK	850 BK
CAV_7	7
CAV_2	2
KA1	HEATER SEAT FRT-DRVR and PASS
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
850_BK	850 BK
CAV_12	12
CONN_X1	X1
750_BK	750 BK
CAV_12	12
CAV_3	3
CAV_5	5
X300	X300
CAV_8	8
CAV_27	27
X800	X800
CAV_6	6
CAV_11	11
X600	X600
CAV_20	20
CAV_24	24
CAV_12	12
CAV_8	8
CAV_28	28
X320	X320
CAV_16	16
CAV_15	15
X610	X610
CAV_8	8
CAV_5	5
G305	G305
X800	X800
X800	X800
X600	X600
X357	X357
J306	J306
J307	J307
J305	J305
X2	X2
X300	X300
X800	X800
X600	X600
X320	X320
X610	X610
K10	K10 Coolant Heater Control Module
A9B	A9B Outside Rearview Mirror - Passenger
E17P	E17P Outside Rearview Mirror Glass - Passenger
S13P	S13P Door Lock Switch - Passenger
A23P	A23P Door Latch Assembly - Passenger
S32RR	S32RR Seat Heating Switch - Right Rear (KA6)
B27RR	B27RR Door Handle Switch - Right Rear Exterior
A23RR	A23RR Door Latch Assembly - Right Rear
S91	S91 Park Brake Control Switch
K38	K38 Chassis Control Module
K85	K85 Passenger Presence Module
K114B	K114B Hybrid/EV Powertrain Control Module 2
A28	A28 Hybrid/EV Battery Contactor Assembly
K29F	K29F Seat Heating Control Module - Front (KA1)
S79RR	S79RR Window Switch - Right Rear
S79P	S79P Window Switch - Passenger
K16	K16 Battery Energy Control Module
A4	A4 Hybrid/EV Battery Pack
P2	P2 Transmission Shift Lever Position Indicator
S156	S156 Transmission Shift Lever Knob
S3	S3 Transmission Shift Lever
B27P	B27P Door Handle Switch - Passenger Exterior
A24P	A24P Door Handle Assembly - Passenger Exterior

G355, G356, G357, G358, G401 and G405

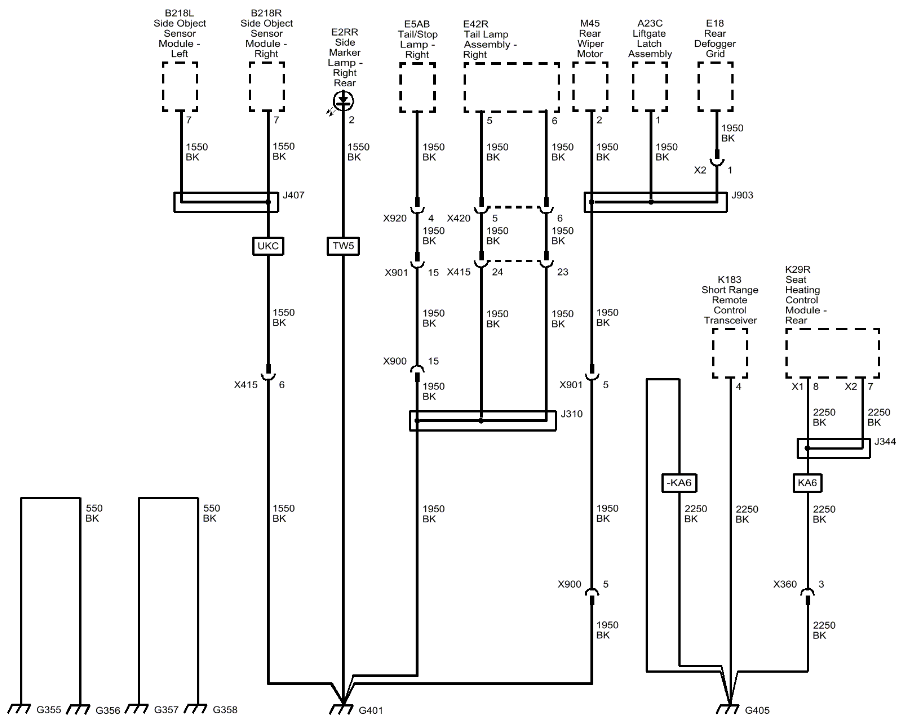

B218L Side Object Sensor Module - Left
B218R Side Object Sensor Module - Right
E2RR Side Marker Lamp - Right Rear
E5AB Tail/Stop Lamp - Right
E42R Tail Lamp Assembly - Right
M45 Rear Wiper Motor
A23C Liftgate Latch Assembly
E18 Rear Defogger Grid
K183 Short Range Remote Control Transceiver
K29R Seat Heating Control Module - Rear
7
7
2
5
6
2
1
1550 BK
1550 BK
1550 BK
1950 BK
1950 BK
1950 BK
1950 BK
1950 BK
1950 BK
X2 1
J407
J903
X920 4
X420 5
6
X901 15
X415 24
23
UKC
TW5
X900 15
X415 6
X901 5
J310
X1 8
X2 7
4
2250 BK
2250 BK
J344
-KA6
KA6
550 BK
550 BK
1550 BK
1950 BK
1950 BK
2250 BK
2250 BK
2250 BK
X900 5
X360 3
G355
G356
G357
G358
G401
G405

Fig. 76: G355, G356, G357, G358, G401 and G405
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1550_BK	1550 BK
CAV_7	7
1550	Ground
1550_BK	1550 BK
1550_BK	1550 BK
CAV_7	7
1950	Ground
1950_BK	1950 BK
CAV_5	5
1950_BK	1950 BK
1950_BK	1950 BK
TW5	LAMP-TAIL and STOP, SAE, LED
CAV_4	4
1950_BK	1950 BK
1950_BK	1950 BK
1950_BK	1950 BK
CAV_15	15
CAV_15	15
1950_BK	1950 BK
1950_BK	1950 BK
1950_BK	1950 BK
1950_BK	1950 BK
CAV_6	6
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
1550_BK	1550 BK
CAV_6	6
1550_BK	1550 BK
1950_BK	1950 BK
1950_BK	1950 BK
CAV_1	1
1950_BK	1950 BK
1950_BK	1950 BK
1950_BK	1950 BK
1950_BK	1950 BK
CAV_2	2
CAV_5	5
CAV_5	5
2250	Ground
2250_BK	2250 BK
350	Ground
CAV_4	4
2250_BK	2250 BK
2250_BK	2250 BK
CAV_7	7
CONN_X2	X2
CAV_8	8
CONN_X1	X1
2250_BK	2250 BK
2250_BK	2250 BK
CAV_3	3
1950_BK	1950 BK
2250_BK	2250 BK
KA6	HEATER SEAT-REAR
KA6	HEATER SEAT-REAR
550	Ground
550_BK	550 BK
550_BK	550 BK
CAV_2	2
CAV_1	1
X420	X420
CAV_5	5
CAV_6	6
X415	X415
CAV_24	24
CAV_23	23
G401	G401
X920	X920
X901	X901
X900	X900
J310	J310
J407	J407
X415	X415
X900	X900
J903	J903
X901	X901
G405	G405
J344	J344
X360	X360
G355	G355
G356	G356
G357	G357
G358	G358
X2	X2
X420	X420
X415	X415
E5AB	E5AB Tail/Stop Lamp - Right
E42R	E42R Tail Lamp Assembly - Right
E2RR	E2RR Side Marker Lamp - Right Rear
B218R	B218R Side Object Sensor Module - Right (UKC)
B218L	B218L Side Object Sensor Module - Left (UKC)
M45	M45 Rear Wiper Motor
A23C	A23C Liftgate Latch Assembly
E18	E18 Rear Defogger Grid
K29R	K29R Seat Heating Control Module - Rear (KA6)
K183	K183 UHF Short Range Low Energy Remote Control Access Transceiver

G404 and G900

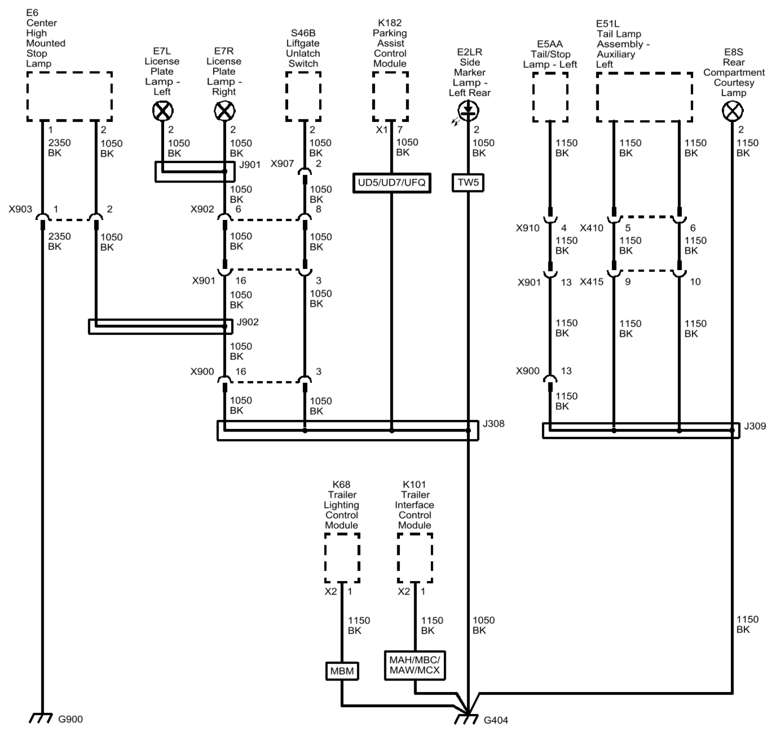

E6 Center High Mounted Stop Lamp
E7L License Plate Lamp - Left
E7R License Plate Lamp - Right
S46B Liftgate Unlatch Switch
K182 Parking Assist Control Module
E2LR Side Marker Lamp - Left Rear
E5AA Tail/Stop Lamp - Left
E51L Tail Lamp Assembly - Auxiliary Left
E8S Rear Compartment Courtesy Lamp
2350 BK
1050 BK
1150 BK
X1
X2
X903
X902
X901
X900
X907
X910
X410
X415
J901
J902
J308
J309
UD5/UD7/UFQ
TW5
K68 Trailer Lighting Control Module
K101 Trailer Interface Control Module
MBM
MAH/MBC/ MAW/MCX
G900
G404

Fig. 77: G404 and G900
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1050	Ground
1050_BK	1050 BK
1050_BK	1050 BK
CAV_2	2
1050_BK	1050 BK
CAV_2	2
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
CAV_7	7
CONN_X1	X1
1150	Ground
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
CAV_2	2
CAV_2	2
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
CAV_2	2
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
2350	Ground
2350_BK	2350 BK
CAV_1	1
2350_BK	2350 BK
1050_BK	1050 BK
1050_BK	1050 BK
1050_BK	1050 BK
UD5	PARK ASSIST-FRONT AND REAR
UD7	PARK ASSIST-REAR
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
TW5	LAMP-TAIL and STOP, SAE, LED
1150_BK	1150 BK
CAV_2	2
CAV_4	4
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
CAV_13	13
CAV_13	13
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
1150_BK	1150 BK
CAV_1	1
CONN_X2	X2
CAV_2	2
MAH	Â
MBC	Â
MAW	Â
MCX	Â
1150_BK	1150 BK
CAV_1	1
CONN_X2	X2
MBM	Â
X902	X902
CAV_6	6
CAV_8	8
X901	X901
CAV_16	16
CAV_3	3
X903	X903
CAV_1	1
CAV_2	2
X900	X900
CAV_16	16
CAV_3	3
X410	X410
CAV_5	5
CAV_6	6

Callout	Component Name
X415	X415
CAV_9	9
CAV_10	10
G404	G404
J901	J901
X907	X907
J902	J902
G900	G900
J309	J309
X910	X910
X901	X901
X900	X900
J308	J308
X902	X902
X901	X901
X903	X903
X900	X900
X410	X410
X415	X415
E7L	E7L License Plate Lamp - Left
E7R	E7R License Plate Lamp - Right
S46B	S46B Liftgate Unlatch Switch
E6	E6 Center High Mounted Stop Lamp
E2LR	E2LR Side Marker Lamp - Left Rear
E5AA	E5AA Tail/Stop Lamp - Left
E8S	E8S Rear Compartment Courtesy Lamp
K101	K101 Trailer Interface Control Module (MAH/MBC/MAW/MCX)
E51L	E51L Tail Lamp Assembly - Auxiliary Left
K182	K182 Parking Assist Control Module
K68	K68 Tralier Lighting Control Moduel (MBM)

Article GUID: A00890038

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

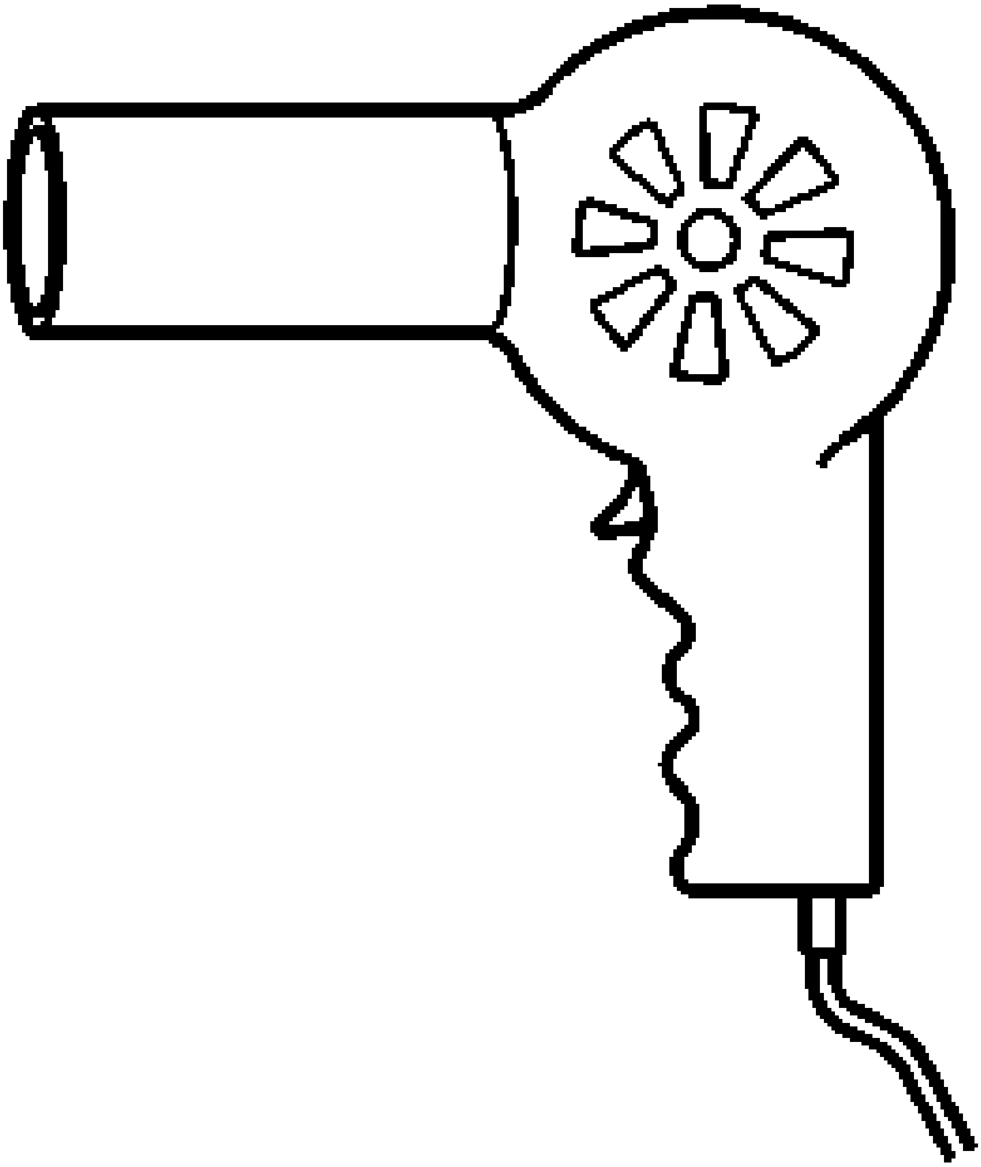
Illustration	Tool Number / Description
	EL-25070 EL-38125-5A EL-38125-5 J-38125-5A Heat Gun 500 - 700 F

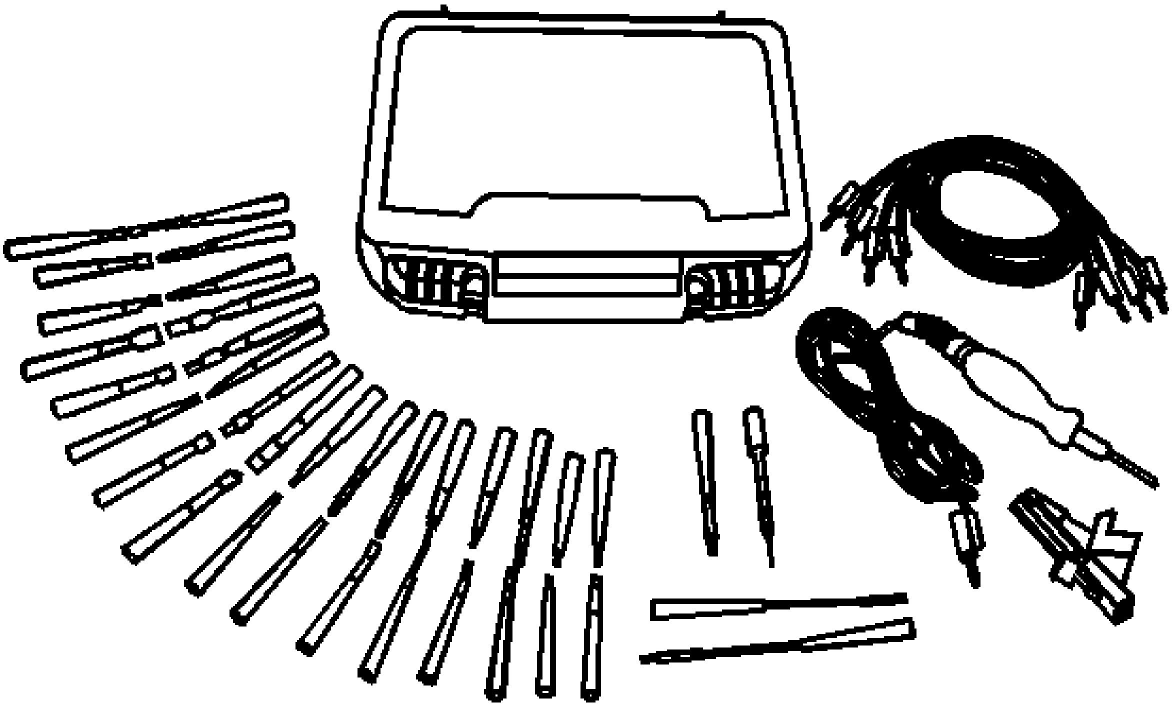
Illustration	Tool Number / Description
	EL-35616 KM-609 Tyco Electronic Tool (5 - 1579007 - 3) Terminal Test Probe Kit

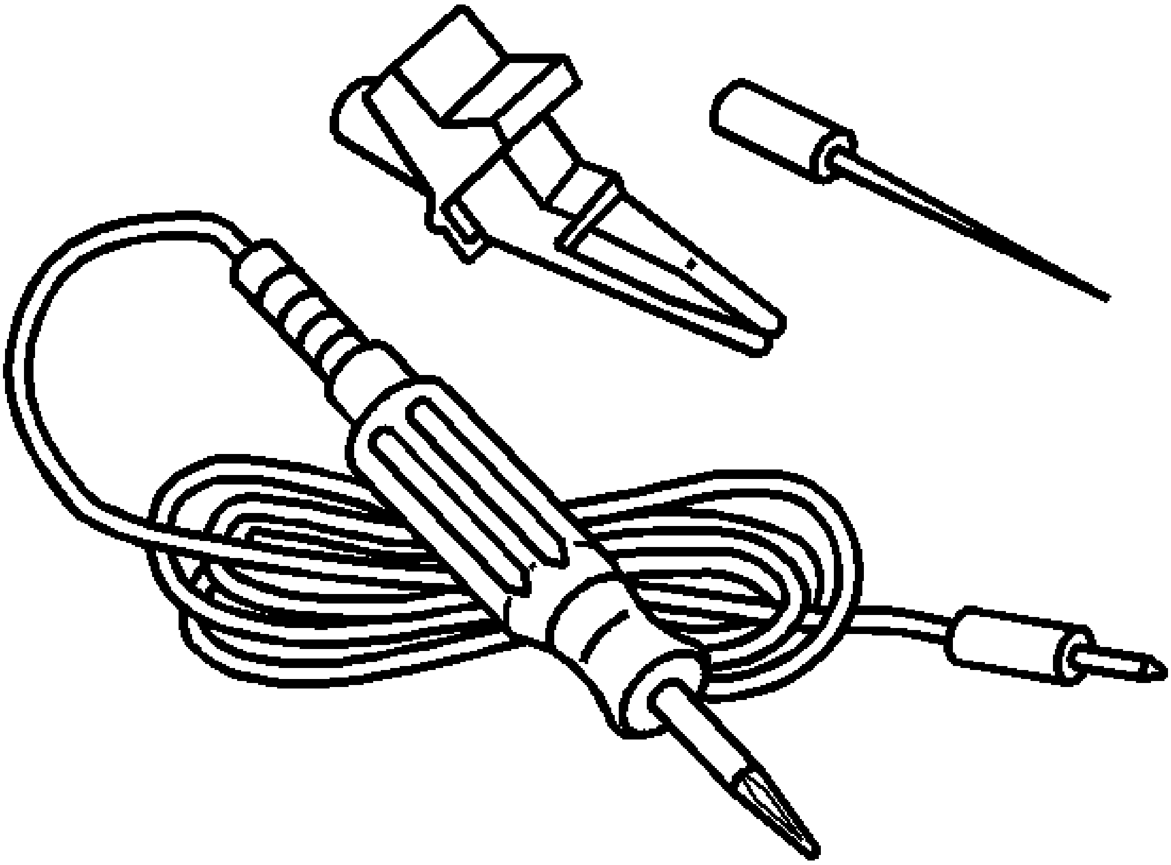
Illustration	Tool Number / Description
	EL-35616-200 KM-J-34142-B Test Light - Probe Kit

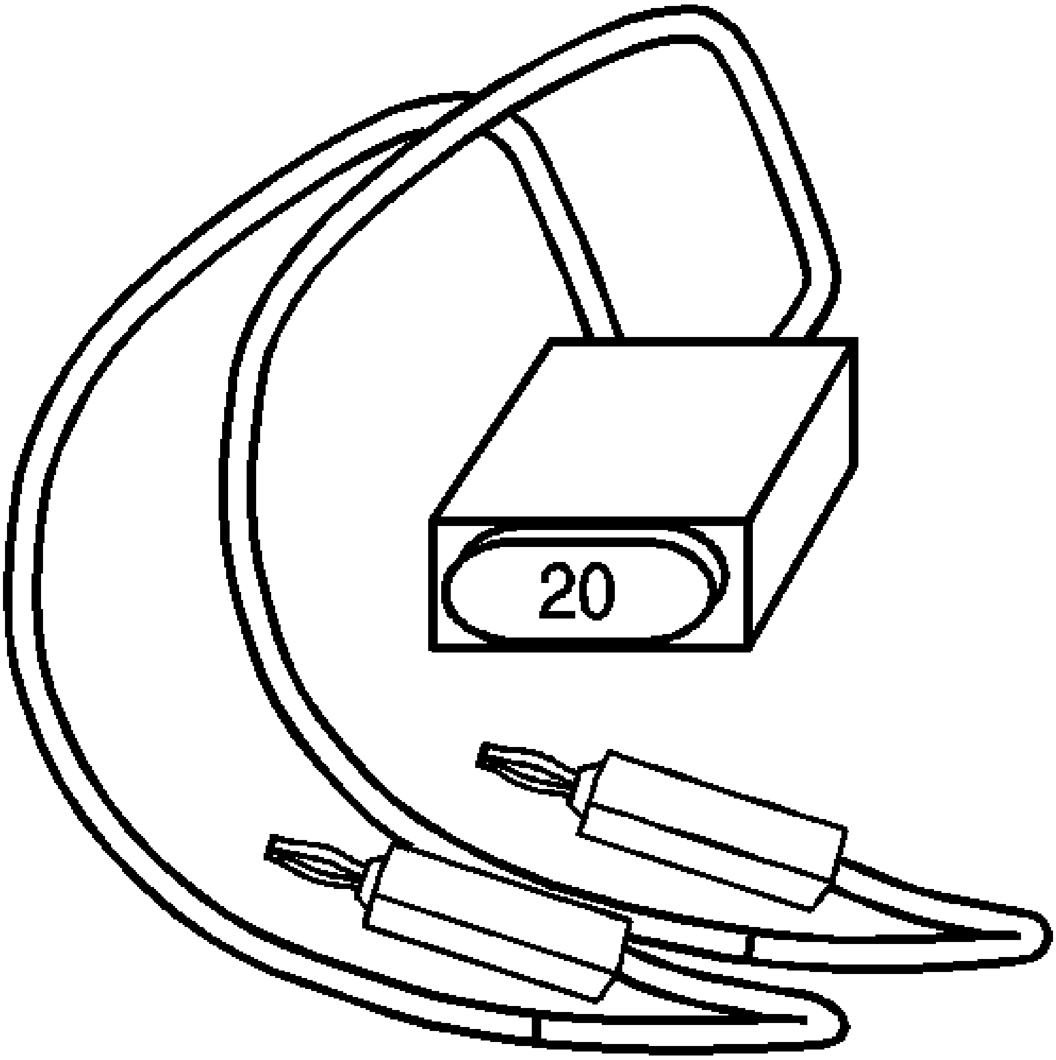
Illustration	Tool Number / Description
	EL-35616-20F KM-963 Fused Jumper Wire

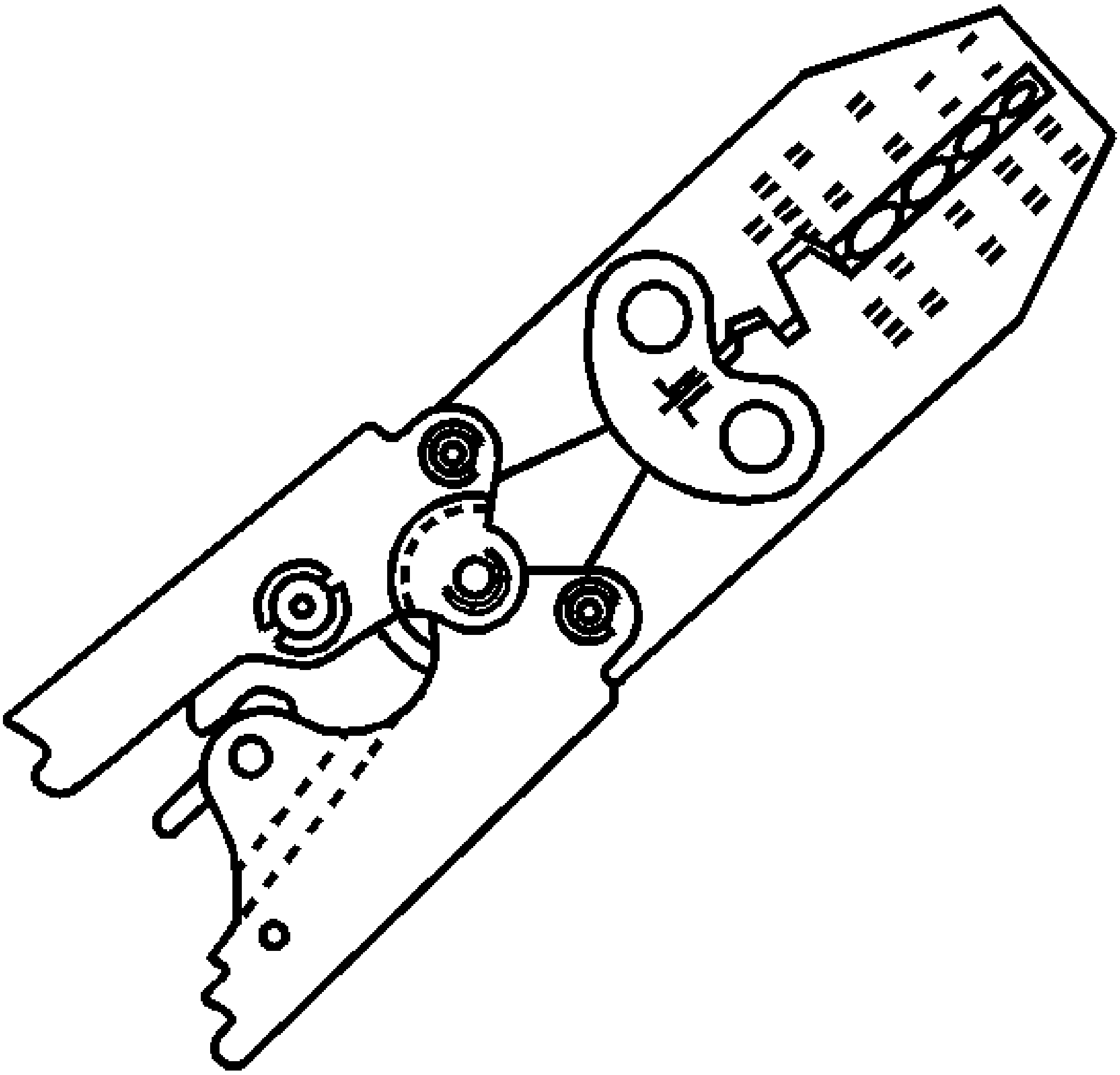
Illustration	Tool Number / Description
	EL-38125 - EU (Europe) J-38125-8 (North America Only) EL-38125 - 10 (Non-North America/Non Europe) Splice Sleeve Crimp Tool

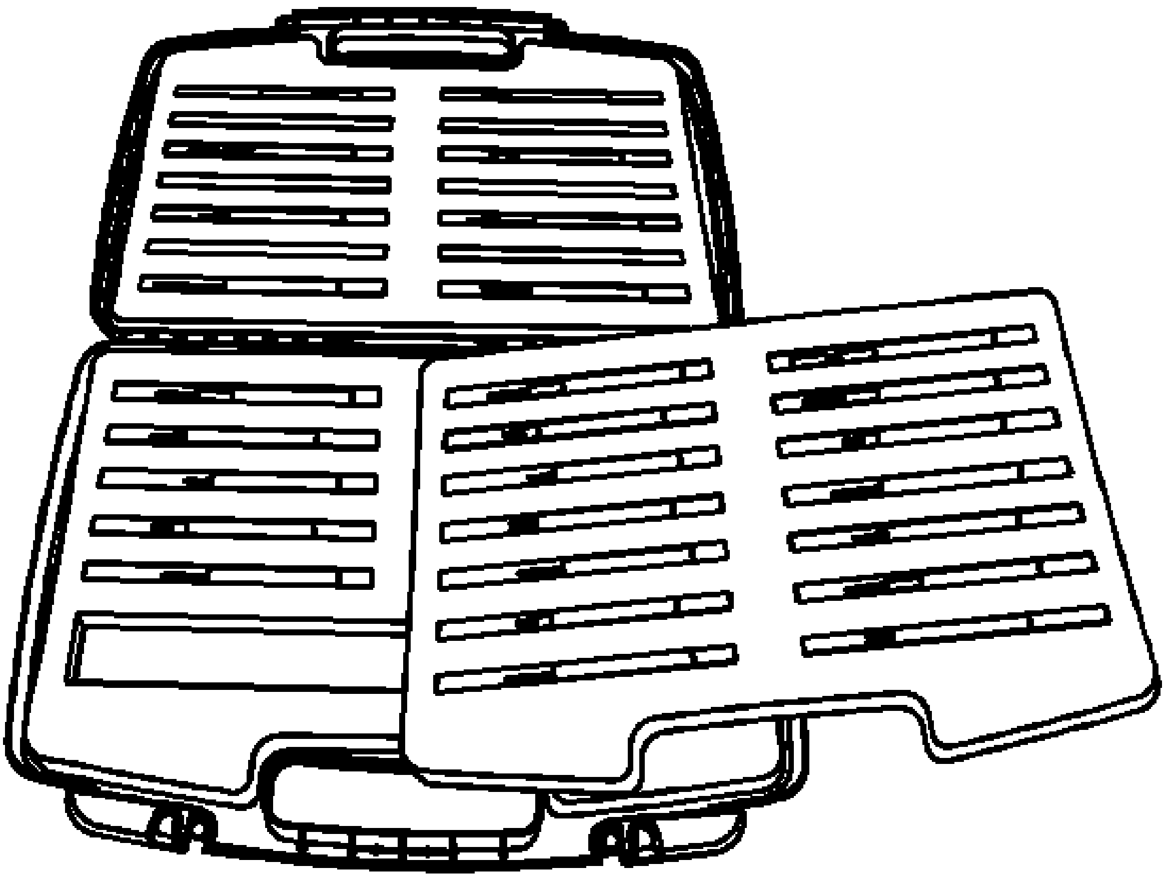
Illustration	Tool Number / Description
	EL-38125-550 (North America Only) Terminal Release Tool Kit

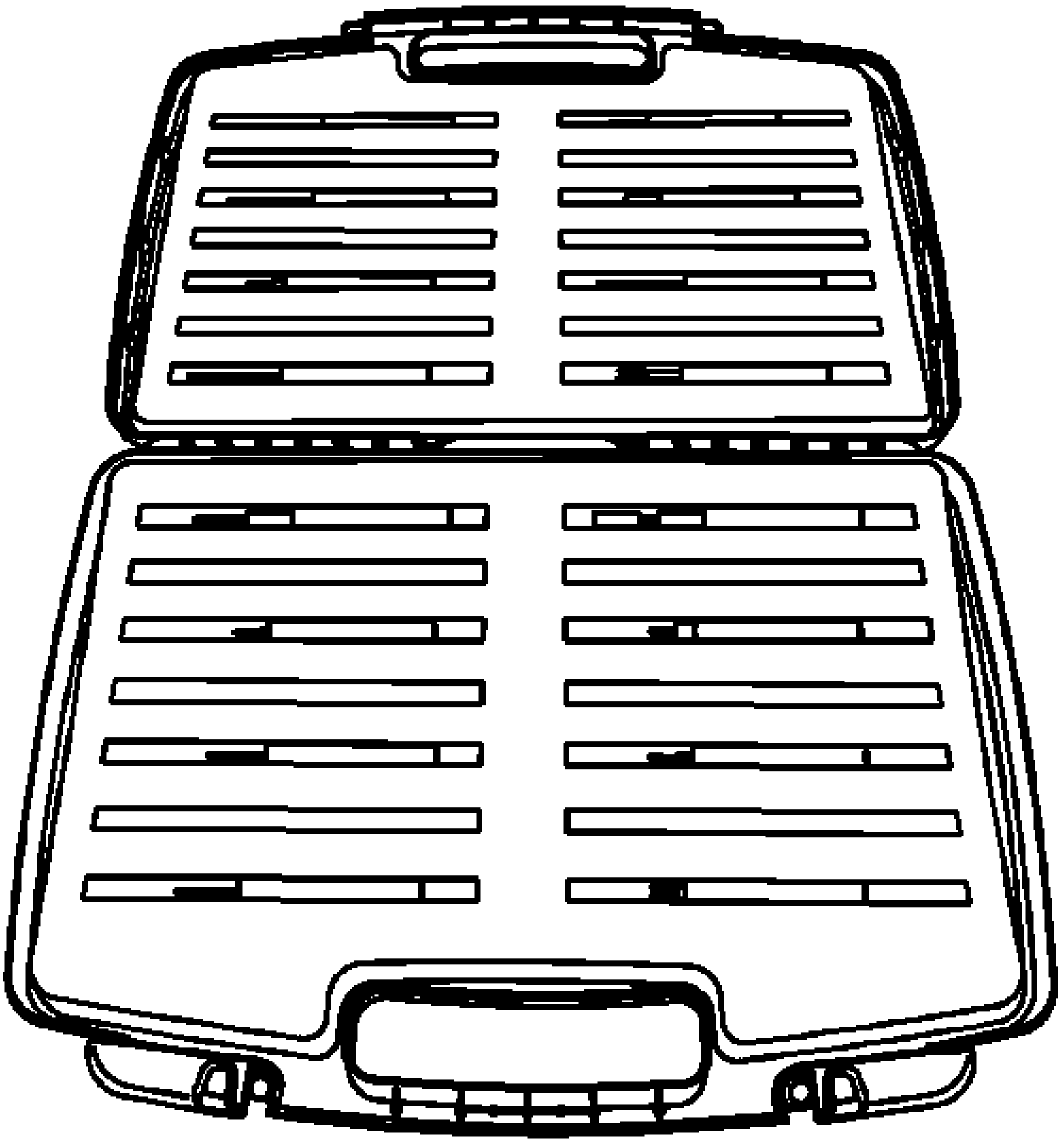
Illustration	Tool Number / Description
	EL-38125-580 (Non-North America) Terminal Release Tool Kit
	EL-39200 Digital Multimeter

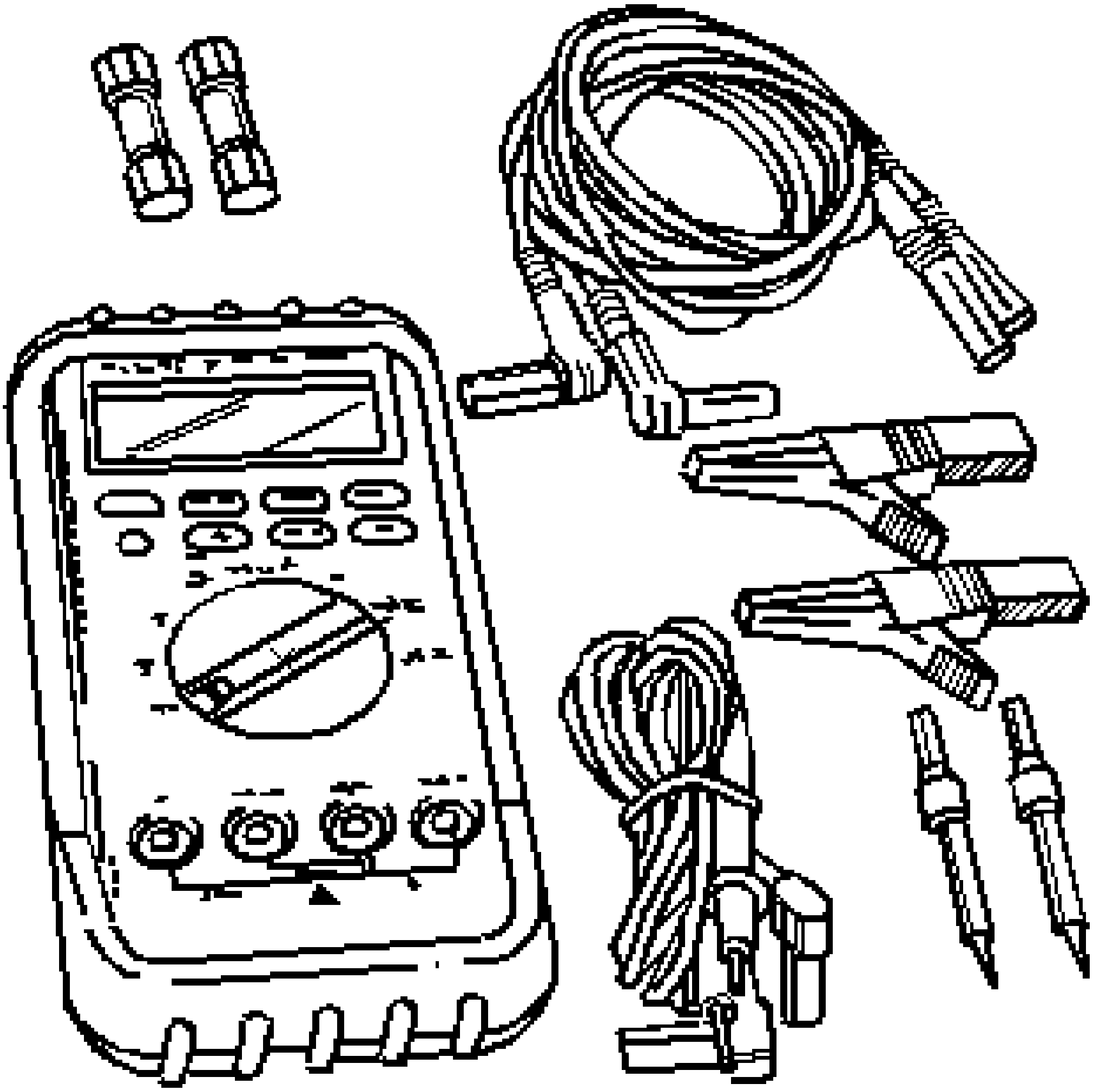
Illustration	Tool Number / Description
	

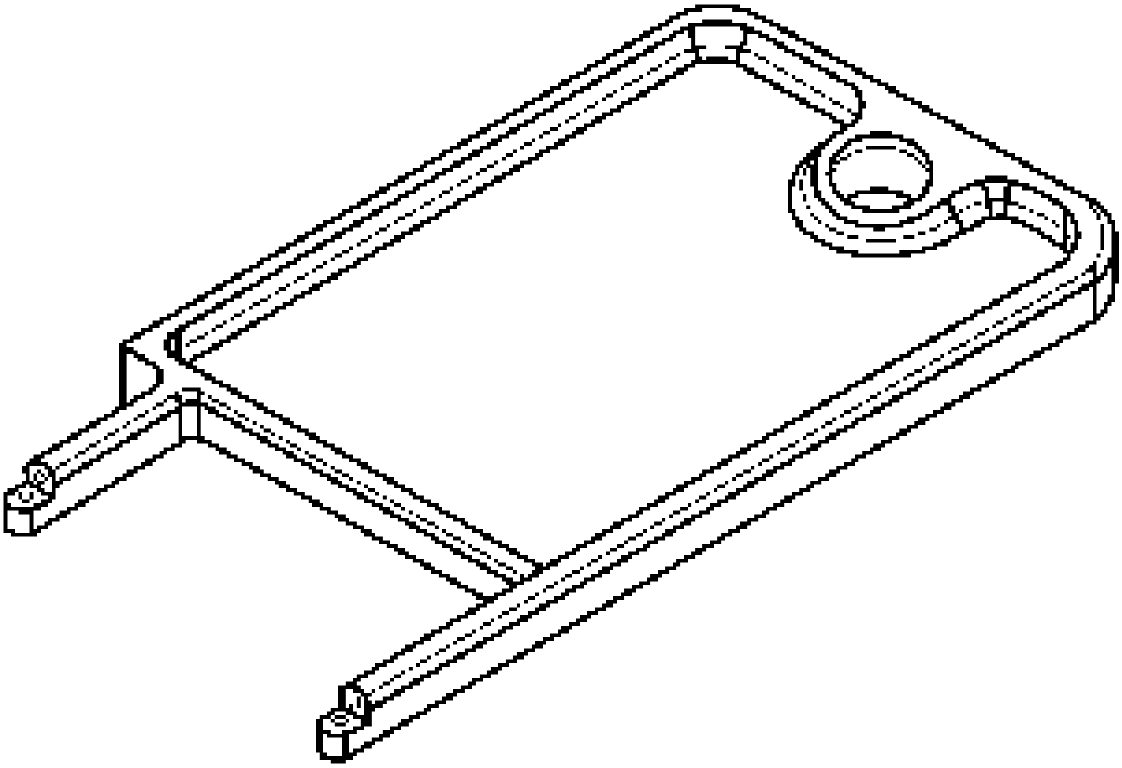
Illustration	Tool Number / Description
	EL-42759 Ignition Switch Connector Release Tool

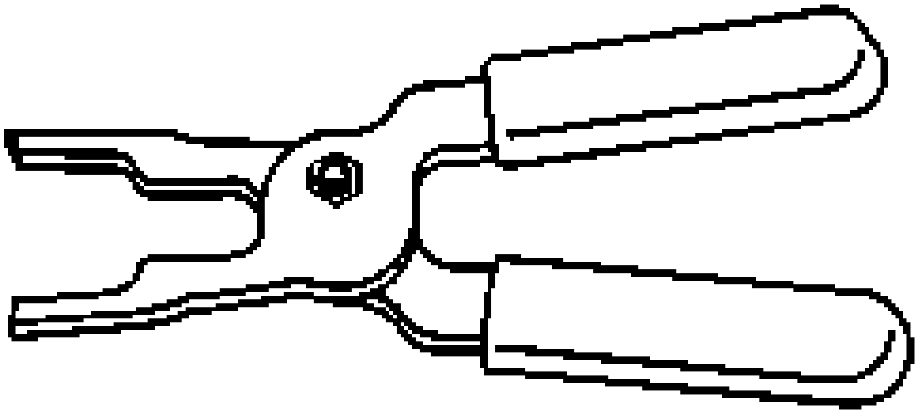
Illustration	Tool Number / Description
	EL-43244 Relay Puller Pliers

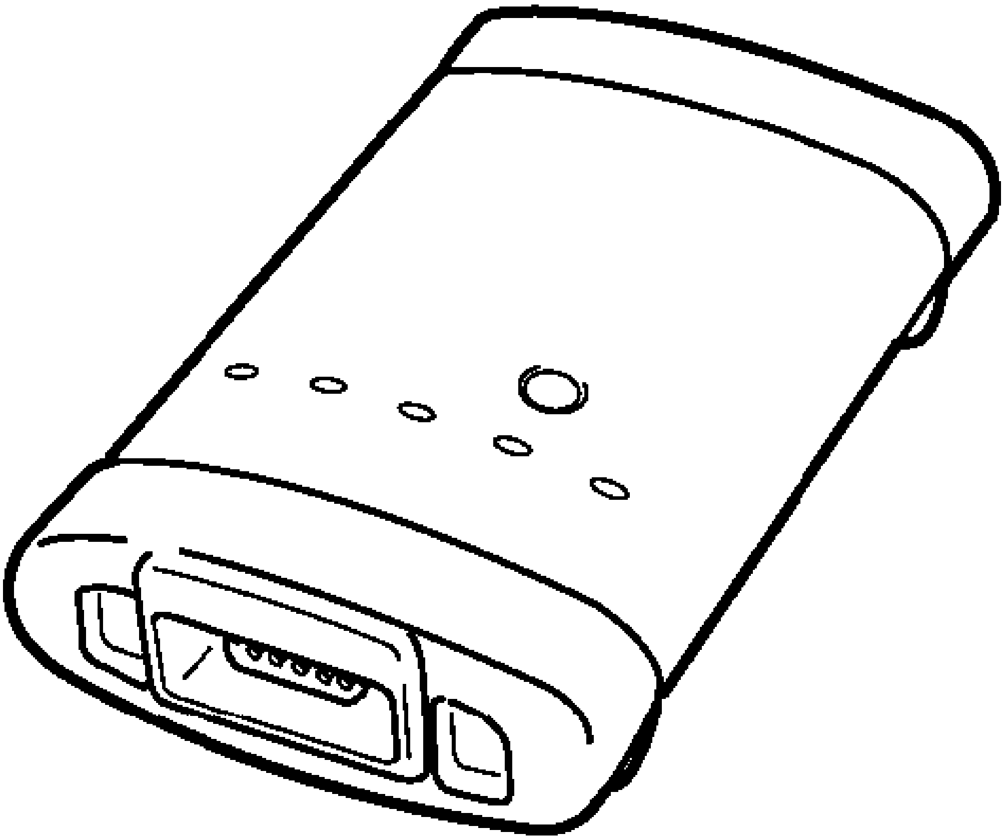
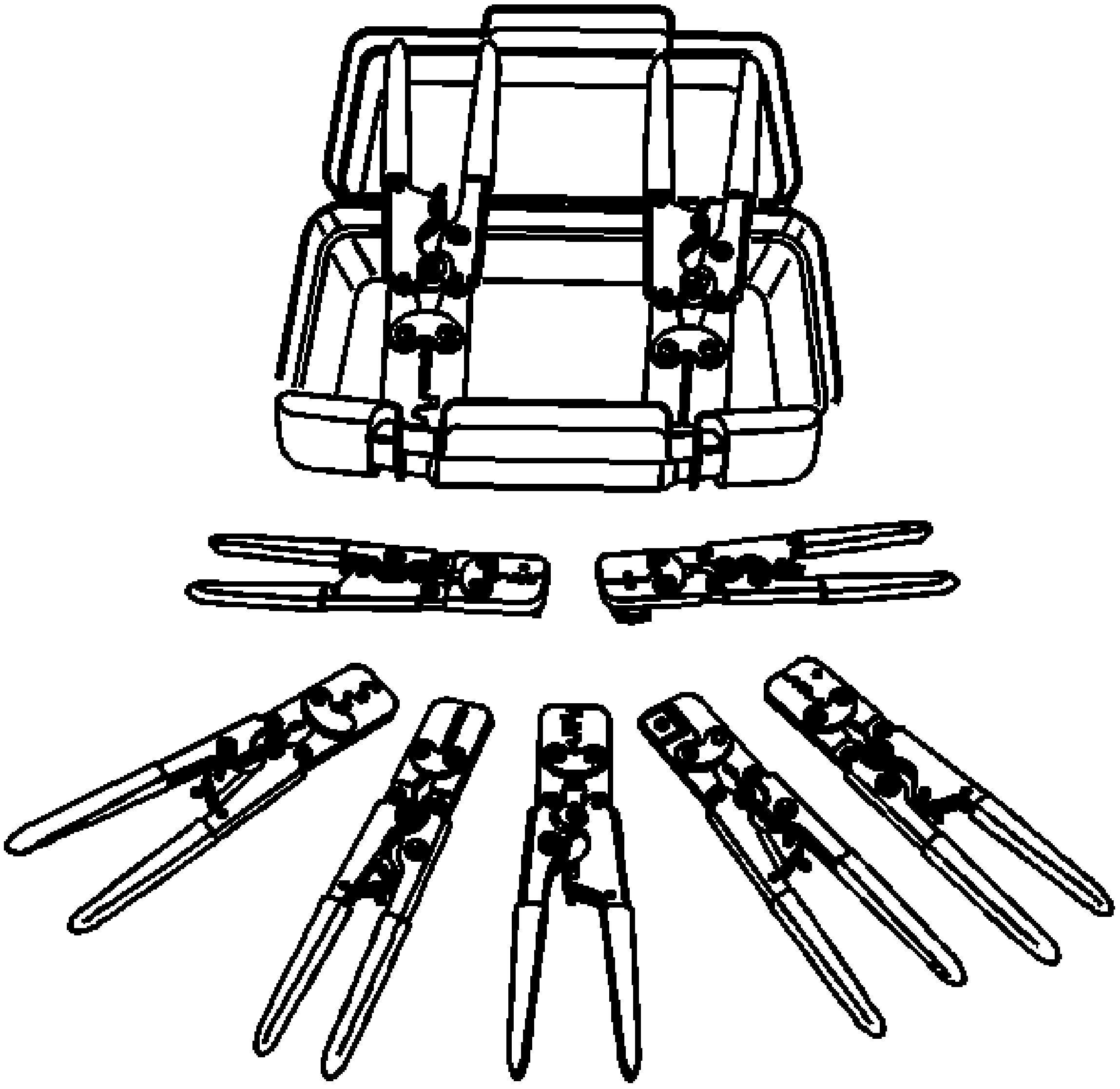
Illustration	Tool Number / Description
	EL-47955 J-2534 Multi Diagnostic Interface MDI

Illustration	Tool Number / Description
	EL-50040 (Holden Only) Crimping Tool Kit

Back To Article

EMISSION CONTROL ABBREVIATIONS

Gasoline & Diesel

"A"

A/C

Air Conditioning

A/C-ISUS

A/C Idle Speed-Up Solenoid

A/F

Air/Fuel

AAI

Air Assist Injector

ACL

Air Cleaner (Thermostatic Air Cleaner)

ACL-BMS

ACL Bimetallic Sensor

ACL-CKV

ACL Check Valve

ACL-DV

ACL Delay Valve

ACL-ESC

Electronic Spark Control

ACL-PVS

ACL Ported Vacuum Switch

ACL-RDV

ACL Reverse Delay Valve

ACL-RDVS

ACL Reverse Delay Valve (Single)

ACL-TCV

ACL Thermal Control Valve

ACL-TS

ACL Temperature Sensor

ACL-TSOV

ACL Temperature Sensor Override Valve

ACL-TVS

ACL Thermal Vacuum Switch

ACL-TVV

ACL Thermal Vacuum Valve

ACL-VCDV

ACL Vacuum Control Delay Valve

ACL-VCV

ACL Vacuum Control Valve

ACL-VM

ACL Vacuum Motor

ACL-WP

ACL Wax Pellet Type Motor

ADS

Anti-Dieseling Solenoid

AFR

Air/Fuel Ratio Sensor

AFS

Air/Fuel Ratio Sensor

AIH

Air Intake Heaters

AIH-TS

AIH Temperature Sensor

AIR

Air Injection System

AIS

Air Injection System

AIS-ACV

AIS Air Control Valve

AIS-AF

Air Injection System Air Filter

AIS-AMV

AIS Air Management Valve

AIS-ASV

AIS Air Switching Valve

AIS-BPV

AIS By-Pass Valve

AIS-CC

AIS Computer Controlled

AIS-CKV

AIS Check Valve

AIS-CSV

AIS Control Solenoid Valve

AIS-CV

AIS Combination Valve

AIS-DV

AIS Diverter Valve

AIS-IMCV

AIS Intake Manifold Change-Over Valve

AIS-MCV

AIS Manifold Change-Over Valve

AIS-OWV

AIS One Way Valve

AIS-PAF

AIS Pulse Air Feeder

AIS-PM

AIS Pump Motor

AIS-PV

AIS Pneumatic Valve

AIS-RV

AIS Relief Valve

AIS-SAV

AIS Secondary Air Valve

AIS-SOL

AIS Solenoid

AIS-SV

AIS Solenoid Valve

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIS-VT

AIS Vacuum Tank

AIS-VCV

AIS Vacuum Control Valve

AIS-VSV

AIS Vacuum Switching Valve

AIV

Air Injection Valve

AIV-SOL

Air Injection Valve Solenoid

ALVW

Adjusted Loaded Vehicle Weight

AMV

Air Management Valve

AP

Air Pump Injection System

AP-ABV

Air Pump Air Bypass Valve

AP-ACV

AP Air Control Valve

AP-AMV

AP Air Management Valve

AP-ASRV

AP Air Switching Relief Valve

AP-ASS

AP Air Switching Solenoid

AP-ASV

AP Air Switching Valve

AP-BP

AP By-Pass Valve

AP-BPV

AP By-Pass Valve

AP-CKV

AP Check Valve

AP-CS

AP Control Solenoid

AP-CV

AIR Cut-Off Valve

AP-DCTO

AP Dual Coolant Temperature Override

AP-DLY

AP Delay Valve

AP-DV

AP Diverter Valve

AP-EADV

AP Electric Air Control Diverter Valve

AP-EAMR

AP Electric Air Management Relay

AP-EAMS

AP Electric Air Management Solenoid

AP-EAP

AP Electric Air Pump

AP-EC

AP Electromagnetic Clutch

AP-ERLY

AP Electric Air Pump Relay

AP/PAIR

Pulsed Secondary Air Injection

AP-RDV

AP Reed Valve

AP-RV

AP Relief Valve

AP-SOL

AP Solenoid

AP-SOV

AP Shut-Off Valve

AP-SV

AP Solenoid Valve

AP-SWV

AP Switchover Valve

AP-TV

AP Transmitting Valve

AP-VCS

AP Vacuum Control Solenoid

AP-VCSV

AP Vacuum Controlled Air Shut-Off Valve

AP-VCV

AP Vacuum Control Valve

AP-VSV

AP Vacuum Switching Valve

A/T

Automatic Transmission

ATCV

Air Temperature Control Valve

"B"

BP/EGR

Backpressure EGR System

BP/EGR-BPS

BP/EGR Backpressure Sensor

BP/EGR-BPT

BP/EGR Backpressure Transducer

BP/EGR-BPV

BP/EGR Backpressure Valve

BP/EGR-BS

BP/EGR Bleed Solenoid

BP/EGR-BVSV

BP/EGR Bimetallic Vacuum Switching Valve

BP/EGR-C

BP/EGR Controller

BP/EGR-CLR

BP/EGR Cooler

BP/EGR-CS

BP/EGR Control Solenoid

BP/EGR-CTO

BP/EGR Coolant Temperature Override

BP/EGR-CV

BP/EGR Control Valve

BP/EGR-DCTO

BP/EGR Dual Coolant Temperature Override

BP/EGR-DS

BP/EGR Diagnostic Solenoid

BP/EGR-DSOL

BP/EGR Duty Solenoid

BP/EGR-DTVSW

BP/EGR Distributor Thermal Vacuum Switch

BP/EGR-DV

BP/EGR Delay Valve

BP/EGR-EET

BP/EGR Electric Transducer

BP/EGR-EPV

BP/EGR External Pressure Valve

BP/EGR-FDV

BP/EGR Forward Delay Valve

BP/EGR-LCV

BP/EGR Vacuum Control Valve

BP/EGR-LC

BP/EGR Load Control Valve

BP/EGR-OVS

BP/EGR Orifice Valve Sensing

BP/EGR-PS

BP/EGR Position Sensor

BP/EGR-PT

BP/EGR Pressure Tranducer

BP/EGR-PVS

BP/EGR Ported Vacuum Switch

BP/EGR-RES

BP/EGR Reservoir

BP/EGR-RST

BP/EGR Restrictor

BP/EGR-SOL

BP/EGR Solenoid

BP/EGR-TCTVS

BP/EGR Torque Converter Thermal Vacuum Switch

BP/EGR-TCV

BP/EGR Thermal Control Valve

BP/EGR-TCVLV

BP/EGR Temperature Control Valve

BP/EGR-T

BP/EGR Temperature Sensor

BP/EGR-TS

BP/EGR Temperature Sensor

BP/EGR-TVC

BP/EGR Thermal Control Valve

BP/EGR-TVS

BP/EGR Thermal Vacuum Switch

BP/EGR-TVV

BP/EGR Thermal Vacuum Valve

BP/EGR-VC

BP/EGR Diagnostic Valve

BP/EGR-VCV

BP/EGR Vacuum Control Valve

BP/EGR-VM

BP/EGR Vacuum Modulator

BP/EGR-VRV

BP/EGR Vacuum Regulator Valve

BP/EGR-VS

BP/EGR Vacuum Switch

BP/EGR-VSOL

BP/EGR Vent Solenoid

BP/EGR-VSV

BP/EGR Vacuum Switching Valve

"C"

C-4

Computer Controlled Catalytic Converter

CAC

Charge Air Cooler

CAS

Clean Air System

CB

Crankcase Breather

CB-VC

Crankcase Breather-Vapor Canister

CBPS

Coasting By-Pass System

CBVC

Crankcase Breather Vapor Canister

CCIEV

Coolant Controlled Idle Enrichment Valve

CCO

Computerized Engine Controls

CCS

Controlled Combustion System

CCV

Closed Crankcase Ventilation

CD-REGVLV

Crankcase Depression Regulator Valve

CDRV

Crankcase Depression Relief Valve

CEAB

Cold Engine Air Bleed

CEAB-TVS

CEAB Thermal Vacuum Switch

CEAB-TVV

CEAB Thermal Vacuum Valve

CEC

Computerized Engine Controls

CESS

Cold Engine Sensor Switch

CETS

Cold Engine Temperature Switch

CFI

Continuous Fuel Injection

CMH

Cold Mixture Heater

CNG

Compressed Natural Gas

CO

Carbon Monoxide

CO2

Carbon Dioxide

CPI

Central Port Injection

CRV

Coasting Richer Valve

CSI

Central Sequential Injection

CTAVS

Cold Temperature Activated Vacuum System

CTOX

Continous Trap Oxidizer

CVOT

Crankcase Ventilation Orifice Tube

CVOT-CKV

Crankcase Ventilation Orifice Tube Check Valve

"D"

DCLV

Deceleration Valve

DCS

Deceleration Control System

DDI

Direct Diesel Injection

DFI

Direct Diesel Injection

DI

Direct Injection

DKV

Deceleration Kick Valve

DLCV

Deceleration Mixture Control Valve

DM-TL

Diagnostic Module Tank Leakage

DMS

Dual Manifold System

DOC

Diesel Oxidation Catalyst

DOHC

Dual Overhead Cam

DPD

Dual Point Distributor

DPF

Diesel Particulate Filter

DPF/TWC

Combination Diesel Particulate Filter and Three Way Catalyst

DPFE

Differential Pressure Feedback EGR Valve

DPFEGR

Differential Pressure Feedback EGR Valve

DTM

Deceleration Throttle Modulator

"E"

EAIR

Electric Air Injection System

EAIR-DV

EAIR Diverter Valve

EC

Computerized Engine Controls

ECM

Electronic Control Module

ECU

Electronic Control Unit

EDC

Electronic Diesel Control

EDS

Electronic Diesel System

EEC

Electronic Engine Control

EFE

Early Fuel Evaporation

EFE-CKV

EFE Check Valve

EFE-CV

EFE Control Valve

EFE-DTVS

EFE Delay Thermal Vacuum Switch

EFE-HTR

EFE Heater

EFE-HCV

EFE Heat Control Valve

EFE-OTS

EFE Oil Temperature Switch

EFE-PTC

EFE Positive Temperature Coefficient (Intake Heater Grid)

EFE-PVS

EFE Ported Vacuum Switch

EFE-SOL

EFE Solenoid

EFE-TVS

EFE Thermal Vacuum Switch

EFE-TVV

EFE Thermal Vacuum Valve

EFE-VSV

EFE Vacuum Switching Valve

EFI

Electronic Fuel Injection

EFI-MA

EFI Mass Airflow Sensor

EFI-MAF

EFI Mass Airflow Sensor

EGR

Exhaust Gas Recirculation System

EGR-BCS

EGR Boost Check Solenoid

EGR-BPBV

EGR By-Pass Backpressure Valve

EGR-BPT

EGR Backpressure Transducer

EGR-BPV

EGR By-Pass Valve

EGR-BS

EGR Bleed Solenoid

EGR-BSSV

EGR Boost Sensor Solenoid Valve

EGR-BV

EGR Bypass Valve

EGR-BVSV

EGR Bimetallic Vacuum Switching Valve

EGR-C

EGR Controller

EGR-CC

EGR Coolant Controlled

EGR-CLR

EGR Cooler

EGR-VSOL

EGR Vacuum Solenoid

EGR-CKV

EGR Check Valve

EGR-CS

EGR Control Solenoid

EGR-CSOL

EGR Cut-Off Solenoid

EGR-CSV

EGR Control Solenoid

EGR-CTO

EGR Coolant Temperature Override

EGR-CTS

EGR Charge Temperature Sensor

EGR-CTSW

EGR Charge Temperature Switch

EGR-CTTS

EGR Coolant Temperature Thermoswitch

EGR-CV

EGR Control Valve

EGR-CVCV

EGR Constant Vacuum Control Valve

EGR-CVS

EGR Control Vent Solenoid

EGR-DC

EGR Digital Control

EGR-DCTO

EGR Dual Coolant Temperature Override

EGR-DPFE

Differential Pressure Feedback EGR Sensor

EGR-DPFS

EGR Differential Pressure Feedback Sensor

EGR-DS

EGR Diagnostic Solenoid

EGR-DSOL

EGR Duty Solenoid

EGR-DTVS

EGR Delay Thermal Vacuum Switch

EGR-DTVSW

EGR Distributor Thermal Vacuum Switch

EGR-DV

EGR Delay Valve

EGR-EPRS

EGR Exhaust Pressure Regulator Solenoid

EGR-EPRV

EGR Exhaust Pressure Regulator Valve

EGR-EPV

EGR External Pressure Valve

EGR/EVAP-CSV

EGR/EVAP Control Solenoid Valve

EGR-EVR

EGR Vacuum Regulator

EGR-EVRV

EGR Electronic Vacuum Regulator Valve

EGR-FDV

EGR Forward Delay Valve

EGR-FJS

EGR Floor Jet System

EGR-FPS

EGR Feedback Pressure Sensor

EGR-LCV

EGR Load Control Valve

EGR-MAP

EGR Manifold Absolute Pressure Sensor

EGR-PFE

EGR-PFE Sensor

EGR-PS

EGR Position Sensor

EGR-PSW

EGR Pulse Switch

EGR-PVS

EGR Ported Vacuum Switch

EGR-REG

EGR Regulator

EGR-RES

EGR Reservoir

EGR-RST

EGR Restrictor

EGR-SC

EGR Signal Converter

EGR-SEC

EGR, Secondary

EGR-SEN

EGR Sensor

EGR-SM

EGR Stepper Motor

EGR-SOL

EGR Solenoid

EGR-SU

EGR Switchover Valve

EGR-SUB

Sub-EGR Valve

EGR-SV

EGR Switchover Valve

EGR-SVV

EGR Solenoid Vacuum Valve

EGR-T

EGR Temperature Sensor

EGR-TC

EGR Transmission Controlled

EGR-TCTVS

EGR Torque Converter Thermal Vacuum Switch

EGR-TCV

EGR Thermal Control Valve

EGR-TCVLV

EGR Temperature Control Valve

EGR-TRANS

EGR Transducer

EGR-TS

EGR Temperature Sensor

EGR-TSW

EGR Temperature Switch

EGR-TV

EGR Thermal Valve

EGR-TVD

EGR Throttle Valve Diaphragm

EGR-TVS

EGR Thermal Vacuum Switch

EGR-TVSOL

EGR Throttle Valve Solenoid

EGR-TVV

EGR Thermal Vacuum Valve

EGR-V

EGR Valve

EGR-VA

EGR Vacuum Amplifier

EGR-VCV

EGR Vacuum Control Valve

EGR-VM

EGR Vacuum Modulator

EGR-VR

EGR Vacuum Regulator

EGR-VRS

EGR Vacuum Regulator Solenoid

EGR-VRSV

EGR Vacuum Regulator Solenoid Valve

EGR-VRV

EGR Vacuum Regulator Valve

EGR-VS

EGR Vacuum Switch

EGR-VSDV

EGR Vacuum Switch Dump Valve

EGR-VSEN

EGR Vacuum Sensor

EGR-VSOL

EGR Vent Solenoid

EGR-VSS

EGR Vacuum Switching Solenoid

EGR-VST

EGR Vacuum Surge Tank

EGR-VSV

EGR Vacuum Switching Valve

EGR-VVCS

EGR Venturi Vacuum Control System

EGRB

EGR Boost Sensor

EGRC

EGR Control Solenoid

EGRC-BPT

EGR Control Backpressure Transducer

EGRC-SV

EGR Control Solenoid Valve

EHOC

Electronically Heated Oxidation Catalyst

EHTWC

Electronically Heated Three-Way Catalyst

EI

Electronic Ignition System

EIS

Electronic Ignition System

ELB

Electronic Lean Burn

EPR

Exhaust Pressure Regulator

EPR-SOL

EPR Solenoid

ESA

Electronic Spark Advance

ESIM

Evaporative System Integrity Monitor

EVAP

Fuel Evaporative System

EVAP-AAC

EVAP Auxiliary Air Control

EVAP-BPSV

EVAP By-Pass Solenoid Valve

EVAP-BVSV

EVAP Bimetallic Vacuum Switching Valve

EVAP-CAV

EVAP Canister Air Valve

EVAP-CCV

EVAP Control Canister Close Valve

EVAP-CCVSV

EVAP Control Canister Vent Shut Valve

EVAP-CCVVSV

EVAP Closed Canister Valve Vacuum Switching Valve

EVAP-CDCV

EVAP Canister Drain Cut Valve

EVAP-CKV

EVAP Check Valve

EVAP-CPCS

EVAP Canister Purge Control Solenoid

EVAP-CPCSV

EVAP Canister Purge Control Solenoid Valve

EVAP-CPCV

EVAP Canister Purge Control Valve

EVAP-CPRV

EVAP Canister Purge Regulator Valve

EVAP-CPSV

EVAP Canister Vent Shut Valve

EVAP-CPT

EVAP Canister Purge Timer

EVAP-CPTVS

EVAP Canister Purge Thermal Vacuum Switch

EVAP-CPV

EVAP Canister Vent Valve

EVAP-CPVCSV

EVAP Canister Purge Volume Control

EVAP-CPVCV

EVAP Canister Purge Volume Control Valve

EVAP-CPVDV

EVAP Canister Purge Vacuum Delay Valve

EVAP-CPVR

EVAP Canister Purge Valve Resonator

EVAP-CS

EVAP Control Solenoid

EVAP-CSPS

EVAP Control System Pressure Sensor

EVAP-CSPV

EVAP Canister Purge Valve

EVAP-CST

EVAP Canister Surge Tank

EVAP-CSV

EVAP Control Solenoid Valve

EVAP-CT

EVAP Catch Tank

EVAP-CV

EVAP Control Solenoid Valve

EVAP-CVCS

EVAP Canister Vent Control Solenoid

EVAP-CVCSV

EVAP Canister Vent Control Solenoid Valve

EVAP-CVCV

EVAP Canister Vent Control Valve

EVAP-CVS

EVAP Canister Vent Solenoid

EVAP-CVSV

EVAP Carburetor Vent Switching Valve

EVAP-CVV

EVAP Canister Vent Valve

EVAP-DCTO

EVAP Dual Coolant Temperature Override

EVAP-DF

EVAP Drain Filter

EVAP-DPS

EVAP Differential Pressure Sensor

EVAP-DV

EVAP-Drain Valve

EVAP-ESIM

Evaporative System Integrity Monitor

EVAP-EV

EVAP Emission Valve

EVAP-FBVV

EVAP Fuel Bowl Vent Valve

EVAP-FBVS

EVAP Fuel Bowl Vent Solenoid

EVAP-FCV

EVAP Fuel Cut Valve

EVAP-FLS

EVAP Fuel Level Sensor

EVAP-FOLV

EVAP Fuel Overflow Limiter Valve

EVAP-FR/FTPS

EVAP Rollover Valve/Fuel Tank

EVAP-FS

EVAP Flow Switch

EVAP-FSV

EVAP Flow Switchover Valve

EVAP-FTCV

EVAP Tank Pressure Control Valve

EVAP-FTEV

EVAP Fuel Tank EVAP Valve

EVAP-FTPCSV

EVAP Fuel Tank Pressure Control Solenoid Valve

EVAP-FTPS

EVAP Fuel Tank Pressure Sensor

EVAP-FTS

EVAP Fuel Temperature Sensor

EVAP-FVCV

EVAP Fuel Vapor Control Valve

EVAP-FVS

EVAP Fuel Vapor Separator

EVAP-FVTS

EVAP Fuel Vapor Temperature Sensor

EVAP-FVV

EVAP Fuel Vent Valve

EVAP-FVVV

EVAP Fuel Vapor Vent Valve

EVAP-FWV

EVAP Fuel Vent Valve

EVAP-IVS

EVAP Inner Vent Solenoid

EVAP-LDAF

EVAP Leak Detection Pump Air Filter

EVAP-LDP

EVAP Leak Detection Pump

EVAP-LDPAF

EVAP Leak Detection Pump Air Filter

EVAP-LDPF

EVAP Leak Detection Pump Filter

EVAP-LDPVV

EVAP Leak Detection Pump Vent Valve

EVAP-LSEP

EVAP Liquid Separator

EVAP-NVLD

EVAP Natural Vacuum Leak Detection

EVAP-ORVR

Evaporative On-Board Refueling Vapor Recovery System

EVAP-ORVRCV

Evaporative On-Board Refueling Vapor Recovery Check Valve

EVAP-ORVRFTVRV

EVAP-ORVR Fuel Tank Vapor Recirculation

EVAP-OVCV

EVAP Outer Vent Control Valve

EVAP-OWV

EVAP One-Way Valve

EVAP-PCDV

EVAP Purge Control Diaphram Valve

EVAP-PCS

EVAP Purge Control Solenoid Valve

EVAP-PCSV

EVAP Purge Cut-Off Solenoid Valve

EVAP-PFS

EVAP Purge Flow Sensor

EVAP-PFSVVSV

EVAP Purge Flow Switching Valve Vacuum Switching Valve

EVAP-PPS

EVAP Proportional Purge Solenoid

EVAP-PR

EVAP Purge Resonator

EVAP-PRRV

EVAP Pressure Relief Rollover Valve

EVAP-PRV

EVAP Pressure Relief Valve

EVAP-PS

EVAP Purge Solenoid

EVAP-PSOL

EVAP Purge Solenoid

EVAP-PSSV

EVAP Pressure Switching Solenoid

EVAP-PSVVSV

EVAP Pressure Switching Valve Vacuum Switching Valve

EVAP-PV

EVAP Purge (Frequency) Valve

EVAP-PVS

EVAP Ported Vacuum Switch

EVAP-RV

EVAP Rollover Valve

EVAP-RV/FTPS

EVAP Rollover Valve/Fuel Tank

EVAP-RVSV

EVAP Rollover Vapor Separator Valve

EVAP-SNR

EVAP Canister Sensor

EVAP-SOL

EVAP Solenoid

EVAP-SOV

EVAP Shutoff Valve

EVAP-SSV

EVAP Shut-Off Solenoid Valve

EVAP-SV

EVAP Solenoid Valve

EVAP-TC

EVAP Trap Canister

EVAP-TS

EVAP Temperature Switch

EVAP-TPBPV

EVAP Tank Pressure By-Pass Valve

EVAP-TPCS

EVAP Tank Pressure Control Solenoid

EVAP-TPCV

EVAP Tank Pressure Control Valve

EVAP-TRWV

EVAP Tree-Way Valve

EVAP-TV

EVAP Thermal Valve

EVAP-TVS

EVAP Thermal Vacuum Switch

EVAP-TVV

EVAP Thermal Vacuum Valve

EVAP-TWV

EVAP Two-Way Valve

EVAP-VC

EVAP Vapor Canister

EVAP-VCAT

EVAP Vapor Canister Air Tank

EVAP-VCF

EVAP Vapor Canister Filter

EVAP-VCSV

EVAP Vapor Canister Shut-off Valve

EVAP-VCTV

EVAP Vacuum Control Valve

EVAP-VCV

EVAP Vacuum Canister Valve

EVAP-VCVS

EVAP Vapor Canister Vent Solenoid

EVAP-VLFR

EVAP Vent Line Flow Restrictor

EVAP-VM

EVAP Vacuum Motor

EVAP-VMV

EVAP Vapor Management Valve

EVAP-VPS

EVAP Vapor Pressure Sensor

EVAP-VPSVSV

EVAP Vapor Pressure Sensor Vacuum Switching Valve

EVAP-VS

EVAP Vacuum Sensor

EVAP-VSOL

EVAP Ventilation Solenoid

EVAP-VSOL/LDP

EVAP Ventilation Solenoid/Leak Detection Pump

EVAP-VST

EVAP Vacuum Surge Tank

EVAP-VSV

EVAP Vacuum Switching Valve

EVAP-VV

EVAP Ventilation Valve

EVRS

EGR Vacuum Regulator Solenoid

"F"

FBC

Feedback Carburetor

FCOV

Fuel Change Over Valve

FF

Flex Fuel

FF-CKV

Fuel Fill Check Valve

FF-FCV

Fuel Tank Fuel Cut-Off Valve

FF-FLVV

Fuel Tank Fill Limit Vent Valve

FFC-PVRV

Fuel Fill Cap Pressure Vacuum Relief Valve

FGOV

Fuel Gravity/Overflow Valve

FGVV

Fuel Gravity Vent Valve

FI

Fuel Injected

FICD

Fast Idle Control Device

FISR

Fast Idle Solenoid Relay

FLV

Fill Limit Valve

FLVV

Fill Limiting Vent Valve

FP-CKV

Fill Pipe Check Valve

FP-RV

Fill Pipe Rollover Valve

FR

Fill Pipe Restrictor

FT-FLVV

Fuel Tank Fill Limit Vent Valve

FT-GVV

Fuel Tank Grade Vent Valve

FT-OPRV

Fuel Tank Over Pressure Vent Valve

FT-PCV

Fuel Tank Pressure Control Valve

FT-VCV

Fuel Tank Vapor Control Valve

FT-VRV

Fuel Tank Vapor Recirculation Valve

FTCV

Fuel Tank Check Valve

FTDPS

Fuel Tank Differential Pressure Sensor

FTEV

Fuel Tank EVAP Valve

FTPS

Fuel Tank Pressure Sensor

FTT

Fuel Tank Temperature Sensor

FTTS

Fuel Tank Temperature Sensor

FTV/LSV

Fuel Tank Vapor/Liquid Seperation Valve

FTVCV

Fuel Tank Vapor Control Valve

FTVPRV

Fuel Tank Ventilation Pressure Retention Valve

FVPS

Fuel Vapor Pressure Sensor

FTVV

Fuel Tank Vent Valve

FVV

Fuel Vapor Valve

"G"

GVWR

Gross Vehicle Weight Rating

"H"

HAC

High Altitude Compensator

HAFS

Heated Air Fuel Ratio Sensor

HAI

Hot Air Intake

HAS

High Altitude System

HC

Hydrocarbons

HCAC-VSV

Hydrocarbon Absorber Catalyst Vacuum Switching Valve

HDC

Heavy Duty Cooling

HDC-CTO

HDC Coolant Temperature Override

HFM-SFI

Hot Film Engine Management SFI

HIC

Hot Idle Compensator

HIM

Heated Intake Manifold

HO

High Output

HO2S

Heated Oxygen Sensor

HP

High Performance

HP

Horsepower

HPCA

Housing Pressure Cold Advance

HSC

High Swirl Combustion

"I"

IAC

Idle Air Control Valve

IACV-SW

IACV Switch

ICOM

Idle Compensator

IDI

Indirect Diesel Injection

IES

Idle Enrichment System

IMCO

Improved Combustion System

"K"

KS

Knock Sensor

"L"

LH-SFI

Hot Wire Sequential Multiport Fuel Injection

LVFD

Liquid/Vapor Fuel Discriminator

LVW

Loaded Vehicle Weight

"M"

MD-TICS

Timing & Injection rate Control System

MDP

Manifold Differential Pressure sensor

ME-SFI

Motor Electronics Sequential Fuel Injection

MFI

Multiport Fuel Injection

MFI-MAF

MFI Mass Airflow Sensor

MFLS

Main Fuel Level Sensor

MI

Mechanical Fuel Injection

MIL

Malfunction Indicator Light

M/T

Manual Transmission

"N"

NAC

Nitrogen Oxides (NOx) Adsorbing Catalyst

NLV

Non-Linear Valve

NOS

NOx Sensor

NOx

NOx Emission Control

NOxATWC

NOx Adsorptive TWC

NOxC

Nitrogen Oxide Catalyst

NOxS

Nitrogen Oxide Sensor

NOxTWC

NOx Adsorptive TWC

NSC

Nitrogen Oxides (NOx) Storage Catalyst

"O"

OBD

On-Board Diagnostic System

PBD (F)/(P)

Full/Partial On-Board Diagnostic

OC

Oxidation Catalytic Converter

OHC

Overhead Cam

ORVR

On-Board Refueling Vapor Recovery

ORVR-COV

ORVR Cut-Off Valve

ORVR-CV

ORVR Control Valve

ORVR-FAV

ORVR Fresh Air Valve

ORVR-FMV

ORVR Flow Management Valve

ORVR-FTVCV

ORVR Fuel Tank Vapor Control Valve

ORVR-FTVRV

ORVR Fuel Tank Vapor Recirculation Valve

ORVR-FVRS

ORVR Fuel Vapor Recovery System

ORVR-FVV

ORVR Fuel Vent Valve

ORVR-LV

ORVR Leveling Valve

ORVR-OCKV

ORVR Overfill Check Valve

ORVR-RCV

ORVR Refueling Control Valve

ORVR-VCV

ORVR Vapor Cut Valve

ORVR-VRV

ORVR Vapor Recirculating Valve

ORVR-VSV

ORVR Vent Shut Valve

ORVR-VV

ORVR Vent Valve

OVCV

Outer Vent Control Valve

O2S

Oxygen Sensor

"P"

PAIR

Pulsed Secondary Air Injection

PAIR-ABV

PAIR Anti-Backfire Valve

PAIR-ACOV

PAIR Air Cut-Off Valve

PAIR-ACS

PAIR Air Control Solenoid

PAIR-ACV

PAIR Air Control Valve

PAIR-AIV

PAIR Air Injection Valve

PAIR-ASCS

PAIR Air Suction Control Solenoid

PAIR-ASOV

PAIR Air Shutoff Valve

PAIR-ASS

PAIR Air Switching Solenoid

PAIR-ASV

PAIR Air Switching Valve

PAIR-ASVL

PAIR Air Suction Valve

PAIR-AVCS

PAIR Air Valve Control Solenoid

PAIR-CSV

PAIR Control Solenoid Valve

PAIR-CKV

PAIR Check Valve

PAIR-DV

PAIR Diverter Valve

PAIR-PAF

PAIR Pulse Air Feeder

PAIR-PAV

PAIR Pulse Air Valve

PAIR-RES

PAIR Resonator

PAIR-RV

PAIR Reed Valve

PAIR-SCSV

PAIR Swirl Control Solenoid Valve

PAIR-SCV

PAIR Swirl Control Valve

PAIR-SOL

PAIR Solenoid

PAIR-VSV

PAIR Vacuum Switching Valve

PCM

Powertrain Control Module

PCV

Positive Crankcase Ventilation

PCV-DOV

PCV Dual Orifice Valve

PCV-HCB

PCV Heated Crankcase Breather

PCV-HE

PCV Heating Element

PCV-PRV

PCV Pressure Regulator Valve

PCV-SOL

PCV Solenoid

PEVR

Power Enrichment Vacuum Regulator

PPM

Parts Per Million

PTOX

Periodic Trap Oxidizer

PURCV

Purge Crankcase Ventilation

PVCS

Ported Valve Control System

PVCS-A

PVCS Actuator

PVCS-CS

PVCS Control Solenoid

PVLCS

Power Valve Control System

"R"

RC

NOx Reduction Catalyst

ROV

Rollover Valve

"S"

SAI-SV

Secondary Air Injection Shutoff Valve

SAIR-CV

Secondary Air Injection Control Valve

SC

Supercharged or Super Charger

SC MFI

Supercharged Multiport Fuel Injection

SCR

Selective Catalytic Reduction

SCSV

Swirl Control Solenoid Valve

SCV

Swirl Control Valve

SCV-A

SCV Actuator

SFI

Sequential Multiport Fuel Injection

SFI-MAF

SFI Mass Airflow Sensor

SFLS

Sub-Fuel Level Sensor

SOHC

Single Overhead Cam

SPK

Spark Controls

SPK-AVM

SPK Advance Vacuum Modulator

SPK-BVSV

SPK Bimetal Vacuum Switching Valve

SPK-CC

SPK Computer Controlled

SPK-CKV

SPK Check Valve

SPK-CSSA

SPK Cold Start Spark Advance System

SPK-CSSH

SPK Cold Start Spark Hold System

SPK-CTO

SPK Coolant Temperature Override

SPK-DAVS

SPK Distributor Vacuum Advance Solenoid

SPK-DCKV

SPK Distributor Check Valve

SPK-DCTO

SPK Dual Coolant Temperature Override

SPK-DDD

SPK Dual Diaphragm Distributor

SPK-DMV

SPK Distributor Modulator Valve

SPK-DPD

SPK Dual Point Distributor

SPK-DPVS

SPK Distributor Ported Vacuum Switch

SPK-DRCV

SPK Distributor Retard Control Valve

SPK-DRS

SPK Distributor Retard Solenoid

SPK-DSVMV

SPK Distributor Spark Vacuum Modulator Valve

SPK-DTVS

SPK Distributor Thermal Vacuum Switch

SPK-DTVV

SPK Distributor Thermal Vacuum Valve

SPK-DV

SPK Delay Valve

SPK-DVA

SPK Distributor Vacuum Advance

SPK-DVAS

SPK Distributor Vacuum Advance Solenoid

SPK-DVCS

SPK Distributor Vacuum Control Solenoid

SPK-DVCSW

SPK Distributor Vacuum Controlled Switch

SPK-DVCV

SPK Distributor Vacuum Control Valve

SPK-DVDV

SPK Distributor Vacuum Delay Valve

SPK-DVRS

SPK Distributor Vacuum Retard Switch

SPK-DVRV

SPK Distributor Vacuum Regulating Valve

SPK-DVVV

SPK Distributor Vacuum Vent Valve

SPK-EAVS

SPK Electronically Actuated Vacuum Switch

SPK-EDM

SPK Electronic Distributor Modulator

SPK-EI

SPK Electronic Ignition

SPK-ESA

SPK Electronic Spark Advance

SPK-ESC

SPK Electronic Spark Control (Retard)

SPK-ESS

SPK Electronic Spark Selection

SPK-EST

SPK Electronic Spark Timing

SPK-FDV

SPK Forward Delay Valve

SPK-HPCA

SPK Housing Pressure Cold Advance

SPK-ITCS

SPK Ignition Timing Control System

SPK-ITVS

SPK Ignition Timing Vacuum Switch

SPK-NLVR

SPK Non-Linear Vacuum Regulator

SPK-OSAC

SPK Orifice Spark Advance Control

SPK-PVA

SPK Ported Vacuum Advance

SPK-PVS

SPK Ported Vacuum Switch

SPK-RDO

SPK Retard Delay Orifice

SPK-RDV

SPK Reverse Delay Valve

SPK-RDVD

SPK Reverse Delay Valve (Dual)

SPK-RDVLV

SPK Retard Delay Valve

SPK-RDVS

SPK Reverse Delay Valve (Single)

SPK-RETS

SPK Retard Switch

SPK-SC

SPK Speed Controlled

SPK-SDV

SPK Spark Delay Valve

SPK-SOL

SPK Solenoid

SPK-SRRV

SPK Spark Relay Regulator Valve

SPK-TAVIA

SPK Temperature Activated Vacuum Ignition Advance

SPK-TCS

SPK Transmission Controlled Spark

SPK-TCSYS

SPK Timing Control System

SPK-TIDC

SPK Thermostatic Ignition Distributor Control

SPK-TV

SPK Thermal Valve

SPK-TVS

SPK Thermal Vacuum Switch

SPK-VACTO

SPK Vacuum Advance Coolant Temperature Override

SPK-VAS

SPK Vacuum Advance Solenoid

SPK-VAV

SPK Vacuum Advance Valve

SPK-VR

SPK Vacuum Retard

SPK-VRSW

SPK Vacuum Retard Switch

SPK-VSV

SPK Vacuum Switching Valve

SPK-VTCS

SPK Vacuum Timing Control System

SPL

Smoke Puff Limiter

SRI

Service Reminder Indicator

SSCA

Stepped Speed Control Actuator

SSCS

Stepped Speed Control Solenoid

STS

Service Throttle Soon Light

STVS

Secondary Throttle Valve System

SUB-HO2S

Sub-Heated Oxygen Sensor (after CAT)

SUB-O2S

Sub-Oxygen Sensor

SUB-TWC

Sub Three-Way Catalytic Converter

"T"

TAA

Turbo Air-To-Air

TAA

Throttle Actuator Assembly

TAB

Thermactor Air By-Pass

TAD

Thermactor Air Diverter

TAC

Thermostatic Air Cleaner

TBI

Throttle Body Injection

TBPCS

Throttle By-Pass Control System

TC

Turbo Charger

TCC

Torque Converter Clutch

TCCL

Torque Converter Control

TCD

Throttle Closing Dashpot

TC-DV

TC Delay Valve

TC-TVC

TC Thermal Vacuum Switch

TC-VS

TC Vacuum Switch

TD

Thermactor Diverter

TFT

Tank Fuel Temperature Sensor

THOS2

Third Heated Oxygen Sensor

TICV

Thermal Ignition Control Valve

TIV

Thermal Idle Valve

TK

Throttle Kicker

TLUC

Transmission Lock-Up Converter

TLUC-TVS

TLUC Thermal Vacuum Switch

TLUC-VS

TLUC Vacuum Switch

TM

Throttle Modulator

TOS

Throttle Opener System

TP

Throttle Positioner

TPI

Tuned Port Fuel Injection

TPV

Throttle Poppet Valve

TR

Thermal Reactor

TRC

Throttle Return Control

TRCS

Throttle Return Control Solenoid

TRCTL

Throttle Return Control Throttle Lever Actuator

TRSCV

Throttle Return Solenoid Control Valve

TRTVV

Temperature Regulator Thermal Vacuum Valve

TRVV

Transmission Vacuum Valve

TSOL

Throttle Solenoid

TVISD

Throttle Vacuum Idle Speed Diaphragm

TVM

Transmission Vacuum Modulator

TVS

Thermal Vacuum Switch

TWC

Three-Way Catalytic Converter

TWC+OC

Three-Way + Oxidation Catalytic Converter

"V"

VA

Vacuum Advance Unit

VAC-AMP

Vacuum Amplifier

VA-CTO

VA Coolant Temperature Override

VC

Vapor Canister

VCV

Vacuum Cut Valve

VCV-BV

VCV By-Pass Valve

VLFR

Vent Line Flow Restrictor/Anti-Trickle Fill Valve

"W"

WU

Warm-Up Catalyst

WU-OC

Warm-Up Oxidation Converter

WU-TWC

Warm-Up Three-Way Catalytic Converter

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2017 ENGINE

Maintenance and Lubrication - Bolt EV

SPECIFICATIONS

APPROXIMATE FLUID CAPACITIES

Maintenance Procedure	Link
Hydraulic Brake System Capacities	Approximate Fluid Capacities
Hybrid/EV System Heating and Cooling Capacities	Approximate Fluid Capacities
HVAC Capacities	Approximate Fluid Capacities
Automatic Transmission - 1ET25 (MMF) Capacities	Approximate Fluid Capacities
Washer Solvent Container Capacities	Approximate Fluid Capacities

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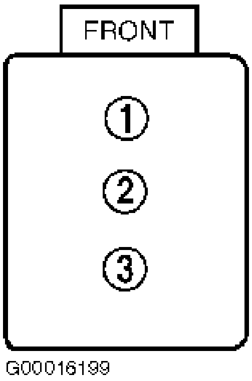
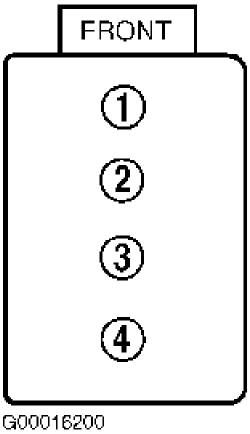
FIRING ORDER & CYLINDER IDENTIFICATION

NOTE: **This information is intended as a quick reference for firing order and cylinder identification only. The information provided covers many vehicles and may include some information that does not apply to the vehicle you have currently selected.**

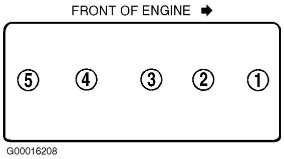
3 CYLINDER ENGINE

Engine Configuration	Firing Order	Cylinder Identification
In-Line 3	1-3-2	

4 CYLINDER ENGINE

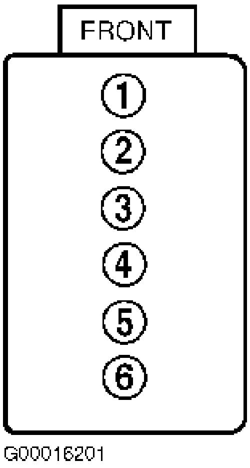
Engine Configuration	Firing Order	Cylinder Identification
In-Line 4	1-3-4-2	

5 CYLINDER ENGINE

Engine Configuration	Firing Order	Cylinder Identification
In-Line 5	1-3-5-4-2	

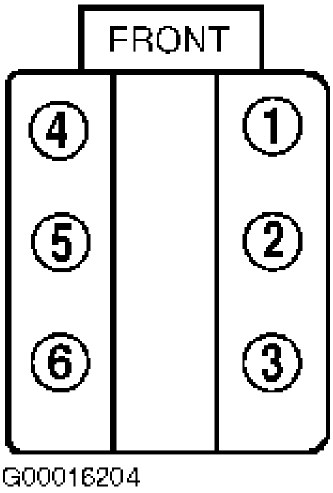
IN-LINE 6 ENGINE

Engine Configuration	Firing Order	Cylinder Identification

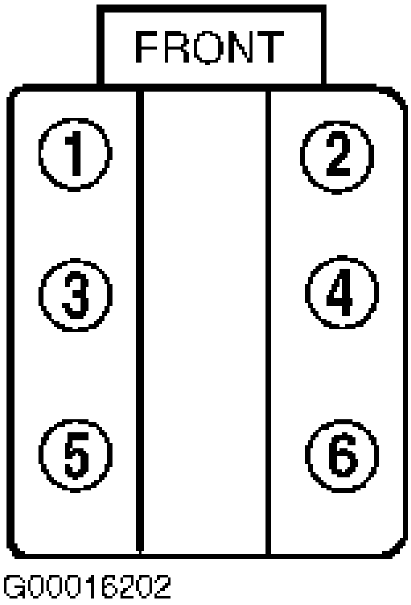
Engine Configuration	**Firing Order**	**Cylinder Identification**
In-Line 6	1-5-3-6-2-4	 FRONT 1 2 3 4 5 6 G00016201

V6 ENGINE

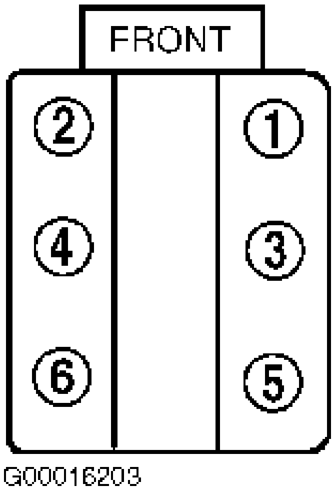
3.5L VIN 4 V6 Engine

Engine Configuration	Firing Order	Cylinder Identification
3.5L VIN 4	1-4-2-5-3-6	 FRONT 4 1 5 2 6 3 G00016204

3.8L & 4.3L V6 Engines

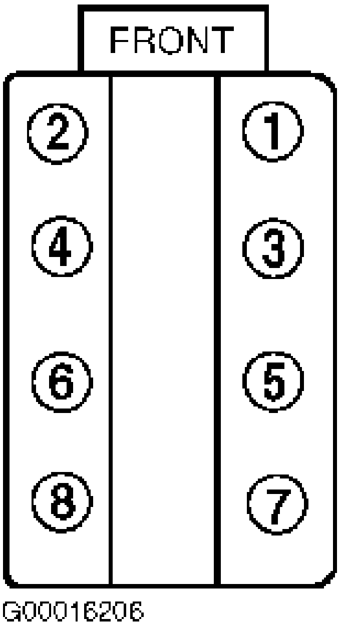
Engine Configuration	**Firing Order**	**Cylinder Identification**
3.8L & 4.3L	1-6-5-4-3-2	 FRONT 1 2 3 4 5 6 G00016202

All Other V6 Engines Except 3.5L (VIN 4), 3.8L & 4.3L

Engine Configuration	Firing Order	Cylinder Identification
All Others	1-2-3-4-5-6	 FRONT 2 1 4 3 6 5 G00016203

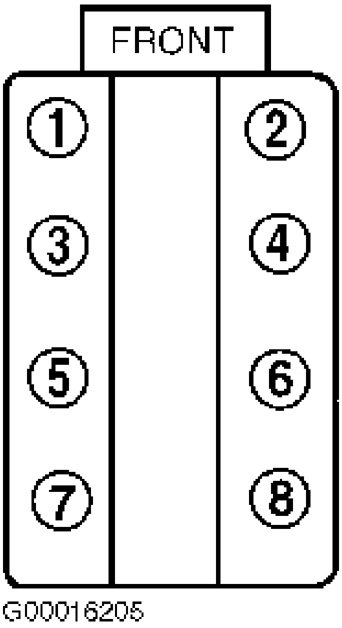
8 CYLINDER ENGINE

4.0L, 4.4L & 4.6L V8 Engines

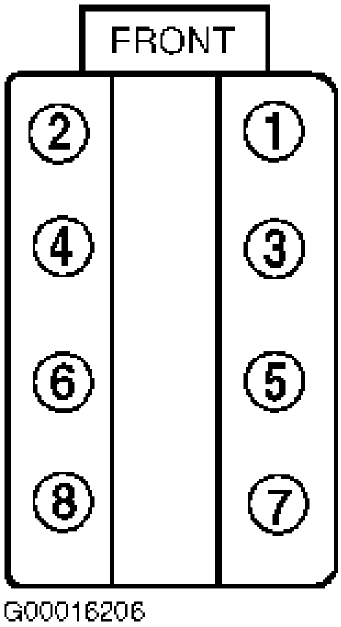
Engine Configuration	Firing Order	Cylinder Identification
4.0L, 4.4L, 4.6L	1-2-7-3-4-5-6-8	 FRONT 2 1 4 3 6 5 8 7 G00016206

5.0L, 5.7L (VIN R & VIN K) & 7.4L V8 Engines

Engine Configuration	Firing Order	Cylinder Identification

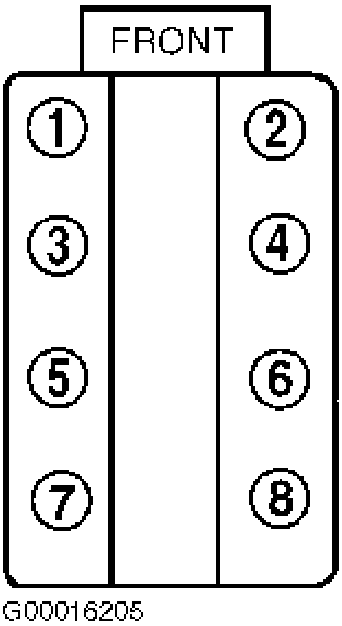
Engine Configuration	Firing Order	Cylinder Identification
5.0L, 5.7L (VIN R & K), 7.4L	1-8-4-3-6-5-7-2	 FRONT 1 2 3 4 5 6 7 8 G00016205

6.6L Diesel V8 Engine

Engine Configuration	Firing Order	Cylinder Identification
6.6L Diesel	1-2-7-8-4-5-6-3	 FRONT 2 1 4 3 6 5 8 7 G00016206

All Other V8 Engines Except 4.0L, 4.4L, 4.6L, 5.0L, 5.7L (VIN R & K), 7.4L & 6.6L

Engine Configuration	Firing Order	Cylinder Identification

Engine Configuration	Firing Order	Cylinder Identification
All Others	1-8-7-2-6-5-4-3	 FRONT 1 2 3 4 5 6 7 8 G00016205

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2017 GENERAL INFORMATION

Air/Wind Noise - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

AIR/WIND NOISE

Special Tools

- **CH-39570** Chassis Ear
- **GE-41416** Ultrasonic Leak Detector

For equivalent regional tools, refer to Special Tools.

WARNING: **Refer to Assistant Driving Warning .**

To analyze a reported wind noise condition, test drive the vehicle to determine the origin of the noise.

Choose a regular route with smooth and straight streets that run in all 4 directions: North, South, East, and West. The area should have little traffic or little noise in order to eliminate interference with the test.

NOTE: **Often there is one primary leak source and one or more secondary leaks that contribute to the noise condition. Repairing only one of the contributing leak sources may not completely repair the total condition but only reduce the condition.**

Drive the vehicle at the speed in which the noise was noticed, or until the noise is heard. Maintain safe and legal speeds.

Many of the waterleak diagnosis tests are also used for the wind noise diagnosis.

Most wind noise is caused either by leaking seals or by misaligned body surfaces. You can diagnose the following types of wind noise with the aid of **CH-39570** ear or **GE-41416** detector.

- Wind whistle
- Wind roar
- Wind rush

When moving at highway speeds, air pressure inside the vehicle becomes greater than the air pressure outside. When a leak occurs, the escaping air causes a hiss or a whistle.

Wind roar occurs when air passes over or through an opening between the 2 body surfaces. To correct the condition, adjust the alignment to the body surfaces.

Wind rush occurs when air presses over the vehicle's body, and is related to the aerodynamics of the vehicle. Wind whistle and wind roar are repairable. Rule out wind whistle and wind roar before concluding that the wind noise is due to wind rush.

Use the following inspections in order to aid in diagnosing wind whistle or wind roar:

1. Note the details for wind noise:
    - The perceived location
    - The location where the noise is loudest
    - When the noise occurs
    - The vehicle speed
    - The interior fan speed

    - The position of the windows
    - What the noise sounds like
2. Inspect the vehicle for the possible cause of the wind noise.
3. Test drive the vehicle and determine if the wind noise is external or internal.
4. Perform a visual inspection of the following components:
    - Loose fasteners
    - Torn weatherstrips
    - Broken weld joints
    - Sealer and/or adhesive skips

TRACING POWDER OR CHALK TEST

Clean the weatherstrips and the contact surfaces with cleaning solvent.

1. Apply powder or chalk in an unbroken line to the contact surface of the weatherstrip surrounding the perimeter of the suspected areas.
2. Close the panel completely without slamming the panel. Closing the panel completely presses the weatherstrip firmly against the mating surface.
3. Inspect the applied line on the weatherstrip. The applied line is marred where contact is good. A corresponding imprint is on the mating surfaces.
4. Gaps or irregularities in the powder or the chalk line on the mating surfaces indicate the areas with a poor seal.

AIR PRESSURE TEST

1. Mask off both the pressure relief valves.
2. Close all the windows.
3. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode.
4. Unlock and close the doors.
5. Listen for escaping air along the door and the window seals with a stethoscope or a length of heater hose.

SOAP SUDS OR BUBBLE TEST

1. Mask off the pressure relief valves.
2. Close all the windows and the doors.
3. Turn the vehicles ventilation fan to the on position, with the selector on high speed and in the defrost mode.
4. Unlock and close the doors.
5. Apply the soap solution to the potential leak areas.
6. Look for bubbles revealing escaping air.

REPAIR INSTRUCTIONS

EXTERIOR WINDNOISE

WARNING: **Refer to Assistant Driving Warning .**

Interior windnoise is not heard when the window is lowered. Interior windnoise is caused by the air leaving the inside of the vehicle through a seal or a seam.

1. Tape over the relief valves to cause added air pressure within the vehicle.
2. Test drive the vehicle and listen for windnoise or a whistle.
3. Pull the vehicle over and make the temporary repairs using masking tape. If you cannot determine the source of the windnoise, perform one or more of the following diagnostic tests:

- Air Pressure Test
- Soap Suds or Bubble Test
- Tracing Powder or Chalk Test

INTERIOR WINDNOISE

WARNING: Refer to Assistant Driving Warning .

Interior windnoise is not heard when the window is lowered. Interior windnoise is caused by the air leaving the inside of the vehicle through a seal or a seam.

1. Tape over the relief valves to cause added air pressure within the vehicle.
2. Test drive the vehicle and listen for windnoise or a whistle.
3. Pull the vehicle over and make the temporary repairs using masking tape. If you cannot determine the source of the windnoise, perform one or more of the following diagnostic tests:
    - Air Pressure Test
    - Soap Suds or Bubble Test
    - Tracing Powder or Chalk Test

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

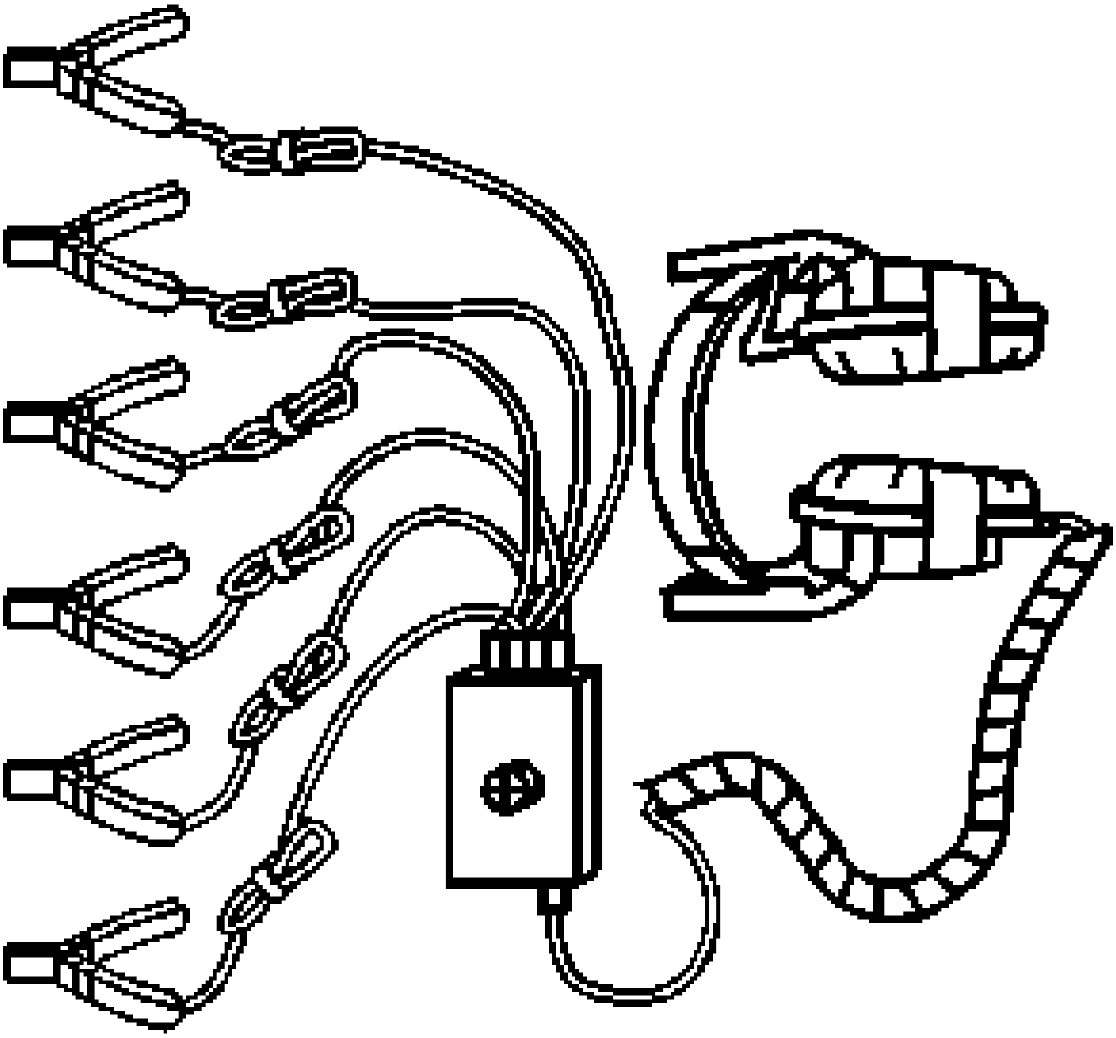
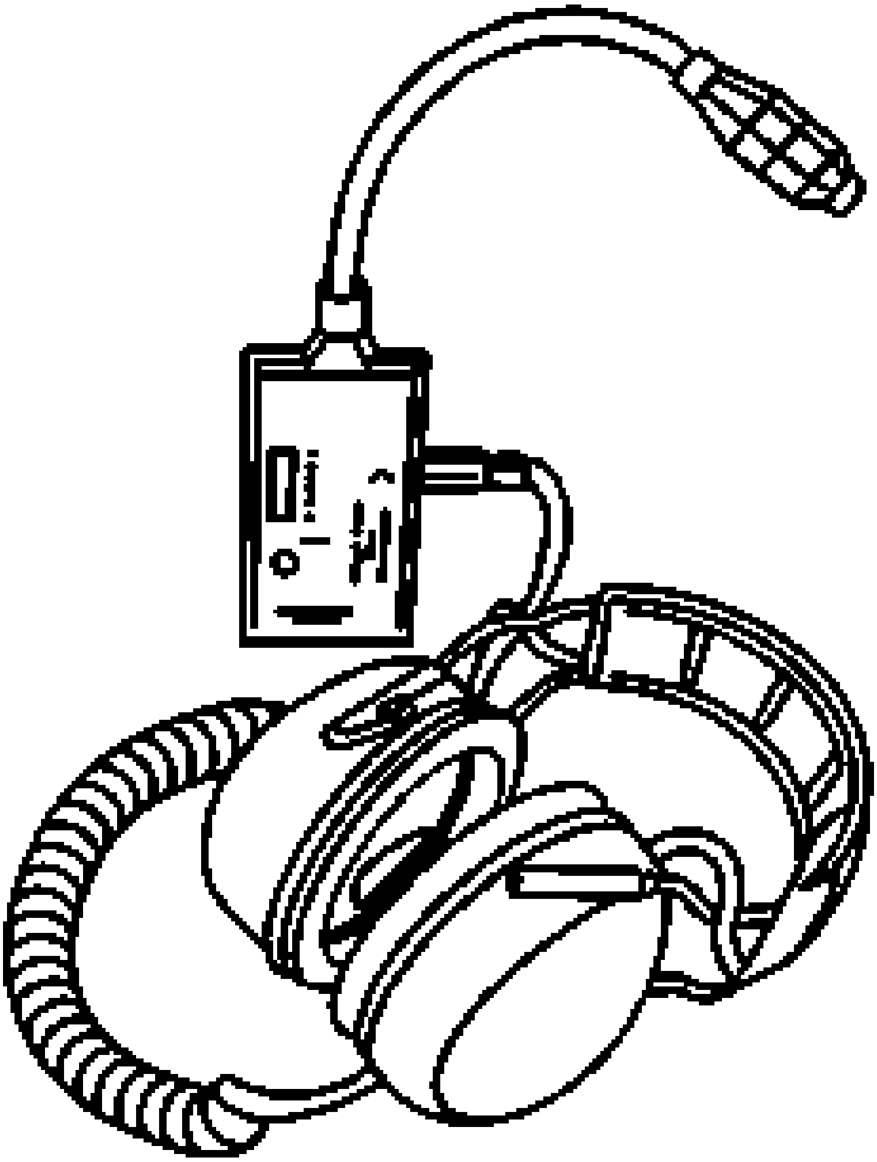
Illustration	Tool Number/ Description
	CH-39570 J 39570 Chassis Ear

Illustration	Tool Number/ Description
	GE-41416 J 41416 Ultrasonic Leak Detector

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GENERAL INFORMATION

Anti-Lock Brake Safety Precautions

* PLEASE READ THIS FIRST *

This article is intended for general information purposes only. This information may not apply to all makes and models. If vehicle is equipped with Anti-Lock Brake System (ABS), refer to appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section for description, operation, depressurizing, testing, system bleeding, trouble shooting and servicing of specific system.

ANTI-LOCK BRAKE SAFETY PRECAUTIONS

WARNING: **Failure to depressurize ABS could lead to physical injury.**

- NEVER open a bleeder valve or loosen a hydraulic line while ABS is pressurized.
- NEVER disconnect or reconnect any electrical connectors while ignition is on. Damage to ABS control unit may result.
- **DO NOT** attempt to bleed hydraulic system without first referring to the appropriate ANTI-LOCK BRAKE SYSTEM article in the BRAKES section.
- Only use specially designed brake hoses/lines on ABS equipped vehicles.
- **DO NOT** tap on speed sensor components (sensor, sensor rings). Sensor rings must be pressed into hubs, NOT hammered into hubs. Striking these components can cause demagnetization or a loss of polarization, affecting the accuracy of the speed signal returning to the ABS control unit.
- **DO NOT** mix tire sizes. Increasing the width, as long as tires remain close to the original diameter, is acceptable. Rolling diameter must be identical for all 4 tires. Some manufacturers recommend tires of the same brand, style and type. Failure to follow this precaution may cause inaccurate wheel speed readings.
- **DO NOT** contaminate speed sensor components with grease. Only use recommended coating, when system calls for an anti-corrosion coating.
- When speed sensor components have been removed, ALWAYS check sensor-to-ring air gaps when applicable. These specifications can be found in each appropriate article.
- ONLY use recommended brake fluids. **DO NOT** use silicone brake fluids in an ABS equipped vehicle.
- When installing transmission devices (CB's, telephones, etc.) on ABS equipped vehicles, **DO NOT** locate the antenna near the ABS control unit (or any control unit).
- Disconnect all on-board computers, when using electric welding equipment.
- **DO NOT** expose the ABS control unit to prolonged periods of high heat (185 Â°F/85Â°C for 2 hours is generally considered a maximum limit).

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GENERAL INFORMATION

Clutch Trouble Shooting

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

ALL MODELS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

CLUTCH TROUBLE SHOOTING

Problem & Possible Cause	Action
Clutch Chatters/Grabs	
Incorrect Pedal Adjustment	Adjust Free Play
Worn Input Shaft Spline	Replace Input Shaft
Binding Pressure Plate	Replace Pressure Plate
Binding Throw-Out Lever	Check Throw-Out Lever, Check Throw-Out Bearing, Check Bearing Retainer
Uneven Pressure Plate Contact With Flywheel	Align/Replace Worn Parts
Transmission Misaligned	Align Transmission
Worn Pressure Plate	Replace Clutch Assembly
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Loose Engine Mounts	Replace Engine Mounts
Clutch Pedal Sticks Down	
Clutch Cable Binding	Replace Clutch Cable
Weak Pressure Plate Springs	Replace Clutch Assembly
Binding Clutch Linkage	Lubricate Linkage
Broken Clutch Pedal Return Spring	Replace Return Spring
Clutch Will Not Release	
Oil-Saturated Disc	Replace Clutch Assembly, Repair Oil Leak
Defective Disc Face	Replace Clutch Assembly
Disc Sticking on Input Shaft Splines	Replace Disc/Input Shaft
Binding Pilot Bearing	Replace Pilot Bearing
Faulty Clutch Master Cylinder	Replace Master Cylinder

Problem & Possible Cause	**Action**
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
Blown Clutch Hose	Replace Hose
Sticky Throw-Out Bearing Sleeve	Clean/Lube Sleeve
Clutch Cable Binding	Replace Clutch Cable
Broken/Loose Bellhousing	Check Bellhousing
Rattling/Squeaking	
Broken Throw-Out Lever Return Spring	Replace Return Spring
Faulty Throw-Out Bearing	Replace Throw-Out Bearing
Faulty Clutch Disc	Replace Clutch Disc
Faulty Pilot Bearing	Replace Pilot Bearing
Worn Throw-Out Bearing	Replace Throw-Out Bearing
Dry Bearing Retainer Slide For Throw-Out Bearing Sleeve	Lubricate Slide
Slipping	
Faulty Pressure Plate	Replace Clutch Assembly
Worn Clutch Disc	Replace Clutch Assembly
Incorrect Alignment	Realign Clutch Assembly
Faulty Clutch Slave Cylinder	Replace Slave Cylinder
No Pedal Pressure	
Leaky Hydraulic System	Check Clutch Master Cylinder, Check Clutch Slave Cylinder
	Check Clutch Hose
Broken Clutch Cable	Replace Clutch Cable
Faulty Throw-Out Lever	Replace Throw-Out Lever
Broken Clutch Linkage	Repair Clutch Linkage
Noisy Clutch Pedal	
Faulty Safety Switch	Check/Replace Switch
Noisy Self-Adj. Ratchet	Replace Ratchet
Dry Throw-Out Bearing	Replace Throw-Out Bearing
Dry Pilot Bearing	Replace Pilot Bearing
Worn Input Shaft	Replace Input Shaft

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GENERAL INFORMATION

Commonly Used Abbreviations

* PLEASE READ THIS FIRST *

NOTE: **This article is intended for general information purposes only. This information may not apply to all makes and models. Not all abbreviations are covered as manufacturers add new ones every day.**

"A"

A

Amperes

ABS

Anti-Lock Brakes

ABRS

Air Bag Restraint System

AC

Alternating Current

A/C

Air Conditioning

ACCS

A/C Cycling Switch

ACCUM

Accumulator

ACCY

Accessory

ACT

Air Charge Temperature Sensor

ADJ

Adjust or Adjustable

ADV

Advance

AFS

Airflow Sensor

AI

Air Injection

AIR or A.I.R.

Air Injection Reactor

AIS

Air Injection System

Alt.

Alternator or Altitude

Amp./amp/amps

Ampere

ASCS

Air Suction Control Solenoid

ASD

Auto Shutdown

ASDM

Air Bag System Diagnostic Module

ASV

Air Suction Valve

A/T

Automatic Transmission/Transaxle

ATC

Automatic Temperature Control

ATDC

After Top Dead Center

ATF

Automatic Transmission Fluid

ATS

Air Temperature Sensor

Aux.

Auxiliary

Avg.

Average

AXOD

Automatic Transaxle Overdrive (Ford Models Only)

"B"

BAC

By-Pass Air Control

BAP

Barometric Absolute Pressure Sensor

BARO

Barometric

Batt.

Battery

Bbl.

Barrel (Example: 4-Bbl.)

BCM

Body Control Module

BHP

Brake Horsepower

BMAP

Barometric and Manifold Absolute Pressure Sensor

BOO

Brake On-Off Switch

B/P

Backpressure

BPS

Barometric Pressure Sensor

BPT

Backpressure Transducer

BTDC

Before Top Dead Center

BTSI

Brake Transmission Shift Interlock

BTU

British Thermal Unit

BVSV

Bimetallic Vacuum Switching Valve

"C"

Â° C

Celsius (Degrees)

Calif.

California

CANP

Canister Purge

CARB

California Air Resources Board

CAT

Catalytic Converter

CB

Circuit Breaker

CBD

Closed Bowl Distributor

cc

cubic centimeter

CCC

Close Coupled Catalyst

CCC

Computer Command Control

CCD

Computer Controlled Dwell

CCOT

Cycling Clutch Orifice Tube

CCW

Counterclockwise

CDI

Capacitor Discharge Ignition

CEC

Computerized Engine Control

CID

Cubic Inch Displacement

cm

Centimeter

CMP

Camshaft Position Sensor

CO

Carbon Monoxide

CO_2

Carbon Dioxide

Cont.

Continued

CONV

Convertible

CP

Canister Purge

CKP

Crankshaft Position Sensor

CTS

Coolant Temperature Sensor

Cu. In.

Cubic Inch

CVC

Constant Vacuum Control

CV

Check Valve or Constant Velocity

CW

Clockwise

CYL or Cyl.

Cylinder

C^3 I

Computer Controlled Coil Ignition

C^4

Computer Controlled Catalytic Converter

"D"

"D"

Drive

DC

Direct Current Or Discharge

DDD

Dual Diaphragm Distributor

Def.

Defrost

Defog.

Defogger

DERM

Diagnostic Energy Reserve Module

DFI

Digital Fuel Injection

Diag.

Diagnostic

DTC

Diagnostic Trouble Code

DIC

Driver Information Center

DIS

Distributorless Ignition System

DIST

Distribution

DLC

Data Link Connector

DOC

Diesel Oxidation Catalyst

DOHC

Double Overhead Cam

DOT

Department of Transportation

DPF

Diesel Particulate Filter

DRB-II

Diagnostic Readout Box

DVOM

Digital Volt-Ohmmeter

"E"

EACV

Electric Air Control Valve

EATX

Electronic Automatic Transaxle

EBCM

Electronic Brake Control Module

EBL

Electronic Back Light

ECM

Engine Control Module

ECT

Engine Coolant Temperature Sensor

EDIS

Electronic Distributorless Ignition System

EEC

Electronic Engine Control

EECS

Evaporative Emission Control System

EEPROM

Electronically Erasable PROM

EFE

Early Fuel Evaporation

EGO

Exhaust Gas Oxygen Sensor

EGR

Exhaust Gas Recirculation

EOT

Engine Oil Temperature

ESA

Electronic Spark Advance

ESC

Electronic Spark Control

EST

Electronic Spark Timing

EVAP

Fuel Evaporative System

EVIC

Electronic Vehicle Information Center

EVP

EGR Valve Position Sensor

EWMA

Exponentially Weighted Moving Average (MODE 6)

Exc.

Except

"F"

Â° F

Fahrenheit (Degrees)

F/B

Fuse Block

Fed.

Federal

FI

Fuel Injection

FICU

Fuel Injection Control Unit

FIPL

Fuel Injector Pump Lever

FLI

Fuel Level Indicator

FPR-VSV

Fuel Pressure Regulator Vacuum Switching Valve

Ft. Lbs.

Foot Pounds

FWD

Front Wheel Drive

"G"

g

grams

Gals.

gallons

GND or GRND

Ground

"H"

HAC

High Altitude Compensation

HC

Hydrocarbons

H/D

Heavy Duty

HO2S

Heated Exhaust Gas Oxygen Sensor

Hg

Mercury

Hgt.

Height

HLDT

Headlight

HO

High Output

HO2S

Heated Oxygen Sensor

HP

High Performance

HSC

High Swirl Combustion

HSO

High Specific Output

HTR

Heater

Hz

Hertz (Cycles Per Second)

"I"

IAC

Idle Air Control

IACV

Idle Air Control Valve

IAT

Intake Air Temperature

IC

Integrated Circuit

ID

Identification

I.D.

Inside Diameter

IFS

Independant Front Suspension

IFS

Inertia Fuel Shutoff (Ford)

Ign.

Ignition

IMRC

Intake Manifold Runner Control

In.

Inches

INCH Lbs.

Inch Pounds

in. Hg

Inches of Mercury

Inj.

Injector

IP

Instrument Panel

IRS

Independant Rear Suspension

ISC

Idle Speed Control

IVD

Interactive Vehicle Dynamics (Ford)

IVSV

Idle Vacuum Switching Valve

"J"

J/B

Junction Block

"K"

KAPWR

Keep Alive Power

k/ohms

kilo-ohms (1000 ohms)

kg

Kilograms (weight)

kg/cm^2

Kilograms Per Square Centimeter

KM/H

Kilometers Per Hour

KOEO

Key On, Engine Off

KOER

Key On, Engine Running

KS

Knock Sensor

kW

Kilowatt

kV

Kilovolt

"L"

L

Liter

lbs. (Lbs. when used in table)

Pounds

LCD

Liquid Crystal Display

L/D

Light Duty

LDP

Leak Detection Pump (Part of EVAP system.)

LED

Light Emitting Diode

LH

Left Hand

"M"

mA

Milliamps

MA or MAF

Mass Airflow

MAFS

Mass Airflow Sensor

MAP

Manifold Absolute Pressure

MAT

Manifold Air Temperature

Mem.

Memory

MEM-CAL

Memory Calibration Chip

mfd.

Microfarads

MFI

Multiport Fuel Injection

MICU

Multiplex Integrated Control Unit (Acura/Honda)

MIL

Malfunction Indicator Light

MPI

Multi-Point (Fuel) Injection

mm

Millimeters

MPH

Miles Per Hour

mV

Millivolts

"N"

NA

Not Available

NAC

NOx Adsorber Catalyst

NCA

No Color Available (Wiring Diagrams)

NGS

New Generation Star

N.m

Newton Meter

No.

Number

Nos.

Numbers

NOx

Oxides of Nitrogen

"O"

O_2

Oxygen

OBD

On-Board Diagnostics

OC

Oxidation Catalyst

OD

Overdrive

O.D.

Outside Diameter

OHC

Overhead Camshaft

OSS

Output Speed Sensor

O/S

Oversize

oz.

Ounce

ozs.

Ounces

"P"

"P"

Park

P/C

Printed Circuit

PCM

Powertrain Control Module

PCS

Purge Control Solenoid

PC-SOL

Purge Control Solenoid

PCV

Positive Crankcase Ventilation

PFI

Port Fuel Injection

PGM-FI

Programmed Fuel Injection

PID

Parameter Identification

PIP

Profile Ignition Pick-up

PNP

Park Neutral Position Switch

P/N

Park/Neutral

PRNDL

Park Reverse Neutral Drive Low

PROM

Programmable Read-Only Memory

psi

Pounds Per Square Inch

P/S

Power Steering

PSPS

Power Steering Pressure Switch

PTC

Positive Temperature Coefficient

PTO

Power Take-Off

Pts.

Pints

Pwr.

Power

"Q"

Qts.

Quarts

"R"

RABS

Rear Anti-Lock Brake System

RECIRC

Recirculation

RH

Right Hand

RPM

Revolutions Per Minute

RWAL

Rear Wheel Anti-Lock Brake

RWD

Rear Wheel Drive

"S"

SAS

Steering Angle Sensor

SBC

Single Bed Converter

SBEC

Single Board Engine Controller

SDARS

Satellite Digital Audio Radio Service

SES

Service Engine Soon

SFI

Sequential (Port) Fuel Injection

SIL

Shift Indicator Light

SIR

Supplemental Inflatable Restraint

SOHC

Single Overhead Cam

SOL or Sol.

Solenoid

SPFI

Sequential Port Fuel Injection

SPK

Spark Control

SPOUT

Spark Output

SRI

Service Reminder Indicator

SRS

Supplemental Restraint System (Air Bag)

STAR

Self-Test Automatic Readout

STO

Self-Test Output

SUB-O_2

Sub Oxygen Sensor

Sw.

Switch

Sys.

System

"T"

TAB

Thermactor Air By-Pass

TAC

Throttle Actuator Module

TAD

Thermactor Air Diverter

TBC

Body Control Module (General Motors)

TBI

Throttle Body Injection

TCC

Torque Converter Clutch

TDC

Top Dead Center

Temp.

Temperature

TFI

Thick Film Ignition

THERMAC

Thermostatic Air Cleaner

TPM

Tire Pressure Monitor

TPMS

Tire Pressure Monitor System

TPS

Throttle Position Sensor/Switch

TS

Temperature Sensor

TV

Thermovalve

TWC

Three-Way Catalyst

"V"

V

Valve

Vac.

Vacuum

VAF

Vane Airflow

VAPS

Variable Assist Power Steering

VCC

Viscous Converter Clutch

VCRM

Variable Control Relay Module

VIN

Vehicle Identification Number

VM

Vacuum Modulator

Volt.

Voltage

VOM

Volt-Ohmmeter (Analog)

VRV

Vacuum Regulator Valve

VSS

Vehicle Speed Sensor

VSV

Vacuum Switching Valve

"W"

W/

With

W/O

Without

WAC

Wide Open Throttle A/C Switch

WOT

Wide Open Throttle

Back To Article

2017 GENERAL INFORMATION

Dangers, Warnings, and Cautions - Bolt EV

INTRODUCTION

DEFINITION OF DANGER, WARNING, CAUTION, AND NOTE

The diagnosis and repair procedures in a GM Service Manual contain both general and specific Dangers, Warnings, Cautions, Notes or Importants. GM is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for the proper operation of the vehicle, however, certain procedures may present a hazard to the technician if they are not followed in the recommended manner. Dangers, Warnings, Cautions and Notes or Importants are elements designed to prevent these hazards, however, not all hazards can be foreseen. This information is placed at strategic locations within the service manual. This information is designed to prevent the following from occurring:

- Serious bodily injury or death to the technician
- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper repair or replacement of vehicle components.
- Any warning or caution that appears in this service category is referenced from the individual service categories.

DANGER Defined

When encountering a DANGER, you will be asked to take a necessary action or not to take a prohibited action. If a DANGER is not heeded, the following consequences may occur:

- Serious bodily injury or death to the technician
- Serious bodily injury or death to other technicians in the workplace area

WARNING Defined

When encountering a WARNING, you will be asked to take a necessary action or not to take a prohibited action. If a WARNING is not heeded, the following consequences may occur:

- Serious bodily injury to the technician
- Serious bodily injury to other technicians in the workplace area
- Serious bodily injury to the driver and/or passenger(s) of the vehicle, if the vehicle has been improperly repaired

CAUTION Defined

CAUTIONS call special attention to a necessary action or to a prohibited action. If a CAUTION is not heeded, the following consequences may occur:

- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper operation or performance of the system or component under repair
- Damage to any systems or components which are dependent upon the proper operation of the system or component under repair
- Improper operation or performance of any systems or components which are dependent upon the proper operation or performance of the system or component under repair

- Damage to fasteners, basic tools, or special tools
- The leakage of coolant, lubricant, or other vital fluids

NOTE or IMPORTANT Defined

NOTE and IMPORTANT statements emphasize a necessary characteristic of a diagnostic or repair procedure. NOTE or IMPORTANT statements are designed to do the following:

- Clarify a procedure
- Present additional information for accomplishing a procedure
- Give insight into the reason or reasons for performing a procedure in the manner recommended
- Present information that will help to accomplish a procedure in a more effective manner
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease

APPROVED EQUIPMENT FOR COLLISION REPAIR WARNING

WARNING: **To avoid personal injury when exposed to welding flashes or to galvanized (Zinc Oxide) metal toxic fumes while grinding/cutting on any type of metal or sheet molded compound, you must work in a properly ventilated area, wearing an approved respirator, eye protection, earplugs, welding gloves, and protective clothing. In addition when grinding aluminum components, always use an extraction system to remove high dust concentration due to risk of explosion.**

ASSISTANT DRIVING WARNING

WARNING: **An assistant should drive the vehicle while the technician checks for the location of the reported condition. Otherwise, personal injury could result.**

BATTERIES PRODUCE EXPLOSIVE GASES WARNING

WARNING: **Batteries produce explosive gases. Batteries contain corrosive acid. Batteries supply levels of electrical current high enough to cause burns. Therefore, in order to reduce the risk of personal injury while working near a battery, observe the following guidelines:**

- **Always shield your eyes.**
- **Avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow battery acid to contact the eyes or the skin.**
  - **Flush any contacted areas with water immediately and thoroughly.**
  - **Get medical help.**

BATTERY DISCONNECT WARNING

WARNING: **Unless directed otherwise, the ignition must be OFF with the key removed, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components.**

For Vehicles equipped with OnStarÂ® (UE1) with Back Up Battery:

The Back Up Battery is a redundant power supply to allow limited OnStarÂ® functionality in the event of a main vehicle battery power

disruption to the VCIM (OnStarÂ®module). Do not disconnect the main vehicle battery or remove the OnStarÂ® fuse with the ignition key in any position other than OFF. Retained accessory power should be allowed to time out or be disabled (simply opening the driver door should disable retained accessory power) before disconnecting power. Disconnecting power to the OnStarÂ® module in any way while the ignition is On or with retained accessory power activated may cause activation of the OnStarÂ® Back-Up Battery system and will discharge and permanently damage the back-up battery. Once the Back-Up Battery is activated it will stay on until it has completely discharged. The back-up battery is not rechargeable and once activated the back-up battery must be replaced.

BRAKE DUST WARNING

WARNING: Avoid taking the following actions when you service wheel brake parts:

- Do not grind brake linings.
- Do not sand brake linings.
- Do not clean wheel brake parts with a dry brush or with compressed air.

Some models or aftermarket brake parts may contain asbestos fibers which can become airborne in dust. Breathing dust with asbestos fibers may cause serious bodily harm. Use a water-dampened cloth in order to remove any dust on brake parts. Equipment is available commercially in order to perform this washing function. These wet methods prevent fibers from becoming airborne.

BRAKE FLUID IRRITANT WARNING

WARNING: Brake fluid may irritate eyes and skin. In case of contact, take the following actions:

- Eye contact - rinse thoroughly with water.
- Skin contact - wash with soap and water.
- If ingested - consult a physician immediately.

BRAKE FLUID WARNING

WARNING: Use only Delco Supreme 11, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT 3 brake fluid from a clean, sealed container. Do not use fluid from an open container that may be contaminated with water. Improper or contaminated fluid could result in damage to components, or loss of braking, with possible injury.

CHECKING HOT TRANSMISSION FLUID THROUGH DRAIN PLUG HOLE WARNING

WARNING: The engine must be running when the transmission fluid fill plug is removed, or excessive fluid loss will occur. Transmission fluid may be hot. Since the actual fluid level is unknown, stand clear when removing the fill plug. Have a container ready to capture any lost fluid. Do not turn the engine off with the fill plug removed, as you can be injured by hot transmission fluid being expelled out of the oil fill opening.

COLLISION SECTIONING WARNING

WARNING: Sectioning should be performed only in the recommended areas. Failure to do so may compromise the structural integrity of the vehicle and cause personal injury if the vehicle is in a collision.

CRACKED WINDOW WARNING

WARNING: If a window is cracked but still intact, crisscross the window with masking tape in order to reduce the risk of damage or personal injury.

DEFROSTER OUTLET WARNING

WARNING: If broken glass falls into the defroster outlets, it can be blown into the passenger compartment and cause personal injury.

ELECTRIC COOLANT FAN WARNING

WARNING: An electric fan under the hood can start up even when the engine is not running and can injure you. Keep hands, clothing and tools away from any underhood electric fan.

EXHAUST SERVICE WARNING

WARNING: In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool.

EYE PROTECTION WARNING

WARNING: Approved safety glasses and gloves should be worn when performing this procedure to reduce the chance of personal injury.

GLASS AND SHEET METAL HANDLING WARNING

WARNING: When working with any type of glass or sheet metal with exposed or rough edges, wear approved safety glasses and gloves in order to reduce the chance of personal injury.

HALOGEN BULB WARNING

WARNING: Halogen bulbs contain gas under pressure. Handling a bulb improperly could cause it to shatter into flying glass fragments. To help avoid personal injury:

- Turn off the lamp switch and allow the bulb to cool before changing the bulb.
- Leave the lamp switch OFF until the bulb change is complete.
- Always wear eye protection when changing a halogen bulb.
- Handle the bulb only by its base. Avoid touching the glass.
- Keep dirt and moisture off the bulb.
- Properly dispose of the used bulb.
- Keep halogen bulbs out of the reach of children.

HOOD HOLD-OPEN DEVICE WARNING

WARNING: When a hood hold open device is being removed or installed, provide alternate support to avoid the possibility of damage to the vehicle or personal injury.

MOVING PARTS AND HOT SURFACES WARNING

WARNING: Avoid contact with moving parts and hot surfaces while working around a running engine in order to prevent physical injury.

PARKING BRAKE AND DRIVE WHEELS WARNING

WARNING: **Apply the parking brake and block the drive wheels before performing this procedure in order to prevent bodily injury.**

PROTECTIVE GOGGLES AND GLOVE WARNING

WARNING: **Always wear protective goggles and gloves when removing exhaust parts as falling rust and sharp edges from worn exhaust components could result in serious personal injury.**

R-1234YF PROPER SERVICE PROCEDURES WARNING

WARNING: ***For personal safety, proper service procedure and refrigerant handling guidelines reference the applicable SAE standards when servicing vehicles equipped with R-1234yf refrigerant systems. Reference SAE J639, SAE J2845, SAE J2842, SAE J2843 & SAE J2851. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.***

RADIATOR CAP REMOVAL WARNING

WARNING: **To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.**

RELIEVING FUEL PRESSURE WARNING

WARNING: **Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.**

REPAIR MATERIAL CURING WARNING

WARNING: **At least 24 hours are required for complete curing of repair material. The repair area should not be physically disturbed until after that time. Insufficient curing of urethane adhesive may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.**

ROAD TEST WARNING

WARNING: **Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury and vehicle damage.**

SAFETY GLASSES AND COMPRESSED AIR WARNING

WARNING: **Wear safety glasses when using compressed air in order to prevent eye injury.**

SAFETY GLASSES WARNING

WARNING: **Wear safety glasses in order to avoid eye damage.**

SENSING AND DIAGNOSTIC MODULE HANDLING WARNING

WARNING: **Be careful when you handle a sensing and diagnostic module (SDM). Do not strike or jolt the SDM. Before applying power to the SDM:**

- **Remove any dirt, grease, etc. from the mounting surface**
- **Position the SDM horizontally on the mounting surface**
- **Point the arrow on the SDM toward the front of the vehicle**
- **Tighten all of the SDM fasteners and SDM bracket fasteners to the specified torque value**

Failure to follow the correct procedure could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

SENSING AND DIAGNOSTIC MODULE VOLTAGE AFTER IGNITION IS TURNED OFF WARNING

WARNING: **The sensing and the diagnosis module (SDM) can maintain sufficient voltage to deploy the airbags and pretensioners for up to 1 minute after the ignition has been turned OFF and the fuse has been removed. If the airbags and pretensioners are not disconnected, do not begin service until one minute has been passed after disconnecting power to the SDM. Failure to do so may cause personal injury.**

SERVICING THE SIR SYSTEM WARNING

WARNING: **When performing service on or around the SIR components or the SIR wiring, follow the procedures listed below in order to temporarily disable the SIR system. Failure to follow the procedures could result in the following:**

- **Air bag deployment**
- **Personal injury**
- **Otherwise unneeded SIR system repairs**

SIR DEPLOYED INFLATOR MODULES ARE HOT WARNING

WARNING: **After deployment, the metal surfaces of the SIR component may be very hot. To help avoid a fire or personal injury:**

- **Allow sufficient time for cooling before touching any metal surface of the SIR component.**
- **Do not place the deployed SIR component near any flammable objects.**

SIR INFLATABLE MODULE DEPLOYMENT OUTSIDE VEHICLE WARNING

WARNING: **When you are deploying an inflator module for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.**

SIR INFLATOR MODULE DISPOSAL WARNING

WARNING: **In order to prevent accidental deployment and the risk of personal injury, do not dispose of an undeployed inflator module as normal shop waste. Undeployed inflator modules contain substances that could cause severe illness or personal injury if their sealed containers are damaged during disposal. Use the following deployment procedures to safely dispose of**

an undeployed inflator module. Failure to observe the following disposal methods may be a violation of appropriate country, regional or local laws.

SIR INFLATOR MODULE HANDLING AND STORAGE WARNING

WARNING: **When carrying an undeployed inflator module:**

- **Do not carry the inflator module by the wires or connector.**
- **Make sure the air bag opening points away from you.**

When storing an undeployed inflator module:

- **Make sure the air bag opening points away from the surface on which the inflator module rests.**
- **Provide free space for the air bag to expand in case of an accidental deployment.**
- **When storing a steering column, do not rest the column with the air bag opening facing down and the column vertical. Lay the column on its side.**

Failure to observe these guidelines may result in personal injury.

SIR SEATBELT PRETENSIONER HANDLING WARNING

WARNING: **When carrying an undeployed inflatable restraint seat belt retractor pretensioner:**

- **Do not carry the seat belt pretensioner by the seat belt webbing or pigtail connector, if equipped.**
- **Carry the seat belt pretensioner by the housing, keeping hands and fingers away from the seat belt webbing.**
- **Make sure the opening, from which the seat belt webbing extends, faces downward and the seat belt webbing hangs freely.**

Failure to observe these guidelines may result in personal injury.

SIR WARNING

WARNING: **This vehicle is equipped with a Supplemental Inflatable Restraint (SIR) System. Failure to follow the correct procedure could cause the following conditions:**

- **Air bag deployment**
- **Personal injury**
- **Unnecessary SIR system repairs**

In order to avoid the above conditions, observe the following guidelines:

- **Refer to Master Electrical Components List in order to determine if you are performing service on or near the SIR components or the SIR wiring.**
- **If you are performing service on or near the SIR components or the SIR wiring, disable the SIR system. Refer to Disabling the SIR System.**

TORQUE-TO-YIELD FASTENER WARNING

WARNING: **This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this**

component. Failure to replace the torque-to-yield or single use fasteners could cause damage to the vehicle, component, or bodily injury.

WORK STALL TEST WARNING

WARNING: One or more of the following guidelines may apply when performing specific required tests in the work stall:

- When a test requires spinning the drive wheels with the vehicle jacked up, adhere to the following precautions:
  - Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual vehicle speed under these conditions. Personal injury may result from excessive wheel spinning.
  - If all of the drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive wheel spinning.
  - All persons should stay clear of the rotating components and the balance weight areas in order to avoid possible personal injury.
  - When running an engine in the repair stall for an extended period of time, use care not to overheat the engine and the transmission.
- When a test requires jacking up the vehicle and running with the wheels and brake rotors removed, adhere to the following precautions:
  - Support the suspension at normal ride height.
  - Do not apply the brake with the brake rotors removed.
  - Do not place the transmission in PARK with the drive axles spinning.
  - Turn Off the ignition in order to stop the powertrain components from spinning.
- When running an engine in the work stall, use the exhaust removal system to prevent breathing dangerous gases.

AIR CONDITIONING COMPRESSOR SUPPORT CAUTION

CAUTION: Ensure the air conditioning compressor is supported by a table or work area sturdy enough to handle the weight. Do not use the hoses to support the compressor. Using the compressor hoses to bear the weight of the compressor may damage the air conditioning compressor/hoses and in turn may cause a refrigerant leak. The hoses are not designed to support the weight of the air conditioning compressor.

AIR IN THE POWER STEERING SYSTEM CAUTION

CAUTION: If the power steering system has been serviced, an accurate fluid level reading cannot be obtained unless air is bled from the steering system. The air in the fluid may cause pump cavitation noise and may cause pump damage over a period of time.

AVOID DAMAGE TO GRID LINES CAUTION

CAUTION: If you use a razor blade or other sharp tool in order to remove the adhesives or foreign objects from the inside of the rear window, use the blade carefully. Damage to the grid lines may result.

BELT DRESSING CAUTION

CAUTION: Do not use belt dressing on the drive belt. Belt dressing causes the breakdown of the composition of the drive belt. Failure to follow this recommendation will damage the drive belt.

BRAKE CALIPER CAUTION

CAUTION: Support the caliper with a piece of wire to prevent damage to the brake line.

BRAKE FLUID DAMAGE TO ELECTRICAL CONNECTIONS CAUTION

CAUTION: Brake fluid will damage electrical connections and painted surfaces. Use shop cloths, suitable containers, and fender covers to prevent brake fluid from contacting these areas. Always re-seal and wipe off brake fluid containers to prevent spills.

BRAKE FLUID EFFECTS ON PAINT AND ELECTRICAL COMPONENTS CAUTION

CAUTION: Avoid spilling brake fluid onto painted surfaces, electrical connections, wiring, or cables. Brake fluid will damage painted surfaces and cause corrosion to electrical components. If any brake fluid comes in contact with painted surfaces, immediately flush the area with water. If any brake fluid comes in contact with electrical connections, wiring, or cables, use a clean shop cloth to wipe away the fluid.

CATALYTIC CONVERTER MOVEMENT CAUTION

CAUTION: To prevent internal damage to the flexible coupling of the catalytic converter assembly, the converter must be supported. The vertical movement at the rear of the catalytic converter assembly must not exceed 6 degrees up or down.

CLEARCOAT/ULTRAVIOLET SCREENERS CAUTION

CAUTION: Removing more than 0.5 mils of the clearcoat can result in early paint failure. The clearcoat contains ultraviolet screeners. Do not finesse sand more than what is required to remove the defect.

CLUTCH ACTUATOR CYLINDER MOUNTING SLEEVE CAUTION

CAUTION: Use a mounting sleeve when installing the clutch actuator cylinder to the transmission. The transmission input shaft has sharp edges and can damage the clutch actuator cylinder. Failure to follow this caution may cause a leak and damage to the clutch actuator cylinder.

CLUTCH HYDRAULIC SYSTEM LUBRICANT CAUTION

CAUTION: Do not use mineral or paraffin-base oil in the clutch hydraulic system. These fluids may damage the rubber parts in the cylinders.

COMPONENT FASTENER TIGHTENING CAUTION

CAUTION: Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

COMPRESSED AIR SHOULD NOT EXCEED 98 KPA (14 PSI) CAUTION

CAUTION: When using compressed air to remove components, air pressure should not exceed 98 kPa (14 psi).

DRIVE AXLE CAUTION

CAUTION: Support the lower control arms in the normal horizontal position in order to avoid damage to the drive axles. Do not operate the vehicle in gear with the wheels hanging down at full travel.

ENGINE COOLANT THERMOSTAT HOUSING CAUTION

CAUTION: Use care when performing this procedure. Use of excessive force may damage the coolant thermostat.

ENGINE LIFTING CAUTION

CAUTION: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or the crankshaft pulley. Lifting the engine in an unapproved manner may cause component damage.

ENGINE MOUNTING CAUTION

CAUTION: Broken engine mountings can cause misalignment of certain drive-train components. Misalignment of drive-train components causes eventual destruction of the drive-train components.

If one engine mount breaks, the rest of the engine mounts will have increased stress put on them. This could cause the rest of the engine mounts to break.

EXTERIOR TRIM EMBLEM REMOVAL CAUTION

CAUTION: Use a plastic, flat-bladed tool to prevent paint damage when removing an emblem/name plate.

FASTENER CAUTION

CAUTION: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Do not use paints, lubricants, or corrosion inhibitors on fasteners, or fastener joint surfaces, unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems. When using fasteners that are threaded directly into plastic, use extreme care not to strip the mating plastic part(s). Use hand tools only, and do not use any kind of impact or power tools. Fastener should be hand tightened, fully seated, and not stripped.

FILLING THE MASTER CYLINDER CAUTION

CAUTION: When filling the master cylinder, use only Delco Supreme 11, GM P/N 12377967 (Canadian P/N 992667), or equivalent DOT 3 brake fluid. Do not use a container which has been used for petroleum based fluids, or a container which is wet with water. Petroleum based fluids will cause swelling and distortion of rubber parts in the hydraulic brake system, and water will mix with brake fluid, lowering the boiling point. Keep all fluid containers capped to prevent contamination.

FLEX DECOUPLER CAUTION

CAUTION: Do not over-flex or damage the flex joint when moving the flex joint from the normal mounting position.

HVAC MODULE DRAIN TUBE CAUTION

CAUTION: Always ensure the HVAC module drain tube is properly installed and secure following a repair. Residual moisture/water can collect inside the HVAC module. The residual moisture or water should not contact electrical modules, electrical connections, wiring, cables or carpeting. Use clean and absorbent shop clothes to protect these components while removing or installing the HVAC module drain tube and/or HVAC module. Moisture/water is a by-product of normal A/C system operation and can result in interior odors or corrosion/damage to electrical components.

IGNITION OFF WHEN DISCONNECTING BATTERY CAUTION

CAUTION: Always turn the ignition OFF when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failing to do so may damage the Powertrain Control Module (PCM) or other electronic components.

INSTALLING HOSES WITHOUT TWISTS OR BENDS CAUTION

CAUTION: The inlet and outlet hoses must not be twisted during installation. Do not bend or distort the inlet or outlet hoses to make installation easier. Failure to follow these procedures could result in component damage.

LIFTGATE ASSIST ROD CAUTION

CAUTION: Apply pressure only at the end of the liftgate/hood assist rod that you are removing or attaching. Do NOT apply pressure to the middle of the rod because damage or bending will result.

POWER STEERING HOSE DISCONNECTED CAUTION

CAUTION: Do not start the vehicle with any power steering gear inlet or outlet hoses disconnected. When disconnected, plug or cap all openings of components. Failure to do so could result in contamination or loss of power steering fluid and damage to the system.

REFRIGERANT PRESSURE DURING TESTING CAUTION

CAUTION: Leak detection shall only be done with the refrigerant that is specified for the system. Do not attempt to increase pressure of the A/C refrigerant system with shop air or another type of refrigerant. Failure to follow the above guidelines could result in damage to the vehicle or its components.

STEERING COLUMN IN LOCK POSITION CAUTION

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The steering shaft coupling
- The intermediate shaft(s)

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has became un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

STEERING WHEEL IN THE FULL TURN POSITION CAUTION

CAUTION: Do not hold the steering wheel in the full turn position longer than 5 seconds, as damage to the steering pump may result.

STEERING WHEEL STRAIGHT AND COLUMN LOCKED CAUTION

CAUTION: With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:

- The steering column
- The intermediate shaft(s)
- The steering gear

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has became un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

TEST PROBE CAUTION

CAUTION: Do not insert test equipment probes (DMM etc.) into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system failure. Always use the J-35616-F GM Approved Terminal Release Tool Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.

When using the J-35616-F GM Approved Terminal Release Tool Kit, ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the J-35616-F GM Approved Terminal Release Tool Kit label on the inside of the J-35616-F GM Approved Terminal Release Tool Kit for the correct adapter along with the connector end view for terminal size.

THREE-WAY CATALYTIC CONVERTER DAMAGE CAUTION

CAUTION: In order to avoid damaging the replacement three-way catalytic converter, correct the engine misfire or mechanical fault before replacing the three-way catalytic converter.

TORQUE-TO-YIELD FASTENER CAUTION

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

USING PROPER POWER STEERING FLUID CAUTION

CAUTION: When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

VEHICLE LIFTING AND JACKING CAUTION

CAUTION: Perform the following steps before beginning any vehicle lifting or jacking procedure:

- Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.
- The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.
- The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.
- Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.
- Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

WINDSHIELD INSTALLATION CAUTION

CAUTION: Do not use spacers when installing a windshield. The stress caused by the spacers may damage the windshield.

Back To Article

GENERAL INFORMATION

Drive Axle Noise Diagnosis

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

UNRELATED NOISES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires and other parts of the vehicle. Make sure that cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any parts.

NON-DRIVE AXLE NOISES

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A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and trim moldings.

In certain conditions, the pitch of exhaust gases may sound like gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow tires, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings can also cause a whistling or whining noise. Ensure that none of these components are causing the noise before disassembling the drive axle.

GEAR NOISE

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A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear noise, make sure that tires, exhaust, and vehicle trim have been checked as possible causes.

CHUCKLE

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to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused by excessive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough to cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

KNOCK

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This is very similar to a chuckle, though it may be louder, and occur on acceleration of deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

CLUNK

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Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, clunk will not be eliminated by overhauling drive axle.

BEARING WHINE

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at driveshaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

BEARING RUMBLE

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to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of driveshaft speed.

CHATTER ON TURNS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

This is a condition where the whole front or rear vibrates when vehicle is moving. The vibration is easily felt and heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates the chatter.

AXLE SHAFT NOISE

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes. Noise will persist with transmission in neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect axle shafts and replace axle bearings. Re-evaluate vehicle for noise before removing any internal components.

VIBRATION

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Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and con occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can be divided into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalance parts.
- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

Back To Article

GENERAL INFORMATION

Electrostatic Discharge (ESD) Warning - Basic Information

* PLEASE READ THIS FIRST *

NOTE: **This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.**

INTRODUCTION

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All Electrostatic Discharge (ESD) sensitive components contain solid state circuits (transistors, diodes, semiconductors) that may become damaged when contacted with an electrostatic charge. The following information applies to all ESD sensitive devices. The ESD symbol shown in Fig. **Fig. 1** may be used on schematics to indicate which components are ESD sensitive. See **Fig. 1**. Although different manufactures may display different symbols to represent ESD sensitive devices, the handling and measuring precautions and procedures are the same.

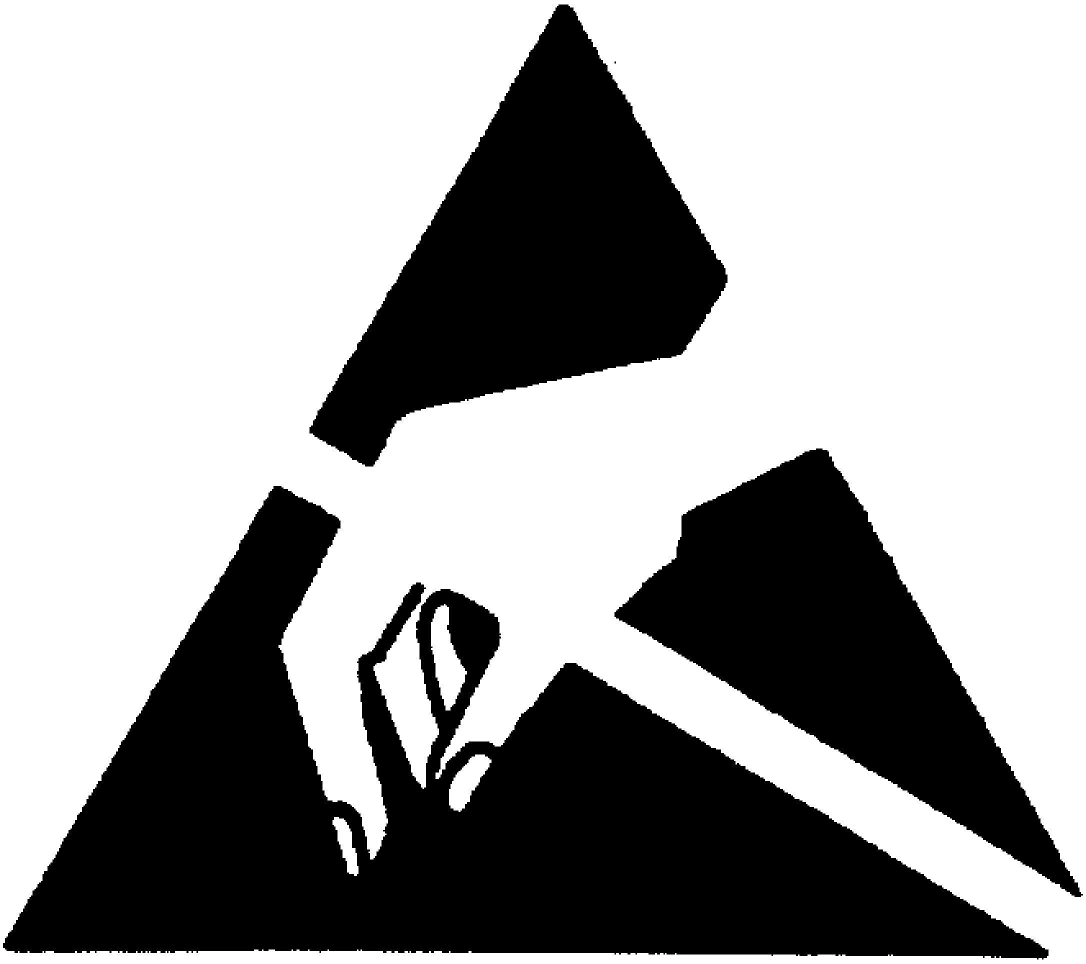

Fig. 1: Sample ESD Symbol

HANDLING STATIC-SENSITIVE CIRCUITS/DEVICES

NOTE: **This article is intended for general information purposes only. Contents are generic in nature and all information may or may not apply to all vehicles.**

When handling an electronic part that is ESD sensitive, the technician should follow these guidelines to reduce any possible electrostatic charge build-up on the technician's body and the electronic part.

1. Always touch a known good ground source before handling the part. This should be repeated while handling the part and more frequently after sitting down from a standing position, sliding across the seat or walking a distance.
2. Avoid touching electrical terminals of the part, unless instructed by a diagnostic procedure.
3. DO NOT open the package of a new part until it is time to install the part.
4. Before removing the part from its package, ground the package to a known good ground source.

CHECKING STATIC-SENSITIVE CIRCUITS/DEVICES

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1. Solid State circuits in electronic devices are shown greatly simplified in schematics. See Fig. 2. Due to the simplification of the electronic devices on the schematic, resistance measurements could be misleading or could lead to an electrostatic discharge. Always follow the recommended diagnostic procedure.

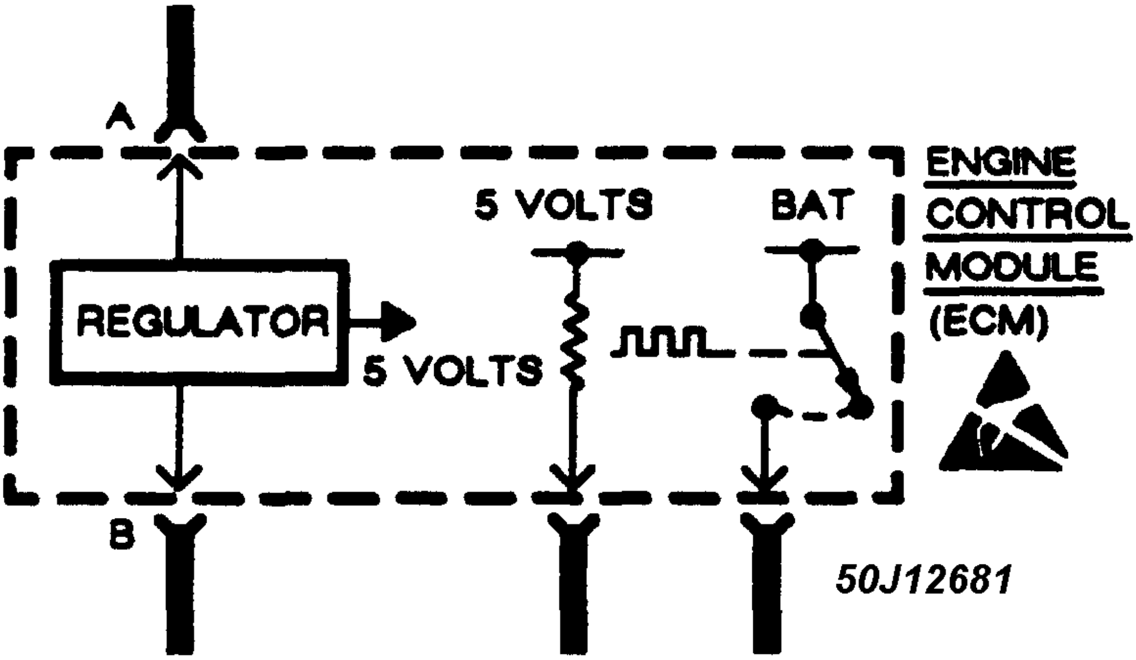
A
5 VOLTS
BAT
ENGINE
CONTROL
MODULE
(ECM)
REGULATOR
5 VOLTS
B
50J12681

Fig. 2: Sample Schematic Showing Typical ESD Sensitive Device

2. Only measure resistance at the terminals of the devices when instructed by the recommended diagnostic procedure.
3. When using a voltmeter, be sure to connect the ground lead first.

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GENERAL INFORMATION

Engine Displacement Conversion Table

CONVERSION TABLE

LITER/CID CONVERSION

Liter	CID
1.0	59
1.0	60
1.0	61
1.1	66
1.1	68
1.1	70
1.2	71
1.2	72
1.2	73
1.2	76
1.3	77
1.3	78
1.3	79
1.3	80
1.3	81
1.3	82
1.4	85
1.4	85
1.4	86
1.5	89
1.5	90
1.5	91
1.6	94
1.6	95
1.6	96
1.6	97
1.6	98
1.6	99
1.7	102
1.7	103
1.7	105
1.8	107
1.8	109
1.8	110
1.8	111
1.8	112
1.9	113
1.9	114
1.9	116
1.9	119
2.0	119
2.0	120
2.0	121

Liter	CID
2.0	122
2.1	125
2.1	126
2.1	128
2.1	129
2.1	130
2.1	131
2.2	132
2.2	133
2.2	134
2.2	135
2.2	136
2.2	137
2.3	138
2.3	140
2.3	141
2.3	143
2.4	143
2.4	144
2.4	145
2.4	146
2.4	147
2.4	149
2.5	150
2.5	151
2.5	152
2.5	153
2.6	155
2.6	156
2.6	157
2.6	158
2.6	159
2.7	162
2.7	163
2.7	164
2.7	167
2.8	168
2.8	170
2.8	171
2.8	173
2.9	174
2.9	179
3.0	180
3.0	181
3.0	182
3.0	183
3.0	184
3.1	191
3.1	192
3.2	193
3.2	194
3.2	195

Liter	CID
3.2	196
3.2	197
3.2	198
3.3	199
3.3	200
3.3	201
3.3	204
3.4	206
3.4	207
3.4	209
3.5	210
3.5	211
3.5	212
3.5	213
3.5	214
3.5	215
3.6	219
3.6	220
3.7	225
3.7	226
3.7	229
3.8	229
3.8	230
3.8	231
3.8	232
3.8	234
3.8	238
3.9	239
3.9	240
3.9	241
4.0	241
4.0	242
4.0	243
4.0	244
4.1	250
4.1	252
4.2	255
4.2	258
4.3	259
4.3	260
4.3	262
4.3	263
4.3	266
4.4	266
4.4	267
4.4	268
4.5	273
4.5	274
4.5	276
4.6	278
4.6	279
4.6	281

Liter	CID
4.6	283
4.7	284
4.7	285
4.7	287
4.7	289
4.8	290
4.8	292
4.9	300
4.9	301
4.9	302
5.0	302
5.0	304
5.0	305
5.0	307
5.1	310
5.2	315
5.2	318
5.3	326
5.4	327
5.4	328
5.4	330
5.5	334
5.5	335
5.6	340
5.6	343
5.7	345
5.7	348
5.7	350
5.8	351
5.8	352
5.9	359
5.9	360
5.9	361
5.9	362
6.0	366
6.0	368
6.1	370
6.1	372
6.2	379
6.2	381
6.3	383
6.4	389
6.4	390
6.4	392
6.5	396
6.6	400
6.6	401
6.6	402
6.6	403
6.7	410
6.8	412
6.8	413

Liter	**CID**
6.8	414
6.8	415
6.9	420
6.9	421
7.0	425
7.0	426
7.0	427
7.0	428
7.0	429
7.0	430
7.1	432
7.2	440
7.4	454
7.5	455
7.5	460
7.6	462
8.0	488
8.2	500
8.8	534
8.8	537
8.8	538
8.9	540
9.0	549
9.1	555
9.3	568
9.3	570
9.6	588
9.8	600
9.9	605
10.0	611

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GENERAL INFORMATION

Engine Overhaul Procedures

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

DESCRIPTION

Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of cleaning, inspection, and assembly processes are included.

ENGINE IDENTIFICATION

Engine may be identified from Vehicle Identification Number (VIN) stamped on a metal tab. Metal tab may be located in different locations depending on manufacturer. Engine identification number or serial number is located on cylinder block. Location varies with each manufacturer.

INSPECTION PROCEDURES

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Engine components must be inspected to meet manufacturer's specifications and tolerances during overhaul. Proper dimensions and tolerances must be met to obtain proper performance and maximum engine life.

Micrometers, depth gauges and dial indicator are used for checking tolerances during engine overhaul. Magnaflux, Magnaglo, dye-check, ultrasonic and x-ray inspection procedures are used for parts inspection.

MAGNETIC PARTICLE INSPECTION

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Magnaflux & Magnaglo

Magnaflux is an inspection technique used to locate material flaws and stress cracks. Component is subjected to a strong magnetic field. Entire component or a localized area can be magnetized. Component is coated with either a wet or dry material that contains fine magnetic particles.

Cracks which are outlined by the particles cause an interruption of magnetic field. Dry powder method of Magnaflux can be used in normal lighting and crack appears as a bright line.

Fluorescent liquid is used along with a Black light in the Magnaglo Magnaflux system. Darkened room is required for this procedure. The crack will appear as a glowing line. Complete demagnetizing of component upon completion is required on both procedures. Magnetic particle inspection applies to ferrous materials only.

PENETRANT INSPECTION

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Zyglo

The Zyglo process coats material with a fluorescent dye penetrant. Component is often warmed to expand cracks that will be penetrated by the dye. Using darkened room and Black light, component is inspected for cracks. Crack will glow brightly.

Developing solution is often used to enhance results. Parts made of any material, such as aluminum cylinder heads or plastics, may be tested using this process.

Dye Check

Penetrating dye is sprayed on the previously cleaned component. Dye is left on component for 5-45 minutes, depending upon material density. Component is then wiped clean and sprayed with a developing solution. Surface cracks will show up as a bright line.

ULTRASONIC INSPECTION

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Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

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If an expensive part is suspected of internal cracking, ultrasonic testing is used. Sound waves are used for component inspection.

X-RAY INSPECTION

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This form of inspection is used on highly stressed components. X-ray inspection may be used to detect internal and external flaws in any material.

PRESSURE TESTING

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Cylinder heads can be tested for cracks using a pressure tester. Pressure testing is performed by plugging all but one of the holes of cylinder head and injecting air or water into the open passage.

Leaks are indicated by the appearance of wet or damp areas when using water. When air is used, it is necessary to spray the head surface with a soap solution. Bubbles will indicate a leak. Cylinder head may also be submerged in water heated to specified temperature to check for cracks created during heat expansion.

CLEANING PROCEDURES

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Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

All components of an engine do not have the same cleaning requirements. Physical methods include bead blasting and manual removal. Chemical methods include solvent blast, solvent tank, hot tank, cold tank and steam cleaning of components.

BEAD BLASTING

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Manual removal of deposits may be required prior to bead blasting, followed by some other cleaning method. Carbon, paint and rust may be removed using bead blasting method. Components must be free of oil and grease prior to bead blasting. Beads will stick to grease or oil soaked areas causing area not to be cleaned.

Use air pressure to remove all trapped residual beads from component after cleaning. After cleaning internal engine parts made of aluminum, wash thoroughly with hot soapy water. Component must be thoroughly cleaned as glass beads will enter engine oil resulting in bearing damage.

CHEMICAL CLEANING

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Solvent tank is used for cleaning oily residue from components. Solvent blasting sprays solvent through a siphon gun using compressed air.

The hot tank, using heated caustic solvents, is used for cleaning ferrous materials only. DO NOT clean aluminum parts such as cylinder heads, bearings or other soft metals using the hot tank. After cleaning, flush parts with hot water.

A non-ferrous part will be ruined and caustic solution will be diluted if placed in the hot tank. Always use eye protection and gloves when using the hot tank.

Use of a cold tank is for cleaning aluminum cylinder heads, carburetors and other soft metals. A less caustic and unheated solution is used. Parts may be left in the tank for several hours without damage. After cleaning, flush parts with hot water.

Steam cleaning, with boiling hot water sprayed at high pressure, is recommended as the final cleaning process when using either hot or cold tank cleaning.

COMPONENT CLEANING

* PLEASE READ THIS FIRST *

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SHEET METAL PARTS

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Examples of sheet metal parts are rocker covers, front and side covers, oil pan and bellhousing dust cover. Glass bead blasting or hot tank may be used for cleaning.

Ensure all mating surfaces are flat. Deformed surfaces should be straightened. Check all sheet metal parts for cracks and dents.

INTAKE & EXHAUST MANIFOLDS

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Using solvent cleaning or bead blasting, clean manifolds for inspection. If intake manifold has an exhaust crossover, all carbon deposits must be removed. Inspect manifolds for cracks, burned or eroded areas, corrosion and damage to fasteners.

Exhaust heat and products of combustion cause threads of fasteners to corrode. Replace studs and bolts as necessary. On "V" type intake manifolds, sheet metal oil shield must be removed for proper cleaning and inspection. Ensure all manifold parting surfaces are flat and free of burrs.

CYLINDER HEAD REPLACEMENT

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REMOVAL

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Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Remove intake and exhaust manifolds and valve cover. Cylinder head and camshaft carrier bolts (if equipped) should be removed only when engine is cold. On many aluminum cylinder heads, removal while hot will cause cylinder head warpage. Mark rocker arm or overhead cam components for location.

Remove rocker arm components or overhead cam components. Components must be installed in original location. Individual design rocker arms may utilize shafts, ball-type pedestal mounts or no rocker arms. For all design types, wire components together and identify according to corresponding valve. Remove cylinder head bolts. Note length and location. Some applications require cylinder head bolts be removed in proper sequence to prevent cylinder head damage. See **Fig. 1**. Remove cylinder head.

INSTALLATION

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Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure all surfaces and head bolts are clean. Check that head bolt holes of cylinder block are clean and dry to prevent block damage when bolts are tightened. Clean threads with tap to ensure accurate bolt torque.

Install head gasket on cylinder block. Some manufacturers may recommend sealant be applied to head gasket prior to installation. Note that all holes are aligned. Some gasket applications may be marked so that certain area faces upward. Install cylinder head using care not to damage head gasket. Ensure cylinder head is fully seated on cylinder block.

Some applications require head bolts be coated with sealant prior to installation. This is done if head bolts are exposed to coolant passages. Some applications require head bolts be coated with light coat of engine oil.

Install head bolts. Head bolts should be tightened in proper steps and sequence to specification. See **Fig. 1**. Install remaining components. Tighten all bolts to specification. Adjust valves if required. See VALVE ADJUSTMENT.

NOTE: **Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.**

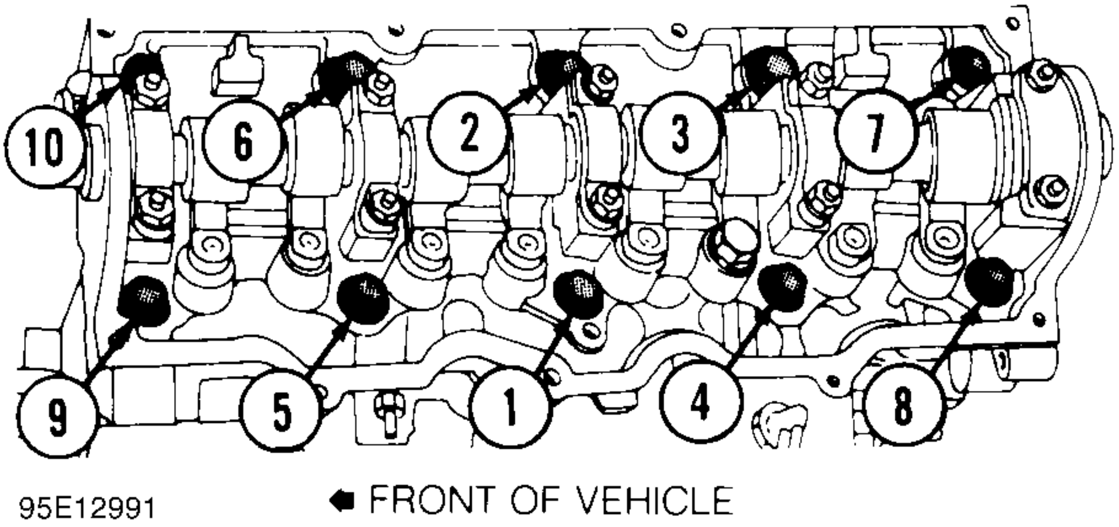

Fig. 1: Typical Cylinder Head Tightening or Loosening Sequence

VALVE ADJUSTMENT

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Engine specifications will indicate valve train clearance and temperature at which adjustment is to be made on most models. In most cases, adjustment will be made with a cold engine. In some cases, both a cold and a hot clearance will be given for maintenance convenience.

On some models, adjustment is not required. Rocker arms are tightened to specification and valve lash is automatically set. On some models with push rod actuated valve train, adjustment is made at push rod end of rocker arm while other models do not require adjustment.

Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

Some models require hydraulic lifter to be bled down and clearance measured. Push rods of different length can be used to obtain proper clearance. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge.

Overhead cam engines designed without rocker arms actuate valves directly on a cam follower. A hardened, removable disc is installed between the cam lobe and lifter. Clearance will be checked between cam heel and adjusting disc in proper sequence using a feeler gauge. Engine will be rotated to obtain all valve adjustments.

On overhead cam engines designed with rocker arms, adjustment is made at valve end of rocker arm. Ensure valve to be adjusted is riding on heel of cam on all engines. Clearance will be checked between tip of rocker arm and tip of valve stem in proper sequence using a feeler gauge. Adjustment is made by rotating adjusting screw until proper clearance is obtained. Lock nut is then tightened. Engine will be rotated to obtain all valve adjustments to manufacturer's specifications.

CYLINDER HEAD OVERHAUL

* PLEASE READ THIS FIRST *

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CYLINDER HEAD DISASSEMBLY

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Mark valves for location. Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator, valve spring, spring seat and valve. See Fig. 2.

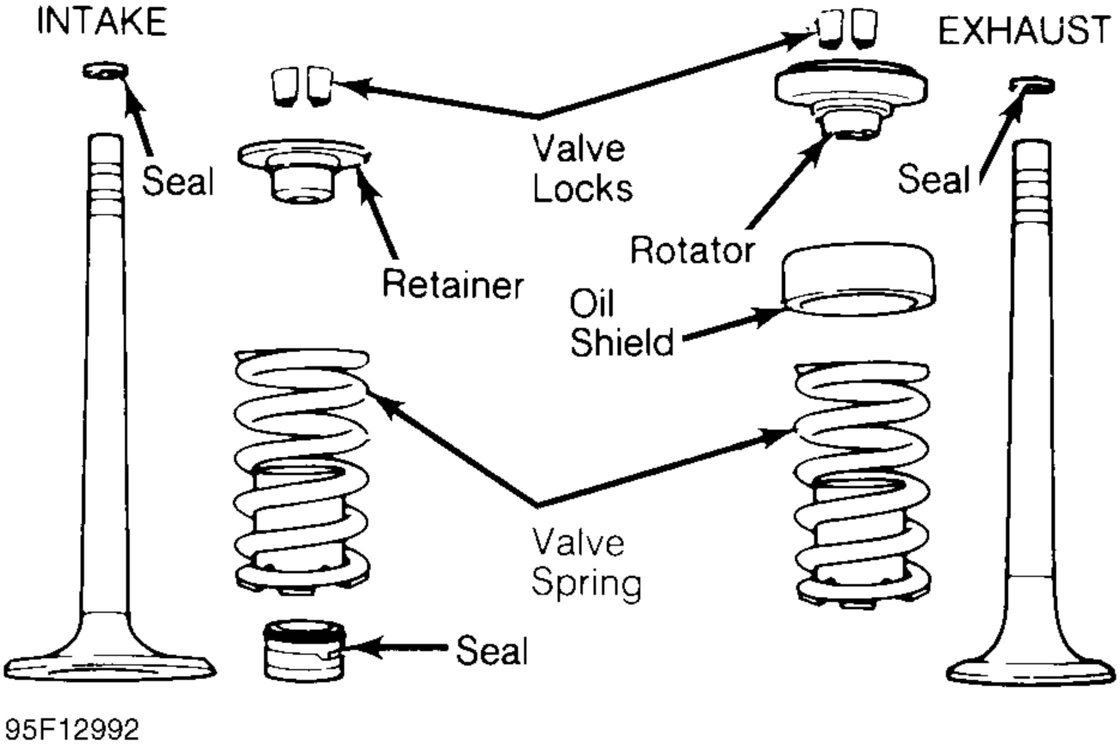

Fig. 2: Exploded View of Valve Assemblies

CYLINDER HEAD CLEANING & INSPECTION

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been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

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Clean cylinder head and valve components using approved cleaning methods. Inspect cylinder head for cracks, damage or warped gasket surface. Place straightedge across gasket surface. Determine clearance at center of straightedge. Measure across both diagonals, longitudinal center line and across cylinder head at several points. See Fig. 3.

On cast iron cylinder heads, if warpage exceeds .003" (.08 mm) in a 6" span, or .006" (.15 mm) over total length, cylinder head must be resurfaced. On most aluminum cylinder heads, if warpage exceeds .002" (.05 mm) in any area, cylinder head must be resurfaced. Warpage specification may vary by manufacturer. If warpage exceeds specification on some cylinder heads, cylinder head must be replaced.

Cylinder head thickness should be measured to determine amount of material which can be removed before replacement is required. Cylinder head thickness must not be less than the manufacturer's specification.

If cylinder head required resurfacing, it may not align properly with intake manifold. On "V" type engines, misalignment is corrected by machining intake manifold surface that contacts cylinder head. Cylinder head may be machined on surface that contacts intake manifold. Using oil stone, remove burrs or scratches from all sealing surfaces.

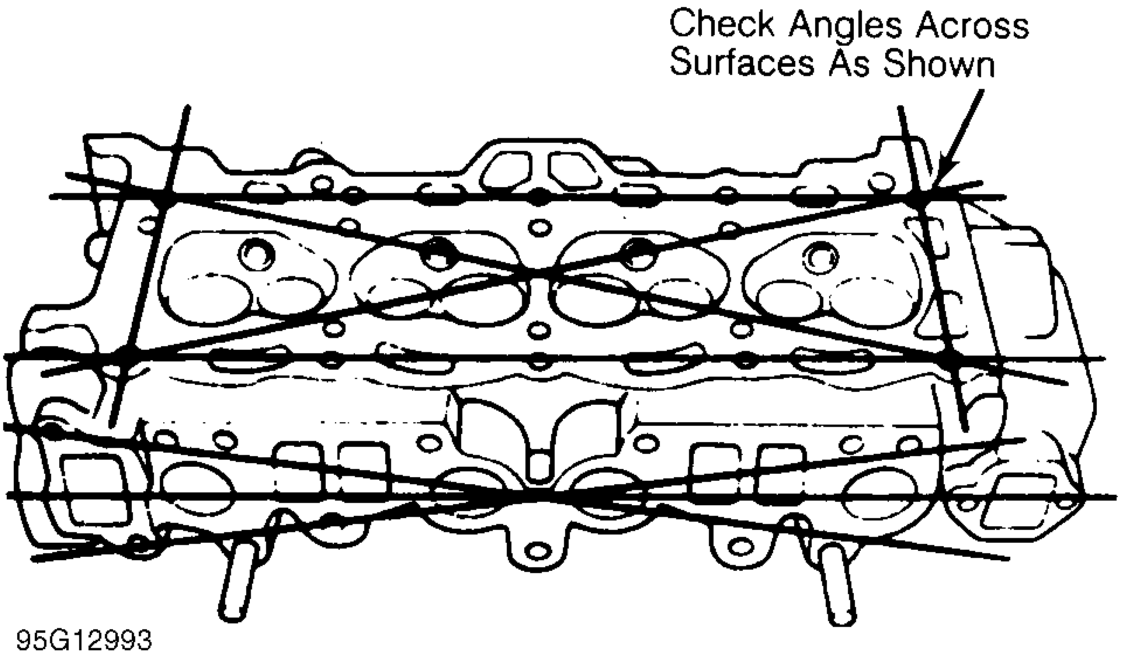

Fig. 3: Checking Cylinder Head for Warpage

VALVE SPRINGS

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Inspect valve springs for corroded or pitted valve spring surfaces which may lead to breakage. Polished spring ends caused by a rotating spring indicate that spring surge has occurred. Replace springs showing evidence of these conditions.

Inspect valve springs for squareness using a 90-degree straightedge. See Fig. 4. Replace valve spring if out-of-square exceeds manufacturer's specification.

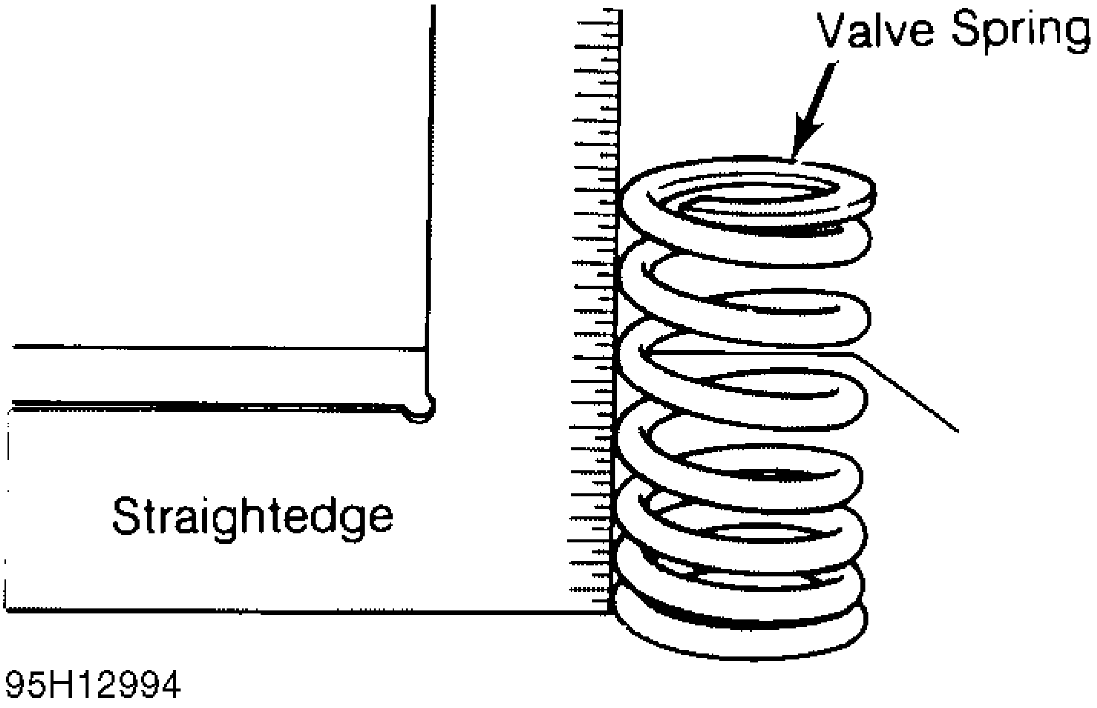

Fig. 4: Checking Valve Spring Squareness

Using vernier caliper, measure free length of all valve springs. Replace springs if not within specification. Using valve spring tester, test valve spring pressure at installed and compressed heights. See Fig. 5.

Usually compressed height is installed height minus valve lift. Replace valve spring if not within specification. It is recommended to replace all valve springs when overhauling cylinder head. Valve springs may need to be installed with color coded end or small coils at specified area according to manufacturer.

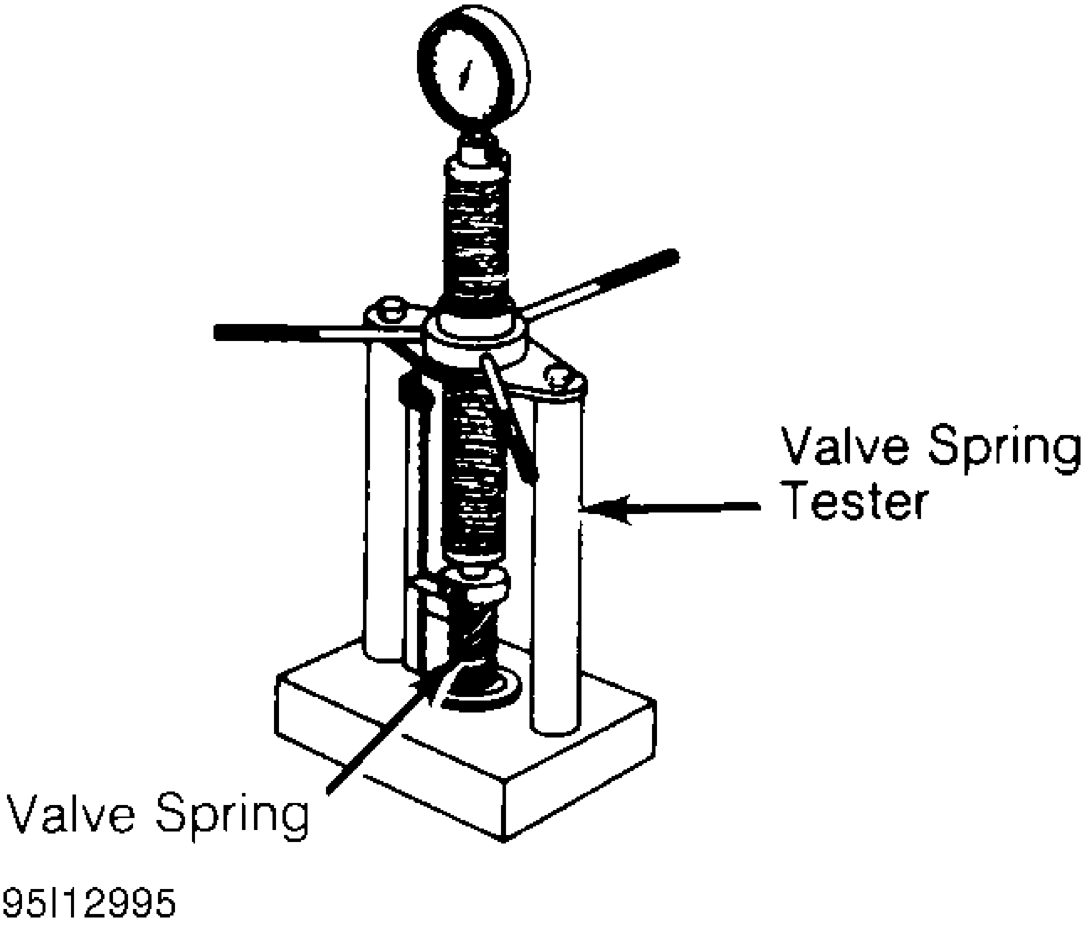

Fig. 5: Checking Valve Spring Pressure

VALVE GUIDE

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Measuring Valve Guide Clearance

Check valve stem-to-guide clearance. Ensure valve stem diameter is within specification. Install valve in valve guide. Install dial indicator assembly on cylinder head with tip resting against valve stem just above valve guide. See Fig. 6.

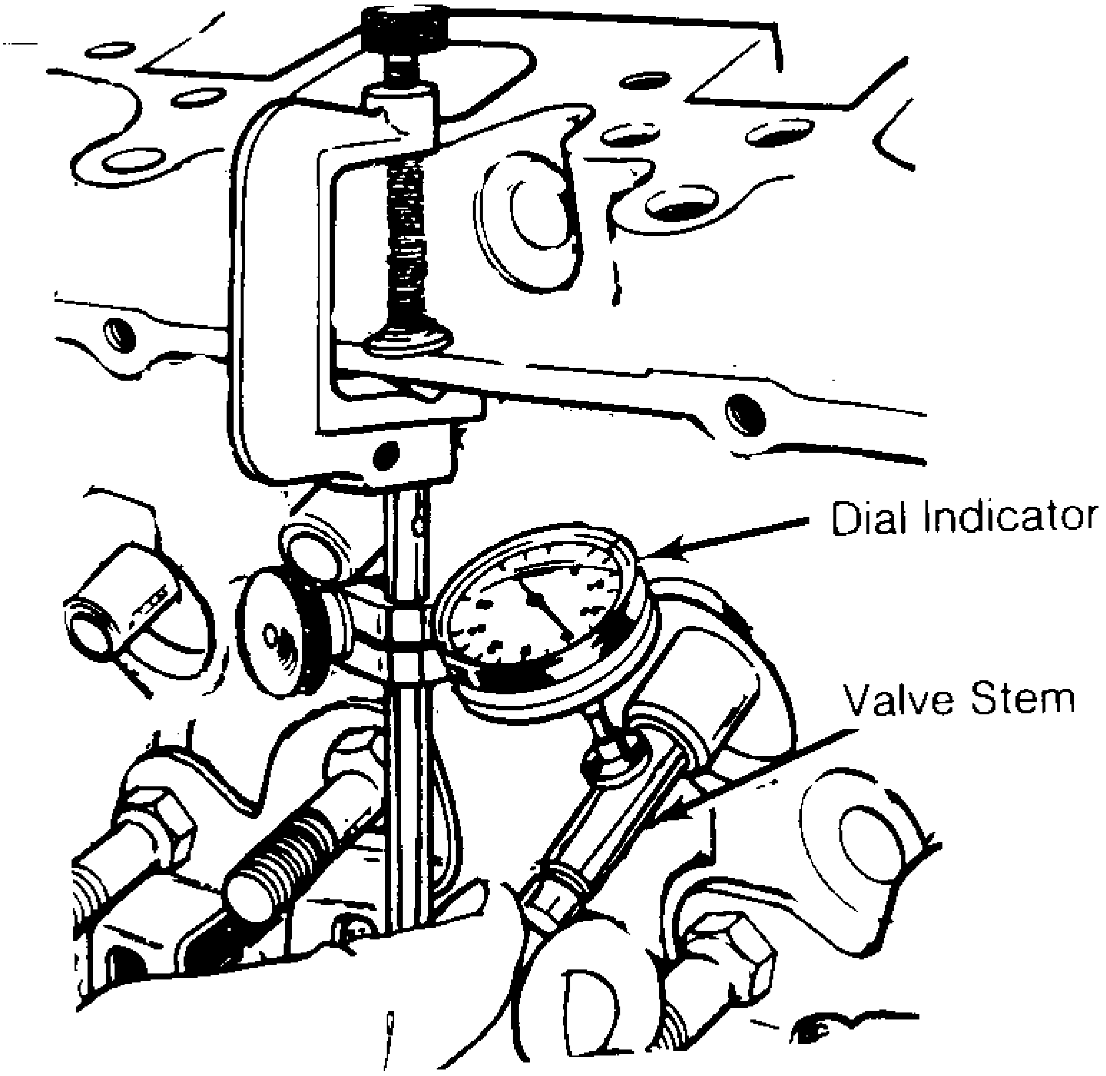

Fig. 6: Measuring Valve Stem-to-Guide Clearance

Lower valve approximately 1/16" below valve seat. Push valve stem against valve guide as far as possible. Adjust dial indicator to zero. Push valve stem in opposite direction and note reading. Clearance must be within specification.

If valve guide clearance exceeds specification, valves with oversize stems may be used and valve guides are reamed to larger size or valve guide must be replaced. On some applications, a false guide is installed, then reamed to proper specification. Valve guide reamer set is used to ream valve guide to obtain proper clearance for new valve.

Reaming Valve Guide

Select proper reamer for size of valve stem. Reamer must be of proper length to provide clean cut through entire length of valve guide. Install reamer in valve guide and rotate to cut valve guide. See Fig. 7.

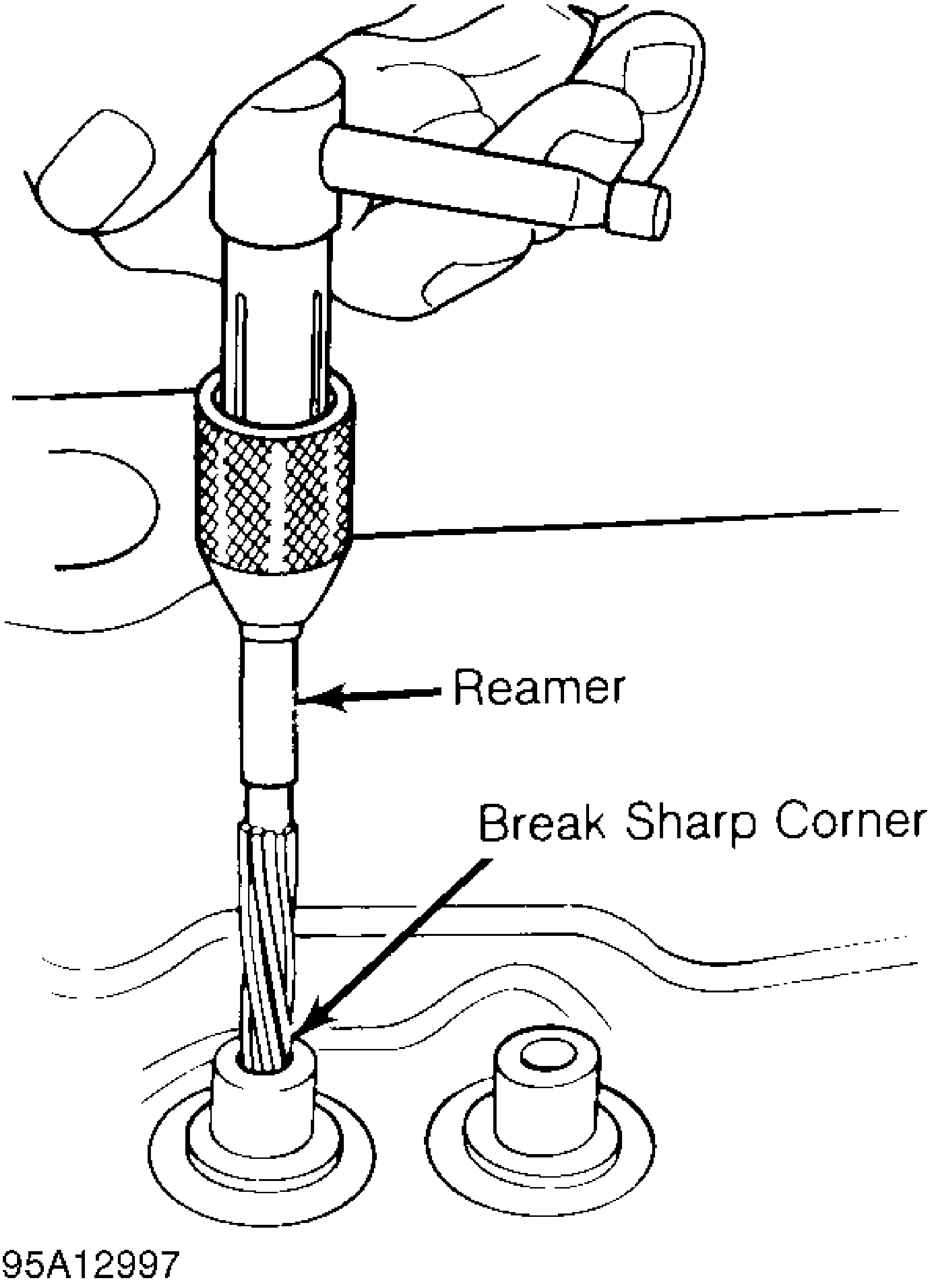

Fig. 7: Reaming Valve Guides

Replacing Valve Guide

Replace valve guide if clearance exceeds specification. Valve guides are either pressed, hammered or shrunk in place, depending upon cylinder head design and type of metal used.

Remove valve guide from cylinder head by pressing or tapping on a stepped drift. See **Fig. 8**. Once valve guide is installed, distance from cylinder head to top of valve guide must be checked. This distance must be within specification.

Aluminum heads are often heated before installing valve guide. Valve guide is sometimes cooled in dry ice prior to installation. Combination of a heated cylinder head and cooled valve guide ensures a tight guide fit upon assembly. The new guide must be reamed to specification.

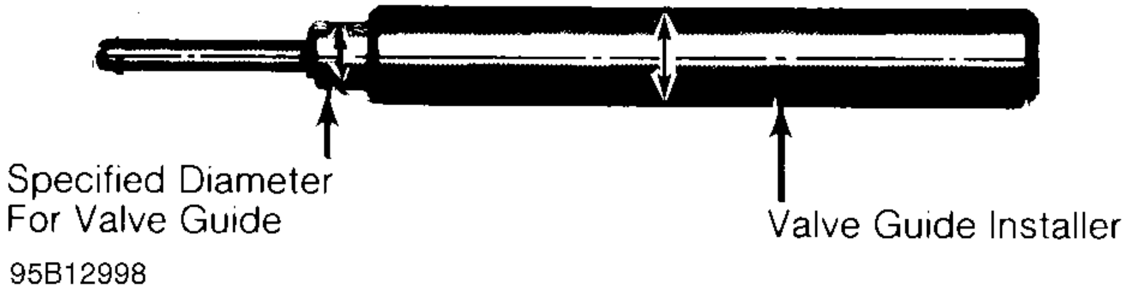

Fig. 8: Typical Valve Guide Remover & Installer

VALVES & VALVE SEATS

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Valve Grinding

Valve stem O.D. should be measured in several areas to indicate amount of wear. Replace valve if not within specification. Valve margin area should be measured to ensure that valve can be ground. See Fig. 9.

If valve margin is less than specification, the valves will be burned. Valve must be replaced. Due to minimum margin dimensions during manufacture, some new type valves cannot be reground. Some manufacturers use stellite coated valves that must NOT be machined. Valves can only be lapped into valve seat.

CAUTION: **Some valves are sodium filled. Extreme care must be used when disposing of damaged or worn sodium-filled valves.**

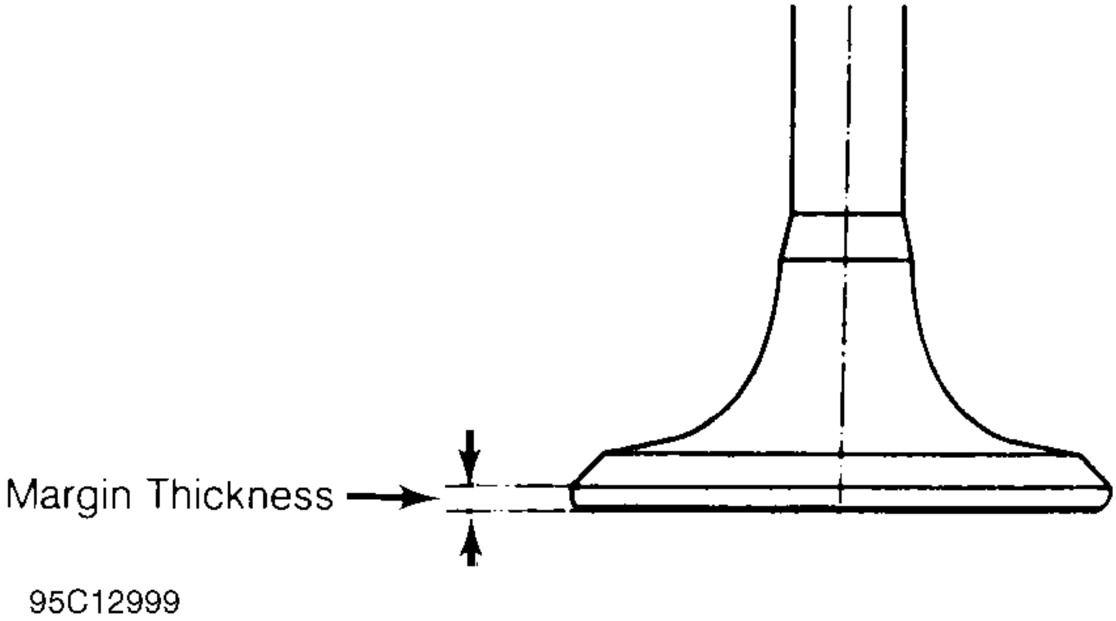

Fig. 9: Measuring Valve Head Margin

Resurface valve to proper angle specification using valve grinding machine. Follow manufacturer's instructions for valve grinding machine. Specifications may indicate a different valve face angle than seat angle. Measure valve margin after grinding. Replace valve if not within specification. Valve stem tip can be refinished using valve grinding machine.

Valve Lapping

During valve lapping of recently designed valves, be sure to follow manufacturer's recommendations. Surface hardening and materials used with some valves do not permit lapping. Lapping process will remove excessive amounts of the hardened surface.

Valve lapping is done to ensure adequate sealing between valve face and seat. Use either a hand drill or lapping stick with suction cup attached.

Moisten and attach suction cup to valve. Lubricate valve stem and guide. Apply a thin coat of fine valve grinding compound between valve and seat. Rotate lapping tool between the palms or with hand drill.

Lift valve upward off the seat and change position often. This is done to prevent grooving of valve seat. Lap valve until a smooth polished seat is obtained. Thoroughly clean grinding compound from components. Valve-to-valve seat concentricity should be checked. See **VALVE SEAT CONCENTRICITY**.

CAUTION: **Valve guides must be in good condition and free of carbon deposits prior to valve seat grinding. Some engines contain an induction hardened valve seat. Excessive material removal will damage valve seats.**

Valve Seat Grinding

Select coarse stone of correct size and angle for seat to be ground. Ensure stone is true and has a smooth surface. Select correct size pilot for valve guide dimension. Install pilot in valve guide. Lightly lubricate pilot shaft. Install stone on pilot. Move stone off and on the seat approximately 2 times per second during grinding operation.

Select a fine stone to finish grinding operation. Various angle grinding stones are used to center and narrow the valve seat as required. See **Fig. 10**.

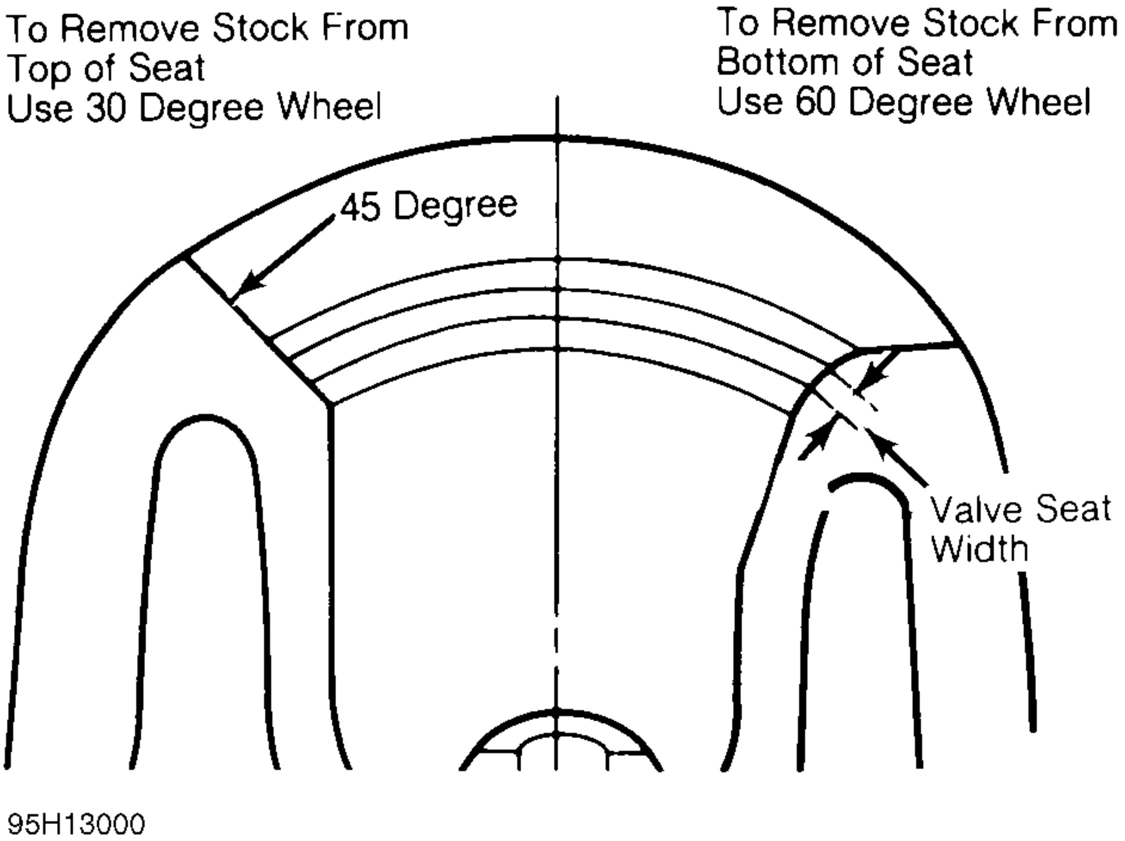

Fig. 10: Adjusting Valve Seat Width

Valve Seat Replacement

Replacement of valve seat inserts is done by cutting out the old insert and machining an oversize insert bore. Replacement oversize insert is usually cooled and the cylinder head is sometimes warmed. Valve seat is pressed into the head. This operation requires specialized machine shop equipment.

Valve Seat Concentricity

Using dial gauge, install gauge pilot in valve guide. Position gauge arm on the valve seat. Adjust dial indicator to zero. Rotate arm 360 degrees and note reading. Runout should not exceed specification.

To check valve-to-valve seat concentricity, coat valve face lightly with Prussian Blue dye. Install valve and rotate it on valve seat. If pattern is even and entire seat is coated at valve contact point, valve is concentric with the valve seat.

CYLINDER HEAD REASSEMBLY

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Valve Stem Installed Height

Valve stem installed height must be checked when new valves are installed or when valves or valve seats have been ground. Install valve in valve guide. Measure distance from tip of valve stem to spring seat. See Fig. 11. Distance must be within specification to allow sufficient clearance for valve operation.

Remove valve and grind valve stem tip if height exceeds specification. Valve tips are surface hardened. DO NOT remove more than .010" (.25 mm) from tip. Chamfer sharp edge of reground valve tip. Recheck valve stem installed height.

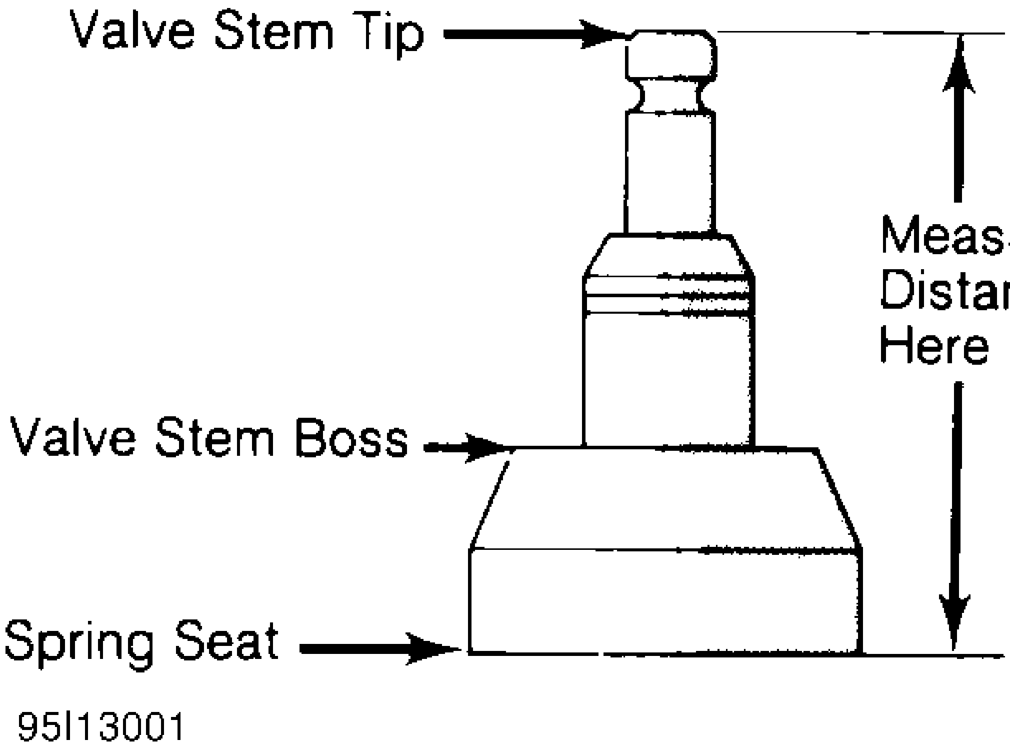

Fig. 11: Measuring Valve Stem Installed Height

VALVE STEM OIL SEALS

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Valve stem oil seals must be installed on valve stem. See Fig. 2. Seals are needed due to pressure differential at the ends of valve guides. Atmospheric pressure above intake guide, combined with manifold vacuum below guide, causes oil to be drawn into the cylinder.

Exhaust guides also have pressure differential created by exhaust gas flowing past the guide, creating a low pressure area. This low pressure area draws oil into the exhaust system.

Some manufacturers require that special color code or specified height valve stem oil seal be installed in designated area.

Replacement (On-Vehicle)

Mark rocker arm or overhead cam components for location. Remove rocker arm components or overhead cam components. Components must be installed in original location. Remove spark plugs. Valve stem oil seals may be replaced by holding valves against seats using air pressure.

Air pressure must be installed in cylinder using an adapter for spark plug hole. An adapter can be constructed by welding air hose connection to spark plug body with porcelain removed.

Rotate engine until piston is at top of stroke. Install adapter in spark plug hole. Apply a minimum of 140 psi (9.8 kg/cm^2) line pressure to adapter. Air pressure should hold valve closed. If air pressure does not hold valve closed, check for damaged or bent valve. Cylinder head must be removed for service.

Using valve spring compressor, compress valve springs. Remove valve locks. Carefully release spring compressor. Remove retainer or rotator and valve spring. Remove valve stem oil seal.

If oversize valves have been installed, oversize oil seals must be used. Coat valve stem with engine oil. Install protective sleeve over end of valve stem. Install new oil seal over valve stem and seat on valve guide. Remove protective sleeve. Install spring seat, valve spring and retainer or rotator. Compress spring and install valve locks. Remove spring compressor. Ensure valve locks are fully seated.

Install rocker arms or overhead cam components. Tighten all bolts to specification. Adjust valves if required. Remove adapter. Install spark plugs, valve cover and gasket.

VALVE SPRING INSTALLED HEIGHT

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Valve spring installed height should be checked during reassembly. Measure height from lower edge of valve spring to the upper edge. DO NOT include valve spring seat or retainer. Distance must be within specification. If valves and/or seats have been ground, a valve spring shim may be required to correct spring height. See Fig. 12.

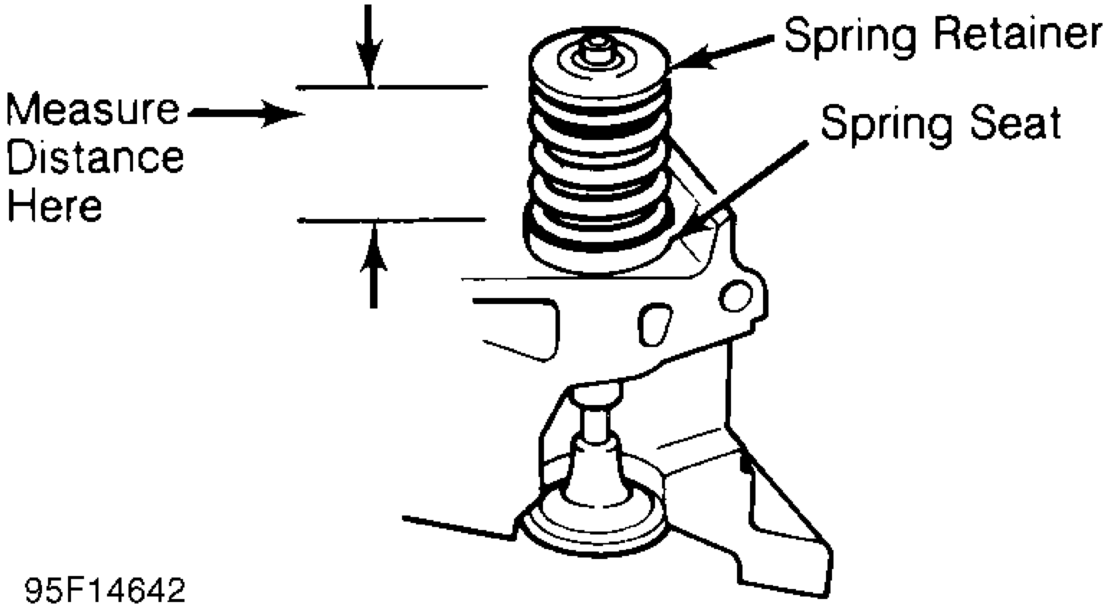

Fig. 12: Measuring Valve Spring Installed Height

ROCKER ARMS & ASSEMBLIES

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Rocker Studs

Rocker studs are either threaded or pressed in place. Threaded studs are removed by locking 2 nuts on the stud. Unscrew the stud by turning the jam nut. Coat new stud threads with Loctite and install. Tighten to specification.

Pressed-in stud can be removed using a stud puller. Ream stud bore to proper specification and press in a new oversize stud. Pressed-in studs are often replaced by cutting threads in the stud bore to accept a threaded stud.

Rocker Arms & Shafts

Mark rocker arms for location. Remove rocker arm retaining bolts. Remove rocker arms. Inspect rocker arms, shafts, bushings and pivot balls (if equipped) for excessive wear. Inspect rocker arms for wear in valve stem contact area. Measure rocker arm bushing I.D. Replace bushings if excessively worn.

The rocker arm valve stem contact point may be reground, using special fixture for valve grinding machine. Remove minimum amount of material as possible. Ensure all oil passages are clear. Install rocker arm components in original location. Ensure rocker arm is properly seated in push rod. Tighten bolts to specification. Adjust valves if required. See **VALVE ADJUSTMENT**.

PUSH RODS

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Remove rocker arms. Mark push rods for location. Remove push rods. Push rods can be steel or aluminum, solid or hollow. Hollow push rods must be internally cleaned to ensure oil passage to rocker arms is cleaned. Check push rods for damage, such as loose ends on steel tipped aluminum types.

Check push rod for straightness. Roll push rod on a flat surface. Using feeler gauge, check clearance at center. Replace push rod if bent. The push rod can also be supported at each end and rotated. A dial indicator is used to detect a bent area in the push rod.

Lubricate ends of push rod and install push rod in original location. Ensure push rod is properly seated in lifter. Install rocker arm. Tighten bolts to specification. Adjust valves if required. See **VALVE ADJUSTMENT**.

LIFTERS

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Hydraulic Lifters

Before replacing a hydraulic lifter for noisy operation, ensure noise is not caused by worn rocker arms or valve tips. Also ensure sufficient oil pressure exists. Hydraulic lifters must be installed in original location. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold, cylinder head or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use a hydraulic lifter remover or magnet. Different type lifters are used. See **Fig. 13**.

On sticking lifters, disassemble and clean lifter. DO NOT mix lifter components or positions. Parts are select-fitted and are not interchangeable. Inspect all components for wear. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. On roller type lifters, inspect roller for flaking, pitting, loss of needle bearings and roughness during rotation.

Measure lifter body O.D. in several areas. Measure lifter bore I.D. Ensure components or oil clearance is within specification. Some models offer oversize lifters. Replace lifter if damaged.

If lifter check valve is not operating, obstructions may be preventing it from closing or valve spring may be broken. Clean or replace components as necessary.

Check plunger operation. Plunger should drop to bottom of the body by its own weight when assembled dry. If plunger is not free, soak lifter in solvent to dissolve deposits.

Lifter leak-down test can be performed on lifter. Lifter must be filled with special test oil. New lifters contain special test oil. Using lifter leak-down tester, perform leak-down test following manufacturer's instructions. If leak-down time is not within specifications, replace lifter assembly.

Lifters should be soaked in clean engine oil several hours prior to installation. Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. See **Fig. 13**. Install lifter in original location. Install remaining components. Valve lash adjustment is not required on most hydraulic lifters. Preload of hydraulic lifter is automatic. Some models may require adjustment.

NOTE: **Some manufacturers require that a crankcase conditioner be added to engine oil and engine operated for specified amount of time to aid in lifter break-in procedure if new lifters or camshaft are installed.**

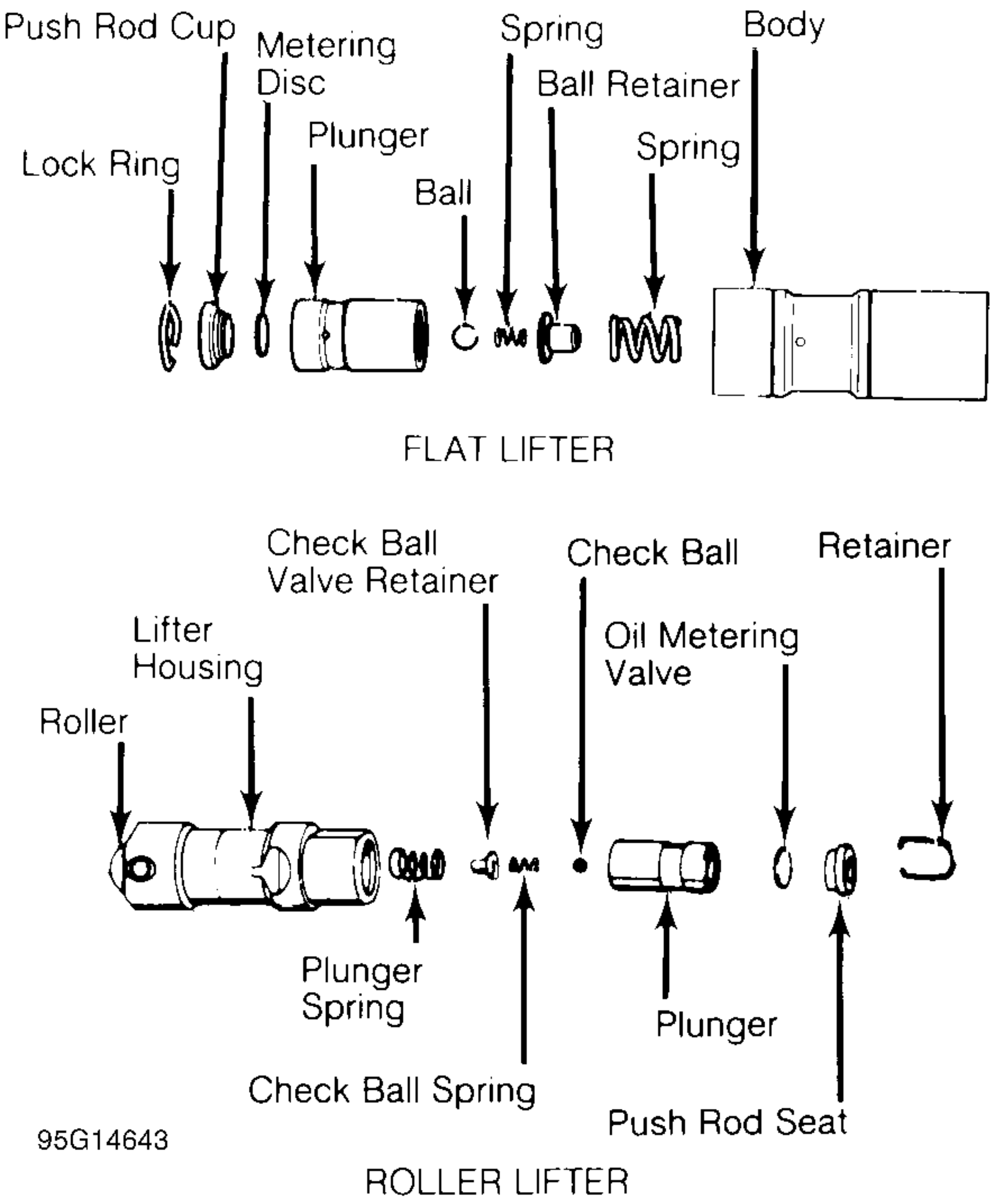
Push Rod Cup
Metering Disc
Spring
Body
Ball Retainer
Lock Ring
Plunger
Spring
Ball
FLAT LIFTER
Check Ball Valve Retainer
Check Ball
Retainer
Lifter Housing
Oil Metering Valve
Roller
Plunger Spring
Plunger
Check Ball Spring
Push Rod Seat
95G14643
ROLLER LIFTER

Fig. 13: Typical Hydraulic Valve Lifter Assemblies

Mechanical Lifters

Lifter assemblies must be installed in original locations. Remove rocker arm assembly and push rod. Mark components for location. Some applications require intake manifold or lifter cover removal. Remove lifter retainer plate (if used). To remove lifters, use lifter remover or magnet.

Inspect push rod contact area and lifter body for scoring or signs of wear. If body is scored, inspect lifter bore for damage and lack of lubrication. Note amount of wear in lifter body-to-camshaft contact area. Surface must have smooth and convex contact face. If wear is apparent, carefully inspect cam lobe.

Coat lifter base, roller (if equipped) and lifter body with ample amount of Molykote or camshaft lubricant. Install lifter in original location. Install remaining components. Tighten bolts to specification. Adjust valves. See VALVE ADJUSTMENT.

PISTONS, CONNECTING RODS & BEARINGS

*** PLEASE READ THIS FIRST ***

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RIDGE REMOVAL

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Ridge in cylinder wall must be removed prior to piston removal. Failure to remove ridge prior to removing pistons will cause piston damage in piston ring lands or grooves.

With piston at bottom dead center, place rag in bore to trap metal chips. Install ridge reamer in cylinder bore. Adjust ridge reamer using manufacturer's instructions. Remove ridge using ridge reamer. DO NOT remove an excessive amount of material. Ensure ridge is completely removed.

PISTON & CONNECTING ROD REMOVAL

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Note top of piston. Some pistons may contain a notch, arrow or be marked FRONT. Piston must be installed in proper direction to prevent damage with valve operation.

Check that connecting rod and cap are numbered for cylinder location and which side of cylinder block the number faces. Proper cap and connecting rod must be installed together. Connecting rod cap must be installed on connecting rod in proper direction to ensure bearing lock procedure. Mark connecting rod and cap if necessary. Pistons must be installed in original location.

Remove cap retaining nuts or bolts. Remove bearing cap. Install tubing protectors on connecting rod bolts. This protects cylinder walls from scoring during removal. Ensure proper removal of ridge. Push piston and connecting rod from cylinder. Connecting rod boss can be tapped with a wooden dowel or hammer handle to aid in removal.

PISTON & CONNECTING ROD

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Disassembly

Using ring expander, remove piston rings. Remove piston pin retaining rings (if equipped). Note direction of piston installation on connecting rod. On pressed type piston pins, special fixtures and procedures according to manufacturer must be used to remove piston pins. Follow manufacturer's recommendations to avoid piston distortion or breakage.

Cleaning

Remove all carbon and varnish from piston. Pistons and connecting rods may be cleaned in cold type chemical tank. Using ring groove cleaner, clean all deposits from ring grooves. Ensure all deposits are cleaned from ring grooves to prevent ring breakage or sticking. DO NOT attempt to clean pistons with wire brush.

Inspection

Inspect pistons for nicks, scoring, cracks or damage in ring areas. Connecting rod should be checked for cracks using Magnaflux procedure. Piston diameter must be measured in manufacturer's specified area.

Using telescopic gauge and micrometer, measure piston pin bore of piston in 2 areas, 90 degrees apart. This is done to check diameter and out-of-round.

Install proper bearing cap on connecting rod. Ensure bearing cap is installed in proper location. Tighten bolts or nuts to specification. Using inside micrometer, measure inside diameter in 2 areas, 90 degrees apart.

Connecting rod I.D. and out-of-round must be within specification. Measure piston pin bore I.D. and piston pin O.D. All components must be within specification. Subtract piston pin diameter from piston pin bore in piston and connecting rod to determine proper fit.

Connecting rod length must be measured from center of crankshaft journal inside diameter to center of piston pin bushing using proper caliper. Connecting rods must be the same length. Connecting rods should be checked on an alignment fixture for bent or twisted condition. Replace all components which are damaged or not within specification.

PISTON & CYLINDER BORE FIT

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Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Ensure cylinder is checked for taper, out-of-round and properly honed prior to checking piston and cylinder bore fit. See CYLINDER BLOCK. Using dial bore gauge, measure cylinder bore.

Measure piston skirt diameter at 90 degree angle to piston pin at specified area by manufacturer. Subtract piston diameter from cylinder bore diameter to determine piston-to-cylinder clearance. Clearance must be within specification. Mark piston for proper cylinder location.

ASSEMBLING PISTON & CONNECTING ROD

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Install piston on connecting rod for corresponding cylinder. Ensure reference marking on top of piston corresponds with connecting rod and cap number. See Fig. 14.

Lubricate piston pin and install in connecting rod. Ensure piston pin retainers are fully seated (if equipped). On pressed type piston pins, follow manufacturer's recommended procedure to avoid distortion or breakage.

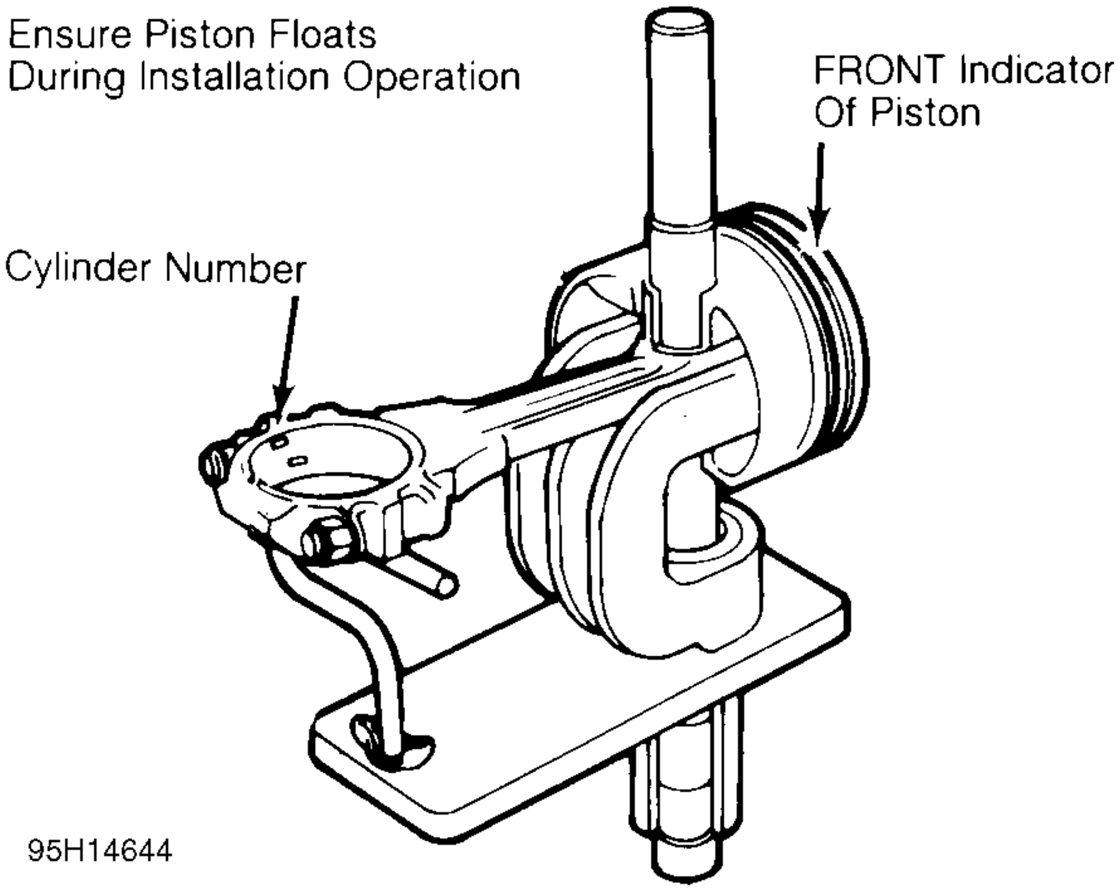

Fig. 14: Installing Typical Piston Pin

CHECKING PISTON RING CLEARANCES

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Piston rings must be checked for side clearance and end gap. To check end gap, install piston ring in cylinder in which it is to be installed. Using an inverted piston, push ring to bottom of cylinder in smallest cylinder diameter.

Using feeler gauge, check ring end gap. See Fig. 15. Piston ring end gap must be within specification. Ring breakage will occur if insufficient ring end gap exists.

Some manufacturers permit correcting insufficient ring end gap by using a fine file while other manufacturers recommend using another ring set. Mark rings for proper cylinder installation after checking end gap.

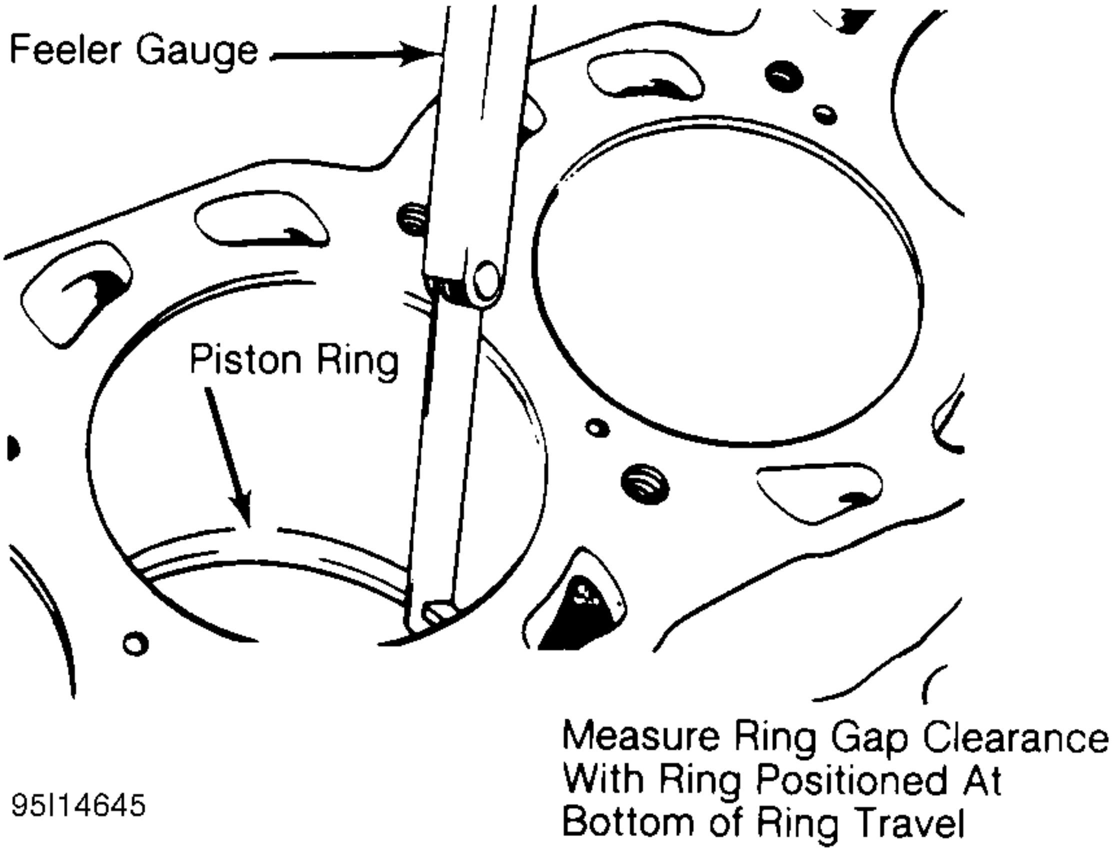
Feeler Gauge
Piston Ring
Measure Ring Gap Clearance With Ring Positioned At Bottom of Ring Travel
95I14645

Fig. 15: Checking Piston Ring End Gap

For checking side clearance, install rings on piston. Using feeler gauge, measure clearance between piston ring and piston ring land. Check side clearance in several areas around piston. Side clearance must be within specification.

If side clearance is excessive, piston ring grooves can be machined to accept oversize piston rings (if available). Normal practice is to replace piston.

PISTON & CONNECTING ROD INSTALLATION

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Cylinders must be honed prior to piston installation. See CYLINDER HONING under CYLINDER BLOCK.

Install upper connecting rod bearings. Lubricate upper bearings with engine oil. Install lower bearings in rod caps. Ensure bearing tabs are properly seated. Position piston ring gaps according to manufacturer's recommendations. See **Fig. 16**. Lubricate pistons, rings and cylinder walls.

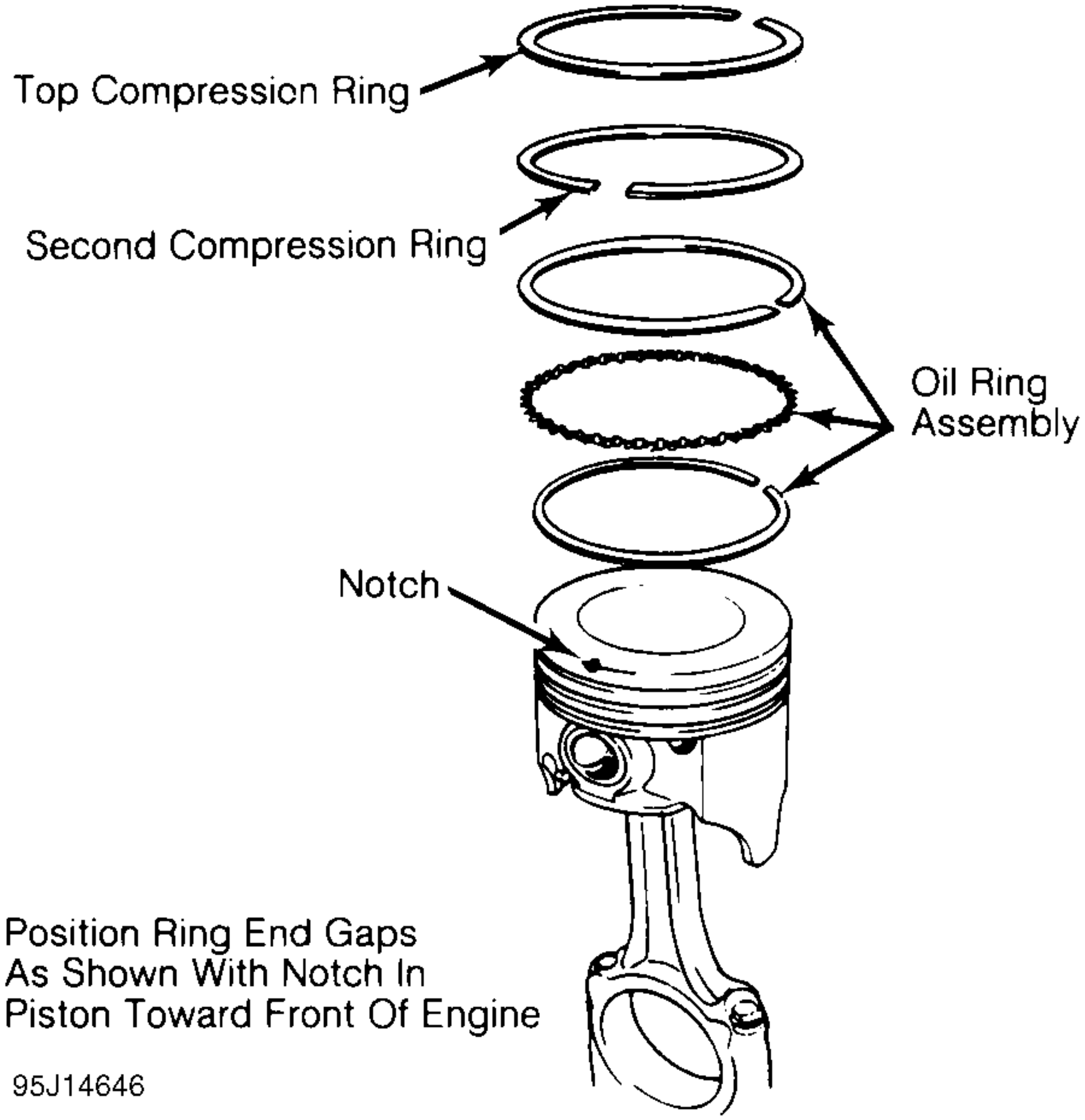
Top Compression Ring
Second Compression Ring
Oil Ring Assembly
Notch
Position Ring End Gaps As Shown With Notch In Piston Toward Front Of Engine
95J14646

Fig. 16: Positioning Typical Piston Ring End Gap

Install ring compressor. Use care not to rotate piston rings. Compress rings with ring compressor. Install plastic tubing protectors over connecting rod bolts. Install piston and connecting rod assembly. Ensure piston notch, arrow or FRONT mark is toward front of engine. See **Fig. 17**.

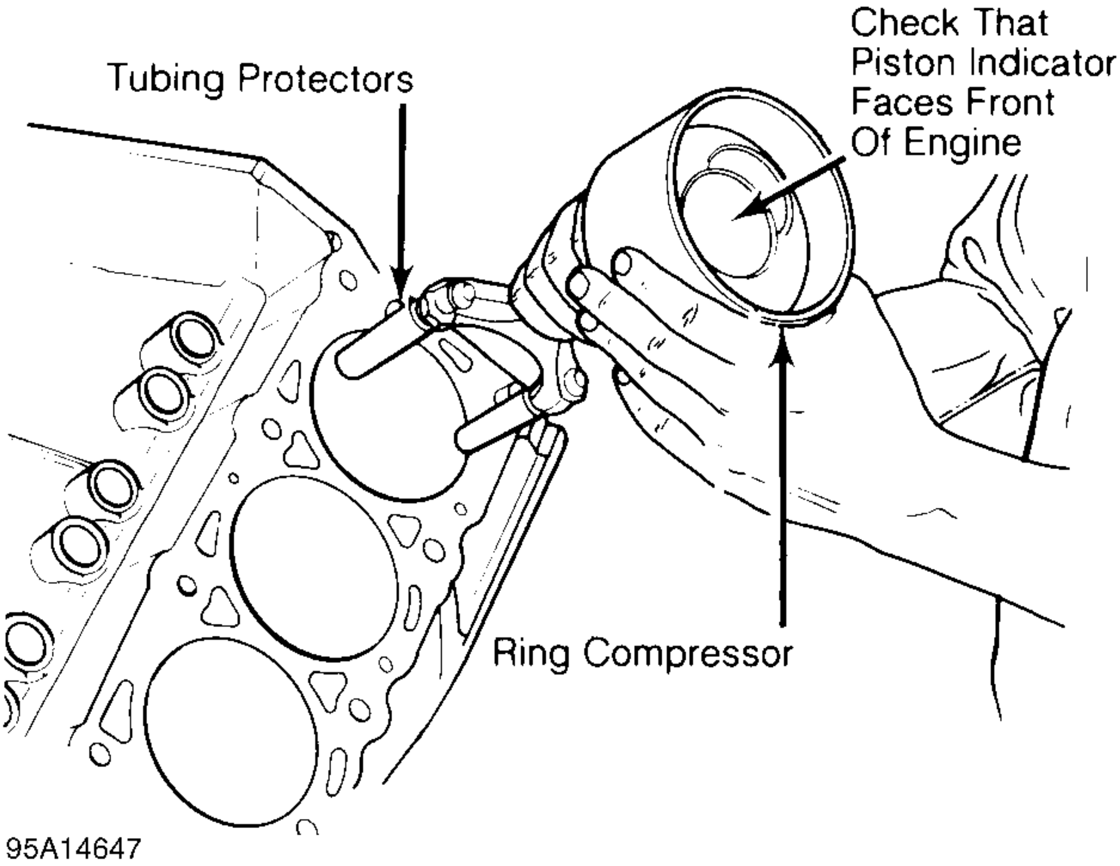

Fig. 17: Installing Piston & Connecting Rod Assembly

Carefully tap piston into cylinder until rod bearing is seated on crankshaft journal. Remove protectors. Install rod cap and bearing. Lightly tighten connecting rod bolts. Repeat procedure for remaining cylinders. Check bearing clearance. See MAIN & CONNECTING ROD BEARING CLEARANCE.

Once clearance is checked, lubricate journals and bearings. Install bearing caps. Ensure marks are aligned on connecting rod and cap. Tighten rod nuts or bolts to specification. Ensure rod moves freely on crankshaft. Check connecting rod side clearance. See CONNECTING ROD SIDE CLEARANCE.

CONNECTING ROD SIDE CLEARANCE

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Position connecting rod toward one side of crankshaft as far as possible. Using feeler gauge, measure clearance between side of connecting rod and crankshaft. See Fig. 18. Clearance must be within specification.

Check for improper bearing installation, wrong bearing cap or insufficient bearing clearance if side clearance is insufficient. Connecting rod may require machining to obtain proper clearance. Excessive clearance usually indicates excessive wear at crankshaft. Crankshaft must be repaired or replaced.

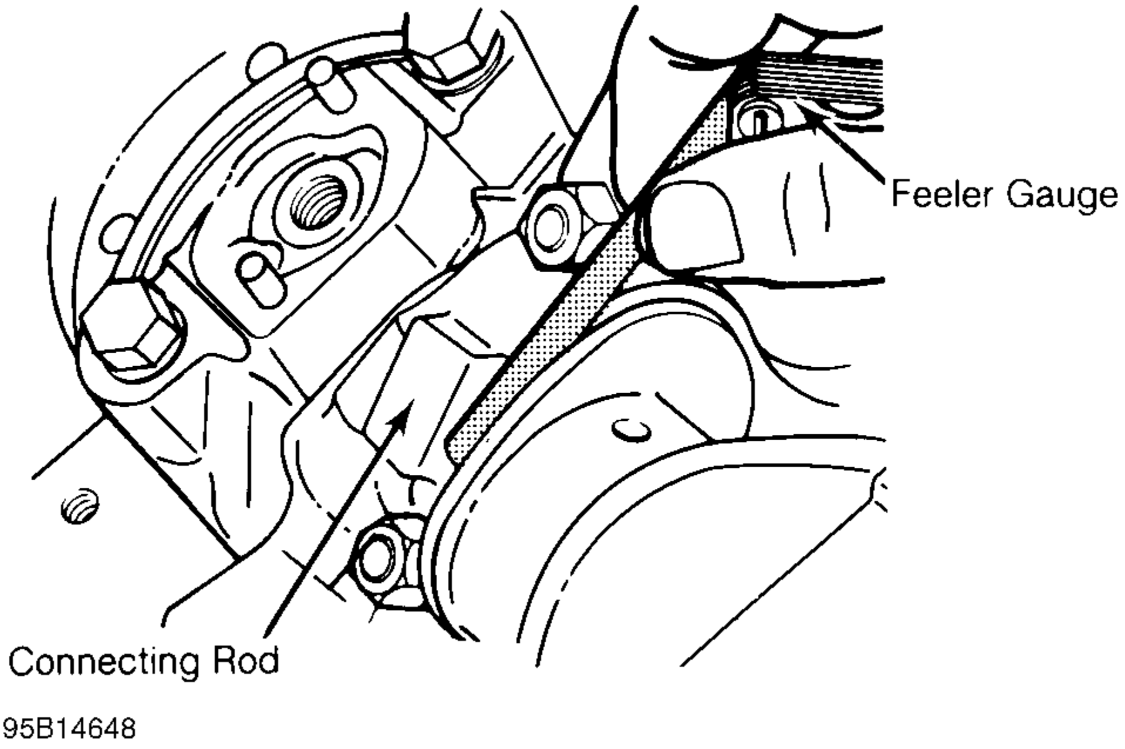

Fig. 18: Measuring Connecting Rod Side Clearance

MAIN & CONNECTING ROD BEARING CLEARANCE

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Plastigage Method

Plastigage method may be used to determine bearing clearance. Plastigage can be used with an engine in service or during reassembly. Plastigage material is oil soluble.

Ensure journals and bearings are free of oil or solvent. Oil or solvent will dissolve material and false reading will be obtained. Install small piece of Plastigage along full length of bearing journal. Install bearing cap in original location. Tighten bolts to specification.

CAUTION: **DO NOT rotate crankshaft while Plastigage is installed. Bearing clearance will not be obtained if crankshaft is rotated.**

Remove bearing cap. Compare Plastigage width with scale on Plastigage container to determine bearing clearance. See Fig. 19. Rotate crankshaft 90 degrees. Repeat procedure. This is done to check journal eccentricity. This procedure can be used to check oil clearance on both connecting rod and main bearings.

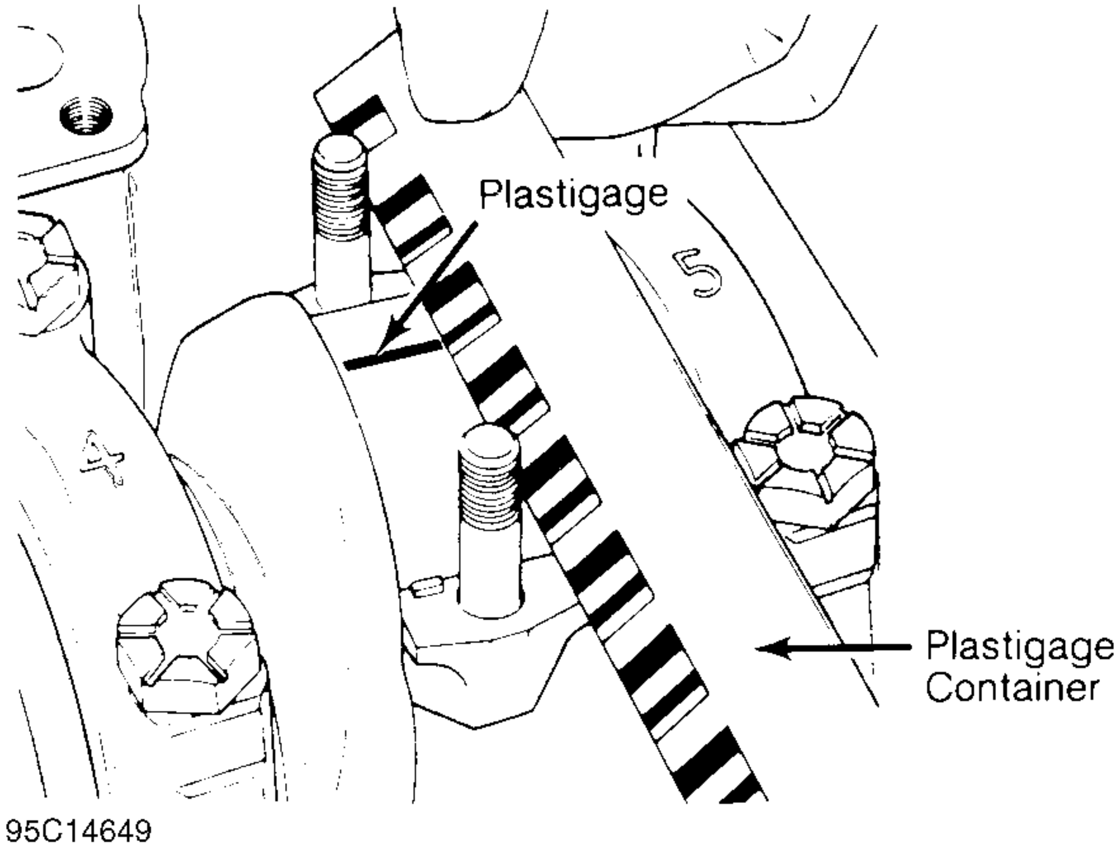

Fig. 19: Measuring Bearing Clearance

Micrometer & Telescopic Gauge Method

A micrometer is used to determine journal diameter, taper and out-of-round dimensions of the crankshaft. See **CLEANING & INSPECTION** under CRANKSHAFT & MAIN BEARINGS in this article.

With crankshaft removed, install bearings and caps in original location on cylinder block. Tighten bolts to specification. On connecting rods, install bearings and caps on connecting rods. Install proper connecting rod cap on corresponding rod. Ensure bearing cap is installed in original location. Tighten bolts to specification.

Using a telescopic gauge and micrometer or inside micrometer, measure inside diameter of connecting rod and main bearings bores. Subtract each crankshaft journal diameter from the corresponding inside bearing bore diameter. This is the bearing clearance.

CRANKSHAFT & MAIN BEARINGS

* PLEASE READ THIS FIRST *

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REMOVAL

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Ensure all main bearing caps are marked for location on cylinder block. Some main bearing caps have an arrow stamped on them. The arrow must face timing belt or timing chain end of engine. Remove main bearing cap bolts. Remove main bearing caps. Carefully remove crankshaft. Use care not to bind crankshaft in cylinder block during removal.

CLEANING & INSPECTION

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Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Thoroughly clean crankshaft using solvent. Dry with compressed air. Ensure all oil passages are clear and free of sludge, rust, dirt and metal chips.

Inspect crankshaft for scoring and nicks. Inspect crankshaft for cracks using Magnaflux procedure. Inspect rear seal area for grooving or damage. Inspect bolt hole threads for damage. If pilot bearing or bushing is used, check pilot bearing or bushing fit in crankshaft. Inspect crankshaft gear for damaged or cracked teeth. Replace gear if damaged. Ensure oil passage plugs are tight (if equipped).

Using micrometer, measure all journals in 4 areas to determine journal taper, out-of-round and undersize. See **Fig. 20**. Some crankshafts can be reground to the next largest undersize, depending on the amount of wear or damage. Crankshafts with rolled fillet cannot be reground and must be replaced.

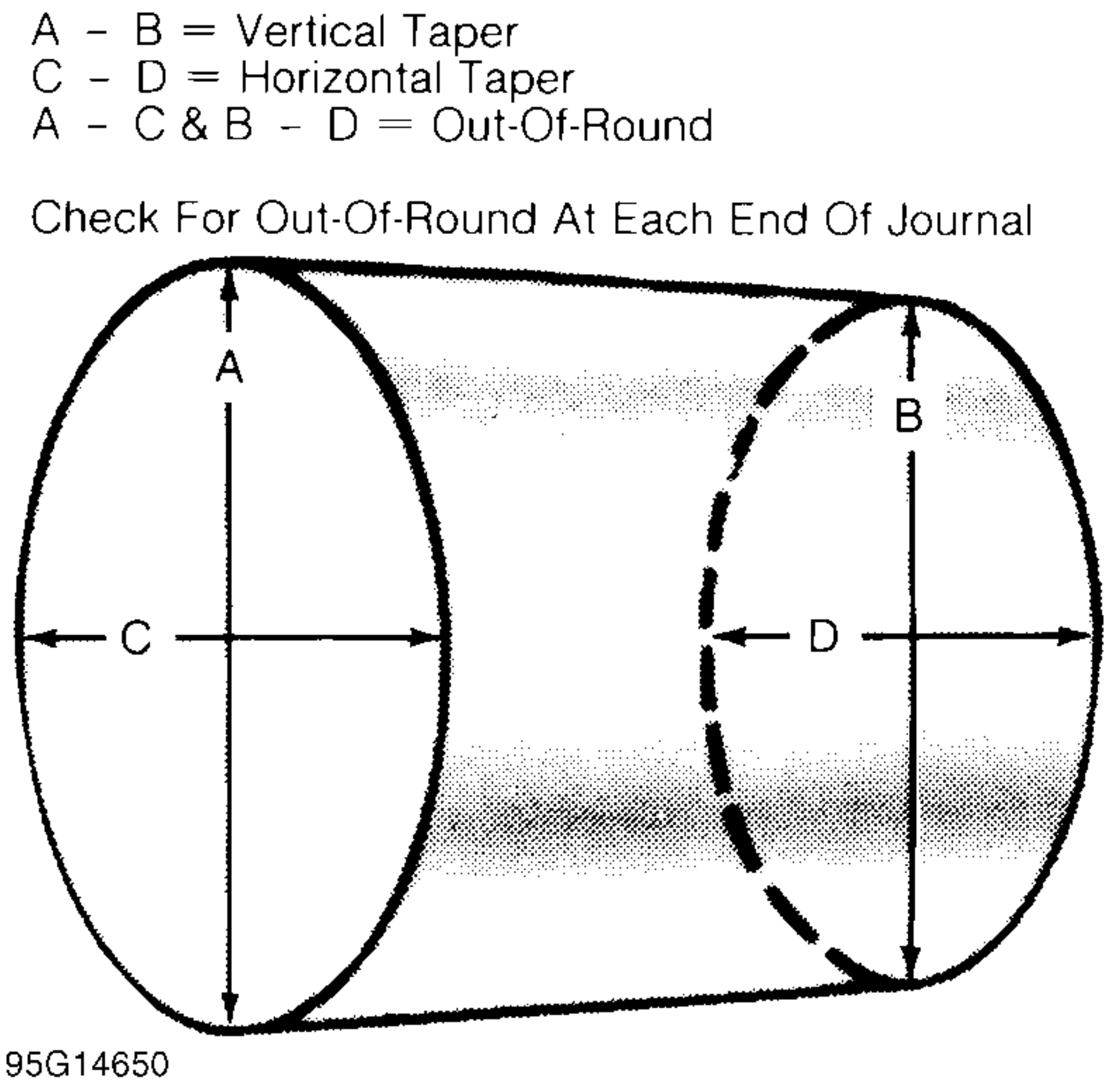
A - B = Vertical Taper
C - D = Horizontal Taper
A - C & B - D = Out-Of-Round
Check For Out-Of-Round At Each End Of Journal
A
B
C
D
95G14650

Fig. 20: Measuring Crankshaft Journals

Crankshaft journal runout should be checked. Install crankshaft in "V" blocks or bench center. Position dial indicator with tip resting on the main bearing journal area. See **Fig. 21**. Rotate crankshaft and note reading. Journal runout must not exceed specification. Repeat procedure on all main bearing journals. Crankshaft must be replaced if runout exceeds specification.

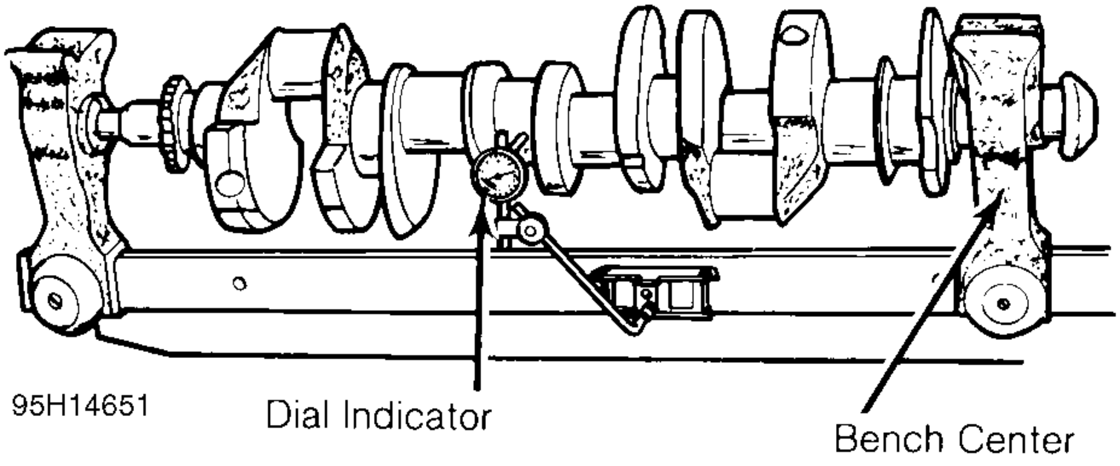
95H14651
Dial Indicator
Bench Center

Fig. 21: Measuring Crankshaft Main Bearing Journal Runout

INSTALLATION

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Install upper main bearing in cylinder block. Ensure lock tab is properly located in cylinder block. Install bearings in main bearing caps. Ensure all oil passages are aligned. Install rear seal (if removed).

Ensure crankshaft journals are clean. Lubricate upper main bearings with clean engine oil. Carefully install crankshaft. Check each main bearing clearance using Plastigage method. See **MAIN & CONNECTING ROD BEARING CLEARANCE**.

Once clearance is checked, lubricate lower main bearing and journals. Install main bearing caps in original location. Install rear seal in rear main bearing cap (if removed). Some rear main bearing caps require sealant to be applied in corners to prevent oil leakage.

Install and tighten all bolts except thrust bearing cap to specification. Tighten thrust bearing cap bolts finger tight only. Some models require that thrust bearing be aligned. On most applications, crankshaft must be moved rearward then forward. Procedure may vary with manufacturer. Thrust bearing cap is then tightened to specification. Ensure crankshaft rotates freely. Crankshaft end play should be checked. See **CRANKSHAFT END PLAY**.

CRANKSHAFT END PLAY

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Dial Indicator Method

Crankshaft end play can be checked using dial indicator. Mount dial indicator on rear of cylinder block. Position dial indicator tip against rear of crankshaft. Ensure tip is resting against flat surface.

Pry crankshaft rearward. Adjust dial indicator to zero. Pry crankshaft forward and note reading. Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

Feeler Gauge Method

Crankshaft end play can be checked using feeler gauge. Pry crankshaft rearward. Pry crankshaft forward. Using feeler gauge, measure clearance between crankshaft and thrust bearing surface. See **Fig. 22**.

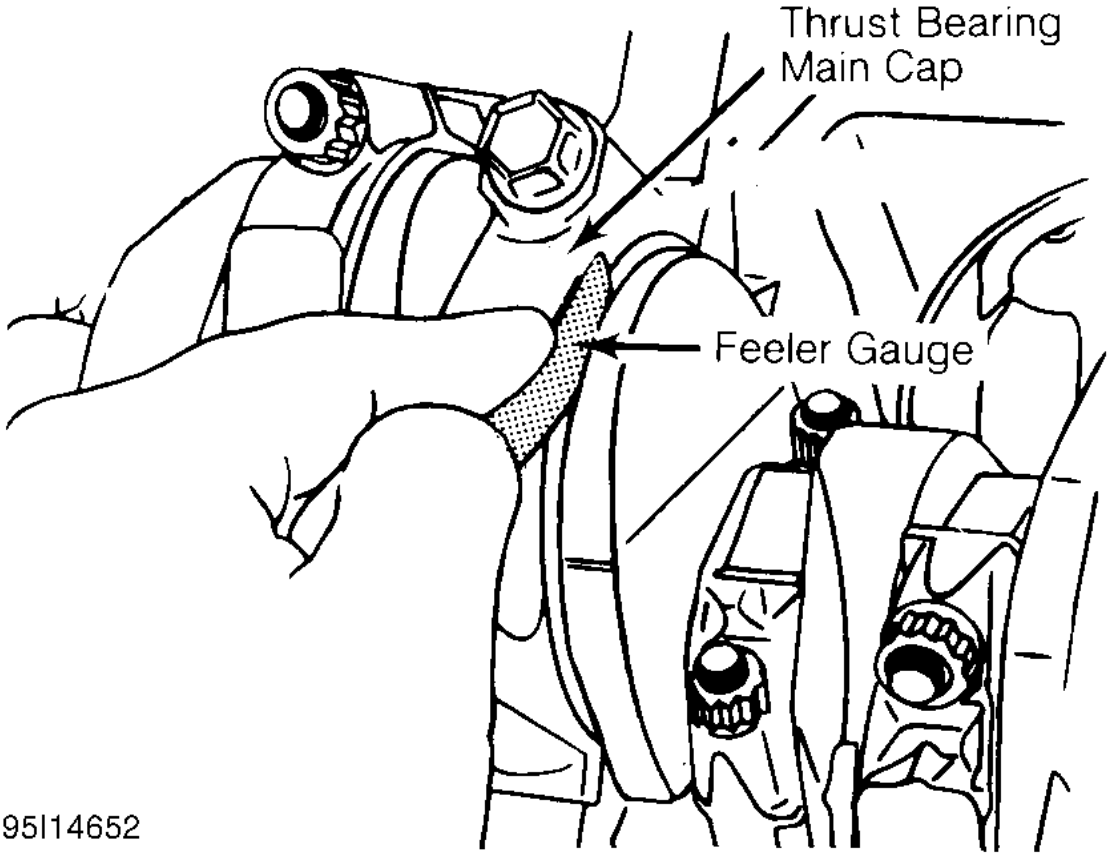

Fig. 22: Checking Crankshaft End Play

Crankshaft end play must be within specification. If end play is not within specification, check for faulty thrust bearing installation or worn crankshaft. Some applications offer oversize thrust bearings.

CYLINDER BLOCK

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Block Cleaning

Only cast cylinder blocks should be hot tank cleaned. Aluminum cylinder blocks should be cleaned using cold tank method. Cylinder block is cleaned in order to remove carbon deposits, gasket residue and water jacket scale. Remove oil gallery plugs, freeze plugs and cam bearings before cleaning block.

Block Inspection

Visually inspect the block. Check suspected areas for cracks using the Dye Penetrant inspection method. Block may be checked for cracks using the Magnaflux method.

Cracks are most commonly found at the bottom of cylinders, main bearing saddles, near expansion plugs and between cylinders and water jackets. Inspect lifter bores for damage. Inspect all head bolt holes for damaged threads. Threads should be cleaned using tap to ensure proper head bolt torque. Consult machine shop concerning possible welding and machining (if required).

Cylinder Bore Inspection

Inspect bore for scoring or roughness. Cylinder bore is dimensionally checked for out-of-round and taper using dial bore gauge. For determining out-of-round, measure cylinder parallel and perpendicular to the block center line. Difference in the 2 readings is the bore out-of-round. Cylinder bore must be checked at top, middle and bottom of piston travel area.

Bore taper is obtained by measuring bore at the top and bottom. If wear has exceeded allowable limits, block must be honed or bored to next available oversize piston dimension.

Cylinder Honing

Cylinder must be properly honed to allow new piston rings to properly seat. Cross-hatching at correct angle and depth is critical to lubrication of cylinder walls and pistons.

A flexible drive hone and power drill are commonly used. Drive hone must be lubricated during operation. Mix equal parts of kerosene and SAE 20W engine oil for lubrication.

Apply lubrication to cylinder wall. Operate cylinder hone from top to bottom of cylinder using even strokes to produce 45 degree cross-hatch pattern on the cylinder wall. DO NOT allow cylinder hone to extend below cylinder during operation.

Recheck bore dimension after final honing. Wash cylinder wall with hot soapy water to remove abrasive particles. Blow dry with compressed air. Coat cleaned cylinder walls with lubricating oil.

Deck Warpage

Check deck for damage or warped gasket surface. Place a straightedge across gasket surface of the deck. Using feeler gauge, measure clearance at center of straightedge. Measure across width and length of cylinder block at several points.

If warpage exceeds specifications, deck must be resurfaced. If warpage exceeds manufacturer's maximum tolerance for material removal, replace block.

NOTE: **Some manufacturers recommend that a total amount of material (cylinder head and cylinder block) can only be removed before components must be replaced.**

Deck Height

Distance from crankshaft center line to block deck is called the deck height. Measure and record front and rear main journals of crankshaft. To compute this distance, install crankshaft and retain with center main bearing and cap only. Measure distance from crankshaft journal to block deck, parallel to cylinder center line.

Add one half of main bearing journal diameter to distance from crankshaft journal to block deck. This dimension should be checked at front and rear of cylinder block. Both readings should be the same.

If difference exceeds specification, cylinder block must be repaired or replaced. Deck height and warpage should be corrected at the same time.

Main Bearing Bore & Alignment

For checking main bearing bore, remove all bearings from cylinder block and main bearing caps. Install main bearing caps in original location. Tighten bolts to specification. Using inside micrometer, measure main bearing bore in 2 areas 90 degrees apart. Determine bore size and out-of-round. If diameter is not within specification, block must be align-bored.

For checking alignment, place a straightedge along center line of main bearing saddles. Check for clearance between straightedge and main bearing saddles. Block must be align-bored if clearance exists.

Expansion Plug Removal

Drill hole in center of expansion plug. Remove with screwdriver or punch. Use care not to damage sealing surface.

Expansion Plug Installation

Ensure sealing surface is free of burrs. Coat expansion plug with sealer. Using wooden dowel or pipe of slightly smaller diameter, install expansion plug. Ensure expansion plug is evenly located.

Oil Gallery Plug Removal

Remove threaded oil gallery plugs using appropriate wrench. Soft press-in plugs are removed by drilling into plug and installing a sheet metal screw. Remove plug with slide hammer or pliers.

Oil Gallery Plug Installation

Ensure threads or sealing surface is clean. Coat threaded oil gallery plugs with sealer and install. Replacement soft press-in plugs are installed with a hammer and drift.

CAMSHAFT

* PLEASE READ THIS FIRST *

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CLEANING & INSPECTION

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Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Clean camshaft with solvent. Ensure all oil passages are clear. Inspect cam lobes and bearing journals for pitting, flaking or scoring. Using micrometer, measure bearing journal O.D.

Support camshaft at each end with "V" blocks. Position dial indicator with tip resting on center bearing journal. Rotate camshaft and note camshaft runout reading. If reading exceeds specification, replace camshaft.

Check cam lobe lift by measuring base circle of camshaft using micrometer. Measure again at 90-degree angle to tip of cam lobe. Cam lift can be determined by subtracting base circle diameter from tip of cam lobe measurement.

Different lift dimensions are given for intake and exhaust cam lobes. Reading must be within specification. Replace camshaft if cam lobes or bearing journals are not within specification.

Inspect camshaft gear for chipped, eroded or damaged teeth. Replace gear if damaged. On camshafts using thrust plate, measure distance between thrust plate and camshaft shoulder. Replace thrust plate if not within specification.

CAMSHAFT BEARINGS

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Removal & Installation

Remove camshaft rear plug. Camshaft bearing remover is assembled with shoulder resting against bearing to be removed according to manufacturer's instructions. Tighten puller nut until bearing is removed. Remove remaining bearings, leaving front and rear bearings until last. These bearings act as a guide for camshaft bearing remover.

To install new bearings, puller is rearranged to pull bearings toward the center of block. Ensure all lubrication passages of bearing are aligned with cylinder block. Coat new camshaft rear plug with sealant. Install camshaft rear plug. Ensure plug is even in cylinder block.

CAMSHAFT INSTALLATION

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Lubricate bearing surfaces and cam lobes with ample amount of Molykote or camshaft lubricant. Carefully install camshaft. Use care not to damage bearing journals during installation. Install thrust plate retaining bolts (if equipped). Tighten bolts to specification. On overhead camshafts, install bearing caps in original location. Tighten bolts to specification. On all applications, check camshaft end play.

CAMSHAFT END PLAY

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Using dial indicator, check camshaft end play. Position dial indicator on front of engine block or cylinder head. Position indicator tip against camshaft. Push camshaft toward rear of cylinder head or engine and adjust indicator to zero.

Move camshaft forward and note reading. Camshaft end play must be within specification. End play may be adjusted by relocating gear, shimming thrust plate or replacing thrust plate depending on each manufacturer.

TIMING CHAINS & BELTS

* PLEASE READ THIS FIRST *

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TIMING CHAINS

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Timing chains will stretch during operation. Limits are placed upon amount of stretch before replacement is required. Timing chain stretch will alter ignition timing and valve timing.

To check timing chain stretch, rotate crankshaft to eliminate slack from one side of timing chain. Mark reference point on cylinder block. Rotate crankshaft in opposite direction to eliminate slack from remaining side of timing chain. Force other side of chain outward and measure distance between reference point and timing chain. See Fig. 23. Replace timing chain and gears if not within specification.

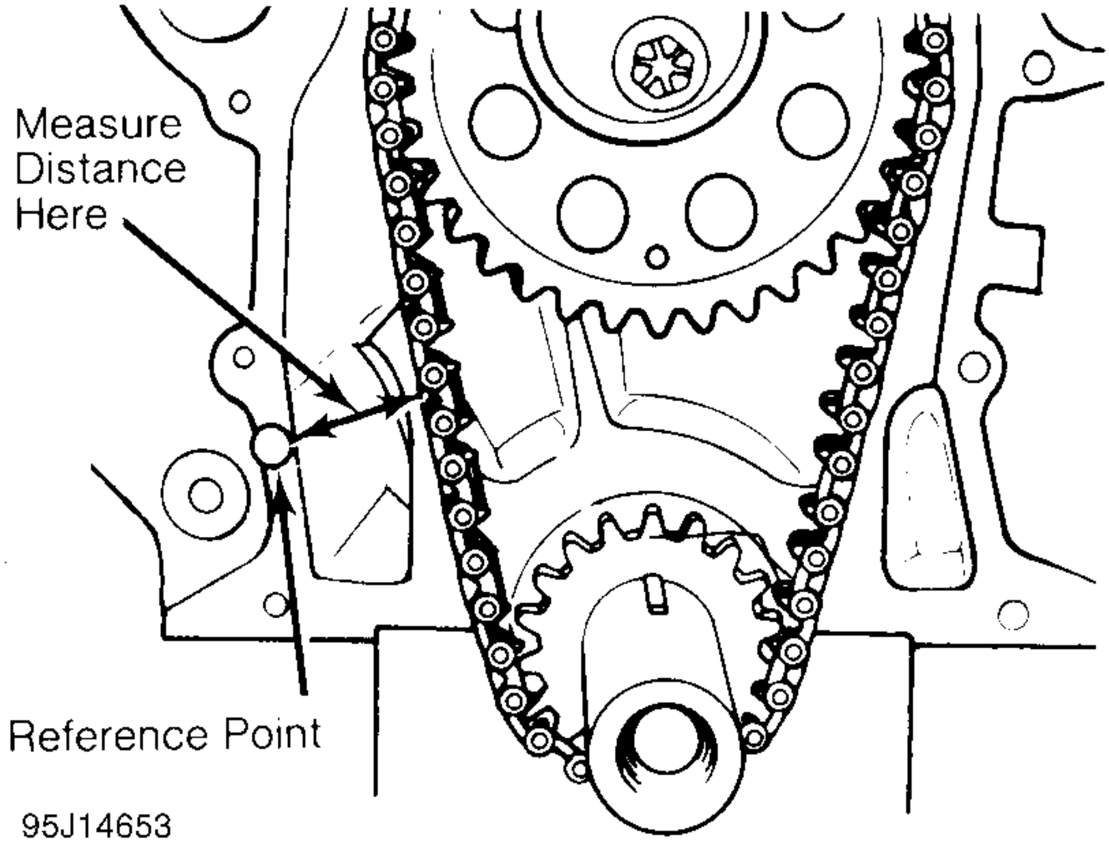

Fig. 23: Measuring Timing Chain Stretch

Timing chains must be installed so timing marks on camshaft gear and crankshaft gear are aligned according to manufacturer. See Fig. 24.

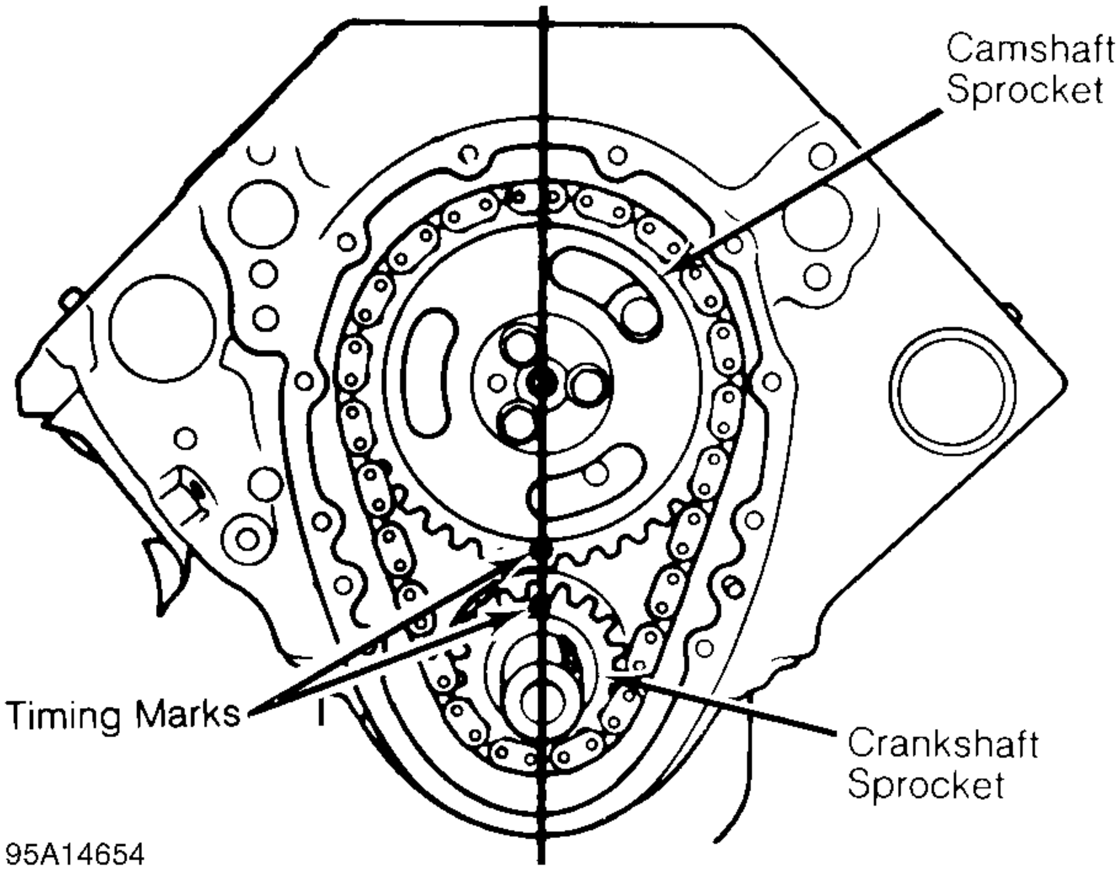

Fig. 24: Typical Gear Timing Mark Alignment

TIMING BELTS

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Cogged tooth belts are commonly used on overhead cam engines. Inspect belt teeth for rounded corners or cracking. Replace belt if it is cracked, damaged, missing teeth or oil soaked.

Used timing belt must be installed in original direction of rotation. Inspect all sprocket teeth for wear. Replace all worn sprockets. Sprockets are marked for timing purposes. Engine is positioned so that crankshaft sprocket mark will be upward. Camshaft sprocket is aligned with reference mark on cylinder head or timing belt cover and then timing belt can be installed. See Fig. 25.

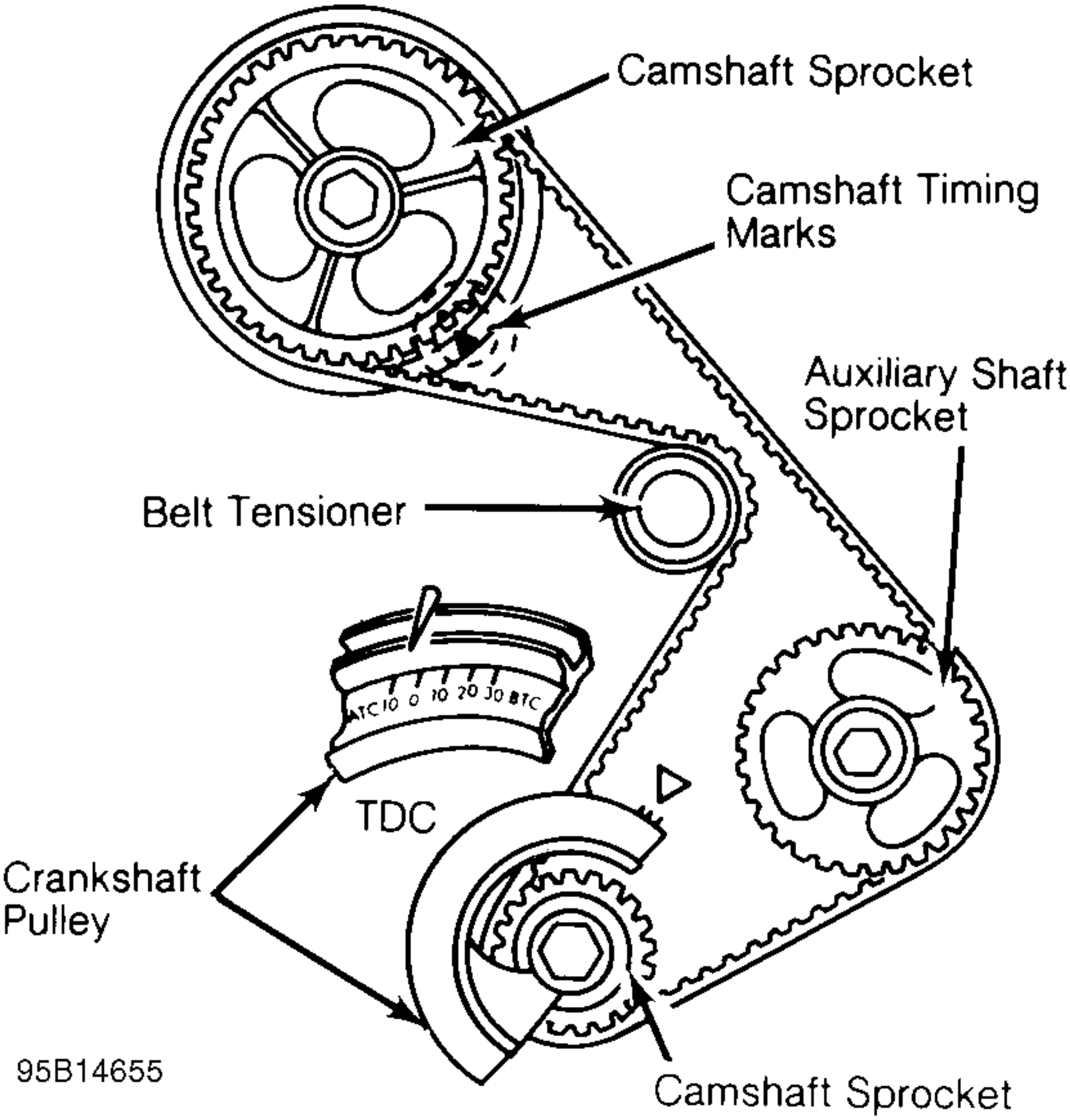
Camshaft Sprocket
Camshaft Timing Marks
Auxiliary Shaft Sprocket
Belt Tensioner
ATC 10 0 10 20 30 BTC
TDC
Crankshaft Pulley
95B14655
Camshaft Sprocket

Fig. 25: Typical Camshaft Belt Sprocket Alignment

TENSION ADJUSTMENT

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If guide rails are used with spring loaded tensioners, ensure at least half of original rail thickness remains. Spring loaded tensioner should be inspected for damage.

Ensure all timing marks are aligned. Adjust belt tension using manufacturer's recommendations. Belt tension may require checking using tension gauge. See Fig. 26.

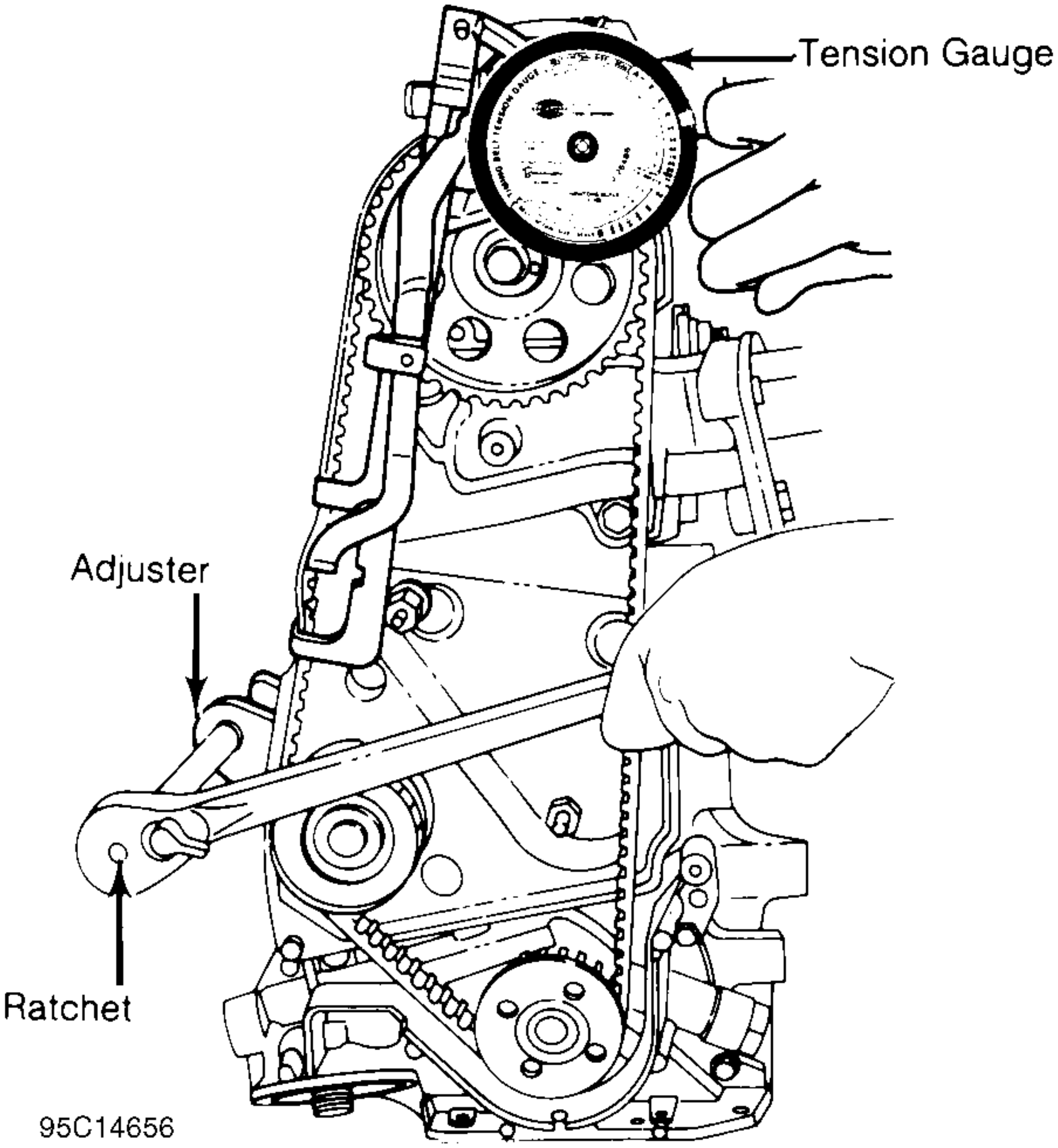

Fig. 26: Adjusting Typical Timing Belt Tension

TIMING GEARS

* PLEASE READ THIS FIRST *

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TIMING GEAR BACKLASH & RUNOUT

NOTE: Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process.

Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

On engines where camshaft gear operates directly on crankshaft gear, gear backlash and runout must be checked. To check backlash, install dial indicator with tip resting on tooth of camshaft gear. Rotate camshaft gear as far as possible. Adjust indicator to zero. Rotate camshaft gear in opposite direction as far as possible and note reading.

To determine timing gear runout, mount dial indicator with tip resting on face edge of camshaft gear. Adjust indicator to zero. Rotate camshaft gear 360 degrees and note reading. If backlash or runout exceeds specification, replace camshaft and/or crankshaft gear.

REAR MAIN OIL SEAL INSTALLATION

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

One-Piece Type Seal

For one-piece type oil seal installation, coat block contact surface of seal with sealer if seal is not factory coated. Ensure seal surface is free of burrs. Lubricate seal lip with engine oil and press seal into place using proper oil seal installer. See Fig. 27.

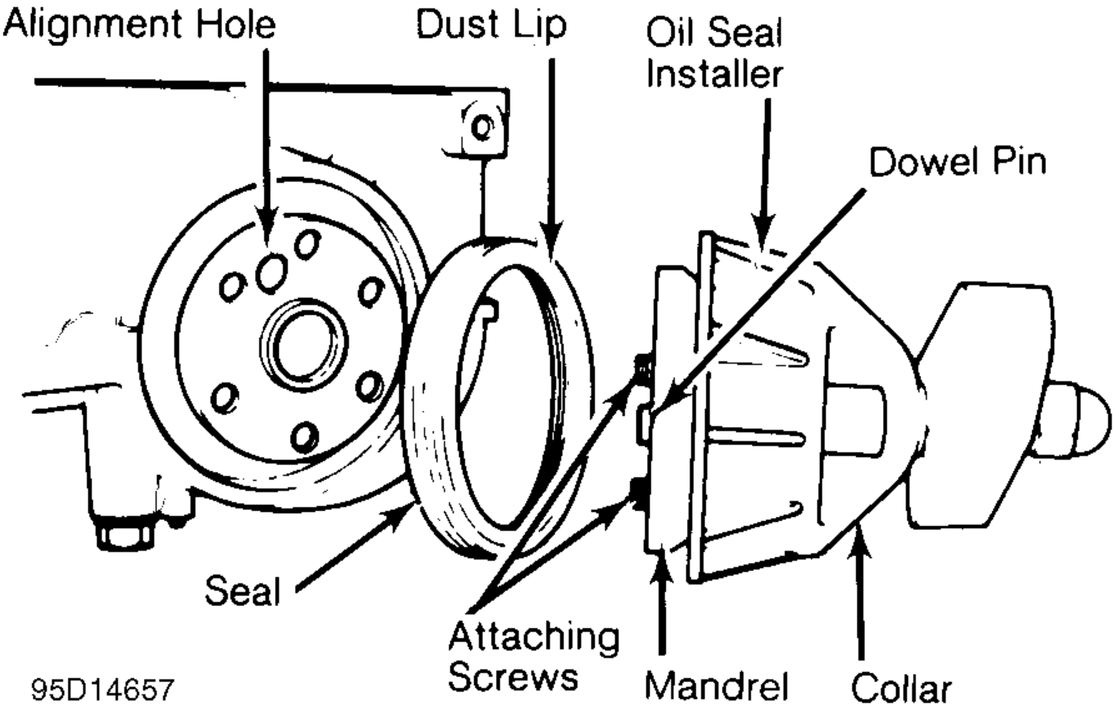

Fig. 27: Installing Typical One-Piece Oil Seal

Rope Type Seal

For rope type rear main oil seal installation, press seal lightly into seat area. Using seal installer, fully seat seal in bearing cap or cylinder block.

Trim seal ends even with cylinder block parting surface. Some applications require sealer to be applied on main bearing cap before installing. See **Fig. 28**.

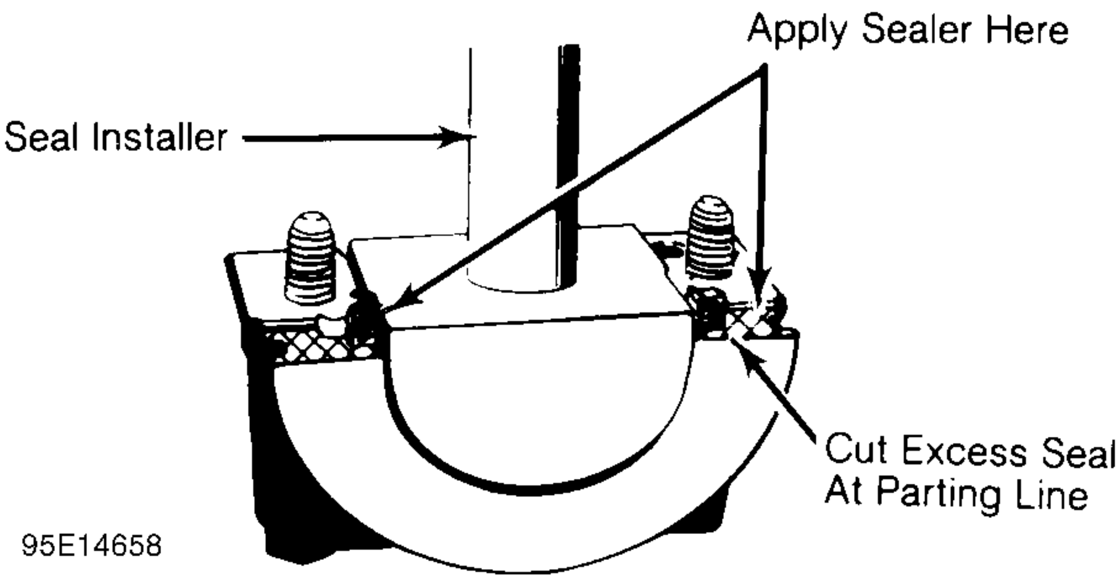
Apply Sealer Here
Seal Installer
Cut Excess Seal At Parting Line
95E14658

Fig. 28: Installing Typical Rope Seal

Split-Rubber Type Seal

Follow manufacturer's procedures when installing split-rubber type rear main oil seals. Installation procedures vary with manufacturer and engine type. See **Fig. 29**.

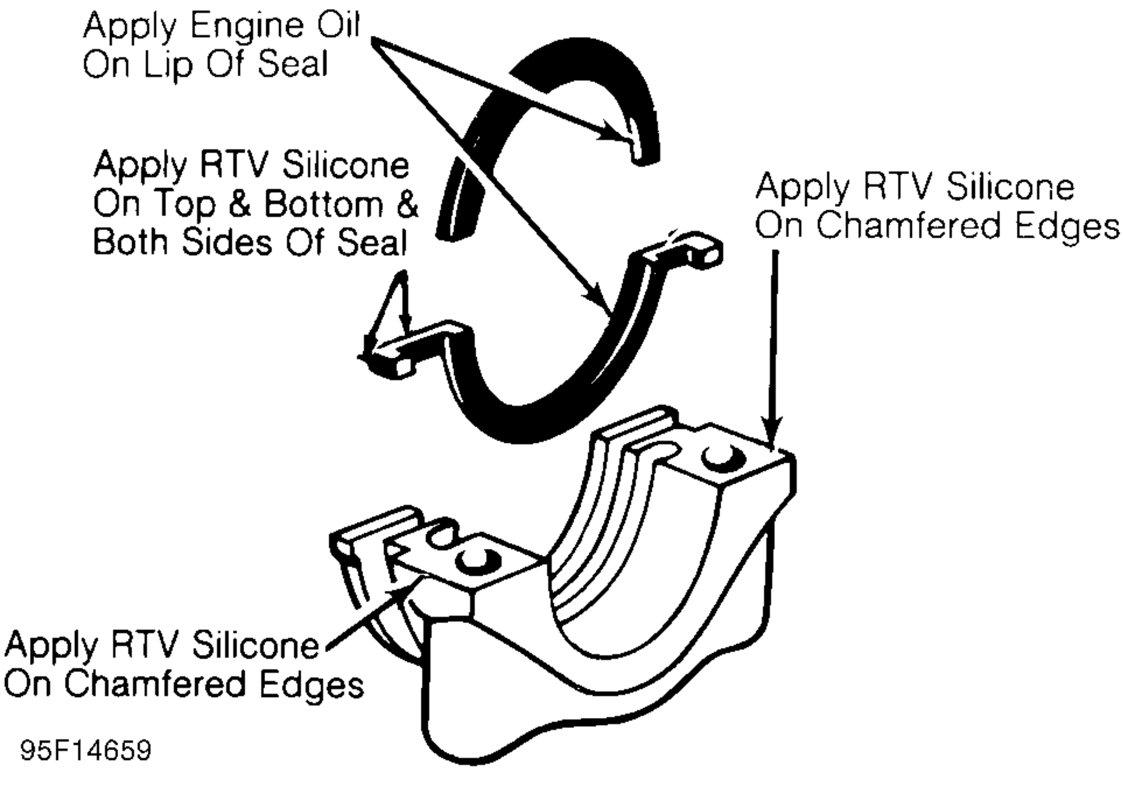
Apply Engine Oil On Lip Of Seal
Apply RTV Silicone On Top & Bottom & Both Sides Of Seal
Apply RTV Silicone On Chamfered Edges
Apply RTV Silicone On Chamfered Edges
95F14659

Fig. 29: Installing Typical Split-Rubber Seal

OIL PUMP

* PLEASE READ THIS FIRST *

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ROTOR TYPE

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Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark oil pump rotor locations before removing. See Fig. 30. Remove outer rotor and measure thickness and diameter. Measure inner rotor thickness. Inspect shaft for scoring or wear. Inspect rotors for pitting or damage. Inspect cover for grooving or wear. Replace worn or damaged components.

Measure outer rotor-to-body clearance. Replace pump assembly if clearance exceeds specification. Measure clearance between rotors. See Fig. 31. Replace shaft and both rotors if clearance exceeds specification.

Install rotors in pump body. Position straightedge across pump body. Using feeler gauge, measure clearance between rotors and straightedge. Pump cover wear is measured using a straightedge and feeler gauge. Replace pump if clearance exceeds specification.

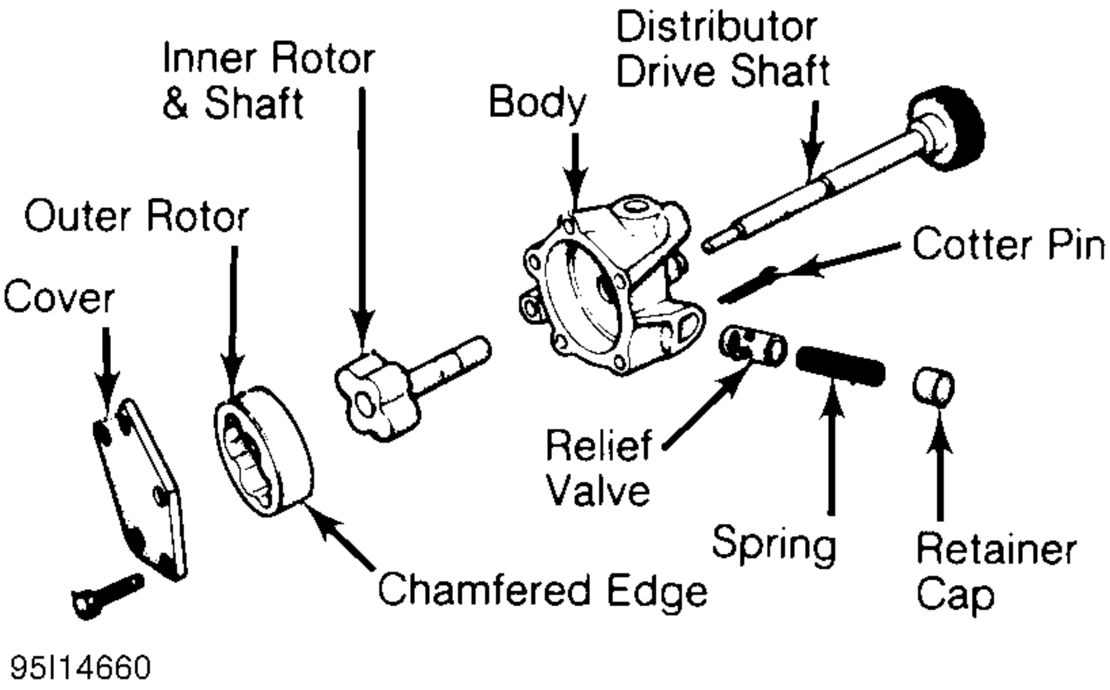

Fig. 30: Typical Rotor Type Oil Pump

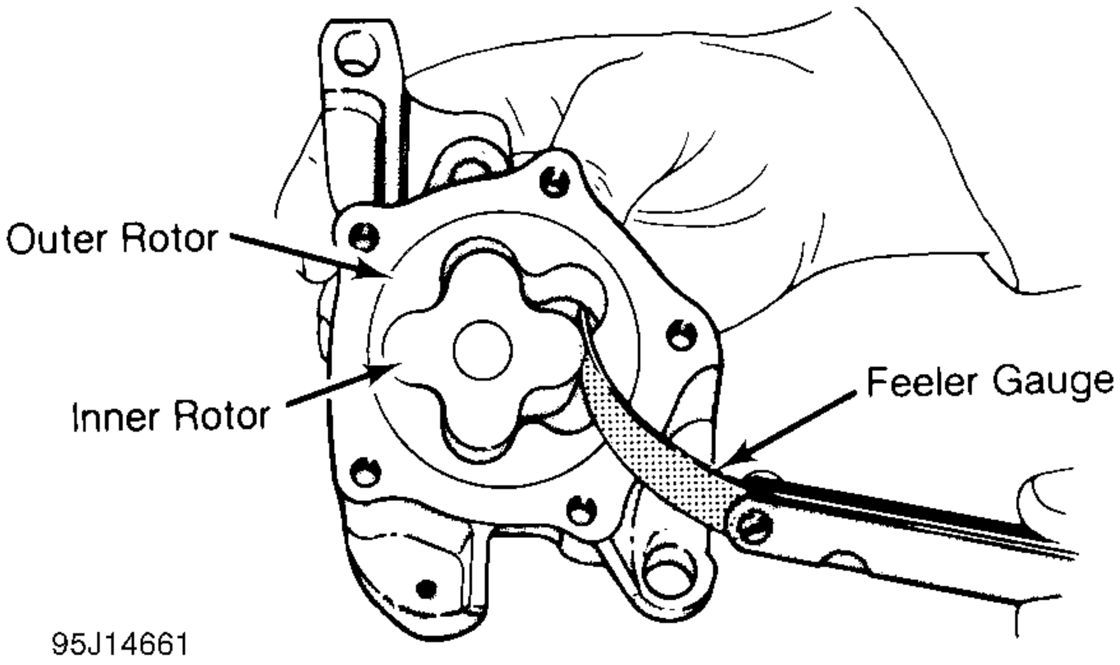

Fig. 31: Measuring Rotor Clearance

GEAR TYPE

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Mark oil pump gear location before removing. See Fig. 32. Remove gears from pump body. Inspect gears for pitting or damage. Inspect cover for grooving or wear. Measure gear diameter and length. Measure gear housing cavity depth and diameter. See Fig. 33. Replace worn or damaged components.

Pump cover wear is measured using a straightedge and feeler gauge. Replace pump or components if warpage or wear exceeds specification, or mating surface of pump cover is scratched or grooved.

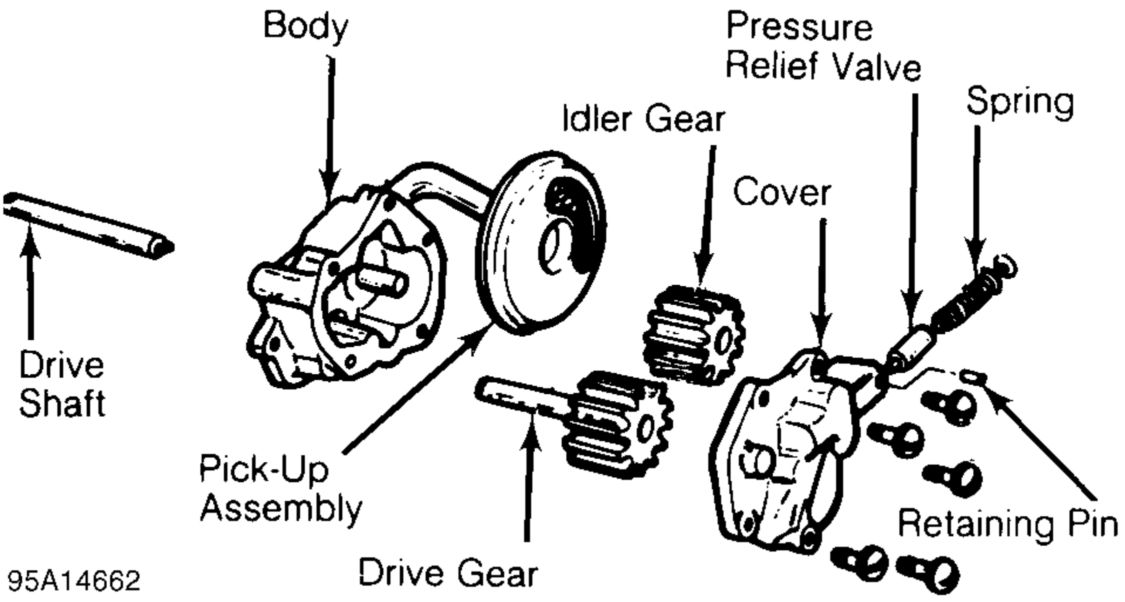
Body
Pressure
Relief Valve
Idler Gear
Spring
Cover
Drive
Shaft
Pick-Up
Assembly
Retaining Pin
Drive Gear
95A14662

Fig. 32: Typical Gear Type Oil Pump

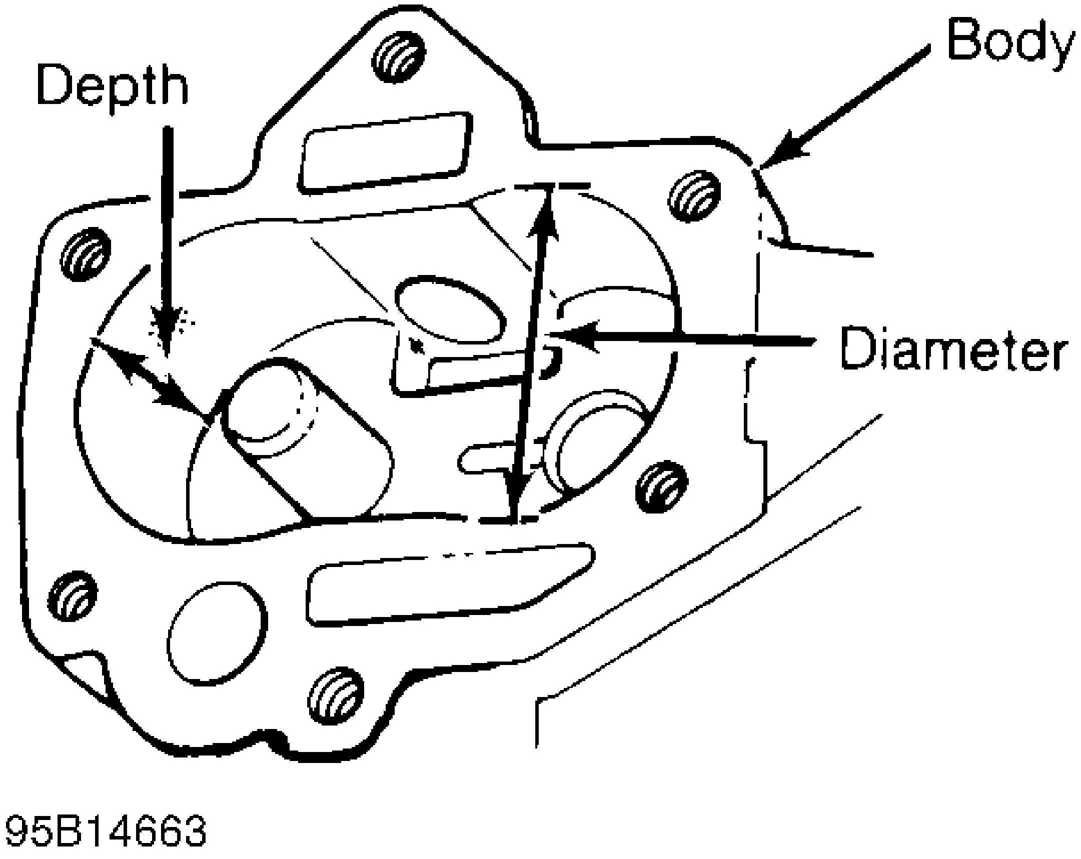
Depth
Body
Diameter
95B14663

Fig. 33: Measuring Oil Pump Gear Cavity

BREAK-IN PROCEDURE

*** PLEASE READ THIS FIRST ***

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

ENGINE PRE-OILING

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Pre-oil engine prior to operation to prevent engine damage. Lightly oiled oil pump will cavitate unless oil pump cavities are filled with engine oil or petroleum jelly.

Engine pre-oiling can be done using pressure oiler (if available). Connect pressure oiler to cylinder block oil passage such as oil pressure sending unit. Operate pressure oiler long enough to ensure correct amount of oil has filled crankcase. Check oil level while pre-oiling.

If pressure oiler is not available, disconnect ignition system. Remove oil pressure sending unit and replace with oil pressure test gauge. Using starter motor, rotate engine starter until gauge shows normal oil pressure for several seconds. DO NOT crank engine for more than 30 seconds to avoid starter motor damage. Ensure oil pressure has reached the most distant point from the oil pump.

NOTE: **If new lifters or camshaft are installed, some manufacturers require that a crankcase conditioner be added to engine oil. The engine should be operated for specified amount of time to aid in lifter break-in procedure.**

INITIAL START-UP

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Start engine and operate engine at low speed while checking for coolant, fuel and oil leaks. Stop engine. Recheck coolant and oil level. Adjust if necessary.

CAMSHAFT

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Break-in procedure is required when new or reground camshaft has been installed. Operate and maintain engine speed between 1500-2500 RPM for approximately 30 minutes. Procedure may vary due to manufacturer's recommendations.

PISTON RINGS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Piston rings require a break-in procedure to ensure seating of rings to cylinder walls. Serious damage may occur to rings if correct procedures are not followed.

Extremely high piston ring temperatures are obtained during break-in process. If rings are exposed to excessively high RPM or high cylinder pressures, ring damage can occur. Follow piston ring manufacturer's recommended break-in procedure.

FINAL ADJUSTMENTS

NOTE: **Examples used in this article are general in nature and do not necessarily relate to a specific engine or system. Illustrations and procedures have been chosen to guide mechanic through engine overhaul process. Descriptions of processes of cleaning, inspection, assembly and machine shop practice are included.**

Always refer to appropriate engine overhaul article, if available, in the ENGINES section for complete overhaul procedures and specifications for the vehicle being repaired.

Check or adjust ignition timing and dwell (if applicable). Adjust valves (if necessary). Adjust idle speed and mixture. Retighten cylinder heads (if required). If cylinder head or block is aluminum, retighten bolts when engine is cold. Follow the engine manufacturer's recommended break-in procedure and maintenance schedule for new engines.

NOTE: **Some manufacturers require that head bolts be retightened after specified amount of operation. This must be done to prevent head gasket failure.**

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GENERAL INFORMATION

Engine Performance Diagnostic Routine Outline

* PLEASE READ THIS FIRST *

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

WHERE DOES DRIVEABILITY DIAGNOSIS START?

PERFORM BASIC INSPECTION

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

1. Verify Customer Complaint
2. Check for Relevant Technical Service Bulletins (TSBs)
3. Perform Visual Inspection **(See Basic Diagnostic Procedures)**
4. Test Engine Sub-Systems **(See Basic Diagnostic Procedures)**
    - Mechanical Condition (Compression)
    - Ignition Output
    - Fuel Delivery
5. Check Air Induction System For Leaks
6. Check & Adjust Basic Engine Settings**(See On-Vehicle Adjustments)**
    - Ignition Timing
    - Idle Speed

CHECK FOR TROUBLE CODES

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

1. Check for Diagnostic Trouble Codes (DTCs).**(See Self-Diagnostics)**
2. Repair cause of DTCs.
3. Clear PCM memory and repeat self-test.

DIAGNOSE SYMPTOM

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

1. If no self-diagnostics available, or no trouble codes present, identify symptom.
2. See trouble shooting procedure to identify problem. **(See Trouble Shooting - No Codes)**

TEST SYSTEM

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

1. Perform required tests. **(See Systems & Component Testing)**
2. Verify complaint is repaired.

Back To Article

GENERAL INFORMATION

Engine Performance Safety Precautions

- Always refer to Emission Decal in engine compartment before servicing vehicle. If manual and decal differ, always use decal specifications.
- Do not allow or create a condition of misfire in more than one cylinder for an extended period of time. Damage to converter may occur due to loading converter with unburned air/fuel mixture.
- Always turn ignition off and disconnect negative battery cable BEFORE disconnecting or connecting computer or other electrical components.
- DO NOT drop or shock electrical components such as computer, airflow meter, etc.
- DO NOT use fuel system cleaning compounds that are not recommended by the manufacturer. Damage to gaskets, diaphragm materials and catalytic converter may result.
- Before performing a compression test or cranking engine using a remote starter switch, disconnect coil wire from distributor and secure it to a good engine ground, or disable ignition.
- Before disconnecting any fuel system component, ensure fuel system pressure is released.
- Use a shop towel to absorb any spilled fuel to prevent fire.
- DO NOT create sparks or have an open flame near battery.
- If any fuel system components such as hoses or clamps are replaced, ensure they are replaced with components designed for fuel system use.
- Always reassemble throttle body components with new gaskets, "O" rings and seals.
- If equipped with an inertia switch, DO NOT reset switch until fuel system has been inspected for leaks.
- Wear safety goggles when drilling or grinding.
- Wear proper clothing which protects against chemicals and other hazards.

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GENERAL INFORMATION

English-Metric Conversion Chart

METRIC CONVERSIONS

Metric conversions are making life more difficult for the mechanic. In addition to increasing the number of tools required, metric-dimensioned nuts and bolts are used alongside English components in many new vehicles. The mechanic has to decide which tool to use, slowing down the job. The tool problem can be solved by trial and error, but some metric conversions aren't so simple.

Converting temperature, lengths or volumes requires a calculator and conversion charts, or else a very nimble mind. Conversion charts are only part of the answer though, because they don't help you "think" metric, or "visualize" what you are converting. The following examples are intended to help you "see" metric sizes:

LENGTH

Meters are the standard unit of length in the metric system. The smaller units are 10ths (decimeter), 100ths (centimeter), and 1000ths (millimeter) of a meter. These common examples might help you to visualize the metric units:

- A meter is slightly longer than a yard (about 40 inches).
- An aspirin tablet is about one centimeter across (.4 inches).
- A millimeter is about the thickness of a dime.

VOLUME

The metric weight system is based on the gram, with the most common unit being the kilogram (1000 grams). Our comparable units are ounces and pounds:

- A kilogram is about 2.2 pounds.
- A kilogram is about 2.2 pounds.

TORQUE

Torque is somewhat complicated. The term describes the amount of effort exerted to turn something. A chosen unit of weight or force is applied to a lever of standard length. The resulting leverage is called torque. In our standard system, we use the weight of one pound applied to a lever a foot long, resulting in the unit called a foot-pound. A smaller unit is the inch-pound (the lever is one inch long). Metric units include the meter kilogram (lever one meter long with a kilogram of weight applied) and the Newton-meter (lever one meter long with force of one Newton applied). Some conversions are:

- A meter kilogram is about 7.2 foot pounds.
- A foot pound is about 1.4 Newton-meters.
- A centimeter kilogram (cmkg) is equal to .9 inch pounds.

PRESSURE

Pressure is another complicated measurement. Pressure is described as a force or weight applied to a given area. Our common unit is pounds per square inch. Metric units can be expressed in several ways. One is the kilogram per square centimeter (kg/cm^2). Another unit of pressure is the Pascal (force of one Newton on an area of one square meter), which equals about 4 ounces on a square yard. Since this is a very small amount of pressure, we usually see the kiloPascal, or kPa (1000 Pascals). Another common automotive term for pressure is the bar (used by German manufacturers), which equals 10 Pascals. Thoroughly confused? Try the examples below:

- Atmospheric pressure at sea level is about 14.7 psi.

- Atmospheric pressure at sea level is about 1 bar.
- Atmospheric pressure at sea level is about 1 kg/cm^2 .
- One pound per square inch is about 7 kPa.

CONVERSION FACTORS

CONVERSION FORMULA

To Convert	To	Multiply By
LENGTH		
Millimeters (mm)	Inches	.03937
Inches	Millimeters	25.4
Meters (M)	Inches	39.37
Meters (M)	Feet	3.28084
Feet	Meters	.3048
Kilometers (Km)	Miles	.62137
AREA		
Square Centimeters (cm^2)	Square Inches	.155
Square Inches	Square Centimeters	6.45159
VOLUME		
Cubic Centimeters	Cubic Inches	.06103
Cubic Inches	Cubic Centimeters	16.38703
Liters	Cubic Inches	61.025
Cubic Inches	Liters	.01639
Liters	Quarts	1.05672
Quarts	Liters	.94633
Liters	Pints	2.11344
Pints	Liters	.47317
Liters	Ounces	33.81497
Ounces	Liters	.02957
WEIGHT		
Grams	Ounces	.03527
Ounces	Grams	28.34953
Kilograms	Pounds	2.20462
Pounds	Kilograms	.45359
WORK		
Centimeter Kilograms	Inch Pounds	.8676
Pounds/Sq. Inch	Kilograms/Sq. Centimeter	.07031
Bar	Pounds/Sq. Inch	14.504
Pounds/Sq. Inch	Bar	.06895
Atmosphere	Pounds/Sq. Inch	14.696
Pounds/Sq. Inch	Atmosphere	.06805
TEMPERATURE		
Centigrade Degrees	Fahrenheit Degrees	(CÂ°x^9 /$_5$)+32
Fahrenheit Degrees	Centigrade Degrees	(FÂ°-32)x^5 /$_9$

EQUIVALENCIES

Inches	Decimals	mm
1/64	.016	.397
1/32	.031	.794
3/64	.047	1.191
1/16	.063	1.588
5/64	.078	1.984

Inches	Decimals	mm
3/32	.094	2.381
7/64	.109	2.778
1/8	.125	3.175
9/64	.141	3.572
5/32	.156	3.969
11/64	.172	4.366
3/16	.188	4.763
13/64	.203	5.159
7/32	.219	5.556
15/64	.234	5.953
1/4	.250	6.350
17/64	.266	6.747
9/32	.281	7.144
19/64	.297	7.541
5/16	.313	7.938
21/64	.328	8.334
11/32	.344	8.731
23/64	.359	9.128
3/8	.375	9.525
25/64	.391	9.992
13/32	.406	10.319
27/64	.422	10.716
7/16	.438	11.113
29/64	.453	11.509
15/32	.469	11.906
31/64	.484	12.303
1/2	.500	12.700
33/64	.516	13.097
17/32	.531	13.494
35/64	.547	13.891
9/16	.563	14.288
37/64	.578	14.684
19/32	.594	15.081
39/64	.609	15.478
5/8	.625	15.875
41/64	.641	16.272
21/32	.656	16.669
43/64	.672	17.066
11/16	.687	17.463
45/64	.703	17.859
23/32	.719	18.256
47/64	.734	18.653
3/4	.750	19.050
49/64	.766	19.447
25/32	.781	19.844
51/64	.797	20.241
13/16	.813	20.638
53/64	.828	21.034
27/32	.844	21.431
55/64	.859	21.828
7/8	.875	22.225
57/64	.891	22.622

Inches	Decimals	mm
29/32	.906	23.019
59/64	.922	23.416
15/16	.938	23.813
61/64	.953	24.209
31/32	.969	24.606
63/64	.984	25.003
1	1.000	25.400

Release September 2019

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GENERAL INFORMATION

Gear Tooth Contact Patterns

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

INSPECTION

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Wipe lubricant from internal parts. Rotate gears and inspect for wear or damage. Mount dial indicator to housing and check backlash at several points around ring gear. Backlash must be within specification at all points. If no defects are found, check gear tooth pattern contact.

NOTE: **Drive pattern should be well centered on ring gear teeth. Coast pattern should be centered, but may be slightly toward toe of ring gear teeth.**

GEAR TOOTH CONTACT PATTERN

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

1. Paint ring gear teeth with marking compound. Wrap cloth or rope around drive pinion flange to act as brake. Rotate gear until clear contact pattern is obtained.
2. Contact pattern will indicate whether correct pinion bearing mounting shim has been installed and if drive gear backlash has been set properly. Backlash between drive gear pinion must be maintained within specified limits until correct tooth pattern is obtained.

ADJUSTMENTS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

GEAR BACKLASH & PINION SHIM CHANGES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

1. With no change in backlash, moving pinion further from ring gear moves drive pattern toward heel and top of tooth, and moves coast pattern toward toe and top of tooth.
2. With no change in backlash, moving pinion closer to ring gear moves drive pattern toward toe and bottom of tooth, and moves coast pattern toward heel and bottom of tooth.
3. With no change in pinion shim thickness, an increase in backlash moves ring gear further from pinion. Both drive and coast patterns move toward heel and top of tooth.
4. With no change in pinion shim thickness, a decrease in backlash moves ring gear closer to pinion gear. Both drive and coast patterns move toward toe and bottom of tooth.

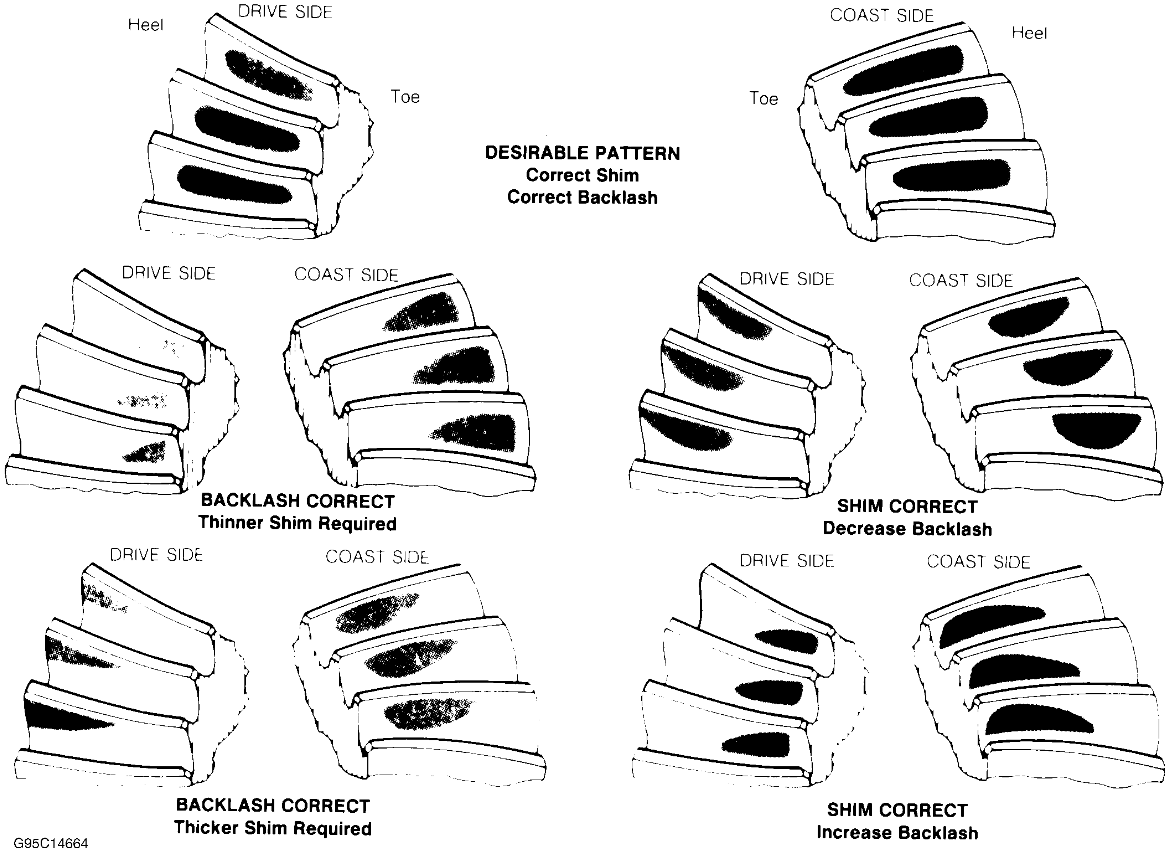
Heel
DRIVE SIDE
Toe
DESIRABLE PATTERN
Correct Shim
Correct Backlash
COAST SIDE
Heel
Toe
DRIVE SIDE
COAST SIDE
BACKLASH CORRECT
Thinner Shim Required
DRIVE SIDE
COAST SIDE
SHIM CORRECT
Decrease Backlash
DRIVE SIDE
COAST SIDE
BACKLASH CORRECT
Thicker Shim Required
DRIVE SIDE
COAST SIDE
SHIM CORRECT
Increase Backlash
G95C14664

Fig. 1: Drive Axle Gear Tooth Patterns

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GENERAL INFORMATION

General Cooling System Service

* PLEASE READ THIS FIRST *

This article is generic in nature and all information does not apply to all vehicles including those without a liquid cooling system. For vehicle specific information, see the appropriate articles in the ENGINE category.

DESCRIPTION

The liquid cooling system consists of a radiator, water pump, thermostat, electric or belt-driven cooling fan, pressure cap, heater, and various connecting hoses and cooling passages in the engine block and cylinder head.

MAINTENANCE

DRAINING

Remove radiator cap and open heater control valve to maximum heat position. Open drain cocks or remove plugs in bottom of radiator and engine block. In-line engines usually have one plug or drain cock, while "V" type engines have 2, one in each bank of cylinders.

FLUSHING

CAUTION: **Some manufacturers use an aluminum and plastic radiator. Flushing solution must be compatible with aluminum.**

Radiator

Connect flushing gun to water outlet of radiator. Disconnect water inlet hose. To prevent flooding engine, use a hose connected to radiator inlet. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

Engine Block

To flush engine, remove thermostat. Connect flushing gun to water outlet of radiator. Use air in short bursts to prevent damage to radiator. Continue flushing until water runs clear.

REFILLING

To prevent air from being trapped in engine block, engine should be running when refilling cooling system. After system is full, continue running engine until thermostat is open, then recheck fill level. Do not overfill system.

TESTING

THERMOSTAT

1. Remove and inspect thermostat for corrosion and proper seating of valve. If okay, suspend thermostat and thermometer in a 50/50 mixture of coolant and water. See **Fig. 1**. DO NOT allow thermostat or thermometer to touch bottom or container. Heat water until thermostat begins to open.
2. Read temperature on thermometer. This is the initial opening temperature and should be within specification. Continue heating water until thermostat is fully open and note temperature. This is the fully open temperature. If either reading is not to specification, replace thermostat.

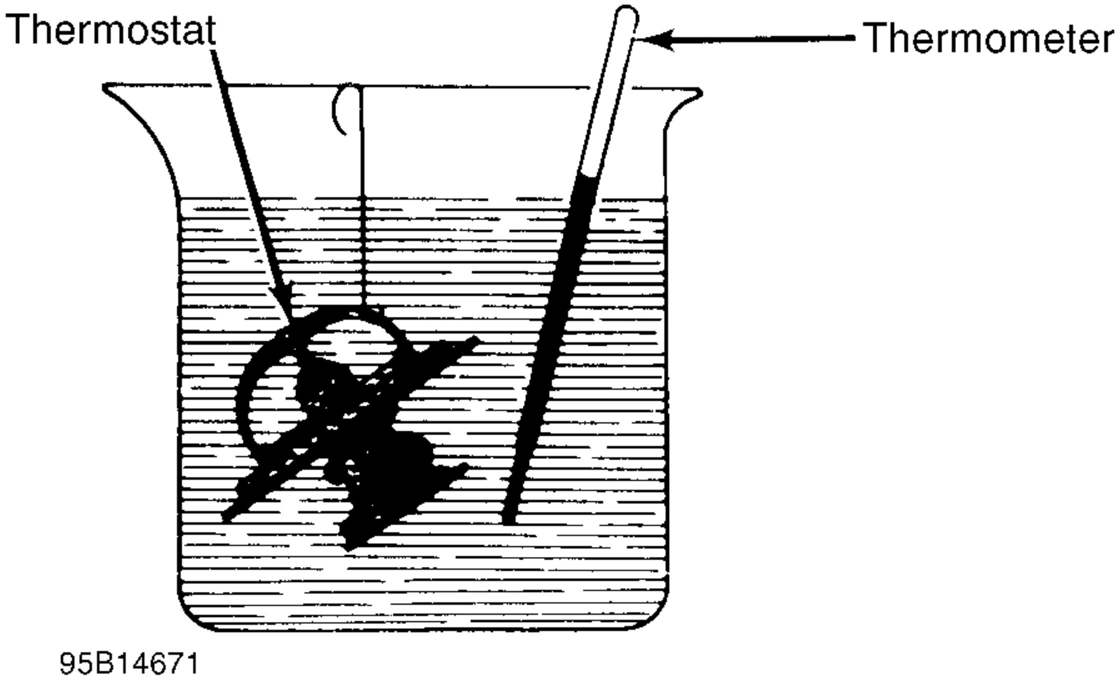

Fig. 1: Testing Thermostat in Coolant/Water Solution

PRESSURE TESTING

A pressure tester is used to check both radiator cap and complete cooling system. Follow pressure tester manufacturer instructions and test components as follows:

Radiator Cap

Visually inspect radiator cap. If cap looks okay, connect pressure tester to cap. See Fig. 2. Pressurize tester to full radiator cap specification. Replace cap if it fails to hold pressure.

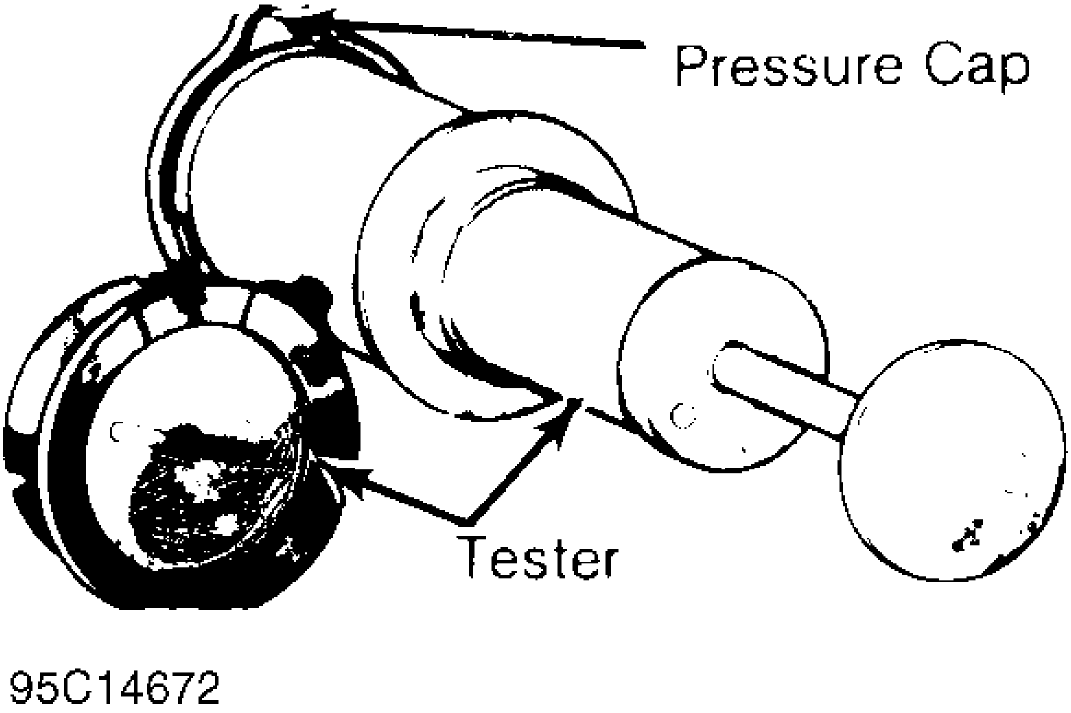

Fig. 2: Pressure Testing Radiator Cap

Cooling System

1. Turn ignition off and allow engine to cool. Ensure radiator if filled to correct level. Remove cap and attach pressure tester to radiator. Pressurize tester to full radiator rating specification.
2. If pressure drops, check for external leaks. If no leaks are found, start engine and allow to idle. If pressure builds up immediately, check cylinder head and block for cracks. If pressure does not build up immediately, go to next step.

CAUTION: **DO NOT allow excess pressure to build in cooling system or damage may result.**

3. Using pressure tester, pump cooling system up to pressure specified on radiator cap. If pump gauge pointer vibrates, compression or combustion leak into cooling system is indicated. Isolate leak by shorting each spark plug wire to cylinder block. Gauge pointer vibration will stop or decrease when leaking cylinder is shorted.

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2017 GENERAL INFORMATION

General Information - Bolt EV

INTRODUCTION

ARROWS AND SYMBOLS

The arrows and symbols shown below are used in service information to indicate position of vehicle, direction, and location.

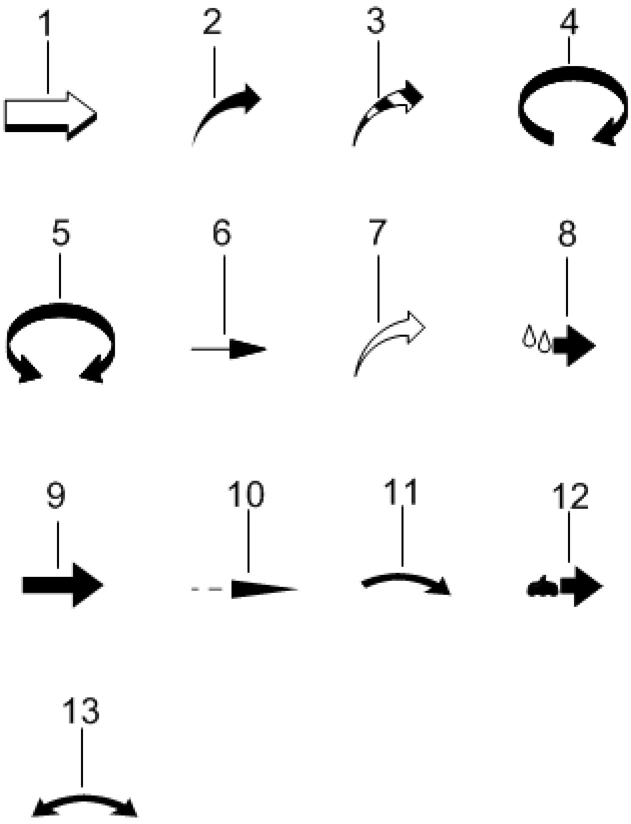


Fig. 1: Arrows and Symbols
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front of Vehicle Arrow - Direction of arrow may vary.
2	View Detail Arrow - Direction of arrow may vary.
3	Ambient Air Mixed with Another Gas or Indicate Temperature Change Arrow - Direction of arrow may vary.
4	Motion or Direction Single Arrow
5	Motion or Direction Double Arrow
6	Dimension Arrow - Used for showing a dimension.
7	Ambient/Clean Air Flow or Cool Air Flow Arrow - Direction of arrow may vary.
8	Lubrication Point Arrow - Oil or Fluid
9	Task Related Arrow - Used to show task related location.
10	Sectioning Arrow - Used to show sectioning.
11	Motion Arrow - Direction of arrow may vary.
12	Lubrication Point Arrow - Grease or Petroleum Jelly
13	Multidirectional Arrow

ACRONYMS AND UNITS

Acronyms

Acronym	Meaning	Definition
2WD	Two-Wheel Drive	Indicates that a vehicle has 2 driven wheels OR that a 4WD vehicle uses only 2 wheels for propulsion. So it can be the description of a vehicle configuration OR the operational mode of the drivetrain.
4WD	Four-Wheel Drive	Four-wheeled vehicle with a drivetrain that allows all four wheels to receive power from the engine simultaneously which provides better control on various surfaces. Can be used to describe the configuration of the vehicle OR as the operational mode of the drivetrain. 4WD vehicles usually can turn 2 wheels off to be in a 2WD mode. See also AWD.
A/C	Air Conditioning	The cooling and dehumidification of indoor air for thermal comfort.
A/D	Analog to Digital	Used in context of converting electrical analog signals to digital signals.
ABS	Antilock Braking System	System on motor vehicles which prevents the wheels from locking while braking which helps the driver maintain control in heavy braking conditions.
AC	Alternating Current	An electrical current whose magnitude and direction vary cyclically.
AM	Amplitude Modulation	Method of impressing data onto an alternating-current (AC) carrier waveform.
APP	Accelerator Pedal Position	A pedal that controls the throttle valve.
AWD	All-Wheel Drive	All-wheel-drive systems are designed to function on all types of surfaces, both on- and off-road, and most of them cannot be switched off. This can also be called full-time four wheel drive. See also 4WD.
AWG	American Wire Gauge	American wire gauge is a standardized wire gauge system used since 1857 predominantly in the United States for the diameters of round, solid, nonferrous, electrically conducting wire. E.g. a wire of AWG10 has a diameter of 2.588mm, AWG20 corresponds to a diameter of 0.812mm.
B+	Battery Positive Voltage	The electrical potential on the positive terminal of the battery.
BARO	Barometric Pressure	Atmospheric pressure as measured by a barometer.
BCM	Body Control Module	This module supplies vehicle occupants with visual and audible information and controls various vehicle functions,
BECM	Battery Energy Control Module	Control module used to regulate the battery voltage.
BPP	Brake Pedal Position	Position of the foot pedal that moves a piston in the master brake cylinder.
CAN	Controller Area Network	Serial data connection between control modules by Bosch
CCM	Chassis Control Module	The module that controls various vehicle functions on the Chassis, like Engine/Trans Mount, Active Grille Air Shutter, Load Leveling, etc•••
CD	Compact Disc	A small optical disk on which data such as music, text, or graphic images is digitally encoded.

Acronym	Meaning	Definition
CNG	Compressed Natural Gas	This a substitute for gasoline or diesel fuel. It is made by compressing natural gas (which is mainly composed by methane (CH4), in a percentage range of 70% to 98%)
CO	Carbon Monoxide	This is a product of the incomplete combustion of carbon-containing compounds, at room temperature this is a gas. It consists of one carbon atom covalently bonded to one oxygen atom.
CO2	Carbon Dioxide	Chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom.
CPA	Connector Position Assurance	Part of an electrical connector that prevents the connector from moving out of its socket. Usually needs to be pressed to unlock the connector when disconnecting it.
CPP	Clutch Pedal Position	A lever operated with the foot that controls the coupling that connects or disconnects driving and driven parts of a driving mechanism.
CV	Constant Velocity	Used in conjunction with CV joints, which connect two shafts at an angle while both shafts always have the same rotational speed without variations.
CVT	Continuously Variable Transmission	A transmission in which the ratio of the rotational speeds of two shafts, as the input shaft and output shaft of a vehicle or other machine, can be varied continuously within a given range, providing an infinite number of possible ratios which improves fuel economy.
D	Drive	D on the transmission gear selector lever.
DAB	Digital Audio Broadcast	Technology for broadcasting of audio using digital radio (carries information via digital signal) transmission.
DC	Direct Current	Continuous current, constant flow of electric charge.
DLC	Data Link Connector	This is an electronic connector typically located underneath the driver's side dashboard, just above the pedals. The connector has 16 pins.
DMM	Digital Multimeter	Electronic measuring instrument that combines several functions in one unit. The most basic instruments include an ammeter, voltmeter, and ohmmeter.
DOHC	Dual Overhead Camshaft	Dual overhead camshafts (DOHC) are higher performance engines, they produce more power, and can run at higher speeds because they allow an engine to have four valves per cylinder. Each camshaft operates two of the valves, one camshaft handles the intake valves, and one handles the exhaust valves
DPF	Diesel Particulate Filter	Device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine.
DRL	Daytime Running Lamps	White lights mounted on the front of an automobile that automatically switch on when the key is turned and are intended for daytime use, to increase the visibility of the automobile.
DSCC	Distance Sensing Cruise Control	A type of cruise control that automatically maintains the distance between vehicles.
DSP	Digital Signal Processor	A specialized microprocessor designed specifically for digital signal processing, generally in real-time computing.

Acronym	Meaning	Definition
DTC	Diagnostic Trouble Code	An electronic signal stored in an automotive computer, indicating the presence of a fault detected by that computer.
DVD	DVD	A popular optical disc storage media format the size of a CD. Used mainly for movies but also for data. DVD has no spelled out version (officially it does not mean Digital Video Disc or Digital Versatile Disc, it just means DVD).
EBCM	Electronic Brake Control Module	This module contains a microprocessor and software for antilock braking system operation.
ECM	Engine Control Module	This electronic module works with a vehicle's sensors and engine control devices to insure that the engine operates at maximum efficiency and performance. It performs three vital functions. Receives electronic signals from engine sensors. Analyzes the data and makes an engine performance decision (based on the pre-set parameters within the unit). Sends an "output command" to an actuator that adjusts engine performance.
ECT	Engine Coolant Temperature	A measure of how hot or cold the fluid which flows through the engine in order to prevent its overheating, transferring the heat produced by the device to other devices that utilize or dissipate it.
EEPROM	Electrically Erasable Programmable Read-Only Memory	A non-volatile storage chip used in computers and other devices to store small amounts of volatile data, e.g. calibration tables or device configuration.
EGR	Exhaust Gas Recirculation	Is an NOx (nitrogen oxide and nitrogen dioxide) reduction technique used in most gasoline and diesel engines. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders.
EMI	Electromagnetic Interference	Electromagnetic interference (also called radio frequency interference) is a disturbance that affects an electrical circuit due to either electromagnetic conduction or electromagnetic radiation emitted from an external source.
ESD	Electrostatic Discharge	The sudden and momentary electric current that flows between two objects at different electrical potentials.
EV	Electric Vehicle	A category of vehicles that only have an electric drive system.
EVAP	Evaporative Emission	A system that controls the fuel fumes in the fuel tank.
FM	Frequency Modulation	In telecommunication this is a way to convey information over a carrier wave by varying its frequency.
FWD	Front-Wheel Drive	A form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only.
GMLAN	General Motors Local Area Network	A local-area network is a computer network covering a small geographic area, like a home or vehicle. This specific type of LAN connects several controllers inside the vehicle and was developed by General Motors.
GPS	Global Positioning System	Satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense.

Acronym	Meaning	Definition
GSM	Global System for Mobile Communications	Globally accepted standard for digital cellular communication.
GVW	Gross Vehicle Weight	Maximum total weight of a road vehicle or trailer that is loaded, including the weight of the vehicle itself plus fuel, passengers, cargo, and trailer tongue weight.
HD	Heavy Duty	Robust design to accommodate large work loads.
HID	High Intensity Discharge	A type of light that produces a bright light by using gas filled bulbs. (gas is usually mercury, metal halide, and high-pressure sodium) Uses very little battery power and is a very "cool" light.
HO2S	Heated Oxygen Sensor	Heated oxygen sensors have an internal heater circuit that brings the sensor up to operating temperature more quickly than an unheated sensor. An oxygen sensor must be hot (about 600 - 650Â°F) before it will generate a voltage signal. The hot exhaust from the engine will provide enough heat to bring an O2 sensor up to operating temperature.
HVAC	Heating Ventilation Air Conditioning	This system is sometimes referred to as climate control. Ventilation air ducts installed throughout a vehicle that supply conditioned air to a room through rectangular or round outlet vents.
I^2 C	Inter-Integrated Circuit	Serial data connection between Integrated Circuits (microchips) inside a control module invented by Phillips
IAT	Intake Air Temperature	Temperature of the air entering intake air flow system of the engine.
ICE	Internal Combustion Engine	An engine in which the combustion of fuel and an oxidizer (typically air) occurs in a confined space called a combustion chamber.
ID	Identification	Number or Code that identifies a component or control module. Can be written on the part or be transmitted on a bus or via radio.
ISP	Internet Service Provider	A company that furnishes corporations and individual consumers with various services, mainly access to the Internet.
ISS	Input Shaft Speed	Rotational speed of the input shaft of a transmission.
LAN	Local Area Network	Standard network connection PC's.
LCD	Liquid Crystal Display	A thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector.
LED	Light Emitting Diode	Small light bulbs that fit easily into an electrical circuit they do not have a filament that will burn out, and they do not get especially hot. They are illuminated solely by the movement of electrons in a semiconductor material.
LIN	Local Interconnect Network	Computer networking bus system used within automotive network architectures. Similar to CAN, but cheaper and less powerful.
LPG	Liquefied Petroleum Gas	A mixture of mainly propane and butane, produced commercially and stored under pressure to keep it in a liquid state.
MAF	Mass Air Flow	The amount of air drawn into the engine
MAP	Manifold Absolute Pressure	Pressure in the engine intake system after the throttle valve referenced to a perfect vacuum.

Acronym	Meaning	Definition
MDI	Multiple Diagnostics Interface	A device used by GM dealers that enables a PC to communicate with the control modules in a vehicle.
MIL	Malfunction Indicator Lamp	An indicator of the internal status of a car engine.
MOST	Media Oriented Systems Transport	Serial communication bus to transmit audio and video information.
N	Neutral	A state of the transmission in which it is not engaged.
NiMH	Nickel Metal Hydride	A type of rechargeable battery that uses a hydrogen absorbing alloy for the negative electrode.
NOx	Nitrogen Oxides	Refers to any of the following oxygen compounds of nitrogen or a mixture of them. Nitric Oxide, Nitrogen dioxide, Nitrous Oxide, Dinitrogen trioxide, Dinitrogen tetroxide, Dinitrogen pentoxide.
O2	Oxygen	A colorless, odorless, tasteless, gaseous chemical element with the chemical symbol O and atomic number 8.
O2S	Oxygen Sensor	An electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed.
OBD	On-Board Diagnostic	A generic term referring to a vehicle's self-diagnostic and reporting capability.
OEM	Original Equipment Manufacturer	A producer that provides a product to its customers, who proceed to modify or bundle it before distributing it to their customers.
OSS	Output Shaft Speed	Rotational speed of the output shaft of a transmission.
P	Park	A state in which the transmission is set so one can leave the vehicle.
PCB	Printed Circuit Board	A thin plate on which chips and other electronic components are placed.
PCM	Powertrain Control Module	A control module that features the functions of both, the engine and the transmission control module.
PCMCIA	Personal Computer Memory Card Industry Association	An international standards body and trade association with over 100 member companies that was founded in 1989 to establish standards for Integrated Circuit cards and to promote interchangeability among mobile computers where ruggedness, low power, and small size were critical.
PIN	Personal Identification Number	A secret numeric password shared between a user and a system that can be used to authenticate the user to the system.
PPE	Personal Protective Equipment	Protective clothing, helmets, goggles, or other garment designed to protect the wearer's body from injury.
PRNDL	Park, Reverse, Neutral, Drive, Low	Park, Reverse, Neutral, Drive, Low (automatic transmission positions).
PTC	Positive Temperature Coefficient	Refers to materials that experience an increase in electrical resistance when their temperature is raised.
PTO	Power Take-Off	A splined driveshaft, usually on a tractor or truck that can be used to provide power to an attachment or separate machine. This mechanism allows implements to draw energy from the tractor's engine.
PVC	Polyvinyl Chloride	A thermoplastic copolymer.

Acronym	Meaning	Definition
PWM	Pulse Width Modulation	Square shaped type of signal that carries the information in the ratio between on and off times.
R	Reverse	Rearward: directed or moving toward the rear;
RAM	Random Access Memory	A type of computer data storage. It today takes the form of integrated circuits that allow the stored data to be accessed in any order.
RCT	Radiator Coolant Temperature	This is the heat intensity of the radiator coolant measured in degrees. The radiator is a part of the cooling system that removes the engine heat. Coolant is a mixture of water and antifreeze (ethylene glycol) which lowers the freezing point of the water in the coolant system, this fluid also picks up heat from the engine and transfers it to the air.
RDS	Radio Data System	A standard from the European Broadcasting Union for sending small amounts of digital information using conventional FM radio broadcasts.
RF	Radio Frequency	A frequency or rate of oscillation within the range of about 3 Hz and 300 GHz. This range corresponds to frequency of alternating current electrical signals used to produce and detect radio waves.
ROM	Read-Only Memory	A class of storage media used in computers and other electronic devices. Data stored in ROM cannot be modified.
RPO	Regular Production Option	A three digit/letter code given to parts, assemblies, and systems originally installed on the vehicle. These RPO codes designate options and are assigned by General Motors.
RSA	Rear Seat Audio	An auxiliary set of controls that operate the main audio system from the rear seat. Rear passengers can also operate a different media source than the front passengers.
RWD	Rear-Wheel Drive	A common engine/transmission layout in which the engine is in the front of the vehicle, but the front mid-engine, rear mid-engine and rear engine layouts are also used.
SCV	Speed Controlled Volume	The volume control is set for a desired sound level in the vehicle as the vehicle increases its speed, the sound level is adjusted.
SDM	Sensing and Diagnostic Module	The name given to air bag modules used in General Motors vehicles.
SIM	Subscriber Identity Module	Part of a removable smart card Integrated Circuit Card. This is used for mobile cellular telephone devices such as mobile computers and mobile phones. SIM cards securely store the service-subscriber key used to identify a subscriber. The SIM card allows users to change phones by simply removing the SIM card from one mobile phone and inserting it into another mobile phone or broadband telephony device.
SIR	Supplemental Inflatable Restraint	Technical term for the air bag. Air bag is a stretchable membrane, which inflates during an automobile accident to provide cushioning to the passenger's head and torso to prevent injury to the passengers.

Acronym	Meaning	Definition
SPI	Serial Peripheral Interface	This is an interface that enables the serial (one bit at a time) exchange of data between two devices. An SPI operates in full duplex mode. This means that data can be transferred in both directions at the same time. It is a standard bus technology like CAN or I2C.
SPS	Service Programming System	System that enables repair facilities to update the software in control modules.
SUV	Sport Utility Vehicle	A passenger vehicle which combines the towing capacity of a pickup truck with the passenger-carrying space of a minivan.
SVS	Service Vehicle Soon	Indicator lamp or symbol for a malfunction related to a vehicle component or system.
TA	Traffic Announcement	Message spoken on radio regarding the movement of vehicles or pedestrians through an area or along a route. The buttons on radios that enable this announcements are also often labeled TA.
TAC	Throttle Actuator Control	A motor which moves the engine throttle plate or valve, controlled by the engine control module. A throttle plate limits the amount of air entering a internal combustion gasoline engine.
TAP	Transmission Adaptive Pressure	The transmission control module learns each component's characteristics and adjusts fluid pressure accordingly.
TCC	Torque Converter Clutch	Resides in a torque converter to connect an engine to an automatic transmission. The clutch is applied when conditions are correct to achieve a 1:1 ratio of engine crankshaft to transmission input shaft.
TCM	Transmission Control Module	A module that controls electronic automatic transmissions. It uses sensors from the vehicle as well as data provided by the Engine Control Module to calculate how and when to change gears in the vehicle for optimum performance, fuel economy and shift quality.
TDC	Top Dead Center	The piston is in its highest position relative to the combustion chamber.
TIS	Techline Information System	The PC-based global dealership diagnostic software that provides the technician the ability to reference the most recent service information via the service department's computer.
TPA	Terminal Position Assurance	An additional locking mechanism inside an electric connector that holds the pins in place.
TV	Television	A telecommunication system for broadcasting and receiving moving pictures and sound over a distance.
USB	Universal Serial Bus	A type of communication bus connection between a computer and a peripheral device.
VCI	Vehicle Communications Interface	A diagnostic tool that communicates to modules of multiple communication protocols in a vehicle by converting vehicle serial data into PC serial data communication.
VIN	Vehicle Identification Number	Used by manufacturers to uniquely identify motor vehicles using 17 characters.
VSCM	Vehicle Stability Control Module	This module uses information from several sensors to detect a loss of vehicle traction, then works with the antilock brake system to apply individual brakes to help keep the vehicle on its intended path.

Acronym	Meaning	Definition
VSS	Vehicle Speed Sensor	Sends data regarding how fast the car is traveling at the moment of driving. It is designed to be able to record the rate at which the vehicle's crankshaft is spinning.
WOT	Wide Open Throttle	When the throttle blade or valve is at its maximum open position, allowing maximum air to enter an internal combustion gasoline engine.
WLAN	Wireless Local Area Network	Standard to transmit digital data via radio frequency.
XM	XM (Satellite Radio)	XM Satellite Radio Holdings (XM) is one of two satellite radio services in the United States and Canada. XM provides pay-for-service radio, analogous to cable television. Its service includes 73 different music channels, 39 news, sports, talk, and entertainment channels, 21 regional traffic and weather channels and 23 play-by-play sports channels (2008).
XML	Extensible Markup Language	A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

Units

Unit	Meaning	Definition
m^2	Square Meter	Area
A	Ampere	Electrical
Ah	Ampere Hour	Electrical
C	Coulomb	Electrical
dBm	Decibel Meter	Electrical
dBmV	Decibel Millivolt	Electrical
mV/DIV	Millivolts per Division	Electrical
mV/s	Millivolts per Second	Electrical
Ω	Ohm	Electrical
V	Volt	Electrical
V/DIV	Volts per Division	Electrical
V/ms	Volts per Millisecond	Electrical
W	Watt	Electrical
mm^3 /stroke	Cubic Millimeters per Stroke	Flow
gal/h	Gallons per Hour	Flow
g/s	grams per second	Flow
g/stroke	Grams per Stroke	Flow
kg/100km	Kilograms per 100 Kilometer	Flow
kg/h	Kilograms per Hour	Flow
km/L	kilometer/liter	Flow
L/100km	Liters per 100 Kilometers	Flow
L/h	Liters per Hour	Flow
L/min	Liters per Minute	Flow
MPG	Miles per Gallon	Flow
mg/s	Milligrams per Second	Flow
mg/stroke	Milligrams per stroke	Flow
ft	feet	Length
in	Inch	Length
m	Meter	Length
mi	Mile	Length
bar	Bar	Mechanical

Unit	Meaning	Definition
bar/min	Bars per Minute	Mechanical
in. H2O	Inches of Water	Mechanical
in. H2O/s	Inches of Water per second	Mechanical
kPa/s	Kilopascals per Second	Mechanical
N	Newton	Mechanical
Â	Newton Meter	Mechanical
Pa	Pascal	Mechanical
Pa/s	Pascals per Second	Mechanical
lb ft	Pound Foot	Mechanical
PSI	Pound-Force per Square Inch	Mechanical
Counts	Counts	Misc.
Cycles	Cycles	Misc.
dB	Decibel	Misc.
Â°	Degree	Misc.
Â°C	Degree Centigrade	Misc.
Â°CA	Degree Crankshaft Angle	Misc.
Â°F	Degree Fahrenheit	Misc.
Â°/s	Degree per Second	Misc.
Hz	Hertz	Misc.
kbit/s	Kilobit per second	Misc.
lx	Lux	Misc.
ppm	Parts per Million	Misc.
%	Percent	Misc.
%/min	Percents per Minute	Misc.
%/sec	Percents per Second	Misc.
Pulses	Pulses	Misc.
:1	Ratio	Misc.
RPM	Revolutions per Minute	Misc.
Steps	Steps	Misc.
W/m^2	Watts per Square Meter	Misc.
g	g (Acceleration)	Movement
km/h	Kilometers per Hour	Movement
m/s	Meters per Second	Movement
m/s^3	Meters per Second Cubed	Movement
m/s^2	Meters per Second Squared	Movement
MPH	Miles per Hour	Movement
mm/s	Millimeters per Second	Movement
d	Day	Time
h	Hour	Time
hh:mm:ss	Hour:Minute:Second	Time
ms/DIV	Milliseconds per Division	Time
min	Minute	Time
s	Second	Time
s/DIV	Seconds per Division	Time
yy-mm-dd	Year-Month-Day (2 digits)	Time
yyyy-mm-dd	Year-Month-Day (4 digits, preferred)	Time
m^3	Cubic Meter	Volume
gal	Gallon	Volume
L	Liter	Volume
mL	milliliters	Volume
US gal	US Gallon	Volume

Unit	Meaning	Definition
US pt	US Pint	Volume
US qt	US Quart	Volume
kg	Kilogram	Weight

GRAPHIC COLORS AND GRAPHIC SYMBOLS

Graphic Colors - General

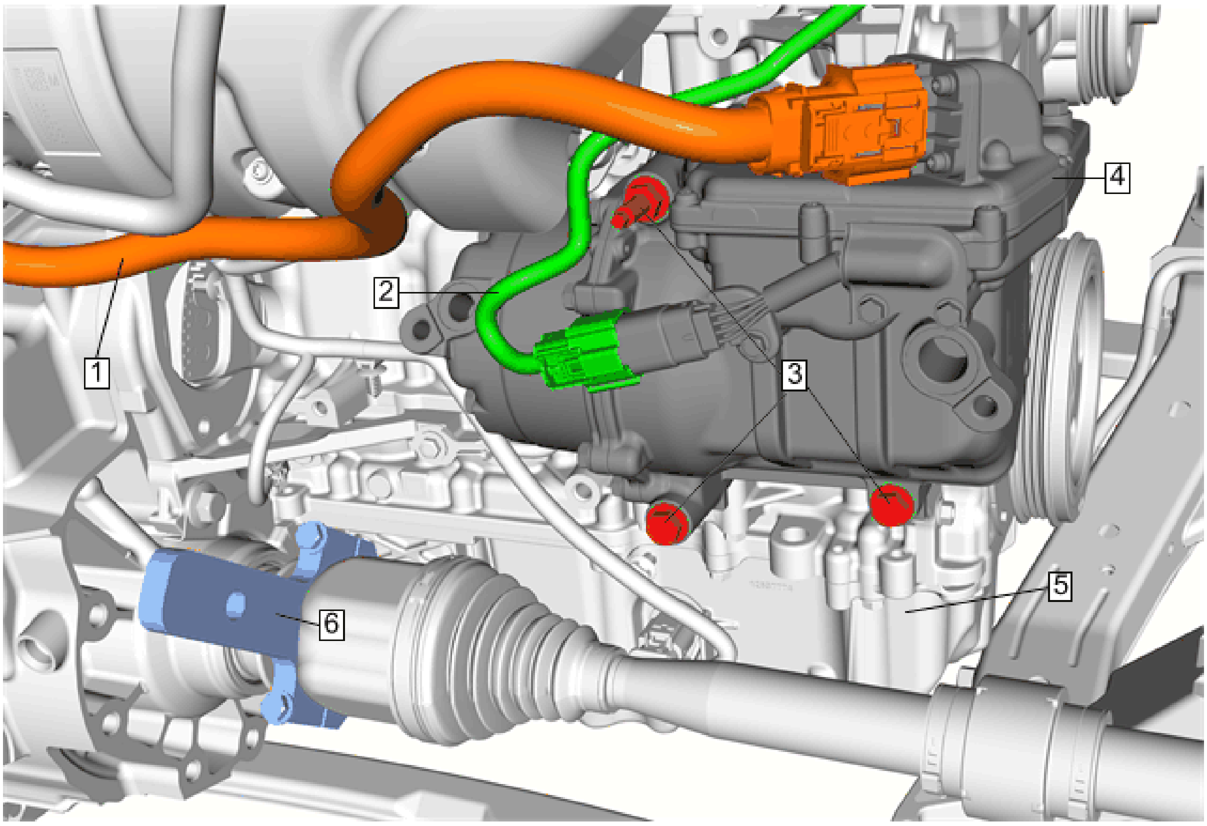
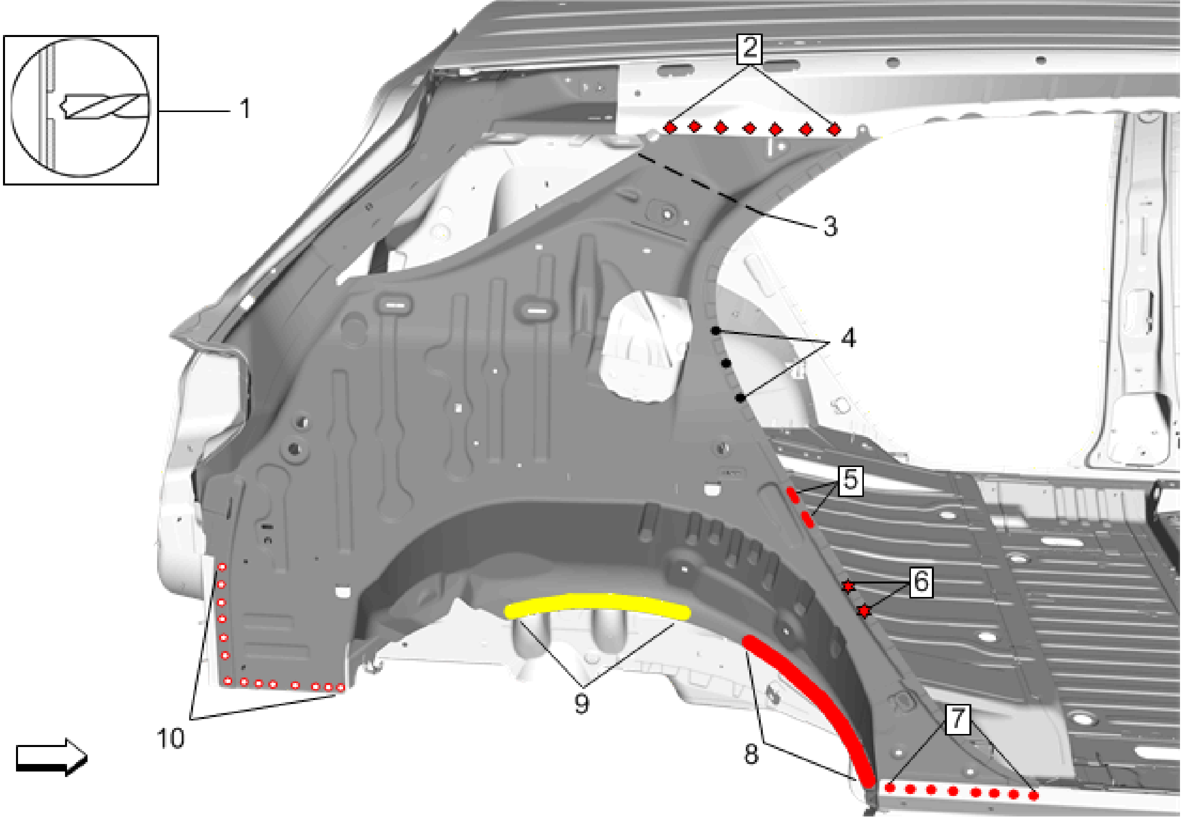


Fig. 2: Graphic Colors - General
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Orange - High voltage electrical connectors and harnesses being removed or installed.
2	Green - Electrical connectors and harnesses being removed or installed.
3	Red - Fasteners being removed or installed.
4	Dark Gray - Standout color that shows the component being removed or installed.
5	Light Gray - Background detail to show component location.
6	Light Blue - Special tool being used.

Graphic Symbols - Collision Repair



[Fig. 3: Graphic Symbols - Collision Repair](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drill through top layer of material only
2	Structural Rivet
3	Sectioning Location
4	Drill Hole
5	Mig Braze Slot
6	Self-Piercing Rivet
7	Mig/Mag Plug Weld
8	Adhesive
9	Apply Heat
10	Resistance Spot Weld

CUSTOMER CONCERN VERIFICATION SHEETS

The GM Customer Concern Verification Sheets have been designed to improve communications between the service customer and the technician. The more clearly the technician understands the concern and its symptoms, the more likely the concern will be fixed right the first time.

The GM-wide Customer Concern Verification Sheets are available in GM GlobalConnect. The Customer Concern Verification Sheets may be printed and reproduced locally.

TRAINING

Dealers

All U.S. GM Dealers participating in the Center of Learning / GM Service Technical College (STC) Programs can enroll through the Center of Learning website at https://www.centerlearning.com. Within the website, there are individual training paths that are designed to assist in planning the training needs for each individual and their job role. Dealers who have questions about Center of Learning Training should contact the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am - 9:00 pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Fleets

GM Fleet customers with GM Warranty In-Shop agreements are able to participate in service technical training through the Center of Learning/GM Service Technical College (STC).

Assistance for GM fleet registered customers using GM STC training is provided by the Center of Learning help desk at 1-888-748-2687. The help desk is available Monday through Friday, 8:00 am - 9:00 pm Eastern Standard Time, excluding holidays. For GM Access support, contact the GM Access Help Desk at 1-888-337-1010.

Most GM STC course materials have associated charges.

To purchase authentic GM STC Training Materials, contact the GM Training Materials Headquarters at 1-800-393-4831.

Non-GM Dealer Technicians

Technician training for non-GM dealers is available through ACDelco. This training is for ACDelco PSC and Fleet program members employed in the automotive or truck service industry.

ACDelco courses are available at approved GM STC Training Centers. Availability and schedules can be obtained by calling 1-800-825-5886 (prompt 1) or contact us via the web at www.acdelcotechconnect.com and select the Training tab. Seminars are also offered through the ACDelco Warehouse Distribution channel. Contact your Local ACDelco representative or distributor directly for more information.

VEHICLE, ENGINE AND TRANSMISSION ID AND VIN LOCATION, DERIVATIVE AND USAGE

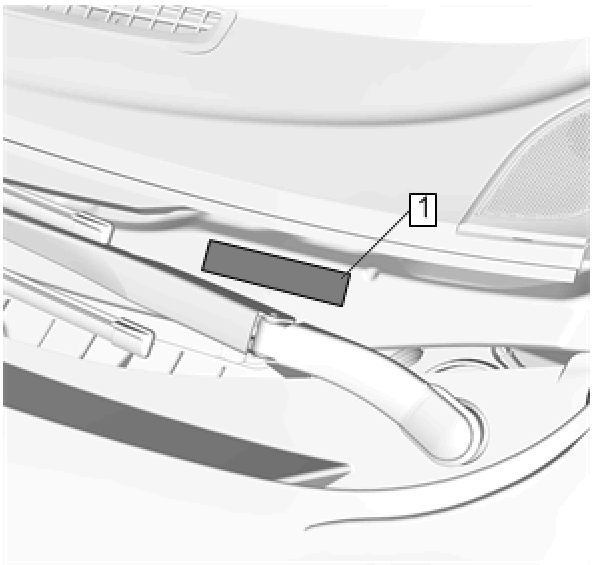


Fig. 4: VIN Plate
Courtesy of GENERAL MOTORS COMPANY

The vehicle identification number (VIN) plate is the legal identifier of the vehicle. The VIN plate (1) is located on the left corner of the plenum upper panel and can be seen through the windshield from the outside of the vehicle.

Position	Definition	Character	Description
1 - 3	Region of Build	1	United States
	Manufacturer	G	General Motors
	Vehicle Brand/Type	1	Chevrolet Passenger Car
		0	Opel Passenger Car
4 - 5	Vehicle Line/Series	W	Chevrolet Bolt EV, LT
		X	Chevrolet Bolt EV, Premier
		7	Chevrolet Bolt EV, (Non-US, Non-Canada)
		6	Opel Bolt EV

Position	Definition	Character	Description
6	Body Style	6	48 - Sedan, 4 - Door, 4 Window, Hatchback
7	RESTRAINT SYSTEM	E	AY0 - Active Manual Belts, Airbags-Driver & Passenger-Front (1st row), Front Seat Side (1st row), Roof Side (all seating rows)
		S	AYF - Active Manual Belts, Airbags - Driver & Passenger Front (1st row), Front Seat Side (1st row) & Rear Seat Side (2nd row), Roof Side (all seating rows), Driver & Passenger knee (1st row)
8	Engine Type	0	EN0 - ENGINE NONE
9	Check Digit	0~9	X - Calculated by POMS
10	Model Year	H	2017
11	Plant Location	4	Orion
12 - 17	Sequence Number	Positions 12 through 17 represent the number sequentially assigned by the manufacturer in the production process.	

1ET25 (MMF) Automatic Transmission ID and VIN Derivative Location

Refer to Transmission Identification Information .

VEHICLE CERTIFICATION, TIRE PLACARD, ANTI-THEFT, AND SERVICE PARTS ID LABEL

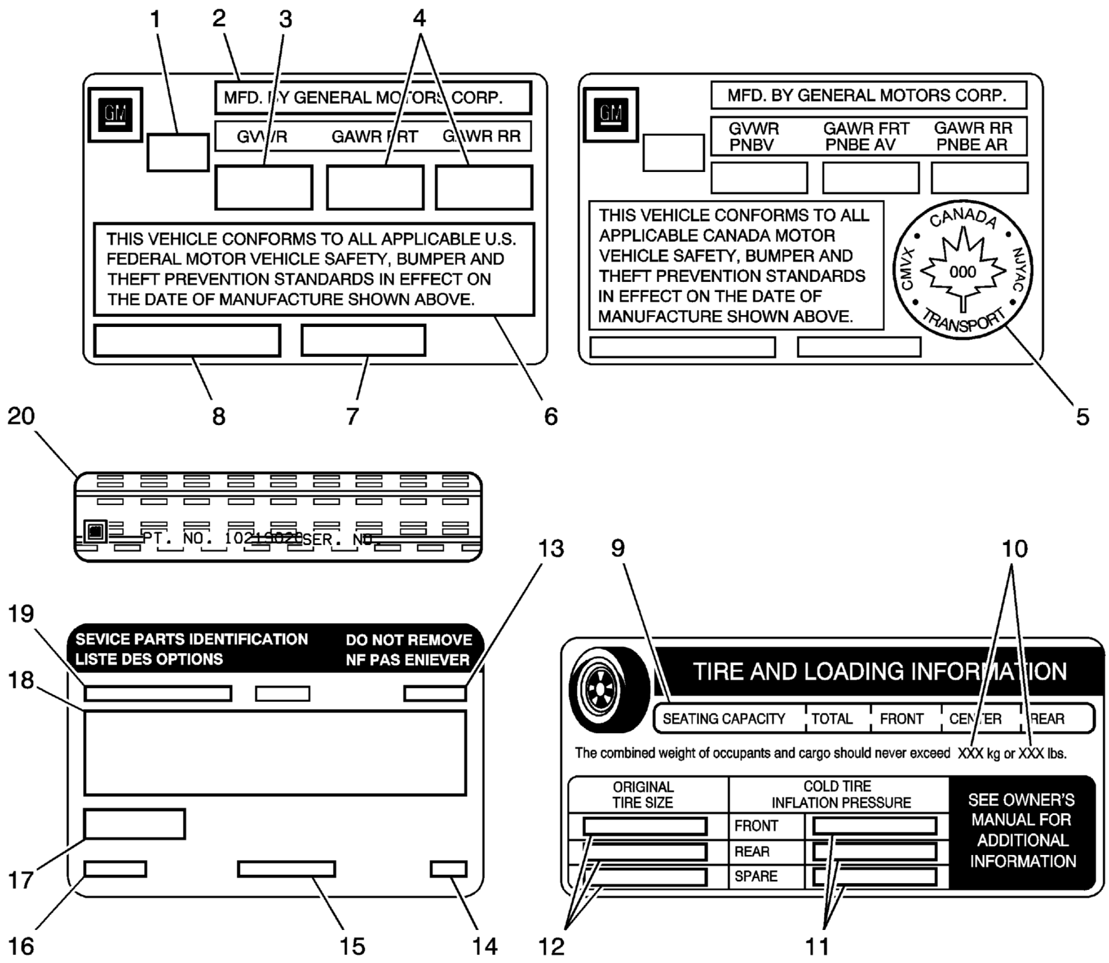

1
2
3
4
MFD. BY GENERAL MOTORS CORP.
GVWR
GAWR FRT
GAWR RR
THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S. FEDERAL MOTOR VEHICLE SAFETY, BUMPER AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
MFD. BY GENERAL MOTORS CORP.
GVWR PNBV
GAWR FRT PNBE AV
GAWR RR PNBE AR
THIS VEHICLE CONFORMS TO ALL APPLICABLE CANADA MOTOR VEHICLE SAFETY, BUMPER AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
CANADA
NJYAC
TRANSPORT
CMVX
000
20
8
7
6
5
PT. NO. 10215028 SER. NO
13
9
10
19
SEVICE PARTS IDENTIFICATION
LISTE DES OPTIONS
DO NOT REMOVE
NF PAS ENIEVER
18
TIRE AND LOADING INFORMATION
SEATING CAPACITY
TOTAL
FRONT
CENTER
REAR
The combined weight of occupants and cargo should never exceed XXX kg or XXX lbs.
ORIGINAL TIRE SIZE
COLD TIRE INFLATION PRESSURE
FRONT
REAR
SPARE
SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION
17
16
15
14
12
11

Fig. 5: Vehicle Certification, Tire Place Card, Anti-Theft & Service Parts ID Labels

Courtesy of GENERAL MOTORS COMPANY

Callout	Description

Vehicle Certification Label
The vehicle certification label is located on the driver side B pillar and displays the following assessments:
• Gross Vehicle Weight Rating (GVWR)
• Gross Axle Weight Rating (GAWR), front and rear
• The gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. The gross vehicle weight must not exceed the Gross Vehicle Weight Rating. Include the following items when figuring the GVW:
  • The base vehicle weight (factory weight)
  • The weight of all vehicles accessories
  • The weight of the driver and the passengers
  • The weight of the cargo	

1	Name of Manufacturer
2	Gross Vehicle Weight Rating
3	Gross Axle Weight Rating (Front, Rear)
4	Canadian Safety Mark (w/RPO Z49)
5	Certification Statement
6	Vehicle Class Type (Pass Car, etc.)
7	Vehicle Identification Number
8	Date of Manufacture (Mo/Yr)
Tire Placard The tire placard label is located on the driver side B pillar and displays the following assessments:	
9	Specified Occupant Seating Positions
10	Maximum Vehicle Capacity Weight
11	Tire Pressure, Front, Rear, and Spare (Cold)
12	Original Equipment Tires Size
Service Parts ID Label The vehicle service parts identification label is located in the rear compartment in the right hand quarter stowage pocket. The label is use to help identify the vehicle original parts and options.	
13	Vehicle Identification Number
14	Engineering Model Number (Vehicle Division, Line, and Body Style)
15	Interior Trim Level and Decor
16	Exterior (Paint Color) WA Number
17	Paint Technology
18	Special Order Paint Colors and Numbers
19	Vehicle Option Content
Anti-Theft Label	
20	The Federal law requires that General Motors label certain body parts on this vehicle with the VIN. The purpose of the law is to reduce the number of motor vehicle thefts by helping in the tracing and recovery of parts from stolen vehicles. Labels are permanently affixed to an interior surface of the part. The label on the replacement part contains the letter R, the manufacturer's logo, and the DOT symbol. The anti-theft label must be covered before any painting, rustproofing procedures, and uncovered after the procedures. Failure to follow the precautionary steps may result in liability for violation of the Federal Vehicle Theft Prevention Standard and possible suspicion to the owner that the part was stolen.

RPO CODE DESCRIPTION

The following table provides the description of the Regular Production Option (RPO) codes that are available on the vehicle. The vehicle's RPO list is printed on the Service Parts Identification Label.

RPO	Description

RPO	Description
4F1	INTERIOR TRIM-DK GALVANIZED
4F3	INTERIOR TRIM-LIGHT #1 (D2JBI)
5A7	WHEEL SPARE-NONE
5AZ	ACCESSORY-SAFETY KIT - UNIVERSAL
5VQ	ACCESSORY-PUBX BEDLINER - W/INTEGRAL STORAGE COMPARTMENTS
5XB	ACCESSORY-CHARGE CORD SET - 110/120V - STANDARD
62G	ACCESSORY-ACCENT LIGHTING - FRONT EXTERIOR
6X1	COMPONENT FRT LH-NON-COMPUTER SEL SUSP
7X1	COMPONENT FRT RH-NON-COMPUTER SEL SUSP
8X2	COMPONENT RR LH-NON-COMPUTER SEL SUSP
9L3	TIRE SPARE-NONE
9X2	COMPONENT RR RH-NON-COMPUTER SEL SUSP
A64	SEAT RR-SPLIT, FOLDING, 40/60
A69	RESTRAINT-SEAT BELT TENSIONER, FRT, VAR. 2
A70	RESTRAINT-SEAT BELT TENSIONER, FRT
AAL	RESTRAINT-KNEE, BOLSTER, LH/RH
ACO	IDENTIFICATION-ACCESSORY CATALOG OFFERING
AED	WINDOW REG PASS DR-POWER OPERATED, EXPRESS DOWN
AEQ	WINDOW REG REAR DR-POWER OPERATED, EXPRESS DOWN
AG6	ADJUSTER PASS ST-MANUAL, 4 WAY (DO NOT USE ON NEW PROGRAMS AFTER MY18)
AH3	ADJUSTER FRT ST-MANUAL, 4 WAY, DRIVER (DO NOT USE ON NEW PROGRAMS AFTER MY18)
AKP	WINDOW TYPE-SOLAR ABSORBING
AKX	WINDSHIELD TYPE-SOLAR ABSORBING
AL0	SENSOR INDICATOR-INFLATABLE RESTRAINT, FRT PASS/CHILD PRESENCE DETECTOR
AQP	RESTRAINT-HEAD, RR SEAT, CENTER
AR7	SEAT-FRT BKT, STANDARD
ASV	EQUIPMENT-SENSOR AIR MOISTURE & W/S TEMP
AT7	RESTRAINT SYSTEM RR-SEAT, SHLDR, RETR, 3 POINT, 3 SHLDR
ATH	LOCK CONTROL, ENTRY-REMOTE ENTRY, EXTENDED RANGE, PASSIVE ENTRY, ALL DOORS
AU3	LOCK CONTROL-SIDE DR, ELEC
AXG	WINDOW REG DRVR DR-POWER OPERATED, EXPRESS UP/DOWN
AXJ	VEHICLE TYPE-PASSENGER CAR
AY0	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER & PASS FRT, SEAT SIDE, ROOF SIDE
AYF	RESTRAINT SYSTEM-SEAT, INFLATABLE, DRIVER & PASS FRT, FRT SEAT SIDE & RR SEAT SIDE, ROOF SIDE, KNEE
B32	COVERING FRT-FLOOR MATS, AUX
B33	COVERING REAR-FLOOR MATS, AUX
B9U	LOCK CONTROL RR CMPT-L/GATE REM CONT, ELEC OPEN/CLOSE
BAG	PARTS PKG-EXPORT
BAH	EQUIPMENT-SECURITY SYSTEM, IMMOBILIZATION, STEP TWO
BTM	SWITCH-ENGINE START, KEYLESS
BTT	ALARM-REMOTE PANIC
BTV	REMOTE START-ENGINE
C23	WIPER SYS WINDSHIELD-PULSE, NON-VARIABLE DELAY
C25	WIPER SYS RR WINDOW-INTERMITTENT
C35	HEATER-DUCT, RR PASS

RPO	Description
C49	DEFOGGER-RR WINDOW, ELECTRIC
C68	HVAC SYSTEM-AIR CONDITIONER FRT, AUTO, ELECTRONIC CONTROLS
C95	LAMP-INTR, ROOF, COURTESY & DUAL READING
C9J	LAMP-INTR, AMBIENT, I/P
CBT	PROVISIONS-FAST CHARGING ACCOMMODATIONS
CE1	WIPER SYS WINDSHIELD-PULSE, MOISTURE SENSITIVE
CV3	COUNTRY-MEXICO
CW1	COUNTRY-KOREA
D31	MIRROR I/S R/V-TILT
D75	HANDLE O/S DOOR-BODY COLOR
D7A	HANDLE O/S DOOR-BODY COLOR, CHROME STRIP
D91	HANDLE, REAR CLOSURE-O/S, L/GATE, R/CMPT, COLOR
DA5	ARM REST-RR SEAT, CENTER
DBU	CONSOLE-FRT COMPT, FLOOR, ARM REST SLIDING
DD8	MIRROR I/S R/V-LT SENSITIVE
DG6	MIRROR O/S-LH & RH, REMOTE CONTROL, ELECTRIC, MANUAL FOLDING, HEATED, COLOR
DLR	MIRROR O/S-LH & RH, REMOTE CONTROL, ELECTRIC, HEATED, POWER FOLDING, COLOR, TURN SIGNAL
DLS	MIRROR O/S-LH & RH, REMOTE CONTROL, ELECTRIC, HEATED, MANUAL FOLDING, COLOR, TURN SIG IND
DLV	MIRROR I/S FRT VAN-SUNSHADE, DRIVER & PASS, W/MIRROR & COVER
DRZ	MIRROR I/S R/V-LT SENSITIVE, FULL VIDEO DISPLAY
E21	HANDLE-I/S, DR, CHROME
E27	HANDLE-ASSIST, PASS
E91	POCKET-FRONT SEAT BACK, PASS
EF7	COUNTRY-UNITED STATES OF AMERICA (USA)
EFZ	PROP ENGY STOR PACK-PROPULSION BATTERY, LI, 345V, 175AH, UNDERBODY
EN0	ENGINE-NONE
EPH	TRANS RANGE SEL SYS-ELECTRONIC
FE5	SUSPENSION SYSTEM-RIDE, HANDLING, PERFORMANCE
FE9	CERTIFICATION-EMISSION, FEDERAL
FJP	VEHICLE FUEL-(NONE)
FJQ	RATIO-7.05
FU1	CHASSIS-STANDARD
FX3	RIDE AND HANDLING-AUTOMATIC ELECTRONIC CONTROLLED
G7Q	PRIMARY COLOR-EXTERIOR, SON OF A GUN GRAY MET (139X)
GAN	PRIMARY COLOR-EXTERIOR, SWITCHBLADE SILVER MET (G) 636R
GAZ	PRIMARY COLOR-EXTERIOR, SUMMIT WHITE (G) 8624
GB8	PRIMARY COLOR-EXTERIOR, BLACK MEET KETTLE MET (384A)
GD1	PRIMARY COLOR-BLUE ME AWAY MET (388A)
GGB	PRIMARY COLOR-BLUE PERSUASION MET(413B)
GGQ	PRIMARY COLOR-BURNING HOT MET(425B)
GK8	COMPARTMENT-STOWAGE, REAR, DOUBLE FLOOR
GPJ	PRIMARY COLOR-GLORY RED TINT-2 (434B)
HO1	INTERIOR TRIM CONFIG-LEATHER, LEVEL3, DARK GALVANIZED / SKY COOL GRAY
HO2	INTERIOR TRIM CONFIG-CLOTH, LEVEL2, DARK GALVANIZED / SKY COOL GRAY

RPO	Description
HO5	INTERIOR TRIM CONFIG-LEATHER, LEVEL3, DARK GALVANIZED / SKY COOL GRAY VAR1
HO6	INTERIOR TRIM CONFIG-LEATHER, LEVEL3, LIGHT ASH GRAY / CERAMIC WHITE
HPB	ELECTRIFIED PROPULS-ELECTRIC, BEV, GEN 2, FWD
I17	ENGINEERING YEAR-2017
IOB	RADIO-INFOTAINMENT SYSTEM - MIDLEVEL HMI, MIDLEVEL CONNECTIVITY
J67	BRAKE SYSTEM-POWER, FRT & RR DISC, ABS, 15"
J71	BRAKE PARKING-POWER OPERATED
JBJ	BOOSTER-BRAKE - NONE
JSA	SALES PACKAGE-DELUXE PACKAGE
K12	FILTER-AIR, POLLUTANT
K23	HIGH VOLTAGE CHARGER-7.2KW
K34	CRUISE CONTROL-AUTOMATIC, ELECTRONIC
K4C	CHARGER-INDUCTIVE PORTABLE WIRELESS DEVICE
K5W	BATTERY-LN1, AGM, 12V, 50AH, 520ENCCA
KA1	HEATER SEAT FRT-DRVR & PASS
KA6	HEATER SEAT-REAR
KRK	KNOB-TRANS CONT LEVER, LEATHER, SATIN SILVER, CHROME
KRV	REFRIGERANT-LOW GWP
KTF	KEY-PRIMARY FOLDABLE, ADDITIONAL FOLDABLE
KWP	GENERATOR-NONE
LHD	VEHICLE DRIVE-LEFTHAND DRIVE
MMF	TRANSMISSION-AUTO, ELECTRIC, GM, GEM, GEN 2, DRIVE UNIT, X68F
MUQ	CONTROL-SHIFT, AUTO TRANS, STRG COL MTD
N34	STEERING WHEEL-LEATHER, 3 SPOKES
N37	STEERING COLUMN-TILT, TELESCOPING
N52	STEERING WHEEL-3 SPOKES, DELUXE
NC9	EMISSION SYSTEM-CALIFORNIA, ZEV
NCH	LOCK-MANUAL CHILD LOCK SYSTEM (REAR DOOR LATCH)
NE1	CERTIFICATION-EMISSION, GEOGRAPHICALLY RESTRICTED REGISTRATION FOR VEHICLES UP TO 14, 000 LBS GVW (USE 2003 MDL YR
NJ1	STEERING-POWER, NON-VARIABLE RATIO, ELECTRIC
NT7	EMISSION SYSTEM-FEDERAL, TIER 2
ORN	PLANT CODE-ORION, MI, USA
QBM	TIRE ALL-215/50R17 SL 91H BW ALS-S VAR 1
RJX	WHEEL-17 X 6.5, J, ALUMINUM, DESIGN 2
RNW	WHEEL-17 X 6.5, J, ALUMINUM, DESIGN
RWV	ACCESSORY-CARGO AREA ORGANIZER - FIXED
RYV	ACCESSORY-FLOOR MATS - ECONOMY CARPET
SB7	ACCESSORY-DECAL PACKAGE - DESIGN 1
SD4	ACCESSORY-TIRE INFLATOR
SFE	ACCESSORY-WHEEL LOCKS
SFJ	ACCESSORY-WINDOW SHADES - REFLECTIVE
SFZ	ACCESSORY-EMBLEM - EXTERIOR - DESIGN 1
SGI	ACCESSORY-SILL PLATES - ALUMINIUM
SIF	ACCESSORY-RSE - PORTABLE MEDIA CONNECTIVITY PACKAGE
T4F	HEADLAMPS-HIGH INTENSITY DISCHARGE
T7E	LAMP SYSTEM-DAYTIME RUNNING, LED
T83	CONTROL, HEADLAMPS-AUTOMATIC ON-OFF

RPO	Description
TCU	LICENSE PLATE-FRT & RR MOUNTING, ECE
TD1	REFLECTOR-SAFETY TRIANGLE
TDM	MODE-TEEN DRIVER SETTINGS
TQ5	HEADLAMP HIGH BEAM-AUTO CONTROL
TR6	CONTROL, HEADLAMPS-LEVELING SYSTEM, MANUAL
TT9	LAMP-STOP, HIGH LEVEL, LED TYPE
TUI	LAMP-FRT TURN SIGNAL, AMBER
TUR	GRILLE-RADIATOR, DK SILVER
TUS	GRILLE-RADIATOR, BLACK PC MET
TW5	LAMP-TAIL & STOP, SAE, LED
U05	HORN-DUAL
U18	SPEEDOMETER-INST, KILO
U25	LAMP-INTR, RR COMPT, COURTESY
U2K	DIGITAL AUDIO SYSTEM-S-BAND
UC1	SPEEDOMETER-INST, MILES
UC3	CONTROL-STEERING WHEEL, RADIO & PHONE, REDUNDANT CONTROLS
UD5	PARK ASSIST-FRONT AND REAR
UD7	PARK ASSIST-REAR
UDV	DISPLAY INSTRUMENT-DRIVER INFO ENHANCED, FULL CLUSTER (MULTI COLOR GRAPHIC)
UE1	COMMUNICATION SYSTEM-VEHICLE, ONSTAR
UE4	SENSOR INDICATOR-FOLLOWING DISTANCE
UEU	SENSOR INDICATOR-FORWARD COLLISION ALERT
UEV	COMMUNICATION EQUIP-AUTOMATIC TOLL COLLECTION
UFA	DISPLAY-OUTSIDE TEMPERATURE
UFG	SENSOR INDICATOR-REAR CROSS TRAFFIC ALERT
UFQ	PARK ASSIST-FRONT, REAR, LATERAL-FRONT (SEMIAUTOMATIC STEERING ADVANCED PARKING AID)
UGM	SENSOR EQUIPMENT-OUTSIDE AIR TEMPERATURE SENSOR
UHG	INDICATOR-SEAT BELT WARNING, DRIVER
UHH	INDICATOR-SEAT BELT WARNING, PASSENGER
UHX	LANE ACTIVE SAFETY-KEEP ASSIST
UHY	COLL IMMINENT BRK-LOW SPEED, VEH FWD MOVEMENT, BRAKE PREFILL, INTEGRATED BRAKE ASSIST
UJM	TIRE PRESS INDICATOR-MANUAL LEARN
UKC	SIDE ACTIVE SAFETY-OBSTACLE DETECTION ENHANCED
UKJ	PED DETECTION FRT-BASIC, PEDESTRIANS
UQ3	SPEAKER SYSTEM-ENHANCED AUDIO
UQA	SPEAKER SYSTEM-PREMIUM AUDIO, BRANDED AMPLIFIER
UQK	RESTRAINT PROVISIONS-CHILD, ISOFIX 2 POINT ONLY, POINT/LAT CH(INC 2 TOP TETHER POINTS)
UQL	RESTRAINT PROVISIONS-CHILD, ISOFIX 2 POINT ONLY, POINT/LAT CH(INC 3 TOP TETHER POINTS)
US2	VEHICLE VIN-NON-SALEABLE, 0777 SERIES (DO NOT USE)
USS	RECEPTACLE-USB CHARGE PORT
UST	RECEPTACLE-DUAL USB, SINGLE AUX
UTJ	THEFT DETERENT-ELECTRICAL, UNAUTHORIZED ENTRY
UUQ	ANTENNA-ROOF, RADIO, SHARK FIN
UVC	VISION-REAR VIEW, MONO, ANALOG
UVD	STEERING WHEEL HEAT-MANUAL
UVH	VISION-360 VIEW, MONO, ANALOG
V2P	LUGGAGE CARRIER-RF RAIL

RPO	Description
V9G	MODEL CONVERSION-CHEVROLET LT
VAV	ACCESSORY-FLOOR MATS - ALL WEATHER
VD1	PROVISION OPTIONS-EUROPE
VEE	BUMPER FRT-BODY COLOR, FRT & RR
VIX	PLATE-VEHICLE IDENTIFICATION - VISUAL (GMDAT)
VIY	PLATE-VEHICLE IDENTIFICATION - ASTERISK (*) MARK (GMDAT)
VJQ	HOOK-TOW, FRT
VJR	HOOK-TOW, RR
VKD	LICENSE PLATE-FRT & RR MOUNTING, SAE
VLI	ACCESSORY-MAT - TRUNK / CARGO AREA
VNU	VIN FORMAT-U.S. TYPE
VNV	VIN FORMAT-KOREA TYPE
VPH	VEHICLE PREPARATION-OVERSEAS DELIVERY
VRK	VAA/COMPONENT REL-ROOF TRIM
VRS	ACCESSORY-CARGO SECURITY SHADE
VV4	COMMUNICATION EQUIP-MOBILE INTERNET CONNECTIVITY
VYW	ACCESSORY-FLOOR MATS - PREMIUM CARPET - DESIGN 1
W2D	ACCESSORY-CARGO NET
WMH	VIN MODEL YEAR-2017
WN1	ORNAMENTATION-NAMEPLATE "BOLT EV"
WPR	SALES PACKAGE-ADVANCED SAFETY 1
WPU	SALES PACKAGE-LT DLX
WPX	SALES PACKAGE-LTZ SAFETY #2
WU5	SWITCH-I/P LP DIMR
XL7	FREQUENCIES RATING-315 MHZ, LONG DISTANCE
XL8	FREQUENCIES RATING-433 MHZ
Y4K	PROTECTOR-VEHICLE, COVER
YF5	CERTIFICATION-EMISSION, CALIFORNIA
YM8	IDENTIFICATION-LIMITED PERSONALIZATION OPTION (LPO)
Z1N	MODEL CONVERSION-CHEVROLET PREMIER
Z49	COUNTRY-CANADA
ZPN	WARRANTY-36, 000 MILE, 3 YEARS
ZY9	WARRANTY-100, 000 KM, 3 YEARS

FASTENERS

Metric Fasteners

This vehicle provides fastener dimensions using the metric system. Most metric fasteners are approximate in diameter to equivalent English fasteners. Make replacements using fasteners of the same nominal diameter, thread pitch, and strength.

A number marking identifies the OE metric fasteners except cross-recess head screws. The number also indicates the strength of the fastener material. A PosidriveÂ® or Type 1A cross-recess identifies a metric cross-recess screw. For best results, use a Type 1A cross-recess screwdriver, or equivalent, in PosidriveÂ® recess head screws.

GM Engineering Standards and North American Industries have adopted a portion of the ISO-defined standard metric fastener sizes. The purpose was to reduce the number of fastener sizes used while retaining the best thread qualities in each thread size. For example, the metric M6.0 X 1 screw, with nearly the same diameter and 25.4 threads per inch replaced the English 1/4 - 20 and 1/4 - 28 screws. The thread pitch is midway between the English coarse and fine thread pitches.

Fastener Strength Identification

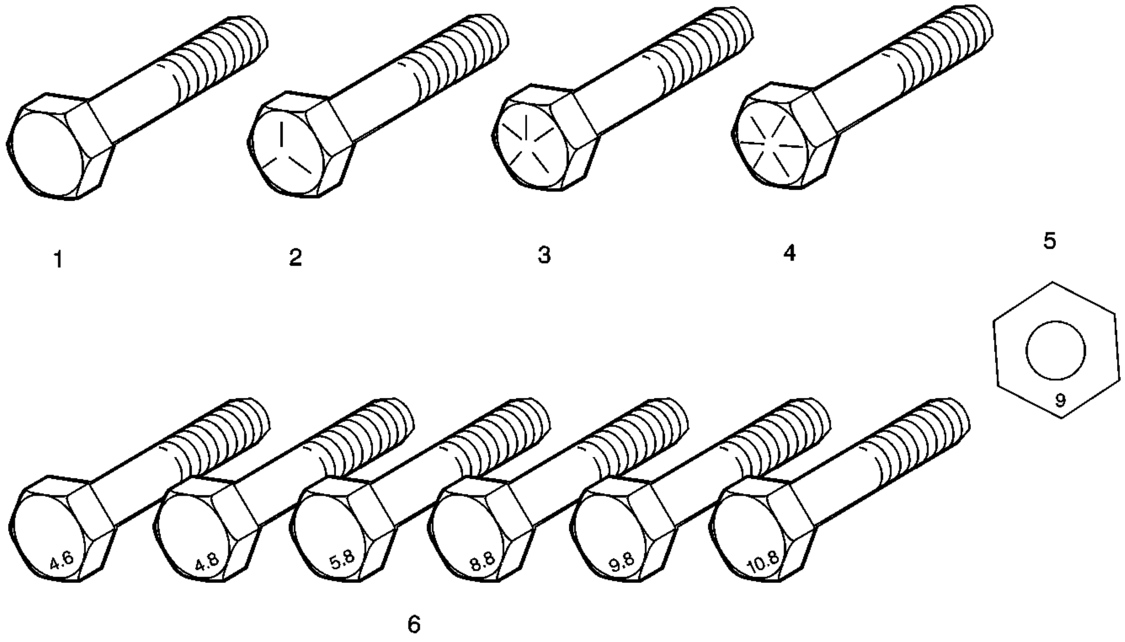


Fig. 6: Fastener Strength Marks
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	English Bolt, Grade 2 (Strength Class)
2	English Bolt, Grade 5 (Strength Class)
3	English Bolt, Grade 7 (Strength Class)
4	English Bolt, Grade 8 (Strength Class)
5	Metric Nut, Strength Class 9
6	Metric Bolts, Strength Class Increases as Numbers Increase

The most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt. The English, inch strength classes range from grade 2 to grade 8. Radial lines are embossed on the head of each bolt in order to identify the strength class. The number of lines on the head of the bolt is 2 lines less than the actual grade. For example, a grade 8 bolt will have 6 radial lines on the bolt head. Some metric nuts are marked with a single digit strength identification number on the nut face.

The correct fasteners are available through GM SPO. Many metric fasteners available in the aftermarket parts channels are designed to metric standards of countries other than the United States, and may exhibit the following:

- Lower strength
- No numbered head marking system
- Wrong thread pitch

The metric fasteners on GM products are designed to new, international standards. The following are the common sizes and pitches, except for special applications:

- M6.0 X 1
- M8 X 1.25
- M10 X 1.5
- M12 X 1.75
- M14 X 2.00
- M16 X 2.00

Prevailing Torque Fasteners

Prevailing torque fasteners create a thread interface between the fastener and the fastener counterpart in order to prevent the fastener from loosening.

All Metal Prevailing Torque Fasteners

These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

These fasteners accomplish the thread interface by the presence of a nylon material on the fastener threads.

Adhesive Coated Fasteners

These fasteners accomplish the thread interface by the presence of a thread-locking compound on the fastener threads. Refer to the appropriate repair procedure in order to determine if the fastener may be reused and the applicable thread-locking compound to apply to the fastener.

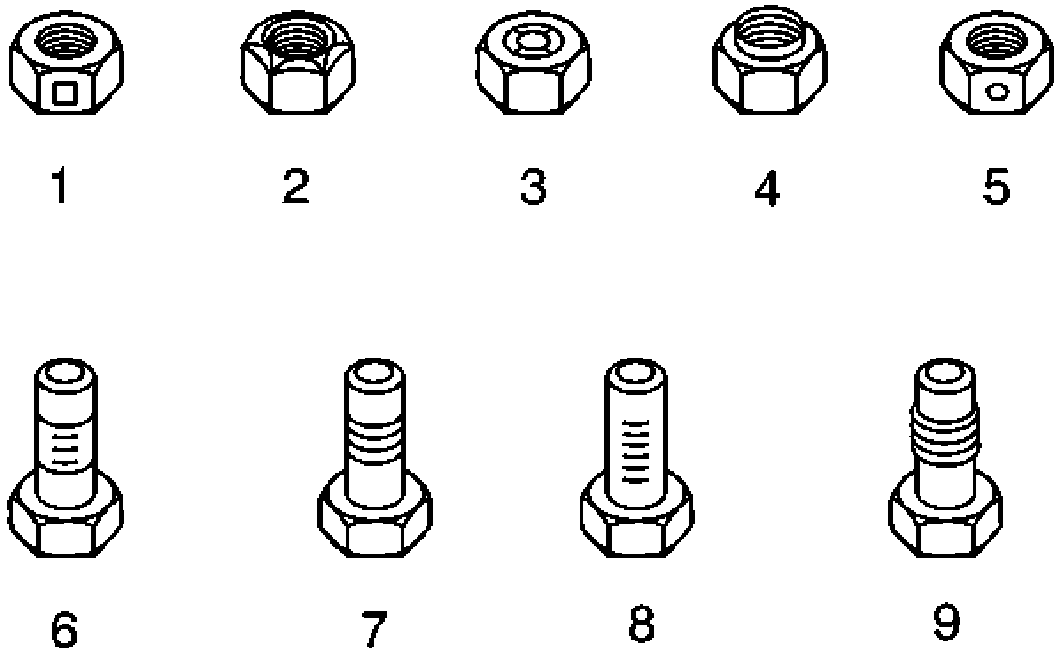


Fig. 7: Adhesive Coated Fasteners
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Prevailing Torque Nut, Center Lock Type
2	Prevailing Torque Nut, Top Lock Type
3	Prevailing Torque Nut, Nylon Patch Type
4	Prevailing Torque Nut, Nylon Washer Insert Type
5	Prevailing Torque Nut, Nylon Insert Type

Callout	Component Name
6	Prevailing Torque Bolt, Dry Adhesive Coating Type
7	Prevailing Torque Bolt, Thread Profile Deformed Type
8	Prevailing Torque Bolt, Nylon Strip Type
9	Prevailing Torque Bolt, Out-of-Round Thread Area Type

A prevailing torque fastener may be reused ONLY if:

- The fastener and the fastener counterpart are clean and not damaged
- There is no rust on the fastener
- The fastener develops the specified minimum torque against its counterpart prior to the fastener seating

Metric Prevailing Torque Fastener Minimum Torque Development

	Specification	
Application	**Metric**	**English**
All Metal Prevailing Torque Fasteners		
• 6 mm	0.4 N.m	4 lb in
• 8 mm	0.8 N.m	7 lb in
• 10 mm	1.4 N.m	12 lb in
• 12 mm	2.1 N.m	19 lb in
• 14 mm	3 N.m	27 lb in
• 16 mm	4.2 N.m	37 lb in
• 20 mm	7 N.m	62 lb in
• 24 mm	10.5 N.m	93 lb in
Nylon Interface Prevailing Torque Fasteners		
• 6 mm	0.3 N.m	3 lb in
• 8 mm	0.6 N.m	5 lb in
• 10 mm	1.1 N.m	10 lb in
• 12 mm	1.5 N.m	13 lb in
• 14 mm	2.3 N.m	20 lb in
• 16 mm	3.4 N.m	30 lb in

Application	Specification	
	Metric	English
- 20 mm	5.5 N.m	49 lb in
- 24 mm	8.5 N.m	75 lb in

English Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
- 1/4 in	0.5 N.m	4.5 lb in
- 5/16 in	0.8 N.m	7.5 lb in
- 3/8 in	1.3 N.m	11.5 lb in
- 7/16 in	1.8 N.m	16 lb in
- 1/2 in	2.3 N.m	20 lb in
- 9/16 in	3.2 N.m	28 lb in
- 5/8 in	4 N.m	36 lb in
- 3/4 in	7 N.m	62 lb in
Nylon Interface Prevailing Torque Fasteners		
- 1/4 in	0.3 N.m	3 lb in
- 5/16 in	0.6 N.m	5 lb in
- 3/8 in	1 N.m	9 lb in
- 7/16 in	1.3 N.m	12 lb in
- 1/2 in	1.8 N.m	16 lb in
- 9/16 in	2.5 N.m	22 lb in
- 5/8 in	3.4 N.m	30 lb in
- 3/4 in	5 N.m	45 lb in

THREAD INSERTS

General Purpose Thread Repair Kits.

These kits are available commercially.

Repair Procedure

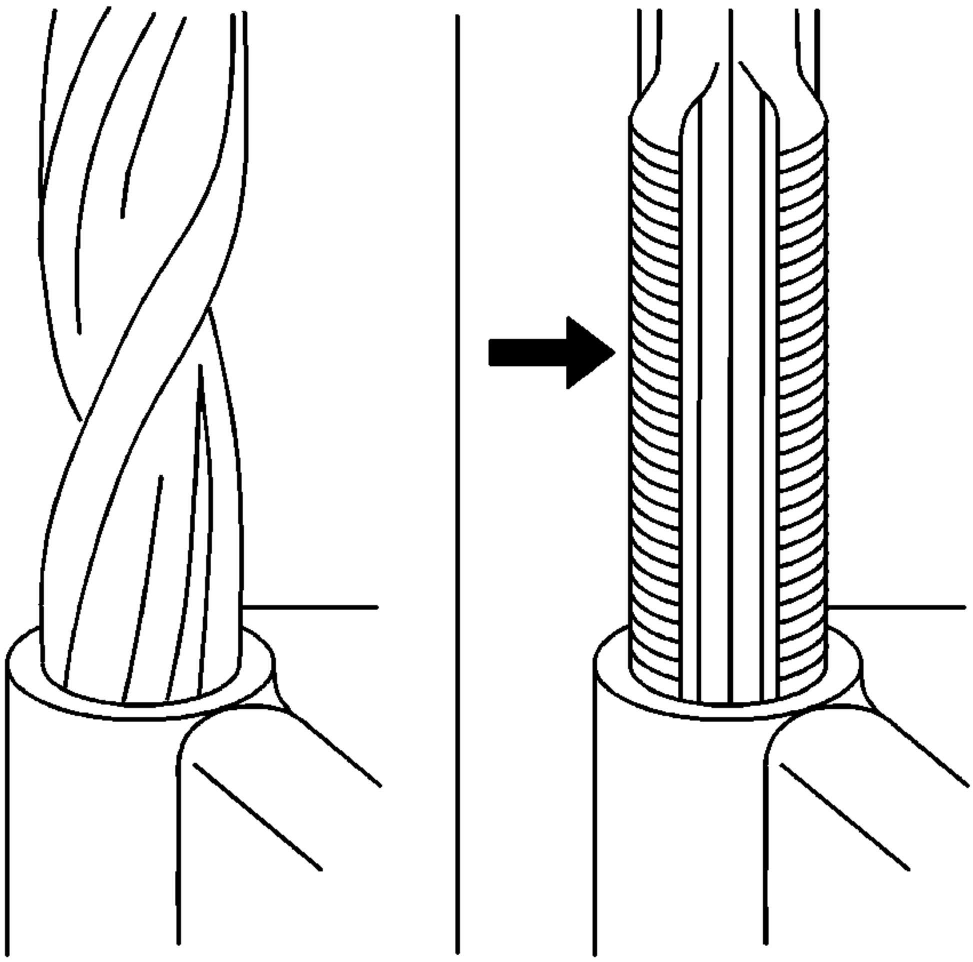


Fig. 8: Drilling & Tapping Damaged Threads
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Refer to Safety Glasses Warning .**

NOTE: **Refer to the thread repair kit manufacturer's instructions regarding the size of the drill and tap to use.**

Avoid any buildup of chips. Back out the tap every few turns and remove the chips.

1. Determine the size, the pitch, and the depth of the damaged thread. If necessary, adjust the stop collars on the cutting tool and tap to the required depth.
2. Drill out the damaged threads. Clean out any chips.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.

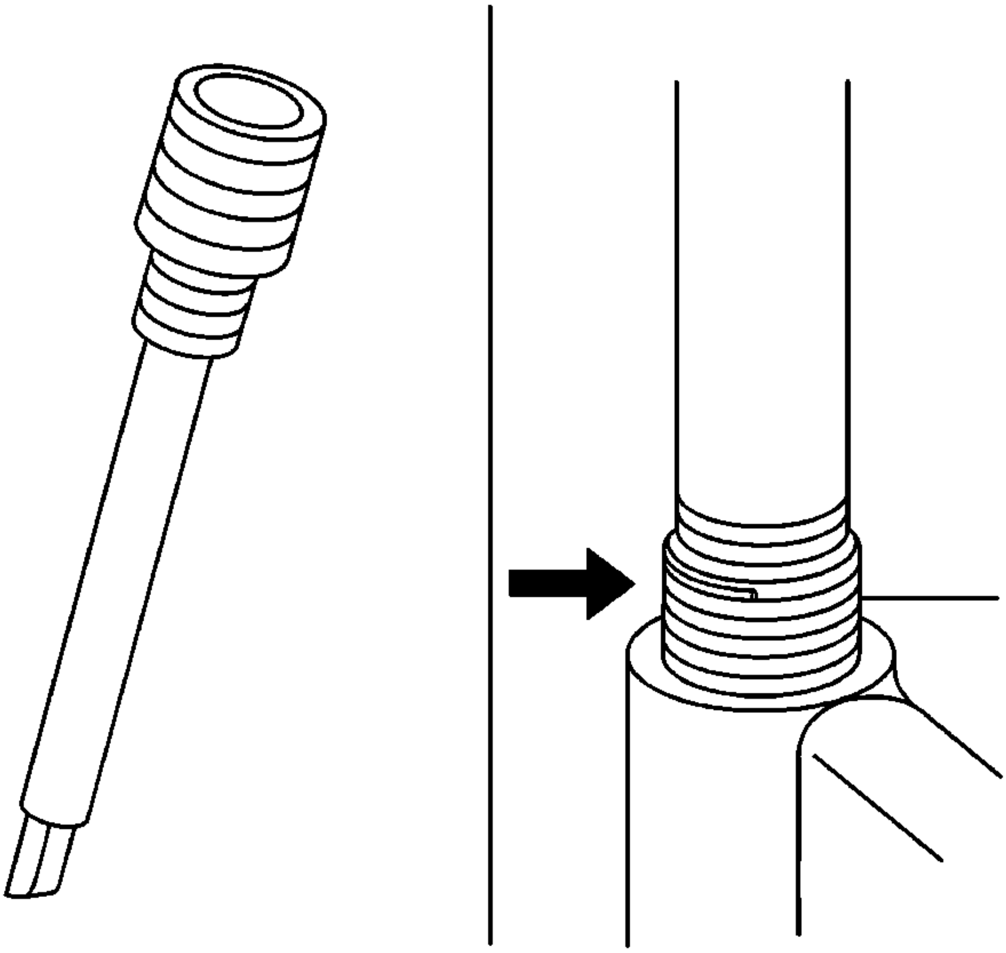


Fig. 9: Thread Insert
Courtesy of GENERAL MOTORS COMPANY

4. Thread the thread insert onto the mandrel of the installer. Engage the tang of the insert onto the end of the mandrel.

NOTE: The insert should be flush to one turn below the surface.

5. Lubricate the insert with light engine oil, except when installing in aluminum and install the insert.
6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.

REGISTERED AND NON-REGISTERED TRADEMARKS

Listed below are Registered Trademarks (Â®) or Non-Registered Trademarks (™) which may appear in this service manual.

A
ACÂ®
ACCUTURNÂ®
ACDelcoÂ®
Active Fuel Management™
AcuzincÂ®
AirbankÂ®
AllisonÂ®
AMMCOÂ®
AUTOFUSEÂ®

AUTOTRACÂ®
B
BendixÂ®
BluetoothÂ®
BON-AMIÂ®
BoschÂ®
BoseÂ®
C
CaterpillarÂ®
CATÂ®
C-QuamÂ®
D
DelcoÂ®
Delco BoseÂ®
Delco ElectronicsÂ®
Delco FreedomÂ®
Delco LOC IIÂ®
Delco MoraineÂ®
Delco RemyÂ®
Delco SoundÂ®
Delco SupremeÂ®
Delco TechÂ®
DELCOREÂ®
DelphiÂ®
DEX-COOLÂ®
DEXOILÂ®
DEXRONÂ®
DEXSTEER™
DNRÂ®
DolbyÂ®
DRÂ®
DuracellÂ®
DuraguardÂ®
DurastopÂ®
Duramax™
E
Eaton CorporationÂ®
EMDÂ®
ETRÂ®
F
FLO-LITEÂ®
G
General MotorsÂ®
GMÂ®
GM Goodwrench ServiceÂ®
GM OptikleenÂ®
GM Parts™
GM PassÂ®
GM UltraliteÂ®
GMACÂ®
GoodwrenchÂ®
GTPÂ®
H

Homelink™
HYDRA-MATICÂ®
I
IlluminationÂ®
INSTA-TRACÂ®
IntuneÂ®
L
LOCTITE™
Lord Fusor™
M
MAGNASTEERÂ®
MaxifuseÂ®
MetripackÂ®
MicropackÂ®
MinifuseÂ®
Mr GoodwrenchÂ®
N
NorthstarÂ®
O
OnStarÂ®
OptikleenÂ®
P
PASS-KEYÂ®
PASS-KEYIIÂ®
PASSLOCK™
PK3Â®
PozidrivÂ®
ProÂ®
Q
Quad 4Â®
R
RAINSENSE™
Rapid FireÂ®
S
ScotchBrite™
Scotchguard™
SignalsÂ®
Sikkens™
Soft-RayÂ®
Solar-RayÂ®
StabilitrakÂ®
SunrayceÂ®
SuperlubeÂ®
SycloneÂ®
T
Tech 2Â®
TechlineÂ®
TeflonÂ®
TefzelÂ®
Theft-IÂ®
TheftlockÂ®
TiltmasterÂ®
TORXÂ®

TransjelÂ®
TransguideÂ®
Twilight SentinelÂ®
U
UltraliteÂ®
V
VelcroÂ®
W
Weatherpack™

DOOR LOCK AND IGNITION LOCK FOLDING AND NON-FOLDING KEY CUTTING

High Security keys are available from the service parts system.

Obtain the key code from the security card or from the GM Dealer World, Parts, Key Code Look Up system.

If you have the key code and access to a Triax-E., BD Laser or other code key cutting machine from the GM Dealer Equipment Catalog, you may cut a new key.

If you have the original key and access to a Matrix S, BD Laser or other key duplicating machine, you may duplicate the key.

If you do not have a high security key cutting machine, order the side cut key from the service parts system. Include the key code in the NOTE field. Indicate the timing and the method of the shipment.

Inspect the new key operation in the lock cylinder. Ensure the new key operates effectively.

FRONT SIDE DOOR LOCK CYLINDER CODING

Special Tools

BO-49753 Assembly Tool

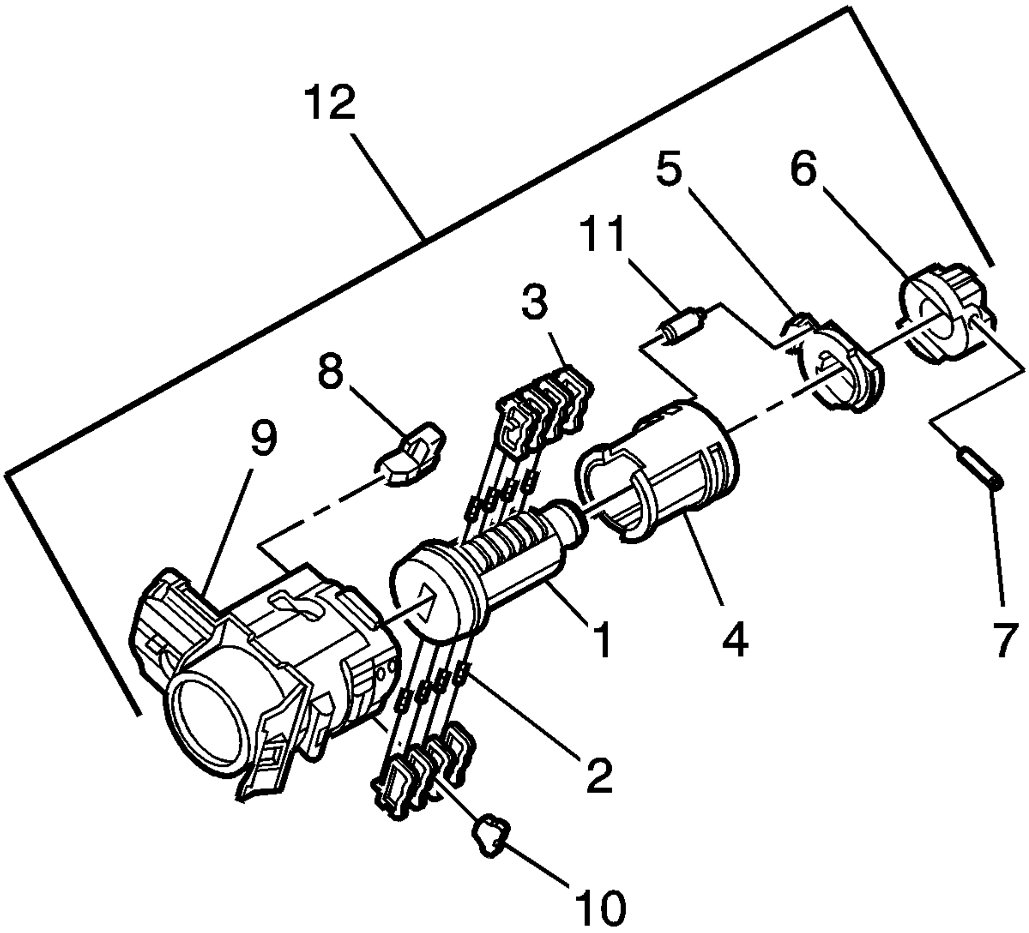


Fig. 10: Lock Components
Courtesy of GENERAL MOTORS COMPANY

The door lock cylinder uses 8 of the 8 cut positions. The tumbler positions are staggered from side to side, 4 on one side and 4 on the other, are not self-retaining, and are not snap in.

NOTE: **All lock cylinders for side milled keys have right and left tumblers. The location of the tooth of the tumbler determines whether it is right of left. Illustrations in this procedure show the right tumblers on the top and the left tumblers on the bottom. All tumblers are marked 1R, 1L, 2R, or 2L. The number being cut depth and the letter meaning right or left.**

1. Hold the door lock cylinder (1) so the side with the 4 tumbler spring pockets faces up, pocket nearest to the cylinder head.
2. Insert the tumbler springs (2) into the 4 spring pockets. This side uses left tumblers.

3. Install the tumbler (3) for key cut position one in the slot nearest to the front of the lock cylinder. Install the remaining tumblers, key cut positions 3, 5, and 7, following the key code and same process. Press the tumblers in place until they are secure.
4. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
5. Turn the cylinder so the side with the 4 tumbler spring wells faces up. This side uses right tumblers.
6. Insert the tumbler springs into the 4 spring pockets.
7. The first tumbler closest to the front of the lock cylinder to be loaded will be the second key cut position, the second number in the key code. Install the remaining tumblers for the key cut positions 4, 6, and 8. Press the tumblers in place until they are secure.
8. Check the correct loading of the tumblers by inserting the key into the cylinder. All tumblers should be flush with the lock cylinder body.
9. Insert the key and lightly lubricate the cylinder body diameter and tumbler surfaces and a small amount in the head of the cylinder using the supplied grease.
10. Insert the sleeve (4) onto the cylinder assembly.
11. Insert the clutch (5) and driver (6) onto the cylinder (1).

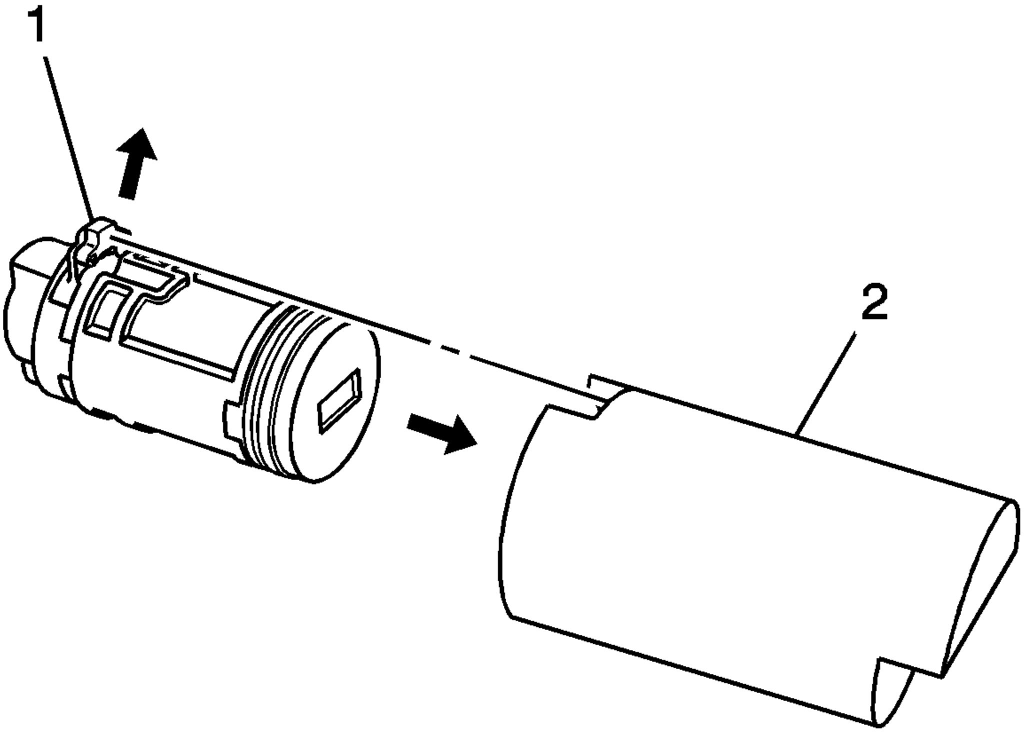


Fig. 11: Loading Cylinder Into Special Tool
Courtesy of GENERAL MOTORS COMPANY

12. Load the cylinder into the **BO-49753** assembly tool so that the clutch (1) indexes with the notch in the opening of the tool (2).

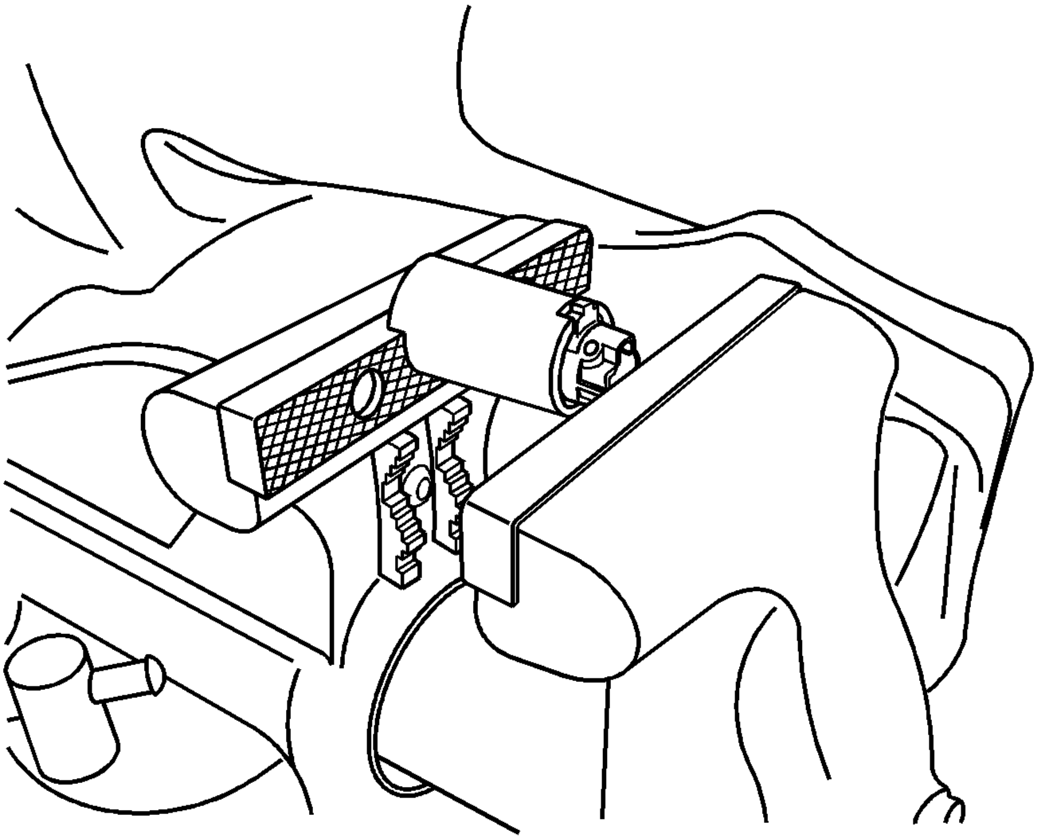


Fig. 12: Loading Assembly Tool Into Vise
Courtesy of GENERAL MOTORS COMPANY

13. Load the assembly tool with the lock cylinder into a vice and tighten the vice ONLY enough to hold the tool and lock the cylinder in place.

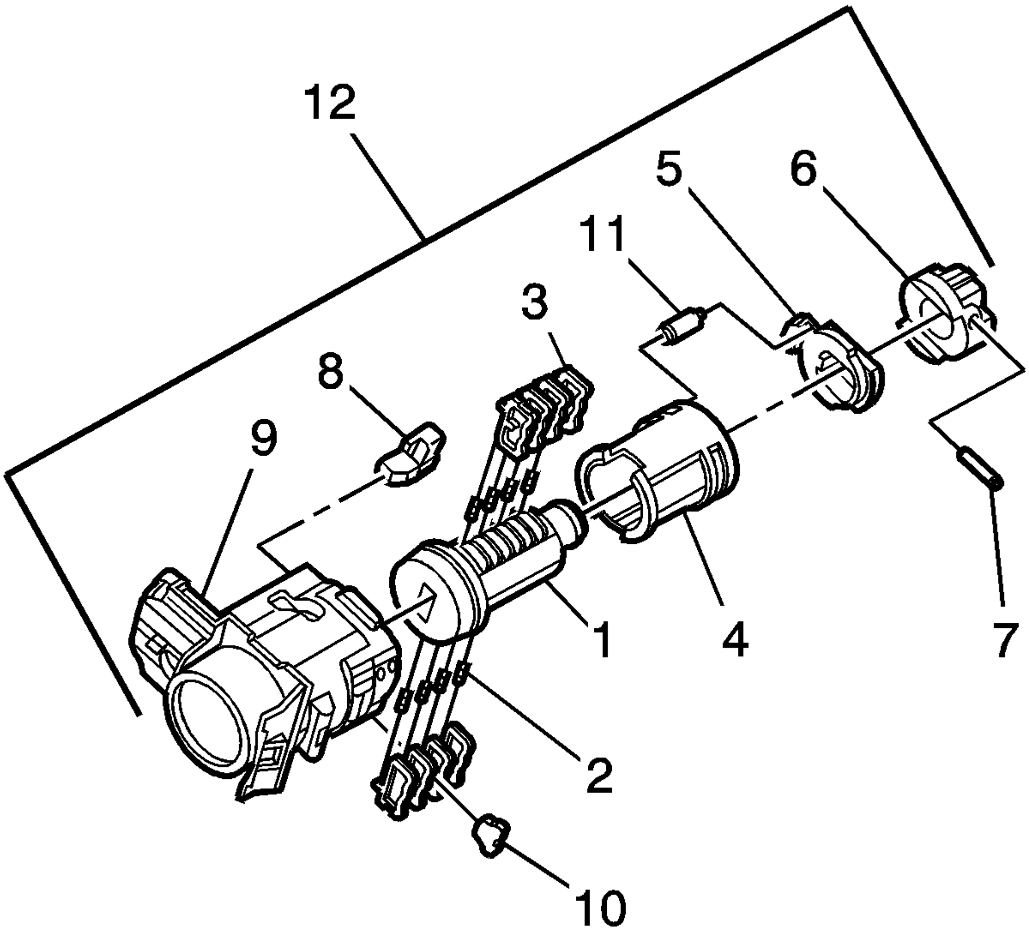


Fig. 13: Lock Components
Courtesy of GENERAL MOTORS COMPANY

14. Insert the roll pin (7) into the driver (6) and install it using a 1/16 inch pin punch.
15. Insert the buffer (8) in the case (9), verify the buffer is properly seated.
16. Install the free wheel pin (11) in the sleeve (4) and clutch (5) and insert the assembly into the case (9).
17. With the lock cylinder assembly installed in the case (9), install the retainer (10) and stake the retainer in place using a small punch and hammer to peen the case material onto the exposed ends of the installed retainer (10).
18. Insert the key into the lock and function the lock to check for proper assembly and smooth operation.

LIFTING AND JACKING THE VEHICLE

NOTE: **The use of a LOW PROFILE LIFT ARMS SYSTEM may be required to**

avoid unwanted contact with the vehicle body and structure depending on lifting equipment used. Refer to the manufacturer recommendation for their applications of low profile lift arms system for their lifting equipment.

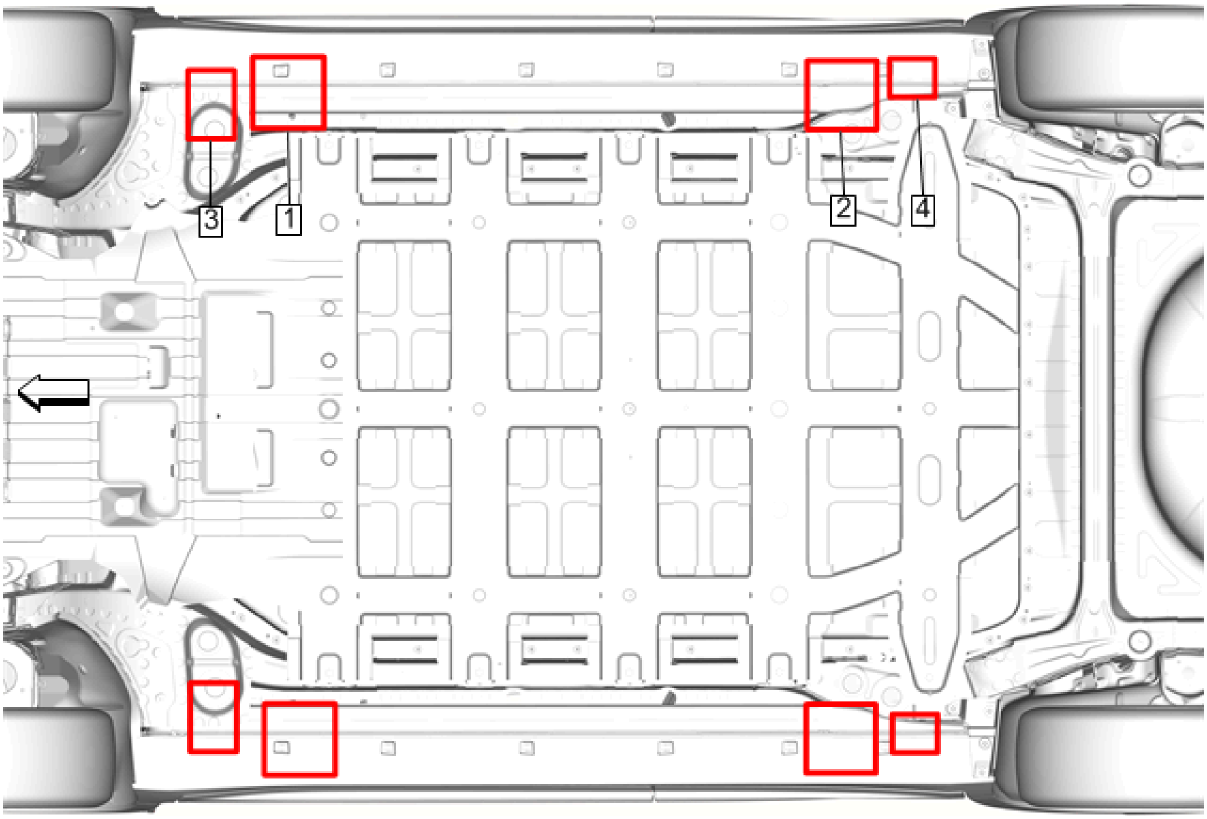


Fig. 14: Vehicle Jacking Points
Courtesy of GENERAL MOTORS COMPANY

WARNING: **To avoid any vehicle damage, serious personal injury or death:**

- **When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.**
- **When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.**

WARNING: **To avoid any vehicle damage, serious personal injury or death, always use the jackstands to support the vehicle when lifting the vehicle with a jack.**

CAUTION: **Perform the following steps before beginning any vehicle lifting or jacking procedure:**

- **Remove or secure all of the vehicle contents in order to avoid any shifting or any movement that may occur during the vehicle lifting or jacking procedure.**
- **The lifting equipment or the jacking equipment weight rating must meet or exceed the weight of the vehicle and any vehicle contents.**

- **The lifting equipment or the jacking equipment must meet the operational standards of the lifting equipment or jacking equipment manufacturer.**
- **Perform the vehicle lifting or jacking procedure on a clean, hard, dry, level surface.**
- **Perform the vehicle lifting or jacking procedure only at the identified lift points. DO NOT allow the lifting equipment or jacking equipment to contact any other vehicle components.**

Failure to perform the previous steps could result in damage to the lifting equipment or the jacking equipment, the vehicle, and/or the vehicle contents.

Vehicle Lifting - Frame Contact Lift

Front Lift Pads

When lifting the vehicle with a frame-contact lift, place the front lift pads on the rocker outer panel weld flange (1), as shown.

Rear Lift Pads

When lifting the vehicle with a frame-contact lift, place the rear lift pads on the rocker outer panel weld flange (2), as shown.

Vehicle Jacking

CAUTION: **When you are jacking the vehicle at the front locations, be certain that the jack or the jack lift pad does not contact the front fascia, front fascia air dam, or the front fenders. If such contact occurs, vehicle damage may result. When jacking at selected front locations additional clearance may be required for the jacking points.**

NOTE: **When you are lifting a vehicle with a service jack, block the wheels at the opposite end from which you are lifting. Use jack stands to provide additional support.**

When using a service jack under the front of the vehicle use one of the following locations:

Front of Vehicle

Place the service jack pad at the front compartment side rail bracket panel and rocker outer panel weld flange (3), as shown with rubber or wood block.

Rear of Vehicle

NOTE: **Place jackstands ONLY under strong and stable vehicle structures.**

Place the service jack pad rocker outer panel weld flange (4), as shown with rubber or wood block.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS ORDERING INFORMATION

Special Tools

The special service tools shown in this service manual that have product numbers beginning with J, BO, GE, CH, DT, EN, EL, SA, OR KM are available for worldwide distribution.

US, Canada and Caribbean only:

NOTE: **For Special Service tools only - see different location below for**

diagnostic tools & equipment.

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Warren

MI

48092-3499

U.S.A

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Fax: 1-800-578-7375 or 586-578-7321

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Bosch Automotive Service Solutions

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Mexico

Phone: +5255 2595 1630

Fax: +5255 2595 1639

Inquiries can be sent to: herramientas@service-solutions.com

South America, Excluding Brazil:

Bosch Automotive Service Solutions

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Mexico

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GENERAL INFORMATION

Manual Transmission Trouble Shooting

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

INTRODUCTION

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

There are many times when the transmission is incorrectly blamed for shifting problems or noises that are actually caused by other reasons. Shift difficulties are frequently caused by conditions outside of the transmission or transaxle. Typical conditions include: shift linkage, shift cables, alignment of engine to transmission, worn engine mounts or clutch problems. Drive train noises may come from many sources such as tires, road surfaces, wheel bearings, differentials, engine or exhaust system. Repairing or overhauling transmission will not cure these problems.

No manufacturer makes a perfectly quiet transmission. Gear rollover noise is present in most constant mesh transmissions and will tend to disappear when the clutch is disengaged or transmission is placed in gear. If clutch is properly adjusted, clutch release bearing noise will disappear when release bearing is moved enough to slide release bearing away from pressure plate.

Trouble shooting can be helped by driving vehicle on a smooth level road to help eliminate tire and body noise. Note whether noise occurs on acceleration, coasting, deceleration or steady driving conditions. Some problems may only occur when transmission is either hot or cold. Gear lubricant that is too thick can cause hard shifting on cold mornings before engine is warm and vehicle has been driven.

MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	**Possible Cause**
Noisy In Forward Gears	Low Gear Oil Level, Loose Bellhousing Bolts, Worn Bearings Or Gears
Clunk On Deceleration (FWD Only)	Loose Engine Mounts, Worn Inboard CV Joints, Worn Differential Pinion Shaft, Oversized Side Gear Hub Counterbore in Case
Gear Clash When Shifting Forward Gears	Clutch Out Of Alignment, Shift Linkage Damaged Or Out Of Adjustment, Gears Or Synchronizers Damaged, Low Gear Oil Level
Transmission Noisy When Moving (RWD Only); Quiet In Neutral With Clutch Engaged	Worn Rear Output Shaft Bearing
Gear Rattle	Worn Bearings, Worn Gear Oil, Low Gear Oil, Worn Gears
Steady Ticking At Idle (Increases With RPM)	Broken Tooth On A Gear
Gear Clash When Shifting Forward Gears	Worn Or Broken Synchronizers, Faulty Clutch
Loud Whine In Reverse	Normal Condition (1)
Noise When Stepping On Clutch	Faulty Release Bearing, Worn Pilot Bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty Release Bearing, Uneven Pressure Plate Fingers
Click Or Snap When Clutch Is Engaged	Worn Clutch Fork, Worn Pivot Ball, Worn Or Broken Front Bearing Retainer

Condition	Possible Cause
Transmission Shifts Hard	Clutch Not Releasing, Incorrect Gear Oil, Shift Mechanism Binding, Clutch Installed Backward
Will Not Shift Into One Gear, Shifts Into All Others	Bent Shift Fork, Worn Detent Balls
Locked Into Gear, Cannot Shift	Clutch Adjustment, Worn Detent Balls
Transmission Jumps Out Of Gear	Pilot Bearing Worn, Bent Shift Fork, Worn Gear Teeth Or Face, Excessive Gear Train End Play, Worn Synchronizers, Missing Detent Ball Spring, Shift Mechanism Worn Or Out Of Adjustment, Engine Or Transmission Mount Bolts Loose, Transmission Not Aligned
Shift Lever Rattle	Worn Detents Or Shift Lever, Worn Shift Fork, Worn Synchronizer Sleeves
Shift Lever Hops Under Acceleration	Worn Engine Or Transmission Mounts
(1) Most units use spur cut gears in Reverse and are naturally noisy.	

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GENERAL INFORMATION

Parasitic Load Explanation & Test Procedures

* PLEASE READ THIS FIRST *

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GENERAL INFORMATION

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

The term Parasitic Load refers to electrical devices that continue to use or draw current after the ignition switch is turned to OFF position. This small amount of continuous battery draw is expressed in milliamps (mA). On Chrysler vehicles, a typical Parasitic Load should be no more than 30 milliamps (0.030 amps). On Ford Motor Co. and General Motors vehicles produced after 1980, a typical Parasitic Load should be no more than 50 milliamps (0.050 amps).

Vehicles produced since 1980 have memory devices that draw current with ignition off for as long as 20 minutes before shutting down the Parasitic Drain. When Parasitic Load exceeds normal specifications, the vehicle may exhibit dead battery and no-start condition.

Follow test procedure for checking Parasitic Loads to completion. A brief overview of a suggested test procedure is included along with some typical Parasitic Load specifications. Refer to GENERAL MOTORS PARASITIC LOAD TABLE chart.

TESTING FOR PARASITIC LOAD

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

CAUTION: **Always turn ignition off when connecting or disconnecting battery cables, battery chargers or jumper cables. DO NOT turn test switch to OFF position (which causes current to run through ammeter or vehicle electrical system).**

NOTE: **Memory functions of various accessories must be reset after the battery is reconnected.**

The battery circuit must be opened to connect test switch (shunt) and ammeter into the circuit. When a battery cable is removed, timer circuits within the vehicle computer are interrupted and immediately begin to discharge. If in doubt about the condition of the ammeter fuse, test it with an ohmmeter prior to beginning test. An open fuse will show the same reading (00.00) as no parasitic drain. Begin test sequence with the meter installed and on the 10-amp scale. Select lower scale to read parasitic draw.

CHRYSLER IGNITION OFF DRAW (IOD) TEST

To test for excessive IOD, verify that all electrical accessories are OFF. Turn off all lights, remove ignition key, and close all doors and decklid. If the vehicle is equipped with electronic accessories (illuminated entry, automatic load leveler, body computer, or high line radio), allow the system to automatically shut off (time out), up to 3 minutes.

1. Raise the hood and disconnect both battery cables, negative first.

CAUTION: IOD greater than 3 amps may damage millampmeter.

2. Reconnect the negative cable and connect a typical 12-volt test light (low wattage bulb) between the positive cable clamp and the positive battery post. Remove the engine compartment lamp bulb. If the test light does not light, proceed to step 3. If the test light does light, proceed to step, 4. The test light will indicate IOD greater than 3 amps. After higher amperage IOD has been corrected, proceed to step 3.
3. ith 12-volt test light still connected (not lit), connect an ammeter (milliampere scale) between the positive cable clamp and the positive battery post, disconnect test light, refer to instructions provided with ammeter being used. A reading of 30 milliamperes or less indicates normal electrical draw. If ammeter reads more than 30 milliamperes, excessive IOD must be corrected.
4. Locate the fuse panel and remove fuses or circuit breakers one at a time, and observe ammeter after each fuse or circuit breaker is removed. If test light goes out and the reading drops below 30 milliamperes when a certain fuse or circuit breaker is removed, that circuit may have a defect.
5. If IOD is detected after all fuses and circuit breakers have been removed, disconnect the 60-way connector at the Single Module Engine Control (SMEC), located outboard of the battery.
6. If excessive IOD is detected after all fused circuits and SMEC have been verified, disconnect the B+ terminal from the alternator. If reading drops below 30 milliamperes, reinstall all fuses and circuit breakers, reconnect B+ terminal at alternator, reconnect battery, and perform alternator diagnostics.
7. Install engine compartment lamp bulb.

TEST PROCEDURE USING TEST SWITCH

1. Turn ignition off. Remove negative battery terminal cable. Install Disconnect Tool (J-38758) test switch male end to negative battery cable. Turn test switch knob to OFF position (current through meter). Install negative battery cable to the female end of test switch.
2. Turn test switch knob to ON position (current through switch). Road test vehicle with vehicle accessories on (radio, air conditioner, etc). After road test, turn ignition switch to LOCKED position and remove key. Connect ammeter terminals to test switch terminals. See **Fig. 1**. Select 10-amp scale.
3. Turn off all electrical accessories. Turn off interior lights, underhood lamp, trunk light, illuminated entry, etc. To avoid damaging ammeter or obtaining a false meter reading, all accessories must be off before turning test switch knob to OFF position.
4. Turn test switch knob to OFF position to allow current to flow through ammeter. If meter reads wrong polarity, turn test switch to ON position and reverse leads. Turn test switch to OFF position. Observe current reading. If reading is less than 2 amps, turn test switch to ON position to keep electrical circuits powered-up.
5. Select low amp scale. Switch lead to the correct meter position. Turn test switch to OFF position and compare results to normal current draw. See **GENERAL MOTORS PARASITIC LOAD TABLE (MILLIAMPS)**. If current draw is unusually high for the vehicle's overall electrical system, remove system fuses one at a time until current draw returns to normal.
6. Turn test switch to ON position each time door is opened or fuse is removed. Turn switch to OFF position to read current draw value through meter. When the cause of excessive current drain has been located and repaired, remove test switch and reconnect negative battery cable to the negative battery terminal.

INTERMITTENT PARASITIC LOAD PROBLEMS

Intermittent parasitic load can occur because of a memory device that does not power down with ignition off. With an intermittent parasitic load, battery draw can be greater than 1.0 amp.

To find an intermittent problem requires that an ammeter and Disconnect Tool (J-38758) test switch be connected and left in the circuit. See **Fig. 1**. Road test vehicle. After road test, turn ignition off and remove key.

Monitor the milliamps scale for 15-20 minutes after ignition is turned off. This allows monitoring memory devices to determine if they time out and stop drawing memory current. The test switch is needed to protect ammeter when the vehicle is started.

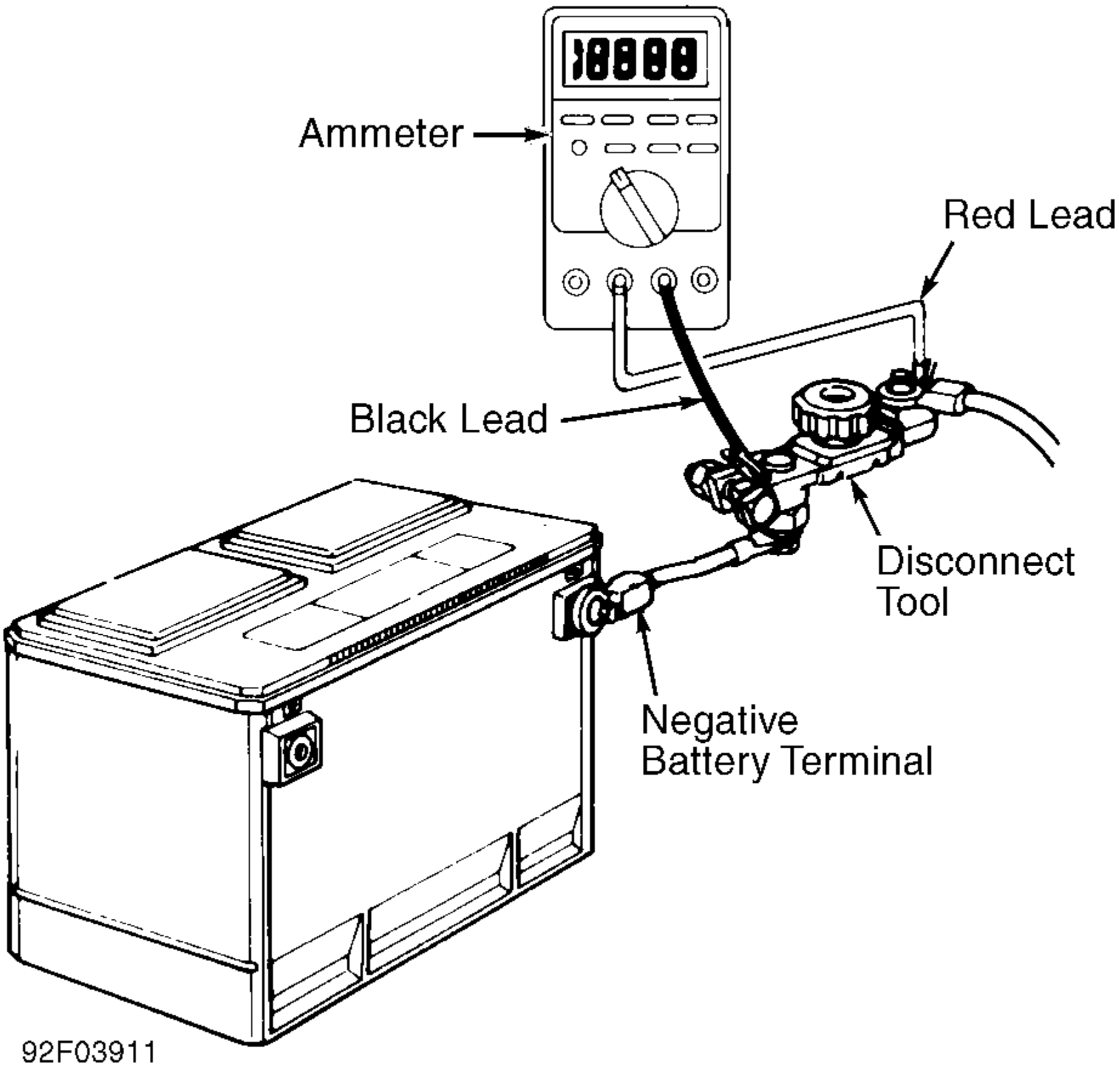

Ammeter
Red Lead
Black Lead
Disconnect Tool
Negative Battery Terminal
92F03911

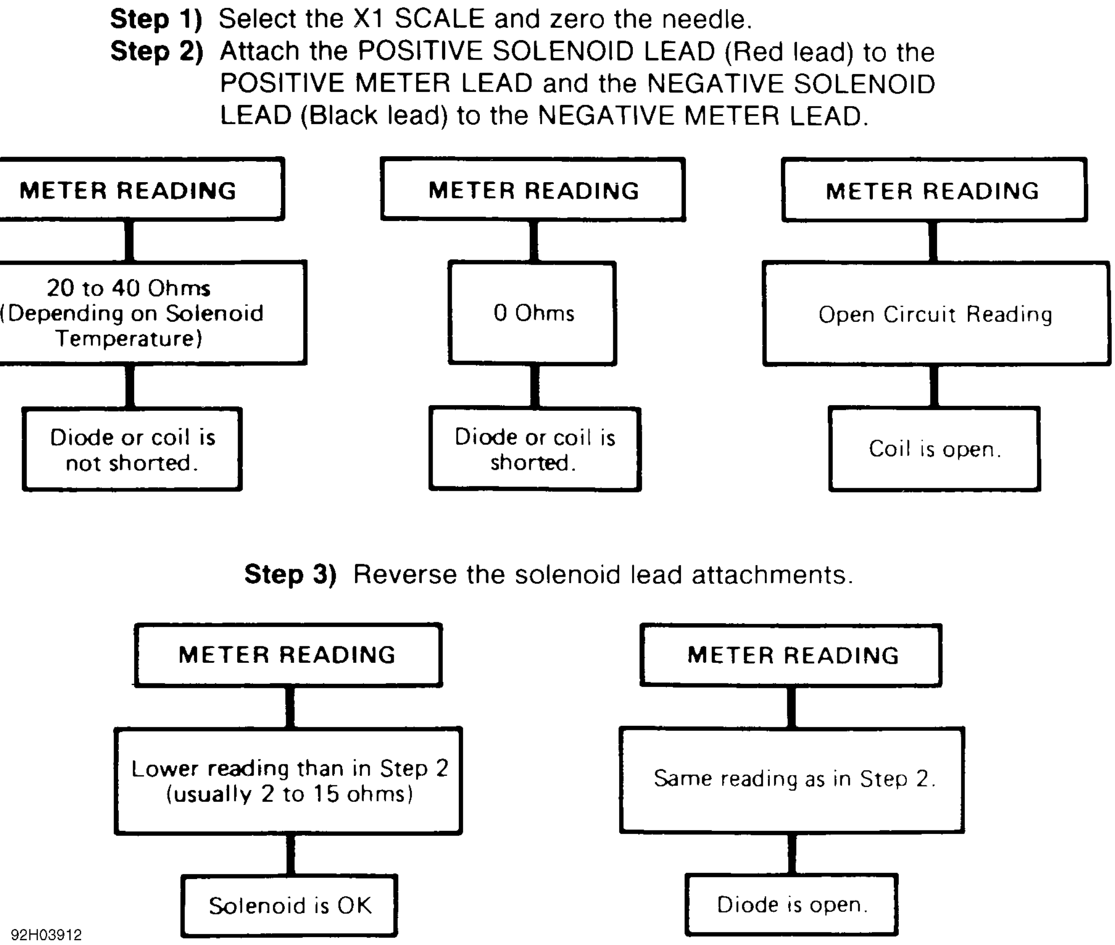
Fig. 1: Connecting Kent-Moore Disconnect Tool (J-38758)
Courtesy of GENERAL MOTORS CORP.

GENERAL MOTORS PARASITIC LOAD

Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Anti-Theft System	0.4	1.0	.....
Auto Door Lock	1.0	1.0	.....
Body Control Module	3.6	12.4	20
Central Processing System	1.6	2.7	20
Electronic Control Module	5.6	10.0	.....
Electronic Level Control	2.0	3.3	20
Heated Windshield Module	0.3	0.4	.....
HVAC Power Module	1.0	1.0	.....
Illuminated Entry	1.0	1.0	1
Light Control Module	0.5	1.0	.....
Oil Level Module	0.1	0.1	.....
Multi-Function Chime	1.0	1.0	.....

Component	Normal Draw	Maximum Draw	Time-Out (Minutes)
Pass Key Decoder Module	0.75	1.0	.....
Power Control Module	5.0	7.0	.....
Retained Accessory Power	3.8	3.8	.....
Radio	7.0	8.0	15
Twilight Sentinel Module	1.0	1.0	.....
Voltage Regulator	1.4	2.0	.....

DIODE CHECK & SOLENOID TEST



Step 1) Select the X1 SCALE and zero the needle.
Step 2) Attach the POSITIVE SOLENOID LEAD (Red lead) to the POSITIVE METER LEAD and the NEGATIVE SOLENOID LEAD (Black lead) to the NEGATIVE METER LEAD.

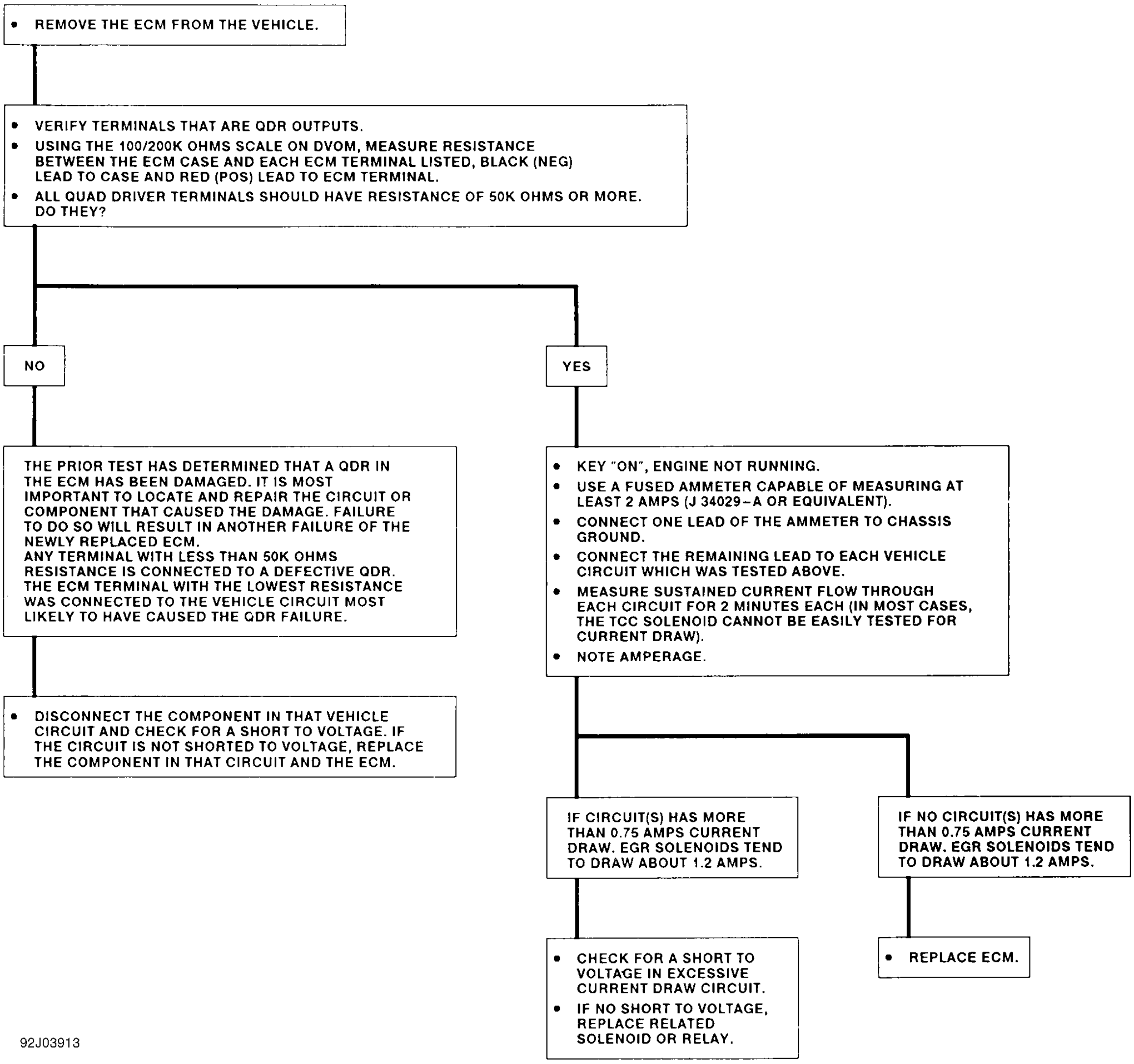
METER READING
20 to 40 Ohms (Depending on Solenoid Temperature)
Diode or coil is not shorted.
METER READING
0 Ohms
Diode or coil is shorted.
METER READING
Open Circuit Reading
Coil is open.

Step 3) Reverse the solenoid lead attachments.

METER READING
Lower reading than in Step 2 (usually 2 to 15 ohms)
Solenoid is OK
METER READING
Same reading as in Step 2.
Diode is open.
92H03912

Fig. 2: Diode Check & Solenoid Test
Courtesy of GENERAL MOTORS CORP.

QUAD DRIVER TEST



- REMOVE THE ECM FROM THE VEHICLE.

- VERIFY TERMINALS THAT ARE QDR OUTPUTS.
- USING THE 100/200K OHMS SCALE ON DVOM, MEASURE RESISTANCE BETWEEN THE ECM CASE AND EACH ECM TERMINAL LISTED, BLACK (NEG) LEAD TO CASE AND RED (POS) LEAD TO ECM TERMINAL.
- ALL QUAD DRIVER TERMINALS SHOULD HAVE RESISTANCE OF 50K OHMS OR MORE. DO THEY?

THE PRIOR TEST HAS DETERMINED THAT A QDR IN THE ECM HAS BEEN DAMAGED. IT IS MOST IMPORTANT TO LOCATE AND REPAIR THE CIRCUIT OR COMPONENT THAT CAUSED THE DAMAGE. FAILURE TO DO SO WILL RESULT IN ANOTHER FAILURE OF THE NEWLY REPLACED ECM. ANY TERMINAL WITH LESS THAN 50K OHMS RESISTANCE IS CONNECTED TO A DEFECTIVE QDR. THE ECM TERMINAL WITH THE LOWEST RESISTANCE WAS CONNECTED TO THE VEHICLE CIRCUIT MOST LIKELY TO HAVE CAUSED THE QDR FAILURE.

- DISCONNECT THE COMPONENT IN THAT VEHICLE CIRCUIT AND CHECK FOR A SHORT TO VOLTAGE. IF THE CIRCUIT IS NOT SHORTED TO VOLTAGE, REPLACE THE COMPONENT IN THAT CIRCUIT AND THE ECM.

- KEY "ON", ENGINE NOT RUNNING.
- USE A FUSED AMMETER CAPABLE OF MEASURING AT LEAST 2 AMPS (J 34029-A OR EQUIVALENT).
- CONNECT ONE LEAD OF THE AMMETER TO CHASSIS GROUND.
- CONNECT THE REMAINING LEAD TO EACH VEHICLE CIRCUIT WHICH WAS TESTED ABOVE.
- MEASURE SUSTAINED CURRENT FLOW THROUGH EACH CIRCUIT FOR 2 MINUTES EACH (IN MOST CASES, THE TCC SOLENOID CANNOT BE EASILY TESTED FOR CURRENT DRAW).
- NOTE AMPERAGE.

IF CIRCUIT(S) HAS MORE THAN 0.75 AMPS CURRENT DRAW. EGR SOLENOIDS TEND TO DRAW ABOUT 1.2 AMPS.

- CHECK FOR A SHORT TO VOLTAGE IN EXCESSIVE CURRENT DRAW CIRCUIT.
- IF NO SHORT TO VOLTAGE, REPLACE RELATED SOLENOID OR RELAY.

IF NO CIRCUIT(S) HAS MORE THAN 0.75 AMPS CURRENT DRAW. EGR SOLENOIDS TEND TO DRAW ABOUT 1.2 AMPS.

- REPLACE ECM.

Fig. 3: Quad Driver Test

Courtesy of GENERAL MOTORS CORP.

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2017 GENERAL INFORMATION

Programming and Setup - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

CONTROL MODULE REFERENCES

Reference Information

- Data Link References
- Diagnostic System Check - Vehicle
- Diagnostic Trouble Code (DTC) List - Vehicle
- Symptoms - Vehicle

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
A11	Radio Scan Tool Information	Radio/Navigation System Schematics	Radio Replacement	Radio Programming and Setup
B218L/R	Side Object Sensor Module Scan Tool Information	Object Detection Schematics	Side Object Sensing Alert Module Replacement	Side Object Sensor Module Programming and Setup
G1	Air Conditioning Compressor Control Module	HVAC Schematics	Air Conditioning and Drive Motor Battery Cooling Compressor Replacement	Air Conditioning Compressor Control Module Programming and Setup
K9	Body Control Module Scan Tool Information	Body Control System Schematics	Body Control Module Replacement	Body Control Module Programming and Setup
K16	Battery Energy Control Module Scan Tool Information	Hybrid/EV Energy Storage Schematics	Battery Energy Control Module Replacement	Battery Energy Control Module Programming and Setup
K17	Electronic Brake Control Module Scan Tool Information Electronic Brake Control Module Scan Tool Information (HP4)	Antilock Brake System Schematics	Electronic Brake Control Module Replacement	Electronic Brake Control Module Programming and Setup
K20	K20 Engine Control Module: Scan Tool Information	Hybrid/EV Controls Schematics	Engine Control Module Replacement	K20 Engine Control Module: Programming and Setup
K29	Heated Seat Control Module	Heated/Cooled Seat Schematics	Front Seat Heater Vent Control Module Replacement	Seat Heating Control Module Programming and Setup
K29R	Rear Seat Heater Control Module	Heated/Cooled Seat Schematics	Â	Rear Seat Heater Control Module Programming and Setup

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
K32	Steering Wheel Heat Control Module	Steering Wheel Schematics	Steering Wheel Heat Control Module Replacement	Steering Wheel Heat Control Module Programming and Setup
K33	Heating, Ventilation and Air Conditioning Control Module Scan Tool Information	HVAC Schematics	Heater and Air Conditioning Remote Control Replacement	HVAC Control Module Programming and Setup
K36	Inflatable Restraint Sensing and Diagnostic Module Scan Tool Information	SIR Schematics	Airbag Sensing and Diagnostic Module Replacement	Inflatable Restraint Sensing and Diagnostic Module Programming and Setup
K38	Chassis Control Module Scan Tool Information	Electronic Transmission Range Selector Schematics	Chassis Control Module Replacement	Chassis Control Module Programming and Setup
K43	Power Steering Control Module Scan Tool Information	Power Steering Schematics	Steering Column Replacement	Power Steering Control Module Programming and Setup
K56	Serial Data Gateway Module	Data Communication Schematics	Serial Data Gateway Module Replacement	Serial Data Gateway Module Programming and Setup
K73	Telematics Communication Interface Control Module Scan Tool Information	OnStar/Telematics Schematics	Communication Interface Module Replacement	Telematics Communication Interface Control Module Programming and Setup
K84	Keyless Entry Control Module Scan Tool Information	Remote Function Schematics	Keyless Entry Control Module Replacement	Keyless Entry Control Module Programming and Setup
K89	Immobilizer Control Module	Immobilizer Schematics	Theft Deterrent Module Replacement	Immobilizer Control Module Programming and Setup
K101	Trailer Lamp Control Module	Exterior Lights Schematics	Tail Lamp Control Module Replacement	Trailer Lamp Control Module Programming and Setup (MAH/MBC/MAW/MCX)
K109	Front View Camera Module Scan Tool Information	Object Detection Schematics	Front View Camera Replacement	Front View Camera Module Programming and Setup
K114B	Hybrid Powertrain Control Module 2 Scan Tool Information	Hybrid/EV Cooling Schematics or Hybrid/EV Energy Storage Schematics	Hybrid Powertrain Control Module 2 Replacement	Hybrid Powertrain Control Module 2 Programming and Setup
K132	Pedestrian Alert Sound Control Module Programming and Setup	Horn Schematics	Pedestrian Sound Alert Module Replacement	Pedestrian Alert Sound Control Module Programming and Setup

Code	Control Module/Scan Tool Information	Schematic	Repair Instruction	Programming and Setup
K157	Video Processing Control Module Scan Tool Information	Object Detection Schematics	Video Processing Module Replacement	Video Processing Control Module Programming and Setup
K173	Transmission Range Control Module	Electronic Transmission Range Selector Schematics	Â	Transmission Range Control Module Programming and Setup
K177	Brake Booster Control Module Scan Tool Information	Hydraulic Brake Schematics	Power Brake Master Cylinder Booster Assembly Replacement	Brake Booster Control Module Programming and Setup
K182	Parking Assist Control Module Scan Tool Information	Object Detection Schematics	Parking Assist Control Module Replacement	Parking Assist Control Module Programming and Setup
K190	Power Line Communication Module Scan Tool Information	Data Communication Schematics	Power Line Communication Module Replacement	Power Line Communication Module Programming and Setup
P16	Instrument Cluster Scan Tool Information	Instrument Cluster Schematics	Instrument Cluster Replacement	Instrument Cluster Programming and Setup
T6/K114A	Power Inverter Module Hybrid Powertrain Control Module Scan Tool Information	Hybrid/EV Controls Schematics	Drive Motor Power Inverter Module Replacement	Hybrid Powertrain Control Module Programming and Setup
T18/K57	Battery Charger	Plug-In Charging Schematics	Drive Motor Battery Charger Replacement (Except Dubai) Drive Motor Battery Charger Replacement (Dubai)	Battery Charger Programming and Setup

REPAIR INSTRUCTIONS

K20 ENGINE CONTROL MODULE: PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption**

during programming, programming failure or ECU damage may occur.

- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct power mode.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECM or Reprogram ECM

To program a replacement or an existing ECM, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select ECM Programming and follow the on-screen instructions.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Vehicle in Service Mode, attempt to reprogram the ECU. The ECU should program.
    - If the ECU still cannot be programmed, replace the ECU.

K68 TRAILER LIGHTING CONTROL MODULE: PROGRAMMING AND SETUP (MBM)

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

Replace and Program Control Module or Reprogram Control Module

This control module does not require SPS programming but does require the following setup procedures after a new control module is installed:

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K68 Trailer Lamp Control Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K68 Trailer Lamp Control Module - Setup and follow the on-screen instructions.
5. On the SPS Supported Controllers screen, select K68 Trailer Lamp Control Module - Configuration and follow the on-screen instructions.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, vehicle in Service Mode.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Control Module replacement, programming and setup

ACCESSORY DC POWER CONTROL MODULE PROGRAMMING AND SETUP

This device requires no programming or setup.

AIR CONDITIONING COMPRESSOR CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**

- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select Electric A/C Compressor Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
   - **If the control module cannot be reprogrammed**
   1. Vehicle OFF for one minute, vehicle in Service Mode.
   2. Verify the control module can be reprogrammed.
      - If the control module cannot be reprogrammed, replace the control module.
      - If the control module can be reprogrammed.
   3. All OK.
   - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for control module replacement, programming and setup

BATTERY CHARGER PROGRAMMING AND SETUP

This device requires no programming or setup.

BATTERY ENERGY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Battery Energy Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the Vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the Vehicle OFF for at least one minute.
4. Turn the Vehicle in Service Mode and attempt to reprogram the ECU. The ECU should program.
    - If the ECU still cannot be programmed, replace the ECU.

BODY CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**

- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- **EL-46079** Tire Pressure Monitor Diagnostic Tool or **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to Special Tools.

Replace and Program Control Module

To program a replacement K9 Body Control Module (BCM), perform the following procedure:

1. Install **EL-49642** SPS programming support tool.

NOTE: **Make sure the vehicle ignition switch state is in appropriate position for the following step.**

- **For Key Ignition System, begin with the ignition in the RUN position.**
- **For Push Button Start System, begin with the vehicle in vehicle OFF power mode. The Service Programming System will power mode the vehicle.**

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.
4. Perform the following for the appropriate ignition type prior to proceeding with the next step:
    - Key Ignition System: Key in the ignition and any additional keys must be away from the vehicle at least 3 m.
    - Push Button Start System: Keyless entry transmitter must be in the programming pocket. Refer to the owner manual for the exact pocket location. All additional transmitters must be away from the vehicle at least 3 m.

NOTE: **The following programming step may take between 10 - 12 min and progress will appear to have stopped during this process. This is a normal security timer response and a restart should not be performed. If the DTC B389A set immediately after programming a replacement BCM, the Immobilizer Learn procedure was not properly completed. The Immobilizer Learn procedure needs to be performed again.**

5. On the SPS Supported Controllers screen, select Z1 Immobilizer Learn. On the next screen, select Body Control Module IMMO Learn with Existing Transponder or Remote Key and follow the on-

screen instructions. When Immobilizer Learn is complete, press the Unlock button on the keyless entry transmitter to allow the keyless entry transmitter to exit the Immobilizer Learn mode.

NOTE: **When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.**

- **For Key Ignition System, begin with the ignition in the RUN position.**
- **For Push Button Start System, begin with the vehicle in vehicle ON power mode.**

6. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
7. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
8. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
9. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
    1. Disconnect the scan tool from the X84 Data Link Connector.
    2. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
    3. Ignition ON/Vehicle In Service Mode, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
    4. Use the scan tool to clear the DTCs.

Reprogram Control Module

To program an existing K9 Body Control Module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.

NOTE: **Make sure the vehicle ignition switch state is in appropriate position for the following step.**

- **For Key Ignition System, begin with the ignition in the RUN position.**
- **For Push Button Start System, begin with the vehicle in vehicle ON power mode.**

2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K9 Body Control Module - Programming and follow the on-screen instructions.

NOTE: **When performing the Tire Pressure Monitor Sensor Learn during BCM setup, the EL-46079 tire pressure monitor diagnostic tool must be used to activate each tire pressure sensor for vehicles with UJM.**

4. On the SPS Supported Controllers screen, select K9 Body Control Module - Setup (or K9 Body Control Module - Configuration & Setup) and follow the on-screen instructions.
5. Check the driver information center display for additional messages regarding further calibration instructions. If there are no additional driver information center instructions present, programming is complete.
6. At the end of programming, choose the "Clear DTCs" function on the SPS screen.
7. If ABS, Traction Control and/or Stabilitrak indicators are ON and DTC C0161 is set in the K17 Electronic Brake Control Module after performing BCM programming and setup, do the following:
    1. Disconnect the scan tool from the X84 Data Link Connector.

2. Ignition/Vehicle OFF, all access doors closed, all vehicle systems OFF, and all keys at least 3 m (9.8 ft) away from the vehicle. It may take up to 2 min to power down.
3. Ignition ON/Vehicle In Service Mode, verify DTC C0161 is in history. If not, repeat the above step to make sure the vehicle is in sleep mode.
4. Use the scan tool to clear the DTCs.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON/Vehicle In Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
   - **If the control module cannot be reprogrammed**
   1. Ignition/Vehicle OFF for one minute, ignition ON/Vehicle In Service Mode.
   2. Verify the control module can be reprogrammed.
      - If the control module cannot be reprogrammed, replace the control module.
      - If the control module can be reprogrammed.
   3. All OK.
   - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Control Module replacement, programming and setup

BRAKE BOOSTER CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program Control Module or Reprogram Control Module

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.

3. On the SPS Supported Controllers screen, select Brake Booster Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Control Module replacement, programming and setup

CHASSIS CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K38 Chassis Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. With a scan tool, perform the Suspension Sensor Trim Height Calibration, if applicable.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
   - **If the control module cannot be reprogrammed**
   1. Ignition OFF for one minute, ignition ON.
   2. Verify the control module can be reprogrammed.
      - If the control module cannot be reprogrammed, replace the control module.
      - If the control module can be reprogrammed.
   3. All OK.
   - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Control Module replacement, programming and setup

ELECTRONIC BRAKE CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K17 Electronic Brake Control Module - Setup while following the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Control Module replacement, programming and setup

FRONT VIEW CAMERA MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running**

lights), HVAC, radio, etc.
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**
- **If the windshield was replaced, the Frontview camera module must be calibrated.**
- **If the Frontview camera module was removed and reinstalled, no action is necessary.**

Following Replacement of Windshield

Do not reprogram the frontview camera module when only the windshield is replaced, unless directed by a service procedure, or a service bulletin.

The K109 Frontview Camera Module must be calibrated, refer to **Front View Camera Module Learn** .

Front View Camera Module Replacement

If the Front View Camera Module needs to be replaced, the following procedures must be performed:

1. Connect a scan tool to the vehicle and access Service Programming System (SPS).
2. Perform the SPS function Front View Camera Module - Programming and follow the on-screen instructions.
3. Clear DTCs after completing the programming procedure.
4. Following programming, the module will require calibration. Refer to **Front View Camera Module Learn** .

Front View Camera Module Reprogramming

Do not reprogram the Front View Camera Module, unless directed by a service procedure, or a service bulletin.

1. Connect a scan tool to the vehicle and access Service Programming System (SPS).
2. Perform the SPS function Front View Camera Module - Programming and follow the on-screen instructions.
3. Clear DTCs after completing the programming procedure.
4. Following programming, the module will require calibration. Refer to **Front View Camera Module Learn** .

SEAT HEATING CONTROL MODULE PROGRAMMING AND SETUP

This device does not require programming or setup.

HVAC CONTROL MODULE PROGRAMMING AND SETUP

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**

NOTE:

- **Do NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Verify the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption**

during programming, programming failure or control module damage may occur.

- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the below mentioned special tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn Off or disable systems that may put a load on the vehicle's battery. For example, interior lights, daytime running lights, HVAC, and radio.**
- **During the programming procedure, follow the Service Programming System (SPS) prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to No.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Equivalent regional tools: **Special Tools**.

Programming an Existing or New Control Module

To program an existing or new control module, perform the following procedure:

1. Install the special tool: EL-49642 SPS Programming Support Tool
2. Ignition - On / Vehicle - In Service Mode
3. Access SPS and follow the on-screen instructions for the control module: K33 HVAC Control Module
4. Perform the SPS function: Programming

Unsuccessful Programming Recovery

If programming a control module is not successful, perform the following procedure:

1. Verify the control module, data link connector and programming tool connections are secure and the tool software is up to date.
2. Ignition - On / Vehicle - In Service Mode
3. Perform the SPS function: Programming

   Verify the control module programming is successful.

   - **If the programming is not successful**
   1. Ignition/Vehicle - Off - For greater than 1 min
   2. Ignition - On / Vehicle - In Service Mode
   3. Perform the SPS function: Programming
      - If the programming is not successful - Replace the component: K33 HVAC Control Module
      - If the programming is successful
   4. All OK.
   - **If the programming is successful**
4. All OK..

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

For control module replacement, programming, and setup refer to: **Control Module References**

HYBRID POWERTRAIN CONTROL MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

NOTE: **Before programming please ensure the 12V battery is fully charged and close the hood. Programming with the hood open could result in a no-start condition. If a no-start condition occurs, please close the hood and consult Electronic Service Information regarding "Clear Secured High Voltage DTCs".**

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Power Inverter Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Immobilizer Learn - Setup and follow the on-screen instructions.
5. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.

   NOTE: **If the K114A Hybrid Powertrain Control Module is programmed with the hood open, the vehicle will not start until the hood is closed. Normal operation will return after the hood has been closed.**

2. Attempt to reprogram the ECU.

3. If the ECU can still not be programmed, turn the vehicle OFF for at least 1 minute.
4. Turn the vehicle ON and attempt to reprogram the ECU. The ECU should program.
    - If the ECU still cannot be programmed, replace the ECU.

HYBRID POWERTRAIN CONTROL MODULE 2 PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

CAUTION: **DO NOT program the hybrid powertrain control module 2 with the drive motor battery charger cable connected to the vehicle. Charging while programming may result in damage to the High Voltage Battery Disconnect Relays.**

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"
5. With a scan tool, perform the Hybrid/EV Battery Pack Capacity Learn and follow the on-screen instructions.
6. With a scan tool, perform the Clear Secured High Voltage DTCs and follow the on-screen instructions.
7. With a scan tool, Clear All DTCs.
8. With a scan tool, select Hybrid/EV Battery Pack Charging Adaptive Learn Reset in the Hybrid Powertrain Control Module 2 Reset Functions menu and follow the on-screen instructions.

Reprogram Control Module

To program an existing control module, perform the following procedure:

CAUTION: **DO NOT program the hybrid powertrain control module 2 with the drive motor battery charger cable connected to the vehicle. Charging while programming may result in damage to the High Voltage Battery Disconnect Relays.**

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Hybrid Powertrain Control Module 2 - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs"

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for hybrid/EV powertrain control module 2 replacement, programming and setup.

IMMOBILIZER CONTROL MODULE PROGRAMMING AND SETUP

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V**

jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.

- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**
- **The air bag indicator light may remain ON after the body control module (BCM), or Inflatable Restraint Sensing and Diagnostic Moduleis replaced, and during the programming procedure for the BCM until after the procedure is completed. When installing a new Inflatable Restraint Sensing and Diagnostic Module, there may be several DTCs set prior to programming. Once programmed, these DTCs should be in history and can be cleared.**
- **Failure to complete the following Setup procedure may cause DTC B1001 to be set in the Inflatable Restraint Sensing and Diagnostic Module.**

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K36 Inflatable Restraint Sensing and Diagnostic Module - Programming and Setup and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

NOTE: **GMNA Regions: When SPS failure message E4489 occurs during programming or calibration, do not call TCSC immediately. Record at which point the failure occurred before it displayed the E4489 message. When this occurs, proceed to GDS2. Download the appropriate vehicle configuration and select the Inflatable Restraint Sensing and Diagnostic Module. Under Identification Information, look at parameters: Software Module 1 Identifier and Software Module 2 Identifier. If either of these are populated with a value of 1 or more, replace the Inflatable Restraint Sensing and Diagnostic Module. Record these parameter values on the back of the job card.**

Non GMNA Regions: When SPS displays message indicating that programming may fail and the programming event fails at 0%, replace the Inflatable Restraint Sensing and Diagnostic Module. Verify no other DTC's or issues exist with the module prior to replacement. Record all DTCs and relevant information on the back of the job card.

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
   - **If the control module cannot be reprogrammed**
   1. Ignition OFF for one minute, ignition ON.
   2. Verify the control module can be reprogrammed.
      - If the control module cannot be reprogrammed, replace the control module.
      - If the control module can be reprogrammed.
   3. All OK.

- **If the control module can be reprogrammed**

3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Control Module replacement, programming and setup

INSTRUMENT CLUSTER PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), and HVAC.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**
- **To prevent programming failure due to unintended wireless drops, It is recommended that a wired MDI connection be used when reprogramming the Instrument Cluster**

Diagnostic Aids

The programming steps in the Service Programming System (SPS) screens may not be in functional order. Be sure to follow the programming steps in the order listed below.

Replace and Program ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Instrument Cluster - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Instrument Cluster - Setup and Configuration and follow the on-screen instructions.

NOTE:

- **The USB File Transfer procedure is performed after the new Instrument Cluster is installed in the vehicle. This procedure**

- **requires the use of a USB memory stick. The radio must be on during this procedure. The USB File Transfer procedure is not required for vehicles with UDC.**
- **Software currently loaded on the USB Drive will be verified and if files are incorrect they will be deleted and correct files will be loaded. If files residing on the USB Drive are correct for the vehicle being serviced, the Techline terminal will not delete those files and allow the drive to be re-used.**

5. On the SPS Supported Controllers screen, select Instrument Cluster - USB File Transfer and follow the on-screen instructions.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Instrument Cluster - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select Instrument Cluster - Setup and Configuration and follow the on-screen instructions.

NOTE:

- **The USB File Transfer procedure requires the use of a USB memory stick. The radio must be on during this procedure. The USB File Transfer procedure is not required for vehicles with UDC.**
- **Software currently loaded on the USB Drive will be verified and if files are incorrect they will be deleted and correct files will be loaded. If files residing on the USB Drive are correct for the vehicle being serviced, the Techline terminal will not delete those files and allow the drive to be re-used.**

5. On the SPS Supported Controllers screen, select Instrument Cluster - USB File Transfer and follow the on-screen instructions.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the ignition OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the ignition OFF for at least one minute.
4. Turn the ignition ON and attempt to reprogram the ECU. The ECU should program.
    - If the ECU still cannot be programmed, replace the ECU.

KEYLESS ENTRY CONTROL MODULE PROGRAMMING AND SETUP

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured**

- **with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Keyless Entry Control Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the vehicle OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the vehicle OFF for at least one minute.
4. Turn the vehicle to Service Mode and attempt to reprogram the ECU. The ECU should program.
    - If the ECU still cannot be programmed, replace the ECU.

PARKING ASSIST CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**

- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Sensor Replacement

Following Parking Assist Sensor replacement, the sensors must be calibrated. Refer to **Parking Assist Sensor Learn Calibration** .

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Programming and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. Following Parking Assist Control Module replacement, the sensors must be calibrated. Refer to **Parking Assist Sensor Learn Calibration** .

Reprogram Control Module

Do not reprogram the parking assist control module, unless directed by a service procedure, or a service bulletin.

To reprogram an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K182 Parking Assist Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the K182 Parking Assist Control Module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the parking assist control module can be reprogrammed.
    - **If the K182 Parking Assist Control Module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the parking assist control module can be reprogrammed.
        - If the K182 Parking Assist Control Module cannot be reprogrammed, replace the parking assist control module.
        - If the K182 Parking Assist Control Module can be reprogrammed.
    3. All OK.
    - **If the K182 Parking Assist Control Module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming and setup

PASSENGER PRESENCE SYSTEM PROGRAMMING AND SETUP

When the passenger presence system is replaced or serviced, perform the rezeroing procedure for the passenger presence system. Refer to Passenger Presence System Rezeroing for the rezeroing procedure.

PEDESTRIAN ALERT SOUND CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Replace and Program ECU

To program a replacement control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K132 Pedestrian Alert Sound Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Reprogram ECU

To reprogram an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K132 Pedestrian Alert Sound Control Module - Configuration and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for pedestrian alert sound control module replacement, programming and setup

POWER LINE COMMUNICATION MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the *EL-49642* SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights, including daytime running lights, HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Scan Tool Reference

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

Replace and Program Control Module or Reprogram Control Module

CAUTION: **DO NOT program the power line communication module with the drive motor battery charger cable connected to the vehicle. Charging the drive motor battery while programming may result in damage to the DC charging contactors.**

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select Power Line Communication Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the Clear All DTCs function on the SPS screen

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.

        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for power line communication module replacement, programming and setup.

POWER STEERING CONTROL MODULE PROGRAMMING AND SETUP

The following service procedures require either a programming or a setup event performed for a complete repair.

The electronic power steering control module is part of the power steering assist motor assembly and is electronically paired with the steering gear's sensors.

- If the complete steering gear INCLUDING the assist motor assembly was replaced, or for reprogramming of an existing power steering system WITHOUT replacement, refer to the POWER STEERING CONTROL MODULE REPROGRAMMING instructions in this article.
- If ONLY the Power Steering Assist Motor assembly is replaced, follow the POWER STEERING CONTROL MODULE REPLACEMENT instructions.

Replace and Program Control Module

NOTE: **During the procedures listed below, critical data is retrieved from vehicle components and stored in the scan tool computer's hard drive. This data is needed during the programming and setup sequences.**

Ensure the same scan tool is used and capable of reading, storing, and writing the vehicle's system data.

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. With the Power Steering Assist Motor replaced and reconnected, on the SPS Supported Controllers screen, select Electronic Power Steering - Programming and follow the on-screen instructions.
3. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
4. Verify that the steering wheel angle alignment is correct. Refer to **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment**
5. Ignition ON.
6. On the SPS Supported Controllers screen, select Electronic Power Steering - Setup and follow the on-screen instructions.
7. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Power Steering Control Module Reprogramming

Do not program or reprogram the electronic power steering control module unless directed by a service procedure or a service bulletin.

NOTE: **This procedure applies to reprogramming of the existing steering gear or the initial programming if the complete steering gear assembly including the assist motor was replaced. If only the power steering control module is replaced, follow the Power Steering Control Module Replacement instructions above.**

1. Access the Service Programming System (SPS) and follow the on-screen instructions.

2. On the SPS Supported Controllers screen, select Electronic Power Steering - Programming and follow the on-screen instructions.
3. Ignition OFF and all vehicle systems OFF. It may take up to 2 minutes for all vehicle systems to power down.
4. Ignition ON.
5. On the SPS Supported Controllers screen, select Electronic Power Steering - Setup and follow the on-screen instructions.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Steering Angle Sensor Centering and Software Endstop Learning

For the steering angle sensor centering and software endstop learning, refer to **Power Steering Control Module Calibration** .

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

RADIO PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS programming support tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

- If programming of the control module is being performed at the direction of a bulletin or PI, follow the instructions provided in that document.
- During audio system programming you may be required to select multiple calibrations dependent upon vehicle equipment. Have the vehicle build/RPO information available during the following procedure to ensure the correct calibrations are selected.
- Dependant upon vehicle equipment, the current software level of the module, or the release of updates, USB programming may not be required when replacing/reprogramming the control module. If USB files for the application are not available via SPS, or if the files already in the radio are the same or newer than what is available via SPS, or have not been received in another manner of distribution, the USB update process will not need to be performed.
- All data will be erased from the USB device BEFORE the calibration is downloaded onto the device. To ensure important information is NOT erased, always verify that NO information is stored on the device BEFORE beginning the calibration download. If required, transfer important files to another storage device BEFORE beginning the calibration download.
- The length of time for the USB programming to complete will vary depending on the number and size of the files in the update.
- The USB programming will not allow the installation of the same software. If the same software is detected on the USB stick, Radio will display "Invalid Update" message.
- Make sure USB stick is removed after update is complete. If the USB stick is left connected an "Invalid Update" message will be displayed when the radio is powered on.

Reference Information

Special Tools

- **EL-49642** SPS Programming Support Tool
- USB 2.0 flash drive with a minimum capacity of 4 GB.

For equivalent regional tools, refer to Special Tools.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

NOTE: **The vehicle must remain in PARK during the programming procedure.**

1. Install the **EL-49642** SPS Programming Support Tool.
2. Connect a USB drive to the computer.

   NOTE: **If using a pre-configured USB drive supplied by General Motors, proceed to step 6.**

3. Access the Service Programming System (SPS) and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select A11 Radio - USB Copy/ USB File Transfer, and follow the on-screen instructions.

   NOTE:

   - **If there are no files available for USB transfer via SPS, or if the files already in the radio are the same or newer than what is available via SPS proceed to step 10.**
   - **Software currently loaded on the USB Drive will be verified and if files are incorrect they will be deleted and correct files will be loaded. If files residing on the USB Drive are correct for the vehicle being serviced, the Techline terminal will not delete those files and allow the drive to be re-used.**

5. Upon completion of the file transfer, remove the USB drive from the computer.
6. Ignition ON, radio ON.
7. Connect the USB drive to the USB port in the vehicle and follow the instructions.

8. When programming is complete, remove the USB device from the vehicle USB port.
9. Access the Service Programming System (SPS) and follow the on-screen instructions.
10. On the SPS Supported Controllers screen, select A11 Radio - Programming, and follow the on-screen instructions.
11. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

XM Activation (If Equipped)

IMPORTANT: After replacement of an XM receiver, call XM radio to deactivate the receiver that has been removed from the vehicle.

1. Turn the radio ON, tune to the XM channel 0, and record the radio ID. The radio ID will be needed for activation of the receiver.
2. From the USA, Call XM radio at 1 - 800 - 556 - 3600 to activate the receiver. From Canada, call 1 - 877 - 438 - 9677.
3. Park the vehicle outside in an area with an unobstructed view of the southern sky.
4. Leave the vehicle outside with the ignition switch in the ACC position and the radio on for 30 minutes to activate XM service.
5. Once activated, the radio will receive the remaining XM channels.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Valet Mode Reset

1. Verify no DTCs are set.
    - **If any DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If no DTCs are set**
2. Select the Radio control function Erase Valet Mode Code with the scan tool.
3. Select Clear and confirm the selection to erase the code.

REAR SEAT HEATER CONTROL MODULE PROGRAMMING AND SETUP

This device does not require programming or setup.

REMOTE CONTROL DOOR LOCK RECEIVER PROGRAMMING AND SETUP

Diagnostic Aids

The remote control door lock receiver only functions as an antenna, receiving the signals sent by the keyless entry transmitter and forwarding them to the body control module (BCM). The keyless entry software is contained wholly within the BCM.

Replace and Program ECU or Reprogram ECU

This ECU does not require SPS programming or any setup procedures.

SERIAL DATA GATEWAY MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing K56 Serial Data Gateway Module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K56 Serial Data Gateway Module - Programming and follow the on-screen instructions.
4. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
   - **If the control module cannot be reprogrammed**
   1. Ignition OFF for one minute, ignition ON.
   2. Verify the control module can be reprogrammed.
      - If the control module cannot be reprogrammed, replace the control module.
      - If the control module can be reprogrammed.

        3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Control Module replacement, programming and setup

SIDE OBJECT SENSOR MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured with the correct calibration software, the ECU will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program ECU or Reprogram ECU

To program a replacement or an existing ECU, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select Right Side Object Sensor or Left Side Object Sensor - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. DO NOT turn the ignition OFF. Ensure that all ECU, DLC and programming tool connections are secure and the TIS terminal operating software is up to date.
2. Attempt to reprogram the ECU.
3. If the ECU can still not be programmed, turn the ignition OFF for at least one minute.
4. Turn the ignition ON and attempt to reprogram the ECU. The ECU should program.
    - If the ECU still cannot be programmed, replace the ECU.

STEERING WHEEL HEAT CONTROL MODULE PROGRAMMING AND SETUP

This device requires no programming or setup.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

- Before beginning any programming first determine which Generation of the Telematics Communication Interface Control Module you are working with. One way to accomplish this is by using a scan tool. The Telematics Communication Interface Control Module Generation will be listed under the Selected Vehicle Configuration section, in addition the Generation (9 or 10) can be determined from the Module ID data table. Additional programming steps may be necessary depending on the generation of the module.
- It is critical to use the service replacement Communication Interface Module only in the vehicle for which it was ordered.
- Failure to perform the following procedures will result in a red LED, DTC(s) being set, and limited or incomplete OnStarÂ® services.
- An OnStarÂ® button press to the OnStarÂ® call center is required to complete the procedure.
- To fully activate an OnStarÂ® module, both the setup and activation request procedures must be completed on all vehicles with and without an active OnStarÂ® subscription to insure the unit has been setup properly for the vehicle it has been installed into and also to update the OnStarÂ® with the correct unit information.
- To initialize the Turn-by-Turn feature, the vehicle must first be driven In open sky condition at speeds greater than 10 mph (16 kph) or more for a minimum of 5 miles (8 km), and perform at least 2 left and 2 right 90 degree turns coming to complete stops prior to each turn.
- On vehicles up fitted with TTY capabilities, it is necessary to perform a power cycle of the OnStarÂ® Interface Module (OTIM), and toggle the TTY mode after completing the Communication Interface Module installation and setup procedures.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

Replace and Program Control Module or Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS programming support tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.

   NOTE:

   - **Due to a change in SPS you must select 'Reprogram ECU', for Telematics Communication Interface Control Module Programming from the Selected Programming Process even if the unit is being replaced.**
   - **If 'Replace and Program ECU' is selected the Telematics Communication Interface Control Module will not be listed in the Supported Controllers screen. You must go back and select 'Reprogram ECU'.**

   -

3. In the SPS Supported Controllers screen, select Telematics Communication Interface Control Module Programming and Service Activation and follow the on-screen instructions.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
5. After Telematics Communication Interface Control Module Programming and Service Activation, if the vehicle is equipped with RPO VV4, on the Supported Controllers screen select 'OnStar WiFi Enable (Gen 10 only) Programming' and follow the on-screen instructions.
6. Press the OnStarÂ® Blue Button to call OnStarÂ® and have the system activated. If the customer refused OnStarÂ® services (terms and conditions) and the vehicle is equipped with RPO VV4 have the OnStarÂ® consultant turn off the WiFi demo message that occurs after every ignition on event.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
   - **If the control module cannot be reprogrammed**
   1. Ignition OFF for one minute, ignition ON.
   2. Verify the control module can be reprogrammed.
      - If the control module cannot be reprogrammed, replace the control module.
      - If the control module can be reprogrammed.
   3. All OK.
   - **If the control module can be reprogrammed**
3. All OK.

TRAILER LAMP CONTROL MODULE PROGRAMMING AND SETUP (MAH/MBC/MAW/MCX)

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running**

lights), HVAC, radio, etc.
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to Special Tools.

Replace and Program Control Module or Reprogram Control Module

This control module does not require SPS programming but does require the following setup procedures after a new control module is installed:

To program a replacement or an existing control module, perform the following procedure:

1. Install **EL-49642** SPS Programming Support Tool.
2. Access the Service Programming System (SPS) and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K101 Trailer Interface Control Module - Programming and follow the on-screen instructions.
4. On the SPS Supported Controllers screen, select K101 Trailer Interface Control Module - Setup and follow the on-screen instructions.
5. On the SPS Supported Controllers screen, select K101 Trailer Interface Control Module - Configuration and follow the on-screen instructions.
6. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Vehicle in Service Mode. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
   - **If the control module cannot be reprogrammed**
   1. Ignition OFF for one minute, vehicle in Service Mode.
   2. Verify the control module can be reprogrammed.
      - If the control module cannot be reprogrammed, replace the control module.
      - If the control module can be reprogrammed.
   3. All OK.
   - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for Control Module replacement, programming and setup

TRANSMISSION RANGE CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the ECU is not properly configured**

with the correct calibration software, the ECU will not control all of the vehicle features properly.

- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or ECU damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Diagnostic Aids

- Resolve any current DTC's that are present relating to the Electronic Transmission Range Select system prior to programming module. Refer to **Electronic Transmission Range Selector Description** . Faults in any component or module that work together in this system may cause the programming/setup failure.
- Replacement of Transmission Range Control Module requires proper installation of module and in some cases a linkage between the module and the transmission. If installation is not performed properly, programming or setup procedure may fail.
- If programming/setup failure occurs, refer to the wiring diagnostics to resolve any electrical faults, check Transmission Range Control Module and linkage installation if applicable and attempt reprogramming 2 additional times before replacing Transmission Range Control Module.

Reference Information

Special Tools

EL-49642 SPS Programming Support Tool

For equivalent regional tools, refer to **Special Tools**.

Replace and Program Control Module

To program a replacement control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K173 Transmission Range Control Module - Programming and follow the on-screen instructions.
3. On the SPS Supported Controllers screen, select K173 Transmission Range Control Module - Setup.
4. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Reprogram Control Module

NOTE: **Reprogramming a TRCM does not require setup. TRCM setup is only required when you have removed the TRCM, loosened the fasteners to the TRCM mounting bracket, modified the adjustment rod/linkage, or tampered with the interface between the TRCM and the transmission.**

To program an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.

2. On the SPS Supported Controllers screen, select K173 Transmission Range Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Control Module replacement, programming and setup

VIDEO PROCESSING CONTROL MODULE PROGRAMMING AND SETUP

NOTE:

- **DO NOT program a control module unless directed to by a service procedure or a service bulletin. If the control module is not properly configured with the correct calibration software, the control module will not control all of the vehicle features properly.**
- **Ensure the programming tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during programming, programming failure or control module damage may occur.**
- **Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. When required install the EL-49642 SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack disconnected from the AC voltage supply. DO NOT connect a battery charger.**
- **Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.**
- **During the programming procedure, follow the SPS prompts for the correct ignition switch position.**
- **Clear DTCs after programming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.**

Replace and Program Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K157 Video Processing Control Module - Programming and follow the on-screen instructions.

3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.
4. With a scan tool, perform the K157 Video Processing Control Module calibration. Refer to **Video Processing Control Module Calibration**

Reprogram Control Module

To program a replacement or an existing control module, perform the following procedure:

1. Access the Service Programming System (SPS) and follow the on-screen instructions.
2. On the SPS Supported Controllers screen, select K157 Video Processing Control Module - Programming and follow the on-screen instructions.
3. At the end of programming, choose the "Clear All DTCs" function on the SPS screen.

Unsuccessful Programming Recovery

In the event of an interrupted or unsuccessful programming event, perform the following steps:

1. Ignition ON. Ensure the control module, DLC and programming tool connections are secure and the SPS software is up to date.
2. Verify the control module can be reprogrammed.
    - **If the control module cannot be reprogrammed**
    1. Ignition OFF for one minute, ignition ON.
    2. Verify the control module can be reprogrammed.
        - If the control module cannot be reprogrammed, replace the control module.
        - If the control module can be reprogrammed.
    3. All OK.
    - **If the control module can be reprogrammed**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for Control Module replacement, programming and setup

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

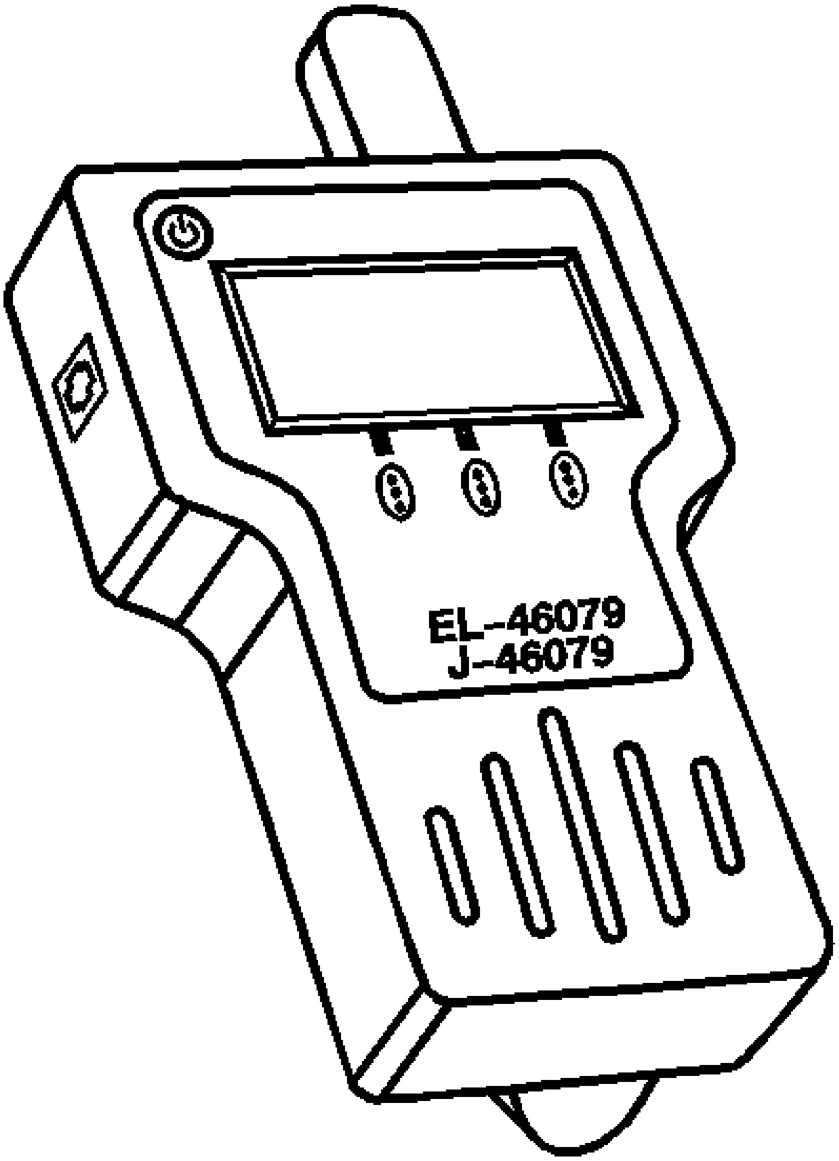
Illustration	Tool Number/ Description
 EL-46079 J-46079	EL 46079 J 46079 Tire Pressure Monitor Diagnostic Tool

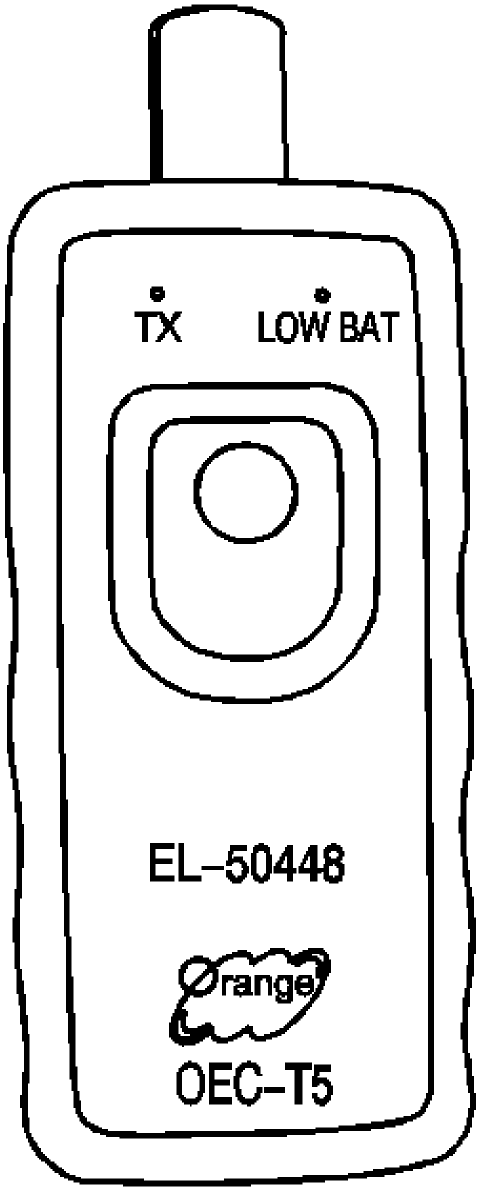
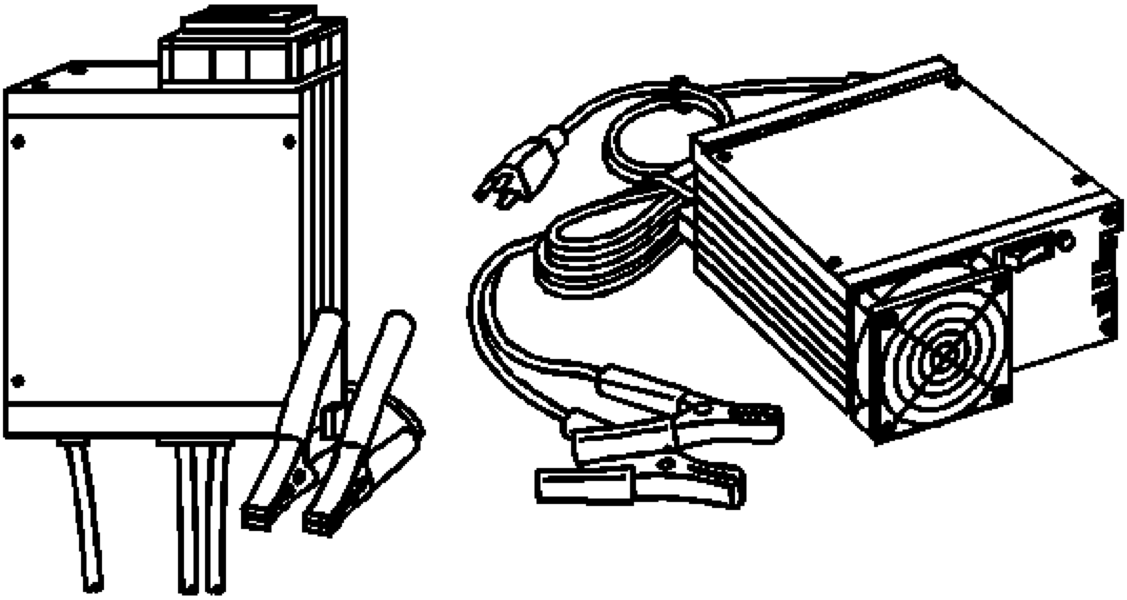
Illustration	Tool Number/ Description
 TX LOW BAT EL-50448 Orange OEC-T5	EL 50448 Tire Pressure Monitor Sensor Activation Tool

Illustration	Tool Number/ Description
	EL 49642 EL 50113 Europe - Use recommended equivalent workshop equipment SPS Programming Support Tool

Back To Article

2017 GENERAL INFORMATION

Squeaks and Rattles - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

SQUEAKS AND RATTLES

Special Tools

- **CH-39570** Chassis Ear
- **GE-41416** Ultrasonic Leak Detector

For equivalent regional tools, refer to Special Tools.

NOTE: **Squeaks and rattles are caused by improperly controlled relative motion between vehicle components. There are 4 ways to prevent squeaks and rattles.**

To aid in diagnosing, use CH-39570 ear or GE-41416 detector.

- Attach the component that squeaks or rattles securely.
- Separate the components that squeak or rattle to prevent contact.
- Insulate the components that squeak or rattle.
- Insulate low uniform friction surfaces to eliminate stickslip motion.

SYMPTOMS - SQUEAKS AND RATTLES

Rattle Coming From the Side Rail

Checks	Action
Check the brake lines.	• Tap lightly on the brake lines and listen for a rattle. • Install plastic tie straps to secure the brake lines tightly together.

Rattle Under Vehicle at Higher RPM

Checks	Action
Check for heat shield contact with the underbody.	• Raise the vehicle and perform a visual inspection. • Bend the heat shield slightly to gain clearance from the underbody.

Thump From Rear of Vehicle on Bumps

Checks	Action

Checks	Action
Check for a properly secured spare tire or tire repair kit in the rear compartment.	• Open the rear compartment and perform a visual inspection of the spare tire or the tire repair kit and the tools. • Tightly secure the spare tire or the tire repair kit and all tools. • Perform a road test to verify that the noise is eliminated.

Glass Knock Coming From the Rear of the Vehicle When Driving Over Bumps

Checks	Action
Check for an out-of-adjustment hatchback latch.	• Test drive the vehicle in order to verify this condition. • Loosen the latch nuts and adjust the latch downward.

Rattle Coming From Door

Checks	Action
Check for rattling electrical connectors inside the door trim panel.	• Tap on the trim panel and listen for a rattle. • Remove the trim panel and wrap foam padding around the connectors as required.

Squeak When Operating Doors

Checks	Action
Check for a lack of lubrication of the door hinge pins.	• Operate the doors and listen for squeaks. • Lubricate the door hinge pins with light oil and coat with lithium grease.

Squeak Coming From Console When Shifting Manual Transmission Condition Occurs In Cold Weather with a Cold Engine

Checks	Action
Check the manual transaxle control lever lower boot.	• Move the control lever between gears and listen for squeaks. • Remove the floor console and replace the lower shift boot or apply talcum powder to the lower shift boot.

Buzz From the Left Side of Instrument Panel

Checks	Action
Check for vibration of the fuse box cover against the instrument panel side trim.	• Tap on the cover with a finger and listen for a buzz. • Apply felt pads to the side trim where the cover makes contact.

Squeak Coming From Instrument Cluster Trim Plate

Checks	Action

Checks	Action
Check for rubbing the cluster trim plate on the instrument panel.	- Test drive the vehicle in order to verify this condition. - Remove the instrument cluster trim plate and install felt tape to the edges.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

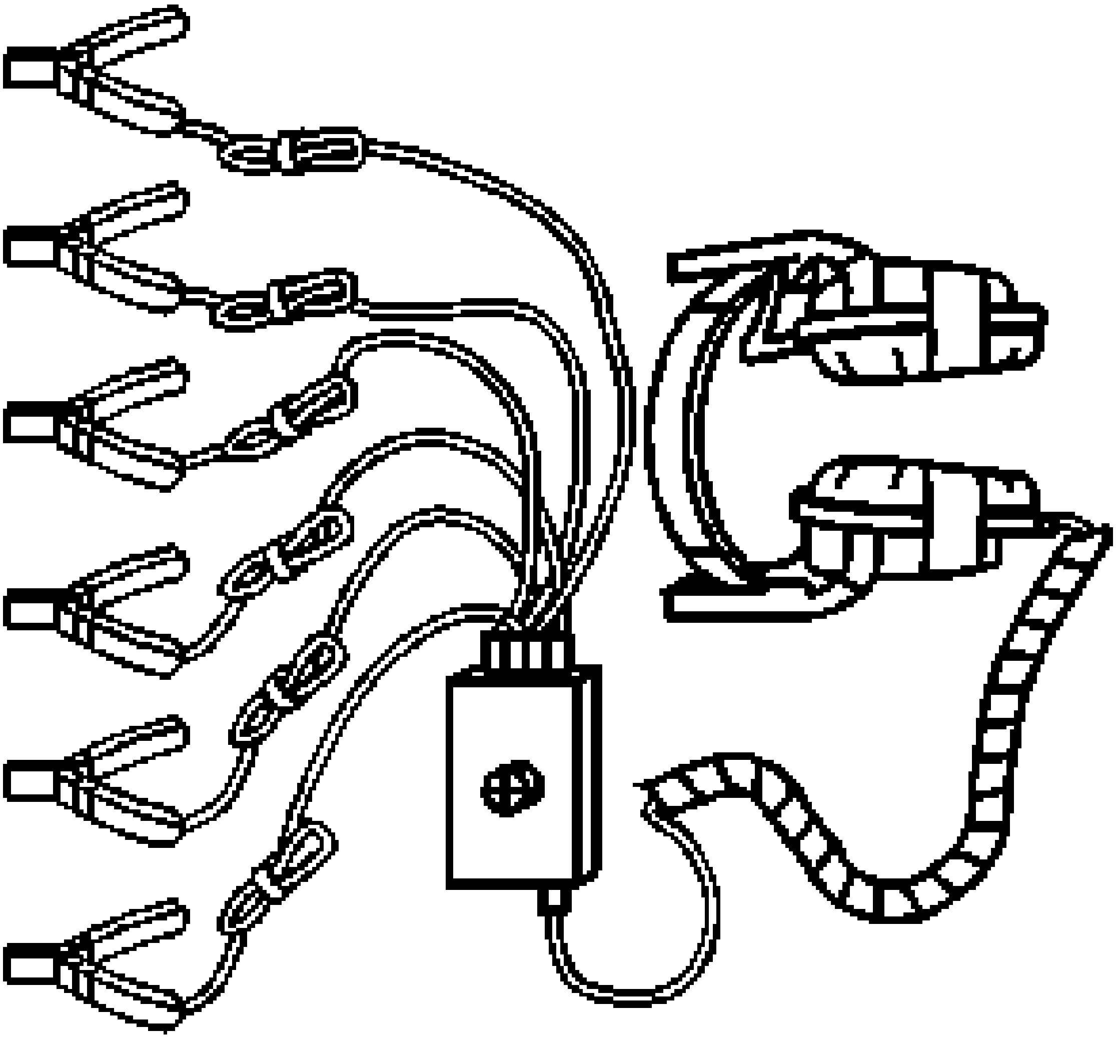
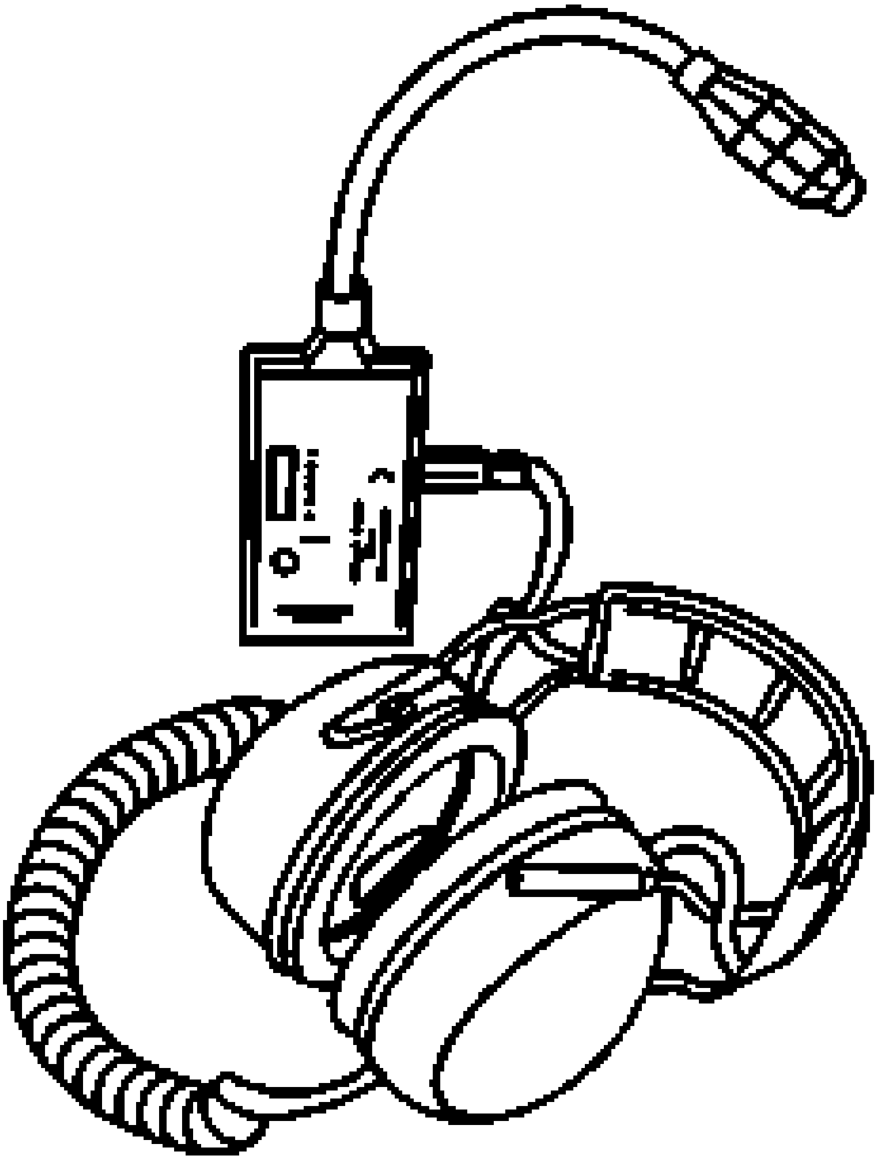
Illustration	Tool Number/ Description
	CH-39570 J 39570 Chassis Ear

Illustration	Tool Number/ Description
	GE-41416 J 41416 Ultrasonic Leak Detector

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GENERAL INFORMATION

State Emission Standards - Gasoline

ALASKA

NOTE: Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

NOTE: As of March 1, 2012, Alaska is not testing for tailpipe emissions.

ALASKA EMISSION STANDARDS - ANCHORAGE & FAIRBANKS (2-SPEED IDLE TEST)

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Passenger Cars (1)		
1968-71	1000 (5.0)	1000 (4.0)
1972-74	1000 (4.0)	1000 (3.0)
1975-80	1000 (2.0)	1000 (2.0)
1981-83	1000 (1.0)	1000 (1.0)
1984-93	750 (1.0)	750 (1.0)
1994-	200 (0.5)	200 (0.5)
Light & Medium Duty Trucks (1)		
1968-72	1000 (5.0)	1000 (4.0)
1973-78	1000 (4.0)	1000 (3.0)
1979-83	1000 (2.0)	1000 (2.0)
1984-93	750 (1.0)	750 (1.0)
1994-	220 (0.5)	220 (0.5)
Heavy Duty Vehicles (2)		
1968-73	1000 (5.0)	1000 (5.0)
1974-93	1000 (4.0)	1000 (4.0)
1994-	220 (1.0)	220 (1.0)
(1) 8500 GVWR or less.		
(2) 8500 GVWR or more.		

ARIZONA

NOTE: Curb idle only test are for vehicles with full-time 4WD, non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on 1967-80 light-duty gasoline powered vehicles and all heavy-duty gasoline powered vehicles.

ARIZONA EMISSION STANDARDS - PHOENIX AREA (CURB IDLE & LOADED CRUISE TESTS)

Application (1)	Idle HC ppm (CO %)	(2) Loaded/Cruise HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	500 (4.20)
1967-71 More Than 4-Cyl.	450 (5.00)	450 (3.75)
1972-74 4-Cyl. Or Less	400 (5.50)	400 (4.20)
1972-74 More Than 4-Cyl.	400 (5.00)	400 (3.75)
1975-78 4-Cyl. Or Less	250 (2.20)	250 (1.65)
1975-78 More Than 4-Cyl.	250 (2.00)	250 (1.50)
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.20)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	(3)	(3)
Light Duty Trucks (6001-8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 4-Cyl. Or Less	220 (2.20)	220 (1.65)
1979 More Than 4-Cyl.	220 (2.00)	220 (1.50)
1980	220 (1.20)	220 (1.20)
1981 & Newer	220 (1.20)	.....
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	350 (3.00)
1979 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....

(1) 4-stroke engines only.

(2) Except AWD, non-defeatable traction control and motorcycles.

(3) Same as light duty vehicles.

ARIZONA EMISSION STANDARDS - PHOENIX AREA (IM147 TEST)

Application	HC gpm (CO gpm)	NOx gpm

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1981-82	3.0 (25.0)	3.5
1983-85	2.4 (20.0)	3.5
1986-89	1.6 (15.0)	2.5
1990-93	1.0 (12.0)	2.5
1994 & Newer	0.8 (12.0)	2.0
Light Trucks (6000 GVWR Or Less)		
1981-85	4.0 (40.0)	5.5
1986-89	3.0 (25.0)	4.5
1990-93	2.0 (20.0)	4.0
1994 & Newer	1.6 (20.0)	3.0
Light Duty Trucks (6000-8500 GVWR)		
1981-85	4.4 (48.0)	7.0
1986-87	4.0 (40.0)	5.5
1988-89	3.0 (25.0)	5.5
1990-93	3.0 (25.0)	5.0
1994 & Newer	2.4 (25.0)	4.0

NOTE: **Curb idle test only for 1967-80 light-duty gasoline vehicles, all vehicles with full-time 4WD and/or non-defeatable traction control and motorcycles. Curb idle and loaded cruise tests are performed on all 1981 and later vehicles except those with full-time 4WD and/or non-defeatable traction control.**

ARIZONA EMISSION STANDARDS - TUCSON AREA (CURB IDLE & LOADED CRUISE TESTS)

Application (1)	Idle HC ppm (CO %)	(2) Loaded/Cruise HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1967-71 4-Cyl. Or Less	500 (5.50)	.....
1967-71 More Than 4-Cyl.	450 (5.00)	.....
1972-74 4-Cyl. Or Less	400 (5.50)	.....
1972-74 More Than 4-Cyl.	400 (5.00)	.....
1975-78 4-Cyl. Or Less	250 (2.20)	.....

Application (1)	Idle HC ppm (CO %)	(2) Loaded/Cruise HC ppm (CO %)
1975-78 More Than 4-Cyl.	250 (2.00)	.....
Light Duty Vehicles (8500 GVWR Or Less)		
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.20)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Light Duty Trucks (6000 GVWR Or Less)		
1967-80	(3)	(3)
Light Duty Trucks (6001-8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	.....
1979 4-Cyl. Or Less	220 (2.20)	.....
1979 More Than 4-Cyl.	220 (2.00)	.....
1980	220 (1.20)	.....
1981 & Newer	220 (1.20)	220 (1.20)
Heavy Duty Trucks (Greater Than 8500 GVWR)		
1967-74	(3)	(3)
1975-78	350 (4.00)	.....
1979-80	300 (4.00)	.....
1981 & Newer	300 (4.00)	300 (3.00)
Motorcycles		
1967 & Newer	1800 (5.50)	.....

(1) 4-stroke engines only.

(2) Except AWD, non-defeatable traction control and motorcycles.

(3) Same as light duty vehicles.

CALIFORNIA

CALIFORNIA EMISSION STANDARDS ASM TESTS

Specific vehicle cutpoints are available on the California BAR web site at www.bar.ca.gov under the Industry tab, then Cutpoints Application.

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)					PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
							ASM 5015			ASM 2525			ASM 5015			ASM 2525		
		PC	LDT1	LDT2	MDV		HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO
1	1974-	X	X	X		A	235.4	2.56	1301.5	185.4	2.36	1161.5	435.4	4.26	2659.3	385.4	4.06	2459.3
						B	436041.7	4453.19	1192593.0	436041.7	4453.19	1192593.0	436041.7	4453.19	1703703.7	436041.7	4453.19	1703703.7
2	1975-1980	X				A	123.0	0.91	1016.3	90.3	0.71	876.3	315.3	2.51	2051.9	265.3	2.31	1851.9
						B	273316.7	1362.96	1043519.0	273316.7	1362.96	1043519.0	273316.7	1362.96	1490740.7	273316.7	1362.96	1490740.7
3	1981-1983	X				A	63.2	0.64	850.0	42.1	0.44	680.0	253.1	2.14	1844.4	192.4	1.94	1644.4
						B	234259.3	1064.81	894444.5	212963.0	1064.81	894444.5	234259.3	1064.81	1277777.8	212963.0	1064.81	1277777.8
4	1984-1986	X				A	67.0	0.52	850.0	42.1	0.32	680.0	242.4	2.02	1744.4	192.4	1.82	1544.4
						B	212963.0	979.63	894444.5	212963.0	979.63	894444.5	212963.0	979.63	1277777.8	212963.0	979.63	1277777.8
5	1987-1992	X				A	57.0	0.48	608.0	31.7	0.32	547.0	231.7	1.98	1729.6	181.7	1.82	1529.6
						B	191666.7	851.85	596296.3	191666.7	979.63	596296.3	191666.7	851.85	851851.9	191666.7	979.63	851851.9
6	1993-1995	X				A	59.0	0.29	617.1	24.3	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	89951.3	724.07	271314.8	89951.3	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
7	1996-2000	X				A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
8	2001-2003	X				A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
9	2004+	X				A	16.8	0.29	260.0	0.5	0.23	547.0	234.3	1.79	1759.3	184.3	1.73	1559.3
						B	128501.9	724.07	596296.3	128501.9	851.85	596296.3	128501.9	724.07	553703.7	128501.9	851.85	553703.7
10	1975-1978		X			A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
						B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
11	1979-1983		X			A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
						B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
12	1984-1987		X			A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
						B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
13	1988-1992		X			A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
						B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
14	1993-1995		X			A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
15	1996-2000		X			A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
16	2001-2003		X			A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
17	2004+		X			A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
18	1975-1978			X		A	139.4	1.08	1320.9	105.0	0.88	1180.9	330.0	2.58	2487.0	280.0	2.38	2287.0
						B	225000.0	2025.00	745370.4	225000.0	2025.00	745370.4	225000.0	2025.00	1064814.8	225000.0	2025.00	1064814.8
19	1979-1983			X		A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
						B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
20	1984-1987			X		A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
						B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
21	1988-1992			X		A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
						B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
22	1993-1995			X		A	68.3	0.30	377.0	33.3	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	78750.0	1350.00	525000.0	78750.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
23	1996-2000			X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
24	2001-2003			X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
25	2004+			X		A	22.1	0.30	377.0	5.8	0.40	630.0	247.5	1.60	1350.0	197.5	1.70	1400.0
						B	112500.0	1350.00	525000.0	112500.0	1500.00	525000.0	112500.0	1350.00	750000.0	112500.0	1500.00	750000.0
26	1978-				X	A	173.3	2.90	1703.3	123.3	2.70	1563.3	423.3	5.40	3233.3	373.3	5.20	3033.3
						B	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	2333333.3	583333.3	3500.00	2333333.3
27	1979-1983				X	A	139.4	0.88	1315.7	80.0	0.68	1175.7	320.0	2.38	2479.6	255.0	2.18	2279.6
						B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	851851.9	150000.0	2025.00	851851.9
28	1984-1987				X	A	91.3	0.41	945.0	63.1	0.50	840.0	280.0	1.71	1850.0	230.0	1.80	1700.0
						B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	750000.0	150000.0	2250.00	1500000.0
29	1988-1992				X	A	83.0	0.27	875.0	63.1	0.43	735.0	270.0	1.57	1600.0	220.0	1.73	1400.0
						B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	750000.0	150000.0	1875.00	750000.0
30	1993-1995				X	A	83.0	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
31	1996-2000				X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
32	2001-2003				X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0
33	2004+				X	A	71.2	0.30	875.0	60.0	0.70	735.0	300.0	1.60	1750.0	250.0	2.00	1550.0
						B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	750000.0	150000.0	1500.00	750000.0

Fig. 1: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Light & Medium Duty Vehicles (ASM Test)

ESC	MODEL YEAR GROUP	VEHICLE TYPE (by GVWR and LVW)						PASS/FAIL EMISSION STANDARD						GROSS POLLUTER STANDARD					
								ASM 5015			ASM 2525			ASM 5015			ASM 2525		
		PC	LDT1	LDT2	MDV	HDV		HC	CO	NO	HC	CO	NO	HC	CO	NO	HC	CO	NO
46	1978-					X	A	243.8	3.92	2615.8	199.8	3.92	2770.8	594.9	7.29	4970.0	605.4	7.57	5375.4
							B	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3	583333.3	3500.00	1633333.3
47	1979 - 1983					X	A	205.5	2.16	2250.6	106.0	1.96	2400.6	454.2	6.62	4231.1	338.1	6.54	4657.2
							B	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3	225000.0	2025.00	596296.3	150000.0	2025.00	596296.3
48	1984 - 1987					X	A	143.0	1.60	2162.5	78.0	1.80	1975.0	307.5	6.67	4238.5	250.0	6.48	3989.5
							B	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0	150000.0	1725.00	525000.0	150000.0	2250.00	1050000.0
49	1988 - 1992					X	A	105.0	1.01	2112.5	78.0	1.24	2062.5	300.0	5.87	3865.9	250.0	4.98	3929.9
							B	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0	150000.0	1725.00	525000.0	150000.0	1875.00	525000.0
50	1993 - 1995					X	A	105.0	0.49	1912.5	75.0	1.22	1862.5	300.0	2.61	3825.0	250.0	3.49	3929.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
51	1996 - 2000					X	A	105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0
52	2001+					X	A	105.0	0.49	1662.5	75.0	1.16	1462.5	300.0	2.61	3325.0	250.0	3.32	3085.9
							B	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0	150000.0	1350.00	525000.0	150000.0	1500.00	525000.0

Fig. 2: California Emission Standards - Enhanced & Partially Enhanced Program Areas - Heavy Duty Vehicles (ASM Test)

LEGEND

ESC - Emission Standard Category
GVWR - Manufacture's Gross Vehicle Weight Rating
LVW - Loaded Vehicle Weight
PC - Passenger Car
LDT1 - Light-Duty Truck up through 3750 LVW and GVWR no greater than 6000 lbs.
LDT2 - Light-Duty Truck greater than 3750 LVW and GVWR no greater than 6000 lbs.
MDV - Medium-Duty Vehicle, GVWR from 6001 to 8500 lbs.
HC - Hydrocarbon, ppm
CO - Carbon Monoxide, %

NO - Nitric Oxide, ppm

PASS/FAIL EMISSION STANDARDS = A+B / VTW

PASS/FAIL STANDARDS - Emission standards used to determine if a vehicle passes the emission inspection. A vehicle passes if the emission levels are equal to or less than the standards for HC, CO and NO for ASM 5015 and ASM 2525.

GROSS POLLUTER STANDARDS - Emission standards used to designate a vehicle as a gross polluter. A vehicle is designated as a gross polluter if the emission levels at the time of the initial inspection, before repairs are greater than the gross polluter standards for HC, CO or NO for ASM 5015 or ASM 2525.

NOTE: **If test data on emission pass/fail rates or gross polluter identification rates indicate adjustments are required, the emission standards may be increased or decreased by the bureau by 30% or by the following tolerances, or standards may be set for any specific vehicle and engine configuration which the bureau determines has excessive errors of commission of omission, whichever is necessary to comply with Section 44001.5 of the Health and Safety Code.**

COLORADO

COLORADO EMISSION STANDARDS - ENHANCED PROGRAM (IM240)

Application	HC gpm	CO gpm	NOx gpm
Passenger Cars			
1982	3.5	45	5.0
1983	3.5	30	4.5
1984	3.0	30	4.5
1985	2.5	20	4.5
1986	2.5	20	4.5
1987	2.5	20	4.0
1988 & 1989	2.0	20	4.0
1990	2.0	20	3.5
1991	1.5	20	3.5
1992	1.5	15	3.5
1993	1.5	15	3.5
1994	1.2	15	3.0
1995	1.2	15	2.5
1996	1.2	15	2.0
1997	1.2	15	2.0
1998 & Newer	1.2	15	1.5
Light Duty Vehicles			
1982	6.0	65	6.0
1983	6.0	65	6.0
1984	5.0	55	6.0
1985	4.5	45	6.0
1986	4.0	40	6.0
1987	3.5	30	5.5
1988 & 1989	3.0	25	5.0
1990	3.0	25	5.0
1991	2.5	25	4.5
1992	2.5	25	4.5
1993	2.5	25	4.5
1994	2.0	20	4.0
1995	2.0	20	4.0

Application	HC gpm	CO gpm	NOx gpm
1996	1.2	15	3.5
1997	1.2	15	3.0
1998	1.2	15	2.0
1999 & Newer	1.2	15	2.0

COLORADO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm	CO %
Passenger Cars & Light Duty Trucks		
1970 & Earlier	1000	3.5
1971	1000	3.0
1972	1000	3.0
1973	1000	3.0
1974	1000	3.0
1975	600	2.0
1976	600	2.0
1977	400	1.5
1978	400	1.5
1979	400	1.5
1980	400	1.5
1981 & Newer	220	1.2
Heavy Duty Trucks (6000 GVWR Or Greater)		
1967 Or Earlier	1500	7.0
1968-69	1200	6.5
1969	1200	6.5
1970	1000	5.5
1971	1000	5.5
1972	1000	5.5
1973	1000	5.5
1974	1000	5.5
1975	1000	5.5
1976	1000	5.5
1977	1000	5.5
1978	1000	5.5
Heavy Duty Trucks (8501 GVWR Or Greater)		
1979	800	4.0
1980	800	3.5
1981	600	3.0
1982	600	3.0
1983	600	3.0
1984	600	3.0
1985	600	3.0
1986 & Newer	300	2.0

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO)
10,000 GVWR Or Less	
1979	250 (2.1)
1980	225 (2.0)
1981-82	200 (1.2)
1983	175 (1.0)

Application	HC ppm (CO)
1984-87	150 (1.0)
1988 & Newer	125 (1.0)

DELAWARE

DELAWARE EMISSION STANDARDS - KENT, NEW CASTLE & SUSSEX COUNTIES (IDLE TEST)

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-70	900 (9.0)
1971-74	600 (6.0)
1975-79	400 (4.0)
1980	220 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1970-72	900 (9.0)
1973-78	600 (6.0)
1979-83	400 (4.0)
1984 & Newer	220 (1.2)

DISTRICT OF COLUMBIA

DISTRICT OF COLUMBIA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles & Trucks (26000 GVWR Or Less)	
1968-70	1250 (11.0)
1971-74	1200 (9.0)
1975-79	600 (6.5)
1980	300 (1.5)
1981 & Newer	220 (1.2)

GEORGIA

NOTE: **The Georgia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and older model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

GEORGIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application (1)	HC ppm (CO %)
1979	500 (5.0)
1980	350 (3.5)
1981-83	250 (1.5)
1984 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

IDAHO

IDAHO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles	
8500 GVWR Or Less	
1965-74	900 (5.0)

Application	HC ppm (CO %)
1975-79	700 (3.0)
1980	400 (1.5)
1981 & Newer	220 (1.2)
Heavy Duty Trucks	
8501 GVWR Or More	
1965-74	900 (6.0)
1975-80	700 (5.0)
1981 & Newer	500 (3.0)

ILLINOIS

ILLINOIS EMISSION STANDARDS - IM240 TEST

Application	HC gpm	CO gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	2.00	60.0
1983-87	2.00	30.0
1988-95	0.80	15.0
1996 & Newer	0.60	10.0
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (3750 LVW Or More) (1)	0.80	13.0
1996 & Newer (3750 LVW Or Less) (1)	0.60	10.0
Light Duty Trucks (6001-6500 GVWR)		
1981-83	7.50	100.0
1984-87	3.20	80.0
1988-95	1.60	40.0
1996 & Newer (5750 ALVW Or More)	0.80	15.0
1996 & Newer (5750 ALVW Or Less)	0.80	13.0
(1) Loaded Vehicle Weight (LVW) is vehicle curb weight plus 300 lbs.		

ILLINOIS EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Vehicles (6000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-77	700 (7.0)
1978-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Light Duty Vehicles (8000 GVWR Or Less)	
1968-71	900 (9.0)
1972-74	800 (8.0)
1975-78	700 (7.0)
1979-80	600 (6.0)
1981-83	300 (3.0)
1984 & Newer	220 (1.2)
Heavy Duty Vehicles (8001 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)

Application	HC ppm (CO %)
1985 & Newer	300 (3.0)

INDIANA

INDIANA EMISSION STANDARDS - IM93 TEST

Application	HC gpm (CO gpm)	NOx (gpm)
Passenger Cars		
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-90	1.4 (20)	3.0
1991-95	0.8 (15)	2.5
1996 & Newer	0.6 (10)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	3.5
1991-95	1.6 (40)	3.0
1996 & Newer	0.8 (20)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1981-83	5.0 (80)	7.0
1984-86	3.2 (70)	7.0
1987-90	2.2 (55)	5.0
1991-96	1.6 (40)	4.5
1997 & Newer	0.8 (20)	4.5
Heavy Duty Trucks (8501-9000 GVWR)		
1981-82	7.5 (100)	8.0
1983-84	6.0 (100)	8.0
1985-86	5.0 (75)	8.0
1987-90	3.0 (60)	8.0
1991-97	2.4 (40)	8.0
1998 & Newer	2.0 (30)	6.0

INDIANA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1976-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1976-78	500 (5.0)
1979-83	350 (3.5)
1984 & Newer	220 (1.2)

KENTUCKY

NOTE: **Currently, there is no emission testing in Kentucky.**

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (IDLE TEST)

Application	**HC ppm (CO)**
Passenger Cars (Automobiles)	
1968	950 (8.5)
1969	900 (8.5)
1970	850 (8.1)
1972	800 (8.0)
1973	800 (7.8)
1974	800 (7.6)
1975	700 (7.5)
1976	700 (6.5)
1977	650 (6.3)
1978	600 (5.5)
1979	600 (4.5)
1980	250 (2.5)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968	1300 (8.0)
1969	1200 (8.0)
1970-71	1100 (8.0)
1972-73	1000 (7.8)
1974	950 (7.8)
1975	900 (7.0)
1976-77	700 (7.0)
1978	700 (6.3)
1979	450 (5.5)
1980	450 (4.0)
1981	350 (1.7)
1982 & Newer	220 (1.2)
Light Duty Trucks (6001-10,000 GVWR)	
1969	1500 (9.0)
1970	1100 (8.0)
1971	1000 (8.0)
1972-75	950 (7.5)
1976	900 (7.5)
1977	850 (7.5)
1978	700 (6.0)
1979	650 (5.5)
1980	550 (5.0)
1981	450 (4.0)
1982	400 (2.5)
1983	350 (2.0)
1984	220 (1.5)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (10,001-18,000 GVWR)	
1968	1500 (9.0)
1969-70	1300 (8.5)
1971	1200 (8.5)
1972-76	1000 (7.0)
1977-80	900 (6.5)
1982-83	400 (3.0)
1984 & Newer	250 (1.5)

MARYLAND

MARYLAND EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1984-87	1.80 (30.0)	2.8
1988-90	1.40 (30.0)	2.5
1991-93	1.00 (20.0)	2.2
1994-95	0.90 (20.0)	2.1
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	2.80 (80.0)	5.8
1988-90	2.40 (80.0)	3.0
1991-93	2.00 (60.0)	2.7
1994-95	1.80 (60.0)	2.6
Light Duty Trucks (6001-8500 GVWR)		
1984-87	2.90 (80.0)	6.6
1988-90	2.40 (80.0)	4.2
1991-93	2.00 (60.0)	4.0
1994-95	1.80 (60.0)	3.7
Heavy Duty Trucks (8501-9999 GVWR)		
1984	5.80 (100.0)	7.7
1985-86	4.70 (80.0)	7.7
1987	3.00 (80.0)	7.7
1988-90	2.60 (80.0)	7.0
1991-97	2.50 (60.0)	5.5
1998 & Newer	2.20 (60.0)	4.0

MARYLAND EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1977	500 (6.0)
1978	430 (5.5)
1979	400 (4.0)
1980	220 (1.7)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-9999 GVWR)	
1977	580 (7.0)

Application	HC ppm (CO %)
1978	550 (6.7)
1979	470 (5.0)
1980	350 (5.0)
1981	250 (3.0)
1982	220 (2.5)
1983	220 (1.5)
1984 & Newer	220 (1.2)
Heavy Duty Trucks (10,000-26,000 GVWR)	
1977-78	650 (7.0)
1979	650 (6.5)
1980-82	500 (6.0)
1983	500 (3.5)
1984-85	440 (3.0)
1986	280 (2.5)
1987 & Newer	220 (1.2)

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - MA31 TEST

Application	HC gpm (CO gpm)	NOx gpm
Passenger Cars		
1984-90	2.0 (30)	3.0
1991-95	1.2 (20)	2.5
1996 & Newer	0.8 (13)	2.0
Light Duty Trucks (6000 GVWR Or Less)		
1984-87	3.2 (80)	7.0
1988-1990	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
1996 & Newer (3750 LVW (1) Or Less)	0.8 (15)	2.0
1996 & Newer (3751 LVW (1) Or Greater)	1.0 (20)	2.5
Light Duty Trucks (6001-8500 GVWR)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer (5750 ALVW (2) Or Less)	1.0 (20)	2.5
1996 & Newer (5751 ALVW (2) Or Greater)	2.4 (60)	4.0
Heavy Duty Trucks (8501-10,000 Or Greater)		
1984-87	3.2 (80)	7.0
1988-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5
1996 & Newer	2.4 (60)	4.0
(1) Loaded Vehicle Weight (LVW). (2) Adjusted Loaded Vehicle Weight (ALVW).		

MASSACHUSETTS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
All Vehicles	
1984-86	220 (0.80)
1987 & Newer	100 (0.60)

MISSOURI

MISSOURI EMISSION STANDARDS - JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1981-82	0.80 (30.0)	2.0
1983-95	0.80 (15.0)	2.0
1996 & Newer	0.60 (10.0)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	3.40 (70.0)	4.5
1984-87	1.60 (40.0)	4.5
1988-95	1.60 (40.0)	2.5
1996 & Newer (Less Than 3750 LVW)	0.80 (13.0)	1.8
1996 & Newer (3750 LVW Or Less)	0.60 (10.0)	1.5
Light Duty Trucks (6001-8500 GVWR)		
1981-83	3.4 (70.0)	4.5
1984-87	1.6 (40.0)	4.5
1988-95	1.60 (40.0)	3.5
1996 & Newer (5750 ALVW Or Less)	0.80 (13.0)	1.8
1996 & Newer (5750 ALVW Or More)	0.80 (15.0)	2.0

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - IDLE TEST

Application (1)	HC ppm (CO %)
1971-74	700 (7.0)
1975-79	600 (6.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)

(1) 8500 GVWR or less.

MISSOURI EMISSION STANDARDS - FRANKLIN, JEFFERSON, ST. CHARLES & ST. LOUIS COUNTIES - REMOTE SENSING CLEAN SCREEN TEST

Application (1)	HC ppm (CO %)	NOx ppm
All Vehicles (8500 GVWR Or Less)		
1971 & Newer	200 (0.5)	2000

(1) 8500 GVWR or less.

NEVADA

NEVADA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1968-69	800 (4.0)
1970-74	700 (3.5)
1975-78	500 (2.5)
1979-80	500 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1400 (7.0)
1970-78	1400 (6.0)
1979	1000 (5.0)
1980	1000 (4.0)
1981 & Newer	1000 (3.5)

NEW JERSEY

NOTE: **The New Jersey program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

NEW JERSEY EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)		
1967 & Earlier	1400 (8.5)	.....
1968-70	700 (7.0)	.....
1971-74	500 (5.0)	.....
1975-80	300 (3.0)	.....
1981 & Newer	220 (1.2)	100 (0.5)
Heavy Duty Vehicles (8501 GVWR Or Greater)		
1967 & Earlier	1400 (8.5)	.....
1968-70	1200 (8.5)	.....
1971-74	700 (6.0)	.....
1975-78	500 (4.0)	.....
1979 & Earlier	300 (3.0)	.....

NEW MEXICO

NEW MEXICO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)		
1975-78	500 (5.0)	500 (5.0)
1979-80	400 (4.0)	400 (4.0)
1981-85	220 (1.2)	220 (1.2)
1986-90	200 (1.2)	200 (1.2)
1991-95	180 (1.2)	180 (1.2)
Light Duty Trucks (6001-8000 GVWR)		
1975-78	600 (6.0)	600 (6.0)
1979-80	600 (4.5)	600 (4.5)
1981-82	400 (2.7)	400 (3.0)
1983-88	300 (1.2)	300 (3.0)

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
1989-95	220 (1.2)	220 (1.2)
Medium Duty Trucks (8001-10,000 GVWR)		
1975 & Newer	650 (6.5)	650 (6.5)

NEW YORK

NEW YORK EMISSION STANDARDS - IM240 TEST

Application	HC gpm Composite	HC gpm Phase 2	CO gpm Composite	CO gpm Phase 2	NOx gpm Both
Light Duty Vehicles					
1981-82	0.80	0.50	30.0	24.0	2.0
1983-95	0.80	0.50	15.0	12.0	2.0
1996 & Newer	0.60	0.40	10.0	8.0	1.5
Light Duty Trucks (6000 GVWR Or Less)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	2.5
1996 & Newer (3750 LVW Or Less)	0.60	0.40	10.0	8.0	1.5
1996 & Newer (3751 LVW Or More)	0.80	0.50	13.0	10.0	1.8
Light Duty Trucks (6501-8500 GVWR)					
1981-83	3.40	2.00	70.0	56.0	4.5
1984-87	1.60	1.00	40.0	32.0	4.5
1988-95	1.60	1.00	40.0	32.0	3.5
1996 & Newer (5750 ALVW Or Less)	0.80	0.50	13.0	10.0	1.8
1996 & Newer (5751 ALVW Or More)	0.80	0.50	15.0	12.0	2.0

NEW YORK EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1978	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1978	600 (4.5)
1979 & Newer	300 (3.0)

NORTH CAROLINA

NORTH CAROLINA EMISSION STANDARDS - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1977	450 (4.5)
1978-79	350 (3.5)
1980	250 (2.0)
1981 & Newer	250 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1977-78	500 (5.0)
1979 & Newer	400 (4.0)

OHIO

NOTE: The Ohio program incorporates original U.S. EPA recommended start-up ASM2525 standards for all model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.

OHIO EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)

OREGON

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND ENHANCED AREA - BAR31

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Passenger Cars		
1981-82	2.0 (64)	3.70
1983-89	2.0 (32)	3.70
1990-95	1.2 (30)	3.00
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6000 GVWR Or Less)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	4.62
1990-95	2.4 (80)	3.75
1996 & Newer	OBD-II Test	OBD-II Test
Light Duty Trucks (6001-8500 GVWR)		
1981-83	8.5 (149)	8.32
1984-87	4.0 (85)	8.32
1988-89	4.0 (85)	6.47
1990-95	2.4 (80)	5.25
1996 & Newer	OBD-II Test	OBD-II Test

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA BASIC TEST - 2-SPEED IDLE TEST

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Light Duty Passenger Cars (6000 GVWR Or Less)		
1975-80 (No Catalyst)	300 (2.5)	-
1975-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1975 & Newer (2-Stroke)	n/a (7.0)	-
Light Duty Trucks (6001-8500 GVWR)		
1975-78 (All)	350 (2.5)	-
1979-80 (No Catalyst)	300 (2.5)	-
1979-80 (Catalyst)	220 (1.0)	-
1981 & Newer (All)	220 (1.0)	220 (1.0)
1996 & Newer (3750 LVW Or Less)	0.9 (20)	2.25

Application	Idle HC ppm (CO %)	2500 RPM HC ppm (CO %)
Heavy Duty Trucks (8501 GVWR Or More)		
1975-78 (Carbureted)	500 (4.0)	n/a (3.0)
1975-78 (Fuel Injection)	500 (4.0)	-
1979-84 (Carbureted)	350 (3.0)	n/a (3.0)
1979-84 (Fuel Injection)	350 (3.0)	-
1985 & Newer (No Catalyst)	350 (3.0)	n/a (3.0)
1985 & Newer (W/Catalyst)	220 (1.0)	220 (1.0)

OREGON EMISSION STANDARDS - METROPOLITAN PORTLAND & ROGUE VALLEY AREA BASIC TEST - EXHAUST OPACITY TEST

Application	Opacity % @ Idle	Opacity % @ High Idle
1975 & Newer		
2-Cycle Engines	20	.....
Gasoline Engines	0	0

PENNSYLVANIA

NOTE: **The Pennsylvania (in Philadelphia area) program incorporates original U.S. EPA recommended start-up ASM5015 standards for 1981 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

PENNSYLVANIA EMISSION STANDARDS - PITTSBURGH & OLDER PHILADELPHIA VEHICLES - IDLE TEST

Application	HC ppm (CO %)
6000 GVWR Or Less	
1975-79	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	130 (1.0)
6001-9000 GVWR	
1975-78	650 (6.0)
1979	400 (4.0)
1980	300 (3.0)
1981-92	220 (1.2)
1993 & Newer	180 (1.0)

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - RI2000 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles		
1974 & Earlier	15.92 (132.44)	14.92
1975-76	6.74 (96.21)	9.92
1977-79	6.74 (96.21)	6.59
1980	2.25 (45.48)	6.59

Application	HC gpm (CO gpm)	NOx gpm
1981-82	2.25 (45.48)	3.25
1983-95	2.25 (23.74)	3.25
1996 & Newer	1.84 (16.50)	2.42
Light Duty Trucks (6000 GVWR Or Less)		
1975 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1988-90	3.88 (59.97)	4.09
1991-95	3.88 (59.97)	4.09
1996 & Newer (3750 LVW Or Less)	1.84 (16.50)	2.42
1996 & Newer (3751 LVW Or More)	2.25 (20.84)	2.92
Light Duty Trucks (6001-8500 GVWR)		
1974 & Earlier	16.94 (175.92)	14.92
1975-78	8.78 (117.95)	9.92
1979-83	7.55 (103.45)	7.42
1984-87	3.88 (59.97)	7.42
1989-90	3.88 (59.97)	5.75
1991-95	3.88 (59.97)	5.75
1996 & Newer (5750 LVW Or Less)	2.25 (20.84)	2.92
1996 & Newer (5751 LVW or More)	5.51 (23.74)	3.25

RHODE ISLAND EMISSION STANDARDS - 2-SPEED IDLE TEST

Application Idle (1)	HC ppm (CO %)
1967 & Earlier	800 (7.0)
1968-74	700 (6.0)
1975-78	300 (3.0)
1979-80	300 (2.5)
1981 & Newer	220 (1.2)
(1) 8500 GVWR or less.	

TENNESSEE

TENNESSEE EMISSION STANDARDS - MEMPHIS - IDLE TEST

Application	HC ppm (CO %)

Application	HC ppm (CO %)
Light Duty Vehicles (9000 GVWR Or Less)	
1971 & Older	900 (8.9)
1972-74	700 (8.2)
1975-79	600 (7.5)
1980	400 (4.7)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (9001-25,999 GVWR)	
1971 & Older	1000 (8.9)
1972-74	1000 (8.2)
1975-79	1000 (8.0)
1980	800 (6.0)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - DAVIDSON & NASHVILLE COUNTIES - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TENNESSEE EMISSION STANDARDS - FOUR COUNTY AREA SURROUNDING NASHVILLE - IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1975-77	500 (5.0)
1978-79	400 (4.0)
1980	300 (3.0)
1981 & Newer	220 (1.2)
Medium Duty Trucks (6001-8500 GVWR)	
1975-77	750 (6.5)
1978-79	600 (6.0)
1980	400 (4.5)
1981 & Newer	400 (4.0)

TEXAS

NOTE: **The Texas program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1995 and newer model year vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.**

TEXAS EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1979	600 (6.0)
1980	400 (4.0)
1981 & Newer	220 (1.2)

Application	HC ppm (CO %)
Heavy Duty Vehicles (8501 GVWR Or More)	
1979-81	700 (7.0)
1982-84	500 (5.0)
1985 & Newer	300 (3.0)

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DC98 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1989-90	2.00 (30)	3.0
1991-95	1.2 (20)	2.5
Light Duty Trucks (6000 GVWR Or Less)		
1989-90	3.2 (80)	3.5
1991-95	2.4 (60)	3.0
Light Duty Trucks (6001-8500 GVWR)		
1989-90	3.2 (80)	5.0
1991-95	2.4 (60)	4.5

UTAH EMISSION STANDARDS - DAVIS COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Vehicles (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Heavy Duty Vehicles (8501 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

NOTE: **The Salt Lake County program incorporates California style ASM2525 and ASM5015 standards for 1968 and newer model year vehicles; however, actual cutpoints are unique to this program and current information is not available at this time.**

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)

Application	HC ppm (CO %)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

UTAH EMISSION STANDARDS - UTAH & WEBER COUNTIES - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Light Duty Vehicles (6000 GVWR Or Less)	
1968-69	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981-95	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-99	800 (6.0)
1970-74	700 (5.0)
1975-76	600 (4.0)
1977-79	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979	500 (3.0)
1980	300 (2.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1968-69	1500 (7.0)
1970-78	1200 (5.0)
1979-80	1000 (4.0)
1981 & Newer	800 (3.5)

VIRGINIA

NOTE: **The Virginia program incorporates original U.S. EPA recommended start-up ASM2525 and ASM5015 standards for 1981 and newer model year**

vehicles. Refer to appropriate model year range in appropriate table. See U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS.

VIRGINIA EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
8500 GVWR Or Less	
1975-90	400 (4.0)
1980	220 (2.0)
1981-89	220 (1.2)
1990-95	125 (1.0)
1996 & Newer	100 (0.75)
8501-10,000 GVWR	
1975-79	400 (4.0)
1980	220 (2.0)
1981-90	220 (1.2)
1991-96	150 (1.0)
1997 & Newer	125 (0.75)

WASHINGTON

WASHINGTON EMISSION STANDARDS - ASM2525 TEST

Application	HC ppm (CO %)
1980 & Earlier (Light-Duty Vehicles)	
1750 GVWR	400 (4.2)
1875 GVWR	380 (4.0)
2000 GVWR	350 (3.8)
2125 GVWR	340 (3.6)
2250 GVWR	320 (3.4)
2375 GVWR	300 (3.2)
2500 GVWR	290 (3.0)
2625 GVWR	270 (2.9)
2750 GVWR	260 (2.8)
2875 GVWR	250 (2.7)
3000 GVWR	240 (2.6)
3125 GVWR	230 (2.5)
3250 GVWR	220 (2.4)
3375 GVWR	220 (2.3)
3500 GVWR	210 (2.2)
3625 GVWR	200 (2.1)
3750 Or Greater GVWR (Passenger Cars Only)	200 (2.1)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)
1981 & Newer (Light-Duty Vehicles)	
1750 GVWR	250 (1.8)
1875 GVWR	240 (1.7)
2000 GVWR	220 (1.6)
2125 GVWR	210 (1.5)
2250 GVWR	200 (1.5)
2375 GVWR	190 (1.4)
2500 GVWR	180 (1.3)
2625 GVWR	180 (1.3)
2750 GVWR	171 (1.2)
2875 GVWR	160 (1.2)
3000 GVWR	160 (1.1)
3125 GVWR	150 (1.1)

Application	HC ppm (CO %)
3250 GVWR	150 (1.0)
3375 GVWR	150 (1.0)
3500 GVWR	150 (1.0)
3625 GVWR	150 (1.0)
3750 Or Greater GVWR (Passenger Cars Only)	150 (1.0)
3750 Or Greater GVWR (Light Duty Trucks)	300 (2.5)

WASHINGTON EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	Idle/2500 RPM HC ppm (CO %)
Light Duty Vehicles (8500 GVWR Or Less)	
1980 & Earlier	600 (3.0)
1981 & Newer	220 (1.2)
Heavy Duty Trucks (8500 GVWR Or More)	
1981 & Newer	400 (3.0)

WISCONSIN

WISCONSIN EMISSION STANDARDS - IM240 TEST

Application	HC gpm (CO gpm)	NOx gpm
Light Duty Vehicles (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-76	3.0 (65)	6.0
1977-79	3.0 (65)	4.0
1980	2.0 (60)	4.0
1981-82	2.0 (60)	3.0
1983-86	2.0 (30)	3.0
1987-93	0.8 (15)	2.0
1991-95	0.8 (15)	2.0
1996 & Newer	0.6 (10)	1.5
Light Duty Trucks (6000 GVWR Or Less)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1987	1.6 (40)	4.5
1988-95	1.6 (40)	2.5
1996 & Newer (3750 LVW Or Less)	0.6 (10)	1.5
1996 & Newer (3751 LVW Or More)	0.8 (13)	1.8
Light Duty Trucks (6001-8500 GVWR)		
1968-72	7.0 (120)	7.0
1973-74	7.0 (120)	6.0
1975-78	4.0 (80)	6.0
1979-83	3.4 (70)	4.5
1984-86	3.2 (70)	4.5
1988-96	1.6 (40)	3.5
1997 & Newer (5750 ALVW Or Less)	0.8 (13)	1.8
1997 & Newer (5751 ALVW Or More)	0.8 (15)	2.0
Heavy Duty Trucks (8501-10,000 GVWR)		

Application	HC gpm (CO gpm)	NOx gpm
1968-69	20.0 (200)	15.0
1970-73	10.0 (175)	10.0
1974-78	10.0 (150)	10.0
1979-84	7.5 (100)	8.0
1985-86	5.0 (80)	8.0
1987-90	2.0 (40)	6.0
1991-97	2.0 (40)	5.0
1998 & Newer	2.0 (30)	4.0
Heavy Duty Trucks (10,001 GVWR or More)		
1968-69	24.0 (250)	30.0
1970-73	13.0 (175)	20.0
1974-78	13.0 (150)	20.0
1979-84	11.5 (150)	16.0
1985-86	10.0 (150)	16.0
1987-90	3.5 (70)	11.0
1991-97	3.5 (70)	9.0
1998 & Newer	3.5 (60)	7.0

WISCONSIN EMISSION STANDARDS - 2-SPEED IDLE TEST

Application	HC ppm (CO %)
Passenger Cars	
1968-71	800 (8.0)
1972-74	550 (7.0)
1975-77	450 (5.5)
1978	350 (4.0)
1979	275 (3.0)
1980	230 (2.0)
1981 & Newer	220 (1.2)
Light Duty Trucks (6000 GVWR Or Less)	
1968-71	800 (8.0)
1972-74	700 (7.0)
1975-77	500 (6.0)
1978	450 (5.0)
1979	300 (3.0)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Light Duty Trucks (6001-8500 GVWR)	
1968-69	1450 (9.0)
1970-71	800 (8.0)
1972-74	700 (7.0)
1975-77	550 (6.5)
1978	450 (5.5)
1979	300 (3.0)

Application	HC ppm (CO %)
1980	275 (2.5)
1981-84	250 (2.0)
1985 & Newer	220 (1.2)
Heavy Duty Trucks (8501 GVWR Or More)	
1968-71	1500 (9.5)
1972-78	900 (9.0)
1979-84	700 (7.0)
1985 & Newer	300 (3.0)

U. S. EPA ASM2525 & ASM5015 START-UP EMISSION STANDARDS

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-76 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4980
1875	729 (3.70)	4990	717 (5.14)	4906
2000	688 (3.49)	4919	676 (4.85)	4838
2125	650 (3.31)	4853	638 (4.58)	4776
2250	615 (3.13)	4792	604 (4.34)	4720
2375	583 (2.98)	4736	573 (4.12)	4668
2500	554 (2.83)	4685	544 (3.91)	4620
2625	528 (2.70)	4639	518 (3.73)	4577
2750	503 (2.58)	4596	495 (3.56)	4374
2875	481 (2.47)	4484	473 (3.41)	4176
3000	461 (2.37)	4290	453 (3.27)	3996
3125	443 (2.28)	4114	435 (3.14)	3832
3250	426 (2.20)	3952	419 (3.02)	3681
3375	411 (2.12)	3804	404 (2.91)	3544
3500	397 (2.05)	3669	390 (2.82)	3418
3625	384 (1.99)	3544	377 (2.73)	3302
3750	372 (1.93)	3429	365 (2.64)	3195
3875	361 (1.87)	3323	355 (2.57)	3096
4000	351 (1.82)	3224	345 (2.49)	3003
4125	341 (1.77)	3131	335 (2.43)	2917
4250	332 (1.73)	3044	326 (2.36)	2836
4375	323 (1.68)	2961	318 (2.31)	2759
4500	315 (1.64)	2883	310 (2.25)	2686
4625	308 (1.61)	2807	302 (2.19)	2616
4750	300 (1.57)	2735	295 (2.14)	2549
4875	293 (1.53)	2665	288 (2.09)	2483
5000	286 (1.50)	2597	281 (2.04)	2420
5125	279 (1.46)	2530	274 (2.00)	2359
5250	272 (1.43)	2466	267 (1.95)	2298
5375	266 (1.40)	2403	261 (1.90)	2240
5500	259 (1.37)	2341	255 (1.86)	2183
5625	253 (1.34)	2282	248 (1.82)	2127
5750	247 (1.31)	2224	243 (1.78)	2074
5875	241 (1.28)	2168	237 (1.74)	2022
6000	236 (1.25)	2116	232 (1.70)	1973
6125	231 (1.23)	2066	227 (1.66)	1927
6250	226 (1.20)	2020	222 (1.63)	1884
6375	222 (1.18)	1979	218 (1.60)	1846
6500	218 (1.16)	1943	214 (1.57)	1813

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6625	215 (1.15)	1913	211 (1.55)	1785
6750	213 (1.14)	1890	209 (1.54)	1764
6875	211 (1.13)	1875	207 (1.52)	1750
7000	211 (1.12)	1870	207 (1.52)	1745
7125 Or More	211 (1.12)	1874	206 (1.52)	1745

U.S. EPA ASM EMISSION STANDARDS - 1977-79 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (3.92)	4990	761 (5.45)	4950
1875	729 (3.70)	4990	717 (5.14)	4655
2000	688 (3.49)	4707	676 (4.85)	4384
2125	650 (3.31)	4441	638 (4.58)	4136
2250	615 (3.13)	4197	604 (4.34)	3909
2375	583 (2.98)	3974	573 (4.12)	3701
2500	554 (2.83)	3771	544 (3.91)	3512
2625	528 (2.70)	3585	518 (3.73)	3339
2750	503 (2.58)	3416	495 (3.56)	3181
2875	481 (2.47)	3261	473 (3.41)	3037
3000	461 (2.37)	3120	453 (3.27)	2906
3125	443 (2.28)	2992	435 (3.14)	2787
3250	426 (2.20)	2874	419 (3.02)	2677
3375	411 (2.12)	2767	404 (2.91)	2577
3500	397 (2.05)	2668	390 (2.82)	2486
3625	384 (1.99)	2578	377 (2.73)	2401
3750	372 (1.93)	2494	365 (2.64)	2323
3875	361 (1.87)	2417	355 (2.57)	2251
4000	351 (1.82)	2345	345 (2.49)	2184
4125	341 (1.77)	2277	335 (2.43)	2122
4250	332 (1.73)	2214	326 (2.36)	2063
4375	323 (1.68)	2154	318 (2.31)	2007
4500	315 (1.64)	2096	310 (2.25)	1953
4625	308 (1.61)	2042	302 (2.19)	1903
4750	300 (1.57)	1989	295 (2.14)	1854
4875	293 (1.53)	1938	288 (2.09)	1806
5000	286 (1.50)	1889	281 (2.04)	1760
5125	279 (1.46)	1840	274 (2.00)	1715
5250	272 (1.43)	1793	267 (1.95)	1672
5375	266 (1.40)	1747	261 (1.90)	1629
5500	259 (1.37)	1703	255 (1.86)	1587
5625	253 (1.34)	1659	248 (1.82)	1547
5750	247 (1.31)	1617	243 (1.78)	1508
5875	241 (1.28)	1577	237 (1.74)	1471
6000	236 (1.25)	1539	232 (1.70)	1435
6125	231 (1.23)	1503	227 (1.66)	1401
6250	226 (1.20)	1469	222 (1.63)	1371
6375	222 (1.18)	1439	218 (1.60)	1343
6500	218 (1.16)	1413	214 (1.57)	1318
6625	215 (1.15)	1391	211 (1.55)	1298

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
6750	213 (1.14)	1374	209 (1.54)	1283
6875	211 (1.13)	1364	207 (1.52)	1273
7000 Or More	211 (1.12)	1360	207 (1.52)	1269

U.S. EPA ASM EMISSION STANDARDS - 1980 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	4990	282 (3.64)	4950
1875	275 (2.63)	4990	266 (3.43)	4655
2000	260 (2.48)	4707	252 (3.24)	4384
2125	246 (2.35)	4441	239 (3.06)	4136
2250	234 (2.23)	4197	227 (2.90)	3909
2375	223 (2.12)	3974	216 (2.76)	3701
2500	212 (2.02)	3771	206 (2.62)	3512
2625	203 (1.92)	3585	197 (2.50)	3339
2750	194 (1.84)	3416	189 (2.39)	3181
2875	187 (1.76)	3261	181 (2.29)	3037
3000	180 (1.69)	3120	174 (2.19)	2906
3125	173 (1.63)	2992	168 (2.11)	2787
3250	167 (1.57)	2874	162 (2.03)	2677
3375	162 (1.52)	2767	157 (1.96)	2577
3500	157 (1.47)	2668	152 (1.89)	2486
3625	152 (1.42)	2578	148 (1.84)	2401
3750	148 (1.38)	2492	144 (1.78)	2323
3875	144 (1.34)	2417	140 (1.73)	2251
4000	140 (1.31)	2345	137 (1.68)	2184
4125	137 (1.27)	2277	133 (1.64)	2122
4250	134 (1.24)	2214	130 (1.60)	2063
4375	131 (1.21)	2154	127 (1.56)	2007
4500	128 (1.18)	2096	124 (1.52)	1953
4625	125 (1.15)	2042	122 (1.48)	1903
4750	122 (1.13)	1989	119 (1.45)	1854
4875	120 (1.10)	1938	117 (1.42)	1806
5000	117 (1.08)	1889	114 (1.38)	1760
5125	115 (1.05)	1840	112 (1.35)	1715
5250	112 (1.03)	1793	110 (1.32)	1672
5375	110 (1.01)	1747	107 (1.29)	1629
5500	108 (0.99)	1703	105 (1.26)	1587
5625	106 (0.97)	1659	103 (1.24)	1547
5750	104 (0.94)	1617	101 (1.21)	1508
5875	102 (0.92)	1577	99 (1.18)	1471
6000	100 (0.91)	1539	97 (1.16)	1435
6125	98 (0.89)	1503	95 (1.13)	1401
6250	96 (0.87)	1469	94 (1.11)	1371
6375	95 (0.86)	1439	92 (1.09)	1343
6500	93 (0.84)	1413	91 (1.08)	1318
6625	92 (0.83)	1391	90 (1.06)	1298
6750	91 (0.82)	1374	89 (1.05)	1283
6875	91 (0.82)	1364	89 (1.04)	1273

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7000	91 (0.82)	1360	88 (1.04)	1269
7125 Or More	90 (0.81)	1360	88 (1.04)	1269

U.S. EPA ASM EMISSION STANDARDS - 1981-82 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (2.78)	2272	282 (3.64)	2114
1875	275 (2.63)	2181	266 (3.43)	1991
2000	260 (2.48)	2058	252 (3.24)	1877
2125	246 (2.35)	1944	239 (3.06)	1774
2250	234 (2.23)	1839	227 (2.90)	1678
2375	223 (2.12)	1744	216 (2.76)	1592
2500	212 (2.02)	1657	206 (2.62)	1512
2625	203 (1.92)	1577	197 (2.50)	1440
2750	194 (1.84)	1504	189 (2.39)	1374
2875	187 (1.76)	1438	181 (2.29)	1313
3000	180 (1.69)	1378	174 (2.19)	1258
3125	173 (1.63)	1323	168 (2.11)	1208
3250	167 (1.57)	1273	162 (2.03)	1163
3375	162 (1.52)	1227	157 (1.96)	1121
3500	157 (1.47)	1184	152 (1.89)	1082
3625	152 (1.42)	1146	148 (1.84)	1047
3750	148 (1.38)	1110	144 (1.78)	1014
3875	144 (1.34)	1077	140 (1.73)	984
4000	140 (1.31)	1046	137 (1.68)	956
4125	137 (1.27)	1017	133 (1.64)	930
4250	134 (1.24)	990	130 (1.60)	905
4375	131 (1.21)	964	127 (1.56)	882
4500	128 (1.18)	939	124 (1.52)	859
4625	125 (1.15)	916	122 (1.48)	838
4750	122 (1.13)	893	119 (1.45)	818
4875	120 (1.10)	872	117 (1.42)	798
5000	117 (1.08)	850	114 (1.38)	778
5125	115 (1.05)	830	112 (1.35)	760
5250	112 (1.03)	810	110 (1.32)	741
5375	110 (1.01)	790	107 (1.29)	723
5500	108 (0.99)	771	105 (1.26)	706
5625	106 (0.97)	752	103 (1.24)	689
5750	104 (0.94)	734	101 (1.21)	673
5875	102 (0.92)	717	99 (1.18)	657
6000	100 (0.91)	701	97 (1.16)	642
6125	98 (0.89)	685	95 (1.13)	628
6250	96 (0.87)	671	94 (1.11)	615
6375	95 (0.86)	658	92 (1.09)	604
6500	93 (0.84)	647	91 (1.08)	593
6625	92 (0.83)	638	90 (1.06)	585
6750	91 (0.82)	631	89 (1.05)	578
6875	91 (0.82)	626	89 (1.04)	574
7000	91 (0.82)	624	88 (1.04)	573

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
7125 Or More	90 (0.81)	625	88 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1983-90 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	291 (1.64)	2272	282 (1.83)	2114
1875	275 (1.55)	2181	266 (1.72)	1991
2000	260 (1.47)	2058	252 (1.63)	1877
2125	246 (1.39)	1944	239 (1.54)	1774
2250	234 (1.31)	1839	227 (1.47)	1678
2375	223 (1.26)	1744	216 (1.39)	1592
2500	212 (1.20)	1657	206 (1.33)	1512
2625	203 (1.15)	1577	197 (1.27)	1440
2750	194 (1.10)	1504	189 (1.21)	1374
2875	187 (1.05)	1438	181 (1.16)	1313
3000	180 (1.01)	1378	174 (1.12)	1258
3125	173 (0.98)	1323	168 (1.08)	1208
3250	167 (0.94)	1273	162 (1.04)	1163
3375	162 (0.91)	1227	157 (1.00)	1121
3500	157 (0.88)	1184	152 (0.97)	1082
3625	152 (0.86)	1146	148 (0.94)	1047
3750	148 (0.83)	1110	144 (0.92)	1014
3875	144 (0.81)	1077	140 (0.89)	984
4000	140 (0.79)	1046	137 (0.87)	956
4125	137 (0.77)	1017	133 (0.85)	930
4250	134 (0.75)	990	130 (.83)	905
4375	131 (0.74)	964	127 (0.81)	882
4500	128 (0.72)	939	124 (0.79)	859
4625	125 (0.70)	916	122 (0.77)	838
4750	122 (0.69)	893	119 (0.76)	818
4875	120 (0.67)	872	117 (0.74)	798
5000	117 (0.66)	850	114 (0.73)	778
5125	115 (0.65)	830	112 (0.71)	760
5250	112 (0.63)	810	110 (0.70)	741
5375	110 (0.62)	790	107 (0.68)	723
5500	108 (0.61)	771	105 (0.67)	706
5625	106 (0.59)	752	103 (0.65)	689
5750	104 (0.58)	734	101 (0.64)	673
5875	102 (0.57)	717	99 (0.63)	657
6000	100 (0.56)	701	97 (0.62)	642
6125	98 (0.55)	685	95 (0.61)	628
6250	96 (0.54)	671	94 (0.60)	615
6375	95 (0.53)	658	92 (0.59)	604
6500	93 (0.52)	647	91 (0.58)	593
6625	92 (0.52)	638	90 (0.57)	585
6750	91 (0.51)	631	89 (0.57)	578
6875	91 (0.51)	626	89 (0.56)	574
7000	91 (0.51)	624	88 (0.56)	573
7125	90 (0.51)	625	88 (0.56)	573

Test Weight	**ASM5015**		**ASM2525**	
	HC ppm (CO %)	**NOx ppm**	**HC ppm (CO %)**	**NOx ppm**
7250 Or More	90 (0.50)	625	88 (0.56)	573

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY VEHICLES

Test Weight	**ASM5015**		**ASM2525**	
	HC ppm (CO %)	**NOx ppm**	**HC ppm (CO %)**	**NOx ppm**
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1994 & NEWER + TIER 1 LIGHT DUTY VEHICLES

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm

Test Weight	**ASM5015**		**ASM2525**	
	HC ppm (CO %)	**NOx ppm**	**HC ppm (CO %)**	**NOx ppm**
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2540
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	**ASM5015**		**ASM2525**	
	HC ppm (CO %)	**NOx ppm**	**HC ppm (CO %)**	**NOx ppm**
1750	1118 (8.02)	4990	1098 (9.90)	4980

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	2725	381 (4.85)	2587
1875	368 (3.34)	2649	359 (4.57)	2435
2000	348 (3.16)	2499	339 (4.31)	2295
2125	329 (2.99)	2360	321 (4.08)	2167
2250	312 (2.83)	2232	305 (3.86)	2050

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2375	297 (2.69)	2115	290 (3.66)	1943
2500	283 (2.56)	2009	276 (3.48)	1845
2625	270 (2.44)	1912	263 (3.32)	1756
2750	258 (2.33)	1823	252 (3.17)	1675
2875	247 (2.23)	1742	241 (3.03)	1601
3000	237 (2.14)	1668	232 (2.91)	1533
3125	228 (2.06)	1601	223 (2.79)	1471
3250	220 (1.99)	1539	215 (2.69)	1415
3375	213 (1.92)	1483	208 (2.60)	1363
3500	206 (1.86)	1432	201 (2.51)	1316
3625	200 (1.80)	1384	195 (2.43)	1273
3750	194 (1.74)	1340	189 (2.36)	1233
3875	188 (1.69)	1300	184 (2.29)	1195
4000	183 (1.65)	1262	179 (2.22)	1161
4125	179 (1.61)	1227	175 (2.16)	1126
4250	174 (1.56)	1194	170 (2.11)	1098
4375	170 (1.53)	1162	166 (2.06)	1069
4500	166 (1.49)	1132	162 (2.01)	1042
4625	162 (1.46)	1104	159 (1.96)	1015
4750	159 (1.42)	1076	155 (1.91)	990
4875	155 (1.39)	1049	152 (1.87)	966
5000	152 (1.36)	1023	148 (1.82)	942
5125	148 (1.33)	998	145 (1.78)	919
5250	145 (1.30)	974	142 (1.74)	896
5375	142 (1.27)	950	139 (1.70)	874
5500	139 (1.24)	926	136 (1.66)	853
5625	136 (1.12)	904	133 (1.62)	832
5750	133 (1.19)	882	130 (1.59)	812
5875	130 (1.16)	860	127 (1.55)	793
6000	127 (1.14)	840	124 (1.52)	774
6125	125 (1.11)	822	122 (1.49)	757
6250	123 (1.09)	804	120 (1.46)	741
6375	120 (1.07)	788	118 (1.43)	727
6500	119 (1.06)	775	116 (1.41)	714
6625	117 (1.04)	763	114 (1.39)	704
6750	116 (1.03)	755	113 (1.37)	696
6875	115 (1.02)	749	113 (1.36)	691
7000 Or More	115 (1.02)	747	112 (1.36)	689

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6000 GVWR OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	2272	315 (3.64)	2114
1875	306 (2.63)	2181	297 (3.43)	1991
2000	289 (2.48)	2058	281 (3.24)	1877
2125	274 (2.35)	1944	267 (3.06)	1774
2250	260 (2.23)	1839	253 (2.90)	1678
2375	247 (2.12)	1744	241 (2.76)	1592
2500	236 (2.02)	1657	230 (2.62)	1512

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2625	225 (1.92)	1577	219 (2.50)	1440
2750	216 (1.84)	1504	210 (2.39)	1374
2875	207 (1.76)	1438	210 (2.29)	1313
3000	199 (1.69)	1378	194 (2.19)	1258
3125	191 (1.63)	1323	186 (2.11)	1208
3250	185 (1.57)	1273	180 (2.03)	1163
3375	179 (1.52)	1227	174 (1.96)	1121
3500	173 (1.47)	1184	169 (1.89)	1082
3625	168 (1.42)	1146	164 (1.84)	1047
3750	163 (1.38)	1110	159 (1.78)	1014
3875	159 (1.34)	1077	155 (1.73)	984
4000	155 (1.31)	1046	151 (1.68)	956
4125	151 (1.27)	1017	147 (1.64)	930
4250	147 (1.24)	990	143 (1.60)	905
4375	144 (1.21)	964	140 (1.56)	882
4500	141 (1.18)	939	137 (1.52)	859
4625	137 (1.15)	916	134 (1.48)	838
4750	134 (1.13)	893	131 (1.45)	818
4875	132 (1.10)	872	128 (1.42)	798
5000	129 (1.08)	850	126 (1.38)	778
5125	126 (1.05)	830	123 (1.35)	760
5250	123 (1.03)	810	120 (1.32)	741
5375	121 (1.01)	790	118 (1.29)	723
5500	118 (0.99)	771	115 (1.26)	706
5625	116 (0.97)	752	113 (1.24)	689
5750	113 (0.94)	734	111 (1.21)	673
5875	111 (0.92)	717	108 (1.18)	657
6000	109 (0.91)	701	106 (1.16)	642
6125	107 (0.89)	685	104 (1.13)	628
6250	105 (.087)	671	102 (1.11)	615
6375	103 (0.86)	658	101 (1.09)	604
6500	102 (0.84)	647	99 (1.08)	593
6625	101 (0.83)	638	98 (1.06)	585
6750	100 (0.82)	631	97 (1.05)	578
6875	99 (0.82)	626	97 (1.04)	574
7000	99 (0.82)	624	96 (1.04)	573
7125 Or More	98 (0.81)	625	96 (1.04)	573

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3750 LVW OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	142 (0.80)	1212	136 (0.77)	1095
1875	134 (0.75)	1142	129 (0.73)	1031
2000	127 (0.71)	1077	123 (0.69)	973
2125	121 (0.68)	1018	116 (0.66)	920
2250	115 (0.64)	964	111 (0.62)	871
2375	109 (0.61)	915	106 (0.59)	827
2500	105 (0.59)	869	101 (0.57)	786
2625	100 (0.56)	828	97 (0.54)	749

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
2750	96 (0.54)	791	93 (0.52)	715
2875	92 (0.52)	756	89 (0.50)	684
3000	89 (0.50)	725	86 (0.48)	656
3125	86 (0.48)	696	83 (0.46)	630
3250	83 (0.46)	670	80 (0.45)	607
3375	81 (0.45)	647	78 (0.43)	585
3500	78 (0.44)	625	76 (0.42)	566
3625	76 (0.42)	605	74 (0.41)	547
3750	74 (0.41)	586	72 (0.40)	531
3875	72 (0.40)	569	70 (0.39)	515
4000	71 (0.39)	553	68 (0.38)	501
4125	69 (0.38)	538	67 (0.37)	487
4250	67 (0.37)	524	65 (0.36)	475
4375	66 (0.36)	510	64 (0.35)	463
4500	65 (0.36)	498	63 (0.35)	440
4625	63 (0.35)	486	61 (0.34)	440
4750	62 (0.34)	474	60 (0.33)	430
4875	61 (0.34)	463	59 (0.33)	420
5000	60 (0.33)	452	58 (0.32)	410
5125	58 (0.32)	441	57 (0.31)	400
5250	57 (0.32)	431	56 (0.31)	391
5375	56 (0.31)	420	55 (0.30)	382
5500	55 (0.30)	410	54 (0.30)	373
5625	54 (0.30)	401	53 (0.29)	364
5750	53 (0.29)	391	52 (0.29)	356
5875	52 (0.29)	383	51 (0.28)	348
6000	51 (0.28)	374	50 (0.28)	340
6125	50 (0.28)	366	49 (0.27)	333
6250	50 (0.27)	359	48 (0.27)	326
6375	49 (0.27)	352	48 (0.26)	320
6500	48 (0.26)	346	47 (0.26)	315
6625	48 (0.26)	341	46 (0.26)	311
6750	47 (0.26)	338	46 (0.26)	307
6875	47 (0.26)	335	46 (0.25)	305
7000 Or More	47 (0.25)	335	46 (0.25)	305

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (3751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1968-72 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4990
1875	1052 (7.56)	4990	1034 (9.90)	4990
2000	992 (7.14)	4990	975 (9.90)	4990
2125	938 (6.75)	4990	921 (9.66)	4990
2250	887 (6.40)	4990	872 (9.14)	4990
2375	841 (6.07)	4990	827 (8.67)	4990
2500	800 (5.78)	4990	786 (8.25)	4990
2625	761 (5.51)	4990	748 (7.85)	4990
2750	726 (5.26)	4990	714 (7.50)	4772
2875	695 (5.03)	4892	683 (7.17)	4556
3000	666 (4.83)	4680	654 (6.87)	4359
3125	639 (4.64)	4488	628 (6.60)	4180

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3250	615 (4.47)	4311	604 (6.35)	4016
3375	593 (4.31)	4150	583 (6.13)	3866
3500	573 (4.17)	4002	563 (5.92)	3728
3625	554 (4.04)	3867	544 (5.73)	3602
3750	537 (3.91)	3741	527 (5.55)	3485
3875	521 (3.80)	3625	512 (5.39)	3377
4000	506 (3.70)	3517	497 (5.24)	3276
4125	492 (3.60)	3416	484 (5.09)	3182
4250	479 (3.51)	3321	471 (4.96)	3094
4375	467 (3.42)	3230	459 (4.83)	3010
4500	455 (3.34)	3145	447 (4.71)	2930
4625	444 (3.26)	3063	436 (4.60)	2854
4750	433 (3.18)	2983	425 (4.49)	2780
4875	423 (3.11)	2907	415 (4.38)	2709
5000	412 (3.03)	2833	405 (4.28)	2640
5125	402 (2.97)	2760	395 (4.18)	2573
5250	393 (2.90)	2690	386 (4.08)	2507
5375	383 (2.83)	2621	376 (3.98)	2443
5500	374 (2.77)	2554	367 (3.89)	2381
5625	365 (2.70)	2489	359 (3.80)	2321
5750	357 (2.64)	2426	350 (3.71)	2262
5875	348 (2.59)	2366	342 (3.62)	2206
6000	341 (2.53)	2308	334 (3.54)	2152
6125	333 (2.48)	2254	327 (3.47)	2102
6250	326 (2.43)	2204	320 (3.40)	2056
6375	320 (2.39)	2159	314 (3.34)	2014
6500	315 (2.35)	2119	309 (3.28)	1977
6625	310 (2.32)	2087	304 (3.23)	1947
6750	307 (2.29)	2062	301 (3.20)	1924
6875	305 (2.28)	2046	299 (3.17)	1909
7000	304 (2.27)	2040	298 (3.17)	1904
7125 Or More	304 (2.27)	2045	298 (3.17)	1904

U.S. EPA ASM EMISSION STANDARDS - 1973-74 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	1118 (8.02)	4990	1098 (9.90)	4980
1875	1052 (7.56)	4990	1034 (9.90)	4906
2000	992 (7.14)	4919	975 (9.90)	4838
2125	938 (6.75)	4853	921 (9.66)	4776
2250	887 (6.40)	4792	872 (9.14)	4720
2375	841 (6.07)	4736	827 (8.67)	4668
2500	800 (5.78)	4685	786 (8.25)	4620
2625	761 (5.51)	4639	748 (7.85)	4577
2750	726 (5.26)	4596	714 (7.50)	4374
2875	695 (5.03)	4484	683 (7.17)	4176
3000	666 (4.83)	4290	654 (6.87)	3996
3125	639 (4.64)	4114	628 (6.60)	3832
3250	615 (4.47)	3952	604 (6.35)	3681

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3375	593 (4.31)	3804	583 (6.13)	3544
3500	573 (4.17)	3669	563 (5.92)	3418
3625	554 (4.04)	3544	544 (5.73)	3302
3750	537 (3.91)	3429	527 (5.55)	3195
3875	521 (3.80)	3323	512 (5.39)	3096
4000	506 (3.70)	3224	497 (5.24)	3003
4125	492 (3.60)	3131	484 (5.09)	2917
4250	479 (3.51)	3044	471 (4.96)	2836
4375	467 (3.42)	2961	459 (4.83)	2759
4500	455 (3.34)	2883	447 (4.71)	2686
4625	444 (3.26)	2807	436 (4.60)	2616
4750	433 (3.18)	2735	425 (4.49)	2549
4875	423 (3.11)	2665	415 (4.38)	2483
5000	412 (3.03)	2597	405 (4.28)	2420
5125	402 (2.97)	2530	395 (4.18)	2359
5250	393 (2.90)	2466	386 (4.08)	2298
5375	383 (2.83)	2403	376 (3.98)	2240
5500	374 (2.77)	2341	367 (3.89)	2183
5625	365 (2.70)	2282	359 (3.80)	2127
5750	357 (2.64)	2224	350 (3.71)	2074
5875	348 (2.59)	2168	342 (3.62)	2022
6000	341 (2.53)	2116	334 (3.54)	1973
6125	333 (2.48)	2066	327 (3.47)	1927
6250	326 (2.43)	2020	320 (3.40)	1884
6375	320 (2.39)	1979	314 (3.34)	1846
6500	315 (2.35)	1943	309 (3.28)	1813
6625	310 (2.32)	1913	304 (3.23)	1785
6750	307 (2.29)	1890	301 (3.20)	1764
6875	305 (2.28)	1875	299 (3.17)	1750
7000	304 (2.27)	1870	298 (3.17)	1745
7125 Or More	304 (2.27)	1874	298 (3.17)	1745

U.S. EPA ASM EMISSION STANDARDS - 1975-78 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	843 (5.07)	4990	828 (7.26)	4980
1875	794 (4.78)	4990	780 (6.84)	4906
2000	749 (4.51)	4919	736 (6.45)	4838
2125	707 (4.26)	4853	695 (6.10)	4776
2250	669 (4.04)	4792	658 (5.78)	4720
2375	635 (3.83)	4736	624 (5.48)	4668
2500	603 (3.65)	4685	593 (5.21)	4620
2625	574 (3.48)	4639	564 (4.96)	4577
2750	548 (3.32)	4596	539 (4.73)	4374
2875	524 (3.18)	4484	515 (4.53)	4176
3000	502 (3.05)	4290	493 (4.34)	3996
3125	482 (2.93)	4114	474 (4.17)	3832
3250	464 (2.82)	3952	456 (4.01)	3681
3375	447 (2.72)	3804	440 (3.87)	3544

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3500	432 (2.63)	3669	424 (3.74)	3418
3625	418 (2.55)	3544	411 (3.62)	3302
3750	405 (2.47)	3429	398 (3.51)	3195
3875	393 (2.40)	3323	386 (3.40)	3096
4000	382 (2.33)	3224	375 (3.31)	3003
4125	371 (2.27)	3131	365 (3.22)	2917
4250	361 (2.21)	3044	355 (3.13)	2836
4375	352 (2.16)	2961	346 (3.05)	2759
4500	343 (2.11)	2883	337 (2.98)	2686
4625	335 (2.06)	2807	329 (2.90)	2616
4750	327 (2.01)	2735	321 (2.83)	2549
4875	319 (1.96)	2665	313 (2.77)	2483
5000	311 (1.92)	2597	305 (2.70)	2420
5125	304 (1.87)	2530	298 (2.64)	2359
5250	296 (1.83)	2466	291 (2.58)	2298
5375	289 (1.79)	2403	284 (2.51)	2240
5500	282 (1.75)	2341	277 (2.46)	2183
5625	276 (1.71)	2282	271 (2.40)	2127
5750	269 (1.67)	2224	264 (2.34)	2074
5875	263 (1.63)	2168	258 (2.29)	2022
6000	257 (1.60)	2116	252 (2.24)	1973
6125	251 (1.57)	2066	247 (2.19)	1927
6250	246 (1.54)	2020	242 (2.15)	1884
6375	242 (1.51)	1979	237 (2.11)	1846
6500	238 (1.48)	1943	233 (2.07)	1813
6625	234 (1.46)	1913	230 (2.04)	1785
6750	232 (1.45)	1890	227 (2.02)	1764
6875	230 (1.44)	1875	225 (2.00)	1750
7000	229 (1.43)	1870	225 (2.00)	1745
7125 Or More	229 (1.43)	1874	225 (2.00)	1745

U.S. EPA ASM EMISSION STANDARDS - 1979-83 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	774 (4.31)	4990	761 (6.06)	4960
1875	729 (4.06)	4990	717 (5.70)	4738
2000	688 (3.83)	4778	676 (5.38)	4535
2125	650 (3.63)	4578	638 (5.09)	4349
2250	615 (3.44)	4395	604 (4.82)	4179
2375	583 (3.26)	4228	573 (4.57)	4024
2500	554 (3.10)	4076	544 (4.35)	3881
2625	528 (2.96)	3936	518 (4.14)	3752
2750	503 (2.83)	3809	495 (3.95)	3579
2875	481 (2.71)	3669	473 (3.78)	3417
3000	461 (2.60)	3510	453 (3.62)	3270
3125	443 (2.50)	3366	435 (3.48)	3135
3250	426 (2.40)	3234	419 (3.35)	3012
3375	411 (2.32)	3113	404 (3.23)	2899
3500	397 (2.24)	3002	390 (3.12)	2796

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3625	384 (2.17)	2900	377 (3.02)	2701
3750	372 (2.11)	2806	365 (2.93)	2614
3875	361 (2.05)	2719	355 (2.58)	2533
4000	351 (1.99)	2638	345 (2.77)	2457
4125	341 (1.94)	2562	335 (2.69)	2387
4250	332 (1.89)	2490	326 (2.62)	2320
4375	323 (1.84)	2423	318 (2.55)	2258
4500	315 (1.80)	2359	310 (2.49)	2198
4625	308 (1.76)	2297	302 (2.43)	2140
4750	300 (1.72)	2238	295 (2.37)	2085
4875	293 (1.68)	2180	288 (2.32)	2032
5000	286 (1.64)	2125	281 (2.26)	1980
5125	279 (1.60)	2070	274 (2.21)	1930
5250	272 (1.56)	2017	267 (2.16)	1881
5375	26 (1.53)	1966	261 (2.11)	1833
5500	259 (1.49)	1916	255 (2.06)	1786
5625	253 (1.46)	1867	248 (2.01)	1740
5750	247 (1.43)	1820	243 (1.96)	1697
5875	241 (1.40)	1774	237 (1.92)	1654
6000	236 (1.37)	1731	232 (1.88)	1614
6125	231 (1.34)	1690	227 (1.84)	1577
6250	226 (1.31)	1653	222 (1.80)	1542
6375	222 (1.29)	1619	218 (1.77)	1510
6500	218 (1.27)	1590	214 (1.74)	1483
6625	215 (1.25)	1565	211 (1.72)	1460
6750	213 (1.24)	1546	209 (1.70)	1443
6875	211 (1.23)	1534	207 (1.68)	1432
7000	211 (1.23)	1530	207 (1.68)	1428
7125 Or More	211 (1.22)	1531	206 (1.68)	1428

U.S. EPA ASM EMISSION STANDARDS - 1984-87 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4990	381 (4.85)	4960
1875	368 (3.34)	4990	359 (4.57)	4738
2000	348 (3.16)	4778	339 (4.31)	4535
2125	329 (2.99)	4578	321 (4.08)	4349
2250	312 (2.83)	4395	305 (3.86)	4179
2375	297 (2.69)	4228	290 (3.66)	4024
2500	283 (2.56)	4076	276 (3.48)	3881
2625	270 (2.44)	3936	263 (3.32)	3752
2750	258 (2.33)	3809	252 (3.17)	3579
2875	247 (2.23)	3669	241 (3.03)	3417
3000	237 (2.14)	3510	232 (2.91)	3270
3125	228 (2.06)	3366	223 (2.79)	3135
3250	220 (1.99)	3234	215 (2.69)	3012
3375	213 (1.92)	3113	208 (2.60)	2899
3500	206 (1.86)	3002	201 (2.51)	2796
3625	200 (1.80)	2900	195 (2.43)	2701

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3750	194 (1.74)	2806	189 (2.36)	2614
3875	188 (1.69)	2719	184 (2.29)	2533
4000	183 (1.65)	2638	179 (2.22)	2457
4125	179 (1.61)	2562	175 (2.16)	2387
4250	174 (1.56)	2490	170 (2.11)	2320
4375	170 (1.53)	2423	166 (2.06)	2258
4500	166 (1.49)	2359	162 (2.01)	2198
4625	162 (1.46)	2297	159 (1.96)	2140
4750	159 (1.42)	2238	155 (1.91)	2085
4875	155 (1.39)	2180	152 (1.87)	2032
5000	152 (1.36)	2125	148 (1.82)	1980
5125	148 (1.33)	2070	145 (1.78)	1930
5250	145 (1.30)	2017	142 (1.74)	1881
5375	142 (1.27)	1966	139 (1.70)	1833
5500	139 (1.24)	1916	136 (1.66)	1786
5625	136 (1.12)	1867	133 (1.62)	1740
5750	133 (1.19)	1820	130 (1.59)	1697
5875	130 (1.16)	1774	127 (1.55)	1654
6000	127 (1.14)	1731	124 (1.52)	1614
6125	125 (1.11)	1690	122 (1.49)	1577
6250	123 (1.09)	1653	120 (1.46)	1542
6375	120 (1.07)	1619	118 (1.43)	1510
6500	119 (1.06)	1590	116 (1.41)	1483
6625	117 (1.04)	1565	114 (1.39)	1460
6750	116 (1.03)	1546	113 (1.37)	1443
6875	115 (1.02)	1534	113 (1.36)	1432
7000	115 (1.02)	1530	112 (1.36)	1428
7125 Or More	115 (1.02)	1531	112 (1.36)	1428

U.S. EPA ASM EMISSION STANDARDS - 1988-90 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	390 (3.54)	4084	381 (4.85)	4005
1875	368 (3.34)	4054	359 (4.57)	3767
2000	348 (3.16)	3824	339 (4.31)	3548
2125	329 (2.99)	3609	321 (4.08)	3348
2250	312 (2.83)	3411	305 (3.86)	3165
2375	297 (2.69)	3231	290 (3.66)	2998
2500	283 (2.56)	3066	276 (3.48)	2845
2625	270 (2.44)	2916	263 (3.32)	2706
2750	258 (2.33)	2779	252 (3.17)	2579
2875	247 (2.23)	2654	241 (3.03)	2463
3000	237 (2.14)	2539	232 (2.91)	2357
3125	228 (2.06)	2435	223 (2.79)	2260
3250	220 (1.99)	2340	215 (2.69)	2172
3375	213 (1.92)	2253	208 (2.60)	2092
3500	206 (1.86)	2174	201 (2.51)	2018
3625	200 (1.80)	2100	195 (2.43)	1950
3750	194 (1.74)	2033	189 (2.36)	1887

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
3875	188 (1.69)	1970	184 (2.29)	1829
4000	183 (1.65)	1912	179 (2.22)	1775
4125	179 (1.61)	1857	175 (2.16)	1724
4250	174 (1.56)	1806	170 (2.11)	1677
4375	170 (1.53)	1757	166 (2.06)	1632
4500	166 (1.49)	1711	162 (2.01)	1589
4625	162 (1.46)	1666	159 (1.96)	1548
4750	159 (1.42)	1624	155 (1.91)	1508
4875	155 (1.39)	1583	152 (1.87)	1470
5000	152 (1.36)	1542	148 (1.82)	1433
5125	148 (1.33)	1503	145 (1.78)	1397
5250	145 (1.30)	1465	142 (1.74)	1362
5375	142 (1.27)	1428	139 (1.70)	1327
5500	139 (1.24)	1392	136 (1.66)	1294
5625	136 (1.12)	1357	133 (1.62)	1261
5750	133 (1.19)	1323	130 (1.59)	1230
5875	130 (1.16)	1290	127 (1.55)	1199
6000	127 (1.14)	1259	124 (1.52)	1171
6125	125 (1.11)	1230	122 (1.49)	1144
6250	123 (1.09)	1203	120 (1.46)	1119
6375	120 (1.07)	1179	118 (1.43)	1096
6500	119 (1.06)	1158	116 (1.41)	1077
6625	117 (1.04)	1140	114 (1.39)	1060
6750	116 (1.03)	1127	113 (1.37)	1048
6875	115 (1.02)	1118	113 (1.36)	1040
7000 Or More	115 (1.02)	1115	112 (1.36)	1037

U.S. EPA ASM EMISSION STANDARDS - 1991-95 LIGHT DUTY TRUCKS (6001 GVWR OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3631	315 (3.64)	3532
1875	306 (2.63)	3586	297 (3.43)	3323
2000	289 (2.48)	3383	281 (3.24)	3131
2125	274 (2.35)	3192	267 (3.06)	2955
2250	260 (2.23)	3018	253 (2.90)	2794
2375	247 (2.12)	2859	241 (2.76)	2646
2500	236 (2.02)	2714	230 (2.62)	2512
2625	225 (1.92)	2581	219 (2.50)	2389
2750	216 (1.84)	2460	210 (2.39)	2277
2875	207 (1.76)	2350	210 (2.29)	2175
3000	199 (1.69)	2249	194 (2.19)	2082
3125	191 (1.63)	2157	186 (2.11)	1997
3250	185 (1.57)	2073	180 (2.03)	1920
3375	179 (1.52)	1997	174 (1.96)	1849
3500	173 (1.47)	1926	169 (1.89)	1784
3625	168 (1.42)	1862	164 (1.84)	1724
3750	163 (1.38)	1802	159 (1.78)	1669
3875	159 (1.34)	1747	155 (1.73)	1618
4000	155 (1.31)	1695	151 (1.68)	1570

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4125	151 (1.27)	1647	147 (1.64)	1526
4250	147 (1.24)	1602	143 (1.60)	1484
4375	144 (1.21)	1559	140 (1.56)	1444
4500	141 (1.18)	1518	137 (1.52)	1406
4625	137 (1.15)	1479	134 (1.48)	1370
4750	134 (1.13)	1441	131 (1.45)	1336
4875	132 (1.10)	1405	128 (1.42)	1302
5000	129 (1.08)	1369	126 (1.38)	1269
5125	126 (1.05)	1335	123 (1.35)	1237
5250	123 (1.03)	1031	120 (1.32)	1206
5375	121 (1.01)	1269	118 (1.29)	1176
5500	118 (0.99)	1237	115 (1.26)	1147
5625	116 (0.97)	1206	113 (1.24)	1118
5750	113 (0.94)	1176	111 (1.21)	1090
5875	111 (0.92)	1147	108 (1.18)	1064
6000	109 (0.91)	1120	106 (1.16)	1039
6125	107 (0.89)	1094	104 (1.13)	1015
6250	105 (.087)	1070	102 (1.11)	993
6375	103 (0.86)	1049	101 (1.09)	973
6500	102 (0.84)	1030	99 (1.08)	956
6625	101 (0.83)	1014	98 (1.06)	941
6750	100 (0.82)	1003	97 (1.05)	931
6875	99 (0.82)	995	97 (1.04)	924
7000	99 (0.82)	992	96 (1.04)	921
7125 Or More	98 (0.81)	992	96 (1.04)	921

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5750 LVW OR LESS)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	224 (1.26)	1819	216 (1.22)	1642
1875	212 (1.19)	1713	205 (1.16)	1547
2000	201 (1.13)	1616	194 (1.09)	1460
2125	191 (1.07)	1527	184 (1.04)	1380
2250	182 (1.02)	1446	175 (0.99)	1307
2375	173 (0.97)	1372	167 (0.94)	1240
2500	166 (0.93)	1304	160 (0.90)	1179
2625	159 (0.89)	1242	153 (0.86)	1123
2750	152 (0.85)	1186	147 (0.82)	1072
2875	146 (0.82)	1134	141 (0.79)	1026
3000	141 (0.79)	1088	136 (0.76)	984
3125	136 (0.76)	1045	132 (0.73)	945
3250	132 (0.73)	1006	127 (0.71)	910
3375	128 (0.71)	970	123 (0.69)	878
3500	124 (0.69)	937	120 (0.67)	848
3625	120 (0.67)	907	117 (0.65)	821
3750	117 (0.65)	879	114 (0.63)	796
3875	114 (0.63)	853	111 (0.61)	773
4000	112 (0.62)	829	108 (0.60)	751
4125	109 (0.60)	807	106 (0.58)	731

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4250	107 (0.59)	786	103 (0.57)	712
4375	104 (0.58)	766	101 (0.56)	694
4500	102 (0.57)	747	99 (0.55)	677
4625	100 (0.55)	728	97 (0.54)	661
4750	98 (0.54)	711	95 (0.53)	645
4875	96 (0.53)	694	93 (0.52)	630
5000	94 (0.52)	677	92 (0.51)	615
5125	93 (0.51)	661	90 (0.50)	600
5250	91 (0.50)	646	88 (0.49)	586
5375	89 (0.49)	631	86 (0.48)	573
5500	87 (0.48)	616	85 (0.47)	559
5625	86 (0.47)	601	83 (0.46)	546
5750	84 (0.46)	587	82 (0.45)	534
5875	83 (0.45)	574	80 (0.44)	522
6000	81 (0.44)	561	79 (0.44)	510
6125	80 (0.44)	549	78 (0.43)	499
6250	79 (0.43)	538	76 (0.42)	489
6375	77 (0.42)	528	75 (0.42)	480
6500	76 (0.42)	519	74 (0.41)	473
6625	76 (0.41)	512	74 (0.41)	466
6750	75 (0.41)	507	73 (0.41)	461
6875	75 (0.40)	503	73 (0.40)	458
7000 Or More	74 (0.40)	502	72 (0.40)	457

U.S. EPA ASM EMISSION STANDARDS - 1994 + TIER 1 LIGHT DUTY TRUCKS (5751 LVW OR MORE)

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1750	324 (2.78)	3178	315 (3.64)	3060
1875	306 (2.63)	3117	297 (3.43)	2879
2000	289 (2.48)	2941	281 (3.24)	2713
2125	274 (2.35)	2776	267 (3.06)	2561
2250	260 (2.23)	2625	253 (2.90)	2422
2375	247 (2.12)	2487	241 (2.76)	2295
2500	236 (2.02)	2361	230 (2.62)	2179
2625	225 (1.92)	2246	219 (2.50)	2073
2750	216 (1.84)	2142	210 (2.39)	1976
2875	207 (1.76)	2046	210 (2.29)	1888
3000	199 (1.69)	1959	194 (2.19)	1808
3125	191 (1.63)	1879	186 (2.11)	1734
3250	185 (1.57)	1806	180 (2.03)	1667
3375	179 (1.52)	1740	174 (1.96)	1606
3500	173 (1.47)	1679	169 (1.89)	1550
3625	168 (1.42)	1623	164 (1.84)	1498
3750	163 (1.38)	1571	159 (1.78)	1451
3875	159 (1.34)	1523	155 (1.73)	1407
4000	155 (1.31)	1479	151 (1.68)	1365
4125	151 (1.27)	1437	147 (1.64)	1327
4250	147 (1.24)	1398	143 (1.60)	1291
4375	144 (1.21)	1360	140 (1.56)	1257

Test Weight	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
4500	141 (1.18)	1325	137 (1.52)	1224
4625	137 (1.15)	1291	134 (1.48)	1193
4750	134 (1.13)	1259	131 (1.45)	1163
4875	132 (1.10)	1227	128 (1.42)	1134
5000	129 (1.08)	1196	126 (1.38)	1106
5125	126 (1.05)	1167	123 (1.35)	1078
5250	123 (1.03)	1138	120 (1.32)	1051
5375	121 (1.01)	1109	118 (1.29)	1025
5500	118 (0.99)	1082	115 (1.26)	1000
5625	116 (0.97)	1055	113 (1.24)	975
5750	113 (0.94)	1029	111 (1.21)	951
5875	111 (0.92)	1004	108 (1.18)	928
6000	109 (0.91)	980	106 (1.16)	906
6125	107 (0.89)	958	104 (1.13)	886
6250	105 (.087)	937	102 (1.11)	867
6375	103 (0.86)	919	101 (1.09)	850
6500	102 (0.84)	902	99 (1.08)	835
6625	101 (0.83)	889	98 (1.06)	823
6750	100 (0.82)	879	97 (1.05)	813
6875	99 (0.82)	872	97 (1.04)	807
7000	99 (0.82)	870	96 (1.04)	805
7125 Or More	98 (0.81)	870	96 (1.04)	805

U. S. EPA REVISED FINAL ASM EMISSION STANDARDS (ASM5015 & ASM2525)

NOTE: EPA has not published a revised final standards for High Altitude, Light Duty Trucks 2 (6000-8500 GVWR), or vehicles older than 1980 model year. EPA guidance as of February 2003 states that a program may choose to use combinations of the Original and the Revised Final Standards.

U.S. EPA REVISED FINAL ASM EMISSION STANDARDS

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
Passenger Cars				
1980	275 (1.3)	8500	500 (2.3)	4750
1981-82	275 (1.3)	3600	500 (2.3)	3500
1983-89	275 (1.1)	3600	500 (1.6)	3500
1990 & Newer	275 (1.1)	3600	300 (1.6)	3500
Light Duty Trucks (Less Than 6000 GVWR)				
1980-83	1140 (9.7)	14,145	340 (23.28)	32,200
1984-87	537 (5.4)	14,145	160 (12.96)	32,200
1988-95	537 (5.4)	7380	160 (12.96)	16,800

Application	ASM5015		ASM2525	
	HC ppm (CO %)	NOx ppm	HC ppm (CO %)	NOx ppm
1996 & Newer	275 (1.1)	6150	82 (4.40)	14,000

U.S. EPA IM240 EMISSION STANDARDS

START-UP STANDARDS

Start-up standards should be used during the first 2 years of program operation. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles certified to Tier 1 standards as well.

U.S. EPA IM240 HYDROCARBONS EMISSION START-UP STANDARDS

Application	Hydrocarbons (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	0.80	0.50
1991-95	1.20	0.75
1983-90	2.00	1.25
1980-82	2.00	1.25
1975-79	7.50	5.00
1968-74	10.0	6.00
High Altitude Light Duty Vehicles		
1983-84	2.00	1.25
1982	2.00	1.25
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.80	0.50
1996 & Newer (More Than 3750 LVW)	1.00	0.63
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.00	0.63
1996 & Newer (More Than 5750 ALVW)	2.40	1.50
1991-95	2.40	1.50
1984-90	3.20	2.00
1979-83	7.50	5.00
1975-78	8.00	5.00
1968-74	10.0	6.00
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	3.00	2.00
1984-90	4.00	2.50
1982-83	8.00	5.00
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	3.00	1.90

Application	Hydrocarbons (Grams/Mile)	
	Composite	Phase 2
1985-86	5.00	3.10
1979-84	6.00	3.80
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION START-UP STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	15.0	12.0
1991-95	20.0	16.0
1983-90	30.0	24.0
1980-82	60.0	48.0
1975-79	90.0	72.0
1968-74	150.0	120.0
High Altitude Light Duty Vehicles		
1983-84	60.0	48.0
1982	75.0	60.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	15.0	12.0
1996 & Newer (More Than 3750 LVW)	20.0	16.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	20.0	16.0
1996 & Newer (More Than 5750 ALVW)	60.0	48.0
1991-95	60.0	48.0
1984-90	80.0	64.0
1979-83	100.0	80.0
1975-78	120.0	96.0
1968-74	150.0	120.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	70.0	56.0
1984-90	90.0	72.0
1982-83	130.0	104.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	60.0	48.0
1985-86	75.0	60.0
1979-84	100.0	80.0
1974-78	150.00	120.0
1970-73	175.00	140.00

Application	Carbon Monoxide (Grams/Mile)	
	Composite	Phase 2
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION START-UP STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	2.0	2.0
1991-95	2.5	2.5
1981-90	3.0	3.0
1977-80	6.0	6.0
1973-76	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Vehicles		
1982-84	3.0	3.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	2.0	2.0
1996 & Newer (More Than 3750 LVW)	2.5	2.5
1991-95	3.0	3.0
1988-90	3.5	3.5
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1991 & Newer	3.0	3.0
1988-90	3.5	3.5
1982-87	7.0	7.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	2.5	2.5
1996 & Newer (More Than 5750 ALVW)	4.0	4.0
1991-95	4.5	4.5
1988-90	5.0	5.0
1979-87	7.0	7.0
1973-78	9.0	9.0
1968-72	10.0	10.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1991 & Newer	4.5	4.5
1988-90	5.0	5.0
1982-87	7.0	7.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	6.0	6.0
1979-90	8.0	8.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

FINAL STANDARDS

Final standards are recommended for vehicles tested in calendar years 1997 and later. Tier 1 standards are recommended for all 1996 and newer vehicles and may be used for 1994 and newer vehicles.

U.S. EPA IM240 HYDROCARBONS EMISSION FINAL STANDARDS

Application	Hydrocarbons (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	0.60	0.40
1980-95	0.80	0.50
1975-79	3.00	2.00
1968-74	7.00	4.50
High Altitude Light Duty Vehicles		
1982-84	1.20	0.75
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	0.60	0.40
1996 & Newer (More Than 3750 LVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	0.80	0.50
1996 & Newer (More Than 5750 ALVW)	0.80	0.50
1984-95	1.60	1.00
1979-83	3.40	2.00
1975-78	4.00	2.50
1968-74	7.00	4.50
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	2.00	1.25
1984-87	2.00	1.25
1982-83	4.00	2.50
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	2.00	1.30
1987-97	2.00	1.30
1985-86	3.00	1.90
1979-84	5.00	3.10
1970-78	10.0	6.30
1969 & Earlier	20.0	12.50

U.S. EPA IM240 CARBON MONOXIDE EMISSION FINAL STANDARDS

Application	Carbon Monoxide (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	10.0	8.0
1983-95	15.0	12.0
1980-82	30.0	24.0
1975-79	65.0	52.0
1968-74	120.0	96.0
High Altitude Light Duty Vehicles		
1983-84	30.0	24.0
1982	45.0	36.0

Application	Carbon Monoxide (Grams/Mile)	
	Composite	Phase 2
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	10.0	8.0
1996 & Newer (More Than 3750 LVW)	13.0	10.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		
1988 & Newer	60.0	48.0
1984-87	60.0	48.0
1982-83	90.0	72.0
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	13.0	10.0
1996 & Newer (More Than 5750 ALVW)	15.0	12.0
1984-95	40.0	32.0
1979-83	70.0	56.0
1975-78	80.0	64.0
1968-74	120.0	96.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1984 & Newer	60.0	48.0
1982-83	90.0	72.0
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	30.0	24.0
1987-97	40.0	32.0
1985-86	50.0	40.0
1979-84	75.0	60.0
1974-78	150.0	120.0
1970-73	175.0	140.0
1969 & Earlier	200.0	160.0

U.S. EPA IM240 OXIDES OF NITROGEN EMISSION FINAL STANDARDS

Application	Oxides Of Nitrogen (Grams/Mile)	
	Composite	Phase 2
Light Duty Vehicles		
1996 & Newer	1.5	1.5
1981-95	2.0	2.0
1977-80	4.0	4.0
1973-76	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Vehicles		
1982-84	2.0	2.0
Light Duty Trucks (0-6000 Lbs. GVWR)		
1996 & Newer (Less Than 3750 LVW)	1.5	1.5
1996 & Newer (More Than 3750 LVW)	1.8	1.8
1988-95	2.5	2.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (0-6000 Lbs. GVWR)		

Application	Oxides Of Nitrogen (Grams/Mile)	
Composite		Phase 2
1988 & Newer	2.5	2.5
1982-87	4.5	4.5
Light Duty Trucks (6001-8500 Lbs. GVWR)		
1996 & Newer (Less Than 5750 ALVW)	1.8	1.8
1996 & Newer (More Than 5750 ALVW)	2.0	2.0
1988-95	3.5	3.5
1979-87	4.5	4.5
1973-78	6.0	6.0
1968-72	7.0	7.0
High Altitude Light Duty Trucks (6001-8500 Lbs. GVWR)		
1988 & Newer	3.5	3.5
1982-87	4.5	4.5
Heavy Duty Trucks (Greater Than 8500 Lbs. GVWR)		
1998 & Newer	4.0	4.0
1991-97	5.0	5.0
1979-90	6.0	6.0
1970-78	10.0	10.0
1969 & Earlier	15.0	15.0

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GENERAL INFORMATION

State Emission Standards

ARIZONA

NOTE: Because of frequent revisions in state emission standards, the emission standards listed in this article should only be used as a guide.

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL OPACITY LOADED CRUISE TEST)

Application	Altitude (Feet)	Opacity (% For 10 Seconds)
Light Duty Vehicles (8500 GVWR Or Less)		
All Years	Less Than 2000	20 Or Less
Â Â	2001-4000	30 Or Less
Â Â	Greater Than 4000	40 Or Less

ARIZONA EMISSION STANDARDS - PHOENIX & TUCSON AREA (DIESEL J1667 SNAP IDLE TEST)

Application	Altitude (Feet)	Opacity (% For 10 Seconds)
Heavy Duty Vehicles (8500 GVWR Or Greater)		
1990 & Earlier	All	55
1991 & Newer	All	40

COLORADO

COLORADO EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
14,000 GVWR Or Less	
Non-Turbo	40
Turbo	35
14,000 GVWR Or More	
Non-Turbo	35
Turbo	20

CONNECTICUT

CONNECTICUT EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
10,000 GVWR Or Less	
1979 & Newer	20
26,000 GVWR Or More	
1974 & Earlier	70
1974-90	55
1991 & Newer	40

IDAHO

IDAHO EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
All Weight Range	

Application	Opacity %
1965-74	70
1975-91	55
1992 & Newer	40

KENTUCKY

KENTUCKY EMISSION STANDARDS - BOONE, CAMPBELL & KENTON COUNTIES (DIESEL OPACITY)

Application	Opacity
18,000 GVWR Or Less	
All Years	10% @ Idle

MASSACHUSETTS

MASSACHUSETTS EMISSION STANDARDS - DIESEL OPACITY

Application	Opacity %
Light Duty (8500 GVWR Or Less)	
1984 & Newer	20
Light Duty (8501-10,000 GVWR Or Less)	
1984 & Newer	40
Heavy Duty Buses (10,000 GVWR Or More)	
1984-93	40
1994 & Newer	30
Heavy Duty Trucks (10,000 Or Less GVWR)	
1984-90	55
1991 & Newer	40

NEW YORK

NEW YORK EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Heavy Duty Vehicles (8500 GVWR Or More)	
1973 & Earlier	70
1974-90	55
1991 & Newer	40

OHIO

OHIO EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel	20

RHODE ISLAND

RHODE ISLAND EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
All Model Years (8500 GVWR Or Less)	20

UTAH

UTAH EMISSION STANDARDS - DAVIS COUNTY - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel - Turbo (16,000 GVWR Or Less)	30
Light Duty Diesel - Non-Turbo (16,000 GVWR Or Less)	35

Application	Opacity %
Heavy Duty Diesel (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - SALT LAKE COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

UTAH EMISSION STANDARDS - UTAH COUNTY - DIESEL OPACITY TEST

Application	Opacity %
All Model Years - Turbo (16,000 GVWR Or Less)	30
All Model Years - Non-Turbo (16,000 GVWR Or Less)	35
All Model Years (16,000 GVWR Or More)	70

WASHINGTON

WASHINGTON EMISSION STANDARDS - DIESEL OPACITY TEST

Application	Opacity %
Light Duty Diesel (8500 GVWR Or Less)	
All Model Years	20
Heavy Duty Diesel (8500 GVWR Or More)	
1991 & Earlier	55
1992 & Newer	40

Back To Article

GENERAL INFORMATION

Symptom Check List Worksheets

* PLEASE READ THIS FIRST *

NOTE: **This article is intended for general information purposes only. It does not apply specifically to one make or model.**

PURPOSE

NOTE: **This article is intended for general information purposes only. It does not apply specifically to one make or model.**

WHY USE THE SYMPTOM CHECK LIST WORKSHEETS?

One of the most difficult and critical lines of communication is between the service customer and the technician. The clearer the technician understands the customer's concerns, the more likely the problem will be "fixed right the first time".

The Symptom Check List Worksheets in this article are designed to improve this communication. When used consistently, they can be helpful in reducing shop comebacks, increasing technician productivity, and producing satisfied customers. They also provide other benefits:

- Reduce "No Trouble Found" problems
- Increase customer involvement
- Customer perceive that "they really care and listen"
- Save time during peak write-up periods
- Reduce recontacting customers for additional information
- Improve night drop information
- Insure all the right questions are asked at write-up

MAKING THE WORKSHEETS A PART OF YOUR NORMAL ROUTINE

The following information contains ideas that may be helpful in forming habits that promote daily use of the Symptom Check Lists:

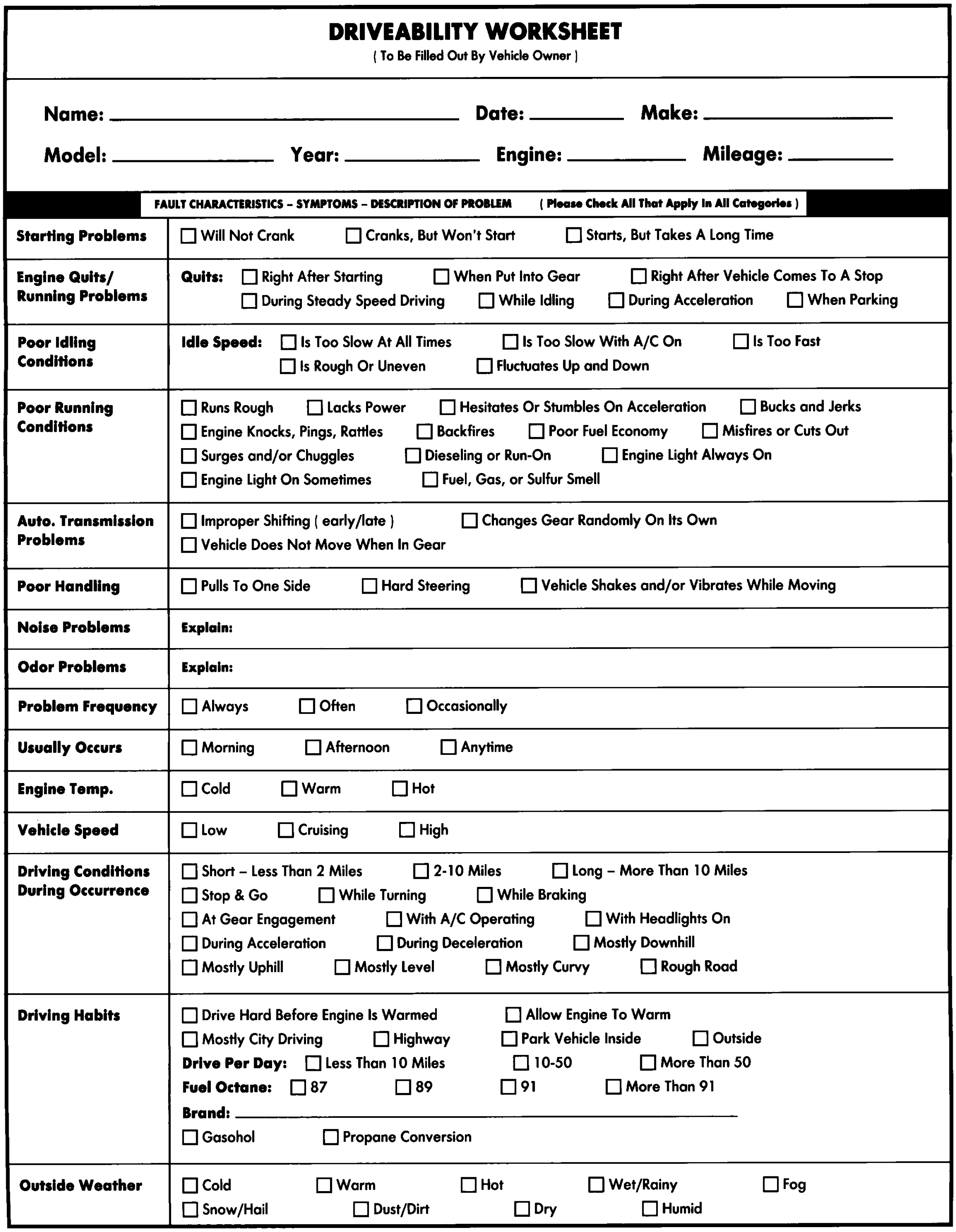
- HAVE THE SERVICE ADVISER FILL OUT THE FORM(S) WITH THE CUSTOMER WHENEVER POSSIBLE.
- Place them in your night drop for the customer to fill out, along with an instruction sheet to help them understand what to do.
- Hand out the worksheets to customers while they wait in line during the peak morning rush and ask them to fill it out. It will save time for all concerned and improve the quality of information received from the customer.
- Make sure it is attached to the hard copy when it goes to the technician.
- Place a copy with the final repair papers and review it with the customer at delivery.
- Put a new worksheet in the glovebox of all departing customers.
- Require that you personally see a copy of all worksheets filled out for shop comebacks.
- Hold a shop meeting to get employee buy-in and their ideas on how to make it effective in your shop.

There are many other ways to utilize the concept, but as with every other idea, successful implementation depends on employee involvement and buy-in.

SYMPTOM CHECK LIST WORKSHEETS

CONDENSED VERSION - ALL ON ONE PAGE

NOTE: Have the service adviser fill out this form with the customer whenever possible.



DRIVEABILITY WORKSHEET

(To Be Filled Out By Vehicle Owner)

Name: ____________________ **Date:** __________ **Make:** ____________

Model: ____________ **Year:** ____________ **Engine:** ____________ **Mileage:** __________

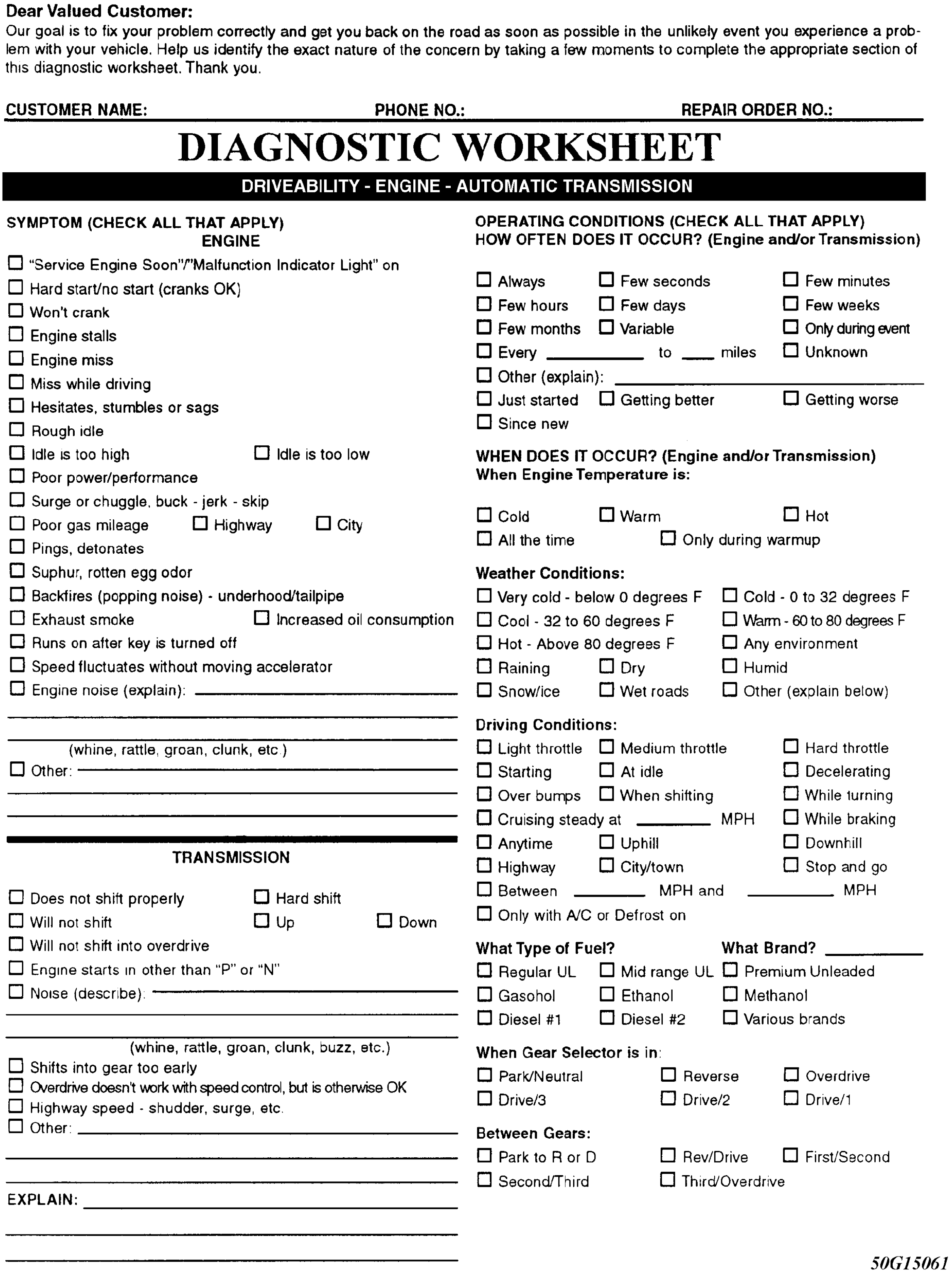
FAULT CHARACTERISTICS – SYMPTOMS – DESCRIPTION OF PROBLEM (**Please Check All That Apply In All Categories**)

Starting Problems	☐ Will Not Crank ☐ Cranks, But Won't Start ☐ Starts, But Takes A Long Time
Engine Quits/ Running Problems	**Quits:** ☐ Right After Starting ☐ When Put Into Gear ☐ Right After Vehicle Comes To A Stop ☐ During Steady Speed Driving ☐ While Idling ☐ During Acceleration ☐ When Parking
Poor Idling Conditions	**Idle Speed:** ☐ Is Too Slow At All Times ☐ Is Too Slow With A/C On ☐ Is Too Fast ☐ Is Rough Or Uneven ☐ Fluctuates Up and Down
Poor Running Conditions	☐ Runs Rough ☐ Lacks Power ☐ Hesitates Or Stumbles On Acceleration ☐ Bucks and Jerks ☐ Engine Knocks, Pings, Rattles ☐ Backfires ☐ Poor Fuel Economy ☐ Misfires or Cuts Out ☐ Surges and/or Chuggles ☐ Dieseling or Run-On ☐ Engine Light Always On ☐ Engine Light On Sometimes ☐ Fuel, Gas, or Sulfur Smell
Auto. Transmission Problems	☐ Improper Shifting (early/late) ☐ Changes Gear Randomly On Its Own ☐ Vehicle Does Not Move When In Gear
Poor Handling	☐ Pulls To One Side ☐ Hard Steering ☐ Vehicle Shakes and/or Vibrates While Moving
Noise Problems	**Explain:**
Odor Problems	**Explain:**
Problem Frequency	☐ Always ☐ Often ☐ Occasionally
Usually Occurs	☐ Morning ☐ Afternoon ☐ Anytime
Engine Temp.	☐ Cold ☐ Warm ☐ Hot
Vehicle Speed	☐ Low ☐ Cruising ☐ High
Driving Conditions During Occurrence	☐ Short – Less Than 2 Miles ☐ 2-10 Miles ☐ Long – More Than 10 Miles ☐ Stop & Go ☐ While Turning ☐ While Braking ☐ At Gear Engagement ☐ With A/C Operating ☐ With Headlights On ☐ During Acceleration ☐ During Deceleration ☐ Mostly Downhill ☐ Mostly Uphill ☐ Mostly Level ☐ Mostly Curvy ☐ Rough Road
Driving Habits	☐ Drive Hard Before Engine Is Warmed ☐ Allow Engine To Warm ☐ Mostly City Driving ☐ Highway ☐ Park Vehicle Inside ☐ Outside **Drive Per Day:** ☐ Less Than 10 Miles ☐ 10-50 ☐ More Than 50 **Fuel Octane:** ☐ 87 ☐ 89 ☐ 91 ☐ More Than 91 **Brand:** ______________________ ☐ Gasohol ☐ Propane Conversion
Outside Weather	☐ Cold ☐ Warm ☐ Hot ☐ Wet/Rainy ☐ Fog ☐ Snow/Hail ☐ Dust/Dirt ☐ Dry ☐ Humid

Fig. 1: Entire Vehicle - Symptom Check List For Customer

FULL VERSION - ALL ON FOUR PAGES

NOTE: Have the service adviser fill out these forms with the customer whenever possible.



Dear Valued Customer:

Our goal is to fix your problem correctly and get you back on the road as soon as possible in the unlikely event you experience a problem with your vehicle. Help us identify the exact nature of the concern by taking a few moments to complete the appropriate section of this diagnostic worksheet. Thank you.

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO.:**

DIAGNOSTIC WORKSHEET

DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)

ENGINE

- ☐ "Service Engine Soon"/"Malfunction Indicator Light" on
- ☐ Hard start/no start (cranks OK)
- ☐ Won't crank
- ☐ Engine stalls
- ☐ Engine miss
- ☐ Miss while driving
- ☐ Hesitates, stumbles or sags
- ☐ Rough idle
- ☐ Idle is too high ☐ Idle is too low
- ☐ Poor power/performance
- ☐ Surge or chuggle, buck - jerk - skip
- ☐ Poor gas mileage ☐ Highway ☐ City
- ☐ Pings, detonates
- ☐ Suphur, rotten egg odor
- ☐ Backfires (popping noise) - underhood/tailpipe
- ☐ Exhaust smoke ☐ Increased oil consumption
- ☐ Runs on after key is turned off
- ☐ Speed fluctuates without moving accelerator
- ☐ Engine noise (explain): ____________

(whine, rattle, groan, clunk, etc.)

- ☐ Other: ____________

TRANSMISSION

- ☐ Does not shift properly ☐ Hard shift
- ☐ Will not shift ☐ Up ☐ Down
- ☐ Will not shift into overdrive
- ☐ Engine starts in other than "P" or "N"
- ☐ Noise (describe): ____________

(whine, rattle, groan, clunk, buzz, etc.)

- ☐ Shifts into gear too early
- ☐ Overdrive doesn't work with speed control, but is otherwise OK
- ☐ Highway speed - shudder, surge, etc.
- ☐ Other: ____________

EXPLAIN: ____________

OPERATING CONDITIONS (CHECK ALL THAT APPLY)

HOW OFTEN DOES IT OCCUR? (Engine and/or Transmission)

☐ Always ☐ Few seconds ☐ Few minutes
☐ Few hours ☐ Few days ☐ Few weeks
☐ Few months ☐ Variable ☐ Only during event
☐ Every ________ to ____ miles ☐ Unknown
☐ Other (explain): ____________
☐ Just started ☐ Getting better ☐ Getting worse
☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)

When Engine Temperature is:

☐ Cold ☐ Warm ☐ Hot
☐ All the time ☐ Only during warmup

Weather Conditions:

☐ Very cold - below 0 degrees F ☐ Cold - 0 to 32 degrees F
☐ Cool - 32 to 60 degrees F ☐ Warm - 60 to 80 degrees F
☐ Hot - Above 80 degrees F ☐ Any environment
☐ Raining ☐ Dry ☐ Humid
☐ Snow/ice ☐ Wet roads ☐ Other (explain below)

Driving Conditions:

☐ Light throttle ☐ Medium throttle ☐ Hard throttle
☐ Starting ☐ At idle ☐ Decelerating
☐ Over bumps ☐ When shifting ☐ While turning
☐ Cruising steady at ______ MPH ☐ While braking
☐ Anytime ☐ Uphill ☐ Downhill
☐ Highway ☐ City/town ☐ Stop and go
☐ Between ______ MPH and ______ MPH
☐ Only with A/C or Defrost on

What Type of Fuel? **What Brand?** ________

☐ Regular UL ☐ Mid range UL ☐ Premium Unleaded
☐ Gasohol ☐ Ethanol ☐ Methanol
☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

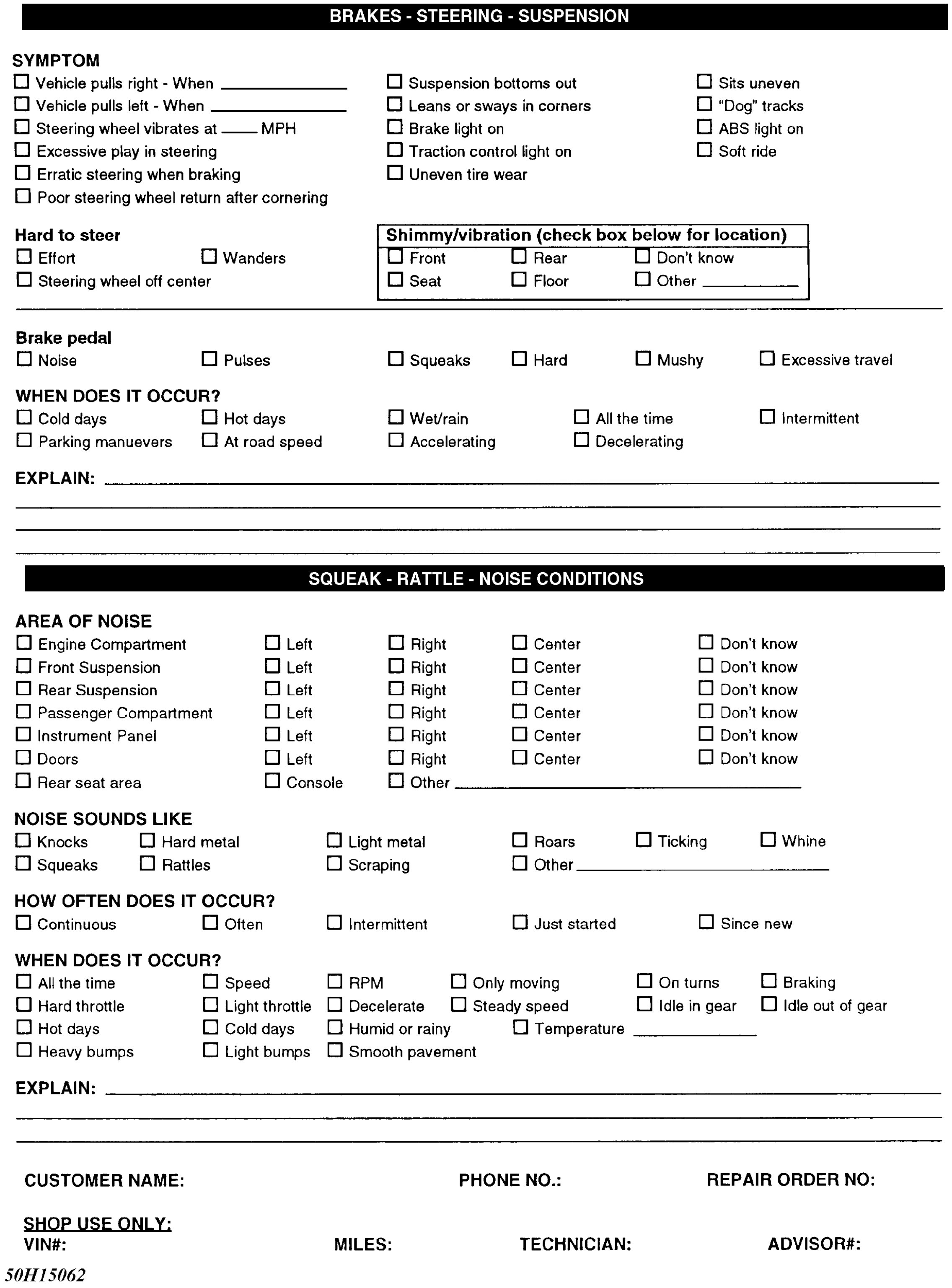
☐ Park/Neutral ☐ Reverse ☐ Overdrive
☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

☐ Park to R or D ☐ Rev/Drive ☐ First/Second
☐ Second/Third ☐ Third/Overdrive

50G15061

Fig. 2: Symptom Check List - Page 1



BRAKES - STEERING - SUSPENSION

SYMPTOM

☐ Vehicle pulls right - When ____________
☐ Vehicle pulls left - When ____________
☐ Steering wheel vibrates at ____ MPH
☐ Excessive play in steering
☐ Erratic steering when braking
☐ Poor steering wheel return after cornering
☐ Suspension bottoms out
☐ Leans or sways in corners
☐ Brake light on
☐ Traction control light on
☐ Uneven tire wear
☐ Sits uneven
☐ "Dog" tracks
☐ ABS light on
☐ Soft ride

Hard to steer

☐ Effort
☐ Steering wheel off center
☐ Wanders

Shimmy/vibration (check box below for location)

☐ Front ☐ Rear ☐ Don't know
☐ Seat ☐ Floor ☐ Other __________

Brake pedal

☐ Noise ☐ Pulses ☐ Squeaks ☐ Hard ☐ Mushy ☐ Excessive travel

WHEN DOES IT OCCUR?

☐ Cold days
☐ Parking manuevers
☐ Hot days
☐ At road speed
☐ Wet/rain
☐ Accelerating
☐ All the time
☐ Decelerating
☐ Intermittent

EXPLAIN: ____

____

____

____

SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment ☐ Left ☐ Right ☐ Center ☐ Don't know
☐ Front Suspension ☐ Left ☐ Right ☐ Center ☐ Don't know
☐ Rear Suspension ☐ Left ☐ Right ☐ Center ☐ Don't know
☐ Passenger Compartment ☐ Left ☐ Right ☐ Center ☐ Don't know
☐ Instrument Panel ☐ Left ☐ Right ☐ Center ☐ Don't know
☐ Doors ☐ Left ☐ Right ☐ Center ☐ Don't know
☐ Rear seat area ☐ Console ☐ Other ____________________

NOISE SOUNDS LIKE

☐ Knocks
☐ Squeaks
☐ Hard metal
☐ Rattles
☐ Light metal
☐ Scraping
☐ Roars
☐ Other ____________________
☐ Ticking
☐ Whine

HOW OFTEN DOES IT OCCUR?

☐ Continuous ☐ Often ☐ Intermittent ☐ Just started ☐ Since new

WHEN DOES IT OCCUR?

☐ All the time
☐ Hard throttle
☐ Hot days
☐ Heavy bumps
☐ Speed
☐ Light throttle
☐ Cold days
☐ Light bumps
☐ RPM
☐ Decelerate
☐ Humid or rainy
☐ Smooth pavement
☐ Only moving
☐ Steady speed
☐ Temperature __________
☐ On turns
☐ Idle in gear
☐ Braking
☐ Idle out of gear

EXPLAIN: ____

____

____

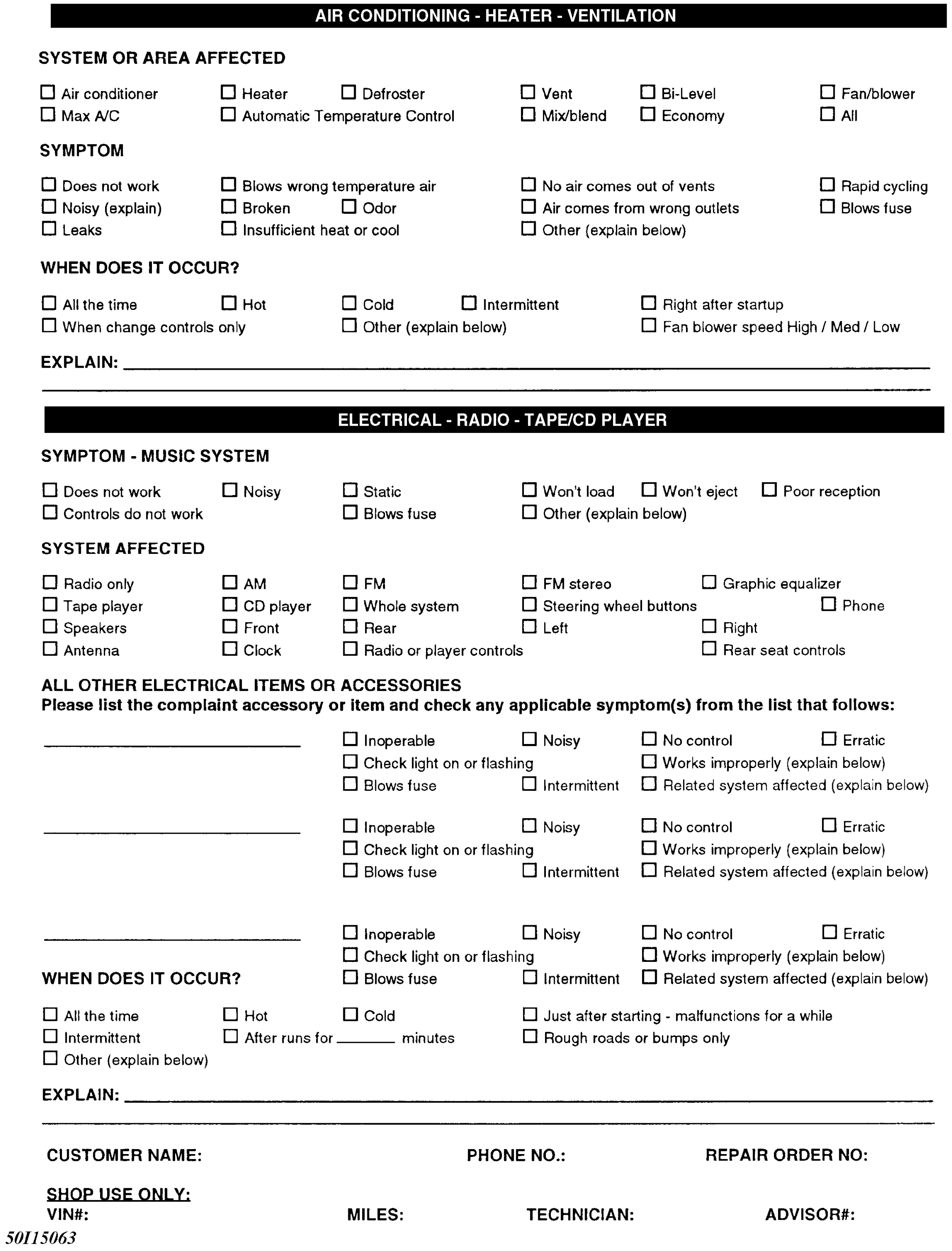
CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:

VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15062

Fig. 3: Symptom Check List - Page 2



AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

☐ Air conditioner ☐ Heater ☐ Defroster ☐ Vent ☐ Bi-Level ☐ Fan/blower
☐ Max A/C ☐ Automatic Temperature Control ☐ Mix/blend ☐ Economy ☐ All

SYMPTOM

☐ Does not work ☐ Blows wrong temperature air ☐ No air comes out of vents ☐ Rapid cycling
☐ Noisy (explain) ☐ Broken ☐ Odor ☐ Air comes from wrong outlets ☐ Blows fuse
☐ Leaks ☐ Insufficient heat or cool ☐ Other (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Intermittent ☐ Right after startup
☐ When change controls only ☐ Other (explain below) ☐ Fan blower speed High / Med / Low

EXPLAIN: ____

____

ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

______________________ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

______________________ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

______________________ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for ________ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

EXPLAIN: ____

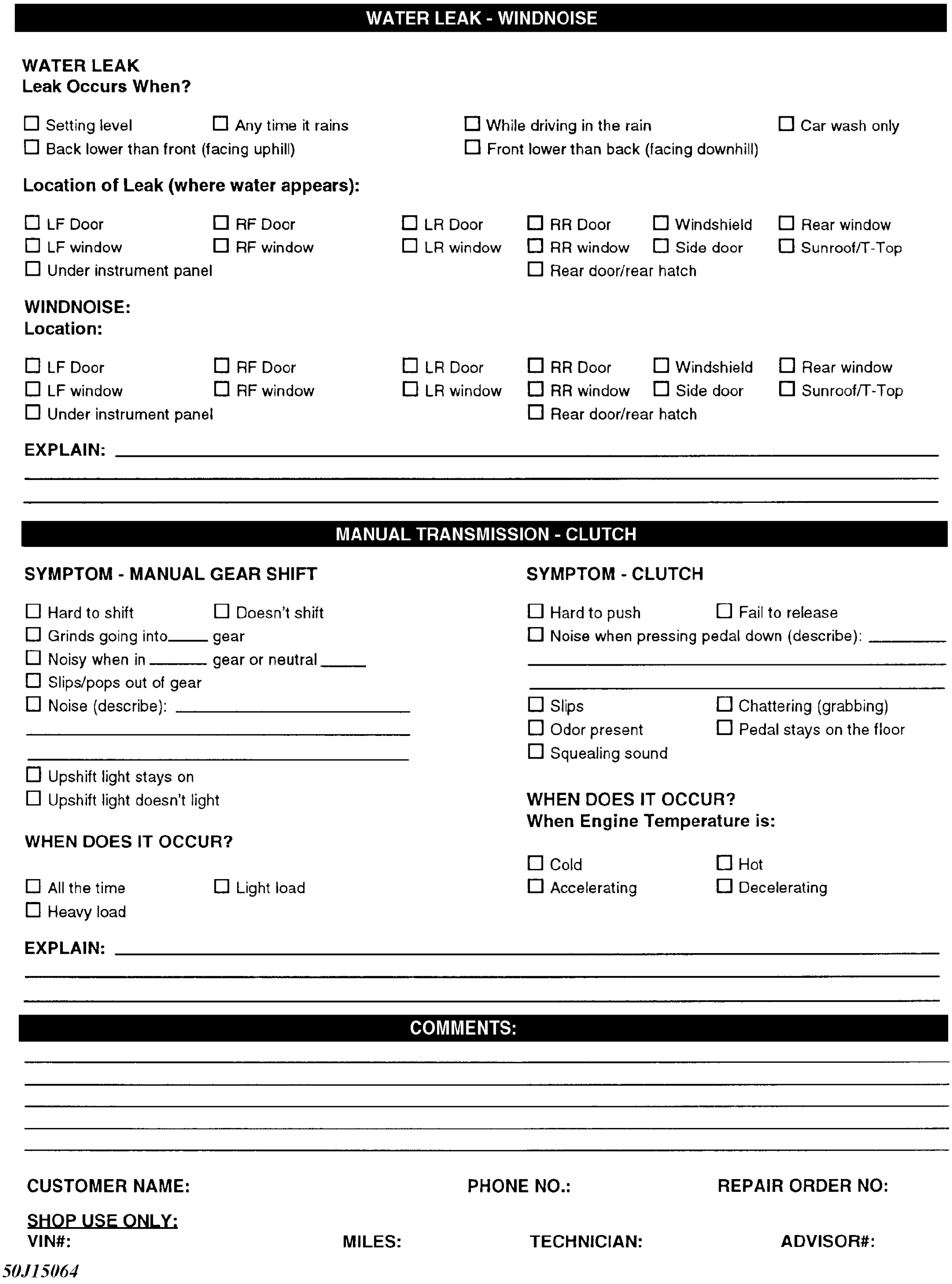
____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50I15063

Fig. 4: Symptom Check List - Page 3



WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level
☐ Back lower than front (facing uphill)
☐ Any time it rains
☐ While driving in the rain
☐ Front lower than back (facing downhill)
☐ Car wash only

Location of Leak (where water appears):

☐ LF Door
☐ LF window
☐ Under instrument panel
☐ RF Door
☐ RF window
☐ LR Door
☐ LR window
☐ RR Door
☐ RR window
☐ Rear door/rear hatch
☐ Windshield
☐ Side door
☐ Rear window
☐ Sunroof/T-Top

WINDNOISE:
Location:

☐ LF Door
☐ LF window
☐ Under instrument panel
☐ RF Door
☐ RF window
☐ LR Door
☐ LR window
☐ RR Door
☐ RR window
☐ Rear door/rear hatch
☐ Windshield
☐ Side door
☐ Rear window
☐ Sunroof/T-Top

EXPLAIN: ____________________

MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

☐ Hard to shift
☐ Grinds going into_____ gear
☐ Noisy when in _______ gear or neutral _____
☐ Slips/pops out of gear
☐ Noise (describe): ____________________
☐ Doesn't shift
☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

☐ All the time
☐ Heavy load
☐ Light load

SYMPTOM - CLUTCH

☐ Hard to push
☐ Noise when pressing pedal down (describe): __________
☐ Fail to release
☐ Slips
☐ Odor present
☐ Squealing sound
☐ Chattering (grabbing)
☐ Pedal stays on the floor

WHEN DOES IT OCCUR?
When Engine Temperature is:

☐ Cold
☐ Accelerating
☐ Hot
☐ Decelerating

EXPLAIN: ____________________

COMMENTS:

CUSTOMER NAME:

PHONE NO.:

REPAIR ORDER NO:

SHOP USE ONLY:

VIN#:

MILES:

TECHNICIAN:

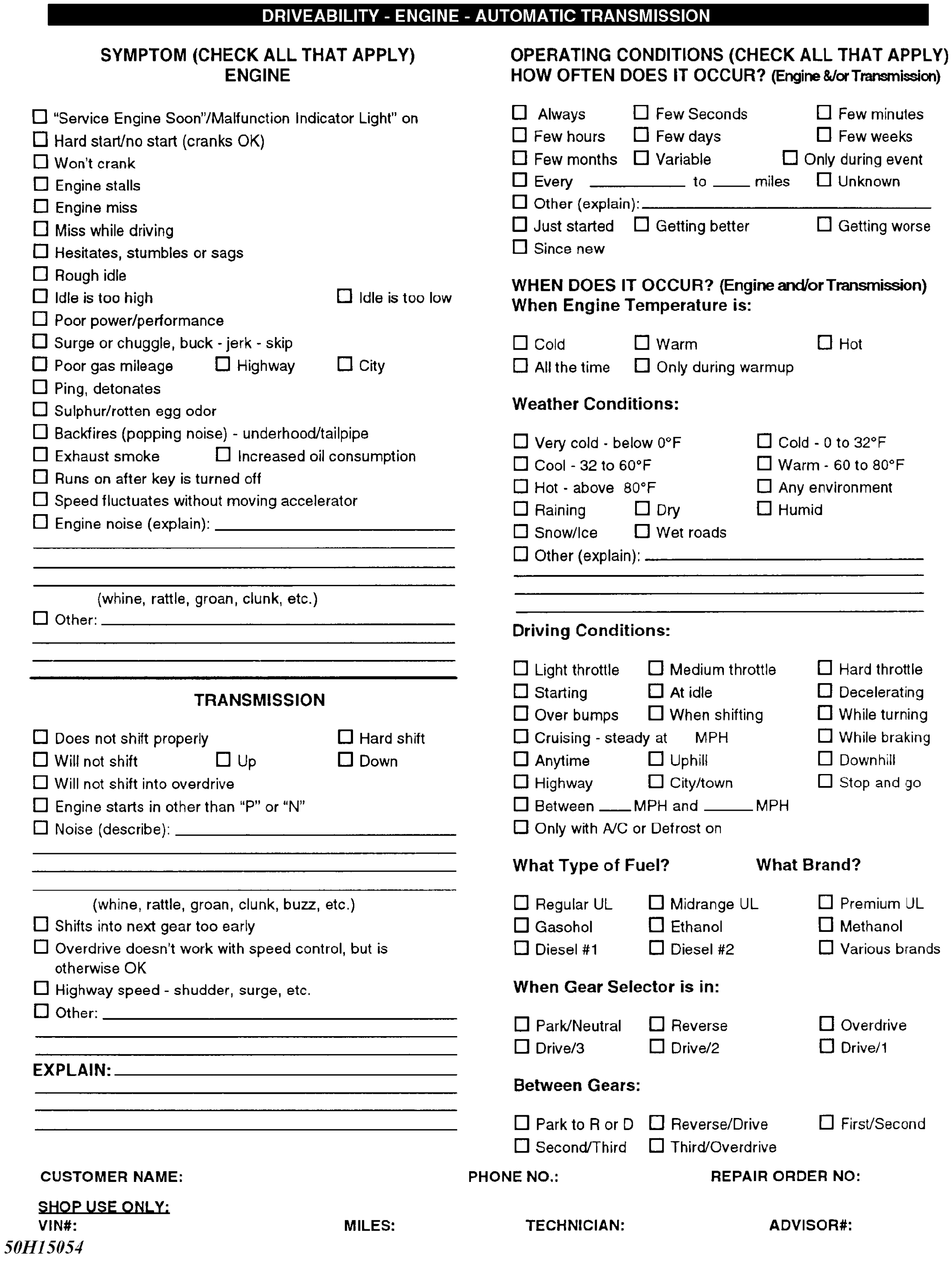
ADVISOR#:

50J15064

Fig. 5: Symptom Check List - Page 4

INDIVIDUAL SYSTEM-BASED CHECK LISTS

NOTE: **Have the service adviser fill out these forms with the customer whenever possible.**



DRIVEABILITY - ENGINE - AUTOMATIC TRANSMISSION

SYMPTOM (CHECK ALL THAT APPLY)
ENGINE

☐ "Service Engine Soon"/Malfunction Indicator Light" on
☐ Hard start/no start (cranks OK)
☐ Won't crank
☐ Engine stalls
☐ Engine miss
☐ Miss while driving
☐ Hesitates, stumbles or sags
☐ Rough idle
☐ Idle is too high ☐ Idle is too low
☐ Poor power/performance
☐ Surge or chuggle, buck - jerk - skip
☐ Poor gas mileage ☐ Highway ☐ City
☐ Ping, detonates
☐ Sulphur/rotten egg odor
☐ Backfires (popping noise) - underhood/tailpipe
☐ Exhaust smoke ☐ Increased oil consumption
☐ Runs on after key is turned off
☐ Speed fluctuates without moving accelerator
☐ Engine noise (explain): ____________

(whine, rattle, groan, clunk, etc.)
☐ Other: ____________

TRANSMISSION

☐ Does not shift properly ☐ Hard shift
☐ Will not shift ☐ Up ☐ Down
☐ Will not shift into overdrive
☐ Engine starts in other than "P" or "N"
☐ Noise (describe): ____________

(whine, rattle, groan, clunk, buzz, etc.)
☐ Shifts into next gear too early
☐ Overdrive doesn't work with speed control, but is otherwise OK
☐ Highway speed - shudder, surge, etc.
☐ Other: ____________

EXPLAIN: ____________

OPERATING CONDITIONS (CHECK ALL THAT APPLY)
HOW OFTEN DOES IT OCCUR? (Engine &/or Transmission)

☐ Always ☐ Few Seconds ☐ Few minutes
☐ Few hours ☐ Few days ☐ Few weeks
☐ Few months ☐ Variable ☐ Only during event
☐ Every ________ to _____ miles ☐ Unknown
☐ Other (explain): ____________
☐ Just started ☐ Getting better ☐ Getting worse
☐ Since new

WHEN DOES IT OCCUR? (Engine and/or Transmission)
When Engine Temperature is:

☐ Cold ☐ Warm ☐ Hot
☐ All the time ☐ Only during warmup

Weather Conditions:

☐ Very cold - below 0°F ☐ Cold - 0 to 32°F
☐ Cool - 32 to 60°F ☐ Warm - 60 to 80°F
☐ Hot - above 80°F ☐ Any environment
☐ Raining ☐ Dry ☐ Humid
☐ Snow/Ice ☐ Wet roads
☐ Other (explain): ____________

Driving Conditions:

☐ Light throttle ☐ Medium throttle ☐ Hard throttle
☐ Starting ☐ At idle ☐ Decelerating
☐ Over bumps ☐ When shifting ☐ While turning
☐ Cruising - steady at MPH ☐ While braking
☐ Anytime ☐ Uphill ☐ Downhill
☐ Highway ☐ City/town ☐ Stop and go
☐ Between _____ MPH and _______ MPH
☐ Only with A/C or Defrost on

What Type of Fuel? **What Brand?**

☐ Regular UL ☐ Midrange UL ☐ Premium UL
☐ Gasohol ☐ Ethanol ☐ Methanol
☐ Diesel #1 ☐ Diesel #2 ☐ Various brands

When Gear Selector is in:

☐ Park/Neutral ☐ Reverse ☐ Overdrive
☐ Drive/3 ☐ Drive/2 ☐ Drive/1

Between Gears:

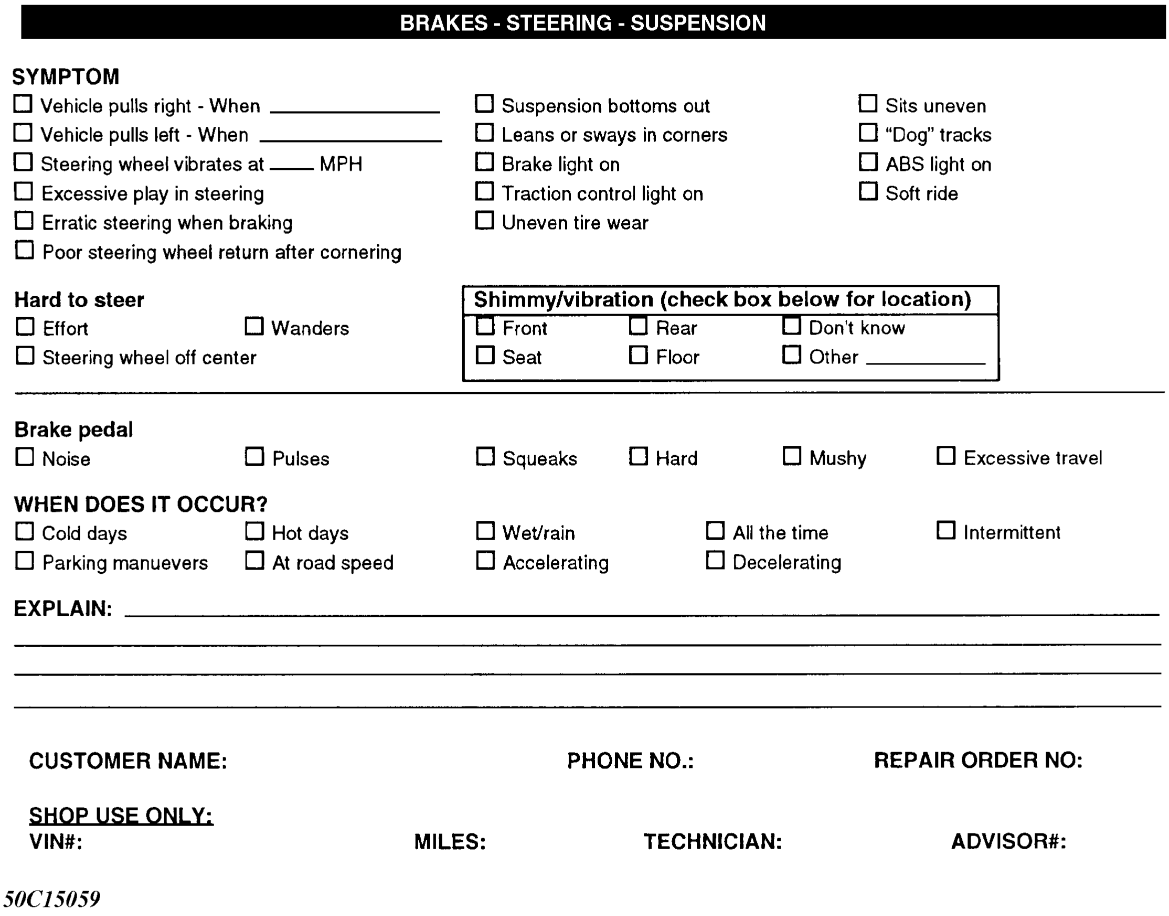
☐ Park to R or D ☐ Reverse/Drive ☐ First/Second
☐ Second/Third ☐ Third/Overdrive

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50H15054

Fig. 6: Engine Driveability & Automatic Transmission



BRAKES - STEERING - SUSPENSION

SYMPTOM

☐ Vehicle pulls right - When ____________
☐ Vehicle pulls left - When ____________
☐ Steering wheel vibrates at ____ MPH
☐ Excessive play in steering
☐ Erratic steering when braking
☐ Poor steering wheel return after cornering
☐ Suspension bottoms out
☐ Leans or sways in corners
☐ Brake light on
☐ Traction control light on
☐ Uneven tire wear
☐ Sits uneven
☐ "Dog" tracks
☐ ABS light on
☐ Soft ride

Hard to steer

☐ Effort
☐ Steering wheel off center
☐ Wanders

Shimmy/vibration (check box below for location)

☐ Front
☐ Seat
☐ Rear
☐ Floor
☐ Don't know
☐ Other ____________

Brake pedal

☐ Noise
☐ Pulses
☐ Squeaks
☐ Hard
☐ Mushy
☐ Excessive travel

WHEN DOES IT OCCUR?

☐ Cold days
☐ Parking manuevers
☐ Hot days
☐ At road speed
☐ Wet/rain
☐ Accelerating
☐ All the time
☐ Decelerating
☐ Intermittent

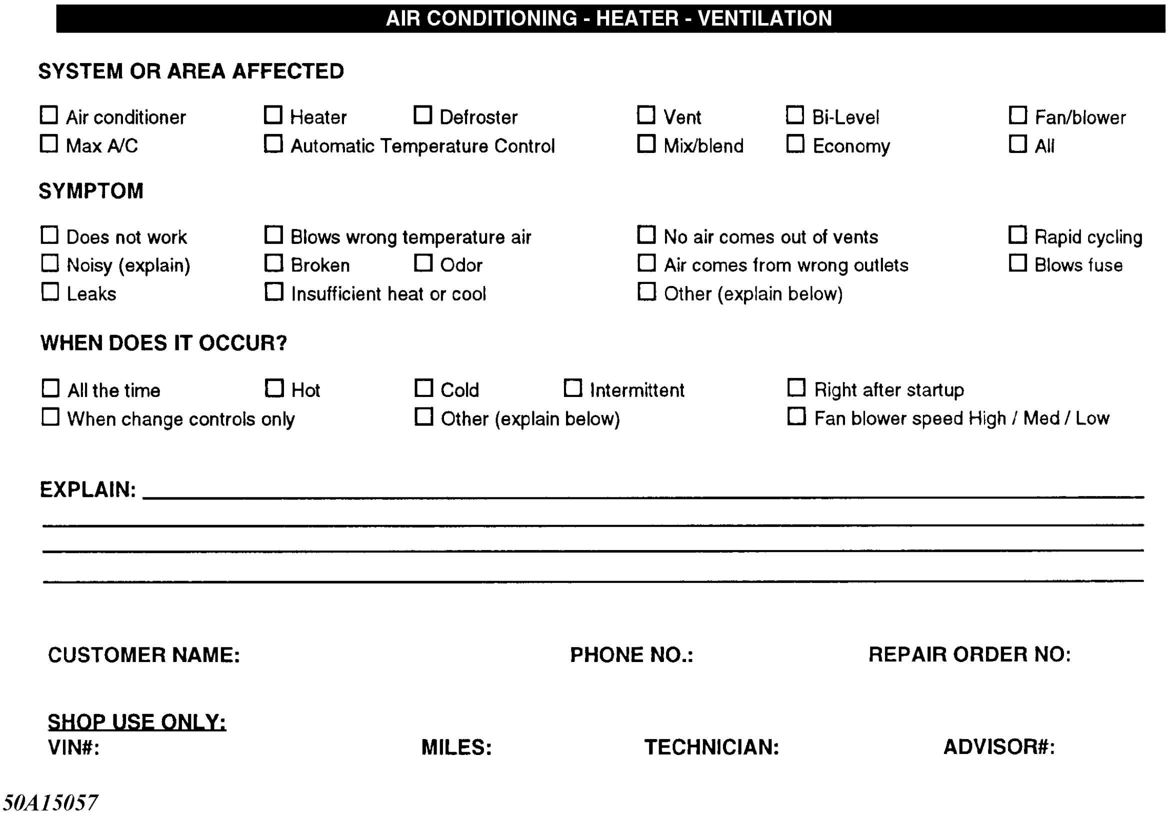
EXPLAIN: ____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50C15059

Fig. 7: Brakes, Steering, & Suspension



AIR CONDITIONING - HEATER - VENTILATION

SYSTEM OR AREA AFFECTED

☐ Air conditioner
☐ Max A/C
☐ Heater
☐ Automatic Temperature Control
☐ Defroster
☐ Vent
☐ Mix/blend
☐ Bi-Level
☐ Economy
☐ Fan/blower
☐ All

SYMPTOM

☐ Does not work
☐ Noisy (explain)
☐ Leaks
☐ Blows wrong temperature air
☐ Broken
☐ Insufficient heat or cool
☐ Odor
☐ No air comes out of vents
☐ Air comes from wrong outlets
☐ Other (explain below)
☐ Rapid cycling
☐ Blows fuse

WHEN DOES IT OCCUR?

☐ All the time
☐ When change controls only
☐ Hot
☐ Cold
☐ Other (explain below)
☐ Intermittent
☐ Right after startup
☐ Fan blower speed High / Med / Low

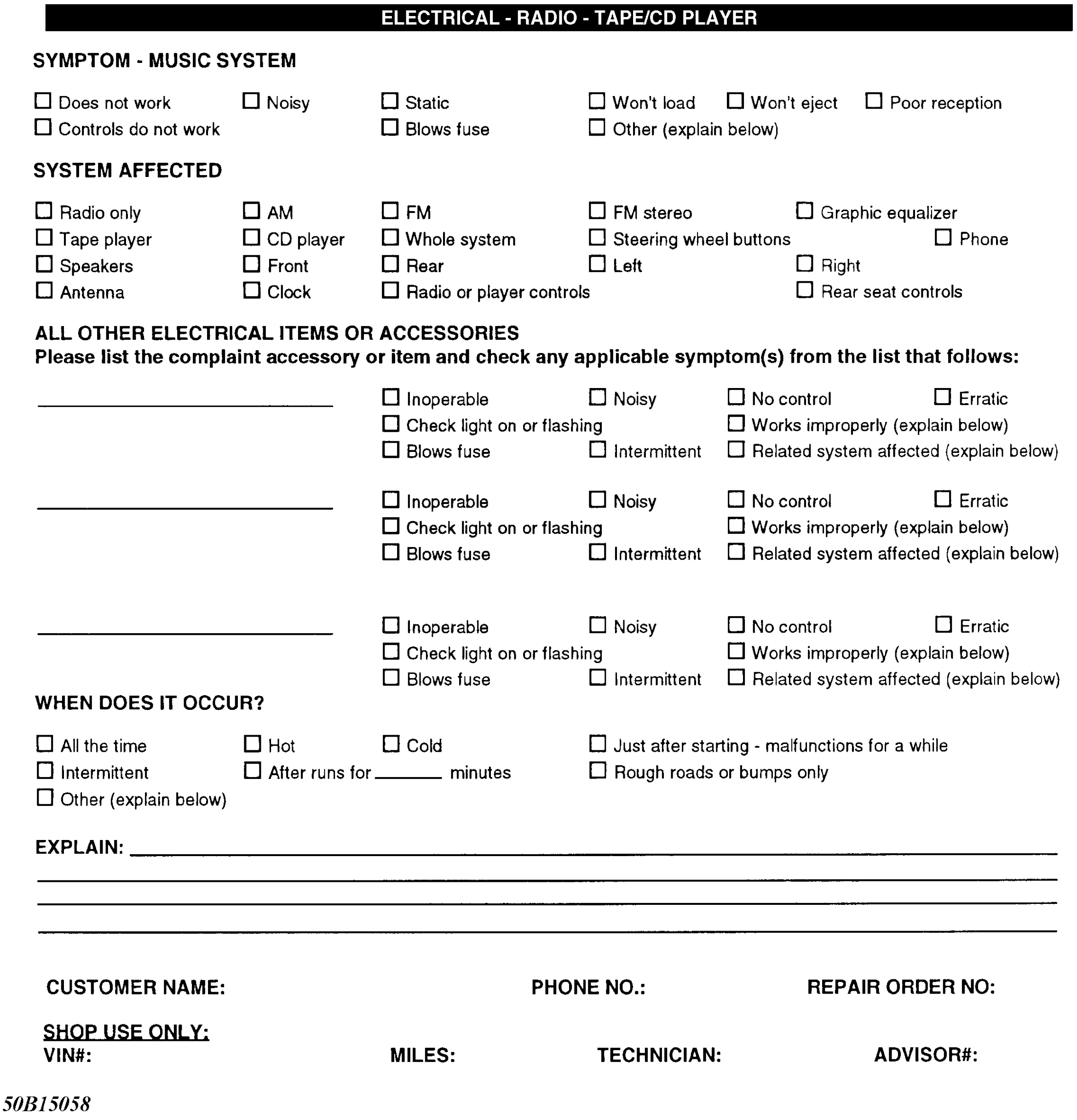
EXPLAIN: ____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50A15057

Fig. 8: Air Conditioning, Heater & Ventilation



ELECTRICAL - RADIO - TAPE/CD PLAYER

SYMPTOM - MUSIC SYSTEM

☐ Does not work ☐ Noisy ☐ Static ☐ Won't load ☐ Won't eject ☐ Poor reception
☐ Controls do not work ☐ Blows fuse ☐ Other (explain below)

SYSTEM AFFECTED

☐ Radio only ☐ AM ☐ FM ☐ FM stereo ☐ Graphic equalizer
☐ Tape player ☐ CD player ☐ Whole system ☐ Steering wheel buttons ☐ Phone
☐ Speakers ☐ Front ☐ Rear ☐ Left ☐ Right
☐ Antenna ☐ Clock ☐ Radio or player controls ☐ Rear seat controls

ALL OTHER ELECTRICAL ITEMS OR ACCESSORIES
Please list the complaint accessory or item and check any applicable symptom(s) from the list that follows:

____________________ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

____________________ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

____________________ ☐ Inoperable ☐ Noisy ☐ No control ☐ Erratic
☐ Check light on or flashing ☐ Works improperly (explain below)
☐ Blows fuse ☐ Intermittent ☐ Related system affected (explain below)

WHEN DOES IT OCCUR?

☐ All the time ☐ Hot ☐ Cold ☐ Just after starting - malfunctions for a while
☐ Intermittent ☐ After runs for ______ minutes ☐ Rough roads or bumps only
☐ Other (explain below)

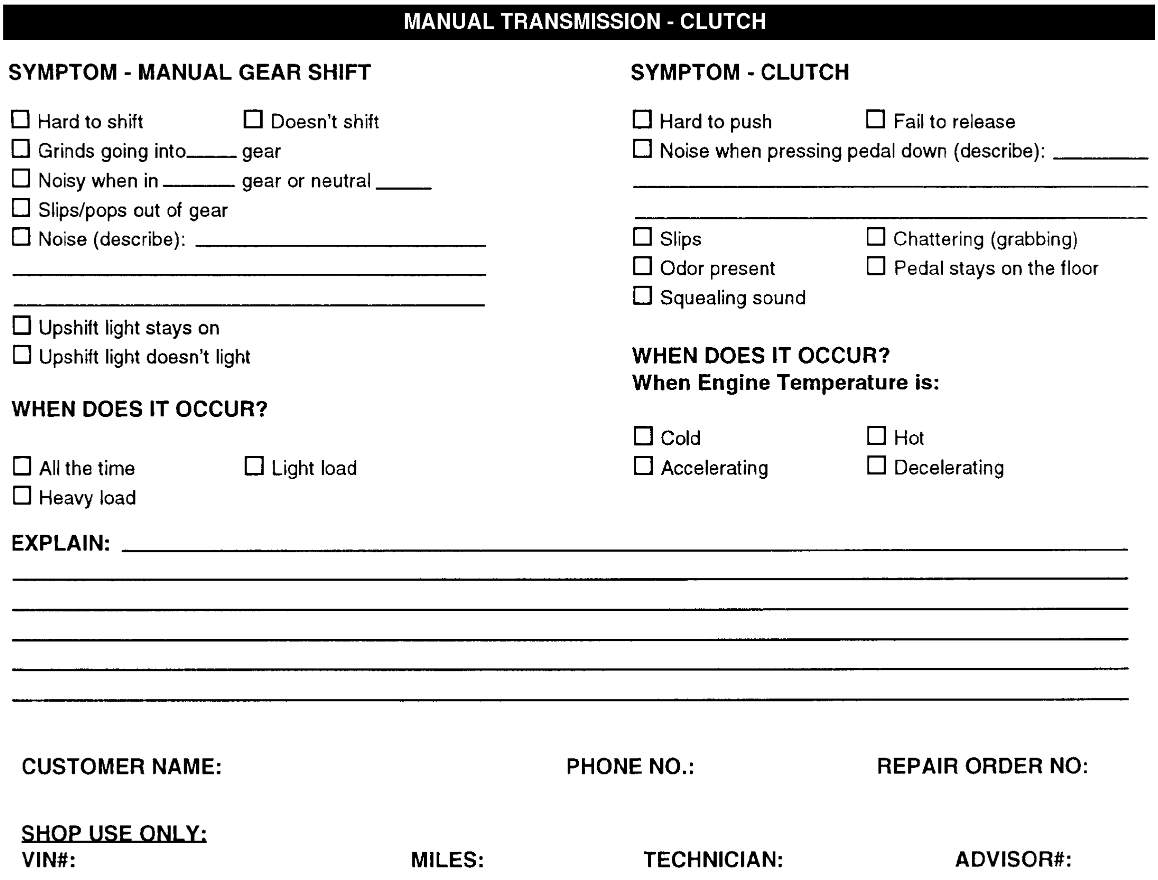
EXPLAIN: ____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50B15058

Fig. 9: Electrical, Radio & Tape/CD Player



MANUAL TRANSMISSION - CLUTCH

SYMPTOM - MANUAL GEAR SHIFT

☐ Hard to shift ☐ Doesn't shift
☐ Grinds going into_____ gear
☐ Noisy when in ______ gear or neutral _____
☐ Slips/pops out of gear
☐ Noise (describe): ________________________

☐ Upshift light stays on
☐ Upshift light doesn't light

WHEN DOES IT OCCUR?

☐ All the time ☐ Light load
☐ Heavy load

SYMPTOM - CLUTCH

☐ Hard to push ☐ Fail to release
☐ Noise when pressing pedal down (describe): _________

☐ Slips ☐ Chattering (grabbing)
☐ Odor present ☐ Pedal stays on the floor
☐ Squealing sound

WHEN DOES IT OCCUR?

When Engine Temperature is:

☐ Cold ☐ Hot
☐ Accelerating ☐ Decelerating

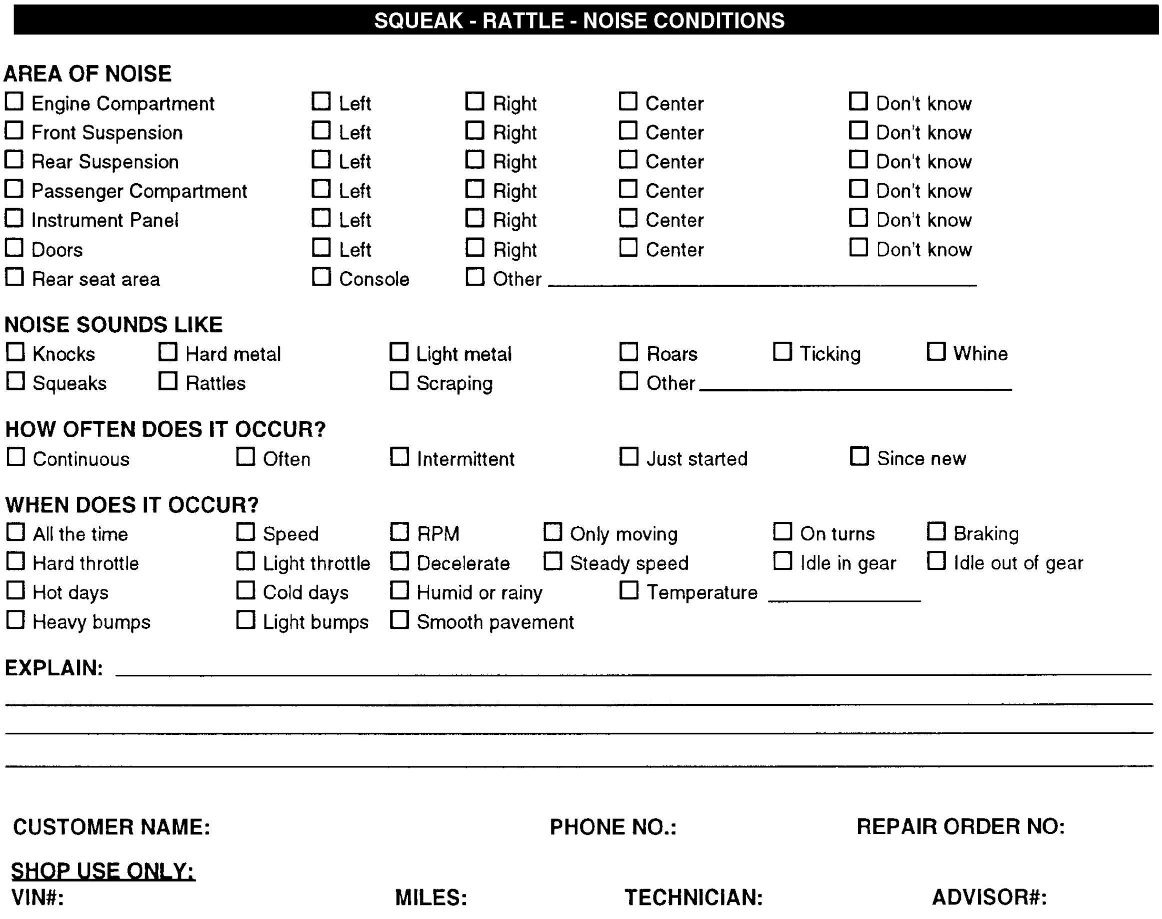
EXPLAIN: ____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50J15056

Fig. 10: Manual Transmission & Clutch



SQUEAK - RATTLE - NOISE CONDITIONS

AREA OF NOISE

☐ Engine Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Front Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear Suspension	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Passenger Compartment	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Instrument Panel	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Doors	☐ Left	☐ Right	☐ Center	☐ Don't know
☐ Rear seat area	☐ Console	☐ Other ____________________		

NOISE SOUNDS LIKE

☐ Knocks ☐ Hard metal ☐ Light metal ☐ Roars ☐ Ticking ☐ Whine
☐ Squeaks ☐ Rattles ☐ Scraping ☐ Other ________________

HOW OFTEN DOES IT OCCUR?

☐ Continuous ☐ Often ☐ Intermittent ☐ Just started ☐ Since new

WHEN DOES IT OCCUR?

☐ All the time ☐ Speed ☐ RPM ☐ Only moving ☐ On turns ☐ Braking
☐ Hard throttle ☐ Light throttle ☐ Decelerate ☐ Steady speed ☐ Idle in gear ☐ Idle out of gear
☐ Hot days ☐ Cold days ☐ Humid or rainy ☐ Temperature ________
☐ Heavy bumps ☐ Light bumps ☐ Smooth pavement

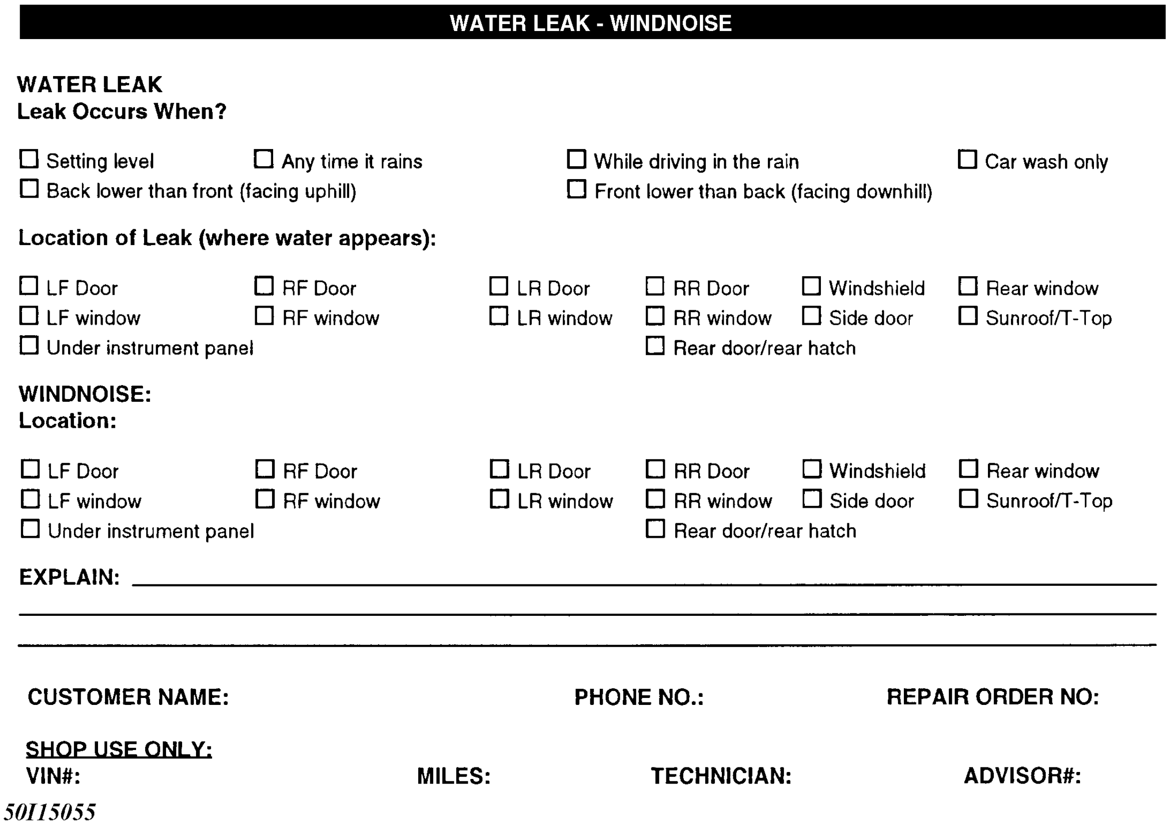
EXPLAIN: ____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50F15060

Fig. 11: Squeak, Rattle, & Noise Conditions



WATER LEAK - WINDNOISE

WATER LEAK
Leak Occurs When?

☐ Setting level ☐ Any time it rains ☐ While driving in the rain ☐ Car wash only
☐ Back lower than front (facing uphill) ☐ Front lower than back (facing downhill)

Location of Leak (where water appears):

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

WINDNOISE:
Location:

☐ LF Door ☐ RF Door ☐ LR Door ☐ RR Door ☐ Windshield ☐ Rear window
☐ LF window ☐ RF window ☐ LR window ☐ RR window ☐ Side door ☐ Sunroof/T-Top
☐ Under instrument panel ☐ Rear door/rear hatch

EXPLAIN: ____
____
____

CUSTOMER NAME: **PHONE NO.:** **REPAIR ORDER NO:**

SHOP USE ONLY:
VIN#: **MILES:** **TECHNICIAN:** **ADVISOR#:**

50I15055

Fig. 12: Water Leak & Wind Noise

Back To Article

GENERAL INFORMATION

Trouble Shooting - Basic Procedures

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. The purpose of this Trouble Shooting information is to provide a list of common causes to problem symptoms. For model-specific Trouble Shooting, refer to SUBJECT, DIAGNOSTIC, or TESTING articles available in the section(s) you are accessing.**

ACCESSORIES & ELECTRICAL

CHARGING SYSTEM TROUBLE SHOOTING

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BASIC CHARGING SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Vehicle Will Not Start	
Dead battery	Check battery cells, alternator belt tension and alternator output
Loose or corroded battery connections	Check all charging system connections
Ignition circuit or switch malfunction	Check and replace as necessary
Alternator Light Stays On With Engine Running	
Loose or worn alternator drive belt	Check alternator drive tension and condition, See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Loose alternator wiring connections	Check all charging system connections
Short in alternator light wiring	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Defective alternator stator or diodes	See Bench Tests in ALTERNATOR article

CONDITION & POSSIBLE CAUSE	CORRECTION
Defective regulator	See Regulator Check in ALTERNATOR article
Alternator Light Stays Off With Ignition Switch ON	
Blown fuse	See WIRING DIAGRAMS
Defective alternator	See Testing in ALTERNATOR article
Defective indicator light bulb or socket	See Indicator Warning Lights in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Alternator Light Stays OFF With Ignition Switch ON	
Short in alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective rectifier bridge	See Bench Tests in ALTERNATOR article
Lights or Fuses Burn Out Frequently	
Defective alternator wiring	See On-Vehicle Tests in ALTERNATOR article
Defective regulator	See Regulator Check in ALTERNATOR article
Defective battery	Check and replace as necessary
Ammeter Gauge Shows Discharge	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in TUNE-UP article in the TUNE-UP section
Defective wiring	Check all wires and wire connections
Defective alternator or regulator	See Bench Tests and On-Vehicle Tests in ALTERNATOR article
Defective ammeter, or improper ammeter wiring connection	See Testing in STANDARD INSTRUMENTS in the ACCESSORIES & EQUIPMENT section
Noisy Alternator	
Loose drive pulley	Tighten drive pulley attaching nut
Loose mounting bolts	Tighten all alternator mounting bolts
Worn or dirty bearings	See Bearing Replacement ALTERNATOR article
Defective diodes or stator	See Bench Test in ALTERNATOR article
Battery Does Stay Charged	
Loose or worn drive belt	Check alternator drive belt tension and condition. See Belt Adjustment in appropriate TUNE-UP article in the TUNE-UP section
Loose or corroded battery connections	Check all charging system connections

CONDITION & POSSIBLE CAUSE	CORRECTION
Loose alternator connections	Check all charging system connections
Defective alternator or battery	See On-Vehicle Tests and Bench Tests in ALTERNATOR article
Add-on electrical accessories exceeding alternator capacity	Install larger alternator
Battery Overcharged-Uses Too Much Water	
Defective battery	Check alternator output and repair as necessary
Defective alternator	See On-Vehicle Test and Bench Tests in ALTERNATOR article
Excessive alternator voltage	Check alternator output and repair as necessary

IGNITION SYSTEM TROUBLE SHOOTING

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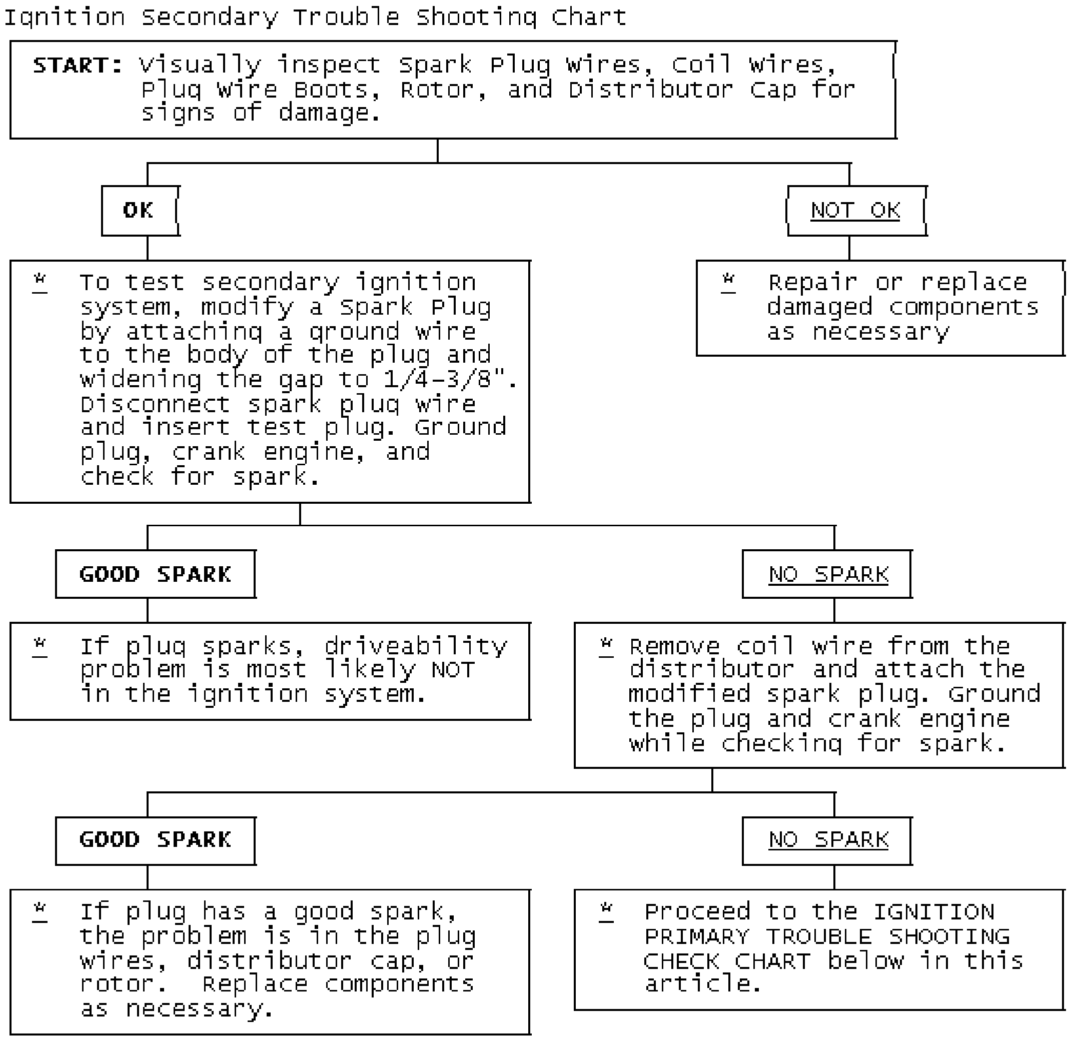


Iqnition Secondary Trouble Shootinq Chart

START: Visually inspect Spark Plug Wires, Coil Wires, Pluq Wire Boots, Rotor, and Distributor Cap for signs of damage.

OK

* To test secondary ignition system, modify a Spark Plug by attachinq a qround wire to the body of the plug and widening the gap to 1/4-3/8". Disconnect spark pluq wire and insert test plug. Ground plug, crank engine, and check for spark.

GOOD SPARK

* If pluq sparks, driveability problem is most likely NOT in the ignition system.

NO SPARK

* Remove coil wire from the distributor and attach the modified spark plug. Ground the plug and crank engine while checkinq for spark.

GOOD SPARK

* If plug has a good spark, the problem is in the plug wires, distributor cap, or rotor. Replace components as necessary.

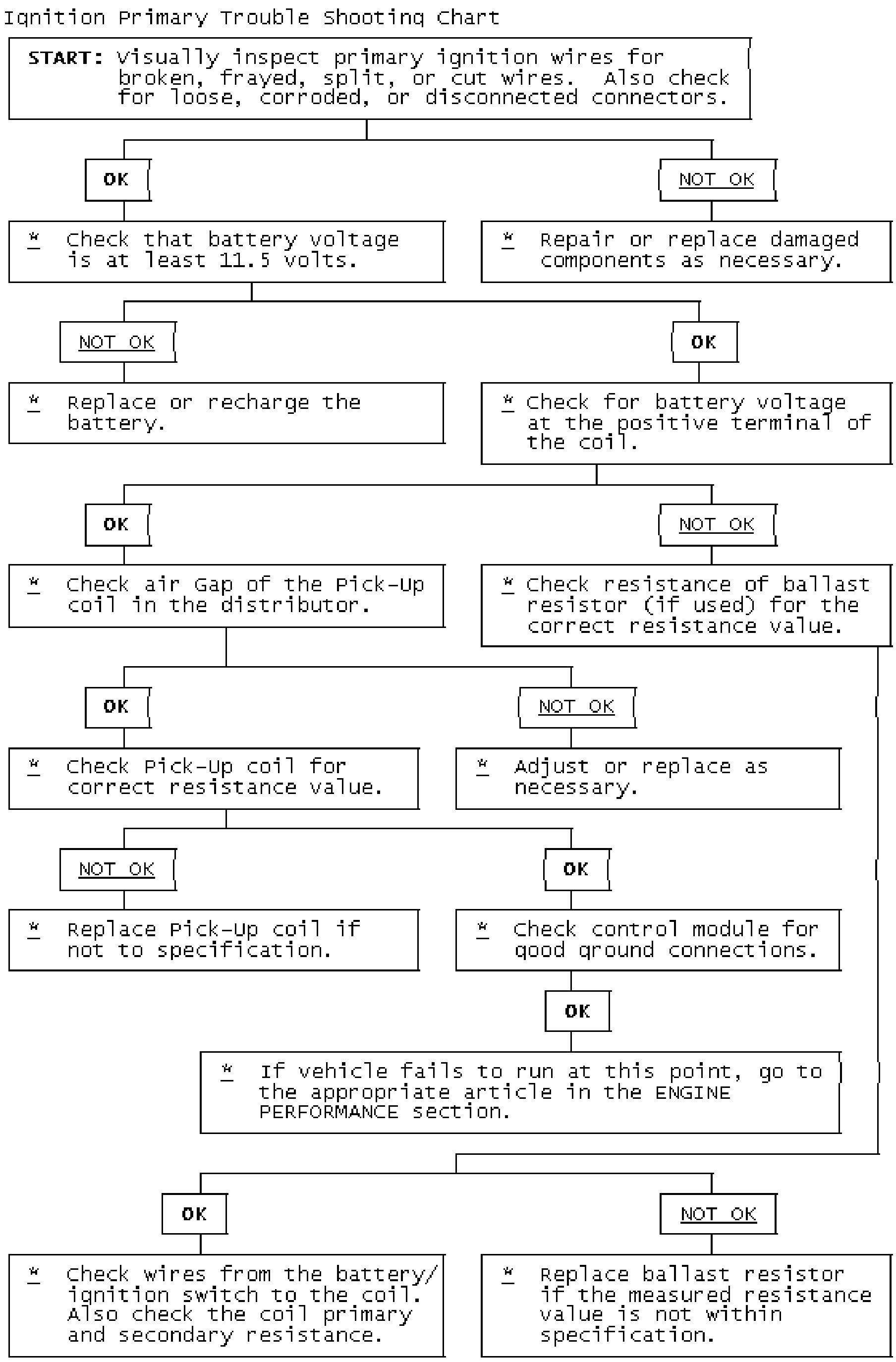
NO SPARK

* Proceed to the IGNITION PRIMARY TROUBLE SHOOTING CHECK CHART below in this article.

NOT OK

* Repair or replace damaged components as necessary

Fig. 1: Ignition Secondary Trouble Shooting Chart



Ignition Primary Trouble Shooting Chart

START: Visually inspect primary ignition wires for broken, frayed, split, or cut wires. Also check for loose, corroded, or disconnected connectors.

OK

* Check that battery voltage is at least 11.5 volts.

NOT OK

* Replace or recharge the battery.

OK

* Check for battery voltage at the positive terminal of the coil.

OK

* Check air Gap of the Pick-Up coil in the distributor.

OK

* Check Pick-Up coil for correct resistance value.

NOT OK

* Replace Pick-Up coil if not to specification.

OK

* Check control module for good ground connections.

OK

* If vehicle fails to run at this point, go to the appropriate article in the ENGINE PERFORMANCE section.

NOT OK

* Adjust or replace as necessary.

NOT OK

* Check resistance of ballast resistor (if used) for the correct resistance value.

OK

* Check wires from the battery/ignition switch to the coil. Also check the coil primary and secondary resistance.

NOT OK

* Replace ballast resistor if the measured resistance value is not within specification.

NOT OK

* Repair or replace damaged components as necessary.

Fig. 2: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

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BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	

CONDITION & POSSIBLE CAUSE	CORRECTION
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole	See STARTER article shoes
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearing	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch	Replace ignition switch contacts sticking
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	solenoid
Low Current Draw	
Worn brushes or weak brush springs	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

AIR CONDITIONING & HEAT

AIR CONDITIONING TROUBLE SHOOTING

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BASIC AIR CONDITIONING TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Compressor Not Working	Compressor clutch circuit open.
.....	Compressor clutch coil inoperative.
.....	Poor clutch ground connection.
.....	Fan belts loose.
.....	Thermostatic switch inoperative.
.....	Thermostatic switch not adjusted.
.....	Ambient temperature switch open.
.....	Superheat fuse blown.
Excessive Noise or Vibration	Missing or loose mounting bolts.
.....	Bad idler pulley bearings.
.....	Fan belts not tightened correctly.
.....	Compressor clutch contacting body.
.....	Excessive system pressure.
.....	Compressor oil level low.
.....	Damaged clutch bearings.
.....	Damaged reed valves.
.....	Damaged compressor.

CONDITION	POSSIBLE CAUSE
Insufficient or No Cooling; Compressor Working	Expansion valve inoperative.
.....	Heater control valve stuck open.
.....	Low system pressure.
.....	Blocked condenser fins.
.....	Blocked evaporator fins.
.....	Vacuum system leak.
.....	Vacuum motors inoperative.
.....	Control cables improperly adjusted.
.....	Restricted air inlet.
.....	Mode doors binding.
.....	Blower motor inoperative.
.....	Temperature above system capacity.

HEATER SYSTEM TROUBLE SHOOTING

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BASIC HEATER SYSTEM TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Insufficient, Erratic, or No Heat	Low Coolant Level
.....	Incorrect thermostat.
.....	Restricted coolant flow through core.
.....	Heater hoses plugged.
.....	Misadjusted control cable.
.....	Sticking heater control valve.
.....	Vacuum hose leaking.
.....	Vacuum hose blocked.
.....	Vacuum motors inoperative.
.....	Blocked air inlet.
.....	Inoperative heater blower motor.
.....	Oil residue on heater core fins.
.....	Dirt on heater core fins.
Too Much Heat	Improperly adjusted cables.
.....	Sticking heater control valve.
.....	No vacuum to heater control valve.
.....	Temperature door stuck open.
Air Flow Changes During Acceleration	Vacuum system leak.
.....	Bad check valve or reservoir.
Air From Defroster At All Times	Vacuum system leak.
.....	Improperly adjusted control cables.
.....	Inoperative vacuum motor.
Blower Does Not Operate Correctly	Blown fuse.
.....	Blower motor windings open.
.....	Resistors burned out.
.....	Motor ground connection loose.
.....	Wiring harness connections loose.

CONDITION	POSSIBLE CAUSE
.....	Blower motor switch inoperative.
.....	Blower relay inoperative.
.....	Fan binding or foreign object in housing.
.....	Fan blades broken or bent.

BRAKES

BRAKE SYSTEM TROUBLE SHOOTING

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BRAKE SYSTEM TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Brakes Pull Left or Right	
Incorrect tire pressure	Inflate tires to proper pressure
Front end out of alignment	See WHEEL ALIGNMENT
Mismatched tires	Check tires sizes
Restricted brake lines or hoses	Check hose routing
Loose or malfunctioning caliper	See DISC BRAKES or BRAKE SYSTEM
Bent shoe or oily linings	See DRUM BRAKES or BRAKE SYSTEM
Malfunctioning rear brakes	See DRUM, DISC BRAKES or BRAKE SYSTEM
Loose suspension parts	See SUSPENSION
Noises Without Brakes Applied	
Front linings worn out	Replace linings
Dust or oil on drums or rotors	See DRUM, DISC BRAKES or BRAKE SYSTEM
Noises With Brakes Applied	
Insulator on outboard shoe damaged	See DISC BRAKES or BRAKE SYSTEM
Incorrect pads or linings	Replace pads or linings
Brake Rough, Chatters or Pulsates	
Excessive lateral runout	Check rotor runout
Parallelism not to specifications	Reface or replace rotor
Wheel bearings not adjusted	See SUSPENSION
Rear drums out-of-round	Reface or replace drums
Disc pad reversed, steel against rotor	Remove and reinstall pad
Excessive Pedal Effort	
Malfunctioning power unit	See POWER BRAKES or BRAKE SYSTEM
Partial system failure	Check fluid and pipes
Worn disc pad or lining	Replace pad or lining
Caliper piston stuck or sluggish	See DISC BRAKES or BRAKE SYSTEM

CONDITION & POSSIBLE CAUSE	CORRECTION
Master cylinder piston stuck	See MASTER CYLINDERS or BRAKE SYSTEM
Brake fade due to incorrect pads for linings	Replace pads or linings
Linings or pads glazed	Replace pads or linings
Worn drums	Reface or replace drums
Excessive Pedal Travel	
Partial brake system failure	Check fluid and pipes
Insufficient fluid in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Air trapped in system	See BRAKE BLEEDING or BRAKE SYSTEM
Rear brakes not adjusted	See Adjustments in DRUM BRAKES or BRAKE SYSTEM
Bent shoe or lining	See DRUM BRAKES or BRAKE SYSTEM
Plugged master cylinder cap	See MASTER CYLINDERS or BRAKE SYSTEM
Improper brake fluid	Replace brake fluid
Pedal Travel Decreasing	
Compensating port plugged	See MASTER CYLINDERS or BRAKE SYSTEM
Swollen cup in master cylinder	See MASTER CYLINDERS or BRAKE SYSTEM
Master cylinder piston not returning	See MASTER CYLINDERS or BRAKE SYSTEM
Weak shoe retracting springs	See DRUM BRAKES BRAKE SYSTEM
Wheel cylinder piston sticking	See DRUM BRAKES or BRAKE SYSTEM
Dragging Brakes	
Master cylinder pistons not returning	See MASTER CYLINDERS BRAKE SYSTEM
Restricted brake lines or hoses	Check line routing
Incorrect parking brake adjustment	See DRUM BRAKES BRAKE SYSTEM
Parking Brake cables frozen	See DRUM BRAKES BRAKE SYSTEM
Incorrect installation of inboard disc pad	Remove and replace correctly
Power booster output rod too long	See POWER BRAKE UNITS BRAKE SYSTEM
Brake pedal not returning freely	See DISC, DRUM BRAKES BRAKE SYSTEM
Brakes Grab or Uneven Braking Action	
Malfunction of combination valve	See CONTROL VALVE or BRAKE SYSTEM

CONDITION & POSSIBLE CAUSE	CORRECTION
Malfunction of power brake unit	See POWER BRAKE UNITS or BRAKE SYSTEM
Binding brake pedal	See DISC, DRUM BRAKES or BRAKE SYSTEM
Pulsation or Roughness	
Uneven pad wear caused by caliper	See DISC BRAKES or BRAKE SYSTEM
Uneven rotor wear	See DISC BRAKES or BRAKE SYSTEM
Drums out-of-round	Reface or replace drums

ENGINE MECHANICAL

COOLING SYSTEM TROUBLE SHOOTING

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COOLING SYSTEM TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Overheating	
Coolant Leak	Fill/Pressure Test System
A/C Condenser Fins Clogged	Remove/Clean Condenser
Radiator Fins Clogged	Remove/Clean Radiator
Thermostat Stuck Closed	Replace Thermostat
Clogged Cooling System Passages	Clean/Flush Cooling System
Water Pump Malfunction	Replace Water Pump
Fan Clutch Malfunction	Replace Fan Clutch
Retarded Ignition Timing	Reset Ignition Timing
Cooling Fan Malfunction	Test Cooling Fan/Circuit
Cooling Fan Motor Malfunction	Test Fan Motor
Cooling Fan Relay Malfunction	Test Fan Relay
Faulty Radiator Cap	Replace Radiator Cap
Broken/Slipping Fan Belt	Replace Fan Belt
Restricted Exhaust	Repair Exhaust System
Corrosion	
Impurities In Coolant	Clean/Flush System
Coolant Leakage	
Damaged hose	Replace Hose
Leaky Water Pump	Replace Water Pump
Damaged Radiator Seam	Replace/Repair Radiator
Leaky Thermostat Cover	Replace Thermostat Cover
Cylinder Head Problem	Check Head/Head Gasket
Leaky Freeze Plugs	Replace Freeze Plugs
Recovery System Inoperative	
Loose and/or Defective Radiator Cap	Replace Radiator Cap
Overflow Tube Clogged and/or Leaking	Repair Tube

CONDITION & POSSIBLE CAUSE	CORRECTION
Recovery Bottle Vent Restricted	Clean Vent
No Heater Core Flow	
Collapsed Heater Hose	Replace Heater Hose
Plugged Heater Core	Clean/Replace Heater Core
Faulty Heater Valve	Replace Heater Valve

GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING

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BASIC GASOLINE ENGINE - MECHANICAL TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Lopes At Idle	
Intake manifold-to-head leaks	Replace manifold gasket, See ENGINES
Blown head gasket	Replace head gasket, See ENGINES
Worn timing gears, chain or sprocket	Replace gears, chain or sprocket
Worn camshaft lobes	Replace camshaft, See ENGINES
Overheated engine	Check cooling system, See COOLING
Blocked crankcase vent valve	Remove restriction
Leaking EGR valve	Repair leak and/or replace valve
Faulty fuel pump	Replace fuel pump
Engine Has Low Power	
Leaking fuel pump	Repair leak and/or replace fuel pump
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Sticking valves or weak valve springs	Check valve train components, See ENGINES
Incorrect valve timing	Reset valve timing, See ENGINES
Worn camshaft lobes	Replace camshaft, See ENGINES
Blown head gasket	Replace head gasket. See ENGINES.
Clutch slipping	Adjust pedal and/or replace components, See ENGINES
Engine overheating	Check cooling system, See COOLING
Auto. Trans. pressure regulator valve faulty	Replace pressure regulator valve
Auto. Trans. fluid level too low	Add fluid as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Improper vacuum diverter valve operation	Replace vacuum diverter valve
Vacuum leaks	Inspect vacuum system and repair as required
Leaking piston rings	Replace piston rings, See ENGINES
Faulty High Speed Operation	
Low fuel pump volume	Replace fuel pump
Leaking valves or worn	Replace valves and/or springs, See ENGINES
Incorrect valve timing	Reset valve timing,See ENGINES
Intake manifold restricted	Remove restriction
Worn distributor shaft	Replace distributor
Faulty Acceleration	
Improper fuel pump stroke	Remove pump and reset pump stroke
Incorrect ignition timing	Reset ignition timing, See TUNE-UP
Leaking valves	Replace valves, See ENGINES
Worn fuel pump diaphragm or piston	Replace diaphragm or piston
Intake Backfire	
Improper ignition timing	Reset ignition timing, See TUNE-UP
Faulty accelerator pump discharge	Replace accelerator pump
Improper choke operation	Check choke and adjust as required
Defective EGR valve	Replace EGR valve
Fuel mixture too lean	Reset air/fuel mixture, See TUNE-UP
Choke valve initial clearance too large	Reset choke valve initial clearance
Exhaust Backfire	
Vacuum leak	Inspect and repair vacuum system
Faulty vacuum diverter valve	Replace vacuum diverter valve
Faulty choke operation	Check choke and adjust as required
Exhaust system leak	repair exhaust system leak
Engine Detonation	
Ignition timing too far advanced	Reset ignition timing, See TUNE-UP
Faulty ignition system	Check ignition timing, See TUNE-UP
Spark plugs loose or faulty	Retighten or replace plugs
Fuel delivery system clogged	Inspect lines, pump and filter for clog
EGR valve inoperative	Replace EGR valve
PCV system inoperative	Inspect and/or replace hoses or valve
Vacuum leaks	Check vacuum system and repair leaks

CONDITION & POSSIBLE CAUSE	**CORRECTION**
Excessive combustion chamber deposits	Remove built-up deposits
Leaking, sticking or broken valves	Inspect and/or replace valves
External Oil Leakage	
Fuel pump improperly seated or worn gasket	Remove pump, replace gasket and seat properly
Oil pan gasket broken or pan bent	Straighten pan and replace gasket
Timing chain cover gasket broken	Replace timing chain cover gasket
Rear main oil seal worn	Replace rear main oil seal
Oil pan drain plug not seated properly	Remove and reinstall drain plug
Camshaft bearing drain hole blocked	Remove restriction
Oil pressure sending switch leaking	Remove and reinstall sending switch
Excessive Oil Consumption	
Worn valve stems or guides	Replace stems or guides, See ENGINES
Valve "O" ring seals damaged	Replace "O" ring seals, See ENGINES
Plugged oil drain back holes	Remove restrictions
Improper PCV valve operation	Replace PCV valve
Engine oil level too high	Remove excess oil
Engine oil too thin	Replace thicker oil
Valve stem oil deflectors damaged	Replace oil deflectors
Incorrect piston rings	Replace piston rings, See ENGINES
Piston ring gaps not staggered	Reinstall piston rings, See ENGINES
Insufficient piston ring tension	Replace rings, See ENGINES
Piston ring grooves or oil return	slots clogged Replace piston rings, See ENGINES
Piston rings sticking in grooves	Replace piston rings, See ENGINES
Piston ring grooves excessively worn	Replace piston and rings, See ENGINES
Compression rings installed upside down	Replace compression rings correctly, See ENGINES
Worn or scored cylinder walls	Rebore cylinders or replace block
Mismatched oil ring expander and rail	Replace oil ring expander and rail, See ENGINES
Intake gasket dowels too long	Replace intake gasket dowels
Excessive main or connecting rod bearing clearance	Replace main or connecting rod bearings, See ENGINES
No Oil Pressure	
Low oil level	Add oil to proper level
Oil pressure sender or gauge broken	Replace sender or gauge
Oil pump malfunction	Remove and overhaul oil pump, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Oil pressure relief valve sticking	Remove and reinstall valve
Oil pump passages blocked	Overhaul oil pump, See ENGINES
Oil pickup screen or tube blocked	Remove restriction
Loose oil inlet tube	Tighten oil inlet tube
Loose camshaft bearings	Replace camshaft bearings, See ENGINES
Internal leakage at oil passages	Replace block or cylinder head
Low Oil Pressure	
Low engine oil level	Add oil to proper level
Engine oil too thin	Remove and replace with thicker oil
Excessive oil pump clearance	Reduce oil pump clearance, See ENGINES
Oil pickup tube or screen blocked	Remove restrictions
Main, rod or cam bearing clearance excessive	Replace bearing to reduce clearance, See ENGINES
High Oil Pressure	
Improper grade of oil	Replace with proper oil
Oil pressure relief valve stuck closed	Eliminate binding
Oil pressure sender or gauge faulty	Replace sender or gauge
Noisy Main Bearings	
Inadequate oil supply	Check oil delivery to main bearings
Excessive main bearing clearance	Replace main bearings, See ENGINES
Excessive crankshaft end play	Replace crankshaft, See ENGINES
Loose flywheel or torque converter	Tighten attaching bolts
Loose or damaged vibration damper	Tighten or replace vibration damper
Crankshaft journals out-of-round	Re-grind crankshaft journals
Excessive belt tension	Loosen belt tension
Noisy Connecting Rods	
Excessive bearing clearance or missing bearing	Replace bearing, See ENGINES
Crankshaft rod journal out-of-round	Re-grind crankshaft journal
Misaligned connecting rod or cap	Remove rod or cap and realign
Incorrectly tightened rod bolts	Remove and re-tighten rod bolts
Noisy Pistons and Rings	
Excessive piston-to-bore clearance	Install larger pistons, See ENGINES
Bore tapered or out-of-round	Rebore block
Piston ring broken	Replace piston rings, See ENGINES
Piston pin loose or seized	Replace piston pin, See ENGINES
Connecting rods misaligned	Realign connecting rods

CONDITION & POSSIBLE CAUSE	CORRECTION
Ring side clearance too loose or tight	Replace with larger or smaller rings
Carbon build-up on piston	Remove carbon
Noisy Valve Train	
Worn or bent push rods	Replace push rods, See ENGINES
Worn rocker arms or bridged pivots	Replace push rods, See ENGINES
Dirt or chips in valve lifters	Remove lifters and remove dirt/chips
Excessive valve lifter leak-down	Replace valve lifters, See ENGINES
Valve lifter face worn	Replace valve lifters, See ENGINES
Broken or cocked valve springs	Replace or reposition springs
Too much valve stem-to-guide clearance	Replace valve guides, See ENGINES
Valve bent	Replace valve, See ENGINES
Loose rocker arms	Retighten rocker arms, See ENGINES
Excessive valve seat run-out	Reface valve seats, See ENGINES
Missing valve lock	Install new valve lock
Excessively worn camshaft lobes	Replace camshaft, See ENGINES
Plugged valve lifter oil holes	Eliminate restriction or replace lifter
Faulty valve lifter check ball	Replace lifter check ball, See ENGINES
Rocker arm nut installed upside down	Remove and reinstall correctly
Valve lifter incorrect for engine	Remove and replace valve lifters
Faulty push rod seat or lifter plunger	Replace plunger or push rod
Noisy Valves	
Improper valve lash	Re-adjust valve lash, See ENGINES
Worn or dirty valve lifters	Clean and/or replace lifters
Worn valve guides	Replace valve guides, See ENGINES
Excessive valve seat or face run-out	Reface seats or valve face
Worn camshaft lobes	Replace camshaft, See ENGINES
Loose rocker arm studs	Re-tighten rocker arm studs, See ENGINES
Bent push rods	Replace push rods, See ENGINES
Broken valve springs	Replace valve springs, See ENGINES
Burned,Sticking or Broken Valves	
Weak valve springs or warped valves	Replace valves and/or springs, See ENGINES

CONDITION & POSSIBLE CAUSE	CORRECTION
Improper lifter clearance	Re-adjust clearance or replace lifters
Worn guides or improper guide clearance	Replace valve guides, See ENGINES
Out-of-round valve seats or improper seat width	Re-grind valve seats
Gum deposits on valve stems, seats or guide	Remove deposits
Improper spark timing	Re-adjust spark timing
Broken Pistons/Rings	
Undersize pistons	Replace with larger pistons, See ENGINES
Wrong piston rings	Replace with correct rings, See ENGINES
Out-of-round cylinder bore	Re-bore cylinder bore
Improper connecting rod alignment	Remove and realign connecting rods
Excessively worn ring grooves	Replace pistons, See ENGINES
Improperly assembled piston pins	Re-assemble pin-to-piston, See ENGINES
Insufficient ring gap clearance	Install new rings, See ENGINES
Engine overheating	Check cooling system
Incorrect ignition timing	Re-adjust ignition timing, See TUNE-UP
Excessive Exhaust Noise	
Leaks at manifold to head, or to pipe	Replace manifold or pipe gasket
Exhaust manifold cracked or broken	Replace exhaust manifold, See ENGINES

ENGINE PERFORMANCE

CARBURETOR TROUBLE SHOOTING:

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BASIC COLD START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Choke not closing	Check choke operation, see FUEL SYSTEMS
Choke linkage bent	Check linkage, see FUEL SYSTEM
Engine Starts, Then Dies	
Choke vacuum kick setting too wide	Check setting and adjust see, FUEL SYSTEMS
Fast idle RPM too low	Reset RPM to specification, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS

CONDITION & POSSIBLE CAUSE	CORRECTION
Vacuum leak	Inspect vacuum system for leaks
Low fuel pump outlet	Repair or replace pump, see FUEL SYSTEMS
Low carburetor fuel level	Check float setting see FUEL SYSTEM
Engine Quits Under Load	
Choke vacuum kick setting incorrect	Reset vacuum kick setting,see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEM
Incorrect hot fast idle speed RPM	Reset fast idle RPM, see TUNE-UP
Engine Starts, Runs Up, Then Idles, Slowly With Black Smoke	
Choke vacuum kick set too narrow	Reset vacuum kick, see FUEL SYSTEMS
Fast idle cam index incorrect	Reset fast idle cam index, see FUEL SYSTEMS
Hot fast idle RPM too low	Reset fast idle RPM, see TUNE-UP

BASIC HOT START SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Engine flooded	Allow fuel to evaporate

BASIC COLD ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Stalls in Gear	
Choke vacuum kick setting incorrect	Reset choke vacuum kick, see FUEL SYSTEMS
Fast idle RPM incorrect	Reset fast idle RPM, see TUNE-UP
Fast idle cam index incorrect	Reset fast idle cam see FUEL SYSTEMS
Acceleration Sag or Stall	
Defective choke control switch	Replace choke control switch
Choke vacuum kick setting incorrect	Reset choke vacuum kick see, FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, FUEL SYSTEMS
Accelerator pump defective	Repair or replace pump see FUEL SYSTEMS
Secondary throttles not closed	Inspect lockout adjustment, see FUEL SYSTEMS
Sag or Stall After Warmup	
Defective choke control switch	Replace choke control switch, see FUEL SYSTEMS
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Float level incorrect (too low)	Adjust float level, see FUEL SYSTEMS
Backfiring & Black Smoke	

CONDITION & POSSIBLE CAUSE	CORRECTION
Plugged heat crossover system	Remove restriction

BASIC WARM ENGINE DRIVEABILITY SYMPTOMS TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Hesitation With Small Amount of Gas Pedal Movement	
Vacuum leak	Inspect vacuum lines
Accelerator pump weak or inoperable	Replace pump, see FUEL SYSTEMS
Float level setting too low	Reset float level, see,FUEL SYSTEMS
Metering rods sticking or binding	Inspect and/or replace rods, see FUEL SYSTEMS
Carburetor idle or transfer system plugged	Inspect system and remove restriction
Frozen or binding heated air inlet	Inspect heated air door for binding
Hesitation With Heavy Gas Pedal Movement	
Defective accelerator pump	Replace pump, see FUEL SYSTEMS
Metering rod carrier sticking or binding	Remove restriction
Large vacuum leak	Inspect vacuum system and repair leak
Float level setting too low	Reset float level, see FUEL SYSTEMS
Defective fuel pump, lines or filter	Inspect pump, lines and filter
Air door setting incorrect	Adjust air door setting, see FUEL

DIESEL ENGINE TROUBLE SHOOTING

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NOTE: **Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.**

BASIC DIESEL ENGINE TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Crank	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Bad starter connections or bad starter	Check connections and/or replace starter
Engine Cranks Slowly, Won't Start	
Bad battery connections or dead batteries	Check connections and/or replace batteries
Engine oil too heavy	Replace engine oil
Engine Cranks Normally, But Will Not Start	
Glow plugs not functioning	Check glow plug system, see FUEL SYSTEMS

CONDITION & POSSIBLE CAUSE	CORRECTION
Glow plug control not functioning	Check controller, see FUEL SYSTEMS
Fuel not injected into cylinders	Check fuel injectors, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Fuel filter blocked	Replace fuel filter
Fuel tank filter blocked	Replace fuel tank filter
Fuel pump not operating	Check pump operation and/or replace pump
Fuel return system blocked	Inspect system and remove restriction
No voltage to fuel solenoid	Check solenoid and connections
Incorrect or contaminated fuel	Replace fuel
Incorrect injection pump timing	Re-adjust pump timing, see FUEL SYSTEMS
Low compression	Check valves, pistons, rings, see ENGINES
Injection pump malfunction	Inspect and/or replace injection pump
Engine Starts, Won't Idle	
Incorrect slow idle adjustment	Reset idle adjustment, see TUNE-UP
Fast idle solenoid malfunctioning	Check solenoid and connections
Fuel return system blocked	Check system and remove restrictions
Glow plugs go off too soon	See glow plug diagnosis in FUEL SYSTEMS
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
No fuel to injection pump	Check fuel delivery system
Incorrect or contaminated fuel	Replace fuel
Low compression	Check valves, piston, rings, see ENGINES
Injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Fuel solenoid closes in RUN position	Check solenoid and connections
Engines Starts/Idles Rough W/out Smoke or Noise	
Incorrect slow idle adjustment	Reset slow idle, see TUNE-UP
Injection line fuel leaks	Check lines and connections
Fuel return system blocked	Check lines and connections
Air in fuel system	Bleed air from system
Incorrect or contaminated fuel	Replace fuel
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engines Starts and Idles Rough W/out Smoke or Noise, But Clears After Warm-Up	
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Engine not fully broken in	Put more miles on engine
Air in system	Bleed air from system

CONDITION & POSSIBLE CAUSE	CORRECTION
Injector nozzle malfunction	Check nozzles, see FUEL SYSTEMS
Engine Idles Correctly, Misfires Above Idle	
Blocked fuel filter	Replace fuel filter
Injection pump timing incorrect	Reset pump timing, see FUEL SYSTEMS
Incorrect or contaminated fuel	Replace fuel
Engine Won't Return To Idle	
Fast idle adjustment incorrect	Reset fast idle, see TUNE-UP
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
External linkage binding	Check linkage and remove binding
Fuel Leaks On Ground	
Loose or broken fuel line	Check lines and connections
Internal injection pump seal leak	Replace injection pump, see FUEL SYSTEMS
Cylinder Knocking Noise	
Injector nozzles sticking open	Test injectors, see FUEL SYSTEMS
Very low nozzle opening pressure	Test injectors and/or replace
Loss of Engine Power	
Restricted air intake	Remove restriction
EGR valve malfunction	Replace EGR valve
Blocked or damaged exhaust system	Remove restriction and/or replace components
Blocked fuel tank filter	Replace filter
Restricted fuel filter	Remove restriction and/or replace filter
Block vent in gas cap	Remove restriction and/or replace cap
Tank-to-injection pump fuel supply blocked	Check fuel lines and connections
Blocked fuel return system	Remove restriction
Incorrect or contaminated fuel	Replace fuel
Blocked injector nozzles	Check nozzle for blockage, see FUEL SYSTEMS
Low compression	Check valves, rings, pistons, see ENGINES
Loud Engine Noise With Black Smoke	
Basic timing incorrect	Reset timing, see FUEL SYSTEMS
EGR valve malfunction	Replace EGR valve
Internal injection pump malfunction	Replace injection pump, see FUEL SYSTEMS
Incorrect injector pump housing pressure	Check pressure, see FUEL SYSTEMS
Engine Overheating	
Cooling system leaks	Check cooling system and repair leaks
Belt slipping or damaged	Check tension and/or replace belt

CONDITION & POSSIBLE CAUSE	CORRECTION
Thermostat stuck closed	Remove and replace thermostat, see ENGINE COOLING
Head gasket leaking	Replace head gasket
Oil Light on at Idle	
Low oil pump pressure	Check oil pump operation, see ENGINES
Oil cooler or line restricted	Remove restriction and/or replace cooler
Engine Won't Shut Off	
Injector pump fuel solenoid does not return fuel valve to OFF position	Remove and check solenoid and replace if needed

VACUUM PUMP DIAGNOSIS

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

FUEL INJECTION TROUBLE SHOOTING

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BASIC FUEL INJECTION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start (Cranks Normally)	
Cold start valve inoperative	Test valve and circuit
Poor connection;vacuum or wiring	Check vacuum and electrical connections
Contaminated fuel	Test fuel for water or alcohol
Defective fuel pump relay or circuit	Test relay and wiring
Battery too low	Charge and test battery
Low fuel pressure	Test pressure regulator and fuel pump, check for restricted lines and filters
No distributor reference pulses	Repair ignition system as necessary
Open coolant temperature sensor circuit	Test sensor and wiring
Shorted W.O.T. switch in T.P.S.	Disconnect W.O.T. switch, engine should start
Defective ECM	Replace ECM
Fuel tank residual pressure valve leaks	Test for fuel pressure drop after shut down
Hard Starting	

CONDITION & POSSIBLE CAUSE	CORRECTION
Disconnected hot air tube to air cleaner	Reconnect tube and test control valve
Defective Idle Air Control (IAC) valve	Test valve operation and circuit
Shorted, open or misadjusted T.P.S.	Test and adjust or replace T.P.S.
EGR valve open	Test EGR valve and control circuit
Poor Oxygen sensor signal	Test for shorted or circuit
Incorrect mixture from PCV system	Test PCV for flow, check sealing of oil filter cap
Poor High Speed Operation	
Low fuel pump volume	Faulty pump or restricted fuel lines or filters
Poor MAP sensor signal	Test MAP sensor, vacuum hose and wiring
Poor Oxygen sensor signal	Test for shorted or open sensor or circuit
Open coolant temperature sensor circuit	Test sensor and wiring
Faulty ignition operation	Check wires for cracks or poor con- nections, test secondary voltage with oscilloscope
Contaminated fuel	Test fuel for water or alcohol
Intermittent ECM ground	Test ECM ground connection for resistance
Restricted air cleaner	Replace air cleaner
Restricted exhaust system	Test for exhaust manifold back pressure
Poor MAF sensor signal	Check leakage between sensor and manifold
Poor VSS signal	If tester for ALCL hook-up is available check that VSS reading matches speedometer
Ping or Knock on Acceleration	
Poor Knock sensor signal	Test for shorted or open sensor or circuit
Poor Baro sensor signal	Test for shorted or open sensor or circuit
Improper ignition timing	See VEHICLE EMISSION CONTROL LABEL (where applicable)
Check for engine overheating problems	Low coolant, loose belts or electric cooling fan inoperative

NOTE: **For additional electronic fuel injection trouble shooting information, see the appropriate article in the ENGINE PERFORMANCE section (not all vehicles have Computer Engine Control articles). Information is provided there for diagnosing fuel system problems on vehicles with electronic fuel injection.**

IGNITION SYSTEM TROUBLE SHOOTING

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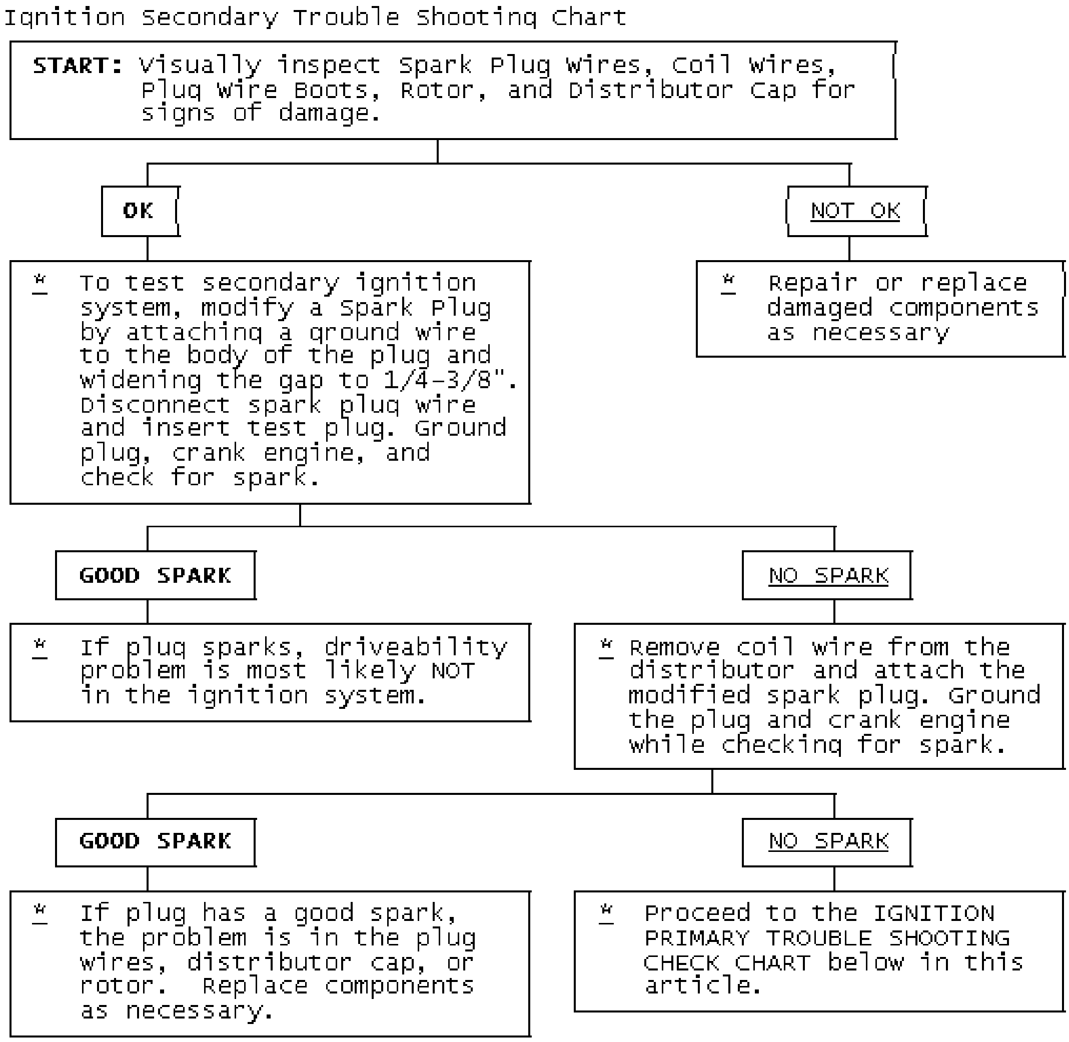
Ignition Secondary Trouble Shooting Chart
START: Visually inspect Spark Plug Wires, Coil Wires, Plug Wire Boots, Rotor, and Distributor Cap for signs of damage.
OK
NOT OK
* To test secondary ignition system, modify a Spark Plug by attaching a ground wire to the body of the plug and widening the gap to 1/4-3/8". Disconnect spark plug wire and insert test plug. Ground plug, crank engine, and check for spark.
* Repair or replace damaged components as necessary
GOOD SPARK
NO SPARK
* If plug sparks, driveability problem is most likely NOT in the ignition system.
* Remove coil wire from the distributor and attach the modified spark plug. Ground the plug and crank engine while checking for spark.
GOOD SPARK
NO SPARK
* If plug has a good spark, the problem is in the plug wires, distributor cap, or rotor. Replace components as necessary.
* Proceed to the IGNITION PRIMARY TROUBLE SHOOTING CHECK CHART below in this article.

Fig. 3: Ignition Secondary Trouble Shooting Chart

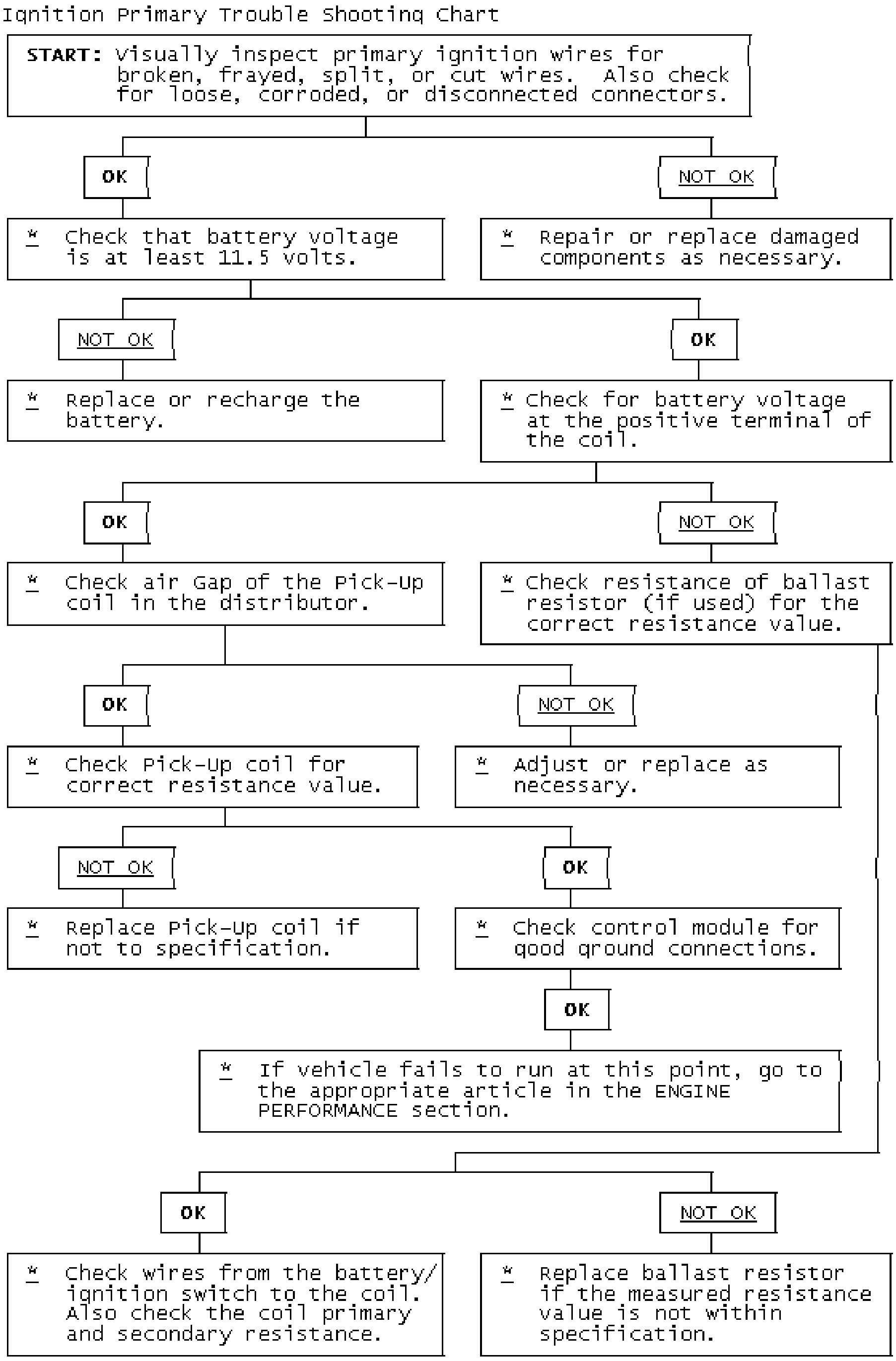
Ignition Primary Trouble Shooting Chart
START: Visually inspect primary ignition wires for broken, frayed, split, or cut wires. Also check for loose, corroded, or disconnected connectors.
OK
NOT OK
* Check that battery voltage is at least 11.5 volts.
* Repair or replace damaged components as necessary.
NOT OK
OK
* Replace or recharge the battery.
* Check for battery voltage at the positive terminal of the coil.
OK
NOT OK
* Check air Gap of the Pick-Up coil in the distributor.
* Check resistance of ballast resistor (if used) for the correct resistance value.
OK
NOT OK
* Check Pick-Up coil for correct resistance value.
* Adjust or replace as necessary.
NOT OK
OK
* Replace Pick-Up coil if not to specification.
* Check control module for good ground connections.
OK
* If vehicle fails to run at this point, go to the appropriate article in the ENGINE PERFORMANCE section.
OK
NOT OK
* Check wires from the battery/ ignition switch to the coil. Also check the coil primary and secondary resistance.
* Replace ballast resistor if the measured resistance value is not within specification.

Fig. 4: Ignition Primary Trouble Shooting Chart

STARTER TROUBLE SHOOTING

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BASIC STARTER TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Starter Fails to Operate	

CONDITION & POSSIBLE CAUSE	CORRECTION
Dead battery or bad connections between starter and battery	Check battery charge and all wires and connections to starter
Ignition switch faulty or misadjusted	Adjust or replace ignition switch
Open circuit between starter switch ignition terminal on starter relay	Check and repair wires and connections as necessary
Starter relay or starter defective	See Testing in STARTER article
Open solenoid pull-in wire	See Testing in STARTER article
Starter Does Not Operate and Headlights Dim	
Weak battery or dead cell	Charge or replace battery as necessary
Loose or corroded battery connections	Check that battery connections are clean and tight
Internal ground in starter windings	See Testing in STARTER article
Grounded starter fields	See Testing in STARTERS
Armature rubbing on pole shoes	See STARTER article
Starter Turns but Engine Does Not Rotate	
Starter clutch slipping	See STARTER article
Broken clutch housing	See STARTER article
Pinion shaft rusted or dry	See STARTER article
Engine basic timing incorrect	See Ignition Timing in TUNE-UP article
Broken teeth on engine flywheel	Replace flywheel and check for starter pinion gear damage
Starter Will Not Crank Engine	
Faulty overrunning clutch	See STARTER article
Broken clutch housing	See STARTER article
Broken flywheel teeth	Replace flywheel and check for starter pinion gear damage
Armature shaft sheared or reduction gear teeth stripped	See STARTER article
Weak battery	Charge or replace battery as necessary
Faulty solenoid	See On-Vehicle Tests in STARTER article
Poor grounds	Check all ground connections for tight and clean connections
Ignition switch faulty or misadjusted	Adjust or replace ignition switch as necessary
Starter Cranks Engine Slowly	
Battery weak or defective	Charge or replace battery as necessary
Engine overheated	See ENGINE COOLING SYSTEM article
Engine oil too heavy	Check that proper viscosity oil is used

CONDITION & POSSIBLE CAUSE	CORRECTION
Poor battery-to-starter connections	Check that all between battery and starter are clean and tight
Current draw too low or too high	See Bench Tests in STARTER article
Bent armature, loose pole shoes screws or worn bearings	See STARTER article
Burned solenoid contacts	Replace solenoid
Faulty starter	Replace starter
Starter Engages Engine Only Momentarily	
Engine timing too far advanced	See Ignition Timing in TUNE-UP article
Overrunning clutch not engaging properly	Replace overrunning clutch. See STARTER article
Broken starter clutch	See STARTER article
Broken teeth on engine flywheel	Replace flywheel and check starter pinion gear for damage
Weak drive assembly thrust spring	See STARTER article
Weak hold-in coil	See Bench Tests in STARTER article
Starter Drive Will Not Engage	
Defective point assembly	See Testing in STARTER article
Poor point assembly ground	See Testing in STARTER article
Defective pull-in coil	Replace starter solenoid
Starter Relay Does Not Close	
Dead battery	Charge or replace battery as necessary
Faulty wiring	Check all wiring and connections leading to relay
Neutral safety switch faulty	Replace neutral safety switch
Starter relay faulty	Replace starter relay
Starter Drive Will Not Disengage	
Starter motor loose on mountings	Tighten starter attach bolts
Worn drive end bushing	See STARTER article
Damaged engine flywheel teeth	Replace flywheel and starter pinion gear for damage
Drive yolk return spring broken or missing	Replace return spring
Faulty ignition switch	Replace ignition switch
Insufficient clearance between winding leads to solenoid terminal and main contact in solenoid	Replace starter solenoid
Starter clutch not disengaging	Replace starter clutch
Ignition starter switch contacts sticking	Replace ignition switch
Starter Relay Operates but Solenoid Does Not	
Faulty solenoid switch, switch connections or relay	Check all wiring between relay and solenoid or replace relay or solenoid as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Broken lead or loose soldered connections	Repair wire or wire connections as necessary
Solenoid Plunger Vibrates When Switch is Engaged	
Weak battery	Charge or replace battery as necessary
Solenoid contacts corroded	Clean contacts or replace solenoid
Faulty wiring	Check all wiring leading to solenoid
Broken connections inside switch cover	Repair connections or replace solenoid
Open hold-in wire	Replace solenoid
Low Current Draw	
Worn brushes or weak	Replace brushes or brush springs as necessary
High Pitched Whine During Cranking Before Engine Fires but Engine Fires and Cranks Normally	
Distance too great between starter pinion and flywheel	Align starter or check that correct starter and flywheel are being used
High Pitched Whine After Engine Fires With Key released. Engine Fires and Cranks Normally	
Distance too small between starter pinion and flywheel	Flywheel runout contributes to the intermittent nature

TUNE-UP TROUBLE SHOOTING - GAS ENGINE VEHICLES

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BASIC SPARK PLUG TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Normal Spark Plug Condition	
Light Tan or Gray deposits	No Action
Electrode not burned or fouled	No Action
Gap tolerance not changed	No Action
Cold Fouling or Carbon Deposits	
Overrich air/fuel mixture	Adjust air/fuel mixture, see ENGINE PERFORMANCE section
Faulty choke	Replace choke assembly, see ENGINE PERFORMANCE section
Clogged air filter	Clean and/or replace air filter
Incorrect idle speed or dirty carburetor	Reset idle speed and/ or clean carburetor
Faulty ignition wires	Replace ignition wiring
Prolonged operation at idle	Shut engine off during long idle
Sticking valves or worn valve guide seals	Check valve train
Wet Fouling or Oil Deposits	

CONDITION & POSSIBLE CAUSE	CORRECTION
Worn rings and pistons	Install new rings and pistons
Excessive cylinder wear	Rebore or replace block
Excessive valve guide clearance	Worn or loose bearing
Gap Bridged	
Deposits in combustion chamber becoming fused to electrode	Clean combustion chamber of deposits
Blistered Electrode	
Engine overheating	Check cooling system
Wrong type of fuel	Replace with correct fuel
Loose spark plugs	Retighten spark plugs
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Pre-Ignition or Melted Electrodes	
Incorrect type of fuel	Replace with correct fuel
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Burned valves	Replace valves
Engine Overheating	Check cooling system
Wrong type of spark plug, too hot	Replace with correct spark plug, see ENGINE PERFORMANCE
Chipped Insulators	
Severe detonation	Check for over-advanced timing or combustion
Improper gapping procedure	Re-gap spark plugs
Rust Colored Deposits	
Additives in unleaded fuel	Try different fuel brand
Water In Combustion Chamber	
Blown head gasket or cracked head	Repair or replace head or head gasket

NOTE: **Before diagnosing an electronic ignition system, ensure that all wiring is connected properly between distributor, wiring connector and spark plugs. Ignition problem will show up either as: Engine Will Not Start or Engine Runs Rough.**

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Won't Start	
Open circuit between distributor and bulkhead connector	Repair circuit
Open circuit between bulkhead connector and ignition switch	Repair circuit
Open circuit between ignition switch and starter solenoid	Repair circuit
Engine Runs Rough	
Fuel lines leaking or clogged	Tighten fitting, remove restriction
Initial timing incorrect	Reset ignition timing see ENGINE PERFORMANCE
Centrifugal advance malfunction	Repair distributor advance
Defective spark plugs or wiring	Replace plugs or plug wiring
Component Failure	

CONDITION & POSSIBLE CAUSE	CORRECTION
Spark arc-over on cap, rotor or coil	Replace cap, rotor or or coil
Defective pick-up coil	Replace pick-up coil
Defective ignition coil	Replace ignition coil
Defective vacuum unit	Replace vacuum unit
Defective control module	Replace control module

BASIC ELECTRONIC IGNITION TROUBLE SHOOTING CHARTS - USING OSCILLOSCOPE PATTERNS

CONDITION & POSSIBLE CAUSE	CORRECTION
Firing Voltage Lines are the Same, but Abnormally High	
Retarded ignition timing	Reset ignition timing, see ENGINE PERFORMANCE section
Fuel mixture too lean	Readjust carburetor, see ENGINE PERFORMANCE
High resistance in coil wire	Replace coil wire
Corrosion in coil tower terminal	Clean and/or replace coil
Corrosion in distributor coil terminal	Clean and/or replace distributor cap
Firing Voltage Lines are the Same but Abnormally Low	
Fuel mixture too rich	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in coil wire causing arcing	Replace coil wire
Cracked coil tower causing arcing	Replace coil
Low coil output	Replace coil
Low engine compression	Determine cause and repair
One or More, But Not All Firing Voltage Lines are Higher Than Others	
Carburetor idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
EGR valve stuck open	Clean and/or replace valve
High resistance in spark plug wires	Replace spark plug wires
Cracked or broken spark plug insulator	Replace spark plugs
Intake vacuum leak	Repair leak
Defective spark plugs	Replace spark plugs
Corroded spark plug terminals	Replace spark plugs
One or More, But Not All Firing Voltage Lines Are Lower Than Others	
Curb idle mixture not balanced	Readjust carburetor, see ENGINE PERFORMANCE
Breaks in plug wires	Replace plug wires causing arcing
Cracked coil tower causing arcing	Replace coil
Low compression	Determine cause and repair
Defective spark plugs	Replace spark plugs
Corroded spark plugs	Replace spark plugs
Cylinders Not Firing	
Cracked distributor cap terminals	Replace distributor cap
Shorted spark plug wire	Determine cause and repair

CONDITION & POSSIBLE CAUSE	CORRECTION
Mechanical problem in engine	Determine cause and repair
Defective spark plugs	Replace spark plugs
Spark plugs fouled	Replace spark plugs

BASIC DRIVEABILITY PROBLEMS TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Hard Starting	
Binding carburetor linkage	Eliminate binding
Binding choke linkage	Eliminate binding
Binding choke piston	Eliminate binding
Restricted choke vacuum	Check vacuum lines for blockage
Worn or dirty needle valve and seat	Clean carburetor, see ENGINE PERFORMANCE
Float sticking	Readjust or replace float see the ENGINE PERFORMANCE section
Incorrect choke adjustment	Reset choke adjustment see ENGINE PERFORMANCE
Defective coil	Replace coil
Improper spark plug gap	Regap spark plugs
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Detonation	
Over-advanced ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective spark plugs	Replace spark plugs
Fuel lines clogged	Clean fuel lines
EGR system malfunction	Check and repair EGR system
PCV system malfunction	Repair PCV system
Vacuum leaks	Check and repair vacuum system
Loose fan belts	Tighten or replace fan belts, see ENGINE PERFORMANCE
Restricted airflow	Remove restriction
Vacuum advance malfunction	Check distributor operation
Dieseling	
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate blinding
Binding choke linkage or fast idle cam	Eliminate binding
Defective idle solenoid	Replace idle solenoid see ENGINE PERFORMANCE
Improper base idle speed	Reset idle speed, see see ENGINE PERFORMANCE

CONDITION & POSSIBLE CAUSE	CORRECTION
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Incorrect idle mixture setting	Reset idle mixture, see ENGINE PERFORMANCE
Faulty Acceleration	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Engine cold and choke too lean	Adjust choke and allow engine to warm-up
Defective spark plugs	Replace spark plugs
Defective coil	Replace coil
Faulty Low Speed Operation	
Clogged idle transfer slots	Clean idle transfer slots, see FUEL
Restricted idle air bleeds and passages	Disassemble and clean carburetor, see FUEL
Clogged air cleaner	Replace air filter
Defective spark plugs	Replace spark plugs
Defective ignition wires	Replace ignition wire see ENGINE PERFORMANCE
Defective distributor cap	Replace distributor cap
Faulty High Speed Operation	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Defective distributor centrifugal advance	Replace advance mechanism
Defective distributor vacuum advance	Replace advance unit
Incorrect spark plugs or plug gap	Check gap and/or replace spark plugs
Faulty choke operation	Check choke and repair as required
Clogged vacuum passages	Remove restrictions
Improper size or clogged main jet	Check jet size and clean, see FUEL
Restricted air cleaner	Check filter and replace as necessary
Defective distributor cap, rotor or coil	Replace cap, rotor or coil
Misfire at All Speeds	
Defective spark plugs	Replace spark plugs
Defective spark plug wires	Replace spark plug wires
Defective distributor cap, rotor, or coil	Replace cap, rotor, or coil
Cracked or broken vacuum hoses	Replace vacuum hoses
Vacuum leaks	Repair vacuum leaks
Fuel lines clogged	Remove restriction
Hesitation	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair Vacuum leaks
Binding carburetor linkage	Eliminate binding
Binding throttle linkage	Eliminate binding

CONDITION & POSSIBLE CAUSE	CORRECTION
Binding choke linkage or fast idle cam	Eliminate binding
Improper float setting	Readjust float setting, see FUEL
Cracked or broken ignition wires	Replace ignition wires
Rough Idle, Missing or Stalling	
Incorrect curb idle or fast idle speed	Reset idle speed, see see ENGINE PERFORMANCE
Incorrect basic timing	Reset ignition timing see ENGINE PERFORMANCE
Improper idle mixture adjustment	Reset idle mixture, see ENGINE PERFORMANCE
Improper feedback system operation	Check feedback system see ENGINE PERFORMANCE
Incorrect spark plug gap	Reset spark plug gap, see ENGINE PERFORMANCE
Moisture in ignition components	Dry components
Loose or broken ignition wires	Replace ignition wires
Damaged distributor cap or or rotor	Replace distributor cap or rotor
Faulty ignition coil	Replace ignition coil
Fuel filter clogged or worn	Replace fuel filter
Damaged idle mixture screw	Replace idle mixture screw, see FUEL
Improper fast idle cam adjustment	Reset fast idle cam adjustment, see TUNE- see ENGINE PERFORMANCE
Improper EGR valve operation	Replace EGR valve
Faulty PCV valve air flow	Replace PCV valve
Choke binding or improper choke setting	Reset choke or eliminate binding
Vacuum leak	Repair vacuum leak
Improper float bowl fuel level	Reset float adjustment, see FUEL
Clogged air bleed or idle passages	Clean carburetor passages, see FUEL
Clogged or worn air cleaner filter	Replace air filter
Faulty choke vacuum diaphragm	Replace diaphragm, see ENGINE PERFORMANCE
Exhaust manifold heat valve inoperative	Replace heat valve
Improper distributor spark advance	Check distributor operation
Leaking valves or valve components	Check and repair valvetrain
Improper carburetor mounting	Remove and remount carburetor
Excessive play in distributor shaft	Replace distributor
Loose or corroded wiring connections	Repair or replace as required

CONDITION & POSSIBLE CAUSE	CORRECTION
Engine Surges	
Improper PCV valve airflow	Replace PCV valve
Vacuum leaks	Repair vacuum leaks
Clogged air bleeds	Remove restriction
EGR valve malfunction	Replace EGR valve
Restricted air cleaner filter	Replace air filter
Cracked or broken vacuum hoses	Replace vacuum hoses
Cracked or broken ignition wires	Replace ignition wires
Vacuum advance malfunction	Check unit and replace as necessary
Defective or fouled spark plugs	Replace spark plugs
Ping or Spark Knock	
Incorrect ignition timing	Reset ignition timing see ENGINE PERFORMANCE
Distributor centrifugal or vacuum advance malfunction	Check operation and replace as necessary
Carburetor setting too lean	Readjust mixture setting, see ENGINE PERFORMANCE
Vacuum leak	Eliminate vacuum leak
EGR valve malfunction	Replace EGR valve
Poor Gasoline Mileage	
Cracked or broken vacuum	Replace vacuum hoses hoses
Vacuum leaks	Repair vacuum leaks
Defective ignition wires	Replace wires
Incorrect choke setting	Readjust setting, see ENGINE PERFORMANCE
Defective vacuum advance	Replace vacuum advance
Defective spark plugs	Replace spark plugs
Binding carburetor power piston	Eliminate binding
Dirt in carburetor jets	Clean and/or replace jets
Incorrect float adjustment	Readjust float setting, see FUEL
Defective power valve	Replace power valve, see ENGINE PERFORMANCE
Incorrect idle speed	Readjust idle speed
Engine Stalls	
Improper float level	Readjust float level
Leaking needle valve and seat	Replace needle valve and seat
Vacuum leaks	Eliminate vacuum leaks

VACUUM PUMP - DIESEL TROUBLE SHOOTING

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NOTE: **Diesel engines mechanical diagnosis is the same as gasoline engines for items such as noisy valves, bearings, pistons, etc. The following trouble shooting covers only items pertaining to diesel engines.**

VACUUM PUMP (DIESEL) TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Noise	
Loose pump-to-drive assembly screws	Tighten screws
Loose tube on pump assembly	Tighten tube
Valves not functioning properly	Replace valves
Oil Leakage	
Loose end plug	Tighten end plug
Bad seal crimp	Remove and re-crimp seal

MANUAL TRANSMISSION

MANUAL TRANSMISSION TROUBLE SHOOTING

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MANUAL TRANSMISSION/TRANSAXLE TROUBLE SHOOTING

Condition	Possible Cause
Noisy In Forward Gears	Low gear oil level, Loose bell housing bolts, Worn bearings or gears
Clunk On Deceleration (FWD Only)	Loose engine mounts, Worn inboard CV joints, Worn differential pinion shaft, Side gear hub counterbore in case worn oversize
Gear Clash When Shifting Forward Gears	Clutch Out Of Adjustment, Shift linkage damaged or out of adjustment, Gears or synchronizers damaged, Low gear oil level
Transmission Noisy When Moving (RWD Only) Quiet In Neutral With Clutch Engaged	Worn rear outputshaft bearing
Gear Rattle	Worn bearings, Wrong gear oil, Low gear oil, Worn gears
Steady Ticking At Idle (Increases With RPM)	Broken tooth on gear
Gear Clash When Shifting Forward Gears	Worn or broken synchronizers
Loud Whine In Reverse	Normal condition (1)
Noise When Stepping On Clutch	Bad release bearing, Worn pilot bearing
Ticking Or Screeching As Clutch Is Engaged	Faulty release bearing, Uneven pressure plate fingers
Click Or Snap When Clutch Is Engaged	Worn clutch fork, Worn or broken front bearing retainer
Transmission Shifts Hard	Clutch not releasing, Shift mechanism binding, Clutch installed backwards
Will Not Shift Into One Gear, Shifts Into All Others	Bent shift fork, Worn detent balls
Locked Into Gear, Cannot Shift	Clutch adjustment, Worn detent balls

Condition	Possible Cause
Transmission Jumps Out Of Gear	Pilot bearing worn, Bent shift fork, Worn gear teeth or face, Excessive gear train end play, Worn synchronizers, Missing detent ball spring, Shift mechanism worn or out of adjustment, Engine or transmission mount bolts loose or out of adjustment, Transmission not aligned
Shift Lever Rattle	Worn shift lever or detents, Worn shift forks, Worn synchronizers sleeve
Shift Lever Hops Under Acceleration	Worn engine or transmission mounts
(1) Most units use spur cut gears in reverse and are noisy	

POWERTRAIN

CLUTCH TROUBLE SHOOTING

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BASIC CLUTCH TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Chattering or Grabbing	
Incorrect clutch adjustment	Adjust clutch
Oil, grease or glaze on facings	Disassemble and clean or replace
Loose "U" joint flange	See DRIVE AXLES article
Worn input shaft spline	Replace input shaft
Binding pressure plate	Replace pressure plate
Binding release lever	See CLUTCH article
Binding clutch disc hub	Replace clutch disc
Unequal pressure plate contact	Replace worn/misaligned components
Loose/bent clutch disc	Replace clutch disc
Incorrect transmission alignment	Realign transmission
Worn pressure plate, disc or flywheel	Replace damaged components
Broken or weak pressure springs	Replace pressure plate
Sticking clutch pedal	Lubricate clutch pedal & linkage
Incorrect clutch disc facing	Replace clutch disc
Engine loose in chassis	Tighten all mounting bolts
Failure to Release	
Oil or grease on clutch facings	Clean or replace clutch clutch disc
Incorrect release lever or pedal adjustment	See CLUTCH article
Worn or broken clutch facings	Replace clutch disc
Bent clutch disc or pressure plate	Replace damaged components
Clutch disc hub binding on input shaft	Clean or replace clutch disc and/or input shaft
Binding pilot bearing	Replace pilot bearing

CONDITION & POSSIBLE CAUSE	CORRECTION
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Binding clutch cable	See CLUTCH article
Defective clutch master	Replace master cylinder
Defective clutch slave	Replace slave cylinder
Air in hydraulic system	Bleed hydraulic system
Rattling	
Weak or broken release lever spring	Replace spring and check alignment
Damaged pressure plate	Replace pressure plate
Broken clutch return spring	Replace return spring
Worn splines on clutch disc or input shaft	Replace clutch disc and/or input shaft
Worn clutch release bearing	Replace release bearing
Dry or worn pilot bearing	Lubricate or replace pilot bearing
Unequal release lever contact	Align or replace release lever
Incorrect pedal free play	Adjust free play
Warped or damaged clutch disc	Replace damaged components
Slipping	
Pressure springs worn or	Release pressure plate
Oily, greasy or worn facings	Clean or replace clutch disc
Incorrect clutch alignment	Realign clutch assembly
Warped clutch disc or pressure plate	Replace damaged components
Binding release levers or clutch pedal	Lubricate and/or replace release components
Squeaking	
Worn or damaged release	Replace release bearing
Dry or worn pilot or release bearing	Lubricate or replace assembly
Pilot bearing turning in crankshaft	Replace pilot bearing and/or crankshaft
Worn input shaft bearing	Replace bearing and seal
Incorrect transmission alignment	Realign transmission
Dry release fork between pivot	Lubricate release fork and pivot
Heavy and/or Stiff Pedal	
Sticking release bearing sleeve	Replace release bearing and/or sleeve
Dry or binding clutch pedal hub	Lubricate and align components
Floor mat interference with pedal	Lay mat flat in proper area
Dry or binding ball/fork pivots	Lubricate and align components
Faulty clutch cable	Replace clutch cable
Noisy Clutch Pedal	
Faulty interlock switch	Replace interlock switch
Self-adjuster ratchet noise	Lubricate or replace self-adjuster
Speed control interlock switch	Lubricate or replace interlock switch

CONDITION & POSSIBLE CAUSE	CORRECTION
Clutch Pedal Sticks Down	
Binding clutch cable	See CLUTCH article
Springs weak in pressure plate	Replace pressure plate
Binding in clutch linkage	Lubricate and free linkage
Noisy	
Dry release bearing	Lubricate or replace release bearing
Dry or worn pilot bearing	Lubricate or replace bearing
Worn input shaft bearing	Replace bearing
Transmission Click	
Weak springs in pressure	Replace pressure plate plate
Release fork loose on ball stud	Replace release fork and/or ball stud
Oil on clutch disc damper	Replace clutch disc
Broken spring in slave cylinder	Replace slave cylinder

DRIVE AXLE - NOISE DIAGNOSIS

Unrelated Noises

Some driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. Ensure cause of trouble actually is in the drive axle before adjusting, repairing, or replacing any of its parts.

Non-Drive Axle Noises

A few conditions can sound just like drive axle noise and have to be considered in pre-diagnosis. The 4 most common noises are exhaust, tires, CV/universal joints and wheel trim rings.

In certain conditions, the pitch of the exhaust gases may e gear whine. At other times, it may be mistaken for a wheel bearing rumble.

Tires, especially radial and snow, can have a high-pitched tread whine or roar, similar to gear noise. Also, some non-standard tires with an unusual tread construction may emit a roar or whine.

Defective CV/universal joints may cause clicking noises or excessive driveline play that can be improperly diagnosed as drive axle problems.

Trim and moldings also can cause a whistling or whining noise. Ensure none of these components are causing the noise before disassembling the drive axle.

Gear Noise

A "howling" or "whining" noise from the ring and pinion gear can be caused by an improper gear pattern, gear damage, or improper bearing preload. It can occur at various speeds and driving conditions, or it can be continuous.

Before disassembling axle to diagnose and correct gear ke sure that tires, exhaust, and vehicle trim have been checked as possible causes.

Chuckle

This is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 40 MPH and usually can be heard until vehicle comes to a complete stop. The frequency varies with the speed of the vehicle.

A chuckle that occurs on the driving phase is usually caused ive clearance due to differential gear wear, or by a damaged tooth on the coast side of the pinion or ring gear. Even a very small tooth nick or a ridge on the edge of a gear tooth is enough the cause the noise.

This condition can be corrected simply by cleaning the gear tooth nick or ridge with a small grinding wheel. If either gear is damaged or scored badly, the gear set must be replaced. If metal has broken loose, the carrier and housing must be cleaned to remove particles that could cause damage.

Knock

This is very similar to a chuckle, though it may be louder, and occur on acceleration or deceleration. Knock can be caused by a gear tooth that is damaged on the drive side of the ring and pinion gears. Ring gear bolts that are hitting the carrier casting can cause knock. Knock can also be due to excessive end play in the axle shafts.

Clunk

Clunk is a metallic noise heard when an automatic transmission is engaged in Reverse or Drive, or when throttle is applied or released. It is caused by backlash somewhere in the driveline, but not necessarily in the axle. To determine whether driveline clunk is caused by the axle, check the total axle backlash as follows:

1. Raise vehicle on a frame or twinpost hoist so that drive wheels are free. Clamp a bar between axle companion flange and a part of the frame or body so that flange cannot move.
2. On conventional drive axles, lock the left wheel to keep it from turning. On all models, turn the right wheel slowly until it is felt to be in Drive condition. Hold a chalk marker on side of tire about 12" from center of wheel. Turn wheel in the opposite direction until it is again felt to be in Drive condition.
3. Measure the length of the chalk mark, which is the total axle backlash. If backlash is one inch or less, drive axle is not the source of clunk noise.

Bearing Whine

Bearing whine is a high-pitched sound similar to a whistle. It is usually caused by malfunctioning pinion bearings. Pinion bearings operate at drive shaft speed. Roller wheel bearings may whine in a similar manner if they run completely dry of lubricant. Bearing noise will occur at all driving speeds. This distinguishes it from gear whine, which usually comes and goes as speed changes.

Bearing Rumble

Bearing rumble sounds like marbles being tumbled. It is usually caused by a malfunctioning wheel bearing. The lower pitch is because the wheel bearing turns at only about 1/3 of drive shaft speed.

Chatter On Turns

This is a condition where the entire front or rear of vehicle vibrates when vehicle is moving. The vibration is plainly felt as well as heard. Extra differential thrust washers installed during axle repair can cause a condition of partial lock-up that creates this chatter.

Axle Shaft Noise

Axle shaft noise is similar to gear noise and pinion bearing whine. Axle shaft bearing noise will normally distinguish itself from gear noise by occurring in all driving modes (Drive, cruise, coast and float), and will persist with transmission in Neutral while vehicle is moving at problem speed.

If vehicle displays this noise condition, remove suspect parts, replace wheel seals and install a new set of bearings. Re-evaluate vehicle for noise before removing any internal components.

Vibration

Vibration is a high-frequency trembling, shaking or grinding condition (felt or heard) that may be constant or variable in level and can occur during the total operating speed range of the vehicle.

The types of vibrations that can be felt in the vehicle can d into 3 main groups:

- Vibrations of various unbalanced rotating parts of the vehicle.
- Resonance vibrations of the body and frame structures caused by rotating of unbalanced parts.

- Tip-in moans of resonance vibrations from stressed engine or exhaust system mounts or driveline flexing modes.

DRIVE AXLE - RWD TROUBLE SHOOTING

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DRIVE AXLE (RWD) TROUBLE SHOOTING

CONDITION & POSSIBLE CAUSE	CORRECTION
Knocking or Clunking	
Differential Side Gear Clearance	Check Clearance
Worn Pinion Shaft	Replace Pinion Shaft
Axle Shaft End Play	Check End Play
Missing Gear Teeth	Check Differential/Replace Gear
Wrong Axle Backlash	Check Backlash
Misaligned Driveline	Realign Driveline
Clinking During Engagement	
Side Gear Clearance	Check Clearance
Ring and Pinion Backlash	Check Backlash
Worn/Loose Pinion Shaft	Replace Shaft/Bearing
Bad "U" Joint	Replace "U" Joint
Sticking Slip Yoke	Lube Slip Yoke
Broken Rear Axle Mount	Replace Mount
Loose Drive Shaft Flange	Check Flange
Click/Chatter On Turns	
Differential Side Gear Clearance	Check Clearance
Wrong Turn On Plates (1)	Replace Clutch Plates
Wrong Differential Lubricant (1)	Change Lubricant
Knock Or Click	
Flat Spot on Rear Wheel Bearing	Replace Wheel Bearing
Low Vibration At All Speeds	
Faulty Wheel Bearing	Replace Wheel Bearing
Faulty "U" Joint	Replace "U" Joint
Faulty Drive Shaft	Balance Drive Shaft
Faulty Companion Flange	Replace Flange
Faulty Slip Yoke Flange	Replace Flange

(1) Limited slip differential only.

FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING

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BASIC FWD AXLE SHAFTS & CV JOINTS TROUBLE SHOOTING CHART

CONDITION	POSSIBLE CAUSE
Grease Leaks	CV boot torn or cracked
Clicking Noise on Cornering	Damaged outer CV
Clunk Noise on Acceleration	Damaged inner CV
Vibration or Shudder on Acceleration	Sticking, damaged or worn CV Misalignment or spring height

STEERING & SUSPENSION

MANUAL STEERING GEAR TROUBLE SHOOTING

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BASIC MANUAL STEERING GEAR TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise in Rack and Pinion	
Rack and pinion mounting bracket loose	Tighten all mounting bolts
Lack of/or incorrect lubricant	Correct as necessary
Steering gear mounting bolts loose	Tighten all mounting bolts
Excessive Play	
Front wheel bearing improperly adjusted	See FRONT SUSPENSION article
Loose or worn steering linkage	See STEERING LINKAGE article
Loose or worn steering gear shift	See MANUAL STEERING GEAR article
Steering arm loose on gear shaft	See MANUAL STEERING GEAR article
Steering gear housing bolts loose	Tighten all mounting bolts
Steering gear adjustment too loose	See MANUAL STEERING GEAR article
Steering arms loose on knuckles	Tighten and check steering linkage
Rack and pinion mounting loose	Tighten all mounting bolts
Rack and pinion out of adjustment	See adjustment in STEERING article
Tie rod end loose	Tighten and check steering linkage
Excessive Pitman shaft-to-ball nut lash	Repair as necessary
Poor Returnability	
Lack of lubricant in ball joint or linkage	Lubricate and service systems
Binding in linkage or ball joints	See STEERING LINKAGE and SUSPENSION article
Improper front end alignment	See WHEEL ALIGNMENT article
Improper tire pressure	Inflate to proper pressure
Tie rod binding	Inflate to proper pressure
Shaft seal rubbing shaft	See STEERING COLUMN article

CONDITION & POSSIBLE CAUSE	CORRECTION
Excessive Vertical Motion	
Improper tire pressure	Inflate to proper pressure
Tires, wheels or rotors out of balance	Balance tires then check wheels and rotors
Worn or faulty shock absorbers	Check and replace if necessary
Loose tie rod ends or steering	Tighten or replace if necessary
Loose or worn wheel bearings	See SUSPENSION article
Steering Pulls to One Side	
Improper tire pressure	Inflate to proper pressure
Front tires are different sizes	Rotate or replace if necessary
Wheel bearings not adjusted properly	See FRONT SUSPENSION article
Bent or broken suspension components	See FRONT SUSPENSION article
Improper wheel alignment	See WHEEL ALIGNMENT article
Brakes dragging	See BRAKES article
Instability	
Low or uneven tire pressure	Inflate to proper pressure
Loose or worn wheel bearings	See FRONT SUSPENSION article
Loose or worn idler arm bushing	See FRONT SUSPENSION article
Loose or worn strut bushings	See FRONT SUSPENSION article
Incorrect front wheel alignment	See WHEEL ALIGNMENT article
Steering gear not centered	See MANUAL STEERING GEARS article
Springs or shock	Check and replace if necessary
Improper cross shaft	See MANUAL STEERING GEARS article

POWER STEERING TROUBLE SHOOTING

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BASIC POWER STEERING TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Rattle or Chucking Noise	
Pressure hoses touching engine parts	Adjust to proper clearance
Loose Pitman shaft	Adjust or replace if necessary
Tie rods ends or Pitman arm loose	Tighten and check system
Rack and pinion mounts loose	Tighten all mounting bolts

CONDITION & POSSIBLE CAUSE	CORRECTION
Free play in worm gear	See POWER STEERING GEAR article
Loose sector shaft or thrust bearing adjustment	See POWER STEERING GEAR
Free play in pot coupling	See STEERING COLUMN article
Worn shaft serrations	See STEERING COLUMN article
Growl in Steering Pump	
Excessive pressure in hoses	Restricted hoses, see POWER STEERING GEAR article
Scored pressure plates	See POWER STEERING GEAR article
Scored thrust plates or rotor	See POWER STEERING GEAR article
Extreme wear of cam ring	See POWER STEERING GEAR article
Rattle in Steering Pump	
Vanes not installed	See POWER STEERING PUMP article
Vanes sticking in rotor	See POWER STEERING PUMP article
Swish noise in Pump	
Defective flow control valve	See POWER STEERING PUMP article
Groan in Steering Pump	
Air in fluid	See POWER STEERING PUMP article
Poor pressure hose connection	Tighten and check, replace if necessary
Squawk When Turning	
Damper "O" ring on valve spool cut	See POWER STEERING PUMP article
Moan or Whine in Pump	
Pump shaft bearing scored	Replace bearing and fluid
Air in fluid or fluid level low	See POWER STEERING PUMP article
Hose or column grounded	Check and replace if necessary
Cover "O" ring missing or damaged	See POWER STEERING PUMP article
Valve cover baffle missing or damaged	See POWER STEERING PUMP article
Interference of components in pump	See POWER STEERING PUMP article
Loose or poor bracket alignment	Correct or replace if necessary
Hissing When Parking	
Internal leakage in steering gear	Check valved assembly first
Chirp in Steering Pump	
Loose or worn power steering belt	Adjust or replace if necessary
Buzzing When Not Steering	

CONDITION & POSSIBLE CAUSE	CORRECTION
Noisy pump	See POWER STEERING PUMP article
Free play in steering shaft bearing	See STEERING COLUMN article
Bearing loose on shaft serrations	See STEERING COLUMN article
Clicking Noise in Pump	
Pump slippers too long	See POWER STEERING PUMP article
Broken slipper springs	See POWER STEERING PUMP article
Excessive wear or nicked rotors	See POWER STEERING PUMP article
Damaged cam contour	See POWER STEERING PUMP article
Poor Return of Wheel	
Wheel rubbing against turn signal	See STEERING COLUMN SWITCHES article
Flange rubbing steering gear adjuster	See STEERING COLUMN article
Tight or frozen steering shaft bearing	See STEERING COLUMN article
Steering gear out of adjustment	See POWER STEERING GEAR article
Sticking or plugged spool valve	See POWER STEERING PUMP article
Improper front end alignment	See WHEEL ALIGNMENT article
Wheel bearings worn or loose	See FRONT SUSPENSION article
Ties rods or ball joints binding	Check and replace if necessary
Intermediate shaft joints binding	See STEERING COLUMN article
Kinked pressure hoses	Correct or replace if necessary
Loose housing head spanner nut	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Sector shaft adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Worm thrust bearing adjusted too tight	See ADJUSTMENTS in POWER STEERING GEAR article
Reaction ring sticking in cylinder	See POWER STEERING GEAR article
Reaction ring sticking in housing head	See POWER STEERING GEAR article
Steering pump internal leakage	See POWER STEERING PUMP article
Steering gear-to-column misalignment	See STEERING COLUMN article
Lack of lubrication in linkage	Service front suspension

CONDITION & POSSIBLE CAUSE	CORRECTION
Lack of lubrication in ball joints	Service front suspension
Increased Effort When Turning Wheel Fast Foaming, Milky Power Steering Fluid, Low Fluid Level or Low Pressure	
High internal pump leakage	See POWER STEERING PUMP article
Power steering pump belt slipping	Adjust or replace if necessary
Low fluid level	Check and fill to proper level
Engine idle speed to low	Adjust to correct setting
Air in pump fluid system	See POWER STEERING PUMP article
Pump output low	See POWER STEERING PUMP article
Steering gear malfunctioning	See POWER STEERING GEAR article
Wheel Surges or Jerks	
Low fluid level	Check and fill to proper level
Loose fan belt	Adjust or replace if necessary
Insufficient pump pressure	See POWER STEERING PUMP article
Sticky flow control valve	See POWER STEERING PUMP article
Linkage hitting oil pan at full turn	Replace bent components
Kick Back or Free Play	
Air in pump fluid system	See POWER STEERING PUMP article
Worn poppet valve in steering gear	See POWER STEERING PUMP article
Excessive over center lash	See POWER STEERING GEAR article
Thrust bearing out of adjustment	See POWER STEERING GEAR article
Free play in pot coupling	See POWER STEERING PUMP article
Steering gear coupling loose on shaft	See POWER STEERING PUMP article
Steering disc mounting bolts loose	Tighten or replace if necessary
Coupling loose on worm shaft	Tighten or replace if necessary
Improper sector shaft adjustment	See POWER STEERING GEAR article
Excessive worm piston side play	See POWER STEERING GEAR article
Damaged valve lever	See POWER STEERING GEAR article
Universal joint loose	Tighten or replace if necessary
Defective rotary valve	See POWER STEERING GEAR article
No Power When Parking	

CONDITION & POSSIBLE CAUSE	CORRECTION
Sticking flow control valve	See POWER STEERING PUMP article
Insufficient pump pressure output	See POWER STEERING PUMP article
Excessive internal pump leakage	See POWER STEERING PUMP article
Excessive internal gear leakage	See POWER STEERING PUMP article
Flange rubs against gear adjust plug	See STEERING COLUMN article
Loose pump belt	Adjust or replace if necessary
Low fluid level	Check and add proper amount of fluid
Engine idle too low	Adjust to correct setting
Steering gear-to-column misaligned	See STEERING COLUMN article
No Power, Left Turn	
Left turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Left turn reaction seal damaged/missing	See POWER STEERING GEAR article
Cylinder head "O" ring damaged	See POWER STEERING PUMP article
No Power, Right Turns	
Column pot coupling bottomed	See STEERING COLUMN article
Right turn reaction seal "O" ring worn	See POWER STEERING GEAR article
Right turn reaction seal damaged	See POWER STEERING GEAR article
Internal leakage through piston end plug	See POWER STEERING GEAR article
Internal leakage through side plugs	See POWER STEERING GEAR article
Lack of Effort in Turning	
Left and/or right reaction seal sticking in cylinder head	Replace, see POWER STEERING GEAR article
Wanders to One Side	
Front end alignment incorrect	See WHEEL ALIGNMENT article
Unbalanced steering gear valve	See POWER STEERING GEAR article
Low Pressure Due to Steering Pump	
Flow control valve stuck or inoperative	See POWER STEERING PUMP article
Pressure plate not flat against cam ring	See POWER STEERING PUMP article
Extreme wear of cam ring	Replace and check adjustments
Scored plate, thrust plate or rotor	See POWER STEERING PUMP article
Vanes not installed properly	See POWER STEERING PUMP article

CONDITION & POSSIBLE CAUSE	CORRECTION
Vanes sticking in rotor slots	See POWER STEERING PUMP article
Cracked/broken thrust or pressure plate	See POWER STEERING PUMP article

STEERING COLUMN TROUBLE SHOOTING

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BASIC STEERING COLUMN TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Noise in Steering	
Coupling pulled apart	See STEERING COLUMNS article
Column not correctly aligned	See STEERING COLUMNS article
Broken lower joint	Replace joint
Horn contact ring not	See STEERING COLUMN article
Bearing not lubricated	See STEERING COLUMN article
Shaft snap ring not properly seated	Reseat or replace snap ring
Plastic spherical joint not lubricated	See STEERING COLUMN article
Shroud or housing loose	Tighten holding screws
Lock plate retaining ring not seated	See STEERING COLUMN article
Loose sight shield	Tighten holding screws
High Steering Shaft Effort	
Column assembly misaligned	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Tight steering universal joint	See STEERING COLUMN article
High Shift Effort	
Column is out of alignment	See STEERING COLUMN article
Improperly installed dust shield	Adjust or replace
Seals or bearings not lubricated	See STEERING COLUMNS article
Mounting bracket screws too long	Replace with new shorter screws
Burrs on shift tube	Remove burrs or replace tube
Lower bowl bearing assembled wrong	See STEERING COLUMN article
Shift tube bent or broken	Replace as necessary
Improper adjustment of shift levers	See STEERING COLUMN article
Improper Trans. Shifting	
Sheared shift tube joint	Replace as necessary

CONDITION & POSSIBLE CAUSE	CORRECTION
Sheared lower shaft lever	Replace as necessary
Improper shift lever adjustment	See STEERING COLUMN article
Improper gate plate adjustment	See STEERING COLUMN article
Excess Play in Column	
Instrument panel bracket bolts loose	Tighten bolts and check bracket
Broken weld nut on jacket	See STEERING COLUMN article
Instrument bracket capsule sheared	See STEERING COLUMN article
Column bracket/jacket bolts loose	Tighten bolts and check bracket
Steering Locks in Gear	
Release lever mechanism	See STEERING COLUMN article

SUSPENSION TROUBLE SHOOTING

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BASIC SUSPENSION TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Front End Noise	
Loose or worn wheel	See Wheel Bearing Adjustment in SUSPENSION
Worn shocks or shock mountings	Replace struts or strut mountings
Worn struts or strut mountings	Replace struts or strut mountings
Loose or worn lower control arm	See SUSPENSION
Loose steering gear-to-frame bolts	See STEERING
Worn control arm bushings	See SUSPENSION
Ball joints not lubricated	Lubricate ball joints & see Ball Joint Checking in SUSPENSION
Front Wheel Shake, Shimmy, or Vibration	
Tires or wheels out of balance	Check tire balance
Incorrect wheel alignment	See WHEEL ALIGNMENT
Drive shaft unbalanced	Check drive shaft balance
Loose or worn wheel bearings	See WHEEL ALIGNMENT
Loose or worn tie rod ends	See SUSPENSION
Worn upper ball joints	See Ball Joint Checking in SUSPENSION
Worn shock absorbers	Replace shock absorbers
Worn strut bushings	Replace strut bushings
Car Pulls to One Side	

CONDITION & POSSIBLE CAUSE	CORRECTION
Mismatched or uneven tires	Check tire condition
Broken or sagging springs	See SUSPENSION
Loose or worn strut bushings	See SUSPENSION
Improper wheel alignment	See WHEEL ALIGNMENT
Improper rear axle alignment	Check rear axle alignment
Power steering gear unbalanced	See STEERING
Front brakes dragging	See BRAKES
Abnormal Tire Wear	
Unbalanced tires	Check tire balance & rotation
Sagging or broken springs	See SUSPENSION
Incorrect front end alignment	See WHEEL ALIGNMENT
Faulty shock absorbers	Replace chock absorbers
Scuffed Tires	
Toe-In incorrect	See WHEEL ALIGNMENT
Suspension arm bent or twisted	See appropriate SUSPENSION article
Springs Bottom or Sag	
Bent or broken springs	See SUSPENSION
Leaking or worn shock absorbers	Replace shock absorbers
Frame misalignment	Check frame for damage
Spring Noises	
Loose "U" Bolts	See SUSPENSION
Loose or worn bushings	See SUSPENSION
Worn or missing interliners	See SUSPENSION
Shock Absorber Noise	
Loose shock mountings	Check & tighten mountings
Worn bushings	Replace bushings
Air in system	Bleed air from system
Undercoating on shocks	Remove undercoating
Car Leans or Sways on Corners	
Loose stabilizer bar	See SUSPENSION
Faulty shocks or mountings	Replace shocks or mountings
Broken or sagging springs	See SUSPENSION
Shock Absorbers Leaking	
Worn seals or reservoir tube crimped	See SUSPENSION
Broken Springs	
Loose "U" bolts	See SUSPENSION
Inoperative shock absorbers	Replace shock absorbers

WHEEL ALIGNMENT TROUBLE SHOOTING

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BASIC WHEEL ALIGNMENT TROUBLE SHOOTING CHART

CONDITION & POSSIBLE CAUSE	CORRECTION
Premature Tire Wear	
Improper tire inflation	Check tire pressure
Front alignment out of tolerance	See ALIGNMENT SPECS in WHEEL ALIGNMENT section
Suspension components worn	See SUSPENSION section
Steering system components worn	See STEERING section
Improper standing height	See WHEEL ALIGNMENT
Uneven or sagging springs	See SUSPENSION section
Bent wheel	See WHEEL ALIGNMENT
Improper torsion bar adjustment	See SUSPENSION section
Loose or worn wheel bearings	See WHEEL BEARING ADJ. in SUSPENSION section
Worn or defective shock	Replace shock absorbers
Tires out of balance	Check tire balance
Pulls to One Side	
Improper tire inflation	Check tire pressure
Brake dragging	See BRAKE section
Mismatched tires	See WHEEL ALIGNMENT
Broken or sagging spring	See SUSPENSION section
Broken torsion bar	See SUSPENSION section
Power steering valve not centered	See STEERING section
Front alignment out of tolerance	See WHEEL ALIGNMENT section
Defective wheel bearing	See WHEEL BEARINGS in SUSPENSION section
Uneven sway bar links	See SUSPENSION section
Frame bent	Check for frame damage
Steering system bushing worn	See STEERING section
Hard Steering	
Idler arm bushing too tight	See STEERING LINKAGE in STEERING section
Ball joint tight or seized	See SUSPENSION section
Steering linkage too tight	See STEERING LINKAGE in STEERING section
Power steering fluid low	Add proper amount of fluid
Power steering drive belt loose	See STEERING section
Power steering pump defective	See STEERING section
Steering gear out of adjustment	See STEERING section
Incorrect wheel alignment	See WHEEL ALIGNMENT
Damaged steering gear	See STEERING section
Damaged suspension	See SUSPENSION section
Bent steering knuckle or supports	See SUSPENSION section
Vehicle "Wanders"	
Strut rod or control arm bushing worn	See SUSPENSION section

CONDITION & POSSIBLE CAUSE	**CORRECTION**
Loose or worn wheel bearings	See WHEEL BEARINGS in SUSPENSION section
Improper tire inflation	Check tire pressure
Stabilizer bar missing or defective	See SUSPENSION section
Wheel alignment out of tolerance	See Adjustment in WHEEL ALIGNMENT section
Broken spring	See SUSPENSION section
Defective shock absorber	Replace shock absorbers
Worn steering & suspension components	See SUSPENSION section
Front End Shimmy	
Tire out of balance/round	Check tire balance
Excessive wheel runout	See WHEEL ALIGNMENT
Insufficient or improper caster	See WHEEL ALIGNMENT section
Worn suspension or steering components	See SUSPENSION section
Defective shock absorbers	Replace shock absorber
Wheel bearings worn or loose	See WHEEL BEARING ADJ. in SUSPENSION section
Power steering reaction Bracket loose	See STEERING section
Steering gear box (rack) mounting loose	See STEERING section
Steering gear adjustment loose	See STEERING section
Worn spherical joints	See SUSPENSION section
Toe-In Not Adjustable	
Lower control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Camber Not Adjustable	
Control arm bent	See SUSPENSION section
Frame bent	Check frame for damage
Hub & bearing not seated properly	See SUSPENSION section

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GENERAL INFORMATION

TROUBLE SHOOTING

* PLEASE READ THIS FIRST *

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

ENGINE PERFORMANCE

NOTE: **This article is generic in nature and all information does not apply to all vehicles. For vehicle specific information, see the appropriate articles in the ENGINE PERFORMANCE category.**

TUNE-UP TROUBLE SHOOTING

Problem & Possible Cause	Action
Carbon Fouled Plugs	
Clogged Air Filter	Replace Air Filter
Incorrect Idle Speed	Reset Idle Speed
Faulty Ignition Wiring	Replace Ignition Wiring
Sticky Valves/Worn Valve Seal	Check Valve Train
Fuel Injection Operation	Check Fuel Injection
Wet/Oil Fouled Plugs	
Worn Rings/Pistons	Overhaul/Replace Engine
Excessive Cylinder Wear	Overhaul/Replace Engine
Plug Gap Bridged	
Combustion Chamber Carbon Deposits	Clean Combustion Chamber
Blistered Electrode	
Engine Overheating	Check Cooling System
Loose Spark Plugs	Clean/Torque Plugs
Over-Advanced Timing	Reset Timing
Wrong Plug Heat Range	Install Correct Plug
Melted Electrodes	
Incorrect Timing	Reset Timing
Burned Valves	Replace Valves
Engine Overheating	Check Cooling System
Wrong Plug Heat Range	Install Correct Plug
Engine Won't Start	
Loose Connections	Check Connections
No Power	Check Fuses/Battery
Loose/Worn Timing Belt/Chain/Gears	Check Belt/Chain/Gears
Engine Runs Rough	
Leaky/Clogged Fuel Injectors	Repair Fuel Injectors

Problem & Possible Cause	**Action**
Leaky/Clogged Fuel Lines	Repair Fuel Lines
Clogged Fuel Filter	Replace Fuel Filter
Incorrect Timing	Reset Timing/Check Advance
Faulty Plugs/Wires	Replace Plugs/Wires
Uneven Compression	Overhaul/Replace Engine
Poor Acceleration	
Incorrect Ignition Timing	Reset Timing
Leaky Valves	Check Compression
Component Failure	
Spark Arcing	Replace Faulty Part
Defective Pick-Up Coil	Replace Pick-Up Coil
Defective Ignition Coil	Replace Ignition Coil
Defective Control Unit	Replace Control Unit
Ignition Diagnosis By Scope Pattern	
All Firing Lines Abnormally High	
Retarded Ignition Timing	Reset Ignition Timing
Lean Air/Fuel Mixture	Adjust Fuel Mixture
High Secondary Resistance	Repair Secondary Ignition
All Firing Lines Abnormally Low	
Rich Air/Fuel Mixture	Adjust Air/Fuel Mixture
Arcing Coil Wire	Replace Coil Wire
Cracked Coil	Replace Coil
Low Coil Output	Replace Coil
Low Compression	Check/Repair Engine
Several High Firing Lines	
Fuel Mixture Unbalanced	Check Fuel System
EGR Valve Stuck Open	Clean/Replace EGR Valve
High Plug Wire Resistance	Replace Plug Wire
Cracked/Broken Plugs	Replace Plugs
Intake Vacuum Leak	Repair Leak
Several Low Firing Lines	
Fuel Mixture Unbalanced	Adjust Fuel Mixture
Plug Wires Arcing	Replace Plug Wires
Cracked Coil Arcing	Replace Coil
Uneven Compression	Check/Repair Engine
Faulty Spark Plugs	Replace Plugs
Cylinders Not Firing	
Cracked Distributor Cap	Replace Cap

Problem & Possible Cause	Action
Shorted Plug Wires	Replace Plug Wires
Mechanical Engine Fault	Check/Repair Engine
Spark Plugs Fouled	Replace Plugs
Carbon Track in Distributor Cap	Replace Cap
Hard Starting	
Defective Ignition Coil(s)	Replace Coil(s)
Fouled Spark Plugs	Replace Plugs
Incorrect Timing	Reset Ignition Timing

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FUEL INJECTION TROUBLE SHOOTING

Problem & Possible Cause	Action
Cold Start Valve Inoperative	Test Cold Start Valve
Poor Vacuum/Electrical Connection	Repair Connections
Contaminated Fuel	Test Fuel for Water/Alcohol
Bad Fuel Pump Relay/Circuit	Test Relay/Wiring
Battery Voltage Low	Charge/Test Battery
Low Fuel Pressure	Test Press. Regulator/Pump
No Distributor Reference Pulse	Repair Ignition System
Coolant Temp. Sensor Defective	Test Temp. Sensor/Circuit
No Power To Injectors	Check Injector Fuse/Relay
Hard Starting	
Defective Idle Air Control (IAC)	Test IAC and Circuit
EGR Valve Open	Test EGR Valve/Control Circuit
Restricted Fuel Lines	Inspect/Replace Fuel Lines
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Engine Stalls During Parking Maneuver	Check P.S. Press. Switch
Rough Idle	
Dirty Fuel Injectors	Clean/Replace Injectors
Poor MAP Sensor Signal	Test MAP Sensor/Circuit
Intermittent Fuel Injector Operation	Check Harness Connectors
Erratic Vehicle Speed Sensor Inputs	Harness Too Close to Plug Wires
Poor O_2 Sensor Signal	Test O_2 Sensor/Circuit
Faulty PCV System	Check PCV Valve and Hoses
Poor Acceleration	
Weak Fuel Pump	Replace Fuel Pump

Problem & Possible Cause	Action
Dirty Fuel Injectors	Clean/Replace Injectors
Excessive Intake Valve Deposits	Clean Intake System
Poor High Speed Operation	
Low Fuel Pump Volume	Faulty Fuel Pump/Filter
Poor MAP Sensor Signal	Test Speed Sensor/Circuit
Acceleration Ping/Knock	
Faulty EGR System	Check EGR Valve and Hoses
Poor Knock Sensor Signal	Test Knock Sensor/Circuit
Poor Baro Sensor Signal	Test Baro Sensor/Circuit
Improper Ignition Timing	Adjust Timing
Engine Overheating	Check Cooling System
Poor Quality Fuel	Use Different Fuel
Carbon Build-Up	Decarbon Engine

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GENERAL INFORMATION

INTRODUCTION

Mitchell1Â® obtains wiring diagrams and technical service bulletins, containing wiring diagram changes, from the domestic and import manufacturers. These are checked for accuracy and are all redrawn into a consistent format for easy use. All system wiring diagrams are available in color format and may be viewed and or printed in color or black and white, depending on your program settings and available printer hardware.

In the past, when cars were simpler, diagrams were simpler. All components were connected by wires, and diagrams seldom exceeded 4 pages in length. Today, some wiring diagrams require more than 16 pages. It would be impractical to expect a service technician to trace a wire from page 1 across every page to page 16.

Removing some of the wiring maze reduces eyestrain and time wasted searching across several pages. Today, the majority of Mitchell1Â® diagrams follow a much improved format, which permits space for internal switch details, and component and ground locations.

Components shown with a dashed line instead of a solid line indicate not all circuits are shown in this particular diagram (circuits shown in system diagrams are typically applicable to that system only). The remaining circuits connected to that component will be shown in the appropriate system that they apply to.

Today, the wiring diagram necessary to support a given repair procedure is included within that article or a link is provided to the appropriate SYSTEM WIRING DIAGRAM article. For example, the wiring diagram for a Ford EEC-IV system may be included in ENGINE PERFORMANCE and WIRING DIAGRAMS articles for Ford Motor Co. The wiring diagram for a cruise control system may be included in ACCESSORIES & EQUIPMENT section for the specific vehicle manufacturer, and the wiring diagram for an anti-lock brake system may be included in BRAKES and WIRING DIAGRAMS for the specific manufacturer.

WIRING DIAGRAMS contains all wiring diagrams not included in STARTING & CHARGING SYSTEMS and ACCESSORIES & EQUIPMENT. This includes: Data Link Connectors, Ground Distribution, Power Distribution, Engine Performance, Electric Cooling Fans, Anti-Lock Brakes, Electronic Suspension and Electronic Steering wiring diagrams. The Data Link Connectors wiring diagrams show the circuits by which the various on-board computers exchange information, and the diagnostic connectors used for diagnosis and their location. The Ground Distribution wiring diagrams show all vehicle ground points, their location, and the components common to those ground points. The Power Distribution wiring diagrams show the power feed circuits and the components common to those power feeds.

Wiring diagrams used to support the information in ACCESSORIES & EQUIPMENT are drawn in a "top-down" format. The diagrams are drawn with the power source at the top of the diagram and the ground point at the bottom of the diagram. Component locations are identified on the wiring diagrams. Any wires that do not connect directly to a component are identified on the diagram to indicate where they go.

WIRING DIAGRAM COLOR ABBREVIATIONS

COLOR ABBREVIATIONS

Color	Normal	Optional	Misc. Euro Models
Black	BLK	BK	B
Blue	BLU	BU	U
Brown	BRN	BN	N
Clear	CLR	CR	L

Color	Normal	Optional	Misc. Euro Models
Dark Blue	DK BLU	DK BU	-
Dark Green	DK GRN	DK GN	-
Green	GRN	GN	G
Gray	GRY	GY	S
Light Blue	LT BLU	LT BU	-
Light Green	LT GRN	LT GN	-
Orange	ORG	OG	O
Pink	PNK	PK	K
Purple	PPL	PL	P
Red	RED	RD	R
Tan	TAN	TN	-
Violet	VIO	VI	-
White	WHT	WT	W
Yellow	YEL	YL	Y

WIRING DIAGRAM SYMBOLS

NOTE: Standard wiring symbols are used on all wiring diagrams. The list below will help clarify any symbols that are not easily understood at a glance. Most components are labeled "Motor", "Switch" or "Relay" in addition to being drawn with the standard symbol.

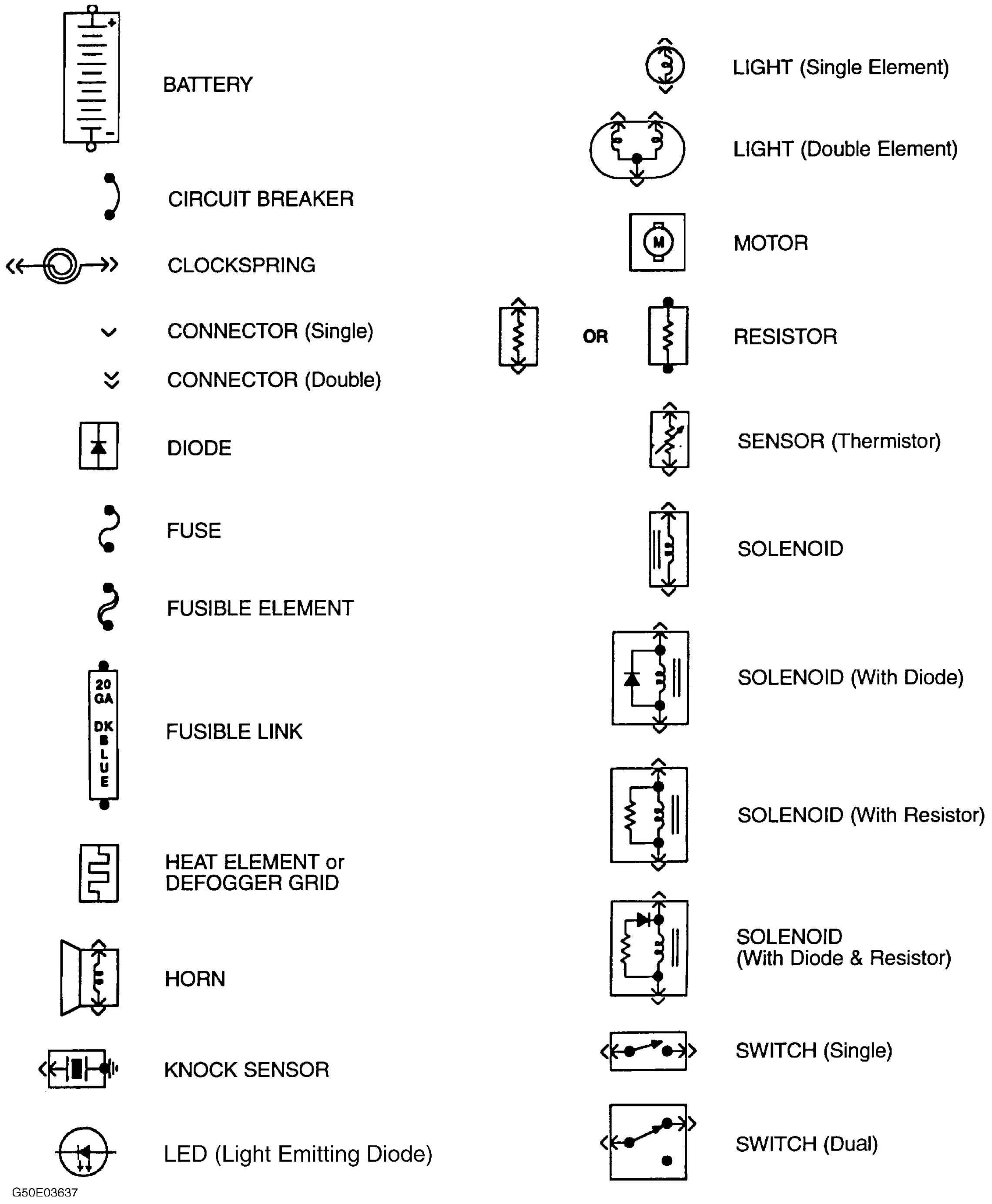
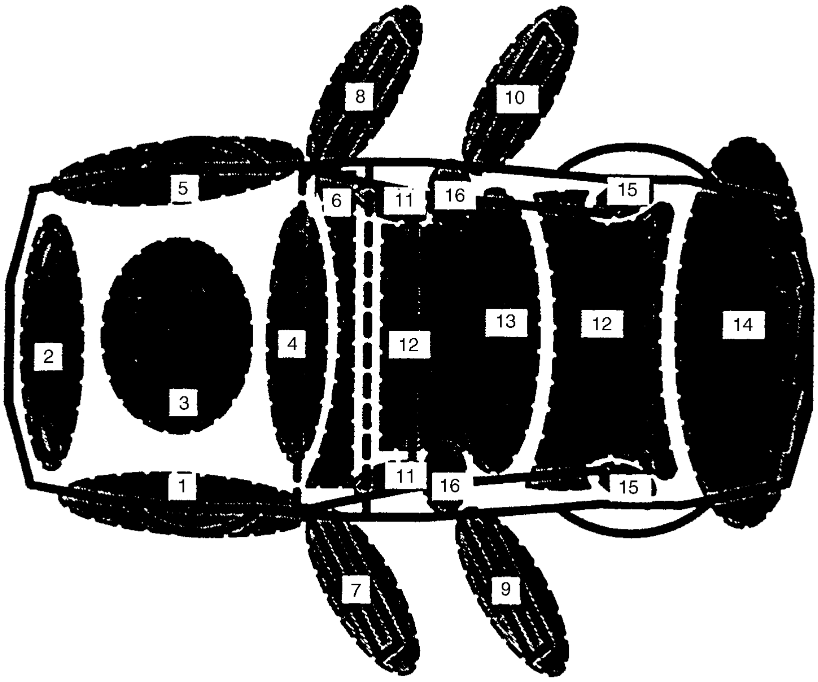

BATTERY
CIRCUIT BREAKER
CLOCKSPRING
CONNECTOR (Single)
CONNECTOR (Double)
DIODE
FUSE
FUSIBLE ELEMENT
20 GA DK BLUE
FUSIBLE LINK
HEAT ELEMENT or DEFOGGER GRID
HORN
KNOCK SENSOR
LED (Light Emitting Diode)
G50E03637
LIGHT (Single Element)
LIGHT (Double Element)
M
MOTOR
OR
RESISTOR
SENSOR (Thermistor)
SOLENOID
SOLENOID (With Diode)
SOLENOID (With Resistor)
SOLENOID (With Diode & Resistor)
SWITCH (Single)
SWITCH (Dual)

Fig. 1: Identifying Standard Wiring Diagram Symbols

WIRING DIAGRAM GROUND NUMBER LOCATIONS

NOTE: The following illustration depicts standardized ground numbers and locations to be used in conjunction with Mitchell1's Â® wiring diagrams applying to 2001 and prior model years only. See Fig. 2. Wiring diagrams applying to newer model years depict manufacturer-specified ground numbers and locations. Do not utilize the illustration with 2002 and newer model year wiring diagrams.



1) Left Fender
G100 .... Front Of Fender
G102 .... On Shock Tower
G104 .... Rear Of Fender

2) Front of Vehicle
G106 .... Behind Left Headlight
G107 .... Behind Right Headlight
G108 .... Left Radiator Support
G109 .... Right Radiator Support

3) Engine
G110 .... Left Front Of Engine
G111 .... Left Front Behind Battery
G112 .... Left Side Of Engine
G114 .... Left Rear Of Engine
G115 .... Rear Of Engine
G117 .... Right Rear Of Engine
G119 .... Right Front Of Engine
G120 .... Right Side Of Engine
G125 .... Front Of Engine
G127 .... Left Underside Of Hood
G128 .... Right Underside Of Hood
G129 .... Top Center Of Transaxle

4) Safety Wall
G116 .... Left Side Of Safety Wall
G121 .... Center Of Safety Wall
G123 .... Right Side Of Safety Wall

5) Right Fender
G101 .... Front Of Fender
G103 .... On Shock Tower
G105 .... Rear Of Fender

6) Instrument Panel
G200 .... Left Kick Panel
G201 .... Right Side Of I/P
G202 .... Left Side Of I/P
G203 .... Right Kick Panel
G204 ... Left Rear Of Steering Support
G205 .. Right Rear Of Steering Support
G206 .... Center Of I/P
G207 .... Top Of Steering Column

7) Left Front Door
G500 .... Left Front Door

8) Right Front Door
G600 .... Right Front Door

9) Left Rear Door
G700 .... Left Rear Door

10) Right Rear Door
G800 .... Right Rear Door

11) "A" Pillars
G900 .... Left "A" Pillar
G901 .... Right "A" Pillar

12) Passenger Compartment
G300 .... Below Left Front Seat
G301 .... Below Right Front Seat
G302 .... Below Center Console
G303 .... Below Right Rear Seat
G304 .... Below Left Rear Seat
G306 ..... Below Center Of Rear Seat
G307 ...... Below Right Rear Window
G309 .... Left Front Door Sill
G310 .... Behind Right Rear Seat
G311 .... Center Of Rear Shelf
G312 .... Behind Left Rear Seat

13) Roof
G902 .... Left Front Of Roof
G903 .... Right Front Of Roof
G906 .... Left Rear Of Roof
G907 .... Right Rear Of Roof
G908 .... Center Front Of Roof
G909 .... Center Rear Of Roof

14) Rear Of Vehicle
G400 .... Left Front Side Of Trunk
G401 .... Right Front Side Of Trunk
G402 .... Left Rear Wheelwell
G403 .... Right Rear Wheelwell
G404 .... Left Rear Side Of Trunk
G405 .... Right Rear Side Of Trunk
G406 .... Center Rear Of Trunk Lid
G407 .... Center Rear Of Trunk
G408 .... Center Front Of Trunk
G409 .... Rear Of Cargo Bed

15) "C" Pillars
G904 .... Left "C" Pillar
G905 .... Right "C" Pillar

16) "B" Pillars
G305 .... Right "B" Pillar
G308 .... Left "B" Pillar

G00027307

Fig. 2: Ground Numbers & Locations (2001 & Prior Model Years)

WIRING DIAGRAM COMPONENT LOCATIONS

When trying to locate a component in a wiring diagram and you don't know the specific system where it is located, use this handy component locator to find the system wiring diagram in which the component is located. Then, go to that system and locate the component within the wiring diagram.

For example, if you don't know the specific system in which the ignition switch is located, look up ignition switch in the wiring diagram component location tables and go to the appropriate wiring diagram(s) which contain either full or partial views of the ignition switch. The full view of the ignition switch is located in Power Distribution.

The first listing for the component will be the full or most complete view of the component. Additional listings will be partial views of the component. Not all components are used on all models.

All components will have a partial view in Ground Distribution and Power Distribution. Data Link Connectors show connecting circuits between modules. Alternate names for components may be listed in wiring diagram component locations tables.

WIRING DIAGRAM COMPONENT LOCATIONS

Component	Wiring Diagram
ABS Electronic Control Unit	Anti-Lock Brakes; Data Link Connectors
ABS Hydraulic Unit	Anti-Lock Brakes
Acceleration Sensor	Anti-Lock Brakes
Accessory Delay Relay	Power Windows
A/C Compressor Clutch Relay	Engine Performance
A/C Sensor	Engine Performance
A/C Pressure Switch	Engine Performance
Adaptive Lamp Control Module	Exterior Lights
Air Bag(s)	Air Bag Restraint System
Air Bag Module	Air Bag Restraint System
Air Bag Sensor(s)	Air Bag Restraint System
Air Injection Pump Relay	Engine Performance
Air Temperature Sensor	Overhead Console
Alternator (Generator)	Generators & Regulators
Anti-Theft Control Module	Anti-Theft System; Starters
Autolamp Control Relay	Headlight Systems; Daytime Running Lights
Automatic Shutdown (ASD) Relay	Engine Performance; Generators & Regulators
Autostick Switch	Engine Performance
Auxiliary Battery Relay	Generators & Regulators
Back-Up Lights	Back-Up Lights; Exterior Lights
Barometric (BARO) Pressure Sensor	Engine Performance
Battery	Power Distribution
Battery Temperature Sensor	Engine Performance
Body Control Module	Body Control Computer; Anti-Theft System; Daytime Running Lights; Engine Performance; Headlight Systems; Warning Systems
Boost Control Solenoid	Engine Performance
Boost Sensor	Engine Performance
Brake Fluid Level Switch	Analog Instrument Panels
Brake On/Off (BOO) Switch	Cruise Control Systems; Engine Performance; Shift Interlock Systems
Buzzer Module	Warning Systems
Camshaft Position (CMP) Sensor	Engine Performance
Central Control Module	Anti-Theft System
Clockspring	Air Bag Restraint System; Cruise Control Systems; Steering Column Switches
Clutch Pedal Position Switch	Starters
Clutch Start Switch	Starters
Combination Meter	Analog Instrument Panels
Constant Control Relay Module (CCRM)	Engine Performance; Electric Cooling Fans
Convenience Center	Power Distribution; Illumination/Interior Lights
Convertible Top Motor	Power Convertible Top
Convertible Top Switch	Power Convertible Top
Crankshaft Position (CKP) Sensor	Engine Performance
Cruise Control Module	Cruise Control Systems
Cruise Control Switch	Cruise Control Systems
Condenser Fan Relay(s)	Electric Cooling Fans
Data Link Connector (DLC)	Engine Performance
Daytime Running Lights Module	Daytime Running Lights; Exterior Lights
Defogger Relay	Rear Window Defogger
Diagnostic Energy Reserve Module (DERM)	Air Bag Restraint System
Discriminating Sensor (Air Bag)	Air Bag Restraint System

Component	**Wiring Diagram**
Distributor	Engine Performance
Door Lock Actuators	Power Door Locks; Remote Keyless Entry
Door Lock Relay(s)	Power Door Locks
Electrochromic Mirror	Power Mirrors
Electronic Level Control (ELC) Height Sensor	Electronic Suspension
Electronic Level Control (ELC) Module	Electronic Suspension
Engine Coolant Temperature (ECT) Sending Unit	Analog Instrument Panels
Engine Coolant Temperature (ECT) Sensor	Engine Performance
Engine Control Module	Engine Performance; Generators & Regulators; Starters
ETACS ECU	Warning Systems; Power Windows; Remote Keyless Entry
Evaporative (EVAP) Emissions Canister	Engine Performance
EVAP Canister Purge Solenoid	Engine Performance
EVAP Canister Vent Solenoid	Engine Performance
Exhaust Gas Recirculation (EGR) Valve	Engine Performance
Fuel Tank Vacuum Sensor	Engine Performance
Fog Lights	Headlight Systems; Daytime Running Lights
Fog Light Relay	Headlight Systems; Daytime Running Lights
Fuel Door Release Solenoid	Power Fuel Door Release
Fuel Gauge Sending Unit	Analog Instrument Panels
Fuel Injectors	Engine Performance
Fuel Pump	Engine Performance
Fuel Pump Relay	Engine Performance; Power Distribution
Fuse/Relay Block	Power Distribution
Fusible Links	Power Distribution; Generators & Regulators; Starters
Generator	Generators & Regulators; Engine Performance; Power Distribution
Generic Electronic Module (GEM)	Body Control Modules; Electronic Suspension
Glow Plug Relay	Engine Performance
Glow Plugs	Engine Performance
Grounds	Ground Distribution
Headlight Door Module	Headlight Doors
Headlight Relay	Headlight Systems; Daytime Running Lights
Headlights	Headlight Systems; Daytime Running Lights
Heated Oxygen Sensor(s) (HO2S)	Engine Performance
Heated Windshield Control Module	Heated Windshields
Height Sensor	Electronic Suspension
Horns	Steering Column Switches
Horn Relay	Steering Column Switches
Idle Air Control (IAC) Motor/Valve	Engine Performance
Ignition Coil(s)	Engine Performance
Ignition Key Lock Cylinder	Anti-Theft System
Ignition Module	Engine Performance
Ignition Switch	Power Distribution; Engine Performance; Generators & Regulators; Starters
Illuminated Entry Module	Illumination/Interior Lights
Illumination Lights	Illumination/Interior Lights
Impact Sensor	Air Bag Restraint System
Inertia Fuel Shutoff Switch	Engine Performance
Inhibit Relay	Starters

Component	Wiring Diagram
Instrument Cluster	Analog Instrument Panels
Intake Air Temperature (IAT) Sensor	Engine Performance
Interior Lights	Illumination/Interior Lights
Interlock Switch	Starters
Junction Block	Power Distribution
Keyless Entry Receiver	Remote Keyless Entry
Key Reminder Switch	Starters
Knock Sensor	Engine Performance
Lamp Control Module	Exterior Lights
License Plate Lamp	Exterior Lights
Lighting Control Module	Lighting Control Modules; Anti-Theft System; Daytime Running Lights; Headlight Systems
Lower Relay	Power Convertible Top
Malfunction Indicator Light (MIL)	Engine Performance; Instrument Panels
Manifold Absolute Pressure (MAP) Sensor	Engine Performance
Mass Airflow (MAF) Sensor	Engine Performance
Mega Fuse	Generators & Regulators
Memory Seat/Mirror Module	Memory Systems
Mirror Defogger	Rear Window Defogger
Moon Roof Motor	Power Moon Roof
Moon Roof Relay	Power Moon Roof
Multi-Function Control Module	Warning Systems
Neutral Safety Switch	Starters
Oil Level Switch	Engine Performance
Oil Pressure Switch/Sending Unit	Analog Instrument Panels; Engine Performance
Overhead Console	Overhead Console
Oxygen Sensor(s) (O2S)	Engine Performance
Parking Brake Switch	Analog Instrument Panels
Park Lights	Exterior Lights
Park/Neutral Position Switch	Starters; Engine Performance; Anti-Theft System; Body Control Module
Perimeter Lighting Control Relay	Exterior Lights
Power Amplifier	Power Antennas
Power Antenna Module	Power Antennas
Power Antenna Motor	Power Antennas
Power Distribution Center	Power Distribution; Generators & Regulators; Starters
Power Door Lock Motors	Power Door Locks
Power Mirror Motors	Power Mirrors; Memory Systems
Power Sliding Door Controller	Power Sliding Side Door
Power Seat Motors	Power Seats; Memory Systems
Power Steering Pressure Switch	Engine Performance
Power Top Motor	Power Convertible Top
Power Top Relay(s)	Power Convertible Top
Powertrain Control Module	Engine Performance; Analog Instrument Panels; Cruise Control Systems; Data Link Connectors; Generators & Regulators; Starters
Power Window Motors	Power Windows
Power Window Relay(s)	Power Windows
Radiator Fan Motor(s)	Electric Cooling Fans
Radiator Fan Relay(s)	Engine Performance; Electric Cooling Fans;
Rainsense Module	Wiper/Washer Systems
Raise Relay	Power Convertible Top

Component	**Wiring Diagram**
Remote Anti-Theft Personality (RAP) Module	Anti-Theft System; Starters; Warning Systems
Seat Belt Pretensioners	Air Bag Restraint System
Seat Belt Retractor Solenoid	Passive Restraints
Seat Belt Switch	Air Bag Restraint System; Passive Restraints
Shift Interlock Solenoid	Shift Interlock Systems
Shift Lock Actuator	Shift Interlock Systems
Side Marker Lights	Exterior Lights
SIR Coil Assembly (Clockspring)	Air Bag Restraint System
Slip Ring (Clockspring)	Air Bag Restraint System; Steering Column Switches
SRS Control Module	Air Bag Restraint System
Starter Motor	Starters
Starter Interrupt Relay	Starters
Starter Solenoid	Starters
Starter Relay	Starters
Steering Wheel Position Sensor	Anti-Lock Brakes
Stoplights	Exterior Lights
Stoplight Switch	Engine Performance; Cruise Control Systems; Anti-Lock Brakes
Sun Roof ECU	Power Sun Roof
Sun Roof Motor	Power Sun Roof
Sun Roof Position Sensor	Power Sun Roof
Taillights	Exterior Lights
Throttle Position (TP) Sensor	Engine Performance
Torque Converter Clutch Solenoid/Switch	Engine Performance
Traction Control Switch	Anti-Lock Brakes
Trailer Tow Connector	Exterior Lights
Trailer Tow Relay	Exterior Lights
Transmission/Transaxle	Engine Performance
Transmission Control Module (TCM)	Engine Performance; Starters
Transmission Range Sensor	Starters; Back-Up Lights; Engine Performance
Transmission Range Switch	Back-Up Lights; Engine Performance; Anti-Theft System
Turn Signal Flasher	Exterior Lights
Turn Signal Lights	Exterior Lights
Twilight Sentinel Switch	Headlight Systems; Daytime Running Lights
Vapor Canister Leak Detection Pump	Engine Performance
Vehicle Control Module (VCM)	Engine Performance
Vehicle Dynamic Module	Electronic Suspension
Vehicle Speed Control Servo	Cruise Control Systems
Vehicle Speed Sensor	Data Link Connectors; Analog Instrument Panels; Cruise Control Systems; Electronic Suspension
Voltage Regulator	Generators & Regulators
Water-In-Fuel Sensor	Engine Performance; Analog Instrument Panels
Wheel Speed Sensors	Anti-Lock Brakes
Window Timer Module	Power Convertible Top
Windshield Intermittent Wiper Relay	Wiper/Washer Systems
Windshield Washer Motor	Wiper/Washer Systems
Wiper Motor	Wiper/Washer Systems

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2017 GENERAL INFORMATION

Vehicle Diagnostic Information - Diagnostic Information and Procedures - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

STRATEGY BASED DIAGNOSIS

The goal of Strategy Based Diagnosis is to provide guidance when you create a plan of action for each specific diagnostic situation. Following a similar plan for each diagnostic situation, you will achieve maximum efficiency when you diagnose and repair vehicles. Although each of the Strategy Based Diagnosis steps are numbered, you are not required to complete every step in order to successfully diagnose a customer concern. The first step of your diagnostic process should always be Understand and Verify the Customer's Concern. The final step of your diagnostic process should be to Repair and verify the Fix. Refer to the steps listed below for the correct Strategy Based Diagnosis.

NOTE: **For additional information on the following steps refer to the corresponding numbered paragraphs listed below.**

1. Understand and verify the customers concern.
2. Verify the vehicle is not operating as designed:
    - **If the vehicle is operating as designed review the suggestions listed below:**
    - Check Identical Vehicle
    - Customer Misunderstanding of System - Explain operation to customer or refer to owners or service manual
    - Customer dissatisfaction - Submit a Field Product Report
    - **If the vehicle is not operating as designed**
3. Perform preliminary checks - Visual inspections and operational
    - **If the customers concern is found, refer to step 7**
    - **If the customers concern is not found**
4. Perform the Diagnostic System Check - Vehicle, determine the diagnostic service category to perform.
    - **If the customers concern is found, refer to step 7**
    - **If the customers concern is not found**
5. Check for related Bulletins, Recalls and Preliminary Information.
    - **If the customers concern is found, refer to step 7**
    - **If the customers concern is not found**
6. Follow the diagnostic path listed below:
    1. Current DTC - Follow DTC Diagnostics
    2. Symptom no DTC - Follow Symptom Diagnostics
    3. No published diagnostic - Analyze and develop diagnostics or call Technical Assistance
    4. Intermittent/History DTC - See diagnostic detail below
7. Isolate the root cause then repair and verify the fix.
8. Re-examine the concern.
    - **If the vehicle is not repaired, refer to step 1**
    - **If the vehicle is repaired**
9. All OK.

Additional Information

1. Understand and Verify the Customer's Concern: The first part of this step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed.
2. Vehicle Operating as Designed: This condition exists when the vehicle is found to operate normally. The condition described by the customer may be normal. Compare with another like vehicle that is operating normally under the same conditions described by the customer. Explain your findings and the operation of the system to the customer. If the customer is dissatisfied submit a Field Product Report.
3. Preliminary Checks: Conduct a thorough visual inspection. Review the service history. Detect unusual sounds or odors. Gather diagnostic trouble code (DTC) information in order to achieve an effective repair.
4. Perform Published Diagnostic System Check- Vehicle: The **Diagnostic System Check - Vehicle** verifies the proper operation of the system. This will lead the technician in an organized approach to diagnostics and identify what category of diagnostic to perform.
5. Check for related Bulletins, Recalls and Preliminary Information (PI).
6. Diagnostic categories:
    1. Current DTC: Follow the designated DTC diagnostic in order to make an effective repair. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**.
    2. Symptom - No DTC: Select the appropriate symptom diagnostic. Follow the diagnostic steps or suggestions in order to complete the repair. Refer to **Symptoms - Vehicle**.
    3. No Published Diagnostics: Analyze the Concern. Develop a plan for the diagnostics. The service manual schematics will help you to see system power, ground, input, and output circuits. You can also identify splices and other areas where multiple circuits are tied together. Look at component locations to see if components, connectors or harnesses may be exposed to extreme temperature, moisture, or corrosives (road salt, battery acid, oil or other fluids). Utilize the wiring diagrams, system description and operation, and system circuit description.
    4. Intermittent/History DTC: An intermittent condition is one that does not occur continuously, may be difficult to duplicate, and will only occur when certain conditions are met. Generally, an intermittent is caused by faulty electrical connections and wiring, malfunctioning components, electromagnetic/radio frequency interference, driving conditions, or aftermarket equipment. The following approaches/tools may prove to be beneficial in locating and repairing an intermittent condition or history DTC.
        - Combining technicians knowledge with the available service information.
        - Evaluate the symptoms and conditions described by the customer.

          North America - The GM Customer Concern Verification Sheets have been designed to improve communications between the service customer and the technician. The more clearly the technician understands the concern and its symptoms, the more likely the concern will be fixed right the first time. The blank CCVS can be found in GM Global Connect under Service, Service Forms.
        - Follow the suggestions on **Testing for Intermittent Conditions and Poor Connections** .
        - Use a tool with data capturing capabilities like scan tool, digital multi-meter, or (if available) a vehicle data recorder.
7. Isolate the Root Cause then Repair and Verify Fix: After isolating the root cause, make the repairs and validate for the correct operation by performing the **Diagnostic Repair Verification**. Verifying that the DTC or symptom has been corrected may involve road testing the vehicle.
8. Re-examine the Concern: If a technician cannot successfully find or isolate the concern, a re-evaluation is necessary. Re-verify the concern. The concern could be an intermittent or normal condition.

DIAGNOSTIC PROCEDURE INSTRUCTIONS

The following is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

Diagnostic Instructions

A link to the **Diagnostic System Check - Vehicle** is provided here. This procedure should be performed prior to performing other diagnostic procedures, as this prevents misdiagnosis where there are integrated system dependencies.

A link to the **Strategy Based Diagnosis** is provided here. This provides an overview on how a technician should diagnose a vehicle.

A link to the **Diagnostic Procedure Instructions** is provided here. This information is an overview of instructions for all 16 categories which may be included in a diagnostic procedure.

DTC Descriptor

Describes what DTCs are diagnosed in this procedure. The DTC number, with Symptom Description when applicable, and descriptor are written out.

Diagnostic Fault Information

The diagnostic Fault Information table identifies each circuit that makes up an electrical subsystem and the associated circuit faults. DTCs and symptoms are listed in the table for all circuit fault modes. This information can be used to diagnose an electrical fault, or as a quick visual aid showing how the different symptoms and DTCs apply for the subsystem being diagnosed.

Even though all the DTCs and symptoms are shown in this table it does not mean they will all be diagnosed in the same procedure.

An example table from an engine coolant temperature (ECT) procedure:

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
ECT Sensor Signal	P0117	P0118	P0118	P0125, P0128
ECT Low Reference	-	P0118	P0118	P0125, P0128

Typical Scan Tool Data

The Typical Scan Tool Data table identifies a scan tool data parameter and its value in reference to potential circuit faults.

An example table from an ECT procedure:

ECT Sensor Temperature - PCM

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine Running **Parameter Normal Range:** -32 to +130Â°C (-26 to +275Â°F)			
ECT Signal	140Â°C (284Â°F)	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)
Low Reference	-	-40Â°C (-40Â°F)	-40Â°C (-40Â°F)*
* Internal ECM damage may occur if shorted to B+			

Circuit/System Description

Circuit/System Description identifies how a circuit/system normally functions.

Conditions for Running the DTC

Conditions for Running the DTC, identifies what conditions must be present to allow the diagnostic to run.

Conditions for Setting the DTC

Conditions for Setting the DTC, identifies the condition(s) that must be present in order to fail the diagnostic and when to set the DTC.

Action Taken When the DTC Sets

Actions Taken When the DTC sets, identifies the default actions taken when a control module sets a DTC.

Conditions for Clearing the DTC

Conditions for Clearing the DTC, identifies the conditions that must be met in order to clear the DTC.

Diagnostic Aids

Diagnostic Aids are suggestions which explain other methods to diagnose the condition. It also provides unique information about the system used to assist the technician in finding and repairing a vehicle condition.

Reference Information

Reference Information includes links providing additional information for the diagnostic procedure.

For example:

- Schematic Reference
- Connector End View Reference
- Description and Operation
- Electrical Information Reference
- DTC Type Reference
- Scan Tool Reference
- Special Tools Required

Circuit/System Verification

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, performing the Circuit/System Verification category first, aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

This category also serves to route the technician to other diagnostic procedures which should be performed first; for example, a DTC with a higher priority.

NOTE: **Any diagnostic step that asks if a DTC is set is referring to a Set, Current, Present, Active DTC status. This does not include any other DTC status. For example History, Not Run, Passed and Failed.**

Circuit/System Verification is a non-intrusive procedure outlining how to verify that a system or a portion of a system is functioning correctly. During the verification process, the vehicle is kept intact and tested as a complete system. This verification is used to assist the technician in determining whether a condition is current or intermittent. When a condition is determined to be intermittent, a technician can use the link in Electrical Information Reference: **Testing for Intermittent Conditions and Poor Connections** for additional testing information.

The technician should be able to identify if the fault is occurring on the input circuit - signal or on the output circuit - control when applicable. The technician will need to decide from the verification results if the system is working correctly or if further diagnosis needs to be performed in either Circuit/System Testing and/or Component Testing.

To assist the technician in identifying a common part a component code is used. These codes are not translated so they will always be the same even though the part name may have slight variance. The component codes will always be the same once assigned to a unique part name and will be found on the schematics and in the diagnostic procedure categories Circuit/System Verification, Circuit/System Testing, and Component Testing categories.

Component Codes

The component codes used on the schematics will have the base code with an extension to identify location or quantity. For example the ABS wheel speed sensors are identified on the schematic with a base code (B5) and a location extension (LF, RF, LR, and RR) as seen below:

- B5LF Wheel Speed Sensor (WSS)-Left Front
- B5RF Wheel Speed Sensor (WSS)-Right Front
- B5LR Wheel Speed Sensor (WSS)-Left Rear
- B5RR Wheel Speed Sensor (WSS)-Right Rear

B5 is the base code for the wheel speed sensor and the LF, RF, LR, and RR indicate the on vehicle location.

The diagnostic procedures will use the base code (B5) for a wheel speed sensor but may or may not use the extension identifying location (LF, RF, LR, and RR). Example: Vehicle OFF, disconnect the harness connector at the appropriate B5 wheel speed sensor. This is done so the diagnostic procedure can be common for all four wheel speed sensors and not have to take into account part location or quantity.

Where the diagnostic states "the appropriate" it is up to the technician to identify which component is being diagnosed by the symptom stated on the RO (drivers door lock is inoperative) or by the DTC descriptor (DTC C0585 04: Left Rear Actuator Circuit Open).

Circuit/System Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

Circuit/System Testing is a step by step, positive-flow, testing sequence which allows the technician to perform each test step, in sequence, until a fault is detected. If the result of a numbered test step is achieved, the normal flow is to proceed to the next numbered test step (indicated by the down pass arrow). If the result of a numbered test step is NOT achieved, the right repair arrow bullet below the failed test will identify what actions need to take place.

Intrusive diagnostics are performed to locate the system fault. System harness connections are disconnected from the module or component to test individual circuit functions. The module or component will be used to assist in verifying the circuit function. When a test does not pass, the repair steps () will indicate what circuit faults to test for example, short to voltage, short to ground or open/high resistance.

When testing for individual circuit faults, the technician is expected to include terminal inspections such as connection surfaces and terminal tension at both the harness and component/module. Additionally, a technician can use the links in Electrical Information Reference: **Testing for Intermittent Conditions and Poor Connections** , or **Circuit Testing** for additional information.

The control modules and components will also be diagnosed during these test steps. A retest of a control module or component should always be performed before replacement. For example, re-connect all components and modules and retest the system to verify the condition still exists before replacing modules or components.

Component Testing

The diagnostic format does not force a technician to any of the 3 diagnostic categories (Circuit/System Verification, Circuit/System Testing and Component Testing). However, beginning with the Circuit/System Verification category aids in determining if a vehicle condition is current. Some diagnostic categories may state that another category must be performed first when there are testing dependencies.

Component Testing can offer static and/or dynamic component tests. These tests can be used to verify if a component is operating correctly to avoid unnecessary replacement.

Testing modules in this category will not be offered. In most cases, the module is used to verify the harness circuits in the Circuit/System Testing category and a retest of the module should always be performed before replacement.

Repair Instructions

Repair Instructions provides a link to **Diagnostic Repair Verification**. This link describes how to verify the vehicle is repaired.

All links to Repair or Replacement procedures are located here.

Repair Verification

Repair Verification describes how to verify the vehicle is repaired when additional instructions are needed beyond what is in Diagnostic Repair Verification.

DIAGNOSTIC SYSTEM CHECK INSTRUCTIONS

The following is an overview of instructions for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure.

Diagnostic Instructions

A link to **Strategy Based Diagnosis** is provided as an overview on how a technician should diagnose a vehicle.

A link to the Diagnostic System Check Instructions is provided. This provides an overview of instructions and examples for the general information and 14 step System Verification included in the Diagnostic System Check - Vehicle procedure. The examples in this document are intended to give the technician a general idea of what the test step is referring to. They are not intended to list every possible condition or situation.

Diagnostic Systems Check steps are listed by priority to guide the technician to the appropriate diagnostic procedure to correct the customer concern. There are many ways to determine the priority of diagnosing a vehicle concern. Some faults can cause customer perceived symptoms in areas unrelated to the fault. Using an example from the System Check, after reading DTCs, the technician is asked to verify there are no Electronic Control Unit Internal Performance Faults present. It is important that any internal performance issues are addressed prior to continuing through the System Check. There is no benefit addressing other DTCs that could be set due to an internal fault to a control module. If the fault is present, performing the diagnostic procedure for that fault will likely correct the customer perceived concern and possibly eliminate other DTCs that may be set.

Not all steps of the Diagnostic System Check have to be performed. The Diagnostic System Check tries to prioritize the test steps with the highest priority faults first. The technician is then lead to another document to do the actual diagnosis or repair. The strategy is to repair higher level faults that may be the cause of other system or component level symptoms. Additionally, the Diagnostic System Check can only be used for a single fault at a time. If additional faults are present, the technician must perform the diagnostic system check for each concern until all customer concerns are corrected.

Once a repair has been completed, General Motors diagnostic strategy is to always have the technician verify that the customer concern has been corrected. This is to prevent comebacks and to ensure customer satisfaction with their dealership experience. Therefore a link has been provided to **Diagnostic Repair Verification** procedure for the technician to verify the customer concern has been corrected.

There are some assumptions made when General Motors prepares service information. They include the following areas which are presumed to function as designed:

- The 12 V battery is fully charged. General Motors assumes the majority of vehicles brought in for repair will be able to start and be driven into the service stall. If the vehicle has a dead battery, it is slow cranking or for any other reason the technician feels the customer concern may be battery related, a link is provided to **Battery Inspection/Test** . This procedure will guide the technician through inspecting and verifying the battery functions properly.

- Fuses should not be open. General Motors does not call out in diagnostic procedures to verify a fuse. The technician is expected to find an open fuse when the diagnostic test step states to check for an open circuit condition. Therefore a link has been provided to **Power Distribution Schematics** , and **Electrical Center Identification Views** for technicians to reference power sources and fuse locations if they feel there may be loss of power due to an open fuse condition.
- Ground circuits are clean, tight, and in the correct location. General Motors assumes that the original ground circuits have not been compromised. The technician is expected to find a poor ground connection when the diagnostic test step states to test the ground circuit for an open/high resistance. Therefore a link has been provided to **Ground Distribution Schematics** , and **Harness Routing Views** for technicians to reference ground locations and which ground circuits may be related to the customer concern.
- All connectors/terminals fully seated in the area of concern. General Motors assumes that all connections are properly installed. The technician is expected to find an open or poor connection when the diagnostic test step asks to test the circuit for an open/high resistance. Therefore a link has been provided to **COMPONENT CONNECTOR END VIEWS - INDEX** for technicians to reference which connections may be related to the customer concern.
- There are no aftermarket devices that affect the operation of the system. General Motors can only author diagnostic and repair information for vehicle systems and components that are original equipment or genuine GM Accessories. Aftermarket equipment can negatively affect original equipment operation and lead a technician's diagnosis of a concern in the wrong direction. Therefore a link has been provided to **Checking Aftermarket Accessories** that guides a technician through the possible causes of vehicle problems related to aftermarket accessories.
- The scan tool powers up. General Motors assumes that power is available at the Data Link Connector and the scan tool will power on. Therefore a link has been provided to **Scan Tool Does Not Power Up** if the technician finds that the scan tool does not power on.

Diagnostic System Check

1. VERIFY CUSTOMER CONCERN - This step is to obtain as much information as possible from the customer. Are there aftermarket accessories on the vehicle? When does the condition occur? Where does the condition occur? How long does the condition last? How often does the condition occur? Review the service history of the vehicle for previous repairs that could help diagnose the current concern.

   Now that the technician understands the customer concern, they should validate the concern on the vehicle. In order to verify the concern, the technician should be familiar with the normal operation of the system and refer to the owner or service manual for any information needed. Inspect the visible system components for obvious damage or conditions that could cause the concern. Conduct a thorough visual inspection. Detect unusual sounds or odors.

   The condition described by the customer may be normal. If the technician finds the vehicle to operate normally, compare with another like vehicle that is operating normally, under the same conditions described by the customer. If this is the case, explain your findings and the operation of the system to the customer. If the customer is dissatisfied, submit a Field Product Report.

2. BULLETIN SEARCH - By searching for related bulletins, recall/field actions and preliminary information documents, a procedure for a known field issue may resolve the customer concern with little or no diagnosis necessary saving the technician diagnostic time.
3. MECHANICAL CONCERNS - This step is designed to take the technician directly to a list of symptom diagnostic procedures. The technician is asked to verify the symptoms exhibited by the system are mechanical in nature and not related to an electrical system, see some examples below. If the technician feels the concern could be related to an electrical system, they should continue through the Diagnostic System Check to verify the electrical functionality of vehicle. If the technician feels the concern is exclusively related to a mechanical system, a link to **Symptoms - Vehicle** is provided to select the appropriate symptom diagnostic procedure for the customer concern.

   Examples:

- Brake noise or diagnosing irregular pad wear
- Water leak diagnosis
- Engine or transmission fluid leak diagnosis
- Manual window or door lock diagnosis
- Vehicle vibration diagnosis
- Exhaust noise or leak diagnosis

4. VEHICLE POWER UP VERIFICATION - The technician is asked in this step to turn the ignition key ON and verify that the vehicle powers up. The technician should look for clues that multiple vehicle systems are receiving vehicle power mode messages, such as the cluster waking up, the radio powers on, the HVAC blower is operational, windshield wipers turn on, etc, with the key ON. This would be a rare condition as both the power mode master and back-up power mode master would have to be inoperable, however, if the vehicle does not power up, a link to **Power Mode Mismatch** is provided.
5. CONTROL MODULE COMMUNICATION and DTC CHECK - The technician is asked in this step to record the following three pieces of data on the Repair Order; any control module that the scan tool determined is not communicating, any DTC and symptom byte set current or history, and the control module that has set the DTC.

   This is considered a setup step for the rest of the Diagnostic System Check. The technician is not expected to do anything other than record the three pieces of data provided by the scan tool on the Repair Order. This provides the information needed to complete the rest of the diagnostic system check.

   To complete this step, the technician is asked to utilize the scan tool function called Vehicle DTC Information located in Vehicle Control Systems. This function will query every possible control module on the vehicle requesting all DTCs. During the DTC query, the scan tool will try to establish communication with each control module. If the scan tool can communicate with the control module during the DTC request, it will display PRESENT and provide the number of DTCs set in the control module. If the scan tool cannot communicate with a control module, it will only display NOT COMMUNICATING. Since the scan tool cannot determine if a given control module should be present or not, the technician is asked in a future step to verify that the vehicle was not built with control modules listed as NOT COMMUNICATING.

   If the scan tool cannot establish communications with ALL of the vehicles control modules, a link to **Data Link References** is provided. A faulty control module or fault with the serial data circuit can cause no communication with all of the control modules on the vehicle. If any control module communicates on the serial data circuit, continue through the Diagnostic System check, as a future step will address any specific non communicating or group of non communicating control modules.

   Once the scan tool has completed the routine, the technician should review each control module that has set a DTC and document them on the Repair Order. When reviewing the DTCs, the technician should take notice if any DTCs are powertrain related, and if so, navigate in the scan tool to the Powertrain area and utilize the Capture Info function. This will upload any Freeze Frame/Failure Records stored in the control module to the scan tool in case the data is lost from the control module. As an example, if the technician commands a Clear DTCs function on a powertrain controller, all diagnostic information stored in the controller is erased. This includes Freeze Frame/Failure Records and Inspection/Maintenance System Status indicators, if required for your region.

6. CONTROL MODULE INTERNAL PERFORMANCE FAULTS - The technician is asked to review the DTCs recorded in step 4 and verify there are no control module internal performance faults set current. This type of fault may be the cause of other symptoms or DTCs displayed by the vehicle. By addressing this fault first, the technician may find the other concerns are resolved. The technician should always follow the diagnostic procedure for these types of faults prior to replacing any control module. If the technician finds a control module has an internal performance fault, a link is provided to **Diagnostic Trouble Code (DTC) List - Vehicle** to select the appropriate DTC diagnostic procedure.

   Examples:

   - B1000 Electronic Control Unit Performance
   - B101D ECU Hardware Performance
   - C0550 Electronic Control Unit Performance
   - C056D ECU Hardware Performance
   - C0570 Auxiliary Electronic Control Unit Performance
   - P0606 Control Module Internal Performance
   - P0607 Control Module Performance

7. CONTROL MODULE COMMUNICATION VERIFICATION - This step is used to ensure the control modules that are NOT COMMUNICATING were not built on the vehicle. To understand if the vehicle was built with that option, we provide a link to the **Data Link References** , document where Regular Production Options (RPOs) are listed next to ECU names and can be compared to those the vehicle was built with. If the technician determines that a control that is NOT COMMUNICATING should be present, the technician is asked to follow the appropriate diagnostic procedure listed in the **Data Link References** document.
8. COMMUNICATION and POWER MODE FAULTS - This step is asking the technician to look for communication DTCs or DTCs related to control modules powering up based on power mode, communication enable or wake-up circuits. See in the below table some examples of the DTCs the technician should diagnose prior to continuing through the Diagnostic System Check. The technician should review the list of DTCs recorded in step 4 and verify that none of these type of DTCs are present. If so, the technician is referred to the **Diagnostic Trouble Code (DTC) List - Vehicle** to select the appropriate DTC diagnostic procedure.

   Examples:

   - U0140 Lost Communication With Body Control Module
   - U0164 Lost Communication With HVAC Control Module
   - U0170 Lost Communication With Passenger Presence Detection Module
   - U0402 Invalid Data Received From Transmission Control Module
   - U0452 Invalid Data Received From Inflatable Restraint Sensing and Diagnostic Module
   - U1814 Powertrain High Speed Communication Enable Circuit
   - B1428 Ignition Switched Power Run/Crank Relay Circuit
   - B137B Accessory Power Module Wake Up Circuit
   - C0897 Control Module Power Moding
   - P2536 Ignition Accessory Switch Circuit
9. POWER MODE VERIFICATION - This step verifies the Power Mode Master is receiving the proper output state of the push button switch. The technician should use the main power mode input, which is the push button switch. The test should not be performed using a key fob, if the MIL is illuminated the powertrain controller may disable this input. The technician is asked to perform the test with the driver door open. This ensures the retained accessory power mode is inactive during this test which could result in different scan tool readings. The technician is only asked to verify the current Power Mode parameter in the power mode data display list. If the parameter does not match the actual vehicle power mode state, a link is provided to perform the **Power Mode Mismatch** diagnostic procedure.
10. REMAINING DTC REVIEW - Here the technician is asked to review any remaining DTCs that were not addressed in previous steps. The technician is asked first to verify there are no control module supply voltage, system voltage or 5 V circuit DTCs present. Control modules, systems or components with insufficient or zero voltage can cause one or multiple symptoms to exist on the vehicle. Control module voltage issues could also be the cause of failures during a programming event. The technician should correct voltage issues prior to addressing any programming or configuration DTCs. The technician should then check for any ECU programming, setup or configuration DTCs. By programming software or configuring a control module, the technician could correct the customer concern unobtrusively. The remaining DTCs, which are usually specific system or component faults, are diagnosed last. They can include ECU input and output circuit DTCs or individual circuit faults that usually cause single symptoms or failure modes on the vehicle and can be fixed following the proper DTC diagnostic procedure. In general, the technician should think about what DTCs or faults could be caused by another DTC or fault. A failed sensor may set a component DTC and then the system may set a DTC indicating the system

cannot operate properly. By correcting the sensor fault, the system may now operate properly and the system level DTC will transition to history. Refer to the examples within each category below to understand the differences between these DTCs. If DTCs of these type are current, the technician is referred to **Diagnostic Trouble Code (DTC) List - Vehicle** to choose the correct DTC diagnostic procedure.

1. Voltage DTCs
    - B1325 Device Power 1 Circuit
    - C0875 Device Voltage Reference Input 2 Circuit
    - C1001 Adaptive Cruise Control Indicators Supply Voltage Circuit
    - P0641 5 V Reference Circuit
    - P0787 Downshift Timing Solenoid Control Circuit Low Voltage
2. Programming, Setup, Configuration or Software Performance DTCs
    - B3943 Steering Column Lock has Not Learned Column Integration Module
    - B101E ECU Software Performance
    - B1019 System Configuration Error
    - C0558 Calibration Data Not Programmed
    - P0630 VIN Not Programmed or Mismatched - Powertrain Control Module (PCM)
3. Component related DTCs
    - B0013 Driver Frontal Deployment Loop Stage 2
    - B0163 Passenger Compartment Temp Sensor Circuit
    - C0045 Left Rear Wheel Speed Sensor Circuit
    - P0565 Cruise Control Switch Circuit
    - P0751 1-2 Shift Solenoid (SS) Valve Performance
4. System related DTCs
    - B1010 System Sensors Data Mismatch
    - C0176 System Thermal Error
    - C0561 System Disabled Information Stored
    - P1564 Vehicle Acceleration Too High - Cruise Control Disabled
    - P1625 Transmission Control Module (TCM) System Reset
5. Any other remaining DTCs - The technician should diagnose and correct any other DTCs that are left that were not from the categories above.

11. EMISSION RELATED INSPECTION/MAINTENANCE TESTING CONCERNS - Several regions require that a vehicle pass on-board diagnostic system tests and the inspection/maintenance emission tests in order to renew license plates or vehicle registration. This is accomplished by viewing the Inspection/Maintenance System Status display on a scan tool. Using a scan tool, the technician can observe the Inspection/Maintenance System Status in order to verify that the vehicle meets the criteria that comply with the local area requirements. If inspection and maintenance checks are required in your region, and the customer concern is related to not passing an Inspection/Maintenance test, a link is provided to **Inspection/Maintenance System Check** where the technician can choose the appropriate Inspection/Maintenance System Check for the actual engine application being used.
12. SYMPTOM DIAGNOSIS - At this step, the diagnostics are assuming that the only information the technician has available to diagnose the customer concern are symptoms of a problem. There are no DTCs set current or history. There may be a Driver Information Center display message or a system indicator to aid in identifying the root cause. The technician should evaluate the symptoms and conditions described by the customer and perform the symptoms diagnostics for the area of customer concern. A link is provided to **Symptoms - Vehicle** which contains a list of all symptoms related to this service manual publication.

DIAGNOSTIC STARTING POINT - VEHICLE

Begin the system diagnosis with **Diagnostic System Check - Vehicle**. The Diagnostic System Check - Vehicle will provide a complete strategy to locate and repair a mechanical or electrical vehicle fault. Not following this strategy may cause additional diagnostic time and/or misdiagnosis.

The Diagnostic System Check - Vehicle will provide the following strategy:

- When to verify the customer concern and identify related bulletins, recalls and preliminary information
- When to identify a control module that is not communicating, a control module that has set a DTC, and the DTC diagnostic priority
- When to address power mode concerns
- When to verify the engine cranks and runs
- When to diagnose symptom related concerns

DIAGNOSTIC SYSTEM CHECK - VEHICLE

Diagnostic Instructions

- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic System Check Instructions** provides an overview of each diagnostic category.
- Continue through the Diagnostic System Check until you are directed to follow a particular diagnostic or repair procedure. Once a repair has been completed, perform the **Diagnostic Repair Verification** and verify the customer concern has been corrected.

The diagnostic procedures within this manual are developed on the assumption that the following areas function as designed:

- The 12 V battery is fully charged and cables are clean and tight. Refer to **Battery Inspection/Test** .
- Fuses are not open. Refer to **Power Distribution Schematics** , and **Electrical Center Identification Views** .
- Ground circuits for the area of customer concern are clean, tight, and in the correct location. Refer to **Ground Distribution Schematics** , and **Harness Routing Views** .
- All connectors/terminals fully seated in the area of concern. Refer to **COMPONENT CONNECTOR END VIEWS - INDEX** .
- There are no aftermarket devices that affect the operation of the system. Refer to **Checking Aftermarket Accessories** .
- The scan tool powers up. Refer to **Scan Tool Does Not Power Up** .

Diagnostic System Check

1. **VERIFY CUSTOMER CONCERN** - Understand and validate the customer concern. Inspect the visible system components for obvious damage or conditions that may cause the concern.
2. **BULLETIN SEARCH** - Check for related bulletins, recalls/field actions, and preliminary information.
3. **MECHANICAL CONCERNS** - Verify the symptom is not exclusively a mechanical concern.
    - **If the symptom is exclusively a mechanical concern**

      Refer to **Symptoms - Vehicle**.

    - **If the symptom is not a mechanical concern**

NOTE: **Do not clear any DTCs unless instructed to do so by a diagnostic procedure. If any DTC is Powertrain related, select Capture Info to store DTC and Freeze Frame/Failure Records to the scan tool.**

4. **VEHICLE POWER UP VERIFICATION** - Vehicle in Service Mode, verify the vehicle powers up.
    - **If the vehicle does not power up**

      Refer to **Power Mode Mismatch** .

    - **If the vehicle powers up**

5. **CONTROL MODULE COMMUNICATION and DTC CHECK** - Using a scan tool, perform the Vehicle DTC Information function and verify at least one control module communicates with the scan tool. Record on the Repair Order the following information:
    - Any control module that is not communicating.
    - Any DTC, including symptom byte, and the control module that has set the DTC.
    - **If the scan tool does not communicate with any control module on the vehicle**

      Refer to Data Link References .

    - **If the scan tool communicates with any control module**
6. **CONTROL MODULE INTERNAL PERFORMANCE FAULTS** - Verify there is no current control module Internal Performance DTCs set.
    - **If any DTC of this type is set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle.

    - **If no DTC of this type is set**
7. **CONTROL MODULE COMMUNICATION VERIFICATION** - Verify the vehicle is not built with any control module listed as not communicating with the scan tool; refer to Data Link References .
    - **If the vehicle is built with a control module that is not communicating**

      Refer to Data Link References .

    - **If all control modules the vehicle is built with are communicating**
8. **COMMUNICATION and POWERMODE FAULTS** - Verify there are no current control module Power Mode or Communication DTCs set.
    - **If any DTC of this type is set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle.

    - **If no DTC of this type is set**

NOTE: **The electric propulsion system will be active in the vehicle ON state during this test. Ensure the vehicle is out of gear and the parking brake is applied. Turn the vehicle power mode to vehicle OFF as soon as the vehicle ON power mode parameter has been observed.**

9. **POWER MODE VERIFICATION** - Driver door open, observe the scan tool Power Mode parameter while cycling the push button switch through all the power modes. Verify the current Power Mode parameter matches the actual vehicle power mode states.
    - **If the Power Mode parameter does not match the vehicle power mode states**

      Refer to Power Mode Mismatch .

    - **If the Power Mode parameter matches the vehicle power mode states**
10. **REMAINING DTC REVIEW** - Verify there are no other DTCs set.
    - **If other DTCs are set**

      Diagnose them in the order listed below. Refer to Diagnostic Trouble Code (DTC) List - Vehicle.

    1. Voltage DTCs
    2. Programming, Setup or Configuration or Software Performance DTCs
    3. Component related DTCs
    4. System related DTCs
    5. Any remaining DTCs
    - **If no other DTCs are set**

11. **EMISSION RELATED INSPECTION/MAINTENANCE TESTING CONCERNS** - If inspection and maintenance checks are required in your region, verify the customer concern is not related to inspection/maintenance testing.
    - **If the customer concern is related to inspection/maintenance testing**

      Refer to **Inspection/Maintenance System Check**.

    - **If the customer concern is not related to inspection/maintenance testing**
12. **SYMPTOM DIAGNOSIS** - Diagnose any remaining customer concern. Refer to **Symptoms - Vehicle**.

POWERTRAIN DIAGNOSTIC TROUBLE CODE (DTC) TYPE DEFINITIONS

Action Taken When the DTC Sets - Type A

- The ECM illuminates the malfunction indicator lamp (MIL) as commanded a diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Action Taken When the DTC Sets - Type B

- The control module illuminates the MIL on the second or third consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC - Type A or Type B

- The control module turns OFF the MIL after 3 or 4 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 Drive Cycles where the DTC runs and passes. The Drive Cycle varies by DTC and can be found in the Conditions for Running the DTC.

Action Taken When the DTC Sets - Type C

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The MIL will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC - Type C

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 Drive Cycles where the DTC runs and passes. The drive cycle varies by DTC and can be found in the Conditions for Running the DTC.
- The DTC can be cleared with a scan tool.

DIAGNOSTIC TROUBLE CODE (DTC) LIST - VEHICLE

This master list includes all applicable diagnostic trouble codes in alphanumeric order.

DTC	Diagnostic Procedure
B0012	Supplemental Restraints - **DTC B0012 or B0013**
B0013	Supplemental Restraints - **DTC B0012 or B0013**

DTC	Diagnostic Procedure
B0014	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0015	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**
B0016	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0017	Supplemental Restraints - **DTC B0017 or B0024**
B0018	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0019	Supplemental Restraints - **DTC B0019 or B0020**
B001A	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**
B001B	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**
B0020	Supplemental Restraints - **DTC B0019 or B0020**
B0021	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0022	Supplemental Restraints - **DTC B0015, B001A, B001B, or B0022**
B0023	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0024	Supplemental Restraints - **DTC B0017 or B0024**
B0025	Supplemental Restraints - **DTC B0016, B0018, B0023, or B0025**
B0031	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0038	Supplemental Restraints - **DTC B0014, B0021, B0031, or B0038**
B0052	Supplemental Restraints - **DTC B0052**
B0071	Supplemental Restraints - **DTC B0071**
B0072	Seat Belts - **DTC B0072 or B0073**
B0073	Seat Belts - **DTC B0072 or B0073**
B0081	Supplemental Restraints - **DTC B0081 (Passenger Presence System)** **DTC B0081 (Inflatable Restraint Sensing and Diagnostic Module)**
B0082	Supplemental Restraints - **DTC B0082**
B0083	Supplemental Restraints - **DTC B0083 or B0084**
B0084	Supplemental Restraints - **DTC B0083 or B0084**
B0085	Supplemental Restraints - **DTC B0085 or B0088**
B0086	Supplemental Restraints - **DTC B0086 or B0087**
B0087	Supplemental Restraints - **DTC B0086 or B0087**
B0088	Supplemental Restraints - **DTC B0085 or B0088**
B0091	Supplemental Restraints - **DTC B0091**
B0092	Supplemental Restraints - **DTC B0092 or B0093**
B0093	Supplemental Restraints - **DTC B0092 or B0093**
B010E	Horns and Pedestrian Alerts - **DTC B010E**
B0173	HVAC - Automatic - **DTC B0173 or B0178**
B0178	HVAC - Automatic - **DTC B0173 or B0178**
B018A	HVAC - Automatic - **DTC B018A, B048C, B048F, or B1395**
B0193	HVAC - Automatic - **DTC B0193**
B0223	HVAC - Automatic - **DTC B0223, B0233, B023A, or B0408**
B0233	HVAC - Automatic - **DTC B0223, B0233, B023A, or B0408**
B023A	HVAC - Automatic - **DTC B0223, B0233, B023A, or B0408**
B0283	Fixed and Moveable Windows - **DTC B0283**
B0408	HVAC - Automatic - **DTC B0223, B0233, B023A, or B0408**
B048C	HVAC - Automatic - **DTC B018A, B048C, B048F, or B1395**
B048E	HVAC - Automatic - **DTC B048E**
B048F	HVAC - Automatic - **DTC B018A, B048C, B048F, or B1395**
B0550	Displays and Gauges - **DTC B0550**
B059A	Seat Belts - **DTC B059A**
B067F	Supplemental Restraints - **DTC B067F or B0680**
B0680	Supplemental Restraints - **DTC B067F or B0680**
B071F	Displays and Gauges - **DTC B071F**
B094C	Object Detection and Pedestrian Protection - **DTC B094C**
B094D	Object Detection and Pedestrian Protection - **DTC B094D OR B094E**

DTC	Diagnostic Procedure
B094E	Object Detection and Pedestrian Protection - DTC B094D OR B094E
B0954	Object Detection and Pedestrian Protection - DTC B0954, B0955, B0956, or B0957
B0955	Object Detection and Pedestrian Protection - DTC B0954, B0955, B0956, or B0957
B0956	Object Detection and Pedestrian Protection - DTC B0954, B0955, B0956, or B0957
B0957	Object Detection and Pedestrian Protection - DTC B0954, B0955, B0956, or B0957
B0958	Object Detection and Pedestrian Protection - DTC B0958, B0959, B0960, or B0961
B0959	Object Detection and Pedestrian Protection - DTC B0958, B0959, B0960, or B0961
B095D	Object Detection and Pedestrian Protection - DTC B095D or B095E
B095E	Object Detection and Pedestrian Protection - DTC B095D or B095E
B0960	Object Detection and Pedestrian Protection - DTC B0958, B0959, B0960, or B0961
B0961	Object Detection and Pedestrian Protection - DTC B0958, B0959, B0960, or B0961
B0967	Object Detection and Pedestrian Protection - DTC B0967 or B0968
B0968	Object Detection and Pedestrian Protection - DTC B0967 or B0968
B096B	Object Detection and Pedestrian Protection - DTC B096B
B096C	Object Detection and Pedestrian Protection - DTC B096C or B096D
B096D	Object Detection and Pedestrian Protection - DTC B096C or B096D
B097B	Wiring Systems and Power Management - DTC B097B
B0987	Object Detection and Pedestrian Protection - DTC B0987
B1000	Data Communications - DTC B1000
B1001	Data Communications - DTC B1001
B1001	Supplemental Restraints - DTC B1001 (Inflatable Restraint Sensing and Diagnostic Module) DTC B1001 (Passenger Presence System)
B1008	Object Detection and Pedestrian Protection - DTC B1008
B1011	Object Detection and Pedestrian Protection - DTC B1011
B1015	Object Detection and Pedestrian Protection - DTC B1015
B1016	Data Communications - DTC B1016
B1019	Supplemental Restraints - DTC B1019
B101D	Data Communications - DTC B101D
B101E	Data Communications - DTC B101E
B123E	Cellular, Entertainment, and Navigation - DTC B123E
B124B	Cellular, Entertainment, and Navigation - DTC B124B
B124F	Cellular, Entertainment, and Navigation - DTC B124F
B125A	Cellular, Entertainment, and Navigation - DTC B125A
B125C	Cellular, Entertainment, and Navigation - DTC B125C
B1265	Cellular, Entertainment, and Navigation - DTC B1265
B1271	Cellular, Entertainment, and Navigation - DTC B1271
B1277	Cellular, Entertainment, and Navigation - DTC B1277
B127B	Object Detection and Pedestrian Protection - DTC B127B
B127E	Cellular, Entertainment, and Navigation - DTC B127E
B1287	Cellular, Entertainment, and Navigation - DTC B1287
B1325	12 V Starting and Charging - DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC
B1330	12 V Starting and Charging - DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC
B1370	Wiring Systems and Power Management - DTC B1370
B1395	Lighting - DTC B1395
B1395	HVAC - Automatic - DTC B018A, B048C, B048F, or B1395
B1405	Object Detection and Pedestrian Protection - DTC B1405
B1445	Wiring Systems and Power Management - DTC B1445
B1446	Cellular, Entertainment, and Navigation - DTC B1446 or B1447
B1447	Cellular, Entertainment, and Navigation - DTC B1446 or B1447
B144A	Wiring Systems and Power Management - DTC B144A

DTC	Diagnostic Procedure
B144B	Wiring Systems and Power Management - **DTC B144B**
B1451	Wiring Systems and Power Management - **DTC B1451**
B1474	Vehicle Access - **DTC B1474 or B3849**
B147E	Wiring Systems and Power Management - **DTC B147E or B147F**
B147F	Wiring Systems and Power Management - **DTC B147E or B147F**
B1480	Lighting - **DTC B1480**
B1516	12 V Starting and Charging - **DTC B1516**
B1517	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
B151A	12 V Starting and Charging - **DTC B151A**
B1527	12 V Starting and Charging - **DTC B1527**
B1534	Vehicle Access - **DTC B1534 or B1535**
B1535	Vehicle Access - **DTC B1534 or B1535**
B154A	Mirrors - **DTC B154A or B154B**
B154B	Mirrors - **DTC B154A or B154B**
B191A	Seat Heating and Cooling - **DTC B191A or B191B**
B191B	Seat Heating and Cooling - **DTC B191A or B191B**
B2455	Cellular, Entertainment, and Navigation - **DTC B2455**
B2462	Cellular, Entertainment, and Navigation - **DTC B2462**
B2470	Cellular, Entertainment, and Navigation - **DTC B2470**
B2476	Cellular, Entertainment, and Navigation - **DTC B2476 or B2482**
B2482	Cellular, Entertainment, and Navigation - **DTC B2476 or B2482**
B2540	Lighting - **DTC B2540**
B2545	Lighting - **DTC B2545**
B2570	Lighting - **DTC B2570**
B257A	Lighting - **DTC B257A**
B2580	Lighting - **DTC B2580**
B2585	Lighting - **DTC B2585 or B3867**
B258A	Lighting - **DTC B258A**
B2600	Lighting - **DTC B2600 or B2605**
B2605	Lighting - **DTC B2600 or B2605**
B2610	Lighting - **DTC B2610**
B2615	Lighting - **DTC B2615**
B2625	Lighting - **DTC B2625**
B2745	Antilock Brake System - **DTC B2745**
B274E	Horns and Pedestrian Alerts - **DTC B274E or B274F**
B274F	Horns and Pedestrian Alerts - **DTC B274E or B274F**
B2955	Immobilizer - **DTC B2955**
B297B	Vehicle Access - **DTC B297B or B297C**
B297C	Vehicle Access - **DTC B297B or B297C**
B2A00	Electronic Transmission Range Select - **DTC B2A00**
B3006	Bolted Exterior Body Panels and Closures - **DTC B3006**
B302A	Immobilizer - **DTC B302A**
B3031	Immobilizer - **DTC B3031**
B3055	Immobilizer - **DTC B3055**
B305C	Immobilizer - **DTC B305C**
B305D	Remote Functions - **DTC B305D**
B305E	Wiring Systems and Power Management - **DTC B305E**
B3060	Immobilizer - **DTC B3060**
B3101	Remote Functions - **DTC B3101**
B3105	Remote Functions - **DTC B3105**
B3106	Remote Functions - **DTC B3106**

DTC	Diagnostic Procedure
B3109	Remote Functions - **DTC B3109-B3113**
B310D	Remote Functions - **DTC B310D-B310F**
B310E	Remote Functions - **DTC B310D-B310F**
B310F	Remote Functions - **DTC B310D-B310F**
B3110	Remote Functions - **DTC B3109-B3113**
B3111	Remote Functions - **DTC B3109-B3113**
B3112	Remote Functions - **DTC B3109-B3113**
B3113	Remote Functions - **DTC B3109-B3113**
B3119	Remote Functions - **DTC B3119**
B3120	Remote Functions - **DTC B3120**
B3121	Remote Functions - **DTC B3121**
B3122	Remote Functions - **DTC B3122**
B3123	Remote Functions - **DTC B3123**
B3124	Remote Functions - **DTC B3124**
B3125	Vehicle Access - **DTC B3125, B3130, or B3135**
B3130	Vehicle Access - **DTC B3125, B3130, or B3135**
B3135	Vehicle Access - **DTC B3125, B3130, or B3135**
B3140	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B3145	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B3150	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B3155	Vehicle Access - **DTC B3140, B3145, B3150, or B3155**
B316B	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B317A	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B318A	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B319A	Fixed and Moveable Windows - **DTC B316B, B317A, B318A, or B319A**
B3205	Fixed and Moveable Windows - **DTC B3205**
B3245	Vehicle Access - **DTC B324A or B3245**
B324A	Vehicle Access - **DTC B324A or B3245**
B356A	Object Detection and Pedestrian Protection - **DTC B356A**
B3588	Lighting - **DTC B3588**
B3596	Lighting - **DTC B3596**
B3600	Lighting - **DTC B3600**
B3622	Secondary and Configurable Customer Controls - **DTC B3622**
B3650	Lighting - **DTC B3650**
B370A	Wipers and Washers - **DTC B370A**
B370B	Wipers and Washers - **DTC B370B**
B371A	Wipers and Washers - **DTC B371A**
B371C	Wipers and Washers - **DTC B371C**
B3794	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
B3806	Lighting - **DTC B3806**
B3811	Wipers and Washers - **DTC B3811**
B3844	HVAC - Automatic - **DTC B3844**
B3849	Vehicle Access - **DTC B1474 or B3849**
B3867	Lighting - **DTC B2585 or B3867**
B3873	Wipers and Washers - **DTC B3873**
B3881	Lighting - **DTC B3881 or B3882 (MBM)** **DTC B3881 or B3882 (MAH/MBC/MAW/MCX)**
B3882	Lighting - **DTC B3881 or B3882 (MBM)** **DTC B3881 or B3882 (MAH/MBC/MAW/MCX)**
B3883	Lighting - **DTC B3883**
B3884	Lighting - **DTC B3884**

DTC	Diagnostic Procedure
B388B	Lighting - **DTC B388B or B388C (MBM)** **DTC B388B or B388C (MAH/MBC/MAW/MCX)**
B388C	Lighting - **DTC B388B or B388C (MBM)** **DTC B388B or B388C (MAH/MBC/MAW/MCX)**
B3890	Lighting - **DTC B3890 or B3891 (MBM)** **DTC B3890 or B3891 (MAH/MBC/MAW/MCX)**
B3891	Lighting - **DTC B3890 or B3891 (MBM)** **DTC B3890 or B3891 (MAH/MBC/MAW/MCX)**
B389A	Immobilizer - **DTC B389A**
B3902	Immobilizer - **DTC B3902**
B390D	Object Detection and Pedestrian Protection - **DTC B390D**
B390F	Object Detection and Pedestrian Protection - **DTC B390F**
B3924	Immobilizer - **DTC B3924-B3928**
B3925	Immobilizer - **DTC B3924-B3928**
B3926	Immobilizer - **DTC B3924-B3928**
B3927	Immobilizer - **DTC B3924-B3928**
B3928	Immobilizer - **DTC B3924-B3928**
B3935	Immobilizer - **DTC B3935**
B3948	Lighting - **DTC B3948 or B3949**
B3949	Lighting - **DTC B3948 or B3949**
B3950	Lighting - **DTC B3950 or B3951**
B3951	Lighting - **DTC B3950 or B3951**
B395A	Object Detection and Pedestrian Protection - **DTC B395A**
B395B	Object Detection and Pedestrian Protection - **DTC B395B**
B395C	Object Detection and Pedestrian Protection - **DTC B395C**
B3976	Immobilizer - **DTC B3976**
B3984	Immobilizer - **DTC B3984**
B399A	Object Detection and Pedestrian Protection - **DTC B399A**
B399B	Object Detection and Pedestrian Protection - **DTC B399B**
B399C	Object Detection and Pedestrian Protection - **DTC B399C**
B399D	Object Detection and Pedestrian Protection - **DTC B399D**
C0035	Antilock Brake System **DTC C0035-C0051**
C0036	Antilock Brake System **DTC C0035-C0051**
C0037	Antilock Brake System **DTC C0035-C0051**
C0038	Antilock Brake System **DTC C0035-C0051**
C0039	Antilock Brake System **DTC C0035-C0051**
C0040	Antilock Brake System **DTC C0035-C0051**
C0041	Antilock Brake System **DTC C0035-C0051**
C0042	Antilock Brake System **DTC C0035-C0051**
C0043	Antilock Brake System **DTC C0035-C0051**
C0044	Antilock Brake System **DTC C0035-C0051**
C0045	Antilock Brake System **DTC C0035-C0051**
C0046	Antilock Brake System **DTC C0035-C0051**
C0047	Antilock Brake System **DTC C0035-C0051**
C0048	Antilock Brake System **DTC C0035-C0051**
C0049	Antilock Brake System **DTC C0035-C0051**
C0050	Antilock Brake System **DTC C0035-C0051**
C0051	Antilock Brake System **DTC C0035-C0051**
C0055	Antilock Brake System - **DTC C0055**
C005A	Antilock Brake System - **DTC C005A**
C0075	Hydraulic Brakes - **DTC C0075**
C0110	Antilock Brake System **DTC C0110**
C0115	Antilock Brake System - **DTC C0115**

DTC	Diagnostic Procedure
C0116	Antilock Brake System **DTC C0116**
C0121	Antilock Brake System **DTC C0121**
C0126	Hydraulic Brakes - **DTC C0126**
C0131	Antilock Brake System - **DTC C0131**
C0161	Antilock Brake System **DTC C0161**
C0176	Power Steering - **DTC C0176**
C0179	Antilock Brake System - **DTC C0179**
C0186	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287**
C018B	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287**
C0196	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287**
C019B	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287**
C0245	Antilock Brake System **DTC C0245**
C0267	Hydraulic Brakes - **DTC C0267**
C0274	Antilock Brake System - **DTC C0274**
C0277	Lighting - **DTC C0277 or C0890**
C027E	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287**
C0280	Antilock Brake System - **DTC C0280**
C0287	Antilock Brake System - **DTC C0186, C018B, C0196, C019B, C027E, or C0287**
C028B	Park Brake - **DTC C028B**
C028F	Park Brake - **DTC C028F**
C0293	Park Brake - **DTC C0293**
C0297	Lighting - **DTC C0297**
C029F	Hydraulic Brakes - **DTC C029F**
C0460	Power Steering - **DTC C0460**
C0545	Power Steering - **DTC C0545**
C0561	Antilock Brake System - **DTC C0561**
C0569	Antilock Brake System - **DTC C0569**
C0569	Tire Pressure Monitoring - **DTC C0569**
C056D	Data Communications - **DTC C056D**
C056E	Data Communications - **DTC C056E**
C056E	Power Steering - **DTC C056E**
C0579	Hydraulic Brakes - **DTC C0579, C057A, or C057E**
C057A	Hydraulic Brakes - **DTC C0579, C057A, or C057E**
C057E	Hydraulic Brakes - **DTC C0579, C057A, or C057E**
C057F	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C0580	Hydraulic Brakes - **DTC C0580 or C0594**
C0582	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C058A	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C0590	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C0591	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C0594	Hydraulic Brakes - **DTC C0580 or C0594**
C0595	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C0596	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C0750	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**
C0755	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**
C0760	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**

DTC	Diagnostic Procedure
C0765	Tire Pressure Monitoring - **DTC C0750, C0755, C0760, or C0765**
C0775	Tire Pressure Monitoring - **DTC C0775**
C0800	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
C0890	Lighting - **DTC C0277 or C0890**
C0899	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
C0900	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
C10EA	Antilock Brake System - **DTC C10EA**
C10EB	Antilock Brake System - **DTC C10EB**
C1200	Antilock Brake System - **DTC C1200**
C1201	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
C1217	Automatic Transmission - 1ET25 (MMF) - **DTC C1217, C1301, or C1302**
C124F	Antilock Brake System - **DTC C124F or C1250-C1254**
C1250	Antilock Brake System - **DTC C124F or C1250-C1254**
C1251	Antilock Brake System - **DTC C124F or C1250-C1254**
C1252	Antilock Brake System - **DTC C124F or C1250-C1254**
C1253	Antilock Brake System - **DTC C124F or C1250-C1254**
C1254	Antilock Brake System - **DTC C124F or C1250-C1254**
C1275	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C1276	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C1277	Hydraulic Brakes - **DTC C057F, C0582, C058A, C0590, C0591, C0595, C0596, or C1275-C1277**
C1278	Hydraulic Brakes - **DTC C1278 or C1279**
C1279	Hydraulic Brakes - **DTC C1278 or C1279**
C1280	Park Brake - **DTC C1280 or C1281**
C1280	Electronic Transmission Range Select - **DTC C1280**
C1281	Park Brake - **DTC C1280 or C1281**
C1284	Antilock Brake System **DTC C1284 or C1285**
C1285	Antilock Brake System **DTC C1284 or C1285**
C1286	Antilock Brake System **DTC C1286**
C1287	Antilock Brake System **DTC C1287**
C12E1	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
C12E2	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
C1301	Automatic Transmission - 1ET25 (MMF) - **DTC C1217, C1301, or C1302**
C1302	Automatic Transmission - 1ET25 (MMF) - **DTC C1217, C1301, or C1302**
C1303	Park Brake - **DTC C1303**
C1449	Hydraulic Brakes - **DTC C1449**
C1586	Park Brake - **DTC C1586 (HEV)**
C1587	Park Brake - **DTC C1587 (HEV)**
C1588	Park Brake - **DTC C1588 (HEV)**
P0071	Displays and Gauges - **DTC P0071-P0074**
P0072	Displays and Gauges - **DTC P0071-P0074**
P0073	Displays and Gauges - **DTC P0071-P0074**
P0074	Displays and Gauges - **DTC P0071-P0074**
P0480	Hybrid/EV System Heating and Cooling - **DTC P0480**

DTC	Diagnostic Procedure
P0513	Immobilizer - **DTC P0513**
P0532	HVAC - Automatic - **DTC P0532 or P0533**
P0533	HVAC - Automatic - **DTC P0532 or P0533**
P0534	HVAC - Automatic - **DTC P0534**
P0561	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
P0562	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
P0563	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
P0564	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0565	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0567	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0568	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P056C	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0572	Cruise Control - **DTC P0572 or P0573**
P0573	Cruise Control - **DTC P0572 or P0573**
P0575	Cruise Control - **DTC P0575**
P057B	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P057B	Hybrid/EV Controls - **DTC P057B-P057E**
P057C	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P057C	Hybrid/EV Controls - **DTC P057B-P057E**
P057D	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P057D	Hybrid/EV Controls - **DTC P057B-P057E**
P057E	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P057E	Hybrid/EV Controls - **DTC P057B-P057E**
P0580	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P0581	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P059F	Bumpers and Fascias - **DTC P059F or P151E**
P05DC	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P05DD	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P05DE	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P05DF	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P05E0	Hydraulic Brakes - **DTC P057B-P057E, P05DC-P05DF, or P05E0**
P0601	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - **DTC P0601-P0604, P0606, or P062F (Hybrid Powertrain Control Module 1)**
P0601	Hybrid/EV Controls - ECM - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P0601	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P0601	Hydraulic Brakes - **DTC P0601, P0603, P0604, P0606, P060B, or P062F**
P0602	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - **DTC P0601-P0604, P0606, or P062F (Hybrid Powertrain Control Module 1)**
P0602	Hybrid/EV Controls - ECM - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P0602	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**

DTC	Diagnostic Procedure
P0603	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - **DTC P0601-P0604, P0606, or P062F (Hybrid Powertrain Control Module 1)**
P0603	Hybrid/EV Controls - ECM - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P0603	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P0603	Hydraulic Brakes - **DTC P0601, P0603, P0604, P0606, P060B, or P062F**
P0604	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - **DTC P0601-P0604, P0606, or P062F (Hybrid Powertrain Control Module 1)**
P0604	Hybrid/EV Controls - ECM - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P0604	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P0604	Hydraulic Brakes - **DTC P0601, P0603, P0604, P0606, P060B, or P062F**
P0605	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P0606	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P0606	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - **DTC P0601-P0604, P0606, or P062F (Hybrid Powertrain Control Module 1)**
P0606	Hybrid/EV Controls - ECM - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P0606	Hydraulic Brakes - **DTC P0601, P0603, P0604, P0606, P060B, or P062F**
P0607	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P060A	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P060B	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P060B	Hydraulic Brakes - **DTC P0601, P0603, P0604, P0606, P060B, or P062F**
P060C	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P061B	Hybrid/EV Controls - **DTC P061B**
P062F	Hybrid/EV Controls - Hybrid Powertrain Control Module 1 - **DTC P0601-P0604, P0606, or P062F (Hybrid Powertrain Control Module 1)**
P062F	Hybrid/EV Controls - ECM - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P062F	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P062F	Hydraulic Brakes - **DTC P0601, P0603, P0604, P0606, P060B, or P062F**
P0630	Hybrid/EV Controls - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P0633	Immobilizer - **DTC P0633**
P0641	Hybrid/EV Controls - **DTC P0641, P0651, P0697, or P06A3**
P0642	Hydraulic Brakes - **DTC P0642, P06A6, or P06A7**
P0650	Hybrid/EV Controls - **DTC P0650, P263A, or P263B**
P0651	Hybrid/EV Controls - **DTC P0641, P0651, P0697, or P06A3**
P0685	Hybrid/EV Controls - **DTC P0685-P0687, P0689, P0690, or P1682**
P0686	Hybrid/EV Controls - **DTC P0685-P0687, P0689, P0690, or P1682**
P0687	Hybrid/EV Controls - **DTC P0685-P0687, P0689, P0690, or P1682**
P0689	Hybrid/EV Controls - **DTC P0685-P0687, P0689, P0690, or P1682**
P0690	Hybrid/EV Controls - **DTC P0685-P0687, P0689, P0690, or P1682**
P0697	Hybrid/EV Controls - **DTC P0641, P0651, P0697, or P06A3**
P06A3	Hybrid/EV Controls - **DTC P0641, P0651, P0697, or P06A3**
P06A6	Hydraulic Brakes - **DTC P0642, P06A6, or P06A7**

DTC	Diagnostic Procedure
P06A7	Hydraulic Brakes - **DTC P0642, P06A6, or P06A7**
P06AF	Hybrid/EV Controls - **DTC P06AF**
P06B1	Hybrid/EV Controls - **DTC P06B1 or P06B2**
P06B2	Hybrid/EV Controls - **DTC P06B1 or P06B2**
P06E4	Data Communications - **DTC P06E4 (Hybrid/EV Powertrain Control Module 2)**
P0703	Cruise Control - **DTC P0703**
P0711	Automatic Transmission - 1ET25 (MMF) - **DTC P0711-P0713**
P0712	Automatic Transmission - 1ET25 (MMF) - **DTC P0711-P0713**
P0713	Automatic Transmission - 1ET25 (MMF) - **DTC P0711-P0713**
P073D	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P1769, or P1789**
P073E	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P1769, or P1789**
P07B3	Electronic Transmission Range Select - **DTC P07B3-P07B5**
P07B4	Electronic Transmission Range Select - **DTC P07B3-P07B5**
P07B9	Electronic Transmission Range Select - **DTC P07B9-P07BB**
P07BA	Electronic Transmission Range Select - **DTC P07B9-P07BB**
P07BB	Electronic Transmission Range Select - **DTC P07B9-P07BB**
P07B5	Electronic Transmission Range Select - **DTC P07B3-P07B5**
P07BE	Electronic Transmission Range Select - **DTC P07BE or P17F3**
P07E4	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P1769, or P1789**
P07E5	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P1769, or P1789**
P082A	Electronic Transmission Range Select - **DTC P082A-P082F**
P082B	Electronic Transmission Range Select - **DTC P082A-P082F**
P082C	Electronic Transmission Range Select - **DTC P082A-P082F**
P082D	Electronic Transmission Range Select - **DTC P082A-P082F**
P082E	Electronic Transmission Range Select - **DTC P082A-P082F**
P082F	Electronic Transmission Range Select - **DTC P082A-P082F**
P0856	Antilock Brake System - **DTC P0856**
P089B	Electronic Transmission Range Select - **DTC P089B-P089D or P08A0-P08A2**
P089C	Electronic Transmission Range Select - **DTC P089B-P089D or P08A0-P08A2**
P089D	Electronic Transmission Range Select - **DTC P089B-P089D or P08A0-P08A2**
P08A0	Electronic Transmission Range Select - **DTC P089B-P089D or P08A0-P08A2**
P08A1	Electronic Transmission Range Select - **DTC P089B-P089D or P08A0-P08A2**
P08A2	Electronic Transmission Range Select - **DTC P089B-P089D or P08A0-P08A2**
P0A0C	Hybrid/EV Energy Storage - **DTC P0A0C or P0A0D**
P0A0D	Hybrid/EV Energy Storage - **DTC P0A0C or P0A0D**
P0A1F	Data Communications - **DTC P0A1F, P1A01, P1A05, or P1A06**
P0A3F	Hybrid/EV Controls - **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**
P0A40	Hybrid/EV Controls - **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**
P0A5E	Hybrid/EV Controls - **DTC P0A5E, P0A61, or P0A64**
P0A61	Hybrid/EV Controls - **DTC P0A5E, P0A61, or P0A64**
P0A64	Hybrid/EV Controls - **DTC P0A5E, P0A61, or P0A64**
P0A78	Hybrid/EV Controls - **DTC P0A78**
P0A7E	Hybrid/EV System Heating and Cooling - **DTC P0A7E**
P0A7F	Hybrid/EV Energy Storage - **DTC P0A7F**
P0A8D	Hybrid/EV Controls - **DTC P0A8D or P0A8F**
P0A8F	Hybrid/EV Controls - **DTC P0A8D or P0A8F**

DTC	Diagnostic Procedure
P0A9C	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0A9D	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0A9E	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AA1	Hybrid/EV Energy Storage - **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**
P0AA4	Hybrid/EV Energy Storage - **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**
P0AA6	Hybrid/EV Energy Storage - **DTC P0AA6 or P1AE6**
P0ABB	Hybrid/EV Energy Storage - **DTC P0ABB, P0ABC, or P0ABD**
P0ABC	Hybrid/EV Energy Storage - **DTC P0ABB, P0ABC, or P0ABD**
P0ABD	Hybrid/EV Energy Storage - **DTC P0ABB, P0ABC, or P0ABD**
P0AC1	Hybrid/EV Energy Storage - **DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB**
P0AC2	Hybrid/EV Energy Storage - **DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB**
P0AC4	Hybrid/EV Controls - **DTC P0AC4, P1E00, P25A2, P25C9, or P26C8**
P0AC6	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AC7	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AC8	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AC9	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0ACA	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0ACB	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0ACC	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0ACD	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AD9	Hybrid/EV Energy Storage - **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**
P0ADD	Hybrid/EV Energy Storage - **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**
P0AE4	Hybrid/EV Energy Storage - **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**
P0AE9	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AEA	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AEB	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0AEE	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0AEF	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0AF0	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0AF7	12 V Starting and Charging - **DTC P0AF7**
P0AF8	Hybrid/EV Energy Storage - **DTC P0AF8**

DTC	Diagnostic Procedure
P0AFA	Hybrid/EV Energy Storage - **DTC P0AFA or P0AFB**
P0AFB	Hybrid/EV Energy Storage - **DTC P0AFA or P0AFB**
P0B10	Hybrid/EV Energy Storage - **DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB**
P0B11	Hybrid/EV Energy Storage - **DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB**
P0B13	Hybrid/EV Energy Storage - **DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB**
P0B3B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B3C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B3D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B3E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B40	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B41	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B42	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B43	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B45	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B46	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B47	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B48	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B4A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B4B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B4C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B4D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B4F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B50	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B51	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B52	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B54	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B55	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B56	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B57	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P0B59	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B5A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B5B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B5C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B5E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B5F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B60	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B61	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B63	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B64	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B65	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B66	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B68	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B69	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B6A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B6B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B6D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B6E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B6F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B70	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B72	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B73	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B74	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B75	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B77	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B78	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B79	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B7A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P0B7C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B7D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B7E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B7F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B81	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B82	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B83	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B84	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B86	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B87	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B88	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B89	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B8B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B8C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B8D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B8E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B90	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B91	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B92	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B93	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B95	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B96	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B97	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B98	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B9A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B9B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B9C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0B9D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P0B9F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA2	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA7	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BA9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BAA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BAB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BAC	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BAE	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BAF	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB3	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB8	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BB9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BBA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BBB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P0BC3	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0BC4	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0BC5	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0BD2	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**

DTC	Diagnostic Procedure
P0BD3	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0BD4	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0BDC	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0BDD	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0BDE	Hybrid/EV Controls - **DTC P0AEE, P0AEF, P0AF0, P0BD2-P0BD4, or P0BDC-P0BDE**
P0BE6	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BE7	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BE8	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BEA	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BEB	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BEC	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BEE	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BEF	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BF0	Hybrid/EV Controls - **DTC P0BE6-P0BE8, P0BEA-P0BEC, P0BEE, P0BEF, or P0BF0**
P0BFD	Hybrid/EV Controls - **DTC P0BFD**
P0C01	Hybrid/EV Controls - **DTC P0C01**
P0C0B	Hybrid/EV Controls - **DTC P0C0B**
P0C11	Hybrid/EV Controls - **DTC P0C11-P0C13**
P0C12	Hybrid/EV Controls - **DTC P0C11-P0C13**
P0C13	Hybrid/EV Controls - **DTC P0C11-P0C13**
P0C17	Hybrid/EV Controls - **DTC P0C17 or P1B0F**
P0C19	Hybrid/EV Controls - **DTC P0C19**
P0C2D	Hybrid/EV Controls - **DTC P0C2D or P0C2E**
P0C2E	Hybrid/EV Controls - **DTC P0C2D or P0C2E**
P0C34	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0C35	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0C36	Hybrid/EV System Heating and Cooling - **DTC P0A9C-P0A9E, P0AC6-P0ACD, P0AE9-P0AEB, P0BC3-P0BC5, or P0C34-P0C36**
P0C43	Hybrid/EV System Heating and Cooling - **DTC P0C43-P0C46**
P0C44	Hybrid/EV System Heating and Cooling - **DTC P0C43-P0C46**
P0C45	Hybrid/EV System Heating and Cooling - **DTC P0C43-P0C46**
P0C46	Hybrid/EV System Heating and Cooling - **DTC P0C43-P0C46**
P0C47	Hybrid/EV System Heating and Cooling - **DTC P0C47, P1E8C, or P1E8D**
P0C4E	Hybrid/EV Controls - **DTC P0C4E**
P0C52	Hybrid/EV Controls - **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**
P0C53	Hybrid/EV Controls - **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**

DTC	Diagnostic Procedure
P0C5C	Hybrid/EV Controls - **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**
P0C5D	Hybrid/EV Controls - **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**
P0C76	Hybrid/EV Controls - **DTC P0C76**
P0C78	Hybrid/EV Energy Storage - **DTC P0C78 or P3061**
P0CCC	Vehicle Access - **DTC P0CCC, P0CCE, or P0CCF**
P0CCE	Vehicle Access - **DTC P0CCC, P0CCE, or P0CCF**
P0CCF	Vehicle Access - **DTC P0CCC, P0CCE, or P0CCF**
P0CE9	Hybrid/EV System Heating and Cooling - **DTC P0CE9, P1F44, or P1F45**
P0CEF	Hybrid/EV System Heating and Cooling - **DTC P0CEF-P0CF2**
P0CF0	Hybrid/EV System Heating and Cooling - **DTC P0CEF-P0CF2**
P0CF1	Hybrid/EV System Heating and Cooling - **DTC P0CEF-P0CF2**
P0CF2	Hybrid/EV System Heating and Cooling - **DTC P0CEF-P0CF2**
P0CF4	Plug-In Charging - **DTC P0CF4-P0CF6 (North America, Korea)**
P0CF5	Plug-In Charging - **DTC P0CF4-P0CF6 (North America, Korea)**
P0CF6	Plug-In Charging - **DTC P0CF4-P0CF6 (North America, Korea)**
P0CF9	Plug-In Charging - **DTC P0CF9 or P0D01**
P0D01	Plug-In Charging - **DTC P0CF9 or P0D01**
P0D09	Hybrid/EV Energy Storage - **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**
P0D0A	Hybrid/EV Energy Storage - **DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3**
P0D1F	Plug-In Charging - **DTC P0D1F**
P0D26	Plug-In Charging - **DTC P0D26**
P0D2B	Plug-In Charging - **DTC P0D2B or P0D2C**
P0D2C	Plug-In Charging - **DTC P0D2B or P0D2C**
P0D3E	Plug-In Charging - **DTC P0D3E-P0D40**
P0D3F	Plug-In Charging - **DTC P0D3E-P0D40**
P0D40	Plug-In Charging - **DTC P0D3E-P0D40**
P0D4D	Plug-In Charging - **DTC P0D4D-P0D4F**
P0D4E	Plug-In Charging - **DTC P0D4D-P0D4F**
P0D4F	Plug-In Charging - **DTC P0D4D-P0D4F**
P0D57	Plug-In Charging - **DTC P0D57-P0D59 (North America, Korea)**
P0D58	Plug-In Charging - **DTC P0D57-P0D59 (North America, Korea)**
P0D59	Plug-In Charging - **DTC P0D57-P0D59 (North America, Korea)**
P0D5A	Plug-In Charging - **DTC P0D5A**
P0D5E	Plug-In Charging - **DTC P0D5E**
P0D69	HVAC - Automatic - **DTC P0D69-P0D7F**
P0D6A	HVAC - Automatic - **DTC P0D69-P0D7F**
P0D6B	HVAC - Automatic - **DTC P0D69-P0D7F**
P0D6C	HVAC - Automatic - **DTC P0D69-P0D7F**
P0D6D	HVAC - Automatic - **DTC P0D69-P0D7F**
P0D6E	HVAC - Automatic - **DTC P0D69-P0D7F**
P0D6F	HVAC - Automatic - **DTC P0D69-P0D7F**
P0E61	Plug-In Charging - **DTC P0E61 or P0E65**
P0E65	Plug-In Charging - **DTC P0E61 or P0E65**
P1485	Hybrid/EV System Heating and Cooling - **DTC P1485-P1487**
P1486	Hybrid/EV System Heating and Cooling - **DTC P1485-P1487**
P1487	Hybrid/EV System Heating and Cooling - **DTC P1485-P1487**
P148A	Hybrid/EV System Heating and Cooling - **DTC P148A-P148C**
P148B	Hybrid/EV System Heating and Cooling - **DTC P148A-P148C**
P148C	Hybrid/EV System Heating and Cooling - **DTC P148A-P148C**

DTC	Diagnostic Procedure
P150D	Hybrid/EV Controls - **DTC P150D or P150E**
P150E	Hybrid/EV Controls - **DTC P150D or P150E**
P151C	HVAC - Automatic - **DTC P151C or P2516-P2518**
P151E	Bumpers and Fascias - **DTC P059F or P151E**
P152A	Automatic Transmission - 1ET25 (MMF) - **DTC P152A or P152D**
P152C	Automatic Transmission - 1ET25 (MMF) - **DTC P152C**
P152D	Automatic Transmission - 1ET25 (MMF) - **DTC P152A or P152D**
P152E	Automatic Transmission - 1ET25 (MMF) - **DTC P152E**
P154F	HVAC - Automatic - **DTC P154F**
P155A	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P155B	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P155C	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P156A	HVAC - Automatic - **DTC P156A-P156C**
P156B	HVAC - Automatic - **DTC P156A-P156C**
P156C	HVAC - Automatic - **DTC P156A-P156C**
P158A	Cruise Control - **DTC P158A**
P15B9	Wiring Systems and Power Management - **DTC P15B9 or P15BA**
P15BA	Wiring Systems and Power Management - **DTC P15B9 or P15BA**
P15C6	HVAC - Automatic - **DTC P15C6 or P15C8-P15CB**
P15C8	HVAC - Automatic - **DTC P15C6 or P15C8-P15CB**
P15C9	HVAC - Automatic - **DTC P15C6 or P15C8-P15CB**
P15CA	HVAC - Automatic - **DTC P15C6 or P15C8-P15CB**
P15CB	HVAC - Automatic - **DTC P15C6 or P15C8-P15CB**
P15F1	Hybrid/EV Controls - **DTC P15F1**
P15F6	Object Detection and Pedestrian Protection - **DTC P15F6**
P15F8	Antilock Brake System - **DTC P15F8**
P15FC	Hybrid/EV Controls - **DTC P15FC**
P162B	Immobilizer - **DTC P162B**
P162C	Cruise Control - **Cruise Control Malfunction - DTC B3794, P0564, P0565, P0567, P0568, P056C, P0580, P0581, P155A-P155C, or P162C**
P1631	Immobilizer - **DTC P1631**
P1649	Immobilizer - **DTC P1649**
P1682	Hybrid/EV Controls - **DTC P0685-P0687, P0689, P0690, or P1682**
P16B7	Data Communications - **DTC P16B7**
P16B8	Data Communications - **DTC P16B8-P16BA**
P16B9	Data Communications - **DTC P16B8-P16BA**
P16BA	Data Communications - **DTC P16B8-P16BA**
P16E8	Wiring Systems and Power Management - **DTC P16E8**
P16E9	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P16F0	Data Communications - **DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B**
P16F3	Hybrid/EV Controls - **DTC P16F3**
P16F3	Hybrid/EV Controls - ECM - **DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)**
P16F4	Hybrid/EV Controls - **DTC P16F4**
P16F4	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P16FF	Hybrid/EV Controls - **DTC P16FF**

DTC	Diagnostic Procedure
P173A	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P173B	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P173C	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P173D	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P173E	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P173F	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P174B	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P174C	Electronic Transmission Range Select - **DTC P174C**
P174D	Electronic Transmission Range Select - **DTC P174D or P17AB**
P175F	Automatic Transmission - 1ET25 (MMF) - **DTC P175F**
P1762	Automatic Transmission - 1ET25 (MMF) - **DTC P1762**
P1769	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P1769, or P1789**
P1771	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P1772	Electronic Transmission Range Select - **DTC P1772, P1773, P1775, or P1778**
P1773	Electronic Transmission Range Select - **DTC P1772, P1773, P1775, or P1778**
P1774	Electronic Transmission Range Select - **DTC P1774 or P177A**
P1775	Automatic Transmission - 1ET25 (MMF) - **DTC P1775**
P1775	Electronic Transmission Range Select - **DTC P1772, P1773, P1775, or P1778**
P1778	Electronic Transmission Range Select - **DTC P1772, P1773, P1775, or P1778**
P177A	Electronic Transmission Range Select - **DTC P1774 or P177A**
P1787	Electronic Transmission Range Select - **DTC P1787 or P17C8**
P1789	Electronic Transmission Range Select - **DTC P073D, P073E, P07E4, P07E5, P1769, or P1789**
P178B	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P178C	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P178D	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P178E	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17A3	Electronic Transmission Range Select - **DTC P17A3-P17A5**
P17A4	Electronic Transmission Range Select - **DTC P17A3-P17A5**
P17A5	Electronic Transmission Range Select - **DTC P17A3-P17A5**
P17A6	Electronic Transmission Range Select - **DTC P17A6 or P17F4**

DTC	Diagnostic Procedure
P17A7	Electronic Transmission Range Select - **DTC P17A7-P17A9**
P17A8	Electronic Transmission Range Select - **DTC P17A7-P17A9**
P17A9	Electronic Transmission Range Select - **DTC P17A7-P17A9**
P17AA	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17AB	Electronic Transmission Range Select - **DTC P174D or P17AB**
P17AC	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17AD	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17AE	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B1	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B2	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B3	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B3	Wiring Systems and Power Management - **DTC P17B3 or P17B4**
P17B4	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B4	Wiring Systems and Power Management - **DTC P17B3 or P17B4**
P17B5	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B5	Wiring Systems and Power Management - **DTC P17B5**
P17B6	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B7	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B8	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17B9	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17BA	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17BB	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17BC	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**

DTC	Diagnostic Procedure
P17BD	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17BE	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17BF	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17C8	Electronic Transmission Range Select - **DTC P1787 or P17C8**
P17CB	Electronic Transmission Range Select - **DTC P17CB**
P17CF	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17D5	Electronic Transmission Range Select - **DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5**
P17F3	Electronic Transmission Range Select - **DTC P07BE or P17F3**
P17F4	Electronic Transmission Range Select - **DTC P17A6 or P17F4**
P1824	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P182A	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P182B	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P182C	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P182D	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P182E	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P182F	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P1838	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P1839	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P1840	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P1841	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18B5	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18B6	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18B7	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18B8	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18B9	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18BA	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18BC	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**

DTC	Diagnostic Procedure
P18BF	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18C0	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18C2	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P18C3	Automatic Transmission - 1ET25 (MMF) - **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3**
P190A	Hybrid/EV Controls - **DTC P190A-P190C**
P190B	Hybrid/EV Controls - **DTC P190A-P190C**
P190C	Hybrid/EV Controls - **DTC P190A-P190C**
P19FA	Hybrid/EV System Heating and Cooling - **DTC P19FA-P19FC**
P19FB	Hybrid/EV System Heating and Cooling - **DTC P19FA-P19FC**
P19FC	Hybrid/EV System Heating and Cooling - **DTC P19FA-P19FC**
P19FD	Hybrid/EV System Heating and Cooling - **DTC P19FD-P19FF**
P19FE	Hybrid/EV System Heating and Cooling - **DTC P19FD-P19FF**
P19FF	Hybrid/EV System Heating and Cooling - **DTC P19FD-P19FF**
P1A01	Data Communications - **DTC P0A1F, P1A01, P1A05, or P1A06**
P1A05	Data Communications - **DTC P0A1F, P1A01, P1A05, or P1A06**
P1A06	Data Communications - **DTC P0A1F, P1A01, P1A05, or P1A06**
P1A07	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1A0C	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
P1A0D	12 V Starting and Charging - **DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC**
P1A5E	Wiring Systems and Power Management - **DTC P1A5E or P1A5F**
P1A5F	Wiring Systems and Power Management - **DTC P1A5E or P1A5F**
P1A60	Wiring Systems and Power Management - **DTC P1A60**
P1AE6	Hybrid/EV Energy Storage - **DTC P0AA6 or P1AE6**
P1AE8	Hybrid/EV Controls - **DTC P1AE8 or P1AE9**
P1AE9	Hybrid/EV Controls - **DTC P1AE8 or P1AE9**
P1AEC	Hybrid/EV Controls - **DTC P1AEC or P1AEE**
P1AEE	Hybrid/EV Controls - **DTC P1AEC or P1AEE**
P1AF0	Hybrid/EV Controls - **DTC P1AF0**
P1AF4	Hybrid/EV Controls - **DTC P1AF4 or P1AF5**
P1AF5	Hybrid/EV Controls - **DTC P1AF4 or P1AF5**
P1B03	Hybrid/EV Controls - **DTC P0A3F, P0A40, P0C52, P0C53, P0C5C, P0C5D, or P1B03**
P1B0B	Hybrid/EV Controls - **DTC P1B0B or P1B0C**
P1B0C	Hybrid/EV Controls - **DTC P1B0B or P1B0C**
P1B0D	Hybrid/EV Controls - **DTC P1B0D**
P1B0F	Hybrid/EV Controls - **DTC P0C17 or P1B0F**
P1B16	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B17	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B18	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B19	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B1A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1B1B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B1C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B1D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B1E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B1F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B20	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B21	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B22	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B23	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B24	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B25	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B26	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B27	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B28	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B29	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B2A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B2B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B2C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B2D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B3F	Hybrid/EV Energy Storage - **DTC P1B3F or P1B40**
P1B40	Hybrid/EV Energy Storage - **DTC P1B3F or P1B40**
P1B41	Hybrid/EV Controls - **DTC P1B41**
P1B45	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B46	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B47	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B48	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B49	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B4A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B4B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1B4C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B4D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B4E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B4F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B50	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B51	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B52	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B53	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B54	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B55	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B56	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B57	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B58	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B59	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B5A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B5B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B5C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B5D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B5E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B5F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B60	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B61	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B62	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B63	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B64	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B65	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B66	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B67	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1B68	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B69	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B6A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B6B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B6C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B6D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B6E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B6F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B70	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B71	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B72	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B73	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B74	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B75	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B76	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B77	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B78	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B79	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B7A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B7B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B7C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B7D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B7E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B7F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B80	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B81	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B82	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B83	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1B84	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B85	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B86	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B87	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B88	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B89	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B8A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B8B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B8C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B8D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B8E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B8F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B90	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B91	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B92	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B93	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B94	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B95	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B96	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B97	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B98	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B99	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B9A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B9B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B9C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B9D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B9E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1B9F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1BA0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA2	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA3	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA7	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA8	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BA9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BAA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BAB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BAC	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BAD	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BAE	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BAF	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB2	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB3	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB7	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB8	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BB9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BBA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BBB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1BBC	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BBD	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BBE	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BBF	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC2	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC3	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC7	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC8	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BC9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BCA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BCB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BCC	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BCD	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BCE	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BCF	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD2	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD3	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD7	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1BD8	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BD9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BDA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BDB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BDC	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BDD	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BDE	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BDF	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE2	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE3	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE7	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE8	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BE9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BEA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BEB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BEC	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BED	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BEE	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BEF	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF0	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF1	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF2	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF3	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1BF4	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF5	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF6	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF7	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF8	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BF9	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BFA	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BFB	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BFC	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BFD	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1BFE	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E00	Hybrid/EV Controls - **DTC P0AC4, P1E00, P25A2, P25C9, or P26C8**
P1E01	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E02	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E03	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E04	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E05	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E06	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E0A	Hybrid/EV Controls - **DTC P1E0A**
P1E4A	Hybrid/EV Controls - **DTC P1E4A**
P1E4C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E4D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E4E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E4F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E50	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E51	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E52	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E53	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E54	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1E55	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E56	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E57	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E58	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E59	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E5A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E5B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E5C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E5D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E5E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E5F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E60	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E61	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E62	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E63	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E64	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E65	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E66	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E67	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E68	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E69	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E6A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E6B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E6C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E6D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E6E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E6F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E70	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**

DTC	Diagnostic Procedure
P1E71	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E72	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E73	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E74	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E75	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E76	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E77	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E78	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E79	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E7A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E7B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E7C	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E7D	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E7E	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E7F	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E80	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E81	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E82	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E83	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E84	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E85	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E86	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E87	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E88	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E89	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E8A	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E8B	Hybrid/EV Energy Storage - **DTC P0B3B-P0BBB, P1B16-P1B2D, P1B45-P1BFE, P1E01-P1E06, or P1E4C-P1E8B**
P1E8C	Hybrid/EV System Heating and Cooling - **DTC P0C47, P1E8C, or P1E8D**
P1E8D	Hybrid/EV System Heating and Cooling - **DTC P0C47, P1E8C, or P1E8D**

DTC	Diagnostic Procedure
P1E8E	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E8F	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E90	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E91	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E92	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1E93	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1E94	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E95	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E96	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E97	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E98	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1E99	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1E9A	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E9B	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E9C	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E9D	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1E9E	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1E9F	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1EA0	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1EA1	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1EA2	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**

DTC	Diagnostic Procedure
P1EA3	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1EA4	Hybrid/EV Energy Storage - DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041
P1EA5	Hybrid/EV Energy Storage - DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040
P1EAB	Hybrid/EV Energy Storage - DTC P1EAB or P1EAC
P1EAC	Hybrid/EV Energy Storage - DTC P1EAB or P1EAC
P1EAD	Hybrid/EV Energy Storage - DTC P1EAD-P1EB0 or P3240-P3253
P1EAE	Hybrid/EV Energy Storage - DTC P1EAD-P1EB0 or P3240-P3253
P1EAF	Hybrid/EV Energy Storage - DTC P1EAD-P1EB0 or P3240-P3253
P1EB0	Hybrid/EV Energy Storage - DTC P1EAD-P1EB0 or P3240-P3253
P1EB1	Data Communications - DTC P1EB1
P1EB2	Data Communications - DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B
P1EB3	Data Communications - DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B
P1EB4	Data Communications - DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B
P1EB5	Data Communications - DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B
P1EB9	Data Communications - DTC P1EB9
P1EBA	Hybrid/EV Energy Storage - DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB
P1EBB	Hybrid/EV Energy Storage - DTC P0AC1, P0AC2, P0B10, P0B11, P0B13, P1EBA, or P1EBB
P1EBD	Hybrid/EV Energy Storage - DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3
P1EC0	Hybrid/EV Energy Storage - DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3
P1EC1	Data Communications - DTC P1EC1 or P1EC2
P1EC2	Data Communications - DTC P1EC1 or P1EC2
P1EC3	Hybrid/EV Energy Storage - DTC P0AA1, P0AA4, P0AD9, P0ADD, P0AE4, P0D09, P0D0A, P1EBD, P1EC0, or P1EC3
P1EC6	Hybrid/EV System Heating and Cooling - DTC P1EC6
P1ECE	Plug-In Charging - DTC P1ECE
P1EE6	Plug-In Charging - DTC P1EE6 (North America, Korea)
P1EFC	12 V Starting and Charging - DTC B1325, B1330, B1517, C0800, C0899, C0900, C12E1, C12E2, P0561-P0563, P1A0C, P1A0D, or P1EFC
P1F06	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1F07	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1F08	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1F09	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1F0A	HVAC - Automatic - DTC P1F0A-P1F0D
P1F0B	HVAC - Automatic - DTC P1F0A-P1F0D
P1F0C	HVAC - Automatic - DTC P1F0A-P1F0D
P1F0D	HVAC - Automatic - DTC P1F0A-P1F0D
P1F17	Hybrid/EV Energy Storage - DTC P1F17
P1F44	Hybrid/EV System Heating and Cooling - DTC P0CE9, P1F44, or P1F45
P1F45	Hybrid/EV System Heating and Cooling - DTC P0CE9, P1F44, or P1F45

DTC	Diagnostic Procedure
P1F59	Hybrid/EV Controls - **DTC P1F59, P1F5A, or P1F5B**
P1F5A	Hybrid/EV Controls - **DTC P1F59, P1F5A, or P1F5B**
P1F5B	Hybrid/EV Controls - **DTC P1F59, P1F5A, or P1F5B**
P1F5D	Hybrid/EV Controls - **DTC P1F5D or P1F5E**
P1F5E	Hybrid/EV Controls - **DTC P1F5D or P1F5E**
P1FA6	Data Communications - **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**
P1FA7	Data Communications - **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**
P1FA8	Data Communications - **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**
P1FA9	Data Communications - **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**
P1FAA	Data Communications - **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**
P1FAB	Data Communications - **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**
P1FAC	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FAD	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FAE	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FAF	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB0	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB1	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB2	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB3	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB4	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB5	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB6	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB7	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB8	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FB9	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FBA	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**

DTC	Diagnostic Procedure
P1FBB	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FBC	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FBD	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FBE	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FBF	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FC0	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FC1	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FC2	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FC3	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1FC4	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1FC5	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1FC6	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1FC7	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1FC8	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P1FC9	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1FCA	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1FCB	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1FCC	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1FCD	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1FCE	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P1FCF	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FD0	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P1FD1	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**

DTC	Diagnostic Procedure
P1FD2	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FD3	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FD4	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FD5	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD6	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD7	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD8	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FD9	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE0	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE1	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE2	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE3	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE4	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE5	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE6	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE7	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE8	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FE9	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF0	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF1	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF2	Hybrid/EV Energy Storage - DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045
P1FF3	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P1FF4	Hybrid/EV Energy Storage - DTC P1FF4
P1FFB	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFC	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFD	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFE	Hybrid/EV System Heating and Cooling - DTC P1FFB-P1FFE
P1FFF	Hybrid/EV System Heating and Cooling - DTC P1FFF
P2122	Hybrid/EV Controls - DTC P2122, P2123, P2127, P2128, or P2138
P2123	Hybrid/EV Controls - DTC P2122, P2123, P2127, P2128, or P2138
P2127	Hybrid/EV Controls - DTC P2122, P2123, P2127, P2128, or P2138
P2128	Hybrid/EV Controls - DTC P2122, P2123, P2127, P2128, or P2138
P2138	Hybrid/EV Controls - DTC P2122, P2123, P2127, P2128, or P2138
P215B	Automatic Transmission - 1ET25 (MMF) - DTC P215B
P2516	HVAC - Automatic - DTC P151C or P2516-P2518
P2517	HVAC - Automatic - DTC P151C or P2516-P2518
P2518	HVAC - Automatic - DTC P151C or P2516-P2518
P2534	Wiring Systems and Power Management - DTC P2534 or P2535
P2535	Wiring Systems and Power Management - DTC P2534 or P2535
P2537	Wiring Systems and Power Management - DTC P2537
P257D	Bolted Exterior Body Panels and Closures - DTC P257D-P257F
P257E	Bolted Exterior Body Panels and Closures - DTC P257D-P257F
P257F	Bolted Exterior Body Panels and Closures - DTC P257D-P257F
P25A2	Hybrid/EV Controls - DTC P0AC4, P1E00, P25A2, P25C9, or P26C8
P25C6	Hydraulic Brakes - DTC P25C6 or P25C7

DTC	Diagnostic Procedure
P25C7	Hydraulic Brakes - DTC P25C6 or P25C7
P25C9	Hybrid/EV Controls - DTC P0AC4, P1E00, P25A2, P25C9, or P26C8
P262B	Data Communications - DTC P0601-P0607, P060A-P060C, P0610, P062F, P16E9-P16F0, or P262B
P262B	Hybrid/EV Controls - DTC P0601-P0604, P0606, P062F, P0630, P16F3, or P262B (ECM)
P263A	Hybrid/EV Controls - DTC P0650, P263A, or P263B
P263B	Hybrid/EV Controls - DTC P0650, P263A, or P263B
P26C8	Hybrid/EV Controls - DTC P0AC4, P1E00, P25A2, P25C9, or P26C8
P2797	Hybrid/EV Controls - DTC P2797
P2798	Hybrid/EV Controls - DTC P2798 or P2799
P2799	Hybrid/EV Controls - DTC P2798 or P2799
P3002	Plug-In Charging - DTC P3002, P3003, P301F, or P3020
P3003	Plug-In Charging - DTC P3002, P3003, P301F, or P3020
P3005	Plug-In Charging - DTC P3005, P3006, P3021, or P3022
P3006	Plug-In Charging - DTC P3005, P3006, P3021, or P3022
P300B	Plug-In Charging - DTC P300B
P300C	Plug-In Charging - DTC P300C, P300D, or P300F
P300D	Plug-In Charging - DTC P300C, P300D, or P300F
P300F	Plug-In Charging - DTC P300C, P300D, or P300F
P3010	Plug-In Charging - DTC P3010, P3013, or P3014
P3013	Plug-In Charging - DTC P3010, P3013, or P3014
P3014	Plug-In Charging - DTC P3010, P3013, or P3014
P3015	Plug-In Charging - DTC P3015, P3018, P301C, or P301D
P3018	Plug-In Charging - DTC P3015, P3018, P301C, or P301D
P301C	Plug-In Charging - DTC P3015, P3018, P301C, or P301D
P301D	Plug-In Charging - DTC P3015, P3018, P301C, or P301D
P301E	Plug-In Charging - DTC P301E
P301F	Plug-In Charging - DTC P3002, P3003, P301F, or P3020
P3020	Plug-In Charging - DTC P3002, P3003, P301F, or P3020
P3021	Plug-In Charging - DTC P3005, P3006, P3021, or P3022
P3022	Plug-In Charging - DTC P3005, P3006, P3021, or P3022
P302B	Plug-In Charging - DTC P302B-P302D
P302C	Plug-In Charging - DTC P302B-P302D
P302D	Plug-In Charging - DTC P302B-P302D
P302F	Plug-In Charging - DTC P302F (North America, Korea)
P3030	Data Communications - DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B
P3031	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3032	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3033	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3034	Data Communications - DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042
P3035	Hybrid/EV Energy Storage - DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040
P3036	Hybrid/EV Energy Storage - DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041

DTC	Diagnostic Procedure
P3037	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P3038	Data Communications - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P3039	Data Communications - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P303A	Data Communications - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P3043	Data Communications - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P3044	Data Communications - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P3045	Data Communications - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P303B	Data Communications - **DTC P1EB2-P1EB5, P1FA6-P1FAB, P3030, or P303B**
P303C	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P303D	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P303E	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P303F	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P3040	Hybrid/EV Energy Storage - **DTC P1A07, P1E93, P1E99, P1E9F, P1EA5, P1FC3-P1FC8, P3035, or P3040**
P3041	Hybrid/EV Energy Storage - **DTC P1E92, P1E98, P1E9E, P1EA4, P1FC9, P1FCA-P1FCE, P3036, or P3041**
P3042	Data Communications - **DTC P1E8E-P1E91, P1E94-P1E97, P1E9A-P1E9D, P1EA0-P1EA3, P1F06-P1F09, P1FAC-P1FC2, P1FCF-P1FD4, P1FF3, P3031-P3034, P3037, P303C-P303F, or P3042**
P3043	Hybrid/EV Energy Storage - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P3044	Hybrid/EV Energy Storage - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P3045	Hybrid/EV Energy Storage - **DTC P1FD5-P1FF2, P3038-P303A, or P3043-P3045**
P3061	Hybrid/EV Energy Storage - **DTC P0C78 or P3061**
P3240	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3241	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3242	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3243	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3244	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3245	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3246	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3247	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3248	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3249	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3250	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3251	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3252	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P3253	Hybrid/EV Energy Storage - **DTC P1EAD-P1EB0 or P3240-P3253**
P325C	Plug-In Charging - **DTC P325C or P325D**
P325D	Plug-In Charging - **DTC P325C or P325D**
P325F	Plug-In Charging - **DTC P325F (North America, Korea)**
U0020	Data Communications - **DTC U0020**
U0073	Data Communications - **DTC U0073 or U2100**
U0074	Data Communications - **DTC U0074**
U0077	Data Communications - **DTC U0077**

DTC	Diagnostic Procedure
U0078	Data Communications - **DTC U0078**
U007A	Data Communications - **DTC U007A**
U007B	Data Communications - **DTC U007B**
U007C	Data Communications - **DTC U007C**
U007D	Data Communications - **DTC U007D**
U0100-U02FF	Data Communications - **DTC U0100-U02FF**
U0300-U0336	Data Communications - **DTC U0300-U0336**
U0400-U05FF	Data Communications - **DTC U0400-U05FF**
U1026	Data Communications - **DTC U1026**
U1340-U135F	Data Communications - **DTC U1340-U135F**
U1500-U15FF	Data Communications - **DTC U1500-U15FF**
U1653	Data Communications - **DTC U1653**
U179A	Data Communications - **DTC U179A**
U179D	Data Communications - **DTC U179D**
U1803	Data Communications - **DTC U1803**
U1806	Data Communications - **DTC U1806**
U180B	Data Communications - **DTC U180B**
U1814	Data Communications - **DTC U1814**
U1817	Data Communications - **DTC U1817**
U1818	Data Communications - **DTC U1818**
U182D	Data Communications - **DTC U182D**
U1833	Data Communications - **DTC U1833**
U183E	Data Communications - **DTC U183E**
U184A	Data Communications - **DTC U184A**
U184B	Data Communications - **DTC U184B**
U184C	Data Communications - **DTC U184C**
U184D	Data Communications - **DTC U184D**
U184E	Data Communications - **DTC U184E**
U185A	Data Communications - **DTC U185A**
U185B	Data Communications - **DTC U185B**
U1860	Data Communications - **DTC U1860**
U1885	Data Communications - **DTC U1885**
U18A4	Data Communications - **DTC U18A4**
U18A6	Data Communications - **DTC U18A6**
U18A9	Data Communications - **DTC U18A9**
U18AA	Data Communications - **DTC U18AA**
U18AB	Data Communications - **DTC U18AB**
U18AC	Data Communications - **DTC U18AC**
U18AD	Data Communications - **DTC U18AD**
U18AF-U18B4	Data Communications - **DTC U18AF-U18B4**
U18B5	Data Communications - **DTC U18B5**
U18B9-U18BF	Data Communications - **DTC U18B9-U18BF**
U2099	Data Communications - **DTC U2099**
U2100	Data Communications - **DTC U0073 or U2100**
U2160-U2231	Data Communications - **DTC U2160-U2231**

DTC	Diagnostic Procedure
U2401	Data Communications - **DTC U2401**
U2409	Data Communications - **DTC U2409**
U240A	Data Communications - **DTC U240A**
U2500-U25FF	Data Communications - **DTC U2500-U25FF**
U2602	Data Communications - **DTC U2602**
U2603-U2606	Data Communications - **DTC U2603-U2606 or U2617-U2624**
U2617-U2624	Data Communications - **DTC U2603-U2606 or U2617-U2624**
U3000	Data Communications - **DTC U3000**
U3001	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**
U3003	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**
U3006-U3009	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**
U3012	Data Communications - **DTC U3012**
U3013	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**
U3014	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**
U3018	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**
U3019	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**
U3500-U350B	12 V Starting and Charging - **DTC U3001, U3003, U3006-U3009, U3013, U3014, U3018, U3019, or U3500-U350B**

SYMPTOM BYTE LIST

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(00 - 0F) General Electrical Failures This category includes standard wiring failure modes (for example, shorts and opens), direct current (DC) quantities related by Ohm's Law and quantities related to amplitude, frequency or rate of change, and wave shape.		
00	-	This sub type is used for failures that cannot be assigned to a specific sub type. No additional information is available.
01	Short to Battery	This sub type is used for failures where the Electronic Control Unit measures vehicle system (battery positive) potential for greater than a specified time period or when some other value is expected.
02	Short to Ground	This sub type is used for failures where the Electronic Control Unit measures ground (battery negative) potential for greater than a specified time period or when some other value is expected.
03	Low Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage below a specified range but not necessarily a short to ground.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
04	Open	This sub type is used for failures where the Electronic Control Unit determines an open circuit via lack of bias voltage, low current flow, no change in state of an input in response to an output, etc.
05	High Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
06	Low Voltage/Open	This sub type is used for failures where the condition detected by the Electronic Control Unit is the same for either indicated failure mode.
07	High Voltage	This sub type is used for failures where the Electronic Control Unit measures a voltage above a specified range but not necessarily a short to battery.
08	Performance - Signal Invalid	This sub type is used for failures where the value of the signal is not plausible given the operating conditions.
09	Too Fast Transitions	This sub type is used for failures where the signal transitions more quickly than is reasonably allowed.
0A	Too Slow Transitions	This sub type is used for failures where the signal transitions more slowly than is reasonably allowed.
0B	High Current	This sub type is used for failures where the Electronic Control Unit measures current flow above a specified range.
0C	Low Current	This sub type is used for failures where the Electronic Control Unit measures current flow below a specified range.
0D	High Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance above a specified range.
0E	Low Resistance	This sub type is used for failures where the Electronic Control Unit infers a circuit resistance below a specified range.
0F	Signal Erratic	This sub type is used for failures where the signal is momentarily implausible (not long enough for Signal Invalid) or discontinuous.
(10 - 1F) Additional General Electrical Failures This category includes the overflow from category 0.		
10	-	Currently not used.
11	High Input	This sub type is used for failures where some circuit quantity is above a specified range.
12	Low Input	This sub type is used for failures where some circuit quantity is below a specified range.
13	Low Voltage/High Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage below a specified range.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
14	High Voltage/Low Temperature	This sub type is used for failures where a temperature sensor with a negative temperature coefficient detects a voltage above a specified range.
15	Performance - Signal Rising Time Failure	This sub type is used for failures where the signal rise time is outside a specified range.
16	Performance - Signal Falling Time Failure	This sub type is used for failures where the signal fall time is outside a specified range.
17	Performance - Signal Shape/Waveform Failure	This sub type is used for failures where the shape of the signal (plot of the amplitude with respect to time) is not correct (for example, improper circuit impedance.)
18	Low Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage below a specified range but not necessarily a short to ground (for example, gain too low).
19	High Signal Amplitude	This sub type is used for failures where the Electronic Control Unit measures a signal voltage above a specified range but not necessarily a short to battery (for example, gain too high).
1A	Performance - Bias Level Out of Range	This sub type is used for failures where the Electronic Control Unit applies a bias voltage to a circuit upon which is superimposed a signal voltage (for example, Oxygen Sensor Circuit.)
1B	Signal Cross Coupled	This sub type is used for failures where the Electronic Control Unit detects a circuit shorted to another circuit when both circuits are controlled by the Electronic Control Unit.
1C	-	Currently not used.
1D	-	Currently not used.
1E	-	Currently not used.
1F	Erratic	This sub type is used for failures where the Electronic Control Unit momentarily detects one of the conditions defined above but not long enough to set a specific sub type.
(20 - 2F) FM / PWM Failures This category includes faults related to Frequency Modulated (FM) and Pulse Width Modulated (PWM) inputs and outputs of the Electronic Control Unit and faults where position is determined by counts.		
20	-	Currently not used.
21	Incorrect Period	This sub type is used for failures where the Electronic Control Unit measures an incorrect duration for one cycle of the output.
22	Too Short Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too narrow with respect to time.
23	Too Long Low-Time	This sub type is used for failures where the Electronic Control Unit detects the low pulse is too wide with respect to time.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
24	Too Short High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too narrow with respect to time.
25	Too Long High-Time	This sub type is used for failures where the Electronic Control Unit detects the high pulse is too wide with respect to time.
26	Low Frequency	This sub type is used for failures where the Electronic Control Unit detects too few cycles in a given time period.
27	High Frequency	This sub type is used for failures where the Electronic Control Unit detects too many cycles in a given time period.
28	Incorrect Frequency	This sub type is used for failures where the Electronic Control Unit measures an incorrect number of cycles in a given time period.
29	Too Few Pulses	This sub type is used for failures where the Electronic Control Unit measures too few pulses (for example, position is calibrated in counts from one extreme to the other).
2A	Too Many Pulses	This sub type is used for failures where the Electronic Control Unit measures too many pulses (for example, position is calibrated in counts from one extreme to the other).
2B	Missing Reference	This sub type is used for failures where the Electronic Control Unit does not detect a reference for a signal circuit or a group of signal circuits.
2C	-	Currently not used.
2D	-	Currently not used.
2E	-	Currently not used.
2F	-	Currently not used.
(30 - 3F) Electronic Control Unit Internal Failures This category includes faults related to memory, software, and internal electrical circuitry; requiring component replacement.		
30	-	Currently not used.
31	Internal Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
32	General Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where memory type is not specified.
33	Special Memory Malfunction	This sub type is used by the Electronic Control Unit to indicate a memory failure where the specific memory type is not defined in this category.
34	RAM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) failure.
35	ROM Malfunction	This sub type is used by the Electronic Control Unit to indicate a Read Only Memory (ROM) failure.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
36	EEPROM Performance/Malfunction	This sub type is used by the Electronic Control Unit to indicate an Electrically Erasable Programmable Read Only Memory (EEPROM) failure.
37	Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a failure in the execution of operational software
38	Supervision Software Malfunction	This sub type is used by the Electronic Control Unit to indicate a loop time error in the execution of the operational software.
39	Internal Malfunction	This sub type is used by the Electronic Control Unit to indicate the detection of an internal circuit failure.
3A	Incorrect Component Installed	This sub type is used by the Electronic Control Unit to indicate a mismatch between the hardware connected to the Electronic Control Unit and the hardware expected by the Electronic Control Unit.
3B	Self-Test Malfunction	This sub type is used by the Electronic Control Unit to indicate a sensor self-test failure launched by an Electronic Control Unit command.
3C	Internal Communication Malfunction	This sub type is used by the Electronic Control Unit to indicate loss of an internal communication line, for example, between microprocessors in a dual microprocessor configuration.
3D	-	Currently not used.
3E	-	Currently not used.
3F	-	Currently not used.
(40 - 4F) Electronic Control Unit Programming Failures This category includes faults related to operational software, calibrations, and options; remedied by programming the Electronic Control Unit.		
40	-	Currently not used.
41	Not Programmed	This sub type is used to indicate that only boot software is present in the Electronic Control Unit.
42	Calibration Not Programmed	This sub type is used to indicate that operational software is present but calibration data is not.
43	EEPROM Incorrect Programming	This sub type is used to indicate an EEPROM error that may be remedied by reprogramming the module.
44	Security Access Not Activated	This sub type is used to indicate that programming was attempted without unlocking the Electronic Control Unit.
45	Variant Not Programmed	This sub type is used to indicate the need to enter (program) the sub system option content.
46	Configuration Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle option content.
47	VIN Not Programmed	This sub type is used to indicate the need to enter (program) the vehicle identification number (VIN).

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
48	Security Code Not Programmed	This sub type is used to indicate the need to enter (program) the theft / security code.
49	RAM Incorrect Programming	This sub type is used by the Electronic Control Unit to indicate a Random Access Memory (RAM) error remedied by reprogramming.
4A	Programming Checksum Error	This sub type is used by the Electronic Control Unit to indicate an incorrect checksum calculation where memory type is not specified.
4B	Calibration Not Learned	This sub type is used by the Electronic Control Unit to indicate that a password, operational range, etc. for a sensor or actuator must be learned by the Electronic Control Unit.
4C	DTC Memory Full	This sub type is used by the Electronic Control Unit to indicate that more DTCs have been detected than can be accommodated by the memory allocated for DTC storage.
4D	Stack Overflow	This subtype is used by the Electronic Control Unit to indicate that more memory has been used in a stack than is allocated to a program.
4E	-	Currently not used.
4F	-	Currently not used.
(50 - 5F) Algorithm Based Failures This category includes faults based on comparing two or more input parameters for plausibility or comparing a single parameter to itself with respect to time.		
50	-	Currently not used.
51	-	Currently not used.
52	-	Currently not used.
53	Low Temperature	This sub type is used for failures where the Electronic Control Unit calculates a low temperature condition based upon the duration of certain operating parameters.
54	High Temperature	This sub type is used for failures where the Electronic Control Unit calculates a high temperature condition based upon the duration of certain operating parameters.
55	Too Few Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects fewer than the expected number of transitions.
56	Too Many Transitions	This sub type is used for failures where the Electronic Control Unit monitors a parameter over time within specified limits and detects more than the expected number of transitions.
57	-	Currently not used.
58	Performance	This sub type is used for failures where the Electronic Control Unit does not see the expected change to a parameter or group of parameters in response to a particular event.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
59	Protection Time-Out	This sub type is used for failures where the Electronic Control Unit detects a function is active for greater than a specified time period.
5A	Not Plausible	This sub type is used for failures where the Electronic Control Unit compares two or more input parameters for plausibility.
5B	-	Currently not used.
5C	-	Currently not used.
5D	-	Currently not used.
5E	-	Currently not used.
5F	-	Currently not used.
(60 - 6F) Mechanical Failures This category includes faults detected by inappropriate motion in response to an Electronic Control Unit controlled output.		
60	-	Currently not used.
61	Stuck	This sub type is used for failures where the Electronic Control Unit does not detect any motion in response to energizing a motor, solenoid, relay, etc.
62	Stuck Open	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to close some piece of equipment.
63	Stuck Closed	This sub type is used for failures where the Electronic Control Unit does not detect any motion upon commanding the operation of a motor, solenoid, relay, etc., to open some piece of equipment.
64	Slip Detected	This sub type is used for failures where the Electronic Control Unit detects excessive duration to command a motor, solenoid, relay, etc., to move a piece of equipment to a desired position.
65	Emergency Position Not Achievable	This sub type is used for failures where the Electronic Control Unit is unable to command a motor, solenoid, relay, etc., to move a piece of equipment to the emergency position.
66	Incorrect Mounting	This sub type is used for failures where the server detects incorrectly mounted components, for example, acceleration sensor showing a position error of 90Â°.
67	Incorrect Assembly	This sub type is used for failures where the control module has detected that the component has been incorrectly installed (for example, hydraulic pipes crossed over, circuits cross wired) or polarity errors.
68	-	Currently not used.
69	-	Currently not used.
6A	-	Currently not used.
6B	-	Currently not used.
6C	-	Currently not used.
6D	-	Currently not used.
6E	-	Currently not used.
6F	-	Currently not used.

Symptom Byte	Symptom Byte Description	Symptom Byte Definition
(70 - 7F) Bus Signal / Message Failures This category includes faults related to bus hardware and signal integrity. This category is also used when the physical input for a signal is located in one Electronic Control Unit and another Electronic Control Unit diagnoses the circuit.		
70	-	Currently not used.
71	Invalid Data	This sub type is used by the Electronic Control Unit to indicate a signal was received with the corresponding validity bit equal to Invalid or post processing of the signal determines it is invalid.
72	Message Counter Incorrect	This sub type is used by the Electronic Control Unit to indicate a signal was received without the corresponding rolling count value being properly updated.
73	Parity Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect parity calculation.
74	Bus Signal Checksum Error	This sub type is used by the Electronic Control Unit to indicate a message was processed with an incorrect protection (checksum) calculation.
75	Serial Data Link High Input	This sub type is used for failures where some circuit quantity, reported via serial data, is above a specified range.
76	Serial Data Link Low Input	This sub type is used for failures where some circuit quantity, reported via serial data, is below a specified range.
77	-	Currently not used.
78	-	Currently not used.
79	-	Currently not used.
7A	-	Currently not used.
7B	-	Currently not used.
7C	-	Currently not used.
7D	-	Currently not used.
7E	-	Currently not used.
7F	Bus Signal Erratic	This sub type is used for failures where the signal, reported via serial data, is momentarily implausible or discontinuous.
(80 - FF) Reserved Unique System Specific - See specific diagnostic procedures for symptom byte information if these symptom bytes are used.		

SYMPTOMS - VEHICLE

Body Repair

- Symptoms - Active Grille Air Shutter
- Symptoms - Bolted Exterior Body Panels and Closures

Body Systems

- Symptoms - Fixed and Moveable Windows
- Symptoms - Horns
- Symptoms - Lighting
- Symptoms - Mirrors
- Symptoms - Vehicle Access

- Symptoms - Wiper/Washer Systems

Brakes

- Symptoms - Antilock Brake System
- Symptoms - Hydraulic Brakes
- Symptoms - Park Brake

Driveline/Axle

Symptoms - Wheel Drive Shafts

Driver Information and Entertainment

- Symptoms - Cellular Communication
- Symptoms - Entertainment
- Symptoms - Displays and Gauges
- Symptoms - Secondary and Configurable Customer Controls

Propulsion

- Symptoms - Engine Electrical
- Symptoms - Cruise Control
- Symptoms - Hybrid Controls

General Information

- Symptoms - Squeaks and Rattles
- Symptoms - Vibration Diagnosis and Correction

HVAC

Symptoms - HVAC Systems - Automatic

Power and Signal Distribution

- Symptoms - Data Communications
- Symptoms - Mobile Device Wireless Charger
- Symptoms - Power Outlets
- Symptoms - Wiring Systems

Safety and Security

- Symptoms - Immobilizer
- Symptoms - Object Detection
- Symptoms - Remote Functions
- Symptoms - Seat Belts
- Symptoms - SIR
- Symptoms - Theft Deterrent

Seats

Symptoms - Seat Heating and Cooling

Steering

- Symptoms - Power Steering System
- Symptoms - Steering Wheel and Column

Suspension

- Symptoms - Suspension General Diagnosis
- Symptoms - Tire Pressure Monitoring

Transmission

- Symptoms - Automatic Transmission

INSPECTION/MAINTENANCE SYSTEM CHECK

There are no Inspection/Maintenance System Check testing requirements for this vehicle.

DIAGNOSTIC REPAIR VERIFICATION

NOTE: **After a repair has been made, some DTCs require the ignition to be turned OFF then back ON before the scan tool function will clear the DTC.**

1. Vehicle OFF.
2. Install any components or connectors that have been removed or replaced during diagnosis.
3. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
4. Vehicle in Service Mode.
5. Clear the DTCs.
6. Vehicle OFF for 60 seconds.
7. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to the Diagnostic Trouble Code (DTC) List - Vehicle and perform the appropriate diagnostic procedure.

   Or

   If the repair was symptom related, duplicate the conditions under which the customer concern occurred to verify the repair. If the customer concern reoccurs or another symptom is present, return to Symptoms - Vehicle and perform the appropriate symptom diagnostic.

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2017 GENERAL INFORMATION

Vehicle Diagnostic Information - Specifications - Bolt EV

SPECIFICATIONS

K20 ENGINE CONTROL MODULE: SCAN TOOL INFORMATION

The ECM scan tool data list contains all ECM related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the engine scan tool data list only after the following is determined:

- The Diagnostic System Check - Vehicle is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The ECM scan tool data list represents values that would be seen on a normally running vehicle.

NOTE: **A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.**

Only the parameters listed below are referenced in this service manual for use in diagnosis.

ECM Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle On/Park or Neutral/Accessories Off/Brake Pedal Released			
14V Power Module Setpoint	Vehicle On	Percent	The target output percentage the 14V Power Module will try to maintain.
14V Power Module Setpoint	Vehicle On	Volts	The target output the 14V Power Module will try to maintain in volts.
5V Reference 1, 2, 3, or 4	Vehicle ON	5V	These parameters display the voltage sensed on the 5V reference circuits at the control module. The scan tool will display a higher value at higher voltage. The scan tool will display a lower value at lower voltage.

Parameter	System State	Expected Value	Description
5V Reference 1, 2, 3, or 4 Circuit Status	Vehicle ON	OK	This parameter displays OK if there is no 5V reference circuit condition. If the circuit is shorted to ground or shorted to B+, Malfunction is displayed.
A/C High Side Pressure Sensor	kPa/psi	Varies	This parameter displays the pressure from the A/C high side pressure sensor signal circuit to the control module. *Varies with temperature, humidity, and altitude.
Accelerator Pedal Position	Accelerator pedal not actuated	0%	This parameter displays the angle of the APP as calculated by the control module using the signals from the APP sensors.
	Accelerator pedal fully actuated	100%	
Active Grille Air Shutter Position	%	Varies	The actual PWM duty cycle output to the actuator. Active Grill Air Shutters are flaps controlled by the ECM at the front grille to control the amount of air flow.
Active Grille Air Shutter Position Command	%	Varies	This parameter displays the commanded PWM duty cycle output to the actuator. Active Grill Air Shutters are flaps controlled by the ECM at the front grille to control the amount of air flow.
Ambient Air Temperature	Â°C (Â°F)	Varies	This parameter displays the surrounding air temperature at any given altitude.
APP Sensor 1	Accelerator pedal not actuated	0.88 - 1.08V	This parameter displays the actual voltage on the accelerator pedal position (APP) Sensor 1 signal circuit as measured by the control module.
	Accelerator pedal fully actuated	4.17 - 4.37V	
APP Sensor 1 Circuit Status	Vehicle ON	OK	This parameter displays the APP Sensor 1 Out of Range

Parameter	System State	Expected Value	Description
			Sensor 1 Out of Range indicates that the sensed accelerator pedal position 1 sensor value is currently out of range or that a malfunction has been detected based upon the sensed accelerator pedal position 1 sensor value being out of range.
APP Sensor 1 Position	Accelerator pedal not actuated	0%	This parameter displays the angle of the APP sensor 1 as calculated by the control module using the signal from the APP sensor 1. APP sensor 1 is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
	Accelerator pedal fully actuated	100%	
APP Sensor 1 Learned Applied Position	%	%	This parameter displays the learned maximum (fully applied) position of Accelerator Pedal Position (APP) Sensor 1.
APP Sensor 1 Learned Released Position	-	Volts	This parameter displays the accelerator pedal sensor 1 signal at its minimum learned position (pedal released) as a percentage of its reference voltage. The minimum learned position is automatically updated periodically as determined by an algorithm. This is not a static value from a single learn event.
APP Sensor 2	Accelerator pedal not actuated	0.39 - 0.59V	This parameter displays the actual voltage on the accelerator pedal position (APP) Sensor 2 signal circuit as measured by the control module.
	Accelerator pedal fully actuated	2.02 - 2.22V	
APP Sensor 2 Circuit Status	Vehicle ON	OK	This parameter displays the APP Sensor 2 Out of Range indicates that the

Parameter	System State	Expected Value	Description
			sensed accelerator pedal position 2 sensor value is currently out of range or that a malfunction has been detected based upon the sensed accelerator pedal position 1 sensor value being out of range.
APP Sensor 2 Position	Accelerator pedal not actuated	0%	This parameter displays the angle of the APP sensor 2 as calculated by the control module using the signal from the APP sensor 2. APP sensor 2 is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
	Accelerator pedal fully actuated	100%	
APP Sensor 2 Learned Applied Position	%	%	This parameter displays the learned maximum (fully applied) position of Accelerator Pedal Position (APP) Sensor 2.
APP Sensor 2 Learned Released Position	-	Volts	This parameter displays the accelerator pedal sensor 2 signal at its minimum learned position (pedal released) as a percentage of its reference voltage. (The minimum learned position is automatically updated) periodically as determined by an algorithm. This is not a static value from a single learn event.)
APP Sensors	-	0%	This parameter displays the average of the APP sensors as calculated by the

Parameter	System State	Expected Value	Description
			throttle actuator control (TAC) module. The APP average is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.
Axle Torque	-	Â	This parameter displays the torque request for the slow response air path (control of the throttle). Based on current conditions the hybrid controller determines the optimum engine torque, which it sends as a request to the Engine Control Module.
Base Model Part Number	Numeric	Varies	This parameter displays the module Base Model Part Number.
Battery Current Sensor	Amps	Varies	This parameter displays the battery current in amperes.
Brake Pedal Position Sensor Signal	%	%	This parameter displays the device that measures or monitors the relative position of the brake pedal as it travels from a position where it is fully depressed to a position where the driver's foot is completely off the pedal or vice versa.
Calibration Part Number 1 - 10	Numeric	Varies	This parameter displays the software module calibration part number.
Calibration Verification Number 1 - 10	Numeric	Varies	This parameter displays the verification number.
Charge Indicator	-	Off	Indicates the status of the charge indicator on the instrument panel cluster.
Cold Temperature Mode	Yes/No	No	The scan tool displays Yes or No. This is the current state of the Cold Temperature

Parameter	System State	Expected Value	Mode Description
Cruise Control	Enabled/Disabled	Disabled	This parameter displays the status of the cruise control system as determined by the control module.
Cruise Control Cancel Switch	Cruise Control ON	Active/Inactive/Invalid	This parameter displays the status of the cruise control cancel switch.
Cruise Control Disengage History 1 - 8	Cruise Control ON	Reason for Cruise Disengagement	The parameter displays the last 8 cruise control disengages in order from 1 - 8, with 8 being the most recent. There are approximately 40 possible causes for the cruise control to disengage.
Cruise Control Inhibit Reason	Cruise Control ON	Varies	The parameter displays the reason why the cruise control system is inhibited. There are approximately 40 possible causes for the cruise control to be inhibited.
Cruise Control On/Off Switch	Cruise Control ON	ON/OFF	This parameter displays the ECM monitored status of the cruise control switch. A closed switch is displayed as ON.
Cruise Control Resume/Accelerate Switch	Cruise Control ON	Active/Inactive/Invalid	This parameter displays ON, when the cruise ON/OFF switch is ON and the resume switch is pressed, the ECM detects a predetermined voltage value for the resume switch.
Cruise Control Set/Coast Switch	Cruise Control ON	Active/Inactive/Invalid	This parameter displays ON, when the cruise ON/OFF switch is ON and the ECM detects a predetermined voltage value for the set switch.
Distance Since DTC Cleared	-	Varies	This parameter displays the distance accumulated since an emission diagnostic

Parameter	System State	Expected Value	Description
			trouble code was cleared. The scan tool will display increasing distance as the vehicle is driven.
Distance Since First Malfunction	Vehicle ON	0 km/h (0 MPH)	This parameter displays in kilometers or miles the distance traveled since a Malfunction occurred.
Distance Since Last Malfunction	-	Varies	This parameter displays the distance accumulated when the emission diagnostic trouble code last failed.
Driver Requested Axle Torque	-	Varies	This parameter displays the drivers requested axle torque as determined by the ECM. The ECM monitors accelerator pedal position and determines how much axle torque is required in order to meet the drivers request. The parameter display range is -8192 to +8191.75.
ECM Authentication Status	Vehicle ON	Unknown/Incorrect /Negative Response/Valid	This parameter displays the ECM Authentication Status result of the comparison between the last received immobilizer response and the expected response calculated into the ECM.
ECM Response Source	Vehicle ON	Ignition Switch Start/Remote Vehicle Start/Exterior Power Take Off (PTO) Vehicle Start	This parameter displays the ECM Response Source used to calculate the ECM response.
End Model Part Number	Numeric	Varies	This parameter displays the module End Model Part Number.
Extended Travel Brake Pedal Position Signal	Applied/Released/Invalid	Released	This parameter displays the brake pedal travel beyond a moderate/extended

Parameter	System State	Expected Value	Description
			travel threshold by the platform brake sensing module and is received over serial data.
Hood Position	Open/Closed	Closed	This parameter displays the status of the hood latch switch as determined by the ECM.
Ignition Input Accessory	Active/Inactive	Active	This parameter displays the voltage of the accessory feed circuit of the hybrid powertrain control module. The parameter display range is 0 - 65.535V.
Ignition Input Off/On/Start	Active/Inactive	Active	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module. The parameter display range is 0 - 65.535V.
Ignition 1 Signal	Volts	Varies	This parameter displays the voltage of the ignition feed circuit of the ECM.
Immobilizer Auto Learn Counter	Counts	Varies	This indicates the number of autolearn cycles that have been successfully completed within the immobilizer system.
Immobilizer Automatic Learn Timer	hh:mm:ss	Varies	This indicates the time elapsed within the current autolearn cycle within the immobilizer system.
Immobilizer Password Learn	-	Yes	This parameter displays Yes when a valid theft password has been learned.
Immobilizer Security Code Accepted	Yes/No	Yes	This parameter displays that the Security Code Accepted received is correct.
Immobilizer Security Code Lockout	Active/Inactive	Inactive	This parameter displays the Security Code Lockout Active has not passed and lockout is active.
Immobilizer Security Code Lockout Active Timer	ms	Varies	This parameter displays the time elapsed since the receipt of the correct

Parameter	System State	Expected Value	Description
			security code within the immobilizer system.
Immobilizer Security Code Programmed	-	Yes	This parameter displays if the immobilizer system security code has been programmed.
Immobilizer Security Code Programming Counter	Counts	Varies	This parameter displays the number of times a new immobilizer security code has been programmed through secure access. This counter can only be incremented.
Immobilizer Security Code Reset Counter	Counts	Varies	This parameter displays the number of times the immobilizer security code has been reset to the default value through secure access. This counter can only be incremented.
Immobilizer Security Information Programmed	Yes/No	Yes	This parameter displays that the immobilizer key has been programmed.
Immobilizer System Status	-	Varies	This parameter displays the current state of the immobilizer System Status. The states include the following: Standby, Disabled at Startup, Disabled Due to No Response, Disabled Due to Negative Response, Disabled Due to Incorrect Response, Post Release, Pre-Release, Released.
Internal Mode Switch	Park, Reverse, Neutral, Drive, Low, Invalid	Park	This switch indicates transmission range. This is a contact switch attached to the control

Parameter	System State	Expected Value	Description
			valve body within the transmission. The 9 outputs from the switch indicate which position is selected by the transmission manual shaft.
Internal Mode Switch A/B/C/P	High/Low	Low/High/High/Low	This displays the position of each internal mode switch state. A/B/C/P are identification for the 4 switches.
Low-Voltage Circuit Enable Command	-	Yes	Indicates if the low voltage circuit is enabled.
MIL Command	Vehicle ON	ON/OFF	This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit by the engine control module (ECM).
MIL Control Circuit High Voltage Test Status	-	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp (MIL) control. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Control Circuit Low Voltage Test Status	-	OK	This parameter displays the status of the control circuit for the malfunction indicator lamp (MIL) control. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Control Circuit Open Test Status	-	OK	This parameter displays the status of the control circuit for the malfunction

Parameter	System State	Expected Value	Description
			indicator lamp (MIL) control. The scan tool displays OK, Malfunction, or Not Run. OK indicates that no circuit malfunctions are detected during the current test.
MIL Requested by DTC	Vehicle ON	Yes/No	This parameter displays the reason the engine control module illuminated the MIL. The scan tool will display Yes when the MIL is requested as a result of an A or B type DTC. The scan tool will display No if the MIL is illuminated for another reason, such as transmission DTCs.
Power Mode	Vehicle ON	OFF/Accessory/Run /Crank Request	This Parameter displays the state of the System Power Mode. This signal is based upon the state of the system power mode received over serial communication from the vehicle electronics. If the serial data signal not received, the Parameter will display OFF.
Remote Vehicle Start Disable History 1 - 8	-	Varies	This parameter indicates one of the last eight reasons the powertrain has disabled the remote vehicle start.
Remote Vehicle Start Request Signal	On/Off	On	This parameter indicates if the vehicle has been requested to On due to a remote start command.
Software Module 1 - 10 Identifier	Numeric	Varies	This parameter the software module identifier.
Transmission Fluid Temperature	Â°C	Varies	This parameter displays the transmission fluid temperature as

Parameter	System State	Expected Value	Description
			reported by the transmission fluid temperature sensor.
Vehicle Speed	-	0 km/h (0 MPH)	This parameter displays the speed of the vehicle as calculated by the transmission control module (TCM) from information received from the vehicle speed sensor.
VIN Programming Counter	Counts	Varies	This parameter displays the number of times the VIN has been programmed. This counter can only be incremented.

ECM Scan Tool Output Controls

Control Function	Description
Active Grille Air Shutter Position	This test will be used to cycle the Air shutter from open to closed. Upon successfully closing a Pass/No Pass condition will be shown to the technician based on a Validity bit supplied by the ECM.
Malfunction Indicator Lamp (MIL)	This function controls the malfunction indicator lamp (MIL). The normal commanded state is None. When commanded ON or OFF, the ECM turns the malfunction indicator lamp (MIL) ON or OFF. This output can also be monitored on the scan tool data parameter MIL Command. The system remains in the commanded state until cancelled by the scan tool.
14V Power Module Setpoint	This function controls the target output the 14V Power Module will try to maintain.

BODY CONTROL MODULE SCAN TOOL INFORMATION

Body Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Definition
Operating Conditions: Ignition ON, Vehicle in Park, All Doors Closed			
5 V Ignition Switch	-	Accessory / Key Out	The scan tool displays Off, Accessory, Run, or Crank. This parameter displays the ignition switch mode.
Accent Lighting 1 Command	-	Varies	This parameter displays the interior lighting ambient 1 command as a percentage.
Accent Lighting 2 Command	-	Varies	This parameter displays the interior lighting ambient 2 command as a percentage.
Accessory	-	Active	The scan tool displays Active or Inactive.
Accessory Power Mode Indicator Command	-	Varies	This parameter displays ignition switch accessory LED PWM command as a percentage.
Accessory Relay Command	-	Active	The scan tool displays Active or Inactive.
Accessory/Retained Accessory Power Relay Command	-	Active	The scan tool displays Active or Inactive. This parameter displays the retained accessory power relay status.

Parameter	System State	Expected Value	Definition
All Doors Lock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the door lock status.
Ambient Light Sensor	-	Varies	The scan tool displays volts. This parameter displays the ambient light sensor signal voltage.
Ambient Light Status	-	Night	The scan tool displays Unknown, Night, or Day. This parameter displays the ambient light level status.
Automatic Headlamps Disable Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp disable switch status.
Automatic Transmission Manual Shift Switch	-	Off	The scan tool displays Off or On. This parameter displays the transmission tap up tap down switch status.
Backup Lamps Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the backup lamps relay status.
Battery Current Sensor	-	Varies	The scan tool displays the battery current in amperes.
Battery Low at Start	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the battery level is low when the vehicle starts.
Battery Reconnect Detected	-	No	The scan tool displays No or Yes when a battery disconnect/reconnect event has been detected.
Battery Voltage	-	Varies	The scan tool displays the current battery voltage.
BCM-Controlled Charging Voltage	-	Active	The scan tool displays Active or Inactive.
BCM-Requested Charging Voltage Reduction	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the BCM has detected a low battery voltage condition.
Boot Software Part Number	-	Varies	The scan tool displays the boot software part number.
Brake Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the brake lamp command status.
Brake Pedal Applied	-	Inactive	The scan tool displays Active or Inactive.
Brake Pedal Initial Travel Position Achieved	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor	-	Varies	This displays Counts. This numeric value is the current brake pedal position.
Brake Pedal Position Sensor High Voltage During Learn	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Learn	-	No	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned.
Brake Pedal Position Sensor Learned Home Position	-	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the home position.

Parameter	System State	Expected Value	Definition
Brake Pedal Position Sensor Learned Released Position	-	Yes	The scan tool displays No or Yes. This parameter displays Yes when the brake pedal position sensor has learned the released position.
Brake Pedal Position Sensor Learned Released Position	-	Varies	The scan tool displays volts.
Brake Pedal Position Sensor Learned Released Position	-	Varies	The scan tool displays percentage.
Brake Pedal Position Sensor Low Voltage During Learn	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Move During Learn	-	No	The scan tool displays No or Yes. This parameter displays the brake pedal sensor learn status.
Brake Pedal Position Sensor Pulled Up from Home Position	-	No	The scan tool displays No or Yes.
Brake Pedal Position Sensor Reference	-	Varies	The scan tool displays the brake pedal position as voltage value. This parameter displays the current brake pedal position sensor reference.
Brake Pedal Pulled Up from Home Position	-	No	The scan tool displays No or Yes.
Brake Pedal Pulled Up from Released Position	-	No	The scan tool displays No or Yes.
Brake Transmission Shift Interlock Solenoid Actuator	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history.
Brake Transmission Shift Interlock Solenoid Actuator Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the last remote start diagnostic status history.
Calculated Brake Pedal Position	-	Varies	The scan tool displays volts.
Calculated Brake Pedal Position	-	Varies	The scan tool displays percentage.
Calibration Part Number 1-20	-	Varies	The scan tool displays the software module calibration part number.
Center Brake Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the center brake lamp status.
Center Stop Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the center stop lamp status.
Central Door Lock Switch on Center Console/Passenger Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door lock switch status.
Child Security Lock Indicator Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the child security lock indicator command status.
Child Security Lock Motors Command	-	Inactive	The scan tool displays Active or Inactive.

Parameter	System State	Expected Value	Definition
Child Security Lock/Window Lockout Switch	-	Inactive	The scan tool displays Active or Inactive.
Child Security Lock/Window Lockout Switch Indicator Command	-	Inactive	The scan tool displays Active or Inactive.
Content Theft Deterrent Alarm Status	-	Disarmed	The scan tool displays Off, Armed, or Disarmed. This parameter displays the content theft alarm status.
Content Theft Deterrent Disarmed Until Vehicle Closed	-	No	The scan tool displays No or Yes. This parameter displays the content theft deterrent system status.
Content Theft Deterrent Mode	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Content Theft Deterrent Trigger History 1-3	-	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, or Glass Breakage. This parameter displays the content theft deterrent trigger history status.
Courtesy Lamps Duty Cycle Command	-	Varies	This parameter displays the interior lights dimming command as a percentage.
Crank Abort	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Cruise Charging Set Level	-	Varies	This parameter displays cruise charging set level.
Cruise Control Switch Status	-	OFF	The scan tool displays CANCEL, OFF, ON, RESUME, SET or ERROR. This parameter displays the cruise control switch status.
Current Content Theft Deterrent Trigger	-	None	The scan tool displays None, Driver door, Passenger door, Left rear door, Right rear door, Rear closure, Midgate, Tonneau Cover, Hood, Ignition Voltage, Intrusion, Inclination, Telematics enhanced service alarm, Battery reconnect detected, Unauthorized PWM change, Security Indicates Tamper, Glass Breakage. This parameter displays the content theft deterrent current alarm trigger.
Current Driver	-	1-8	This parameter displays the current driver in vehicle.
Disable Battery Saver Relay Command	-	Inactive	The scan tool displays Active or Inactive.

Parameter	System State	Expected Value	Definition
Dome Lamp Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the dome lamp switch status.
Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door Ajar switch status.
Driver Door Key Unlock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Driver Door Unlock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver door unlock command status.
Driver Seat Heating Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Seat Heating/Venting/Cooling Mode	-	Off	The scan tool displays On or Off.
Driver Seat Ventilation Switch	-	Inactive	The scan tool displays Active or Inactive.
Driver Window Learned	-	Yes	The scan tool displays No or Yes.
Driver Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window main control down switch input status.
Driver Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch express input status.
Driver Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the driver window switch UP input status.
Driver Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express Down, Express, Up, Error, Inhibit, or Local Switch Overridden. This parameter displays the driver window motor mode status.
Driver Window Motor Reversing Status	-	No	The scan tool displays No or Yes.
Driver Window Motor Sensing System Fault Status	-	No	The scan tool displays No or Yes.
Driver Window Motor Undervoltage Status	-	No	The scan tool displays No or Yes.
Enable Battery Saver Relay Command	-	Inactive	The scan tool displays Active or Inactive.
End Model Part Number	-	Varies	This parameter displays the end model part number.
Engine Stalled	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.

Parameter	System State	Expected Value	Definition
Environment Identification	-	Unknown	The parameter displays the vehicle environment identification successful status.
Front Fog Lamps Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp relay status.
Front Fog Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front fog lamp switch status.
Front Passenger Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the front passenger window down switch status.
Front Passenger Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch express input status.
Front Passenger Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch UP input status.
Front Tire Pressure on Placard	-	Varies	The scan tool displays kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.
Fuel Economy Mode Inhibited - Low Charging Voltage	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the fuel economy mode status.
Generator Regulator Setpoint	-	Varies	The scan tool displays percentage.
Glove Box Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the instrument panel compartment release switch status.
Hazard Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the hazard lamps switch status.
Hazard Lamps Switch Backlight Command	-	Varies	The scan tool displays percentage. This parameter displays hazard switch backlight level PWM command status.
Headlamps On Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp on switch status.
Headlamps Flash Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamps flash to pass switch status.
Headlamp Washer Relay Command	-	Inactive	The scan tool displays Active or Inactive.
High Beam Select Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam switch status.
High Beam Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the high beam command status.

Parameter	System State	Expected Value	Definition
Hood Ajar Switch	-	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Ajar Switch Signal 1	-	Inactive	This parameter display the remote start diagnostic status history or the last remote start diagnostic status history.
Hood Position	-	CLOSED	The scan tool displays CLOSED, AJAR, or OPENED. This parameter displays the hood position.
Horn Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Horn Switch	-	Inactive	The scan tool displays Active or Inactive.
Idle Boost Level 2-3 Counter	-	Varies	This parameter displays the state of the idle boost level as counts.
Idle Charging Set Level	-	Varies	This parameter displays idle charging set level.
Ignition Mode Switch Dimming Command	-	Varies	The scan tool displays percentage.
Ignition Switch Reference	-	Varies	This parameter displays the ignition switch voltage reference.
Ignition Switch Signal Voltage	-	Varies	This parameter displays the ignition switch signal voltage.
Ignition Switch Status	-	Inactive	This parameter displays the ignition switch status.
Immobilizer Allows Engine To Start	-	Unknown	The scan tool displays Unknown, Incorrect, Not Allowed, or Valid. This parameter displays the immobilizer status.
Immobilizer Automatic Learn Timer	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the automatic learn timer status.
Immobilizer Environment Device 1-4	-	Unknown	The scan tool displays Incorrect, Correct, Not Received, Not Programmed or Unknown. This parameter displays the immobilizer source status.
Immobilizer Password Learn	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the password learn status.
Immobilizer Password Learn Scan Tool Delay	-	Varies	This parameter displays the auto learn timer status.
Immobilizer Security Code Accepted	-	No	The scan tool displays No or Yes.
Immobilizer Security Code Lockout	-	No	The scan tool displays No or Yes.
Immobilizer Security Code Programmed	-	Yes	The scan tool displays No or Yes.
In Park Switch Status	-	On	The scan tool displays On or Off. This parameter displays the park switch status.
Inadvertent Load Command	-	Active	The scan tool displays Active or Inactive.
Indicator Dimming Duty Cycle Command	-	Varies	The scan tool displays percentage. This parameter displays indicator lighting PWM command status.

Parameter	System State	Expected Value	Definition
Interior/Courtesy Lighting Master Switch	-	Door	The scan tool displays Door or other lighting switch status.
Interior Trunk Lid/Liftgate Window Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive.
Key Capture Solenoid Actuator	-	Active	The scan tool display Active or Inactive. This parameter displays column lock input status.
Key Fob 1-4 Battery Status	-	OK	The scan tool displays OK or other key fob battery status. This parameter displays the key fob battery status.
Key Fob 1-4 Function	-	Undefined	The scan tool displays Inactive, Lock, Unlock Driver Door, All Door Unlock, Release Rear Closure, Actuate Left Sliding Door, Actuate Right Sliding door, Panic Alarm, Release Fuel door, Actuate Power Windows, Actuate Folding Top, Start Engine, Stop Engine, Programmed, Locator Alarm, Close Liftgate, Open Liftgate, Stop Liftgate While Closing, Stop Liftgate While opening, Deadlock All Doors, Stop Liftgate Motion, Start Liftgate Motion, Stop Left Sliding Door Motion, Stop Right Sliding Door Motion, Comfort open, or Comfort close. This parameter displays the key fob function status.
Key Fob in Vehicle	-	Inactive	This parameter displays the current key fob in the vehicle.
Key In Cylinder Switch	-	Active	The scan tool displays Active or Inactive.
Key In Cylinder Switch/Key Fob in Vehicle	-	Yes	The scan tool displays No or Yes.
Key in Ignition Status	-	Inactive	The scan tool displays Key Out or Key In. This parameter displays the key in ignition status.
Key Part Number	-	Varies	This parameter displays the key part number.
Key Type	-	Master Key	The scan tool displays Unknown, Master Key, Valet Key, Fleet Key, or Unconfigured. This parameter displays the key type.
Last Door Lock Function	-	All Doors Lock	The scan tool displays NO Action, PC UNDB Lock, PC Unlock, Unlock, Unlock Driver, Unlock Passenger, Unlock Left Rear, Unlock Right Rear, Unlock Cargo Liftgate, Unlock Driver Side, Unlock Passenger Side, Unlock Non Driver, Unlock All, Lock All, DBL Lock, or UNDBL Lock.
LED Backlight Dimming Command	-	Varies	The scan tool displays as a percentage. This parameter displays LED backlight dimming PWM command status.
Left Brake Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left brake lamp command status.

Parameter	System State	Expected Value	Definition
Left Dedicated Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left dedicated daytime running lamp command status.
Left Front Tire Pressure	-	Varies	This parameter displays left front tire pressure in PSI.
Left Front Tire Pressure Sensor Identification	-	Varies	This parameter displays left front tire pressure sensor ID.
Left Front Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes. This parameter display tire pressure monitor system learned status.
Left Front Tire Pressure Sensor Mode	-	Learn Mode - Pressure Triggered	The scan tool parameter displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Front Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Left Front Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Left Front Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Left Low Beam/Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays left low beam/daytime running lamp status.
Left Park Lamps Command	-	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.
Left Rear Child Security Lock Switch	-	Inactive	This parameter displays Active or Inactive.
Left Rear Door Ajar Switch	-	Inactive	This parameter displays Active or Inactive. This parameter displays the left rear door ajar switch status.
Left Rear Tire Pressure	-	Varies	This parameter displays left rear tire pressure in PSI.
Left Rear Tire Pressure Sensor Identification	-	Varies	This parameter displays left rear tire pressure sensor ID.
Left Rear Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes. This parameter displays tire pressure monitor system learned status.
Left Rear Tire Pressure Sensor Mode	-	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered.
Left Rear Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Left Rear Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive. The parameter displays turn lamp outage status.
Left Rear Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.

Parameter	System State	Expected Value	Definition
Left Rear Window Learned	-	Yes	The scan tool displays No or Yes.
Left Rear Window Main Control Down Switch	-	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Main Control Express Switch	-	Inactive	The scan tool display Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays driver window switch inputs.
Left Rear Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Left Rear Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive.
Left Stop Lamp Command	-	Varies	The scan tool display percentage.
Left Turn Signal Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the left turn signal switch status.
License Plate Lamps Command	-	Inactive	The scan tool displays Active or Inactive.
Load Reduction Level 2-3 Counter	-	Varies	The scan tool display as counts.
Low Beam Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the headlamp low beam relay status.
Manufacturers Enable Counter	-	Varies	This parameter tool displays various counter values.
Master Keys Learned	-	Varies	This parameter displays the total number of master keys learned.
Module Diagnostic Address	-	Varies	This parameter displays module diagnostic address.
Number of Key Fobs In Vehicle	-	1	This parameter displays the number of fobs located in the vehicle.
Odometer	-	Varies	This parameter displays the vehicle mileage.
Outside Rear View Mirror Courtesy Lamp Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Brake Switch	-	Active	The scan tool displays Active or Inactive. This parameter displays front exterior lighting status.
Park Lamps Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the parklamp switch is activated.
Passenger Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door ajar switch status.
Passenger Door Lock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door lock switch status.
Passenger Door Unlock Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock switch status.

Parameter	System State	Expected Value	Definition
Passenger Door(s) Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Passenger Door(s) Unlock Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger door unlock status.
Passenger Seat Heating Switch	-	Inactive	The scan tool displays Active or Inactive.
Passenger Seat Heating/Venting/Cooling Mode	-	Off	The scan tool displays On or Off.
Passenger Seat Ventilation Switch	-	Inactive	The scan tool displays Active or Inactive.
Passenger Window Learned	-	Yes	The scan tool displays No or Yes. This parameter displays the passenger window learned status.
Passenger Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Passenger Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the passenger window switch status.
Pickup Bed Cargo Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays pickup bed cargo lamp command status.
Previous Key Type	-	Unknown	This parameter displays previous driver identification device type.
Primary Key Status	-	Yes	The scan tool displays No or Yes.
Push Button Ignition Switch	-	Inactive	The scan tool displays Active or Inactive.
Push Button Ignition Switch Voltage	-	Varies	This parameter displays the push button ignition switch voltage.
Rain Sensor	-	Inactive	The scan tool displays Active or Inactive.
Rear Closure Ajar Switch	-	Active	The scan tool displays Active or Inactive.
Rear Closure Cylinder Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Rear Closure Cylinder Unlock Switch	-	Inactive	The scan tool displays Active or Inactive.
Rear Tire Pressure on Placard	-	Varies	This parameter displays the rear tire pressure in kPa or PSI. This parameter displays the specified tire pressure placard information programmed in the BCM for tire pressure monitoring.
Regulated Voltage Control Mode	-	Voltage	The scan tool displays voltage.
Remote Vehicle Start Attempts Exhausted	-	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining start attempts.
Remote Vehicle Start Crank Time	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Remote Vehicle Start Disabled by Driver	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.

Parameter	System State	Expected Value	Definition
Remote Vehicle Start Source	-	Ignition Switch Start	The scan tool displays Ignition Switch Start or Remote Vehicle Start.
Remote Vehicle Starts Exhausted	-	Varies	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history or remaining remote starts.
Right Brake Lamp Command	-	Varies	The scan tool display percentage. This parameter displays right brake lamp PWM command status.
Right Dedicated Daytime Running Lamp Command	-	Varies	The scan tool display percentage. This parameter displays right dedicated DRL PWM command status.
Right Front Tire Pressure	-	Varies	This parameter displays right front tire pressure in PSI.
Right Front Tire Pressure Sensor Identification	-	Varies	This parameter displays right front tire pressure sensor ID.
Right Front Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes.
Right Front Tire Pressure Sensor Mode	-	Stationary	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode or Learn Mode Pressure Triggered.
Right Front Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal, or High.
Right Front Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Right Front Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Right Low Beam/Daytime Running Lamp Command	-	Varies	The scan tool displays percentage. This parameter displays right low beam/daytime running lamp status.
Right Park Lamps Command	-	Varies	The scan tool displays percentage. This parameter displays rear exterior lighting status.
Right Rear Child Security Lock Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Door Ajar Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Tire Pressure	-	Varies	This parameter displays right rear tire pressure in PSI.
Right Rear Tire Pressure Sensor Identification	-	Varies	This parameter displays right rear tire pressure sensor ID.
Right Rear Tire Pressure Sensor Location Learned	-	Yes	The scan tool displays No or Yes.
Right Rear Tire Pressure Sensor Mode	-	Learn Mode - Pressure Triggered	The scan tool displays Learn Mode, Undefined, Remeasure Data Mode, Rolling Mode, Enter Off Mode, Exit Off Mode, or Learn Mode Pressure Triggered. This parameter displays the pressure sensor mode status.

Parameter	System State	Expected Value	Definition
Right Rear Tire Pressure Status	-	Normal	The scan tool displays Unknown, Normal, Very Low Pressure, Low, Weak Signal or High. This parameter displays the right rear tire pressure status.
Right Rear Turn Signal Bulb Out Feedback	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Turn Signal/Hazard Lamp Command	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Down Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Express Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Main Control Up Switch	-	Inactive	The scan tool displays Active or Inactive.
Right Rear Window Motor Mode	-	Local Switch Overridden	The scan tool displays Down, Express, Up, Inhibit, or Local Switch Overridden.
Right Rear Window Switch at Door	-	Inactive	The scan tool displays Active or Inactive.
Right Stop Lamp Command	-	Varies	The scan tool displays percentage.
Right Turn Signal Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the right turn signal switch status.
Run Abort	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Run Relay Command	-	Active	The scan tool displays Active or Inactive.
Run/Crank	-	Inactive	The scan tool displays Active or Inactive.
Run/Crank Relay Command	-	Active	The scan tool displays Active or Inactive.
Run/Crank Power Mode Indicator Command	-	Varies	The scan tool displays percentage. This parameter displays ignition switch run LED PWM command status.
Secondary Key Status	-	No	The scan tool displays No or Yes.
Security Indicator Command	-	Varies	The scan tool displays percentage. This parameter displays security LED PWM command status.
Selected Front Tire Type	-	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the front tire type.
Selected Rear Tire Type	-	Standard Load	The scan tool displays No Tire Type, Metric Standard Load, Metric Extra Load, Load Range C, Load Range D, or Load Range E. This parameter displays the rear tire type.
Start-Up State of Charge	-	Varies	The scan tool displays percentage. This parameter displays startup state of charge status.

Parameter	System State	Expected Value	Definition
State of Charge	-	Varies	The scan tool displays percentage. This parameter displays state of charge status.
Sunroof Enabled	-	Active	The scan tool displays Active or Inactive.
Sunroof Motor Overtemperature	-	Inactive	The scan tool displays Active or Inactive.
Sunroof Not Learned	-	Inactive	The scan tool displays Active or Inactive.
Sunroof Position	-	Closed	The scan tool displays Closed, Open, Venting, Comfort Open, Closing, Opening. This parameter displays the current sunroof position.
Sunroof Remote Command	-	Inactive	The scan tool displays Sunroof Secure Close, Venting, Close, or Open. This parameter displays the last sunroof remote command.
Sunroof Slide Switch	-	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof slide switch status.
Sunroof Tilt Switch	-	Inactive	The scan tool displays Inactive, Open, Close, Short to Ground, Short to Battery or Stuck. This parameter displays the sunroof tilt switch status. When the switch experiences a malfunction Short to Ground, Short to Battery or Stuck will be displayed.
Sunroof/Sunshade Motor Overtemperature	-	Inactive	The scan tool displays Active or Inactive.
Sunroof/Sunshade Switch	-	Inactive	The scan tool displays Inactive, Express Open, Open, Express Close, Close, Short to Ground, Short to Battery, or Stuck. This parameter displays the sunroof or sunshade switch status.
Sunshade Enabled	-	Active	The scan tool displays Active or Inactive.
Sunshade Not Learned	-	Inactive	The scan tool displays Active or Inactive.
Sunshade Position	-	Closed	The scan tool displays Ajar, Closed, Opened, Closing, or Opening. This parameter displays the sunshade position status.
Sunshade Remote Command	-	Inactive	The scan tool displays Close or Open. This parameter displays the last sunshade remote command.
Tamper Status	-	No	The scan tool displays No or Yes.
Telematics Enhanced Service Override Active	-	No	The scan tool displays No or Yes. This parameter displays vehicle theft deterrent system status.
Total Keys Learned	-	Varies	This parameter displays the number of keys learned.
Traction Control Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the traction control switch is active.

Parameter	System State	Expected Value	Definition
Transponder Authentication	-	Initializing	The scan tool displays Inactive, Initializing, ID Received, Password Received, Data Reception Complete, or Data Transmission Complete. This parameter displays the transponder key communication status.
Transponder Key Status	-	OK	The scan tool displays OK, LIN Bus Initialization Malfunction, Antenna Initialization Malfunction, Password Error, No Valid Key Detected, LIN Bus Communication Malfunction, or Antenna Malfunction. This parameter displays the transponder key communication error status.
Trunk Lamp Command	-	Varies	The scan tool displays as percentage.
Trunk Lid/Liftgate Window Exterior Unlatch Switch	-	Inactive	The scan tool displays Active or Inactive.
Trunk Lid/Liftgate Window Unlatch Command	-	Inactive	The scan tool displays Active or Inactive.
Valet Keys Learned	-	Varies	This parameter displays the number of valet keys learned.
Valet Mode Status	-	Inactive	This parameter displays the remote start diagnostic status history or the last remote start diagnostic status history.
Valet switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays Active when the valet switch is on.
Vehicle Identification Number (VIN)	-	Varies	This parameter displays the vehicle identification number.
Window Lockout Switch	-	Inactive	The scan tool displays Active or Inactive.
Window Lockout Switch Indicator Command	-	Inactive	The scan tool displays Active or Inactive.
Windshield Washer Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer relay status.
Windshield Washer Switch	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield washer switch status.
Windshield Wiper Park Switch	-	Active	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Relay Command	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper High Speed Switch	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Motor Relay Command	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper relay status.
Windshield Wiper Stalled During Sweep	-	Inactive	The scan tool displays Active or Inactive.
Windshield Wiper Stalled in Park Position	-	Inactive	The scan tool displays Active or Inactive. This parameter displays the windshield wiper stalled status.

Parameter	System State	Expected Value	Definition
Windshield Wiper Switch	-	Off	The scan tool displays Off, Delay 1, Delay 2, Delay 3, Delay 4, Delay 5, or Low. This parameter displays the windshield wiper switch status.

Body Control Module Scan Tool Output Controls

Scan Tool Output Control	Description
Accent Lighting 1	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accent Lighting 2	The BCM activates the accent lighting when you select On. The value should be 100%. All accent lighting should illuminate until commanded Off.
Accessory Power Mode Indicator	The BCM activates the accessory indicator when you select On. The value should be 100%. The yellow LED accessory indicator on start button should illuminate until commanded Off.
Accessory Power Relay	The BCM actuates the accessory power relay when you select On. The accessory power relay should turn on allowing specific vehicle functions to operate.
Accessory/Retained Accessory Power Relay	The BCM actuates the retained accessory power relay when you select On. The retained accessory power relay should turn on allowing specific vehicle functions to operate.
All Doors Lock	The BCM activates all doors lock when you select Lock. All doors should lock.
All Doors Lock/Unlock	The BCM activates all doors lock/unlock when you select Lock/Unlock.
Auxiliary Ignition Run Relay	The BCM controls the Ignition Run Coil Control circuit to turn it On and Off.
Backup Lamps	The BCM actuates the backup lamps relay when you select On. The backup lamps should illuminate until commanded Off. Engine must be running.
Battery Saver Relay	The BCM activates the battery saver relay when you select Enable. This command sets the low power mode relay in the state in which it does not supply power to the non-essential parts of the vehicle. This is used to prevent the battery from being depleted when the vehicle is not used for a long period of time.
Brake Pedal Position Sensor Learn	The BCM activates the brake pedal position sensor learn when you select Learn. The brake pedal position sensor learn procedure should start.
Brake Transmission Shift Interlock Solenoid Actuator	The BCM activates the transmission shift interlock solenoid actuator when you select On.
Brake Transmission Shift Interlock Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Center Brake Lamp	The BCM activates the center brake lamp when you select On. The center brake lamp should illuminate until commanded Off.
Center Stop Lamp	The BCM activates the center stop lamp when you select On. The center stop lamp should illuminate until commanded Off.
Child Security Lock Indicator	The BCM activates the child security lock indicator when you select On. The child security lock indicator should illuminate until commanded Off.
Child Security Lock Motors	The BCM actuates the child security door motor when you select Lock. The child security doors should lock.

Scan Tool Output Control	Description
Child Security Lock/Window Lockout Switch Indicator	The BCM activates the child security lock/window lockout switch indicator when you select On. The child security lock/window lockout switch indicator should illuminate until commanded Off.
Clear Driver Window Learned Values	When you select Clear the clear driver window learn procedure should start.
Clear Passenger Window Learned Values	When you select Clear the clear left rear window learn procedure should start.
Courtesy Lamps	The BCM activates the courtesy lamps when you select On. The value should be 100%. The courtesy lamps should illuminate until commanded Off.
Driver Door Unlatch	The BCM activates the output circuit to unlatch the driver door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Driver Door Unlock	The BCM pulses the driver door unlock motor when you select Unlock. The driver door should unlock.
Driver Window Motor	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.
Driver Window Motor Mode	The BCM activates the driver window motor when you select Up/Down/Stop/Express Up/Express Down. The driver window should follow the appropriate command.
Front Fog Lamps	The BCM actuates the front fog lamps relay when you select On. The front fog lamps relay should turn on.
Generator Regulator Setpoint	The BCM changes the output of the generator.
Hazard Lamps Switch Backlight	The BCM activates the hazard lamps switch when you select On. The value should be 100%. The hazard lamps switch backlight should illuminate until commanded Off.
High Beams	The BCM activates the high beam command when you select On. The high beam lights should illuminate. The headlamps have to be on.
Horn Relay	The BCM activates the horn when you select On. The horn should sound.
Inadvertent Load	The BCM activates the inadvertent load command when you select On. (It is an electronic request to shut down an electrical or electronic device that is drawing power from the battery at a time when there should be no activity, usually after the key has been removed from the ignition for a period of time.)
Incandescent Dimming	The BCM activates the incandescent light dimming when you select On. The values should be 100%. The incandescent light dimming should illuminate until commanded Off.
Indicator Dimming	The BCM activates the indicator dimming when you select On. The values should be 100%. The indicator should illuminate until commanded Off.
LED Backlight Dimming	The BCM activates the LED backlight dimming when you select On. The values should be 100%. The LED backlight dimming for control switches should illuminate until commanded Off.
Left Brake Lamp	The BCM activates the left brake lamp when you select On. The values should be 100%. The left brake lamp should illuminate until commanded Off.
Left Dedicated Daytime Running Lamp	The BCM activates the left dedicated daytime running lamp when you select ON. The value changes to 100%. The left daytime running lamp should illuminate.
Left Front Park Lamp	The BCM activates the left front park lamp when you select ON with a value of 100%. The left front park lamp should illuminate.

Scan Tool Output Control	Description
Left Front Park Lamp/Daytime Running Lamp	The BCM activates the left front park lamp/daytime running lamp when you select ON with a value of 100%. The left front park lamp/daytime running lamp should illuminate.
Left Front Turn Signal Lamp	The BCM activates the left front turn signal lamp when you select On. The left front turn signal lamp should illuminate until commanded Off.
Left Headlamp Lamp Low Beam	The BCM activates the left headlamp low beam when you select On. The values should be 100%. The left headlamp low beam should illuminate until commanded Off.
Left Park Lamps	The BCM activates the left park lamps when you select ON with a value of 100%. The left park lamps should illuminate.
Left Rear Park Lamp	The BCM activates the left rear park lamp when you select ON with a value of 100%. The left rear park lamp should illuminate.
Left Rear Stop/Park Lamp	The BCM activates the left rear stop/park lamp when you select ON with a value of 100%. The left rear stop/park lamp should illuminate.
Left Rear Turn Signal Lamp	The BCM activates the left rear turn signal lamp when you select On. The left rear turn signal lamp should illuminate until commanded Off.
Left Rear Turn Signal/Stop Lamp	The BCM activates the left rear turn signal/stop lamp when you select On. The left rear turn signal/stop lamp should illuminate until commanded Off.
Left Rear Window Motor	The BCM activates the left rear window motor when you select Up/Down/Stop/Express Down. The left rear window should follow the appropriate command.
Left Stop Lamp	The BCM activates the left stop lamp when you select ON with a value of 100%. The left stop lamp should illuminate.
Left Trailer Turn Signal Lamp	The BCM activates the left trailer turn signal lamp when you select ON with a value of 100%. The left trailer turn signal lamp should illuminate.
License Plate Lamps	The BCM activates the license plate lamps when you select On. The license plate lights should turn on until commanded Off.
Liftgate Unlatch	The BCM actuates the rear compartment lid release actuator when you select Unlatch. The trunk or liftgate should open.
LIN Bus Device Identification Data	When you select Update the LIN Bus Device part number and calibration part number should be updated.
Low Beam Lamps	The BCM activates the low beam lamps when you select On. The low beam lamps should turn on.
Low Beam Relay	The BCM activates the low beams when you select On. The low beam lights should turn on.
Outside Rear View Mirror Courtesy Lamp	The BCM activates the outside rear view mirror courtesy lamp when you select On. The outside rear view mirror courtesy lamp (at the bottom) should illuminate.
Passenger Door(s) Unlatch	The BCM activates the output circuit to unlatch the passenger door with a passive entry passive start when you select Unlatch. There is NO door handle on this type of vehicle to open the door. Instead, there is a pad that you press to unlatch the door.
Passenger Door(s) Unlock	The BCM pulses the passenger door unlock motor when you select Unlock. The passenger door should unlock.
Passenger Window Motor	The BCM activates the passenger window motor when you select Up/Down/Stop/Express Up/Express Down. The passenger window should follow the appropriate command.
Pickup Bed Cargo Lamp	The BCM activates the pickup bed cargo lamp when you select On. The values should be 100%. The pickup bed cargo lamp should illuminate until commanded Off.
Rear Fog Lamp(s) Relay	The BCM activates the rear fog lamps when you select On. The rear fog lamps should turn on.
Right Brake Lamp	The BCM activates the right brake lamp when you select On. The value should be 100%. The right brake lamp should illuminate until commanded Off.

Scan Tool Output Control	Description
Right Dedicated Daytime Running Lamp	The BCM activates the right dedicated daytime running lamp when you select On. The value should be 100%. The right daytime running lamp should illuminate.
Right Front Park Lamp	The BCM activates the right front park lamp when you select ON with a value of 100%. The right front park lamp should illuminate.
Right Front Park Lamp/Daytime Running Lamp	The BCM activates the right front park lamp/daytime running lamp when you select ON with a value of 100%. The right front park lamp/daytime running lamp should illuminate.
Right Front Turn Signal Lamp	The BCM activates the right front turn signal lamp when you select On. The right front turn signal/hazard lamp should illuminate.
Right Headlamp Low Beam	The BCM activates the right headlamp low beam when you select On. The right headlamp low beam should illuminate.
Right Park Lamps	The BCM activates the right park lamps when you select ON with a value of 100%. The right park lamps should illuminate.
Right Rear Park Lamp	The BCM activates the right rear park lamp when you select ON with a value of 100%. The right rear park lamp should illuminate.
Right Rear Stop/Park Lamp	The BCM activates the right rear stop/park lamp when you select ON with a value of 100%. The right rear stop/park lamp should illuminate.
Right Rear Turn Signal Lamp	The BCM activates the right rear turn signal/hazard lamp when you select On. The right rear turn signal lamp should illuminate until commanded Off.
Right Rear Turn Signal/Stop Lamp	The BCM activates the right rear turn signal/stop lamp when you select On. The right rear turn signal/stop lamp should illuminate until commanded Off.
Right Rear Window Motor	The BCM activates the right rear window motor when you select Up/Down/Stop/Express Down. The right rear window should follow the appropriate command.
Right Stop Lamp	The BCM activates the right stop lamp when you select ON with a value of 100%. The right stop lamp should illuminate.
Right Trailer Turn Signal Lamp	The BCM activates the right trailer turn signal lamp when you select ON with a value of 100%. The right trailer turn signal lamp should illuminate.
Run Relay	The BCM actuates the run relay when you select On. The run relay should turn on.
Run/Crank Relay	The BCM actuates the run/crank relay when you select On. The run/crank relay should turn on.
Run/Start Power Mode Indicator	The BCM activates the run/start lamp when you select On. The value should be 100%. The green LED on engine start/stop button should illuminate until commanded Off.
Security Indicator	The BCM activates the security indicator command when you select On. The security indicator at center of dash (or at DRL sensor) should illuminate until commanded Off.
Stop Lamps	The BCM activates the stop lamps when you select ON with a value of 100%. The stop lamps should illuminate.
Tire Pressure Sensors Learn	The BCM activates the tire pressure sensor learn procedure when you select Learn.
Tire Type/Pressure Selection	When you select OK, you can change tire type and load range.
Trailer Backup Lamps	The BCM activates the trailer backup lamps when you select ON with a value of 100%. The trailer backup lamps should illuminate.
Trailer Park Lamps	The BCM activates the trailer park lamps when you select ON with a value of 100%. The trailer park lamps should illuminate.
Transmission Range Indicator	The BCM activates the transmission range indicator when you select On. The transmission range indicator at the shifter should illuminate until commanded Off.
Trunk Lamp	The BCM activates the trunk lamp when you select On. The value should be 100%. The trunk lamp should illuminate until commanded Off.

Scan Tool Output Control	Description
Trunk Lid Unlatch	The BCM activates the trunk lid unlatch when you select On. The trunk lid should unlatch.
Window Lockout Switch Indicator	The BCM activates the window lockout switch indicator when you select On. The window lockout switch indicator should illuminate until commanded Off.
Windshield Washer Relay	The BCM actuates the windshield washer relay when you select On. The windshield washer relay should turn on.
Windshield Wiper High Speed Relay	The BCM actuates the windshield wiper high speed relay when you select On. The windshield wiper high speed relay should turn on.
Windshield Wiper Motor Relay	The BCM actuates the windshield wiper motor relay when you select On. The windshield wiper motor relay should turn on.

BRAKE BOOSTER CONTROL MODULE SCAN TOOL INFORMATION

The electronic brake booster control module (EBBCM) scan tool data parameters list contains all EBBCM related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Electronic Brake Booster Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Vehicle in Service Mode			
Battery Voltage	-	Varies	This parameter will display the control module voltage.
Brake Booster Pump Motor Torque	-	Varies	This parameter displays the amount of torque currently being produced by the electric motor.
Brake Pedal Position Calculated from Input Rod Position Sensor 1	-	Varies	The travel of the brake booster input rod is used to calculate the travel of the brake pedal, which actuates the rod.
Brake Pedal Position Calculated from Input Rod Position Sensor 2	-	Varies	This displays ml/s. The scan tool displays the brake system target flow rate request.
Input Rod Position	-	Varies	This parameter indicates the location of the push rod which is connected to the brake pedal.
Input Rod Position Sensors 1 and 2 Supply Voltage	-	Varies	This parameter refers to the voltage used to power the internal position sensors (brake booster input rod position).
Motor Driver Temperature 1	-	Varies	Temperature of the electric motor.
Motor Driver Temperature 2	-	Varies	Temperature of the electric motor.
Output Rod Position	-	Varies	This parameter indicates the location of the push rod which is connected to the brake master cylinder.
Target Flow Rate Request by Electronic Brake Control Module	-	Varies	This parameter displays the brake system target flow rate
Target Pressure Request by Electronic Brake Control Module	-	Varies	This parameter displays the brake system target pressure

CHASSIS CONTROL MODULE SCAN TOOL INFORMATION

Chassis Control Module (CCM) Scan Tool Data Parameters for Fuel System

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine Idling at Normal Operating Temperature/Vehicle is in Park or Neutral			
Desired Fuel Pressure	-	306.8 kPa (44.5 psi)	This displays kPa (psi). This is the desired fuel pressure.
Fuel Pump Command	-	On	The scan tool displays On or Off. This is the current state of the fuel pump command.
Fuel Pump Signal Command	-	Varies	This displays %. This is the commanded fuel pump signal measured in percentage.
Fuel Pressure Sensor	-	296.4 - 310.3 kPa (43 - 45 psi)	This displays kPa (psi). This is the current pressure at the fuel pressure sensor.
Fuel Pressure Sensor	-	2.00 - 3.00 Volts	This voltage can vary depending on the engine application, engine load, operating conditions and other factors. This display is in Volts. This is the fuel pressure sensor voltage.
Ignition 1 Signal	-	Varies	This displays Volts. This is the current ignition 1 signal.
LT Fuel Pump Trim	-	Varies	This displays a numeric value. This is the long term (LT) fuel pump trim.
ST Fuel Pump Trim	-	Varies	This displays a numeric value. This is the short term (ST) fuel pump trim.

Chassis Control Module (CCM) Scan Tool Output Controls for Fuel System

Output Control	Description
Fuel Pressure Control	This output control is used to control the fuel pressure.
Fuel Pump	This output control is used to command the fuel pump ON and OFF.
Fuel Pump Trim Reset	This output control is used to reset the fuel pump trim.

CCM Scan Tool Parameters for Active Grille Air Shutters (If Equipped)

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine Idling at Normal Operating Temperature / Vehicle is in Park or Neutral			
Active Grille Air Shutter Position Command (Single Shutter System)	-	Varies	This displays %. This is the commanded active grille air shutter position.
Active Grille Air Shutter Position (Single Shutter System)	-	Varies	This displays %. This is the actual active grille air shutter position.
Active Grille Air Shutter 1 Position Command (Dual Shutter System)	-	Varies	This displays %. This is the commanded active grille air shutter position.

Parameter	System State	Expected Value	Description
Active Grille Air Shutter 1 Position (Dual Shutter System)	-	Varies	This displays %. This is the actual active grille air shutter position.
Active Grille Air Shutter 2 Position Command (Dual Shutter System)	-	Varies	This displays %. This is the commanded active grille air shutter position.
Active Grille Air Shutter 2 Position (Dual Shutter System)	-	Varies	This displays %. This is the actual active grille air shutter position.

CCM Scan Tool Output Controls for Active Grille Air Shutters (If Equipped)

Output Control	Description
Active Grille Air Shutter System (Single Shutter System)	This output control is used to perform the Active Grille Air Shutter Actuator test. It is used to cycle the active grille air shutter open and closed. The test result will display pass or fail based on the ability of the louvers to cycle open and closed.
Active Grille Air Shutter 1 (Dual Shutter System)	This output control is used to perform the Active Grille Air Shutter Actuator test. It is used to cycle the active grille air shutter open and closed. The test result will display pass or fail based on the ability of the louvers to cycle open and closed.
Active Grille Air Shutter 2 (Dual Shutter System)	This output control is used to perform the Active Grille Air Shutter Actuator test. It is used to cycle the active grille air shutter open and closed. The test result will display pass or fail based on the ability of the louvers to cycle open and closed.

CCM Scan Tool Parameters for Active Engine Mounts (If Equipped)

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine Idling at Normal Operating Temperature / Vehicle is in Park or Neutral			
Engine Mount Actuator Output 1	-	On/Off	The scan tool will display On/Off. This is the engine mount actuator commanded state.
Engine Mount Actuator Output 2	-	On/Off	The scan tool will display On/Off. This is the engine mount actuator commanded state.
Engine Mount Actuator Control Circuit 1 Status (2014 model year only)	-	Passed	The scan tool displays Passed/Short to Battery/Short to Ground/Open This is the engine mount actuator control circuit 1 condition.
Engine Mount Actuator Control Circuit 2 Status (2014 model year only)	-	Passed	The scan tool displays Passed/Short to Battery/Short to Ground/Open This is the engine mount actuator control circuit 2 condition.

CCM Scan Tool Output Controls for Active Engine Mounts (If Equipped)

Output Control	Description
Engine Mount Actuator Output 1	This output control is used to turn the engine mount actuator 1 On and Off.
Engine Mount Actuator Output 2	This output control is used to turn the engine mount actuator 2 On and Off.

CCM Scan Tool Parameters for Exhaust Flow Control Valves (If Equipped)

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine Idling at Normal Operating Temperature / Vehicle is in Park or Neutral			
Exhaust Flow Control Valve Command	-	Open/Closed	Exhaust Flow Valve Commanded State
Exhaust Flow Control Valve Command	-	%	Exhaust Flow Valve Commanded Duty Cycle (0%-100%)
Exhaust Flow Control Valve Performance Mode	-	Active/Inactive	Exhaust Flow Valve Control Status
Exhaust Flow Control Valve Rumble Mode	-	Active/Inactive	Exhaust Flow Valve Control Status
Exhaust Flow Control Valve	-	Active/Inactive	Exhaust Flow Valve Control Status
Cylinder Deactivation Exhaust Flow Valve Command	-	Open/Closed/Disabled	Exhaust Flow Valve Commanded State
Cylinder Deactivation Exhaust Flow Control Valve	-	Active/Inactive	Exhaust Flow Valve Control Status
Cylinder Deactivation Exhaust Flow Control Valve 1 Position	-	Open range is 4 - 28 degrees Closed range is 64 - 93 degrees	Cylinder Deactivation Exhaust Flow Control Valve 1 actual position in degrees
Cylinder Deactivation Exhaust Flow Control Valve 2 Position	-	Open range is 4 - 28 degrees Closed range is 64 - 93 degrees	Cylinder Deactivation Exhaust Flow Control Valve 2 actual position in degrees

CCM Scan Tool Output Controls for Exhaust Flow Control Actuators (If Equipped)

Output Control	Description
Exhaust Flow Control Valve Command	This output control is used to cycle the exhaust flow control valve open and closed.
Cylinder Deactivation Exhaust Flow Valve Command	This output control is used to cycle the cylinder deactivation exhaust flow control valve open and closed.

CCM Scan Tool Parameters for Trailer Brake Control System (If Equipped)

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine Idling at Normal Operating Temperature / Vehicle is in Park or Neutral			
ABS Active Signal	-	OK	The scan tool displays Ok/Not Ok. The scan tool displays Ok when no problems are found with the ABS Active Signal serial data message from the electronic brake control module to the chassis control module.
Antilock Braking System	-	Inactive	The scan tool displays Active/Inactive. The scan tool displays Inactive when the ABS system is not functioning.
Automatic Brake Control Gain Request From EBCM	-	0 - 100%	The scan tool displays a number between 0 - 100%.

Parameter	System State	Expected Value	Description
Automatic Brake Request From EBCM	-	No	The scan tool displays Yes/No. This is a request from the EBCM to apply the trailer brakes.
Automatic-Brake Torque	-	Nm	The scan tool displays a numerical value.
Automatic-Brake Torque Signal	-	Ok	The scan tool displays Ok/Not Ok. The scan tool displays Ok when no problems are found with the Automatic Brake Torque Signal serial data message to the chassis control module.
Automatic Braking Active Signal	-	Ok	The scan tool displays Ok/Not OK. The scan tool displays OK when no problems are found with the Automatic Braking Active Signal serial data message to the chassis control module.
Automatic Braking Event	-	Not Detected	The scan tool displays Detected/Not Detected. This parameter represents a command to apply the trailer brakes from the adaptive cruise control system.
Brake Master Cylinder Pressure Sensor	-	Varies	The scan tool will display brake fluid pressure in the master cylinder. The scan tool will display a kPa or psi signal received from the chassis control module.
Brake Pressure Signal	-	OK	The scan tool will display Ok/Not Ok. The scan tool will display a serial data message received from the chassis control module.
Brake Request from EBCM	-	Ok	The scan tool displays Ok/Not Ok. The scan tool displays Ok when no problems are found with the Brake Request signal serial data message from the electronic brake control module to the chassis control module.
Desired Trailer Brake Control Duty Cycle	-	0 - 100%	The scan tool displays a number between 0 - 100%. This number represents a duty cycle request signal from the chassis control module to the trailer brake power module.
Deviation Between Manual Trailer Brake Apply Request Signal 1 and 2	-	Varies	The scan tools displays a percentage difference between the Apply Request Signal 2 and Redundant Request Signal 1.
Driver Initiated Brake Event	-	Not Detected	The scan tool displays Detected/Not Detected. The scan tool detects when the driver has applied the trailer brakes.
Induced Voltage by Trailer Brake Coil	-	0 - 20 V	The scan tool displays a voltage. This number represents the actual voltage supplied by the trailer brake power module to the trailer brakes.

Parameter	System State	Expected Value	Description
Manual Trailer Brake Apply Request Signal 1	-	Varies	The scan tool displays a percentage. This represents a brake apply signal between the chassis control module and the trailer brake power module.
Manual Trailer Brake Apply Request Signal 2	-	Varies	The scan tool displays a percentage. This represents a brake apply signal between the chassis control module and the trailer brake power module.
Stop Lamp Signal	-	Not Requested	The scan tool displays Requested/Not Requested. This is the brake pedal position sensor signal from the BCM to the chassis control module.
Trailer Brake Automatic Control State	-	Normal	The scan tool displays Normal/Active/Temporarily Inhibited/Temporarily Limited/Permanently Failed/Communication Failed/Disabled by Calibration. This represents the operational state of the chassis control module.
Trailer Brake Control Duty Cycle	-	0 - 100%	The scan tool displays a percentage. This is the pulse width modulated output signal from the trailer brake power module to the trailer brakes.
Trailer Brake Control Output Circuit	-	Okay	The scan tool displays Unknown/Short to Battery/Short to Ground/Okay. This represents the state of health of the output circuit from the trailer brake power module to the trailer brakes.
Trailer Brake Control Output Circuit	-	0 - 20 V	The scan tool displays a voltage. This represents the voltage supplied by the trailer brake power module to the trailer brakes.
Trailer Brake Power Control Module	-	De-Energized	The scan tool displays Energized/De-Energized. This represents the state of the trailer brake power module.
Trailer Brake Power Control Module Battery Voltage	-	Varies	The scan tool displays a voltage. This represents the battery voltage supplied to the trailer brake power module.
Trailer Brake Type	-	Undefined	The scan tool displays Undefined when a trailer is not connected to the vehicle. The scan tool displays Electromagnetic Brakes or Electrohydraulic Brakes when a trailer is connected to the vehicle. The type displayed is based on what is detected by the chassis control module.

Parameter	System State	Expected Value	Description
Trailer Brake User Gain	-	Varies	The scan tool displays percent of full gain setting. The scan tool displays 0 - 100%. Each full gain setting represents an increment of approximately 10 percent of full gain setting. Approximately 40% will be indicated with a gain setting of 4.0, 65% will be indicated with a gain setting of 6.5, etc.
Trailer Brake User Gain Switch	-	Varies	The scan tool displays percent of full gain setting. The scan tool displays 0 - 100%. Each full gain setting represents an increment of approximately 10 percent of full gain setting. Approximately 40% will be indicated with a gain setting of 4.0, 65% will be indicated with a gain setting of 6.5, etc.
Vehicle Speed	-	Varies	The scan tool displays 0 - 327 km/h (0 - 204 mph). The scan tool displays 0 km/h (0 mph) when the vehicle is not moving. This is the vehicle speed serial data message from the ECM.
Vehicle Stability Enhancement System Signal	-	Ok	The scan tool displays Ok/Not Ok. The scan tool displays Ok when no problems are found with the Vehicle Stability Enhancement System signal to the chassis control module.
Wheel Speed Signal	-	Ok	The scan tool displays Ok/Not Ok. The scan tool displays Ok when no problems are found with the Wheel Speed signal from the EBCM to the chassis control module.

Chassis Control Module (CCM) Scan Tool Output Controls for Trailer Brake Control System (If Equipped)

Output Control	Description
Trailer Brake Control Signal	This output control is used to turn the trailer brake power control module on and off.
Trailer Brake Duty Cycle	This output control is used to control the trailer brake apply signal from trailer brake power control module.

CCM Scan Tool Parameters for Vehicle Level Control (If Equipped)

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
Left Rear Vehicle Level Position Sensor	-	.25 - 4.75 Volts	This displays Volts. This is the level position sensor voltage.
Right Rear Vehicle Level Position Sensor	-	.25 - 4.75 Volts	This displays Volts. This is the level position sensor voltage.
Vehicle Level Control Compressor Over Temperature	-	No	This displays Yes or No. This will display Yes if the compressor is overheated.
Excessive Compressor Activity	-	No	This displays Yes or No. This will display Yes if the compressor activity is excessive.

Parameter	System State	Expected Value	Description
Vehicle Level Control Status	-	Normal	This displays Normal/Uneven Surface or Hoisted/Overloaded/Failed.
Vehicle Level Control Compressor	-	Varies	This displays On or Off. This will display if the compressor is on or off.
Vehicle Level Control Exhaust Valve	-	Varies	This displays Open or Closed. This will display if the exhaust valve is open or closed.
Vehicle Level Control Pressure Sensor	-	.4 - 4.8 Volts	This displays Volts. This is the level control pressure sensor voltage.
Vehicle Leveling Sensors Supply Voltage	-	4.9 - 5.1 Volts	This displays Volts. This is the leveling sensors supply voltage.
Vehicle Level Control Pressure Sensor Supply Voltage	-	4.9 - 5.1 Volts	This displays Volts. This is the level control pressure sensor supply voltage.
Vehicle Level Trim Height Status	-	Learned/Not Learned	This displays if the level trim height status

CCM Scan Tool Output Controls for Vehicle Level Control (If Equipped)

Output Control	Description
Suspension Position Sensor Trim Height	This output control is used to learn the trim height.
Vehicle Level Control Compressor Relay	This output control is used to command the compressor ON and OFF.
Vehicle Level Control Exhaust Valve	This output control is used to command the exhaust valve ON and OFF.

CCM Scan Tool Parameters for Transmission Cooling Fan (If Equipped)

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine Idling at Normal Operating Temperature / Vehicle is in Park or Neutral			
Transmission Cooling Fan Circuit High Voltage Test Status	-	OK	Malfunction/Not Run/OK
Transmission Cooling Fan Circuit Open Test Status	-	OK	Malfunction/Not Run/OK
Transmission Cooling Fan Circuit Low Voltage Status	-	OK	Malfunction/Not Run/OK
Transmission Cooling Fan Command	-	Yes/No	The scan tool displays Yes/No. This shows if the transmission cooling fan is being commanded ON.
Transmission Cooling Fan Duty Cycle	-	0 - 100%	The scan tool displays a percentage. This is the transmission cooling fan ON duty cycle.

CCM Scan Tool Output Controls for Transmission Cooling Fan (If Equipped)

Output Control	Description

Output Control	Description
Transmission Cooling Fan Duty Cycle	This output control is used to control the transmission cooling fan.

ELECTRONIC BRAKE CONTROL MODULE SCAN TOOL INFORMATION

The electronic brake control module (EBCM) scan tool data parameters list contains all ABS related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Electronic Brake Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
ABS Pump Motor Voltage	-	0 V	The scan tool displays the commanded pump motor voltage.
Acceleration Sensor Longitudinal Signal	-	Varies	The scan tool displays 0 - 5 V depending on the vehicle's longitudinal acceleration.
Antilock Braking System	-	On	The scan tool displays On or Off. Off is displayed when the ABS is disabled.
Brake Fluid Level Sensor	-	OK	The scan tool displays OK when the brake fluid is at correct level and Low when the brake fluid is low.
Brake Pedal Position Sensor	Brake pedal released	Inactive	The scan tool displays Inactive or Active depending on the state of the brake pedal.
	Brake pedal applied	Active	
Brake Pressure Sensor	Brake pedal released	0 - 1 V	The scan tool displays 0 - 5 V depending on the applied hydraulic brake pressure.
	Brake pedal applied	1 - 5 V	
Delivered Torque	-	Varies	The scan tool displays 0 - 100% depending on the how much torque the engine is delivering.
Dynamic Rear Proportioning Status	-	On	The scan tool displays On or Off. Off is displayed when the dynamic rear proportioning system is disabled.
Lateral Acceleration Signal	-	Varies	The scan tool displays 0 - 5 V depending on the vehicle's lateral acceleration.
Left Front Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left front inlet solenoid valve is commanded ON.
Left Front Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left front outlet solenoid valve is commanded ON.
Left Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left front wheel speed sensor.
Left Rear Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left rear inlet solenoid valve is commanded ON.
Left Rear Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the left rear outlet solenoid valve is commanded ON.
Left Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left rear wheel speed sensor.

Parameter	System State	Expected Value	Description
Pump Motor Relay Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the pump motor is commanded ON.
Primary Isolation Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the isolation solenoid valve is commanded ON.
Primary Prime Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the prime solenoid valve is commanded ON.
Requested Torque	-	Varies	The scan tool displays 0 - 100% depending on the how much torque is requested.
Right Front Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right front inlet solenoid valve is commanded ON.
Right Front Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right front outlet solenoid valve is commanded ON.
Right Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right front wheel speed sensor.
Right Rear Inlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right rear inlet solenoid valve is commanded ON.
Right Rear Outlet Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the right rear outlet solenoid valve is commanded ON.
Right Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right rear wheel speed sensor.
Secondary Isolation Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the isolation solenoid valve is commanded ON.
Secondary Prime Solenoid Valve Feedback	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the prime solenoid valve is commanded ON.
Steering Column Position	Steering wheel in straight position	-5 to +5Â°	The scan tool displays Â°. This is the current position of the steering angle sensor.
	Steering wheel turned left until stop	450 - 550Â°	
	Steering wheel turned right until stop	-550 to -450Â°	
System Voltage	-	11 - 14 V	The scan tool displays V. This is the current battery voltage.
Traction Control System	Traction control switch released	On	The scan tool displays On or Off. Off is displayed when traction control is disabled.
	Traction control switch pressed	Off	

Parameter	System State	Expected Value	Description
Variable Effort Steering Solenoid Valve Command	-	Varies	The scan tool displays A. This is the current applied to the variable effort steering solenoid valve.
Variable Effort Steering Solenoid Valve Feedback	-	Varies	The scan tool displays A. This is the variable effort steering solenoid valve feedback signal.
Vehicle Stability Enhancement System Relay Feedback	-	Inactive	The scan tool displays Inactive or Active depending on the state of the stability control.
Vehicle Stability System	Traction control switch released	On	The scan tool displays On or Off. Off is displayed when stability control is disabled.
	Traction control switch pressed for 5 s	Off	
Yaw Rate Signal	-	Varies	The scan tool displays 0 - 5 V depending on the vehicle's yaw rate.

Electronic Brake Control Module Scan Tool Output Controls

Output Control	Description
ABS Left Front Solenoid Valves	Commands the solenoid valves ON or OFF.
ABS Left Rear Solenoid Valves	Commands the solenoid valves ON or OFF.
ABS Pump Motor	Commands the ABS pump motor Increase or Decrease.
ABS Right Front Solenoid Valves	Commands the solenoid valves ON or OFF.
ABS Right Rear Solenoid Valves	Commands the solenoid valves ON or OFF.
Automated Brake Bleed	This is used in order to bleed ABS hydraulics. Refer to **Hydraulic Brake System Bleeding**
Brake Pressure Sensor Calibration	This is used in order to calibrate the brake pressure sensor.
Pressure Control Solenoid Valve	Commands the variable effort steering solenoid valve Increase or Decrease.
Steering Wheel Angle Sensor Learn	This function activates the steering wheel angle sensor learn procedure.
Traction Control Left Front Solenoid Valves	Commands the solenoid valves ON or OFF.
Traction Control Left Rear Solenoid Valves	Commands the solenoid valves ON or OFF.
Traction Control Right Front Solenoid Valves	Commands the solenoid valves ON or OFF.
Traction Control Right Rear Solenoid Valves	Commands the solenoid valves ON or OFF.
Yaw Rate Sensor Learn	This function activates the yaw rate sensor learn procedure.

ELECTRONIC BRAKE CONTROL MODULE SCAN TOOL INFORMATION (HP4)

The electronic brake control module (EBCM) scan tool data parameters list contains all ABS related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Electronic Brake Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Service Mode			
ABS Pump Motor Voltage	-	Varies	The scan tool displays the pump motor voltage.
Antilock Braking System	-	Inactive	The scan tool displays Inactive or Active. Active is displayed when the antilock braking system is in traction control event.
Antilock Braking System Status	-	No	The scan tool displays No or Yes. If there is an ABS malfunction the scan tool will display Yes.
Brake Booster Electric Vacuum Pump	-	Varies	This displays voltage of the Electric Vacuum Pump
Brake Controls Brake Pedal Position Sensor without Offset	-	Varies	This displays mm. This is the value used to compare the position of the primary piston sensors.
Brake Controls Brake Pedal Position Sen. 5 Volt Supply Voltage	-	Varies	This displays volts. This is the voltage supply to the brake controls brake pedal position sensor.
Brake Controls Brake Pedal Position	-	Varies	The scan tool displays the brake pedal counts. Learned or Not Learned. This is the brake controls brake pedal position sensor zeroed or learned value.
Brake Boost Power Status	-	Enabled	The scan tool displays Enabled or Disabled.
Brake Master Cylinder Pressure Sensor	-	Varies	This displays psi/kpa. This is the current brake applied pressure.
Brake Fluid Level Sensor	-	Varies	This displays volts. This is the voltage supply to the brake fluid level sensor signal.
Brake Pedal Position Sensor Signal	Brake pedal released	Released	The scan tool displays Applied or Release depending on the state of the brake pedal.
	Brake pedal applied	Applied	
Brake Pressure Sensor	Brake pedal released	0 - 1.55 V	The scan tool displays 0 - 5 V depending on the applied hydraulic brake pressure.
	Brake pedal applied	1.55 - 5 V	
Dynamic Rear Proportioning Status	-	No	The scan tool displays No or Yes. If the EBCM disables the dynamic rear proportioning due to a fault the scan tool will display Yes.
Engine Drag Control Status	-	No	The scan tool displays No or Yes. If the EBCM detects an ABS event, it sends a signal to the ECM to reduce engine power and Yes is displayed on the scan tool.
High Pressure Accumulator Sensor	-	Varies	This displays the pressure of the accumulator.
Ignition Voltage	-	Varies	This displays volts. This is the voltage status of the electronic brake control module (EBCM).
Lateral Acceleration	-	Varies	The scan tool displays the current lateral acceleration in m/s^2

Parameter	System State	Expected Value	Description
Left Front Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left front inlet solenoid valve is commanded ON.
Left Front Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left front outlet solenoid valve is commanded ON.
Left Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left front wheel speed sensor.
Left Rear Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left rear inlet solenoid valve is commanded ON.
Left Rear Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the left rear outlet solenoid valve is commanded ON.
Left Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the left rear wheel speed sensor.
Longitudinal Acceleration	-	Varies	The scan tool displays the current longitudinal acceleration in m/s^2
Panic Brake Assist Status	-	No	The scan tool displays No or Yes. If the EBCM disables the panic brake assist due to a fault the scan tool will display Yes.
Regenerative Braking Status	-	Active	The scan tool displays Active or Inactive.
Right Front Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right front inlet solenoid valve is commanded ON.
Right Front Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right front outlet solenoid valve is commanded ON.
Right Front Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right front wheel speed sensor.
Right Rear Inlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right rear inlet solenoid valve is commanded ON.
Right Rear Outlet Solenoid Valve Command	-	Off	The scan tool displays Off or On. On is displayed when the right rear outlet solenoid valve is commanded ON.
Right Rear Wheel Speed Sensor	-	0 km/h (0 MPH)	The scan tool displays km/h (MPH) depending on the current speed of the right rear wheel speed sensor.
Steering Wheel Angle Sensor Signal	Steering wheel in straight position	-5 to +5Â°	The scan tool displays Â°. This is the current position of the steering angle sensor.
	Steering wheel turned left until stop	450 - 550Â°	
	Steering wheel turned right until stop	-550 to -450Â°	
System Voltage	-	11 - 14 V	The scan tool displays V. This is the current battery voltage.

Parameter	System State	Expected Value	Description
Traction Control System	-	No	The scan tool displays No or Yes. If there is a traction control malfunction the scan tool displays Yes.
Vehicle Stability System Status	-	No	The scan tool displays No or Yes. If there is a stability control malfunction the scan tool displays Yes.
Yaw Rate	-	Varies	The scan tool displays the current yaw rate in Â°/s.

Electronic Brake Control Module Scan Tool Output Controls

Output Control	Description
Automated Brake Bleed	This is used in order to bleed ABS hydraulics.
ABS Pump Motor	This is used in order to command the ABS pump motor On or Off.
ABS Left Front Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Right Front Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Left Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
ABS Right Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Left Front Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Right Front Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Left Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
Traction Control Right Rear Solenoid Valves	Commands the solenoid valve ON or OFF.
Rear Brake Caliper Piston Extend	Commands the rear brake caliper piston to Extend Travel
Rear Brake Caliper Piston Retract	Commands the rear brake caliper piston to Retract Travel
Left Park Brake Actuator	Commands the park brake actuator ON or OFF.
Right Park Brake Actuator	Commands the park brake actuator ON or OFF.

Electronic Brake Control Module Configuration/Reset Functions

Functions	Description
Yaw Rate Sensor Learn	This learn is used to calibrate the multi-axis acceleration sensor.
Steering Angle Sensor Learn	This learn is used to calibrate the steering angle sensor.
Park Brake Calibration	This learn is used to calibrate the rear electronic parking brakes.

FRONT VIEW CAMERA MODULE SCAN TOOL INFORMATION

NOTE: **Due to software and hardware variations, not all information may be applicable.**

Front View Camera Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Lane Departure Warning ON			
System Voltage	-	Varies	The scan tool displays the system voltage depending of the current battery voltage.

Parameter	System State	Expected Value	Description
System Power Mode	-	Run	The scan tool displays Off, Accessory, Run, Cranking or Undefined. This is the state of the ignition switch.
Power Mode Controlled by Backup Device	-	Run	The scan tool displays Off, Accessory, Running or Cranking depending of the current power mode.
Frontview Camera System Status	-	On	The scan tool displays Normal, Malfunction or Undefined depending on the state of the Frontview Camera System.
Frontview Camera Calibration Status	-	Learn Successful	The scan tool displays Not Calibrated, Calibrated, Dynamically Calibrated or Undefined. This is the current state of the calibration.
Frontview Camera Learn Mode Status	-	Yes	The scan tool displays percentage between 0 - 100% depending on the state of the frontview camera learn mode.
Distance to Object	-	Varies	The scan tool displays meters between 0 - 255 depending on the distance from a detectable object to the vehicle.
Lane Departure Warning Status	-	Varies	The scan tool displays Off, Disabled, Not Ready to Assist, Ready to Assist, Malfunction, Unknown or Undefined depending on the state of the lane departure warning system.
Lane Keep Assist Status	-	Varies	The scan tool displays Off, Disabled, Not Ready to Assist, Ready to Assist, Malfunction, Unknown or Undefined depending on the state of the lane keep assist system.
Lane Departure Warning Switch Status	-	Off	The scan tool displays Off, Disabled, Not Ready to Assist, Ready to Assist, Malfunction, Unknown, Undefined depending on the state of the lane departure warning switch.
Lane Keep Assist Switch Status	-	Off	The scan tool displays Off, Disabled, Not Ready to Assist, Ready to Assist, Malfunction, Unknown, Undefined depending on the state of the lane departure warning switch.
Lane Departure Warning Indicator Status	-	Off	The scan tool displays Off, On, Malfunction, Unknown or Undefined depending on the state of the lane departure warning system.
Forward Collision Alert Function Status	-	Off	The scan tool displays Off, On, Malfunction, Unknown or Undefined depending on the state of the lane departure warning system.
Automatic High Beam Activation Status	-	Enabled	The scan tool displays Disabled, Enabled or Undefined depending on the state of the automatic high beam assist system.

Parameter	System State	Expected Value	Description
Frontview Camera Disable History 1 - 4	-	Varies	The scan tool displays Empty, Lane Departure Warning Indicator Malfunction, Lane Departure Warning Switch Malfunction, Sensors Obstructed, Accelerator Pedal Position Out of Range, Driven Wheel Speed Signal Invalid, Non-Driven Wheel Speed Invalid, Brake Pedal Moderate Travel Signal Invalid, Brake Pedal Initial Travel Position Achieved, Lost Communication with Steering Wheel Angle Sensor Module, Invalid Data Received From Steering Wheel Angle Sensor Module, Forward Collision Alert Switch Malfunction, Clutch Pedal Position (CPP) Sensor Performance, Transmission Gear Engaged, Acceleration Sensor Longitudinal Signal, Invalid Data Received From Yaw Rate Sensor Module, Power Mode Controlled by Backup Device, System Power Mode, Overvoltage, Undervoltage or Undefined depending on the history data of the frontview camera disable history.
Glare Free High Beam Assist	-	Varies	The scan tool displays Off, Disabled, Malfunction, Enabled, Unknown, or Undefined.
Following Distance Indicator Status	-	Varies	The scan tool displays Disabled, Not Ready to Assist, Ready to Assist, or Undefined.
Low Beam Decision Reason	-	Varies	The scan tool displays Tail Lights, On Coming Lights, Low Speed, City, Bright Scene, Fog, High Yaw, or Adverse weather
FCA Vehicle Type	-	Varies	The scan tool displays Unknown, Truck, Car, MotorBike, Bicycle, Pedestrian, or Undecided. This is the Forward Collision Alert type.
FCA Number of Vehicle Detected	-	Varies	The scan tool displays the number of vehicles detected between 0 - 255 depending on the number of vehicles detected.

NOTE: **Due to software and hardware variations, not all information may be applicable.**

Front View Camera Module Scan Tool Output Controls

Output Control	Description
Clear Disable History Data	The frontview camera control module clears all disable history buffers when commanded from the scan tool.
Forward Collision Alert Switch	The frontview camera control module switches the forward collision alert system to Near, Medium or Far when commanded from the scan tool.
High Beams	The frontview camera control module switches the high beams On or Off when commanded from the scan tool.
Lane Departure Warning Indicator	The frontview camera control module switches the lane departure warning indicator On or Off when commanded from the scan tool.

Output Control	Description
Lane Departure Warning Switch	The frontview camera control module switches the lane departure warning system On or Off when commanded from the scan tool.
Vehicle Direction Camera Learn	The frontview camera control module initializes the service point calibration of the frontview camera and switches into the learn mode when commanded from the scan tool.

BATTERY ENERGY CONTROL MODULE SCAN TOOL INFORMATION

Battery Energy Control Module Data

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Control Module Voltage Signal	Volts	This parameter displays the voltage monitored at the control module terminal connected to the Ignition 1 circuit. A typical value will be whatever the current available 12 V battery/charging voltage is (12 - 15.5 V).
5 V Reference 1	Volts	This parameter displays the reference voltage provided by the control module to various sensors (3 V). This voltage is then used by the various sensors to produce a feedback signal to the electronic control module.
Hybrid/EV Battery Pack Low Resolution Current Sensor	Amps	This parameter displays the current flowing in and out of the battery pack. There are 2 current sensors combined into one assembly that measure total battery pack current. One is a low resolution and one is a high resolution.
Hybrid/EV Battery Pack High Resolution Current Sensor	Amps	This parameter displays the current flowing in and out of the battery pack. There are 2 current sensors combined into one assembly that measure total battery pack current. One is a low resolution and one is a high resolution.
Hybrid/EV Battery Pack Terminal 1 Voltage	Volts	This parameter displays the Hybrid/EV Battery pack voltage as measured at the Battery side of the high voltage contactor relays.
Power Mode	Off/ Accessory/ Crank Request	This parameter displays the status of the ignition switch.

Temperature Data

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 1	Degrees C	This parameter displays the temperature within Battery Module 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 2	Degrees C	This parameter displays the temperature within Battery Module 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 3	Degrees C	This parameter displays the temperature within Battery Module 5 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 4	Degrees C	This parameter displays the temperature within Battery Module 6 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 5	Degrees C	This parameter displays the temperature within Battery Module 8 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 6	Degrees C	This parameter displays the temperature within Battery Module 10 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery Pack Coolant Temperature Sensor 1	Degrees C	This parameter displays the Hybrid/EV Battery pack coolant temperature measured at the coolant loop inlet of the Hybrid/EV Battery pack.

Voltage Data 1

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 1	Volts	This parameter displays the voltage of Battery Cell Group 1 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 2	Volts	This parameter displays the voltage of Battery Cell Group 2 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 3	Volts	This parameter displays the voltage of Battery Cell Group 3 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 4	Volts	This parameter displays the voltage of Battery Cell Group 4 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 5	Volts	This parameter displays the voltage of Battery Cell Group 5 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 6	Volts	This parameter displays the voltage of Battery Cell Group 6 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 7	Volts	This parameter displays the voltage of Battery Cell Group 7 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 8	Volts	This parameter displays the voltage of Battery Cell Group 8 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 9	Volts	This parameter displays the voltage of Battery Cell Group 9 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 10	Volts	This parameter displays the voltage of Battery Cell Group 10 within Module 1, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 11	Volts	This parameter displays the voltage of Battery Cell Group 11 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 12	Volts	This parameter displays the voltage of Battery Cell Group 12 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 13	Volts	This parameter displays the voltage of Battery Cell Group 13 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 14	Volts	This parameter displays the voltage of Battery Cell Group 14 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 15	Volts	This parameter displays the voltage of Battery Cell Group 15 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 16	Volts	This parameter displays the voltage of Battery Cell Group 16 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 17	Volts	This parameter displays the voltage of Battery Cell Group 17 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 18	Volts	This parameter displays the voltage of Battery Cell Group 18 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 19	Volts	This parameter displays the voltage of Battery Cell Group 19 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 20	Volts	This parameter displays the voltage of Battery Cell Group 20 within Module 2, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 21	Volts	This parameter displays the voltage of Battery Cell Group 21 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 22	Volts	This parameter displays the voltage of Battery Cell Group 22 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 23	Volts	This parameter displays the voltage of Battery Cell Group 23 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 24	Volts	This parameter displays the voltage of Battery Cell Group 24 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 25	Volts	This parameter displays the voltage of Battery Cell Group 25 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 26	Volts	This parameter displays the voltage of Battery Cell Group 26 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 27	Volts	This parameter displays the voltage of Battery Cell Group 27 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 28	Volts	This parameter displays the voltage of Battery Cell Group 28 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 29	Volts	This parameter displays the voltage of Battery Cell Group 29 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 30	Volts	This parameter displays the voltage of Battery Cell Group 30 within Module 3, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 31	Volts	This parameter displays the voltage of Battery Cell Group 31 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 32	Volts	This parameter displays the voltage of Battery Cell Group 32 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 2

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 33	Volts	This parameter displays the voltage of Battery Cell Group 33 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 34	Volts	This parameter displays the voltage of Battery Cell Group 34 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 35	Volts	This parameter displays the voltage of Battery Cell Group 35 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 36	Volts	This parameter displays the voltage of Battery Cell Group 36 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 37	Volts	This parameter displays the voltage of Battery Cell Group 37 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 38	Volts	This parameter displays the voltage of Battery Cell Group 38 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 39	Volts	This parameter displays the voltage of Battery Cell Group 39 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 40	Volts	This parameter displays the voltage of Battery Cell Group 40 within Module 4, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 41	Volts	This parameter displays the voltage of Battery Cell Group 41 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 42	Volts	This parameter displays the voltage of Battery Cell Group 42 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 43	Volts	This parameter displays the voltage of Battery Cell Group 43 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 44	Volts	This parameter displays the voltage of Battery Cell Group 44 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 45	Volts	This parameter displays the voltage of Battery Cell Group 45 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 46	Volts	This parameter displays the voltage of Battery Cell Group 46 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 47	Volts	This parameter displays the voltage of Battery Cell Group 47 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 48	Volts	This parameter displays the voltage of Battery Cell Group 48 within Module 5, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 49	Volts	This parameter displays the voltage of Battery Cell Group 49 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 50	Volts	This parameter displays the voltage of Battery Cell Group 50 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 51	Volts	This parameter displays the voltage of Battery Cell Group 51 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 52	Volts	This parameter displays the voltage of Battery Cell Group 52 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 53	Volts	This parameter displays the voltage of Battery Cell Group 53 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 54	Volts	This parameter displays the voltage of Battery Cell Group 54 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 55	Volts	This parameter displays the voltage of Battery Cell Group 55 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 56	Volts	This parameter displays the voltage of Battery Cell Group 56 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 57	Volts	This parameter displays the voltage of Battery Cell Group 57 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 58	Volts	This parameter displays the voltage of Battery Cell Group 58 within Module 6, Section 5 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 59	Volts	This parameter displays the voltage of Battery Cell Group 59 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 60	Volts	This parameter displays the voltage of Battery Cell Group 60 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 61	Volts	This parameter displays the voltage of Battery Cell Group 61 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 62	Volts	This parameter displays the voltage of Battery Cell Group 62 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 63	Volts	This parameter displays the voltage of Battery Cell Group 63 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 64	Volts	This parameter displays the voltage of Battery Cell Group 64 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.

Voltage Data 3

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		
Hybrid/EV Battery 65	Volts	This parameter displays the voltage of Battery Cell Group 65 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 66	Volts	This parameter displays the voltage of Battery Cell Group 66 within Module 7, Section 4 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 67	Volts	This parameter displays the voltage of Battery Cell Group 67 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 68	Volts	This parameter displays the voltage of Battery Cell Group 68 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 69	Volts	This parameter displays the voltage of Battery Cell Group 69 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 70	Volts	This parameter displays the voltage of Battery Cell Group 70 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 71	Volts	This parameter displays the voltage of Battery Cell Group 71 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 72	Volts	This parameter displays the voltage of Battery Cell Group 72 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 73	Volts	This parameter displays the voltage of Battery Cell Group 73 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 74	Volts	This parameter displays the voltage of Battery Cell Group 74 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 75	Volts	This parameter displays the voltage of Battery Cell Group 75 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 76	Volts	This parameter displays the voltage of Battery Cell Group 76 within Module 8, Section 3 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 77	Volts	This parameter displays the voltage of Battery Cell Group 77 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 78	Volts	This parameter displays the voltage of Battery Cell Group 78 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 79	Volts	This parameter displays the voltage of Battery Cell Group 79 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 80	Volts	This parameter displays the voltage of Battery Cell Group 80 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 81	Volts	This parameter displays the voltage of Battery Cell Group 81 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 82	Volts	This parameter displays the voltage of Battery Cell Group 82 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 83	Volts	This parameter displays the voltage of Battery Cell Group 83 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 84	Volts	This parameter displays the voltage of Battery Cell Group 84 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 85	Volts	This parameter displays the voltage of Battery Cell Group 85 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 86	Volts	This parameter displays the voltage of Battery Cell Group 86 within Module 9, Section 2 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 87	Volts	This parameter displays the voltage of Battery Cell Group 87 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 88	Volts	This parameter displays the voltage of Battery Cell Group 88 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 89	Volts	This parameter displays the voltage of Battery Cell Group 89 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 90	Volts	This parameter displays the voltage of Battery Cell Group 90 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 91	Volts	This parameter displays the voltage of Battery Cell Group 91 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 92	Volts	This parameter displays the voltage of Battery Cell Group 92 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 93	Volts	This parameter displays the voltage of Battery Cell Group 93 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

Parameter	Expected Value	Definition
Hybrid/EV Battery 94	Volts	This parameter displays the voltage of Battery Cell Group 94 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 95	Volts	This parameter displays the voltage of Battery Cell Group 95 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.
Hybrid/EV Battery 96	Volts	This parameter displays the voltage of Battery Cell Group 96 within Module 10, Section 1 of the Hybrid Battery Pack, as measured by the battery energy control module.

HEATING, VENTILATION AND AIR CONDITIONING CONTROL MODULE SCAN TOOL INFORMATION

Heating Ventilation and Air Conditioning Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/ Vehicle in Service Mode			
A/C Button/Switch	A/C Button released	Inactive	The scan tool displays Active or Inactive depending on the state of the A/C switch.
	A/C Button pressed	Active	
A/C Compressor Refrigerant Solenoid Valve Command	-	0 - 100%	The scan tool displays % depending on the command for compressor displacement. The value increases stepwise from 0 - 100% depending on the command/request.
A/C Indicator	A/C Off	Off	The scan tool displays On or Off depending on the state of the A/C mode.
	A/C On	On	
A/C Evaporator Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the A/C evaporator temperature sensor.
A/C Request Signal	A/C Off	Inactive	The scan tool displays Active or Inactive depending on the state of the A/C mode.
	A/C On	Active	
Air Inlet Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Air Inlet Door Actuator Direction	-	Stop	The scan toll displays Stop, Outside Air, Increase, Recirculation, Decrease or Not Used depending on the state of the recirculation door. During the movement of the door, the scan tool shows Increase or Decrease depending on the movement direction.
Air Inlet Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Air Inlet Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Air Quality Sensor / Odor (AQS) Button/Switch	Button released	Inactive	The scan tool displays Active or Inactive depending on the state of the A/C switch.
	Button pressed	Active	

Parameter	System State	Expected Value	Description
Air Quality / Odor (AQS) Sensor	-	Varies	The scan tool displays counts. The value increases with the increasing of the pollution of the ambient air.
Air Quality Sensor / Odor (AQS) Indicator	AQS Off	Off	The scan tool displays On or Off depending on the state of the AQS indicator command
	AQS On	On	
Air Recirculation Button/Switch	Button released	Inactive	The scan tool displays Active or Inactive depending on the state of the air recirculation mode switch.
	Button pressed	Active	
Air Recirculation Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Air Recirculation Door Actuator Direction	-	Stop	The scan toll displays Stop, Outside Air, Increase, Recirculation, Decrease or Not Used depending on the state of the recirculation door. During the movement of the door, the scan tool shows Increase or Decrease depending on the movement direction.
Air Recirculation Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Air Recirculation Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Air Recirculation Indicator	Recirculation Off	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Recirculation On	On	
Air Recirculation LED	Recirculation Off	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Recirculation On	On	
Air Recirculation Mode Switch	Air recirculation switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the air recirculation mode switch.
	Air recirculation switch pressed	Active	
Auto HVAC Button/ Switch	Auto HVAC button released	Inactive	The scan tool displays On or Off depending on the state of the Auto HVAC button.
	Auto HVAC button pressed	Active	
Auto HVAC Indicator	Auto mode is deactivated	Off	The scan tool displays On or Off depending on the state of the Auto mode command.
	Auto mode is activated	On	
Auto HVAC Switch	Auto HVAC switch released	Inactive	The scan tool displays On or Off depending on the state of the Auto HVAC switch.
	Auto HVAC switch pressed	Active	
Auto Recirculation Button/ Switch	-	Inactive	The scan tool displays Up, Down, or Inactive depending on the state of the switch.

Parameter	System State	Expected Value	Description
Auto Recirculation Indicator	Auto Recirculation is deactivated	Off	The scan tool displays On or Off depending on the state of the Auto Recirculation indicator command.
	Auto Recirculation is activated	On	
Auxiliary Blower Motor Button/Switch	-	Varies	The scan tool displays AUTO, OFF, 1, 2, 3, 4, or 5 depending on the position of the auxiliary blower motor switch.
Auxiliary Blower Motor Speed	-	0 - 100%	The scan tool displays % depending on the feedback. The value increases stepwise from 0 - 100% depending on the feedback.
Auxiliary Blower Motor Speed Command	-	0 - 100%	The scan tool displays % depending on the command. The value increases stepwise from 0 - 100% depending on the command/request.
Auxiliary Blower Motor Speed Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Auxiliary Blower Motor Switch - Rotary	-	Varies	The scan tool displays AUTO, OFF, 1, 2, 3, 4, or 5 depending on the position of the auxiliary blower motor switch.
Auxiliary Coolant Pump	-	Varies	The scan tool displays Active or Inactive depending on the requested state of the coolant pump.
Auxiliary Coolant Pump Relay Command	-	Varies	The scan tool displays Active or Inactive depending on the requested state of the relay.
Auxiliary Coolant Pump Speed Command Duty Cycle	-	0 - 100%	The scan tool displays % depending on the command. The value increases stepwise from 0 - 100% depending on the command/request.
Auxiliary Coolant Pump Speed Feedback Duty Cycle	-	0 - 100%	The scan tool displays % depending on the feedback. The value increases stepwise from 0 - 100% depending on the feedback.
Auxiliary Heater Coolant Pump Fault Status	-	Normal	The scan tool displays Normal, High/Low Current, Flow Restricted, Overvoltage, Over temperature, or Circuit Open/ Shorted indicating the status of the coolant pump.
Auxiliary Heater Output Status	-	OK	The scan tool displays OK, or Malfunction indicating the status of the auxiliary heater.
Auxiliary Mode Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the rear mode actuator.
Auxiliary Mode Door Actuator Direction	-	Stop	The scan toll displays Stop, Increase, or Decrease depending on the state of therear mode actuator. During the movement of the door, the scan tool shows Increase or Decrease depending on the movement direction.
Auxiliary Mode Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.

Parameter	System State	Expected Value	Description
Auxiliary Mode Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the rear mode actuator.
Auxiliary Mode Switch Indicator	Auxiliary Mode Switch inactive	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Auxiliary Mode Switch active	On	
Auxiliary Mode Switch Position - Knob	-	Varies	The scan tool displays Auto, Floor, Bi-level or Panel depending on the position of the switch.
Auxiliary Mode Switch Position - Toggle	-	Varies	The scan tool displays Auto, Floor, Bi-level or Panel depending on the position of the switch.
Base Model Part Number	-	Varies	Displays the currently installed part number of module.
Battery Voltage	-	Varies	The scan tool displays V. This is the current battery voltage.
Bi-Level Button/ Switch	Bi-Level Switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Bi-Level Switch pressed	Active	
Bi-Level Indicator	Bi-Level mode selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Bi-Level mode deselected	On	
Blower Motor Speed	-	0 - 100%	The scan tool displays % depending on the state of the selected blower motor speed. The value increases stepwise from 0 - 100% depending on the selected speed.
Blower Motor Speed 1 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 2 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 3 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 4 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 5 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed 6 Indicator	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
Blower Motor Speed Command	-	0 - 100%	The scan tool displays % depending on the state of the selected blower motor speed. The value increases stepwise from 0 - 100% depending on the selected speed.

Parameter	System State	Expected Value	Description
Blower Motor Switch-Toggle	-	Inactive	The scan tool displays Up, Down or Inactive depending on the state of the blower motor switch.
Date Programmed	-	Varies	The scan tool displays the date the module was last programmed.
Desired Left Temperature	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Desired Rear Temperature	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Desired Right Temperature	-	Varies	The scan tool displays Â°C (Â°F). This is the currently selected temperature setting.
Diagnostic Data Identifier	-	Varies	The scan tool displays the 4 character alphanumeric device ID.
End Model Part Number	-	Varies	The scan tool displays the end software module part number.
Enhanced Defrost Button/ Switch	Enhanced defrost switch released	Inactive	The scan tool displays On or Off depending on the state of the switch.
	Enhanced defrost switch pressed	Active	
Enhanced Defrost Indicator	Enhanced defrost mode is deactivated	Off	The scan tool displays On or Off depending on the state of the enhanced defrost mode.
	Enhanced defrost mode is activated	On	
Floor Mode Button/ Switch	Floor mode switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Floor mode switch pressed	Active	
Floor Mode Indicator	Floor mode Not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Floor mode selected	On	
Fresh Air Button/Switch	Fresh air switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Fresh air switch pressed	Active	
Fresh Air Indicator	Fresh air not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Fresh air selected	On	
Front Defog Button/Switch	Front defog switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Front defog switch pressed	Active	
Front Defog Indicator	Front defog not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.

Parameter	System State	Expected Value	Description
	Front defog selected	On	
Front Defrost Button/ Switch	Defrost switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Defrost switch pressed	Active	
Front Defrost Indicator	Front defrost not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Front defrost selected	On	
Front HVAC System Status	-	Varies	The scan tool displays Comfort, ECO, or Fan Only depending on the selected operating mode of the HVAC system.
Front HVAC System Status Indicator	-	Varies	The scan tool displays: Link Active, AQS Active, Front Off Active, Fan Blower Minus Active, Fan Blower Plus Active, Knob Fan Active, Knob Temp Active, FR Fahrenheit Active, FR Celsius Active, FL Fahrenheit Active, FL Celsius Active, Front Fan 6 Active, Front Fan 5 Active, Front Fan 4 Active, Front Fan 3 Active, Front Fan 2 Active, Front Fan 1 Active, FL Active, Rear Enable Active, Extended Defrost Active, Heat Mode Active, Bi-level Active, Floor Active, Vent Active, Defog Active, Rear Defrost Active, Automatic Active, Fresh Active, Recirculation Active, or A/C Active depending on the current operating mode of the HVAC system.
Heat Mode Button/Switch	Heat switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Heat switch pressed	Active	
Heat Mode Indicator	Heat not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Heat selected	On	
Heater Core Coolant Temperature Sensor	-	-40 to +215Â°C (-40 to +419Â°F)	The scan tool displays Â°C (Â°F). This is the temperature of the coolant at the inlet of the coolant heater
Heating Element 1 Duty Cycle Command	-	Varies	The scan tool displays % from 0 - 100, depending on the state of the command.
High Voltage Heater Pump Status	-	Varies	The scan tool displays % from 0 - 100, depending on the feedback.
HVAC Indicator Commanded Status	-	Varies	The scan tool displays On or Off depending on the state of the indicator command.
HVAC Actuators Supply Voltage	-	Active	The scan tool displays Active or Inactive. Inactive is displayed if there is a malfunction at the actuators supply voltage circuit.
HVAC Control Switch Activations - Extended	-	Inactive	The scan tool displays Active or Inactive. Active is displayed when a switch is pressed.

Parameter	System State	Expected Value	Description
HVAC Heater Coolant Pump Speed Command Duty Cycle	-	Varies	The scan tool displays % from 0 - 100, depending on the state of the command.
HVAC Heater Coolant Pump Speed Feedback Duty Cycle	-	Varies	The scan tool displays % from 0 - 100, depending on the feedback.
HVAC Mode Status	-	Varies	The scan tool displays: Peak Performance Mode, Normal, Economy Mode, Blower Only Mode, or Heater Economy Mode indicating the currently selected mode.
Hybrid/EV Battery Pack Coolant Pump Command	-	Varies	The scan tool displays % from 0 - 100, depending on the state of the command.
Hybrid/EV Battery Pack Coolant Pump Speed	-	Varies	The scan tool displays % from 0 - 100, depending on the feedback.
Hydrocarbon Air Quality Sensor	-	Varies	The scan tool displays counts. The value increases with the increasing of the pollution of the ambient air.
Ignition Voltage	-	11 - 14 V	The scan tool displays the current Ignition voltage.
Instrument Panel Vents Button/Switch	Instrument Panel Vent switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Instrument Panel Vent switch pressed	Active	
Instrument Panel Vents Indicator	Panel Vents not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	Panel Vents selected	On	
Left / Single Solar Sensor	-	Varies	The scan tool displays W/m^2 . This is the current sun heat intensity.
Left Temperature Button/ Switch	-	Inactive	The scan tool displays Up, Down, or Inactive depending on the state of the temperature switch.
Left Temperature Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Left Temperature Door Actuator Direction	-	Varies	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Left Temperature Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Left Temperature Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Left Temperature Knob Position	-	Varies	The scan tool displays Increase or Decrease when the left temperature knob is rotated.
Lower Left Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the duct temperature sensor.
Lower Rear Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the duct temperature sensor.

Parameter	System State	Expected Value	Description
Lower Right Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the duct temperature sensor.
Manufacturing Enable Counter	-	0	The scan toll displays 0 - 255 counts. This counter typically decrements 1 count per ignition cycle. 0 indicates a locked ECU.
Manufacturing Traceability Data	-	Varies	This parameter displays the diagnostic module traceability number, which may be up to 16 digits long. This information may be used in certain situations to identify the manufacturer of the component.
Mode Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the actuator.
Mode Door Actuator Direction	-	Stop	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Mode Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Mode Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Mode Switch - Toggle	-	Inactive	The scan tool displays Up, Down, or Inactive depending on the state of the mode switch.
Mode Switch Knob Position	-	Varies	The scan tool displays: Rear, Sync, Floor/Vent/Defrost (Tri-Level), Vent/Defrost, Front Defrost, Foot/Defrost 3 (Blend+), Foot/Defrost 2 (Blend), Foot/Defrost 1 (Floor +), Foot (Floor), Bi-level 3 (Bi-level +), Bi-level 2 (Bi-level), Bi-level 1 (Panel +), Face (Panel), or AUTO depending on the position of the switch.
MULTI-ZONE Button/ Switch	MULTI-ZONE switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	MULTI-ZONE switch pressed	Active	
MULTI-ZONE Indicator	MULTI-ZONE not selected	Off	The scan tool displays On or Off depending on the state of the indicator command.
	MULTI-ZONE selected	On	
Outside Air Temperature Sensor Voltage	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the outside air temperature sensor.
Passenger Compartment Air Temperature (Filtered)	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the stored temperature of the passenger compartment air temperature sensor.
Passenger Compartment Air Temperature (Unfiltered)	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the passenger compartment air temperature sensor.

Parameter	System State	Expected Value	Description
Passenger Compartment Humidity	-	3 - 100%	The scan tool displays %. This is the current relative humidity level at the windshield temperature and inside moisture sensor.
Passenger Compartment Humidity Sensor Temperature	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the humidity sensing element temperature sensor.
Rear Defogger Button/ Switch	Rear Defogger switch released	Inactive	The scan tool displays Active or Inactive depending on the state of the switch.
	Rear Defogger switch pressed	Active	
Rear Defogger Deactivation Reason	-	Varies	The scan tool displays: Auto Start Active, Rear Defrost Inhibited, Load Shed Active, Convertible Top Down, or Battery State of Charge Low. This is the reason the defogger has been disabled.
Rear Defogger Indicator	Rear defogger is deactivated	Off	The scan tool displays On or Off depending on the state of the rear defogger.
	Rear defogger is activated	On	
Rear Defogger Status	Rear defogger is deactivated	Off	The scan tool displays On or Off depending on the state of the rear defogger command.
	Vehicle ON/ Rear defogger is activated	On	
Rear In Vehicle Temperature Sensor (Filtered)	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the stored temperature of the rear passenger compartment air temperature sensor.
Rear In Vehicle Temperature Sensor (Unfiltered)	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the rear passenger compartment air temperature sensor.
Rear Temperature Button/Switch	-	Inactive	The scan tool displays Up, Down or Inactive depending on the state of the temperature switch.
Rear Temperature Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the mode actuator.
Rear Temperature Door Actuator Direction	-	Stop	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Rear Temperature Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Rear Temperature Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Rear Temperature Knob Position	-	Varies	The scan tool displays Increase or Decrease when the rear temperature knob is rotated.
Repair Shop Code or Tester Serial Number	-	Varies	This number may be used in certain situations to identify the supplier, control module and diagnostic capability of the component.

Parameter	System State	Expected Value	Description
Right Solar Load	-	Varies	The scan tool displays W/m^2 . This is the current sun heat intensity.
Right Solar Sensor	-	Varies	The scan tool displays W/m^2 . This is the current sun heat intensity.
Right Temperature Button/ Switch	-	Inactive	The scan tool displays Up, Down or Inactive depending on the state of the temperature switch.
Right Temperature Door Actuator Command	-	Varies	The scan tool displays Counts. This is the desired position of the mode actuator.
Right Temperature Door Actuator Direction	-	Stop	The scan tool displays stop, increase, or decrease. This is the current direction of the actuator.
Right Temperature Door Actuator Learn Status	-	Complete	The scan tool displays Not Running, In Progress, Complete, or Failed depending on the actuator calibration status.
Right Temperature Door Actuator Position	-	Varies	The scan tool displays Counts. This is the actual position of the actuator.
Right Temperature Knob Position	-	Varies	The scan tool displays Increase or Decrease when the right temperature knob is rotated.
Security Code Accepted	-	Yes	The scan tool displays Yes or No depending on the current security code status.
Security Code Lockout	-	Security Code Accepted	The scan tool displays Tool Learn Delay Active, Vehicle Assembly Mode Flag, Security Code Lockout Active, Security Code Programmed, Security Code Accepted depending on the current security code status.
Security Code Lockout Active	-	Inactive	When active, the scan tool displays a timer which prohibits programming the security code when a certain number of attempts have been exceeded. The security code is a method of verifying that the module has not been swapped with a module from another vehicle
Security Code Programmed	-	Yes	The scan tool displays Yes or No depending on the current security code status.
Security Code Programming Counter	-	Varies	This parameter indicates the number of times the security code has been programmed. The security code is a method of verifying that the module has not been swapped with a module from another vehicle.
Security Code Reset Counter	-	Varies	This parameter indicates the number of times the security code has been reset. The security code is a method of verifying that the module has not been swapped with a module from another vehicle.
Software Module 1 Identifier	-	Varies	The scan tool displays the software calibration part number 1.
Software Module 2 Identifier	-	Varies	The scan tool displays the software calibration part number 2.

Parameter	System State	Expected Value	Description
Software Module 3 Identifier	-	Varies	The scan tool displays the software calibration part number 3.
Sun Azimuth	-	0 - 90Â°	The scan tool displays degrees. This is the current angle in the horizontal plane between the sun and the vehicle driving direction.
Sun Elevation	-	0 - 360Â°	The scan tool displays degrees. This is the current angle in the vertical sun height.
Sunload / Sun Intensity	-	0 - 1200 W/m^2	The scan tool displays W/m^2 . This is the current sun heat intensity.
Upper Left Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the upper left duct temperature sensor.
Upper Rear Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the rear upper duct temperature sensor.
Upper Right Duct Air Temperature Sensor	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the upper right duct temperature sensor.
Vehicle Identification Number (VIN)	-	Varies	The scan tool displays the learned vehicle identification number.
Windshield Temperature	-	-40 to +80Â°C (-40 to +176Â°F)	The scan tool displays Â°C (Â°F). This is the current temperature at the windshield temperature sensor.

Heating Ventilation and Air Conditioning Control Module Scan Tool Output Controls

Output Control	Description
A/C Compressor Clutch Enable	This control function enables or disables the A/C Compressor Clutch. The scan tool displays Engaged or Disengaged depending on the state of the A/C compressor clutch.
A/C Compressor Valave Control	This control function increases or decreases the command to the A/C Compressor Solenoid in %. The scan tool displays amperage in % depending on the state of the command for increased/decreased compressor displacement.
Aero Shutter Enable	This control function commands the state of the Aero Shutter between Active and Not Active.
Air Inlet Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Air Recirculation Door Actuator Direction	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Auxiliary Blower Motor Speed	This control function commands the auxiliary blower motor speed from 0 to 100% and back again.
Auxiliary Coolant Pump Speed	The HVAC control module enables or disables the coolant pump, and varies the pump speed when commanded from the scan tool.
Auxiliary Heater Output Enable	This control function increases or decreases the command to the Auxiliary Heater in %. The scan tool displays amperage in % depending on the state of the command.

Output Control	Description
Auxiliary Mode Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Blower Motor Speed/ Command	This control function commands the blower motor speed from 0 to 100% and back again.
Heater Core Pump Relay Control Circuit	This control function commands the heater core pump relay On and Off.
Illuminate All Indicators	The HVAC control module illuminates all the indicators when commanded from the scan tool.
Left Temperature Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Mode Door Position Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Rear Defogger	This control function enables or disables the Rear Defogger. The scan tool displays Active or Not Active depending on the state of the rear defogger command.
Rear Temperature Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Right Temperature Door Actuator Control	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.
Single Zone Temperature Actuator Direction	This control function commands the door position to increase or decrease. During the movement of the door, the scan tool shows Increase or Decrease dependant on the movement direction. When the position of the door is reached, the scan tool displays Stop.

Heating Ventilation and Air Conditioning Control Module Configuration/Reset Functions

Output Control	Description
HVAC Afterblow Configuration	This control function enables or disables the afterblow configuration. When enabled, the Afterblow mode operates the blower motor after the engine has been turned off and the air conditioning has been used. This operation of the blower motor aids in drying the evaporator core
HVAC Actuators Learn	The HVAC control module executes the Motor Learn Routine when commanded. The actuators are commanded to their extreme travel available at both ends. These values are then used for future reference when determining door position.
Reset Source ID	Resets the communication IDs between modules

HYBRID POWERTRAIN CONTROL MODULE SCAN TOOL INFORMATION

The hybrid powertrain control module is a non-serviceable module within the power inverter module, often referred to as the drive motor generator power inverter module assembly. The Hybrid Powertrain Control Module Scan Tool Data Parameters list contains hybrid controls-related parameters. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Hybrid Powertrain Control Module Scan Tool Data Parameters list only after the following is determined:

- The **Diagnostic System Check - Vehicle** is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly

The scan tool values from a properly running vehicle may be used for comparison with the vehicle you are diagnosing. The Hybrid Powertrain Control Module Scan Tool Data Parameters list represents values that would be seen on a normally running vehicle.

NOTE: **A scan tool that displays faulty data should not be used. The scan tool concern should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.**

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to **Symptoms - Hybrid Controls** for diagnosis.

Hybrid Powertrain Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Run			
Auxiliary Transmission Fluid Pump	-	Varies	This parameter displays auxiliary transmission fluid pump speed in percent. The parameter display range is 0 - 100%.
Axle Torque	-	Varies	This parameter displays actual axle torque. The parameter display range is -8192 to +8191.75.
Axle Torque Command	-	Varies	This parameter displays commanded axle torque. The parameter display range is -8192 to +8191.75.
Axle Torque Immediate	-	Varies	This parameter displays the immediate axle torque required when accelerating. the parameter display range is -8192 to +8191.75.
Calculated Throttle Position	Pedal Released	0%	This parameter displays the position of the accelerator pedal as determined by the ECM. This parameter is not active when the transmission is in Park or Neutral. 100% is displayed when the pedal is fully depressed. The parameter display range is 0 - 100%.
	Pedal Fully Depressed	100%	
Contactor Open Reason History 1	-	Varies	This parameter identifies why contactors were commanded open.
Contactor Open Reason History 2	-	Varies	This parameter identifies why contactors were commanded open.

Parameter	System State	Expected Value	Description
Contactor Open Reason History 3	-	Varies	This parameter identifies why contactors were commanded open.
Contactor Open Reason History 4	-	Varies	This parameter identifies why contactors were commanded open.
Contactor Open Reason History 5	-	Varies	This parameter identifies why contactors were commanded open.
Contactor Open Reason History 6	-	Varies	This parameter identifies why contactors were commanded open.
Contactor Open Reason History 7	-	Varies	This parameter identifies why contactors were commanded open.
Contactor Open Reason History 8	-	Varies	This parameter identifies why contactors were commanded open.
Drive Motor Current	-	Varies	This parameter indicates the DTC current consumed by the drive motor.
Drive Motor Current	-	Varies	This parameter indicates the current supplied to the drive motor.
Drive Motor Inverter Status	-	Varies	This parameter indicates the state of the inverter.
Drive Motor Inverter Status	-	Varies	This parameter indicates the current state of the drive motor inverter.
Drive Motor Inverter Supply Voltage Circuit	-	Varies	This parameter displays the high voltage circuit voltage as detected by the drive motor control which detects voltage in a range from 0 - 655.35 V.
Drive Motor Inverter Supply Voltage Circuit	-	Varies	This parameter indicates the voltage on the DC bus at the inverter for the drive motor.
Drive Motor Inverter Temperature Sensor 1	-	Varies	This parameter indicates the temperature of inverter temperature sensor 1.
Drive Motor Inverter Temperature Sensor 2	-	Varies	This parameter indicates the temperature of inverter temperature sensor 2.
Drive Motor Inverter Temperature Sensor 3	-	Varies	This parameter indicates the temperature of inverter temperature sensor 3.
Drive Motor Negative Supply Isolation Voltage	-	Varies	This parameter indicates the high voltage negative to chassis voltage as measured at the motor.
Drive Motor Phase U Current	-	Varies	This parameter indicates the current flow to phase U of the electric motor.
Drive Motor Phase V Current	-	Varies	This parameter indicates the current flow to phase V of the electric motor.

Parameter	System State	Expected Value	Description
Drive Motor Phase W Current	-	Varies	This parameter indicates the current flow to phase W of the electric motor.
Drive Motor Positive Supply Isolation Voltage	-	Varies	This parameter indicates the high voltage positive to chassis voltage as measured at the motor.
Drive Motor Speed	-	Varies	This parameter indicates the speed, in revolutions per minute, of hybrid electric motor 1 as determined from the resolver.
Drive Motor Temperature	-	Varies	This parameter indicates the temperature of inverter temperature sensor 1.
Drive Motor Torque	-	Varies	This parameter indicates the torque value for the drive motor.
Driver Requested Axle Torque	-	No	This parameter displays the status of an Autostart Entry due to the drivers request for axle torque. Autostart is requested when the drivers axle torque requirements cannot be maintained without the internal combustion engine. The parameter display range is Yes, No.
ECM Challenge Status	-	Varies	this parameter indicates if the engine control module has sent out a request to immobilizer module to reply with a password.
Hybrid Powertrain Control Module Authentication Status	-	Varies	This parameter indicates the result of the comparison between the last received immobilizer system response and the expected response calculated by the hybrid powertrain control module.
Hybrid Powertrain Control Module High Voltage Circuit	-	Varies	This parameter displays the high voltage circuit voltage as detected by the hybrid powertrain control module which detects voltage in a range from 0 - 655.35 V.
Hybrid Powertrain Control Module Response Source	-	Varies	This parameter will match the ECM parameter and indicates the source used to calculate the hybrid powertrain control module response. The sources include Normal Start, Remote Vehicle Start, PTO Remote Start.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Current	-	Varies	this parameter displays the actual current flow of the high voltage (300 V) electrical system as determined by the Hybrid Powertrain Control Module 2. The parameter display range is -1638.4 to +1638.35 Amps. A negative current value indicates a battery charge while a positive current value indicates a battery discharge.
Hybrid/EV Battery Pack State of Charge	-	Varies	This parameter displays the state of charge of the battery pack as determined by the Hybrid Powertrain Control Module 2. The parameter display range is 0 - 100%.
Ignition Input Accessory	-	Varies	This parameter displays the voltage of the accessory feed circuit of the hybrid powertrain control module. The parameter display range is 0 - 65.535 V.
Ignition Input Off/On/Start	-	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module. The parameter display range is 0 - 65.535 V.
Ignition 1 Signal	-	Varies	This parameter displays the voltage of the ignition feed circuit of the hybrid powertrain control module.
Immobilizer Password Learn	-	Varies	The vehicle theft deterrent (VTD) module must be put in a learn mode to learn the correct password when the module is replaced.
Immobilizer Automatic Learn Timer	-	Varies	This parameter indicates the time elapsed within the current autolearn cycle within the immobilizer system.
Immobilizer Password Learn Counter	-	Varies	This parameter indicates the number of times the immobilizer system password has been reset.
Immobilizer Password Learn Scan Tool Delay	-	Varies	This parameter indicates that the security code has been accepted but the tool learn delay is active and will not allow learning enabled, programming security code, or resetting security code.
Immobilizer Security Code Accepted	-	Varies	This parameter indicates that the received security code is correct.
Immobilizer Security Code Function	-	Varies	This parameter indicates the current state of the immobilizer security code function.
Immobilizer Security Code Lockout	-	Varies	This parameter indicates that the security code has not passed and lockout is active.

Parameter	System State	Expected Value	Description
Immobilizer Security Code Lockout Active Timer	-	Varies	This parameter indicates the time elapsed since the receipt of the correct security code within the immobilizer system.
Immobilizer Security Code Programmed	-	Varies	This parameter indicates that the security code has been programmed.
Immobilizer Security Code Programming Counter	-	Varies	This parameter indicates the number of times a new immobilizer security code has been programmed through secure access. This counter can only be incremented.
Immobilizer Security Code Reset Counter	-	Varies	This parameter indicates the number of times the immobilizer security code has been reset to the default value through secure access. This counter can only be incremented.
Immobilizer Security Information Programmed	-	Varies	This parameter indicates that the immobilizer key has been programmed.
Immobilizer System Status	-	Varies	This parameter indicates the current state of the immobilizer algorithm.
Immobilizer Valid Response Received Time	-	Varies	This parameter indicates the actual time needed for the immobilizer to respond with a correct password.
Isolation Voltages Delta	-	Varies	This parameter indicates the voltage difference between the drive motor positive supply isolation voltage and the drive motor negative supply isolation voltage.
Isolation Voltages Ratio	-	Varies	This parameter indicates the ratio between the drive motor positive supply isolation voltage and the drive motor negative supply isolation voltage.
Maximum Hybrid/EV Battery Module Temperature	-	Varies	This parameter indicates the temperature of the hybrid battery module with the highest temperature.
Minimum Hybrid/EV Battery Module Temperature	-	Varies	This parameter indicates the temperature of the hybrid battery module with the lowest temperature.
Power Mode	-	Varies	This parameter displays system power mode status as determined by ignition switch inputs to the power mode master. System power mode status should match the ignition switch position.

Parameter	System State	Expected Value	Description
Regenerative Braking Axle Torque Request	-	Varies	This parameter indicates the Regenerative Braking Axle Torque Request value sent form the anti-lock brake module to the hybrid powertrain control module.
Regenerative Braking Status	-	Varies	This Parameter identifies why contactors were commanded open.
Regenerative Braking Torque Predicted	-	Varies	This parameter indicates the Regenerative Braking Axle Torque Request value sent from the anti-lock brake module to the hybrid powertrain control module.
Security Code Lockout Active Timer	-	Varies	This parameter indicates the time elapsed since the immobilizer security code lockout has been activated either due to a battery disconnect or an incorrect immobilizer security code being entered.
Total Brake Torque	-	Varies	This parameter indicates the actual state of blended regenerative braking as determined by the hybrid control module.
Vehicle Speed Sensor	-	Varies	This parameter indicates vehicle speed calculated from the transmission output speed.
VIN Programming Counter	-	Varies	This parameter indicates the number of times the VIN has been programmed. This counter can only be incremented.

Hybrid Powertrain Control Module Scan Tool Output Controls

Functions	Description
Auxiliary Transmission Fluid Pump Speed	Â
Regenerative Braking Status	• The hybrid powertrain control module will enable or disable blended regenerative braking. • When the vehicle is ON there are no limits to this control.

Functions	Description
Clear Secured High Voltage DTC	• This output control is used to clear a latched high voltage (HV) lockout state. • The hybrid powertrain control modules 1 and 2 monitor for high voltage safety conditions such as airbag deploy events and certain HV system faults. • If these conditions are present either module may set a DTC and prevent HV enabling until after this Output Control is exercised. **NOTE:** **Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout.** • Always refer to **Clear Secured High Voltage DTCs** procedure in Hybrid/EV Energy Storage service information for the proper sequence of procedures required to reset a HV lockout state.

HYBRID POWERTRAIN CONTROL MODULE 2 SCAN TOOL INFORMATION

Charge History Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: The Charge History parameters capture the conditions present during the last five AC charge events. A charge event is recorded whenever the charge coupler is fully mated to the charge receptacle. History 1 is the most recent charge event. The Charge History parameters are cleared only during an HPCM2 replacement and/or programming event.		
Charge History (1 thru 5) - 110 V AC Input	Varies	This parameter displays if the 110 V charge cord was active during this charge event.
Charge History (1 thru 5) - 240 V AC Input	Varies	This parameter displays if the 240 V charge cord was active during this charge event.
Charge History (1 thru 5) - Autostart Inhibit	Varies	This parameter displays if the charge event was interrupted because of an engine start. An engine start could be commanded via remote start, key crank, cold battery, etc.
Charge History (1 thru 5) - Battery Charger Temperature Too High	No	This parameter displays if the charge event was interrupted because the Battery Charger internal temperature exceeded a set value.
Charge History (1 thru 5) - Charging Cord Error	No	This parameter displays if the vehicle battery charger is requesting utility power but AC input voltage is not present. Refer to DTC P1EE6.
Charge History (1 thru 5) - Contactor Open	No	This parameter displays if the charging related contactor(s) were commanded open, interrupting the charge event.
Charge History (1 thru 5) - Full Charge	Varies	This parameter displays if the high voltage battery was completely charged during this charge event.
Charge History (1 thru 5) - High Severity Fault	No	This parameter displays if high voltage battery DTCs such as cell overvoltage had set, inhibiting the charge event.
Charge History (1 thru 5) - Hybrid/EV Battery Pack Protection	No	This parameter displays if high voltage battery DTCs had set, inhibiting the charge event.
Charge History (1 thru 5) - Hybrid/EV Battery Pack Temperature Too Low	No	This parameter displays if the charge event was interrupted because the high voltage battery temperature was too low to allow charging.

Parameter	Expected Value	Definition
Charge History (1 thru 5) - Low Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
Charge History (1 thru 5) - Low Voltage - Battery Voltage Low Before Charge	No	This parameter displays if the 12 V accessory battery voltage was too low prior to the charging event being enabled.
Charge History (1 thru 5) - Low Voltage - Battery Voltage Low During Charge	No	This parameter displays if the 12 V accessory battery voltage was too low during the charge event.
Charge History (1 thru 5) - Maximum Cell Voltage	No	This parameter displays if the maximum voltage for one of the high voltage battery cells was exceeded, interrupting the charge event.
Charge History (1 thru 5) - Maximum Charge Time Exceeded	No	This parameter displays if the maximum charge time was exceeded during this charge event. Maximum charge time varies by vehicle model with 40 hours being the shortest maximum allowed charge time.
Charge History (1 thru 5) - Medium Severity Fault	No	This parameter displays if high voltage battery DTCs had set, interrupting the charge event.
Charge History (1 thru 5) - Multiple Plug - In Events Within 30 Seconds	No	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 30 second time frame.
Charge History (1 thru 5) - Multiple Plug - In Events Within 5 Minutes	No	This parameter displays if that several charge cord connections/disconnections were observed at the charger receptacle in a 5 minute time frame.
Charge History (1 thru 5) - Time of Day Inhibit	Varies	This parameter displays if programmable charging (time of day/rate based) had delayed charging at some point during this event.
Charge History (1 thru 5) - Unplugged at Vehicle	Varies	This parameter displays if the charge event was interrupted because the charge cord was disconnected at the vehicle charge receptacle.
Charge History (1 thru 5) - Unplugged at Wall	Varies	This parameter displays if the charge event was interrupted when AC voltage was lost to the charge cord. Most likely this occurred by either the charge cord plug being removed from the household receptacle or a household utility circuit breaker tripping open.
Charge History (1 thru 5) - Utility Company Inhibit	Varies	This parameter displays if smart charging had delayed charging at some point during this charge event due to a utility company commanded transmitted via Onstar.
Charge History (1 thru 5) - Vehicle Conditions Not Correct	Yes	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have been met.

Charge History Scan Tool Data Parameters (w/CBT)

Parameter	Expected Value	Definition
Operating Conditions: The DC Charge History parameters capture the conditions present during the last five fast charge events. A fast charge event is recorded whenever the charge coupler is fully mated to the charge receptacle. History 1 is the most recent charge event. The DC Charge History parameters are cleared only during an HPCM2 replacement and/or programming event.		

Parameter	Expected Value	Definition
DC Charge History (1 thru 5) - Active Cooling Enabled	Varies	This parameter displays if active cooling was active. The electric A/C compressor will be turned ON and the coolant control valve will be set to the chiller position allowing the air conditioning refrigerant to cool the hybrid/EV battery coolant.
DC Charge History (1 thru 5) - Bulk Charge Complete	Varies	This parameter displays if the high voltage battery was almost completely charged.
DC Charge History (1 thru 5) - Charge High Voltage Output Active	Varies	This parameter displays if the DC Charge contactors are closed.
DC Charge History (1 thru 5) - Charge Receptacle Overtemperature	No	This parameter displays if the system has commanded the DC Charge contactors open to protect the charge receptacle from overheating.
DC Charge History (1 thru 5) - Charge Station Pilot Duty Cycle Not 5%	No	This parameter displays if a valid Pilot signal was not received.
DC Charge History (1 thru 5) - Charge System Integrity Not Verified	No	This parameter displays if the DC Charge system integrity was not verified.
DC Charge History (1 thru 5) - Charge System Integrity Verified	Yes	This parameter displays if the DC Charge system integrity was verified.
DC Charge History (1 thru 5) - Charger Functions Available	Yes	This parameter displays if the DC Charger functions are available.
DC Charge History (1 thru 5) - Charger Functions Unavailable	No	This parameter displays if the DC Charger functions are not available.
DC Charge History (1 thru 5) - Charger Conditions Correct	Varies	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have been met.
DC Charge History (1 thru 5) - Charger Conditions Not Correct	Varies	This parameter displays if the required vehicle conditions to allow charging such as gear selector in Park, valid charger pilot signal have not been met.
DC Charge History (1 thru 5) - Charging Enabled	Varies	This parameter displays if DC charging was enabled.
DC Charge History (1 thru 5) - Charging Stopped by Cordset	Varies	This parameter displays if DC charging was interrupted by the Cordset.
DC Charge History (1 thru 5) - Cordset Correct for Charging	Yes	This parameter displays if the correct cordset was connected to the vehicle.
DC Charge History (1 thru 5) - DC Not Provided	No	This parameter displays if DC voltage was not provided by the off-vehicle charge station.
DC Charge History (1 thru 5) - Full Charge	Varies	This parameter displays if the high voltage battery was completely charged.
DC Charge History (1 thru 5) - Precharge Failure	No	This parameter displays if a precharge failure occurred, interrupting the charge event. Precharge occurs in the milliseconds prior to closing both the main bus contactors. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled.
DC Charge History (1 thru 5) - Propulsion System Active	Varies	This parameter displays if DC charging was inhibited because the propulsion system was active.
DC Charge History (1 thru 5) - Run/Crank Active	Varies	This parameter displays if the ignition power mode was in Run/Crank.

Hybrid Powertrain Control Module 2 Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Vehicle in Run			
12 V Battery Maintenance Mode	-	Inactive	This parameter displays if the 14 V Power Module is maintaining the state of charge of the 12 V battery.
14 V Power Module Power Available From Hybrid/EV Battery Pack	-	Varies	This parameter displays the amount of electrical power in kW the Hybrid/EV battery pack can supply to the 14 V Power Module.
A/C Compressor Command	-	Varies	This parameter displays if the A/C compressor is Engaged, Disengaged, or Aborted.
A/C Compressor Power Consumption	-	Varies	This parameter displays the amount of electrical power in kW the A/C Compressor is consuming from the high voltage system.
A/C Compressor Power Limit	-	No	This parameter displays if the electric power available to the Electric A/C compressor motor is at its limit.
A/C Compressor Speed	-	Varies	This parameter displays the actual speed of the electric A/C compressor motor shaft. This parameter is active only when the cabin controls are set to condition the vehicle.
A/C Compressor Speed Command	-	Varies	This parameter displays the commanded speed of the electric A/C compressor motor shaft. This parameter is active only when the cabin controls are set to condition the vehicle or Active Cooling of the hybrid/EV battery pack is occurring.
A/C High Side Pressure Sensor	Compressor OFF	Equal to low side	This parameter displays the pressure of the A/C system high side pressure sensor.
	Compressor ON	Higher than low side	
A/C Low Side Pressure Sensor	Compressor OFF	Equal to high side	This parameter displays the pressure of the A/C system low side pressure sensor.
	Compressor ON	Lower than high side	
A/C Low Side Pressure Sensor	-	Varies	This parameter displays the voltage of the A/C system low side pressure sensor.
Actively Tested Isolation Resistance of Complete Vehicle	-	Varies	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the status of the scan tool disable isolation diagnostic test.

Parameter	System State	Expected Value	Description
Airbag Deployed	-	No	This parameter displays if the contactors are commanded open because an air bag has deployed.
Ambient Air Temperature	-	Varies	This parameter displays the temperature of the air surrounding the vehicle.
Average Hybrid/EV Battery Pack Temperature	-	Varies	This parameter displays the average temperature for all of the Hybrid/EV battery pack module sensors.
Battery Charger AC Input Status Duty Cycle	Charging	10 - 90%	This parameter displays the duty cycle for the battery charger AC input voltage. The duty cycle is 10% when voltage is less than 60 V RMS. The duty cycle is 90% when voltage is greater than 280 V RMS.
Battery Charger DC Output Status Duty Cycle	Charging	10 - 90%	This parameter displays the duty cycle for the battery charger DC output voltage. The duty cycle is 10% when voltage is less than 0 V. The duty cycle is 90% when voltage is greater than 500 V.
Battery Charger Control Circuit Status	Charging	Passed/Failed	This parameter displays the diagnostic status of the battery charger command circuit.
Battery Charger Enable Circuit Status	Charging	Passed/Failed	This parameter displays the diagnostic status of the battery charger enable circuit.
Battery Charger Power Level	Charging	AC Level 1 AC Level 2 DC Fast Charge	This parameter displays the battery charger power level.
Battery Charger High Output	-	Varies	This parameter displays the current in amps supplied by the Battery Charger Control Module to the high voltage battery.
Battery Charger High Output	-	Varies	This parameter displays the voltage supplied by the Battery Charger Control Module to the high voltage battery.
Battery Charger High Output	-	Varies	This parameter displays the power in kilowatts supplied by the Battery Charger Control Module to the high voltage battery.
Battery Charger High Voltage Energy Output During Last Charge	-	Varies	This parameter displays the energy (kW) the battery charger has delivered into the high voltage Hybrid/EV battery pack during the last charge event.
Battery Charger High Voltage Power Output Available	-	Varies	This parameter displays the maximum battery charger power output in kW available for Hybrid/EV battery pack charging.

Parameter	System State	Expected Value	Description
Battery Charger Input	-	Varies	This parameter displays the current in amps monitored by the Battery Charger Control Module on the charge cord.
Battery Charger Input	-	Varies	This parameter displays the voltage monitored by the Battery Charger Control Module on the charge cord.
Battery Charger Input 120 V AC	-	Varies	This parameter displays the battery charging system is connected to 120 V AC.
Battery Charger Input 240 V AC	-	Varies	This parameter displays the battery charging system is connected to 240 V AC.
Battery Charger Input Current Command	Charging	Varies	This parameter displays the commanded battery charger input current.
Battery Charger Power Input Available	-	Varies	This parameter displays the maximum power in kW available at the battery charger plug receptacle coming from the wall outlet/utility supply.
Battery Charger Total Power Output Available	-	Varies	This parameter displays the maximum battery charger power output in Watts available for Hybrid/EV battery pack charging.
Battery Charging System	-	OK	This parameter displays if the components that make up the charge system are allowing charging.
Battery Charging System Efficiency (Active Test)	-	62 - 100%	This parameter displays the battery charging system efficiency determined by the active (intrusive) test. Efficiency is calculated by dividing battery charger output power by input power.
Battery Charging System Efficiency (Passive Test)	-	62 - 100%	This parameter displays the battery charging system efficiency determined by the passive (non-intrusive) test. Efficiency is calculated by dividing battery charger output power by input power.
Battery Charging System Efficiency Test Result (Active Test)	-	Passed/Failed	This parameter displays the pass/fail status of the battery charging system efficiency active test.
Battery Charging System Efficiency Test Status (Active Test)	-	Running/Not Running	This parameter displays the run status of the battery charging system efficiency active test.
Battery Charging System Efficiency Test Status (Passive Test)	-	Running/Not Running	This parameter displays the run status of the battery charging system efficiency passive test.

Parameter	System State	Expected Value	Description
Battery Charging System High Voltage Interlock Circuit	-	Energized	The charging high voltage interlock circuit routes through several charging-related components and connectors to determine if access to high voltage components is being attempted. This parameter displays if the high voltage interlock circuit is currently monitoring for high voltage system integrity.
Battery Charging System High Voltage Interlock Circuit Status	-	Pass	The charging high voltage interlock circuit routes through several charging-related components and connectors to determine if access to high voltage components is being attempted. This parameter displays if the results of the control modules diagnostic test of the charging high voltage interlock circuit.
Battery Charging System Indicator Status	-	Varies	This parameter displays the status of the charging system indicator (LEDs/Bulbs/Icons) visible to the operator of the vehicle.
Battery Charging System Isolation Test Status	-	Passed	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the status of the battery charging system isolation diagnostic test.
Battery Charging System Sensors	-	OK	This parameter displays if the battery charging system sensors are allowing charging.
Battery Charging System Status	-	Ready/Not Ready	This parameter displays the readiness of the battery charging system.
Battery Charging System Operating Conditions	-	OK	This parameter displays if the battery charging system operating conditions are allowing charging.
Battery Charging System Positive Contactor Command	Propulsion Active or Charge Mode	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on (+) side of the battery charging / 14 V power module system.
	Not in Charge Mode or Propulsion Active	Open	
Battery Charging System Receptacle Switch	-	Varies	This parameter displays the state of the switch at the receptacle where the charge cord plugs in.
Blower Motor Speed Request	-	Varies	This parameter displays the requested speed of the blower motor from 0 to 100%..

Parameter	System State	Expected Value	Description
Charge Port Door	-	Varies	This parameter displays the state of the switch at the door where the charge cord plugs in.
Charging System Inactive Time	-	Varies	This parameter displays the amount of time, in seconds, the charging system was inactive.
Climate control Target Temperature	-	Varies	This parameter displays the temperature that the climate control system is attempting to reach/maintain.
Control Pilot Duty Cycle	Charging	0 - 100%	This parameter displays the duty cycle of the battery charger control pilot.
Control Pilot Period	Charging	Varies	This parameter displays the time period of the battery charger control pilot.
Control Pilot Voltage	Charging	Varies	This parameter displays the voltage of the battery charger control pilot.
Cooling Fan Motor Command	-	Varies	This parameter displays the commanded air flow in percent of the radiator coolant fan.
Crash Event Lockout	-	No	This parameter displays if the contactors are commanded open due to a vehicle crash event being detected.
DC Charge Port Current	-	Varies	This parameter displays the current in amps supplied to the high voltage battery by the DC Fast Charge (CBT) receptacle terminals.
DC Charge Port Lock Actuator Position Voltage	-	Varies	This parameter displays the voltage sensed at the B281 Hybrid/EV Battery Charger Receptacle Lock Actuator Position Sensor circuit.
DC Charge Port Lock Actuator Position Sensor	-	Varies	This parameter displays the voltage sensed at the M110 Hybrid/EV Battery Charger Receptacle Lock Actuator switch.
DC Charge Port Temperature	-	Varies	This parameter displays the temperature of the DC Fast Charge (CBT) receptacle terminals.
DC Charging Port Disconnected While Charging Lockout	-	Varies	This parameter displays if DC Charging is disabled because the charge cable had been removed while charge current was present.

Parameter	System State	Expected Value	Description
DC Negative Supply Isolation Voltage	-	Varies	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the real-time indication of isolation status for the negative charging bus. The parameter should be near the same as the positive isolation voltage.
DC Positive Supply Isolation Voltage	-	Varies	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the real-time indication of isolation status for the positive charging bus. The parameter should be near the same as the negative isolation voltage.
Desired Charge End Time (120 V)	-	Varies	This parameter displays the scheduled end time for a level 1 charge.
Desired Charge End Time (220 V)	-	Varies	This parameter displays the scheduled end time for a level 2 charge.
Discharge Fault Lockout	-	No	This parameter displays if the scan tool disable procedure has failed due to a fault in the high voltage discharge circuit.
Discharging	-	No	This parameter displays if the system is inhibiting contactor closure because the high voltage system is currently in the process of discharging the capacitors on the high voltage bus. Discharging usually occurs immediately following opening of the high voltage contactors.
Distance Since DTC Cleared	-	Varies	This parameter displays the distance in miles or kilometers since OBD diagnostic trouble codes (DTCs) have been cleared using the service tool.
Distance With MIL On	-	Varies	This parameter displays the accumulated distance in miles or kilometers driven with the malfunction indicator lamp (MIL) on.

Parameter	System State	Expected Value	Description
Drive Motor 1 Control Module Negative Supply Isolation Voltage	-	Varies	This parameter displays the voltage as measured by the high voltage isolation sensing circuit. Refer to **Hybrid/EV System High Voltage Isolation Description** .
Drive Motor 1 Control Module Positive Supply Isolation Voltage	-	Varies	This parameter displays the voltage as measured by the high voltage isolation sensing circuit. Refer to **Hybrid/EV System High Voltage Isolation Description** .
Engine Hood Switch	-	Varies	This parameter displays the position of the hood in percent as determined by the hood latch switch.
Estimated Time To Full Charge	-	Varies	This parameter displays the estimated hours remaining until the battery pack is fully charged.
High Voltage Interlock Circuit Fault	-	No	This parameter displays if the contactors are commanded open because the high voltage interlock circuit is detected open or faulted.
High Voltage System Being Serviced Lockout	-	No	This parameter displays if the contactors are commanded open because the scan tool high voltage disabling procedure successfully completed.
High Voltage System Interlock Circuit	HV Enabled	Energized	The high voltage interlock circuit routes through several components and connectors to determine if access to high voltage components is being attempted. This parameter displays if the high voltage interlock circuit is currently monitoring for high voltage system integrity.
	HV Not Enabled	De-Energized	
High Voltage System Interlock Circuit Status	HV Enabled	Pass	The high voltage interlock circuit routes through several components and connectors to determine if access to high voltage components is being attempted. This parameter displays the results of the control modules diagnostic test of the high voltage interlock circuit.
	HV Not Enabled	Unknown	
High Voltage Inverter Voltage	HV Enable	Near Hybrid/EV Battery Pack Voltage	This parameter displays the electrical potential of the high voltage bus as currently monitored by the Hybrid/EV Powertrain Control Module 1.
High Voltage System Isolation Test Status	HV Enabled	Not Running	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative

Parameter	System State	Expected Value	Description
			high voltage circuits isolated from the vehicle chassis. This parameter displays the status of the Hybrid/EV battery pack isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The status will clear whenever DTCs are cleared.
	HV Not Enabled	Running/Complete	
Hood Position	-	Varies	This parameter displays the position of the hood as determined by the hood latch switch.
Hybrid/EV Battery DC Charging Negative Contactor Command	-	Varies	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the T28 Battery Charger internal contactor (relay) on (-) side of the battery fast charging system.
Hybrid/EV Battery DC Charging Positive Contactor Command	-	Varies	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the T28 Battery Charger internal contactor (relay) on (+) side of the battery fast charging system.
Hybrid/EV Battery Energy Used Since Last Full Charge	-	Varies	This parameter displays the amount of energy in Mega Joules consumed by the vehicle since the last complete battery pack full charge.
Hybrid/EV Battery Negative Contactor Command	HV Enabled	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on the (-) side of the Hybrid/EV Battery pack.
	HV Not Enabled	Open	
Hybrid/EV Battery Pack Active Isolation Test Status	-	Varies	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. The parameter displays the status of the battery system isolation diagnostic test.
Hybrid/EV Battery Pack Capacity	-	Varies	This parameter displays the capacity of the hybrid/EV battery pack expressed in engineering data form.
Hybrid/EV Battery Pack Charging Limit	-	Varies	This parameter displays the maximum charge power limit in watts of the Hybrid/EV battery pack based on current conditions such as temperature and state of charge.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Coolant Pump Command	-	Varies	This parameter displays the commanded percentage coolant flow for the Hybrid/EV battery pack coolant pump.
Hybrid/EV Battery Pack Coolant Pump Feedback	-	45 - 55%	This parameter displays the internal diagnostic status of the Hybrid/EV battery pack coolant pump. A duty cycle of 45 to 55% indicates no internal pump faults detected.
Hybrid/EV Battery Pack Coolant Pump Speed	-	Varies	This parameter displays the actual speed of the Hybrid/EV battery pack coolant pump motor shaft.
Hybrid/EV Battery Pack Coolant Temperature Sensor 1	-	Varies	A sensor monitors the temperature of coolant circulating through the Hybrid/EV battery pack. This parameter displays Sensor 1 which monitors temperature of the coolant entering the battery pack.
Hybrid/EV Battery Thermal Conditioning Inactive Time	-	Varies	This parameter displays the amount of time, in seconds, thermal conditioning was inactive.
Hybrid/EV Battery Thermal Conditioning Request	-	Varies	This parameter displays the state of the Hybrid/EV battery pack thermal state request. The battery pack can be either passively or actively cooled or heated.
Hybrid/EV Battery Thermal Conditioning Status	-	Varies	This parameter displays the state of the Hybrid/EV battery pack thermal state. The battery pack can be either passively or actively cooled or heated.
Hybrid/EV Battery Pack Coolant Level Switch	-	Varies	The B258 hybrid/EV battery pack coolant level switch is attached to the coolant surge tank. The level sensor is a 2 state switch which changes state when the level in the surge tank gets low. This parameter displays the voltage monitored by the B258 Hybrid/EV Battery Coolant Level Switch circuit.
Hybrid/EV Battery Pack Current	-	Varies	This parameter displays the amount of current in amps flowing in or out of the Hybrid/EV battery pack.
Hybrid/EV Battery Pack Heater Power	-	Varies	This parameter displays the electric power in kW requested by the Hybrid Powertrain Control Module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Heater Power Command	-	Varies	This parameter displays the electric power in percent commanded by the Hybrid Powertrain Control Module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Heater Power Command	-	Varies	This parameter displays the electric power in kW commanded by the Hybrid Powertrain Control Module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Heater Power Limited	-	No	This parameter displays if the electric power available to the Hybrid/EV battery pack coolant heater is at its limit.
Hybrid/EV Battery Pack Heater Power Request	-	Varies	This parameter displays the electric power in kW requested by the hybrid powertrain control module 2 to the Hybrid/EV battery pack coolant heater in order to warm the battery pack.
Hybrid/EV Battery Pack Isolation Test Status	-	Passed	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the results obtained when the Hybrid/EV battery pack last performed its internal isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The status will be cleared whenever DTCs are cleared.
Hybrid/EV Battery Pack Maximum Voltage	-	Varies	This parameter displays the total Hybrid/EV battery pack maximum voltage measured during the current ignition cycle.
Hybrid/EV Battery Pack Minimum State of Charge Limit	-	Varies	This parameter displays the minimum permissible Hybrid/EV battery pack state of charge in percent. The Hybrid/EV system will not discharge the battery pack below this limit.
Hybrid/EV Battery Pack State of Charge Gauge	-	Varies	This parameter displays the battery pack state of charge as displayed on the vehicle instrument panel.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Pack Minimum Voltage	-	Varies	This parameter displays the total Hybrid/EV battery pack minimum voltage measured during the current ignition cycle.
Hybrid/EV Battery Pack Precharge Contactor Command	HV Enable Initiated	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the operation of the Hybrid/EV Battery pack precharge contactor relay. Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled.
	HV Fully Enabled or HV Not Enabled	Open	
Hybrid/EV Battery Pack Resistance	-	Varies	This parameter displays the Hybrid/EV battery pack resistance value in ohms.
Hybrid/EV Battery Pack State of Charge	-	Varies	This parameter displays the percentage available capacity remaining in a Hybrid/EV battery pack.
Hybrid/EV Battery Pack State of Charge Gauge	-	Varies	This parameter displays the percentage Hybrid/EV battery pack state of charge as indicated to the operator of the vehicle.
Hybrid/EV Battery Pack Voltage	-	Varies	This parameter displays the electrical potential of the Hybrid/EV battery pack as currently monitored.
Hybrid/EV Battery Positive Contactor Command	HV Enabled	Closed	This parameter displays the Hybrid Powertrain Control Module 2 Commanded state of the contactor (relay) on the (+) side of the Hybrid/EV Battery pack.
	HV Not Enabled	Open	
Hybrid/EV Battery System Precharge Current Too High	-	No	Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. This parameter displays if the contactors are commanded open because of excessive Precharge current.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery System Precharge Time Too Long	-	No	Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing the high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. The time required to precharge is based upon the system voltage and capacitance. This parameter displays if the contactors are commanded open because the time required to precharge was too slow.
Hybrid/EV Battery System Precharge Time Too Short	-	No	Precharge occurs in the milliseconds prior to closing the main (-) bus contactor. By routing high voltage through a resistor, precharge prevents voltage spikes from occurring whenever high voltage is enabled. The time required to precharge is based upon the system voltage and capacitance. This parameter displays if the contactors are commanded open because the time required to precharge was too fast.
Hybrid/EV Battery Temperature Sensor with Maximum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module that is reporting the maximum temperature value.
Hybrid/EV Battery Temperature Sensor with Minimum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module that is reporting the minimum temperature value.
Hybrid/EV Battery Voltage Sensor with Maximum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module voltage sensor that is reporting the highest voltage.
Hybrid/EV Battery Voltage Sensor with Minimum Value	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the index-number of the battery module voltage sensor that is reporting the lowest voltage.

Parameter	System State	Expected Value	Description
Hybrid/EV Battery Voltage Sensors Average	-	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the average voltage measured at all of the cells/modules.
Hybrid/EV Electronics Coolant Pump Command	-	Varies	This parameter displays the percent commanded coolant flow for the Hybrid/EV electronics coolant pump.
Hybrid/EV Electronics Coolant Pump Feedback	-	45 - 55%	This parameter displays the internal diagnostic status for the Hybrid/EV electronics coolant pump. A duty cycle of 45 to 55% indicates no internal pump faults detected.
Hybrid/EV Electronics Coolant Pump Speed	-	Varies	This parameter displays the actual speed of the Hybrid/EV electronics coolant pump motor shaft.
Hybrid/EV Electronics Coolant Temperature	-	Varies	This parameter displays the temperature of the coolant within the hybrid electronics cooling system.
Hybrid/EV Powertrain Control Module Request	-	No	This parameter displays if the hybrid/EV powertrain control module (1) is requesting the contactors to be open.
Ignition 1 Signal	-	Varies	This parameter displays the voltage monitored at the control module terminal connected to the Ignition 1 circuit.
Isolation Test Resistance	-	Varies	Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis. This parameter displays the amount of isolation observed when the Hybrid/EV battery pack last performed its isolation diagnostic test. This test may run at accessory wake up or immediately following key-off. The value will be set to zero whenever DTCs are cleared.
Maximum Hybrid/EV Battery Module Temperature	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the temperature of the battery module reporting the highest temperature.

Parameter	System State	Expected Value	Description
Maximum Hybrid/EV Battery Module Voltage	-	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the maximum voltage measured at any of the cells/modules.
Minimum Hybrid/EV Battery Module Temperature	-	Varies	The Hybrid/EV battery pack contains many individual battery cells or modules. This parameter displays the temperature of the battery module reporting the lowest temperature.
Minimum Hybrid/EV Battery Module Voltage	-	Varies	The Hybrid/EV battery pack contains many individual hybrid battery cells or modules. This parameter displays the minimum voltage measured at any of the cells/modules.
Over/Under Voltage Lockout	-	No	This parameter displays if the scan tool disable procedure has failed due to a High or Low voltage condition.
Overtemperature	-	No	This parameter displays if the system is commanding contactors open to protect them from overheating. The contactors will overheat if cycled too many times within a short amount of time.
Passenger Compartment Heater Power Limited	-	No	This parameter displays if the electric power available to the passenger compartment heater power is at its limit.
Power Delivered to Electric A/C Compressor from Hybrid/EV Battery Pack	-	Varies	This parameter displays the electric power in kW commanded by the hybrid powertrain control module 2 to the A/C compressor in order for it to provide Hybrid/EV battery pack and/or passenger compartment cooling. This parameter is active only when the cabin controls are set to condition the vehicle.
Power Delivered to Electric Passenger Compartment Heater from Hybrid/EV Battery Pack	-	Varies	This parameter displays the electric power in kW commanded by the hybrid powertrain control module 2 to the passenger compartment heater in order for it to provide heat. This parameter is active only when the cabin controls are set to condition the vehicle.

Parameter	System State	Expected Value	Description
Power Requested by Electric A/C Compressor from Hybrid/EV Battery Pack	-	Varies	This parameter displays the electric power in kW estimated by hybrid powertrain control module 2 necessary to provide Hybrid/EV battery pack and/or passenger compartment cooling. This parameter is active only when the cabin controls are set to condition the vehicle.
Power Requested by Electric Passenger Compartment Heater from Hybrid/EV Battery Pack	-	Varies	This parameter displays the electric power in kW estimated by hybrid powertrain control module 2 necessary to provide passenger compartment heating. This parameter is active only when the cabin controls are set to condition the vehicle.
Power Mode	-	Run	This parameter displays the status of the ignition switch.
Proximity Detection Circuit	-	Varies	The proximity detection circuit detects the presence of the drive motor battery charge cord. This parameter displays the voltage monitored on the detection circuit.
Requested DC Charging Current	-	Varies	This parameter displays the DC charging current requested of the off-board fast charge station.
Service High Voltage Shutdown Stage 1	-	Varies	This parameter displays the status of the High Voltage Disabling procedure. Each stage of the procedure performs a different task in the high voltage shutdown and disabling process. Refer to **High Voltage Disabling** .
Service High Voltage Shutdown Stage 2	-	Varies	This parameter displays the status of the High Voltage Disabling procedure. Each stage of the procedure performs a different task in the high voltage shutdown and disabling process. Refer to **High Voltage Disabling** .
Service High Voltage Shutdown Stage 3	-	Varies	This parameter displays the status of the High Voltage Disabling procedure. Each stage of the procedure performs a different task in the high voltage shutdown and disabling process. Refer to **High Voltage Disabling** .

Parameter	System State	Expected Value	Description
Service High Voltage Shutdown Stage 4	-	Varies	This parameter displays the status of the High Voltage Disabling procedure. Each stage of the procedure performs a different task in the high voltage shutdown and disabling process. Refer to **High Voltage Disabling** .
Shutdown Mode	-	No	Shutdown Mode is the semi-operational state while a control module is turning off. Shutdown mode allows time for house-keeping tasks such as writing data to stored memory. This parameter displays if the module is in the process of shutting down.
Stuck Open	-	No	This parameter displays the contactors are commanded open because the module has detected one or more of the high voltage contactors will not close.
Time Propulsion System Was Inactive	-	Varies	This parameter displays the time in seconds the propulsion system was inactive during charging.
Warm-Ups Since DTC Cleared	-	Varies	This parameter displays the number of OBD defined warm-up cycles since the last time codes were cleared with a scan tool or, when applicable, with a 12 V battery disconnect. A warm-up cycle occurs after the propulsion system has been active for 1000 consecutive seconds with run/crank ignition active.

Hybrid Powertrain Control Module 2 Configuration/Reset Functions

Functions	Description
DC Charging Disabled Reset	This reset function is used to reset a DC Charge Disable condition that occurs after certain DTCs are set.
EV Range Reset	This reset function is used to reset the learned EV Range to the operator of the vehicle.
Hybrid/EV Battery Pack Capacity Learn	This reset function is used to learn the hybrid/EV battery pack capacity whenever the HPCM2, the Hybrid/EV Battery pack or individual hybrid/EV battery sections are replaced. Refer to the **Hybrid/EV Battery Pack Capacity Learn** procedure in Hybrid/EV Energy Storage.
Hybrid/EV Battery Pack Charging Adaptive Learn Reset	This reset function is used to reset the learned adaptive charging limits.
Hybrid/EV Battery Pack Contactor Open Reasons Reset	The hybrid/EV powertrain control module 2, Hybrid/EV Battery Contactor Open Reasons scan tool parameter list identifies all past events that commanded contactors open. This reset function is used to set all history reasons for contactor open events to NO. Refer to **Clear Secured High Voltage DTCs** procedure in Hybrid/EV Energy Storage.

Functions	Description
Hybrid/EV Battery Pack Data Reset	This reset function is used to reset certain engineering data parameters.

Hybrid Powertrain Control Module 2 Scan Tool Output Controls

Output Control	Description
AC Compressor Speed	This output control is used to vary the electric A/C compressor speed.
Battery Charging System Efficiency Test (Active Test)	This output control activates the battery charger control module to perform its internal efficiency test.
Clear Secured High Voltage DTCs	• This output control is used to clear a latched high voltage (HV) lockout state. • The hybrid powertrain control modules 1 and 2 monitor for high voltage safety conditions such as airbag deploy events and certain HV system faults. • If these conditions are present either module may set a DTC and prevent HV enabling until after this Output Control is exercised. **NOTE:** **Performing a scan tool DTC Clear may clear the diagnostic that set the HV lockout state, but will not reset the lockout.** • Always refer to **Clear Secured High Voltage DTCs** procedure in Hybrid/Energy Storage service information for the proper sequence of procedures required to reset a HV lockout state.
Cooling Fan Motor	This output control is used to vary the coolant radiator cooling fan motor between 10% and 90%.
DC Charge Port Lock	This output control is used to energize the M110 Hybrid/EV Battery Charger Receptacle-Lock Actuator {CBT Only} which in turn Locks and Unlocks the charge cord to the receptacle.
High Voltage Disabling	This output control initiates the on-vehicle control module software to attempt to disable and discharge high voltage outside of the Hybrid/EV battery pack. Always refer to the **High Voltage Disabling** procedure in Hybrid/EV Energy Storage.
Hybrid/EV Battery Contactors	This output control is used to energize the high voltage contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.

Hybrid/EV Battery Pack Active Isolation Test	• Vehicles equipped with high voltage storage and propulsion capability are designed with both the positive and negative high voltage circuits isolated from the vehicle chassis.
	• This output control commands the hybrid powertrain control module 2 to measure the isolation of the hybrid/EV battery pack
	• The following control limits apply:
	  ◦ All high voltage contactors are open
	  ◦ The vehicle power mode is OFF
	Depress and hold the brake pedal while the vehicle power mode is OFF to wake up the modules prior to enabling this output control.

Hybrid/EV Battery Pack Coolant Pump	This output control is used to vary the coolant pump speed between 20% and 80%.

Output Control	Description
Hybrid/EV Battery Pack Heater Passive Isolation Test	This output control is used to energize the Battery Pack Heater while monitoring for high voltage loss of isolation condition.
Hybrid/EV Battery Pack Heater Power	This output control is used to energize the Battery Pack Heater to confirm heating function.
Hybrid/EV DC Charging Contactors	This output control is used to energize the T24 Battery Charger {CBT only} internal high voltage negative and positive contactors for diagnostic purposes. Refer to the applicable high voltage contactor diagnostic trouble code for setup and usage instructions.
Hybrid/EV Electronics Coolant Pump	This output control is used to vary the coolant pump speed between 20% and 80%.

INFLATABLE RESTRAINT PASSENGER PRESENCE SYSTEM SCAN TOOL INFORMATION

Passenger Presence Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
Base Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the PPS module which is stored in non volatile memory.
Battery Voltage	Volts	The scan tool will display battery voltage.
Calibration Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the calibration file in the PPS module.
End Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the PPS module in production.
Manufacturer's Traceability Number	Varies, 16 Digit Number	The scan tool displays the 16 digit traceability number in the PPS module.
Passenger Air Bag Enable/Disable Request by Passenger Presence Module	Disable	The scan tool displays the Passenger Air Bag Enable/Disable Request by Passenger Presence Module.
Passenger Presence Module Primary Key	Hex Value	The scan tool indicates the primary key Hex value.
Passenger Presence System Reporting DTC(s)	Yes/No	The PPS module will report if there are DTCs set in the passenger presence module.
Passenger Seat Occupancy Status	Empty Seat	The scan tool displays Undefined, Empty Seat, Occupied, or Invalid. This is the state of the passenger seat if it is occupied or empty and monitored by the passenger presence system.
Power Mode	Off / Accessory / Run / Crank Request	The scan tool will display the power mode of the vehicle.
Primary Key Status	Valid/Invalid	The scan tool displays Valid if the primary key matches what is stored to memory in the PPS module.
Received Primary Key	Hex Value	The scan tool displays a Hex value indicating the PPS module received primary key data.
Software Part Number	Varies, 8 Digit Number	The scan tool displays the software part number in the PPS module.

INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE SCAN TOOL INFORMATION

NOTE: **Some parameters and values in the table below may not apply to every vehicle.**

Sensing and Diagnostic Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
2nd Row Left Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the left rear seat belt reminder sensor pad is enabled to the SDM.
2nd Row Left Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the left rear seat belt reminder sensor pad has been learned by the SDM.
2nd Row Left Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the left rear seat belt switch when the seat belt is buckled or unbuckled.
2nd Row Middle Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the rear middle seat belt reminder sensor pad is enabled to the SDM.
2nd Row Middle Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the rear middle seat belt reminder sensor pad has been learned by the SDM.
2nd Row Middle Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the middle rear seat belt switch when the seat belt is buckled or unbuckled.
2nd Row Middle Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the rear right seat belt reminder sensor pad is enabled to the SDM.
2nd Row Middle Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the rear right seat belt reminder sensor pad has been learned by the SDM.
2nd Row Right Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the right rear seat belt switch when the seat belt is buckled or unbuckled.
Air Bag Malfunction Indicator	On/Off/Flashes	The scan tool will display On or Flashes if there is a problem with the SIR system. Any problems within the SIR system will illuminate the air bag indicator. The indicator will either flash or stay on.
Base Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the SDM which is stored in non volatile memory.
Calibration Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the calibration file in the SDM.
Deployment Loop 1-18 Enable Status	Enabled/Disabled	The scan tool displays Enabled or Disabled. This is the status of the air bag or pretensioner.
Deployment Loop 1-18 Learn Status	Learned/Not Learned	The scan tool displays Learned or Not learned. Learned is displayed if the SDM has defined the number loop programmed from an air bag or pretensioner.

Parameter	Expected Value	Definition
Deployment Loop 1-18 Resistance	1.44 - 4.25 Ohms	The scan tool displays the resistance of the learned loop of the air bag or pretensioner when connected to the SDM.
Deployment Loop 1-18 Type	Varies	The scan tool displays the name of the air bag or pretensioner associated with the loop type 1 - 18.
Driver Seat Belt Reminder Indicator	On/Off	The scan tool displays On if this indicator is on. If the indicator is on it means the seat belt has not been buckled.
Driver Seat Belt Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat belt sensor in the seat belt buckle is enabled to the SDM.
Driver Seat Belt Sensor Learn Status	Learned/Not learned	The scan tool displays Learned or Not Learned. Learned is displayed if the driver seat belt sensor has been learned by the SDM.
Driver Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the driver seat belt switch when the seat belt is buckled or unbuckled.
Driver Seat Position Sensor	Rearward/Forward	The scan tool will display if the driver seat is forward or rearward of the sensor set position.
Driver Seat Position Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat position sensor is enabled to the SDM.
Driver Seat Position Sensor Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the driver seat position sensor has been learned by the SDM.
End Model Part Number	Varies, 8 Digit Number	The scan tool displays the part number of the SDM in production.
Impact Sensor 1-8 Enable Status	Enabled/Disabled	The scan tool displays Enabled or Disabled This is the status of the impact sensor.
Impact Sensor 1-8 Learn Status	Learned/Not Learned	The scan tool displays Learned or Not learned. Learned is displayed if the SDM has learned and has assigned a number to that impact sensor.
Impact Sensor 1-8 Type	Equipped/Not Equipped	The scan tool displays the name of the impact sensor associated with the type 1 - 8.
Inflatable Restraint Sensing and Diagnostic Module Primary Key	Hex Value	The scan tool indicates the primary key Hex value.
Manufacturer's Traceability Number	Varies, 16 Digit Number	The scan tool displays the 16 digit traceability number in the SDM.
Module Setup	Incomplete/Complete	The scan tool indicates if the SDM is set up.
Passenger Air Bag Disabled Switch	On/Off	The scan tool displays Off when the customer manually turns the passenger airbag off with this switch.
Passenger Air Bag Off Indicator	On/Off	The scan tool displays Off when the passenger indicator is not illuminated. This indicator is off when the disable switch is in the off position or no one is sitting in the passenger seat.

Parameter	Expected Value	Definition
Passenger Air Bag On Indicator	On/Off	The scan tool displays On when the passenger indicator is illuminated. This indicator is on when the disable switch is in the on position and someone is sitting in the passenger seat.
Passenger Air Bag Status	Enabled/Disabled	The scan tool displays if the passenger air bag is enabled to the SDM.
Passenger Air Bag Disable Indicator Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag disable indicator is enabled to the SDM.
Passenger Air Bag Disable Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag disable indicator.
Passenger Air Bag Disable Switch Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag disable switch is enabled to the SDM.
Passenger Air Bag Disable Switch Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag disable switch.
Passenger Air Bag Enable Indicator Enable Status	Enabled/Disabled	The scan tool displays if the passenger air bag enable indicator is enabled to the SDM.
Passenger Air Bag Enable Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the status of the passenger air bag enable indicator.
Passenger Classification	00 - 07	The scan tool will display what type of individual is sitting in the passenger seat.
Passenger Presence Detection System Enable Status	Enabled/Disabled	The scan tool displays if the passenger presence system is enabled to the SDM.
Passenger Presence Detection System Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the SDM has learned the passenger presence system.
Passenger Presence Detection System Reporting DTC(s)	Yes/No	The SDM will report if there are DTCs set in the passenger presence module.
Passenger Seat Belt Reminder Indicator	On/Off	The scan tool displays On if this indicator is on. If the indicator is on it means the seat belt has not been buckled.
Passenger Seat Belt Reminder Indicator Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat belt reminder indicator is enabled to the SDM.
Passenger Seat Belt Reminder Indicator Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt reminder indicator has been learned by the SDM.
Passenger Seat Belt Reminder Sensor Pad Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat belt reminder sensor pad is enabled to the SDM.

Parameter	Expected Value	Definition
Passenger Seat Belt Reminder Sensor Pad Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt reminder sensor pad has been learned by the SDM.
Passenger Seat Belt Sensor Enable Status	Enabled/Disabled	The scan tool displays if the seat position sensor is enabled to the SDM.
Passenger Seat Belt Sensor Learn Status	Learned/Not learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat belt sensor has been learned by the SDM.
Passenger Seat Belt Status	Buckled/Unbuckled	The scan tool displays Buckled or Unbuckled. This is the state of the passenger seat belt switch when the seat belt is buckled or unbuckled.
Passenger Seat Occupancy Status	Empty Seat/Occupied	The scan tool displays Occupied if someone is sitting in the passenger seat.
Passenger Seat Position Sensor	Rearward/Forward	The scan tool will display if the passenger seat is forward or rearward of the sensor set position.
Passenger Seat Position Sensor Enable Status	Disabled/Enabled	The scan tool displays if the passenger seat position sensor pad is enabled to the SDM.
Passenger Seat Position Sensor Learn Status	Learned/Not Learned	The scan tool displays Learned or Not Learned. Learned is displayed if the passenger seat position sensor has been learned by the SDM.
Power Mode	Off/Accessory/Run/Crank Request	The scan tool will display the power mode of the vehicle.
Primary Key Status	Valid/Invalid	The scan tool displays Valid if the primary key matches what is stored to memory in the SDM.
Primary Key Status Last Ignition Cycle	Invalid/Valid	The SDM checks to see if the primary key data received is valid.
Received Primary Key	Hex Value	The scan tool displays a Hex value indicating the SDM received primary key data.
Rollover Sensor Enable Status	Disabled/Enabled	The scan tool displays if the rollover sensor is enabled to the SDM.
Rollover Sensor Learn Status	Learn/Unlearn	The scan tool displays Learned or Not Learned. Learned is displayed if the rollover sensor has been learned by the SDM.
Security Code Accepted	Yes/No	The SDM either accepts the security code or it does not. The scan tool displays Yes if the security code has been accepted by the SDM.
Security Code Lockout	Yes/No	The scan tool displays Yes if the SDM has been locked out because of the security code not being accepted.
Security Code Lockout Active Timer	Random Value	The SDM uses a timer before the security code is locked in the SDM.
Security Code Programmed	Yes/No	The scan tool displays Yes if the SDM has been programmed with the security code.
Security Code Programming Counter	Random Value	The SDM uses a counter for the value of the security code programming.

Parameter	Expected Value	Definition
Security Code Reset Counter	Random Value	The SDM uses a counter to reset the value of the security code.
Software Part Number	Varies, 8 Digit Number	The scan tool displays the software part number in the SDM.
Vehicle Identification Number	Varies, 17 Digit Number	The VIN number of the vehicle programmed into the SDM.
VIN Programmed	Yes/No	The scan tool displays Yes if the VIN has been programmed into the SDM.
VIN Programming Counter	Random Value	The SDM uses this counter while programming the VIN.

INSTRUMENT CLUSTER SCAN TOOL INFORMATION

Instrument Cluster Scan Tool Data Parameters

Parameter	Expected Value	Description
Operating Conditions: Vehicle in Service Mode		
Ambient Air Temperature	15 Â°C	The scan tool displays outside temperature in Â°C.
Battery Voltage	12 - 14 V	The scan tool displays Volts. This is the current battery voltage signal.
Coolant Level Switch	Open	The scan tool displays either Open, Closed, or Not Available.
Driver Information Center Switch	Active/Inactive	The scan tool displays Active or Inactive. This is the state of the driver information center reset switch.
Driver Information Center Switch	Varies	The scan tool displays Volts. This is the current driver information center switch input voltage.
	Inactive	The scan tool displays either Inactive, Up, Down, or Menu. This is the state of the driver information center switch.
Engine Speed	Varies	The scan tool displays the engine RPM.
Odometer Lock Status	Active/Inactive	The scan tool displays Active or Inactive. Active means the odometer is locked.
Washer Fluid Level Switch	Open	The scan tool displays either Open, Closed, or Not Available.
Vehicle Speed	Varies	The scan tool displays the vehicle speed.

Instrument Cluster Scan Tool Output Controls

Output Control	Description
All Indicators	This function is used to command all the indicators ON or OFF.
CAN Bus Configuration Learn	This function is used to Reset the source ID for low speed CAN Bus communications.
Driver Information Center Dimming	This function is used to command the dimming of the driver information display to Increase or Decrease by 10%.
Driver Information Center Options	This function is used to command the driver information center buttons using the scan tool.
Driver Information Center Segments	This function is used to command the driver information center segments ON and OFF.
Instrument Cluster Gauge Sweep	Since there are no gauges, the instrument cluster will go through a screen test sequence instead of sweeping the gauges.

KEYLESS ENTRY CONTROL MODULE SCAN TOOL INFORMATION

Keyless Entry Control Module Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Vehicle in Service Mode		

Parameter	Expected Value	Definition
Battery Voltage	V	This parameter indicates the battery voltage as measured at the module
Driver Door Ajar Switch	Active/Inactive	This parameter indicates that the driver door is ajar; it is open, but the safety latch is engaged.
Driver Door Open Switch	Active/Inactive	This parameter indicates that the driver door is more than just ajar, it is open.
Driver Door Unlock Switch	Active/Inactive	This parameter indicates if the driver door is locked or unlocked.
Exterior Driver Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Exterior Driver Door Handle Proximity Sensor	Active, Inactive, Fault	This is a capacitive proximity sensor on the exterior of the driver door handle. It allows the user to lock the door by pressing a small rectangle on the outside of the door handle if a key is detected leaving the vehicle.
Passenger Door Open Switch	Active/Inactive	This parameter indicates that the passenger door is more than just ajar, it is open.
Passenger Door Ajar Switch	Active/Inactive	This parameter indicates that the passenger door is ajar; it is open, but the safety latch is engaged.
Exterior Passenger Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Exterior Passenger Door Handle Proximity Sensor	Active, Inactive, Fault	This is a capacitive proximity sensor on the exterior of the driver door handle. It allows the user to lock the door by pressing a small rectangle on the outside of the door handle if a key is detected leaving the vehicle.
Left Rear Door Ajar Switch	Active/Inactive	This parameter indicates that the driver's side rear door is ajar; it is open, yet the safety latch is engaged.
Exterior Left Rear Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Right Rear Door Ajar Switch	Active/Inactive	This parameter indicates that the passenger's side rear door is ajar; it is open, yet the safety latch is engaged.
Exterior Right Rear Door Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the door should be unlocked. If the vehicle responds correctly to the challenge, the door will be unlocked or unlatched.
Liftgate Ajar Switch	Active/Not Active	This switch indicates if the rear closure of the vehicle is ajar.
Liftgate Handle Switch	Active/Inactive	This switch begins the challenge and response to determine if the rear closure should be unlatched. If the vehicle responds correctly to the challenge, the rear liftgate will be unlatched.

PARKING ASSIST CONTROL MODULE SCAN TOOL INFORMATION

NOTE: **Due to software and hardware variations, not all information may be applicable.**

Parking Assist Control Module Scan Tool Data Parameters - Identification Information

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Vehicle Identification Number (VIN)	-	Varies	The scan tool displays the Vehicle Identification Number
Diagnostic Data Identifier	-	Varies	The scan tool displays the Diagnostic Data Identifier
XML Configuration Compatibility Identifier	-	Varies	The scan tool displays the XML Configuration Compatibility Identifier
XML Data File Part Number	-	Varies	The scan tool displays the XML Data File Part Number
XML Data File Alpha Code	-	Varies	The scan tool displays the XML Data File Alpha Code
Module Diagnostic Address	-	Varies	The scan tool displays the Module Diagnostic Address
Manufacturer's Traceability Number	-	Varies	The scan tool displays the Manufacturer's Traceability Number
Software Part Number	-	Varies	The scan tool displays the Software Part Number
Calibration Part Number 2	-	Varies	The scan tool displays the Calibration Part Number 2
End Model Part Number	-	Varies	The scan tool displays the End Model Part Number
Base Model Part Number	-	Varies	The scan tool displays the Base Model Part Number
Software Module 1 Identifier Alpha Code	-	Varies	The scan tool displays the Software Module 1 Identifier Alpha Code
End Model Part Number Alpha Code	-	Varies	The scan tool displays the End Model Part Number Alpha Code
Base Model Part Number Alpha Code	-	Varies	The scan tool displays the Base Model Part Number Alpha Code
GMLAN Identification Data - Bus 1 Type	-	Varies	The scan tool displays the GMLAN Identification Data - Bus 1 Type
GMLAN Identification Data - Data Dictionary 1 Version	-	Varies	The scan tool displays the GMLAN Identification Data - Data Dictionary 1 Version
GMLAN Identification Data - GMLAN Kernel 1 Version	-	Varies	The scan tool displays the GMLAN Identification Data - GMLAN Kernel 1 Version
Date Programmed	-	Varies	The scan tool displays the date the module was programmed

Parking Assist Control Module Scan Tool Data Parameters - Park Assist System Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Power Mode	-	Run	The scan tool displays Off, Accessory, Run or Crank. This is the state of the ignition switch.
Battery Voltage	-	11 - 14 V	The scan tool displays V. This is the current battery voltage.
Parking Assist System Status	-	Enable	The scan tool displays Disable, Enable, Inhibited or Failed. This is the state of the parking assist system.

Parameter	System State	Expected Value	Description
Parking Assist Chime	-	Varies	The scan tool displays On or Off. On is displayed if there is an object within the measuring range of the object sensors.
Parking Assist Sensors	-	ON	The scan tool displays On or Off.
Calculated Transmission Range	Transmission in reverse	Park	The scan tool displays Park, Reverse, Neutral, Drive or Unknown depending on the state of the commanded gear.
Parking Assist Switch	-	Active/Inactive	The scan tool displays Active or Inactive depending on the state of the parking assist switch.
Advanced Parking Assist Switch	-	Active/Inactive	The scan tool displays Active or Inactive depending on the state of the advanced parking assist switch.
Parking Assist Sensors Reference Voltage	-	7.3 - 12.1 V	The scan tool displays V. This is the amount of voltage being sent to the object sensors.
Parking Assist Switch LED	-	Varies	The scan tool displays On or Off depending on the state of the parking assist switch LED.
Right Side Object Detection Indicator	-	Varies	The scan tool displays a blank, On or Off depending on the state of the right side object detection indicator command status.
Left Side Object Detection Indicator	-	Varies	The scan tool displays a blank, On or Off depending on the state of the left side object detection indicator command status.
Advanced Parking Assist Status	-	Standby	The scan tool displays Standby, Active, or Inactive depending on the state of the advanced parking assist.

Parking Assist Control Module Scan Tool Data Parameters - Parking Assist Sensor Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Parking Assist Sensors	-	ON	The scan tool displays On or Off.
Parking Assist Sensors Reference Voltage	-	7.3 - 12.1 V	The scan tool displays V. This is the voltage being sent to the object sensors.
Left Front Advanced Parking Assist Side Object Sensor	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Front Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Front Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Front Advanced Parking Assist Side Object Sensor	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.

Parameter	System State	Expected Value	Description
Right Front Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Front Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Rear Advanced Parking Assist Side Object Sensor	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Rear Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Left Rear Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Rear Advanced Parking Assist Side Object Sensor	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Rear Outer Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.
Right Rear Inner Object Sensor Distance to Object	-	32767 mm	The scan tool displays mm. This is the distance between the parking assist sensor and the nearest object.

Parking Assist Control Module Scan Tool Data Parameters - Parking Assist Disable History 1 - 4 Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Parking Assist Disable History 1	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 2	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 3	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.

Parameter	System State	Expected Value	Description
Parking Assist Disable History 4	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.

Parking Assist Control Module Scan Tool Data Parameters - Parking Assist Disable History 5 - 7 Data

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON/Engine OFF/Parking Assist ON			
Parking Assist Disable History 5	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 6	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.
Parking Assist Disable History 7	-	Varies	The scan tool displays None, Manual Disable, Park Brake Applied, Trailer or Other Attached Object, Excessive Speed in Reverse, No or Invalid Sensor Signals, Sensor Disturbance, Sensors Dirty, Sound Signal Return Time Not Plausible. This is the state of the park assist disable history.

Parking Assist Control Module Scan Tool Output Controls

Output Control	Description
Park Assist Switch LED	The parking assist control module illuminates the advanced park assist LED of the when commanded from the scan tool.
Clear Disable History Data	The parking assist control module clears the Parking Assist Disable History data when commanded from the scan tool.
Clear Side Object Detection Disable History	The parking assist control module clears the Side Object Detection Disable History data when commanded from the scan tool.
CAN Bus Configuration Learn	The parking assist control module learns the CAN Bus configuration when commanded from the scan tool.
Parking Assist Sensor Learn	The parking assist control module learns the Parking Assist Sensor configuration when commanded from the scan tool.

PEDESTRIAN ALERT SOUND CONTROL MODULE SCAN TOOL INFORMATION

Scan Tool Data Parameters

Parameter	Expected Value	Description
Operating Conditions: Vehicle in Service Mode		

Parameter	Expected Value	Description
System Power Mode	On	The scan tool displays the present state of the System Power Mode. This can be Off, On, or Service Mode.
High Speed CAN Bus Communication Enable Status	Enabled	The scan tool will display either Enabled or Disabled.
Pedestrian Alert Sound System	Active	The scan tool will display Disabled, Active, or Malfunction.
Pedestrian Alert Sound	Active	The scant tool will display Active or Inactive.
Pedestrian Alert Sound When Driving Forward	Sound 1	The scan tool will display None, Sound 1, Sound 2, or Sound 3.
Pedestrian Alert Sound When Driving Backwards	Sound 1	The scan tool will display None, Sound 1, Sound 2, or Sound 3.
Service Pedestrian Alert Sound System Message	Inactive	The scan tool will display Active or Inactive.

POWER LINE COMMUNICATION MODULE SCAN TOOL INFORMATION

CAN Bus Communication Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
DC Battery Charger Communication Error	Vehicle is connected to a DC fast charge station	No	This parameter displays if there is a communication error between the power line communication module and the DC fast charge station.
High Speed CAN Bus Communication Request Active	Vehicle in Service Mode	Yes	This parameter displays if the power line communication module is communicating on the high speed CAN bus.
High Voltage Energy Management Communication Bus Communication Request Active	Vehicle in Service Mode	Yes	This parameter displays if the power line communication module is communicating on the high voltage energy management CAN bus.

POWER STEERING CONTROL MODULE SCAN TOOL INFORMATION

Power Steering Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
Ignition Cycle Counter	-	Varies	This displays the number of ignition cycles.
Calculated System Temperature	-	Varies	This displays Â° C. This is the current system temperature.
Steering Wheel Angle	-	Varies	This displays Degrees. This displays the current steering wheel angle in degrees.
Steering Wheel Input Torque	-	Varies	This displays. This displays the current steering input torque in.

Parameter	System State	Expected Value	Description
Power Steering Motor Overload Protection Counter	-	Varies	This displays counts. This displays the Electric Power Steering Motor Overload Protection Incidents counter.
Power Steering Control Module SPS Calibration Status	-	True/False	Indicates the completion status of the Electric Power Steering calibration.
Power Steering Control Module Center Procedure	-	True/False	Indicates the completion status of the Electric Power Steering centering procedure.
Engine Speed	-	0 RPM	This displays RPM. This is the current engine speed from the ECM.
Vehicle Speed	-	0 Km/h (0 MPH)	This displays km/h (mph). This is the current vehicle speed.
Motor Feedback Current	-	Varies	This displays amps (A). This displays the Electric Power Steering Motor Current Feedback.
Delivered Torque	-	Varies	This displays. This displays the current value of the Output Torque of the Electric Power Steering.
Power Mode	-	OFF/Accessory/Run/Crank Request	This displays system power mode.
Battery Voltage	-	Varies	This displays Volts. This is the current battery voltage.

Power Steering Control Module Scan Tool Output Controls

Output Control	Description
Clear Driver-Specific Steering Angles	Command to reset the steering rack end of travel limit position as determined by software.
Clear Softstops	Command to reset the steering gear soft end stops as determined by software.
Temporarily Turn Off Active Pull Compensation Function	Command to disable the Active Pull Compensation feature during the key cycle. The power steering control module will return to normal operation with the feature enabled upon exiting the procedure.
Clear Active Pull Compensation Learned Limits	Command to reset the Active Pull Compensation learned values.
Temporarily Turn Off Smooth Road Shake Compensation Function	Command to disable the Smooth Road Shake Compensation feature during the key cycle. The power steering control module will return to normal operation with the feature enabled upon exiting the procedure.
Disable All System Outputs	Command to disable all system outputs of the power steering control module.

RADIO SCAN TOOL INFORMATION

Radio Scan Tool Data Parameters

Parameter	Expected Value	Definition
Operating Conditions: Ignition ON		
Battery Voltage	Varies	The scan tool displays volts. This is the voltage at the input to the radio.
System Power Mode	Run	The scan tool displays Off, Accessory, Run or Crank Request. This is the current power mode of the radio.
Valet Mode	Inactive	Indicates if the system is in Valet mode.
Radio Theft Armed	Learned VIN	The scan tool displays Learned VIN or No VIN. This is the state of the VIN programming in the radio.
Radio Theft Locked	Inactive	The scan tool displays Active or Inactive. This is the state of the theft lock system. Active indicates the radio is locked. Inactive indicates the theft lock system is armed and the radio is unlocked.
Test Bench Mode	Inactive	The scan tool displays Active or Inactive. This parameter indicates if the radio is in bench or user mode.
Radio Power Button	Varies	Indicates if the Radio Power button is in the ON or OFF state.
End Model Part Number	Varies	End Model Part Number is the part number for the hardware of the control module with software and calibrations.
Base Model Part Number	Varies	Base Model Part Number is the part number for the hardware without software and calibrations.
Boot Software Part Number	Varies	The scan tool displays the boot software ID number.
Calibration Part Number 1	Varies	The scan tool displays the software module ID 1.
Calibration Part Number 2	Varies	The scan tool displays the software module ID 2.
Calibration Part Number 3	Varies	The scan tool displays the software module ID 3.
Calibration Part Number 4	Varies	The scan tool displays the software module ID 4.
Calibration Part Number 5	Varies	The scan tool displays the software module ID 5.
Calibration Part Number 6	Varies	The scan tool displays the software module ID 6.
Calibration Part Number 7	Varies	The scan tool displays the software module ID 7.
Calibration Part Number 8	Varies	The scan tool displays the software module ID 8.
Calibration Part Number 9	Varies	The scan tool displays the software module ID 9.
Calibration Part Number 10	Varies	The scan tool displays the software module ID 10.
Vin Digits 2-17	Varies	The scan tool displays the learned VIN digits 2-17.

Radio Scan Tool Output Controls

Scan Tool Output Control	Description
Left Front Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.

Scan Tool Output Control	Description
Left Rear Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Right Front Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Right Rear Speaker	This output control is used to command the speaker ON and OFF. Commanding the speaker ON will generate a test tone to be generated through the selected loudspeaker.
Chime Function Test	This output command is used to command the chime ON and OFF.
Rear Camera Display Control	This output control will command the rear camera display ON and OFF. Commending the rear camera on will display the rear camera image on the info display screen.
Rear Park Assist Steering Wheel Position Control	This output control will command the rear park assist steering wheel position ON and OFF. Commanding the rear park assist steering wheel position ON will display the steering wheel position guide lines on the info display screen.

SIDE OBJECT SENSOR MODULE SCAN TOOL INFORMATION

Side Object Detection Scan Tool Parameters

Parameter	System State	Expected Value	Definition
Operating Conditions: Ignition ON			
Manufacturer's Traceability Number	-	Varies	The scan tool displays the Manufacturer's Traceability Number
Manufacturer Enable Counter	-	Varies	The scan tool displays the Manufacturer Enable Counter
Module Diagnostic Address	-	Varies	The scan tool displays the Software Module 1 Identifier
Software Module 1 Identifier	-	Varies	The scan tool displays the Software Module 1 Identifier
Software Module 2 Identifier	-	Varies	The scan tool displays the Software Module 2 Identifier
End Model Part Number	-	Varies	The scan tool displays the End Model Part Number
Base Model Part Number	-	Varies	The scan tool displays the Base Model Part Number
Software Module 1 Identifier Alpha Code	-	Varies	The scan tool displays the Software Module 1 Identifier Alpha Code
Software Module 2 Identifier Alpha Code	-	Varies	The scan tool displays the Software Module 2 Identifier Alpha Code
End Model Part Number Alpha Code	-	Varies	The scan tool displays the End Model Part Number Alpha Code
Base Model Part Number Alpha Code	-	Varies	The scan tool displays the Base Model Part Number Alpha Code

Side Object Detection Module Output Controls

Scan Tool Output Control	Description
Object Detection Alert Indicators	When commanded by the scan tool, the module will provide power to illuminate the side blind zone indicators in appropriate outside rear view mirror. The outside rear view mirror indicator will illuminate.
Rear Cross Traffic Audible Alert	When commanded by the scan tool, the module will send a signal to the audio system to turn on the rear cross traffic audible alert signal. The audio system will beep.

Scan Tool Output Control	Description
Rear Cross Traffic Haptic Alert	When commanded by the scan tool, the module will send a signal to the memory seat module to turn on the rear cross traffic haptic alert. The driver's seat will vibrate.
Rear Cross Traffic Visual Alert	When commanded by the scan tool, the module will turn on the rear cross traffic alert indicators on infotainment display. The infotainment display will illuminate with the appropriate rear cross traffic alert.

TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE SCAN TOOL INFORMATION

Telematics Communication Interface Control Module Scan Tool Data Parameters

Parameter	System State	Expected Value	Description
Operating Conditions: Ignition ON			
GPS Data			
• Dead Reckoning Calibration Status	-	Calibrated or Not Calibrated	Indicates the dead reckoning calibration status.
• Position Calibration Method	-	Varies	Indicates the method used to determine current location. (0) GPS, (1) Wheel Speed Dead Reckoning only, (2) Combined Wheel Speed and GPS, (3) Gyro only, (4) Combined Gyro and GPS, (5) No Fix
• Month	-	MM	This displays the current month.
• Day	-	DD	This displays the current day of the month.
• Year	-	YY	This displays the current year.
• Hour	-	HH	This displays the GPS current hour (24 hour format - GMT).
• Minute	-	MM	This displays the GPS current minute.
• Second	-	SS	This displays the GPS current second.
• Number of Satellites Tracked	-	Varies	The scan tool displays the number of satellites being tracked by the telematics communication interface control module.
Signal Strength Data			
• GSM Signal Strength	-	Varies	The scan tool displays 0 - 127. This is the telematics communication interface control module signal strength.

Parameter	System State	Expected Value	Description
- Current Public Land Mobile Network	-	Varies	Identifies the cellular communications network currently in use by the telematics communication interface control module. Each network has a unique decimal number assigned to it for identification.
Bluetooth Data			
- Bluetooth	-	Enabled	Indicates if the Bluetooth system is enabled or disabled.
- Bluetooth Link Status	-	Varies	Indicates the current link status. (0) Unconnected, (1) Connected / Idle, (2) Call active, (3) 3-way calling active
- Bluetooth Link Quality	-	Varies	The scan tool displays a decimal value between 0 and 255.
- Bluetooth Phone to Telematics Communication Interface Control Module Authentication Status	-	Active or Inactive	Displays the bluetooth phone to telematics communication interface control module authentication status.
- Bluetooth Phone to Telematics Communication Interface Control Module Communication Status	-	Active or Inactive	Displays the bluetooth phone to telematics communication interface control module status.
- Bluetooth Phone Voice Recognition Status	-	Active or Inactive	Displays the bluetooth phone to voice recognition status.
WLAN Device Data			
Off-Board Navigation	-	Enabled or Disabled	Indicates if Off-Board Navigation is enabled or disabled
Wireless LAN	-	Enabled or Disabled	Indicates the capability of the wireless communication of the Telematics Communication Interface Control Module
Number of WLAN Devices	-	Varies	Indicates the number of Wireless devices present
Active WLAN 2.4GHz Chennel	-	Varies	Indicates the active Wireless channel being used on the 2.4 GHz frequency
WLAN Link Status	-	Radio System - Never, Remembered but Not Associated or Associated	Indicates the link status of the Telematics Communication Interface Control Module and Infotainment system
GSM Signal Strength	-	Varies	State for Received Signal Strength Indicator

Parameter	System State	Expected Value	Description
Mobile Communication Standard	-	2G, 3G, 4G or 4G LTE	State for Cellular Data Connection. Indicates the currently used data rate speed
WLAN Password	-	Varies	Indicates the Telematics Communication Interface Control Module Wireless Password
WLAN SSID (Service Set Identifier)	-	Varies	Indicates the Telematics Communication Interface Control Module Wireless Service Name
WLAN Encryption - WPA (Wi - Fi Protected Access)	-	Active or Inactive	Indicates if the WLAN Encryption - WPA (Wi - Fi Protected Access) is Active or Inactive
WLAN Encryption - WPA2 (Wi - Fi Protected Access II)	-	Active or Inactive	Indicates if the WLAN Encryption - WPA2 (Wi - Fi Protected Access II) is Active or Inactive
WLAN Encryption - AES (Advanced Encryption Standard)	-	Active or Inactive	Indicates if the WLAN Encryption - AES (Advanced Encryption Standard) is Active or Inactive
WLAN Encryption - TKIP (Temporal Key Intergrity Protocol)	-	Active or Inactive	Indicates if the WLAN Encryption - TKIP (Temporal Key Integrity Protocol) is Active or Inactive

Telematics Communication Interface Control Module Scan Tool Output Controls

Output Control	Description
B1000 Information	This shows the data recorded when DTC B1000 was set in the telematics communication interface control module.
Green Indicator	The telematics communication interface control module illuminates the green LED when ON is selected.
Phone Call Test	When ON is selected, telematics communication interface control module commands OnStar to connect to the OnStar Center.
Red Indicator	The telematics communication interface control module illuminates the red LED when ON is selected.
Preferred Roaming List Update	The telematics communication interface control module performs a preferred roaming list (PRL) update when this is selected.
Remote Vehicle Speed Limiting Reset	This function resets the speed limiting feature.

VIDEO PROCESSING CONTROL MODULE SCAN TOOL INFORMATION

Video Processing Control Module Scan Tool Parameters

Parameter	System State	Expected Value	Definition
Operating Conditions: Ignition ON			
Display Mode	-	Varies	The scan tool displays Camera View Mode, Camera Learn Mode, or Triggered Video Recorder Mode
Rear Camera Malfunction	-	Varies	The scan tool displays True or False
Right Camera Malfunction	-	Varies	The scan tool displays True or False
Left Camera Malfunction	-	Varies	The scan tool displays True or False
Front Camera Malfunction	-	Varies	The scan tool displays True or False
Next Learn Position	-	Varies	The scan tool displays Mat Position A, Mat Position B, Mat Position C, Mat Position D, Mat Position E, Mat Position F
Learn Status	-	Learn Successfull	The scan tool displays Not in Learn Mode, Vertex Passed, Vertex Failed, Learn Successfull, Learn Failed.

Parameter	System State	Expected Value	Definition
Current Learn Error Status	-	Varies	The scan tool displays Front Camera Lost Target Board, Right Camera Lost Target Board, Rear Camera Lost Target Board, Left Camera Lost Target Board, Front Camera Detected Vertex is Wrong, Right Camera Detected Vertex is Wrong, Rear Camera Detected Vertex is Wrong, Left Camera Detected Vertex is Wrong, Front Camera Detected Shape is Wrong, Right Camera Detected Shape is Wrong, Rear Camera Detected Shape is Wrong, Left Camera Detected Shape is Wrong, Front Camera Installed out of Tolerance, Right Camera Installed out of Tolerance, Rear Camera Installed out of Tolerance, Left Camera Installed out of Tolerance
Battery Voltage	-	Varies	The scan tool displays the battery voltage
Dealer Alignment Status	-	Varies	The scan tool displays the Dealer Alignment Status
Factory Alignment Status	-	Varies	The scan tool displays the Factory Alignment Status
Vehicle Identification Number (VIN)	-	Varies	The scan tool displays the learned VIN
Repair Shop Code Or Tester Serial Number	-	Varies	The scan tool displays Repair Shop Code Or Tester Serial Number
Programming Date	-	Varies	The scan tool displays Programming Date
Diagnostic Data Identifier	-	Varies	The scan tool displays the Diagnostic Data Identifier
Manufacturer Enable Counter	-	Varies	The scan tool displays the Manufacturer Enable Counter
Module Diagnostic Address	-	Varies	The scan tool displays the Software Module 1 Identifier
Manufacturer's Traceability Number	-	Varies	The scan tool displays the Manufacturer's Traceability Number
Boot Software Part Number	-	Varies	The scan tool displays the Boot Software Part Number
Software Module 1 Identifier	-	Varies	The scan tool displays the Software Module 1 Identifier
Software Module 2 Identifier	-	Varies	The scan tool displays the Software Module 2 Identifier
Software Module 3 Identifier	-	Varies	The scan tool displays the Software Module 3 Identifier
Software Module 4 Identifier	-	Varies	The scan tool displays the Software Module 4 Identifier
Software Module 5 Identifier	-	Varies	The scan tool displays the Software Module 5 Identifier
Software Module 6 Identifier	-	Varies	The scan tool displays the Software Module 6 Identifier
Software Module 7 Identifier	-	Varies	The scan tool displays the Software Module 7 Identifier
End Model Part Number	-	Varies	The scan tool displays the End Model Part Number

Parameter	System State	Expected Value	Definition
Base Model Part Number	-	Varies	The scan tool displays the Base Model Part Number
Software Module 1 Identifier Alpha Code	-	Varies	The scan tool displays the Software Module 1 Identifier Alpha Code
Software Module 2 Identifier Alpha Code	-	Varies	The scan tool displays the Software Module 2 Identifier Alpha Code
End Model Part Number Alpha Code	-	Varies	The scan tool displays the End Model Part Number Alpha Code
Base Model Part Number Alpha Code	-	Varies	The scan tool displays the Base Model Part Number Alpha Code

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SPECIFICATIONS

TIRE AND WHEEL RUNOUT SPECIFICATIONS

Application	Specification	
	Metric	**English**
Tire and Wheel Assembly - Lateral and Radial		
- Off-Vehicle	1.27 mm	0.050 in
- On-Vehicle	1.52 mm	0.060 in
Wheel, Aluminum		
- Lateral	0.762 mm	0.030 in
- Radial	0.762 mm	0.030 in
Wheel, Steel		
- Lateral	1.143 mm	0.045 in
- Radial	1.015 mm	0.040 in
Wheel Hub/Axle Flange - Guideline	0.132 mm	0.0052 in
Wheel Stud - Guideline	0.25 mm	0.010 in

DIAGNOSTIC INFORMATION AND PROCEDURES

VIBRATION DIAGNOSIS, STARTING POINT, AND CORRECTION

The information contained in this Vibration Diagnosis and Correction section is designed to cover various vehicle designs and configurations. Not all content will apply to all vehicles.

NOTE: **The following steps must be completed before using the analysis tables or the symptom tables.**

1. Perform the Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope) table before using the other Vibration Analysis tables or the Symptom tables in order to effectively diagnose the customer's concern.

   The use of Vibration Analysis - Road Testing will first provide duplication of virtually any vibration concern and then identify the correct procedure for diagnosing the area of concern which has been duplicated.

2. Review the following Vibration Diagnostic Process.
3. Review the general descriptions to familiarize yourself with vibration theory and terminology, the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH), or the **EL-38792 - A** Electronic Vibration Analyzer (EVA) 2, and the **EL-38792 - VS** Vibrate Software. Reviewing this information will help you determine whether the condition described by the customer is a potential operating characteristic or not.

   Refer to the following:

- Vibration Theory and Terminology
- Oscilloscope Diagnostic Kit Description and Operation
- Electronic Vibration Analyzer (EVA) Description and Operation
- Vibrate Software Description and Operation
- Reed Tachometer Description

Vibration Diagnostic Process

NOTE: Using the following steps of the vibration diagnostic process will help you to effectively narrow-down and pin-point the search for the specific source of a vibration concern and to arrive at an accurate repair.

1. Gather specific information on the customer's vibration concern.
2. Perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to duplicate the customer's concern and evaluate the symptoms of the concern under changing conditions. Observe what the vibration feels like and what it sounds like. Observe when the symptoms first appear, when they change, and when they cease.
3. Determine if the customer's vibration concern is truly an abnormal condition or something that is potentially an operating characteristic of the vehicle.
4. Systematically eliminate or "rule-out" possible vehicle systems.
5. Focus diagnostic efforts on the remaining vehicle system and systematically eliminate or "rule-out" possible components of that system.
6. Make a repair on the remaining component, or components, which have not been eliminated systematically, and must therefore be the cause of the vibration.
7. Verify that the customer's concern has been eliminated or at least brought to an acceptable level.
8. Again perform the road testing steps in sequence as identified in Vibration Analysis - Road Testing in order to verify that the vehicle did not have more than one vibration occurring.

Preliminary Visual/Physical Inspection

- Inspect for aftermarket equipment and modifications which could affect the operation of the vehicle rotating component systems.
- Inspect the easily accessible or visible components of the vehicle rotating component systems for obvious damage or conditions which could cause the symptom.
- Inspect the tire inflation pressures for the proper pressure.

Diagnostic Aids

Improper component routing or isolation, or components which are worn or faulty may be the cause of intermittent conditions that are difficult to duplicate. If the vibration concern could not be duplicated by following the steps of the Vibration Diagnostic Process, refer to Vibration Diagnostic Aids.

VIBRATION ANALYSIS - ROAD TESTING (EL-38792-A ELECTRONIC VIBRATION ANALYZER)

Special Tools

EL-38792-A Electronic Vibration Analyzer (EVA) 2

For equivalent regional tools, refer to Special Tools and Equipment.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5

Obtaining rotational speed for the components rotating at tire/wheel speed is critical to systematically eliminating specific vehicle component groups. These component rotational speeds can be generated by using an electronic vibration analyzer, or through calculating them manually.

9

NOTE: **Be certain to OBSERVE for disturbances that match the customer's description FIRST, then look at the vibration analyzer frequency which corresponds with that disturbance.**

Proper location of the vibration analyzer sensor onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.

10

Accelerate to a speed high enough above the speed of the disturbance to allow for the time needed to shift into NEUTRAL before coasting down through the disturbance range.

Step	Action	Yes	No
1	Did you review the Diagnostic Starting Point - Vibration Diagnosis?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to **Step 6**	Go to **Step 3**
3	Visually inspect the tire and wheel assemblies, steering components and suspension components for any possible faults. Are the tire and wheel assemblies, steering components and suspension components in good working condition?	Go to **Step 5**	Go to **Step 4**
4	**NOTE:** **Do NOT operate the vehicle until the faults are corrected.** Correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components before proceeding.Did you correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components?	Go to **Step 5**	Go to **Step 3**
5	1. Obtain the drive axle final drive ratio. 2. If the vibration analyzer has suitable software, obtain the transmission gear ratios. 3. If the a vibration analyzer is not available, take note of the tire size on each axle, then calculate the tire rotational speed for each size tire used. Refer to **Component Rotational Speed Calculation**. Did you obtain the powertrain ratios for use with the vibration analyzer, or calculate the component rotational speeds, if a vibration analyzer is NOT available?	Go to **Step 6**	-
6	1. Install a scan tool. 2. With the scan tool, bring up the Powertrain Control Module data list. Is the scan tool operating properly?	Go to **Step 7**	Go to **Diagnostic Starting Point - Vehicle**

Step	Action	Yes	No
7	Using a vibration analyzer is the preferred method for gathering necessary vibration frequency data. If a vibration analyzer is not available, the necessary vibration frequency data will have to be obtained based on symptoms observed during testing. Review **Symptoms - Vibration Diagnosis and Correction** to become familiar with the possible frequency ranges. Review Symptoms - Vibration Diagnosis and Correction, as necessary throughout the remainder of diagnostics. Is a vibration analyzer available for use?	Go to **Step 8**	-
8	Install the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2). Is the vibration analyzer operating properly?	Go to **Step 9**	Go to **Electronic Vibration Analyzer (EVA) Description and Operation**
9	1. Install the vibration analyzer sensor, if available, to the component identified by the customer as most respondent to the vibration. If no component was identified, install the vibration analyzer sensor, if available, to the steering column. You may have to move the sensor to other locations later. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customer's description and note the following conditions: • The vehicle speed • The transmission gear range and the specific gear • The vibration frequency reading, if detected by the vibration analyzer • The feel and/or sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the steering column, then move the vibration analyzer sensor, if available, onto that component and repeat steps 2 and 3. Were you able to duplicate the customer's concern?	Go to **Step 10**	Go to **Vibration Diagnostic Aids**
10	1. Accelerate the vehicle to a speed higher than the speed at which the disturbance occurs. **NOTE:** **Let the vehicle coast to a stop before shifting back into gear.** 2. Shift the vehicle into NEUTRAL and allow the vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting-down in NEUTRAL?	Go to **Step 12**	Go to **Step 11**

Step	Action	Yes	No
11	1. Select a smooth, level road and slowly accelerate the vehicle up to the speed at which the disturbance occurs. 2. Decelerate and safely downshift by one gear range. 3. Operate the vehicle at the same VEHICLE SPEED at which the disturbance occurs. Does the same disturbance still occur while going the same vehicle speed in a lower gear range?	Go to **Vibration Analysis - Hub and/or Axle Input**	Go to **Symptoms - Vibration Diagnosis and Correction**
12	If the vibration analyzer is not available, refer to **Symptoms - Vibration Diagnosis and Correction**. Did the vibration analyzer detect a dominant frequency?	Go to **Step 13**	Go to **Symptoms - Vibration Diagnosis and Correction**
13	1. If the vibration analyzer HAS the features, use the drive axle final drive ratio, and the specific transmission gear ratio to make a comparison to the dominant frequency reading recorded. 2. If the vibration analyzer does NOT have the features, compare the dominant frequency reading recorded to the component rotational data which you calculated previously. Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to **Vibration Analysis - Tire and Wheel**	Go to **Symptoms - Vibration Diagnosis and Correction**

VIBRATION ANALYSIS - ROAD TESTING (CH-51450-NVH OSCILLOSCOPE)

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-47955** Multi Diagnostic Interface (MDI)

For equivalent regional tools, refer to **Special Tools and Equipment**.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

NOTE: **Be certain to OBSERVE for disturbances that match the customers description FIRST, then look at the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH) frequency which corresponds with that disturbance.**

8

Proper location of the **CH-51450-NVH** oscilloscope accelerometer onto the component which is most excited by the vibration disturbance is critical to obtaining an accurate frequency reading.

This test will duplicate virtually any disturbance which occurs while the vehicle is in motion.

9

Accelerate to a speed high enough above the speed of the disturbance to allow for the time needed to shift into NEUTRAL and for the engine to decrease in RPM to idle speed before coasting down through the disturbance range.

10

This test will either eliminate or confirm the engine as a contributing cause of the customer concern.

Step	Action	Yes	No

Step	Action	Yes	No
1	Did you review the Diagnostic Starting Point - Vibration Diagnosis?	Go to **Step 2**	Go to **Diagnostic Starting Point - Vehicle**
2	Did the customer concern indicate that the vibration occurs ONLY while the vehicle is standing still?	Go to **Step 6**	Go to **Step 3**
3	Visually inspect the tire and wheel assemblies, steering components and suspension components for any possible faults. Are the tire and wheel assemblies, steering components and suspension components in good working condition?	Go to **Step 5**	Go to **Step 4**
4	**NOTE:** **Do NOT operate the vehicle until the faults are corrected.** Correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components before proceeding.Did you correct the faults with the tire and wheel assemblies, steering components, and/or the suspension components?	Go to **Step 5**	Go to **Step 3**
5	Obtain the drive axle final drive ratio. Did you obtain the drive axle final drive ratio?	Go to **Step 6**	-
6	Install the **CH-51450-NVH** Oscilloscope and the **EL-47955** MDI. Is the **CH-51450-NVH** Oscilloscope operating properly?	Go to **Step 7**	**Oscilloscope Diagnostic Kit Description and Operation**

Step	Action	Yes	No
7	1. Install the **CH-51450-NVH-TA183** accelerometer to the pinion area of the drive axle. Route the accelerometer cable clear of rotating parts and loosely secure the wire clear of moving parts. If it is not possible to install the **CH-51450-NVH-TA183** accelerometer to the drive axle, install the accelerometer to an exposed portion of the floor panel or seat track in the area that the customer noted is most respondent to the vibration. 2. Select a smooth, level road. 3. With the vehicle at a stand-still, apply the brake pedal and place the transmission in the lowest forward gear. **NOTE:** **Do not accelerate to the point of causing the drive wheels to squeal, slip, or hop. This would obscure the results of the test.** 4. Release the brake pedal and accelerate aggressively to 32 km/h (20 mph). 5. Observe the vehicle for disturbances that match the customers description and note the following conditions: • The vibration frequency reading, if detected, by the **CH-51450-NVH** Oscilloscope • The feel and/or sound of the disturbance 6. If a reading could not be obtained by the **CH-51450-NVH** Oscilloscope, move the **CH-51450-NVH-TA183** accelerometer to another part that is respondent to the vibration and repeat Steps 3-5. Were you able to duplicate the customer concern?	Go to **Vibration Analysis - Hub and/or Axle Input**	Go to **Step 8**

Step	Action	Yes	No
8	1. Install the **CH-51450-NVH-TA183** accelerometer to the component identified by the customer as most respondent to the vibration. If no component was identified, install the **CH-51450-NVH-TA183** accelerometer to the drivers side right seat rail. You may have to move the sensor to other locations later. 2. Select a smooth, level road and slowly accelerate the vehicle up to highway speed. 3. Observe the vehicle for disturbances that match the customers description and note the following conditions or take a snapshot using the **CH-51450-NVH** software: • The vehicle speed • The engine RPM • The transmission gear range and the specific gear • The vibration frequency reading, if detected, by the **CH-51450-NVH** Oscilloscope • The feel and/or the sound of the disturbance 4. If the vibration seems to excite a particular component of the vehicle more than the sear rail, move the **CH-51450-NVH-TA183** accelerometer onto that component and repeat Steps 2 and 3. Were you able to duplicate the customer concern?	Go to **Step 9**	Go to **Vibration Diagnostic Aids**
9	1. Accelerate the vehicle to a speed higher than the speed at which the disturbance occurs. **NOTE:** **If the vehicle is equipped with a continuously variable type automatic transmission, let the vehicle coast to a stop before shifting back into gear.** 2. Shift the vehicle into NEUTRAL and allow the vehicle to coast down through the disturbance range. Does the disturbance still occur while coasting down in NEUTRAL?	Go to **Step 11**	Go to **Step 10**
10	1. Select a smooth, level road and slowly accelerate the vehicle up to the speed at which the disturbance occurs. 2. Decelerate and safely downshift by one gear range. 3. Operate the vehicle at the same VEHICLE SPEED at which the disturbance occurs. Does the same disturbance still occur while going the same vehicle speed in a lower gear range?	Go to **Vibration Analysis - Hub and/or Axle Input**	Go to **Symptoms - Vibration Diagnosis and Correction**

Step	Action	Yes	No
11	If the **CH-51450-NVH** Oscilloscope is not available, refer to Symptoms - Vibration Diagnosis and Correction. Did the **CH-51450-NVH** Oscilloscope detect a dominant frequency?	Go to **Step 12**	Go to Symptoms - Vibration Diagnosis and Correction
12	Does the frequency data clearly fall within the tire/wheel parameters ONLY?	Go to Vibration Analysis - Tire and Wheel	Go to Symptoms - Vibration Diagnosis and Correction

COMPONENT ROTATIONAL SPEED CALCULATION

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-38792-A** Electronic Vibration Analyzer (EVA) 2
- **EL-47955** Multi Diagnostic Interface (MDI)

For equivalent regional tools, refer to Special Tools and Equipment.

NOTE: **If using the CH-51450-NVH Oscilloscope Diagnostic Kit (w/NVH), the component rotation is integrated into the tool. The diameter of the pulley will need to be measured and manually entered into the NVH software.**

Tire Rotational Speed

Determining Tire Revolutions Per Second at 8 km/h (5 mph) - Using EVA

Tire and wheel assembly rotational speed can be obtained through using the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2. Perform the following steps using the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 to obtain the rotational speed at 8 km/h (5 mph). Use the Enter key to advance and the Exit key to backup.

1. On the Main Menu screen, select Auto Mode.
2. On the Suspected Source screen, select Vehicle Speed.
3. On the Tire Info Source screen, select Manual Entry.
4. On the Tire Width screen, enter the specific width of the tires.

   For example: For a P245/45/R18 tire, enter 245.

5. On the Aspect Ratio screen, enter the specific aspect ratio of the tires.

   For example: For a P245/45/R18 tire, enter 0.45.

6. On the Rim Diameter screen, enter the specific rim diameter size.

   For example: For a P245/45/R18 tire, enter 18.0.

7. On the Driveshaft Configuration screen, enter FWD, even if the vehicle is a rear wheel drive.
8. The next screen will display the tire size just entered for confirmation.

   For example: 245 0.45 18.0 - Front Wheel Drive. If the tire size displayed is correct, press Enter.

9. On the Vehicle Speed Units screen, press Enter, disregard mph or km/h.
10. Press the Exit key several times slowly while watching the backwards progression of the screens. Stop at the Tire Info Source screen.
11. On the Tire Info Source screen, select RPS at 5 mph.
12. The next screen will display the revolutions per second (RPS) at 8 km/h (5 mph) for that specific tire size.

    For example: The P245/45/R18 will display 1.08 RPS.

Calculating Tire Revolutions Per Second at 8 km/h (5 mph) - Without Oscilloscope or EVA

If the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 is not available, the tire and wheel assembly rotational speed can be calculated approximately by performing the following steps.

1. Convert the rim diameter size from inches to centimeters.

   For example: For a P245/45/R18 tire, the rim diameter of 18 in X 2.54 converts to 45.72 cm.

2. Calculate the radius of the rim by dividing the rim diameter by 2.

   For example: For a P245/45/R18 tire, the rim diameter of 18 is converted to 45.72 cm divided by 2 = rim radius 22.86 cm.

3. Calculate the approximate tire sidewall height by multiplying the specific tire tread width by the aspect ratio, then reduce 7 percent from the amount by multiplying by 93 percent to approximate load on the tire reducing the sidewall height.

   For example: For a P245/45/R18 tire, tread width 245 mm X aspect ratio as a decimal 0.45 = 110 mm X 0.93 = approximate sidewall height 102.30 mm.

4. Convert the calculated approximate tire sidewall height from millimeters to centimeters.

   For example: For a P245/45/R18 tire, approximate sidewall height 102.30 mm converts to 10.23 cm.

5. Calculate the approximate tire and wheel assembly radius by adding the rim radius and approximate sidewall height, both in cm.

   For example: For a P245/45/R18 tire, rim radius 22.86 cm + 10.23 cm = approximate tire and wheel assembly radius 33.09 cm.

6. Calculate the approximate circumference of the tire and wheel assembly by multiplying 2 X pi, or 6.283185 X the approximate tire and wheel assembly radius.

   For example: For a P245/45/R18 tire, 6.283185 X approximate tire and wheel assembly radius 33.09 cm = approximate tire and wheel assembly circumference 207.911 cm.

7. Calculate the approximate revolutions per kilometer by dividing the number of cm in 1 km, 100, 000 cm by the approximate tire and wheel assembly circumference.

   For example: For a P245/45/R18 tire, 100, 000 cm divided by approximate tire and wheel assembly circumference 207.911 cm = approximate revolutions per kilometer 480.975.

8. Calculate the approximate revolutions per second (RPS), or Hz, by dividing the approximate revolutions per kilometer by the number of seconds to travel 1 km at a speed of 8 km per hour, 450 seconds.

   For example: For a P245/45/R18 tire, approximate revolutions per kilometer 480.975 divided by the number of seconds to travel 1 km at a speed of 8 km per hour, 450 seconds = approximate RPS, or Hz 1.069 rounded to 1.07.

Calculating Tire Revolutions Per Second, or Hz at Concern Speed

A size P235/75R15 tire rotates ONE complete revolution per second (RPS), or 1 Hz, at a vehicle speed of 8 km/h (5 mph). This means that at 16 km/h (10 mph), the same tire will make TWO complete revolutions in one second, 2 Hz, and so on.

1. Determine the rotational speed of the tires in revolutions per second (RPS), or Hertz (Hz), at 8 km/h (5 mph), based on the size of the tires. Refer to the preceding Tire Rotational Speed information.

   For example: According to the Tire Rotational Speed information, a P245/45R18 tire makes 1.08 revolutions per second (Hz) at a vehicle speed of 8 km/h (5 mph). This means that for every increment of 8 km/h (5 mph) in vehicle speed, the tire's rotation increases by 1.08 revolutions per second, or Hz.

2. Determine the number of increments of 8 km/h (5 mph) that are present, based on the vehicle speed in km/h (mph) at which the disturbance occurs.

   For example: Assume that a disturbance occurs at a vehicle speed of 96 km/h (60 mph). A speed of 96 km/h (60 mph) has 12 INCREMENTS of 8 km/h (5 mph):

96 km/h (60 mph) divided by 8 km/h (5 mph) = 12 increments

3. Determine the rotational speed of the tires in revolutions per second, or Hz, at the specific vehicle speed in km/h (mph) at which the disturbance occurs.

   For example: To determine the tire rotational speed at 96 km/h (60 mph), multiply the number of increments of 8 km/h (5 mph) by the revolutions per second, or Hz, for one increment:

   12 increments X 1.08 Hz = 12.96 Hz, rounded to 13 Hz

   NOTE: **If the EL-38792-A Electronic Vibration Analyzer (EVA) 2 is not available, compare the calculated rotational speed to the frequency range associated with the symptoms of the vibration concern. Refer to Symptoms - Vibration Diagnosis and Correction.**

4. Compare the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, to the dominant frequency recorded on the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 during testing. If the frequencies match, then a first-order disturbance related to the rotation of the tire/wheel assemblies is present.

   If the frequencies do not match, then the disturbance may be related to a higher order of tire/wheel assembly rotation.

5. To compute higher order tire/wheel assembly rotation related disturbances, multiply the rotational speed of the tires at the specific vehicle speed at which the disturbance occurs, by the order number:

   13 Hz X 2, for second order = 26 Hz second-order tire/wheel assembly rotation related

   13 Hz X 3, for third order = 39 Hz third-order tire/wheel assembly rotation related

   If any of these computations match the frequency of the disturbance, a disturbance of that particular order, relating to the rotation of the tire/wheel assemblies and/or driveline components, also rotating at the same speed, is present.

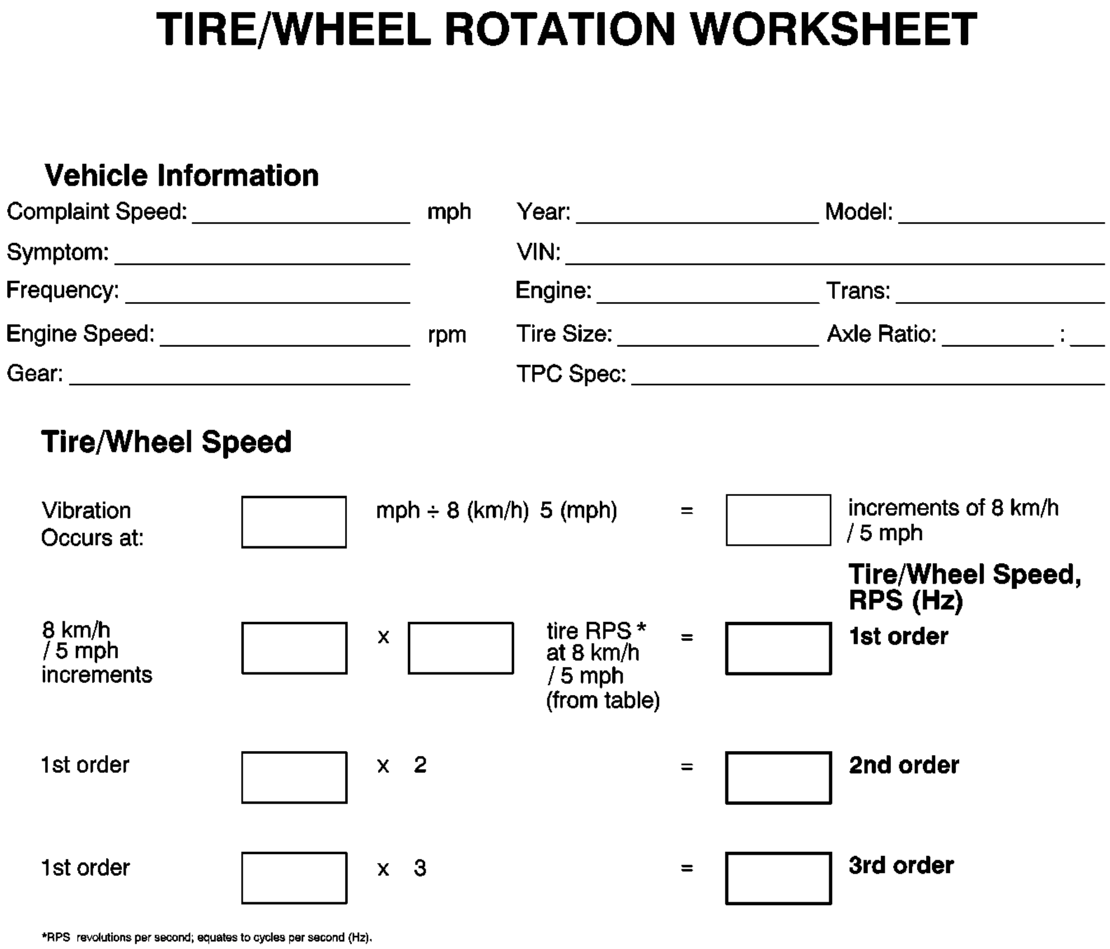
Component Rotational Speed Worksheet

Utilize the following worksheet as an aid in calculating the first, second and third order of tire/wheel assembly rotational speed related disturbances that may be present in the vehicle.

If after completing the Tire/Wheel Rotation Worksheet, the frequencies calculated do NOT match the dominant frequency of the disturbance recorded during testing, either recheck the data, or attempt to rematch the figures allowing for 1 1/2 - 8 km/h (1 - 5 mph) of speedometer error.

If the possible tire/wheel assembly rotational speed related frequencies still do not match the dominant frequency of the disturbance, the disturbance is most likely torque/load sensitive.

If after completing the Tire/Wheel Rotation Worksheet, one of the frequencies calculated DOES match the dominant frequency of the disturbance, the disturbance is related to the rotation of that component group - tire/wheel assembly related.



TIRE/WHEEL ROTATION WORKSHEET

Vehicle Information

Complaint Speed: ________________ mph
Symptom: ________________
Frequency: ________________
Engine Speed: ________________ rpm
Gear: ________________

Year: ________________ Model: ________________
VIN: ________________
Engine: ________________ Trans: ________________
Tire Size: ________________ Axle Ratio: ________ : ___
TPC Spec: ________________

Tire/Wheel Speed

Vibration Occurs at:	☐	mph ÷ 8 (km/h) 5 (mph)		=	☐	increments of 8 km/h / 5 mph
						Tire/Wheel Speed, RPS (Hz)
8 km/h / 5 mph increments	☐	x	☐	tire RPS * at 8 km/h / 5 mph (from table) =	☐	**1st order**
1st order	☐	x	2	=	☐	**2nd order**
1st order	☐	x	3	=	☐	**3rd order**

*RPS revolutions per second; equates to cycles per second (Hz).

Fig. 1: Tire/Wheel Rotation Worksheet
Courtesy of GENERAL MOTORS COMPANY

VIBRATION ANALYSIS - TIRE AND WHEEL

Test Description

The numbers below refer to the step numbers in the diagnostic table:

4

A build-up of foreign material on a tire and wheel assembly and/or a damaged, abnormally or excessively worn tire and wheel assembly could cause a vibration disturbance.

6

Tire and wheel assemblies that exhibit excessive runout when measured while mounted on the vehicle, may or may not be contributing to, or causing a vibration disturbance. On-vehicle runout, if present, could contribute to, or cause a vibration disturbance, but the cause of the on-vehicle runout may not be the tire and wheel assemblies.

7

Tire and wheel assemblies that exhibit excessive runout when measured off of the vehicle could cause a vibration disturbance.

9

Tire and wheel assemblies that exhibit marginal runout - within acceptable limits, but close to the maximum - when measured off of the vehicle could still be contributing to a vibration disturbance, if its mating hub/axle flange also exhibits marginal runout. When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration disturbance.

14

Brake rotors and/or brake drums, if equipped, that exhibit excessive imbalance could contribute to, or possibly cause a vibration disturbance.

15

A hub/axle flange and/or wheel studs that exhibit excessive runout could cause a vibration disturbance.

16

When the tire and wheel assembly and the hub axle flange are mounted to each other, the combined stack-up of their marginal amounts of runout could combine to produce an excessive amount of runout, which could cause a vibration disturbance. Match-mounting or vectoring the tire and wheel assembly to the hub/axle flange will modify the amount of combined runout.

18

Force variation may be present in a tire and wheel assembly that exhibited acceptable balance and runout. Force variation, if present, could contribute to, or cause a vibration disturbance.

20

Vibration disturbances could be affected by, or possibly caused by, components that are susceptible to steering input and/or torque-load input.

22

On-vehicle balancing, or finish-balancing can be used to reduce small amounts of imbalance which may be present as a result of the combined stack-up of the tire and wheel assembly with other components which may exhibit marginal balance.

Step	Action	Yes	No
1	Has the Vibration Analysis - Road Testing table been completed?	Go to **Step 2**	Go to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**
2	Based on the Vibration Analysis - Road Testing table, is the concern first-order tire and wheel assembly related?	Go to **Step 4**	Go to **Step 3**
3	Based on the Vibration Analysis - Road Testing table, is the concern second-order, or higher-order tire and wheel assembly related?	Go to **Step 18**	Go to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**
4	Visually inspect the tire and wheel assemblies for the following: • Debris build-up, such as packed mud, undercoating, ice/snow buildup, road tar, etc. • Damage, abnormal or excessive wear Refer to **Tire and Wheel Inspection**. Do any of the tire and wheel assemblies exhibit any of the conditions listed?	Go to **Step 5**	Go to **Step 6**

Step	Action	Yes	No
5	1. Remove the debris from the tire and wheel assemblies. 2. Replace the damaged, abnormally or excessively worn wheels or tires as necessary. Did you complete the repair or replacement?	Go to **Step 23**	-
6	Measure the on-vehicle runout of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**. Does the runout measurement indicate a runout concern?	Go to **Step 7**	Go to **Step 12**
7	Measure the off-vehicle runout of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - Off Vehicle**. Does the runout measurement indicate a runout concern?	Go to **Step 19**	Go to **Step 8**
8	Is the vehicle equipped with run-flat tires?	Go to **Step 12**	Go to **Step 9**
9	Are any of the tire and wheel assembly runout measurements marginal; within acceptable limits, but close to the maximum?	Go to **Step 10**	Go to **Step 15**
10	**NOTE:** **Ensure that each tire and wheel assembly that is match-mounted is properly balanced before reinstalling to the vehicle.** 1. Match-mount the tire-to-wheel for each tire and wheel assembly with marginal runout. Refer to **Tire-to-Wheel Match-Mounting (Vectoring)**. 2. Measure the runout of each match-mounted tire and wheel assembly. Refer to **Tire and Wheel Assembly Runout Measurement - Off Vehicle**. Were you able to significantly reduce the amount of tire and wheel assembly runout?	Go to **Step 11**	Go to **Step 19**
11	Re-measure the on-vehicle runout of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**. Does the measurement indicate a runout concern?	Go to **Step 15**	Go to **Step 23**
12	Inspect the balance of the tire and wheel assemblies. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**. Are any or the tire and wheel assemblies out of balance?	Go to **Step 13**	Go to **Step 14**
13	Balance the tire and wheel assemblies as necessary. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**. Were you able to achieve balance?	Go to **Step 23**	Go to **Vibration Diagnostic Aids**
14	1. Inspect the brake rotors and brake drums, if equipped, for damage. 2. Inspect the balance of the brake rotors and brake drums, if equipped. Refer to **Brake Rotor/Drum Balance Inspection**. 3. Replace brake rotors and/or brake drums, if equipped, that are damaged and/or out of balance. Did you find and correct a condition?	Go to **Step 23**	Go to **Step 17**

Step	Action	Yes	No
15	1. Measure the runout of the hub/axle flanges and the wheel studs, if equipped. 2. Inspect the wheel bolts, if equipped, for straightness and damage. 3. Refer to **Hub/Axle Flange and Wheel Stud Runout Inspection**. 4. If the inspection procedure indicates a runout concern, replace the appropriate components: • Wheel studs, if equipped • Wheel bolts, if equipped • Wheel bearing/hub assembly Did you find and correct a condition?	Go to **Step 23**	Go to **Step 16**
16	1. Match-mount the tire and wheel assemblies-to-hub/axle flanges. Refer to **Tire and Wheel Assembly-to-Hub/Axle Flange Match-Mounting**. 2. Re-measure the on-vehicle runout of tire and wheel assemblies. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**. Were you able to significantly reduce the amount of on-vehicle tire and wheel assembly runout?	Go to **Step 23**	Go to **Step 2**
17	Inspect for radial and lateral force variation. Refer to **Tire and Wheel Assembly Isolation Test**. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to **Step 19**	Go to **Step 20**
18	Inspect for radial and lateral force variation. Refer to **Tire and Wheel Assembly Isolation Test**. Were you able to isolate one or more of the tire and wheel assemblies as the cause of the disturbance?	Go to **Step 19**	Go to **Step 21**
19	Replace any tires and/or wheels that were isolated as the cause of the disturbance, as necessary. Did you complete the replacement?	Go to **Step 23**	-
20	Perform the Vibration Analysis - Hub/Axle Input table. Refer to **Vibration Analysis - Hub and/or Axle Input**. Did you find and correct a condition?	Go to **Step 23**	Go to **Step 22**
21	Perform the Vibration Analysis - Hub/Axle Input table. Refer to **Vibration Analysis - Hub and/or Axle Input**. Did you find and correct a condition?	Go to **Step 23**	Go to **Vibration Diagnostic Aids**
22	Finish-balance the tire and wheel assemblies on-vehicle. Refer to **Tire and Wheel Assembly Balancing - On-Vehicle**. Did you complete the on-vehicle finish balancing?	Go to **Step 23**	-
23	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**. Is the vibration still present?	Go to **Step 2**	System OK

VIBRATION ANALYSIS - HUB AND/OR AXLE INPUT

Test Description

The numbers below refer to the step numbers on the diagnostic table:

2

This test will determine the effect of turning input on the vibration.

6

This test will determine the effect of an initial heavy torque load on the vibration.

7

Damaged or worn wheel drive shafts may cause a noise or vibration that may be transferred into the passenger compartment.

8

Damaged or worn wheel bearings may cause a noise or vibration that may be transferred into the passenger compartment.

9

Damaged or worn suspension components may cause a noise or vibration that may be transferred into the passenger compartment.

10

Damaged or worn powertrain mounts and/or exhaust mounts may cause a noise or vibration that may be transferred into the passenger compartment.

11

Incorrect trim height may cause binding and/or interference between components that may produce a vibration.

Step	Action	Yes	No
1	Has the Vibration Analysis - Road Testing table been completed?	Go to **Step 2**	Go to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**

Step	Action	Yes	No
2	1. Operate the vehicle at the speed of the vibration concern. 2. While maintaining the concern speed, drive the vehicle through slow, sweeping turns - first in one direction, then in the other direction. 3. Observe the vehicle for changes in the vibration disturbance. 4. Select a smooth, level surface, such as an empty parking lot or a remote road. 5. While maintaining the vehicle at the concern speed if possible, drive the vehicle through sharp turns; 360 degrees - first in one direction, then in the other direction. 6. Observe the vehicle for changes in the vibration disturbance. Did the characteristics of the vibration change significantly - become worse or go away - during these steps?	Go to **Step 3**	Go to **Step 6**
3	Did you hear a clicking noise and/or feel a shudder during these steps?	Go to **Step 7**	Go to **Step 4**
4	Did you hear a growling noise during these steps?	Go to **Step 8**	Go to **Step 5**
5	Did you hear a popping noise during these steps?	Go to **Step 9**	Go to **Step 12**
6	1. With the vehicle at a stand-still, apply the regular brake and place the transmission in the lowest forward gear. **NOTE:** **Do not accelerate to the point of causing the drive wheels to squeal, slip or hop - this would obscure the results of the test.** 2. Release the regular brakes and accelerate aggressively to 32 km/h (20 mph). 3. Observe the vehicle for changes in the vibration disturbance. Did you feel a shudder or shaking during these steps?	Go to **Step 7**	Go to **Vibration Diagnostic Aids**
7	1. Inspect the wheel drive shafts, if equipped, for damage, abnormal and/or excessive wear. 2. If the inspection indicated that a wheel drive shaft is damaged, abnormally and/or excessively worn, replace the shaft. Did you find and correct a condition?	Go to **Step 12**	Go to **Step 9**
8	1. Inspect the wheel bearings for wear and/or damage. 2. Replace any of the wheel bearings found to be worn and/or damaged. Did you find and correct a condition?	Go to **Step 12**	Go to **Vibration Diagnostic Aids**

Step	Action	Yes	No
9	1. Inspect the following suspension components for wear, damage, looseness and/or possible contact with other vehicle components: - Struts/shock absorbers - Springs - Bushings - Insulators 2. Replace any of the suspension components found to be worn, damaged, loose and/or contacting other vehicle components. Did you find and correct a condition?	Go to **Step 12**	Go to **Step 10**

10	1. Inspect the powertrain mounts - engine, transmission, transfer case, and direct-mount differential, if equipped - and any powertrain braces for the following conditions:
	- Loose and/or missing fasteners
	- Improper alignment
	- Cracked, dry-rotted, and/or oil-soaked insulators
	- Twisted, broken, torn, and/or collapsed insulators
	- Bent, twisted, and/or deformed brackets
	2. Replace powertrain mounts as necessary.
	3. Inspect the exhaust system components for the following:
	- Loose and/or missing fasteners
	  - Heat Shields
	  - Joints and/or couplings:
	    Nuts, bolts, studs, clamps, straps
	  - Bracket and/or insulator mounting
	- Inadequate clearance to body and/or chassis components
	  Inspect with the exhaust system both COLD and HOT; in NEUTRAL, FORWARD and REVERSE gears
	- Improper alignment
	- Disconnected and/or missing insulators
	- Cracked, dry-rotted, and/or oil-soaked insulators
	- Stretched, twisted, broken, torn, and/or collapsed insulators
	- Bent, twisted, cracked, and/or deformed brackets
	4. Repair, replace, and/or realign exhaust system components as necessary.
	Did you find and correct a condition?
		Go to **Step 12**	Go to **Step 11**

11	Inspect the vehicle trim height and adjust as necessary. Refer to **Trim Height Inspection** . Did you find and correct a condition?	Go to **Step 12**	Go to **Vibration Diagnostic Aids**

Step	Action	Yes	No
12	1. Install or connect any components that were removed or disconnected during diagnosis. 2. Perform the Vibration Analysis - Road Testing table. Refer to Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope). Is the vibration still present?	Go to **Step 2**	System OK

VIBRATION DIAGNOSTIC AIDS

NOTE: **If you have not reviewed the Diagnostic Starting Point - Vehicle and completed the Vibration Analysis tables as indicated, refer to Diagnostic Starting Point - Vehicle BEFORE proceeding.**

The diagnostic information contained in this Diagnostic Aids section will help you determine the correct course of action to take for the following 4 main conditions. Refer to the appropriate condition from this list:

- Vibration Diagnostic Aids - Vibration Intermittent or Not Duplicated
- Vibration Diagnostic Aids - Vibration Duplicated, Component Not Identified
- Vibration Diagnostic Aids - Vibration Duplicated, Difficult to Isolate/Balance Component
- Vibration Diagnostic Aids - Vibration Duplicated, Appears to Be Potential Operating Characteristic

VIBRATION DIAGNOSTIC AIDS - VIBRATION INTERMITTENT OR NOT DUPLICATED

NOTE: **If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.**

If you have not been able to duplicate the vibration concern or have only been able to duplicate the concern intermittently, review the following information.

Most vibration concerns that cannot be duplicated are due to either specific conditions that are not present during the duplicating attempts, or due to not following the procedures designed to duplicate concerns properly and in the sequence indicated.

Specific Conditions Can Affect the Condition

Consider the following conditions which may not have been present while attempts were made to duplicate the vibration concern. Attempt to obtain more specific information from the customer as to the EXACT conditions that are present when they experience the vibration which they are concerned about. Attempt to duplicate the vibration concern again while recreating the EXACT conditions necessary, except those which pose a safety concern or are outside the boundaries of normal operating conditions, such as loading the vehicle beyond its designed weight ratings, etc.

Most attempts to duplicate a vibration concern are made after the vehicle has been driven to the repair facility and perhaps even sat inside the building for a time; the vehicle may be too warm to detect the concern during duplication efforts. The opposite could also occur; perhaps the vehicle has sat out in the cold for a time and fails to reach full operating temperatures during attempts to duplicate the concern.

Temperature, Ground-Out, Accessory Load

Flat Spots on Tires

Tires which have sat and been cool for a time can develop flat spots.

Irregular Wear on Tire Treads

Tires which have sat and been cool for a time will be stiffer and any irregular wear conditions will be more noticeable than they will be once the tires have warmed and softened.

Vehicle Payload

The vibration concern may only occur when the vehicle is carrying heavy payloads or towing a trailer; the vehicle may have been empty during duplication efforts.

Heavy Payload

The vehicle may have been empty during attempts to duplicate the vibration concern, but the customer may actually experience the vibration concern while the vehicle is carrying a large payload.

Roadway Selection

The selection of roadways used to perform the vibration duplication procedures is likely to be in the near vicinity of the repair facility and may not provide a road surface that is similar enough to the surface on which the customer usually drives the vehicle.

The customer may only experience the vibration on a particular roadway. Perhaps the roadway is overly crowned or is very bumpy or rough.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, COMPONENT NOT IDENTIFIED

NOTE: **If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.**

Aftermarket Add-On Accessories

Aftermarket accessories which have been added to the vehicle can actually transmit and magnify INHERENT component rotational frequencies, if the accessories were not installed correctly.

An accessory should be installed in such a way that it is isolated from becoming a possible transfer path into the rest of the vehicle. For example, if a set of running boards has been installed improperly and they are sensitive to a particular frequency of a rotating component, the running boards could begin to respond to the frequency and actually create a disturbance once the amplitude of the frequency reaches a high enough point, probably at a higher vehicle speed.

If the same set of running boards were installed properly - isolated properly - the transfer path would be removed and the disturbance would no longer be present.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, DIFFICULT TO ISOLATE/BALANCE COMPONENT

NOTE: **If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.**

If you have duplicated the vibration concern but have had difficulty in balancing a component or isolating a component, refer to the following information.

Most vibration concerns are corrected or eliminated through correcting excessive runout of a component, correcting balance of a component or isolating a component which has come into abnormal contact with another object/component.

Components which can generate a lot of energy and are experiencing excessive runout, imbalance or ground-out can produce a vibration with a strong enough amplitude that the vibration can transmit to components which are closely related. This type of a condition is usually related to and sensitive to torque-load. The most likely system that could exhibit this type of a condition is the driveline.

VIBRATION DIAGNOSTIC AIDS - VIBRATION DUPLICATED, APPEARS TO BE POTENTIAL OPERATING CHARACTERISTIC

NOTE: **If you have not completed the Vibration Analysis tables as indicated and reviewed Vibration Diagnostic Aids, refer to Vibration Diagnostic Aids BEFORE proceeding.**

Check Service Bulletins

If BOTH of the following statements are TRUE, then check service bulletins for the condition identified. If the condition has already been identified and investigated prior to this vehicle, and has been determined to be something that is not truly an operating characteristic or that perhaps is not design-intent, there will likely be adjustments or corrections identified which will address the condition.

- You CAREFULLY followed the steps indicated through reviewing the Diagnostic Starting Point - Vibration Diagnosis and completing the Vibration Analysis tables identified and you have duplicated the vibration concern.
- You have come to the conclusion through comparison with a very equally-equipped, same model year and type, KNOWN GOOD vehicle that the customer's concern is a condition that appears to be a potential operating characteristic of the vehicle.

SYMPTOMS - VIBRATION DIAGNOSIS AND CORRECTION

NOTE: **Perform the following steps in sequence BEFORE using these symptom tables.**

1. Begin the diagnosis of a vibration concern by reviewing **Diagnostic Starting Point - Vehicle** to become familiar with the diagnostic process used to properly diagnose vibration concerns.
2. Perform the **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)** table before using these symptom tables in order to duplicate and effectively diagnose the customer's concern.

Symptom Tables

Refer to a Vibration Analysis table as indicated in the following symptom tables, based on the most dominant characteristic of the customer's vibration concern, felt or heard, that is evident during the appropriate condition of the occurrence.

Vibration Symptoms that are Felt

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Shake	Can sometimes be seen or felt in the steering wheel, seat or console. Related terminology: shimmy, wobble, waddle, shudder, hop	5 - 20 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to **Vibration Analysis - Tire and Wheel**
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
Roughness	Similar to the feeling of holding a jigsaw.	20 - 50 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to **Vibration Analysis - Tire and Wheel**
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
Buzz	Similar to the feeling of holding an electric razor. May be felt in the hands through the steering wheel, in the feet through the floor, or in the seat of the pants.	50 - 100 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
Tingling	May produce a "pins and needles" sensation or may put hands or feet "to sleep". Highest vibration frequency range that can still be felt.	Greater than 100 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to **Vibration Analysis - Hub and/or Axle Input**

Vibration Symptoms that are Heard

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus

Category	Description	Typical Frequency Range	Condition of Occurrence	Area of Focus
Boom	Usually heard as an interior noise similar to the noise of a bowling ball rolling down an alley, deep thunder, or a bass drum. • Related terminology - droning, growling, moaning, roaring, rumbling, humming • May not be accompanied by a perceptible vibration or roughness	20 - 60 Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Go to **Vibration Analysis - Tire and Wheel**
			Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
Moan or Drone	Similar to the sound of a bumblebee or blowing air across the top of a bottle. • Related terminology - humming, buzzing, resonance • May be accompanied by a perceptible vibration such as a buzz	60 - 120 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
Howl	Similar to the sound of the wind howling.	120 - 300 Hz	Vehicle Speed Sensitive Affected by torque/load and/or steering input	Go to **Vibration Analysis - Hub and/or Axle Input**
Whine	Similar to the sound of mosquitoes, turbine engines, or vacuum cleaners.	300 - 500 Hz	Vehicle Speed Sensitive Affected by torque/load	Go to **Symptoms - Automatic Transmission**

VEHICLE-TO-VEHICLE DIAGNOSTIC COMPARISON

Comparing the customer's vehicle to a KNOWN GOOD vehicle that is essentially identical will help determine if the customer's concern may be characteristic of a vehicle design. To arrive at a valid conclusion, the comparison must be performed under the same conditions, using the same criteria, on a vehicle that has the same option content as the customer's vehicle.

The comparison vehicle must match the customer's vehicle in the following areas:

- Model Year
- Make
- Model
- Body style
- Powertrain configuration
- Driveline configuration
- Final drive ratio
- Tire/wheel size and type
- Suspension package
- Trailering package
- GVW rating
- Performance options
- Luxury options

TIRE AND WHEEL INSPECTION

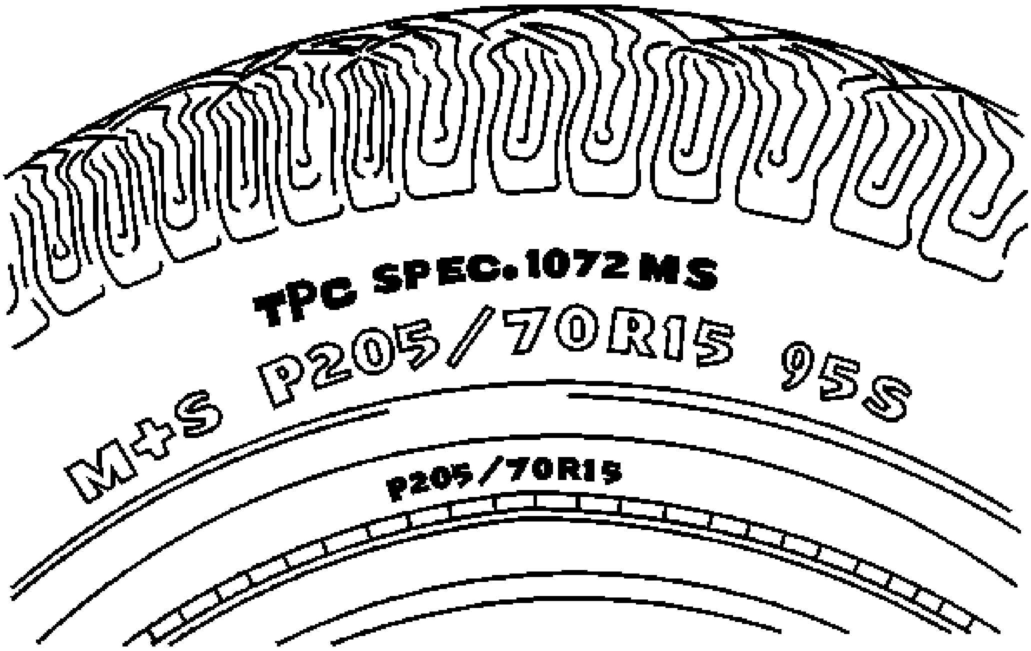


Fig. 2: Tire Performance Criteria (TPC) Rating Markings
Courtesy of GENERAL MOTORS COMPANY

The tires on all new production models have a tire performance criteria (TPC) rating number molded on the sidewall. The TPC rating will appear as a 4-digit number preceded by the letters TPC SPEC on the tire wall near the tire size. A replacement tire should have the same TPC rating.

Tire Wear

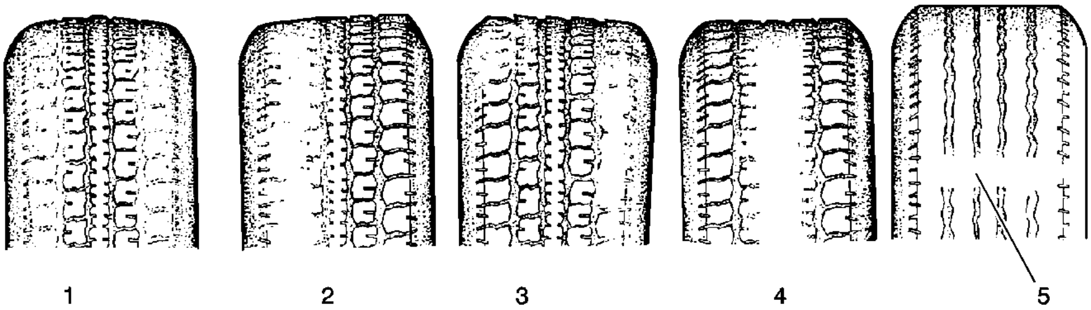


Fig. 3: Types Of Tire Wear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Hard Cornering/Underinflation
2	Incorrect Alignment/Lack of Rotation

Callout	Component Name
3	Incorrect Alignment/Non-uniform Tire
4	Heavy Acceleration/Over inflation
5	Wear Indicator

Inspect the tire and wheel assemblies for the following conditions:

- Unusual wear such as cupping, flat spots, and/or heel-and-toe wear

  These conditions can cause tire growl, tire howl, slapping noises, and/or vibrations throughout the vehicle.

- Proper inflation to specifications for the vehicle
- Bulges in the sidewalls

  Do not confuse bulges, which are an abnormal condition, with normal ply splices which are commonly seen as indentations in the sidewall.

- Bent rim flanges

TIRE AND WHEEL ASSEMBLY RUNOUT MEASUREMENT - ON-VEHICLE

1. Raise and support the vehicle.
2. Closely inspect each tire for proper and even bead seating.
3. If any of the tire beads were not properly or evenly seated, reseat the tire bead, then proceed to step 4. Refer to Tire and Wheel Removal and Installation .
4. Following the tire inflation placard on the drivers door, inspect and if necessary adjust the tire inflation pressures.

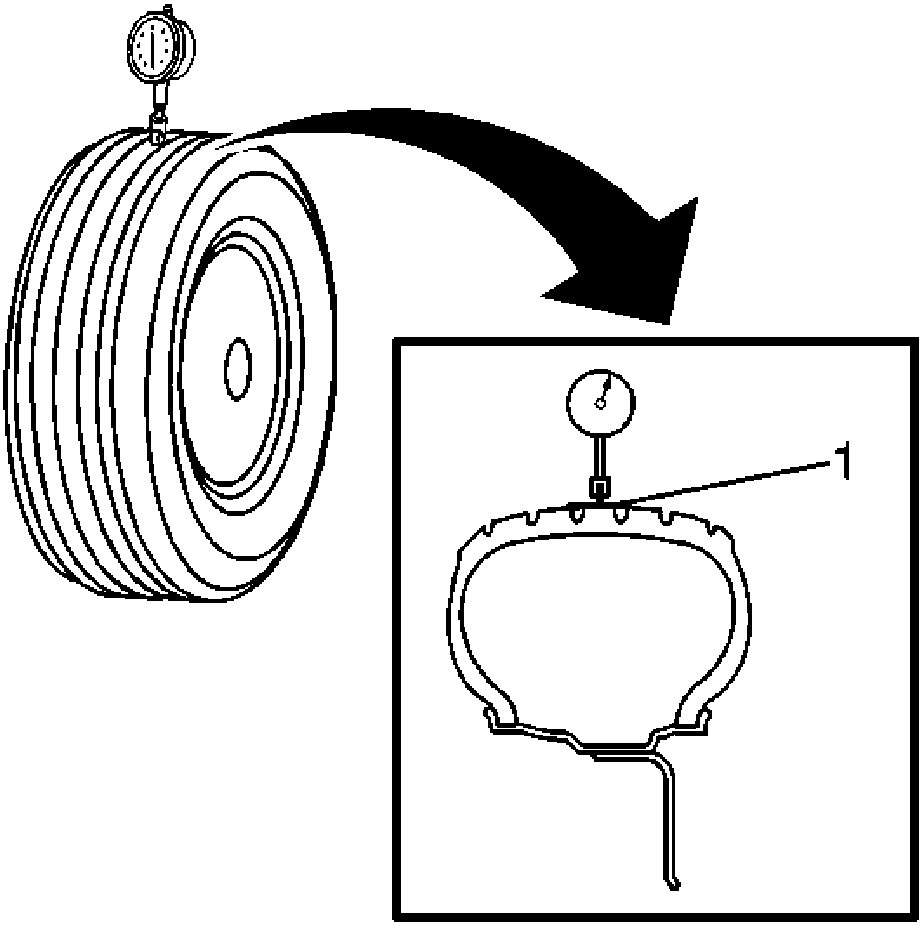


Fig. 4: Measuring Tire & Wheel Assembly Radial Runout
Courtesy of GENERAL MOTORS COMPANY

5. Wrap the circumference of each tire with tape (1) in the center tread area.

   Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.

6. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
7. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
8. Set the dial indicator to zero at the low spot.
9. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

   Specification

   Maximum tire and wheel assembly radial runout - measured on-vehicle: 1.52 mm (0.060 in)

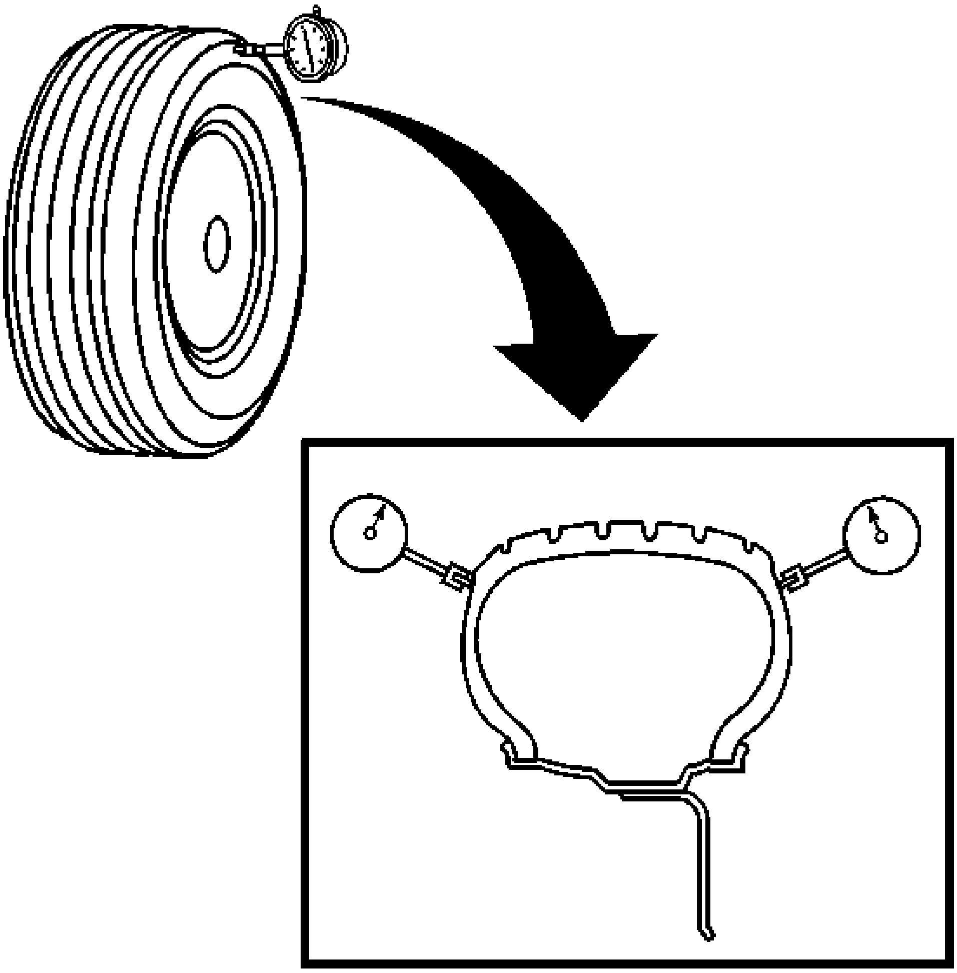


Fig. 5: Measuring Tire & Wheel Assembly Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

10. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.
11. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
12. Set the dial indicator to zero at the low spot.
13. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

    Specification

    Maximum tire and wheel assembly lateral runout - measured on-vehicle: 1.52 mm (0.060 in)

14. Repeat steps 4 through 12 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.

15. Lower the vehicle.

TIRE AND WHEEL ASSEMBLY RUNOUT MEASUREMENT - OFF VEHICLE

1. Raise and support the vehicle.
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies from the vehicle.
4. Closely inspect each tire for proper and even bead seating.
5. If any of the tire beads were not properly or evenly seated, reseat the tire bead, then proceed to step 6. Refer to Tire and Wheel Removal and Installation .
6. Mount a tire and wheel assembly on a spin-type wheel balancer.

   Locate the tire and wheel assembly on the balancer with a cone through the back side of the center pilot hole.

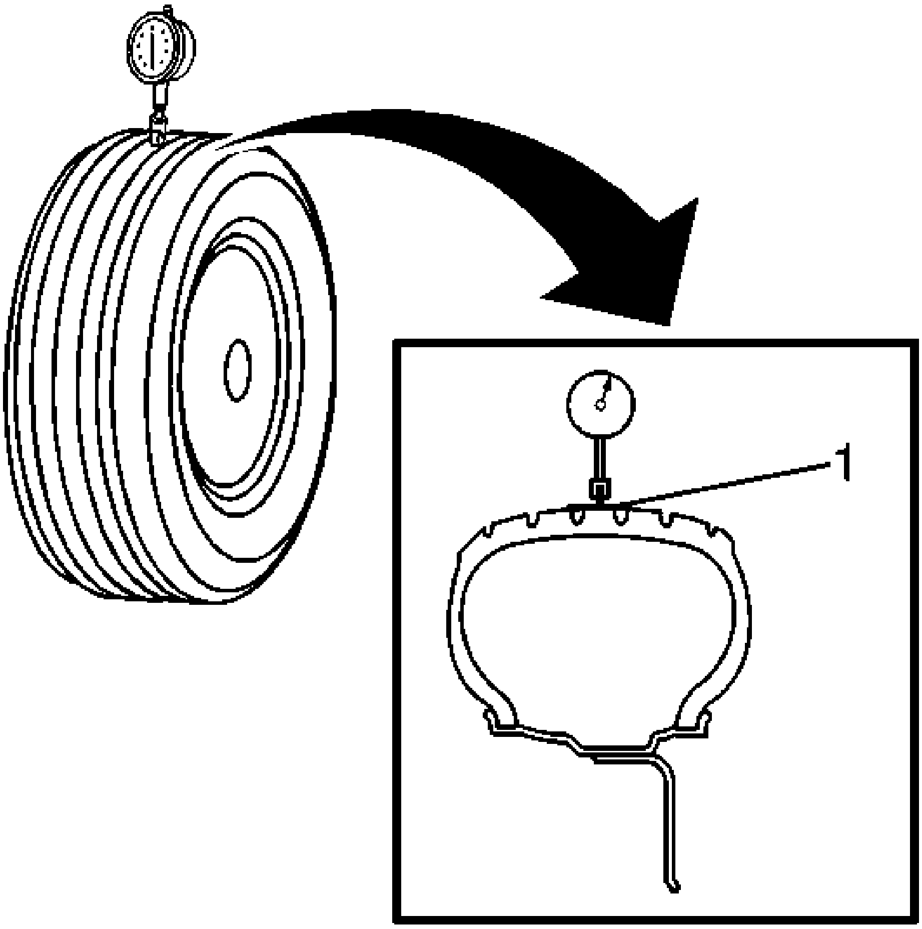


Fig. 6: Measuring Tire & Wheel Assembly Radial Runout
Courtesy of GENERAL MOTORS COMPANY

7. Wrap the outer circumference of each tire with tape (1) in the center tread area.

   Wrapping the tread with tape allows for a smooth and accurate reading of radial runout to be obtained.

8. Position the dial indicator on the taped portion of the tire tread such that the dial indicator is perpendicular to the tire tread surface.
9. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
10. Set the dial indicator to zero at the low spot.
11. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of radial runout.

    Specification

Maximum tire and wheel assembly radial runout - measured off-vehicle: 1.27 mm (0.050 in)

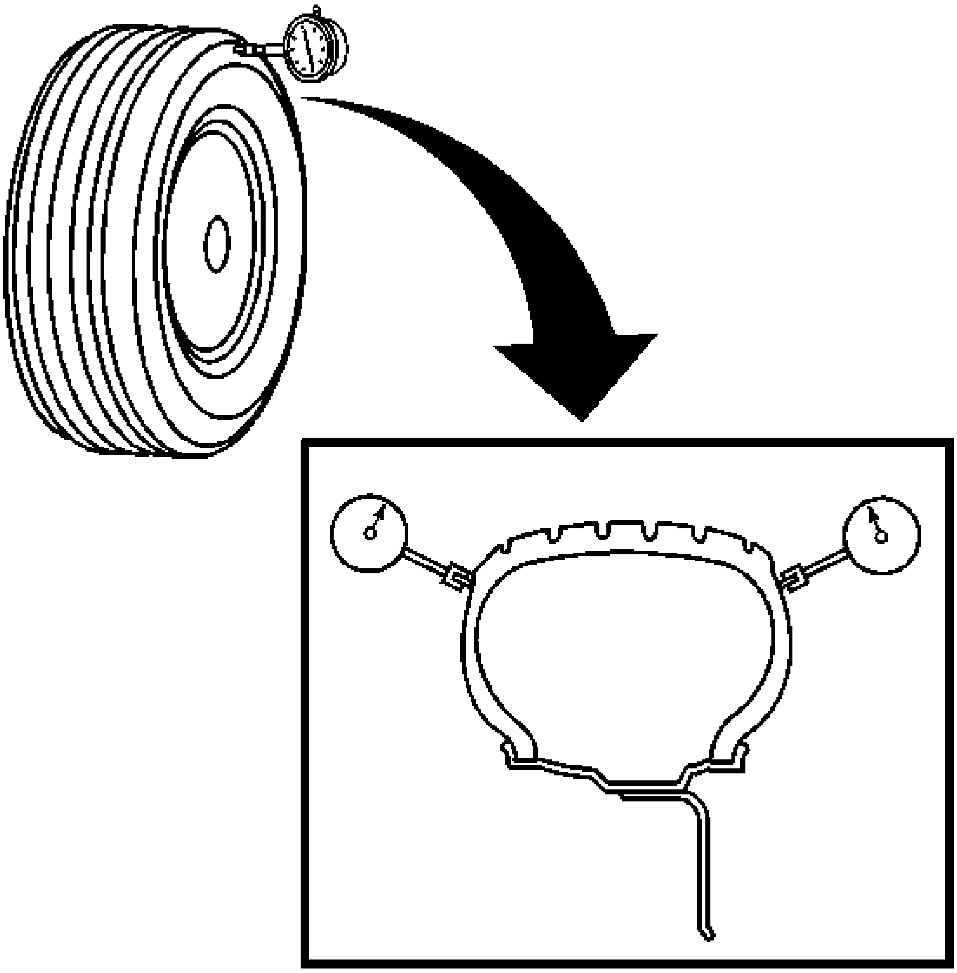


Fig. 7: Measuring Tire & Wheel Assembly Lateral Runout
Courtesy of GENERAL MOTORS COMPANY

12. Position the dial indicator on a smooth portion of the tire sidewall, as close to the tread as possible, such that the dial indicator is perpendicular to the tire sidewall surface.
13. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot. Ignore any jumps or dips due to sidewall splices.
14. Set the dial indicator to zero at the low spot.
15. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of lateral runout. Ignore any jumps or dips due to sidewall splices and attain an average runout measurement.

    Specification

    Maximum tire and wheel assembly lateral runout - measured off-vehicle: 1.27 mm (0.050 in)

16. Repeat steps 6 through 15 until all of the tire and wheel assembly radial and lateral runout measurements have been taken.
17. If ANY of the tire and wheel assembly runout measurements were NOT within specifications, proceed to step 19.
18. If ALL of the tire and wheel assembly runout measurements WERE within specifications, then the off-vehicle tire and wheel assembly runout is considered acceptable.

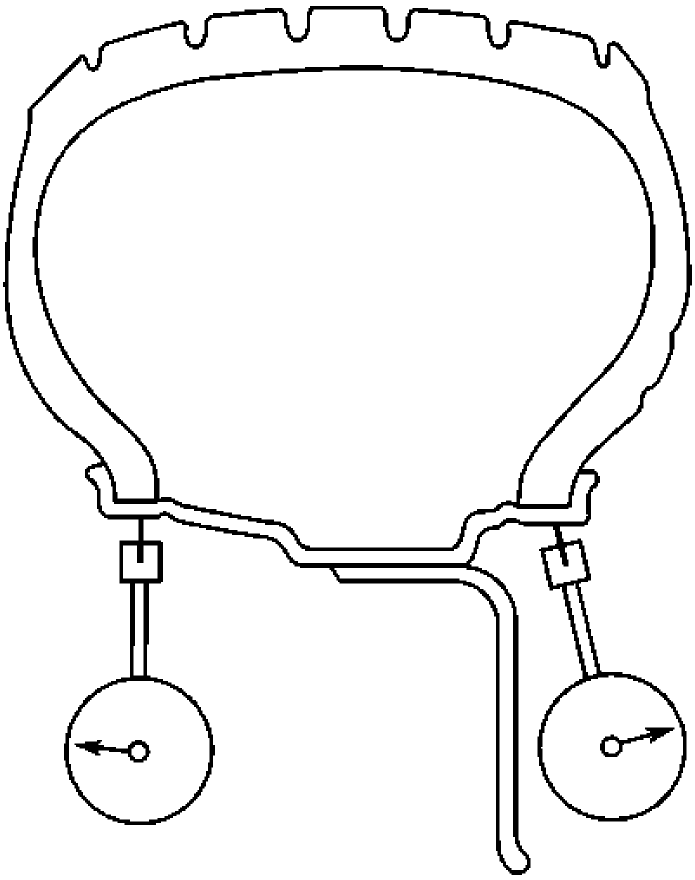


Fig. 8: Measuring Wheel Radial Runout (Off-Vehicle, Tire Mounted)
Courtesy of GENERAL MOTORS COMPANY

19. Position the dial indicator on the horizontal outer surface of the wheel rim flange - with the tire still mounted - such that the dial indicator is perpendicular to the rim flange surface.

    Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.

20. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
21. Set the dial indicator to zero at the low spot.
22. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel radial runout.

    Specification

    - Maximum aluminum wheel radial runout - measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
    - Maximum steel wheel radial runout - measured off-vehicle, tire mounted: 1.015 mm (0.040 in)

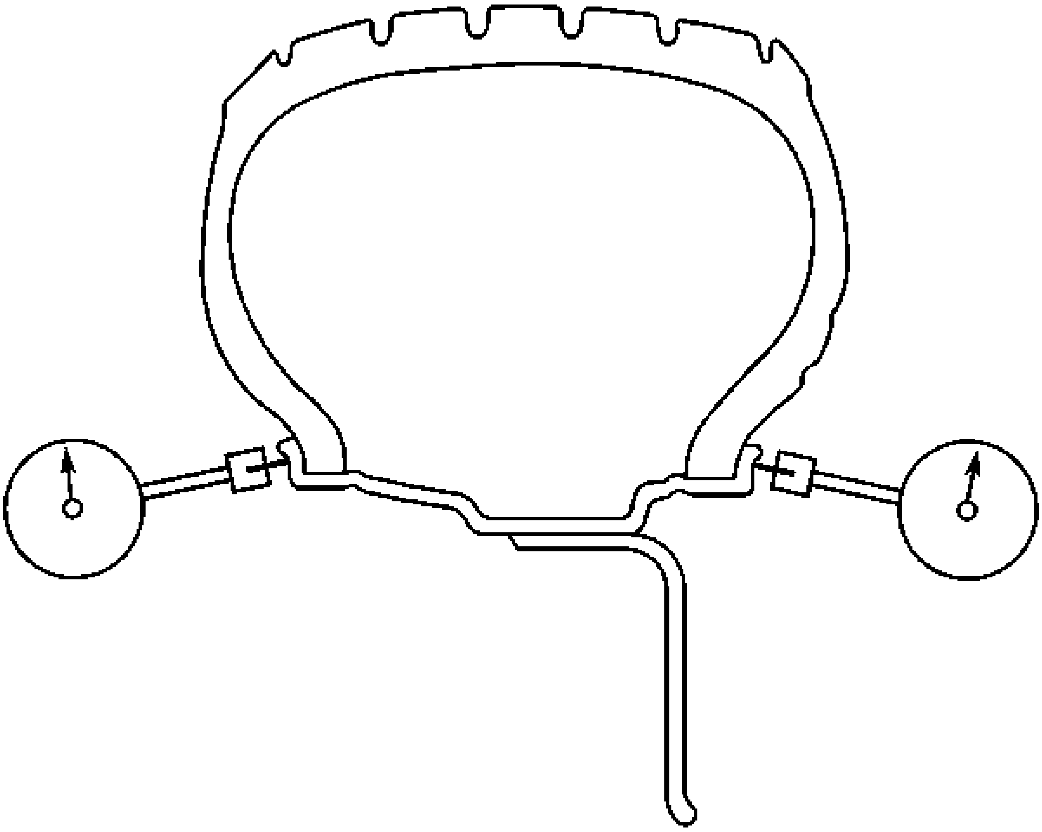


Fig. 9: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Mounted)
Courtesy of GENERAL MOTORS COMPANY

23. Position the dial indicator on the vertical outer surface of the wheel rim flange - with the tire still mounted - such that the dial indicator is perpendicular to the rim flange surface.

    Wheel runout should be measured on both the inboard and outboard rim flanges, unless wheel design will not permit. Ignore any jumps or dips due to paint drips, chips, or welds.

24. Slowly rotate the tire and wheel assembly one complete revolution in order to find the low spot.
25. Set the dial indicator to zero at the low spot.
26. Slowly rotate the tire and wheel assembly one more complete revolution and measure the total amount of wheel lateral runout.

    Specification

    - Maximum aluminum wheel lateral runout - measured off-vehicle, tire mounted: 0.762 mm (0.030 in)
    - Maximum steel wheel lateral runout - measured off-vehicle, tire mounted: 1.143 mm (0.045 in)
27. Repeat steps 19 through 26 until all of the wheel radial and lateral runout measurements have been taken on each of the - tire and wheel - assemblies with assembly runout measurements which were NOT within specifications.
28. If any of the wheel runout measurements were NOT within specifications, proceed to Measuring Wheel Runout - Tire Dismounted.
29. For any of the wheel runout measurements which WERE within specifications, while the - tire and wheel - assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.
30. After replacement of any tires, always re-measure the runout of the affected tire and wheel assembly, or assemblies.
31. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.

32. Lower the vehicle.

Wheel Runout Measurement - Tire Dismounted

1. On the tire and wheel assembly, or assemblies with wheel runout measurements - tire mounted - which were NOT within specifications, mark each tire and wheel in relation to each other.
2. Dismount the tire from the wheel.
3. Mount the wheel on a spin-type wheel balancer.
4. Locate the wheel on the balancer with a cone through the back side of the center pilot hole.

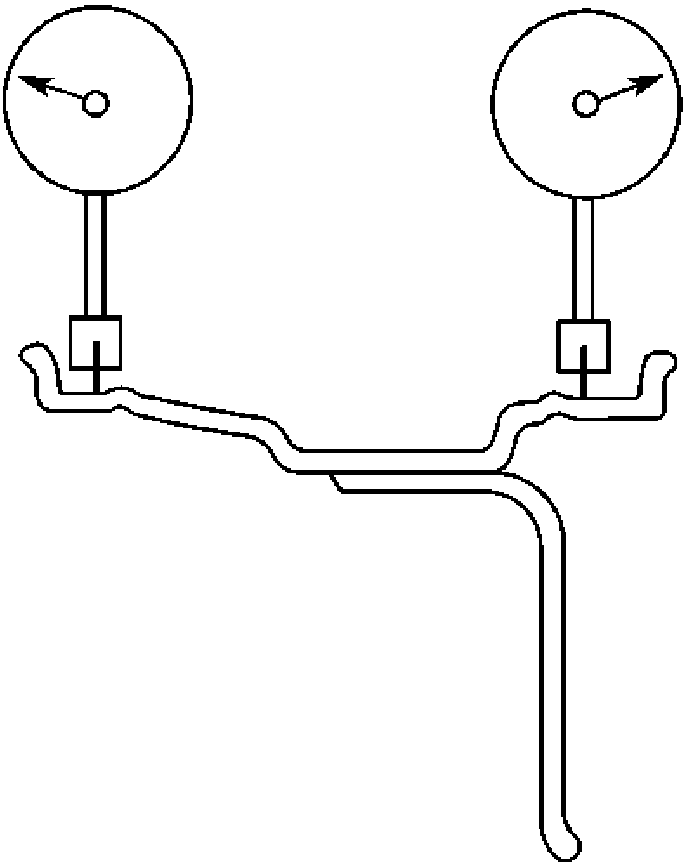


Fig. 10: Measuring Wheel Radial Runout (Off-Vehicle, Tire Dismounted)
Courtesy of GENERAL MOTORS COMPANY

5. Position the dial indicator on the horizontal inner surface of the wheel rim flange - with the tire dismounted - such that the dial indicator is perpendicular to the rim flange surface.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

6. Slowly rotate the wheel one complete revolution in order to find the low spot.
7. Set the dial indicator to zero at the low spot.
8. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel radial runout.

   Specification

   - Maximum aluminum wheel radial runout - measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
   - Maximum steel wheel radial runout - measured off-vehicle, tire dismounted: 1.015 mm (0.040 in)

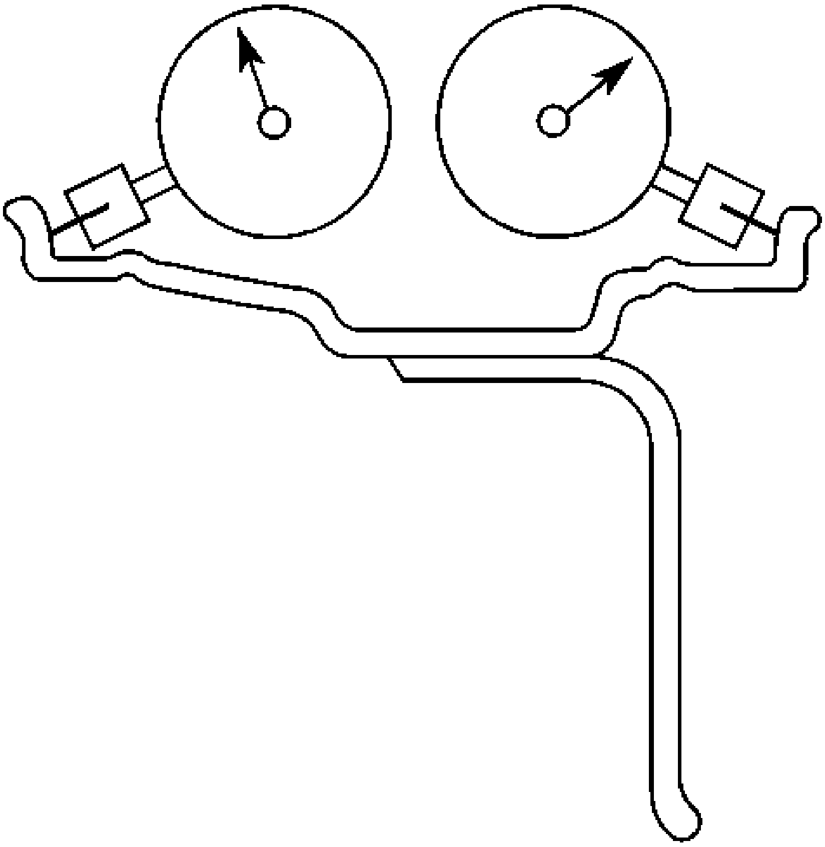


Fig. 11: Measuring Wheel Lateral Runout (Off-Vehicle, Tire Dismounted)
Courtesy of GENERAL MOTORS COMPANY

9. Position the dial indicator on the vertical inner surface of the wheel rim flange - with the tire dismounted - such that the dial indicator is perpendicular to the rim flange surface.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

10. Slowly rotate the wheel one complete revolution in order to find the low spot.
11. Set the dial indicator to zero at the low spot.
12. Slowly rotate the wheel one more complete revolution and measure the total amount of wheel lateral runout.

    Specification

    - Maximum aluminum wheel lateral runout - measured off-vehicle, tire dismounted: 0.762 mm (0.030 in)
    - Maximum steel wheel lateral runout - measured off-vehicle, tire dismounted: 1.143 mm (0.045 in)
13. Repeat steps 2 through 12 until all of the wheel radial and lateral runout measurements - tire dismounted - have been taken on each wheel with runout measurements - tire mounted - which were NOT within specifications.
14. If any of the wheel runout measurements - tire dismounted - were NOT within specifications, replace the wheel.

    Always measure the runout of any replacement wheels.

15. For any of the wheel runout measurements which WERE within specifications, while the - tire and wheel - assembly runout measurements were NOT within specifications, replace the tire, then balance the assembly. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.
16. Using the matchmarks made prior to dismounting the tire, or tires, mount the tire, or tires to the wheel, or wheels, then balance the assembly, or assemblies. Refer to **Tire and Wheel Assembly Balancing - Off**

Vehicle.

Always measure the runout of any of the tire and wheel assemblies which have had the tires dismounted and mounted.

17. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle.
18. Lower the vehicle.

BRAKE ROTOR/DRUM BALANCE INSPECTION

WARNING: **Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.**

1. Support the vehicle drive axle on a suitable hoist. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel assemblies from the drive axle. Refer to **Tire and Wheel Removal and Installation** .

WARNING: **Refer to Work Stall Test Warning .**

3. Reinstall the wheel nuts in order to retain the brake rotors.
4. Run the vehicle at the concern speed while inspecting for the presence of the vibration.

CAUTION: **Do not depress the brake pedal with the brake rotors and/or the brake drums removed, or with the brake calipers repositioned away from the brake rotors, or damage to the brake system may result.**

5. If the vibration is still present, remove the rotors from the drive axle, then run the vehicle back to the concern speed.
6. If the vibration is eliminated when the brake rotors are removed from the drive axle, repeat the test with one rotor installed at a time. Replace the rotor that is causing or contributing to the vibration concern.

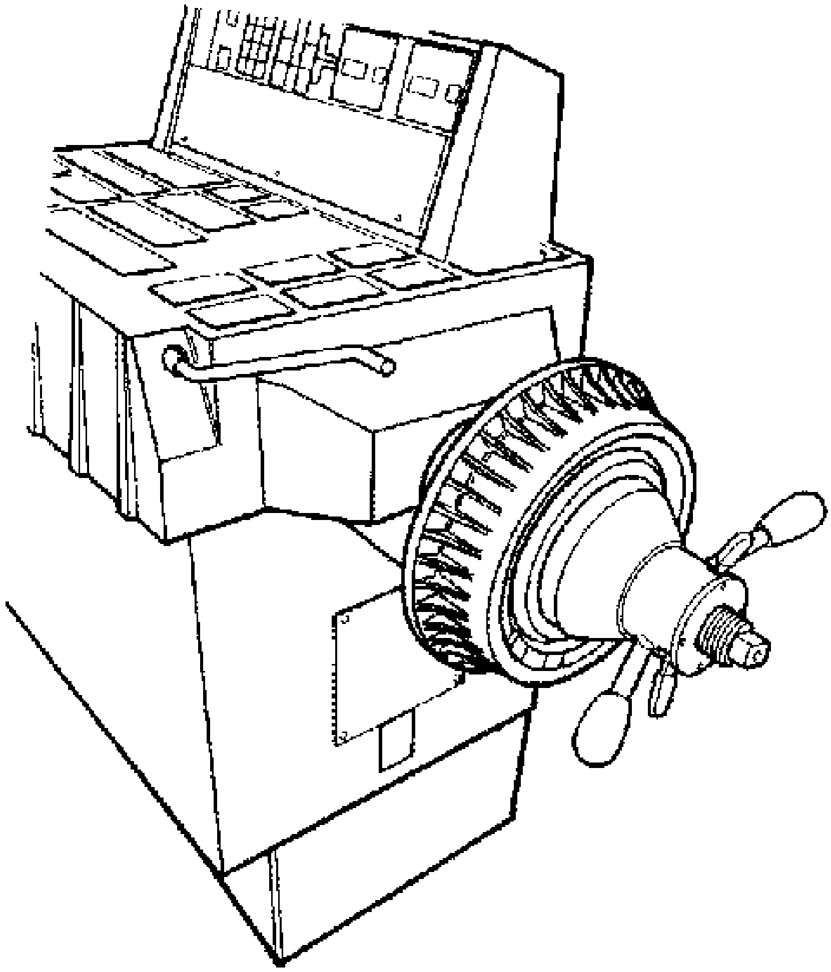


Fig. 12: Balancing Brake Drum
Courtesy of GENERAL MOTORS COMPANY

7. If a brake rotor was replaced as a result of following the previous steps, or if necessary to confirm the results obtained during the previous steps, and/or to check the non-drive axle components, perform the following:
    1. Mount the brake rotor/drum on a balancer in the same manner as a tire and wheel assembly.

NOTE: **Check brake rotors/drums for static imbalance only; ignore the dynamic imbalance readings.**

    2. Inspect the rotor/drum for static imbalance.

There is not a set tolerance for brake rotor/drum static imbalance. However, any brake rotor/drum measured in this same manner which is over 21 g (3/4 oz) may have the potential to cause or contribute to a vibration. Rotors/drums suspected of causing or contributing to a vibration should be replaced. Any rotor/drum that is replaced should be checked for imbalance in the same manner.

HUB/AXLE FLANGE AND WHEEL STUD RUNOUT INSPECTION

Special Tools

GE-8001 Dial Indicator Set, or equivalent

WARNING: **Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.**

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.

3. Remove the tire and wheel assemblies from the vehicle. Refer to **Tire and Wheel Removal and Installation** .
4. Remove the brake rotors and/or brake drums from the vehicle. Clean the mounting surfaces of the brake rotors, the brake drums, if equipped, and the hub/axle flanges of any loose debris, rust, and corrosion.

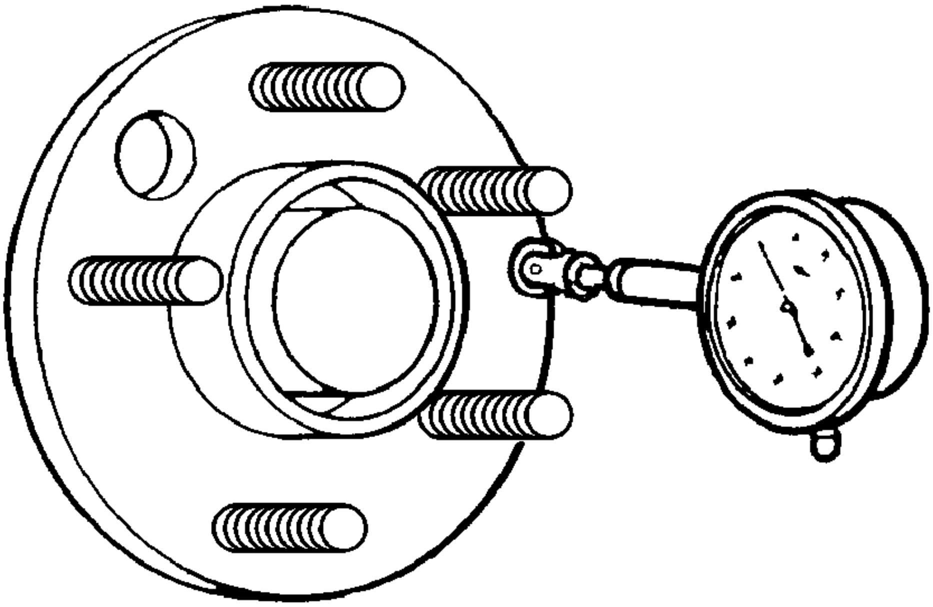


Fig. 13: Measuring Wheel Hub/Axle Flange Runout
Courtesy of GENERAL MOTORS COMPANY

5. Position the **GE-8001** Dial Indicator Set, or equivalent, on the machined surface of the wheel hub/axle flange outside of the wheel studs.
6. Rotate the hub one complete revolution in order to find the low spot.
7. Set the **GE-8001** Dial Indicator Set, or equivalent, to zero at the low spot.
8. Rotate the hub one more complete revolution and measure the total amount of wheel hub/axle flange runout.

   Specification - Guideline

   Wheel hub/axle flange runout tolerance guideline: 0.132 mm (0.005 in)

9. If the runout of the wheel hub/axle flange IS within specification and the vehicle is equipped with wheel studs, proceed to step 13.
10. If the runout of the wheel hub/axle flange IS within specification and the vehicle is equipped with wheel bolts, proceed to step 19.
11. If the runout of the wheel hub/axle flange is marginal, the wheel hub may or may not be the source of the disturbance.
12. If the runout of the wheel hub/axle flange is excessive, replace the wheel hub/axle flange. Measure the runout of the new wheel hub/axle flange.

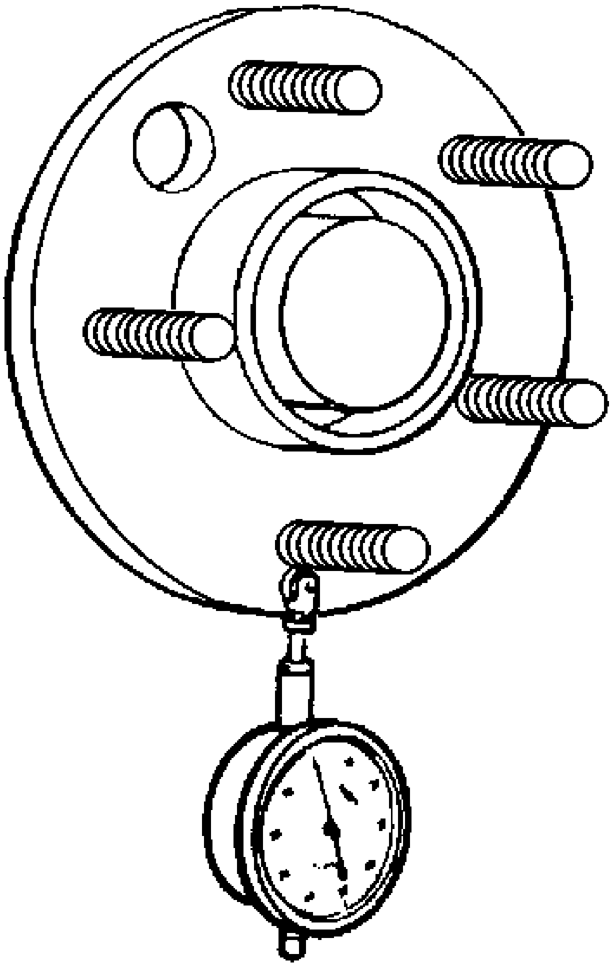


Fig. 14: Measuring Wheel Stud Runout
Courtesy of GENERAL MOTORS COMPANY

13. Position the **GE-8001** Dial Indicator Set, or equivalent, in order to contact the wheel mounting studs.

    Measure the stud runout as close to the flange as possible.

14. Turn the hub one complete revolution to register on each of the wheel studs.
15. Zero the **GE-8001** Dial Indicator Set, or equivalent, on the lowest stud.
16. Rotate the hub one more complete revolution and measure the total amount of wheel stud - stud circle - runout.

    Specification - Guideline

    Wheel stud runout tolerance guideline: 0.254 mm (0.010 in)

17. If the runout of the wheel studs - stud circle - is marginal, the wheel studs may or may not be contributing to the disturbance.
18. If the runout of the wheel studs - stud circle - is excessive, replace the wheel studs as necessary. Measure the runout of the new wheel studs.
19. Inspect the threads and the tapered seat portion on each of the wheel bolts for damage.
20. Wheel bolts exibiting damaged threads and/or damaged tapered seats require replacement.
21. Place the threaded portion of each wheel bolt along a straight edge to inspect for straightness.
22. Wheel bolts that are not straight require replacement.

TIRE AND WHEEL ASSEMBLY ISOLATION TEST

Force Variation

Force variation refers to a radial or lateral movement of the tire and wheel assembly which acts much like runout, however, force variation has to do with variations in the construction of the tire. These variations in tire construction may actually cause vibration in a vehicle, even though the tire and wheel assembly runout and balance may be within specifications.

Radial Force Variation

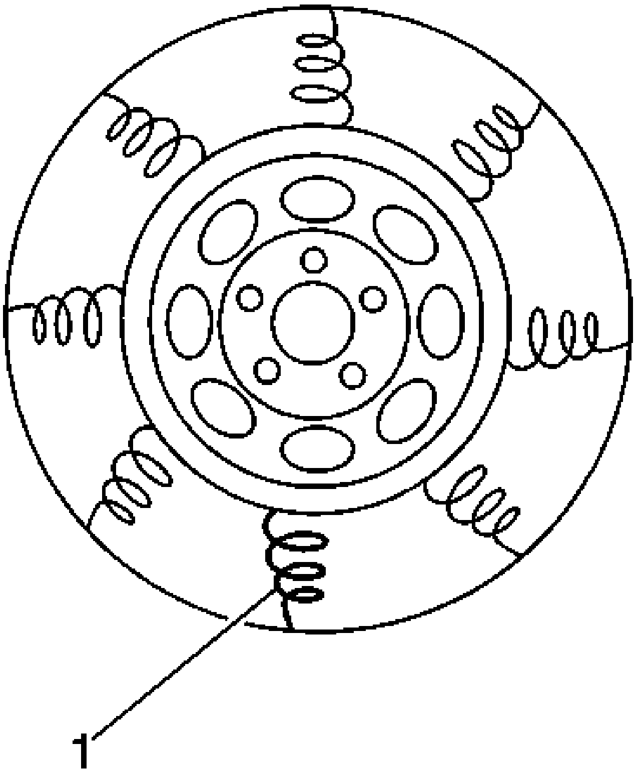


Fig. 15: Radial Force Variation
Courtesy of GENERAL MOTORS COMPANY

Radial force variation refers to the difference in the stiffness of a tire sidewall as the tire rotates and contacts the road. Tire sidewalls have some stiffness due to splices in the different plies of the tire, but these stiffness differences do not cause a problem unless the force variation is excessive. Stiff spots (1) in a tire sidewall can deflect a tire and wheel assembly upward as the assembly contacts the road.

Lateral Force Variation

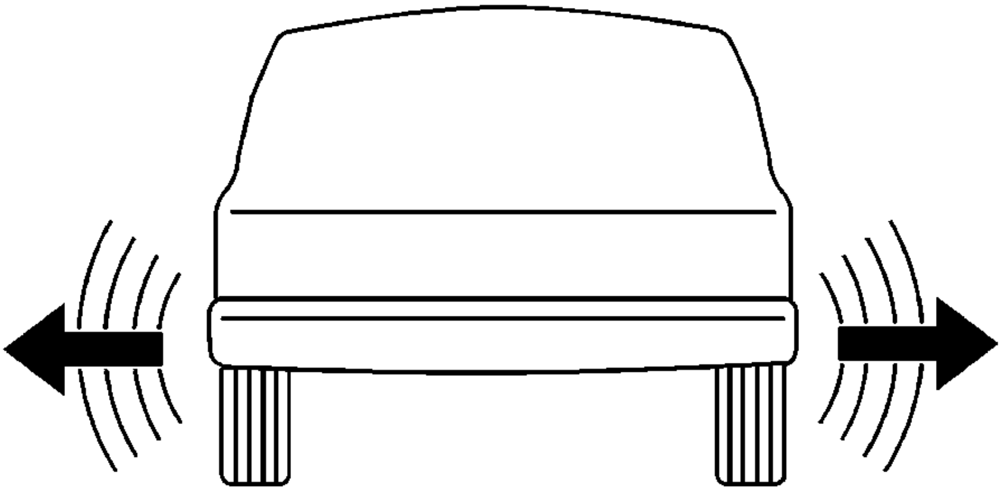


Fig. 16: Tire Wobble/Waddle
Courtesy of GENERAL MOTORS COMPANY

Lateral force variation refers to the difference in the stiffness or conformity of the belts within a tire as the tire rotates and contacts the road. Tire belts may have some stiffness or conformity differences, but these differences do not cause a problem unless the force variation is excessive. These variations in the belts of the tire can deflect the vehicle sideways or laterally. A shifted belt inside a tire may cause lateral force variation.

In most cases where excessive lateral force variation exists, the vehicle will display a wobble or waddle at low speeds, 8 - 40 km/h (5 - 25 mph), on a smooth road surface.

Isolation Test Procedure

Perform the following test in order to determine if force variation is present in the vehicle.

1. Substitute a set of KNOWN GOOD, pre-tested tire and wheel assemblies of the same size and type for the suspected original assemblies. Refer to **Tire and Wheel Removal and Installation** .
2. Road test the vehicle to determine if the vibration is still present. Refer to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**.
3. If the vibration is still present while using the known good set of tire and wheel assemblies, then force variation is not the cause of the vibration.
4. If the vibration is eliminated when using the known good set of tire and wheel assemblies, install one of the original tire and wheel assemblies using the matchmarks made prior to removal. Refer to **Tire and Wheel Removal and Installation** . Road test the vehicle to determine if the vibration has returned. Refer to **Vibration Analysis - Road Testing (EL-38792-A Electronic Vibration Analyzer)Vibration Analysis - Road Testing (CH-51450-NVH Oscilloscope)**.
5. Continue the process of installing the original tire and wheel assemblies one at a time, then road testing the vehicle, until the tire and wheel assembly, or assemblies which is causing the vibration has been identified.

6. Replace the tire, or tires on the vibration-causing tire and wheel assembly, or assemblies, then balance the assembly, or assemblies. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.

REPAIR INSTRUCTIONS

TIRE AND WHEEL ASSEMBLY BALANCING - OFF VEHICLE

WARNING: **Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:**

- **Clean away any dirt or deposits from the inside of the wheels.**
- **Remove any stones from the tread.**
- **Wear eye protection.**
- **Use coated weights on aluminum wheels.**

Tire and Wheel Assembly Balancer Calibration

Tire and wheel balancers can drift out of calibration over time, or can become inaccurate as a result of heavy use. There will likely not be any visual evidence that a calibration problem exists. If a balancer is not calibrated within specifications, and a tire and wheel assembly is balanced on that machine, the assembly may actually be imbalanced.

Tire and wheel assembly balancer calibration should be checked approximately every 2 weeks, if the machine is used frequently, and/or whenever the balance readings are questionable.

Tire and Wheel Assembly Balancer Calibration Test

NOTE: **If the balancer fails any of the steps in this calibration test, the balancer should be calibrated according to the manufacturer's instructions. If the balancer cannot be calibrated, contact the manufacturer for assistance.**

Inspect the calibration of the tire and wheel assembly balancer according to the manufacturer's recommendations, or perform the following test.

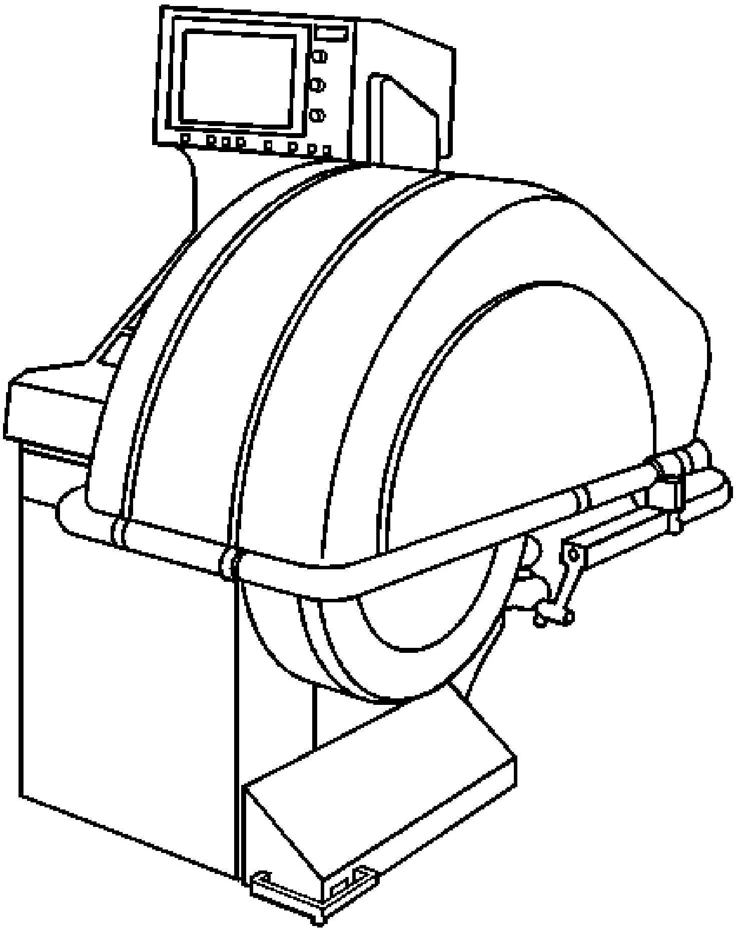


Fig. 17: Tire & Wheel Assembly Balancer
Courtesy of GENERAL MOTORS COMPANY

1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.

   Specification

   Zero within 7 g (1/4 oz)

3. If the balancer is within the specification range, balance a tire and wheel assembly - that is within radial and lateral runout tolerances - to ZERO, using the same balancer.
4. After the tire and wheel assembly has been balanced, add an 85 g (3 oz) test weight to the wheel at any location.
5. Spin the tire and wheel assembly again. Note the readings.
   - In the static and dynamic modes, the balancer should call for 85 g (3 oz) of weight, 180 degrees opposite the test weight.
   - In the dynamic mode, the weight should be called for on the flange of the wheel opposite the test weight.
6. With the assembly imbalanced to 85 g (3 oz), cycle the balancer 5 times.
7. Inspect the balancer readings:

   Specification

   Maximum variation: 7 g (1/4 oz)

8. Index the tire and wheel assembly on the balancer shaft, 90 degrees from the previous location.
9. Cycle the balancer with the assembly at the new location.
10. Inspect the balancer readings:

    Specification

Maximum variation: 7 g (1/4 oz)

11. Repeat steps 8 through 10 until the tire and wheel assembly has been cycled and checked at each of the 4 locations on the balancer shaft.

Tire and Wheel Assembly Balancing Guidelines

NOTE: **Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.**

It is strongly recommended that the tire and wheel assembly runout be measured and corrected if necessary BEFORE the assemblies are balanced.

If the runout of the tire and wheel assemblies has not yet been measured, refer to Tire and Wheel Assembly Runout Measurement - Off Vehicle before proceeding.

There are 2 types of tire and wheel balance:

Static Balance

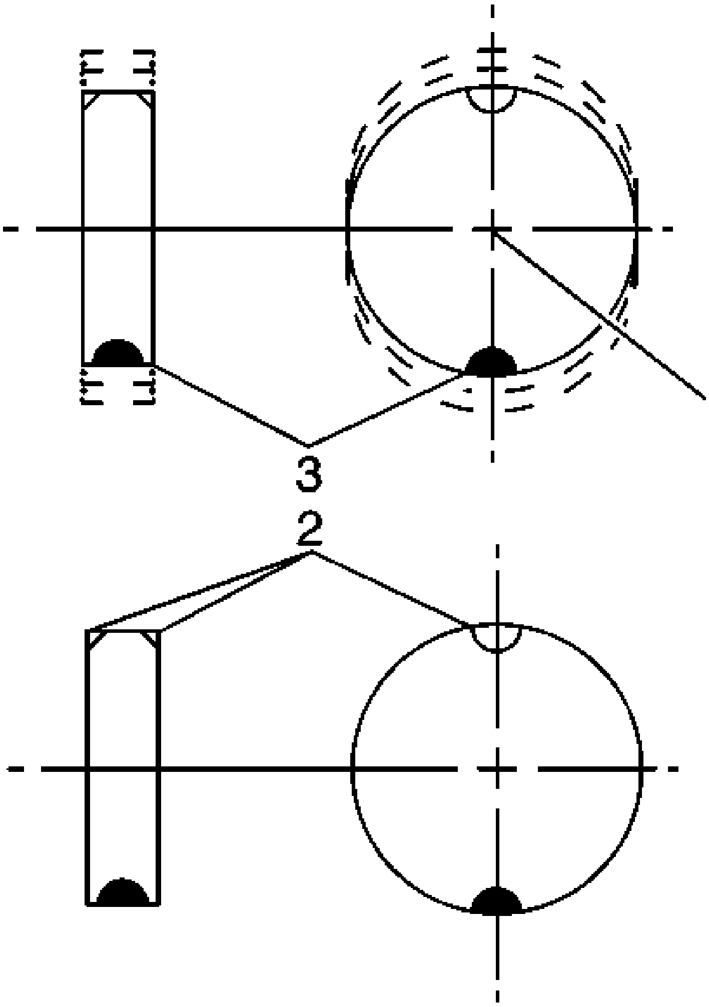


Fig. 18: Static Balance
Courtesy of GENERAL MOTORS COMPANY

Static balance is the equal distribution of weight around the wheel circumference. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have static imbalance can produce a bouncing action called tramp.

Dynamic Balance

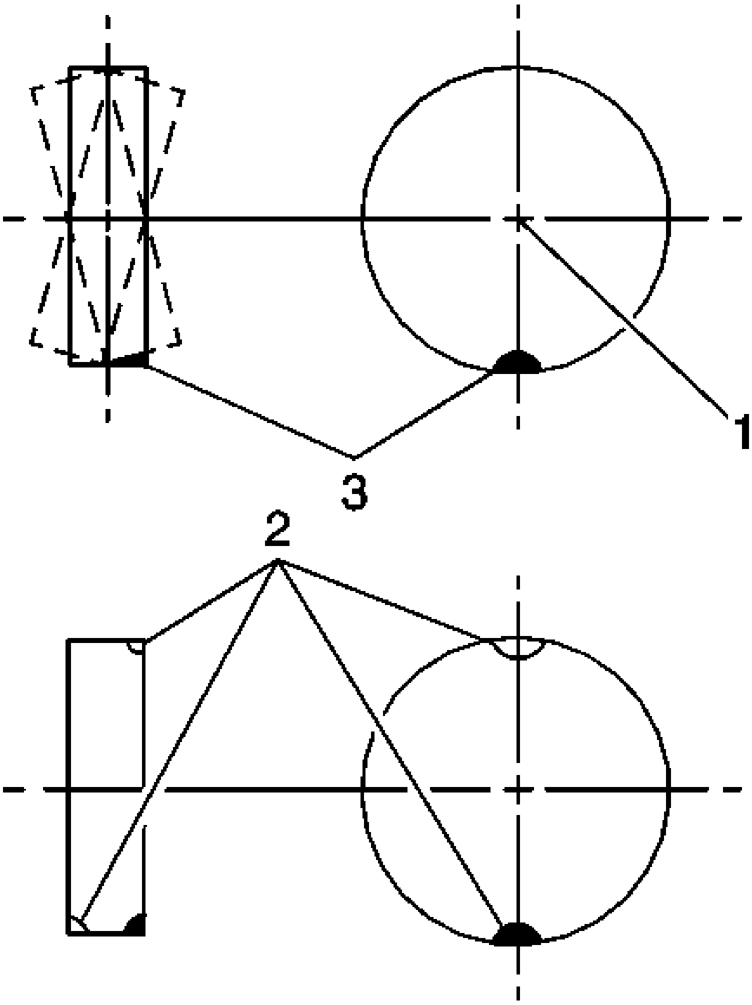


Fig. 19: Dynamic Balance
Courtesy of GENERAL MOTORS COMPANY

Dynamic balance is the equal distribution of weight on each side of the tire and wheel assembly centerline. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have dynamic imbalance have a tendency to move from side to side and can cause an action called shimmy.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance; however, vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance. As little as 14 - 21 g (1/2 - 3/4 oz) imbalance is capable of inducing a vibration in some vehicle models.

Balancing Procedure

NOTE: **When balancing tire and wheel assemblies, use a known good, recently calibrated, off-vehicle, two-plane dynamic balancer set to the finest balance mode available.**

WARNING: **Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.**

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. Refer to Tire and Wheel Removal and Installation .
4. Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels.

Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting concerns.

5. Be sure to use the correct type of wheel balance weights for the type of wheel rim being balanced. Be sure to use the correct type of coated wheel balance weights on aluminum wheels. Refer to Wheel Weight Usage.
6. Balance all four tire and wheel assemblies as close to zero as possible.
7. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle. Refer to **Tire and Wheel Removal and Installation** .
8. Lower the vehicle.

Wheel Weight Usage

Tire and wheel assemblies can be balanced using either the static or dynamic method.

Clip-on Weights

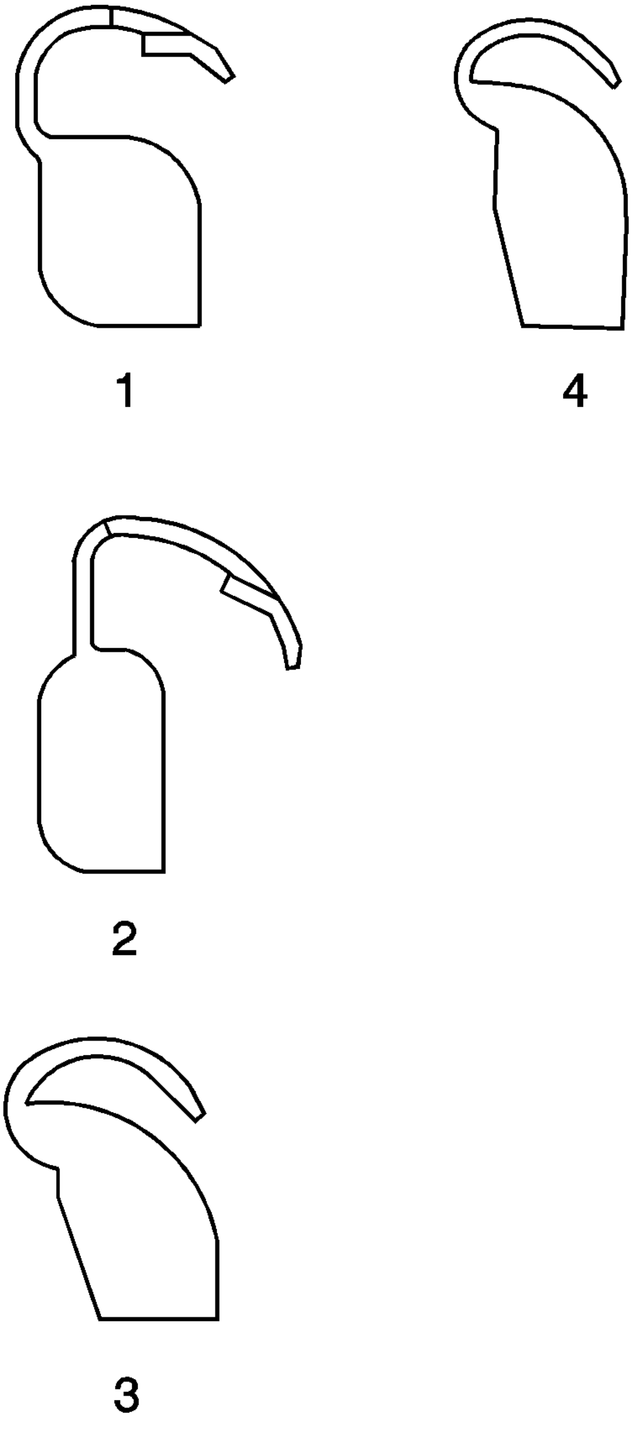


Fig. 20: Clip-On Wheel Weight Types
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When balancing factory aluminum wheels with clip-on wheel balance weights, be sure to use special polyester-coated weights. These coated weights reduce the potential for corrosion and damage to aluminum wheels.**

These coated weights reduce the potential for corrosion and damage to aluminum wheels.

- MC (1) and AW (2) series weights are approved for use on aluminum wheels.
- P (3) series weights are approved for use on steel wheels only.
- T (4) series coated weights are approved for use on both steel and aluminum wheels.

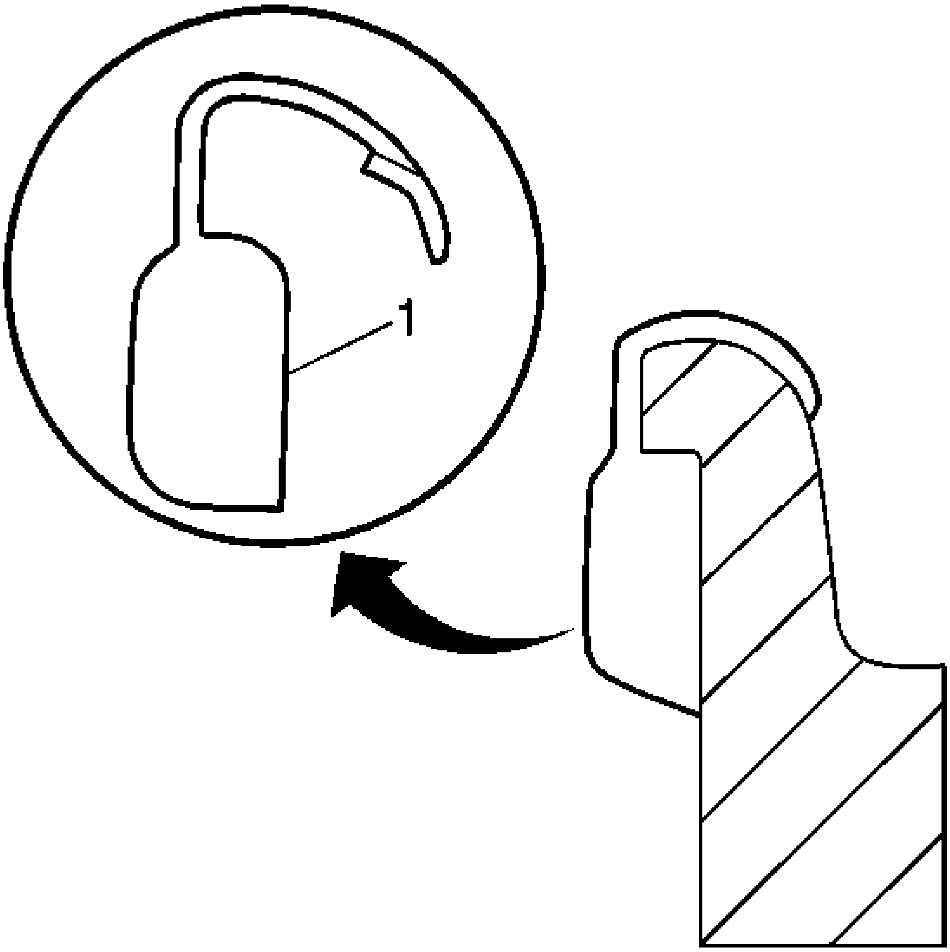


Fig. 21: Attaching Clip-On Wheel Weight
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a nylon or plastic-tipped hammer when installing coated clip-on wheel balance weights to minimize the possibility of damage to the polyester coating.**

The contour and style of the wheel rim flange will determine which type of clip-on wheel weight (1) should be used. The weight should follow the contour of the rim flange. The weight clip should firmly grip the rim flange.

Wheel Weight Placement - Clip-on Weights

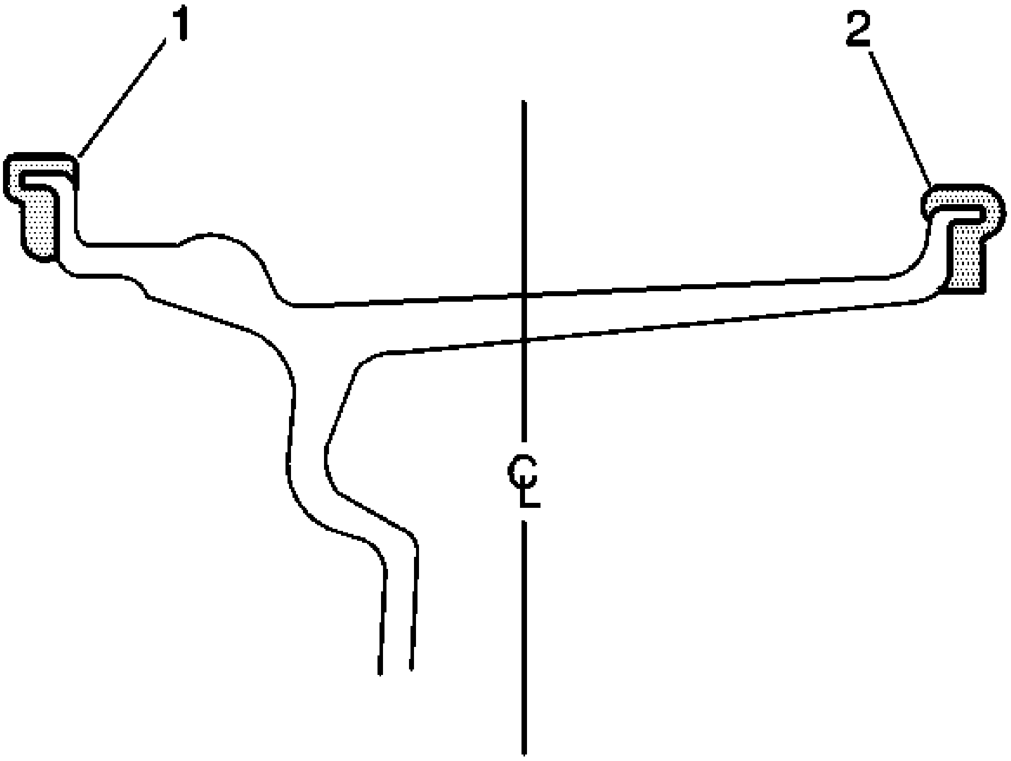


Fig. 22: Clip-On Weight Placement
Courtesy of GENERAL MOTORS COMPANY

When static balancing, locate the wheel balance weights on the inboard flange (2) if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the inboard (2) and outboard (1) flanges.

When dynamic balancing, locate the wheel balance weights on the inboard (2) and outboard (1) rim flanges at the positions specified by the wheel balancer.

Adhesive Weights

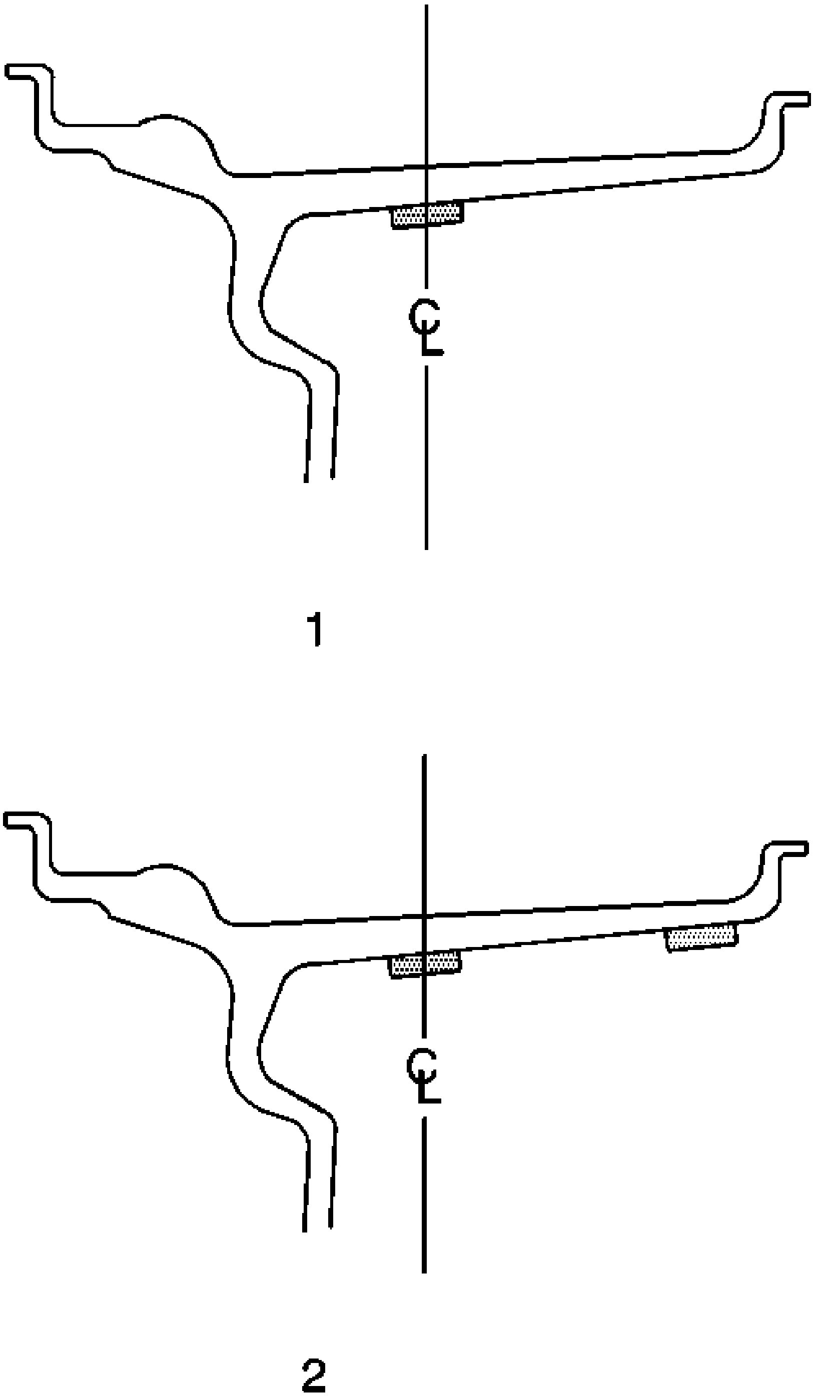


Fig. 23: Adhesive Weight Wheel Placement
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing adhesive balance weights on flangeless wheels, do NOT install the weight on the outboard surface of the rim.**

Adhesive wheel balance weights may be used on factory aluminum wheels. Perform the following procedure to install adhesive wheel balance weights.

1. Determine the correct areas for placement of the wheel weights on the wheel.
    - When static balancing, locate the wheel balance weights along the wheel centerline (1) on the inner wheel surface if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the wheel centerline and the inboard edge of the inner wheel surface (2).
    - When dynamic balancing, locate the wheel balance weights along the wheel centerline and the inboard edge of the inner wheel surface (2) at the positions specified by the wheel balancer.
2. Ensure that there is sufficient clearance between the wheel weights and brake system components.

NOTE: **Do not use abrasives to clean any surface of the wheel.**

3. Using a clean cloth or paper towel with a general purpose cleaner, thoroughly clean the designated balance weight attachment areas of any corrosion, overspray, dirt or any other foreign material.
4. To ensure there is no remaining residue, wipe the balance weight attachment areas again, using a clean cloth or paper towel with a mixture of half isopropyl alcohol and half water.
5. Dry the attachment areas with hot air until the wheel surface is warm to the touch.
6. Warm the adhesive backing on the wheel balance weights to room temperature.
7. Remove the protective covering from the adhesive backing on the back of the balance weights. DO NOT touch the adhesive surface.
8. Apply the wheel balance weights to the wheel, press into place with hand pressure.
9. Secure the wheel balance weights to the wheel with a 90 N (21 lb) force applied with a roller.

TIRE AND WHEEL ASSEMBLY BALANCING - ON-VEHICLE

Special Tools

EL-38792-A Electronic Vibration Analyzer (EVA) 2

If after following the tire and wheel vibration diagnostic process, some amount of tire and wheel vibration is still evident, an on-vehicle high-speed spin balancer may be used to perform an on-vehicle balance in an attempt to finish balance the tire and wheel assemblies, wheel hubs, brake rotors, brake drums, if equipped, and wheel trim, if equipped, simultaneously. On-vehicle balancing can also compensate for minor amounts of residual runout encountered as a result of mounting the tire and wheel assembly on the vehicle, as opposed to the balance which was achieved on the off-vehicle balancer.

In order to perform an on-vehicle balancing procedure, carefully follow the on-vehicle balancer manufacturer's specific operating instructions and carefully consider the following information before proceeding:

- Vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance.
- When performing an on-vehicle balance, great care must be taken when placing the wheel balance weights on the wheels. If the wheel balance weights are not placed accurately, they can actually induce dynamic imbalance and thus increase the severity of the vibration.
- Inspect the vehicle wheel bearings to ensure that they are in good condition.
- Thoroughly inspect all on-vehicle balancing equipment and ensure that it is fully within the manufacturer's recommended specifications.
- Do not remove the off-vehicle balance weights. The purpose of on-vehicle balance is to fine tune the assembly balance already achieved off-vehicle, not to start over.
- Leave all wheel trim installed whenever possible.
- If the on-vehicle balancer calls for more than 56 g (2 oz) of additional weight, split the weight between the inboard and outboard flanges of the wheel, so as not to upset the dynamic balance of the assembly achieved in the off-vehicle balance. For wheel balance weight information, refer to **Tire and Wheel Assembly Balancing - Off Vehicle**.
- If available, tape-off an area on top of the fenders and the quarter panels, then place the vibration sensor of the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 on the fender or quarter panel above the specific tire and wheel assembly while it is being on-vehicle balanced.

  The **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 will provide a visual indication of the amplitude of the vibration, and the effect that the on-vehicle balance has on it.

TIRE-TO-WHEEL MATCH-MOUNTING (VECTORING)

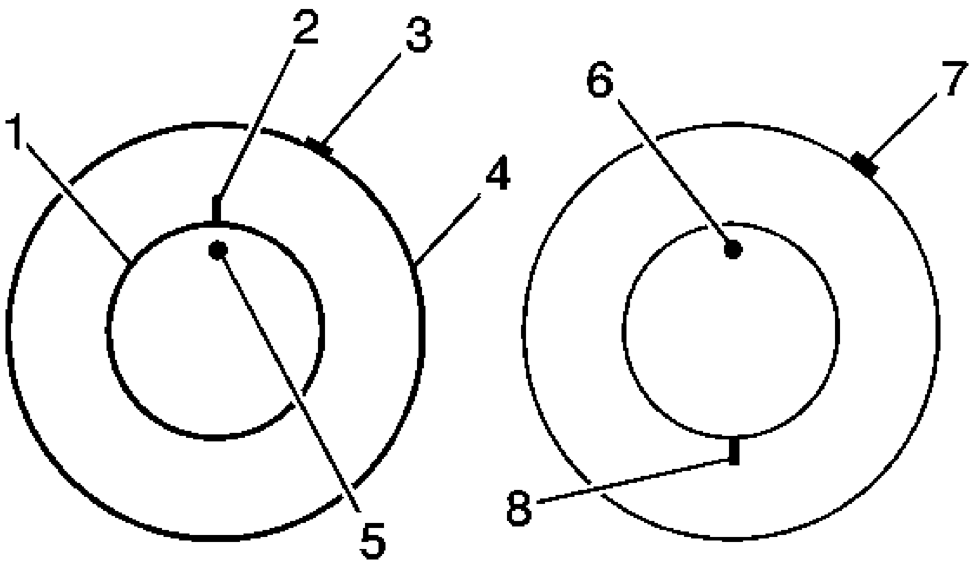


Fig. 24: Tire-to-Wheel Match-Mounting
Courtesy of GENERAL MOTORS COMPANY

NOTE: **After remounting a tire to a wheel or after replacing a tire and/or a wheel, remeasure the tire and wheel assembly runout in order to verify that the amount of runout has been reduced and brought to within tolerances. Ensure that the tire and wheel assembly is properly balanced before reinstalling to the vehicle.**

1. Mark the location of the high spot (3) on the tire as determined during the off-vehicle tire and wheel assembly runout measurement.
2. Place a reference mark (2) on the tire sidewall at the location of the valve stem (5).
    - Always refer to the valve stem as the 12 o'clock position.
    - Refer to the location of the high spot (3) by its clock position on the wheel, relative to the valve stem.
3. Mount the tire and wheel assembly on a tire machine and break down the bead. Do not dismount the tire from the wheel at this time.
4. Rotate the tire 180 degrees on the rim so that the valve stem reference mark (8) is now at the 6 o'clock position in relation to the valve stem (6). You may need to lubricate the bead in order to easily rotate the tire on the wheel.
5. Reinflate the tire and seat the bead properly.
6. Mount the assembly on the tire balancer and remeasure the runout. Mark the new location of the assembly runout high spot on the tire.
7. If the assembly runout has been reduced and is within tolerance, no further steps are necessary. Balance the tire and wheel assembly, then install the assembly to the vehicle. Refer to the following:
    - Tire and Wheel Assembly Balancing - Off Vehicle
    - Tire and Wheel Removal and Installation
8. If the clock location of the high spot remained at or near the original clock location of the high spot (7) and the assembly runout has NOT been reduced, the wheel is the major contributor to the assembly runout concern.

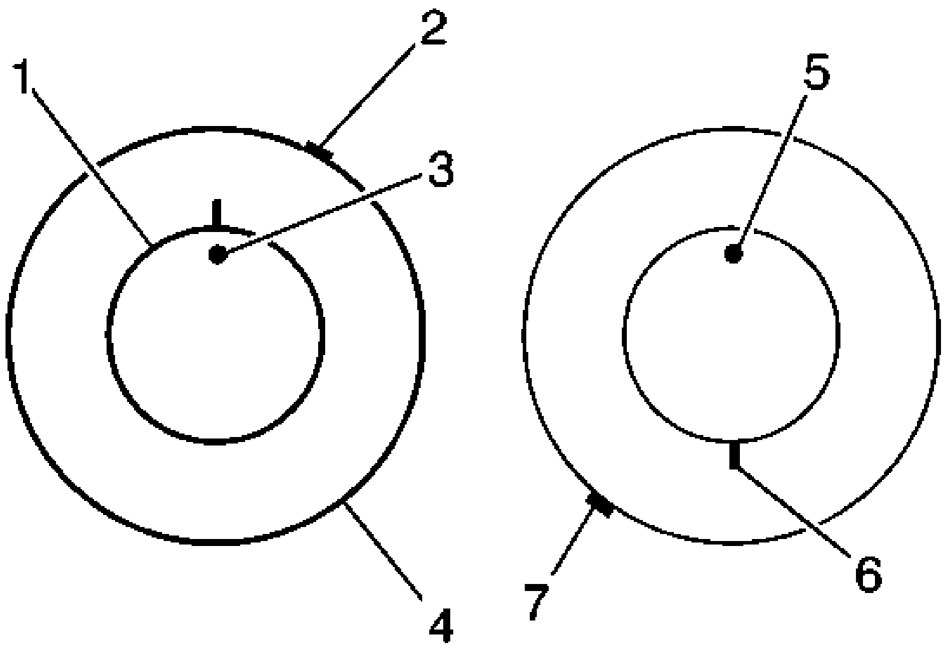


Fig. 25: Match-Mounting Tire-To-Wheel
Courtesy of GENERAL MOTORS COMPANY

9. If the clock location of the high spot has moved, however the assembly runout has NOT been reduced, perform the following steps:
    1. If the clock location of the high spot (7) is now at or near a position 180 degrees from the original clock location of the high spot, the tire is the major contributor to the assembly runout concern.
    2. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and the wheel are both contributing to the assembly runout concern. Rotate the tire an additional 90 degrees in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly runout.

TIRE AND WHEEL ASSEMBLY-TO-HUB/AXLE FLANGE MATCH-MOUNTING

NOTE: **After remounting a tire and wheel assembly to a hub/axle flange, remeasure the tire and wheel assembly on-vehicle runout in order to verify that the amount of runout has been reduced and brought to within tolerances.**

1. Mark the location of the high spot on the tire and wheel assembly as determined during the on-vehicle tire and wheel assembly runout measurement.
2. Place a reference mark on the wheel stud that is located closest to the wheel valve stem.
    - Always refer to the reference mark on the wheel stud as the 12 o'clock position.
    - Refer to the location of the high spot by its clock position on the tire and wheel assembly, relative to the marked wheel stud.
3. Remove the tire and wheel assembly from the hub/axle flange. Refer to Tire and Wheel Removal and Installation .
4. Rotate the tire and wheel assembly as close to 180 degrees as possible on the hub/axle flange, so that the wheel valve stem is now approximately at the 6 o'clock position in relation to the marked wheel stud.
5. Reinstall the wheel lug nuts to secure the tire and wheel assembly in the new position. Refer to Tire and Wheel Removal and Installation .

6. Remeasure the tire and wheel assembly on-vehicle runout. Mark the new location of the assembly on-vehicle runout high spot on the tire. Refer to **Tire and Wheel Assembly Runout Measurement - On-Vehicle**.
7. If the assembly on-vehicle runout has been reduced and is within tolerance, no further steps are necessary.
8. If the assembly runout has NOT been reduced, perform the following steps:
    1. If the clock location of the high spot remained at or near the original clock location of the high spot, the hub/axle flange and/or the brake rotor/drum mounting flange is the major contributor to the assembly on-vehicle runout concern.
    2. If the clock location of the high spot is now at or near a position 180 degrees from the original clock location of the high spot, the tire and wheel assembly is the major contributor to the assembly on-vehicle runout concern.
    3. If the clock location of the high spot is now in-between the 2 extremes, then both the tire and wheel assembly and the hub/axle flange are contributing to the assembly on-vehicle runout concern. Rotate the tire and wheel assembly as close to an additional 90 degrees as possible in both the clockwise and the counterclockwise directions to obtain the lowest amount of assembly on-vehicle runout.

DESCRIPTION AND OPERATION

VIBRATION THEORY AND TERMINOLOGY

Vibration Theory

The designs and engineering requirements of vehicles have undergone drastic changes over the last several years.

Vehicles are stiffer and provide more isolation from road input than they did previously. The structures of today's stiffer vehicles are less susceptible to many of the vibrations which could be present in vehicles of earlier designs, however, vibrations can still be detected in a more modern vehicle if a transfer path is created between a rotating component and the body of the vehicle.

There are not as many points of isolation from the road in many vehicles today. If a component produces a strong enough vibration, it may overcome the existing isolation and the component needs to be repaired or replaced.

The presence/absence of unwanted noise and vibration is linked to the customer's perception of the overall quality of the vehicle.

Vibration is the repetitive motion of an object, back and forth, or up and down. The following components cause most vehicle vibrations:

- A rotating component
- The engine combustion process firing impulses

Rotating components will cause vibrations when excessive imbalance or runout is present. During vibration diagnosis, the amount of allowable imbalance or runout should be considered a TOLERANCE and not a SPECIFICATION. In other words, the less imbalance or runout the better.

Rotating components will cause a vibration concern when they are not properly isolated from the passenger compartment: Engine firing pulses can be detected as a vibration if a motor mount is collapsed.

A vibrating component operates at a consistent rate (km/h, mph, or RPM). Measure the rate of vibration in question. When the rate/speed is determined, relate the vibration to a component that operates at an equal rate/speed in order to pinpoint the source. Vibrations also tend to transmit through the body structure to other components. Therefore, just because the seat vibrates does not mean the source of vibration is in the seat.

Vibrations consist of the following three elements:

- The source - the cause of the vibration
- The transfer path - the path the vibration travels through the vehicle
- The responder - the component where the vibration is felt

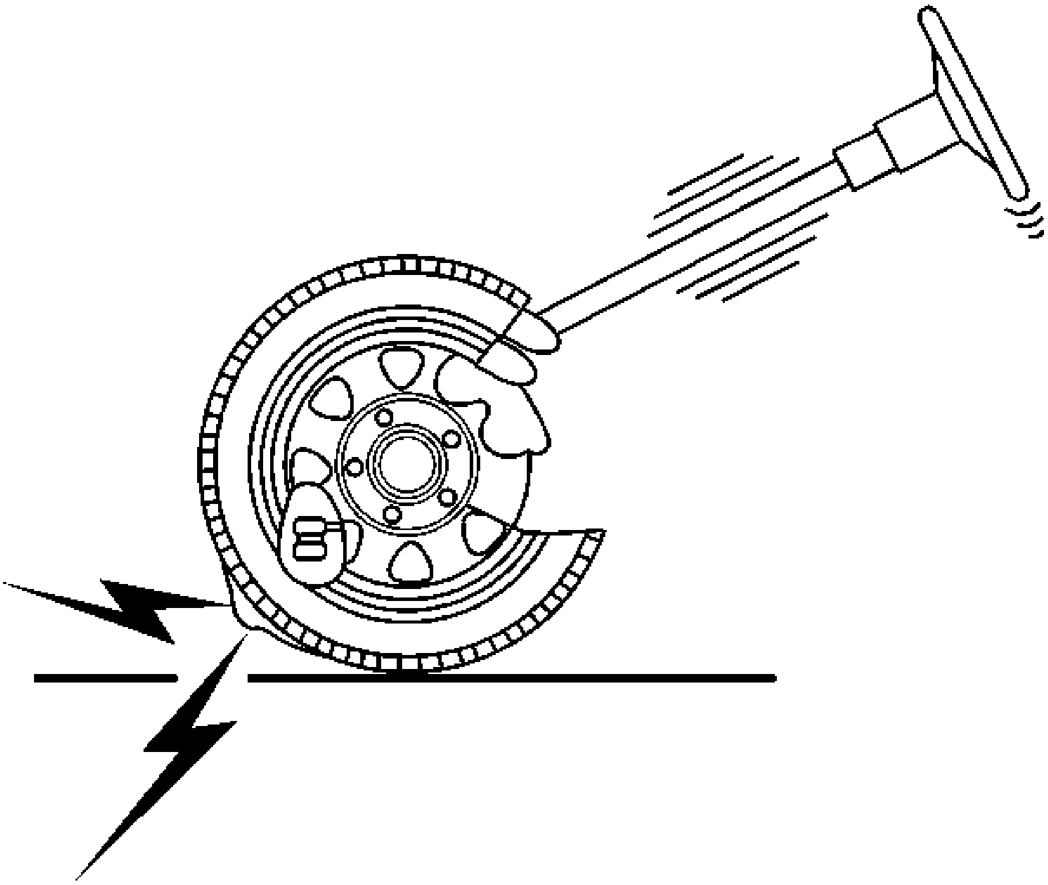


Fig. 26: Unbalanced Tire Vibration
Courtesy of GENERAL MOTORS COMPANY

In the preceding picture, the source is the unbalanced tire. The transfer path is the route the vibrations travels through the vehicle's suspension system into the steering column. The responder is the steering wheel, which the customer reports as vibrating. Eliminating any one of these three elements will usually correct the condition. Decide, from the gathered information, which element makes the most sense to repair. Adding a brace to the steering column may keep the steering wheel from vibrating, but adding a brace is not a practical solution. The most direct and effective repair would be to properly balance the tire.

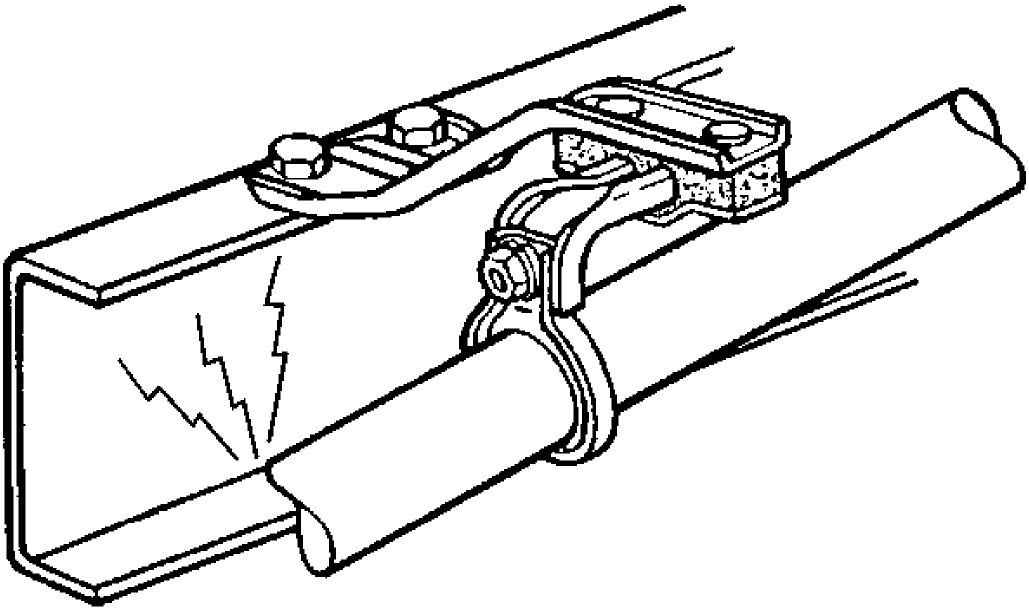


Fig. 27: Exhaust Pipe Noise
Courtesy of GENERAL MOTORS COMPANY

Vibration can also produce noise. As an example, consider a vehicle that has an exhaust pipe grounded to the frame. The source of the vibration is the engine firing impulses traveling through the exhaust. The transfer path is a grounded or bound-up exhaust hanger. The responder is the frame. The floor panel vibrates, acting as a large speaker, which produces noise. The best repair would be to eliminate the transfer path. Aligning the exhaust system and correcting the grounded condition at the frame would eliminate the transfer path.

Basic Vibration Terminology

The following are the 2 primary components of vibration diagnosis:

- The physical properties of objects
- The object's properties of conducting mechanical energy

The repetitive up and down or back and forth movement of a component cause most customer vibration complaints. The following are the common components that vibrate:

- The steering wheel
- The seat cushion
- The frame
- The IP

Vibration diagnosis involves the following simple outline:

1. Measure the repetitive motion and assign a value to the measurement in cycles per second or cycles per minute.
2. Relate the frequency back on terms of the rotational speed of a component that is operating at the same rate or speed.

3. Inspect and test the components for conditions that cause vibration.

For example, performing the following steps will help demonstrate the vibration theory:

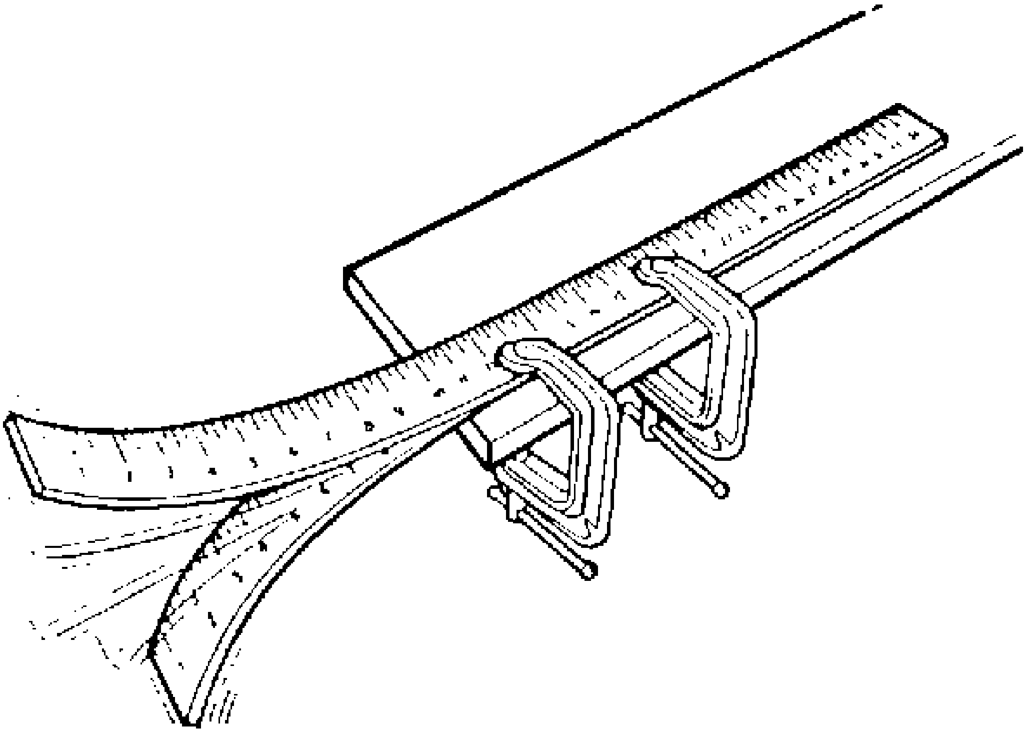


Fig. 28: Demonstrating Vibration Theory
Courtesy of GENERAL MOTORS COMPANY

1. Clamp a yardstick to the edge of a table, leaving about 50 cm (20 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The motion of the stick occurs in repetitive cycles. The cycle begins at midpoint, continues through the lowest extreme of travel, then back past the midpoint, through the upper extreme of travel, and back to the midpoint where the cycle begins again.

The cycle occurs over and over again at the same rate, or frequency. In this case, about 10 cycles in one second. If we measure the frequency to reflect the number of complete cycles that the yardstick made in one minute, the measure would be 10 cycles x 60 seconds = 600 cycles per minute (cpm).

We have also found a specific amount of motion, or amplitude, in the total travel of the yardstick from the very top to the very bottom. Redo the experiment as follows:

1. Reclamp the yardstick to the edge of a table, leaving about 25 cm (10 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The stick vibrates at a much faster frequency: 30 cycles per second (1, 800 cycles per minute).

Cycle

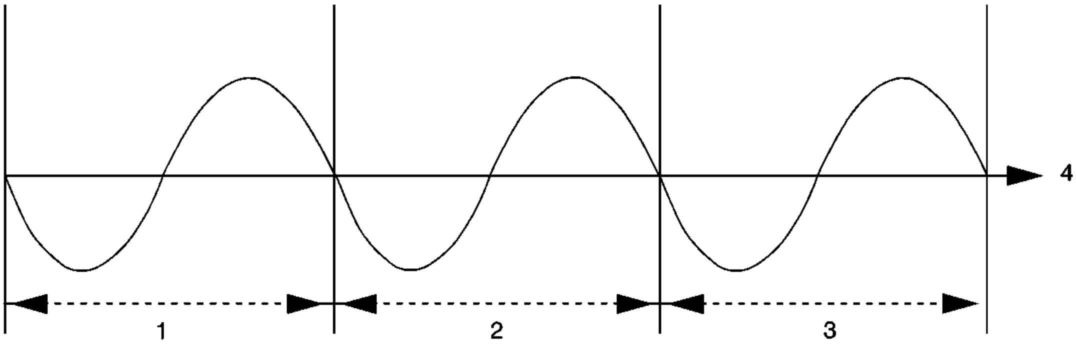


Fig. 29: Powertrain Vibration Cycles
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	1st Cycle
2	2nd Cycle
3	3rd Cycle
4	Time

Vibration Cycles in Powertrain Components

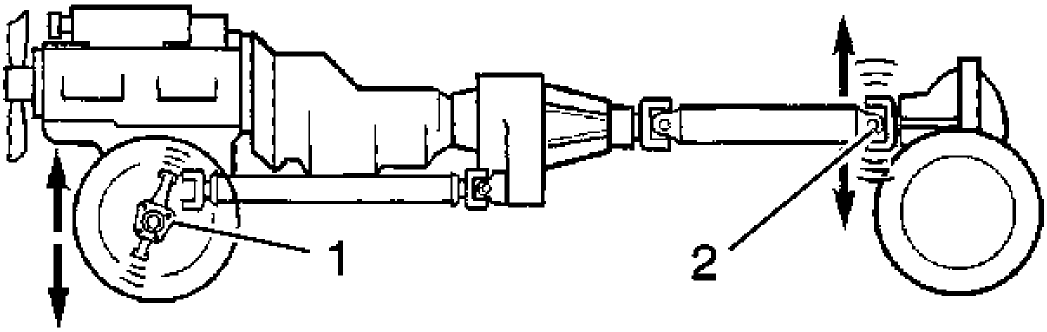


Fig. 30: Vibration Cycles In Powertrain Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Spindle
2	Pinion Nose

The word cycle comes from the same root as the word circle. A circle begins and ends at the same point, as thus, so does a cycle. All vibrations consist of repetitive cycles.

Frequency

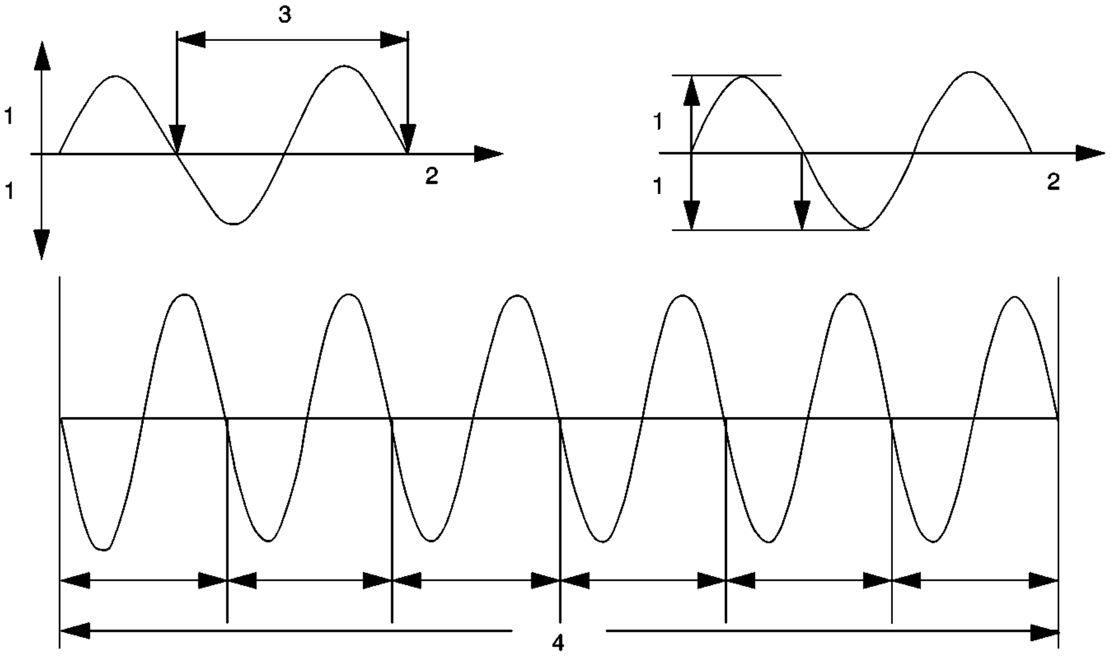


Fig. 31: Vibration Frequency
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Amplitude
2	Reference
3	Time in Seconds
4	1 Second

Frequency is defined as the rate at which an event occurs during a given period of time. With a vibration, the event is a cycle, and the period of time is 1 second. Thus, frequency is expressed in cycles per second.

The proper term for cycles per seconds is Hertz (Hz). This is the most common way to measure frequency. Multiply the Hertz by 60 to get the cycles or revolutions per minute (RPM).

Amplitude

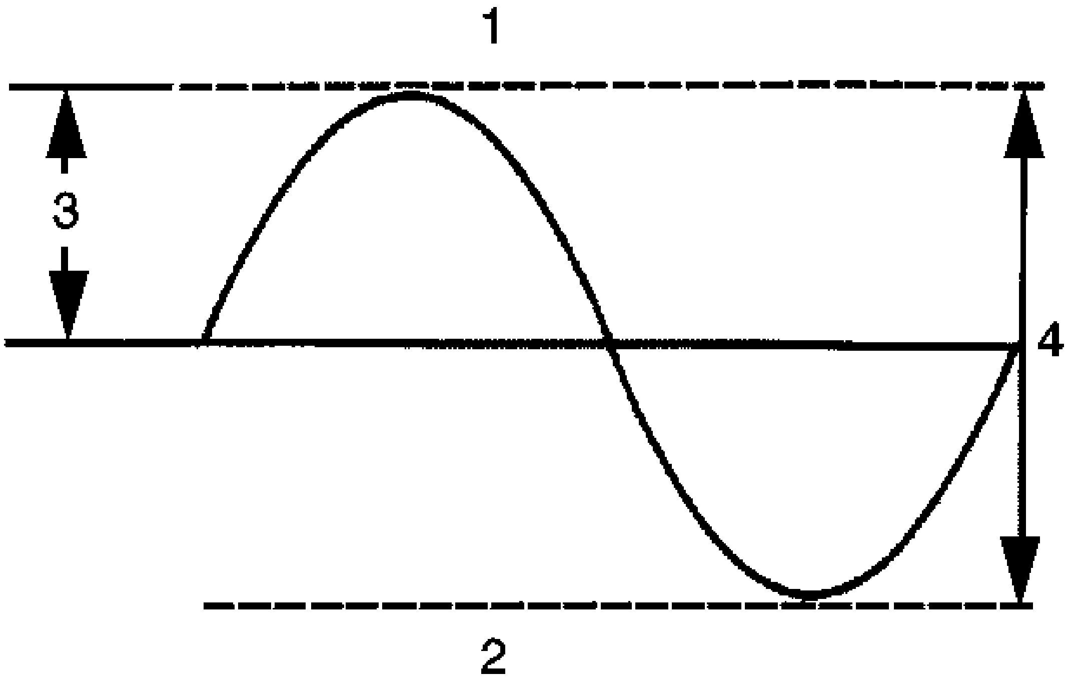


Fig. 32: Vibration Amplitude
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Maximum
2	Minimum
3	Zero-to-Peak Amplitude
4	Peak-to-Peak Amplitude

Amplitude is the maximum value of a periodically varying quantity. Used in vibration diagnostics, we are referring it to the magnitude of the disturbance. A severe disturbance would have a high amplitude; a minor disturbance would have a low amplitude.

Amplitude is measured by the amount of actual movement, or the displacement. For example, consider the vibration caused by an out-of-balance wheel at 80 km/h (50 mph) as opposed to 40 km/h (25 mph). As the speed increases, the amplitude increases.

Free Vibration

Free vibration is the continued vibration in the absence of any outside force. In the yardstick example, the yardstick continued to vibrate even after the end was released.

Forced Vibration

Forced vibration is when an object is vibrating continuously as a result of an outside force.

Centrifugal Force Due to an Imbalance

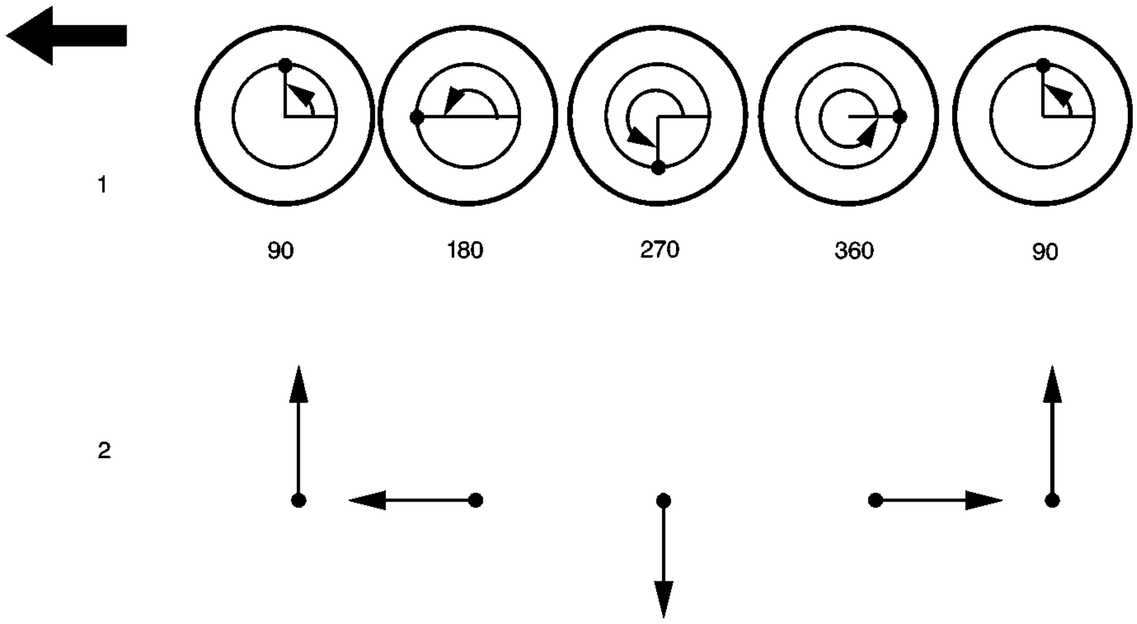


Fig. 33: Centrifugal Force Components
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Location of Imbalance (Degrees)
2	Centrifugal Force Acting on Spindle

A spinning object with an imbalance generates a centrifugal force. Performing the following steps will help to demonstrate centrifugal force:

1. Tie a nut to a string.
2. Hold the string. The nut hangs vertically due to gravity.
3. Spin the string. The nut will spin in a circle.

Centrifugal force is trying to make the nut fly outward, causing the pull you feel on your hand. An unbalanced tire follows the same example. The nut is the imbalance in the tire. The string is the tire, wheel, and suspension assembly. As the vehicle speed increases, the disturbing force of the unbalanced tire can be felt in the steering wheel, the seat, and the floor. This disturbance will be repetitive (Hz) and the amplitude will increase. At higher speeds, both the frequency and the amplitude will increase. As the tire revolves, the imbalance, or the centrifugal force, will alternately lift the tire up and force the tire downward, along with the spindle, once for each revolution of the tire.

Natural or Resonant Frequency

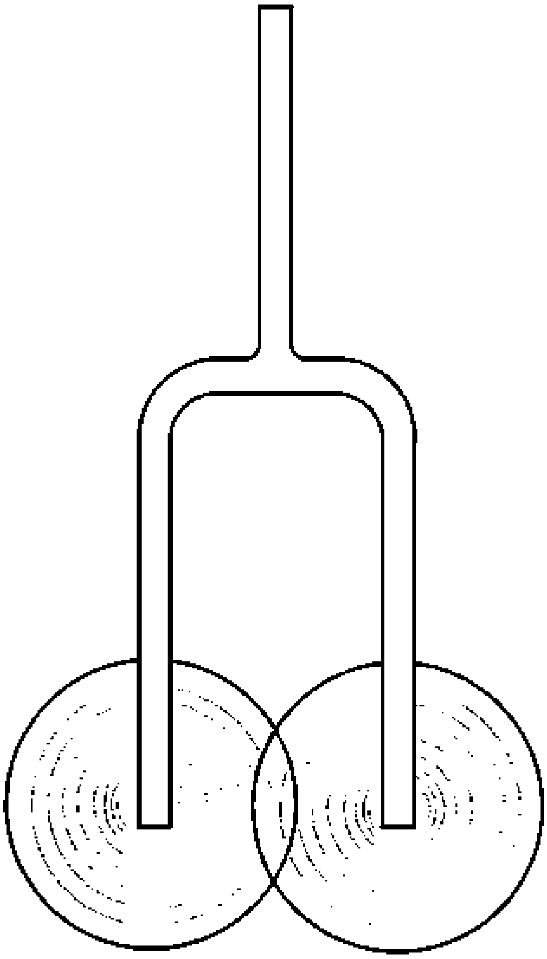


Fig. 34: Natural Frequency
Courtesy of GENERAL MOTORS COMPANY

The natural frequency is the frequency at which an object tends to vibrate. Bells, guitar strings, and tuning forks are all examples of objects that tend to vibrate at specific frequencies when excited by an external force.

Suspension systems, and even engines within the mounts, have a tendency to vibrate at certain frequencies. This is why some vibration complaints occur only at specific vehicle speeds or engine RPM.

The stiffness and the natural frequency of a material have a relationship. Generally, the stiffer the material, the higher the natural frequency. The opposite is also true. The softer a material, the lower the natural frequency. Conversely, the greater the mass, the lower the natural frequency.

Resonance

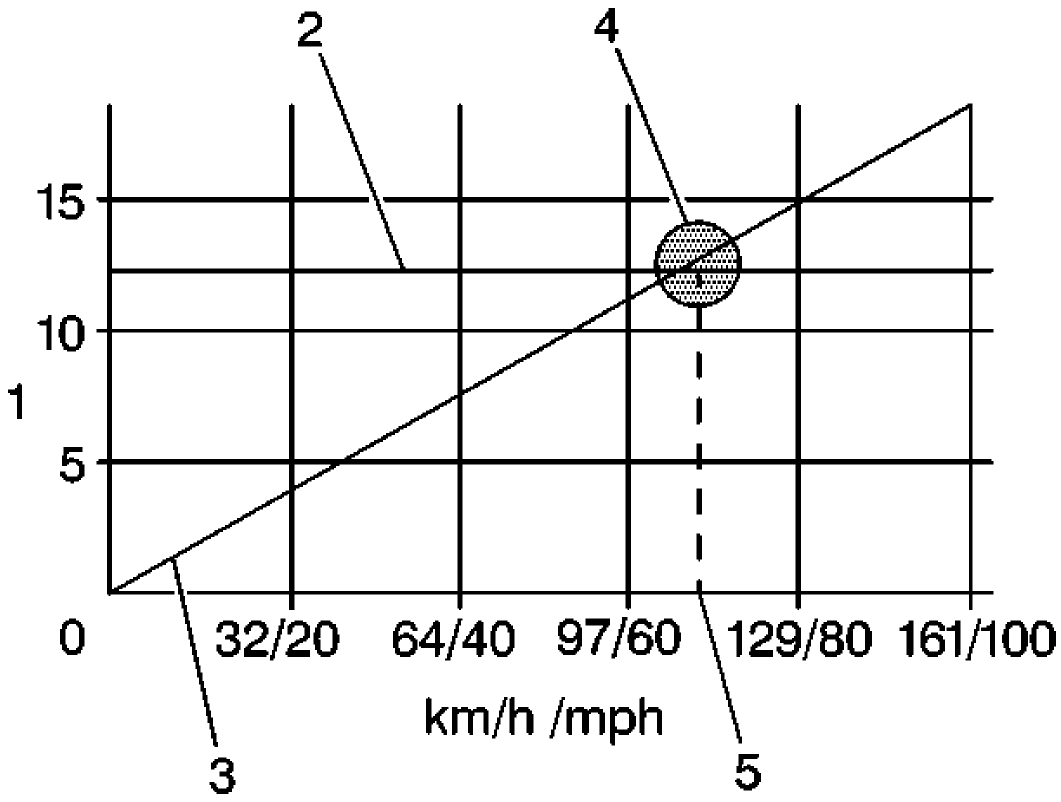


Fig. 35: Natural Frequency Of A Typical Automotive Front Suspension
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Frequency - cps
2	Suspension Frequency
3	Unbalanced Excitation
4	Point of Resonance
5	Problem Speed

All objects have natural frequencies. The natural frequency of a typical automotive front suspension is in the 10 - 15 Hz range. This natural frequency is the result of the suspension design. The suspension's natural frequency is the same at all vehicle speeds. As the tire speed increases along with the vehicle speed, the disturbance created by the tire increases in frequency. Eventually, the frequency of the unbalanced tire will intersect with the natural frequency of the suspension. This causes the suspension to vibrate. The intersecting point is called the resonance.

The amplitude of a vibration will be greatest at the point of resonance. While the vibration may be felt above and below the problem speed, the vibration may be felt the most at the point of resonance.

Damping

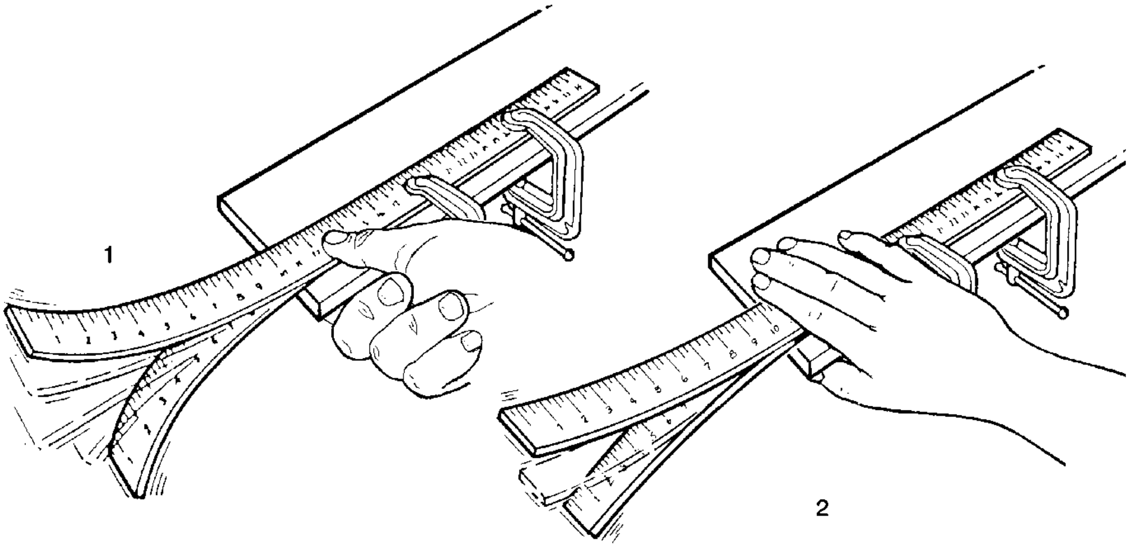


Fig. 36: Low & High Damping
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Low Damping
2	High Damping

Damping is the ability of an object or material to dissipate or absorb vibration. The automotive shock absorber is a good example. The function of the shock absorber is to absorb or dampen the oscillations of the suspension system.

Beating (Phasing)

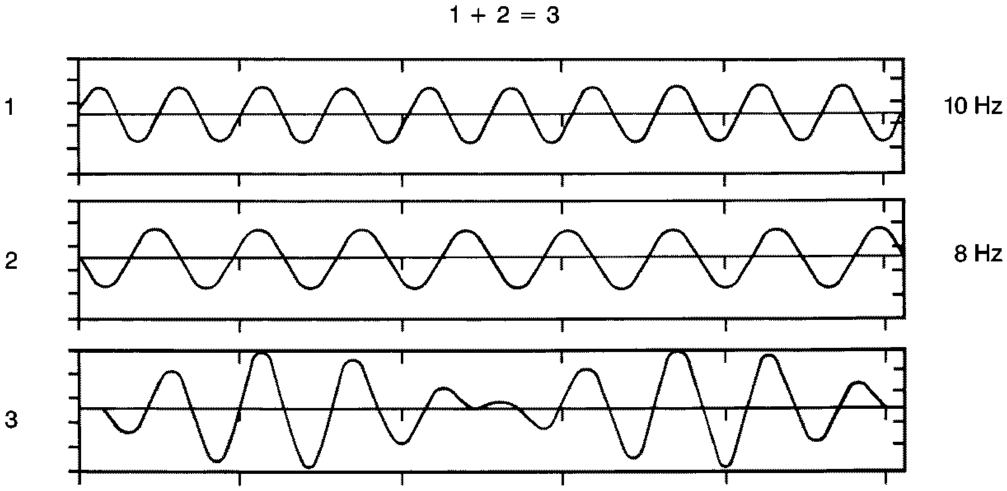


Fig. 37: Beating Or Phasing
Courtesy of GENERAL MOTORS COMPANY

Two separate disturbances that are relatively close together in frequency will lead to a condition called beating, or phasing. A beating vibration condition will increase in intensity or amplitude in a repetitive fashion as the vehicle travels at a steady speed. This beating vibration can produce the familiar droning noise heard in some vehicles.

Beating occurs when 2 vibrating forces are adding to each other's amplitude. However, 2 vibrating forces can also subtract from each other's amplitude. The adding and subtracting of amplitudes in similar frequencies is called beating. In many cases, eliminating either one of the disturbances can correct the condition.

Order

Order refers to how many times an event occurs during 1 revolution of a rotating component.

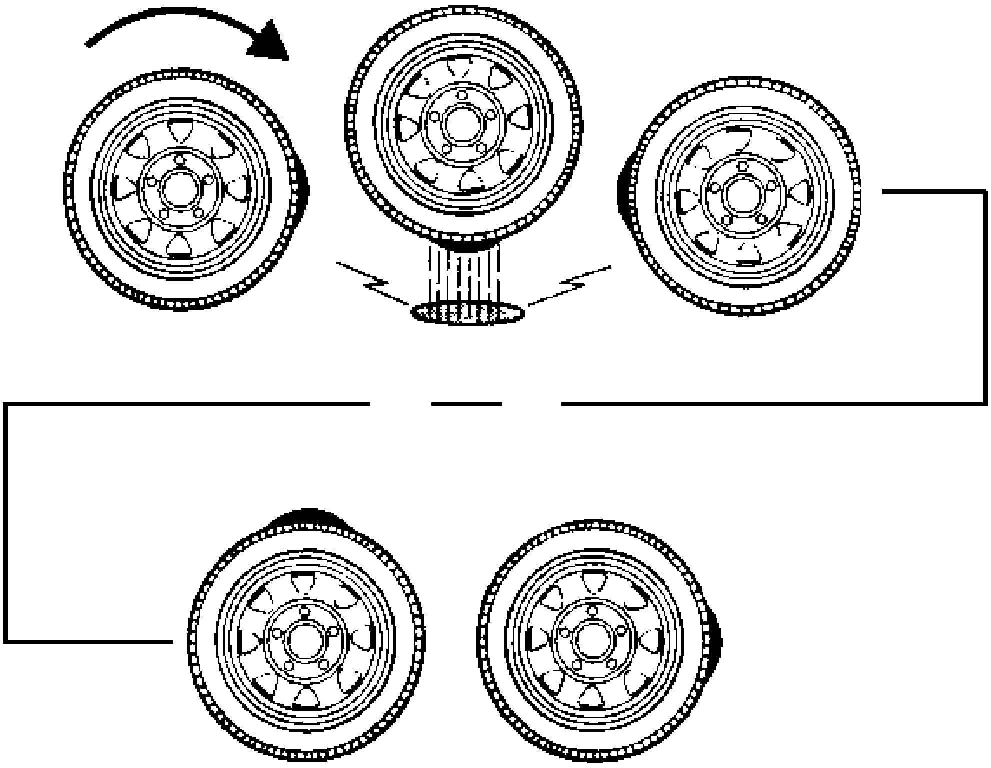


Fig. 38: First-Order Vibration
Courtesy of GENERAL MOTORS COMPANY

For example, a tire with 1 high spot would create a disturbance once for every revolution of the tire. This is called first-order vibration.

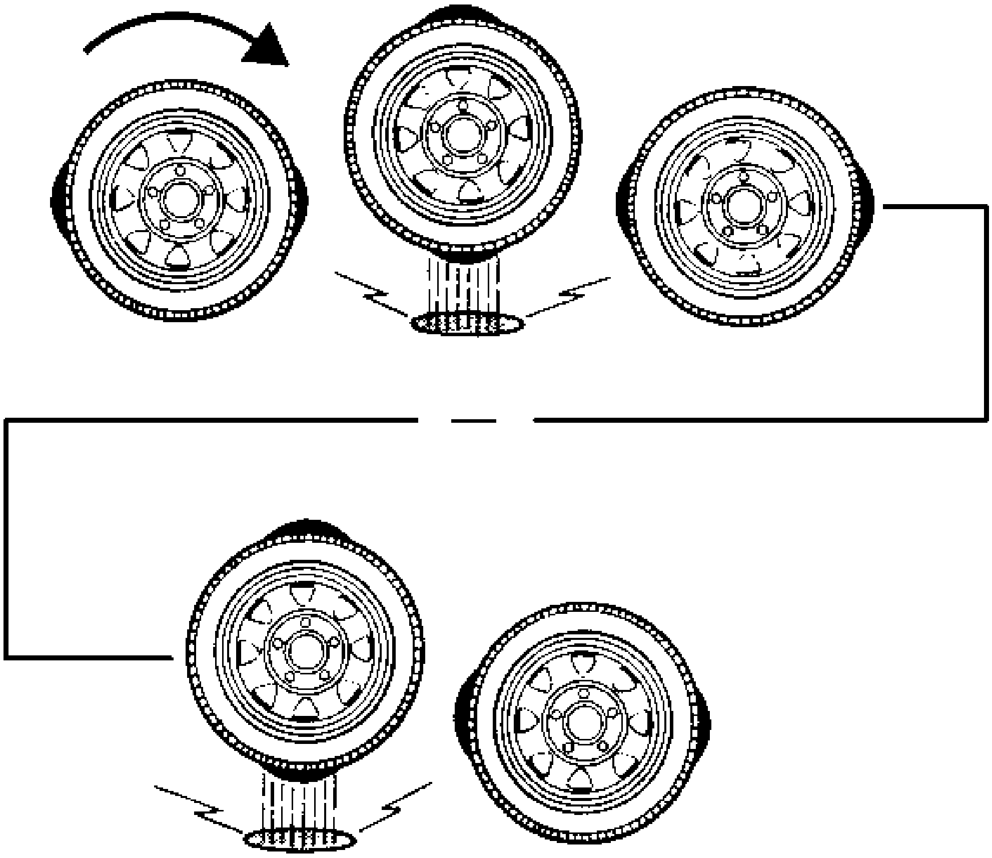


Fig. 39: Second-Order Vibration
Courtesy of GENERAL MOTORS COMPANY

An oval-shaped tire with 2 high spots would create a disturbance twice for every revolution. This is called second-order vibration. Three high spots would be third-order, and so forth. Two first-order vibrations may add or subtract from the overall amplitude of the disturbance, but that is all. Two first-order vibrations do not equal a second-order. Due to centrifugal force, an unbalanced component will always create at least a first-order vibration.

ELECTRONIC VIBRATION ANALYZER (EVA) DESCRIPTION AND OPERATION

Special Tools

- **EL-38792-25** Inductive Pickup Timing Light
- **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2)

For equivalent regional tools, refer to Special Tools and Equipment.

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2), is a 12 - volt powered hand-held device, similar to a scan tool, which receives input from an attached vibration sensor or accelerometer and displays the most dominate input frequency(ies) (up to three) on its liquid crystal display. The vibration concern frequency(ies) are obtained through the use of the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) while following the Vibration Analysis Diagnostic Tables. The frequency(ies) obtained, when applied to the Vibration Analysis Diagnostic Tables, are used as a primary input to help determine the source of the vibration concern.

EVA Vibration Sensor

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor incorporates a 6.1 m (20 ft) cord, that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt.

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) contains 2 sensor input ports which can be activated individually to allow for 2 individual vibration sensor inputs. The vibration sensors can then be placed in 2 different locations in the vehicle and their individual inputs can be read without having to stop a test, move the sensor and resume the test. The use of 2 vibration sensors can help in more quickly finding and recording an accurate frequency of the vibration concern, and in more quickly making comparisons between 2 different areas of a single component, or a vehicle system, during the diagnostic process.

EVA Vibration Sensor Placement

Proper placement of the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor (accelerometer) is critical to ensure that proper vibration readings are obtained by the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2). The vibration sensor should be placed on the specific vehicle component identified as being the most respondent to the vibration. If no component has been identified, install the sensor to the steering column as a starting point.

EVA Vibration Sensor-to-Component Attachment

NOTE: **The EL-38792-A Electronic Vibration Analyzer 2 (EVA 2) vibration sensor must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.**

The vibration sensor of the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) is designed to pickup disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor is therefore directional sensitive and must be attached to vehicle components such that the side of the sensor marked UP is always facing upright and the sensor body is as close to horizontal as possible. The sensor must be installed in the exact same position each time tests are repeated or comparisons are made to other vehicles.

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor can be attached to vehicle components in various ways. For non-ferrous surfaces, such as the shroud of a steering column, the sensor can be attached using putty, or hook and loop fasteners. For ferrous surfaces, the sensor can be attached using a magnet supplied with the sensor.

EVA Software Cartridge

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) uses a software cartridge, the GE-38792-60, which provides various information to the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2). The GE-38792-60 provides the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) with an additional feature which can be selected and utilized to assist in diagnosing vibration concerns.

NOTE: **The Auto-Mode function of the EL-38792-A Electronic Vibration Analyzer 2 (EVA 2) cartridge, GE-38792-60, is designed to be used in SUPPORT of the Vibration Analysis Diagnostic Tables ONLY.**

This support-feature is available through the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) Auto-Mode function. When selected, the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) will prompt the user to select which one of 2 vehicle systems (vehicle speed or engine speed), is the SUSPECTED source of the vibration concern. Using the inputted vehicle data parameters along with the most dominate vibration frequency obtained, it will identify a SUSPECTED source of the vibration concern, such as first-order tire and wheel. This can be a useful feature when used in conjunction with the Vibration Analysis Diagnostic Tables, to confirm results obtained through the diagnostic process.

EVA Smart Strobe Function

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) can be used to identify some rotating components/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, **EL-38792-25** Inductive Pickup Timing Light, or equivalent included with the GE-38792-25 - KIT, or available separately. Using the Smart Strobe function enables the user to input the vibration frequency to which the strobe will flash. By marking the suspected rotating component, such as a pulley, adjusting the strobe frequency to match the dominant vibration frequency at the engine RPM noted during diagnosis, and then operating the engine at that specific RPM, the mark on the object will appear to be stationary if that object is imbalanced.

EVA Strobe Balancing Function

The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) can be used to identify the light spot on a propeller shaft IF the propeller shaft rotational speed is the dominant frequency of the vibration concern. The **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) is equipped with a strobe light trigger wire which can be used with an inductive pickup timing light, **GE-38792-25** Inductive Pickup Timing Light, or equivalent included with the J-38792-25 - KIT, or available separately, and in conjunction with the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor to identify the light spot on a propeller shaft and to help in making a determination as to when propeller shaft balance is obtained.

Averaging/Non-Averaging Modes

The EVA provides 2 modes of displaying the most dominate frequencies which the EVA vibration sensor (accelerometer) detects; averaging and non-averaging (instantaneous).

The averaging mode uses multiple vibration samples taken over a period of time and then displays the most dominant frequencies which have been averaged-out. Using the averaging mode minimizes the distractions caused by a sudden vibration frequency being displayed that is not related to the concern vibration, such as from pot holes or from uneven road surfaces.

The non-averaging (instantaneous) mode is more sensitive to vibration disturbances than the averaging mode. Using the non-averaging mode will generate instantaneous frequency displays which are not averaged across multiple samples over a period of time; the specific vibration frequencies that occur at a specific moment during diagnostic testing will be displayed at that moment. The non-averaging (instantaneous) mode is useful when measuring a vibration disturbance that exists for only a short period of time or during acceleration/deceleration testing.

When operating the EVA in the averaging mode along with the Auto Mode, "A" will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the averaging mode and the Manual Mode, "AVG" will be displayed along the top center of the screen.

When operating the EVA in the non-averaging (instantaneous) mode along with the Auto Mode, "I" will be displayed along the top of the screen to the left of the vibration sensor input port being used. When operating the EVA in the non-averaging (instantaneous) mode and the Manual Mode, the top center of the screen will be blank.

EVA Display

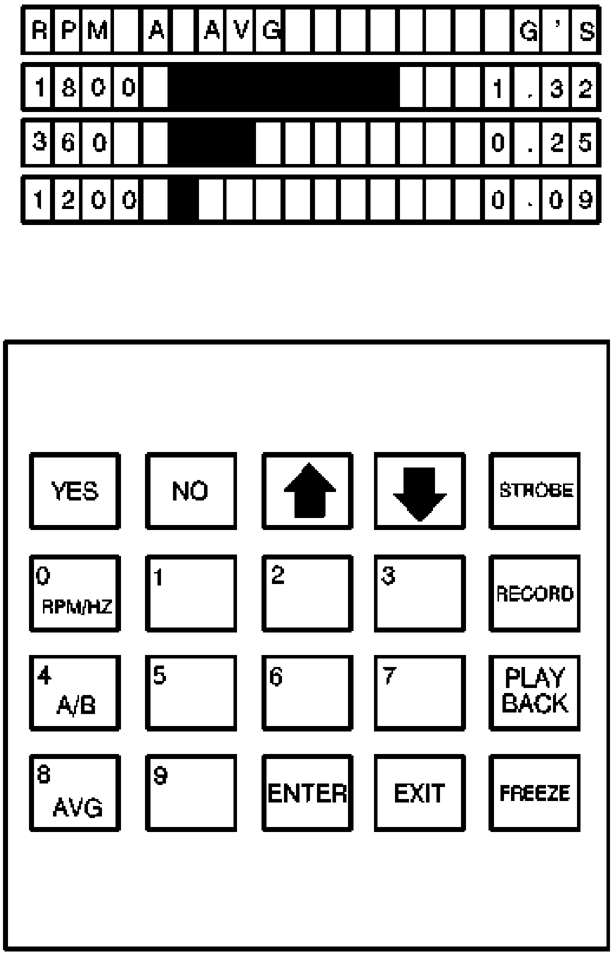


Fig. 40: EVA Display
Courtesy of GENERAL MOTORS COMPANY

The most dominant input frequencies, up to three, received from the **EL-38792-A** Electronic Vibration Analyzer 2 (EVA 2) vibration sensor, are displayed in descending order of amplitude strength.

The frequency readings are displayed along the left side of the screen, followed to the right by either a bar graph or the suspected source of the vibration - depending upon the mode selected, then the amplitude reading for each frequency along the right side of the screen. The top row of the screen indicates the units of measure being displayed for the frequencies along the left side and for the amplitudes along the right side. The top row also indicates the vibration sensor input port which was selected on the keypad (A or B) and which mode was selected: averaging or non-averaging (instantaneous).

The frequency(ies) can be displayed in either revolutions per minute (RPM) or revolutions per second; Hertz (Hz). The selected display type (RPM or Hz) will be indicated at the left side of the screen, above the frequency readings.

When the AUTO MODE function is not in use, a bar graph is displayed next to each frequency to provide a quick visual indication of the relative amplitude strength.

When the AUTO MODE function is being used, the suspected source of the vibration is displayed next to each frequency to provide support to the diagnostic process.

The actual amplitude strength of each frequency is displayed at the right side of the screen and shown in G's-of-acceleration force.

OSCILLOSCOPE DIAGNOSTIC KIT DESCRIPTION AND OPERATION

Special Tools

- **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH)
- **EL-47966** Multi Diagnostic Interface MDI

For equivalent regional tools, refer to Special Tools and Equipment.

The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) is an automotive oscilloscope which receives input from an attached accelerometer and displays all input frequencies on a laptop or tablet computer. The vibration concern frequency(ies) are obtained through the use of the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) hardware, while vehicle component speed data is gathered through the **EL-47966** Multi Diagnostic Interface MDI. The MDI data is integrated into the Oscilloscope software so that vibration(s) can be tied to specific vehicle components based on their speed to determine the source of the vibration concern.

Oscilloscope Inputs

The **CH-51450-TA183** accelerometer incorporates a 3 m (9.8 ft) cord that allows the sensor to be placed on virtually any component of the vehicle where a vibration concern is felt. The accelerometer uses a self-powered NVH interface module. The NVH interface module uses a replaceable battery. Input B is the default port for a single accelerometer. The cord used to connect the NVH interface module to the **CH-51450-NVH** Oscilloscope is 5 m (16.4 ft) long.

Input D is used for the **CH-51450-TA186** optical tachometer sensor which is used during driveline balancing. It incorporates a 2.5 m (8.2 ft) cord and a 5 m (16.4 ft) cord.

There is also an optional microphone that can be used with the **CH-51450-NVH** Oscilloscope.

Oscilloscope Accelerometer Placement

Proper placement of the **CH-51450-TA183** accelerometer is critical to ensure that proper vibration readings are obtained by the **CH-51450-NVH** Oscilloscope. The accelerometer should be placed on the drivers side inboard seat track. Once a baseline reading has been taken, the accelerometer can be placed on the point of the customer concern to verify what the customer is hearing or feeling.

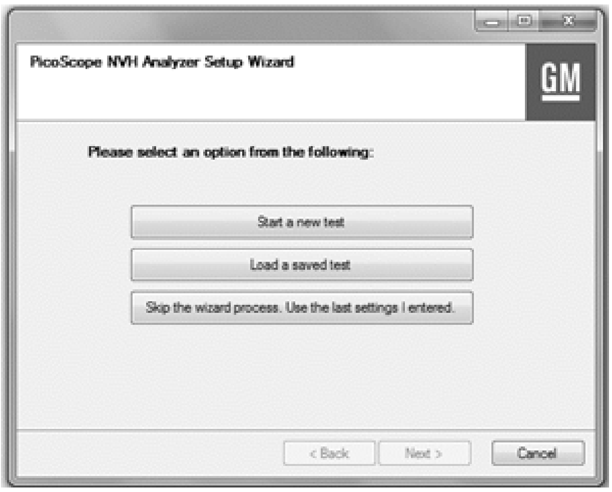
Oscilloscope Accelerometer-to-Component Attachment

NOTE: **The CH-51450-TA183 accelerometer must be attached to vehicle components in the manner indicated in order to achieve accurate frequency readings of the vibration disturbance.**

The accelerometer of the **CH-51450-NVH** Oscilloscope is designed to pick up disturbances which primarily occur in the vertical plane, since most vibrations are felt in that same up-and-down direction. The **CH-51450-TA183** accelerometer is therefore directionally sensitive, and must be attached to vehicle components such that the cord end is always facing upright, and the sensor body is as close to horizontal as possible. The sensor must be installed in the exact same position each time tests are repeated, or comparisons are made to other vehicles.

The **CH-51450-TA183** accelerometer can be attached to vehicle components in various ways. For non-ferrous surfaces, such as the shroud of a steering column, the sensor can be attached using putty, or hook and loop fasteners. For ferrous surfaces, the sensor can be attached using the **CH-51450-TA096** magnet supplied with the sensor. For hard aluminum surfaces, a ferrous washer can be glued on using a cyanoacrylate (super glue) and then the magnet can be used.

NVH Software Set-up


PicoScope NVH Analyzer Setup Wizard
GM

Please select an option from the following:

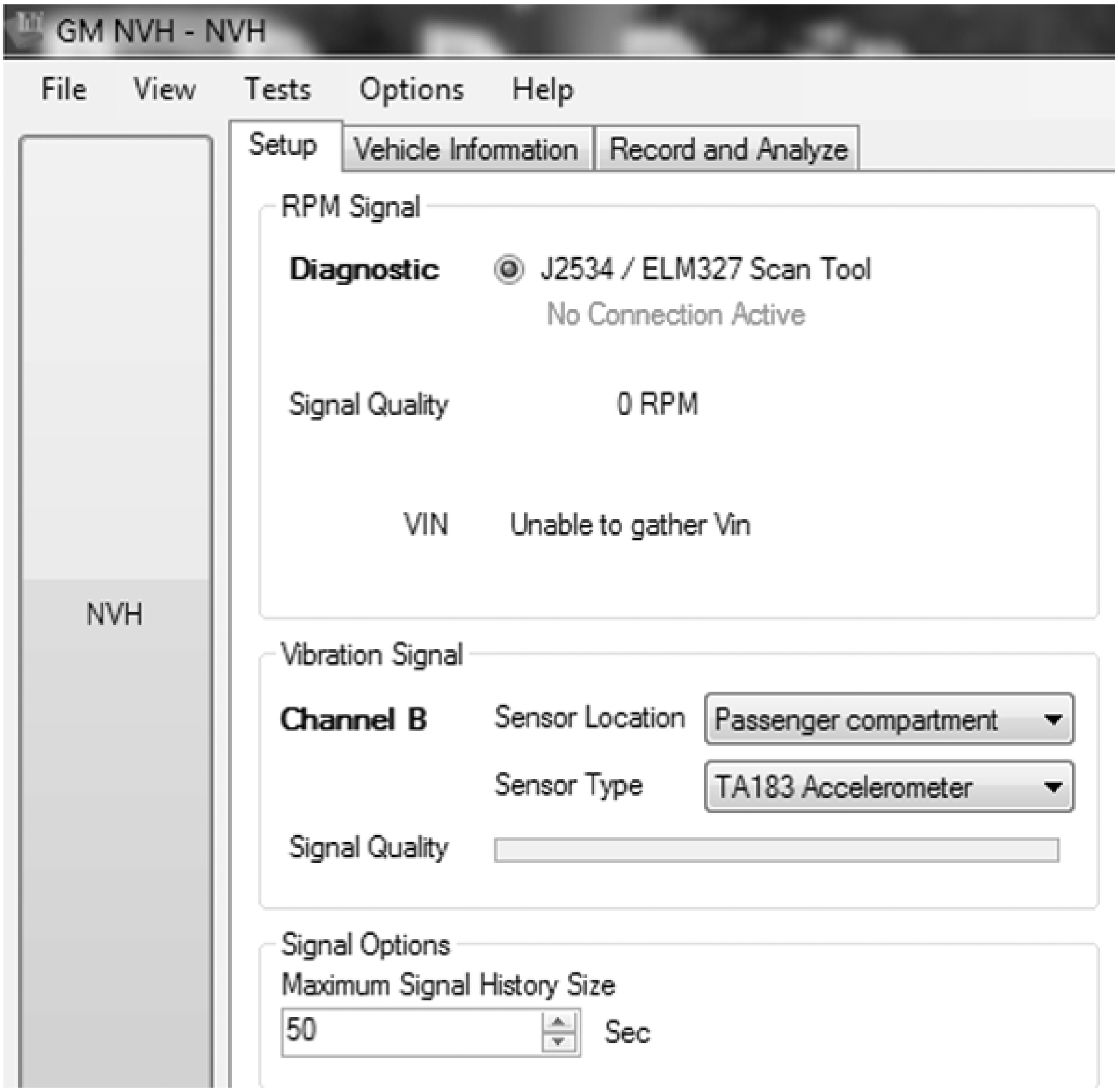
Start a new test
Load a saved test
Skip the wizard process. Use the last settings I entered.
< Back
Next >
Cancel

Fig. 41: NVH Software Set-Up Display Screen
Courtesy of GENERAL MOTORS COMPANY

When the NVH software is first opened and the NVH tab is selected, there is a set-up wizard within the **CH-51450-NVH** NVH software which has a step-by-step guide to ensure the **CH-51450-NVH** Oscilloscope and MDI are connected correctly, and to input the vehicle information.

Oscilloscope NVH Display

The **CH-51450-NVH** Oscilloscope display consists of three tabs:



RPM Signal

Diagnostic ● J2534 / ELM327 Scan Tool

No Connection Active

Signal Quality 0 RPM

VIN Unable to gather Vin

Vibration Signal

Channel B Sensor Location: Passenger compartment

Sensor Type: TA183 Accelerometer

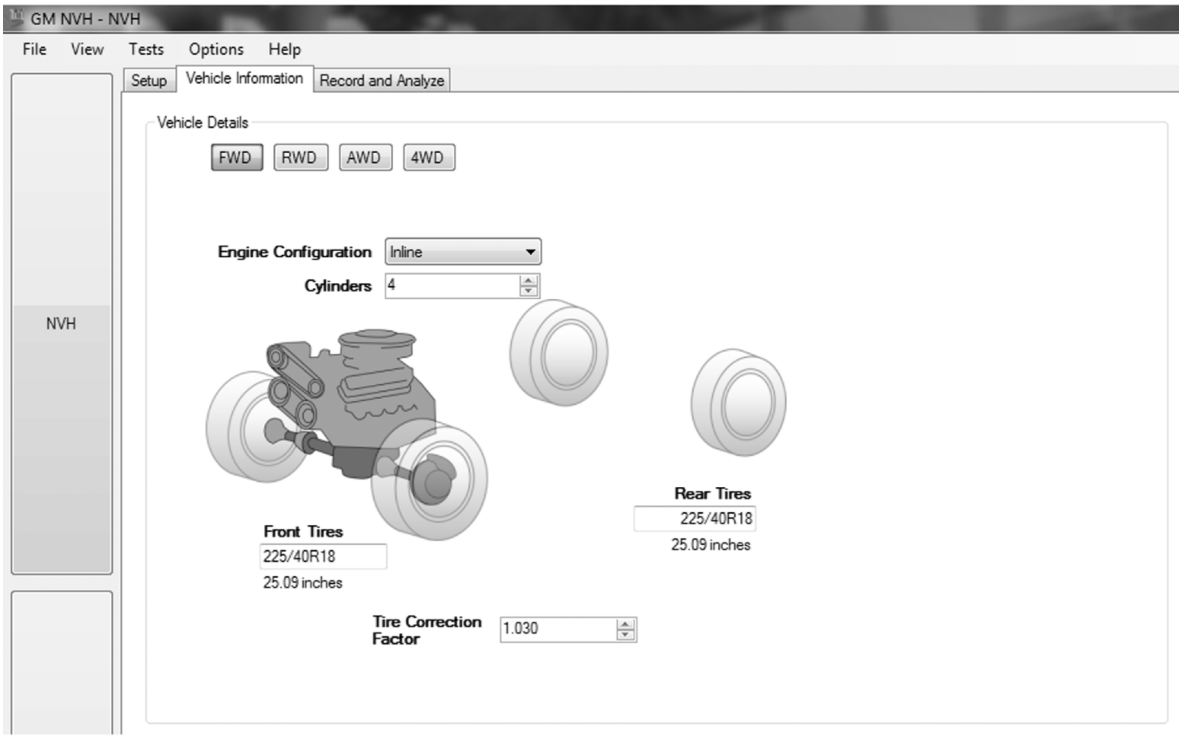
Signal Quality

Signal Options

Maximum Signal History Size: 50 Sec

Fig. 42: Oscilloscope NVH Set-Up Display Screen
Courtesy of GENERAL MOTORS COMPANY

The first tab is set-up. The set-up information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary. A laptop or desktop computer, **EL-47966** Multi Diagnostic Interface MDI, **CH-51450-NVH** Oscilloscope, **CH-51450-TA148** NVH interface, and **CH-51450-TA183** accelerometer are needed to do a vibration analysis.


GM NVH - NVH
File
View
Tests
Options
Help
Setup
Vehicle Information
Record and Analyze
NVH
Vehicle Details
FWD
RWD
AWD
4WD

Engine Configuration: Inline

Cylinders: 4

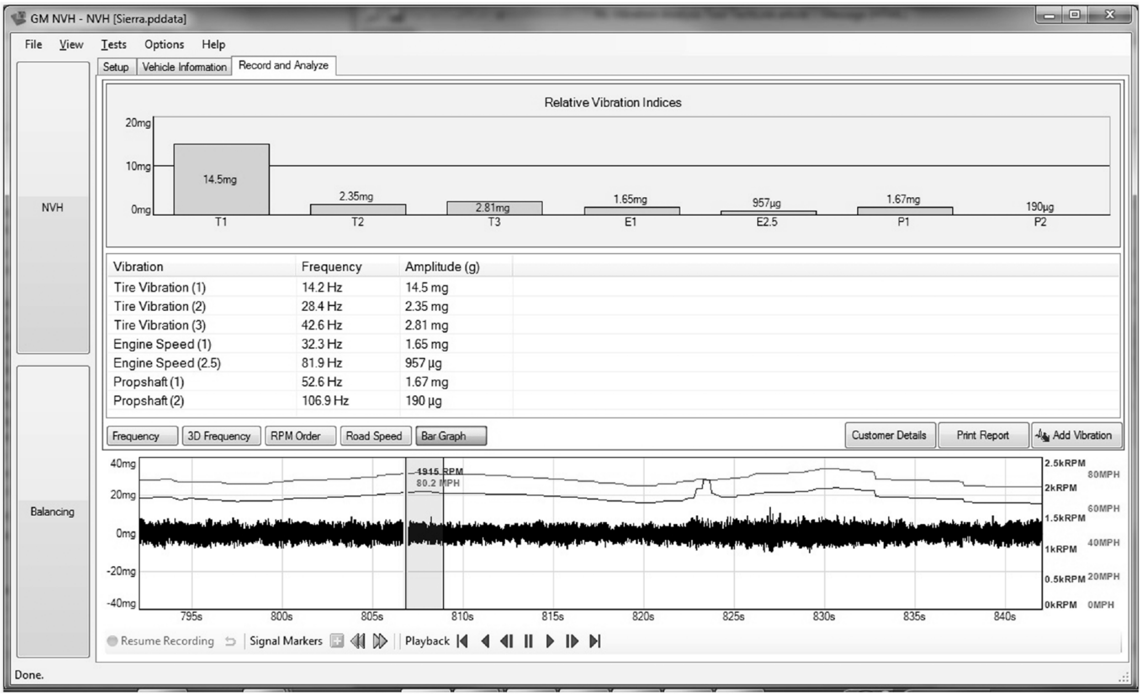
Front Tires: 225/40R18
25.09 inches

Rear Tires: 225/40R18
25.09 inches

Tire Correction Factor: 1.030

Fig. 43: Oscilloscope NVH Vehicle Information Display Screen
Courtesy of GENERAL MOTORS COMPANY

The second tab is vehicle information. The vehicle information can be entered here if not already done through the set-up wizard. It can also be updated here, if necessary.


GM NVH - NVH [Sierra.pddata]
File
View
Tests
Options
Help
Setup
Vehicle Information
Record and Analyze
NVH
Balancing
Relative Vibration Indices
20mg
10mg
0mg
14.5mg
2.35mg
2.81mg
1.65mg
957µg
1.67mg
190µg
T1
T2
T3
E1
E2.5
P1
P2
Frequency
3D Frequency
RPM Order
Road Speed
Bar Graph
Customer Details
Print Report
Add Vibration
40mg
20mg
0mg
-20mg
-40mg
1915 RPM
80.2 MPH
795s
800s
805s
810s
815s
820s
825s
830s
835s
840s
2.5kRPM
2kRPM
1.5kRPM
1kRPM
0.5kRPM
0kRPM
80MPH
60MPH
40MPH
20MPH
0MPH
Resume Recording
Signal Markers
Playback
Done.

Vibration	Frequency	Amplitude (g)
Tire Vibration (1)	14.2 Hz	14.5 mg
Tire Vibration (2)	28.4 Hz	2.35 mg
Tire Vibration (3)	42.6 Hz	2.81 mg
Engine Speed (1)	32.3 Hz	1.65 mg
Engine Speed (2.5)	81.9 Hz	957 µg
Propshaft (1)	52.6 Hz	1.67 mg
Propshaft (2)	106.9 Hz	190 µg

Fig. 44: Oscilloscope NVH Record And Analyze Display Screen
Courtesy of GENERAL MOTORS COMPANY

The third tab is the record and analyze tab. The standard display will show the known input frequencies received from the **CH-51450-TA183** accelerometer as a bar graph at the top of the screen. At the middle of the screen, the input frequencies are listed as text. The frequency(ies) are displayed in Hertz (Hz). If desired, the frequency(ies) can be displayed in RPM by clicking Options, then Advanced Options. The actual amplitude strength of each frequency is displayed and shown in g's of acceleration (expressed to the thousandth of a force of gravity, or "milli-g"). At the bottom of the screen, it also shows a plot of all frequency inputs along with engine speed in blue, and vehicle speed in red. The data can be saved in 50 second increments. The data can then be saved by clicking File, then Save. Files that are saved can then be loaded into the software by clicking File, then Load.

Oscilloscope Balancing

The **CH-51450-NVH** Oscilloscope with balancing software can be used to identify some rotating component/systems which exhibit imbalance IF the component rotational speed is the dominant frequency of the vibration concern. The **CH-51450-NVH** Oscilloscope is used with the **CH-51450-TA186** optical tachometer sensor. The optical tachometer sensor directly measures component rotational speed so a known weight can be added for a baseline reading. Then the oscilloscope will determine where to add a specific amount of weight to the component.

For example, the **CH-51450-NVH** Oscilloscope can be used to balance the driveline on rear wheel drive and all wheel drive vehicles. The methods that can be employed are a tuned weight approach for drivelines that use couplers and a dual hose clamp approach for drivelines that use CV or two-axis universal joints. The balancing process consists of the **CH-51450-TA186** optical tachometer sensor to directly read the driveline speed and software that directs where the weights should be placed depending on the type of driveline/propeller shaft being balanced.

Oscilloscope Balancing Software Set-up

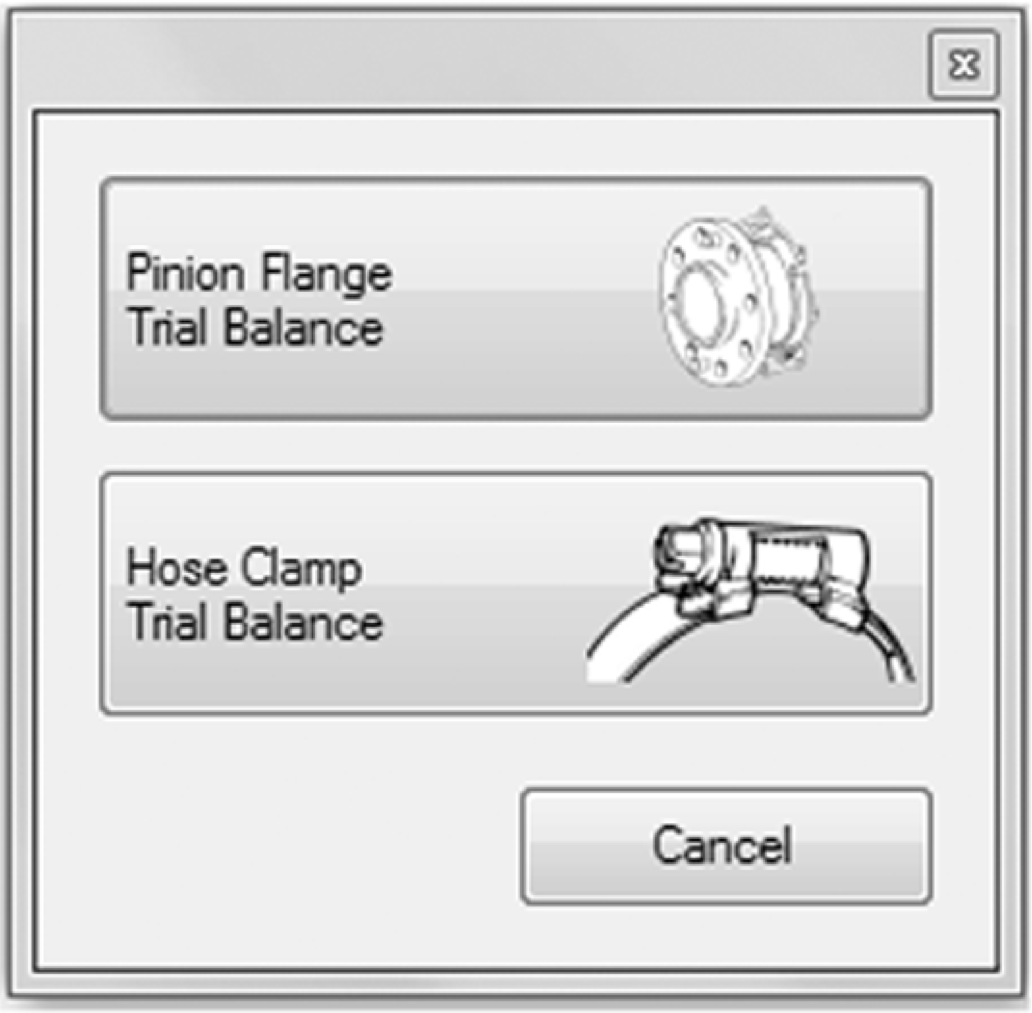
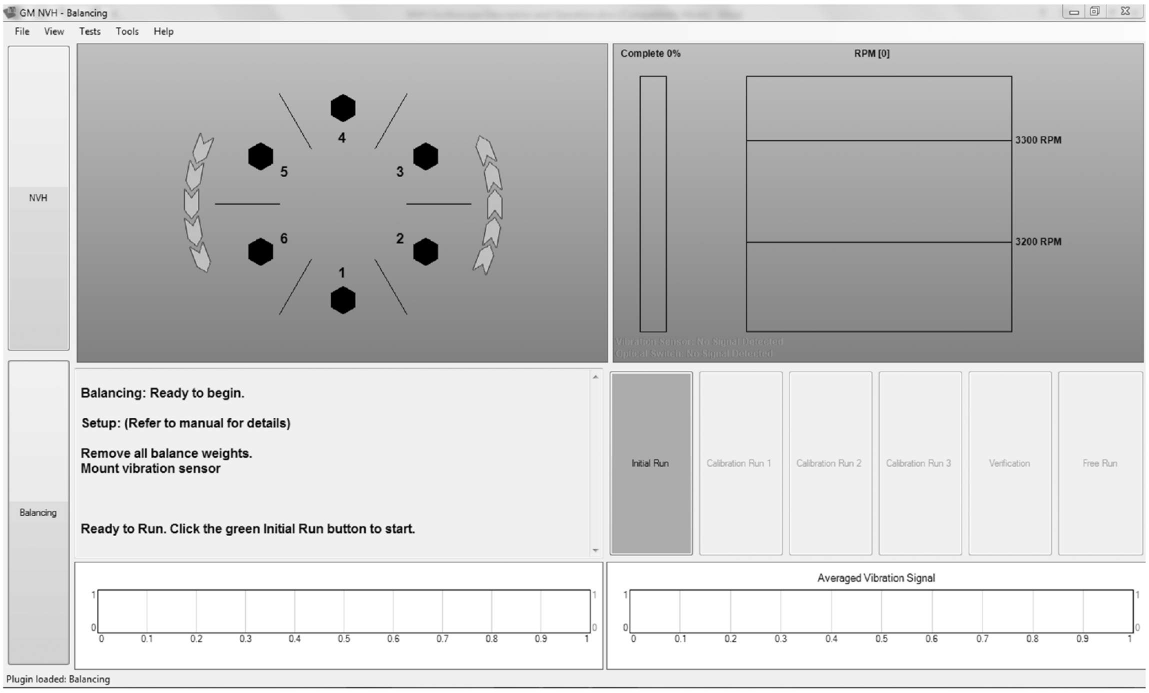


Fig. 45: Oscilloscope Balancing Software Set-Up Display Screen
Courtesy of GENERAL MOTORS COMPANY

When the NVH software is first opened and the Balancing tab is selected, a pop-up box within the **CH-51450-NVH** balancing software will ask which type of balancing method is to be used. The two methods are pinion flange or hose clamp. Then either the wizard (which will walk through the connections and input data) or advanced configuration can be chosen to input the initial information and start the balancing procedure.

Oscilloscope Balancing Display

The propeller shaft balancing will consist of an initial run, three calibration runs, and a verification run. The software will walk through what is required for each run.


GM NVH - Balancing
File View Tests Tools Help
NVH
Balancing
4
5
3
6
2
1
Complete 0%
RPM [0]
3300 RPM
3200 RPM
Vibration Sensor: No Signal Detected
Optical Switch: No Signal Detected
Initial Run
Calibration Run 1
Calibration Run 2
Calibration Run 3
Verification
Free Run
Averaged Vibration Signal
1
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Plugin loaded: Balancing

Balancing: Ready to begin.

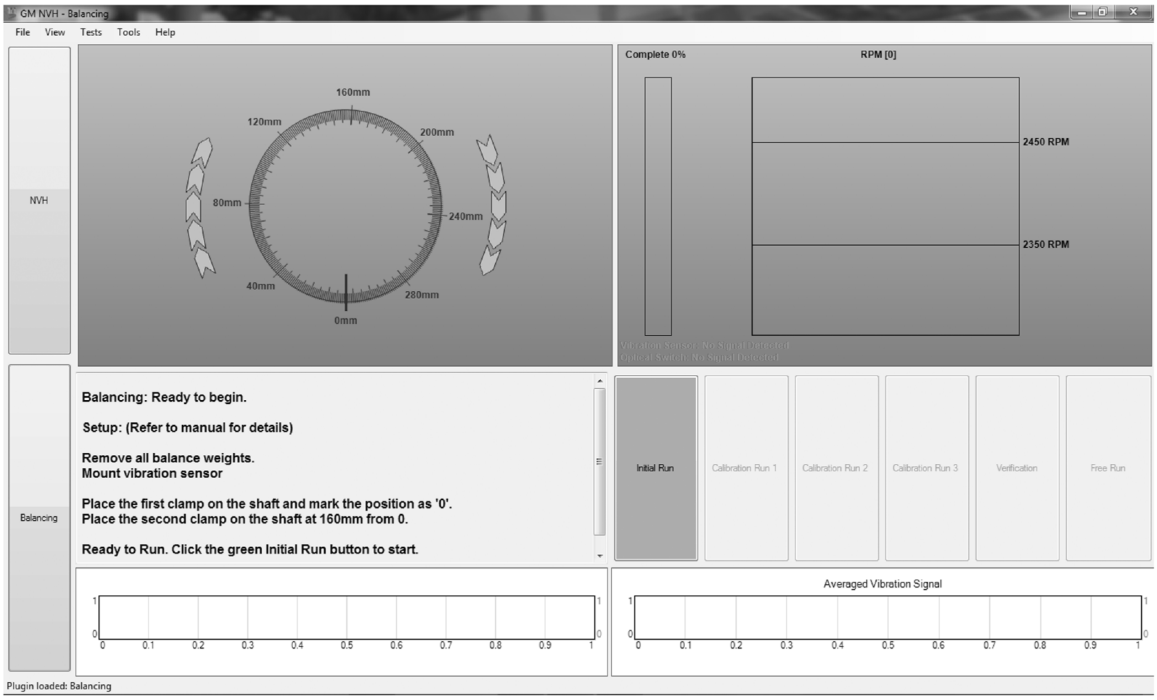
Setup: (Refer to manual for details)

Remove all balance weights.
Mount vibration sensor

Ready to Run. Click the green Initial Run button to start.

Fig. 46: Pinion Flange Balancing Screen
Courtesy of GENERAL MOTORS COMPANY

An example of the pinion flange balancing screen is shown above.


GM NVH - Balancing
File View Tests Tools Help
NVH
Balancing
160mm
120mm
200mm
80mm
240mm
40mm
280mm
0mm
Complete 0%
RPM [0]
2450 RPM
2350 RPM
Vibration Sensor: No Signal Detected
Optical Switch: No Signal Detected
Initial Run
Calibration Run 1
Calibration Run 2
Calibration Run 3
Verification
Free Run
Averaged Vibration Signal
1
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Plugin loaded: Balancing

Balancing: Ready to begin.

Setup: (Refer to manual for details)

Remove all balance weights.
Mount vibration sensor

Place the first clamp on the shaft and mark the position as '0'.
Place the second clamp on the shaft at 160mm from 0.

Ready to Run. Click the green Initial Run button to start.

Fig. 47: Hose Clamp Balancing Screen
Courtesy of GENERAL MOTORS COMPANY

An example of the hose clamp balancing screen is shown above.

VIBRATE SOFTWARE DESCRIPTION AND OPERATION

The **EL-38792-VS** Vibrate Software, is a computer software program which is designed to be used in support of the Vibration Analysis diagnostic tables, along with the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2, and a scan tool, to help in determining the source of a vibration concern. The **EL-38792-VS** Vibrate Software is designed to provide quick calculations and produce a chart of the rotational speeds and frequency ranges for specific vehicle systems and components, based upon vehicle data parameters inputted by the user.

The **EL-38792-VS** Vibrate Software uses the vehicle data parameters, such as axle ratio, number of engine cylinders, etc. to create the base chart, depicting the relationships of the various vehicle systems and/or components. The chart view can be modified to show data related to vehicle speed only, engine speed only, or both vehicle speed and engine speed. The user can then plot the dominant frequency reading obtained on the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 which correlates with the vibration concern, and the engine RPM obtained on a scan tool which correlates with the concern. Once these pieces of data are correctly plotted, the chart will point to the source of the vibration concern, which should confirm the results obtained through the Vibration Analysis diagnostic tables.

The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) includes a version of the vibrate software within its help file.

REED TACHOMETER DESCRIPTION

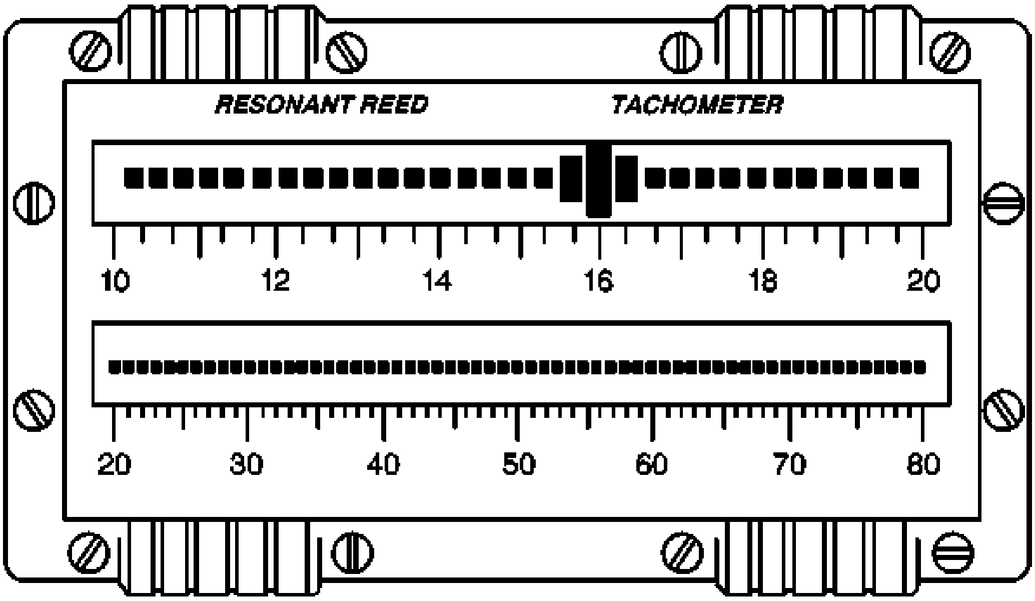


Fig. 48: Reed Tachometer
Courtesy of GENERAL MOTORS COMPANY

The reed tachometer consists of 2 rows of reeds arranged side-by-side. Each reed is tuned to vibrate or resonate when it is excited by a specific frequency. The reeds are arranged by their specific resonant frequency, increasing from left to right, ranging from 10 - 80 Hz. This arrangement allows for a visual display of the most dominate frequencies which fall within this range.

The reed tachometer can be a helpful diagnostic tool, however it is extremely sensitive to external inputs that are not related to the vibration concern, such as rough road surfaces, etc., and it is difficult to master its use. Due to these conditions, the reed tachometer has limited diagnostic capability.

Due to the limited diagnostic capability, limited availability and increasing costs of the reed tachometer, it is NOT recommended as the primary tool to use in diagnosing a vibration concern.

When diagnosing a vibration concern, use the **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2. The **CH-51450-NVH** Oscilloscope Diagnostic Kit (w/NVH) or the **EL-38792-A** Electronic Vibration Analyzer (EVA) 2 have been designed to overcome the shortcomings to the reed tachometer. Refer to **Oscilloscope Diagnostic Kit Description and Operation**, or **Electronic Vibration Analyzer (EVA) Description and Operation**.

SPECIAL TOOLS AND EQUIPMENT

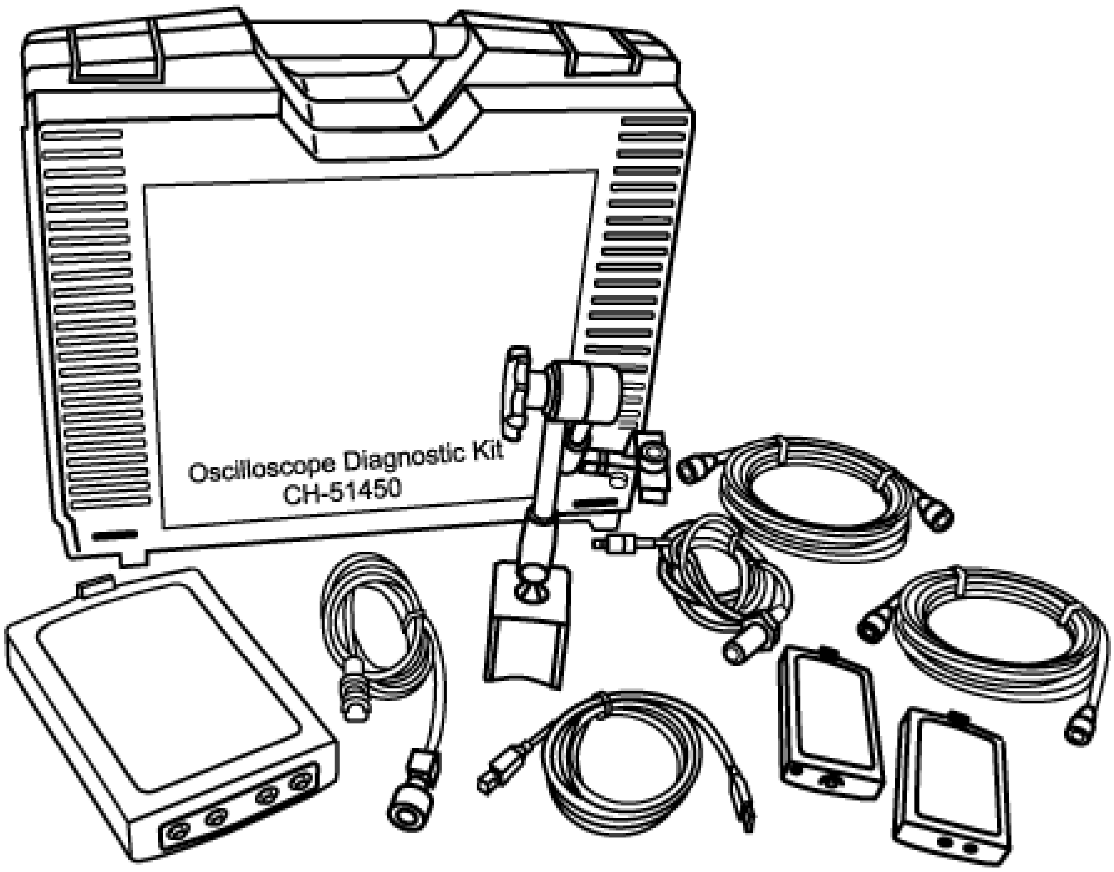
Illustration	Tool Number/Description
 Oscilloscope Diagnostic Kit CH-51450	CH 51450-NVH Oscilloscope Diagnostic Kit (w/NVH)

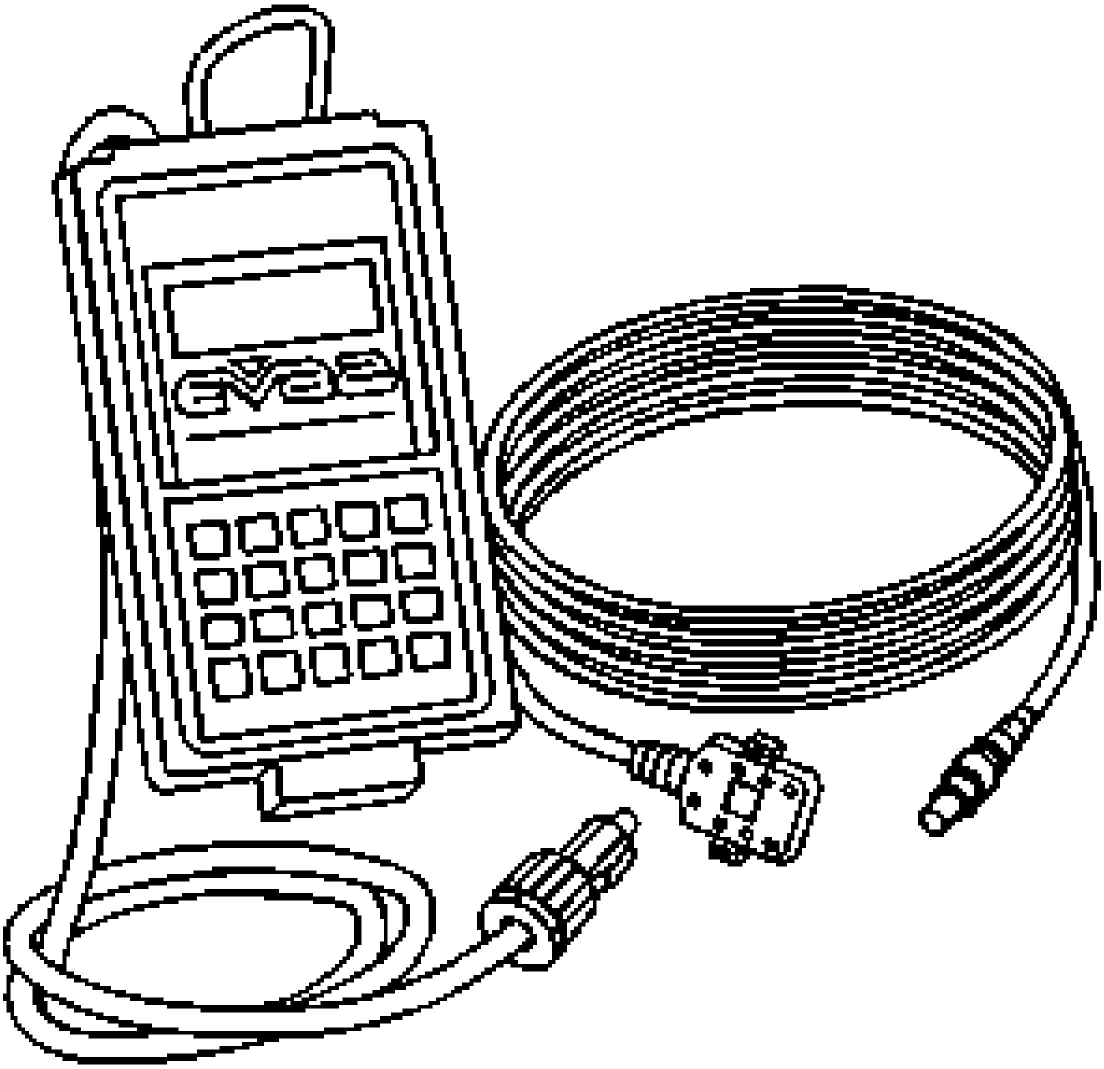
Illustration	Tool Number/Description
	EL 38792-A J 38792-A Electronic Vibration Analyzer (EVA) 2

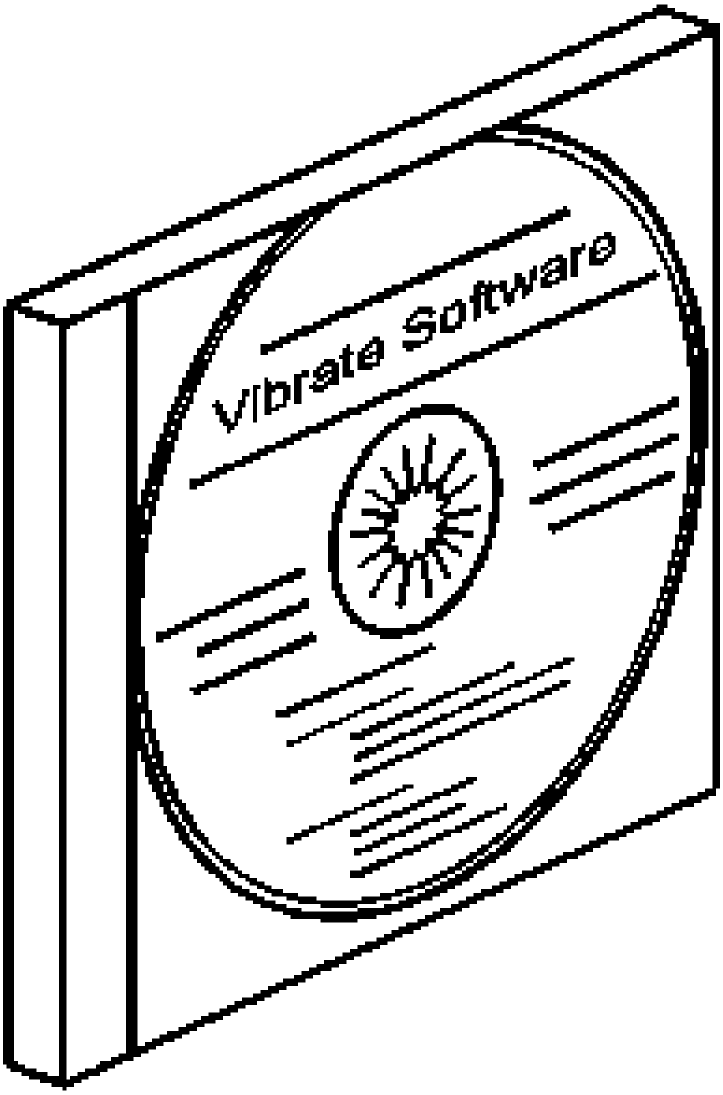
Illustration	Tool Number/Description
 Vibrate Software	EL 38792-VS J 38792-VS Vibration Software

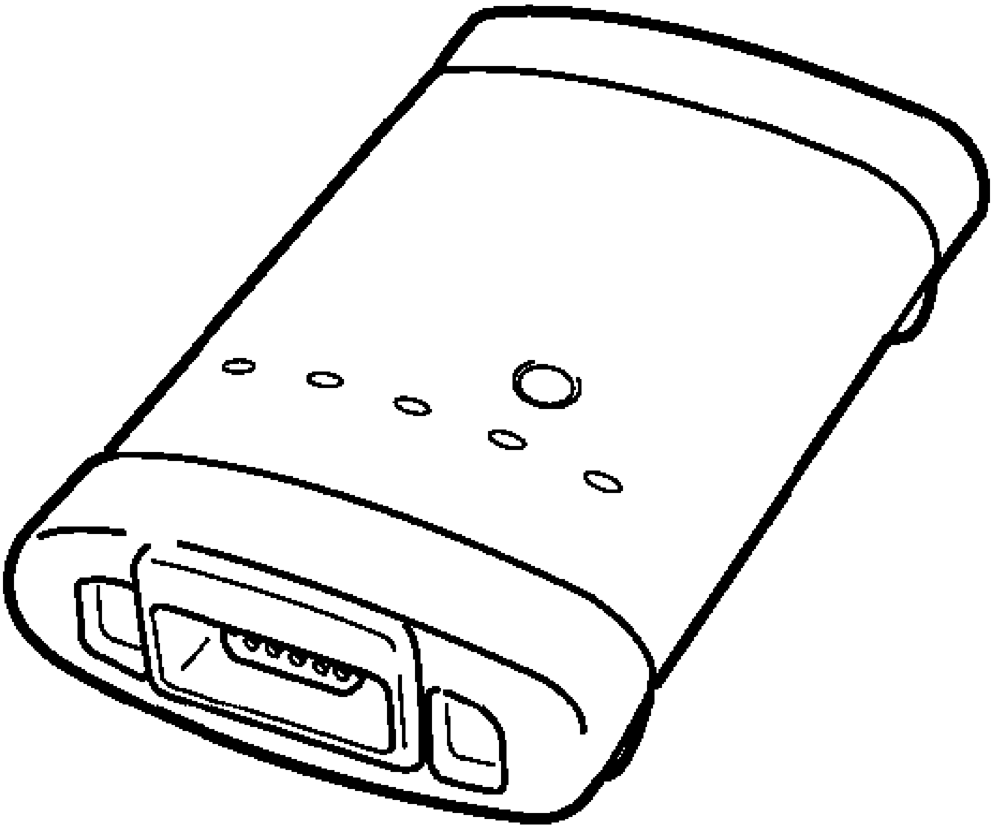
Illustration	Tool Number/Description
	EL 47955 J 2534 Multi Diagnostic Interface MDI

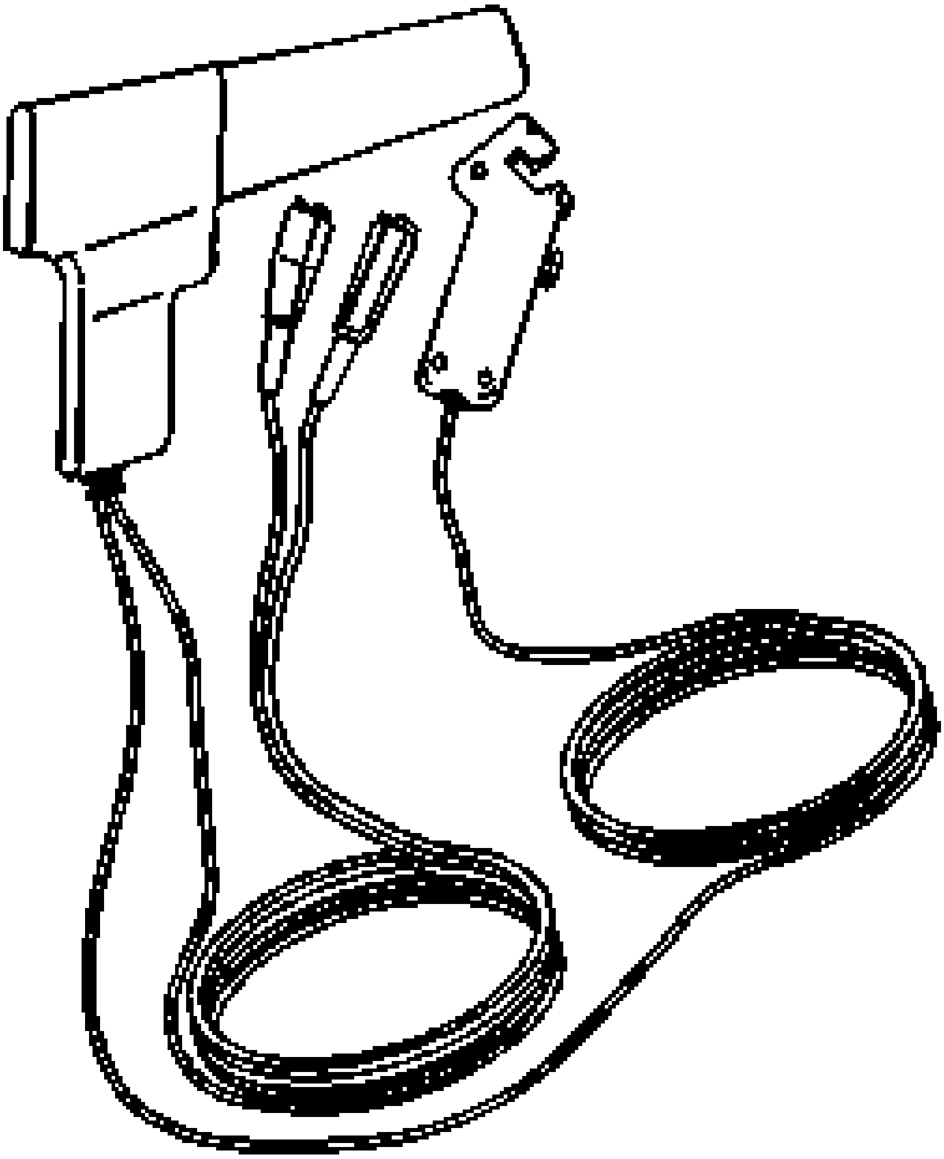
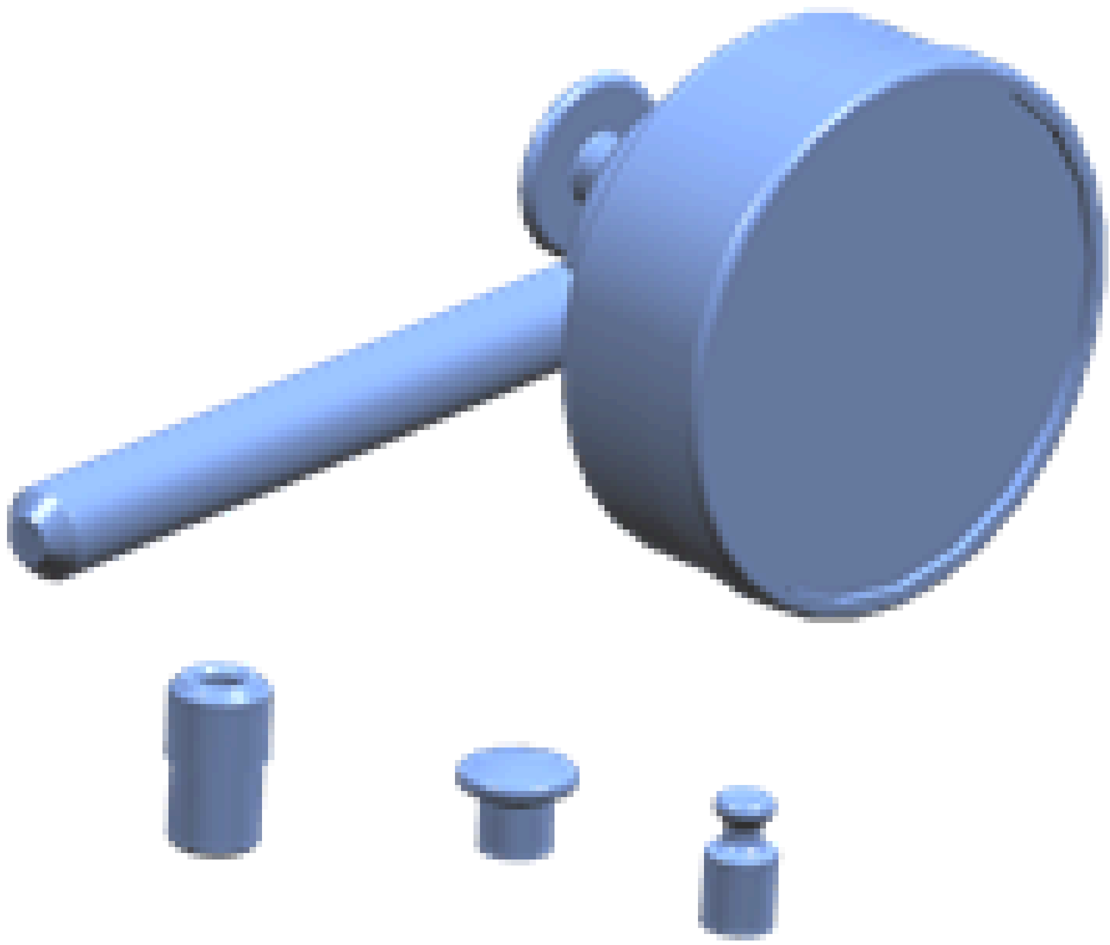
Illustration	Tool Number/Description
	EN 38792-25 J 38792-25 Inductive Pickup Timing Light

Illustration	Tool Number/Description
	GE 8001 J 8001 Dial Indicator Set

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2017 GENERAL INFORMATION

Waterleaks - Bolt EV

DIAGNOSTIC INFORMATION AND PROCEDURES

WATERLEAK TEST PREPARATION

- GM vehicles are designed to operate under normal environmental conditions.
- The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications cannot take into consideration any artificial conditions, i.e., high pressure car washes.
- The water leak test procedure has been correlated to the natural elements and will determine the ability of a vehicle to perform under normal operating conditions.
- The first step in diagnosing a leak is determining the conditions under which a leak occurs. If the general leak area can be found, the exact entry point can be isolated using a water hose or an air hose. Some trim panels or components may need to be removed in order to repair the leak.
- If leaks are found around a door, door window, rear compartment lid or liftgate area this does not necessarily indicate a bad weatherstrip. An adjustment to these areas may resolve the condition.

1. **Watertest Stand Assembly**

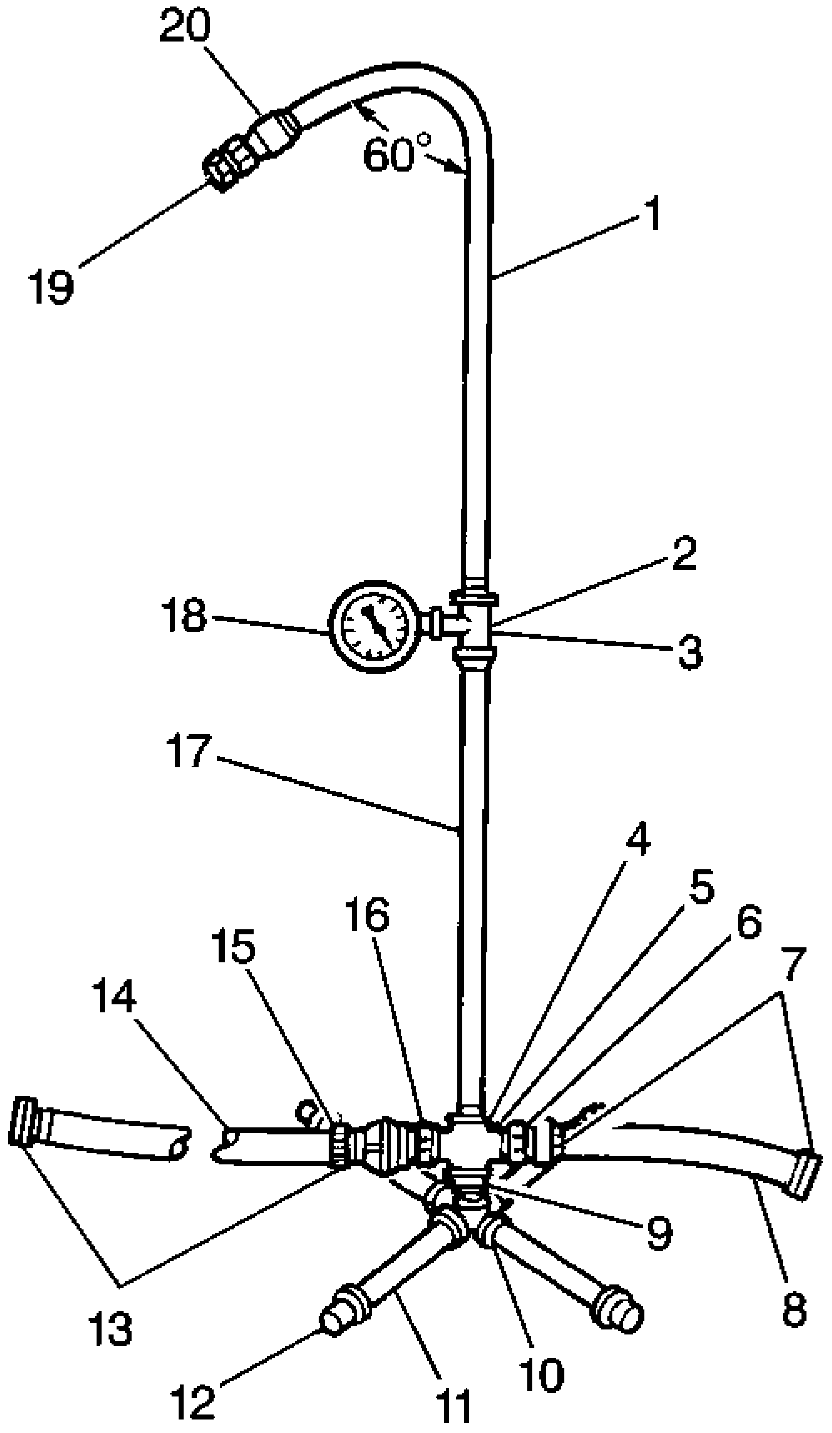

Fig. 1: Watertest Stand Assembly

Courtesy of GENERAL MOTORS COMPANY

Assemble the water test stand as shown.

Callout	Component Name
1	Pipe (0.5 x 36 in)
2	Reducing Tee, Right Stand Only (0.5 x 0.5 x 0.25 in)
3	Coupling, Left Stand Only, (0.5 in)
4	Tee, Left Stand Only (0.5 in)
5	Cross, Right Stand Only (0.5 in)
6	Pipe to Hose Nipple, Right Stand Only (0.5 in)
7	Female Hose Coupling (5/8 in)
8	Input Hose, Right Stand Only (2.0 ft) (5/8 in diameter)
9	Close Nipple (0.5 in)

Callout	Component Name
10	Cross (0.5 in) with Weld-On Cap (0.5 in)
11	Nipple (0.5 x 12 in)
12	Cap (0.5 in)
13	Female Hose Coupling (5/8 in)
14	Cross Hose (12 ft) (5/8 in diameter)
15	Hose Quick Connect
16	Pipe to Hose Nipple (0.5 in)
17	Pipe (0.5 x 60 in)
18	Water Pressure Gauge, Right Stand Only
19	Full Jet Spray Nozzle, No. 1/2GG-25 or Equivalent
20	Coupling (0.5 in)

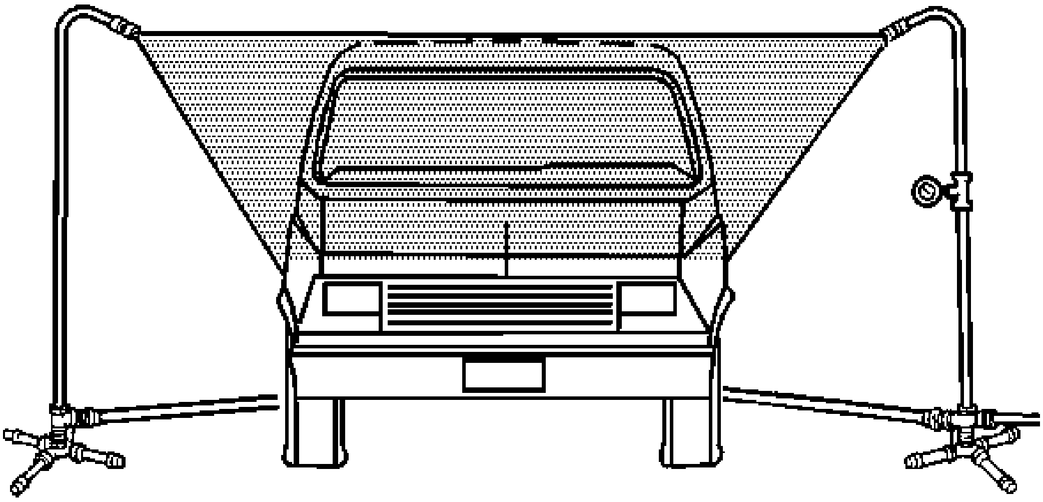

Fig. 2: How Water Spray From Stands Should Overlap Vehicle
Courtesy of GENERAL MOTORS COMPANY

2. Position the stands as shown.

   The water spray from the stands should overlap the vehicle as shown.

3. Have an assistant inside of the vehicle during the test in order to locate any leaks.
4. The water pressure at the nozzle should maintain a 155 kPa (22 psi), for at least 4 minutes.

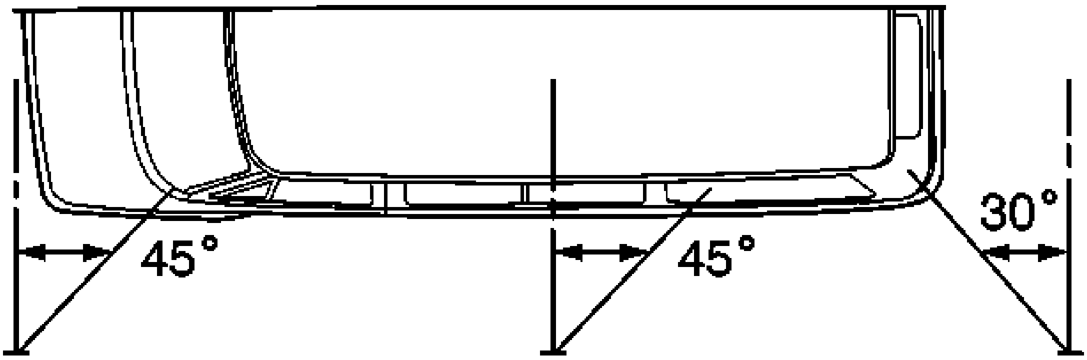

Fig. 3: Proper Water Spray Angles
Courtesy of GENERAL MOTORS COMPANY

5. In order to check the windshield, aim the water spray 30 degrees down and 45 degrees toward the rear.

   Aim the water towards the corner of the windshield.

6. In order to check the side windows for leaks, position the water stand towards the center of the rear quarter, aiming the water spray 30 degrees down and 45 degrees toward the rear.
7. In order to check the back window, aim the water spray 30 degrees down and 30 degrees toward the front.

DUST LEAKS

Dust may leak into the vehicle where water will not. This happens particularly in the lower portion of the interior.

Forward motion of the vehicle can create a slight vacuum which pulls air and dust into the vehicle.

In order to determine the location of dust leaks, perform the following steps:

1. Remove the mats from the floor.
2. Remove the mats from the kick panel.
3. Remove the insulation from the floor.
4. Remove the insulation from the kick panel.
5. Drive the vehicle on a dusty road.
6. Examine the interior.

Dust in the shape of a small cone or slit will usually be found at the point of leakage.

7. Mark the points of leakage.

NOTE: Ensure that the interior is darkened when performing this step.

8. Shine bright lamps on the underside of the floor and the cowl.
9. Have an assistant mark any points inside of the vehicle for any points where the light shines through.
    - Inspect the weld joints.
    - Inspect the body mounts.
10. Seal any leaks with an air-drying, body-sealing compound.

WATER HOSE TEST

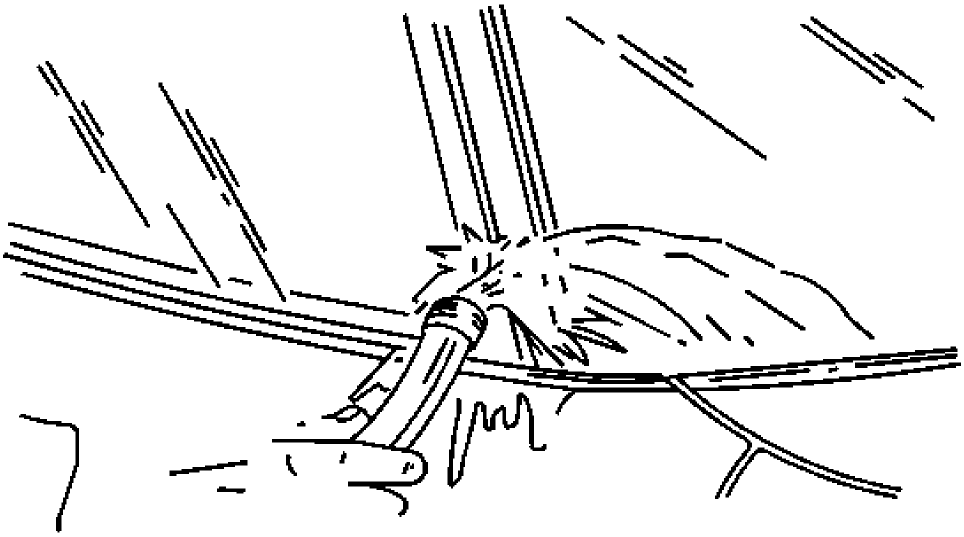

Fig. 4: Performing Water Hose Test
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a water hose without the nozzle attached.

1. Have an assistant inside of the vehicle in order to locate the leak.
2. Begin testing at the base of the window or the windshield.
3. Slowly move the hose upward and across the top of the vehicle.

AIR HOSE TEST

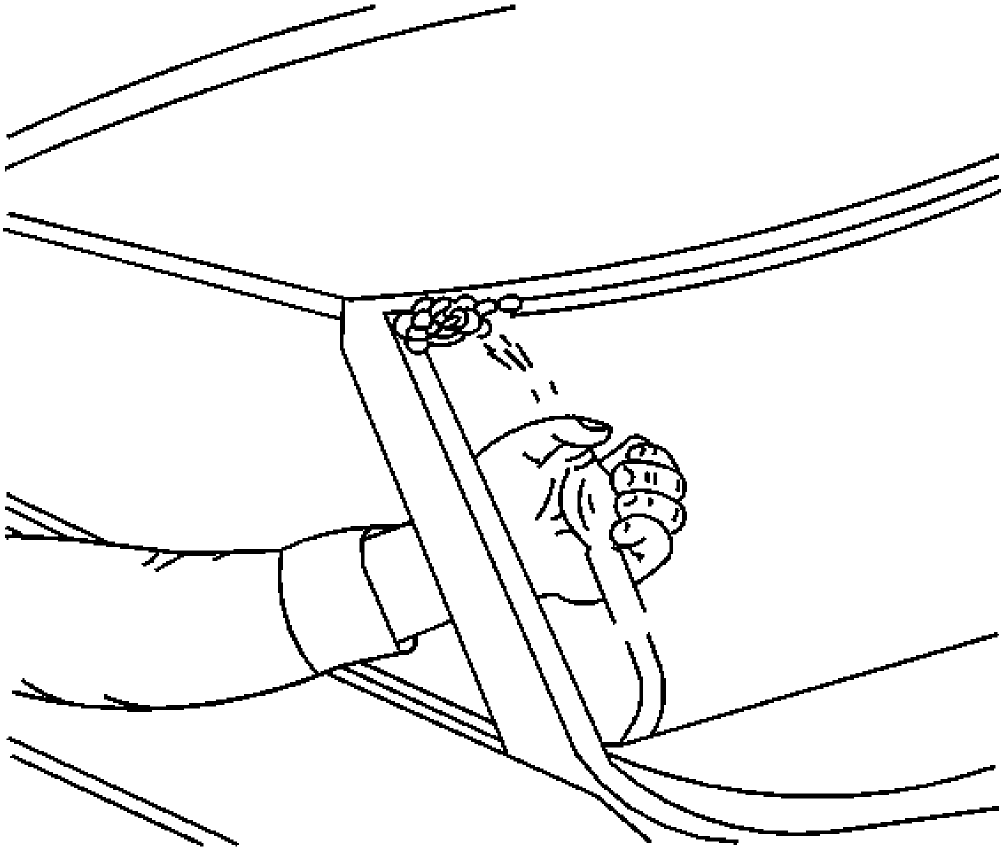

Fig. 5: Performing Air Hose Test
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The air hose test should only be used on fully cured urethane adhesive. Otherwise, damage to the urethane adhesive bead could result in additional leaks.**

1. Using a liquid detergent, diluted with water in a spray bottle, spray the window at the edges. Begin at the bottom and gradually move up and across the top.

NOTE: **The compressed air should not exceed 205 kPa (30 psi).**

2. Have an assistant inside of the vehicle with an air hose.
3. Have the assistant aim the compressed air at the suspected areas.

   Bubbles will form in the soap solution at the location of the leak.

REPAIR INSTRUCTIONS

BODY WATERLEAK REPAIR

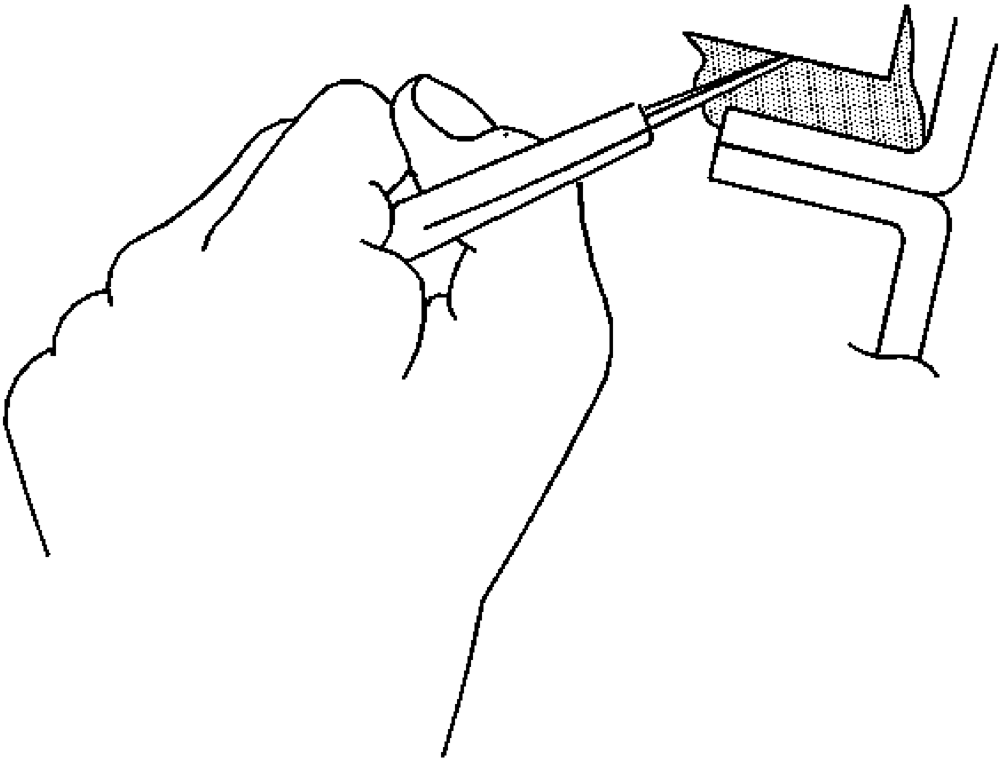

Fig. 6: Cutting Out Portion Of Adhesive Caulking (1 Of 2)
Courtesy of GENERAL MOTORS COMPANY

WARNING: **If the vehicle interior is exposed to moisture and becomes soaked up to the level of the sensing and diagnostic module (SDM), the SDM and SDM harness connector must be replaced. The SDM could be activated when powered, which could cause airbag deployment and result in personal injury.**

Depending on the location of the waterleak, you may have to remove certain interior components in order to repair the leak.

1. If the floor carpet is wet refer to **Floor Carpet Drying** .

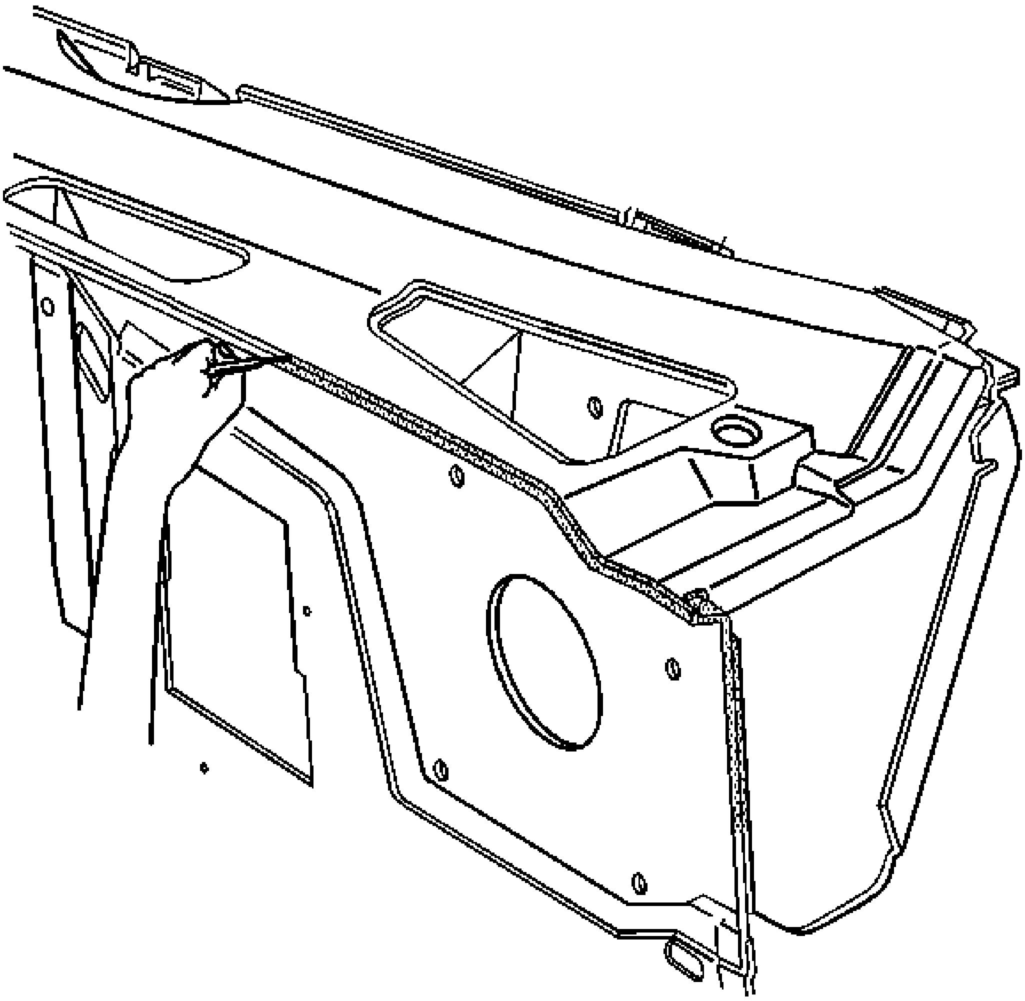

Fig. 7: Cutting Out Portion Of Adhesive Caulking (2 Of 2)
Courtesy of GENERAL MOTORS COMPANY

2. Cut out a portion of the adhesive caulking in the leak area from inside or outside of the vehicle.
3. Clean and remove all loose particles of the adhesive old caulking from the area.
4. Apply joint body and seam sealer where the old adhesive caulking was removed.
5. Allow the adhesive caulking to dry for several hours.
6. Test for leaks.
7. Install the trim, if removed.

STATIONARY WINDOW WATERLEAK REPAIR

WARNING: **If any water enters the vehicle interior up to the level of the carpet or higher and soaks the carpet, the sensing and diagnostic module (SDM) and the SDM harness connector may need to be replaced. The SDM could be activated when powered, which could cause deployment of the air bag(s) and result in personal injury. Before attempting these procedures, the SIR system must be disabled. Refer to Disabling the SIR System.**

With the ignition OFF, inspect the SDM mounting area, including the carpet. If any significant soaking or evidence of significant soaking is detected, you must perform the following tasks:

1. **Remove all water.**
2. **Repair the water damage.**
3. **Replace the SDM harness connector.**
4. **Replace the SDM.**

Failure to follow these tasks could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

1. If the floor carpet is wet refer to **Floor Carpet Drying** .
2. Remove the trim moldings or the headliner in order to repair the leak, if needed.
3. Determine the source of water entry.
4. If water is leaking at the edge of the windshield, reseal the windshield using Urethane Adhesive Systems which meet GM Specification GM 3651G.
5. If water leaks into the vehicle at the sides of the stationary windows, reseal the window using Urethane Adhesive Systems which meet GM Specification GM 3651G.

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GENERAL INFORMATION

Waveforms - Injector Pattern Tutorial

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

PURPOSE OF THIS ARTICLE

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

Learning how to interpret injector drive patterns from a Lab Scope can be like learning ignition patterns all over again. This article exists to ease you into becoming a skilled injector pattern interpreter.

You will learn:

- How a DVOM and noid light fall short of a lab scope.
- The two types of injector driver circuits, voltage controlled & current controlled.
- The two ways injector circuits can be wired, constant ground/switched power & constant power/switched ground.
- The two different pattern types you can use to diagnose with, voltage & current.
- All the valuable details injector patterns can reveal.

SCOPE OF THIS ARTICLE

This is NOT a manufacturer specific article. All different types of systems are covered here, regardless of the specific year/make/model/engine.

The reason for such broad coverage is because there are only a few basic ways to operate a solenoid-type injector. By understanding the fundamental principles, you will understand all the major points of injector patterns you encounter. Of course there are minor differences in each specific system, but that is where a waveform library helps out.

If this is confusing, consider a secondary ignition pattern. Even though there are many different implementations, each still has a primary voltage turn-on, firing line, spark line, etc.

If specific waveforms are available in On Demand for the engine and vehicle you are working on, you will find them in the Engine Performance section under the Engine Performance category.

IS A LAB SCOPE NECESSARY?

INTRODUCTION

You probably have several tools at your disposal to diagnose injector circuits. But you might have questioned "Is a lab scope necessary to do a thorough job, or will a set of noid lights and a multifunction DVOM do just as well?"

In the following text, we are going to look at what noid lights and DVOMs do best, do not do very well, and when they can mislead you. As you might suspect, the lab scope, with its ability to look inside an active circuit, comes to the rescue by answering for the deficiencies of these other tools.

OVERVIEW OF NOID LIGHT

The noid light is an excellent "quick and dirty" tool. It can usually be hooked to a fuel injector harness fast and the flashing light is easy to understand. It is a dependable way to identify a no-pulse situation.

However, a noid light can be very deceptive in two cases:

- If the wrong one is used for the circuit being tested. Beware: Just because a connector on a noid light fits the harness does not mean it is the right one.
- If an injector driver is weak or a minor voltage drop is present.

Use the Right Noid Light

In the following text we will look at what can happen if the wrong noid light is used, why there are different types of noid lights (besides differences with connectors), how to identify the types of noid lights, and how to know the right type to use.

First, let's discuss what can happen if the incorrect type of noid light is used. You might see:

- A dimly flashing light when it should be normal.
- A normal flashing light when it should be dim.

A noid light will flash dim if used on a lower voltage circuit than it was designed for. A normally operating circuit would appear underpowered, which could be misinterpreted as the cause of a fuel starvation problem.

Here are the two circuit types that could cause this problem:

- Circuits with external injector resistors. Used predominately on some Asian & European systems, they are used to reduce the available voltage to an injector in order to limit the current flow. This lower voltage can cause a dim flash on a noid light designed for full voltage.
- Circuits with current controlled injector drivers (e.g. "Peak and Hold"). Basically, this type of driver allows a quick burst of voltage/current to flow and then throttles it back significantly for the remainder of the pulse width duration. If a noid light was designed for the other type of driver (voltage controlled, e.g. "Saturated"), it will appear dim because it is expecting full voltage/current to flow for the entire duration of the pulse width.

Let's move to the other situation where a noid light flashes normally when it should be dim. This could occur if a more sensitive noid light is used on a higher voltage/amperage circuit that was weakened enough to cause problems (but not outright broken). A circuit with an actual problem would thus appear normal.

Let's look at why. A noid light does not come close to consuming as much amperage as an injector solenoid. If there is a partial driver failure or a minor voltage drop in the injector circuit, there can be adequate amperage to fully operate the noid light BUT NOT ENOUGH TO OPERATE THE INJECTOR.

If this is not clear, picture a battery with a lot of corrosion on the terminals. Say there is enough corrosion that the starter motor will not operate; it only clicks. Now imagine turning on the headlights (with the ignition in the RUN position). You find they light normally and are fully bright. This is the same idea as noid light: There is a problem, but enough amp flow exists to operate the headlights ("noid light"), but not the starter motor ("injector").

How do you identify and avoid all these situations? By using the correct type of noid light. This requires that you understanding the types of injector circuits that your noid lights are designed for. There are three. They are:

- Systems with a voltage controlled injector driver. Another way to say it: The noid light is designed for a circuit with a "high" resistance injector (generally 12 ohms or above).
- Systems with a current controlled injector driver. Another way to say it: The noid light is designed for a circuit with a low resistance injector (generally less than 12 ohms) without an external injector resistor.
- Systems with a voltage controlled injector driver and an external injector resistor. Another way of saying it: The noid light is designed for a circuit with a low resistance injector (generally less than

12 ohms) and an external injector resistor.

NOTE: **Some noid lights can meet both the second and third categories simultaneously.**

If you are not sure which type of circuit your noid light is designed for, plug it into a known good car and check out the results. If it flashes normally during cranking, determine the circuit type by finding out injector resistance and if an external injector resistor is used. You now know enough to identify the type of injector circuit. Label the noid light appropriately.

Next time you need to use a noid light for diagnosis, determine what type of injector circuit you are dealing with and select the appropriate noid light.

Of course, if you suspect a no-pulse condition you could plug in any one whose connector fit without fear of misdiagnosis. This is because it is unimportant if the flashing light is dim or bright. It is only important that it flashes.

In any cases of doubt regarding the use of a noid light, a lab scope will overcome all inherent weaknesses.

OVERVIEW OF DVOM

A DVOM is typically used to check injector resistance and available voltage at the injector. Some techs also use it check injector on-time either with a built-in feature or by using the dwell/duty function.

There are situations where the DVOM performs these checks dependably, and other situations where it can deceive you. It is important to be aware of these strengths and weaknesses. We will cover the topics above in the following text.

Checking Injector Resistance

If a short in an injector coil winding is constant, an ohmmeter will accurately identify the lower resistance. The same is true with an open winding. Unfortunately, an intermittent short is an exception. A faulty injector with an intermittent short will show "good" if the ohmmeter cannot force the short to occur during testing.

Alcohol in fuel typically causes an intermittent short, happening only when the injector coil is hot and loaded by a current high enough to jump the air gap between two bare windings or to break down any oxides that may have formed between them.

When you measure resistance with an ohmmeter, you are only applying a small current of a few milliamps. This is nowhere near enough to load the coil sufficiently to detect most problems. As a result, most resistance checks identify intermittently shorted injectors as being normal.

There are two methods to get around this limitation. The first is to purchase an tool that checks injector coil windings under full load. The Kent-Moore J-39021 is such a tool, though there are others. The Kent-Moore costs around $240 at the time of this writing and works on many different manufacturer's systems.

The second method is to use a lab scope. Remember, a lab scope allows you to see the regular operation of a circuit in real time. If an injector is having an short or intermittent short, the lab scope will show it.

Checking Available Voltage At the Injector

Verifying a fuel injector has the proper voltage to operate correctly is good diagnostic technique. Finding an open circuit on the feed circuit like a broken wire or connector is an accurate check with a DVOM. Unfortunately, finding an intermittent or excessive resistance problem with a DVOM is unreliable.

Let's explore this drawback. Remember that a voltage drop due to excessive resistance will only occur when a circuit is operating? Since the injector circuit is only operating for a few milliseconds at a time, a DVOM will only see a potential fault for a few milliseconds. The remaining 90+% of the time the unloaded injector circuit will show normal battery voltage.

Since DVOMs update their display roughly two to five times a second, all measurements in between are averaged. Because a potential voltage drop is visible for such a small amount of time, it gets "averaged out", causing you to miss it.

Only a DVOM that has a "min-max" function that checks EVERY MILLISECOND will catch this fault consistently (if used in that mode). The Fluke 87 among others has this capability.

A "min-max" DVOM with a lower frequency of checking (100 millisecond) can miss the fault because it will probably check when the injector is not on. This is especially true with current controlled driver circuits. The Fluke 88, among others fall into this category.

Outside of using a Fluke 87 (or equivalent) in the 1 mS "min-max" mode, the only way to catch a voltage drop fault is with a lab scope. You will be able to see a voltage drop as it happens.

One final note. It is important to be aware that an injector circuit with a solenoid resistor will always show a voltage drop when the circuit is energized. This is somewhat obvious and normal; it is a designed-in voltage drop. What can be unexpected is what we already covered--a voltage drop disappears when the circuit is unloaded. The unloaded injector circuit will show normal battery voltage at the injector. Remember this and do not get confused.

Checking Injector On-Time With Built-In Function

Several DVOMs have a feature that allows them to measure injector on-time (mS pulse width). While they are accurate and fast to hookup, they have three limitations you should be aware of:

- They only work on voltage controlled injector drivers (e.g "Saturated Switch"), NOT on current controlled injector drivers (e.g. "Peak & Hold").
- A few unusual conditions can cause inaccurate readings.
- Varying engine speeds can result in inaccurate readings.

Regarding the first limitation, DVOMs need a well-defined injector pulse in order to determine when the injector turns ON and OFF. Voltage controlled drivers provide this because of their simple switch-like operation. They completely close the circuit for the entire duration of the pulse. This is easy for the DVOM to interpret.

The other type of driver, the current controlled type, start off well by completely closing the circuit (until the injector pintle opens), but then they throttle back the voltage/current for the duration of the pulse. The DVOM understands the beginning of the pulse but it cannot figure out the throttling action. In other words, it cannot distinguish the throttling from an open circuit (de-energized) condition.

Yet current controlled injectors will still yield a millisecond on-time reading on these DVOMs. You will find it is also always the same, regardless of the operating conditions. This is because it is only measuring the initial completely-closed circuit on-time, which always takes the same amount of time (to lift the injector pintle off its seat). So even though you get a reading, it is useless.

The second limitation is that a few erratic conditions can cause inaccurate readings. This is because of a DVOM's slow display rate; roughly two to five times a second. As we covered earlier, measurements in between display updates get averaged. So conditions like skipped injector pulses or intermittent long/short injector pulses tend to get "averaged out", which will cause you to miss important details.

The last limitation is that varying engine speeds can result in inaccurate readings. This is caused by the quickly shifting injector on-time as the engine load varies, or the RPM moves from a state of acceleration to stabilization, or similar situations. It too is caused by the averaging of all measurements in between DVOM display periods. You can avoid this by checking on-time when there are no RPM or load changes.

A lab scope allows you to overcome each one of these limitations.

Checking Injector On-Time With Dwell Or Duty

If no tool is available to directly measure injector millisecond on-time measurement, some techs use a simple DVOM dwell or duty cycle functions as a replacement.

While this is an approach of last resort, it does provide benefits. We will discuss the strengths and weaknesses in a moment, but first we will look at how a duty cycle meter and dwell meter work.

How A Duty Cycle Meter and Dwell Meter Work

All readings are obtained by comparing how long something has been OFF to how long it has been ON in a fixed time period. A dwell meter and duty cycle meter actually come up with the same answers using different scales. You can convert freely between them. See **RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS TABLE**.

The DVOM display updates roughly one time a second, although some DVOMs can be a little faster or slower. All measurements during this update period are tallied inside the DVOM as ON time or OFF time, and then the total ratio is displayed as either a percentage (duty cycle) or degrees (dwell meter).

For example, let's say a DVOM had an update rate of exactly 1 second (1000 milliseconds). Let's also say that it has been measuring/tallying an injector circuit that had been ON a total of 250 mS out of the 1000 mS. That is a ratio of one-quarter, which would be displayed as 25% duty cycle or 15Â° dwell (six-cylinder scale). Note that most duty cycle meters can reverse the readings by selecting the positive or negative slope to trigger on. If this reading were reversed, a duty cycle meter would display 75%.

Strengths of Dwell/Duty Meter

The obvious strength of a dwell/duty meter is that you can compare injector on-time against a known-good reading. This is the only practical way to use a dwell/duty meter, but requires you to have known-good values to compare against.

Another strength is that you can roughly convert injector mS on-time into dwell reading with some computations.

A final strength is that because the meter averages everything together it does not miss anything (though this is also a severe weakness that we will look at later). If an injector has a fault where it occasionally skips a pulse, the meter registers it and the reading changes accordingly.

Let's go back to figuring out dwell/duty readings by using injector on-time specification. This is not generally practical, but we will cover it for completeness. You NEED to know three things:

- Injector mS on-time specification.
- Engine RPM when specification is valid.
- How many times the injectors fire per crankshaft revolution.

The first two are self-explanatory. The last one may require some research into whether it is a bank-fire type that injects every 360Â° of crankshaft rotation, a bank-fire that injects every 720Â°, or an SFI that injects every 720Â°. Many manufacturers do not release this data so you may have to figure it out yourself with a frequency meter.

Here are the four complete steps to convert millisecond on-time:

1. Determine the injector pulse width and RPM it was obtained at. Let's say the specification is for one millisecond of on-time at a hot idle of 600 RPM.
2. Determine injector firing method for the complete 4 stroke cycle. Let's say this is a 360Â° bank-fired, meaning an injector fires each and every crankshaft revolution.
3. Determine how many times the injector will fire at the specified engine speed (600 RPM) in a fixed time period. We will use 100 milliseconds because it is easy to use. Six hundred crankshaft Revolutions Per Minute (RPM) divided by 60 seconds equals 10 revolutions per second. Multiplying 10 times .100 yields one; the crankshaft turns one time in 100 milliseconds. With exactly one crankshaft rotation in 100 milliseconds, we know that the injector fires exactly one time.
4. Determine the ratio of injector on-time vs. off-time in the fixed time period, then figure duty cycle and/or dwell. The injector fires one time for a total of one millisecond in any given 100 millisecond period. One hundred minus one equals 99. We have a 99% duty cycle. If we wanted to know the dwell (on 6 cylinder scale), multiple 99% times .6; this equals 59.4Â° dwell.

Weaknesses of Dwell/Duty Meter

The weaknesses are significant. First, there is no one-to-one correspondence to actual mS on-time. No manufacturer releases dwell/duty data, and it is time-consuming to convert the mS on-time readings. Besides, there can be a large degree of error because the conversion forces you to assume that the injector(s) are always firing at the same rate for the same period of time. This can be a dangerous assumption.

Second, all level of detail is lost in the averaging process. This is the primary weakness. You cannot see the details you need to make a confident diagnosis.

Here is one example. Imagine a vehicle that has a faulty injector driver that occasionally skips an injector pulse. Every skipped pulse means that that cylinder does not fire, thus unburned O2 gets pushed into the exhaust and passes the O2 sensor. The O2 sensor indicates lean, so the computer fattens up the mixture to compensate for the supposed "lean" condition.

A connected dwell/duty meter would see the fattened pulse width but would also see the skipped pulses. It would tally both and likely come back with a reading that indicated the "pulse width" was within specification because the rich mixture and missing pulses offset each other.

This situation is not a far-fetched scenario. Some early GM 3800 engines were suffering from exactly this. The point is that a lack of detail could cause misdiagnosis.

As you might have guessed, a lab scope would not miss this.

RELATIONSHIP BETWEEN DWELL & DUTY CYCLE READINGS

Dwell Meter (2)	Duty Cycle Meter
1Â°	1%
15Â°	25%
30Â°	50%
45Â°	75%
60Â°	100%

(1) These are just some examples for your understanding. It is okay to fill in the gaps.

(2) Dwell meter on the six-cylinder scale.

THE TWO TYPES OF INJECTOR DRIVERS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

OVERVIEW

There are two types of transistor driver circuits used to operate electric fuel injectors: voltage controlled and current controlled. The voltage controlled type is sometimes called a "saturated switch" driver, while the current controlled type is sometimes known as a "peak and hold" driver.

The basic difference between the two is the total resistance of the injector circuit. Roughly speaking, if a particular leg in an injector circuit has total resistance of 12 or more ohms, a voltage control driver is used. If less than 12 ohms, a current control driver is used.

It is a question of what is going to do the job of limiting the current flow in the injector circuit; the inherent "high" resistance in the injector circuit, or the transistor driver. Without some form of control, the current flow through the injector would cause the solenoid coil to overheat and result in a damaged injector.

VOLTAGE CONTROLLED CIRCUIT ("SATURATED SWITCH")

The voltage controlled driver inside the computer operates much like a simple switch because it does not need to worry about limiting current flow. Recall, this driver typically requires injector circuits with a total leg resistance of 12 or more ohms.

The driver is either ON, closing/completing the circuit (eliminating the voltage-drop), or OFF, opening the circuit (causing a total voltage drop).

Some manufacturers call it a "saturated switch" driver. This is because when switched ON, the driver allows the magnetic field in the injector to build to saturation. This is the same "saturation" property that you are familiar with for an ignition coil.

There are two ways "high" resistance can be built into an injector circuit to limit current flow. One method uses an external solenoid resistor and a low resistance injector, while the other uses a high resistance injector without the solenoid resistor. See the left side of Fig. **Fig. 1**.

In terms of injection opening time, the external resistor voltage controlled circuit is somewhat faster than the voltage controlled high resistance injector circuit. The trend, however, seems to be moving toward use of this latter type of circuit due to its lower cost and reliability. The ECU can compensate for slower opening times by increasing injector pulse width accordingly.

NOTE: **Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.**

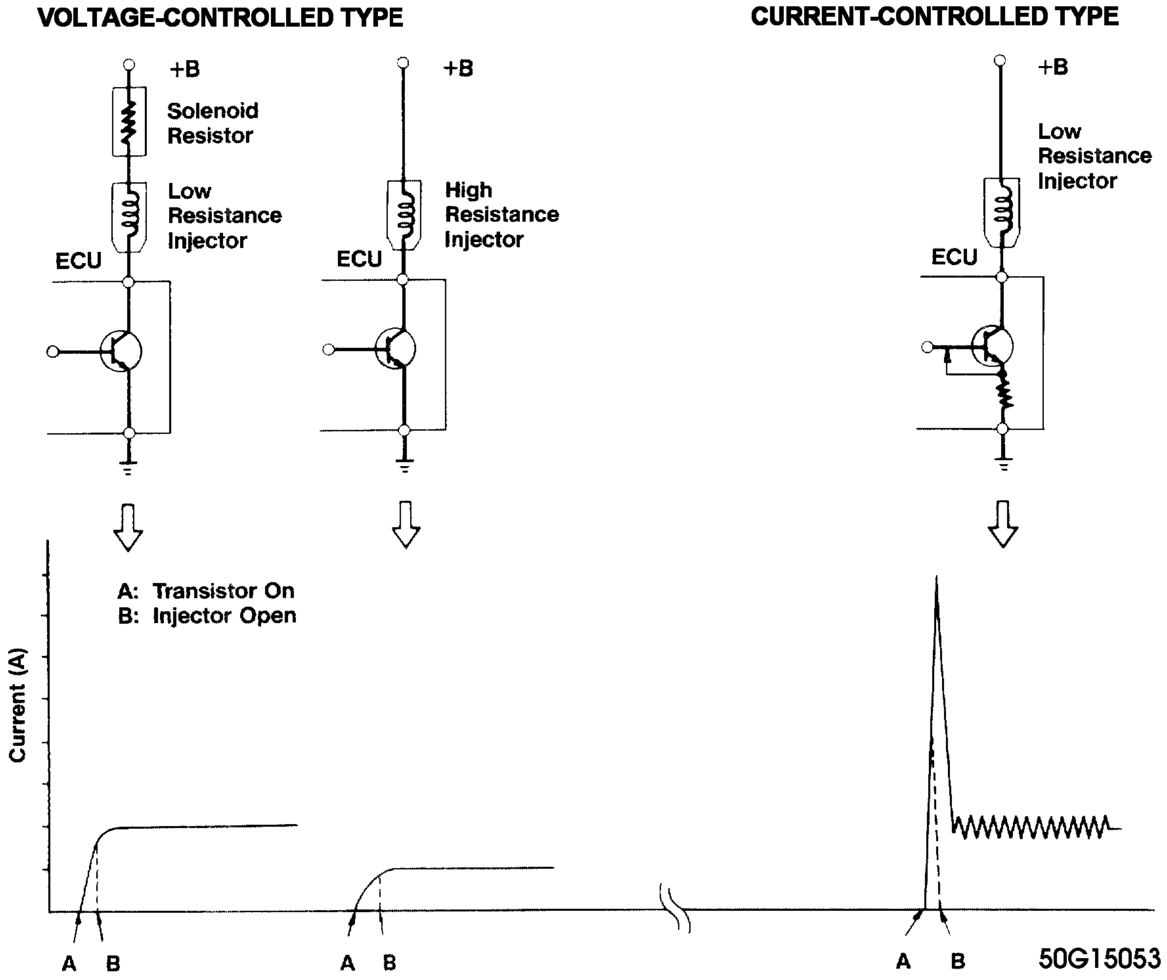

Fig. 1: Injector Driver Types - Current and Voltage

CURRENT CONTROLLED CIRCUIT ("PEAK & HOLD")

The current controlled driver inside the computer is more complex than a voltage controlled driver because as the name implies, it has to limit current flow in addition to its ON-OFF switching function. Recall, this driver typically requires injector circuits with a total leg resistance of less than 12 ohms.

Once the driver is turned ON, it will not limit current flow until enough time has passed for the injector pintle to open. This period is preset by the particular manufacturer/system based on the amount of current flow needed to open their injector. This is typically between two and six amps. Some manufacturers refer to this as the "peak" time, referring to the fact that current flow is allowed to "peak" (to open the injector).

Once the injector pintle is open, the amp flow is considerably reduced for the rest of the pulse duration to protect the injector from overheating. This is okay because very little amperage is needed to hold the injector open, typically in the area of one amp or less. Some manufacturers refer to this as the "hold" time, meaning that just enough current is allowed through the circuit to "hold" the already-open injector open.

There are a couple methods of reducing the current. The most common trims back the available voltage for the circuit, similar to turning down a light at home with a dimmer.

The other method involves repeatedly cycling the circuit ON-OFF. It does this so fast that the magnetic field never collapses and the pintle stays open, but the current is still significantly reduced. See the right side of Fig. **Fig. 1** for an illustration.

The advantage to the current controlled driver circuit is the short time period from when the driver transistor goes ON to when the injector actually opens. This is a function of the speed with which current flow reaches its peak due to the low circuit resistance. Also, the injector closes faster when the driver turns OFF because of the lower holding current.

NOTE: **Never apply battery voltage directly across a low resistance injector. This will cause injector damage from solenoid coil overheating.**

THE TWO WAYS INJECTOR CIRCUITS ARE WIRED

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Like other circuits, injector circuits can be wired in one of two fundamental directions. The first method is to steadily power the injectors and have the computer driver switch the ground side of the circuit. Conversely, the injectors can be steadily grounded while the driver switches the power side of the circuit.

There is no performance benefit to either method. Voltage controlled and current controlled drivers have been successfully implemented both ways.

However, 95% percent of the systems are wired so the driver controls the ground side of the circuit. Only a handful of systems use the drivers on the power side of the circuit. Some examples of the latter are the 1970's Cadillac EFI system, early Jeep 4.0 EFI (Renix system), and Chrysler 1984-87 TBI.

INTERPRETING INJECTOR WAVEFORMS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

INTERPRETING A VOLTAGE CONTROLLED PATTERN

NOTE: **Voltage controlled drivers are also known as "Saturated Switch" drivers. They typically require injector circuits with a total leg resistance of 12 ohms or more.**

NOTE: **This example is based on a constant power/switched ground circuit.**

- See **Fig. 2** for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This can occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Note that circuits with external injector resistors will not be any different because the resistor does not affect open circuit voltage.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

The points between "B" and "D" represent the time in milliseconds that the injector is being energized or held open. This line at Point "C" should remain flat. Any distortion or upward bend indicates a ground problem, short problem, or a weak driver. Alert readers will catch that this is exactly opposite of the current controlled type drivers (explained in the next section), because they bend upwards at this point.

How come the difference? Because of the total circuit resistance. Voltage controlled driver circuits have a high resistance of 12+ ohms that slows the building of the magnetic field in the injector. Hence, no counter voltage is built up and the line remains flat.

On the other hand, the current controlled driver circuit has low resistance which allows for a rapid magnetic field build-up. This causes a slight inductive rise (created by the effects of counter voltage) and hence, the upward bend. You should not see that here with voltage controlled circuits.

Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts at the top of Point "D".

If you do see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning the injector has a weak winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

Point "E" brings us to a very interesting section. As you can see, the voltage dissipates back to supply value after the peak of the inductive kick. Notice the slight hump? This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking because of a faulty injector

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

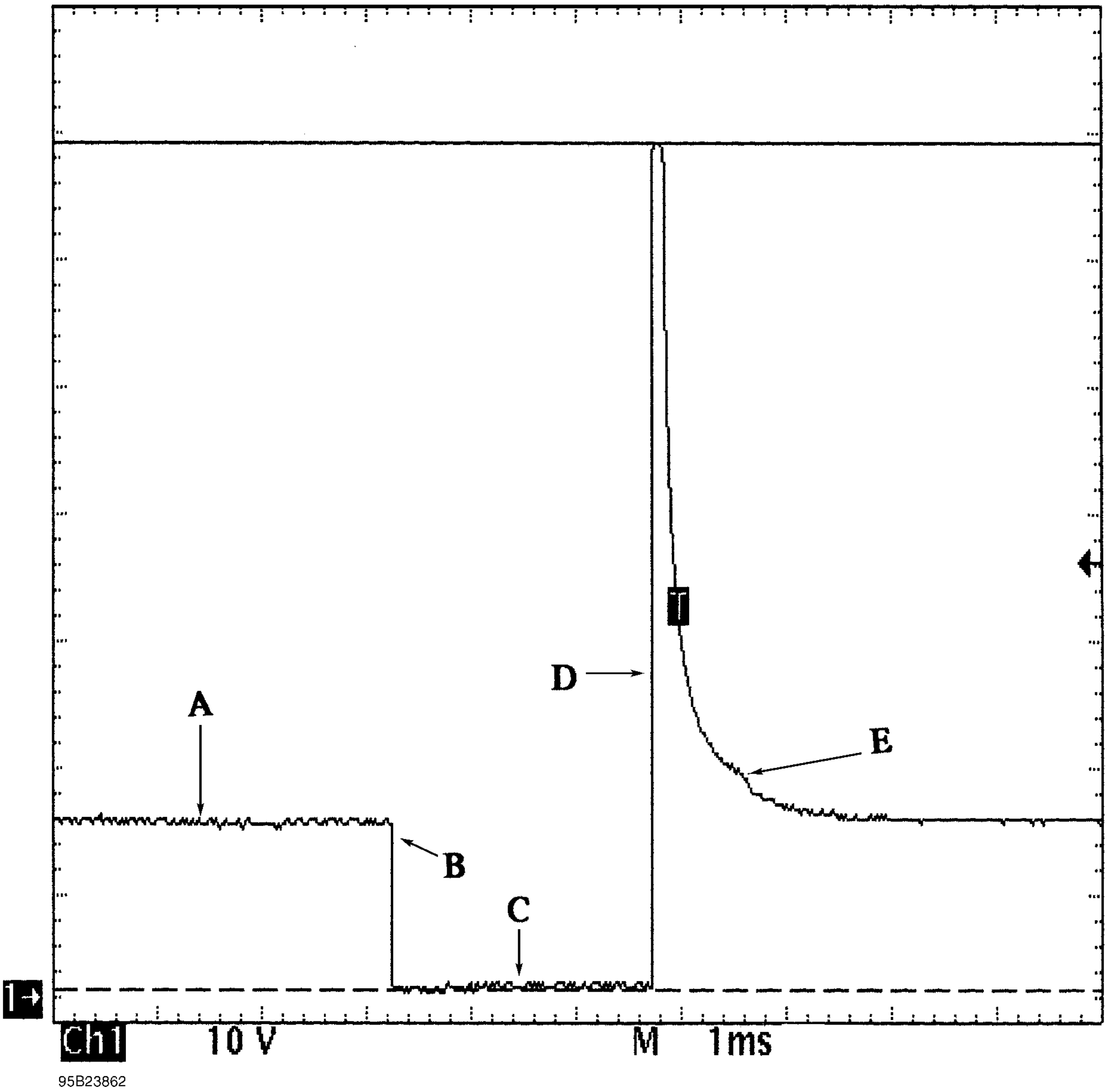


Fig. 2: Identifying Voltage Controlled Type Injector Pattern

INTERPRETING A CURRENT CONTROLLED PATTERN

NOTE: **Current controlled drivers are also known as "Peak and Hold" drivers. They typically require injector circuits with a total leg resistance with less than 12 ohm.**

NOTE: **This example is based on a constant power/switched ground circuit.**

- See Fig. 3 for pattern that the following text describes.

Point "A" is where system voltage is supplied to the injector. A good hot run voltage is usually 13.5 or more volts. This point, commonly known as open circuit voltage, is critical because the injector will not get sufficient current saturation if there is a voltage shortfall. To obtain a good look at this precise point, you will need to shift your Lab Scope to five volts per division.

You will find that some systems have slight voltage fluctuations here. This could occur if the injector feed wire is also used to power up other cycling components, like the ignition coil(s). Slight voltage fluctuations are normal and are no reason for concern. Major voltage fluctuations are a different story, however. Major voltage shifts on the injector feed line will create injector performance problems. Look for excessive resistance problems in the feed circuit if you see big shifts and repair as necessary.

Point "B" is where the driver completes the circuit to ground. This point of the waveform should be a clean square point straight down with no rounded edges. It is during this period that current saturation of the injector windings is taking place and the driver is heavily stressed. Weak drivers will distort this vertical line.

Point "C" represents the voltage drop across the injector windings. Point "C" should come very close to the ground reference point, but not quite touch. This is because the driver has a small amount of inherent resistance. Any significant offset from ground is an indication of a resistance problem on the ground circuit that needs repaired. You might miss this fault if you do not use the negative battery post for your Lab Scope hook-up, so it is HIGHLY recommended that you use the battery as your hook-up.

Right after Point "C", something interesting happens. Notice the trace starts a normal upward bend. This slight inductive rise is created by the effects of counter voltage and is normal. This is because the low circuit resistance allowed a fast build-up of the magnetic field, which in turn created the counter voltage.

Point "D" is the start of the current limiting, also known as the "Hold" time. Before this point, the driver had allowed the current to free-flow ("Peak") just to get the injector pintle open. By the time point "D" occurs, the injector pintle has already opened and the computer has just significantly throttled the current back. It does this by only allowing a few volts through to maintain the minimum current required to keep the pintle open.

The height of the voltage spike seen at the top of Point "D" represents the electrical condition of the injector windings. The height of this voltage spike (inductive kick) is proportional to the number of windings and the current flow through them. The more current flow and greater number of windings, the more potential for a greater inductive kick. The opposite is also true. The less current flow or fewer windings means less inductive kick. Typically you should see a minimum 35 volts.

If you see approximately 35 volts, it is because a zener diode is used with the driver to clamp the voltage. Make sure the beginning top of the spike is squared off, indicating the zener dumped the remainder of the spike. If it is not squared, that indicates the spike is not strong enough to make the zener fully dump, meaning there is a problem with a weak injector winding.

If a zener diode is not used in the computer, the spike from a good injector will be 60 or more volts.

At Point "E", notice that the trace is now just a few volts below system voltage and the injector is in the current limiting, or the "Hold" part of the pattern. This line will either remain flat and stable as shown here, or will cycle up and down rapidly. Both are normal methods to limit current flow. Any distortion may indicate shorted windings.

Point "F" is the actual turn-off point of the driver (and injector). To measure the millisecond on-time of the injector, measure between points "C" and "F". Note that we used cursors to do it for us; they are measuring a 2.56 mS on-time.

The top of Point "F" (second inductive kick) is created by the collapsing magnetic field caused by the final turn-off of the driver. This spike should be like the spike on top of point "D".

Point "G" shows a slight hump. This is actually the mechanical injector pintle closing. Recall that moving an iron core through a magnetic field will create a voltage surge. The pintle is the iron core here.

This pintle hump at Point "E" should occur near the end of the downward slope, and not afterwards. If it does occur after the slope has ended and the voltage has stabilized, it is because the pintle is slightly sticking. Some older Nissan TBI systems suffered from this.

If you see more than one hump it is because of a distorted pintle or seat. This faulty condition is known as "pintle float".

It is important to realize that it takes a good digital storage oscilloscope or analog lab scope to see this pintle hump clearly. Unfortunately, it cannot always be seen.

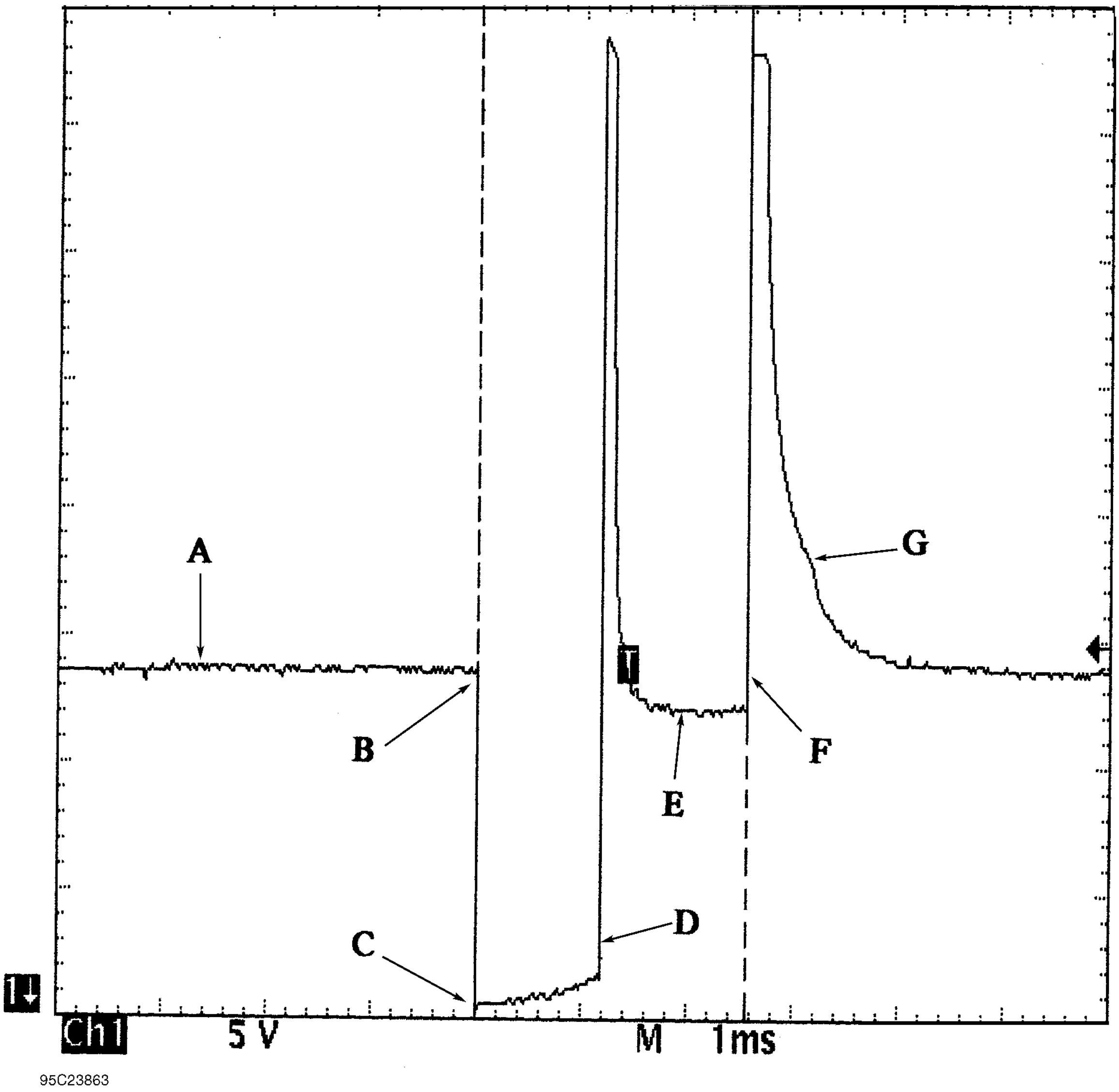


Fig. 3: Identifying Current Controlled Type Injector Pattern

CURRENT WAVEFORM SAMPLES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

The waveform pattern shown in Fig. Fig. 4 indicate a normal current waveform from a Ford 3.0L V6 VIN [U] engine. This voltage controlled type circuit pulses the injectors in groups of three injectors. Injectors No. 1, 3, and 5 are pulsed together and cylinders 2, 4, and 6 are pulsed together. The specification for an acceptable bank resistance is 4.4 ohms. Using Ohm's Law and assuming a hot run voltage of 14 volts, we determine that the bank would draw a current of 3.2 amps.

However this is not the case because as the injector windings become saturated, counter voltage is created which impedes the current flow. This, coupled with the inherent resistance of the driver's transistor, impedes the current flow even more. So, what is a known good value for a dynamic current draw on a voltage controlled bank of injectors? The waveform pattern shown below indicates a good parallel injector current flow of 2 amps. See Fig. 4.

Note that if just one injector has a resistance problem and partially shorts, the entire parallel bank that it belongs to will draw more current. This can damage the injector driver.

The waveform pattern in Fig. Fig. 5 indicates this type of problem with too much current flow. This is on other bank of injectors of the same vehicle; the even side. Notice the Lab Scope is set on a one amp per division scale. As you can see, the current is at an unacceptable 2.5 amps.

It is easy to find out which individual injector is at fault. All you need to do is inductively clamp onto each individual injector and compare them. To obtain a known-good value to compare against, we used the good bank to capture the waveform in Fig. **Fig. 6**. Notice that it limits current flow to 750 milliamps.

The waveform shown in Fig. **Fig. 7** illustrates the problem injector we found. This waveform indicates an unacceptable current draw of just over one amp as compared to the 750 milliamp draw of the known-good injector. A subsequent check with a DVOM found 8.2 ohms, which is under the 12 ohm specification.

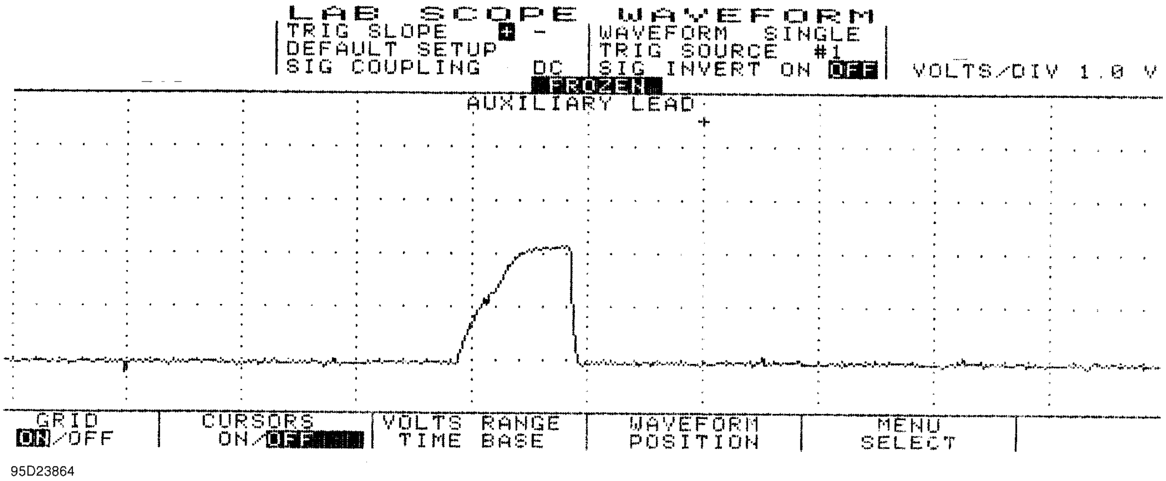

LAB SCOPE WAVEFORM
TRIG SLOPE + -
DEFAULT SETUP
SIG COUPLING DC
WAVEFORM SINGLE
TRIG SOURCE #1
SIG INVERT ON OFF
VOLTS/DIV 1.0 V
FROZEN
AUXILIARY LEAD
GRID ON/OFF
CURSORS ON/OFF
VOLTS RANGE TIME BASE
WAVEFORM POSITION
MENU SELECT
95D23864

Fig. 4: Injector Bank w/Normal Current Flow - Current Pattern

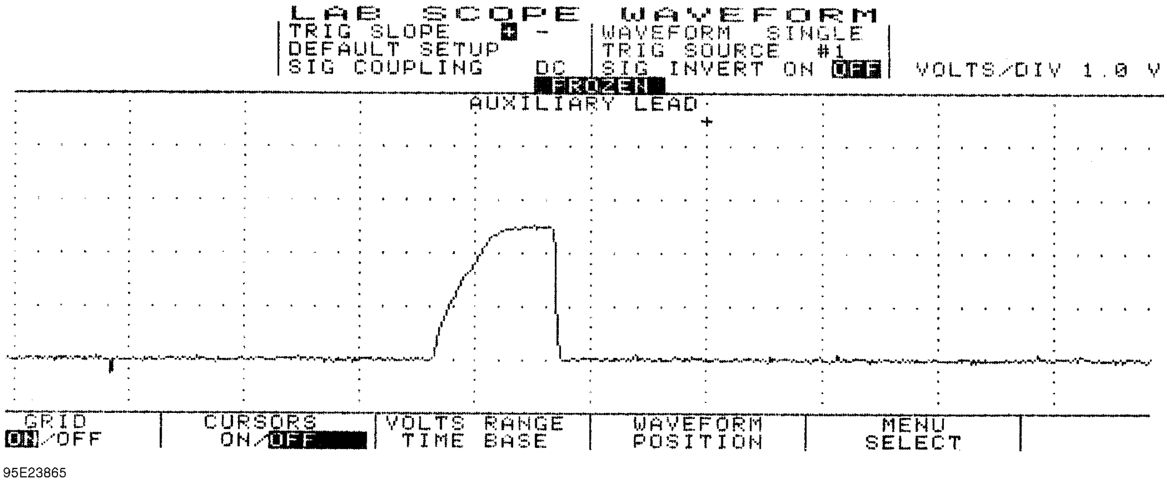
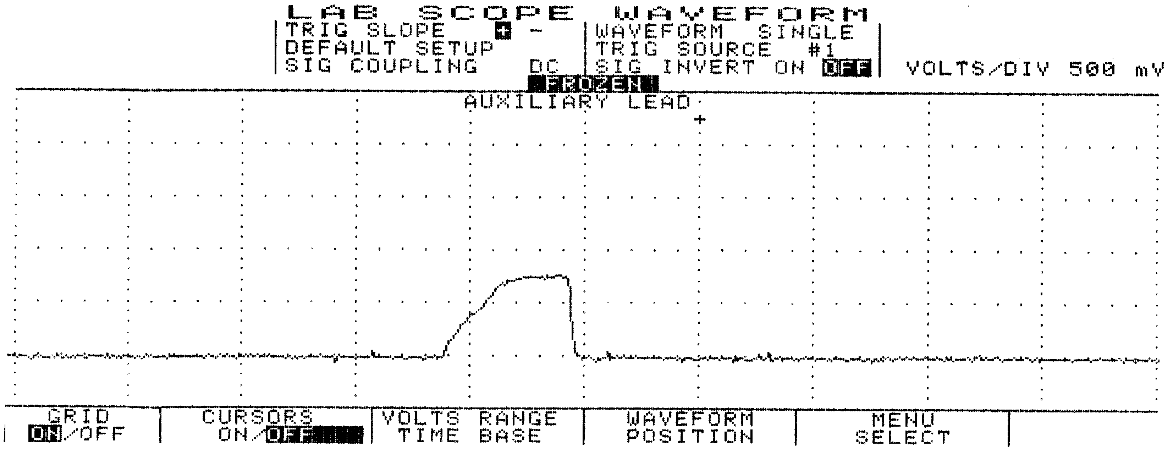
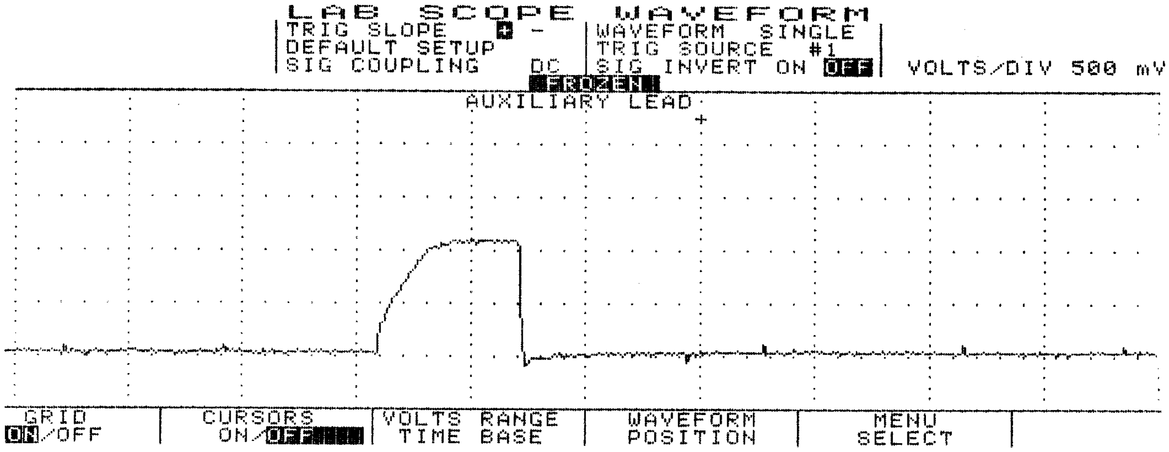

LAB SCOPE WAVEFORM
TRIG SLOPE + -
DEFAULT SETUP
SIG COUPLING DC
WAVEFORM SINGLE
TRIG SOURCE #1
SIG INVERT ON OFF
VOLTS/DIV 1.0 V
FROZEN
AUXILIARY LEAD
GRID ON/OFF
CURSORS ON/OFF
VOLTS RANGE TIME BASE
WAVEFORM POSITION
MENU SELECT
95E23865

Fig. 5: Injector Bank w/Excessive Current Flow - Current Pattern



95F23866

Fig. 6: Single Injector w/Normal Current Flow - Current Pattern



95G23867

Fig. 7: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

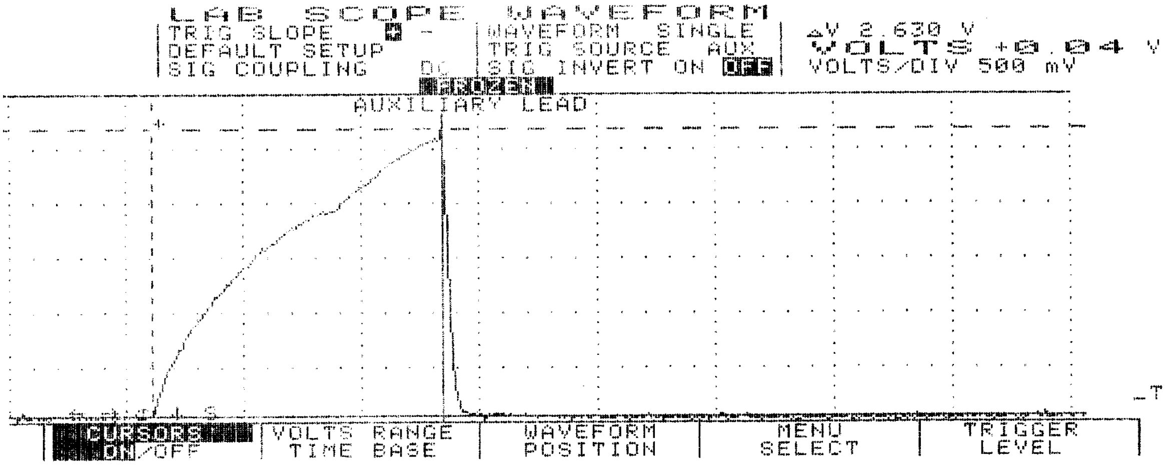
This time we will look at a GM 3.1L V6 VIN [T]. Fig. **Fig. 8** shows the 1, 3, 5 (odd) injector bank with the current waveform indicating about a 2.6 amp draw at idle. This pattern, taken from a known good vehicle, correctly stays at or below the maximum 2.6 amps current range. Ideally, the current for each bank should be very close in comparison.

Notice the small dimple on the current flow's rising edge. This is the actual injector opening or what engineers refer to as the "set point." For good idle quality, the set point should be uniform between the banks.

When discussing Ohm's Law as it pertains to this parallel circuit, consider that each injector has specified resistance of 12.2 ohms. Since all three injectors are in parallel the total resistance of this parallel circuit drops to 4.1 ohms. Fourteen volts divided by four ohms would pull a maximum of 3.4 amps on this bank of injectors. However, as we discussed in **EXAMPLE #1** above, other factors knock this value down to roughly the 2.6 amp neighborhood.

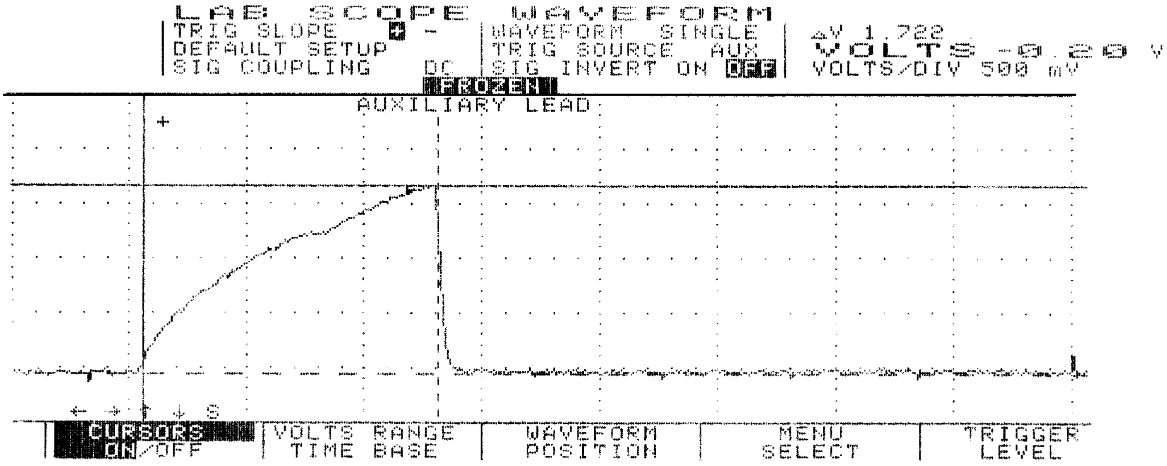
Now we are going to take a look at the even bank of injectors; injectors 2, 4, and 6. See **Fig. 9**. Notice this bank peaked at 1.7 amps at idle as compared to the 2.6 amps peak of the odd bank (Fig. **Fig. 8**). Current flow between even and odd injectors banks is not uniform, yet it is not causing a driveability problem. That is because it is still under the maximum amperage we figured out earlier. But be aware this vehicle could develop a problem if the amperage flow increases any more.

Checking the resistance of this even injector group with a DVOM yielded 6.2 ohms, while the odd injector group in the previous example read 4.1 ohms.


LAB SCOPE WAVEFORM
TRIG SLOPE + -
DEFAULT SETUP
SIG COUPLING DC
WAVEFORM SINGLE
TRIG SOURCE AUX
SIG INVERT ON OFF
ΔV 2.630 V
VOLTS +0.04 V
VOLTS/DIV 500 mV
FROZEN
AUXILIARY LEAD
T
CURSORS ON/OFF
VOLTS RANGE TIME BASE
WAVEFORM POSITION
MENU SELECT
TRIGGER LEVEL

95E23873

Fig. 8: Injector Odd Bank w/Normal Current Flow - Current Pattern


LAB SCOPE WAVEFORM
TRIG SLOPE + -
DEFAULT SETUP
SIG COUPLING DC
WAVEFORM SINGLE
TRIG SOURCE AUX
SIG INVERT ON OFF
ΔV 1.722
VOLTS -0.20 V
VOLTS/DIV 500 mV
FROZEN
AUXILIARY LEAD
CURSORS ON/OFF
VOLTS RANGE TIME BASE
WAVEFORM POSITION
MENU SELECT
TRIGGER LEVEL

95F23874

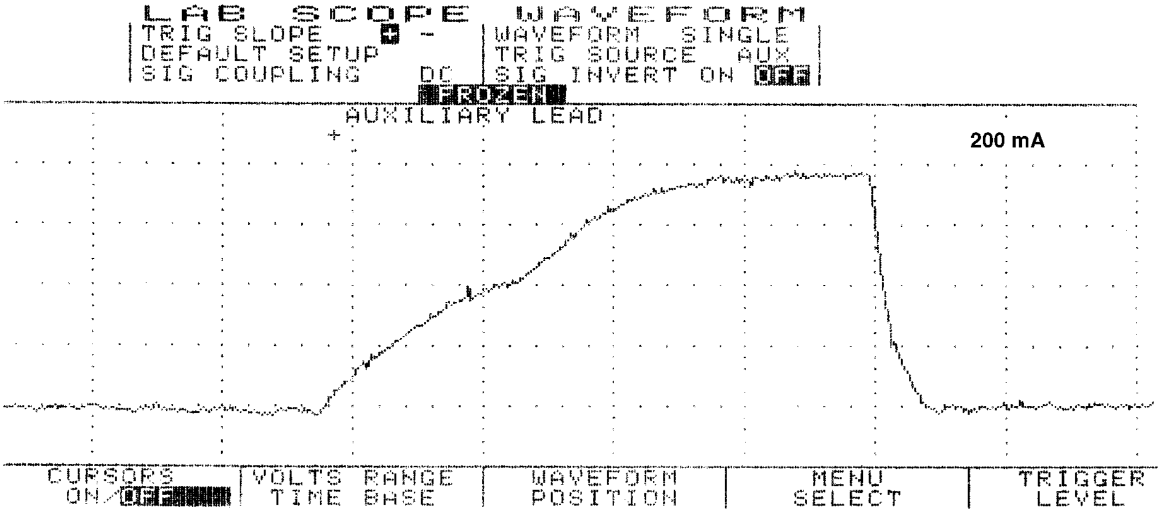
Fig. 9: Injector Even Bank w/Normal Current Flow - Current Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

Example #3 is of a Ford 5.0L V8 SEFI. Fig. Fig. 10 shows a waveform of an individual injector at idle with the Lab Scope set on 200 milliamps per division. Notice the dimple in the rising edge. This dimple indicates the actual opening of the injector (set point) occurred at 400 milliamps and current peaked at 750 milliamps. This is a good specification for this engine.

The next waveform pattern in Fig. Fig. 11 shows an abnormality with another injector. With the Lab Scope set on 500 milliamps per division, you can see that the current waveform indicates a 1200 milliamp draw. This is a faulty injector.

Abnormally low resistance injectors create excessive current draw, causing rough idle, and possible computer driver damage.


LAB SCOPE WAVEFORM

TRIG SLOPE + -

DEFAULT SETUP

SIG COUPLING DC

WAVEFORM SINGLE

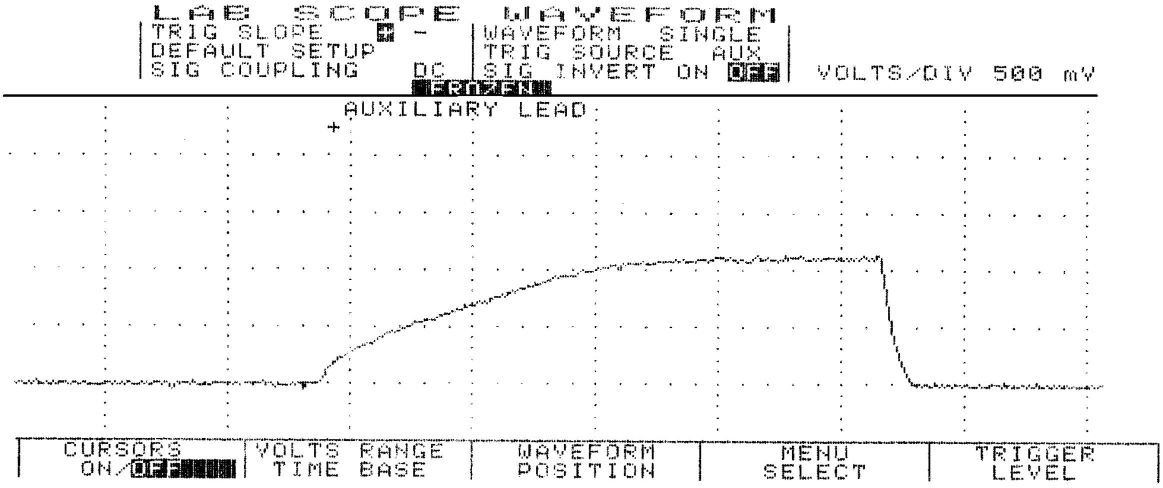
TRIG SOURCE AUX

SIG INVERT ON OFF

FROZEN
AUXILIARY LEAD
+
200 mA
CURSORS ON/OFF
VOLTS RANGE TIME BASE
WAVEFORM POSITION
MENU SELECT
TRIGGER LEVEL

95G23875

[Fig. 10: Single Injector w/Normal Current Flow - Current Pattern]


LAB SCOPE WAVEFORM

TRIG SLOPE + -

DEFAULT SETUP

SIG COUPLING DC

WAVEFORM SINGLE

TRIG SOURCE AUX

SIG INVERT ON OFF

VOLTS/DIV 500 mV

FROZEN
AUXILIARY LEAD
+
CURSORS ON/OFF
VOLTS RANGE TIME BASE
WAVEFORM POSITION
MENU SELECT
TRIGGER LEVEL

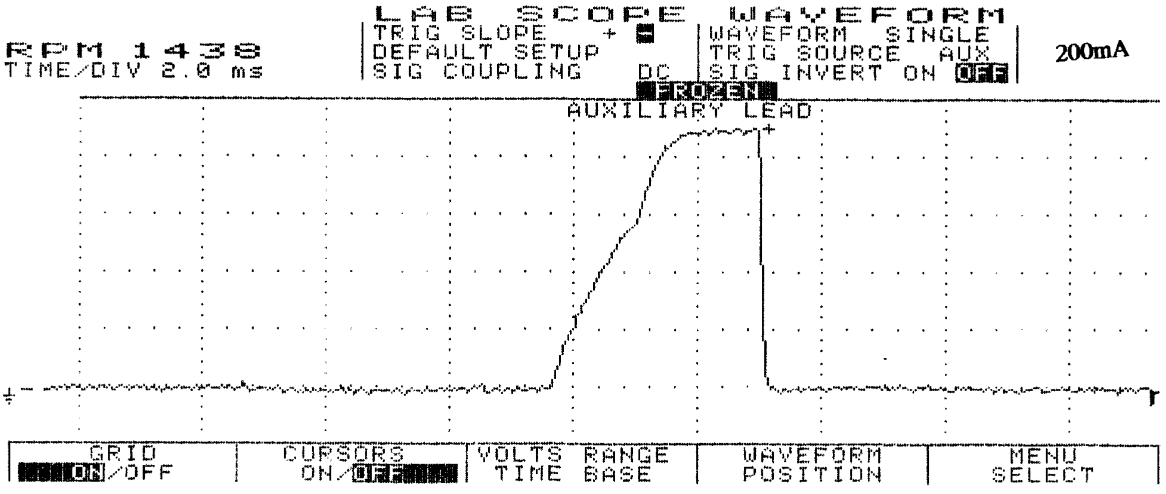
95H23876

[Fig. 11: Single Injector w/Excessive Current Flow - Current Pattern]

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

Example #4 is of a Ford 4.6L SEFI VIN [W]. See Fig. 12 for the known-good waveform pattern. This Ford system is different from the one above in EXAMPLE #3 as it peaks at 900 milliamps and the actual opening of the injector (set point) is just below 600 milliamps.

This is offered as a comparison against the Ford pattern listed above, as they are both Ford SEFI injectors but with different operating ranges. The point is that you should not make any broad assumptions for any manufacturer.



LAB SCOPE WAVEFORM

RPM 1438

TIME/DIV 2.0 ms

TRIG SLOPE + -

DEFAULT SETUP

SIG COUPLING DC

WAVEFORM SINGLE

TRIG SOURCE AUX

SIG INVERT ON OFF

FROZEN

AUXILIARY LEAD

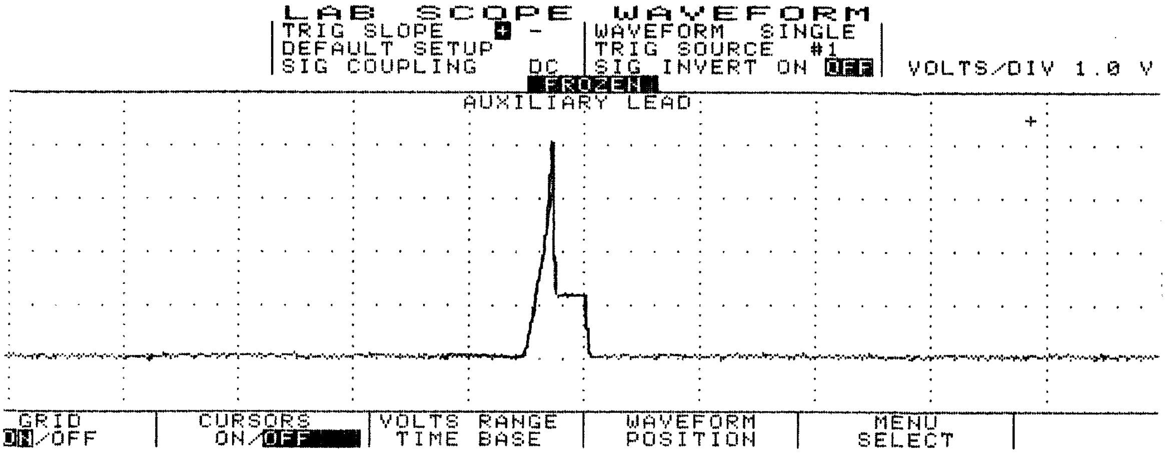
200mA

95D23872

Fig. 12: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

The known-good waveform in Fig. Fig. 13 is from a Chrysler 3.0L V6 PFI VIN [3]. It is a perfect example of the peak and hold theory. The waveform shows a 1-amp per division current flow, ramping to 4 amps and then decreasing to 1-amp to hold the injector open.



LAB SCOPE WAVEFORM

TRIG SLOPE + -

DEFAULT SETUP

SIG COUPLING DC

WAVEFORM SINGLE

TRIG SOURCE #1

SIG INVERT ON OFF

VOLTS/DIV 1.0 V

FROZEN

AUXILIARY LEAD

95H23868

Fig. 13: Injector Bank w/Normal Current Flow - Current Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This next known-good waveform is from a Ford 5.0L V8 CFI VIN [F]. See Fig. 14. The pattern, which is set on a 250 milliamps scale, indicates a 1.25 amp peak draw and a hold at 350 milliamps.

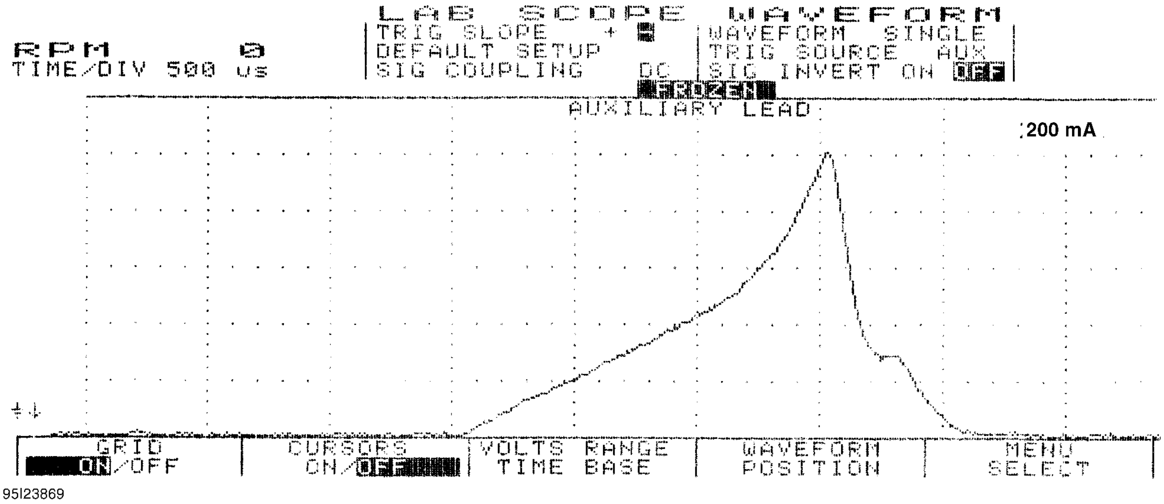


Fig. 14: Single Injector w/Normal Current Flow - Current Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

The known-good current controlled type waveform in Fig. Fig. 15 is from a GM 2.0L TBI VIN [1]. With the lab scope set at 2 amps per division, notice that this system peaks at 4 amps and holds at 1 amp.

The next waveform is from the same type of engine, except that it shows a faulty injector. See Fig. 16. Notice that the current went to almost 5 amps and stayed at 1 amp during the hold pattern. Excessive amounts of current flow from bad injectors are a common source of intermittent computer shutdown. Using a current waveform pattern is the most accurate method of pinpointing this problem.

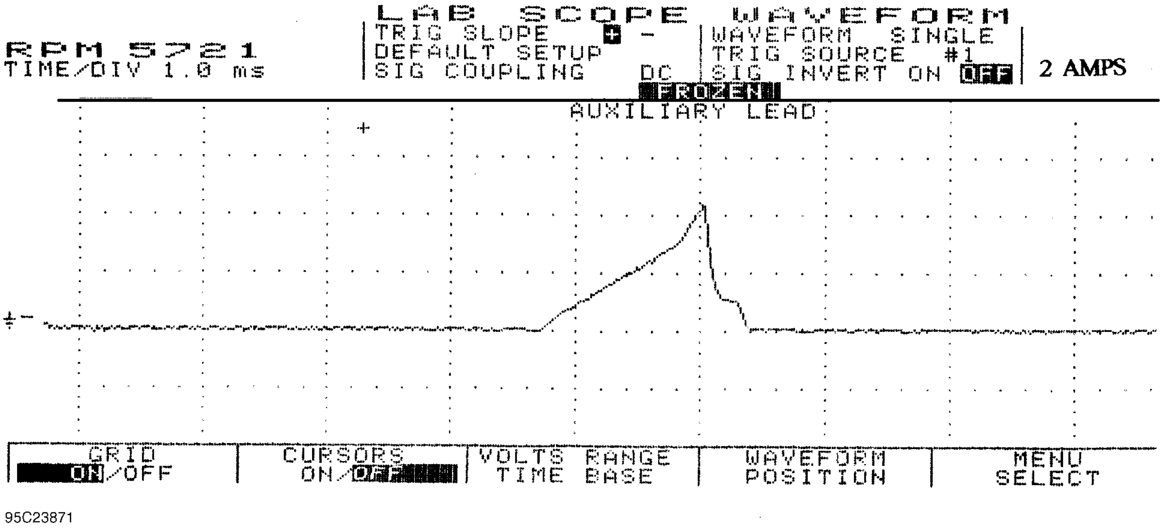


Fig. 15: Single Injector w/Normal Current Flow - Current Pattern

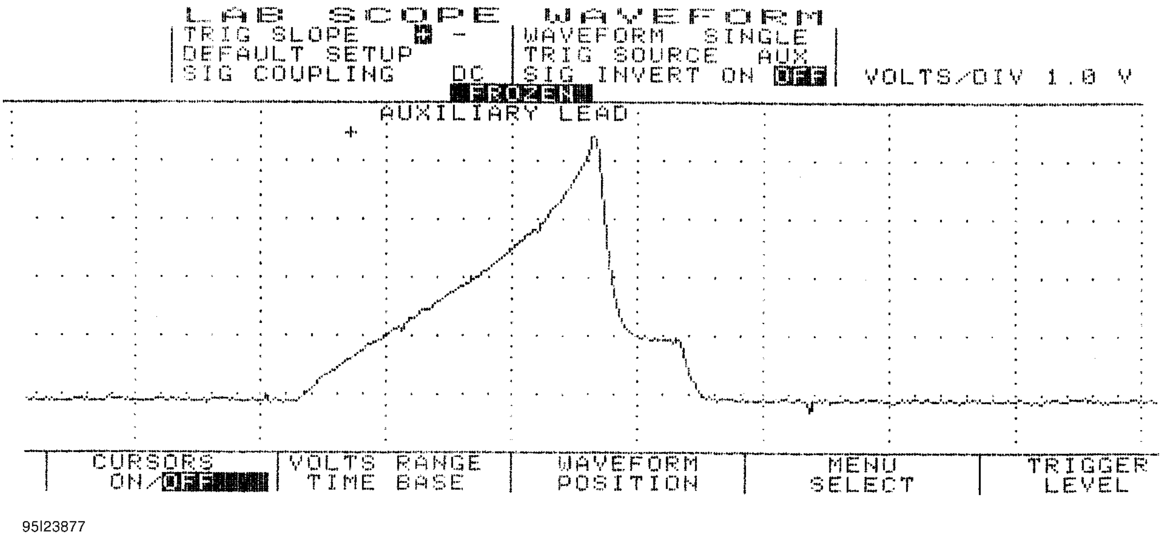


Fig. 16: Single Injector w/Excessive Current Flow - Current Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

This known-good CPI system waveform from a GM 4.3L V6 CPI VIN [W] peaks at 4 amps and holds at 1-amp. See **Fig. 17** for waveform.

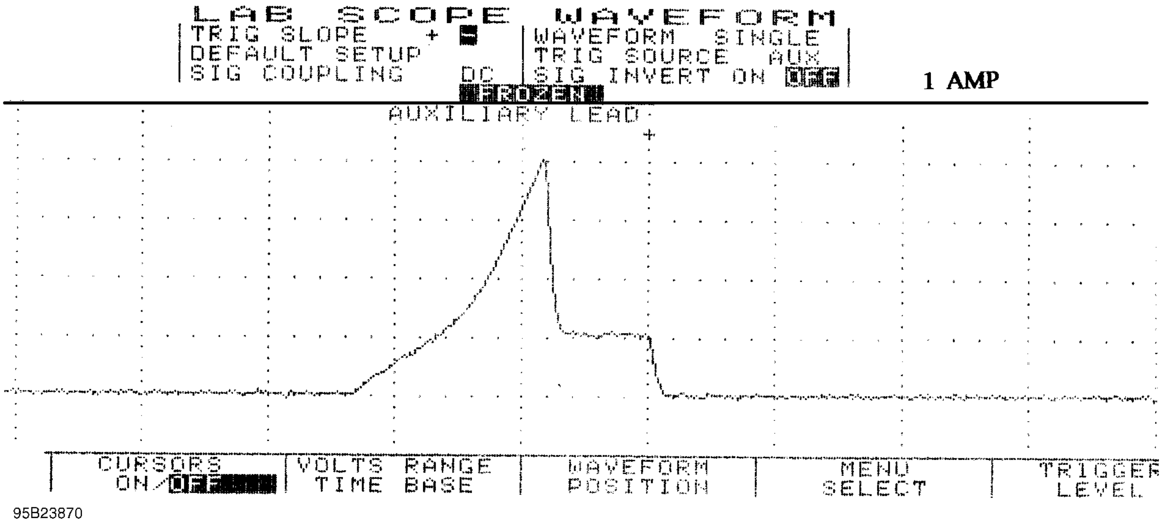


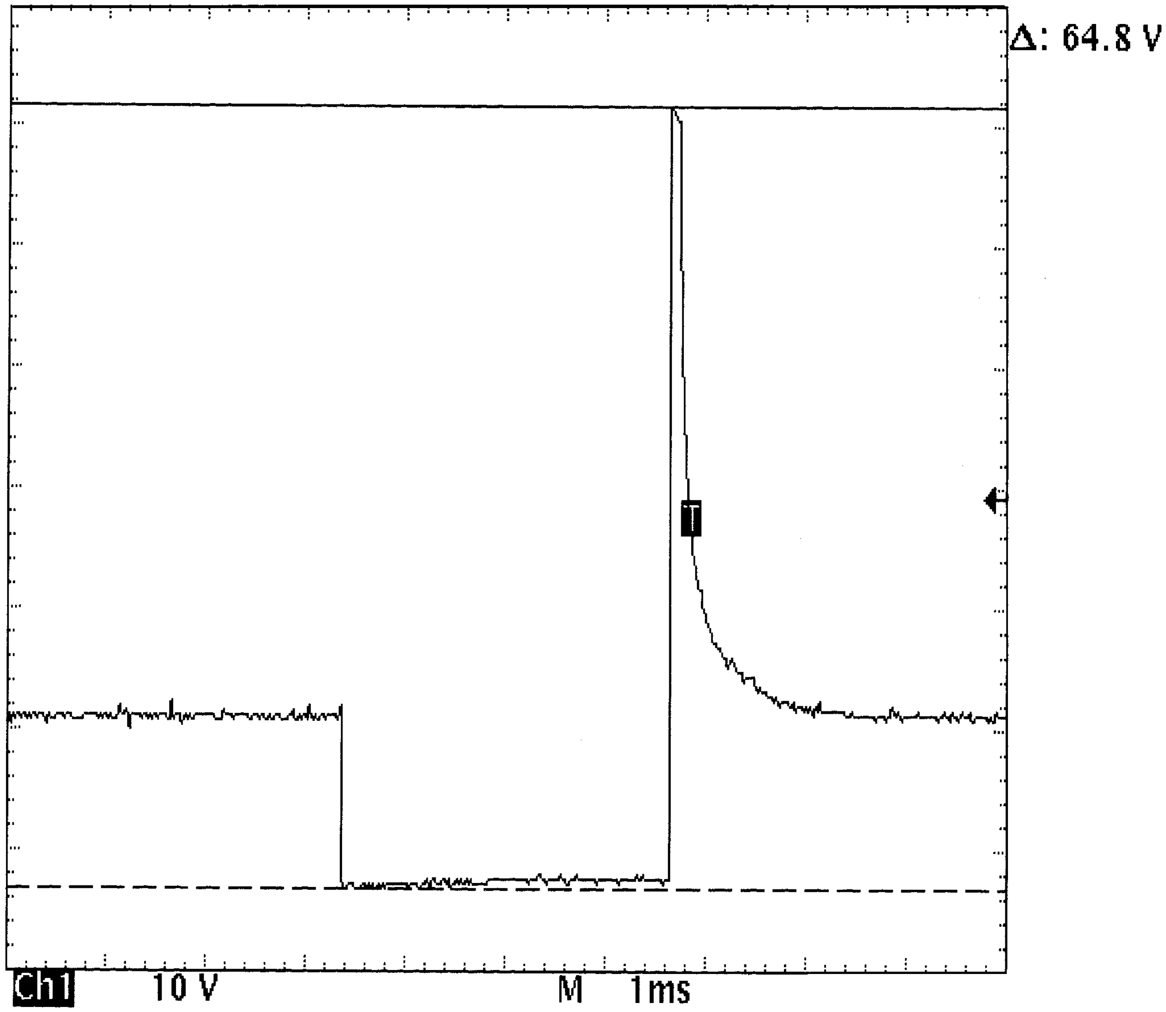
Fig. 17: Single Injector w/Normal Current Flow - Current Pattern

VOLTAGE WAVEFORM SAMPLES

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

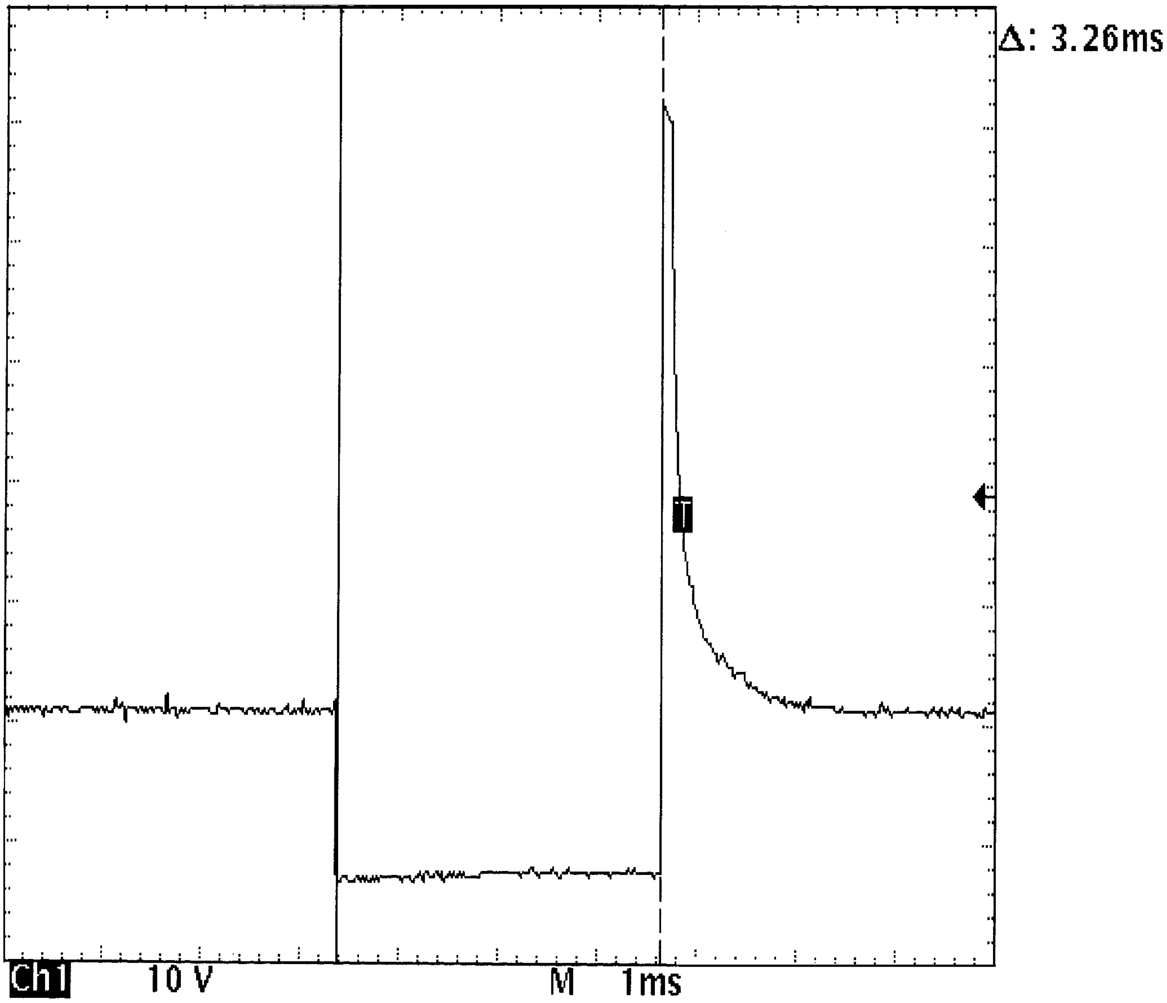
EXAMPLE #1 - VOLTAGE CONTROLLED DRIVER

These two known-good waveform patterns are from a Ford 4.6L V8 VIN [W]. Fig. **Fig. 18** illustrates the 64 volt inductive kick on this engine, indicating no clamping is occurring. The second pattern, Fig. **Fig. 19**, was taken during hot idle, closed loop, and no load.



95E23857

Fig. 18: Injector Bank - Known Good - Voltage Pattern



95F23858

Fig. 19: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #2 - VOLTAGE CONTROLLED DRIVER

The known-good waveform pattern in Fig. **Fig. 20** is from a GM 3.8L V6 PFI VIN [3]. It was taken during hot idle, closed loop and no load.

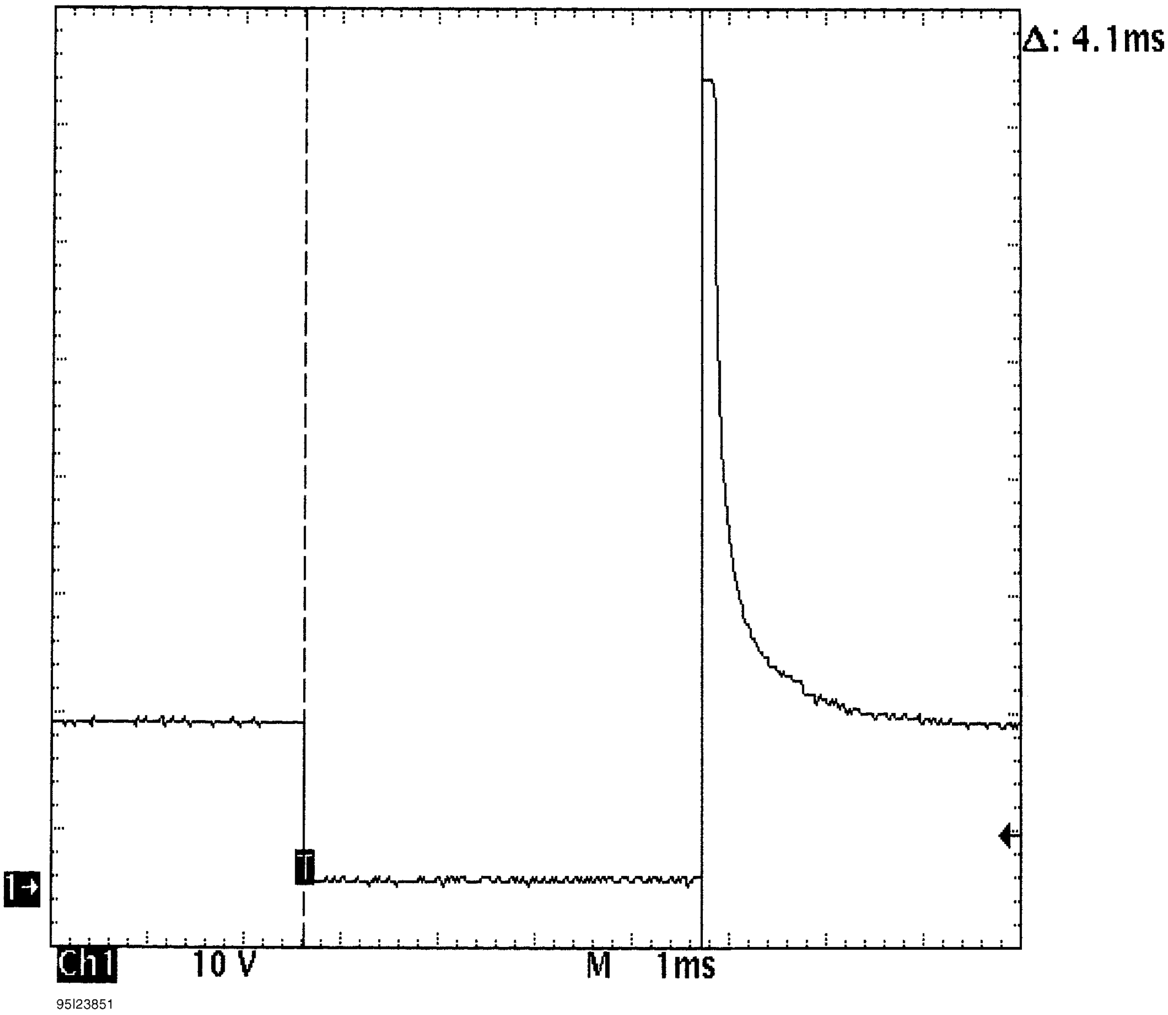


Fig. 20: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #3 - VOLTAGE CONTROLLED DRIVER

This known-good waveform pattern, Fig. **Fig. 21**, is from a GM 5.0L V8 TPI VIN [F]. It was taken during hot idle, closed loop and no load.

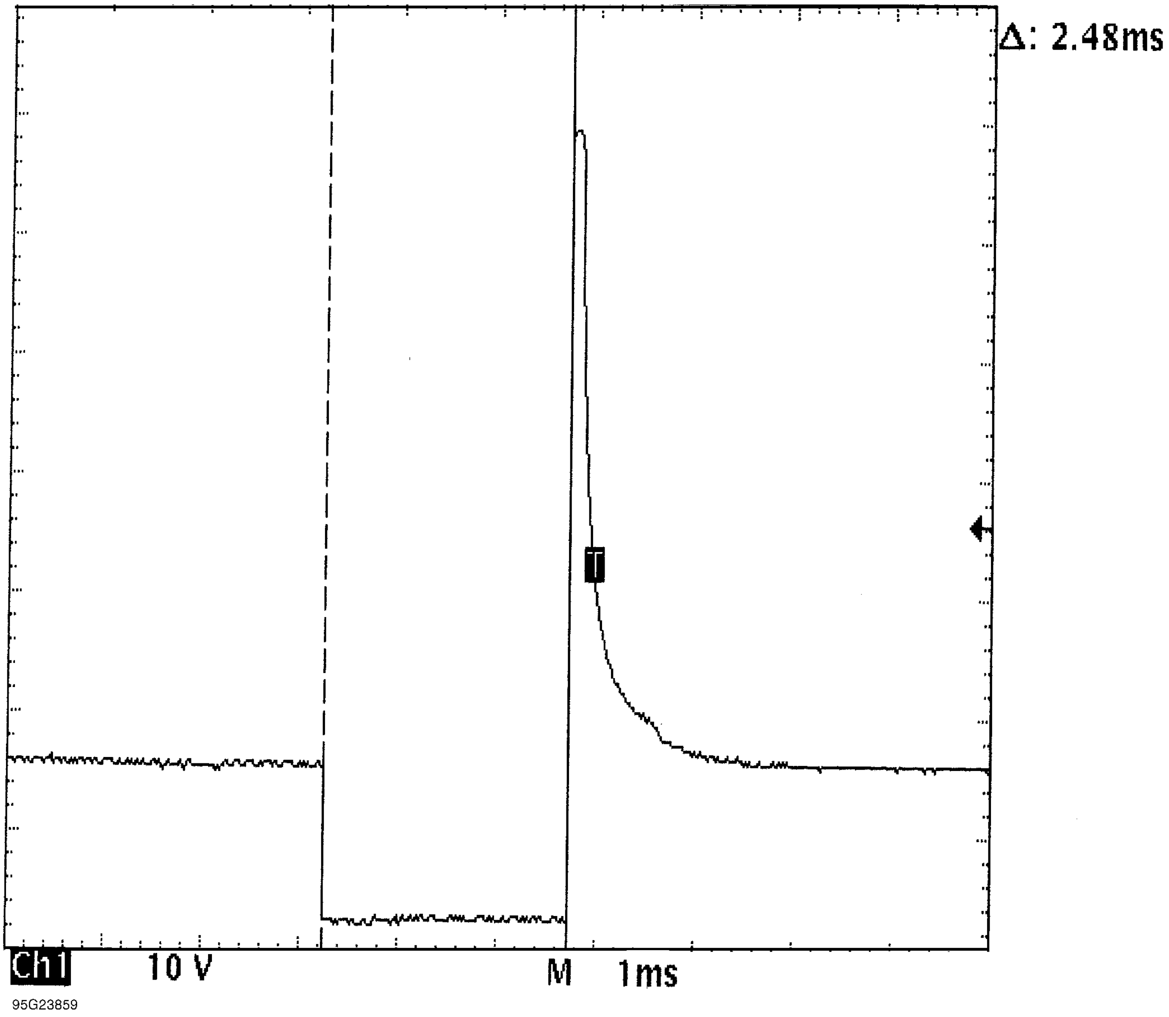
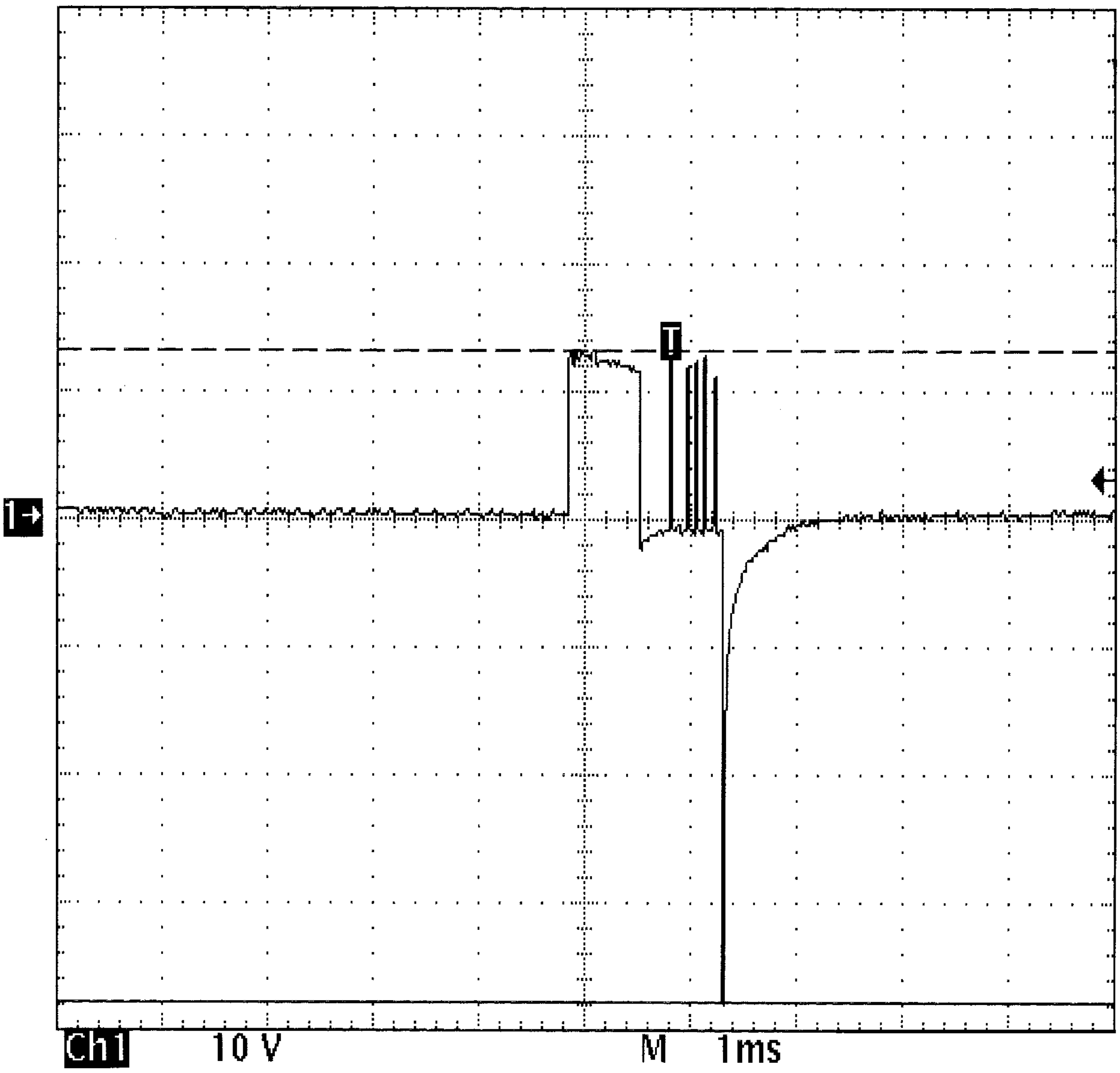


Fig. 21: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #4 - CURRENT CONTROLLED DRIVER

From 1984 to 1987, Chrysler used this type injector drive on their TBI-equipped engines. See Fig. 22 for a known-good pattern. Instead of the ground side controlling the injector, Chrysler permanently grounds out the injector and switches the power feed side. Most systems do not work this way.

These injectors peak at 6 amps of current flow and hold at 1 amp.



95J23860

Fig. 22: Single Injector - Known Good - Voltage Pattern

EXAMPLE #5 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a Chrysler 3.0L V6 VIN [3]. The first waveform, Fig. **Fig. 23**, is a dual trace pattern that illustrates how Chrysler uses the rising edge of the engine speed signal to trigger the injectors. The second waveform, Fig. **Fig. 24**, was taken during hot idle, closed loop, and no load.

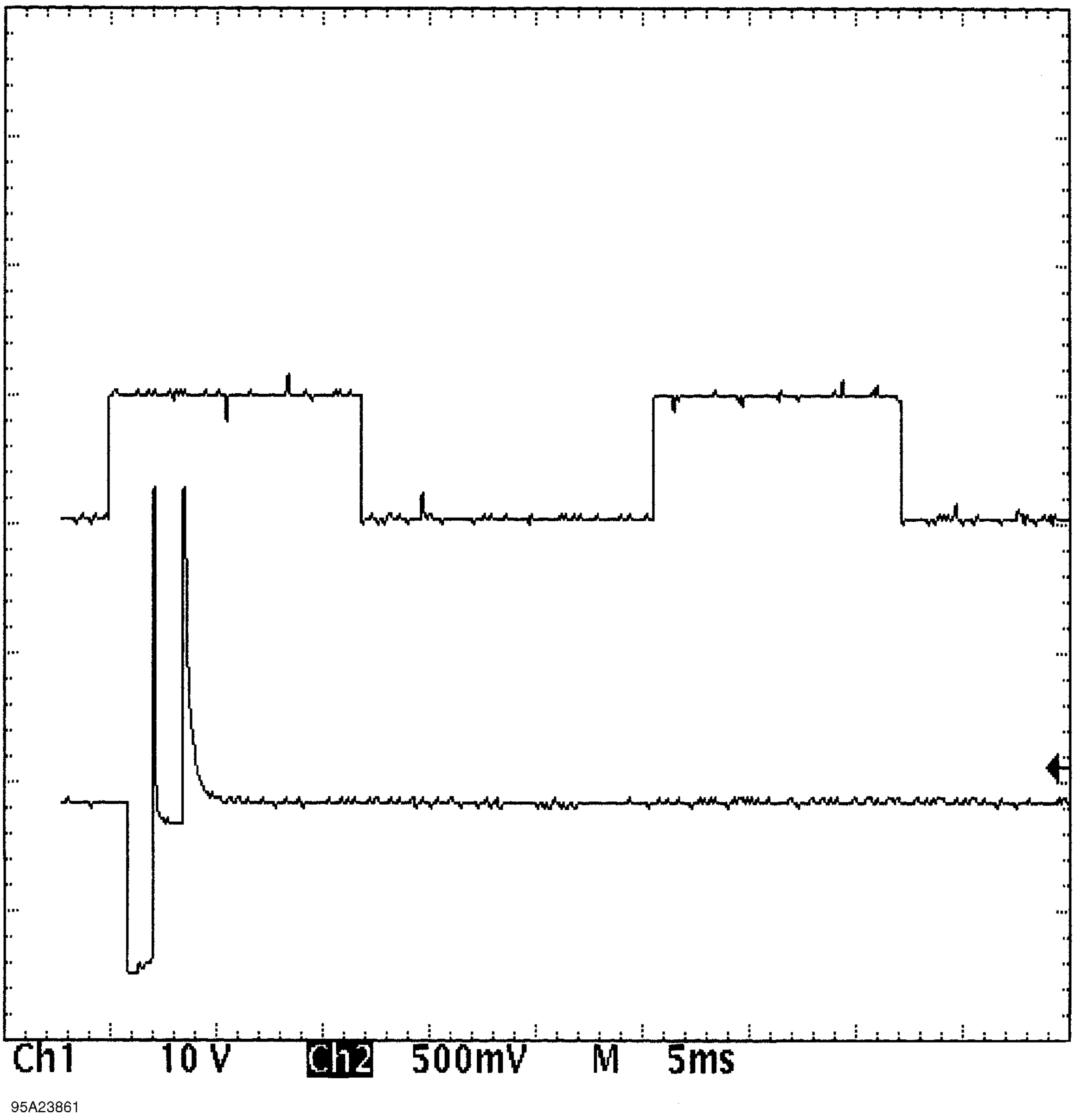
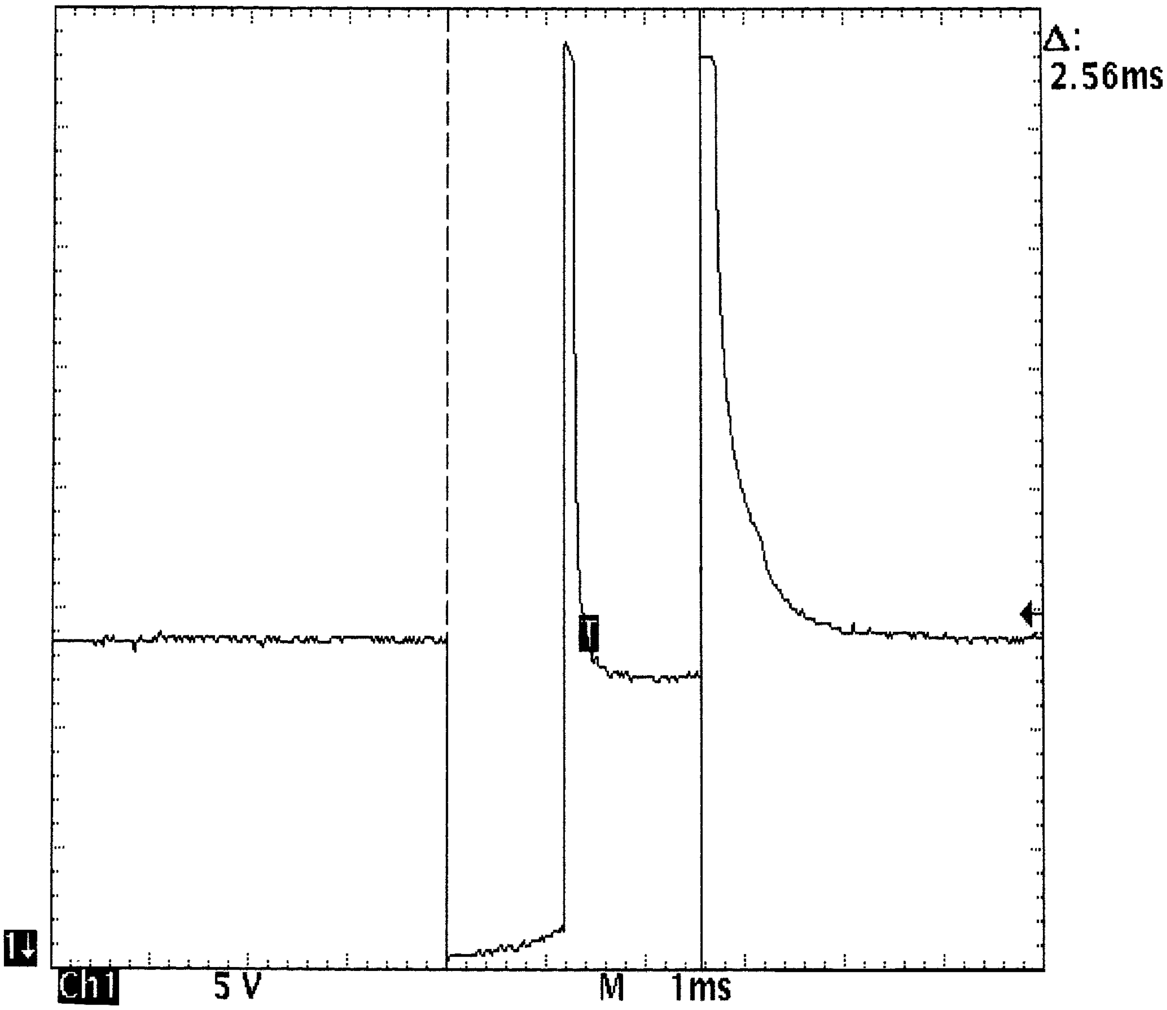


Fig. 23: Injector Bank - Known Good - Voltage Pattern



95B23854

Fig. 24: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #6 - CURRENT CONTROLLED DRIVER

This known-good pattern from a Ford 3.0L V6 PFI VIN [U] illustrates that a zener diode inside the computer is used to clamp the injector's inductive kick to 35-volts on this system. See Fig. 25.

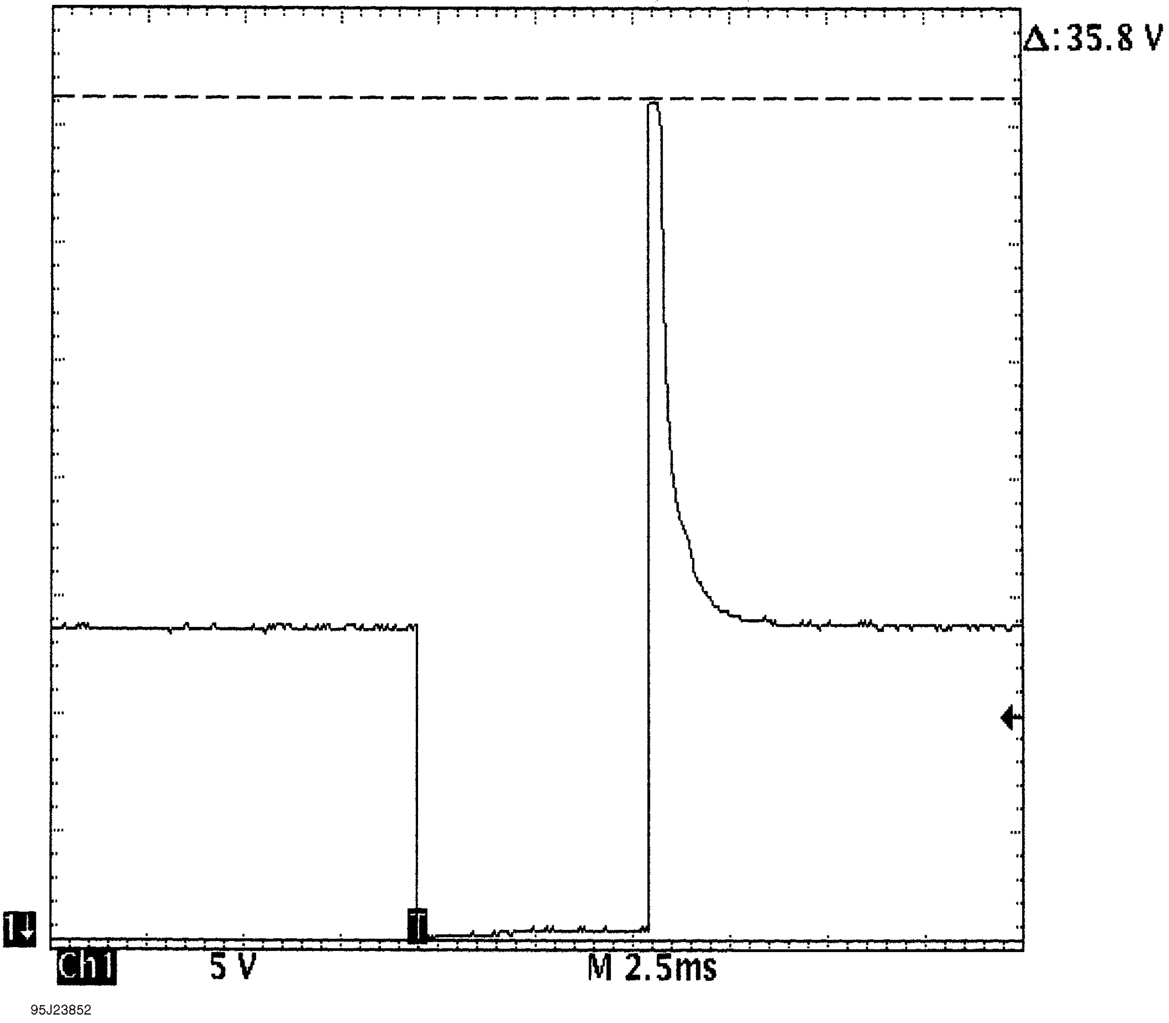


Fig. 25: Injector Bank - Known Good - Voltage Pattern

EXAMPLE #7 - CURRENT CONTROLLED DRIVER

This known-good waveform from a Ford 5.0L V8 CFI VIN [F] was taken during hot idle, closed loop, and no load. See Fig. 26.

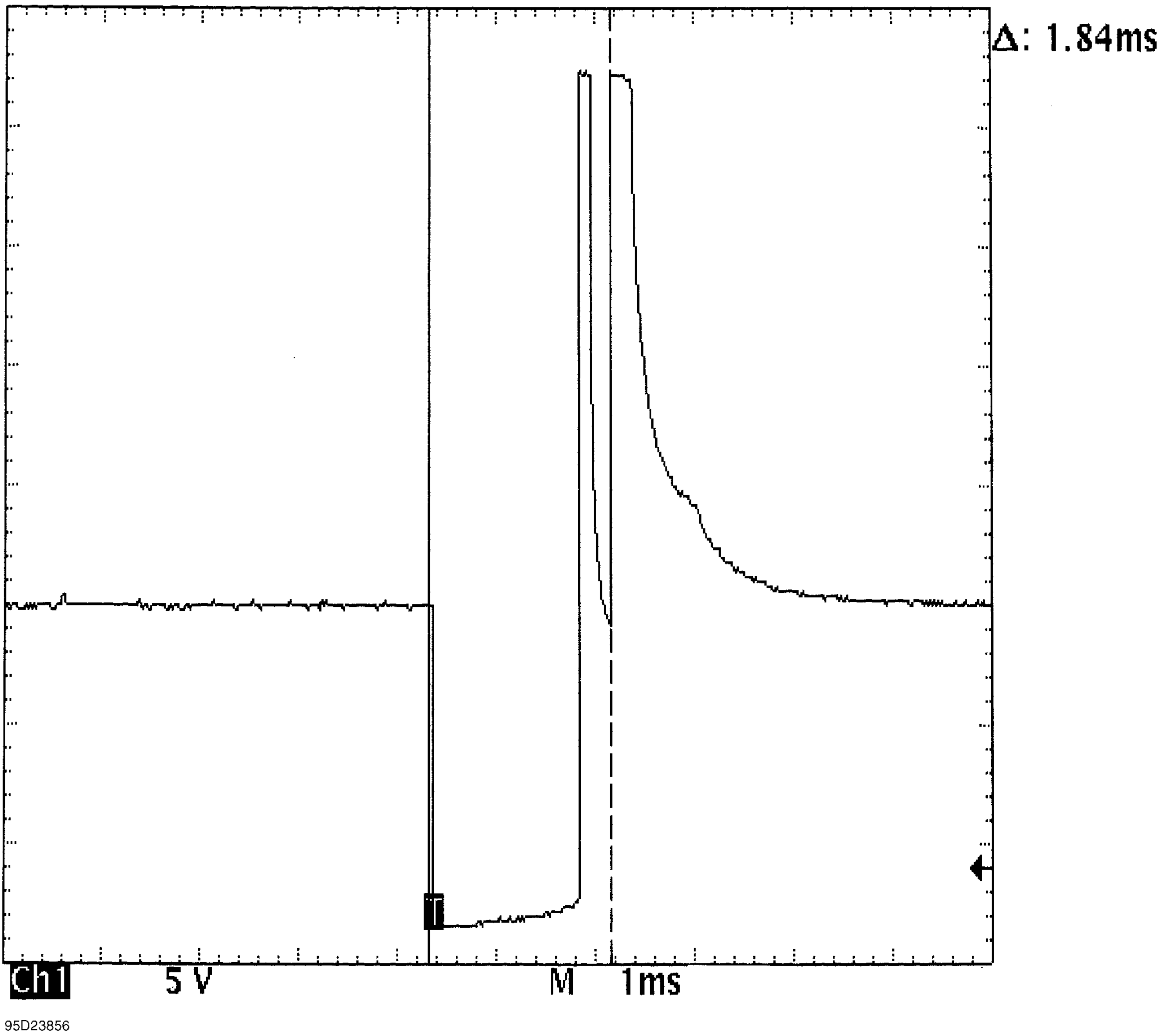
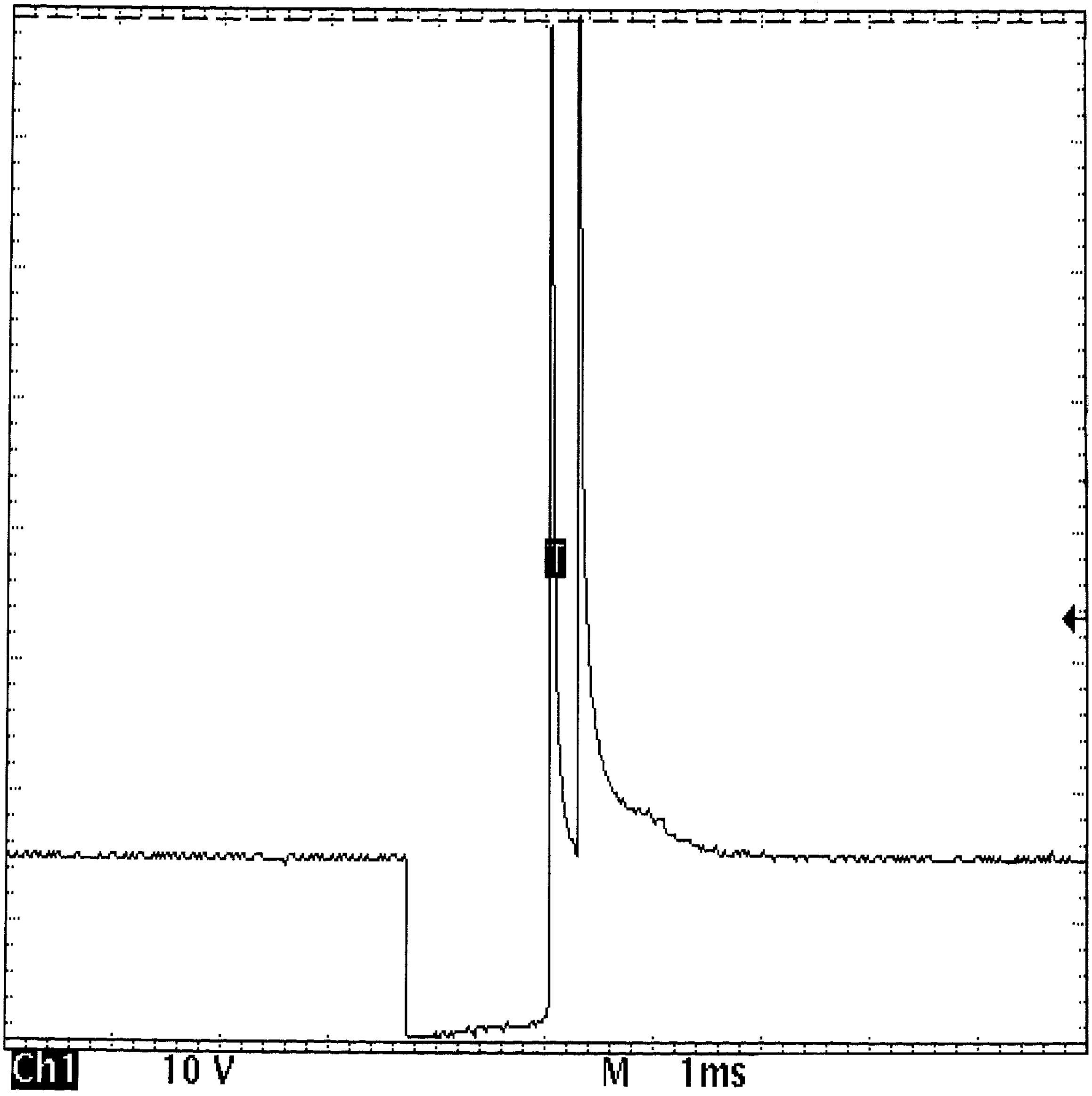


Fig. 26: Single Injector - Known Good - Voltage Pattern

EXAMPLE #8 - CURRENT CONTROLLED DRIVER

These two known-good waveform patterns are from a GM 2.0L In-Line 4 VIN [1]. Fig. **Fig. 27** illustrates the 78 volt inductive spike that indicates a zener diode is not used. The second waveform, Fig. **Fig. 28**, was taken during hot idle, closed loop, and no load.



95D23849

Fig. 27: Single Injector - Known Good - Voltage Pattern

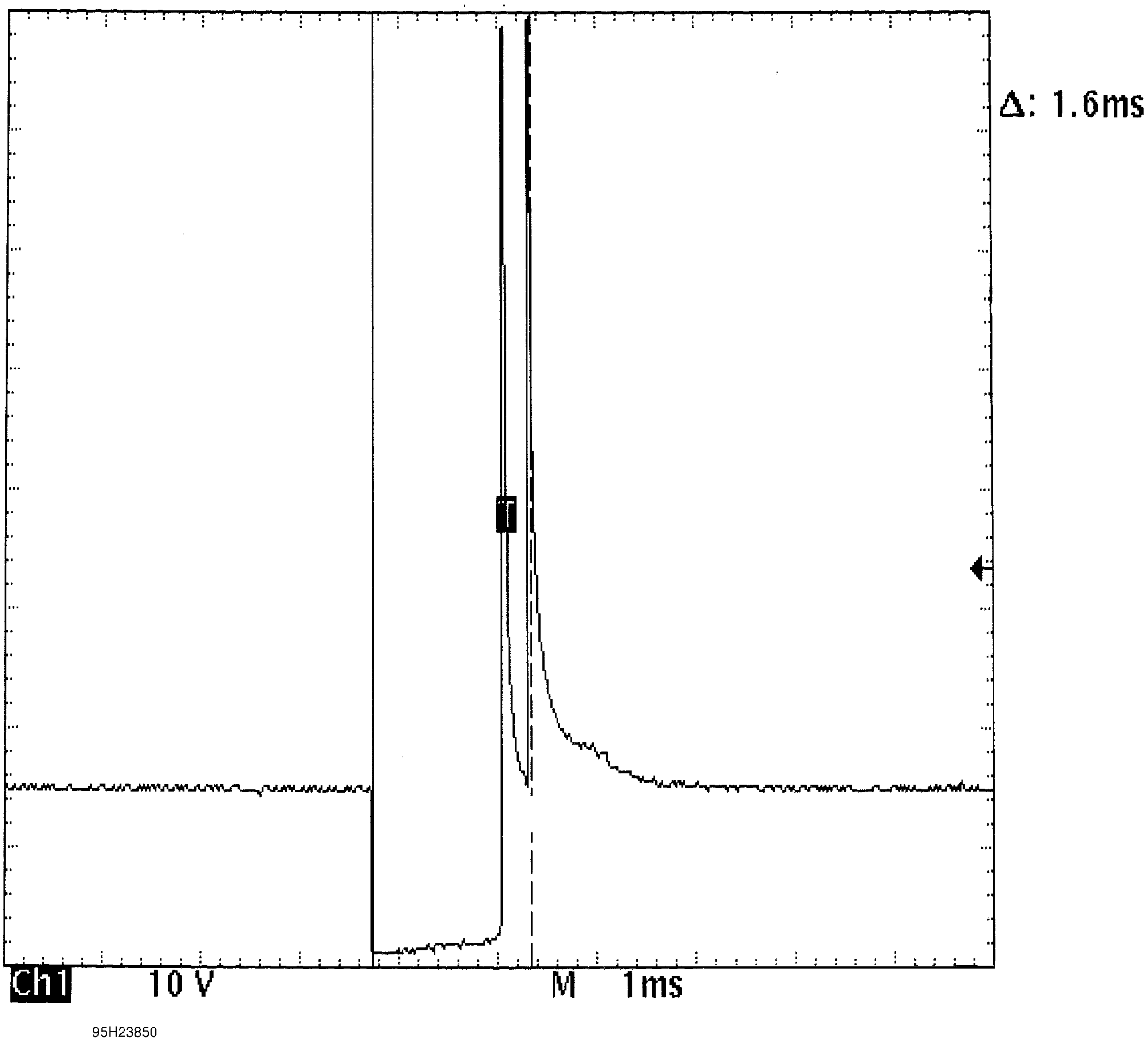


Fig. 28: Single Injector - Known Good - Voltage Pattern

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GENERAL INFORMATION

Wheel Alignment Theory & Operation

* PLEASE READ THIS FIRST *

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

PRE-ALIGNMENT INSTRUCTIONS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

GENERAL ALIGNMENT CHECKS

Before adjusting wheel alignment, check the following:

- Each axle uses tires of same construction and tread style, equal in tread wear and overall diameter. Verify that radial and axial runout is not excessive. Inflation should be at manufacturer's specifications.
- Steering linkage and suspension must not have excessive play. Check for wear in tie rod ends and ball joints. Springs must not be sagging. Control arm and strut rod bushings must not have excessive play. See Fig. 1.

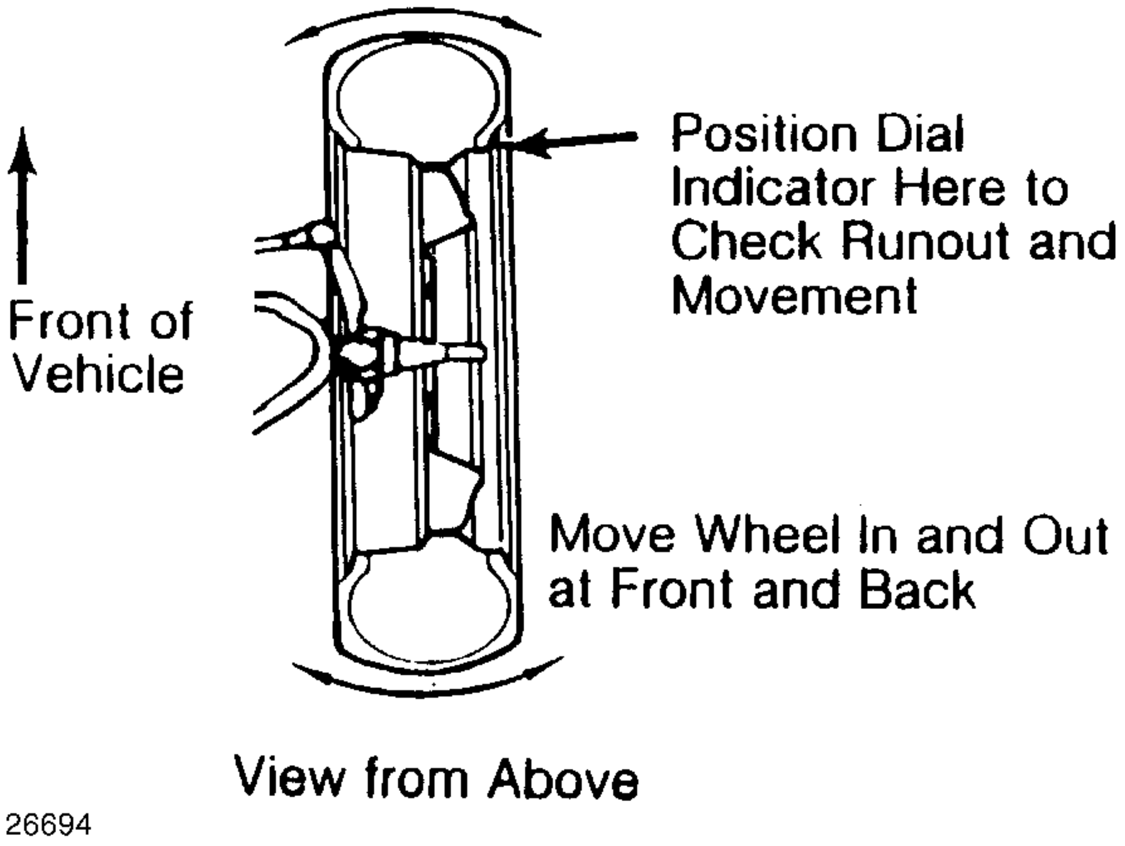
Position Dial Indicator Here to Check Runout and Movement
Front of Vehicle
Move Wheel In and Out at Front and Back
View from Above
26694

Fig. 1: Checking Steering Linkage

- Vehicle must be on level floor with full fuel tank, no passenger load, spare tire in place and no load in trunk. Bounce front and rear end of vehicle several times. Confirm vehicle is at normal riding height.
- Steering wheel must be centered with wheels in straight ahead position. If required, shorten one tie rod adjusting sleeve and lengthen opposite sleeve (equal amount of turns). See Fig. 2.
- Wheel bearings should have the correct preload and lug nuts must be tightened to manufacturer's specifications. Adjust camber, caster and toe-in using this sequence. Follow instructions of the alignment equipment manufacturer.

CAUTION: **DO NOT attempt to correct alignment by straightening parts. Damaged parts MUST be replaced.**

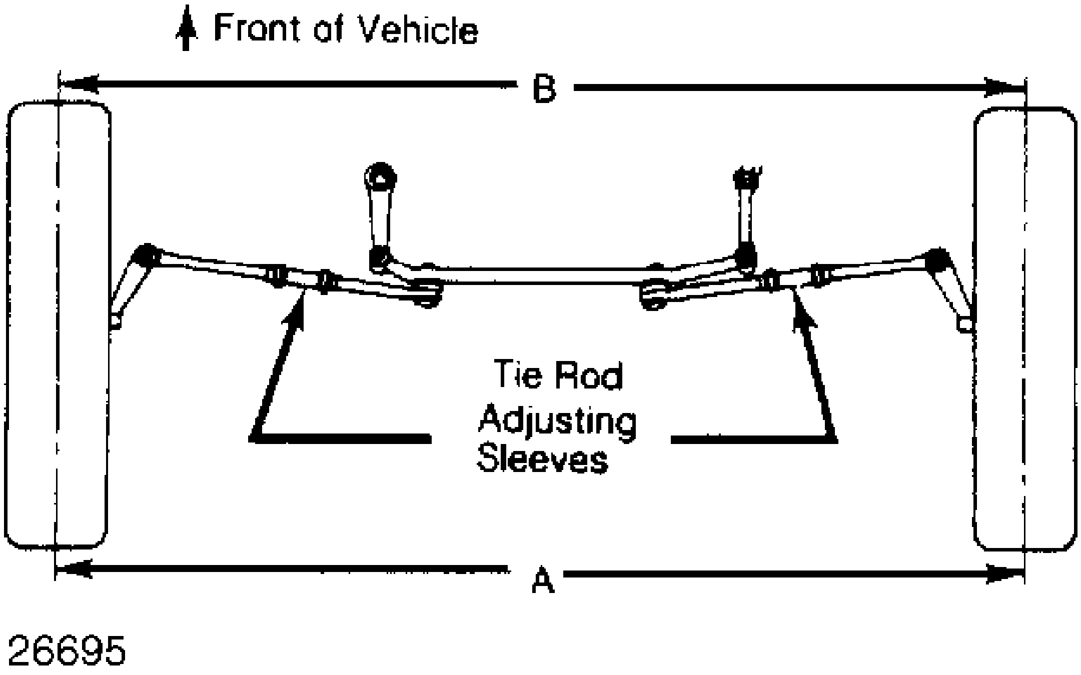

Fig. 2: Adjusting Tie Rod Sleeves (Top View)

ADJUSTMENTS

NOTE: **This is GENERAL information. This article is not intended to be specific to any unique situation or individual vehicle configuration. For model-specific information see appropriate articles where available.**

CAMBER

1. Camber is the tilting of the wheel, outward at either top or bottom, as viewed from front of vehicle. See Fig. 3.
2. When wheels tilts outward at the top (from centerline of vehicle), camber is positive. When wheels tilt inward at top, camber is negative. Amount of tilt is measured in degrees from vertical.

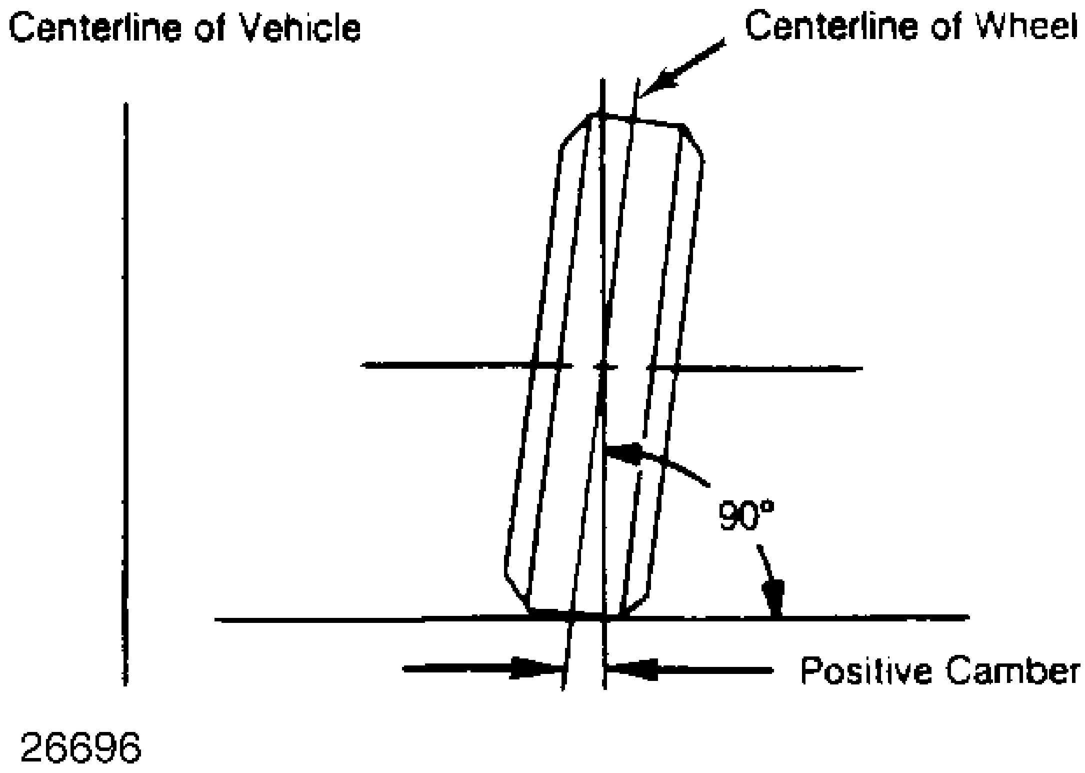
Centerline of Vehicle
Centerline of Wheel
90°
Positive Camber
26696

Fig. 3: Determining Camber Angle

CASTER

1. Caster is tilting of front steering axis either forward or backward from vertical, as viewed from side of vehicle. See Fig. 4.
2. When axis is tilted backward from vertical, caster is positive. This creates a trailing action on front wheels. When axis is tilted forward, caster is negative, causing a leading action on front wheels.

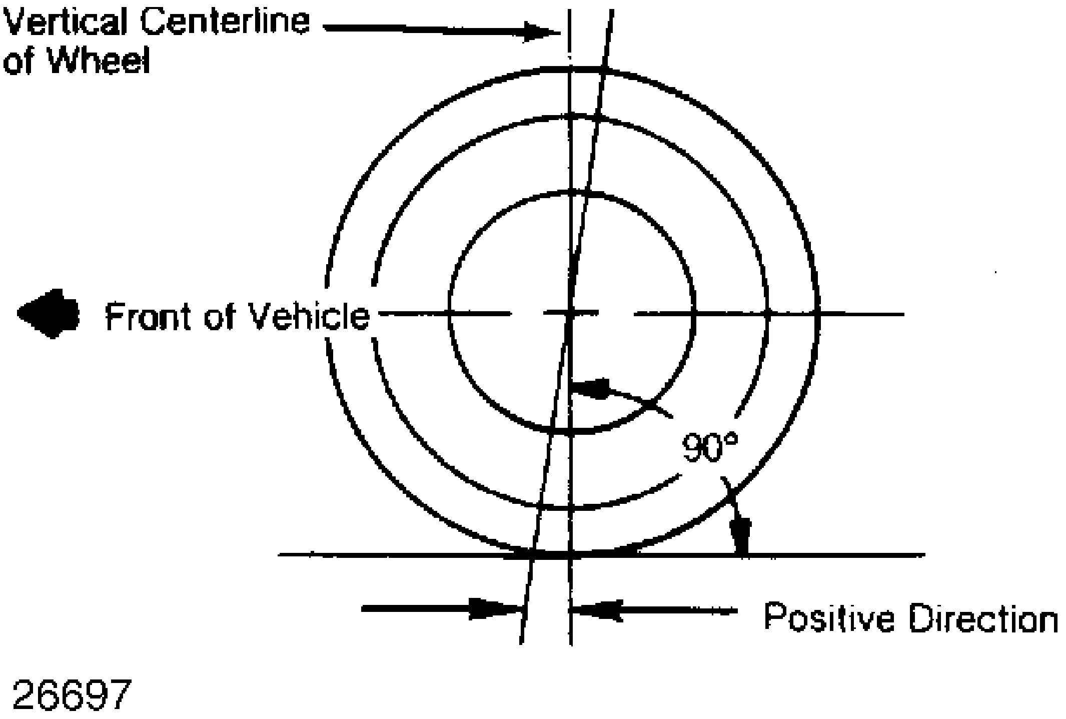

Fig. 4: Determining Caster Angle

TOE-IN ADJUSTMENT

Toe-in is the width measured at the rear of the tires subtracted by the width measured at the front of the tires at about spindle height. A positive figure would indicate toe-in and a negative figure would indicate toe-out. If the distance between the front and rear of the tires is the same, toe measurement would be zero. To adjust:

1) Measure toe-in with front wheels in straight ahead position and steering wheel centered. To adjust toe-in, loosen clamps and turn adjusting sleeve or adjustable end on right and left tie rods. See **Fig. 2** and **Fig. 5** .

2) Turn equally and in opposite directions to maintain steering wheel in centered position. Face of tie rod end must be parallel with machined surface of steering rod end to prevent binding.

3) When tightening clamps, make certain that clamp bolts are positioned so there will be no interference with other parts throughout the entire travel of linkage.

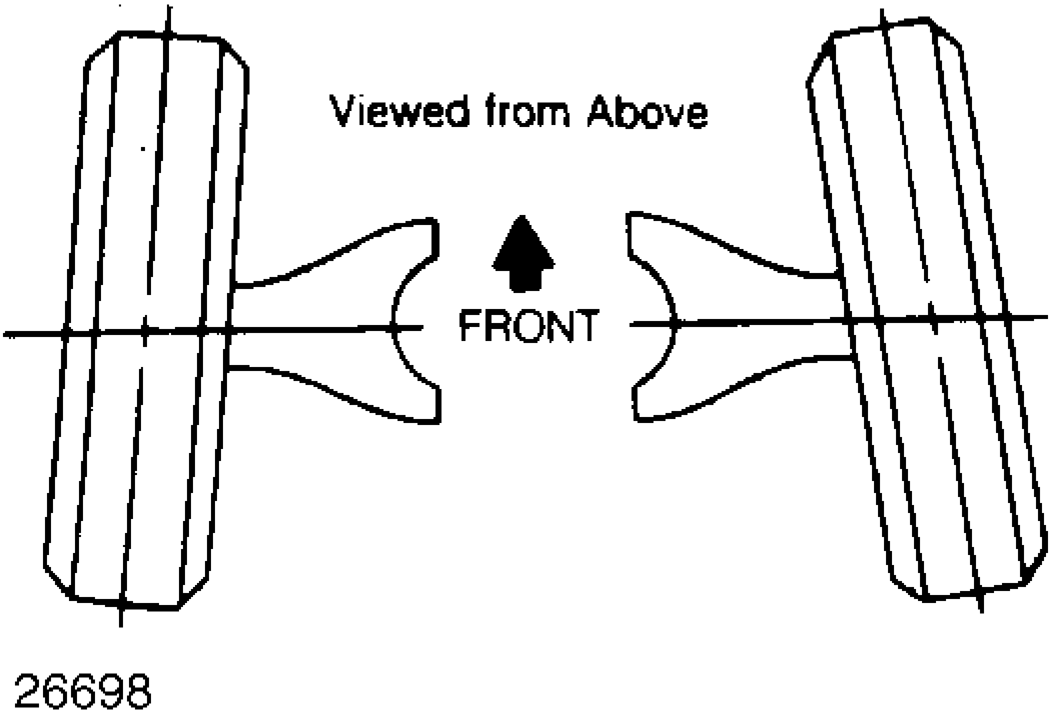

Fig. 5: Wheel Toe-In (Dimension A Less Dimension B)

TOE-OUT ON TURNS

1. Toe-out on turns (turning radius) is a check for bent or damaged parts, and not a service adjustment. With caster, camber, and toe-in properly adjusted, check toe-out with weight of vehicle on wheels.
2. Use a full floating turntable under each wheel, repeating test with each wheel positioned for right and left turns. Incorrect toe-out generally indicates a bent steering arm. Replace arm, if necessary, and recheck wheel alignment.

STEERING AXIS INCLINATION

1. Steering axis inclination is a check for bent or damaged parts, and not a service adjustment. Vehicle must be level and camber should be properly adjusted. See Fig. 6.
2. If camber cannot be brought within limits and steering axis inclination is correct, steering knuckle is bent. If camber and steering axis inclination are both incorrect by approximately the same amount, the upper and lower control arms are bent.

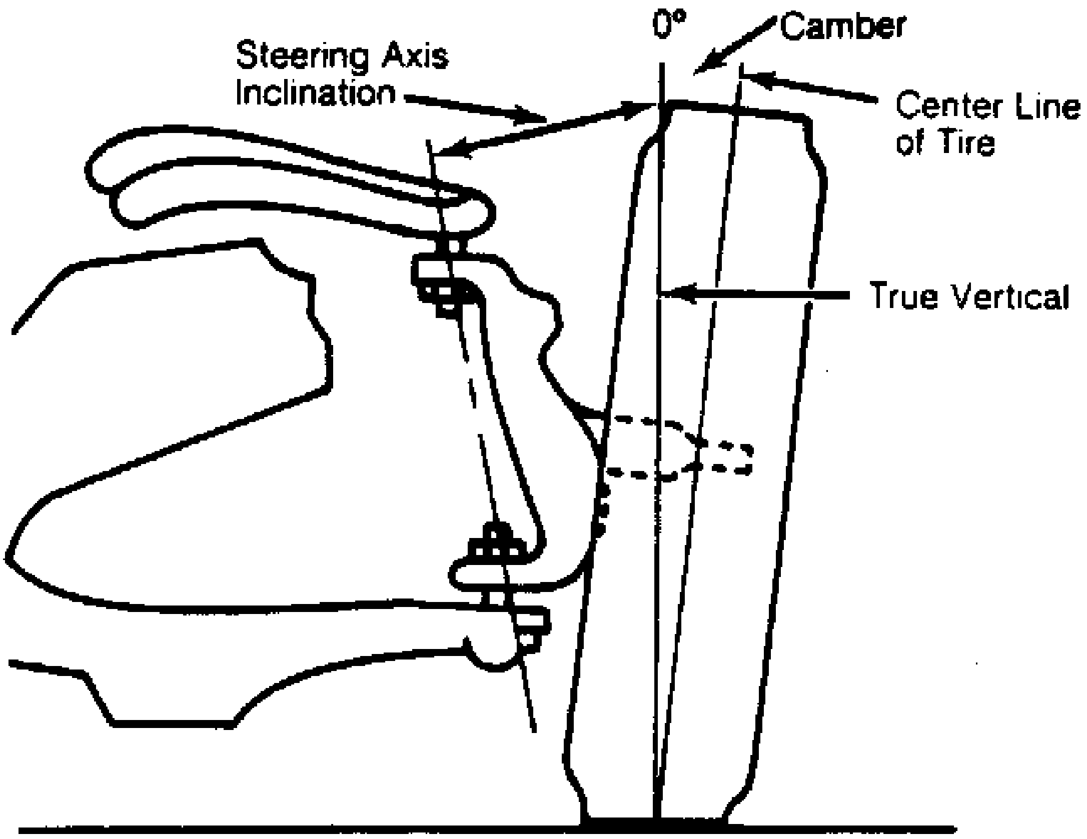
0°
Camber
Steering Axis Inclination
Center Line of Tire
True Vertical

Fig. 6: Checking Steering Axis Inclination

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2017 HVAC

Heating, Ventilation, and Air Conditioning - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Air Conditioning Evaporator Thermal Expansion Valve Sealing Washer
Air Conditioning Refrigerant Pressure Sensor O-ring
Air Conditioning Receiver and Dehydrator Plug Seal
Liquid Line Hose Seal

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Air Conditioning and Drive Motor Cooling Compressor Bolt	22 N.m (16 lb ft)
Air Conditioning and Drive Motor Cooling Compressor Nut	22 N.m (16 lb ft)
Air Conditioning and Drive Motor Cooling Compressor Stud	10 N.m (89 lb in)
Air Conditioning Compressor Hose Bolt	22 N.m (16 lb ft)
Air Conditioning Compressor Hose Nut	22 N.m (16 lb ft)
Air Conditioning Compressor Pressure Relief Valve	7 N.m (62 lb in)
Air Conditioning Condenser hose Bolt	22 N.m (16 lb ft)
Air Conditioning condenser hose nut	22 N.m (16 lb ft)
Air Conditioning Evaporator Hose and Air Conditioning Evaporator Hose Nut	22 N.m (16 lb ft)
Air Conditioning Evaporator Hose Nut	22 N.m (16 lb ft)
Air Conditioning Evaporator Thermal Expansion Valve Bolt	7 N.m (62 lb in)
Air Inlet Duct Nut	3 N.m (27 lb in)
Blower Upper Case Screw	2.5 N.m (22 lb in)
Floor Front Air Outlet Duct Bolt	2.5 N.m (22 lb in)
Floor Rear Air Outlet Duct Nut	3 N.m (27 lb in)
Front Floor Console Bracket Bolt	2.5 N.m (22 lb in)
Front Floor Console Rear Air Duct Fastener	2.5 N.m (22 lb in)
Front Floor Console Rear Air Duct Screw	2.5 N.m (22 lb in)
Heater and Air Conditioning Evaporator and Blower Module Nut	9 N.m (80 lb in)
Heater and Air Conditioning Evaporator Case Screw	2.5 N.m (22 lb in)
Heater Case Screw	2.5 N.m (22 lb in)
Heater Coolant Heater Bracket Bolt	9 N.m (80 lb in)
Heater Coolant Heater Bracket Nut	9 N.m (80 lb in)
Heater Coolant Heater Wiring Harness Bolt	9 N.m (80 lb in)
Heater Coolant Pump Bolt	9 N.m (80 lb in)

Application	Specification
	Metric (English)
Heater Coolant Pump Bracket Bolt	9 N.m (80 lb in)
Heater Core Tube Bracket Screw	2.5 N.m (22 lb in)
Instrument Panel Outlet Air Outlet Duct Bolt	2.5 N.m (22 lb in)
Side Window Defogger Outlet Duct Bolt	2.5 N.m (22 lb in)

APPROXIMATE FLUID CAPACITIES

Application	Specification		
	Metric	English	
Cooling system (Heater cooling)	2.0 liters	2.12 quarts	
Refrigerant Charge, R-1234yf	725 g	1.6 lbs	Â
Total System POE Oil Capacity	120 ml	4.1 oz	
Compressor[2]	80 ml[1]	2.7 oz[1]	
Condenser	20 ml[1]	0.7 oz[1]	
Desiccant Cartridge	10 ml[1]	0.3 oz[1]	
Evaporator	20 ml[1]	0.7 oz[1]	
Drive Motor Battery Cooler	15 ml[1]	0.5 oz[1]	
Any Line Set (Hose/Tube or Assembly) Replacement	10 ml[1]	0.3 oz[1]	
Abrupt Refrigerant Loss	40 ml[3]	1.4 oz[3]	

[1] If more than the specified amount of POE oil was drained from a component, add the equal amount of oil drained.

[2] The service compressor contains 80 ml (2.7 oz) of POE oil.

[3] Abrupt refrigerant loss due to large leak, hose rupture, collision, or pressure relief valve opening. Conditions that allow the refrigerant to seep or bleed off over time do not cause this oil loss. Upon replacement of a component that caused a large refrigerant loss, also add the required amount of oil for the particular component.

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number		
		United States	Korea	Europe
POE Oil (R-1234yf)	Lubricant	88862657	88862657	Refer to Electronic Parts Catalog.

DIAGNOSTIC INFORMATION AND PROCEDURES

HANDLING OF REFRIGERANT LINES AND FITTINGS

CAUTION: **To avoid system damage use only R-1234yf and R-134a dedicated tools when servicing the A/C system.**

- Keep all metal tubing lines free of dents or kinks. Any line restrictions will cause the loss of system capacity.
- Never bend a flexible hose line to a radius of less than four times the diameter of the hose.
- Never allow a flexible hose line to come within 65 mm (2 - 1/2 in) of the exhaust manifold.
- Inspect flexible hose lines regularly for leaks or brittleness.
- Replace flexible hose lines with new lines if you find signs of deterioration or leaking.
- Discharge the refrigeration system of all refrigerant before disconnecting any fitting in the refrigeration system.
- Proceed very cautiously regardless of the gauge readings.

WARNING: **For personal protection, goggles and lint-free gloves should be worn and a**

clean cloth wrapped around fittings, valves, and connections when doing work that includes opening the refrigerant system. If refrigerant comes in contact with any part of the body severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.

- Open the fittings very slowly.
- If you notice pressure when you loosen a fitting, allow the pressure to bleed off as described Discharging, Adding Oil, Evacuating, and Charging Procedures for A/C System.
- Cap or tape any refrigerant line immediately after it is opened. This will prevent the entrance of moisture and dirt, which can cause internal compressor wear or plugged lines in the condenser, the evaporator core, the expansion valve, or the compressor inlet screens.

NOTE: **Use two proper wrenches to connect the fittings.**

- Back up the opposing fitting to prevent distortion of the connecting lines or the components.
- Keep the sealing surfaces in perfect condition. A burr or a piece of dirt may cause a refrigerant leak.
- When seal washers are used, always install the seal washer without lubrication.
- When O-rings are used, always lightly coat the new O-ring seal with the proper viscosity and type refrigerant oil prior to installation.

LEAK TESTING

Special Tools

- **GE-41447** A/C Tracer Dye-Box of 24
- **GE-42220** Universal 12V Leak Detection Lamp
- **GE-43872** Fluorescent Dye Cleaner
- **GE-50078** Electronic Leak Detector

Equivalent regional tools. Special Tools

Refrigerant Leak Testing

Technicians repairing or servicing motor vehicle air conditioning (MVAC) systems must be trained and certified by an EPA approved organization. Certification is obtained by passing an EPA approved examination. (http://www.epa.gov/ozone/title6/609/technicians/609certs.html)

WARNING: **Technicians must only use a SAE J2913 certified electronic leak detector when checking for leaks in an R-1234yf A/C refrigerant system. Other, non - certified, leak detection devices could serve as ignition sources in the presence of hydrocarbons or other flammable refrigerants. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.**

WARNING: **Refer to R-1234yf Proper Service Procedures Warning**

WARNING: ***R1234-yf is considered a mildly flammable refrigerant and proper refrigerant leak testing should be completed to ensure safe and proper operation. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.***

CAUTION: **Leak detection shall only be done with the refrigerant that is specified for the system. Do not attempt to increase pressure of the A/C refrigerant system with shop air or another type of refrigerant. Failure to follow the above guidelines could result in damage to the vehicle or its components.**

NOTE: **General Motors vehicles are manufactured with fluorescent dye installed in the A/C refrigerant system.**

The fluorescent dye mixes and flows with the A/C compressor oil throughout the refrigerant system.

NOTE: **The only time adding additional fluorescent dye is required is after flushing the A/C system.**

Verifying some passive leaks may require using **GE-50078** Electronic Leak Detector or a SAE J2913 certified electronic leak detector, even though the refrigerant system contains fluorescent dye.

Fluorescent Leak Detection

Fluorescent dye will assist in locating any leaks in the A/C system.

- Condensation on the evaporator core or the refrigerant lines may wash the compressor oil and fluorescent dye away from the actual leak. Condensation may also carry dye through the HVAC module drain.
- Leaks in the A/C system will be indicated in a light green or yellow color when using the leak detection lamp.

  Use the leak detection lamp in the following areas:

  - All fittings or connections that use seal washers or O-rings
  - All of the A/C components
  - The A/C compressor shaft seal
  - The A/C hoses and pressure switches
  - The HVAC module drain tube, if the evaporator core is suspected of leaking
  - The service port sealing caps
  - The sealing cap is the primary seal for the service ports.
- Follow the instructions supplied with **GE-42220** Universal 12V Leak Detection Lamp.
- To prevent false diagnosis in the future, thoroughly clean the residual dye from any area where leaks were found. Use a rag and the approved **GE-43872** Fluorescent Dye Cleaner.

Fluorescent Dye Injection

NOTE: **Use only fluorescent dye approved by General Motors.**

- Not all of the fluorescent dyes are compatible with all air conditioning oils. Some types of dye decrease the oil viscosity or may chemically react with the oil.
- **GE-41447** A/C Tracer Dye-Box of 24 can be poured directly into a removed A/C component.

NOTE: **Do NOT overcharge the A/C system with dye.**

- Leak detection dye requires time to work. Depending upon the leak rate, a leak may not become visible for between 15 minutes and 7 days.
- To prevent false diagnosis, thoroughly clean any residual dye from the service port with a rag and the approved **GE-43872** Fluorescent Dye Cleaner.

Electronic Leak Detector - SAE J2913 Certified

Ensure that the vehicle has at least 15 percent of the specified refrigerant charge in the A/C refrigeration system in order to perform a leak test. Refer to **Refrigerant Recovery and Recharging**.

NOTE: **Follow a continuous path in order to ensure that you will not miss any possible leaks. Test all areas of the system for leaks.**

Follow the manufacturer instructions supplied with **GE-50078** Electronic Leak Detector or a SAE J2913 certified electronic leak detector.

AIR CONDITIONING (A/C) SYSTEM PERFORMANCE TEST

This test measures the operating efficiency of the A/C system under the following conditions:

- The current ambient air temperature
- The current relative humidity

- The high side pressure of the A/C system
- The low side pressure of the A/C system
- The temperature of the air being discharged into the passenger compartment

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1

This step determines if the A/C system has at least the minimum refrigerant charge required to operate the system without damage.

2

This step measures the performance of the A/C system.

3

This step is to allow for vehicle variations as well as high ambient temperatures.

Step	Action	Values	Yes	No
NOTE: - **The ambient air temperature must be at least 16Â°C (60Â°F).** - **Do not induce additional air flow across the front of the vehicle during the test.** - **If you were sent here from a DTC diagnostic table, clear the DTC upon completion of this test.**				
1	1. Park the vehicle inside or in the shade. 2. Open the windows in order to ventilate the interior of the vehicle. 3. If the A/C system was operating, allow the A/C system to equalize for about 2 minutes. 4. Turn OFF the ignition. 5. Install the **J-43600** ACR 2000 Air Conditioning Service Center or **GE-48800** CoolTech A/C Recharge Machine. 6. Record the ambient air temperature and humidity. 7. Record the low and high side STATIC pressure readings. Are both the low side and high side pressures within the specified value?	More than 16Â°C (60Â°F) - 345 kPa (50 psi) More than 24Â°C (75Â°F) - 483 kPa (70 psi) More than 33Â°C (90Â°F) - 690 kPa (100 psi)	Go to **Step 2**	Go to Leak Testing

Step	Action	Values	Yes	No
2	**NOTE:** **Record the relative humidity and the ambient air temperature at the time of the test.** 1. Close the vehicle doors and windows. 2. Open the drivers door window 12.7 - 15.2 cm (5 - 6 in). 3. Select the following HVAC control settings: • The A/C is ON. • The coldest temperature setting • The maximum blower speed • Recirculation mode • The instrument panel (I/P) outlet mode • All I/P outlets are OPEN. 4. Install thermometers in the left and right center panel air outlets. 5. Apply the parking brake. 6. Place the transaxle/transmission in one of the following positions: • PARK (Automatic) • NEUTRAL (Manual) 7. Start the engine and warm to operating temperature. 8. Operate the A/C system for 5 minutes. 9. Inspect A/C components for the following conditions: • Abnormal frost areas • Unusual noises 10. Record the following information: • The panel outlet air temperatures • The low-side pressure • The high-side pressure 11. Compare the low and high side pressures and the panel output temperatures to the A/C Performance Table below. Does all the data recorded fall within the specified ranges of the A/C Performance Table below?	-	Go to **Step 5**	Go to **Step 3**

Step	Action	Values	Yes	No
3	If the pressures and temperatures recorded do not fall within the specified ranges: 1. Continue to operate the A/C system for an additional 5 minutes. 2. Record the pressures and temperatures again. 3. Compare the low and high side pressures and the panel output temperature to the A/C Performance Table below. Does all the data recorded fall within the specified ranges of the A/C Performance Table below?	-	Go to **Step 5**	Go to **Step 4**
4	Perform the necessary repairs. Refer to **A/C Diagnostics Chart**. Is the action complete?	-	Go to **Step 5**	-
5	Operate the system in order to verify the test results. Did you find the same results?	-	System OK	Go to **Symptoms - HVAC Systems - Automatic**

A/C Performance Table

Ambient Temperature	Relative Humidity	Low Side Service Port Pressure	High Side Service Port Pressure	Maximum Left Center Discharge Air Temperature
13 - 18Â°C (55 - 65Â°F)	0 - 100%	151 - 227 kPa (22 - 33 psi)	1191 - 1467 kPa (173 - 213 psi)	7Â°C (43Â°F)
19 - 24Â°C (66 - 75Â°F)	Less than 40%	151 - 213 kPa (22 - 31 psi)	1419 - 1743 kPa (206 - 253 psi)	5Â°C (41Â°F)
	Greater than 40%	158 - 241 kPa (23 - 35 psi)	1398 - 1750 kPa (203 - 254 psi)	8Â°C (46Â°F)
25 - 29Â°C (76 - 85Â°F)	Less than 35%	158 - 220 kPa (23 - 32 psi)	1646 - 1942 kPa (239 - 282 psi)	8Â°C (45Â°F)
	35 - 50%	172 - 227 kPa (25 - 33 psi)	1646 - 1956 kPa (239 - 284 psi)	8Â°C (46Â°F)
	Greater than 50%	179 - 241 kPa (26 - 35 psi)	1660 - 1977 kPa (241 - 287 psi)	10Â°C (50Â°F)
30 - 35Â°C (86 - 95Â°F)	Less than 30%	172 - 234 kPa (25 - 34 psi)	1839 - 2177 kPa (267 - 316 psi)	9Â°C (48Â°F)
	30 - 50%	179 - 234 kPa (26 - 34 psi)	1860 - 2218 kPa (270 - 322 psi)	10Â°C (50Â°F)
	Greater than 50%	186 - 241 kPa (27 - 35 psi)	1880-2266 kPa (273 - 329 psi)	13Â°C (54Â°F)
36 - 41Â°C (96 - 105Â°F)	Less than 20%	186 - 248 kPa (27 - 36 psi)	2067 - 2397 kPa (300 - 348 psi)	12Â°C (52Â°F)
	20 - 40%	186 - 241 kPa (27 - 35 psi)	2080 - 2452 kPa (302 - 356 psi)	13Â°C (54Â°F)
	Greater than 40%	192 - 241 kPa (28 - 35 psi)	2122 - 2501 kPa (308 - 363 psi)	13Â°C (55Â°F)
42 - 46Â°C (106 - 115Â°F)	Less than 20%	206 - 261 kPa (30 - 38 psi)	2301 - 2597 kPa (334 - 377 psi)	13Â°C (55Â°F)
	Greater than 20%	206 - 254 kPa (30 - 37 psi)	2321 - 2659 kPa (337 - 386 psi)	14Â°C (57Â°F)
47 - 49Â°C (116 - 120Â°F)	Below 30%	220 - 268 kPa (32 - 39 psi)	2521 - 2831 kPa (366 - 411 psi)	17Â°C (61Â°F)

A/C DIAGNOSTICS CHART

A/C System Concern		Potential Causes
Compressor Inoperative		Electrical Wiring Issue
		No or Low Refrigerant Charge
		Compressor Internal Malfunction
		Compressor Clutch Malfunction
		A/C Pressure Sensor Malfunction
		Evaporator Air Temperature (EAT) Malfunction
		HVAC Controls Malfunction
Low Side Gauge Reading	**High Side Gauge Reading**	**Potential Causes**
Same as High Side	Same as Low Side	No or Low Refrigerant Charge
		Compressor Malfunction
		A/C Pressure Sensor Malfunction
		EAT Malfunction
		HVAC Controls Malfunction
Normal	Normal	Temperature Actuator Malfunction
		Temperature Door Malfunction
Low	Low	Low Refrigerant Charge
		Restriction between the Compressor Outlet and Low Side Port
	Low/Normal	Evaporator Freezing/EAT Malfunction
	High	Compressor Stuck at Maximum Displacement/EAT Malfunction
Normal/High	Normal/High	PAG or POE Oil Overcharge
High	Low	Restriction between the Low Side Port and Compressor Inlet
		Expansion Device Stuck Open
		Compressor has Low Displacement or Internal Malfunction
	High	Malfunctioning Cooling Fans
		Refrigerant Overcharge
		Restricted Condenser Air Flow
		Air in A/C System

NOTE:

Restrictions can occur in any part of an A/C system and may result in various gauge pressure values, depending on the system design and service port locations. The use of a non-contact, infrared thermometer can help diagnose a restricted A/C system with the ability to quickly observe significant, unexpected temperature changes in components and plumbing due to debris, contamination, pinched/damaged hoses, etc.

HEATING PERFORMANCE DIAGNOSTIC

Step	Action	Yes	No
DEFINITION: Heating system performance.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Automatic**

Step	Action	Yes	No
2	**WARNING:** **Refer to Moving Parts and Hot Surfaces Warning .** 1. Turn ignition to on. 2. Select vent mode. 3. Select the warmest temperature setting. 4. Select Maximum blower speed. 5. Feel the temperature of the heater core inlet hose. Does the heater core inlet hose feel warm to hot?	Go to **Step 3**	Go to **Step 9**
3	1. Select the minimum blower speed. 2. Feel the temperature of the heater core inlet and outlet hoses. Does the heater core inlet hose feel warmer than the heater core outlet hose?	Go to **Step 7**	Go to **Step 4**
4	1. Install a thermometer into the center I/P panel air outlet. 2. Secure a thermometer to the heater core outlet hose. 3. Select the maximum blower speed. 4. Record the temperature at the following location. 5. Record the temperature at the following locations: - The center I/P panel air outlet - The heater core outlet hose 6. Compare the recorded temperatures. Are the two temperature readings about equal?	Go to **Step 5**	Go to **Step 6**
5	1. Inspect and repair the following areas of the vehicle for cold air leaks: - The cowl - The recirculation door - The HVAC module case 2. Perform the necessary repairs. Are the repairs complete?	Go to **Step 11**	-
6	1. Inspect the temperature door operation. 2. Perform any necessary repairs. Are the repairs complete?	Go to **Step 11**	-

Step	Action	Yes	No
7	1. Turn the ignition to off. 2. Backflush the heater core. 3. Turn the ignition to on. 4. Select the vent mode. 5. Select the minimum blower speed. 6. Select the warmest temperature setting. 7. Feel the temperature of the heater core inlet and outlet hoses. Does the heater core inlet hose feel warmer than the heater core outlet hose?	Go to **Step 8**	Go to **Step 11**
8	Replace the heater core. **Heater Core Replacement** Is the repair complete?	Go to **Step 11**	-
9	Inspect and repair the following areas: • Kinked hose • Heater valve inlet filter • Air in the coolant circuit • Inoperable heater valve Did you find and correct the condition?	Go to **Step 11**	Go to **Step 10**
10	Inspect the coolant heater control module. Is the repair complete?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

DEFROSTING INSUFFICIENT

Step	Action	Yes	No
DEFINITION: Time required to defrost the windshield is longer than normal.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Automatic**
2	1. Turn ignition to ON.. 2. Select the DEFROST mode. 3. Select the maximum blower speed. Does sufficient air flow from the defroster outlets?	Go to **Step 3**	Go to **Step 6**
3	**WARNING:** **Refer to Moving Parts and Hot Surfaces Warning .** 1. Select the minimum blower speed. 2. Select the maximum temperature setting. 3. Feel the temperature of the inlet and outlet hoses at the heater core. Does the inlet hose feel warmer than the outlet hose?	Go to **Step 7**	Go to **Step 4**
4	Perform the A/C system performance test. **Air Conditioning (A/C) System Performance Test** Is the A/C system operating within the specifications?	Go to **Step 5**	Go to **Step 8**
5	Inspect for correct operation of the air inlet door. Is the air inlet door operating correctly?	Go to **Step 10**	Go to **Step 9**

Step	Action	Yes	No
6	Repair the air delivery concern. **Diagnostic Starting Point - Vehicle** Is the repair complete?	Go to **Step 10**	-
7	Repair the heating concern. **Heating Performance Diagnostic** Is the repair complete?	Go to **Step 10**	-
8	Repair the A/C performance concern. **Air Conditioning (A/C) System Performance Test** Is the repair complete?	Go to **Step 10**	-
9	Repair the air inlet door concern. **Air Inlet Housing Replacement** Is the repair complete?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you find and correct the problem?	System OK	Go to **Step 2**

NOISE DIAGNOSIS - BLOWER MOTOR

Step	Action	Yes	No
DEFINITION: Noise originating from the blower motor.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Automatic**
2	Inspect the air inlet grille for debris. Is debris present?	Go to **Step 8**	Go to **Step 3**
3	1. Sit inside the vehicle. 2. Close the vehicle doors and windows. 3. Turn the ignition to the accessory position. 4. Cycle the blower motor through all of the speeds and modes in order to determine where and when the noise occurs. Is a noise evident during the blower operation?	Go to **Step 4**	Go to **Step 11**
4	Inspect for excessive vibration at each blower motor speed by feeling the blower case. Is excess vibration present?	Go to **Step 6**	Go to **Step 5**
5	Listen to the blower motor at each speed. Is the blower motor making a squeaking or chirping noise?	Go to **Step 9**	Go to **Step 11**
6	1. Remove the blower motor. Refer to **Blower Motor Replacement**. 2. Inspect the blower motor impeller for deposits of foreign material. 3. Inspect the blower motor for deposits of foreign material. Did you find any foreign material on the blower motor or blower motor impeller?	Go to **Step 8**	Go to **Step 7**
7	Inspect the blower motor for the following conditions: • Cracked blades • A loose impeller retainer • Improper impeller alignment Did you find any of these conditions?	Go to **Step 9**	Go to **Step 10**

Step	Action	Yes	No
8	Remove the foreign material. Is the action complete?	Go to **Step 10**	-
9	Replace the blower motor. Refer to **Blower Motor Replacement**. Is the repair complete?	Go to **Step 11**	-
10	Install the blower motor. Refer to **Blower Motor Replacement**. Is the action complete?	Go to **Step 11**	-
11	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

AIR CONDITIONING COMPRESSOR OIL DIAGNOSIS

NOTE: **To avoid repeat compressor failure, always inspect the condition of the refrigerant oil and take the appropriate corrective action before installing the replacement compressor.**

Condition	Corrective Action
Clean Oil no debris present	No corrective action necessary.
Clean Oil with debris present	• Inspect the suction port of the replacement compressor for presence of a suction screen. If the replacement compressor does NOT contain a suction screen, install suction screen in the line. • Replace desiccant or component containing the desiccant. • Replace desiccant filter if applicable. • Remove and inspect high pressure side filter (if applicable). • Remove, inspect, clean, or replace orifice tube. • If the system has a front orifice tube and is equipped with a filter in the rear auxiliary line, remove, inspect, clean, or replace the filter. • If the system has a front orifice tube and is not equipped with a filter in the rear auxiliary line, remove the filter in the auxiliary TXV and Install a universal inline A/C Filter P/N 89016656 (AC Delco P/N 15-10413) as close to the rear TXV as possible.
Dark brown/black and/or pungent/unusual odor with no debris present	• Replace desiccant or component containing the desiccant. • Replace desiccant filter if applicable. • Flush refrigerant system. Refer to **Flushing**.
Dark brown/black and/or pungent/unusual odor with debris present	• Replace desiccant or component containing the desiccant. • Replace desiccant filter if applicable. • Flush refrigerant system. Refer to **Flushing**. • Inspect the suction port of the replacement compressor for presence of a suction screen. If the replacement compressor does NOT contain a suction screen, install suction screen. • Remove and inspect high pressure side filter (if applicable). • Remove, inspect, clean, or replace orifice tube. • If the system has a front orifice tube and is equipped with a filter in the rear auxiliary line, remove, inspect, clean, or replace the filter. • If the system has a front orifice tube and is not equipped with a filter in the rear auxiliary line, remove the filter in the auxiliary TXV and install a universal inline A/C Filter P/N 89016656 (AC Delco P/N 15-10413) as close to the rear TXV as possible.
Oil Overcharge	Flush refrigerant system. Refer to **Flushing**.

Condition	Corrective Action
Refrigerant Contamination	Flush refrigerant system. Refer to **Flushing**.
Hybrid Polyolester Refrigerant Oil (POE) Contamination	• Flush refrigerant system. Refer to **Flushing**. • Replace desiccant or component containing the desiccant. • Replace desiccant filter if applicable.

NOISE DIAGNOSIS - HVAC MODULE

Step	Action	Yes	No
DEFINITION: Noise originating from the HVAC module.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Automatic**
2	1. Start the engine. 2. Cycle through all of the following: • Blower motor speeds • HVAC modes • Temperature control settings 3. Determine the type of noise: • Scrape, pop • Tick/click, chirp or groaning • Air rush/whistle Is a scrape or pop noise evident when selecting modes or temperature settings?	Go to **Step 6**	Go to **Step 3**
3	Is a tick/click, chirping, groaning or scraping noise present, but decreases as blower motor speed is decreased?	Go to **Step 6**	Go to **Step 4**
4	Is an air rush/whistle noise evident in all modes but not all temperature settings?	Go to **Step 6**	Go to **Step 5**
5	Is an air rush/whistle noise evident only in defrost or floor mode?	Go to **Step 6**	Go to **Step 6**
6	Remove the IP carrier. **Instrument Panel Assembly Replacement** . Is the action complete?	Go to **Step 7**	-
7	1. Inspect the air flow doors for proper operation. 2. Inspect the ducts for obstructions or foreign materials. Were any of these conditions found?	Go to **Step 10**	Go to **Step 8**
8	Inspect the mode and temperature doors and seals for warping or cracking. Are the doors in normal condition?	Go to **Step 11**	Go to **Step 9**
9	Replace the appropriate door and/or seals. Is the repair complete?	Go to **Step 11**	-
10	Remove any obstructions or foreign material found. Is the action complete?	Go to **Step 11**	-
11	Install the IP Assembly. **Instrument Panel Assembly Replacement** . Is the action complete?	Go to **Step 12**	-
12	Operate the system to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

ODOR DIAGNOSIS

Step	Action	Yes	No
DEFINITION: Odor originating or noticed through the HVAC system.			
1	Were you sent here from Symptoms or another diagnostic table?	Go to **Step 2**	Go to **Symptoms - HVAC Systems - Automatic**
2	1. Sit inside the vehicle. 2. Close all of the doors and windows. 3. Start Turn ignition to on. 4. Select the maximum blower speed. 5. Select the PANEL air outlet mode. 6. Select the coldest temperature setting. 7. Cycle through all of the blower speeds, modes and temperatures to define what type of odor is present. - Musty smell - Coolant smell - Oil smell Does the odor have a musty smell?	Go to **Step 3**	Go to **Step 8**
3	Inspect the HVAC filter and the air inlet grille for debris. Is debris present?	Go to **Step 4**	Go to **Step 5**
4	Remove any debris. Is the action complete?	Go to **Step 15**	-
5	Inspect for wet carpeting. Is the carpet wet?	Go to **Step 6**	Go to **Step 8**
6	Inspect for the following conditions: 1. Water leaks around the windshield 2. Blockage of the HVAC module drain 3. Leaks around the door seals Is a leak present?	Go to **Step 7**	Go to **Step 15**
7	Repair the leak as necessary. Is the repair complete?	Go to **Step 15**	-
8	Does the odor have a coolant smell?	Go to **Step 9**	Go to **Step 12**
9	Inspect the cooling system for leaks. **Hybrid Cooling System Leak Test** , or **Cabin Heater Coolant Heater System Loss of Coolant** Is a leak present?	Go to **Step 10**	Go to **Step 12**
10	Inspect for coolant leaking inside the vehicle or for a film build-up on the windshield. Is the condition present?	Go to **Step 11**	Go to **Step 15**
11	Replace the heater core. **Heater Core Replacement** Is the repair complete?	Go to **Step 15**	-
12	Does the odor have an oily smell?	Go to **Step 13**	Go to **Step 15**

Step	Action	Yes	No
13	1. Inspect the engine compartment for any leaks. Refer to the following procedures: • Oil Leak Diagnosis • Fluid Leak Diagnosis 2. Repair any oil leaks. Is the repair complete?	Go to **Step 15**	-
14	A musty odor can be caused by mold or mildew build-up on the evaporator or the heater core or inside of the HVAC module. **Odor Correction** Is the action complete?	Go to **Step 15**	-
15	Operate the system in order to verify the repair. Did you find and correct the condition?	System OK	Go to **Step 2**

CABIN HEATER COOLANT HEATER SYSTEM LOSS OF COOLANT

Step	Action	Yes	No
DEFINITION: The heater coolant heater cooling system is losing coolant either internally or externally.			
1	Inspect the coolant level. Is the coolant at the proper level?	Go to **Step 13**	Go to **Step 2**
2	Fill the cooling system to the proper level. **Heater Coolant Heater Draining and Filling** Is the action complete?	Go to **Step 3**	-
3	Overheating can cause a loss of coolant. Is the Heater Coolant Heater Cooling system overheating?	Go to **Step 11**	Go to **Step 4**
4	Visually inspect the hoses, pipes and hose clamps. Are any of the hoses, clamps or pipes leaking?	Go to **Step 12**	Go to **Step 5**
5	Visually inspect the following components: • Coolant surge tank • Coolant pressure cap • Air separator • Radiators • Coolant pumps • Coolant valves • Heater Coolant Heater Are any of the listed components leaking?	Go to **Step 12**	Go to **Step 6**
6	1. Pressure test the heater coolant heater cooling system. **Cabin Heater Coolant Heater System Leak Testing** 2. With the heater coolant heater cooling system pressurized, visually inspect the components listed in step 5. Are any leaks present?	Go to **Step 12**	Go to **Step 7**
7	Pressure test the coolant pressure cap. **Cabin Heater Coolant Heater System Pressure Cap Testing** Does the coolant pressure cap hold pressure?	Go to **Step 9**	Go to **Step 8**
8	Replace the coolant pressure cap. Is the repair complete?	Go to **Step 13**	-

Step	Action	Yes	No
9	1. Pressure test the heater coolant heater cooling system. Cabin Heater Coolant Heater System Leak Testing 2. With the cooling system pressurized, remove the heater coolant heater cooling system pressure cap. Does the heater coolant heater cooling system hold pressure?	-	Go to **Step 10**
10	Replace the surge tank. Heater Coolant Surge Tank Replacement Is the repair complete?	Go to **Step 13**	-
11	Repair the heater coolant heater cooling system overheating condition. Is the repair complete?	Go to **Step 13**	-
12	Repair or replace the leaking component. Refer to the appropriate repair. Is the repair complete?	Go to **Step 13**	-
13	Operate the system in order to verify the repair. **NOTE:** **Do not use stop leak or any other chemicals. Only use premix Dexcool (50/50 mixture of Dexcool and deionized)** Did you find and correct the condition?	System OK	Go to **Step 2**

CABIN HEATER COOLANT HEATER SYSTEM PRESSURE CAP TESTING

Special Tools

- **GE-46143** Radiator Cap and Surge Tank Test Adapter
- **EN-24460-A** Cooling System Pressure Tester

For equivalent regional tools, Refer to Fastener Specifications .

Pressure Cap Testing

WARNING: **To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.**

1. Remove the pressure cap.
2. Wash the pressure cap sealing surface with water.

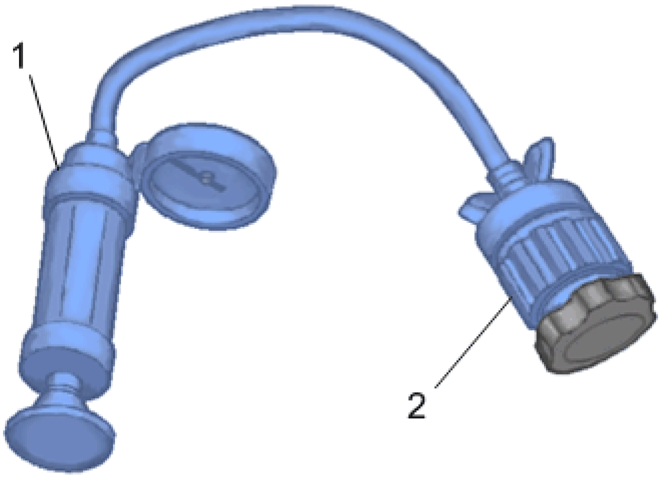

Fig. 1: Identifying Pressure Cap Tester
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Lubricate GE-46143 Radiator Cap and Surge Tank Test Adapter and pressure cap O-rings with coolant and press cap to seat O-ring on GE-46143 Radiator Cap and Surge Tank Test Adapter before turning to engage threads.**

3. Use the **EN-24460-A** Cooling System Pressure Tester (1) with **GE-46143** Radiator Cap and Surge Tank Test Adapter (2) in order to test the pressure cap.
4. Test the pressure cap for the following conditions:
   - Pressure release when the **EN-24460-A** Cooling System Pressure Tester exceeds the pressure rating of the pressure cap.
   - Maintain the rated pressure for at least 10 seconds.

     Note the rate of pressure loss.
5. Replace the pressure cap under the following conditions:
   - The pressure cap does not release pressure which exceeds the rated pressure of the cap.
   - The pressure cap does not hold the rated pressure.

CABIN HEATER COOLANT HEATER SYSTEM LEAK TESTING

Special Tools

- **EN-24460-A** Cooling System Pressure Tester
- **GE-46143** Radiator Cap and Surge Tank Test Adapter

For equivalent regional tools, Refer to Fastener Specifications .

WARNING: **Under pressure, the temperature of the solution in the radiator can be considerably higher, without boiling. Removing the radiator cap while the engine is hot (pressure is high), will cause the solution to boil instantaneously, with explosive force. The solution will spew out over the engine, fenders, and the person removing the cap. Serious bodily injury may result. Flammable antifreeze, such as alcohol, is not recommended for use at any time. Flammable antifreeze could cause a serious fire.**

WARNING: **In order to help avoid being burned, do not remove the radiator cap while the engine and the radiator are hot. Scalding fluid and steam can be blown out**

under pressure if the cap is removed too soon.

1. Remove the pressure cap.
2. Test the operation of the pressure cap. Cabin Heater Coolant Heater System Pressure Cap Testing
3. Wash the pressure cap mating surface with water.

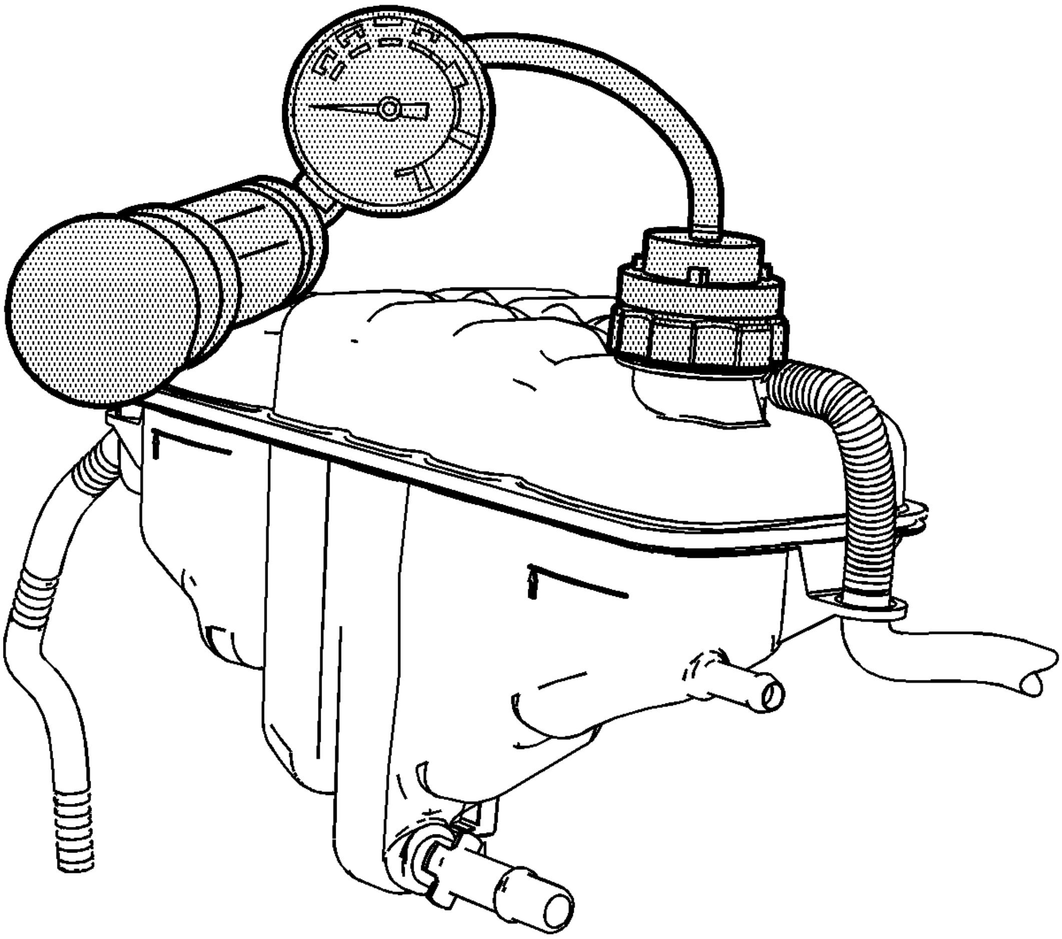

Fig. 2: Cooling System Pressure Tester Components
Courtesy of GENERAL MOTORS COMPANY

4. Use the **EN-24460-A** Cooling System Pressure Tester with the **GE-46143** Radiator Cap and Surge Tank Test Adapter in order to apply pressure to the cooling system.

   Do not exceed the pressure cap rating.

5. The cooling system should hold the rated pressure for at least 2 minutes.

   Observe the gauge for any pressure loss.

   NOTE: **Do not use stop leak or any other chemicals. Only use premix Dexcool (50/50 mixture of Dexcool and deionized)**

6. Repair any leaks as required.

REPAIR INSTRUCTIONS

ODOR CORRECTION

Eliminating Air Conditioning (A/C) Odor

Odors may be emitted from the air conditioning system primarily at start up in hot, humid climates. The following conditions may cause the odor:

- Debris is present in the HVAC module
- Microbial growth on the evaporator core

When the blower motor fan is turned on, the microbial growth may release an unpleasant musty odor into the passenger compartment. To remove odors of this type, the microbial growth must be eliminated. Perform the following procedure:

Deodorize the evaporator core using Deodorizing Aerosol Kit.

Perform the following steps in order to deodorize the A/C system:

1. Ensure that the plenum which draws outside air into the HVAC module is clear of debris.
2. Disable the air conditioning (A/C) compressor clutch operation by disconnecting the clutch coil electrical connector.
3. Dry the evaporator core by performing the following steps:
    1. Turn the ignition to run mode.
    2. Select the warmest temperature setting.
    3. Select the recirculation mode.
    4. Run the blower motor on high for 10 minutes.
4. Locate an area in the air conditioning duct between the blower motor and the evaporator core downstream of the blower motor.
5. Drill a 3.175 mm (0.125 in) hole where the hole will not interfere with or damage the following components:
    - The blower motor
    - The evaporator core
    - Any other operating part the of system
6. Wear safety goggles and latex gloves in order to perform the following actions:
    1. Select the maximum blower speed.
    2. Insert the deodorizer extension tube into the hole to the mark on the extension tube.
    3. Use short spray bursts and vary the direction of spray for a 2 - 3 minute period of time.
7. Shut the engine OFF. Allow the vehicle to sit for 3 - 5 minutes.
8. Seal the 3.175 mm (0.125 in) hole with body sealer or RTV gasket compound.
9. Turn the ignition to run mode.
10. Operate the blower motor on high for 15 - 20 minutes to dry.
11. Reconnect the A/C compressor clutch coil electrical connector.
12. Verify proper A/C clutch operation.

REFRIGERANT RECOVERY AND RECHARGING

Special Tools

- **GE-45037** A/C Oil Injector
- **GE-50078** Electronic Leak Detector
- **GE-50300-A** R-1234yf Air Conditioning Refrigerant Recovery/Recharge Cart
- **GE-50957** Machine R-1234yf Contaminated Refrigerant
- **GE-50744** A/C R1234yf PAG Oil Injector Hose

For equivalent regional tools, refer to Special Tools.

General Information

R-1234yf (HFO-1234yf) - 2, 3, 3, 3 - Tetrafluoroprop-1-ene (CF3CFCH2), is an olefin containing hydrogen, fluorine and carbon with thermodynamic properties similar to R-134a. This refrigerant is a mildly flammable gas. It has a boiling point of -29.2Â°C, a vapor pressure of 583 kPa absolute at 20Â°C, no ozone depletion potential, and a global warming potential (GWP) of 4.

R-1234yf supply tank is white with red band to denote flammability.

In certain regions, technicians repairing or servicing motor vehicle air conditioning (MVAC) systems must be trained and certified by the appropriate regional or national regulatory agency.

- In the USA, refer to the EPA website for MVAC training requirements. http://www.epa.gov/ozone/title6/609/technicians/609certs.html
- In Canada, refer to the Environment Canada website for MVAC training requirements. http://www.ec.gc.ca/ozone/default.asp?lang=En&n=943E1CAB-1#ws4E6F6835
- In Europe, refer to Commission Regulation (EC) No 307/2008 for MVAC training requirements. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:092:0025:0027:EN:PDF

WARNING: **Refer to R-1234yf Proper Service Procedures Warning .**

Vehicles equipped with R-1234yf refrigerant systems have unique low and high side service fittings.

The proper handling procedures should be followed for all refrigerants as designated by the refrigerant manufacturer's Material Safety Data Sheet (MSDS).

Refrigerant Recovery and Recharging

To remove, recycle and install R-1234yf from/to a vehicles refrigerant system only use **GE-50300-A** R-1234yf Air Conditioning Refrigerant Recovery/Recharge Cart or refrigerant recovery recharge equipment certified to meet the requirements of SAE J2843.

To remove contaminated refrigerant from a vehicles refrigerant system use **GE-50957** Machine R-1234yf Contaminated Refrigerant or only service equipment designed for contaminated refrigerant removal and certified to meet the requirements of SAE J2851. Refrigerant recovered by this equipment cannot be reused or recycled on site and must be sent to an approved reclamation facility for reprocessing or disposal.

To prevent accidental release of refrigerant and minimize safety concerns, the installation of any refrigerant service equipment to the vehicle shall only be done with the engine off and after the refrigerant high side pressure has been reduced (approximately 2 - 3 minutes).

Open the windows and/or doors before charging the vehicle to prevent an accumulation of refrigerant in case of a major refrigerant leak.

WARNING: ***R-1234yf is heavier than air and may accumulate in low or pit areas - make sure these areas are properly ventilated. Failure to follow this precaution may cause personal injury.***

Refrigerant service equipment is required to ensure adequate refrigerant recovery to reduce emissions and provide for accurate recharging of mobile air conditioning systems. Venting refrigerant to the atmosphere is illegal in the USA and EU and may have restrictions in other regions.

WARNING: ***To prevent personal injury, avoid breathing any refrigerant vapor and lubricant mist. Servicing of R-1234yf systems shall only be done in well ventilated work areas. To remove R-1234yf refrigerant from the A/C refrigerant system, recover using SAE J2843 certified equipment. Un-controlled release of R-1234yf refrigerant in the work area may result in high concentrations of R-1234yf that can be flammable. If an accidental system discharge occurs, ventilate the work area before continuing service. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.***

WARNING: **For personal protection, goggles and lint-free gloves should be worn and a clean cloth wrapped around fittings, valves, and connections when doing work that includes opening the refrigerant system. If refrigerant comes in contact with any part of the body severe frostbite and personal injury can result. The exposed area should be flushed immediately with cold water and prompt medical help should be obtained.**

WARNING: **Evaporators in vehicles equipped with R-1234yf refrigerant systems must never**

be repaired or replaced with an evaporator removed from another or salvage vehicle. Use only new SAE J2842 certified and labeled evaporator(s) as replacement parts. Failure to follow this guideline could pose a health and/or safety risk to the vehicle occupant(s).

CAUTION: **Air Conditioning (A/C) desiccant must be replaced if the A/C refrigerant system has been open to atmosphere for more than four hours, or if the A/C refrigerant oil has been contaminated. Failure to replace the A/C desiccant will result in damage to the A/C refrigerant system.**

CAUTION: **Use only the refrigerant and the charge amount specified in "Refrigerant System Specifications" found in HVAC Service Manual or the vehicles under hood refrigerant label. Use of incorrect refrigerant or charge amounts may result in poor system performance and premature system failure.**

CAUTION: **Use only the lubricant specified for this vehicles refrigerant system. Do not mix refrigerant oils which may result in system contamination and unknown reaction by-products which may cause HVAC System failure.**

To protect the refrigerant supply **GE-50300-A** R-1234yf Air Conditioning Refrigerant Recovery/Recharge Cart or SAE J2843 equipment requires the refrigerant to be analyzed for purity prior to its recovery or transfer. The equipment is required to receive an acceptable reading from the integrated refrigerant identifier prior to recovery or transfer.

If an unacceptable reading is received (and the presence of foreign gases detected) the refrigerant is considered contaminated and the equipment will not allow its recovery or transfer to an onboard storage vessel. If refrigerant is contaminated use **GE-50957** Machine R-1234yf Contaminated Refrigerant or SAE J2851 compliant equipment to recover for reclamation and/or disposal at an EPA approved facility (http://www.epa.gov/ozone/title6/608/reclamation/reclist.html) or regional approved facility.

As a safety precaution **GE-50300-A** R-1234yf Air Conditioning Refrigerant Recovery/Recharge Cart or SAE J2843 compliant equipment requires the MAC system to pass a pre-charge leak test (to detect the possibility of a gross system leak prior to charging, >0.3 g/s) prior to allowing the MAC system to be charged. The pressurized portion of this test will require the technician set the vehicles HVAC blower motor on high, A/C switch off and air distribution mode set to floor. The technician shall insert a **GE-50078** Electronic Leak Detector or J2913-compliant electronic leak detector, set to low sensitivity (14 grams/year leak rate) into the center of a floor duct outlet, as far as possible. When the technician confirms that the vehicle is set up for the pressurized leak check the **GE-50300-A** R-1234yf Air Conditioning Refrigerant Recovery/Recharge Cart will install 15% of the programmed charge into the vehicles refrigerant system. The technician monitors the electronic leak detector for 5 minutes or until the detector alarms.

The equipments display will then ask the following:

1. Was this test performed? If the technician replies Yes, the display next shall ask,
2. Was a leak found? If technician replies Yes, the machine shall only allow recovery and evacuation to allow repair. If the technician replies No, the display shall continue with,
3. Is there an auxiliary evaporator? If the technician replies No the machine shall permit completion of the recharge process. If the technician replies Yes, the display shall instruct the technician to perform a leak check with **GE-50078** Electronic Leak Detector or a J2913-compliant detector at a rear evaporator outlet, then ask,
4. Was an auxiliary evaporator leak check performed? If the technician replies Yes, the display will continue with Was a leak found? and if the answer is Yes, the machine shall only allow recovery and evacuation to allow repair. If the technician replies No, the machine shall permit completion of the recharge process.

A/C Refrigerant System Oil Charge Replenishing

If oil was removed from the A/C system during the recovery process or due to component replacement, the oil must be replenished. Oil can be injected into a charged system using **GE-45037** injector with **GE-50744** A/C R1234yf PAG Oil Injector Hose. For the proper quantities of oil to add to the A/C refrigerant system, refer to Approximate Fluid Capacities.

FLUSHING

Special Tools

- **GE-45268** A/C Flushing Adapter Kit
- **GE-45268-130** 1234yf Refrigerant Adapters
- **GE-50078** Enhanced Leak Detector
- **GE-50300** Air Conditioning Service Center for HFO1234yf

Equivalent regional tools. Special Tools.

General Information

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Technicians repairing or servicing motor vehicle air conditioning (MVAC) must be trained and certified by an EPA approved organization. Certification is obtained by passing an EPA approved examination. (http://www.epa.gov/ozone/title6/609/technicians/609certs.html)

WARNING: **Refer to R-1234yf Proper Service Procedures Warning .**

NOTE:

- **The high voltage (HV) electric air conditioning (A/C) compressor uses a polyolester (POE) refrigerant oil instead of a polyalkylene glycol (PAG) synthetic refrigerant oil. This is due to the better electrical resistance of the POE oil and its ability to provide HV isolation.**
- **When servicing vehicles with an electric compressor, first perform the hose flush procedure to clear the unit of residual air conditioning system oil. Failure to perform this procedure will cause contamination of the hybrid system as well as failure of the compressor. The hose flush procedure is found in the GE-50300 Instruction Manual.**
- **Failure to flush the GE-50300 hoses before adding refrigerant to a vehicle with an electric air conditioning compressor may result in an unacceptable amount of air conditioning oil entering the refrigerant system. It may also cause a battery energy control module hybrid battery voltage system isolation lost diagnostic trouble code (DTC P1AE7) to be set.**

Flush Procedure

NOTE: **Flushing is not intended to remove metal from the air conditioning system.**

Flushing is intended to remove the following:

- Contaminated Air Conditioning Compressor oil
- Desiccant, following a desiccant bag failure
- Overcharge of Air Conditioning Compressor oil
- Refrigerant contamination

NOTE: **Warmer engine or ambient temperatures decreases the refrigerant recovery time during the air conditioning flush procedure.**

1. Recover the refrigerant. Refrigerant Recovery and Recharging
2. Remove the air conditioning condenser. Air Conditioning Condenser Replacement
3. Remove the air conditioning receiver and dehydrator. Receiver and Dehydrator Replacement
4. Install the air conditioning receiver and dehydrator plug without the air conditioning refrigerant desiccant. Receiver and Dehydrator Replacement

5. Install the air conditioning condenser. **Air Conditioning Condenser Replacement**
6. Remove the air conditioning evaporator thermal expansion valve. **Air Conditioning Evaporator Thermal Expansion Valve Replacement**
7. Remove the air conditioning evaporator thermal expansion valve stud from the air conditioning evaporator thermal expansion valve.
8. Install the air conditioning evaporator thermal expansion valve stud onto the GE-45268-115 adapter.
9. Install GE-45268-115 in place of the air conditioning evaporator thermal expansion valve.
10. Remove the drive motor battery coolant cooler thermal expansion valve. **Drive Motor Battery Coolant Cooler Replacement**
11. Remove the drive motor battery coolant cooler thermal expansion valve stud from the drive motor battery coolant cooler thermal expansion valve.
12. Install the drive motor battery coolant cooler thermal expansion valve stud onto the GE-45268-115 adapter.
13. Install GE-45268-115 in place of the drive motor battery coolant cooler thermal expansion valve.
14. Remove the air conditioning and drive motor battery cooling compressor. **Air Conditioning and Drive Motor Battery Cooling Compressor Replacement**
15. If equipped, remove the screen in the end of the air conditioning condenser hose.
16. Install GE-45268-4 to the air conditioning compressor hose.
17. Install GE-45268-5 to the air conditioning condenser hose.
18. Forward flow refrigerant flushing is recommended for contaminated refrigerant or POE oil.

    NOTE: **The filter inside GE-45268-1 is serviceable. Remove and discard the check valve from the filter.**

    1. Service the filter before each flush.
    2. Connect the GE-45268-1 flush filter to the suction port of the GE-45268-4 flush adapter.
    3. Connect the blue hose from the GE-50300 Air Conditioning Service Center to the J 45268-1 flush filter adapter.
    4. Connect the red hose from the GE-50300 Air Conditioning Service Center to the GE-45268-5 flush adapter.
19. Reverse flow refrigerant flushing is recommended for desiccant cartridge failure.

    NOTE: **The filter inside GE-45268-1 is serviceable. Remove and discard the check valve from the filter.**

    1. Service the filter before each flush.
    2. Connect the J 45268-1 flush filter to the discharge port of the GE-45268-5 flush adapter.
    3. Connect the blue hose from the GE-50300 Air Conditioning Service Center to the J 45268-1 flush filter adapter.
    4. Connect the red hose from the GE-50300 Air Conditioning Service Center to the suction port of the GE-45268-4 flush adapter.
20. Install the GE-45268-10 to the air conditioning compressor to condenser hose assembly.
21. Install fitting GE-45268-128 to the filter cylinder end of GE-45268-1.
22. Connect GE-45268-1 filter to GE-45268-7 adapter.

    NOTE: **Close the valve on the external refrigerant tank, before starting the flush process.**

23. Flush the air conditioning system. Follow the instructions supplied with the **GE-50300** Air Conditioning Service Center.
24. Remove the GE-45268-4 from the air conditioning compressor hose.
25. Remove the GE-45268-5 from the air conditioning condenser hose.

    NOTE: **Flushing will remove all the POE oil from the air conditioning system.**

The air conditioning system must be replenished with the correct amount of POE oil.

26. If you will reinstall the removed air conditioning and drive motor battery cooling compressor, perform the following procedure:
    1. Remove the air conditioning and drive motor battery cooling compressor drain plug.
    2. Drain the POE oil from the air conditioning and drive motor battery cooling compressor. Rotate the compressor input shaft to assist in draining the PAG oil from the compressor.
    3. Install the air conditioning and drive motor battery cooling compressor drain plug and tighten to 30 N.m (22 lb ft).
    4. Add the total system capacity of POE oil to the air conditioning and drive motor battery cooling compressor. Approximate Fluid Capacities
27. If you are replacing the air conditioning and drive motor battery cooling compressor after flushing the system, perform the following procedure:
    1. Do not drain the POE oil from the air conditioning and drive motor battery cooling compressor.
    2. Deduct the amount of POE oil shipped with the air conditioning and drive motor battery cooling compressor from the amount of POE oil listed in the approximate fluid capacities table. Approximate Fluid Capacities
    3. Add the calculated amount to the compressor, as needed.

NOTE: **Flushing will remove fluorescent leak detection dye from air conditioning system.**

28. Remove the air conditioning condenser. Air Conditioning Condenser Replacement

NOTE: **The air conditioning refrigerant desiccant is manufactured with a POE fluorescent leak detection dye wafer inside.**

29. Replace the air conditioning receiver and dehydrator. Receiver and Dehydrator Replacement
30. Install the air conditioning condenser. Air Conditioning Condenser Replacement
31. Remove the GE-45268-115 in place of the air conditioning evaporator thermal expansion valve.
32. Remove the GE-45268-115 in place of the drive motor battery coolant cooler thermal expansion valve.
33. Inspect the air conditioning evaporator thermal expansion valve for debris. Clean or replace as needed. Air Conditioning Evaporator Thermal Expansion Valve Replacement
34. Inspect the drive motor battery coolant cooler thermal expansion valve for debris. Clean or replace as needed. Drive Motor Battery Coolant Cooler Replacement
35. If equipped, Clean and install the screen in the end of the air conditioning condenser hose.
36. Install the air conditioning and drive motor battery cooling compressor. Air Conditioning and Drive Motor Battery Cooling Compressor Replacement
37. Evacuate and recharge the air conditioning system. Refrigerant Recovery and Recharging
38. Leak test the fittings using **GE-50078** Enhanced Leak Detector.

HEATER COOLANT HEATER DRAINING AND FILLING

Special Tools

- **GE-26568** Coolant and Battery Tester
- **GE-46143 - 2** Cooling System Adapter
- **GE-47716** Vac-N-Fill Coolant Refill Tool

For equivalent regional tools, refer to Special Tools .

WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults**

before working on the high voltage cooling system could result in personal injury or death.

WARNING: **Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.**

WARNING: **To avoid being burned, do not remove the radiator cap or surge tank cap while the engine is hot. The cooling system will release scalding fluid and steam under pressure if radiator cap or surge tank cap is removed while the engine and radiator are still hot.**

Draining Procedure

NOTE: **Draining of the cooling system or replacement of any cabin heater coolant heater system parts requires the actuation of the Hybrid/EV Battery Pack Coolant Pump Bleed Procedure in the GDS tool.**

1. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

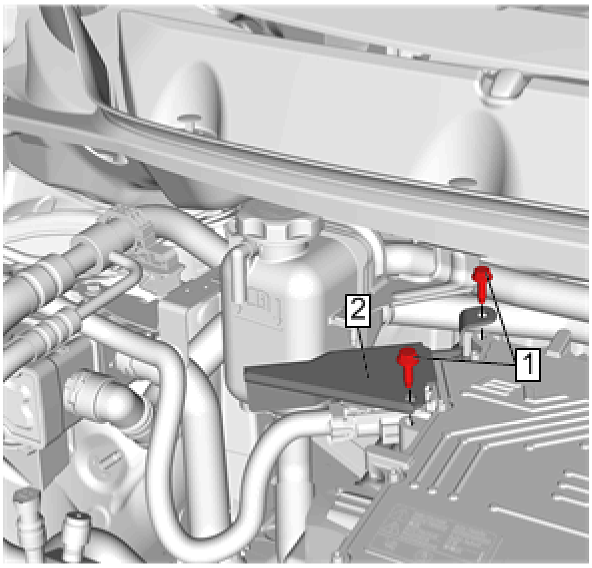


Fig. 3: Protector Securing Bolt And Protector
Courtesy of GENERAL MOTORS COMPANY

2. Remove the protector securing bolt (1) and the protector (2).

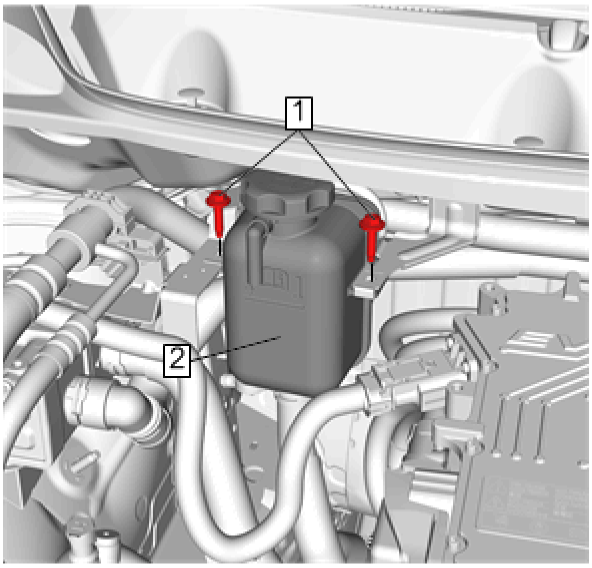


Fig. 4: Surge Tank Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove the surge tank bolt (1) and reposition the surge tank (2) forward to install the cooling system adaptor to the surge tank.
4. Remove the radiator surge tank cap.
5. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
6. Place a drain pan under the vehicle.
7. Remove the front compartment air deflector. **Front Compartment Air Deflector Replacement**
8. Remove the auxiliary heater outlet hose from the heater coolant pump. **Auxiliary Heater Outlet Hose Replacement**

Vac-N-Fill Procedure

1. Install the auxiliary heater outlet hose to the heater coolant pump. **Auxiliary Heater Outlet Hose Replacement**
2. Install the front compartment air deflector. **Front Compartment Air Deflector Replacement**
3. Turn vehicle power OFF and remove all keyless entry transmitters from the vehicle and secure in a place outside the vehicle.

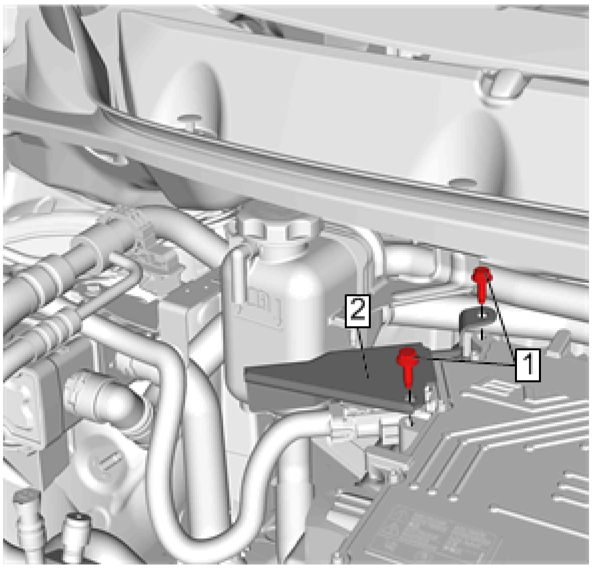


Fig. 5: Protector Securing Bolt And Protector
Courtesy of GENERAL MOTORS COMPANY

4. Remove the protector securing bolt (1) and the protector (2).

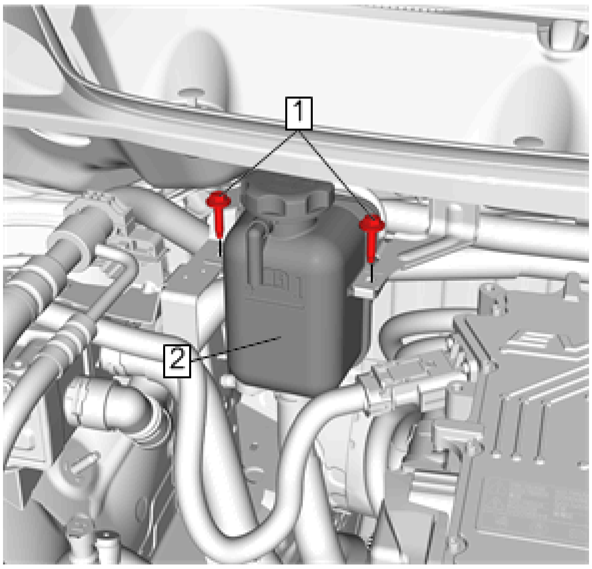


Fig. 6: Surge Tank Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove the surge tank bolt (1) and reposition the surge tank (2) forward to install the cooling system adaptor to the surge tank.

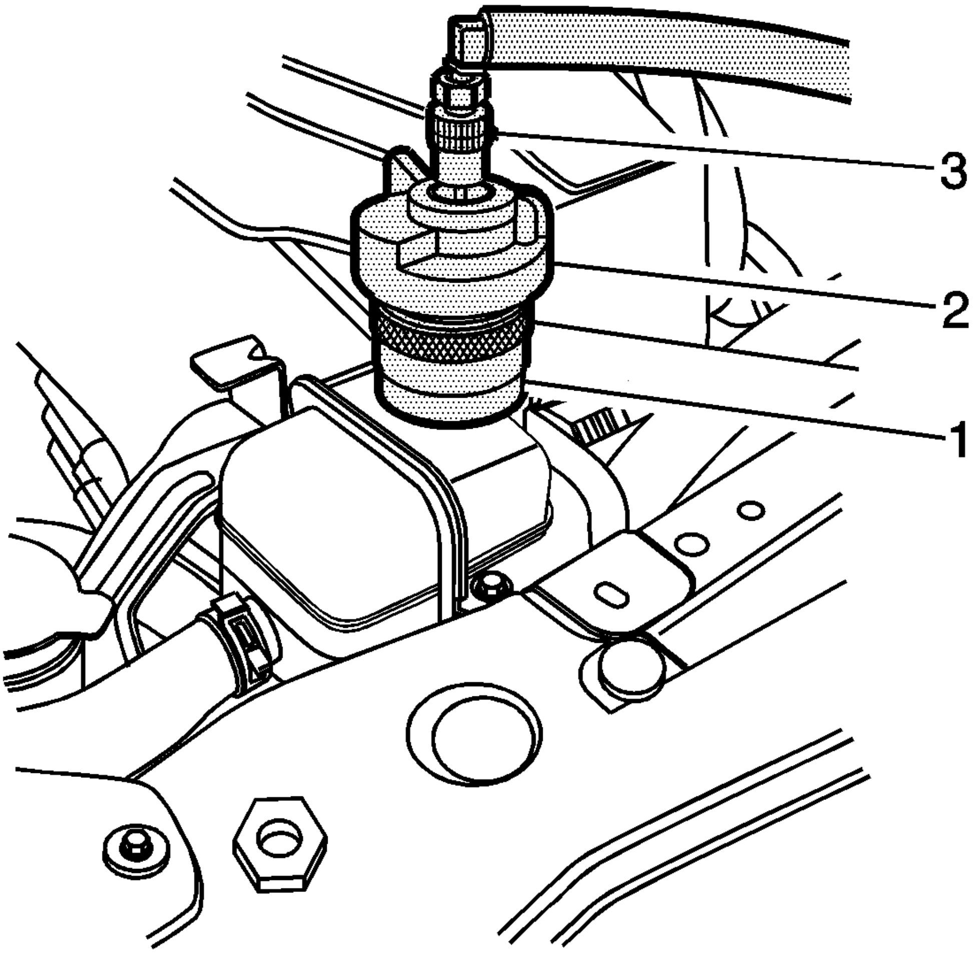


Fig. 7: Installing GE-46143-2 Adapter
Courtesy of GENERAL MOTORS COMPANY

NOTE: **To prevent boiling of the coolant/water mixture in the vehicles cooling system, do not apply vacuum to a cooling system above 49Â°C (120Â°F). The tool will not operate properly when the coolant is boiling.**

6. Install **GE-46143-2** adapter (1).
7. Attach the Van-N-Fill cap (2) to **GE-46143-2** adapter (1).
8. Attach the vacuum gauge assembly (3) to the Vac-N-Fill cap (2).

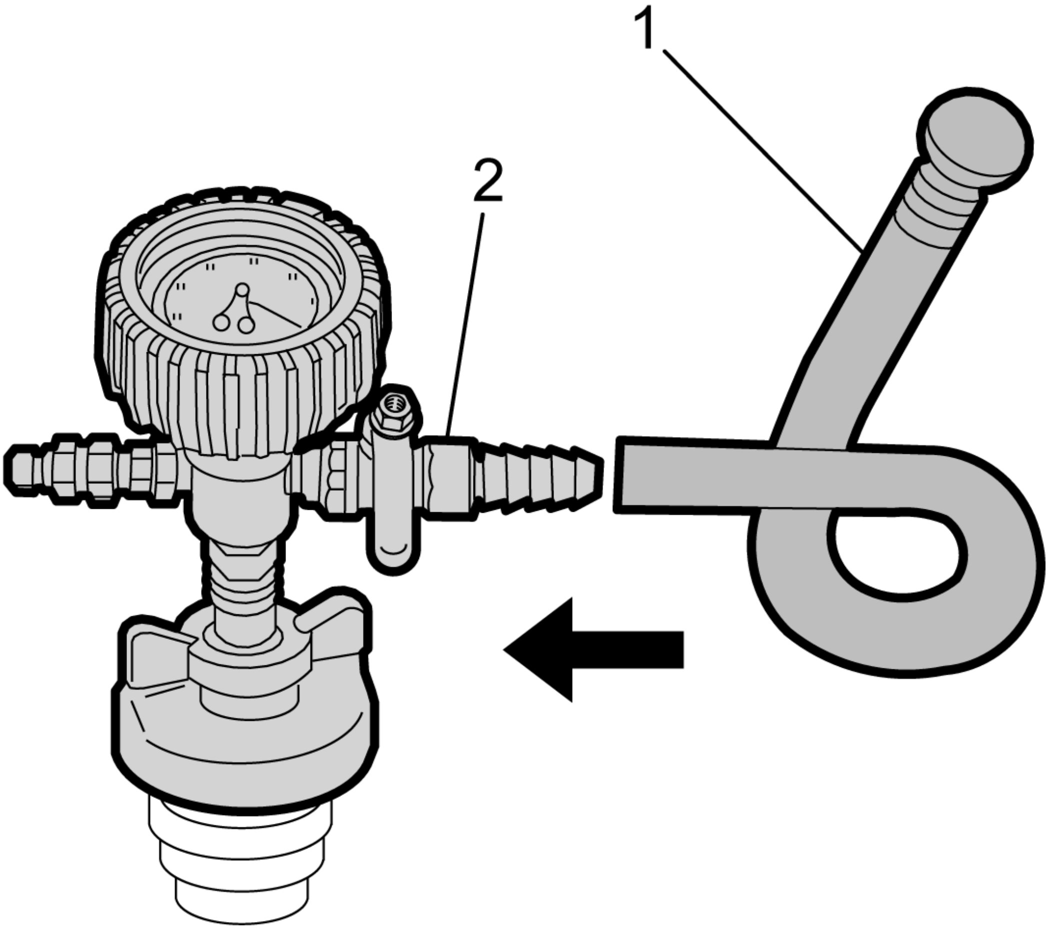


Fig. 8: Vacuum Gauge Assembly & Fill Hose
Courtesy of GENERAL MOTORS COMPANY

9. Attach the fill hose (1) to the barb fitting on the vacuum gauge assembly.

   Ensure that the valve is closed.

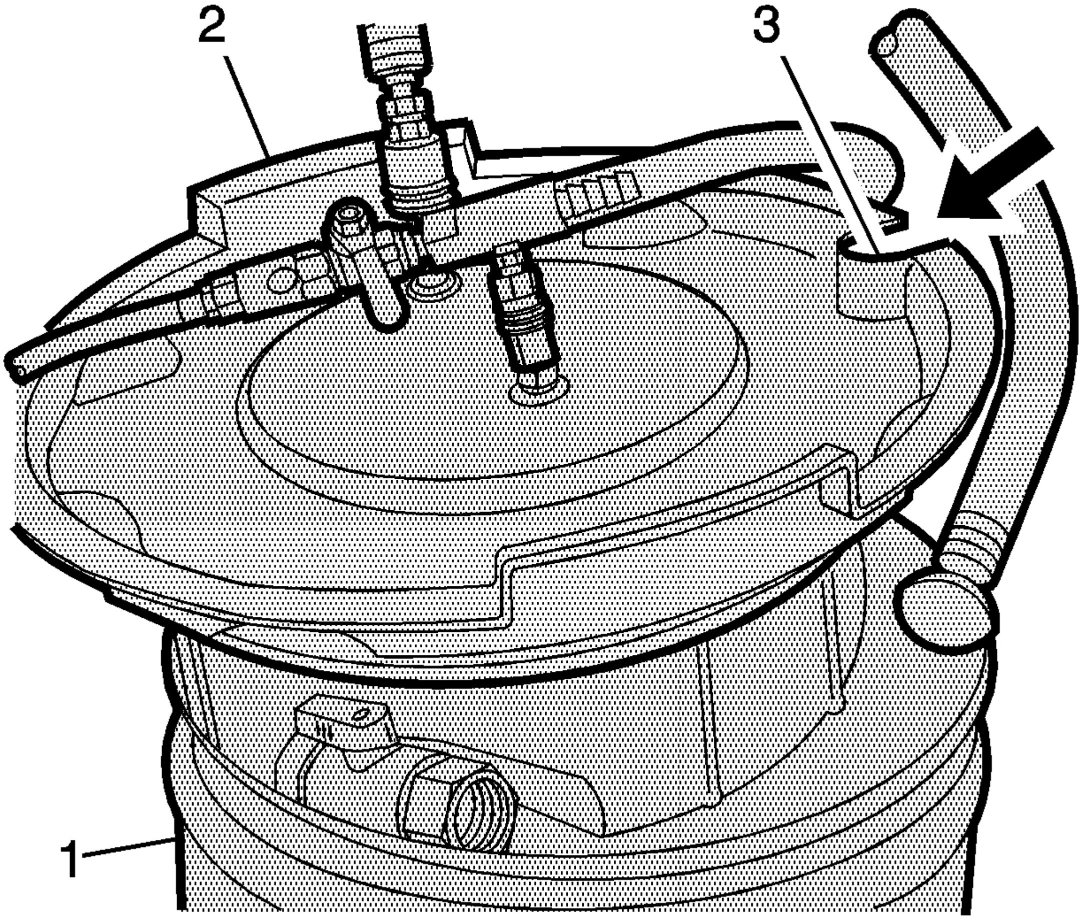


Fig. 9: Graduated Reservoir, Vacuum Tank & Cut-Out Area
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a Pre-mixed DEXCOOLÂ® (50/50 mixture of DEXCOOLÂ® and deionized water). Always use more coolant than necessary. This will eliminate air from being drawn into the cooling system.**

10. Pour the coolant mixture into the graduated reservoir (1).
11. Place the fill hose in the graduated reservoir (1).

NOTE: **Prior to installing the vacuum tank onto the graduated reservoir, ensure that the drain valve located on the bottom of the tank is closed.**

12. Install the vacuum tank (2) on the graduated reservoir with the fill hose routed through the cut-out area (3) in the vacuum tank.

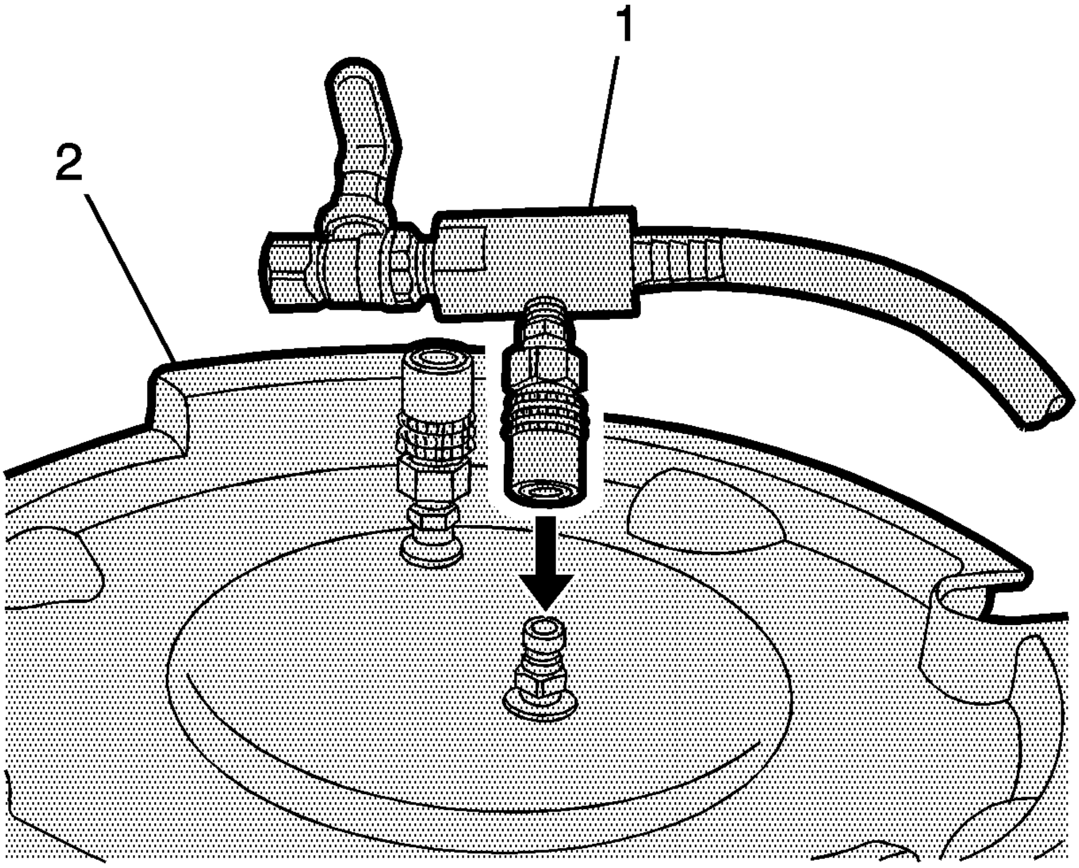


Fig. 10: Vacuum Tank & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

13. Attach the venturi assembly (1) to the vacuum tank (2).

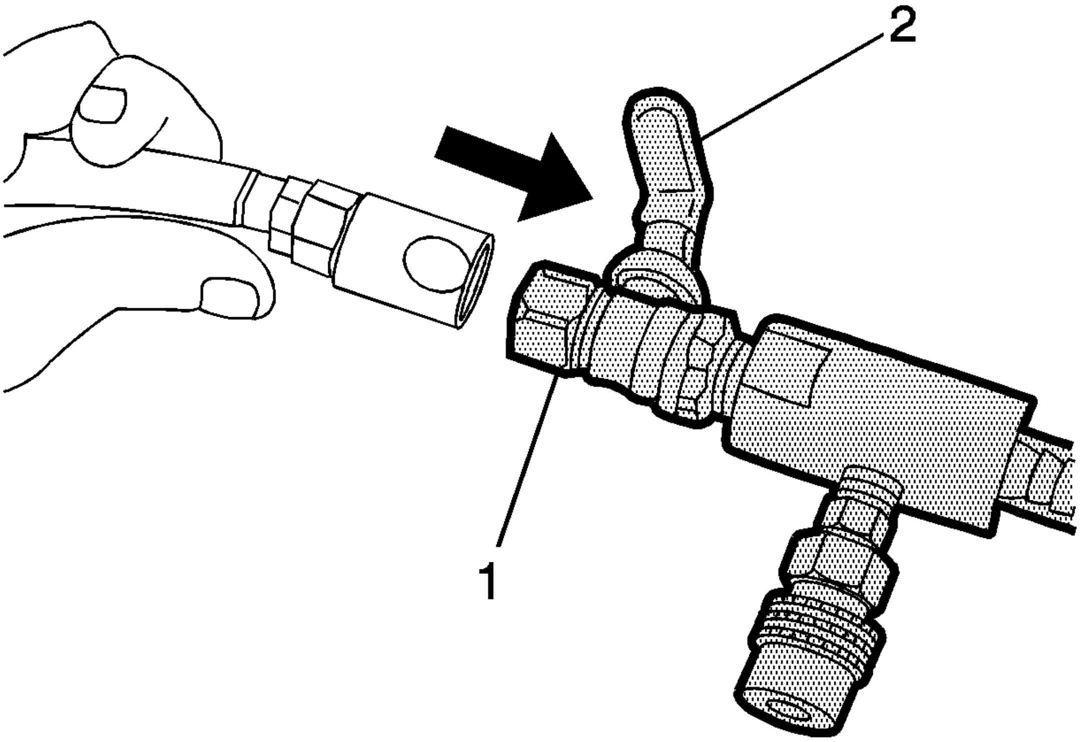


Fig. 11: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

14. Attach a shop air hose to the venturi assembly (1).

    Ensure the valve (2) on the venturi assembly is closed.

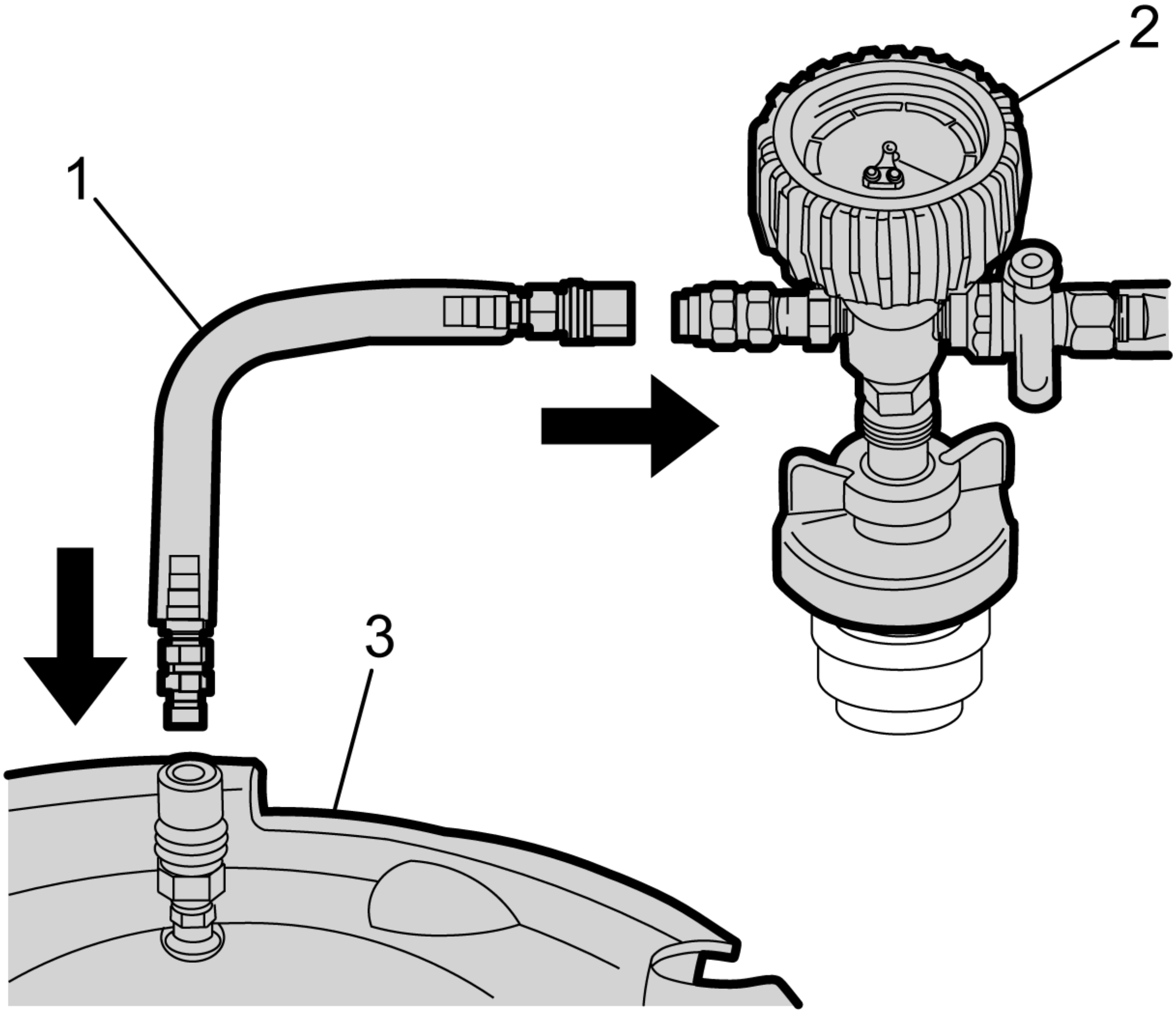


Fig. 12: Vacuum Hose, Gauge Assembly & Tank
Courtesy of GENERAL MOTORS COMPANY

15. Attach the vacuum hose (1) to the vacuum gauge assembly (2) and the vacuum tank (3).

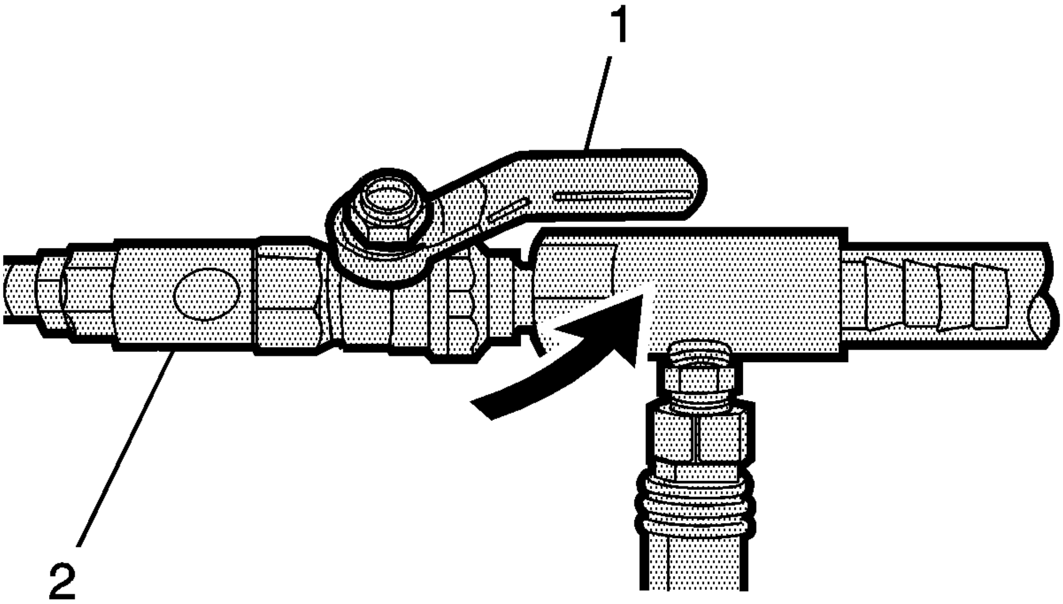


Fig. 13: Valve & Venturi Assembly
Courtesy of GENERAL MOTORS COMPANY

16. Open the valve (1) on the venturi assembly (2). The vacuum gauge will begin to rise and a hissing noise will be present.

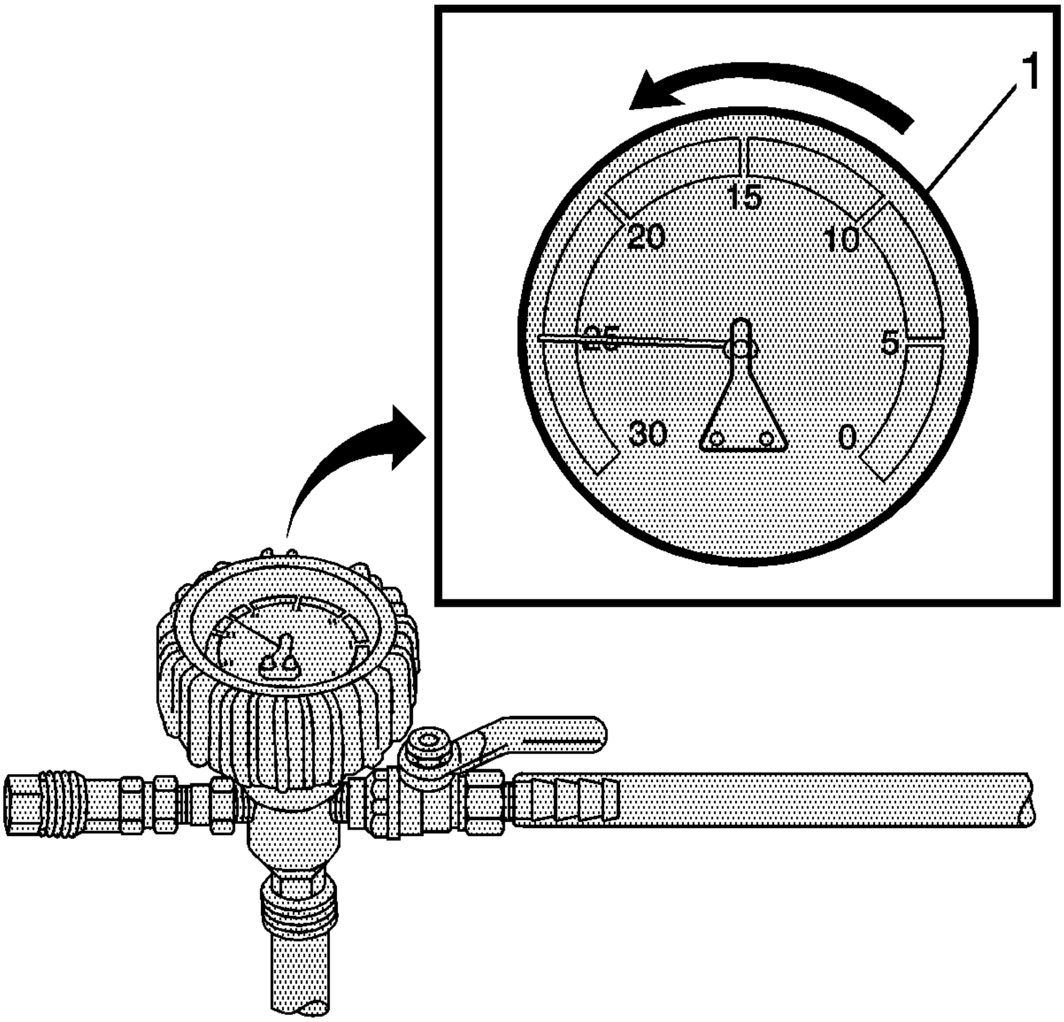


Fig. 14: Vacuum Gauge Needle
Courtesy of GENERAL MOTORS COMPANY

17. Continue to draw vacuum until the needle stops rising (1). This should be 610 - 660 mm Hg (24 - 26 in Hg).

    Cooling hoses may start to collapse. This is normal due to vacuum draw.

18. To aid in the fill process, position the graduated reservoir above the coolant fill port.

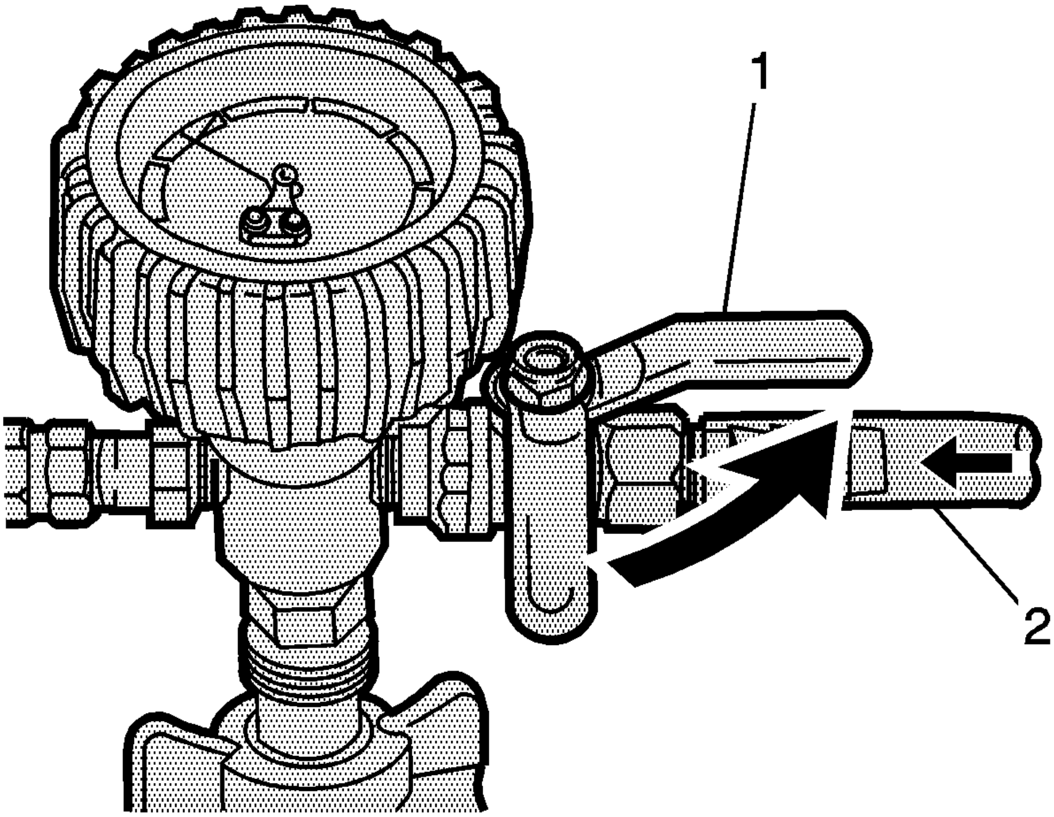


Fig. 15: Vacuum Gauge Assembly & Needle
Courtesy of GENERAL MOTORS COMPANY

19. Slowly open the valve (1) on the vacuum gauge assembly (2). When the coolant reaches the top of the fill hose, close the valve. This will eliminate air from the fill hose.
20. Close the valve on the venturi assembly.
21. If there is a suspected leak in the cooling system, allow the system to stabilize under vacuum and monitor for vacuum loss.

    If vacuum loss is observed, refer to **Cabin Heater Coolant Heater System Loss of Coolant**.

22. Open the valve on the vacuum gauge assembly. The vacuum gauge will drop as coolant is drawn into the system.

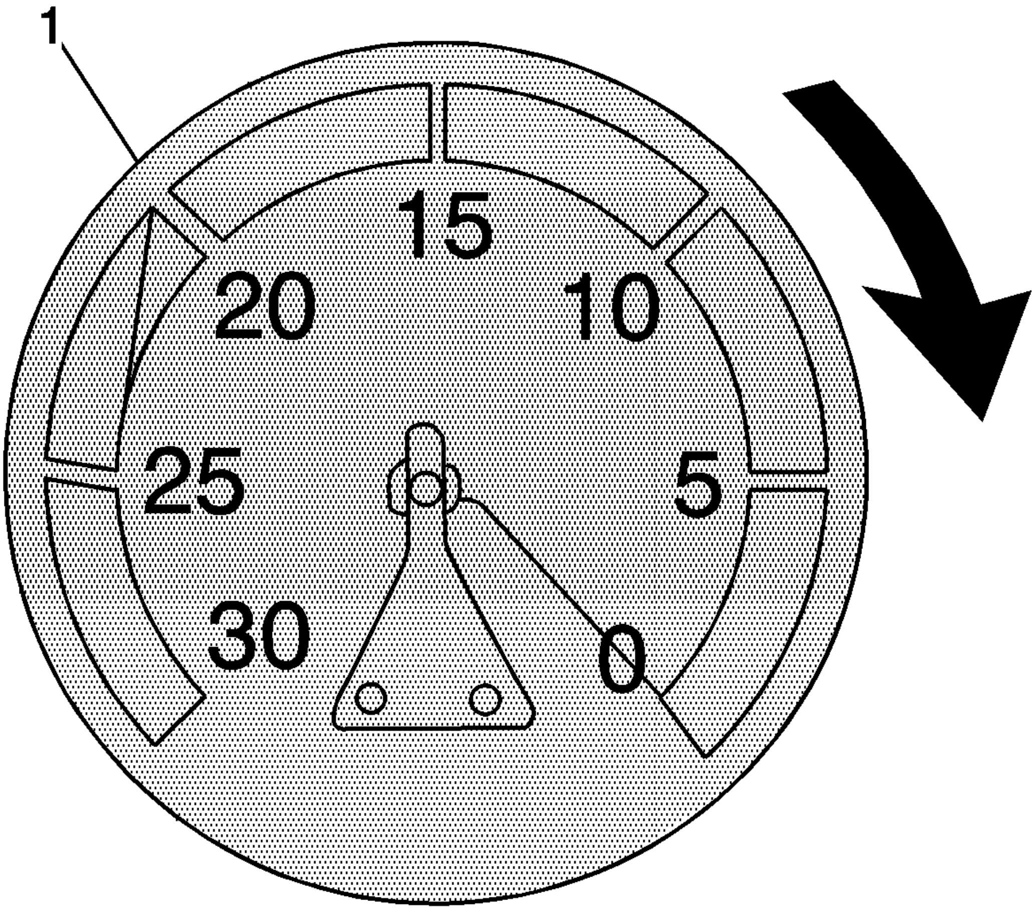


Fig. 16: Vacuum Gauge
Courtesy of GENERAL MOTORS COMPANY

23. Once the vacuum gauge (1) reaches zero, close the valve on the vacuum gauge assembly and repeat steps 15 - 21.
24. Ensure that the vehicle is in service mode. **Power Mode Description and Operation**
25. Detach the Vac-N-Fill cap from the **GE-46143-2** adapter.
26. Remove **GE-46143-2** adapter from the surge tank fill neck.

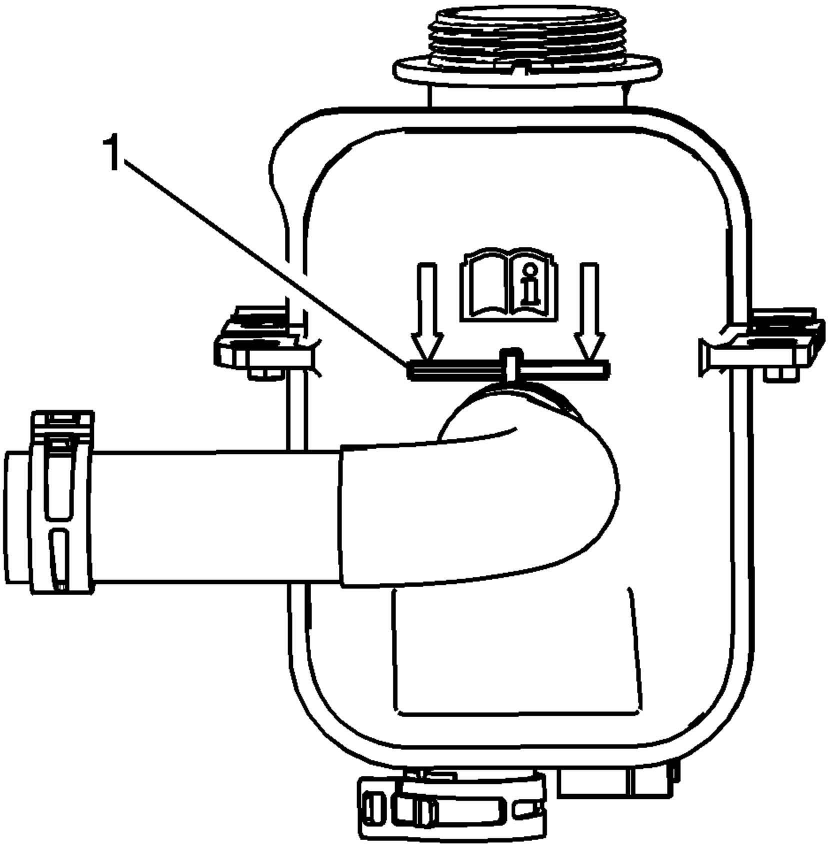


Fig. 17: Adjusting Surge Tank Coolant Level To Position Just Above Seam
Courtesy of GENERAL MOTORS COMPANY

27. Adjust the surge tank coolant level to a position just above the seam (1).
28. Inspect the concentration of the coolant mixture using **GE-26568** tester.

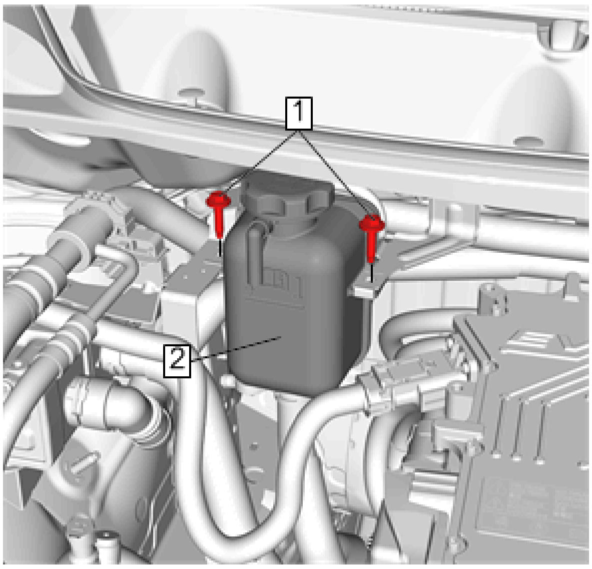


Fig. 18: Surge Tank Bolt
Courtesy of GENERAL MOTORS COMPANY

29. Position the surge tank (2) and tighten the surge tank bolt (1) to 9 N.m (80 lb in).

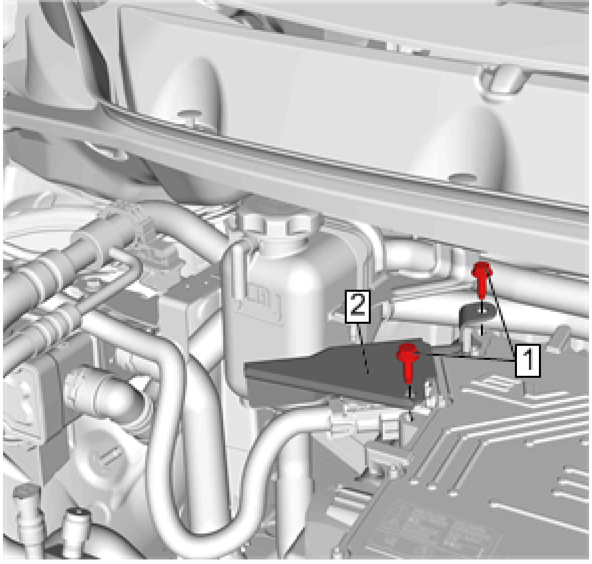


Fig. 19: Protector Securing Bolt And Protector
Courtesy of GENERAL MOTORS COMPANY

30. Install the protector (2) and tighten the protector securing bolt (1) to 9 N.m (80 lb in).

REMOVING EXCESS COOLANT FROM SYSTEM

NOTE: **After filling the cooling system, the extraction hose can be used to remove excess coolant to achieve the proper coolant level.**

1. Detach the vacuum hose from the vacuum gauge assembly.

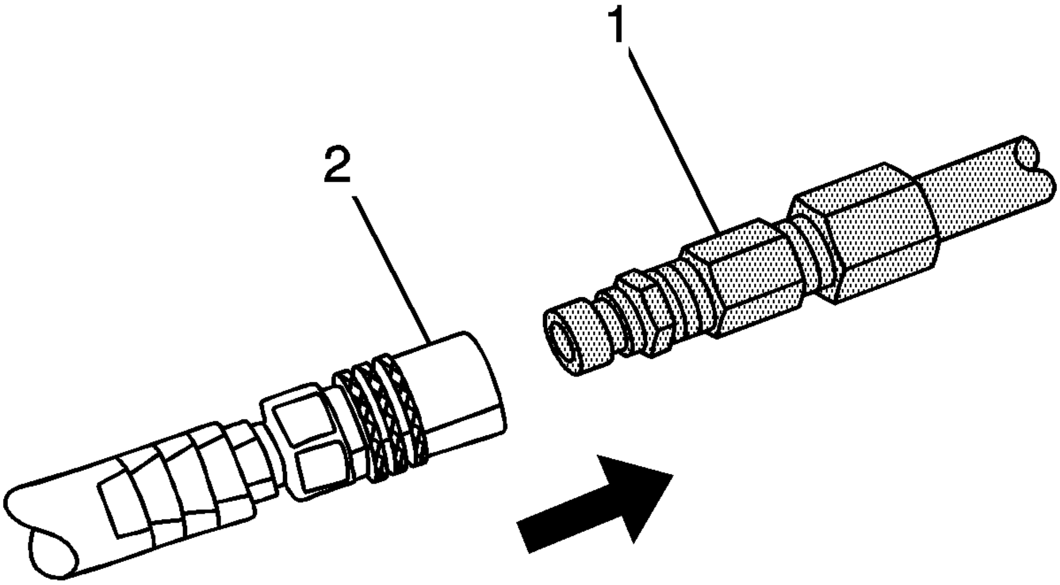


Fig. 20: Vacuum Hose & Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

2. Attach the extraction hose (1) to the vacuum hose (2).

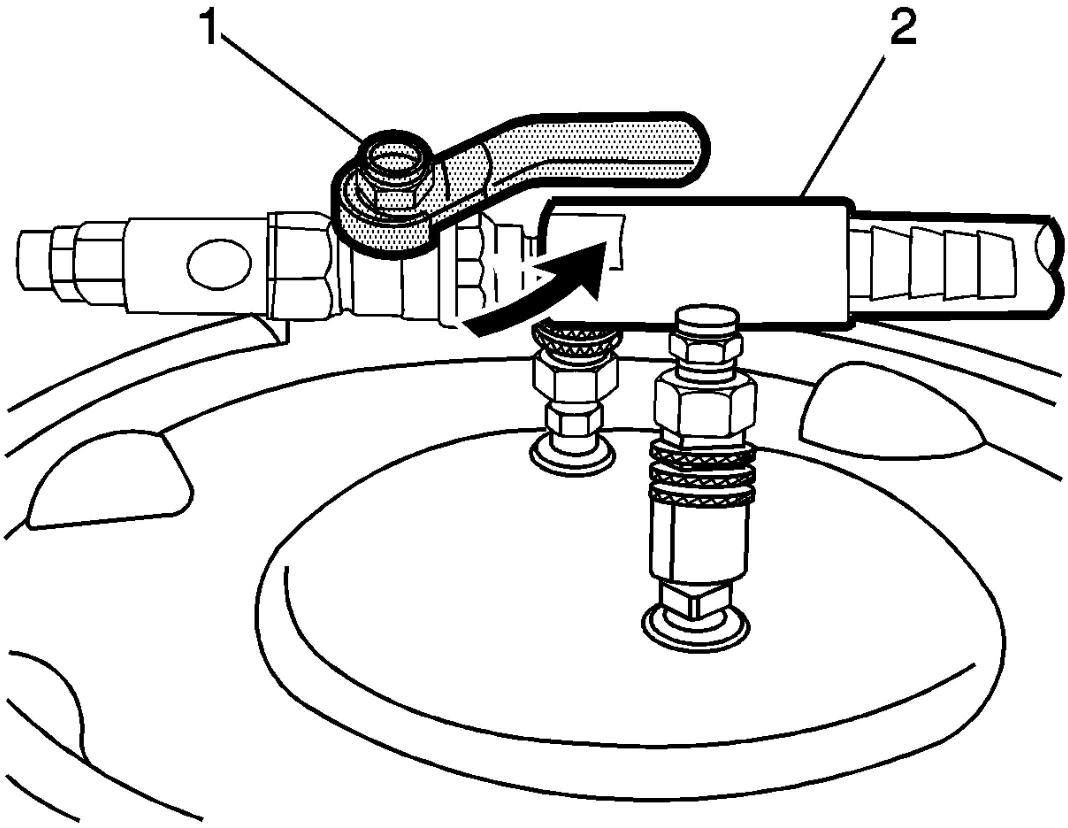


Fig. 21: Venturi Assembly & Valve
Courtesy of GENERAL MOTORS COMPANY

3. Open the valve (1) on the venturi assembly (2) to start a vacuum draw.

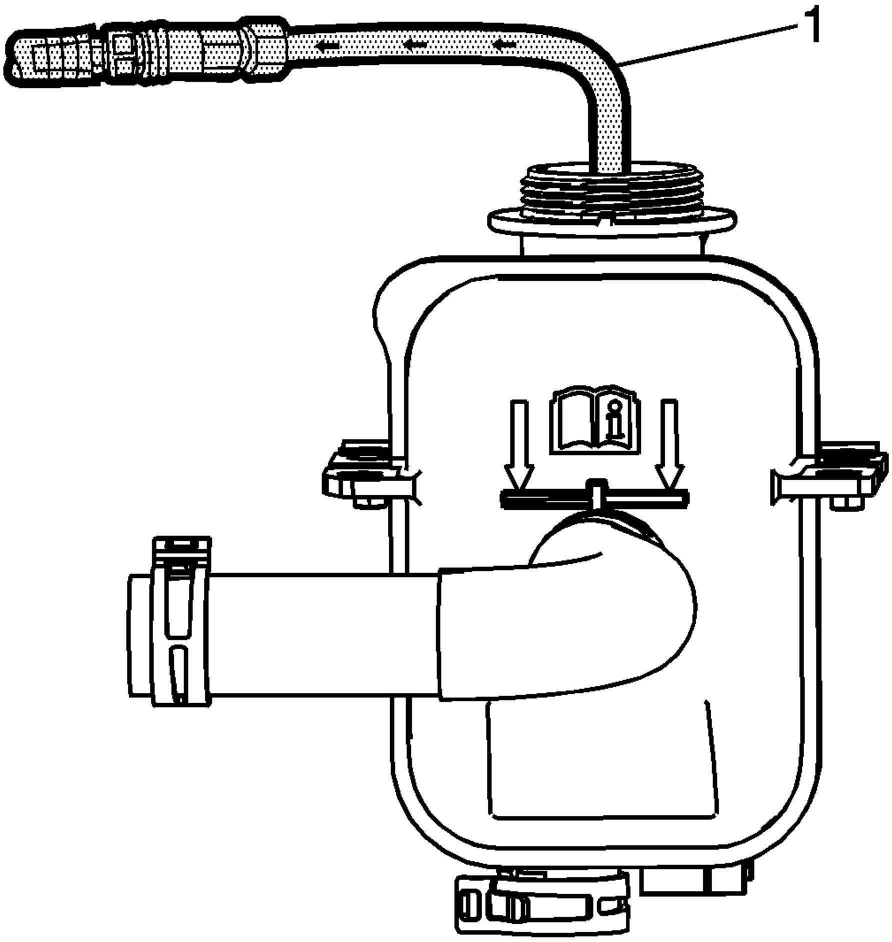


Fig. 22: Extraction Hose
Courtesy of GENERAL MOTORS COMPANY

4. Assemble the extraction hose (1) and insert into the surge tank.

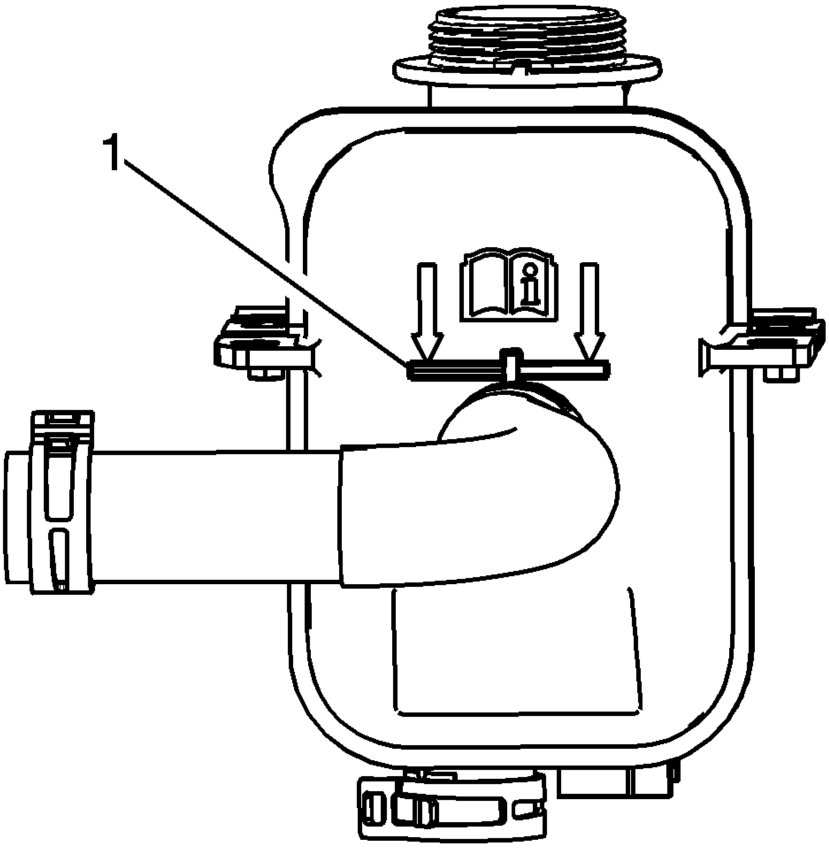


Fig. 23: Adjusting Surge Tank Coolant Level To Position Just Above Seam
Courtesy of GENERAL MOTORS COMPANY

5. Adjust the surge tank coolant level to a position just above the seam (1).
6. The vacuum tank has a drain valve on the bottom of the tank. Open the valve to drain coolant from the vacuum tank into a suitable container for disposal.

AIR CONDITIONING AND DRIVE MOTOR BATTERY COOLING COMPRESSOR REPLACEMENT

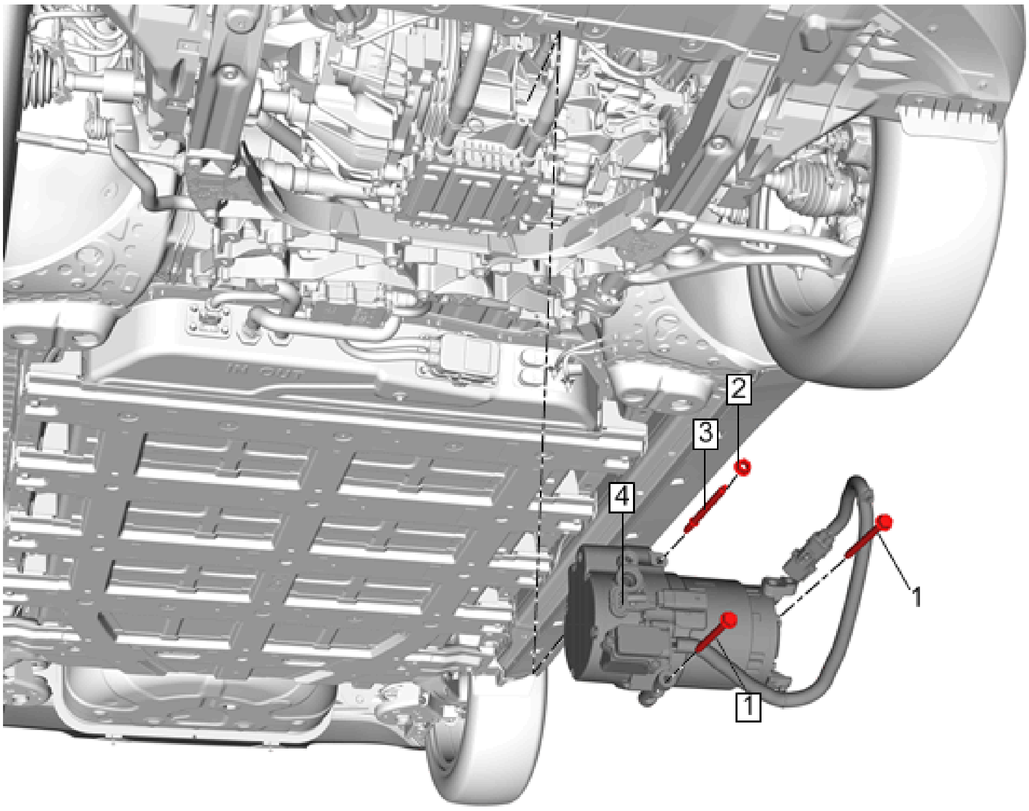


Fig. 24: Air Conditioning and Drive Motor Battery Cooling Compressor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

WARNING:

Do not use a service jack in locations other than those specified to lift this vehicle. Lifting the vehicle with a jack in those other locations could cause the vehicle to slip off the jack and roll; this could cause injury or death.

CAUTION:

This A/C system's high voltage A/C Compressor uses Polyolester (POE) refrigerant oil instead of Polyalkylene Glycol (PAG) refrigerant oil. Use only approved GM POE oil no more than two hours after removal from its sealed moisture proof packaging (reference GM POE label for proper usage) in refrigerant systems equipped with a High Voltage A/C compressor. GM POE oil is intended to be used with the GE-45037-A A/C oil injector and the GE-48997 A/C POE oil injector hose. Use of any refrigerant oil other than the approved GM POE, handled and installed per GM's requirements may result in compressor failure and/or loss of HV isolation with associated DTC's set.

Preliminary Procedures

1. Disable the high voltage. **High Voltage Disabling**
2. Remove the air conditioning compressor hose from the compressor. **Air Conditioning Compressor Hose Replacement**
3. Remove the air conditioning condenser hose from the compressor. **Air Conditioning Condenser Hose Replacement**
4. Remove the left front wheelhouse liner. **Front Wheelhouse Liner Replacement**

Callout	Component Name
1	Air Conditioning and Drive Motor Cooling Compressor Bolt (Qty: 2) **CAUTION:** **Fastener Caution** **Tighten** 22 N.m (16 lb ft)
2	Air Conditioning and Drive Motor Cooling Compressor Nut **Tighten** 22 N.m (16 lb ft)
3	Air Conditioning and Drive Motor Cooling Compressor Stud **Tighten** 10 N.m (89 lb in)

Callout	Component Name
4	Air Conditioning and Drive Motor Cooling Compressor **Procedure** 1. Disconnect and unclip the high voltage compressor connector. 2. Disconnect the low voltage connector. 3. A/C compressor oil balancing is not required. The service A/C compressor contains enough oil; however, add any oil that was removed during the A/C system recovery process. Refer to **Refrigerant Recovery and Recharging**. 4. If replacing the A/C compressor, it is necessary to program the replacement A/C compressor. **Control Module References** . 5. Enable the high voltage. **High Voltage Enabling**

COMPRESSOR PRESSURE RELIEF VALVE REPLACEMENT

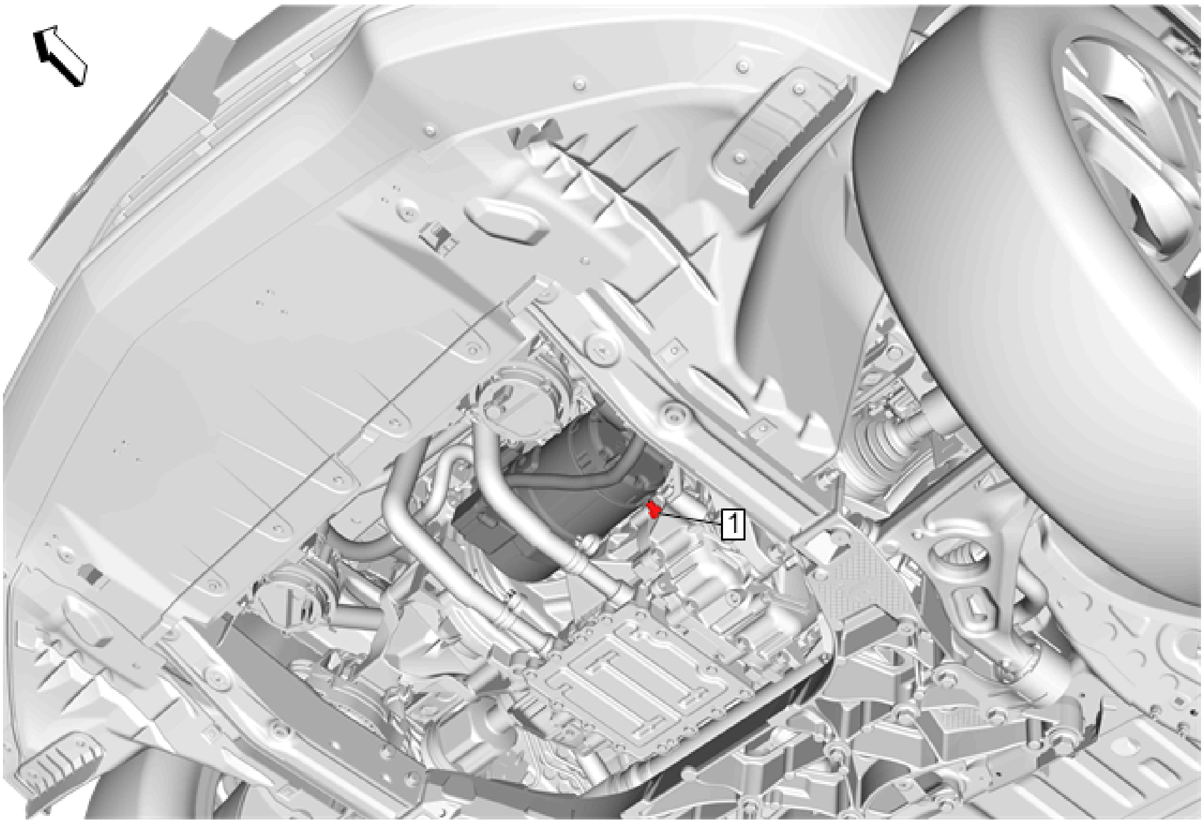


Fig. 25: Compressor Pressure Relief Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
	Preliminary Procedure
1.	**Refrigerant Recovery and Recharging**
2.	**Front Compartment Air Deflector Replacement**
1	Air Conditioning Compressor Pressure Relief Valve **CAUTION:** **Component Fastener Tightening Caution** **Tighten** 7 N.m (62 lb in)

AIR CONDITIONING SYSTEM SEAL REPLACEMENT

Removal Procedure

1. Disassemble the A/C refrigerant components. Refer to the appropriate repair procedure.

   NOTE: **Cap or tape the open A/C refrigerant components immediately to prevent system contamination.**

2. Cap or tape the A/C refrigerant components.

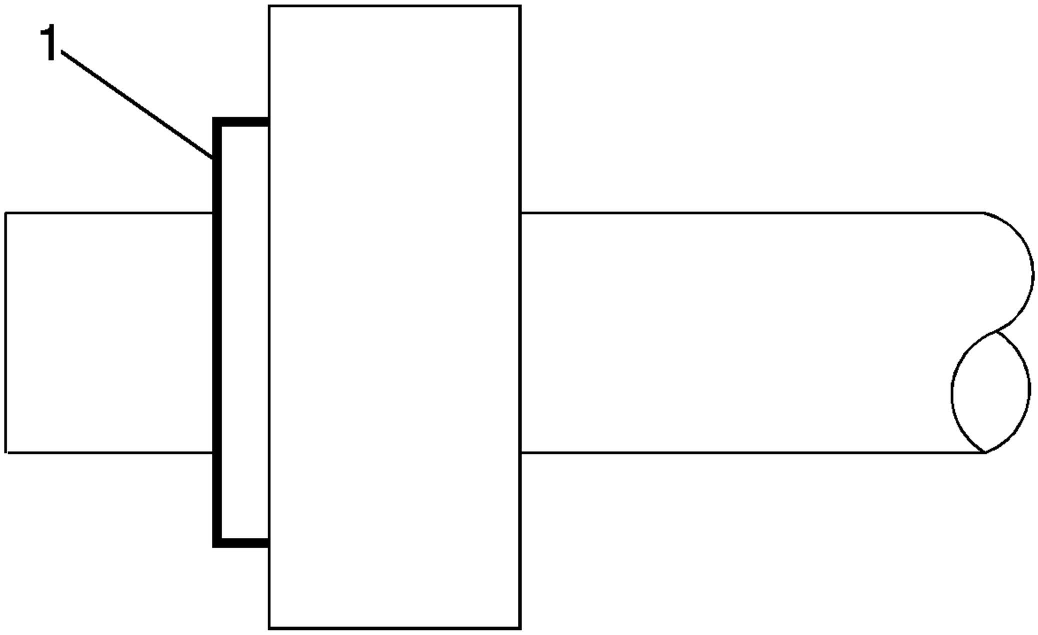


Fig. 26: A/C Refrigerant Sealing Washer
Courtesy of GENERAL MOTORS COMPANY

3. Remove the sealing washer (1) from the A/C refrigerant component.
4. Inspect the seal washer for signs of damage to help determine the root cause of the failure.
5. Inspect the A/C refrigerant components for damage or burrs. Repair if necessary.

   NOTE: **DO NOT reuse sealing washer.**

6. DISCARD the sealing washer.

Installation Procedure

NOTE: **Flat washer type seals do not require lubrication.**

1. Inspect the new sealing washer for any signs of cracks, cuts, or damage.

   Do not use a damaged sealing washer.

2. Remove the cap or tape from the A/C refrigerant components.

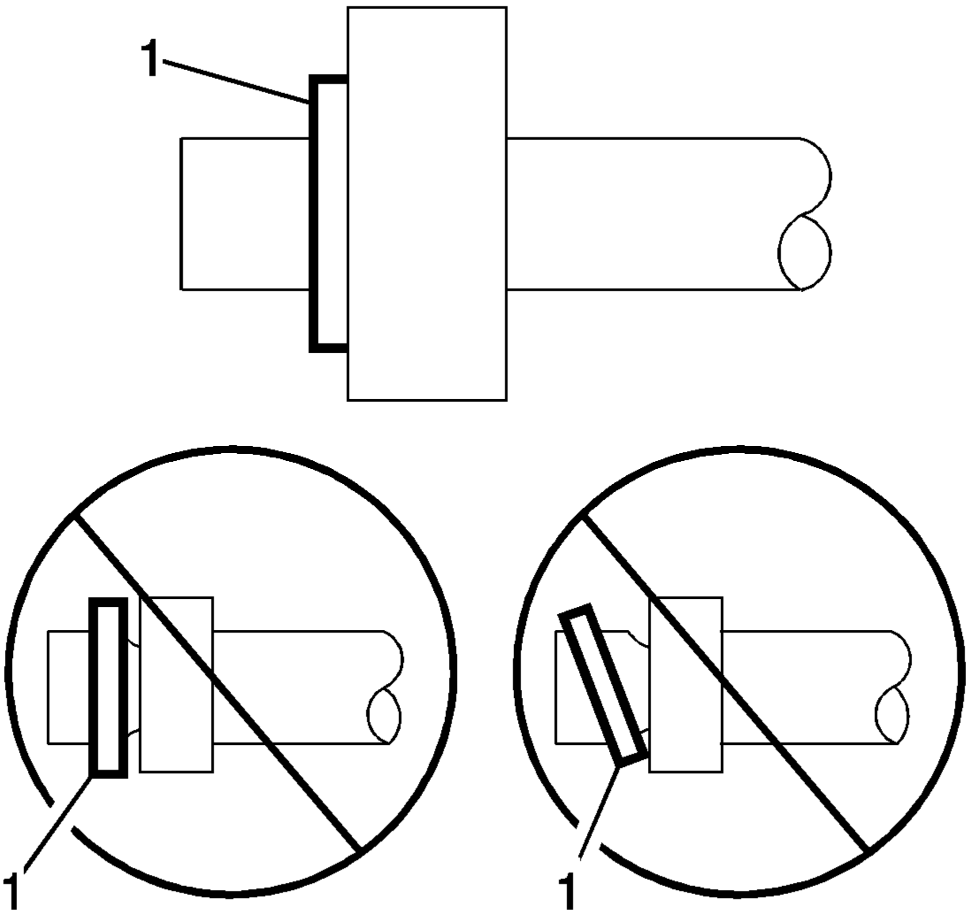


Fig. 27: Identifying Proper Seating Of A/C Refrigerant O-Ring
Courtesy of GENERAL MOTORS COMPANY

3. Using a lint-free clean, dry cloth, clean the sealing surfaces of the A/C refrigerant components.
4. Carefully install the NEW sealing washer (1) onto the A/C refrigerant component.

   The sealing washer (1) must completely bottom against the surface of the fitting.

   NOTE: **After tightening the A/C components, there should be a slight sealing gap of approximately 1.2 mm (3/64 in) between the A/C line and the A/C component.**

5. Assemble the remaining A/C refrigerant components. Refer to the appropriate repair procedure.

AIR CONDITIONING O-RING SEAL REPLACEMENT

Removal Procedure

1. Disassemble the A/C refrigerant components. Refer to the appropriate repair procedure

   NOTE: **Cap or tape the open A/C refrigerant components immediately to prevent system contamination.**

2. Cap or tape the A/C refrigerant components.

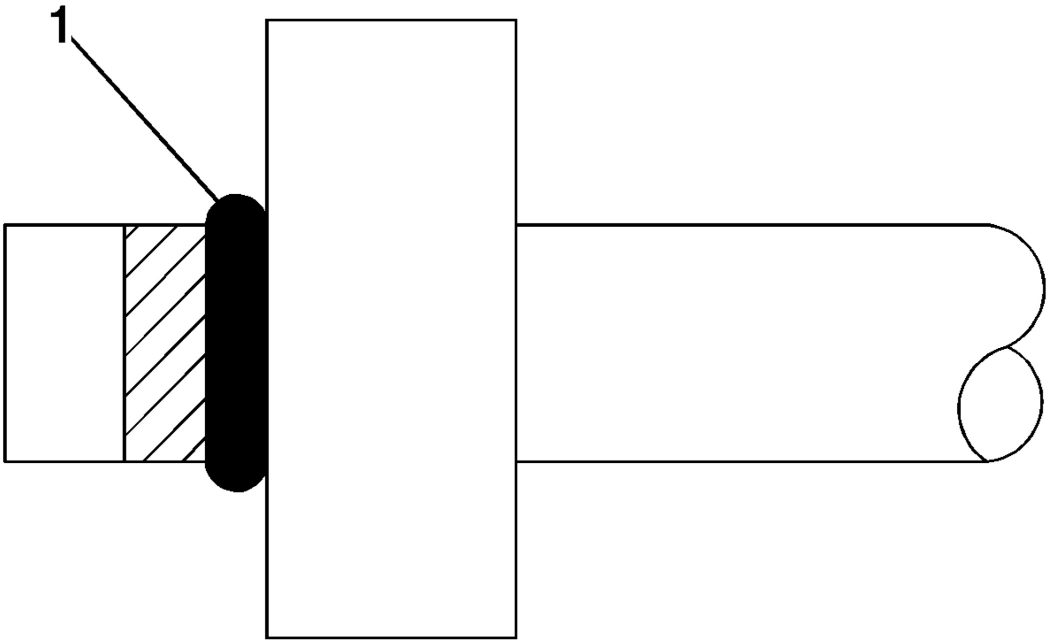


Fig. 28: O-ring seal
Courtesy of GENERAL MOTORS COMPANY

3. Remove the O-ring seal (1) from the A/C refrigerant component.
4. Inspect the O-ring seal for signs of damage to help determine the root cause of the failure.
5. Inspect the A/C refrigerant components for damage or burrs. Repair if necessary.
6. DISCARD the O-ring seal.

Installation Procedure

1. Inspect the new O-ring seal for any sign of cracks, cuts, or damage.
2. Remove the cap or tape from the A/C refrigerant components.
3. Using a lint-free clean, dry cloth, carefully clean the sealing surfaces of the A/C refrigerant components.

NOTE: **Use only the recommended refrigerant oil or damage to the A/C system could occur.**

4. Lightly coat the new O-ring seal with the recommended refrigerant oil. **Adhesives, Fluids, Lubricants, and Sealers**

NOTE: **DO NOT reuse O-ring seals.**

5. Carefully slide the NEW O-ring seal (1) onto the A/C refrigerant component.

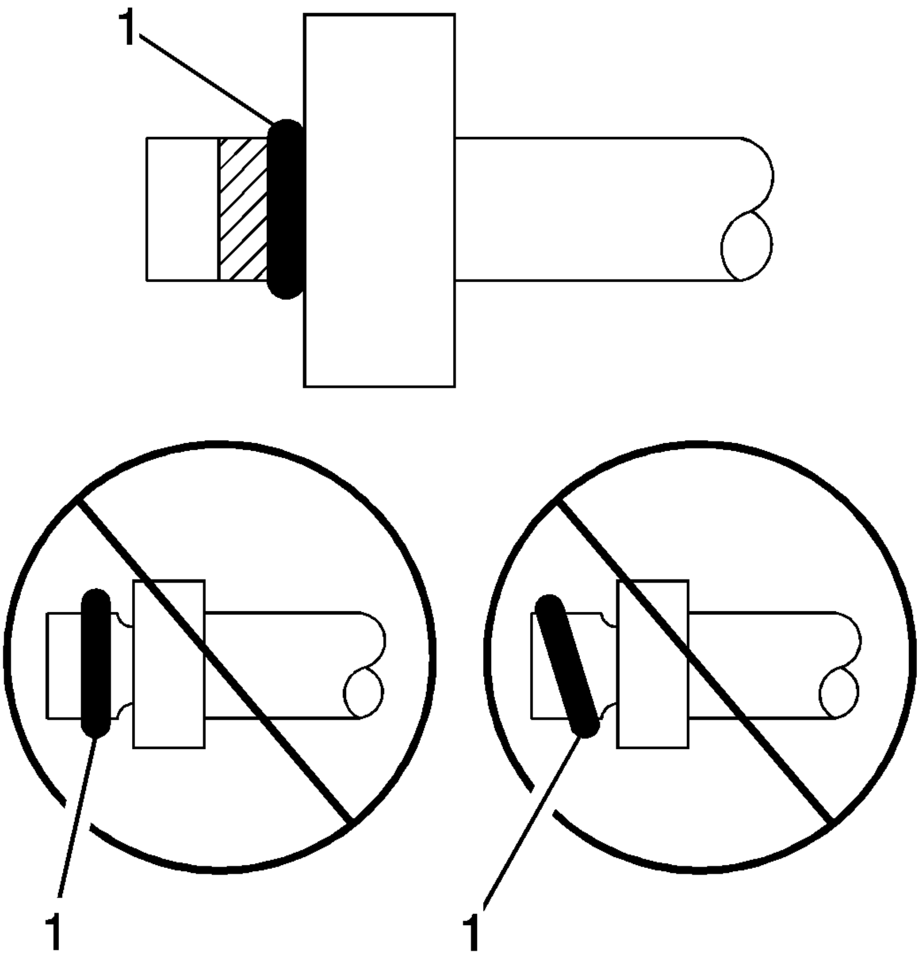


Fig. 29: Identifying Good & Bad Sealing Washer Positions
Courtesy of GENERAL MOTORS COMPANY

6. The O-ring seal (1) must be fully seated.
7. Assemble the A/C components.

   Refer to the appropriate repair procedure.

AIR CONDITIONING COMPRESSOR HOSE REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
2. Recover the refrigerant. **Refrigerant Recovery and Recharging**

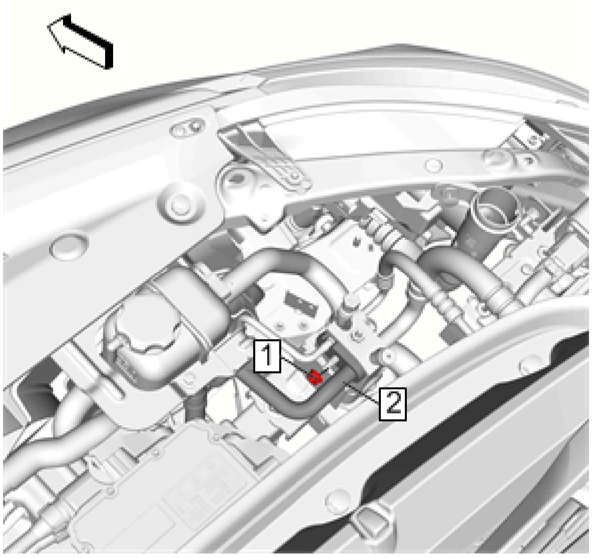


Fig. 30: Air Conditioning Compressor Hose Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove the air conditioning compressor hose nut (1).
4. Remove the air conditioning compressor hose (2) from the air conditioning evaporator hose.
5. Raise the vehicle. **Lifting and Jacking the Vehicle**
6. Remove Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**

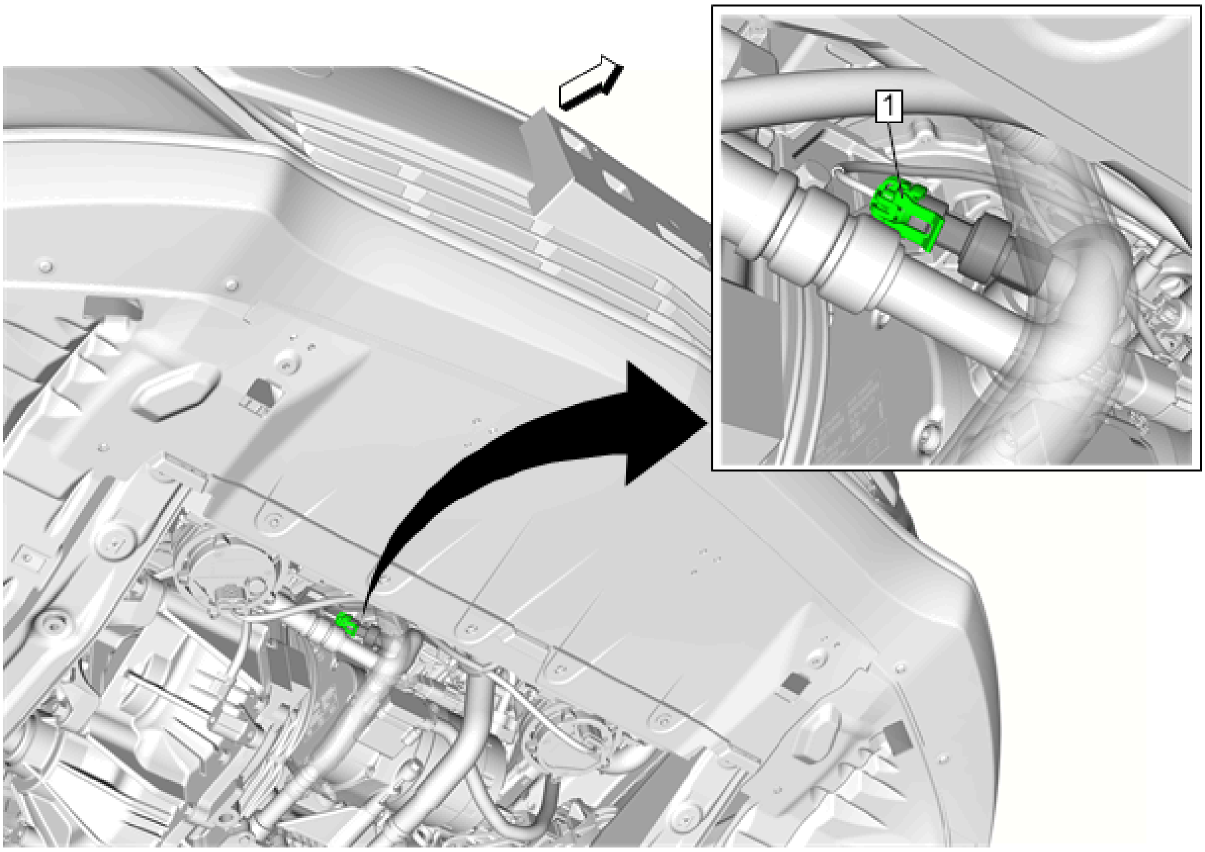


Fig. 31: Electrical Connector And Air Conditioning (A/C) Refrigerant Pressure Sensor
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the electrical connector (1) from the air conditioning (A/C) refrigerant pressure sensor.

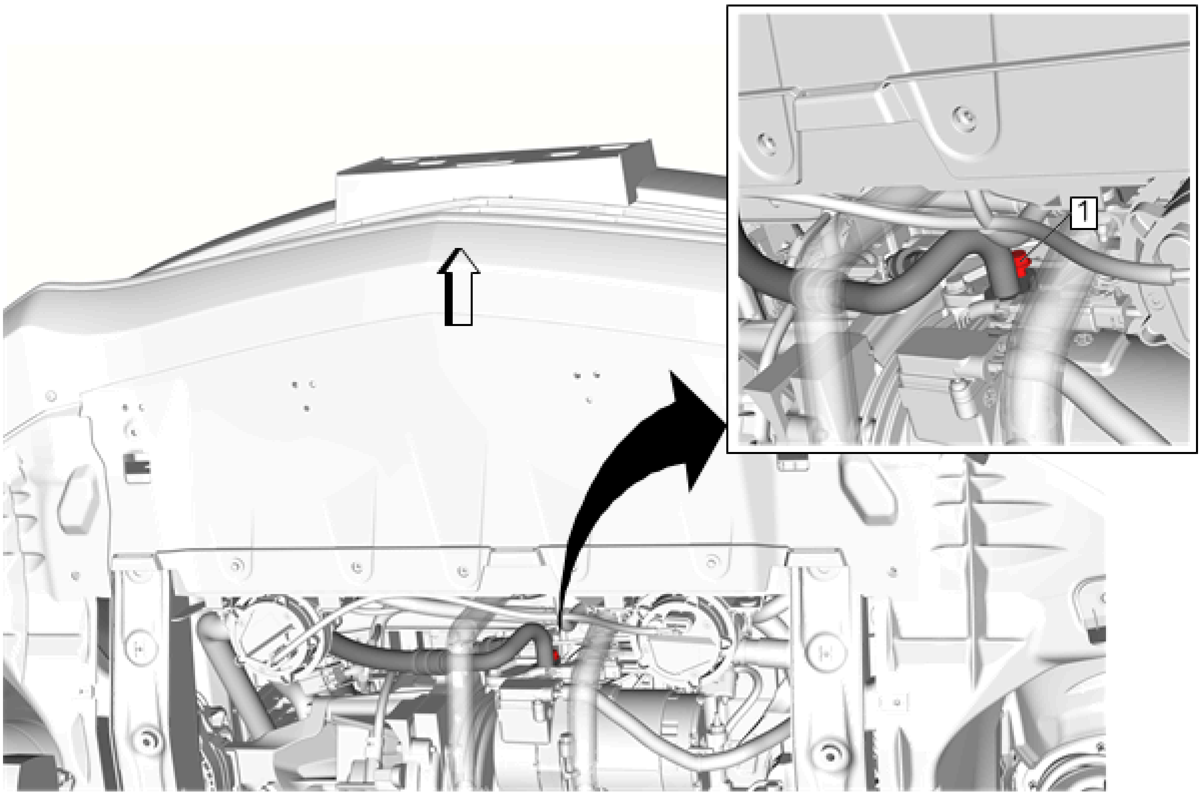


Fig. 32: Air Conditioning Compressor Hose Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove the air conditioning compressor hose bolt (1) from the air conditioning compressor.

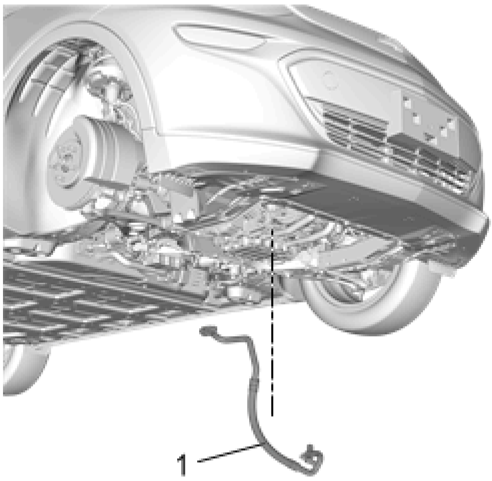


Fig. 33: Air Conditioning Compressor Hose
Courtesy of GENERAL MOTORS COMPANY

9. Remove Air Conditioning Compressor Hose (1)
10. Remove the low pressure air conditioning refrigerant pressure sensor. **Air Conditioning Refrigerant Pressure Sensor Replacement - Low Pressure**

Installation Procedure

1. Install the low pressure air conditioning refrigerant pressure sensor. **Air Conditioning Refrigerant Pressure Sensor Replacement - Low Pressure**
2. Change the air conditioning sealing washer. **Air Conditioning System Seal Replacement**

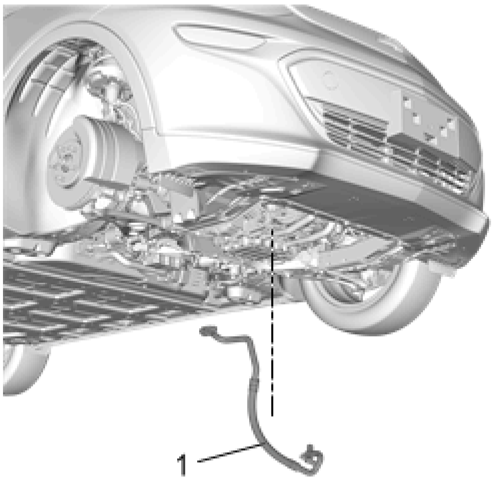


Fig. 34: Air Conditioning Compressor Hose
Courtesy of GENERAL MOTORS COMPANY

3. Position the air conditioning compressor hose (1) to the vehicle.

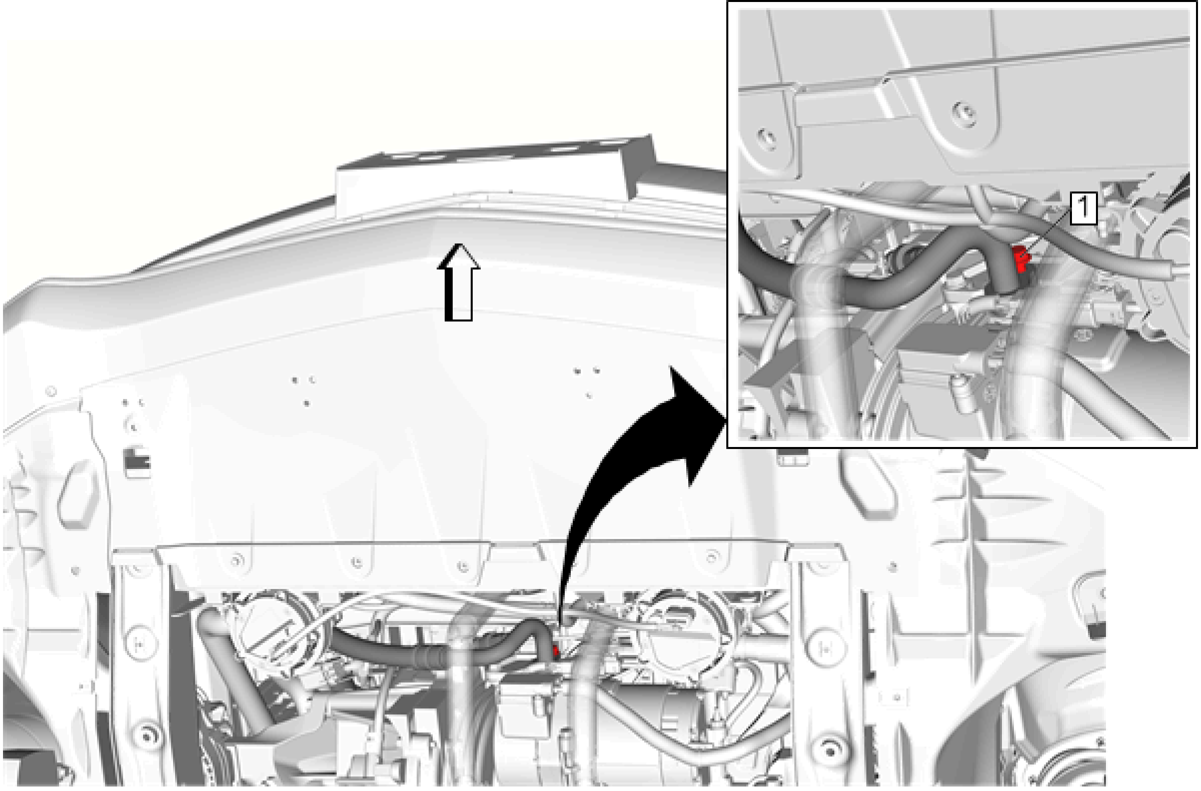


Fig. 35: Air Conditioning Compressor Hose Bolt
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

4. Install the air conditioning compressor hose bolt (1) to the air conditioning compressor and tighten to 22 N.m (16 lb ft).

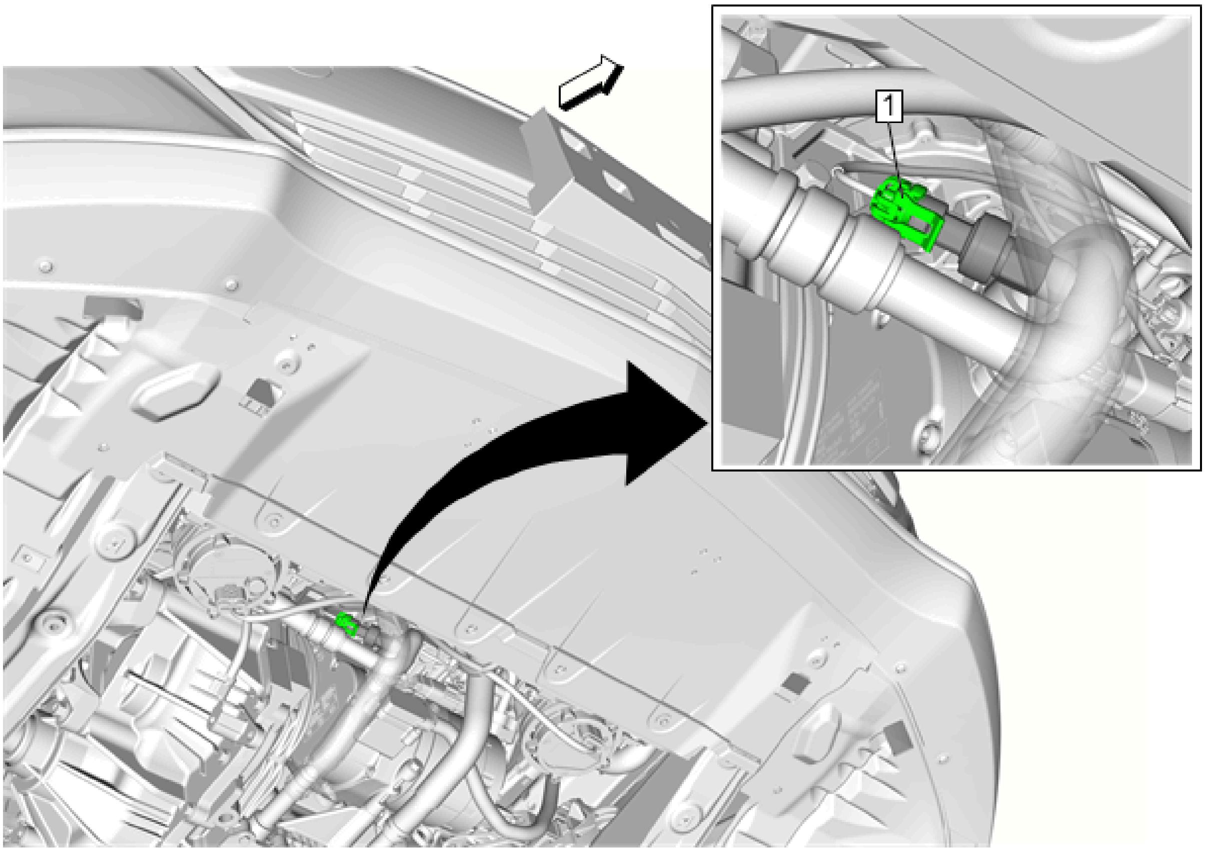


Fig. 36: Electrical Connector And Air Conditioning (A/C) Refrigerant Pressure Sensor
Courtesy of GENERAL MOTORS COMPANY

5. Connect the electrical connector (1) to the air conditioning (A/C) refrigerant pressure sensor.
6. Install Front Compartment Air Deflector Front Compartment Air Deflector Replacement
7. Lower the vehicle.

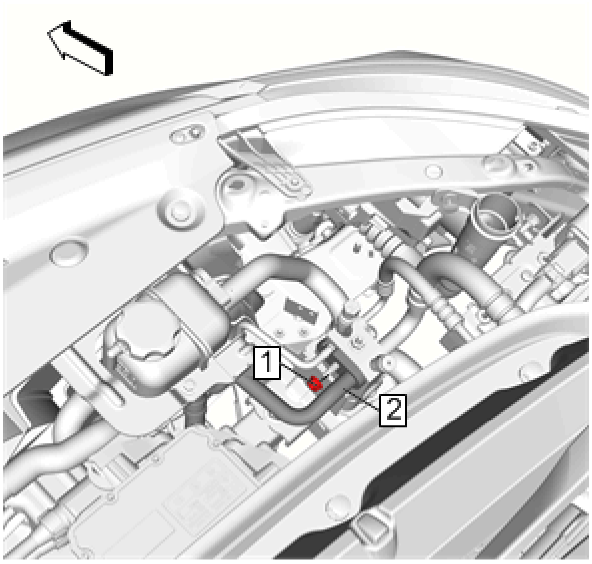


Fig. 37: Air Conditioning Compressor Hose Nut
Courtesy of GENERAL MOTORS COMPANY

8. Install the air conditioning compressor hose (2) to the air conditioning evaporator hose.
9. Tighten the air conditioning compressor hose nut (1) to 22 N.m (16 lb ft)
10. Evacuate and charge the refrigerant system. **Refrigerant Recovery and Recharging**
11. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

AIR CONDITIONING CONDENSER HOSE REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
2. Recover the refrigerant. **Refrigerant Recovery and Recharging**

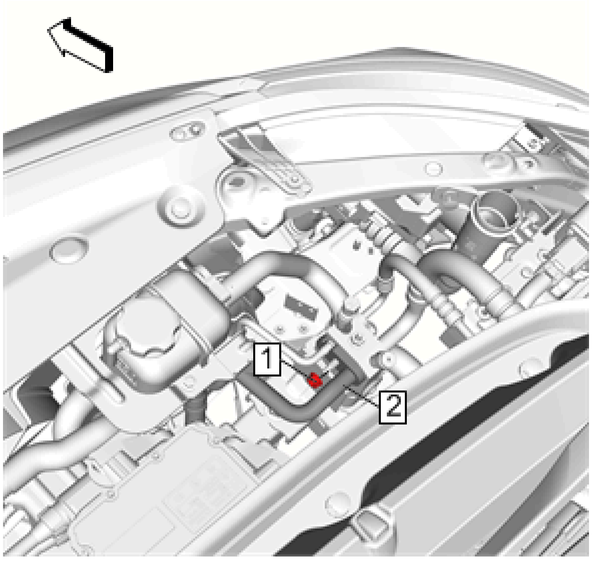


Fig. 38: Air Conditioning Compressor Hose Nut
Courtesy of GENERAL MOTORS COMPANY

3. Remove the air conditioning compressor hose nut (1). **Air Conditioning Compressor Hose Replacement**

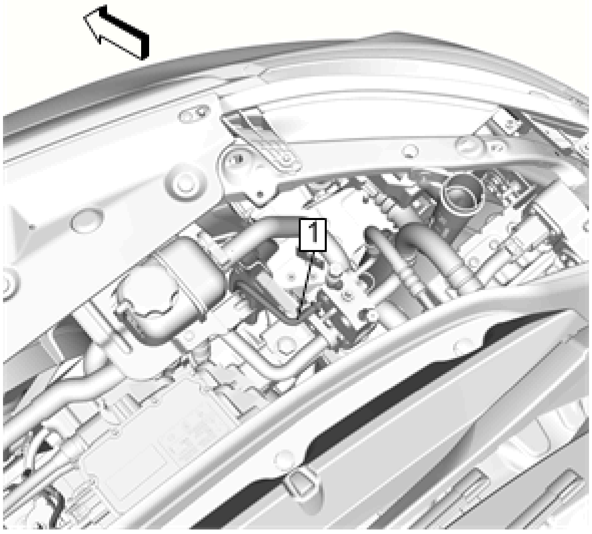


Fig. 39: Air Conditioning Condenser Hose
Courtesy of GENERAL MOTORS COMPANY

4. Remove the air conditioning condenser hose (1) from the air conditioning evaporator hose.
5. Raise the vehicle. Lifting and Jacking the Vehicle
6. Remove Front Compartment Air Deflector Front Compartment Air Deflector Replacement
7. Remove Front Bumper Fascia Front Bumper Fascia Replacement (North America) Front Bumper Fascia Replacement (Europe, Korea)

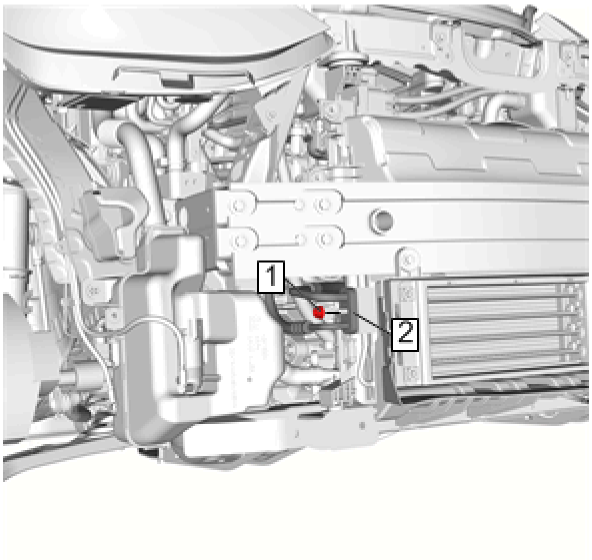


Fig. 40: Air Conditioning Condenser Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

8. Remove the air conditioning condenser hose nut (1).
9. Remove the air conditioning condenser hose (2) from the air conditioning condenser.

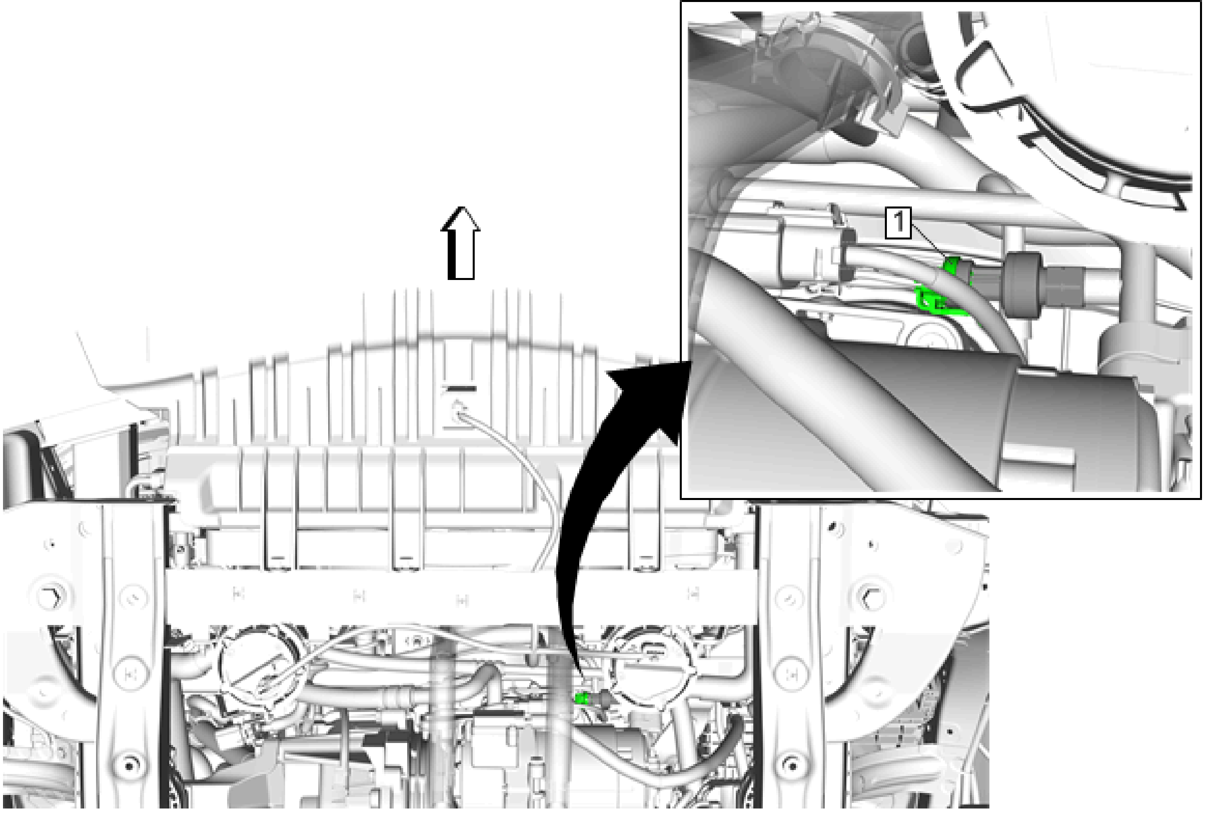


Fig. 41: Electrical Connector And Air Conditioning (A/C) Refrigerant Pressure Sensor
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the electrical connector (1) from the air conditioning (A/C) refrigerant pressure sensor.

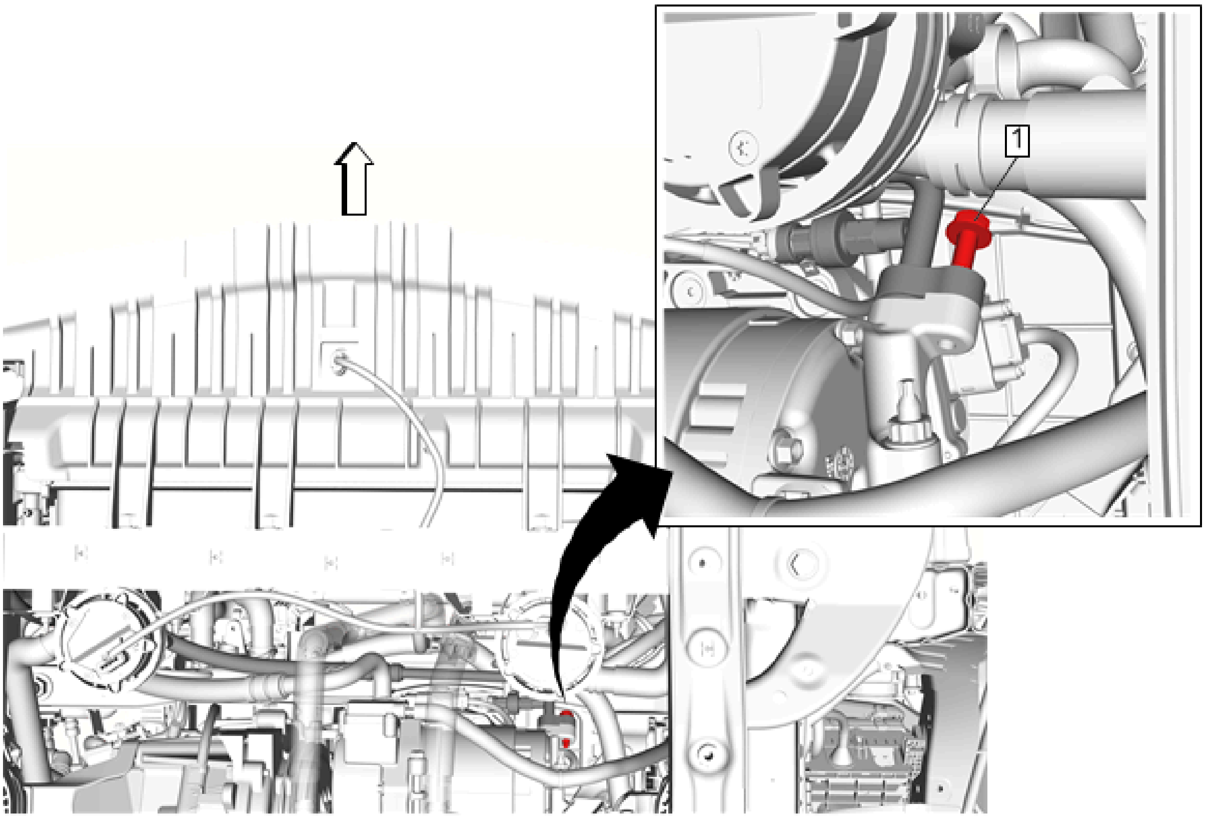


Fig. 42: Air Conditioning Condenser Hose Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Remove the air conditioning condenser hose bolt (1) from the air conditioning compressor.

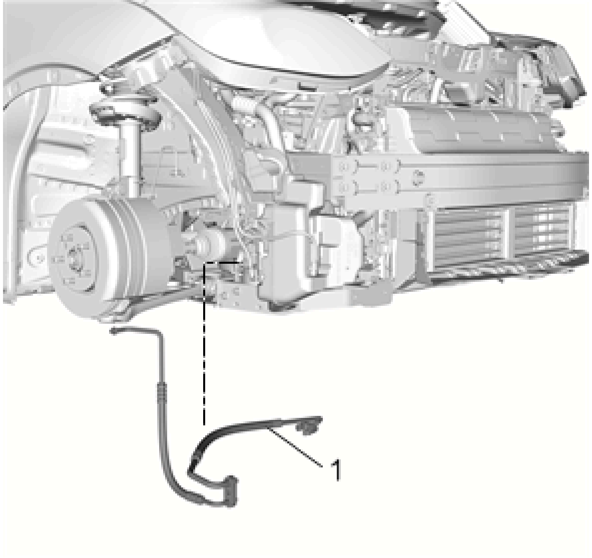


Fig. 43: Air Conditioning Condenser Hose
Courtesy of GENERAL MOTORS COMPANY

12. Remove Air Conditioning Condenser Hose (1)
13. Remove the high pressure air conditioning refrigerant pressure sensor. **Air Conditioning Refrigerant Pressure Sensor Replacement - High Pressure**

Installation Procedure

1. Install the high pressure air conditioning refrigerant pressure sensor. **Air Conditioning Refrigerant Pressure Sensor Replacement - High Pressure**
2. Change the air conditioning sealing washer. **Air Conditioning System Seal Replacement**

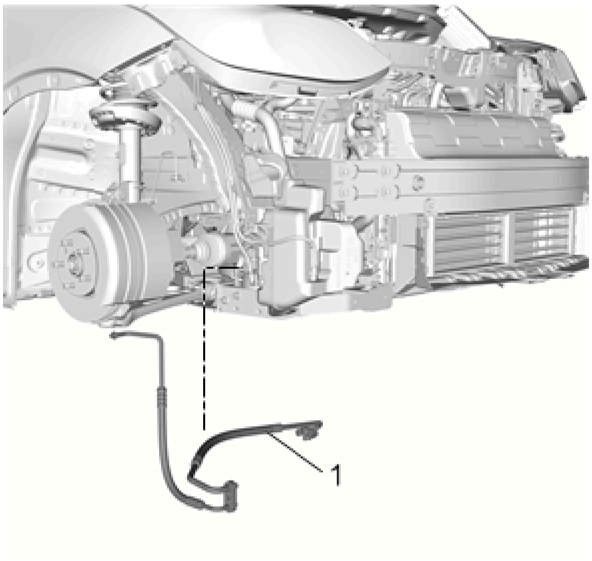
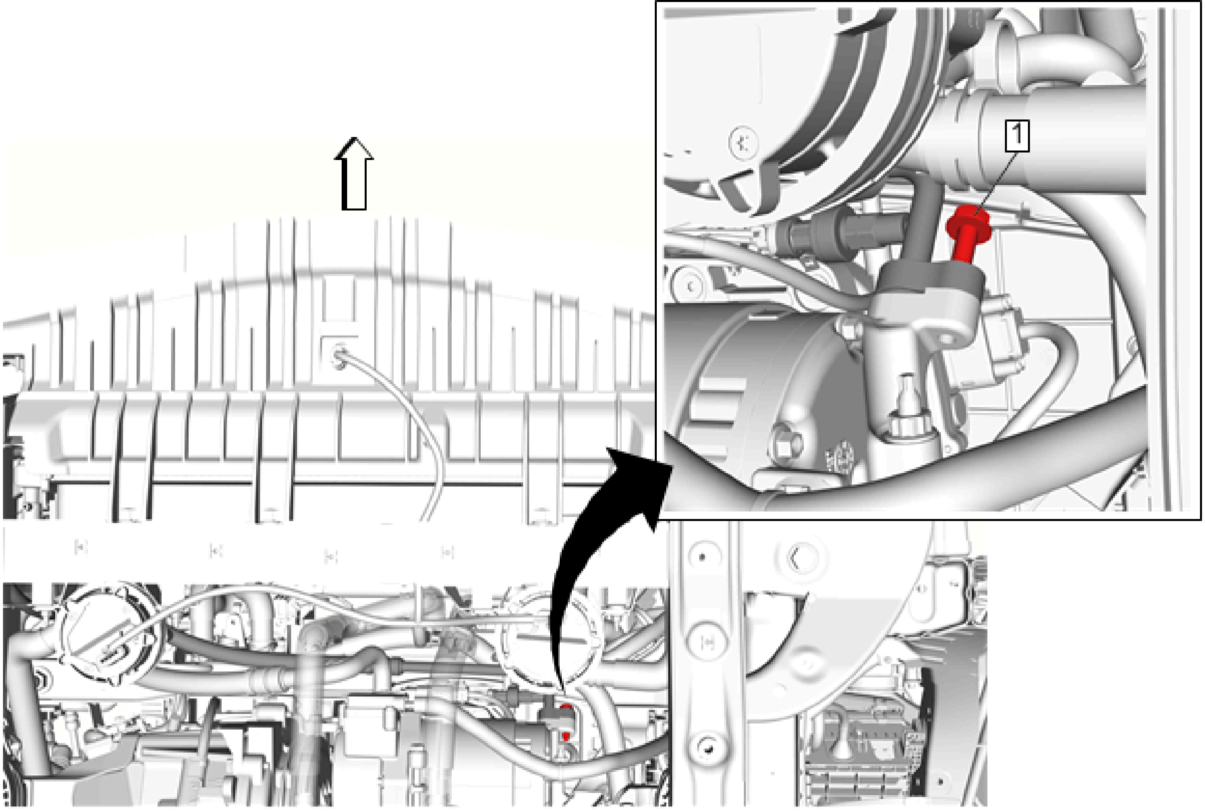


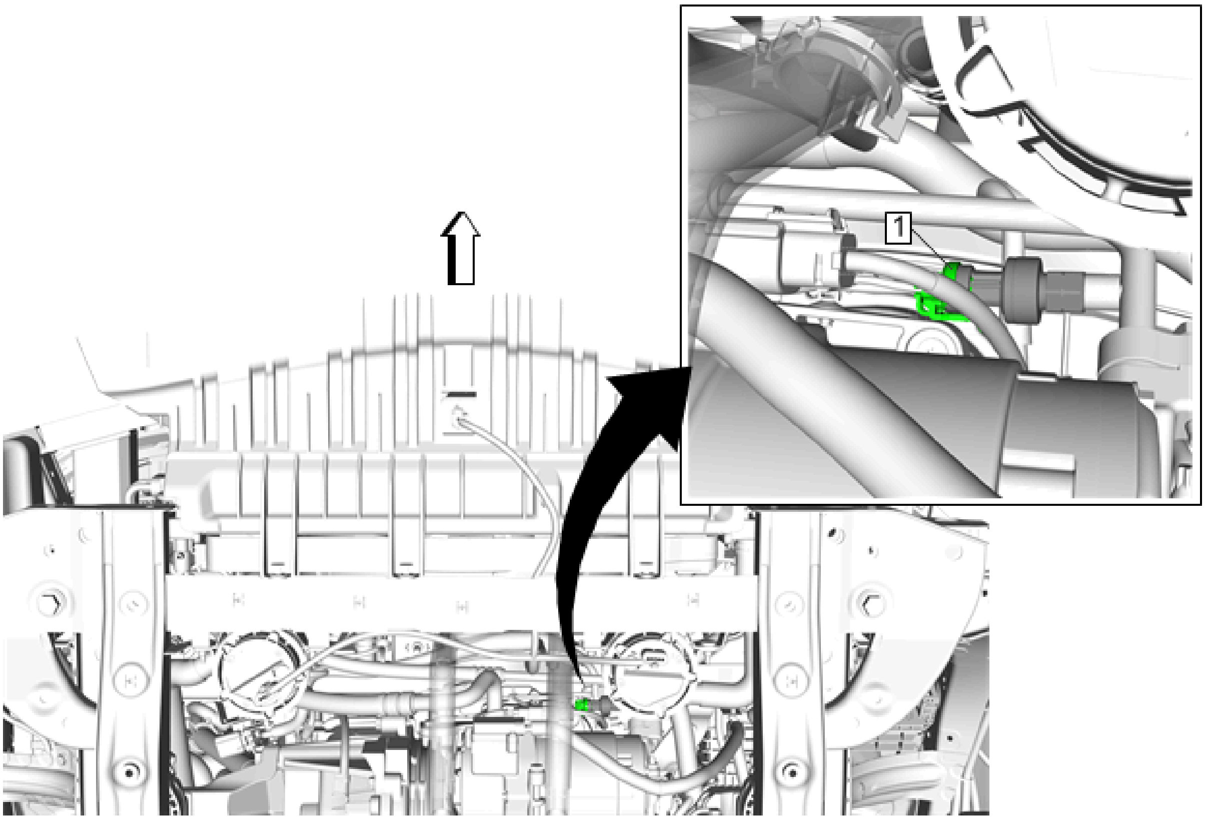
Fig. 44: Air Conditioning Condenser Hose
Courtesy of GENERAL MOTORS COMPANY

3. Position the air conditioning condenser hose (1) to the vehicle.



[Fig. 45: Air Conditioning Condenser Hose Bolt](#)
Courtesy of GENERAL MOTORS COMPANY

4. Install the air conditioning condenser hose bolt (1) to the compressor and tighten to 22 N.m (16 lb ft).



[Fig. 46: Electrical Connector And Air Conditioning (A/C) Refrigerant Pressure Sensor](#)
Courtesy of GENERAL MOTORS COMPANY

5. Connect the electrical connector (1) to the air conditioning (A/C) refrigerant pressure sensor.

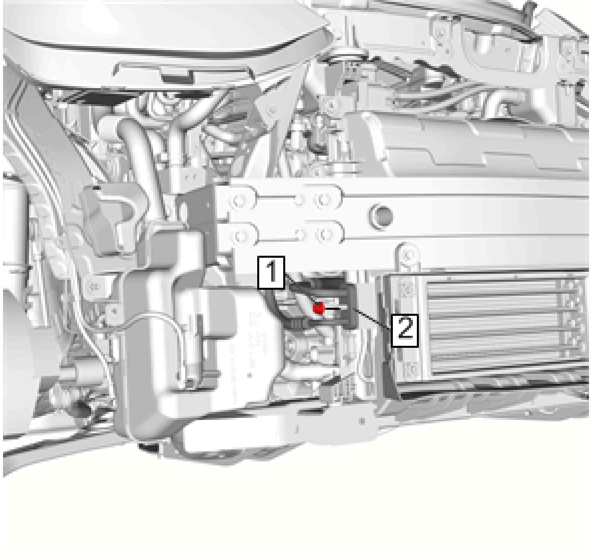


Fig. 47: Air Conditioning Condenser Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

6. Install the air conditioning condenser hose (1) to the air conditioning condenser.
7. Install the air conditioning condenser hose nut (2) and tighten to 22 N.m (16 lb ft).
8. Install Front Bumper Fascia **Front Bumper Fascia Replacement (North America)** **Front Bumper Fascia Replacement (Europe, Korea)**
9. Install Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
10. Lower the vehicle.

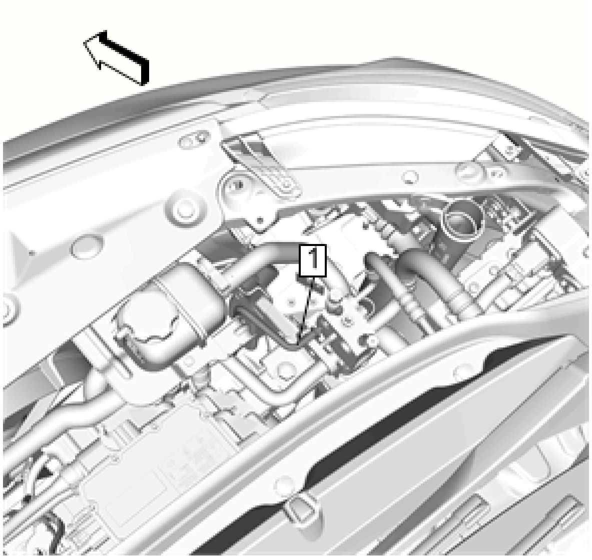


Fig. 48: Air Conditioning Condenser Hose
Courtesy of GENERAL MOTORS COMPANY

11. Install the air conditioning condenser hose (1) to the air conditioning evaporator hose.

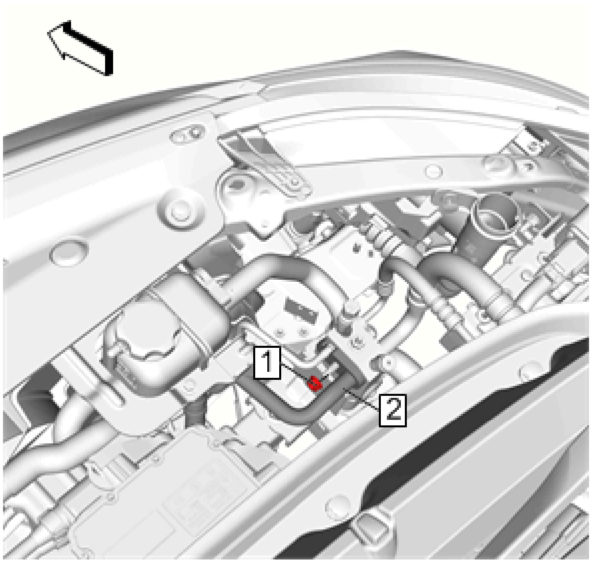


Fig. 49: Air Conditioning Compressor Hose Nut
Courtesy of GENERAL MOTORS COMPANY

12. Remove the air conditioning compressor hose nut (1). Air Conditioning Compressor Hose Replacement
13. Evacuate and charge the refrigerant system. Refrigerant Recovery and Recharging
14. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

AIR CONDITIONING EVAPORATOR HOSE ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection
2. Recover the refrigerant. Refrigerant Recovery and Recharging

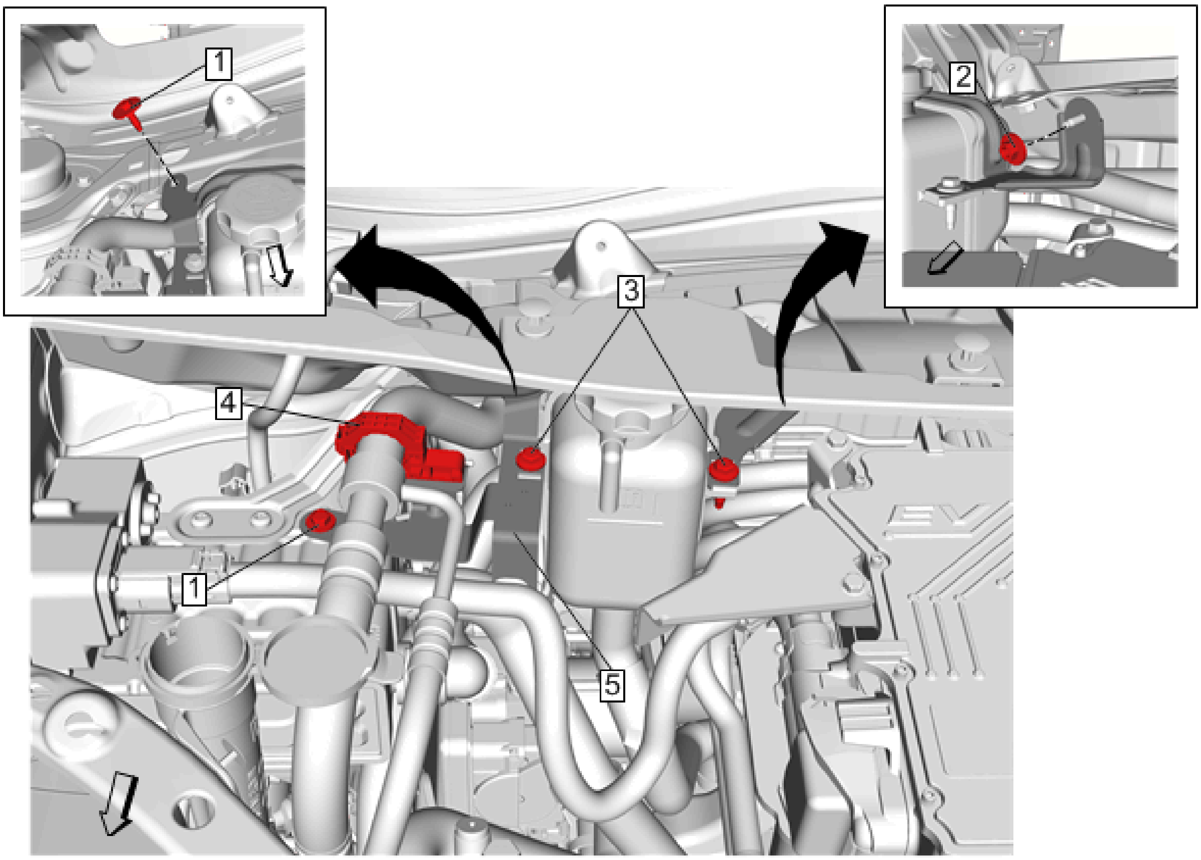


Fig. 50: Radiator Surge Tank Support Bracket (Heater)
Courtesy of GENERAL MOTORS COMPANY

3. Remove the radiator surge tank support bracket (4) - heater. Radiator Surge Tank Support Bracket Replacement (Heater)

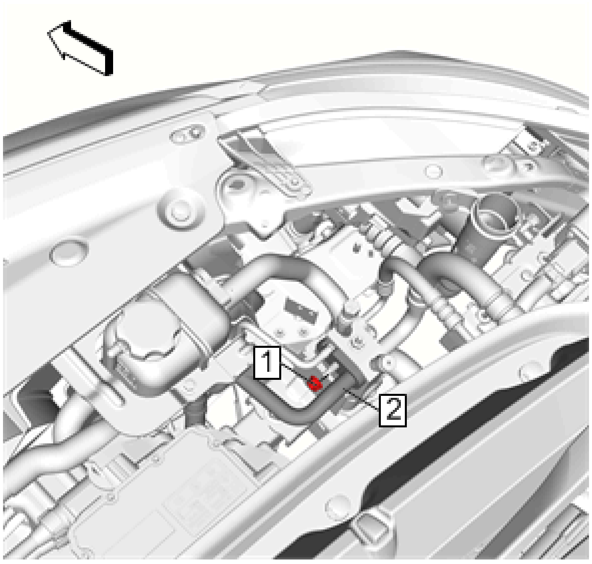


Fig. 51: Air Conditioning Compressor Hose Nut
Courtesy of GENERAL MOTORS COMPANY

4. Remove the air conditioning compressor hose nut (1) and reposition the compressor hose (2) and the condenser hose from the air conditioning evaporator hose. Air Conditioning Condenser Hose Replacement

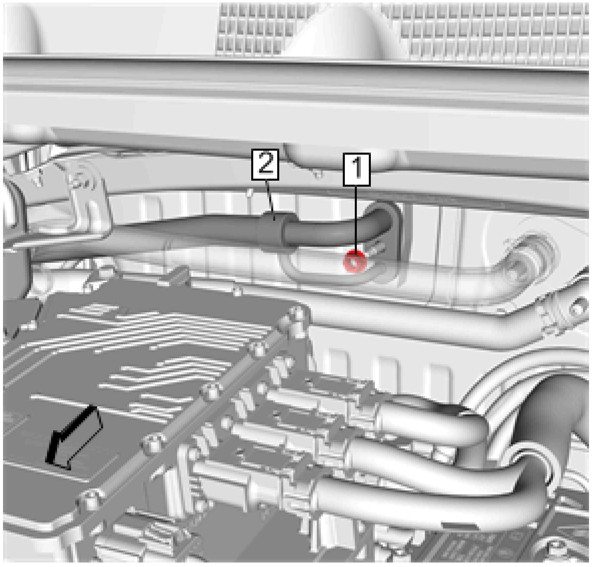


Fig. 52: Air Conditioning Evaporator Hose Nut
Courtesy of GENERAL MOTORS COMPANY

5. Remove the air conditioning evaporator hose nut (1) and remove the air conditioning evaporator hose (2) from TXV stud.

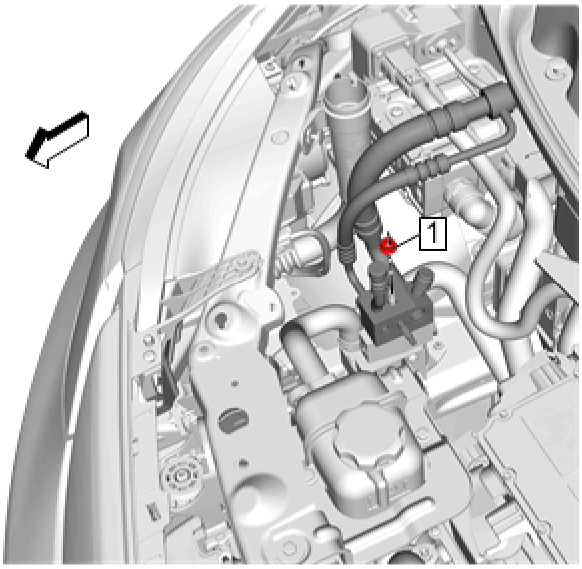


Fig. 53: Air Conditioning Evaporator Hose Nut
Courtesy of GENERAL MOTORS COMPANY

6. Remove the air conditioning evaporator hose nut (1).

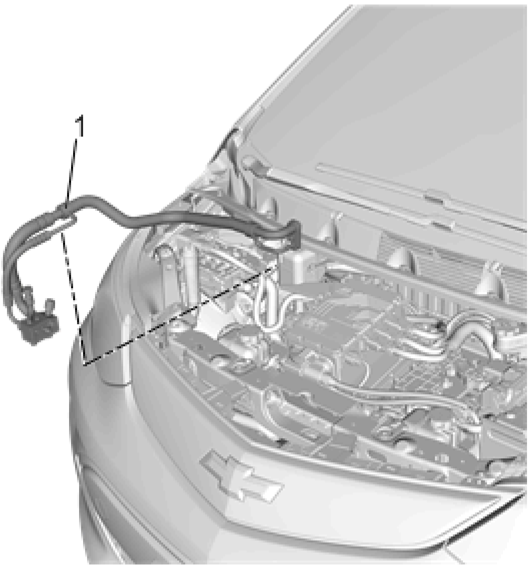


Fig. 54: Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

7. Remove the air conditioning evaporator hose (1) from the vehicle.

Installation Procedure

1. Change the air conditioning sealing washer. Air Conditioning System Seal Replacement

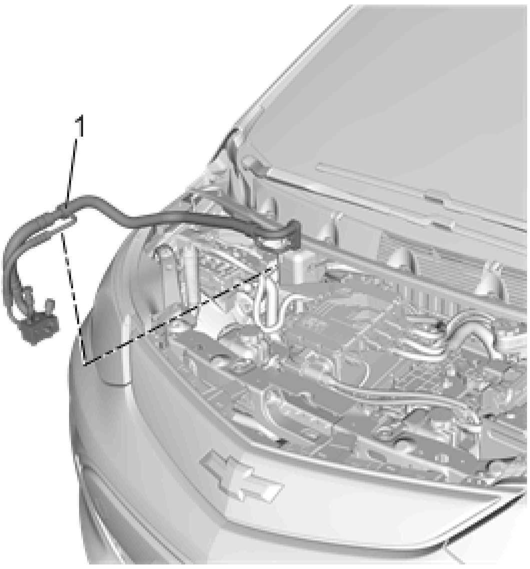


Fig. 55: Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

2. Position the air conditioning evaporator hose (1) to the vehicle.

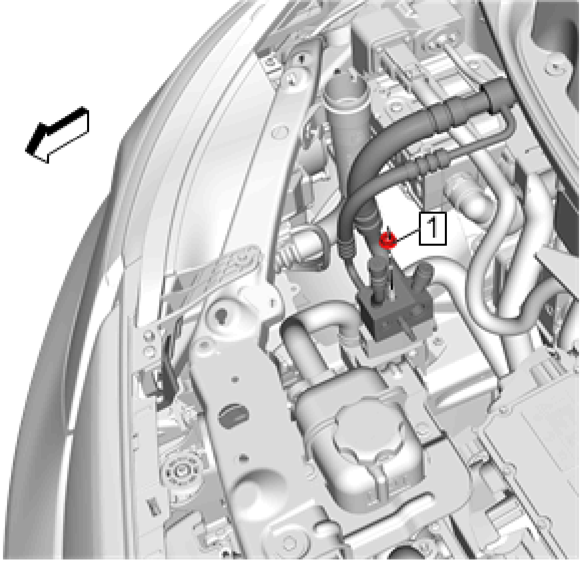


Fig. 56: Air Conditioning Evaporator Hose Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Install the air conditioning evaporator hose and the air conditioning evaporator hose nut (1) and tighten to 22 N.m (16 lb ft).

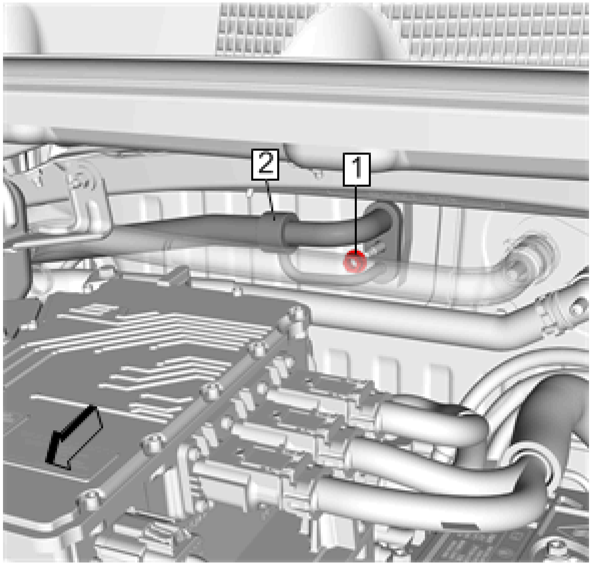


Fig. 57: Air Conditioning Evaporator Hose Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install the air conditioning evaporator hose (2) and the air conditioning evaporator hose nut (1) and tighten to 22 N.m (16 lb ft).

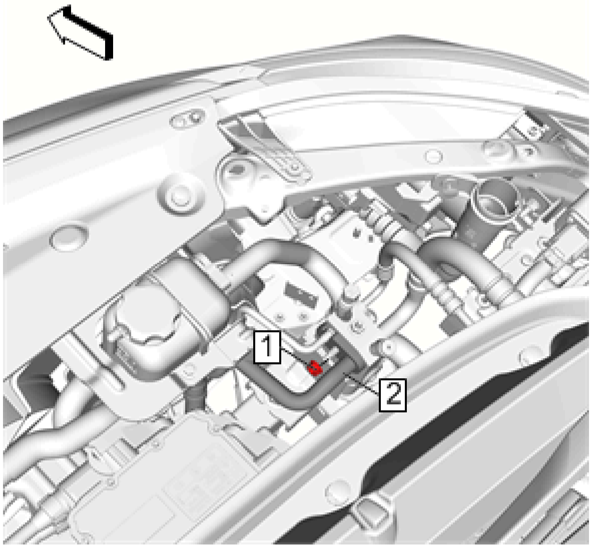


Fig. 58: Air Conditioning Compressor Hose Nut
Courtesy of GENERAL MOTORS COMPANY

5. Position the compressor hose (2) and the condenser hose to the air conditioning evaporator hose and tighten the air conditioning compressor hose nut (1). **Air Conditioning Condenser Hose Replacement**

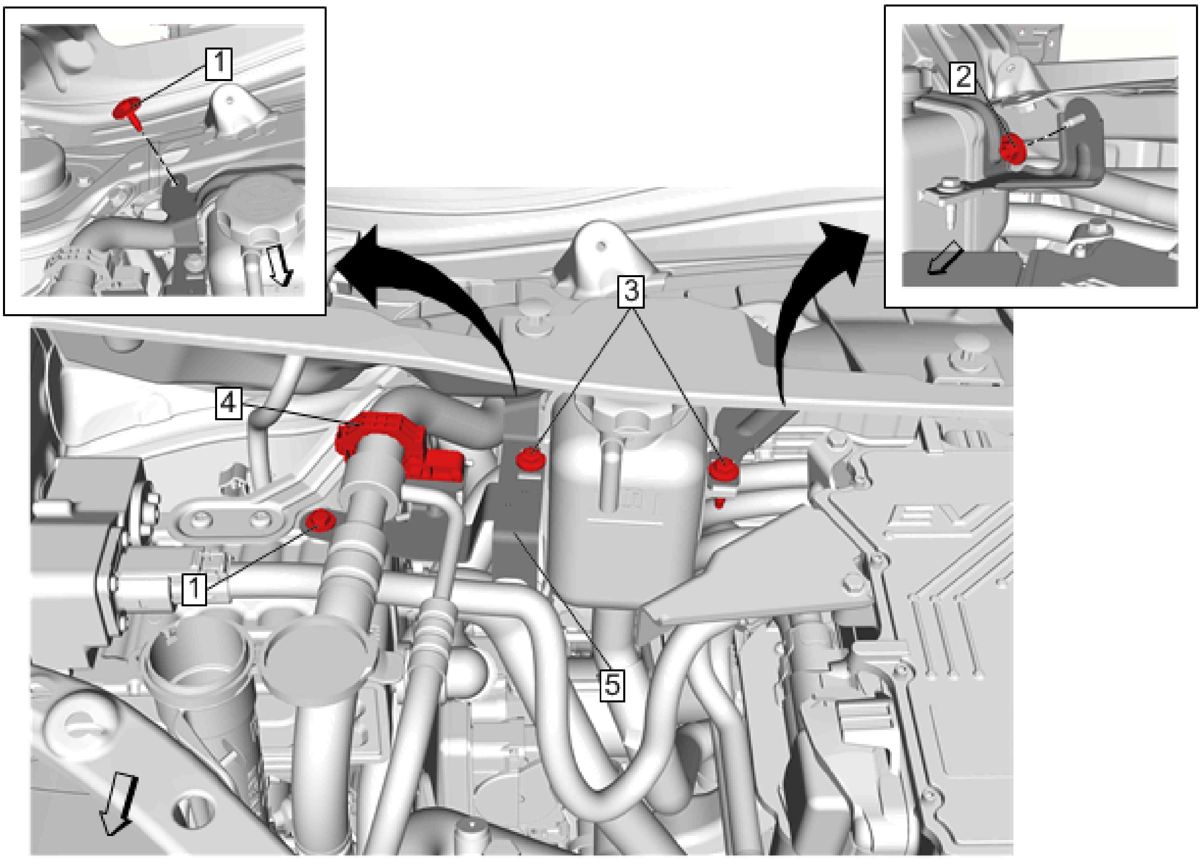


Fig. 59: Radiator Surge Tank Support Bracket (Heater)
Courtesy of GENERAL MOTORS COMPANY

6. Install the radiator surge tank support bracket (4) - heater. **Radiator Surge Tank Support Bracket Replacement (Heater)**
7. Charge the refrigerant system. **Refrigerant Recovery and Recharging**
8. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

RECEIVER AND DEHYDRATOR REPLACEMENT

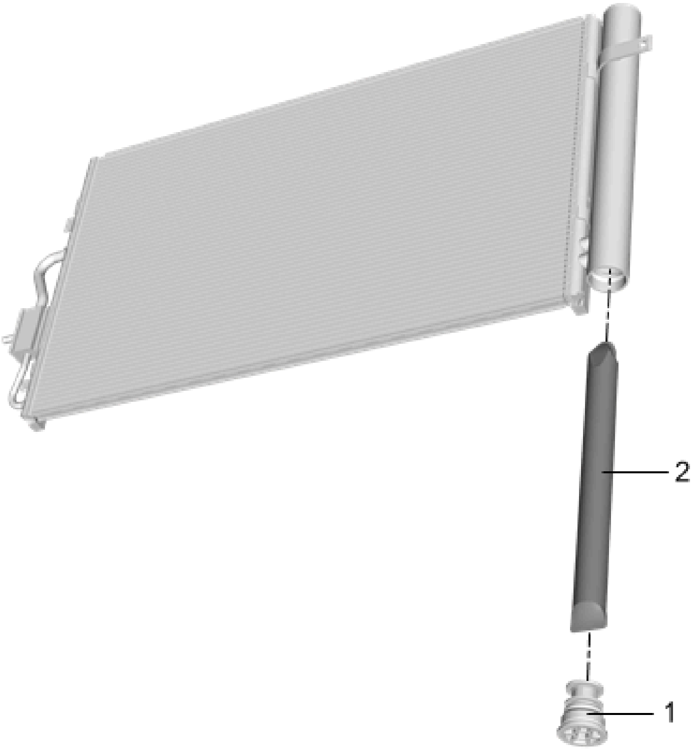


Fig. 60: Receiver and Dehydrator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection 2. Recover the refrigerant. Refrigerant Recovery and Recharging 3. Air Conditioning Condenser Replacement	
1	Air Conditioning Receiver and Dehydrator Plug **NOTE:** **Remove and DISCARD the old seal. Replace with NEW seal.**
2	Air Conditioning Refrigerant Desiccant **Procedure** 1. Recharge the refrigerant. Refrigerant Recovery and Recharging 2. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

AIR CONDITIONING EVAPORATOR THERMAL EXPANSION VALVE REPLACEMENT

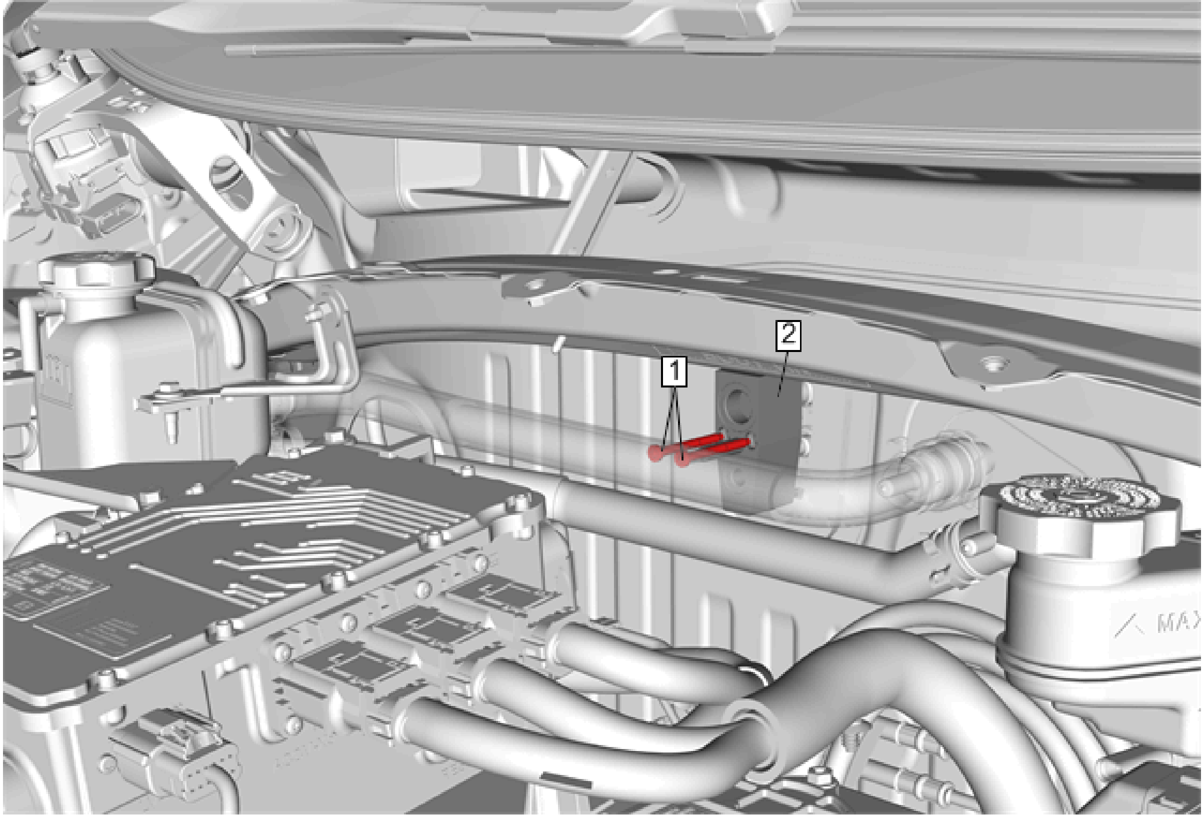


Fig. 61: Air Conditioning Evaporator Thermal Expansion Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Recover the refrigerant. **Refrigerant Recovery and Recharging** 2. Remove Air Conditioning Evaporator Hose@Air Conditioning Evaporator Thermal Expansion Valve **Air Conditioning Evaporator Hose Assembly Replacement**	
1	Air Conditioning Evaporator Thermal Expansion Valve Bolt (Qty: 2) **CAUTION:** **Fastener Caution** **Tighten** 7 N.m (62 lb in)
2	Air Conditioning Evaporator Thermal Expansion Valve **Procedure** 1. Remove and DISCARD the old sealing washers. Replace with NEW sealing washers. 2. Evacuate and charge the refrigerant system. **Refrigerant Recovery and Recharging**

AIR CONDITIONING REFRIGERANT PRESSURE SENSOR REPLACEMENT - LOW PRESSURE

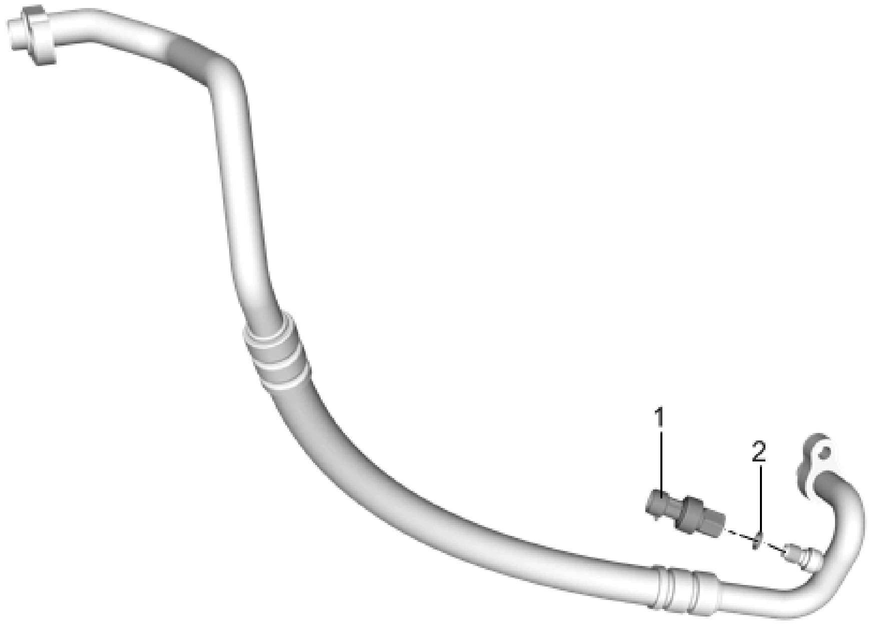
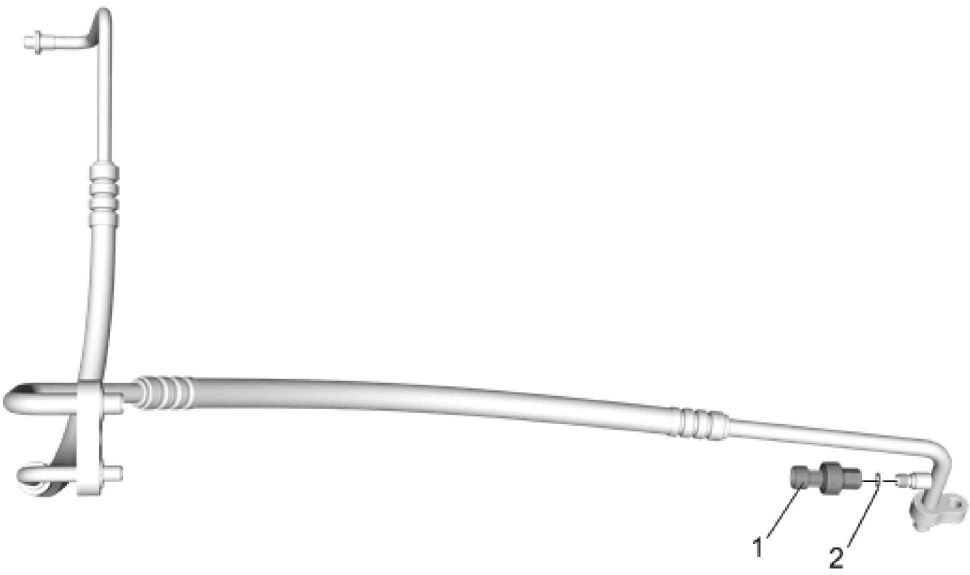


Fig. 62: Air Conditioning Refrigerant Pressure Sensor - Low Pressure
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.
Preliminary Procedure Front Compartment Air Deflector Replacement</td></tr>
<tr><td>1</td><td>Air Conditioning Refrigerant Pressure Sensor
CAUTION:
Refer to Fastener Caution .
Procedure
Disconnect the electrical connector.</td></tr>
<tr><td>2</td><td>Air Conditioning Refrigerant Pressure Sensor O-ring
NOTE:
Remove and DISCARD the O-ring and replace with NEW only. Air Conditioning O-Ring Seal Replacement
Procedure
Recharge the refrigerant. Refrigerant Recovery and Recharging</td></tr>
</table>

AIR CONDITIONING REFRIGERANT PRESSURE SENSOR REPLACEMENT - HIGH PRESSURE



[Fig. 63: Air Conditioning Refrigerant Pressure Sensor - High Pressure]()
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Before conducting any repair to this high voltage cooling system, it is necessary to determine/verify whether no high-voltage system faults exist. If high-voltage faults exist, follow published DTC diagnostics/repair procedures prior to performing any cooling system repairs. Failure to correct High Voltage Faults before working on the high voltage cooling system could result in personal injury or death.** **Preliminary Procedure** Remove the left front wheelhouse liner. **Front Wheelhouse Liner Replacement**	
1	Air Conditioning Refrigerant Pressure Sensor **CAUTION:** **Refer to Fastener Caution .** **Procedure** Disconnect the electrical connector.
2	Air Conditioning Refrigerant Pressure Sensor O-ring **NOTE:** **Remove and DISCARD the O-ring and replace with NEW only. Air Conditioning O-Ring Seal Replacement** **Procedure** Recharge the refrigerant. **Refrigerant Recovery and Recharging**

AIR CONDITIONING CONDENSER REPLACEMENT

Removal Procedure

1. Recover the refrigerant. **Refrigerant Recovery and Recharging**

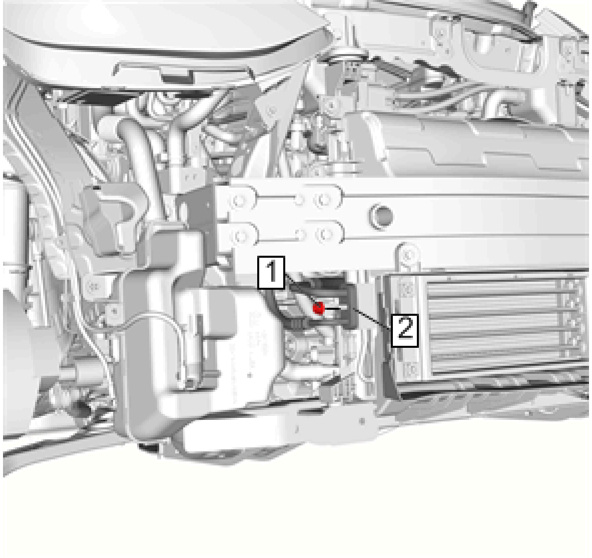


Fig. 64: Air Conditioning Condenser Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

2. Remove Air Conditioning Condenser Hose (2)@Air Conditioning Condenser Assembly **Air Conditioning Condenser Hose Replacement**

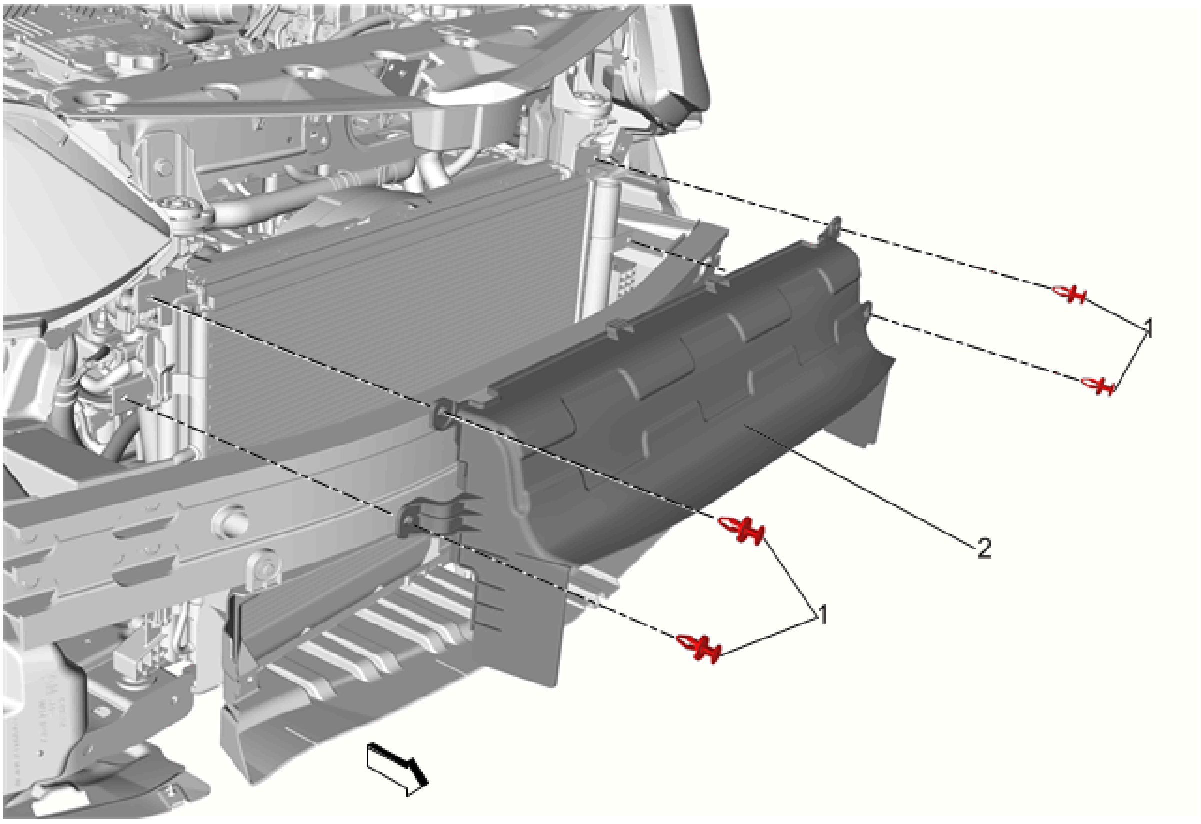


Fig. 65: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

3. Remove Radiator Air Upper Baffle and Deflector (2)**Radiator Air Upper Baffle and Deflector Replacement**

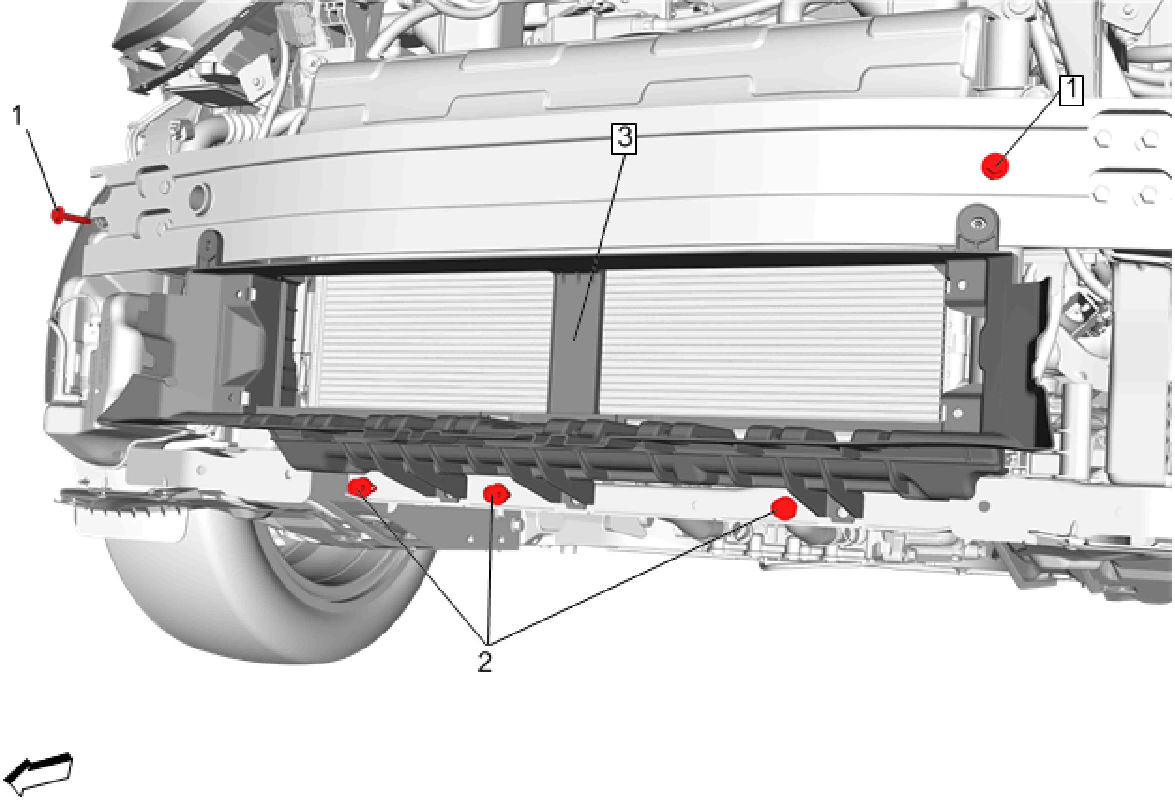


Fig. 66: Radiator Air Lower Baffle and Deflector Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Remove Radiator Air Lower Baffle and Deflector Assembly (3)**Radiator Air Lower Baffle and Deflector Replacement**

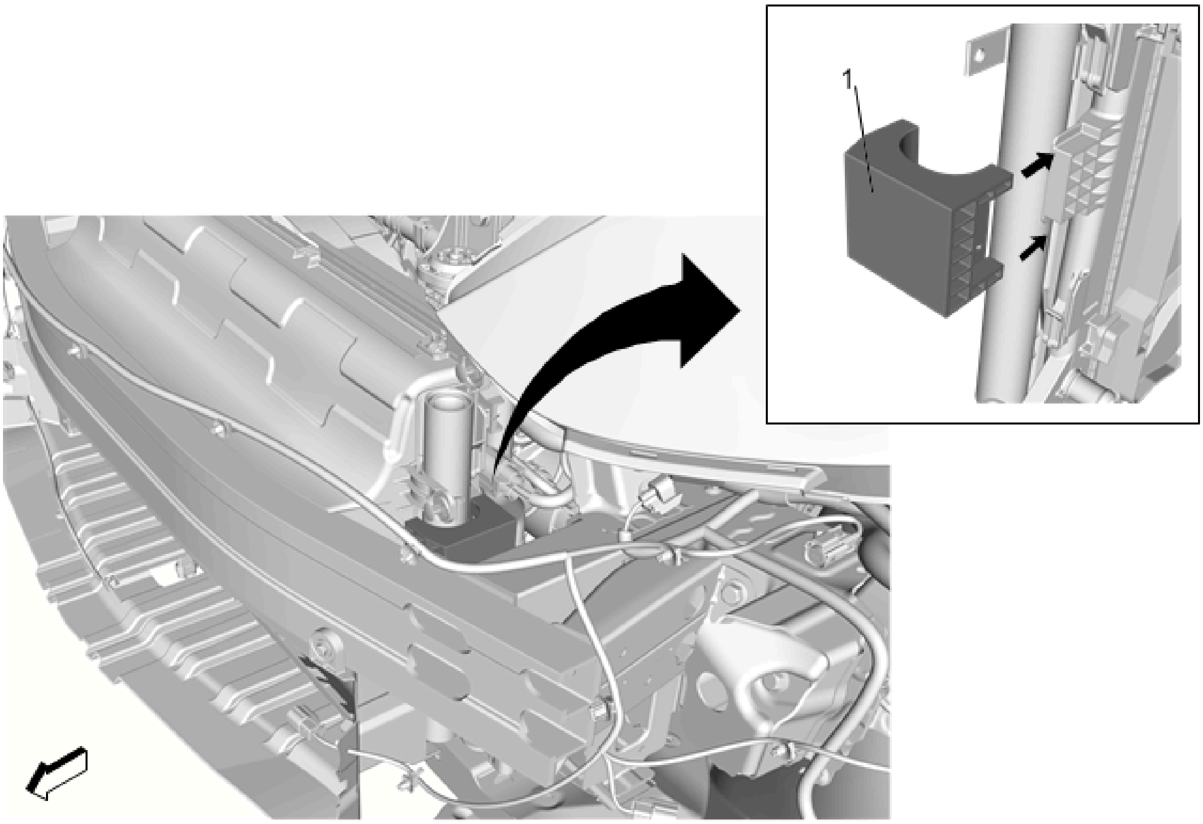
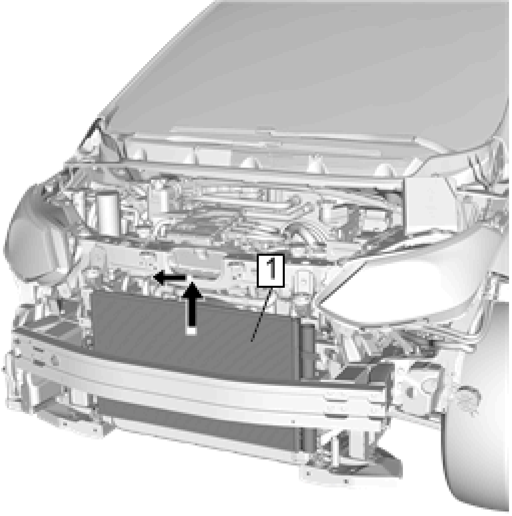


Fig. 67: Radiator Protector
Courtesy of GENERAL MOTORS COMPANY

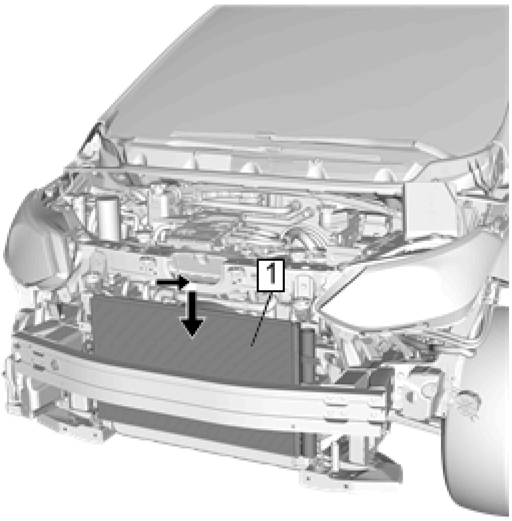
5. Remove the radiator protector (1). **Radiator Protector Replacement**



[Fig. 68: Air Conditioning Condenser](#)
Courtesy of GENERAL MOTORS COMPANY

6. Remove Air Conditioning Condenser (1) @Air Conditioning Condenser Bracket

Installation Procedure



[Fig. 69: Air Conditioning Condenser](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Air Conditioning Condenser (1) @Air Conditioning Condenser Bracket

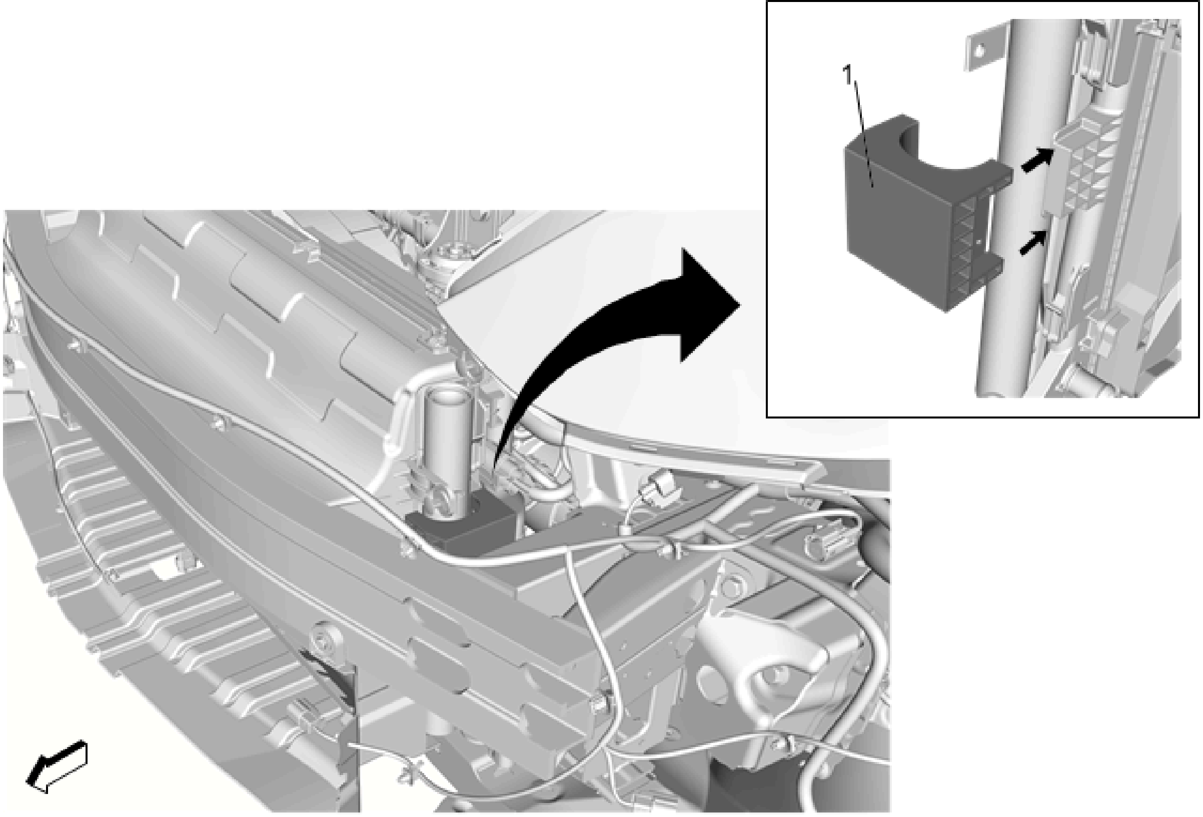


Fig. 70: Radiator Protector
Courtesy of GENERAL MOTORS COMPANY

2. Install the radiator protector (1). Radiator Protector Replacement

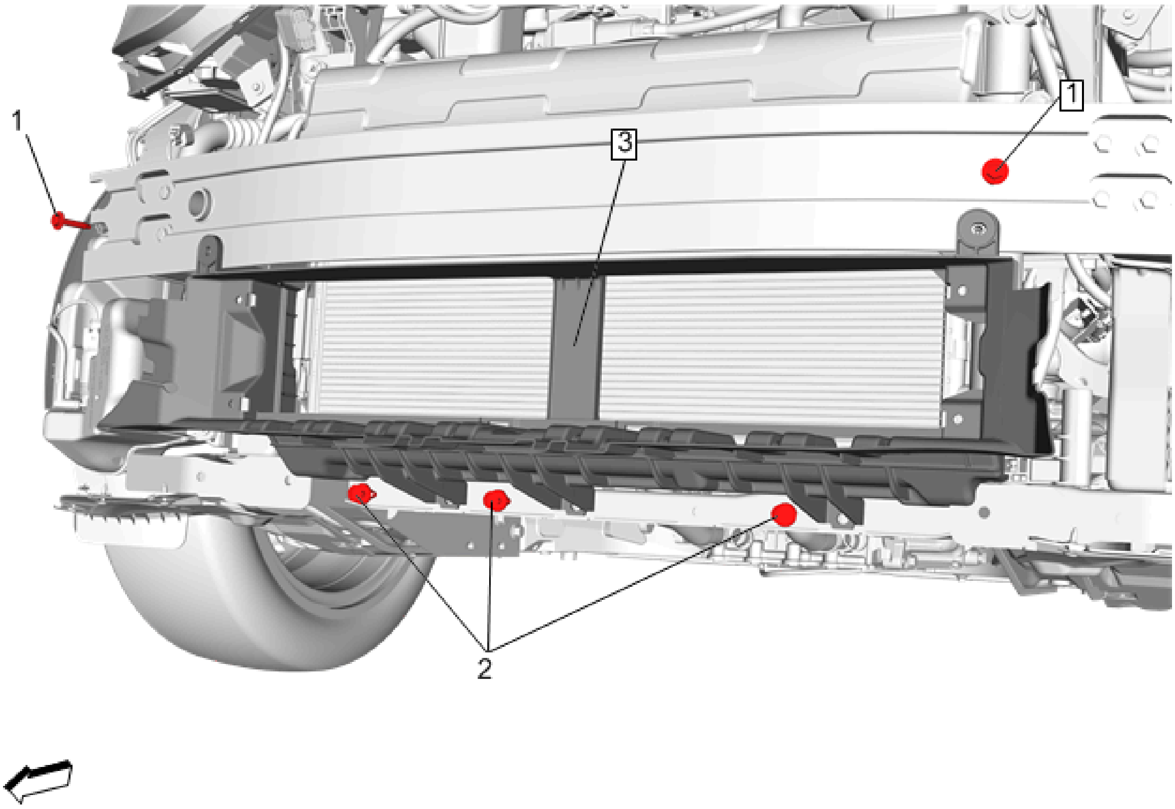


Fig. 71: Radiator Air Lower Baffle and Deflector Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Install Radiator Air Lower Baffle and Deflector Assembly (3)Radiator Air Lower Baffle and Deflector Replacement

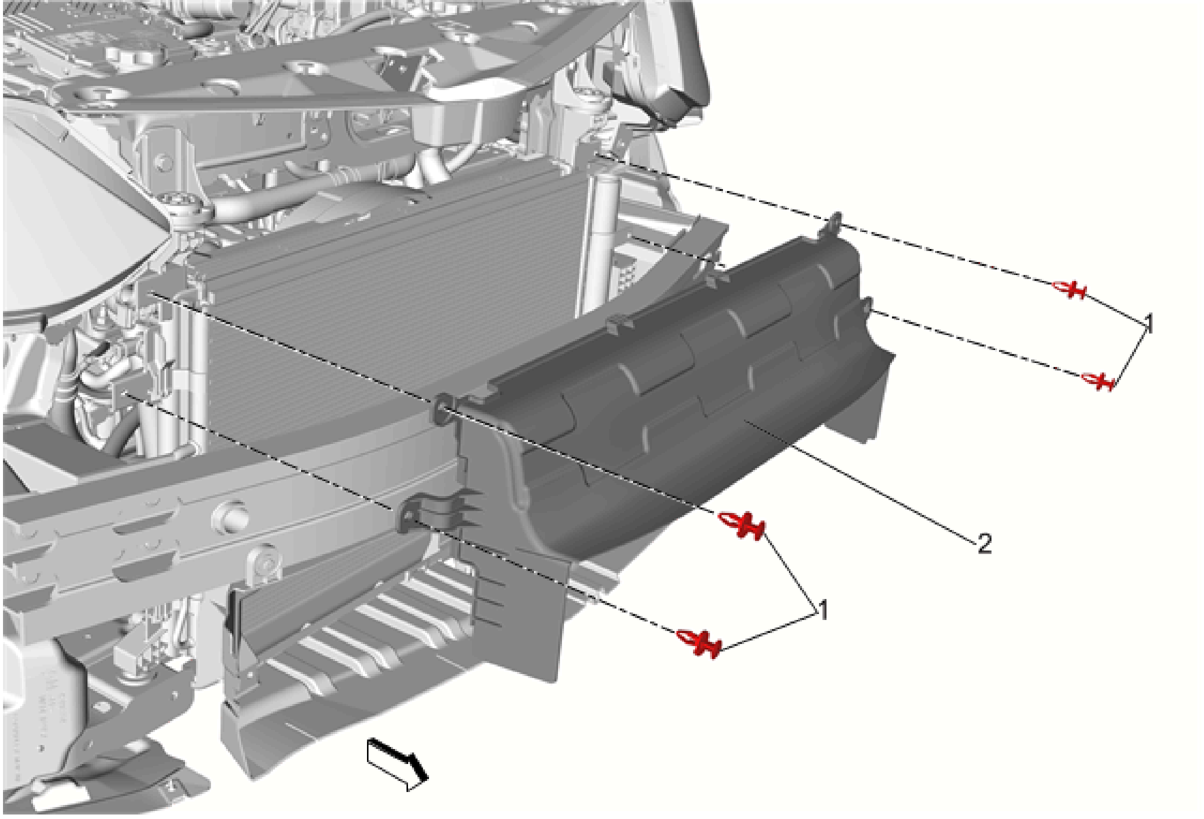


Fig. 72: Radiator Air Upper Baffle And Deflector
Courtesy of GENERAL MOTORS COMPANY

4. Install Radiator Air Upper Baffle and Deflector (2)**Radiator Air Upper Baffle and Deflector Replacement**

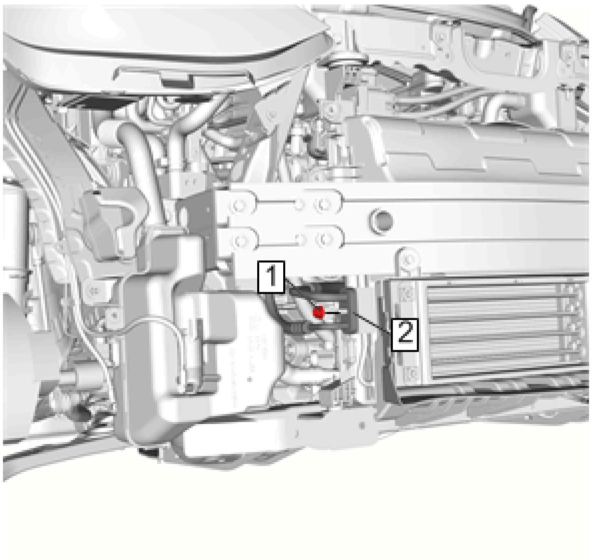


Fig. 73: Air Conditioning Condenser Hose And Nut
Courtesy of GENERAL MOTORS COMPANY

5. Install Air Conditioning Condenser Hose (2) @Air Conditioning Condenser Assembly **Air Conditioning Condenser Hose Replacement**
6. Recharge the refrigerant. **Refrigerant Recovery and Recharging**

HEATER AND AIR CONDITIONING EVAPORATOR AND BLOWER MODULE REMOVAL AND INSTALLATION

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
2. Recover the refrigerant. **Refrigerant Recovery and Recharging**
3. Drain the cooling system. **Heater Coolant Heater Draining and Filling**
4. Remove Heater Inlet Hose@Heater Core Tube **Heater Inlet Hose Replacement**

5. Remove Heater Outlet Hose@Heater Core Tube **Heater Outlet Hose Replacement**
6. Remove Air Conditioning Evaporator Hose Assembly@Air Conditioning Evaporator Thermal Expansion Valve **Air Conditioning Evaporator Hose Assembly Replacement**

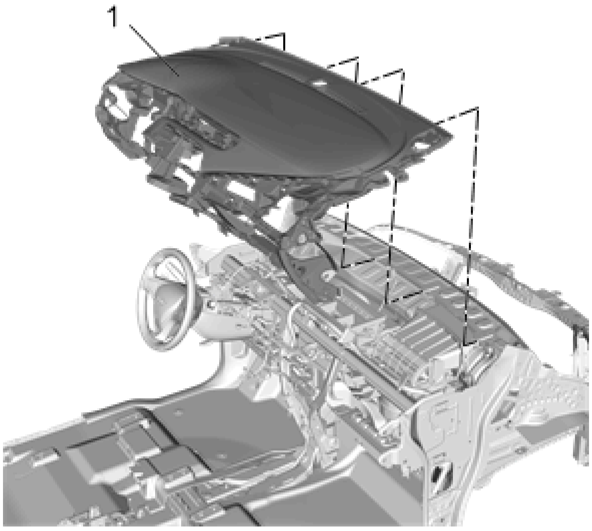


Fig. 74: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Remove Instrument Panel Assembly(1)**Instrument Panel Assembly Replacement**

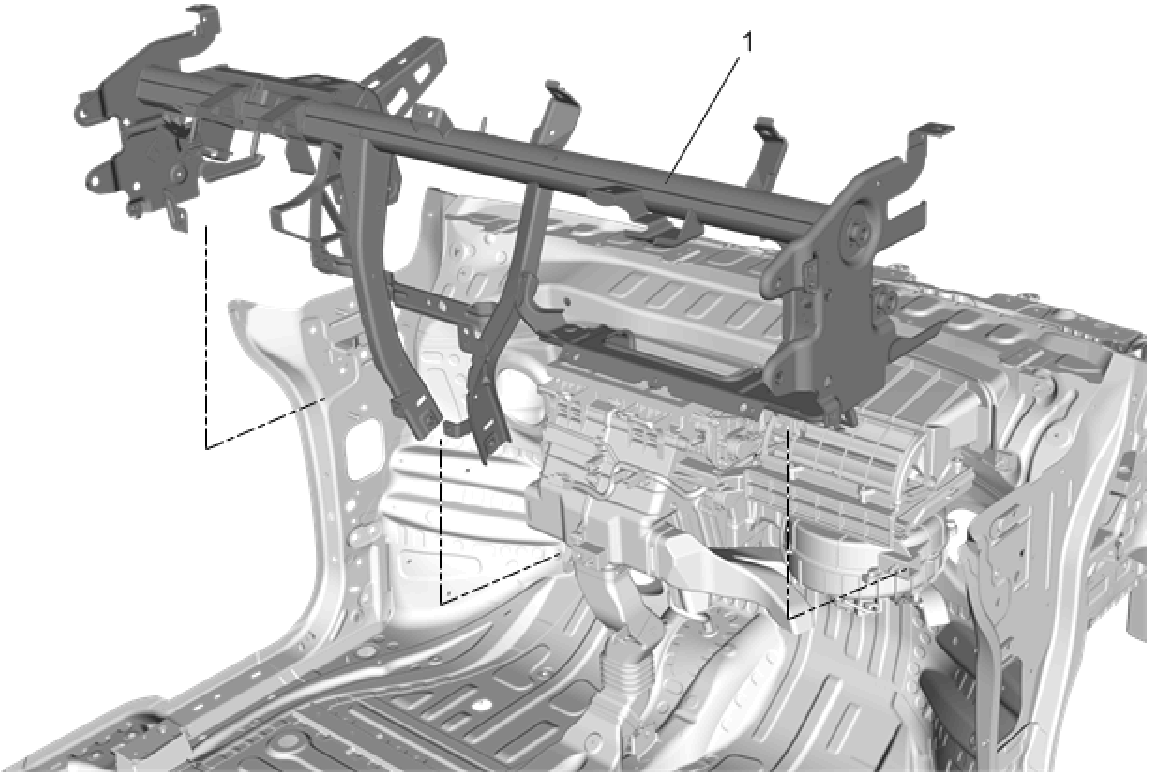
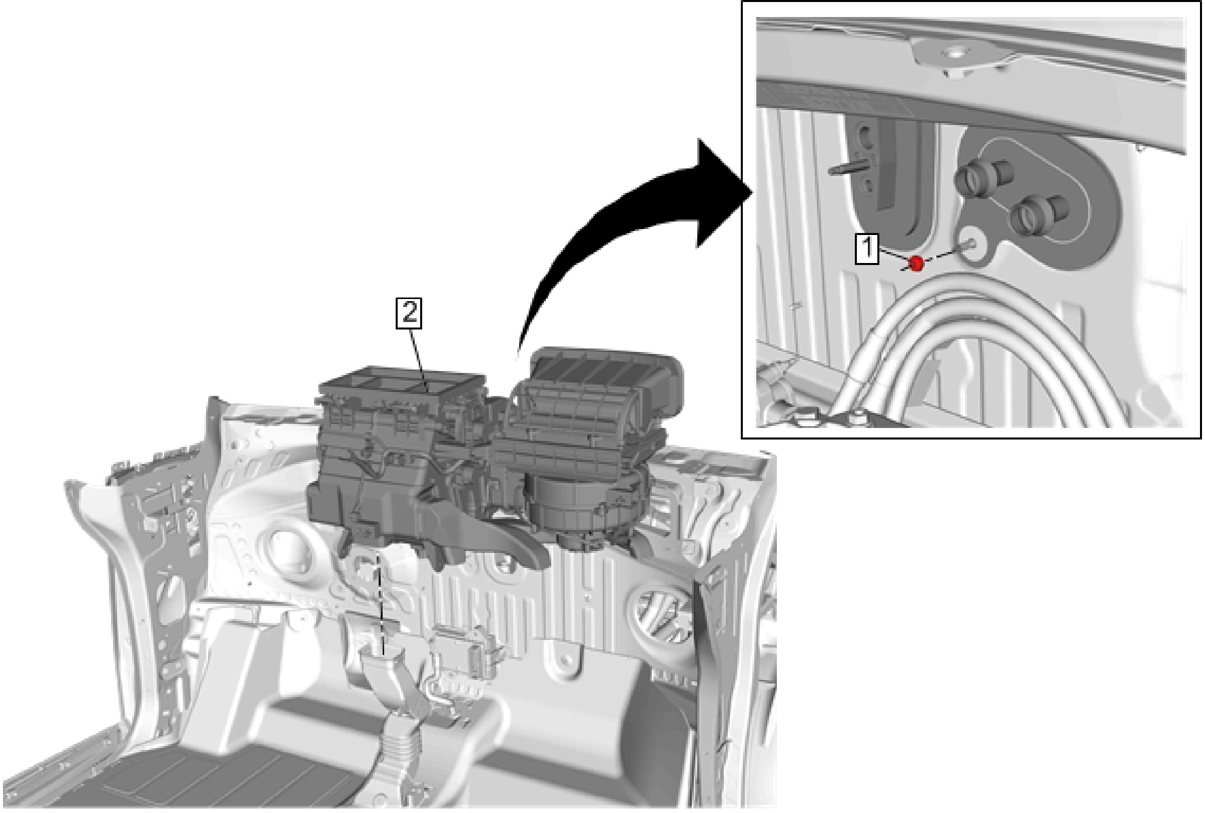


Fig. 75: Instrument Panel Tie Bar Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Remove Instrument Panel Tie Bar(1) **Instrument Panel Tie Bar Replacement**
9. Remove Air Conditioning Evaporator and Blower Module Drain Hose **Air Conditioning Evaporator and Blower Module Drain Hose Replacement**
10. Remove Floor Front Air Outlet Duct **Floor Front Air Outlet Duct Replacement**
11. Disconnect and unclip the electrical.
12. Cap the heater core tube to prevent spillage.

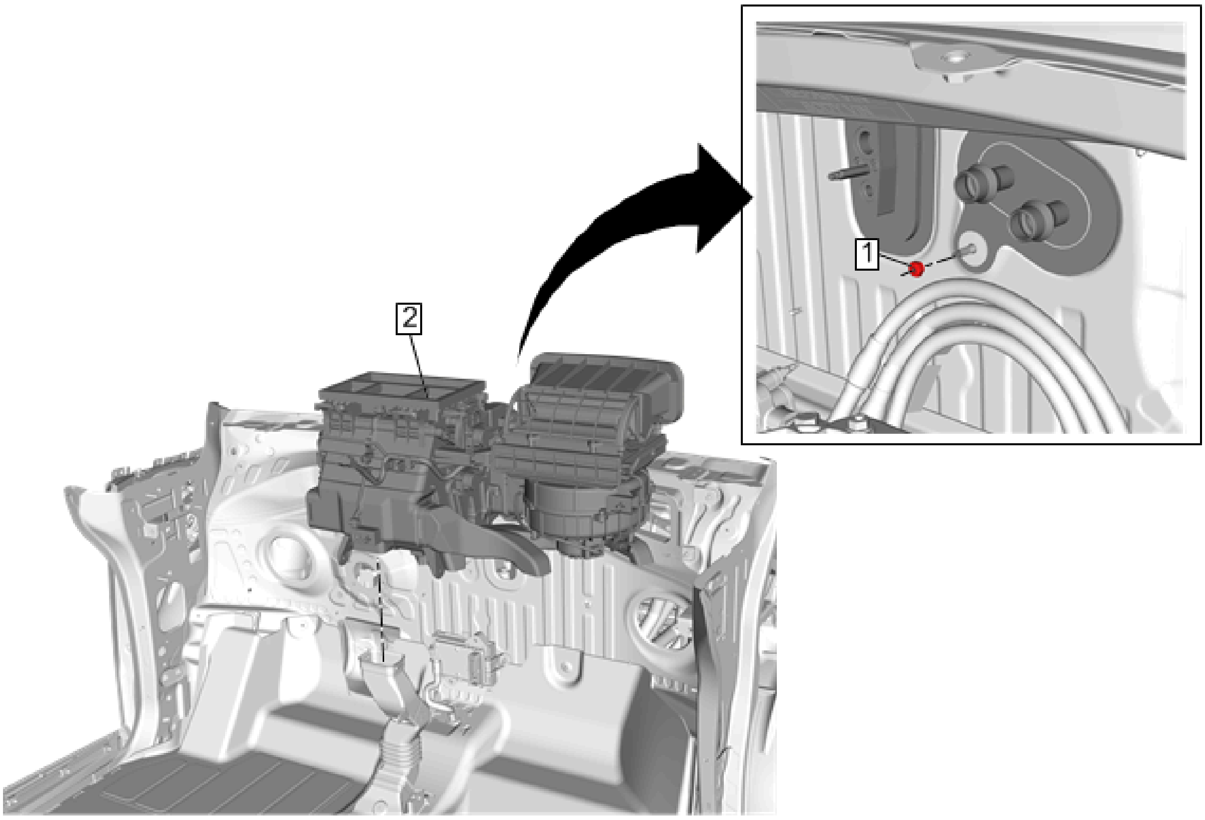


[Fig. 76: Heater and Air Conditioning Evaporator and Blower Module](#)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to HVAC Module Drain Tube Caution**

13. From within the engine compartment, remove the heater and air conditioning evaporator and blower module nut (1) securing the heater and air conditioning evaporator and blower module to the cowl panel.
14. Remove Heater and Air Conditioning Evaporator and Blower Module (2)
15. Transfer components as necessary.

Installation Procedure



[Fig. 77: Heater and Air Conditioning Evaporator and Blower Module](#)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

1. Position the Heater and Air Conditioning Evaporator and Blower Module (2) into the vehicle and temporarily support it.
2. From within the engine compartment, install the heater and air conditioning evaporator and blower module nut (1) securing the heater and air conditioning evaporator and blower module to the cowl panel, and tighten to 9 N.m (80 lb in).
3. Uncap the heater core tube.
4. Connect and clip the electrical.
5. Install Floor Front Air Outlet Duct **Floor Front Air Outlet Duct Replacement**
6. Install Air Conditioning Evaporator and Blower Module Drain Hose **Air Conditioning Evaporator and Blower Module Drain Hose Replacement**

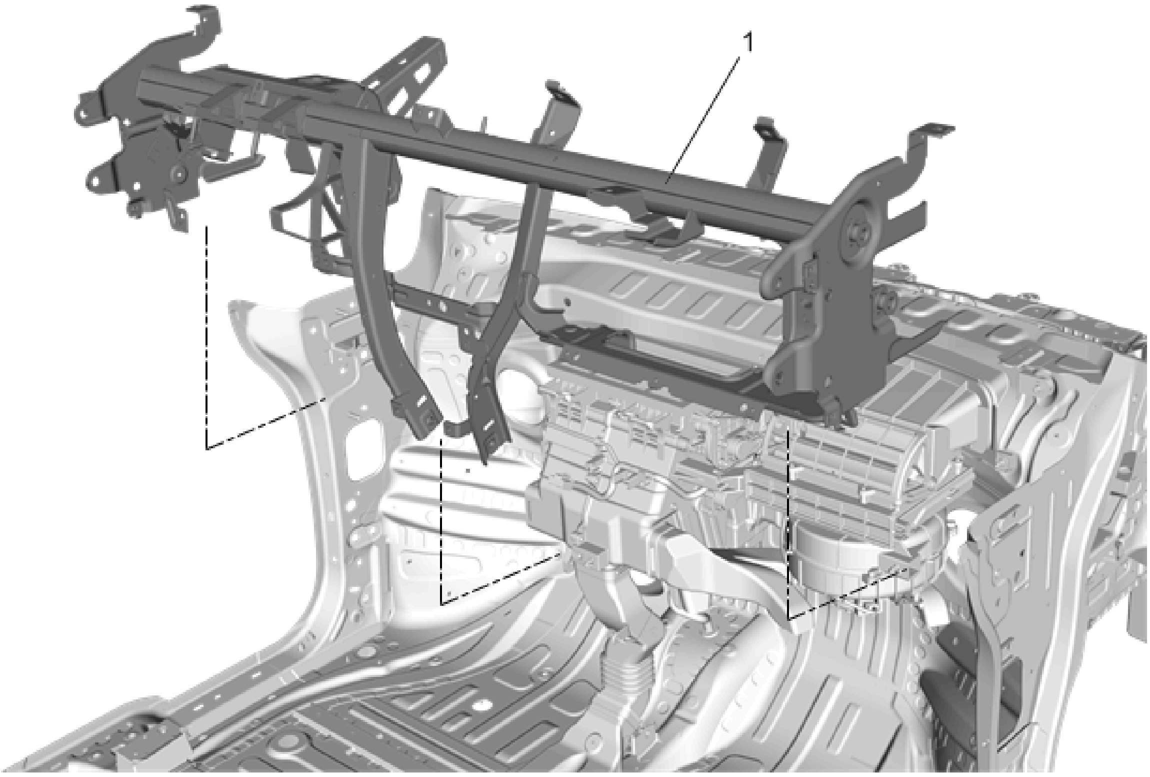


Fig. 78: Instrument Panel Tie Bar Assembly
Courtesy of GENERAL MOTORS COMPANY

7. Install Instrument Panel Tie Bar(1) **Instrument Panel Tie Bar Replacement**

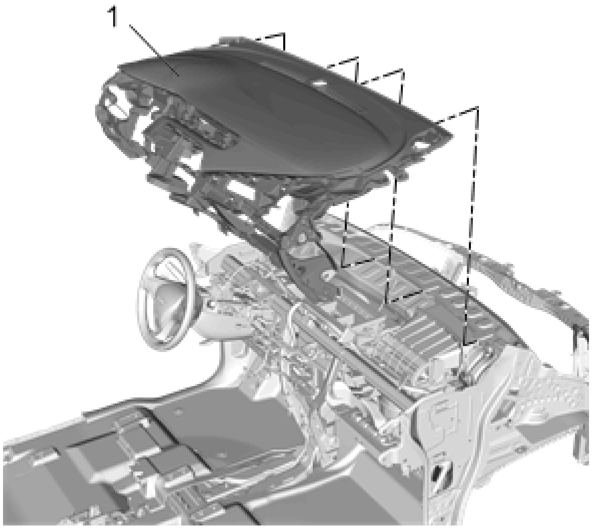


Fig. 79: Instrument Panel Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Install Instrument Panel Assembly(1) **Instrument Panel Assembly Replacement**
9. Install Air Conditioning Evaporator Hose Assembly@Air Conditioning Evaporator Thermal Expansion Valve **Air Conditioning Evaporator Hose Assembly Replacement**
10. Install Heater Outlet Hose@Heater Core Tube **Heater Outlet Hose Replacement**
11. Install Heater Inlet Hose@Heater Core Tube **Heater Inlet Hose Replacement**
12. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
13. Fill the cooling system to the proper level. **Heater Coolant Heater Draining and Filling**
14. Evacuate and charge the refrigerant system. **Refrigerant Recovery and Recharging**
15. Perform the actuator calibration procedure. **Actuator Recalibration**
16. Clear the DTCs.
17. Inspect for coolant leaks.
18. Inspect for refrigerant leaks.

HEATER AND AIR CONDITIONING EVAPORATOR CASE REPLACEMENT

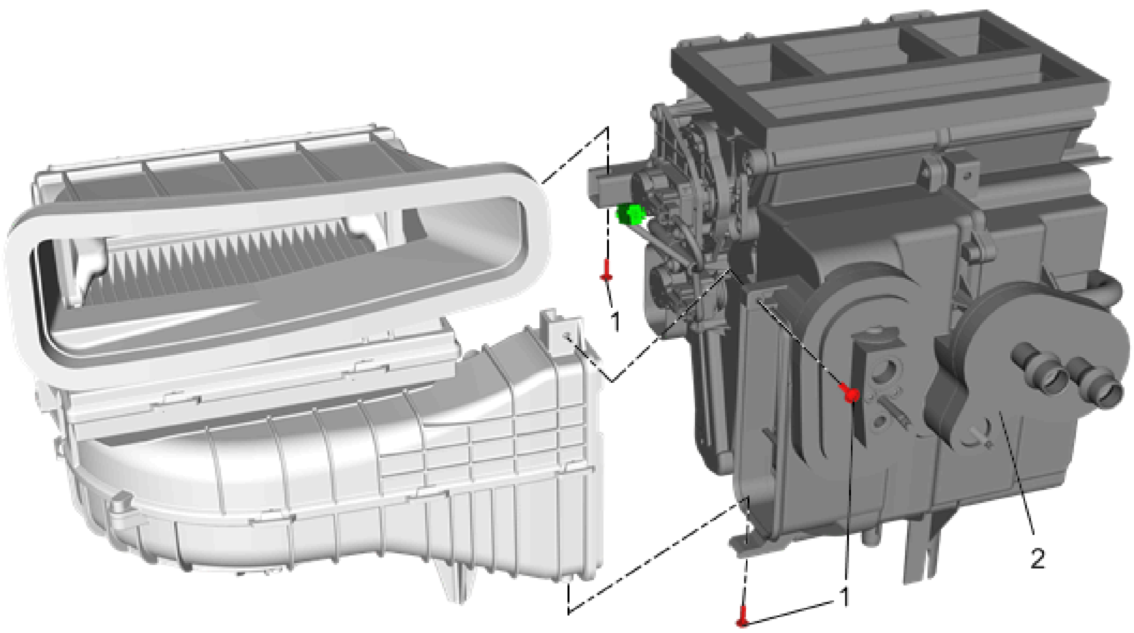


Fig. 80: Heater and Air Conditioning Evaporator Case
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the heater coolant heater system. **Heater Coolant Heater Draining and Filling** 2. Remove the heater and air conditioning evaporator and blower module. **Heater and Air Conditioning Evaporator and Blower Module Removal and Installation**	
1	Heater and Air Conditioning Evaporator Case Screw (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
2	Heater and Air Conditioning Evaporator Case **Procedure** 1. Disconnect the electrical connector. 2. Install the heater and air conditioning evaporator and blower module. Heater and Air Conditioning Evaporator and Blower Module Removal and Installation 3. Fill the heater coolant heater system. Heater Coolant Heater Draining and Filling

BLOWER LOWER CASE REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection
2. Recover the refrigerant. Refrigerant Recovery and Recharging

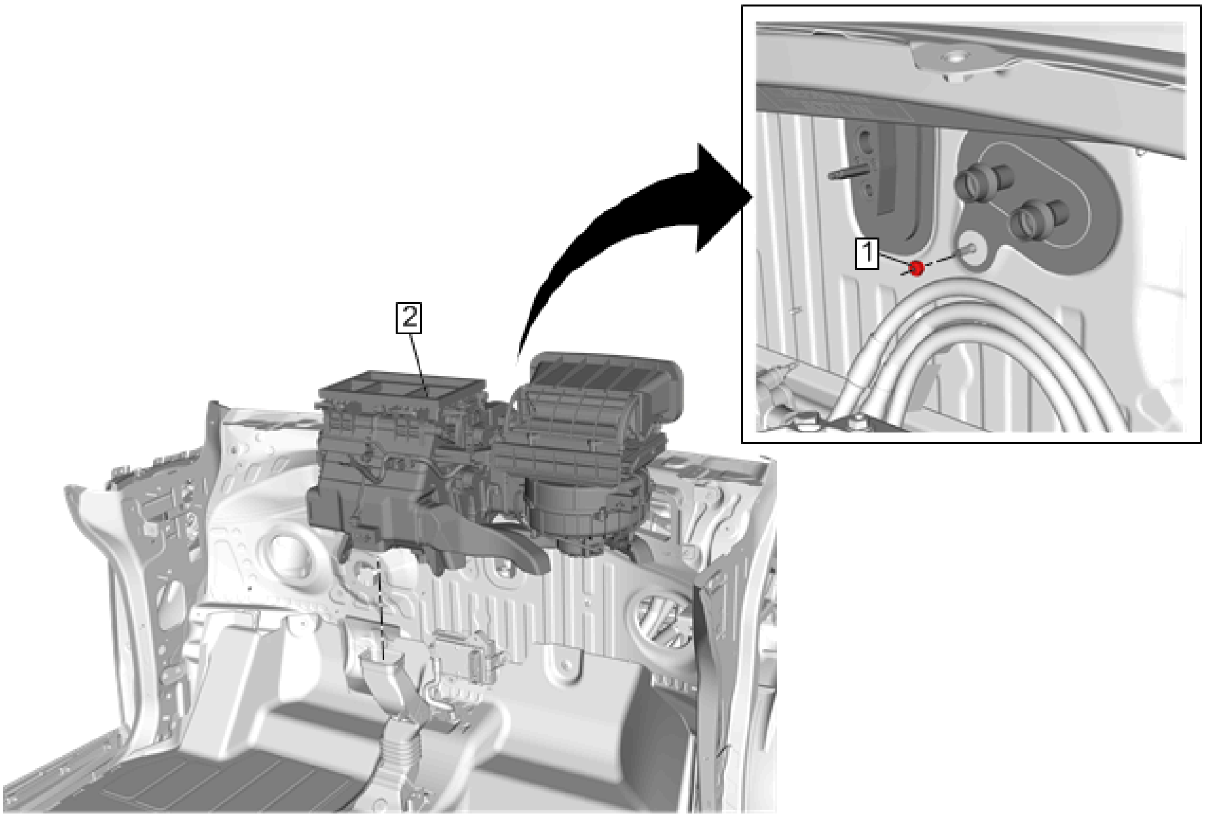


Fig. 81: Heater and Air Conditioning Evaporator and Blower Module
Courtesy of GENERAL MOTORS COMPANY

3. Remove Heater and Air Conditioning Evaporator and Blower Module (2)Heater and Air Conditioning Evaporator and Blower Module Removal and Installation

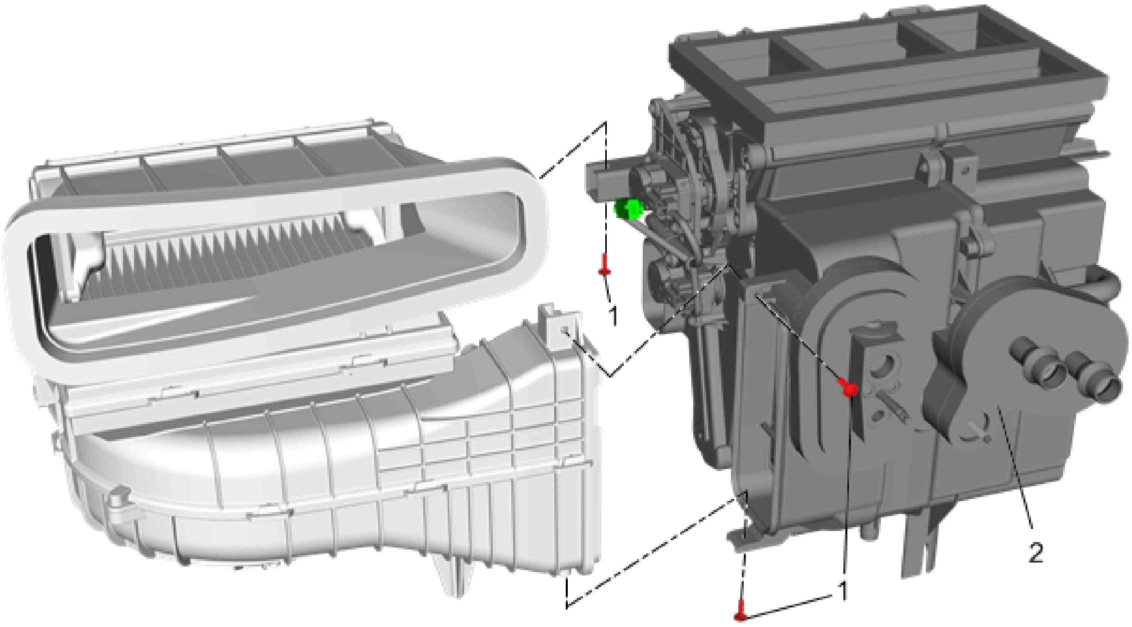


Fig. 82: Heater and Air Conditioning Evaporator Case
Courtesy of GENERAL MOTORS COMPANY

4. Remove Heater and Air Conditioning Evaporator Case (2) **Heater and Air Conditioning Evaporator Case Replacement**

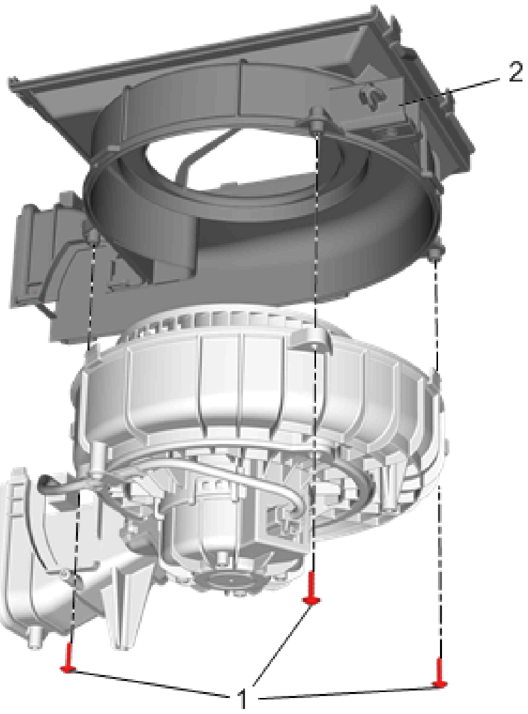
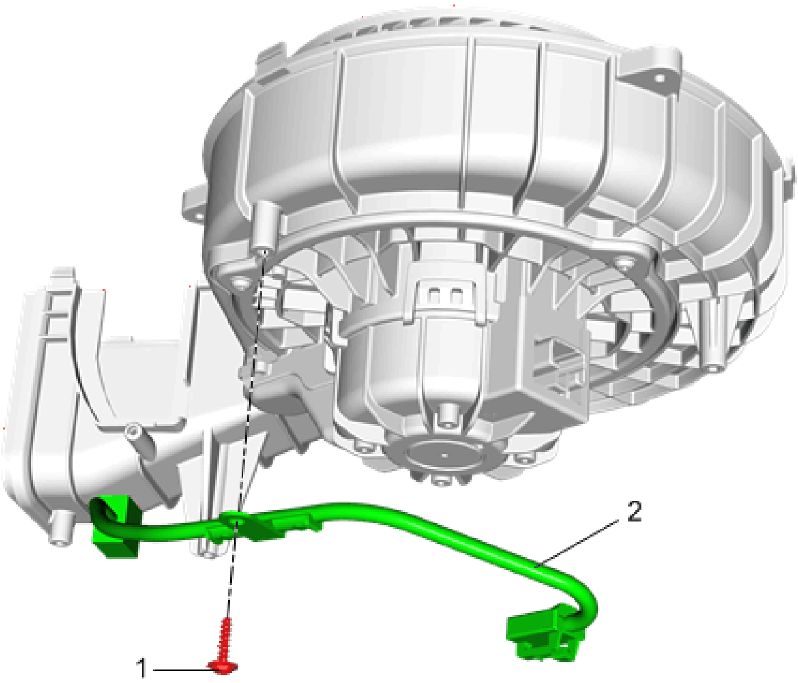


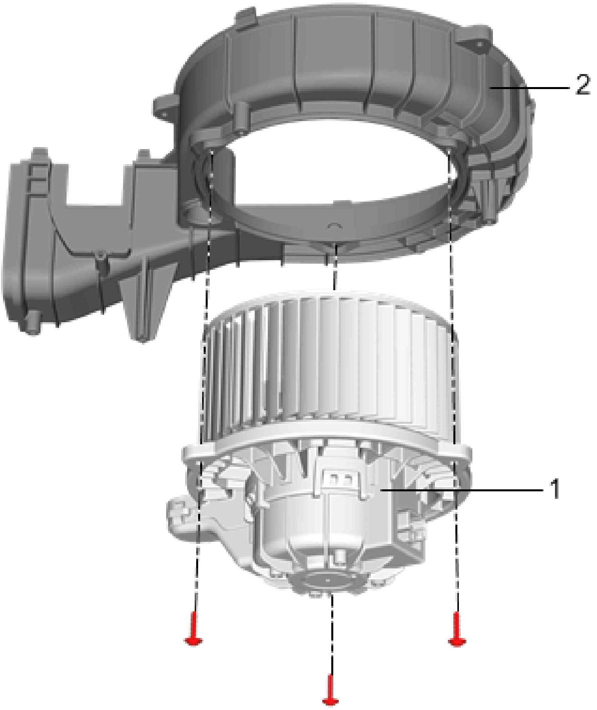
Fig. 83: Blower Upper Case
Courtesy of GENERAL MOTORS COMPANY

5. Remove Blower Upper Case (2) **Blower Upper Case Replacement**



[**Fig. 84: Screw**]
Courtesy of GENERAL MOTORS COMPANY

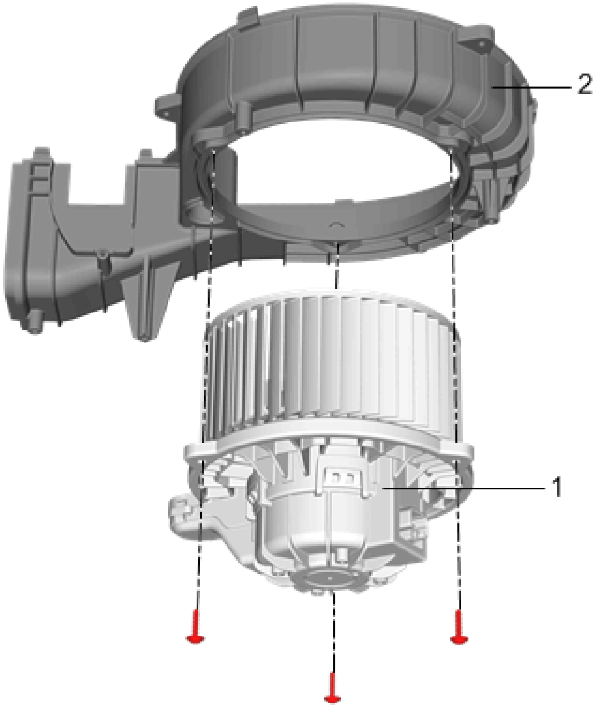
6. Remove Screw (1)
7. Remove the electrical wiring harness (2)



[**Fig. 85: Blower Motor**]
Courtesy of GENERAL MOTORS COMPANY

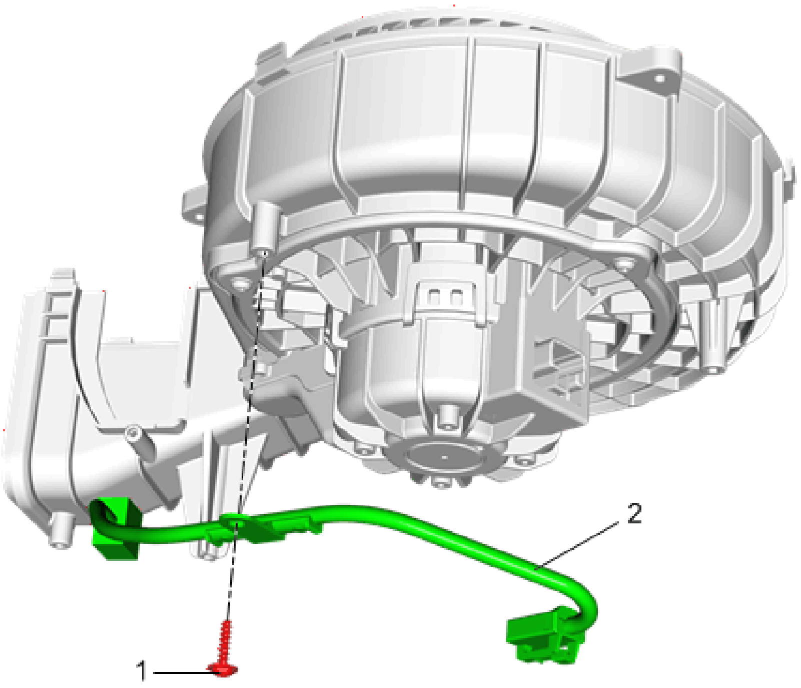
8. Remove Blower Motor (1) **Blower Motor Replacement**
9. Remove Blower Lower Case (2)

Installation Procedure



[Fig. 86: Blower Motor](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Blower Lower Case (2)
2. Install Blower Motor(1) [Blower Motor Replacement](#)



[Fig. 87: Screw](#)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: [Fastener Caution](#)

3. Install the electrical wiring harness (2).
4. Install Screw (1) and tighten

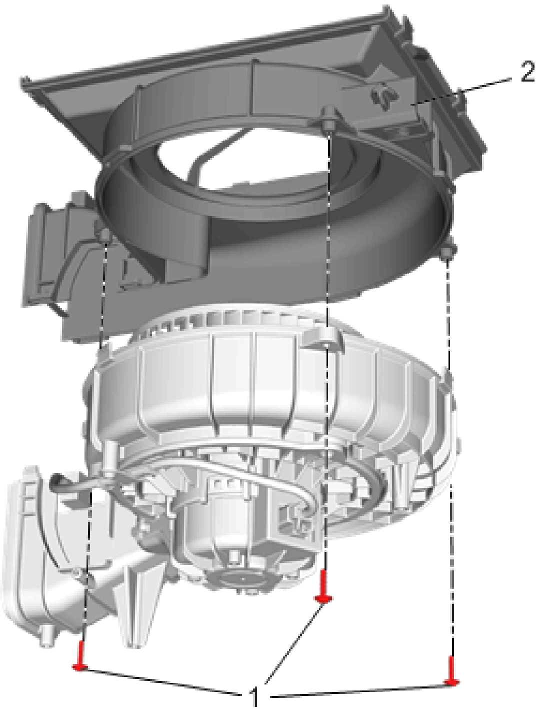


Fig. 88: Blower Upper Case
Courtesy of GENERAL MOTORS COMPANY

5. Install Blower Upper Case(2) **Blower Upper Case Replacement**

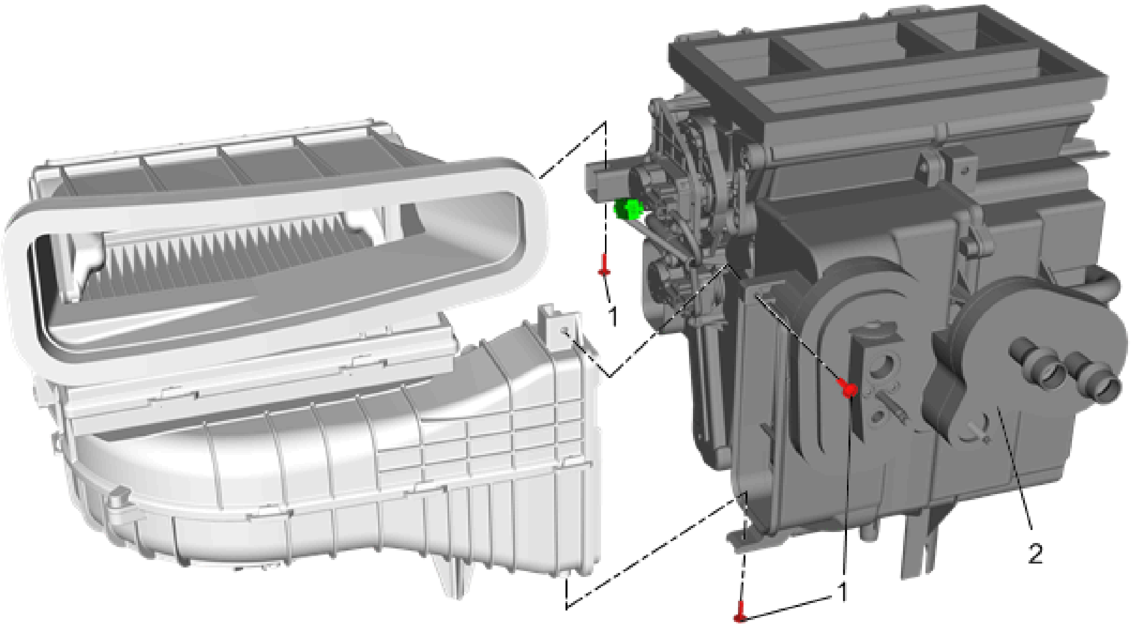


Fig. 89: Heater and Air Conditioning Evaporator Case
Courtesy of GENERAL MOTORS COMPANY

6. Install Heater and Air Conditioning Evaporator Case(2) **Heater and Air Conditioning Evaporator Case Replacement**

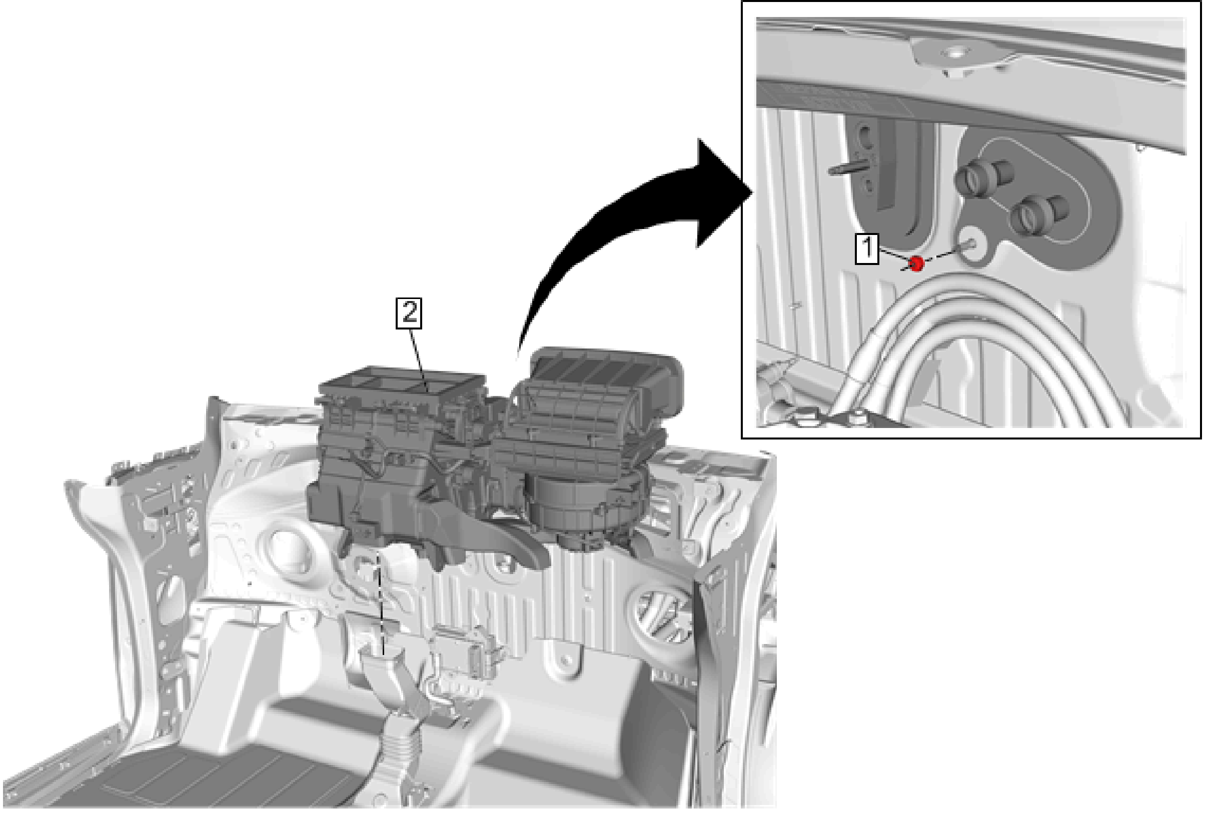


Fig. 90: Heater and Air Conditioning Evaporator and Blower Module
Courtesy of GENERAL MOTORS COMPANY

7. Install Heater and Air Conditioning Evaporator and Blower Module (2)**Heater and Air Conditioning Evaporator and Blower Module Removal and Installation**
8. Evacuate and charge the refrigerant system. **Refrigerant Recovery and Recharging**
9. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

BLOWER UPPER CASE REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**
2. Recover the refrigerant. **Refrigerant Recovery and Recharging**

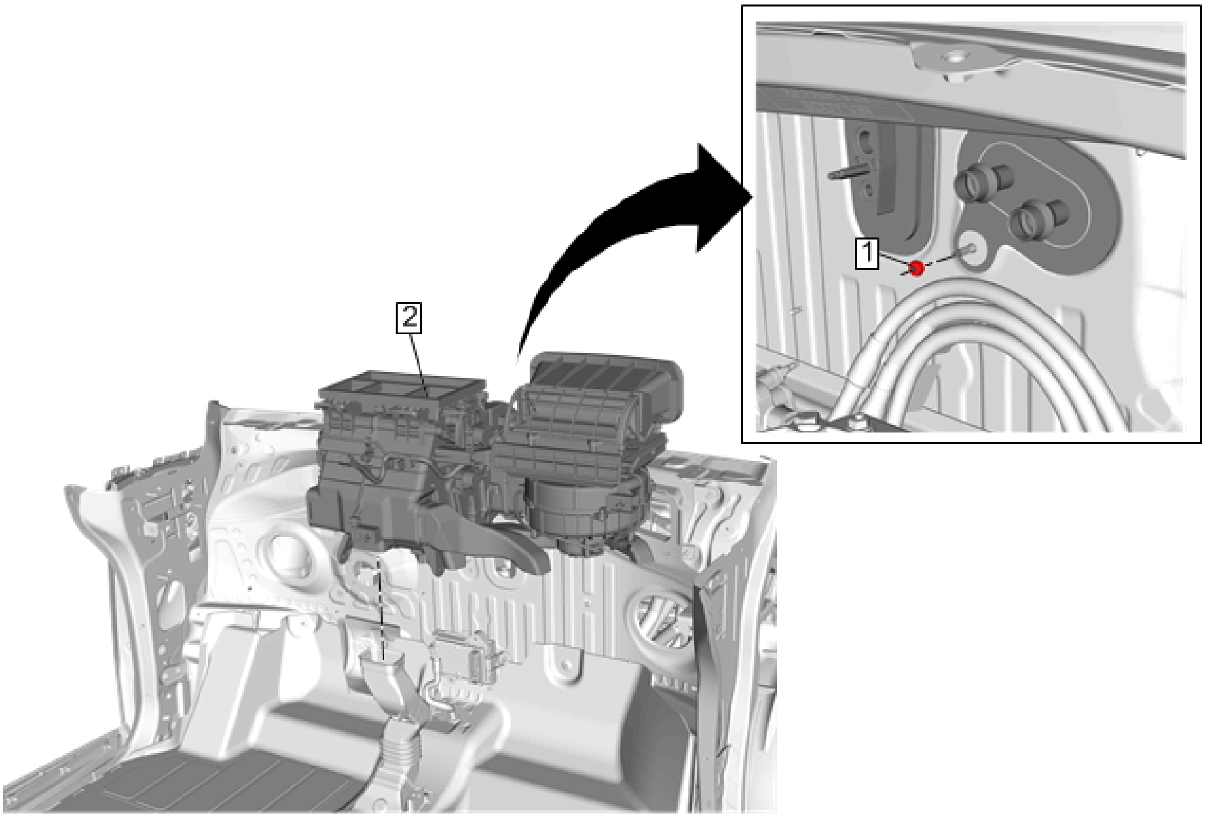


Fig. 91: Heater and Air Conditioning Evaporator and Blower Module
Courtesy of GENERAL MOTORS COMPANY

3. Remove Heater and Air Conditioning Evaporator and Blower Module(2) **Heater and Air Conditioning Evaporator and Blower Module Removal and Installation**

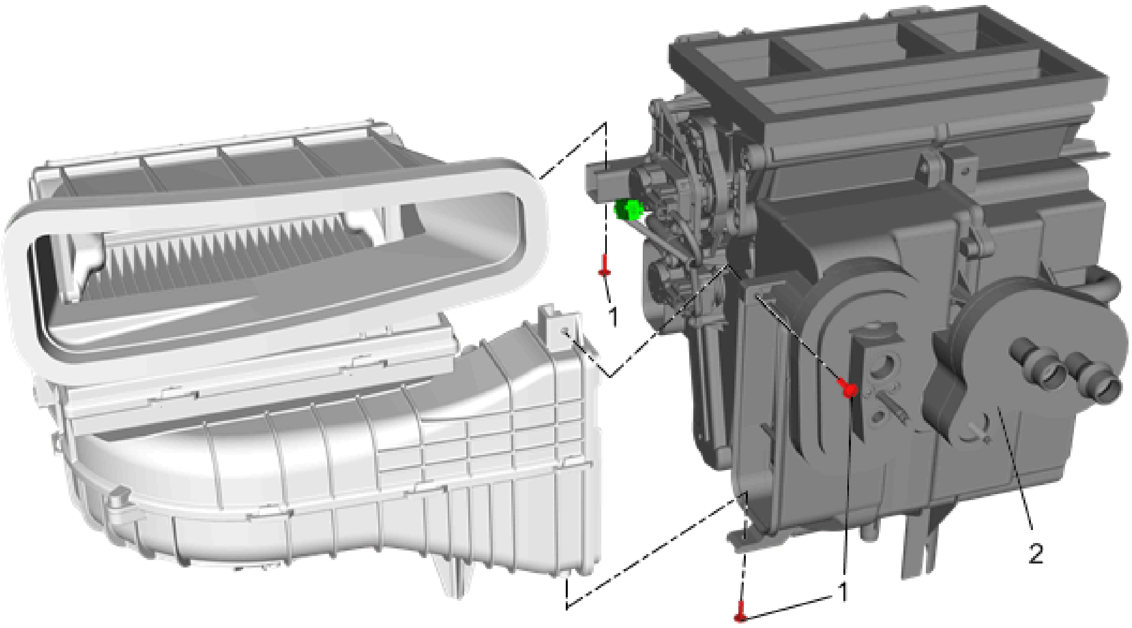


Fig. 92: Heater and Air Conditioning Evaporator Case
Courtesy of GENERAL MOTORS COMPANY

4. Remove Heater and Air Conditioning Evaporator Case (2) **Heater and Air Conditioning Evaporator Case Replacement**

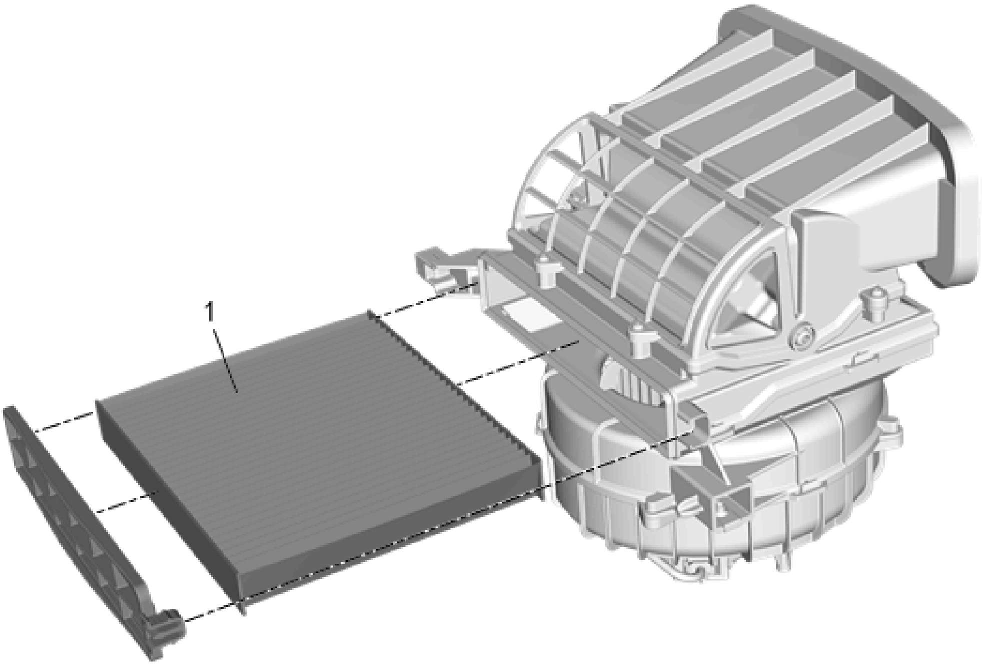


Fig. 93: Passenger Compartment Air Filter
Courtesy of GENERAL MOTORS COMPANY

5. Remove Passenger Compartment Air Filter (1)Passenger Compartment Air Filter Replacement

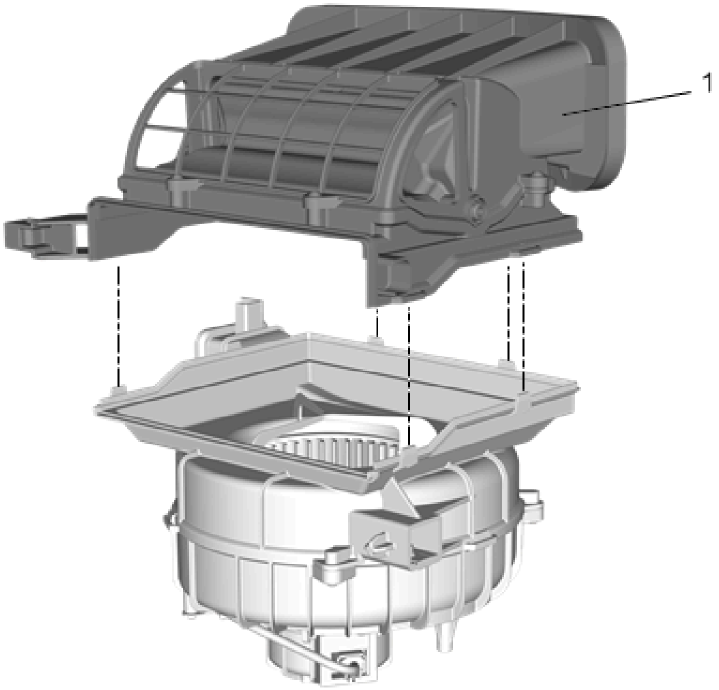


Fig. 94: Air Inlet Housing
Courtesy of GENERAL MOTORS COMPANY

6. Remove Air Inlet Housing (1)Air Inlet Housing Replacement

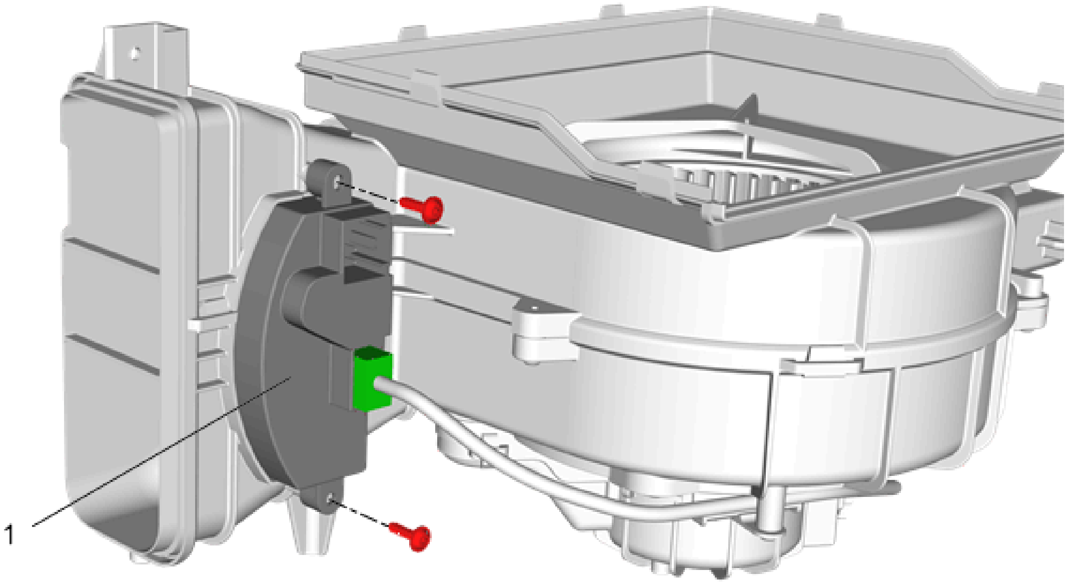
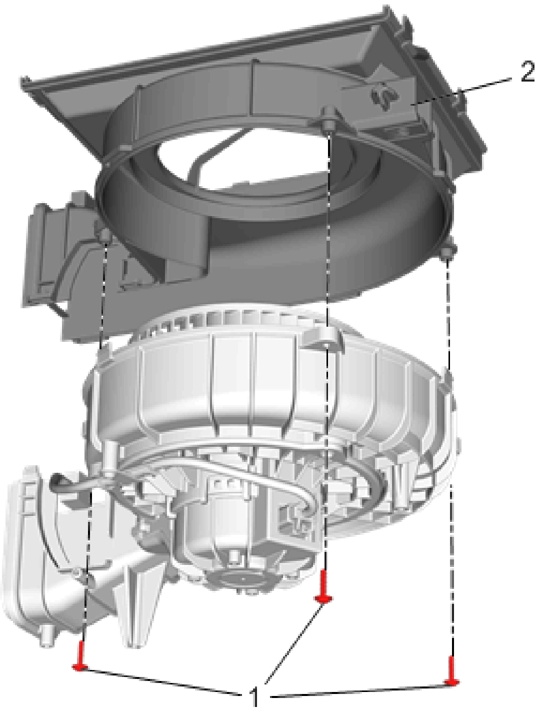


Fig. 95: Blower Motor Control Module
Courtesy of GENERAL MOTORS COMPANY

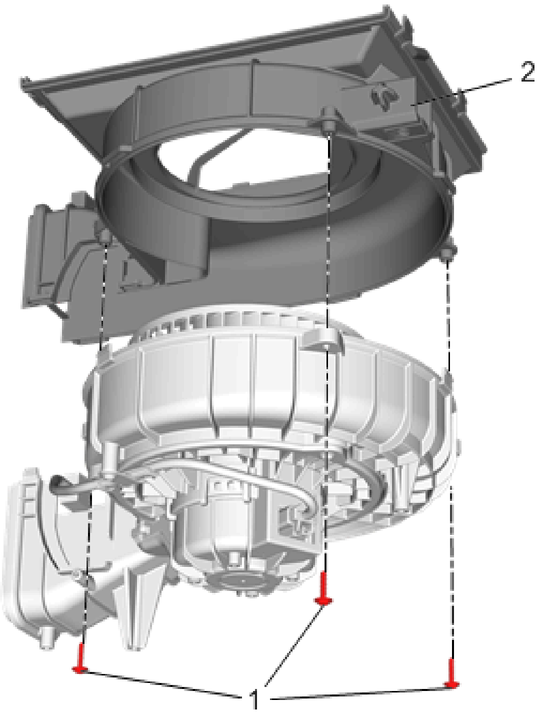
7. Remove Blower Motor Control Module (1) Blower Motor Control Replacement (Module Mounted)



[Fig. 96: Blower Upper Case](#)
Courtesy of GENERAL MOTORS COMPANY

8. Remove Blower Upper Case Screw (1)
9. Remove Blower Upper Case(2)
10. Using the appropriate tools, release the integral retaining features.

Installation Procedure



[Fig. 97: Blower Upper Case](#)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: [Fastener Caution](#)

1. Install Blower Upper Case(2)

2. Install Blower Upper Case Screw (1) and tighten 2.5 N.m (22 lb in)

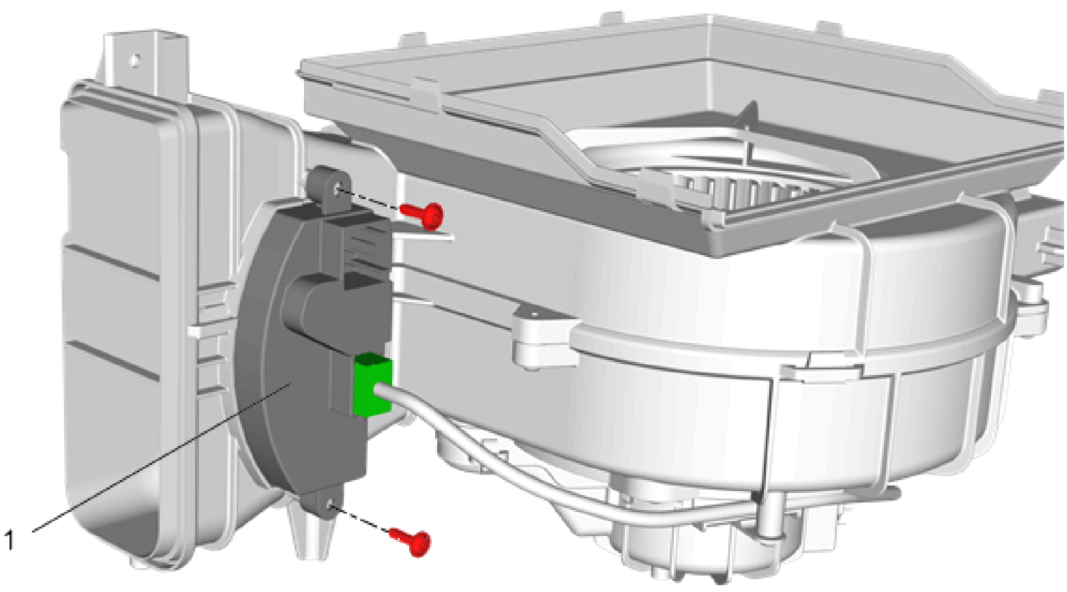


Fig. 98: Blower Motor Control Module
Courtesy of GENERAL MOTORS COMPANY

3. Install Blower Motor Control Module(1) **Blower Motor Control Replacement (Module Mounted)**

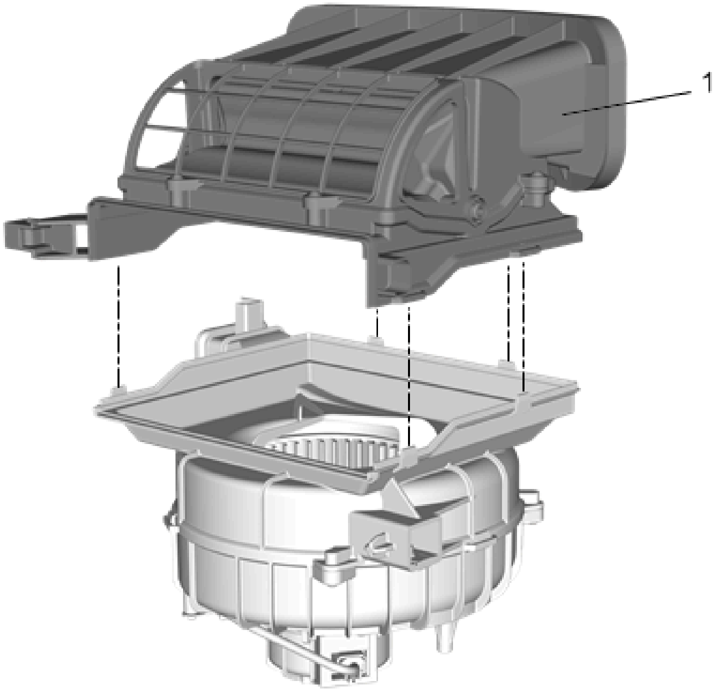


Fig. 99: Air Inlet Housing
Courtesy of GENERAL MOTORS COMPANY

4. Install Air Inlet Housing(1) **Air Inlet Housing Replacement**

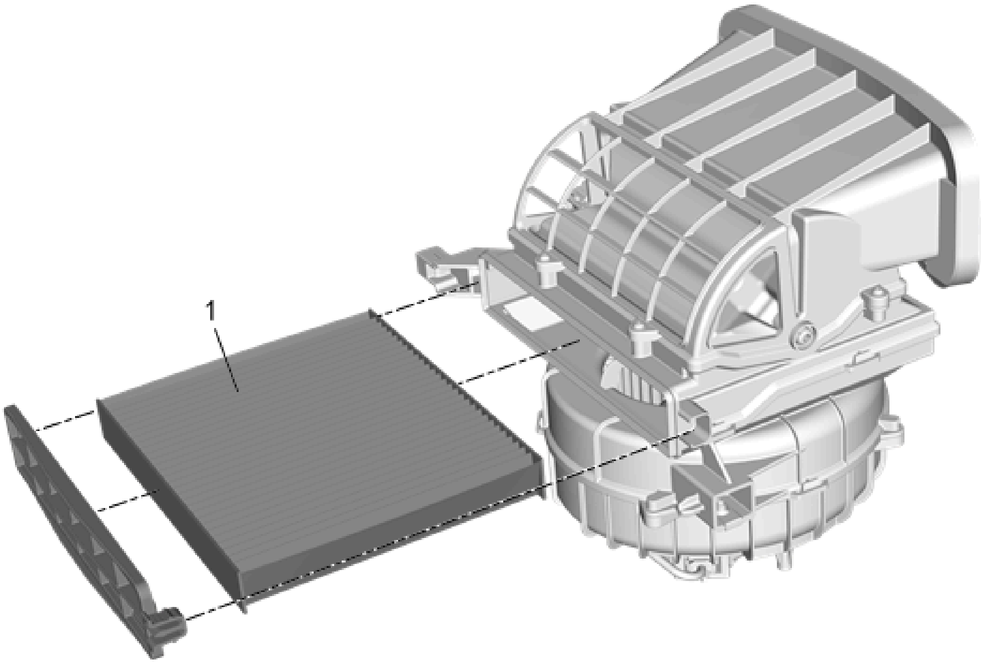


Fig. 100: Passenger Compartment Air Filter
Courtesy of GENERAL MOTORS COMPANY

5. Install Passenger Compartment Air Filter(1) **Passenger Compartment Air Filter Replacement**

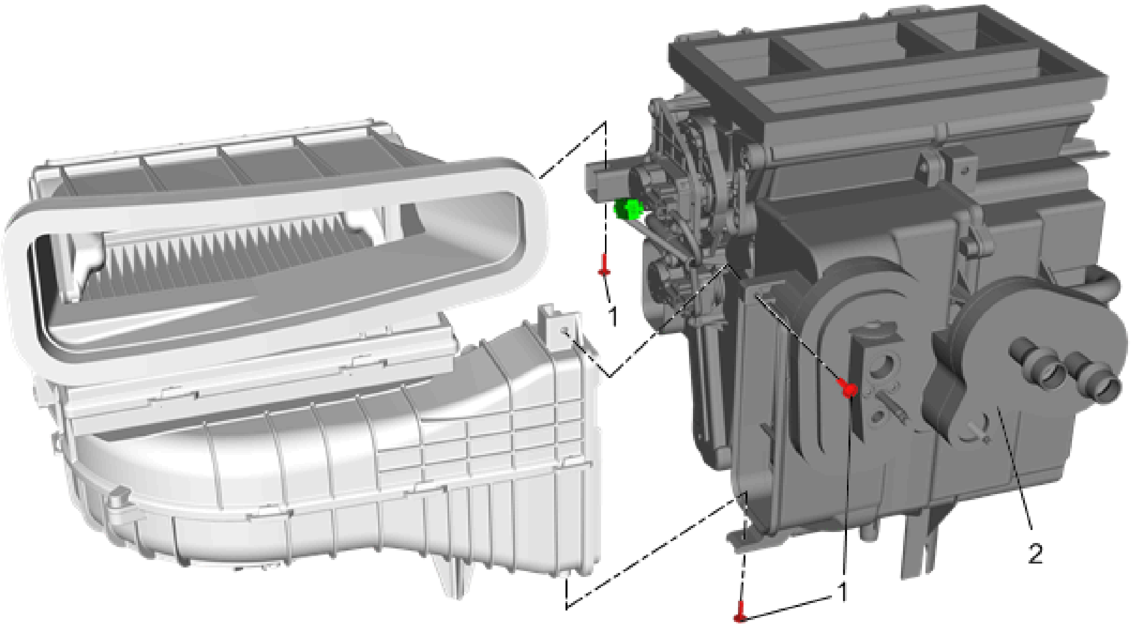


Fig. 101: Heater and Air Conditioning Evaporator Case
Courtesy of GENERAL MOTORS COMPANY

6. Install Heater and Air Conditioning Evaporator Case(2) **Heater and Air Conditioning Evaporator Case Replacement**

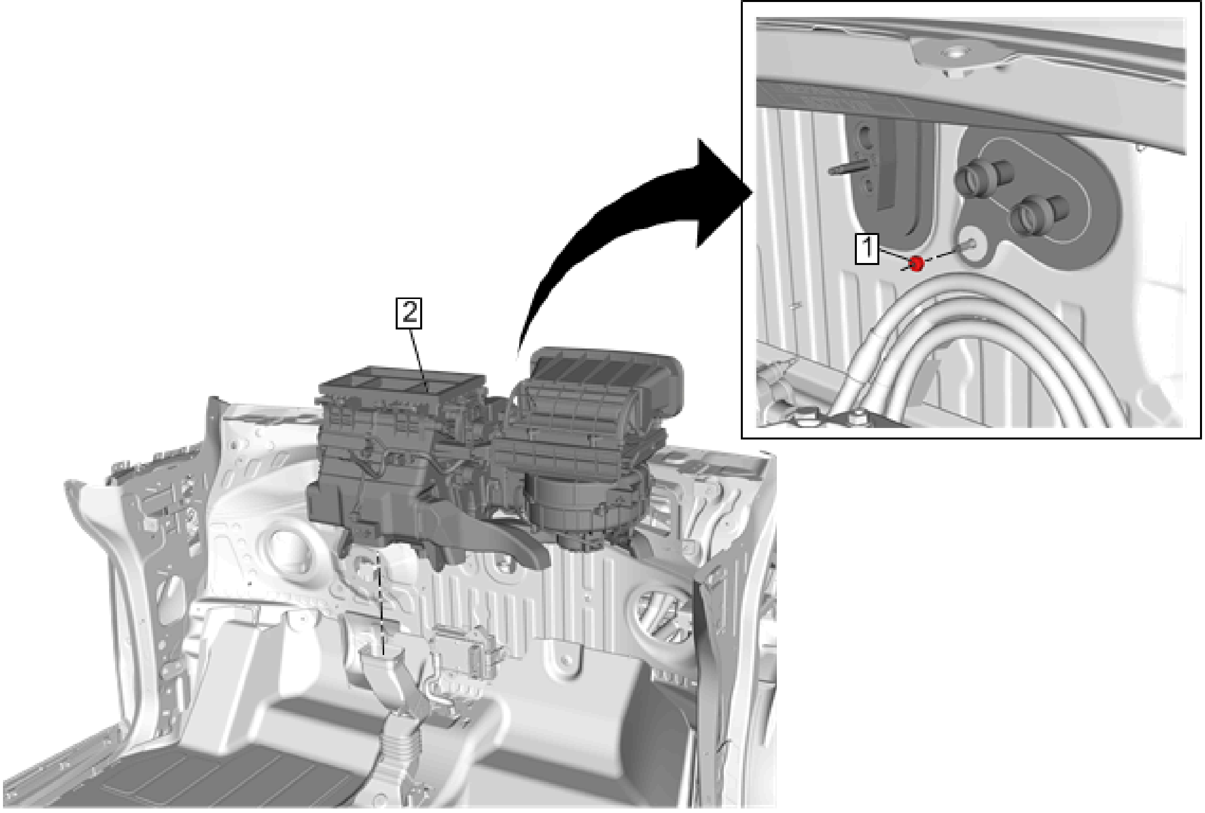


Fig. 102: Heater and Air Conditioning Evaporator and Blower Module
Courtesy of GENERAL MOTORS COMPANY

7. Install Heater and Air Conditioning Evaporator and Blower Module(2) Heater and Air Conditioning Evaporator and Blower Module Removal and Installation
8. Evacuate and charge the refrigerant system. Refrigerant Recovery and Recharging
9. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

AIR CONDITIONING EVAPORATOR REPLACEMENT

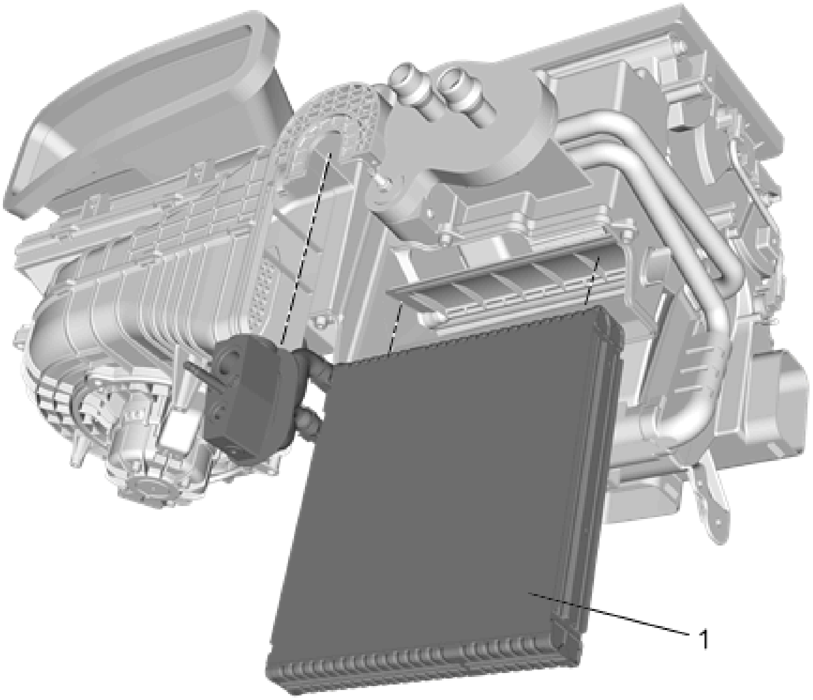


Fig. 103: Air Conditioning Evaporator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection 2. Remove the heater and air conditioning evaporator and blower module. Heater and Air Conditioning Evaporator and Blower Module Removal and Installation 3. Heater Case Replacement	
1	Air Conditioning Evaporator **Procedure** 1. Transfer components as necessary. 2. Install the heater and air conditioning evaporator and blower module. Heater and Air Conditioning Evaporator and Blower Module Removal and Installation 3. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

AIR CONDITIONING EVAPORATOR AND BLOWER MODULE DRAIN HOSE REPLACEMENT

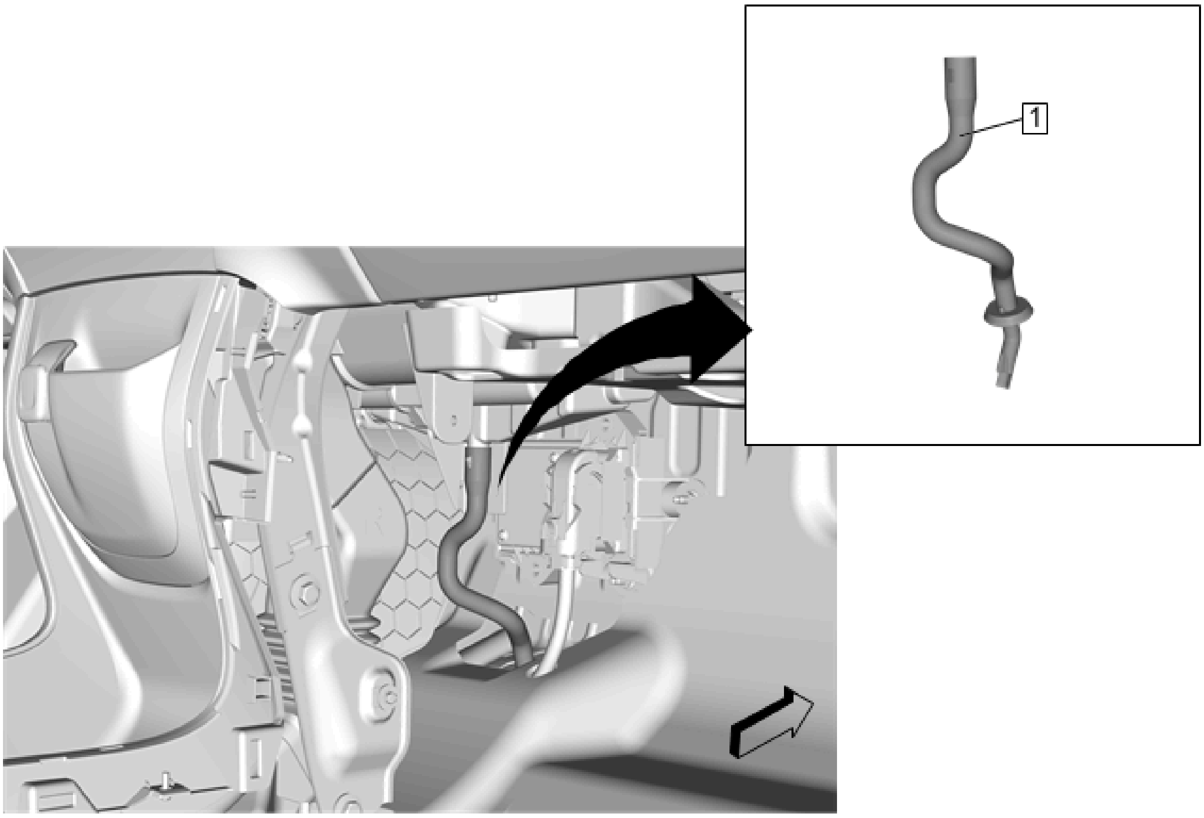


Fig. 104: Air Conditioning Evaporator and Blower Module Drain Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: **Refer to HVAC Module Drain Tube Caution .** **Preliminary Procedure** Front Floor Console Replacement	
1	Air Conditioning Evaporator and Blower Module Drain Hose **Procedure** Release and pull off the drain hose from the HVAC module assembly and unsnap the drain fitting grommet from the front floor panel.

HEATER INLET HOSE REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools:Special Tools

Removal Procedure

1. Drain the cooling system. Heater Coolant Heater Draining and Filling

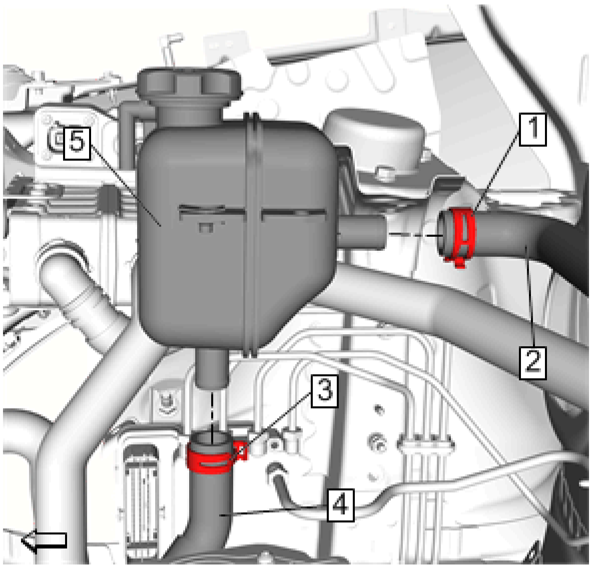


Fig. 105: Heater Coolant Surge Tank And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

2. Disengage the clamp (1) and remove the heater inlet hose (2) from the heater coolant surge tank. Heater Coolant Surge Tank Replacement

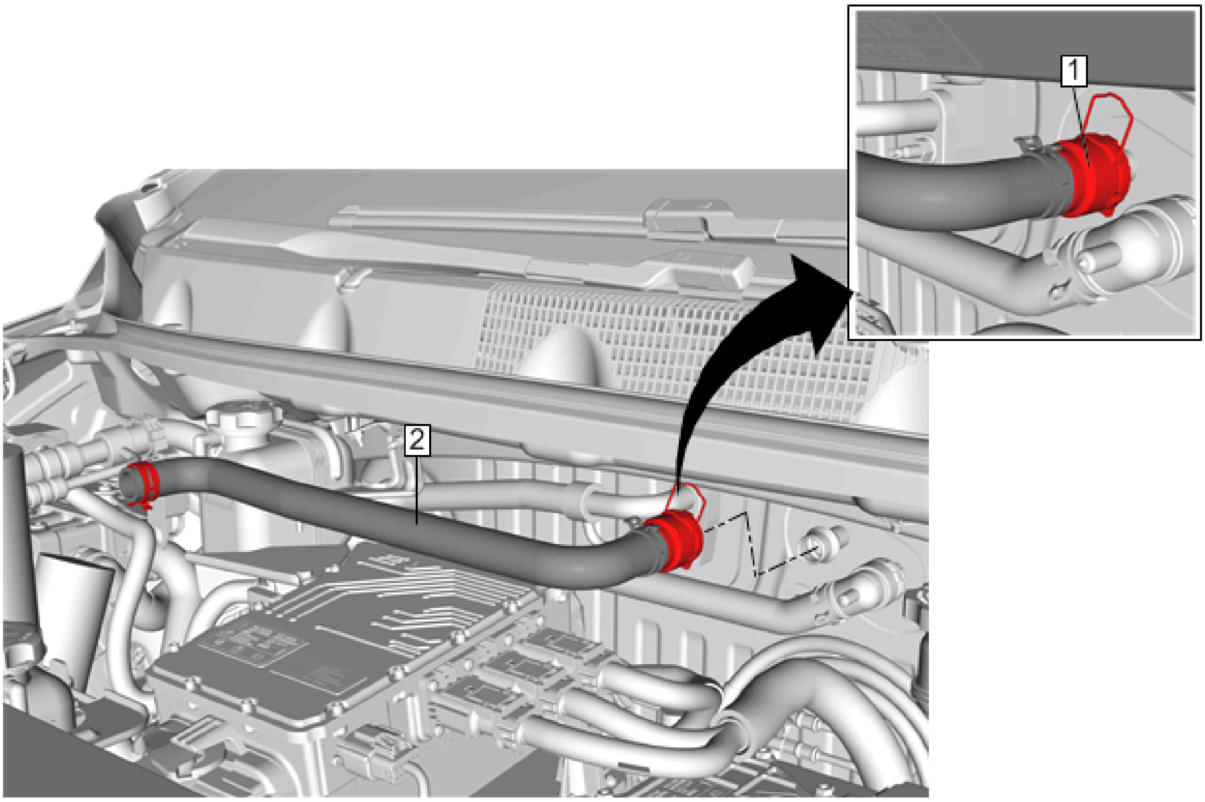


Fig. 106: Heater Inlet Hose Quick Connect And Heater Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Heater Inlet Hose Quick Connect (1)
4. Remove Heater Inlet Hose (2)@Heater Core Inlet Tube

Installation Procedure

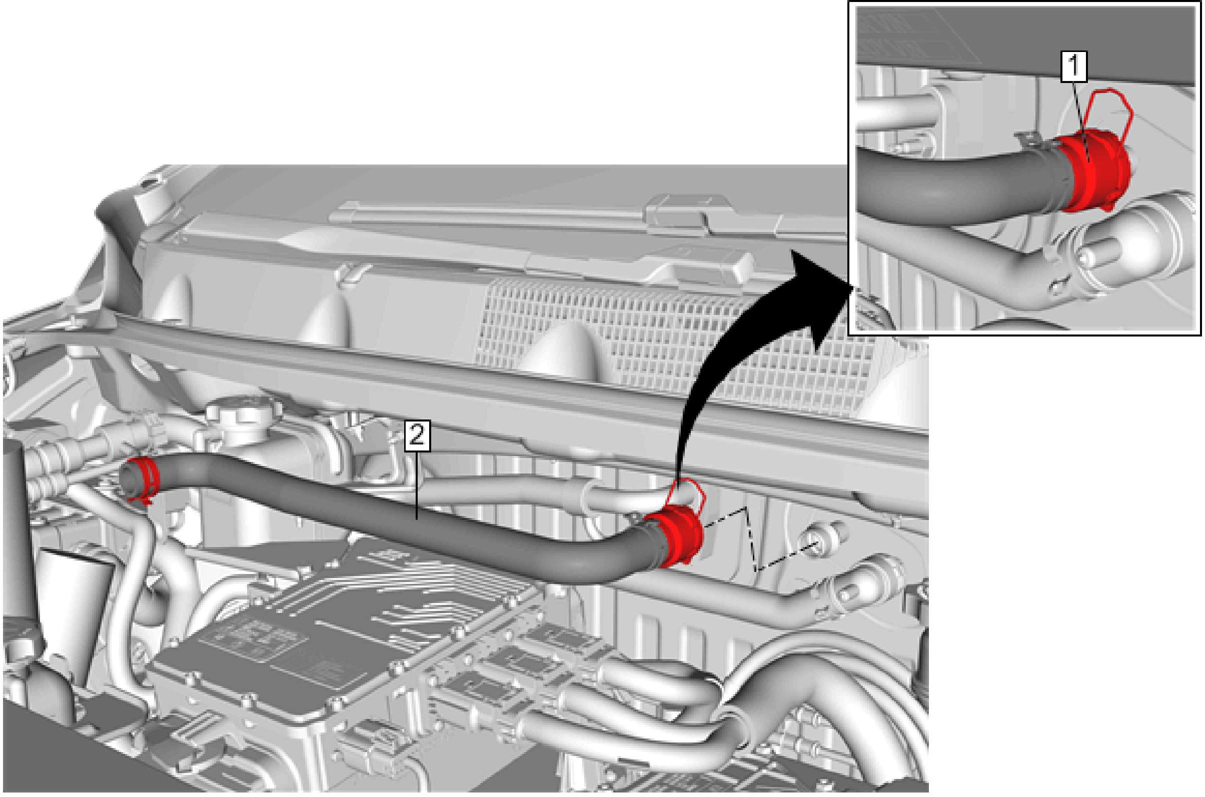


Fig. 107: Heater Inlet Hose Quick Connect And Heater Inlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Heater Inlet Hose (2)@Heater Core Inlet Tube
2. Connect Heater Inlet Hose Quick Connect (1)

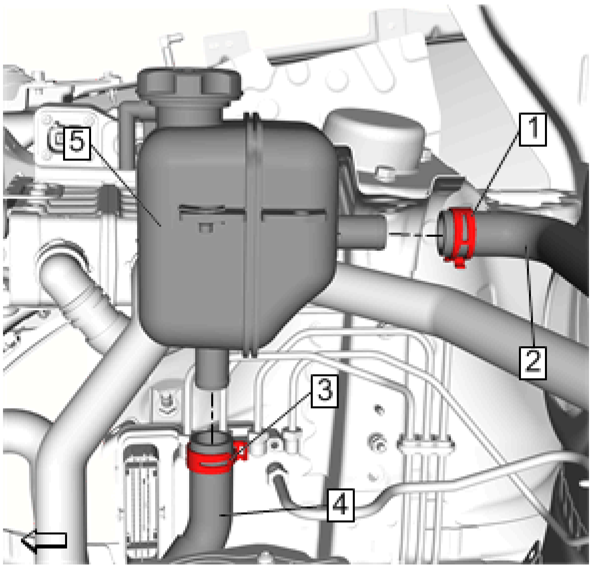


Fig. 108: Heater Coolant Surge Tank And Attaching Components
Courtesy of GENERAL MOTORS COMPANY

3. Install the heater inlet hose (2) to the heater coolant surge tank and engage the clamp (1). Heater Coolant Surge Tank Replacement
4. Fill the cooling system. Heater Coolant Heater Draining and Filling

AUXILIARY HEATER INLET HOSE REPLACEMENT

Special Tools

- **BO-38185** Hose Clamp Pliers

Equivalent regional tools:Special Tools

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Drain the cooling system. **Heater Coolant Heater Draining and Filling**
3. Remove Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
4. Remove Front Wheelhouse Liner-Right Side **Front Wheelhouse Liner Replacement**

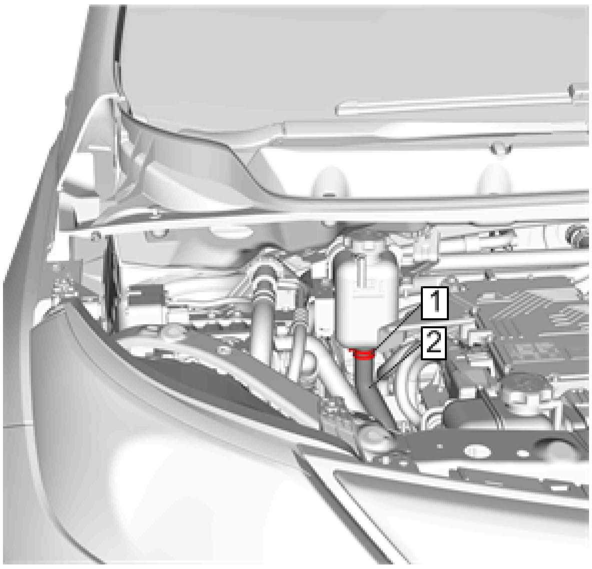


Fig. 109: Auxiliary Heater Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Auxiliary Heater Inlet Hose Clamp (1)**Hose Clamp Replacement Guidelines - Spring Type**

   Use the **BO-38185** Hose Clamp Pliers.

6. Remove Auxiliary Heater Inlet Hose(2)@Heater Coolant Surge Tank
7. Raise and support the vehicle. **Lifting and Jacking the Vehicle**

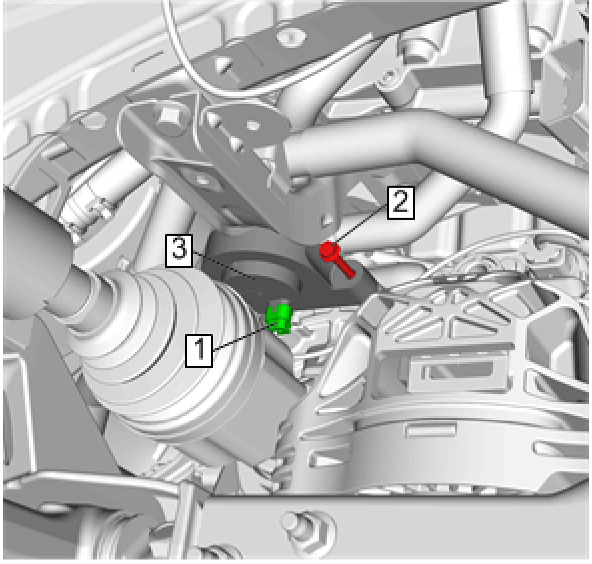


Fig. 110: Heater Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the heater coolant pump electrical connector (1).
9. Remove the heater coolant pump bolt (2).
10. Reposition the heater coolant pump on the rubber mount to access the clamp.

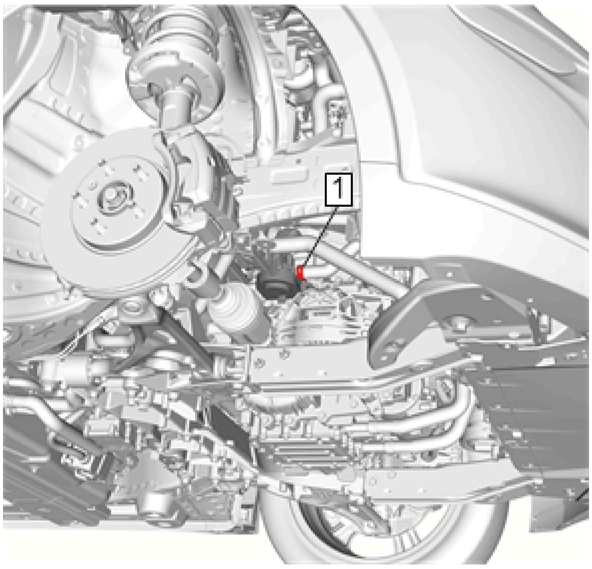


Fig. 111: Auxiliary Heater Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

11. Disengage Auxiliary Heater Outlet Hose Clamp (1)**Hose Clamp Replacement Guidelines - Spring Type**
12. Remove the auxiliary heater outlet hose from the heater coolant pump.
13. Remove the heater coolant pump with the auxiliary heater inlet hose.

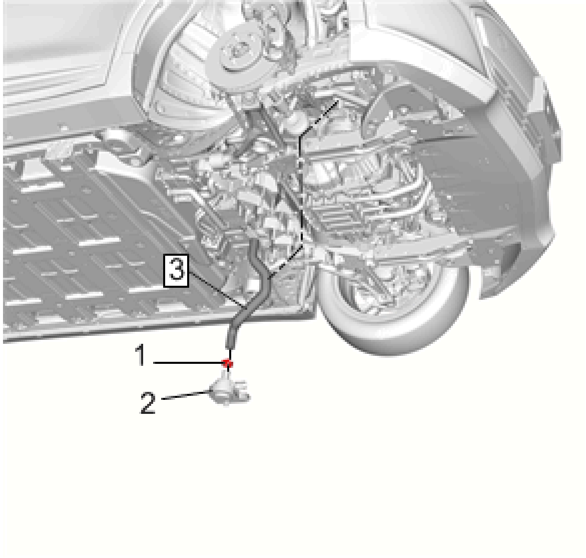


Fig. 112: Auxiliary Heater Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

14. Disengage Auxiliary Heater Inlet Hose Clamp (1) **Hose Clamp Replacement Guidelines - Spring Type**
15. Remove Auxiliary Heater Inlet Hose (3) @Heater Coolant Pump(2)

Installation Procedure

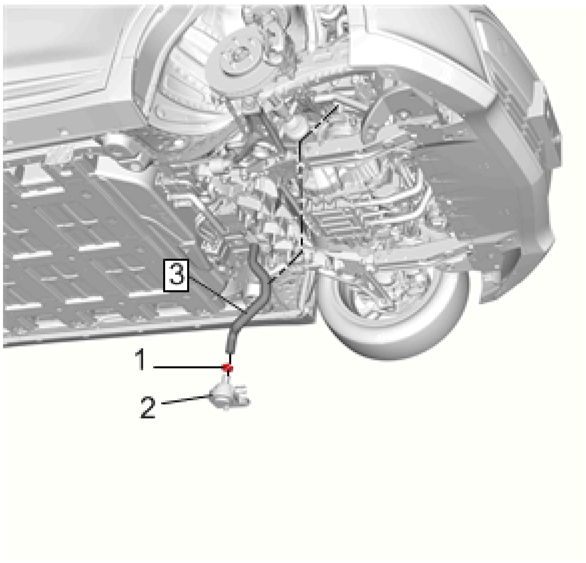


Fig. 113: Auxiliary Heater Inlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Install Auxiliary Heater Inlet Hose (3)@Heater Coolant Pump (2)
2. Engage Auxiliary Heater Inlet Hose Clamp (1)**Hose Clamp Replacement Guidelines - Spring Type**
3. Position the heater coolant pump with the auxiliary heater inlet hose.

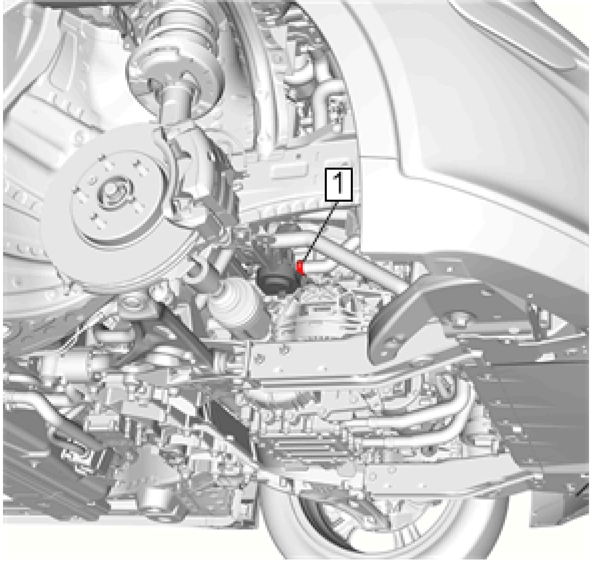


Fig. 114: Auxiliary Heater Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Engage Auxiliary Heater Outlet Hose Clamp (1)**Hose Clamp Replacement Guidelines - Spring Type**

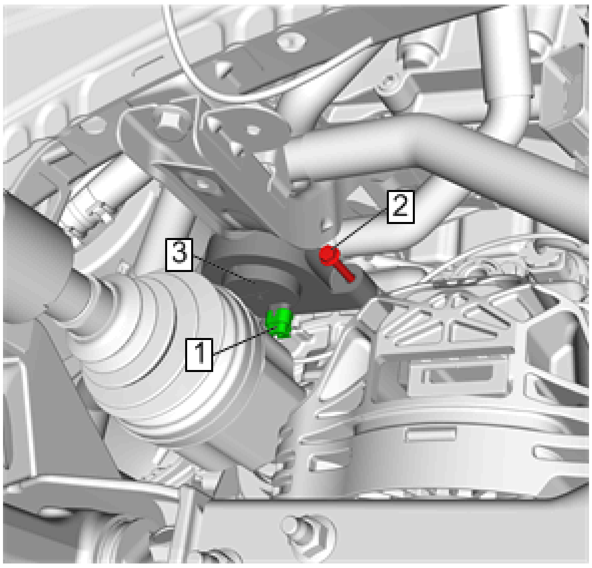


Fig. 115: Heater Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten the heater coolant pump bolt (2) to 9 N.m (80 lb in).
6. Connect the heater coolant pump electrical connector (1).
7. Lower the vehicle

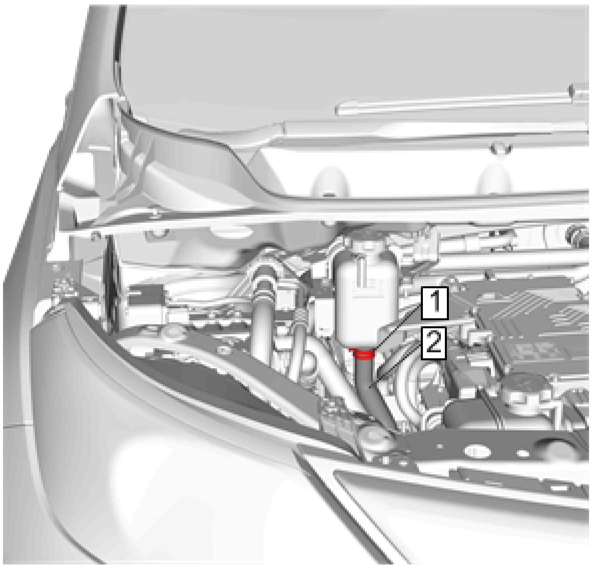


Fig. 116: Auxiliary Heater Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Install Auxiliary Heater Inlet Hose(2)@Heater Coolant Surge Tank
9. Engage Auxiliary Heater Inlet Hose Clamp(1) **Hose Clamp Replacement Guidelines - Spring Type**
10. Install Front Wheelhouse Liner-Right Side **Front Wheelhouse Liner Replacement**
11. Install Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
12. Fill the cooling system to the proper level. **Heater Coolant Heater Draining and Filling**
13. Enable the high voltage system. **High Voltage Enabling**
14. Start the engine and check for coolant leaks.

AUXILIARY HEATER OUTLET HOSE REPLACEMENT

Special Tools

Equivalent regional tools:**Special Tools**

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Remove Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
3. Remove Front Wheelhouse Liner-Right Side **Front Wheelhouse Liner Replacement**
4. Place a drain pan beneath the vehicle.

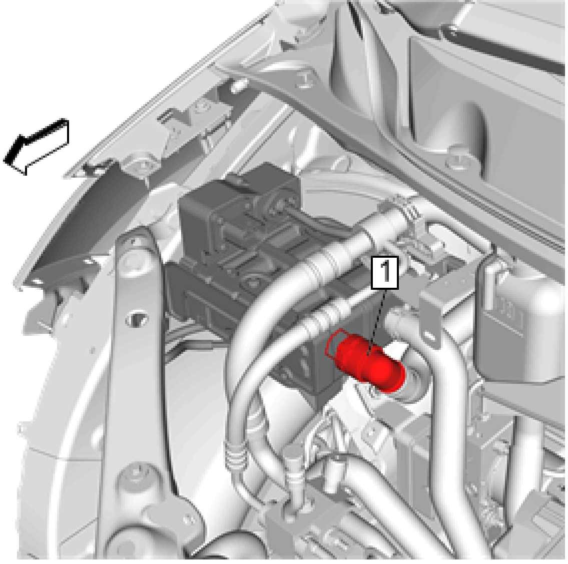


Fig. 117: Heater Outlet Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

5. Remove Heater Outlet Hose Quick Connector (1) and Heater Outlet Hose @ Heater Coolant Heater **Heater Outlet Hose Replacement**

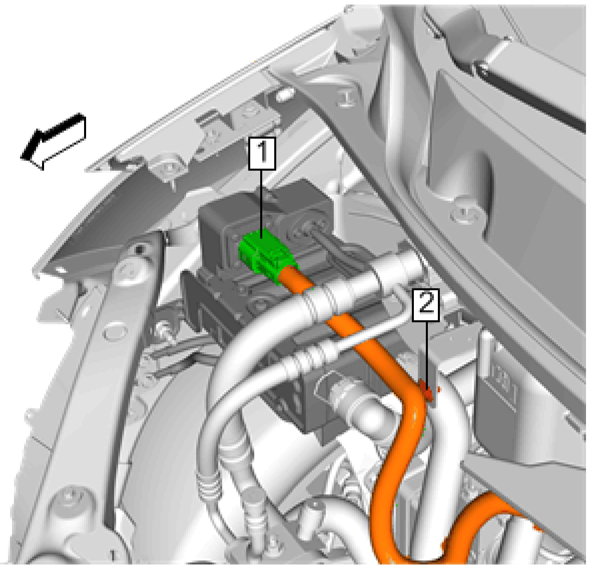


Fig. 118: High Voltage Cable Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect High Voltage Cable Electrical Connector (1) @Heater Coolant Heater

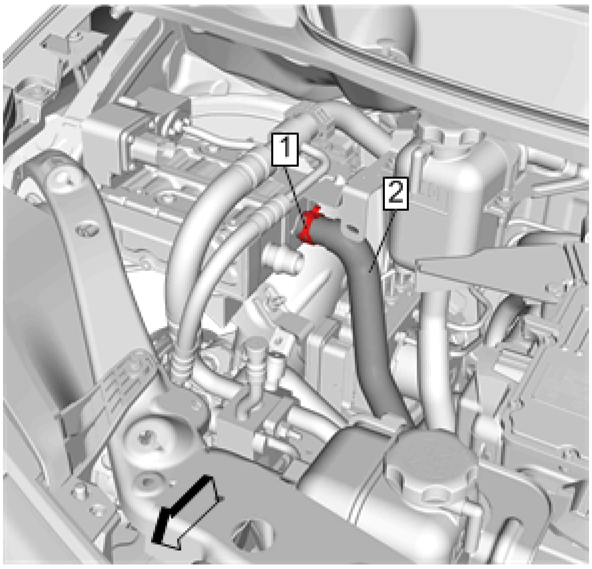


Fig. 119: Auxiliary Heater Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Disengage Auxiliary Heater Outlet Hose Clamp(1) Hose Clamp Replacement Guidelines - Spring Type

   Use the **BO-38185** Hose Clamp Pliers.

8. Remove Auxiliary Heater Outlet Hose(2)@Heater Coolant Heater
9. Raise the vehicle. Lifting and Jacking the Vehicle

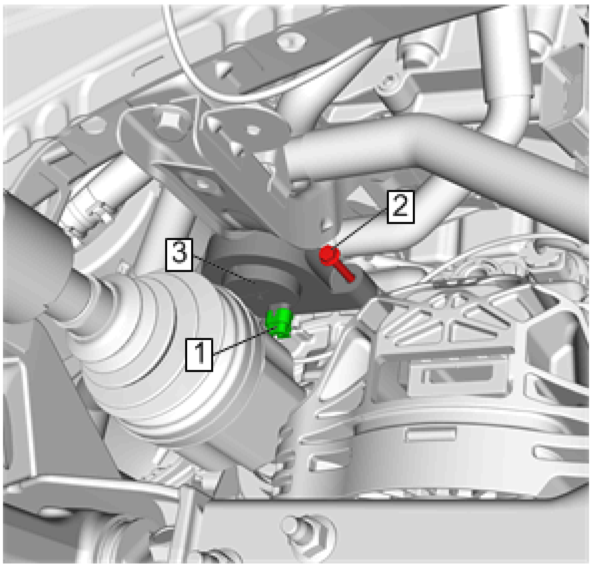


Fig. 120: Heater Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

10. Disconnect the heater coolant pump electrical connector (1).
11. Remove the heater coolant pump bolt (2).
12. Reposition the heater coolant pump on the rubber mount to access the clamp.

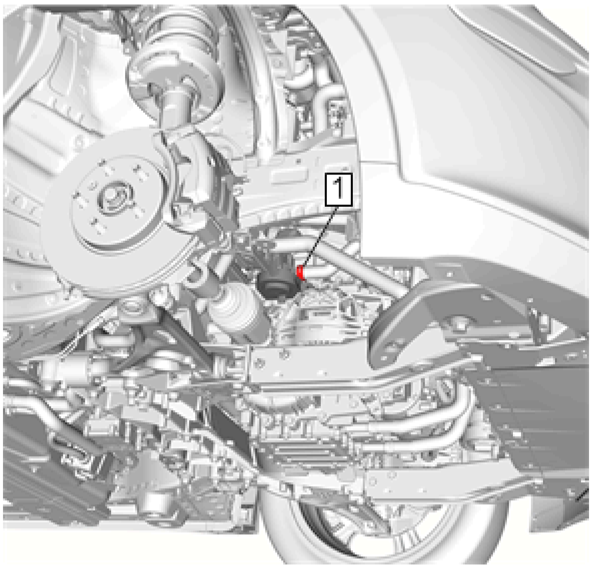


Fig. 121: Auxiliary Heater Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

13. Disengage Auxiliary Heater Outlet Hose Clamp (1)Hose Clamp Replacement Guidelines - Spring Type
14. Remove Auxiliary Heater Outlet Hose@Heater Coolant Pump

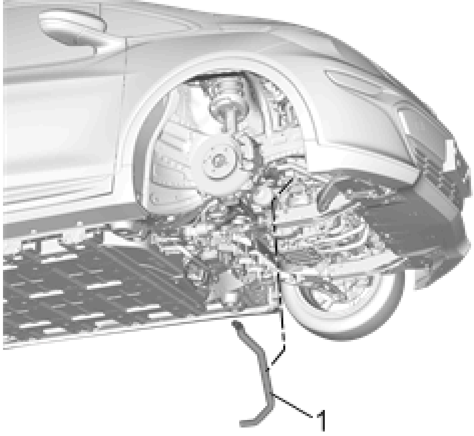


Fig. 122: Auxiliary Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

15. Remove Auxiliary Heater Outlet Hose (1)

Installation Procedure

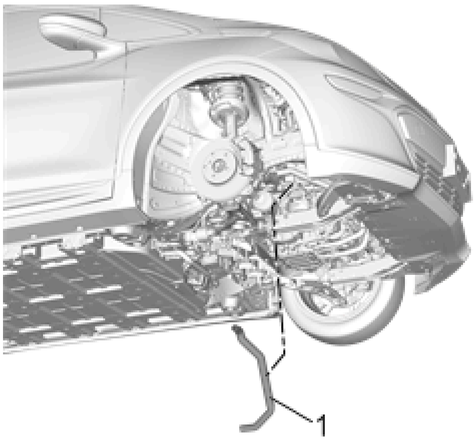


Fig. 123: Auxiliary Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

1. Position Auxiliary Heater Outlet Hose (1)

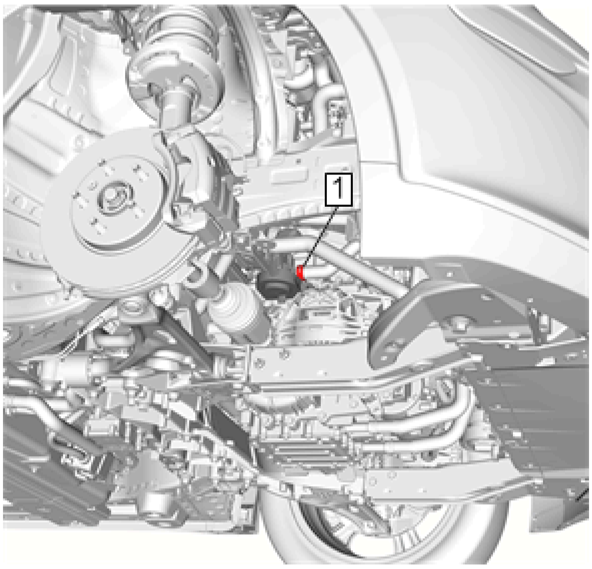


Fig. 124: Auxiliary Heater Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Remove Auxiliary Heater Outlet Hose@Heater Coolant Pump
3. Engage Auxiliary Heater Outlet Hose Clamp (1) Hose Clamp Replacement Guidelines - Spring Type

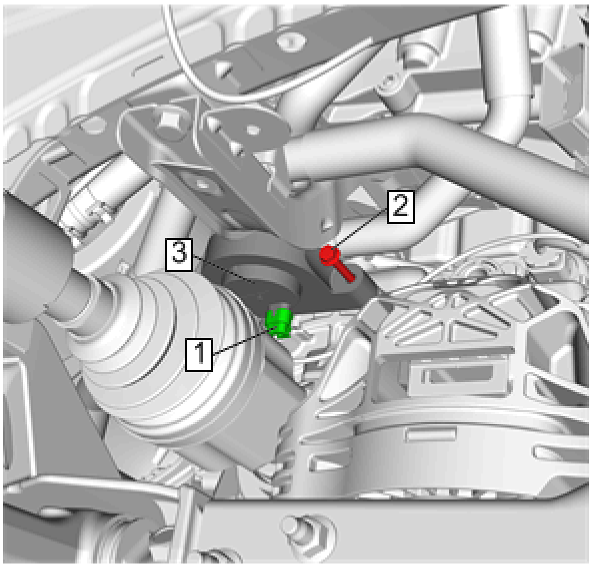


Fig. 125: Heater Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Install and tighten the heater coolant pump bolt (2) to 9 N.m (80 lb in).
5. Connect the heater coolant pump electrical connector (1).
6. Lower the vehicle.

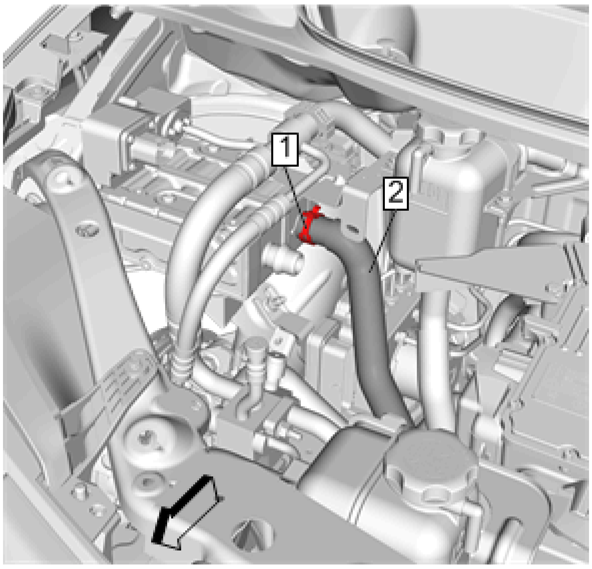


Fig. 126: Auxiliary Heater Outlet Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Install Auxiliary Heater Outlet Hose(2)@ Heater Coolant Heater
8. Engage Auxiliary Heater Outlet Hose Clamp(1)Hose Clamp Replacement Guidelines - Spring Type

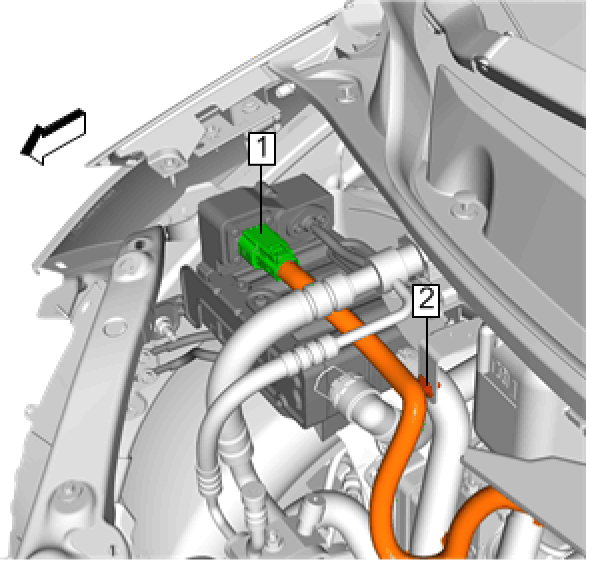


Fig. 127: High Voltage Cable Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

9. Connect High Voltage Cable Connector (1)@ Heater Coolant Heater

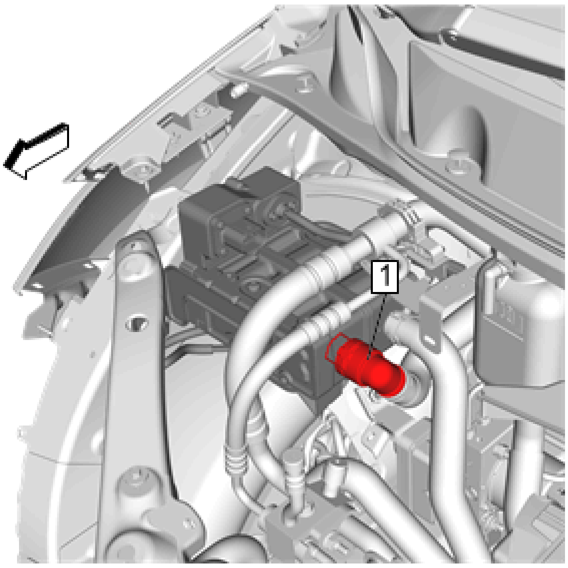


Fig. 128: Heater Outlet Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

10. Install Heater Outlet Hose Quick Connector (1) and Heater Outlet Hose @Heater Coolant Heater **Heater Outlet Hose Replacement**
11. Install Front Wheelhouse Liner-Right Side **Front Wheelhouse Liner Replacement**
12. Install Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
13. Fill the cooling system to the proper level. **Heater Coolant Heater Draining and Filling**
14. Enable the high voltage system. **High Voltage Enabling**
15. Start the engine and check for coolant leaks.

HEATER OUTLET HOSE REPLACEMENT

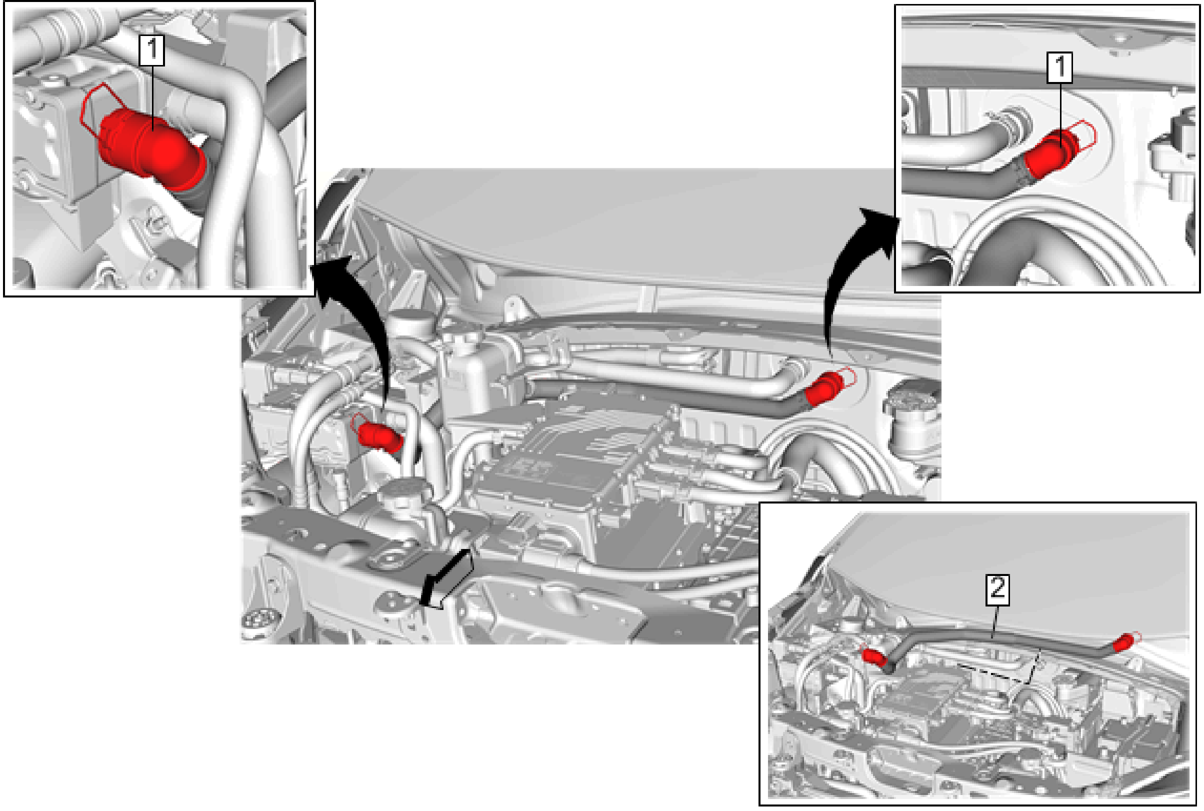


Fig. 129: Heater Outlet Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drain the cooling system. Heater Coolant Heater Draining and Filling	
1	Heater Outlet Hose Quick Connect
2	Heater Outlet Hose **Procedure** 1. Fill the cooling system to the proper level. Heater Coolant Heater Draining and Filling 2. Start the engine and check for coolant leaks.

HEATER COOLANT PUMP REPLACEMENT

Special Tools

- **BO-38185** Hose Clamp Pliers

Equivalent regional tools:Special Tools

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
    - **Visually and functionally inspect the gloves before use.**
    - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. **High Voltage Disabling**
2. Drain the cooling system. **Heater Coolant Heater Draining and Filling**
3. Remove Front Compartment Air Deflector **Front Compartment Air Deflector Replacement**
4. Remove Front Wheelhouse Liner-Right Side **Front Wheelhouse Liner Replacement**

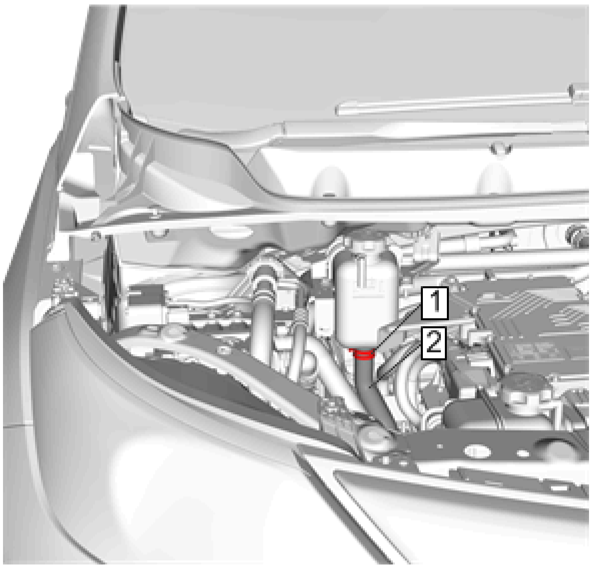


Fig. 130: Auxiliary Heater Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Disengage Auxiliary Heater Inlet Hose Clamp (1)**Hose Clamp Replacement Guidelines - Spring Type**

   Use the **BO-38185** Hose Clamp Pliers.

6. Remove Auxiliary Heater Inlet Hose(2)@Heater Coolant Surge Tank
7. Raise and support the vehicle. **Lifting and Jacking the Vehicle**

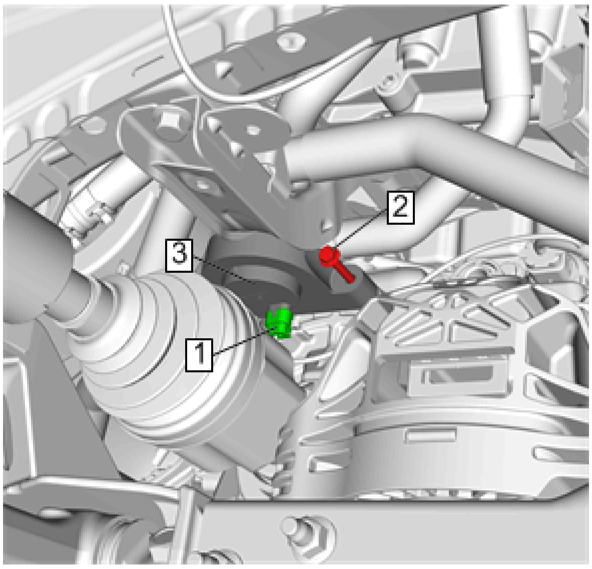


Fig. 131: Heater Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the heater coolant pump electrical connector (1).
9. Remove the heater coolant pump bolt (2).
10. Reposition the heater coolant pump on the rubber mount to access the clamp.

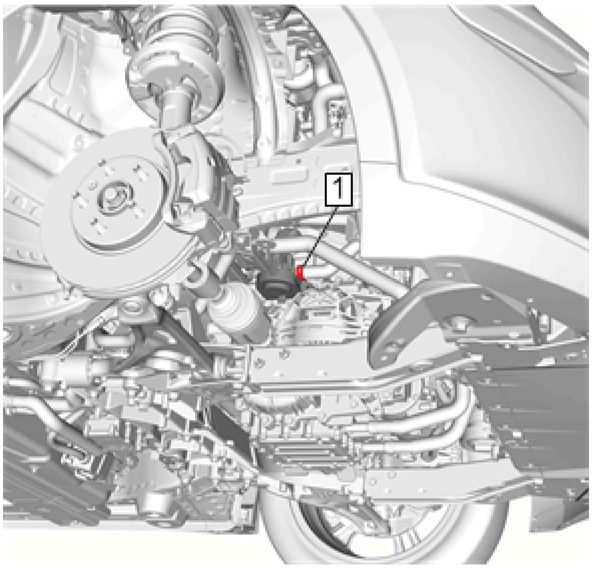


Fig. 132: Auxiliary Heater Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

11. Disengage Auxiliary Heater Outlet Hose Clamp (1)**Hose Clamp Replacement Guidelines - Spring Type**
12. Remove the auxiliary heater outlet hose from the heater coolant pump.

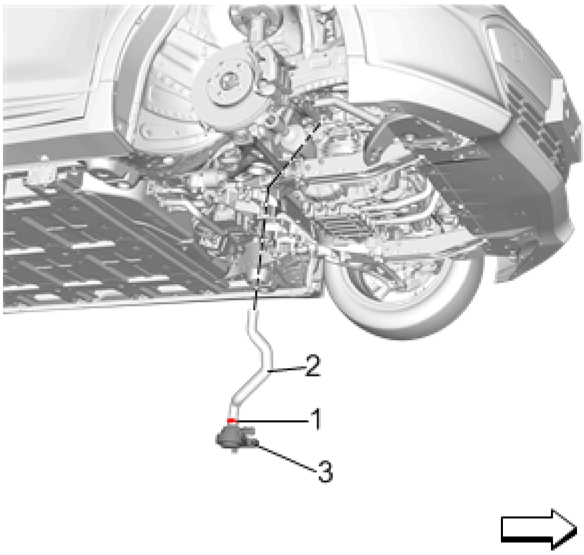


Fig. 133: Auxiliary Heater Inlet Hose Clamp And Heater Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

13. Remove the heater coolant pump with the auxiliary heater inlet hose.
14. Disengage Auxiliary Heater Inlet Hose Clamp (1)**Hose Clamp Replacement Guidelines - Spring Type**
15. Remove Heater Coolant Pump (3)@Auxiliary Heater Inlet Hose (2)

Installation Procedure

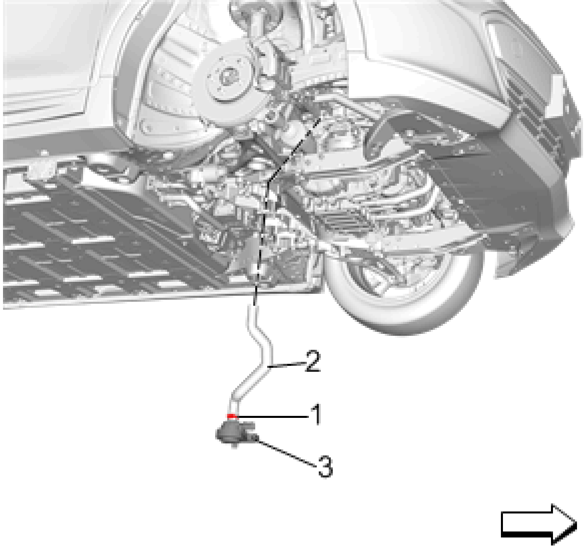


Fig. 134: Auxiliary Heater Inlet Hose Clamp And Heater Coolant Pump
Courtesy of GENERAL MOTORS COMPANY

1. Install Heater Coolant Pump(3)@Auxiliary Heater Inlet Hose (2)
2. Engage Auxiliary Heater Inlet Hose Clamp (1)Hose Clamp Replacement Guidelines - Spring Type
3. Position the heater coolant pump with the auxiliary heater inlet hose.

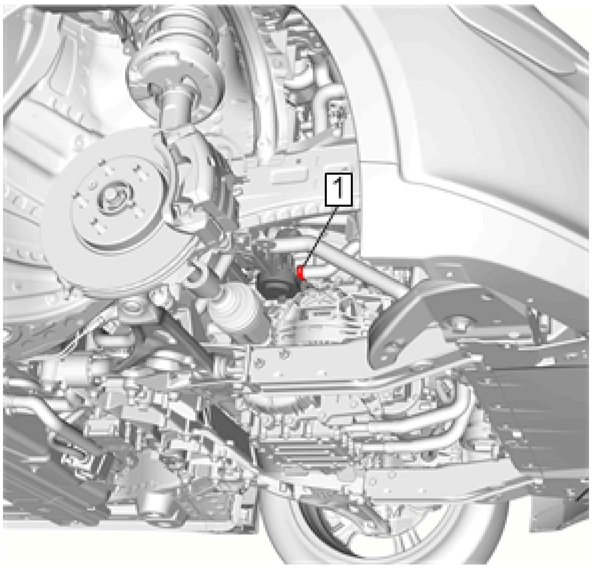


Fig. 135: Auxiliary Heater Outlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Engage Auxiliary Heater Outlet Hose Clamp (1)Hose Clamp Replacement Guidelines - Spring Type

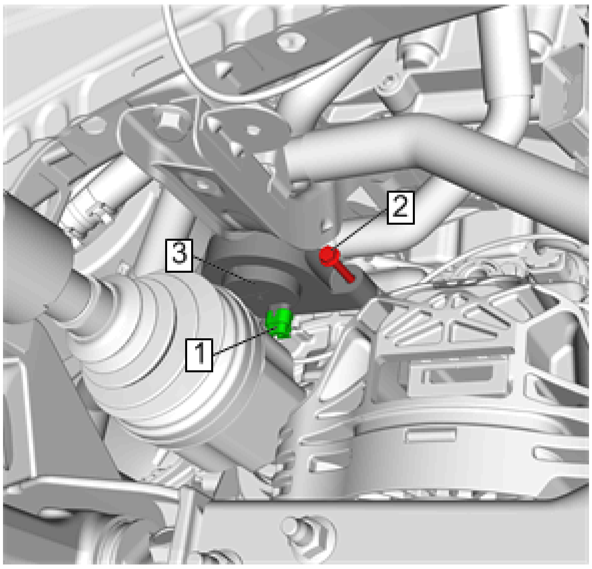


Fig. 136: Heater Coolant Pump Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten the heater coolant pump bolt (2) to 9 N.m (80 lb in).
6. Connect the heater coolant pump electrical connector (1).
7. Lower the vehicle

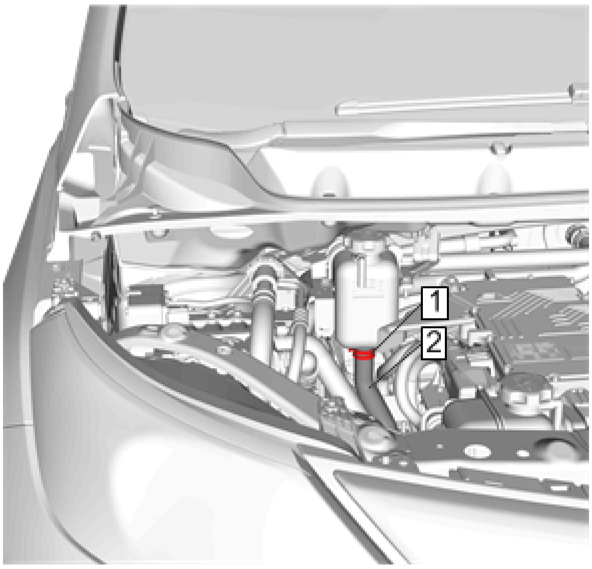


Fig. 137: Auxiliary Heater Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

8. Install Auxiliary Heater Inlet Hose(2)@Heater Coolant Surge Tank
9. Engage Auxiliary Heater Inlet Hose Clamp(1)Hose Clamp Replacement Guidelines - Spring Type
10. Install Front Wheelhouse Liner-Right Side Front Wheelhouse Liner Replacement
11. Install Front Compartment Air Deflector Front Compartment Air Deflector Replacement
12. Fill the cooling system to the proper level. Heater Coolant Heater Draining and Filling
13. Enable the high voltage system. High Voltage Enabling
14. Start the engine and check for coolant leaks.

PASSENGER COMPARTMENT AIR FILTER REPLACEMENT

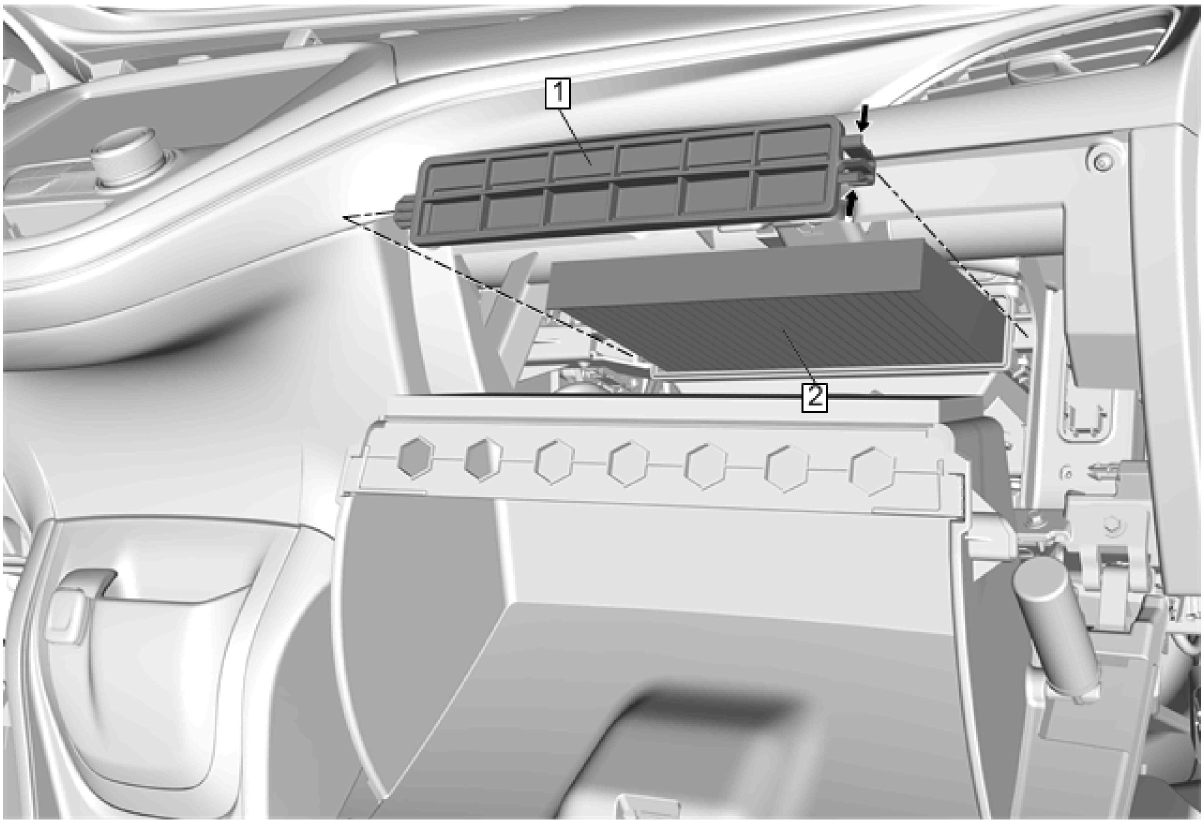


Fig. 138: Passenger Compartment Air Filter
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Open the instrument panel compartment door. 2. Disconnect the instrument panel compartment door dampener from the instrument panel compartment. 3. Squeeze the sides of the instrument panel compartment door and lower the instrument panel compartment door past the stops.	
1	Passenger Compartment Air Filter Cover **Procedure** Push the cover tab and remove the filter cover.
2	Passenger Compartment Air Filter

AIR INLET DUCT REPLACEMENT

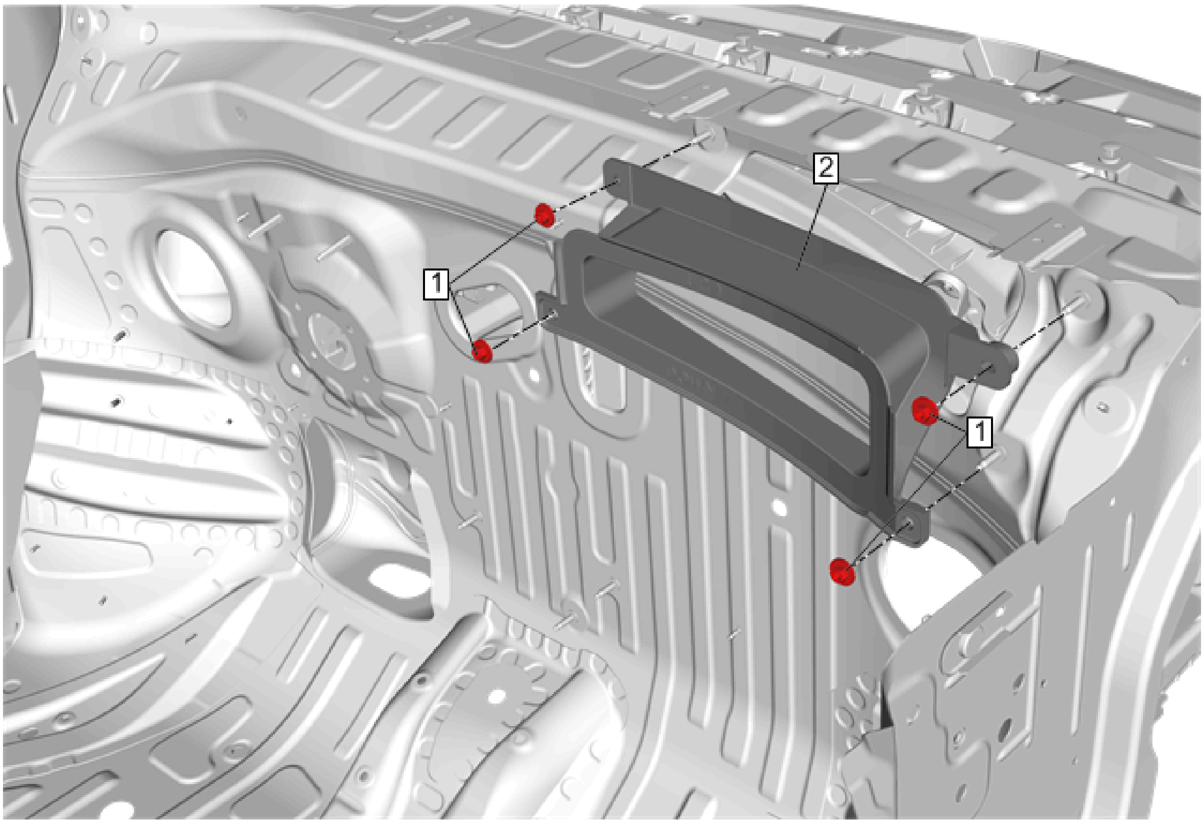


Fig. 139: Air Inlet Duct
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection 2. Remove the heater and air conditioning evaporator and blower module. Heater and Air Conditioning Evaporator and Blower Module Removal and Installation	
1	Air Inlet Duct Nut (Qty: 4) **CAUTION:** Fastener Caution **Tighten** 3 N.m (27 lb in)

Callout	Component Name
2	Air Inlet Duct **Procedure** 1. Install the heater and air conditioning evaporator and blower module. **Heater and Air Conditioning Evaporator and Blower Module Removal and Installation** 2. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

AIR INLET HOUSING REPLACEMENT

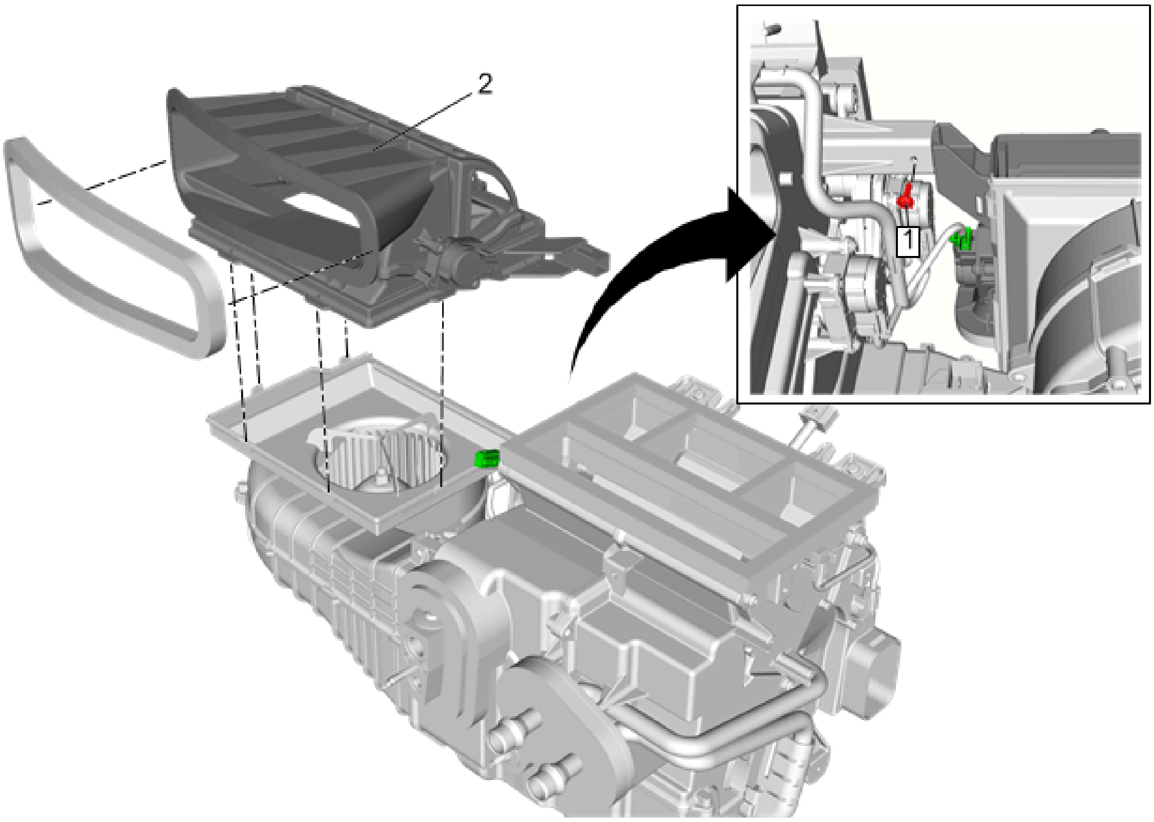


Fig. 140: Air Inlet Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove the heater and air conditioning evaporator and blower module. **Heater and Air Conditioning Evaporator and Blower Module Removal and Installation** 2. **Passenger Compartment Air Filter Replacement**	
1	Heater and Air Conditioning Evaporator Case Screw **CAUTION:** **Fastener Caution** **Tighten** 2.5 N.m (22 lb in)

Callout	Component Name
2	Air Inlet Housing **Procedure** 1. Use the appropriate tool to unlatch the air inlet housing from the upper blower motor housing. 2. Install the heater and air conditioning evaporator and blower module. **Heater and Air Conditioning Evaporator and Blower Module Removal and Installation**

BLOWER MOTOR CONTROL REPLACEMENT (MODULE MOUNTED)

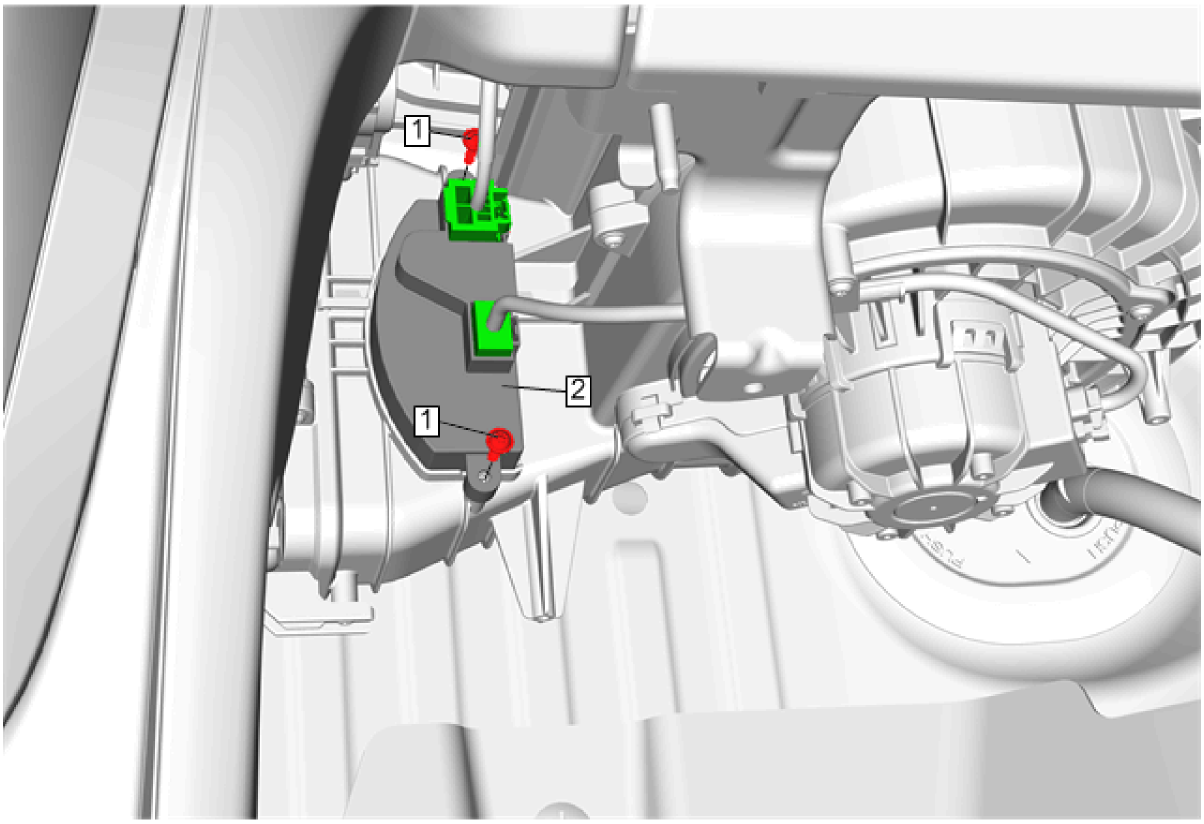


Fig. 141: Blower Motor Control (Module Mounted)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection** 2. **Floor Front Air Outlet Duct Replacement - Right Side**	
1	Blower Motor Control Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .**
2	Blower Motor Control **Procedure** 1. Disconnect the blower motor control electrical connector. 2. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

BLOWER MOTOR REPLACEMENT

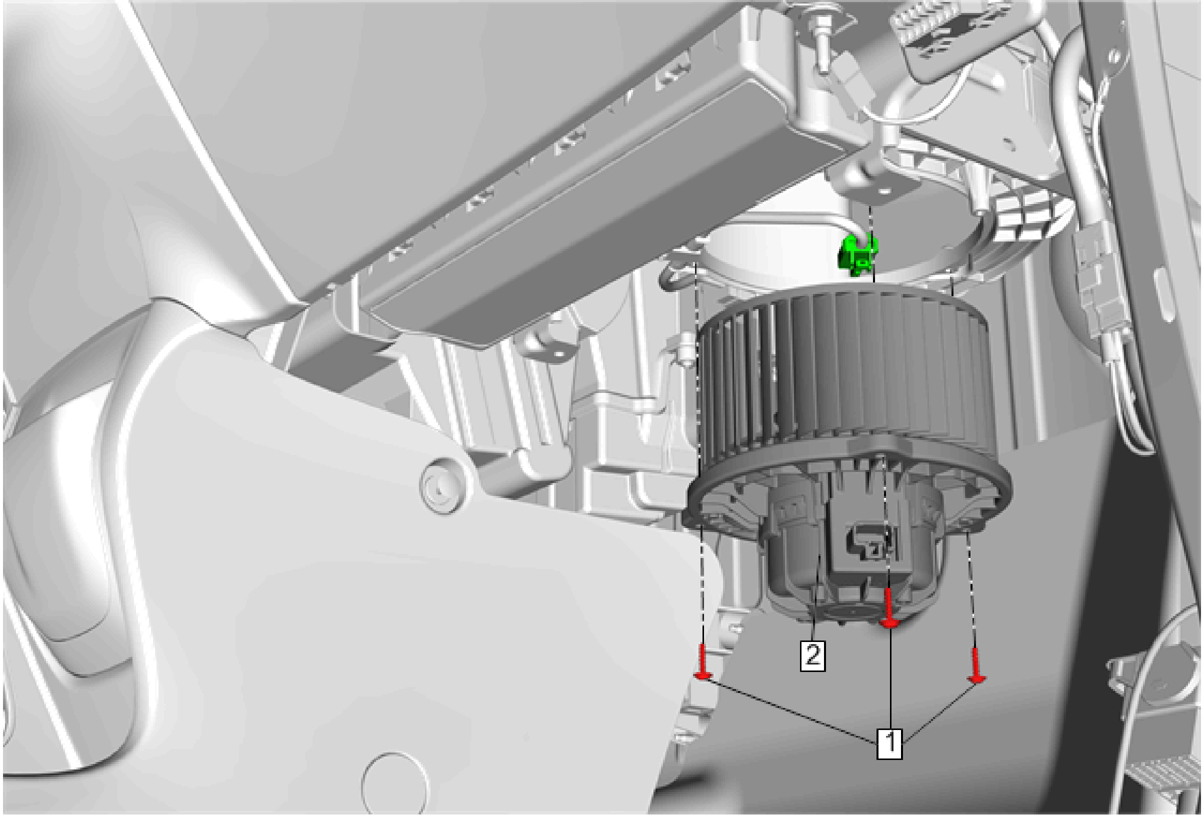


Fig. 142: Blower Motor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection 2. Floor Front Air Outlet Duct Replacement - Right Side	
1	Blower Motor Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution .**
2	Blower Motor **Procedure** 1. Disconnect the blower motor electrical connector. 2. Remove the blower motor harness fastener and reposition the harness. 3. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

SIDE WINDOW DEFOGGER OUTLET GRILLE REPLACEMENT - LEFT SIDE

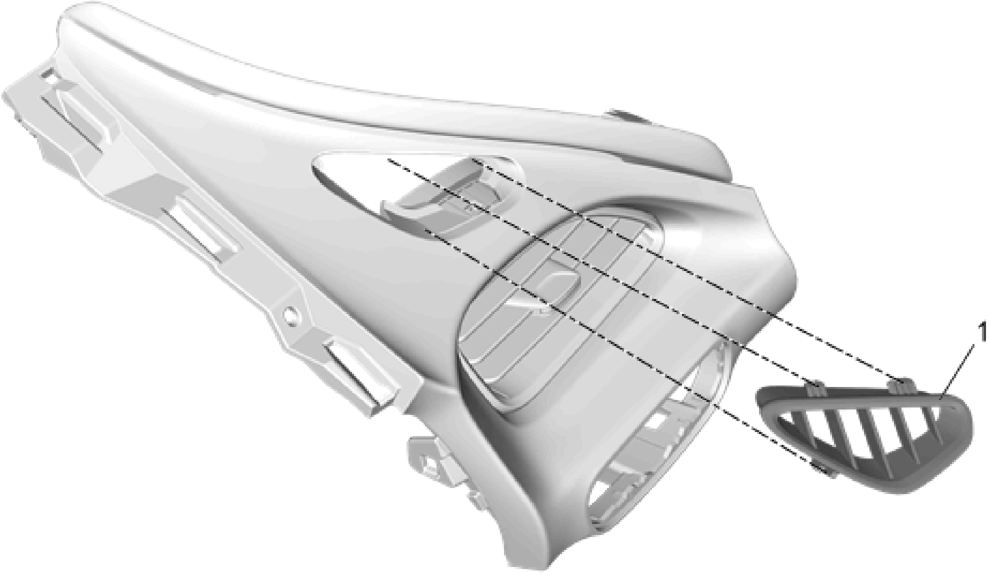


Fig. 143: Side Window Defogger Outlet Grille - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Trim Pad Replacement - Left Side	
1	Side Window Defogger Outlet Grille - Left Side **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs.

SIDE WINDOW DEFOGGER OUTLET GRILLE REPLACEMENT - RIGHT SIDE

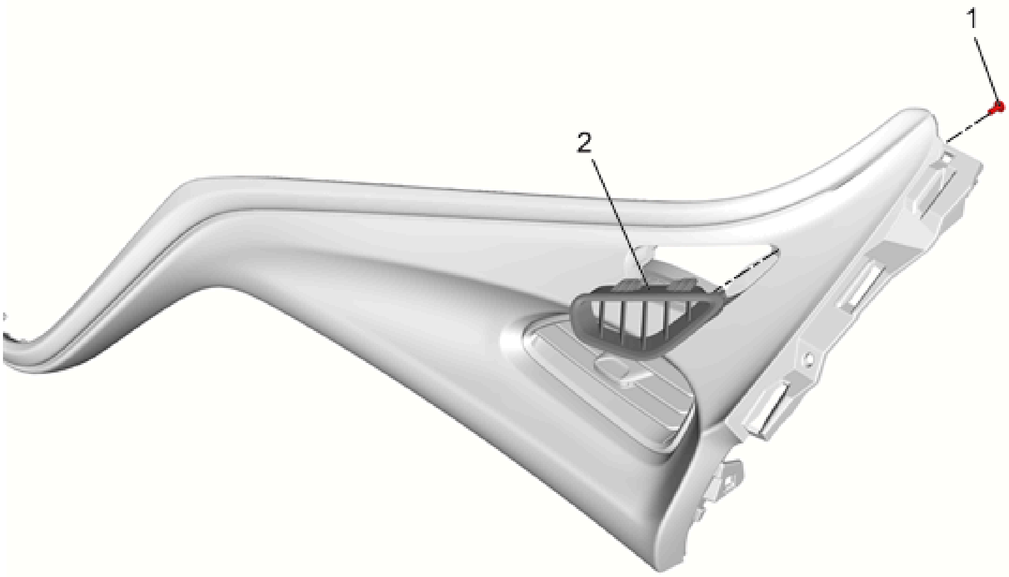


Fig. 144: Side Window Defogger Outlet Grille - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Trim Pad Replacement - Right Side	
1	Side Window Defogger Outlet Grille Screw **CAUTION:** **Refer to Fastener Caution .**
2	Side Window Defogger Outlet Grille **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs.

INSTRUMENT PANEL OUTER AIR OUTLET REPLACEMENT - LEFT SIDE

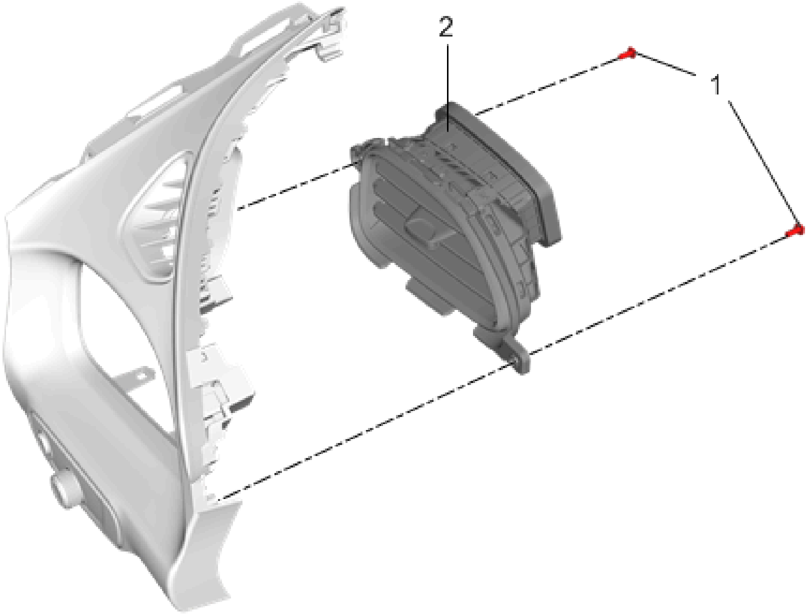


Fig. 145: Instrument Panel Outer Air Outlet - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Trim Pad Replacement - Left Side	
1	Instrument Panel Outer Air Outlet Screw (Qty: 2) **CAUTION:** **Refer to Fastener Caution .**
2	Instrument Panel Outer Air Outlet - Left Side **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs.

INSTRUMENT PANEL OUTER AIR OUTLET REPLACEMENT - RIGHT SIDE

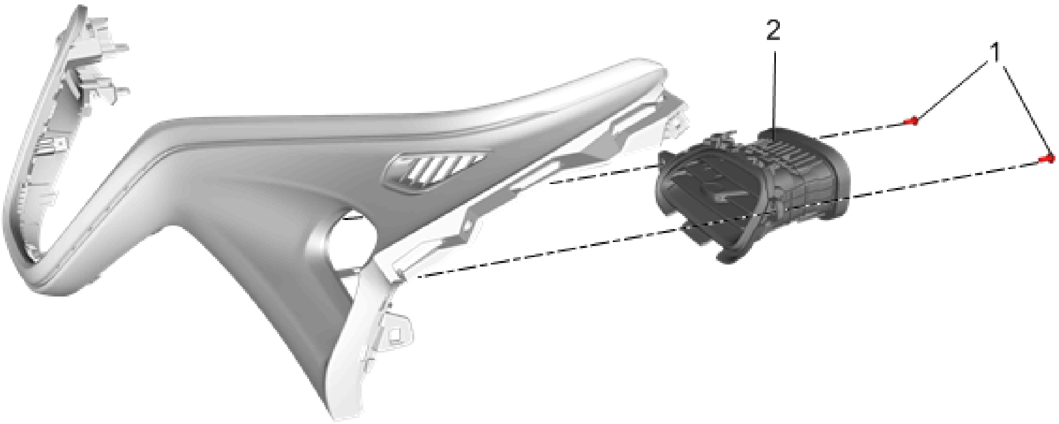


Fig. 146: Instrument Panel Outer Air Outlet - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Trim Pad Replacement - Right Side	
1	Instrument Panel Outer Air Outlet Screw (Qty: 2) **CAUTION:** **Refer to Fastener Caution .**
2	Instrument Panel Outer Air Outlet - Right Side **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs.

INSTRUMENT PANEL COMPARTMENT AIR DUCT REPLACEMENT

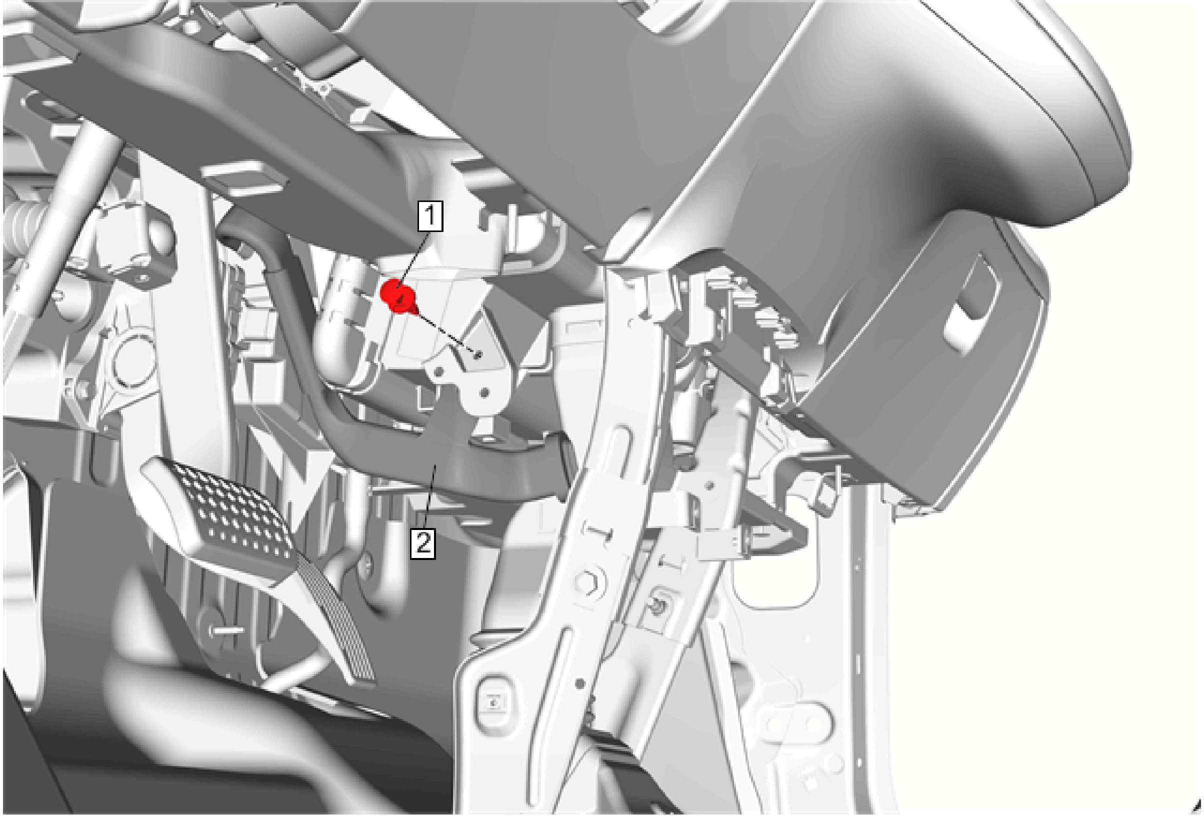


Fig. 147: Instrument Panel Compartment Air Duct
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Replacement	
1	Instrument Panel Compartment Air Duct Push Pin **CAUTION:** **Refer to Fastener Caution .**
2	Instrument Panel Compartment Air Duct

FLOOR FRONT AIR OUTLET DUCT REPLACEMENT

Removal Procedure

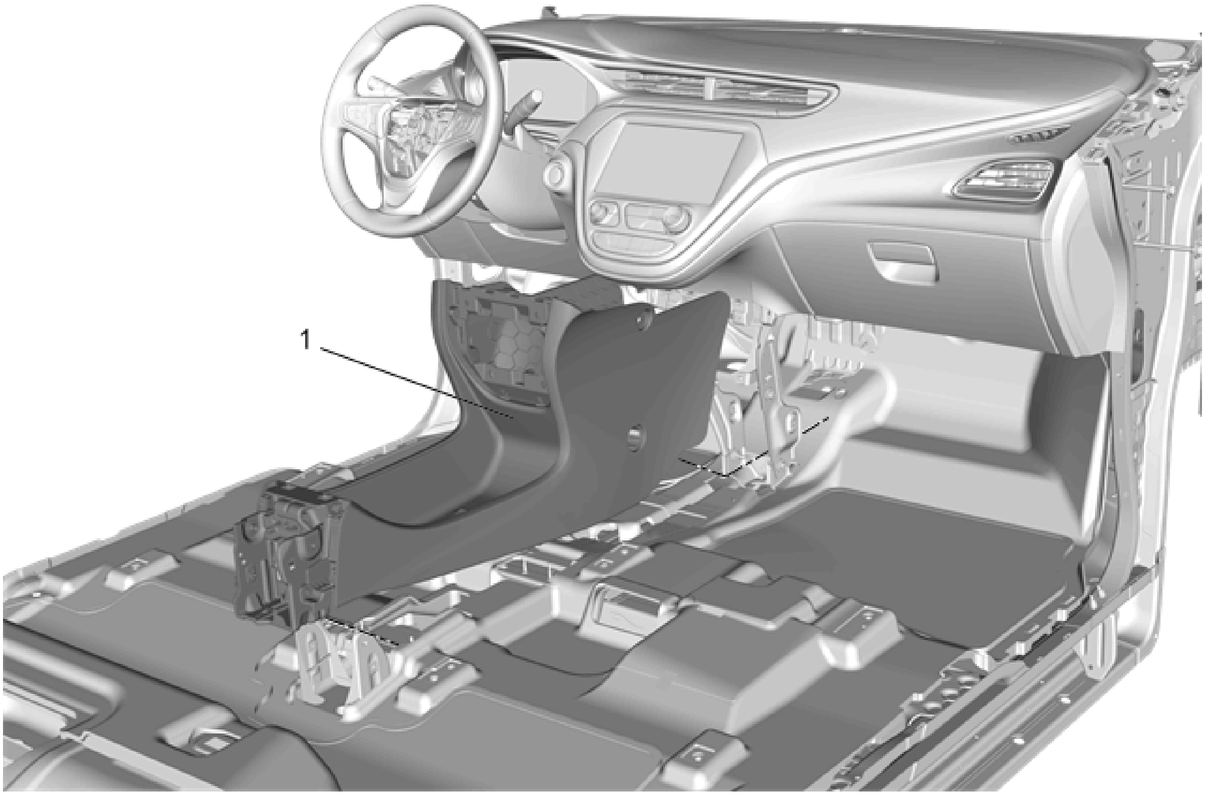


Fig. 148: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

1. Remove Front Floor Console (1)**Front Floor Console Replacement**

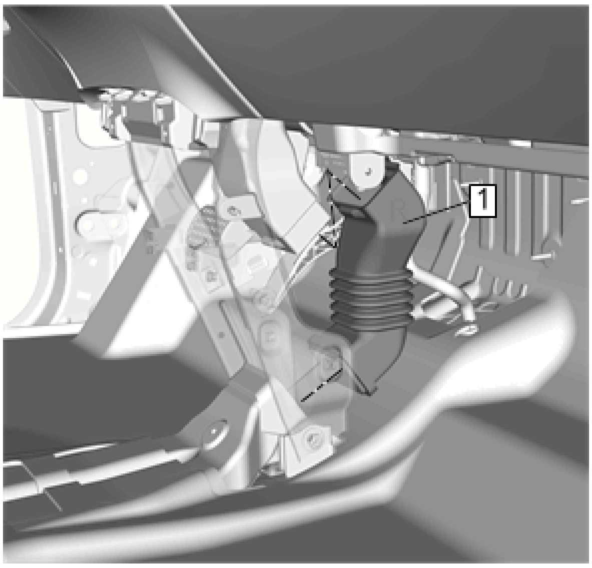


Fig. 149: Floor Front Air Outlet Duct Adapter
Courtesy of GENERAL MOTORS COMPANY

2. Remove Floor Front Air Outlet Duct Adapter(1)

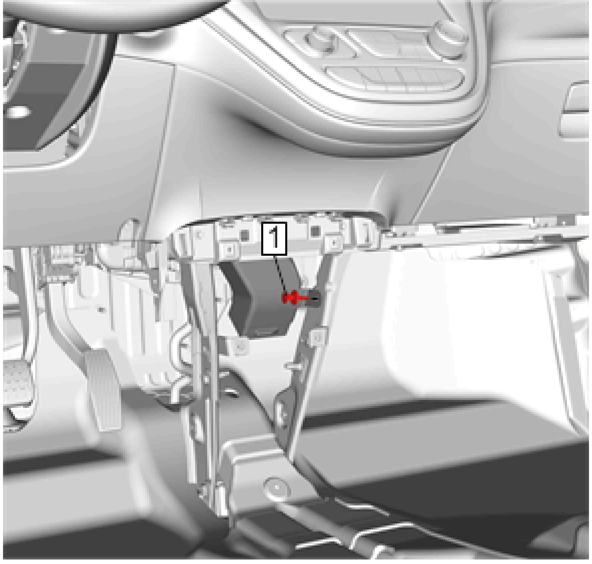


Fig. 150: Floor Front Air Outlet Duct Push Pin
Courtesy of GENERAL MOTORS COMPANY

3. Remove Push Pin(1)

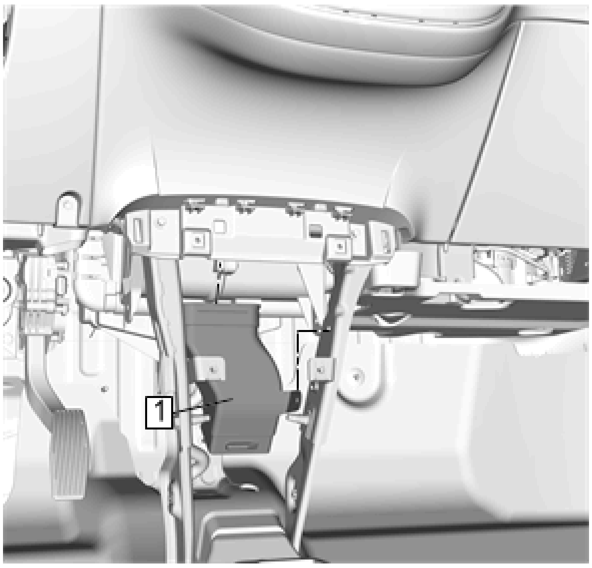


Fig. 151: Floor Front Air Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

4. Remove Floor Front Air Outlet Duct (1)

Installation Procedure

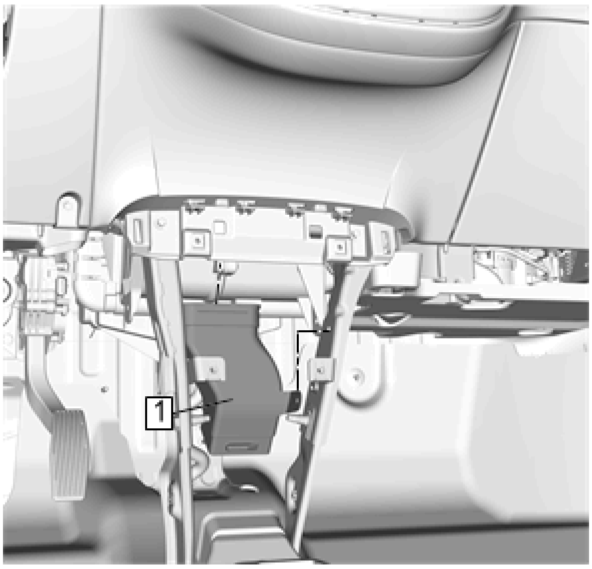


Fig. 152: Floor Front Air Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

1. Install Floor Front Air Outlet Duct (1)

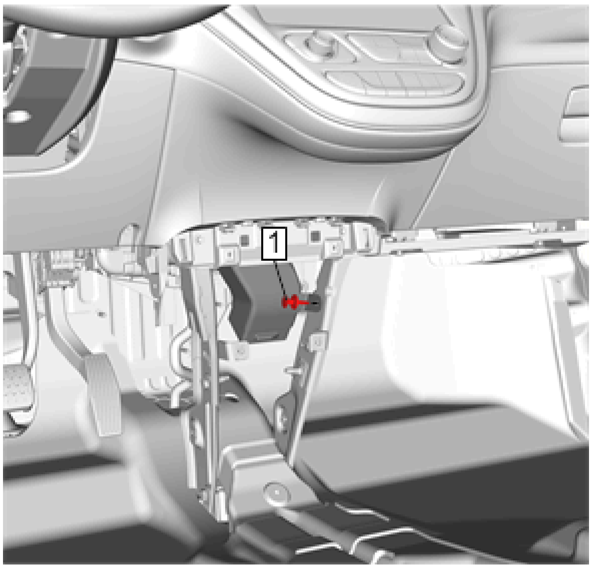


Fig. 153: Floor Front Air Outlet Duct Push Pin
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

2. Install Push Pin(1)

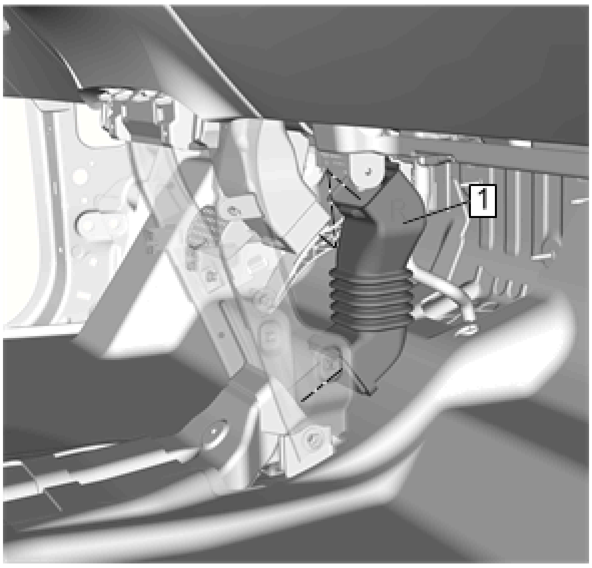


Fig. 154: Floor Front Air Outlet Duct Adapter
Courtesy of GENERAL MOTORS COMPANY

3. Install Floor Front Air Outlet Duct Adapter(1)

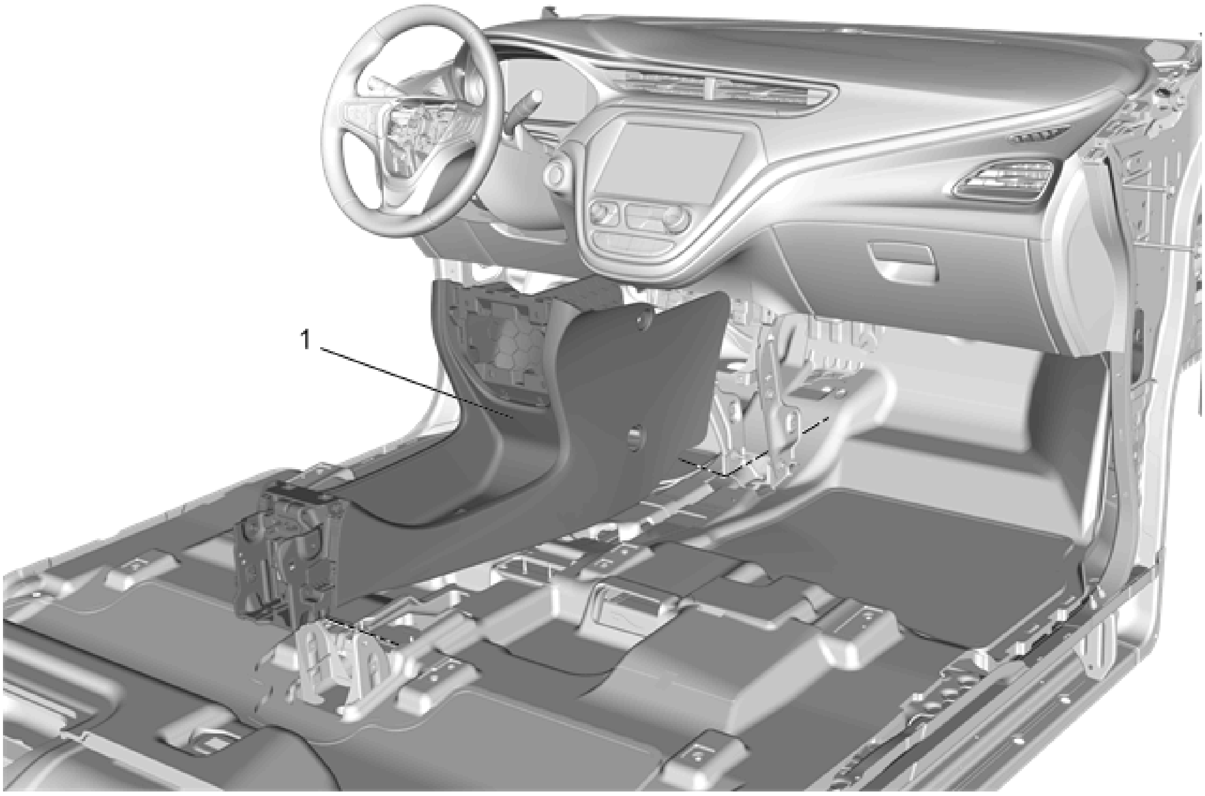


Fig. 155: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Floor Console(1) **Front Floor Console Replacement**

FLOOR FRONT AIR OUTLET DUCT REPLACEMENT - RIGHT SIDE

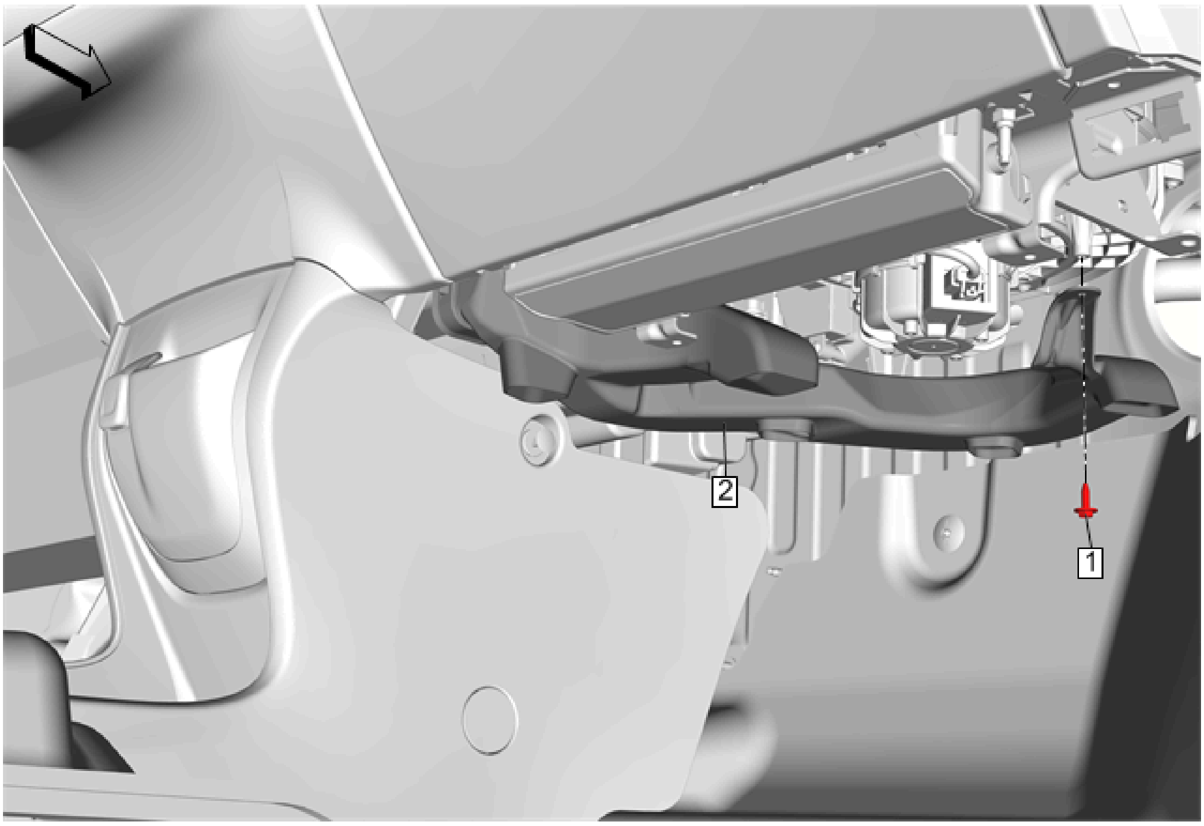


Fig. 156: Floor Front Air Outlet Duct - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Instrument Panel Lower Trim Panel Insulator Replacement**	

Callout	Component Name
1	Floor Front Air Outlet Duct Bolt **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Floor Front Air Outlet Duct - Right Side

FLOOR FRONT AIR OUTLET DUCT REPLACEMENT - LEFT SIDE

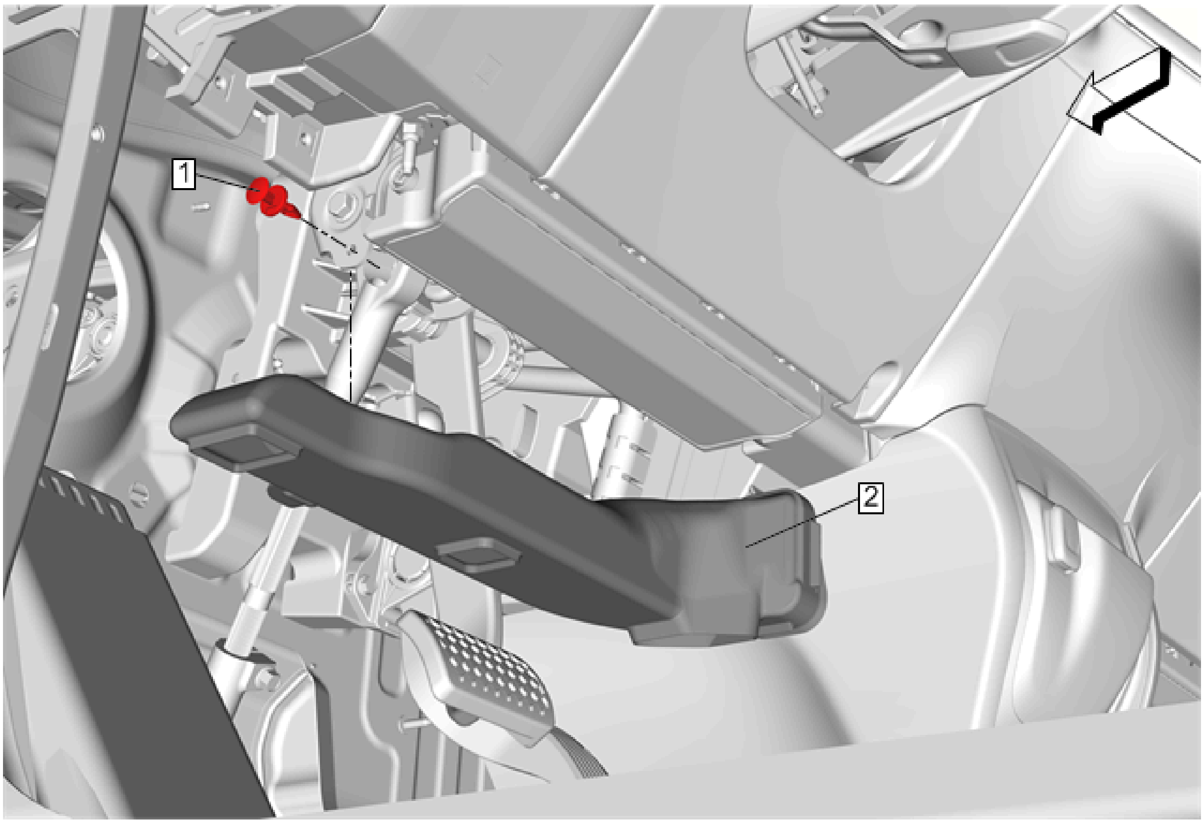


Fig. 157: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Floor Front Air Outlet Duct Retainer **CAUTION:** Fastener Caution
2	Floor Front Air Outlet Duct - Left Side

FRONT FLOOR CONSOLE REAR AIR DUCT REPLACEMENT (WIRELESS CHARGING DUCT - REAR)

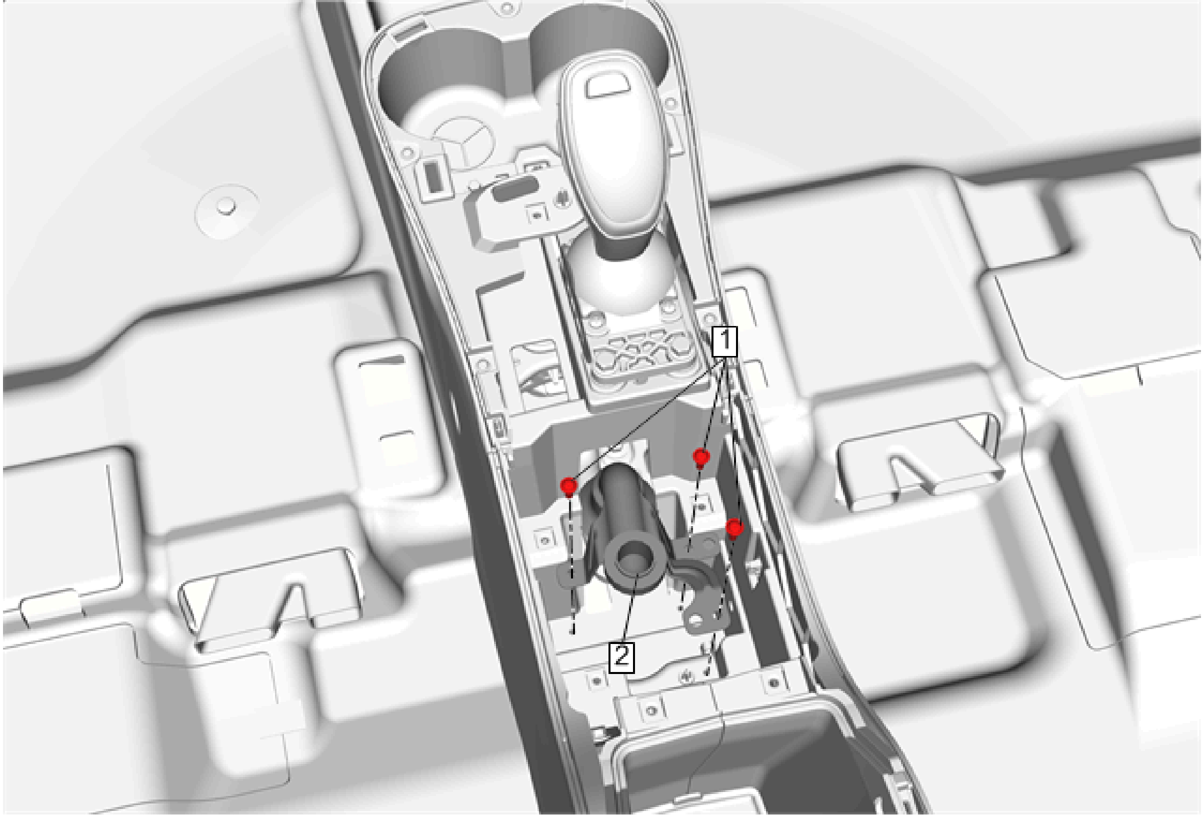


Fig. 158: Front Floor Console Rear Air Duct (Wireless Charging Duct - Rear)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure **Floor Front Air Outlet Duct Replacement**	
1	Front Floor Console Rear Air Duct Fastener (Qty: 3) **CAUTION:** **Refer to Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Front Floor Console Rear Air Duct-Rear

FRONT FLOOR CONSOLE REAR AIR DUCT REPLACEMENT (WIRELESS CHARGING DUCT - MIDDLE)

Removal Procedure

1. Disconnect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

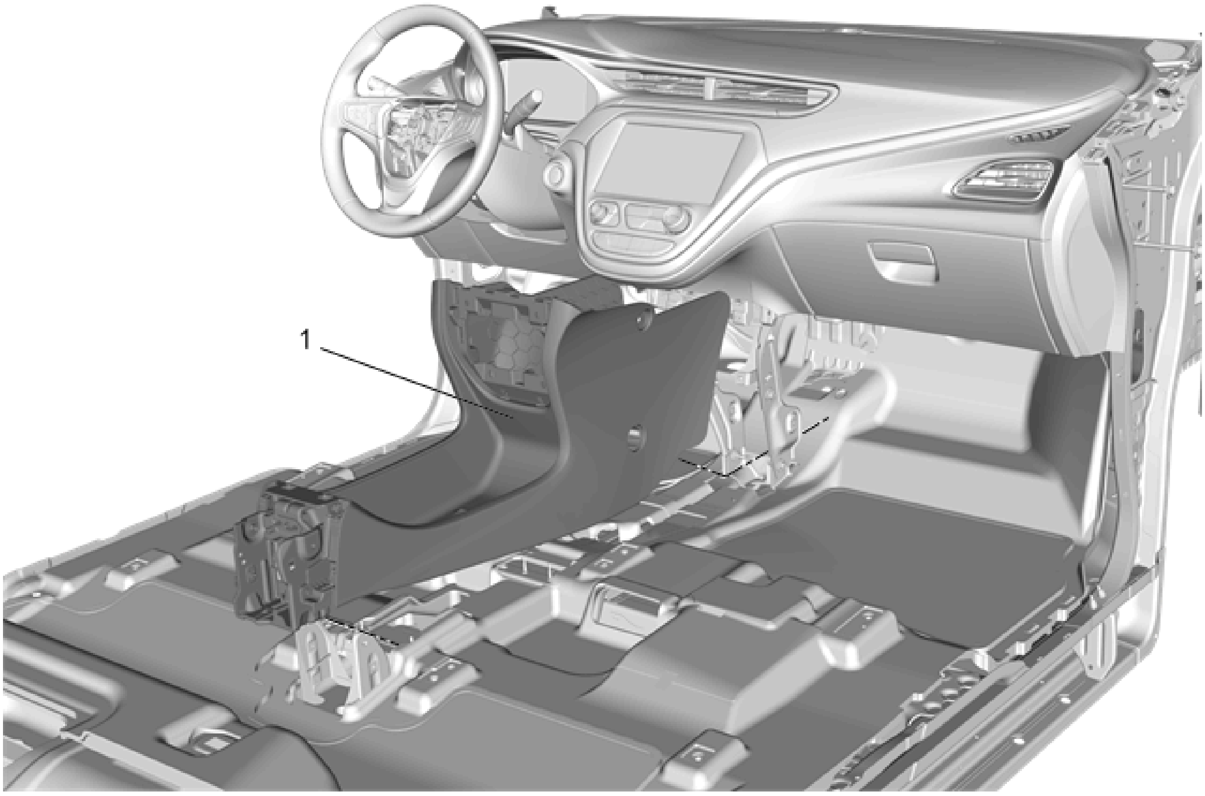


Fig. 159: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

2. Remove Front Floor Console(1)**Front Floor Console Replacement**

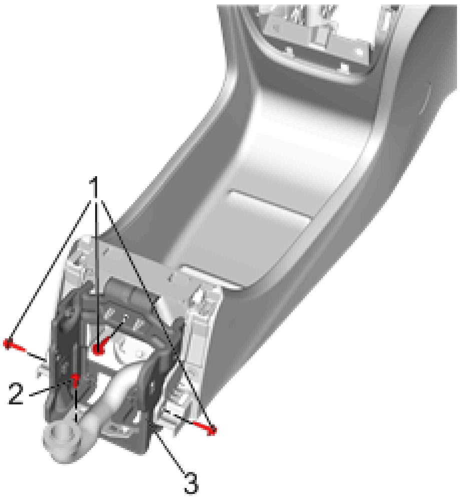


Fig. 160: Front Floor Console Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Floor Console Bracket Bolt(1)
4. Remove Front Floor Console Rear Air Duct Screw (2)
5. Remove Front Floor Console Bracket(3)

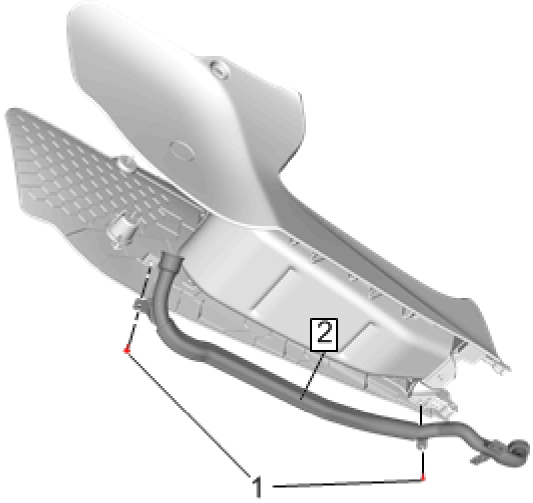


Fig. 161: Front Floor Console Rear Air Duct Screw
Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Floor Console Rear Air Duct Screw (1)
7. Remove Front Floor Console Rear Air Duct (2)

Installation Procedure

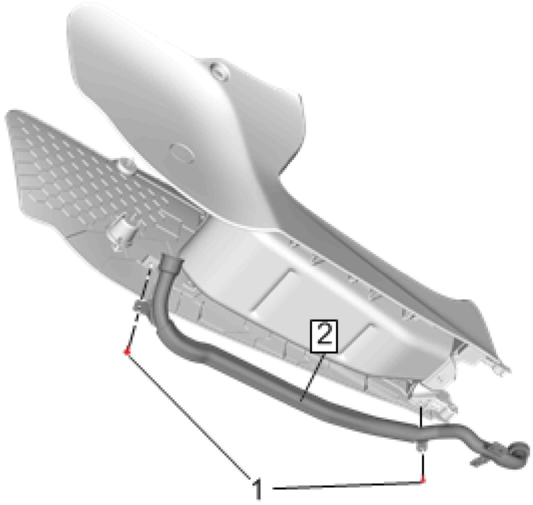


Fig. 162: Front Floor Console Rear Air Duct Screw
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

1. Install Front Floor Console Rear Air Duct(2)
2. Install Front Floor Console Rear Air Duct Screw (1) and tighten 2.5 N.m (22 lb in)

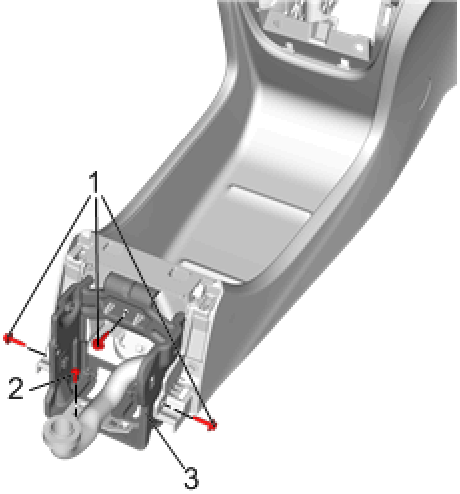


Fig. 163: Front Floor Console Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Install Front Floor Console Bracket(3)
4. Install Front Floor Console Rear Air Duct Screw (2) and tighten 2.5 N.m (22 lb in)
5. Install Front Floor Console Bracket Bolt(1) and tighten 2.5 N.m (22 lb in)

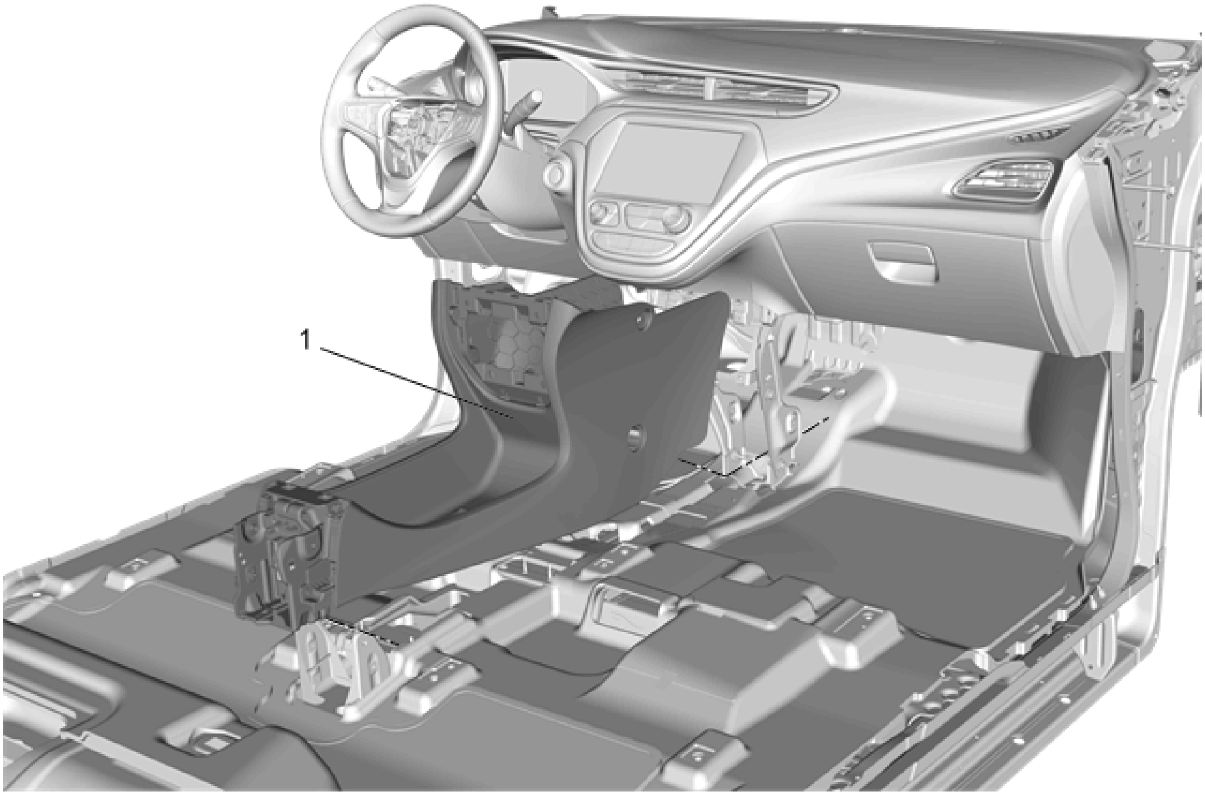


Fig. 164: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

6. Install Front Floor Console(1) **Front Floor Console Replacement**
7. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection**

FRONT FLOOR CONSOLE REAR AIR DUCT REPLACEMENT (WIRELESS CHARGING DUCT - FRONT)

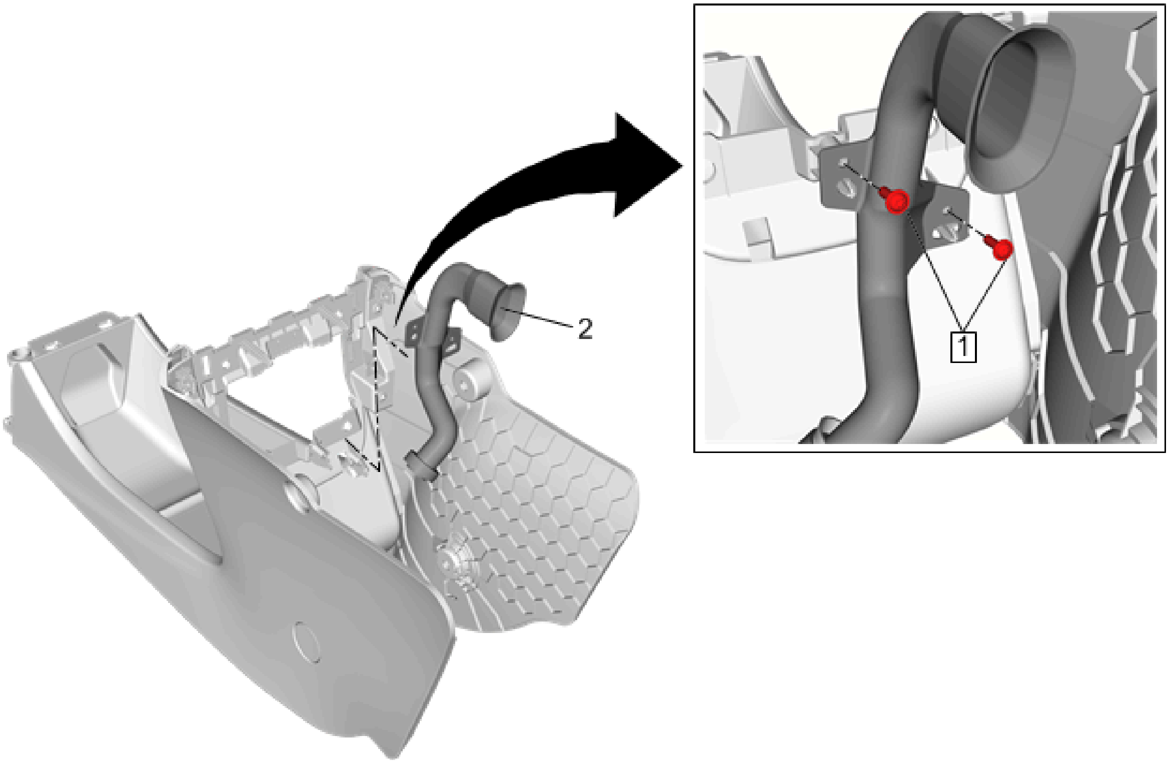


Fig. 165: Front Floor Console Rear Air Duct (Wireless Charging Duct - Front)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Replacement	
1	Front Floor Console Rear Air Duct Fastener (Qty: 2) **CAUTION:** **Refer to Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Front Floor Console Rear Air Duct-Front

FLOOR REAR AIR OUTLET DUCT ADAPTER REPLACEMENT

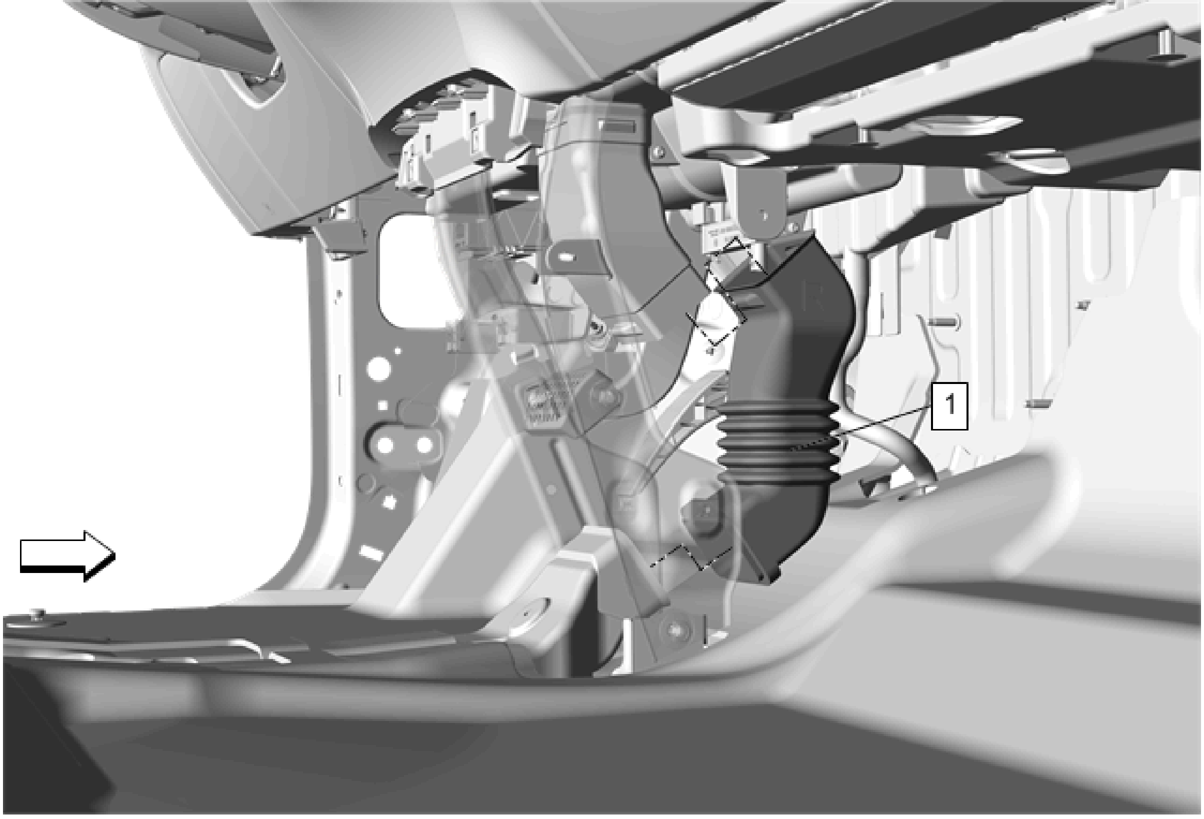


Fig. 166: Floor Rear Air Outlet Duct Adapter
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Replacement	
1	Floor Rear Air Outlet Duct Adapter **Procedure** Use a flat bladed plastic tool to remove.

INSTRUMENT PANEL CENTER AIR OUTLET DUCT REPLACEMENT

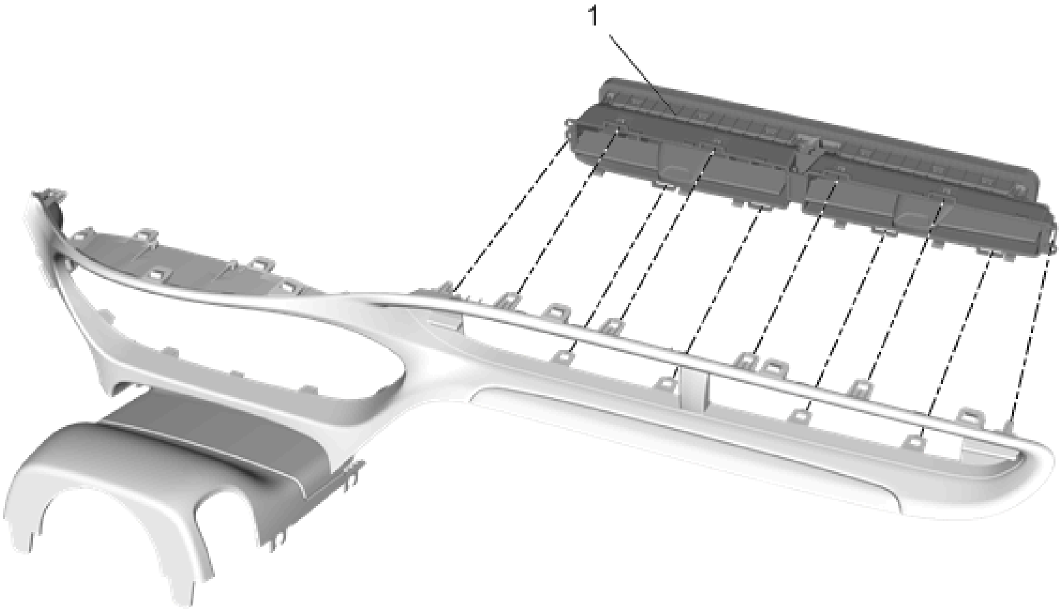


Fig. 167: Instrument Panel Center Air Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Column Upper Trim Cover Replacement	
1	Instrument Panel Center Air Outlet Duct **Procedure** 1. Use a flat bladed plastic trim tool. 2. Release the plastic retaining tabs.

INSTRUMENT PANEL OUTER AIR OUTLET DUCT REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection
2. Remove nstrument Panel Assembly Instrument Panel Assembly Replacement

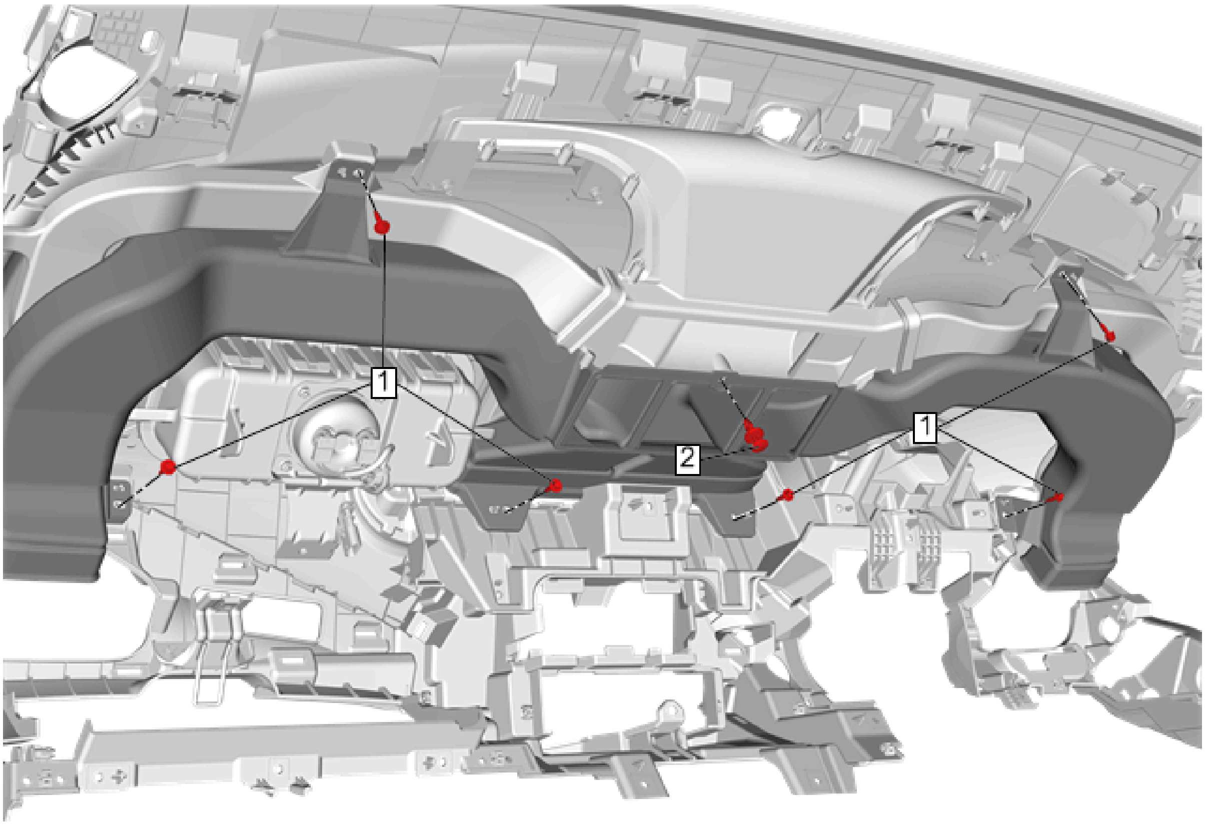


Fig. 168: Instrument Panel Outlet Air Outlet Duct Bolt And Push Pin
Courtesy of GENERAL MOTORS COMPANY

3. Remove Instrument Panel Outlet Air Outlet Duct Bolt (1)
4. Remove Instrument Panel Outlet Air Outlet Duct Push Pin (2)

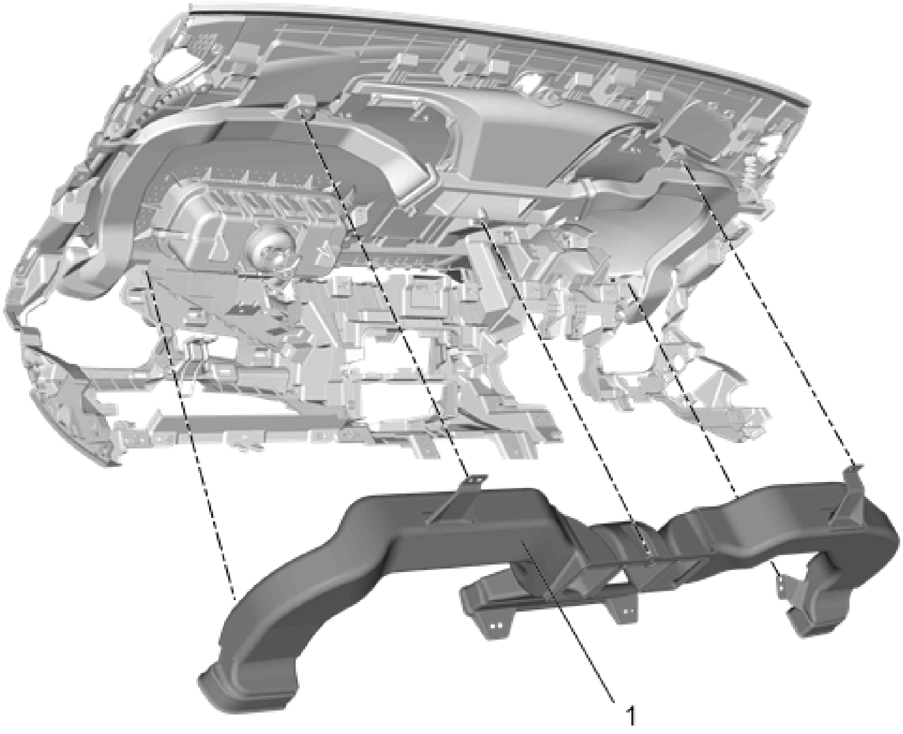


Fig. 169: Instrument Panel Outer Air Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

5. Remove Instrument Panel Outer Air Outlet Duct (1)

Installation Procedure

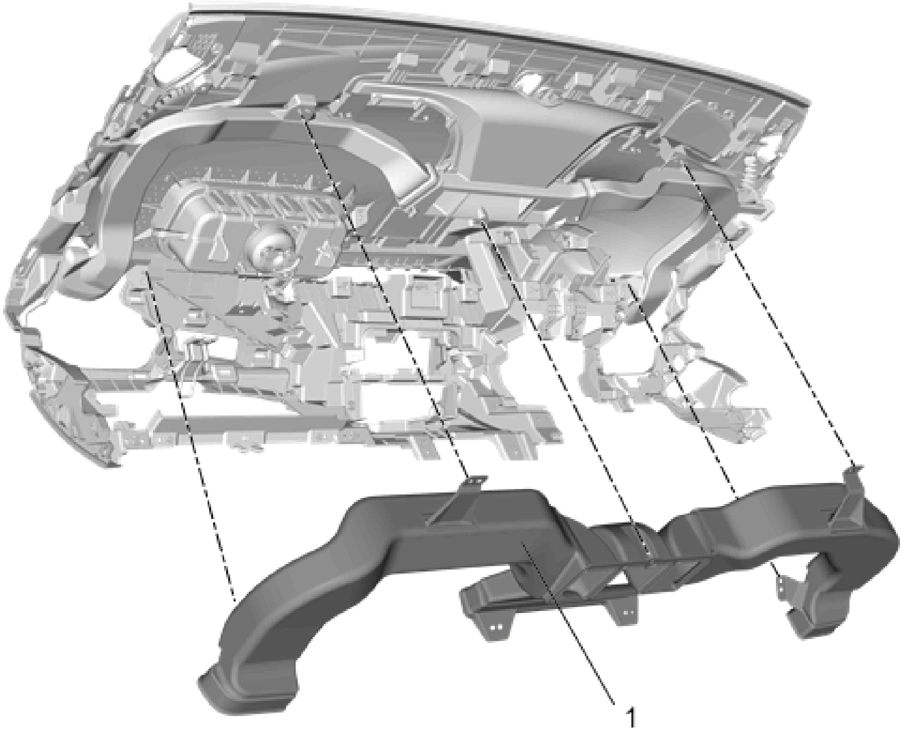


Fig. 170: Instrument Panel Outer Air Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

1. Install nstrument Panel Outer Air Outlet Duct (1)

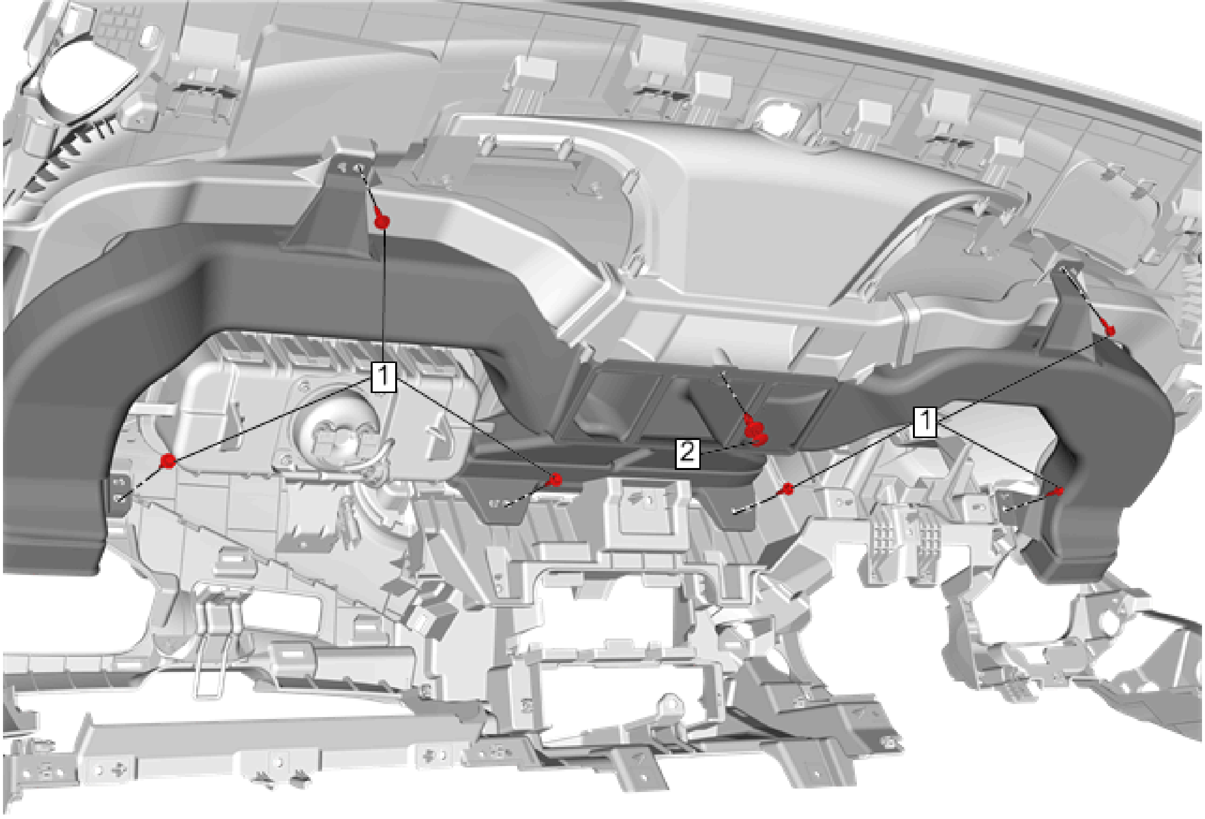


Fig. 171: Instrument Panel Outlet Air Outlet Duct Bolt And Push Pin
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

2. Install Instrument Panel Outlet Air Outlet Duct Push Pin (2)
3. Install Instrument Panel Outlet Air Outlet Duct Bolt (1) and tighten 2.5 N.m (22 lb in)
4. Install Instrument Panel Assembly Instrument Panel Assembly Replacement
5. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

WINDSHIELD DEFROSTER OUTLET DUCT REPLACEMENT

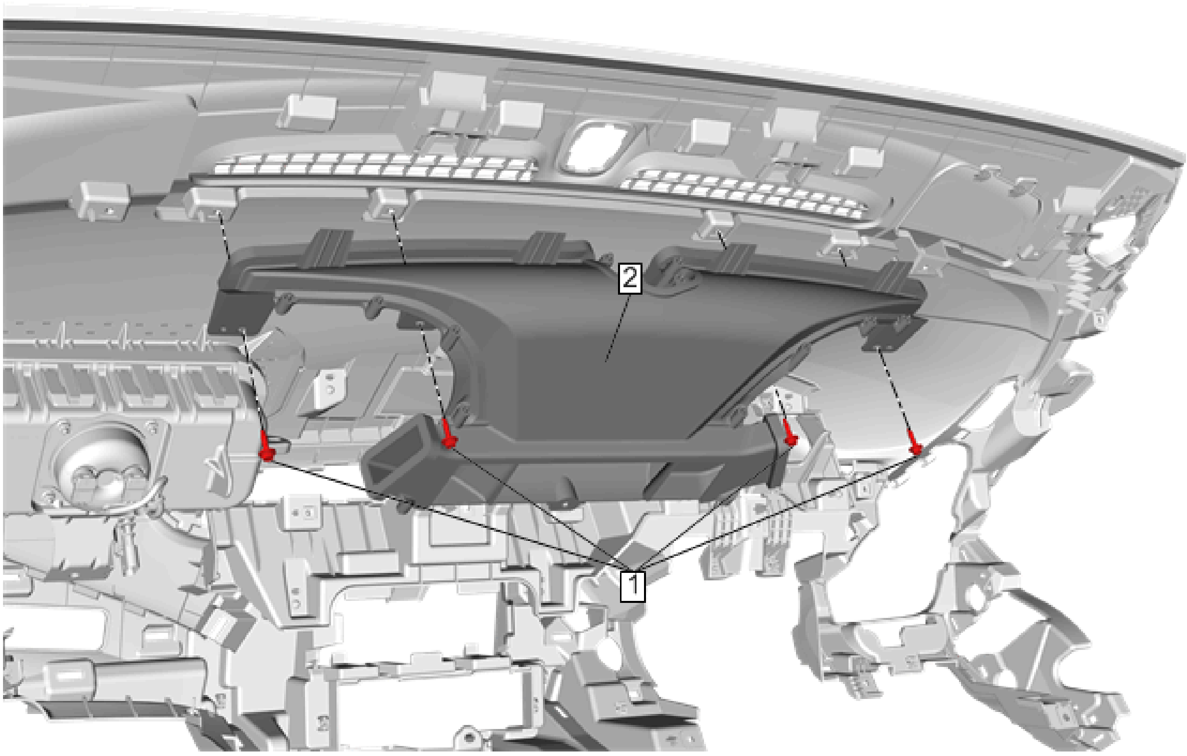


Fig. 172: Windshield Defroster Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Side Window Defogger Outlet Duct Replacement - Left Side 2. Side Window Defogger Outlet Duct Replacement - Right Side	
1	Side Window Defogger Outlet Duct Bolt (Qty: 4) **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Windshield Defroster Outlet Duct

SIDE WINDOW DEFOGGER OUTLET DUCT REPLACEMENT - LEFT SIDE

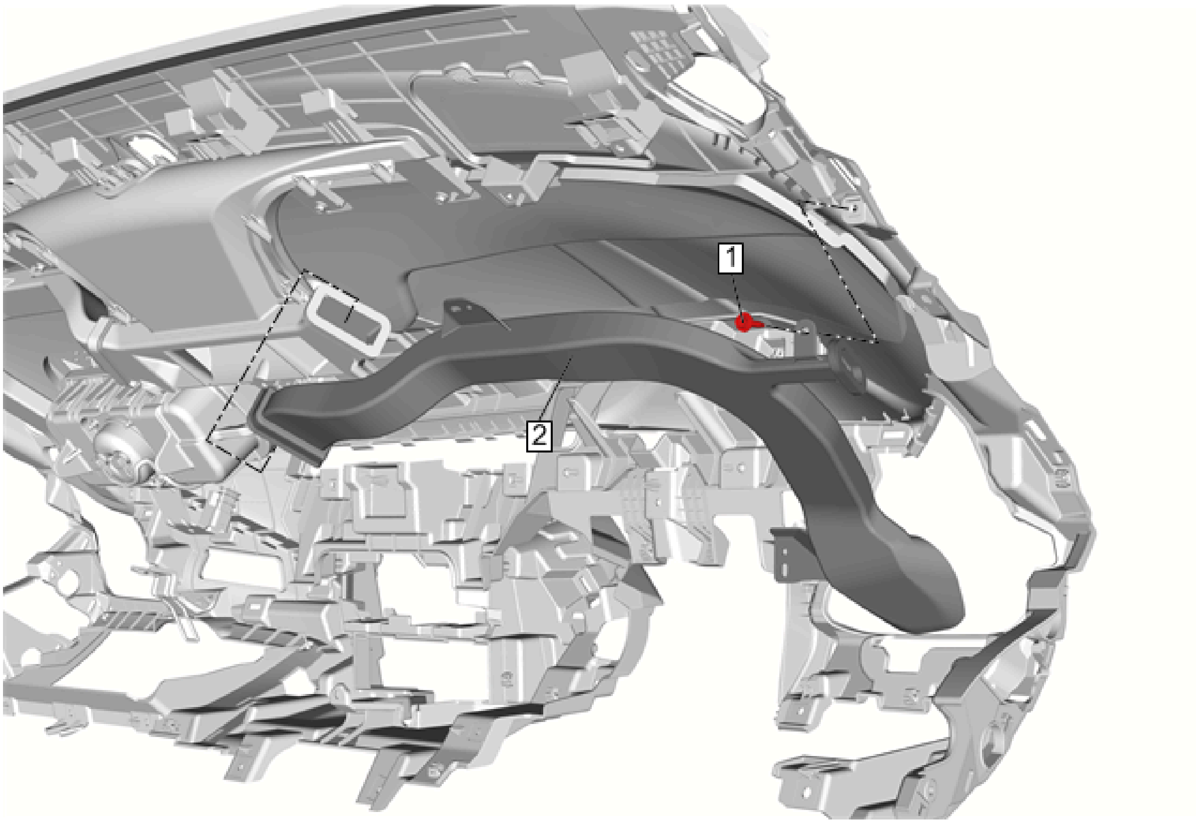


Fig. 173: NO CONTENT
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Outer Air Outlet Duct Replacement	
1	Side Window Defogger Outlet Duct Bolt **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Side Window Defogger Outlet Duct - Left Side

SIDE WINDOW DEFOGGER OUTLET DUCT REPLACEMENT - RIGHT SIDE

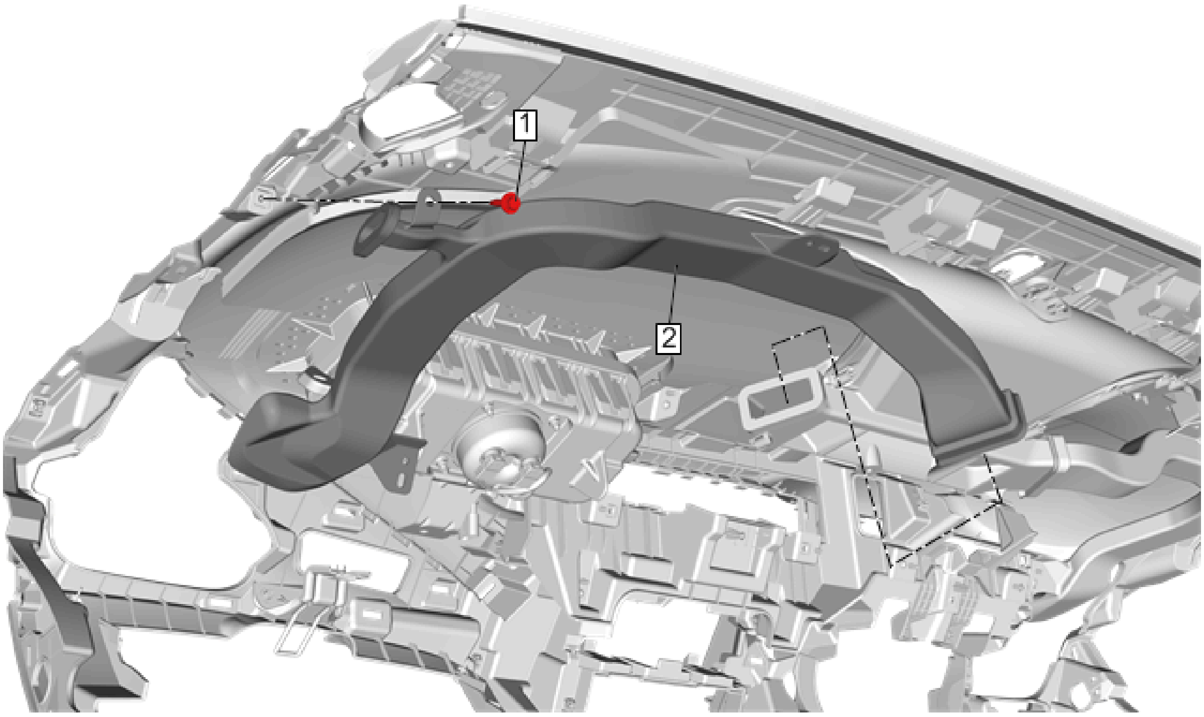


Fig. 174: Side Window Defogger Outlet Duct - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Outer Air Outlet Duct Replacement	
1	Side Window Defogger Outlet Duct Bolt **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Side Window Defogger Outlet Duct - Right Side

FLOOR REAR AIR OUTLET DUCT REPLACEMENT

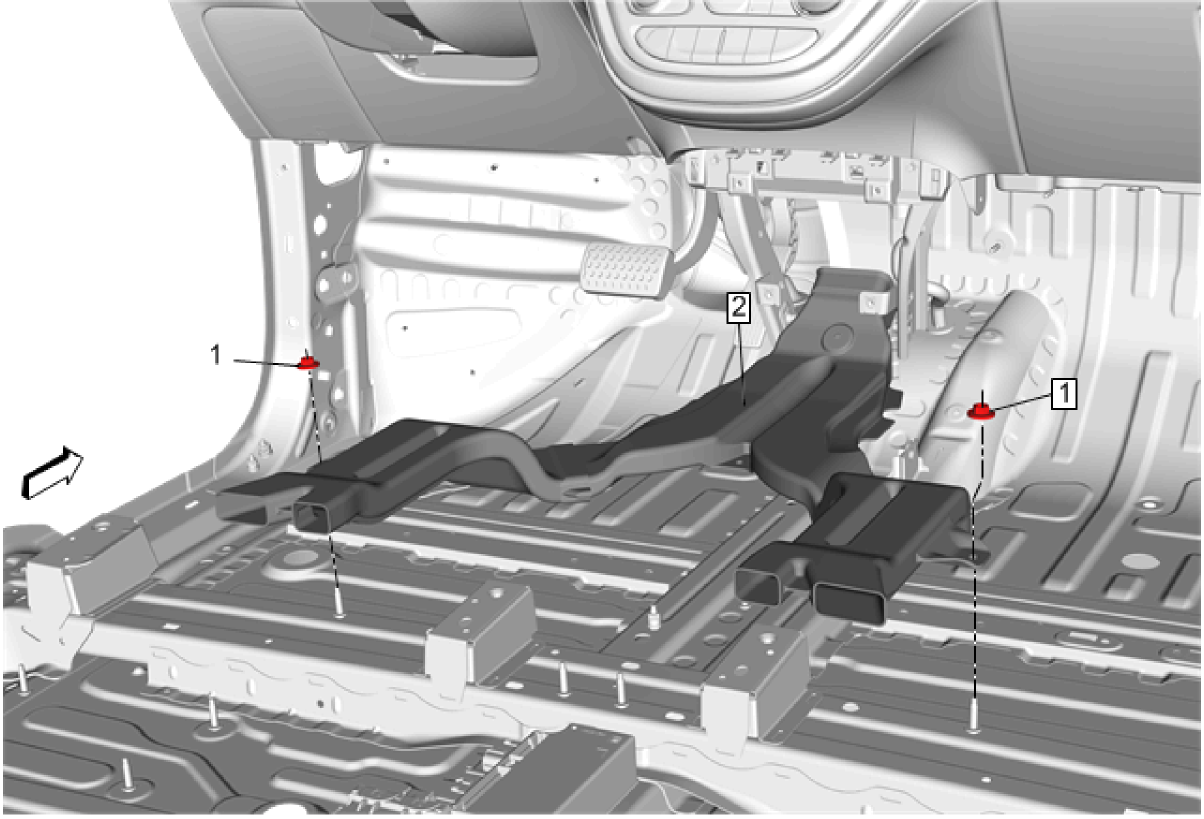


Fig. 175: Floor Rear Air Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Floor Panel Carpet Replacement	
1	Floor Rear Air Outlet Duct Nut (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 3 N.m (27 lb in)
2	Floor Rear Air Outlet Duct

HEATER CORE REPLACEMENT

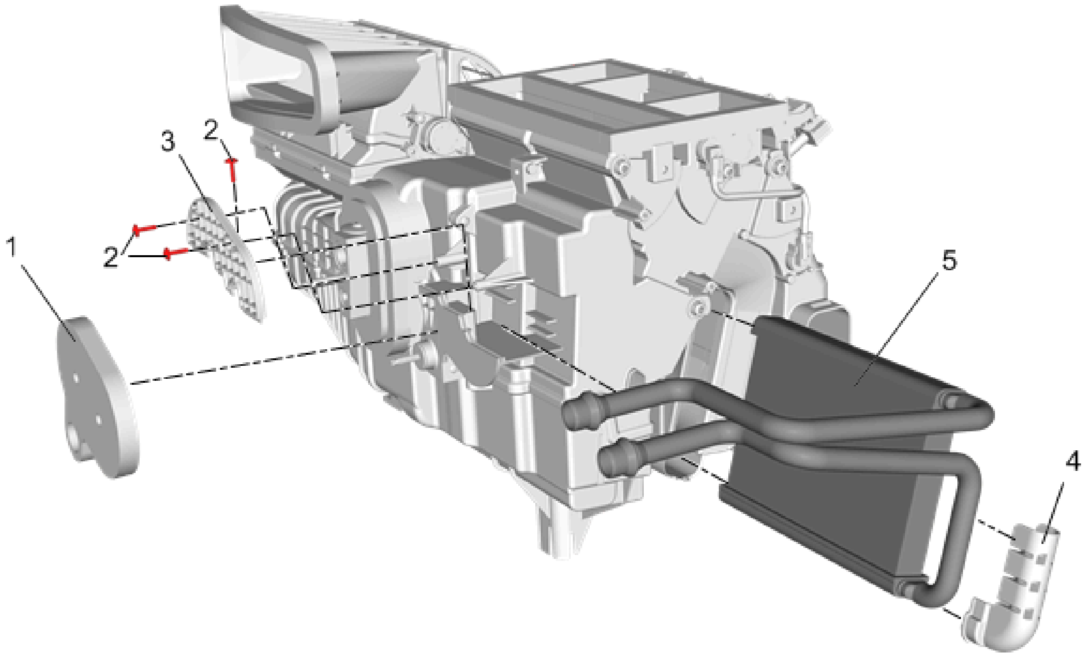


Fig. 176: Heater Core
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the heater coolant heater system. Heater Coolant Heater Draining and Filling. 2. Remove the heater and air conditioning evaporator and blower module. Heater and Air Conditioning Evaporator and Blower Module Removal and Installation	
1	Heater and Air Conditioning Evaporator Tube Seal
2	Heater Core Tube Bracket Screw (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
3	Heater Core Tube Bracket
4	Heater Core Tube Cover
5	Heater Core

HEATER COOLANT HEATER REPLACEMENT

Special Tools

BO-38185 Hose Clamp Pliers

Equivalent regional tools:Special Tools

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. High Voltage Disabling
2. Drain the cooling system. Heater Coolant Heater Draining and Filling

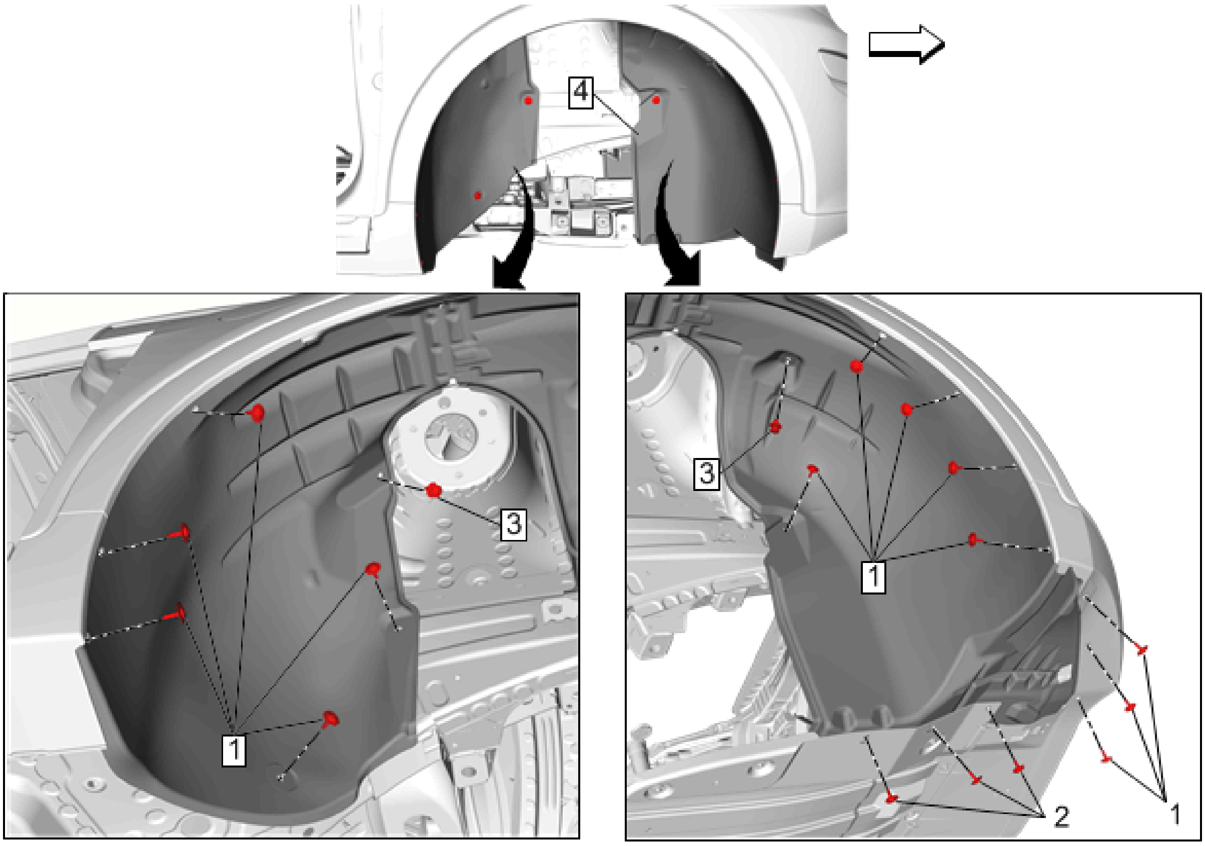


Fig. 177: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Wheelhouse Liner(4)-Right Side Front Wheelhouse Liner Replacement

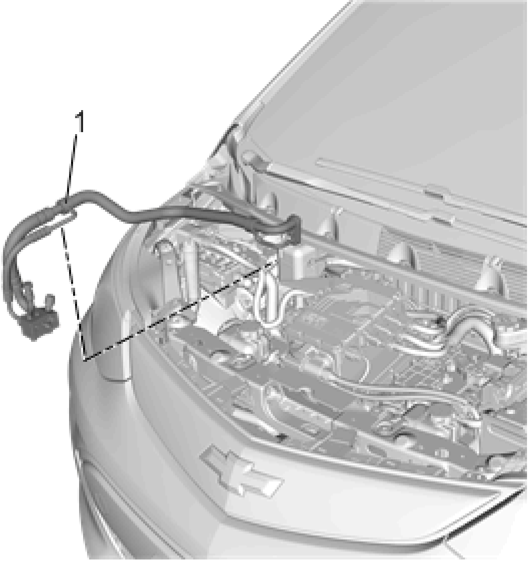


Fig. 178: Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

4. Remove Air Conditioning Evaporator Hose(1) **Air Conditioning Evaporator Hose Assembly Replacement**

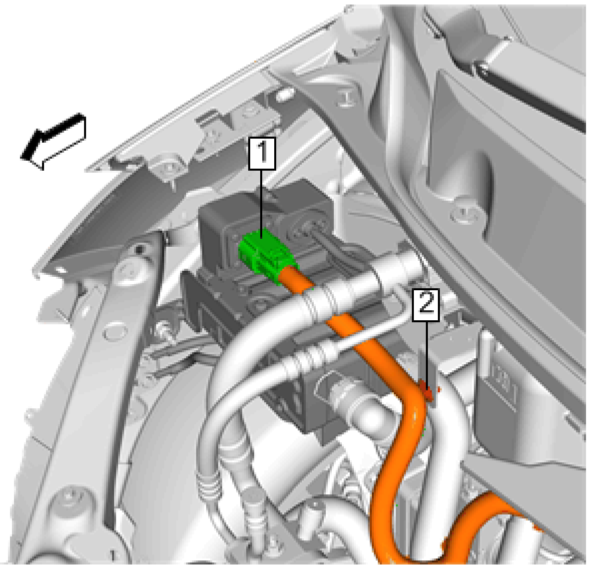


Fig. 179: High Voltage Cable Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the high voltage cable connector (1) from the heater coolant heater.
6. Unclip the cable retainer (2).

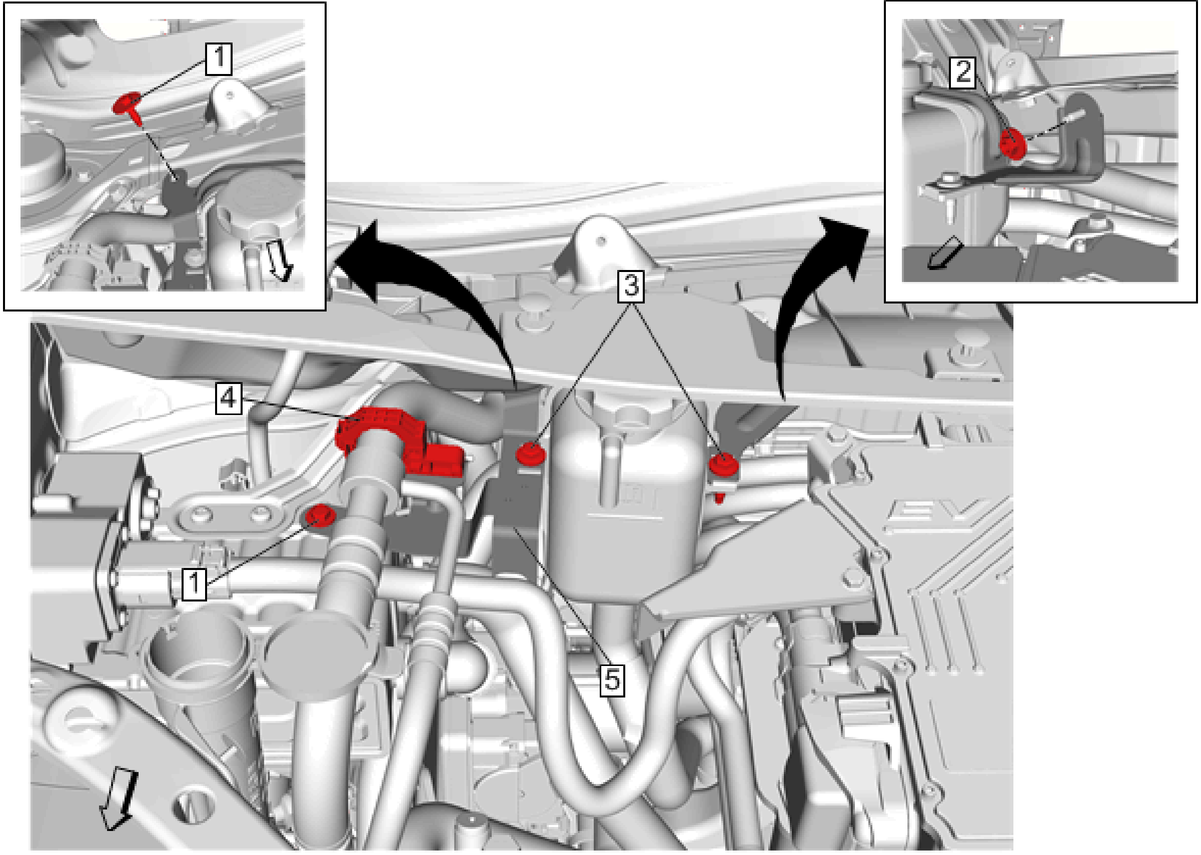


Fig. 180: Radiator Surge Tank Support Bracket (Heater)
Courtesy of GENERAL MOTORS COMPANY

7. Remove Radiator Surge Tank Support Bracket (1) - Heater **Radiator Surge Tank Support Bracket Replacement (Heater)**

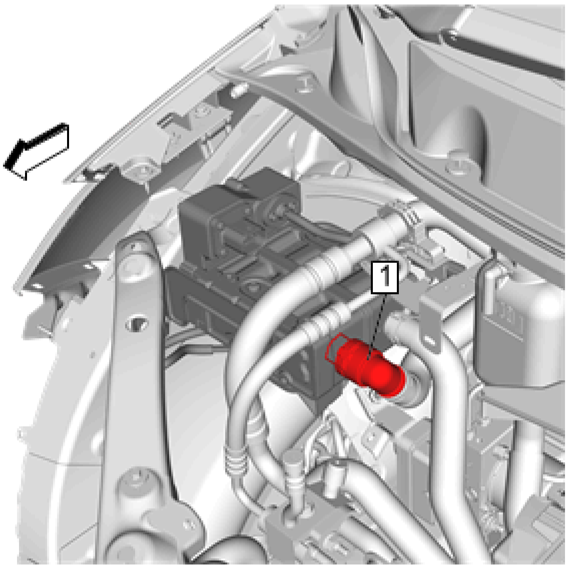


Fig. 181: Heater Outlet Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Heater Outlet Hose Quick Connect (1) **Heater Outlet Hose Replacement**

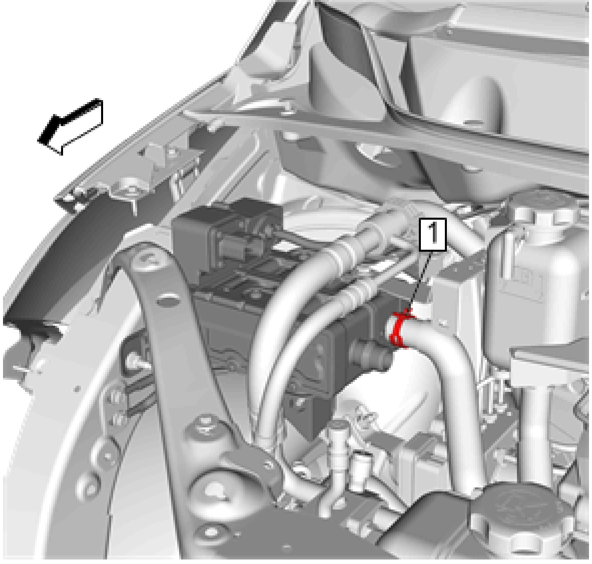


Fig. 182: Auxiliary Heater Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

9. Reposition the auxiliary heater inlet hose clamp (1) using **BO-38185** Hose Clamp Pliers. Hose Clamp Replacement Guidelines - Spring Type
10. Remove Auxiliary Heater Outlet Hose@Heater Coolant Hear Auxiliary Heater Outlet Hose Replacement

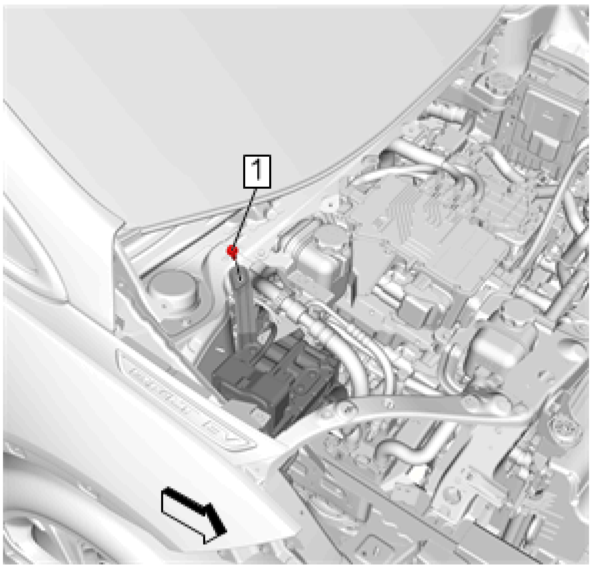


Fig. 183: Heater Coolant Heater Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

11. Remove the heater coolant heater bracket bolt (1).

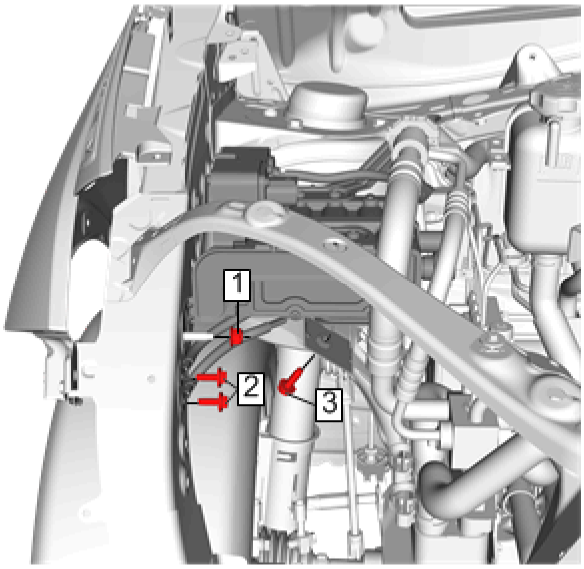


Fig. 184: Heater Coolant Heater Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

12. Remove the heater coolant heater bracket nut (1).
13. Remove the heater coolant heater wiring harness bolt (2) with the wiring harness.
14. Remove the heater coolant heater bracket bolt (3).

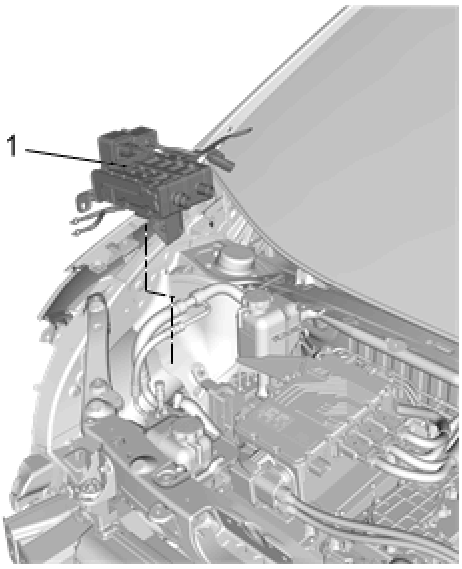


Fig. 185: Heater Coolant Heater
Courtesy of GENERAL MOTORS COMPANY

15. Disconnect the electrical connectors from the heater coolant heater.
16. Remove the heater coolant heater (1).

Installation Procedure

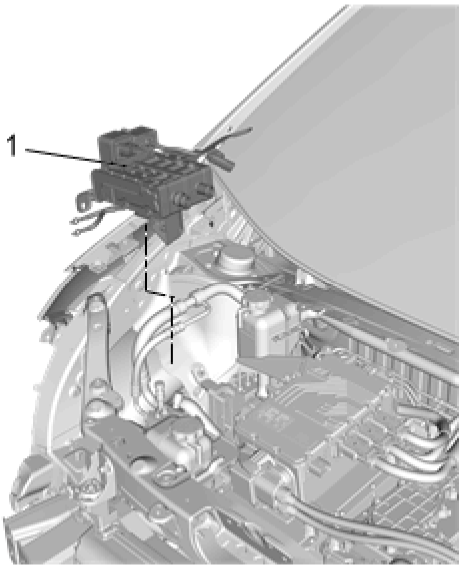


Fig. 186: Heater Coolant Heater
Courtesy of GENERAL MOTORS COMPANY

1. Position the heater coolant heater (1) to the vehicle.
2. Connect the electrical connectors from the heater coolant heater.

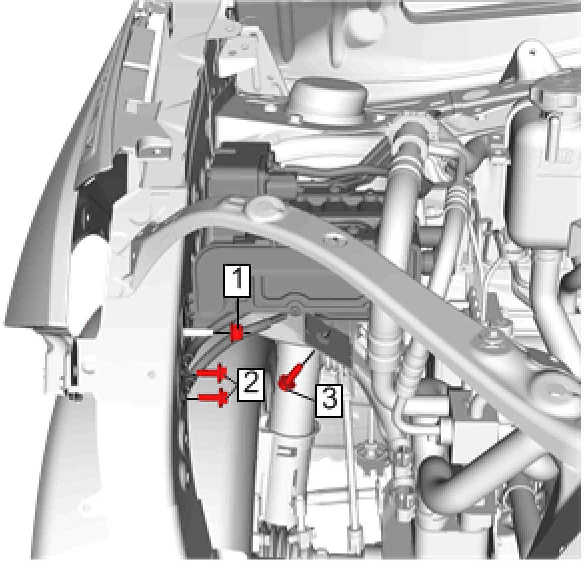


Fig. 187: Heater Coolant Heater Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

3. Install the heater coolant heater bracket bolt (3) and tighten to 9 N.m (80 lb in).
4. Install the heater coolant heater wiring harness bolt (2) with the wiring harness and tighten to 9 N.m (80 lb in).
5. Install the heater coolant heater bracket nut (1) and tighten to 9 N.m (80 lb in).

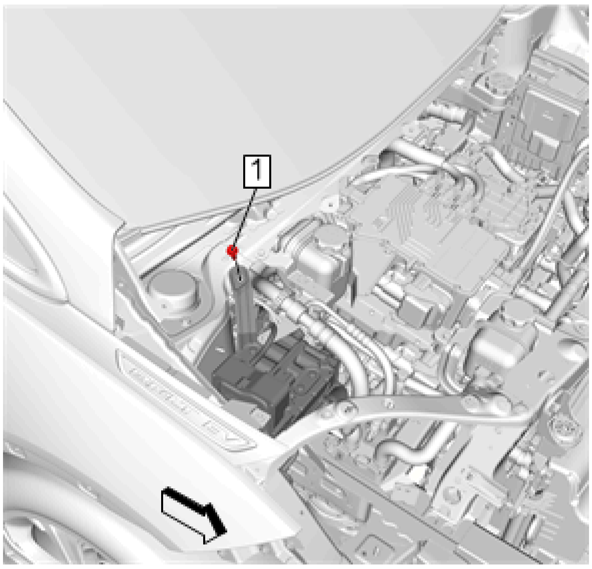


Fig. 188: Heater Coolant Heater Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Install the heater coolant heater bracket bolt (1) and tighten to 9 N.m (80 lb in).

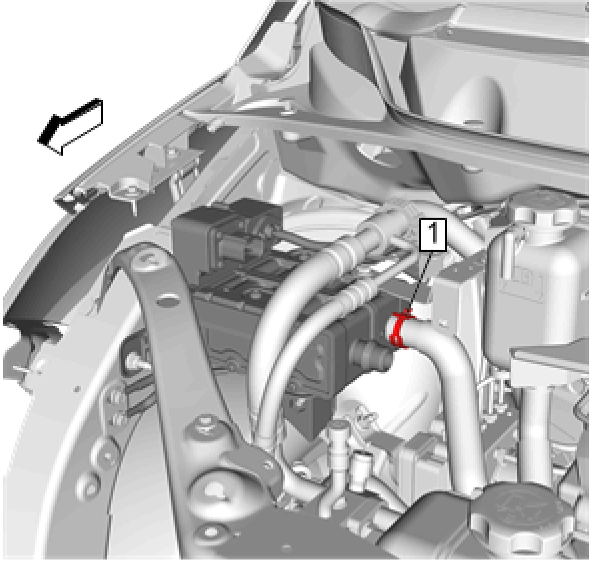


Fig. 189: Auxiliary Heater Inlet Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

7. Install Auxiliary Heater Outlet Hose@Heater Coolant Heater Auxiliary Heater Outlet Hose Replacement
8. Position the auxiliary heater inlet hose clamp (1) using **BO-38185** Hose Clamp Pliers. Hose Clamp Replacement Guidelines - Spring Type

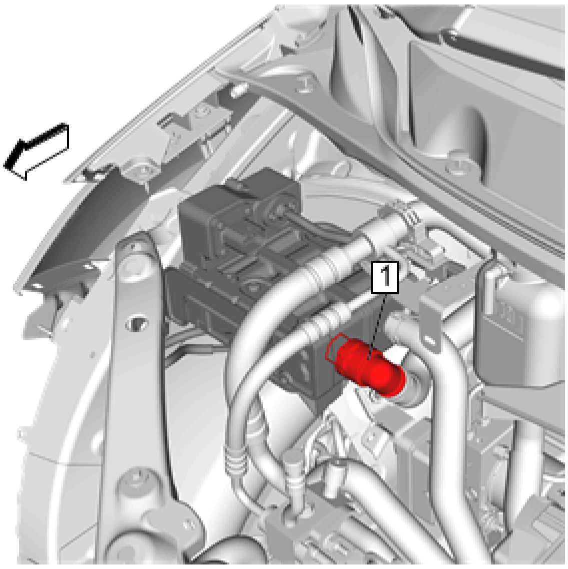


Fig. 190: Heater Outlet Hose Quick Connector
Courtesy of GENERAL MOTORS COMPANY

9. Connect Heater Outlet Hose Quick Connect (1)Heater Outlet Hose Replacement

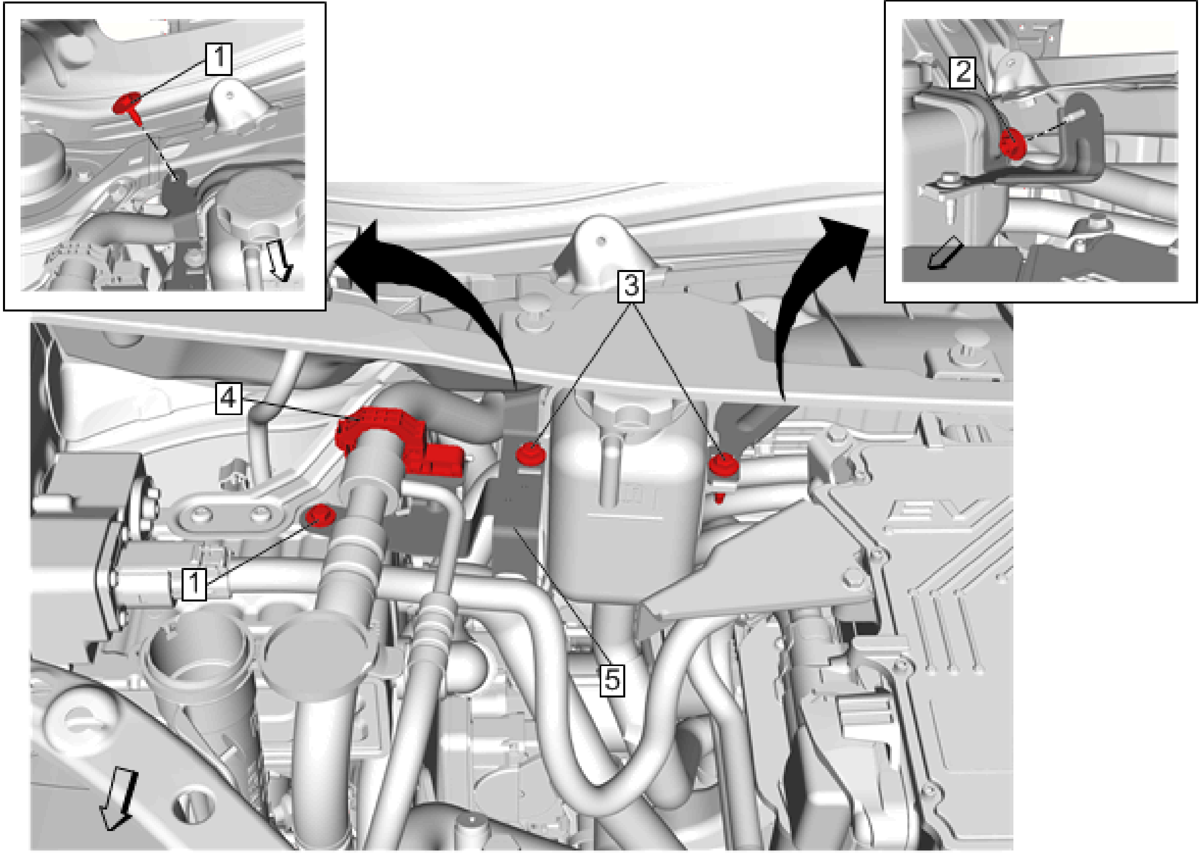


Fig. 191: Radiator Surge Tank Support Bracket (Heater)
Courtesy of GENERAL MOTORS COMPANY

10. Install Radiator Surge Tank Support Bracket (1) - Heater **Radiator Surge Tank Support Bracket Replacement (Heater)**

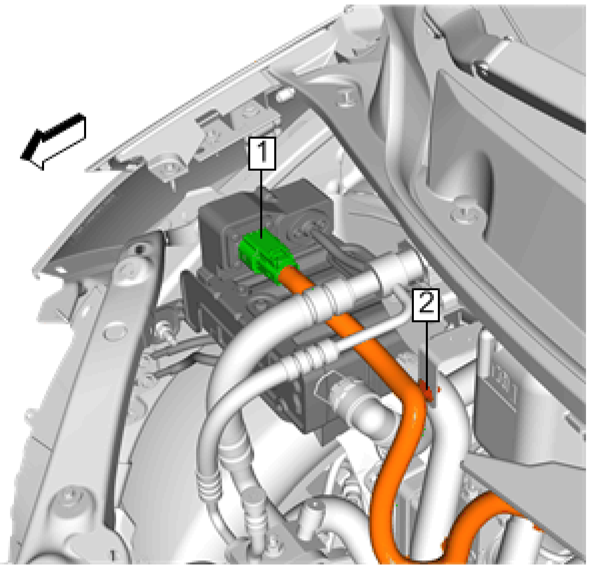


Fig. 192: High Voltage Cable Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

11. Clip the cable retainer (2).
12. Connect the high voltage cable connector (1) to the heater coolant heater.

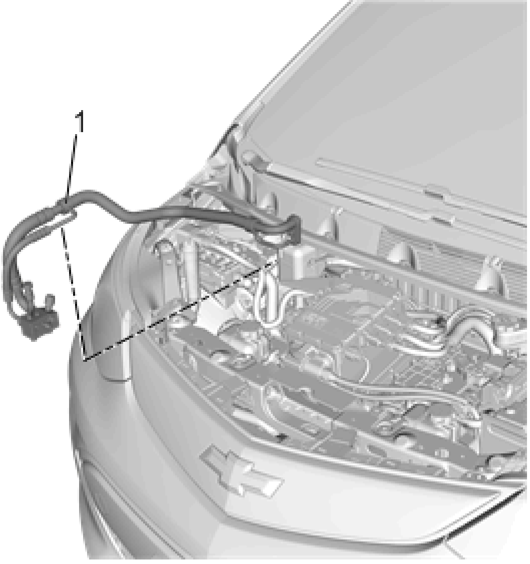


Fig. 193: Air Conditioning Evaporator Hose
Courtesy of GENERAL MOTORS COMPANY

13. Install Air Conditioning Evaporator Hose(1) Air Conditioning Evaporator Hose Assembly Replacement

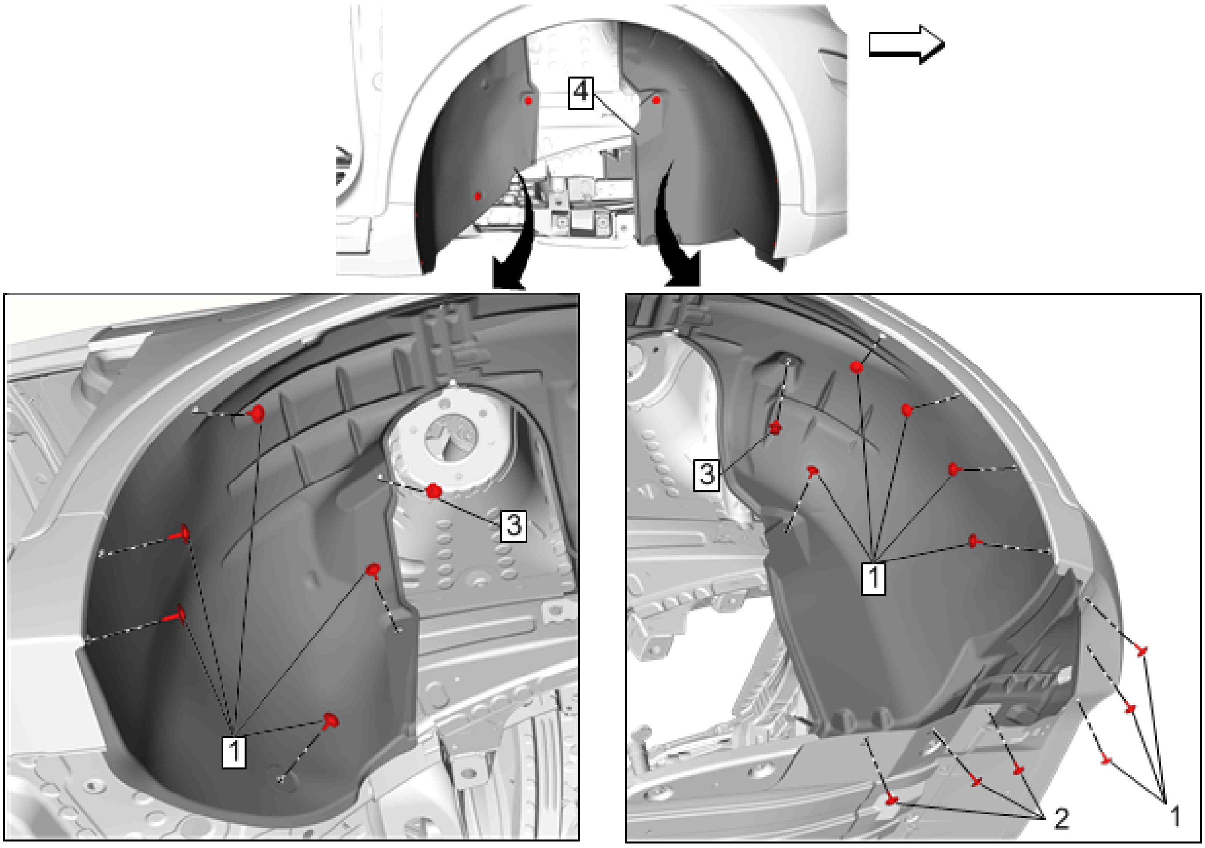


Fig. 194: Front Wheelhouse Liner
Courtesy of GENERAL MOTORS COMPANY

14. Install Front Wheelhouse Liner(4)-Right Side Front Wheelhouse Liner Replacement
15. Fill the cooling system. Heater Coolant Heater Draining and Filling
16. Enable the high voltage system. High Voltage Enabling

HEATER CASE REPLACEMENT

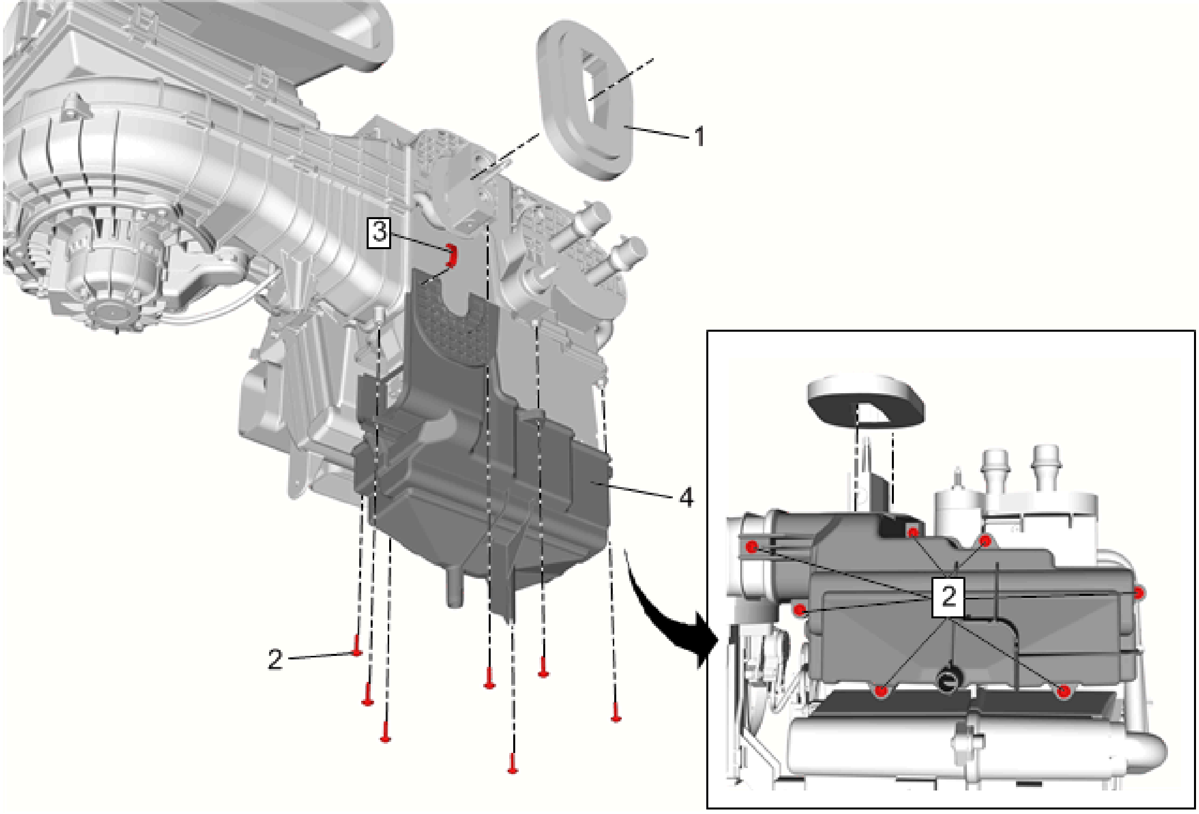


Fig. 195: Heater Case
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection 2. Remove the heater and air conditioning evaporator and blower module. Heater and Air Conditioning Evaporator and Blower Module Removal and Installation	
1	Heater and Air Conditioning Evaporator and Blower Module Seal
2	Heater Case Screw (Qty: 7) **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
3	Heater and Air Conditioning Evaporator Case Clip
4	Heater Case **Procedure** Separate the heater case from the module assembly.

DESCRIPTION AND OPERATION

HEATING AND AIR CONDITIONING SYSTEM DESCRIPTION AND OPERATION

Heating

The heating system uses a high voltage heater to provide heat to the passenger compartment. The high voltage heater is used when the passenger compartment heat is requested. The high voltage heater provides different levels of heat depending on the amount of heat needed and outside temperature.

The HVAC Control Module turns on the coolant pump and monitors the temperature sensors in the passenger compartment, outside air and high voltage heater to determine the position of the coolant flow control valve and if the high voltage heater is needed. Passenger compartment heat is provided by air flowing through the heater core. The heater core is heated by coolant from the high voltage heater.

The heating system circulates a 50/50 mixture of Dex-cool and deionized water.

Air Conditioning

The A/C system uses the refrigerant R-1234yf which is a gas at very low temperatures and can transfer heat from the passenger compartment and high voltage battery to the outside air. The A/C system is mechanically protected with the use of a high pressure relief valve on the A/C compressor. If the refrigerant pressure sensor were to fail or if the A/C system becomes restricted and the refrigerant pressure continued to rise, the high pressure relief will open and release refrigerant from the system.

The high voltage electric A/C compressor is a self contained high voltage inverter, electric motor, and direct coupled compressor. The electric A/C compressor has the ability to run and provide cooling performance while the vehicle is not running. The electronic climate control module and the Vehicle Integration Control Module (VICM) will command the electric A/C compressor to a speed necessary to maintain a desired cooling level rather than cycle the electric A/C compressor on and off.

The electric A/C compressor builds pressure and adds heat to the refrigerant gas. The refrigerant gas flows from the electric A/C compressor to the condenser where heat is transferred to the outside air when the refrigerant condenses from a gas to a liquid. The liquid refrigerant then flows to a thermal expansion valve (TXV) on the battery chiller. The TXV lowers the pressure of the liquid refrigerant which makes the refrigerant expand from a liquid to a vapor. The low pressure refrigerant vapor flows into the battery chiller and begins to boil and change into a gas as the refrigerant absorbs heat from the battery coolant also flowing inside the battery chiller. The battery coolant and refrigerant are separated by several plates inside the battery chiller. The liquid refrigerant also flows to a second TXV on the evaporator. The low pressure refrigerant vapor flows from the TXV into the evaporator and begins to boil and change into a gas as the refrigerant absorbs heat from the passenger compartment air that is flowing through the outside of the evaporator. The moister in the passenger compartment air condenses on the outside of the evaporator and flows down to the bottom of the HVAC module where it drains outside the passenger compartment through a drain hose. The low pressure refrigerant gas then flows from the battery chiller and the evaporator back to the electric A/C compressor where the cycle is repeated.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

Illustration	Tool Number/ Description
	BO 38185 J 38185 Hose Clamp Pliers
	EN 24460-A J 24460-A Cooling System Pressure Tester

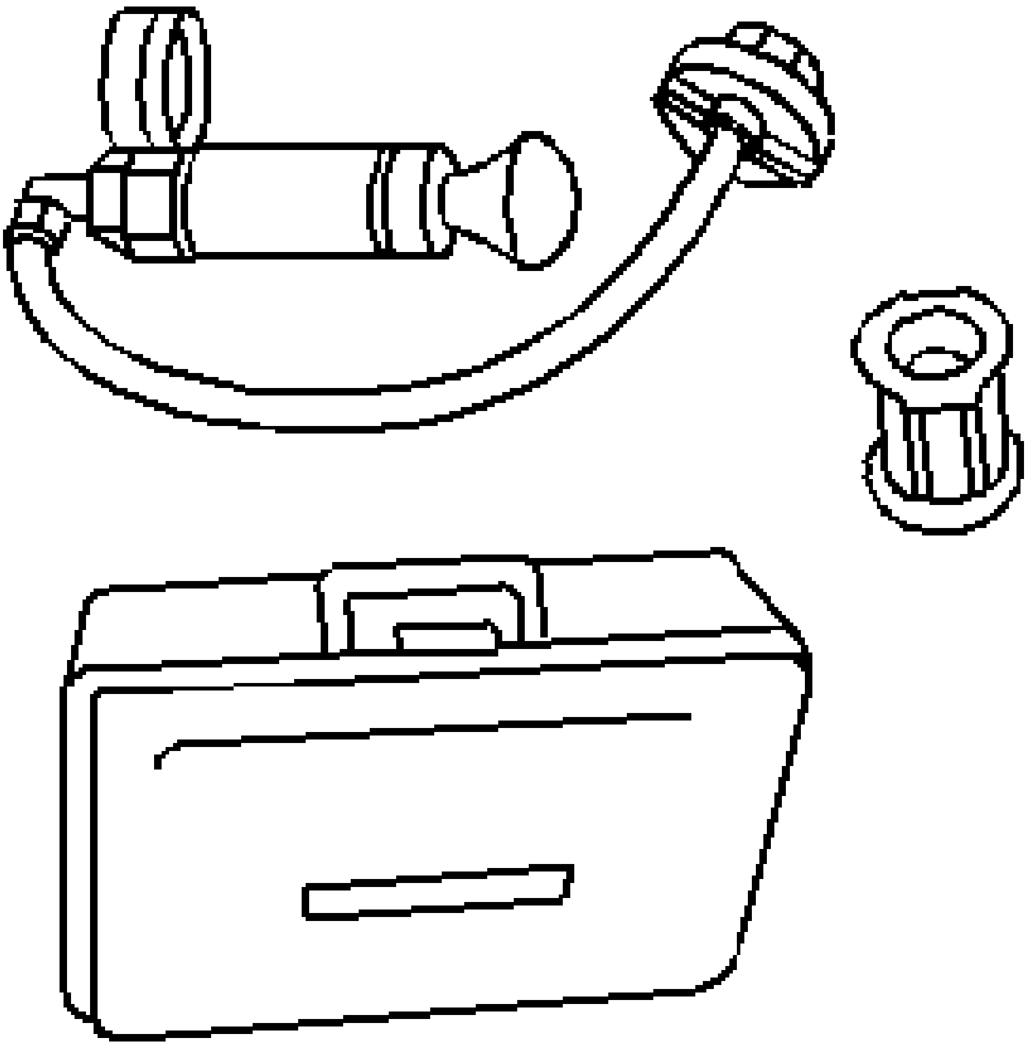
Illustration	Tool Number/ Description
	

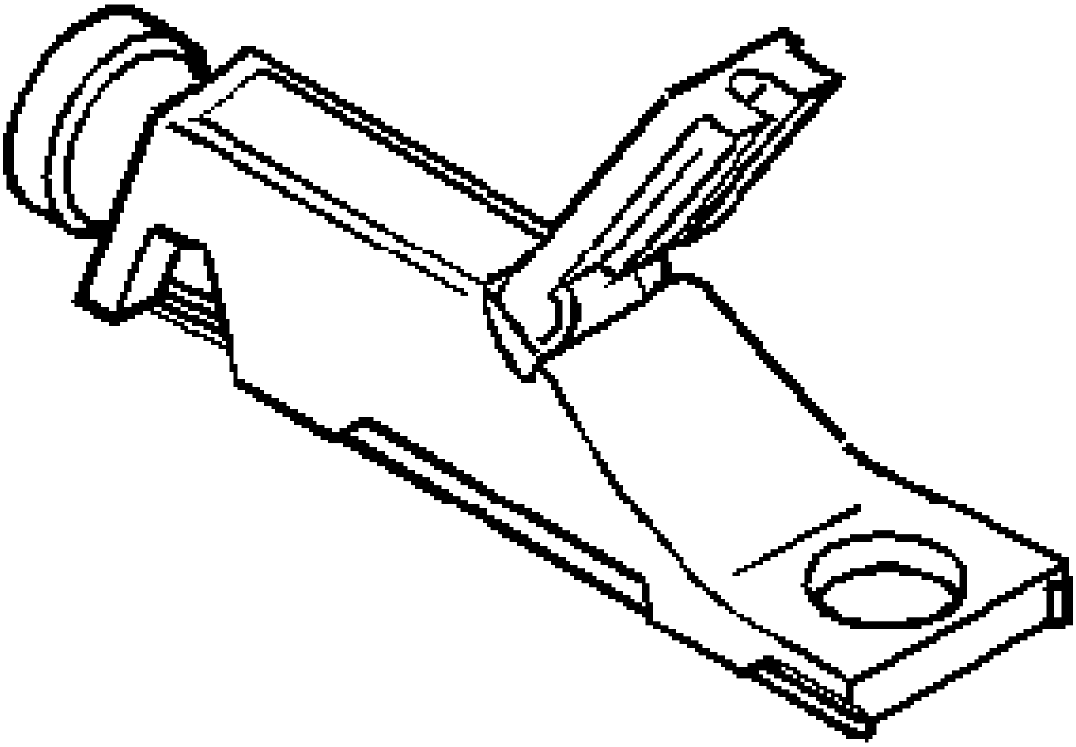
Illustration	Tool Number/ Description
	GE 26568 J 26568 Coolant and Battery Tester

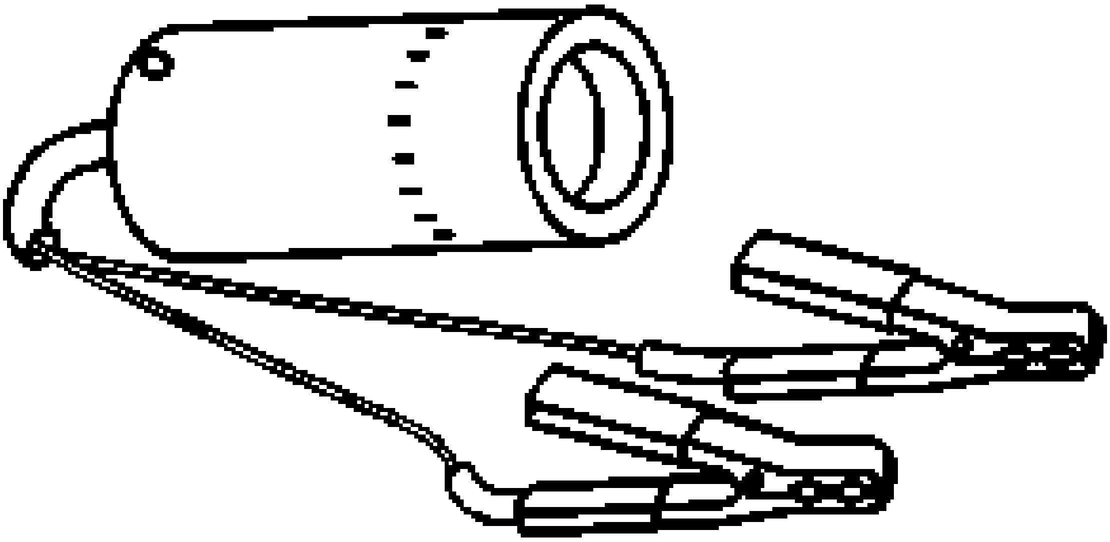
Illustration	Tool Number/ Description
	GE 42220 J 42220 Universal 12V Leak Detection Lamp

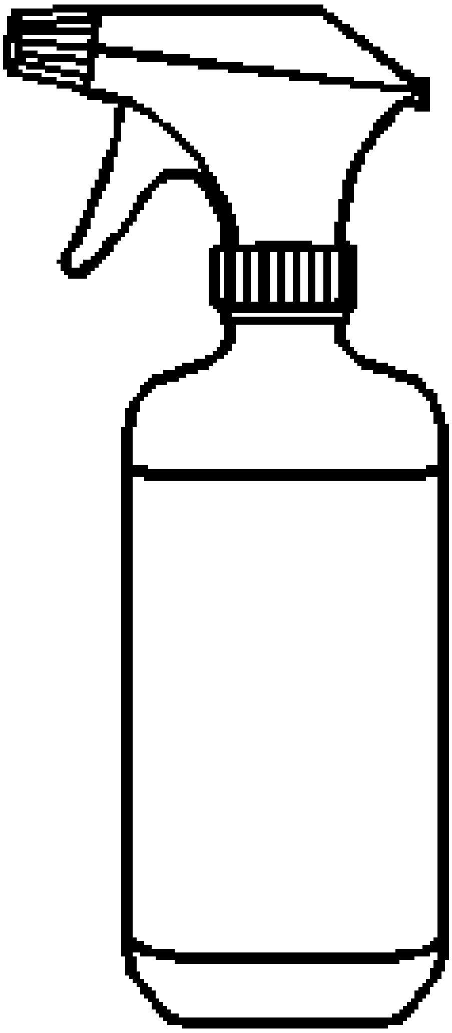
Illustration	Tool Number/ Description
	GE 43872 J 43872 Fluorescent Dye Cleaner

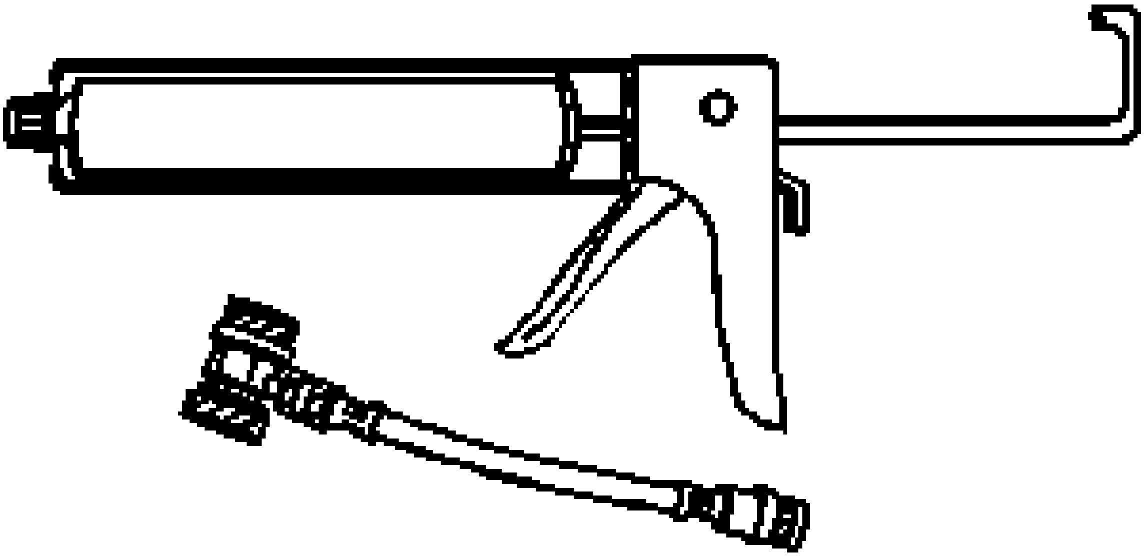
Illustration	Tool Number/ Description
	GE 45037-A J 45037-A A/C PAG/POE Oil Injector

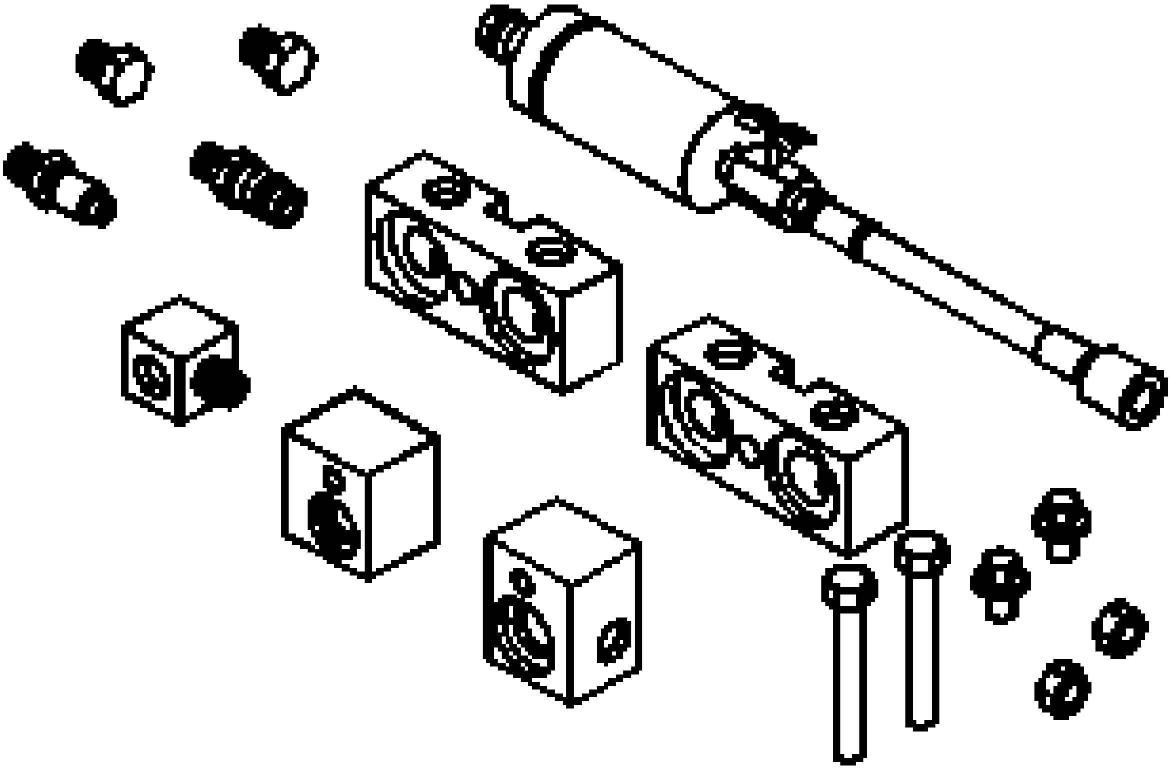
Illustration	Tool Number/ Description
	GE 45268 J 45268 Flush Adapter Kit

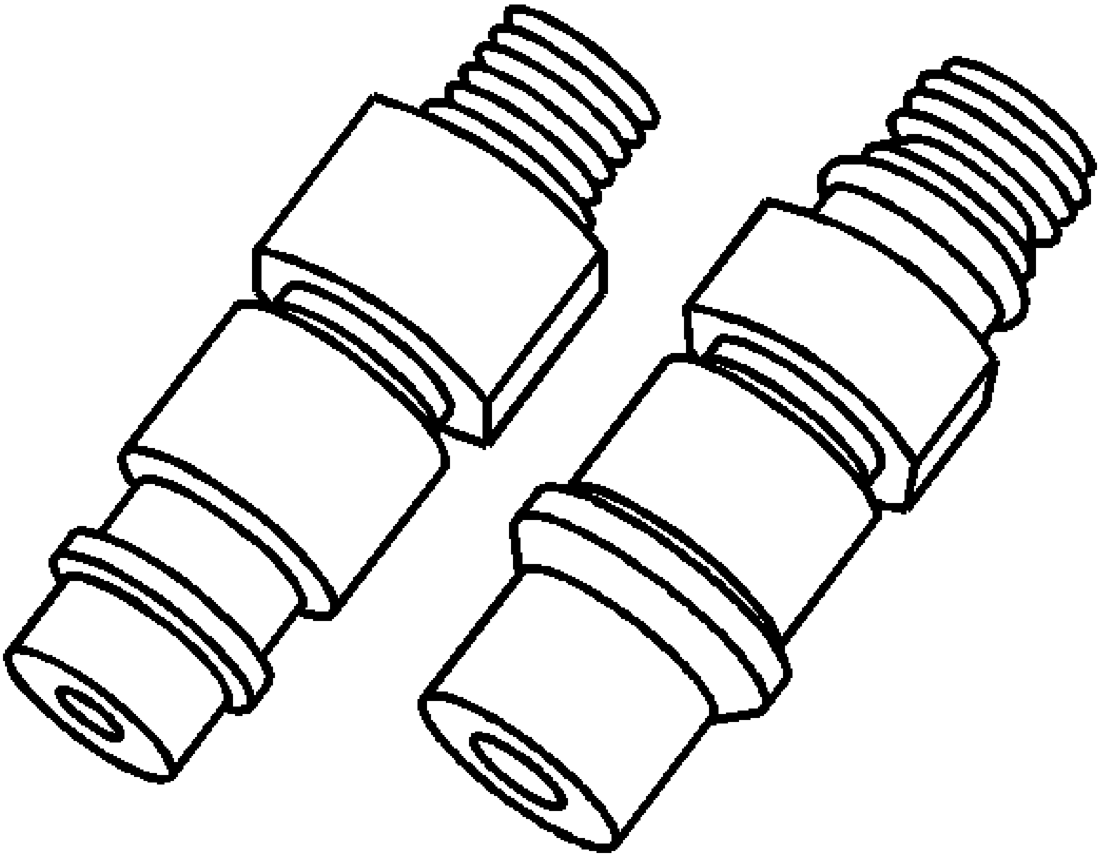
Illustration	Tool Number/ Description
	GE-45268-130 (Includes GE-45268-128 and GE-45268-129) R1234yf Flush Adapters

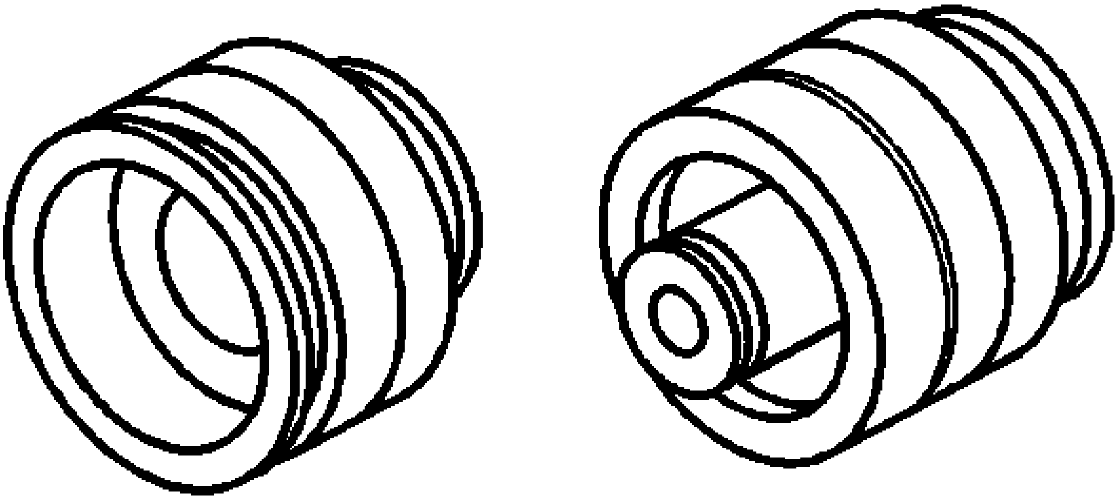
Illustration	Tool Number/ Description
	GE 46143 Cooling System Adapter

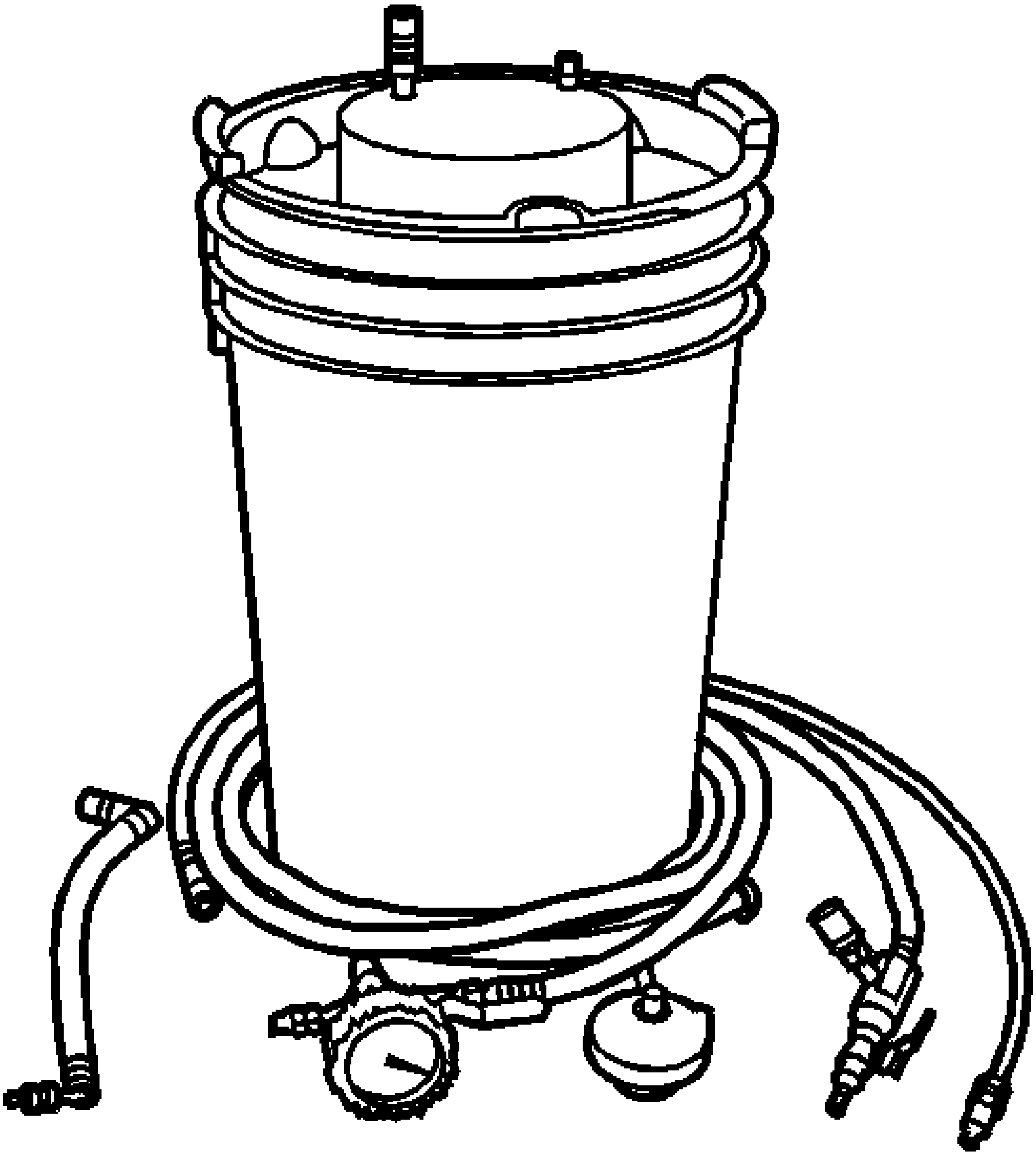
Illustration	Tool Number/ Description
	GE 47716 Vac-N-Fill Coolant Refill Tool

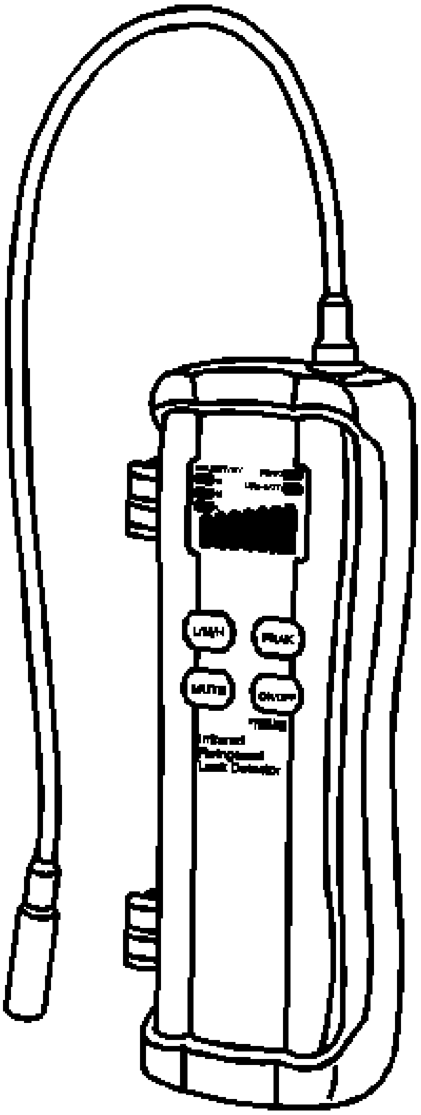
Illustration	Tool Number/ Description
 L/M/H PEAK MUTE ON/OFF Infrared Refrigerant Leak Detector	GE 50078 Electronic Leak Detector

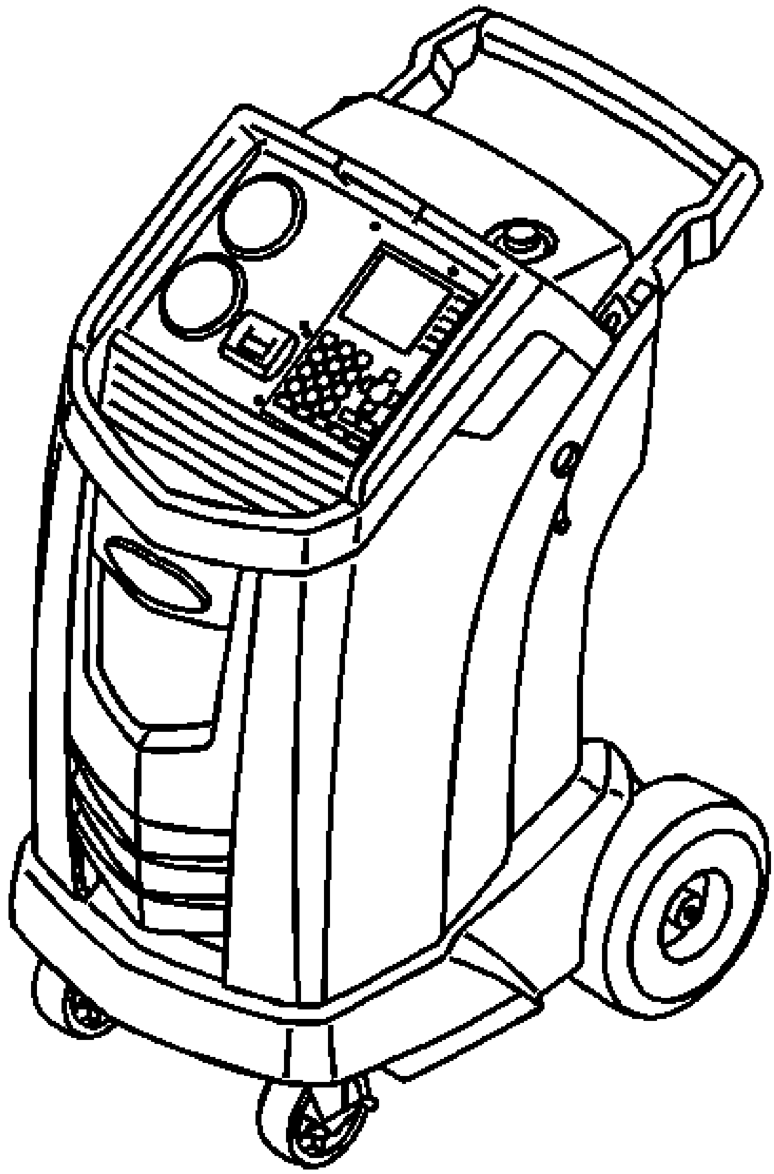
Illustration	Tool Number/ Description
	GE 50300 R-1234yf A/C Refrigerant Recovery/Recharge Cart

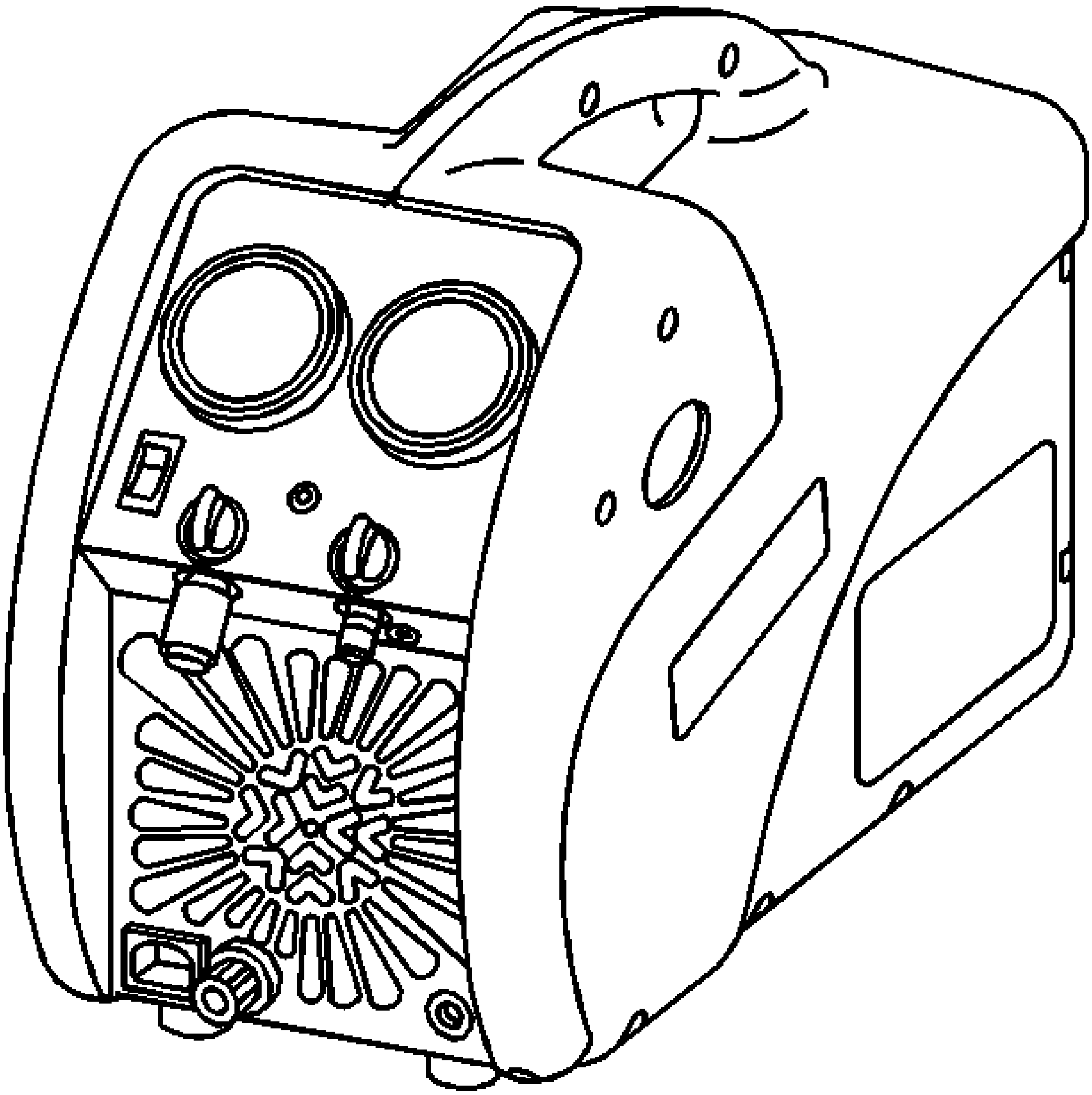
Illustration	Tool Number/ Description
	GE 50957 Machine R-1234yf Contaminated Refrigerant

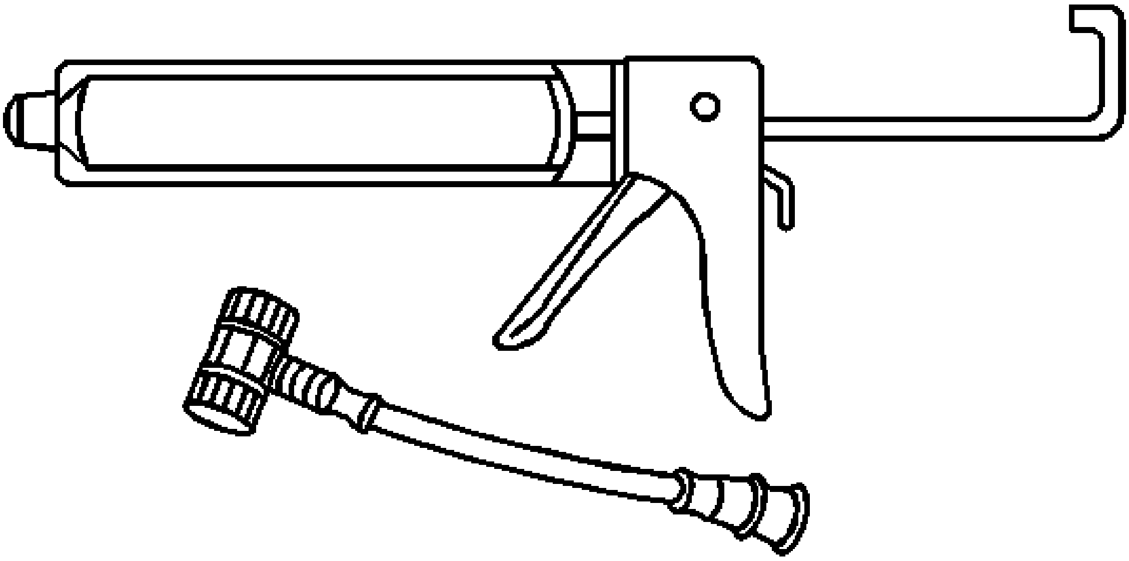
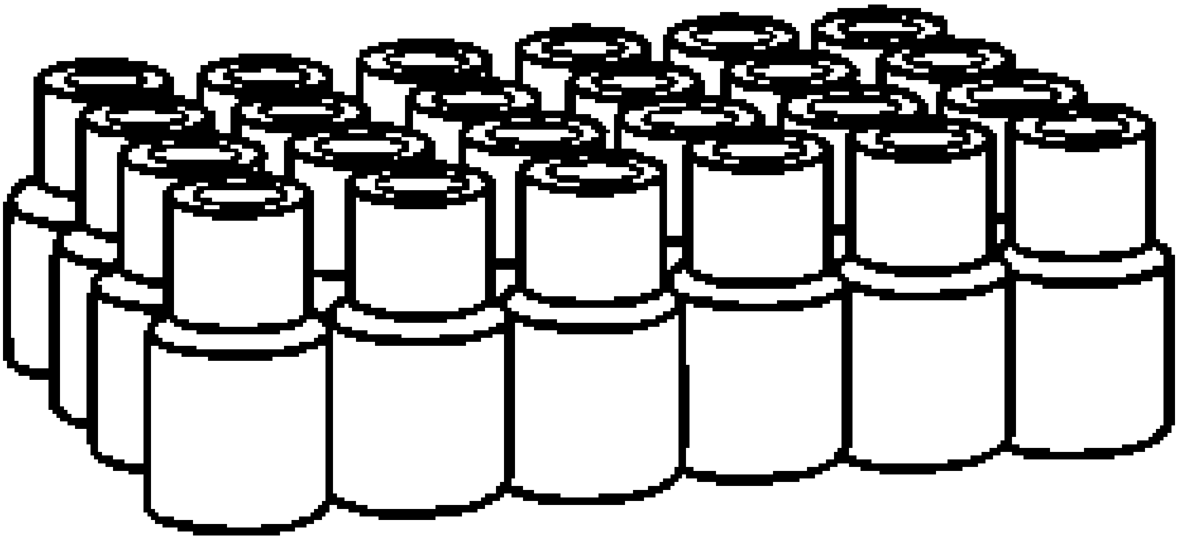
Illustration	Tool Number/ Description
	GE 50744 R-1234yf PAG Oil Injector Hose
	GE 41447 J 41447 R-134a A/C Tracer Dye - Box of 24

Illustration	Tool Number/ Description
	

Back To Article

2017 HVAC

HVAC - Automatic - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Air Conditioning Wiring Harness Screw	2.5 N.m (22 lb in)
Air Inlet Valve Actuator Fastener	2.5 N.m (22 lb in)
Blower Motor Control Module Bolt	2.5 N.m (22 lb in)
Lever Screw	2.5 N.m (22 lb in)
Mode Valve Actuator Bolt	2.5 N.m (22 lb in)
Temperature Valve Actuator Fastener	2.5 N.m (22 lb in)

SCHEMATIC WIRING DIAGRAMS

HVAC WIRING SCHEMATICS

Power, Ground, Data Communication and Blower Controls

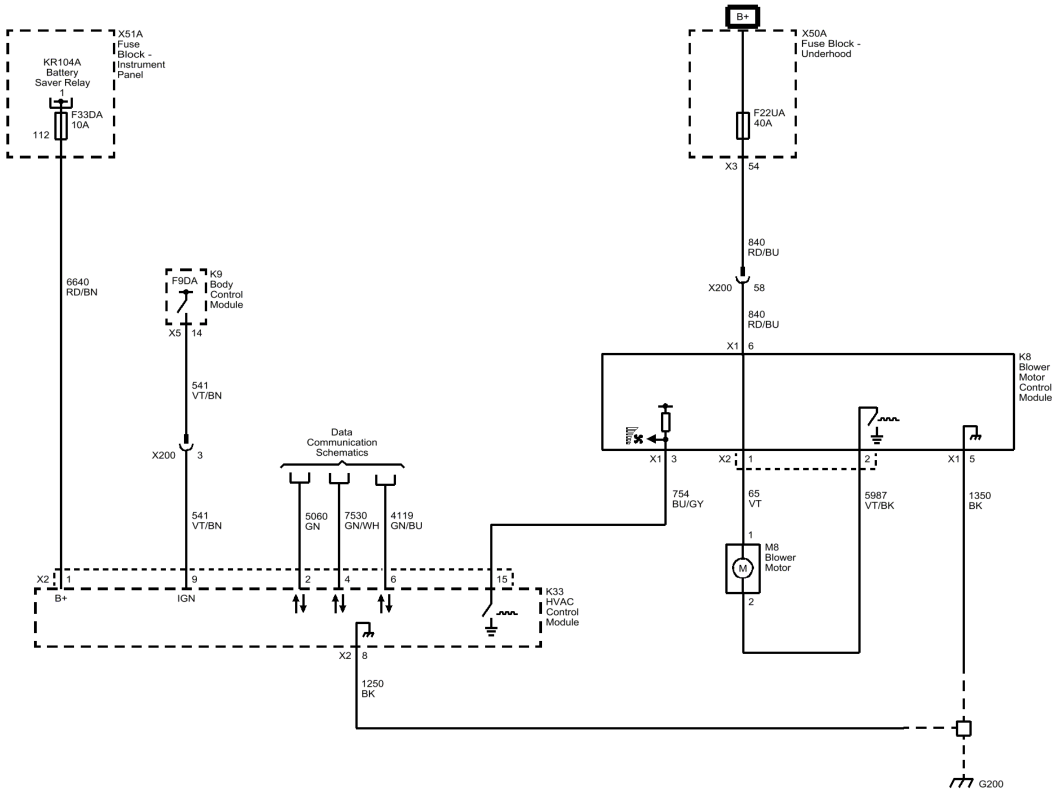

X51A Fuse Block - Instrument Panel
KR104A Battery Saver Relay
1
F33DA 10A
112
6640 RD/BN
B+
X50A Fuse Block - Underhood
F22UA 40A
X3 54
840 RD/BU
X200 58
840 RD/BU
X1 6
K8 Blower Motor Control Module
F9DA
K9 Body Control Module
X5 14
541 VT/BN
X200 3
541 VT/BN
Data Communication Schematics
5060 GN
7530 GN/WH
4119 GN/BU
X1 3
X2 1
2
X1 5
754 BU/GY
65 VT
5987 VT/BK
1350 BK
1
M8 Blower Motor
M
2
X2 1
9
2
4
6
15
B+
IGN
K33 HVAC Control Module
X2 8
1250 BK
G200

Fig. 1: Power, Ground, Data Communication and Blower Controls

Courtesy of GENERAL MOTORS COMPANY

Actuators

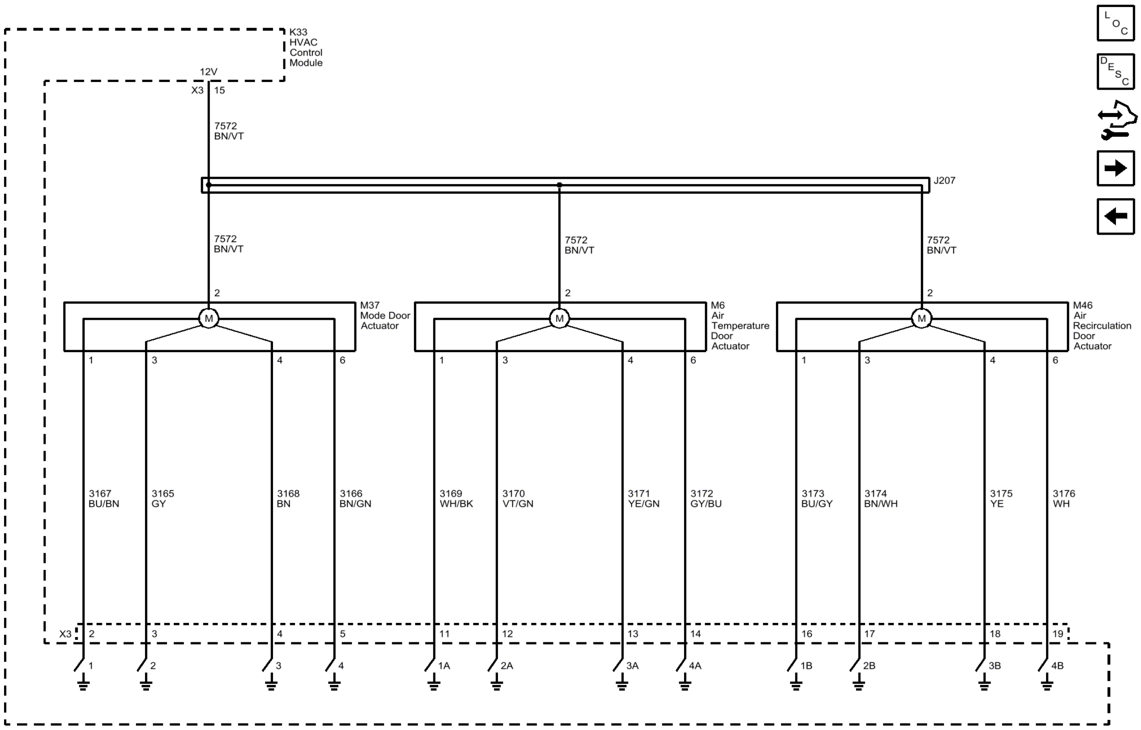

K33 HVAC Control Module
12V
X3 15
7572 BN/VT
J207
M37 Mode Door Actuator
M6 Air Temperature Door Actuator
M46 Air Recirculation Door Actuator
M
3167 BU/BN
3165 GY
3168 BN
3166 BN/GN
3169 WH/BK
3170 VT/GN
3171 YE/GN
3172 GY/BU
3173 BU/GY
3174 BN/WH
3175 YE
3176 WH
X3
1A 2A 3A 4A 1B 2B 3B 4B

Fig. 2: Actuators

Courtesy of GENERAL MOTORS COMPANY

Sensors

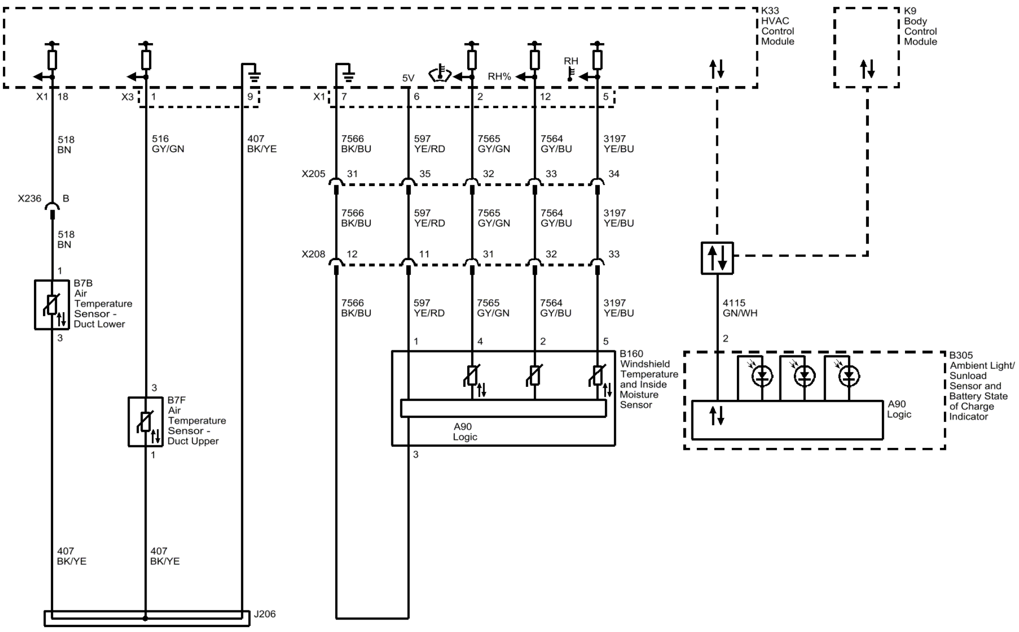

K33 HVAC Control Module
K9 Body Control Module
X1 18
X3 1
9
X1 7
5V
RH%
RH
518 BN
516 GY/GN
407 BK/YE
7566 BK/BU
597 YE/RD
7565 GY/GN
7564 GY/BU
3197 YE/BU
X205
X236
X208
B7B Air Temperature Sensor - Duct Lower
B7F Air Temperature Sensor - Duct Upper
B160 Windshield Temperature and Inside Moisture Sensor
A90 Logic
4115 GN/WH
B305 Ambient Light/ Sunload Sensor and Battery State of Charge Indicator
J206

Fig. 3: Sensors

Courtesy of GENERAL MOTORS COMPANY

Cabin Heater

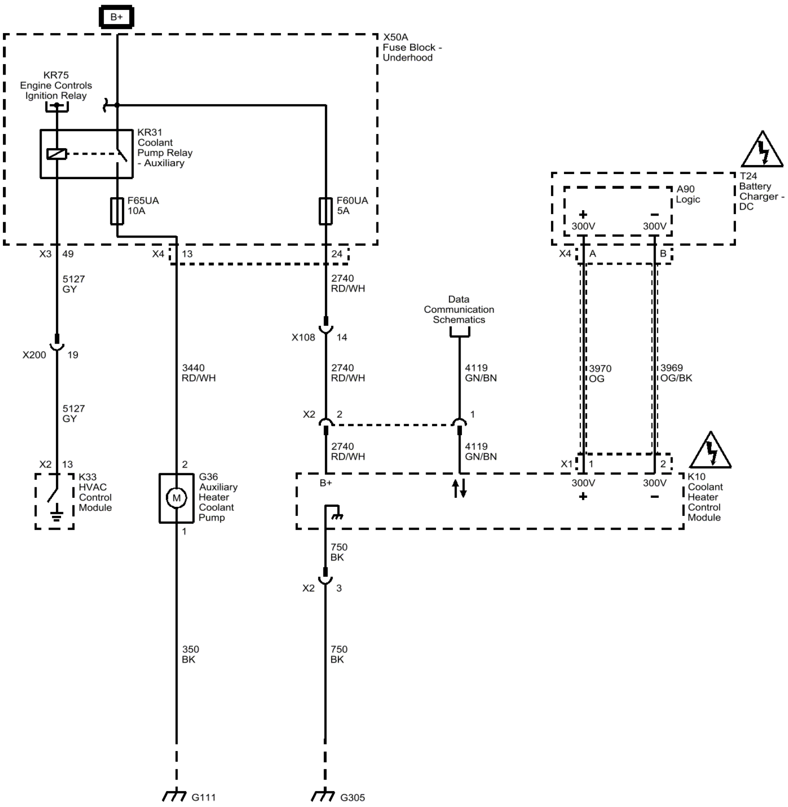

B+
X50A
Fuse Block -
Underhood
KR75
Engine Controls
Ignition Relay
KR31
Coolant
Pump Relay
- Auxiliary
F65UA
10A
F60UA
5A
X3 49
X4 13
24
5127
GY
X200 19
5127
GY
X2 13
K33
HVAC
Control
Module
3440
RD/WH
2
G36
Auxiliary
Heater
Coolant
Pump
1
350
BK
G111
2740
RD/WH
X108 14
2740
RD/WH
X2 2
2740
RD/WH
B+
750
BK
X2 3
750
BK
G305
Data
Communication
Schematics
4119
GN/BN
1
4119
GN/BN
A90
Logic
T24
Battery
Charger -
DC
300V
300V
X4 A
B
3970
OG
3969
OG/BK
X1 1
2
300V
300V
K10
Coolant
Heater
Control
Module

Fig. 4: Cabin Heater

Courtesy of GENERAL MOTORS COMPANY

Compressor Controls

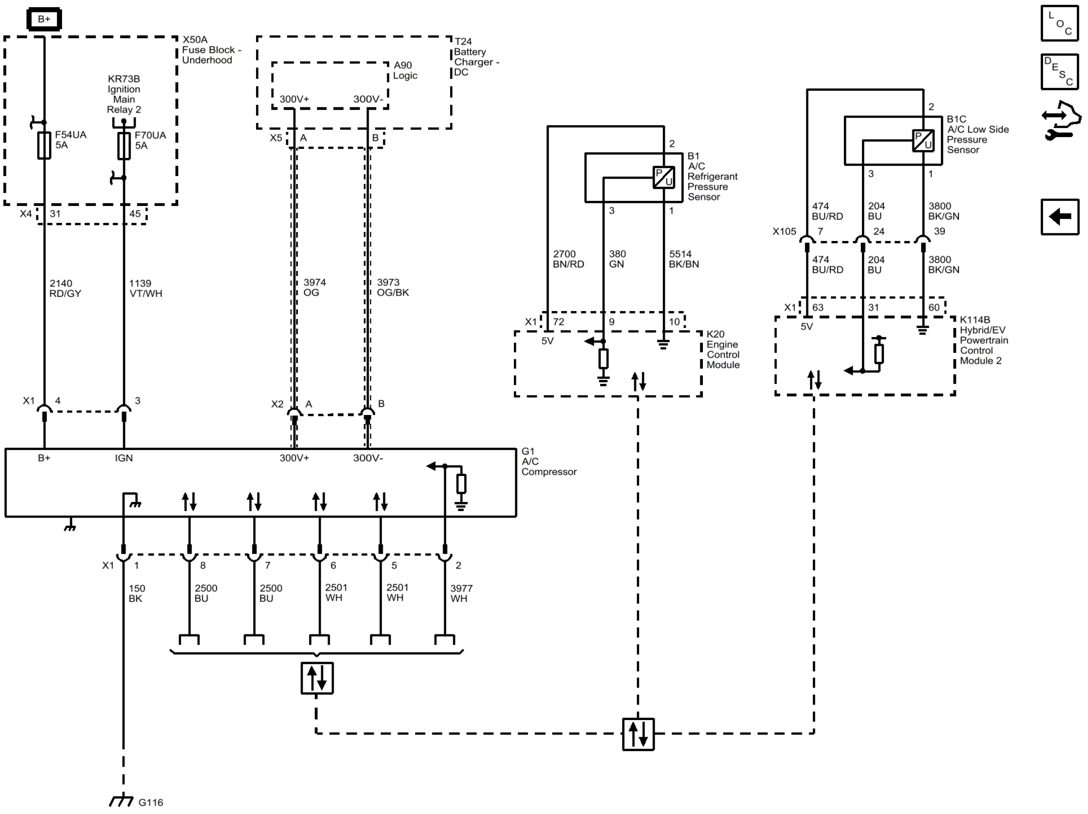

B+
X50A
Fuse Block -
Underhood
KR73B
Ignition
Main
Relay 2
F54UA
5A
F70UA
5A
X4 31
45
2140
RD/GY
1139
VT/WH
X1 4
3
T24
Battery
Charger -
DC
A90
Logic
300V+
300V-
X5 A
B
3974
OG
3973
OG/BK
X2 A
B
B+
IGN
300V+
300V-
G1
A/C
Compressor
X1 1
8
7
6
5
2
150
BK
2500
BU
2500
BU
2501
WH
2501
WH
3977
WH
G116
2
B1
A/C
Refrigerant
Pressure
Sensor
3
1
2700
BN/RD
380
GN
5514
BK/BN
X1 72
9
10
5V
K20
Engine
Control
Module
2
B1C
A/C Low Side
Pressure
Sensor
3
1
474
BU/RD
204
BU
3800
BK/GN
X105 7
24
39
474
BU/RD
204
BU
3800
BK/GN
X1 63
31
60
5V
K114B
Hybrid/EV
Powertrain
Control
Module 2

Fig. 5: Compressor Controls

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

HVAC COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
A20 Radio/HVAC Controls	Driver Information Display Replacement
B1 A/C Refrigerant Pressure Sensor	Air Conditioning Refrigerant Pressure Sensor Replacement - High Pressure
B160 Windshield Temperature and Inside Moisture Sensor	Inside Air Moisture and Windshield Temperature Sensor Replacement (With Front View Camera)Inside Air Moisture and Windshield Temperature Sensor Replacement (Without Front View Camera)
B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator	Sun Load, Ambient Light, and Charge Indicator Sensor Replacement
B1C A/C Low Side Pressure Sensor	Air Conditioning Refrigerant Pressure Sensor Replacement - Low Pressure
B7B Air Temperature Sensor - Duct Lower	Duct Air Temperature Sensor Replacement - Lower
B7F Air Temperature Sensor - Duct Upper	Duct Air Temperature Sensor Replacement - Upper
G1 A/C Compressor	Air Conditioning and Drive Motor Battery Cooling Compressor Replacement
G17 Heater Coolant Pump	Heater Coolant Pump Replacement
K8 Blower Motor Control Module	Blower Motor Control Replacement (Module Mounted)
K10 Coolant Heater Control Module	Heater Coolant Heater Replacement
K33 HVAC Control Module	Heater and Air Conditioning Remote Control Replacement
M6 Air Temperature Actuator	Temperature Valve Actuator Replacement
M8 Blower Motor	Blower Motor Replacement
M37 Mode Door Actuator	Mode Valve Actuator Replacement
M46 Air Recirculation Door Actuator	Air Inlet Valve Actuator Replacement

DTC B0173 OR B0178: UPPER/LOWER LEFT DUCT AIR TEMPERATURE SENSOR CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B0173 02

Upper Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0173 05

Upper Left Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B0178 02

Lower Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0178 05

Lower Left Duct Air Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Upper Left Duct Air Temperature Sensor Signal	B0173 02	B0173 05	B0173 05	-
Lower Left Duct Air Temperature Sensor Signal	B0178 02	B0178 05	B0178 05	-
Low Reference	-	B0173 05, B0178 05	-	-

Circuit/System Description

The air temperature sensors are 2-wire negative temperature co-efficient thermistors. The vehicle uses the following air temperature sensors:

- Air temperature sensor left upper
- Air temperature sensor left lower

A signal and low reference circuit enables the sensor to operate. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor signal voltage decreases as the resistance decreases. The sensor operates within a temperature range between -40 to +85Â°C (-40 to +185Â°F). The sensor signal varies between 0 - 5 V. The HVAC control module converts the signal to a range between 0 - 255 counts. As the air temperature increases the count value will decrease. If the HVAC control module detects a malfunctioning sensor, then the control module software will use a default air temperature value. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

Conditions for Running the DTC

The vehicle is turned ON.

Conditions for Setting the DTC

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

A default value is used when the DTC is set.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects a failure.
- The history DTC will clear after 100 fault-free ignition cycles.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate temperature sensor. It may take up to 10 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the appropriate low reference circuit terminal listed below and ground.
    - B7B Air Temperature Sensor - Duct Lower - terminal 3
    - B7F Air Temperature Sensor - Duct Upper - terminal 1
    - **If 10 Ω or greater**
    1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC control module.
    - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the appropriate signal circuit terminal listed below and ground.
    - B7B Air Temperature Sensor - Duct Lower - terminal 1
    - B7F Air Temperature Sensor - Duct Upper - terminal 3
    - **If less than 4.8 V**
    1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K33 HVAC Control Module.
    - **If between 4.8 - 5.2 V**
5. Test or replace the temperature sensor.
6. Verify the DTC or symptom is corrected while operating the HVAC system under the Conditions for Running the DTC.
    - **If the DTC or symptom is not corrected**

      Replace the K33 HVAC Control Module.

    - **If the DTC or symptom is corrected**

7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

DTC B018A, B048C, B048F, OR B1395: WINDSHIELD TEMPERATURE SENSOR/HUMIDITY SENSOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B018A 02

Windshield Temperature Sensor Circuit Short to Ground

DTC B018A 05

Windshield Temperature Sensor Circuit High Voltage/Open

DTC B048C 02

Humidity Sensor Humidity Circuit Short to Ground

DTC B048C 05

Humidity Sensor Humidity Circuit High Voltage/Open

DTC B048F 02

Humidity Sensor Temperature Circuit Short to Ground

DTC B048F 05

Humidity Sensor Temperature Circuit High Voltage/Open

DTC B1395 03

Control Module Voltage Reference Output Circuit Low Voltage

DTC B1395 07

Control Module Voltage Reference Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1395 03	-	B1395 07	-
Signal Terminal 2	B048C 02	B048C 05	B048C 05	-
Signal Terminal 5	B048F 02	B048F 05	B048F 05	-
Signal Terminal 4	B018A 02	B018A 05	B018A 05	-
Ground	-	B018A 05, B048C 05, B048F 05	-	-

Circuit/System Description

The windshield temperature and inside moisture sensor integrates the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor.

This sensor assembly provides information about:

- Relative humidity level on inside windshield
- Temperature of the inside windshield
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity on the compartment side of the windshield. It also detects the temperature of the windshield surface on the compartment side. Both values are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element. It is only needed if the thermal contact between the humidity sensing element and the inside windshield surface is not sufficient.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B018A 02, B048C 02, B048C 02 or B1395 03

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V for more than 50 ms.

B018A 05, B048C 05, B048C 05 or B1395 07

The HVAC control module detects the sensor signal out of range. The signal voltage is greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

- The system will use the last valid values as default.
- If no value is read at the time of fault, the HVAC control module uses 60% for humidity.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B160 windshield temperature and inside moisture sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 60 Ω between the low reference circuit terminal 3 and ground.
   - **If 60 Ω or greater**
   1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K33 HVAC control module.
   - **If less than 60 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
   2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 5 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K33 HVAC control module.
   - **If greater than 5.2 V**
   1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module, Vehicle in Service Mode.
   2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K33 HVAC control module.
   - **If between 4.8 - 5.2 V**
5. Verify the scan tool parameters listed below are less than -37Â°C (-35Â°F).
   - Windshield Temperature
   - Passenger Compartment Humidity Sensor Temperature
   - **If -37Â°C (-35Â°F) or greater**
   1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
   2. Test for infinite resistance between the signal circuit terminals listed below and ground:
      - Windshield temperature sensor signal terminal 4
      - Passenger compartment humidity sensor temperature signal terminal 5
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K33 HVAC control module.
   - **If less than -37Â°C (-35Â°F)**
6. Verify the scan tool Passenger Compartment Humidity parameter is greater than 95%.
   - **If 95% or less**
   1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.

    2. Test for infinite resistance between the signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K33 HVAC control module.
    - **If greater than 95%**

7. Install a 3 A fused jumper wire between each signal circuit terminal listed below and the low reference circuit terminal 3 one at a time.
    - Windshield temperature sensor signal terminal 4
    - Passenger compartment humidity sensor temperature signal terminal 5
8. Verify the appropriate scan tool parameter listed below is greater than 114Â°C (238Â°F).
    - Windshield Temperature
    - Passenger Compartment Humidity Sensor Temperature
    - **If 114Â°C (238Â°F) or less**

    1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
    2. Test for less than 1 V between the signal circuit terminals listed below and ground:
        - Windshield temperature sensor signal terminal 4
        - Passenger compartment humidity sensor temperature signal terminal 5
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC control module.

    - **If greater than 114Â°C (238Â°F)**
9. Install a 3 A fused jumper wire between the passenger compartment humidity sensor signal circuit terminal 2 and the low reference circuit terminal 3.
10. Verify the scan tool Passenger Compartment Humidity parameter is less than 5%.
    - **If 5% or greater**

    1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
    2. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC control module.

    - **If less than 5%**
11. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module, Vehicle in Service Mode.
12. Test for less than 1 V between the signal circuit terminal 2 and ground.
    - **If 1 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 1 V**
13. Test or replace the B160 windshield temperature and inside moisture sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for HVAC control module replacement, programming and setup

DTC B0193: FRONT BLOWER MOTOR SPEED CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0193 01

Front Blower Motor Speed Circuit Short to Battery

DTC B0193 06

Front Blower Motor Speed Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Blower Motor Control Module B+	B0193 06	B0193 06	-	-
Blower Motor B+	1	1	-	-
Blower Motor Control Module Control	B0193 06	B0193 06	B0193 01	-
Blower Motor Control	2	1	1	-
Blower Motor Control Module Ground	-	1	-	-
1. Blower Motor Inoperative 2. Blower Motor Always ON				

Circuit/System Description

The blower motor control module is an interface between the HVAC control module and the blower motor. The blower motor control module has 5 circuits: a B+ input, ground, a control circuit from the HVAC control module, a B+ output to the blower motor, and a low side pulse width modulation (PWM) output. The HVAC control module provides a low side (PWM) signal to the blower motor control module in order to request the blower motor speed. The blower motor control module grounds the blower motor using a low side PWM signal in order to vary the blower motor speed.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B0193 01

The voltage at the HVAC control module output to the blower motor control module is always high.

B0193 06

The voltage at the HVAC control module output to the blower motor control module is always low or fluctuating.

Action Taken When the DTC Sets

The blower motor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

Inspect the motor shaft for rust or other foreign material which may prohibit proper motor operation.

If the motor operates properly please reinstall it and check for Preliminary Information or Technical Service Bulletins.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K8 Blower Motor Control Module. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 6 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Vehicle OFF, remove the test lamp.
    2. Test for less than 2 Ω in the B+ circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, verify the fuse is not open and there is voltage at the fuse.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Vehicle OFF, remove the test lamp.
    2. Test for infinite resistance between the B+ circuit terminal 6 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Disconnect the X2 harness connector at the K8 Blower Motor Control Module and disconnect the harness connector at the M8 Blower Motor.
    4. Test for infinite resistance between the M8 Blower Motor B+ circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, test or replace the M8 Blower Motor.
    - **If the test lamp illuminates**

4. Vehicle in Service Mode. Test for less than 1 V between the control circuit terminal 3 and ground.
   - **If 1 V or greater**
   1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC Control Module. Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K33 HVAC Control Module
   - **If less than 1 V**
5. Vehicle OFF. It may take up to 10 min for all vehicle systems to power down.
6. Test for infinite resistance between the control circuit terminal 3 and ground.
   - **If less than infinite resistance**
   1. Disconnect the X2 harness connector at the K33 HVAC Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K33 HVAC Control Module
   - **If infinite resistance**

NOTE: Verify the ignition is OFF before connecting the blower motor control module or incorrect test results may occur.

7. Vehicle OFF, connect the X1 harness connector at the K8 Blower Motor Control Module. Vehicle in Service Mode.
8. While backprobing terminal 3 at the K8 Blower Motor Control Module, test for greater than 1 V between the control circuit and ground.
   - **If less than 1 V**

     Replace the K8 Blower Motor Control Module.

   - **If 1 V or greater**
9. Verify the voltage decreases and increases while using the controls to change the blower speed selection.
   - **If the voltage does not decrease and increase as the blower speed selection is changed**
   1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
   2. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K33 HVAC Control Module.
   - **If the voltage decreases and increases as the blower speed selection is changed**
10. Vehicle OFF, disconnect the harness connector at the M8 Blower Motor, Vehicle in Service Mode and blower ON.
11. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module.
    2. Test for less than 2 Ω in the control circuit end to end.
       - If 2 Ω or greater, repair the open/high resistance in the circuit.
       - If less than 2 Ω replace the K8 Blower Motor Control Module.
    - **If the test lamp illuminates**
12. Connect a test lamp between control circuit terminal 2 and B+ circuit terminal 1.
13. Verify the test lamp becomes progressively brighter as the blower speed is increased and progressively dimmer as the blower speed is decreased.
    - **If the test lamp does not illuminate**
    1. Vehicle OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module, Vehicle in Service Mode.

        2. Test for less than 1 V between the control circuit and ground.
            - If 1 V or greater, repair the short to voltage on the circuit.
            - If less than 1 V
        3. Test for less than 2 Ω in the control circuit end to end.
            - If 2 Ω or greater, repair the open/high resistance in the circuit.
            - If less than 2 Ω replace the K8 Blower Motor Control Module.
    - **If the test lamp illuminates, but does not change in brightness**
        1. Vehicle OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module.
        2. Test for infinite resistance between the control circuit and ground.
            - If less than infinite resistance, repair the short to ground on the circuit.
            - If infinite resistance, replace the K8 Blower Motor Control Module.
    - **If the test lamp changes in brightness as the blower speed is changed**

14. Test or replace the M8 Blower Motor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

DTC B0223, B0233, B023A, OR B0408: AIR FLOW/TEMPERATURE CONTROL

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0223

Recirculate Position Command 1 Circuit

DTC B0233

Air Flow Control Circuit

DTC B023A

HVAC Actuators Supply Voltage

DTC B0408

Main Temperature Control Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stepper Motors 12 V Reference	B023A 02	B0223 06, B0233 06, B0408 06, 1	-	-
Recirculation Actuator Control 1	B0223 06, 1	B0223 06, 1	B0223 01, 1	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Recirculation Actuator Control 2	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Recirculation Actuator Control 3	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Recirculation Actuator Control 4	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Air Temperature Actuator Control 1	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 2	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 3	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 4	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Mode Actuator Control 1	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 2	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 3	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 4	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
1. Actuator door malfunction				

Circuit/System Description

Stepper motors are used for temperature regulation, air distribution control and recirculation flap control.

With the appropriate switches at the HVAC control, the desired door positions can be selected. The selected values are passed to the HVAC control module via serial data. The HVAC control module supplies a 12 V reference voltage to the stepper motors and energizes the stepper motors with a pulsed ground signal. The stepper motors put the appropriate door into the calculated position in order to reach the desired temperature, mode. and recirculation position.

Conditions for Running the DTC

- Vehicle on, or in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B023A 02

The stepper motors supply output is shorted to ground.

B0223 01, B0233 01 or B0408 01

At least one control output (of 4 possible outputs) of the appropriate stepper motor is shorted to voltage when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

B0223 06, B0233 06 or B0408 06

At least one control output (of 4 possible outputs) of the appropriate stepper motor is shorted to ground or open when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

Action Taken When the DTC Sets

B023A 02

- The affected output will be switched off for hardware protection.

- All stepper motors are deactivated.

B0223, B0233 or B0408

- The affected output will be switched off for hardware protection.
- The affected stepper motor is deactivated.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

During diagnosis, it is important to verify that the air control door and any associated components (linkage, cams, gears, etc.) operate properly. Inspect for any conditions that may limit or prevent the air control door from moving smoothly or moving through its full range of travel. Any mechanical issues should be corrected first, before proceeding with electrical diagnosis.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the **Actuator Recalibration** procedure.
2. Verify the concern or DTC has been corrected.
    - **If the concern or DTC has not been corrected**
    1. Verify DTC B023A is not set.
        - If DTC B023A is set, refer to Circuit/System Testing - DTC B023A
        - If DTC B023A is not set, refer to Circuit/System Testing - DTC B0223, B0233 or B0408.
    - **If the concern or DTC has been corrected**
3. All OK.

Circuit/System Testing

DTC B023A

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the components listed below. It may take up to 2 min for all vehicle systems to power down.
    - M37 Mode Door Actuator

   - M46 Air Recirculation Door Actuator
   - M6 Air Temperature Door Actuator
2. Disconnect the X3 harness connector at the K33 HVAC Control Module.
3. Test for infinite resistance between the K33 HVAC Control Module circuit terminal 15 X3 and ground.
   - **If less than infinite resistance**

     Repair the short to ground on the circuit.

   - **If infinite resistance**
4. Vehicle OFF, connect the X3 harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.
5. Verify DTC B023A is not set.
   - **If the DTC is set.**

     Replace the K33 HVAC Control Module.

   - **If the DTC is not set.**
6. Verify DTC B023A does not set after connecting each of the components listed below one at a time and operating them through their full range.
   - M37 Mode Door Actuator
   - M46 Air Recirculation Door Actuator
   - M6 Air Temperature Door Actuator
   - **If the DTC sets after connecting one of the components**

     Replace the actuator that was connected immediately before the DTC set.

   - **If the DTC does not set**
7. All OK.

DTC B0223, B0233 or B0408

1. Vehicle OFF, disconnect the harness connector at the appropriate door actuator, It may take up to 2 min for all vehicle systems to power down. Vehicle in Service Mode.

   NOTE: **If more than one actuator is affected, test the B+ circuit at each actuator.**

2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
   - **If the test lamp does not illuminate**
   1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K33 HVAC control module.
   - **If the test lamp illuminates**
3. Command the appropriate actuator with a scan tool.
4. Verify a test lamp is flashing on and off when connected between the B+ circuit terminal 2 and each control circuit terminal listed below:
   - Control Circuit - terminal 1
   - Control Circuit - terminal 3
   - Control Circuit - terminal 4
   - Control Circuit - terminal 6

    - **If the test lamp is always OFF**
    1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module. Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K33 HVAC Control Module.
    - **If the test lamp is always ON**
    1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K33 HVAC Control Module.
    - **If the test lamp is flashing On and Off**
5. Test or replace the actuator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

DTC B048E: AUXILIARY HEATER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B048E 00

Auxiliary Heater System Malfunction

DTC B048E 39

Auxiliary Heater System Internal Malfunction

DTC B048E 58

Auxiliary Heater System Incorrect Reaction After Event

DTC B048E 5A

Auxiliary Heater System Plausibility Failure

Circuit/System Description

The coolant heater control module is a high voltage electric heater. High voltage is supplied from the hybrid/EV battery pack. A fused battery input, ground, and LIN serial data from the HVAC control module are used to control the operation of the coolant heater control module.

The HVAC control module requests heater operation if the coolant temperature is low and additional heat is required to meet the desired settings of the HVAC system.

The coolant heater control module monitors itself during operation, and if a fault is detected a message is sent to the HVAC control module. The HVAC control module then sets the DTC.

Conditions for Running the DTC

- 12 V battery system voltage is greater than 10.2 V.
- The HVAC control module is ON.
- The electrical auxiliary heater is commanded ON.

Conditions for Setting the DTC

B048E 00

- The coolant heater control module reports a recoverable fault for greater than 30 seconds.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 39

- The coolant heater control module reports an internal malfunction for greater than 30 seconds.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 58

- The coolant heater control module reports a limited operation status for greater than 10 minutes.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 5A

- The HVAC control module determines the coolant temperature reported by the coolant heater control module is not rational based on the vehicle operating conditions for greater than 10 minutes.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

Action Taken When the DTC Sets

- The DIC displays the Service Heater Soon message
- The coolant heater is inoperative, or operates in a limited state.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

- Verify the cooling system is full before performing diagnostics. A low or aerated coolant condition may cause this DTC to set.
- Insufficient or no coolant flow through the coolant heater due to a restriction, blockage, or coolant pump malfunction may cause this DTC to set.
- Insufficient or no voltage from the Hybrid/EV battery may cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Check for bulletins before proceeding.**

1. Verify that no other DTCs are set.
    - **If any other DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If no other DTCs are set**
2. Verify that DTC B048E 39 is not set.
    - **If DTC B048E 39 is set**

      Replace the K10 Coolant Heater Control Module

    - **If DTC B048E 39 is not set**
3. Verify that DTC B048E 00 is not set.
    - **If DTC B048E 00 is set**

      Refer to Circuit/System Testing

    - **If DTC B048E 00 is not set**
4. Verify the cooling system is filled to the proper level.
    - **If the cooling system is not filled to the proper level**
    1. Diagnose and correct the cause of the improper coolant level.
    2. Fill the cooling system to the proper level. Refer to .
    3. Clear DTCs and re-evaluate the concern.
    - **If the cooling system is filled to the proper level**
5. Verify the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter.
    - **If the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is NOT within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter**

      Allow the system to cool until the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter.

    - **If the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter**
6. Verify the G36 Auxiliary Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump On and Off with a scan tool.
    - **If the G36 Auxiliary Heater Coolant Pump does not operate**

    Refer to Auxiliary Heater Coolant Pump Malfunction.

  - **If the G36 Auxiliary Heater Coolant Pump operates**

7. Vehicle ON, HVAC system set to hot, blower set to high.
8. Verify the scan tool parameter Coolant Heater Control Module Status displays only Normal Running.
    - **If the scan tool parameter Coolant Heater Control Module Status displays only Limited Operation**
    1. Verify the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60Â°C (140Â°F) and the parameter Coolant Heater Current is greater than 15 A.
        - If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60Â°C (140Â°F) and the parameter Coolant Heater Current is less than 15 A, replace the K10 Coolant Heater Control Module
        - If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60Â°C (140Â°F) and the parameter Coolant Heater Current is greater than 15 A, refer to step 9.
    - **If the scan tool parameter Coolant Heater Control Module Status switches between Limited Operation and Normal Running.**

      Refer to step 10.

    - **If the scan tool parameter Coolant Heater Control Module Status displays only Normal Running**
9. Continue to operate the system for 10 min.
10. Verify the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is within 5Â°C (9Â°F) of parameter Desired Heater Core Outlet Coolant temperature.
    - **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is not within 5Â°C (9Â°F) of parameter Desired Heater Core Outlet Coolant temperature.**

      Replace the K10 Coolant Heater Control Module

    - **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is within 5Â°C (9Â°F) of parameter Desired Heater Core Outlet Coolant temperature.**
11. Vehicle OFF. Inspect the cooling system for restrictions or blockages in coolant flow. Refer to Heating Performance Diagnostic .
    - **If restrictions or blockages in coolant flow are found.**
    1. Diagnose and correct the cause of the restrictions or blockage.
    2. Verify the G36 Auxiliary Heater Coolant Pump operates.
    3. Clear DTCs and re-evaluate the concern.
    - **If no restrictions or blockages are found**
12. All OK.

Circuit/System Testing

NOTE: **Perform Circuit/System Verification before Circuit/System Testing.**

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must**

be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the K10 Coolant Heater Control Module. Refer to **High Voltage Disabling** .
2. Disconnect the X2 harness connector at the K10 Coolant Heater Control Module and the X4 harness connector at the T24 Battery Charger - DC. Refer to **High Voltage Connectors** .
3. Test for less than 2 Ω end to end between the 300-Volt Positive and Negative Cable circuit terminals listed below:
   - K10 Coolant Heater Control Module harness connector terminal A X2 and T24 Battery Charger - DC harness connector terminal A X4.
   - K10 Coolant Heater Control Module harness connector terminal B X2 and T24 Battery Charger - DC harness connector terminal B X4.
   - **If 2 Ω or greater**

     Replace the 300-Volt Positive and Negative Cable.
   - **If less than 2 Ω**
4. Disconnect the X3 harness connector at the T24 Battery Charger - DC. Refer to **High Voltage Connectors** .
5. Test for less than 2 Ω between the component terminals listed below:
   - T24 Battery Charger - DC connector terminal A X3 and T24 Battery Charger - DC connector terminal A X4.
   - T24 Battery Charger - DC connector terminal B X3 and T24 Battery Charger - DC connector terminal B X4.
   - **If 2 Ω or greater**

     Replace the T24 Battery Charger - DC and the K10 Coolant Heater Control Module.
   - **If less than 2 Ω**
6. Replace the K10 Coolant Heater Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup.

DTC B3844: ENGINE COOLANT CIRCULATION PUMP CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B3844 01

Engine Coolant Circulation Pump Circuit Short to Battery

DTC B3844 06

Engine Coolant Circulation Pump Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Pump Relay Coil Control	B3844 06, 2	B3844 06, 1	B3844 01, 1	-
Coolant Pump Relay Controlled Output	B3844 06, 1	1	2	-
Coolant Pump Ground	-	1	-	-
1. Coolant Pump inoperative 2. Coolant pump always on				

Circuit/System Description

The coolant heater pump is controlled by a relay. When operating conditions exist that requires the coolant heater to operate, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay. The coolant pump then circuilates the coolant within the coolant heater system.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G17 Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump On and Off with a scan tool.
    - **If the G17 Heater Coolant Pump does not operate**

      Refer to Circuit/System Testing

    - **If the G17 Heater Coolant Pump operates**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X3 harness connector at the X50A Fuse Block- Underhood.
2. Connect a test lamp between the control circuit terminal 49 and B+, Vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF when commanding the Auxiliary Coolant Pump On and Off with a scan tool.
    - **If the test lamp is always OFF**

   1. Vehicle OFF, remove the test lamp, disconnect the X2 harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Vehicle OFF.
   4. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K33 HVAC Control Module.
   - **If the test lamp is always ON**
   1. Vehicle OFF, remove the test lamp, disconnect the X2 harness connector at the K33 HVAC Control Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K33 HVAC Control Module.
   - **If the test lamp turns ON and OFF**
4. Vehicle OFF and all vehicle systems OFF, connect the X3 harness connector at the X50A Fuse Block- Underhood. Disconnect the harness connector at the G17 Heater Coolant Pump. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
6. Connect a test lamp between the control circuit terminal 2 and ground.
7. Verify the test lamp turns ON and OFF when commanding the Auxiliary Coolant Pump ON and OFF with a scan tool.
   - **If the test lamp is always OFF and the circuit fuse is good**
   1. Vehicle OFF, remove the test lamp, disconnect the X4 harness connector at the X50A Fuse Block- Underhood.
   2. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the X50A Fuse Block- Underhood.
   - **If the test lamp is always OFF and the circuit fuse is open**
   1. Vehicle OFF, remove the test lamp.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, test or replace the G17 Heater Coolant Pump.
   - **If the test lamp is always ON**
   1. Vehicle OFF, disconnect the disconnect the X4 harness connector at the X50A Fuse Block- Underhood, Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the X50A Fuse Block- Underhood.
   - **If the test lamp turns ON and OFF**
8. Test or replace the G17 Heater Coolant Pump.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

DTC P0532 OR P0533: AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of the diagnostic category.

DTC Descriptors

DTC P0532

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage

DTC P0533

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0532	P0532	P0533	-
Signal	P0532	P0532	P0533	-
Low Reference	-	P0533	-	-

Circuit/System Description

The engine control module monitors the high side refrigerant pressure through the high side A/C refrigerant pressure sensor. The engine control module supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the engine control module to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the engine control module commands the cooling fans on.

Conditions for Running the DTC

P0532 and P0533

- Any of the conditions for setting the DTC are met for 15 s.
- 12 V battery system voltage is between 11 - 18 V.

Conditions for Setting the DTC

P0532

The engine control module detects that the A/C pressure is less than.25 V.

P0533

The engine control module detects that the A/C pressure is greater than 4.75 V.

Action Taken When the DTC Sets

This is a type B DTC.

Conditions for Clearing the DTC

This is a type B DTC.

Diagnostic Aids

A malfunction within the refrigerant system causing high pressure can cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Install the appropriate Air Conditioning Service Center.
3. Verify the high side pressure reading on the Air Conditioning Service Center gauge is within 10% of the scan tool ECM A/C High Side Pressure Sensor parameter.
    - **If the reading is not within 10%**

      Refer to Circuit/System Testing.
    - **If the reading is within 10%**
4. Refer to **Air Conditioning (A/C) System Performance Test** .

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B1 A/C Refrigerant Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
    - **If less than 4.8 V**

    1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 5.2 V**
    1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K20 Engine Control Module.
    - **If between 4.8 - 5.2 V**
5. Verify the scan tool Engine Control Module A/C High Side Pressure Sensor parameter is less than.25 V.
    - **If.25 V or greater**
    1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module, vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit terminal 3 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K20 Engine Control Module.
    - **If less than.25 V**
6. Connect a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
7. Verify the scan tool A/C High Side Pressure Sensor parameter is greater than 4.75 V.
    - **If 4.75 V or less**
    1. Vehicle OFF, remove the jumper wire and disconnect the harness connectors at the K20 Engine Control Module.
    2. Test for infinite resistance between the signal circuit terminal 3 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K20 Engine Control Module.
    - **If greater than 4.75 V**
8. Test or replace the B1 A/C Refrigerant Pressure Sensor.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- HVAC Component Replacement Reference
- Control Module References for control module replacement, programming and setup

DTC P0534: AIR CONDITIONING (A/C) REFRIGERANT CHARGE LOW

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC P0534

Air Conditioning (A/C) Refrigerant Charge Low

Circuit/System Description

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down and dehumidify the cabin and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High Voltage Battery and inverts it to alternating current for the motor. The AC compressor may be activated when any of the following events occur:

- The customer selects Heat and A/C.
- The HVAC system is fan only but the customer selects defrost mode
- The High Voltage Battery Thermal System requests the AC compressor on to help maintain the battery temperature

The Hybrid Powertrain control module 2 (HPCM2) uses values from the A/C refrigerant pressure transducers, ambient air temperature sensor, cabin climate control request, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the HPCM2 to the A/C compressor control module via serial data message.

Conditions for Running the DTC

DTC P0534 Case 1

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor has been off for more than 60 min.
- The AC compressor is commanded on and operating above 500 RPM
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

DTC P0534 Case 2

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor is off for more than 60 min.
- Outside air temperature is greater than 15Â° C (59Â°F).
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

DTC P0534 Case 3

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor is off for more than 60 min.
- Outside air temperature is greater than 5Â° C (41Â°F).
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

Conditions for Setting the DTC

DTC P0534 Case 1

Low side pressure is less than 90 kPa (13.05 PSI) within 60 sec of the compressor turning on

DTC P0534 Case 2

Low side pressure is less than 150 kPa (21.75 PSI) for outside air temperature greater than 20Â° C (68Â°F).

DTC P0534 Case 3

Low side pressure is less than 100 kPa (14.50 PSI) for outside air temperature between 5 - 20Â° C (41 - 68Â° F).

Action Taken When the DTC Sets

Active cooling mode for the battery may be disabled.

Conditions for Clearing the DTC

P0534 is a type B DTC.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Install the appropriate air conditioning service center, vehicle in Service Mode.
2. Verify the low side pressure reading on the Air Conditioning Service Center is within 3% of the scan tool A/C Low Side Pressure Sensor parameter.
   - **If the reading is not within 3%**

     Refer to **DTC P151C or P2516-P2518**.

   - **If the reading is within 3%**
3. Verify the high side pressure reading on the Air Conditioning Service Center is within 3% of the scan tool A/C High Side Pressure Sensor parameter.
   - **If the reading is not within 3%**

     Refer to **DTC P0532 or P0533**.

   - **If the reading is within 3%**
4. Verify the A/C System is operating correctly, refer to **Air Conditioning (A/C) System Performance Test** .
5. Clear all codes in the K114B Hybrid Powertrain Control Module 2 using a scan tool.

6. Verify DTC P0534 does not set while operating the HVAC system under the Conditions for Running the DTC.
    - **If the DTC is set**

      Replace the K114B Hybrid Powertrain Control Module 2.

    - **If the DTC is not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup.

DTC P0D69-P0D7F: A/C COMPRESSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0D69

A/C Compressor Motor Voltage Sensor Performance

DTC P0D6A

A/C Compressor Motor Voltage Sensor Circuit High Voltage

DTC P0D6B

A/C Compressor Motor Voltage Sensor Circuit Low Voltage

DTC P0D71

Electric A/C Compressor Control Module Internal Temperature Sensor Performance

DTC P0D72

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit High Voltage

DTC P0D73

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit Low Voltage

DTC P0D74

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit Intermittent

Circuit/System Description

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High Voltage Battery and inverts it to alternating current for the motor. The AC compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button

- The HVAC control, in AUTO mode, requests the electric AC compressor on to help in cooling the cabin or removing moisture in the defrost mode
- The High Voltage Battery Thermal System requests the AC compressor on to help maintain the battery temperature

The Hybrid Powertrain control module 2 uses values from the A/C refrigerant pressure transducers, A/C refrigerant thermistor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This speed request message is sent from the Hybrid/EV Powertrain Control Module 2 to the A/C compressor control module via serial data message.

Conditions for Running the DTC

DTC P0D69

- 12 V battery system voltage is greater than 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A; P0D6B, P1EC3, P2534, P2535, P3061, U0111, U016B, or U185A must not be set.

DTC P0D6A

- 12 V battery system voltage is above 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P2534, P2535, or U016B must not be set.

DTC P0D6B

- 12 V battery system voltage is above 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P0AA4, P0AD9, P0C78, P0D5E, P1EC3, P2534, P2535, P3061, or U016B must not be set.

DTC P0D71

- 12 V battery system voltage is above 10.2 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor has been off for more than 6 hours
- Outside air temperature is greater than -7Â°C (19Â°F)
- DTCs P0071, P0072, P0073, P0074, P0532, P0533, P0606, P0D72, P0D73, P0D74, P2534, P2535, or U016B must not be set

DTC P0D72, P0D73

- 12 V battery system voltage is above 10.2 V.
- DTCs P2534, P2535, or U016B must not be set

Conditions for Setting the DTC

DTC P0D69

A/C compressor motor voltage is greater than 33 V.

DTC P0D6A

The A/C compressor high voltage input sensor value is greater than 543.08 V for more than 1 second.

DTC P0D6B

The A/C compressor high voltage input sensor value is less than 28.58 V for more than 1 second.

DTC P0D71

The A/C compressor processor temperature sensor value is greater than 45Â°C (113Â°F).

AND

The difference between the A/C compressor processor temperature sensor value and the outside air temperature value is greater than 60Â°C (108Â°F).

DTC P0D72

A/C compressor processor temperature sensor value is less than -40Â°C (-40Â°F) more than 1 second.

DTC P0D73

A/C compressor processor temperature sensor value is greater than 150Â°C (302Â°F) for more than 1 second.

Action Taken When the DTC Sets

The A/C compressor is disabled.

Conditions for Clearing the DTC

These are all type B DTC's

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0071, P0072, P0073, P0074, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P1EC3, P2534, P2535, P3061, U0111, U016B, or U185A are not set.
   - **If any of the DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**

3. Verify that DTC P0D6B is not set.
    - **If DTC P0D6B is set**

      Refer to Circuit/System Testing

    - **If DTC P0D6B is not set**
4. Verify that DTC P0D69, P0D6A, P0D71, P0D72, P0D73, or P0D74 are not set.
    - **If any of the DTCs are set**
    1. Program the G1 A/C Compressor and the K114B Hybrid/EV Powertrain Control Module 2 with the latest software calibration.
    2. Verify the DTC's do not set
        - If any of the DTC's set, replace the affected control module.
        - If none of the DTC's are set
    3. All OK.
    - **If none of the DTCs are set**
5. All OK.

Circuit/System Testing

NOTE: **Perform Circuit/System Verification before Circuit/System Testing.**

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the G1 A/C Compressor. Refer to **High Voltage Disabling** .
2. Disconnect the X2 harness connector at the G1 A/C Compressor and the X5 harness connector at the T24 Battery Charger - DC. Refer to **High Voltage Connectors** .
3. Test for less than 2 Ω end to end between the 300-Volt Positive and Negative Cable circuit terminals listed below:
    - G1 A/C Compressor harness connector terminal A X2 and T24 Battery Charger - DC harness connector terminal A X5.
    - G1 A/C Compressor harness connector terminal B X2 and T24 Battery Charger - DC harness connector terminal B X5.
    - **If 2 Ω or greater**

      Replace the 300-Volt Positive and Negative Cable.

    - **If less than 2 Ω**
4. Disconnect the X3 harness connector at the T24 Battery Charger - DC. Refer to **High Voltage Connectors** .
5. Test for less than 2 Ω between the component terminals listed below:
    - T24 Battery Charger - DC connector terminal A X3 and T24 Battery Charger - DC connector terminal A X5.

  - T24 Battery Charger - DC connector terminal B X3 and T24 Battery Charger - DC connector terminal B X5.
  - **If 2 Ω or greater**

    Replace the T24 Battery Charger - DC and the G1 A/C Compressor.

  - **If less than 2 Ω**

6. Replace the G1 A/C Compressor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

DTC P151C OR P2516-P2518: AIR CONDITIONING (A/C) REFRIGERANT LOW SIDE PRESSURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P151C

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Not Plausible

DTC P2516

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Performance

DTC P2517

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Circuit Low Voltage

DTC P2518

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0CE5 00, P0CE6 00, P0606 00, P2517 00, P26A6 00, P2681 00	P2516 00 P2517 00	P0CE7 00, P0606 00, P2518 00, P26A7 00	-
A/C Low Pressure Sensor Signal	P2516 00 P2517 00	P2517 00	P0CE5 00, P0CE7 00, P0606 00, P2518 00, P26A5 00, P26A9 00	P2516 00
Low Reference	-	P2517 00	-	-

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 monitors the low side refrigerant pressure through the A/C pressure sensor. The Hybrid/EV Powertrain Control Module 2 supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the Hybrid/EV Powertrain Control Module 2 to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low.

Conditions for Running the DTC

P151C

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs may be active: P2517, P2518, P0073, P0072, P0071, P0119, P0118, P0117, P0116, P0531, P0532, P0533, P0606.
- Outside Air Temperature raw and corrected values must have had a chance to settle out. Once this occurs these variables are assigned a status of valid. The vehicle may need to have some time driving in EV mode.
- Coolant temperature must be within 15 degrees of outside air temperature.
- Outside Air Temperature between 0Â°C (32Â°F) and 25Â°C (77Â°F).
- AC compressor must have been off for an hour since the last time the AC compressor was on.
- High side refrigerant pressure reading must be between 0 kPa and 675 kPa.

P2516

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs may be active: P2517, P2518, P0073, P0072, P0071, P0119, P0118, P0117, P0116, P0606.
- Coolant temperature must be within 15 degrees of outside air temperature.
- AC compressor must have been off for an hour since the last time the AC compressor was on.
- AC compressor must be turned on for one minute. (This may require the service technician to select an HVAC mode that causes the AC compressor to run).

P2517 or P2518

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.

Conditions for Setting the DTC

DTC P151C

- The A/C low side Refrigerant Pressure reading and the A/C high side Refrigerant Pressure reading differ by more than 200 kPa (29 psi).
- Loss of HVAC Control Module communication

DTC P2516

The difference between the A/C low side pressure Sensor before compressor on and after compressor on changes less than 50 kPa (7 psi) over a 15 second period.

DTC P2517

The Hybrid/EV Powertrain Control Module 2 detects a short to ground or open at the A/C low side pressure sensor signal circuit.

DTC P2518

The Hybrid/EV Powertrain Control Module 2 detects a short to voltage at the A/C low side pressure sensor signal circuit.

Action Taken When the DTC Sets

These are type B DTCs.

Conditions for Clearing the DTC

These are type B DTCs.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTCs U0140 and U184B are not set.
   - **If any of the DTCs are set**

     Refer to **DTC U0100-U02FF** , or **DTC U184B** .

   - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, all vehicle systems OFF, scan tool disconnected, and key removed from vehicle, disconnect the harness connector at the B1C A/C Low Side Pressure Sensor. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
   - **If less than 4.8 V**
   1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the terminals listed below and ground.
      - Terminal 63
      - Terminal 64
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 5 V reference circuit terminal 63 end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If greater than 5.2 V**
   1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
   2. Test for less than 1 V between the terminals listed below and ground.
      - Signal circuit terminal 25
      - Signal circuit terminal 31
      - Signal circuit terminal 50
      - 5 V reference circuit terminal 63
      - 5 V reference circuit terminal 64
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If between 4.8 - 5.2 V**
5. Verify the scan tool Hybrid/EV Powertrain Control Module 2 A/C Low Side Pressure Sensor parameter is less than 0.1 V.
   - **If 0.1 V or greater**
   1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit terminal 3 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
   - **If less than 0.1 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
7. Verify the scan tool A/C Low Side Pressure Sensor parameter is greater than 4.8 V.
   - **If 4.8 V or less**
   1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If greater than 4.8 V**

8. Test or replace the B1C A/C Low Side Pressure Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

DTC P154F: ELECTRIC A/C COMPRESSOR MOTOR INPUT CURRENT- POSITIVE CONTACTOR STATE NOT PLAUSIBLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P154F

Electric A/C Compressor motor Input Current- Positive Contactor State Not Plausible

Circuit/System Description

The hybrid powertrain control module 2 receives serial data messages from the A/C compressor. If the electrical current reported by the compressor is not logical based on the currently commanded state, the hybrid powertrain control module 2 sets the DTC.

Conditions for Running the DTC

- Vehicle ON
- 12 V battery system voltage above 10.2 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs are set: P0532, P0533, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A, P0D6B, P15CA, P1EC3, P1F0A, P1F0C, P1F0D, P2534, P2535, P3061, U0111, U016B, or U185A.
- The time since the high voltage contactors have been commanded opened or closed is greater than 1 s.
- Hybrid/EV Powertrain Control Module 2 monitors the data from the A/C compressor every 250 ms when the above conditions are met.

Conditions for Setting the DTC

DTC P154F is a Type B DTC.

Condition 1

- The high voltage battery contactors are commanded open.
- Electrical current is reported via serial data from the A/C compressor.

Condition 2

- The high voltage battery contactors are commanded closed.
- The A/C compressor is commanded OFF (0 RPM).
- Electrical current is reported via serial data from the A/C compressor.

  OR

- The RPM reported via serial data from the A/C compressor is greater than 60 RPM.

Condition 3

- The high voltage battery contactors are commanded closed.
- The high voltage battery is between 300 - 410 V.
- The A/C compressor is commanded ON.
- The RPM reported via serial data from the A/C compressor is between 1000 - 8600 RPM.
- The A/C refrigerant high side pressure reported via serial data from the ECM is between 200 - 2300 kPa (29 - 334 PSI).
- Electrical current reported via serial data from the A/C compressor is less than 0.2 A or greater than 27 A.

Action Taken When the DTC Sets

DTC P154F is a Type B DTC.

Conditions for Clearing the DTC

DTC P154F is a Type B DTC.

Diagnostic Aids

These DTCs may be set during a stall.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify DTCs P0532, P0533, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A, P0D6B, P15CA, P1EC3, P1F0A, P1F0C, P1F0D, P2534, P2535, P3061, U0111, U016B, or U185A. are not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If none of the DTCs are set**
2. Replace the G1 A/C Compressor.
3. Verify DTC P154F does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTCs sets**

      Replace the K114B Hybrid/EV Powertrain Control Module 2.

    - **If the DTCs does not set**
4. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

HVAC Component Replacement Reference

Control Module References for control module replacement, programming and setup.

DTC P156A-P156C: AIR CONDITIONING (A/C) PRESSURE TOO HIGH WHEN A/C OFF, TOO LOW WHEN A/C ON

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of the diagnostic category.

DTC Descriptors

DTC P156A

Air Conditioning (A/C) Pressure Too High when A/C Off

DTC P156B

Air Conditioning (A/C) Pressure Too Low when A/C On

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0452, P0532, P0641	P0532	P0453, P0533, P0641	-
Signal	P0532	P0532	P0533	P0531, P156A, P156B
Low Reference	-	P0533	-	-

Circuit/System Description

The engine control module monitors the high side refrigerant pressure through the high side A/C refrigerant pressure sensor. The engine control module supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the engine control module to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the engine control module commands the cooling fans on.

If the engine control module detects the refrigerant pressure sensor signal is not logical based on the current operating conditions, the engine control module sets the DTC.

Conditions for Running the DTC

P156A

- Vehicle ON
- None of these DTCs are set: P0532, P0533, or U016B
- The compressor has been OFF for more than 20 s.
- The ECM monitors the A/C high side pressure every 100 ms when the above conditions are met.

P156B

- Vehicle ON
- None of these DTCs are set: P0532, P0533, or U016B
- The compressor has been ON for more than 10 s.
- The ECM monitors the A/C high side pressure every 100 ms when the above conditions are met.

Conditions for Running the DTC

P156A

- P156A is a type B DTC
- The ECM detects the A/C high side pressure is too high based on the current operating conditions.

P156B

- P156B is a type B DTC
- The ECM detects the A/C high side pressure is too low based on the current operating conditions.

Action Taken When the DTC Sets

P156A and P156B are type B DTCs

Conditions for Clearing the DTC

P156A and P156B are type B DTCs

Diagnostic Aids

A malfunction within the refrigerant system causing can cause these DTCs to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

GE-48800 CoolTech A/C Recharge Machine

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other DTCs are set.
   - **If any other DTCs are set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

3. Install the **GE-48800** CoolTech A/C Recharge Machine.
4. Verify the high side pressure reading on the Air Conditioning Service Center is within 10% of the scan tool ECM A/C High Side Pressure Sensor parameter.
    - **If the reading is not within 10%**

      Refer to **DTC P0532 or P0533**.

    - **If the reading is within 10%**
5. Refer to **Air Conditioning (A/C) System Performance Test** .

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P15C6 OR P15C8-P15CB: ELECTRIC A/C COMPRESSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for a overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P15C6

Electric A/C Compressor Speed Request Signal Message Counter Incorrect

DTC P15C8

Electric A/C Compressor Data Message Counter Incorrect

DTC P15C9

Electric A/C Compressor Status Message Counter Incorrect

DTC P15CA

Electric A/C Compressor Sensors Signal Message Counter Incorrect

DTC P15CB

Electric A/C Compressor Sensors Status Message Counter Incorrect

Circuit/System Description

The hybrid powertrain control module 2 receives serial data messages from the A/C compressor. If the message counter from the A/C compressor is not incrementing based on the currently commanded state, the hybrid powertrain control module 2 sets the DTC.

Conditions for Running the DTC

- Vehicle ON
- 12 V battery system voltage above 10.2 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs are set: P2534, P2535, or U016B
- The A/C compressor is active.
- Hybrid/EV Powertrain Control Module 2 monitors the data from the A/C compressor every 100 ms when the above conditions are met.

Conditions for Setting the DTC

The hybrid powertrain control module 2 detects the message counter from the A/C compressor is not being updated.

Action Taken When the DTC Sets

DTCs P15C6, P15C8, P15C9, P15CA, and P15CB are Type B DTCs.

Conditions for Clearing the DTC

DTCs P15C6, P15C8, P15C9, P15CA, and P15CB are Type B DTCs.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Hybrid/EV Cooling System Description and Operation**

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTCs P2534, P2535, or U016B are not set.
    - **If DTC P2534, P2535, or U016B are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If DTC P2534, P2535, or U016B are not set**
2. Replace the G1 A/C Compressor.
3. Verify DTCs P15C6, P15C8, P15C9, P15CA, or P15CB do not set while operating the vehicle within the Conditions for Running the DTC.
    - **If any of the DTCs are set**

      Replace the K114B Hybrid/EV Powertrain Control Module 2.

    - **If none of the DTCs are set**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

HVAC Component Replacement Reference

Control Module References for control module replacement, programming and setup.

DTC P1F0A-P1F0D: A/C COMPRESSOR MOTOR, ELECTRIC A/C COMPRESSOR CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1F0A

A/C Compressor Motor Speed Performance

DTC P1F0B

A/C Compressor Motor Start-Up Current Performance

DTC P1F0C

Electric A/C Compressor Control Module A/C Compressor Motor Current Feedback Circuit Low Voltage

DTC P1F0D

Electric A/C Compressor Control Module A/C Compressor Motor Current Feedback Circuit High Voltage

Circuit/System Description

The A/C compressor function is to provide refrigerant flow in the A/C refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High voltage battery and inverts it to alternating current for the motor. The A/C compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button
- The HVAC control, in AUTO mode, requests the electric A/C compressor on to help in cooling the cabin or removing moisture in the defrost mode
- The High Voltage Battery Thermal System requests the A/C compressor on to help maintain the battery temperature

The Hybrid/EV powertrain control module 2 uses values from the A/C refrigerant pressure transducers, A/C refrigerant thermistor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the Hybrid/EV powertrain control module 2 to the A/C compressor control module via serial data message.

A/C Compressor has a motor start up procedure that can take a variable length of time to run to bring the motor up to requested speed. Length of time is dependent on external conditions such as underhood temperature and high side pressure. In hotter conditions, the motor start up time will be longer. The A/C compressor control module monitors an internal parameter known as the DC link current which is based off DC input current. It is not possible to measure this parameter externally.

Conditions for Running the DTC

DTC P1F0A

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0B

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0C

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0D

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

Conditions for Setting the DTC

DTC P1F0A

- A/C compressor control module temperature is greater than 85Â°C (185Â°F) and compressor motor speed does not reach to 1800 RPM within 20 s after the start of spinning
- A/C compressor control module temperature is less than or equal to 85Â°C and A/C compressor motor speed does not reach to 1800 RPM.

DTC P1F0B

Any A/C compressor control module phase current (U/V/W) greater than or equal to -1 A during initial motor startup process

DTC P1F0C

A/C compressor control module DC link Current is less than 2.5 A for 6 s

DTC P1F0D

A/C compressor control module DC link Current is greater than 36.7 A for 6 s

Action Taken When the DTC Sets

The A/C compressor control module is disabled but will retry once the compressor speed request goes to 0 RPM and a new speed request greater than 0 RPM is sent.

Conditions for Clearing the DTC

These are type B DTC's

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTCs P1F0A-P1F0D are not set.
   - **If any of the DTCs are set**
   1. Program the G1 A/C Compressor and the K114B Hybrid/EV Powertrain Control Module 2 with the latest software calibration.
   2. Verify the DTCs do not set
      - If any of the DTCs set, replace the affected control module.
      - If none of the DTCs are set
   3. All OK.
   - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

SYMPTOMS - HVAC SYSTEMS - AUTOMATIC

NOTE: **The following steps must be completed before using the symptom tables:**

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
   - There are no DTCs set.
   - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Automatic HVAC Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Verify the A/C compressor turns freely and is not seized.

- Verify that the customer is using the correct key to enable personalization and is not inadvertently activating auxiliary HVAC controls.
- The A/C compressor will not operate in cold outside air temperatures.
- The following conditions may cause window fogging:
  - Wet carpet or mats
  - High humidity
  - Interior water leak
  - Blocked A/C evaporator drain tube
  - Maximum passenger capacity
  - Blocked body pressure relief valves
- Inspect the air distribution system for causes of reduced air flow:
  - Obstructed or dirty passenger compartment air filter, if equipped
  - Blocked or damaged air inlet or outlet vents

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

HVAC System Malfunction

HVAC SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Aids

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distribution ducts

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Check for bulletins before proceeding.**

1. Vehicle in Service Mode.
2. Verify every applicable scan tool switch parameter changes when pressing the appropriate switch on the A20 Radio/HVAC Controls.
   - **If any parameter does not change**

     Replace the A20 Radio/HVAC Controls.

   - **If all parameters change**
3. Verify the blower motor operates properly with the blower motor switch in each speed position.
   - **If the blower motor does not operate properly in each speed position**

     Refer to **DTC B0193**.

   - **If the blower motor operates properly in each speed position**
4. Verify every HVAC door moves correctly when pressing the appropriate switch.
   - **If any HVAC door does not move correctly**

     Refer to **DTC B0223, B0233, B023A, or B0408**.

   - **If all HVAC doors move correctly**
5. Install the appropriate ACR Air Conditioning Service Center, Vehicle in Service Mode
6. Verify the high side pressure on the gauge is within 10% of the scan tool A/C High Side Pressure Sensor parameter.
   - **If the A/C High Side Pressure Sensor parameter is not within 10%**

     Refer to **DTC P0532 or P0533**.

   - **If the A/C High Side Pressure Sensor parameter is within 10%**
7. Verify the A/C High Side Pressure Sensor parameter is between 269-2929 kPa (39-425 PSI).
   - **If the reading is not between 269-2929 kPa (39-425 PSI)**

     Refer to **Air Conditioning (A/C) System Performance Test**

   - **If the reading is between 269-2929 kPa (39-425 PSI)**
8. Verify the low side pressure on the gauge is within 10% of the scan tool A/C Low Side Pressure Sensor parameter.
   - **If the A/C Low Side Pressure Sensor parameter is not within 10%**

     Refer to **DTC P151C or P2516-P2518**.

   - **If the A/C Low Side Pressure Sensor parameter is within 10%**
9. Verify the scan tool parameters listed below are within 10% of ambient temperature.
   - Lower Left Duct Air Temperature Sensor
   - Upper Left Duct Air Temperature Sensor
   - **If not within 10% of ambient temperature**

     Refer to **DTC B0173 or B0178**.

   - **If within 10% of ambient temperature**

NOTE: **If the vehicle is equipped with RPO CE1, proceed to step 11.**

10. Verify the scan tool parameters listed below are within 10% of actual conditions.
    - Passenger Compartment Humidity
    - Passenger Compartment Humidity Sensor Temperature
    - Passenger Compartment Windshield Temperature
    - **If not within 10% of actual conditions**

      Refer to DTC B018A, B048C, B048F, or B1395.

    - **If within 10% of actual conditions**
11. Vehicle ON, A/C system ON.
12. Verify cool air flows from the ducts with the temperature control in the coldest position.
    - **If the air is not cool**

      Refer to Air Conditioning (A/C) System Performance Test

    - **If the air is cool**
13. Vehicle in Service Mode.
14. Verify the G36 Auxiliary Heater Coolant Pump turns On and Off when commanded with a scan tool.
    - **If the G36 Auxiliary Heater Coolant Pump does not turn On and Off**

      Refer to DTC B3844.

    - **If the G36 Auxiliary Heater Coolant Pump turns On and Off**
15. Vehicle ON, verify the K10 Coolant Heater Control Module is operating properly.
    - **If the K10 Coolant Heater Control Module is not operating properly**

      Refer to DTC B048E

    - **If the K10 Coolant Heater Control Module is operating properly**
16. Verify warm air flows from the ducts with the temperature control in the warmest position.
    - **If the air is not warm**

      Refer to Heating Performance Diagnostic .

    - **If the air is warm**
17. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- HVAC Component Replacement Reference
- Control Module References for control module replacement, programming and setup

AUXILIARY HEATER COOLANT PUMP MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B3844 01

Engine Coolant Circulation Pump Circuit Short to Battery

DTC B3844 06

Engine Coolant Circulation Pump Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Pump Relay Coil Control	B3844 06, 2	B3844 06, 1	B3844 01, 1	-
Coolant Pump Relay Controlled Output	B3844 06, 1	1	2	-
Coolant Pump Ground	-	1	-	-
1. Coolant Pump inoperative 2. Coolant pump always on				

Circuit/System Description

The coolant heater pump is controlled by a relay. When operating conditions exist that requires the coolant heater to operate, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay. The coolant pump then circulates the coolant within the coolant heater system.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G17 Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump On and Off with a scan tool.
    - **If the G17 Heater Coolant Pump does not operate**

      Refer to **DTC B3844**.

    - **If the G17 Heater Coolant Pump operates**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

AFTERBLOW ENABLING

Afterblow is a feature that dries the evaporator core by operating the blower motor after the engine is turned off. This aids in reducing microbial growth that can create undesirable odors.

The vehicle does not come equipped with the afterblow feature turned on. If the afterblow feature is required due to an odor concern, it must be enabled by using the scan tool.

Use the following procedure to enable the afterblow feature:

1. Connect the Scan Tool.
2. Ignition ON/ Vehicle in Service Mode
3. Select Module Diagnostics.
4. Select HVAC Control Module.
5. Select Configuration/Reset Functions.
6. Select HVAC Afterblow Configuration.

When afterblow has been enabled, the following conditions must be met for the HVAC control module to operate afterblow:

- The vehicle must be turned OFF.
- The outside air temperature must be at least 11Â°C (52Â°F) when the compressor was last operating before the engine was turned OFF.
- The A/C compressor must have operated for more than 2 minutes before the engine was turned OFF.
- The system voltage must be above 12 V.

Once the above conditions have been met, the blower motor will operate at a low blower speed, following the sequence below up to 5 times:

1. The blower motor will be OFF for 7 - 11 minutes.
2. The blower motor will operate for 20 - 60 seconds.

ACTUATOR RECALIBRATION

Preferred Method (with Scan Tool)

NOTE: **Do not operate any HVAC controls while the HVAC control module is calibrating as this may interrupt the process. If interrupted, improper HVAC performance will result.**

1. Using a scan tool, perform the HVAC Actuators Learn in the HVAC Control Module.
2. Follow the scan tool directions to complete the procedure.
3. Operate the system and verify that no DTCs have set as current DTCs.
4. If DTC B101E 4B is set after attempting the actuator recalibration procedure, perform the following:
    1. Verify which actuator does not have a scan tool learn status parameter status of complete.
    2. Verify the unlearned actuator is physically rotating - A common cause of DTC B101E 4B is an actuator that is electrically OK but fails to physically rotate (e.g. stripped gears).
    3. If the unlearned actuator is not physically rotating, replace the actuator, otherwise replace the HVAC control module.

Alternate Method (without Scan Tool)

NOTE: **Do not operate any HVAC controls while the HVAC control module is calibrating as this may interrupt the process. If interrupted, improper HVAC performance will result.**

1. Ignition OFF/ Vehicle OFF.

2. Remove the HVAC control module fuse for a minimum of 10 s.
3. Install the HVAC control module fuse.
4. Start the vehicle.
5. Wait 40 s for the HVAC control module to self-calibrate.

REPAIR INSTRUCTIONS

HEATER AND AIR CONDITIONING REMOTE CONTROL REPLACEMENT

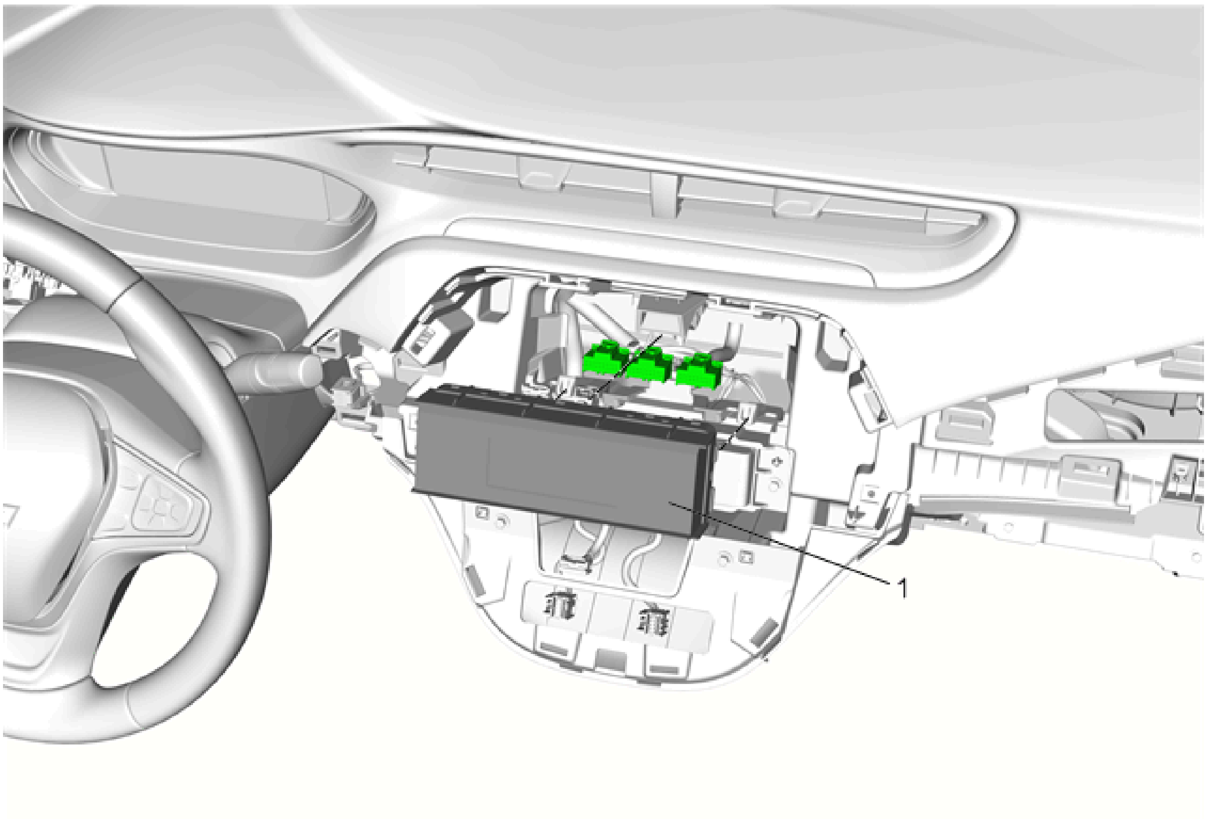

Fig. 6: Heater and Air Conditioning Remote Control
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Trim Plate Replacement	
1	Heater and Air Conditioning Remote Control **Procedure** 1. Release the retaining tabs. 2. Disconnect the electrical connector. 3. Program the heater and air conditioning remote control. Control Module References

AIR CONDITIONING WIRING HARNESS REPLACEMENT

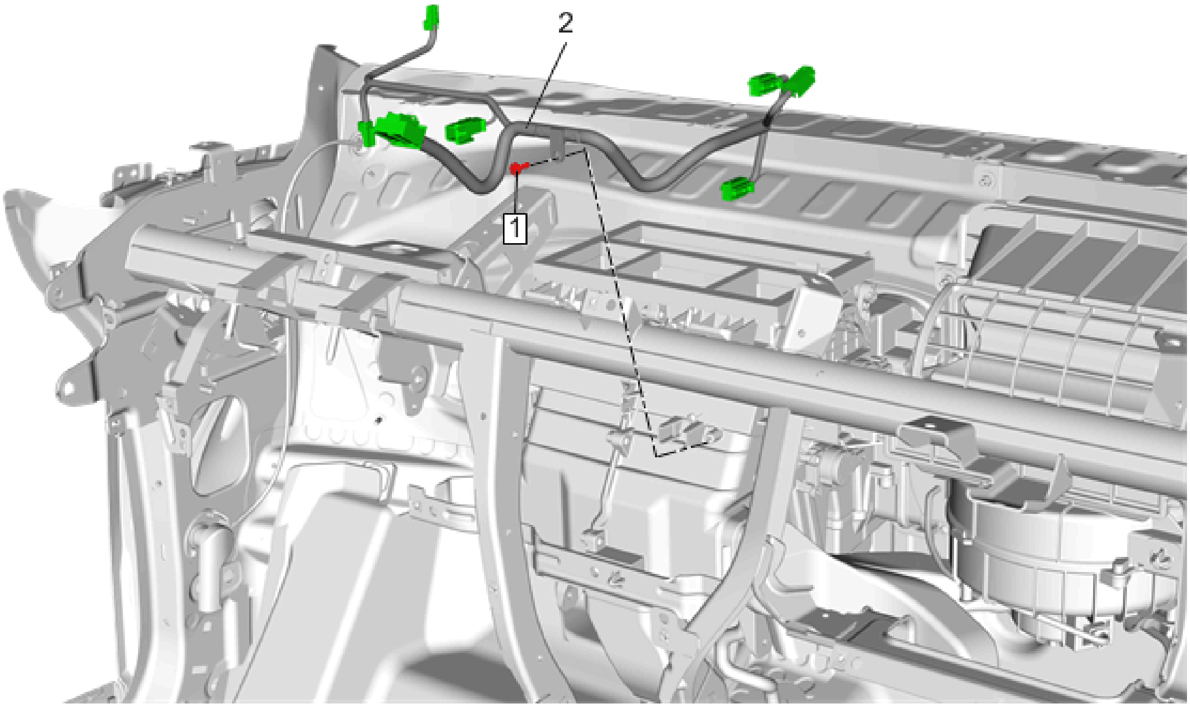

Fig. 7: Air Conditioning Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Instrument Panel Assembly Replacement 2. Loosen the tie bar, if necessary. Instrument Panel Tie Bar Replacement	
1	Air Conditioning Wiring Harness Screw **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Air Conditioning Wiring Harness **Procedure** Disconnect the electrical connectors.

AIR INLET VALVE ACTUATOR REPLACEMENT

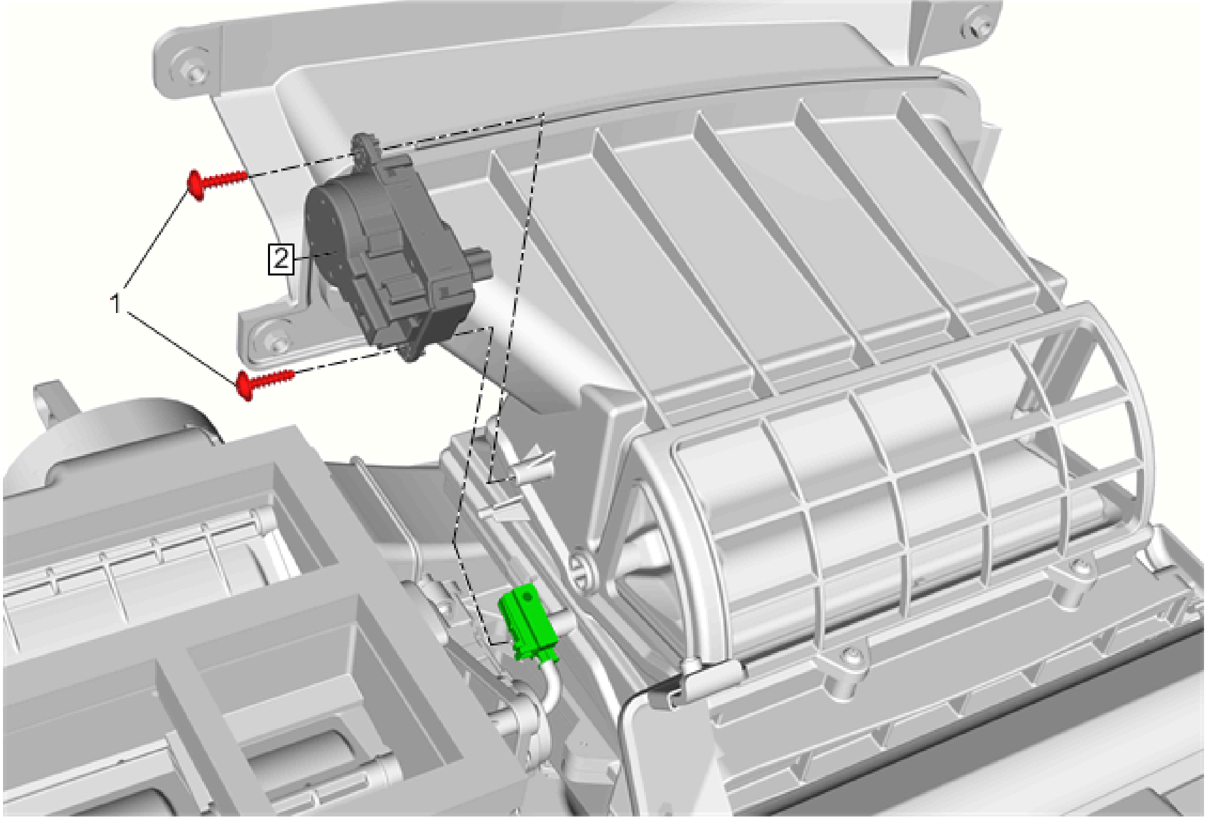

Fig. 8: Air Inlet Valve Actuator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the air inlet housing. Air Inlet Housing Replacement	
1	Air Inlet Valve Actuator Fastener (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Air Inlet Valve Actuator **Procedure** Perform the programming and setup. Actuator Recalibration

MODE VALVE ACTUATOR REPLACEMENT

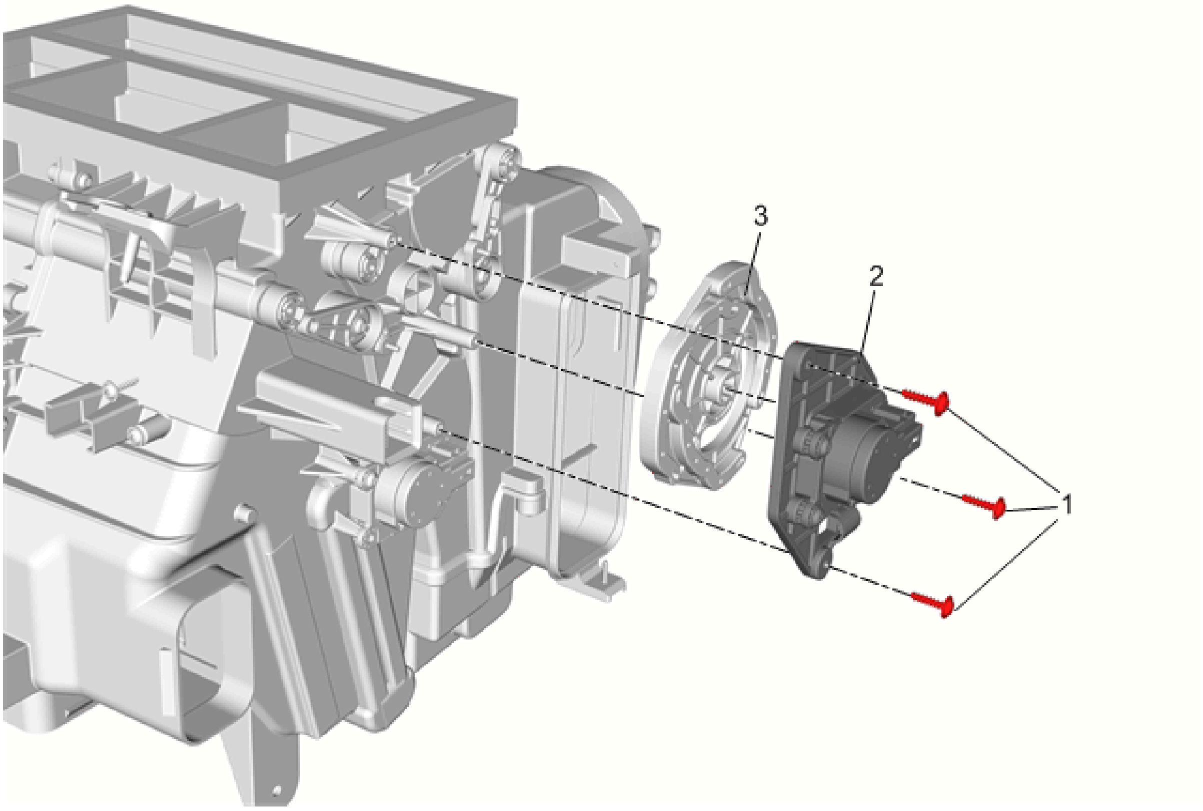

Fig. 9: Mode Valve Actuator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Heater and Air Conditioning Evaporator Case Replacement	
1	Mode Valve Actuator Bolt (Qty: 3) **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
2	Mode Valve Actuator **Procedure** 1. Mark cam and levers for proper installation. 2. Disconnect the electrical connector. 3. Reposition the air conditioning module wiring harness. 4. Actuator Recalibration
3	Mode Control Cam **Procedure** Remove the mode control cam from the actuator.

MODE CONTROL CAM REPLACEMENT

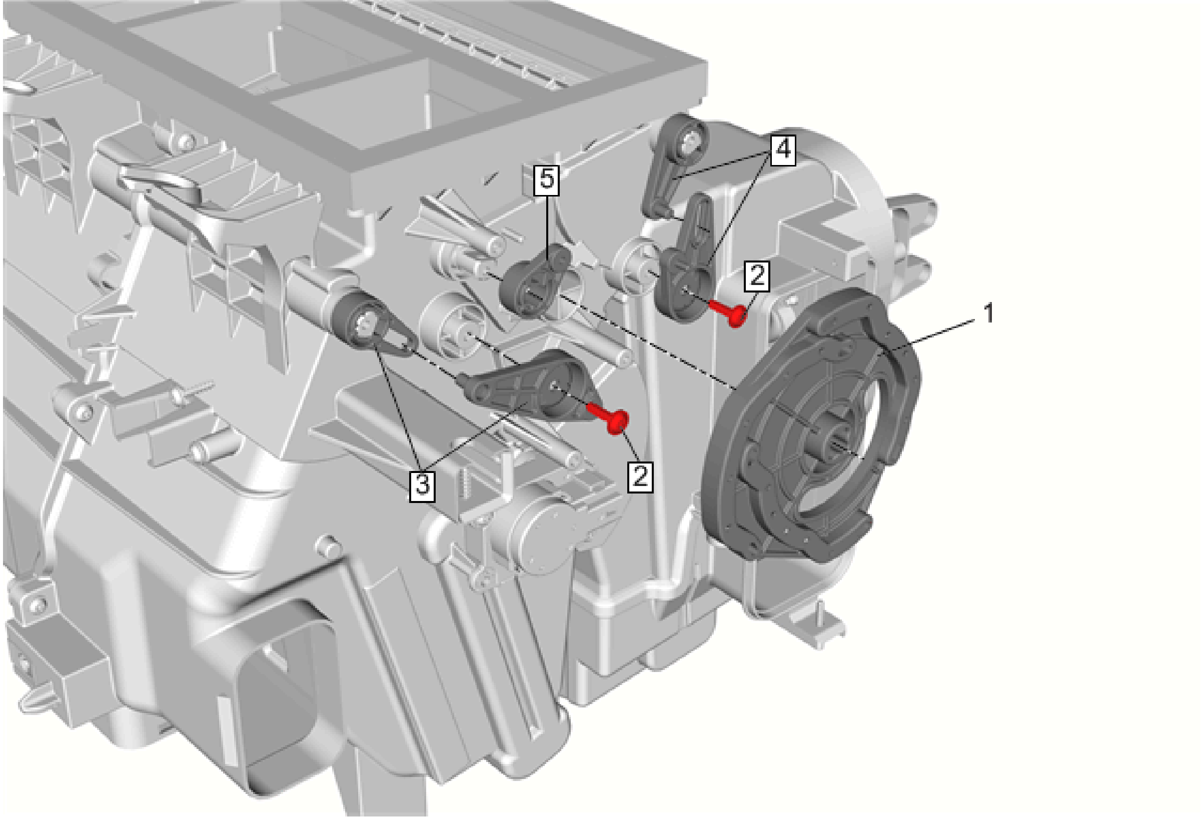

Fig. 10: Mode Control Cam
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Mode Valve Actuator Replacement	
1	Mode Control Cam **Procedure** 1. Mark the cam and levers for proper installation. 2. Lubricate the mode control cam in order to assure proper operation. Use Polylub GLY 801™, or equivalent.
2	Lever Screw (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 2.5 N.m (22 lb in)
3	Floor Air Valve Lever
4	Defroster Valve Lever
5	Vent Valve Gear

TEMPERATURE VALVE ACTUATOR REPLACEMENT

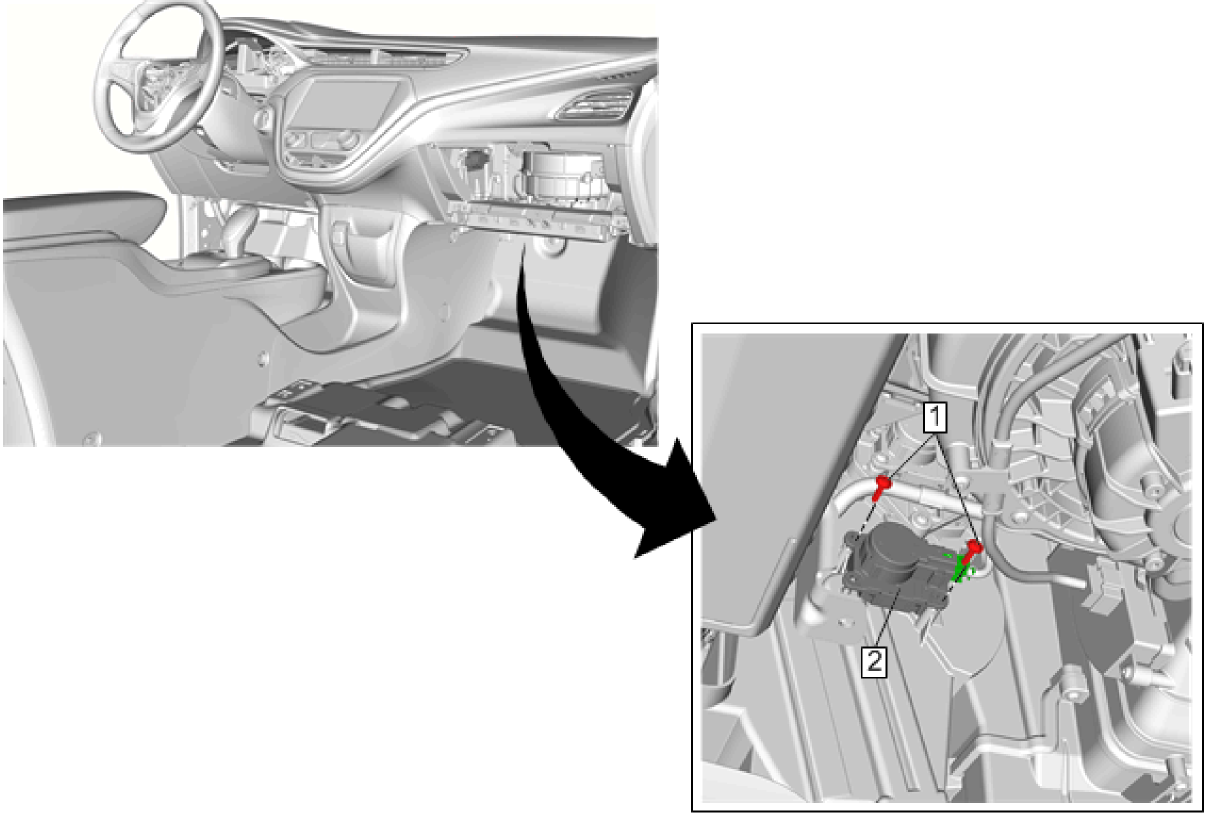

Fig. 11: Temperature Valve Actuator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Compartment Replacement	
1	Temperature Valve Actuator Fastener (Qty: 2) **CAUTION:** **Fastener Caution** **Tighten** 2.5 N.m (22 lb in)
2	Temperature Valve Actuator **Procedure** 1. Disconnect the electrical connector. 2. Actuator Recalibration

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - UPPER

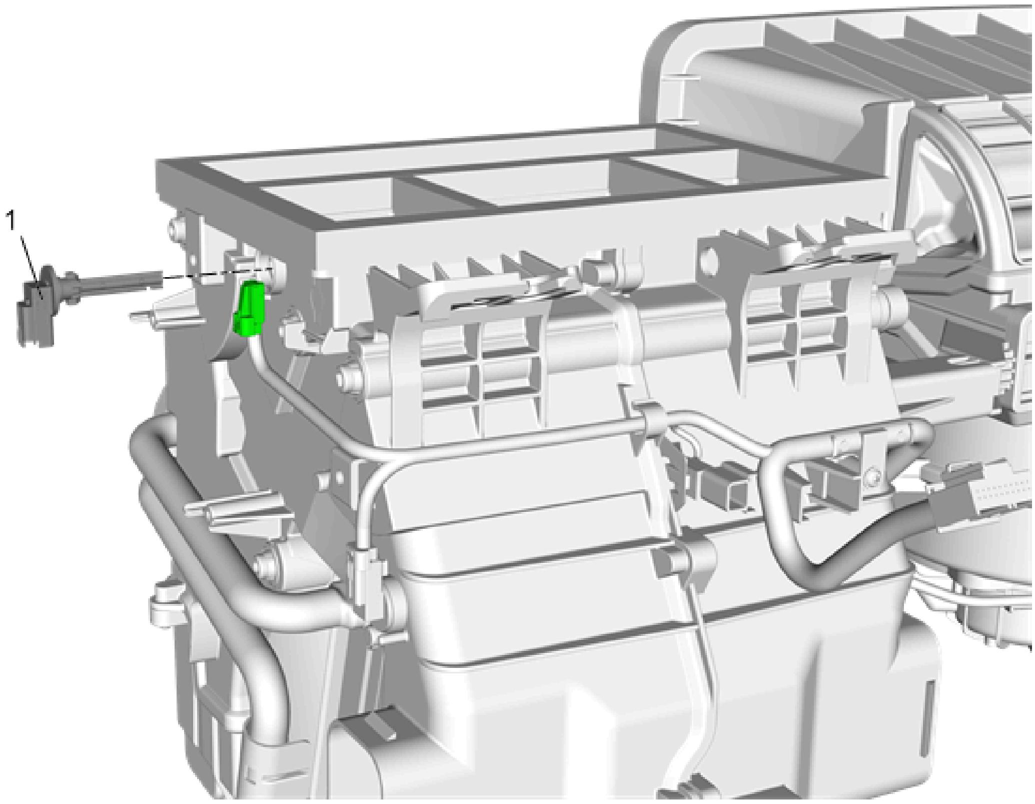

Fig. 12: Duct Air Temperature Sensor - Upper
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Instrument Panel Lower Airbag Bracket Replacement 2. Floor Front Air Outlet Duct Replacement - Left Side	
1	Duct Air Temperature Sensor - Upper **Procedure** 1. Disconnect the electrical connector. 2. Rotate the sensor counter clockwise to remove.

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - LOWER

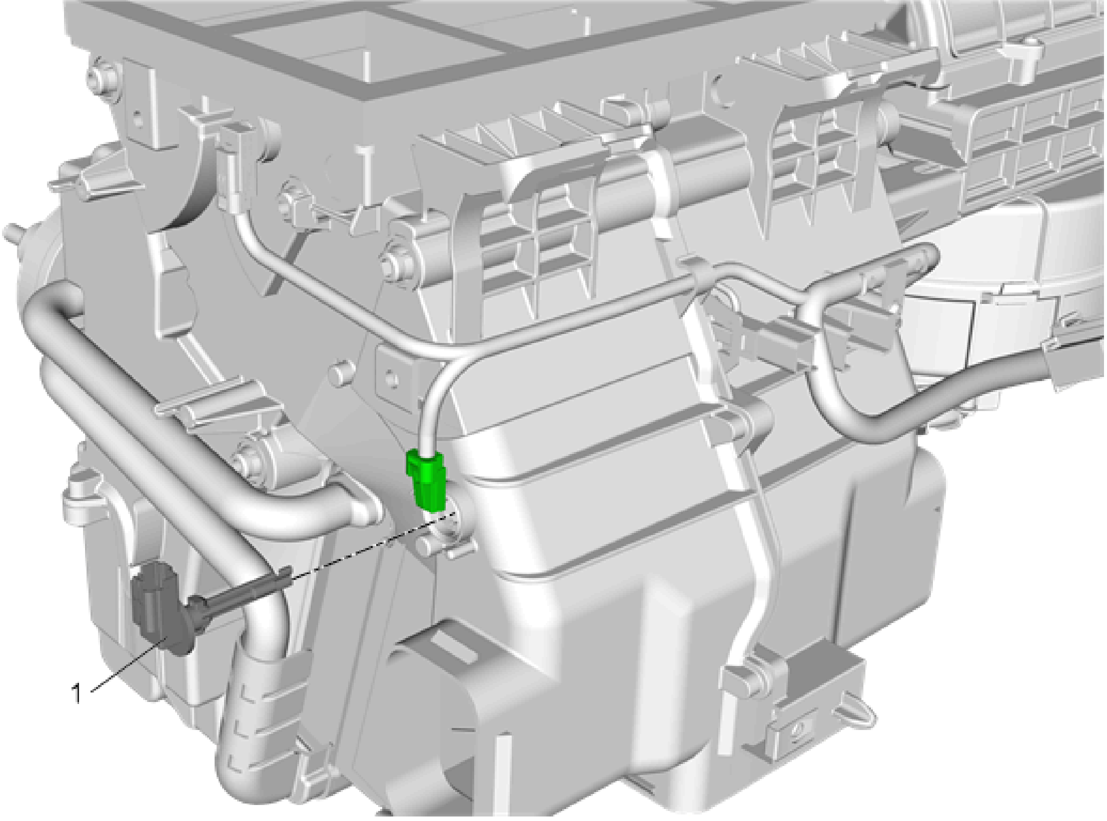

Fig. 13: Duct Air Temperature Sensor - Lower
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Instrument Panel Lower Airbag Bracket Replacement 2. Floor Front Air Outlet Duct Replacement - Left Side	
1	Duct Air Temperature Sensor - Lower **Procedure** 1. Disconnect the electrical connector. 2. Rotate the sensor clockwise to remove.

INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT (WITH FRONT VIEW CAMERA)

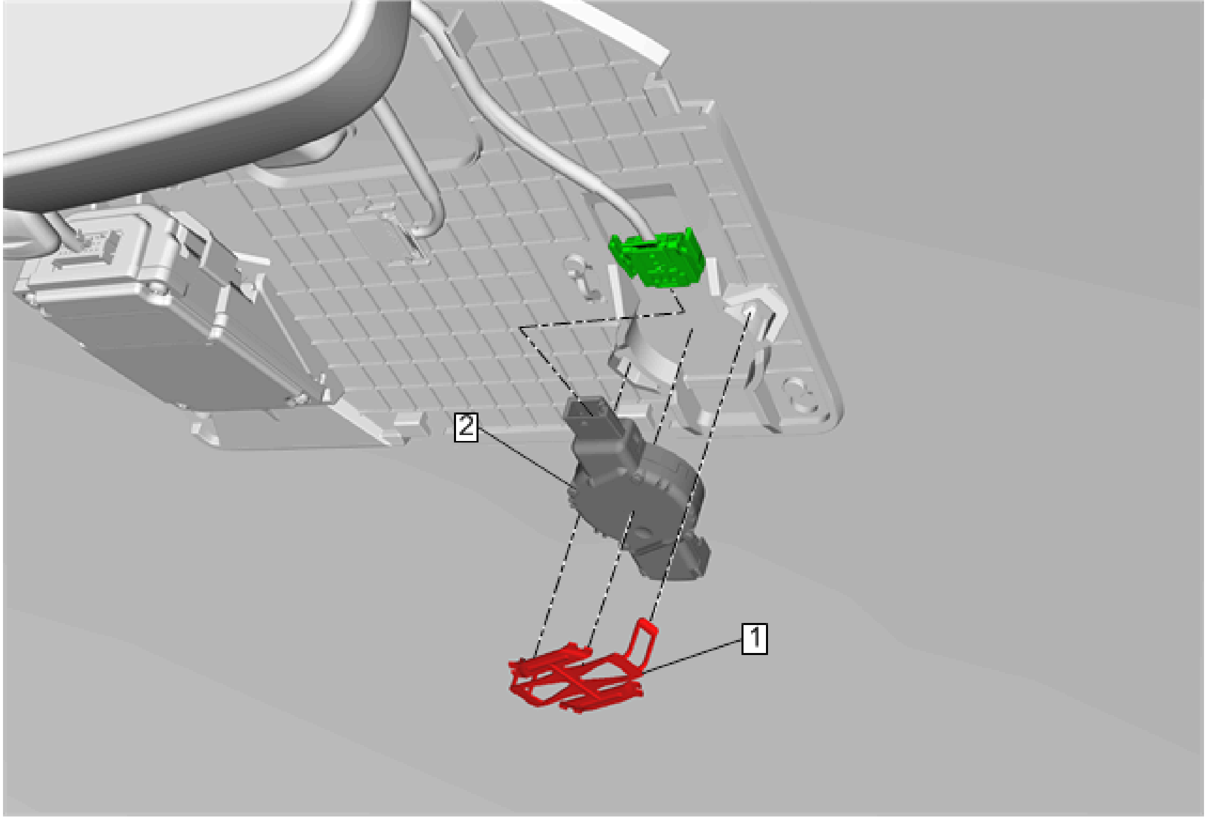

Fig. 14: Windshield Outside Moisture/Ambient Light and Humidity Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera)	
1	Windshield Outside Moisture/Ambient Light and Humidity Sensor Retainer **Procedure** Unlock the retaining tabs.
2	Windshield Outside Moisture/Ambient Light and Humidity Sensor **Procedure** Disconnect the electrical connector.

INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT (WITHOUT FRONT VIEW CAMERA)

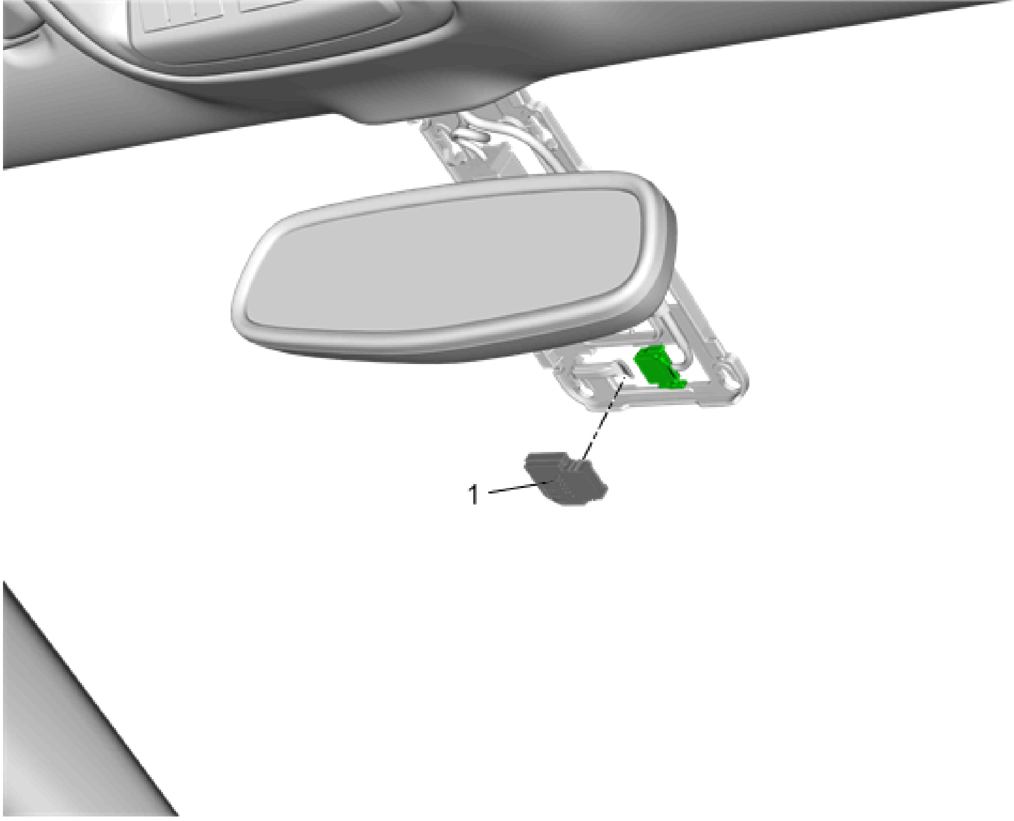

Fig. 15: Inside Air Moisture and Windshield Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure Windshield Multifunction Sensor Mount Bracket Cover Replacement (without Front View Camera)	
1	Inside Air Moisture and Windshield Temperature Sensor **Procedure** 1. Unclip the inside air moisture and windshield temperature sensor from the inside rearview mirror support bracket 2. Disconnect the electrical connector.

SUN LOAD, AMBIENT LIGHT, AND CHARGE INDICATOR SENSOR REPLACEMENT

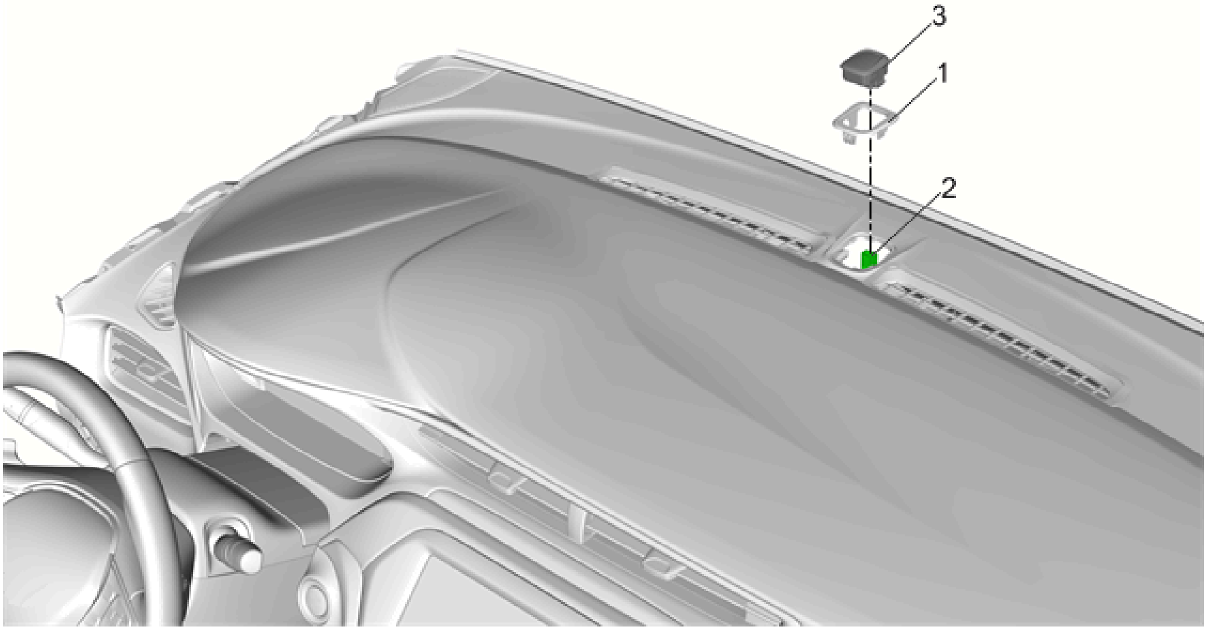

Fig. 16: Sun Load, Ambient Light, and Charge Indicator Sensor
Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
1	Daytime Running Lamp Ambient Light Bezel **Procedure** Using a plastic trim tool to release the bezel from the instrument panel.
2	Sun Load, Ambient Light, and Charge Indicator Sensor Connector **Procedure** Disconnect the electrical connector.
3	Sun Load, Ambient Light, and Charge Indicator Sensor **Procedure** Separate the sensor from the bezel.

BLOWER MOTOR CONTROL MODULE REPLACEMENT

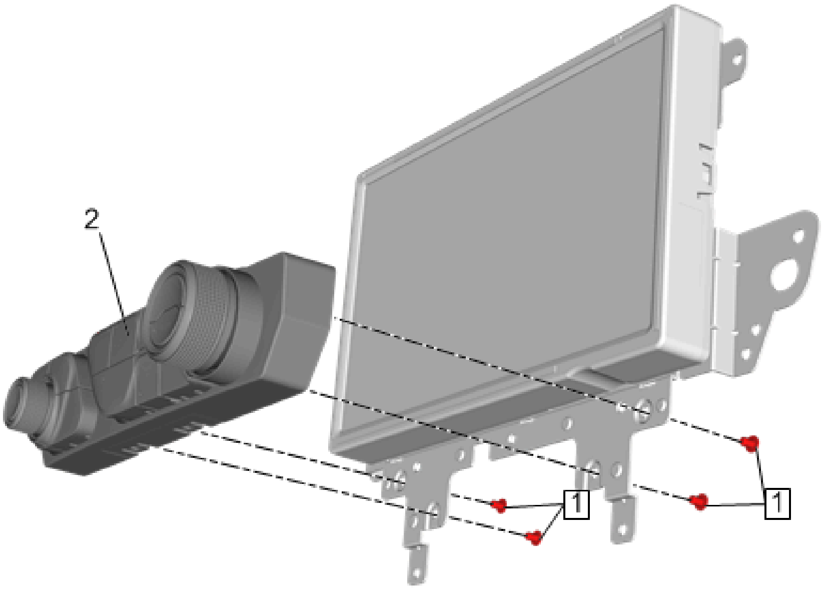

Fig. 17: Blower Motor Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Driver Information Display Replacement	
1	Blower Motor Control Module Bolt (Qty: 4) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 2.5 N.m (22 lb in)
2	Blower Motor Control Module

DESCRIPTION AND OPERATION

AUTOMATIC HVAC DESCRIPTION AND OPERATION

The air temperature and the air delivery description and operation are divided into the following areas:

- HVAC Control Components
- Air Speed
- Air Delivery
- Heating and A/C Operation
- Recirculation Operation
- Automatic Operation
- Coolant Heater Control Module
- Coolant and A/C System Refrigerant

HVAC Control Components

HVAC Control

The HVAC control contains all the switches and knobs which are required to control the functions of HVAC and serve as interface between the operator and the HVAC control module. The HVAC controls are part of the radio/HVAC controls assembly. The selected values are passed to the HVAC control module via serial data.

HVAC Control Module

The HVAC control module is a serial data device that interfaces between the operator and the HVAC system to maintain and control desired air temperature and air distribution settings. The battery positive voltage circuit provides power that the HVAC control module uses for keep alive memory. If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from keep alive memory. The body control module (BCM), which is the vehicle power mode master, provides a device ON-Signal. The HVAC control module provides blower, air delivery mode and air temperature settings.

The HVAC control module supports the following features:

Feature	Availability
Afterblow	Available if reprogrammed by the technician
Purge	Yes
Personalization	Yes
Actuator Calibration	Yes

Actuators

Doors in the HVAC case assembly are used to control air flow. The HVAC control module operates the doors through the use of actuators, with one actuator being used for each door. The system has the following air control doors and associated actuators: mode, temperature, and recirculation.

Each actuator used in the system is a 5-wire stepper motor. The HVAC control module supplies a 12 V reference voltage to the stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motor moves the associated air control door into the calculated position in order to reach the selected position. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the air control door.

Blower Motor Control Module

The blower motor control module controls the speed of the blower motor by increasing or decreasing the voltage drop on the ground side of the blower motor. The HVAC control module provides a low side pulse width modulation (PWM) signal to the blower motor control module via the blower motor speed control circuit. As the requested blower speed increases, the HVAC control module increases the amount of time that the speed signal is modulated to ground. As the requested blower speed decreases, the HVAC control module decreases the amount of time that the signal is modulated to ground.

Duct Temperature Sensors

The air temperature sensors are 2-wire negative temperature co-efficient thermistors. The sensors operate within a temperature range of -40 to +85Â°C (-40 to +185Â°F). The sensors are installed in the air distribution ducts and measure the temperature of the air that streams from the ducts. The HVAC control module uses these values to calculate the mixed air flap position.

A/C Refrigerant High Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2 - 4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The engine control module (ECM) converts the voltage signal to a pressure value. When pressure is too high or too low, the ECM will not allow the A/C compressor to engage.

A/C Refrigerant Low Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2 - 4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The Hybrid/EV Powertrain Control Module 2 monitors the low side refrigerant pressure through the A/C pressure sensor.

A/C Compressor

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes high voltage direct current from the vehicle's high voltage battery and inverts it to alternating current for the motor. The AC compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button or
- The HVAC control, in ECO climate or Comfort Climate Settings, requests the electric AC compressor on to help in cooling the cabin or removing moisture in conditions where the windows may fog or
- The hybrid/EV powertrain control module 2 requests the AC compressor on to help maintain the battery temperature

The hybrid/EV powertrain control module 2 uses values from the A/C refrigerant pressure sensor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors, and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the hybrid/EV powertrain control module 2 to the A/C compressor control module via serial data message.

Ambient Light/Sunload Sensor

The ambient light/sunload sensor includes the sunload sensor and passenger compartment temperature sensor.

This sensor assembly provides information about:

- Sun heat intensity
- Passenger compartment temperature

The solar sensor is connected to ground and to a 5 V stabilized voltage supply through the HVAC control module. As the sunload increases, the sensor signal voltage also increases and vice versa. The signal varies between 1.4 - 4.5 V and is provided to the HVAC control module.

The passenger compartment temperature sensor is a negative temperature co-efficient thermistor. A signal and low reference circuit enables the sensor to operate. As the air temperature increases, the sensor resistance decreases. The sensor signal varies between 0 - 5 V.

Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

Windshield Temperature and Inside Moisture Sensor

The windshield temperature and inside moisture sensor includes the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor.

This sensor assembly provides information about:

- Relative humidity level at windshield (compartment side)
- Temperature of the windshield inside (compartment side)
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity of the compartment side of the windshield. It also detects the temperature of the windshield surface on the passenger compartment side. Both values are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element.

When equipped with RPO CE1, the HVAC control module receives this information via serial data from the rain sensor module. When not equipped with CE1, the sensor values are received from signal circuits to the HVAC control module.signal circuits

HVAC Coolant Pump

The coolant heater pump is controlled by a relay. When operating conditions exist that requires coolant flow, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay.

Air Speed

The blower control switch is part of the HVAC faceplate control. The selected value of the blower switch position is sent to the HVAC control module via serial data.

The blower motor control circuitry is integrated within the blower motor control module. The HVAC control module provides a ground pulse width modulation (PWM) signal to the blower motor control module to request a specific motor speed. The blower motor control module translates the PWM signal and drives the motor accordingly.

Air Delivery

The HVAC control module controls the distribution of air within the passenger compartment by the use of the mode actuator. The modes that may be selected are:

- Defrost
- Defog
- Panel
- Floor
- BiLevel

In auto mode, the air delivery mode is controlled automatically based on cooling/warming needs of the compartment. The desired air distribution mode can be selected with the air distribution buttons at the HVAC faceplate control. The HVAC control delivers the values to the HVAC control module via serial data. The HVAC control module controls the mode actuator so that it drives the flap to the calculated position. Depending on the position of the flap, air is distributed through various ducts leading to the outlets in the dash. Turning the mode flap to the defrost position, the HVAC control module will move the recirculation actuator to outside air, reducing window fogging. When defrost is selected, the blower motor will be activated. The HVAC control module enables a high volume of air delivered to the front defrost vents. A/C is available in all modes.

The rear window defogger does not affect the HVAC system.

Recirculation Operation

The recirculation switch is integrated into the HVAC control. The selected recirculation switch position is sent to the HVAC control module via LIN-Bus. The HVAC control module controls the air intake using the recirculation actuator. In recirculation mode the recirculation door opens in order to circulate the air within the vehicle. In fresh air mode the recirculation door is closed in order to route outside air into the vehicle.

Inside air recirculation is prevented if the defrost mode is active. When the defrost mode is active, the recirculation actuator opens the recirculation door and outside air is circulated to the windshield to reduce fogging.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on passenger compartment side of the windshield compartment side. The A/C compressor and the defrost mode are activated to prevent or remove fog on the passenger compartment side of the windshield.

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. Regardless of the temperature setting, the following can affect the rate that the HVAC system can achieve the desired temperature:

- Ambient air temperature
- Difference between inside and desired temperature
- Blower motor speed setting
- Mode setting
- Air conditioning control module operation
- Hybrid/EV powertrain control module 2 operation
- Coolant heater control module

Pressing the climate mode buttons (Comfort Mode or ECO Mode) enables the HVAC control module to determine whether to request A/C compressor and coolant heater activation. Based on the thermal conditions of the vehicle the HVAC control module sends a serial data message to the hybrid/EV powertrain control module 2 for the A/C request. The hybrid/EV powertrain control module 2 will request the A/C compressor control Module to engage A/C. The HVAC control module sends the heating request to the coolant heater control module to produce heat.

Climate Mode button (Fan Only) will disable all heating and cooling of the vehicle unless overridden by dehumidification requirements.

Automatic Operation

The user can select to operate the Blower, Recirculation and Air Delivery operations in auto per auto operation mode.

To put the HVAC system in full automatic mode, the following is required:

1. The auto button must be pressed.
2. The system indicates that all 3 functions are being operated automatically by lighting the auto button LED.

When the auto button is pressed, the system responds by putting the blower, air delivery and recirculation into auto mode. If any of these functions are adjusted then the auto button indication shall go off and the function will leave auto operation and follow the user requested setting: auto, blower, air delivery and recirculation. In this setting the blower request is adjusted to quickly heat the cabin initially. After comfort is reached, the blower speed is minimized to reduce noise and temperature drifts.

Under cold ambient temperatures, the automatic HVAC system provides heat in the most efficient manner. The operator can select an extreme temperature setting but the system will not warm the vehicle any faster. Under warm ambient temperatures, the automatic HVAC system also provides air conditioning in the most efficient manner. Selecting an extreme cool temperature will not cool the vehicle any faster.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on the passenger compartment side of the windshield and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The A/C compressor and the defrost mode may be activated to prevent or remove fog on the passenger compartment side of the windshield. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield.

Coolant Heater Control Module

The coolant heater control module is a high voltage electric heater. High voltage is supplied from the hybrid/EV battery pack. A fused battery input, ground, and LIN serial data from the HVAC control module are used to control the operation of the coolant heater control module.

The coolant heater control module is an essential element of the hybrid heating system. When cabin heat is required, the HVAC control module commands the coolant heater control module activation via serial data, and commands the coolant pump relay on to operate the coolant pump to circulate the coolant. Heated coolant from the coolant heater will meet HVAC temperature demands. The coolant heater control module will be commanded OFF if the coolant temperature exceeds the desired temperature.

Heater coolant enters the heater core through the inlet heater hose, in a pressurized state. The heater core is located inside the HVAC module. The ambient air drawn through the HVAC module, absorbs the heat of the coolant flowing through the heater core. Heated air is distributed to the passenger compartment, through the HVAC module, for passenger comfort. Opening or closing the air temperature flap controls the amount of heat delivered to the passenger compartment. The coolant exits the heater core through the return heater hose and recirculates back to the system.

Coolant and A/C System Refrigerant

For information on coolant, coolant flow, A/C refrigerant, and the A/C refrigerant cycle, refer to **Heating and Air Conditioning System Description and Operation** .

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REMINDER INDICATOR (RESET PROCEDURES)

GM: Buick / Cadillac / Chevrolet / GMC / Olds / Pontiac - 1980-19

ENGINE OIL REPLACEMENT REMINDER

NOTE: **Most 1981-88 General Motors vehicles do not use a Service Reminder Indicator (SRI).**

NOTE: **To determine the appropriate reset procedure, refer to ENGINE OIL REPLACEMENT REMINDER RESET INDEX. Only vehicles listed in this index have an oil change reminder reset.**

ENGINE OIL REPLACEMENT REMINDER RESET INDEX

Model & Year	Reset Procedure
Alero	
1999-03	Engine Oil Replacement Reminder Reset - Procedure 01
2004	Engine Oil Replacement Reminder Reset - Procedure 03
Acadia	
2007-10	Engine Oil Replacement Reminder Reset - Procedure 16
2011-19	Engine Oil Replacement Reminder Reset - Procedure 06
Allante	
1989-93	Engine Oil Replacement Reminder Reset - Procedure 23
ATS	
2013-19	Engine Oil Replacement Reminder Reset - Procedure 33
Aurora	
1995-99	Engine Oil Replacement Reminder Reset - Procedure 27
2001-03	Engine Oil Replacement Reminder Reset - Procedure 06
Avalanche	
2002-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-13	Engine Oil Replacement Reminder Reset - Procedure 06
Aveo / Wave	
2009-11	Engine Oil Replacement Reminder Reset - Procedure 03
Aztek	
2001-05	Engine Oil Replacement Reminder Reset - Procedure 03
Bravada	
2002-04	Engine Oil Replacement Reminder Reset - Procedure 11
Bonneville	
2003-05	Engine Oil Replacement Reminder Reset - Procedure 06
Brougham	
1992	Engine Oil Replacement Reminder Reset - Procedure 03
Cascada	
2016-19	Engine Oil Replacement Reminder Reset - Procedure 18
Camaro	
1998-02	Engine Oil Replacement Reminder Reset - Procedure 01
2010-15	Engine Oil Replacement Reminder Reset - Procedure 18
2016-19	Engine Oil Replacement Reminder Reset - Procedure 33
Canyon	
2004-12	Engine Oil Replacement Reminder Reset - Procedure 10
2015-19	Engine Oil Replacement Reminder Reset - Procedure 18
Caprice	

Model & Year	Reset Procedure
1994	Engine Oil Replacement Reminder Reset - Procedure 02
1995-96	Engine Oil Replacement Reminder Reset - Procedure 03
2011-17	Engine Oil Replacement Reminder Reset - Procedure 18
Captiva Sport	
2012-15	Engine Oil Replacement Reminder Reset - Procedure 06
Century	
1997-04	Engine Oil Replacement Reminder Reset - Procedure 06
City Express	
2015-19	Engine Oil Replacement Reminder Reset - Procedure 03
Classic	
2005	Engine Oil Replacement Reminder Reset - Procedure 04
Cobalt & G5 Pursuit (Canadian)	
2005-10	Engine Oil Replacement Reminder Reset - Procedure 04
Colorado	
2004-12	Engine Oil Replacement Reminder Reset - Procedure 10
2015-19	Engine Oil Replacement Reminder Reset - Procedure 18
Corvette	
1990-96	Engine Oil Replacement Reminder Reset - Procedure 05
1997-13	Engine Oil Replacement Reminder Reset - Procedure 06
2014-19	Engine Oil Replacement Reminder Reset - Procedure 33
Cruze	
2011-19	Engine Oil Replacement Reminder Reset - Procedure 18
Cruze Limited	
2016	Engine Oil Replacement Reminder Reset - Procedure 18
CT6	
2016-19	Engine Oil Replacement Reminder Reset - Procedure 33
CTS	
2003-04	Engine Oil Replacement Reminder Reset - Procedure 20
2005-08	Engine Oil Replacement Reminder Reset - Procedure 22
2009	Engine Oil Replacement Reminder Reset - Procedure 06
2010-11	Engine Oil Replacement Reminder Reset - Procedure 03 or Engine Oil Replacement Reminder Reset - Procedure 19
2012-15	Engine Oil Replacement Reminder Reset - Procedure 06
2016-19	Engine Oil Replacement Reminder Reset - Procedure 33
Cutlass Calais, Cutlass Supreme, Cutlass Ciera, Cutlass Cruiser	
1990-91	Engine Oil Replacement Reminder Reset - Procedure 28
DeVille	
1991-93	Engine Oil Replacement Reminder Reset - Procedure 25
1994-99	Engine Oil Replacement Reminder Reset - Procedure 19
2000-05	Engine Oil Replacement Reminder Reset - Procedure 16
DeVille Concours	
1994-96	Engine Oil Replacement Reminder Reset - Procedure 19
1997-99	Engine Oil Replacement Reminder Reset - Procedure 06
DTS	
2006-11	Engine Oil Replacement Reminder Reset - Procedure 06
Eighty Eight & Ninety Eight	
1990-91	Engine Oil Replacement Reminder Reset - Procedure 28
1992-94	Engine Oil Replacement Reminder Reset - Procedure 29
1995-97	Engine Oil Replacement Reminder Reset - Procedure 30
Eldorado	
1989-91	Engine Oil Replacement Reminder Reset - Procedure 24

Model & Year	Reset Procedure
1992-93	Engine Oil Replacement Reminder Reset - Procedure 26
1994-97	Engine Oil Replacement Reminder Reset - Procedure 19
1997-02	Engine Oil Replacement Reminder Reset - Procedure 06
ELR	
2014-16	Engine Oil Replacement Reminder Reset - Procedure 33
Enclave	
2008-19	Engine Oil Replacement Reminder Reset - Procedure 16
Encore	
2013-19	Engine Oil Replacement Reminder Reset - Procedure 18
Envision	
2016-19	Engine Oil Replacement Reminder Reset - Procedure 33
Envoy Series	
2002-06	Engine Oil Replacement Reminder Reset - Procedure 06
2007-09	Engine Oil Replacement Reminder Reset - Procedure 04
Equinox	
2005-09	Engine Oil Replacement Reminder Reset - Procedure 03
2010-14	Engine Oil Replacement Reminder Reset - Procedure 06
2015-19	Engine Oil Replacement Reminder Reset - Procedure 34
Escalade Series	
2002-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-14	Engine Oil Replacement Reminder Reset - Procedure 06
2015-19	Engine Oil Replacement Reminder Reset - Procedure 33
Express/ Chevy Express/ Cutaway/ RV	
2003-17	Engine Oil Replacement Reminder Reset - Procedure 03
2018	Engine Oil Replacement Reminder Reset - Procedure 33
Firebird	
1998-02	Engine Oil Replacement Reminder Reset - Procedure 06
Fleetwood	
1991-92	Engine Oil Replacement Reminder Reset - Procedure 25
1993-96	Engine Oil Replacement Reminder Reset - Procedure 03
Grand Am	
1999-02	Engine Oil Replacement Reminder Reset - Procedure 02
2003-05	Engine Oil Replacement Reminder Reset - Procedure 03
Grand Prix	
1998-03	Engine Oil Replacement Reminder Reset - Procedure 03
2004-08	Engine Oil Replacement Reminder Reset - Procedure 06
GTO	
2004-06	Engine Oil Replacement Reminder Reset - Procedure 03
G5	
2007-10	Engine Oil Replacement Reminder Reset - Procedure 04
G6	
2005-10	Engine Oil Replacement Reminder Reset - Procedure 32
G8	
2008-09	Engine Oil Replacement Reminder Reset - Procedure 09
HHR	
2006-11	Engine Oil Replacement Reminder Reset - Procedure 04
Impala	
2000-06	Engine Oil Replacement Reminder Reset - Procedure 08
2007-13	Engine Oil Replacement Reminder Reset - Procedure 06
2014-19	Engine Oil Replacement Reminder Reset - Procedure 33
Impala Limited	
2014-16	Engine Oil Replacement Reminder Reset - Procedure 16

Model & Year	**Reset Procedure**
Intrigue	
1998-02	Engine Oil Replacement Reminder Reset - Procedure 03
LaCrosse & Allure	
2005-13	Engine Oil Replacement Reminder Reset - Procedure 18
2014-19	Engine Oil Replacement Reminder Reset - Procedure 33
LeSabre	
1994-99	Engine Oil Replacement Reminder Reset - Procedure 12
2000-05	Engine Oil Replacement Reminder Reset - Procedure 14
Lucerne	
2006-10	Engine Oil Replacement Reminder Reset - Procedure 06
2011	Engine Oil Replacement Reminder Reset - Procedure 18
Lumina	
1997-01	Engine Oil Replacement Reminder Reset - Procedure 06
Malibu	
2004-07	Engine Oil Replacement Reminder Reset - Procedure 13
2008-12	Engine Oil Replacement Reminder Reset - Procedure 04
2013-19	Engine Oil Replacement Reminder Reset - Procedure 18
Malibu Limited	
2016	Engine Oil Replacement Reminder Reset - Procedure 18
Montana	
2000-05	Engine Oil Replacement Reminder Reset - Procedure 03
Monte Carlo	
1997-99	Engine Oil Replacement Reminder Reset - Procedure 06
2000-06	Engine Oil Replacement Reminder Reset - Procedure 08
2007	Engine Oil Replacement Reminder Reset - Procedure 06
Park Avenue	
1991-94	Engine Oil Replacement Reminder Reset - Procedure 15
1995-96	Engine Oil Replacement Reminder Reset - Procedure 12
1997-05	Engine Oil Replacement Reminder Reset - Procedure 14
Pickup/ C3500/ Cab & Chassis (C/K)	
1996-00	Engine Oil Replacement Reminder Reset - Procedure 03
Rainier	
2004-07	Engine Oil Replacement Reminder Reset - Procedure 17
Regal (All Versions)	
1997-04	Engine Oil Replacement Reminder Reset - Procedure 06
2011-13	Engine Oil Replacement Reminder Reset - Procedure 18
2014-19	Engine Oil Replacement Reminder Reset - Procedure 33
Rendezvous	
2002-07	Engine Oil Replacement Reminder Reset - Procedure 17
Roadmaster	
1994	Engine Oil Replacement Reminder Reset - Procedure 15 or Engine Oil Replacement Reminder Reset - Procedure 02
1995-96	Engine Oil Replacement Reminder Reset - Procedure 03
Savana Series/ Cutaway/ RV	
2003-17	Engine Oil Replacement Reminder Reset - Procedure 03
2018	Engine Oil Replacement Reminder Reset - Procedure 33
Seville	
1989-91	Engine Oil Replacement Reminder Reset - Procedure 24
1992-93	Engine Oil Replacement Reminder Reset - Procedure 26
1994-97	Engine Oil Replacement Reminder Reset - Procedure 19
1998-04	Engine Oil Replacement Reminder Reset - Procedure 16

Model & Year	Reset Procedure
Sierra Series	
1999-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-19	Engine Oil Replacement Reminder Reset - Procedure 06
Silhouette	
2000-01	Engine Oil Replacement Reminder Reset - Procedure 03
2002-04	Engine Oil Replacement Reminder Reset - Procedure 06
Silverado Series	
2001-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-15	Engine Oil Replacement Reminder Reset - Procedure 06
2016-19	Engine Oil Replacement Reminder Reset - Procedure 33
Solstice	
2006-10	Engine Oil Replacement Reminder Reset - Procedure 04
Sonic	
2012-19	Engine Oil Replacement Reminder Reset - Procedure 18
Spark	
2013-16	Engine Oil Replacement Reminder Reset - Procedure 35
2017-19	Engine Oil Replacement Reminder Reset - Procedure 18
SRX	
2004	Engine Oil Replacement Reminder Reset - Procedure 20
2005-06	Engine Oil Replacement Reminder Reset - Procedure 22
2007-09	Engine Oil Replacement Reminder Reset - Procedure 06
2010-12	Engine Oil Replacement Reminder Reset - Procedure 18
2013-16	Engine Oil Replacement Reminder Reset - Procedure 33
SS	
2014-17	Engine Oil Replacement Reminder Reset - Procedure 18
SSR	
2004	Engine Oil Replacement Reminder Reset - Procedure 03
2005-06	Engine Oil Replacement Reminder Reset - Procedure 06
STS	
2005-11	Engine Oil Replacement Reminder Reset - Procedure 07
Suburban	
2000-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-19	Engine Oil Replacement Reminder Reset - Procedure 06
Tahoe	
2000-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-19	Engine Oil Replacement Reminder Reset - Procedure 06
Terrain	
2011-19	Engine Oil Replacement Reminder Reset - Procedure 34
Toronado	
1989-92	Engine Oil Replacement Reminder Reset - Procedure 31
Torrent	
2006-09	Engine Oil Replacement Reminder Reset - Procedure 03
Trailblazer	
2002-09	Engine Oil Replacement Reminder Reset - Procedure 11
Traverse	
2009-19	Engine Oil Replacement Reminder Reset - Procedure 06
Trax	
2013-19	Engine Oil Replacement Reminder Reset - Procedure 18
Uplander, Montana SV6 (Canadian)	
2005-08	Engine Oil Replacement Reminder Reset - Procedure 06
Venture	
2000-04	Engine Oil Replacement Reminder Reset - Procedure 03

Model & Year	Reset Procedure
2005	Engine Oil Replacement Reminder Reset - Procedure 06
Verano	
2012-17	Engine Oil Replacement Reminder Reset - Procedure 18
Volt	
2011-15	Engine Oil Replacement Reminder Reset - Procedure 21
2016-19	Engine Oil Replacement Reminder Reset - Procedure 33
XLR	
2004	Engine Oil Replacement Reminder Reset - Procedure 06
2005-09	Engine Oil Replacement Reminder Reset - Procedure 19
XT5	
2017-19	Engine Oil Replacement Reminder Reset - Procedure 33
XTS	
2013-19	Engine Oil Replacement Reminder Reset - Procedure 33
Yukon Series	
2000-06	Engine Oil Replacement Reminder Reset - Procedure 03
2007-19	Engine Oil Replacement Reminder Reset - Procedure 06

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 01

1. The CHANGE OIL (or CHANGE ENGINE OIL) message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change.
2. To reset the oil life monitor, turn the ignition switch to RUN position, with engine off. Press the TRIP/OIL RESET button on the instrument panel for 12 seconds. The OIL CHANGE light will start to flash to confirm that system is reset (on some models a chime will also sound). Reset is complete when OIL CHANGE light goes out.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 02

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil. To reset CHANGE OIL light:

1. Remove IP fuse block cover (cover can be seen when driver's door is open).
2. Turn ignition ON, engine OFF.
3. Press OIL RESET button and hold for 5 seconds.
4. If Oil Life light does not reset, repeat procedure with ignition OFF.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 03

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the engine oil is nearly worn out. A CHANGE OIL light on the instrument cluster is illuminated when it is time to change the engine oil.

1. To reset oil life monitor and turn off CHANGE OIL light (or message), turn ignition to ON position with engine off.
2. Depress accelerator pedal to wide open throttle 3 times within 5 seconds.
3. Turn ignition to LOCK/OFF
4. If light (or message) does not turn off, turn ignition OFF and repeat procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 04

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1, 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

Reset Procedure

1. Turn the ignition key to RUN with the engine OFF.
2. Press the INFO and RESET buttons on the Driver Information Center (DIC) at the same time to enter the personalization menu.
3. Press the INFO button to scroll through the available personalization menu modes until the DIC display shows OIL-LIFE RESET.
4. Press the INFO and RESET buttons at the same time for one second and release.
5. Press and hold the reset button until the DIC display shows ACKNOWLEDGED. This will tell you the system has been reset.
6. Turn the key to LOCK/OFF.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 05

Engine oil life monitor calculates engine oil temperature and RPM. It indicates when the oil is nearly worn out. A CHANGE OIL light on left side of instrument cluster is illuminated when it is time to change oil. To reset oil life monitor:

1. Turn ignition on.
2. Depress ENG MET button on trip monitor and release.
3. Within 5 seconds, depress and release ENG MET button again.
4. Within 5 seconds, depress and hold the ENG MET or GAUGES button again. The CHANGE OIL light should flash.
5. Depress and hold the RANGE or GAUGES button until the CHANGE OIL light stops flashing and goes out. When the light goes out, the engine oil life monitor is reset. This should take about 10 seconds.

NOTE: **If the light does not reset, turn ignition off and repeat the procedure.**

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 06

The Driver Information Center (DIC) will display a CHANGE OIL message when an oil change is due. The instrument cluster may also have a CHANGE OIL light. To reset the oil life monitor:

Reset Procedure

1. Turn ignition switch to RUN position, with engine off.
2. Press the TRIP (on some models SELECT or SET/RESET) button, located on the DIC, until the OIL LIFE display appears. Message will display percentage of oil life remaining.

   NOTE: **On models without DIC buttons, use the TRIP/ODOMETER reset stem.**

3. Press and hold SET/RESET button (on some models, the check-symbol button) on DIC for at least 5 seconds. The message will change to indicate that the Oil Life has been reset. On some models, 3 chimes will also sound.
4. Turn ignition off.
5. Turn the key to OFF. If the light or message comes back on when you start your vehicle, the oil life system has not reset. Repeat the procedure.

NOTE: **On some models, if oil life system does not reset, try turning ignition OFF**

after displaying oil life message. Then press and hold reset button.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 07

When the system has calculated that oil life has been diminished, it indicates that an oil change is necessary. A CHANGE ENGINE OIL SOON message in the DIC comes on. Reset the system whenever the engine oil is changed so that the system can calculate the next engine oil change. To reset the system:

1. Press the up or down arrow to scroll the DIC to show OIL LIFE.
2. Once the XXX% ENGINE OIL LIFE menu item is highlighted, press and hold the RESET button until the percentage shows 100%

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 08

The CHANGE ENGINE OIL message is displayed when its time to change engine oil, usually between 3000 and 7500 miles since last oil change. The oil change interval is not based on mileage, but on engine revolutions and engine operating temperature.

1. There are 2 ways to reset the engine oil life monitor. To reset the engine oil life monitor using the accelerator pedal, go to step 4. To reset the engine oil life monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine off. Press and hold the DISP (on some models, TUNE DISP) button (or knob) on the radio for at least 5 seconds until SETTINGS is displayed.
2. Press the SEEK (on some models, SEEK PTYPE or SEEK PSCAN) up or down arrow to scroll through the main menu. Scroll until OIL LIFE appears on the display. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the DISP/TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message indicator has been reset, scroll through the menu until EXIT appears on the display. Press the DISP/TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. To reset the engine oil life monitor using the accelerator pedal, turn ignition on with engine off. Fully depress and release the accelerator pedal slowly 3 times within 5 seconds. If CHANGE ENGINE OIL light flashes, oil life monitor is reset. If the CHANGE ENGINE OIL light comes back on and stays on, oil life monitor has not reset. Repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 09

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. Press and hold the TRIP button on the steering wheel while turning on the ignition. Do not start the engine.
2. The instrument panel cluster will prompt to clear the service code.
3. Release the button.
4. Press and hold ENTER Switch on the left side of the steering wheel for approximately one second.
5. Turn off the ignition.

If the CHANGE ENGINE OIL SOON message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 10

1. Turn ignition ON, with engine off.
2. Press and release reset stem on instrument panel while OIL LIFE message is displayed.
3. Once the alternating OIL LIFE and RESET messages appear, press and hold stem in until several beeps will sound. This confirms that oil life system has been reset. Turn ignition off or full LOCK position. If CHANGE OIL messages comes back after starting engine, repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 11

Reset Procedure

If vehicle is equipped with a Driver Information Center (DIC), reset oil life monitor by pressing the Driver Information Center SELECT button for 5 seconds while ENGINE OIL LIFE is displayed.

Alternate Method

To reset the oil life monitor, turn ignition switch to ON or RUN position with engine off. Depress accelerator pedal slowly to wide open throttle 3 times within 5 seconds. If CHANGE ENG OIL light flashes for 5 seconds, oil life monitor is reset. If the CHANGE ENG OIL light does not flash, oil life monitor has not reset. Repeat this step.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 12

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, turn ignition on. Open glove box to access oil reset button. Press and hold oil reset button in glove box for at least 5 seconds, but not longer than 60 seconds. The CHANGE OIL SOON light will flash 4 times to indicate light has been reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 13

GM Oil Life System calculates when to change your engine oil and filter based on vehicle use. Anytime oil is changed, reset the system so it can calculate when the next oil change is required. If a situation occurs where you change your oil prior to a Change Oil Soon message being turned on, reset the system. After changing the engine oil, reset the system.

1. Display OIL LIFE RESET on the DIC.
2. Press and hold ENTER button for at least one second. An ACKNOWLEDGED display message will appear for 3 seconds or until the next button is pressed. This will tell you the system has been reset.
3. Turn key to OFF.
4. If Change Oil Soon message comes back on when you start your vehicle, engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 14

1. To display this light, press the GAGE INFO or GAGES button on the Driver Information Center (DIC). When oil life index is less than 10 percent, display will show OIL LIFE INDEX CHANGE OIL. After changing oil, reset system.
2. To reset light, display OIL LIFE INDEX. Hold RESET button for more than 5 seconds. After reset, oil life will change to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 15

1. CHANGE OIL SOON light will come on when engine oil has broken down enough to require changing. After changing oil, reset oil life display.
2. To reset light, locate reset button hole under the dash near passenger door. Use a pencil or similar object to push and hold button (inside hole) for 5 seconds. The CHANGE OIL SOON light will

flash 4 times to indicate light has been reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 16

Vehicles WITHOUT Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN, with the engine off. The vehicle must be in P (Park) to access this display. Press the trip odometer reset stem until OIL LIFE REMAINING displays.
2. Press and hold the trip odometer reset stem until OIL LIFE REMAINING shows "100%." Three chimes sound and the CHANGE ENGINE OIL SOON message goes off.
3. Turn the key to LOCK/OFF. If the CHANGE ENGINE OIL SOON message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.

Vehicles WITH Driver Information Center (DIC) Buttons

1. Turn the ignition to ON/RUN position, with the engine off.
2. Press the VEHICLE INFORMATION BUTTON (i) until OIL LIFE REMAINING displays.
3. Press and hold the SET/RESET button (check-mark symbol) until "100%" is displayed. Three chimes sound (on some models) and the CHANGE ENGINE OIL SOON message goes off.
4. Turn ignition to LOCK/OFF position. If the CHANGE ENGINE OIL SOON message comes back on when engine is started, repeat reset procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 17

Reset Procedure

1. Turn the ignition to ON, with the engine off.
2. Press the MODE button until the Driver Information Center (DIC) reads OIL LIFE LEFT/HOLD SET TO RESET.
3. Press and hold the SET button until 100% is displayed. You will hear three chimes and the CHANGE ENGINE OIL message will go off. Turn the key to OFF.
4. If the CHANGE ENGINE OIL message comes back on when engine is started, the engine oil life system has not reset. Repeat the procedure.

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 18

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL message or light will come on. Change the engine oil as soon as possible within the next 600 miles (1 000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

NOTE: **Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.**

Vehicles with DIC (& Steering Wheel Controls)

1. Using the DIC controls on the right side of the steering wheel (see Fig. 1), display REMAINING OIL LIFE on the driver information center (DIC).
2. Press SEL or SET/CLR (check mark icon on some systems) on the DIC controls and hold down for a few seconds to clear the CHANGE ENGINE OIL SOON message and reset the oil life at 100%.

NOTE: **Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.**

NOTE: **If the CHANGE OIL message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.**

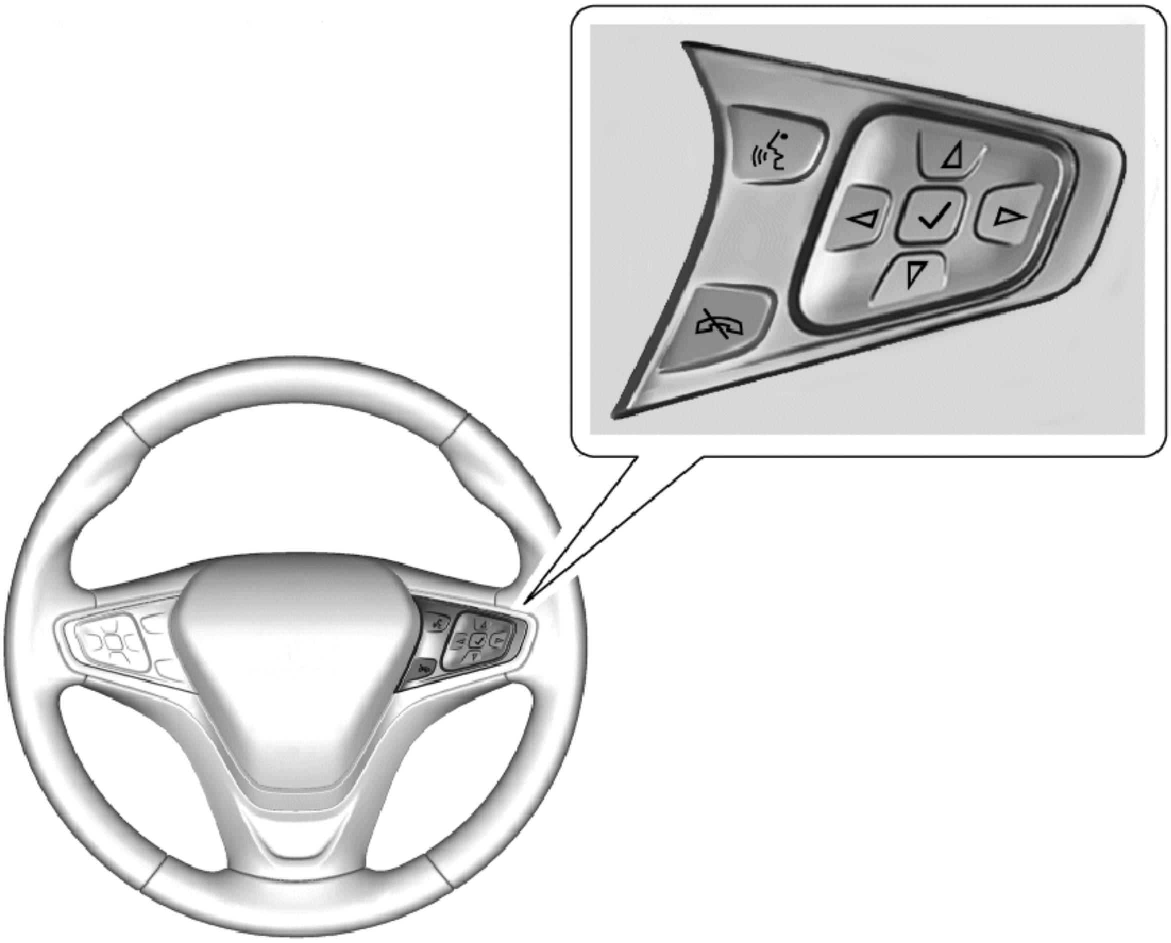

Fig. 1: Identifying DIC Controls (Steering Wheel - Typical)
Courtesy of GENERAL MOTORS COMPANY

Vehicles with DIC (& Turn Signal Lever Controls)

1. Turn the ignition to ON/RUN with the engine off.
2. Press the DIC MENU button on the turn signal lever to enter the Vehicle Information Menu. Use the thumbwheel to scroll through the menu items until you reach REMAINING OIL LIFE. See Fig. 2.

NOTE: **On vehicles with an Uplevel DIC, the controls are at the right-hand side of the steering wheel.**

3. Press the SET/CLR button (on some models, the check-symbol button) while the oil life display is active. After a few seconds, there will be a single chime (on some models) and the oil life will be reset to 100%
4. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE OIL message is off and the REMAINING OIL LIFE 100% message is displayed.

NOTE: **If the CHANGE OIL message comes back on or Code 82 DIC message comes on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.**

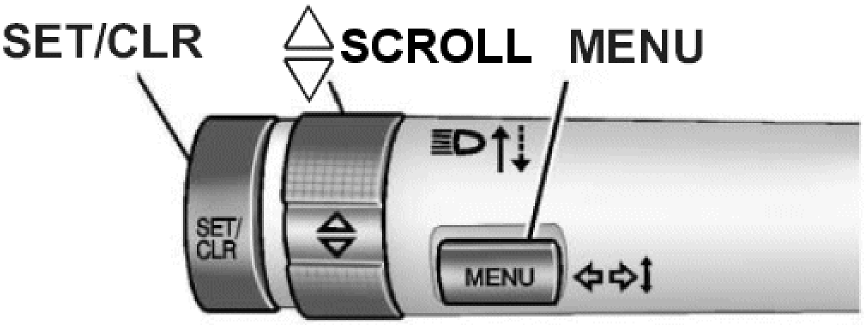

Fig. 2: Identifying DIC Controls (Turn Signal Lever)
Courtesy of GENERAL MOTORS COMPANY

Vehicles without DIC (Some Models)

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, than start the vehicle.

Reset Using Diagnostic Scan Tool (Some Models)

1. Turn on ignition.
2. Connect scan tool.
3. Select Module Diagnosis.
4. Select Engine Control Module.
5. Select Configuration/Reset function.
6. Select Engine Oil System Reset.
7. Push Enter button to run function.
8. Confirm Executed successfully.
9. Turn ignition of and confirm.
10. Turn ignition on and confirm.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 19

1. The Driver Information Center (DIC) will display remaining oil life as a percentage estimate of the useful life of oil.
2. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When oil life expires, display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press INFORMATION (or INFORMATION SKIP) button to display OIL LIFE LEFT. Press and hold RESET (or RESET NO) button until 100 OIL LIFE LEFT (0.0 OIL LIFE LEFT on some early models) is displayed.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 20

With Base Audio System

Press up or down arrow on the INFO button located to right of Driver Information Center (DIC) display to access DIC menu. Once 100 percent ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. Percentage will return to 100 and oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

With Navigation System

Turn the system on by pressing PWR/VOL knob once. PWR/VOL knob is located to lower left of DIC display. Press INFO button located to left of the display to access Vehicle Information menu. Turn TUNE/SEL knob located to lower right of the display until ENGINE OIL LIFE is highlighted. Press TUNE/SEL knob once to select it. When 100 percent Engine Oil Life is displayed, press multifunction button next to reset prompt in upper right corner of the display. Percentage will return to 100 and the oil life indicator will be reset. Repeat procedure if the percentage does not return to 100.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 21

1. Use the SELECT knob to select OIL LIFE on the DIC menu.
2. Press SELECT to start the OIL LIFE reset procedure.
3. The DIC menu will display "Are you sure that you want to reset?" Use SELECT to choose YES to reset oil life or NO to exit and return to the previous menu.
4. If YES is selected, the DIC menu will display RESET OIL LIFE for a short time and then 100% OIL LIFE will be display when OIL LIFE is successfully reset.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 22

With Base Audio System

1. Press the CLR button located to the right of the driver information center (DIC) display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Press the up or down arrow on the INFO button located to the right of the Driver Information Center (DIC) display to access the DIC menu.
3. Once 100% ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
4. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

Without DIC

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, then start the vehicle.

With Navigation System

1. Press the multifunction button, next to the OK prompt in the upper right of the display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it.
2. Turn the system on by pressing the PWR/VOL knob once. The PWR/VOL knob is located to the lower left of the driver information center (DIC) display.
3. Press the INFO button located to the left of the display to access the Vehicle Information menu.
4. Turn the TUNE/SEL knob located to the lower right of the display until Engine Oil Life is highlighted. Press the knob once to select it.
5. Once the 100% Engine Oil Life is displayed, press the multifunction button next to the Reset prompt in the upper right corner of the display. The percentage will return to 100 and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.
6. Turn OFF the key. If the Change Engine Oil message comes back on when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 23

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset service reminder on 1989 models, press RANGE button until OIL LIFE INDEX appears on display. Depress and hold in AVG ECON and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.

4. On 1990-93 models, press RANGE button until OIL LIFE INDEX appears on DIC display. Depress and hold in AVG SPEED and RANGE buttons for more than 5 seconds or until 100 is displayed. This will reset remaining oil life to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 24

1. An OIL LIFE INDEX is one of 4 displays on Driver Information Center (DIC). It will display remaining oil life as a percentage estimate of the useful life of oil.
2. Display will show 100 percent when the system is reset. When remaining oil life is 10 percent or less, the system will display CHANGE OIL SOON. When the oil life expires, the display will show CHANGE ENGINE OIL. After changing oil, reset oil life display.
3. To reset oil life display, press ENG DATA button until OIL LIFE INDEX appears on DIC display. Depress and hold in ENG DATA and RANGE buttons until 100 is displayed. This will reset remaining oil life to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 25

1. An OIL LIFE INDEX is one of the displays on Driver Information Center (DIC). It will display remaining oil life as a estimated percentage of the useful life of oil.
2. It will show 100 percent when the system is reset. When the oil life is 0 percent, the display will show CHANGE ENGINE OIL. After performing necessary services, reset service reminder.
3. To reset service reminder, turn ignition to on position. Do not start engine. Depress and hold RANGE and FUEL USED buttons until OIL LIFE INDEX appears on DIC display. Depress and hold RANGE and RESET buttons for 5-60 seconds.
4. When CHANGE OIL SOON light flashes 4 times, remaining oil life index is reset to 100 percent. If CHANGE OIL SOON comes on and stays on for 5 seconds, display did not reset. Repeat step 3.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 26

1. Oil change reminder display on the Driver Information Center (DIC) is similar to 1990-91 models, but reset procedures are different. After changing oil, reset oil life display.
2. To reset, press INFORMATION button to display OIL LIFE INDEX. Press and hold STORE/RECALL button until 100 is displayed. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 27

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of engine oil or transaxle fluid. When remaining oil or fluid life is 0 percent, the display will show CHANGE OIL NOW or CHANGE TRNS FLUID NOW. After changing engine oil or transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the OIL LIFE or TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, OIL LIFE 100 or TRNS FLUID 100 will be displayed.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 28

1. An oil change reminder displays estimated percentage of the remaining useful life of the oil. When engine is started, a tone will sound and approximate distance to next oil change will be displayed.
2. When remaining oil life is 10 percent or less, the system will calculate distance to next oil change. When the oil life is 0 percent, the display will show CHANGE OIL NOW. After changing oil, reset oil life display.
3. To reset the display, press and hold in OIL button to select the oil life display. Then, press and hold in RESET and OIL buttons for at least 5 seconds. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 29

1. To reset the display, press and release the TEST button.

2. Press and release the OIL button.
3. Press and hold the RESET button for at least 7 seconds. This will reset oil life display to 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 30

1. To reset the display, press and release RESET button on Driver Information Center (DIC).
2. Press SEL button (with down arrow) to select OIL.
3. Press SEL button (with left and right arrows) to display oil life.
4. Press and hold RESET button for about 5 seconds.
5. A reset message will display, then oil life will display 100 percent.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 31

With Information Center Display

OIL LIFE INDEX is one of 4 engine data displays used on models with Information Center display. It will display remaining oil life as estimated percentage of the useful life of oil. It will show 100 percent when the system is reset. After changing oil, reset oil life display.

1. To reset the display, press ENG DATA button (1989-90) or OPTIONS button (1991-92) until oil life index is displayed.
2. Then, press and hold in ENG DATA and GAGE buttons (1989) or RESET/ENTER button (1990-92) for at least 5 seconds. This will reset remaining oil life to 100 percent.

With Visual Information Center

OIL LIFE is one of the displays used on models with a Visual Information Center (VIC). It will display data regarding previous oil change. A bar graph display shows full when oil is changed. Bar graph will go down as vehicle is driven and oil ages. When bar graph reaches CHANGE OIL mark, oil should be changed. After changing oil, reset oil life display.

1. To reset the display, press INFO hard key and then OIL LIFE soft key to display oil life index.
2. Press RESET soft key.
3. A reset confirmation page will appear and ask if oil has been changed. Press YES soft key to reset bar graph, and update last oil change date and mileage information.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 32

When the system has calculated that oil life has been diminished, it will indicate that an oil change is necessary. A CHANGE ENGINE OIL SOON message will come on. Change the engine oil as soon as possible within the next 600 miles (1000 km). It is possible that, if driving under the best conditions, the oil life system may not indicate that an oil change is necessary for over a year. However, the engine oil and filter must be changed at least once a year and at this time the system must be reset.

To reset the Engine Oil Life System, do the following:

1. With the CHANGE OIL SOON message displayed, press any of the three driver information center (DIC) buttons to clear the CHANGE OIL SOON message.
2. Display OIL LIFE RESET on the DIC.
3. Press and hold the ENTER button for at least one second. An ACKNOWLEDGED display message will appear for three seconds or until the next button is pressed. This will tell you the system has reset.
4. Turn the ignition to OFF.

If the CHANGE ENGINE OIL message comes back on when you start the vehicle the Engine Oil Life System has not reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 33

This vehicle has a computer system that indicates when to change the engine oil and filter. This is based on a combination of factors which include engine revolutions, engine temperature, and miles driven. Based on driving conditions, the mileage at which an oil change is indicated can vary considerably. For the oil life system to work properly, the system must be reset every time the oil is changed. To reset the system:

Reset Procedure

1. Using the DIC controls on the right side of the steering wheel, display REMAINING OIL LIFE on the driver information center (DIC).
2. Press SEL (check mark icon on some systems) on the DIC controls and hold down for a few seconds to clear the CHANGE ENGINE OIL SOON message and reset the oil life at 100%.

NOTE: **Be careful not to reset the oil life display accidentally at any time other than after the oil is changed. It cannot be reset accurately until the next oil change.**

Alternate Method (Some Models)

1. Turn the ignition key to RUN with the engine off.
2. Fully press the release the accelerator pedal 3 times within 5 seconds. Several beeps sound. This confirms the oil life system has been reset.
3. If the CHANGE/OIL message comes back on when you start the engine, the engine oil life system has not been reset. Repeat the procedure.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 34

Vehicles with Driver Information Center (DIC)

1. Turn the ignition to ON/RUN with the engine off.
2. Press the DIC MENU button, on the center console or right-hand steering wheel controls, to enter the Vehicle Information Menu.
3. Press either the up or down arrows to view REMAINING OIL LIFE.
4. Press the SET/CLR button until 100% is displayed.
5. Turn the ignition to LOCK/OFF.

The system is reset when the CHANGE ENGINE OIL SOON message goes off.

NOTE: **If the CHANGE OIL message comes back on when the vehicle is started, the engine oil life system has not been reset. Repeat the procedure.**

Alternate Method

1. With the engine OFF, turn the ignition key to RUN.
2. Fully press and release the accelerator pedal slowly three times within five seconds.
3. Turn the key to OFF, than start the vehicle.

ENGINE OIL REPLACEMENT REMINDER RESET - PROCEDURE 35

Reset the system whenever the engine oil is changed so that the system can calculate the next engine oil change. Always reset the engine oil life to 100% after every oil change. It will not reset itself. Use the DIC controls at the right side of the instrument cluster to reset the system.

1. Display remaining oil life (oil can w/ %) on the DIC
2. Press and hold SET/CLR on the DIC for more than five seconds. The oil life will change to 100%.

If the OIL CHANGE DIC message comes back on when the vehicle is started, the engine oil life system has not reset. Repeat the procedure.

EMISSIONS MAINTENANCE REMINDER (REMINDER FLAG)

NOTE: **To determine the appropriate reset procedure, refer to EMISSIONS MAINTENANCE REMINDER RESET. Only vehicles listed in this index have an Oxygen Sensor Reminder Flag reset.**

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Some Models	
1980	Emissions Maintenance Reminder Reset Procedure

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

1. Every 30, 000 miles, a reminder flag appears in speedometer face, indicating service of oxygen sensor is necessary. See Fig. 3. Inspect and service oxygen sensor as necessary and reset flag.
2. To reset flag, remove instrument panel trim plate. Remove instrument cluster lens. Using pointed tool, apply light downward pressure on notches of flag until it is reset. An alignment mark will appear in left center of odometer window when flag is fully reset.

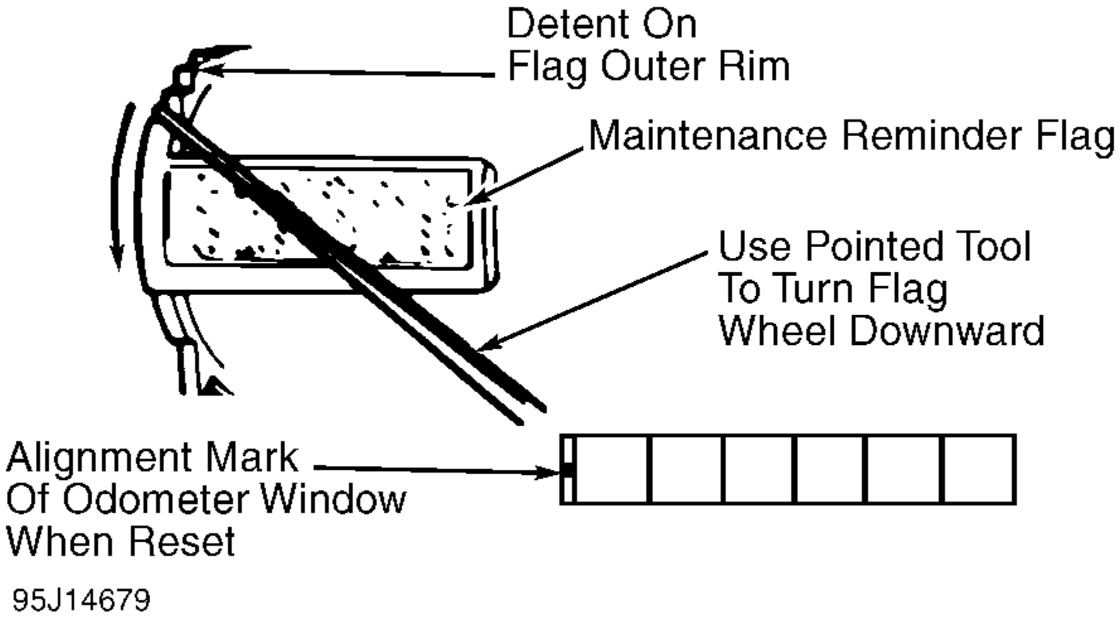

Fig. 3: Resetting Reminder Flag
Courtesy of GENERAL MOTORS CORP.

EMISSIONS MAINTENANCE REMINDER (WARNING LIGHT)

NOTE: **To determine the appropriate reset procedure, refer to EMISSIONS MAINTENANCE REMINDER RESET INDEX. Only vehicles listed in this index have an oxygen sensor warning light reset.**

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Sprint	
1985-86	Emissions Maintenance Reminder Reset Procedure

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

At 30, 000 mile intervals, a SENSOR light in dash will start flashing, indicating oxygen sensor needs replacement. To reset mileage counter (after sensor replacement), locate SENSOR light cancel switch on right side of fuse box. Return cancel switch to OFF position. Start engine to ensure light remains off.

EMISSIONS MAINTENANCE REMINDER (CHECK ENGINE LIGHT)

NOTE: **To determine the appropriate reset procedure, refer to EMISSIONS MAINTENANCE REMINDER RESET INDEX. Only vehicles listed in this index have a check engine light reset.**

EMISSIONS MAINTENANCE REMINDER RESET INDEX

Model & Year	Reset Procedure
Geo Tracker	
1989-94	Emissions Maintenance Reminder Reset Procedure

EMISSIONS MAINTENANCE REMINDER RESET PROCEDURE

Federal Emissions

1. CHECK ENGINE light functions as a service reminder indicator and emission system service. CHECK ENGINE light will come on each 50, 000 miles (PCV and EGR), each 80, 000 miles (oxygen sensor) and each 100, 000 miles (charcoal canister) to indicate needed emission system service.
2. After servicing and/or replacing components, reset CHECK ENGINE light by sliding cancel switch to its opposite position. See CHECK ENGINE LIGHT RESET SWITCH LOCATION (GEO TRACKER)for switch location.

CHECK ENGINE LIGHT RESET SWITCH LOCATION (GEO TRACKER)

Application	Location
1989-91	Behind Access Panel, Directly Below Steering Column
1992-94	(1) Behind Instrument Panel, Next To Left Speaker
(1) See Fig. 4.	

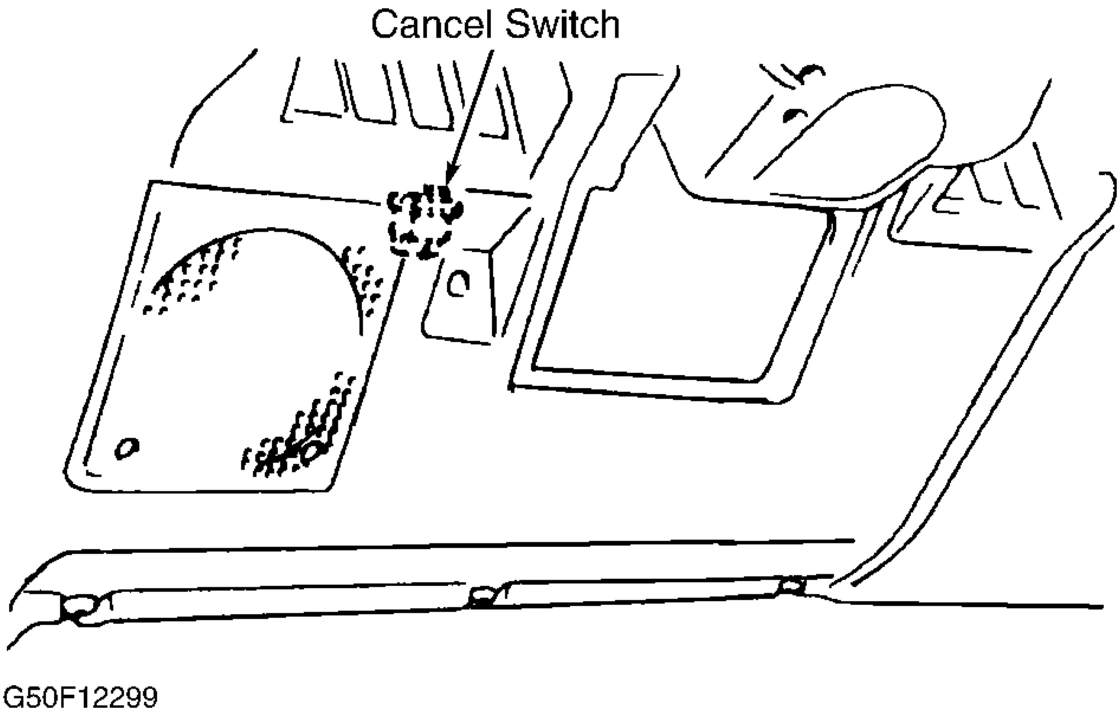

Fig. 4: Check Engine Light Reset Switch Location (1992-94 Geo Tracker - Federal Emissions)
Courtesy of GENERAL MOTORS CORP.

California Emissions

CHECK ENGINE light indicates when it is necessary to have emission system serviced, regardless of mileage. CHECK ENGINE light comes on briefly when starting as a bulb check. If light does not come on or stays on constantly, repair as necessary.

DIESEL FUEL FILTER REPLACEMENT REMINDER

NOTE: **To determine the appropriate reset procedure, refer to Fuel Filter Life Reset Index. Only vehicles listed in this index have a fuel filter life reset.**

FUEL FILTER REPLACEMENT REMINDER RESET INDEX

Application	Reset Procedure
Some Diesel Models	Fuel Filter Replacement Reminder Reset Procedure

FUEL FILTER REPLACEMENT REMINDER RESET PROCEDURE

NOTE: **This procedure applies to some diesel models. Manufacturer does not specify which vehicles are equipped with a Fuel Filter Replacement Reminder.**

NOTE: **ALWAYS reset the FUEL FILTER LIFE system (if equipped) after a fuel filter change.**

"FUEL FILTER LIFE" message will appear when a reset is performed either by using the steering wheel controls or performing manual reset procedure.

1. On vehicles with steering wheel controls, press and hold the select button for 5 seconds while the FUEL FILTER LIFE message is displayed. This message will appear on the Driver Information Center (DIC) for 10 seconds.
2. On vehicles without steering wheel controls, go to next step.
3. Without pressing the pedals, turn the ignition key to the ON position, engine off. Wait 5 seconds.
4. Completely depress the brake and accelerator pedals simultaneously and hold for 10 seconds. The system is now reset. Turn ignition key OFF.
5. On all vehicles, the next time engine is started, the message will no longer be displayed.

MAINTENANCE SERVICE REMINDER

NOTE: **To determine the appropriate reset procedure, refer to MAINTENANCE SERVICE REMINDER RESET INDEX. Only vehicles listed in this index have a Service Reminder reset.**

MAINTENANCE SERVICE REMINDER RESET INDEX

Model & Year	Reset Procedure
6000 STE	
1987-89	Maintenance Service Reminder Reset - Procedure 01
Bonneville	
1988-91	Maintenance Service Reminder Reset - Procedure 01
Caprice	
2011	Maintenance Service Reminder Reset - Procedure 02

MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 01

The SERVICE REMINDER message light is used on models with a Driver Information Center (DIC). After performing necessary services, reset service reminder light.

1. To reset service reminder, push DIC button until desired service item is displayed.
2. Press and hold down the DIC button. With button pressed, the distance display will decrease in increments of 500 miles.
3. Release button when desired distance is displayed on the DIC.

MAINTENANCE SERVICE REMINDER RESET - PROCEDURE 02

The displayed service reminder is reset using a scan tool or by the following procedure:

1. Turn the ignition to the OFF position.
2. Press and hold the TRIP button.
3. Turn the ignition to the ON position.
4. Release the TRIP button.
5. Once in the Service Reset screen, press and hold the ENTER switch for 3-5 seconds. A confirmation beep will sound upon reset.
6. Turn the ignition to the OFF position.

NOTE: **If the service reminder comes back on when you start the vehicle, the Service Reminder Display has not reset. Repeat the procedure.**

TIMING BELT REPLACEMENT REMINDER

NOTE: **To determine the appropriate reset procedure, refer to TIMING BELT REPLACEMENT REMINDER INDEX. Only the vehicles listed in this index have a Timing Belt Replacement Reminder Reset.**

CHANGE TIMING BELT MESSAGE INDEX

Model & Year	Reset Procedure
Chevrolet Cruze - 1.8L LUW and LWE Engines (2011-16)	Timing Belt Replacement Reminder Reset Procedure
Chevrolet Sonic - 1.8L LUW and LWE Engines (2012-16)	Timing Belt Replacement Reminder Reset Procedure

TIMING BELT REPLACEMENT REMINDER RESET PROCEDURE

NOTE: **Applies to 1.8L LUW and LWE engines.**

Description

On LUW and LWE engines, the Instrument Cluster monitors the odometer mileage to determine when a timing belt (if equipped) replacement may be necessary. After the vehicle has accumulated approximately 100, 000 miles (160, 000 kilometers), the Instrument Cluster may display the CHANGE TIMING BELT message.

Message Reset

After the engine timing belt has been replaced, reset the CHANGE TIMING BELT message by locating and removing the fuses that supply power to the Instrument Cluster, for two minutes.

- **2011-16 Cruze** : Fuse #21 (F21DA) Under Dash (Fig. 5)
- **2012-16 Sonic** : Fuse #F26 (F26DA) Under Dash (lower-left of dash - Fig. 6)

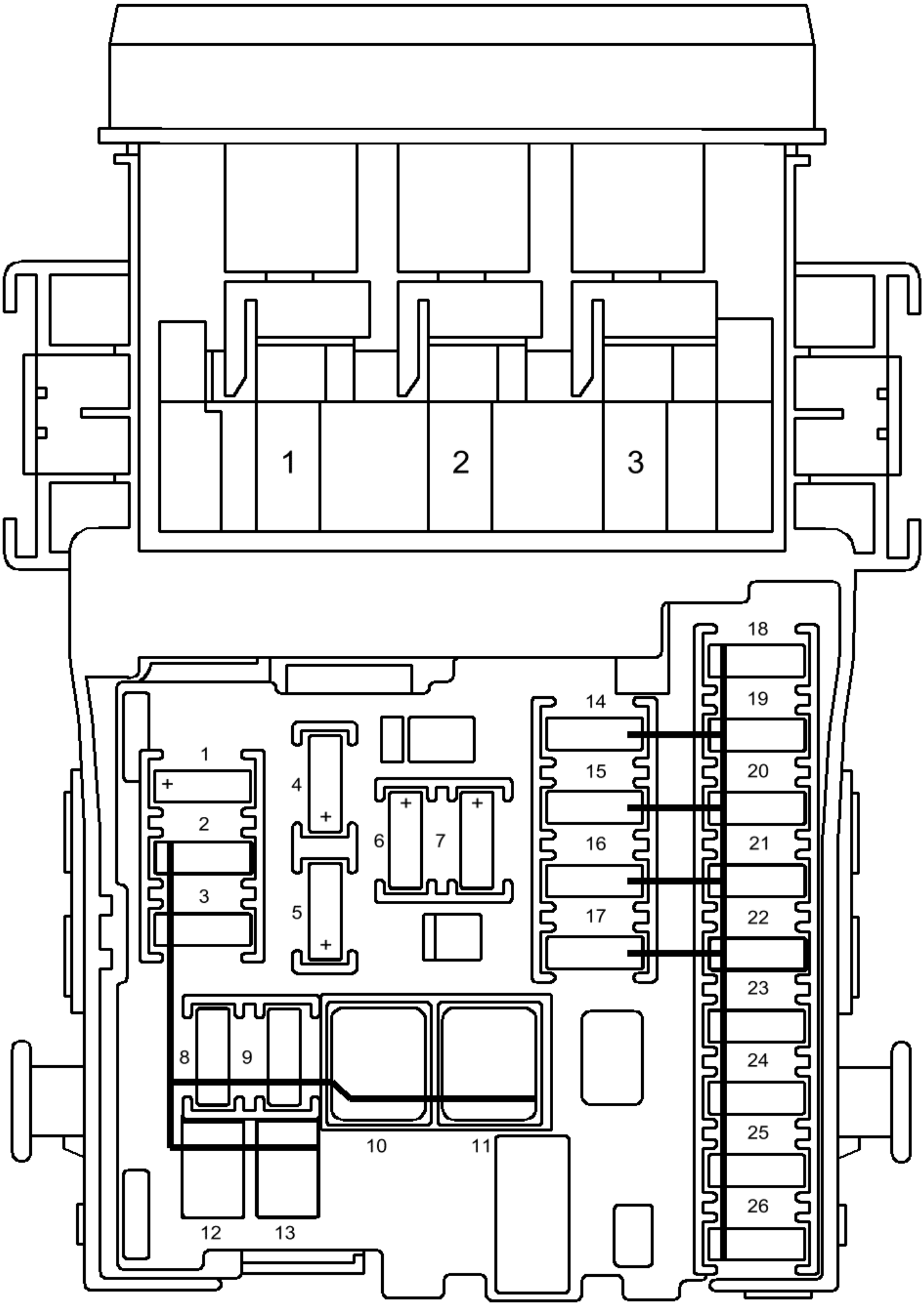
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Fig. 5: Instrument Panel Fuses (Cruze)

Courtesy of GENERAL MOTORS CORP.

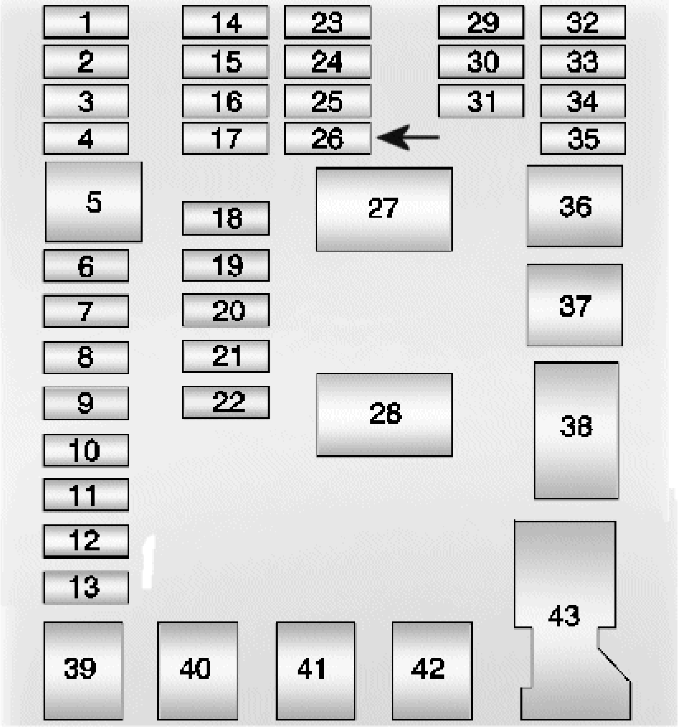


Fig. 6: Instrument Panel Fuses (Sonic)
Courtesy of GENERAL MOTORS CORP.

TRANSMISSION FLUID REPLACEMENT REMINDER

NOTE: **To determine the appropriate reset procedure, refer to TRANSMISSION FLUID REPLACEMENT REMINDER RESET INDEX. Only the vehicles listed in this index have a CHANGE TRANS FLUID MESSAGE reset.**

TRANSMISSION FLUID REPLACEMENT REMINDER RESET INDEX

Model & Year	**Reset Procedure**
Aurora	
1995-99	Transmission Fluid Replacement Reminder Reset - Procedure 04
Concours	
1994-98	Transmission Fluid Replacement Reminder Reset - Procedure 01
1999	Transmission Fluid Replacement Reminder Reset - Procedure 02
CTS	
2003	Transmission Fluid Replacement Reminder Reset - Procedure 03
2004	Transmission Fluid Replacement Reminder Reset - Procedure 02
DeVille	
1992-97	Transmission Fluid Replacement Reminder Reset - Procedure 01
1998-04	Transmission Fluid Replacement Reminder Reset - Procedure 02
Eldorado	
1992-98	Transmission Fluid Replacement Reminder Reset - Procedure 01
1999-00	Transmission Fluid Replacement Reminder Reset - Procedure 02
2001-02	Transmission Fluid Replacement Reminder Reset - Procedure 01
Seville	
1992-97	Transmission Fluid Replacement Reminder Reset - Procedure 01
1998-04	Transmission Fluid Replacement Reminder Reset - Procedure 02
SRX	
2004	Transmission Fluid Replacement Reminder Reset - Procedure 02

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 01

The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due. Change fluid in both the oil pan and side cover.

1. To reset display, turn ignition ON with engine OFF.
2. On the climate control panel, press and hold OFF and REAR DEFOG buttons until TRANS FLUID RESET message appears in DIC (about 5-20 seconds).

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 02

The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due. Percentage of transaxle fluid life remaining may be checked at any time by pressing INFO button several times until TRANS FLUID LIFE message appears.

1. To reset display, turn ignition key ON with engine OFF.
2. Press the INFO button until TRANS FLUID LIFE message appears.
3. Press and hold INFO RESET button until display shows 100 percent TRANS FLUID LIFE. Transaxle fluid life index is now reset.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 03

NOTE: **The CHANGE TRANS FLUID message will appear on the Driver Information Center (DIC) when trans fluid change is due.**

Resetting With Base Audio System

Press CLR button located to the right of the DIC display to acknowledge the CHANGE TRANS FLUID message. This will clear the message from the display and reset it. To reset transmission fluid life indicator, press up or down arrow on INFO button located to the right of the DIC display to access the DIC menu. Once percentage TRANS FLUID LIFE menu item is highlighted, press and hold CLR button. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

Resetting With Navigation System

Press multifunction button located to the right of the DIC display, next to the OK prompt to acknowledge the CHANGE TRANS FLUID message. This will clear the message form the display and reset it. To reset transmission fluid life indicator, turn system on by pressing PWR/VOL knob once. PWR/VOL knob is located to the lower left of the DIC display. Press INFO button located to the left of the DIC display to access the VEHICLE INFO menu. Turn TUNE/SEL knob located to the lower right of the DIC display until TRANS FLUID LIFE is highlighted. Press knob once to select it. Once percentage TRANS FLUID LIFE is displayed, press multifunction button next to the RESET prompt in the upper right corner of the display. Percentage will return to 100, and transmission fluid life indicator will be reset. Repeat if percentage does not return to 100.

TRANSMISSION FLUID REPLACEMENT REMINDER RESET - PROCEDURE 04

1. The Driver Information Center (DIC) displays estimated percentage of the remaining useful life of transaxle fluid. When remaining fluid life is 0 percent, the display will show CHANGE TRNS FLUID NOW. After changing transaxle fluid, reset oil life display.
2. To reset the display, turn ignition on with engine off. Press ENG button to select the TRNS FLUID LIFE percentage display. Then, press and hold in RESET for at least 5 seconds.
3. The word RESET will appear. Then, TRNS FLUID 100 will be displayed.

TIRE PRESSURE MONITOR SYSTEM REMINDER

NOTE: **To determine the appropriate reset procedure, refer to TPMS REMINDER RESET INDEX. Only vehicles listed in this index have a TPMS Reminder Reset.**

TPMS REMINDER RESET INDEX

Model	Application	Procedure
Buick		
Allure	2006-09	TPMS Reminder Reset - Procedure 02

Model	Application	Procedure
Ã,Â	2008-09	TPMS Reminder Reset - Procedure 02
Cascada	2016-19	TPMS Reminder Reset - Procedure 25
Century	1999-05	(1) TPMS Reminder Reset - Procedure 21
Enclave	2008-12	TPMS Reminder Reset - Procedure 02
Ã,Â	2013-19	TPMS Reminder Reset - Procedure 09
Encore	2013-19	TPMS Reminder Reset - Procedure 25
Envision	2016-19	TPMS Reminder Reset - Procedure 26
LaCrosse	2006-09	TPMS Reminder Reset - Procedure 02
Ã,Â	2010-12	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-19	TPMS Reminder Reset - Procedure 26
LaSabre	2002-05	(1) TPMS Reminder Reset - Procedure 20
Lucerne	2006	(1) TPMS Reminder Reset - Procedure 22
Ã,Â	2007-11	TPMS Reminder Reset - Procedure 02
Park Avenue	1998-05	(1) TPMS Reminder Reset - Procedure 20
Rainier	2006-07	TPMS Reminder Reset - Procedure 01
Regal	1999-04	(1) TPMS Reminder Reset - Procedure 21
Ã,Â	2011-12	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-19	TPMS Reminder Reset - Procedure 26
Regal TourX	2018	TPMS Reminder Reset - Procedure 26
Rendezvous	2003-07	(1) TPMS Reminder Reset - Procedure 24
Verano	2012	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-17	TPMS Reminder Reset - Procedure 25
Cadillac		
ATS	2013-19	TPMS Reminder Reset - Procedure 11
CT6	2016-19	TPMS Reminder Reset - Procedure 11
CTS	2004-12	With RPO UH3: TPMS Reminder Reset - Procedure 09 W/O RPO UH3: TPMS Reminder Reset - Procedure 10
Ã,Â	2013-14	TPMS Reminder Reset - Procedure 09
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 11
Deville	2001-05	TPMS Reminder Reset - Procedure 04
DTS	2006-11	TPMS Reminder Reset - Procedure 02
ELR	2014-16	TPMS Reminder Reset - Procedure 11
Escalade Series	2004-06	TPMS Reminder Reset - Procedure 01
Ã,Â	2008-12	TPMS Reminder Reset - Procedure 02
Ã,Â	2013-14	TPMS Reminder Reset - Procedure 09
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 11
Seville	2001-04	TPMS Reminder Reset - Procedure 04
SRX	2008-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012-16	TPMS Reminder Reset - Procedure 11
STS	2005-11	TPMS Reminder Reset - Procedure 03
XLR	2008-09	TPMS Reminder Reset - Procedure 02
XT5	2017-19	TPMS Reminder Reset - Procedure 11
XTS	2013-19	TPMS Reminder Reset - Procedure 11
Chevrolet		
Avalanche	2004-07	TPMS Reminder Reset - Procedure 01
Ã,Â	2008-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012	TPMS Reminder Reset - Procedure 03
Ã,Â	2013	TPMS Reminder Reset - Procedure 09
Aveo / Wave	2008-11	(2) TPMS Reminder Reset - Procedure 07

Model	Application	Procedure
Bolt EV	2017-19	TPMS Reminder Reset - Procedure 28
Camaro	2010-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-15	TPMS Reminder Reset - Procedure 25
Ã,Â	2016-19	TPMS Reminder Reset - Procedure 11
Caprice	2011-13	TPMS Reminder Reset - Procedure 31
Ã,Â	2014-17	TPMS Reminder Reset - Procedure 25
Captiva Sport	2012-15	TPMS Reminder Reset - Procedure 02
City Express	2015-19	TPMS Reminder Reset - Procedure 32
Cobalt	2008-10	TPMS Reminder Reset - Procedure 03
Colorado	2006-12	TPMS Reminder Reset - Procedure 01
Ã,Â	2015-19	Base DIC TPMS Reminder Reset - Procedure 25 Uplevel DIC TPMS Reminder Reset - Procedure 11
Corvette	1987-96	(1) TPMS Reminder Reset - Procedure 20
Ã,Â	1997-04	TPMS Reminder Reset - Procedure 06
Ã,Â	2005-06	TPMS Reminder Reset - Procedure 03
Ã,Â	2007-13	TPMS Reminder Reset - Procedure 09
Ã,Â	2014-19	TPMS Reminder Reset - Procedure 08
Cruze	2011-12	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-19	Base DIC TPMS Reminder Reset - Procedure 25 Uplevel DIC TPMS Reminder Reset - Procedure 11
Cruze Limited	2016	TPMS Reminder Reset - Procedure 25
Equinox	2007	TPMS Reminder Reset - Procedure 05
Ã,Â	2008-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-14	TPMS Reminder Reset - Procedure 25
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 33
Express Van	2008-12	TPMS Reminder Reset - Procedure 02
Ã,Â	2013-19	TPMS Reminder Reset - Procedure 27
HHR	2008-11	TPMS Reminder Reset - Procedure 03
Impala	2000-02	(1) TPMS Reminder Reset - Procedure 13
Ã,Â	2003-05	(1) TPMS Reminder Reset - Procedure 14
Ã,Â	2006-07	TPMS Reminder Reset - Procedure 05
Ã,Â	2008-12	TPMS Reminder Reset - Procedure 02
Ã,Â	2013	TPMS Reminder Reset - Procedure 09
Ã,Â	2014-19	TPMS Reminder Reset - Procedure 28
Impala Limited	2014-16	TPMS Reminder Reset - Procedure 09
Malibu / Classic	2008-11	TPMS Reminder Reset - Procedure 03
Ã,Â	2012	TPMS Reminder Reset - Procedure 02
Ã,Â	2013-14	TPMS Reminder Reset - Procedure 25
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 28
Malibu Limited	2016	TPMS Reminder Reset - Procedure 25
Monte Carlo	2000-02	(1) TPMS Reminder Reset - Procedure 13
Ã,Â	2003-05	(1) TPMS Reminder Reset - Procedure 14
Ã,Â	2006-07	TPMS Reminder Reset - Procedure 05
Orlando (Canada)	2012	TPMS Reminder Reset - Procedure 11
Silverado Series	2006-07	TPMS Reminder Reset - Procedure 01
Ã,Â	2008-11	TPMS Reminder Reset - Procedure 02

Model	Application	Procedure
Ã,Â	2012	TPMS Reminder Reset - Procedure 03
Ã,Â	2013	TPMS Reminder Reset - Procedure 27
Ã,Â	2014-19	TPMS Reminder Reset - Procedure 26
Sonic	2012	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-19	TPMS Reminder Reset - Procedure 25
Spark	2013-15	TPMS Reminder Reset - Procedure 29
Ã,Â	2016-19	TPMS Reminder Reset - Procedure 25
Spark EV	2014-16	TPMS Reminder Reset - Procedure 30
SS	2014-17	TPMS Reminder Reset - Procedure 25
Suburban	2004-07	TPMS Reminder Reset - Procedure 01
Ã,Â	2008-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012	TPMS Reminder Reset - Procedure 03
Ã,Â	2013-14	TPMS Reminder Reset - Procedure 09
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 26
Tahoe	2004-07	TPMS Reminder Reset - Procedure 01
Ã,Â	2008-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012	TPMS Reminder Reset - Procedure 03
Ã,Â	2013-14	TPMS Reminder Reset - Procedure 09
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 26
TrailBlazer	2006-09	TPMS Reminder Reset - Procedure 01
Traverse	2009-12	TPMS Reminder Reset - Procedure 02
Ã,Â	2013-19	TPMS Reminder Reset - Procedure 09
Trax	2013-19	TPMS Reminder Reset - Procedure 25
Uplander	2008	TPMS Reminder Reset - Procedure 03
Volt	2011-12	TPMS Reminder Reset - Procedure 11
Ã,Â	2013-15	TPMS Reminder Reset - Procedure 30
Ã,Â	2016-19	TPMS Reminder Reset - Procedure 11
GMC		
Acadia	2007-11	TPMS Reminder Reset - Procedure 03
Ã,Â	2012	TPMS Reminder Reset - Procedure 02
Ã,Â	2013-16	TPMS Reminder Reset - Procedure 09
Ã,Â	2017-19	TPMS Reminder Reset - Procedure 11
Acadia Limited	2017	TPMS Reminder Reset - Procedure 09
Canyon	2006-12	TPMS Reminder Reset - Procedure 01
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 34
Envoy	2006-09	TPMS Reminder Reset - Procedure 01
Savana Series	2008-12	TPMS Reminder Reset - Procedure 02
Ã,Â	2013-19	TPMS Reminder Reset - Procedure 27
Sierra Series	2006-07	TPMS Reminder Reset - Procedure 01
Ã,Â	2008-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012	TPMS Reminder Reset - Procedure 03
Ã,Â	2013	TPMS Reminder Reset - Procedure 09
Ã,Â	2014-19	TPMS Reminder Reset - Procedure 26
Terrain	2010-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012-19	TPMS Reminder Reset - Procedure 12
Yukon Series	2004-07	TPMS Reminder Reset - Procedure 01
Ã,Â	2008-11	TPMS Reminder Reset - Procedure 02
Ã,Â	2012	TPMS Reminder Reset - Procedure 03
Ã,Â	2013-14	TPMS Reminder Reset - Procedure 09
Ã,Â	2015-19	TPMS Reminder Reset - Procedure 26
Oldsmobile		
Alero	1999-00	(1) TPMS Reminder Reset - Procedure 16

Model	Application	Procedure
Aurora	2001-03	(1) TPMS Reminder Reset - Procedure 17
Pontiac		
Aztek	2003-05	(1) TPMS Reminder Reset - Procedure 23
Bonneville	2000-05	(1) TPMS Reminder Reset - Procedure 15
G3	2009	TPMS Reminder Reset - Procedure 02
G5	2008-10	TPMS Reminder Reset - Procedure 02
G6	2008-10	TPMS Reminder Reset - Procedure 02
G8	2008-09	TPMS Reminder Reset - Procedure 02
Grand Am	1999-05	(1) TPMS Reminder Reset - Procedure 18
Grand Prix	2008	TPMS Reminder Reset - Procedure 02
Solstice	2008-10	TPMS Reminder Reset - Procedure 02
Torrent	2008-09	TPMS Reminder Reset - Procedure 02
Wave	2008	TPMS Reminder Reset - Procedure 02
Vibe	2005-10	(1) TPMS Reminder Reset - Procedure 19

(1) This is an Indirect TPM System. A tire sensor activation tool is not required for this procedure.

(2) A tire sensor activation tool cannot be used for this procedure.

TPMS REMINDER RESET - PROCEDURE 01

NOTE: **When the wheels have been rotated, or a tire pressure sensor or EGM/LGM has been replaced, retrain tire pressure sensors.**

NOTE: **The DIC will display the "SERVICE TIRE MONITOR" message if one or more of the tire pressure sensors has malfunctioned or if all of the sensors have not been programmed successfully. If, after the relearn procedure, the warning indicators are still on, there is a problem in the TPM system.**

NOTE: **If this procedure is performed following replacement and reprogramming of the Liftgate Module (LGM), DIC may display a low tire pressure fault and all tire pressures read 0 psi. If this problem occurs, see appropriate manufacturer service information.**

NOTE: **The TPM system will cancel the learn mode if more than 2 minutes have passed and no sensors have been learned, or if the system has been in learn mode for more than 5 minutes. If the learn mode is canceled before any sensor has been learned, the EGM/LGM will remember all current sensor IDs and their locations. As soon as the first sensor ID code is learned, all other IDs are erased from the EGM/LGM's memory. On models that display the individual tire pressure on DIC, updated tire pressures will not be displayed until EGM/LGM receives 2 more valid transmissions from each sensor.**

NOTE: **Before proceeding with the steps below, ensure that no other sensor learn procedure is being performed simultaneously, or that tire pressures are not being adjusted on a TPM equipped vehicle within close proximity.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF. Apply parking brake.

   NOTE: **If Learn Mode cannot be enabled, TPM system is not enabled in EGM/LGM. See appropriate manufacturer service information.**

3. To enable Learn Mode, turn headlight switch from OFF to parking lamps 4 times within 4 seconds. A double horn chirp will sound and the low tire pressure indicator will begin to flash to indicate the learn mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.
7. Test drive the vehicle above 25 mph for at least 2 minutes before viewing tire pressures on DIC.

TPMS REMINDER RESET - PROCEDURE 02

NOTE: **If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.**

NOTE: **When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.**

NOTE: **Under the following conditions, the TPM system may not function properly:**

- **If one or more of the tire pressure sensors are missing or inoperable.**
- **A compact spare tire is used.**

NOTE: **If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be retrained.**

NOTE: **The relearn procedure must be completed within 15 minutes from when the vehicle is stationary after being driven at 20 mph (32 km/h), or greater, for 10 seconds.**

NOTE: **The learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor that has not been learned. If the learn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the learn mode is canceled after the first sensor is learned, the following will occur:**

- **All stored sensor IDs will be invalidated in the RCDLR memory.**
- **If equipped, the DIC will display dashes instead of tire pressures.**
- **DTC C0775 will be set.**

These conditions will now require the learn procedure to be repeated for the system to function properly.

IMPORTANT: Ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.

1. Turn ignition switch to ACC position. Apply parking brake.
2. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
3. To enable Learn Mode:
    - On vehicles equipped with keyless entry, simultaneously press the keyless entry transmitters lock and unlock buttons until a double horn chirp sounds indicating the Learn Mode has been enabled. On vehicles with DIC, a TIRE LEARN message may be displayed. The left front turn signal will also be illuminated.
    - On vehicles not equipped with keyless entry, press and release the driver information center (DIC) INFO button until the TIRE LEARN message appears on the DIC display. Press and hold the SET/RESET button until a double horn chirp sounds indicating the Learn Mode has been enabled. The left front turn signal will also be illuminated.
4. Ignition ON.
5. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
6. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After left rear sensor has been learned, turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 03

NOTE: **If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.**

NOTE: **When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.**

NOTE: **In vehicles without the "UH3" option, each turn signal will illuminate one at a time indicating which location is to be learn.**

NOTE: **The TPM system will cancel the learn mode if more then 2 minutes have passed and no sensors have been learned, or if the ignition switch is turn to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.**

NOTE: **Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ACC position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.

    NOTE: **The left front turn signal will also illuminate to indicate the learn mode has been enabled.**

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 04

NOTE: **If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.**

NOTE: **When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.**

NOTE: **The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.**

NOTE: **Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.

   NOTE: **If the TPM Learn Mode cannot be enabled, ensure the TPM option is enabled in the RCDLR. See appropriate manufacturer service information.**

3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.

   NOTE: **If a horn chirp does not sound after 15 seconds, remove, then re-apply TPM sensor relearn magnet.**

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 05

NOTE: **If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.**

NOTE: **When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.**

NOTE: **The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.**

NOTE: **Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
6. After the left rear sensor ID is learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn the ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 06

NOTE: **If the wheels have been rotated, or tire pressure sensor or Remote Control Door Lock Receiver (RCDLR) is replaced, the TPM system needs to relearn tire pressure sensor IDs.**

NOTE: **When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on, there is a problem in the TPM system. See appropriate manufacturer service information.**

NOTE: **The TPM system will cancel Learn Mode if ignition is turned off, if more than 1 or 2 minutes has passed and no sensors have been learned, vehicle battery voltage is less than 8 volts, all 4 sensors have been learned, or if the RCDLR has been in Learn Mode for more than 5 minutes. If Learn Mode is cancelled before any IDs are learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition ON with engine OFF.
3. Press RESET button on DIC in order to clear any warning messages.
4. Press and release OPTIONS button until display is blank.
5. Press and hold RESET button for 3 seconds.

NOTE: **If the DIC does not display "TIRE TRAINING" message, ensure TPM option is enabled in the RCDLR. See appropriate manufacturer service information.**

6. Press and release OPTIONS button until "TIRE TRAINING" is displayed.
7. Press and release RESET button. The DIC should display "LEARN L FRONT TIRE", verifying Learn Mode has been enabled.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After the horn chirp sounds, proceed to the next 3 sensors in the following order: right front, right rear, then left rear.
10. Turn the ignition switch to OFF position to exit the learn mode.

TPMS REMINDER RESET - PROCEDURE 07

NOTE: **An OEM scan tool or Pressure Increase/Decrease Method is used to perform this procedure.**

NOTE: **Before proceeding with this process, ensure that no other learn procedure is being performed simultaneously or that tire pressures are not being adjusted on another TPM equipped vehicle within close proximity. Stray signals from other TPM equipped vehicles just driving by can be inadvertently learned. If any random horn chirps are heard from the vehicle while performing the learn procedure, most likely a stray sensor has been learned and the procedure will need to be cancelled and repeated. Under these circumstances, performing the TPM Learn Procedure away from other vehicles would be highly recommended. In the event a particular sensor activation does not cause the horn to chirp, it may be necessary to rotate the wheel valve stem to a different position due to the sensor signal is being blocked by another component.**

1. Ignition ON with engine OFF, apply the parking brake.
2. Using a scan tool, initiate the TPM Learn Mode.
3. Perform the procedure by following the menu selections. A double horn chirp will sound and the IPC tire pressure monitor indicator warning lamp icon will flash indicating Learn Mode is enabled.
4. Starting with the left front tire, active the sensors by one of the following methods:
    - Hold the antenna of the scan tool, aimed upward, against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button and wait for a horn chirp. Once the horn chirp has sounded, the sensor information is learned.
    - Increase/decrease the tire pressure for 8-10 seconds then wait for a horn chirp. The horn chirp may occur before or up to 30 seconds after the 8-10 second pressure increase/decrease time period has been reached. Once the horn chirp has sounded, the sensor information has been learned.
5. After the horn chirp has sounded, repeat step 4 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
6. After the left rear sensor is learned, a double horn chirp will sound indicating all sensor IDs have been learned and the tire pressure module will exit the Learn mode turning OFF the IPC tire pressure monitor warning indicator lamp icon.
7. Ignition OFF, adjust all tires to the recommended pressures. Refer to the tire placard label.

TPMS REMINDER RESET - PROCEDURE 08

Automatic Sensor Learn Process

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. When a tire is installed, the vehicle must be stationary for about 20 minutes before the system recalculates. The following relearn process takes up to 10 minutes, driving at a minimum speed of 12 mph (19 km/h). A dash (-) or pressure value will display in the DIC. A warning message displays in the DIC if a problem occurs during the relearn process.

TPMS REMINDER RESET - PROCEDURE 09

NOTE: **For Cadillac CTS with RPO UH3, use this procedure. For CTS without RPO UH3, see Procedure 10.**

NOTE: **If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.**

NOTE: **When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.**

NOTE: **The TPM system will cancel the learn mode if more then 2 minutes have passed and no sensors have been learned, or if the ignition switch is turn to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.**

NOTE: **Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to RUN position. Apply parking brake.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled. On some models, a TIRE LEARNING ACTIVE message may also be displayed on the DIC screen.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 10

NOTE: **For Cadillac CTS without RPO UH3, use this procedure. For CTS with RPO UH3, see Procedure 9.**

NOTE: **If a tire pressure sensor or the Remote Control Door Lock Receiver (RCDLR) is replaced, or if wheels have been rotated, tire pressure sensor must be relearned.**

NOTE: **When the tire pressure warning light illuminates and warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning indicators are still on or display shows dashes instead of a value, there is a problem in the TPM system. See appropriate manufacturer service information.**

NOTE: **The TPM system will cancel the learn mode if more then 2 minutes have passed and no sensors have been learned, or if the ignition switch is turn to the OFF position. If the learn mode is canceled before the first ID is learned, the RCDLR will remember all previously stored IDs and their locations. As soon as the first sensor ID is learned, all other IDs are erased from the RCDLR's memory. If the learn mode is canceled after the first ID is learned, the RCDLR will store the IDs as invalid and the DIC will display dashes instead of tire pressures.**

NOTE: **Before proceeding with the registration procedure, ensure that no other sensor learn procedure is being performed simultaneously, or that no tire pressures are being adjusted on another TPM equipped vehicle within close proximity.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Depending on ignition type:
   - With standard ignition switch, place the switch in the RUN position.
   - With electronic keyless ignition, place the switch in the ACC position.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a double horn chirp sounds, indicating the Learn Mode has been enabled.
4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 11

NOTE: **This procedure is for vehicles with an Uplevel DIC.**

When a low tire pressure condition is detected, the TPMS illuminates the low tire pressure warning light on the instrument cluster. A message to check the pressure in a specific tire displays in the Driver Information Center (DIC). The low tire pressure warning light and the DIC warning message come on at each ignition cycle until the tires are inflated to the correct inflation pressure. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Place the vehicle power mode in ON/RUN/START.
4. Make sure the Tire Pressure info display option is turned on. The info displays on the DIC can be turned on and off through the Settings menu.
5. Use the five-way DIC control on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SEL button located in the center of the five-way DIC control. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.
8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching

process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.

10. Press STOP to turn the ignition off.

TPMS REMINDER RESET - PROCEDURE 12

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Use the MENU button (center console) to select the Vehicle Information Menu in the Driver Information Center (DIC). Use the arrow keys to scroll to the Tire Pressure screen
5. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the process should display.
6. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
7. Start with the driver side front tire. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position.
8. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Turn the ignition to LOCK/OFF.

TPMS REMINDER RESET - PROCEDURE 13

LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or when vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. There are 2 ways to reset the tire inflation monitor. To reset the tire inflation monitor using the exterior or interior lamp controls, go to step 4. To reset tire inflation monitor using the radio, turn the radio off. Turn ignition to ACC or ON, with the engine OFF. Press and hold the TUNE DISP button on the radio for at least 5 seconds until settings is displayed.
2. To scroll through the main menu:
   - On Impala, press the SEEK PTYPE up or down arrow.
   - On Monte Carlo, press the SEEK PSCAN up or down arrow.

   On all models, scroll until TIRE MON appears on the display. Press the 1 PREV or 2 NEXT button to enter the sub-menu. RESET will be displayed.
3. Press the TUNE DISP button to reset. A chime will sound to verify the new setting and DONE will be displayed for one second. Once the message has been reset, scroll through the menu until EXIT appears on the display. Press the TUNE DISP button to exit the program. A chime will sound to verify the exit.
4. Reset the tire inflation monitor:

- On Impala, using the interior lighting controls, turn the switch from OFF to ON position 3 times with ignition switch in ON position.
- On Monte Carlo, using the exterior lighting controls, turn the switch from OFF to parking lamps 3 times with ignition switch in ON position.

TPMS REMINDER RESET - PROCEDURE 14

NOTE: **There are 3 different ways to reset the Tire Pressure Monitor (TPM) system. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the 3 speed ranges to complete the calibration process.**

Using Exterior Lamp Switch

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Cycle the exterior lamp switch from OFF to parking lamps 3 times within 5 seconds.
4. Use the scan tool in order to clear the TPM DTC.

Using RDS Radio, If Equipped

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn the ignition to ACC or ON, with the engine OFF.
3. Turn the radio OFF.
4. Press and hold the DISP button until SETTINGS is displayed.
5. Press the SEEK up or down arrows until TIRE MON is displayed.
6. Press the PREV or NEXT button to enter the sub-menu. RESET will be displayed.
7. Press the DISP button, A chime will sound and DONE will be displayed.
8. Scroll until EXIT is displayed.
9. Press the DISP button to exit the TPM reset mode. A chime will sound to verify exit.
10. Use the scan tool in order to clear the TPM DTC.

Using Scan Tool

1. Adjust all tire pressures to the recommended kPa/psi.
2. Install the scan tool.
3. Turn ignition ON with engine OFF.
4. With the scan tool select Special Functions.
5. Select TIM Reset.
6. Press the Reset soft key.
7. Use the scan tool in order to clear the TPM DTC.

TPMS REMINDER RESET - PROCEDURE 15

CHECK TIRE PRESSURE or TIRE PRESS message will come on if air pressure in one tire is lower than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Message will stay on until system is recalibrated. Check and adjust air pressure in all 4 tires before recalibrating system.

NOTE: **If vehicle is equipped with Systems Monitor, go to step 2.**

1. To recalibrate vehicle equipped with Driver Information Center (DIC), turn ignition ON with engine OFF. Using the MODE and SELECT button on DIC, change display until TIRE PRESSURE appears. Press and hold RESET button for 5 seconds. TIRE PRESSURE RESET should now appear on display. If TIRE PRESSURE RESET does not appear on display after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.

2. To recalibrate vehicle equipped with Systems Monitor, turn ignition ON with engine OFF. Press and hold TIRE PRESS RESET button for 5 seconds. TIRE PRESS light on the Systems Monitor should begin to flash. Release the TIRE PRESS RESET button. TIRE PRESS light should go out and system is now reset. If TIRE PRESS light does not begin to flash after 5 seconds, repair system as necessary. Using a scan tool, clear TPM DTC.

TPMS REMINDER RESET - PROCEDURE 16

CHECK TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi (kPa) less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, or if air pressure is adjusted. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.

1. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
2. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the CHECK TIRE PRESSURE indicator light will begin to flash. While the CHECK TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If CHECK TIRE PRESSURE light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS REMINDER RESET - PROCEDURE 17

NOTE: **When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.**

NOTE: **When the low tire pressure warning messages appear, immediately check air pressure of all tires and adjust to the specified pressure. If warning messages are still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.**

NOTE: **Under the following conditions, the system may not function properly:**

- **More than one tire is low.**
- **Only one tire is replaced with a new tire during service.**
- **Vehicle is moving faster than 65 mph (105 km/h).**
- **The system is not yet calibrated.**
- **Tire treadwear is uneven.**
- **Compact spare tire is installed.**
- **Tire chains are being used.**
- **Vehicle is being driven on a rough or frozen road.**
- **If ABS warning light is on.**

CAUTION: **DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.**

NOTE: **There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:**

- ***Using DIC Reset Button*** **(if no scan tool is available)**
- ***Using Scan Tool*** **(if an OBD-II compatible scan tool is available).**

Using DIC Reset Button

1. Turn ignition switch to OFF position.

2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press SELECT right arrow button until "GAGE" is displayed.
5. Press SELECT down arrow button until "TIRE PRESSURE" is displayed.
6. Press and hold RESET button until "TIRE PRESSURE RESET" is displayed.
7. Release RESET button. DIC should display "TIRE PRESSURE NORMAL".
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
    - 15-40 mph (24-64 km/h).
    - 40-70 mph (64-113 km/h).
    - 70-90 mph (113-145 km/h).

NOTE: **The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.**

NOTE: **Learning process does not need to be completed during a single trip.**

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select "SPECIAL FUNCTIONS".
5. Select "TIRE PRESSURE RESET".
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
    - 15-40 mph (24-64 km/h).
    - 40-70 mph (64-113 km/h).
    - 70-90 mph (113-145 km/h).

NOTE: **The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.**

NOTE: **Learning process does not need to be completed during a single trip.**

TPMS REMINDER RESET - PROCEDURE 18

The Tire Pressure Monitor (TPM) system alerts the driver when a large change in the pressure of one tire exists, while the vehicle is being driven. The TPM system uses the Electronic Brake Control Module (EBCM), ABS wheel speed sensor inputs, class 2 serial data circuit, and the Driver Information Center (DIC) to perform the system functions. The EBCM contains software to calculate relative tire pressure differences. The software requires approximately 30 minutes of straight line driving in 3 different speed ranges to complete the calibration process to have full capability for detecting a tire pressure condition. The speed ranges are 15-40 mph, 40-70 mph and 70-90 mph.

1. LOW TIRE PRESSURE light comes on if air pressure in one tire drops to 12 psi less than the other 3 tires, if tires are rotated, if tire(s) are repaired or replaced, if air pressure is adjusted or if vehicle battery is disconnected. Light will stay on until ignition is turned off or RESET button is pressed. Check and adjust air pressure in all 4 tires before resetting system.
2. To reset tire inflation monitor, turn ignition ON with engine OFF. Press and release the RESET button. RESET button is located inside of driver's side instrument panel fuse block (left end of instrument panel). The CHANGE OIL indicator light will begin to flash.
3. Press and release the RESET button again. The CHANGE OIL indicator light will turn off, and the LOW TIRE PRESSURE indicator light will begin to flash. While the LOW TIRE PRESSURE indicator light is flashing, press and hold the RESET button until the chime sounds indicating system is reset. If the LOW TIRE PRESSURE indicator light does not go out, repeat reset procedure. If system still will not reset, repair system as necessary.

TPMS REMINDER RESET - PROCEDURE 19

NOTE: **After resetting, the tire pressure monitoring (TPM) system requires 60 minutes or more of driving at a speed of 30 km/h (19 mph) or above to complete the calibration process to have full capability for detecting a tire pressure condition.**

1. Adjust all tire pressures to the recommended kPa/psi.
2. Turn ignition ON with engine OFF.
3. Press and hold the tire pressure warning reset switch until the tire pressure warning indicator blinks 3 times at one second intervals.
4. If the tire pressure warning indicator does not blink, repeat the procedure starting at step 2.
5. Drive the vehicle for 60 minutes or more at a speed of 30 km/h (19 mph).
6. Verify the system has initialized. Turn ignition ON with engine OFF and observe the tire pressure warning indicator.
    - System Initialized: light on for 3 seconds.
    - System not initialized: light on for 4 seconds.

TPMS REMINDER RESET - PROCEDURE 20

NOTE: **When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.**

CAUTION: **DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.**

NOTE: **When the tire pressure warning message appears on DIC, immediately check air pressure of all tires and adjust to the specified pressure. If warning message is still displayed, there is a malfunction in the TPM system. See appropriate manufacturer service information.**

NOTE: **Under the following conditions, the system may not function properly:**

- **More than one tire is low.**
- **Vehicle is moving faster than 65 mph (105 km/h).**
- **The system is not yet calibrated.**
- **Tire treadwear is uneven.**
- **Compact spare tire is installed.**
- **Tire chains are being used.**
- **Vehicle is being driven on a rough or frozen road.**
- **If ABS warning light is on.**

NOTE: **There are 2 ways to recalibrate the Tire Pressure Monitor (TPM) system:**

- ***Using DIC Reset Button*** **(if no scan tool is available)**
- ***Using Scan Tool*** **(if an OBD-II compatible scan tool is available).**

Using DIC Reset Button

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold appropriate button (located on left side of steering column) until "TIRE PRESSURE" message appears on display:
    - 1997-99 models: Press and hold GAGES button
    - 2000-05 models: Press and hold GAGES INFO button
5. Press and hold RESET button for 5 seconds. After 5 seconds, "TIRE PRESSURE RESET" message should appear on display.
6. Release RESET button. A "TIRE PRESSURE NORMAL" message should appear on display.
7. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
    - 15-40 mph (24-64 km/h).
    - 40-70 mph (64-113 km/h).
    - 70-90 mph (113-145 km/h).

NOTE: **The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.**

NOTE: **Learning process does not need to be completed during a single trip.**

Using Scan Tool

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Connect scan tool. Turn ignition ON with engine OFF.
4. Using scan tool, select SPECIAL FUNCTIONS.
5. Select TIM RESET.
6. Press RESET soft key. A "TIRE PRESSURE NORMAL" message should appear on display.
7. If necessary, use scan tool to clear any TPM Diagnostic Trouble Codes (DTCs).
8. After resetting, the TPM system requires up to 30 minutes of straight line driving in each of the following speed ranges to complete calibration process:
    - 15-40 mph (24-64 km/h).
    - 40-70 mph (64-113 km/h).
    - 70-90 mph (113-145 km/h).

NOTE: **The EBCM learns tire pressure calibration for each speed range independently. In Monitor Mode 1, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Monitor Mode 2, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.**

NOTE: **Learning process does not need to be completed during a single trip.**

TPMS REMINDER RESET - PROCEDURE 21

Using Reset Button (1999-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Press and hold the red RESET button located in the passenger side instrument panel fuse block.
3. The LOW TIRE indicator will flash 3 times, then turn off.
4. Use scan tool to clear the TPM DTC.

Using Scan Tool (2003-05 Models)

1. Adjust all tire pressures to the recommended Psi (kPa). See vehicle's Loading Information Label for recommended tire pressure. Turn ignition ON with engine OFF.
2. Install scan tool. Turn ignition ON with engine OFF.
3. With scan tool, select Special Functions.
4. Select TIM Reset.
5. Press Reset soft key.
6. LOW TIRE indicator will flash 3 times, then turn OFF.
7. Clear the TPM DTC.

TPMS REMINDER RESET - PROCEDURE 22

NOTE: **When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.**

CAUTION: **DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.**

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button chime sounds and "TIRE PRESSURE RESET" is displayed and a chime sounds 3 times.
6. Release SET button and DIC will display "TIRE PRESSURE NORMAL".

   NOTE: **If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure. If it does not work after two tries, refer to appropriate service information.**

7. After resetting, the TPM system requires up to 5 miles of driving in each of the following speed ranges to complete the calibration process:
   - 25-40 mph (40-64 km/h).
   - 40-60 mph (65-96 km/h).
   - 60-85 mph (96-136 km/h).

   NOTE: **Learning process does not need to be completed during a single trip.**

TPMS REMINDER RESET - PROCEDURE 23

1. Check and adjust air pressure in all 4 tires before resetting system. Refer to tire placard located on the inside edge of the driver's door. Turn ignition ON, with engine OFF.
2. Press the MODE button on the Driver Information System until LOW TIRE PRESSURE HOLD SET TO RESET is displayed.
3. Press and hold the SET button until a chime sounds and TIRE PRESSURE RESET is displayed and a chime sounds 3 times.
4. Release the SET button and TIRE PRESSURE NORMAL will be displayed.

TPMS REMINDER RESET - PROCEDURE 24

NOTE: **When a spare tire is mounted, a wheel is replaced or rotated, or tire pressure has been adjusted, TPM system will need to be recalibrated.**

CAUTION: **DO NOT recalibrate TPM system until all problems are fixed and tire pressure in all 4 tires has been adjusted. If recalibration is done when tire pressures are incorrect, TPM system will not work properly and may not set an alert when a tire pressure is low or high.**

1. Turn ignition switch to OFF position.
2. Ensure all tire pressures are adjusted to the pressure recommended on tire pressure label.
3. Turn ignition ON with engine OFF.
4. Press and hold the MODE button until DIC display reads "LOW TIRE PRESSURE HOLD SET TO RESET".
5. Press and hold SET button until a chime sounds and "TIRE PRESSURE RESET" is displayed.
6. System will now sound a chime 3 times, and DIC will display "TIRE PRESSURE NORMAL".

   NOTE: **If low tire pressure warning message is still set, TPM system has not reset. Repeat procedure.**

7. After resetting, the TPM system requires up to 5 miles (8 km) of flat, smooth road, straight line driving in each of the 4 speed ranges (about 10-20 minutes in each range) to complete the calibration process:
   - 19-40 mph (31-65 km/h).
   - 40-59 mph (65-95 km/h).
   - 59-74.5 mph (95-120 km/h).
   - 74.5-90 mph (120-145 km/h).

   NOTE: **The EBCM learns tire pressure calibration for each speed range independently. In Calibration Mode, EBCM has only partially learned tire pressure calibration for speed range and has limited detection capability for a tire pressure condition. In Detection Mode, EBCM has fully learned tire pressure calibration for speed range and has full detection capability for a tire pressure condition.**

   NOTE: **Learning process does not need to be completed during a single trip.**

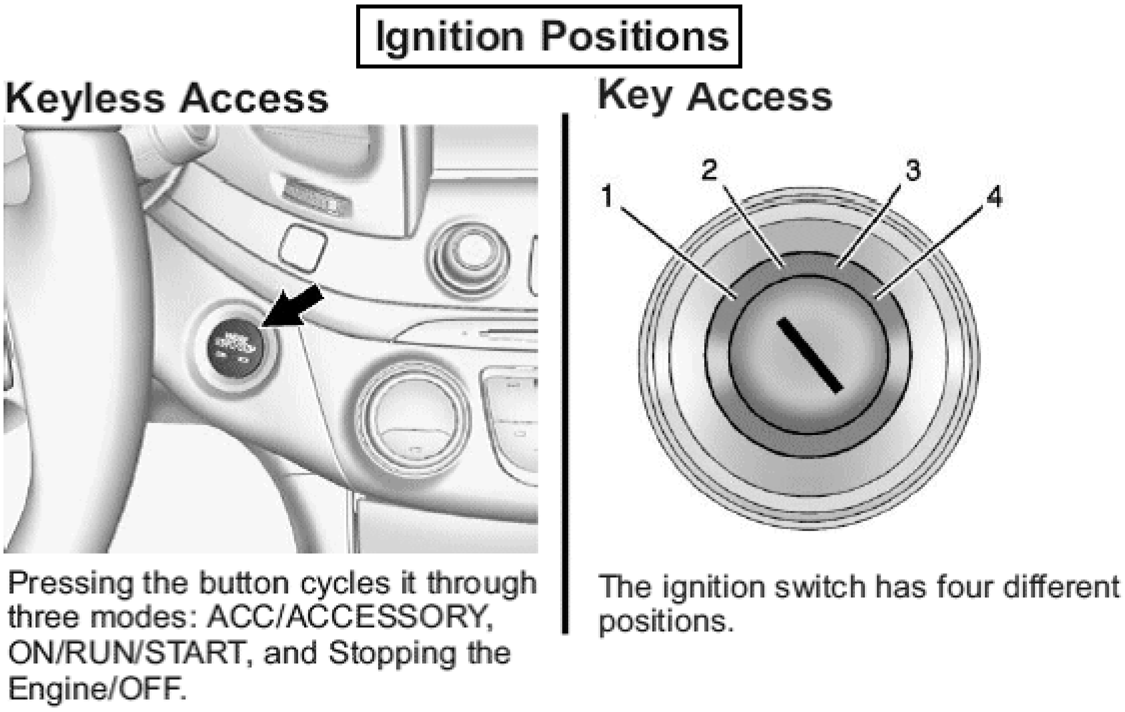
TPMS REMINDER RESET - PROCEDURE 25

NOTE: **This procedure is for vehicles with a Base DIC.**

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions using a TPMS relearn tool. There are two minutes to match the first tire/wheel position, and five minutes overall to match all four tire/wheel positions. If it takes longer, the matching process stops and must be restarted.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See **Fig. 7**.
4. Use the MENU button to select the VEHICLE INFORMATION MENU in the Driver Information Center (DIC). See **Fig. 8**.
5. Use the thumbwheel (or up and down arrows) to scroll to the TIRE PRESSURE MENU item screen.
6. Press the SET/CLR button to begin the sensor matching process. A message requesting acceptance of the process should display.
7. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.



Pressing the button cycles it through three modes: ACC/ACCESSORY, ON/RUN/START, and Stopping the Engine/OFF.

The ignition switch has four different positions.

Fig. 7: Ignition Positions (Key & Keyless)
Courtesy of GENERAL MOTORS CORP.

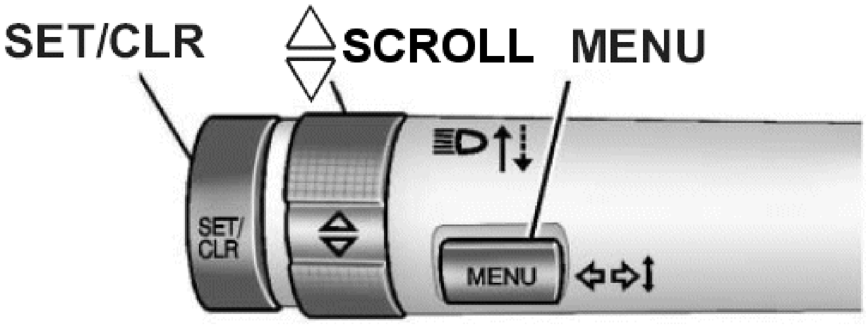


Fig. 8: Identifying DIC Controls (Turn Signal Lever)
Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 26

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Up-level Driver Information Center (DIC) Only: Make sure the TIRE PRESSURE INFO page option is turned on. The info pages on the DIC can be turned on and off through the SETTINGS menu.
5.
    - **Up-Level DIC** : Use the DIC controls (arrow buttons) on the right side of the steering wheel to scroll to the TIRE PRESSURE screen under the DIC info page.
    - **Base-Level DIC** : Use the TRIP ODOMETER RESET stem to scroll to the TIRE PRESSURE screen.
6.
    - **Up-Level DIC** : Press and hold the SET/RESET button (check-mark symbol) located in the center of the DIC controls.
    - **Base-Level DIC** : Press and hold the TRIP ODOMETER RESET stem for about five seconds. A message asking if the process should begin should appear. Select YES and press the TRIP ODOMETER RESET stem to confirm the selection.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 27

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn ignition switch to ON/RUN position, with engine OFF.
3. Simultaneously press the keyless entry transmitter's lock and unlock buttons until a horn chirp sounds, indicating Learn Mode has been enabled. The TIRE LEARNING ACTIVE message displays on the DIC screen.

NOTE: **If the vehicle does not have RKE, press the Driver Information Center (DIC) vehicle information button until the PRESS (check mark**

symbol) TO RELEARN TIRE POSITIONS message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen. If the vehicle does not have RKE or DIC buttons, press the trip odometer reset stem on the instrument cluster until the PRESS (check mark symbol) TO RELEARN TIRE POSITIONS message displays. The horn sounds twice to signal the receiver is in relearn mode and TIRE LEARNING ACTIVE message displays on the DIC screen.

4. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
5. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
6. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 28

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/ RUN with the engine OFF or place the vehicle power mode in ON/ RUN/ START. See **Fig. 7**.
4. Make sure the Tire Pressure info page option is turned on. The info pages on the Driver Information Center (DIC) can be turned on and off through the Settings menu.
5. Use the DIC controls on the right side of the steering wheel to scroll to the Tire Pressure screen under the DIC info page.
6. Press and hold the SET/RESET button (check mark symbol) located in the center of the DIC controls.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 29

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Press the MENU button (right-hand side of instrument cluster) once on the Driver Information Center (DIC).
5. Press the up or down arrow button until the Tire Learn screen is displayed.
6. Press and hold the SET/CLR button to begin the sensor matching process.
7. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 30

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

TPMS sensors are mounted onto each tire and wheel assembly, excluding the spare tire and wheel assembly. Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the vehicle's tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Put the vehicle in ON/ RUN and place the vehicle in P (Park).
4. If the Driver Information Center (DIC) display is minimized, press the SELECT knob to maximize it. See **Fig. 9**.
5. Use the SELECT knob to scroll to the Tire Pressure display screen.
6. Press and hold the SELECT knob for five seconds to begin the sensor matching process. A message displays confirming to begin the process.
7. Use the SELECT knob to select YES with the highlighted selection, and press the SELECT knob again to confirm the selection.
8. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
9. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
10. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
11. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

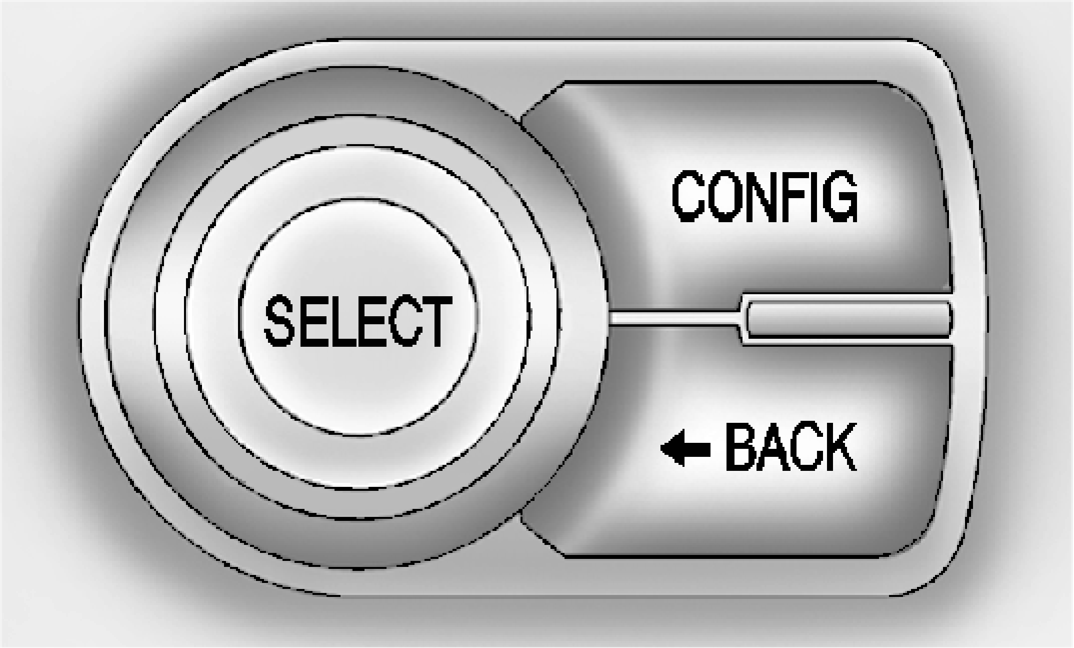


Fig. 9: Identifying DIC Controls (Spark EV)
Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 31

NOTE: **You have two minutes to match the first tire/wheel position, and five minutes overall to match all four tire/wheel positions. If it takes longer, the matching process stops and must be restarted.**

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine off.
4. Enter the learn sequence from the TPM Learn screen, located under the Customization Menu in the instrument panel cluster. Press SRCE button until you see Customize Options and then press ENTER (left pointing arrow). Move the thumbwheel up or down to scroll through the available options. Press ENTER to select an item. To exit the current menu, or go back, use the thumbwheel to select BACK (left arrow) at the top of the screen and then press ENTER.
5. Start with the driver side front tire. The driver side front indicator lamp also comes on to indicate that corner's sensor is ready to be learned. Place a tire sensor activation tool against the tire sidewall, near the valve stem. Then press the button to activate the TPMS sensor. A horn chirp confirms that the sensor identification code has been matched to this tire and wheel position
6. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
7. After the driver side rear TPMS sensor has been learned the horn chirps two times. The driver side rear indicator lamp turns off and the TPMS sensor matching process is done. Turn the ignition switch to LOCK/OFF.

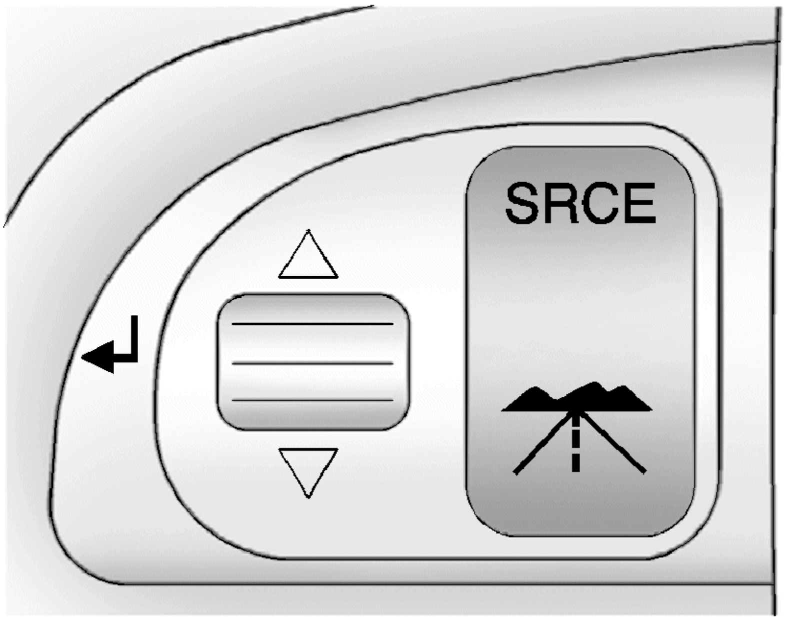


Fig. 10: Identifying DIC Controls
Courtesy of GENERAL MOTORS CORP.

TPMS REMINDER RESET - PROCEDURE 32

NOTE: **An OEM or generic TPMS sensor activation tool is used to perform this procedure.**

NOTE: **The sensor learn procedure must be performed after every tire rotation, tire pressure indicator module replacement, or sensor replacement. Make sure the TPM sensor activation tool battery is sufficient to complete TPM learn process. Do not place the TPM tool directly on the valve stem. The TPM tool should be placed against the tire sidewall near the valve stem. The TPM sensor learn activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. The low tire pressure warning light will start to flash to indicate the learn mode has been enabled. The front and back turn signals will flash twice when a sensor has been learned.**

1. Ignition ON with engine OFF, apply the parking brake.
2. Using a sensor activation tool, initiate the TPM Learn Mode.
3. Starting with the left front tire, active the sensor by holding the antenna of the tire pressure sensor activation tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for the front and back turn signals to flash twice. If the front and back turn signals do not flash, repeat the sensor activation sequence with the tool. Once the front and back turn signals have flashed twice, the sensor information is learned.

   NOTE: **Follow the sensor order listed here since there is no visual indicator on the vehicle for the sensor learn order.**

4. After the front and back turn signals have flashed twice, repeat step 2 for the remaining 3 sensors in the following order: Right front, Right rear, Left rear.
5. When the left rear sensor has been learned, the front and back turn signals will flash twice, the learn process is complete and the tire pressure indicator module exits the Learn mode.

TPMS REMINDER RESET - PROCEDURE 33

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Set the parking brake.
3. Turn the ignition to ON/RUN with the engine OFF.
4. Press the MENU button (center console) to select the Vehicle Information Menu in the Driver Information Center (DIC).
5. Use the arrow keys to scroll to the Tire Pressure screen.
6. Press the SET/CLR button to begin the sensor matching process. A message should display requesting acceptance of the process.
7. Press the SET/CLR button again to confirm the selection. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
8. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
9. After horn chirp has sounded, proceed to the next 3 sensors in the following order: right front, right rear and left rear.
10. After left rear sensor has been learned, a double horn chirp will sound, indicating all 4 sensor IDs have been learned. Turn ignition switch to OFF position to exit Learn Mode.

TPMS REMINDER RESET - PROCEDURE 34

If refilling a low tire, no specific reset procedure is required. All warnings are extinguished once the TPMS receives a signal that all tires are properly inflated.

Each TPMS sensor has a unique identification code. The identification code needs to be matched to a new tire/wheel position after rotating the tires or replacing one or more of the TPMS sensors. The TPMS sensor matching process should also be performed after replacing a spare tire with a road tire containing the TPMS sensor. The malfunction light and the DIC message should go off at the next ignition cycle. The sensors are matched to the tire/ wheel positions, using a TPMS relearn tool.

1. Set the tire pressure of all wheels to pressure specified on the tire and loading information label.
2. Turn the ignition to ON/RUN with the engine OFF. Set the parking brake.
3. Up-level Driver Information Center (DIC) Only: Make sure the TIRE PRESSURE INFO page option is turned on. The info pages on the DIC can be turned on and off through the SETTINGS menu.
4.
    - **Up-Level DIC** : Use the DIC controls (arrow buttons) on the right side of the steering wheel to scroll to the TIRE PRESSURE screen under the DIC info page.
    - **Base-Level DIC** : Use the MENU button to select the Vehicle Information menu in the DIC. Use the thumbwheel to scroll to the Tire Pressure Menu item screen. See Fig. 8.
5.
    - **Up-Level DIC** : Press and hold the SET/RESET button (check-mark symbol) located in the center of the DIC controls.
    - **Base-Level DIC** : Press the SET/CLR button to begin the sensor matching process. A message asking if the process should begin should appear. Press the SET/CLR button again to confirm the selection.
6. The horn sounds twice to signal the receiver is in relearn mode and the TIRE LEARNING ACTIVE message displays on the DIC screen.
7. Starting with left front tire, hold a tire sensor activation tool against the side wall of the tire, within 3 inches of the valve stem. Activate tool until a horn chirp sounds.
8. After horn chirp has sounded and the right turn signal has illuminated, proceed to the next 3 sensors in the following order: right front, right rear and left rear.

9. After left rear sensor has been learned, the horn sounds two times to indicate the sensor identification code has been matched to the driver side rear tire, and the TPMS sensor matching process is no longer active. The TIRE LEARNING ACTIVE message on the DIC display screen goes off.
10. Turn the ignition switch to LOCK/OFF.
11. Set all four tires to the recommended air pressure level as indicated on the Tire and Loading Information label.

Back To Article

2017 RESTRAINTS

Seat Belts - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

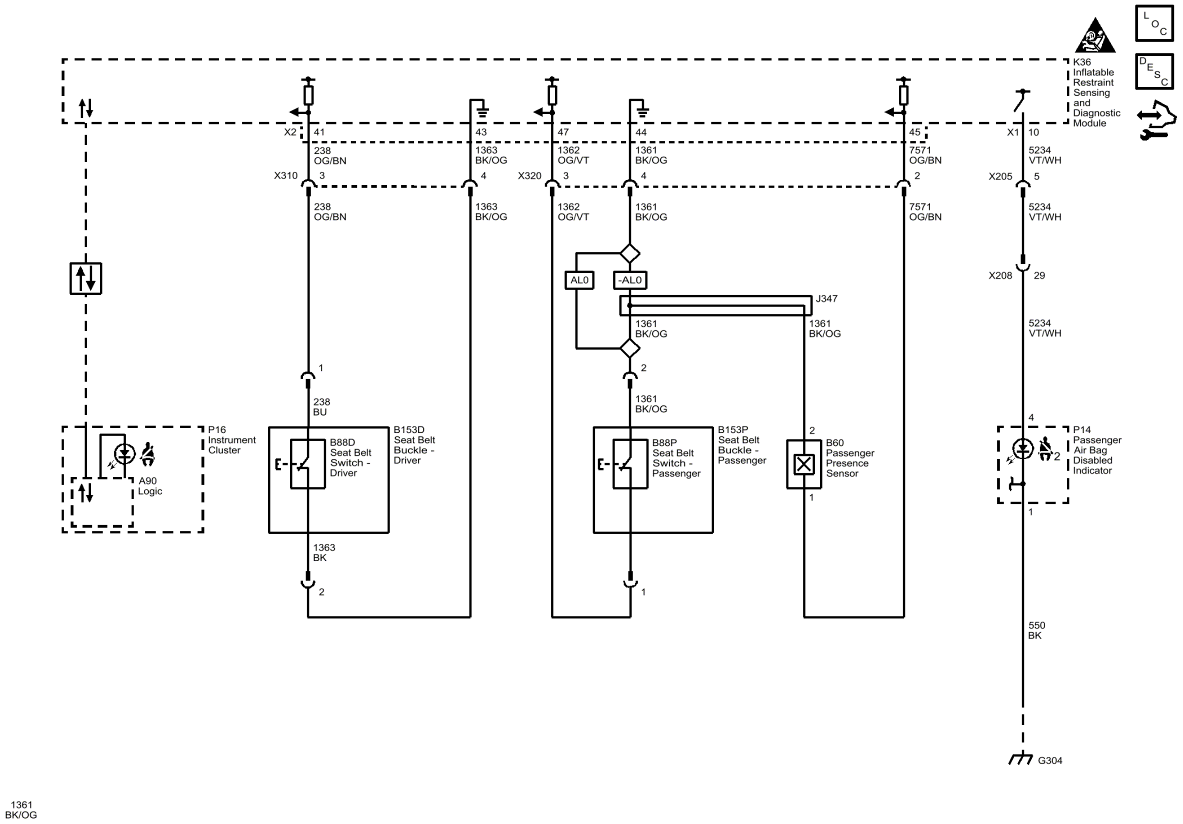
Single Use Threaded Fastener/Component Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***	
Front Seat Belt Buckle Fastener	45 N.m (33 lb ft)
Rear Center Seat Belt Buckle Nut	45 N.m (33 lb ft)
Rear Center Seat Belt Retractor Nut	45 N.m (33 lb ft)
Rear Seat Belt Buckle Nut	45 N.m (33 lb ft)
Rear Seat Belt Retractor Bolt	45 N.m (33 lb ft)

SCHEMATIC WIRING DIAGRAMS

SEAT BELT WIRING SCHEMATICS

Switches and Indicators



K36
Inflatable Restraint Sensing and Diagnostic Module
L O C
D E S C
X2
41
43
47
44
45
X1
10
238 OG/BN
1363 BK/OG
1362 OG/VT
1361 BK/OG
7571 OG/BN
5234 VT/WH
X310
3
4
X320
3
4
2
X205
5
238 OG/BN
1363 BK/OG
1362 OG/VT
1361 BK/OG
7571 OG/BN
5234 VT/WH
X208
29
ALO
-ALO
J347
1361 BK/OG
1361 BK/OG
5234 VT/WH
1
238 BU
2
1361 BK/OG
P16
Instrument Cluster
A90 Logic
B88D Seat Belt Switch - Driver
B153D Seat Belt Buckle - Driver
B88P Seat Belt Switch - Passenger
B153P Seat Belt Buckle - Passenger
2
B60 Passenger Presence Sensor
1
4
P14 Passenger Air Bag Disabled Indicator
2
1
1363 BK
2
1
550 BK
G304
1361 BK/OG

Fig. 1: Switches and Indicators

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0072 OR B0073: DRIVER/PASSENGER SEAT BELT SWITCH CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptors

DTC B0072

Driver Seat Belt Switch Circuit

DTC B0073

Passenger Seat Belt Switch Circuit

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Seat Belt Buckle Signal	B0072 02, B0072 0B	B0072 04, B0072 06, B0072 0C	B0072 04, B0072 06	B0072 01, B0072 05	B0072 08
Driver Seat Belt Buckle Low Reference	-	B0072 04, B0072 06, B0072 0C	B0072 04, B0072 06	-	-
Passenger Seat Belt Buckle Signal	B0073 02, B0073 0B	B0073 04, B0073 06, B0073 0C	B0073 04, B0073 06	B0073 01, B0073 05	B0073 08
Passenger Seat Belt Buckle Low Reference	-	B0073 04, B0073 06, B0073 0C	B0073 04, B0073 06	-	-

Circuit/System Description

The inflatable restraint seat belt buckle switch is within the seat belt buckle and provides an input to the inflatable restraint sensing and diagnostic module (SDM). The inflatable restraint sensing and diagnostic module supplies a low reference circuit and a seat belt switch signal circuit to determine a buckled or unbuckled condition. The inflatable restraint sensing and diagnostic module monitors the seat belt switch circuits and if a fault is detected a DTC will be set.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0072 01 or B0073 01

The seat belt switch circuit is shorted to voltage.

B0072 02 or B0073 02

The seat belt switch circuit is shorted to ground.

B0072 04 or B0073 03

The seat belt switch circuit is open.

B0072 05 or B0073 05

The seat belt switch circuit is shorted to voltage or open.

B0072 06 or B0073 06

The seat belt switch circuit is shorted to ground or open.

B0072 08 or B0073 08

The seat belt switch signal is invalid.

B0072 0B or B0073 0B

The seat belt switch signal is above threshold.

B0072 0C or B0073 0C

The seat belt switch signal is below threshold.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module will store a DTC and illuminate the air bag indicator in the instrument cluster.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the appropriate scan tool Seat Belt Status parameter changes between Buckled and Unbuckled when the seat belt is buckled and unbuckled.
    - **If the parameter does not change**

      Refer to Circuit/System Testing.

    - **If the parameter changes**
3. All OK.

Circuit/System Testing

NOTE: **When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**

- **B153D Seat Belt Buckle-Driver**
- **B153P Seat Belt Buckle-Passenger**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Ignition OFF. Scan tool disconnected. Disconnect the harness connector at the appropriate B153 Seat Belt Buckle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
   - **If 5 Ω or greater**
   1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 5 Ω**
3. Ignition ON.
4. Verify the appropriate scan tool Seat Belt Status parameter is Buckled.
   - **If not Buckled**
   1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the signal circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If Buckled**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the appropriate scan tool Seat Belt Status parameter is Unbuckled.
   - **If not Unbuckled**
   1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If Unbuckled**
7. Test or replace the B153 Seat Belt Buckle.

Component Testing

1. Ignition OFF. Scan tool disconnected. Disconnect the harness connector at the appropriate B153 Seat Belt Buckle. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the signal terminal 1 and the low reference terminal 2.
   - **If 5 Ω or greater**

     Replace the B153 Seat Belt Buckle.

        - **If less than 5 Ω**

3. Insert the seat belt into the buckle.
4. Test for infinite resistance between the signal terminal 1 and the low reference terminal 2.
    - **If less than infinite resistance**

      Replace the B153 Seat Belt Buckle.

    - **If infinite resistance**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Belt Buckle Replacement**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming, and setup.

DTC B059A: PASSENGER SEAT BELT INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptors

DTC B059A 01

Passenger Seat Belt Indicator Circuit Short to Battery

DTC B059A 02

Passenger Seat Belt Indicator Circuit Short to Ground

DTC B059A 04

Passenger Seat Belt Indicator Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Seat Belt Switch Signal	1	2	2	-
Passenger Seat Belt Switch Low Reference	-	2	-	-
Passenger Seat Belt Indicator Control	B059A 02, 3	B059A 04, 3	B059A 01, 4	-
Ground	-	B059A 04, 3	-	-
1. Indicator will remain ON with Seat Belt Buckled. 2. Indicator will illuminate only for the bulb check. 3. Indicator will not illuminate. 4. Indicator always ON.				

Circuit/System Description

The Inflatable Restraint Sensing and Diagnostic Module (SDM) monitors the passenger seat status and the passenger Seat Belt Buckle switch and provides an output to the passenger seat belt indicator. When the Inflatable Restraint Sensing and Diagnostic Module detects the passenger seat is occupied and the seat belt is not fastened, the Inflatable Restraint Sensing and Diagnostic Module supplies a pulse width modulated signal to control the passenger seat belt indicator circuit. The Inflatable Restraint Sensing and Diagnostic Module monitors the passenger seat belt indicator circuits and if a fault is detected a DTC will be set.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B059A 01

The passenger seat belt indicator circuit is shorted to voltage.

B059A 02

The passenger seat belt indicator circuit is shorted to ground.

B059A 04

The passenger seat belt indicator circuit is open.

Action Taken When the DTC Sets

The Inflatable Restraint Sensing and Diagnostic Module will store the DTC.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**

- **P14 Passenger Air Bag Disable Indicator**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**

1. Ignition OFF, disconnect the harness connector at the P14 Passenger Air Bag Disable Indicator.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Connect a test lamp between the control circuit terminal 4 and ground. Ignition On/Vehicle in Service Mode.
4. Verify with a scan tool, command the Passenger Seat Belt Reminder Indicator ON and OFF, the test lamp should turn ON and OFF while changing between the commanded states.
    - **If the test lamp is always on**
    1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition On/Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If the test lamp is always off**
    1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If test lamp turns on and off while changing between the commanded states**
5. Test or replace the P14 Passenger Air Bag Disable Indicator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Airbag Arming Status Display Replacement** for P14 Passenger Air Bag Disable Indicator replacement.
- **Control Module References** for device replacement, programming, and setup.

SYMPTOMS - SEAT BELTS

NOTE: **Review the seat belt system description and operation in order to familiarize yourself with the system and how it functions. Refer to Seat Belt System Description and Operation.**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the seat belt system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to the following symptom diagnostic procedure in order to diagnose the symptom:

- **Seat Belt Indicator Malfunction - Driver**
- **Seat Belt Indicator Malfunction - Passenger**

SEAT BELT DOES NOT RETRACT

1. Grasp the seat belt and pull it out slowly and evenly from the retractor, do that in 15 - 25 mm (5/8 - 1 in) increments, continuing until the seat belts entire length has been pulled out.
2. Release the seat belt and allow the retractor to slowly retract the full length of the seat belt. The seat belt must retract without any additional help.
3. Additionally, make sure that the seat belt can be stopped at any time while retracting and then resumed while being released again. This muss also be possible in all retracting positions.
4. Should problems be observed in step 3, perform the first two steps 2 more times.
5. Should the retractor, after performing these steps, not function freely and properly, it is to be replaced with a new part.

SEAT BELT INDICATOR MALFUNCTION - DRIVER

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Driver Seat Belt Switch Signal	1	2	2	-
Driver Seat Belt Switch Low Reference	-	2	-	-
1. Indicator will remain ON with seat belt buckled. 2. Indicator will illuminate only for the bulb check.				

Circuit/System Description

The driver seat belt switch is a 2-wire switch wired to the Inflatable Restraint Sensing and Diagnostic Module (SDM) using a signal circuit and a low reference circuit. When the seat belt is unbuckled the switch is closed, and when the seat belt is buckled the switch is open. The Inflatable Restraint Sensing and Diagnostic Module sends the status of the driver seat belt via serial data to the instrument cluster. After receiving the message, the instrument cluster controls the illumination of the driver seat belt indicator.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the driver seat belt indicator turns ON and OFF when commanding the instrument cluster all indicators ON and OFF with a scan tool.
   - **If the driver seat belt indicator does not turn ON and OFF as commanded .**

     Replace the P16 Instrument Cluster.

   - **If the driver seat belt indicator does turn ON and OFF as commanded**
2. Verify the scan tool Diver Seat Belt Switch parameter changes between Buckled and Unbuckled when buckling and unbuckling the driver seat belt.
   - **If the parameter does not change**

     Refer to Circuit/System Testing.

   - **If the parameter changes**
3. All OK.

Circuit/System Testing

NOTE: **When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**

- **B153D Seat Belt Buckle-Driver**
- **Seat belt switch harness connector**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**
- **Inflatable Restraint Sensing and Diagnostic Module wiring harness connector**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B153D Seat Belt Buckle-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
   - **If 5 Ω or greater**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 2 Ω in each low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Driver Seat Belt Status parameter is Buckled.
   - **If not Buckled**
   1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the seat belt switch signal circuit terminal 1 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If Buckled**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool Driver Seat Belt Status parameter is Unbuckled.
    - **If Unbuckled**
    1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in each circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If Unbuckled**
7. Test or replace the B153D Seat Belt Buckle-Driver.

Component Testing

1. Ignition OFF, disconnect the harness connector at the B153D Seat Belt Buckle-Driver, buckle the driver seat belt.
2. Test for infinite resistance between the signal circuit terminal 1 and the low reference terminal 2.
    - **If not infinite resistance**

      Replace the B153D Seat Belt Buckle-Driver.

    - **If infinite resistance**
3. Unbuckle the driver seat belt.
4. Test for less than 1 Ω between the signal circuit terminal 1 and the low reference terminal 2.
    - **If 1 Ω or greater**

      Replace the B153D Seat Belt Buckle-Driver.

    - **If less than 1 Ω**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Front Seat Belt Buckle Replacement
- Control Module References for Inflatable Restraint Sensing and Diagnostic Module or instrument cluster replacement, programming and setup

SEAT BELT INDICATOR MALFUNCTION - PASSENGER

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Seat Belt Switch Signal	1	2	2	-
Low Reference	-	2	-	-
1. Indicator will remain ON with seat belt buckled. 2. Indicator will illuminate only for the bulb check.				

Circuit/System Description

When an individual is sitting in the passenger seat the passenger presence sensor detects the individual. A signal to the inflatable restraint sensing and diagnostic module indicates a person is in the passenger seat. The inflatable restraint sensing and diagnostic module will turn the passenger seat belt indicator. The passenger seat belt switch is a 2-wire switch wired to the inflatable restraint sensing and diagnostic module using a signal circuit and a low reference circuit. When the seat belt is unbuckled the switch is closed, and when the seat belt is buckled the switch is open. The inflatable restraint sensing and diagnostic module sends the status of the passenger seat belt via a hard wire to the passenger air bag disable indicator. After receiving the message, the passenger air bag disable indicator controls the illumination of the passenger seat belt indicator.

Reference Information

Schematic Reference

Seat Belt Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Seat Belt System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. With a scan tool, Command the Passenger Seat Belt Reminder Indicator ON and OFF.
    - **If the passenger seat belt reminder indicator turns ON and OFF as commanded**

      Refer to Passenger Seat Belt Switch Malfunction

    - **If the passenger seat belt reminder indicator does not turn ON and OFF as commanded**

      Refer to Passenger Seat Belt Indicator Malfunction

Circuit/System Testing

NOTE: **When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected**

component/connector.

- **B153P Seat Belt Buckle - Passenger**
- **B153P Seat Belt Buckle - Passenger harness connector**
- **K36 Inflatable Restraint Sensing and Diagnostic Module**
- **K36 Inflatable Restraint Sensing and Diagnostic Module harness connector**

Passenger Seat Belt Switch Malfunction

1. Ignition OFF. Disconnect the harness connector at the B153P Seat Belt Buckle - Passenger.
2. Test for less than 5 Ω between the low reference circuit terminal 2 and ground.
    - **If 5 Ω or greater**
    1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
        - **If less than 5 Ω**
3. Ignition ON.
4. Verify the scan tool Passenger Seat Belt Status parameter listed below is Buckled.
    - **If the scan tool Passenger Seat Belt Status parameter does not display Buckled**
    1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the seat belt switch signal circuit terminal 1 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If the scan tool Passenger Seat Belt Status parameter does display Buckled**
5. Install a 3 A fused jumper wire between the signal circuit terminal 1 and the low reference circuit terminal 2.
6. Verify the scan tool Passenger Seat Belt Status parameter is Unbuckled.
    - **If the scan tool Passenger Seat Belt Status parameter does not display Unbuckled**
    1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
    3. Test for less than 2 Ω in each circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If the scan tool Passenger Seat Belt Status parameter does display Unbuckled**
7. Ignition OFF, reconnect all harness connectors. Ignition ON.
8. With a scan tool, monitor the Passenger Seat Belt Status parameter while buckling and unbuckling the seat belt. The parameter should display Buckled and Unbuckled when buckling and unbuckling the seat belt.
    - **If the Passenger Seat Belt Status parameter does not display Buckled and Unbuckled**

      Test or replace the B153P Seat Belt Buckle - Passenger.

    - **If the Passenger Seat Belt Status parameter does display Buckled and Unbuckled**
9. All OK.

Passenger Seat Belt Indicator Malfunction

1. Ignition OFF. Disconnect the harness connector at the P14 Passenger Air Bag Disabled Indicator.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 10 Ω**
3. Ignition ON. With a scan tool, command the Passenger Seat Belt Reminder Indicator OFF.
4. Test for less than 11 V between the control circuit terminal 4 and ground.
    - **If 11 V or greater**
    1. Ignition OFF. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
    2. Test for less than 1 V between the control circuit terminal 4 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 11 V**
5. With a scan tool, command the Passenger Seat Belt Reminder Indicator ON.
6. Test for greater than 4 V between the control circuit terminal 4 and ground.
    - **If 4 V or less**
    1. Ignition OFF. Disconnect the X 1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the control circuit terminal 4 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
    3. Test for less than 2 Ω between the control circuit terminal 4 and ground.
        - If 2 Ω or greater repair the open/high resistance in the circuit.
        - If less than 2 Ω replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 4 V**
7. Ignition OFF, reconnect all harness connectors. Ignition ON.
8. With a scan tool, Command the Passenger Seat Belt Reminder Indicator ON and OFF.
    - **If the passenger seat belt reminder indicator does not turn ON and OFF as commanded**

      Replace the P14 Passenger Air Bag Disabled Indicator.

    - **If the passenger seat belt reminder indicator turns ON and OFF as commanded**
9. All OK.

Component Testing

1. Ignition OFF. Disconnect the harness connector at the B153P Seat Belt Buckle - Passenger. Buckle the B153P Seat Belt Buckle - Passenger.
2. Test for infinite resistance between the signal circuit terminal 1 and the low reference terminal 2 at the B153P Seat Belt Buckle - Passenger.
    - **If there is not infinite resistance**

      Replace the B153P Seat Belt Buckle - Passenger.

    - **If there is infinite resistance**
3. Unbuckle the B153P Seat Belt Buckle - Passenger.
4. Test for less than 1 Ω between the signal circuit terminal 1 and the low reference terminal 2 at the B153P Seat Belt Buckle - Passenger.
    - **If 1 Ω or greater**

      Replace the B153P Seat Belt Buckle - Passenger.

- **If less than 1 Ω**

5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Belt Buckle Replacement** for B153P Seat Belt Buckle - Passenger replacement.
- **Instrument Panel Airbag Arming Status Display Replacement** for P14 Passenger Air Bag Disable Indicator replacement.
- **Control Module References** for device replacement, programming and setup.

REPAIR INSTRUCTIONS

PASSENGER PRESENCE SEAT BELT SENSOR REPLACEMENT

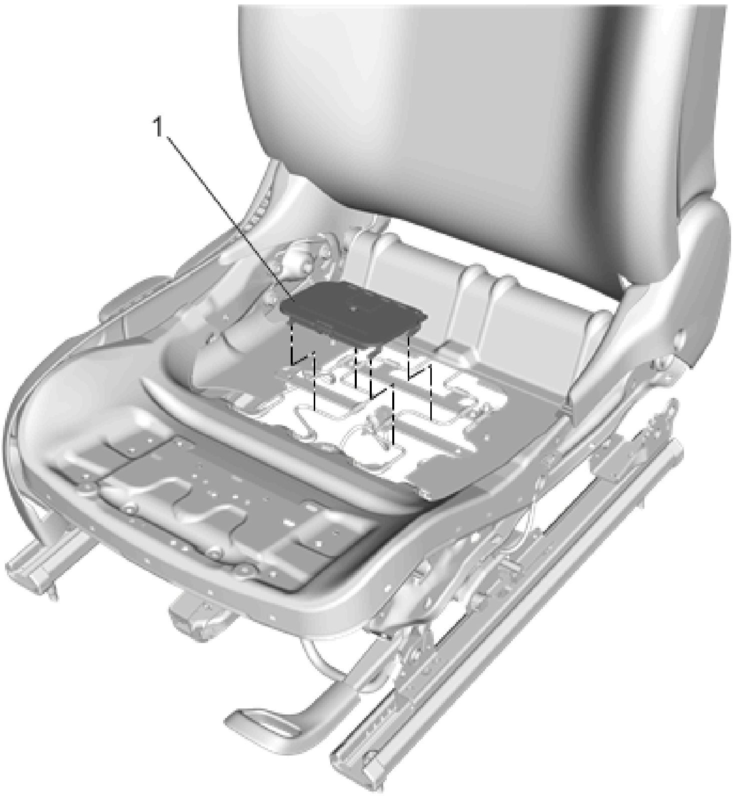


Fig. 2: Passenger Presence Seat Belt Sensor
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Front Seat Cushion Cover and Pad Replacement
2. Front Seat Cushion Heater Replacement (Korea) Front Seat Cushion Heater Replacement (North America)</td></tr>
<tr><td>1</td><td>Passenger Presence Seat Belt Sensor
Procedure
1. Disconnect the electrical connector.
2. Perform the passenger presence system re-zeroing. Passenger Presence System Rezeroing</td></tr>
</table>

REPAIRS AND INSPECTIONS REQUIRED AFTER A COLLISION

WARNING: **Restraint systems can be damaged in a collision. To help avoid injury and ensure that all parts in need of replacement are replaced:**

- **Replace any seat belt system that was in use during the collision serious enough to deploy any automatic restraint device such as air bags and seat belt pretensioners. This not only includes seat belt systems in use by people of adult size, but seat belt systems used to secure child restraints, infant carriers and booster seats, including LATCH system and top tether anchorages.**
- **Replace any seat belt system that has torn, worn, or damaged components. This not only includes adult seat belt systems, but built-in child restraints and LATCH system components, if any.**
- **Replace any seat belt system if you observe the words "REPLACE" or "CAUTION", or if a yellow tag is visible. Do not replace a seat belt if only the child seat caution label is visible.**
- **Replace any seat belt system if you are doubtful about its condition. This not only includes adult seat belt systems, but built-in child restraints, LATCH system components, and any restraint system used to secure infant carriers, child restraints, and booster seats.**

  Do NOT replace single seat belt system components in vehicles that have been in a collision as described above. Always replace the entire seat belt system with the buckle, guide and retractor assembly, which includes the latch and webbing material.

After a minor collision where no automatic restraint device was deployed, seat belt system replacement may not be necessary, unless some of the parts are torn, worn, or damaged.

FRONT SEAT BELT BUCKLE REPLACEMENT

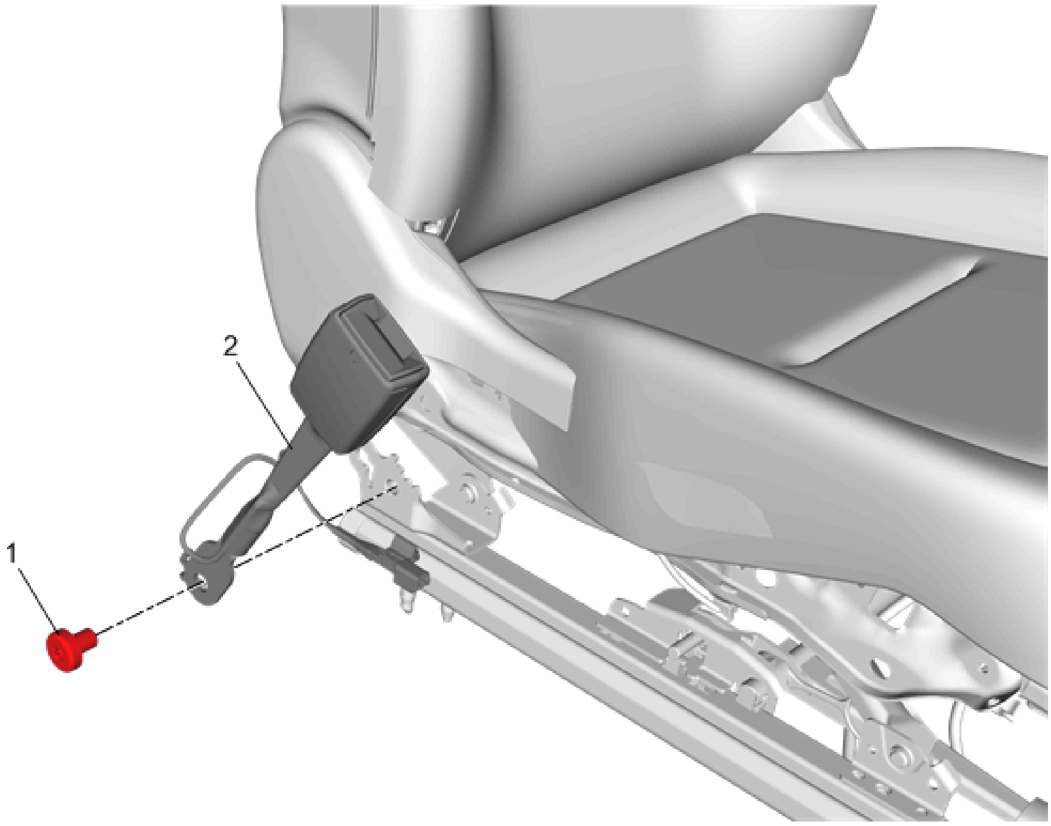


Fig. 3: Front Seat Belt Buckle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Driver or Passenger Seat Removal and Installation	

Callout	Component Name
1	Front Seat Belt Buckle Fastener **CAUTION:** Fastener Caution **Tighten** 45 N.m (33 lb ft) **NOTE:** **Selfcutting bolts, prevailing nuts must be replaced if loosened.**
2	Front Seat Belt Buckle **Procedure** Disconnect the electrical connector.

REAR SEAT BELT BUCKLE REPLACEMENT

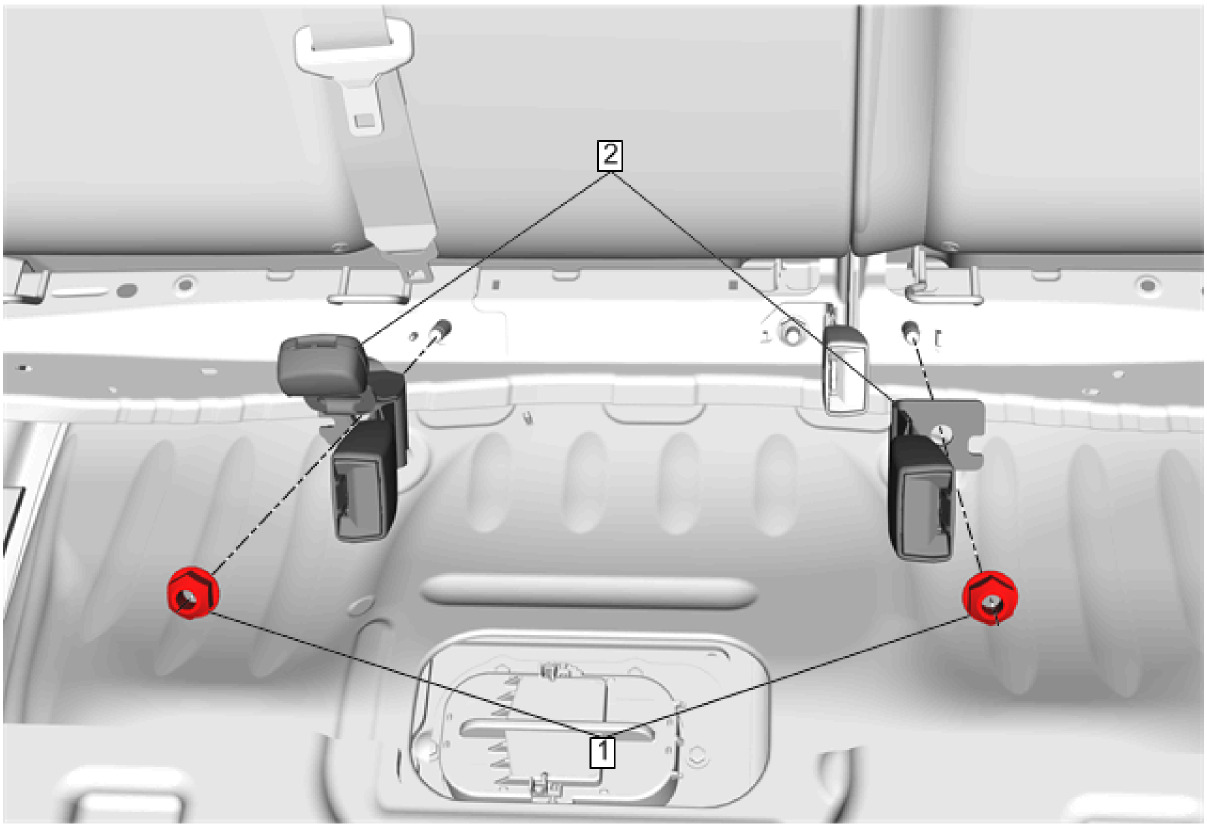


Fig. 4: Rear Seat Belt Buckle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Cushion Removal and Installation	

Callout	Component Name
1	Rear Seat Belt Buckle Nut (Qty: 2) **CAUTION:** **Fastener Caution** **Tighten** 45 N.m (33 lb ft) **NOTE:** **Selfcutting bolts, prevailing nuts must be replaced if loosened.**
2	Rear Seat Belt Buckle **Procedure** If replacing the right buckle, release the center retractor belt from the mini buckle. Rear Center Seat Belt Retractor Replacement

REAR CENTER SEAT BELT BUCKLE REPLACEMENT

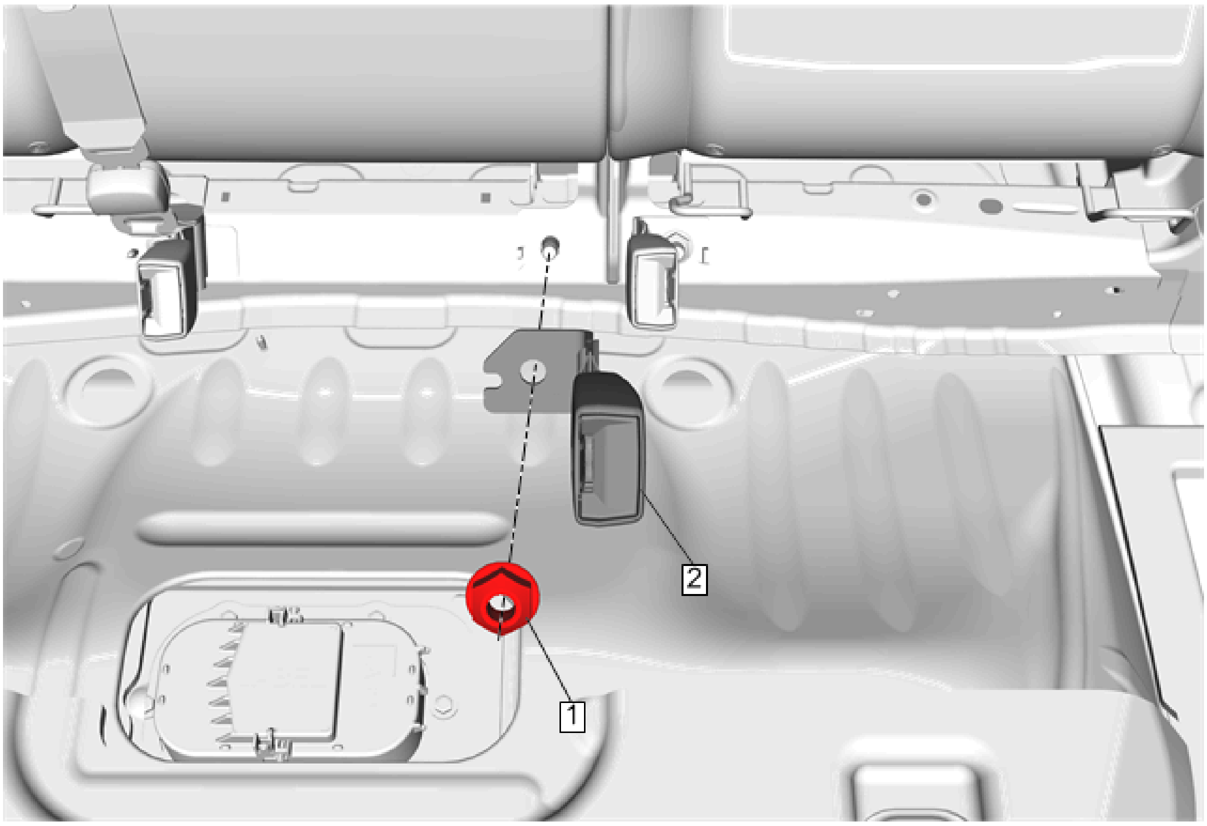


Fig. 5: Rear Center Seat Belt Buckle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Rear Seat Cushion Removal and Installation	

Callout	Component Name
1	Rear Center Seat Belt Buckle Nut **CAUTION:** Fastener Caution **Tighten** 45 N.m (33 lb ft) **NOTE:** **Selfcutting bolts, prevailing nuts must be replaced if loosened.**
2	Rear Center Seat Belt Buckle

REAR CENTER SEAT BELT RETRACTOR REPLACEMENT

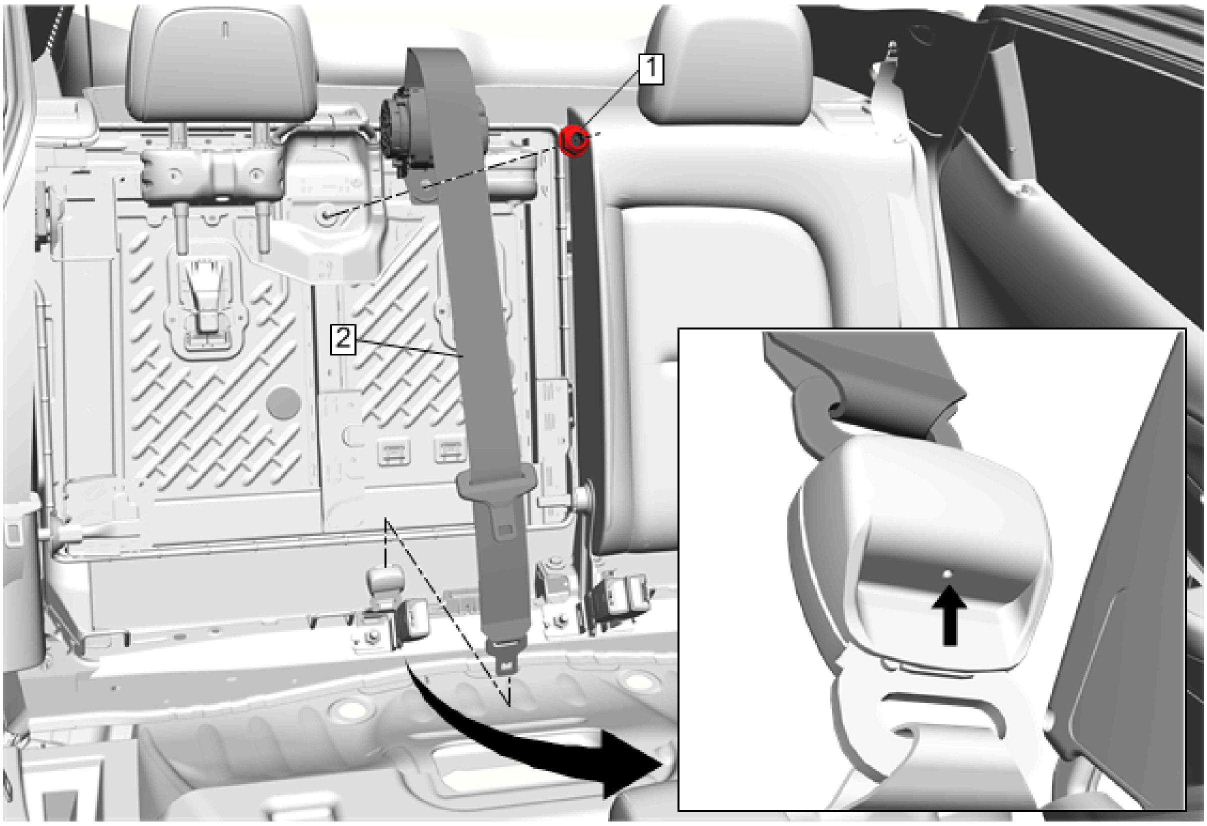


Fig. 6: Rear Center Seat Belt Retractor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Push pin in the slot on mini-buckle to disengage the rear center seat belt retractor from rear center seat belt buckle. 2. Rear Seat Back Cushion Cover and Pad Replacement (60%) Rear Seat Back Cushion Cover and Pad Replacement (with Armrest, 60%) Rear Seat Back Cushion Cover and Pad Replacement (40%) **NOTE:** **Do not separate the cover from the pad.**	

Callout	Component Name
1	Rear Center Seat Belt Retractor Nut **CAUTION:** Fastener Caution **Tighten** 45 N.m (33 lb ft) **NOTE:** **Selfcutting bolts, prevailing nuts must be replaced if loosened.**
2	Rear Seat Center Belt Retractor

REAR SEAT BELT RETRACTOR REPLACEMENT

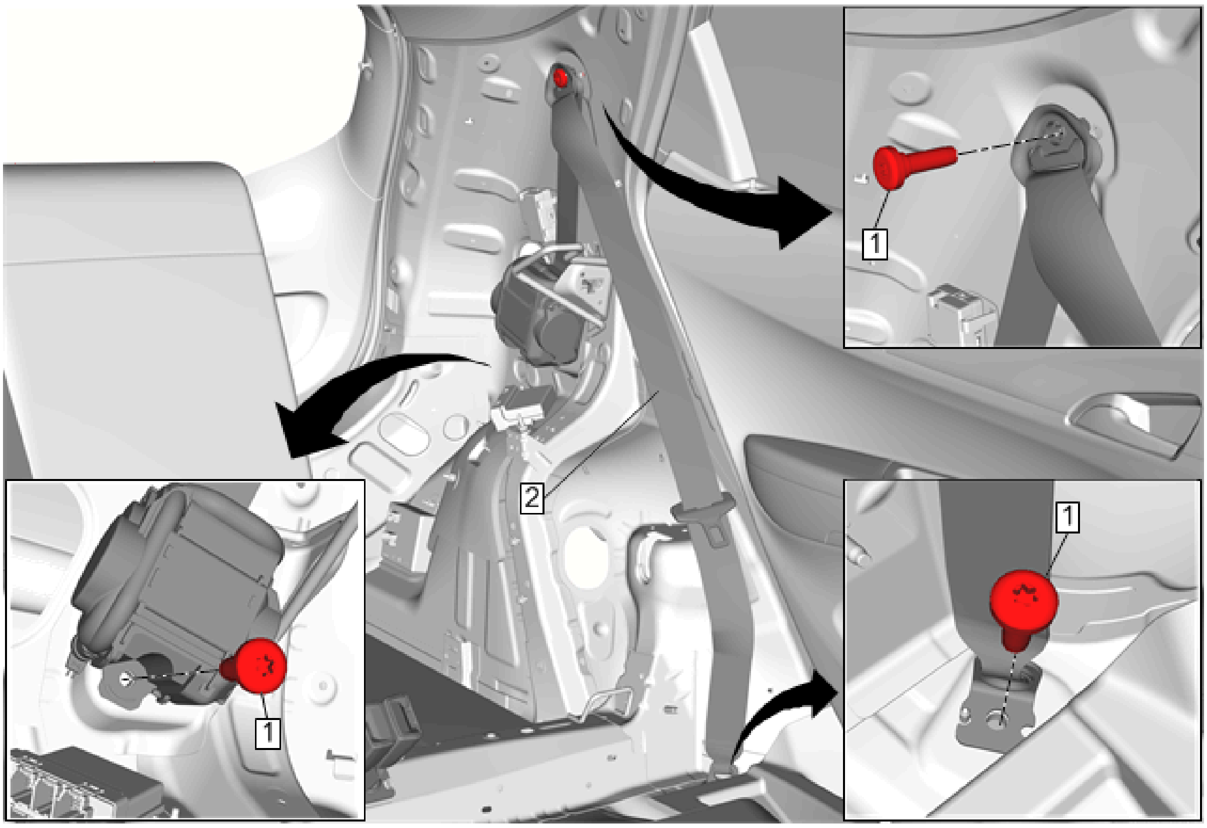


Fig. 7: Rear Seat Belt Retractor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: SIR Warning **Preliminary Procedures** 1. Disable the supplement inflatable restraint (SIR) system. SIR Disabling and Enabling 2. Rear Seat Cushion Removal and Installation 3. Body Lock Pillar Upper Trim Panel Replacement 4. Quarter Lower Rear Trim Panel Replacement	

Callout	Component Name
1	Rear Seat Belt Retractor Bolt (Qty: 3) **CAUTION:** **Fastener Caution** **Tighten** 45 N.m (33 lb ft) **NOTE:** **When the seat belt retractor is replaced with a new one, there is no thread in the nut welded in the body. This is normal as the bolt will make the thread in the welded nut when the bolt is tightened.** **NOTE:** **Selfcutting bolts, prevailing nuts must be replaced if loosened.**
2	Rear Seat Belt Retractor **Procedure** Enable the supplement inflatable restraint (SIR) system. **SIR Disabling and Enabling**

DESCRIPTION AND OPERATION

SEAT BELT SYSTEM DESCRIPTION AND OPERATION

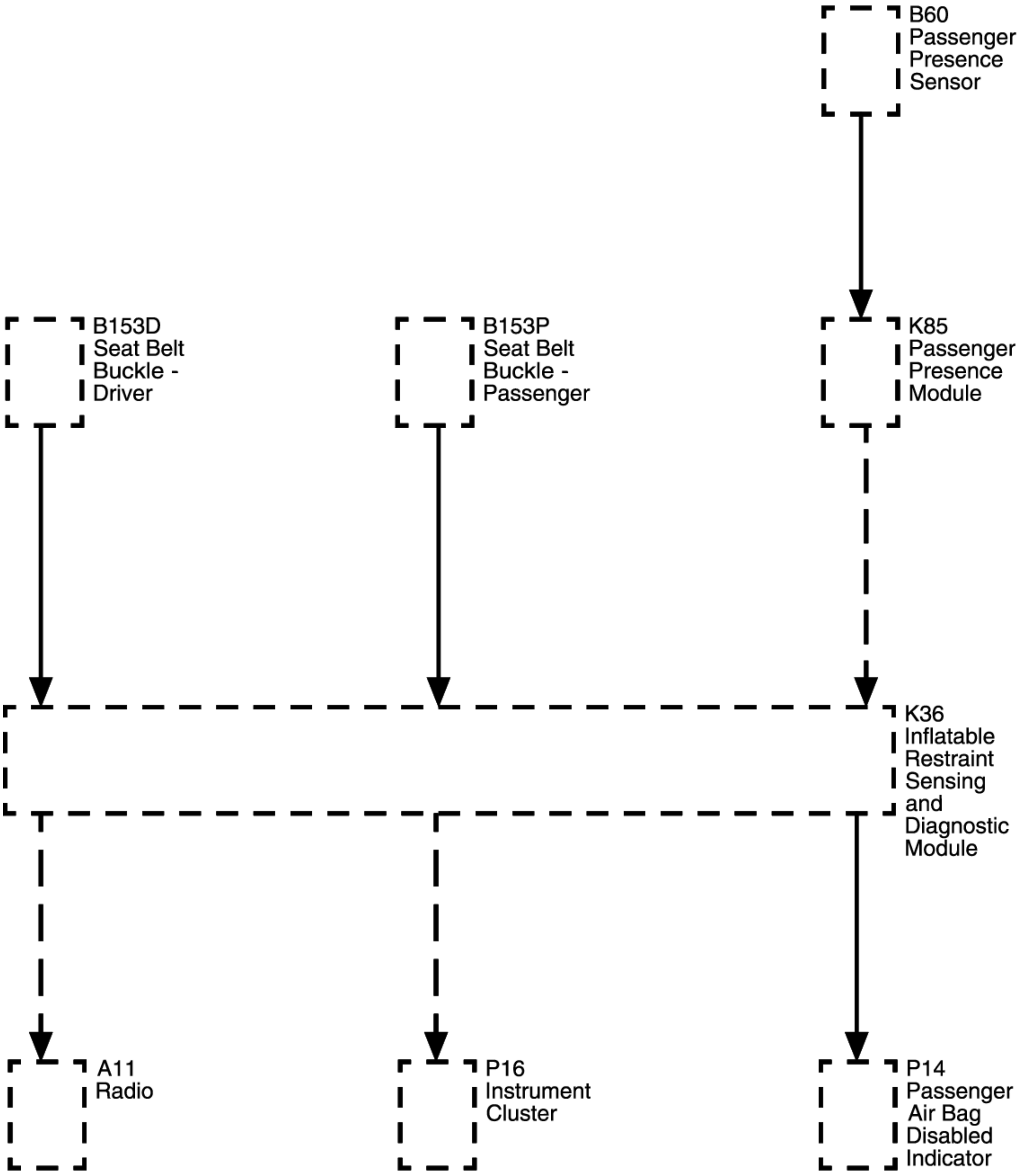

B60
Passenger
Presence
Sensor
B153D
Seat Belt
Buckle -
Driver
B153P
Seat Belt
Buckle -
Passenger
K85
Passenger
Presence
Module
K36
Inflatable
Restraint
Sensing
and
Diagnostic
Module
A11
Radio
P16
Instrument
Cluster
P14
Passenger
Air Bag
Disabled
Indicator

Fig. 8: Seat Belt with P14 Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
B153D	B153D Seat Belt Buckle - Driver
B153P	B153P Seat Belt Buckle - Passenger
K36	K36 Inflatable Restraint Sensing and Diagnostic Module
A11	A11 Radio
P16	P16 Instrument Cluster
B60	B60 Passenger Presence Sensor
K85	Passenger Presence Module
P14	P14 Passenger Air Bag Disabled Indicator

Restraint System

NOTE: **If the vehicle has been in a collision, refer to Repairs and Inspections Required After a Collision**

The vehicle has front and rear seat belts that are the primary means of occupant restraint. Seat belts help to keep the occupants inside the passenger compartment and to gradually reduce the impact forces during the following events:

- Frontal impact type crashes
- Rear impact type crashes
- Side impact type crashes
- Roll-over type crashes

All seat belt retractors have emergency locks. The retractors remain unlocked during normal operation and under normal driving conditions. The retractors remain unlocked during normal conditions in order to allow free movement of the upper body of each occupant. A pendulum locks the seat belt webbing into position. The pendulum causes a locking bar to engage a cog on the spool of the retractor mechanism when the following conditions occur:

- A rapid extraction of the seat belt webbing from the retractor
- An abrupt change in vehicle speed
- An abrupt change in vehicle direction
- Operation of the vehicle on a steep upgrade
- Operation of the vehicle on a downgrade

The seat belts have an automatic locking (cinch) feature. The cinch feature is activated when the seat belt webbing is completely extended from the retractor. The cinch feature prevents the webbing from extending beyond the position from which it is allowed to retract. Use of the cinch feature is recommended for securing a child seat. The cinch feature may be cancelled by allowing the webbing to wind back completely into the retractor. After the cinch feature is cancelled, the webbing is unlocked. After the cinch feature is cancelled, the webbing will extend from the retractor. This vehicle is also equipped with a supplemental inflatable restraint (SIR) system. Refer to **Supplemental Inflatable Restraint System Description and Operation**

Front Seat Belt System

The front seat belt system includes a driver and passenger seat belt pretensioner retractor. Both front seat belt pretensioners includes a seat belt switch in the seat buckle which controls a reminder lamp and a tone alarm.

NOTE: **The front passenger seat is equipped with a passenger presence detection sensor, which detects an occupant. If the passenger presence detection sensor detects an empty front passenger seat, then the passenger fasten safety belt indicator will be disabled.**

- When the driver seat belt is buckled and the ignition switch is turned ON, the following events will occur:
  - The tone alarm will not operate.
  - The reminder lamp will not operate.
- When the passenger seat belt is buckled with an occupant sitting in the passenger front seat, then the ignition switch is turned ON, the following events will occur:
  - The tone alarm will not operate.
  - The reminder lamp, which is located within the Passenger Air Bag Disable Indicator, will not be turned ON.
- When the driver seat belt is not buckled and the ignition switch is in the ON position, the following events will occur:
  - The tone alarm will operate for 4 - 8 seconds and then go OFF.
  - The fasten safety belt indicator will turn ON for 20 seconds, until the driver seat belt is buckled.
- When the passenger seat belt is not buckled with an occupant sitting in the passenger front seat, then the ignition switch is turned ON, the following events will occur:
  - The tone alarm will operate for 4 - 8 seconds and then go OFF.
  - The reminder lamp, which is located within the Passenger Air Bag Disable Indicator, will be turned ON.

Rear Seat Belt System

The Rear Seat Belt System includes the following components:

- The rear seat belt retractor is located at the wheelhouse panel and attached to the floor panel by the rear seat shoulder belt retractor bracket.
- The rear seat belt buckles and the center seat belt buckle are attached to each seat.

Child Seat Restraint System

WARNING: **A child in a rear-facing child restraint can be seriously injured if the right-front passengers air bag inflates. This is because the back of a rear-facing child restraint would be very close to the inflating air bag. NEVER use a rear-facing child restraint in this vehicle. If a forward-facing child restraint is suitable for your child, ALWAYS move the front passenger seat as far back as it will go and then install the child restraint. Be sure the child restraint position does not conflict with any additional requirements provided by the manufacturer. For more information, refer to the vehicle owners manual and the instruction that came with the child restraint.**

A child in a rear-facing child restraint can be seriously injured if the right-front passengers air bag inflates. This is because the back of a rear-facing child restraint would be very close to the inflating air bag. NEVER use a rear-facing child restraint in this vehicle. If a forward-facing child restraint is suitable for your child, ALWAYS move the front passenger seat as far back as it will go and then install the child restraint. Be sure the child restraint position does not conflict with any additional requirements provided by the manufacturer. For more information, refer to the vehicle owners manual and the instruction that came with the child restraint.

The child seat may only be used in a forward facing seating location. The child seat should be installed and secured according to the manufacturer's directions. If the child seat has a top strap, the seat will need to be anchored. Passengers should not be allowed to sit at locations where the seat belts are being used to secure the child seat.

All vehicles are equipped with a dual-mode type retractor with emergency and automatic locking features. The automatic locking feature is for restraint of a child seat. The child seat can be secured by pulling the seat belt all the way out to lock it. Then tighten the seat belt around the child seat.

If a child seat is to be used in the second seat position, a special dealer-installed anchor must be used in order to anchor the child seat top strap. This only applies to the seats designed with the top strap provision and for the vehicles sold in Canada. In order to ensure the correct top strap angle, the child seat is only to be used at the seating position for which the top strap anchor is installed.

Fasten Safety Belt Indicators

There are two fasten safety belt indicators for this vehicle. The driver fasten safety belt reminder is displayed in the instrument cluster, and the passenger fasten safety belt reminder is displayed in the passenger air bag disable indicator. The fasten safety belt indicator may only be ON during RUN. The fasten safety belt indicator illuminates under the following conditions:

- During the bulb check
- The inflatable restraint sensing and diagnostic module (SDM) sends the status of the driver seat belt to the instrument cluster via serial data. The passenger seat belt status is sent to the passenger air bag disable indicator via a hardwire. If any of the seat belts are unfastened, the instrument cluster will send a message requesting a chime sound to be turned ON after a bulb check.

Back To Article

2017 RESTRAINTS

Supplemental Restraints - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Airbag Sensing and Diagnostic Module Nut	9 N.m (80 lb in)
Airbag Side Impact Rear Sensor Fastener	7.5 N.m (66 lb in)
Airbag Side Impact Sensor Fastener	7.5 N.m (66 lb in)
Front and Rear Row Seat Roof Rail Airbag Fastener	9 N.m (80 lb in)
Front Seat Belt Anchor Bolt	5 N.m (44 lb in)
Front Seat Belt Anchor Plate Tensioner Bolt	5 N.m (44 lb in)
Front Seat Belt Retractor Bolt	45 N.m (33 lb ft)
Front Seat Belt Retractor Fastener	5 N.m (44 lb in)
Front Seat Outboard Seat Back Airbag Nut	3.5 N.m (31 lb in)
Instrument Panel Lower Airbag Bracket Bolt - Large	9 N.m (80 lb in)
Instrument Panel Lower Airbag Bracket Bolt - Small	2.5 N.m (22 lb in)
Instrument Panel Lower Airbag Bracket Nut	5 N.m (44 lb in)
Instrument Panel Lower Airbag Nut	9 N.m (80 lb in)
Rear Seat Bolster Airbag Bracket Bolt	3.25 N.m (29 lb in)
Rear Seat Bolster Airbag Nut	3.25 N.m (29 lb in)
Supplemental Inflatable Restraint Front End Discriminating Sensor Bolt	7.5 N.m (66 lb in)

SCHEMATIC WIRING DIAGRAMS

SIR WIRING SCHEMATICS

Power, Ground, Serial Data, Indicators and Passenger Presence System

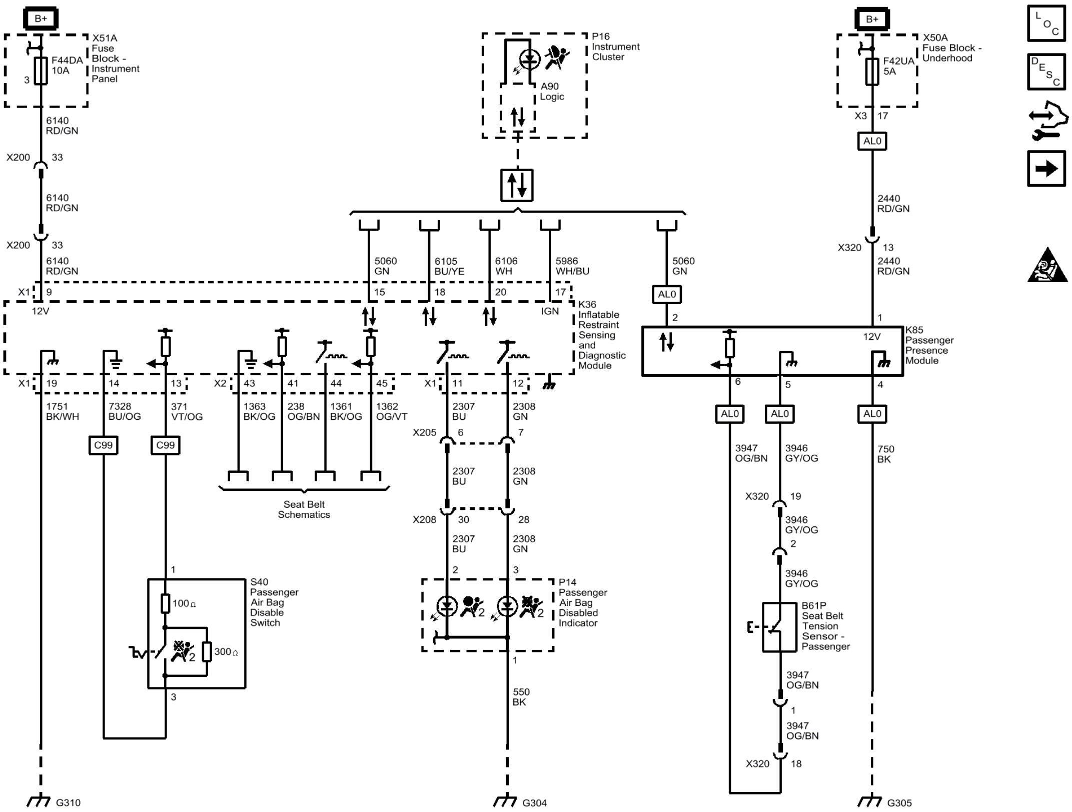

B+
X51A Fuse Block - Instrument Panel
F44DA 10A
6140 RD/GN
X200 33
P16 Instrument Cluster
A90 Logic
B+
X50A Fuse Block - Underhood
F42UA 5A
X3 17
AL0
2440 RD/GN
X320 13
5060 GN
6105 BU/YE
6106 WH
5986 WH/BU
12V
IGN
K36 Inflatable Restraint Sensing and Diagnostic Module
K85 Passenger Presence Module
1751 BK/WH
7328 BU/OG
371 VT/OG
C99
1363 BK/OG
238 OG/BN
1361 BK/OG
1362 OG/VT
Seat Belt Schematics
2307 BU
2308 GN
X205
X208
S40 Passenger Air Bag Disable Switch
100Ω
300Ω
P14 Passenger Air Bag Disabled Indicator
550 BK
3947 OG/BN
3946 GY/OG
750 BK
X320 19
B61P Seat Belt Tension Sensor - Passenger
X320 18
G310
G304
G305

Fig. 1: Power, Ground, Serial Data, Indicators and Passenger Presence System

Courtesy of GENERAL MOTORS COMPANY

Front Impact Sensing and Deployment

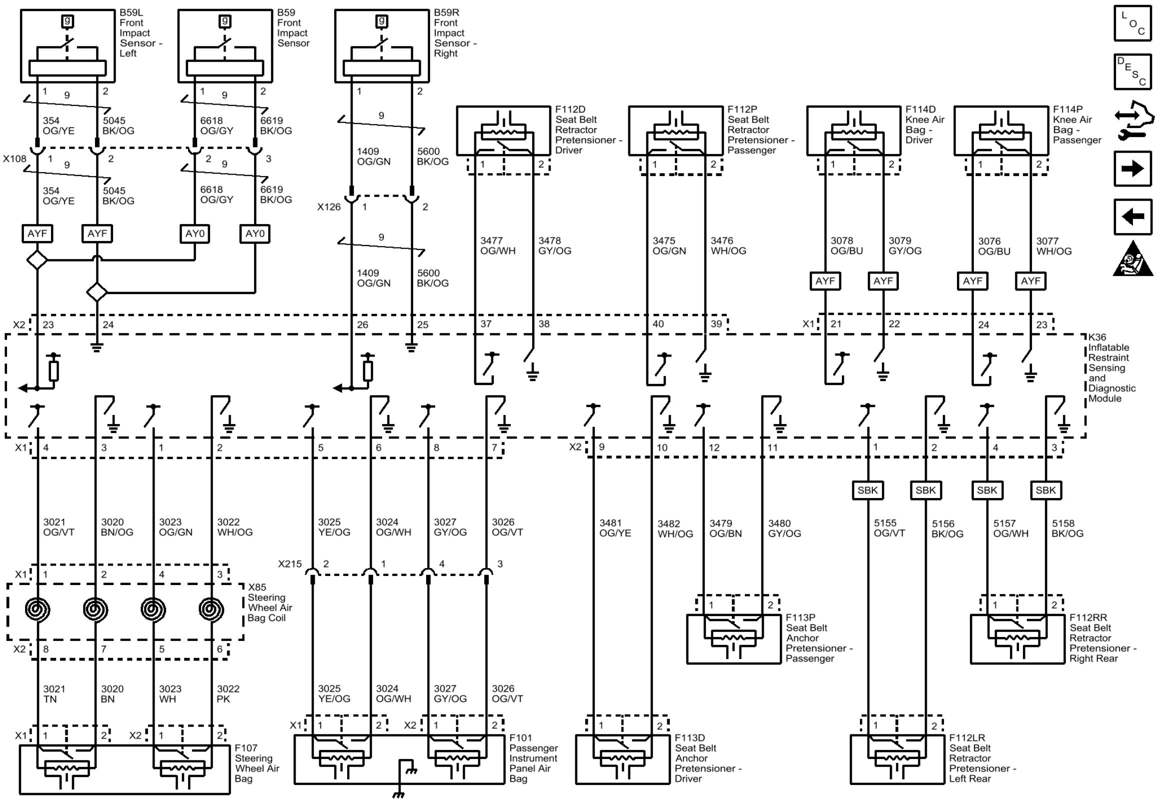

B59L Front Impact Sensor - Left
B59 Front Impact Sensor
B59R Front Impact Sensor - Right
354 OG/YE
5045 BK/OG
6618 OG/GY
6619 BK/OG
1409 OG/GN
5600 BK/OG
X108
X126
AYF
AY0
F112D Seat Belt Retractor Pretensioner - Driver
F112P Seat Belt Retractor Pretensioner - Passenger
F114D Knee Air Bag - Driver
F114P Knee Air Bag - Passenger
3477 OG/WH
3478 GY/OG
3475 OG/GN
3476 WH/OG
3078 OG/BU
3079 GY/OG
3076 OG/BU
3077 WH/OG
K36 Inflatable Restraint Sensing and Diagnostic Module
3021 OG/VT
3020 BN/OG
3023 OG/GN
3022 WH/OG
3025 YE/OG
3024 OG/WH
3027 GY/OG
3026 OG/VT
3481 OG/YE
3482 WH/OG
3479 OG/BN
3480 GY/OG
SBK
5155 OG/VT
5156 BK/OG
5157 OG/WH
5158 BK/OG
X85 Steering Wheel Air Bag Coil
X215
F113P Seat Belt Anchor Pretensioner - Passenger
F112RR Seat Belt Retractor Pretensioner - Right Rear
3021 TN
3020 BN
3023 WH
3022 PK
F107 Steering Wheel Air Bag
F101 Passenger Instrument Panel Air Bag
F113D Seat Belt Anchor Pretensioner - Driver
F112LR Seat Belt Retractor Pretensioner - Left Rear

Fig. 2: Front Impact Sensing and Deployment

Courtesy of GENERAL MOTORS COMPANY

Side Impact Sensing and Deployment

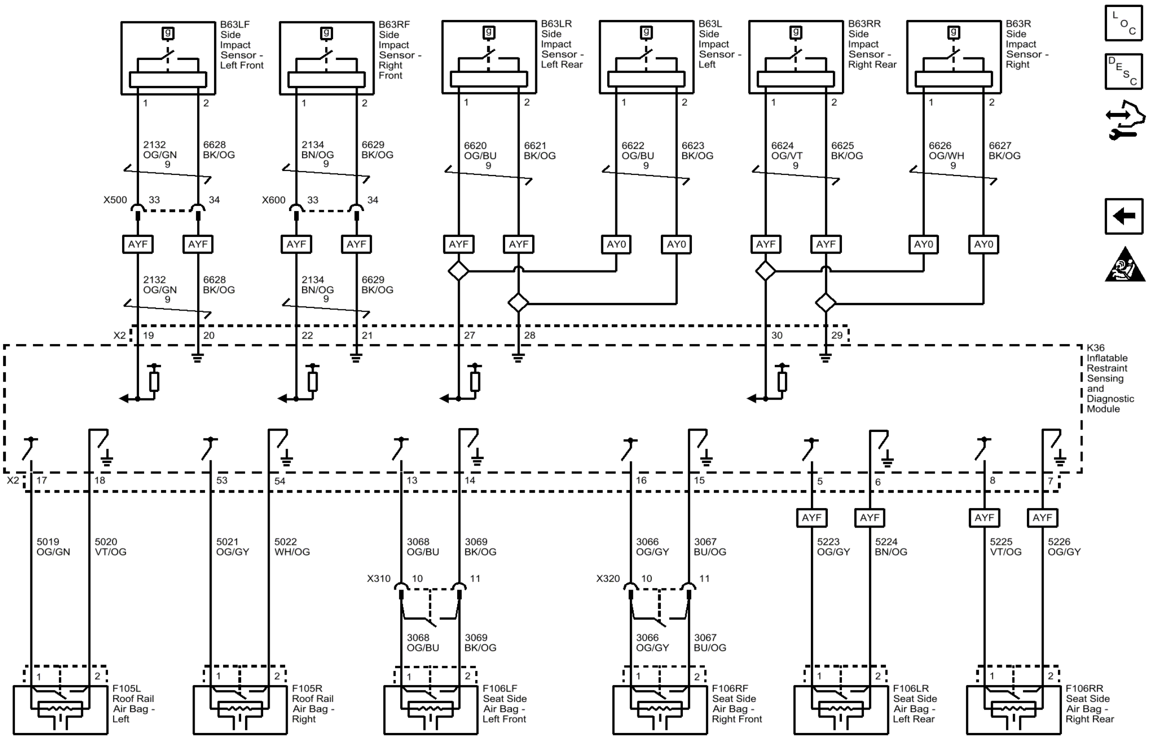

B63LF Side Impact Sensor - Left Front
B63RF Side Impact Sensor - Right Front
B63LR Side Impact Sensor - Left Rear
B63L Side Impact Sensor - Left
B63RR Side Impact Sensor - Right Rear
B63R Side Impact Sensor - Right
1
2
2132 OG/GN 9
6628 BK/OG
2134 BN/OG 9
6629 BK/OG
6620 OG/BU 9
6621 BK/OG
6622 OG/BU 9
6623 BK/OG
6624 OG/VT 9
6625 BK/OG
6626 OG/WH 9
6627 BK/OG
X500
X600
33
34
AYF
AY0
X2
19
20
22
21
27
28
30
29
K36 Inflatable Restraint Sensing and Diagnostic Module
17
18
53
54
13
14
16
15
5
6
8
7
5019 OG/GN
5020 VT/OG
5021 OG/GY
5022 WH/OG
3068 OG/BU
3069 BK/OG
3066 OG/GY
3067 BU/OG
5223 OG/GY
5224 BN/OG
5225 VT/OG
5226 OG/GY
X310
X320
10
11
F105L Roof Rail Air Bag - Left
F105R Roof Rail Air Bag - Right
F106LF Seat Side Air Bag - Left Front
F106RF Seat Side Air Bag - Right Front
F106LR Seat Side Air Bag - Left Rear
F106RR Seat Side Air Bag - Right Rear

Fig. 3: Side Impact Sensing and Deployment
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B0012 OR B0013: DRIVER STEERING WHEEL AIR BAG DEPLOYMENT LOOP STAGE 1/STAGE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptors

DTC B0012 01

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Short to Battery

DTC B0012 02

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Short to Ground

DTC B0012 04

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Open

DTC B0012 0D

Driver Steering Wheel Air Bag Deployment Loop Stage 1 High Resistance

DTC B0012 0E

Driver Steering Wheel Air Bag Deployment Loop Stage 1 Low Resistance

DTC B0013 01

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Short to Battery

DTC B0013 02

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Short to Ground

DTC B0013 04

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Open

DTC B0013 0D

Driver Steering Wheel Air Bag Deployment Loop Stage 2 High Resistance

DTC B0013 0E

Driver Steering Wheel Air Bag Deployment Loop Stage 2 Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Steering Wheel Air Bag Stage 1 High Control	B0012 02, B0012 0E	B0012 0D	B0012 04, B0012 0D	B0012 01	-
Driver Steering Wheel Air Bag Stage 1 Low Control	B0012 02, B0012 0E	B0012 0D	B0012 04, B0012 0D	B0012 01	-
Driver Steering Wheel Air Bag Stage 2 High Control	B0013 02, B0013 0E	B0013 0D	B0013 04, B0013 0D	B0013 01	-
Driver Steering Wheel Air Bag Stage 2 Low Control	B0013 02, B0013 0E	B0013 0D	B0013 04, B0013 0D	B0013 01	-

Circuit/System Description

During a frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy the steering wheel air bag. The SDM performs continuous diagnostic tests on the deployment loops to check for proper circuit continuity and for shorts to ground or voltage. There are two shorting bars used within the steering wheel air bag coil connector which will short together both steering wheel air bag stage 1 high control circuit and steering wheel air bag stage 1 low control circuit and both steering wheel air bag stage 2 high control circuit and steering wheel air bag stage 2 low control circuit when the connector is disconnected. This will help to prevent unwanted deployment of the steering wheel air bag during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0012 01 stage 1 or B0013 01 stage 2

The steering wheel air bag deployment loop is shorted to voltage for 2 s

B0012 02 stage 1 or B0013 02 stage 2

The steering wheel air bag deployment loop is shorted to ground for 2 s

B0012 04 stage 1 or B0013 04 stage 2

The steering wheel air bag deployment loop is open for 2 s

B0012 0D stage 1 or B0013 0D stage 2

The steering wheel air bag deployment loop resistance is greater than 4.4 Ω for 2 s

B0012 0E stage 1 or B0013 0E stage 2

The steering wheel air bag deployment loop resistance is less than 1.7 Ω for 2 s

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployment.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

A worn steering wheel air bag coil can cause a repeated history DTC to set. To verify this condition, turn the steering wheel 360 degrees in one direction then back 360 degrees in the other direction, multiple times, while viewing the scan tool Deployment Loop Resistance parameters.

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Steering wheel air bag assembly
- Steering wheel air bag coil assembly
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Driver steering wheel air bag**
  - **Driver steering wheel air bag coil**
  - **Inflatable restraint sensing and diagnostic module**
  - **Air bag wiring harness connector**
  - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the appropriate scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any spikes or dropouts while turning the steering wheel 360 degrees in one direction then back 360 degrees in the other direction.
   - **If less than 2.1 Ω or greater than 4.0 Ω**

     Refer to Circuit/System Testing.

   - **If there are spikes or dropouts**

     Replace the X85 Steering Wheel Air Bag Coil.

   - **If between 2.1 - 4.0 Ω without any spikes or dropouts**
2. Verify DTC B0012 or B0013 is only set as a history DTC.
   - **If the DTC is set as current**

     Refer to Circuit/System Testing.

   - **If the DTC is set as history**
3. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any drop outs or spikes while moving the harness near each connector listed below.
   - X85 Steering Wheel Air Bag Coil
   - F107 Steering Wheel Air Bag
   - Any inline harness connector
   - K36 Inflatable Restraint Sensing and Diagnostic Module
   - **If the reading is erratic while moving the harness, perform the following**

- Inspect each connector terminal for damage or corrosion and repair as necessary
- Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
- Ensure each connector and CPA is correctly seated
- **If between 2.1 - 4.0 Ω without any spikes or dropouts**

4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the scan tool and disconnect the appropriate harness connector listed below at the F107 Driver Steering Wheel Air Bag.
   - DTC B0012 connector X1
   - DTC B0013 connector X2
2. Test for greater than 25 Ω between the control circuit terminal 1 and the control circuit terminal 2.
   - **If 25 Ω or less**
   1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

      NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.**

   2. Test for infinite resistance between the two control circuits.
      - If less than infinite resistance, repair the short between the two circuits.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 25 Ω**
3. Ignition ON.
4. Test for less than 11 V between each control circuit terminal listed below and ground:
   - Control circuit terminal 1
   - Control circuit terminal 2
   - **If 11 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 Ω between each control circuit terminal listed below and ground:
   - Control circuit terminal 1
   - Control circuit terminal 2
   - **If 25 Ω or less**
   1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

      NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a**

connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.

    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 25 Ω**
7. Install a 3 A fused jumper wire between the control circuit terminal 1 and the control circuit terminal 2, ignition ON.
8. Verify the appropriate scan tool Deployment Loop Resistance parameter is consistently less than 2 Ω while turning the steering wheel 360 degrees in one direction then back 360 degrees in the other direction.
    - **If the reading is erratic while turning the steering wheel**

      Replace the X85 Steering Wheel Air Bag Coil.

    - **If 2 Ω or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for less than 2 Ω in the K85 Steering Wheel Airbag Coil and each control circuit end to end.
        - If 2 Ω or greater, replace the X85 Steering Wheel Air Bag Coil or repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 2 Ω**
9. Ignition OFF, connect the harness connector at the F107 Steering Wheel Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0012 or B0013 is not set.
    - **If DTC B0012 or B0013 is set**

      Test or replace the F107 Steering Wheel Air Bag.

    - **If DTC B0012 or B0013 is not set**
12. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Steering Wheel Airbag Coil Replacement
- Steering Wheel Airbag Replacement
- SIR/SRS Wiring Repairs
- Control Module References for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0014, B0021, B0031, OR B0038: SEAT SIDE AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0014 01

Driver Seat Side Air Bag Deployment Loop Short to Battery

DTC B0014 02

Driver Seat Side Air Bag Deployment Loop Short to Ground

DTC B0014 04

Driver Seat Side Air Bag Deployment Loop Open

DTC B0014 0D

Driver Seat Side Air Bag Deployment Loop High Resistance

DTC B0014 0E

Driver Seat Side Air Bag Deployment Loop Low Resistance

DTC B0021 01

Passenger Seat Side Air Bag Deployment Loop Short to Battery

DTC B0021 02

Passenger Seat Side Air Bag Deployment Loop Short to Ground

DTC B0021 04

Passenger Seat Side Air Bag Deployment Loop Open

DTC B0021 0D

Passenger Seat Side Air Bag Deployment Loop High Resistance

DTC B0021 0E

Passenger Seat Side Air Bag Deployment Loop Low Resistance

DTC B0031 01

Left Rear Seat Side Air Bag Deployment Loop Short to Battery

DTC B0031 02

Left Rear Seat Side Air Bag Deployment Loop Short to Ground

DTC B0031 04

Left Rear Seat Side Air Bag Deployment Loop Open

DTC B0031 0D

Left Rear Seat Side Air Bag Deployment Loop High Resistance

DTC B0031 0E

Left Rear Seat Side Air Bag Deployment Loop Low Resistance

DTC B0038 01

Right Rear Seat Side Air Bag Deployment Loop Short to Battery

DTC B0038 02

Right Rear Seat Side Air Bag Deployment Loop Short to Ground

DTC B0038 04

Right Rear Seat Side Air Bag Deployment Loop Open

DTC B0038 0D

Right Rear Seat Side Air Bag Deployment Loop High Resistance

DTC B0038 0E

Right Rear Seat Side Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Left Front Seat Side Air Bag High Control	B0014 02, B0014 0E	B0014 0D	B0014 04, B0014 0D	B0014 01	-
Left Front Seat Side Air Bag Low Control	B0014 02, B0014 0E	B0014 0D	B0014 04, B0014 0D	B0014 01	-
Right Front Seat Side Air Bag High Control	B0021 02, B0021 0E	B0021 0D	B0021 04, B0021 0D	B0021 01	-
Right Front Seat Side Air Bag Low Control	B0021 02, B0021 0E	B0021 0D	B0021 04, B0021 0D	B0021 01	-
Left Rear Seat Side Air Bag High Control	B0031 02, B0031 0E	B0031 0D	B0031 04, B0031 0D	B0031 01	-
Left Rear Seat Side Air Bag Low Control	B0031 02, B0031 0E	B0031 0D	B0031 04, B0031 0D	B0031 01	-
Right Rear Seat Side Air Bag High Control	B0038 02, B0038 0E	B0038 0D	B0038 04, B0038 0D	B0038 01	-
Right Rear Seat Side Air Bag Low Control	B0038 02, B0038 0E	B0038 0D	B0038 04, B0038 0D	B0038 01	-

Circuit/System Description

During a side or frontal crash of sufficient force, the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag. There are 2 shorting bars used within the connector that will short the control circuits together when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or retractor pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0014 01, B0021 01, B0031 01, B0038 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0014 02, B0021 02, B0031 02, B0038 02

The air bag control circuit is shorted to ground for 2 seconds.

B0014 04, B0021 04, B0031 04, B0038 04

The air bag control circuit is open for 2 seconds.

B0014 0D, B0021 0D, B0031 0D, B0038 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 seconds.

B0014 0E, B0021 0E, B0031 0E, B0038 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 seconds.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Front and rear seat side air bags
- Left and right roof rail air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Seat side air bag**
  - **Inflatable restraint sensing and diagnostic module**
  - **All wiring harness connectors**
  - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the appropriate scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any spikes or dropouts while moving the harness near each connector.
   - F106 Seat Side Air Bag
   - Any inline harness connector
   - K36 Inflatable Restraint Sensing and Diagnostic Module
   - **If less than 2.1 Ω or greater than 4.0 Ω**

     Refer to Circuit/System Testing.
   - **If there are spikes or dropouts, perform the following:**
   - Inspect each connector terminal and harness for damage or corrosion and repair as necessary.
   - Apply dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal.
   - Ensure each connector and CPA is correctly seated.
   - **If between 2.1 - 4.0 Ω without any spikes or dropouts**
2. All OK

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, disconnect the harness connector at the appropriate F106 Seat Side Air Bag.
2. Test for greater than 25 Ω between the control circuit terminals 1 and 2.
   - **If 25 Ω or less**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.**

   2. Test for infinite resistance between the 2 control circuits.
      - If less than infinite resistance, repair the short between the 2 circuits.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 25 Ω**
3. Ignition ON.
4. Test for less than 11 V between each control circuit terminal listed below and ground:
   - Control circuit terminal 1
   - Control circuit terminal 2
   - **If 11 V or greater**
   1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 Ω between each control circuit terminal listed below and ground:
   - Control circuit terminal 1
   - Control circuit terminal 2
   - **If 25 Ω or less**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 25 Ω**
7. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2, ignition ON.
8. Verify the appropriate scan tool Deployment Loop Resistance parameter is less than 2 Ω.
   - **If 2 Ω or greater**
   1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 2 Ω in each control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 2 Ω**
9. Ignition OFF, connect the harness connector at the F106 Seat Side Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0014, B0021, B0031, or B0038 is not set.
    - **If DTC B0014, B0021, B0031, or B0038 is set**

Test or replace the F106 Seat Side Air Bag.

- **If DTC B0014, B0021, B0031, or B0038 is not set**

12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Outboard Seat Back Airbag Replacement**
- **Rear Seat Bolster Airbag Replacement**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming, and setup

DTC B0015, B001A, B001B, OR B0022: DRIVER/PASSENGER SEAT BELT RETRACTOR/ANCHOR PRETENSIONER DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0015

Driver Seat Belt Retractor Pretensioner Deployment Loop

DTC B001A

Driver Seat Belt Anchor Pretensioner Deployment Loop

DTC B001B

Passenger Seat Belt Anchor Pretensioner Deployment Loop

DTC B0022

Passenger Seat Belt Retractor Pretensioner Deployment Loop

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Seat Belt Retractor Pretensioner High Control	B0015 02, B0015 0E	B0015 0D	B0015 04, B0015 0D	B0015 01	-
Driver Seat Belt Retractor Pretensioner Low Control	B0015 02, B0015 0E	B0015 0D	B0015 04, B0015 0D	B0015 01	-
Driver Seat Belt Anchor Pretensioner Low Control	B001A 02, B001A 0E	B001A 0D	B001A 04	B001A 01	-
Driver Seat Belt Anchor Pretensioner High Control	B001A 02, B001A 0E	B001A 0D	B001A 04	B001A 01	-
Passenger Seat Belt Anchor Pretensioner Low Control	B001B 02, B001B 0E	B001B 0D	B001B 04	B001B 01	-
Passenger Seat Belt Anchor Pretensioner High Control	B001B 02, B001B 0E	B001B 0D	B001B 04	B001B 01	-

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Passenger Seat Belt Retractor Pretensioner High Control	B0022 02, B0022 0E	B0022 0D	B0022 04, B0022 0D	B0022 01	-
Passenger Seat Belt Retractor Pretensioner Low Control	B0022 02, B0022 0E	B0022 0D	B0022 04, B0022 0D	B0022 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short together control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0015 01, B001A 01, B001B 01, B0022 01

The pretensioner control circuit is shorted to voltage for 2 s.

B0015 02, B001A 02, B001B 02, B0022 02

The pretensioner control circuit is shorted to ground for 2 s.

B0015 04, B001A 04, B001B 04, B0022 04

The pretensioner control circuit is open for 2 s.

B0015 0D, B001A 0D, B001B 0D, B0022 0D

The pretensioner deployment loop resistance is greater than 4.2 Ω for 2 s.

B0015 0E, B001A 0E, B001B 0E, B0022 0E

The pretensioner deployment loop resistance is less than 1.4 Ω for 2 s.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: The following diagnostic aids apply for both current and history DTCs.

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Driver and passenger anchor or retractor pretensioners
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE: **Refer to SIR Service Precautions.**

- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Seat belt retractor pretensioner**
  - **Seat belt anchor pretensioner**
  - **Inflatable restraint sensing and diagnostic module**
  - **Seat belt retractor pretensioner wiring harness connector**
  - **Seat belt anchor pretensioner wiring harness connector**
  - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or**

equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify the appropriate scan tool Deployment Loop Resistance parameters stay consistently between 2.1 and 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:
    - F112 Seat Belt Retractor Pretensioner
    - F113 Seat Belt Anchor Pretensioner
    - Any inline harness connector
    - K36 Inflatable Restraint Sensing and Diagnostic Module
    - **If less than 2.1 or greater than 4.0 Ω**

      Refer to Circuit/System Testing.

    - **If there are spikes or dropouts, perform the following**
    - Inspect each connector terminal and harness for damage or corrosion and repair as necessary
    - Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
    - Insure each connector and CPA is correctly seated.
    - **If within 2.1 and 4.0 Ω without any spikes or dropouts**
2. All OK

Circuit/System Testing

1. Ignition OFF. Scan tool disconnected. Disconnect the appropriate harness connector listed below:
    - F112 Seat Belt Retractor Pretensioner
    - F113 Seat Belt Anchor Pretensioner
2. Test for greater than 25 Ω between the control circuit terminals 1 and 2.
    - **If 25 Ω or less**
    1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

       NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.**

    2. Test for infinite resistance between the two control circuits.
        - If less than infinite resistance, repair the short between the two circuits.
        - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 25 Ω**
3. Ignition ON.
4. Test for less than 11 V between the control circuit terminals listed below and ground:
    - Control circuit terminal 1
    - Control circuit terminal 2
    - **If 11 V or greater**
    1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON

   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 Ω between the control circuit terminals listed below and ground:
   - Control circuit terminal 1
   - Control circuit terminal 2
   - **If 25 Ω or less**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 25 Ω**
7. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2. Ignition ON.
8. Verify the appropriate scan tool Deployment Loop Resistance parameter is less than 2 Ω.
   - **If 2 Ω or greater**
   1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 2 Ω in each control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 2 Ω**
9. Ignition OFF, connect the harness connector at the F112 Seat Belt Retractor Pretensioner or F113 Seat Belt Anchor Pretensioner, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0015, B001A, B001B, or B0022 is not set.
    - **If DTC B0015, B001A, B001B, or B0022 is set**

      Replace the appropriate F112 Seat Belt Retractor Pretensioner or F113 Seat Belt Anchor Pretensioner.

    - **If DTC B0015, B001A, B001B, or B0022 is not set**
12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Belt Anchor Plate Tensioner Replacement**
- **Front Seat Belt Retractor Replacement**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0016, B0018, B0023, OR B0025: ROOF RAIL AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0016 01

Left Roof Rail Air Bag Deployment Loop Short to Battery

DTC B0016 02

Left Roof Rail Air Bag Deployment Loop Short to Ground

DTC B0016 04

Left Roof Rail Air Bag Deployment Loop Open

DTC B0016 0D

Left Roof Rail Air Bag Deployment Loop High Resistance

DTC B0016 0E

Left Roof Rail Air Bag Deployment Loop Low Resistance

DTC B0023 01

Right Roof Rail Air Bag Deployment Loop Short to Battery

DTC B0023 02

Right Roof Rail Air Bag Deployment Loop Short to Ground

DTC B0023 04

Right Roof Rail Air Bag Deployment Loop Open

DTC B0023 0D

Right Roof Rail Air Bag Deployment Loop High Resistance

DTC B0023 0E

Right Roof Rail Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Left Roof Rail Air Bag High Control	B0016 02, B0016 0E	B0016 0D	B0016 04, B0016 0D	B0016 01	-
Left Roof Rail Air Bag Low Control	B0016 02, B0016 0E	B0016 0D	B0016 04, B0016 0D	B0016 01	-
Right Roof Rail Air Bag High Control	B0023 02, B0023 0E	B0023 0D	B0023 04, B0023 0D	B0023 01	-
Right Roof Rail Air Bag Low Control	B0023 02, B0023 0E	B0023 0D	B0023 04, B0023 0D	B0023 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short together control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0016 01, B0023 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0016 02, B0023 02

The air bag control circuit is shorted to ground for 2 seconds.

B0016 04, B0023 04

The air bag control circuit is open for 2 seconds.

B0016 0D, B0023 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 seconds.

B0016 0E, B0023 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 seconds.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Left and right roof rail air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. DTCs of deployment loops which are in the seat DTC can occur because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment type loop parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

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Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- Connector Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Roof rail air bag**
  - **Roof rail air bag wiring harness connector**
  - **Inflatable restraint sensing and diagnostic module**
  - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the appropriate scan tool Deployment Loop Resistance parameter stays consistently between 2.1 and 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:
   - F105L Roof Rail Air Bag - Left
   - F105R Roof Rail Air Bag - Right
   - Any inline harness connector
   - K36 inflatable restraint sensing and diagnostic module
   - **If less than 2.1 or greater than 4.0 Ω**

     Refer to Circuit/System Testing.

   - **If there are spikes or dropouts, perform the following**
   - Inspect each connector terminal and harness for damage or corrosion and repair as necessary
   - Ensure each connector and CPA is correctly seated.
   - **If within 2.1 and 4.0 Ω without any spikes or dropouts**

2. All OK

Circuit/System Testing

1. Ignition OFF. Scan tool disconnected. Disconnect the harness connector at the appropriate F105 Roof Rail Air Bag. It may take up to 2 min for all vehicle systems to power down.
2. Test for greater than 25 Ω between the control circuit terminals 1 and 2.
   - **If 25 Ω or less**
   1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.

      NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.**

   2. Test for infinite resistance between the two control circuits.
      - If less than infinite resistance, repair the short between the two circuits.
      - If infinite resistance, replace the K36 inflatable restraint sensing and diagnostic module.
   - **If greater than 25 Ω**
3. Ignition ON.
4. Test for less than 11 V between the control circuit terminals listed below and ground:
   - Control circuit terminal 1
   - Control circuit terminal 2
   - **If 11 V or greater**
   1. Ignition OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module. Ignition ON.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 inflatable restraint sensing and diagnostic module.
   - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 Ω between the control circuit terminals listed below and ground:
   - Control circuit terminal 1
   - Control circuit terminal 2
   - **If 25 Ω or less**
   1. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K36 inflatable restraint sensing and diagnostic module.
   - **If greater than 25 Ω**
7. Ignition OFF. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2. Ignition ON.
8. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω.
   - **If 2 Ω or greater**
   1. Ignition OFF. Disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.

    2. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 inflatable restraint sensing and diagnostic module.
  - **If less than 2 Ω**

9. Ignition OFF, connect the harness connector at the F105 Roof Rail Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0016 or B0023 is not set.
    - **If DTC B0016 or B0023 is set**

      Test or replace the F105 Roof Rail Air Bag.

    - **If DTC B0016 or B0023 is not set**
12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front and Rear Row Seat Roof Rail Airbag Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0017 OR B0024: DRIVER/PASSENGER KNEE AIR BAG DEPLOYMENT LOOP

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0017 01

Driver Knee Air Bag Deployment Loop Short to Battery

DTC B0017 02

Driver Knee Air Bag Deployment Loop Short to Ground

DTC B0017 04

Driver Knee Air Bag Deployment Loop Open

DTC B0017 0D

Driver Knee Air Bag Deployment Loop High Resistance

DTC B0017 0E

Driver Knee Air Bag Deployment Loop Low Resistance

DTC B0024 01

Passenger Knee Air Bag Deployment Loop Short to Battery

DTC B0024 02

Passenger Knee Air Bag Deployment Loop Short to Battery

DTC B0024 04

Passenger Knee Air Bag Deployment Loop Open

DTC B0024 0D

Passenger Knee Air Bag Deployment Loop High Resistance

DTC B0024 0E

Passenger Knee Air Bag Deployment Loop Low Resistance

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Driver Knee Air Bag High Control	B0017 02, B0017 0E	B0017 0D	B0017 04, B0017 0D	B0017 01	-
Driver Knee Air Bag Low Control	B0017 02, B0017 0E	B0017 0D	B0017 04, B0017 0D	B0017 01	-
Passenger Knee Air Bag High Control	B0024 02, B0024 0E	B0024 0D	B0024 04, B0024 0D	B0024 01	-
Passenger Knee Air Bag Low Control	B0024 02, B0024 0E	B0024 0D	B0024 04, B0024 0D	B0024 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag. There are 2 shorting bars used within the connector that will short together the control circuits, when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or retractor pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0017 01, B0024 01

The air bag control circuit is shorted to voltage for 2 seconds.

B0017 02, B0024 02

The air bag control circuit is shorted to ground for 2 seconds.

B0017 04, B0024 04

The air bag control circuit is open for 2 seconds.

B0017 0D, B0024 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 seconds.

B0017 0E, B0024 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 seconds.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.

- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Driver and passenger knee air bags
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connector can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set. Deployment loop DTCs of air bags in the seats can set because of stress or damage to the harness due to seat movement. Move the seat to the full extent of travel while using the scan tool to observe deployment loop resistance parameters.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or**

replacement of the affected component/connector.
    - **Knee air bag**
    - **Inflatable restraint sensing and diagnostic module**
    - **All wiring harness connectors**
    - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 and 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:
    - F114D Knee Air Bag - Driver
    - F114P Knee Air Bag - Passenger
    - Any inline harness connector
    - K36 Inflatable Restraint Sensing and Diagnostic Module
    - **If less than 2.1 or greater than 4.0 Ω**

      Refer to Circuit/System Testing.

    - **If there are spikes or dropouts, perform the following:**
    - Inspect each connector terminal and harness for damage or corrosion and repair as necessary.
    - Apply dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
    - Ensure each connector and CPA is correctly seated
    - **If within 2.1 and 4.0 Ω without any spikes or dropouts**
2. All OK

Circuit/System Testing

1. Ignition OFF, disconnect the scan tool and disconnect the harness connector at the appropriate F114 Knee Air Bag.
2. At the harness connector, test for greater than 25 Ω between the control circuit terminals 1 and 2.
    - **If 25 Ω or less**
    1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

       NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental inflator deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.**

    2. Test for infinite resistance between the 2 control circuits.
        - If less than infinite resistance, repair the short between the 2 circuits.

        - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 25 Ω**

3. Ignition ON.
4. Test for less than 11 V between the control circuit terminals listed below and ground:
    - Control circuit terminal 1
    - Control circuit terminal 2
    - **If 11 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 Ω between the control circuit terminals listed below and ground:
    - Control circuit terminal 1
    - Control circuit terminal 2
    - **If 25 Ω or less**
    1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 25 Ω**
7. Install a 3 A fused jumper wire between the control circuit terminals 1 and 2, ignition ON.
8. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω.
    - **If 2 Ω or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 2 Ω**
9. Ignition OFF, disconnect the 3 A fused jumper wire. Connect the harness connector at the F114 Knee Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
10. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0017 or B0024 is not set.
    - **If DTC B0017 or B0024 is set**

      Test or replace the appropriate F114 Knee Air Bag.

    - **If DTC B0017 or B0024 is not set**
12. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Lower Airbag Replacement - Driver Side**
- **Instrument Panel Lower Airbag Replacement - Passenger Side**

- **Control Module References** for K36 Inflatable Restraint Sensing and Diagnostic Module replacement, programming, and setup

DTC B0019 OR B0020: PASSENGER INSTRUMENT PANEL AIR BAG DEPLOYMENT LOOP STAGE 1/STAGE 2

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0019

Passenger Instrument Panel Air Bag Deployment Loop Stage 1

DTC B0020

Passenger Instrument Panel Air Bag Deployment Loop Stage 2

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
Passenger Instrument Panel Air Bag Stage 1 High Control	B0019 02, B0019 0E	B0019 0D	B0019 04, B0019 0D	B0019 01	-
Passenger Instrument Panel Air Bag Stage 1 Low Control	B0019 02, B0019 0E	B0019 0D	B0019 04, B0019 0D	B0019 01	-
Passenger Instrument Panel Air Bag Stage 2 High Control	B0020 02, B0020 0E	B0020 0D	B0020 04, B0020 0D	B0020 01	-
Passenger Instrument Panel Air Bag Stage 2 Low Control	B0020 02, B0020 0E	B0020 0D	B0020 04, B0020 0D	B0020 01	-

Circuit/System Description

During a side or frontal crash of sufficient force the inflatable restraint sensing and diagnostic module (SDM) will allow current to flow through the deployment loop in order to deploy an air bag or pretensioner. There are 2 shorting bars which will short the control circuits together when the connector is disconnected. This will help to prevent unwanted deployment of the air bag or pretensioner during servicing.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0019 01, B0020 01

The air bag control circuit is shorted to voltage for 2 s.

B0019 02, B0020 02

The air bag control circuit is shorted to ground for 2 s.

B0019 04, B0020 04

The air bag control circuit is open for 2 s.

B0019 0D, B0020 0D

The air bag deployment loop resistance is greater than 4.2 Ω for 2 s.

B0019 0E, B0020 0E

The air bag deployment loop resistance is less than 1.4 Ω for 2 s.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module will store a DTC, however if an event occurs the system will still attempt deployments.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

An incorrectly installed connector position assurance (CPA) or incorrectly seated connector can cause a shorting bar to short both control circuits together. Check the connectors and CPAs if a DTC with symptom byte 02 or 0E is set, to ensure the shorting bars are not causing the circuits to be shorted together. Shorting bars are used in the locations listed below:

- Passenger instrument panel air bag
- Inline harness connectors
- Harness side of the inflatable restraint sensing and diagnostic module connector

Terminal fretting or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 04 or 0D is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38125-580 Terminal Release Tool Kit

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Passenger instrument panel air bag**
  - **inflatable restraint sensing and diagnostic module**
  - **Passenger instrument panel air bag wiring harness connector**
  - **inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify the scan tool Deployment Loop Resistance parameters stay consistently between 2.1 - 4.0 Ω without any spikes or dropouts while moving the harness near each connector listed below:
   - F101 Passenger Instrument Panel Air Bag
   - Any inline harness connector
   - K36 Inflatable Restraint Sensing and Diagnostic Module
   - **If less than 2.1 Ω or greater than 4.0 Ω**

     Refer to Circuit/System Testing.

   - **If there are spikes or dropouts, perform the following**
   - Inspect each connector terminal and harness for damage or corrosion and repair as necessary
   - Apply dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to each connector terminal
   - Insure each connector and CPA is correctly seated.
   - **If between 2.1 - 4.0 Ω without any spikes or dropouts**
2. All OK.

Circuit/System Testing

1. Ignition OFF, scan tool disconnected, disconnect the X215 inline harness connector for the F101 Passenger Instrument Panel Air Bag. It may take up to 2 min for all vehicle systems to power down.
2. Test for greater than 25 Ω between the appropriate control circuit terminals listed below on the K36 Inflatable Restraint Sensing and Diagnostic Module side of the connector:
   - F101 Passenger Instrument Panel Air Bag stage 1 X215 terminal 1 and 2
   - F101 Passenger Instrument Panel Air Bag stage 2 X215 terminal 3 and 4
   - **If 25 Ω or less**

   1. Disconnect the X1 harness connector at the K36 inflatable restraint sensing and diagnostic module.

      NOTE: **Some connectors may be equipped with shorting bars as a safety component to prevent accidental deployment. When testing on a connector with shorting bars, the shorting bars must be disabled to ensure accurate test results. Insert an appropriate pick from EL-38125-580 and depress the shorting bars above the appropriate terminals. This will lift the shorting bar from the terminal and allow accurate test results. Take care not to damage the connector, shorting bar, or terminal when depressing the shorting bar.**

   2. Test for infinite resistance between the two control circuits.
      - If less than infinite resistance, repair the short between the two circuits.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 25 Ω**
3. Ignition ON.
4. Test for less than 11 V between each control circuit terminal listed below on the instrument panel harness side of the connector and ground:
   - X215 control circuit terminal 1
   - X215 control circuit terminal 2
   - X215 control circuit terminal 3
   - X215 control circuit terminal 4
   - **If 11 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
   2. Test for less than 1 V between each control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 11 V**
5. Ignition OFF.
6. Test for greater than 25 Ω between each control circuit terminal listed below on the instrument panel harness side of the connector and ground:
   - X215 control circuit terminal 1
   - X215 control circuit terminal 2
   - X215 control circuit terminal 3
   - X215 control circuit terminal 4
   - **If 25 Ω or less**
   1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 25 Ω**
7. Install a 3 A fused jumper wire between the control circuit terminals listed below on the instrument panel harness side of the connector:
   - F101 Passenger Instrument Panel Air Bag stage 1 X215 terminal 1 and 2
   - F101 Passenger Instrument Panel Air Bag stage 2 X215 terminal 3 and 4
8. Ignition ON.
9. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω.

   - **If 2 Ω or greater**
     1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
     2. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 2 Ω**

10. Ignition OFF, connect the X215 inline harness connector and disconnect the appropriate X1 (DTC B0019) or X2 (DTC B0020) harness connector at the F101 Passenger instrument panel air bag. Ignition ON.
11. Test for less than 11 V between each control circuit terminals listed below and ground:
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X1
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X1
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X2
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X2
    - **If 11 V or greater**

      Repair the short to voltage on the circuit.

    - **If less than 11 V**
12. Ignition OFF.
13. Test for greater than 25 Ω between each control circuit terminals listed below and ground:
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X1
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X1
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 1 X2
    - F101 Passenger Instrument Panel Air Bag control circuit terminal 2 X2
    - **If 25 Ω or less**

      Repair the short to ground on the circuit.

    - **If greater than 25 Ω**
14. Install a 3 A fused jumper wire between the control circuit terminals listed below:
    - F101 Passenger Instrument Panel Air Bag stage 1 control circuit terminal 1 X1 and 2 X1
    - F101 Passenger Instrument Panel Air Bag stage 2 control circuit terminal 1 X2 and 2 X2
15. Ignition ON.
16. Verify the scan tool Deployment Loop Resistance parameter is less than 2 Ω.
    - **If 2 Ω or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for less than 2 Ω in each control circuit end to end.
    - If 2 Ω or greater, repair the open/high resistance in the circuit between the F101 Passenger Instrument Panel Air Bag connector and the X215 inline harness connector.
    - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 2 Ω**
17. Ignition OFF, connect the harness connector at the F101 Passenger Instrument Panel Air Bag, press in the CPA (if equipped) until an audible and/or tactile click is heard.
18. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
19. Verify DTC B0019 or B0020 is not set.
    - **If DTC B0019 or B0020 is set**

      Test or replace the F101 Passenger Instrument Panel Air Bag.

    - **If DTC B0019 or B0020 is not set**

20. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Airbag Replacement**
- **SIR/SRS Wiring Repairs**
- **Control Module References** for device control module replacement, programming and setup

DTC B0052: DEPLOYMENT COMMANDED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using the diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0052 00

Deployment Commanded

DTC B0052 56

Deployment Commanded Too Many Transitions

Circuit/System Description

The inflatable restraint sensing and diagnostic module (SDM) senses vehicle impacts and provides deployment signals to the air bags and anchor and/or retractor pretensioners when warranted. The inflatable restraint sensing and diagnostic module sets DTC B0052 after each command for deployment. DTC B0052 will latch and not clear after 3 commanded deployments by the inflatable restraint sensing and diagnostic module. Therefore the inflatable restraint sensing and diagnostic module has to be replaced.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

- The inflatable restraint sensing and diagnostic module detects a frontal impact of sufficient force to warrant deployment of the frontal air bags.
- The inflatable restraint sensing and diagnostic module detects a side impact or rollover (if equipped) of sufficient force to warrant deployment of a seat air bag and/or roof rail air bag.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- DTC B0052 00 is a DTC that may be cleared with a scan tool without replacing the inflatable restraint sensing and diagnostic module. This DTC will not clear if deployment has been commanded more then two times, and the inflatable restraint sensing and diagnostic module would have to be replaced.
- DTC B0052 56 is a latched DTC. The DTC cannot be cleared with the scan tool. Replacement of the inflatable restraint sensing and diagnostic module is required.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

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Description and Operation

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify that DTC B0052 00 is not set.
    - **If DTC B0052 00 is set**

      Clear the DTC. If the DTC will not clear, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

    - **If DTC B0052 00 is not set**
2. Verify that DTC B0052 56 is not set.
    - **If DTC B0052 56 is set**

      Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

    - **If DTC B0052 56 is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0071: PASSENGER SEAT BELT TENSION SENSOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0071 03

Passenger Seat Belt Tension Sensor Circuit Voltage Below Threshold

DTC B0071 04

Passenger Seat Belt Tension Sensor Circuit Open

DTC B0071 07

Passenger Seat Belt Tension Sensor Circuit Voltage Above Threshold

DTC B0071 08

Passenger Seat Belt Tension Sensor Circuit Voltage Performance - Signal Invalid

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Seat Belt Tension Sensor Signal	B0071 03	B0071 04	B0071 07	B0071 08
Passenger Seat Belt Tension Sensor Low Reference	-	B0071 07	-	-

Circuit/System Description

The seat belt tension sensor is a 2-wire sensor mounted on the passenger seat belt retractor and provides an input to the passenger presence module. When an infant car seat is properly restrained on the front passenger seat, the seat belt is tightly secured through the car seat. The seat belt pulls on the tension sensor and changes the voltage signal to the passenger presence module. The passenger presence module monitors the belt tension sensor signal circuit and if a fault is detected, DTC will be set. When the passenger presence module detects this DTC it will send out a serial data message and the inflatable restraint sensing and diagnostic module will notify the customer of the enable/disable status by illuminating the OFF indicator on the PASSENGER AIR BAG ON/OFF indicators. The inflatable restraint sensing and diagnostic module will then suppress the deployment of the passenger instrument panel air bag and illuminate the AIR BAG indicator.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 volts.

Conditions for Setting the DTC

- The passenger presence module detects the voltage at the passenger seat belt tension sensor signal circuit is less than 0.5 V or greater than 4.5 V for 1 s.
- The passenger presence module detects the voltage at the passenger seat belt tension sensor voltage reference circuit is less than 4.5 V or greater than 9.1 V for 1 s.
- The passenger presence module detects the amperage at the passenger seat belt tension sensor low reference circuit is 25 mA or greater for 1 s.

Action Taken When the DTC Sets

- The passenger presence module will set a DTC, and then communicate with the inflatable restraint sensing and diagnostic module.
- The inflatable restraint sensing and diagnostic module will set DTC B0081
- The inflatable restraint sensing and diagnostic module disables the passenger instrument panel air bag.
- The passenger presence module will illuminate the passenger air bag status OFF indicator.
- The inflatable restraint sensing and diagnostic module requests the instrument panel to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

Inspect the passenger seat belt tension sensor signal and low reference circuits carefully for cutting and/or chafing.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

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Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: **The seat belt buckle replacement with the seat belt tension sensor must be serviced as a complete unit.**

When removing connectors, inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected component/connector:

- **Passenger seat belt tension sensor**
- **Passenger presence module**
- **Passenger seat belt tension sensor wiring harness connector**
- **Passenger presence module wiring harness connector**

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the B61P Seat Belt Tension Sensor - Passenger. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
    - **If greater than 10 Ω**
    1. Ignition OFF, disconnect the harness connector at the K85 Passenger Presence Module. It may take up to 2 min for all vehicle systems to power down.
    2. Test for less than 10 Ω between the low reference circuit and ground.
        - If less than 10 Ω, replace the K85 Passenger Presence Module.
        - If greater than 10 Ω, repair the open/high resistance.
    - **If less than 10 Ω**
3. Ignition On/Vehicle in Service Mode.
4. Test for less than 6 V between the signal circuit terminal 1 and ground.
    - **If 6 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K85 Passenger Presence Module. Ignition On/Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.

        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K85 Passenger Presence Module.
    - **If less than 6 V**

5. Ignition OFF.
6. Test for greater than 5K Ω between the signal circuit terminal 1 and ground. It may take up to 2 minutes for all vehicle systems to power down.
    - **If less than 5K Ω**
    1. Disconnect the harness connector at the K85 Passenger Presence Module.
    2. Test for Infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K85 Passenger Presence Module.
    - **If greater than 5K Ω**
7. Disconnect the harness connector at the K85 Passenger Presence Module.
8. Test for less than 2 Ω between the B61P Seat Belt Tension Sensor - Passenger signal circuit terminal 1 and the K85 Passenger Presence Module signal circuit terminal 6.
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
9. If all circuits test normal, replace the B61P Seat Belt Tension Sensor - Passenger.
10. Ignition On/Vehicle in Service Mode, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
11. Verify DTC B0071 does not set.
    - **If DTC B0071 is set**

      Replace the K85 Passenger Presence Module.

    - **If DTC B0071 is not set**
12. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Front Seat Belt Retractor Replacement for B61P Seat Belt Tension Sensor - Passenger.
- Control Module References for device replacement, programming, and setup.

DTC B0081 (PASSENGER PRESENCE SYSTEM): PASSENGER PRESENCE MODULE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B0081 11

Passenger Presence Module High Input

DTC B0081 4B

Passenger Presence Module Calibration Not Learned

DTC B0081 5A

Passenger Presence Module Not Plausible

Circuit/System Description

When the ignition is turned ON, the inflatable restraint sensing and diagnostic module and the passenger presence module perform tests to diagnose critical malfunctions. Upon a successful power-up mode the inflatable restraint sensing and diagnostic module will illuminate both PASSENGER AIRBAG ON/OFF indicators. If the inflatable restraint sensing and diagnostic module detects a fault in the passenger presence module, it may disable the passenger instrument panel air bag deployment loop, set DTC B0081 and illuminate the air bag indicator.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions must exist for 5 s.

B0081 11

The passenger presence module has failed the rezero procedure.

B0081 4B

The passenger presence module is not calibrated.

B0081 5A

The passenger presence module sets this code when the passenger presence module has lost communication with the inflatable restraint sensing and diagnostic module.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The passenger instrument panel air bag deployment loop will be disabled.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

- If either the inflatable restraint sensing and diagnostic module or passenger presence module were replaced verify that the correct part numbers were used for the vehicle application.
- If this DTC is set as either current or history it may have been caused by an electronic device. If an electronic device (Computers, MP3 Players, Cell Phones, Diagnostic Scan Tool, Power Inverter, etc.) was placed on the passenger seat the passenger presence module may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Make sure there are no objects on the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.
- If this DTC is set as either current or history it may have been caused by an aftermarket seat heater. The aftermarket seat heater may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Remove the aftermarket seat heater from the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.

Reference Information

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **This system is serviced as a kit (seat foam, module and sensing mat). Perform a passenger presence system rezero procedure whenever a component is replaced. Refer to Passenger Presence System Programming and Setup .**
- **Both K36 Inflatable Restraint Sensing and Diagnostic Module and K85 Passenger Presence Module set DTC B0081 but with different symptoms bytes. Therefore it is important to identify which module has set the DTC B0081. Use the symptom bytes as a way of identify the correct module to diagnose.**
- **The K36 Inflatable Restraint Sensing and Diagnostic Module sets a B0081 3A when an incorrect K85 Passenger Presence Module is installed.**

1. Verify that the seat is free of any objects or an aftermarket seat heater.
    - **If objects and/or an aftermarket seat heater is present**
    1. Remove objects and/or aftermarket seat heater.
    2. Ignition ON, clear the DTC.
    3. Verify that DTC B0081 is not set
        - If the DTC B0081 is set, replace the K85 Passenger Presence Module
        - If the DTC B0081 is not set
    4. All OK.
    - **If the seat is empty and does not have an aftermarket seat heater**
2. Verify that DTC B0081 3A is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If DTC B0081 3A is set in the K36 Inflatable Restraint Sensing and Diagnostic Module**

      Replace the K85 Passenger Presence Module.

    - **If DTC B0081 3A is not set in the K36 Inflatable Restraint Sensing and Diagnostic Module**
3. Verify that DTC B0081 11 or DTC B0081 4B is not set in the K85 Passenger Presence Module.

    NOTE: **The K36 Inflatable Restraint Sensing and Diagnostic Modulesets a redundant B0081 00 DTC when the K85 Passenger Presence Module sets a DTC B0081 11 or B0081 4B.**

    - **If DTC B0081 11 or DTC B0081 4B is set in the K85 Passenger Presence Module**

      Perform the passenger presence system rezero procedure. Refer to Passenger Presence System Programming and Setup .

    - **If neither of these DTCs are set in the K85 Passenger Presence Module**
4. Verify DTC B0081 5A is not set in the K85 Passenger Presence Module.
    - **If DTC B0081 5A is set in the K85 Passenger Presence Module**
    1. Verify the connections at the K36 Inflatable Restraint Sensing and Diagnostic Module and K85 Passenger Presence Module, for terminal corrosion, properly seated connectors, and the connector position assurance is installed.
    2. Clear the DTC.
    3. Verify DTC B0081 5A does not set in the K85 Passenger Presence Module.

        - If DTC B0081 5A sets, replace the K85 Passenger Presence Module.
        - If DTC B0081 5A does not set
    4. All OK.
    - **If DTC B0081 5A is not set in the K85 Passenger Presence Module**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for passenger presence module or inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0081 (INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE): PASSENGER PRESENCE MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0081 00

Passenger Presence Module Malfunction

DTC B0081 3A

Passenger Presence Module Incorrect Component Installed

Circuit/System Description

When the ignition is turned ON, the Inflatable Restraint Sensing and Diagnostic Module and the Passenger Presence Module perform tests to diagnose critical malfunctions. Upon a successful power-up mode the Inflatable Restraint Sensing and Diagnostic Module will illuminate both PASSENGER AIRBAG ON/OFF indicators. If the Inflatable Restraint Sensing and Diagnostic Module detects a fault in the Passenger Presence Module, it may disable the passenger instrument panel air bag deployment loop, set DTC B0081 00 or DTC B0081 3A and illuminate the AIRBAG indicator.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0081 00

The Inflatable Restraint Sensing and Diagnostic Module has received a fault present message from the Passenger Presence Module.

B0081 3A

The Inflatable Restraint Sensing and Diagnostic Module has received a message from the Passenger Presence Module indicating a vehicle and Passenger Presence Module mismatch.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument cluster to illuminate the AIR BAG indicator.
- The passenger instrument panel air bag deployment loop will be disabled.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

- If either the Inflatable Restraint Sensing and Diagnostic Module or Passenger Presence Module were replaced verify that the correct part numbers were used for the vehicle application.
- If this DTC is set as either current or history it may have been caused by an electronic device. If an electronic device (Computers, MP3 Players, Cell Phones, Diagnostic Scan Tool, Power Inverter, etc.) was placed on the passenger seat the Passenger Presence Module may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Make sure there are no objects on the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.
- If this DTC is set as either current or history it may have been caused by an aftermarket seat heater. The aftermarket seat heater may command the passenger air bag indicator to turn on and/or command the passenger seat belt indicator to turn on. Remove the aftermarket seat heater from the passenger seat and clear the DTCs. If this DTC resets then perform this diagnostic. If the DTC does not reset there is no further work needed on the passenger presence system.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **This system is serviced as a kit (seat foam, module and/or sensing mat). Perform a Passenger Presence System Preload procedure whenever a component is replaced. Refer to Passenger Presence System Programming and Setup .**
- **Both Inflatable Restraint Sensing and Diagnostic Module and Passenger Presence Module set DTC B0081 but with different symptom bytes. Therefore it is important to identify which module has set the DTC B0081. Use the symptom bytes as a way of identify the correct module to diagnose.**

1. Verify that DTC B1001 is not set in the Inflatable Restraint Sensing and Diagnostic Module.

- **If DTC B1001 is set in the Inflatable Restraint Sensing and Diagnostic Module**

  Refer to DTC B1001 (Inflatable Restraint Sensing and Diagnostic Module)DTC B1001 (Passenger Presence System).

- **If DTC B1001 is not set in the Inflatable Restraint Sensing and Diagnostic Module**

2. Verify that DTC B0074, B101D, or B101E is not set in the Passenger Presence Module.
   - **If any of these DTCs are set in the Passenger Presence Module**

     Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

   - **If none of these DTCs are set in the Passenger Presence Module**

NOTE: **The Inflatable Restraint Sensing and Diagnostic Module sets a redundant B0081 00 DTC when the Passenger Presence Module sets a DTC B0081 11 or B0081 4B.**

3. Verify that DTC B0081 00 is not set in the Inflatable Restraint Sensing and Diagnostic Module
   - **If DTC B0081 00 is set in the Inflatable Restraint Sensing and Diagnostic Module**

     The Passenger Presence Module has set B0081 11 or a B0081 4B. Refer to B0081 (Passenger Presence Module) for diagnosis.

   - **If DTC B0081 00 is not set in the Inflatable Restraint Sensing and Diagnostic Module**

NOTE: **The Inflatable Restraint Sensing and Diagnostic Module sets a B0081 3A when an incorrect Passenger Presence Module is installed.**

4. Verify that DTC B0081 3A is not set in the Inflatable Restraint Sensing and Diagnostic Module.
   - **If DTC B0081 3A is set in the Inflatable Restraint Sensing and Diagnostic Module**

     Replace the K85 Passenger Presence Module.

   - **If DTC B0081 3A is not set in the Inflatable Restraint Sensing and Diagnostic Module**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for device replacement, programming and setup

DTC B0082: PASSENGER PRESENCE DETECTION SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC B0082 01

Passenger Presence Detection Sensor Short to Battery

DTC B0082 02

Passenger Presence Detection Sensor Short to Ground

DTC B0082 04

Passenger Presence Detection Sensor Open Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Presence Detection Sensor Signal	B0082 02	B0082 04	B0082 01	-
Passenger Presence Detection Sensor Ground	-	B0082 04	B0082 04	-

Circuit/System Description

The passenger presence detection sensor is within the passenger seat cushion and provides an input to the Inflatable Restraint Sensing and Diagnostic Module (SDM). The SDM supplies a low reference circuit and a passenger presence detection sensor signal circuit to determine seated or unseated condition of passenger seat.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0082 01

The K36 Inflatable Restraint Sensing and Diagnostic Module detects a short to voltage in the passenger presence detection sensor signal circuit.

B0082 02

The K36 Inflatable Restraint Sensing and Diagnostic Module detects a short to ground in the passenger presence detection sensor signal circuit

B0082 04

The K36 Inflatable Restraint Sensing and Diagnostic Module detects an open/high resistance in the passenger presence detection sensor signal circuit or the seat belt reminder sensor ground circuit

Action Taken When the DTC Sets

The SIR System is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present
- When the fault is no longer present, the DTC will be a history DTC
- A history DTC will clear after 50 ignition cycles

Reference Information

Schematic Reference

- **Seat Belt Schematics**
- **SIR Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. With passenger seat empty, verify the scan tool Passenger Seat Occupancy Status parameter is Empty Seat.
   - **If scan tool Passenger Seat Occupancy Status parameter is not Empty Seat**

     Refer to Circuit/System Testing.

   - **If scan tool Passenger Seat Occupancy Status parameter is Empty Seat**
3. With the passenger seat occupied, verify the scan tool Passenger Seat Occupancy Status parameter is Occupied.
   - **If scan tool Passenger Seat Occupancy Status parameter is not Occupied**

     Refer to Circuit/System Testing.

   - **If scan tool Passenger Seat Occupancy Status parameter is Occupied**
4. All OK.

Circuit/System Testing

1. Ignition OFF.
2. Disconnect the harness connector at the B60 Passenger Presence Sensor.
3. Test for less than 30 Ω between the low reference circuit terminal 2 and ground.
   - **If 30 Ω or greater**
   1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 2 Ω in the B60 Passenger Presence Sensor low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 30 Ω**
4. Ignition On/Vehicle in Service Mode, test for 4.75 - 5.25 V between the signal circuit terminal 1 and ground.
   - **If less than 4.75 V**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 5.25 V**
   1. Ignition OFF.
   2. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.

3. Ignition On/Vehicle in Service Mode.
4. Test for less than 1 V between the signal circuit and ground.
    - If 1 V or greater, repair the short to voltage on the circuit.
    - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
- **If between 4.75 - 5.25 V**

5. Replace the B60 Passenger Presence Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Front Seat Cushion Cover and Pad Replacement**
- **Control Module References** for device replacement, programming and setup

DTC B0083 OR B0084: LEFT FRONT/RIGHT FRONT IMPACT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0083 01

Left Front Impact Sensor High Voltage/Open

DTC B0083 02

Left Front Impact Sensor Short to Ground

DTC B0083 04

Left Front Impact Sensor Open

DTC B0083 05

Left Front Impact Sensor High Voltage/Open

DTC B0083 39

Left Front Impact Sensor Internal Malfunction

DTC B0083 3A

Left Front Impact Sensor Incorrect Component Installed

DTC B0083 71

Left Front Impact Sensor Invalid Data

DTC B0084 01

Right Front Impact Sensor High Voltage/Open

DTC B0084 02

Right Front Impact Sensor Short to Ground

DTC B0084 04

Right Front Impact Sensor Open

DTC B0084 05

Right Front Impact Sensor High Voltage/Open

DTC B0084 39

Right Front Impact Sensor Internal Malfunction

DTC B0084 3A

Right Front Impact Sensor Incorrect Component Installed

DTC B0084 71

Right Front Impact Sensor Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Impact Sensor High Signal	B0083 02	B0083 01, B0083 04, B0083 05	B0083 01	B0083 3A
Left Front Impact Sensor Low Reference	B0083 02	B0083 01, B0083 04, B0083 05	B0083 01	B0083 3A
Right Front Impact Sensor High Signal	B0084 02	B0083 01, B0083 04, B0083 05	B0084 01	B0084 3A
Right Front Impact Sensor Low Reference	B0084 02	B0083 01, B0083 04, B0083 05	B0084 01	B0084 3A

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the Supplemental Inflatable Restraint (SIR) System performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the inflatable restraint sensing and diagnostic module. The impact sensors can assist in determining the severity of some frontal and side collisions. The inflatable restraint sensing and diagnostic module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the inflatable restraint sensing and diagnostic module determines a deployment is warranted, the inflatable restraint sensing and diagnostic module will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0083 01, B0084 01

- The sensor has been shorted to voltage.
- The sensor has High Voltage/Open.

B0083 02, B0084 02

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 milliseconds.

B0083 04, B0083 05, B0084 04, B0084 05

- The sensor circuit is open.
- The inflatable restraint sensing and diagnostic module has not received a message from the sensor for greater than 375 milliseconds.

B0083 39, B0084 39

- The inflatable restraint sensing and diagnostic module has received a Not OK message from the sensor.
- The inflatable restraint sensing and diagnostic module has not received a message.

B0083 3A, B0084 3A

- The inflatable restraint sensing and diagnostic module has received identification message from the sensor, which does not match the identification stored in the inflatable restraint sensing and diagnostic module memory.
- The inflatable restraint sensing and diagnostic module has reset the impact sensor twice without detecting the correct identification message.

B0083 71, B0084 71

The inflatable restraint sensing and diagnostic module has received invalid serial data from the sensor.

Action Taken When the DTC Sets

The inflatable restraint sensing and diagnostic module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

Terminal fretting, damaged terminals, damaged connectors, or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 05 is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Impact sensor**
  - **Impact sensor wiring harness connector**
  - **Inflatable restraint sensing and diagnostic module**
  - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify that DTC B0083 or B0084 symptom byte 39 or 71 is not set as current.
   - **If DTC B0083 or B0084 symptom byte 39 or 71 is set as current**

     Replace the appropriate B59 Impact Sensor.

   - **If DTC B0083 or B0084 symptom byte 39 or 71 is not set as current**
2. Verify that the inflatable restraint sensing and diagnostic module calibrations match the VIN, software part number, and calibration part number.
   - **If the inflatable restraint sensing and diagnostic module calibrations do not match the VIN data**

     Program the inflatable restraint sensing and diagnostic module.

   - **If the inflatable restraint sensing and diagnostic module calibrations match the VIN data**
3. Verify the B59 Front Impact Sensors have the correct part numbers, matching the label part numbers with the parts catalog.
   - **If the inflatable restraint sensing and diagnostic module part numbers do not match**

     Replace the incorrect B59 Front Impact Sensor

   - **If the inflatable restraint sensing and diagnostic module part numbers do match**
4. Verify that DTC B0083 or B0084 symptom byte 01, 02, 04, or 05 is not set as current.
   - **If DTC B0083 or B0084 symptom byte 01, 02, 04, or 05 is set as current**

     Refer to Circuit/System Testing.

   - **If DTC B0083 or B0084 symptom byte 01, 02, 04, 05 is not set as current**
5. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B59 front impact sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**

   1. Ignition OFF, disconnect the X2 harness connector at the K36 inflatable restraint sensing and diagnostic module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 inflatable restraint sensing and diagnostic module.
   - **If less than 10 Ω**

3. Test for greater than 50k Ω between the signal circuit terminal 1 and ground.
   - **If 50k Ω or less**
   1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 50k Ω**
4. Ignition ON, wait 1 min, test for less than 1 V between the signal circuit terminal 1 and ground.
   - **If 1 V or greater**
   1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
   2. Test for less than 1 V between the signal circuit and ground.
      - If greater than 1 V, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange and manually set the DMM range to 000.0 V.**

5. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V. Ignition ON.
6. Verify the MAX voltage captured by the DMM is between 4 - 9V.
   - **If less than 4 V**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 9V**
   1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
   2. Test for less than 1 V between the signal circuit terminal 1 and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If between 4 - 9V**
7. Ignition OFF, reconnect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
8. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
9. Operate the vehicle under the conditions for setting the DTC. The DTC should not set.

- **If the DTC sets**

  Replace the B59 Impact Sensor.

- **If the DTC does not set**

10. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Front End Discriminating Sensor Replacement - Right Side (with AYF)**
- **Airbag Front End Discriminating Sensor Replacement - Left Side (with AYF)**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0085 OR B0088: LEFT FRONT/RIGHT REAR SIDE IMPACT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0085 01

Left Front Side Impact Sensor Open/High Resistance

DTC B0085 02

Left Front Side Impact Sensor Short to Ground

DTC B0085 04

Left Front Side Impact Sensor Open

DTC B0085 39

Left Front Side Impact Sensor Internal Malfunction

DTC B0085 3A

Left Front Side Impact Sensor Incorrect Component Installed

DTC B0088 01

Right Rear Side Impact Sensor Open/High Resistance

DTC B0088 02

Right Rear Side Impact Sensor Short to Ground

DTC B0088 04

Right Rear Side Impact Sensor Open

DTC B0088 39

Right Rear Side Impact Sensor Internal Malfunction

DTC B0088 3A

Right Rear Side Impact Sensor Incorrect Component Installed

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Front Side Impact Sensor High Signal	B0085 02, B0088 02	B0085 01, B0085 04	B0085 01, B0088 01	B0085 39
Left Front Side Impact Sensor Low Reference	B0085 02, B0088 02	B0085 01, B0085 04	B0085 01, B0088 01	B0085 39
Right Rear Side Impact Sensor High Signal	B0085 02, B0088 02	B0088 01, B0088 04	B0085 01, B0088 01	B0088 39
Right Rear Side Impact Sensor Low Reference	B0085 02, B0088 02	B0088 01, B0088 04	B0085 01, B0088 01	B0088 39

Circuit/System Description

The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the Inflatable Restraint Sensing and Diagnostic Module (SDM). The impact sensors can assist in determining the severity of some frontal and side collisions. The Inflatable Restraint Sensing and Diagnostic Module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the Inflatable Restraint Sensing and Diagnostic Module determines a deployment is warranted, the Inflatable Restraint Sensing and Diagnostic Module will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0085 01, B0088 01

- The impact sensor has an open/high resistance.
- The impact sensor has been shorted to voltage.

B0085 02, B0088 02

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 ms.

B0085 04, B0088 04

- The impact sensor has an open or high resistance.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message from the sensor for greater than 375 ms.

B0085 39, B0088 39

- The Inflatable Restraint Sensing and Diagnostic Module has received a Not OK message from the sensor.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message.

B0085 3A, B0088 3A

- The Inflatable Restraint Sensing and Diagnostic Module has received identification message from the sensor, which does not match the identification stored in the Inflatable Restraint Sensing and Diagnostic Module memory.
- The Inflatable Restraint Sensing and Diagnostic Module has reset the impact sensor twice without detecting the correct identification message.

Action Taken When the DTC Sets

The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Reference Information

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- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Side Impact Sensor**
  - **Inflatable Restraint Sensing and Diagnostic Module**
  - **Front impact sensor wiring harness connector**
  - **Side Impact Sensor wiring harness connector**
  - **Inflatable Restraint Sensing and Diagnostic Module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify that DTC B0085 or B0088 symptom byte 39 is not set as current.
    - **If DTC B0085 or B0088 symptom byte 39 is set as current**

      Replace the sensor listed below:

    - B0085 - B63LF Side Impact Sensor-Left Front
    - B0088 - B63RR Side Impact Sensor-Right Rear
    - **If DTC B0085 or B0088 symptom byte 39 is not set as current**
2. Verify that DTC B0085 or B0088 symptom byte 3A is not set as current.
    - **If DTC B0085 or B0088 symptom byte 3A is set as current**

      Replace the incorrect B63 Side Impact Sensor

    - **If DTC B0085 or B0088 symptom byte 3A is not set as current**
3. Verify that DTC B0085 or B0088 symptom byte 02 or 05 is set as current.
    - **If only DTC B0085 symptom byte 01, 02 or 04 is set as current**

      Refer to Circuit/System Testing - Only DTC B0085 or B0088 is set.

    - **If only DTC B0088 symptom byte 01, 02 or 04 is set as current**

      Refer to Circuit/System Testing - Only DTC B0085 or B0088 is set.

    - **If both DTC B0085 or B0088 symptom byte 01 or 02 is set as current**

      Refer to Circuit/System Testing - Both DTC B0085 and B0088 are set.

    - **If DTC B0085 or B0088 symptom byte 01 or 02 is not set as current**
4. All OK.

Circuit/System Testing

NOTE: **The signal circuit is shared at the K36 Inflatable Restraint Sensing and Diagnostic Module between the B63LF Side Impact Sensor - Left Front and the B63RR Side Impact Sensor - Right Rear (DTC B0085 and DTC B0088). Therefore a short to ground or short to voltage in either of these signal circuits can set a DTC for both circuits, and an open in either circuit will only set its corresponding DTC.**

Only DTC B0085 or B0088 is set

1. Ignition OFF, disconnect the harness connector at the appropriate B63 Side Impact Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4-9 V between the signal circuit terminal 1 and ground.
    - **If less than 4 V**
    1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the signal circuit and ground.

      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 9V**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If between 4-9 V**
5. Ignition OFF, connect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
6. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
7. Verify the DTC does not set.
   - **If the DTC sets**
   1. Replace the B63 Side Impact Sensor.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
      - If the DTC does not set.
   3. All OK.
   - **If the DTC does not set**
8. All OK

Both DTC B0085 and B0088 are set

1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for greater than 50k Ω between each signal circuit listed below and ground:
   - Left front signal circuit - terminal 19 X2
   - Right rear signal circuit - terminal 30 X2
   - **If 50k Ω or less**
   1. Ignition OFF. Disconnect the harness connector at the B63 Side Impact Sensor that failed the test. Ignition ON.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the B63 Side Impact Sensor.
   - **If greater than 50k Ω**
3. Ignition ON.
4. Test for less than 1 V between the signal circuit terminals listed below and ground:
   - Left front signal circuit - terminal 19 X2
   - Right rear signal circuit - terminal 30 X2
   - **If 1 V or greater**
   1. Disconnect the harness connector at the B63 Side Impact Sensor that failed the test.
   2. Test for less than 1 V between signal circuit and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.
      - If less than 1 V, replace the B63 Side Impact Sensor.
   - **If less than 1 V**
5. Ignition OFF, connect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.

6. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
7. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

    - **If the DTC does not set**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Side Impact Sensor Replacement - Front Side Door (with AYF)**
- **Airbag Side Impact Rear Sensor Replacement (with AYF)**
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC B0086 OR B0087: RIGHT FRONT/LEFT REAR SIDE IMPACT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0086 01

Right Front Side Impact Sensor High Voltage/Open

DTC B0086 02

Right Front Side Impact Sensor Short to Ground

DTC B0086 04

Right Front Side Impact Sensor Open

DTC B0086 39

Right Front Side Impact Sensor Internal Malfunction

DTC B0086 3A

Right Front Side Impact Sensor Incorrect Component Installed

DTC B0087 01

Left Rear Side Impact Sensor High Voltage/Open

DTC B0087 02

Left Rear Side Impact Sensor Short to Ground

DTC B0087 04

Left Rear Side Impact Sensor Open

DTC B0087 39

Left Rear Side Impact Sensor Internal Malfunction

DTC B0087 3A

Left Rear Side Impact Sensor Incorrect Component Installed

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Right Front Side Impact Sensor High Signal	B0086 02, B0087 02	B0086 01, B0086 04	B0086 01, B0087 01	B0086 39
Right Front Side Impact Sensor Low Reference	B0086 02, B0087 02	B0086 01, B0086 04	B0086 01, B0087 01	B0086 39
Left Rear Side Impact Sensor High Signal	B0086 02, B0087 02	B0087 01, B0087 04	B0086 01, B0087 01	B0087 39
Left Rear Side Impact Sensor Low Reference	B0086 02, B0087 02	B0087 01, B0087 04	B0086 01, B0087 01	B0087 39

Circuit/System Description

The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the Inflatable Restraint Sensing and Diagnostic Module (SDM). The impact sensors can assist in determining the severity of some frontal and side collisions. The Inflatable Restraint Sensing and Diagnostic Module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the Inflatable Restraint Sensing and Diagnostic Module determines a deployment is warranted, the Inflatable Restraint Sensing and Diagnostic Module will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0086 01, B0087 01

- The impact sensor has been shorted to voltage.
- The impact sensor has an open/high resistance.

B0086 02, B0087 02

- The sensor has been shorted to ground.
- The sensor current is greater than 23 mA for greater than 5 ms.

B0086 04, B0087 04

- The sensor circuit is open.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message from the sensor for greater than 375 ms.

B0086 39, B0087 39

- The Inflatable Restraint Sensing and Diagnostic Module has received a Not OK message from the sensor.
- The Inflatable Restraint Sensing and Diagnostic Module has not received a message.

B0086 3A, B0087 3A

- The Inflatable Restraint Sensing and Diagnostic Module has received identification message from the sensor, which does not match the identification stored in the Inflatable Restraint Sensing and Diagnostic Module memory.

- The Inflatable Restraint Sensing and Diagnostic Module has reset the impact sensor twice without detecting the correct identification message.

Action Taken When the DTC Sets

The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Reference Information

Schematic Reference

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Connector End View Reference

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- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Refer to SIR Service Precautions.**

Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.

- **Side Impact Sensor**
- **Inflatable Restraint Sensing and Diagnostic Module**
- **Front impact sensor wiring harness connector**
- **Side Impact Sensor wiring harness connector**
- **Inflatable Restraint Sensing and Diagnostic Module wiring harness connector**

NOTE: **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.**

If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.

1. Verify that DTC B0086 or B0087 symptom byte 39 is not set as current.
    - **If DTC B0086 or B0087 symptom byte 39 is set as current**

      Replace the sensor listed below:

    - B0086 - B63LF Side Impact Sensor-Right Front
    - B0087 - B63RR Side Impact Sensor-Left Rear
    - **If DTC B0086 or B0087 symptom byte 39 is not set as current**
2. Verify that DTC B0086 or B0087 symptom byte 3A is not set as current.
    - **If DTC B0086 or B0087 symptom byte 3A is set as current**

      Replace the incorrect B63 Side Impact Sensor

    - **If DTC B0086 or B0087 symptom byte 3A is not set as current**
3. Verify that DTC B0086 or B0087 symptom byte 02 or 05 is set as current.
    - **If only DTC B0086 symptom byte 01, 02 or 04 is set as current**

      Refer to Circuit/System Testing - Only DTC B0086 or B0087 is set.

    - **If only DTC B0087 symptom byte 01, 02 or 04 is set as current**

      Refer to Circuit/System Testing - Only DTC B0086 or B0087 is set.

    - **If both DTC B0086 or B0087 symptom byte 01, 02 or 04 is set as current**

      Refer to Circuit/System Testing - Both DTC B0086 and B0087 are set.

    - **If DTC B0086 or B0087 symptom byte 01, 02 or 04 is not set as current**
4. All OK.

Circuit/System Testing

NOTE: **The signal circuit is shared at the K36 Inflatable Restraint Sensing and Diagnostic Module between the B63RF Side Impact Sensor right front and the B63LR Side Impact Sensor left rear (DTC B0086 and DTC B0087). Therefore a short to ground or short to voltage in either of these signal circuits can set a DTC for both circuits, and an open in either circuit should only set its corresponding DTC.**

Only DTC B0086 or B0087 is set

1. Ignition OFF, disconnect the harness connector at the appropriate B63 Side Impact Sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 10 Ω**
3. Ignition ON.
4. Test for 4-9 V between the signal circuit terminal 1 and ground.

   - **If less than 4 V**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground in the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If greater than 9V**
   1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If between 4-9 V**
5. Ignition OFF, connect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
6. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
7. Verify the DTC does not set.
   - **If the DTC sets**
   1. Replace the B63 Side Impact Sensor.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
      - If the DTC does not set.
   3. All OK.
   - **If the DTC does not set**
8. All OK.

Both DTC B0086 and B0087 are set

1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for greater than 50k Ω between each signal circuit listed below and ground:
   - Right front signal circuit - terminal 22 X2
   - Left rear signal circuit - terminal 27 X2
   - **If 50k Ω or less**
   1. Disconnect the harness connector at the B63 Side Impact Sensor that failed the test.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the B63 Side Impact Sensor.
   - **If greater than 50k Ω**
3. Ignition ON.
4. Test for less than 1 V between the signal circuit terminals listed below and ground:
   - Right front signal circuit - terminal 22 X2
   - Left rear signal circuit - terminal 27 X2
   - **If 1 V or greater**
   1. Ignition OFF. Disconnect the harness connector at the B63 Side Impact Sensor that failed the test. Ignition ON.
   2. Test for less than 1 V between signal circuit and ground.
      - If 1 V or greater, repair the short to voltage in the circuit.

        - If less than 1 V, replace the B63 Side Impact Sensor.
    - **If less than 1 V**
5. Ignition OFF, connect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
6. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
7. Verify the DTC does not set.
    - **If the DTC sets**
    1. Replace the B63 Side Impact Sensor.
    2. Verify the DTC does not set.
        - If the DTC sets, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
        - If the DTC does not set.
    3. All OK.
    - **If the DTC does not set**
8. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Side Impact Sensor Replacement - Front Side Door (with AYF)**
- **Airbag Side Impact Rear Sensor Replacement (with AYF)**
- **Control Module References** for Inflatable Restraint Sensing and Diagnostic Module replacement, programming and setup

DTC B0091: CENTER FRONT IMPACT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0091

Center Front Impact Sensor

For symptom byte information refer to **Symptom Byte List** .

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B0091 02	B0091 04, B0091 05, B0091 71	B0091 01, B0091 05	B0091 08, B0091 39, B0091 0F
Low Reference	B0091 02	B0091 04, B0091 05, B0091 71	-	-

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the supplemental inflatable restraint (SIR) system performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the inflatable restraint sensing and diagnostic module. The impact sensors can assist in determining the severity of some frontal and side collisions. The inflatable restraint sensing and diagnostic module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the inflatable restraint sensing and diagnostic module determines a deployment is warranted, the inflatable restraint sensing and diagnostic module will cause current to flow through the deployment loops deploying the appropriate air bags. The center front impact sensor and side impact sensors utilize a bidirectional 2-wire circuit. The sensors modulate current on the interface to send identification, state of health, and deployment commands to the inflatable restraint sensing and diagnostic module. The inflatable restraint sensing and diagnostic module serves as a power source and a ground for the sensors. When the ignition is turned ON and input power from the inflatable restraint sensing and diagnostic module is first detected, the sensors respond by performing internal diagnostics and sending an identification to the inflatable restraint sensing and diagnostic module. The inflatable restraint sensing and diagnostic module considers the identification to be valid if the response time is less than 5 s. The sensors continually communicate status messages to the inflatable restraint sensing and diagnostic module, which determines if a fault is present in the sensor circuit. When a fault is detected, the inflatable restraint sensing and diagnostic module may reset the sensors up to 2 times by removing and reapplying power to it. If the fault is still present, the inflatable restraint sensing and diagnostic module will set a DTC.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

B0091 02

- The inflatable restraint sensing and diagnostic module has detected the center front impact sensor has been shorted to ground.
- The center front impact sensor current is greater than 23 mA for greater than 5 ms.

B0091 04

The impact sensor has an open or high resistance.

B0091 05

- The impact sensor has an open or high resistance.
- The impact sensor has been shorted to voltage.

B0091 08

The impact sensor has an invalid signal.

B0091 0F

The impact sensor has an erratic signal.

B0091 39

- The inflatable restraint sensing and diagnostic module has received a Not OK message from the center front impact sensor.
- The inflatable restraint sensing and diagnostic module has not received a message.

B0091 3A

- The inflatable restraint sensing and diagnostic module has received identification message from the center front impact sensor which does not match the identification stored in the inflatable restraint sensing and diagnostic module memory.
- The inflatable restraint sensing and diagnostic module has reset the center front impact sensor twice without detecting the correct identification message.

B0091 71

The inflatable restraint sensing and diagnostic module has received invalid serial data from the center front impact sensor.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument panel cluster to illuminate the AIR BAG indicator.
- The SIR system is disabled and no deployments are allowed.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aid

NOTE: **The following diagnostic aids apply for both current and history DTCs.**

Terminal fretting, damaged terminals, damaged connectors, or incorrectly seated connectors can cause an open/high resistance condition. Check the circuit terminals for fretting or incorrectly seated connector if a DTC with symptom byte 05 or 71 is set.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

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- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Front impact sensor**
  - **Side impact sensor**
  - **Inflatable restraint sensing and diagnostic module**
  - **Front impact sensor wiring harness connector**
  - **Side impact sensor wiring harness connector**
  - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars**

within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.

- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify that DTC B0091 symptom byte 08, 0F, 3A, 39 or 71 is not set as current.
    - **If DTC B0091 symptom byte 08, 0F, 3A, 39 or 71 is set as current**

      Replace the B59 Front Impact Sensor.

    - **If DTC B0091 symptom byte 08, 0F, 3A, 39 or 71 is not set as current**
2. Verify that DTC B0091 symptom byte 01, 02, 04, or 05 is not set as current.
    - **If DTC B0091 symptom byte 01, 02, 04, or 05 is set as current**

      Refer to Circuit/System Testing.

    - **If DTC B0091 symptom byte 01, 02, 04, 05 is not set as current**
3. All OK.

Circuit/System Testing

1. Ignition OFF, and all vehicle systems OFF, disconnect the harness connector at the B59 Front Impact Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF, disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 10 Ω**
3. Test for greater than 50k Ω between the signal circuit terminal 1 and ground.
    - **If 50k Ω or less**
    1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 50k Ω**
4. Ignition ON, wait 1 min, test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If greater than 1 V, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 1 V**

NOTE: **When using the MIN MAX function, autorange on the DMM may not function properly. To ensure accurate test results, turn off autorange**

and manually set the DMM range to 000.0 V.

5. Ignition OFF, install a DMM between the signal circuit terminal 1 and ground. Set the DMM to capture DC voltage using the MIN MAX function. Turn off autorange and manually set the DMM range to 000.0 V. Ignition ON.
6. Verify the MAX voltage captured by the DMM is between 4 - 9V.
    - **If less than 4 V**
    1. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 9V**
    1. Ignition OFF. Disconnect the X2 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
    2. Test for less than 1 V between the signal circuit terminal 1 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If between 4 - 9V**
7. Ignition OFF, reconnect all harness connectors, press in the CPA (if equipped) until an audible and/or tactile click is heard.
8. Ignition ON, clear DTCs. Operate the vehicle within the Conditions for Running the DTC.
9. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the B59 Front Impact Sensor.

    - **If the DTC does not set**
10. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Front End Discriminating Sensor Replacement (with AY0)**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B0092 OR B0093: LEFT CENTER/RIGHT CENTER SIDE IMPACT SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B0092 01

Left Center Side Impact Sensor Short to Battery

DTC B0092 02

Left Center Side Impact Sensor Short to Ground

DTC B0092 04

Left Center Side Impact Sensor Open

DTC B0092 39

Left Center Side Impact Sensor Internal Malfunction

DTC B0092 3A

Left Center Side Impact Sensor Incorrect Component Installed

DTC B0092 71

Left Center Side Impact Sensor Invalid Data

DTC B0093 01

Right Center Side Impact Sensor Short to Battery

DTC B0093 02

Right Center Side Impact Sensor Short to Ground

DTC B0093 04

Right Center Side Impact Sensor Open

DTC B0093 39

Right Center Side Impact Sensor Internal Malfunction

DTC B0093 3A

Right Center Side Impact Sensor Incorrect Component Installed

DTC B0093 71

Right Center Side Impact Sensor Invalid Data

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Left Center Side Impact Sensor High Signal	B0092 02	B0092 04	B0092 01	B0092 3A
Left Center Side Impact Sensor Low Reference	-	B0092 04	B0092 01	B0092 3A
Right Center Side Impact Sensor High Signal	B0093 02	B0093 04	B0093 01	B0093 3A
Right Center Side Impact Sensor Low Reference	-	B0093 04	B0093 01	B0093 3A

Circuit/System Description

The impact sensors are equipped on vehicles to supplement the Supplemental Inflatable Restraint (SIR) System performance. The impact sensors are electronic and are not part of the deployment loops, but instead provide inputs to the inflatable restraint sensing and diagnostic module. The impact sensors can assist in determining the severity of some frontal and side collisions. The inflatable restraint sensing and diagnostic module uses the input from the impact sensors to assist in determining the severity of a collision further supporting air bag deployment. If the inflatable restraint sensing and diagnostic module determines a deployment is warranted, the inflatable restraint sensing and diagnostic module will cause current to flow through the deployment loops deploying the air bags.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

Any of the following conditions exist for 10 seconds:

B0092 01, B0093 01

The impact sensor has been shorted to voltage.

B0092 02, B0093 02

- The impact sensor has been shorted to ground.
- The impact sensor current is greater than 23 mA for greater than 5 milliseconds.

B0092 04, B0093 04

The impact sensor has an open or high resistance.

B0092 39, B0093 39

- The inflatable restraint sensing and diagnostic module has received a Not OK message from the impact sensor.
- The inflatable restraint sensing and diagnostic module has not received a message.

B0092 3A, B0093 3A

- The inflatable restraint sensing and diagnostic module has received identification message from the impact sensor, which does not match the identification stored in the SDM memory.
- The inflatable restraint sensing and diagnostic module has reset the impact sensor twice without detecting the correct identification message.

B0092 71, B0093 71

The SDM has received invalid data from the sensor.

Action Taken When the DTC Sets

The SDM requests the instrument panel cluster to illuminate the AIR BAG indicator.

Conditions for Clearing the DTC

- The condition for setting the DTC no longer exists.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.
- An ignition cycle is required for the DTC to go from current to history.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Testing for Intermittent Conditions and Poor Connections
- Connector Repairs
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **Refer to SIR Service Precautions.**
- **Inspect all terminals for damage or corrosion when disconnecting connectors. Damage or corrosion in the following requires repair or replacement of the affected component/connector.**
  - **Impact sensor**
  - **Inflatable restraint sensing and diagnostic module**
  - **Impact sensor wiring harness connector**
  - **Inflatable restraint sensing and diagnostic module wiring harness connector**
- **The connector and connector position assurance (CPA) may seat independent of each other. Both the connector and CPA should seat with an audible and/or tactile click. The CPA isolates the shorting-bars within the connector allowing the deployment circuit to operate properly. Replace any CPA that is damaged or missing.**
- **If the condition is intermittent or cannot be duplicated, disconnect the connectors and add dielectric grease / lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087). This procedure will correct the high resistance condition due to terminal fretting corrosion.**

1. Verify that DTC B0092 or B0093 symptom byte 3A, 39, or 71 is not set as current.
   - **If DTC B0092 or B0093 symptom byte 3A, 39 or 71 is set as current**

     Replace the appropriate B63 Side Impact Sensor.

   - **If DTC B0092 or B0093 symptom byte 3A, 39 or 71 is not set as current**
2. Verify that DTC B0092 or B0093 symptom byte 01, 02, or 04 is not set as current.
   - **If DTC B0092 or B0093 symptom byte 01, 02, or 04 is set as current**

     Refer to Circuit/System Testing.

   - **If DTC B0092 or B0093 symptom byte 01, 02, or 04 is not set as current**
3. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the appropriate B63 Side Impact Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 10 Ω**
3. Test for greater than 50k Ω between the signal circuit terminal 1 and ground.
    - **If 50k Ω or less**
    1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If greater than 50k Ω**
4. Ignition ON.
5. Test for less than 1 V between the signal circuit terminal 1 and ground.
    - **If 1 V or greater**
    1. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition ON.
    2. Test for less than 1 V between the signal circuit and ground.
        - If greater than 1 V, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 1 V**
6. Ignition OFF, disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
7. Test for less than 2 Ω between the signal circuit end to end from the impact sensor terminal 1 and the K36 Inflatable Restraint Sensing and Diagnostic Module terminal listed below:
    - Left Center Side Impact Sensor terminal 27 X2
    - Right Center Side Impact Sensor terminal 30 X2
    - **If 2 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 2 Ω**
8. Connect all harness connectors. Ignition ON, clear the DTC.
9. Verify the DTC does not set.
    - **If the DTC sets**

      Replace the B63 Side Impact Sensor.

    - **If the DTC does not set**
10. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Airbag Side Impact Center Pillar Sensor Replacement (with AY0)**
- **Control Module References** for device replacement, programming and setup

DTC B067F OR B0680: PASSENGER AIR BAG ON/OFF INDICATOR CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B067F 01

Passenger Air Bag On Indicator Circuit Short to Battery

DTC B067F 02

Passenger Air Bag On Indicator Circuit Short to Ground

DTC B067F 04

Passenger Air Bag On Indicator Circuit Open

DTC B0680 01

Passenger Air Bag Off Indicator Circuit Short to Battery

DTC B0680 02

Passenger Air Bag Off Indicator Circuit Short to Ground

DTC B0680 04

Passenger Air Bag Off Indicator Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Air Bag OFF Indicator Control	B0680 02	B0680 04	B0680 01	-
Passenger Air Bag ON Indicator Control	B067F 02	B067F 04	B067F 01	-
Passenger Air Bag Disable Indicator Ground	-	B067F 04, B0680 04	-	-

Circuit/System Description (C99)

When the ignition switch is turned to ON, the inflatable restraint sensing and diagnostic module (SDM) continuously checks the air bag enable/disable switch position switch and circuit defect by letting regular voltage flow through the switch circuit and verifying the current. The passenger air bag switch controls when the air bag is enabled or disabled and notifies the driver when the passenger instrument panel air bag is enabled or disabled using the passenger air bag ON/OFF indicators. When the inflatable restraint sensing and diagnostic module receives the signal from the passenger air bag disable switch (on/off), the inflatable restraint sensing and diagnostic module will then provide voltage to the appropriate indicator.

Circuit/System Description (ALO)

The passenger air bag ON/OFF indicators are used to notify the driver when the passenger presence system has enabled or disabled the passenger instrument panel air bag. When the ignition is turned ON, the ignition voltage is supplied to the passenger presence module. When the inflatable restraint sensing and diagnostic module receives the appropriate serial data message from the passenger presence system the inflatable restraint sensing and diagnostic module will then provide voltage to the appropriate indicator.

Conditions for Running the DTC

Ignition Voltage is between 9 - 16 V

Conditions for Setting the DTC

The inflatable restraint sensing and diagnostic module detects improper voltage on the control circuit of the passenger air bag ON or OFF indicator

Actions Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- Passenger air bag ON and OFF indicators are disabled.

Conditions for Clearing the DTC

The condition for setting the DTC no longer exists.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **The passenger air bag ON and OFF indicators may not operate as expected if there are supplemental inflatable restraint (SIR) DTCs. Repair all SIR DTCs before proceeding with this diagnostic.**

With C99 Passenger Air Bag Disable Switch

1. Observe the scan tool Passenger Air Bag Disabled Switch parameter while commanding the passenger air bag ON and OFF by using the S40 passenger air bag disable switch. The value should change between On and Off. If the value does not change refer to Passenger Air Bag Disable Switch Circuit/System Testing.
   - **If the Passenger Air Bag Disabled Switch parameter does not change between On and Off**

     Refer to Passenger Air Bag Disable Switch Circuit/System Testing.

   - **If the Passenger Air Bag Disabled Switch parameter does change between On and Off**
2. All OK.

With ALO Passenger Presence System

1. Ignition On/Vehicle in Service Mode.
2. Passenger seat unoccupied.
3. Verify the scan tool Passenger Seat Occupancy Status parameter is Empty.
   - **If the Passenger Seat Occupancy Status parameter does not display Empty**

    The Passenger Presence System Module has set a DTC. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If the Passenger Seat Occupancy Status parameter does display Empty**

4. Passenger seat unoccupied.
5. Verify the passenger air bag OFF indicator is illuminated.
    - **If the passenger air bag OFF indicator is not illuminated**

      Refer to Passenger Air Bag Indicator Circuit/System Testing.

    - **If the passenger air bag OFF indicator is illuminated**
6. Passenger seat occupied.
7. Verify the scan tool Passenger Seat Occupancy Status parameter is Occupied.
    - **If the Passenger Seat Occupancy Status parameter does not display Occupied**

      The Passenger Presence System Module has set a DTC. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If the Passenger Seat Occupancy Status parameter displays Occupied**
8. Passenger seat occupied.
9. Verify the passenger air bag ON indicator is illuminated.
    - **If the passenger air bag ON indicator is not illuminated**

      Refer to Passenger Air Bag Indicator Circuit/System Testing.

    - **If the passenger air bag ON indicator is illuminated**
10. All OK.

Passenger Air Bag Disable Switch Circuit/System Testing (C99)

NOTE: **When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.**

- **Passenger air bag disable switch.**
- **Passenger air bag disable switch wiring harness.**

1. Ignition OFF, disconnect the harness connector at the S40 Passenger Air Bag Disable Switch.
2. Test for less than 30 Ω between the ground circuit terminal 1 and ground.
    - **If 30 Ω or greater**
    1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the signal circuit terminal 3 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
    3. Test for less than 2 Ω in the signal circuit terminal 3 end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 30 Ω**
3. Ignition On/Vehicle in Service Mode.
4. Test for 4.75-5.25 V between the signal circuit terminal 3 and ground.
    - **If less than 4.75 V**
    1. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

3. Test for less than 2 Ω in the signal circuit end to end.
   - If 2 Ω or greater, repair the open/high resistance in the circuit.
   - If less than Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If greater than 5.25 V**

1. Ignition OFF.
2. Disconnect the harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
3. Ignition On/Vehicle in Service Mode.
4. Test for less than 1 V between the signal circuit terminal 3 and ground:
   - If 1 V or greater, repair the short to voltage on the circuit.
   - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

- **If between 4.75 - 5.25 V**

  Replace the S40 Passenger Air Bag Disable Switch.

Passenger Air Bag Indicator Circuit/System Testing (ALO)

NOTE: **When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.**

- **Passenger air bag disable on/off indicator.**
- **Passenger air bag disable on/off indicator wiring harness.**

1. Ignition OFF, disconnect the scan tool, disconnect the harness connector at the P14 Passenger Air Bag Disable Indicator, wait 2 min.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Test for less than 2 Ω in the ground circuit end to end
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition On/Vehicle in Service Mode, command the Passenger Airbag Off Indictor OFF with a scan tool.
4. Test for less than 11 V between the control circuit terminal 3 and ground.
   - **If 11 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition On/Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 inflatable restraint sensing and diagnostic module.
   - **If less than 11 V**
5. Command the Passenger Airbag Off Indictor On with a scan tool.
6. Test for greater than 4 V between the control circuit terminal 3 and ground.
   - **If 4 V or less**
   1. Ignition OFF. Disconnect the X1 harness connector at the K36 inflatable restraint sensing and diagnostic module.
   2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
   3. Test for less than 2 Ω in each control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K36 inflatable restraint sensing and diagnostic module.
   - **If greater than 4 V**

7. Command the Passenger Airbag On Indictor Off, with a scan tool.
8. Test for less than 11 V between the control circuit terminal 2 and ground.
    - **If 11 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K36 inflatable restraint sensing and diagnostic module. Ignition On/Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 inflatable restraint sensing and diagnostic module.
    - **If less than 11 V**
9. Command the Passenger Airbag On Indictor On, with a scan tool.
10. Test for greater than 4 V between the control circuit terminal 2 and ground.
    - **If 4 V or less**
    1. Ignition OFF, disconnect the X1 harness connector at the K36 inflatable restraint sensing and diagnostic module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in each control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 inflatable restraint sensing and diagnostic module.
    - **If greater than 4 V**
11. Test or replace the P14 Passenger Air Bag Disable Indicator.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Instrument Panel Airbag Arming Status Display Replacement**
- **Control Module References** for device replacement, programming and setup.

DTC B1001 (INFLATABLE RESTRAINT SENSING AND DIAGNOSTIC MODULE): OPTION CONFIGURATION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

DTC Descriptor

DTC B1001 00

Option Configuration

Circuit/System Description

The inflatable restraint sensing and diagnostic module stores a primary data key, which is a 4-digit number. When the ignition is turned ON, the inflatable restraint sensing and diagnostic module compares this information to the information stored in the body control module (BCM) via serial data. If there is a mismatch between the information stored in the inflatable restraint sensing and diagnostic module and body control module, DTC B1001 will set.

Conditions for Running the DTC

System voltage is between 9 - 16 V.

Conditions for Setting the DTC

The 4-digit Primary Data Key stored in the inflatable restraint sensing and diagnostic module does not match the 4 digits stored in the body control module.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG indicator.
- The inflatable restraint sensing and diagnostic module disables all deployments.

Conditions for Clearing the DTC

The last 4-digit Primary Data Key in the inflatable restraint sensing and diagnostic module matches the last 4 digits stored in the Body Control Module.

Diagnostic Aids

- This DTC is an indication that an incorrect inflatable restraint sensing and diagnostic module is installed in the vehicle, or that the inflatable restraint sensing and diagnostic module and/or the body control module was replaced without reprogramming the body control module with the new information.
- If the inflatable restraint sensing and diagnostic module was previously programmed and DTC B1001 is now set, the setup portion of program was not completed. Proceed to the inflatable restraint sensing and diagnostic module setup portion of the **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

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Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**
- **Connector Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the scan tool K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status paramater is Valid.
    - **If the K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Invalid**

      Perform the K36 Inflatable Restraint Sensing and Diagnostic Module setup. Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup** .

    - **If the K36 Inflatable Restraint Sensing and Diagnostic Module Primary Key Status parameter is Valid**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

DTC B1001 (PASSENGER PRESENCE SYSTEM): OPTION CONFIGURATION ERROR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1001 00

Option Configuration Error

Circuit/System Description

The Inflatable Restraint Sensing and Diagnostic Module (SDM) stores a 4-digit primary key for the Passenger Presence Module. The Inflatable Restraint Sensing and Diagnostic Module sends the Passenger Presence Module the primary key. If the Passenger Presence Module determines that it is the wrong primary key, the Passenger Presence Module will set DTC B1001 and send the Inflatable Restraint Sensing and Diagnostic Module a vehicle mismatch message. The Inflatable Restraint Sensing and Diagnostic Module then will set DTC B0081 and illuminate the SIR warning indicator. The Passenger Presence Module does not use a secondary key.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 volts.

Conditions for Setting the DTC

The 4-digit primary key stored in the Inflatable Restraint Sensing and Diagnostic Module does not match the 4-digit key stored in the Passenger Presence Module.

Action Taken When the DTC Sets

- The Inflatable Restraint Sensing and Diagnostic Module requests the instrument panel cluster to illuminate the AIR BAG indicator.
- The passenger instrument panel air bag deployment is disabled.

Conditions for Clearing the DTC

The 4-digit Primary Key in the Inflatable Restraint Sensing and Diagnostic Module and in the Passenger Presence Module match.

Diagnostic Aids

This DTC is an indication that the passenger presence system module was not set-up correctly, is not the correct part number or that the Passenger Presence Module is defective.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs
- SIR/SRS Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.**

- **Passenger Presence Module**
- **Passenger Presence Module wiring harness**

1. Verify the correct K85 Passenger Presence Module part number has been installed
    - **If the K85 Passenger Presence Module installed has an incorrect part number**

      Replace the K85 Passenger Presence Module.

    - **If the K85 Passenger Presence Module installed has a correct part number**
2. Verify that DTC B1001 is not set as current in the K85 Passenger Presence Module.
    - **If DTC is set as current. If Inflatable Restraint Sensing and Diagnostic Module part number is correct**
    1. Verify the Inflatable Restraint Sensing and Diagnostic Module part number is correct.
        - If the K36 Inflatable Restraint Sensing and Diagnostic Module part number is incorrect, replace the K36 Inflatable Restraint Sensing and Diagnostic Module
        - If the K36 Inflatable Restraint Sensing and Diagnostic Module part number is correct
    2. Replace the K85 Passenger Presence Module
    - **If the DTC is no set as current**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

Control Module References for K85 Passenger Presence Module and K36 Inflatable Restraint Sensing and Diagnostic Module replacement, setup, and programming

DTC B1019: SYSTEM CONFIGURATION ERROR

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptor

DTC B1019 00

System Configuration Error

Circuit/System Description

The inflatable restraint sensing and diagnostic module monitors the number of safety components installed on the vehicle. When the ignition is turned ON, the inflatable restraint sensing and diagnostic module evaluates the number of safety components installed and compares it to the number of components the inflatable restraint sensing and diagnostic module expects to see on the vehicle with its current calibration. If there is a mismatch between detected components and the components programmed with the inflatable restraint sensing and diagnostic module calibration, DTC B1019 will set. The components (if equipped) that the inflatable restraint sensing and diagnostic module will detect include inflatable restraint deployment loops, impact sensors, passenger presence system components, seat position sensors, disable switches, and seat belt switches.

Conditions for Running the DTC

Ignition voltage is between 9 - 16 V.

Conditions for Setting the DTC

The setup for the inflatable restraint sensing and diagnostic module has not been completed and the inflatable restraint sensing and diagnostic module does not detect the passenger presence system (if equipped), the correct number of sensors, or deployment loops, that is expected with this calibration.

Action Taken When the DTC Sets

- The inflatable restraint sensing and diagnostic module requests the instrument cluster to illuminate the AIR BAG warning indicator.
- The DTC must be cleared before running the setup inflatable restraint sensing and diagnostic module.
- Air bag indicator will continue to flash until inflatable restraint sensing and diagnostic module setup procedure is complete.

Conditions for Clearing the DTC

- The condition for setting the DTC is no longer present.
- A history DTC will clear once 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

The inflatable restraint sensing and diagnostic module scan tool deployment loop, impact sensor, and passenger presence (if equipped) data will match what the inflatable restraint sensing and diagnostic module has been programmed to expect to see on the vehicle. B1019 DTC will set if a deployment loop or impact sensor is added or removed from the system, or if the passenger presence is not detected.

DTC B1019 will set when an open/high resistance DTC sets for a deployment loop or impact sensor. This causes mismatch between the learned and actual components connected to the inflatable restraint sensing and diagnostic module.

DTC B1019 can set with no other DTCs if an unused deployment loop or impact sensor circuit is shorted to ground. This causes a mismatch between the learned and actual components connected to the inflatable restraint sensing and diagnostic module.

Reference Information

Schematic Reference

- **Seat Belt Schematics**
- **SIR Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Seat Belt System Description and Operation**
- **Supplemental Inflatable Restraint System Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **DTC B1019 can set after the inflatable restraint sensing and diagnostic module has been replaced and/or reprogrammed before the setup procedure is completed. The setup procedure cannot be completed if DTC B1019 is set as current or history. If a short or open is detected in a deployment circuit prior to the setup procedure being performed, the inflatable restraint sensing and diagnostic module will set DTC B1019.**

1. Ignition ON.
2. Verify no other K36 Inflatable Restraint Sensing and Diagnostic Module DTCs are set.
   - **If other K36 Inflatable Restraint Sensing and Diagnostic Module DTCs are set**

     Diagnose those DTCs first. Refer to **Diagnostic Trouble Code (DTC) List - Vehicle**

   - **If no other K36 Inflatable Restraint Sensing and Diagnostic Module DTCs are set**
3. Verify the enabled impact sensors identified in the scan tool data list match the number of actual impact sensors installed on the vehicle.
   - **If the number of enabled impact sensors do not match**
   1. Verify the correct K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is loaded in the K36 Inflatable Restraint Sensing and Diagnostic Module.
      - If the K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is correct and the vehicle contains an incorrect number of sensors, identify which sensors are missing to make the vehicle match the K36 Inflatable Restraint Sensing and Diagnostic Module impact sensor calibration scan tool data list.
      - If the calibration file is incorrect
   2. Reprogram the K36 Inflatable Restraint Sensing and Diagnostic Module. Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**
   - **If the number of enabled impact sensors match**
4. Verify the enabled deployment loops identified in the scan tool data list match the deployment loops installed on the vehicle.
   - **If the number of enabled deployment loops do not match**
   1. Verify the correct K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is loaded in the K36 Inflatable Restraint Sensing and Diagnostic Module.
      - If the K36 Inflatable Restraint Sensing and Diagnostic Module calibration file is correct and the vehicle contains an incorrect number of loops, identify which deployment loops are missing to make the vehicle match the K36 Inflatable Restraint Sensing and Diagnostic Module impact sensor calibration scan tool data list.
      - If the calibration file is incorrect

   2. Program the K36 Inflatable Restraint Sensing and Diagnostic Module. Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**
   - **If the number of enabled deployment loops match**
5. Verify a passenger presence system is equipped on the vehicle.
   - **If a passenger presence system is not equipped on the vehicle**

     Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

   - **If a passenger presence system is equipped on the vehicle**
6. Verify the scan tool Passenger Presence System Enable Status parameter is Enabled.
   - **If the Passenger Presence System Enable Status parameter is not Enabled**

     Refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**

   - **If the Passenger Presence System parameter is Enabled**
7. Verify the scan tool Passenger Presence System Learn Status parameter is Learned.
   - **If the Passenger Presence System Learn Status parameter is not Learned**
   1. Ignition OFF, disconnect the scan tool. It may take up to 2 min for all vehicle systems to power down. Ignition ON.
   2. Verify DTC B1019 is not set as current.
      - If the DTC is set as current, refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup**
      - If the DTC is not set as current
   3. All OK.
   - **If the Passenger Presence System Learn status is Learned**
8. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **SIR/SRS Wiring Repairs**
- **Control Module References** for inflatable restraint sensing and diagnostic module replacement, programming and setup

PASSENGER PRESENCE SYSTEM REZEROING

Introduction

The inflatable restraints passenger presence system is a calibrated system that requires re-zeroing or a zero check anytime the seat cushion trim attachments have been removed or the passenger presence system has been replaced. The procedures below are designed to assist in the re-zeroing of the passenger presence system. Before you start, read these procedures carefully and completely. For further information regarding the passenger presence system refer to **Supplemental Inflatable Restraint System Description and Operation**.

NOTE: **The following procedures must be followed:**

1. Read this procedure carefully and completely.
2. The passenger presence system will not function properly if the passenger presence system re-zeroing procedure is not performed.
3. Perform the **Diagnostic Repair Verification** after successfully completing the re-zeroing procedure to ensure the system is functioning properly.

Passenger Presence System Re-zeroing Procedure

NOTE:

- **Before the passenger presence system can be re-zeroed the front passenger seat must be completely empty of all items. The presence**

of any liquid or items on the front passenger seat will affect the calibration and operation of the passenger presence system.

- **DTC B0081 will set if the re-zero system test is performed with:**
    - **An aftermarket seat heater located too close to the sensor mat**
    - **A scan tool, laptop, or other electronic device is in the seat**
    - **The seat is damp or wet**
    - **An object or person is in the seat**

1. Verify that the temperature is between 32Ã‚Â°F (0Ã‚Â°C) to 100Ã‚Â°F (38 Ã‚Â°C) before running a re-zero procedure.
2. Verify the seat is completely dry.
3. Empty the front outboard passenger seat.
4. Verify that all SIR and passenger presence system components, connectors, and connector position assurances are properly connected and mounted.
5. Install a scan tool.
6. Ignition - On / Vehicle - In Service Mode

NOTE: **The presence of current DTCs, except DTC B0081 11 or B0081 4B, will prevent the passenger presence system from re-zeroing and may set additional DTCs.**

7. With a scan tool, perform the Passenger Presence Sensor Learn procedure.
8. If the test fails, confirm that the seat is empty and completely dry. Perform the Passenger Presence Sensor Learn test again. If the test fails again, verify DTC B0081 is not set as current, if the DTC is set refer to **Diagnostic Trouble Code (DTC) List - Vehicle** . If the test successfully completed, cycle the ignition OFF.
9. After the passenger presence system has been successfully re-zeroed, perform the **Diagnostic Repair Verification** .

SYMPTOMS - SIR

NOTE: **Complete the following steps before using the symptom tables:**

1. **Perform Diagnostic System Check - Vehicle before using the symptom tables in order to verify that all of the following are true:**
    - **There are no DTCs set.**
    - **The inflatable restraint sensing and diagnostic module (SDM) can communicate via the serial data link.**
2. **Review the SIR system description and operation in order to familiarize yourself with the system functions. Refer to Supplemental Inflatable Restraint System Description and Operation.**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the SIR system. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Airbag Indicator Malfunction (Driver)Airbag Indicator Malfunction (Passenger)** in order to diagnose the symptom.

AIRBAG INDICATOR MALFUNCTION (DRIVER)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

When the ignition is turned ON the driver air bag indicator will illuminate, and then turn OFF after the bulb check is complete. The inflatable restraint sensing and diagnostic module (SDM) performs diagnostic tests on the SIR system during the bulb check. If any malfunction exists the inflatable restraint sensing and diagnostic module will request the instrument cluster to illuminate the air bag indicator steady, via serial data. If a preexisting malfunction exists, the air bag indicator will illuminate steady immediately after the ignition is turned ON. If the ignition 1 voltage is outside of the normal operating voltage range of 9 - 16 V, the inflatable restraint sensing and diagnostic module will command the instrument cluster to illuminate the air bag indicator ON, even with no DTCs present, and then disable all deployment loops.

Diagnostic Aids

- A DTC B1370 may set if the ignition 1 circuit is outside the 9 - 16 V range.
- A flashing driver air bag indicator is displayed if the inflatable restraint sensing and diagnostic module was programmed but did not fully complete the programming. For a flashing driver airbag indicator, refer to **Inflatable Restraint Sensing and Diagnostic Module Programming and Setup** .

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Testing for Intermittent Conditions and Poor Connections**
- **Connector Repairs**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the air bag indicator turns ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
   - **If the air bag indicator does not turn ON or OFF**

     Replace the P16 Instrument Cluster.

   - **If the air bag indicator does turn ON or OFF**

2. Replace the K36 Inflatable Restraint Sensing and Diagnostic Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **SIR/SRS Wiring Repairs**
- **Control Module References** for instrument cluster or inflatable restraint sensing and diagnostic module replacement, programming and setup

AIRBAG INDICATOR MALFUNCTION (PASSENGER)

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Passenger Air Bag OFF Indicator Control	2	2*	4	-
Passenger Air Bag ON Indicator Control	3	3*	5	-
Passenger Air Bag Disable Indicator Ground	-	1	1	-
1. Both indicators always OFF 2. The OFF indicator will not illuminate 3. The ON indicator will not illuminate 4. The OFF indictor always ON 5. The ON indicator always ON * High resistance may cause the appropriate indicator to illuminate less bright than normal				

Circuit/System Description

The passenger air bag ON/OFF indicators are used to notify the driver when the passenger presence system has enabled or disabled the passenger instrument panel air bag. When the ignition is turned ON, the ignition voltage is supplied to the passenger presence module. When the Inflatable Restraint Sensing and Diagnostic Module (SDM) receives the appropriate serial data message from the passenger presence module the SDM will then provide voltage to the appropriate indicator.

Reference Information

Schematic Reference

SIR Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Supplemental Inflatable Restraint System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: The passenger air bag ON and OFF indicators may not operate as expected if there are supplemental inflatable restraint (SIR) DTCs. Repair all SIR DTCs before proceeding with this diagnostic.

1. Ignition On/Vehicle in Service Mode.
2. Verify the passenger air bag ON indicator turns ON and OFF when commanding the Passenger Air Bag ON Indicator ON and OFF with a scan tool.
   - **If the air bag ON indicator does not turn ON or OFF**

     Refer to Circuit/System Testing.
   - **If the air bag ON indicator turns ON or OFF**
3. Verify the passenger air bag OFF indicator turns ON and OFF when commanding the Passenger Air Bag OFF Indicator ON and OFF with a scan tool.
   - **If the air bag OFF indicator does not turn ON or OFF**

     Refer to Circuit/System Testing.
   - **If the air bag OFF indicator turns ON or OFF**
4. All OK.

Circuit/System Testing

NOTE: When removing connectors inspect for damage or corrosion. Damage or corrosion in the following requires repair or replacement of the affected.

- **P14 Passenger Airbag Disabled Indicator**
- **P14 Passenger Airbag Disabled Indicator wiring harness.**

1. Ignition OFF, disconnect the harness connector at the P14 Passenger Airbag Disabled Indicator. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition On/Vehicle in Service Mode, command the passenger air bag OFF indicator OFF with a scan tool.
4. Test for less than 11 V between the control circuit terminal 3 and ground.
   - **If 11 V or greater**
   1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module, Ignition On/Vehicle in Service Mode.
   2. Test for less than 1 V between the control circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
   - **If less than 11 V**

5. Command the passenger air bag OFF indicator ON with a scan tool.
6. Test for 1 V or greater between the control circuit terminal 3 and ground.
    - **If less than 1 V**
    1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If 1 V or greater**
7. Command the passenger air bag ON indicator OFF with a scan tool.
8. Test for less than 11 V between the control circuit terminal 2 and ground.
    - **If 11 V or greater**
    1. Ignition OFF, disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module. Ignition On/Vehicle in Service Mode.
    2. Test for less than 1 V between the control circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If less than 11 V**
9. Command the passenger air bag ON indicator ON with a scan tool.
10. Test for 1 V or greater between the control circuit terminal 2 and ground.
    - **If less than 1 V**
    1. Disconnect the X1 harness connector at the K36 Inflatable Restraint Sensing and Diagnostic Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K36 Inflatable Restraint Sensing and Diagnostic Module.
    - **If 1 V or greater**
11. Test or replace the P14 Passenger Airbag Disabled Indicator.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Instrument Panel Airbag Arming Status Display Replacement for P14 Passenger Air Bag Disable Indicator replacement
- Control Module References for device replacement, programming and setup

SIR DISABLING AND ENABLING

SIR component location affects how a vehicle should be serviced. There are parts of the SIR system installed in various locations around a vehicle. To find the location of the SIR components refer to Supplemental Inflatable Restraint System Description and Operation.

There are several reasons for disabling the SIR system, such as repairs to the SIR system or servicing a component near or attached to an SIR component. There are several ways to disable the SIR system depending on what type of service is being performed. The following information covers the proper procedures for disabling/enabling the SIR system.

Condition	Action
If the vehicle was involved in an accident with an air bag deployment.	Disconnect the negative battery cable(s) *. Refer to **Repairs and Inspections Required After a Collision**.
When performing SIR diagnostics.	Follow the appropriate SIR service manual diagnostic procedure(s) *
When moving, removing or replacing an SIR component or a component attached to an SIR component. (Anytime you remove fasteners.)	Disconnect the negative battery cable(s) *
If the vehicle is suspected of having shorted electrical wires.	Disconnect the negative battery cable(s) *
When performing electrical diagnosis on components other than the SIR system.	Remove the SIR/Airbag fuse(s) when indicated by the diagnostic procedure to disable the SIR system
* DTC's may be lost when the negative battery cable is disconnected.	

SIR Service Precautions

WARNING: **When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Failure to observe the correct procedure could cause deployment of the SIR components. Serious injury can occur. Failure to observe the correct procedure could also result in unnecessary SIR system repairs.**

The Inflatable Restraint Sensing and Diagnostic Module (SDM) maintains a reserved energy supply. The reserved energy supply provides deployment power for the air bags if the Inflatable Restraint Sensing and Diagnostic Module loses battery power during a collision. Deployment power is available for as much as 2 minutes after disconnecting the vehicle power. Waiting 2 minutes before working on the system after disabling the SIR system prevents deployment of the air bags from the reserved energy supply.

General Service Instructions

The following are general service instructions which must be followed in order to properly repair the vehicle and return it to its original integrity:

- Do not expose air bags to temperatures above 85Ã,Â°C (185Ã,Â°F).
- Verify the correct replacement part number. Do not substitute a component from a different vehicle.
- Use only original GM replacement parts available from your authorized GM dealer. Do not use salvaged parts for repairs to the SIR system.

Discard any of the following components if it has been dropped from a height of 80 cm (31.5 Inches) or greater:

- Inflatable Restraint Sensing and Diagnostic Module (SDM)
- Any air bag
- Driver steering wheel air bag coil
- Any impact sensor
- Seat belt anchor and/or retractor pretensioners
- Passenger presence module and/or occupant sensor

Disabling Procedure - Air Bag Fuse

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Place the ignition in the OFF position.

> **WARNING:** **The SDM may have more than one fused power input. To ensure there is no unwanted SIR deployment, personal injury, or unnecessary SIR system repairs, remove all fuses supplying power to the SDM. With all SDM fuses removed and the ignition switch in the ON position, the AIR**

BAG warning indicator illuminates. This is normal operation, and does not indicate a SIR system malfunction.

3. Locate and remove the fuse(s) supplying power to the Inflatable Restraint Sensing and Diagnostic Module. Refer to **SIR Schematics**, or **Electrical Center Identification Views** .
4. Wait 2 minutes before working on the system.

Enabling Procedure - Air Bag Fuse

1. Place the ignition in the OFF position.
2. Install the fuse(s) supplying power to the Inflatable Restraint Sensing and Diagnostic Module. Refer to **SIR Schematics**, or **Electrical Center Identification Views** .
3. Turn the ignition switch to the ON position. The AIR BAG indicator will illuminate or flash then turn OFF.
4. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

Disabling Procedure - Negative Battery Cable

1. Turn the steering wheel so that the vehicles wheels are pointing straight ahead.
2. Place the ignition in the OFF position.
3. Disconnect the negative battery cable from the battery. Refer to **Battery Negative Cable Disconnection and Connection** .
4. Wait 2 minutes before working on system.

Enabling Procedure - Negative Battery Cable

1. Place the ignition in the OFF position.
2. Connect the negative battery cable to the battery. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Turn the ignition switch to the ON position. The AIR BAG indicator will illuminate or flash then turn OFF.
4. Perform the Diagnostic System Check - Vehicle if the AIR BAG warning indicator does not operate as described. Refer to **Diagnostic System Check - Vehicle** .

REPAIR INSTRUCTIONS

SIR SERVICE PRECAUTIONS

General Service Instructions

WARNING: **If a service procedure indicates that a module is to be replaced, a new production unit MUST be ordered from the GM Parts Catalog or certified supplier. Using a module that has been reset by a 3rd party company is strictly prohibited. Not using a new production unit may result in improper performance of the safety system in the event of an accident, which may result in bodily injury.**

WARNING: **When performing service on or near the SIR components or the SIR wiring, the SIR system must be disabled. Refer to SIR Disabling and Enabling. Failure to observe the correct procedure could cause deployment of the SIR components, personal injury, or unnecessary SIR system repairs.**

WARNING: **Do not strike or jolt the inflatable restraint sensing and diagnostic module (SDM). Before applying power to the SDM, make sure that it is securely fastened with the arrow facing toward the front of the vehicle. Failure to observe the correct installation procedure could cause SIR deployment, personal injury, or unnecessary SIR system repairs.**

NOTE: **The Inflatable Restraint Sensing and Diagnostic Module (SDM) maintains a reserved energy supply. The reserved energy supply provides deployment power for the SIR air bags. Deployment power may be available for up to 2 minutes after disconnecting the vehicle power. Disabling the SIR system prevents deployment of the SIR air bags from the reserved energy supply.**

NOTE: **The following are general service instructions which must be followed in order to properly repair the vehicle and return it to its original integrity:**

- Do not expose air bags to temperatures above 85 Ã,Â°C (185 Ã,Â°F)
- Verify the correct replacement part number. Do not substitute a component from a different vehicle
- Use only original GM replacement parts available from your authorized GM dealer. Do not use salvaged parts for repairs to the SIR system

NOTE: **Discard any of the following components if it has been dropped from a height of 80 cm (31.49 in) or greater:**

- Inflatable Restraint Sensing and Diagnostic Module
- Passenger instrument panel air bag
- Driver steering wheel air bag
- Driver steering wheel air bag coil
- Roof rail air bags
- Front and /or side impact sensors
- Seat belt achor and/or retractor pretensioners
- Front seat side air bag
- Knee air bag

INSTRUMENT PANEL LOWER AIRBAG BRACKET REPLACEMENT

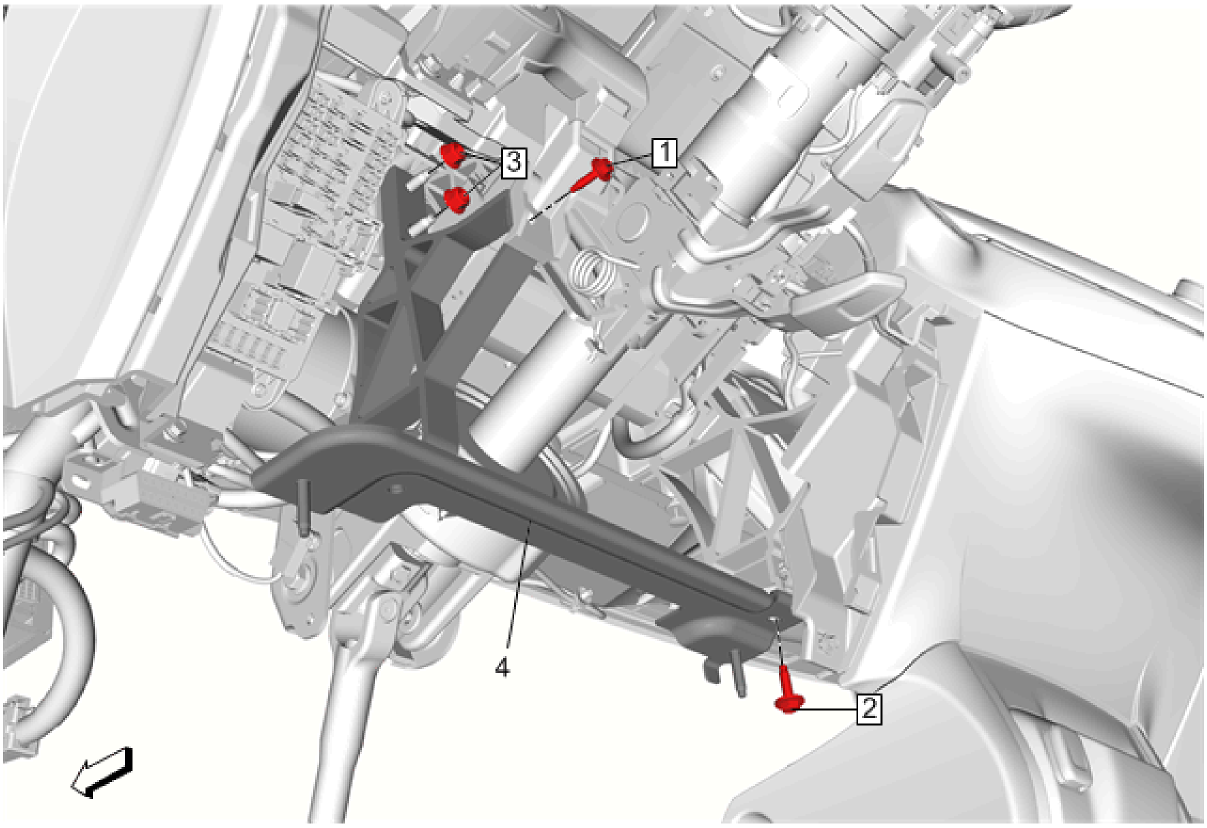


Fig. 4: Instrument Panel Lower Airbag Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Refer to SIR Inflator Module Handling and Storage Warning .
WARNING:
Refer to SIR Warning .
Preliminary Procedures
1. Disable the SIR system. SIR Disabling and Enabling
2. Instrument Panel Lower Airbag Replacement - Driver Side
3. Instrument Panel Knee Bolster Replacement
4. Steering Column Lower Trim Cover Replacement</td></tr>
<tr><td>1</td><td>Instrument Panel Lower Airbag Bracket Bolt - small
CAUTION:
Refer to Fastener Caution .
Tighten
2.5 N.m (22 lb in)</td></tr>
<tr><td>2</td><td>Instrument Panel Lower Airbag Bracket Bolt - large
Tighten
9 N.m (80 lb in)</td></tr>
<tr><td>3</td><td>Instrument Panel Lower Airbag Bracket Nut (Qty: 2)
Tighten
5 N.m (44 lb in)</td></tr>
<tr><td>4</td><td>Instrument Panel Lower Airbag Bracket
Procedure
Enable the SIR System. SIR Disabling and Enabling</td></tr>
</table>

AIRBAG FRONT END DISCRIMINATING SENSOR REPLACEMENT (WITH AY0)

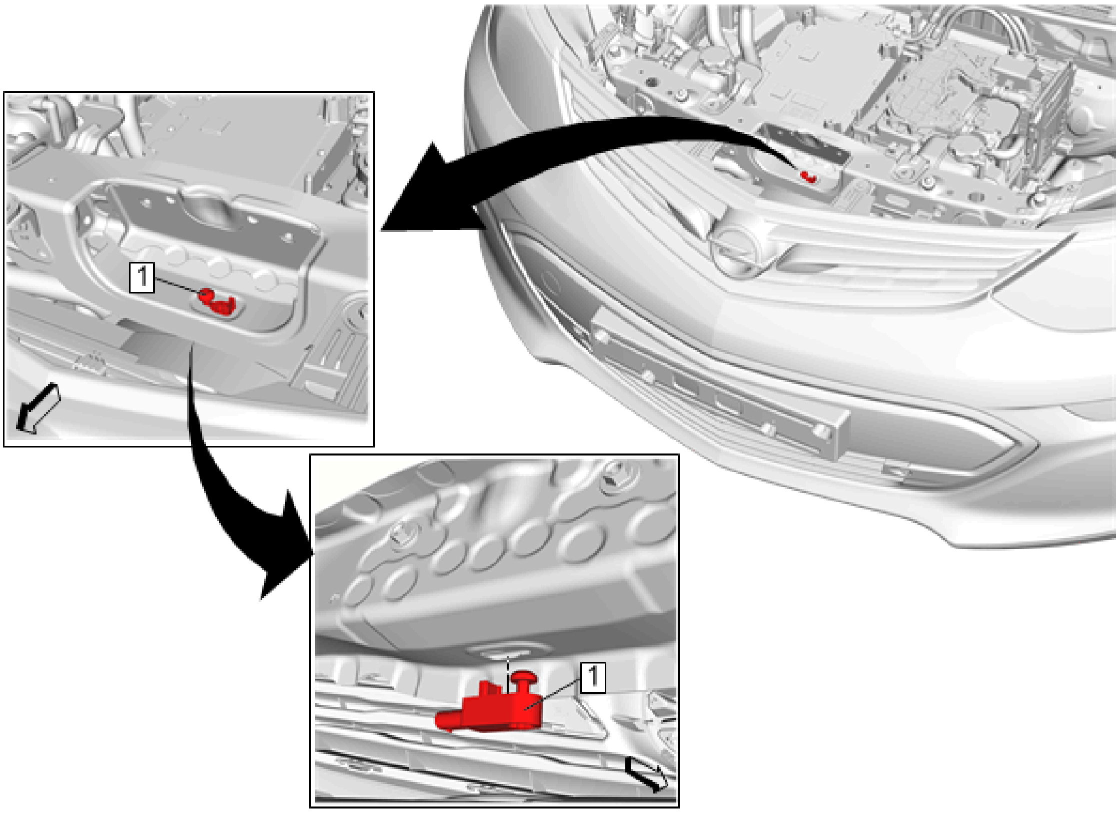


Fig. 5: Airbag Front End Discriminating Sensor (with AY0)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
	WARNING: **Refer to SIR Warning .** **WARNING:** **Refer to SIR Inflator Module Handling and Storage Warning .** **WARNING:** **Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary:** - **The seat cushion frame** - **The seat recliner, if equipped** - **The seat adjuster** - **The seat back frame** **Failure to do so may cause future personal injury.** **Preliminary Procedures** 1. Disable the SIR system. **SIR Disabling and Enabling** 2. Remove the front compartment front sight shield. **Front Compartment Front Sight Shield Replacement** 3. Reposition the hood primary and secondary latch. **Hood Primary and Secondary Latch Replacement**
1	Airbag Front End Discriminating Sensor (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Disconnect the electrical connector. 2. Loosen the fastener and slide the sensor out of the keyhole slot. 3. Enable the SIR System. **SIR Disabling and Enabling** **NOTE:** **Integral sensor assembly bolt uses Left Hand threads. Use counterclockwise rotation to loosen fastener at TORXÃ,Â® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt.** **Tighten** 7.5 N.m (66 lb in)

AIRBAG FRONT END DISCRIMINATING SENSOR REPLACEMENT - RIGHT SIDE (WITH AYF)

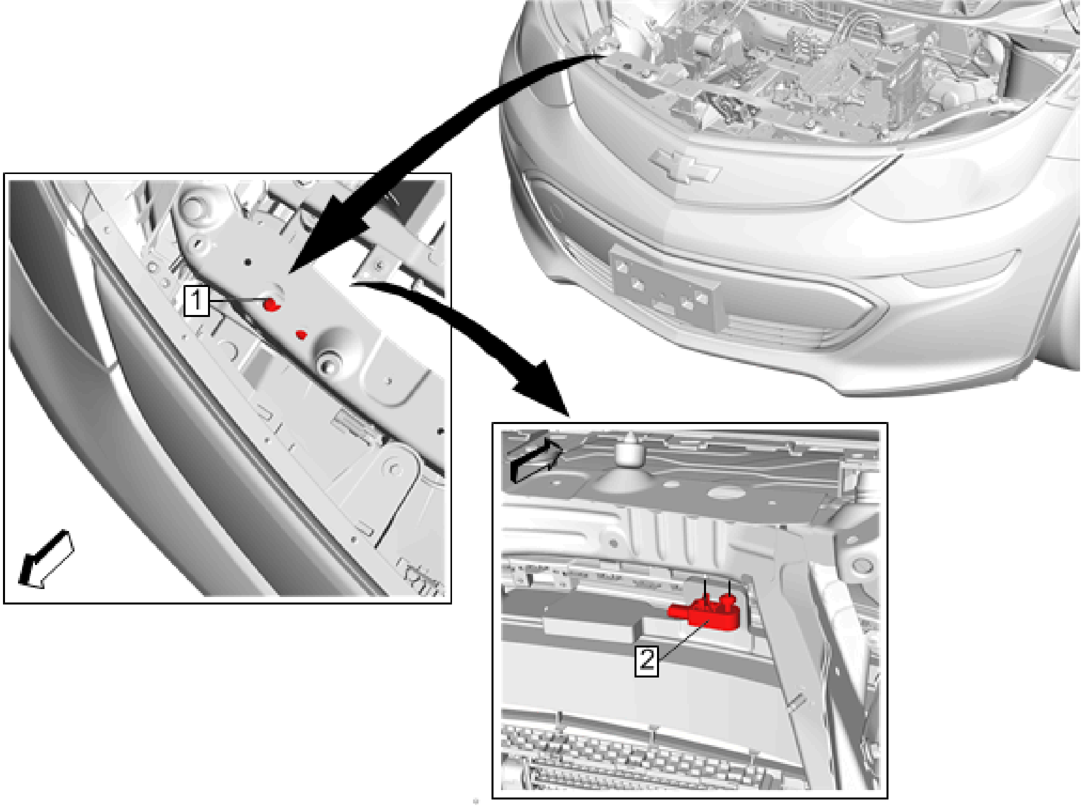


Fig. 6: Airbag Front End Discriminating Sensor - Right Side (with AYF)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

WARNING:

Do not strike or jolt the inflatable restraint front end sensor. Before applying power to the front end sensor make sure that it is securely fastened. Failure to observe the correct installation procedure could cause SIR deployment, personal injury, or unnecessary SIR system repairs.

WARNING:

Refer to SIR Warning .

Preliminary Procedures

1. Disable the SIR system. **SIR Disabling and Enabling**
2. **Front Compartment Front Sight Shield Replacement**

Callout	Component Name
1	Supplemental Inflatable Restraint Front End Discriminating Sensor Bolt **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Access the bolt through the opening of the upper tie bar.** **Procedure** **NOTE:** **Integral sensor bolt uses left hand threads. Use counterclockwise rotation to loosen fastener at TORXÃ,Â® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt.** 1. Loosen the bolts and slide the sensors out of the keyhole slots. 2. The bolts are integral to the sensor and DO NOT remove separately. **Tighten** 7.5 N.m (66 lb in)
2	Supplemental Inflatable Restraint Front End Discriminating Sensor **Procedure** 1. Disconnect electrical connector. 2. Enable the SIR System. SIR Disabling and Enabling

AIRBAG FRONT END DISCRIMINATING SENSOR REPLACEMENT - LEFT SIDE (WITH AYF)

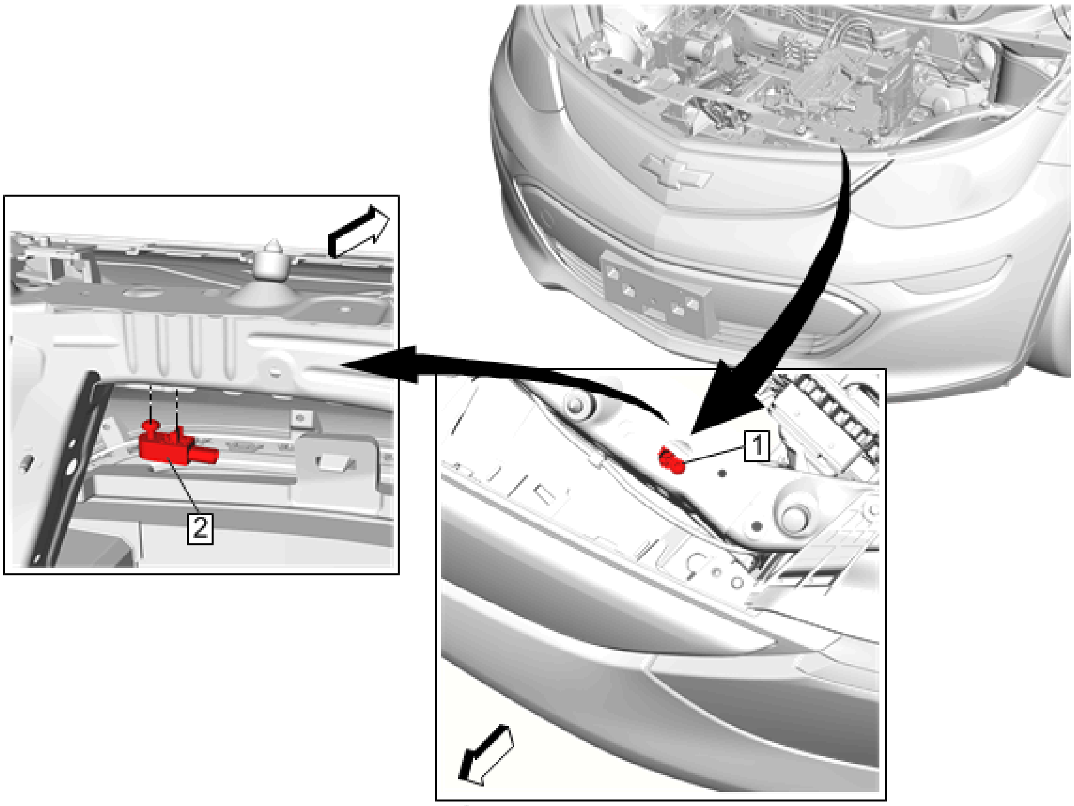


Fig. 7: Airbag Front End Discriminating Sensor - Left Side (with AYF)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: **Do not strike or jolt the inflatable restraint front end sensor. Before applying power to the front end sensor make sure that it is securely fastened. Failure to observe the correct installation procedure could cause SIR deployment, personal injury, or unnecessary SIR system repairs.** **WARNING:** **Refer to SIR Warning .** **Preliminary Procedures** 1. Disable the SIR system. **SIR Disabling and Enabling** 2. **Front Compartment Front Sight Shield Replacement**
1	Supplemental Inflatable Restraint Front End Discriminating Sensor Bolt **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Access the bolt through the opening of the upper tie bar.** **Procedure** **NOTE:** **Integral sensor bolt uses left hand threads. Use counterclockwise rotation to loosen fastener at TORXÃ,Â® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt.** 1. Loosen the bolts and slide the sensors out of the keyhole slots. 2. The bolts are integral to the sensor and DO NOT remove separately. **Tighten** 7.5 N.m (66 lb in)
2	Supplemental Inflatable Restraint Front End Discriminating Sensor **Procedure** 1. Disconnect electrical connector. 2. Enable the SIR System. **SIR Disabling and Enabling**

AIRBAG SENSING AND DIAGNOSTIC MODULE REPLACEMENT

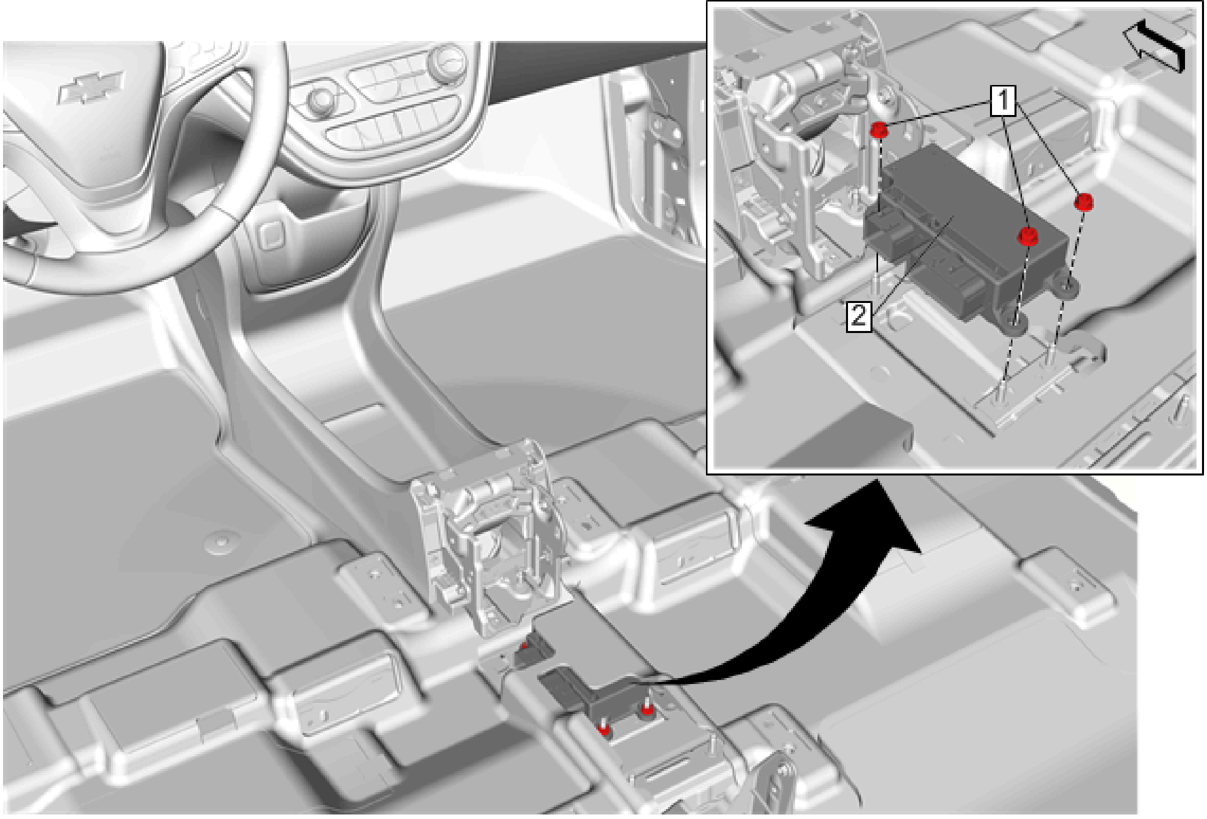


Fig. 8: Airbag Sensing and Diagnostic Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Refer to SIR Warning .** **WARNING:** **Do not strike or jolt the inflatable restraint sensing and diagnostic module (SDM). Before applying power to the SDM, make sure that it is securely fastened with the arrow facing toward the front of the vehicle. Failure to observe the correct installation procedure could cause SIR deployment, personal injury, or unnecessary SIR system repairs.** **Preliminary Procedure** 1. Disable the SIR system. SIR Disabling and Enabling 2. Rear Floor Console Replacement 3. Remove the pedestrian sound alert module and bracket. Pedestrian Sound Alert Module Replacement	
1	Airbag Sensing and Diagnostic Module Nut (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

Callout	Component Name
2	Airbag Sensing and Diagnostic Module **Procedure** 1. Disconnect the electrical connectors. 2. Perform the necessary programming and setup procedure:Control Module References 3. Enable the SIR system. SIR Disabling and Enabling

STEERING WHEEL AIRBAG REPLACEMENT

Removal Procedure

WARNING: **When replacing either a steering wheel or driver airbag, it is mandatory that both components are sourced from the same country. Parts from different countries are not interchangeable and may cause a malfunction of the air bag system causing personal injury.**

WARNING: SIR Inflator Module Handling and Storage Warning

WARNING: SIR Warning

1. Disable the supplemental inflatable restraint (SIR) system. SIR Disabling and Enabling
2. Lower the steering column and move to the maximum rear end position.

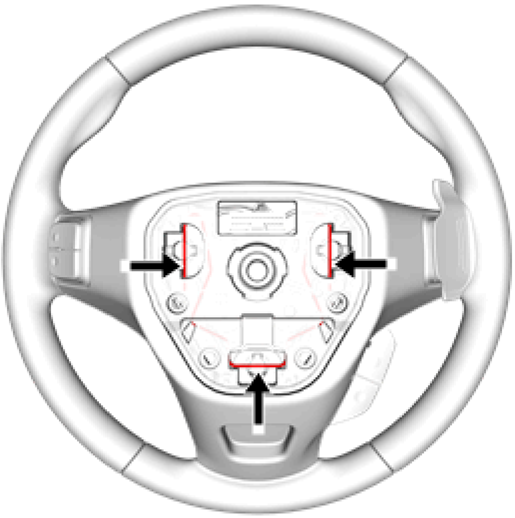


Fig. 9: Steering Wheel Spring Retainers
Courtesy of GENERAL MOTORS COMPANY

3. To remove the airbag steering wheel module, push the spring retainers in the direction of the arrows at the back of the steering wheel.

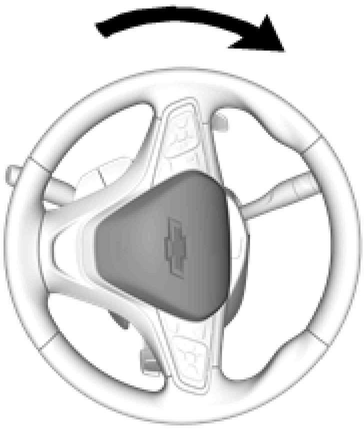


Fig. 10: Steering Wheel Rotated 90 Degrees To Right
Courtesy of GENERAL MOTORS COMPANY

4. Rotate the steering wheel in the 90 degrees to the right.

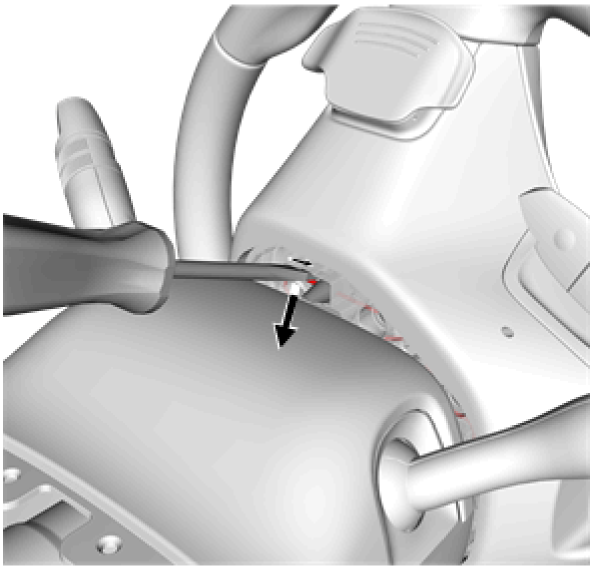


Fig. 11: Small Flathead Screwdriver On Back Of Steering Wheel
Courtesy of GENERAL MOTORS COMPANY

5. Insert a small flathead screwdriver on the back of the steering wheel.
6. Push the screwdriver down like an arrow as shown in the picture while pulling the airbag module.

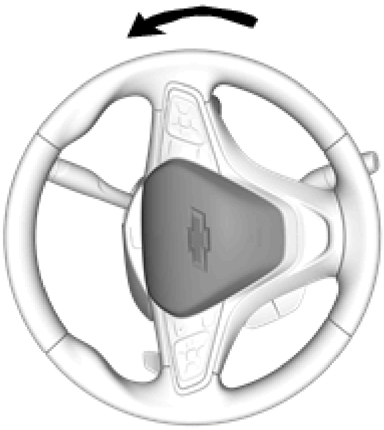


Fig. 12: Steering Wheel Rotated 90 Degrees To Left
Courtesy of GENERAL MOTORS COMPANY

7. Rotate the steering wheel in the 90 degrees to the left.

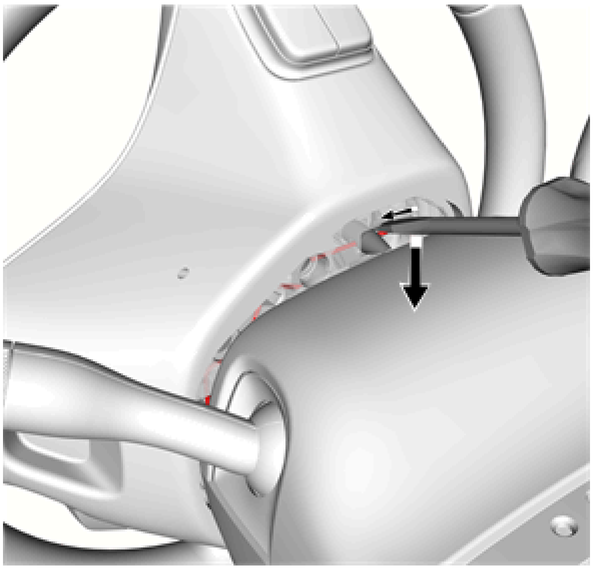


Fig. 13: Small Flathead Screwdriver On Back Of Steering Wheel
Courtesy of GENERAL MOTORS COMPANY

8. Insert a small flathead screwdriver on the back of the steering wheel.
9. Push the screwdriver down like an arrow as shown in the picture while pulling the airbag module.

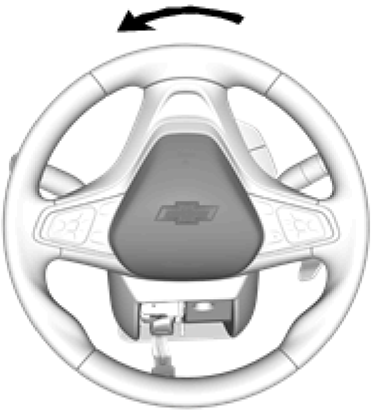


Fig. 14: Steering Wheel Rotated 180 Degrees To Left
Courtesy of GENERAL MOTORS COMPANY

10. Rotate the steering wheel in the 180 degrees.

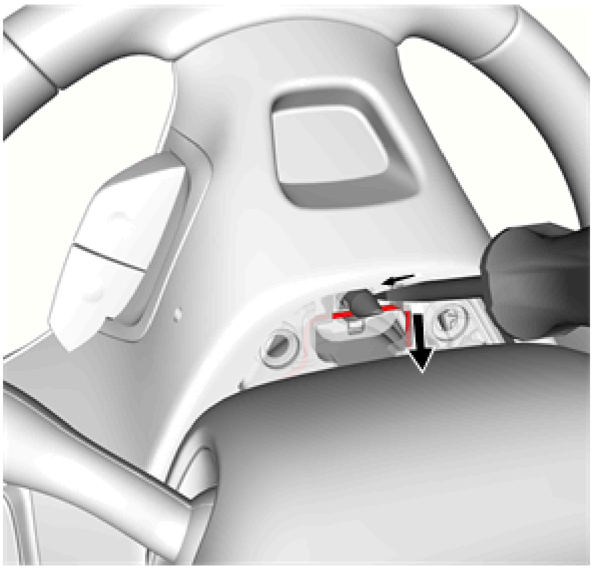


Fig. 15: Small Flathead Screwdriver On Back Of Steering Wheel
Courtesy of GENERAL MOTORS COMPANY

11. Insert a small flathead screwdriver on the back of the steering wheel.
12. Push the screwdriver down like an arrow as shown in the picture while pulling the airbag module.

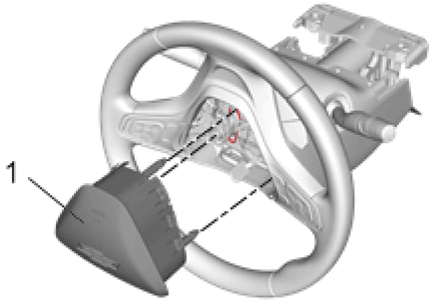


Fig. 16: Airbag Steering Wheel Module
Courtesy of GENERAL MOTORS COMPANY

13. Disconnect the electrical connectors.
14. Remove the airbag steering wheel module (1).

Installation Procedure

1. Ensure that the retaining spring is properly installed.
2. Connect the electrical connectors.

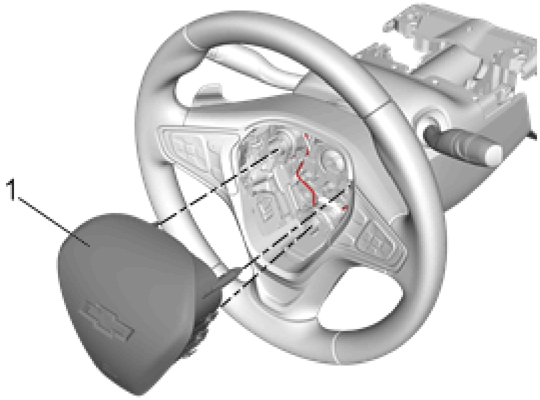


Fig. 17: Airbag Steering Wheel Module
Courtesy of GENERAL MOTORS COMPANY

3. Align the steering wheel airbag fasteners to the steering column fastener holes.

WARNING: **After installation of the steering wheel airbag module to the steering wheel, slightly pull the module outward. If there is no give on the airbag module then it is secured correctly. If the airbag module is not fully attached personal injury could result.**

4. Push the airbag steering wheel module (1) firmly into the steering column in order to engage the fasteners.

5. Enable the SIR system. SIR Disabling and Enabling
6. Inflatable Restraint Module Handling and Scrapping

STEERING WHEEL AIRBAG COIL REPLACEMENT

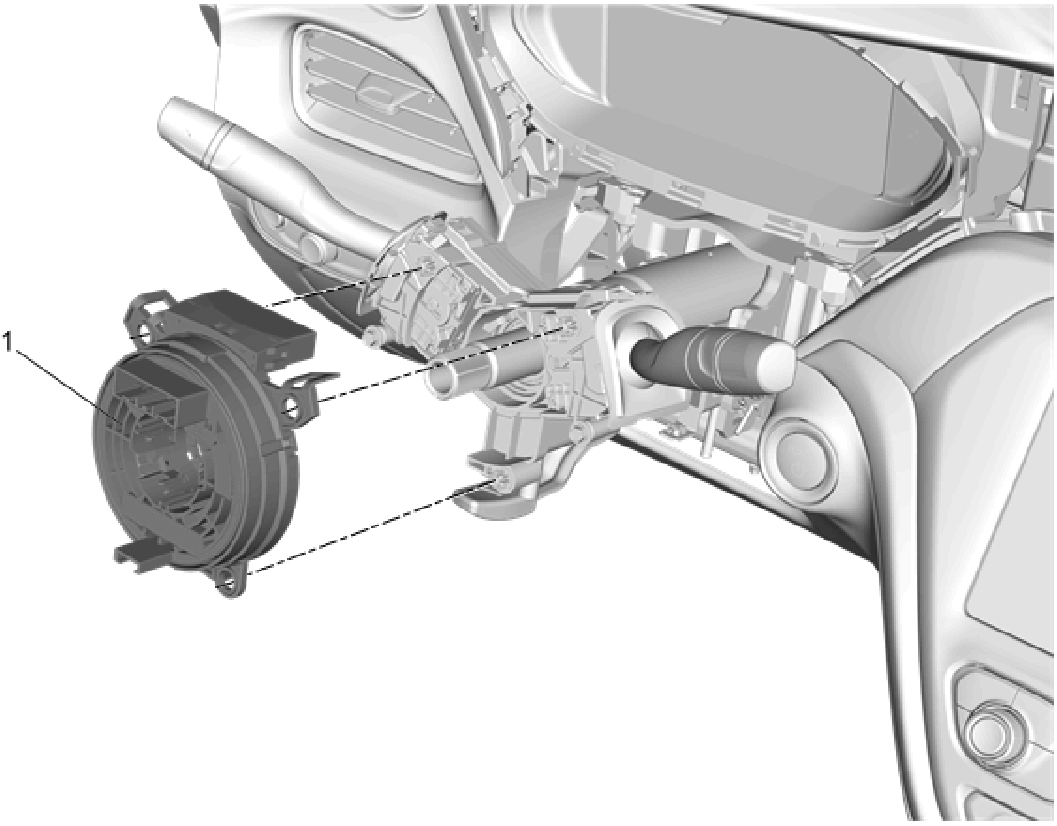


Fig. 18: Steering Wheel Airbag Coil
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Steering Wheel Replacement 2. Steering Column Lower Trim Cover Replacement 3. Reposition the steering column upper trim cover as necessary.	
1	Steering Wheel Airbag Coil **Procedure** 1. Disconnect the electrical connectors. 2. Release the retaining tabs and remove the steering wheel airbag coil from the steering column. 3. Ensure the steering wheel airbag coil is CENTERED during installation. Airbag Steering Wheel Module Coil Centering

AIRBAG STEERING WHEEL MODULE COIL CENTERING

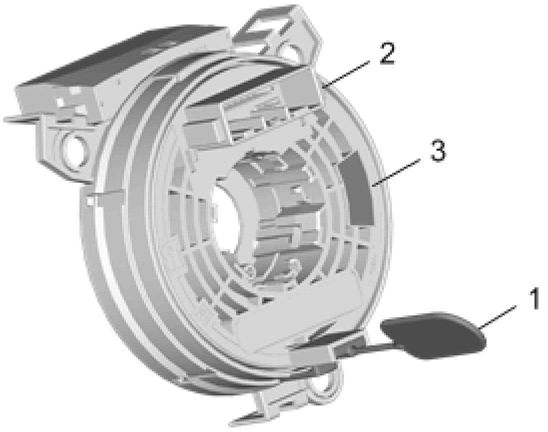


Fig. 19: Steering Wheel Airbag Coil
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **The new SIR coil assembly will be centered. Improper alignment of the SIR coil assembly may damage the unit, causing an inflatable restraint malfunction.**

1. Inspect the steering wheel airbag coil. If the yellow lock pin (1) is present, the uplead post (2) is at the 12 o'clock position and the loop (u-turn) appears in the centering window (3) then the coil is already in the centered position and no further action is required.

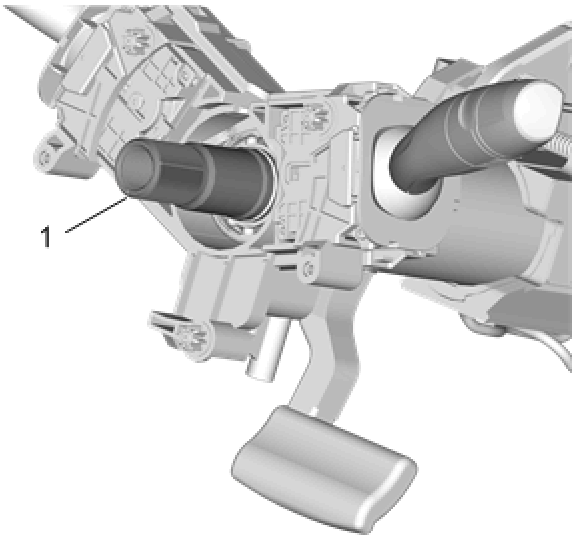


Fig. 20: Block Tooth
Courtesy of GENERAL MOTORS COMPANY

2. If the steering wheel airbag coil needs to be centered, perform the following preliminary steps:
    1. Ensure the wheels on the vehicle are straight ahead.
    2. Ensure the block tooth (1) on the steering shaft is in the 6 o'clock position.

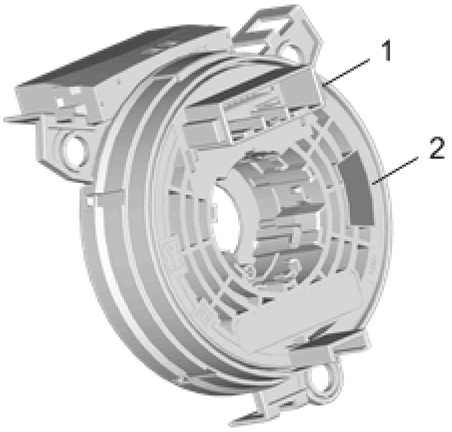


Fig. 21: Centering Steering Wheel Airbag Coil
Courtesy of GENERAL MOTORS COMPANY

3. To center the steering wheel airbag coil, perform the following steps:
    1. Hold the coil with the face up.
    2. Slowly rotate the coil hub clockwise until the coil ribbon stops.
    3. Slowly rotate the coil hub counterclockwise 3 turns until the uplead post (1) is at the 12 o'clock position.
    4. View the centering window (2) and ensure the orange loop (u-turn) is visible. If the loop is visible then the coil is in the center position.
    5. While holding the coil hub in the center position, align the coil with the steering column components and slide the coil onto the steering shaft.

INSTRUMENT PANEL AIRBAG REPLACEMENT

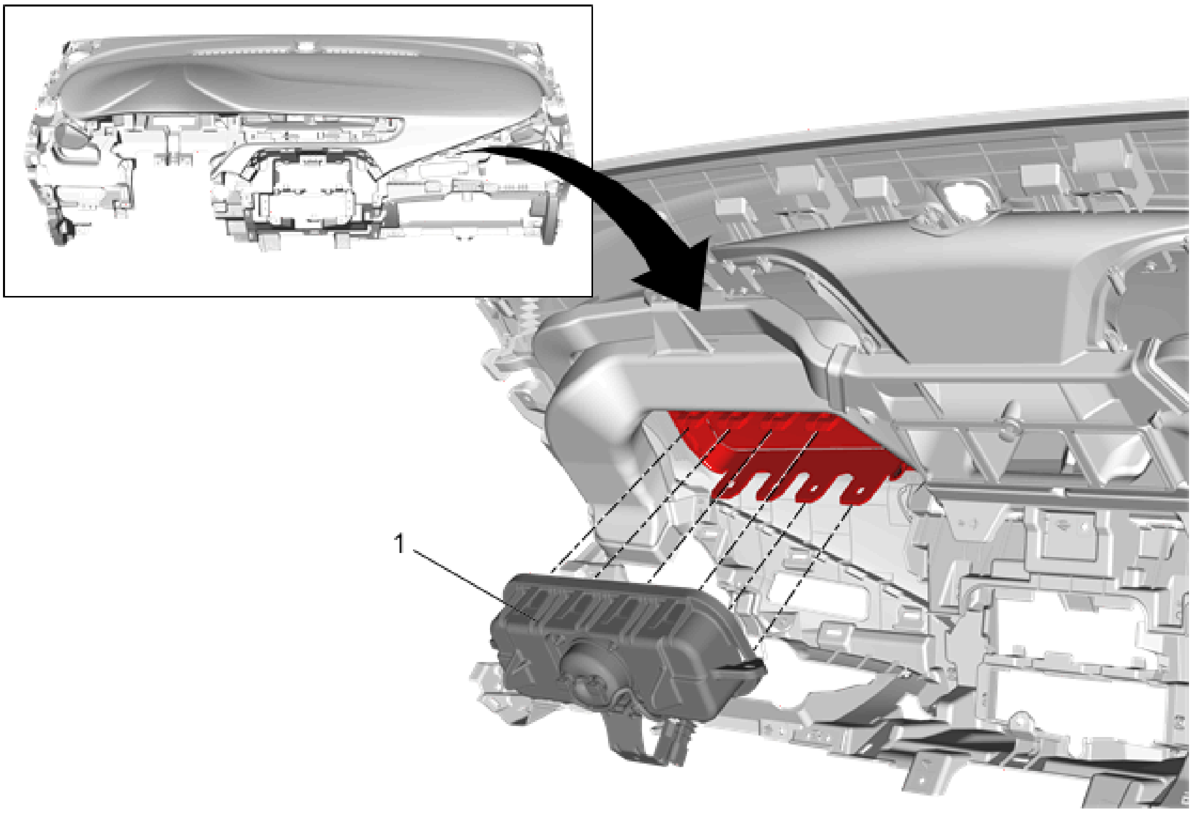


Fig. 22: Instrument Panel Airbag
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">**WARNING:**
Refer to SIR Warning .

Preliminary Procedures
1. Disable the SIR system. SIR Disabling and Enabling
2. Instrument Panel Assembly Replacement</td></tr>
<tr><td>1</td><td>Instrument Panel Airbag

Procedure
1. If the airbag is being replaced, prepare the old airbag for disposal. Inflatable Restraint Module Handling and Scrapping
2. Insert a wood straight edge, one per side behind all locking tabs, to simultaneously release the instrument panel airbag housing from the instrument panel chute without overextending the airbag locking tabs. Use a wood straight edge that is approximately 50.8 cm (20 in) long and 5 mm (0.20 in) thick with a rounded edge.

NOTE:
Some tabs may require manipulation to release completely. Use appropriate thin tool to aid in releasing tabs.

3. Enable the SIR System. SIR Disabling and Enabling</td></tr>
</table>

INSTRUMENT PANEL LOWER AIRBAG REPLACEMENT - DRIVER SIDE

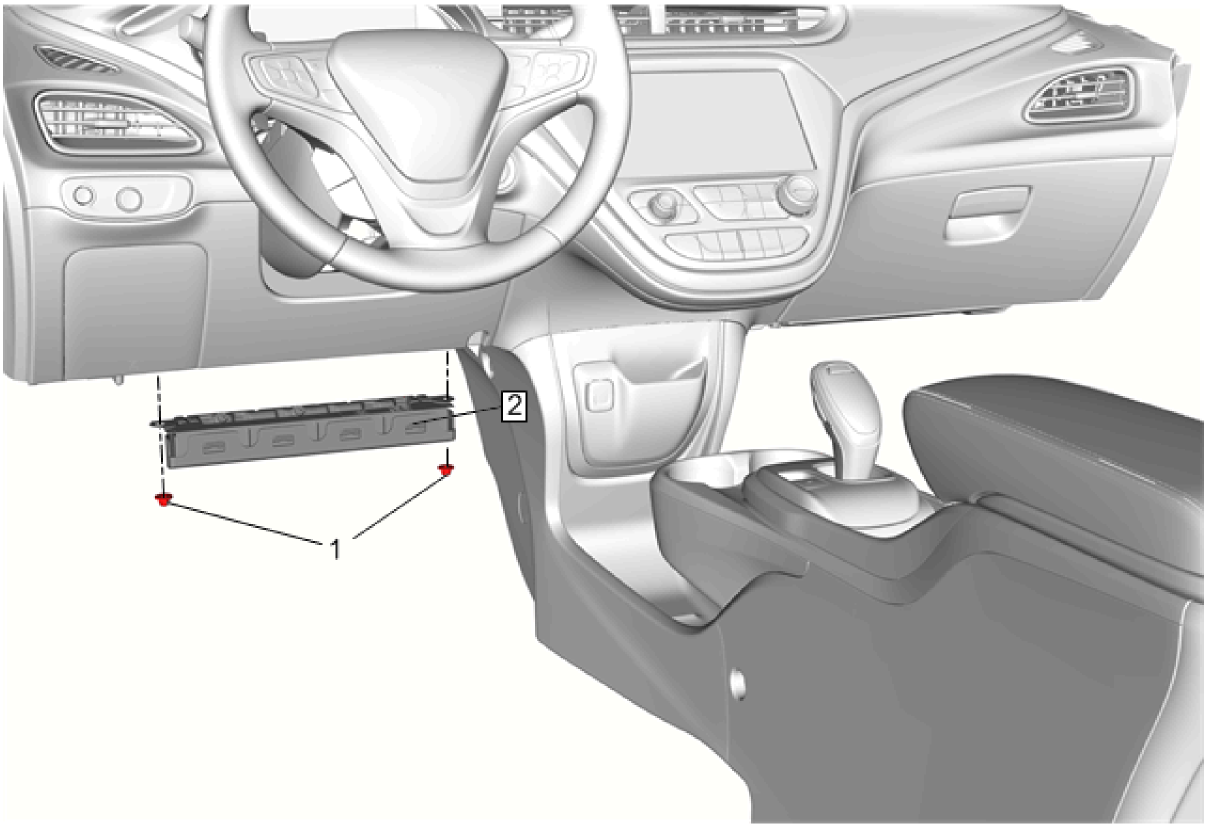


Fig. 23: Instrument Panel Lower Airbag - Driver Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Refer to SIR Inflator Module Handling and Storage Warning .

WARNING:
Refer to SIR Warning .

Preliminary Procedure Disable the SIR system. SIR Disabling and Enabling</td></tr>
<tr><td>1</td><td>Instrument Panel Lower Airbag Nut (Qty: 2)

CAUTION:
Refer to Fastener Caution .

Tighten
9 N.m (80 lb in)</td></tr>
<tr><td>2</td><td>Instrument Panel Lower Airbag - Driver Side

Procedure
1. Disconnect the electrical connector.
2. If the airbag is being replaced, prepare the old airbag for disposal. Inflatable Restraint Module Handling and Scrapping
3. Enable the SIR System. SIR Disabling and Enabling</td></tr>
</table>

INSTRUMENT PANEL LOWER AIRBAG REPLACEMENT - PASSENGER SIDE

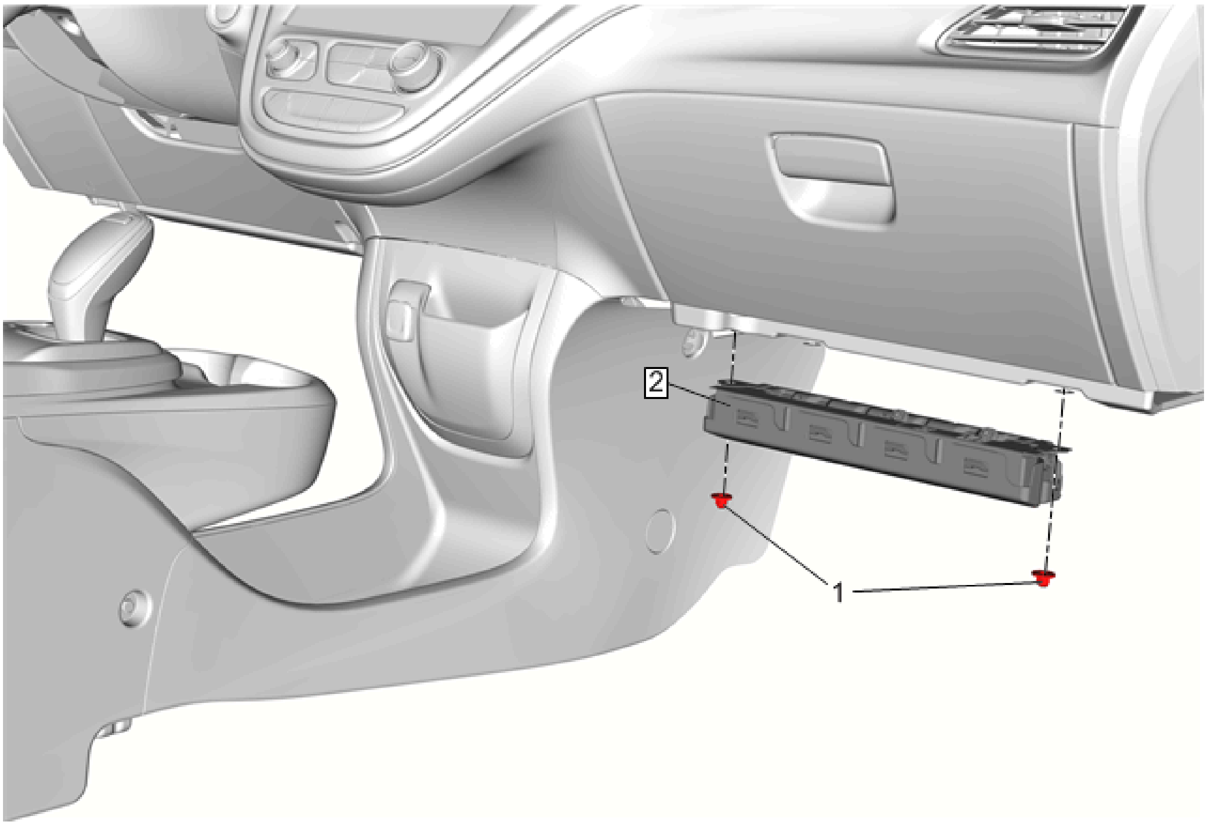


Fig. 24: Instrument Panel Lower Airbag - Passenger Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: **Refer to SIR Inflator Module Handling and Storage Warning .** **WARNING:** **Refer to SIR Warning .** **Preliminary Procedure** Disable the SIR system. **SIR Disabling and Enabling**	
1	Instrument Panel Lower Airbag Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
2	Instrument Panel Lower Airbag - Passenger Side **Procedure** 1. Disconnect the electrical connector. 2. If the airbag is being replaced, prepare the old airbag for disposal. **Inflatable Restraint Module Handling and Scrapping** 3. Enable the SIR System. **SIR Disabling and Enabling**

AIRBAG FRONT PASSENGER PRESENCE MODULE REPLACEMENT

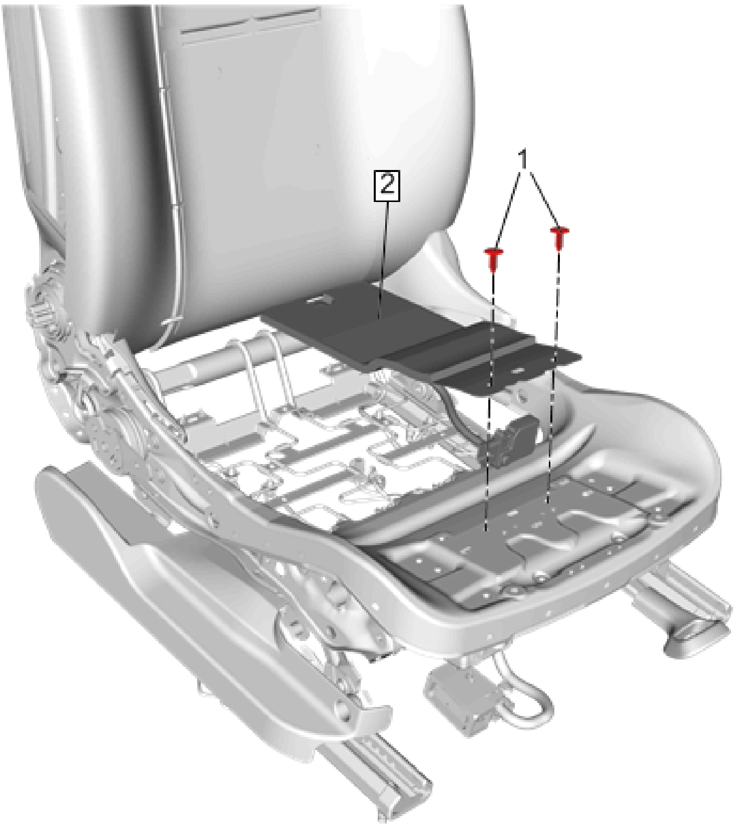


Fig. 25: Airbag Front Passenger Presence Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
To avoid personal injury, perform a preload test on the passenger presence system whenever you remove or replace the seat cushion trim. Failure to do so may cause the system to malfunction.
WARNING:
Replace the passenger presence system as a complete assembly to prevent possible injury to the occupant. All the components in the service kit are assembled and calibrated as a unit. Using only some of the components in the service kit will cause the passenger presence system to operate improperly.
Preliminary Procedure Front Seat Cushion Cover and Pad Replacement</td></tr>
<tr><td>1</td><td>Airbag Front Passenger Presence Module Retainer [2x]</td></tr>
<tr><td>2</td><td>Airbag Front Passenger Presence Module
Procedure
1. Unhook the module from the bracket on the underside of seat frame.
2. Disconnect the electrical connector and remove the sensor and module from the seat pan.
3. Rezero the module after installation. Passenger Presence System Rezeroing</td></tr>
</table>

FRONT AND REAR ROW SEAT ROOF RAIL AIRBAG REPLACEMENT

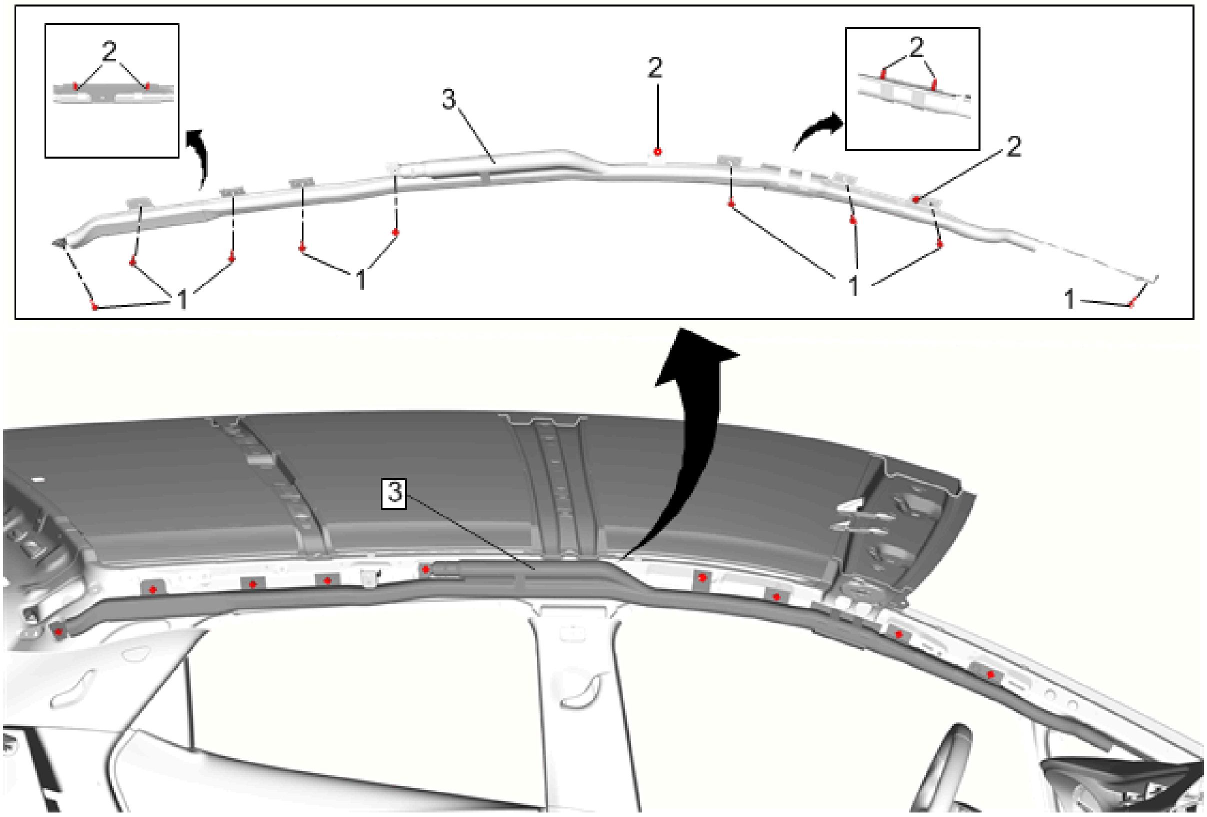


Fig. 26: Front and Rear Row Seat Roof Rail Airbag
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: **Refer to SIR Warning .** **WARNING:** **Refer to SIR Inflator Module Handling and Storage Warning .** **Preliminary Procedures** 1. Disable the SIR system. **SIR Disabling and Enabling** 2. It is only necessary to lower the headliner. Only do those steps in headliner replacement that will lower the headliner enough to gain access to the part. **Headlining Trim Panel Replacement**	
1	Front and Rear Row Seat Roof Rail Airbag Fastener (Qty: 9) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in) **Procedure** Disconnect the electrical connector.
2	Front and Rear Row Seat Roof Rail Airbag Retainer (Qty: 6)
3	Front and Rear Row Seat Roof Rail Airbag **Procedure** 1. Remove the roof side rail inflatable restraint module from the vehicle. 2. If the airbag is being replaced, prepare the old airbag for disposal. **Inflatable Restraint Module Handling and Scrapping** 3. Enable the SIR System. **SIR Disabling and Enabling**

FRONT SEAT OUTBOARD SEAT BACK AIRBAG REPLACEMENT

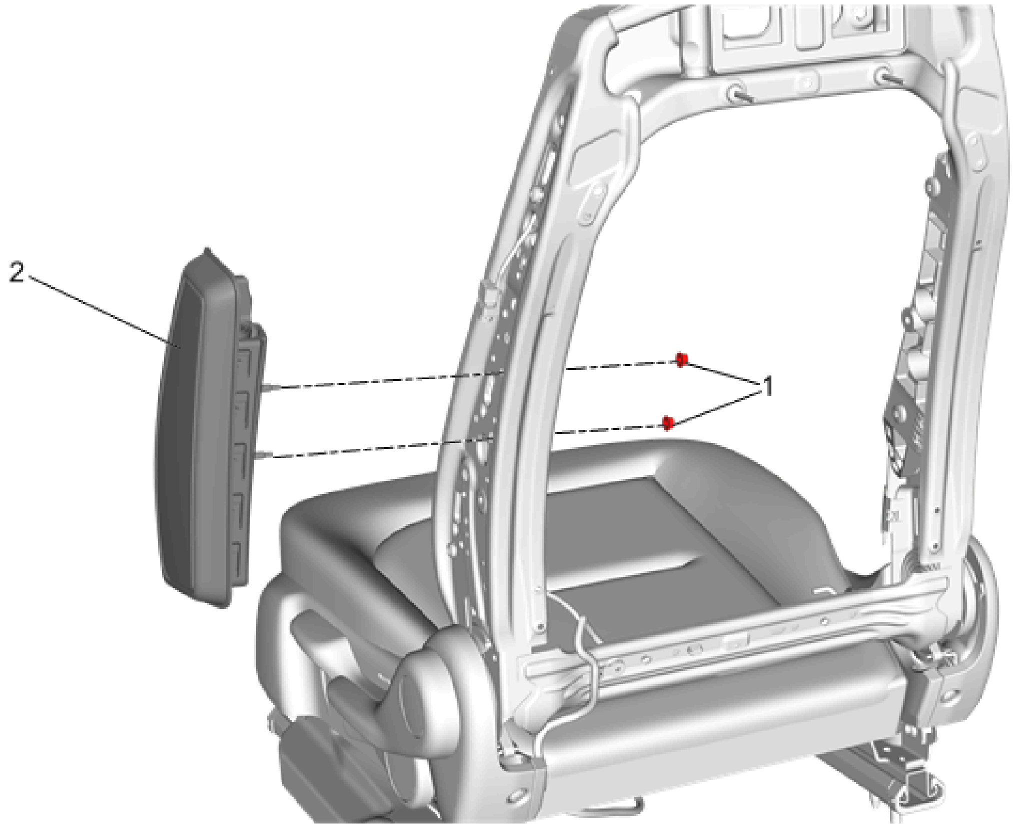


Fig. 27: Front Seat Outboard Seat Back Airbag
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
	WARNING: **Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary:** - **The seat cushion frame** - **The seat recliner, if equipped** - **The seat adjuster** - **The seat back frame** **Failure to do so may cause future personal injury.** **Preliminary Procedure** Front Seat Back Cushion Latch Finish Cover Replacement (Back Panel) Front Seat Back Cushion Latch Finish Cover Replacement (Front Panel)
1	Front Seat Outboard Seat Back Airbag Nut (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 3.5 N.m (31 lb in)
2	Front Seat Outboard Seat Back Airbag **Procedure** 1. Remove the connector position assurance (CPA) from the module electrical connector. 2. Disconnect the electrical connector. 3. Inflatable Restraint Module Handling and Scrapping

REAR SEAT BOLSTER AIRBAG REPLACEMENT

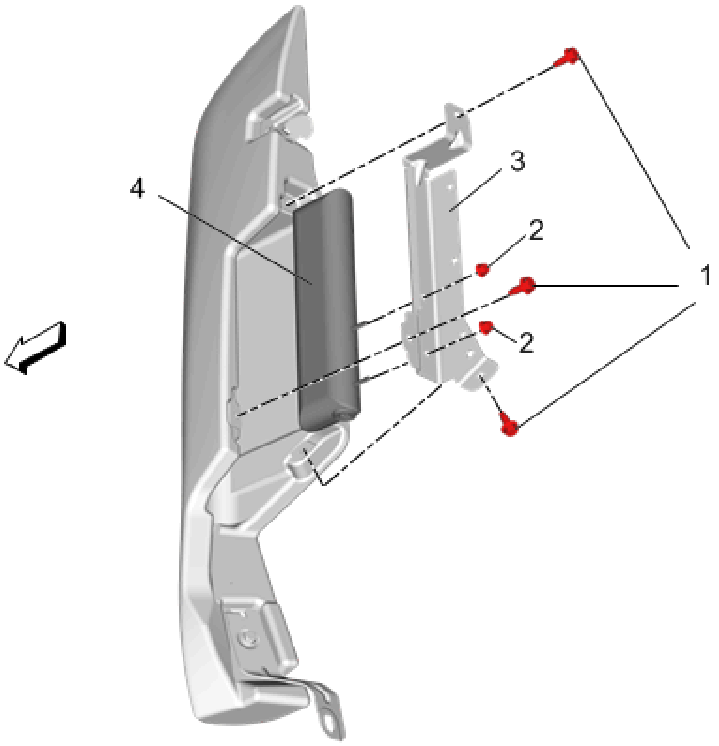


Fig. 28: Rear Seat Bolster Airbag
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Refer to SIR Warning .** **WARNING:** **Following the deployment of a rear seat side air bag, inspect the following parts for damage. Replace these parts if necessary:** • **The rear seat side bolster, attachments, brackets and wiring** • **The rear seat back frame, cushion and cover** • **The rear seat cushion frame, cushion and cover** **Failure to do so may cause future personal injury.** **Preliminary Procedure** Rear Seat Back Bolster Replacement	
1	Rear Seat Bolster Airbag Bracket Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 3.25 N.m (29 lb in)
2	Rear Seat Bolster Airbag Nut (Qty: 2) **Tighten** 3.25 N.m (29 lb in)
3	Rear Seat Bolster Airbag Bracket **Procedure** Reposition the bracket only and leave log rings attached.
4	Rear Seat Bolster Airbag **Procedure** Inflatable Restraint Module Handling and Scrapping

AIRBAG SIDE IMPACT CENTER PILLAR SENSOR REPLACEMENT (WITH AY0)

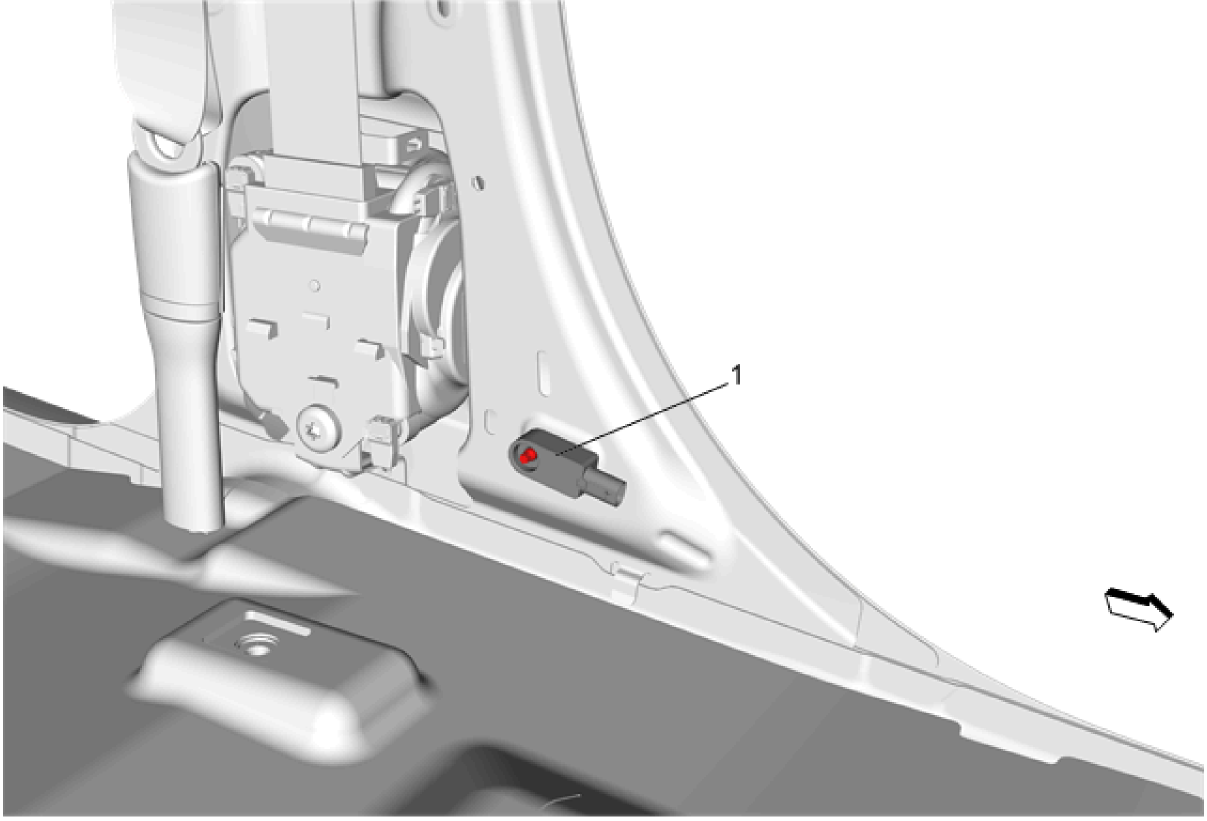


Fig. 29: Airbag Side Impact Center Pillar Sensor (with AY0)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Refer to SIR Warning .** **WARNING:** **Refer to SIR Inflator Module Handling and Storage Warning .** **WARNING:** **Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary:** • **The seat cushion frame** • **The seat recliner, if equipped** • **The seat adjuster** • **The seat back frame** **Failure to do so may cause future personal injury.** **Preliminary Procedures** 1. Disable the SIR system. SIR Disabling and Enabling 2. Remove the center pillar lower trim panel from side being worked on. Center Pillar Lower Trim Panel Replacement	

Callout	Component Name
1	Airbag Side Impact Center Pillar Sensor **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Disconnect the electrical connector. **NOTE:** **Integral sensor bolt uses left hand threads. Use counterclockwise rotation to loosen fastener at TORXÃ‚Â® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt.** 2. Loosen the fastener and slide the sensor out of the keyhole slot. 3. The bolts are integral to the sensor and DO NOT remove separately. 4. Enable the SIR System. SIR Disabling and Enabling **Tighten** 7.5 N.m (66 lb in)

AIRBAG SIDE IMPACT SENSOR REPLACEMENT - FRONT SIDE DOOR (WITH AYF)

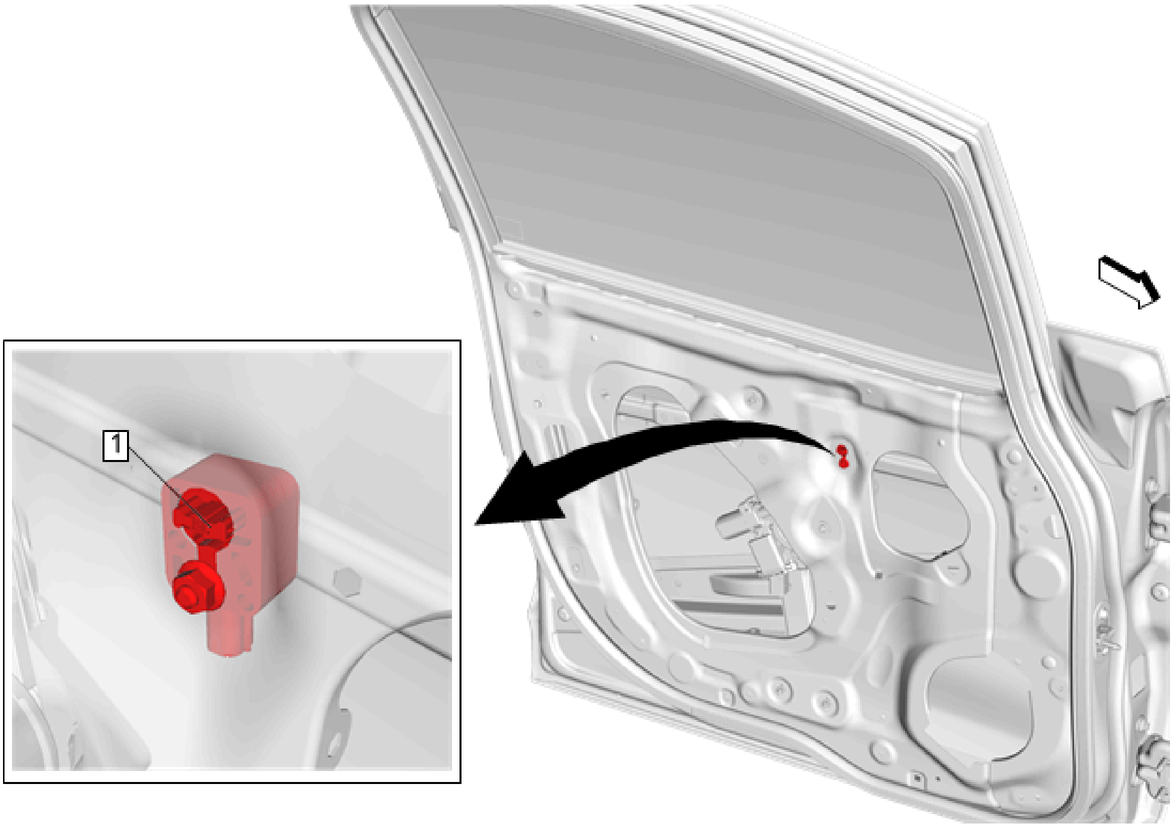


Fig. 30: Airbag Side Impact Sensor - Front Side Door (with AYF)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
	WARNING: **Refer to SIR Warning .** **WARNING:** **Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary:** - **The seat cushion frame** - **The seat recliner, if equipped** - **The seat adjuster** - **The seat back frame** **Failure to do so may cause future personal injury.** **Preliminary Procedures** 1. Disable the SIR system. **SIR Disabling and Enabling** 2. **Front Side Door Trim Replacement** 3. For access to sensor detach the water deflector partly from front of door.
1	Airbag Side Impact Sensor **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **The sensor is located on the inside of the front door inner panel.** **Procedure** 1. Loosen the fastener and slide the sensor out of the keyhole slot. 2. Disconnect the electrical connector. 3. The fastener is integral to the sensor, DO NOT remove separately. 4. Enable the SIR System. **SIR Disabling and Enabling** **Tighten** 7.5 N.m (66 lb in)

AIRBAG SIDE IMPACT REAR SENSOR REPLACEMENT (WITH AYF)

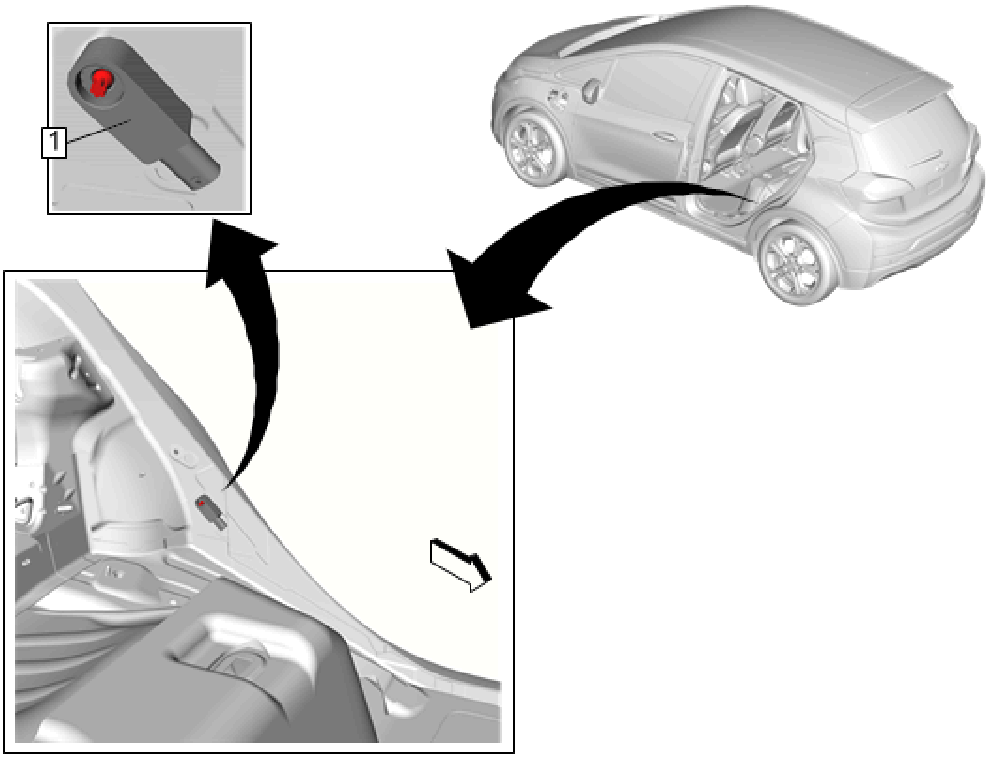


Fig. 31: Airbag Side Impact Rear Sensor (with AYF)
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">WARNING:
Refer to SIR Warning .

WARNING:
Refer to SIR Inflator Module Handling and Storage Warning .

WARNING:
Following the deployment of a side impact air bag, inspect the following parts for damage. Replace these parts if necessary:
• The seat cushion frame
• The seat recliner, if equipped
• The seat adjuster
• The seat back frame
Failure to do so may cause future personal injury.

Preliminary Procedures
1. Disable the SIR system. SIR Disabling and Enabling
2. Rear Side Door Sill Garnish Molding Replacement</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Callout	Component Name
1	Airbag Side Impact Rear Sensor **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Disconnect the electrical connector. **NOTE:** **Integral sensor bolt uses left hand threads. Use counterclockwise rotation to loosen fastener at TORXÃ‚Â® tip end. If accessing at pan head end of the fastener, use clockwise rotation to loosen bolt.** 2. Loosen the fastener and slide the sensor out of the keyhole slot. 3. The bolts are integral to the sensor and DO NOT remove separately. 4. Enable the SIR System. **SIR Disabling and Enabling** **Tighten** 7.5 N.m (66 lb in)

INSTRUMENT PANEL AIRBAG ARMING STATUS DISPLAY REPLACEMENT

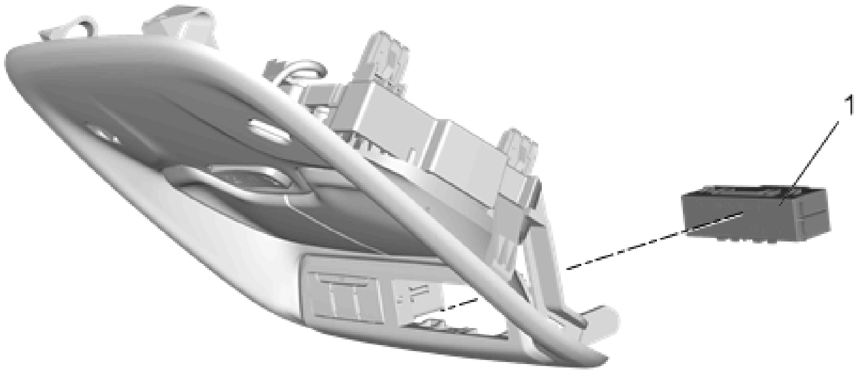


Fig. 32: Instrument Panel Airbag Arming Status Display
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: **Refer to Battery Disconnect Warning .** **Preliminary Procedures** 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection 2. Roof Console Replacement	
1	Instrument Panel Airbag Arming Status Display **Procedure** 1. Release the retaining tabs. 2. Connect the battery negative cable. Battery Negative Cable Disconnection and Connection

FRONT SEAT BELT RETRACTOR REPLACEMENT

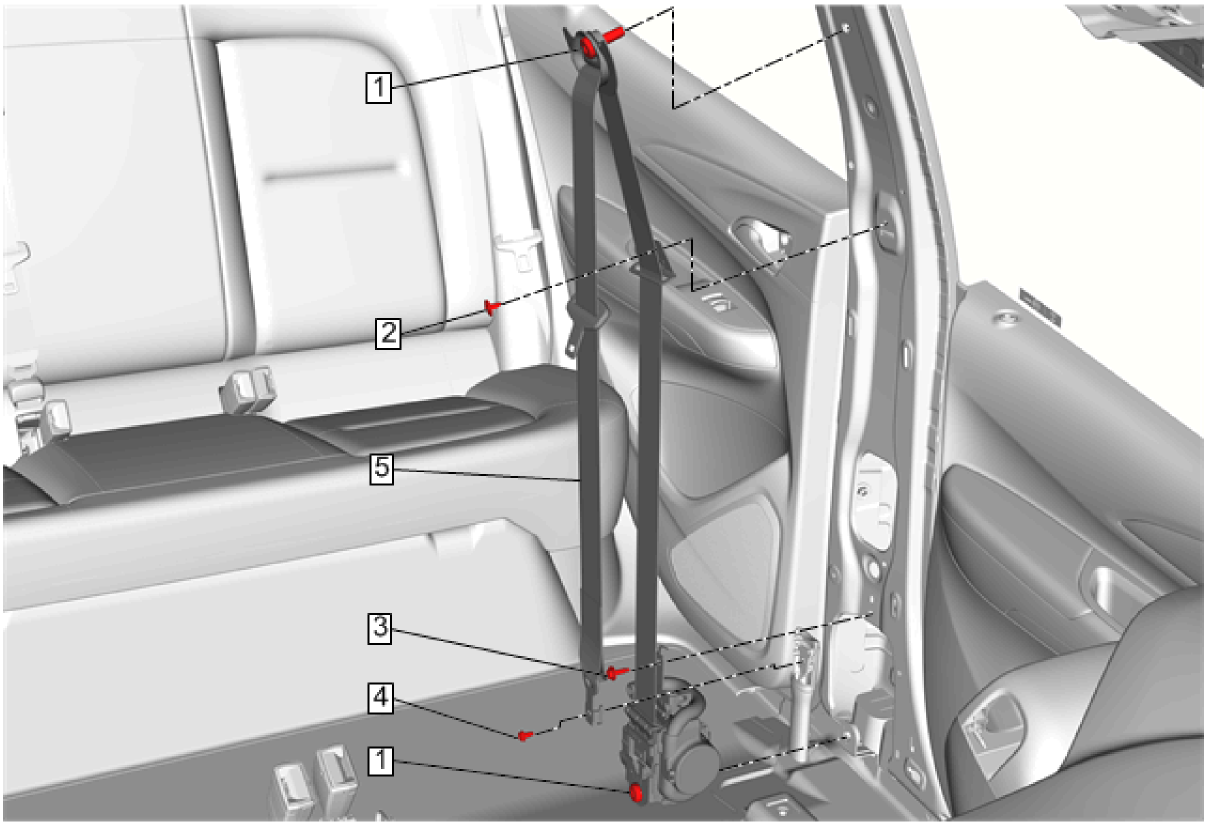


Fig. 33: Front Seat Belt Retractor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **SIR Warning** **Preliminary Procedure** 1. Disable the supplement inflatable restraint (SIR) system. SIR Disabling and Enabling 2. Center Pillar Upper Trim Panel Replacement 3. Center Pillar Lower Trim Panel Replacement	

Callout	Component Name
1	Front Seat Belt Retractor Bolt (Qty: 2) **CAUTION:** Fastener Caution **Tighten** 45 N.m (33 lb ft) **NOTE:** **When the seat belt retractor is replaced with a new one, there is no thread in the nut welded in the body. This is normal as the bolt will make the thread in the welded nut when the bolt is tightened.** **NOTE:** **Self cutting bolts, prevailing nuts must be replaced if loosened.**
2	Front Seat Belt Retractor Retainer
3	Front Seat Belt Retractor Fastener **Tighten** 5 N.m (44 lb in)
4	Front Seat Belt Anchor Plate Tensioner Bolt **Tighten** 5 N.m (44 lb in)
5	Front Seat Belt Retractor **Procedure** 1. Disconnect the electrical connector. 2. Enable the supplement inflatable restraint (SIR) system. SIR Disabling and Enabling

FRONT SEAT BELT ANCHOR PLATE TENSIONER REPLACEMENT

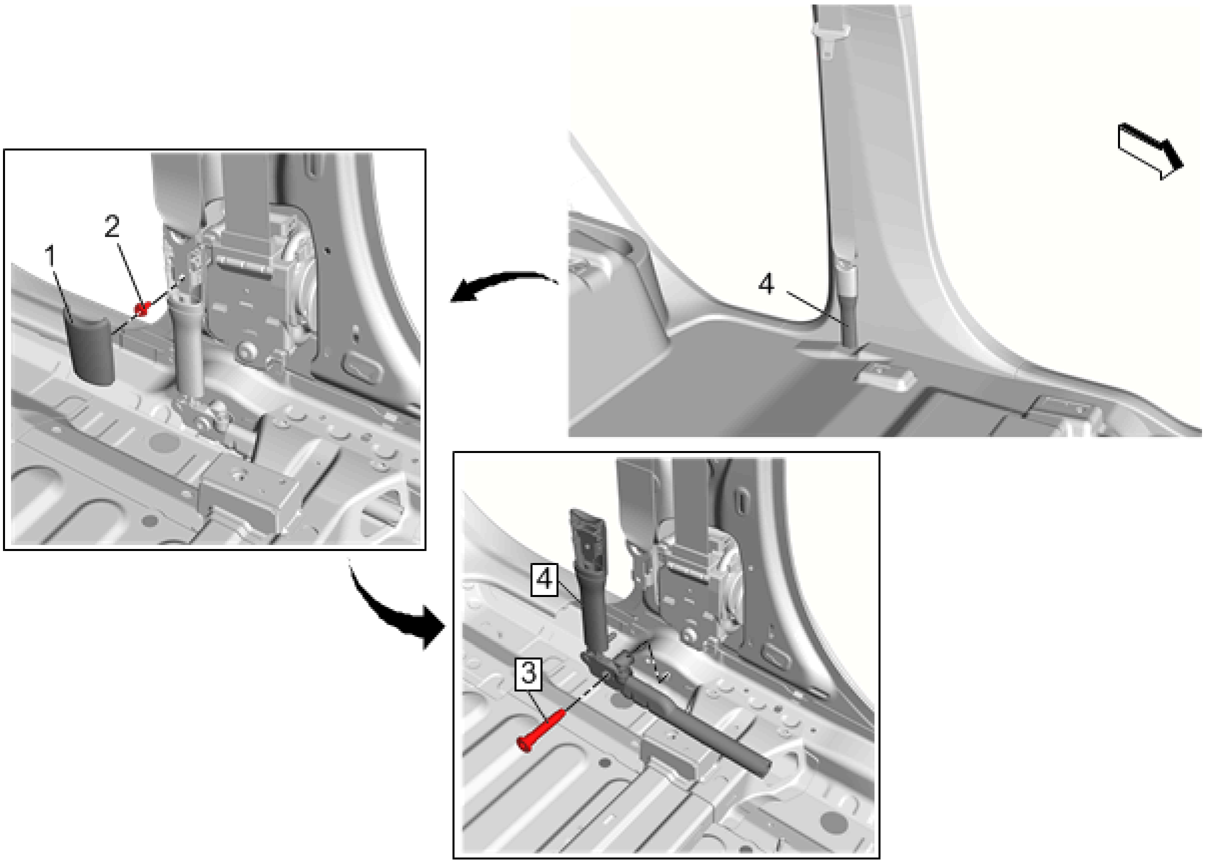


Fig. 34: Front Seat Belt Anchor Plate Tensioner
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Refer to SIR Warning .** **WARNING:** **Refer to SIR Inflator Module Handling and Storage Warning .** **Preliminary Procedures** 1. Disable the SIR system. SIR Disabling and Enabling 2. Center Pillar Lower Trim Panel Replacement	
1	Front Seat Belt Anchor Plate Tensioner Cover
2	Front Seat Belt Anchor Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 5 N.m (44 lb in)
3	Front Seat Belt Anchor Plate Tensioner Bolt **Procedure** Fold the edge of the floor panel carpet down and out of the way to access the bolt. **Tighten** 45 N.m (33 lb ft)
4	Front Seat Belt Anchor Plate Tensioner **Procedure** 1. Disengage the seat belt from the tensioner. 2. Disconnect the electrical connector. 3. Enable the SIR System. SIR Disabling and Enabling

REPAIRS AND INSPECTIONS REQUIRED AFTER A COLLISION

Accident With or Without Air Bag Deployment - Component Inspections

WARNING: **Proper operation of the Supplemental Inflatable Restraint (SIR) sensing system requires that any repairs to the vehicle structure return the vehicle structure to the original production configuration. Not properly repairing the vehicle structure could cause non-deployment of the air bag(s) in a frontal collision or deployment of the air bag(s) for conditions less severe than intended.**

After any collision, inspect the following components as indicated. If you detect any damage, replace the component. If you detect any damage to the mounting points or mounting hardware, repair the component or replace the hardware as needed.

NOTE: **Hybrid Vehicles Only - Perform an inspection of the high voltage system for damage. Refer to High Voltage System Inspection under the Hybrid/EV Controls repair section.**

- The steering column - Inspect the steering column for bending, twisting, buckling or any type of damage.

- The instrument panel knee bolsters and mounting points - Inspect the knee bolsters for bending, twisting, buckling, or any other type of damage.
- The instrument panel brackets, braces, etc. - Inspect for bending, twisting, buckling, or any other type of damage.
- The seat belts - Perform the seat belt operational and functional checks. Refer to **Repairs and Inspections Required After a Collision** .
- The instrument panel cross car beam - Inspect for bending, twisting, buckling, or any other type of damage.
- The instrument panel mounting points and brackets - Inspect for bending, twisting, buckling, or any other type of damage.
- The seats and seat mounting points - Inspect for bending, twisting, buckling, or any other type of damage.
- The roof and headliner mounting points.
- The brake pedal --Inspect the brake pedal for bending, twisting, buckling or any type of damage.

Accident With Frontal Air Bag Deployment - Component Replacement and Inspections

After a collision involving air bag deployment, replace the following components.

- Driver steering wheel air bag
- Passenger instrument panel air bag, if deployed
- Inflatable restraint sensing and diagnostic module (SDM), if SDM has DTC B0052 56
- Front and/or side impact sensors
- Driver/Passenger seat side air bag, if deployed
- Seat back cover if side seat air bag is deployed
- Driver/Passenger seat belt anchor and/or retractor pretensioners

Perform additional inspections on the following components.

- Steering wheel air bag coil and the coil wiring pigtail - Inspect for melting, scorching, or other damage due to excessive heat.
- Mounting points or mounting hardware for the passenger instrument panel air bag, steering wheel air bag, SDM, seat side air bag (if deployed) and seat belt anchor and/or retractor pretensioners - Inspect for any damage and repair or replace each component as needed.

Accident With Side Seat Air Bag Deployment - Component Replacement and Inspections

After a collision involving driver/passenger side seat air bag deployment, replace the following components.

- Left/right side impact sensors on the side of the impact.
- Left/right roof rail air bag on the side of the impact.
- Inflatable restraint sensing and diagnostic module (SDM), if SDM has DTC B0052 56.
- Inflatable restraint seat belt anchor and/or retractor pretensioner.
- Driver or passenger seat back cushion cover replacement.

WARNING: **Do not repair or replace the seat stitching or seams in the seat back trim cover with an internal mounted seat side airbag module. Replace the complete seat back trim cover from the OEM. Non-OEM seat stitching may cause improper airbag deployment which could result in personal injury.**

Perform additional inspections on the following components.

- Mounting points or mounting hardware for the side impact sensors, and driver/passenger side seat air bags on the side of impact - Inspect for any damage and repair or replace each component as needed.
- Mounting points, mounting hardware, headliner and trim pieces for the left/right roof rail air bag on the side of impact - Inspect for any damage and repair or replace each component as needed.

- Mounting points or mounting hardware for the SDM and seat belt anchor and/or retractor pretensioners - Inspect for any damage and repair or replace each component as needed.
- The seat cushion frame
- The seat recliner and cover, if equipped
- The seat adjuster
- The seat back frame
- Door trim assembly
- Impacted seat cushion side covers and switches

Accident With Seat Belt Pretensioner Deployment Only - Component Replacement and Inspections

After a collision involving driver/passenger Seat Belt Retractor or Anchor Pretensioner deployment, replace the following components.

- Driver and Passenger Inflatable restraint seat belt anchor pretensioner and/or retractor pretensioner
- Inflatable Restraint Sensing and Diagnostic Module (SDM), if the Inflatable Restraint Sensing and Diagnostic Module has set DTC B0052 and will not clear

Perform additional inspections for any damage and repair or replace each component as needed on the following components.

- Mounting points or mounting hardware for the Inflatable Restraint Sensing and Diagnostic Module
- Mounting points or mounting hardware for the Seat Belt Anchor Pretensioners
- Mounting points or mounting hardware for the Seat Belt Retractor Pretensioners

Impact Sensor Replacement Guidelines

The impact sensor replacement policy requires replacing sensors in the area of the accident damage. The area of accident damage is defined as the portion of the vehicle which is crushed, bent, or damaged due to a collision. An example of this would be a moderate collision where the front of the vehicle impacts a object. If the vehicle has an impact sensor mounted forward of the radiator, it must be replaced.

- Replace the impact sensor whether or not the air bags have deployed.
- Replace the impact sensor even if it appears to be undamaged.

Impact sensor damage which is not visible, such as slight bending of the mounting bracket or cuts in the wire insulation, can cause improper operation of the SIR system. Do not try to determine whether the impact sensor is undamaged, replace the impact sensor. Also, if you follow a diagnostic trouble code (DTC) procedure and a malfunctioning impact sensor is indicated, replace the impact sensor.

INFLATABLE RESTRAINT MODULE HANDLING AND SCRAPPING

Special Tools

- **EL-38826** SIR Deployment Harness
- **EL-39401-B** SIR Deployment Fixture

For equivalent regional tools, refer to Special Tools.

Live and Undeployed Air Bag

WARNING: **Refer to SIR Inflator Module Handling and Storage Warning .**

Take special care when handling or storing an undeployed air bag. An air bag deployment produces a rapid generation of gas. This may cause the air bag, or an object in front of the air bag, to project through the air in the event of an unlikely deployment.

Dual Stage Air Bags

Dual stage air bags have two deployment stages. If stage 1 was used to deploy a dual stage air bag, stage 2 may still be active. Therefore, a deployed dual stage air bag must be treated as an active air bag. If disposal of a dual stage air bag is required, both deployment loops must be energized to deploy the air bag.

Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will require the disposal of a live and undeployed air bag. Do NOT dispose a live and undeployed air bag through normal disposal channels until the air bag has been deployed.

Do not deploy the air bag in the following situations:

- After replacement of an air bag under warranty - the air bag may need to be returned undeployed to the manufacturer.
- If the vehicle is the subject of a product liability claim, related to the SIR system and is subject to a preliminary investigation - do NOT alter the SIR system in any manner.
- If the vehicle is involved in a campaign affecting the air bags - follow the instructions in the campaign service bulletin for proper SIR handling procedures.

Deployment Procedures

NOTE: **Some countries, states or localities may not allow service deployment of air bags without special permission or training. Local laws regarding deploying and scrapping of air bags/devices with pyrotechnics must be followed.**

You can deploy the air bag either inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation:

Deployment Outside Vehicle - Steering Wheel Air Bag, Instrument Panel Air Bag, and Roof Rail Air Bag

Deploy the air bag outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, you determine that the air bag is malfunctioning.
- The air bag is cosmetically damaged, scratched, or ripped.
- The air bag pigtail is damaged.
- The air bag connector is damaged.
- The air bag connector terminals are damaged.

Deployment and disposal of a malfunctioning air bag is subject to any required retention period.

WARNING: **Refer to SIR Inflator Module Disposal Warning .**

1. Turn OFF the ignition.

   WARNING: **Refer to SIR Inflator Module Handling and Storage Warning .**

2. Remove the air bag.

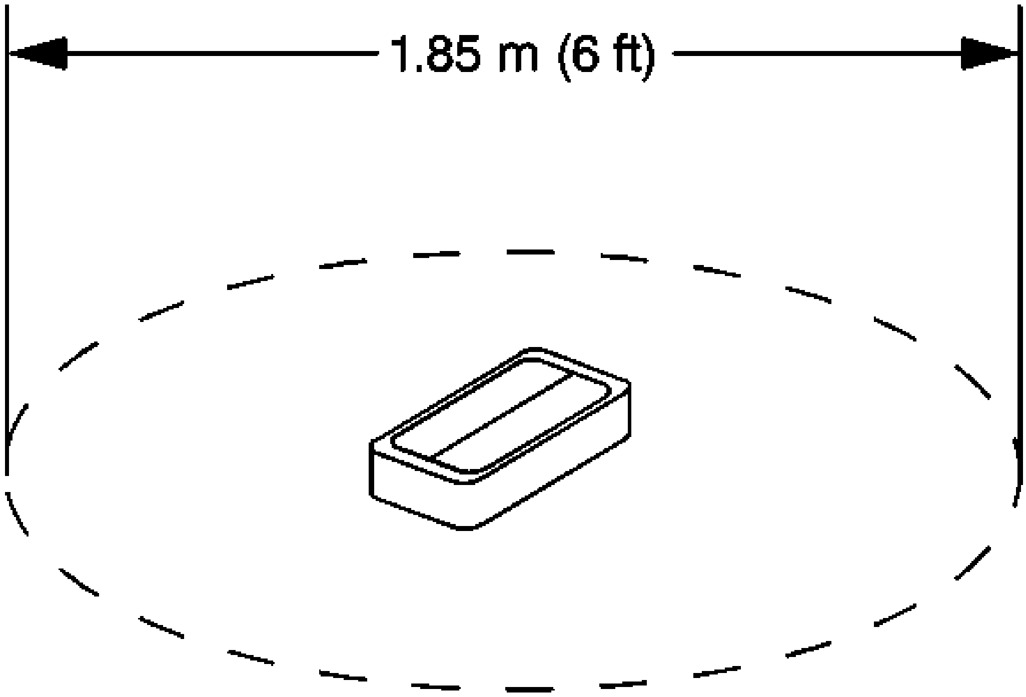


Fig. 35: Clearance For Deployment Of Inflator Module
Courtesy of GENERAL MOTORS COMPANY

3. Clear a space on the ground about 1.85 m (6 ft) in diameter for deployment of the air bag or deployment fixture. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Ensure you have sufficient ventilation.
4. Clear the area of loose or flammable objects.

NOTE: **Dual stage deployments are only used in steering wheel and instrument panel air bags. If stage 1 was used to deploy a dual stage air bag, stage 2 may still be active. If disposal of a dual stage air bag is required, both deployment loops must be energized to deploy the air bag.**

5. If you are deploying a steering wheel air bag, place the air bag in the center of the space with the vinyl trim cover facing up and away from the surface.

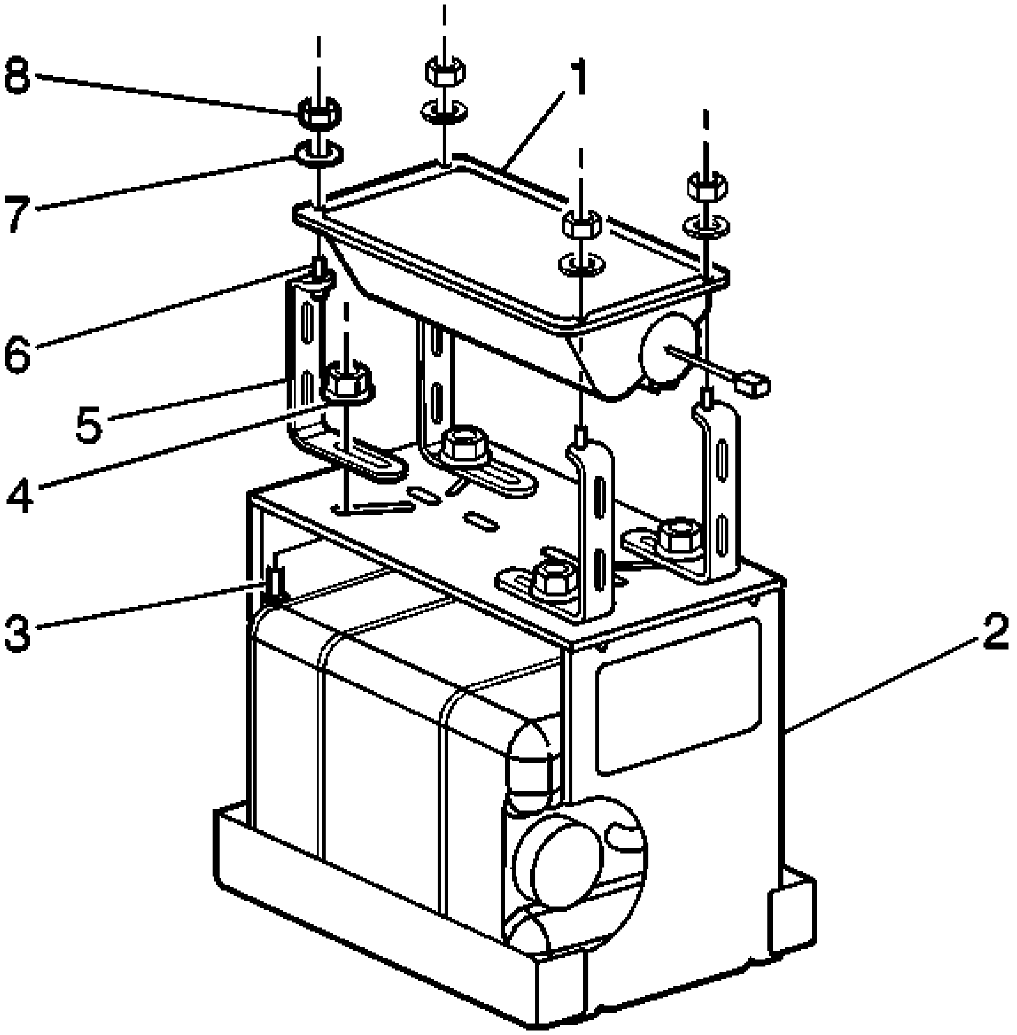


Fig. 36: I/P Module Components
Courtesy of GENERAL MOTORS COMPANY

6. When deploying an instrument panel air bag, perform the following instructions:
    1. Place the **EL-39401-B** fixture in the center of the cleared area.
    2. Fill the deployment fixture with water or sand.
    3. Using the proper nuts and bolts, mount the instrument panel air bag (1) to the deployment fixture (2), with the vinyl trim facing up.
    4. Securely tighten all fasteners that hold the instrument panel air bag (1) to the deployment fixture (2).

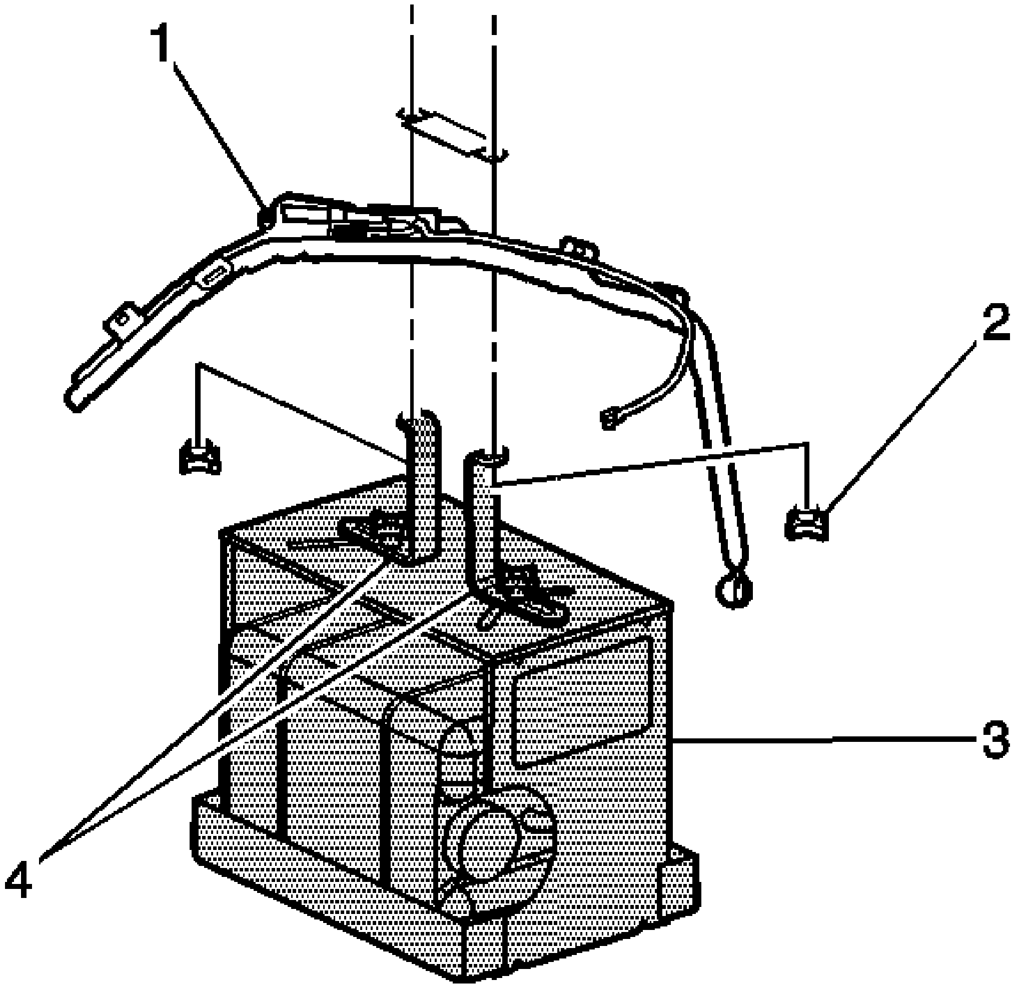


Fig. 37: Fasteners Holding Side Impact Module To Deployment Fixture
Courtesy of GENERAL MOTORS COMPANY

7. When deploying a roof rail air bag, perform the following instructions:
    1. Place the **EL-39401-B** fixture (3) in the center of the cleared area.
    2. Fill the deployment fixture with water or sand to provide sufficient stabilization of fixture during deployment.
    3. Adjust and secure the fixture arms (4) to the deployment fixture (3), using the proper nuts and bolts.
    4. Attach the roof rail air bag in the deployment fixture and securely tighten all fasteners.

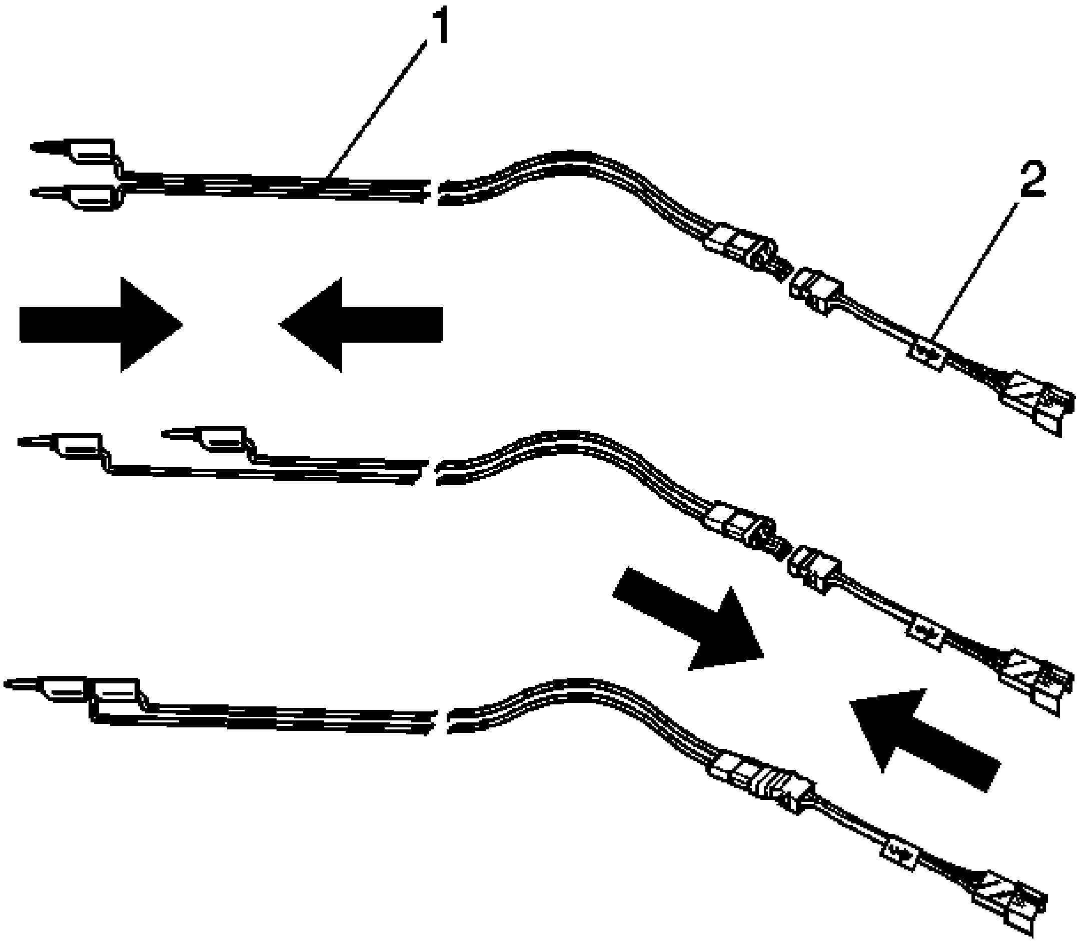


Fig. 38: SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

8. Inspect the **EL-38826** harness and the appropriate pigtail adapter (2) for damage. Replace as needed.
9. Short the 2 SIR deployment harness leads (1) together using one banana plug seated into the other.
10. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).

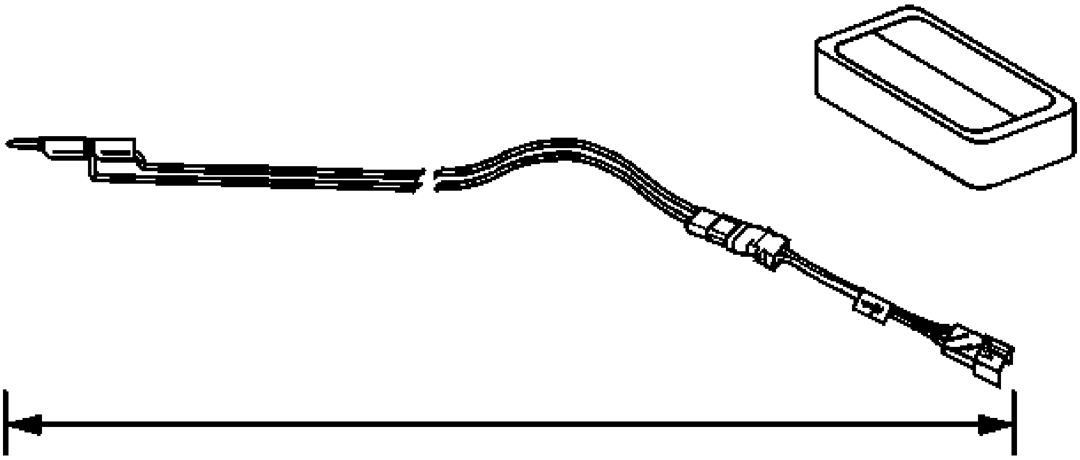


Fig. 39: Extending SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

11. Extend the SIR deployment harness and adapter to the full length from the deployment fixture or area.

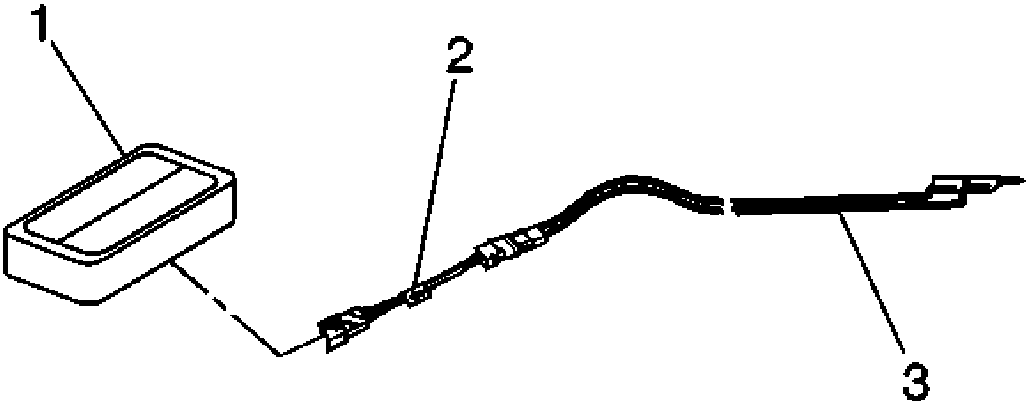


Fig. 40: Inflator Module, SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

NOTE: **On a dual stage air bag, both connectors must be attached to the deployment harness adapter. This will ensure that both stage 1 and stage 2 of the deployment loops are energized, regardless of the deployment state.**

12. Connect the air bag (1) to the adapter (2) on the SIR deployment harness (3).

NOTE:

- **The rapid expansion of gas involved with deploying an air bag is very loud. Notify all the people in the immediate area that you intend to deploy the air bag.**
- **When the air bag deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the air bag due to the force of the rapid expansion of gas inside the air bag.**
- **If you are deploying a dual stage air bag with stage 1 already deployed, the fixture may not move and the noise may have been reduced.**

13. Clear the area of people.

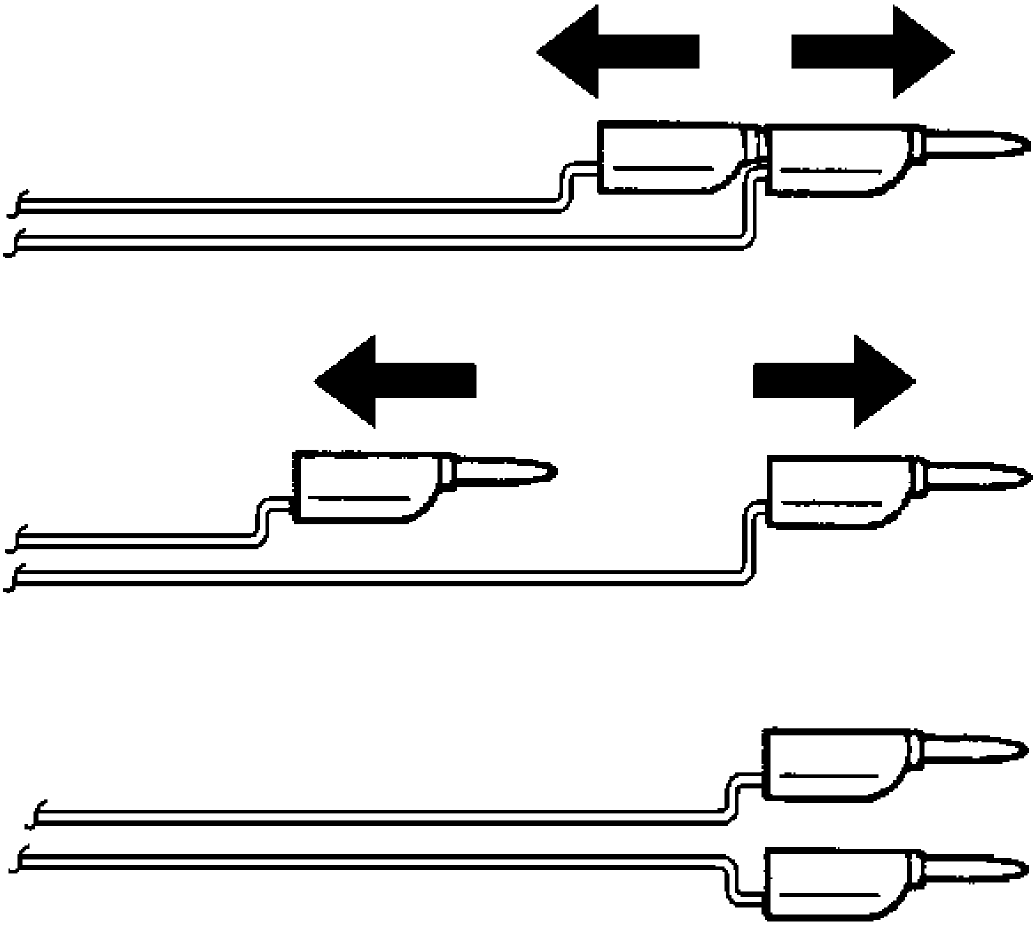


Fig. 41: Separating Banana Plugs
Courtesy of GENERAL MOTORS COMPANY

14. Separate the 2 banana plugs on the SIR deployment harness that were shorted together earlier in the procedure.

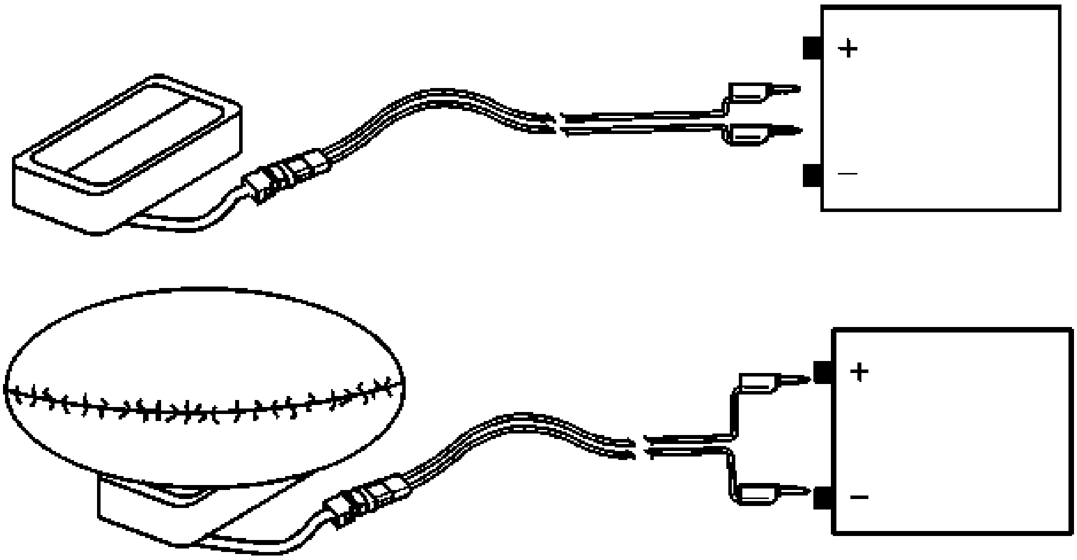


Fig. 42: SIR Deployment Harness Wires To Power Source
Courtesy of GENERAL MOTORS COMPANY

15. Place a 12 V minimum/2A minimum power source, such as a vehicle battery, near the shorted end of the harness.
16. Connect the SIR deployment harness wires to the power source. Deployment of the air bag will occur when contact is made.

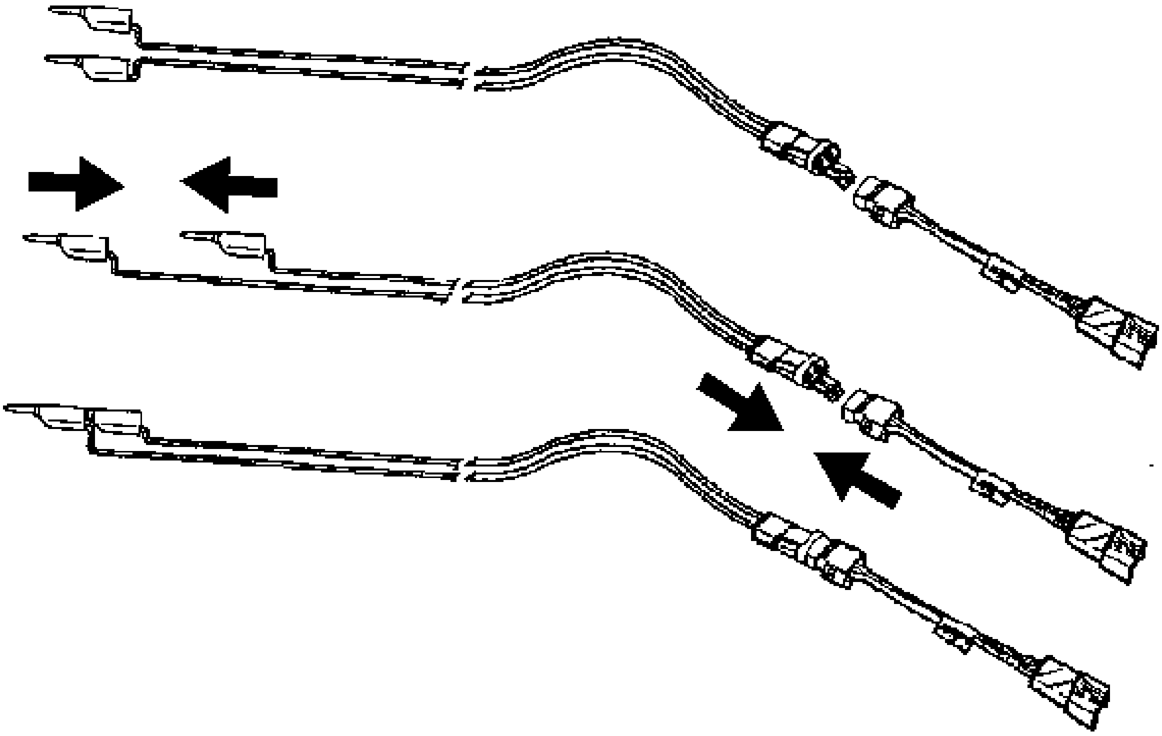


Fig. 43: Deployment Harness Leads
Courtesy of GENERAL MOTORS COMPANY

17. Disconnect the SIR deployment harness from the power source after the air bag deploys.
18. If the air bag did not deploy, disconnect the adapter and discontinue the procedure and contact the Technical Assistance Group.

    If deployment was successful, proceed to the following steps.

WARNING: **Refer to SIR Deployed Inflator Modules Are Hot Warning .**

19. Seat one banana plug into the other in order to short the deployment harness leads.
20. Put on a pair of shop gloves.
21. Disconnect the pigtail adapter from the air bag as soon as possible.
22. Inspect the pigtail adapter and the SIR deployment harness. Replace as needed.
23. Dispose of the deployed air bag through normal refuse channels.
24. Wash your hands with a mild soap.

Deployment Inside Vehicle - Vehicle Scrapping Procedure

Deploy the air bags inside of the vehicle when destroying the vehicle or when salvaging the vehicle for parts. This includes, but is not limited to, the following situations:

- The vehicle has completed all useful life.
- Irrepairable damage occurred to the vehicle in a non-deployment type accident.
- Irrepairable damage occurred to the vehicle during a theft.

- The vehicle is being salvaged for parts to be used on a vehicle with a different VIN, as opposed to rebuilding as the same VIN.

WARNING: **Refer to SIR Inflatable Module Deployment Outside Vehicle Warning .**

1. Lower the driver and passenger windows.
2. Turn the ignition switch to the OFF position and remove the ignition key.
3. Check that all air bags which will be deployed are mounted securely.
4. Remove all loose objects from the front seats.

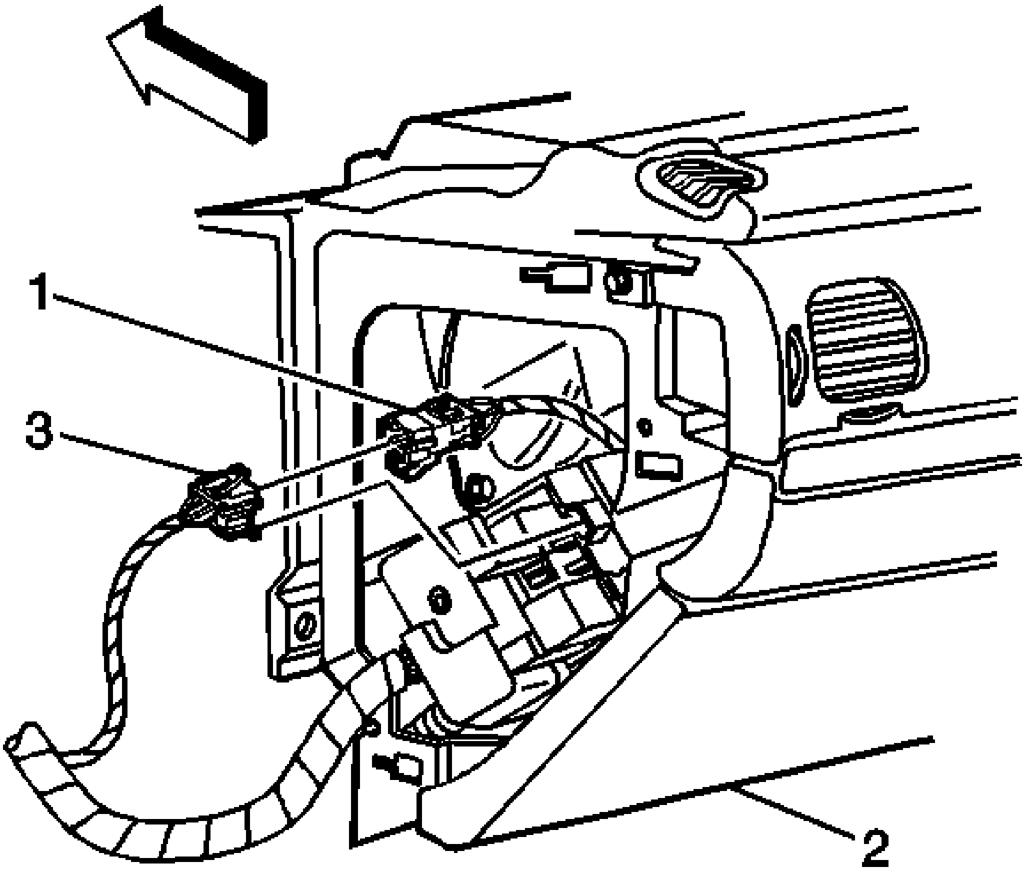


Fig. 44: I/P Module Connector To Vehicle Harness Connector (LH Side I/P)
Courtesy of GENERAL MOTORS COMPANY

WARNING: **A deployed dual stage inflator module will look the same whether one or both stages were used. Always assume a deployed dual stage inflator module has an active stage 2. Improper handling or servicing can activate the inflator module and cause personal injury.**

5. Disconnect the steering wheel air bag yellow connector (1) from vehicle harness yellow connector (3).

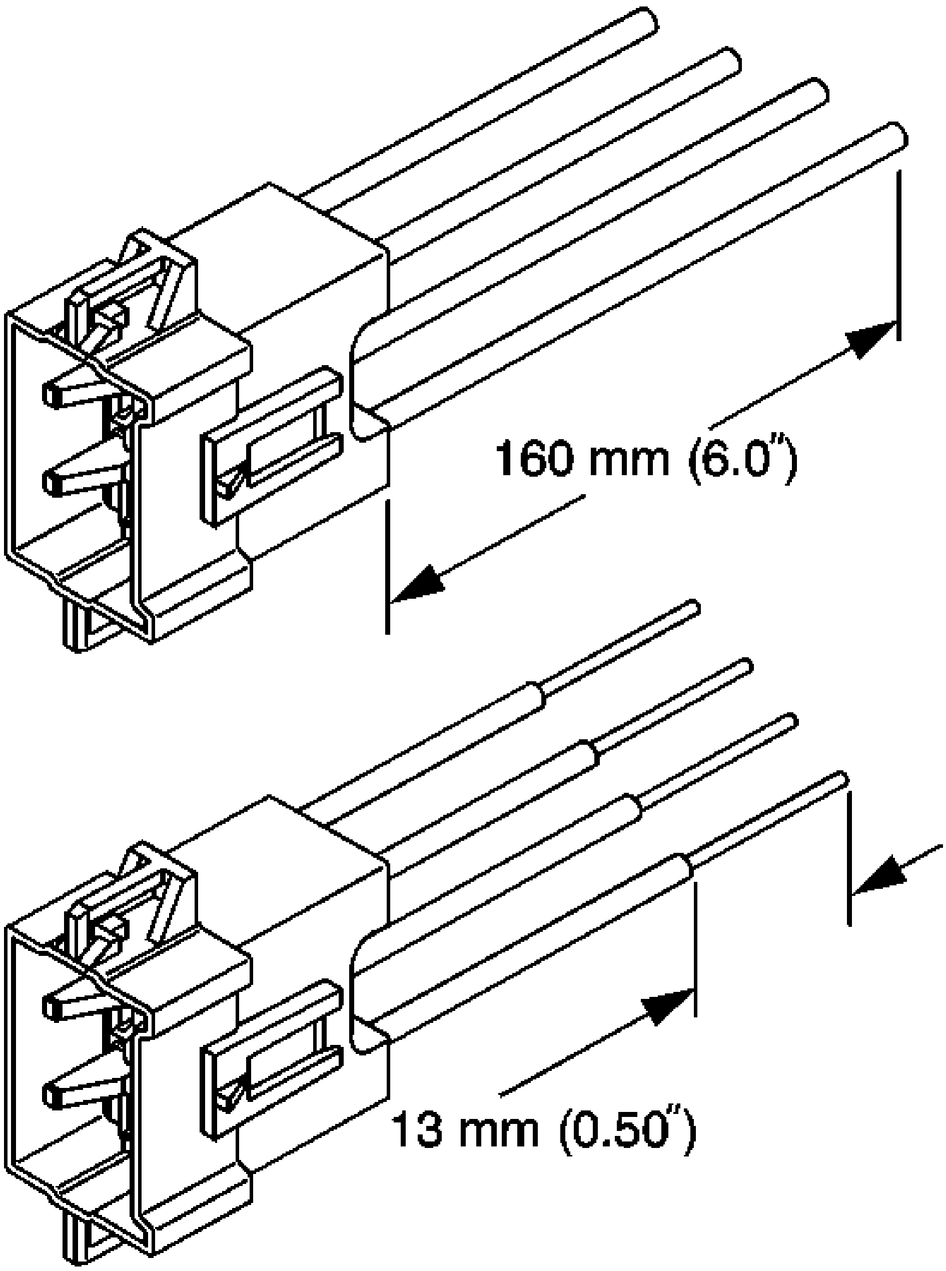


Fig. 45: Stripping SIR Wires
Courtesy of GENERAL MOTORS COMPANY

NOTE: **If the vehicle is equipped with dual stage air bags the steering wheel air bag and instrument panel air bag will each have 4 wires. Refer to COMPONENT CONNECTOR END VIEWS - INDEX for determining high and low circuits.**

6. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
7. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.

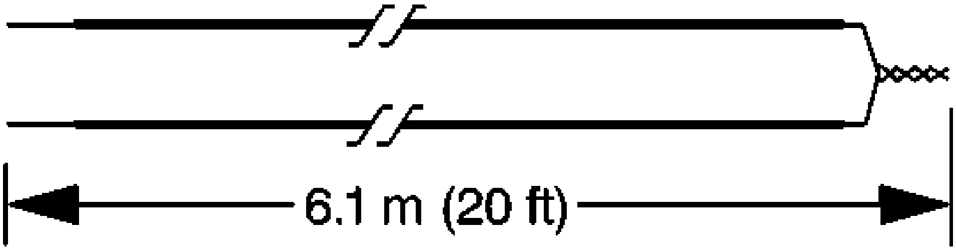


Fig. 46: Fabricating 20 Ft. Deployment Harness
Courtesy of GENERAL MOTORS COMPANY

8. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. Use these wires to fabricate the driver deployment harness.
9. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
10. Twist together one end from each of the wires in order to short the wires. Deployment wires shall remain shorted, and not connected to a power source until you are ready to deploy the air bag.

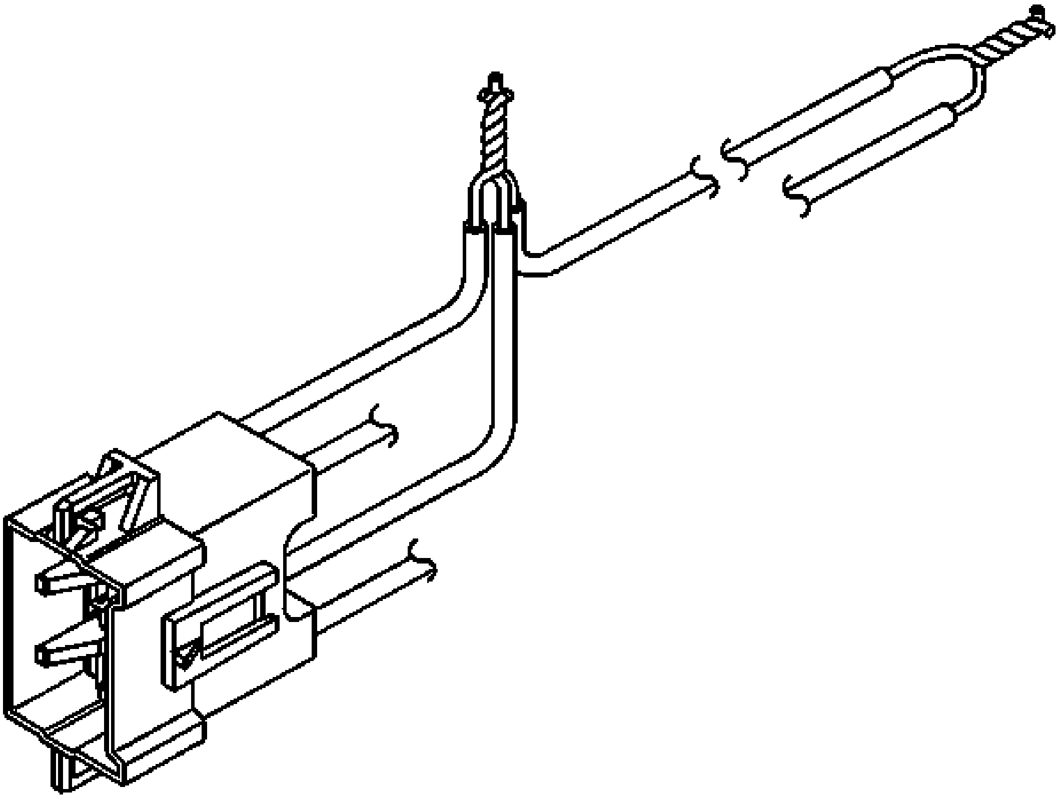


Fig. 47: Twisting Connector Wire Leads (High Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS COMPANY

11. Twist together the 2 connector wire leads from the high circuits from both stages of the steering wheel air bag, to one set of deployment wires. Refer to **COMPONENT CONNECTOR END VIEWS - INDEX** in order to determine the correct circuits.
12. Inspect that the 3-wire connection is secure.
13. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.

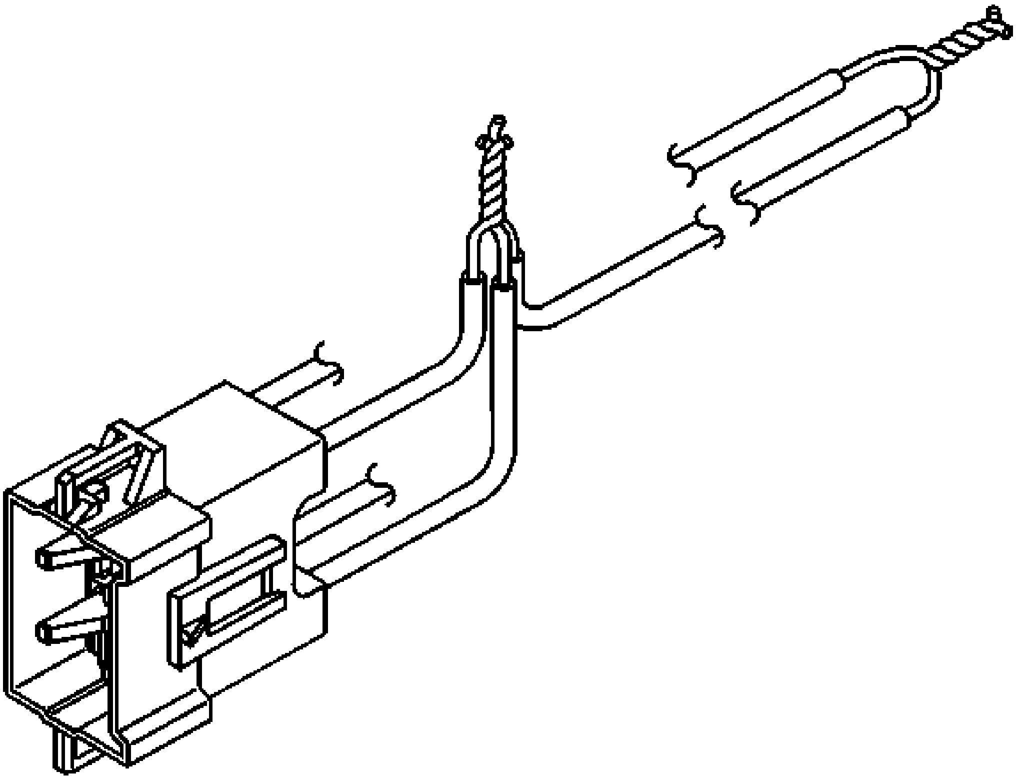


Fig. 48: Twisting Connector Wire Leads (Low Circuits) To Deployment Harness Wire
Courtesy of GENERAL MOTORS COMPANY

14. Twist together the 2 connector wire leads from the low circuits from both stages of the steering wheel air bag, to one set of deployment wires. Refer to **COMPONENT CONNECTOR END VIEWS - INDEX** in order to determine the correct circuits.
15. Inspect that the 3-wire connection is secure.
16. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
17. Connect the deployment harness to the connector on the steering wheel air bag.
18. Route the deployment harness out of the driver side of the vehicle.
19. Disconnect the yellow left roof rail harness connector from the vehicle harness connector.
20. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
21. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
22. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
23. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
24. Twist together one end from each of the wires in order to short the wires.
25. Twist together one connector wire lead to one deployment wire.
26. Secure and insulate the connection using electrical tape.
27. Twist together and tape the remaining connector wire lead to the remaining deployment wire.
28. Connect the deployment harness to the yellow connector of the roof rail air bag.
29. Route the deployment harness out of the driver side of the vehicle.

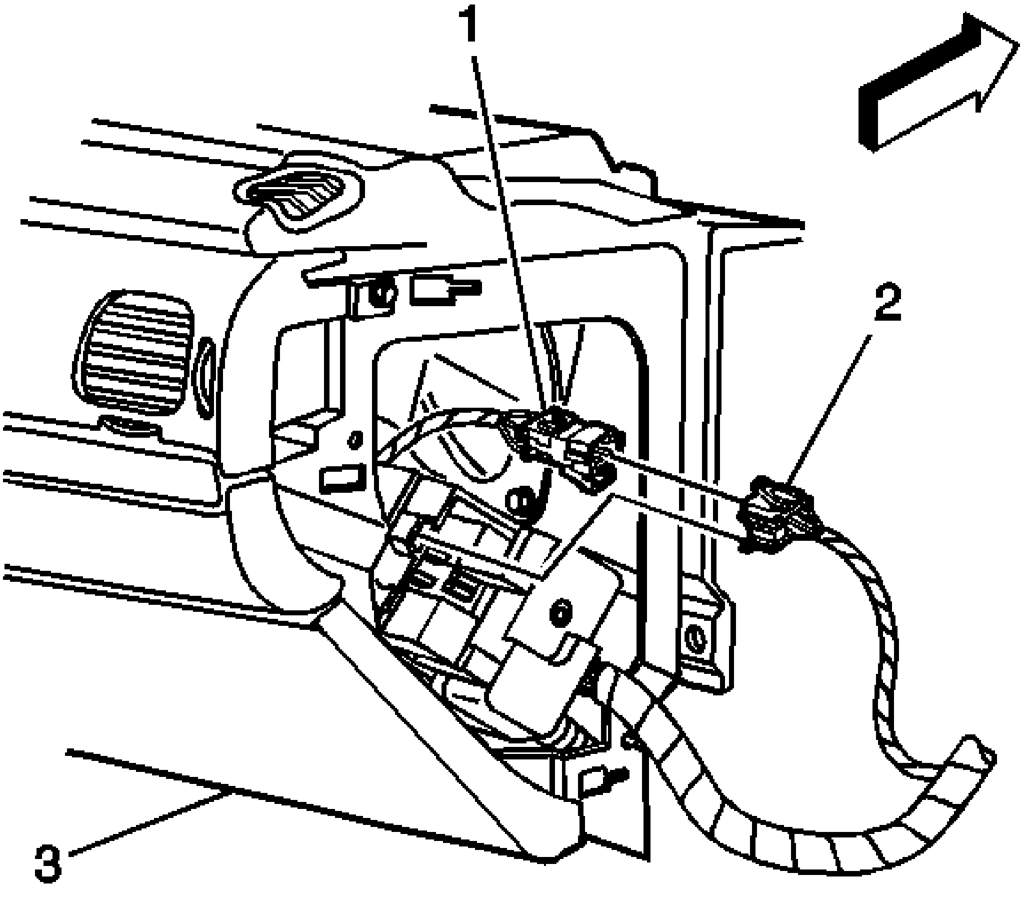


Fig. 49: I/P Module Connector To Vehicle Harness Connector
Courtesy of GENERAL MOTORS COMPANY

30. Disconnect the instrument panel air bag yellow harness connector (1) from the vehicle harness connector (2).

NOTE: **If the vehicle is equipped with dual stage air bags the steering wheel air bag and instrument panel air bag will each have 4 wires. Refer to COMPONENT CONNECTOR END VIEWS - INDEX for determining high and low circuits.**

31. Cut the yellow harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
32. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
33. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the passenger deployment harness.
34. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
35. Twist together one end from each of the wires in order to short the wires.
36. Twist together the 2 connector wire leads from the high circuits from both stages of the instrument panel air bag to one set of deployment wires. Refer to COMPONENT CONNECTOR END VIEWS - INDEX in order to determine the correct circuits.
37. Inspect that the 3-wire connection is secure.
38. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.
39. Twist together the 2 connector wire leads from the low circuits from both stages of the instrument panel air bag to one set of deployment wires. Refer to COMPONENT CONNECTOR END VIEWS - INDEX in order to determine the correct circuits.
40. Inspect that the 3-wire connection is secure.
41. Secure and insulate the 3-wire connection to the deployment harness using electrical tape.

42. Connect the deployment harness to the instrument panel air bag in-line connector.
43. Route the deployment harness out of the passenger side of the vehicle.
44. Disconnect the yellow harness connector to the right roof rail air bag from the vehicle harness connector.
45. Cut the harness connector out of the vehicle, leaving at least 16 cm (6 in) of wire at the connector.
46. Strip 13 mm (0.5 in) of insulation from each of the connector wire leads.
47. Cut two 6.1 m (20 ft) deployment wires from a 0.8 mm (18 gauge) or thicker multi-strand wire. These wires will be used to fabricate the roof rail air bag deployment harness.
48. Strip 13 mm (0.5 in) of insulation from both ends of the wires.
49. Twist together one end from each of the wires in order to short the wires.
50. Twist together one connector wire lead to one deployment wire.
51. Secure and insulate the connection using electrical tape.
52. Twist together and tape the remaining connector wire lead to the remaining deployment wire.
53. Connect the deployment harness to the roof rail air bag yellow connector.
54. Route the deployment harness out of the passenger side of the vehicle.
55. Completely cover the windshield and the front door window openings with a drop cloth.
56. Stretch to the full length all of the deployment harness wires on the right side of the vehicle.
57. Deploy each deployment loop one at a time.
58. Place a power source, 12 V minimum/2A minimum, such as a vehicle battery, near the shorted end of the harnesses.
59. Separate one set of wires and touch the wire ends to the power source in order to deploy the selected air bag.
60. Disconnect the deployment harness from the power source and twist the wire ends together.
61. Continue the same process with the remaining deployment harnesses.
62. Disconnect all harnesses from the vehicle.
63. Discard the harnesses.
64. Scrap the vehicle in the same manner as a non-SIR equipped vehicle.
65. If one or all of the air bags did not deploy, remove the undeployed air bags from the vehicle.

PRETENSIONER HANDLING AND SCRAPPING

Scrapping Procedure

During the course of a vehicles useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) pretensioner. The following information covers the proper procedures for the disposing of a live (undeployed) pretensioner. Deploy the pretensioner before disposal. Do not dispose of a live (undeployed) pretensioner through normal disposal channels until the pretensioner has been deployed. The following information covers the proper procedures for the disposing of a live (undeployed) pretensioner.

- After replacement of a pretensioner under warranty. The pretensioner may need to be returned undeployed to the original manufacturer of pretensioner.
- If the vehicle is the subject of a Product Liability report related to the SIR system and is subject to a Preliminary Investigation (GM-1241). Do not alter the SIR system in any manner.
- If the vehicle is involved in a campaign affecting the pretensioners. Follow the instructions in the Campaign Service Bulletin for proper SIR handling procedures.

Deployment Procedures

NOTE: **Some countries, states or localities may not allow service deployment of air bags without special permission or training. Local laws regarding deploying and scrapping of air bags/devices with pyrotechnics must be followed.**

The pretensioner can be deployed inside or outside of the vehicle. The method used depends upon the final disposition of the vehicle. Review the following procedures in order to determine which will work best in a given situation.

Deployment Inside the Vehicle

Refer to **Inflatable Restraint Module Handling and Scrapping** for deploying the pretensioner inside vehicle under Vehicle Scrapping Procedure.

Deployment Outside Vehicle for Seat Belt Pretensioners

Deploy the seat belt pretensioners outside of the vehicle when the vehicle will be returned to service. Situations that require deployment outside of the vehicle include the following:

- Using the SIR diagnostics, you determine that the seat belt pretensioner is malfunctioning.
- The pretensioner pigtail (if equipped) is damaged.
- The pretensioner connector is damaged.
- The pretensioner connector terminal is damaged.

Deployment and disposal of a malfunctioning seat belt pretensioner is subject to any required retention period.

WARNING: **In order to prevent accidental deployment of the pretensioner which could cause personal injury, do not dispose of an undeployed pretensioner as normal shop waste. The undeployed pretensioner contains substances that could cause severe illness or personal injury if the sealed container is damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed pretensioner. Failure to dispose of a pretensioner as instructed may be a violation of federal, state, or local laws.**

WARNING: **When you are deploying a pretensioner for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.**

Special Tools

- **EL-39401-B** SIR Deployment Fixture
- **EL-38826** SIR Deployment Harness

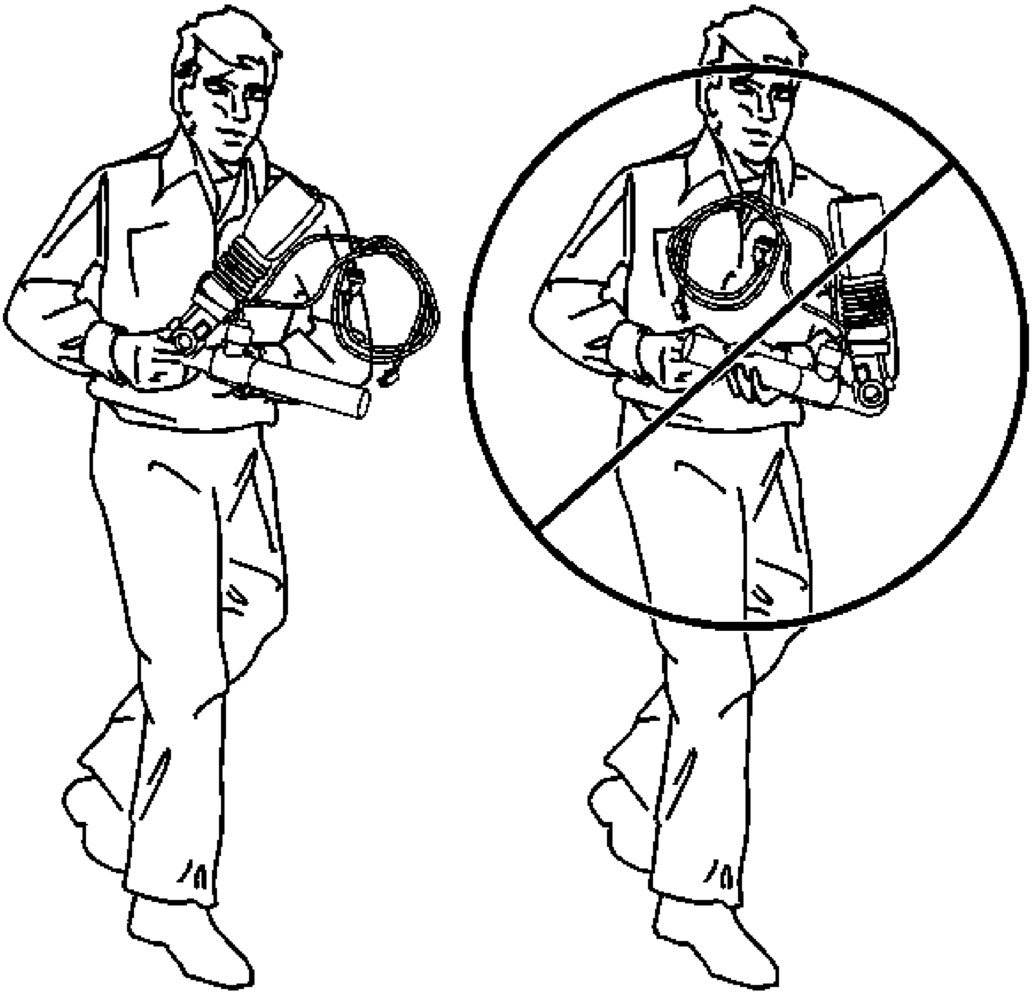


Fig. 50: Proper Pretensioner Carrying
Courtesy of GENERAL MOTORS COMPANY

1. Turn the ignition switch to the OFF position.
2. Remove the ignition key.
3. Put on safety glasses.
4. Remove the seat belt pretensioner from the vehicle.
5. When carrying a pretensioner to the deployment area keep the open end of pretensioner pointed away from the body.

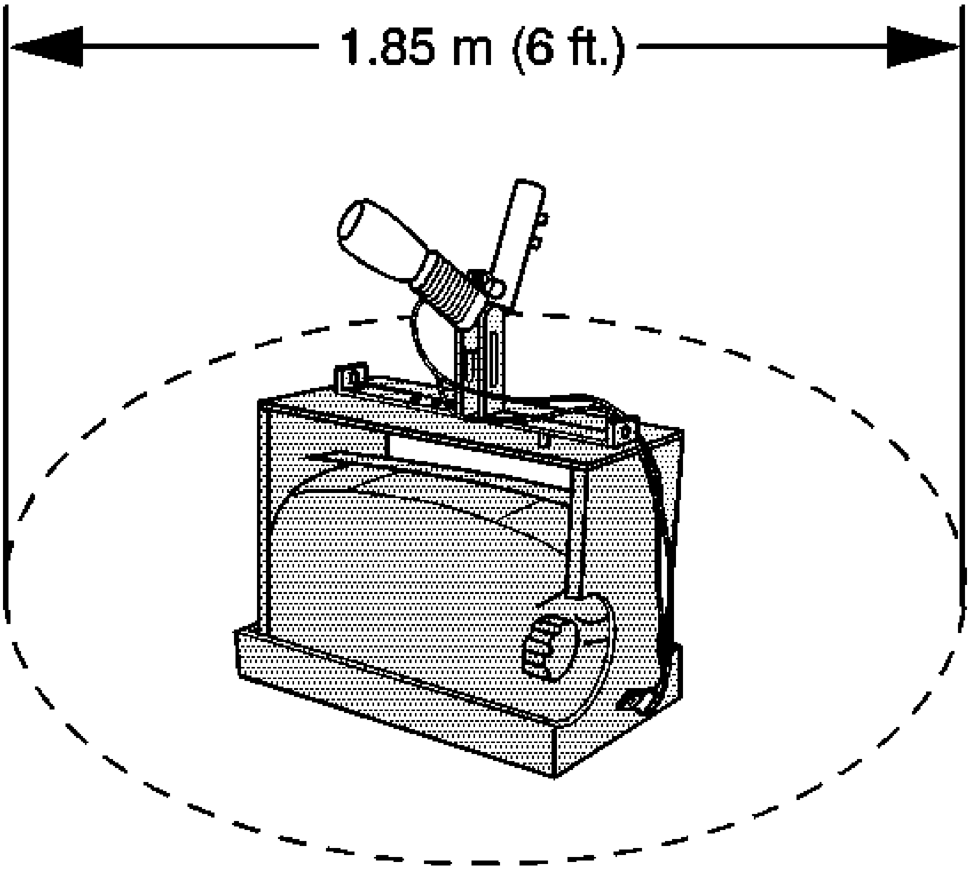


Fig. 51: Pretensioner Deployment Area
Courtesy of GENERAL MOTORS COMPANY

6. Clear a space on the ground about 1.85 M (6 ft) in diameter for deployment of the pretensioner. If possible, use a paved, outdoor location free of activity. Otherwise, use a space free of activity on the shop floor. Make sure you have sufficient ventilation.
7. Make sure no loose or flammable objects are in the area.
8. Place the **EL-39401-B** SIR deployment fixture in the center of the cleared area.
9. Fill the fixture plastic reservoir with water or sand.

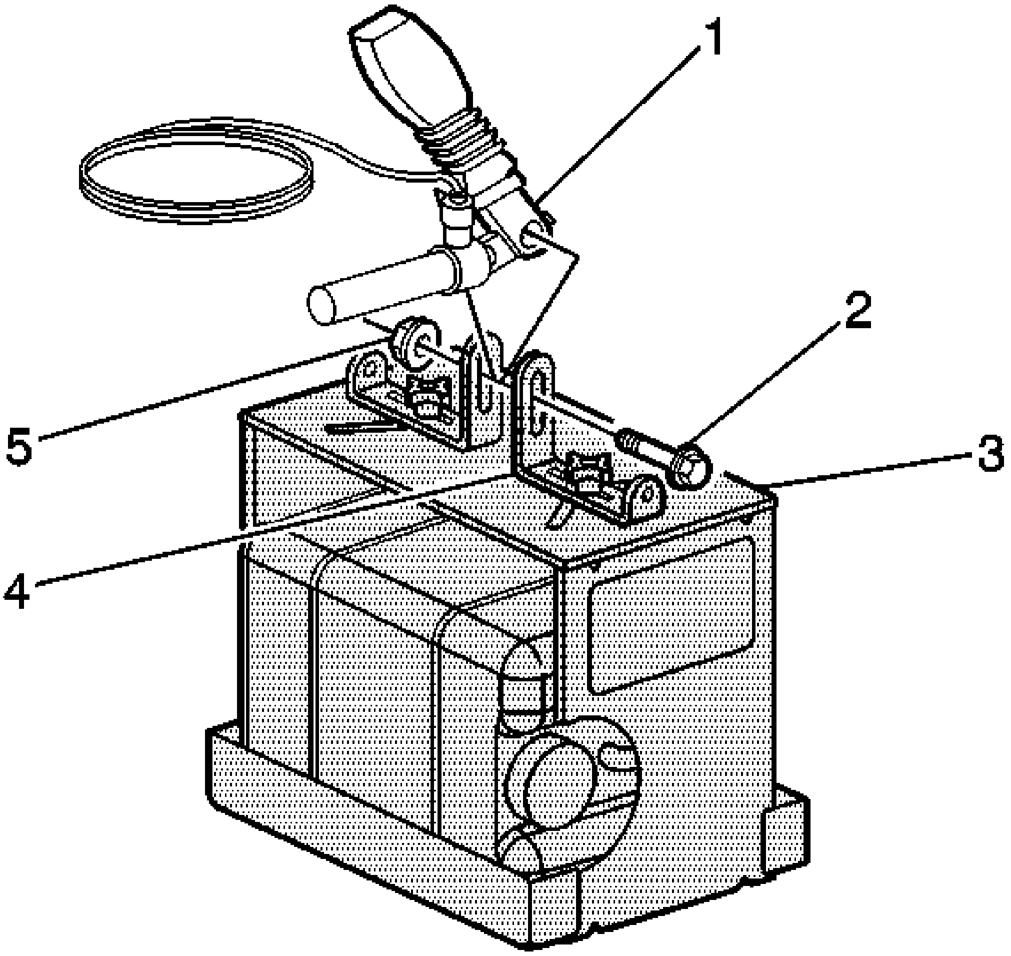


Fig. 52: Mounting Pretensioner In SIR Deployment Fixture
Courtesy of GENERAL MOTORS COMPANY

10. Mount the pretensioner (1) in the SIR deployment fixture (3) with the open end facing up using the following mounting method.
    1. Adjust and secure the EL-39401-B arms (4) to the deployment fixture (3).
    2. To mount, use the proper size bolt (2) and nut (5) with washers in order to secure the pretensioner (1) to the deployment fixture brackets (4).
    3. Securely tighten all fasteners prior to deployment.

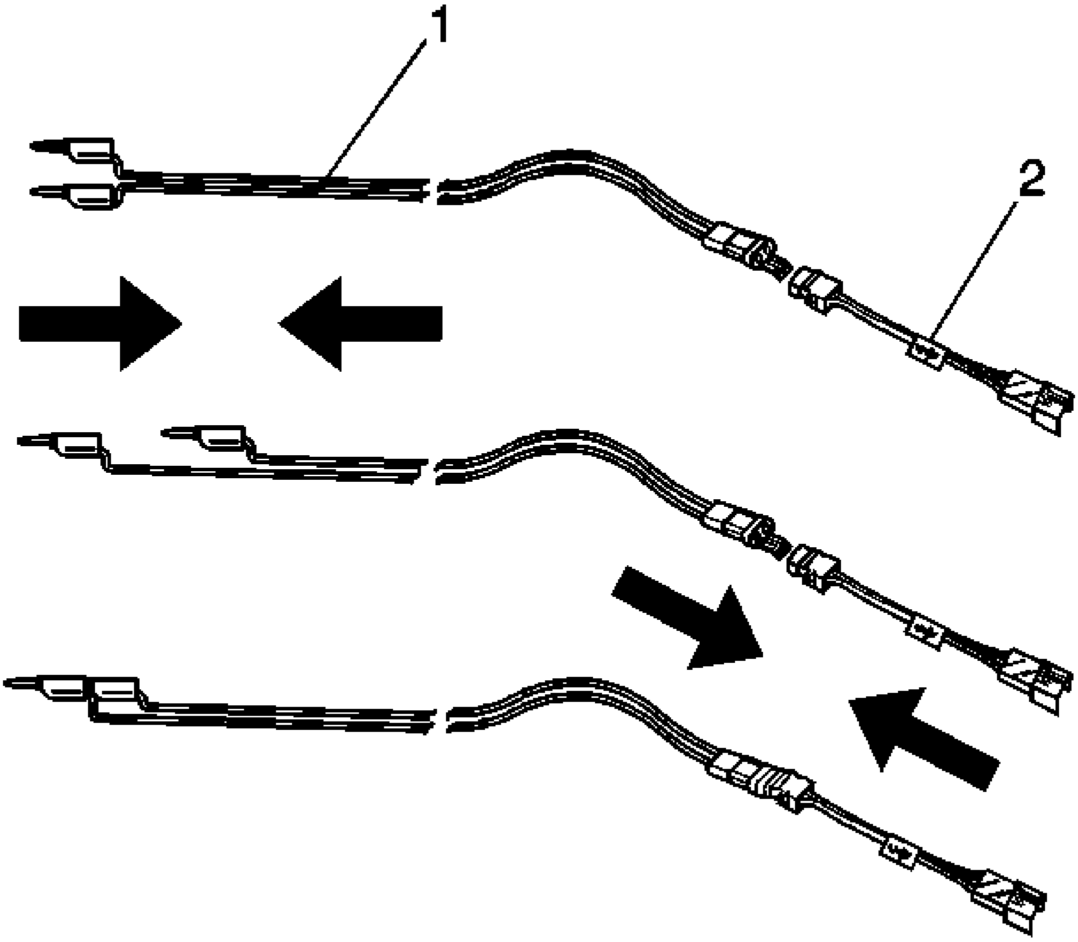
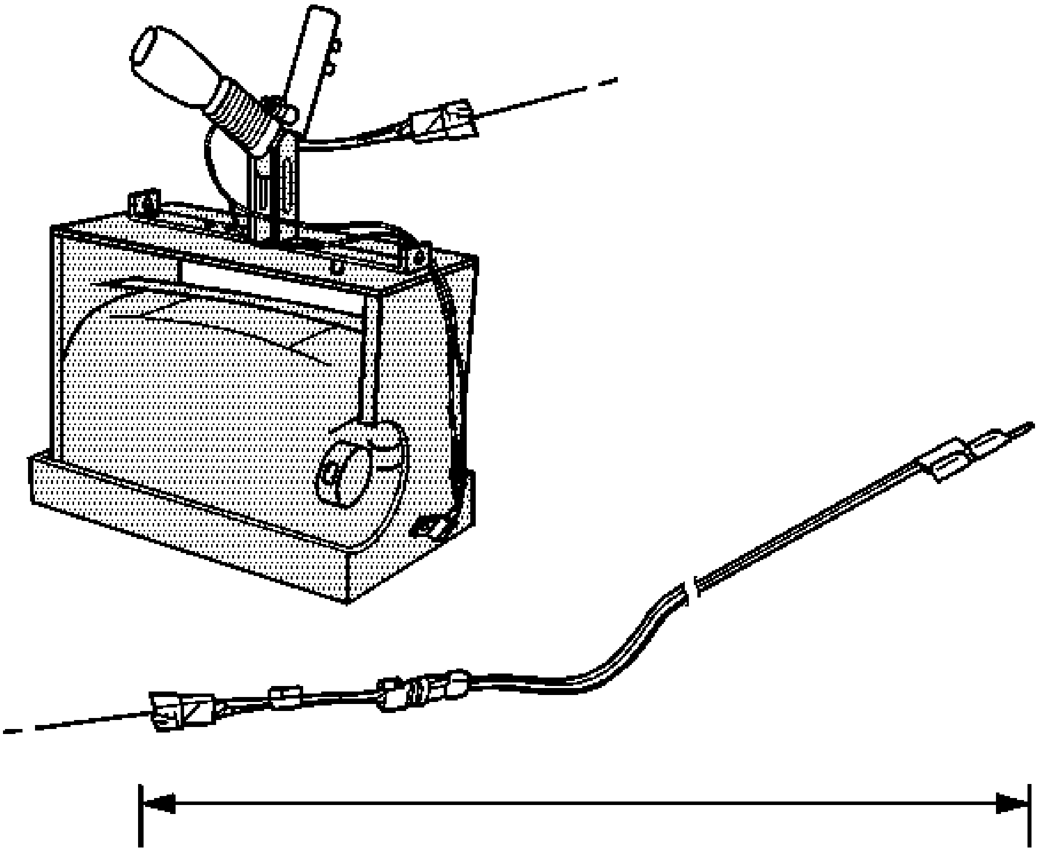


Fig. 53: SIR Deployment Harness & Adapter
Courtesy of GENERAL MOTORS COMPANY

11. Inspect the **EL-38826** SIR deployment harness and the appropriate pigtail adapter for damage. Replace as needed.
12. Short the 2 SIR deployment harness (1) leads together using one banana plug seated into the other.
13. Connect the appropriate pigtail adapter (2) to the SIR deployment harness (1).



[Fig. 54: Extending SIR Deployment Harness & Adapter](#)
Courtesy of GENERAL MOTORS COMPANY

14. Extend the SIR deployment harness and adapter to full length from the deployment fixture.

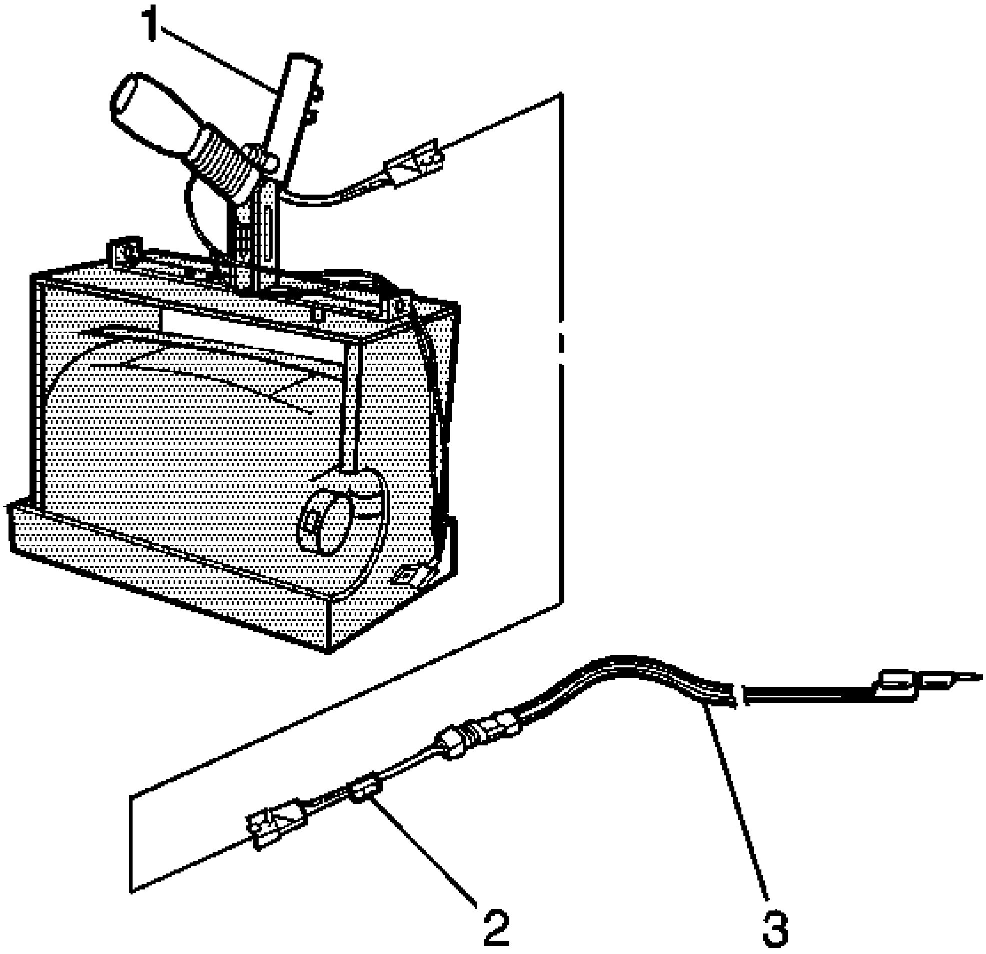


Fig. 55: Connecting Pretensioner To Adapter
Courtesy of GENERAL MOTORS COMPANY

15. Connect the pretensioner (1) to the adapter (2) on the deployment harness (3).

NOTE: **The rapid gas expansion involved with deploying a pretensioner is very loud. Notify all the people in the immediate area that you intend to deploy the seat belt pretensioner.**

16. Clear the area of people.

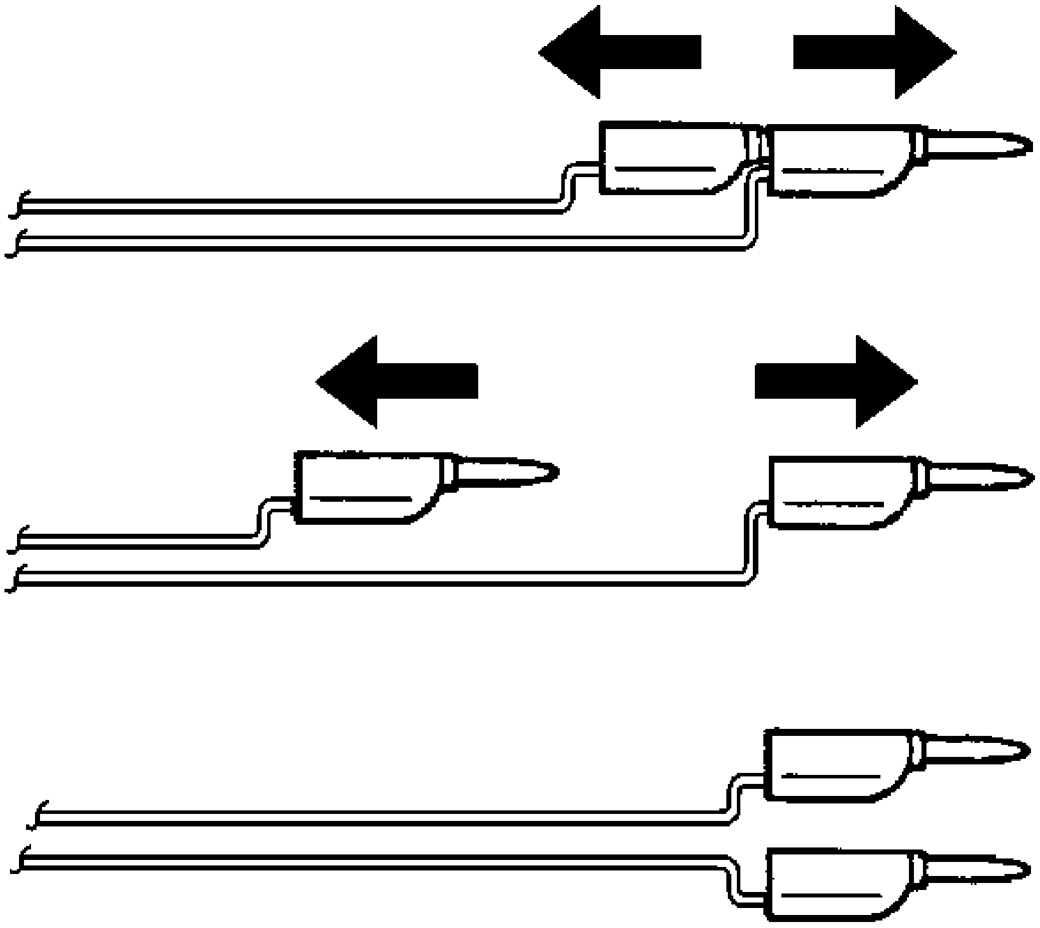


Fig. 56: Separating Banana Plugs
Courtesy of GENERAL MOTORS COMPANY

WARNING: **When you are deploying a pretensioner for disposal, perform the deployment procedures in the order listed. Failure to follow the procedures in the order listed may result in personal injury.**

17. Separate the 2 banana plugs on the SIR deployment harness.

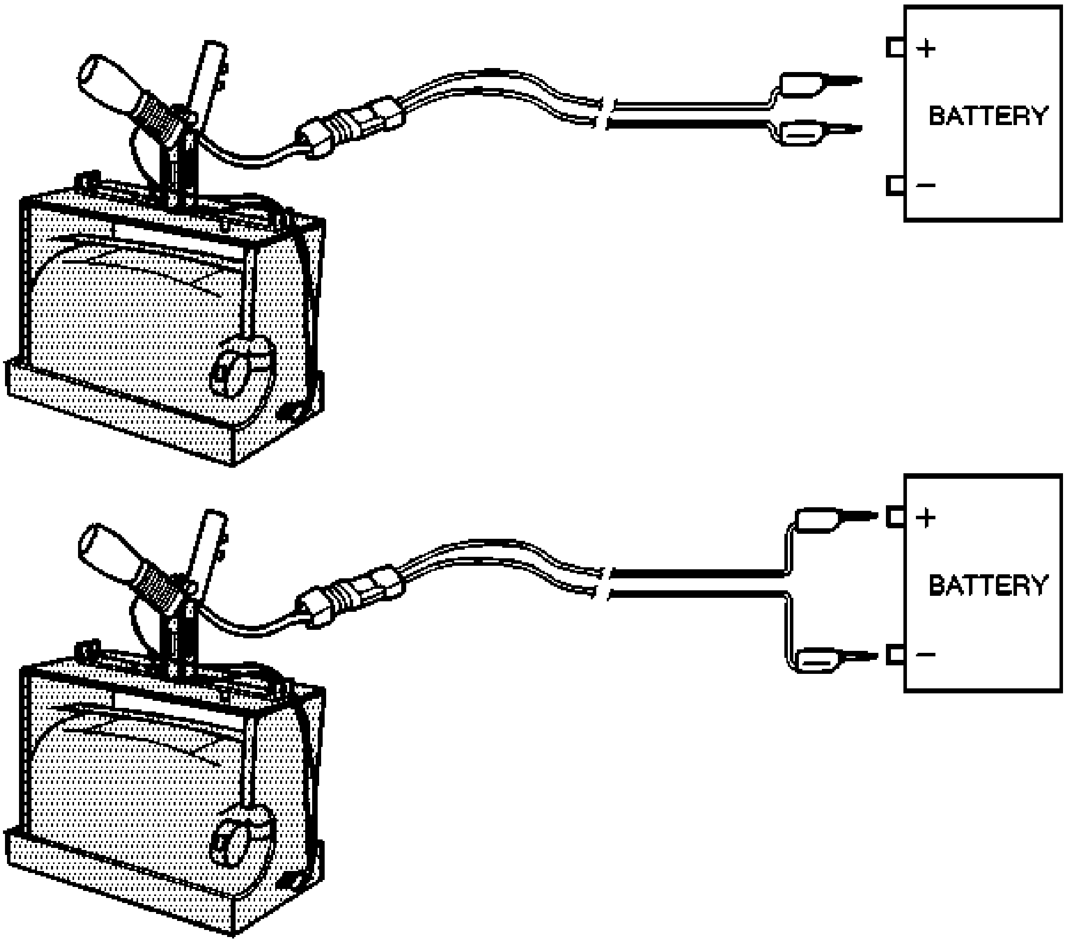


Fig. 57: Deploying Pretensioner
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When the seat belt pretensioner deploys, the deployment fixture may jump about 30 cm (1 ft) vertically. This is a normal reaction of the seat belt pretensioner due to the force of the rapid expansion of gas inside the pretensioner.**

18. Place a 12 V minimum/2 A minimum power source (i.e., vehicle battery) near the shorted end of the harness.
19. Connect the SIR deployment harness wires to the power source. Pretensioner deployment will occur when contact is made.
20. Disconnect the SIR deployment harness from the power source after the pretensioner deploys.

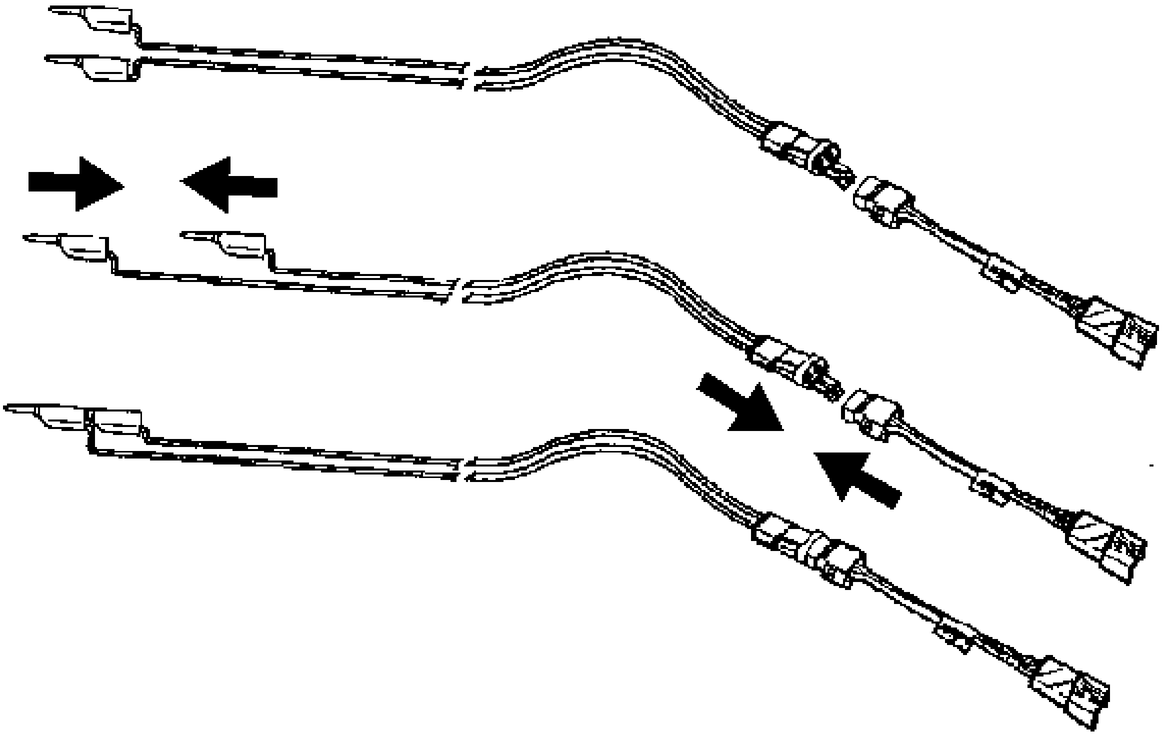


Fig. 58: Deployment Harness Leads
Courtesy of GENERAL MOTORS COMPANY

21. Seat one banana plug into the other in order to short the deployment harness leads.
22. If the pretensioner did not deploy, disconnect the adapter and discontinue the procedure. Contact the Technical Assistance Group. Otherwise, proceed to the following steps.
23. Put on a pair of shop gloves.
24. Disconnect the pigtail adapter from the pretensioner as soon as possible.
25. Inspect the pigtail adapter and the SIR deployment harness. Replace as needed.
26. Dispose of the deployed pretensioner through normal refuse channels.
27. Wash hands with a mild soap.

DESCRIPTION AND OPERATION

SUPPLEMENTAL INFLATABLE RESTRAINT SYSTEM DESCRIPTION AND OPERATION

SIR System Overview

The supplemental inflatable restraint (SIR) system supplements the protection offered by the seat belts. The SIR system contains an inflatable restraint sensing and diagnostic module (SDM), air bags, seat belt pretensioners (anchor and retractor), and impact sensors. The SDM determines the severity of a collision with the assistance of impact sensors located at strategic points on the vehicle. When the SDM detects a collision, the SDM will process the information provided by the sensors to further support air bag or pretensioner deployment. The SDM will deploy the air bags and pretensioners if it detects a collision of sufficient force. If the force of the impact is not sufficient to warrant air bag deployment, the SDM may still deploy the seat belt pretensioners. The SDM contains a sensing device that converts vehicle velocity changes to an electrical signal. The SDM compares these signals to values stored in memory. If the signals exceed a stored value, the SDM will determine the severity of the impact and either cause current to flow through the frontal deployment loops deploying the frontal air bags and pretensioners, or it will deploy the pretensioners only. The SDM continuously monitors the deployment loops for malfunctions and illuminates the SIR system AIR BAG indicator if a fault is detected.The SDM performs continuous diagnostic monitoring of the SIR system electrical components. Upon detection of a circuit malfunction, the SDM will set a DTC and inform the driver by illuminating the SIR system AIR BAG indicator. The steering column and knee bolsters are designed to absorb energy and compress during frontal collisions in order to limit leg movement and decrease the chance of injury to the driver and passenger.

SIR System AIR BAG Indicator

The SIR system AIR BAG indicator, located in the instrument cluster, is used to notify the driver of SIR system malfunctions and to verify that the inflatable restraint sensing and diagnostic module (SDM) is communicating with the instrument cluster. When the ignition is turned ON, the SDM is supplied with ignition positive voltage. The instrument cluster will momentarily turn on the SIR system AIR BAG indicator. While the indicator is on, the SDM conducts tests on all SIR system components and circuits. If no malfunctions are detected the SDM will communicate with the instrument cluster through the serial data circuit and command the SIR system AIR BAG indicator OFF. The SDM provides continuous monitoring of the air bag circuits by conducting a sequence of checks. If a malfunction is detected the SDM will store a diagnostic trouble code (DTC) and command the instrument cluster to illuminate the SIR system AIR BAG indicator via serial data. The presence of a SIR system malfunction could result in non-deployment of the air bags or deployment in conditions less severe than intended. The SIR system AIR BAG indicator will remain ON until the malfunction has been repaired.

Inflatable Restraint Sensing and Diagnostic Module (SDM)

The inflatable restraint sensing and diagnostic module (SDM) is a microprocessor and the control center for the supplemental inflatable restraint (SIR) system. The SDM contains internal sensors along with external impact sensors, mounted at strategic locations on the vehicle. In the event of a collision, the SDM compares the signals from the internal and external impact sensors to a value stored in memory. When the generated signals exceed the stored value, the SDM will cause current to flow through the appropriate deployment loops to deploy the air bags. The SDM records the SIR system status when a deployment occurs and illuminates the SIR system AIR BAG indicator located in the instrument cluster. The SDM performs continuous diagnostic monitoring of the SIR system electrical components and circuitry when the ignition is turned ON. If the SDM detects a malfunction, a DTC will be stored and the SDM will request the instrument cluster to illuminate the SIR system AIR BAG indicator, notifying the driver that a malfunction exists. In the event that ignition positive voltage is lost during a collision, the SDM maintains a 23-volt loop reserve for deployment of the air bags. It is important when disabling the SIR system for servicing or rescue operations to allow the 23-volt loop reserve to dissipate, which could take up to 1 minute.

Air Bags

This vehicle contains 10 air bags. The 10 air bags are located in the steering wheel (dual inflators), instrument panel (passenger side) (dual inflators), driver side (B-pillar), passenger side (B-pillar), driver side (C-pillar), passenger side (C-pillar), driver side knee, passenger side knee, left roof rail, and right roof rail. To view the locations of the air bags refer to **Master Electrical Component List** . Air bags contain a housing, inflatable air bag, two initiating devices (if dual air bags), canister of gas generating material and, in some cases, stored compressed gas. The deployment loops supply current to deploy the air bags. The driver steering wheel and passenger instrument panel air bags have two stages of deployment, which varies the amount of restraint to the occupant according to the collision severity. For moderate frontal collisions the air bags deploy at less than full deployment which consists of stage 1 of the air bag. For more severe frontal collisions a full deployment is initiated which consists of stage 1 and stage 2 of the air bag. The current passing through the air bags ignite the material in the canister producing a rapid generation of gas and is some cases, the release of compressed gas. The gas produced from this reaction rapidly inflates the air bag. Once the air bag is inflated it quickly deflates through the air bag vent holes and/or the bag fabric. A shorting bar (if equipped) is located in the connector.

Seat Belt Pretensioners (Anchor and Retractor)

The seat belt pretensioners (driver and passenger) consist of a housing, seat belt retractor (located in the B-pillar), seat belt anchor (located on the floor), seat belt webbing, an initiator, and a canister of gas generating materials. To view the locations of the seat belt pretentioners refer to Master Electrical Component List . The initiator is part of the seat belt pretensioner deployment loop. When the vehicle is involved in a collision of sufficient force, the SDM causes current to flow through the seat belt deployment loops to the initiator. Current passing through the initiator ignites the material in the canister producing a rapid generation of gas. The gas produced from this reaction deploys the seat belt pretensioners which removes all of the slack in the seat belts. Depending on the severity of the collision, the seat belt pretensioners may deploy without the frontal air bags deploying, or they will deploy immediately before the frontal air bags deploy. A shorting bar (if equipped) is located in the connector.

Impact Sensors

There are multiple impact sensors which may be located in the front of the vehicle, in the front doors or on the B-pillar, and on the C-pillar depending on the vehicle configuration. To view the locations of the impact sensors refer to Master Electrical Component List . The front of vehicle, B-pillar, and C-pillar impact sensors contain a sensing device which monitors vehicle acceleration to detect collisions that are severe enough to warrant air bag deployment. The front door impact sensors contain a sensing device which monitors the door cavity air pressure change to detect side collisions that are severe enough to warrant air bag deployment. It is important when working on components in the door to make sure any items which have a sealing impact on the door (water deflector, exterior door handle, speaker, door harness grommet, or sealing strip) are securely fastened when reinstalled. The impact sensors are not part of the deployment loop, but instead provide input to the Inflatable Restraint Sensing and Diagnostic Module (SDM). The Inflatable Restraint Sensing and Diagnostic Module contains a microprocessor that performs calculations using the measured inputs from acceleration and pressure sensors. When the generated calculations exceed the stored value, the Inflatable Restraint Sensing and Diagnostic Module will cause current to flow through the deployment loops deploying the appropriate air bags.

Passenger Presence Detection System and Passenger Air Bag Indicator

NOTE: **The passenger presence system (PPS) is a calibrated unit. When replacing the assembly all parts in the service kit must remain together. Do not mix any of the old parts with the new parts. After repairing or replacing the PPS, the Preload test must be performed in order to function properly.**

The passenger presence system (PPS) is used to monitor the type of occupant that is sitting in the front passenger seat and communicate the status to the inflatable restraint sensing and diagnostic module (SDM). The SDM then uses this information to determine whether to enable or suppress the deployment of the passenger instrument panel air bag. PPS consists of an electronic control module, a sensor mat in the seat, a harness, and PASSENGER AIR BAG ON/OFF indicators. PPS transmits and receives a low-level electric field. The measured capacitance value of this field is used to determine the type of occupant sitting in the front passenger seat. If the measured capacitance is less than a calibrated value, then the passenger presence module will send a serial data signal to the SDM to disable the passenger instrument panel air bag. If the measured capacitance is greater than a calibrated value, then the passenger presence module will send a serial data signal to the SDM to enable the passenger instrument panel air bag. The SDM will notify the customer of the enable/disable status by illuminating one of the PASSENGER AIR BAG ON/OFF indicator. The PPS monitors itself for faults and will displays diagnostic trouble codes (DTCs) onthe scan tool. When a fault is detected, the passenger presence module sends out a message to the SDM. The SDM responds by sending a command message to the IPC to illuminate the SIR system AIR BAG indicator.

Seat Belt Indicators

The seat belt indicators are controlled through the inflatable restraint sensing and diagnostic module (SDM). For further information on seat belt indicators refer to Seat Belt System Description and Operation .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

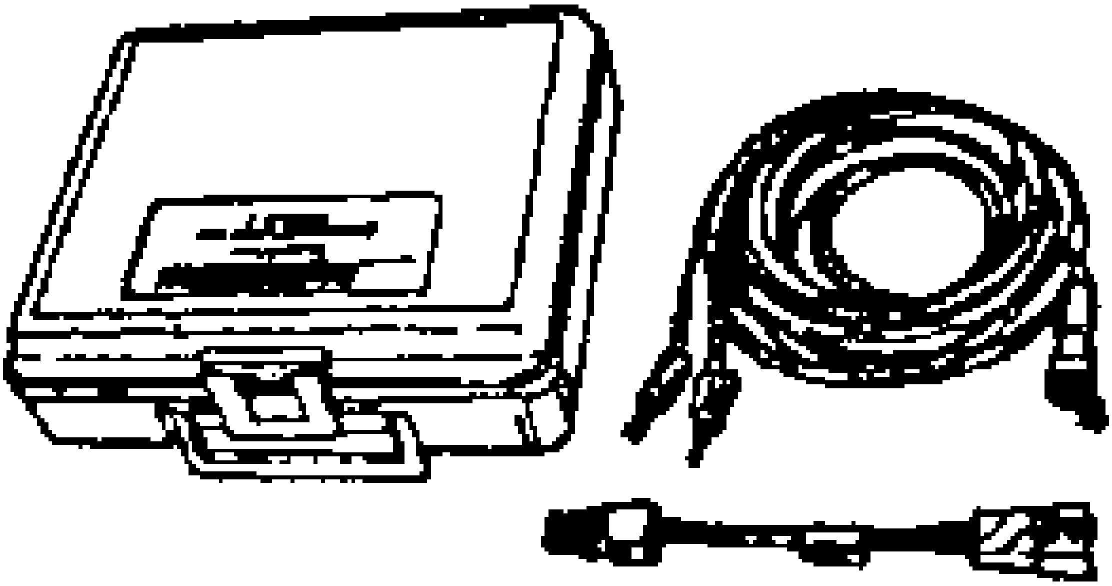
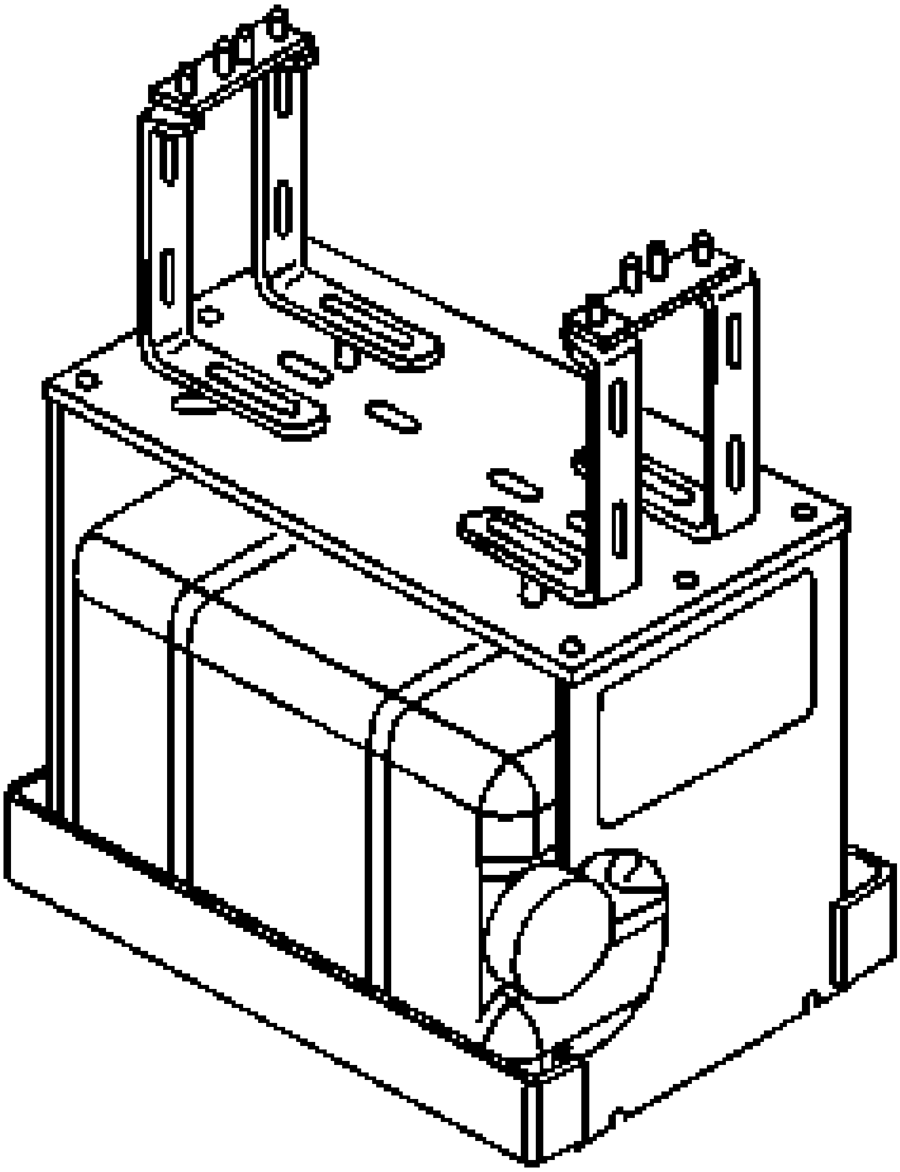
Illustration	Tool Number/ Description
	EL 38826 J 38826 KM 799-3 SIR Deployment Harness
	EL 39401-B J 39401-B SIR Deployment Fixture

Illustration	Tool Number/ Description
	

Back To Article

2017 STEERING

Power Steering - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Steering Gear Boot Inner Clamp

Reusable Threaded Fastener Tightening Specifications

Application	Specification Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Steering Gear Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	45 - 60 Degrees
Steering Linkage Inner Tie Rod	80 N.m (59 lb ft)
Steering Linkage Inner Tie Rod Nut	75 N.m (55 lb ft)
Steering Linkage Outer Tie Rod Nut	
• First Pass:	30 N.m (22 lb ft)
• Final Pass:	120 - 130 Degrees

SCHEMATIC WIRING DIAGRAMS

POWER STEERING WIRING SCHEMATICS

Power Steering

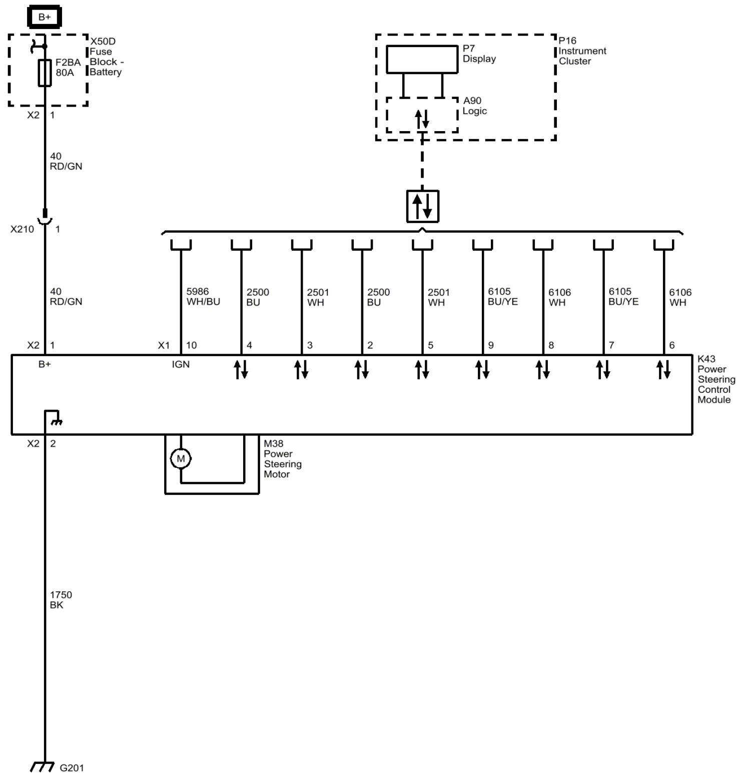

B+
X50D
Fuse
Block -
Battery
F2BA
80A
X2 1
40
RD/GN
X210 1
40
RD/GN
P7
Display
P16
Instrument
Cluster
A90
Logic
5986
WH/BU
2500
BU
2501
WH
2500
BU
2501
WH
6105
BU/YE
6106
WH
6105
BU/YE
6106
WH
X2 1
B+
X1 10
IGN
4
3
2
5
9
8
7
6
K43
Power
Steering
Control
Module
X2 2
M
M38
Power
Steering
Motor
1750
BK
G201

Fig. 1: Power Steering
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0176: CONTROL MODULE TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0176

Control Module Temperature Sensor

Symptom Byte Information: Symptom Byte List

Circuit/System Description

For an overview of the component/system, refer to: **Power Steering System Description and Operation**

Conditions for Running the DTC

- Ignition = On/Vehicle = Service Mode
- Engine = Running
- System Voltage = 9 to 16 V

Conditions for Setting the DTC

Power Steering Control Module Temperature = 115 to 125Â°C (240 to 257Â°F)

Actions Taken When the DTC Sets

Power Steering Output Torque = Reduced

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Diagnostic Aids

This DTC does not indicate any system malfunction.To avoid thermal damage, the power steering control module limits the current to the power steering motor.Aggressive steering may cause reduced steering assist.Discuss with the customer about the driving conditions when the concern occurred.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: **A DTC may set depending on certain driving conditions and would not require a component replacement.Aggressive steering may cause reduced steering assist.Discuss with the customer about the driving conditions when the concern occurred.**

1. Operate the vehicle within the Conditions for Running the DTC. Verify the DTC does not set.
    - **If the DTC sets**
    1. Ignition/Vehicle - Off
    2. Verify the following conditions do not exist: Steering = Binding or Sticking
        - If a condition exists - Refer to: **Steering Effort Hard or Too Easy in One or Both Directions**
        - If no condition exists - Replace the component: K43 Power Steering Control Module
    - **If the DTC is not set**
2. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

- For control module replacement, programming, and setup refer to: **Control Module References**

DTC C0460: STEERING WHEEL ANGLE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0460

Steering Wheel Angle Sensor

Symptom Byte Information: Symptom Byte List

Circuit/System Description

For an overview of the component/system, refer to: **ABS Description and Operation**

Conditions for Running the DTC

- K17 Electronic Brake Control Module = During control module power up
- Ignition Voltage = Greater than 8 V
- Vehicle Speed = Greater than 20 km/h (12 MPH)

Conditions for Setting the DTC

C0460 4B

Steering Wheel Angle Sensor = Calibration Not Learned

C0460 58

Steering Wheel Angle Sensor = Performance

C0460 5A

Steering Wheel Angle Sensor Signal = Not Plausible

Action Taken When the DTC Sets

Active Return and Software Endstops = Not Available

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

C0460 4B

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0460 is not set.
   - **If the DTC is set**
   1. Perform the following procedure/test: **Power Steering Control Module Calibration**
   2. Verify the DTC does not set.
      - If the DTC sets - Replace the component: Steering Column
      - If the DTC is not set
   3. All OK.
   - **If the DTC is not set**
3. All OK.

C0460 58

NOTE: **Inspect the electrical connectors and the ground circuits of the component for poor connections.**

1.
2. Ignition - On / Vehicle - In Service Mode
3. Verify DTC C0460 58 is not set.
   - **If the DTC is set**

     Replace the component: Steering Gear

   - **If the DTC is not set**
4. Ignition/Vehicle - On
5. Rotate the steering wheel from left to right. Verify the scan tool parameter: Steering Wheel Angle - IncreaseorDecrease
   - If the parameter value does not change

     Replace the component: Steering Gear

   - If the parameter value changes
6. All OK.

C0460 5A

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0460 5A is not set.
   - **If the DTC is set**
   1. Verify the following conditions do not exist: Front wheel alignment - Incorrect adjustment - Refer to: **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment**
   2. Verify the scan tool parameter: Steering Wheel Angle = 0 degrees
      - **If not 0 Â°**
   3. Perform the following procedure/test: **Power Steering Control Module Calibration**
   4. Verify the DTC does not set.
      - If the DTC sets - Replace the component: Steering Gear
      - If the DTC does not set
   5. All OK.
   - **If 0 Â°**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: **Diagnostic Repair Verification**

Steering Column Replacement

For control module replacement, programming, and setup refer to: **Control Module References**

DTC C0545: STEERING WHEEL TORQUE SENSOR

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: **Diagnostic System Check - Vehicle**
- Review the description of Strategy Based Diagnosis: **Strategy Based Diagnosis**
- An overview of each diagnostic category can be found here: **Diagnostic Procedure Instructions**

DTC Descriptor

DTC C0545

Steering Wheel Torque Sensor

Symptom Byte Information: **Symptom Byte List**

Circuit/System Description

For an overview of the component/system, refer to: **Power Steering System Description and Operation**

Conditions for Running the DTC

Ignition = On

Conditions for Setting the DTC

- Steering Wheel Torque Sensor = Short to Ground
- Steering Wheel Torque Sensor = Short to Voltage
- Steering Wheel Torque Sensor = Open/High Resistance

Action Taken When the DTC Sets

Power Steering Output Torque = Disabled

Conditions for Clearing the DTC

- A current DTC will clear on the next malfunction-free ignition cycle.
- A history DTC will clear after 40 consecutive malfunction-free ignition cycles.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References

Circuit/System Verification

NOTE: **Inspect the electrical connectors and the ground circuits of the component for poor connections.**

1. Ignition - On / Vehicle - In Service Mode
2. Verify DTC C0545 is not set.
   - **If the DTC is set**
   1. Rotate the steering wheel from left to right. Verify the scan tool parameter: Steering Input Torque - Increase
      - If the parameter value does not change

        Replace the component: Steering Column

      - If the parameter value changes
   2. All OK.
   - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair: Diagnostic Repair Verification

- Steering Column Replacement
- For control module replacement, programming, and setup refer to: Control Module References

DTC C056E: ELECTRONIC CONTROL UNIT SOFTWARE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provide an overview of each diagnostic category.

DTC Descriptors

DTC C056E

Electronic Control Unit Software

For symptom byte information, refer to Symptom Byte List .

Circuit/System Description

After replacement of the power steering control module, the power steering control module must be configured with the proper tuning profile using the service programming system (SPS).

After replacement of the power steering control module, power steering motor, or steering gear, the steering position/torque sensor calibration procedure must be performed.

Conditions for Running the DTC

Ignition OFF, ACCESSORY, or RUN mode.

Conditions for Setting the DTC

The power steering control module has detected missing calibration data, calibration procedure not run or completed, missing VIN, or internal software malfunction.

Actions Taken When DTC Sets

- DTC is stored in memory.
- Steering assist is set to a default level.

Conditions for Clearing the DTC

A current or history DTC will clear after the power steering control module has been programmed and calibrated.

Reference Information

Schematic Reference

Power Steering Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Steering System Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that DTC C056E is not set.
   - **If the DTC C056E is set**
   1. Program the K43 Power Steering Control Module.
   2. Verify the DTC does not set.
      - If the DTC sets, replace the K43 Power Steering Control Module.
      - If the DTC does not set
   3. All OK.
   - **If the DTC C056E is not set**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Control Module References for control module replacement, programming and setup.

SYMPTOMS - POWER STEERING SYSTEM

NOTE: **Review the system description and operation in order to familiarize yourself with the system functions. Refer to Power Steering System Description and**

Operation.

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Rattle, Clunk, Pop or Shudder Noise from the Power Steering System**
- **Whine or Growl Noise from the Power Steering System**
- **Increase in Effort While Turning Steering Wheel**
- **Poor Return of Steering Wheel**
- **Steering Wheel Surges/Jerks While Turning**
- **Steering Effort Hard or Too Easy in One or Both Directions**

RATTLE, CLUNK, POP OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM

Step	Action	Yes	No
1	Did you review the Power Steering System Symptoms and perform the necessary inspections?	Go to Step 2	Go to **Symptoms - Power Steering System**
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to Step 3	System OK
3	Inspect the power steering gear for the proper installation. Refer to **Steering Gear Replacement**. Is the power steering gear installation incorrect?	Go to Step 6	Go to Step 4
4	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to Step 8	Go to Step 5
5	Inspect the suspension. Is the suspension worn?	Go to Step 7	Go to **Noise Diagnosis - Front Suspension**
6	Install the power steering gear correctly. Refer to **Steering Gear Replacement**. Did you complete the repair?	Go to Step 9	-
7	Replace the worn suspension components. Did you complete the repair?	Go to Step 9	-
8	Replace the intermediate shaft. Refer to **Intermediate Steering Shaft Replacement** . Did you complete the repair?	Go to Step 9	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 3

WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

Step	Action	Yes	No
1	Did you review the Power Steering System Symptoms and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Power Steering System**.
2	Verify that a whine or a growl noise is present. Is a whine or a growl noise present?	Go to **Step 3**	System OK

Step	Action	Yes	No
3	Inspect the power steering gear for the proper installation. Refer to **Steering Gear Replacement**. Is the power steering gear installation incorrect?	Go to **Step 6**	Go to **Step 4**
4	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to **Step 8**	Go to **Step 5**
5	Inspect the suspension. Is the suspension worn?	Go to **Step 7**	Go to **Noise Diagnosis - Front Suspension** .
6	Install the power steering gear correctly. Refer to **Steering Gear Replacement**. Did you complete the repair?	Go to **Step 9**	-
7	Replace the worn suspension components. Did you complete the repair?	Go to **Step 9**	-
8	Replace the intermediate shaft. Refer to **Intermediate Steering Shaft Replacement** . Did you complete the repair?	Go to **Step 9**	-
9	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

INCREASE IN EFFORT WHILE TURNING STEERING WHEEL

Step	Action	Yes	No
1	Did you review the Power Steering System Description and Operation and perform the necessary inspections?	Go to **Step 2**	Go to **Power Steering System Description and Operation**
2	Verify that there is an increase in effort while turning is present. Does the system operate normally?	System OK	Go to **Step 3**
3	Check for the following conditions: • Incorrect tire inflation - Refer to **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label** . • Improper tire size Did you find and correct the condition?	Go to **Step 10**	Go to **Step 4**
4	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Check for a binding or worn steering linkage outer tie rod. Is the tie rod binding or worn?	Go to **Step 7**	Go to **Step 5**
5	Check for a worn or binding intermediate steering shaft. Is the intermediate steering shaft worn or binding?	Go to **Step 8**	Go to **Step 6**
6	Check for a worn or binding steering gear. Is the steering gear worn or binding?	Go to **Step 9**	System OK
7	Replace the steering linkage outer tie rod. Refer to **Steering Linkage Outer Tie Rod Replacement**. Did you complete the repair?	Go to **Step 10**	-
8	Replace the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement** . Did you complete the repair?	Go to **Step 10**	-

Step	Action	Yes	No
9	Replace the steering gear. Refer to **Steering Gear Replacement**. Did you complete the repair?	Go to **Step 10**	-
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

POOR RETURN OF STEERING WHEEL

Step	Action	Yes	No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to center.			
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Power Steering System Description and Operation**
2	Verify that poor return of the steering wheel is present. Does the system operate normally?	System OK	Go to **Step 3**
3	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Lubricate the tie rod ends and ball joints, if applicable. 3. Inspect the suspension system for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 4**
4	1. Rotate the steering wheel ONE revolution in both directions. 2. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to **Step 5**	Go to **Step 10**
5	**NOTE:** **Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center.** 1. Disconnect the intermediate shaft from the steering column. 2. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. 3. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction?	Go to **Step 11**	Go to **Step 6**
6	Inspect the intermediate shaft for stiff or loose joints. Repair or replace as necessary. Refer to **Intermediate Steering Shaft Replacement** . Did you find and complete the repair?	Go to **Step 12**	Go to **Step 7**

Step	Action	Yes	No
7	1. Remove the front tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** . 2. Disconnect both outer tie rod ends from the steering knuckles. 3. Use your hands in order to move the tie rod end studs. 4. If abnormally difficult to move, replace the tie rod end. Refer to **Steering Linkage Outer Tie Rod Replacement**. Did you find and complete the repair?	Go to **Step 12**	Go to **Step 8**
8	1. Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a binding strut bearings, ball joints, or axle. 2. Repair or replace any abnormally stiff or loose components. Did you find and complete the repair?	Go to **Step 12**	Go to **Step 9**
9	Inspect for binding in the steering gear. If a binding is present repair or replace the steering gear. Refer to **Steering Gear Replacement**. Did you find and complete the repair?	Go to **Step 12**	Go to **Step 10**
10	Inspect the wheel alignment and adjust as necessary. Refer to **Wheel Alignment Measurement** . Did you find and complete the repair?	Go to **Step 12**	-
11	Inspect the steering column for a binding. If a binding is present, repair or replace the steering column as necessary. Refer to **Steering Column Replacement** . Did you find and complete the repair?	Go to **Step 12**	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

STEERING WHEEL SURGES/JERKS WHILE TURNING

Step	Action	Yes	No
1	Did you perform the Diagnostic Starting Point - Power Steering System?	Go to **Step 2**	Go to **Symptoms - Power Steering System**
2	Verify that the steering wheel surges/jerks while turning. Does the system operate normally?	System OK	Go to **Step 3**
3	Check for worn or binding front suspension components. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 4**
4	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** . 2. Check for a binding or worn rack and pinion outer tie rod end. Is the rack and pinion outer tie rod end binding or worn?	Go to **Step 10**	Go to **Step 5**

Step	Action	Yes	No
5	Check for a worn or binding intermediate steering shaft. Is the intermediate steering shaft worn or binding?	Go to **Step 11**	Go to **Step 6**
6	Check for a worn or binding steering gear. Is the steering gear worn or binding?	Go to **Step 12**	Go to **Step 7**
7	Check for a worn or binding steering column. Is the steering column worn or binding?	Go to **Step 13**	Go to **Step 8**
8	Check for excessive heat in the electric power steering (EPS) motor. Does the EPS motor appear to be overheated?	Go to **Step 9**	Go to **Step 13**
9	**NOTE:** **Do not perform excessive parking lot maneuvers during testing, that can cause the EPS motor to heat up.** Allow the EPS motor to cool and retest the system.Did you correct the condition?	Go to **Step 14**	Go to **Step 13**
10	Replace the steering linkage outer tie rod end. Refer to **Steering Linkage Outer Tie Rod Replacement**. Did you complete the repair?	Go to **Step 14**	-
11	Replace the intermediate steering shaft. Refer to **Intermediate Steering Shaft Replacement** . Did you complete the repair?	Go to **Step 14**	-
12	Replace the steering gear. Refer to **Steering Gear Replacement**. Did you complete the repair?	Go to **Step 14**	-
13	Replace the steering column. Refer to **Steering Column Replacement** . Did you complete the repair?	Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

STEERING EFFORT HARD OR TOO EASY IN ONE OR BOTH DIRECTIONS

Condition	Action
The battery power is low.	Ensure proper battery voltage.
One or both of the intermediate steering shaft boots are binding.	Adjust or replace the intermediate steering shaft boots and/or intermediate steering shaft. Refer to **Intermediate Steering Shaft Inner Boot Replacement** , and **Intermediate Steering Shaft Replacement** .
The intermediate steering shaft joints and/or fasteners are worn or binding.	Tighten or replace the intermediate steering shaft joints and/or fasteners. Refer to **Intermediate Steering Shaft Replacement** .
The steering gear is binding.	Replace the steering gear. Refer to **Steering Gear Replacement**.
The upper steering shaft is bent.	Replace the steering column. Refer to **Steering Column Replacement** .
The connectors to the power steering assist motor are damaged or disconnected.	Verify the connectors are properly connected. Verify the connectors are not damaged. If the connectors are damaged, replace the connectors.
The power steering control module is malfunctioning.	Confirm the DTC. Replace the steering column. Refer to **Steering Column Replacement** .
The power steering assist motor shaft is binding.	Confirm the DTC. Replace the steering column. Refer to **Steering Column Replacement** .

REPAIR INSTRUCTIONS

STEERING LINKAGE OUTER TIE ROD REPLACEMENT

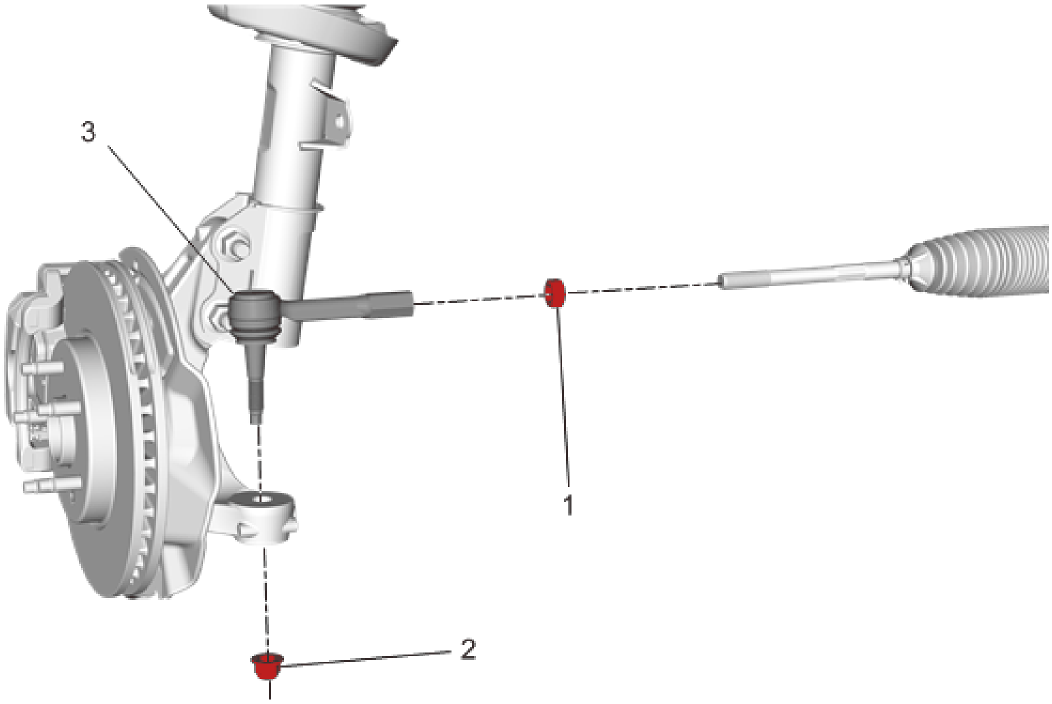


Fig. 2: Steering Linkage Outer Tie Rod
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Raise and support the vehicle. Lifting and Jacking the Vehicle
2. Remove the front tire and wheel assembly. Tire and Wheel Removal and Installation</td></tr>
<tr><td>1</td><td>Steering Linkage Inner Tie Rod Nut
CAUTION:
Refer to Fastener Caution .
NOTE:
Mark the position of the steering linkage inner tie rod nut before removing to aid in installation.
Tighten
75 N.m (55 lb ft)</td></tr>
<tr><td>2</td><td>Steering Linkage Outer Tie Rod Nut
Tighten
1. First Pass: 30 N.m (22 lb ft)
2. Final Pass: 120 - 130 Degrees</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Callout	Component Name
3	Steering Linkage Outer Tie Rod **Procedure** **NOTE:** **The CH-42188-B tie rod end joint / ball joint remover works by putting the nut back on.** 1. Use **CH-42188-B** tie rod end joint / ball joint remover to separate the steering linkage outer tie rod from the steering knuckle. 2. Clean the tapered surface of the steering knuckle. 3. Inspect the steering linkage inner tie rod for bent or damaged threads. If necessary, replace the steering linkage inner tie rod. **Steering Linkage Inner Tie Rod Replacement** 4. Measure and adjust the front toe. **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment** 5. Calibrate the steering angle sensor. **Steering Wheel Angle Sensor Centering** **Special Tools** **CH-42188-B** Tie Rod End Joint / Ball Joint Remover Equivalent regional tools: **Special Tools**

STEERING GEAR BOOT REPLACEMENT

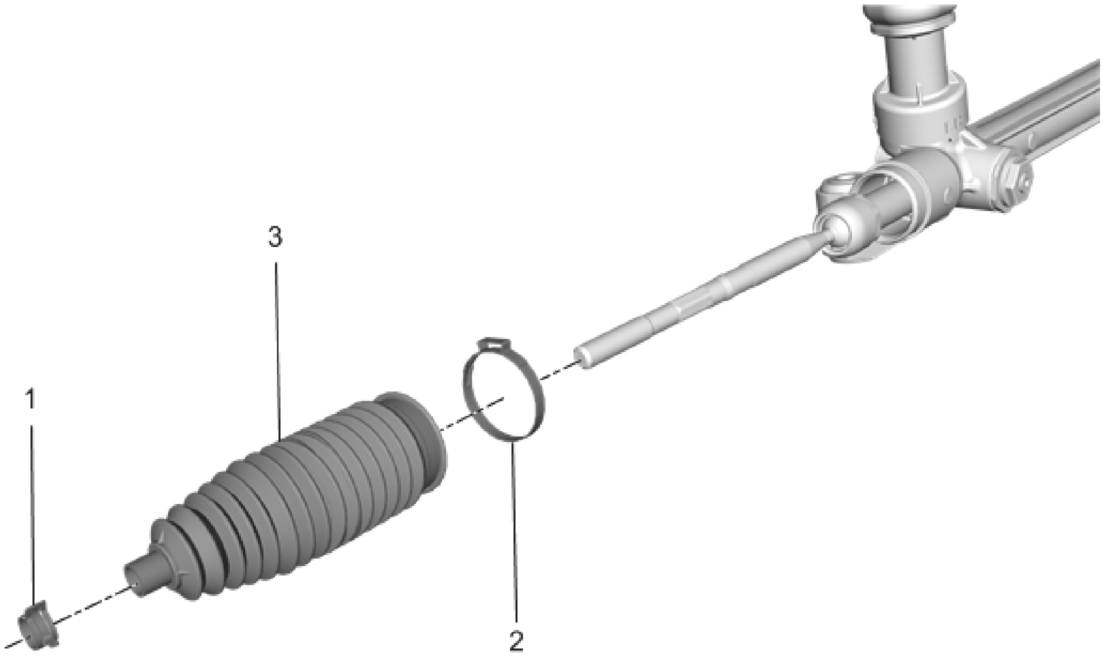


Fig. 3: Steering Gear Boot
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - **Drivetrain and Front Suspension Frame Removal and Installation** 2. **Steering Linkage Outer Tie Rod Replacement**	

Callout	Component Name
1	Steering Gear Boot Outer Clamp
2	Steering Gear Boot Inner Clamp **Procedure** 1. Cut the steering gear boot inner clamp and discard the clamp. 2. Use the **CH-804** boot clamp plier to install a NEW steering gear boot inner clamp. **Special Tools** **CH-804** Boot Clamp Plier Equivalent regional tools: **Special Tools**
3	Steering Gear Boot **Procedure** 1. Inspect the steering linkage inner tie rod for evidence of corrosion or contamination. If corrosion or contamination is evident, replace the steering linkage inner tie rod. **Steering Linkage Inner Tie Rod Replacement** 2. Install the inner boot clamp loosely onto the boot prior to installation. 3. Ensure the steering gear boot is seated in the appropriate groove on the steering gear before installing the steering gear boot clamp.

STEERING GEAR REPLACEMENT

Removal Procedure

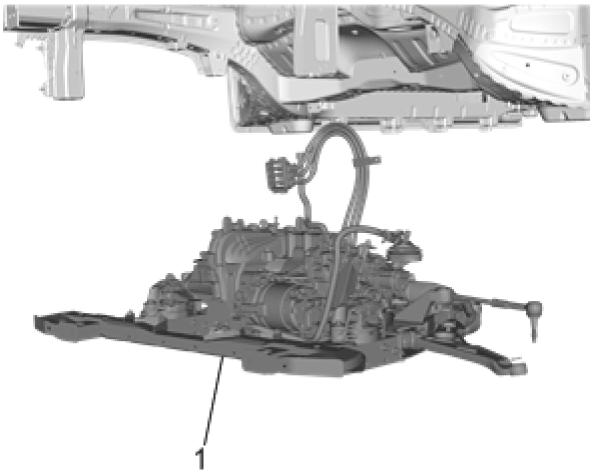


Fig. 4: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - **Drivetrain and Front Suspension Frame Removal and Installation**

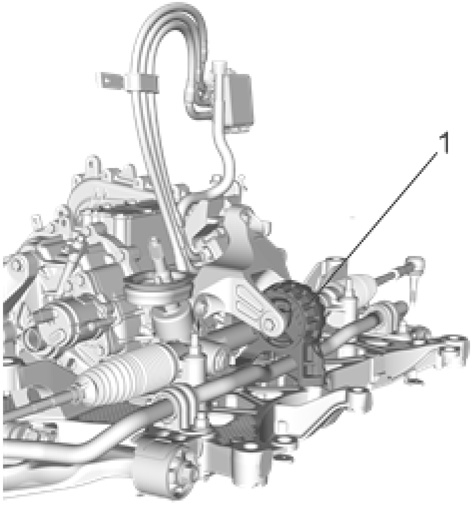


Fig. 5: Drive Motor Rear Mount
Courtesy of GENERAL MOTORS COMPANY

2. Drive Motor Rear Mount - Remove - **Drive Motor Rear Mount Replacement**

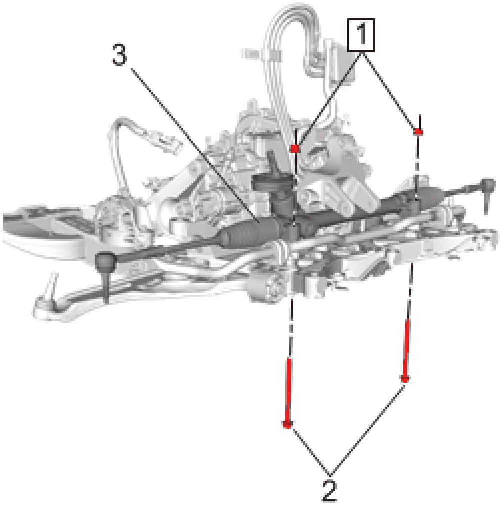
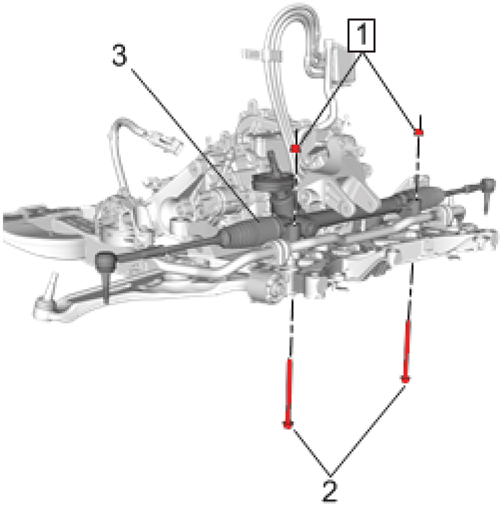


Fig. 6: Steering Gear Nut
Courtesy of GENERAL MOTORS COMPANY

3. Steering Gear Nut - Remove
4. Steering Gear Bolt - Remove
5. Rack and Pinion Steering Gear at Drivetrain and Front Suspension Crossmember - Remove

Installation Procedure

1. Transfer components as necessary.

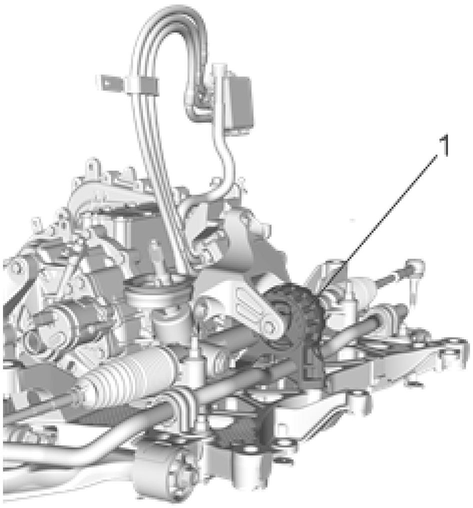


[Fig. 7: Steering Gear Nut]
Courtesy of GENERAL MOTORS COMPANY

2. Rack and Pinion Steering Gear at Drivetrain and Front Suspension Crossmember - Install
3. Steering Gear Bolt - Install
4. Steering Gear Nut - Install

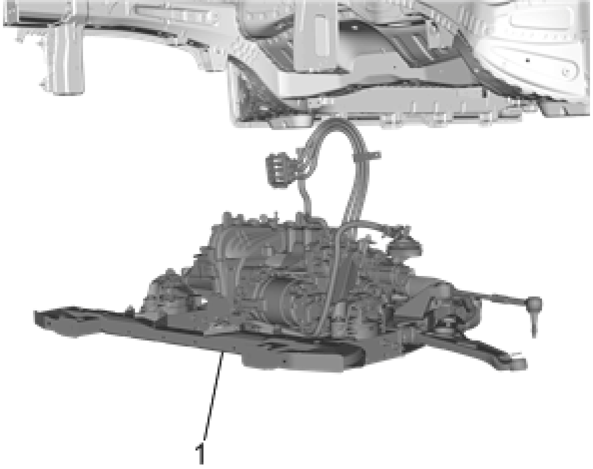
CAUTION: Fastener Caution

5. Steering Gear Bolt - Tighten
    1. First Pass: 100 N.m (74 lb ft)
    2. Final Pass: 45 - 60 Degrees



[Fig. 8: Drive Motor Rear Mount]
Courtesy of GENERAL MOTORS COMPANY

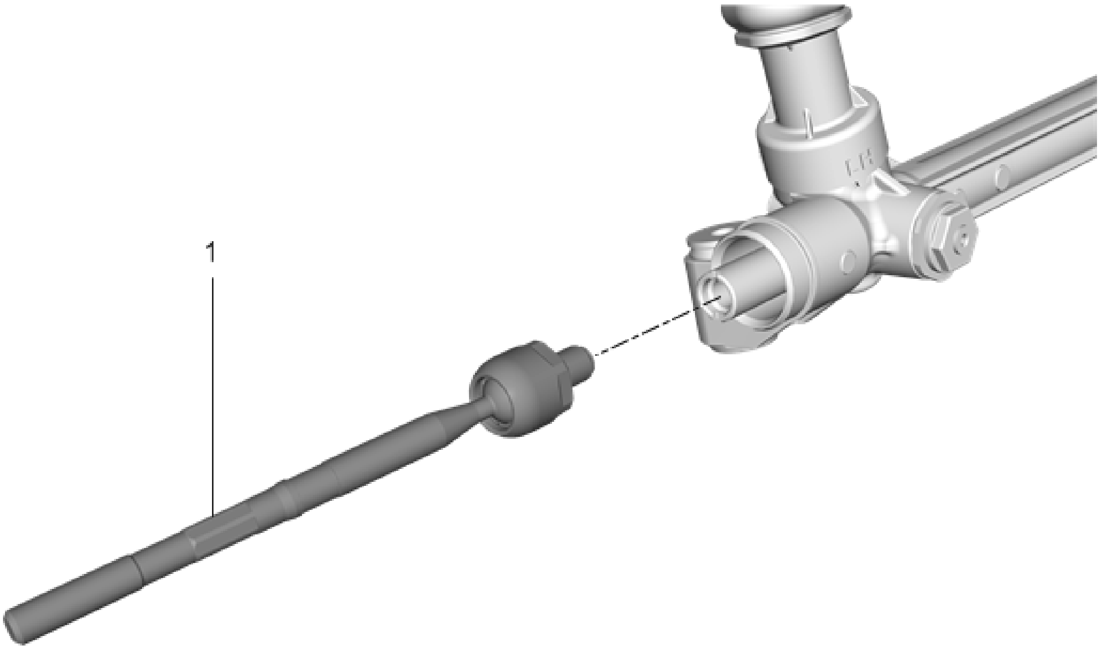
6. Drive Motor Rear Mount - Install - Drive Motor Rear Mount Replacement



[Fig. 9: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly](#)
Courtesy of GENERAL MOTORS COMPANY

7. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Install - **Drivetrain and Front Suspension Frame Removal and Installation**
8. Measure and adjust the front toe. **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment**
9. Calibrate the steering angle sensor. **Steering Wheel Angle Sensor Centering**

STEERING LINKAGE INNER TIE ROD REPLACEMENT



[Fig. 10: Steering Linkage Inner Tie Rod](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Automatic Transmission and Drivetrain and Front Suspension Frame Assembly - Remove - **Drivetrain and Front Suspension Frame Removal and Installation** 2. **Steering Linkage Outer Tie Rod Replacement** 3. **Steering Gear Boot Replacement**	
1	Steering Linkage Inner Tie Rod **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Place a wrench on the flats of the steering linkage inner tie rod housing. 2. Rotate the steering linkage inner tie rod housing counterclockwise to remove the steering linkage inner tie rod from the steering gear rack. 3. Rotate the steering linkage inner tie rod housing clockwise to install the steering linkage inner tie rod to the steering gear rack. 4. Use the **CH-41240-2** wrench and a torque wrench to tighten the steering linkage inner tie rod to specification. 5. Measure and adjust the front toe. **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment** **Tighten** 80 N.m (59 lb ft) **Special Tools** **CH-41240-2** Wrench Equivalent regional tools: **Special Tools**

POWER STEERING CONTROL MODULE CALIBRATION

Steering Angle Sensor Centering and Software Endstop Learning

WARNING: **An inaccurate or not centered steering angle sensor could limit the operation of the electric power steering and may result in personal injury.**

Centering of the steering angle sensor and software endstop learning might be required after certain service procedures are performed. Some of these procedures are as follows:

- Steering angle sensor replacement
- Steering gear replacement
- Power steering assist motor replacement
- Steering column replacement
- Steering linkage inner tie rod replacement
- Steering linkage outer tie rod replacement

NOTE: **It is necessary to perform the steering angle sensor centering BEFORE the software endstop learning.**

Internal Steering Angle Sensor Centering

NOTE: **Ensure the front wheels are facing straight ahead before turning the engine off.**

The centering procedure of the internal steering angle sensor can be completed with the following steps:

Conditions: Front axle measured and set, engine off, vehicle speed 0 km/h (0 MPH), internal steering angle sensor is activated.

1. Using the steering wheel, align the front wheels in the center forward position.
2. Using a scan tool, perform the Configuration/Reset Functions, Steering Wheel Angle Sensor Centering procedure.
3. Steer from the center position slowly 90Â° to the left.
4. Steer slowly back to the center position and then slowly 90Â° to the right.
5. Steer slowly back to the center position.
6. Perform the steering movements again.
7. Centering procedure is completed.

Software Endstop Learning

The software endstop learning procedure can be completed with the following steps:

Conditions: Front axle measured and set, vehicle speed 0 km/h (0 MPH), internal steering angle sensor is calibrated or external steering angle sensor sends a valid CAN signal.

1. Using a scan tool, perform the Configuration/Reset Functions, Power Steering Softstops Reset procedure and follow the on-screen instructions.
2. Rotate the steering wheel to the left until the endstop is reached and hold position for 2 seconds.
3. Rotate the steering wheel to the right until the endstop is reached and hold position for 2 seconds.
4. Return the steering wheel to the center position.
5. Software endstop learning procedure is completed.

DESCRIPTION AND OPERATION

POWER STEERING SYSTEM DESCRIPTION AND OPERATION

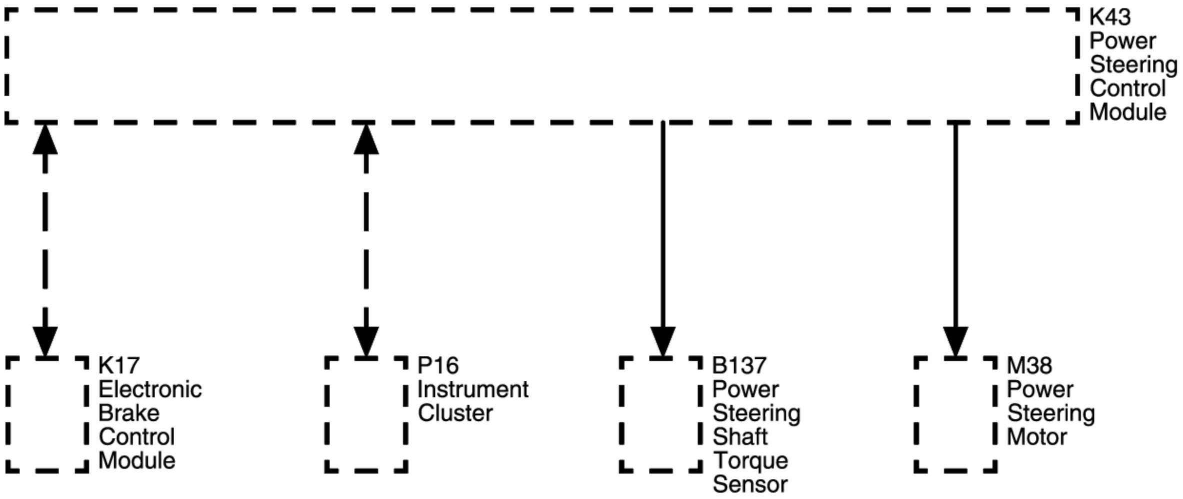

K43 Power Steering Control Module
K17 Electronic Brake Control Module
P16 Instrument Cluster
B137 Power Steering Shaft Torque Sensor
M38 Power Steering Motor

Fig. 11: Power Steering System Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
K43	K43 Power Steering Control Module
K17	K17 Electronic Brake Control Module
P16	P16 Instrument Cluster
B137	B137 Power Steering Shaft Torque Sensor
M38	M38 Power Steering Motor

The electric power steering system reduces the amount of effort needed to steer the vehicle. The system uses the body control module, power steering control module, torque sensor, discrete battery voltage supply circuit, electric power steering motor, serial data bus, and the instrument panel cluster message center to perform the system functions. Any electric power steering components diagnosed to be malfunctioning requires replacement of the steering column assembly, also known as the electric power steering assembly.

Torque Sensor

The power steering control module uses a torque sensor as it's main input for determining the amount of steering assist. The steering column has an input shaft, from the steering wheel to the torque sensor, and an output shaft, from the torque sensor to the steering shaft coupler. The input and output shafts are separated by a torsion bar, where the torque sensor is located. The sensor consists of a compensation coil, detecting coil and 3 detecting rings. These detecting rings have toothed edges that face each other. Detecting ring 1 is fixed to the output shaft, detecting rings 2 and 3 are fixed top the input shaft. The detecting coil is positioned around the toothed edges of detecting rings 1 and 2. As torque is applied to the steering column shaft the alignment of the teeth between detecting rings 1 and 2 changes, which causes the detecting coil signal voltage to change. The power steering control module recognizes this change in signal voltage as steering column shaft torque. The compensation coil is used to compensate for changes in electrical circuit impedance due to circuit temperature changes from the electrical current and voltage levels as well as ambient temperatures for accurate torque detection.

EPS Motor

The electric power steering motor is a 12-volt brushed DC reversible motor. The motor assists steering through a worm shaft and reduction gear located in the steering column housing.

Power Steering Control Module

The power steering control module uses a combination of torque sensor inputs, vehicle speed, calculated system temperature and the steering calibration to determine the amount of steering assist. When the steering wheel is turned, the power steering control module uses signal voltage from the torque sensor to detect the amount of torque being applied to the steering column shaft and the amount of current to command to the electric power steering motor. The power steering control module receives serial data from the engine control module to determine vehicle speed. At low speeds more assist is provided for easy turning during parking maneuvers. At high speeds, less assist is provided for improved road feel and directional stability. In this mode the power steering control module will limit the amount of current commanded to the electric power steering motor which reduces steering assist levels. The power steering control module also chooses which steering calibration to use when the ignition is turned ON, based on the production map number stored in the body control module. The power steering control module contains all 8 of the steering calibrations which are different in relation to the vehicles RPOs. The power steering control module has the ability to detect malfunctions within the electric power steering system. Any malfunction detected will cause the instrument panel cluster message center to display a warning message.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description

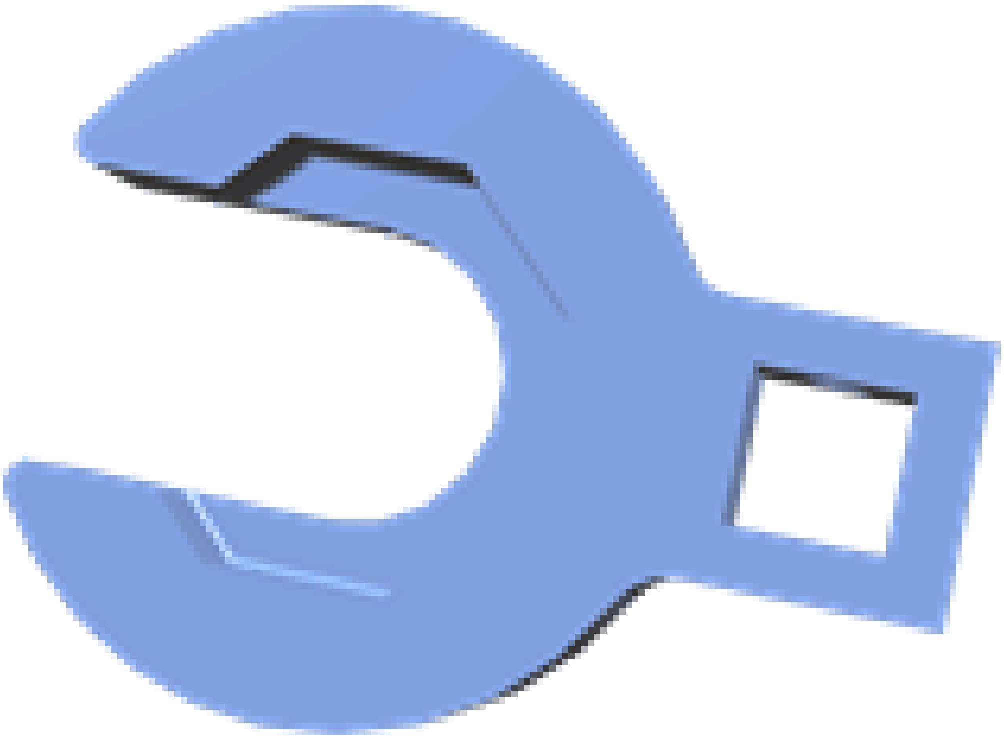
Illustration	Tool Number/ Description
	CH 41240-2 J 41240-2 Wrench

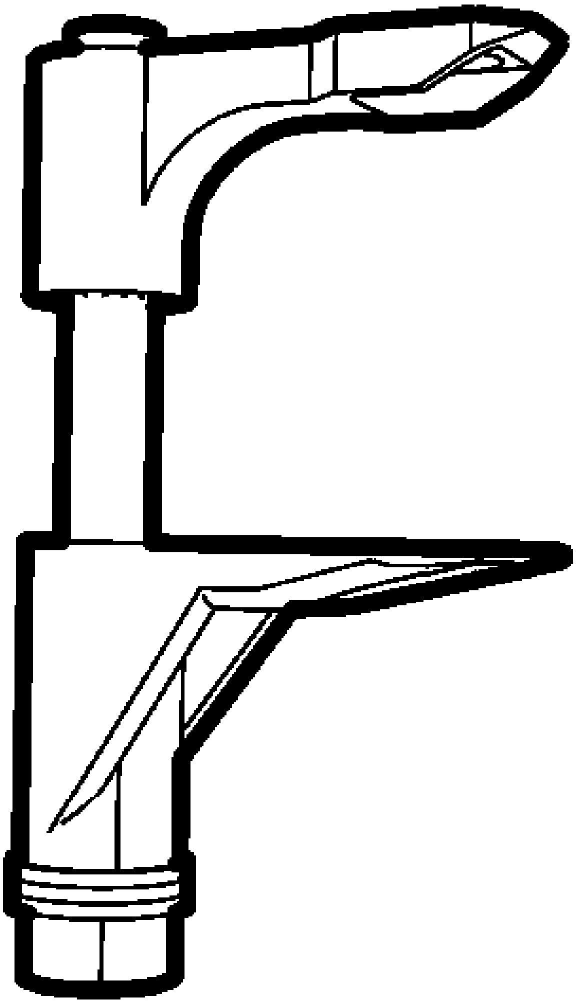
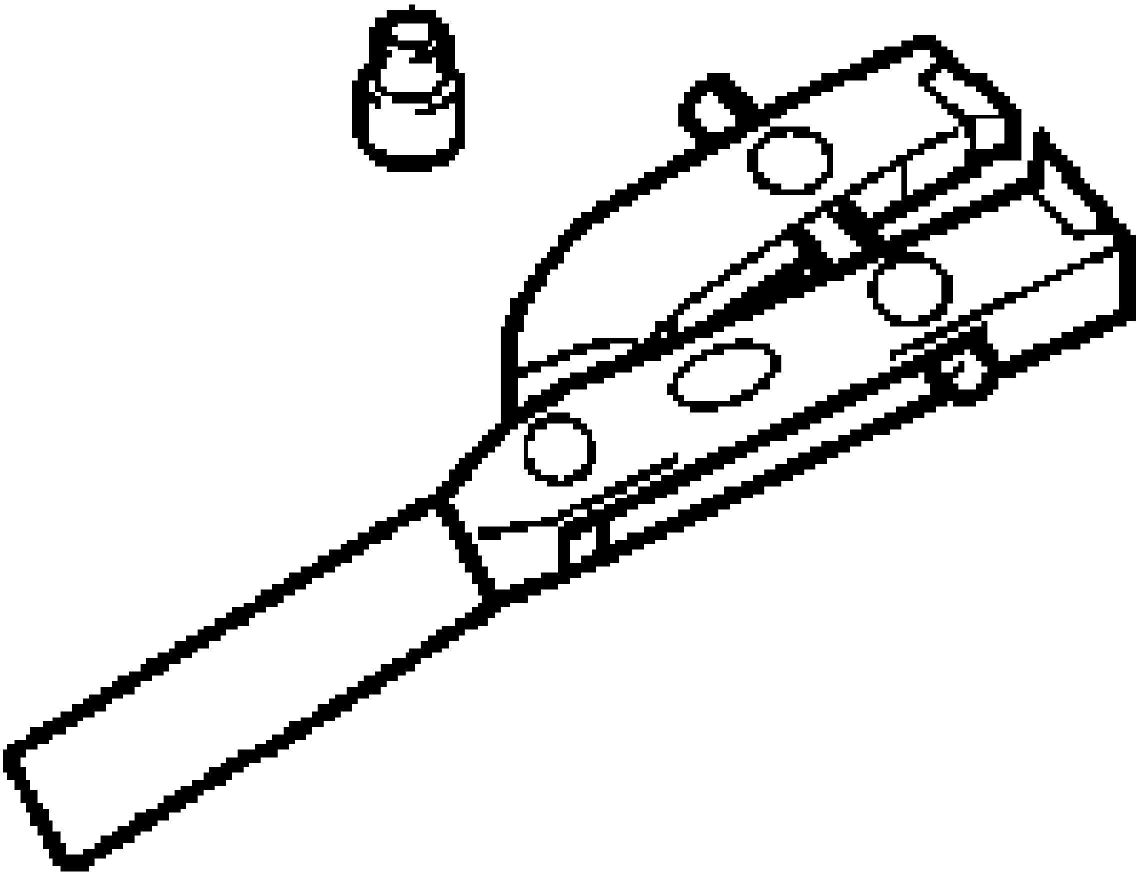
Illustration	Tool Number/ Description
	CH 42188-B J 42188-B CH 24319-B J 24319-B Tie Rod End Joint / Ball Joint Remover

Illustration	Tool Number/ Description
	CH 804 MKM 804 DT 35910 J 35910 Boot Clamp Plier

Back To Article

2017 STEERING

Steering Wheel and Column - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Instrument Panel Steering Column Lower Trim Cover Bolt	2.5 N.m (22 lb in)
Intermediate Steering Shaft Lower Bolt	57 N.m (42 lb ft)
Intermediate Steering Shaft Middle Bolt	49 N.m (36 lb ft)
Intermediate Steering Shaft Upper Bolt	49 N.m (36 lb ft)
Steering Column Lower Support Bracket Bolt	22 N.m (16 lb ft)
Steering Column Upper Support Bracket Nut	22 N.m (16 lb ft)
Steering Wheel Bolt	45 N.m (33 lb ft)

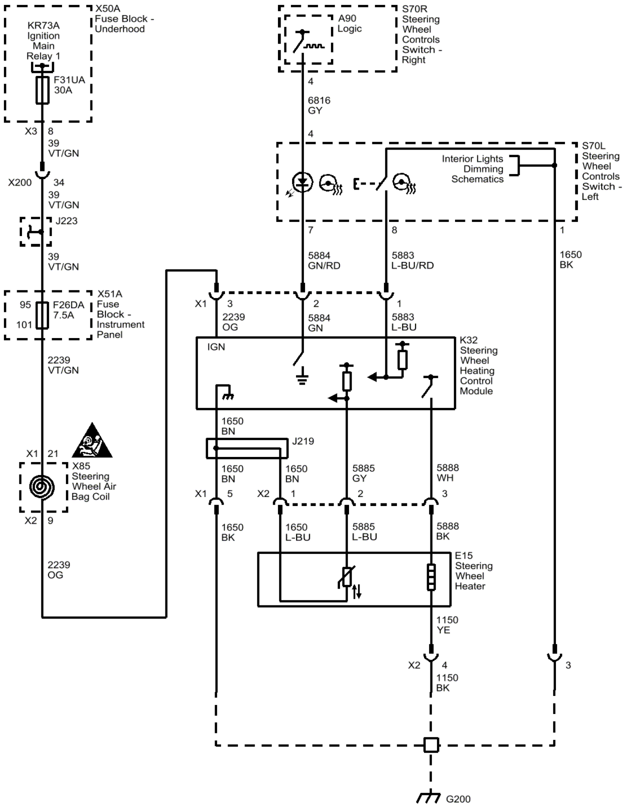
ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Steering Wheel Bolt	Thread Locking Adhesive	12345382	10953489

SCHEMATIC WIRING DIAGRAMS

STEERING WHEEL WIRING SCHEMATICS

Heated Steering Wheel (UVD)

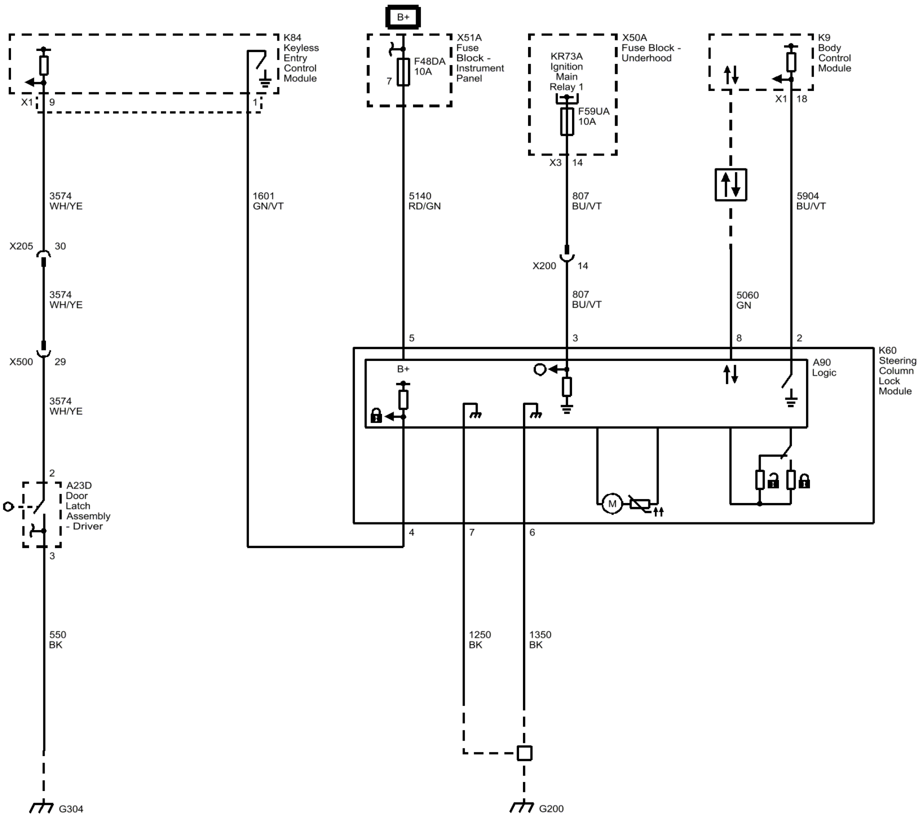

KR73A Ignition Main Relay 1
X50A Fuse Block - Underhood
F31UA 30A
X3 8
39 VT/GN
X200 34
39 VT/GN
J223
39 VT/GN
X51A Fuse Block - Instrument Panel
95
101
F26DA 7.5A
2239 VT/GN
X1 21
X85 Steering Wheel Air Bag Coil
X2 9
2239 OG
A90 Logic
S70R Steering Wheel Controls Switch - Right
4
6816 GY
4
Interior Lights Dimming Schematics
S70L Steering Wheel Controls Switch - Left
7
5884 GN/RD
8
5883 L-BU/RD
1
1650 BK
X1 3
2239 OG
2
5884 GN
1
5883 L-BU
IGN
K32 Steering Wheel Heating Control Module
1650 BN
J219
1650 BN
1650 BN
5885 GY
5888 WH
X1 5
X2 1
2
3
1650 BK
1650 L-BU
5885 L-BU
5888 BK
E15 Steering Wheel Heater
1150 YE
X2 4
3
1150 BK
G200

[Fig. 1: Heated Steering Wheel (UVD)](#)

Courtesy of GENERAL MOTORS COMPANY

COLUMN LOCK WIRING SCHEMATICS

Column Lock (NO6)


K84 Keyless Entry Control Module
X1 9
1
B+
X51A Fuse Block - Instrument Panel
F48DA 10A
7
KR73A Ignition Main Relay 1
X50A Fuse Block - Underhood
F59UA 10A
X3 14
K9 Body Control Module
X1 18
3574 WH/YE
1601 GN/VT
5140 RD/GN
807 BU/VT
5904 BU/VT
X205 30
X200 14
3574 WH/YE
807 BU/VT
5060 GN
X500 29
5
3
8
2
B+
A90 Logic
K60 Steering Column Lock Module
3574 WH/YE
2
A23D Door Latch Assembly - Driver
3
M
4
7
6
550 BK
1250 BK
1350 BK
G304
G200

[Fig. 2: Column Lock (NO6)](#)

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - STEERING WHEEL AND COLUMN

NOTE: **Review the system operation in order to familiarize yourself with the system functions.**

Refer to **Steering Wheel and Column Description and Operation**.

Symptoms List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **High Effort While Tilting Column**
- **Noise in Steering Column**
- **Looseness in Steering Column**

HEATED STEERING WHEEL INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Switch Signal	2	1	-	-
LED Control	3	3	4	-
Switch and LED Ground	-	1	-	-
Module Ground	-	1	-	-
1. Heated Steering Wheel System Inoperative 2. Heated Steering Wheel Always ON 3. LED Inoperative 4. LED Always ON				

Circuit/System Description

The Steering Wheel Heating Control Module controls the heated steering wheel and the heated steering wheel ON indicator based on an input from the heated steering wheel switch. When the heated steering wheel switch is pressed, the switch signal circuit is pulled to ground. This indicates to the heating steering wheel control module that steering wheel heat is requested. When the request is seen, the heated steering module supplies voltage to the indicator lamp and supplies voltage to the heating elements, which are internal to the steering wheel.

Reference Information

Schematic Reference

Steering Wheel Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel and Column Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

1. Ignition ON, heated steering wheel OFF.
2. Verify the steering wheel heater indicator on the S70L Steering Wheel Controls Switch - Left is not illuminated and the steering wheel is not warm.
   - **If the steering wheel is warm**

     Refer to Heated Steering Wheel Malfunction

   - **If the steering wheel is not warm and the steering wheel heater indicator is illuminated**

     Refer to Circuit/System Testing

   - **If the steering wheels heater indicator is not illuminated and the steering wheel is not warm**
3. Verify the steering wheel heater indicator turns ON and OFF and the left and right sides of the steering wheel become warm when pressing and releasing the steering wheel heater switch on the S70L Steering Wheels Controls Switch - Left.
   - **If the steering wheel does not become warm**

     Refer to Heated Steering Wheel Malfunction

   - **If the steering wheel becomes warm, but the steering wheel heater indicator does not turn ON and OFF**

     Refer to Circuit/System Testing

   - **If the steering wheel becomes warm and the steering wheel heater indicator turns ON and OFF**
4. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the X85 Steering Wheel Airbag Coil.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 9 and ground.
   - **If the test lamp does not illuminate and the circuit fuse is good**
   1. Ignition OFF, remove the test lamp.
   2. Test for less than 2 Ω in the ignition circuit end to end.
      - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse. Refer to Power Mode Mismatch .
      - If 2 Ω or greater
   3. Verify the in-line fuse is OK and there is voltage at the fuse.
      - If the in-line fuse is open, replace the K32 Steering Wheel Heating Control Module.

    - If the in-line fuse is OK, repair the open/high resistance in the circuit.
  - **If the test lamp does not illuminate and the circuit fuse is open**
  1. Ignition OFF.
  2. Test for infinite resistance between the ignition voltage circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K32 Steering Wheel Heating Control Module.
  - **If the test lamp illuminates**

5. Ignition OFF, connect the X2 harness connector at the X85 Steering Wheel Airbag Coil. Disconnect the harness connector at the S70L Steering Wheel Control Switch - Left. Ignition ON.
6. Test for B+ between the control circuit terminal 4 and ground.
  - **If less than B+**
  1. Ignition OFF, disconnect the harness connector at the S70R Steering Wheel Control Switch - Right.
  2. Test for infinite resistance between the control circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
  3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the S70R Steering Wheel Control Switch - Right.
  - **If B+**
7. Ignition OFF, connect the harness connector at the S70L Steering Wheel Control Switch - Left. Disconnect the harness connector at the K32 Steering Wheel Heating Control Module.

NOTE: **Verify the instrument panel dimming control is set to bright.**

8. Install a 3 A fused jumper wire between the control circuit terminal 2 and ground. Ignition ON.
9. Verify the steering wheel heat indicator is illuminated.
  - **If the steering wheel heat indicator does not illuminate**

    Replace the S70L Steering Wheel Control Switch - Left

  - **If the steering wheel heat indicator illuminates**
10. Replace the K32 Steering Wheel Heating Control Module.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Cruise Control Switch Replacement
- Control Module References for control module replacement, programming and setup.

HEATED STEERING WHEEL MALFUNCTION

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	1	1	-	-
Switch Signal	2	1	-	-
Switch and LED Ground	-	1	-	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Temperature Sensor Signal	3	3	3	-
Temperature Sensor Ground	-	3	-	-
Heater Element Control	3	3	2	-
Heater Element Ground	-	3	-	-
Module Ground	-	1	-	-
1. Heated Steering Wheel System Inoperative 2. Heated Steering Wheel Always ON 3. Heated Steering Wheel Inoperative				

Circuit/System Description

The heated steering wheel control module controls the heated steering wheel and the heated steering wheel ON indicator based on an input from the heated steering wheel switch. When the heated steering wheel switch is pressed, the switch signal circuit is pulled to ground. This indicates to the heating steering wheel control module that steering wheel heat is requested. When the request is seen, the heated steering wheel control module supplies voltage to the indicator lamp and supplies voltage to the heating elements, which are internal to the steering wheel.

Diagnostic Aids

- Before replacing the steering wheel for complaints of not getting hot enough, a reliable infrared temperature gun should be used to measure the temperature at various points around the rim. The steering wheel's normal operating temperature is 32Â°C (89.6Â°F) and takes approximately 10 min to reach that temperature. It may take up to 20 min for the normal operating temperature to stabilize within the steering wheel rim. There may be spike in temperature during the first 3 - 4 min before it stabilizes at normal operating temperature. The steering wheel will take longer to heat up if the vehicle temperature is below -21Â°C (-5.8Â°F). The steering wheel heater will not operate when the steering wheel temperature is above 32Â°C (89.6Â°F).

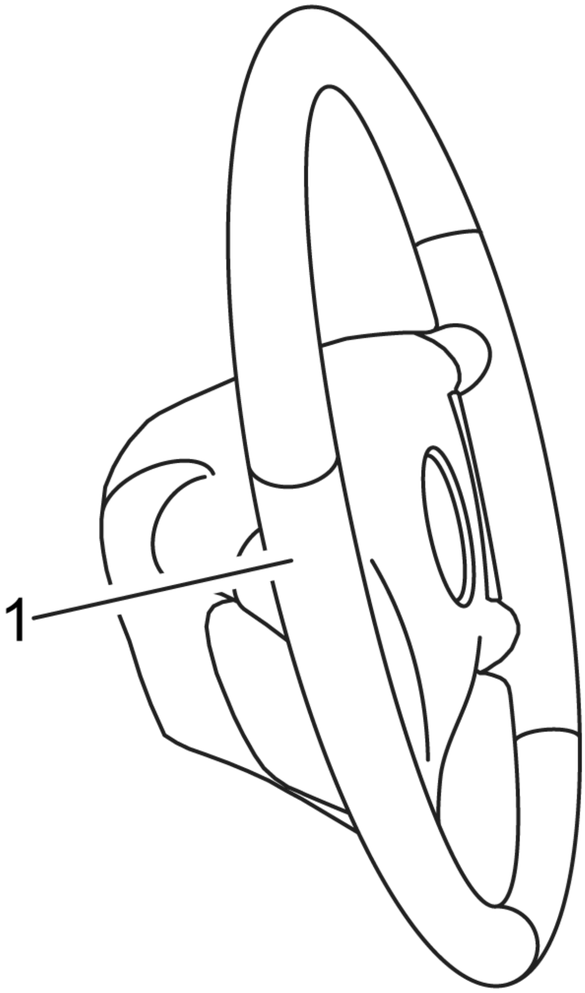


Fig. 3: Steering Wheel Rim Measurement Point
Courtesy of GENERAL MOTORS COMPANY

- The infrared measurements are made at the rim (1) at the 3 and 9 o'clock positions of the steering wheel.

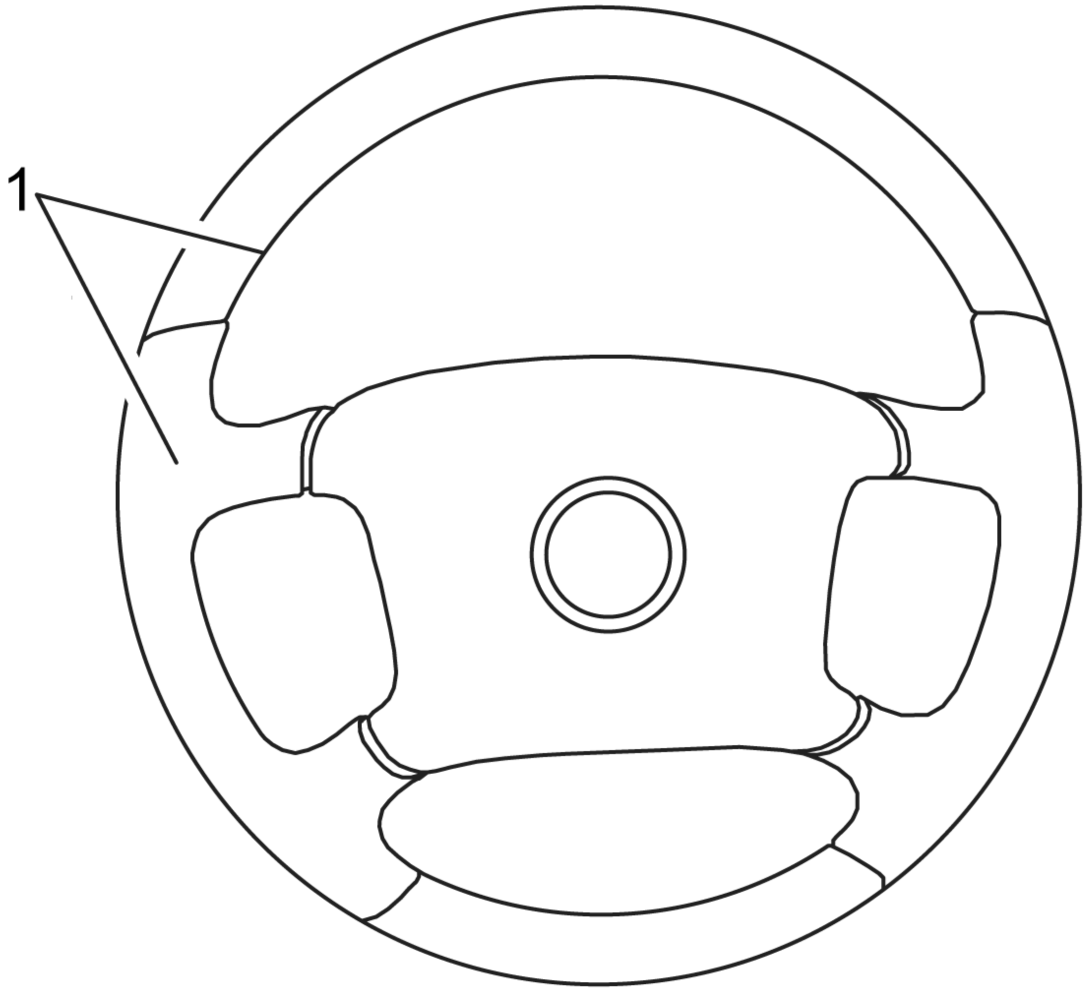


Fig. 4: Temperature Measurement Points
Courtesy of GENERAL MOTORS COMPANY

- The wood sections and the stitching are not heated. Temperature measurements should not be made on the face (1) to insure accurate temperature readings.

Reference Information

Schematic Reference

Steering Wheel Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Steering Wheel and Column Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Circuit/System Verification

Using an Infrared Temperature Gun

1. Engine running, all accessories OFF.
2. Verify the steering wheel heater switch is OFF and the steering wheel heater indicator should not be illuminated.
    - **If the heater indicator is illuminated**

      Refer to **Heated Steering Wheel Indicator Malfunction**

    - **If the heater indicator is not illuminated**

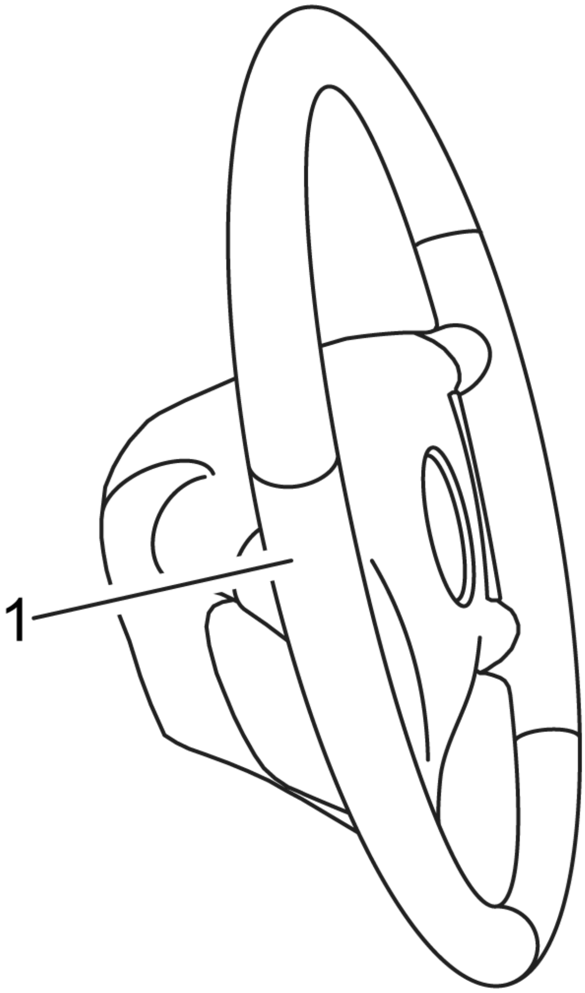


Fig. 5: Steering Wheel Rim Measurement Point
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The Infrared Temperature Gun should be within 50.8mm (2 in) and parallel to the steering wheel rim when taking temperature readings.**

3. Measure the temperature readings at the 3 and 9 o'clock positions on the steering wheel rim (1).
4. Verify that the steering wheel temperature is 25Â°C (77Â°F) or below.
    - **If the steering wheel temperature is greater than 25Â°C (77Â°F)**

      Allow the steering wheel to cool before proceeding to next step.

    - **If the steering wheel temperature is 25Â°C (77Â°F) or below**
5. Press and release the steering wheel heater switch. The steering wheel heater indicator should illuminate. Allow the steering wheel to heat for a minimum of 10 min so that the temperature stabilizes.
    - **If the heater indicator does not illuminate**

      Refer to **Heated Steering Wheel Indicator Malfunction**

- **If the heater indicator illuminates**

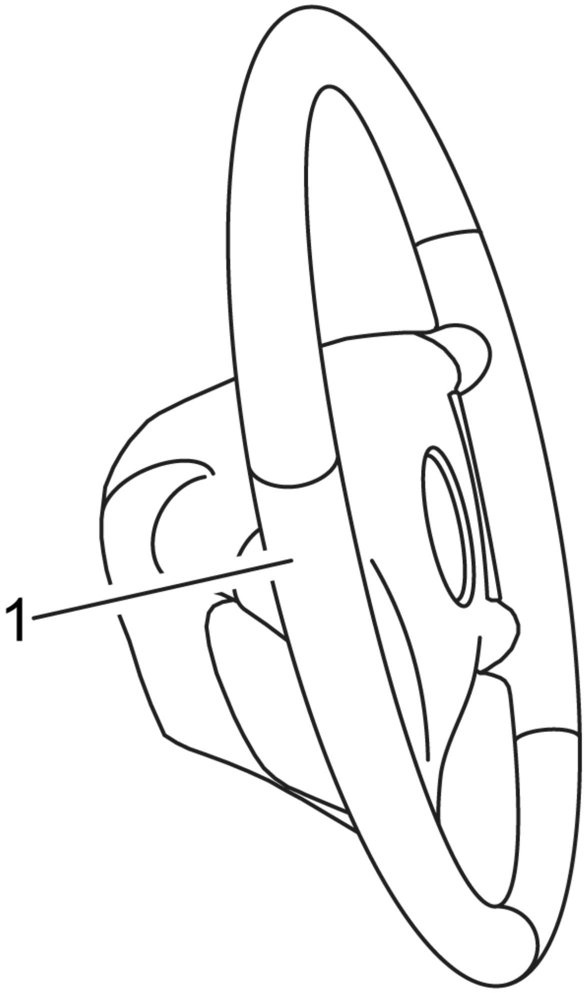


Fig. 6: Steering Wheel Rim Measurement Point
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The Infrared Temperature Gun should be within 50.8mm (2 in) and parallel to the steering wheel rim when taking temperature readings.**

6. Measure the temperature readings at the 3 and 9 o'clock positions on the steering wheel rim (1).
7. Verify that the steering wheel temperature is greater than 28Â°C (82.4Â°F) within 20 min.
    - **If after 20 minutes the measured temperature is less than 28Â°C (82.4Â°F)**

      Refer to Circuit System Testing.

    - **If after 20 minutes the measured temperature is 28Â°C (82.4Â°F) or greater**
8. All OK.

Circuit/System Testing

1. Ignition OFF, disconnect the X2 harness connector at the X85 Steering Wheel Airbag Coil.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**

3. Ignition ON.
4. Verify a test lamp illuminates between the ignition circuit terminal 9 and ground.
    - **If the test lamp does not illuminate and the circuit fuse is good**
    1. Ignition OFF, remove the test lamp.
    2. Test for less than 2 Ω in the ignition circuit end to end.
        - If less than 2 Ω, verify the fuse is OK and there is voltage at the fuse. Refer to **Power Mode Mismatch** .
        - If 2 Ω or greater
    3. Verify the in-line fuse is OK and there is voltage at the fuse.
        - If the in-line fuse is open, replace the K32 Steering Wheel Heating Control Module.
        - If the in-line fuse is OK, repair the open/high resistance in the circuit.
    - **If the test lamp does not illuminate and the circuit fuse is open**
    1. Ignition OFF.
    2. Test for infinite resistance between the ignition voltage circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K32 Steering Wheel Heating Control Module.
    - **If the test lamp illuminates**
5. Ignition OFF, connect the X2 harness connector at the X85 Steering Wheel Airbag Coil. Disconnect the harness connector at the S70L Steering Wheel Control Switch - Left.
6. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
7. Ignition ON.
8. Test for B+ between the signal circuit terminal 8 and ground.
    - **If less than B+**
    1. Ignition OFF, disconnect the in-line harness connector at the K32 Steering Wheel Heating Control Module.
    2. Test for infinite resistance between the control circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the control circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K32 Steering Wheel Heating Control Module.
    - **If B+**
9. Test for infinite resistance between the S70L Steering Wheel Control Switch - Left signal terminal 8 and the ground terminal 1 with the steering wheel heater switch released.
    - **If less than infinite resistance**

      Replace the S70L Steering Wheel Controls Switch - Left.

    - **If infinite resistance**
10. Test for less than 40 Ω between the S70L Steering Wheel Control Switch - Left signal terminal 8 and the ground terminal 1 with the steering wheel heater switch pressed.
    - **If 40 Ω or greater**

      Replace the S70L Steering Wheel Controls Switch - Left

    - **If less than 40 Ω**

11. Connect the harness connector at the S70L Steering Wheel Control Switch - Left. Disconnect the harness connector at the E15 Steering Wheel Heater.
12. Test for less than 10 Ω between the ground circuits listed below and ground.
    - Terminal 1
    - Terminal 4
    - **If 10 Ω or greater**

      Repair the open/high resistance in the circuit.

    - **If less than 10 Ω**
13. Test for 1.5 - 3.0 Ω between the control circuit terminal 3 and the ground terminal 4.
    - **If not within the specified range**

      Replace the E15 Steering Wheel Heater.

    - **If within the specified range**
14. Test for 9 - 11k Ω between the signal circuit terminal 1 and the ground terminal 2.
    - **If not within the specified range**

      Replace the E15 Steering Wheel Heater.

    - **If within the specified range**
15. Replace the K32 Steering Wheel Heating Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Cruise Control Switch Replacement**
- **Control Module References** for control module replacement, programming and setup.

HIGH EFFORT WHILE TILTING COLUMN

Condition	Action
The pivot bolt is damaged or misaligned.	If necessary, replace the steering column. Refer to **Steering Column Replacement**.

NOISE IN STEERING COLUMN

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and perform the necessary inspections?	**Go to Step 2**	Go to **Symptoms - Steering Wheel and Column**
2	Verify that noise is present in the steering column during operation. Is noise present in the steering column during operation?	**Go to Step 3**	System OK
3	Inspect the steering column mounting features for the following conditions: • Steering column mounting fasteners for looseness • Steering column mounting features are sheared Are the steering column mounting features loose?	**Go to Step 9**	**Go to Step 4**
4	Inspect the SIR/SRS coil for noise. Is the SIR/SRS coil noisy?	**Go to Step 10**	**Go to Step 5**

Step	Action	Yes	No
5	Inspect the lock plate retaining ring for correct installation. Is the lock plate retaining ring installed incorrectly?	**Go to Step 11**	**Go to Step 6**
6	Inspect the steering column upper and lower bearings for the following conditions: - Damage - Lubrication - Wear - Proper seating Are the bearings in need of repair or replacement?	**Go to Step 12**	**Go to Step 7**
7	Does the tilt joint need to be lubricated?	**Go to Step 13**	**Go to Step 8**
8	**NOTE:** **This is best evaluated while driving the vehicle, turning the steering and applying the brake pedal.** Inspect the intermediate steering shaft for noise.Is the intermediate steering shaft noisy?	**Go to Step 14**	**Go to Step 15**
9	**NOTE:** **If the steering column mounting is damaged or sheared, the steering column will need to be replaced. Refer to Steering Column Replacement.** Tighten the steering column mounting fasteners to specifications. Refer to **Fastener Specifications**.Did you complete the repair?	**Go to Step 15**	-
10	Replace the SIR/SRS coil. Refer to **Steering Wheel Airbag Coil Replacement** . Did you complete the repair?	**Go to Step 15**	-
11	Install the lock plate retaining ring correctly. Did you complete the repair?	**Go to Step 15**	-
12	**NOTE:** **If the steering column upper and/or lower bearings are not serviceable, the steering column will need to be replaced. Refer to Steering Column Replacement.** Replace the upper and/or lower bearing, if serviceable.Did you complete the repair?	**Go to Step 15**	-
13	Lubricate the tilt joint. Did you complete the repair?	**Go to Step 15**	-
14	Replace the appropriate intermediate steering shaft component. Refer to **Intermediate Steering Shaft Replacement**. Did you complete the repair?	**Go to Step 15**	-
15	Operate the system in order to verify the repair. Did you correct the condition?	System OK	**Go to Step 3**

LOOSENESS IN STEERING COLUMN

Step	Action	Yes	No

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and perform the necessary inspections?	**Go to Step 2**	Go to **Steering Column Replacement**
2	Verify that the steering column is loose. Is the steering column loose?	**Go to Step 3**	System OK
3	Inspect the steering column mounting features for the following conditions. • Steering column mounting fasteners for looseness • Steering column mounting features are sheared Are the steering column mounting features loose?	**Go to Step 5**	**Go to Step 4**
4	Inspect the upper and/or lower bearings for looseness. Are any of the bearings worn or loose?	**Go to Step 6**	**Go to Step 7**
5	**NOTE:** **If the steering column mounting is damaged or sheared, the steering column will need to be replaced. Refer to Steering Column Replacement.** Tighten the steering column mounting fastener to specifications. Refer to **Fastener Specifications**.Did you complete the repair?	**Go to Step 7**	-
6	**NOTE:** **If the steering column mounting is damaged or sheared, the steering column will need to be replaced. Refer to Steering Column Replacement.** Replace the upper and/or lower bearings, if serviceable.Did you complete the repair	**Go to Step 7**	-
7	Operate the system in order to verify the repair. Did you correct the condition?	System OK	**Go to Step 3**

REPAIR INSTRUCTIONS

INTERMEDIATE STEERING SHAFT INNER BOOT REPLACEMENT

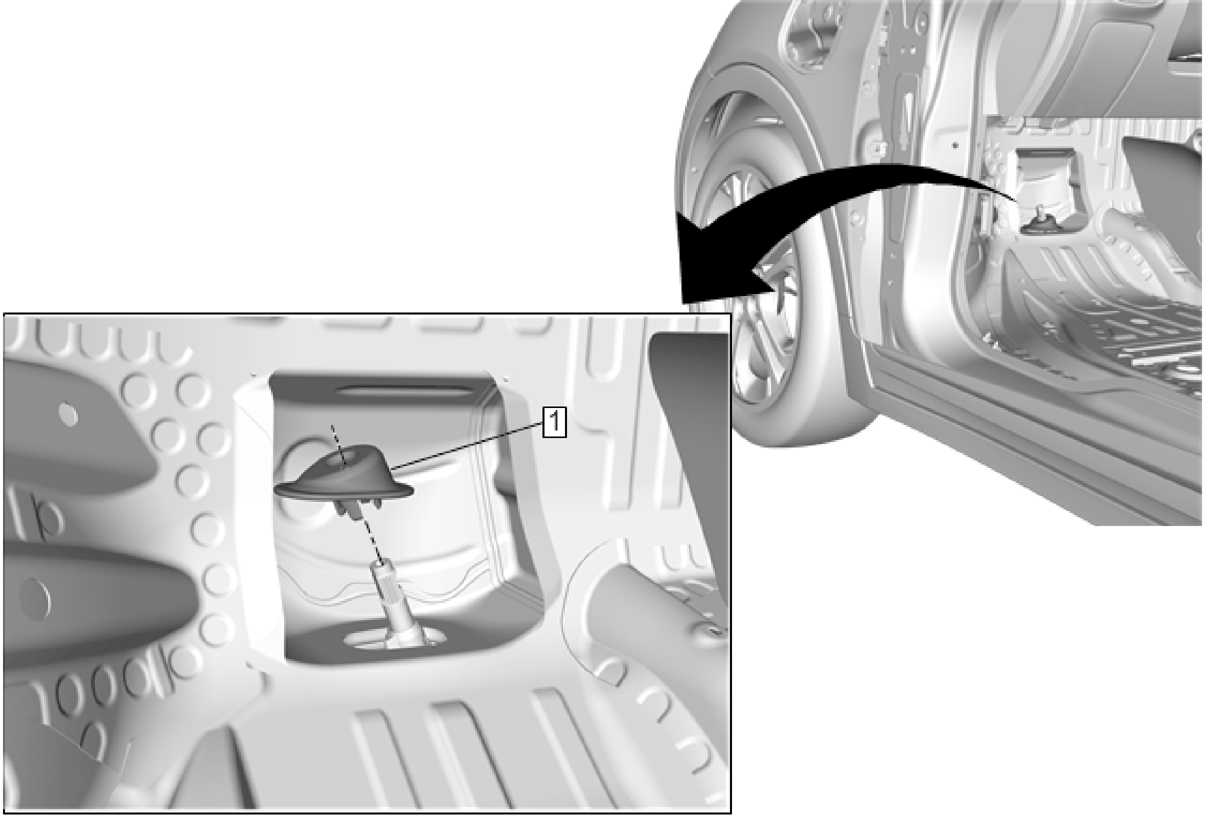


Fig. 7: Intermediate Steering Shaft Inner Boot
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Intermediate Steering Shaft at Steering Gear Pinion Shaft - Disconnect - **Intermediate Steering Shaft Replacement**	
1	Intermediate Steering Shaft Inner Boot **Procedure** 1. Ensure that the steering wheel is set in a straight ahead position and centered. 2. Lift the rubber lip of the intermediate steering shaft inner boot upward to reduce the friction when the intermediate steering shaft inner boot is rotated. 3. Push the intermediate steering shaft inner boot and then rotate it about 45 degrees counterclockwise to release the lock. 4. Remove the intermediate steering shaft inner boot from the steering gear. 5. Position the intermediate steering shaft inner boot over the steering gear and on the dash panel. Ensure the lip on the seal is positioned correctly.

INTERMEDIATE STEERING SHAFT REPLACEMENT

Removal Procedure

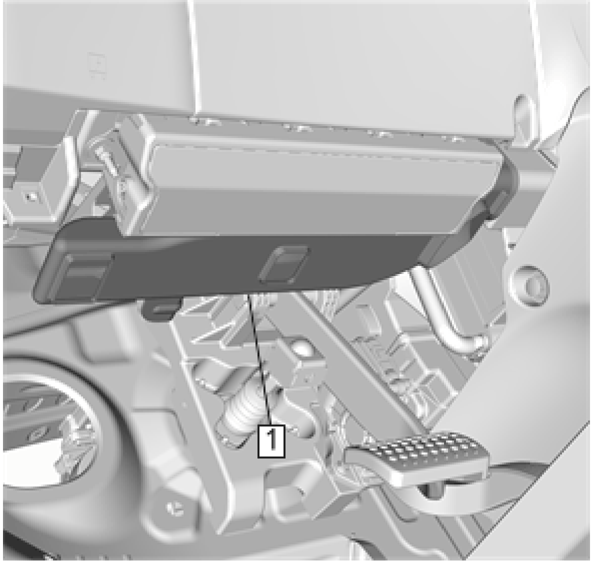


Fig. 8: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

1. Floor Front Air Outlet Duct - Left Side - Remove - Floor Front Air Outlet Duct Replacement - Left Side

CAUTION: **With wheels of the vehicle facing straight ahead, secure the steering wheel utilizing steering column anti-rotation pin, steering column lock, or a strap to prevent rotation. Locking of the steering column will prevent damage and a possible malfunction of the SIR system. The steering wheel must be secured in position before disconnecting the following components:**

- **The steering column**
- **The intermediate shaft(s)**
- **The steering gear**

After disconnecting these components, do not rotate the steering wheel or move the front tires and wheels. Failure to follow this procedure may cause the SIR coil assembly to become un-centered and cause possible damage to the SIR coil. If you think the SIR coil has become un-centered, refer to your specific SIR coil's centering procedure to re-center SIR Coil.

2. Turn the steering wheel to the straight ahead position and secure the steering wheel from moving.

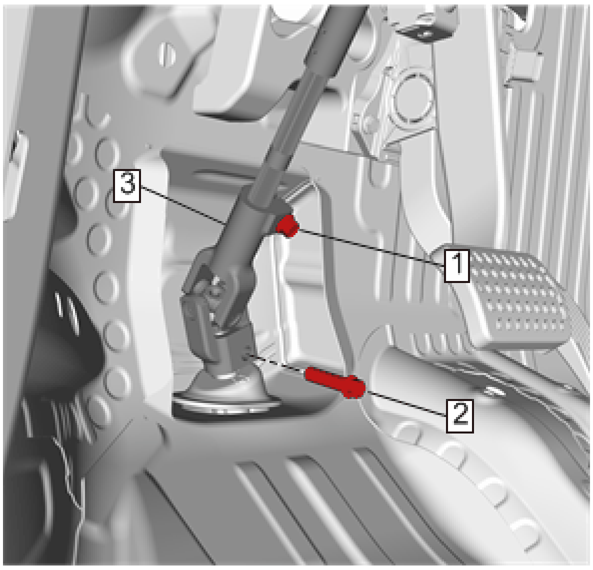


Fig. 9: Intermediate Steering Shaft Middle Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Intermediate Steering Shaft Middle Bolt - Loosen
4. Intermediate Steering Shaft Lower Bolt - Remove
5. Intermediate Steering Shaft at Steering Gear Pinion Shaft - Disconnect

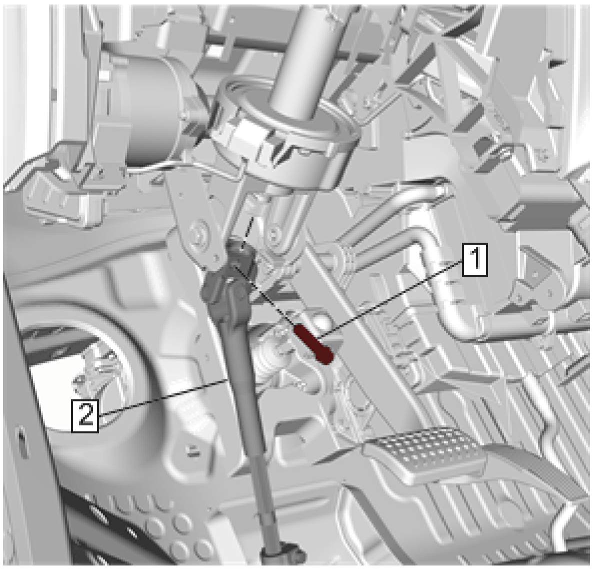


Fig. 10: Intermediate Steering Shaft Upper Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Intermediate Steering Shaft Upper Bolt - Remove
7. Intermediate Steering Shaft at Steering Column Shaft - Disconnect
8. Intermediate Steering Shaft at Vehicle - Remove

Installation Procedure

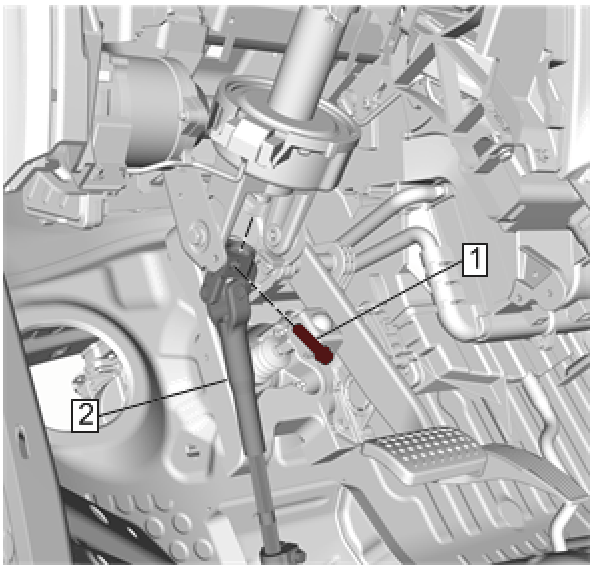


Fig. 11: Intermediate Steering Shaft Upper Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Intermediate Steering Shaft at Vehicle - Install

NOTE: **The recess of the fine tooth in the universal joint have to be precisely aligned to the recess of the fine tooth on the steering column shaft. The bore in the universal joint have to be aligned to the groove on the steering column shaft.**

2. Intermediate Steering Shaft at Steering Column Shaft - Connect

CAUTION: **Refer to Fastener Caution .**

3. Intermediate Steering Shaft Upper Bolt - Install and tighten to 49 N.m (36 lb ft)

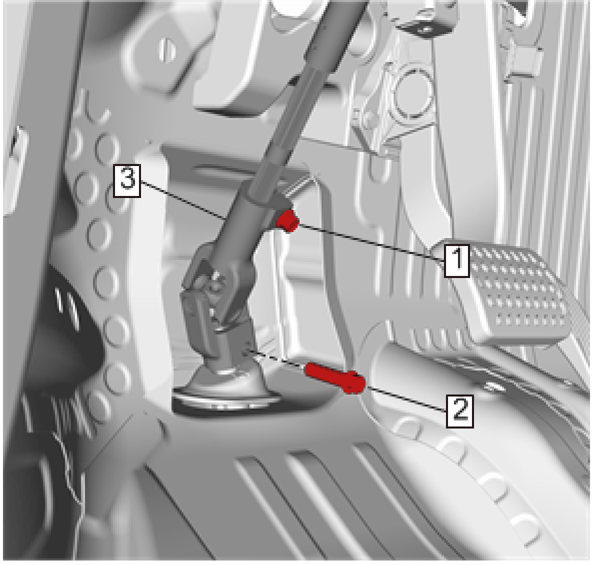


Fig. 12: Intermediate Steering Shaft Middle Bolt
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The recess of the fine tooth in the universal joint have to be precisely aligned to the recess of the fine tooth on the steering gear pinion. The bore in the universal joint have to be aligned to the groove on the steering gear pinion.**

4. Intermediate Steering Shaft at Steering Gear Pinion Shaft - Connect
5. Intermediate Steering Shaft Lower Bolt - Install and tighten to 57 N.m (42 lb ft)
6. Intermediate Steering Shaft Middle Bolt - Tighten to 49 N.m (36 lb ft)

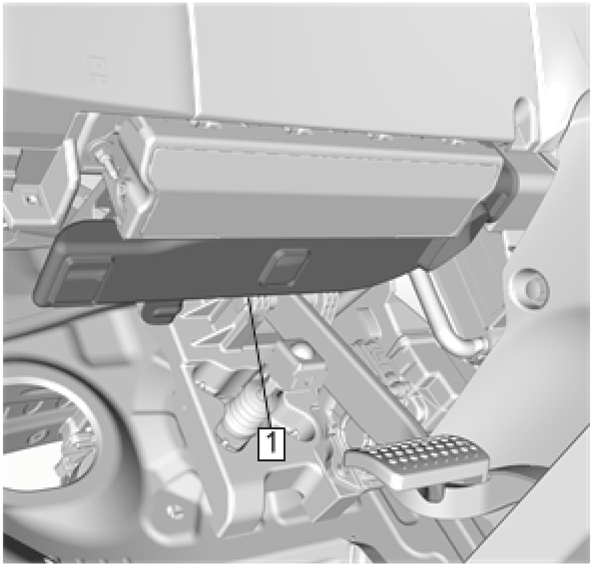


Fig. 13: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

7. Floor Front Air Outlet Duct - Left Side - Install - **Floor Front Air Outlet Duct Replacement - Left Side**

STEERING COLUMN UPPER TRIM COVER REPLACEMENT

Removal Procedure

1. Instrument Panel Trim Pad-Left Side at Vehicle - Remove - **Instrument Panel Trim Pad Replacement - Left Side**

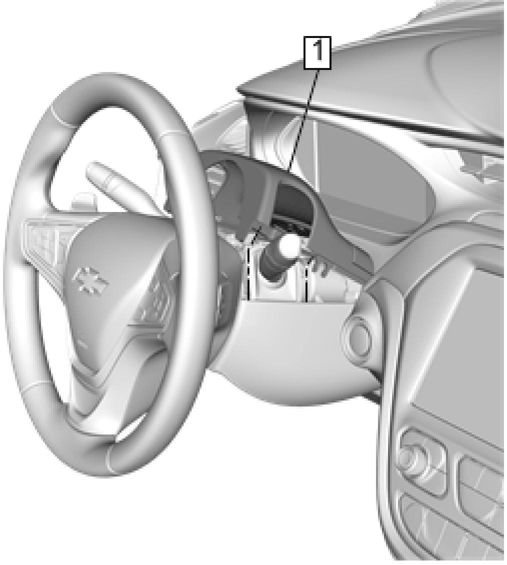


Fig. 14: Instrument Panel Steering Column Upper Trim Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a flat bladed plastic trim tool.**

2. Instrument Panel Steering Column Upper Trim Cover at Instrument Panel Steering Column Lower Trim Cover - Unclip

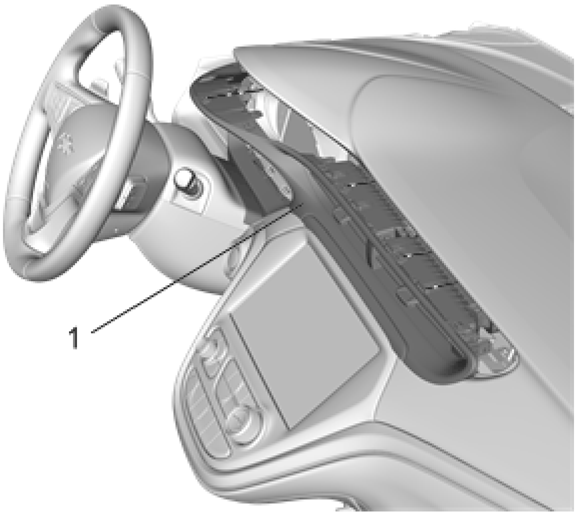
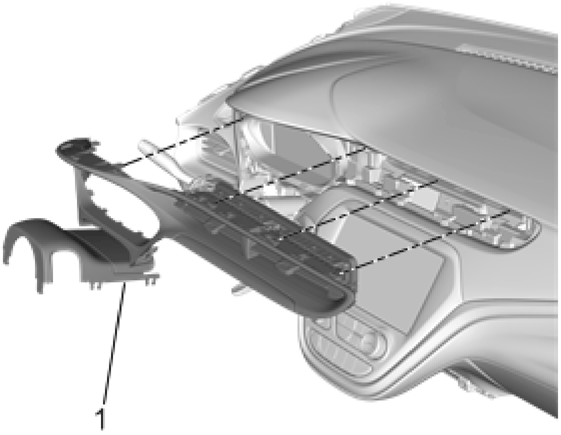


Fig. 15: Instrument Panel Accessory Bezel
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a flat bladed plastic trim tool.**

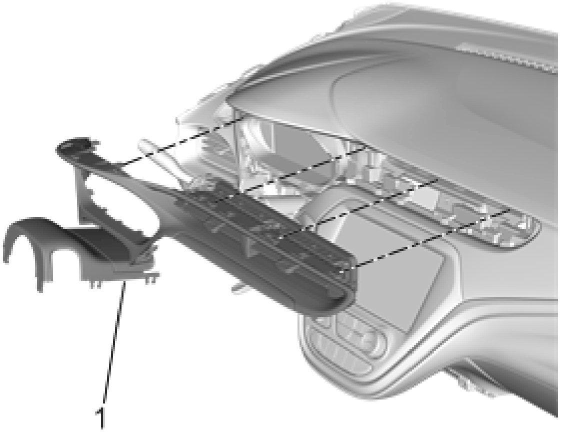
3. Instrument Panel Accessory Bezel at Instrument Panel - Unclip



[**Fig. 16: Instrument Panel Steering Column Upper Trim Cover**](#)
Courtesy of GENERAL MOTORS COMPANY

4. Instrument Panel Steering Column Upper Trim Cover at Vehicle - Remove

Installation Procedure



[**Fig. 17: Instrument Panel Steering Column Upper Trim Cover**](#)
Courtesy of GENERAL MOTORS COMPANY

1. Instrument Panel Steering Column Upper Trim Cover at Vehicle - Install

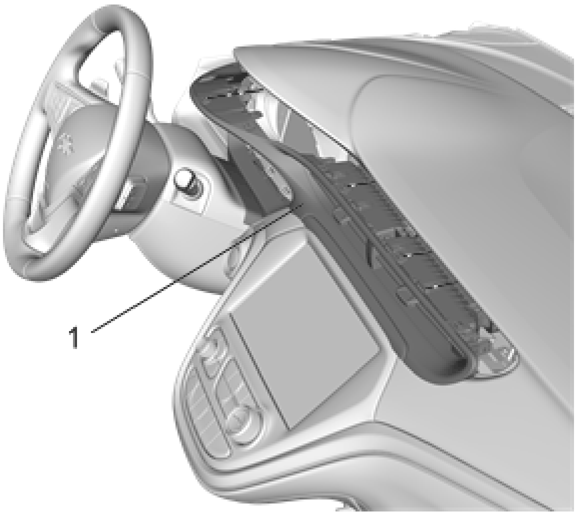


Fig. 18: Instrument Panel Accessory Bezel
Courtesy of GENERAL MOTORS COMPANY

2. Instrument Panel Accessory Bezel at Instrument Panel - Install

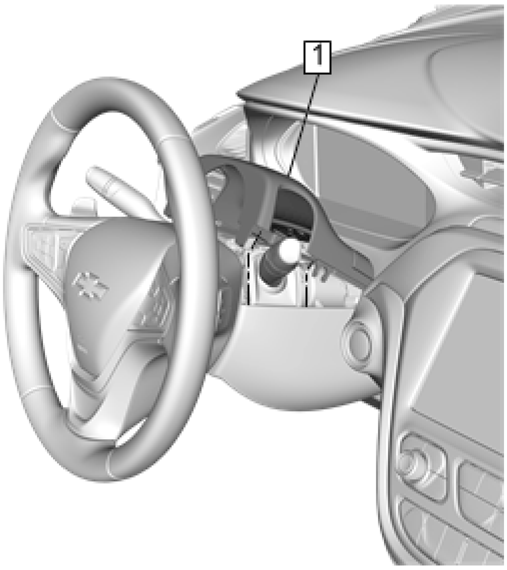


Fig. 19: Instrument Panel Steering Column Upper Trim Cover
Courtesy of GENERAL MOTORS COMPANY

3. Instrument Panel Steering Column Upper Trim Cover at Instrument Panel Steering Column Lower Trim Cover - Install
4. Instrument Panel Trim Pad-Left Side at Vehicle - Install - **Instrument Panel Trim Pad Replacement - Left Side**

STEERING COLUMN LOWER TRIM COVER REPLACEMENT

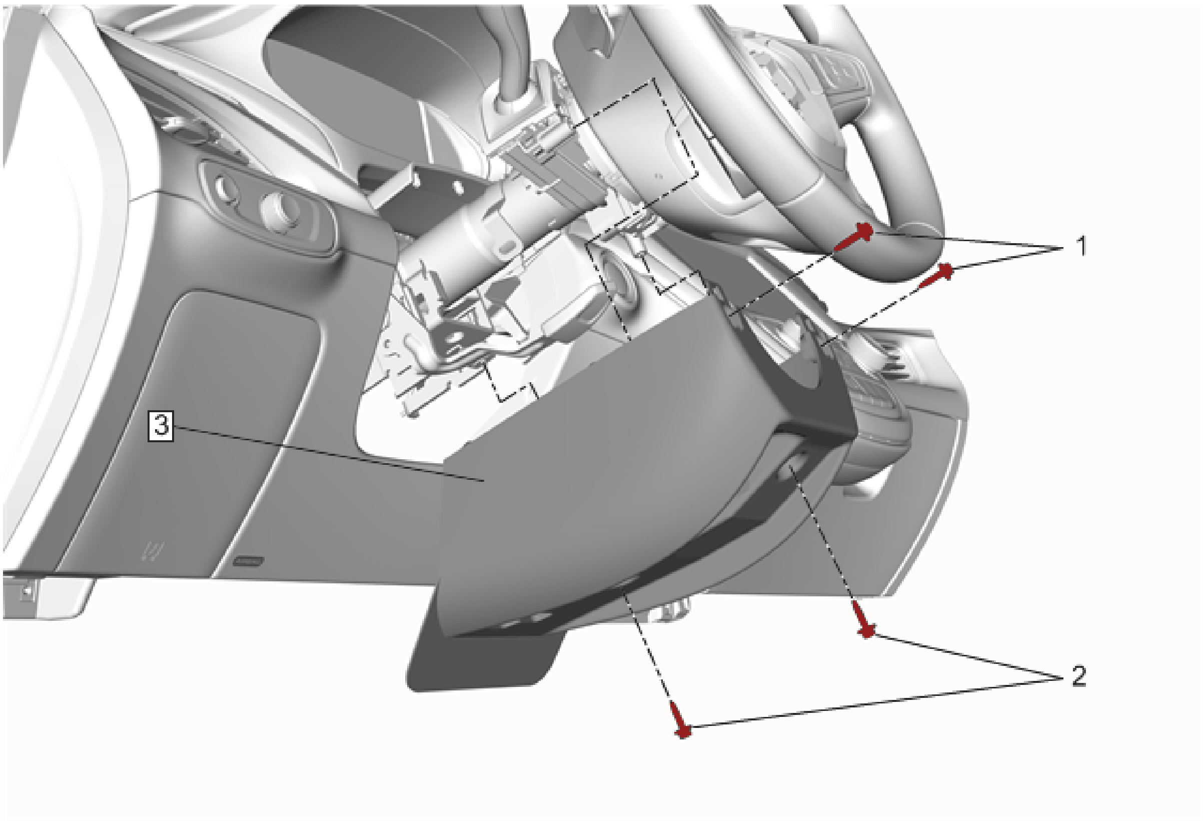


Fig. 20: Steering Column Lower Trim Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Instrument Panel Steering Column Upper Trim Cover at Instrument Panel Steering Column Lower Trim Cover - Separate - **Steering Column Upper Trim Cover Replacement**	

Callout	Component Name
1	Instrument Panel Steering Column Lower Trim Cover Bolt **CAUTION:** **Refer to Fastener Caution .** **Procedure** Rotate the steering wheel left and right to access the fasteners securing the lower trim cover to the turn signal switch bracket. **Tighten** 2.5 N.m (22 lb in)
2	Instrument Panel Steering Column Lower Trim Cover Bolt **Tighten** 2.5 N.m (22 lb in)
3	Instrument Panel Steering Column Lower Trim Cover

TURN SIGNAL SWITCH REPLACEMENT

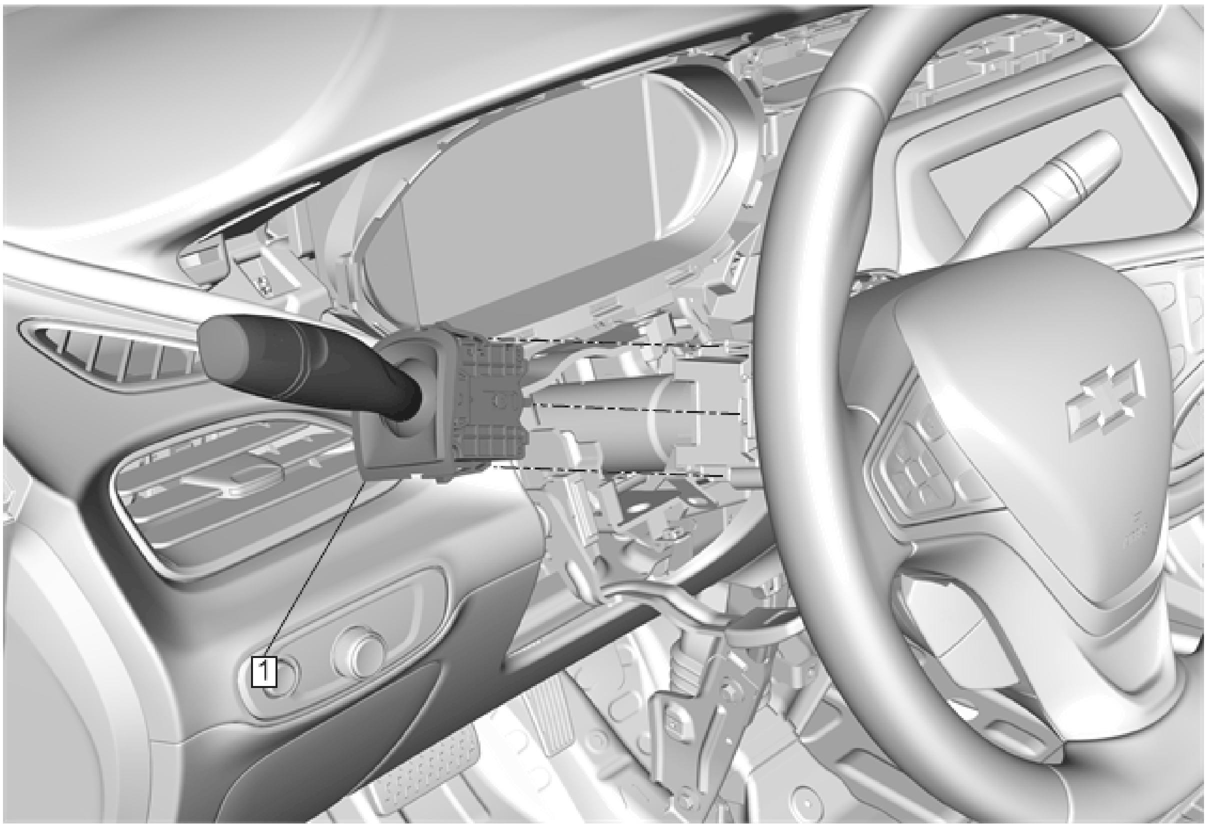


Fig. 21: Turn Signal Switch

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Column Lower Trim Cover Replacement	
1	Turn Signal Switch **Procedure** 1. Disconnect the electrical connector. 2. Release the retaining tabs and remove the turn signal switch from the turn signal switch bracket.

TURN SIGNAL SWITCH BRACKET REPLACEMENT

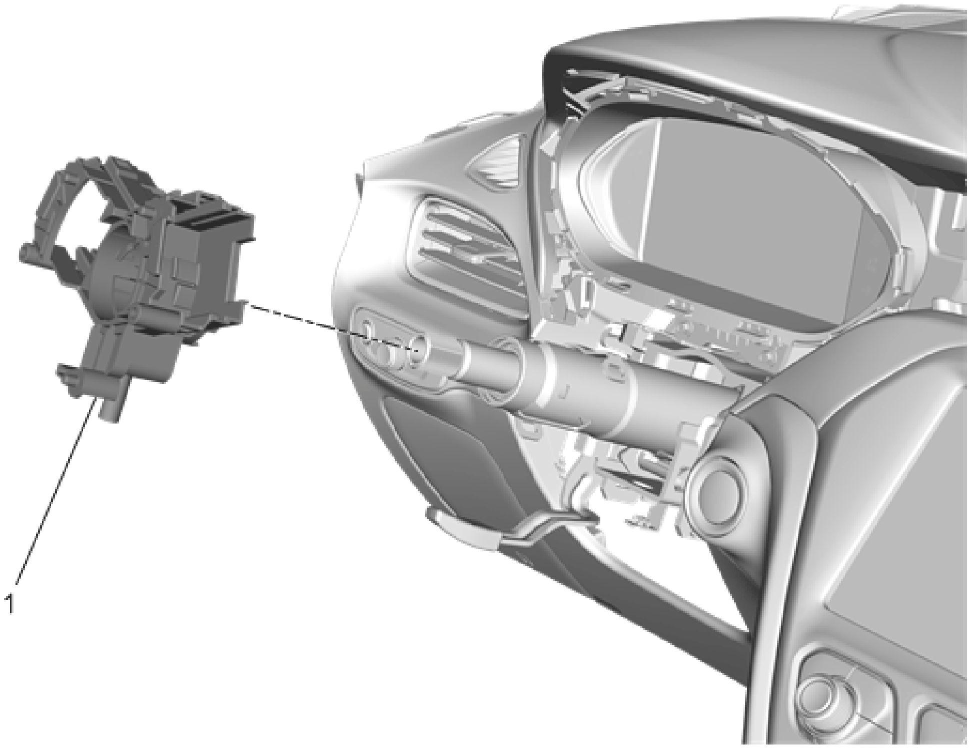


Fig. 22: Turn Signal Switch Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Steering Wheel Airbag Coil Replacement 2. Turn Signal Switch Replacement 3. Windshield Wiper and Washer Switch Replacement	
1	Turn Signal Switch Bracket **Procedure** Release the retaining tabs and remove the turn signal switch bracket from the steering column.

STEERING WHEEL HEAT CONTROL MODULE REPLACEMENT

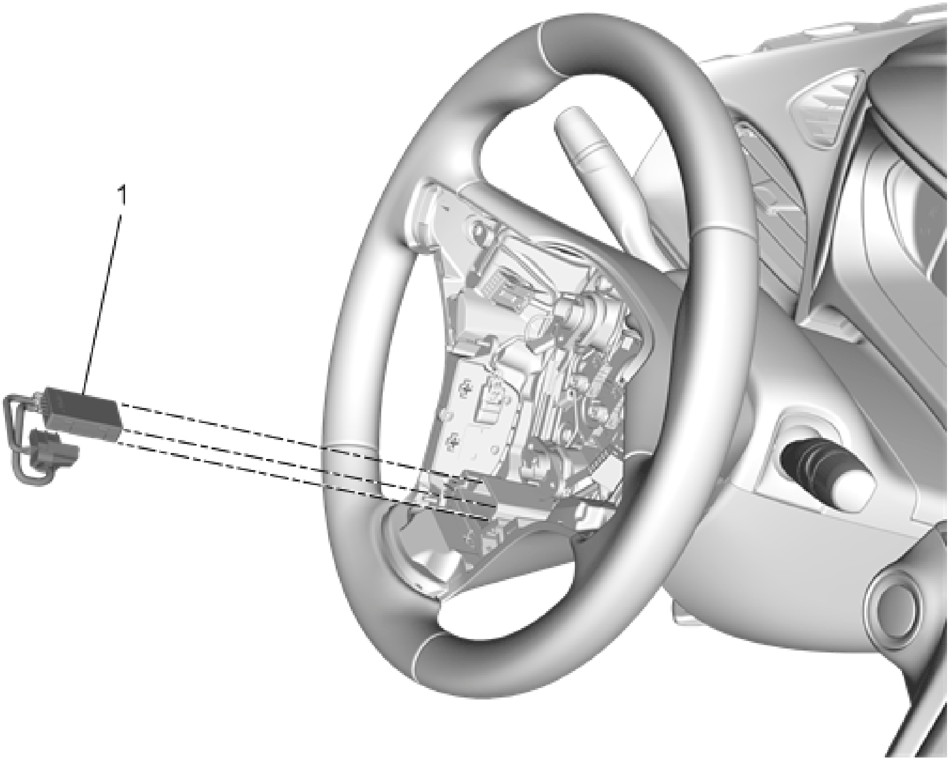


Fig. 23: Steering Wheel Heat Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Wheel Spoke Lower Cover Replacement	
1	Steering Wheel Heat Control Module **Procedure** 1. Remove the steering wheel heat control module in order to expose the electrical connectors. 2. Disconnect the electrical connectors. 3. Remove the steering wheel heat control module from the steering wheel.

STEERING WHEEL REPLACEMENT

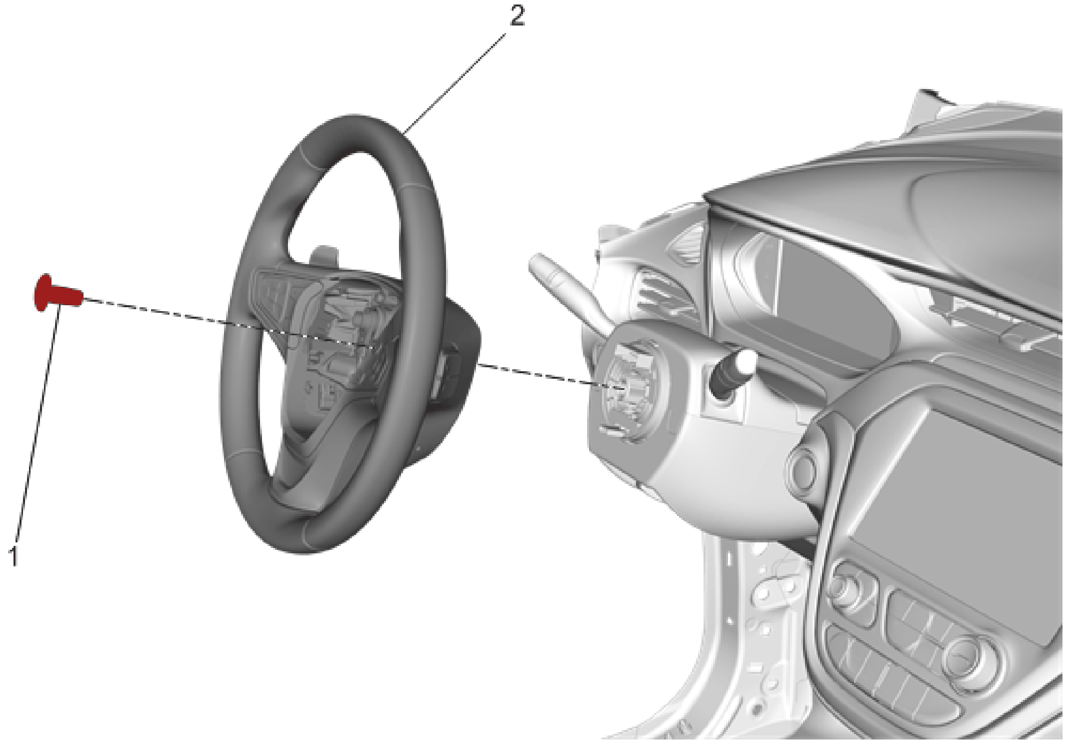


Fig. 24: Steering Wheel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **Refer to SIR Warning .** **WARNING:** **Refer to SIR Inflator Module Handling and Storage Warning .** **Preliminary Procedures** 1. SIR Disabling and Enabling 2. Steering Wheel Airbag Replacement	
1	Steering Wheel Bolt **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Clean the threads of the bolt with denatured alcohol or equivalent and allow to dry. 2. Apply thread locking adhesive to the bolt. Adhesives, Fluids, Lubricants, and Sealers **Tighten** 45 N.m (33 lb ft)

Callout	Component Name
2	Steering Wheel **Procedure** 1. Disconnect the electrical connectors. 2. Install the steering wheel bolt until 2 to 3 threads are engaged. 3. Wiggle the steering wheel until the wheel disengages completely. 4. Steering Wheel Bolt - Remove 5. Steering Wheel - Remove 6. Transfer components as necessary.

STEERING WHEEL SPOKE COVER REPLACEMENT

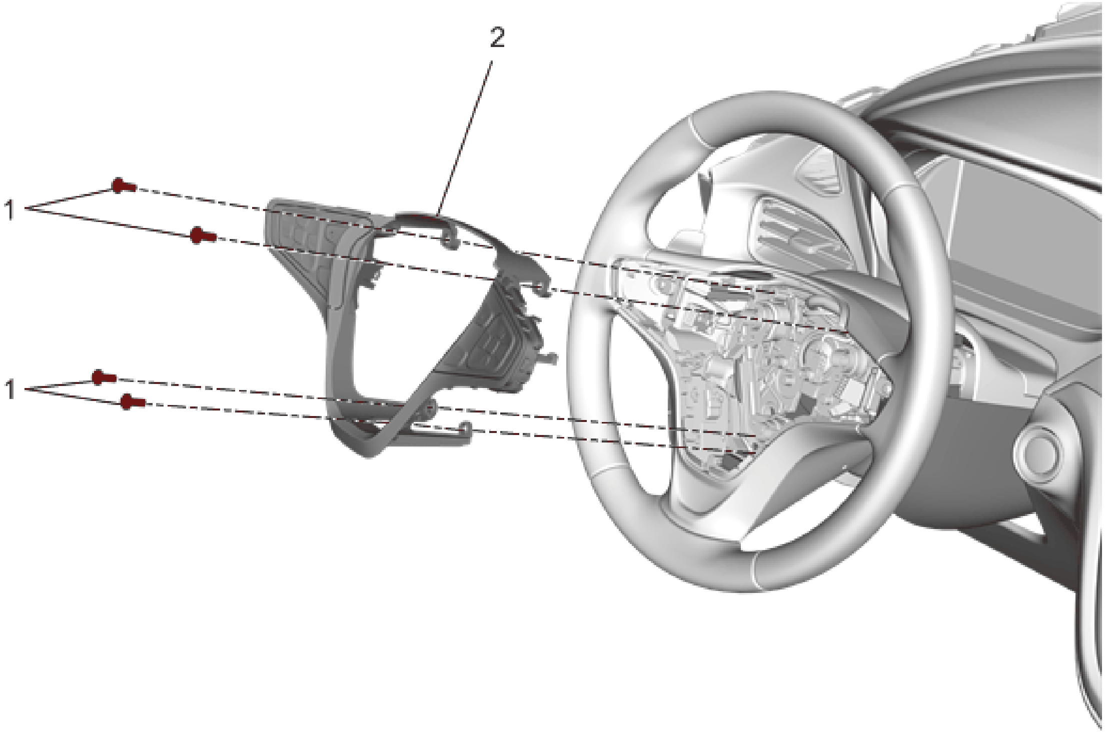


Fig. 25: Steering Wheel Spoke Cover

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Steering Wheel Airbag Replacement	
1	Steering Wheel Spoke Cover Bolt
2	Steering Wheel Spoke Cover **Procedure** 1. Use the appropriate trim tool to release the steering wheel spoke cover from the steering wheel. 2. Disconnect the electrical connectors. 3. Transfer components as necessary.

STEERING WHEEL SPOKE LOWER COVER REPLACEMENT

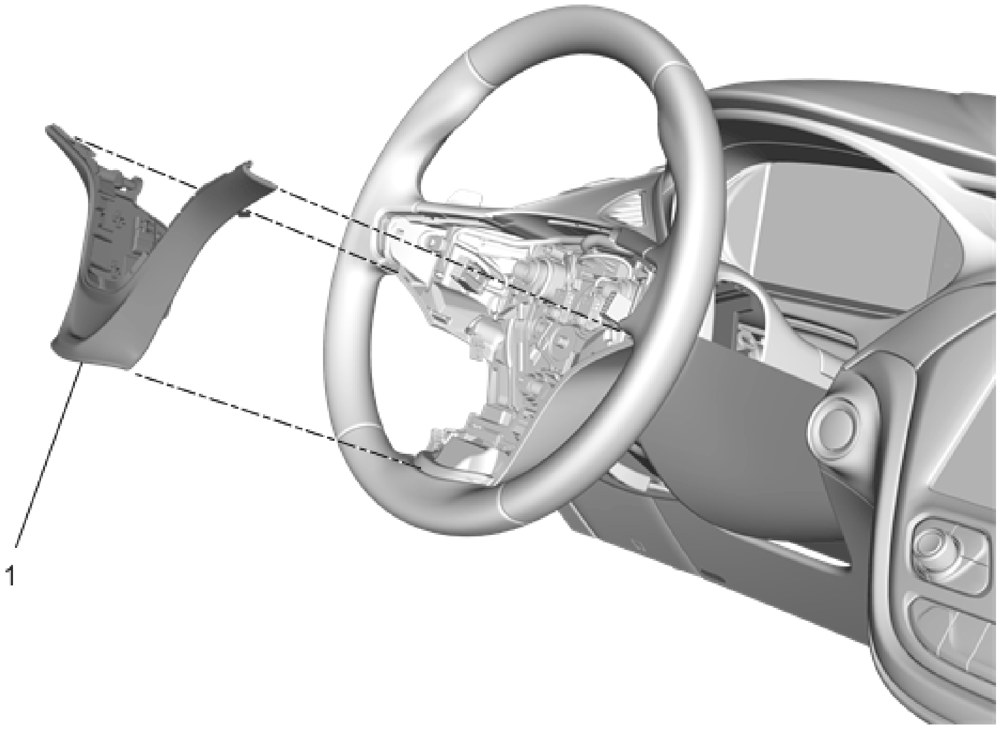


Fig. 26: Steering Wheel Spoke Lower Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Steering Wheel Airbag Replacement 2. Steering Wheel Spoke Cover Replacement	
1	Steering Wheel Spoke Lower Cover **Procedure** 1. Use the appropriate trim tool to release the steering wheel spoke lower cover from the steering wheel. 2. Disconnect the electrical connectors. 3. Transfer components as necessary.

STEERING COLUMN REPLACEMENT

Removal Procedure

WARNING: **Refer to SIR Warning .**

WARNING: **Refer to SIR Inflator Module Handling and Storage Warning .**

1. Disable the SIR system. SIR Disabling and Enabling
2. Steering Wheel Airbag - Remove - Steering Wheel Airbag Replacement
3. Turn the steering wheel to the straight ahead position.
4. Steering Wheel - Remove - Steering Wheel Replacement
5. Steering Column Upper Trim Cover at Steering Column Lower Trim Cover - Separate - Steering Column Upper Trim Cover Replacement

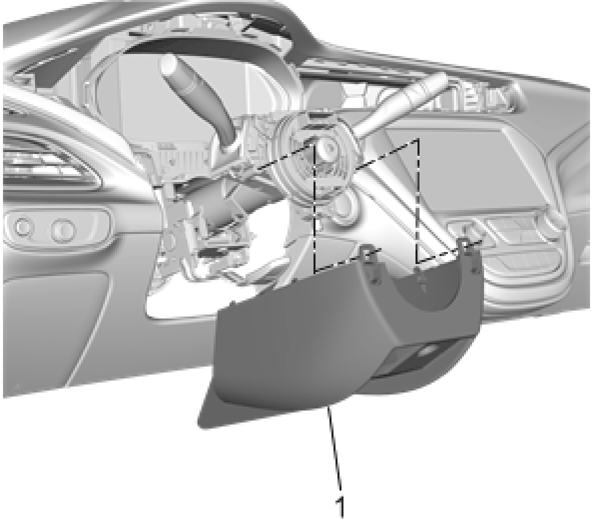


Fig. 27: Steering Column Lower Trim Cover
Courtesy of GENERAL MOTORS COMPANY

6. Steering Column Lower Trim Cover - Remove - **Steering Column Lower Trim Cover Replacement**

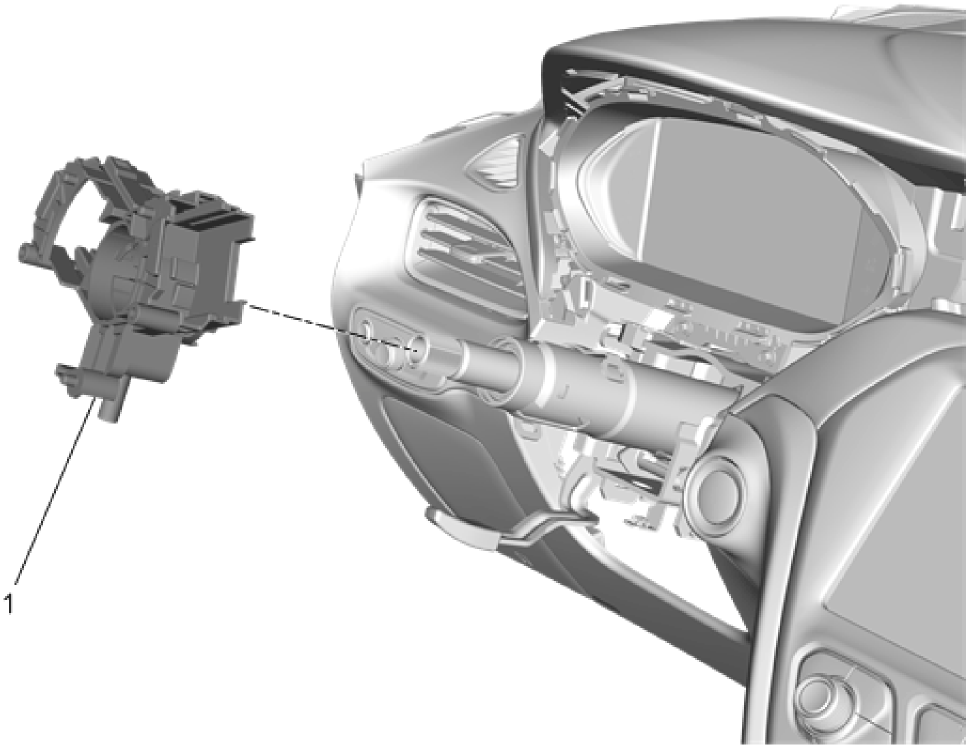


Fig. 28: Turn Signal Switch Bracket
Courtesy of GENERAL MOTORS COMPANY

7. Turn Signal Switch Bracket - Remove - **Turn Signal Switch Bracket Replacement**

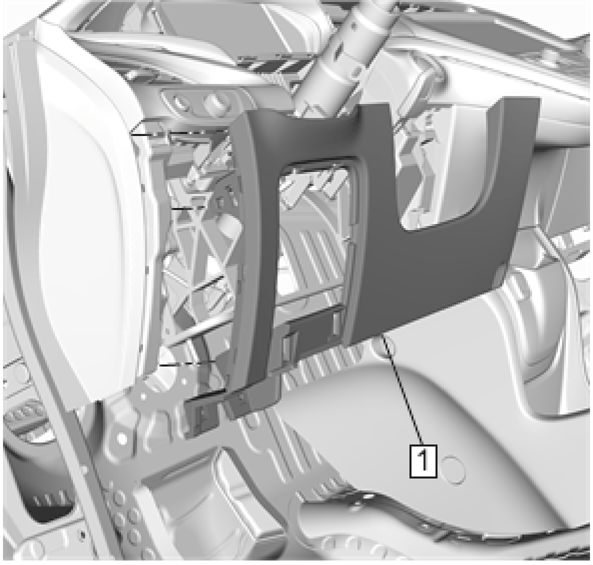


Fig. 29: Instrument Panel Knee Bolster
Courtesy of GENERAL MOTORS COMPANY

8. Instrument Panel Knee Bolster - Remove - **Instrument Panel Knee Bolster Replacement**

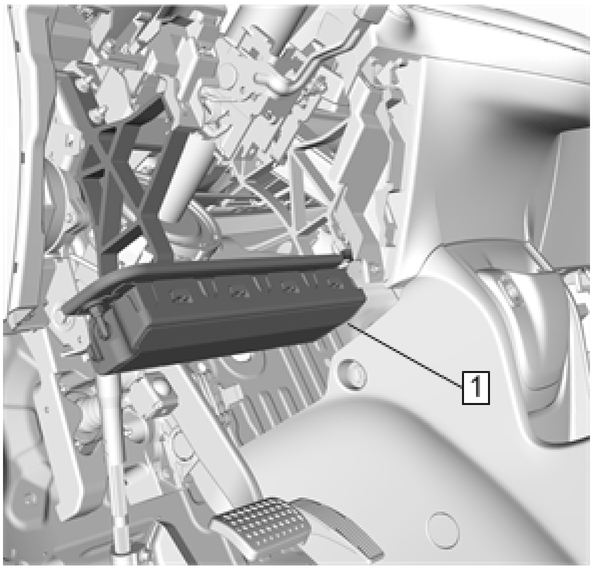


Fig. 30: Instrument Panel Lower Airbag and Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

9. Instrument Panel Lower Airbag and Bracket Assembly - Remove - **Instrument Panel Lower Airbag Bracket Replacement**

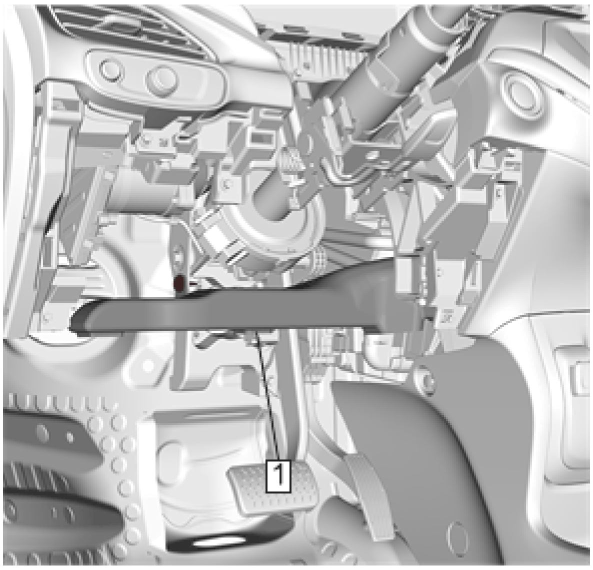


Fig. 31: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

10. Floor Front Air Outlet Duct - Left Side - Remove - Floor Front Air Outlet Duct Replacement - Left Side

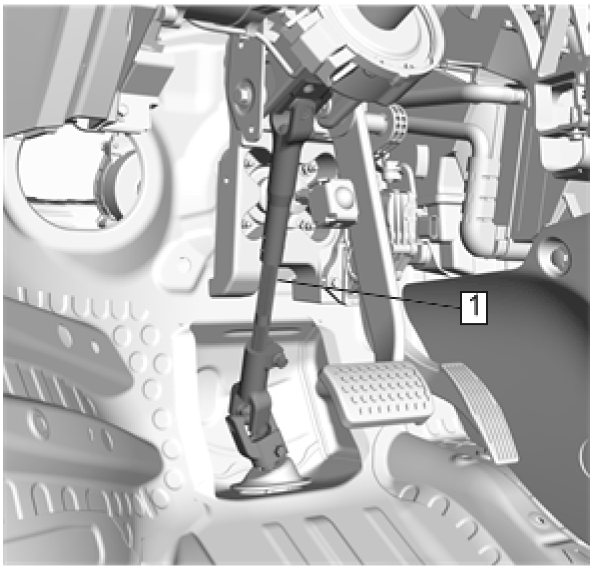


Fig. 32: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

11. Intermediate Steering Shaft - Remove - Intermediate Steering Shaft Replacement
12. Disconnect the electric connectors from the steering column.
13. Remove the instrument panel wiring harness clips from the steering column.

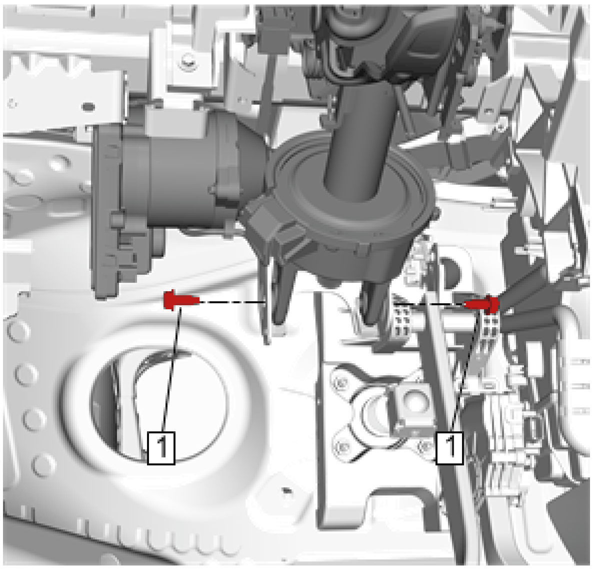


Fig. 33: Steering Column Lower Support Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

14. Steering Column Lower Support Bracket Bolt - Remove

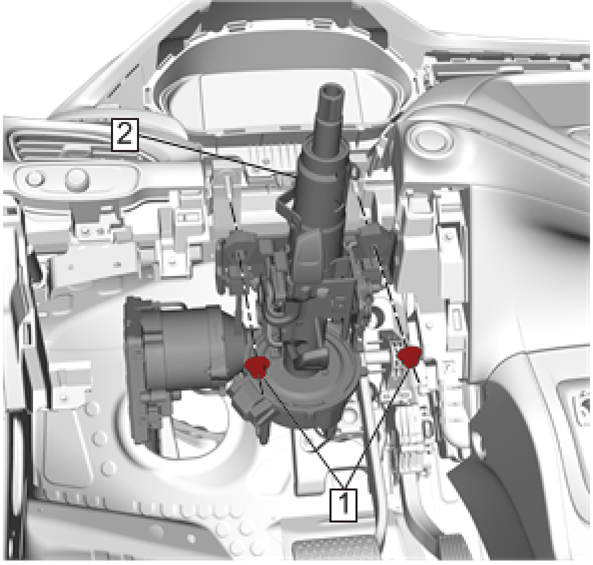


Fig. 34: Steering Column Support Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Support the steering column before removing the steering column support bracket nuts.**

CAUTION: **Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on the end could collapse the steering shaft or loosen the plastic injections, which maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the columns collapsible design. Do NOT hammer on the end of the shaft, because hammering could loosen the plastic injections, which maintain column rigidity. If you need to remove the steering wheel, refer to the Steering Wheel Replacement procedure in this section.**

15. Steering Column Upper Support Bracket Nut - Remove
16. Steering Column at Vehicle - Remove

Installation Procedure

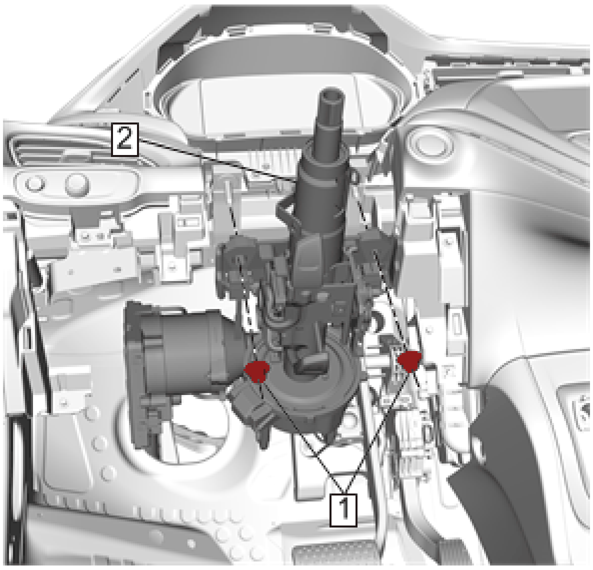


Fig. 35: Steering Column Support Bracket Nuts
Courtesy of GENERAL MOTORS COMPANY

1. Steering Column at Vehicle - Install

CAUTION: **Refer to Fastener Caution .**

2. Steering Column Upper Support Bracket Nut - Install and tighten to 22 N.m (16 lb ft)

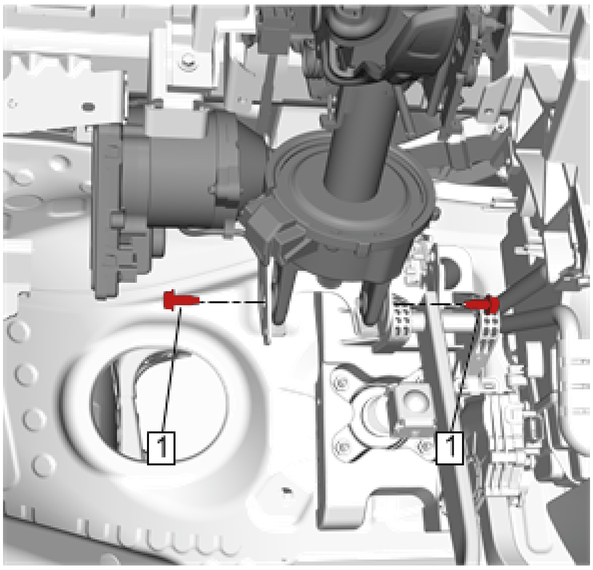


Fig. 36: Steering Column Lower Support Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Steering Column Lower Support Bracket Bolt - Install and tighten to 22 N.m (16 lb ft)
4. Install the instrument panel wiring harness clips to the steering column.
5. Connect the electric connectors to the steering column.

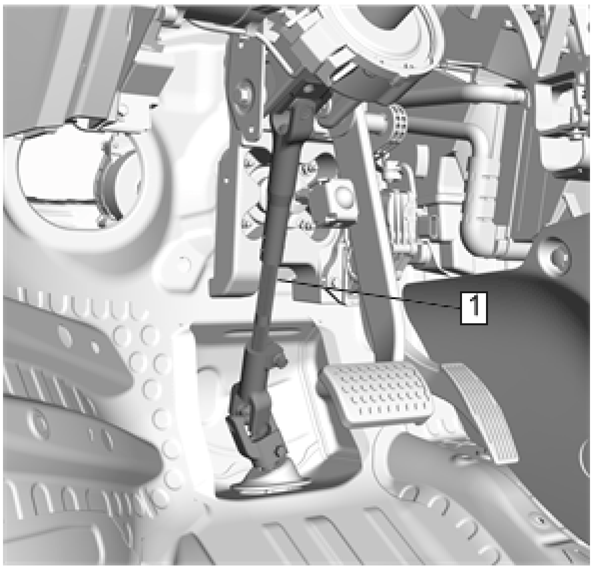


Fig. 37: Intermediate Steering Shaft
Courtesy of GENERAL MOTORS COMPANY

6. Intermediate Steering Shaft - Install - **Intermediate Steering Shaft Replacement**

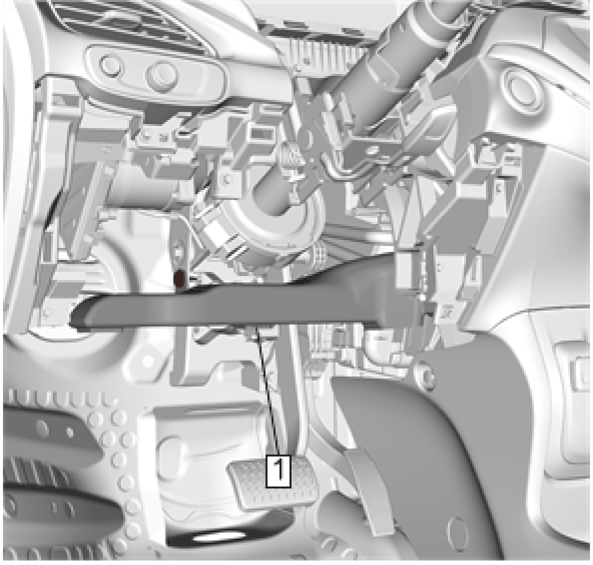


Fig. 38: Floor Front Air Outlet Duct - Left Side
Courtesy of GENERAL MOTORS COMPANY

7. Floor Front Air Outlet Duct - Left Side - Install - **Floor Front Air Outlet Duct Replacement - Left Side**

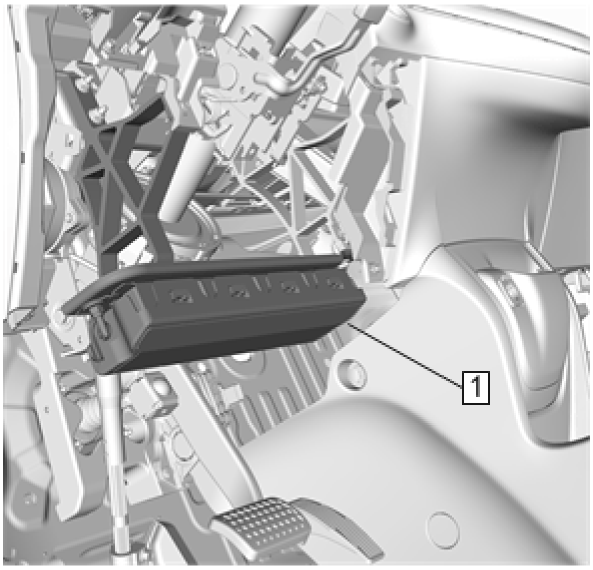


Fig. 39: Instrument Panel Lower Airbag and Bracket Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Instrument Panel Lower Airbag and Bracket Assembly - Install - **Instrument Panel Lower Airbag Bracket Replacement**

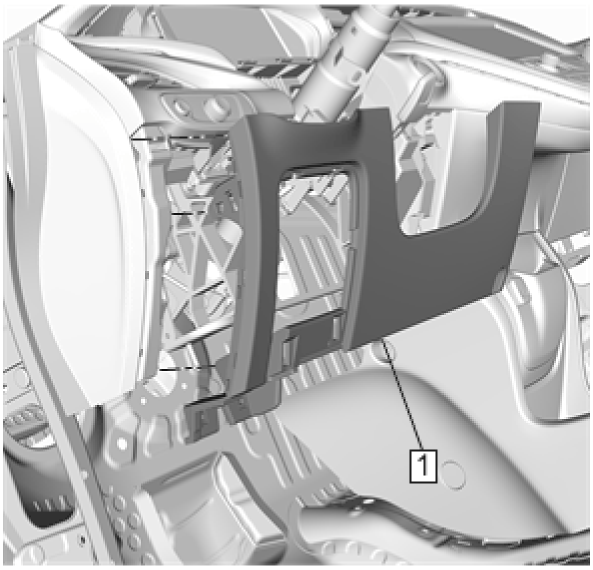


Fig. 40: Instrument Panel Knee Bolster
Courtesy of GENERAL MOTORS COMPANY

9. Instrument Panel Knee Bolster - Install - **Instrument Panel Knee Bolster Replacement**

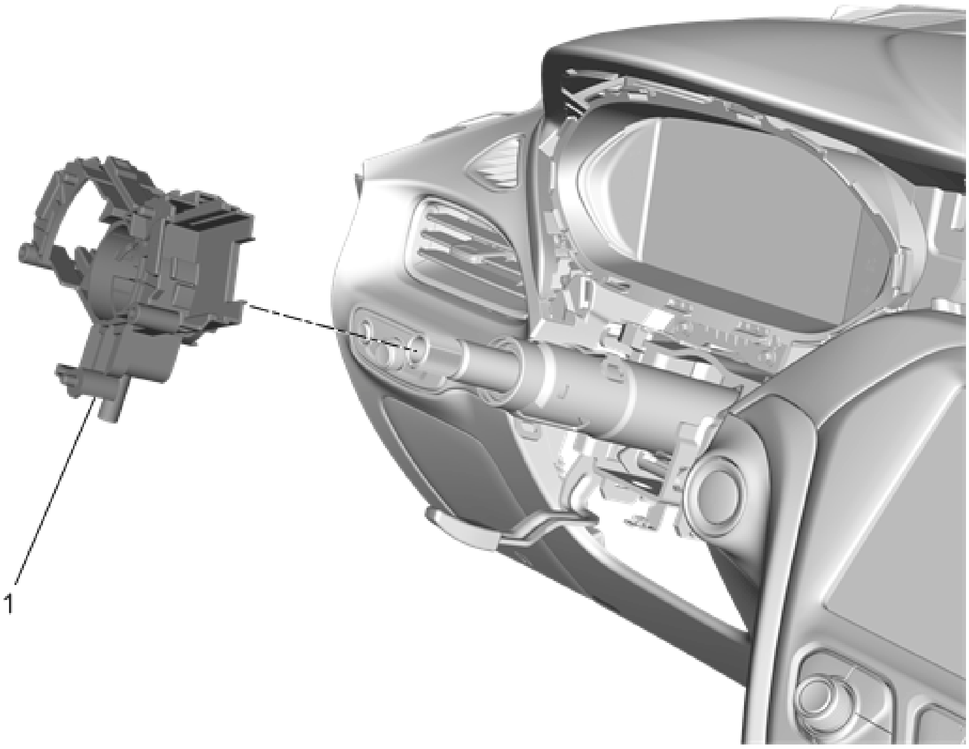


Fig. 41: Turn Signal Switch Bracket
Courtesy of GENERAL MOTORS COMPANY

10. Turn Signal Switch Bracket - Install - **Turn Signal Switch Bracket Replacement**

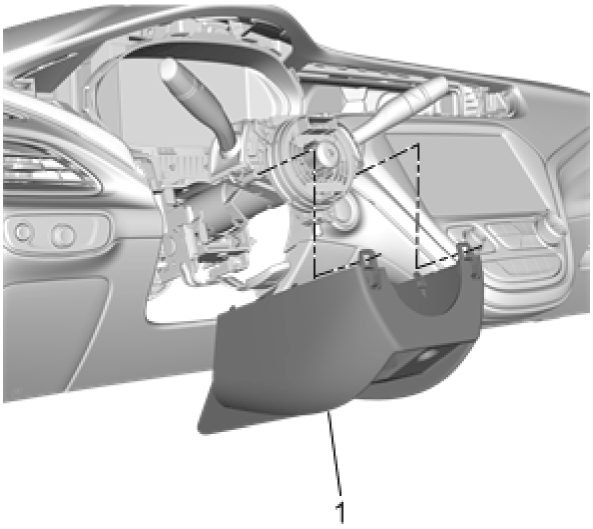


Fig. 42: Steering Column Lower Trim Cover
Courtesy of GENERAL MOTORS COMPANY

11. Steering Column Lower Trim Cover - Install - **Steering Column Lower Trim Cover Replacement**
12. Steering Column Upper Trim Cover at Steering Column Lower Trim Cover - Install - **Steering Column Upper Trim Cover Replacement**
13. Steering Wheel - Install - **Steering Wheel Replacement**
14. Steering Wheel Airbag - Install - **Steering Wheel Airbag Replacement**
15. Enable the SIR System. **SIR Disabling and Enabling**
16. Program the electronic power steering control module. **Control Module References**

17. Calibrate the steering angle sensor. Steering Wheel Angle Sensor Centering

DESCRIPTION AND OPERATION

STEERING WHEEL AND COLUMN DESCRIPTION AND OPERATION

The steering wheel and column has 4 primary functions:

- Vehicle steering
- Vehicle security
- Driver convenience
- Driver safety

Vehicle Steering

The steering wheel is the first link between the driver and the vehicle. The steering wheel is fastened to a steering shaft within the column. At the lower end of the column, the intermediate shaft connects the column to the steering gear.

The steering column can be adjusted vertically and longitudinally.

Vehicle Security

Theft deterrent components are mounted and designed into the steering column. The following components allow the column to be locked in order to minimize theft:

- The ignition switch
- The steering column lock
- The ignition cylinder
- The theft deterrent immobilizer module, if equipped

Driver Convenience

The steering wheel and column may also have driver controls attached for convenience and comfort. The following controls may be mounted on the steering wheel or column.

- The turn signal switch
- The headlamp dimmer switch
- The wiper/washer switch
- The horn pad
- The redundant radio/entertainment system controls
- The tilt functions
- The telephone system controls

Driver Safety

The steering wheel and column has safety features to protect the driver. The following components may be mounted on or near the steering column:

Energy-Absorbing Steering Column: The energy-absorbing steering column compresses in the event of a front-end collision, which reduces the chance of injury to the driver. The energy-absorbing feature, collapsible steering shaft, and break away mounting features help reduce the injury in the event of an accident.

SIR Coil and Module: For additional information on the operation of the SIR coil and module, refer to Supplemental Inflatable Restraint System Description and Operation .

Steering Wheel Angle Sensor: The steering wheel angle sensor is located somewhere along the steering shaft assembly. The sensor measures the position of the steering wheel and the speed at which it is rotated. A signal representing this measurement is provided to the electronic stability control (ESC) in the ABS module.

The Theft Deterrent Immobilizer Module: The immobilizer module is mounted in the steering column lock on cars without Passive Entry Passive Start system (PEPS). Refer to **Immobilizer Description and Operation** .

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2017 SUSPENSION

CHEVROLET WHEEL ALIGNMENT SPECIFICATIONS - BOLT

WHEEL ALIGNMENT SPECIFICATIONS

BOLT EV 205/55 R16

BOLT EV 205/55 R16

Measurement	Minimum	Preferred	Maximum
Left Front Caster (Â°)	4.75	5.5	6.25
Right Front Caster (Â°)	4.75	5.5	6.25
Left Front Camber (Â°)	-1.3	-0.55	0.2
Right Front Camber (Â°)	-1.3	-0.55	0.2
Front Toe (Â°)	-0.18	0.02	0.22
Left SAI (Â°)	0	0	0
Right SAI (Â°)	0	0	0
Left Rear Camber (Â°)	-1.9	-1.4	-0.9
Right Rear Camber (Â°)	-1.9	-1.4	-0.9
Rear Toe (Â°)	-0.15	0.2	0.55
Thrust Angle	0.3	0	0
Left Toe Out, Inward (Â°)	0	0	0
Right Toe Out, Inward (Â°)	0	0	0
Left Toe Out, Outward (Â°)	0	0	0
Right Toe Out, Outward (Â°)	0	0	0
Left Max Turn, Inward (Â°)	0	0	0
Right Max Turn, Inward (Â°)	0	0	0
Left Max Turn, Outward (Â°)	0	0	0
Right Max Turn, Outward (Â°)	0	-	-

BOLT EV 215/50 R17

BOLT EV 215/50 R17

Measurement	Minimum	Preferred	Maximum
Left Front Caster (Â°)	4.75	5.5	6.25
Right Front Caster (Â°)	4.75	5.5	6.25
Left Front Camber (Â°)	-1.3	-0.55	0.2
Right Front Camber (Â°)	-1.3	-0.55	0.2
Front Toe (Â°)	-0.18	0.02	0.22
Left SAI (Â°)	0	0	0
Right SAI (Â°)	0	0	0
Left Rear Camber (Â°)	-1.9	-1.4	-0.9
Right Rear Camber (Â°)	-1.9	-1.4	-0.9
Rear Toe (Â°)	-0.15	0.2	0.55
Thrust Angle	0.3	0	0
Left Toe Out, Inward (Â°)	0	0	0
Right Toe Out, Inward (Â°)	0	0	0
Left Toe Out, Outward (Â°)	0	0	0
Right Toe Out, Outward (Â°)	0	0	0
Left Max Turn, Inward (Â°)	0	0	0
Right Max Turn, Inward (Â°)	0	0	0
Left Max Turn, Outward (Â°)	0	0	0

Measurement	Minimum	Preferred	Maximum
Right Max Turn, Outward (Â°)	0	-	-

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2017 SUSPENSION

Front Suspension - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Front Lower Control Arm Front Bolt	120 N.m (89 lb ft)
Front Lower Control Arm Rear Nut	100 N.m (74 lb ft)
Front Stabilizer Shaft Link Nut	100 N.m (74 lb ft)
Front Suspension Strut Mount Nut	22 N.m (16 lb ft)
Front Suspension Strut Nut	160 N.m (118 lb ft)
Front Suspension Strut Upper Mounting Nut	85 N.m (63 lb ft)
Front Wheel Hub Bolt	
• First Pass:	65 N.m (48 lb ft)
• Final Pass:	30 - 45 Degrees
Steering Knuckle Nut	
• First Pass:	30 N.m (22 lb ft)
• Final Pass:	120 - 135 Degrees

REPAIR INSTRUCTIONS

STABILIZER SHAFT REPLACEMENT

Removal Procedure

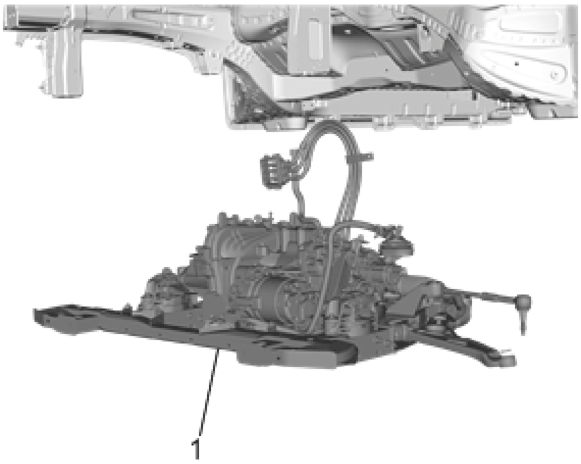


Fig. 1: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Remove - Refer to **Drivetrain and Front Suspension Frame Removal and Installation**

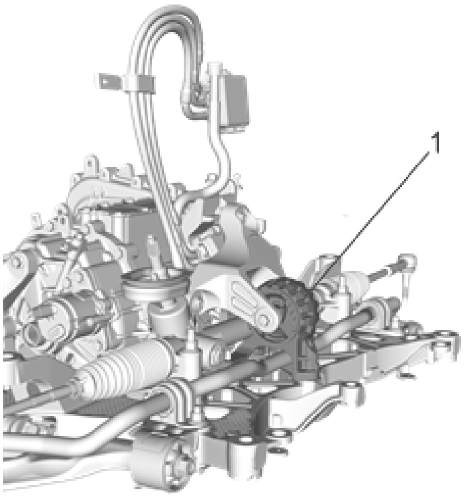


Fig. 2: Drive Motor Rear Mount
Courtesy of GENERAL MOTORS COMPANY

2. Remove Drive Motor Rear Mount (1). Refer to **Drive Motor Rear Mount Replacement**

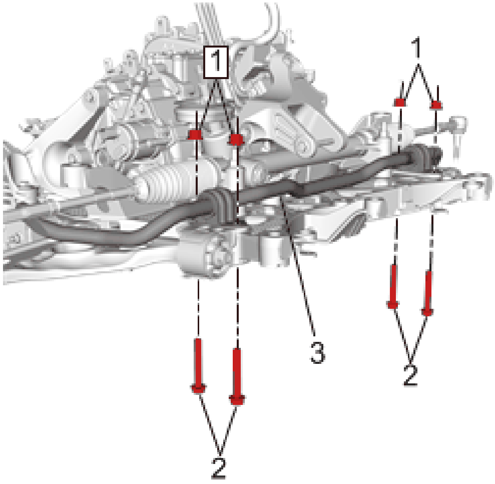


Fig. 3: Front Lower Control Arm Rear Nuts, Bolts And Front Stabilizer Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Lower Control Arm Rear Nuts (1) (Qty: 4)
4. Remove Front Lower Control Arm Rear Bolts (2) (Qty: 4)
5. Remove Front Stabilizer Shaft (3) @ Drivetrain and Front Suspension Crossmember

Installation Procedure

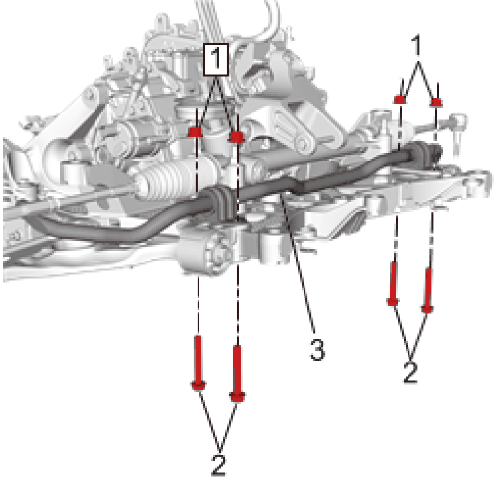


Fig. 4: Front Lower Control Arm Rear Nuts, Bolts And Front Stabilizer Shaft
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Stabilizer Shaft (3) @ Drivetrain and Front Suspension Crossmember
2. Install Front Lower Control Arm Rear Bolts (2) (Qty: 4)

CAUTION: **Refer to Fastener Caution**

3. Install and tighten Front Lower Control Arm Rear Nuts (1) (Qty: 4) to 100 N.m (74 lb ft)

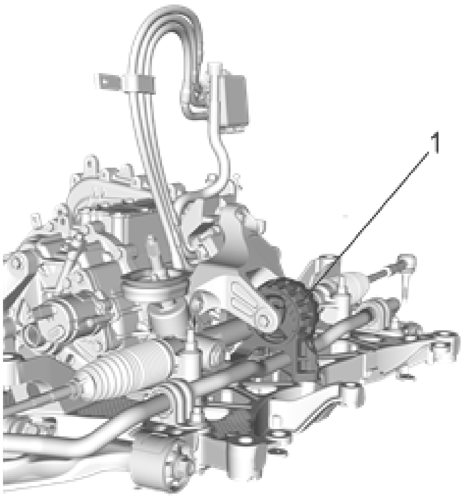


Fig. 5: Drive Motor Rear Mount
Courtesy of GENERAL MOTORS COMPANY

4. Install Drive Motor Rear Mount (1). Refer to Drive Motor Rear Mount Replacement

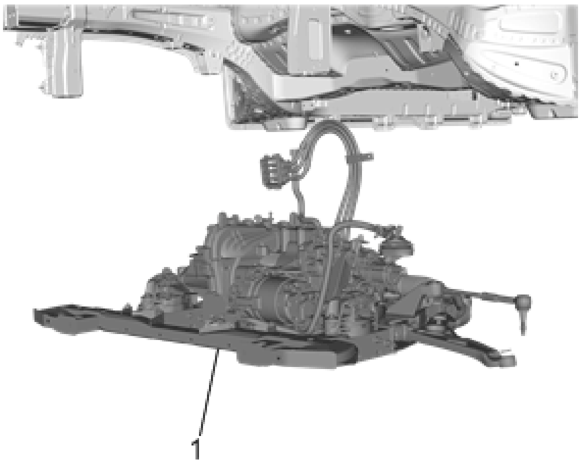


Fig. 6: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

5. Install Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to Drivetrain and Front Suspension Frame Removal and Installation

STABILIZER SHAFT LINK REPLACEMENT

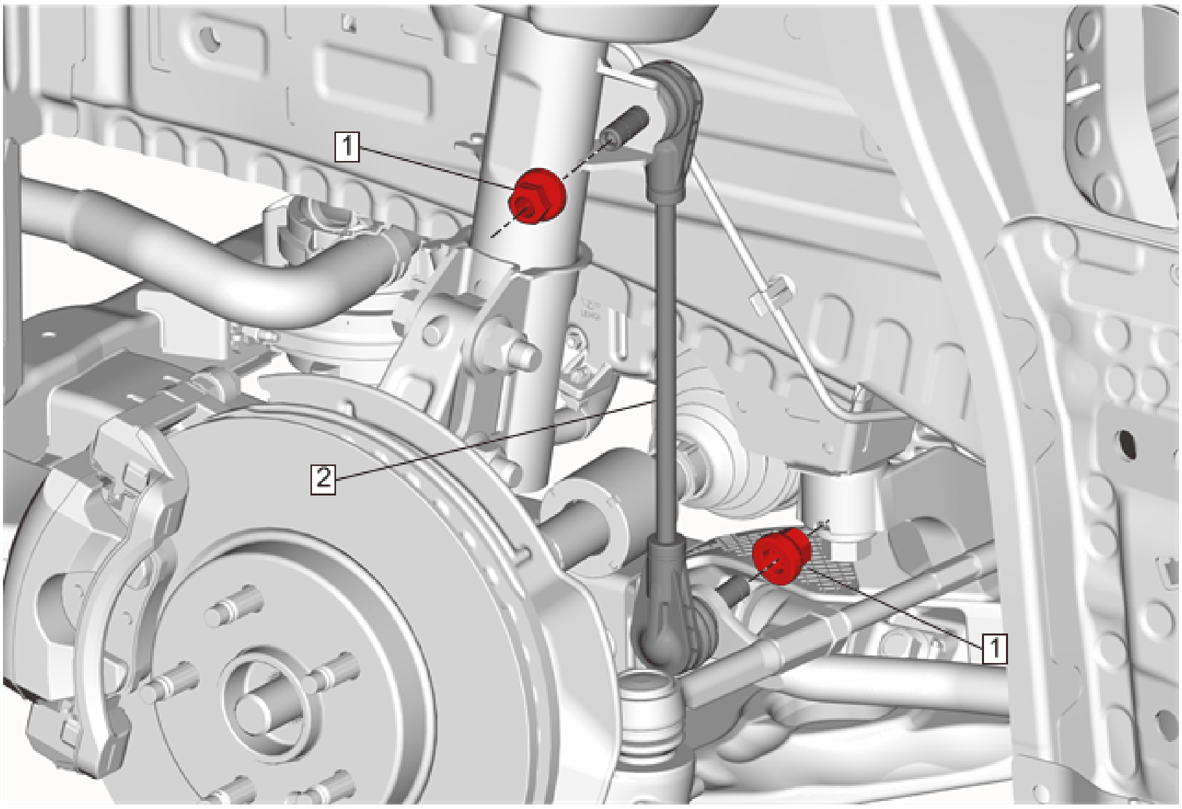


Fig. 7: Stabilizer Shaft Link
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle
2. Remove the front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation</td></tr>
<tr><td>1</td><td>Front Stabilizer Shaft Link Nut (Qty: 2)
CAUTION:
Refer to Fastener Caution .
Tighten
100 N.m (74 lb ft)</td></tr>
<tr><td>2</td><td>Front Stabilizer Shaft Link
Procedure
1. Install the front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
2. Lower the vehicle.</td></tr>
</table>

FRONT WHEEL BEARING AND HUB REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle

2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**

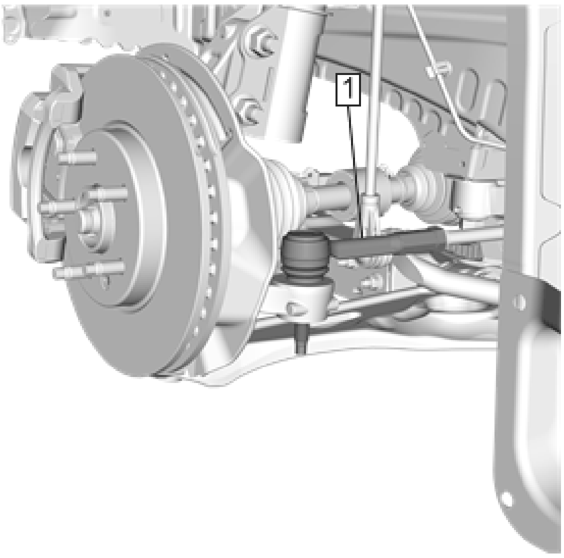


Fig. 8: Steering Linkage Outer Tie Rod
Courtesy of GENERAL MOTORS COMPANY

3. Separate Steering Linkage Outer Tie Rod (1) @ Steering Knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement**

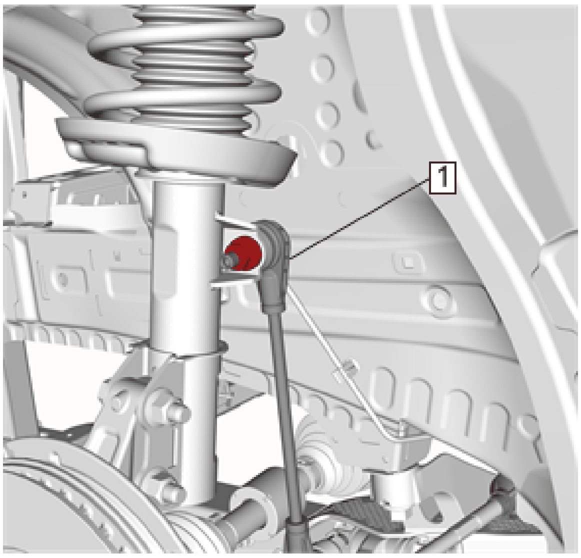


Fig. 9: Front Stabilizer Shaft Link
Courtesy of GENERAL MOTORS COMPANY

4. Separate Front Stabilizer Shaft Link (1) @ Front Suspension Strut. Refer to **Stabilizer Shaft Link Replacement**

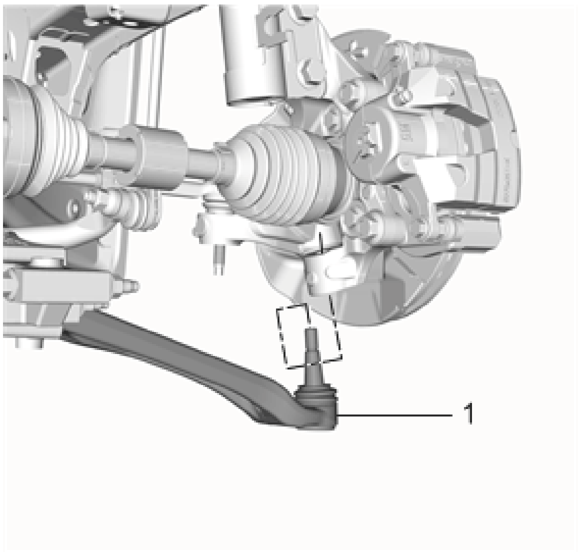


Fig. 10: Front Lower Control Arm Ball Joint
Courtesy of GENERAL MOTORS COMPANY

5. Separate Front Lower Control Arm Ball Joint (1) @ Steering Knuckle. Refer to **Lower Control Arm Replacement**

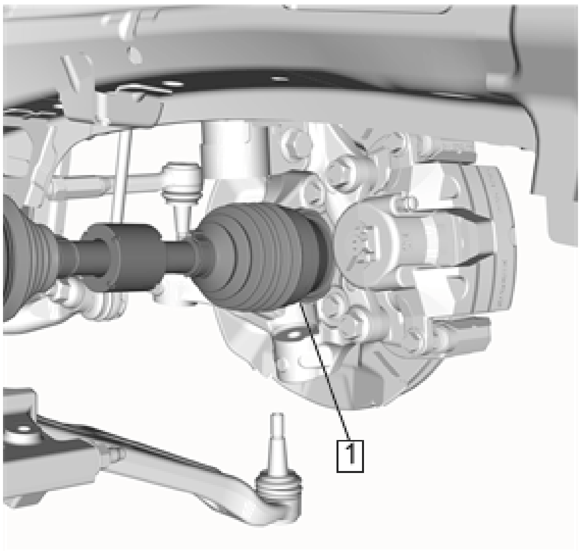


Fig. 11: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

6. Separate Front Wheel Drive Shaft (1) @ Front Wheel Hub. Refer to **Front Wheel Drive Shaft Replacement**

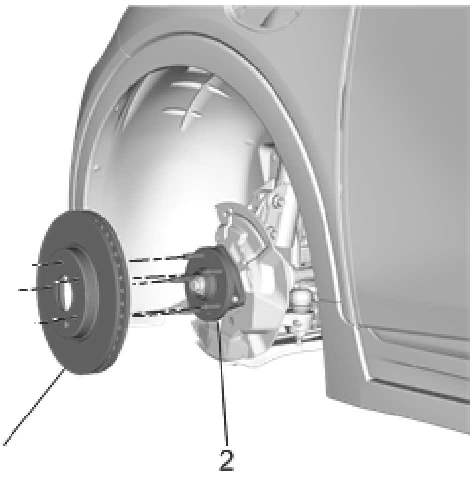


Fig. 12: Front Brake Rotor And Front Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

7. Remove Front Brake Rotor (1) @ Front Wheel Hub (2). Refer to **Front Brake Rotor Replacement**

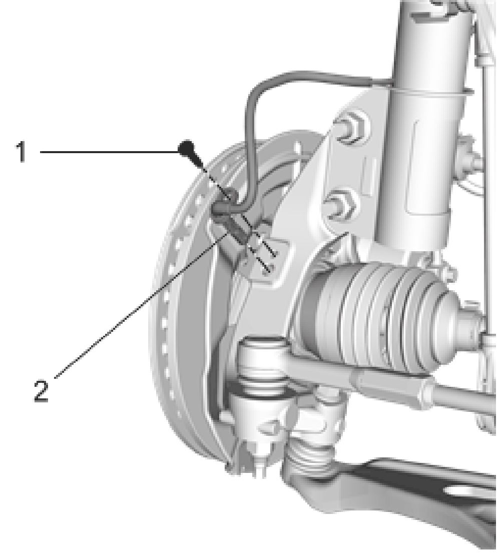


Fig. 13: Front Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove Front Wheel Speed Sensor Bolt (1) @ Steering Knuckle
9. Remove Front Wheel Speed Sensor (2) @ Steering Knuckle

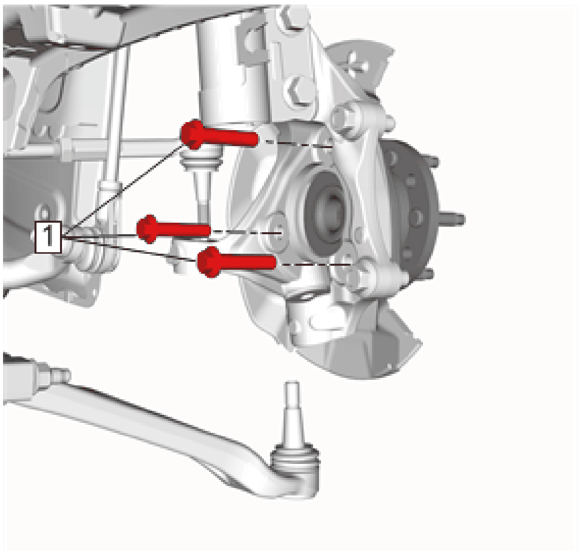


Fig. 14: Front Wheel Hub Bolts
Courtesy of GENERAL MOTORS COMPANY

10. Remove Front Wheel Hub Bolts (1) (Qty: 3)

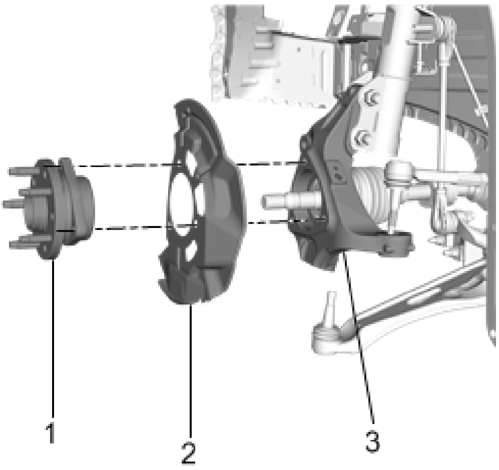


Fig. 15: Front Wheel Bearing/Hub Assembly, Brake Shield And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

11. Remove Front Wheel Bearing and Hub Assembly (1) @ Steering Knuckle (3)
12. Remove Front Brake Shield (2) @ Steering Knuckle (3)

Installation Procedure

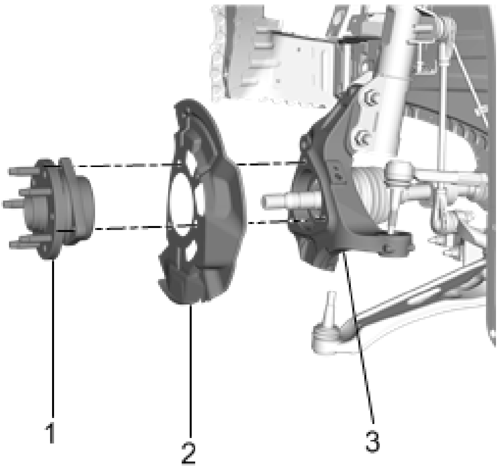


Fig. 16: Front Wheel Bearing/Hub Assembly, Brake Shield And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Brake Shield (2) @ Steering Knuckle (3)
2. Install Front Wheel Bearing and Hub Assembly (1) @ Steering Knuckle (3)

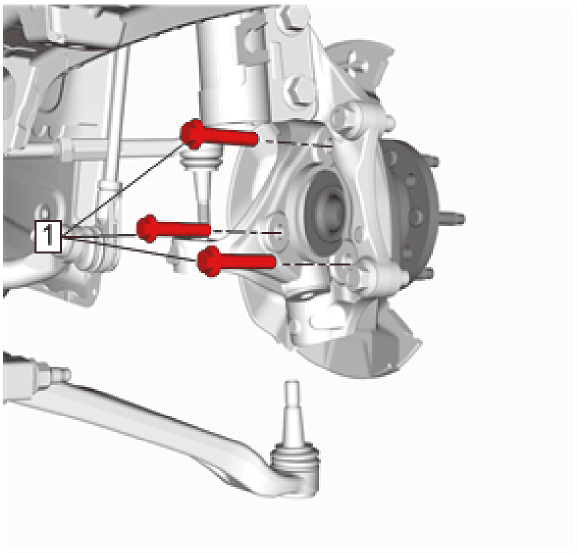


Fig. 17: Front Wheel Hub Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Install and tighten Front Wheel Hub Bolts (1) (Qty: 3)
    1. First Pass: 65 N.m (48 lb ft)
    2. Final Pass: 30 - 45 Degrees

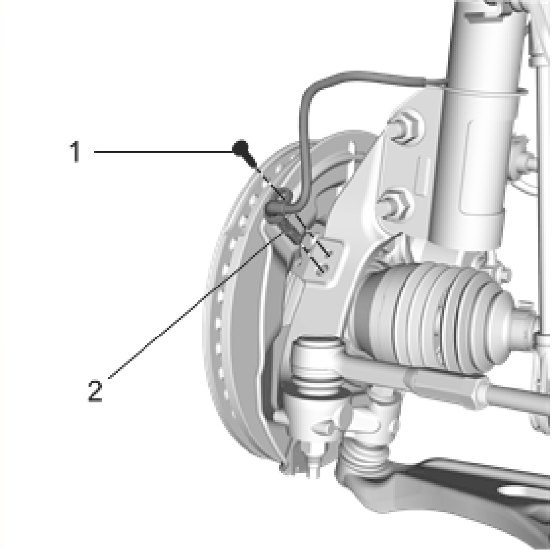


Fig. 18: Front Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Wheel Speed Sensor (2) @ Steering Knuckle
5. Install and tighten Front Wheel Speed Sensor Bolt (1) @ Steering Knuckle. Refer to **Front Wheel Speed Sensor Replacement**

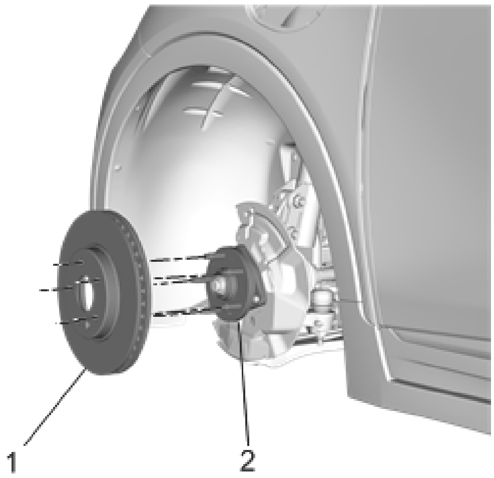


Fig. 19: Front Brake Rotor And Front Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

6. Install Front Brake Rotor (1) @ Front Wheel Hub (2). Refer to **Front Brake Rotor Replacement**

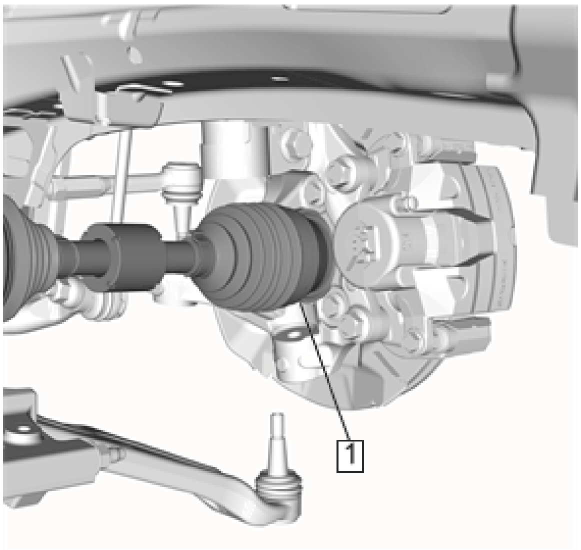


Fig. 20: Front Wheel Drive Shaft
Courtesy of GENERAL MOTORS COMPANY

7. Install Front Wheel Drive Shaft (1) @ Front Wheel Hub. Refer to **Front Wheel Drive Shaft Replacement**

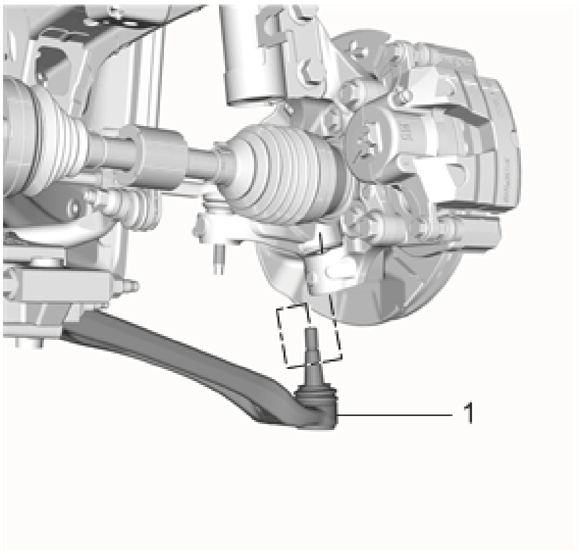


Fig. 21: Front Lower Control Arm Ball Joint
Courtesy of GENERAL MOTORS COMPANY

8. Install Front Lower Control Arm Ball Joint (1) @ Steering Knuckle. Refer to **Lower Control Arm Replacement**

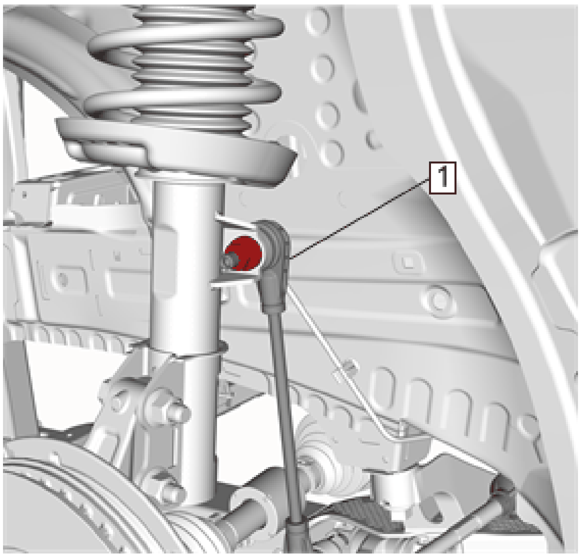


Fig. 22: Front Stabilizer Shaft Link
Courtesy of GENERAL MOTORS COMPANY

9. Install Front Stabilizer Shaft Link (1) @ Front Suspension Strut. Refer to **Stabilizer Shaft Link Replacement**

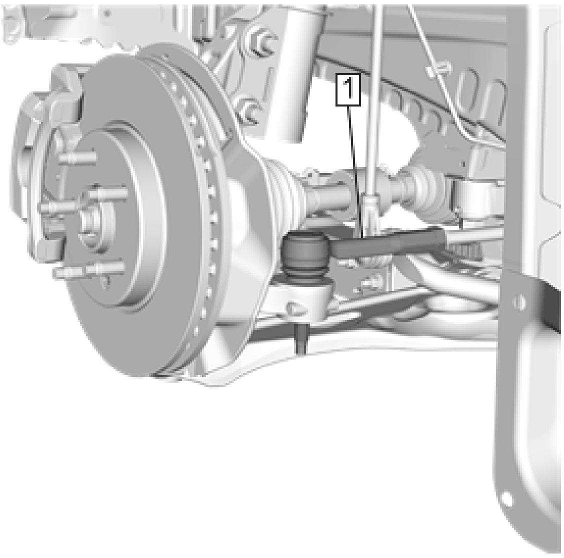


Fig. 23: Steering Linkage Outer Tie Rod
Courtesy of GENERAL MOTORS COMPANY

10. Install Steering Linkage Outer Tie Rod (1) @ Steering Knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement**
11. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
12. Lower the vehicle.

STEERING KNUCKLE REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**

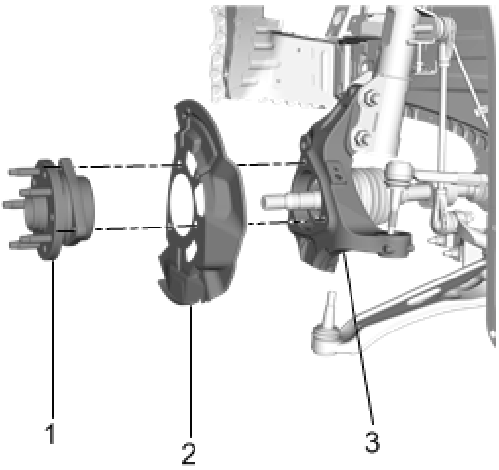


Fig. 24: Front Wheel Bearing/Hub Assembly, Brake Shield And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Wheel Bearing and Hub Assembly (1) @ Steering Knuckle (3). Refer to **Front Wheel Bearing and Hub Replacement**
4. Remove Front Brake Shield (2) @ Steering Knuckle (3)

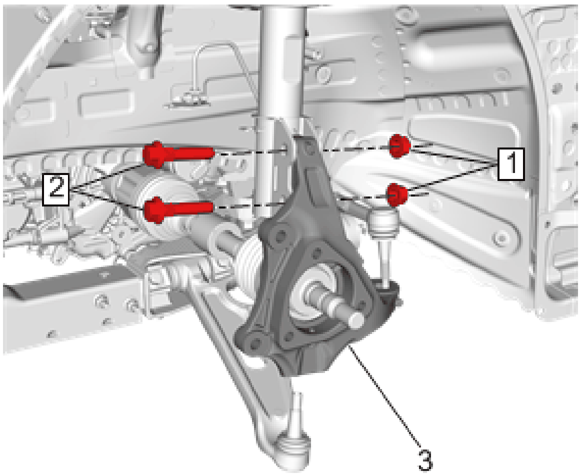


Fig. 25: Front Suspension Strut Nuts, Bolts And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

5. Remove Front Suspension Strut Nuts (1) (Qty: 2)
6. Remove Front Suspension Strut Bolts (2) (Qty: 2)
7. Remove Steering Knuckle (3) @ Vehicle

Installation Procedure

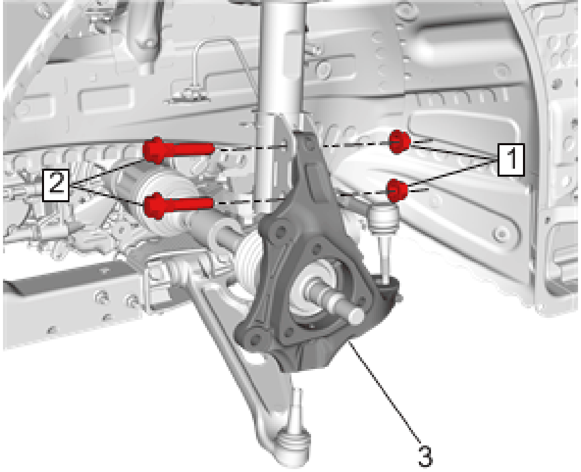


Fig. 26: Front Suspension Strut Nuts, Bolts And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

1. Install Steering Knuckle (3) @ Vehicle
2. Install Front Suspension Strut Bolts (2) (Qty: 2)

CAUTION: **Refer to Fastener Caution**

3. Install and tighten Front Suspension Strut Nuts (1) (Qty: 2) to 160 N.m (118 lb ft)

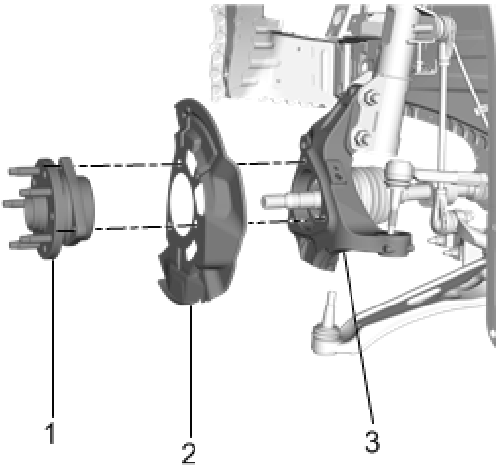


Fig. 27: Front Wheel Bearing/Hub Assembly, Brake Shield And Steering Knuckle
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Brake Shield (2) @ Steering Knuckle (3)
5. Install Front Wheel Bearing and Hub Assembly (1) @ Steering Knuckle (3). Refer to **Front Wheel Bearing and Hub Replacement**
6. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
7. Lower the vehicle.

LOWER CONTROL ARM REPLACEMENT

Special Tools

- **CH-42188-B** Ball Joint Separator
- **J-42188-2A** 6 mm Hex Key

Equivalent regional tools: **Special Tools**

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
3. Remove Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**

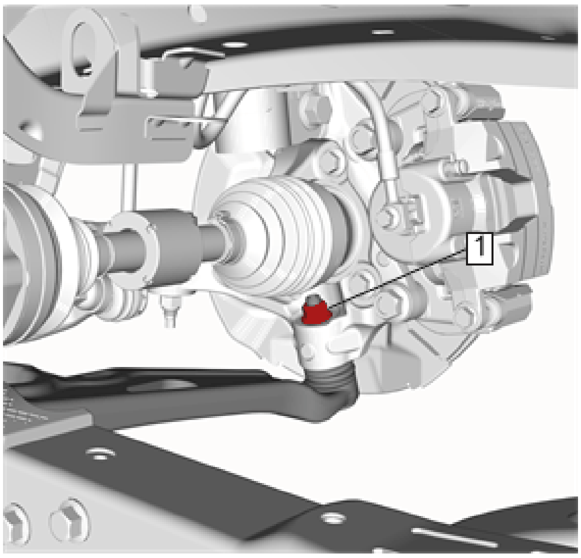


Fig. 28: Steering Knuckle Nut
Courtesy of GENERAL MOTORS COMPANY

4. Loosen Steering Knuckle Nut (1) @ Front Lower Control Arm

   Use the J-42188-2A 6 mm Hex Key to prevent the ball joint pivot from being rotated.

5. Use the CH-42188-B ball joint separator to separate the front lower control arm from the steering knuckle.
6. Remove Steering Knuckle Nut (1) @ Front Lower Control Arm

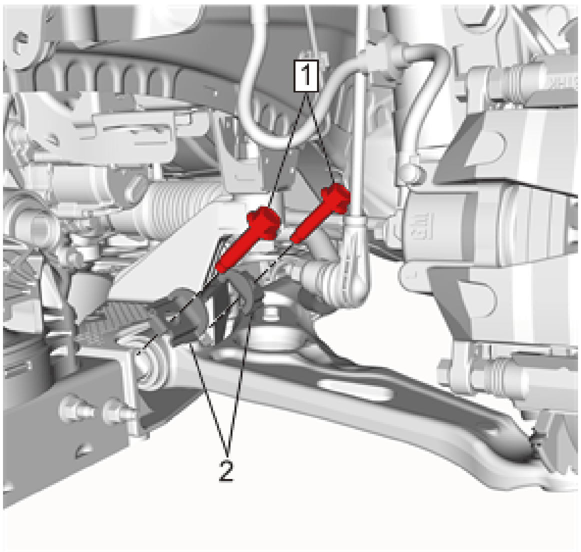


Fig. 29: Front Lower Control Arm Front Bolts And Brackets
Courtesy of GENERAL MOTORS COMPANY

7. Remove Front Lower Control Arm Front Bolts (1) (Qty: 2)
8. Remove Front Lower Control Arm Front Brackets (2) (Qty: 2)

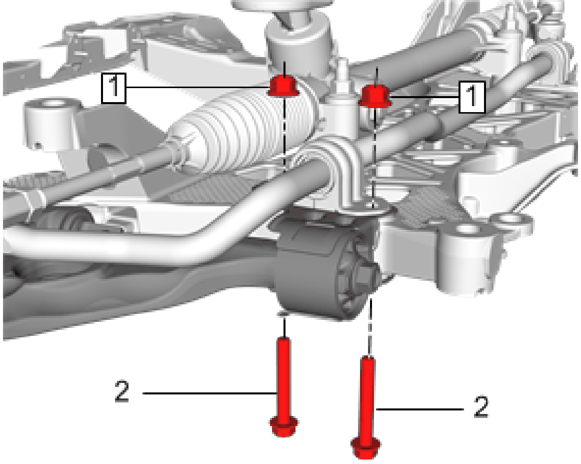


Fig. 30: Front Lower Control Arm Rear Nuts And Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Remove Front Lower Control Arm Rear Nuts (1) (Qty: 2)
10. Remove Front Lower Control Arm Rear Bolts (2) (Qty: 2)

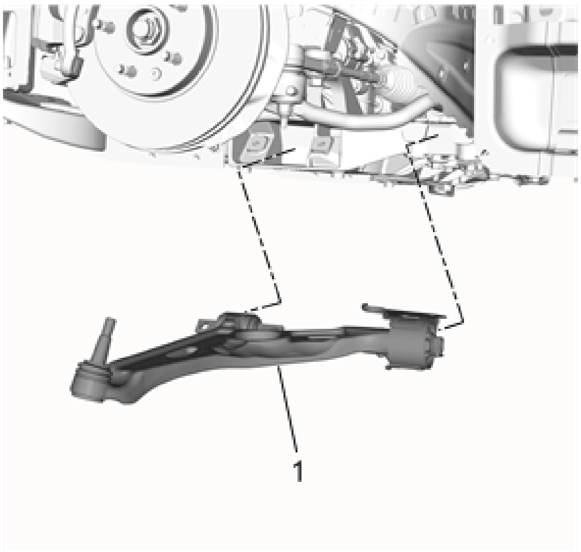
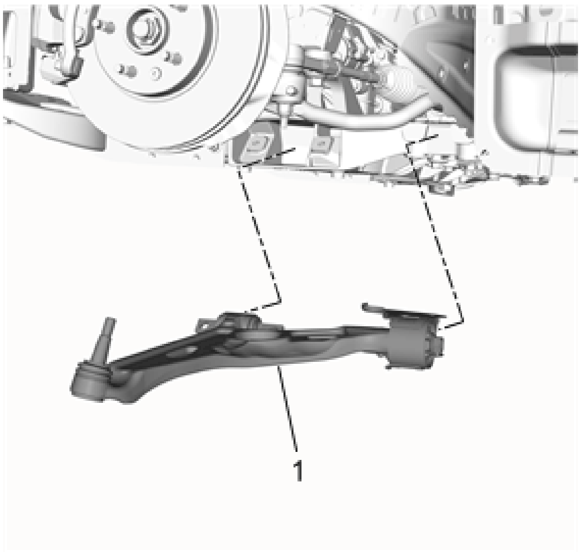


Fig. 31: Front Lower Control Arm
Courtesy of GENERAL MOTORS COMPANY

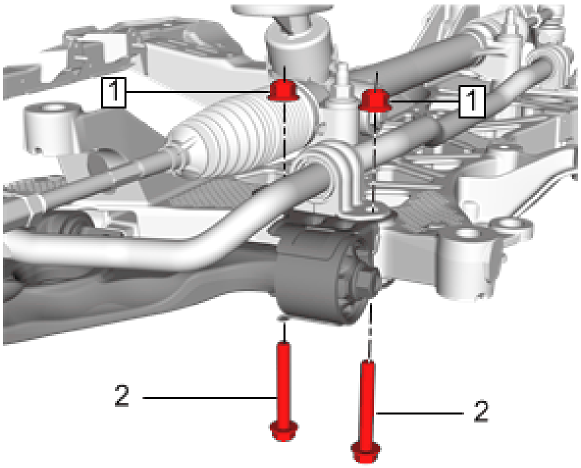
11. Remove Front Lower Control Arm (1) @ Vehicle

Installation Procedure



[Fig. 32: Front Lower Control Arm](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Lower Control Arm (1) @ Vehicle

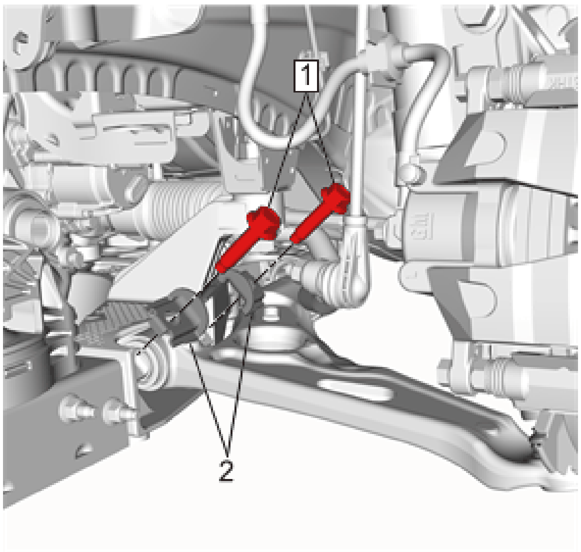


[Fig. 33: Front Lower Control Arm Rear Nuts And Bolts](#)
Courtesy of GENERAL MOTORS COMPANY

2. Install Front Lower Control Arm Rear Bolts (2) (Qty: 2)

CAUTION: **Refer to [Fastener Caution](#)**

3. Install and tighten Front Lower Control Arm Rear Nuts (1) (Qty: 2) to 100 N.m (74 lb ft)



[Fig. 34: Front Lower Control Arm Front Bolts And Brackets](#)
Courtesy of GENERAL MOTORS COMPANY

4. Install Front Lower Control Arm Front Brackets (2) (Qty: 2)
5. Install and tighten Front Lower Control Arm Front Bolts (1) (Qty: 2) to 120 N.m (89 lb ft)

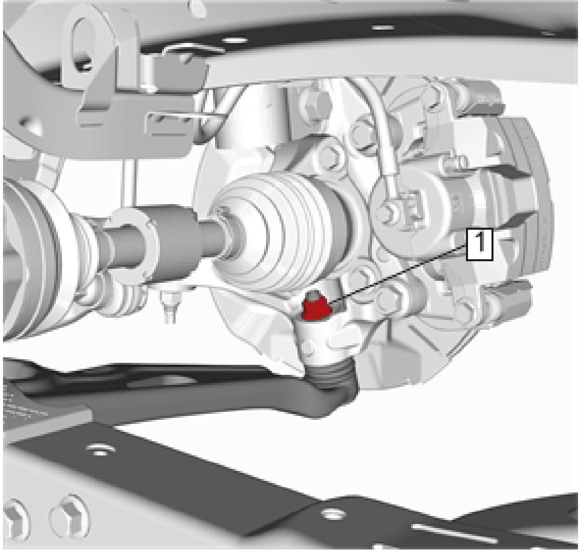


Fig. 35: Steering Knuckle Nut
Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Steering Knuckle Nut (1) @ Front Lower Control Arm

   Use the J-42188-2A 6 mm Hex Key to prevent the ball joint pivot from being rotated.

   1. First Pass: 30 N.m (22 lb ft)
   2. Final Pass: 120 - 135 Degrees
7. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
8. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
9. Lower the vehicle.

WHEEL STUD REPLACEMENT

Special Tools

CH-43631 Ball Joint Separator

Equivalent regional tools: **Special Tools**

Removal Procedure

1. Remove Front Wheel Bearing and Hub Assembly. Refer to **Front Wheel Bearing and Hub Replacement**

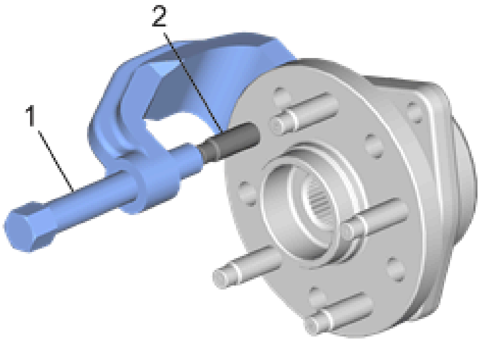


Fig. 36: Separator And Wheel Stud
Courtesy of GENERAL MOTORS COMPANY

2. Use the **CH-43631** separator (1) to remove the wheel stud (2) from the flange on the hub assembly.

   DISCARD the stud.

Installation Procedure

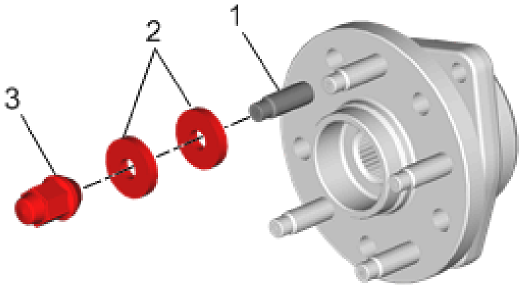


Fig. 37: Wheel Stud, Flat Washers And Wheel Nut
Courtesy of GENERAL MOTORS COMPANY

1. Position the NEW wheel stud (1) in the flange on the hub assembly.
2. Install the CH-45101-100 conical brake rotor washers or flat washers (2) and an OLD wheel nut (3) on the wheel stud.
3. Use a suitable tool to prevent the flange on the hub assembly from rotating.
4. Tighten the wheel nut until the wheel stud is firmly seated.
5. Remove the wheel nut and flat washers.
6. Install Front Wheel Bearing and Hub Assembly. Refer to **Front Wheel Bearing and Hub Replacement**

STRUT AND SHOCK ABSORBER INSPECTION

NOTE: **The strut assembly DOES NOT have to be removed from the vehicle to perform the following inspection procedure.**

NOTE: **A light film of oil on the top portion of the strut is normal. DO NOT replace the strut for this condition.**

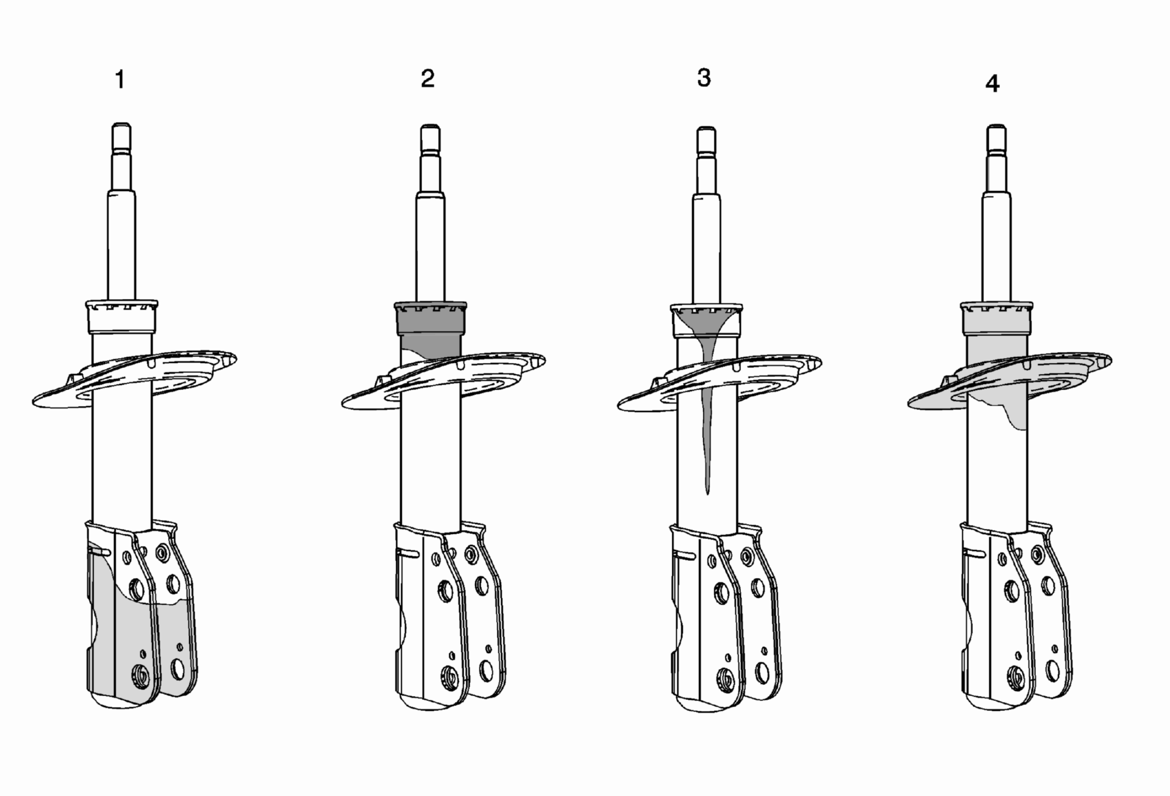


Fig. 38: Strut and Shock Absorber Inspection (Strut)
Courtesy of GENERAL MOTORS COMPANY

Condition 1

Oil or fluid residue only on the bottom of the strut tube or on other strut components and not originating from the shaft seal, is not a strut related problem. DO NOT replace the strut, look for other external leaks.

Condition 2

Light film/residue on the strut tube, but not on the spring seat and originating from the shaft seal, is a NORMAL condition. DO NOT replace the strut.

Condition 3

Oil drip or trail down the strut tube and originating from the shaft seal, is an ABNORMAL condition. Replace the strut.

Condition 4

Extreme wet film of oil covering the strut tube and pooling in the spring seat and originating from the shaft seal, is an ABNORMAL condition. Replace the strut.

Inspection

1. Verify the customer's concern is present. If the concern is present, continue to the next step. If the concern is not present, then the vehicle is operating normally.

NOTE: **The strut assembly DOES NOT have to be removed from the vehicle to perform the following inspection procedure.**

2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Visually inspect each of the shock absorbers or struts for external fluid leaks. Refer to the following conditions 1, 2, 3, and 4 for visual inspection.
   - If conditions 1 or 2 are found, continue to step 4.
   - If conditions 3 or 4 are found, replace strut. Refer to Strut Replacement.
4. If equipped with electronic suspension control system, ensure that the system is working properly. Refer to Diagnostic Starting Point-Electronic Suspension Control.
5. Use your hands in order to lift up and push down on each corner of the vehicle 3 times. Remove your hands from the vehicle. If the corner motion exceeds 2 cycles, replace the strut. If the strut does not exceed 2 cycles, NO repair is necessary.

STRUT ASSEMBLY REMOVAL AND INSTALLATION

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**

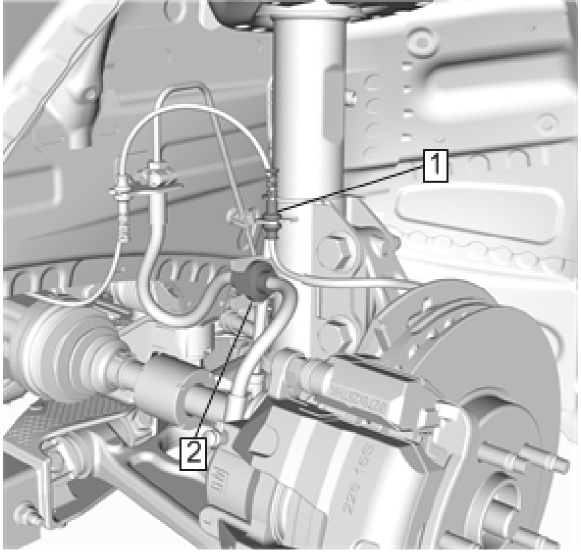


Fig. 39: Front Wheel Speed Sensor Wiring Harness Grommet And Front Brake Hose Grommet
Courtesy of GENERAL MOTORS COMPANY

3. Remove Front Wheel Speed Sensor Wiring Harness Grommet (1) @ Front Suspension Strut
4. Remove Front Brake Hose Grommet (2) @ Front Suspension Strut

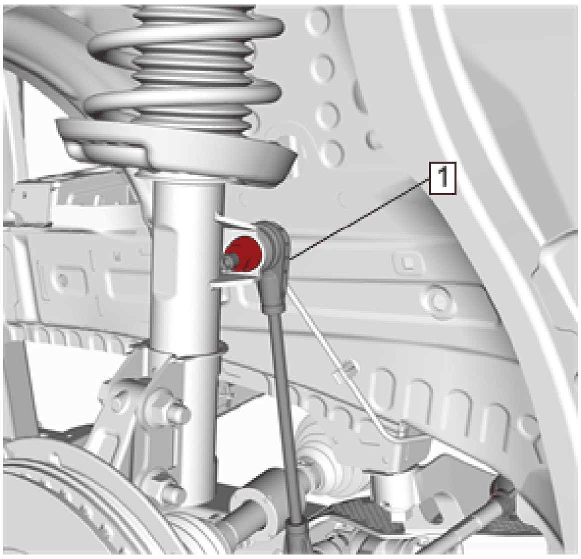


Fig. 40: Front Stabilizer Shaft Link
Courtesy of GENERAL MOTORS COMPANY

5. Separate Front Stabilizer Shaft Link (1) @ Front Suspension Strut. Refer to Stabilizer Shaft Link Replacement

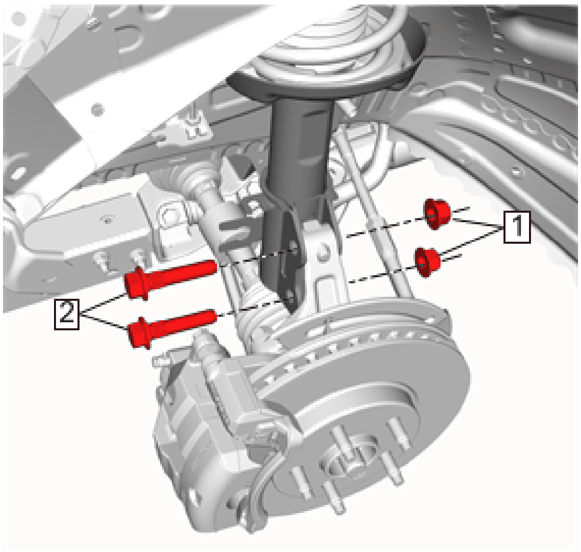


Fig. 41: Front Suspension Strut Nuts And Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove Front Suspension Strut Nuts (1) (Qty: 2)
7. Remove Front Suspension Strut Bolts (2) (Qty: 2)
8. Remove Air Inlet Grille Panel. Refer to **Air Inlet Grille Panel Replacement**
9. Remove Windshield Wiper System Module. Refer to **Windshield Wiper System Module Replacement**

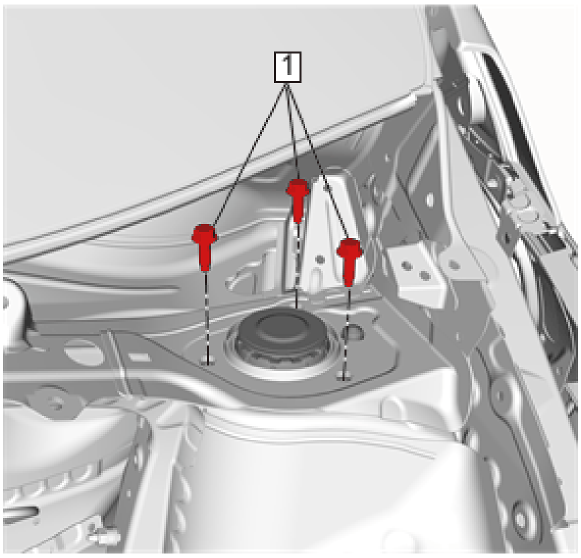


Fig. 42: Front Suspension Strut Mount Nuts
Courtesy of GENERAL MOTORS COMPANY

10. Remove Front Suspension Strut Mount Nuts (1) (Qty: 3)

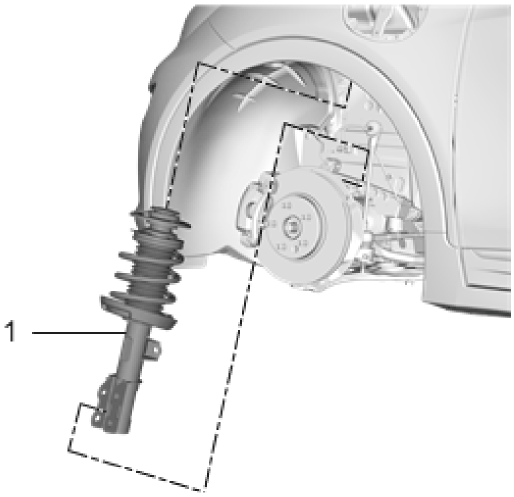


Fig. 43: Front Suspension Strut
Courtesy of GENERAL MOTORS COMPANY

11. Remove Front Suspension Strut (1) @ Vehicle

Installation Procedure

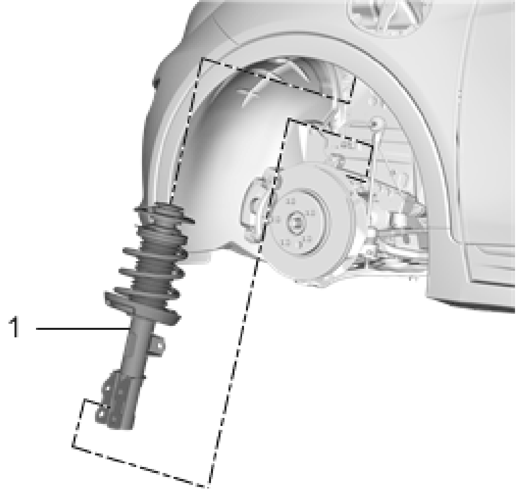


Fig. 44: Front Suspension Strut
Courtesy of GENERAL MOTORS COMPANY

1. Install Front Suspension Strut (1) @ Vehicle

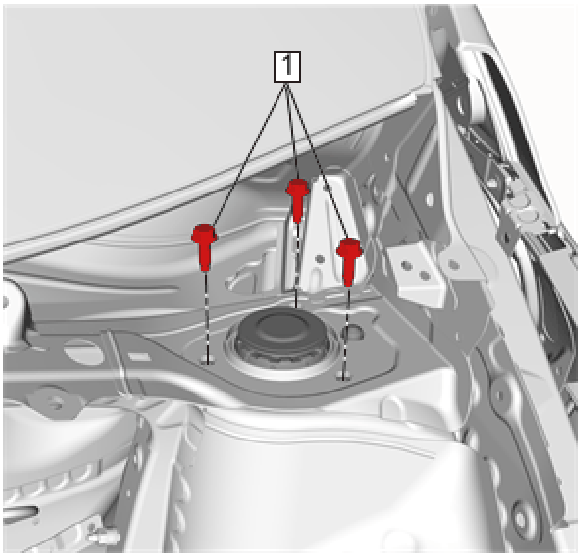


Fig. 45: Front Suspension Strut Mount Nuts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

2. Install and tighten Front Suspension Strut Mount Nuts (1) (Qty: 3) to 22 N.m (16 lb ft)
3. Install Windshield Wiper System Module. Refer to **Windshield Wiper System Module Replacement**
4. Install Air Inlet Grille Panel. Refer to **Air Inlet Grille Panel Replacement**

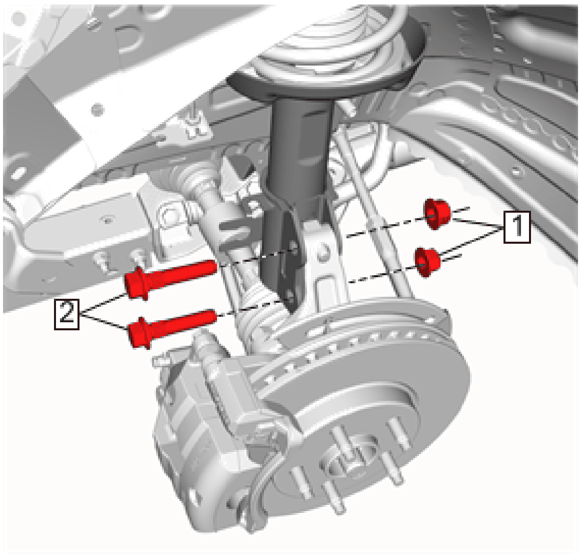


Fig. 46: Front Suspension Strut Nuts And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Suspension Strut Bolts (2) (Qty: 2)
6. Install and tighten Front Suspension Strut Nuts (1) (Qty: 2) to 160 N.m (118 lb ft)

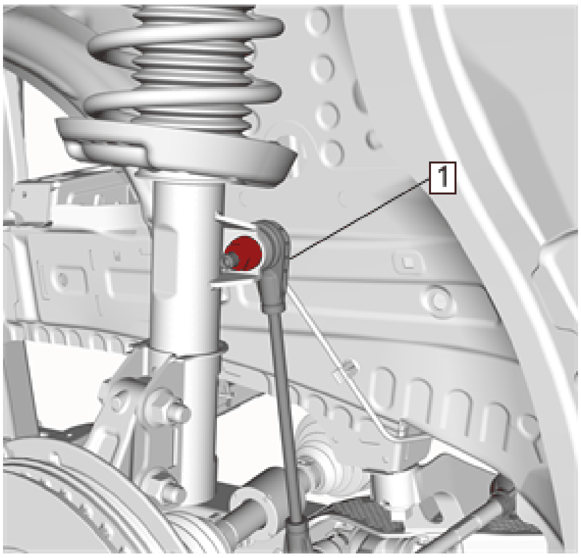


Fig. 47: Front Stabilizer Shaft Link
Courtesy of GENERAL MOTORS COMPANY

7. Install Front Stabilizer Shaft Link (1) @ Front Suspension Strut. Refer to **Stabilizer Shaft Link Replacement**

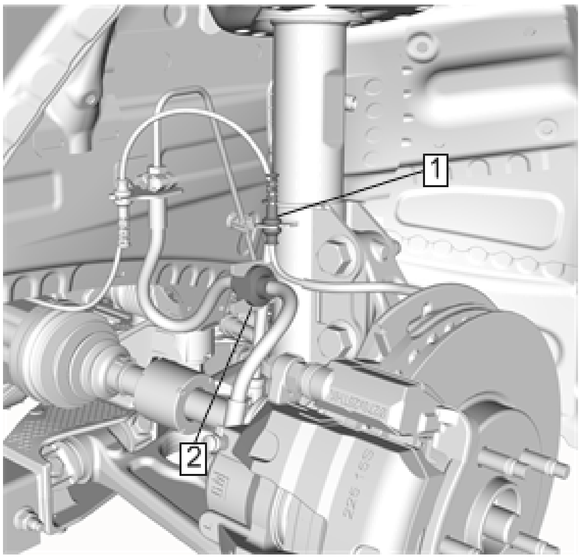


Fig. 48: Front Wheel Speed Sensor Wiring Harness Grommet And Front Brake Hose Grommet
Courtesy of GENERAL MOTORS COMPANY

8. Install Front Brake Hose Grommet (2) @ Front Suspension Strut
9. Install Front Wheel Speed Sensor Wiring Harness Grommet (1) @ Front Suspension Strut
10. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
11. Lower the vehicle.

SUSPENSION SHOCK/STRUT DISPOSAL

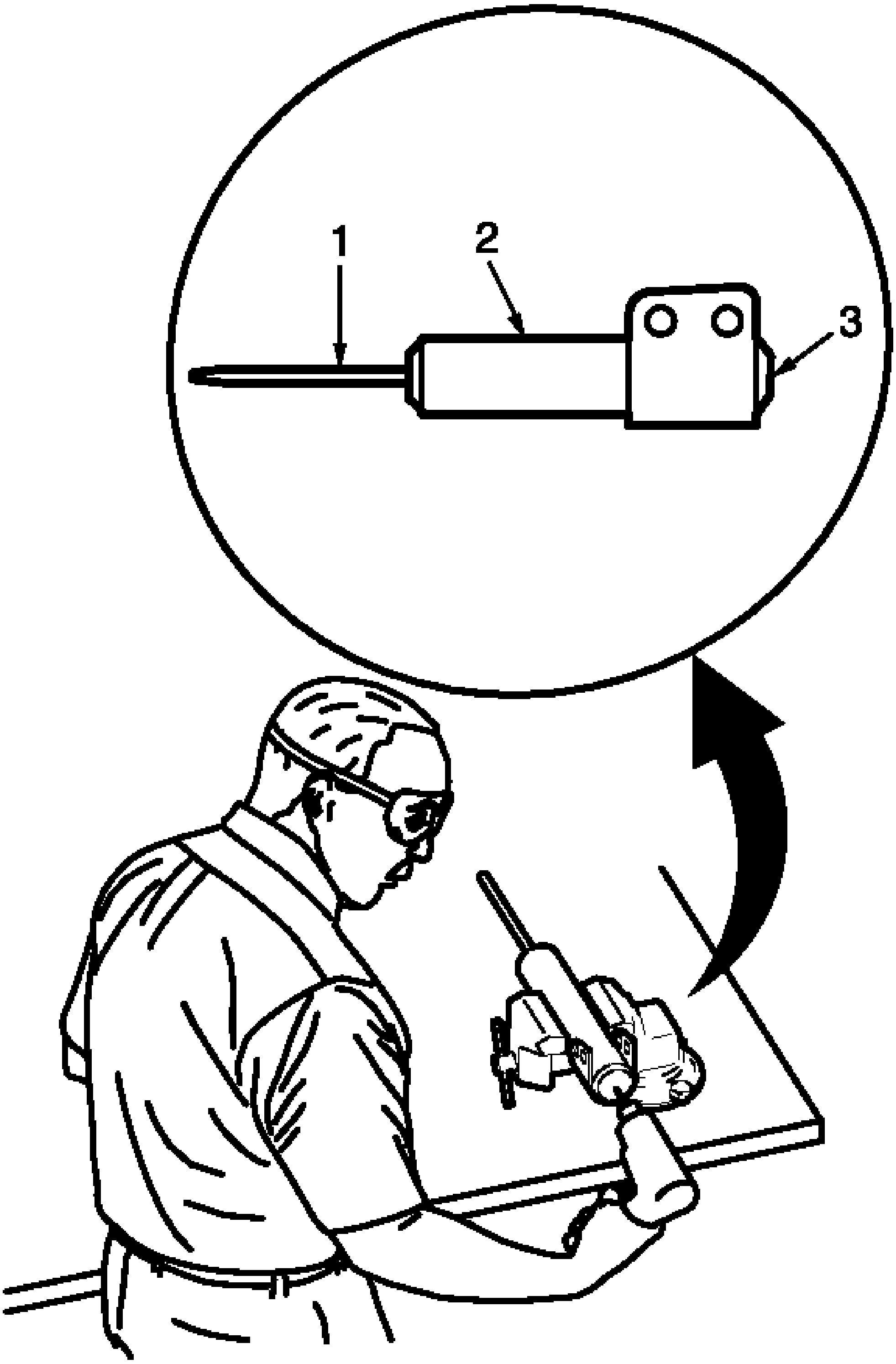


Fig. 49: Drilling Hole In Strut At Center Of End Cap
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Use the proper eye protection when drilling to prevent metal chips from causing physical injury.**

1. Clamp the strut in a vise horizontally with the rod (1) completely extended.
2. Drill a hole in the strut at the center of the end cap (3) using a 5 mm (3/16 in) drill bit. Gas or a gas/oil mixture will exhaust when the drill bit penetrates the strut. Use shop towels in order to contain the escaping oil.
3. Remove the strut from the vise.
4. Hold the strut over a drain pan vertically with the hole down.
5. Move the rod (1) in and out of the tube (2) to completely drain the oil from the strut.

STRUT, STRUT COMPONENT, OR SPRING REPLACEMENT

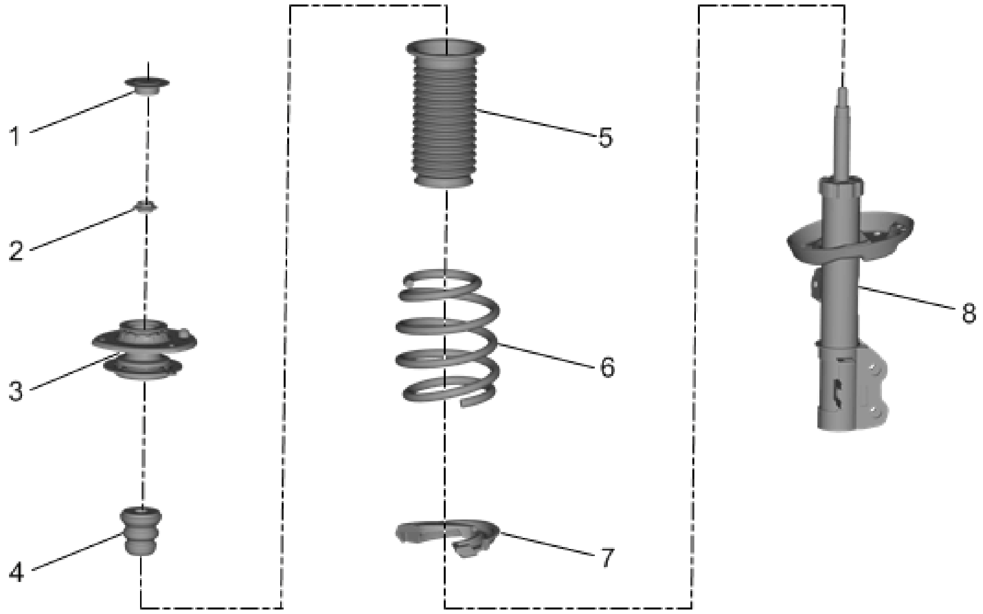


Fig. 50: Strut, Strut Component, or Spring
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: **To prevent personal injury and/or component damage, use the proper tools to support and compress the coil spring prior to removal of the strut shaft nut when removing the coil spring. The coil spring is under extreme pressure and can become a projectile should the spring separate from the strut before all of the tension is relieved.**	
Preliminary Procedure Remove Strut Assembly. Refer to Strut Assembly Removal and Installation	
1	Front Suspension Strut Cartridge Upper Cover
2	Front Suspension Strut Upper Mounting Nut **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Use a suitable spring compressor to compress the front coil spring. 2. Use the **CH-49375** strut wrench to remove and install the front suspension strut upper mounting nut. **Tighten** 85 N.m (63 lb ft) **Special Tools** **CH-49375** Strut Wrench Equivalent regional tools: Special Tools
3	Front Suspension Strut Mount
4	Front Suspension Strut Bumper
5	Front Strut Boot
6	Front Coil Spring
7	Front Coil Spring Lower Insulator
8	Front Suspension Strut

DESCRIPTION AND OPERATION

FRONT SUSPENSION DESCRIPTION AND OPERATION

The front suspension has 2 primary purposes:

- Isolate the driver from irregularities in the road surface.
- Define the ride and handling characteristics of the vehicle.

The front suspension absorbs the impact of the tires traveling over irregular road surfaces and dissipates this energy throughout the suspension system. This process isolates the vehicle occupants from the road surface. The rate at which the suspension dissipates the energy and the amount of energy that is absorbed is how the suspension defines the vehicles ride characteristics.

Ride characteristics are designed into the suspension system and are not adjustable. The ride characteristics are mentioned in this description in order to aid in the understanding of the functions of the suspension system. The suspension system must allow for the vertical movement of the tire and wheel assembly as the vehicle travels over irregular road surfaces while maintaining the tire's horizontal relationship to the road.

This requires that the steering knuckle be suspended between a lower control arm and a strut assembly. The lower control arm attaches from the steering knuckle at the outermost point of the control arm. The attachment is through a ball and socket type joint. The innermost end of the control arm attached at 2 points to the vehicle frame through semi-rigid bushings. The upper portion of the steering knuckle is attached to a strut assembly. The strut assembly then connects to the vehicle body by way of an upper bearing. The steering knuckle is allowed to travel up and down independent of the vehicle body structure and frame.

This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. This spring is retained under tension over the strut assembly. A strut is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A strut is a basic hydraulic cylinder.

The strut is filled with oil and has a moveable shaft that connects to a piston inside the strut. Valves inside the shock absorber offer resistance to oil flow and consequently inhibit rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion to utilize this recoil action of a spring alone. Each end of the strut is designed as the connection point of the suspension system to the vehicle and acts as the coil spring seat. This allows the strut to utilize the dampening action to reduce the recoil of a spring alone. The lower control arm is allowed to pivot at the vehicle frame in a vertical fashion. The ball joint allows the steering knuckle to maintain the perpendicular relationship to the road surface.

Front suspensions systems utilize a stabilizer shaft. The stabilizer bar connects between the left and right lower control arm assemblies through the stabilizer link and stabilizer shaft insulators. This bar controls the amount of independent movement of the suspension when the vehicle turns. Limiting the independent movement defines the vehicles handling characteristics on turns.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

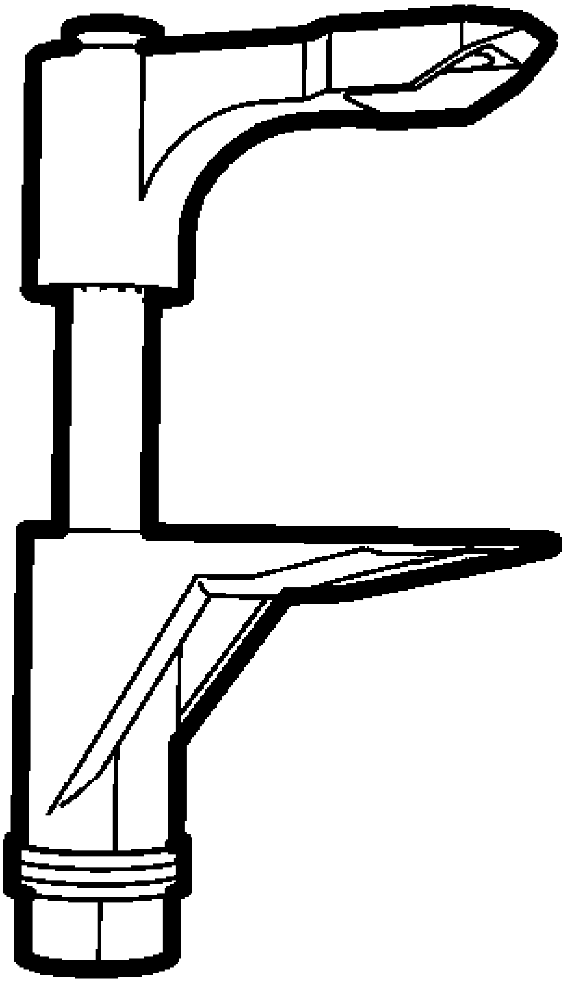
Illustration	Tool Number/Description
	CH 42188-B J 42188-B Tie Rod End Joint/Ball Joint Remover

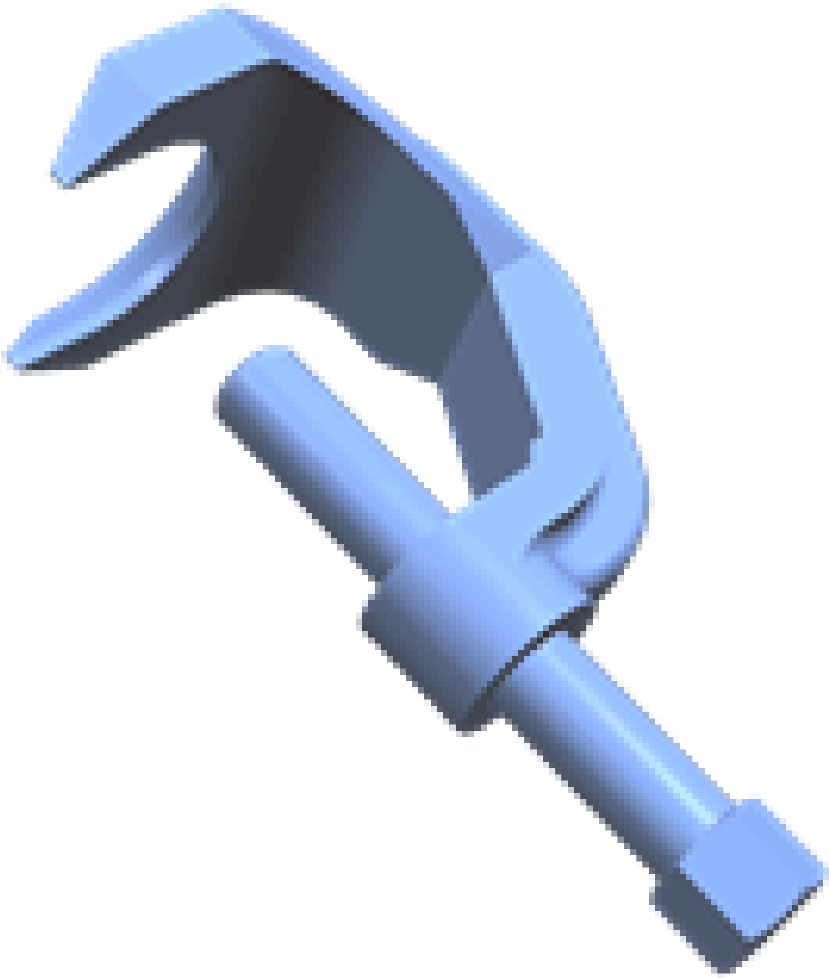
Illustration	Tool Number/Description
	CH 43631 Ball Joint Remover

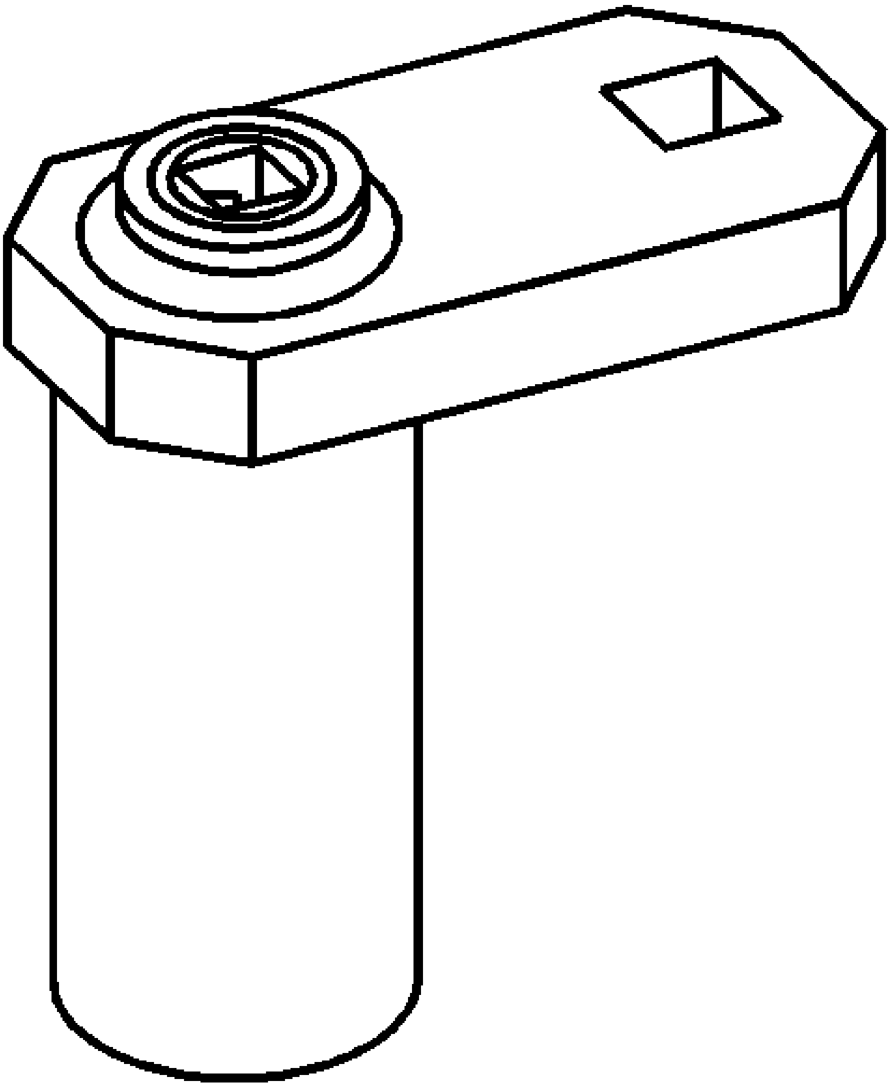
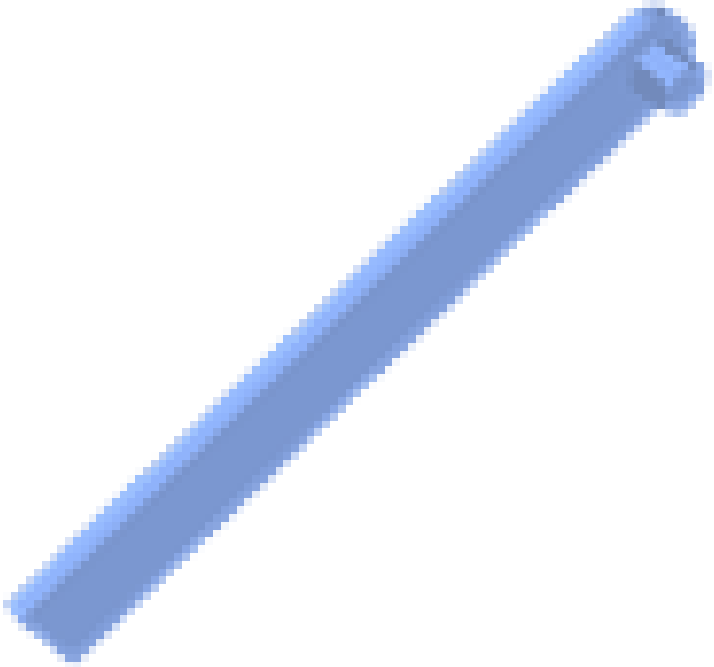
Illustration	Tool Number/Description
	CH 49375 J 42991 Strut Wrench

Illustration	Tool Number/Description
	J 42188-2A 6 mm Hex Key

Back To Article

2017 SUSPENSION

Rear Suspension - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Rear Axle Bolt	
• First Pass:	160 N.m (118 lb ft)
• Final Pass:	30 - 45 Degrees
Rear Brake Hose Bracket Bolt	9 N.m (80 lb in)
Rear Shock Absorber Bolt	
• First Pass:	100 N.m (74 lb ft)
• Final Pass:	30 - 45 Degrees
Rear Suspension Shock Absorber Upper Mounting Nut	40 N.m (30 lb ft)
Rear Suspension Strut Bolt	22 N.m (16 lb ft)
Rear Wheel Hub Bolt	58 N.m (43 lb ft)

REPAIR INSTRUCTIONS

REAR WHEEL BEARING AND HUB REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**

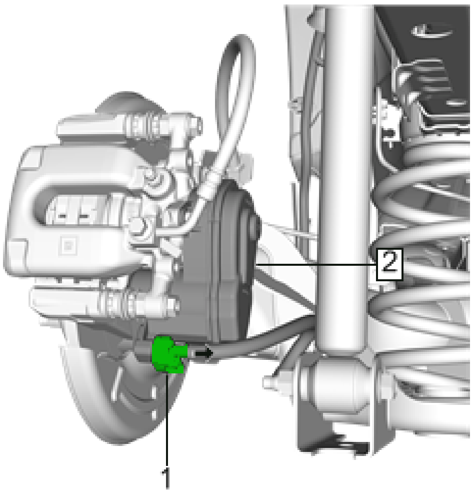


Fig. 1: Electrical Connector And Rear Park Brake Actuator
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Electrical Connector (1) @ Rear Park Brake Actuator (2)

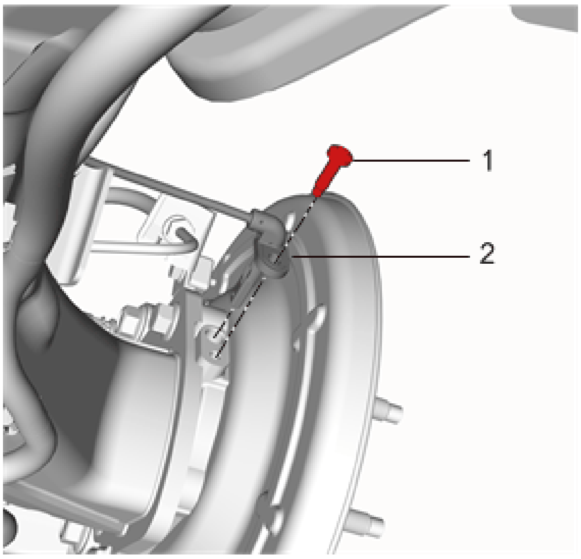


Fig. 2: Rear Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Wheel Speed Sensor Bolt (1) @ Rear Brake Caliper Mount Plate
5. Remove Rear Wheel Speed Sensor (2) @ Rear Brake Caliper Mount Plate

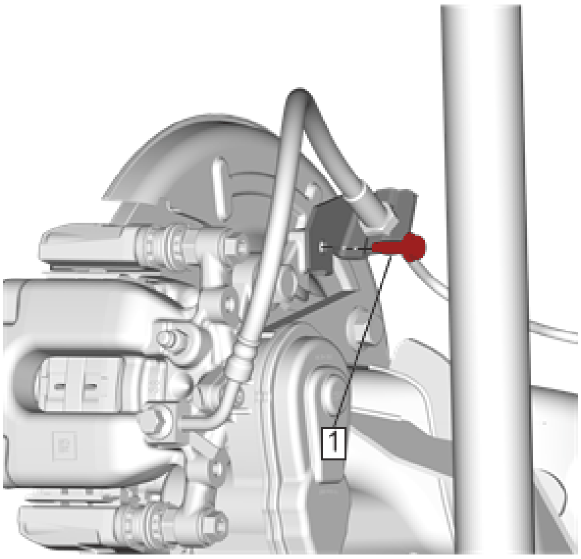


Fig. 3: Rear Brake Hose Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Brake Hose Bracket Bolt (1) @ Rear Brake Caliper Mount Plate
7. Remove Rear Brake Caliper Bracket @ Vehicle. Refer to Rear Brake Caliper Bracket Replacement

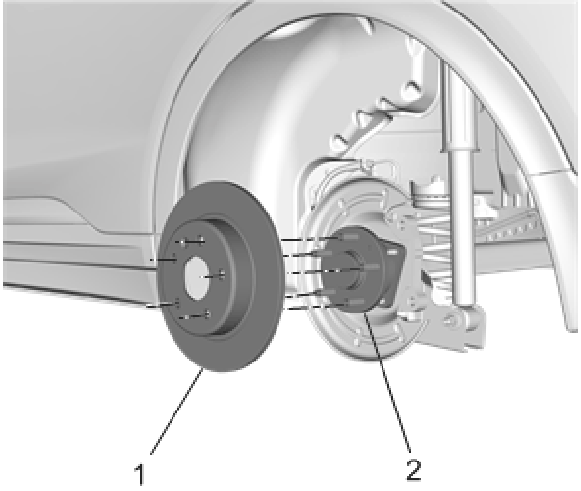


Fig. 4: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

8. Remove Rear Brake Rotor (1) @ Rear Wheel Hub (2). Refer to **Rear Brake Rotor Replacement**

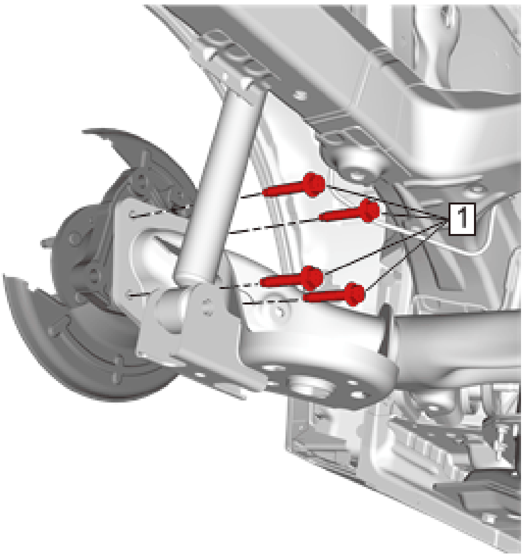


Fig. 5: Rear Wheel Hub Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Remove Rear Wheel Hub Bolts (1) (Qty: 4)

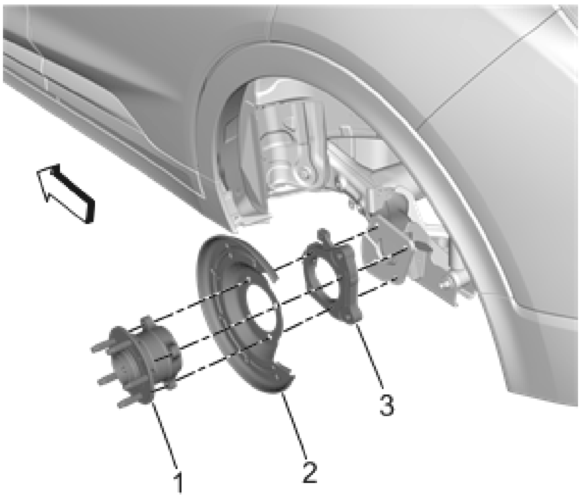


Fig. 6: Rear Wheel Bearing/Hub Assembly, Rear Brake Shield And Caliper Mount Plate
Courtesy of GENERAL MOTORS COMPANY

10. Remove Rear Wheel Bearing and Hub Assembly (1) @ Rear Axle

11. Remove Rear Brake Shield (2) @ Rear Axle
12. Remove Rear Brake Caliper Mount Plate (3) @ Rear Axle

Installation Procedure

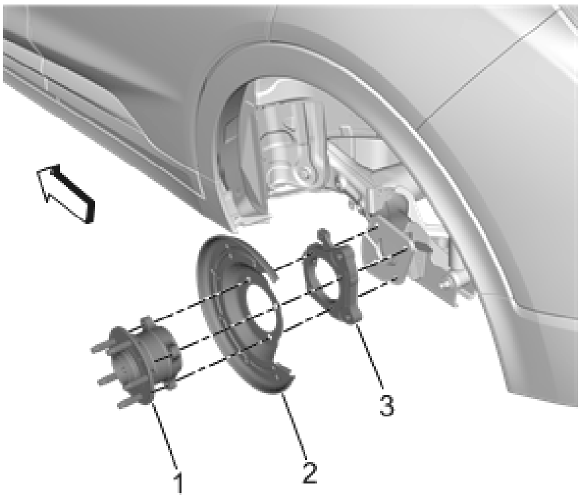


Fig. 7: Rear Wheel Bearing/Hub Assembly, Rear Brake Shield And Caliper Mount Plate
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Brake Caliper Mount Plate (3) @ Rear Axle
2. Install Rear Brake Shield (2) @ Rear Axle
3. Install Rear Wheel Bearing and Hub Assembly (1) @ Rear Axle

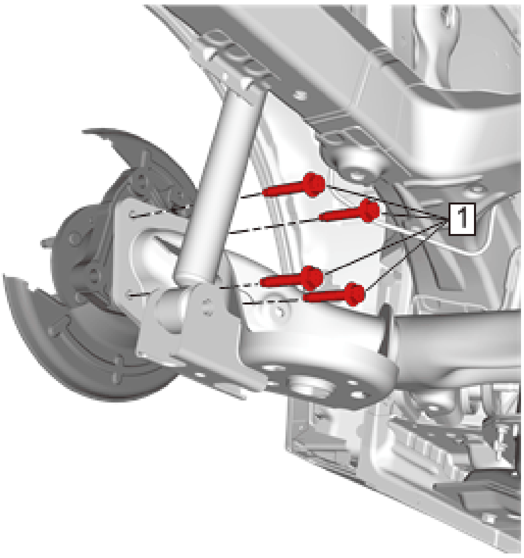


Fig. 8: Rear Wheel Hub Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to Fastener Caution**

4. Install and tighten Rear Wheel Hub Bolts (1) (Qty: 4) to 58 N.m (43 lb ft)

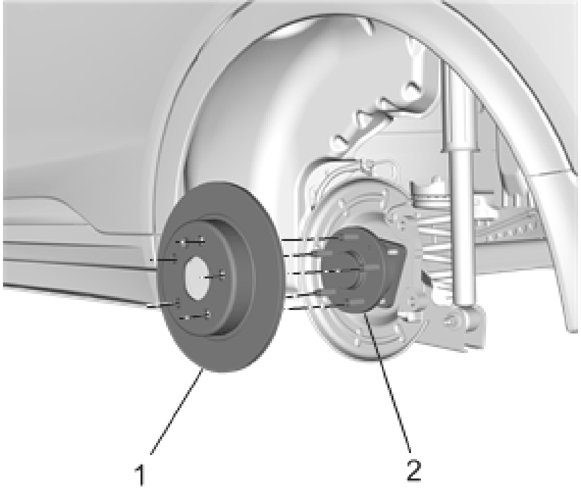


Fig. 9: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

5. Install Rear Brake Rotor (1) @ Rear Wheel Hub (2). Refer to **Rear Brake Rotor Replacement**
6. Install Rear Brake Caliper Bracket @ Vehicle. Refer to **Rear Brake Caliper Bracket Replacement**

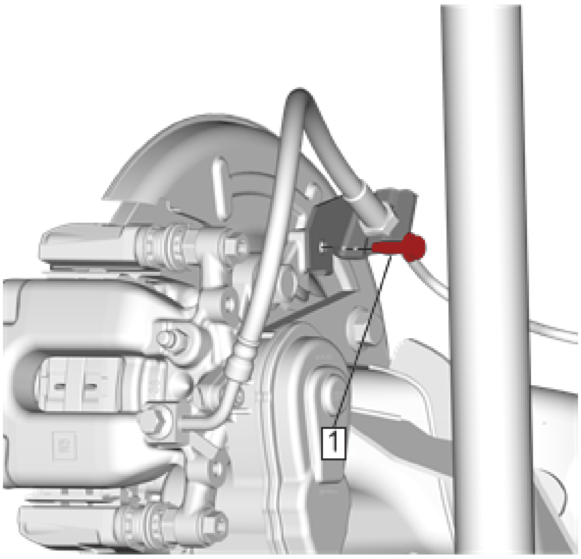


Fig. 10: Rear Brake Hose Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Install and tighten Rear Brake Hose Bracket Bolt (1) @ Rear Brake Caliper Mount Plate to 9 N.m (80 lb in)

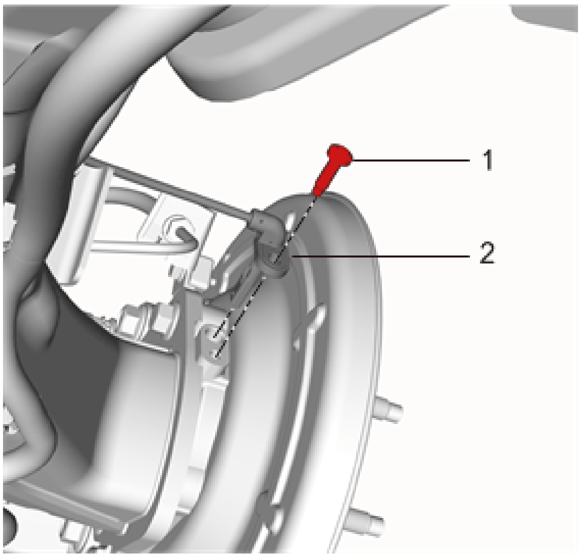


Fig. 11: Rear Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Install Rear Wheel Speed Sensor (2) @ Rear Brake Caliper Mount Plate
9. Install and tighten Rear Wheel Speed Sensor Bolt (1) @ Rear Brake Caliper Mount Plate. Refer to **Rear Wheel Speed Sensor Replacement**

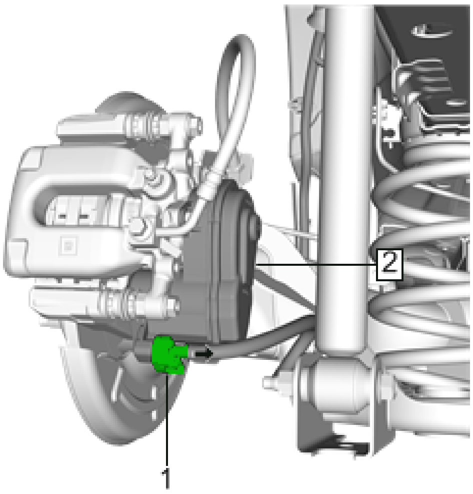


Fig. 12: Electrical Connector And Rear Park Brake Actuator
Courtesy of GENERAL MOTORS COMPANY

10. Connect Electrical Connector (1) @ Rear Park Brake Actuator (2)
11. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
12. Lower the vehicle.

STRUT AND SHOCK ABSORBER INSPECTION

NOTE: **The shock absorber assembly DOES NOT have to be removed from the vehicle to perform the following inspection procedure.**

NOTE: **A light film of oil on the top portion of the lower shock absorber tube is normal. DO NOT replace the shock absorber for this condition.**

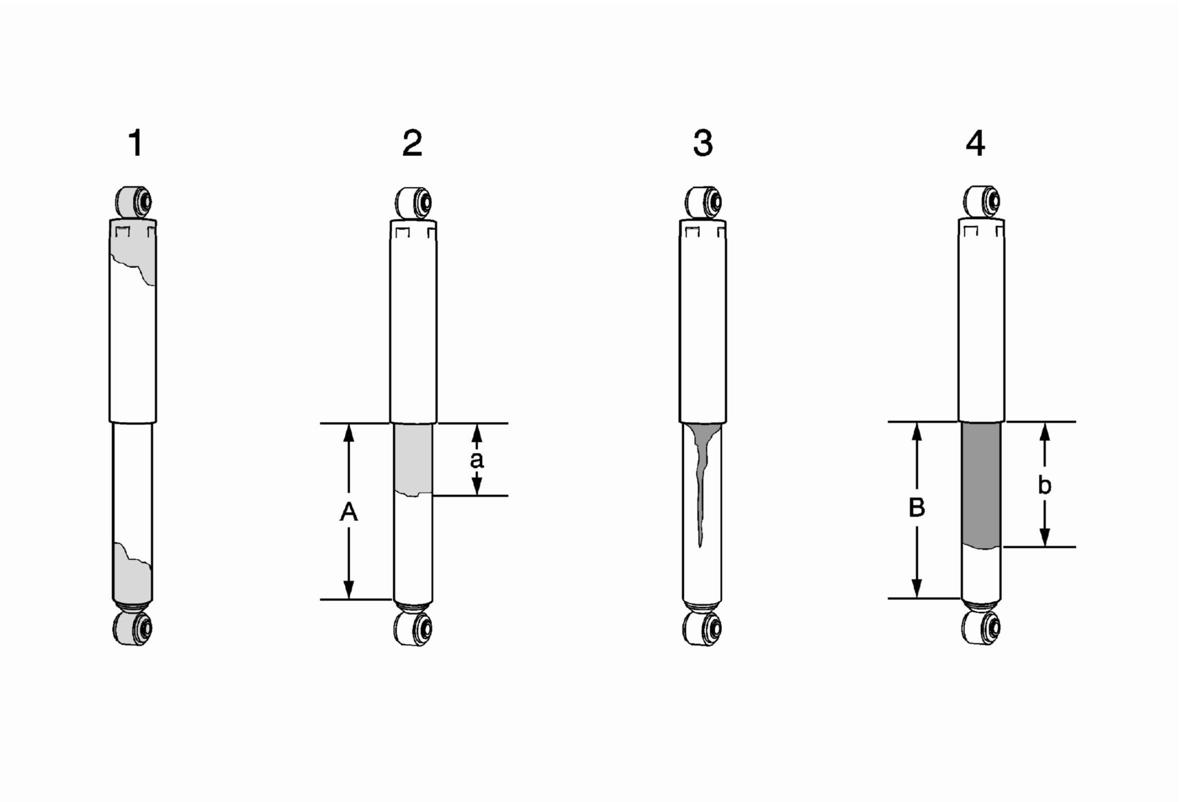


Fig. 13: Identifying Shock Absorber Conditions
Courtesy of GENERAL MOTORS COMPANY

Condition 1

Oil or fluid residue only on the bottom or top of the shock absorber and not originating from the shaft seal, is not a shock absorber related problem. DO NOT replace the shock absorber, look for other external leaks.

Condition 2

Light film/residue on approximately 1/3 (a) or less of the lower shock tube (A) and originating from the shaft seal, is a NORMAL condition. DO NOT replace the shock absorber.

Condition 3

Oil drip or trail down the lower shock tube and originating from the shaft seal, is an ABNORMAL condition. Replace the shock absorber. Refer to **Shock Absorber Replacement**.

Condition 4

An extreme wet film of oil covering more than 1/3 (b) of the lower shock tube and originating from the shaft seal (B), is an ABNORMAL condition. Replace the shock absorber. Refer to **Shock Absorber Replacement**.

Inspection

1. Verify the customer's concern is present. If the concern is present, continue to the next step. If the concern is not present, then the vehicle is operating normally.

NOTE: **The shock absorber assembly DOES NOT have to be removed from the vehicle to perform the following inspection procedure.**

2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Visually inspect each of the shock absorbers for external fluid leaks. Refer to the following conditions 1, 2, 3 and 4 for visual inspection.
   - If conditions 1 or 2 are found, continue to step 4.
   - If conditions 3 or 4 are found, replace shock absorber. Refer to **Shock Absorber Replacement**.
4. Use your hands in order to lift up and push down on each corner of the vehicle 3 times. Remove your hands from the vehicle. If the corner motion exceeds 2 cycles, replace the shock absorber. If the shock absorber does not exceed 2 cycles, NO repair is necessary.

REAR SHOCK ABSORBER BUMPER REPLACEMENT

Special Tools

- **CH-51095** Shock Absorber Strut Nut Wrench

Equivalent regional tools: **Special Tools**

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
3. Remove Rear Wheelhouse Liner. Refer to **Rear Wheelhouse Liner Replacement**

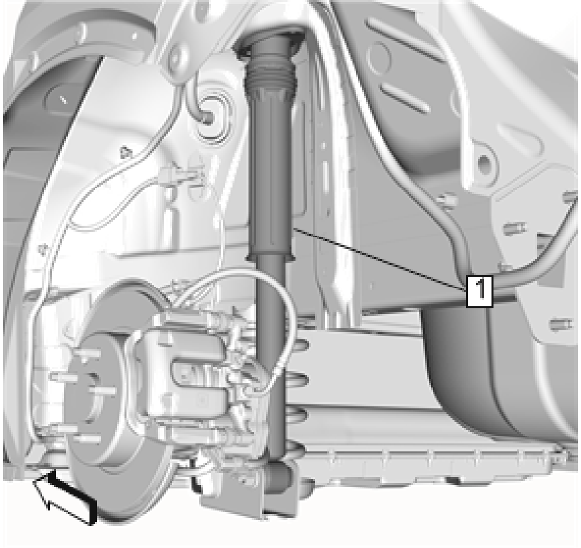


Fig. 14: Rear Shock Absorber
Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Shock Absorber (1) @ Vehicle. Refer to Shock Absorber Replacement

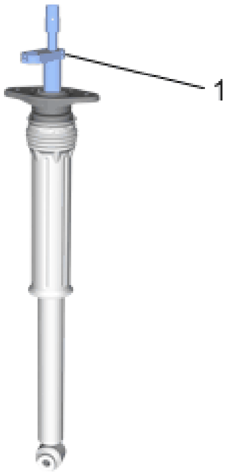


Fig. 15: Shock Absorber Strut Nut Wrench
Courtesy of GENERAL MOTORS COMPANY

5. Use the CH-51095 shock absorber strut nut wrench (1) or equivalent to remove the rear suspension shock absorber upper mounting nut.

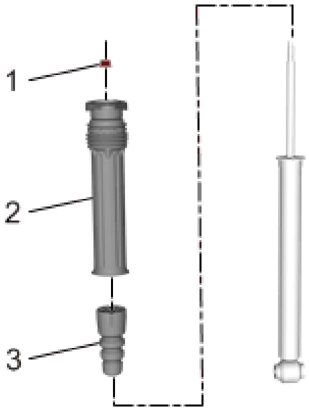


Fig. 16: Rear Shock Absorber Upper Mounting Nut, Mount And Bumper
Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Suspension Shock Absorber Upper Mounting Nut (1)
7. Remove Rear Shock Absorber Mount (2) @ Rear Shock Absorber
8. Remove Rear Shock Absorber Bumper (3) @ Rear Shock Absorber

Installation Procedure

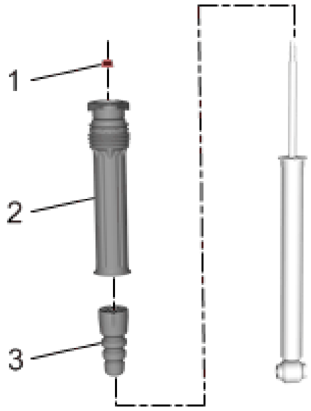


Fig. 17: Rear Shock Absorber Upper Mounting Nut, Mount And Bumper
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Shock Absorber Bumper (3) @ Rear Shock Absorber
2. Install Rear Shock Absorber Mount (2) @ Rear Shock Absorber
3. Install Rear Suspension Shock Absorber Upper Mounting Nut (1)

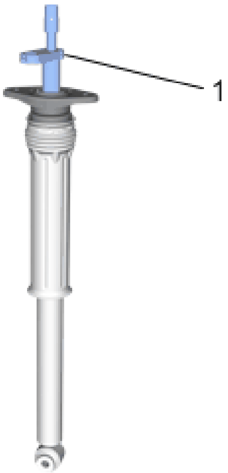


Fig. 18: Shock Absorber Strut Nut Wrench
Courtesy of GENERAL MOTORS COMPANY

4. Use the CH-51095 shock absorber strut nut wrench (1) or equivalent to tighten the rear suspension shock absorber upper mounting nut.

CAUTION: Fastener Caution

5. Install and tighten Rear Suspension Shock Absorber Upper Mounting Nut to 40 N.m (30 lb ft)

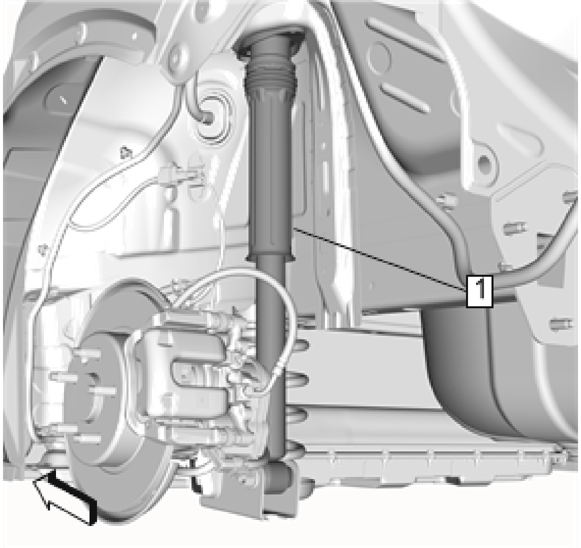


Fig. 19: Rear Shock Absorber
Courtesy of GENERAL MOTORS COMPANY

6. Install Rear Shock Absorber (1) @ Vehicle. Refer to **Shock Absorber Replacement**
7. Install Rear Wheelhouse Liner. Refer to **Rear Wheelhouse Liner Replacement**
8. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
9. Lower the vehicle.

REAR SHOCK ABSORBER MOUNT REPLACEMENT

Special Tools

- **CH-51095** Shock Absorber Strut Nut Wrench

Equivalent regional tools: **Special Tools**

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
3. Remove Rear Wheelhouse Liner. Refer to **Rear Wheelhouse Liner Replacement**

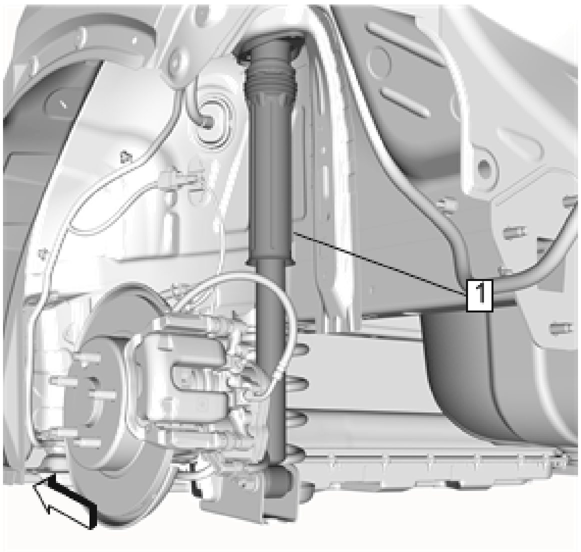


Fig. 20: Rear Shock Absorber
Courtesy of GENERAL MOTORS COMPANY

4. Remove Rear Shock Absorber (1) @ Vehicle. Refer to **Shock Absorber Replacement**

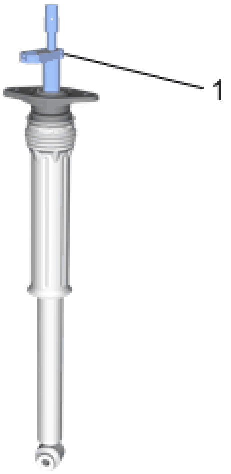


Fig. 21: Shock Absorber Strut Nut Wrench
Courtesy of GENERAL MOTORS COMPANY

5. Use the CH-51095 shock absorber strut nut wrench (1) or equivalent to remove the rear suspension shock absorber upper mounting nut.

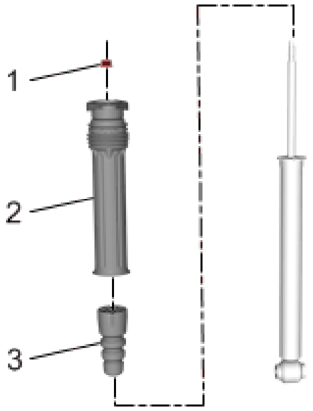


Fig. 22: Rear Shock Absorber Upper Mounting Nut, Mount And Bumper
Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Suspension Shock Absorber Upper Mounting Nut (1)
7. Remove Rear Shock Absorber Mount (2) @ Rear Shock Absorber

Installation Procedure

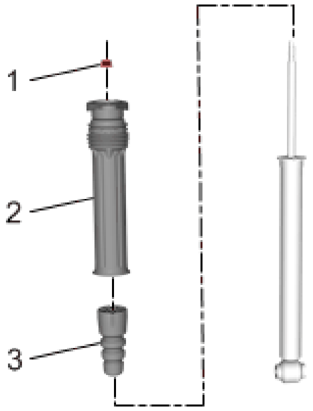


Fig. 23: Rear Shock Absorber Upper Mounting Nut, Mount And Bumper
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Shock Absorber Mount (2) @ Rear Shock Absorber
2. Install Rear Suspension Shock Absorber Upper Mounting Nut (1)

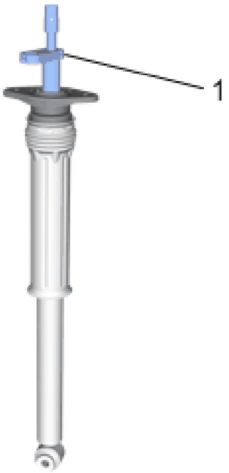


Fig. 24: Shock Absorber Strut Nut Wrench
Courtesy of GENERAL MOTORS COMPANY

3. Use the CH-51095 shock absorber strut nut wrench (1) or equivalent to tighten the rear suspension shock absorber upper mounting nut.

CAUTION: **Refer to Fastener Caution**

4. Install and tighten Rear Suspension Shock Absorber Upper Mounting Nut to 40 N.m (30 lb ft)

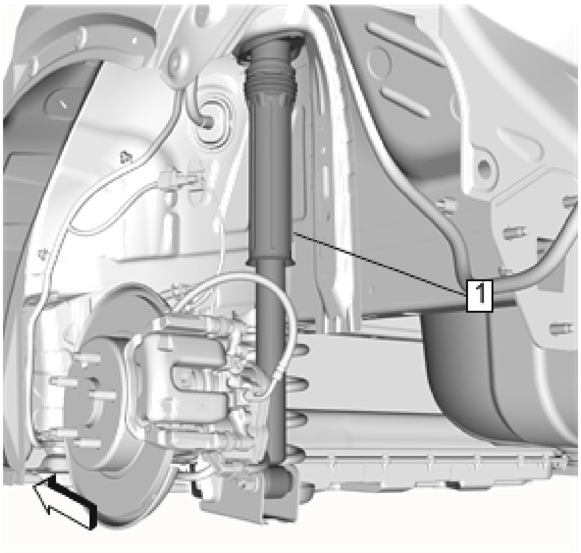


Fig. 25: Rear Shock Absorber
Courtesy of GENERAL MOTORS COMPANY

5. Install Rear Shock Absorber (1) @ Vehicle. Refer to Shock Absorber Replacement
6. Install Rear Wheelhouse Liner. Refer to Rear Wheelhouse Liner Replacement
7. Install the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
8. Lower the vehicle.

SHOCK ABSORBER REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle
2. Remove the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation

3. Remove Rear Wheelhouse Liner. Refer to **Rear Wheelhouse Liner Replacement**
4. Support the rear axle with a hydraulic jack stand.

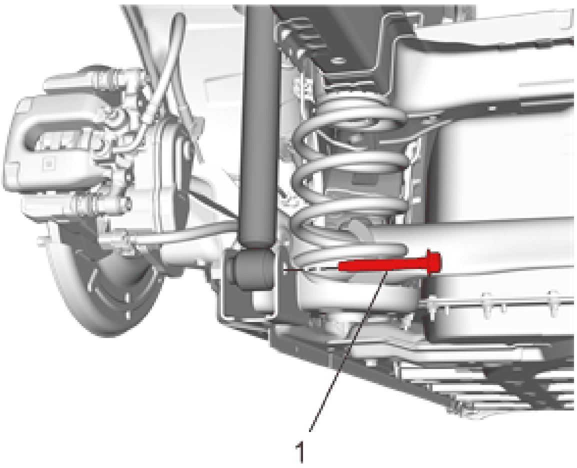


Fig. 26: Rear Shock Absorber Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Remove Rear Shock Absorber Bolt (1) @ Rear Axle
6. Remove the hydraulic jack stand from the vehicle.

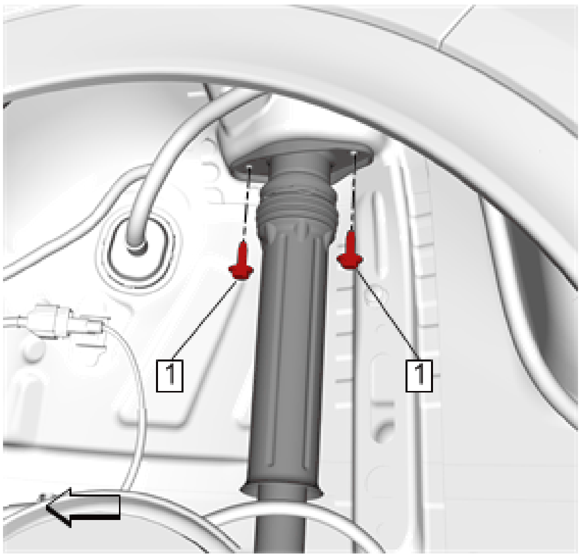
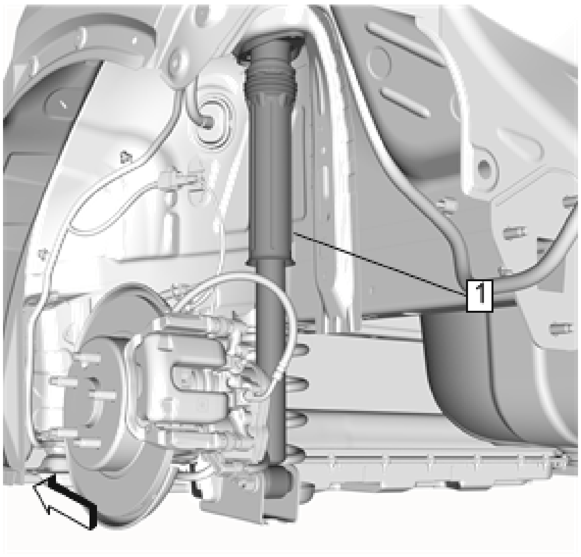


Fig. 27: Rear Suspension Strut Bolts
Courtesy of GENERAL MOTORS COMPANY

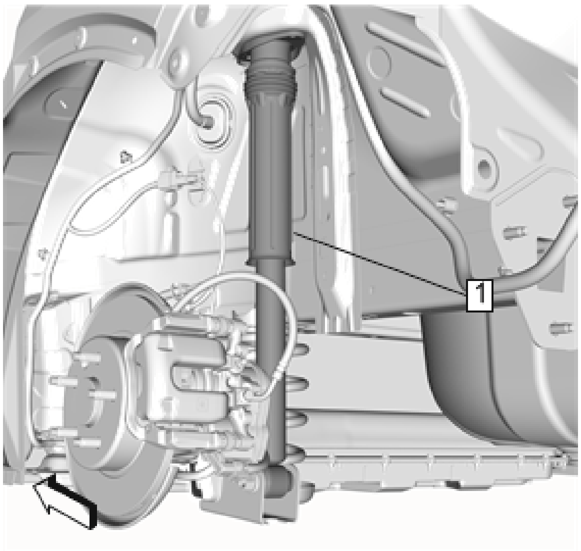
7. Remove Rear Suspension Strut Bolts (1) (Qty: 2)



[Fig. 28: Rear Shock Absorber](#)
Courtesy of GENERAL MOTORS COMPANY

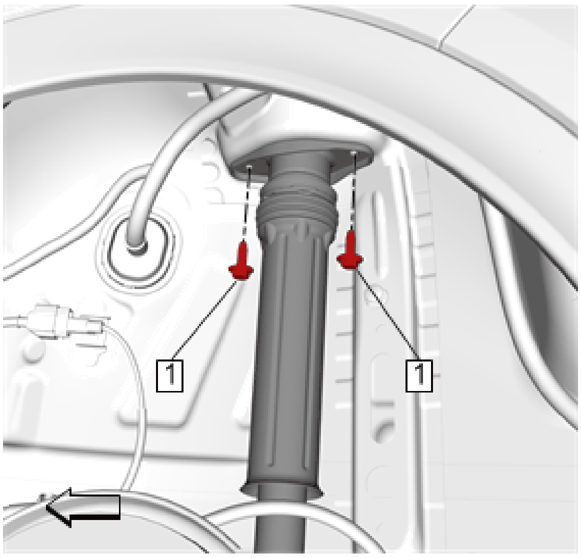
8. Remove Rear Shock Absorber (1) @ Vehicle

Installation Procedure



[Fig. 29: Rear Shock Absorber](#)
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Shock Absorber (1) @ Vehicle



[Fig. 30: Rear Suspension Strut Bolts](#)
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Refer to [Fastener Caution](#)**

2. Install and tighten Rear Suspension Strut Bolts (1) (Qty: 2) to 22 N.m (16 lb ft)
3. Raise and support the rear axle with a hydraulic jack stand.

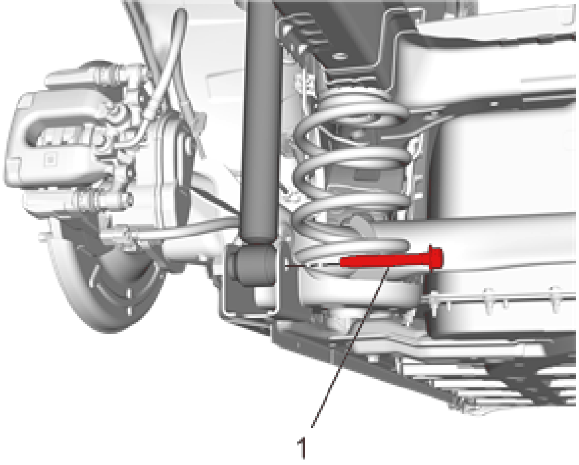


Fig. 31: Rear Shock Absorber Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install and tighten Rear Shock Absorber Bolt (1) @ Rear Axle
    1. First Pass: 100 N.m (74 lb ft)
    2. Final Pass: 30 - 45 Degrees
5. Remove the hydraulic jack stand from the vehicle.
6. Install Rear Wheelhouse Liner. Refer to **Rear Wheelhouse Liner Replacement**
7. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
8. Lower the vehicle.

REAR COIL SPRING REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation**

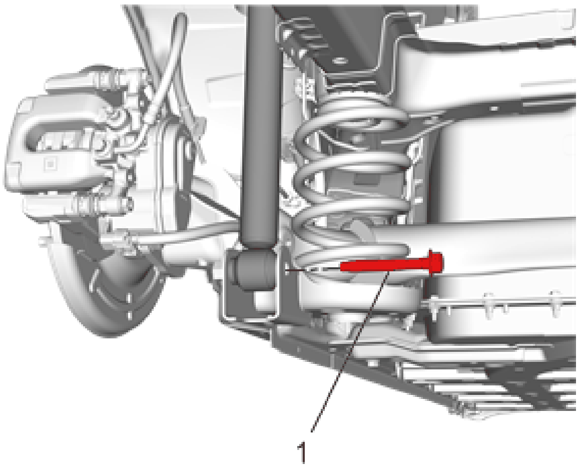


Fig. 32: Rear Shock Absorber Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Support the rear axle with a hydraulic jack stand.
4. Remove Rear Shock Absorber Bolt (1) @ Rear Axle

NOTE: **KEEP supporting the rear axle with the hydraulic jack stand to prevent the rear brake hose and rear wheel speed sensor harness from being damaged.**

5. Using the hydraulic jack stand, slowly lower the rear axle until the tension is not applied to the rear brake hose and rear wheel speed sensor harness.

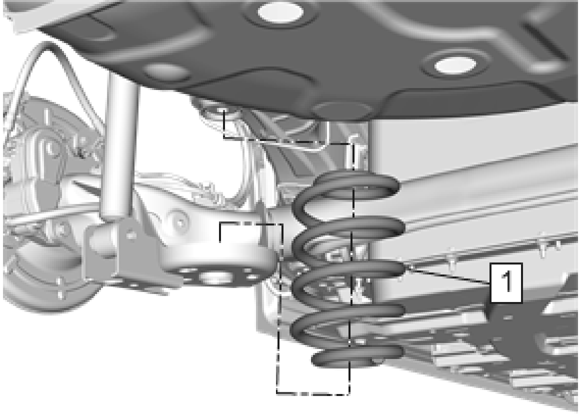


Fig. 33: Rear Coil Spring
Courtesy of GENERAL MOTORS COMPANY

6. Remove Rear Coil Spring (1) @ Vehicle

Installation Procedure

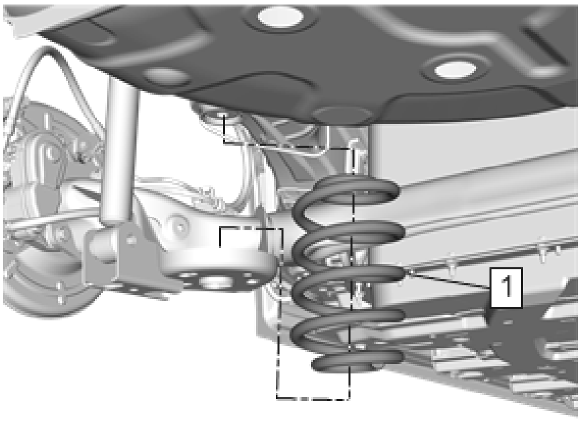


Fig. 34: Rear Coil Spring
Courtesy of GENERAL MOTORS COMPANY

1. Install Rear Coil Spring (1) @ Vehicle

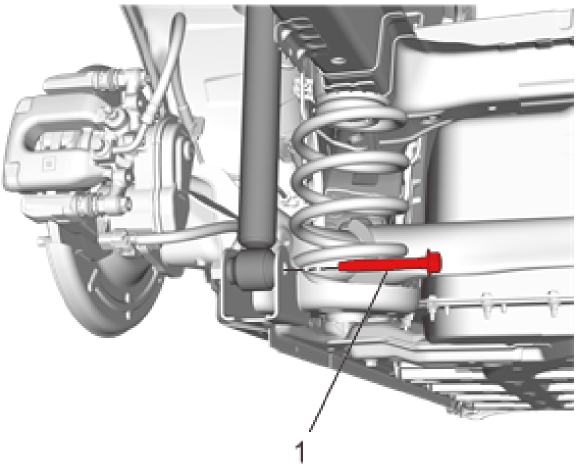


Fig. 35: Rear Shock Absorber Bolt
Courtesy of GENERAL MOTORS COMPANY

2. Raise the hydraulic jack stand in order to install the rear shock absorber bolt.
3. Install and tighten Rear Shock Absorber Bolt (1) @ Rear Axle. Refer to **Shock Absorber Replacement**
4. Remove the hydraulic jack stand.
5. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation**
6. Lower the vehicle.

REAR COIL SPRING INSULATOR REPLACEMENT

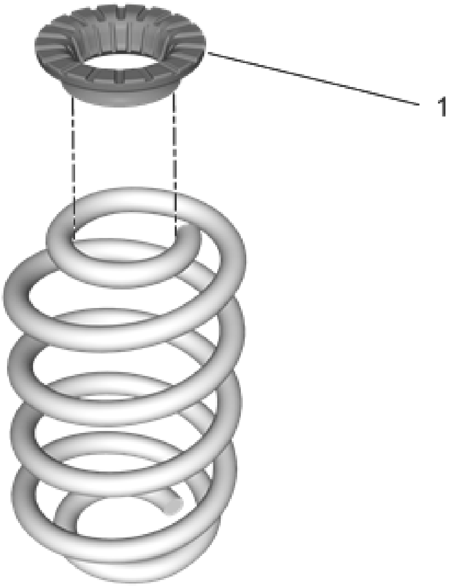


Fig. 36: Rear Coil Spring Insulator
Courtesy of GENERAL MOTORS COMPANY

<table>
<tr><th>Callout</th><th>Component Name</th></tr>
<tr><td colspan="2">Preliminary Procedures
1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle
2. Remove the rear tire and wheel assemblies. Refer to Tire and Wheel Removal and Installation
3. Remove Rear Coil Spring. Refer to Rear Coil Spring Replacement</td></tr>
<tr><td>1</td><td>Rear Coil Spring Insulator</td></tr>
</table>

REAR COIL SPRING LOWER INSULATOR REPLACEMENT

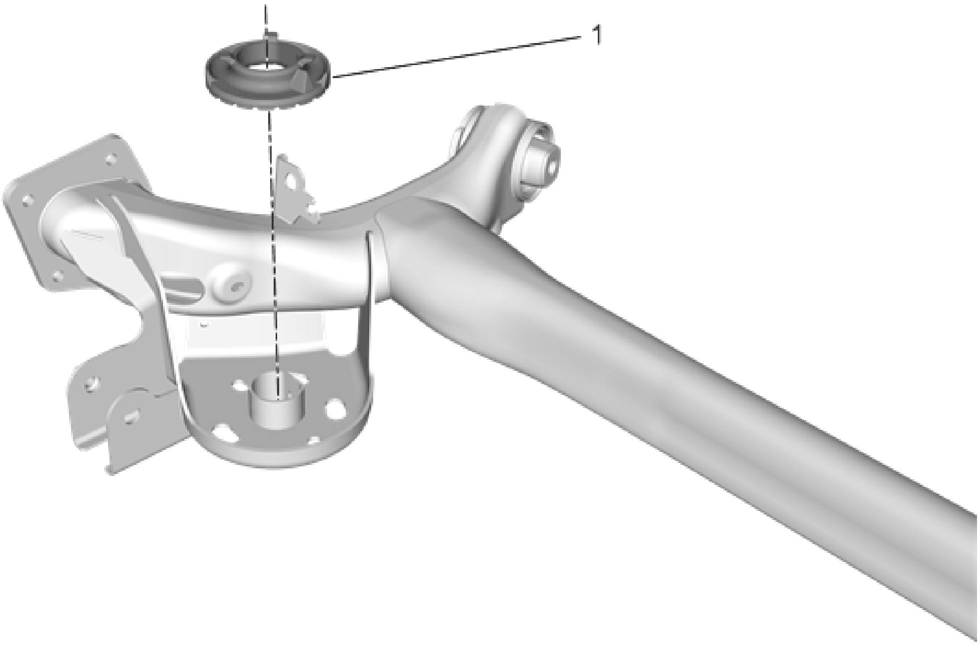


Fig. 37: Rear Coil Spring Lower Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation** 3. Remove Rear Coil Spring. Refer to **Rear Coil Spring Replacement**	
1	Rear Coil Spring Lower Insulator

REAR AXLE REPLACEMENT

Special Tools

- **DT-50187** Rear Axle Supporter

Equivalent regional tools: **Special Tools**

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation**
3. Remove Rear Wheelhouse Liner @ Vehicle. Refer to **Rear Wheelhouse Liner Replacement**

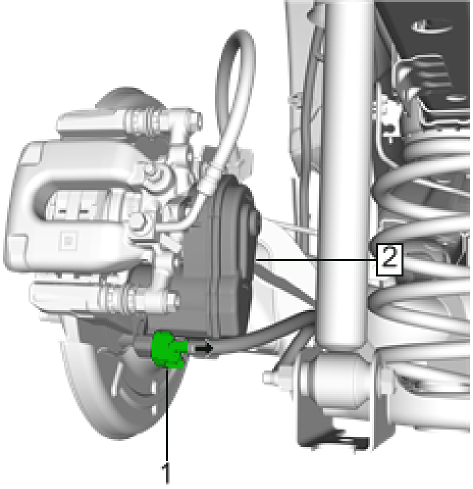


Fig. 38: Electrical Connector And Rear Park Brake Actuator
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Electrical Connector (1) (Qty: 2) @ Rear Park Brake Actuator (2)

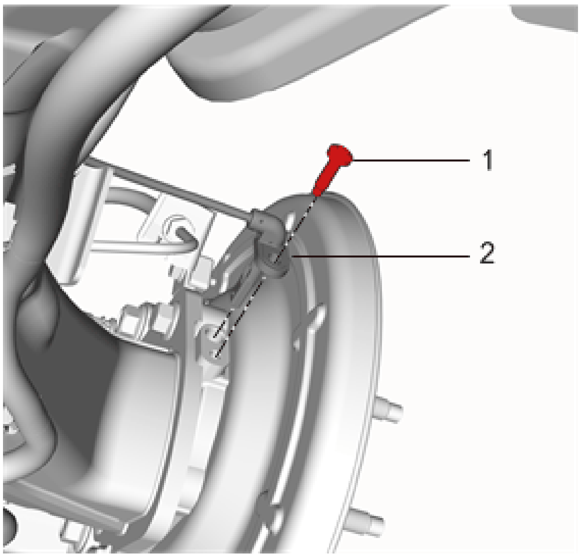


Fig. 39: Rear Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

5. Rear Wheel Speed Sensor Bolt (1) (Qty: 2) @ Rear Brake Caliper Mount Plate
6. Remove Rear Wheel Speed Sensor (2) (Qty: 2) @ Rear Brake Caliper Mount Plate

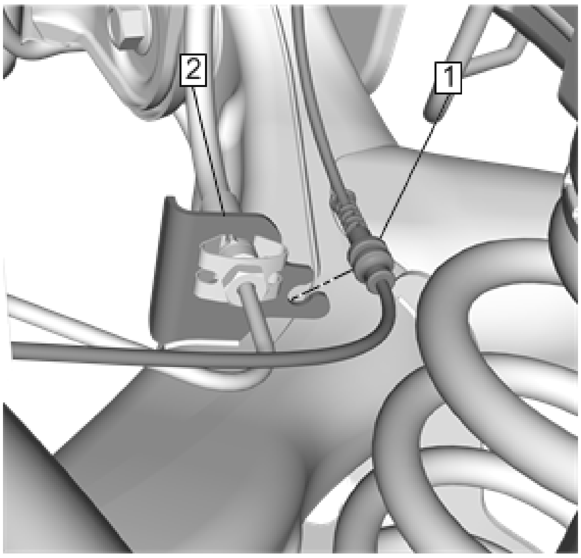


Fig. 40: Rear Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

7. Unclip Rear Wheel Speed Sensor Wiring Harness (1) (Qty: 2) @ Rear Axle Mounted Bracket (2)

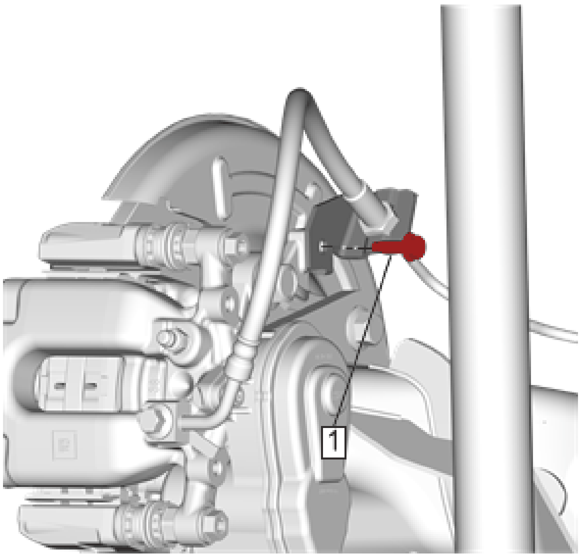


Fig. 41: Rear Brake Hose Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

8. Remove Rear Brake Hose Bracket Bolt (1) (Qty: 2) @ Rear Brake Caliper Mount Plate

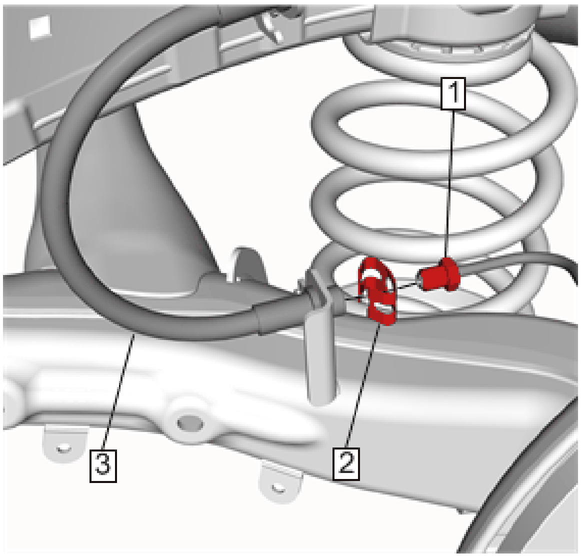


Fig. 42: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer
Courtesy of GENERAL MOTORS COMPANY

9. Remove Rear Brake Pipe Fitting (1) (Qty: 2) @ Rear Brake Hose (3)
10. Remove Rear Brake Hose Retainer (1) (Qty: 2)
11. Separate Rear Brake Hose (3) (Qty: 2) @ Rear Axle
12. Remove Rear Brake Caliper (Qty: 2) @ Vehicle. Refer to **Rear Brake Caliper Replacement**
13. Remove Rear Brake Caliper Bracket (Qty: 2) @ Vehicle. Refer to **Rear Brake Caliper Bracket Replacement**

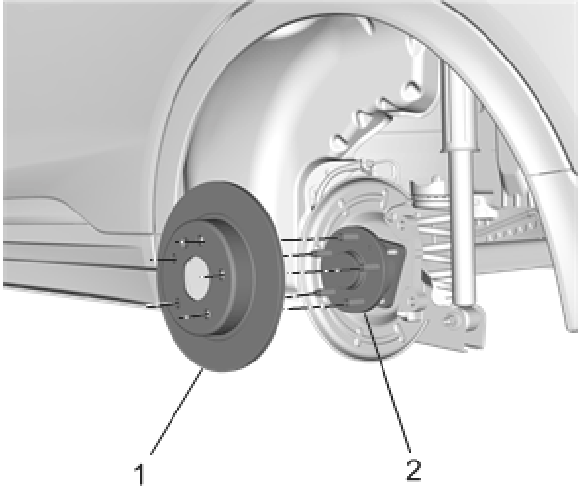


Fig. 43: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

14. Remove Rear Brake Rotor (1) (Qty: 2) @ Rear Wheel Hub (2). Refer to **Rear Brake Rotor Replacement**
15. Remove the body wiring harness clips from the rear axle.

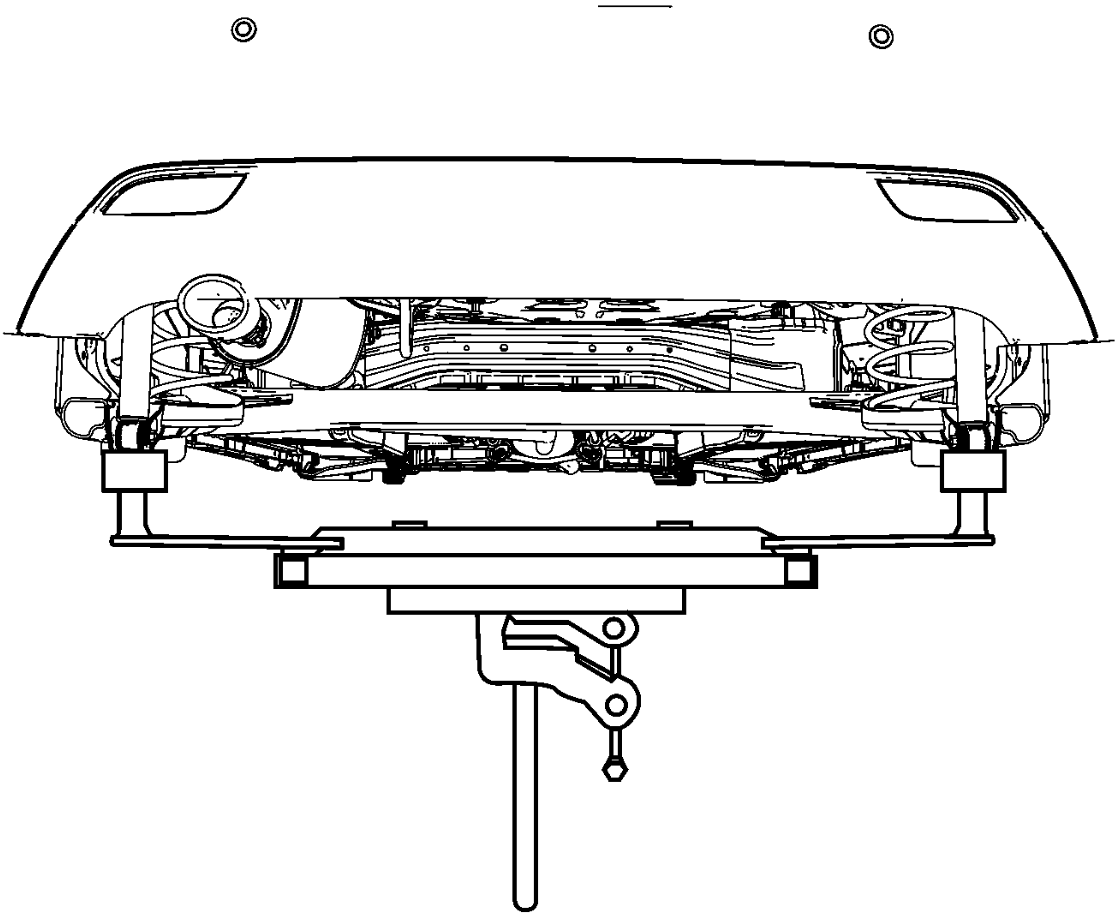


Fig. 44: Hydraulic Jack Stand And DT-50187
Courtesy of GENERAL MOTORS COMPANY

16. Support the rear axle with the DT-50187 rear axle supporter and a hydraulic jack.

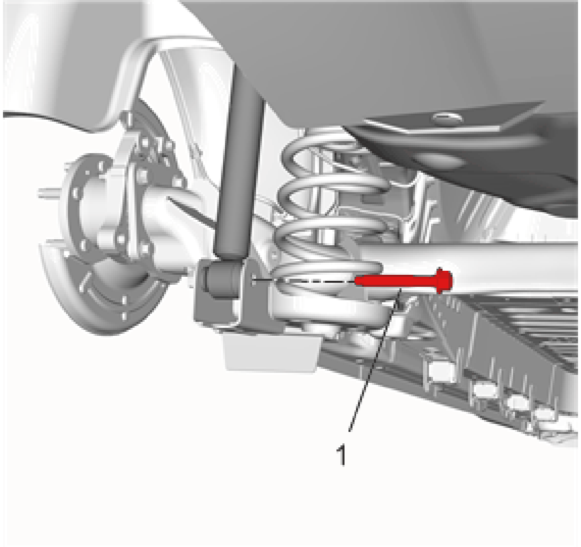


Fig. 45: Rear Shock Absorber Bolt
Courtesy of GENERAL MOTORS COMPANY

17. Remove Rear Shock Absorber Bolt (1) (Qty: 2) @ Rear Axle
18. Lower the hydraulic jack stand.
19. Remove Rear Coil Spring (Qty: 2). Refer to **Rear Coil Spring Replacement**
20. Remove Rear Coil Spring Lower Insulator (Qty: 2). Refer to **Rear Coil Spring Lower Insulator Replacement**

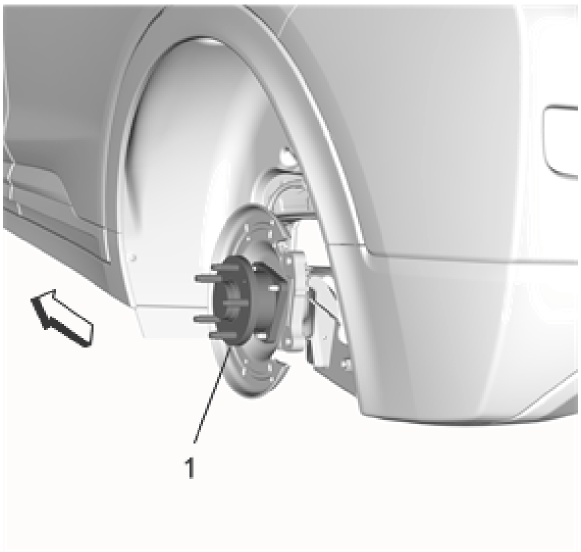
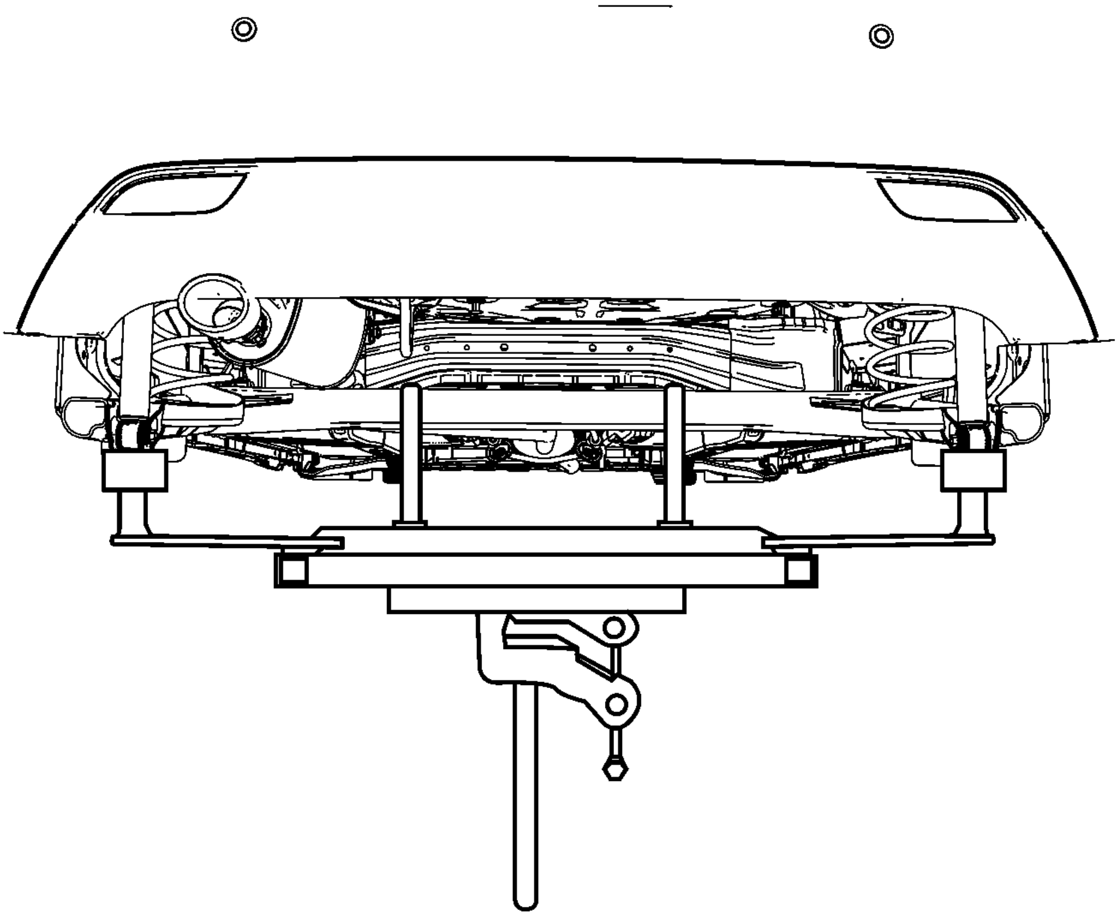


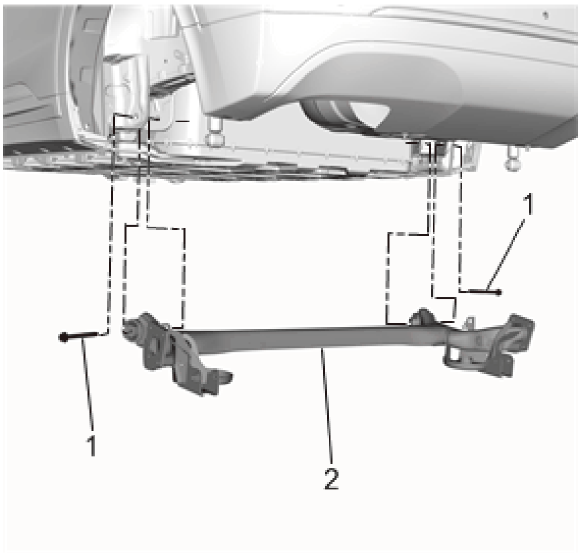
Fig. 46: Rear Wheel Bearing and Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

21. Remove Rear Wheel Bearing and Hub Assembly (1) (Qty: 2) @ Rear Axle. Refer to **Rear Wheel Bearing and Hub Replacement**



[Fig. 47: Hydraulic Jack Stand And DT-50187](#)
Courtesy of GENERAL MOTORS COMPANY

22. Support the DT-50187 rear axle with the rear axle supporter and hydraulic jack.



[Fig. 48: Rear Axle And Bolts](#)
Courtesy of GENERAL MOTORS COMPANY

23. Remove Rear Axle Bolts (1) (Qty: 2)
24. Slowly lower the hydraulic jack stand to remove the rear axle (2) from the vehicle.
25. Remove the rear axle from the hydraulic jack stand with the DT-50187 rear axle supporter.

Installation Procedure

1. Place the rear axle on the hydraulic jack stand with the DT-50187 rear axle supporter.

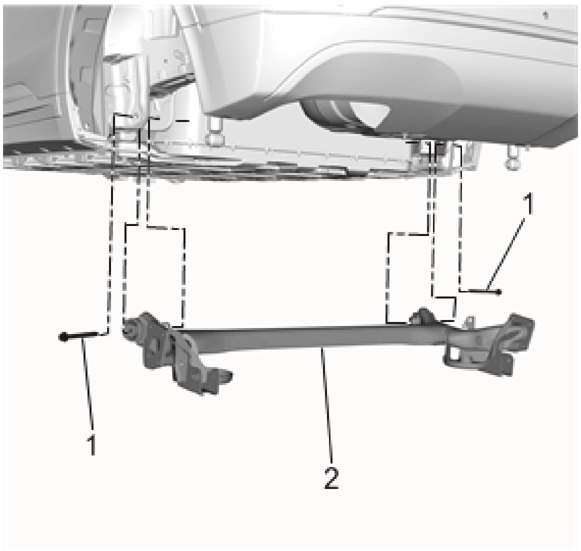


Fig. 49: Rear Axle And Bolts
Courtesy of GENERAL MOTORS COMPANY

2. Using the hydraulic jack stand, raise the rear axle (2) to the correct position.
3. Hand tighten Rear Axle Bolts (1) (Qty: 2)

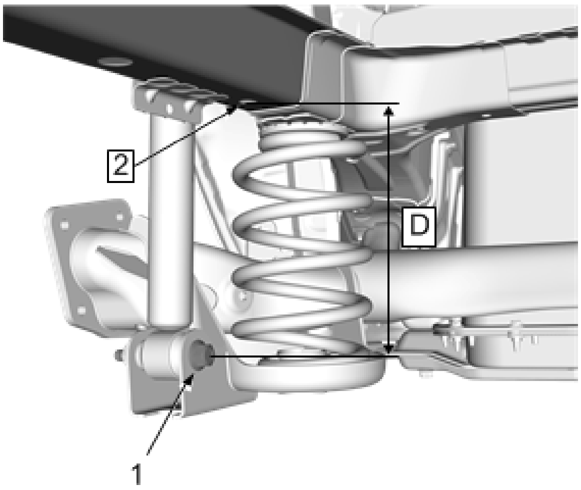


Fig. 50: Identifying D Dimension
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The rear axle to body retaining bolts must be tightened with the axle at the correct suspension height.**

4. Using the rear axle supporter and the hydraulic jack stand, raise the rear axle to the right suspension height specification (D). Refer to **Trim Height Specifications**

CAUTION: **Refer to Fastener Caution**

5. Tighten Rear Axle Bolts (Qty: 2)
    1. First Pass: 160 N.m (118 lb ft)
    2. Final Pass: 30 - 45 Degrees
6. Lower the hydraulic jack stand.
7. Install the body wiring harness clips to the rear axle.

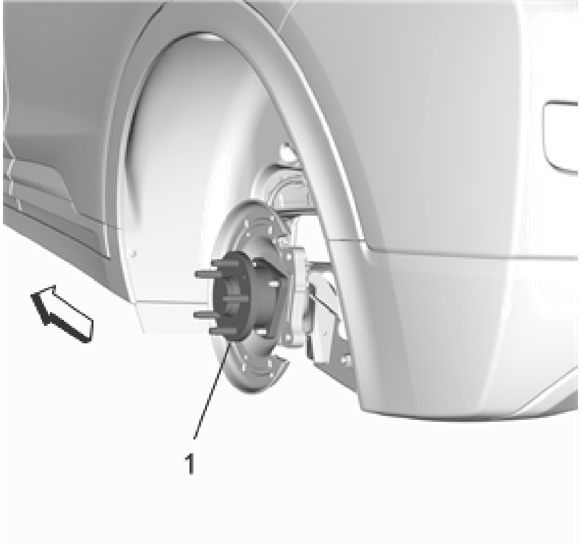


Fig. 51: Rear Wheel Bearing and Hub Assembly
Courtesy of GENERAL MOTORS COMPANY

8. Install Rear Wheel Bearing and Hub Assembly (1) (Qty: 2) @ Rear Axle. Refer to **Rear Wheel Bearing and Hub Replacement**
9. Install Rear Coil Spring Lower Insulator (Qty: 2). Refer to **Rear Coil Spring Lower Insulator Replacement**
10. Install Rear Coil Spring (Qty: 2). Refer to **Rear Coil Spring Replacement**

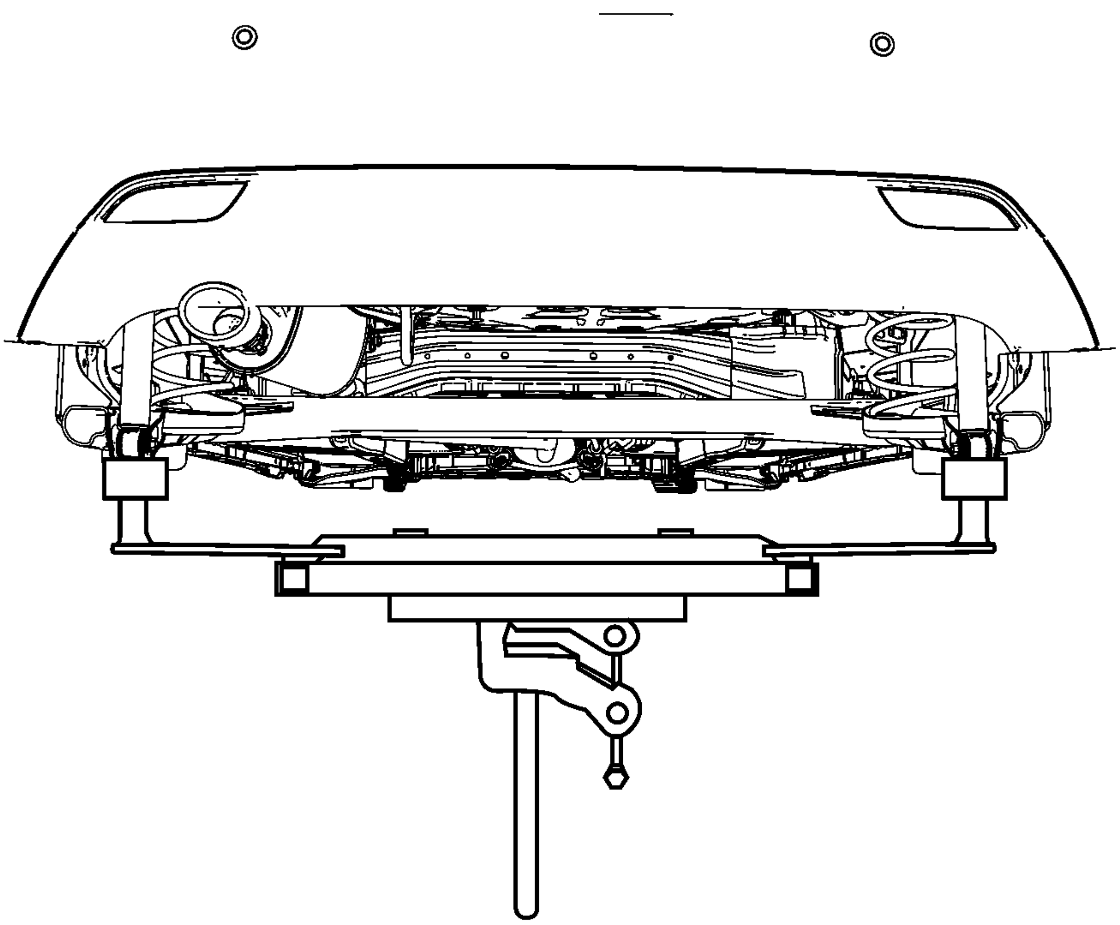


Fig. 52: Hydraulic Jack Stand And DT-50187
Courtesy of GENERAL MOTORS COMPANY

11. Support the rear axle with the DT-50187 rear axle supporter and hydraulic jack.

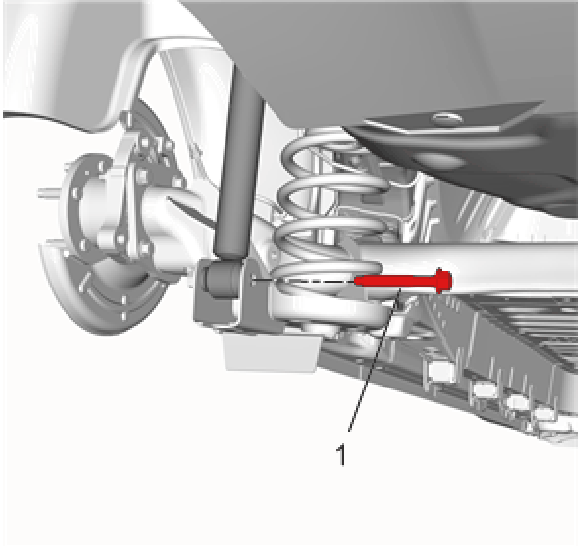


Fig. 53: Rear Shock Absorber Bolt
Courtesy of GENERAL MOTORS COMPANY

12. Install and tighten Rear Shock Absorber Bolt (1) (Qty: 2) @ Rear Axle
    1. First Pass: 100 N.m (74 lb ft)
    2. Final Pass: 30 - 45 Degrees
13. Remove the hydraulic jack with the rear axle supporter from the rear axle.

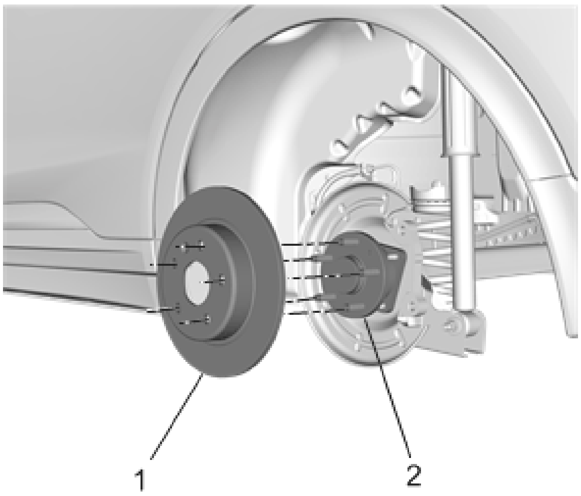
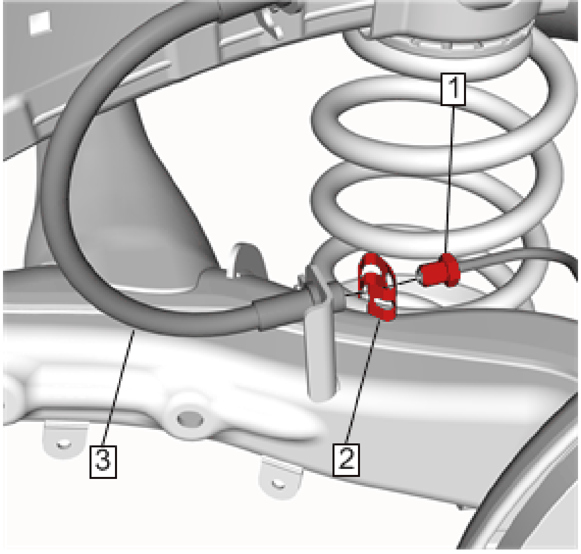


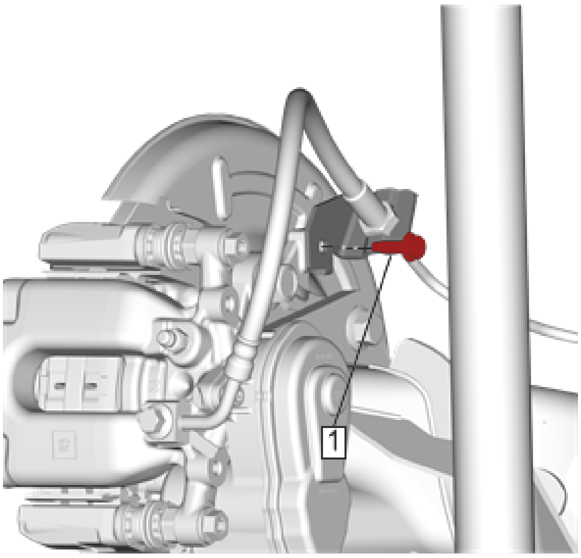
Fig. 54: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

14. Install Rear Brake Rotor (1) @ Rear Wheel Hub (2). Refer to **Rear Brake Rotor Replacement**
15. Install Rear Brake Caliper Bracket (Qty: 2) @ Vehicle. Refer to **Rear Brake Caliper Bracket Replacement**
16. Install Rear Brake Caliper (Qty: 2) @ Vehicle. Refer to **Rear Brake Caliper Replacement**



[**Fig. 55: Rear Brake Pipe Fitting, Rear Brake Hose And Retainer**]()
Courtesy of GENERAL MOTORS COMPANY

17. Install Rear Brake Hose (3) (Qty: 2) @ Rear Axle
18. Install Rear Brake Hose Retainer (2) (Qty: 2)
19. Install and tighten Rear Brake Pipe Fitting (1) (Qty: 2) @ Rear Brake Hose (3). Refer to [**Rear Brake Hose Replacement**]()



[**Fig. 56: Rear Brake Hose Bracket And Bolt**]()
Courtesy of GENERAL MOTORS COMPANY

20. Install and tighten Rear Brake Hose Bracket Bolt (1) (Qty: 2) @ Rear Brake Caliper Mount Plate to 9 N.m (80 lb in)

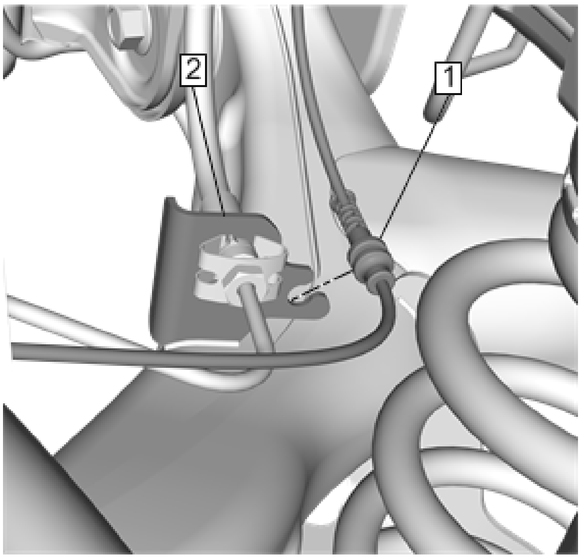


Fig. 57: Rear Wheel Speed Sensor Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

21. Install Rear Wheel Speed Sensor Wiring Harness (1) (Qty: 2) @ Rear Axle Mounted Bracket

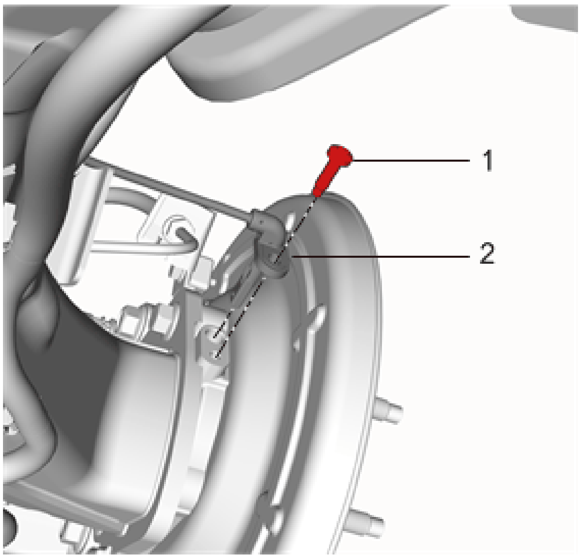


Fig. 58: Rear Wheel Speed Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

22. Install Rear Wheel Speed Sensor (2) (Qty: 2) @ Rear Brake Caliper Mount Plate
23. Install and tighten Rear Wheel Speed Sensor Bolt (1) (Qty: 2) @ Rear Brake Caliper Mount Plate. Refer to **Rear Wheel Speed Sensor Replacement**

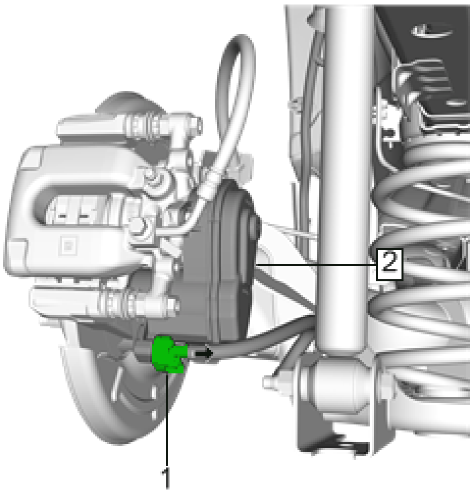


Fig. 59: Electrical Connector And Rear Park Brake Actuator
Courtesy of GENERAL MOTORS COMPANY

24. Connect Electrical Connector (1) (Qty: 2) @ Rear Park Brake Actuator (Qty: 2)
25. Install Rear Wheelhouse Liner (Qty: 2) @ Vehicle. Refer to **Rear Wheelhouse Liner Replacement**
26. Install the rear tire and wheel assemblies. Refer to **Tire and Wheel Removal and Installation**
27. Lower the vehicle.

WHEEL STUD REPLACEMENT

Special Tools

- **CH-43631** Ball Joint Remover

Equivalent regional tools: **Special Tools**

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**

2. Remove the rear tire and wheel assembly. Refer to Tire and Wheel Removal and Installation

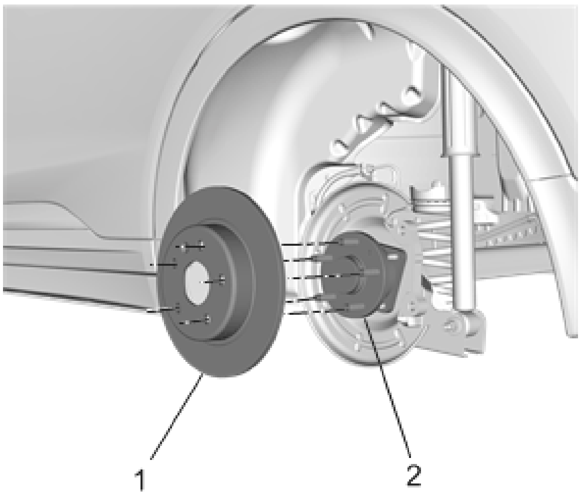


Fig. 60: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

3. Remove Rear Brake Rotor (1) @ Rear Wheel Hub (2). Refer to Rear Brake Rotor Replacement

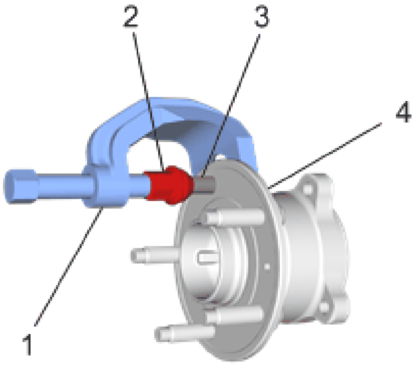


Fig. 61: Ball Joint Remover, Wheel Hub, Wheel Stud And Wheel Nut
Courtesy of GENERAL MOTORS COMPANY

4. Install a wheel nut (2) flush with the end of the wheel stud (3).
5. Using the **CH-43631** ball joint remover (1), remove the wheel stud (3) from the wheel hub (4).

Installation Procedure

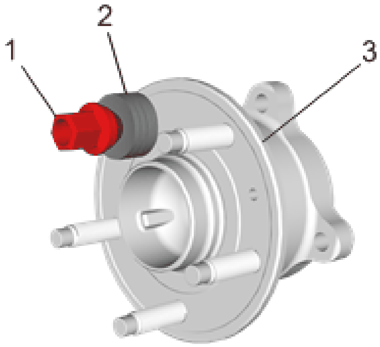


Fig. 62: Wheel Bearing/Hub Flange, Flat Washers And Wheel Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install the NEW wheel stud into the wheel bearing/hub (3).
2. Add enough washers (2) in order to draw the stud into the hub.
3. Install and tighten the wheel nut (1) until the head of the wheel stud is fully seated against the back of the bearing hub flange (3).
4. Remove the wheel nut (1) and the washers (2).

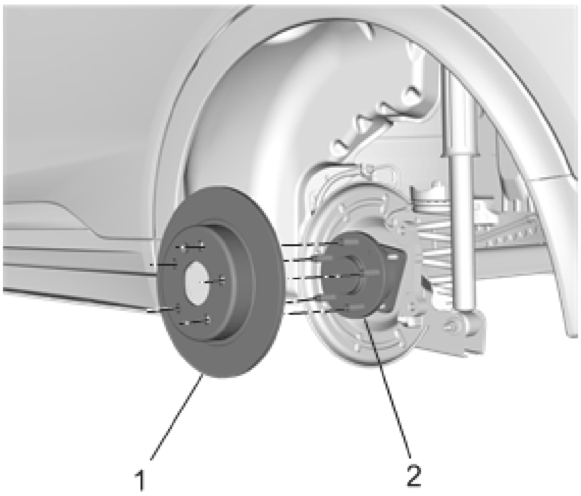


Fig. 63: Rear Brake Rotor And Rear Wheel Hub
Courtesy of GENERAL MOTORS COMPANY

5. Install Rear Brake Rotor (1) @ Rear Wheel Hub (2). Refer to **Rear Brake Rotor Replacement**
6. Install the rear tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
7. Lower the vehicle.

DESCRIPTION AND OPERATION

REAR SUSPENSION DESCRIPTION AND OPERATION

This vehicle has a semi-independent twist-beam rear suspension system consisting of the following components:

- An axle with integral trailing arms
- A "V" shaped twisting cross beam
- Two coil springs
- Two shock absorbers

Axle Assembly

The axle assembly attaches to the underbody through a rubber bushing and bracket located at the front of each integral trailing arm. The brackets are integrated to the underbody side rails. The axle structure itself maintains the geometrical relationship of the wheels relative to the centerline of the body.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description

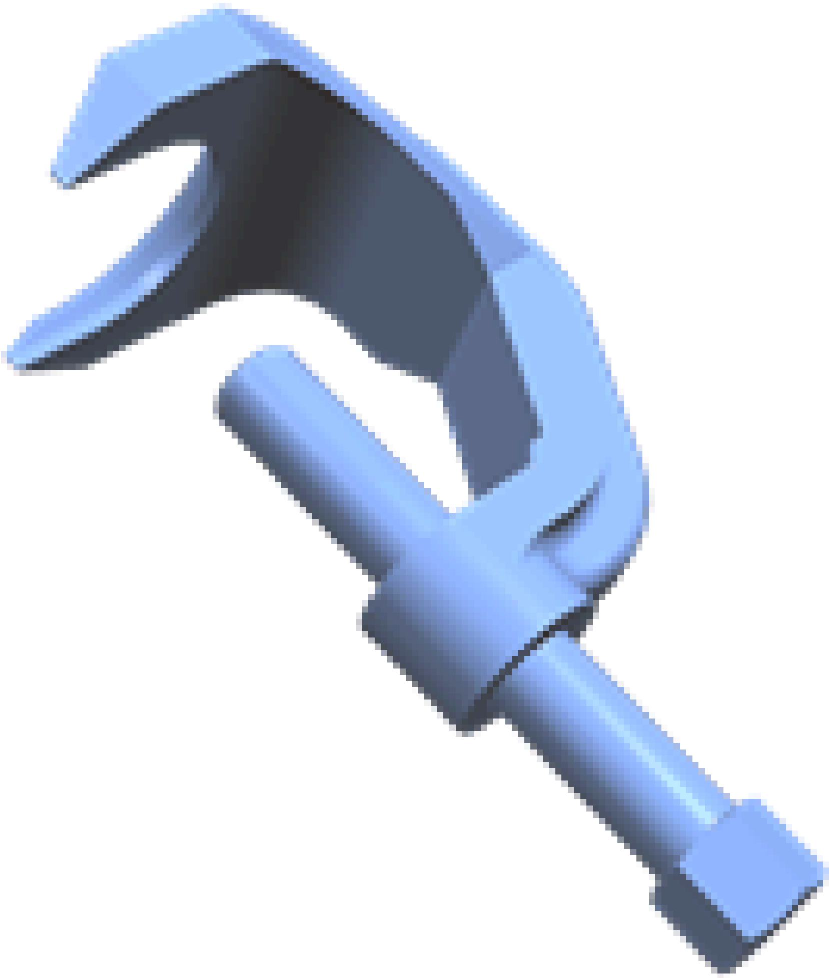
Illustration	Tool Number/Description
	CH 43631 Ball Joint Remover

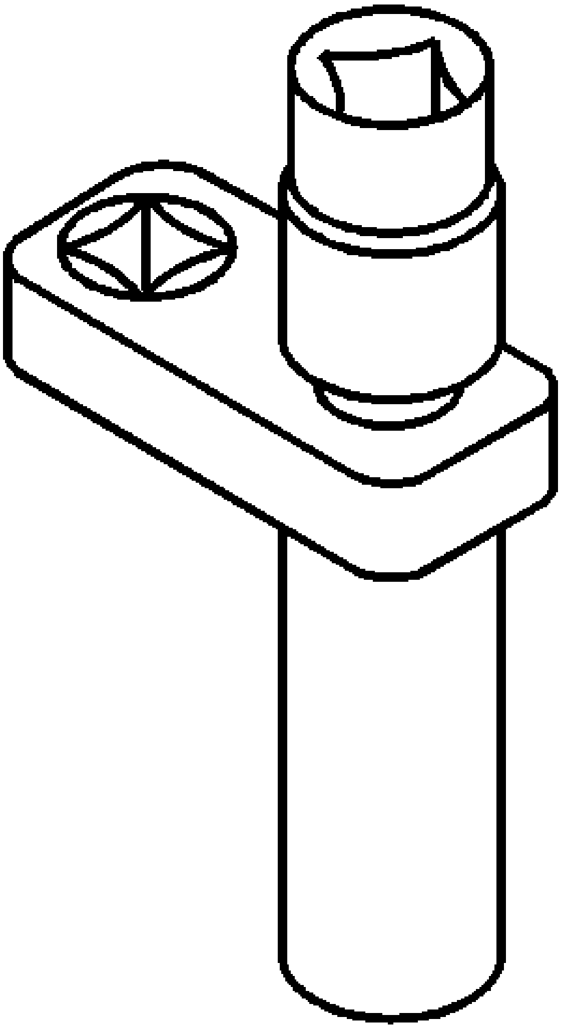
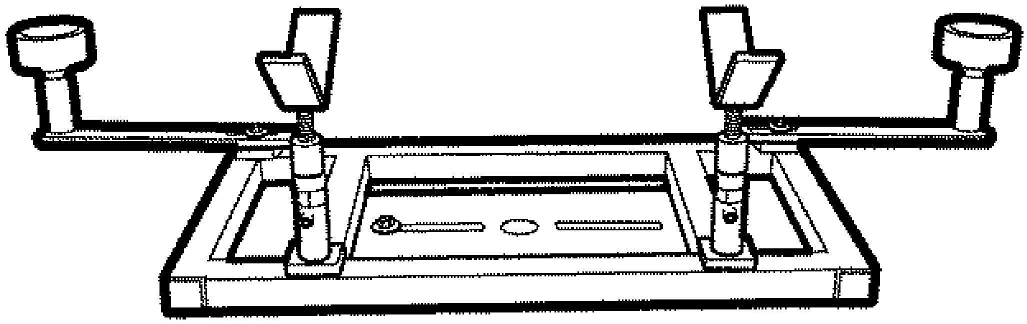
Illustration	Tool Number/Description
	CH 51095 Shock Absorber Strut Nut Wrench

Illustration	Tool Number/Description
	DT 50187 Rear Axle Supporter

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2017 SUSPENSION

Suspension General Diagnosis - Bolt EV

SPECIFICATIONS

TRIM HEIGHT SPECIFICATIONS

For description see Trim Height Inspection, refer to Trim Height Inspection

Model	Tire Size	Z +/ - 10 mm (0.39 in)	D +/ - 10 mm (0.39 in)	P +/ - 12 mm (0.47 in)	R +/ - 12 mm (0.47 in)
1FB48/0FB48	215/50R17	22 mm (0.87 in)	207 mm (8.15 in)	687.1 mm (27.05 in)	686.9 mm (27.04 in)
0FB48	205/55R16	22 mm (0.87 in)	207 mm (8.15 in)	679.1 mm (26.74 in)	678.9 mm (26.73 in)
The conditions refers to full fluid levels (fuel, windshield washer fluid and etc.) with no driver or passenger mass, and no luggage/cargo mass.					

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - SUSPENSION GENERAL DIAGNOSIS

NOTE: **The following step must be completed before using the symptom tables.**

Review the system description and operation in order to familiarize yourself with the system functions. Refer to the appropriate description and operation:

- Front Suspension Description and Operation
- Rear Suspension Description and Operation

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of any of the suspension subsystems.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for correct tire size and inflation pressure.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Ride Diagnosis
- Vehicle Leads/Pulls
- Body Leans or Sways in Corners
- Suspension Bottoms
- Torque Steer
- Memory Steer
- Noise Diagnosis - Front Suspension
- Noise Diagnosis - Rear Suspension

RIDE DIAGNOSIS

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	**NOTE:** **Verify the vehicle suspension package RPO.** Verify that the ride is too soft or too hard.Does the vehicle ride normally?	System OK	Go to **Step 3**
3	Inspect the tire inflation and adjust to specifications. Refer to **Tire Inflation Description** Did you adjust the tire pressure?	Go to **Step 6**	Go to **Step 4**
4	Inspect the vehicle trim height. Refer to **Trim Height Inspection** Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the following suspension components for wear or damage: • Shock absorbers - **Suspension Strut and Shock Absorber Testing - On Vehicle** • Springs Did you find and correct the condition?	Go to **Step 6**	-
6	Drive the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

VEHICLE LEADS/PULLS

Step	Action	Yes	No
DEFINITION: At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle straight path.			
1	Did you review the General Description and perform the visual/physical inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Road test the vehicle in order to verify the complaint. Does the vehicle operate normally?	System OK	Go to **Step 3**
3	Inspect the tire/wheel assemblies for the following conditions: • Correct tire pressure - Refer to the tire placard. • Correct tire size - Refer to the tire placard. • Abnormal tire wear or damage Did you find and correct the condition?	Go to **Step 9**	Go to **Step 4**
4	Perform the radial tire lead/pull correction procedure. Refer to **Radial Tire Lead/Pull Correction** Did you find and correct the condition?	Go to **Step 9**	Go to **Step 5**

Step	Action	Yes	No
5	Inspect and correct/adjust the suspension and steering systems for the following conditions: • Vehicle trim height - **Trim Height Specifications** • Excessively worn, loose, or damaged components Did you find and correct the condition?	Go to **Step 9**	Go to **Step 6**
6	Inspect the brake system for brake drag. With the vehicle suspended on a hoist, brake drag can be identified by rotating each wheel several times and observing whether more force is needed to rotate the left wheel or the right wheel. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
7	Inspect the wheel alignment and adjust as necessary. Refer to **Wheel Alignment Measurement** Did you correct the condition?	Go to **Step 9**	Go to **Step 8**
8	Inspect the steering gear for unequal effort. The vehicle must be suspended on a hoist, the engine running, and the transmission in PARK or NEUTRAL. Grasp the tire assembly and manually simulate a turn from the left of center and the right of center observing whether more force is needed to turn to the left or to the right. If this condition exists replace the steering gear. Did you correct the condition?	System OK	Go to **Step 3**
9	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

BODY LEANS OR SWAYS IN CORNERS

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Verify the vehicle leans or sways in corners. Does the vehicle operate normally?	System OK	Go to **Step 3**
3	Inspect the following components for wear or damage: • Front coil springs • Rear coil springs Are the components worn or damaged?	Go to **Step 5**	Go to **Step 4**
4	1. Inspect the stabilizer shaft link for wear or damage. 2. Replace as necessary. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 2**
5	Replace the springs as necessary. Did you complete the repair?	Go to **Step 6**	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

SUSPENSION BOTTOMS

Step	Action	Yes	No
DEFINITION: A loud bang or thump that can usually be felt and/or heard when the vehicle is driven over bumps. This condition is commonly noticed when the vehicle trim height is too low.			
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Verify that the suspension bottoms. Does the vehicle operate normally?	System OK	Go to **Step 3**
3	Inspect for vehicle overloading and correct the overloading condition as necessary. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 4**
4	Inspect the following components: • Inspect the shock absorbers. Refer to **Suspension Strut and Shock Absorber Testing - On Vehicle** • Inspect for damaged coil springs and torsion bar, and replace as necessary. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the vehicle trim height. Refer to **Trim Height Inspection** Did you complete the trim height inspection procedure?	Go to **Step 6**	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

TORQUE STEER

Step	Action	Yes	No
DEFINITION: On a dry, smooth, flat road, the vehicle has a left or right steering force only during acceleration.			
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	1. Drive the vehicle on a straight, smooth, flat road. 2. Press the accelerator and determine if any additional steering input is required to maintain a straight ahead direction. 3. Repeat this test with the vehicle traveling in the opposite direction in order to eliminate crosswind effects. Lead/pull caused by unlevel roads and crosswinds are considered normal. Does the vehicle exhibit torque steer when the accelerator is pressed?	Go to **Step 3**	System OK

Step	Action	Yes	No
3	1. Drive the vehicle on a straight, smooth, flat road at 64 - 97 km/h (40 - 60 mph). 2. Remove your foot from the accelerator. 3. Shift the transmission into NEUTRAL in order to allow the vehicle to coast. 4. Is any additional steering input required to maintain a straight ahead direction? 5. Repeat this test with the vehicle traveling in the opposite direction in order to eliminate crosswind effects. Lead/pull caused by unlevel roads and crosswinds are considered normal.Does the vehicle direction change when the steering wheel is momentarily released?	Go to **Vehicle Leads/Pulls**	Go to **Step 4**
4	Inspect the front suspension and powertrain mounts for worn or damaged components and repair as necessary. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**
5	Inspect the vehicle trim height. Refer to **Trim Height Inspection** Did you find and correct the condition?	Go to **Step 6**	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	-

MEMORY STEER

Step	Action	Yes	No
DEFINITION: A lead or pull in the direction the driver previously turned the vehicle. Additionally, after turning in the opposite direction, the vehicle will want to lead or pull in that direction.			
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Verify that memory steer is present. Does the system operate normally?	System OK	Go to **Step 3**
3	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Lubricate the tie rod ends and the ball joints if applicable. 3. Inspect the suspension system for worn or damaged components. 4. Repair as necessary. Did you find and correct the condition?	Go to **Step 7**	Go to **Step 4**
4	Inspect for binding strut bearings. 1. Disconnect the strut from the steering knuckle. 2. If the strut is abnormally difficult to rotate, repair or replace the upper bearing mount. Did you find and complete the repair?	Go to **Step 7**	Go to **Step 5**

Step	Action	Yes	No
5	Inspect for binding in the lower ball joints. If the joint is binding, replace the joint. Did you find and complete the repair?	Go to **Step 7**	Go to **Step 6**
6	Inspect the wheel alignment and adjust as necessary. Refer to **Wheel Alignment Measurement** Did you complete the wheel alignment?	Go to **Step 7**	-
7	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	-

NOISE DIAGNOSIS - FRONT SUSPENSION

Step	Action	Yes	No
DEFINITION: Any noise emitted from the front of the vehicle that is induced by VEHICLE SPEED or DRIVING TERRAIN as related to the front suspension.			
1	Did you review the General Description and perform the necessary Inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Attempt to duplicate the condition. Road test the vehicle. Did you duplicate the condition?	Go to **Step 3**	System OK
3	Is the noise reactive to vehicle load or speed?	Go to **Step 4**	Go to **Step 7**
4	Inspect the tires for the following condition: • Proper tire inflation and adjust as necessary - **Tire Inflation Description** • Unusual tire wear - **Tire Diagnosis - Irregular or Premature Wear** • Inspect the wheel nuts for looseness and tighten as necessary. **Fastener Specifications** Did you find and correct the condition?	Go to **Step 14**	Go to **Step 5**
5	Inspect the front wheel bearings. Refer to **Wheel Bearings Diagnosis** Did you find and correct the condition?	Go to **Step 14**	Go to **Step 6**
6	Inspect for front axle or transaxle noises. Refer to **Symptoms - Automatic Transmission** Did you find and correct the condition?	Go to **Step 14**	Go to **Step 7**
7	Bounce the front of the vehicle in order to duplicate the noise. Did you duplicate the noise?	Go to **Step 8**	Go to **Step 9**
8	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Inspect the front suspension components for looseness. Refer to **Fastener Specifications** 3. Inspect the front suspension components for damage and repair as necessary. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**

Step	Action	Yes	No
9	1. Install the **CH-39570** chassis ear or equivalent. 2. Bounce the front of the vehicle, using **CH-39570** chassis ear or equivalent in order to locate the source of the noise. If necessary road test the vehicle. 3. Repair or replace any damaged components as necessary. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
10	Inspect the ball joints and steering components for the following conditions: - Lack of lubrication where applicable - Looseness in the ball joints - Looseness in the tie rods Did you find and correct the condition?	Go to **Step 14**	Go to **Step 11**
11	Inspect for damaged shock absorbers. Refer to **Suspension Strut and Shock Absorber Testing - On Vehicle** Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
12	Inspect the front stabilizer shaft and stabilizer shaft links for damage and repair as necessary. Refer to **Stabilizer Shaft Replacement** , or **Stabilizer Shaft Link Replacement** Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
13	Inspect for control arm damage and repair as necessary. Refer to **Lower Control Arm Replacement** Did you find and correct the condition?	Go to **Step 14**	-
14	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

NOISE DIAGNOSIS - REAR SUSPENSION

Step	Action	Yes	No
DEFINITION: Any noise emitted from the rear of the vehicle that is induced by VEHICLE SPEED or DRIVING TERRAIN as related to the rear suspension.			
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Attempt to duplicate the condition. Road test the vehicle. Did you duplicate the condition?	Go to **Step 3**	System OK
3	Is the noise reactive to vehicle load or speed?	Go to **Step 4**	Go to **Step 6**

Step	Action	Yes	No
4	Perform the following inspections: • Inspect and adjust the tire inflation. Refer to **Tire Inflation Description** • Inspect for unusual tire wear. Refer to **Tire Diagnosis - Irregular or Premature Wear** • Inspect the wheel nuts for looseness. Refer to **Fastener Specifications** Did you find and correct the condition?	Go to **Step 10**	Go to **Step 5**
5	Inspect the rear wheel bearings. Refer to **Wheel Bearings Diagnosis** Did you find and correct the condition?	Go to **Step 10**	Go to **Step 6**
6	Bounce the rear of the vehicle in order to duplicate the noise. Did you duplicate the noise?	Go to **Step 7**	Go to **Step 9**
7	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Inspect the rear suspension components for looseness. Refer to **Fastener Specifications** 3. Inspect the rear suspension components for damage and repair as necessary. Did you find and correct the condition?	Go to **Step 10**	Go to **Step 8**
8	Inspect the rear shock absorber. Refer to **Suspension Strut and Shock Absorber Testing - On Vehicle** Did you find and correct the condition?	Go to **Step 10**	Go to **Step 9**
9	1. Install the **CH-39570** chassis ear or equivalent. 2. Bounce the rear of the vehicle, using **CH-39570** chassis ear or equivalent, in order to locate the source of the noise. If necessary, road test the vehicle. 3. Repair or replace any defect component as necessary. Did you find and correct the condition?	Go to **Step 10**	System OK
10	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

SUSPENSION STRUT AND SHOCK ABSORBER TESTING - ON VEHICLE

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Verify that the customer concern is present. Does the vehicle operate normally?	System OK	Go to **Step 3**

Step	Action	Yes	No
3	**NOTE:** **A light film of oil on the top portion of the shock reservoir is normal.** Inspect each strut or shock absorber for external fluid leakage.Is a strut or shock absorber leaking?	Go to **Step 5**	Go to **Step 4**
4	1. Use your hands in order to lift up and push down each corner of the vehicle 3 times. 2. Remove your hands from the vehicle. 3. Locate a shock or strut that exceeds 2 cycles. Did you locate a shock or strut that exceeds 2 cycles?	Go to **Step 5**	Go to **Step 6**
5	**NOTE:** **Inspect the vehicle trim height in order to correct any possible causes of shock/strut failures. Refer to Trim Height Inspection** Replace the strut or shock absorber. Refer to **Strut, Strut Component, or Spring Replacement** , or **Shock Absorber Replacement** Did you complete the repair?	Go to **Step 6**	-
6	Operate the vehicle in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 3**

WHEEL BEARINGS DIAGNOSIS

Step	Action	Yes	No
1	Did you review the General Description and perform the necessary inspections?	Go to **Step 2**	Go to **Symptoms - Suspension General Diagnosis**
2	Road test the vehicle in order to verify the customer's complaint. Does the vehicle operate normally?	System OK	Go to **Step 3**
3	1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Inspect for tire or wheel damage. Did you find and correct the condition?	Go to **Step 7**	Go to **Step 4**
4	1. Install the **CH-39570** chassis ear. 2. Road test the vehicle to verify the location of the wheel bearing noise. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 5**

Step	Action	Yes	No
5	**NOTE:** **Support the vehicle by the lower control arms or the rear axle to prevent movement during wheel bearing/hub inspection.** 1. Mount and secure the **J-8001** dial indicator. 2. Ensure that the dial indicator contacts the vertical surface of the wheel as close as possible to the top wheel stud. 3. Push and pull on the top of the tire in order to inspect the total travel indicated by the dial indicator. **Specification** Maximum allowable wheel bearing end play: 0.127 mm (0.005 in) Is the measurement greater then the specified value?	Go to **Step 6**	System OK
6	Replace the wheel bearing. Refer to **Front Wheel Bearing and Hub Replacement** , or **Rear Wheel Bearing and Hub Replacement** Did you complete the repair?	Go to **Step 7**	-
7	Road test the vehicle to verify the repair. Does the vehicle operate normally?	System OK	Go to **Step 3**

TRIM HEIGHT INSPECTION

Trim Height Measurement

Trim height is a predetermined measurement relating to vehicle ride height. Incorrect trim heights can cause the vehicle to bottom out over bumps, damage to the suspension components and symptoms similar to wheel alignment problems. Check the trim heights when diagnosing suspension concerns and before checking the wheel alignment.

Perform the following before measuring the trim heights:

- Set the tire pressure to the specifications shown on the certification label. Refer to **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label** .
- Check the fuel level. Add additional weight if necessary to simulate a full tank.
- Make sure the passenger and rear compartments are empty, except for the spare tire.
- Make sure the vehicle is on a flat and level surface, such as an alignment rack.
- Check that all the vehicle doors are securely closed.
- Check that the vehicle hood and rear deck lids are securely closed.
- Check for installed after market accessories or modifications that could affect trim height measurement:
  - Larger or smaller than production wheels and tires.
  - Lifting or Lowering Kits
  - Wheel Opening Flares or Ground Affects

Measuring the P and R Dimension

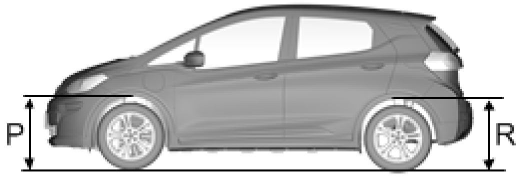

Fig. 1: Identifying P and R Dimensions
Courtesy of GENERAL MOTORS COMPANY

Measurement Definitions

P Height: The vertical distance from the ground to the top of the front wheel opening through the center line of the front wheel

R Height: The vertical distance from the ground to the top of the rear wheel opening through the center line of the rear wheel

Use the following procedures to measure the P and R dimensions:

NOTE:

- **Measure from the center of the wheel well opening to the ground.**
- **The left and right P and R height differences should be no more than 10 mm (0.39 in).**

1. Push the front bumper down a minimum of 38 mm (1.59 in) and release. Perform this step three times.
2. Measure and record the trim height per the "Measurement Definitions" above.
3. Lift the bumper up a minimum of 38 mm (1.59 in) and release. Perform this step three times.
4. Measure and record the trim height per the "Measurement Definitions" above.
5. The true P height measurement is the average of the measurements taken in step 2 and 4. Refer to **Trim Height Specifications**
6. Repeat the above steps at the rear of the vehicle for the R heights.

If the P and R heights are outside of the specifications, measure the Z & D heights.

Measuring the Z Dimension

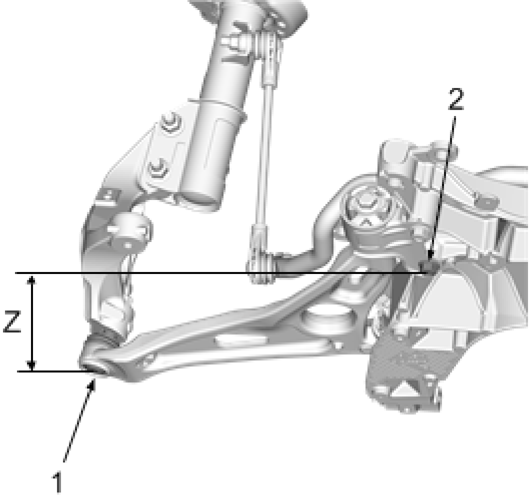

Fig. 2: Identifying Z Dimension
Courtesy of GENERAL MOTORS COMPANY

Measurement Definitions

The Z Height: The vertical distance from the center of lower control arm rear bolt head (2) to the center of the ball joint cup (1)

The Z Height dimension measurement determines the proper ride height for the front end of the vehicle. There is no adjustment procedure. Repair may require replacement of suspension parts.

Use the following procedures to check the Z height dimension:

1. Using your hands, lift the front bumper approximately 38 mm (1.59 in).
2. Gently remove your hands and allow the vehicle to settle.
3. Repeat the jouncing operation a total of 3 times.
4. Measure and record the suspension height per the "Measurement Definitions" above.
5. Using your hands, jounce the front of the vehicle downward approximately 38 mm (1.59 in).
6. Gently remove your hands and allow the vehicle to settle.
7. Repeat the jouncing operation a total of 3 times.
8. Measure and record the suspension height per the "Measurement Definitions" above.
9. The true Z height dimension number is the average of the measurements taken in steps 4 and 8. Refer to **Trim Height Specifications**.

Measuring the D Dimension

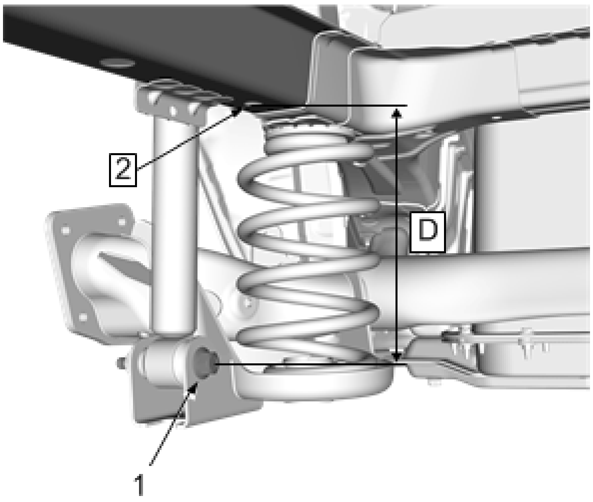

Fig. 3: Identifying D Dimension
Courtesy of GENERAL MOTORS COMPANY

Measurement Definitions

The D Height: The vertical distance from the bottom surface of underbody side rail (2) which is vertically located above the shock absorber lower bolt head to the center of rear shock absorber lower bolt (1)

The D Height dimension measurement determines the proper rear end ride height. There is no adjustment procedure. Repair may require replacement of suspension parts.

Use the following procedure to check the D height dimension:

1. With the vehicle on a flat surface, lift upward on the rear bumper 38 mm (1.59 in).
2. Gently remove your hands and allow the vehicle to settle.
3. Repeat the jouncing operation a total of 2 times.
4. Measure and record the suspension height per the "Measurement Definitions" above.
5. Repeat this task for the other side of the vehicle.
6. Using your hands, jounce the front of the vehicle downward approximately 38 mm (1.59 in).
7. Gently remove your hands and allow the vehicle to settle.
8. Repeat the jouncing operation a total of 2 times.
9. Measure and record the suspension height per the "Measurement Definitions" above.
10. The true D height dimension number is the average of the high and the low measurements. Refer to **Trim Height Specifications**.
11. If these measurements are out of specifications, inspect for the following conditions:
    - Worn or damaged suspension components
    - Collision damage

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2017 SUSPENSION

Tire Pressure Monitoring - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: *All fasteners listed in this table can be reused after removal.*	
Tire Pressure Indicator Sensor Bolt	1.4 N.m (12.4 lb in)

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C0569: SYSTEM CONFIGURATION MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0569 00

System Configuration Malfunction

Circuit/System Description

If the tire type and pressure information is not entered during the body control module (BCM) setup, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the ignition is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0569 will be set and the tire type and pressure information will need to be entered for the system to function correctly.

Conditions for Running the DTC

Ignition On/Vehicle in Service Mode.

Conditions for Setting the DTC

The tire type and pressure information is not entered into the BCM during programming and setup.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has undergone the tire type and pressure selection setup procedure and one ignition cycle has occurred.

Diagnostic Aids

A newly replaced BCM will set DTC C0569 after programming on it's initial ignition ON cycle if the module setup information has not been entered.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition On/Vehicle in Service Mode.
2. Enter the tire type and pressure information into the K9 Body Control Module with a scan tool. Refer to **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label** .
3. Ignition OFF, then Ignition On/Vehicle in Service Mode.
4. Verify DTC C0569 is not set.
    - **If the DTC is set**

      Replace the K9 Body Control Module.

    - **If the DTC is not set.**
5. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming, and setup.

DTC C0750, C0755, C0760, OR C0765: TIRE PRESSURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC C0750 03

Left Front Tire Pressure Sensor Low Voltage

DTC C0750 29

Left Front Tire Pressure Sensor Too Few Pulses

DTC C0750 39

Left Front Tire Pressure Sensor Internal Malfunction

DTC C0755 03

Right Front Tire Pressure Sensor Low Voltage

DTC C0755 29

Right Front Tire Pressure Sensor Too Few Pulses

DTC C0755 39

Right Front Tire Pressure Sensor Internal Malfunction

DTC C0760 03

Left Rear Tire Pressure Sensor Low Voltage

DTC C0760 29

Left Rear Tire Pressure Sensor Too Few Pulses

DTC C0760 39

Left Rear Tire Pressure Sensor Internal Malfunction

DTC C0765 03

Right Rear Tire Pressure Sensor Low Voltage

DTC C0765 29

Right Rear Tire Pressure Sensor Too Few Pulses

DTC C0765 39

Right Rear Tire Pressure Sensor Internal Malfunction

Circuit/System Description

The tire pressure monitor system has a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force puts the sensor into Drive mode. The sensors send the tire pressure data to the remote control door lock receiver (RCDLR) which in turn translates the received sensor data into sensor presence, sensor mode, and tire pressure before passing it onto the body control module (BCM). Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the first sensor to go into Drive mode, then checks if all sensors have gone into Drive mode. If one or more sensors does not go into these modes, or does not transmit at all, the BCM will set DTC C0750, C0755, C0760, or C0765 respectively.

Conditions for Running the DTC

Vehicle speed is greater than 40 km/h (25 MPH).

Conditions for Setting the DTC

- A sensor does not transmit or transmits invalid data to the BCM.
- A sensor low battery condition.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster flashes for 1 min and then remains illuminated after the ignition switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type message.

Conditions for Clearing the DTC

A current DTC will clear when the malfunction is no longer present and one ignition cycle occurs.

Diagnostic Aids

- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool is placed along the tire sidewall and no further than 15 cm (6 in) from the sensor and the antenna is aiming upward.
- Aftermarket wheel valve system locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to **Tire Pressure Indicator Sensor Replacement**.

- Occasionally sensor transmissions are not received by the BCM due to vehicle level radio frequency interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal being blocked by another component.
- Occasionally sensors can become mislocated due to previous tire rotations where the sensor learn procedure was not performed. Always learn the sensors to ensure the DTC set is for that actual physical corner of the vehicle. Refer to **Tire Pressure Indicator Sensor Learn (UJM)**.
- A sensor low battery condition will set a sensor DTC but will not illuminate the low tire pressure indicator or display a message on the driver information center, if equipped. The sensor battery condition can be verified in the scan tool BCM data list. If a sensor low battery condition is indicated on the scan tool, the sensor will need to be replaced. Refer to **Tire Pressure Indicator Sensor Replacement**.
- The Hit Rate of the sensor will help confirm the success rate at which the sensor transmission is being received. A low Hit Rate will signal that there may be interference.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify there are no communication DTCs set along with DTC C0750, C0755, C0760, and C0765.
    - **If a communication DTC is set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .
    - **If a communication DTC is not set**
2. Verify the scan tool Tire Pressure Sensor Rolling Count parameter of all 4 tire pressure sensors is above 50%.
    - **If the Tire Pressure Sensor Rolling Count parameter is below 50% on one or more tires**

      NOTE: **When moving the tire pressure sensor to a different location on the vehicle, keep the tire pressure sensor with the original tire it is installed in.**

      1. Move the appropriate tire to a different location on the vehicle and verify the Tire Pressure Sensor Rolling Count has increased. Refer to **Tire and Wheel Removal and Installation** .
          - If Tire Pressure Sensor Rolling Count parameter does not increase after moving tire to different location, replace the appropriate B2 Tire Pressure Sensor and perform the **Tire Pressure Indicator Sensor Learn (UJM)**.
          - If Tire Pressure Sensor Rolling Count parameter does increase after moving tire to different location, check for any aftermarket devices that could be causing interference to the tire pressure sensor signal.
    - **If the Tire Pressure Sensor Rolling Count parameter is above 50% on one or more tires**
3. Verify if all 4 tire monitor pressure sensor DTCs are not set.
    - If 2 or more tire monitor pressure sensor DTCs are set, test the keyless entry antenna for proper operation, or if antenna is properly seated. Refer to **Keyless Entry System Malfunction**
4. Perform the **Tire Pressure Indicator Sensor Learn (UJM)**.
5. Verify the scan tool Tire Pressure Sensor Mode parameters change to Drive while driving the vehicle above 40 km/h (25 mph) for greater than 2 min.
    - **If a Tire Pressure Sensor Mode parameter does not change to Drive**

    1. Replace the appropriate B2 Tire Pressure Sensor.
    2. Perform the **Tire Pressure Indicator Sensor Learn (UJM)**.

- **If the Tire Pressure Sensor Mode parameter changes to Drive**

6. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tire Pressure Indicator Sensor Replacement**
- **Tire Pressure Indicator Sensor Learn (UJM)**

DTC C0775: TIRE PRESSURE MONITORING SYSTEM SENSORS MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC C0775 00

Tire Pressure Monitoring System Sensors Malfunction

Circuit/System Description

If the body control module (BCM) has been reprogrammed or replaced and the tire pressure sensor learn procedure has not been performed, the tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete. If equipped, the driver information center will also display a service tire monitor type message. Under these circumstances, DTC C0775 will be set in the BCM and the tire pressure sensor learn procedure will need to be performed for the system to function correctly.

Conditions for Running the DTC

Vehicle ON or Vehicle in Service Mode.

Conditions for Setting the DTC

The body control module (BCM) has not learned tire pressure sensor ID and location information from the tire pressure sensors.

Action Taken When the DTC Sets

- The tire pressure monitor system indicator icon on the instrument cluster will flash for 1 min and then remain illuminated after the power switch is cycled ON and the instrument cluster bulb check is complete.
- If equipped, the driver information center displays a service tire monitor type warning message.

Conditions for Clearing the DTC

A current DTC will clear when the BCM has received tire pressure sensor ID and location after tire pressure sensor indicator learn procedure has been performed.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the **Tire Pressure Indicator Sensor Learn (UJM)**.

2. Verify DTC C0775 is not set.
    - **If the DTC is set**
    1. Test the keyless entry antenna for proper operation. Refer to **Keyless Entry System Malfunction** .
    2. Clear DTC.
    3. Verify DTC does not set.
        - If the DTC sets, replace the K9 Body Control Module.
        - If the DTC does not set.

          All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Control Module References for control module replacement, programming, and setup.

SYMPTOMS - TIRE PRESSURE MONITORING

1. Perform the **Diagnostic System Check - Vehicle** , before using the Symptom Tables in order to verify that all of the following are true:
    - The control modules can communicate via the serial data link.
    - If one of the current or previous sensor learn is not successful.
    - If there are dashes displayed in the driver information center. Refer to **Tire Pressure Rolling Count Procedure**
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Tire Pressure Monitor Description and Operation**.

Visual/Physical Inspection

- Inspect if tires are inflated per placard values.
- Inspect for aftermarket devices which could affect the operation of the Tire Pressure Monitoring (TPM) System. Refer to **Checking Aftermarket Accessories** .
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to **Low Tire Pressure Indicator Malfunction** in order to diagnose the symptom.

LOW TIRE PRESSURE INDICATOR MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Circuit/System Description

The tire pressure monitor system has a radio frequency transmitting pressure sensor in each wheel/tire assembly. As vehicle speed increases, centrifugal force puts the sensor into Drive mode. The sensors send the tire pressure data to the remote control door lock receiver (RCDLR), using radio frequency (RF) transmissions. The RCDLR then decodes the RF data and passes it to the body control module (BCM). In turn, the BCM translates the data contained in the tire pressure sensor radio frequency transmissions into sensor presence, sensor mode, and tire pressure. Once vehicle speed is greater than 40 km/h (25 MPH), the BCM waits for the sensors to go into Drive mode.

Each sensor has its own unique identification (ID) code, which it transmits as part of each RF message, that must be learned into the BCM memory. Once all 4 IDs have been learned and vehicle speed is greater than 40 km/h (25 mph), the BCM continuously compares IDs and pressure data in the received transmissions to the learned IDs and vehicle placard pressures to determine if all 4 sensors are present and if one or more tires are low. If the BCM detects a low tire pressure condition or a malfunction in the system, it will send a serial data message to the instrument cluster requesting the appropriate tire pressure monitor indicator illumination and also to display the appropriate data message on the driver information center, if equipped.

Diagnostic Aids

- If unsure about the condition, cycle the ignition and observe the tire pressure monitor indicator icon. If the tire pressure monitor indicator icon is continuously illuminated after the instrument cluster bulb check is completed, a low tire pressure condition is present. Check the tires for damage or leaks and inflate to the tire placard specifications. Refer to **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label** . If the tire pressure monitor indicator icon flashes for 1 min after the instrument cluster bulb check is completed and then remains illuminated, a tire pressure monitor system DTC is set. Perform the **Diagnostic System Check - Vehicle** to proceed with the proper diagnosis.
- Temperature can greatly effect tire pressures. Low tire pressure on a cold morning may cause the tire pressure monitor indicator icon to turn ON. The air pressure in the tire increases as the ambient temperature rises or as the tire warms up while the vehicle is driven. The pressure may increase enough to exceed the predetermined low pressure threshold which will turn OFF the tire pressure monitor indicator icon.
- Some aftermarket wheel valve stem holes are located further from the wheel rim than original equipment wheels. When using the tire pressure monitor special tool to activate a sensor, ensure the tool antenna is no further than 15 cm (6 in) from the sensor and is aiming upward.
- Aftermarket wheel value stem locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event. This is a courtesy item as it is not covered by warranty.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to **Tire Pressure Indicator Sensor Replacement**.
- The sensor activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning. In the event a particular sensor's information is displayed on the special tool upon activation but the horn does not chirp, it may be necessary to rotate the wheel valve stem to a different position due to the RF signal is being blocked by another component.
- Occasionally sensor transmissions are not received by the BCM due to vehicle level RF interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting.
- The Hit Rate of the sensor will help confirm the success rate at which the sensor transmission is being received. A low Hit Rate will signal that there may be interference. Refer to **Tire Pressure Rolling Count Procedure**.

Reference Information

Description and Operation

Tire Pressure Monitor Description and Operation

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Low tire pressure in one or more tires is indicated by a continuously illuminated tire pressure monitor indicator icon after the instrument cluster bulb check is completed. If equipped with a driver information center, a check tire pressure type message will also be displayed.**

When a tire pressure monitor DTC is set, the tire pressure monitor indicator icon will flash for 1 min after the instrument cluster bulb check is completed and then remains illuminated. If equipped with a driver information center, a service tire monitor type message will also be displayed.

1. Adjust all tire pressures to the correct pressure. Refer to **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label** .
2. Drive the vehicle over 40 km/h (25 mph) for greater than 2 min.
3. Verify the low tire pressure indicator is OFF.
   - **If the low tire pressure indicator is ON**
   1. Perform the **Tire Pressure Indicator Sensor Learn (UJM)**.
   2. Record all 4 Tire Pressure Parameters values from the scan tool.
   3. Check and record the tire pressures with a known accurate hand held tire pressure gauge.
   4. Verify that the scan tool Tire Pressure parameters do not differ more than 27.6 kPa (4 psi) from the actual tire pressure readings.
      - If the scan tool Tire Pressure parameters differ more than 27.6 kPa (4 psi), replace the appropriate B2 Tire Pressure Sensor then perform the **Tire Pressure Indicator Sensor Learn (UJM)**.
      - If the scan tool Tire Pressure parameters do not differ more than 27.6 kPa (4 psi)
   5. Verify the BCM Tire Type and Pressure selections are setup correctly with a scan tool. Refer to the **Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label** .
      - If the BCM Tire Type and Pressure selections are incorrect, input the proper placard values for the vehicle with the scan tool then drive the vehicle over 40 km/h (25 mph) for greater than 2 min.
      - If the BCM Tire Type and Pressure selections are correct
   6. Ignition On/Vehicle in Service Mode..
   7. Verify the low tire pressure monitor indicator icon turns ON and OFF when commanding All Indicators ON and OFF with a scan tool.
      - If the low tire pressure monitor icon does not turn ON and OFF, replace the P16 Instrument Cluster.
      - If the low tire pressure monitor icon turns ON and OFF
   8. All OK
   - **If the tire pressure indicator is OFF**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Tire Pressure Indicator Sensor Replacement**
- **Tire Pressure Indicator Sensor Learn (UJM)**
- **Control Module References** for control module replacement, programming, and setup.

TIRE PRESSURE ROLLING COUNT PROCEDURE

Introduction

The Tire Pressure Rolling Count parameter for each sensor can be used to help confirm if the sensor transmissions are being received. As the vehicle is being driven, the Tire Pressure Rolling Count increments with every received TPM sensor transmission. If a suspected Sensor is not incrementing, incrementing very slowly compared to others or not at all, that could be a result of interference from aftermarket devices. The sensor transmission success rate (the rate at which each sensors transmission is being received by the RCDLR) can be verified in the scan tool.

NOTE: **Scan tool procedure will be used if Tire Pressure Sensor exhibits "no Signal or poor intermittent signal reception" Before proceeding, check for the following:**

Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

- A sensor does not transmit or transmits invalid data to the RCDLR.
- A sensor might exhibit low battery condition.

- If equipped, the driver information center displays " dashes" for the suspected sensor.
- Aftermarket wheel valve system locations can cause a sensor to not function correctly.
- A sensor may have been damaged due to a previous wheel/tire service or flat tire event.
- The use of other than GM approved tire sealants can obstruct the sensor pressure sensing port and cause inaccurate tire pressure readings. If this condition is verified, remove the sealer from the tire and replace the sensor. Refer to **Tire Pressure Indicator Sensor Replacement**
- Occasionally sensor transmissions are not received by the RCDLR due to vehicle level radio frequency interference from items such as but not limited to aftermarket ignition systems, DVD players, CB radios, or metallic type window tinting

How to determine if Sensor Signal is poor or has no signal

Use Scan Tool and follow on screen instructions:

1. Select Module Diagnosis
2. Select Body Control Module
3. Select Configuration/Reset Functions
4. Select Tire Pressure Sensor Signal Reset
5. The Tire Pressure Sensor Rolling Count parameters will be displayed

If the Tire Pressure Sensor Rolling Count parameter is below 50% on one or more tires

NOTE: **When moving the tire pressure sensor to a different location on the vehicle, keep the tire pressure sensor with the original tire it is installed in.**

- Move the appropriate tire to a different location on the vehicle and verify the Tire Pressure Sensor Rolling Count has increased. Refer to **Tire and Wheel Removal and Installation** .
- If Tire Pressure Sensor Rolling Count parameter does not increase after moving tire to different location, replace the appropriate B2 Tire Pressure Sensor and perform the **Tire Pressure Indicator Sensor Learn (UJM)**.
- If Tire Pressure Sensor Rolling Count parameter does increase after moving tire to different location, check for any aftermarket devices that could be causing interference to the tire pressure sensor signal. Unplug the device and re-run test.

If the Tire Pressure Sensor Rolling Count parameter is above 50% on one or more tires (Follow normal TPM troubleshooting in Service information)

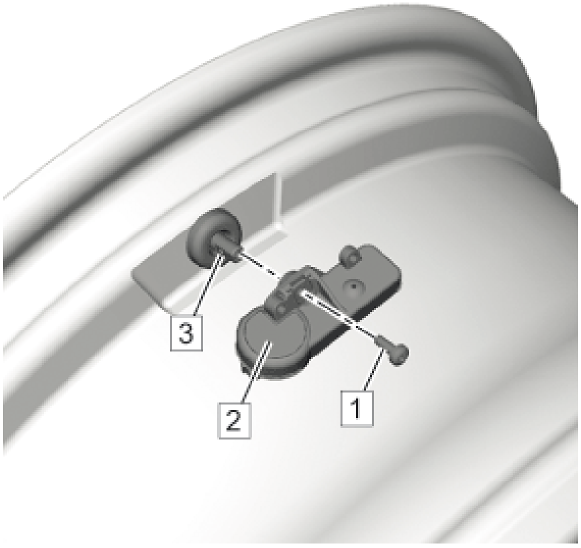
1. Verify if all 4 tire monitor pressure sensor DTCs are not set.
2. If 2 or more tire monitor pressure sensor DTCs are set, test the keyless entry antenna for proper operation, or if antenna is properly seated. Refer to **Keyless Entry System Malfunction** .
3. Perform the **Tire Pressure Indicator Sensor Learn (UJM)**.
4. Verify the scan tool Tire Pressure Sensor Mode parameters change to Drive while driving the vehicle above 40 km/h (25 mph) for greater than 2 min.
5. If a Tire Pressure Sensor Mode parameter does not change to Drive.
6. Replace the appropriate B2 Tire Pressure Sensor.
7. Perform the **Tire Pressure Indicator Sensor Learn (UJM)**.
8. If the Tire Pressure Sensor Mode parameter changes to Drive.
9. All OK.

REPAIR INSTRUCTIONS

TIRE PRESSURE INDICATOR SENSOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
2. Remove the tire and wheel assembly. **Tire and Wheel Removal and Installation**
3. Dismount the tire from the rim. **Tire Dismounting and Mounting**



[Fig. 1: Tire Pressure Transmitter And Valve Stem]
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Never fit the tire pressure indicator sensor on unapproved wheel rims.**

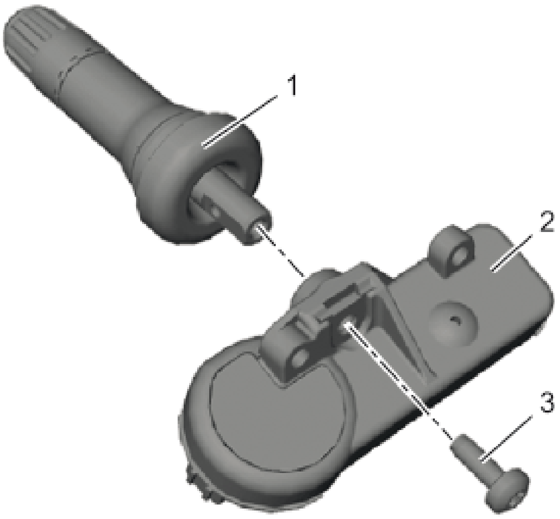
NOTE: **Whenever the tire will be removed from the rim, install a new valve stem and a new bolt. Do not reuse the old parts.**

4. Remove and DISCARD the bolt (1) from the tire pressure transmitter (2) and pull it straight off the tire pressure valve stem (3).

CAUTION: **Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.**

5. Remove and DISCARD the tire pressure valve stem by pulling it through the rim.

Installation Procedure



[Fig. 2: Tire Pressure Transmitter And Valve Stem]
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- **Ensure the flat of the valve lines up with the flats of the snap in the enclosure.**
- **Valve stems and bolts are single use items.**

1. Assemble the tire pressure transmitter (2) to the NEW valve stem (1) and install the NEW bolt (3).

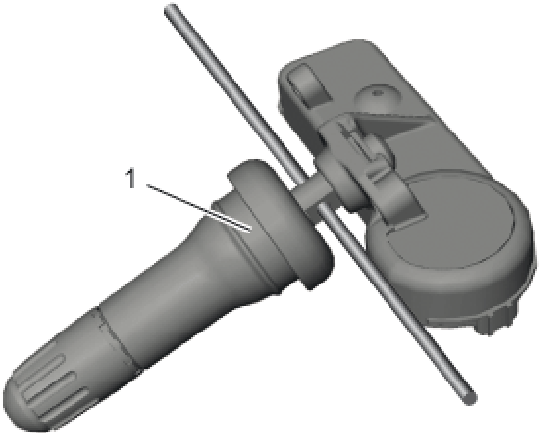


Fig. 3: Anti Rotation Pin
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Fastener Caution

2. Insert an anti rotation pin (1) through the cross-drilled hole in the valve stem and tighten the bolt to 1.4 N.m (12.4 lb in).

NOTE: **When mounting the tires, use an approved tire mounting lubricant.**

3. Apply tire soap to the rubber portion of the valve stem (2).

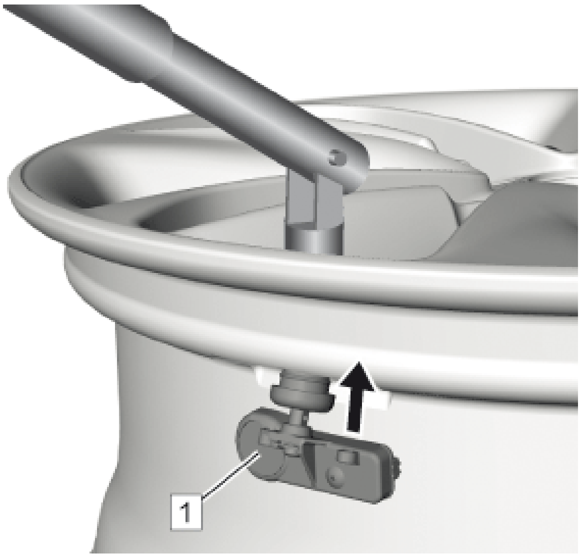
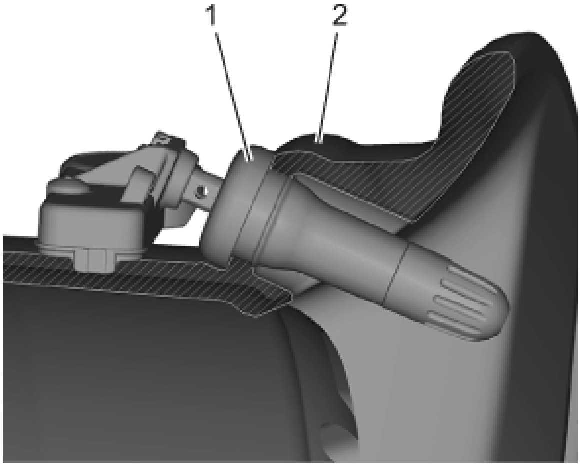


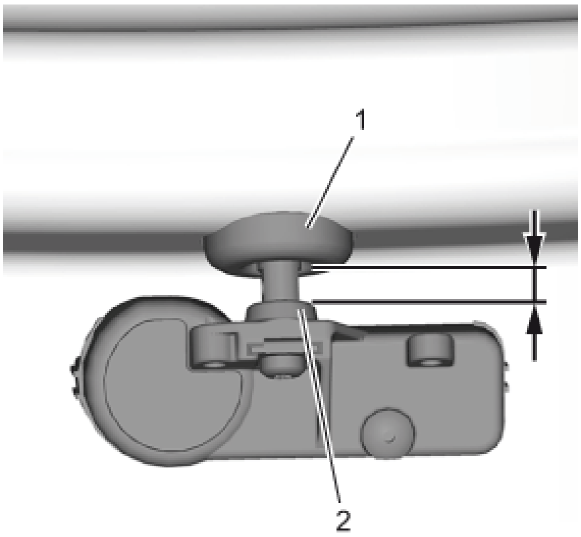
Fig. 4: Valve Stem
Courtesy of GENERAL MOTORS COMPANY

4. Using a tire valve stem mounting tool, pull the valve stem through in a direction parallel to the valve hole on the rim.



[Fig. 5: Valve Stem](#)
Courtesy of GENERAL MOTORS COMPANY

5. Check the valve stem (1) for correct seat on the rim (2).
    - The rim hole edge has to be completely in the notch of the valve stem.
    - The valve and the rim hole have to be concentric.



[Fig. 6: Tire Pressure Transmitter](#)
Courtesy of GENERAL MOTORS COMPANY

6. Make sure that there is a gab between the valve stem (1) and the tire pressure transmitter (2).

NOTE: **The tire should not have contact with the tire pressure indicator sensor during installation to prevent a damage of the tire pressure indicator sensor.**

7. Mount the tire to the rim. **Tire Dismounting and Mounting**
8. Inflate the tire to the specified pressure as stated on the tire placard.
9. Install the NEW dust cap.
10. Balance the tire and wheel assembly.
11. Install the tire and wheel assembly. **Tire and Wheel Removal and Installation**
12. Learn the tire pressure indicator sensor. **Tire Pressure Indicator Sensor Learn (UJM)**.
13. Lower the vehicle.

TIRE PRESSURE INDICATOR SENSOR LEARN (UJM)

Special Tools

- **EL-46079** Tire Pressure Monitor Diagnostic Tool

- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to Special Tools (UJM).

Learn Mode Description

The tire pressure monitor system uses the instrument cluster, body control module (BCM), 4 radio frequency transmitting pressure sensors, remote control door lock receiver (RCDLR) and the serial data circuit to perform the tire pressure monitor learn mode functions. The sensor learn procedure must be performed after every tire rotation, BCM replacement, or sensor replacement. Once the Learn mode has been enabled, each of the sensors unique identification codes can be learned into the BCM memory. When a sensor ID has been learned, the BCM sounds a horn chirp indicating the sensor has transmitted its ID and the BCM has received and learned it. The BCM must learn the sensor IDs in the proper sequence to determine correct sensor location. The first learned ID is assigned to the left front location, the second to right front, the third to right rear and the fourth to left rear. The turn signals will individually illuminate indicating which location is to be learned in the proper sequence.

Sensor Functions Using EL-46079, EL-50448, or Equivalent

Each sensor has an internal low frequency coil. When the tire pressure monitor special tool is used in activate mode, it produces a low frequency transmission that activates the sensor. The sensor responds to a low frequency activation by transmitting in Learn Mode-Remotely Triggered. When the BCM receives a learn mode transmission while in Learn mode, it will assign that sensors ID to the location on the vehicle relative to the order in which it was learned.

Learn Mode Cancellation

The Learn mode will cancel if the ignition is cycled to OFF or if more than 2 minutes has elapsed for any sensor or 5 min overall has elapsed to match all four sensors. If the relearn mode is cancelled before the first sensor is learned, the original sensor IDs will be maintained. If the relearn mode is canceled after the first sensor is learned, the following will occur:

- All stored sensor IDs will be invalidated in the BCM memory.
- If equipped, the driver information center will display dashes instead of tire pressures.
- DTC C0775 will be set.

These conditions will now require the Learn procedure to be repeated for the system to function properly.

Tire Pressure Monitor Learn Procedure

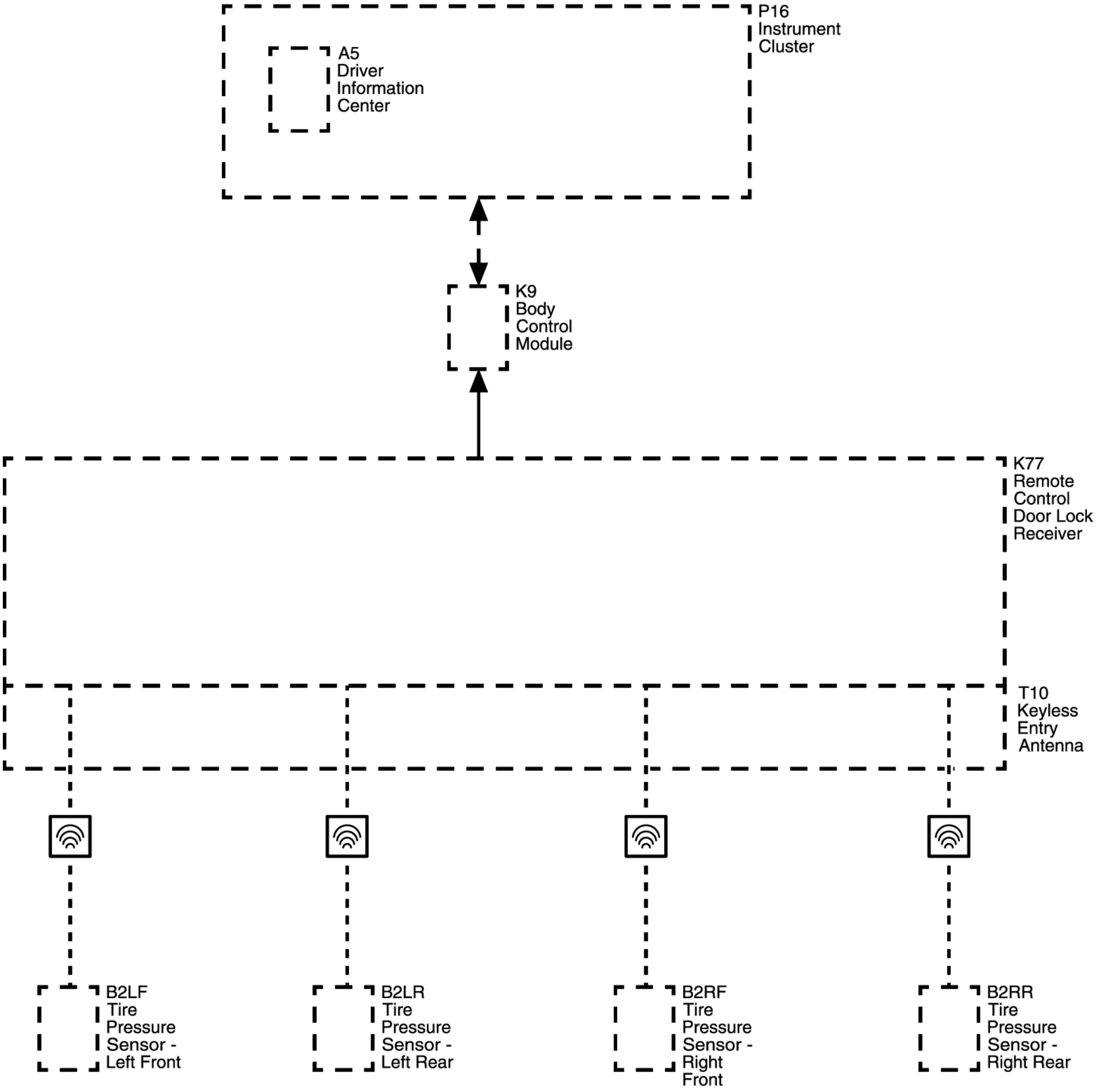
NOTE: **In the event a particular sensor is activated and the horn does not chirp, it may be necessary to rotate the wheel so that the valve stem is in a different position due to the sensor signal is being blocked by another component. Make sure the TPM tool battery is sufficient to complete TPM learn process. Do not place the TPM tool directly on the valve stem. The TPM tool should be placed against the tire sidewall near the valve stem. The TPM sensor learn activation procedure may have to be repeated up to 3 times before determining a sensor is malfunctioning.**

1. Apply park brake (manual transmission only).
2. Ignition On/Vehicle in Service Mode, using a scan tool or driver information center buttons (refer to owners manual), initiate the Tire Pressure Sensors Learn mode. A double horn chirp will sound indicating the Learn mode has been enabled. The left front turn signal will also be illuminated.
3. Starting with the left front tire, active the sensor by holding the antenna of the tire pressure monitor special tool aimed upward against the tire sidewall close to the wheel rim at the valve stem location. Press and release the activate button. Ensure that the transmit indicator on the special tool indicates that the sensor activation signal is being transmitted. Wait for a horn chirp. If the horn does not chirp, repeat the sensor activation sequence with the tool. Once the horn chirp has sounded, the sensor information is learned and the turn signal in the next location to be learned will illuminate.
4. After the horn chirp has sounded and the right front turn signal is illuminated, repeat step 3 for the remaining 3 sensors in the following order:
    1. Right front
    2. Right rear
    3. Left rear

5. When the left rear sensor has been learned and a double horn chirp has sounded, the learn process is complete and the BCM exits the Learn mode.

DESCRIPTION AND OPERATION

TIRE PRESSURE MONITOR DESCRIPTION AND OPERATION



P16
Instrument
Cluster
A5
Driver
Information
Center
K9
Body
Control
Module
K77
Remote
Control
Door Lock
Receiver
T10
Keyless
Entry
Antenna
B2LF
Tire
Pressure
Sensor -
Left Front
B2LR
Tire
Pressure
Sensor -
Left Rear
B2RF
Tire
Pressure
Sensor -
Right
Front
B2RR
Tire
Pressure
Sensor -
Right Rear

Fig. 7: Tire Pressure Monitoring System Block Diagram
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
P16	P16 Instrument Cluster
P9	P9 Driver Information Center Display
K9	K9 Body Control Module
K77	K77 Remote Control Door Lock Receiver
T10	T10 Keyless Entry Antenna
B2LF	B2LF Tire Pressure Sensor - Left Front
B2LR	B2LR Tire Pressure Sensor - Left Rear
B2RF	B2RF Tire Pressure Sensor - Right Front
B2RR	B2RR Tire Pressure Sensor - Right Rear

Special Tools

- **EL-46079/J-46079** Tire Pressure Monitor Diagnostic Tool
- **EL-50448** Tire Pressure Monitor Sensor Activation Tool

For equivalent regional tools, refer to **Special Tools (UJM)**.

The tire pressure monitor system warns the driver when a significant loss of tire pressure occurs in any of the 4 tires and allows the driver to display the individual tire pressures and their locations on the driver information center.

The system uses the body control module (BCM), driver information center, instrument cluster, remote control door lock receiver (RCDLR), and a radio frequency (RF) transmitting pressure sensor in each wheel/tire assembly, and the serial data circuit to perform the system functions. Each sensor has an internal power supply with an approximate 10 year service life.

When the vehicle is stationary, the sensor's internal accelerometer is inactive, which puts the sensors into a Stationary state. In this state the sensors sample tire pressure once every 30 seconds and do not transmit at all if the tire pressure does not change. As vehicle speed increases, centrifugal force activates the sensors internal accelerometer causing the sensors to go into Wake and then Drive mode. In Drive mode, the sensors sample tire pressure once every 30 seconds and transmit in Drive mode once every 60 seconds. The RCDLR receives and translates the data contained in each sensors RF transmission into sensor presence, sensor mode, and tire pressure and passes it to the BCM. In turn, the BCM sends the tire pressure and tire location data to the driver information center via the serial data circuit where they are displayed.

The sensors continuously compare their last pressure sample to their current pressure sample and will transmit in Learn Mode-Pressure Triggered if a 8.3 kPa (1.2 psi) change in tire pressure has been detected in either a Stationary or Drive state. When the tire pressure monitor system detects a significant loss of tire pressure, the tire pressure monitor indicator icon is illuminated on the instrument cluster and if equipped, a tire pressure low, add air to tire type message is displayed on the driver information center. Both the indicator icon and driver information center message can be cleared by adjusting the tire pressures to the recommended pressures and driving the vehicle above 40 km/h (25 mph) for at least 2 minutes.

If power is disconnected from the BCM or if the vehicle battery is disconnected, each tire pressure monitor sensor ID is retained but all of the tire pressure information is lost. Under these circumstances the BCM cannot assume that the tire pressures were maintained over an unknown period of time. If equipped, the driver information center will display all dashes and the scan tool will indicate a default tire pressure value of 1020 kPa (148 psi) for each tire. Driving the vehicle above 40 km/h (25 mph) for at least 2 minutes will activate the sensors causing the driver information center to display the current tire pressures. The **EL-46079/J-46079** tire pressure monitor diagnostic tool, **EL-50448** tire pressure monitor sensor activation tool, or equivalent may also be used to activate the sensors as well.

The BCM has the ability to detect malfunctions within the tire pressure monitor system. In the event a DTC is set, the tire pressure monitor indicator icon on the instrument cluster, if equipped will flash for 1 minute and then remain illuminated after the ignition is turned ON and the instrument cluster bulb check has been completed. Any malfunction detected will cause the driver information center to display a service tire monitor system type message. For more information on other functions of the BCM, refer to **Keyless Entry System Description and Operation** .

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS (UJM)

Illustration	Tool Number/Description

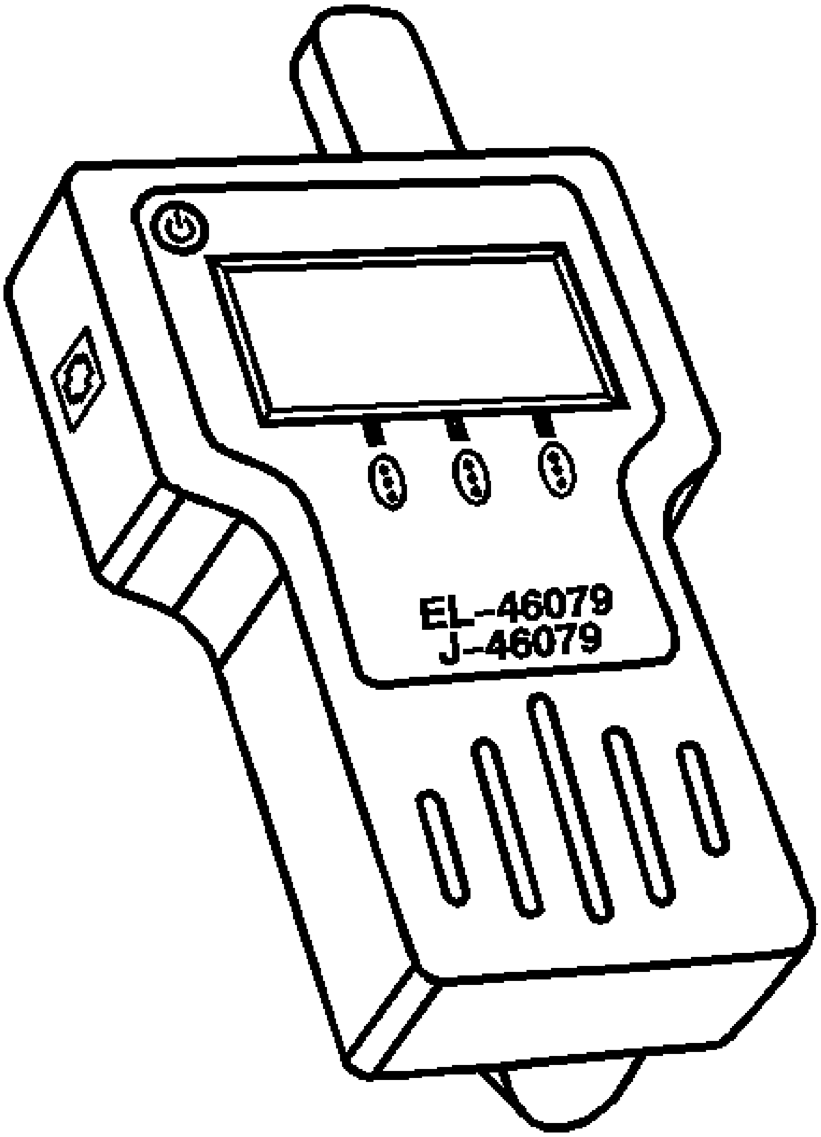
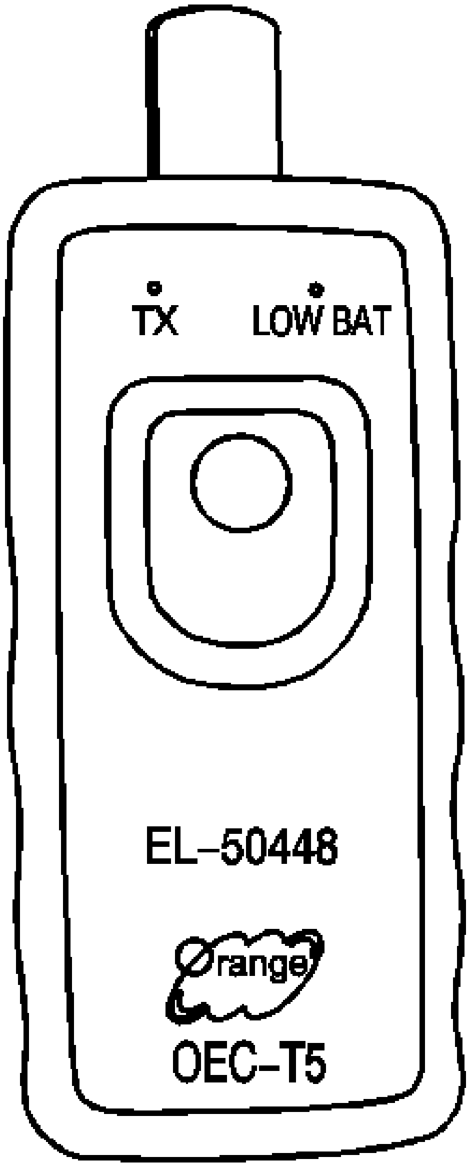
Illustration	Tool Number/Description
 EL-46079 J-46079	EL 46079 Tire Pressure Monitor Diagnostic Tool

Illustration	Tool Number/Description
 TX LOW BAT EL-50448 Ørange OEC-T5	EL 50448 Tire Pressure Monitor Sensor Activation Tool

Back To Article

2017 SUSPENSION

Tires and Wheels - Bolt EV

SPECIFICATIONS

TIRE AND WHEEL SPECIFICATIONS

Inflation Pressure At Full Load

Wheel	Tire Designation	Front		Rear	
		kPa	psi	kPa	psi
17 X 6.5J	215/50 R17	260	38	260	38

NOTE: **For the exact tire inflation pressure on vehicle condition, see the tire placard on the vehicle.**

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Wheel Nut	140 N.m (103 lb ft)

DIAGNOSTIC INFORMATION AND PROCEDURES

TIRE DIAGNOSIS - IRREGULAR OR PREMATURE WEAR

Tire Wear

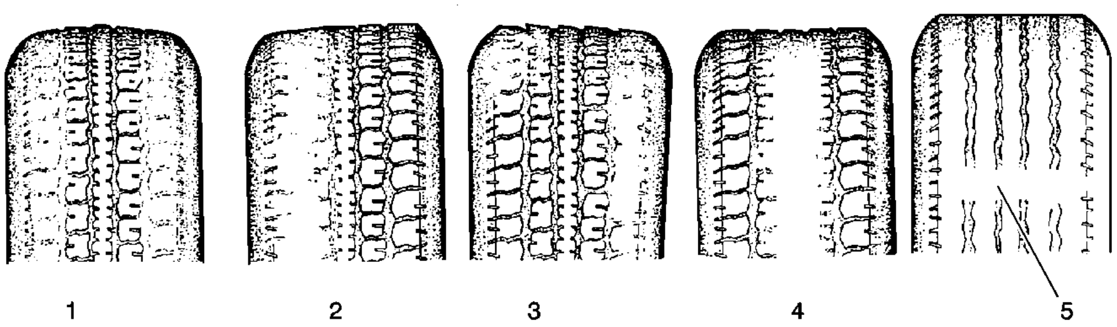


Fig. 1: Identifying Types Of Tire Wear
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Under-Inflation, Hard Cornering, Lack of Regular Rotation
2	Incorrect Wheel Alignment, Hard Cornering, Lack of Regular Rotation
3	Incorrect Wheel Alignment
4	Over-Inflation, Heavy Acceleration, Lack of Regular Rotation

Callout	Component Name
5	Normal Wear to the Wear Indicator

Inspection Procedure

1. Inspect the front tire wear.
2. Inspect the rear tire wear.
3. Rotate the tires if any of the following conditions exist:
    - The amount of time or mileage since the last tire rotation matches the maintenance schedule.
    - The outer tread blocks are worn more than the middle tread blocks (1).
    - The outer tread blocks are worn more than the inner tread blocks (2).
    - The middle tread blocks are worn more than the outer tread blocks (4).
4. Measure the wheel alignment if any of the following conditions exist:
    - The tread blocks have feathered edges (3).
    - The outer tread blocks are worn more than the inner tread blocks (2).
    - The inner tread blocks are worn more than the outer tread blocks (2).
5. Inspect the struts or the shock absorbers if the tire tread exhibits a cupped appearance (3).

TIRE DIAGNOSIS - WADDLE COMPLAINT

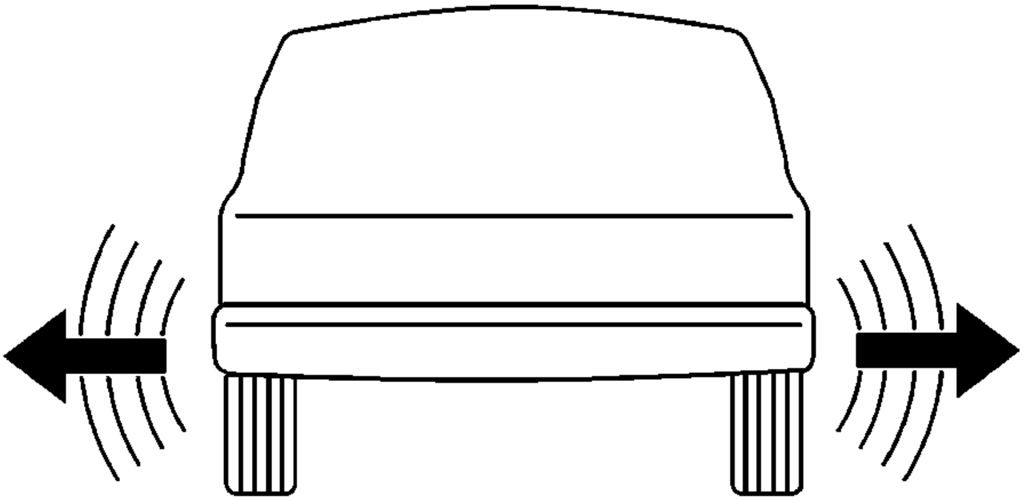


Fig. 2: Identifying Tire Wobble/Waddle
Courtesy of GENERAL MOTORS COMPANY

Tire waddle is a side to side movement at the front of the vehicle and/or the rear of the vehicle. Tire waddle can be caused by the following conditions:

- A steel belt not being straight within the tire
- Excessive lateral runout of the tire
- Excessive lateral runout of the wheel

The tire waddle is most noticeable at a low speed of about 8 - 48 km/h (5 - 30 mph). Tire waddle may appear as ride roughness at 80 - 113 km/h (50 - 70 mph). Tire waddle may appear as a vibration at 80 - 113 km/h (50 - 70 mph).

Inspection Procedure

1. Raise and support the vehicle with safety stands. Refer to **Lifting and Jacking the Vehicle**

   WARNING: **Wear gloves when inspecting the tires in order to prevent personal injury from steel belts sticking through the tire.**

2. Perform the following preliminary inspection:
   1. Mark the tire with a crayon in order to note the start and the stop position.
   2. Rotate each tire and wheel by hand.
   3. Inspect the tire for bulges or bent wheels. Replace as necessary.
3. Use tire substitution in order to identify the faulty tire. Perform the following steps for a tire substitution check:
   1. Use a comparable tire in order to replace each tire, one at a time.
   2. Test drive the vehicle.
   3. If the problem is tire or wheel related, you will eliminate the problem when you remove the faulty tire from the vehicle.

RADIAL TIRE LEAD/PULL CORRECTION

Lead/pull is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel. Lead is usually caused by:

- Incorrect alignment
- Uneven brake adjustment
- Tire construction

The way in which a tire is built can produce lead/pull in the vehicle. Off-center belts on radial tires can cause the tire to develop a side force while the vehicle rolls straight down the road. If one side of the tire has even a little larger diameter than the diameter of the other side, the tire will tend to roll to one side. Unequal diameters will cause the tire to develop a side force which can produce vehicle lead/pull.

The radial lead/pull diagnosis chart should be used to determine whether the problem originates from an alignment problem or from the tires. Part of the lead diagnosis procedure calls for tire rotation that is different from the proper tire rotation pattern. If a medium-mileage to high-mileage tire is moved to the other side of the vehicle, be sure to check for ride roughness. Rear tires will not cause lead/pull.

Step	Action	Yes	No
1	1. Perform wheel alignment preliminary inspection. 2. Check the brakes for dragging. 3. Road test the vehicle. Does the vehicle lead/pull?	Go to **Step 2**	System OK
2	1. Cross switch the front tire and wheel assemblies. 2. Road test the vehicle. Does the vehicle lead/pull?	Go to **Step 3**	System OK

Step	Action	Yes	No
3	Check the front wheel alignment. Is the alignment within specifications?	Go to **Step 4**	Adjust alignment
4	Compare the front camber and front caster to specifications. Are they within specifications?	Go to **Step 7**	Go to **Step 5**
5	Check the vehicle frame. Is the frame bent?	Go to **Step 6**	Go to **Step 1**
6	Straighten the frame. Is the repair complete?	Go to **Step 3**	-
7	1. The probable cause is the tires. 2. Switch the left front tire and wheel assembly with the left rear tire and wheel assembly. 3. Road test the vehicle. Does the vehicle still lead/pull?	Go to **Step 9**	Go to **Step 8**
8	Switch the left front tire and wheel assembly with the left rear tire and wheel assembly, and replace the left front tire. Is the repair complete?	System OK	Go to **Step 1**
9	1. Switch the right front tire and wheel assembly with the right rear tire and wheel assembly. 2. Road test the vehicle. Does the vehicle still lead/pull?	Go to **Step 1**	Go to **Step 10**
10	Switch the right front tire and wheel assembly with the right rear tire and wheel assembly, and replace the right front tire. Is the repair complete?	System OK	Go to **Step 1**

REPAIR INSTRUCTIONS

ALUMINUM WHEEL POROSITY REPAIR

1. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation**
2. Inflate the tire to the manufactures specified pressure as stated on the tire.
3. Submerge the tire/wheel into a water bath in order to locate the leak.
4. Inscribe a mark on the wheel in order to indicate the leak areas.
5. Inscribe a mark on the tire at the valve stem in order to indicate the orientation of the tire to the wheel.

NOTE: **Do not damage the exterior surface of the wheel.**

6. Remove the tire from the wheel. Refer to **Tire Dismounting and Mounting**
7. Use number 80 grit sandpaper to scuff the inside of the rim surface at the leak area.
8. Use general purpose cleaner to clean the leak area.
9. Apply 3 mm (0.12 in) thick layer of adhesive/sealant to the leak area.
10. Allow for the adhesive/sealant to dry.
11. Align the inscribed mark on the tire with the valve stem on the wheel.
12. Install the tire to the wheel. Refer to **Tire Dismounting and Mounting**
13. Pressurize the tire to 276 kPa (40 psi).
14. Submerge the tire/wheel into a water bath in order to ensure the leak is sealed.

15. Inflate the tire to the specified pressure as stated on the tire placard.
16. Balance the tire and wheel. Refer to **Tire and Wheel Assembly Balancing - Off Vehicle**
17. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation**

ALUMINUM WHEEL REFINISHING

Finish Damage Evaluation Procedure

NOTE:

- **If the wheels are chrome-plated, do not re-plate or refinish the wheels.**
- **If the wheels are polished aluminum, do not refinish the wheels in the dealer environment. Utilize a refinisher that meets manufacturer guidelines.**

1. Inspect the wheels for damage from uncoated wheel balance weights or from automatic car wash facilities.
2. Inspect the wheels for the following conditions:
   - Corrosion
   - Scrapes
   - Gouges
3. Verify the damage is not deeper than what sanding can remove.
4. Inspect the wheels for cracks. If a wheel has cracks, discard the wheel.
5. Inspect the wheels for bent rim flanges. If a rim flange is bent, discard the wheel.

Refinishing Procedure

WARNING: **To avoid serious personal injury when applying any two part component paint system, follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and allergic respiratory reaction.**

1. Remove the tire and wheel assembly from the vehicle. Refer to **Tire and Wheel Removal and Installation**
2. Remove the balance weights from the wheel.
3. Remove the tire from the wheel. Refer to **Tire Dismounting and Mounting**

NOTE:

- **Do not re-machine the wheel.**
- **Do not use chemicals in order to strip the paint from the wheel.**

4. Use a suitable cleaner in order to remove the following contaminants from the wheel:
   - Lubricants
   - Wax
   - Dirt
5. Use plastic media blasting in order to remove the paint from the wheel.
6. If the wheel had a machined aluminum finish, spin the wheel and use sand paper in order to restore the circular machined appearance.

NOTE: **The wheel mounting surface and the wheel nut contact surface must remain free of paint.**

7. Mask the wheel mounting surface and the wheel nut contact surface.
8. Follow the paint manufacturer instructions for painting the wheel.
9. Install a new valve stem.

NOTE: **Use new coated balance weights in order to balance the wheel.**

10. Install the tire to the wheel. Refer to **Tire Dismounting and Mounting**
11. Use a suitable cleaner in order to remove the following contaminants from the wheel mounting surface:
    - Corrosion
    - Overspray
    - Dirt
12. Install the tire and wheel assembly to the vehicle. Refer to **Tire and Wheel Removal and Installation**

TIRE AND WHEEL REMOVAL AND INSTALLATION

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**

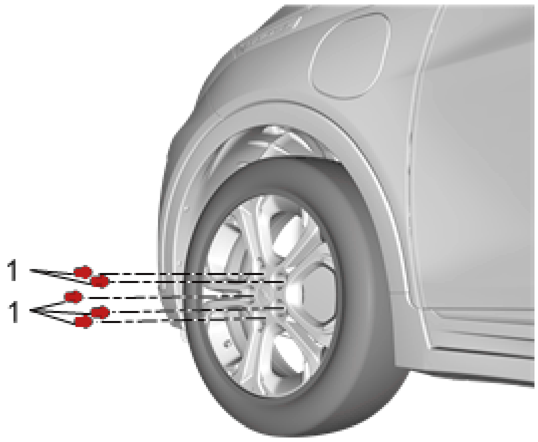


Fig. 3: Wheel Nuts
Courtesy of GENERAL MOTORS COMPANY

2. Remove Wheel Nuts (1) (Qty: 5)

WARNING: **If penetrating oil gets on the vertical surfaces between the wheel and the rotor or drum, it could cause the wheel to work loose as the vehicle is driven, resulting in a loss of control and an injury accident.**

CAUTION: **Removing the wheel may be difficult because of foreign materials or a tight fit between the wheel and the hub/rotor. Slightly tap the tire side wall with a rubber mallet in order to remove the wheel. Failure to follow these instructions may result in damage to the wheel.**

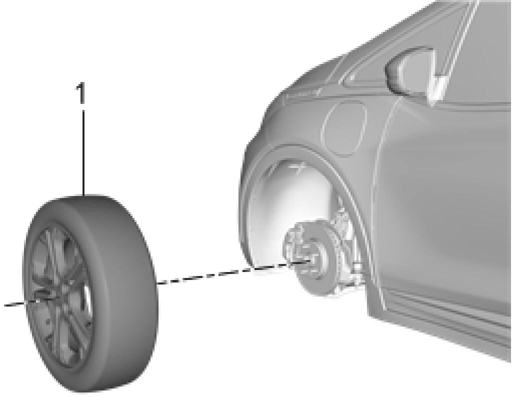


Fig. 4: Tire and Wheel Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Remove Tire and Wheel Assembly (1) @ Vehicle

Installation Procedure

WARNING: **Before installing the wheels, remove any buildup of corrosion on the wheel mounting surface and brake drum or disc mounting surface. Installing wheels with poor metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen. This can cause a wheel to come off when the vehicle is moving, causing loss of control and possibly personal injury.**

NOTE: **Wheel nuts, studs, and mounting surfaces must be clean and dry.**

1. Remove any corrosion or foreign material from the wheel and the hub mounting surfaces.
2. Clean the threads on the wheel studs and wheel nuts.

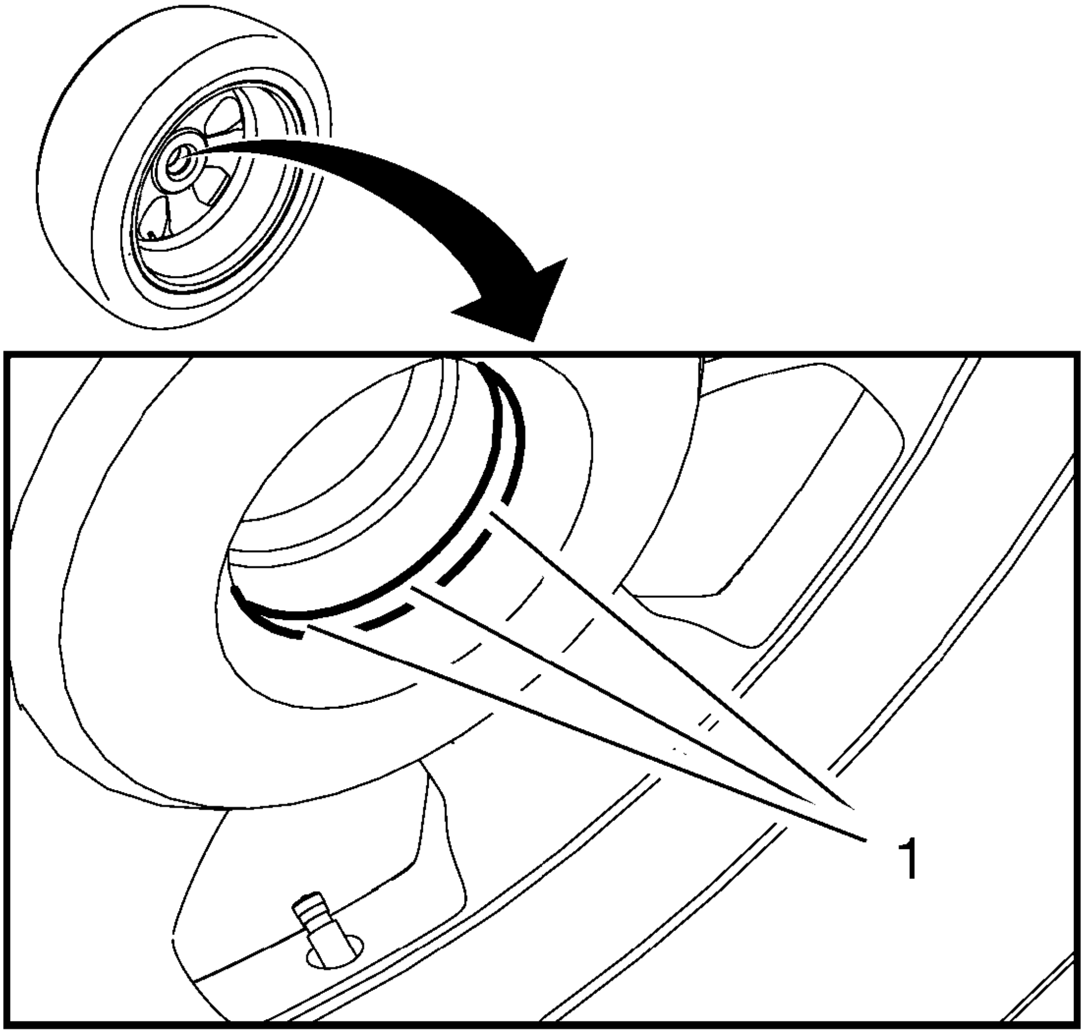


Fig. 5: Wheel Hub Pilot Hole
Courtesy of GENERAL MOTORS COMPANY

3. Apply a small amount of lubricant to the inner diameter of the wheel hub pilot hole (1) where it contacts the wheel hub flange.

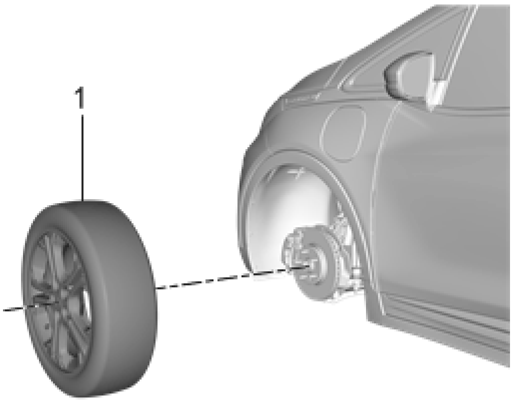


Fig. 6: Tire and Wheel Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Install Tire and Wheel Assembly (1) @ Vehicle

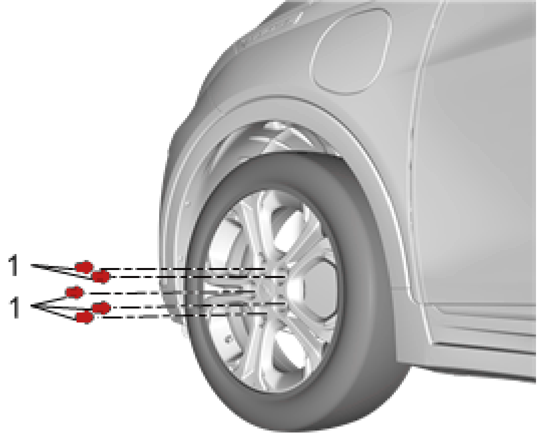


Fig. 7: Wheel Nuts
Courtesy of GENERAL MOTORS COMPANY

5. Install and hand tighten Wheel Nuts (1) (Qty: 5)

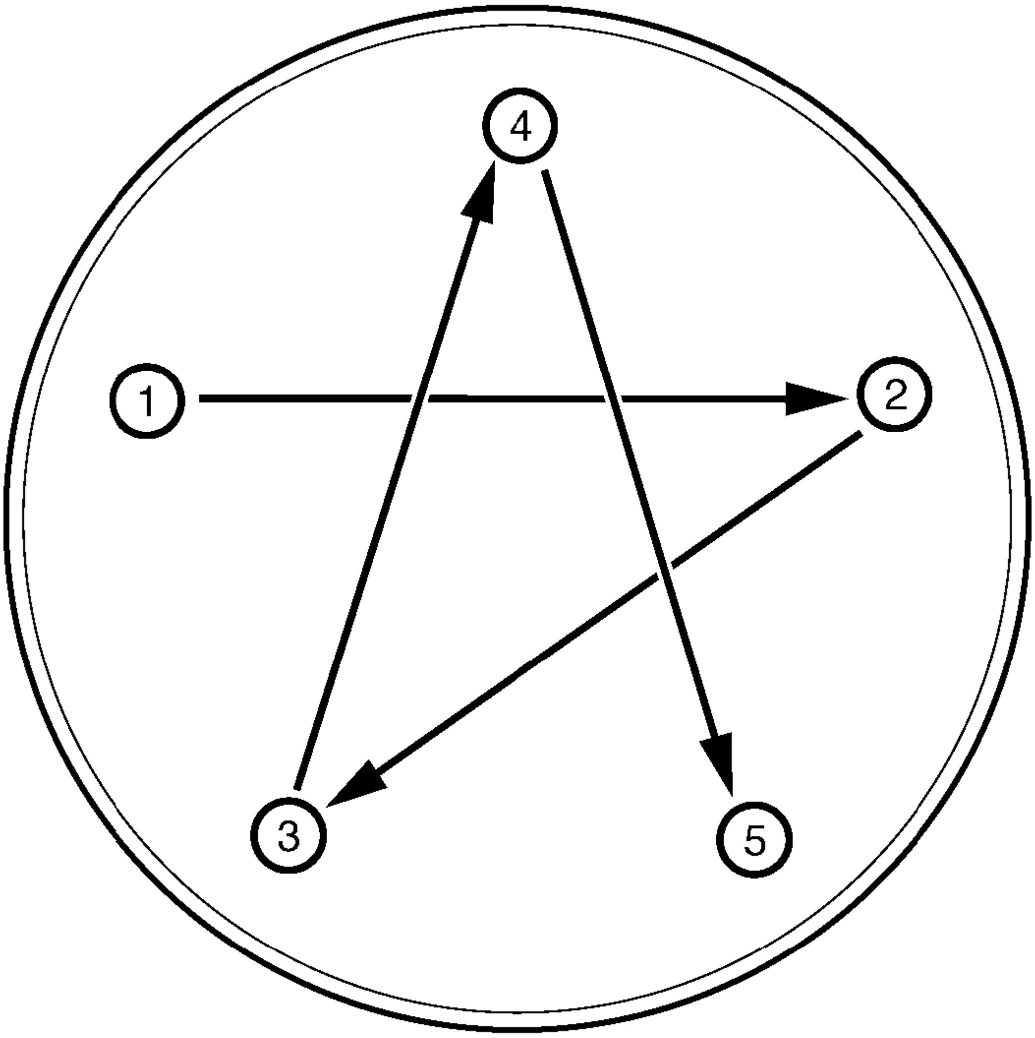


Fig. 8: Wheel Nut Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: **Improperly tightened wheel bolts or nuts can lead to brake pulsation and rotor damage. In order to avoid expensive brake repairs, evenly tighten the wheel bolts or nuts to the proper torque specification.**

CAUTION: **Refer to Fastener Caution .**

6. Using a torque wrench and the appropriate socket, alternately and evenly tighten the wheel nuts to 140 N.m (103 lb ft) in the sequence illustrated.
7. Lower the vehicle.

ALUMINUM WHEEL HUB CAP REPLACEMENT

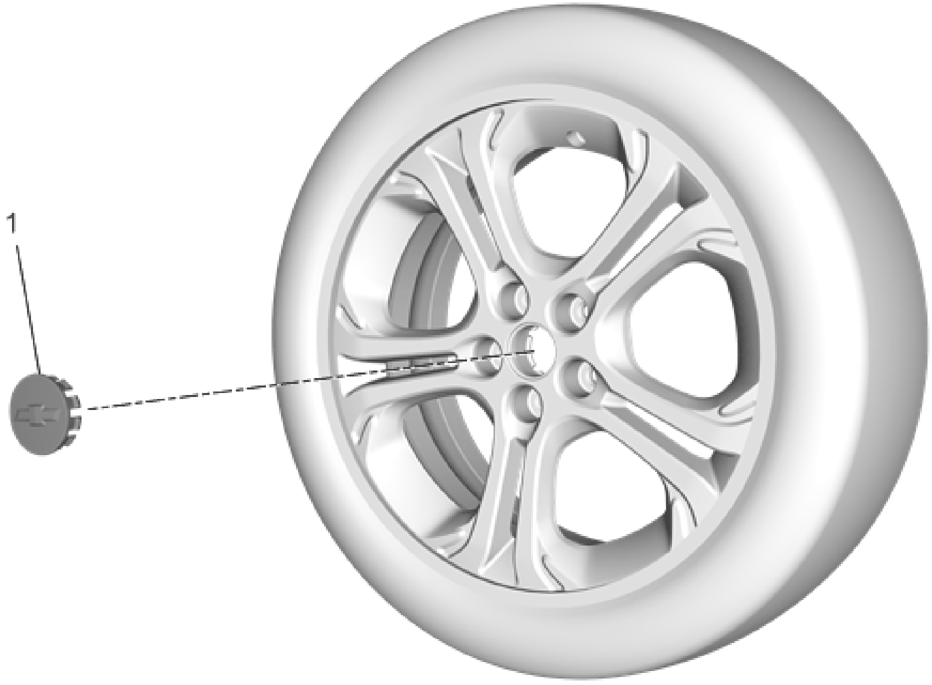


Fig. 9: Aluminum Wheel Hub/Trim Cap
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove Tire and Wheel. Refer to **Tire and Wheel Removal and Installation**	
1	Wheel Trim Cap

TIRE REPAIR

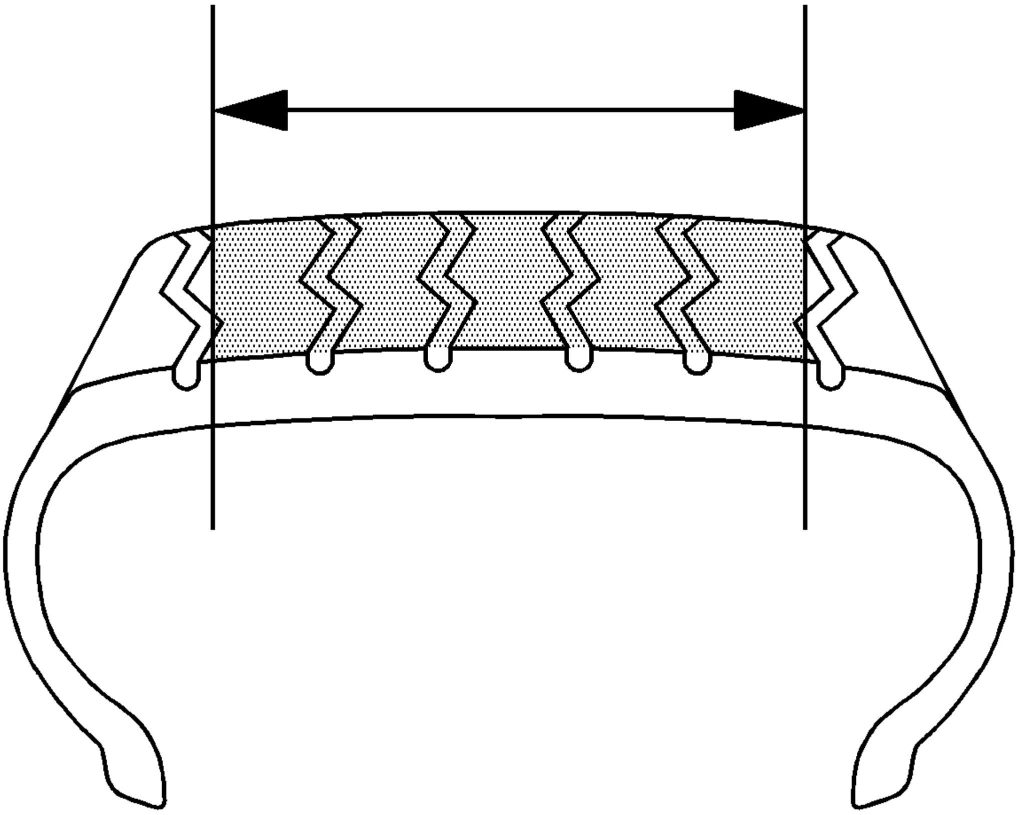


Fig. 10: Identifying Repairable Area On Radial Tire
Courtesy of GENERAL MOTORS COMPANY

WARNING:

- **Tire changing can be dangerous and should be done by trained professionals using proper tools and procedures. Always read and understand any manufacturer's warnings contained in their customers literature or molded into the tire sidewall.**
- **Serious eye and ear injury may result from not wearing adequate eye and ear protection while repairing tires.**
- **NEVER inflate beyond 275 kPa (40 pounds) pressure to seat beads.**
- **NEVER stand, lean or reach over the assembly during inflation.**

NOTE: **Repairable area on a radial tire.**

- **NEVER repair tires worn to the tread indicators 1.59 mm (2/32 in) remaining depth.**
- **NEVER repair tires with a tread puncture larger than 6.35 mm (1/4 in).**
- **NEVER substitute an inner tube for a permissible or non-permissible repair.**
- **NEVER perform an outside-in tire repair (plug only, on the wheel).**
- **Every tire must be removed from the wheel for proper inspection and repair.**
- **Regardless of the type of repair used, the repair must seal the inner liner and fill the injury.**

- **Consult with repair material supplier/manufacturer for repair unit application procedures and repair tools/repair material recommendations.**

Three basic steps for tire puncture repair:

1. Remove the tire from the wheel for inspection and repair.
2. Fill the injury (puncture) to keep moisture out.
3. Seal the inner liner with a repair unit to prevent air loss.

External Inspection

1. Prior to demounting, inspect the tire surface, the valve and the wheel for the source of the leak by using a water and soap solution. Mark the injured area and totally deflate the tire by removing the valve core.
2. Demount the tire from the wheel and place the tire on a well-lighted spreader.

Internal Inspection

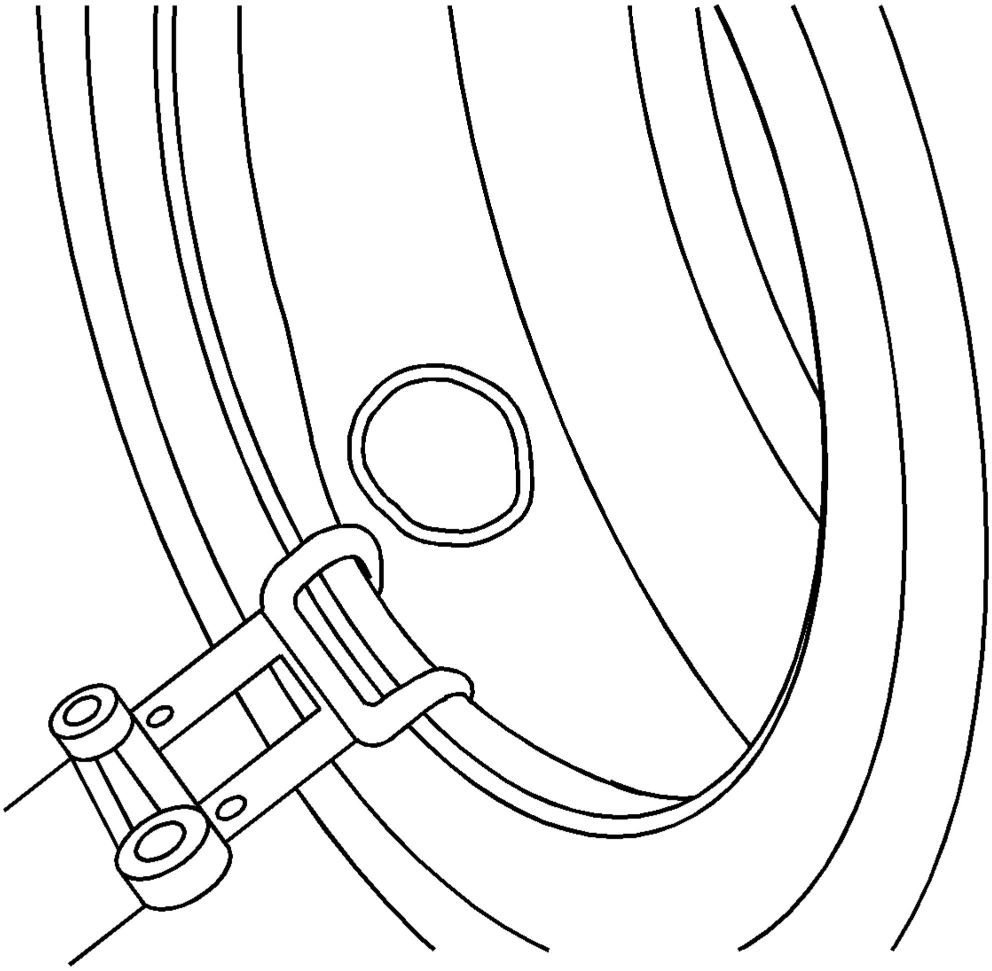


Fig. 11: Marking Tire Puncture Location
Courtesy of GENERAL MOTORS COMPANY

1. Spread the beads and mark the puncture with a tire crayon.
2. Inspect the inner tire for any signs of internal damage.
3. Remove the puncturing object, noting the direction of the penetration.
4. Probe the injury with a blunt awl in order to determine the extent and direction of the injury.
5. Remove any loose foreign material from the injury.
6. Punctures exceeding 6.35 mm (1/4 in) should not be repaired.

Cleaning

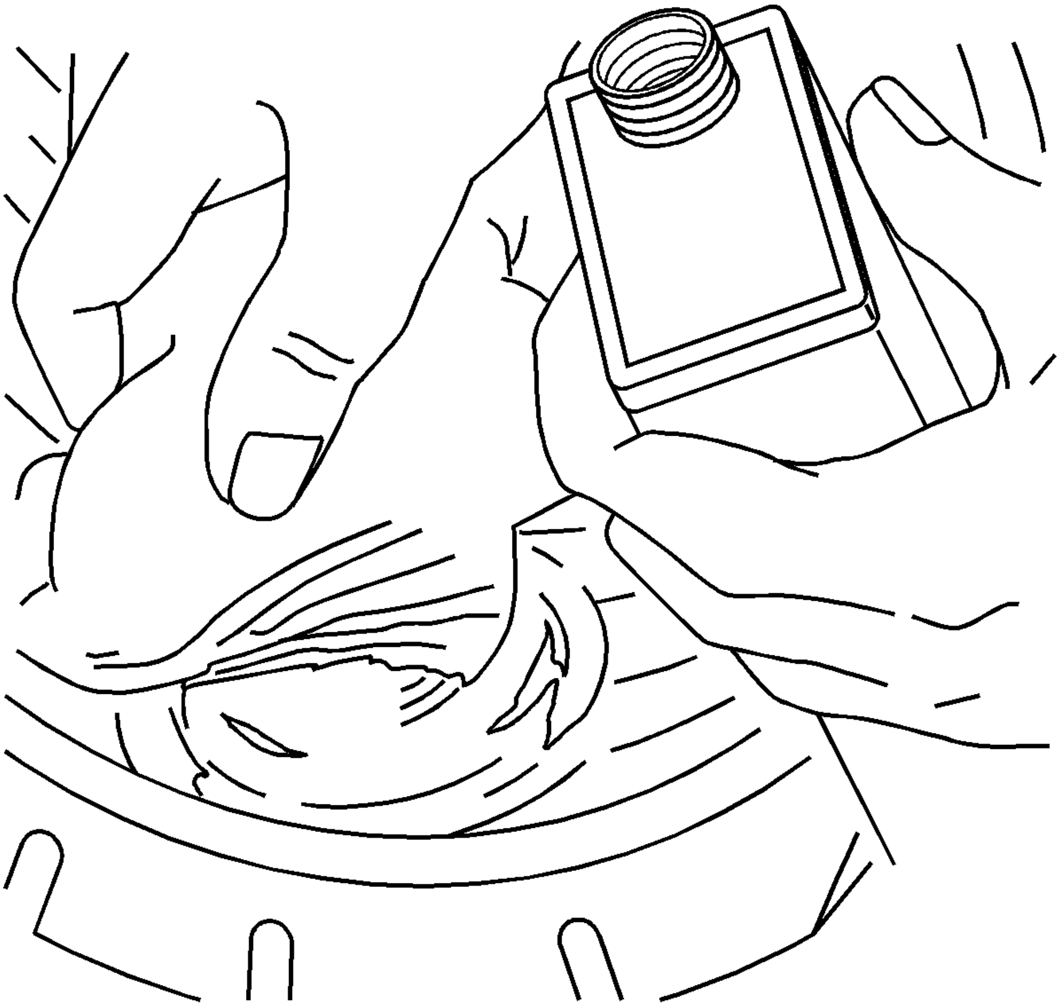


Fig. 12: Cleaning Repair Area
Courtesy of GENERAL MOTORS COMPANY

1. Clean the area around the puncture thoroughly with a proper liner cleaner, clean cloth and a scraper. This step serves to remove dirt and mold lubricants to insure proper adhesion and non-contamination of the buffing tool.
2. Refer to information on the product or manufacturer's Material Safety Data Sheet and follow guidelines for handling and disposal.

Clean the Injury Channel

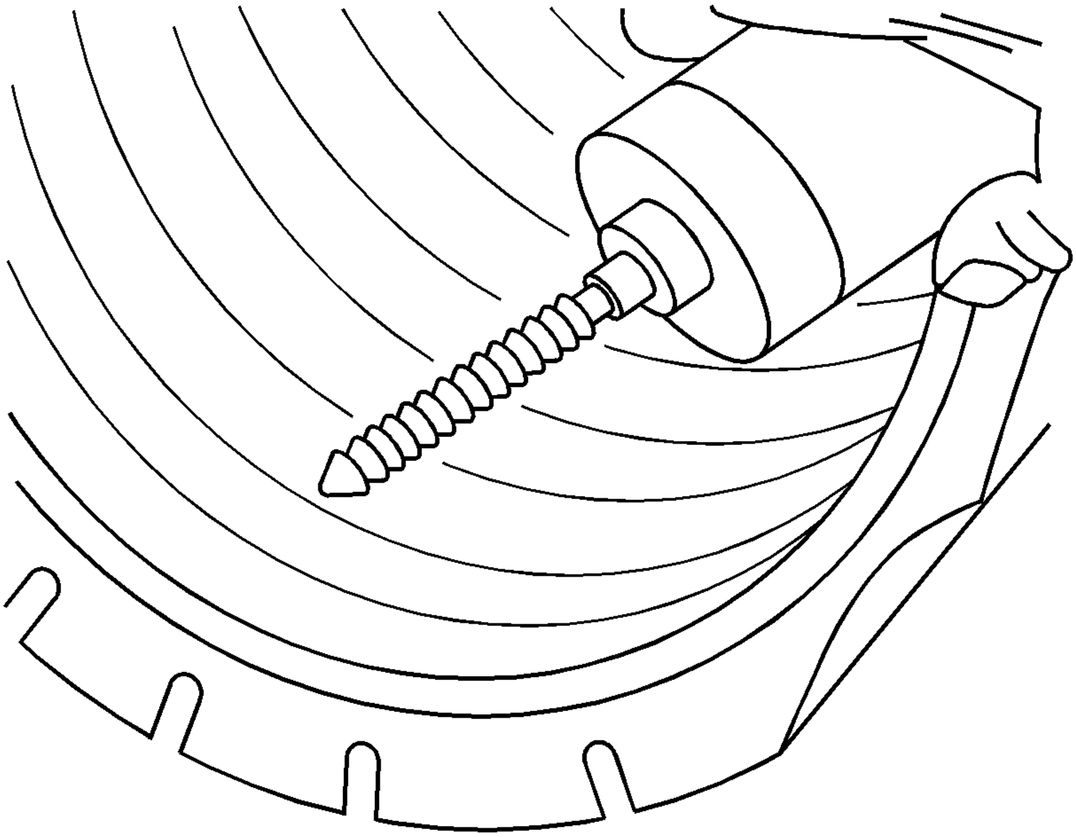


Fig. 13: Identifying Drill Bit
Courtesy of GENERAL MOTORS COMPANY

1. Use a proper hand reamer, carbide cutter or drill bit to ream the puncture channel from the inside of the tire in order to clean the injury.
2. Remove steel wires protruding above the liner surface to prevent damage to the repair unit.
3. Consult your repair material supplier for recommended reaming tool(s).

Fill the Injury

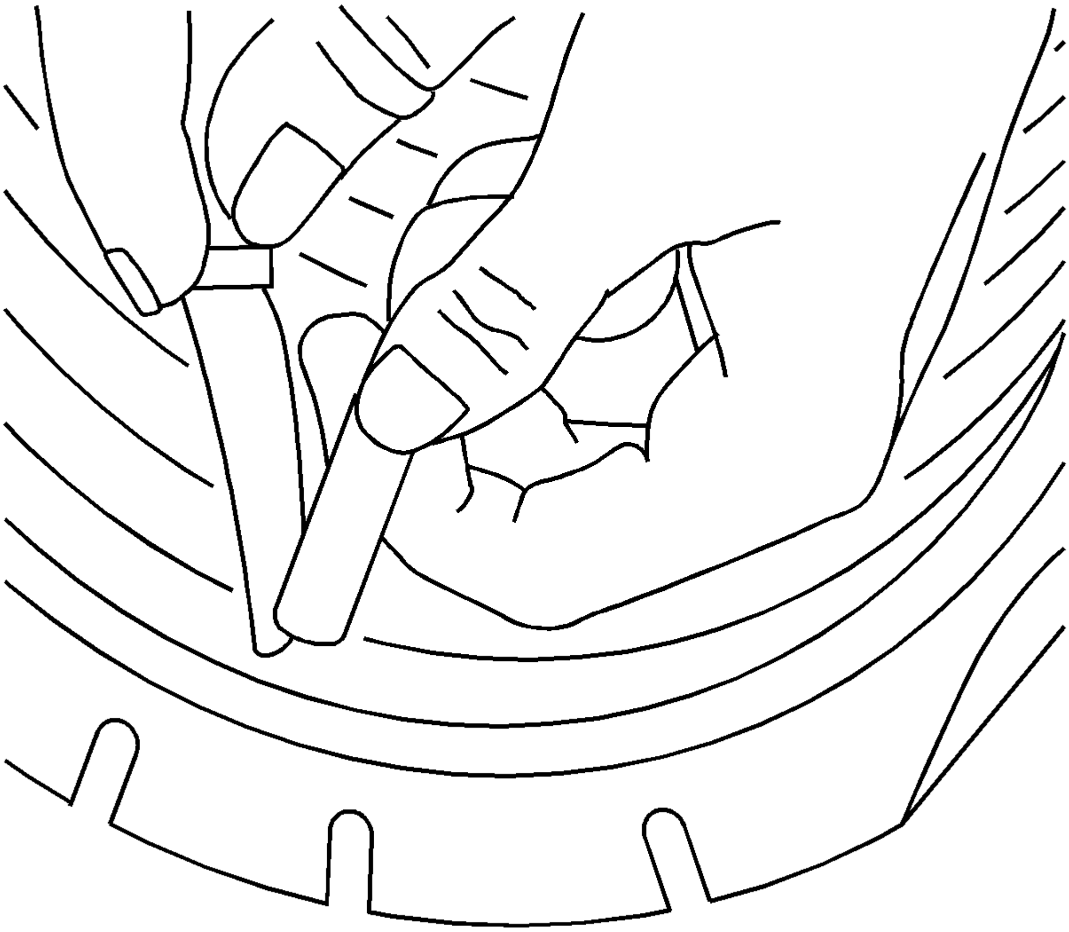


Fig. 14: Filling Injury Channel
Courtesy of GENERAL MOTORS COMPANY

1. It is necessary to fill the injury channel to provide back up for the repair unit and to prevent moisture from entering the tire fabric and steel wires.
2. For combination repair/plug units skip this step. Cement the injured channel and fill the injury from the inside of the tire with the repair plug per repair material manufacturer's recommendations. Without stretching the plug, cut the plug off just above the inside tire surface.
3. Consult your repair material supplier for proper repair material selection.

Repair Unit Selection

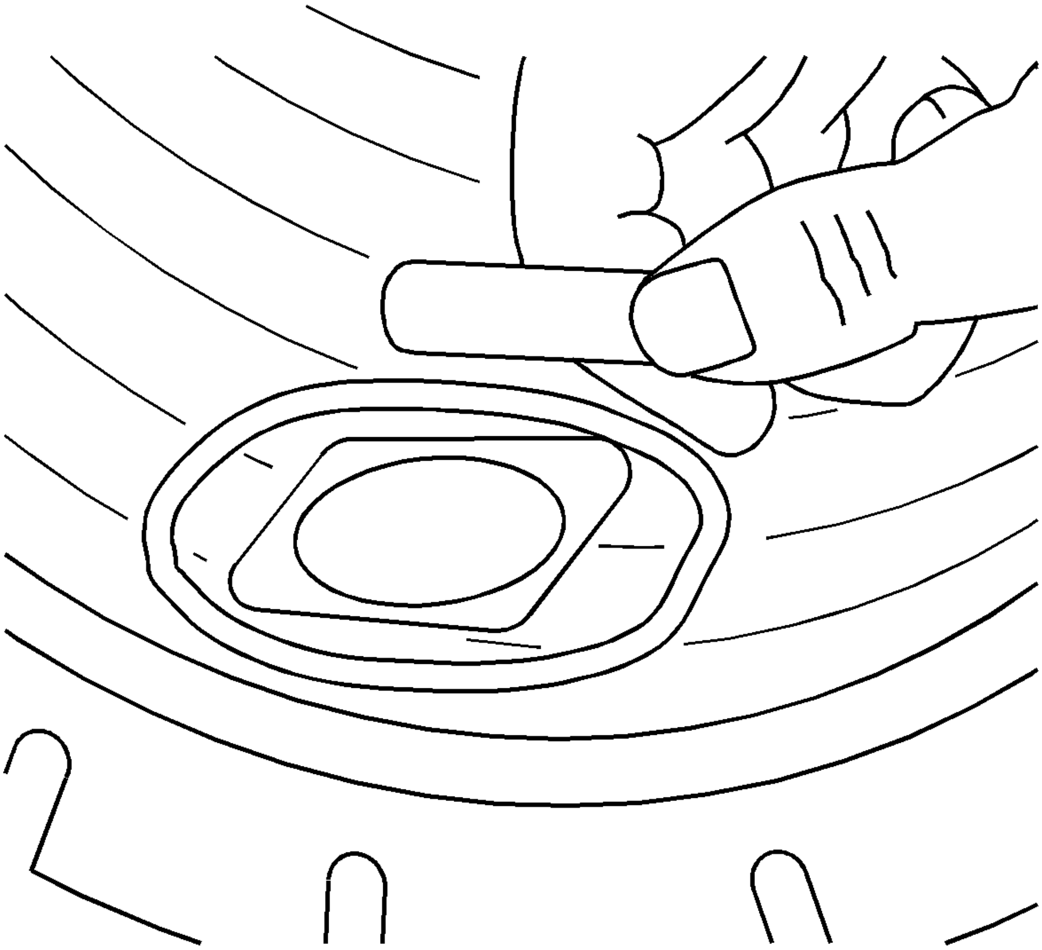


Fig. 15: Outlining Tire Injury Area
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Do not install the repair unit in this step.**

1. Center the repair unit over the injury as a reference and outline an area larger than the unit so that buffing will not remove the crayon marks.
2. Remove the repair unit.
3. DO NOT overlap previous or multiple repair units.
4. Consult your repair material supplier for proper repair unit selection.

Buffing

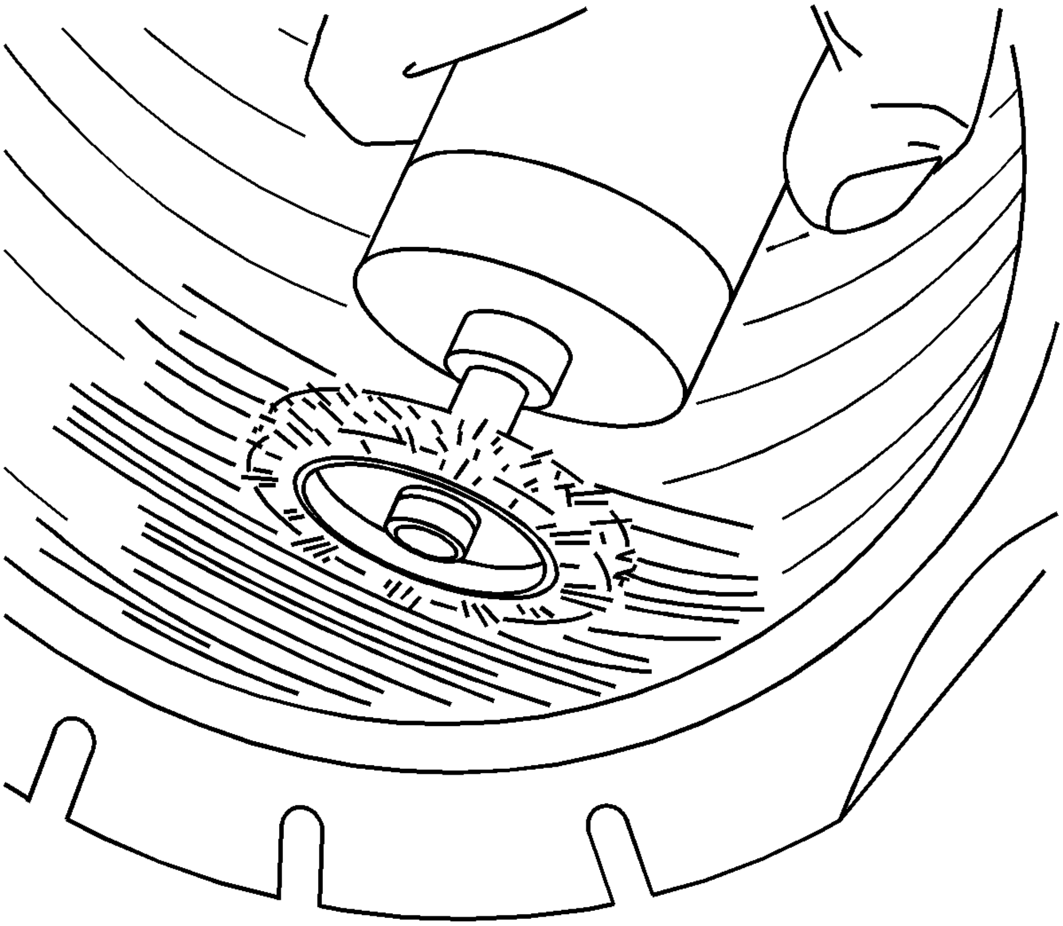


Fig. 16: Buffing Within Marked Area
Courtesy of GENERAL MOTORS COMPANY

1. To prevent contamination and preserve the outline, buff within the marked area thoroughly and evenly with a low speed buffing tool using a fine wire brush or gritted rasp.
2. Buff to a smooth velvet surface (RMA #1 or #2 buffed texture).
3. Use caution not to gouge the inner liner or expose casing fabric.
4. Remove any buffing dust with a vacuum cleaner.
5. Consult your repair material supplier for a proper buffing tool.

Cementing

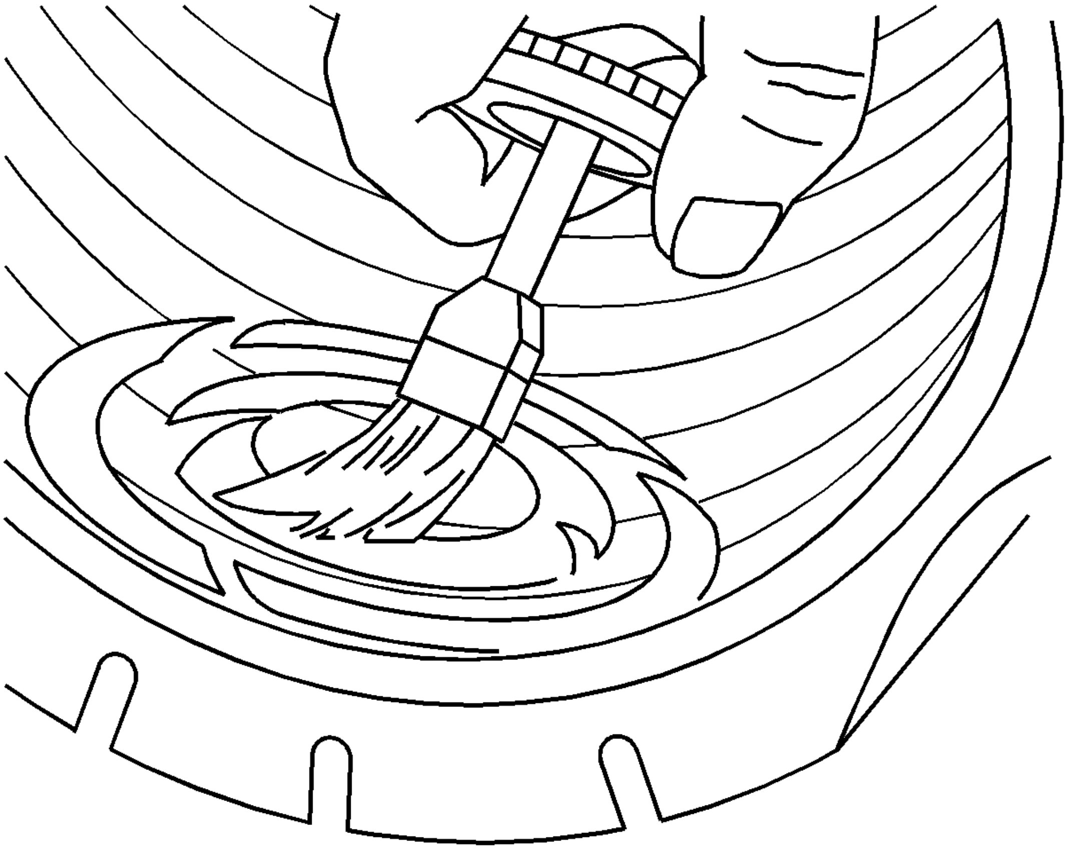


Fig. 17: Applying Chemical Cement
Courtesy of GENERAL MOTORS COMPANY

Apply chemical cement according to the repair material manufacturer's procedures.

Repair Unit Application

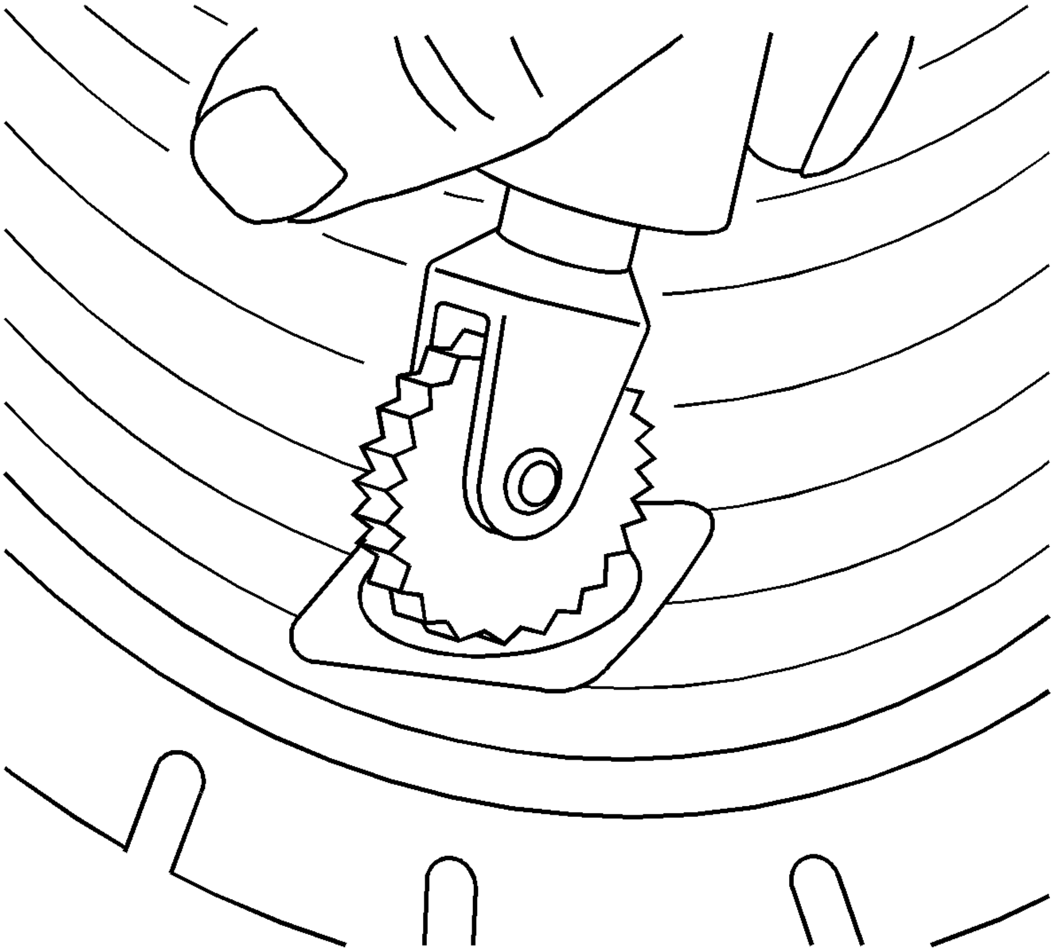


Fig. 18: Stitching Repair Unit
Courtesy of GENERAL MOTORS COMPANY

The tire must be in the relaxed position when the repair unit is installed. Do not spread the beads excessively.

Two-Piece Plug and Repair Units

1. If applicable, install the repair unit so that the alignment is correct.
2. Center the repair unit over the injury and stitch down thoroughly with the stitching tool, working from the center out.

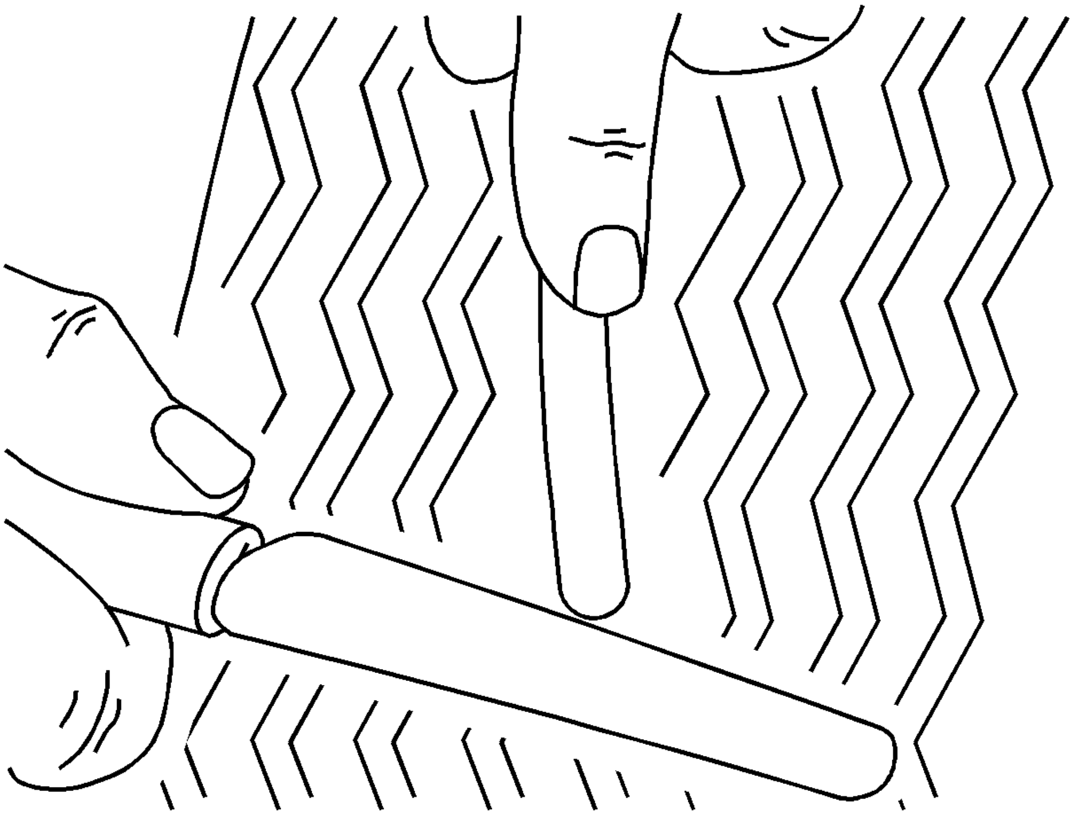


Fig. 19: Cutting Plug Material
Courtesy of GENERAL MOTORS COMPANY

3. Being careful not to stretch the plug material, cut the plug flush with the outer tread.

Combination Repair/Plug Units

1. Pull the plug through the injury until the repair just reaches the liner. Stitch down thoroughly.
2. Follow the repair material manufacturer's recommendations for further installation instructions.

   Consult your repair material supplier for the proper stitching tool.

Safety Cage

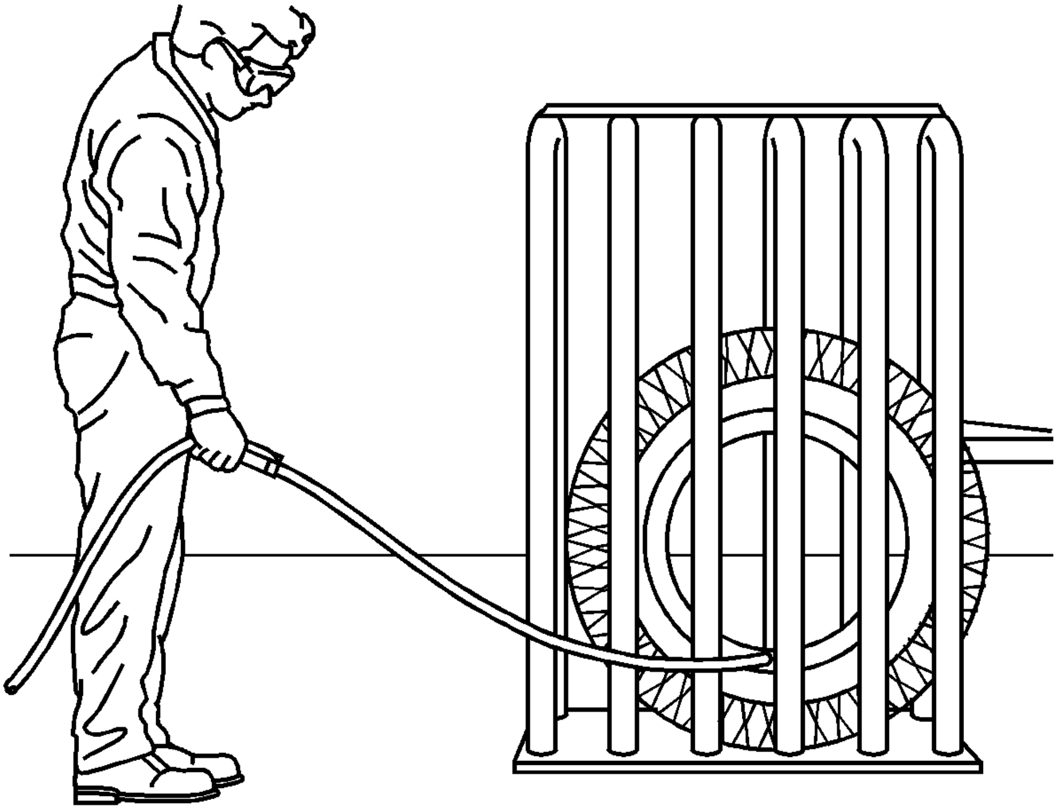


Fig. 20: Using Safety Cage
Courtesy of GENERAL MOTORS COMPANY

Some run flat tires and high performance tires may require more than 275 kPa (40 psi) to seat the bead. In such a case, a tire safety cage must be used. Consult the tire manufacturer for its individual repair policy.

Final Inspection

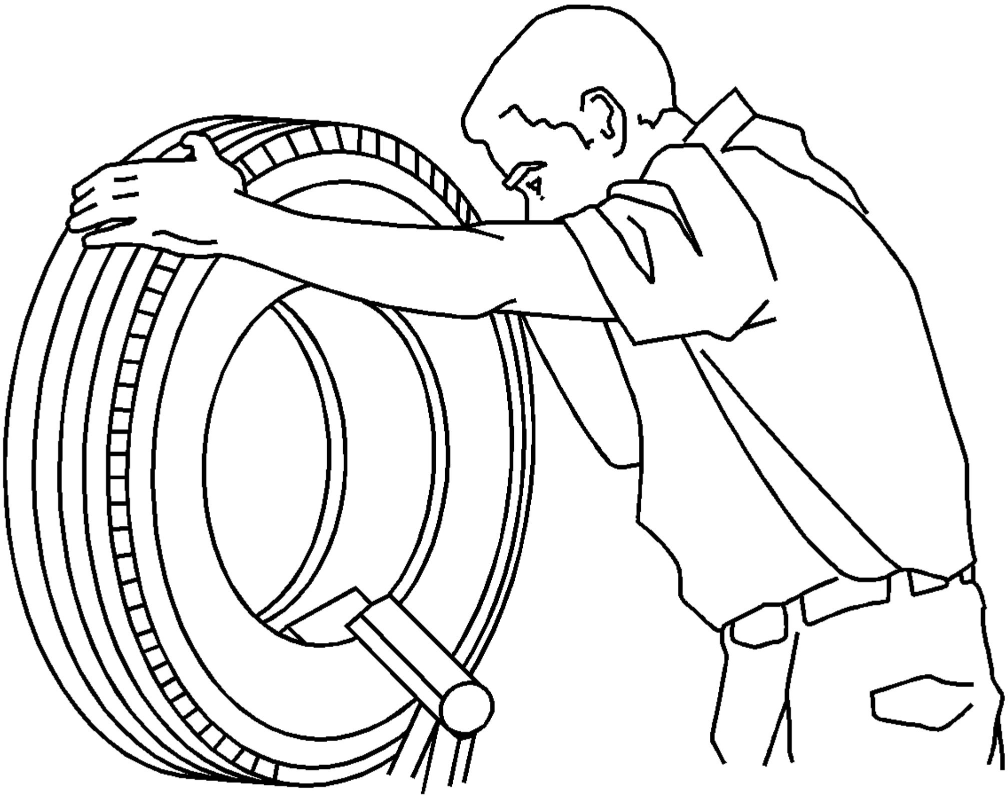


Fig. 21: Performing Final Inspection
Courtesy of GENERAL MOTORS COMPANY

1. After remounting and inflating the tire, check both beads, the repair and the valve with a water and soap solution in order to detect leaks.
2. If the tire continues to lose air, the tire must be demounted and reinspected.
3. Balance the tire and wheel assembly. Refer to Tire and Wheel Assembly Balancing - Off Vehicle .

For additional tire puncture repair information, contact:

Rubber Manufacturers Association (RMA)

1400 K Street, N.W., Suite 900

Washington

DC

20005-2403

Telephone: 202-682-4800

E-mail: info@rma.org

Website: www.rma.org

TIRE DISMOUNTING AND MOUNTING

CAUTION: **Use a tire changing machine in order to dismount tires. Do not use hand tools or tire irons alone in order to remove the tire from the wheel. Damage to the tire beads or the wheel rim could result.**

CAUTION: **Do not scratch or damage the clear coating on aluminum wheels with the tire changing equipment. Scratching the clear coating could cause the aluminum wheel to corrode and the clear coating to peel from the wheel.**

CAUTION: **Damage to either the tire bead or the wheel mounting holes can result from the use of improper wheel attachment or tire mounting procedures. It takes up to 70 seconds for all of the air to completely exhaust from a large tire. Failure to follow the proper procedures could cause the tire changer to put enough force on the tire to bend the wheel at the mounting surface. Such damage may result in vibration and/or shimmy, and under severe usage lead to wheel cracking.**

1. Deflate the tire completely.
2. Use the tire changer in order to remove the tire from the wheel.
3. Use a wire brush or coarse steel wool in order to remove any rubber, light rust or corrosion from the wheel bead seats.

CAUTION: **When mounting the tires, use an approved tire mounting lubricant. DO NOT use silicon or corrosive base compounds to lubricate the tire bead and the wheel rim. A silicon base compound can cause the tire to slip on the rim. A corrosive type compound can cause tire or rim deterioration.**

4. Apply an approved lubricant to the tire bead and the wheel trim.
5. Use the tire changer in order to install the tire to the wheel.

WARNING: **To avoid serious personal injury, do not stand over tire when inflating. The bead may break when the bead snaps over the safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat the beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.**

6. Inflate the tire to the proper air pressure.
7. Ensure that the locating rings are visible on both sides of the tire in order to verify that the tire bead is fully seated on the wheel.

TIRE AND WHEEL BALANCING

WARNING: **Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:**

- **Clean away any dirt or deposits from the inside of the wheels.**
- **Remove any stones from the tread.**
- **Wear eye protection.**
- **Use coated weights on aluminum wheels.**

Tire and Wheel Assembly Balancer Calibration

Tire and wheel balancers can drift out of calibration over time, or can become inaccurate as a result of heavy use. There will likely not be any visual evidence that a calibration problem exists. If a balancer is not calibrated within specifications, and a tire and wheel assembly is balanced on that machine, the assembly may actually be imbalanced.

Tire and wheel assembly balancer calibration should be checked approximately every 2 weeks, if the machine is used frequently, and/or whenever the balance readings are questionable.

Tire and Wheel Assembly Balancer Calibration Test

NOTE: **If the balancer fails any of the steps in this calibration test, the balancer should be calibrated according to the manufacturer's instructions. If the balancer cannot be calibrated, contact the manufacturer for assistance.**

Inspect the calibration of the tire and wheel assembly balancer according to the manufacturer's recommendations, or perform the following test.

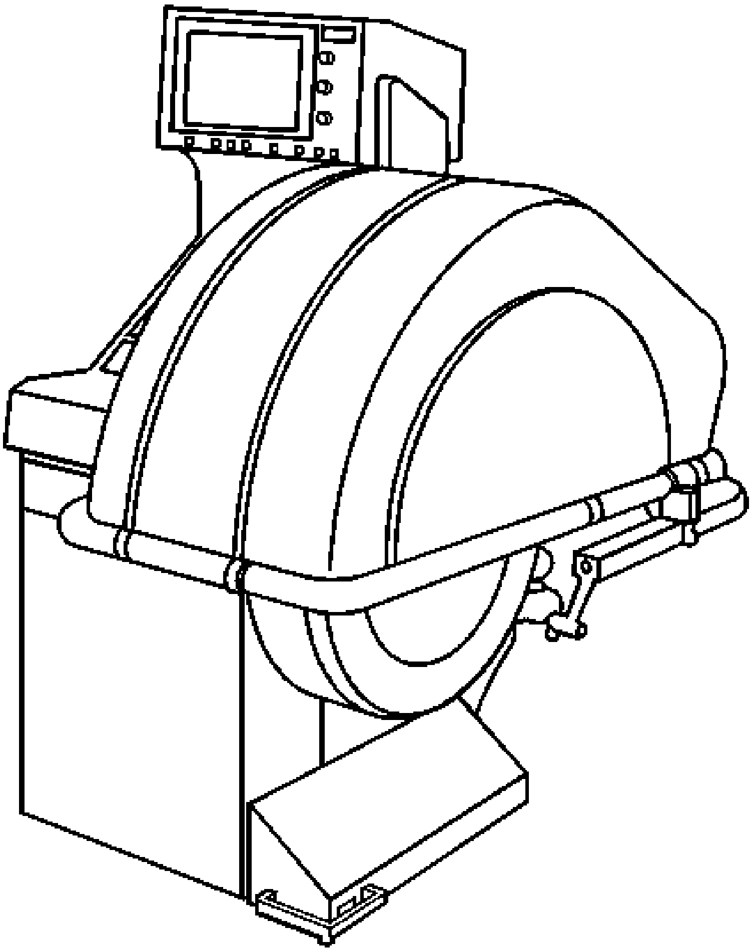


Fig. 22: Tire And Wheel Assembly Balancer
Courtesy of GENERAL MOTORS COMPANY

1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.

   Specification

   Zero within 7 g (1/4 oz)

3. If the balancer is within the specification range, balance a tire and wheel assembly - that is within radial and lateral runout tolerances - to ZERO, using the same balancer.
4. After the tire and wheel assembly has been balanced, add an 85 g (3 oz) test weight to the wheel at any location.
5. Spin the tire and wheel assembly again. Note the readings.
   - In the static and dynamic modes, the balancer should call for 85 g (3 oz) of weight, 180 degrees opposite the test weight.
   - In the dynamic mode, the weight should be called for on the flange of the wheel opposite the test weight.
6. With the assembly imbalanced to 85 g (3 oz), cycle the balancer 5 times.
7. Inspect the balancer readings:

Specification

Maximum variation: 7 g (1/4 oz)

8. Index the tire and wheel assembly on the balancer shaft, 90 degrees from the previous location.
9. Cycle the balancer with the assembly at the new location.
10. Inspect the balancer readings:

    Specification

    Maximum variation: 7 g (1/4 oz)

11. Repeat steps 8 through 10 until the tire and wheel assembly has been cycled and checked at each of the 4 locations on the balancer shaft.

Tire and Wheel Assembly Balancing Guidelines

NOTE: **Tire and wheel assemblies which exhibit excessive runout can produce vibrations even if the assemblies are balanced.**

It is strongly recommended that the tire and wheel assembly runout be measured and corrected if necessary BEFORE the assemblies are balanced.

If the runout of the tire and wheel assemblies has not yet been measured, refer to Tire and Wheel Assembly Runout Measurement - Off Vehicle before proceeding.

There are 2 types of tire and wheel balance:

Static Balance

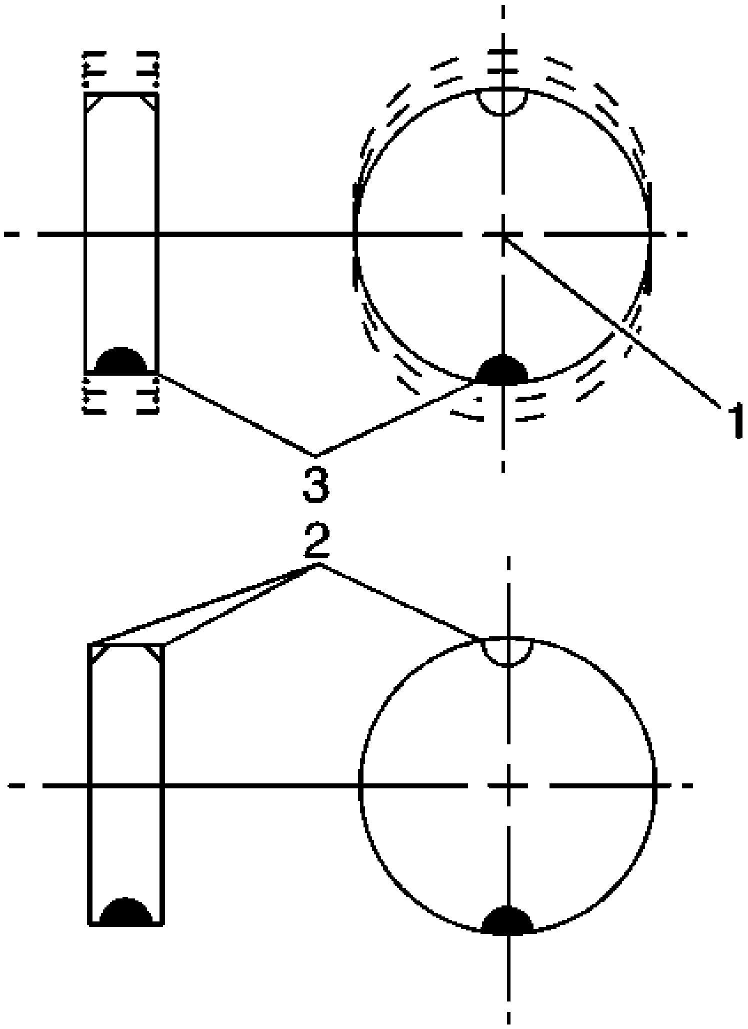


Fig. 23: Static Balance
Courtesy of GENERAL MOTORS COMPANY

Static balance is the equal distribution of weight around the wheel circumference. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have static imbalance can produce a bouncing action called tramp.

Dynamic Balance

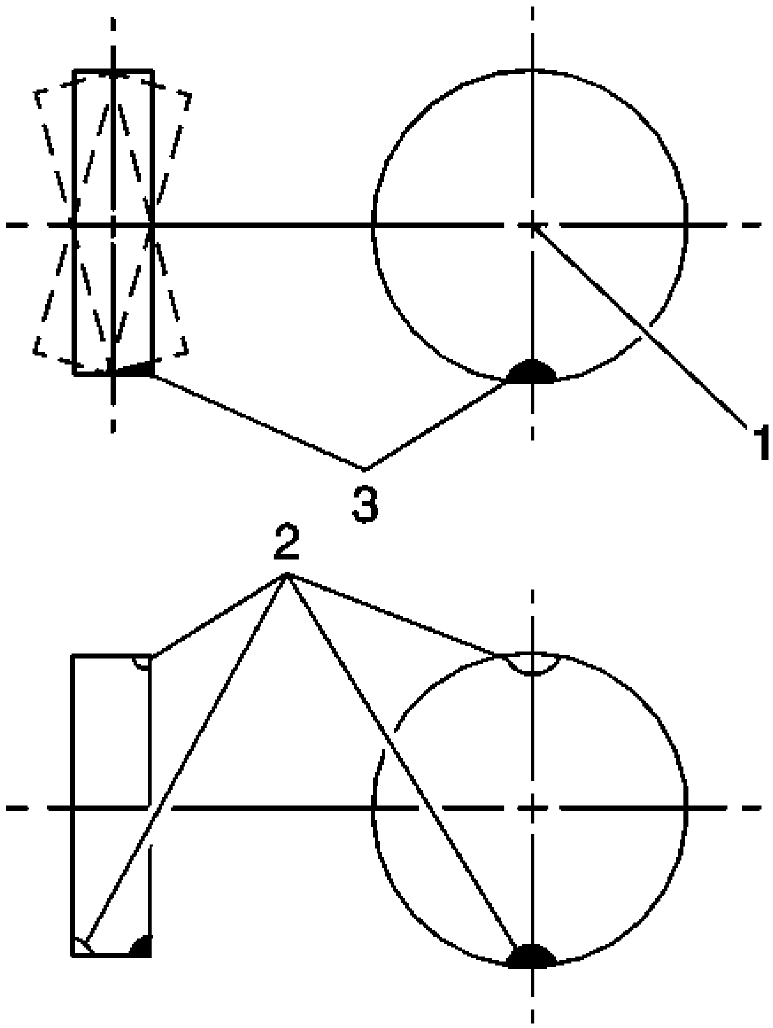


Fig. 24: Dynamic Balance
Courtesy of GENERAL MOTORS COMPANY

Dynamic balance is the equal distribution of weight on each side of the tire and wheel assembly centerline. The wheel balance weights (2) are positioned on the wheel in order to offset the effects of a heavy spot (3). Wheels that have dynamic imbalance have a tendency to move from side to side and can cause an action called shimmy.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance; however, vehicles equipped with low profile, wide tread path, high performance tires and wheels are susceptible to small amounts of dynamic imbalance. As little as 14 - 21 g (1/2 - 3/4 oz) imbalance is capable of inducing a vibration in some vehicle models.

Balancing Procedure

NOTE: **When balancing tire and wheel assemblies, use a known good, recently calibrated, off-vehicle, two-plane dynamic balancer set to the finest balance mode available.**

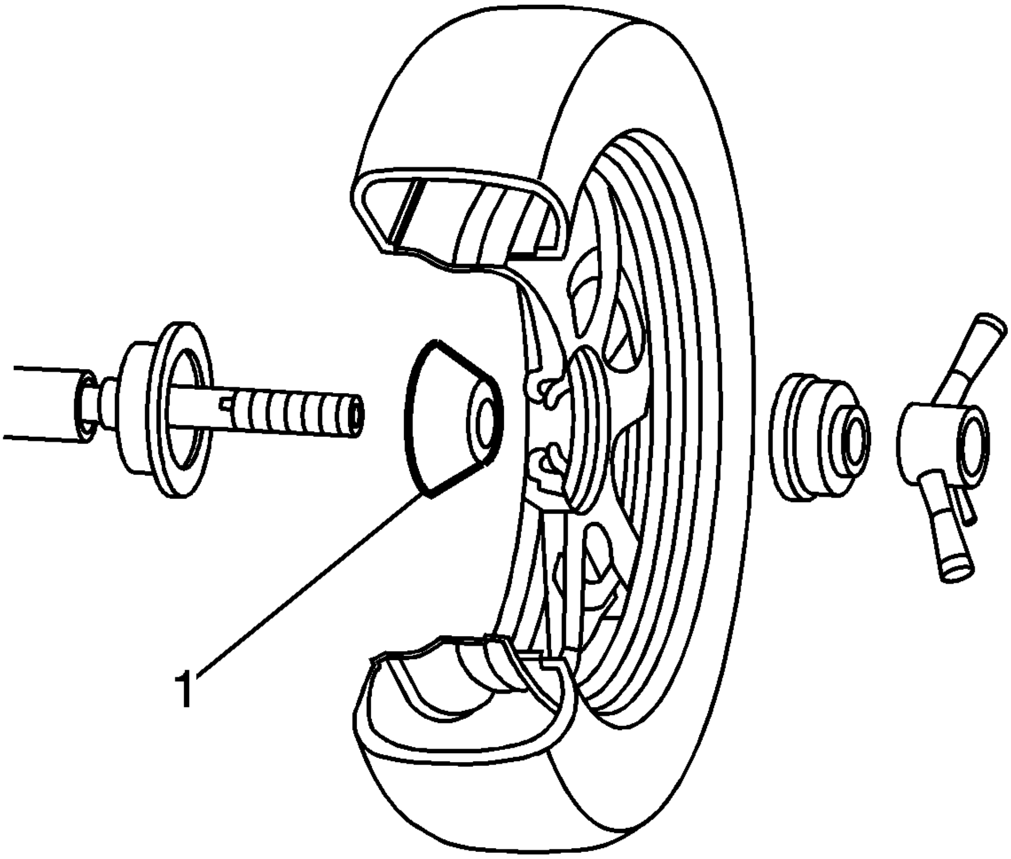


Fig. 25: Wheel Balancer Center Cone
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Carefully follow the wheel balancer manufacturers's instructions for proper mounting of the center cone (1).**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Mark the location of the wheels to the wheel studs and mark the specific vehicle position on each tire and wheel - LF, LR, RF, RR.
3. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. Refer to **Tire and Wheel Removal and Installation**
4. Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels.

   Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting concerns.

5. Be sure to use the correct type of wheel balance weights for the type of wheel rim being balanced. Be sure to use the correct type of coated wheel balance weights on aluminum wheels. Refer to Wheel Weight Usage.
6. Balance all four tire and wheel assemblies as close to zero as possible.
7. Using the matchmarks made prior to removal, install the tire and wheel assemblies to the vehicle. Refer to **Tire and Wheel Removal and Installation**
8. Lower the vehicle.

Wheel Weight Usage

Tire and wheel assemblies can be balanced using either the static or dynamic method.

Clip-on Weights

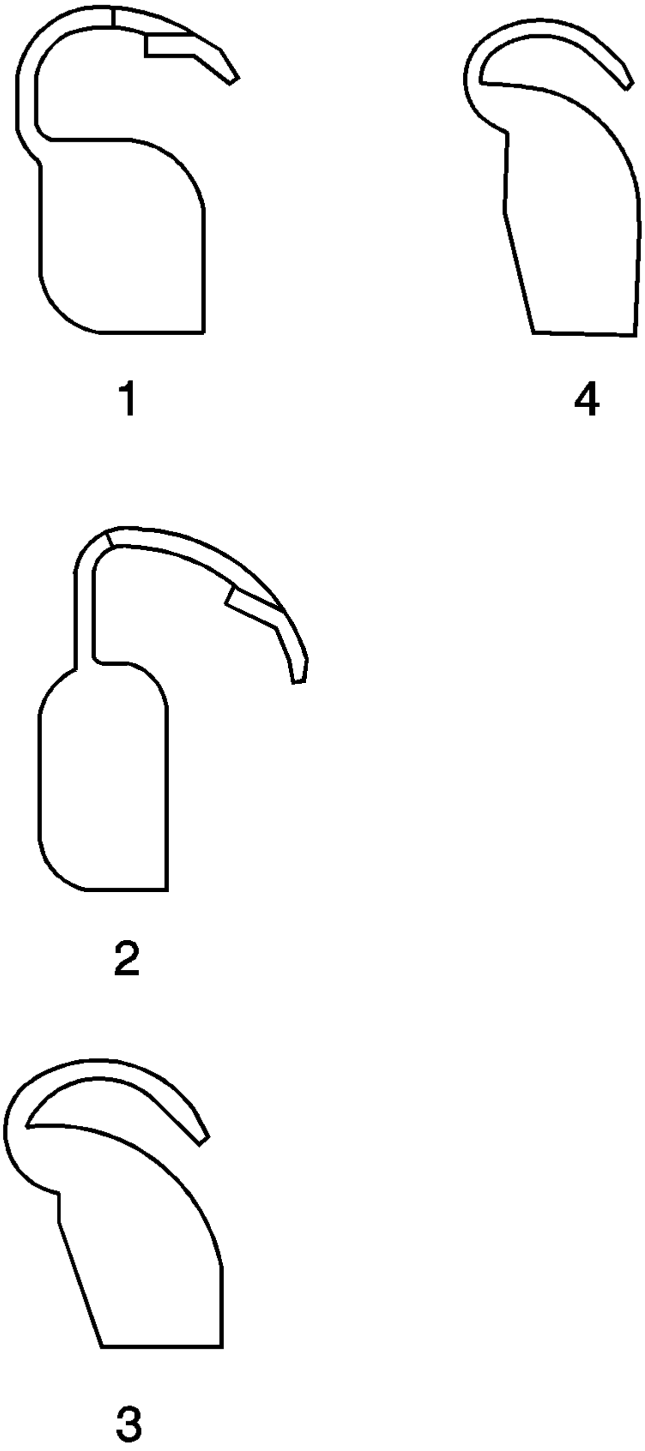


Fig. 26: Identifying Clip-On Wheel Weight Types
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When balancing factory aluminum wheels with clip-on wheel balance weights, be sure to use special polyester-coated weights. These coated weights reduce the potential for corrosion and damage to aluminum wheels.**

These coated weights reduce the potential for corrosion and damage to aluminum wheels.

- MC (1) and AW (2) series weights are approved for use on aluminum wheels.
- P (3) series weights are approved for use on steel wheels only.
- T (4) series coated weights are approved for use on both steel and aluminum wheels.

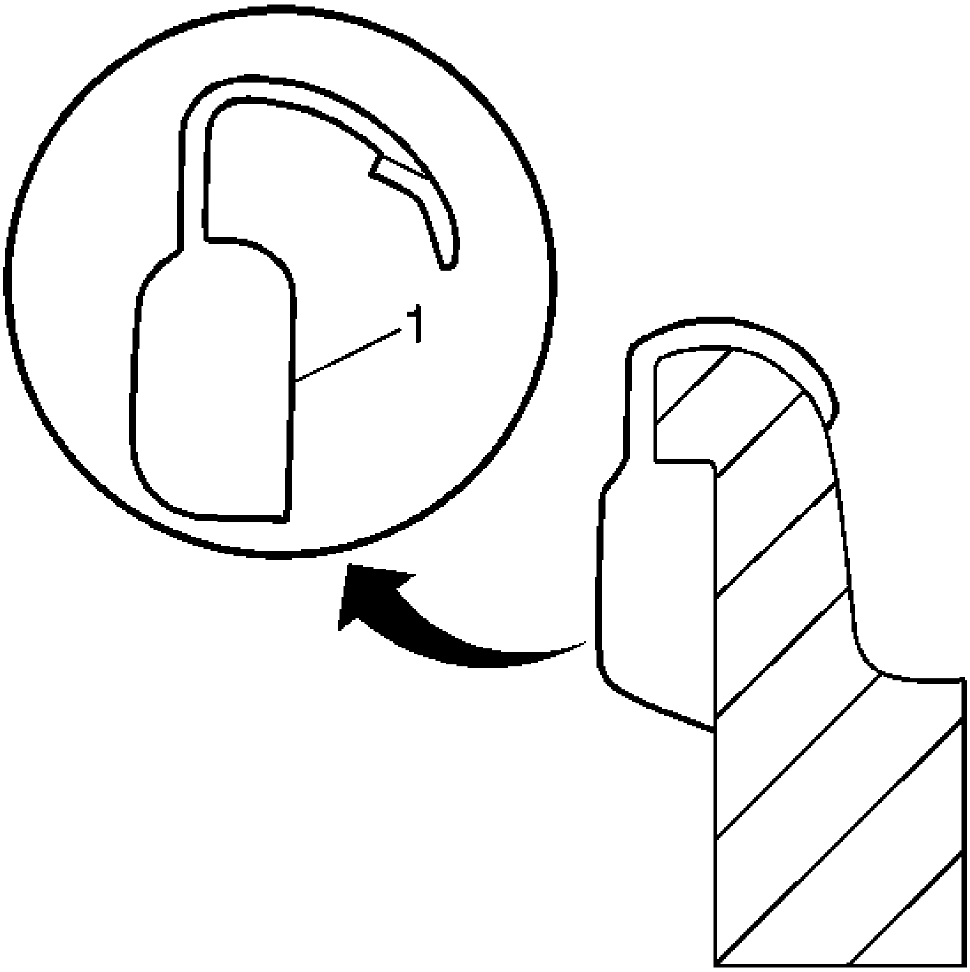


Fig. 27: Attaching Clip-On Wheel Weight
Courtesy of GENERAL MOTORS COMPANY

NOTE: **Use a nylon or plastic-tipped hammer when installing coated clip-on wheel balance weights to minimize the possibility of damage to the polyester coating.**

The contour and style of the wheel rim flange will determine which type of clip-on wheel weight (1) should be used. The weight should follow the contour of the rim flange. The weight clip should firmly grip the rim flange.

Wheel Weight Placement - Clip-on Weights

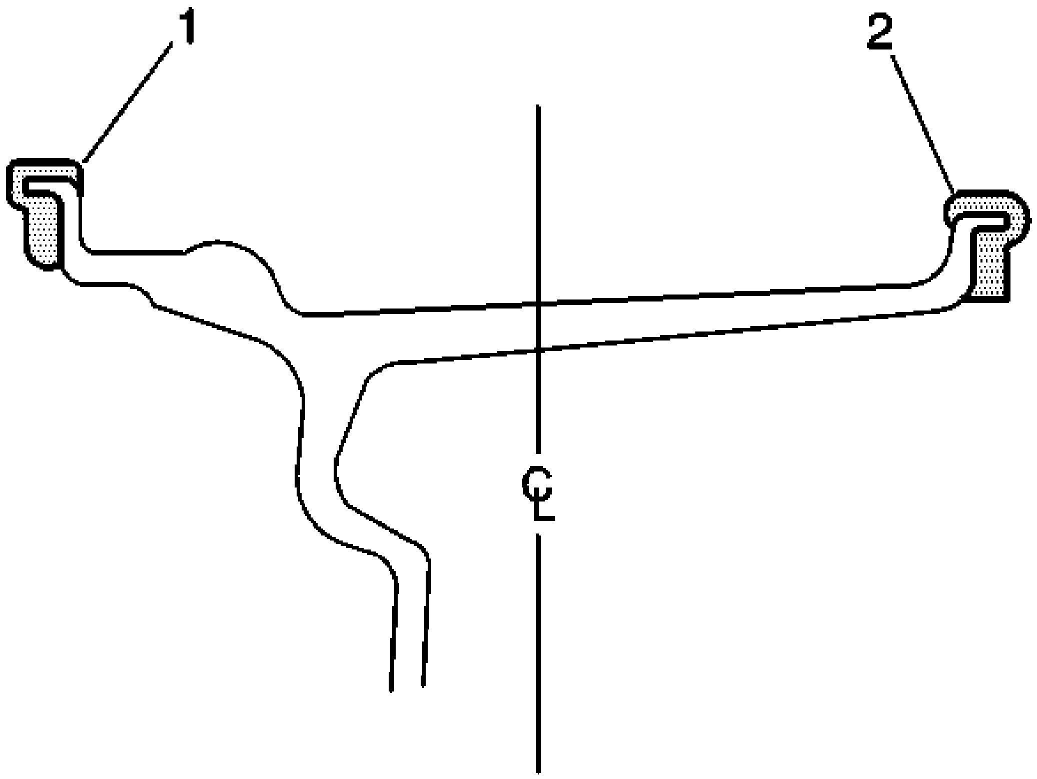


Fig. 28: Clip-On Wheel Weight Placement
Courtesy of GENERAL MOTORS COMPANY

When static balancing, locate the wheel balance weights on the inboard flange (2) if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the inboard (2) and outboard (1) flanges.

When dynamic balancing, locate the wheel balance weights on the inboard (2) and outboard (1) rim flanges at the positions specified by the wheel balancer.

Adhesive Weights

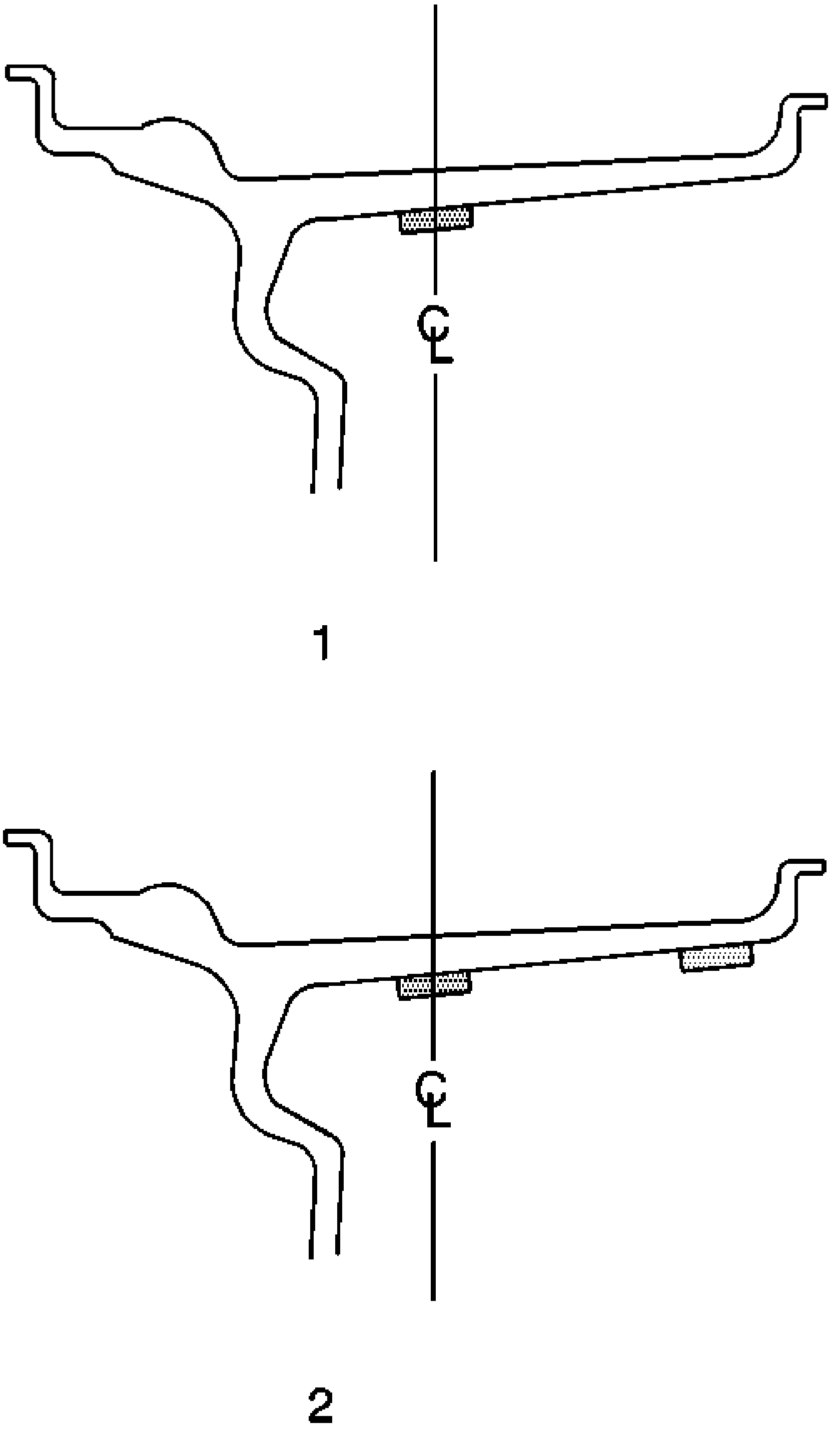


Fig. 29: Adhesive Wheel Weight Placement
Courtesy of GENERAL MOTORS COMPANY

NOTE: **When installing adhesive balance weights on flangeless wheels, do NOT install the weight on the outboard surface of the rim.**

Adhesive wheel balance weights may be used on factory aluminum wheels. Perform the following procedure to install adhesive wheel balance weights.

1. Determine the correct areas for placement of the wheel weights on the wheel.
   - When static balancing, locate the wheel balance weights along the wheel centerline (1) on the inner wheel surface if only 28 g (1 oz) or less is called for. If more than 28 g (1 oz) is called for, split the weights as equally as possible between the wheel centerline and the inboard edge of the inner wheel surface (2).
   - When dynamic balancing, locate the wheel balance weights along the wheel centerline and the inboard edge of the inner wheel surface (2) at the positions specified by the wheel

balancer.

2. Ensure that there is sufficient clearance between the wheel weights and brake system components.

NOTE: **Do not use abrasives to clean any surface of the wheel.**

3. Using a clean cloth or paper towel with a general purpose cleaner, thoroughly clean the designated balance weight attachment areas of any corrosion, overspray, dirt or any other foreign material.
4. To ensure there is no remaining residue, wipe the balance weight attachment areas again, using a clean cloth or paper towel with a mixture of half isopropyl alcohol and half water.
5. Dry the attachment areas with hot air until the wheel surface is warm to the touch.
6. Warm the adhesive backing on the wheel balance weights to room temperature.
7. Remove the protective covering from the adhesive backing on the back of the balance weights. DO NOT touch the adhesive surface.
8. Apply the wheel balance weights to the wheel, press into place with hand pressure.
9. Secure the wheel balance weights to the wheel with a 90 N (21 lb) force applied with a roller.

DESCRIPTION AND OPERATION

GENERAL DESCRIPTION

The factory installed tires are designed to operate satisfactorily with loads up to and including the full rated load capacity when these tires are inflated to the recommended pressures.

The following factors have an important influence on tire life:

- Correct tire pressures
- Correct wheel alignment
- Proper driving techniques
- Tire rotation

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

P-METRIC SIZED TIRES DESCRIPTION

The tire sidewall has a coded marking system, which provides information about the tire.

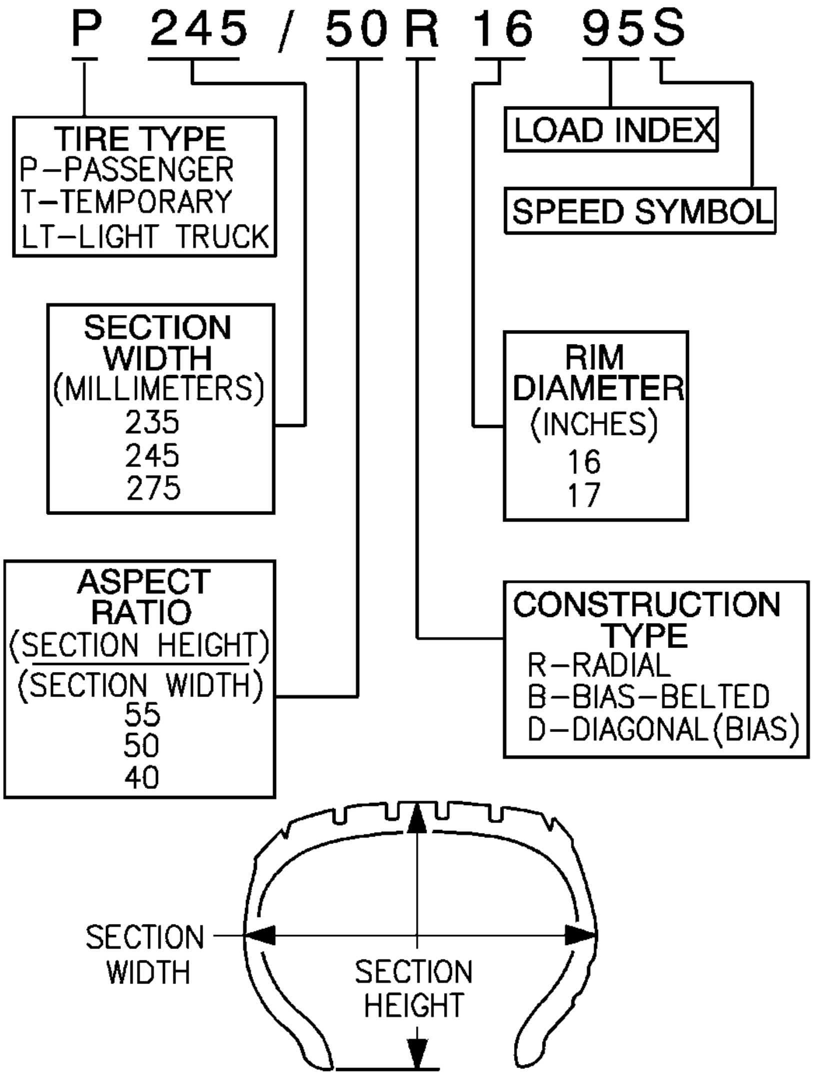

P 245 / 50 R 16 95S
TIRE TYPE
P–PASSENGER
T–TEMPORARY
LT–LIGHT TRUCK
SECTION WIDTH (MILLIMETERS)
235
245
275
ASPECT RATIO
(SECTION HEIGHT) / (SECTION WIDTH)
55
50
40
LOAD INDEX
SPEED SYMBOL
RIM DIAMETER (INCHES)
16
17
CONSTRUCTION TYPE
R–RADIAL
B–BIAS–BELTED
D–DIAGONAL (BIAS)
SECTION WIDTH
SECTION HEIGHT

Fig. 30: Identifying P-Metric Sized Tires Description
Courtesy of GENERAL MOTORS COMPANY

Tire Marking Example:		
P 245 50 R 16 95 S		
P	Passenger Vehicle Designation	
245	Section Width in mm (245 mm)	
50	Aspect Ratio % (Section Height to Section Width) (50 = 50%)	
R	Tire Construction (R = Radial)	
16	Rim Diameter in inches (16 = 16")	
95	Max Load Index	91 = 615 kg
		92 = 630 kg
		93 = 650 kg
		94 = 670 kg
		95 = 690 kg
		96 = 710 kg
		97 = 730 kg
		99 = 775 kg
		104 = 900 kg
		106 = 950 kg
S	Speed Rating	R = 170 km/h

	Tire Marking Example:	
		S = 180 km/h
		H = 210 km/h
		V = 240 km/h
		W = 270 km/h

Most P-metric tire sizes do not have exact corresponding alphanumeric tire sizes. Replacement tires should be of the same tire performance criteria TPC specification number including the same size, the same load range, and the same construction as those originally installed on the vehicle.

Consult a tire dealer if you must replace the P-metric tire with other sizes. Tire companies can best recommend the closest match of alphanumeric to P-metric sizes within their own tire lines.

The above illustration may not correspond with your vehicle, but is meant as an example.

REPLACEMENT WHEELS DESCRIPTION

Replace the wheel if any of the following conditions exist:

- The wheel exhibits excessive runout.
- The wheel is bent.
- The wheel is cracked.
- The wheel is severely rusted.
- The wheel is severely corroded.

NOTE: **Air leaks caused by porosity on aluminum wheels are repairable.**

- The wheel leaks air.

WARNING: **If you are replacing the wheel(s), the wheel stud(s), the wheel nut(s) or the wheel bolt(s), install only new GM original equipment parts. Installation of used parts or non-GM original equipment parts may cause the wheel to loosen, loss of tire air pressure, poor vehicle handling and loss of vehicle control resulting in personal injury.**

CAUTION: **The use of non-GM original equipment wheels may cause:**

- **Damage to the wheel bearing, the wheel fasteners and the wheel**
- **Tire damage caused by the modified clearance to the adjacent vehicle components**
- **Adverse vehicle steering stability caused by the modified scrub radius**
- **Damage to the vehicle caused by the modified ground clearance**
- **Speedometer and odometer inaccuracy**

Replace the wheel, the wheel studs and the wheel nuts, if any of the following conditions exist:

- The wheel has elongated wheel stud holes.
- The wheel nuts loosen repeatedly.

TIRE INFLATION DESCRIPTION

This vehicle has been engineered to operate up to the stated load capacity with wheel and tire assemblies of the type, size, construction, and configuration as originally installed. Maintenance of the tire inflation pressures is critical to the continued satisfactory performance, handling, and operating economy of the vehicle.

Operating the vehicle with improperly inflated tires can adversely affect vehicle performance and may contribute to the following:

- Reduced fuel economy
- Tire overloading
- Shortened tire life
- Excessive tire wear
- Uneven tire wear
- Vehicle handling concerns

Inspect the tire pressures when the vehicle has not been driven for at least 3 hours or not more than 1.6 km (1 mi) and when the tires are cool to the touch.

Tire inflation pressures should be inspected monthly and before an extended trip and adjusted to meet the specifications listed for the particular vehicle. Replace any missing or damaged tire valve stem extensions and/or caps to prevent the intrusion of water and contaminates.

One pound per square inch (psi) equals 6.9 kilopascals (kPa). The following table illustrates the conversion of kilopascals to pounds per square inch:

Inflation Pressure Conversion (Kilopascals to PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60
Conversion: 6.9 kPa = 1 psi			

For the correct inflation pressures refer to the vehicle Tire Placard.

Tires inflated to a higher than recommended pressure can contribute to the following conditions:

- A hard ride
- Tire bruising
- Rapid tread wear at the center of the tire

Tires inflated to a lower than recommended pressure can contribute to the following conditions:

- Tire squeal on turns
- Hard steering
- Rapid and/or uneven wear on the outer edges of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Sluggish vehicle handling
- Higher fuel consumption

Unequal pressure on the same axle can cause the following conditions:

- Uneven braking action

- Steering lead
- Imprecise vehicle handling

Back To Article

2017 SUSPENSION

Wheel Alignment - Bolt EV

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS

Alignment Condition: Full tank of fuel, no passengers and placed on flat level surface.

Front Wheel Alignment Specification

	Caster		Cross Caster (L - R)	Camber		Cross Camber (L - R)	Total Toe (L+R)	Steering Wheel Angle
Model	Left	Right		Left	Right			
All	5.50Â° Â± 0.75Â°	5.50Â° Â± 0.75Â°	Â± 0.75Â°	-0.55Â° Â± 0.75	-0.55Â° Â± 0.75	Â± 0.75Â°	0.02Â° Â± 0.20Â°	0.00Â° Â± 2.50Â°

Rear Wheel Alignment Specification

	Caster		Cross Caster (L - R)	Camber		Cross Camber (L - R)	Total Toe (L+R)	Thrust Angle
Model	Left	Right		Left	Right			
All	-	-	-	-1.40Â° Â± 0.50	-1.40Â° Â± 0.50	Â± 0.75Â°	0.20Â° Â± 0.35Â°	0.00Â° Â± 0.30Â°

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Steering Linkage Inner Tie Rod Nut	75 N.m (55 lb ft)

REPAIR INSTRUCTIONS

WHEEL ALIGNMENT MEASUREMENT

Steering and vibration concerns are not always the result of incorrect alignment. One possible cause is wheel and tire imbalance. Another possibility is tire lead due to worn or improperly manufactured tires. Lead/pull is defined as follows: At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path. Lead is the vehicle deviation from a straight path on a level road without pressure on the steering wheel. Refer to Radial Tire Lead/Pull Correction .

Before performing any adjustments affecting wheel alignment, perform the following inspections in order to ensure correct alignment readings:

- Inspect for visible damage to the suspension components and replace as necessary.
- Inspect the tires for the proper inflation and irregular tire wear. Refer to Tire Diagnosis - Irregular or Premature Wear .
- Inspect the runout of the wheels and the tires. Refer to Tire and Wheel Runout Specifications .
- Inspect the wheel bearings for backlash and excessive play. Refer to Wheel Bearings Diagnosis .

- Inspect the ball joints for looseness or wear.
- Inspect the tie rod ends for looseness or wear.
- Inspect the control arms and stabilizer shaft for looseness or wear.
- Inspect the steering gear for looseness at the frame. Refer to **Fastener Specifications** .
- Inspect the struts/shock absorbers for wear, leaks, and any noticeable noises. Refer to **Suspension Strut and Shock Absorber Testing - On Vehicle** .
- Inspect the vehicle trim height. Refer to **Trim Height Inspection** .
- Inspect the steering wheel for excessive drag or poor return due to stiff or rusted linkage or suspension components.
- Inspect the fuel level. The fuel tank should be full or the vehicle should have a compensating load added.

Give consideration to excess loads, such as tool boxes, sample cases, etc. If normally carried in the vehicle, these items should remain in the vehicle during alignment adjustments. Give consideration also to the condition of the equipment being used for the alignment. Follow the equipment manufacturer's instructions.

Satisfactory vehicle operation may occur over a wide range of alignment settings. However, if the setting exceeds the service allowable specifications, correct the alignment to the service preferred specifications. Refer to **Wheel Alignment Specifications**.

Perform the following steps in order to measure the front and rear alignment angles:

1. Install the alignment equipment according to the manufacturer's instructions.
2. Jounce the front and the rear bumpers 3 times prior to checking the wheel alignment.
3. Measure the alignment angles and record the readings.

NOTE: **Record the "Before" and "After" alignment measurements.**

4. Adjust alignment angles to vehicle specifications, if necessary. Refer to **Wheel Alignment Specifications**.

FRONT CASTER ADJUSTMENT

The front caster is not adjustable. If the front caster angle is not within specifications, inspect for suspension support misalignment or front suspension damage. Replace any damaged suspension components as necessary.

FRONT CAMBER ADJUSTMENT

The front camber is not adjustable. If the front camber angle is not within specifications, inspect for suspension support misalignment or front suspension damage. Replace any damaged suspension components as necessary.

WHEEL ALIGNMENT - STEERING WHEEL ANGLE AND/OR FRONT TOE ADJUSTMENT

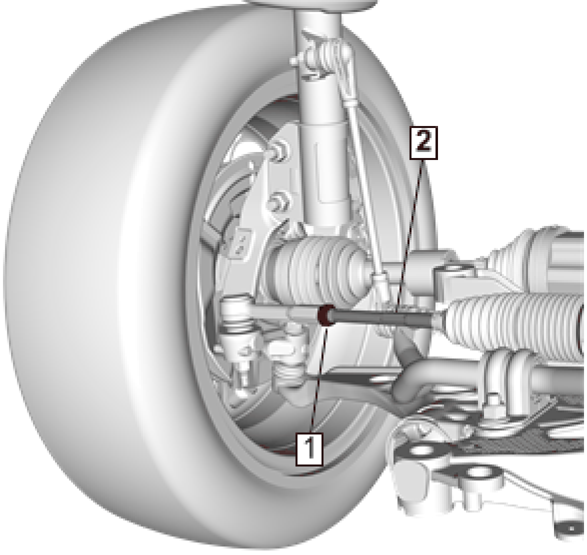


Fig. 1: Steering Linkage Inner Tie Rod Nut And Adjuster
Courtesy of GENERAL MOTORS COMPANY

1. Ensure that the steering wheel is set in a straight ahead position and centered.
2. Loosen Steering Linkage Inner Tie Rod Nut (1)
3. Adjust the toe to specification by turning the adjuster (2). Refer to **Wheel Alignment Specifications**.

CAUTION: **Refer to Fastener Caution .**

4. Tighten Steering Linkage Inner Tie Rod Nut (1) to 75 N.m (55 lb ft)
5. Check and center the steering angle sensor. Refer to **Steering Wheel Angle Sensor Centering** .

DESCRIPTION AND OPERATION

CAMBER DESCRIPTION

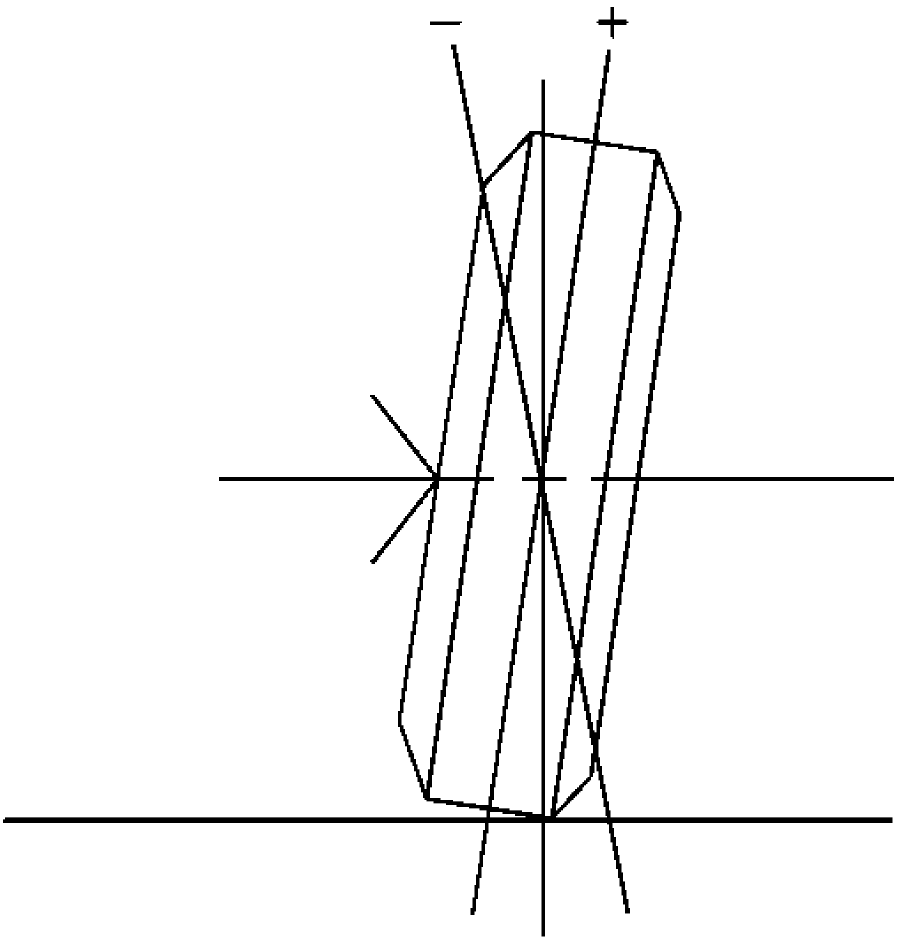


Fig. 2: Illustrating Camber Angle
Courtesy of GENERAL MOTORS COMPANY

Camber is the tilting of the wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is positive (+). When the wheel tilts inward at the top, the camber is negative (-). The amount of tilt is measured in degrees from the vertical. Camber settings influence the directional control and the tire wear.

Too much positive camber will result in premature wear on the outside of the tire and cause excessive wear on the suspension parts.

Too much negative camber will result in premature wear on the inside of the tire and cause excessive wear on the suspension parts.

Unequal side-to-side camber of 1 degree or more will cause the vehicle to pull or lead to the side with the most positive camber.

Cross Camber is the difference between the left camber value and the right camber value.

Cross Camber = L camber - R camber

CASTER DESCRIPTION

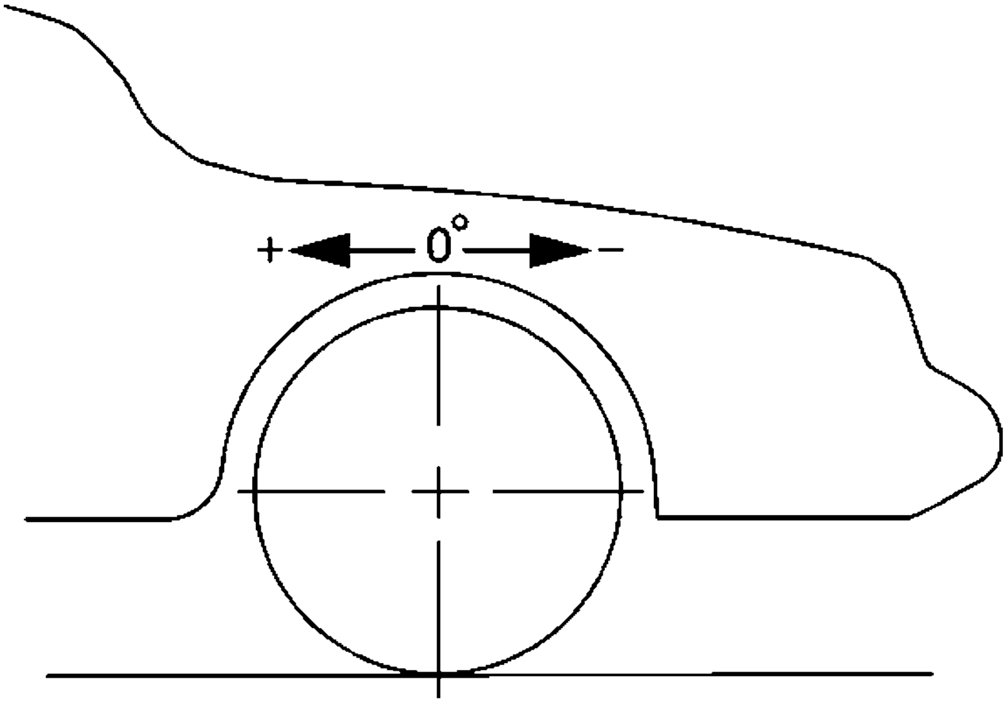


Fig. 3: Illustrating Caster
Courtesy of GENERAL MOTORS COMPANY

Caster is the tilting of the uppermost point of the steering axis either forward or backward, when viewed from the side of the vehicle. A backward tilt is positive (+) and a forward tilt is negative (-). Caster influences directional control of the steering but does not affect the tire wear. Caster is affected by the vehicle height, therefore it is important to keep the body at its designed height.

Overloading the vehicle or a weak or sagging rear spring will affect caster. When the rear of the vehicle is lower than its designated trim height, the front suspension moves to a more positive caster. If the rear of the vehicle is higher than its designated trim height, the front suspension moves to a less positive caster.

With too little positive caster, steering may be touchy at high speed and wheel returnability may be diminished when coming out of a turn. If one wheel has more positive caster than the other, that wheel will pull toward the center of the vehicle. This condition will cause the vehicle to pull or lead to the side with the least amount of positive caster.

LEAD/PULL DESCRIPTION

At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path.

IMPORTANT:	Vehicles will tend to lead/pull in the direction of the road slope as part of normal operation.

Lead/pull is usually caused by the following factors:

- Road slope

- Variability in tire construction
- Wheel alignment (front cross caster and camber)
- Unbalanced steering gear
- Electronic Power Steering (EPS) steering position and torque sensors not calibrated correctly, if equipped.

MEMORY STEER DESCRIPTION

Memory steer is when the vehicle wants to lead or pull in the direction the driver previously turned the vehicle. Additionally, after turning in the opposite direction, the vehicle will want to lead or pull in that direction.

SCRUB RADIUS DESCRIPTION

Ideally, the scrub radius is as small as possible. Normally, the SAI angle and the centerline of the tire and the wheel intersect below the road surface, causing a positive scrub radius. With struts, the SAI angle is much larger than the long arm/short arm type of suspension. This allows the SAI angle to intersect the camber angle above the road surface, forming a negative scrub radius. The smaller the scrub radius, the better the directional stability. Installing aftermarket wheels that have additional offset will dramatically increase the scrub radius. The newly installed wheels may cause the centerline of the tires to move further away from the spindle. This will increase the scrub radius.

A large amount of scrub radius can cause severe shimmy after hitting a bump. Four-wheel drive vehicles with large tires use a steering damper to compensate for an increased scrub radius. Scrub radius is not directly measurable by the conventional methods. Scrub radius is projected geometrically by engineers during the design phase of the suspension.

THRUST ANGLES DESCRIPTION

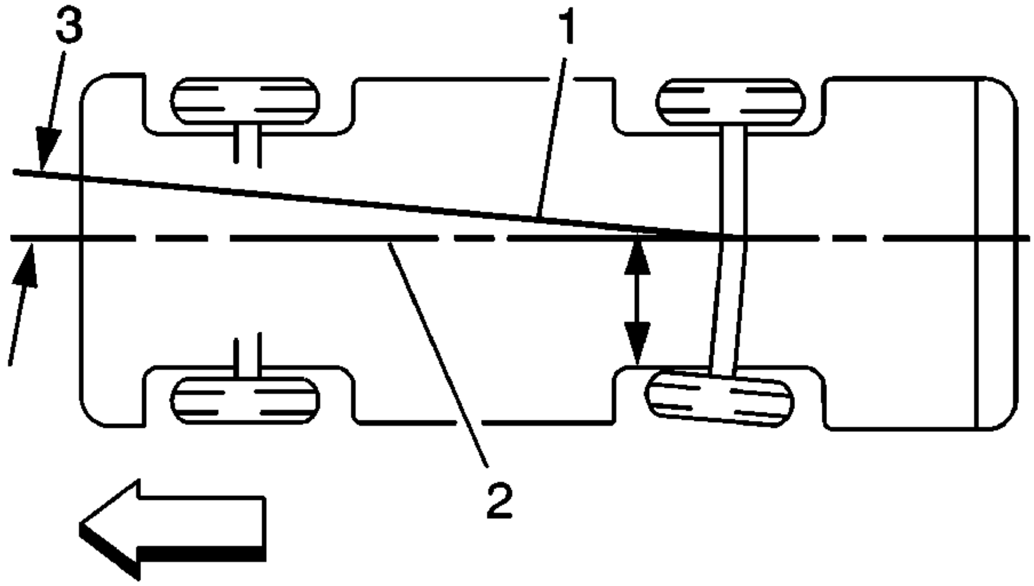


Fig. 4: Illustrating Thrust Angles
Courtesy of GENERAL MOTORS COMPANY

The front wheels aim or steer the vehicle. The rear wheels control tracking. This tracking action relates to the thrust angle (3). The thrust angle is the path that the rear wheels take. Ideally, the thrust angle is geometrically aligned with the body centerline (2).

In the illustration, toe-in is shown on the left rear wheel, moving the thrust line (1) off center. The resulting deviation from the centerline is the thrust angle.

If the thrust angle is not set properly the vehicle may "dog track", the steering wheel may not be centered or it could be perceived as a bent axle. Thrust angle can be checked during a wheel alignment.

Positive thrust angle means the thrust line is pointing to the right hand side (RHS) of the vehicle.

Negative thrust angle means the thrust line is pointing to the left hand side (LHS) of the vehicle.

If the thrust angle is out of specification, moving the axle to body relationship will change the thrust angle reading.

If the vehicle is out in the Positive (+) direction-moving the RHS forward and/or LHS rearward will move the thrust angle towards zero degrees.

If the vehicle is out in the Negative (-) direction-moving the RHS rearward and/or LHS forward will move the thrust angle towards zero degrees.

TOE DESCRIPTION

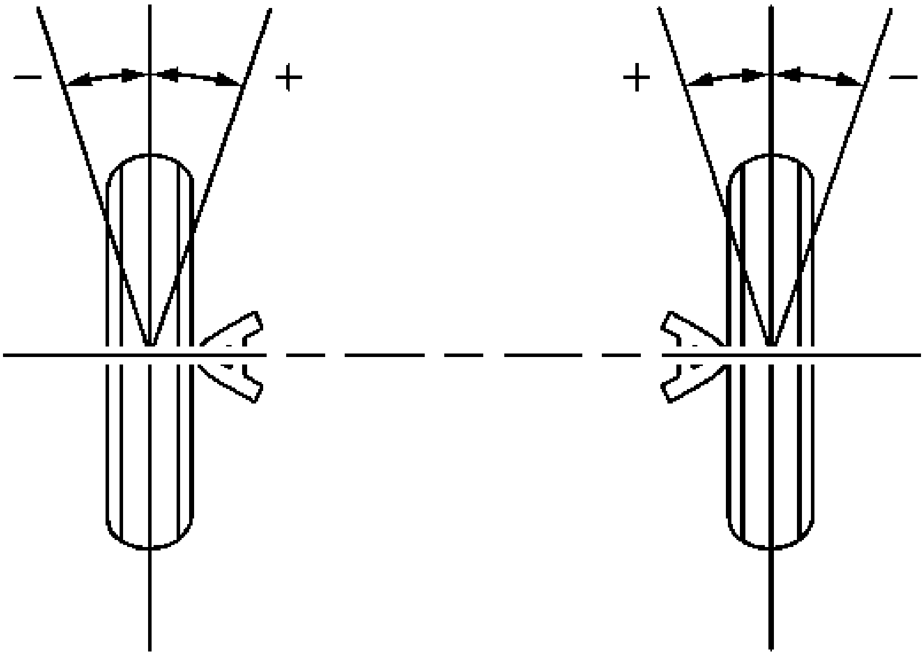


Fig. 5: Illustrating Toe Angle
Courtesy of GENERAL MOTORS COMPANY

Toe is a measurement of how much the front and/or rear wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (-). The actual amount of toe is normally only a fraction of a degree. The purpose of toe is to ensure that the wheels roll parallel.

Toe also offsets the small deflections of the wheel support system that occur when the vehicle is rolling forward. In other words, with the vehicle standing still and the wheels set with toe-in, the wheels tend to roll parallel on the road when the vehicle is moving.

Improper toe adjustment will cause premature tire wear and cause steering instability.

TORQUE STEER DESCRIPTION

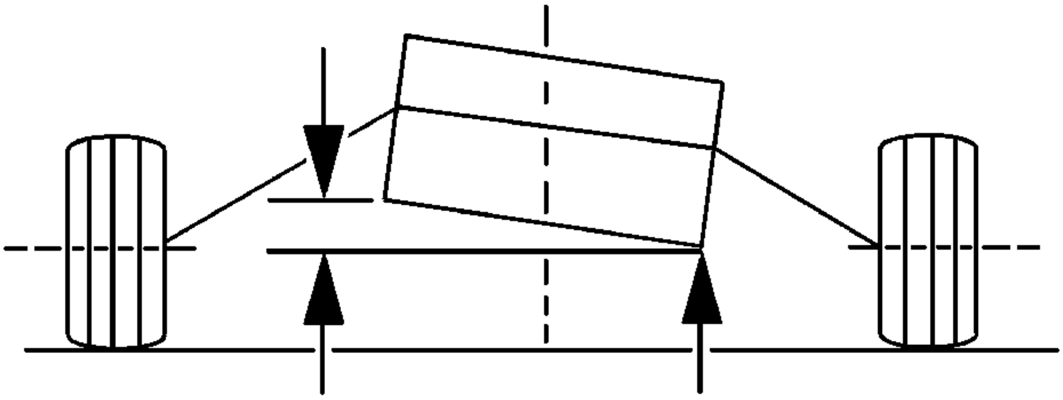


Fig. 6: Identifying Torque Steer
Courtesy of GENERAL MOTORS COMPANY

A vehicle pulls or leads in one direction during hard acceleration. A vehicle pulls or leads in the other direction during deceleration.

The following factors may cause torque steer to be more apparent on a particular vehicle:

- A slightly smaller diameter tire on the right front increases a right torque lead. Inspect the front tires for differences in the brand, the construction, or the size. If the tires appear to be similar, change the front tires from side-to-side and retest the vehicle. Tire and wheel assemblies have the most significant effect on torque steer correction.
- A large difference in the right and left front tire pressure
- Left-to-right differences in the front view axle angle may cause significant steering pull in a vehicle. The pull will be to the side with the most downward sloping axle from the differential to the wheels. Axles typically slope downward from the differential. The slope of the transaxle pan to level ground may be used as an indication of bias axle angles. The side with the higher

transaxle pan (shown on the left side of the illustration) has the most downward sloping axle angle.

WANDER DESCRIPTION

Wander is the undesired drifting or deviation of a vehicle to either side from a straight path with hand pressure on the steering wheel. Wander is a symptom of the vehicle's sensitivity to external disturbances, such as road crown and crosswind, and accentuated by poor on-center steering feel.

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ACTIVE BODYWORKS

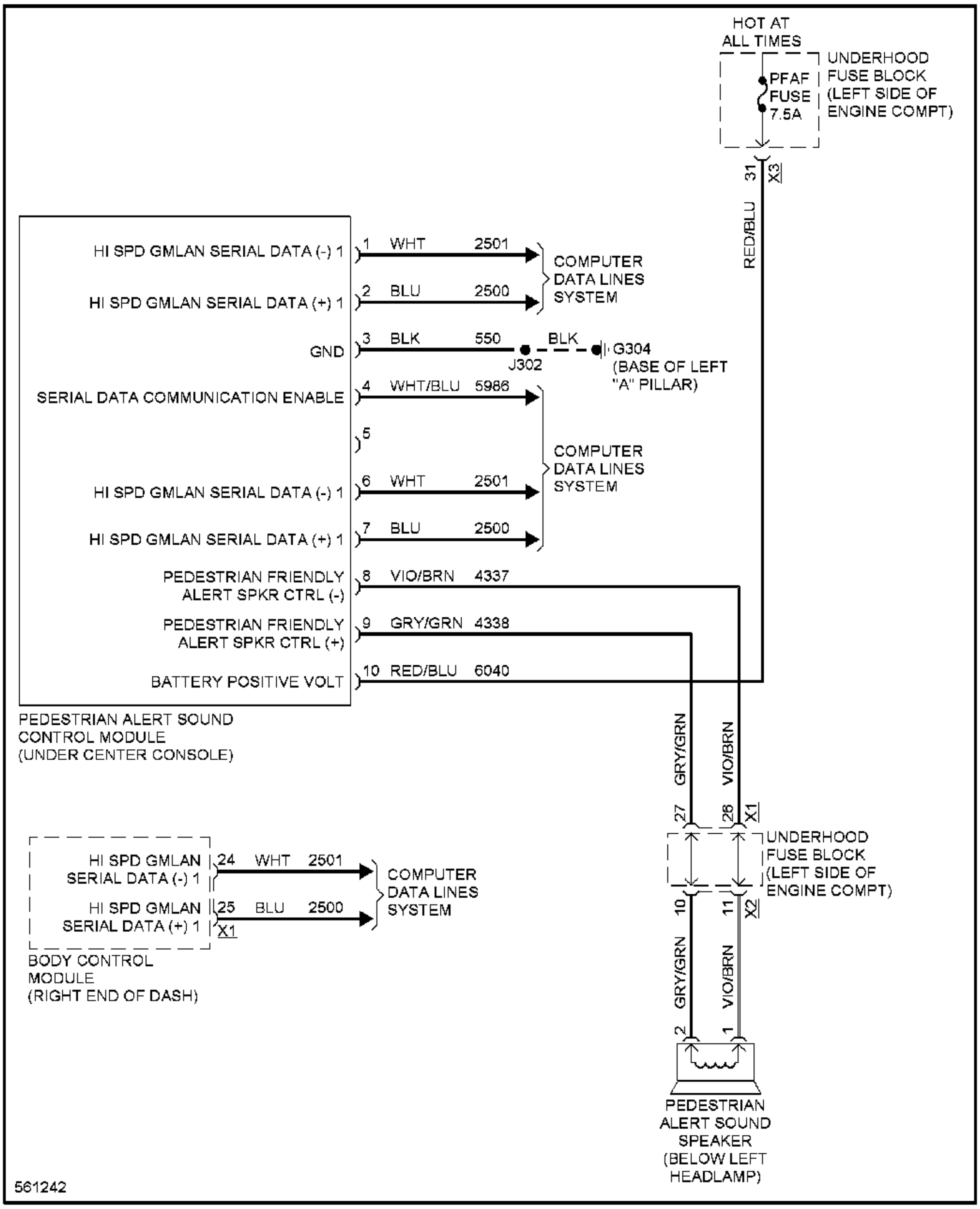

HOT AT ALL TIMES
PFAF FUSE 7.5A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
31
X3
RED/BLU
HI SPD GMLAN SERIAL DATA (-) 1
1 WHT 2501
HI SPD GMLAN SERIAL DATA (+) 1
2 BLU 2500
COMPUTER DATA LINES SYSTEM
GND
3 BLK 550
J302
BLK
G304 (BASE OF LEFT "A" PILLAR)
SERIAL DATA COMMUNICATION ENABLE
4 WHT/BLU 5986
5
HI SPD GMLAN SERIAL DATA (-) 1
6 WHT 2501
HI SPD GMLAN SERIAL DATA (+) 1
7 BLU 2500
COMPUTER DATA LINES SYSTEM
PEDESTRIAN FRIENDLY ALERT SPKR CTRL (-)
8 VIO/BRN 4337
PEDESTRIAN FRIENDLY ALERT SPKR CTRL (+)
9 GRY/GRN 4338
BATTERY POSITIVE VOLT
10 RED/BLU 6040
PEDESTRIAN ALERT SOUND CONTROL MODULE (UNDER CENTER CONSOLE)
GRY/GRN
VIO/BRN
27
28
X1
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
10
11
X2
GRY/GRN
VIO/BRN
2
1
PEDESTRIAN ALERT SOUND SPEAKER (BELOW LEFT HEADLAMP)
HI SPD GMLAN SERIAL DATA (-) 1
24 WHT 2501
HI SPD GMLAN SERIAL DATA (+) 1
25 BLU 2500
X1
COMPUTER DATA LINES SYSTEM
BODY CONTROL MODULE (RIGHT END OF DASH)
561242

Fig. 1: Active Bodyworks Circuit

AIR CONDITIONING

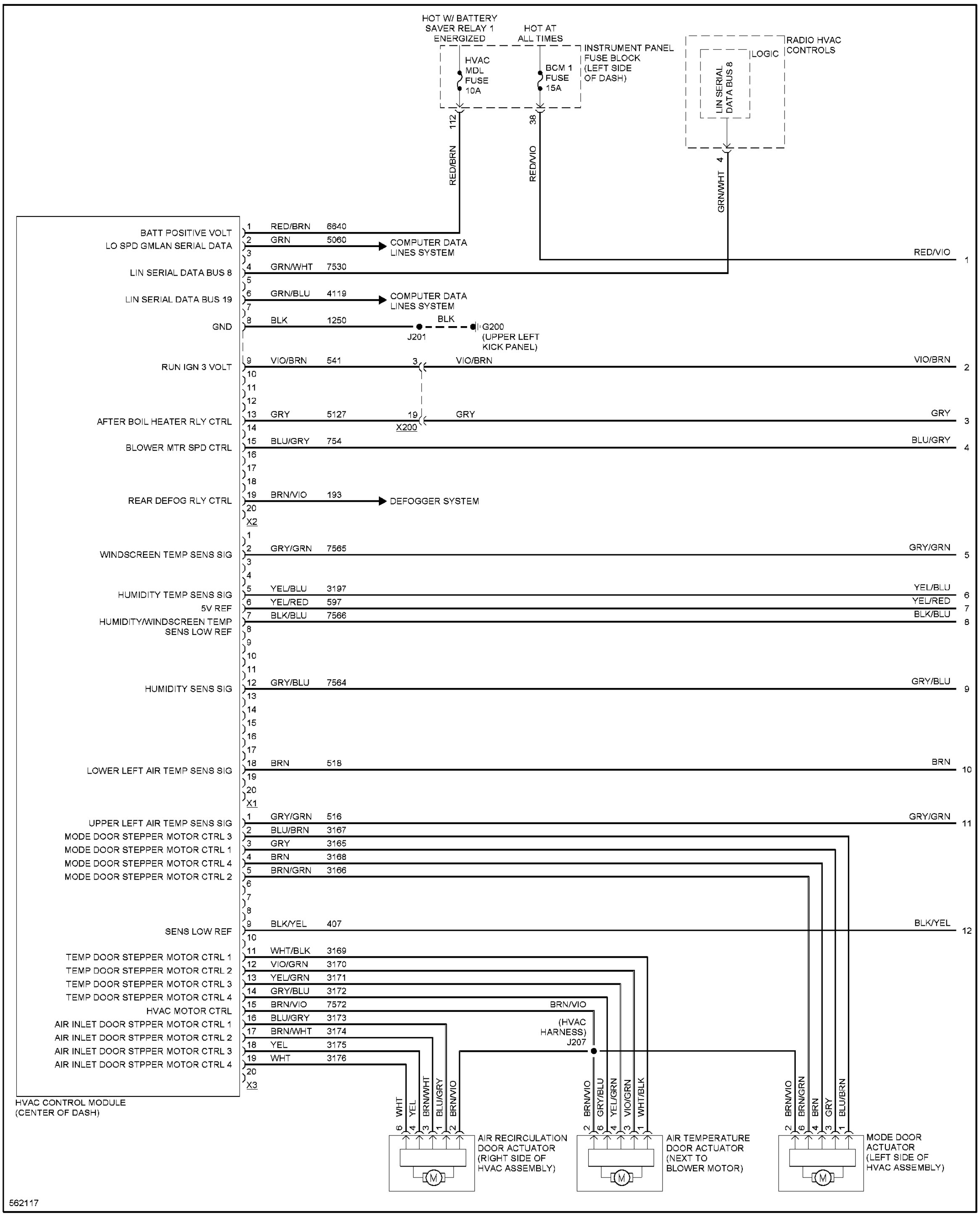

HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
HVAC MDL FUSE 10A
BCM 1 FUSE 15A
112
38
RED/BRN
RED/VIO
RADIO HVAC CONTROLS
LOGIC
LIN SERIAL DATA BUS 8
4
GRN/WHT
BATT POSITIVE VOLT
LO SPD GMLAN SERIAL DATA
LIN SERIAL DATA BUS 8
LIN SERIAL DATA BUS 19
GND
RUN IGN 3 VOLT
AFTER BOIL HEATER RLY CTRL
BLOWER MTR SPD CTRL
REAR DEFOG RLY CTRL
WINDSCREEN TEMP SENS SIG
HUMIDITY TEMP SENS SIG
5V REF
HUMIDITY/WINDSCREEN TEMP SENS LOW REF
HUMIDITY SENS SIG
LOWER LEFT AIR TEMP SENS SIG
UPPER LEFT AIR TEMP SENS SIG
MODE DOOR STEPPER MOTOR CTRL 3
MODE DOOR STEPPER MOTOR CTRL 1
MODE DOOR STEPPER MOTOR CTRL 4
MODE DOOR STEPPER MOTOR CTRL 2
SENS LOW REF
TEMP DOOR STEPPER MOTOR CTRL 1
TEMP DOOR STEPPER MOTOR CTRL 2
TEMP DOOR STEPPER MOTOR CTRL 3
TEMP DOOR STEPPER MOTOR CTRL 4
HVAC MOTOR CTRL
AIR INLET DOOR STPPER MOTOR CTRL 1
AIR INLET DOOR STPPER MOTOR CTRL 2
AIR INLET DOOR STPPER MOTOR CTRL 3
AIR INLET DOOR STPPER MOTOR CTRL 4
HVAC CONTROL MODULE (CENTER OF DASH)
1 RED/BRN 6640
2 GRN 5060
COMPUTER DATA LINES SYSTEM
3
4 GRN/WHT 7530
5
6 GRN/BLU 4119
COMPUTER DATA LINES SYSTEM
7
8 BLK 1250
J201
BLK
G200 (UPPER LEFT KICK PANEL)
9 VIO/BRN 541
3
VIO/BRN
10
11
12
13 GRY 5127
19
X200
GRY
14
15 BLU/GRY 754
16
17
18
19 BRN/VIO 193
DEFOGGER SYSTEM
20
X2
1
2 GRY/GRN 7565
3
4
5 YEL/BLU 3197
6 YEL/RED 597
7 BLK/BLU 7566
8
9
10
11
12 GRY/BLU 7564
13
14
15
16
17
18 BRN 518
19
20
X1
1 GRY/GRN 516
2 BLU/BRN 3167
3 GRY 3165
4 BRN 3168
5 BRN/GRN 3166
6
7
8
9 BLK/YEL 407
10
11 WHT/BLK 3169
12 VIO/GRN 3170
13 YEL/GRN 3171
14 GRY/BLU 3172
15 BRN/VIO 7572
16 BLU/GRY 3173
17 BRN/WHT 3174
18 YEL 3175
19 WHT 3176
20
X3
BRN/VIO
(HVAC HARNESS)
J207
RED/VIO 1
VIO/BRN 2
GRY 3
BLU/GRY 4
GRY/GRN 5
YEL/BLU 6
YEL/RED 7
BLK/BLU 8
GRY/BLU 9
BRN 10
GRY/GRN 11
BLK/YEL 12
WHT 6
YEL 4
BRN/WHT 3
BLU/GRY 1
BRN/VIO 2
AIR RECIRCULATION DOOR ACTUATOR (RIGHT SIDE OF HVAC ASSEMBLY)
BRN/VIO 2
GRY/BLU 6
YEL/GRN 4
VIO/GRN 3
WHT/BLK 1
AIR TEMPERATURE DOOR ACTUATOR (NEXT TO BLOWER MOTOR)
BRN/VIO 2
BRN/GRN 6
BRN 4
GRY 3
BLU/BRN 1
MODE DOOR ACTUATOR (LEFT SIDE OF HVAC ASSEMBLY)
M
562117

Fig. 2: Automatic A/C Circuit (1 of 5)

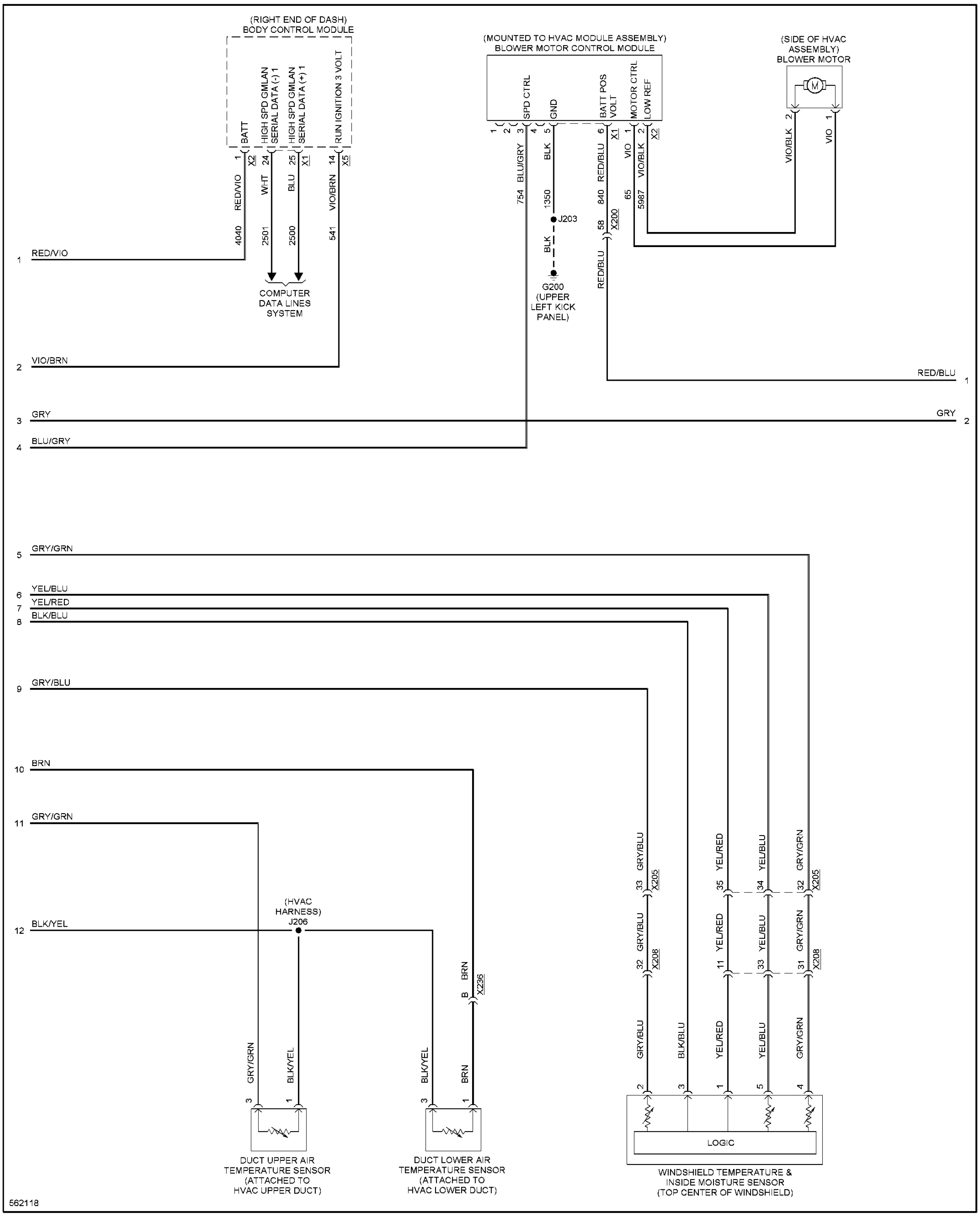

(RIGHT END OF DASH)
BODY CONTROL MODULE
BATT
HIGH SPD GMLAN SERIAL DATA (-) 1
HIGH SPD GMLAN SERIAL DATA (+) 1
RUN IGNITION 3 VOLT
1 X2
24
25 X1
14 X5
RED/VIO 4040
WHT 2501
BLU 2500
VIO/BRN 541
COMPUTER DATA LINES SYSTEM
(MOUNTED TO HVAC MODULE ASSEMBLY)
BLOWER MOTOR CONTROL MODULE
SPD CTRL
GND
BATT POS VOLT
MOTOR CTRL
LOW REF
1 2 3 4 5 6 X1
1 2 X2
754 BLU/GRY
1350 BLK
J203
BLK
G200 (UPPER LEFT KICK PANEL)
840 RED/BLU
58 X200
RED/BLU
65 VIO
5987 VIO/BLK
(SIDE OF HVAC ASSEMBLY)
BLOWER MOTOR
M
2 VIO/BLK
1 VIO
1 RED/VIO
2 VIO/BRN
3 GRY
4 BLU/GRY
RED/BLU 1
GRY 2
5 GRY/GRN
6 YEL/BLU
7 YEL/RED
8 BLK/BLU
9 GRY/BLU
10 BRN
11 GRY/GRN
12 BLK/YEL
(HVAC HARNESS)
J206
B BRN X236
33 GRY/BLU X205
35 YEL/RED
34 YEL/BLU
32 GRY/GRN X205
32 GRY/BLU X208
11 YEL/RED
33 YEL/BLU
31 GRY/GRN X208
GRY/BLU
BLK/BLU
YEL/RED
YEL/BLU
GRY/GRN
2 3 1 5 4
LOGIC
WINDSHIELD TEMPERATURE &
INSIDE MOISTURE SENSOR
(TOP CENTER OF WINDSHIELD)
3 GRY/GRN
1 BLK/YEL
DUCT UPPER AIR TEMPERATURE SENSOR (ATTACHED TO HVAC UPPER DUCT)
3 BLK/YEL
1 BRN
DUCT LOWER AIR TEMPERATURE SENSOR (ATTACHED TO HVAC LOWER DUCT)
562118

Fig. 3: Automatic A/C Circuit (2 of 5)

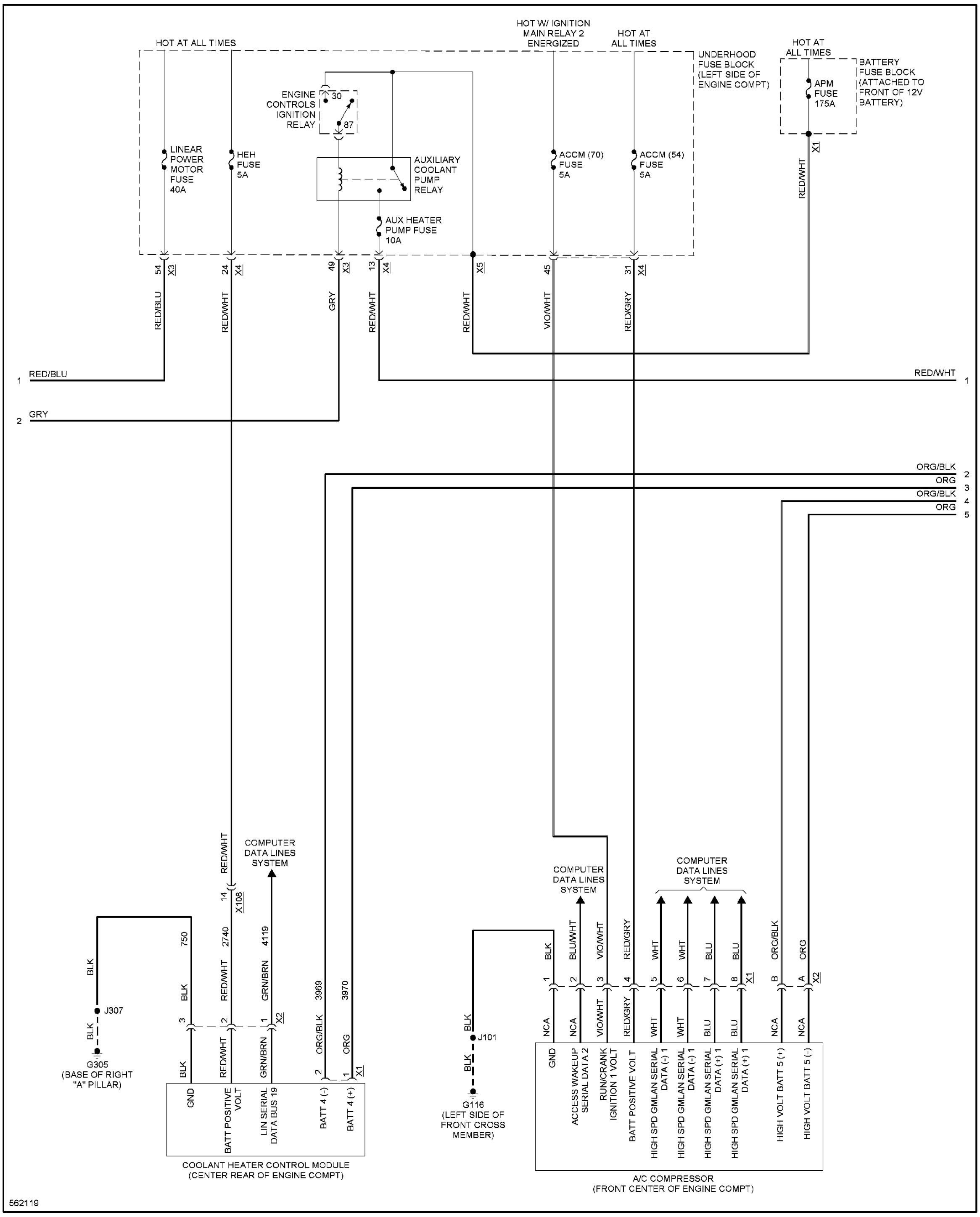

HOT AT ALL TIMES
HOT W/ IGNITION MAIN RELAY 2 ENERGIZED
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
HOT AT ALL TIMES
BATTERY FUSE BLOCK (ATTACHED TO FRONT OF 12V BATTERY)
APM FUSE 175A
ENGINE CONTROLS IGNITION RELAY
30
87
LINEAR POWER MOTOR FUSE 40A
HEH FUSE 5A
AUXILIARY COOLANT PUMP RELAY
AUX HEATER PUMP FUSE 10A
ACCM (70) FUSE 5A
ACCM (54) FUSE 5A
X1
RED/WHT
54 X3
24 X4
49 X3
13 X4
X5
45
31 X4
RED/BLU
RED/WHT
GRY
RED/WHT
RED/WHT
VIO/WHT
RED/GRY
1 RED/BLU
2 GRY
RED/WHT 1
ORG/BLK 2
ORG 3
ORG/BLK 4
ORG 5
RED/WHT
14 X108
COMPUTER DATA LINES SYSTEM
BLK
J307
BLK
G305 (BASE OF RIGHT "A" PILLAR)
750
2740
4119
3969
3970
BLK
RED/WHT
GRN/BRN
ORG/BLK
ORG
3
2
1 X2
2
1 X1
BLK
RED/WHT
GRN/BRN
GND
BATT POSITIVE VOLT
LIN SERIAL DATA BUS 19
BATT 4 (-)
BATT 4 (+)
COOLANT HEATER CONTROL MODULE (CENTER REAR OF ENGINE COMPT)
BLK
J101
BLK
G116 (LEFT SIDE OF FRONT CROSS MEMBER)
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
BLK
BLU/WHT
VIO/WHT
RED/GRY
WHT
WHT
BLU
BLU
ORG/BLK
ORG
1
2
3
4
5
6
7
8 X1
B
A X2
NCA
NCA
VIO/WHT
RED/GRY
WHT
WHT
BLU
BLU
NCA
NCA
GND
ACCESS WAKEUP SERIAL DATA 2
RUN/CRANK IGNITION 1 VOLT
BATT POSITIVE VOLT
HIGH SPD GMLAN SERIAL DATA (-) 1
HIGH SPD GMLAN SERIAL DATA (-) 1
HIGH SPD GMLAN SERIAL DATA (+) 1
HIGH SPD GMLAN SERIAL DATA (+) 1
HIGH VOLT BATT 5 (+)
HIGH VOLT BATT 5 (-)
A/C COMPRESSOR (FRONT CENTER OF ENGINE COMPT)
562119

Fig. 4: Automatic A/C Circuit (3 of 5)

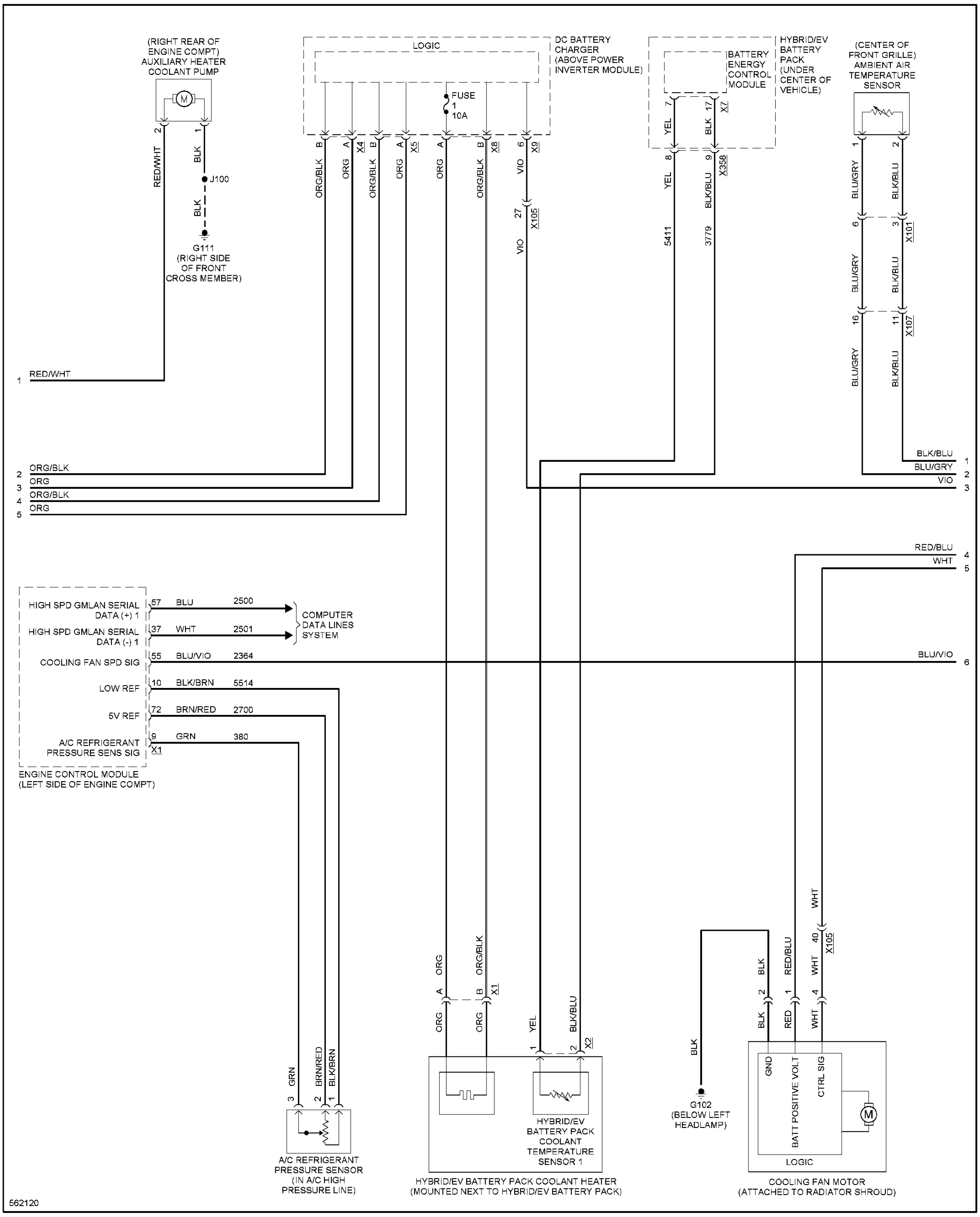

(RIGHT REAR OF ENGINE COMPT) AUXILIARY HEATER COOLANT PUMP
M
2
1
RED/WHT
BLK
J100
BLK
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
LOGIC
FUSE 1 10A
DC BATTERY CHARGER (ABOVE POWER INVERTER MODULE)
B
A
X4
B
A
X5
A
B
X8
6
X9
ORG/BLK
ORG
ORG/BLK
ORG
ORG
ORG/BLK
VIO
27
X105
VIO
BATTERY ENERGY CONTROL MODULE
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
7
17
X7
YEL
BLK
8
9
X358
YEL
BLK/BLU
5411
3779
(CENTER OF FRONT GRILLE) AMBIENT AIR TEMPERATURE SENSOR
1
2
BLU/GRY
BLK/BLU
6
3
X101
BLU/GRY
BLK/BLU
16
11
X107
BLU/GRY
BLK/BLU
1 RED/WHT
2 ORG/BLK
3 ORG
4 ORG/BLK
5 ORG
BLK/BLU 1
BLU/GRY 2
VIO 3
RED/BLU 4
WHT 5
HIGH SPD GMLAN SERIAL DATA (+) 1
57 BLU 2500
HIGH SPD GMLAN SERIAL DATA (-) 1
37 WHT 2501
COMPUTER DATA LINES SYSTEM
COOLING FAN SPD SIG
55 BLU/VIO 2364
BLU/VIO 6
LOW REF
10 BLK/BRN 5514
5V REF
72 BRN/RED 2700
A/C REFRIGERANT PRESSURE SENS SIG
9 GRN 380
X1
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
GRN
BRN/RED
BLK/BRN
3
2
1
A/C REFRIGERANT PRESSURE SENSOR (IN A/C HIGH PRESSURE LINE)
ORG
ORG/BLK
A
B
X1
ORG
ORG
YEL
BLK/BLU
1
2
X2
HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR 1
HYBRID/EV BATTERY PACK COOLANT HEATER (MOUNTED NEXT TO HYBRID/EV BATTERY PACK)
BLK
G102 (BELOW LEFT HEADLAMP)
WHT
40
X105
BLK
RED/BLU
WHT
2
1
4
BLK
RED
WHT
GND
BATT POSITIVE VOLT
CTRL SIG
M
LOGIC
COOLING FAN MOTOR (ATTACHED TO RADIATOR SHROUD)
562120

Fig. 5: Automatic A/C Circuit (4 of 5)

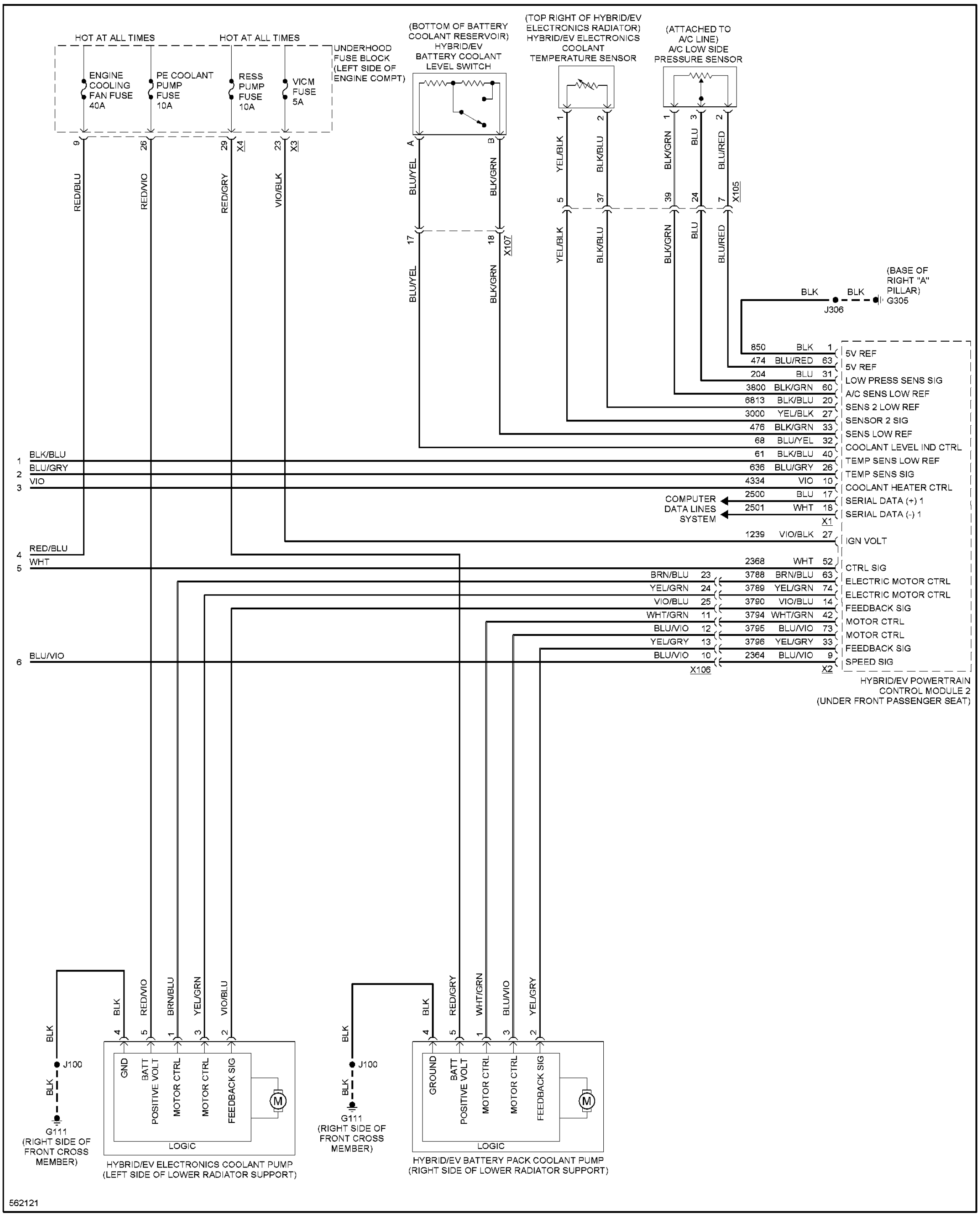

HOT AT ALL TIMES
HOT AT ALL TIMES
ENGINE COOLING FAN FUSE 40A
PE COOLANT PUMP FUSE 10A
RESS PUMP FUSE 10A
VICM FUSE 5A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
(BOTTOM OF BATTERY COOLANT RESERVOIR) HYBRID/EV BATTERY COOLANT LEVEL SWITCH
(TOP RIGHT OF HYBRID/EV ELECTRONICS RADIATOR) HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR
(ATTACHED TO A/C LINE) A/C LOW SIDE PRESSURE SENSOR
9
26
29
X4
23
X3
RED/BLU
RED/VIO
RED/GRY
VIO/BLK
A
B
BLU/YEL
BLK/GRN
17
18
X107
1
2
YEL/BLK
BLK/BLU
5
37
1
3
2
BLK/GRN
BLU
BLU/RED
39
24
7
X105
(BASE OF RIGHT "A" PILLAR)
BLK
BLK
J306
G305
850 BLK 1
474 BLU/RED 63
204 BLU 31
3800 BLK/GRN 60
6813 BLK/BLU 20
3000 YEL/BLK 27
476 BLK/GRN 33
68 BLU/YEL 32
61 BLK/BLU 40
636 BLU/GRY 26
4334 VIO 10
2500 BLU 17
2501 WHT 18
X1
1239 VIO/BLK 27
2368 WHT 52
3788 BRN/BLU 63
3789 YEL/GRN 74
3790 VIO/BLU 14
3794 WHT/GRN 42
3795 BLU/VIO 73
3796 YEL/GRY 33
2364 BLU/VIO 9
X2
5V REF
5V REF
LOW PRESS SENS SIG
A/C SENS LOW REF
SENS 2 LOW REF
SENSOR 2 SIG
SENS LOW REF
COOLANT LEVEL IND CTRL
TEMP SENS LOW REF
TEMP SENS SIG
COOLANT HEATER CTRL
SERIAL DATA (+) 1
SERIAL DATA (-) 1
IGN VOLT
CTRL SIG
ELECTRIC MOTOR CTRL
ELECTRIC MOTOR CTRL
FEEDBACK SIG
MOTOR CTRL
MOTOR CTRL
FEEDBACK SIG
SPEED SIG
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
COMPUTER DATA LINES SYSTEM
1 BLK/BLU
2 BLU/GRY
3 VIO
4 RED/BLU
5 WHT
6 BLU/VIO
BRN/BLU 23
YEL/GRN 24
VIO/BLU 25
WHT/GRN 11
BLU/VIO 12
YEL/GRY 13
BLU/VIO 10
X106
BLK
BLK
J100
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
BLK
RED/VIO
BRN/BLU
YEL/GRN
VIO/BLU
4
5
1
3
2
GND
BATT POSITIVE VOLT
MOTOR CTRL
MOTOR CTRL
FEEDBACK SIG
M
LOGIC
HYBRID/EV ELECTRONICS COOLANT PUMP (LEFT SIDE OF LOWER RADIATOR SUPPORT)
BLK
BLK
J100
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
BLK
RED/GRY
WHT/GRN
BLU/VIO
YEL/GRY
4
5
1
3
2
GROUND
BATT POSITIVE VOLT
MOTOR CTRL
MOTOR CTRL
FEEDBACK SIG
M
LOGIC
HYBRID/EV BATTERY PACK COOLANT PUMP (RIGHT SIDE OF LOWER RADIATOR SUPPORT)
562121

Fig. 6: Automatic A/C Circuit (5 of 5)

ANTI-LOCK BRAKES

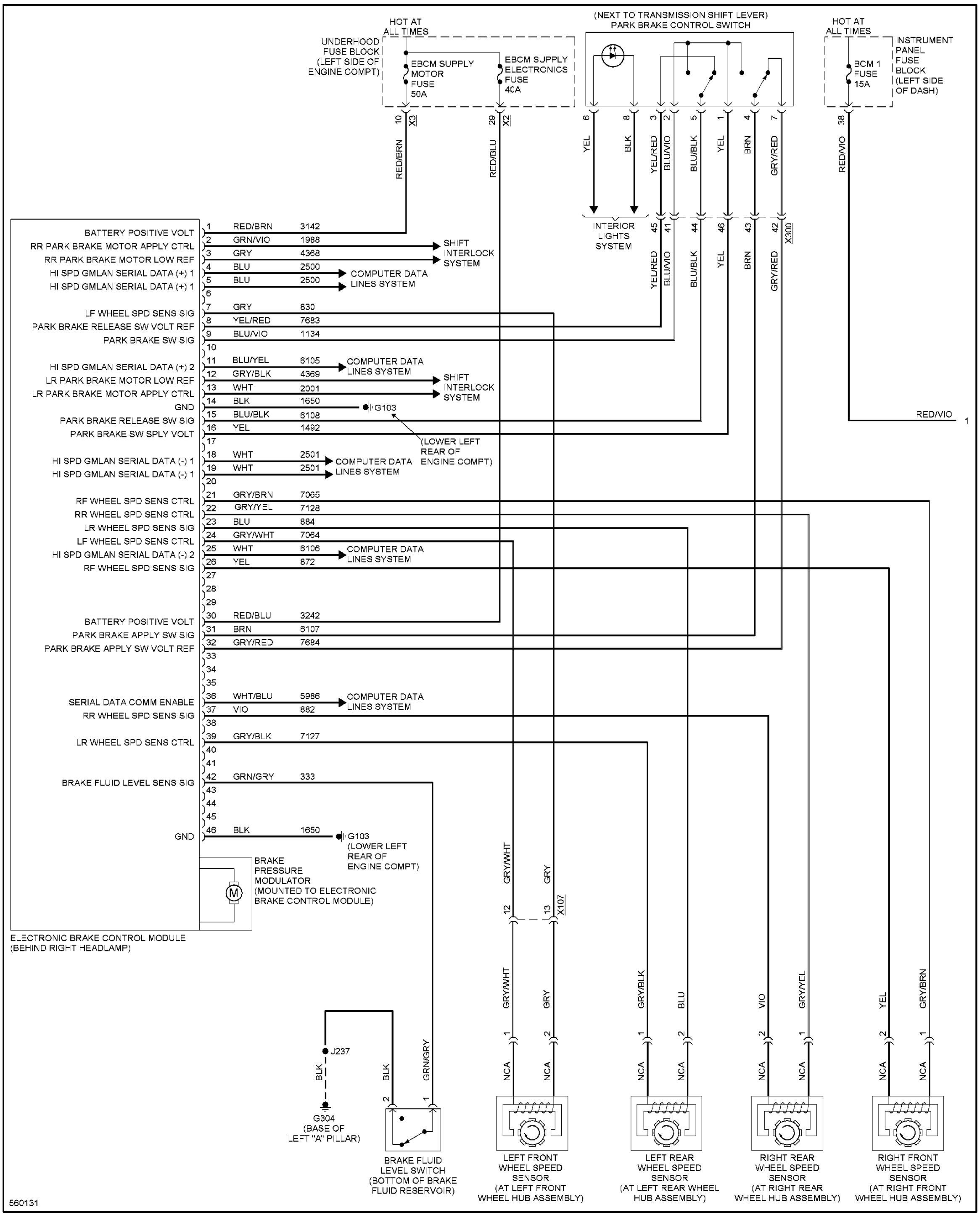

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
EBCM SUPPLY MOTOR FUSE 50A
EBCM SUPPLY ELECTRONICS FUSE 40A
(NEXT TO TRANSMISSION SHIFT LEVER) PARK BRAKE CONTROL SWITCH
HOT AT ALL TIMES
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
10 X3 RED/BRN
29 X2 RED/BLU
6 YEL
8 BLK
3 YEL/RED
2 BLU/VIO
5 BLU/BLK
1 YEL
4 BRN
7 GRY/RED
38 RED/VIO
INTERIOR LIGHTS SYSTEM
45 41 44 46 43 42 X300
BATTERY POSITIVE VOLT 1 RED/BRN 3142
RR PARK BRAKE MOTOR APPLY CTRL 2 GRN/VIO 1988
RR PARK BRAKE MOTOR LOW REF 3 GRY 4368
HI SPD GMLAN SERIAL DATA (+) 1 4 BLU 2500
HI SPD GMLAN SERIAL DATA (+) 1 5 BLU 2500
6
LF WHEEL SPD SENS SIG 7 GRY 830
PARK BRAKE RELEASE SW VOLT REF 8 YEL/RED 7683
PARK BRAKE SW SIG 9 BLU/VIO 1134
10
HI SPD GMLAN SERIAL DATA (+) 2 11 BLU/YEL 6105
LR PARK BRAKE MOTOR LOW REF 12 GRY/BLK 4369
LR PARK BRAKE MOTOR APPLY CTRL 13 WHT 2001
GND 14 BLK 1650
PARK BRAKE RELEASE SW SIG 15 BLU/BLK 6108
PARK BRAKE SW SPLY VOLT 16 YEL 1492
17
HI SPD GMLAN SERIAL DATA (-) 1 18 WHT 2501
HI SPD GMLAN SERIAL DATA (-) 1 19 WHT 2501
20
RF WHEEL SPD SENS CTRL 21 GRY/BRN 7065
RR WHEEL SPD SENS CTRL 22 GRY/YEL 7128
LR WHEEL SPD SENS SIG 23 BLU 884
LF WHEEL SPD SENS CTRL 24 GRY/WHT 7064
HI SPD GMLAN SERIAL DATA (-) 2 25 WHT 6106
RF WHEEL SPD SENS SIG 26 YEL 872
27
28
29
BATTERY POSITIVE VOLT 30 RED/BLU 3242
PARK BRAKE APPLY SW SIG 31 BRN 6107
PARK BRAKE APPLY SW VOLT REF 32 GRY/RED 7684
33
34
35
SERIAL DATA COMM ENABLE 36 WHT/BLU 5986
RR WHEEL SPD SENS SIG 37 VIO 882
38
LR WHEEL SPD SENS CTRL 39 GRY/BLK 7127
40
41
BRAKE FLUID LEVEL SENS SIG 42 GRN/GRY 333
43
44
45
GND 46 BLK 1650
SHIFT INTERLOCK SYSTEM
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
SHIFT INTERLOCK SYSTEM
G103
(LOWER LEFT REAR OF ENGINE COMPT)
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
RED/VIO 1
G103 (LOWER LEFT REAR OF ENGINE COMPT)
BRAKE PRESSURE MODULATOR (MOUNTED TO ELECTRONIC BRAKE CONTROL MODULE)
M
ELECTRONIC BRAKE CONTROL MODULE (BEHIND RIGHT HEADLAMP)
GRY/WHT
GRY
12 13 X107
GRY/WHT GRY GRY/BLK BLU VIO GRY/YEL YEL GRY/BRN
1 2 1 2 2 1 2 1
NCA
J237
BLK
G304 (BASE OF LEFT "A" PILLAR)
BLK
GRN/GRY
2 1
BRAKE FLUID LEVEL SWITCH (BOTTOM OF BRAKE FLUID RESERVOIR)
LEFT FRONT WHEEL SPEED SENSOR (AT LEFT FRONT WHEEL HUB ASSEMBLY)
LEFT REAR WHEEL SPEED SENSOR (AT LEFT REAR WHEEL HUB ASSEMBLY)
RIGHT REAR WHEEL SPEED SENSOR (AT RIGHT REAR WHEEL HUB ASSEMBLY)
RIGHT FRONT WHEEL SPEED SENSOR (AT RIGHT FRONT WHEEL HUB ASSEMBLY)
560131

Fig. 7: Anti-lock Brakes Circuit (1 of 2)

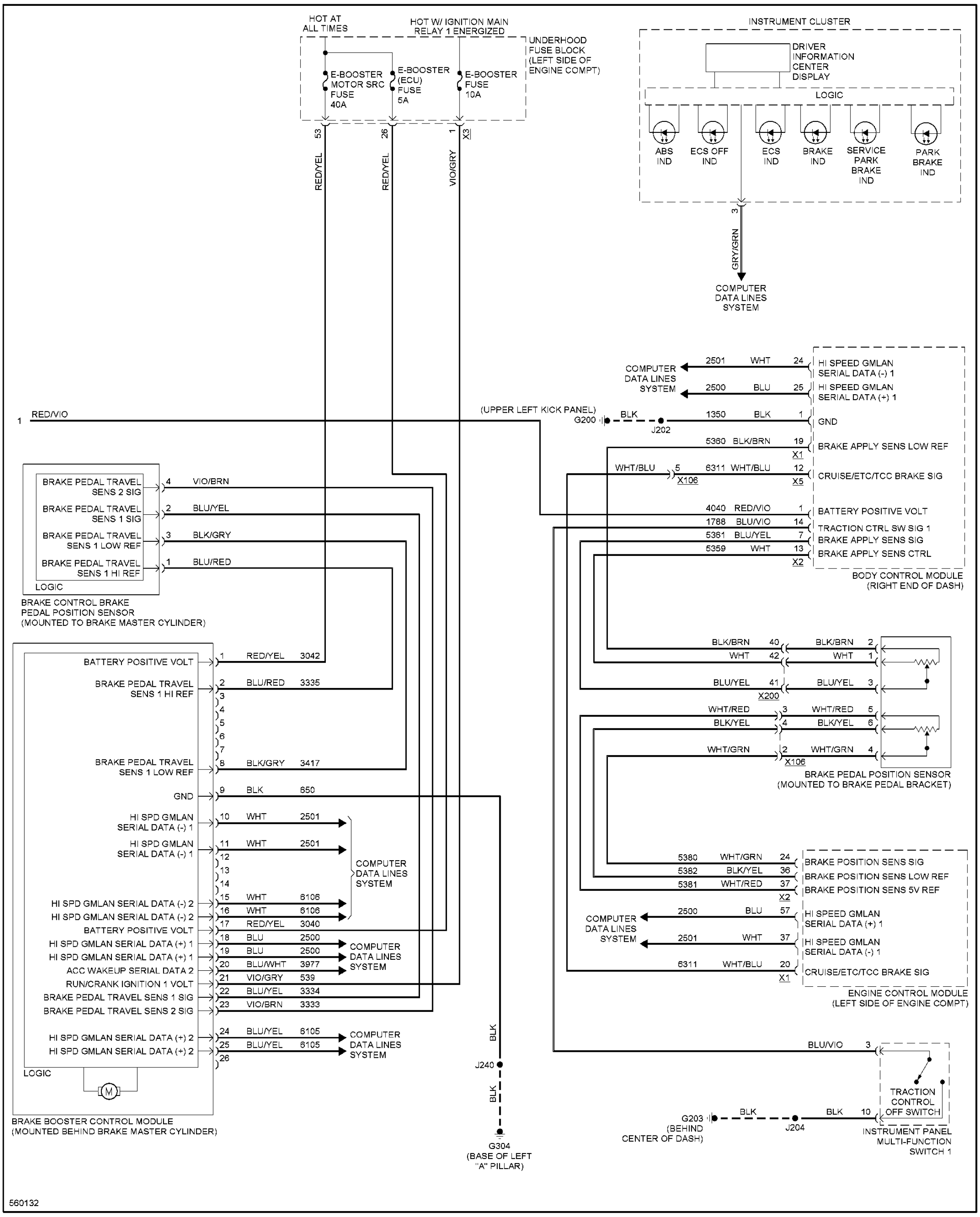

HOT AT ALL TIMES
HOT W/ IGNITION MAIN RELAY 1 ENERGIZED
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
E-BOOSTER MOTOR SRC FUSE 40A
E-BOOSTER (ECU) FUSE 5A
E-BOOSTER FUSE 10A
53
26
1
X3
RED/YEL
RED/YEL
VIO/GRY
INSTRUMENT CLUSTER
DRIVER INFORMATION CENTER DISPLAY
LOGIC
ABS IND
ECS OFF IND
ECS IND
BRAKE IND
SERVICE PARK BRAKE IND
PARK BRAKE IND
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
2501 WHT 24
2500 BLU 25
HI SPEED GMLAN SERIAL DATA (-) 1
HI SPEED GMLAN SERIAL DATA (+) 1
1 RED/VIO
(UPPER LEFT KICK PANEL) G200
BLK
J202
1350 BLK 1
GND
5360 BLK/BRN 19
X1
BRAKE APPLY SENS LOW REF
WHT/BLU 5
X106
6311 WHT/BLU 12
X5
CRUISE/ETC/TCC BRAKE SIG
4040 RED/VIO 1
BATTERY POSITIVE VOLT
1788 BLU/VIO 14
TRACTION CTRL SW SIG 1
5361 BLU/YEL 7
BRAKE APPLY SENS SIG
5359 WHT 13
X2
BRAKE APPLY SENS CTRL
BODY CONTROL MODULE (RIGHT END OF DASH)
BRAKE PEDAL TRAVEL SENS 2 SIG
4 VIO/BRN
BRAKE PEDAL TRAVEL SENS 1 SIG
2 BLU/YEL
BRAKE PEDAL TRAVEL SENS 1 LOW REF
3 BLK/GRY
BRAKE PEDAL TRAVEL SENS 1 HI REF
1 BLU/RED
LOGIC
BRAKE CONTROL BRAKE PEDAL POSITION SENSOR (MOUNTED TO BRAKE MASTER CYLINDER)
BATTERY POSITIVE VOLT
1 RED/YEL 3042
BRAKE PEDAL TRAVEL SENS 1 HI REF
2 BLU/RED 3335
3
4
5
6
7
BRAKE PEDAL TRAVEL SENS 1 LOW REF
8 BLK/GRY 3417
GND
9 BLK 650
HI SPD GMLAN SERIAL DATA (-) 1
10 WHT 2501
HI SPD GMLAN SERIAL DATA (-) 1
11 WHT 2501
12
13
14
COMPUTER DATA LINES SYSTEM
HI SPD GMLAN SERIAL DATA (-) 2
15 WHT 6106
HI SPD GMLAN SERIAL DATA (-) 2
16 WHT 6106
BATTERY POSITIVE VOLT
17 RED/YEL 3040
HI SPD GMLAN SERIAL DATA (+) 1
18 BLU 2500
HI SPD GMLAN SERIAL DATA (+) 1
19 BLU 2500
ACC WAKEUP SERIAL DATA 2
20 BLU/WHT 3977
RUN/CRANK IGNITION 1 VOLT
21 VIO/GRY 539
BRAKE PEDAL TRAVEL SENS 1 SIG
22 BLU/YEL 3334
BRAKE PEDAL TRAVEL SENS 2 SIG
23 VIO/BRN 3333
COMPUTER DATA LINES SYSTEM
HI SPD GMLAN SERIAL DATA (+) 2
24 BLU/YEL 6105
HI SPD GMLAN SERIAL DATA (+) 2
25 BLU/YEL 6105
26
COMPUTER DATA LINES SYSTEM
LOGIC
M
BRAKE BOOSTER CONTROL MODULE (MOUNTED BEHIND BRAKE MASTER CYLINDER)
BLK
J240
BLK
G304 (BASE OF LEFT "A" PILLAR)
BLK/BRN 40
BLK/BRN 2
WHT 42
WHT 1
BLU/YEL 41
X200
BLU/YEL 3
WHT/RED 3
WHT/RED 5
BLK/YEL 4
BLK/YEL 6
WHT/GRN 2
X106
WHT/GRN 4
BRAKE PEDAL POSITION SENSOR (MOUNTED TO BRAKE PEDAL BRACKET)
5380 WHT/GRN 24
BRAKE POSITION SENS SIG
5382 BLK/YEL 36
BRAKE POSITION SENS LOW REF
5381 WHT/RED 37
X2
BRAKE POSITION SENS 5V REF
COMPUTER DATA LINES SYSTEM
2500 BLU 57
HI SPEED GMLAN SERIAL DATA (+) 1
2501 WHT 37
HI SPEED GMLAN SERIAL DATA (-) 1
6311 WHT/BLU 20
X1
CRUISE/ETC/TCC BRAKE SIG
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
BLU/VIO 3
TRACTION CONTROL OFF SWITCH
G203 (BEHIND CENTER OF DASH)
BLK
J204
BLK 10
INSTRUMENT PANEL MULTI-FUNCTION SWITCH 1
560132

Fig. 8: Anti-lock Brakes Circuit (2 of 2)

ANTI-THEFT

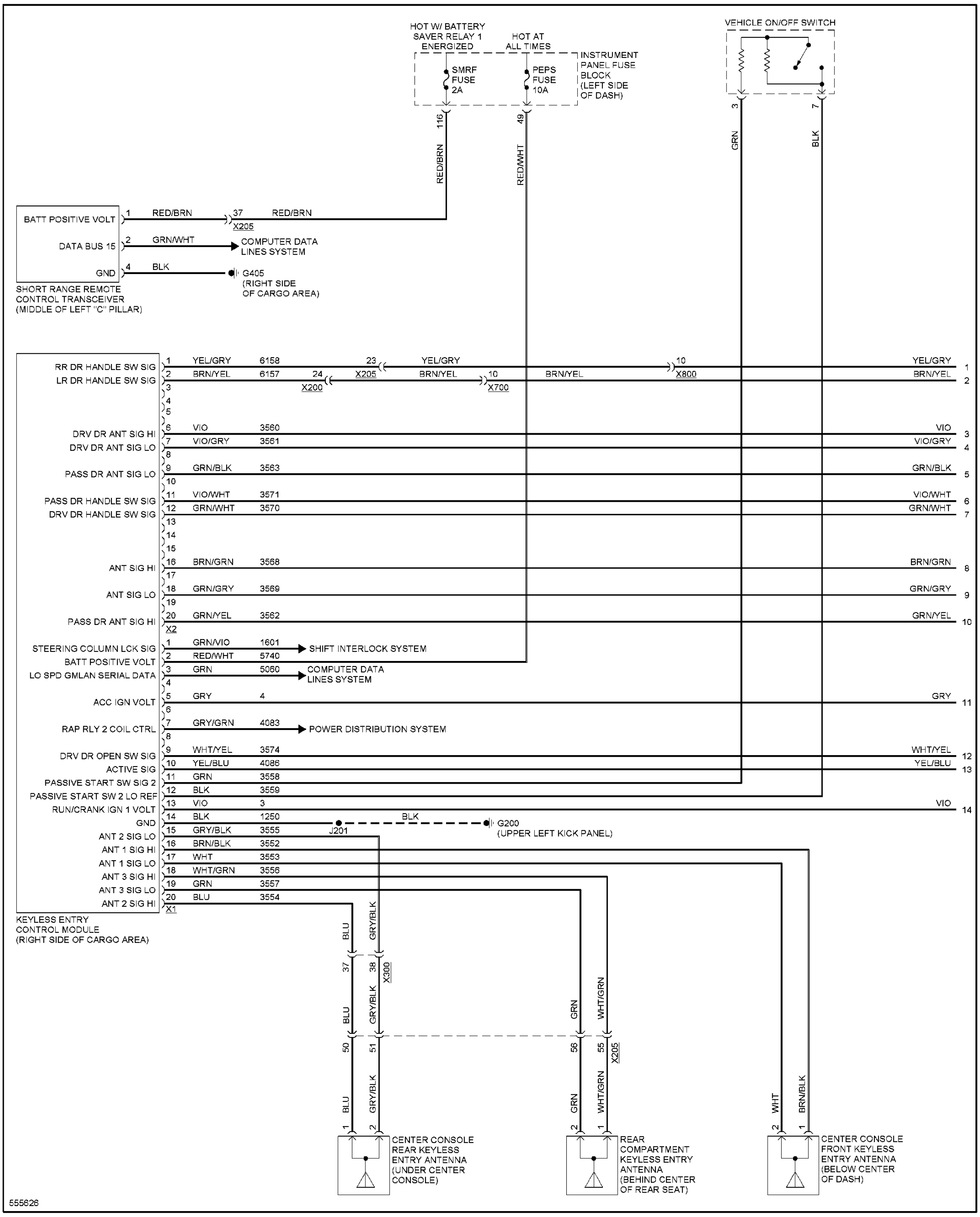

HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
HOT AT ALL TIMES
SMRF FUSE 2A
PEPS FUSE 10A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
VEHICLE ON/OFF SWITCH
116
RED/BRN
49
RED/WHT
3
GRN
7
BLK
BATT POSITIVE VOLT
DATA BUS 15
GND
1 RED/BRN
37 RED/BRN
X205
2 GRN/WHT
COMPUTER DATA LINES SYSTEM
4 BLK
G405 (RIGHT SIDE OF CARGO AREA)
SHORT RANGE REMOTE CONTROL TRANSCEIVER (MIDDLE OF LEFT "C" PILLAR)
RR DR HANDLE SW SIG
LR DR HANDLE SW SIG
1 YEL/GRY 6158
2 BRN/YEL 6157
23 YEL/GRY
24 X200
X205 BRN/YEL
10 X700
BRN/YEL
10 X800
YEL/GRY 1
BRN/YEL 2
DRV DR ANT SIG HI
DRV DR ANT SIG LO
6 VIO 3560
7 VIO/GRY 3561
VIO 3
VIO/GRY 4
PASS DR ANT SIG LO
9 GRN/BLK 3563
GRN/BLK 5
PASS DR HANDLE SW SIG
DRV DR HANDLE SW SIG
11 VIO/WHT 3571
12 GRN/WHT 3570
VIO/WHT 6
GRN/WHT 7
ANT SIG HI
16 BRN/GRN 3568
BRN/GRN 8
ANT SIG LO
18 GRN/GRY 3569
GRN/GRY 9
PASS DR ANT SIG HI
20 GRN/YEL 3562
GRN/YEL 10
X2
STEERING COLUMN LCK SIG
1 GRN/VIO 1601
SHIFT INTERLOCK SYSTEM
BATT POSITIVE VOLT
2 RED/WHT 5740
LO SPD GMLAN SERIAL DATA
3 GRN 5060
COMPUTER DATA LINES SYSTEM
ACC IGN VOLT
5 GRY 4
GRY 11
RAP RLY 2 COIL CTRL
7 GRY/GRN 4083
POWER DISTRIBUTION SYSTEM
DRV DR OPEN SW SIG
9 WHT/YEL 3574
WHT/YEL 12
ACTIVE SIG
10 YEL/BLU 4086
YEL/BLU 13
PASSIVE START SW SIG 2
11 GRN 3558
PASSIVE START SW 2 LO REF
12 BLK 3559
RUN/CRANK IGN 1 VOLT
13 VIO 3
VIO 14
GND
14 BLK 1250
J201
BLK
G200 (UPPER LEFT KICK PANEL)
ANT 2 SIG LO
15 GRY/BLK 3555
ANT 1 SIG HI
16 BRN/BLK 3552
ANT 1 SIG LO
17 WHT 3553
ANT 3 SIG HI
18 WHT/GRN 3556
ANT 3 SIG LO
19 GRN 3557
ANT 2 SIG HI
20 BLU 3554
X1
KEYLESS ENTRY CONTROL MODULE (RIGHT SIDE OF CARGO AREA)
BLU
GRY/BLK
37
38
X300
50
51
56
55
X205
GRN
WHT/GRN
WHT
BRN/BLK
CENTER CONSOLE REAR KEYLESS ENTRY ANTENNA (UNDER CENTER CONSOLE)
REAR COMPARTMENT KEYLESS ENTRY ANTENNA (BEHIND CENTER OF REAR SEAT)
CENTER CONSOLE FRONT KEYLESS ENTRY ANTENNA (BELOW CENTER OF DASH)
555626

Fig. 9: Forced Entry Circuit (1 of 4)

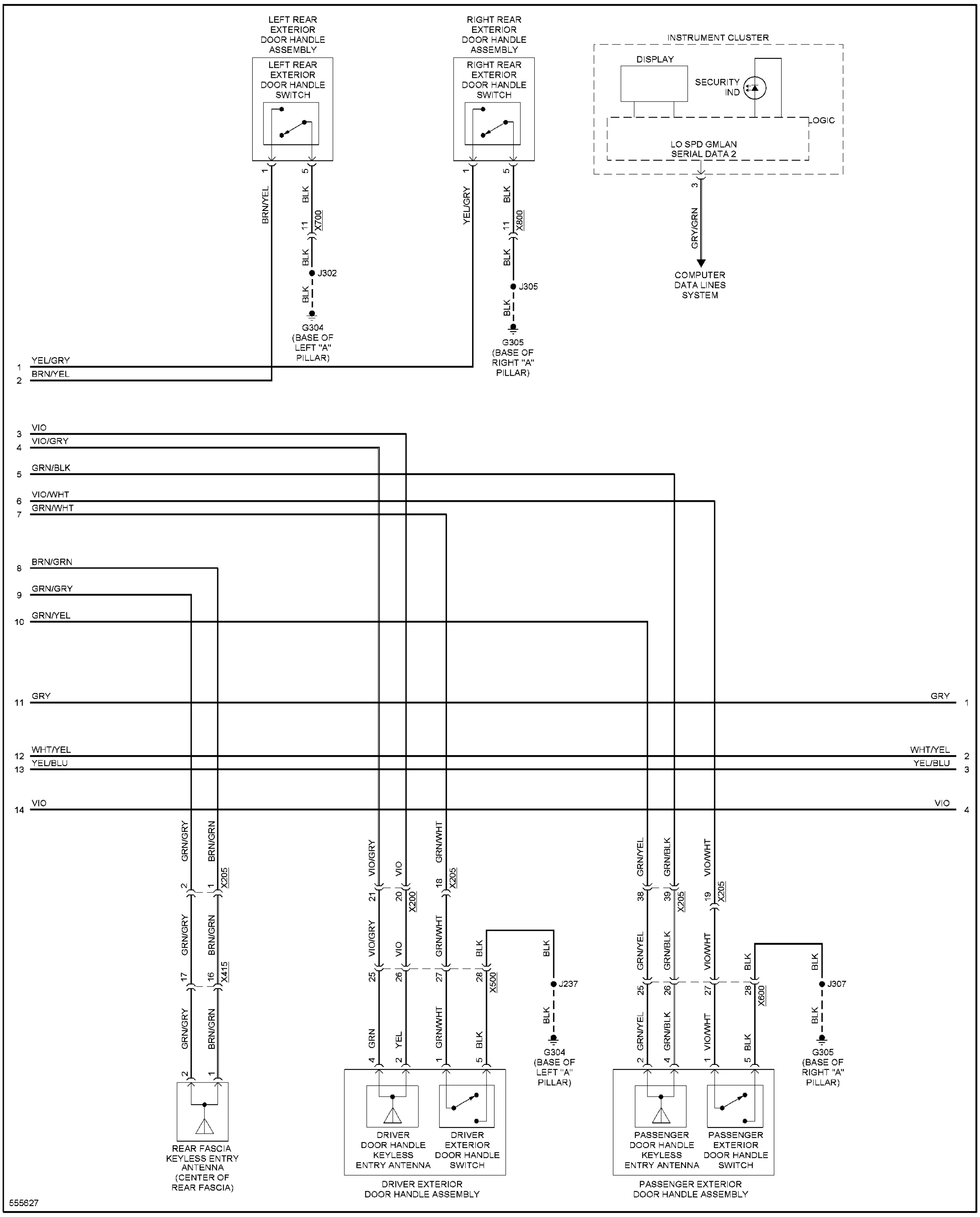

LEFT REAR EXTERIOR DOOR HANDLE ASSEMBLY
LEFT REAR EXTERIOR DOOR HANDLE SWITCH
RIGHT REAR EXTERIOR DOOR HANDLE ASSEMBLY
RIGHT REAR EXTERIOR DOOR HANDLE SWITCH
INSTRUMENT CLUSTER
DISPLAY
SECURITY IND
LOGIC
LO SPD GMLAN SERIAL DATA 2
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
1
5
BRN/YEL
BLK
11
X700
BLK
J302
BLK
G304 (BASE OF LEFT "A" PILLAR)
1
5
YEL/GRY
BLK
11
X800
BLK
J305
BLK
G305 (BASE OF RIGHT "A" PILLAR)
1 YEL/GRY
2 BRN/YEL
3 VIO
4 VIO/GRY
5 GRN/BLK
6 VIO/WHT
7 GRN/WHT
8 BRN/GRN
9 GRN/GRY
10 GRN/YEL
11 GRY
GRY 1
12 WHT/YEL
WHT/YEL 2
13 YEL/BLU
YEL/BLU 3
14 VIO
VIO 4
GRN/GRY
BRN/GRN
2
1
X205
GRN/GRY
BRN/GRN
17
16
X415
GRN/GRY
BRN/GRN
2
1
REAR FASCIA KEYLESS ENTRY ANTENNA (CENTER OF REAR FASCIA)
VIO/GRY
VIO
GRN/WHT
21
20
X200
18
X205
VIO/GRY
VIO
GRN/WHT
BLK
BLK
25
26
27
28
X500
J237
GRN
YEL
GRN/WHT
BLK
BLK
4
2
1
5
G304 (BASE OF LEFT "A" PILLAR)
DRIVER DOOR HANDLE KEYLESS ENTRY ANTENNA
DRIVER EXTERIOR DOOR HANDLE SWITCH
DRIVER EXTERIOR DOOR HANDLE ASSEMBLY
GRN/YEL
GRN/BLK
VIO/WHT
38
39
X205
19
X205
GRN/YEL
GRN/BLK
VIO/WHT
BLK
BLK
25
26
27
28
X600
J307
GRN/YEL
GRN/BLK
VIO/WHT
BLK
BLK
2
4
1
5
G305 (BASE OF RIGHT "A" PILLAR)
PASSENGER DOOR HANDLE KEYLESS ENTRY ANTENNA
PASSENGER EXTERIOR DOOR HANDLE SWITCH
PASSENGER EXTERIOR DOOR HANDLE ASSEMBLY
555627

Fig. 10: Forced Entry Circuit (2 of 4)

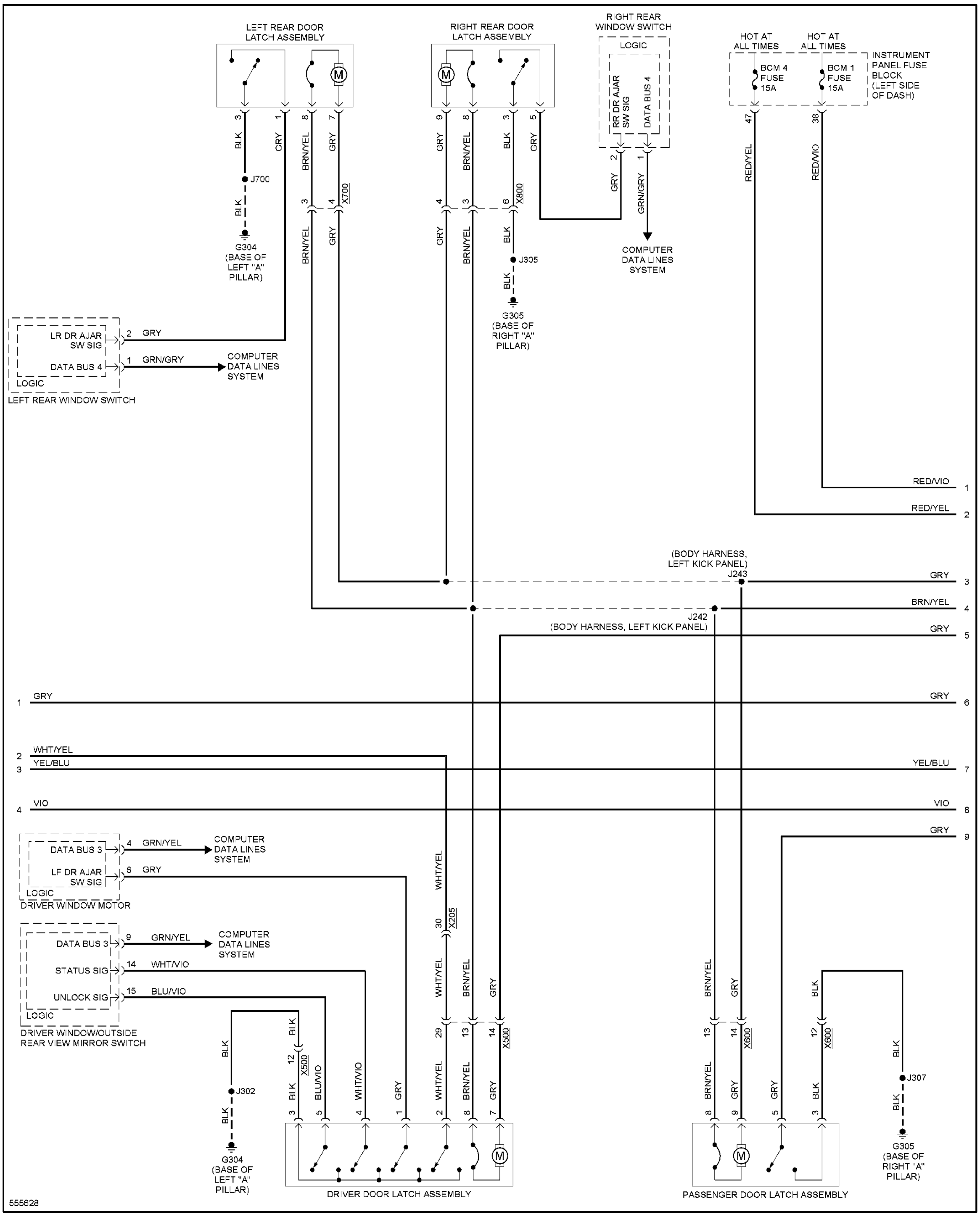

LEFT REAR DOOR LATCH ASSEMBLY
RIGHT REAR DOOR LATCH ASSEMBLY
RIGHT REAR WINDOW SWITCH
LOGIC
RR DR AJAR SW SIG
DATA BUS 4
HOT AT ALL TIMES
HOT AT ALL TIMES
BCM 4 FUSE 15A
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
M
3 BLK
1 GRY
8 BRN/YEL
7 GRY
9 GRY
8 BRN/YEL
3 BLK
5 GRY
2 GRY
1 GRN/GRY
47 RED/YEL
38 RED/VIO
J700
BLK
G304 (BASE OF LEFT "A" PILLAR)
X700
X800
J305
G305 (BASE OF RIGHT "A" PILLAR)
COMPUTER DATA LINES SYSTEM
LR DR AJAR SW SIG
DATA BUS 4
LOGIC
LEFT REAR WINDOW SWITCH
2 GRY
1 GRN/GRY
COMPUTER DATA LINES SYSTEM
RED/VIO 1
RED/YEL 2
(BODY HARNESS, LEFT KICK PANEL)
J243
GRY 3
BRN/YEL 4
J242
(BODY HARNESS, LEFT KICK PANEL)
GRY 5
1 GRY
GRY 6
2 WHT/YEL
3 YEL/BLU
YEL/BLU 7
4 VIO
VIO 8
GRY 9
DATA BUS 3
LF DR AJAR SW SIG
LOGIC
DRIVER WINDOW MOTOR
4 GRN/YEL
6 GRY
COMPUTER DATA LINES SYSTEM
WHT/YEL
30 X205
DATA BUS 3
STATUS SIG
UNLOCK SIG
LOGIC
DRIVER WINDOW/OUTSIDE REAR VIEW MIRROR SWITCH
9 GRN/YEL
14 WHT/VIO
15 BLU/VIO
COMPUTER DATA LINES SYSTEM
29 WHT/YEL
13 BRN/YEL
14 GRY
X500
12 X500
BLK
J302
G304 (BASE OF LEFT "A" PILLAR)
3 BLK
5 BLU/VIO
4 WHT/VIO
1 GRY
2 WHT/YEL
8 BRN/YEL
7 GRY
DRIVER DOOR LATCH ASSEMBLY
13 BRN/YEL
14 GRY
X600
12 BLK
X600
8 BRN/YEL
9 GRY
5 GRY
3 BLK
J307
G305 (BASE OF RIGHT "A" PILLAR)
PASSENGER DOOR LATCH ASSEMBLY
555628

Fig. 11: Forced Entry Circuit (3 of 4)

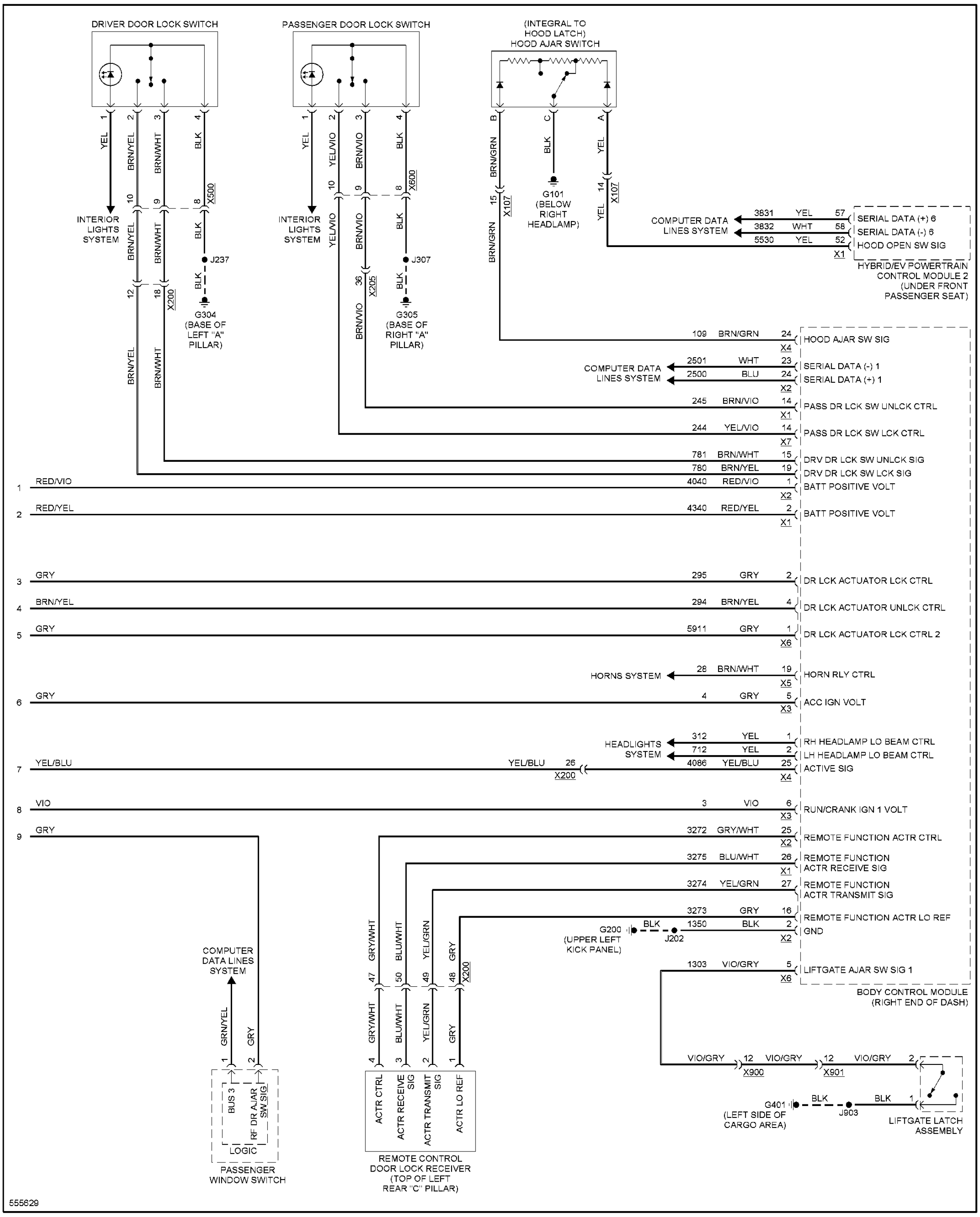

DRIVER DOOR LOCK SWITCH
PASSENGER DOOR LOCK SWITCH
(INTEGRAL TO HOOD LATCH) HOOD AJAR SWITCH
YEL
BRN/YEL
BRN/WHT
BLK
YEL/VIO
BRN/VIO
BRN/GRN
X500
X600
X107
X200
X205
INTERIOR LIGHTS SYSTEM
J237
J307
G304 (BASE OF LEFT "A" PILLAR)
G305 (BASE OF RIGHT "A" PILLAR)
G101 (BELOW RIGHT HEADLAMP)
COMPUTER DATA LINES SYSTEM
3831 YEL 57 SERIAL DATA (+) 6
3832 WHT 58 SERIAL DATA (-) 6
5530 YEL 52 HOOD OPEN SW SIG
X1
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
109 BRN/GRN 24 X4 HOOD AJAR SW SIG
2501 WHT 23 SERIAL DATA (-) 1
2500 BLU 24 X2 SERIAL DATA (+) 1
245 BRN/VIO 14 X1 PASS DR LCK SW UNLCK CTRL
244 YEL/VIO 14 X7 PASS DR LCK SW LCK CTRL
781 BRN/WHT 15 DRV DR LCK SW UNLCK SIG
780 BRN/YEL 19 DRV DR LCK SW LCK SIG
1 RED/VIO 4040 RED/VIO 1 X2 BATT POSITIVE VOLT
2 RED/YEL 4340 RED/YEL 2 X1 BATT POSITIVE VOLT
3 GRY 295 GRY 2 DR LCK ACTUATOR LCK CTRL
4 BRN/YEL 294 BRN/YEL 4 DR LCK ACTUATOR UNLCK CTRL
5 GRY 5911 GRY 1 X6 DR LCK ACTUATOR LCK CTRL 2
HORNS SYSTEM 28 BRN/WHT 19 X5 HORN RLY CTRL
6 GRY 4 GRY 5 X3 ACC IGN VOLT
HEADLIGHTS SYSTEM
312 YEL 1 RH HEADLAMP LO BEAM CTRL
712 YEL 2 LH HEADLAMP LO BEAM CTRL
7 YEL/BLU 26 X200 4086 YEL/BLU 25 X4 ACTIVE SIG
8 VIO 3 VIO 6 X3 RUN/CRANK IGN 1 VOLT
9 GRY
3272 GRY/WHT 25 X2 REMOTE FUNCTION ACTR CTRL
3275 BLU/WHT 26 X1 REMOTE FUNCTION ACTR RECEIVE SIG
3274 YEL/GRN 27 REMOTE FUNCTION ACTR TRANSMIT SIG
3273 GRY 16 REMOTE FUNCTION ACTR LO REF
G200 BLK J202 1350 BLK 2 X2 GND
(UPPER LEFT KICK PANEL)
1303 VIO/GRY 5 X6 LIFTGATE AJAR SW SIG 1
BODY CONTROL MODULE (RIGHT END OF DASH)
GRY/WHT 47
BLU/WHT 50
YEL/GRN 49
GRY 48
COMPUTER DATA LINES SYSTEM
GRN/YEL
BUS 3
RF DR AJAR SW SIG
LOGIC
PASSENGER WINDOW SWITCH
ACTR CTRL
ACTR RECEIVE SIG
ACTR TRANSMIT SIG
ACTR LO REF
REMOTE CONTROL DOOR LOCK RECEIVER (TOP OF LEFT REAR "C" PILLAR)
VIO/GRY 12 X900 VIO/GRY 12 X901 VIO/GRY
G401 BLK J903 BLK
(LEFT SIDE OF CARGO AREA)
LIFTGATE LATCH ASSEMBLY
555629

Fig. 12: Forced Entry Circuit (4 of 4)

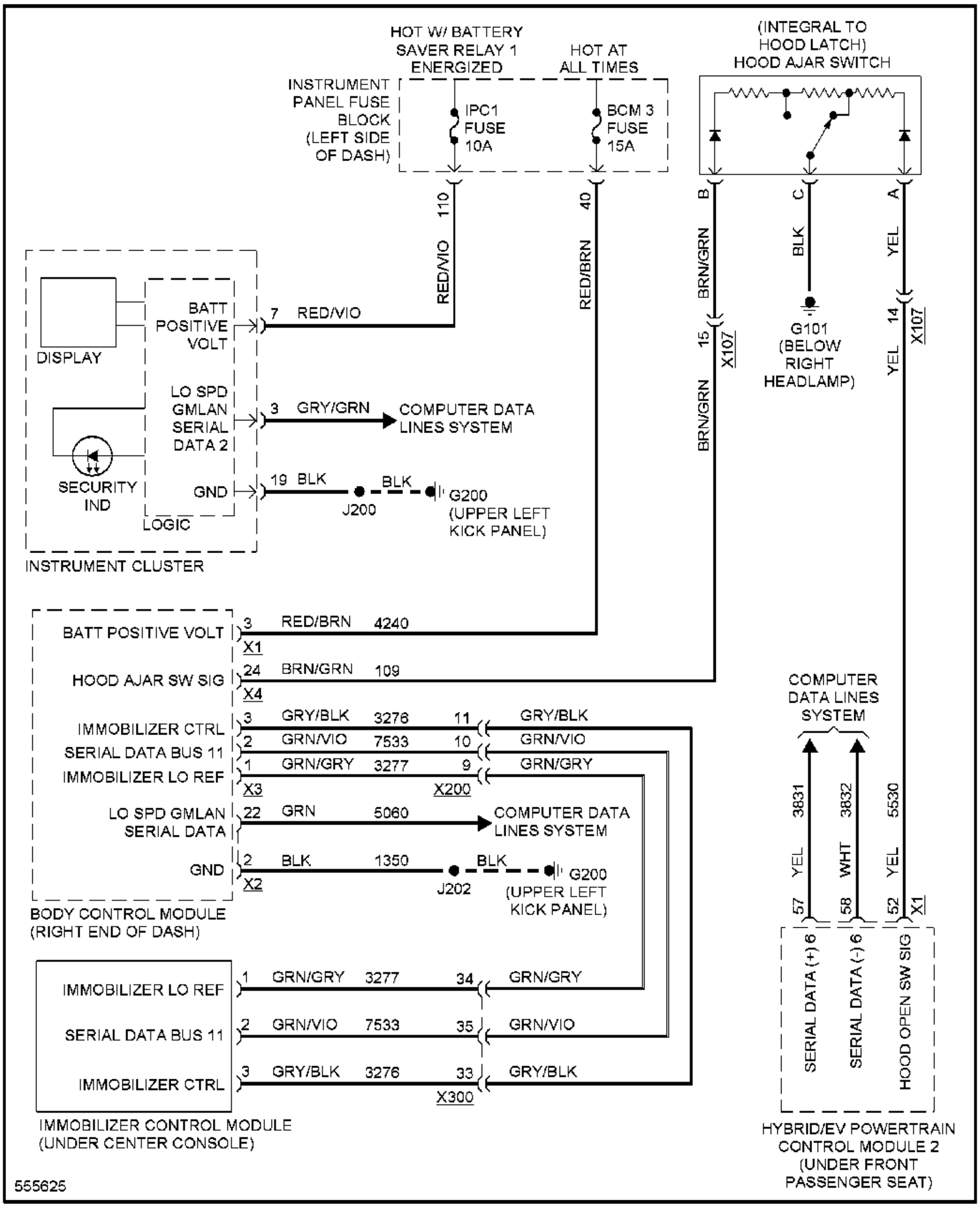

HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
HOT AT ALL TIMES
(INTEGRAL TO HOOD LATCH) HOOD AJAR SWITCH
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
IPC1 FUSE 10A
BCM 3 FUSE 15A
110
RED/VIO
40
RED/BRN
B
BRN/GRN
C
BLK
A
YEL
15
X107
14
X107
G101 (BELOW RIGHT HEADLAMP)
DISPLAY
BATT POSITIVE VOLT
7 RED/VIO
LO SPD GMLAN SERIAL DATA 2
3 GRY/GRN
COMPUTER DATA LINES SYSTEM
SECURITY IND
GND
19 BLK
BLK
J200
G200 (UPPER LEFT KICK PANEL)
LOGIC
INSTRUMENT CLUSTER
BATT POSITIVE VOLT
3 RED/BRN 4240
X1
HOOD AJAR SW SIG
24 BRN/GRN 109
X4
IMMOBILIZER CTRL
3 GRY/BLK 3276 11 GRY/BLK
SERIAL DATA BUS 11
2 GRN/VIO 7533 10 GRN/VIO
IMMOBILIZER LO REF
1 GRN/GRY 3277 9 GRN/GRY
X3
X200
LO SPD GMLAN SERIAL DATA
22 GRN 5060
COMPUTER DATA LINES SYSTEM
GND
2 BLK 1350
BLK
X2
J202
G200 (UPPER LEFT KICK PANEL)
BODY CONTROL MODULE (RIGHT END OF DASH)
COMPUTER DATA LINES SYSTEM
3831 YEL 57
3832 WHT 58
5530 YEL 52
X1
SERIAL DATA (+) 6
SERIAL DATA (-) 6
HOOD OPEN SW SIG
IMMOBILIZER LO REF
1 GRN/GRY 3277 34 GRN/GRY
SERIAL DATA BUS 11
2 GRN/VIO 7533 35 GRN/VIO
IMMOBILIZER CTRL
3 GRY/BLK 3276 33 GRY/BLK
X300
IMMOBILIZER CONTROL MODULE (UNDER CENTER CONSOLE)
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
555625

Fig. 13: Pass-Key Circuit

BODY CONTROL MODULES

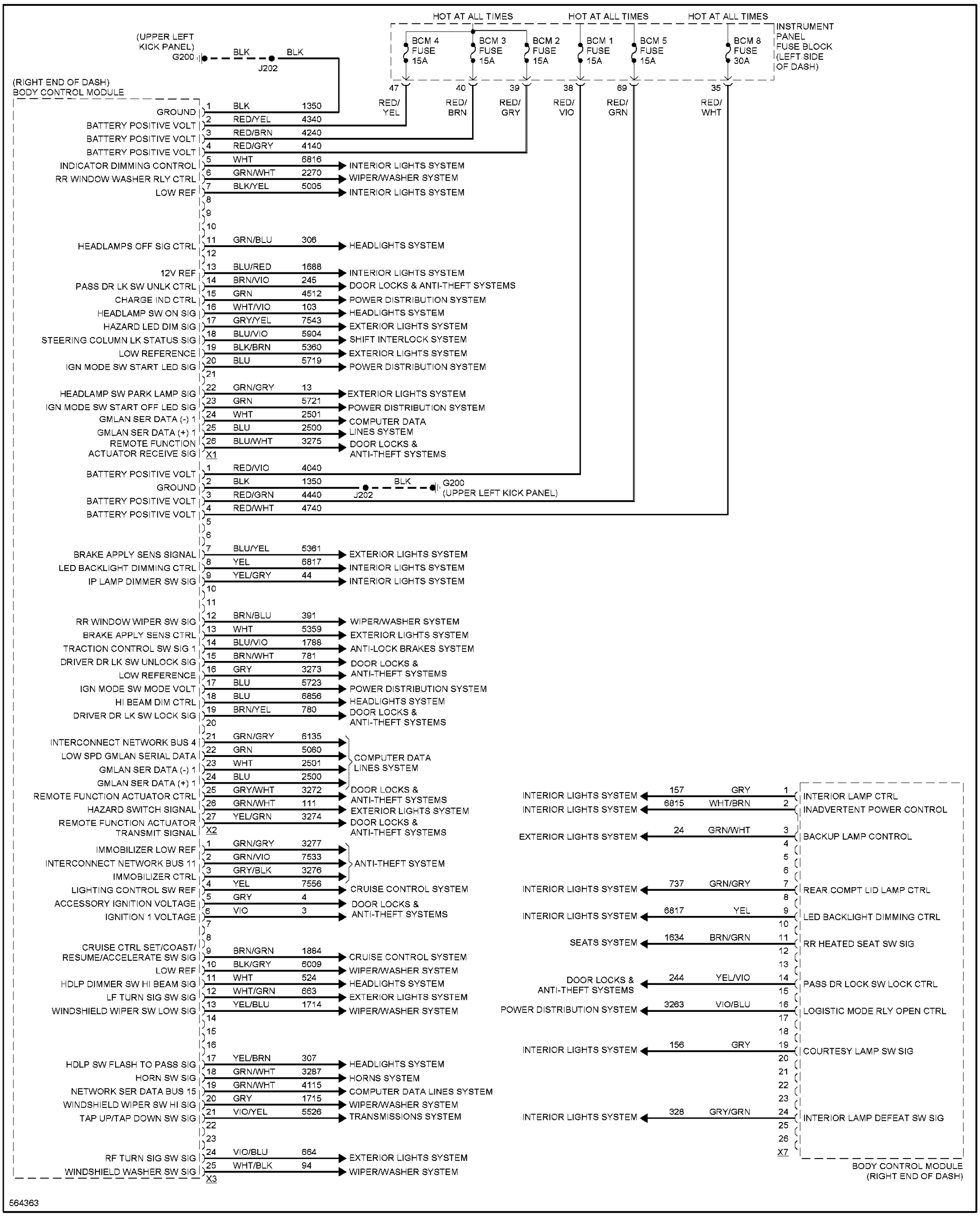

HOT AT ALL TIMES
HOT AT ALL TIMES
HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
BCM 4 FUSE 15A
BCM 3 FUSE 15A
BCM 2 FUSE 15A
BCM 1 FUSE 15A
BCM 5 FUSE 15A
BCM 8 FUSE 30A
47 RED/YEL
40 RED/BRN
39 RED/GRY
38 RED/VIO
69 RED/GRN
35 RED/WHT
(UPPER LEFT KICK PANEL) G200
BLK
J202
BLK
(RIGHT END OF DASH) BODY CONTROL MODULE
GROUND 1 BLK 1350
BATTERY POSITIVE VOLT 2 RED/YEL 4340
BATTERY POSITIVE VOLT 3 RED/BRN 4240
BATTERY POSITIVE VOLT 4 RED/GRY 4140
INDICATOR DIMMING CONTROL 5 WHT 6816 INTERIOR LIGHTS SYSTEM
RR WINDOW WASHER RLY CTRL 6 GRN/WHT 2270 WIPER/WASHER SYSTEM
LOW REF 7 BLK/YEL 5005 INTERIOR LIGHTS SYSTEM
8
9
10
HEADLAMPS OFF SIG CTRL 11 GRN/BLU 306 HEADLIGHTS SYSTEM
12
12V REF 13 BLU/RED 1688 INTERIOR LIGHTS SYSTEM
PASS DR LK SW UNLK CTRL 14 BRN/VIO 245 DOOR LOCKS & ANTI-THEFT SYSTEMS
CHARGE IND CTRL 15 GRN 4512 POWER DISTRIBUTION SYSTEM
HEADLAMP SW ON SIG 16 WHT/VIO 103 HEADLIGHTS SYSTEM
HAZARD LED DIM SIG 17 GRY/YEL 7543 EXTERIOR LIGHTS SYSTEM
STEERING COLUMN LK STATUS SIG 18 BLU/VIO 5904 SHIFT INTERLOCK SYSTEM
LOW REFERENCE 19 BLK/BRN 5360 EXTERIOR LIGHTS SYSTEM
IGN MODE SW START LED SIG 20 BLU 5719 POWER DISTRIBUTION SYSTEM
21
HEADLAMP SW PARK LAMP SIG 22 GRN/GRY 13 EXTERIOR LIGHTS SYSTEM
IGN MODE SW START OFF LED SIG 23 GRN 5721 POWER DISTRIBUTION SYSTEM
GMLAN SER DATA (-) 1 24 WHT 2501 COMPUTER DATA
GMLAN SER DATA (+) 1 25 BLU 2500 LINES SYSTEM
REMOTE FUNCTION ACTUATOR RECEIVE SIG 26 BLU/WHT 3275 DOOR LOCKS & ANTI-THEFT SYSTEMS
X1
BATTERY POSITIVE VOLT 1 RED/VIO 4040
GROUND 2 BLK 1350 BLK G200 (UPPER LEFT KICK PANEL)
J202
BATTERY POSITIVE VOLT 3 RED/GRN 4440
BATTERY POSITIVE VOLT 4 RED/WHT 4740
5
6
BRAKE APPLY SENS SIGNAL 7 BLU/YEL 5361 EXTERIOR LIGHTS SYSTEM
LED BACKLIGHT DIMMING CTRL 8 YEL 6817 INTERIOR LIGHTS SYSTEM
IP LAMP DIMMER SW SIG 9 YEL/GRY 44 INTERIOR LIGHTS SYSTEM
10
11
RR WINDOW WIPER SW SIG 12 BRN/BLU 391 WIPER/WASHER SYSTEM
BRAKE APPLY SENS CTRL 13 WHT 5359 EXTERIOR LIGHTS SYSTEM
TRACTION CONTROL SW SIG 1 14 BLU/VIO 1768 ANTI-LOCK BRAKES SYSTEM
DRIVER DR LK SW UNLOCK SIG 15 BRN/WHT 781 DOOR LOCKS & ANTI-THEFT SYSTEMS
LOW REFERENCE 16 GRY 3273
IGN MODE SW MODE VOLT 17 BLU 5723 POWER DISTRIBUTION SYSTEM
HI BEAM DIM CTRL 18 BLU 6856 HEADLIGHTS SYSTEM
DRIVER DR LK SW LOCK SIG 19 BRN/YEL 780 DOOR LOCKS & ANTI-THEFT SYSTEMS
20
INTERCONNECT NETWORK BUS 4 21 GRN/GRY 6135
LOW SPD GMLAN SERIAL DATA 22 GRN 5060 COMPUTER DATA LINES SYSTEM
GMLAN SER DATA (-) 1 23 WHT 2501
GMLAN SER DATA (+) 1 24 BLU 2500
REMOTE FUNCTION ACTUATOR CTRL 25 GRY/WHT 3272 DOOR LOCKS & ANTI-THEFT SYSTEMS
HAZARD SWITCH SIGNAL 26 GRN/WHT 111 EXTERIOR LIGHTS SYSTEM
REMOTE FUNCTION ACTUATOR TRANSMIT SIGNAL 27 YEL/GRN 3274 DOOR LOCKS & ANTI-THEFT SYSTEMS
X2
IMMOBILIZER LOW REF 1 GRN/GRY 3277
INTERCONNECT NETWORK BUS 11 2 GRN/VIO 7533 ANTI-THEFT SYSTEM
IMMOBILIZER CTRL 3 GRY/BLK 3276
LIGHTING CONTROL SW REF 4 YEL 7556 CRUISE CONTROL SYSTEM
ACCESSORY IGNITION VOLTAGE 5 GRY 4 DOOR LOCKS & ANTI-THEFT SYSTEMS
IGNITION 1 VOLTAGE 6 VIO 3
7
8
CRUISE CTRL SET/COAST/ RESUME/ACCELERATE SW SIG 9 BRN/GRN 1864 CRUISE CONTROL SYSTEM
LOW REF 10 BLK/GRY 6009 WIPER/WASHER SYSTEM
HDLP DIMMER SW HI BEAM SIG 11 WHT 524 HEADLIGHTS SYSTEM
LF TURN SIG SW SIG 12 WHT/GRN 663 EXTERIOR LIGHTS SYSTEM
WINDSHIELD WIPER SW LOW SIG 13 YEL/BLU 1714 WIPER/WASHER SYSTEM
14
15
16
HDLP SW FLASH TO PASS SIG 17 YEL/BRN 307 HEADLIGHTS SYSTEM
HORN SW SIG 18 GRN/WHT 3287 HORNS SYSTEM
NETWORK SER DATA BUS 15 19 GRN/WHT 4115 COMPUTER DATA LINES SYSTEM
WINDSHIELD WIPER SW HI SIG 20 GRY 1715 WIPER/WASHER SYSTEM
TAP UP/TAP DOWN SW SIG 21 VIO/YEL 5526 TRANSMISSIONS SYSTEM
22
23
RF TURN SIG SW SIG 24 VIO/BLU 664 EXTERIOR LIGHTS SYSTEM
WINDSHIELD WASHER SW SIG 25 WHT/BLK 94 WIPER/WASHER SYSTEM
X3
INTERIOR LIGHTS SYSTEM 157 GRY 1 INTERIOR LAMP CTRL
INTERIOR LIGHTS SYSTEM 6815 WHT/BRN 2 INADVERTENT POWER CONTROL
EXTERIOR LIGHTS SYSTEM 24 GRN/WHT 3 BACKUP LAMP CONTROL
4
5
6
INTERIOR LIGHTS SYSTEM 737 GRN/GRY 7 REAR COMPT LID LAMP CTRL
8
INTERIOR LIGHTS SYSTEM 6817 YEL 9 LED BACKLIGHT DIMMING CTRL
10
SEATS SYSTEM 1634 BRN/GRN 11 RR HEATED SEAT SW SIG
12
13
DOOR LOCKS & ANTI-THEFT SYSTEMS 244 YEL/VIO 14 PASS DR LOCK SW LOCK CTRL
15
POWER DISTRIBUTION SYSTEM 3263 VIO/BLU 16 LOGISTIC MODE RLY OPEN CTRL
17
18
INTERIOR LIGHTS SYSTEM 156 GRY 19 COURTESY LAMP SW SIG
20
21
22
23
INTERIOR LIGHTS SYSTEM 328 GRY/GRN 24 INTERIOR LAMP DEFEAT SW SIG
25
26
X7
BODY CONTROL MODULE (RIGHT END OF DASH)
564363

Fig. 14: Body Control Modules Circuit (1 of 2)

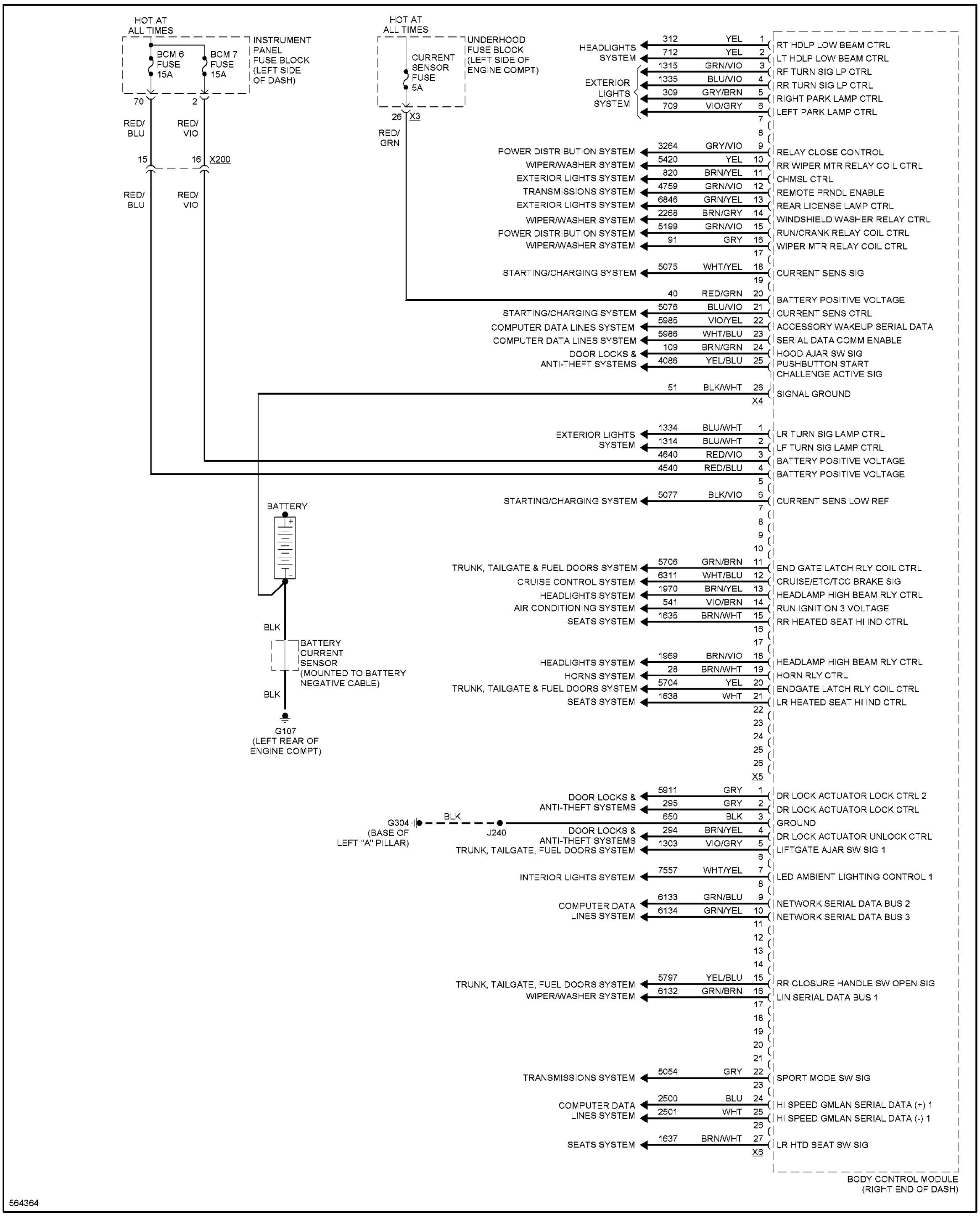

HOT AT ALL TIMES
BCM 6 FUSE 15A
BCM 7 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
70
2
RED/ BLU
RED/ VIO
15
16
X200
RED/ BLU
RED/ VIO
HOT AT ALL TIMES
CURRENT SENSOR FUSE 5A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
26
X3
RED/ GRN
HEADLIGHTS SYSTEM
EXTERIOR LIGHTS SYSTEM
312 YEL 1 RT HDLP LOW BEAM CTRL
712 YEL 2 LT HDLP LOW BEAM CTRL
1315 GRN/VIO 3 RF TURN SIG LP CTRL
1335 BLU/VIO 4 RR TURN SIG LP CTRL
309 GRY/BRN 5 RIGHT PARK LAMP CTRL
709 VIO/GRY 6 LEFT PARK LAMP CTRL
7
8
POWER DISTRIBUTION SYSTEM 3264 GRY/VIO 9 RELAY CLOSE CONTROL
WIPER/WASHER SYSTEM 5420 YEL 10 RR WIPER MTR RELAY COIL CTRL
EXTERIOR LIGHTS SYSTEM 820 BRN/YEL 11 CHMSL CTRL
TRANSMISSIONS SYSTEM 4759 GRN/VIO 12 REMOTE PRNDL ENABLE
EXTERIOR LIGHTS SYSTEM 6846 GRN/YEL 13 REAR LICENSE LAMP CTRL
WIPER/WASHER SYSTEM 2268 BRN/GRY 14 WINDSHIELD WASHER RELAY CTRL
POWER DISTRIBUTION SYSTEM 5199 GRN/VIO 15 RUN/CRANK RELAY COIL CTRL
WIPER/WASHER SYSTEM 91 GRY 16 WIPER MTR RELAY COIL CTRL
17
STARTING/CHARGING SYSTEM 5075 WHT/YEL 18 CURRENT SENS SIG
19
40 RED/GRN 20 BATTERY POSITIVE VOLTAGE
STARTING/CHARGING SYSTEM 5076 BLU/VIO 21 CURRENT SENS CTRL
COMPUTER DATA LINES SYSTEM 5985 VIO/YEL 22 ACCESSORY WAKEUP SERIAL DATA
COMPUTER DATA LINES SYSTEM 5986 WHT/BLU 23 SERIAL DATA COMM ENABLE
DOOR LOCKS & ANTI-THEFT SYSTEMS 109 BRN/GRN 24 HOOD AJAR SW SIG
4086 YEL/BLU 25 PUSHBUTTON START CHALLENGE ACTIVE SIG
51 BLK/WHT 26 SIGNAL GROUND
X4
EXTERIOR LIGHTS SYSTEM 1334 BLU/WHT 1 LR TURN SIG LAMP CTRL
1314 BLU/WHT 2 LF TURN SIG LAMP CTRL
4640 RED/VIO 3 BATTERY POSITIVE VOLTAGE
4540 RED/BLU 4 BATTERY POSITIVE VOLTAGE
5
STARTING/CHARGING SYSTEM 5077 BLK/VIO 6 CURRENT SENS LOW REF
7
8
9
10
TRUNK, TAILGATE & FUEL DOORS SYSTEM 5706 GRN/BRN 11 END GATE LATCH RLY COIL CTRL
CRUISE CONTROL SYSTEM 6311 WHT/BLU 12 CRUISE/ETC/TCC BRAKE SIG
HEADLIGHTS SYSTEM 1970 BRN/YEL 13 HEADLAMP HIGH BEAM RLY CTRL
AIR CONDITIONING SYSTEM 541 VIO/BRN 14 RUN IGNITION 3 VOLTAGE
SEATS SYSTEM 1635 BRN/WHT 15 RR HEATED SEAT HI IND CTRL
16
17
HEADLIGHTS SYSTEM 1969 BRN/VIO 18 HEADLAMP HIGH BEAM RLY CTRL
HORNS SYSTEM 28 BRN/WHT 19 HORN RLY CTRL
TRUNK, TAILGATE & FUEL DOORS SYSTEM 5704 YEL 20 ENDGATE LATCH RLY COIL CTRL
SEATS SYSTEM 1638 WHT 21 LR HEATED SEAT HI IND CTRL
22
23
24
25
26
X5
BATTERY
BLK
BATTERY CURRENT SENSOR (MOUNTED TO BATTERY NEGATIVE CABLE)
BLK
G107 (LEFT REAR OF ENGINE COMPT)
DOOR LOCKS & ANTI-THEFT SYSTEMS 5911 GRY 1 DR LOCK ACTUATOR LOCK CTRL 2
295 GRY 2 DR LOCK ACTUATOR LOCK CTRL
650 BLK 3 GROUND
G304 (BASE OF LEFT "A" PILLAR)
BLK
J240
DOOR LOCKS & ANTI-THEFT SYSTEMS 294 BRN/YEL 4 DR LOCK ACTUATOR UNLOCK CTRL
TRUNK, TAILGATE, FUEL DOORS SYSTEM 1303 VIO/GRY 5 LIFTGATE AJAR SW SIG 1
6
INTERIOR LIGHTS SYSTEM 7557 WHT/YEL 7 LED AMBIENT LIGHTING CONTROL 1
8
COMPUTER DATA LINES SYSTEM 6133 GRN/BLU 9 NETWORK SERIAL DATA BUS 2
6134 GRN/YEL 10 NETWORK SERIAL DATA BUS 3
11
12
13
14
TRUNK, TAILGATE, FUEL DOORS SYSTEM 5797 YEL/BLU 15 RR CLOSURE HANDLE SW OPEN SIG
WIPER/WASHER SYSTEM 6132 GRN/BRN 16 LIN SERIAL DATA BUS 1
17
18
19
20
21
TRANSMISSIONS SYSTEM 5054 GRY 22 SPORT MODE SW SIG
23
COMPUTER DATA LINES SYSTEM 2500 BLU 24 HI SPEED GMLAN SERIAL DATA (+) 1
2501 WHT 25 HI SPEED GMLAN SERIAL DATA (-) 1
26
SEATS SYSTEM 1637 BRN/WHT 27 LR HTD SEAT SW SIG
X6
BODY CONTROL MODULE (RIGHT END OF DASH)
564364

Fig. 15: Body Control Modules Circuit (2 of 2)

COMPUTER DATA LINES

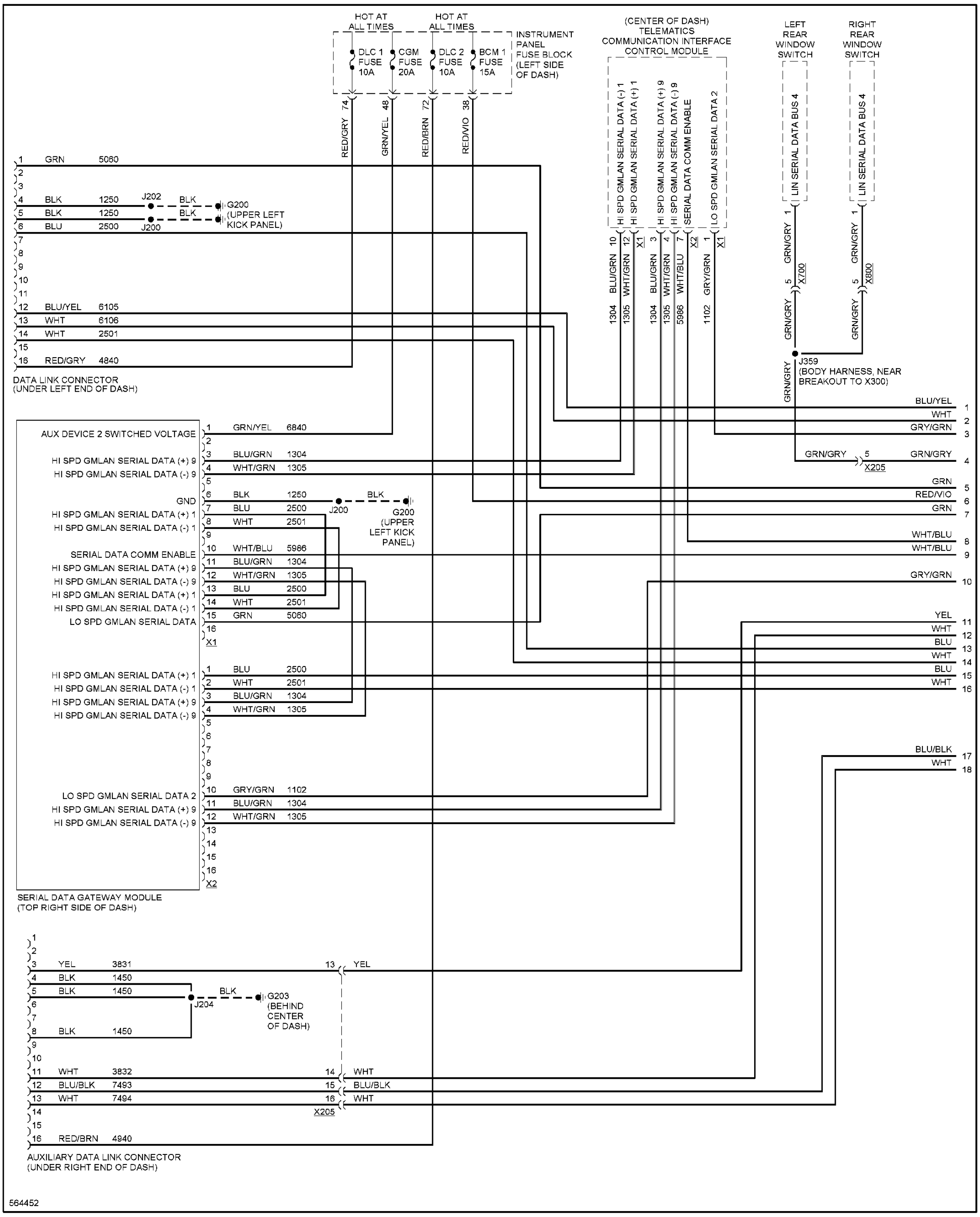

HOT AT ALL TIMES
HOT AT ALL TIMES
DLC 1 FUSE 10A
CGM FUSE 20A
DLC 2 FUSE 10A
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
74 RED/GRY
48 GRN/YEL
72 RED/BRN
38 RED/VIO
(CENTER OF DASH) TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE
HI SPD GMLAN SERIAL DATA (-) 1
HI SPD GMLAN SERIAL DATA (+) 1
HI SPD GMLAN SERIAL DATA (+) 9
HI SPD GMLAN SERIAL DATA (-) 9
SERIAL DATA COMM ENABLE
LO SPD GMLAN SERIAL DATA 2
10 12 X1 3 4 7 X2 1 X1
BLU/GRN 1304
WHT/GRN 1305
BLU/GRN 1304
WHT/GRN 1305
WHT/BLU 5986
GRY/GRN 1102
LEFT REAR WINDOW SWITCH
LIN SERIAL DATA BUS 4
1 GRN/GRY
5 X700
GRN/GRY
RIGHT REAR WINDOW SWITCH
LIN SERIAL DATA BUS 4
1 GRN/GRY
5 X800
GRN/GRY
J359 (BODY HARNESS, NEAR BREAKOUT TO X300)
GRN/GRY
1 GRN 5060
2
3
4 BLK 1250 J202 BLK
5 BLK 1250 BLK
G200 (UPPER LEFT KICK PANEL)
6 BLU 2500 J200
7
8
9
10
11
12 BLU/YEL 6105
13 WHT 6106
14 WHT 2501
15
16 RED/GRY 4840
DATA LINK CONNECTOR (UNDER LEFT END OF DASH)
AUX DEVICE 2 SWITCHED VOLTAGE
HI SPD GMLAN SERIAL DATA (+) 9
HI SPD GMLAN SERIAL DATA (-) 9
GND
HI SPD GMLAN SERIAL DATA (+) 1
HI SPD GMLAN SERIAL DATA (-) 1
SERIAL DATA COMM ENABLE
HI SPD GMLAN SERIAL DATA (+) 9
HI SPD GMLAN SERIAL DATA (-) 9
HI SPD GMLAN SERIAL DATA (+) 1
HI SPD GMLAN SERIAL DATA (-) 1
LO SPD GMLAN SERIAL DATA
1 GRN/YEL 6840
2
3 BLU/GRN 1304
4 WHT/GRN 1305
5
6 BLK 1250 BLK
J200
G200 (UPPER LEFT KICK PANEL)
7 BLU 2500
8 WHT 2501
9
10 WHT/BLU 5986
11 BLU/GRN 1304
12 WHT/GRN 1305
13 BLU 2500
14 WHT 2501
15 GRN 5060
16
X1
HI SPD GMLAN SERIAL DATA (+) 1
HI SPD GMLAN SERIAL DATA (-) 1
HI SPD GMLAN SERIAL DATA (+) 9
HI SPD GMLAN SERIAL DATA (-) 9
1 BLU 2500
2 WHT 2501
3 BLU/GRN 1304
4 WHT/GRN 1305
5
6
7
8
9
LO SPD GMLAN SERIAL DATA 2
HI SPD GMLAN SERIAL DATA (+) 9
HI SPD GMLAN SERIAL DATA (-) 9
10 GRY/GRN 1102
11 BLU/GRN 1304
12 WHT/GRN 1305
13
14
15
16
X2
SERIAL DATA GATEWAY MODULE (TOP RIGHT SIDE OF DASH)
BLU/YEL 1
WHT 2
GRY/GRN 3
GRN/GRY 5 X205 GRN/GRY 4
GRN 5
RED/VIO 6
GRN 7
WHT/BLU 8
WHT/BLU 9
GRY/GRN 10
YEL 11
WHT 12
BLU 13
WHT 14
BLU 15
WHT 16
BLU/BLK 17
WHT 18
1
2
3 YEL 3831
4 BLK 1450
5 BLK 1450
J204
BLK
G203 (BEHIND CENTER OF DASH)
6
7
8 BLK 1450
9
10
11 WHT 3832
12 BLU/BLK 7493
13 WHT 7494
14
15
16 RED/BRN 4940
13 YEL
14 WHT
15 BLU/BLK
16 WHT
X205
AUXILIARY DATA LINK CONNECTOR (UNDER RIGHT END OF DASH)
564452

Fig. 16: Computer Data Lines Circuit (1 of 5)

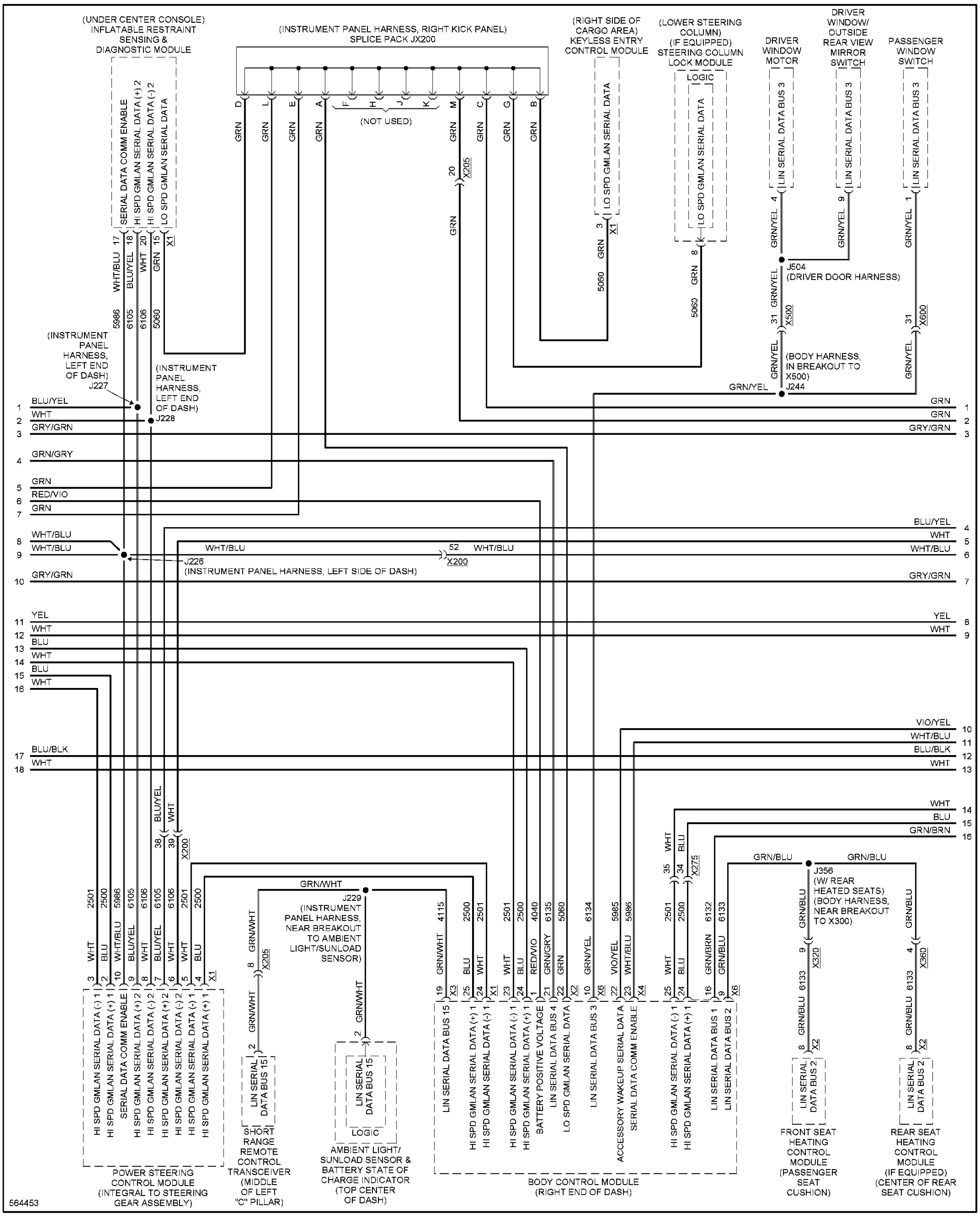

(UNDER CENTER CONSOLE) INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE
SERIAL DATA COMM ENABLE
HI SPD GMLAN SERIAL DATA (+) 2
HI SPD GMLAN SERIAL DATA (-) 2
LO SPD GMLAN SERIAL DATA
(INSTRUMENT PANEL HARNESS, RIGHT KICK PANEL) SPLICE PACK JX200
(NOT USED)
(RIGHT SIDE OF CARGO AREA) KEYLESS ENTRY CONTROL MODULE
LO SPD GMLAN SERIAL DATA
(LOWER STEERING COLUMN) (IF EQUIPPED) STEERING COLUMN LOCK MODULE
LOGIC
DRIVER WINDOW MOTOR
DRIVER WINDOW/ OUTSIDE REAR VIEW MIRROR SWITCH
PASSENGER WINDOW SWITCH
LIN SERIAL DATA BUS 3
J504 (DRIVER DOOR HARNESS)
(BODY HARNESS, IN BREAKOUT TO X500) J244
(INSTRUMENT PANEL HARNESS, LEFT END OF DASH) J227
(INSTRUMENT PANEL HARNESS, LEFT END OF DASH) J228
J226 (INSTRUMENT PANEL HARNESS, LEFT SIDE OF DASH)
X200
X205
X500
X600
X275
X320
X360
J229 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO AMBIENT LIGHT/SUNLOAD SENSOR)
J356 (W/ REAR HEATED SEATS) (BODY HARNESS, NEAR BREAKOUT TO X300)
POWER STEERING CONTROL MODULE (INTEGRAL TO STEERING GEAR ASSEMBLY)
SHORT RANGE REMOTE CONTROL TRANSCEIVER (MIDDLE OF LEFT "C" PILLAR)
LIN SERIAL DATA BUS 15
AMBIENT LIGHT/ SUNLOAD SENSOR & BATTERY STATE OF CHARGE INDICATOR (TOP CENTER OF DASH)
BODY CONTROL MODULE (RIGHT END OF DASH)
LIN SERIAL DATA BUS 4
BATTERY POSITIVE VOLTAGE
ACCESSORY WAKEUP SERIAL DATA
LIN SERIAL DATA BUS 1
LIN SERIAL DATA BUS 2
FRONT SEAT HEATING CONTROL MODULE (PASSENGER SEAT CUSHION)
REAR SEAT HEATING CONTROL MODULE (IF EQUIPPED) (CENTER OF REAR SEAT CUSHION)
HI SPD GMLAN SERIAL DATA (-) 1
HI SPD GMLAN SERIAL DATA (+) 1
5986
6105
6106
5060
2501
2500
4115
4040
6135
6134
5985
6132
6133
564453

Fig. 17: Computer Data Lines Circuit (2 of 5)

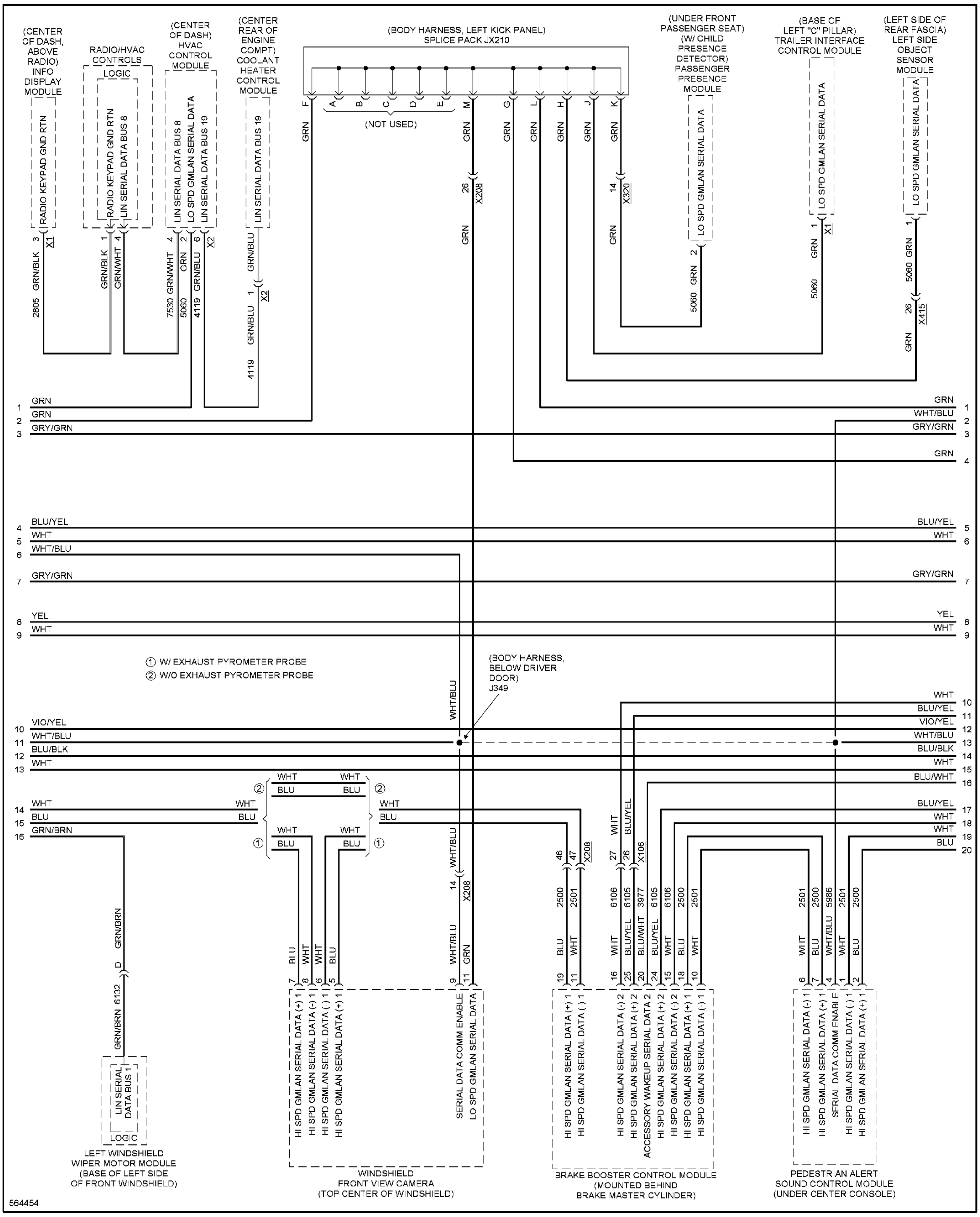


Fig. 18: Computer Data Lines Circuit (3 of 5)

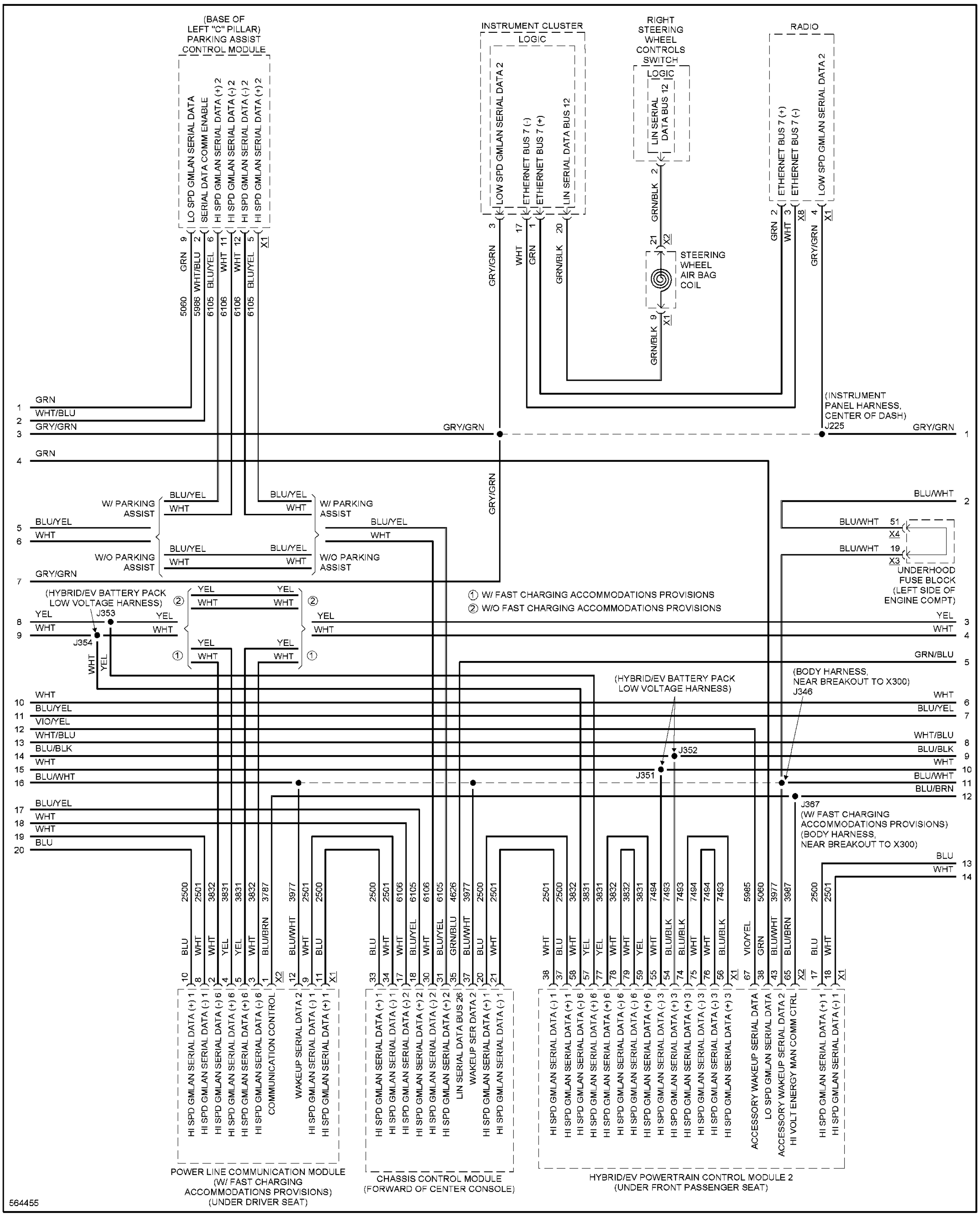

(BASE OF LEFT "C" PILLAR) PARKING ASSIST CONTROL MODULE
LO SPD GMLAN SERIAL DATA
SERIAL DATA COMM ENABLE
HI SPD GMLAN SERIAL DATA (+) 2
HI SPD GMLAN SERIAL DATA (-) 2
INSTRUMENT CLUSTER
LOGIC
LOW SPD GMLAN SERIAL DATA 2
ETHERNET BUS 7 (-)
ETHERNET BUS 7 (+)
LIN SERIAL DATA BUS 12
RIGHT STEERING WHEEL CONTROLS SWITCH
LIN SERIAL DATA BUS 12
STEERING WHEEL AIR BAG COIL
RADIO
ETHERNET BUS 7 (+)
ETHERNET BUS 7 (-)
LOW SPD GMLAN SERIAL DATA 2
(INSTRUMENT PANEL HARNESS, CENTER OF DASH) J225
W/ PARKING ASSIST
W/O PARKING ASSIST
(HYBRID/EV BATTERY PACK LOW VOLTAGE HARNESS)
J353
J354
① W/ FAST CHARGING ACCOMMODATIONS PROVISIONS
② W/O FAST CHARGING ACCOMMODATIONS PROVISIONS
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
(HYBRID/EV BATTERY PACK LOW VOLTAGE HARNESS)
J352
J351
(BODY HARNESS, NEAR BREAKOUT TO X300) J346
J367 (W/ FAST CHARGING ACCOMMODATIONS PROVISIONS) (BODY HARNESS, NEAR BREAKOUT TO X300)
HI SPD GMLAN SERIAL DATA (+) 1
HI SPD GMLAN SERIAL DATA (-) 1
HI SPD GMLAN SERIAL DATA (-) 6
HI SPD GMLAN SERIAL DATA (+) 6
COMMUNICATION CONTROL
WAKEUP SERIAL DATA 2
POWER LINE COMMUNICATION MODULE (W/ FAST CHARGING ACCOMMODATIONS PROVISIONS) (UNDER DRIVER SEAT)
HI SPD GMLAN SERIAL DATA (-) 2
HI SPD GMLAN SERIAL DATA (+) 2
LIN SERIAL DATA BUS 26
WAKEUP SER DATA 2
CHASSIS CONTROL MODULE (FORWARD OF CENTER CONSOLE)
HI SPD GMLAN SERIAL DATA (-) 3
HI SPD GMLAN SERIAL DATA (+) 3
ACCESSORY WAKEUP SERIAL DATA
LO SPD GMLAN SERIAL DATA
ACCESSORY WAKEUP SERIAL DATA 2
HI VOLT ENERGY MAN COMM CTRL
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
564455

Fig. 19: Computer Data Lines Circuit (4 of 5)

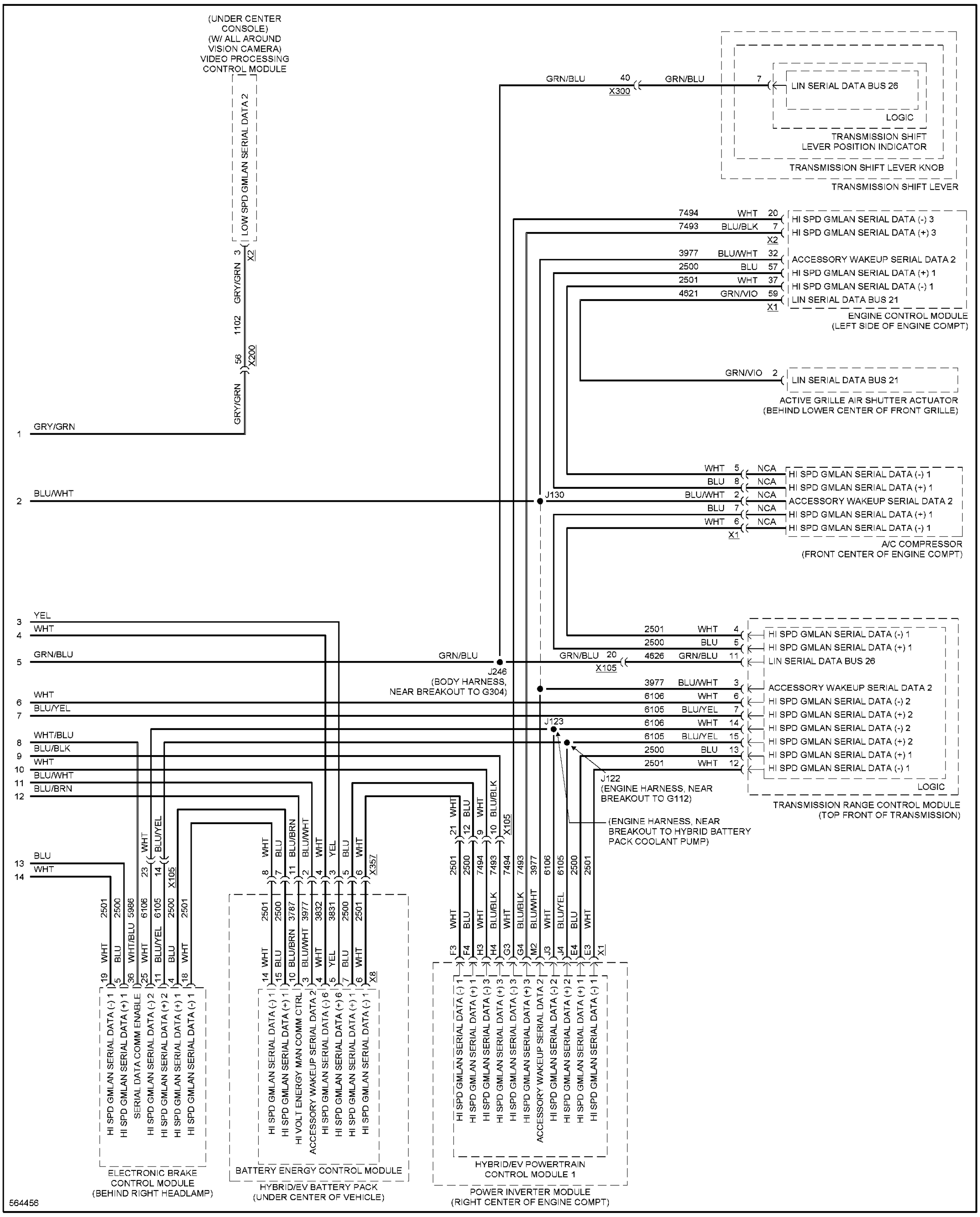

(UNDER CENTER CONSOLE) (W/ ALL AROUND VISION CAMERA) VIDEO PROCESSING CONTROL MODULE
LOW SPD GMLAN SERIAL DATA 2
3 X2 GRY/GRN 1102
56 X200 GRY/GRN
1 GRY/GRN
2 BLU/WHT
3 YEL
4 WHT
5 GRN/BLU
6 WHT
7 BLU/YEL
8 WHT/BLU
9 BLU/BLK
10 WHT
11 BLU/WHT
12 BLU/BRN
13 BLU
14 WHT
GRN/BLU 40 X300 GRN/BLU 7
LIN SERIAL DATA BUS 26
LOGIC
TRANSMISSION SHIFT LEVER POSITION INDICATOR
TRANSMISSION SHIFT LEVER KNOB
TRANSMISSION SHIFT LEVER
7494 WHT 20 HI SPD GMLAN SERIAL DATA (-) 3
7493 BLU/BLK 7 HI SPD GMLAN SERIAL DATA (+) 3
X2
3977 BLU/WHT 32 ACCESSORY WAKEUP SERIAL DATA 2
2500 BLU 57 HI SPD GMLAN SERIAL DATA (+) 1
2501 WHT 37 HI SPD GMLAN SERIAL DATA (-) 1
4521 GRN/VIO 59 LIN SERIAL DATA BUS 21
X1
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
GRN/VIO 2 LIN SERIAL DATA BUS 21
ACTIVE GRILLE AIR SHUTTER ACTUATOR (BEHIND LOWER CENTER OF FRONT GRILLE)
WHT 5 NCA HI SPD GMLAN SERIAL DATA (-) 1
BLU 8 NCA HI SPD GMLAN SERIAL DATA (+) 1
J130 BLU/WHT 2 NCA ACCESSORY WAKEUP SERIAL DATA 2
BLU 7 NCA HI SPD GMLAN SERIAL DATA (+) 1
WHT 6 NCA HI SPD GMLAN SERIAL DATA (-) 1
X1
A/C COMPRESSOR (FRONT CENTER OF ENGINE COMPT)
2501 WHT 4 HI SPD GMLAN SERIAL DATA (-) 1
2500 BLU 5 HI SPD GMLAN SERIAL DATA (+) 1
GRN/BLU GRN/BLU 20 X105 4626 GRN/BLU 11 LIN SERIAL DATA BUS 26
J246 (BODY HARNESS, NEAR BREAKOUT TO G304)
3977 BLU/WHT 3 ACCESSORY WAKEUP SERIAL DATA 2
6106 WHT 6 HI SPD GMLAN SERIAL DATA (-) 2
6105 BLU/YEL 7 HI SPD GMLAN SERIAL DATA (+) 2
J123 6106 WHT 14 HI SPD GMLAN SERIAL DATA (-) 2
6105 BLU/YEL 15 HI SPD GMLAN SERIAL DATA (+) 2
2500 BLU 13 HI SPD GMLAN SERIAL DATA (+) 1
2501 WHT 12 HI SPD GMLAN SERIAL DATA (-) 1
LOGIC
TRANSMISSION RANGE CONTROL MODULE (TOP FRONT OF TRANSMISSION)
J122 (ENGINE HARNESS, NEAR BREAKOUT TO G112)
(ENGINE HARNESS, NEAR BREAKOUT TO HYBRID BATTERY PACK COOLANT PUMP)
23 WHT 14 BLU/YEL X105
19 WHT 2501 HI SPD GMLAN SERIAL DATA (-) 1
5 BLU 2500 HI SPD GMLAN SERIAL DATA (+) 1
36 WHT/BLU 5986 SERIAL DATA COMM ENABLE
25 WHT 6106 HI SPD GMLAN SERIAL DATA (-) 2
11 BLU/YEL 6105 HI SPD GMLAN SERIAL DATA (+) 2
4 BLU 2500 HI SPD GMLAN SERIAL DATA (+) 1
18 WHT 2501 HI SPD GMLAN SERIAL DATA (-) 1
ELECTRONIC BRAKE CONTROL MODULE (BEHIND RIGHT HEADLAMP)
8 WHT 7 BLU 11 BLU/BRN 2 BLU/WHT 4 WHT 3 YEL 5 BLU 6 WHT X357
14 WHT 2501 HI SPD GMLAN SERIAL DATA (-) 1
15 BLU 2500 HI SPD GMLAN SERIAL DATA (+) 1
10 BLU/BRN 3787 HI VOLT ENERGY MAN COMM CTRL
3 BLU/WHT 3977 ACCESSORY WAKEUP SERIAL DATA 2
4 WHT 3832 HI SPD GMLAN SERIAL DATA (-) 6
5 YEL 3831 HI SPD GMLAN SERIAL DATA (+) 6
7 BLU 2500 HI SPD GMLAN SERIAL DATA (+) 1
6 WHT 2501 HI SPD GMLAN SERIAL DATA (-) 1
X8
BATTERY ENERGY CONTROL MODULE
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
21 WHT 12 BLU 9 WHT 10 BLU/BLK X105
F3 WHT 2501 HI SPD GMLAN SERIAL DATA (-) 1
F4 BLU 2500 HI SPD GMLAN SERIAL DATA (+) 1
H3 WHT 7494 HI SPD GMLAN SERIAL DATA (-) 3
H4 BLU/BLK 7493 HI SPD GMLAN SERIAL DATA (+) 3
G3 WHT 7494 HI SPD GMLAN SERIAL DATA (-) 3
G4 BLU/BLK 7493 HI SPD GMLAN SERIAL DATA (+) 3
M2 BLU/WHT 3977 ACCESSORY WAKEUP SERIAL DATA 2
J3 WHT 6106 HI SPD GMLAN SERIAL DATA (-) 2
J4 BLU/YEL 6105 HI SPD GMLAN SERIAL DATA (+) 2
E4 BLU 2500 HI SPD GMLAN SERIAL DATA (+) 1
E3 WHT 2501 HI SPD GMLAN SERIAL DATA (-) 1
X1
HYBRID/EV POWERTRAIN CONTROL MODULE 1
POWER INVERTER MODULE (RIGHT CENTER OF ENGINE COMPT)
564456

Fig. 20: Computer Data Lines Circuit (5 of 5)

COOLING FAN

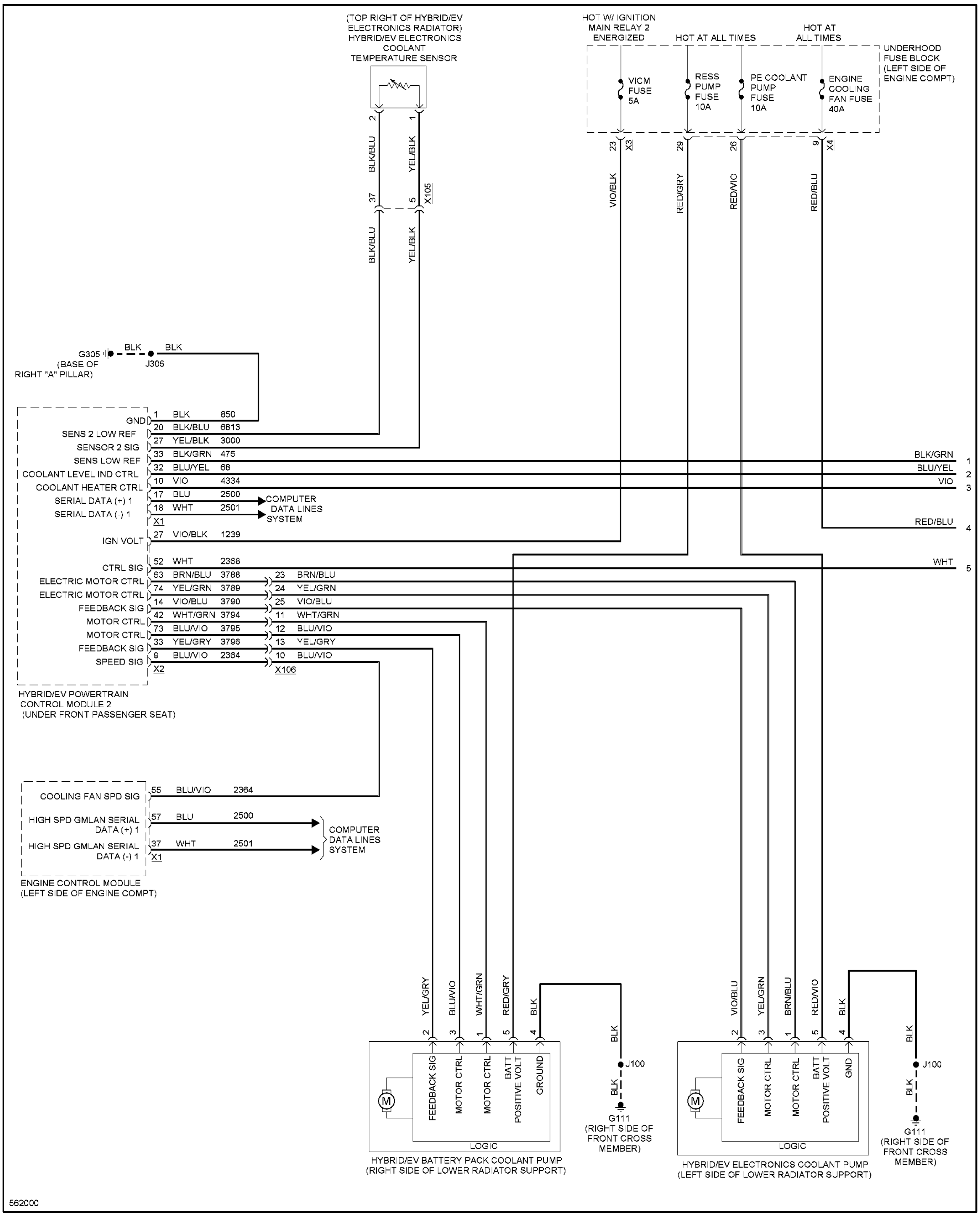

(TOP RIGHT OF HYBRID/EV ELECTRONICS RADIATOR) HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR
HOT W/ IGNITION MAIN RELAY 2 ENERGIZED
HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
VICM FUSE 5A
RESS PUMP FUSE 10A
PE COOLANT PUMP FUSE 10A
ENGINE COOLING FAN FUSE 40A
2
1
BLK/BLU
YEL/BLK
37
5
X105
BLK/BLU
YEL/BLK
23
X3
29
26
9
X4
VIO/BLK
RED/GRY
RED/VIO
RED/BLU
G305
(BASE OF RIGHT "A" PILLAR)
BLK
BLK
J306
GND
SENS 2 LOW REF
SENSOR 2 SIG
SENS LOW REF
COOLANT LEVEL IND CTRL
COOLANT HEATER CTRL
SERIAL DATA (+) 1
SERIAL DATA (-) 1
IGN VOLT
CTRL SIG
ELECTRIC MOTOR CTRL
ELECTRIC MOTOR CTRL
FEEDBACK SIG
MOTOR CTRL
MOTOR CTRL
FEEDBACK SIG
SPEED SIG
1 BLK 850
20 BLK/BLU 6813
27 YEL/BLK 3000
33 BLK/GRN 476
32 BLU/YEL 68
10 VIO 4334
17 BLU 2500
18 WHT 2501
X1
COMPUTER DATA LINES SYSTEM
27 VIO/BLK 1239
52 WHT 2368
63 BRN/BLU 3788
74 YEL/GRN 3789
14 VIO/BLU 3790
42 WHT/GRN 3794
73 BLU/VIO 3795
33 YEL/GRY 3796
9 BLU/VIO 2364
X2
23 BRN/BLU
24 YEL/GRN
25 VIO/BLU
11 WHT/GRN
12 BLU/VIO
13 YEL/GRY
10 BLU/VIO
X106
BLK/GRN 1
BLU/YEL 2
VIO 3
RED/BLU 4
WHT 5
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
COOLING FAN SPD SIG
HIGH SPD GMLAN SERIAL DATA (+) 1
HIGH SPD GMLAN SERIAL DATA (-) 1
55 BLU/VIO 2364
57 BLU 2500
37 WHT 2501
X1
COMPUTER DATA LINES SYSTEM
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
YEL/GRY
BLU/VIO
WHT/GRN
RED/GRY
BLK
2
3
1
5
4
M
FEEDBACK SIG
MOTOR CTRL
MOTOR CTRL
BATT POSITIVE VOLT
GROUND
LOGIC
HYBRID/EV BATTERY PACK COOLANT PUMP (RIGHT SIDE OF LOWER RADIATOR SUPPORT)
BLK
J100
BLK
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
VIO/BLU
YEL/GRN
BRN/BLU
RED/VIO
BLK
2
3
1
5
4
M
FEEDBACK SIG
MOTOR CTRL
MOTOR CTRL
BATT POSITIVE VOLT
GND
LOGIC
HYBRID/EV ELECTRONICS COOLANT PUMP (LEFT SIDE OF LOWER RADIATOR SUPPORT)
BLK
J100
BLK
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
562000

Fig. 21: Cooling Fan Circuit (1 of 2)

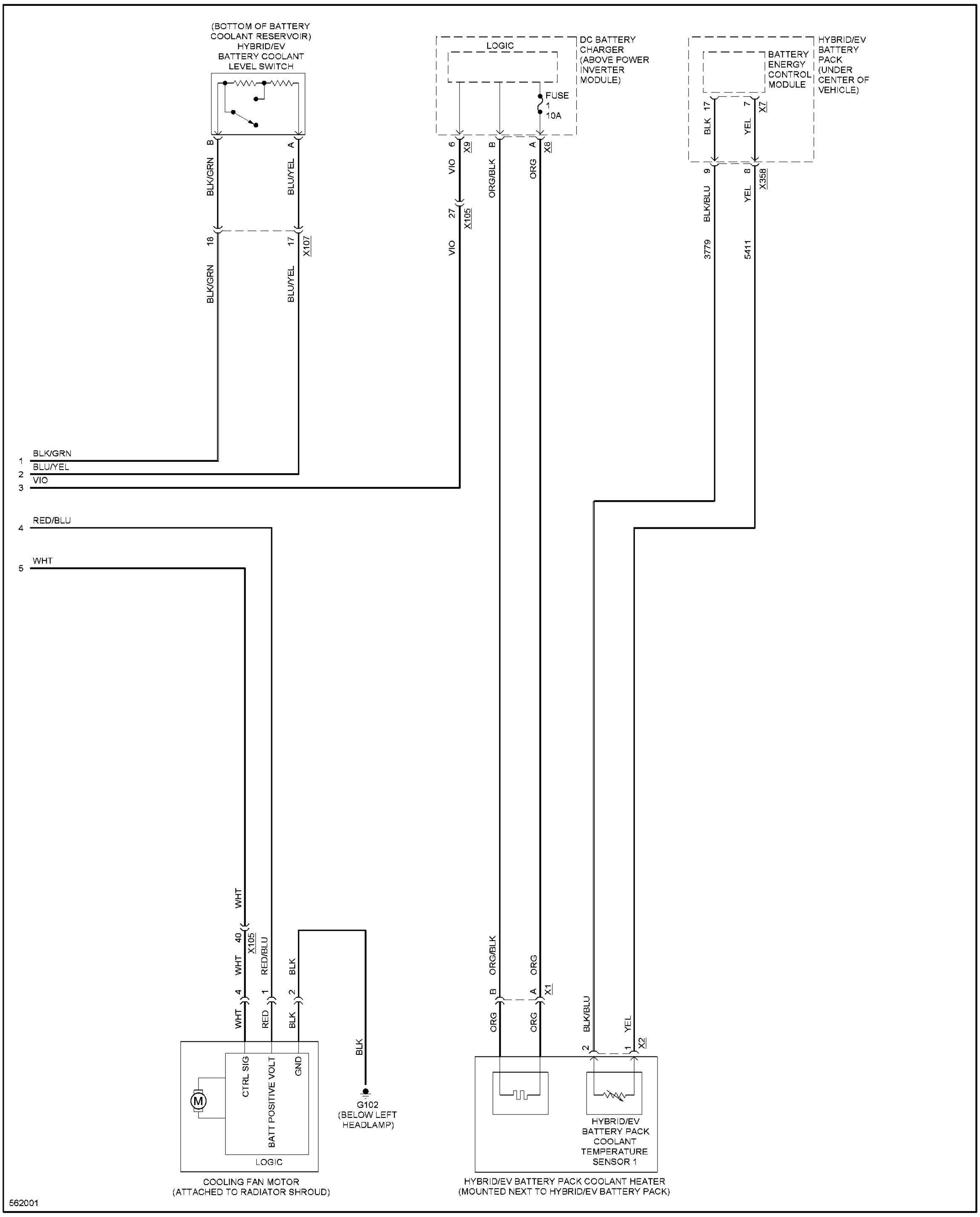

(BOTTOM OF BATTERY COOLANT RESERVOIR) HYBRID/EV BATTERY COOLANT LEVEL SWITCH
LOGIC
DC BATTERY CHARGER (ABOVE POWER INVERTER MODULE)
FUSE 1 10A
BATTERY ENERGY CONTROL MODULE
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
B
A
BLK/GRN
BLU/YEL
18
17
X107
6
B
A
X9
X8
VIO
ORG/BLK
ORG
27
X105
17
7
X7
BLK
YEL
9
8
X358
BLK/BLU
YEL
3779
5411
1 BLK/GRN
2 BLU/YEL
3 VIO
4 RED/BLU
5 WHT
WHT
40
X105
RED/BLU
BLK
4
1
2
RED
GND
CTRL SIG
BATT POSITIVE VOLT
M
LOGIC
COOLING FAN MOTOR (ATTACHED TO RADIATOR SHROUD)
G102 (BELOW LEFT HEADLAMP)
X1
2
1
X2
HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR 1
HYBRID/EV BATTERY PACK COOLANT HEATER (MOUNTED NEXT TO HYBRID/EV BATTERY PACK)
562001

Fig. 22: Cooling Fan Circuit (2 of 2)

CRUISE CONTROL

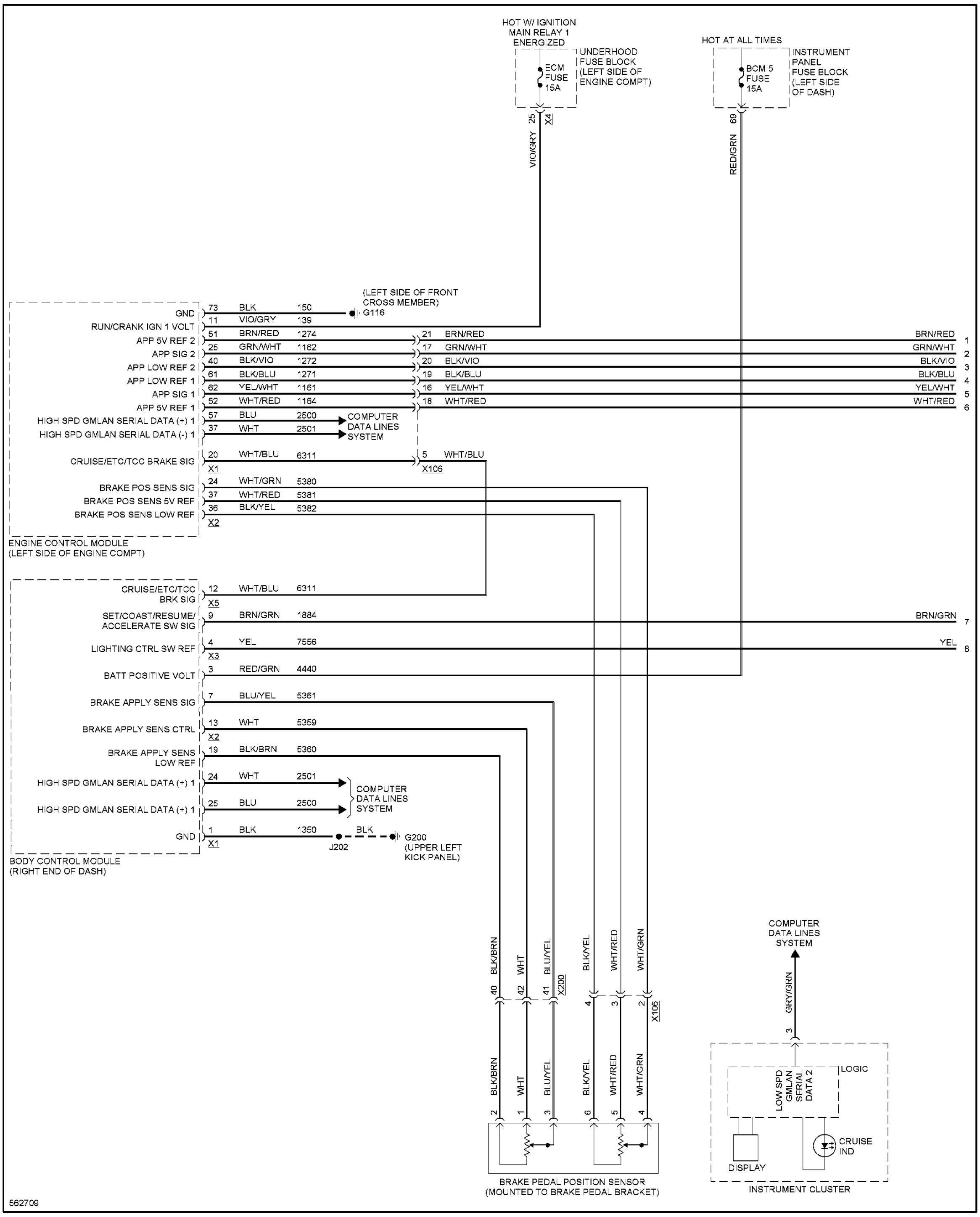

HOT W/ IGNITION MAIN RELAY 1 ENERGIZED
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
ECM FUSE 15A
25 X4
VIO/GRY
HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
BCM 5 FUSE 15A
69
RED/GRN
(LEFT SIDE OF FRONT CROSS MEMBER)
G116
GND 73 BLK 150
RUN/CRANK IGN 1 VOLT 11 VIO/GRY 139
APP 5V REF 2 51 BRN/RED 1274 21 BRN/RED BRN/RED 1
APP SIG 2 25 GRN/WHT 1162 17 GRN/WHT GRN/WHT 2
APP LOW REF 2 40 BLK/VIO 1272 20 BLK/VIO BLK/VIO 3
APP LOW REF 1 61 BLK/BLU 1271 19 BLK/BLU BLK/BLU 4
APP SIG 1 62 YEL/WHT 1161 16 YEL/WHT YEL/WHT 5
APP 5V REF 1 52 WHT/RED 1164 18 WHT/RED WHT/RED 6
HIGH SPD GMLAN SERIAL DATA (+) 1 57 BLU 2500
HIGH SPD GMLAN SERIAL DATA (-) 1 37 WHT 2501
COMPUTER DATA LINES SYSTEM
CRUISE/ETC/TCC BRAKE SIG 20 WHT/BLU 6311 5 WHT/BLU
X1
X106
BRAKE POS SENS SIG 24 WHT/GRN 5380
BRAKE POS SENS 5V REF 37 WHT/RED 5381
BRAKE POS SENS LOW REF 36 BLK/YEL 5382
X2
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
CRUISE/ETC/TCC BRK SIG 12 WHT/BLU 6311
X5
SET/COAST/RESUME/ ACCELERATE SW SIG 9 BRN/GRN 1884 BRN/GRN 7
LIGHTING CTRL SW REF 4 YEL 7556 YEL 8
X3
BATT POSITIVE VOLT 3 RED/GRN 4440
BRAKE APPLY SENS SIG 7 BLU/YEL 5361
BRAKE APPLY SENS CTRL 13 WHT 5359
X2
BRAKE APPLY SENS LOW REF 19 BLK/BRN 5360
HIGH SPD GMLAN SERIAL DATA (+) 1 24 WHT 2501
COMPUTER DATA LINES SYSTEM
HIGH SPD GMLAN SERIAL DATA (+) 1 25 BLU 2500
GND 1 BLK 1350 BLK
X1
J202
G200 (UPPER LEFT KICK PANEL)
BODY CONTROL MODULE (RIGHT END OF DASH)
BLK/BRN
WHT
BLU/YEL
BLK/YEL
WHT/RED
WHT/GRN
40
42
41
X200
4
3
2
X106
BLK/BRN
WHT
BLU/YEL
BLK/YEL
WHT/RED
WHT/GRN
2
1
3
6
5
4
BRAKE PEDAL POSITION SENSOR (MOUNTED TO BRAKE PEDAL BRACKET)
COMPUTER DATA LINES SYSTEM
GRY/GRN
3
LOGIC
LOW SPD GMLAN SERIAL DATA 2
DISPLAY
CRUISE IND
INSTRUMENT CLUSTER
562709

Fig. 23: Cruise Control Circuit (1 of 2)

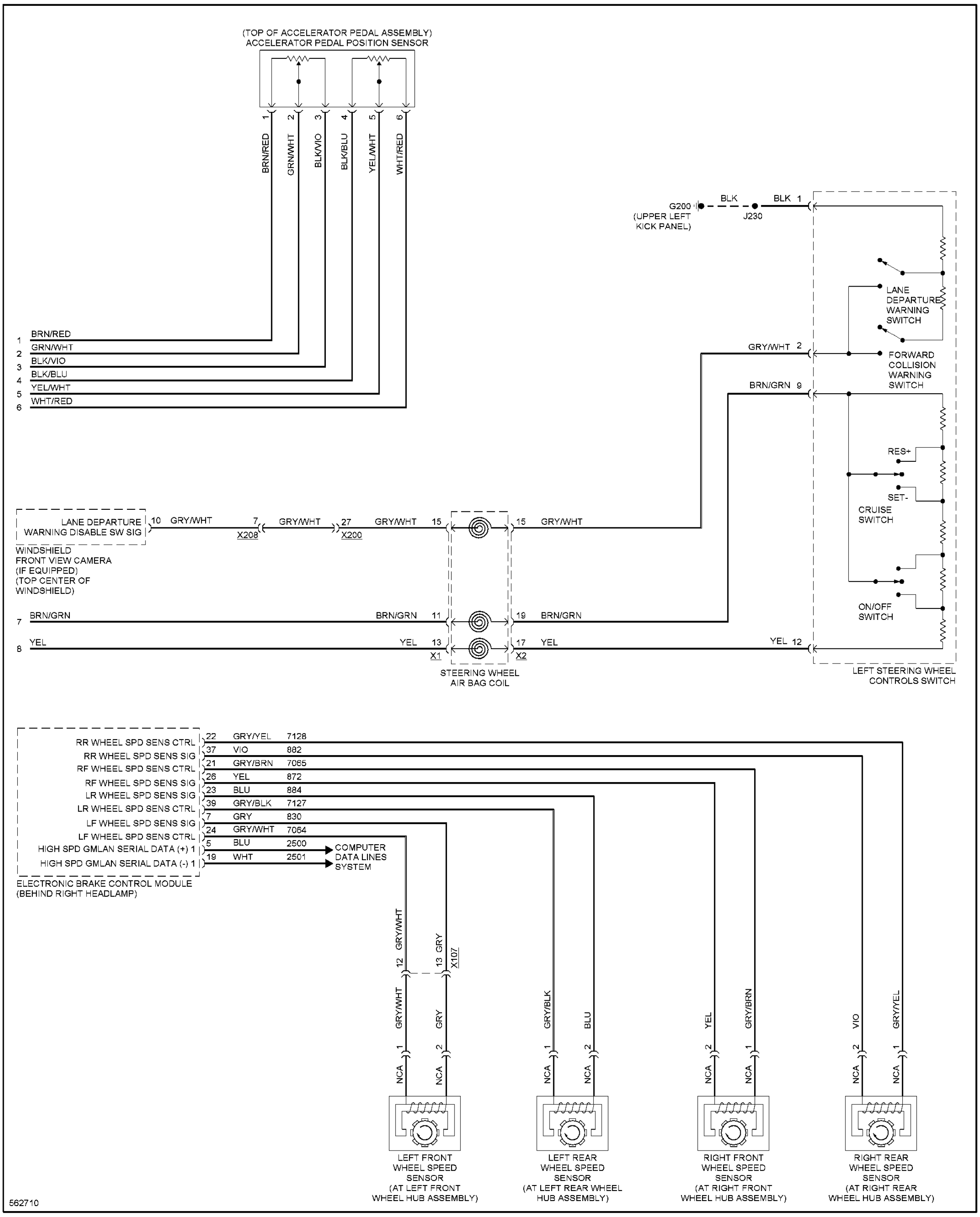

(TOP OF ACCELERATOR PEDAL ASSEMBLY)
ACCELERATOR PEDAL POSITION SENSOR
1 BRN/RED
2 GRN/WHT
3 BLK/VIO
4 BLK/BLU
5 YEL/WHT
6 WHT/RED
G200
(UPPER LEFT KICK PANEL)
BLK
J230
BLK 1
LANE DEPARTURE WARNING SWITCH
GRY/WHT 2
FORWARD COLLISION WARNING SWITCH
BRN/GRN 9
RES+
SET-
CRUISE SWITCH
ON/OFF SWITCH
YEL 12
LEFT STEERING WHEEL CONTROLS SWITCH
LANE DEPARTURE WARNING DISABLE SW SIG
10 GRY/WHT
7 X208
GRY/WHT
27 X200
GRY/WHT 15
15 GRY/WHT
WINDSHIELD FRONT VIEW CAMERA (IF EQUIPPED) (TOP CENTER OF WINDSHIELD)
7 BRN/GRN
BRN/GRN 11
19 BRN/GRN
8 YEL
YEL 13 X1
17 X2 YEL
STEERING WHEEL AIR BAG COIL
RR WHEEL SPD SENS CTRL 22 GRY/YEL 7128
RR WHEEL SPD SENS SIG 37 VIO 882
RF WHEEL SPD SENS CTRL 21 GRY/BRN 7065
RF WHEEL SPD SENS SIG 26 YEL 872
LR WHEEL SPD SENS SIG 23 BLU 884
LR WHEEL SPD SENS CTRL 39 GRY/BLK 7127
LF WHEEL SPD SENS SIG 7 GRY 830
LF WHEEL SPD SENS CTRL 24 GRY/WHT 7064
HIGH SPD GMLAN SERIAL DATA (+) 1 5 BLU 2500
HIGH SPD GMLAN SERIAL DATA (-) 1 19 WHT 2501
COMPUTER DATA LINES SYSTEM
ELECTRONIC BRAKE CONTROL MODULE (BEHIND RIGHT HEADLAMP)
12 GRY/WHT
13 GRY X107
GRY/WHT 1 NCA
GRY 2 NCA
GRY/BLK 1 NCA
BLU 2 NCA
YEL 2 NCA
GRY/BRN 1 NCA
VIO 2 NCA
GRY/YEL 1 NCA
LEFT FRONT WHEEL SPEED SENSOR (AT LEFT FRONT WHEEL HUB ASSEMBLY)
LEFT REAR WHEEL SPEED SENSOR (AT LEFT REAR WHEEL HUB ASSEMBLY)
RIGHT FRONT WHEEL SPEED SENSOR (AT RIGHT FRONT WHEEL HUB ASSEMBLY)
RIGHT REAR WHEEL SPEED SENSOR (AT RIGHT REAR WHEEL HUB ASSEMBLY)
562710

Fig. 24: Cruise Control Circuit (2 of 2)

DEFOGGERS

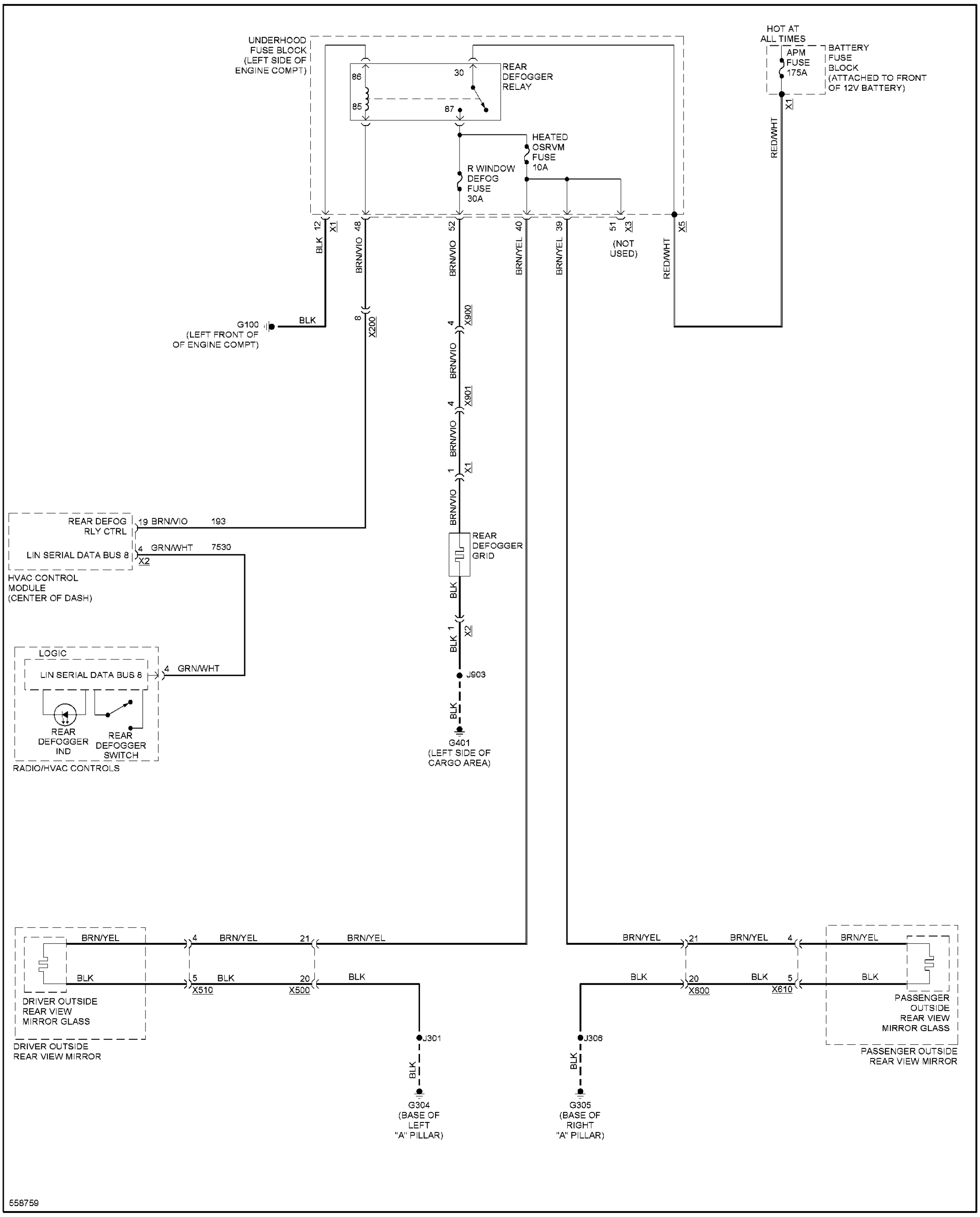

UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
86
85
30
87
REAR DEFOGGER RELAY
HOT AT ALL TIMES
APM FUSE 175A
BATTERY FUSE BLOCK (ATTACHED TO FRONT OF 12V BATTERY)
X1
RED/WHT
HEATED OSRVM FUSE 10A
R WINDOW DEFOG FUSE 30A
BLK 12 X1
BRN/VIO 48
BRN/VIO 52
BRN/YEL 40
BRN/YEL 39
51 X3
(NOT USED)
RED/WHT X5
G100 (LEFT FRONT OF OF ENGINE COMPT)
BLK
8 X200
4 X900
BRN/VIO
4 X901
BRN/VIO
1 X1
BRN/VIO
REAR DEFOGGER GRID
BLK
BLK 1 X2
J903
BLK
G401 (LEFT SIDE OF CARGO AREA)
REAR DEFOG RLY CTRL
19 BRN/VIO 193
LIN SERIAL DATA BUS 8
4 GRN/WHT 7530
X2
HVAC CONTROL MODULE (CENTER OF DASH)
LOGIC
LIN SERIAL DATA BUS 8
4 GRN/WHT
REAR DEFOGGER IND
REAR DEFOGGER SWITCH
RADIO/HVAC CONTROLS
BRN/YEL
BLK
DRIVER OUTSIDE REAR VIEW MIRROR GLASS
DRIVER OUTSIDE REAR VIEW MIRROR
4 BRN/YEL 21
5 BLK 20
X510
X500
BRN/YEL
BLK
J301
BLK
G304 (BASE OF LEFT "A" PILLAR)
BRN/YEL
BLK
21 BRN/YEL 4
20 BLK 5
X600
X610
J308
BLK
G305 (BASE OF RIGHT "A" PILLAR)
BRN/YEL
BLK
PASSENGER OUTSIDE REAR VIEW MIRROR GLASS
PASSENGER OUTSIDE REAR VIEW MIRROR
558759

Fig. 25: Defoggers Circuit

ELECTRONIC POWER STEERING

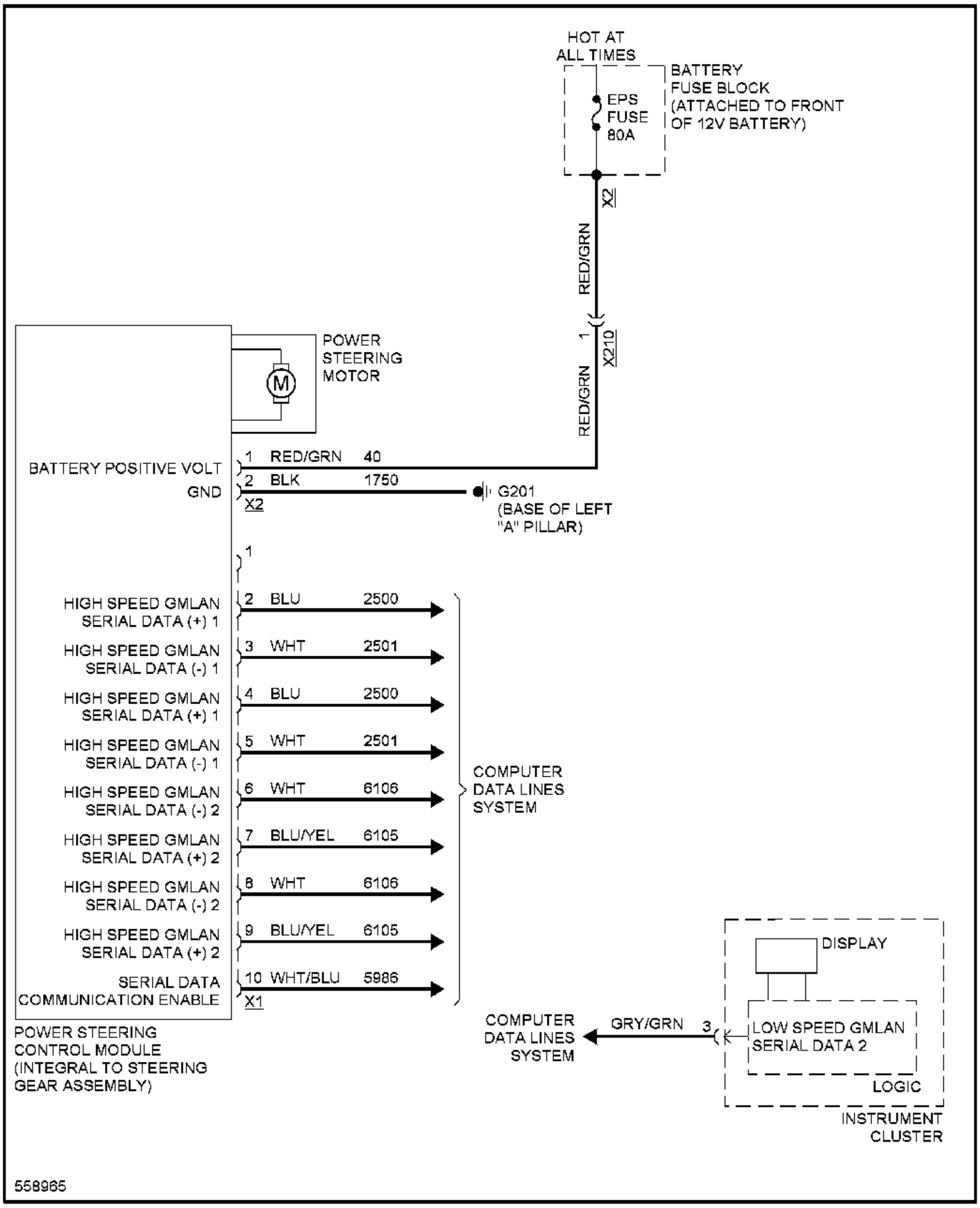

HOT AT
ALL TIMES
BATTERY
FUSE BLOCK
(ATTACHED TO FRONT
OF 12V BATTERY)
EPS
FUSE
80A
X2
RED/GRN
1
X210
RED/GRN
POWER
STEERING
MOTOR
M
BATTERY POSITIVE VOLT
GND
1 RED/GRN 40
2 BLK 1750
X2
G201
(BASE OF LEFT
"A" PILLAR)
1
HIGH SPEED GMLAN
SERIAL DATA (+) 1
2 BLU 2500
HIGH SPEED GMLAN
SERIAL DATA (-) 1
3 WHT 2501
HIGH SPEED GMLAN
SERIAL DATA (+) 1
4 BLU 2500
HIGH SPEED GMLAN
SERIAL DATA (-) 1
5 WHT 2501
HIGH SPEED GMLAN
SERIAL DATA (-) 2
6 WHT 6106
HIGH SPEED GMLAN
SERIAL DATA (+) 2
7 BLU/YEL 6105
HIGH SPEED GMLAN
SERIAL DATA (-) 2
8 WHT 6106
HIGH SPEED GMLAN
SERIAL DATA (+) 2
9 BLU/YEL 6105
SERIAL DATA
COMMUNICATION ENABLE
10 WHT/BLU 5986
X1
COMPUTER
DATA LINES
SYSTEM
POWER STEERING
CONTROL MODULE
(INTEGRAL TO STEERING
GEAR ASSEMBLY)
DISPLAY
COMPUTER
DATA LINES
SYSTEM
GRY/GRN
3
LOW SPEED GMLAN
SERIAL DATA 2
LOGIC
INSTRUMENT
CLUSTER
558965

Fig. 26: Electronic Power Steering Circuit

ENGINE PERFORMANCE

ELECTRIC

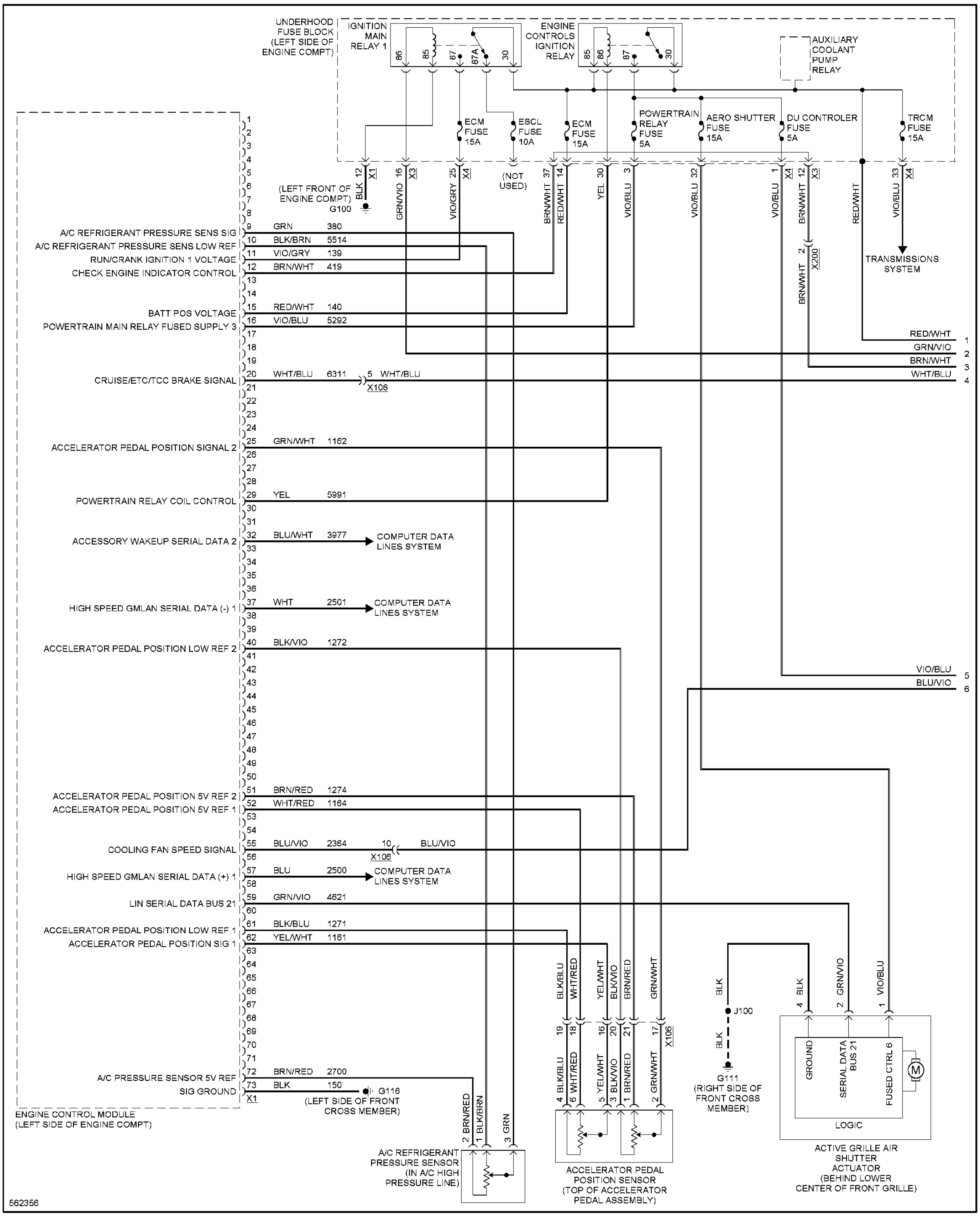

UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
IGNITION MAIN RELAY 1
86
85
87
87A
30
ENGINE CONTROLS IGNITION RELAY
AUXILIARY COOLANT PUMP RELAY
ECM FUSE 15A
ESCL FUSE 10A
ECM FUSE 15A
POWERTRAIN RELAY FUSE 5A
AERO SHUTTER FUSE 15A
DU CONTROLER FUSE 5A
TRCM FUSE 15A
X1
X3
X4
BLK
GRN/VIO
VIO/GRY
(NOT USED)
(LEFT FRONT OF ENGINE COMPT) G100
BRN/WHT
RED/WHT
YEL
VIO/BLU
VIO/BLU
VIO/BLU
BRN/WHT
RED/WHT
VIO/BLU
X200
TRANSMISSIONS SYSTEM
A/C REFRIGERANT PRESSURE SENS SIG
A/C REFRIGERANT PRESSURE SENS LOW REF
RUN/CRANK IGNITION 1 VOLTAGE
CHECK ENGINE INDICATOR CONTROL
BATT POS VOLTAGE
POWERTRAIN MAIN RELAY FUSED SUPPLY 3
CRUISE/ETC/TCC BRAKE SIGNAL
ACCELERATOR PEDAL POSITION SIGNAL 2
POWERTRAIN RELAY COIL CONTROL
ACCESSORY WAKEUP SERIAL DATA 2
HIGH SPEED GMLAN SERIAL DATA (-) 1
ACCELERATOR PEDAL POSITION LOW REF 2
ACCELERATOR PEDAL POSITION 5V REF 2
ACCELERATOR PEDAL POSITION 5V REF 1
COOLING FAN SPEED SIGNAL
HIGH SPEED GMLAN SERIAL DATA (+) 1
LIN SERIAL DATA BUS 21
ACCELERATOR PEDAL POSITION LOW REF 1
ACCELERATOR PEDAL POSITION SIG 1
A/C PRESSURE SENSOR 5V REF
SIG GROUND
9 GRN 380
10 BLK/BRN 5514
11 VIO/GRY 139
12 BRN/WHT 419
15 RED/WHT 140
16 VIO/BLU 5292
20 WHT/BLU 6311
5 WHT/BLU X106
25 GRN/WHT 1162
29 YEL 5991
32 BLU/WHT 3977
COMPUTER DATA LINES SYSTEM
37 WHT 2501
COMPUTER DATA LINES SYSTEM
40 BLK/VIO 1272
51 BRN/RED 1274
52 WHT/RED 1164
55 BLU/VIO 2364
10 BLU/VIO X106
57 BLU 2500
COMPUTER DATA LINES SYSTEM
59 GRN/VIO 4621
61 BLK/BLU 1271
62 YEL/WHT 1161
72 BRN/RED 2700
73 BLK 150
G116 (LEFT SIDE OF FRONT CROSS MEMBER)
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
RED/WHT 1
GRN/VIO 2
BRN/WHT 3
WHT/BLU 4
VIO/BLU 5
BLU/VIO 6
2 BRN/RED
1 BLK/BRN
3 GRN
A/C REFRIGERANT PRESSURE SENSOR (IN A/C HIGH PRESSURE LINE)
BLK/BLU
WHT/RED
YEL/WHT
BLK/VIO
BRN/RED
GRN/WHT
19
18
16
20
21
17
X106
4 BLK/BLU
6 WHT/RED
5 YEL/WHT
3 BLK/VIO
1 BRN/RED
2 GRN/WHT
ACCELERATOR PEDAL POSITION SENSOR (TOP OF ACCELERATOR PEDAL ASSEMBLY)
BLK
J100
BLK
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
4 BLK
2 GRN/VIO
1 VIO/BLU
GROUND
SERIAL DATA BUS 21
FUSED CTRL 6
M
LOGIC
ACTIVE GRILLE AIR SHUTTER ACTUATOR (BEHIND LOWER CENTER OF FRONT GRILLE)
562356

Fig. 27: Electric, Engine Performance Circuit (1 of 16)

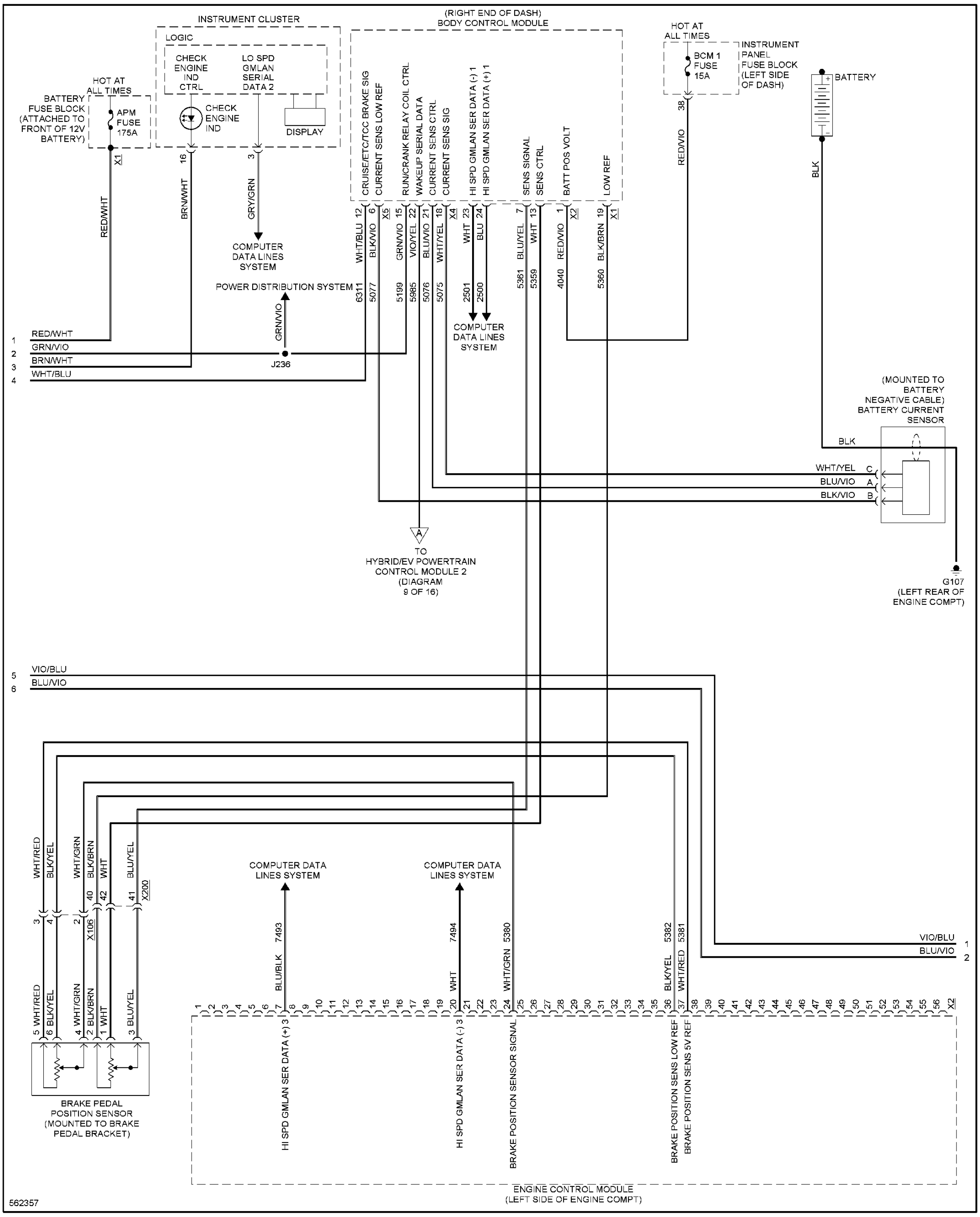

INSTRUMENT CLUSTER
LOGIC
CHECK ENGINE IND CTRL
LO SPD GMLAN SERIAL DATA 2
CHECK ENGINE IND
DISPLAY
HOT AT ALL TIMES
BATTERY FUSE BLOCK (ATTACHED TO FRONT OF 12V BATTERY)
APM FUSE 175A
X1
RED/WHT
16
BRN/WHT
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
POWER DISTRIBUTION SYSTEM
GRN/VIO
J236
(RIGHT END OF DASH) BODY CONTROL MODULE
CRUISE/ETC/TCC BRAKE SIG
CURRENT SENS LOW REF
RUN/CRANK RELAY COIL CTRL
WAKEUP SERIAL DATA
CURRENT SENS CTRL
CURRENT SENS SIG
HI SPD GMLAN SER DATA (-) 1
HI SPD GMLAN SER DATA (+) 1
SENS SIGNAL
SENS CTRL
BATT POS VOLT
LOW REF
12 6 X5 15 22 21 18 X4 23 24 7 13 1 X2 19 X1
WHT/BLU BLK/VIO GRN/VIO VIO/YEL BLU/VIO WHT/YEL WHT BLU BLU/YEL WHT RED/VIO BLK/BRN
6311 5077 5199 5985 5076 5075 2501 2500 5361 5359 4040 5360
COMPUTER DATA LINES SYSTEM
HOT AT ALL TIMES
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
38
RED/VIO
BATTERY
BLK
1 RED/WHT
2 GRN/VIO
3 BRN/WHT
4 WHT/BLU
(MOUNTED TO BATTERY NEGATIVE CABLE) BATTERY CURRENT SENSOR
BLK
WHT/YEL C
BLU/VIO A
BLK/VIO B
A
TO HYBRID/EV POWERTRAIN CONTROL MODULE 2 (DIAGRAM 9 OF 16)
G107 (LEFT REAR OF ENGINE COMPT)
5 VIO/BLU
6 BLU/VIO
WHT/RED BLK/YEL WHT/GRN BLK/BRN WHT BLU/YEL
3 4 2 X106 40 42 41 X200
5 WHT/RED
6 BLK/YEL
4 WHT/GRN
2 BLK/BRN
1 WHT
3 BLU/YEL
BRAKE PEDAL POSITION SENSOR (MOUNTED TO BRAKE PEDAL BRACKET)
COMPUTER DATA LINES SYSTEM
7493 BLU/BLK
COMPUTER DATA LINES SYSTEM
7494 WHT
5380 WHT/GRN
5382 BLK/YEL
5381 WHT/RED
VIO/BLU 1
BLU/VIO 2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 X2
HI SPD GMLAN SER DATA (+) 3
HI SPD GMLAN SER DATA (-) 3
BRAKE POSITION SENSOR SIGNAL
BRAKE POSITION SENS LOW REF
BRAKE POSITION SENS 5V REF
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
562357

Fig. 28: Electric, Engine Performance Circuit (2 of 16)

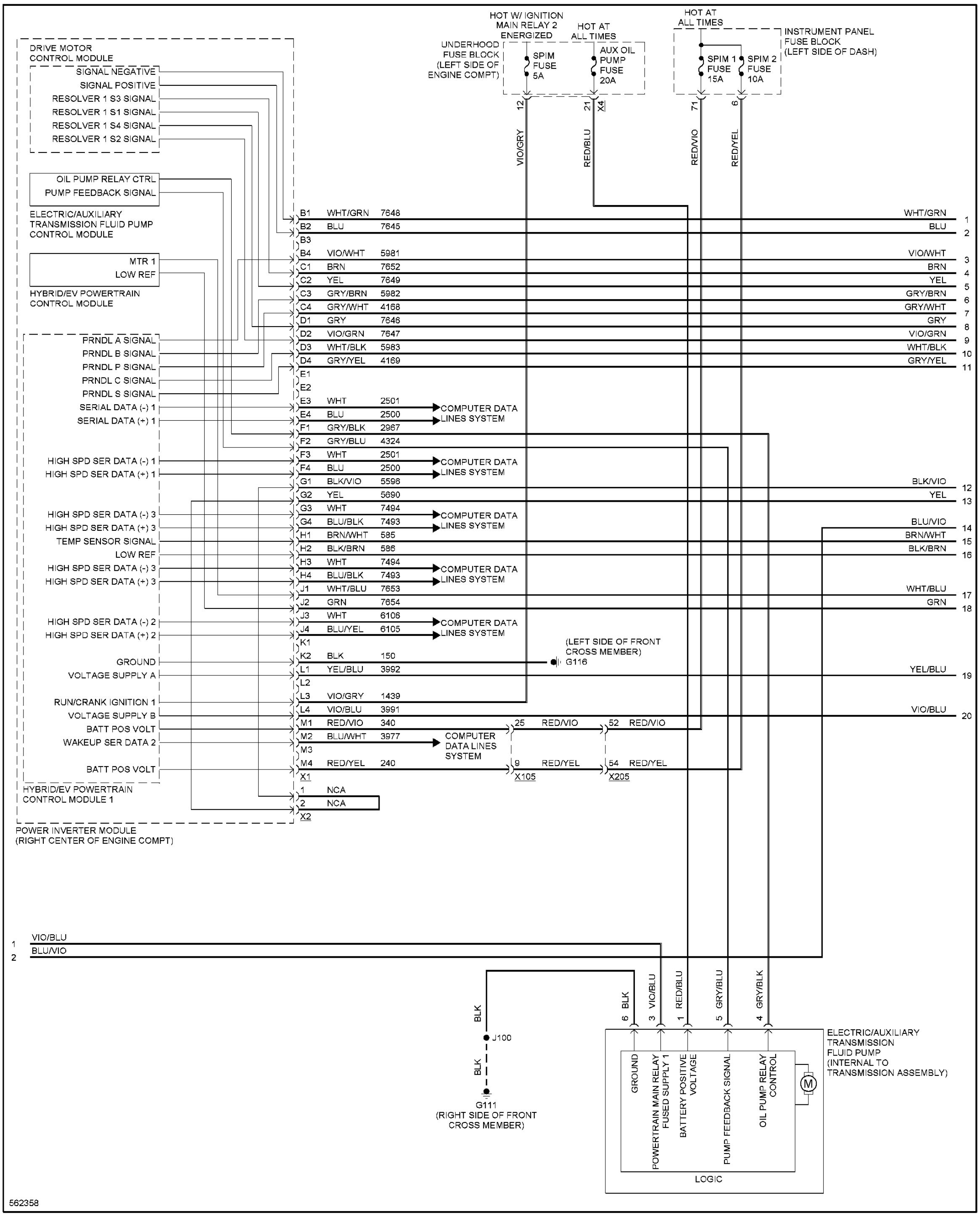


Fig. 29: Electric, Engine Performance Circuit (3 of 16)

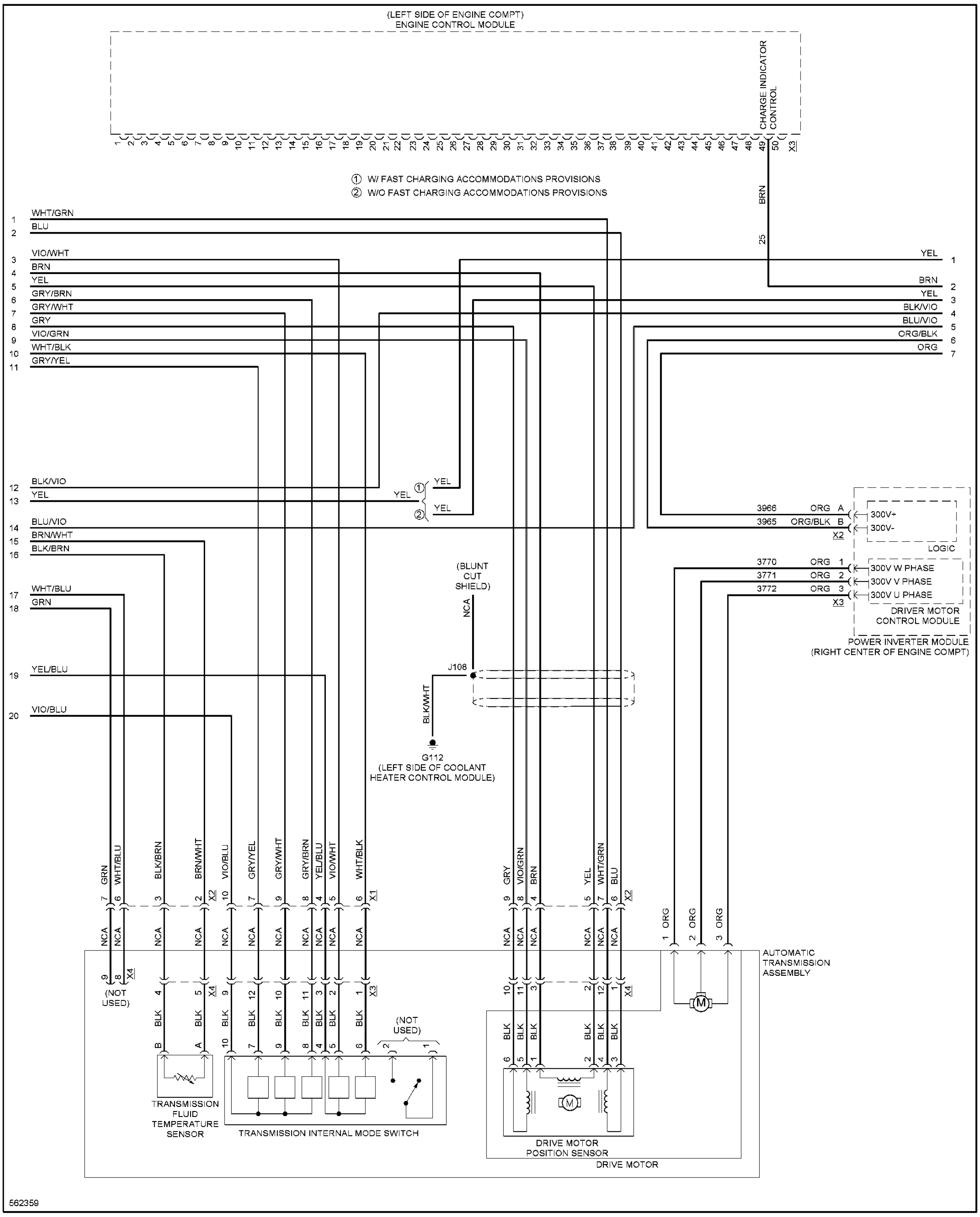

(LEFT SIDE OF ENGINE COMPT)
ENGINE CONTROL MODULE
CHARGE INDICATOR CONTROL
① W/ FAST CHARGING ACCOMMODATIONS PROVISIONS
② W/O FAST CHARGING ACCOMMODATIONS PROVISIONS
(BLUNT CUT SHIELD)
J108
G112
(LEFT SIDE OF COOLANT HEATER CONTROL MODULE)
LOGIC
300V+
300V-
300V W PHASE
300V V PHASE
300V U PHASE
DRIVER MOTOR CONTROL MODULE
POWER INVERTER MODULE
(RIGHT CENTER OF ENGINE COMPT)
AUTOMATIC TRANSMISSION ASSEMBLY
(NOT USED)
TRANSMISSION FLUID TEMPERATURE SENSOR
TRANSMISSION INTERNAL MODE SWITCH
DRIVE MOTOR POSITION SENSOR
DRIVE MOTOR
562359

Fig. 30: Electric, Engine Performance Circuit (4 of 16)

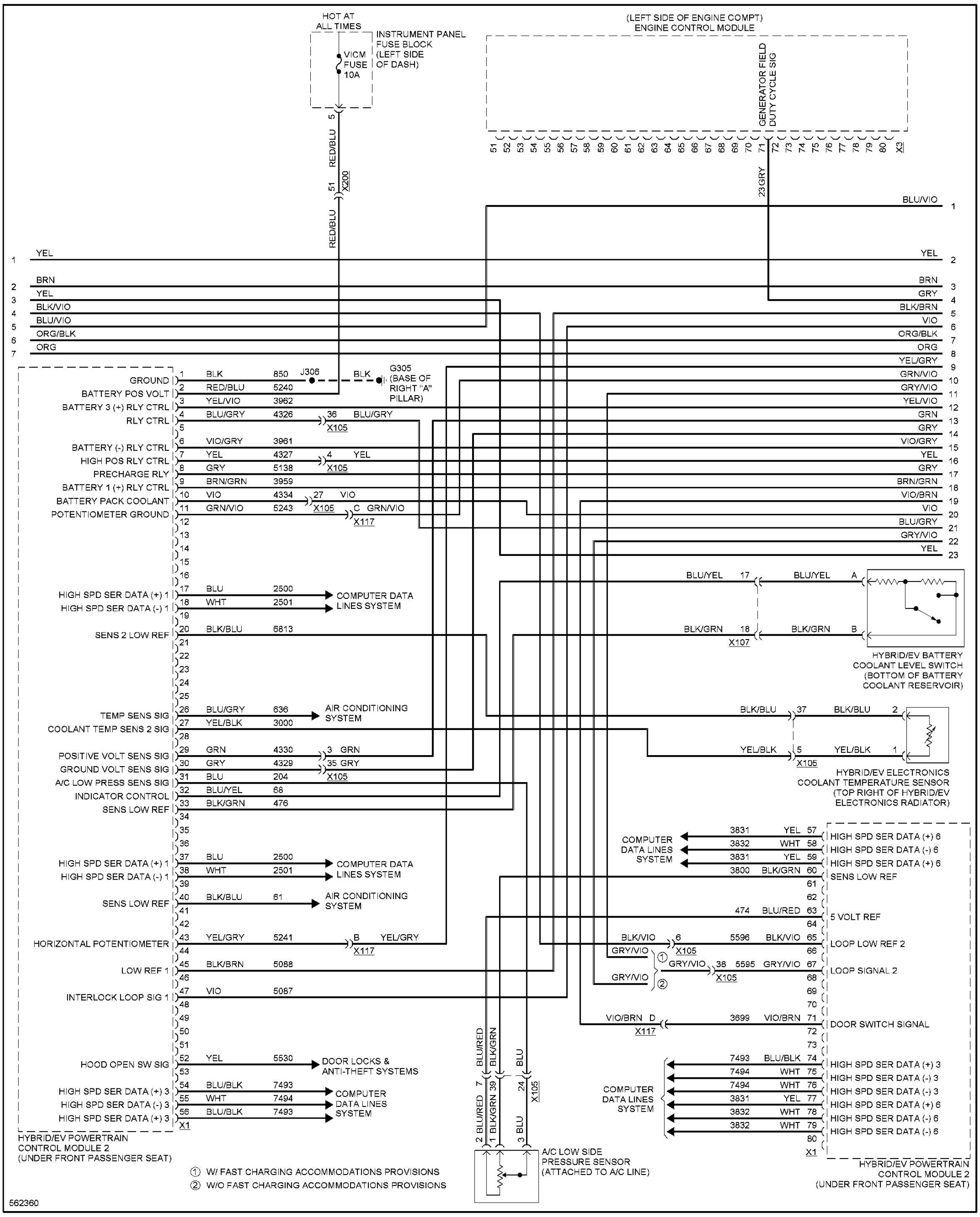

HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
VICM FUSE 10A
(LEFT SIDE OF ENGINE COMPT) ENGINE CONTROL MODULE
GENERATOR FIELD DUTY CYCLE SIG
23GRY
RED/BLU
X200
BLU/VIO
YEL
BRN
YEL
BLK/VIO
BLU/VIO
ORG/BLK
ORG
GRY
BLK/BRN
VIO
YEL/GRY
GRN/VIO
GRY/VIO
YEL/VIO
GRN
VIO/GRY
BRN/GRN
VIO/BRN
BLU/GRY
GROUND
BATTERY POS VOLT
BATTERY 3 (+) RLY CTRL
RLY CTRL
BATTERY (-) RLY CTRL
HIGH POS RLY CTRL
PRECHARGE RLY
BATTERY 1 (+) RLY CTRL
BATTERY PACK COOLANT
POTENTIOMETER GROUND
1 BLK 850
2 RED/BLU 5240
3 YEL/VIO 3962
4 BLU/GRY 4326
6 VIO/GRY 3961
7 YEL 4327
8 GRY 5138
9 BRN/GRN 3959
10 VIO 4334
11 GRN/VIO 5243
J306
BLK
G305 (BASE OF RIGHT "A" PILLAR)
36 BLU/GRY X105
4 YEL X105
27 VIO X105
C GRN/VIO X117
HIGH SPD SER DATA (+) 1
HIGH SPD SER DATA (-) 1
17 BLU 2500
18 WHT 2501
COMPUTER DATA LINES SYSTEM
SENS 2 LOW REF
20 BLK/BLU 6813
TEMP SENS SIG
COOLANT TEMP SENS 2 SIG
26 BLU/GRY 636
27 YEL/BLK 3000
AIR CONDITIONING SYSTEM
POSITIVE VOLT SENS SIG
GROUND VOLT SENS SIG
A/C LOW PRESS SENS SIG
INDICATOR CONTROL
SENS LOW REF
29 GRN 4330
30 GRY 4329
31 BLU 204
32 BLU/YEL 68
33 BLK/GRN 476
3 GRN
35 GRY
X105
37 BLU 2500
38 WHT 2501
40 BLK/BLU 61
HORIZONTAL POTENTIOMETER
43 YEL/GRY 5241
B YEL/GRY X117
LOW REF 1
45 BLK/BRN 5088
INTERLOCK LOOP SIG 1
47 VIO 5087
HOOD OPEN SW SIG
52 YEL 5530
DOOR LOCKS & ANTI-THEFT SYSTEMS
HIGH SPD SER DATA (+) 3
HIGH SPD SER DATA (-) 3
54 BLU/BLK 7493
55 WHT 7494
56 BLU/BLK 7493
X1
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
BLU/YEL 17
BLU/YEL A
BLK/GRN 18
BLK/GRN B
X107
HYBRID/EV BATTERY COOLANT LEVEL SWITCH (BOTTOM OF BATTERY COOLANT RESERVOIR)
BLK/BLU 37
BLK/BLU 2
YEL/BLK 5
YEL/BLK 1
X105
HYBRID/EV ELECTRONICS COOLANT TEMPERATURE SENSOR (TOP RIGHT OF HYBRID/EV ELECTRONICS RADIATOR)
COMPUTER DATA LINES SYSTEM
3831 YEL 57
3832 WHT 58
3831 YEL 59
3800 BLK/GRN 60
HIGH SPD SER DATA (+) 6
HIGH SPD SER DATA (-) 6
HIGH SPD SER DATA (+) 6
SENS LOW REF
474 BLU/RED 63
5 VOLT REF
BLK/VIO 6 X105
5596 BLK/VIO 65
LOOP LOW REF 2
GRY/VIO ①
GRY/VIO 38 X105
5595 GRY/VIO 67
LOOP SIGNAL 2
GRY/VIO ②
VIO/BRN D X117
3699 VIO/BRN 71
DOOR SWITCH SIGNAL
7493 BLU/BLK 74
7494 WHT 75
7494 WHT 76
3831 YEL 77
3832 WHT 78
3832 WHT 79
HIGH SPD SER DATA (+) 3
HIGH SPD SER DATA (-) 3
HIGH SPD SER DATA (-) 3
HIGH SPD SER DATA (+) 6
HIGH SPD SER DATA (-) 6
HIGH SPD SER DATA (-) 6
X1
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
BLU/RED 7
BLK/GRN 39
BLU 24
X105
2 BLU/RED
1 BLK/GRN
3 BLU
A/C LOW SIDE PRESSURE SENSOR (ATTACHED TO A/C LINE)
① W/ FAST CHARGING ACCOMMODATIONS PROVISIONS
② W/O FAST CHARGING ACCOMMODATIONS PROVISIONS
562360

Fig. 31: Electric, Engine Performance Circuit (5 of 16)

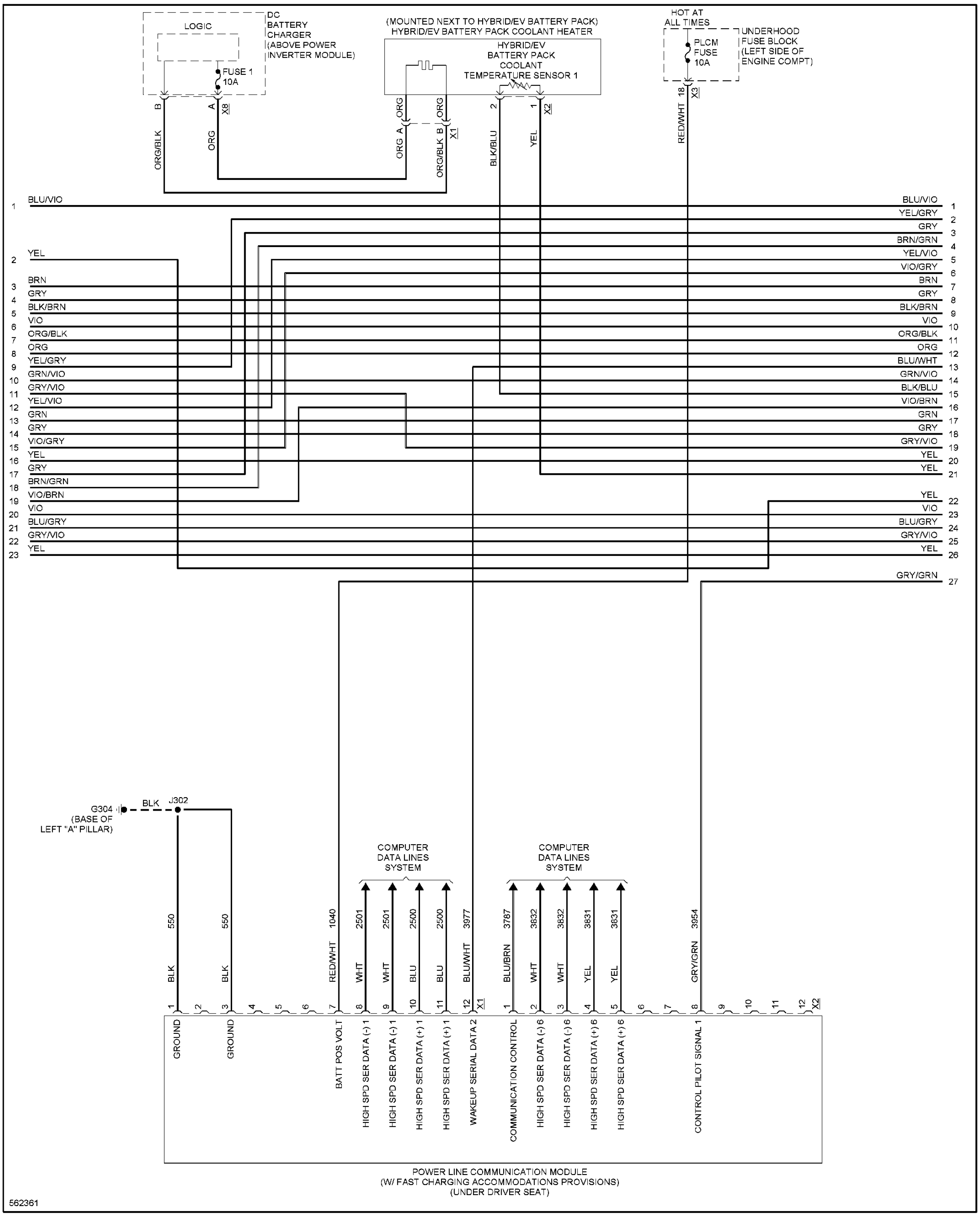

LOGIC
DC BATTERY CHARGER (ABOVE POWER INVERTER MODULE)
FUSE 1 10A
B
A
X8
ORG/BLK
ORG
(MOUNTED NEXT TO HYBRID/EV BATTERY PACK) HYBRID/EV BATTERY PACK COOLANT HEATER
HYBRID/EV BATTERY PACK COOLANT TEMPERATURE SENSOR 1
ORG A
ORG/BLK B
X1
2
1
X2
BLK/BLU
YEL
HOT AT ALL TIMES
PLCM FUSE 10A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
18
X3
RED/WHT
1 BLU/VIO
2 YEL
3 BRN
4 GRY
5 BLK/BRN
6 VIO
7 ORG/BLK
8 ORG
9 YEL/GRY
10 GRN/VIO
11 GRY/VIO
12 YEL/VIO
13 GRN
14 GRY
15 VIO/GRY
16 YEL
17 GRY
18 BRN/GRN
19 VIO/BRN
20 VIO
21 BLU/GRY
22 GRY/VIO
23 YEL
BLU/VIO 1
YEL/GRY 2
GRY 3
BRN/GRN 4
YEL/VIO 5
VIO/GRY 6
BRN 7
GRY 8
BLK/BRN 9
VIO 10
ORG/BLK 11
ORG 12
BLU/WHT 13
GRN/VIO 14
BLK/BLU 15
VIO/BRN 16
GRN 17
GRY 18
GRY/VIO 19
YEL 20
YEL 21
YEL 22
VIO 23
BLU/GRY 24
GRY/VIO 25
YEL 26
GRY/GRN 27
G304 (BASE OF LEFT "A" PILLAR)
BLK
J302
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
550 BLK
550 BLK
1040 RED/WHT
2501 WHT
2501 WHT
2500 BLU
2500 BLU
3977 BLU/WHT
3787 BLU/BRN
3832 WHT
3832 WHT
3831 YEL
3831 YEL
3954 GRY/GRN
1 2 3 4 5 6 7 8 9 10 11 12 X1
1 2 3 4 5 6 7 8 9 10 11 12 X2
GROUND
GROUND
BATT POS VOLT
HIGH SPD SER DATA (-) 1
HIGH SPD SER DATA (-) 1
HIGH SPD SER DATA (+) 1
HIGH SPD SER DATA (+) 1
WAKEUP SERIAL DATA 2
COMMUNICATION CONTROL
HIGH SPD SER DATA (-) 6
HIGH SPD SER DATA (-) 6
HIGH SPD SER DATA (+) 6
HIGH SPD SER DATA (+) 6
CONTROL PILOT SIGNAL 1
POWER LINE COMMUNICATION MODULE (W/ FAST CHARGING ACCOMMODATIONS PROVISIONS) (UNDER DRIVER SEAT)
562361

Fig. 32: Electric, Engine Performance Circuit (6 of 16)

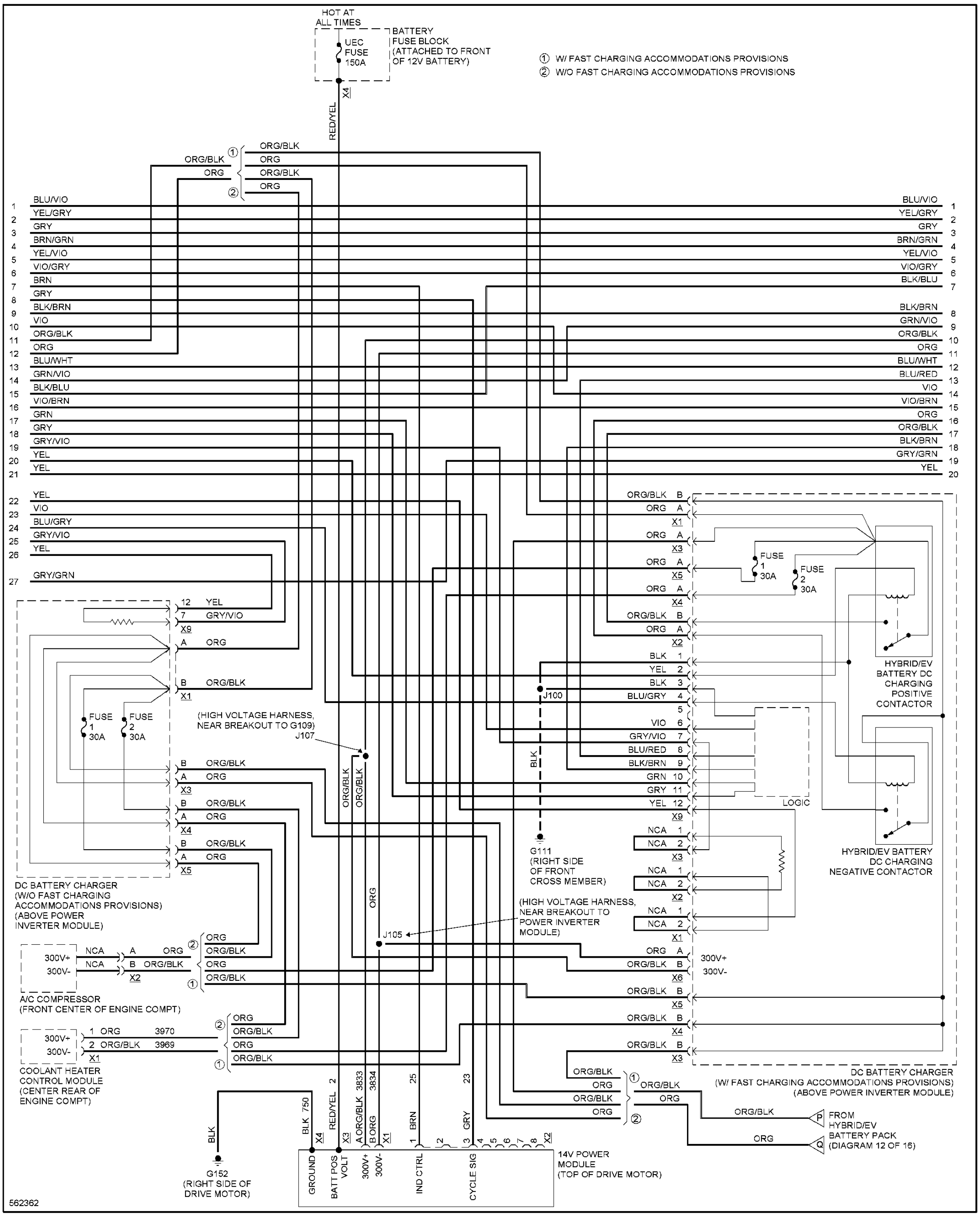

HOT AT ALL TIMES
BATTERY FUSE BLOCK (ATTACHED TO FRONT OF 12V BATTERY)
UEC FUSE 150A
X4
RED/YEL
① W/ FAST CHARGING ACCOMMODATIONS PROVISIONS
② W/O FAST CHARGING ACCOMMODATIONS PROVISIONS
1 BLU/VIO
2 YEL/GRY
3 GRY
4 BRN/GRN
5 YEL/VIO
6 VIO/GRY
7 BRN
8 GRY
9 BLK/BRN
10 VIO
11 ORG/BLK
12 ORG
13 BLU/WHT
14 GRN/VIO
15 BLK/BLU
16 VIO/BRN
17 GRN
18 GRY
19 GRY/VIO
20 YEL
21 YEL
22 YEL
23 VIO
24 BLU/GRY
25 GRY/VIO
26 YEL
27 GRY/GRN
BLU/VIO 1
YEL/GRY 2
GRY 3
BRN/GRN 4
YEL/VIO 5
VIO/GRY 6
BLK/BLU 7
BLK/BRN 8
GRN/VIO 9
ORG/BLK 10
ORG 11
BLU/WHT 12
BLU/RED 13
VIO 14
VIO/BRN 15
ORG 16
ORG/BLK 17
BLK/BRN 18
GRY/GRN 19
YEL 20
DC BATTERY CHARGER (W/O FAST CHARGING ACCOMMODATIONS PROVISIONS) (ABOVE POWER INVERTER MODULE)
FUSE 1 30A
FUSE 2 30A
X9 12 YEL 7 GRY/VIO
X1 A ORG B ORG/BLK
X3 B ORG/BLK A ORG
X4 B ORG/BLK A ORG
X5 B ORG/BLK A ORG
(HIGH VOLTAGE HARNESS, NEAR BREAKOUT TO G109) J107
(HIGH VOLTAGE HARNESS, NEAR BREAKOUT TO POWER INVERTER MODULE) J105
J100
BLK
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
A/C COMPRESSOR (FRONT CENTER OF ENGINE COMPT)
300V+ 300V-
NCA A ORG
NCA B ORG/BLK
X2
COOLANT HEATER CONTROL MODULE (CENTER REAR OF ENGINE COMPT)
1 ORG 3970
2 ORG/BLK 3969
X1
G152 (RIGHT SIDE OF DRIVE MOTOR)
14V POWER MODULE (TOP OF DRIVE MOTOR)
BLK 750 X4 1 GROUND
RED/YEL 2 X3 BATT POS VOLT
ORG/BLK 3833 A 300V+
ORG 3834 B 300V-
X1
BRN 25 1 IND CTRL
2
GRY 23 3 CYCLE SIG
4 5 6 7 8 X2
DC BATTERY CHARGER (W/ FAST CHARGING ACCOMMODATIONS PROVISIONS) (ABOVE POWER INVERTER MODULE)
X1 ORG/BLK B ORG A
X3 ORG A
X5 ORG A
X4 ORG A
X2 ORG/BLK B ORG A
FUSE 1 30A
FUSE 2 30A
X9 BLK 1 YEL 2 BLK 3 BLU/GRY 4 5 VIO 6 GRY/VIO 7 BLU/RED 8 BLK/BRN 9 GRN 10 GRY 11 YEL 12
LOGIC
X3 NCA 1 NCA 2
X2 NCA 1 NCA 2
X1 NCA 1 NCA 2
X6 ORG A ORG/BLK B 300V+ 300V-
X5 ORG/BLK B
X4 ORG/BLK B
X3 ORG/BLK B
HYBRID/EV BATTERY DC CHARGING POSITIVE CONTACTOR
HYBRID/EV BATTERY DC CHARGING NEGATIVE CONTACTOR
P Q FROM HYBRID/EV BATTERY PACK (DIAGRAM 12 OF 16)
562362

Fig. 33: Electric, Engine Performance Circuit (7 of 16)

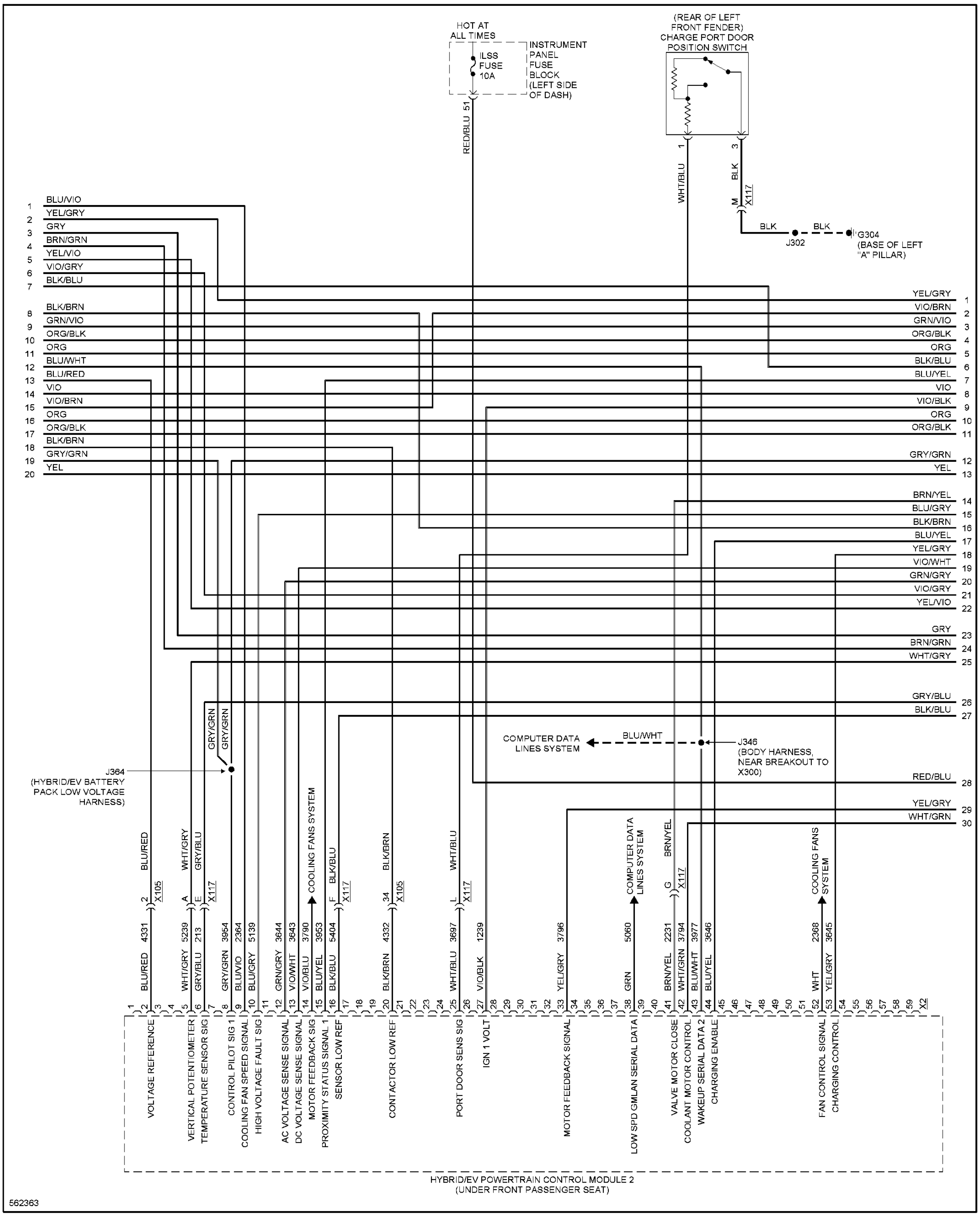

HOT AT ALL TIMES
ILSS FUSE 10A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
RED/BLU 51
(REAR OF LEFT FRONT FENDER) CHARGE PORT DOOR POSITION SWITCH
WHT/BLU 1
BLK 3
M X117
BLK J302 BLK G304 (BASE OF LEFT "A" PILLAR)
1 BLU/VIO
2 YEL/GRY
3 GRY
4 BRN/GRN
5 YEL/VIO
6 VIO/GRY
7 BLK/BLU
8 BLK/BRN
9 GRN/VIO
10 ORG/BLK
11 ORG
12 BLU/WHT
13 BLU/RED
14 VIO
15 VIO/BRN
16 ORG
17 ORG/BLK
18 BLK/BRN
19 GRY/GRN
20 YEL
YEL/GRY 1
VIO/BRN 2
GRN/VIO 3
ORG/BLK 4
ORG 5
BLK/BLU 6
BLU/YEL 7
VIO 8
VIO/BLK 9
ORG 10
ORG/BLK 11
GRY/GRN 12
YEL 13
BRN/YEL 14
BLU/GRY 15
BLK/BRN 16
BLU/YEL 17
YEL/GRY 18
VIO/WHT 19
GRN/GRY 20
VIO/GRY 21
YEL/VIO 22
GRY 23
BRN/GRN 24
WHT/GRY 25
GRY/BLU 26
BLK/BLU 27
RED/BLU 28
YEL/GRY 29
WHT/GRN 30
GRY/GRN GRY/GRN
J364 (HYBRID/EV BATTERY PACK LOW VOLTAGE HARNESS)
COMPUTER DATA LINES SYSTEM
BLU/WHT
J346 (BODY HARNESS, NEAR BREAKOUT TO X300)
BLU/RED 2 X105
WHT/GRY A
GRY/BLU E X117
COOLING FANS SYSTEM
BLK/BLU F X117
BLK/BRN 34 X105
WHT/BLU L X117
COMPUTER DATA LINES SYSTEM
BRN/YEL G X117
COOLING FANS SYSTEM
BLU/RED 4331
WHT/GRY 5239
GRY/BLU 213
GRY/GRN 3954
BLU/VIO 2364
BLU/GRY 5139
GRN/GRY 3644
VIO/WHT 3643
VIO/BLU 3790
BLU/YEL 3953
BLK/BLU 5404
BLK/BRN 4332
WHT/BLU 3697
VIO/BLK 1239
YEL/GRY 3796
GRN 5060
BRN/YEL 2231
WHT/GRN 3794
BLU/WHT 3977
BLU/YEL 3646
WHT 2368
YEL/GRY 3645
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 X2
VOLTAGE REFERENCE
VERTICAL POTENTIOMETER
TEMPERATURE SENSOR SIG
CONTROL PILOT SIG 1
COOLING FAN SPEED SIGNAL
HIGH VOLTAGE FAULT SIG
AC VOLTAGE SENSE SIGNAL
DC VOLTAGE SENSE SIGNAL
MOTOR FEEDBACK SIG
PROXIMITY STATUS SIGNAL 1
SENSOR LOW REF
CONTACTOR LOW REF
PORT DOOR SENS SIG
IGN 1 VOLT
MOTOR FEEDBACK SIGNAL
LOW SPD GMLAN SERIAL DATA
VALVE MOTOR CLOSE
COOLANT MOTOR CONTROL
WAKEUP SERIAL DATA 2
CHARGING ENABLE
FAN CONTROL SIGNAL
CHARGING CONTROL
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
562363

Fig. 34: Electric, Engine Performance Circuit (8 of 16)

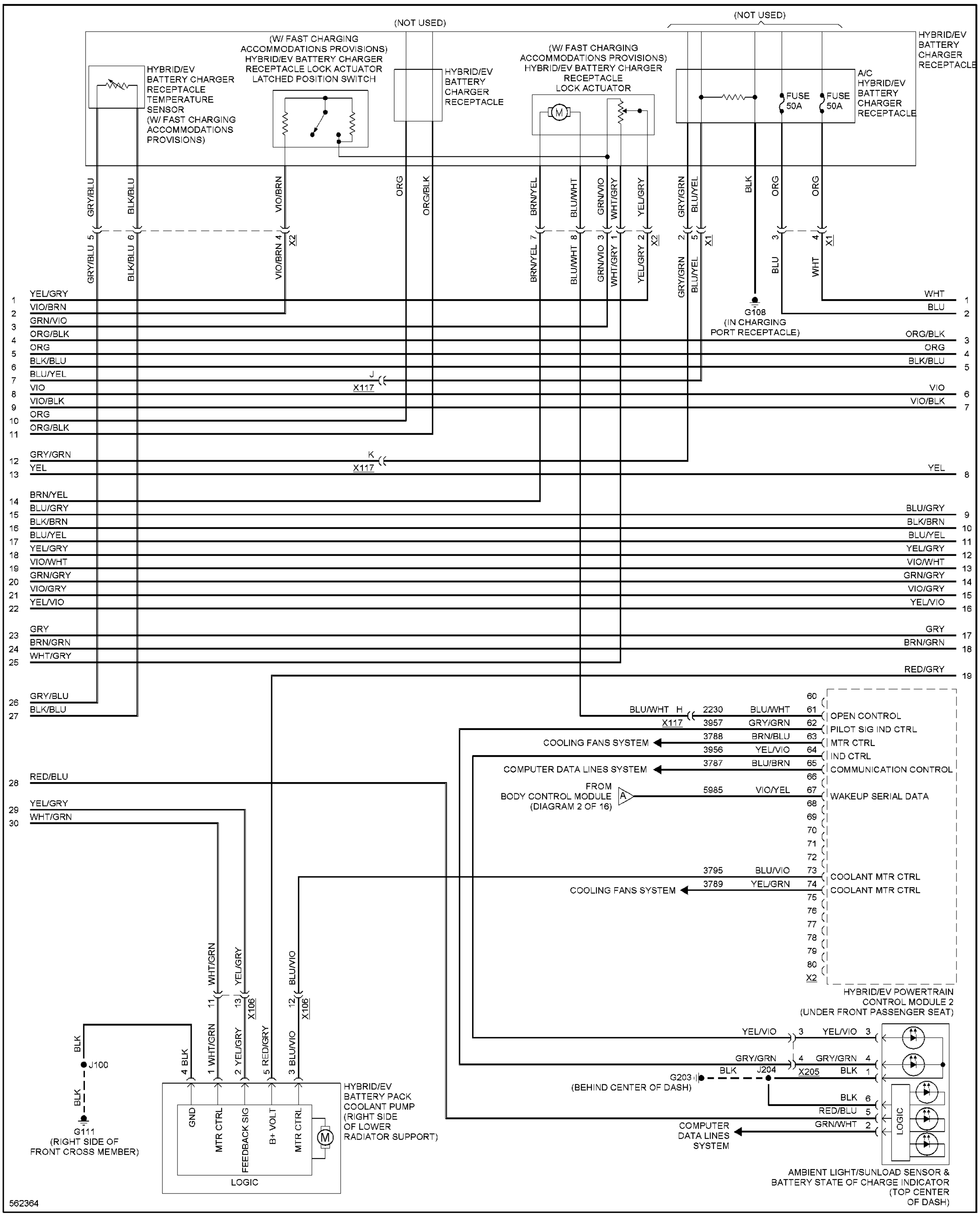

(NOT USED)
(NOT USED)
HYBRID/EV BATTERY CHARGER RECEPTACLE
HYBRID/EV BATTERY CHARGER RECEPTACLE TEMPERATURE SENSOR (W/ FAST CHARGING ACCOMMODATIONS PROVISIONS)
(W/ FAST CHARGING ACCOMMODATIONS PROVISIONS) HYBRID/EV BATTERY CHARGER RECEPTACLE LOCK ACTUATOR LATCHED POSITION SWITCH
HYBRID/EV BATTERY CHARGER RECEPTACLE
(W/ FAST CHARGING ACCOMMODATIONS PROVISIONS) HYBRID/EV BATTERY CHARGER RECEPTACLE LOCK ACTUATOR
M
FUSE 50A
FUSE 50A
A/C HYBRID/EV BATTERY CHARGER RECEPTACLE
GRY/BLU
BLK/BLU
VIO/BRN
ORG
ORG/BLK
BRN/YEL
BLU/WHT
GRN/VIO
WHT/GRY
YEL/GRY
GRY/GRN
BLU/YEL
BLK
ORG
ORG
GRY/BLU 5
BLK/BLU 6
VIO/BRN 4
X2
BRN/YEL 7
BLU/WHT 8
GRN/VIO 3
WHT/GRY 1
YEL/GRY 2
X2
GRY/GRN 2
BLU/YEL 5
X1
BLU 3
WHT 4
X1
G108 (IN CHARGING PORT RECEPTACLE)
1 YEL/GRY
2 VIO/BRN
3 GRN/VIO
4 ORG/BLK
5 ORG
6 BLK/BLU
7 BLU/YEL
8 VIO
9 VIO/BLK
10 ORG
11 ORG/BLK
12 GRY/GRN
13 YEL
14 BRN/YEL
15 BLU/GRY
16 BLK/BRN
17 BLU/YEL
18 YEL/GRY
19 VIO/WHT
20 GRN/GRY
21 VIO/GRY
22 YEL/VIO
23 GRY
24 BRN/GRN
25 WHT/GRY
26 GRY/BLU
27 BLK/BLU
28 RED/BLU
29 YEL/GRY
30 WHT/GRN
J
X117
K
X117
WHT 1
BLU 2
ORG/BLK 3
ORG 4
BLK/BLU 5
VIO 6
VIO/BLK 7
YEL 8
BLU/GRY 9
BLK/BRN 10
BLU/YEL 11
YEL/GRY 12
VIO/WHT 13
GRN/GRY 14
VIO/GRY 15
YEL/VIO 16
GRY 17
BRN/GRN 18
RED/GRY 19
BLU/WHT H
X117
2230 BLU/WHT 61
3957 GRY/GRN 62
3788 BRN/BLU 63
3956 YEL/VIO 64
3787 BLU/BRN 65
5985 VIO/YEL 67
3795 BLU/VIO 73
3789 YEL/GRN 74
60
66
68
69
70
71
72
75
76
77
78
79
80
X2
COOLING FANS SYSTEM
COMPUTER DATA LINES SYSTEM
FROM BODY CONTROL MODULE (DIAGRAM 2 OF 16)
A
COOLING FANS SYSTEM
OPEN CONTROL
PILOT SIG IND CTRL
MTR CTRL
IND CTRL
COMMUNICATION CONTROL
WAKEUP SERIAL DATA
COOLANT MTR CTRL
COOLANT MTR CTRL
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
WHT/GRN
YEL/GRY
BLU/VIO
11
13
X106
12
X106
BLK
J100
BLK
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
4 BLK
1 WHT/GRN
2 YEL/GRY
5 RED/GRY
3 BLU/VIO
GND
MTR CTRL
FEEDBACK SIG
B+ VOLT
MTR CTRL
M
LOGIC
HYBRID/EV BATTERY PACK COOLANT PUMP (RIGHT SIDE OF LOWER RADIATOR SUPPORT)
YEL/VIO 3 YEL/VIO 3
GRY/GRN 4 GRY/GRN 4
BLK J204
X205
BLK 1
G203 (BEHIND CENTER OF DASH)
BLK 6
RED/BLU 5
GRN/WHT 2
COMPUTER DATA LINES SYSTEM
LOGIC
AMBIENT LIGHT/SUNLOAD SENSOR & BATTERY STATE OF CHARGE INDICATOR (TOP CENTER OF DASH)
562364

Fig. 35: Electric, Engine Performance Circuit (9 of 16)

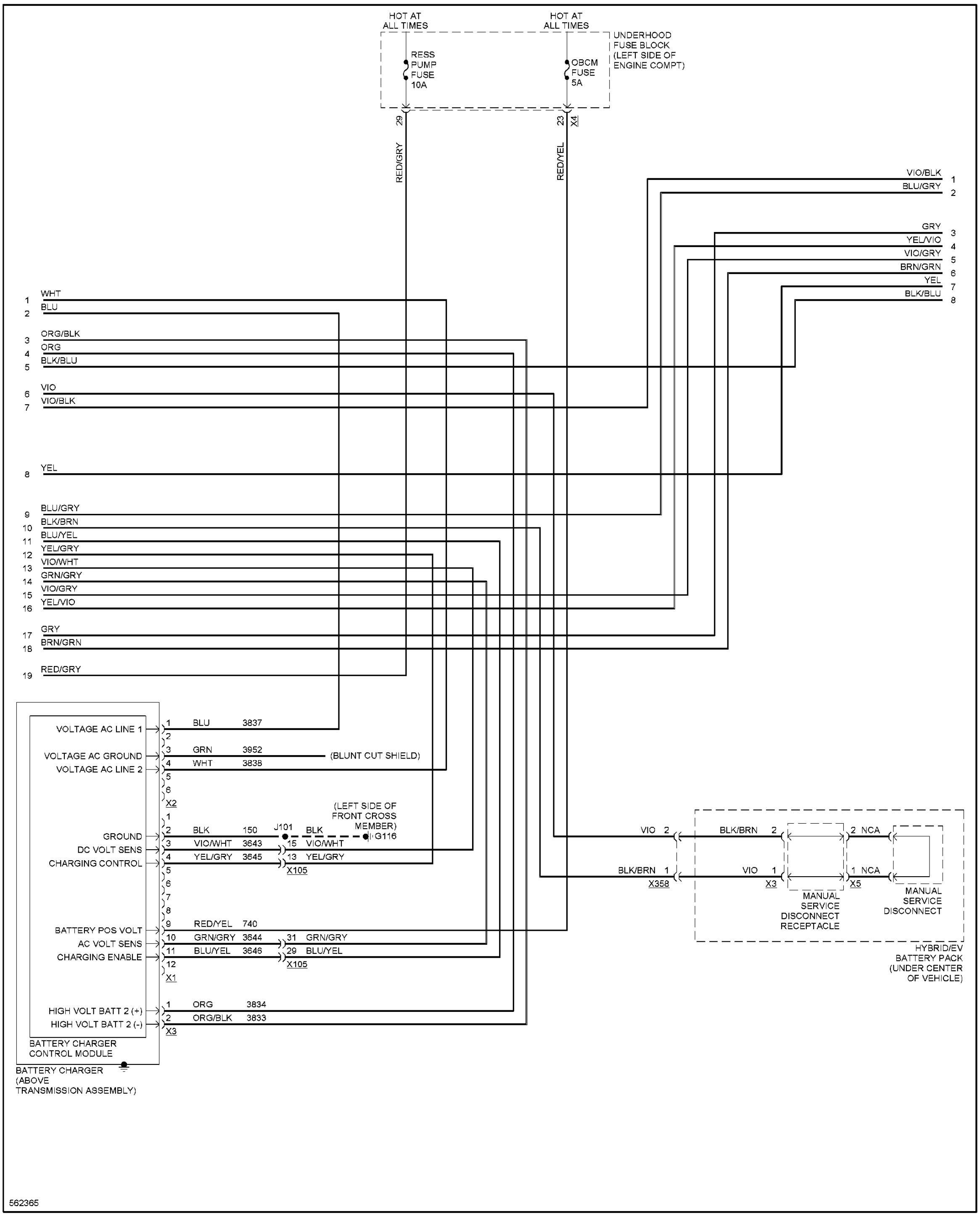

HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
RESS PUMP FUSE 10A
OBCM FUSE 5A
29
23
X4
RED/GRY
RED/YEL
VIO/BLK 1
BLU/GRY 2
GRY 3
YEL/VIO 4
VIO/GRY 5
BRN/GRN 6
YEL 7
BLK/BLU 8
1 WHT
2 BLU
3 ORG/BLK
4 ORG
5 BLK/BLU
6 VIO
7 VIO/BLK
8 YEL
9 BLU/GRY
10 BLK/BRN
11 BLU/YEL
12 YEL/GRY
13 VIO/WHT
14 GRN/GRY
15 VIO/GRY
16 YEL/VIO
17 GRY
18 BRN/GRN
19 RED/GRY
VOLTAGE AC LINE 1
VOLTAGE AC GROUND
VOLTAGE AC LINE 2
1 BLU 3837
2
3 GRN 3952
4 WHT 3838
5
6
X2
(BLUNT CUT SHIELD)
GROUND
DC VOLT SENS
CHARGING CONTROL
1
2 BLK 150
3 VIO/WHT 3643
4 YEL/GRY 3645
5
6
7
8
J101
BLK
(LEFT SIDE OF FRONT CROSS MEMBER)
G116
15 VIO/WHT
13 YEL/GRY
X105
BATTERY POS VOLT
AC VOLT SENS
CHARGING ENABLE
9 RED/YEL 740
10 GRN/GRY 3644
11 BLU/YEL 3646
12
X1
31 GRN/GRY
29 BLU/YEL
X105
HIGH VOLT BATT 2 (+)
HIGH VOLT BATT 2 (-)
1 ORG 3834
2 ORG/BLK 3833
X3
BATTERY CHARGER CONTROL MODULE
BATTERY CHARGER (ABOVE TRANSMISSION ASSEMBLY)
VIO 2
BLK/BRN 1
X358
BLK/BRN 2
VIO 1
X3
2 NCA
1 NCA
X5
MANUAL SERVICE DISCONNECT RECEPTACLE
MANUAL SERVICE DISCONNECT
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
562365

Fig. 36: Electric, Engine Performance Circuit (10 of 16)

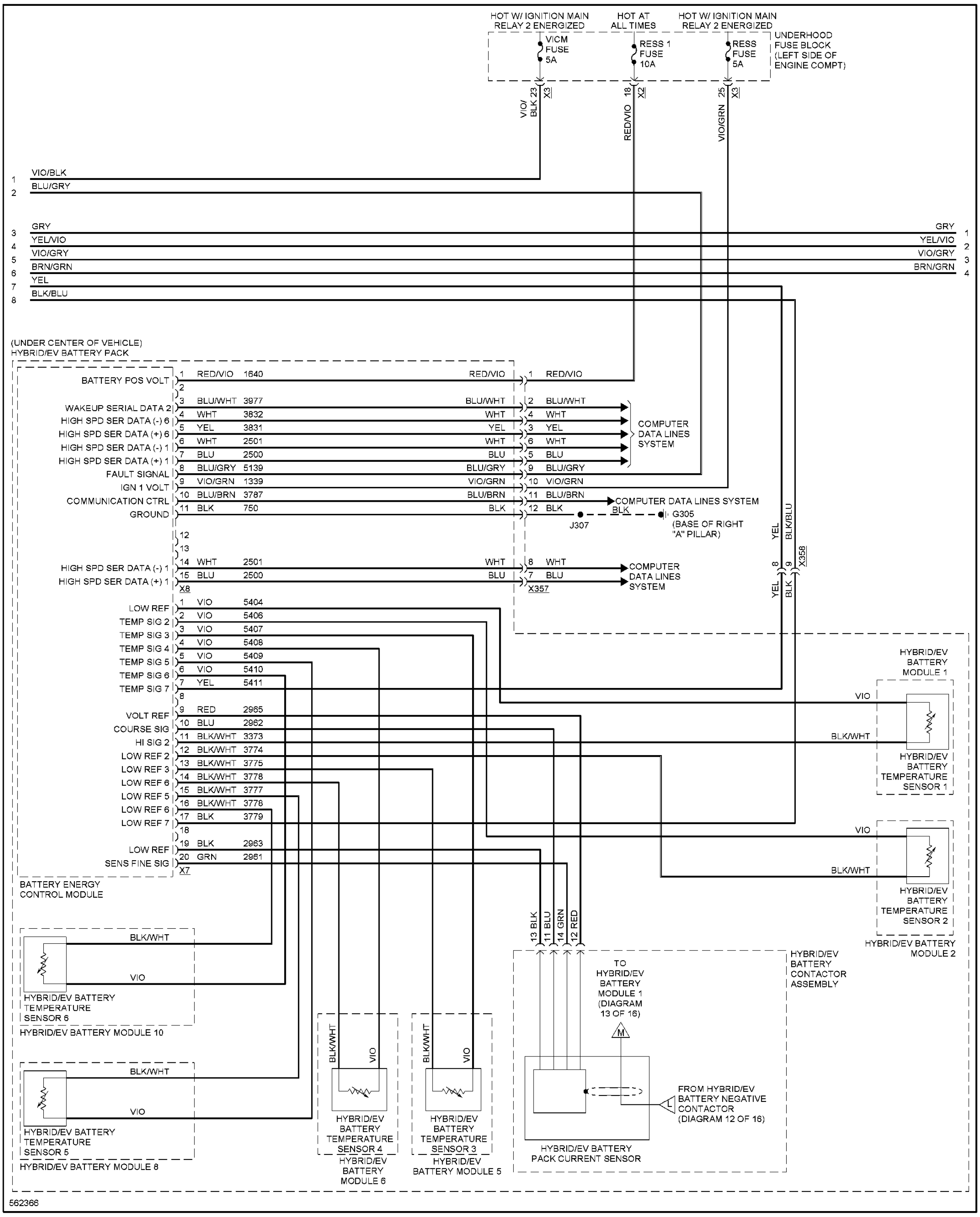

HOT W/ IGNITION MAIN RELAY 2 ENERGIZED
HOT AT ALL TIMES
HOT W/ IGNITION MAIN RELAY 2 ENERGIZED
VICM FUSE 5A
RESS 1 FUSE 10A
RESS FUSE 5A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
VIO/BLK 23 X3
RED/VIO 18 X2
VIO/GRN 25 X3
1 VIO/BLK
2 BLU/GRY
3 GRY
4 YEL/VIO
5 VIO/GRY
6 BRN/GRN
7 YEL
8 BLK/BLU
GRY 1
YEL/VIO 2
VIO/GRY 3
BRN/GRN 4
(UNDER CENTER OF VEHICLE) HYBRID/EV BATTERY PACK
BATTERY POS VOLT 1 RED/VIO 1640
2
WAKEUP SERIAL DATA 2 3 BLU/WHT 3977
HIGH SPD SER DATA (-) 6 4 WHT 3832
HIGH SPD SER DATA (+) 6 5 YEL 3831
HIGH SPD SER DATA (-) 1 6 WHT 2501
HIGH SPD SER DATA (+) 1 7 BLU 2500
FAULT SIGNAL 8 BLU/GRY 5139
IGN 1 VOLT 9 VIO/GRN 1339
COMMUNICATION CTRL 10 BLU/BRN 3787
GROUND 11 BLK 750
12
13
HIGH SPD SER DATA (-) 1 14 WHT 2501
HIGH SPD SER DATA (+) 1 15 BLU 2500
X8
RED/VIO 1 RED/VIO
BLU/WHT 2 BLU/WHT
WHT 4 WHT
YEL 3 YEL
WHT 6 WHT
BLU 5 BLU
BLU/GRY 9 BLU/GRY
VIO/GRN 10 VIO/GRN
BLU/BRN 11 BLU/BRN
BLK 12 BLK
WHT 8 WHT
BLU 7 BLU
X357
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
BLK
J307
G305 (BASE OF RIGHT "A" PILLAR)
COMPUTER DATA LINES SYSTEM
YEL
BLK/BLU
8 YEL
9 BLK
X358
LOW REF 1 VIO 5404
TEMP SIG 2 2 VIO 5406
TEMP SIG 3 3 VIO 5407
TEMP SIG 4 4 VIO 5408
TEMP SIG 5 5 VIO 5409
TEMP SIG 6 6 VIO 5410
TEMP SIG 7 7 YEL 5411
8
VOLT REF 9 RED 2965
COURSE SIG 10 BLU 2962
HI SIG 2 11 BLK/WHT 3373
LOW REF 2 12 BLK/WHT 3774
LOW REF 3 13 BLK/WHT 3775
LOW REF 6 14 BLK/WHT 3778
LOW REF 5 15 BLK/WHT 3777
LOW REF 6 16 BLK/WHT 3776
LOW REF 7 17 BLK 3779
18
LOW REF 19 BLK 2963
SENS FINE SIG 20 GRN 2961
X7
BATTERY ENERGY CONTROL MODULE
HYBRID/EV BATTERY MODULE 1
VIO
BLK/WHT
HYBRID/EV BATTERY TEMPERATURE SENSOR 1
VIO
BLK/WHT
HYBRID/EV BATTERY TEMPERATURE SENSOR 2
HYBRID/EV BATTERY MODULE 2
13 BLK
11 BLU
14 GRN
12 RED
HYBRID/EV BATTERY CONTACTOR ASSEMBLY
TO HYBRID/EV BATTERY MODULE 1 (DIAGRAM 13 OF 16)
M
FROM HYBRID/EV BATTERY NEGATIVE CONTACTOR (DIAGRAM 12 OF 16)
L
HYBRID/EV BATTERY PACK CURRENT SENSOR
BLK/WHT
VIO
HYBRID/EV BATTERY TEMPERATURE SENSOR 6
HYBRID/EV BATTERY MODULE 10
BLK/WHT
VIO
HYBRID/EV BATTERY TEMPERATURE SENSOR 5
HYBRID/EV BATTERY MODULE 8
BLK/WHT
VIO
HYBRID/EV BATTERY TEMPERATURE SENSOR 4
HYBRID/EV BATTERY MODULE 6
BLK/WHT
VIO
HYBRID/EV BATTERY TEMPERATURE SENSOR 3
HYBRID/EV BATTERY MODULE 5
562366

Fig. 37: Electric, Engine Performance Circuit (11 of 16)

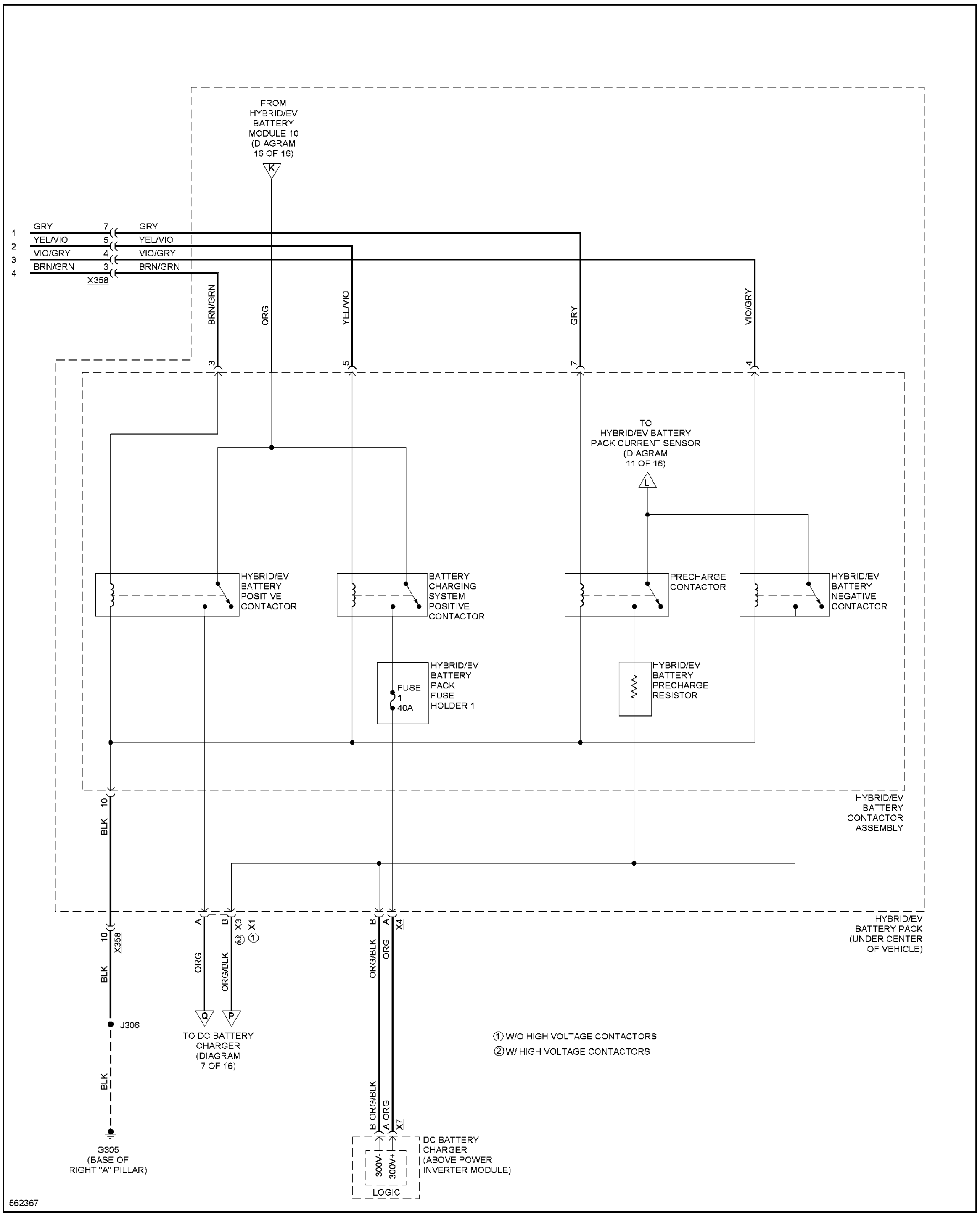

FROM HYBRID/EV BATTERY MODULE 10 (DIAGRAM 16 OF 16)
K
1
2
3
4
GRY
YEL/VIO
VIO/GRY
BRN/GRN
7
5
4
3
X358
GRY
YEL/VIO
VIO/GRY
BRN/GRN
BRN/GRN
ORG
YEL/VIO
GRY
VIO/GRY
3
5
7
4
TO HYBRID/EV BATTERY PACK CURRENT SENSOR (DIAGRAM 11 OF 16)
L
HYBRID/EV BATTERY POSITIVE CONTACTOR
BATTERY CHARGING SYSTEM POSITIVE CONTACTOR
PRECHARGE CONTACTOR
HYBRID/EV BATTERY NEGATIVE CONTACTOR
FUSE 1 40A
HYBRID/EV BATTERY PACK FUSE HOLDER 1
HYBRID/EV BATTERY PRECHARGE RESISTOR
HYBRID/EV BATTERY CONTACTOR ASSEMBLY
10
BLK
A
B
X3
X1
②
①
B
A
X4
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
10
X358
BLK
ORG
ORG/BLK
ORG/BLK
ORG
J306
Q
P
TO DC BATTERY CHARGER (DIAGRAM 7 OF 16)
① W/O HIGH VOLTAGE CONTACTORS
② W/ HIGH VOLTAGE CONTACTORS
BLK
B ORG/BLK
A ORG
X7
300V-
300V+
LOGIC
DC BATTERY CHARGER (ABOVE POWER INVERTER MODULE)
G305 (BASE OF RIGHT "A" PILLAR)
562367

Fig. 38: Electric, Engine Performance Circuit (12 of 16)

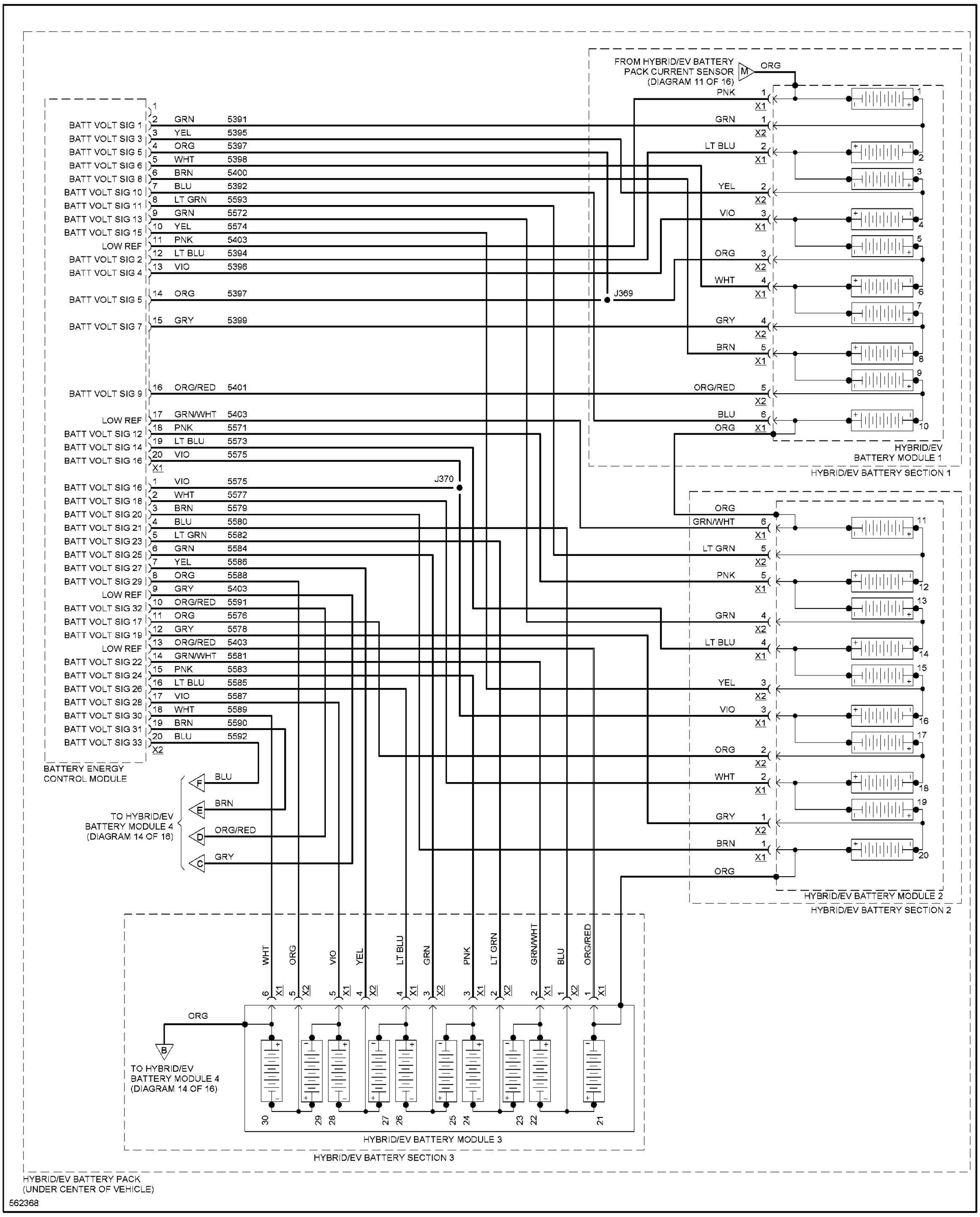

FROM HYBRID/EV BATTERY PACK CURRENT SENSOR (DIAGRAM 11 OF 16)
M
ORG
BATT VOLT SIG 1
BATT VOLT SIG 3
BATT VOLT SIG 5
BATT VOLT SIG 6
BATT VOLT SIG 8
BATT VOLT SIG 10
BATT VOLT SIG 11
BATT VOLT SIG 13
BATT VOLT SIG 15
LOW REF
BATT VOLT SIG 2
BATT VOLT SIG 4
BATT VOLT SIG 5
BATT VOLT SIG 7
BATT VOLT SIG 9
LOW REF
BATT VOLT SIG 12
BATT VOLT SIG 14
BATT VOLT SIG 16
BATT VOLT SIG 16
BATT VOLT SIG 18
BATT VOLT SIG 20
BATT VOLT SIG 21
BATT VOLT SIG 23
BATT VOLT SIG 25
BATT VOLT SIG 27
BATT VOLT SIG 29
LOW REF
BATT VOLT SIG 32
BATT VOLT SIG 17
BATT VOLT SIG 19
LOW REF
BATT VOLT SIG 22
BATT VOLT SIG 24
BATT VOLT SIG 26
BATT VOLT SIG 28
BATT VOLT SIG 30
BATT VOLT SIG 31
BATT VOLT SIG 33
1
2 GRN 5391
3 YEL 5395
4 ORG 5397
5 WHT 5398
6 BRN 5400
7 BLU 5392
8 LT GRN 5593
9 GRN 5572
10 YEL 5574
11 PNK 5403
12 LT BLU 5394
13 VIO 5396
14 ORG 5397
15 GRY 5399
16 ORG/RED 5401
17 GRN/WHT 5403
18 PNK 5571
19 LT BLU 5573
20 VIO 5575
X1
1 VIO 5575
2 WHT 5577
3 BRN 5579
4 BLU 5580
5 LT GRN 5582
6 GRN 5584
7 YEL 5586
8 ORG 5588
9 GRY 5403
10 ORG/RED 5591
11 ORG 5576
12 GRY 5578
13 ORG/RED 5403
14 GRN/WHT 5581
15 PNK 5583
16 LT BLU 5585
17 VIO 5587
18 WHT 5589
19 BRN 5590
20 BLU 5592
X2
BATTERY ENERGY CONTROL MODULE
J369
J370
PNK 1 X1
GRN 1 X2
LT BLU 2 X1
YEL 2 X2
VIO 3 X1
ORG 3 X2
WHT 4 X1
GRY 4 X2
BRN 5 X1
ORG/RED 5 X2
BLU 6 X1
ORG
1
2
3
4
5
6
7
8
9
10
HYBRID/EV BATTERY MODULE 1
HYBRID/EV BATTERY SECTION 1
ORG
GRN/WHT 6 X1
LT GRN 5 X2
PNK 5 X1
GRN 4 X2
LT BLU 4 X1
YEL 3 X2
VIO 3 X1
ORG 2 X2
WHT 2 X1
GRY 1 X2
BRN 1 X1
ORG
11
12
13
14
15
16
17
18
19
20
HYBRID/EV BATTERY MODULE 2
HYBRID/EV BATTERY SECTION 2
TO HYBRID/EV BATTERY MODULE 4 (DIAGRAM 14 OF 16)
F BLU
E BRN
D ORG/RED
C GRY
WHT 6 X1
ORG 5 X2
VIO 5 X1
YEL 4 X2
LT BLU 4 X1
GRN 3 X2
PNK 3 X1
LT GRN 2 X2
GRN/WHT 2 X1
BLU 1 X2
ORG/RED 1 X1
ORG
B
TO HYBRID/EV BATTERY MODULE 4 (DIAGRAM 14 OF 16)
30
29
28
27
26
25
24
23
22
21
HYBRID/EV BATTERY MODULE 3
HYBRID/EV BATTERY SECTION 3
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
562368

Fig. 39: Electric, Engine Performance Circuit (13 of 16)

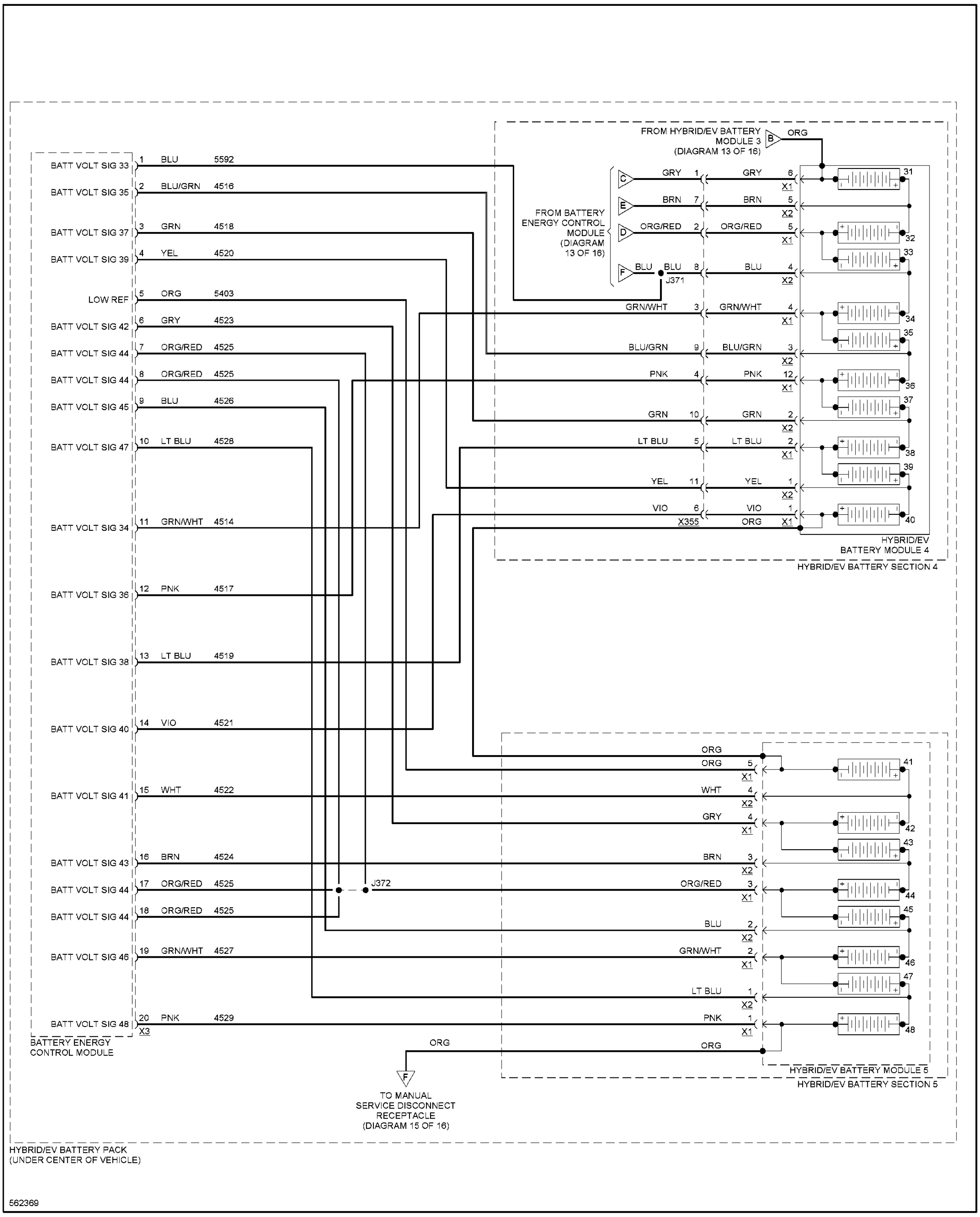

BATT VOLT SIG 33
BATT VOLT SIG 35
BATT VOLT SIG 37
BATT VOLT SIG 39
LOW REF
BATT VOLT SIG 42
BATT VOLT SIG 44
BATT VOLT SIG 44
BATT VOLT SIG 45
BATT VOLT SIG 47
BATT VOLT SIG 34
BATT VOLT SIG 36
BATT VOLT SIG 38
BATT VOLT SIG 40
BATT VOLT SIG 41
BATT VOLT SIG 43
BATT VOLT SIG 44
BATT VOLT SIG 44
BATT VOLT SIG 46
BATT VOLT SIG 48
1 BLU 5592
2 BLU/GRN 4516
3 GRN 4518
4 YEL 4520
5 ORG 5403
6 GRY 4523
7 ORG/RED 4525
8 ORG/RED 4525
9 BLU 4526
10 LT BLU 4528
11 GRN/WHT 4514
12 PNK 4517
13 LT BLU 4519
14 VIO 4521
15 WHT 4522
16 BRN 4524
17 ORG/RED 4525
18 ORG/RED 4525
19 GRN/WHT 4527
20 PNK 4529
X3
BATTERY ENERGY CONTROL MODULE
FROM HYBRID/EV BATTERY MODULE 3 (DIAGRAM 13 OF 16)
B
ORG
FROM BATTERY ENERGY CONTROL MODULE (DIAGRAM 13 OF 16)
C
E
D
F
GRY 1
GRY 6 X1
BRN 7
BRN 5 X2
ORG/RED 2
ORG/RED 5 X1
BLU
BLU 8
J371
BLU 4 X2
GRN/WHT 3
GRN/WHT 4 X1
BLU/GRN 9
BLU/GRN 3 X2
PNK 4
PNK 12 X1
GRN 10
GRN 2 X2
LT BLU 5
LT BLU 2 X1
YEL 11
YEL 1 X2
VIO 6
VIO 1
X355
ORG X1
31
32
33
34
35
36
37
38
39
40
HYBRID/EV BATTERY MODULE 4
HYBRID/EV BATTERY SECTION 4
ORG
ORG 5 X1
WHT 4 X2
GRY 4 X1
BRN 3 X2
ORG/RED 3 X1
J372
BLU 2 X2
GRN/WHT 2 X1
LT BLU 1 X2
PNK 1 X1
ORG
41
42
43
44
45
46
47
48
HYBRID/EV BATTERY MODULE 5
HYBRID/EV BATTERY SECTION 5
ORG
F
TO MANUAL SERVICE DISCONNECT RECEPTACLE (DIAGRAM 15 OF 16)
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
562369

Fig. 40: Electric, Engine Performance Circuit (14 of 16)

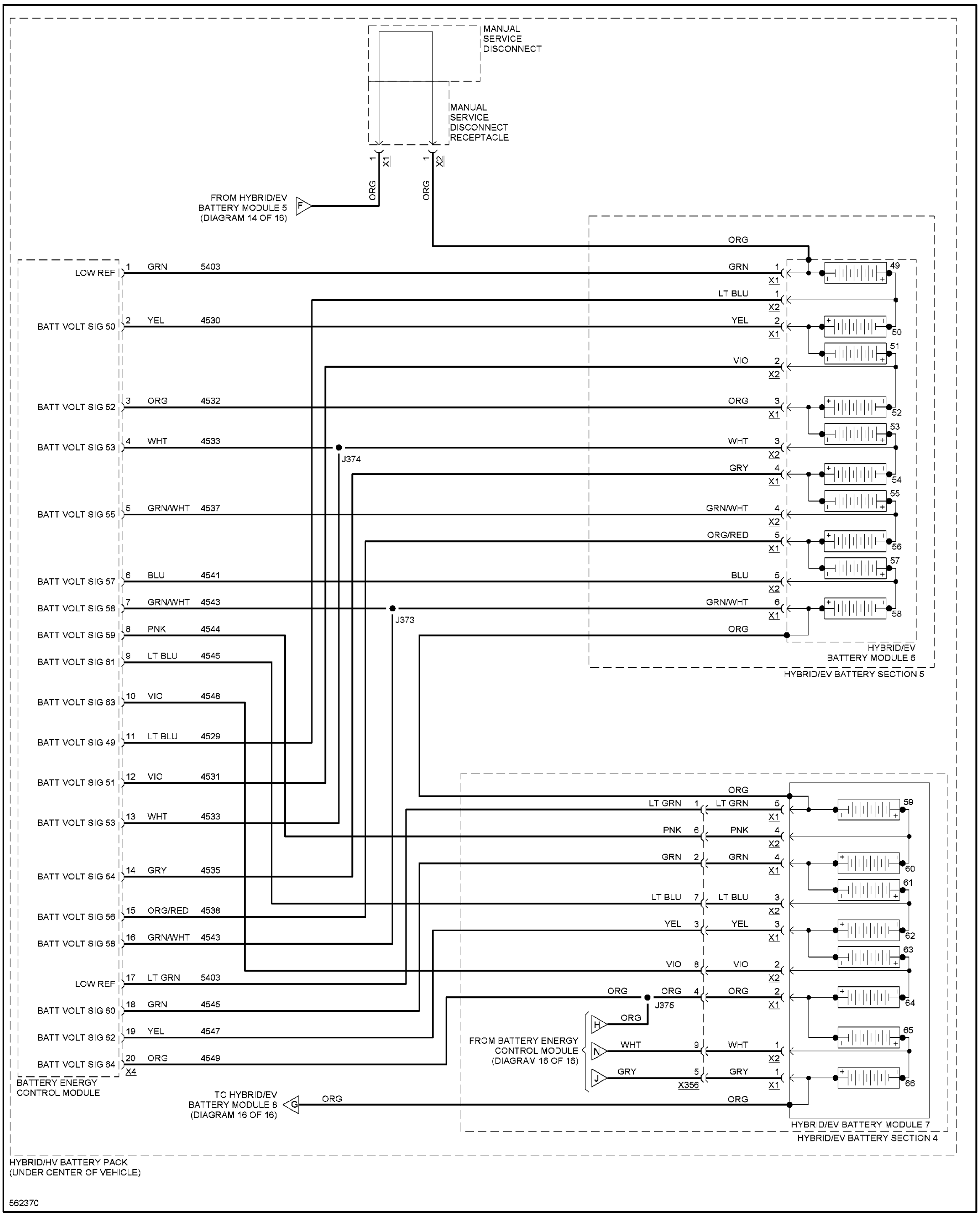

MANUAL SERVICE DISCONNECT
MANUAL SERVICE DISCONNECT RECEPTACLE
X1
X2
ORG
FROM HYBRID/EV BATTERY MODULE 5 (DIAGRAM 14 OF 16)
F
LOW REF
BATT VOLT SIG 50
BATT VOLT SIG 52
BATT VOLT SIG 53
BATT VOLT SIG 55
BATT VOLT SIG 57
BATT VOLT SIG 58
BATT VOLT SIG 59
BATT VOLT SIG 61
BATT VOLT SIG 63
BATT VOLT SIG 49
BATT VOLT SIG 51
BATT VOLT SIG 53
BATT VOLT SIG 54
BATT VOLT SIG 56
BATT VOLT SIG 58
LOW REF
BATT VOLT SIG 60
BATT VOLT SIG 62
BATT VOLT SIG 64
1 GRN 5403
2 YEL 4530
3 ORG 4532
4 WHT 4533
5 GRN/WHT 4537
6 BLU 4541
7 GRN/WHT 4543
8 PNK 4544
9 LT BLU 4546
10 VIO 4548
11 LT BLU 4529
12 VIO 4531
13 WHT 4533
14 GRY 4535
15 ORG/RED 4538
16 GRN/WHT 4543
17 LT GRN 5403
18 GRN 4545
19 YEL 4547
20 ORG 4549
X4
BATTERY ENERGY CONTROL MODULE
J374
J373
J375
ORG
GRN 1 X1
LT BLU 1 X2
YEL 2 X1
VIO 2 X2
ORG 3 X1
WHT 3 X2
GRY 4 X1
GRN/WHT 4 X2
ORG/RED 5 X1
BLU 5 X2
GRN/WHT 6 X1
ORG
49
50
51
52
53
54
55
56
57
58
HYBRID/EV BATTERY MODULE 6
HYBRID/EV BATTERY SECTION 5
ORG
LT GRN 1 LT GRN 5 X1
PNK 6 PNK 4 X2
GRN 2 GRN 4 X1
LT BLU 7 LT BLU 3 X2
YEL 3 YEL 3 X1
VIO 8 VIO 2 X2
ORG ORG 4 ORG 2 X1
H ORG
N WHT 9 WHT 1 X2
J GRY 5 GRY 1 X1
X356
FROM BATTERY ENERGY CONTROL MODULE (DIAGRAM 16 OF 16)
TO HYBRID/EV BATTERY MODULE 8 (DIAGRAM 16 OF 16)
G
ORG
ORG
59
60
61
62
63
64
65
66
HYBRID/EV BATTERY MODULE 7
HYBRID/EV BATTERY SECTION 4
HYBRID/HV BATTERY PACK (UNDER CENTER OF VEHICLE)
562370

Fig. 41: Electric, Engine Performance Circuit (15 of 16)

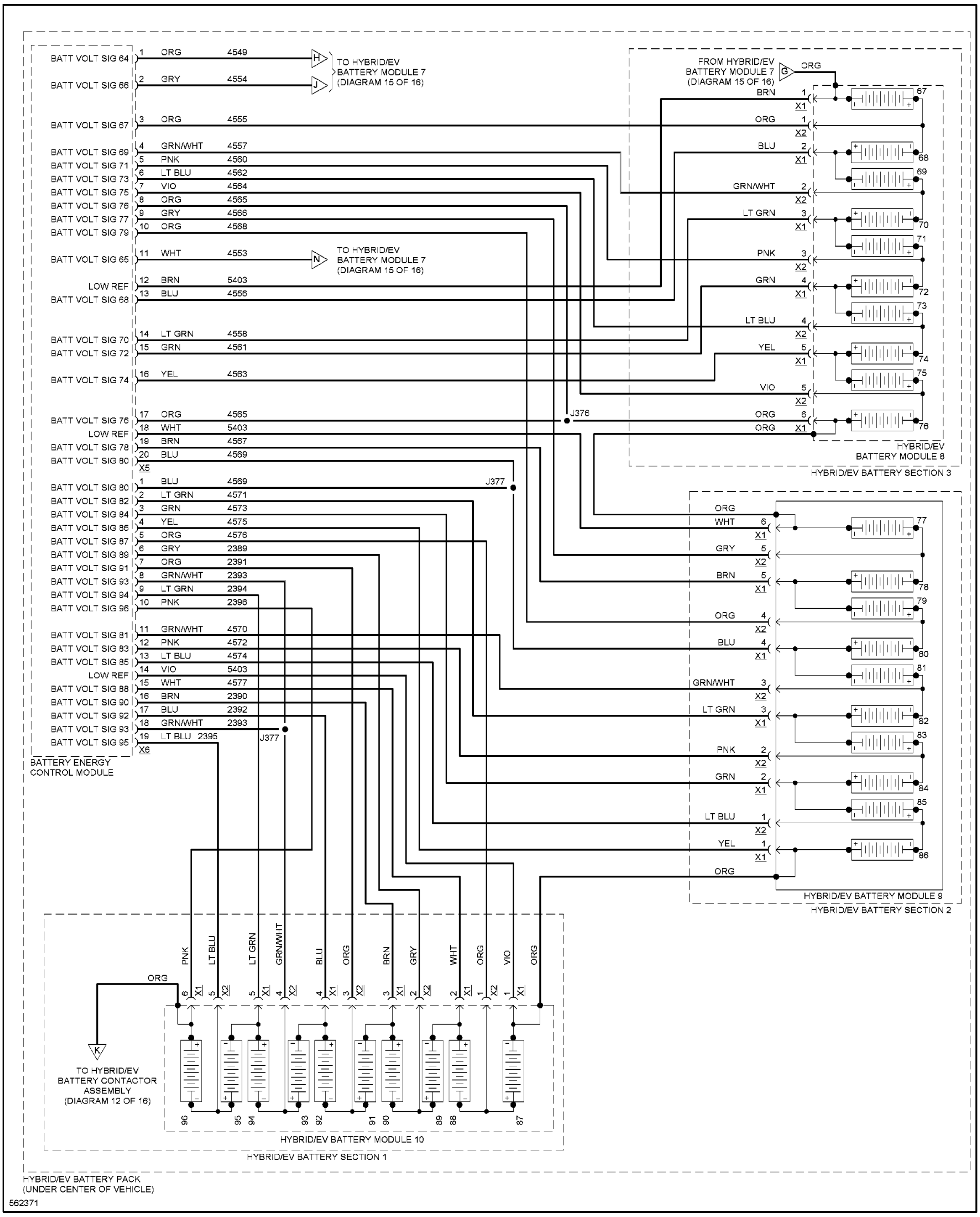

BATT VOLT SIG 64
BATT VOLT SIG 66
BATT VOLT SIG 67
BATT VOLT SIG 69
BATT VOLT SIG 71
BATT VOLT SIG 73
BATT VOLT SIG 75
BATT VOLT SIG 76
BATT VOLT SIG 77
BATT VOLT SIG 79
BATT VOLT SIG 65
LOW REF
BATT VOLT SIG 68
BATT VOLT SIG 70
BATT VOLT SIG 72
BATT VOLT SIG 74
BATT VOLT SIG 76
LOW REF
BATT VOLT SIG 78
BATT VOLT SIG 80
X5
BATT VOLT SIG 80
BATT VOLT SIG 82
BATT VOLT SIG 84
BATT VOLT SIG 86
BATT VOLT SIG 87
BATT VOLT SIG 89
BATT VOLT SIG 91
BATT VOLT SIG 93
BATT VOLT SIG 94
BATT VOLT SIG 96
BATT VOLT SIG 81
BATT VOLT SIG 83
BATT VOLT SIG 85
LOW REF
BATT VOLT SIG 88
BATT VOLT SIG 90
BATT VOLT SIG 92
BATT VOLT SIG 93
BATT VOLT SIG 95
X6
BATTERY ENERGY CONTROL MODULE
1 ORG 4549
2 GRY 4554
3 ORG 4555
4 GRN/WHT 4557
5 PNK 4560
6 LT BLU 4562
7 VIO 4564
8 ORG 4565
9 GRY 4566
10 ORG 4568
11 WHT 4553
12 BRN 5403
13 BLU 4556
14 LT GRN 4558
15 GRN 4561
16 YEL 4563
17 ORG 4565
18 WHT 5403
19 BRN 4567
20 BLU 4569
1 BLU 4569
2 LT GRN 4571
3 GRN 4573
4 YEL 4575
5 ORG 4576
6 GRY 2389
7 ORG 2391
8 GRN/WHT 2393
9 LT GRN 2394
10 PNK 2396
11 GRN/WHT 4570
12 PNK 4572
13 LT BLU 4574
14 VIO 5403
15 WHT 4577
16 BRN 2390
17 BLU 2392
18 GRN/WHT 2393
19 LT BLU 2395
H
J
TO HYBRID/EV BATTERY MODULE 7 (DIAGRAM 15 OF 16)
N
TO HYBRID/EV BATTERY MODULE 7 (DIAGRAM 15 OF 16)
J376
J377
J377
FROM HYBRID/EV BATTERY MODULE 7 (DIAGRAM 15 OF 16)
G
ORG
BRN 1 X1
ORG 1 X2
BLU 2 X1
GRN/WHT 2 X2
LT GRN 3 X1
PNK 3 X2
GRN 4 X1
LT BLU 4 X2
YEL 5 X1
VIO 5 X2
ORG 6
ORG X1
67
68
69
70
71
72
73
74
75
76
HYBRID/EV BATTERY MODULE 8
HYBRID/EV BATTERY SECTION 3
ORG
WHT 6 X1
GRY 5 X2
BRN 5 X1
ORG 4 X2
BLU 4 X1
GRN/WHT 3 X2
LT GRN 3 X1
PNK 2 X2
GRN 2 X1
LT BLU 1 X2
YEL 1 X1
ORG
77
78
79
80
81
82
83
84
85
86
HYBRID/EV BATTERY MODULE 9
HYBRID/EV BATTERY SECTION 2
PNK
LT BLU
LT GRN
GRN/WHT
BLU
ORG
BRN
GRY
WHT
ORG
VIO
ORG
ORG
6 X1
5 X2
5 X1
4 X2
4 X1
3 X2
3 X1
2 X2
2 X1
1 X2
1 X1
K
TO HYBRID/EV BATTERY CONTACTOR ASSEMBLY (DIAGRAM 12 OF 16)
96
95
94
93
92
91
90
89
88
87
HYBRID/EV BATTERY MODULE 10
HYBRID/EV BATTERY SECTION 1
HYBRID/EV BATTERY PACK (UNDER CENTER OF VEHICLE)
562371

Fig. 42: Electric, Engine Performance Circuit (16 of 16)

EXTERIOR LIGHTS

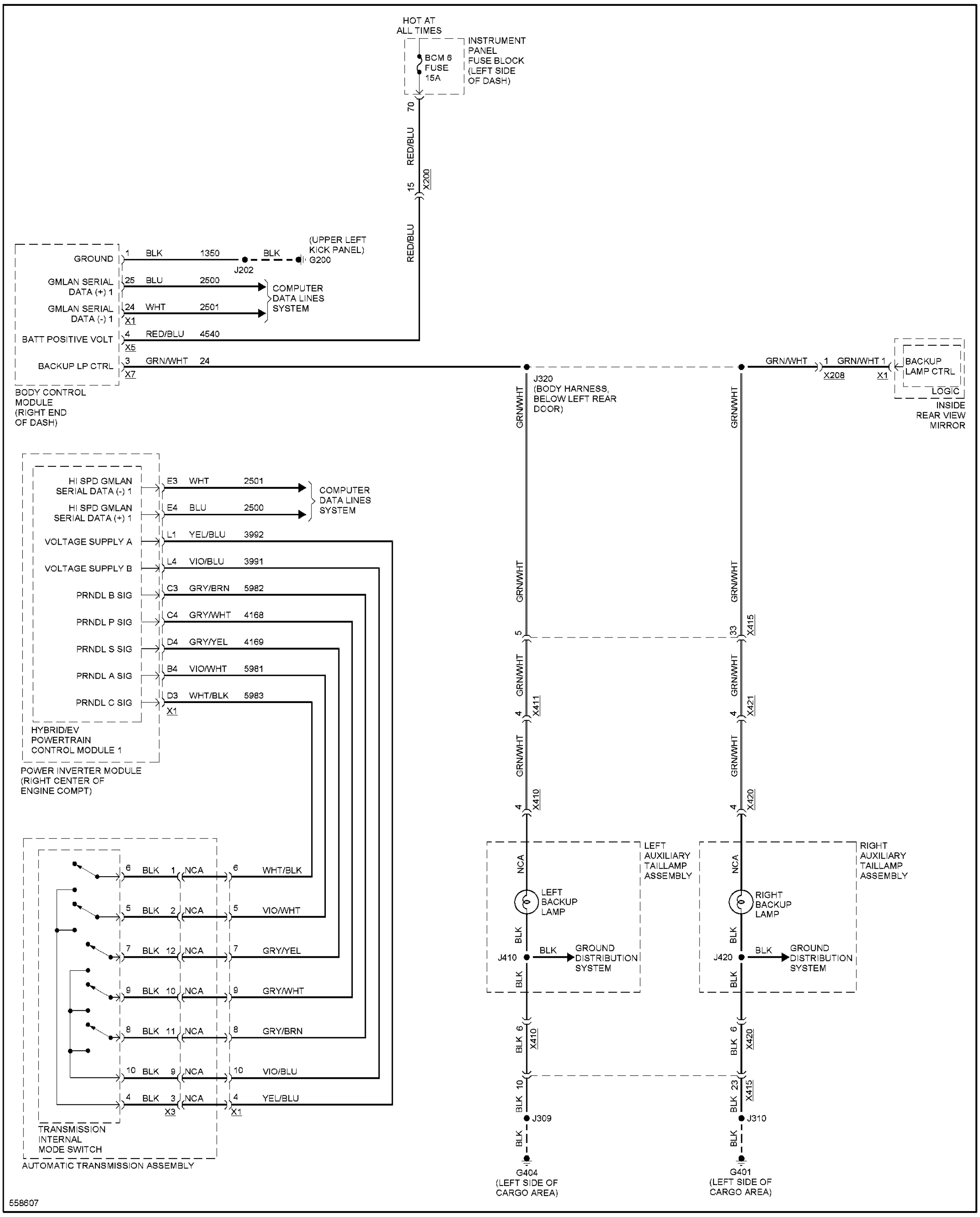

HOT AT ALL TIMES
BCM 6 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
70
RED/BLU
15
X200
RED/BLU
(UPPER LEFT KICK PANEL) G200
GROUND
1 BLK 1350
BLK
J202
GMLAN SERIAL DATA (+) 1
25 BLU 2500
GMLAN SERIAL DATA (-) 1
24 WHT 2501
X1
COMPUTER DATA LINES SYSTEM
BATT POSITIVE VOLT
4 RED/BLU 4540
X5
BACKUP LP CTRL
3 GRN/WHT 24
X7
BODY CONTROL MODULE (RIGHT END OF DASH)
J320 (BODY HARNESS, BELOW LEFT REAR DOOR)
GRN/WHT
GRN/WHT 1 X208
GRN/WHT 1 X1
BACKUP LAMP CTRL
LOGIC
INSIDE REAR VIEW MIRROR
HI SPD GMLAN SERIAL DATA (-) 1
E3 WHT 2501
HI SPD GMLAN SERIAL DATA (+) 1
E4 BLU 2500
COMPUTER DATA LINES SYSTEM
VOLTAGE SUPPLY A
L1 YEL/BLU 3992
VOLTAGE SUPPLY B
L4 VIO/BLU 3991
PRNDL B SIG
C3 GRY/BRN 5982
PRNDL P SIG
C4 GRY/WHT 4168
PRNDL S SIG
D4 GRY/YEL 4169
PRNDL A SIG
B4 VIO/WHT 5981
PRNDL C SIG
D3 WHT/BLK 5983
X1
HYBRID/EV POWERTRAIN CONTROL MODULE 1
POWER INVERTER MODULE (RIGHT CENTER OF ENGINE COMPT)
GRN/WHT
5
33 X415
GRN/WHT
4 X411
4 X421
GRN/WHT
4 X410
4 X420
6 BLK 1 NCA 6 WHT/BLK
5 BLK 2 NCA 5 VIO/WHT
7 BLK 12 NCA 7 GRY/YEL
9 BLK 10 NCA 9 GRY/WHT
8 BLK 11 NCA 8 GRY/BRN
10 BLK 9 NCA 10 VIO/BLU
4 BLK 3 NCA 4 YEL/BLU
X3
X1
TRANSMISSION INTERNAL MODE SWITCH
AUTOMATIC TRANSMISSION ASSEMBLY
NCA
LEFT BACKUP LAMP
LEFT AUXILIARY TAILLAMP ASSEMBLY
BLK
J410
BLK
GROUND DISTRIBUTION SYSTEM
NCA
RIGHT BACKUP LAMP
RIGHT AUXILIARY TAILLAMP ASSEMBLY
BLK
J420
BLK
GROUND DISTRIBUTION SYSTEM
BLK 6 X410
BLK 6 X420
BLK 10
BLK 23 X415
J309
J310
BLK
G404 (LEFT SIDE OF CARGO AREA)
G401 (LEFT SIDE OF CARGO AREA)
558607

Fig. 43: Backup Lamps Circuit

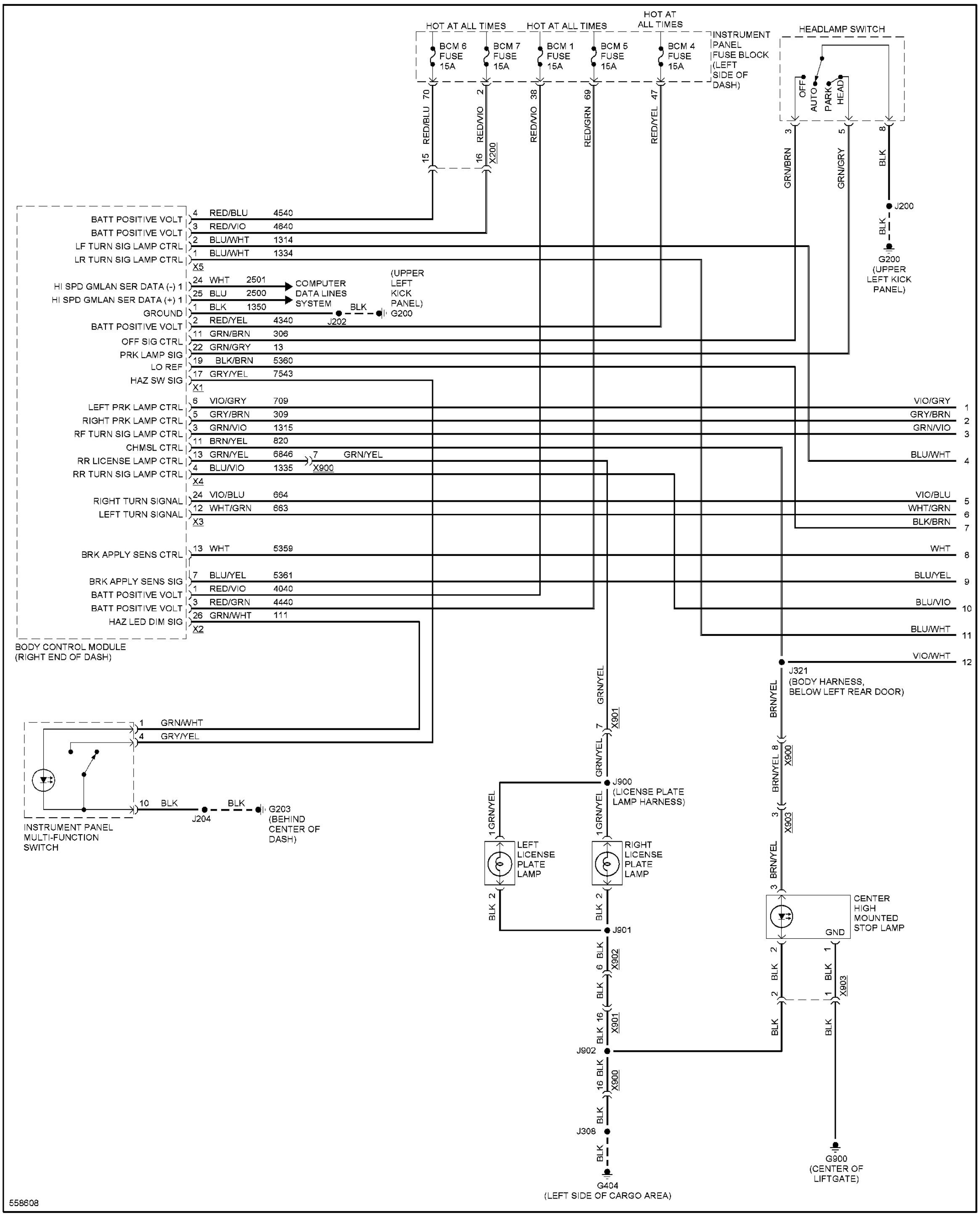
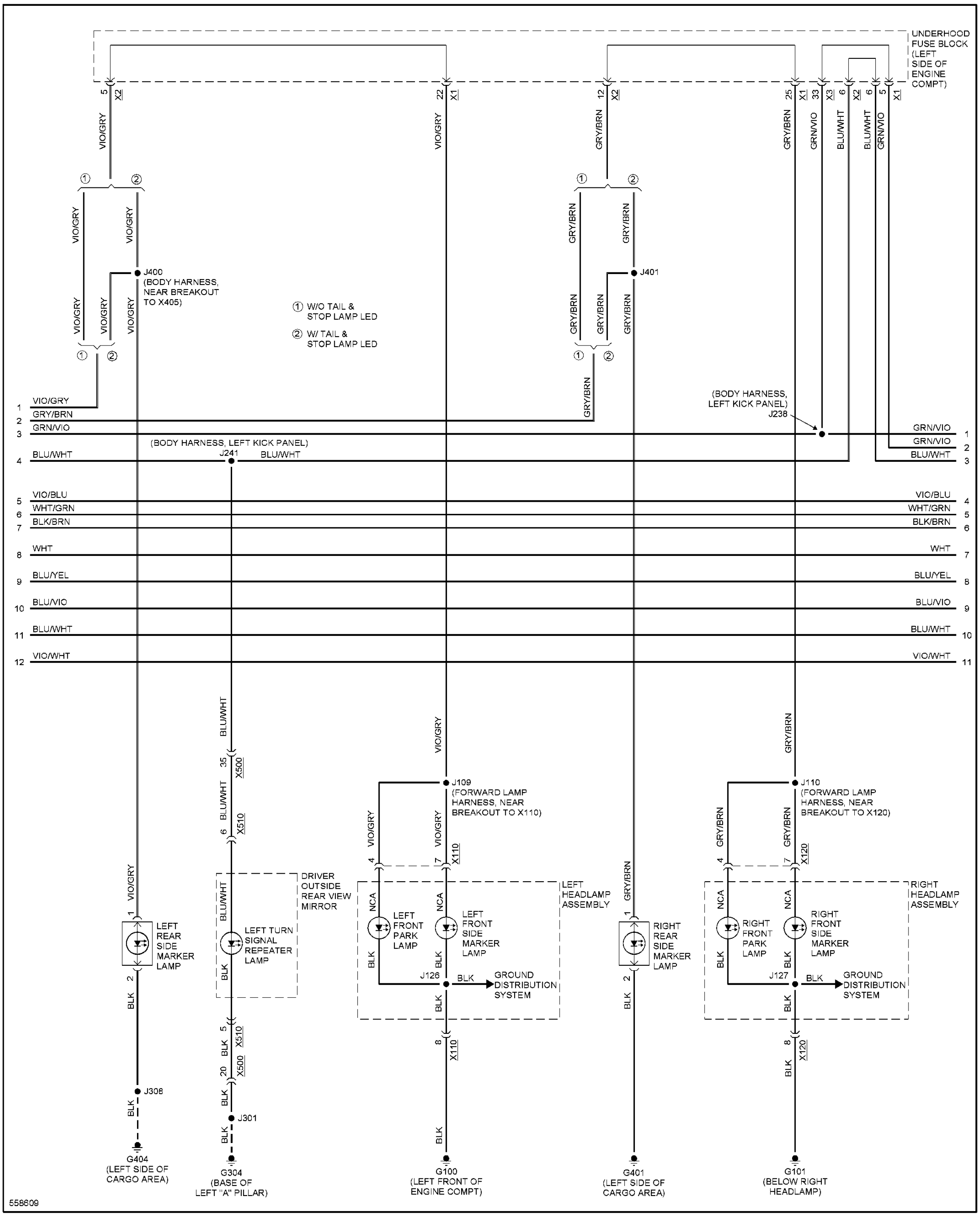

HOT AT ALL TIMES
HOT AT ALL TIMES
HOT AT ALL TIMES
BCM 6 FUSE 15A
BCM 7 FUSE 15A
BCM 1 FUSE 15A
BCM 5 FUSE 15A
BCM 4 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
HEADLAMP SWITCH
OFF
AUTO
PARK
HEAD
70 RED/BLU
2 RED/VIO
38 RED/VIO
69 RED/GRN
47 RED/YEL
15 RED/BLU
16 RED/VIO
X200
3 GRN/BRN
5 GRN/GRY
8 BLK
J200
BLK
G200 (UPPER LEFT KICK PANEL)
BATT POSITIVE VOLT 4 RED/BLU 4540
BATT POSITIVE VOLT 3 RED/VIO 4640
LF TURN SIG LAMP CTRL 2 BLU/WHT 1314
LR TURN SIG LAMP CTRL 1 BLU/WHT 1334
X5
HI SPD GMLAN SER DATA (-) 1 24 WHT 2501
HI SPD GMLAN SER DATA (+) 1 25 BLU 2500
COMPUTER DATA LINES SYSTEM
GROUND 1 BLK 1350
J202
BLK
(UPPER LEFT KICK PANEL) G200
BATT POSITIVE VOLT 2 RED/YEL 4340
OFF SIG CTRL 11 GRN/BRN 306
PRK LAMP SIG 22 GRN/GRY 13
LO REF 19 BLK/BRN 5360
HAZ SW SIG 17 GRY/YEL 7543
X1
LEFT PRK LAMP CTRL 6 VIO/GRY 709
RIGHT PRK LAMP CTRL 5 GRY/BRN 309
RF TURN SIG LAMP CTRL 3 GRN/VIO 1315
CHMSL CTRL 11 BRN/YEL 820
RR LICENSE LAMP CTRL 13 GRN/YEL 6846
7 GRN/YEL X900
RR TURN SIG LAMP CTRL 4 BLU/VIO 1335
X4
RIGHT TURN SIGNAL 24 VIO/BLU 664
LEFT TURN SIGNAL 12 WHT/GRN 663
X3
BRK APPLY SENS CTRL 13 WHT 5359
BRK APPLY SENS SIG 7 BLU/YEL 5361
BATT POSITIVE VOLT 1 RED/VIO 4040
BATT POSITIVE VOLT 3 RED/GRN 4440
HAZ LED DIM SIG 26 GRN/WHT 111
X2
BODY CONTROL MODULE (RIGHT END OF DASH)
VIO/GRY 1
GRY/BRN 2
GRN/VIO 3
BLU/WHT 4
VIO/BLU 5
WHT/GRN 6
BLK/BRN 7
WHT 8
BLU/YEL 9
BLU/VIO 10
BLU/WHT 11
VIO/WHT 12
J321 (BODY HARNESS, BELOW LEFT REAR DOOR)
1 GRN/WHT
4 GRY/YEL
10 BLK
J204
BLK
G203 (BEHIND CENTER OF DASH)
INSTRUMENT PANEL MULTI-FUNCTION SWITCH
GRN/YEL
7 X901
GRN/YEL
J900 (LICENSE PLATE LAMP HARNESS)
1 GRN/YEL
1 GRN/YEL
LEFT LICENSE PLATE LAMP
RIGHT LICENSE PLATE LAMP
BLK 2
BLK 2
J901
BLK 6 X902
BLK 16 X901
J902
BLK 16 X900
BLK
J308
BLK
G404 (LEFT SIDE OF CARGO AREA)
BRN/YEL
BRN/YEL 8 X900
3 X903
BRN/YEL 3
CENTER HIGH MOUNTED STOP LAMP
GND
2 BLK
1 BLK
2 BLK
1 BLK X903
BLK
BLK
G900 (CENTER OF LIFTGATE)
558608

Fig. 44: Exterior Lamps Circuit (1 of 4)


UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
5 X2
22 X1
12 X2
25 X1
33 X3
6 X2
6
5 X1
VIO/GRY
GRY/BRN
GRN/VIO
BLU/WHT
① W/O TAIL & STOP LAMP LED
② W/ TAIL & STOP LAMP LED
J400 (BODY HARNESS, NEAR BREAKOUT TO X405)
J401
(BODY HARNESS, LEFT KICK PANEL) J238
(BODY HARNESS, LEFT KICK PANEL) J241
1 VIO/GRY
2 GRY/BRN
3 GRN/VIO
4 BLU/WHT
5 VIO/BLU
6 WHT/GRN
7 BLK/BRN
8 WHT
9 BLU/YEL
10 BLU/VIO
11 BLU/WHT
12 VIO/WHT
GRN/VIO 1
GRN/VIO 2
BLU/WHT 3
VIO/BLU 4
WHT/GRN 5
BLK/BRN 6
WHT 7
BLU/YEL 8
BLU/VIO 9
BLU/WHT 10
VIO/WHT 11
35 X500
6 X510
DRIVER OUTSIDE REAR VIEW MIRROR
LEFT TURN SIGNAL REPEATER LAMP
5 X510
20 X500
BLK
J109 (FORWARD LAMP HARNESS, NEAR BREAKOUT TO X110)
4
7 X110
LEFT HEADLAMP ASSEMBLY
NCA
LEFT FRONT PARK LAMP
LEFT FRONT SIDE MARKER LAMP
J126
GROUND DISTRIBUTION SYSTEM
8 X110
J110 (FORWARD LAMP HARNESS, NEAR BREAKOUT TO X120)
7 X120
RIGHT HEADLAMP ASSEMBLY
RIGHT FRONT PARK LAMP
RIGHT FRONT SIDE MARKER LAMP
J127
8 X120
1
LEFT REAR SIDE MARKER LAMP
2
RIGHT REAR SIDE MARKER LAMP
J308
J301
G404 (LEFT SIDE OF CARGO AREA)
G304 (BASE OF LEFT "A" PILLAR)
G100 (LEFT FRONT OF ENGINE COMPT)
G401 (LEFT SIDE OF CARGO AREA)
G101 (BELOW RIGHT HEADLAMP)
558609

[**Fig. 45: Exterior Lamps Circuit (2 of 4)**]

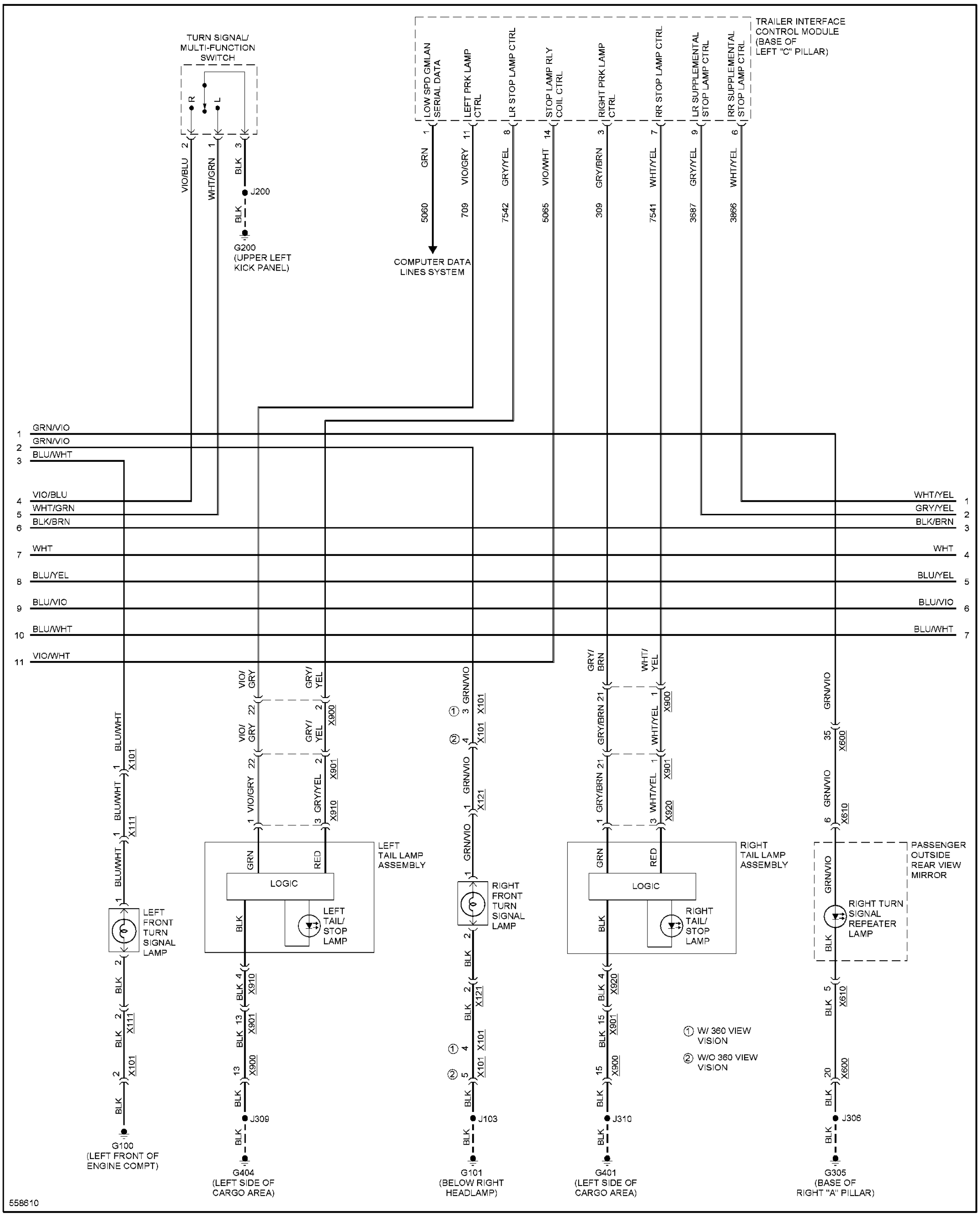

TURN SIGNAL/ MULTI-FUNCTION SWITCH
R
L
VIO/BLU
WHT/GRN
BLK
J200
G200 (UPPER LEFT KICK PANEL)
TRAILER INTERFACE CONTROL MODULE (BASE OF LEFT "C" PILLAR)
LOW SPD GMLAN SERIAL DATA
LEFT PRK LAMP CTRL
LR STOP LAMP CTRL
STOP LAMP RLY COIL CTRL
RIGHT PRK LAMP CTRL
RR STOP LAMP CTRL
LR SUPPLEMENTAL STOP LAMP CTRL
RR SUPPLEMENTAL STOP LAMP CTRL
GRN 5060
VIO/GRY 709
GRY/YEL 7542
VIO/WHT 5065
GRY/BRN 309
WHT/YEL 7541
GRY/YEL 3687
WHT/YEL 3866
COMPUTER DATA LINES SYSTEM
GRN/VIO
GRN/VIO
BLU/WHT
VIO/BLU
WHT/GRN
BLK/BRN
WHT
BLU/YEL
BLU/VIO
BLU/WHT
VIO/WHT
WHT/YEL
GRY/YEL
BLK/BRN
WHT
BLU/YEL
BLU/VIO
BLU/WHT
X101
X111
LEFT FRONT TURN SIGNAL LAMP
G100 (LEFT FRONT OF ENGINE COMPT)
X900
X901
X910
LEFT TAIL LAMP ASSEMBLY
LOGIC
LEFT TAIL/ STOP LAMP
GRN
RED
J309
G404 (LEFT SIDE OF CARGO AREA)
X121
RIGHT FRONT TURN SIGNAL LAMP
J103
G101 (BELOW RIGHT HEADLAMP)
X920
RIGHT TAIL LAMP ASSEMBLY
RIGHT TAIL/ STOP LAMP
J310
G401 (LEFT SIDE OF CARGO AREA)
X600
X610
PASSENGER OUTSIDE REAR VIEW MIRROR
RIGHT TURN SIGNAL REPEATER LAMP
J306
G305 (BASE OF RIGHT "A" PILLAR)
① W/ 360 VIEW VISION
② W/O 360 VIEW VISION
558610

Fig. 46: Exterior Lamps Circuit (3 of 4)

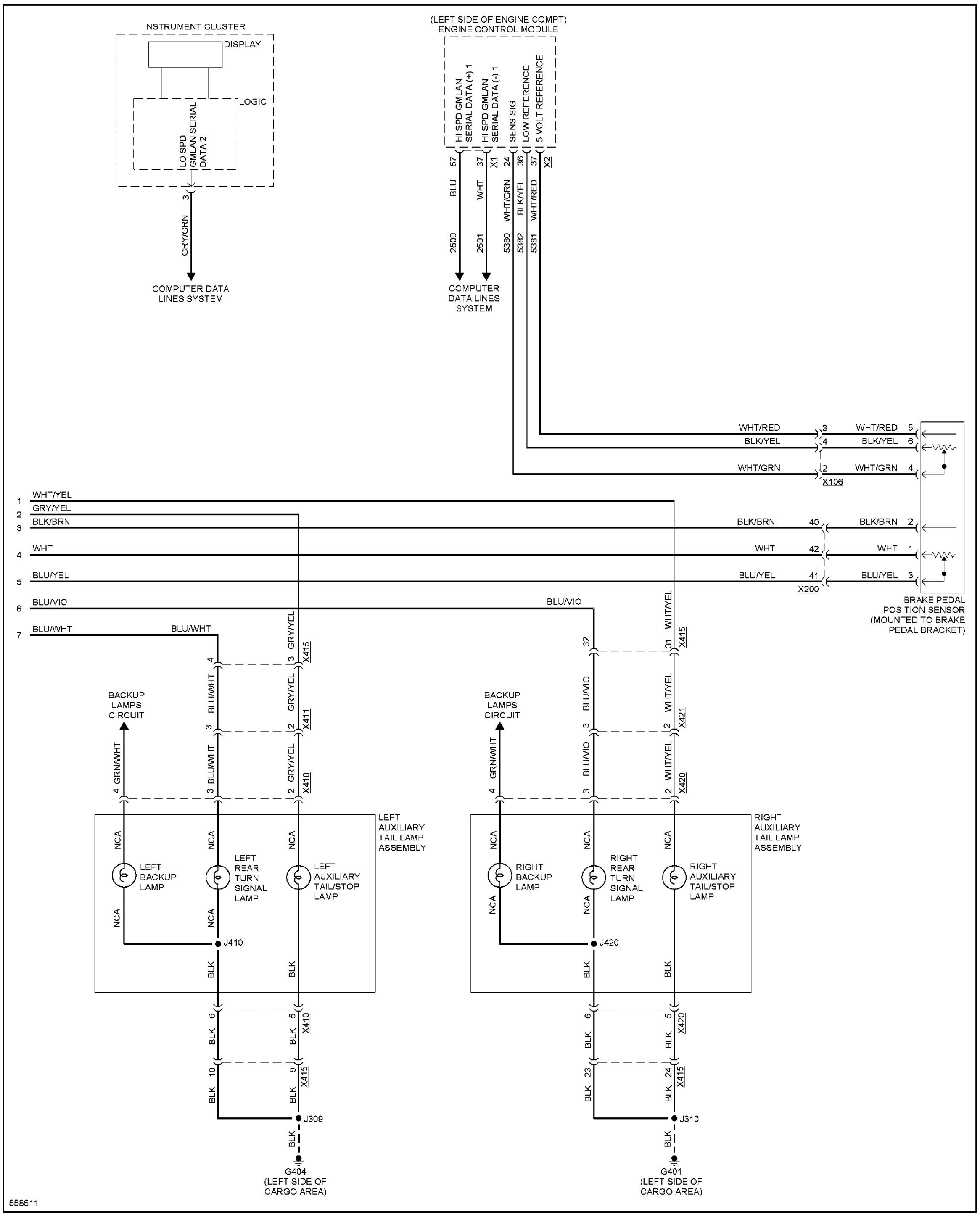

INSTRUMENT CLUSTER
DISPLAY
LOGIC
LO SPD GMLAN SERIAL DATA 2
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
(LEFT SIDE OF ENGINE COMPT) ENGINE CONTROL MODULE
HI SPD GMLAN SERIAL DATA (+) 1
HI SPD GMLAN SERIAL DATA (-) 1
SENS SIG
LOW REFERENCE
5 VOLT REFERENCE
57
37
X1
24
36
37
X2
BLU
WHT
WHT/GRN
BLK/YEL
WHT/RED
2500
2501
5380
5382
5381
COMPUTER DATA LINES SYSTEM
WHT/RED
BLK/YEL
WHT/GRN
X106
BRAKE PEDAL POSITION SENSOR (MOUNTED TO BRAKE PEDAL BRACKET)
WHT/YEL
GRY/YEL
BLK/BRN
WHT
BLU/YEL
BLU/VIO
BLU/WHT
X200
BACKUP LAMPS CIRCUIT
GRN/WHT
X415
X411
X410
X421
X420
LEFT AUXILIARY TAIL LAMP ASSEMBLY
RIGHT AUXILIARY TAIL LAMP ASSEMBLY
NCA
LEFT BACKUP LAMP
LEFT REAR TURN SIGNAL LAMP
LEFT AUXILIARY TAIL/STOP LAMP
RIGHT BACKUP LAMP
RIGHT REAR TURN SIGNAL LAMP
RIGHT AUXILIARY TAIL/STOP LAMP
J410
J420
BLK
J309
J310
G404 (LEFT SIDE OF CARGO AREA)
G401 (LEFT SIDE OF CARGO AREA)
558611

Fig. 47: Exterior Lamps Circuit (4 of 4)

GROUND DISTRIBUTION

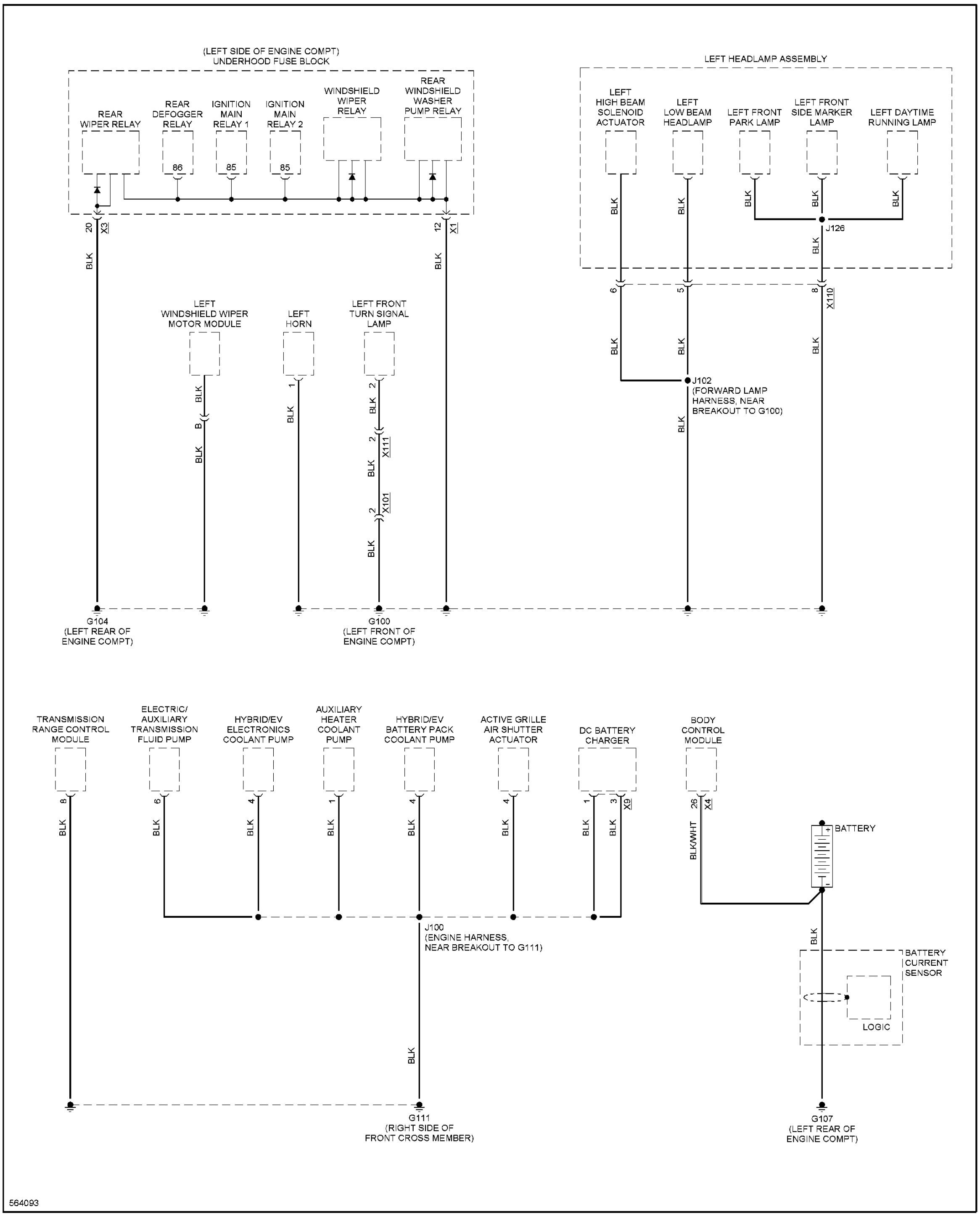

(LEFT SIDE OF ENGINE COMPT)
UNDERHOOD FUSE BLOCK
REAR WIPER RELAY
REAR DEFOGGER RELAY
IGNITION MAIN RELAY 1
IGNITION MAIN RELAY 2
WINDSHIELD WIPER RELAY
REAR WINDSHIELD WASHER PUMP RELAY
86
85
85
20
X3
12
X1
BLK
BLK
LEFT HEADLAMP ASSEMBLY
LEFT HIGH BEAM SOLENOID ACTUATOR
LEFT LOW BEAM HEADLAMP
LEFT FRONT PARK LAMP
LEFT FRONT SIDE MARKER LAMP
LEFT DAYTIME RUNNING LAMP
BLK
BLK
BLK
BLK
BLK
J126
BLK
6
5
8
X110
BLK
BLK
BLK
J102
(FORWARD LAMP HARNESS, NEAR BREAKOUT TO G100)
BLK
LEFT WINDSHIELD WIPER MOTOR MODULE
LEFT HORN
LEFT FRONT TURN SIGNAL LAMP
BLK
B
BLK
1
BLK
2
BLK
2
X111
BLK
2
X101
BLK
G104
(LEFT REAR OF ENGINE COMPT)
G100
(LEFT FRONT OF ENGINE COMPT)
TRANSMISSION RANGE CONTROL MODULE
ELECTRIC/ AUXILIARY TRANSMISSION FLUID PUMP
HYBRID/EV ELECTRONICS COOLANT PUMP
AUXILIARY HEATER COOLANT PUMP
HYBRID/EV BATTERY PACK COOLANT PUMP
ACTIVE GRILLE AIR SHUTTER ACTUATOR
DC BATTERY CHARGER
BODY CONTROL MODULE
8
BLK
6
BLK
4
BLK
1
BLK
4
BLK
4
BLK
1
BLK
3
BLK
X9
26
X4
BLK/WHT
BATTERY
+
-
J100
(ENGINE HARNESS, NEAR BREAKOUT TO G111)
BLK
BLK
BATTERY CURRENT SENSOR
LOGIC
G111
(RIGHT SIDE OF FRONT CROSS MEMBER)
G107
(LEFT REAR OF ENGINE COMPT)
564093

Fig. 48: Ground Distribution Circuit (1 of 6)

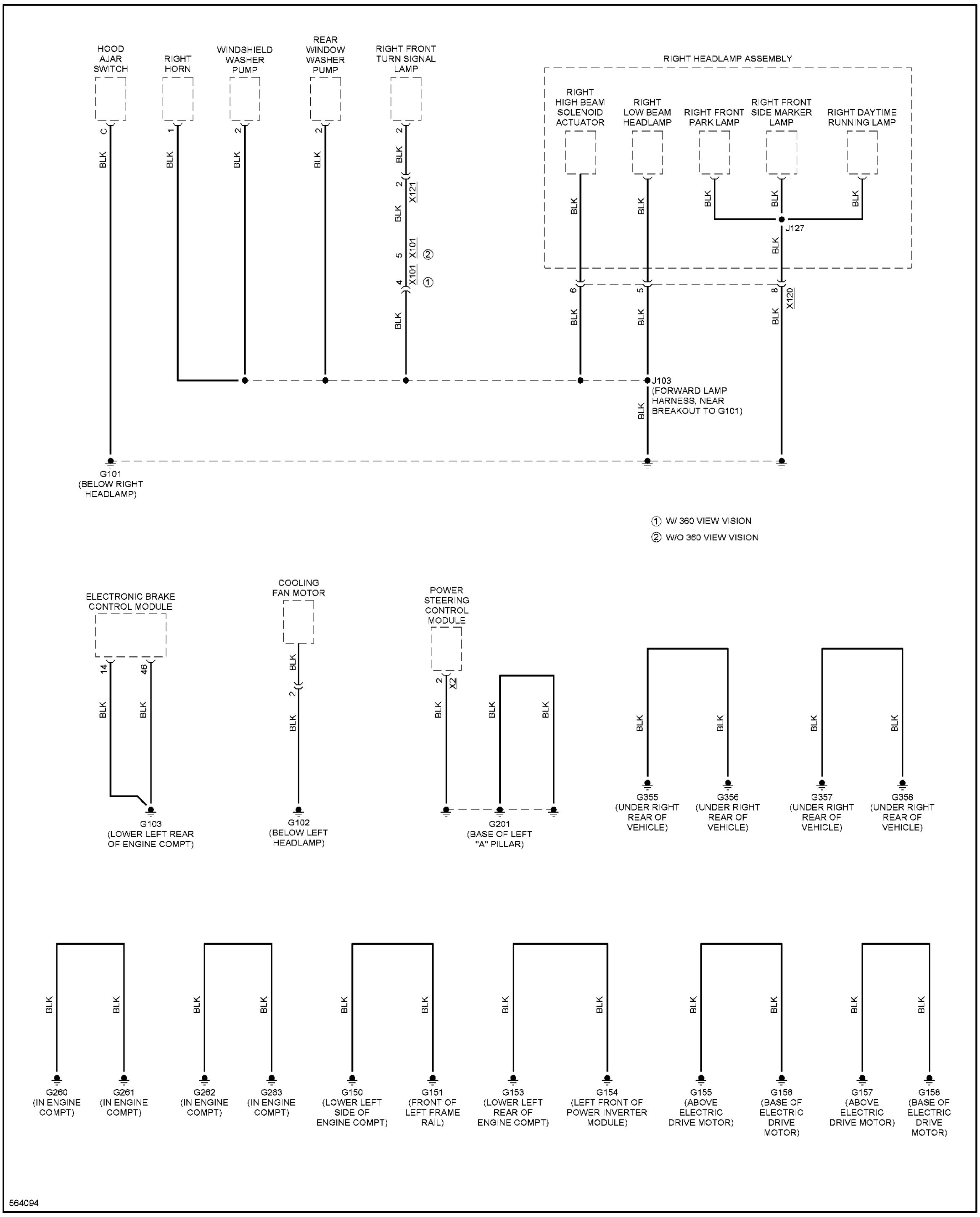

HOOD AJAR SWITCH
RIGHT HORN
WINDSHIELD WASHER PUMP
REAR WINDOW WASHER PUMP
RIGHT FRONT TURN SIGNAL LAMP
RIGHT HEADLAMP ASSEMBLY
RIGHT HIGH BEAM SOLENOID ACTUATOR
RIGHT LOW BEAM HEADLAMP
RIGHT FRONT PARK LAMP
RIGHT FRONT SIDE MARKER LAMP
RIGHT DAYTIME RUNNING LAMP
C
1
2
2
2
BLK
2
X121
X101
5
4
X101
②
①
J127
6
5
8
X120
J103 (FORWARD LAMP HARNESS, NEAR BREAKOUT TO G101)
G101 (BELOW RIGHT HEADLAMP)
① W/ 360 VIEW VISION
② W/O 360 VIEW VISION
ELECTRONIC BRAKE CONTROL MODULE
14
46
COOLING FAN MOTOR
2
POWER STEERING CONTROL MODULE
2
X2
G103 (LOWER LEFT REAR OF ENGINE COMPT)
G102 (BELOW LEFT HEADLAMP)
G201 (BASE OF LEFT "A" PILLAR)
G355 (UNDER RIGHT REAR OF VEHICLE)
G356 (UNDER RIGHT REAR OF VEHICLE)
G357 (UNDER RIGHT REAR OF VEHICLE)
G358 (UNDER RIGHT REAR OF VEHICLE)
G260 (IN ENGINE COMPT)
G261 (IN ENGINE COMPT)
G262 (IN ENGINE COMPT)
G263 (IN ENGINE COMPT)
G150 (LOWER LEFT SIDE OF ENGINE COMPT)
G151 (FRONT OF LEFT FRAME RAIL)
G153 (LOWER LEFT REAR OF ENGINE COMPT)
G154 (LEFT FRONT OF POWER INVERTER MODULE)
G155 (ABOVE ELECTRIC DRIVE MOTOR)
G156 (BASE OF ELECTRIC DRIVE MOTOR)
G157 (ABOVE ELECTRIC DRIVE MOTOR)
G158 (BASE OF ELECTRIC DRIVE MOTOR)
564094

Fig. 49: Ground Distribution Circuit (2 of 6)

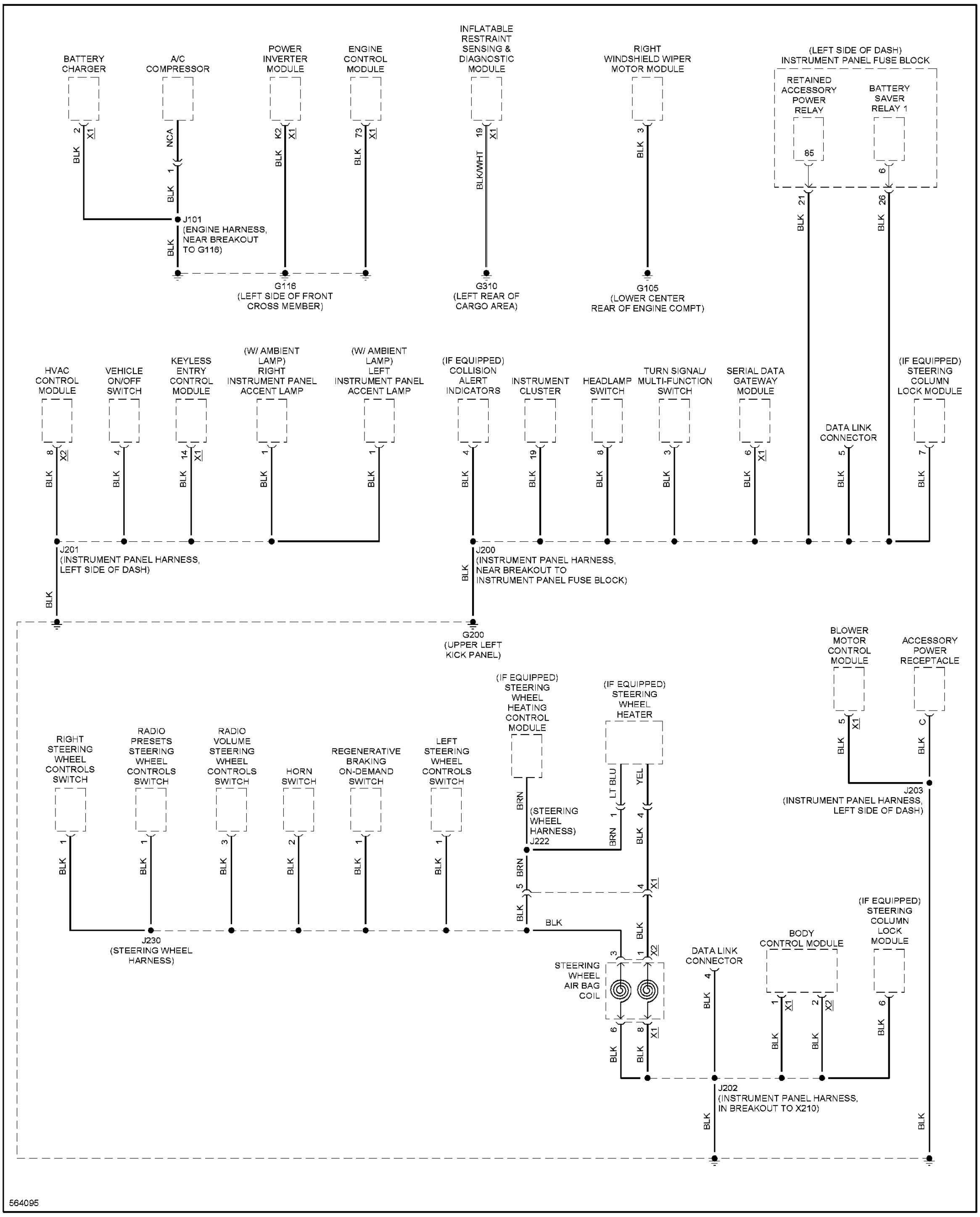

BATTERY CHARGER
A/C COMPRESSOR
POWER INVERTER MODULE
ENGINE CONTROL MODULE
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE
RIGHT WINDSHIELD WIPER MOTOR MODULE
(LEFT SIDE OF DASH) INSTRUMENT PANEL FUSE BLOCK
RETAINED ACCESSORY POWER RELAY
BATTERY SAVER RELAY 1
J101 (ENGINE HARNESS, NEAR BREAKOUT TO G116)
G116 (LEFT SIDE OF FRONT CROSS MEMBER)
G310 (LEFT REAR OF CARGO AREA)
G105 (LOWER CENTER REAR OF ENGINE COMPT)
HVAC CONTROL MODULE
VEHICLE ON/OFF SWITCH
KEYLESS ENTRY CONTROL MODULE
(W/ AMBIENT LAMP) RIGHT INSTRUMENT PANEL ACCENT LAMP
(W/ AMBIENT LAMP) LEFT INSTRUMENT PANEL ACCENT LAMP
(IF EQUIPPED) COLLISION ALERT INDICATORS
INSTRUMENT CLUSTER
HEADLAMP SWITCH
TURN SIGNAL/ MULTI-FUNCTION SWITCH
SERIAL DATA GATEWAY MODULE
DATA LINK CONNECTOR
(IF EQUIPPED) STEERING COLUMN LOCK MODULE
J201 (INSTRUMENT PANEL HARNESS, LEFT SIDE OF DASH)
J200 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO INSTRUMENT PANEL FUSE BLOCK)
G200 (UPPER LEFT KICK PANEL)
BLOWER MOTOR CONTROL MODULE
ACCESSORY POWER RECEPTACLE
J203 (INSTRUMENT PANEL HARNESS, LEFT SIDE OF DASH)
(IF EQUIPPED) STEERING WHEEL HEATING CONTROL MODULE
(IF EQUIPPED) STEERING WHEEL HEATER
RIGHT STEERING WHEEL CONTROLS SWITCH
RADIO PRESETS STEERING WHEEL CONTROLS SWITCH
RADIO VOLUME STEERING WHEEL CONTROLS SWITCH
HORN SWITCH
REGENERATIVE BRAKING ON-DEMAND SWITCH
LEFT STEERING WHEEL CONTROLS SWITCH
(STEERING WHEEL HARNESS) J222
J230 (STEERING WHEEL HARNESS)
STEERING WHEEL AIR BAG COIL
DATA LINK CONNECTOR
BODY CONTROL MODULE
(IF EQUIPPED) STEERING COLUMN LOCK MODULE
J202 (INSTRUMENT PANEL HARNESS, IN BREAKOUT TO X210)
BLK
BLK/WHT
BRN
LT BLU
YEL
X1
X2
NCA
K2
73
19
85
21
26
564095

Fig. 50: Ground Distribution Circuit (3 of 6)

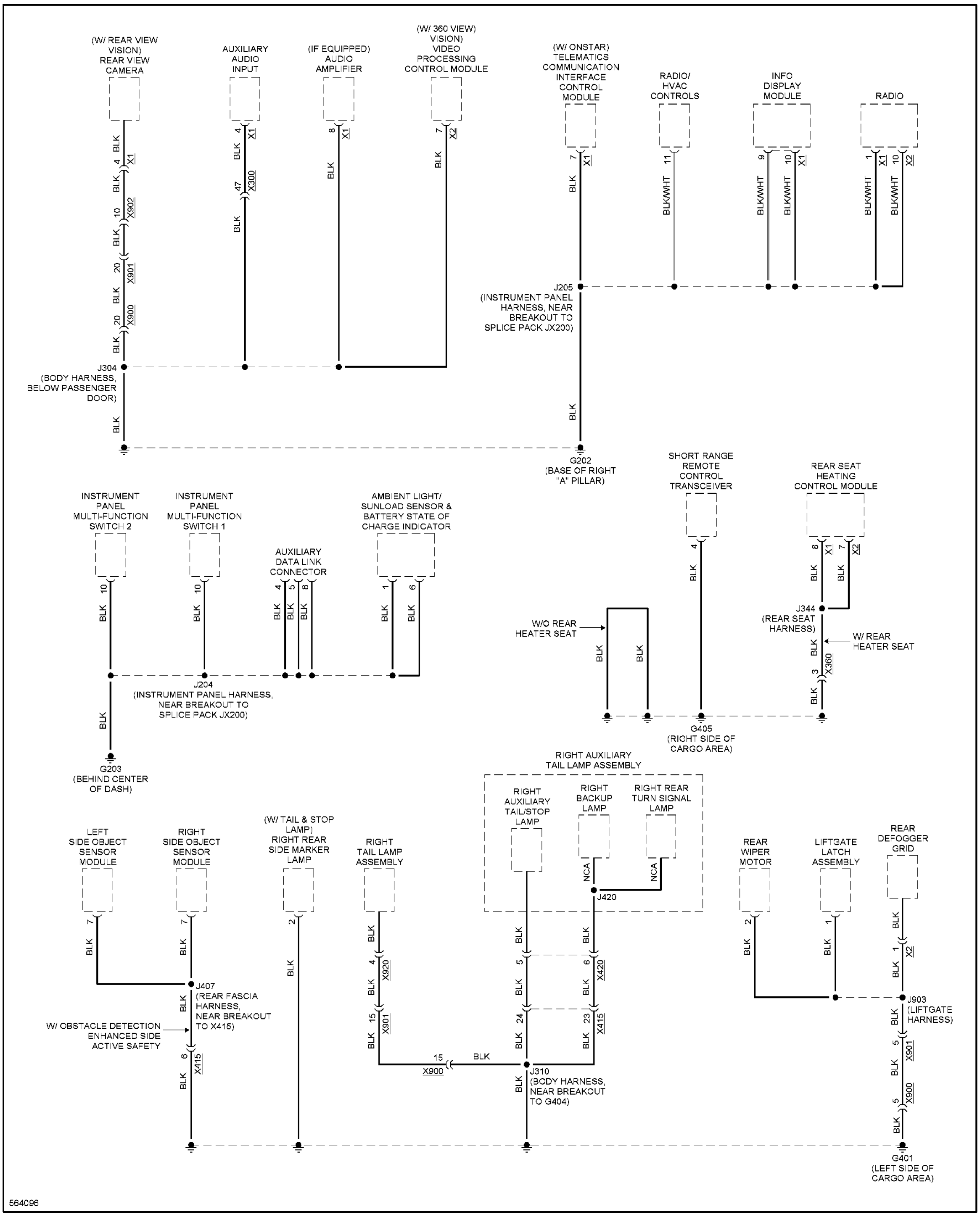

(W/ REAR VIEW VISION) REAR VIEW CAMERA
AUXILIARY AUDIO INPUT
(IF EQUIPPED) AUDIO AMPLIFIER
(W/ 360 VIEW) VISION) VIDEO PROCESSING CONTROL MODULE
(W/ ONSTAR) TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE
RADIO/ HVAC CONTROLS
INFO DISPLAY MODULE
RADIO
BLK
4 X1
10 X902
20 X901
20 X900
47 X300
8 X1
7 X2
7 X1
11
9
10 X1
1 X1
10 X2
BLK/WHT
J304 (BODY HARNESS, BELOW PASSENGER DOOR)
J205 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO SPLICE PACK JX200)
G202 (BASE OF RIGHT "A" PILLAR)
INSTRUMENT PANEL MULTI-FUNCTION SWITCH 2
INSTRUMENT PANEL MULTI-FUNCTION SWITCH 1
AUXILIARY DATA LINK CONNECTOR
AMBIENT LIGHT/ SUNLOAD SENSOR & BATTERY STATE OF CHARGE INDICATOR
SHORT RANGE REMOTE CONTROL TRANSCEIVER
REAR SEAT HEATING CONTROL MODULE
10
4 5 8
1 6
4
8 X1
7 X2
J204 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO SPLICE PACK JX200)
G203 (BEHIND CENTER OF DASH)
W/O REAR HEATER SEAT
J344 (REAR SEAT HARNESS)
W/ REAR HEATER SEAT
3 X360
G405 (RIGHT SIDE OF CARGO AREA)
RIGHT AUXILIARY TAIL LAMP ASSEMBLY
RIGHT AUXILIARY TAIL/STOP LAMP
RIGHT BACKUP LAMP
RIGHT REAR TURN SIGNAL LAMP
NCA
J420
LEFT SIDE OBJECT SENSOR MODULE
RIGHT SIDE OBJECT SENSOR MODULE
(W/ TAIL & STOP LAMP) RIGHT REAR SIDE MARKER LAMP
RIGHT TAIL LAMP ASSEMBLY
REAR WIPER MOTOR
LIFTGATE LATCH ASSEMBLY
REAR DEFOGGER GRID
7
2
4 X920
15 X901
15 X900
5
24
6 X420
23 X415
J407 (REAR FASCIA HARNESS, NEAR BREAKOUT TO X415)
W/ OBSTACLE DETECTION ENHANCED SIDE ACTIVE SAFETY
6 X415
J310 (BODY HARNESS, NEAR BREAKOUT TO G404)
1 X2
J903 (LIFTGATE HARNESS)
5 X901
5 X900
G401 (LEFT SIDE OF CARGO AREA)
564096

Fig. 51: Ground Distribution Circuit (4 of 6)

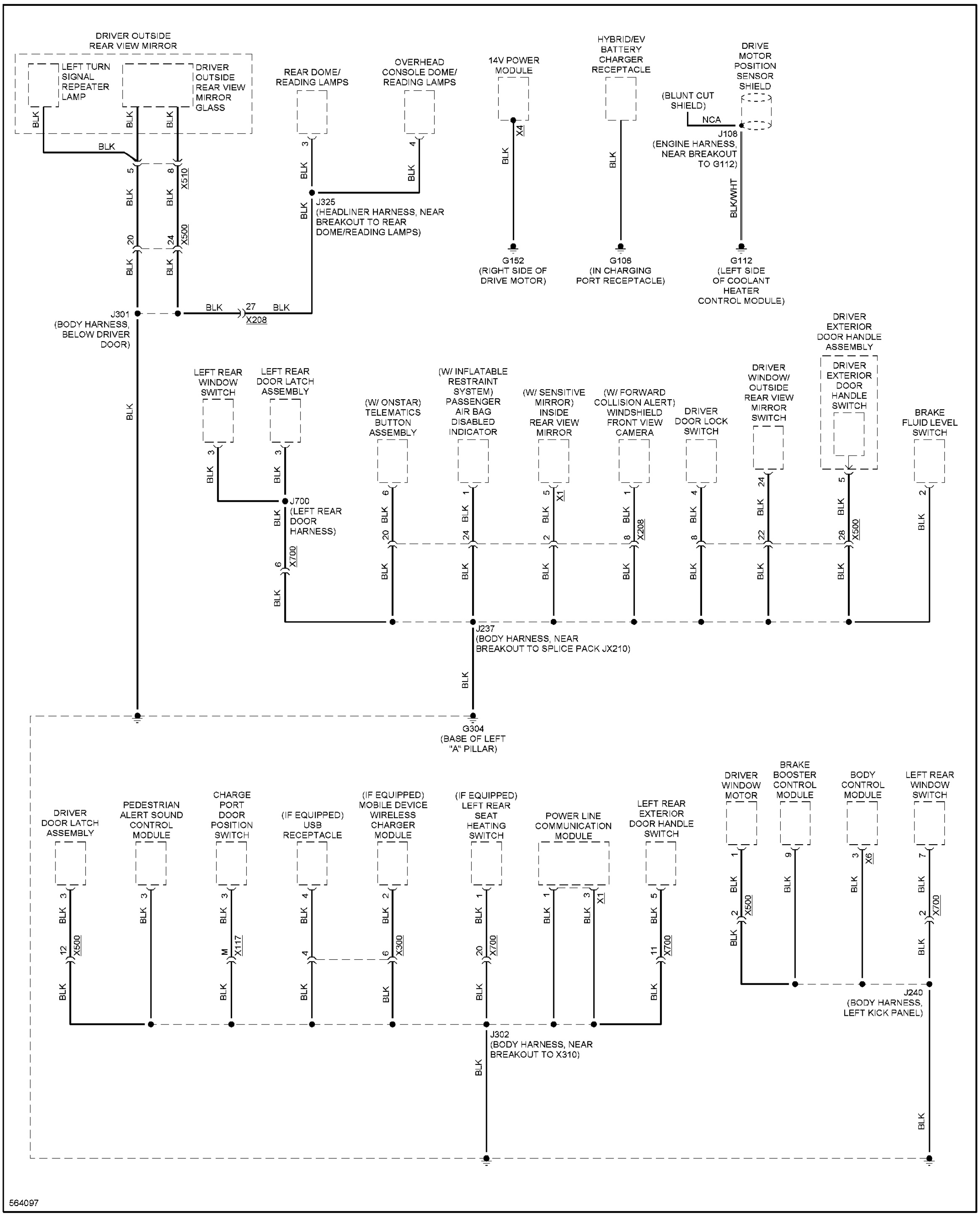

DRIVER OUTSIDE REAR VIEW MIRROR
LEFT TURN SIGNAL REPEATER LAMP
DRIVER OUTSIDE REAR VIEW MIRROR GLASS
REAR DOME/ READING LAMPS
OVERHEAD CONSOLE DOME/ READING LAMPS
14V POWER MODULE
HYBRID/EV BATTERY CHARGER RECEPTACLE
DRIVE MOTOR POSITION SENSOR SHIELD
(BLUNT CUT SHIELD)
NCA
J108 (ENGINE HARNESS, NEAR BREAKOUT TO G112)
BLK/WHT
X4
X510
X500
X208
J325 (HEADLINER HARNESS, NEAR BREAKOUT TO REAR DOME/READING LAMPS)
G152 (RIGHT SIDE OF DRIVE MOTOR)
G108 (IN CHARGING PORT RECEPTACLE)
G112 (LEFT SIDE OF COOLANT HEATER CONTROL MODULE)
J301 (BODY HARNESS, BELOW DRIVER DOOR)
BLK
LEFT REAR WINDOW SWITCH
LEFT REAR DOOR LATCH ASSEMBLY
(W/ ONSTAR) TELEMATICS BUTTON ASSEMBLY
(W/ INFLATABLE RESTRAINT SYSTEM) PASSENGER AIR BAG DISABLED INDICATOR
(W/ SENSITIVE MIRROR) INSIDE REAR VIEW MIRROR
(W/ FORWARD COLLISION ALERT) WINDSHIELD FRONT VIEW CAMERA
DRIVER DOOR LOCK SWITCH
DRIVER WINDOW/ OUTSIDE REAR VIEW MIRROR SWITCH
DRIVER EXTERIOR DOOR HANDLE ASSEMBLY
DRIVER EXTERIOR DOOR HANDLE SWITCH
BRAKE FLUID LEVEL SWITCH
J700 (LEFT REAR DOOR HARNESS)
X700
X1
J237 (BODY HARNESS, NEAR BREAKOUT TO SPLICE PACK JX210)
G304 (BASE OF LEFT "A" PILLAR)
DRIVER DOOR LATCH ASSEMBLY
PEDESTRIAN ALERT SOUND CONTROL MODULE
CHARGE PORT DOOR POSITION SWITCH
(IF EQUIPPED) USB RECEPTACLE
(IF EQUIPPED) MOBILE DEVICE WIRELESS CHARGER MODULE
(IF EQUIPPED) LEFT REAR SEAT HEATING SWITCH
POWER LINE COMMUNICATION MODULE
LEFT REAR EXTERIOR DOOR HANDLE SWITCH
DRIVER WINDOW MOTOR
BRAKE BOOSTER CONTROL MODULE
BODY CONTROL MODULE
LEFT REAR WINDOW SWITCH
X117
X300
X6
J240 (BODY HARNESS, LEFT KICK PANEL)
J302 (BODY HARNESS, NEAR BREAKOUT TO X310)
564097

Fig. 52: Ground Distribution Circuit (5 of 6)

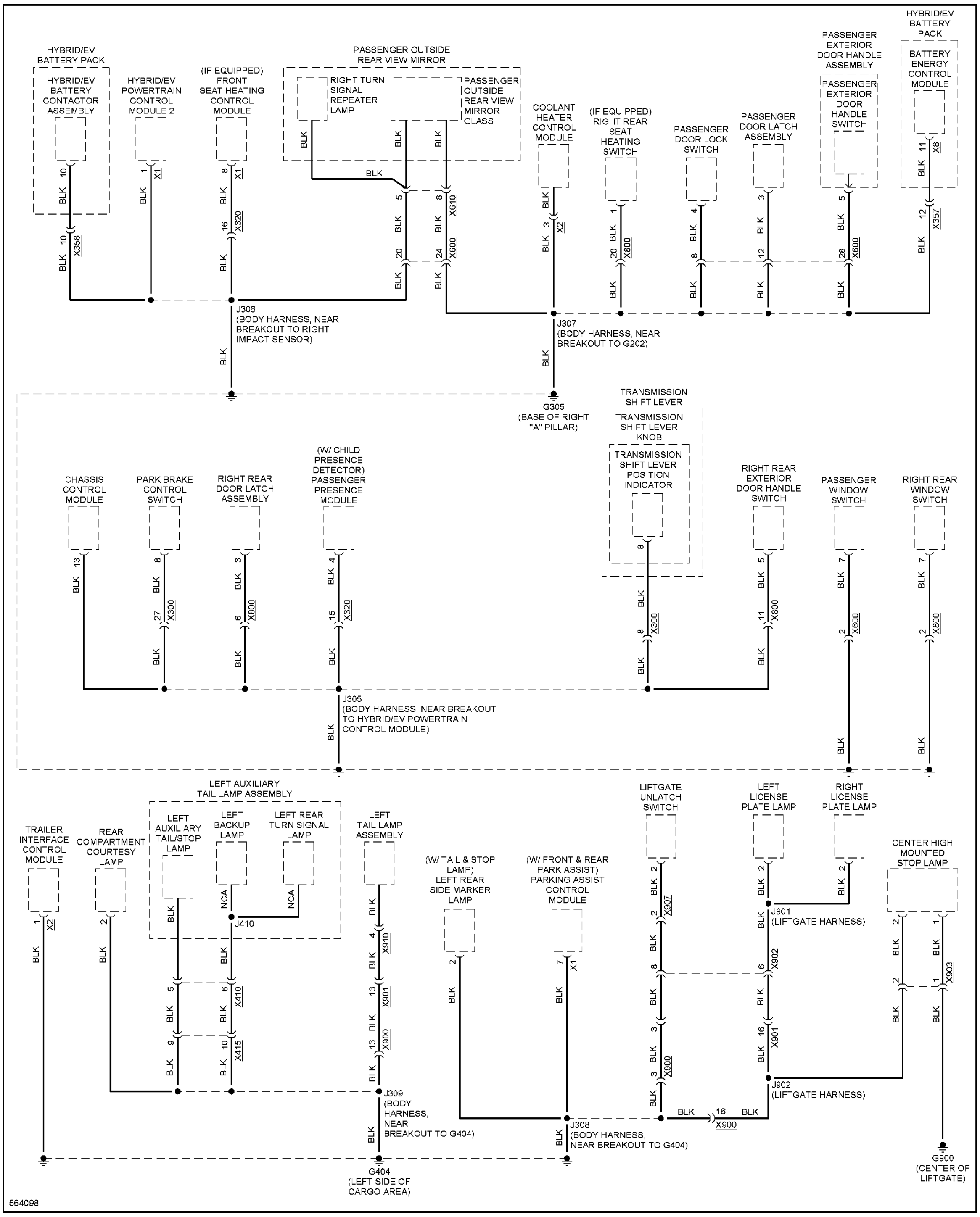

HYBRID/EV BATTERY PACK
HYBRID/EV BATTERY CONTACTOR ASSEMBLY
HYBRID/EV POWERTRAIN CONTROL MODULE 2
(IF EQUIPPED) FRONT SEAT HEATING CONTROL MODULE
PASSENGER OUTSIDE REAR VIEW MIRROR
RIGHT TURN SIGNAL REPEATER LAMP
PASSENGER OUTSIDE REAR VIEW MIRROR GLASS
COOLANT HEATER CONTROL MODULE
(IF EQUIPPED) RIGHT REAR SEAT HEATING SWITCH
PASSENGER DOOR LOCK SWITCH
PASSENGER DOOR LATCH ASSEMBLY
PASSENGER EXTERIOR DOOR HANDLE ASSEMBLY
PASSENGER EXTERIOR DOOR HANDLE SWITCH
HYBRID/EV BATTERY PACK
BATTERY ENERGY CONTROL MODULE
X358
X320
X610
X600
X2
X800
X357
X8
X1
J306 (BODY HARNESS, NEAR BREAKOUT TO RIGHT IMPACT SENSOR)
J307 (BODY HARNESS, NEAR BREAKOUT TO G202)
G305 (BASE OF RIGHT "A" PILLAR)
TRANSMISSION SHIFT LEVER
TRANSMISSION SHIFT LEVER KNOB
TRANSMISSION SHIFT LEVER POSITION INDICATOR
CHASSIS CONTROL MODULE
PARK BRAKE CONTROL SWITCH
RIGHT REAR DOOR LATCH ASSEMBLY
(W/ CHILD PRESENCE DETECTOR) PASSENGER PRESENCE MODULE
RIGHT REAR EXTERIOR DOOR HANDLE SWITCH
PASSENGER WINDOW SWITCH
RIGHT REAR WINDOW SWITCH
X300
J305 (BODY HARNESS, NEAR BREAKOUT TO HYBRID/EV POWERTRAIN CONTROL MODULE)
LEFT AUXILIARY TAIL LAMP ASSEMBLY
TRAILER INTERFACE CONTROL MODULE
REAR COMPARTMENT COURTESY LAMP
LEFT AUXILIARY TAIL/STOP LAMP
LEFT BACKUP LAMP
LEFT REAR TURN SIGNAL LAMP
LEFT TAIL LAMP ASSEMBLY
(W/ TAIL & STOP LAMP) LEFT REAR SIDE MARKER LAMP
(W/ FRONT & REAR PARK ASSIST) PARKING ASSIST CONTROL MODULE
LIFTGATE UNLATCH SWITCH
LEFT LICENSE PLATE LAMP
RIGHT LICENSE PLATE LAMP
CENTER HIGH MOUNTED STOP LAMP
NCA
J410
X410
X415
X910
X901
X900
X907
X902
X903
J901 (LIFTGATE HARNESS)
J902 (LIFTGATE HARNESS)
J309 (BODY HARNESS, NEAR BREAKOUT TO G404)
J308 (BODY HARNESS, NEAR BREAKOUT TO G404)
G404 (LEFT SIDE OF CARGO AREA)
G900 (CENTER OF LIFTGATE)
BLK
564098

Fig. 53: Ground Distribution Circuit (6 of 6)

HEADLIGHTS

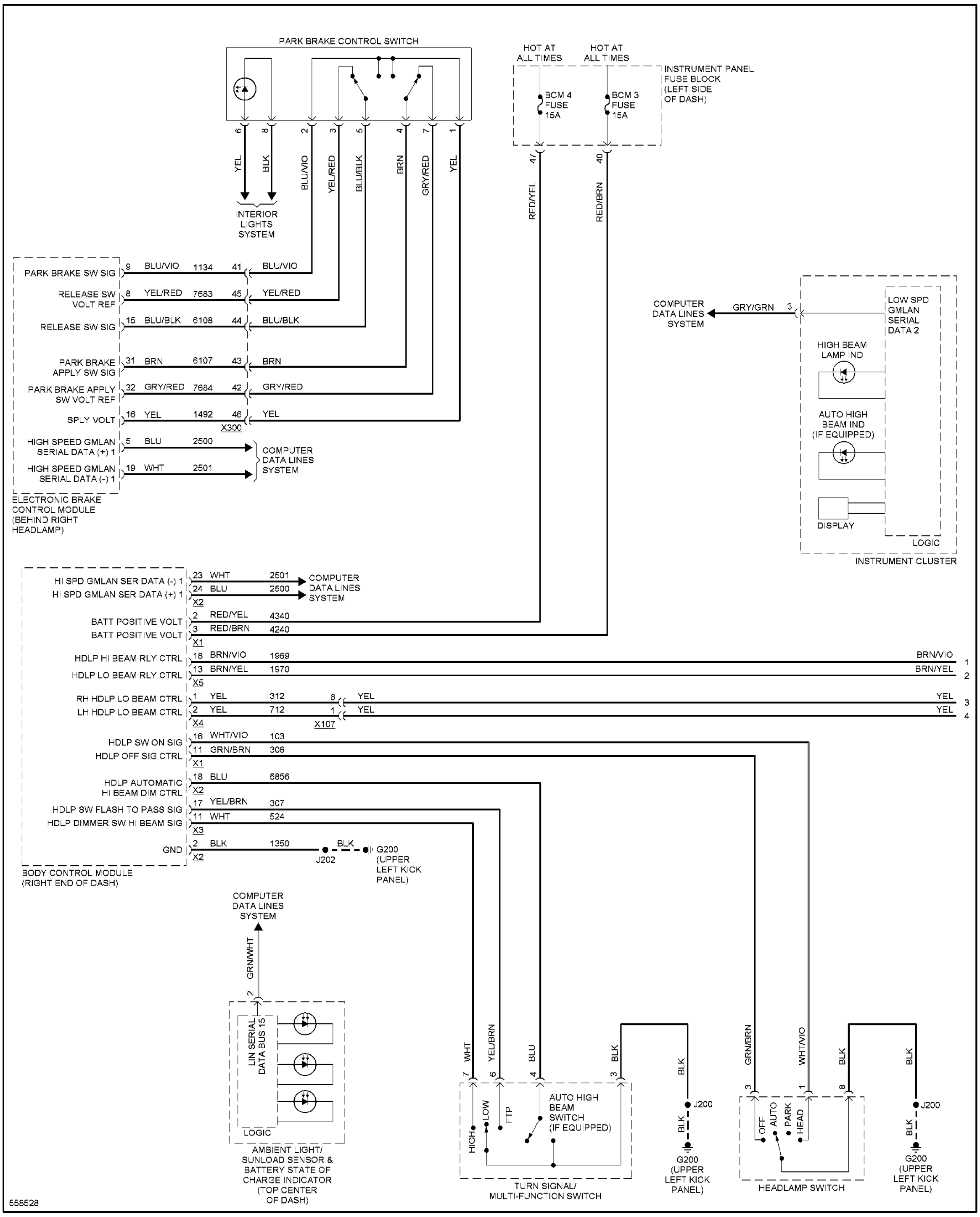

PARK BRAKE CONTROL SWITCH
HOT AT ALL TIMES
HOT AT ALL TIMES
BCM 4 FUSE 15A
BCM 3 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
6 YEL
8 BLK
2 BLU/VIO
3 YEL/RED
5 BLU/BLK
4 BRN
7 GRY/RED
1 YEL
47 RED/YEL
40 RED/BRN
INTERIOR LIGHTS SYSTEM
PARK BRAKE SW SIG 9 BLU/VIO 1134 41 BLU/VIO
RELEASE SW VOLT REF 8 YEL/RED 7683 45 YEL/RED
RELEASE SW SIG 15 BLU/BLK 6106 44 BLU/BLK
PARK BRAKE APPLY SW SIG 31 BRN 6107 43 BRN
PARK BRAKE APPLY SW VOLT REF 32 GRY/RED 7684 42 GRY/RED
SPLY VOLT 16 YEL 1492 46 YEL
X300
HIGH SPEED GMLAN SERIAL DATA (+) 1 5 BLU 2500
HIGH SPEED GMLAN SERIAL DATA (-) 1 19 WHT 2501
COMPUTER DATA LINES SYSTEM
ELECTRONIC BRAKE CONTROL MODULE (BEHIND RIGHT HEADLAMP)
COMPUTER DATA LINES SYSTEM
GRY/GRN 3
LOW SPD GMLAN SERIAL DATA 2
HIGH BEAM LAMP IND
AUTO HIGH BEAM IND (IF EQUIPPED)
DISPLAY
LOGIC
INSTRUMENT CLUSTER
HI SPD GMLAN SER DATA (-) 1 23 WHT 2501
HI SPD GMLAN SER DATA (+) 1 24 BLU 2500
X2
COMPUTER DATA LINES SYSTEM
BATT POSITIVE VOLT 2 RED/YEL 4340
BATT POSITIVE VOLT 3 RED/BRN 4240
X1
HDLP HI BEAM RLY CTRL 18 BRN/VIO 1969
HDLP LO BEAM RLY CTRL 13 BRN/YEL 1970
X5
BRN/VIO 1
BRN/YEL 2
RH HDLP LO BEAM CTRL 1 YEL 312 6 YEL
LH HDLP LO BEAM CTRL 2 YEL 712 1 YEL
X4
X107
YEL 3
YEL 4
HDLP SW ON SIG 16 WHT/VIO 103
HDLP OFF SIG CTRL 11 GRN/BRN 306
X1
HDLP AUTOMATIC HI BEAM DIM CTRL 18 BLU 6856
X2
HDLP SW FLASH TO PASS SIG 17 YEL/BRN 307
HDLP DIMMER SW HI BEAM SIG 11 WHT 524
X3
GND 2 BLK 1350
X2
J202
BLK
G200 (UPPER LEFT KICK PANEL)
BODY CONTROL MODULE (RIGHT END OF DASH)
COMPUTER DATA LINES SYSTEM
GRN/WHT
2
LIN SERIAL DATA BUS 15
LOGIC
AMBIENT LIGHT/ SUNLOAD SENSOR & BATTERY STATE OF CHARGE INDICATOR (TOP CENTER OF DASH)
7 WHT
6 YEL/BRN
4 BLU
3 BLK
HIGH
LOW
FTP
AUTO HIGH BEAM SWITCH (IF EQUIPPED)
TURN SIGNAL/ MULTI-FUNCTION SWITCH
BLK
J200
BLK
G200 (UPPER LEFT KICK PANEL)
3 GRN/BRN
1 WHT/VIO
8 BLK
OFF
AUTO
PARK
HEAD
HEADLAMP SWITCH
BLK
J200
BLK
G200 (UPPER LEFT KICK PANEL)
558528

Fig. 54: Headlights Circuit (1 of 2)

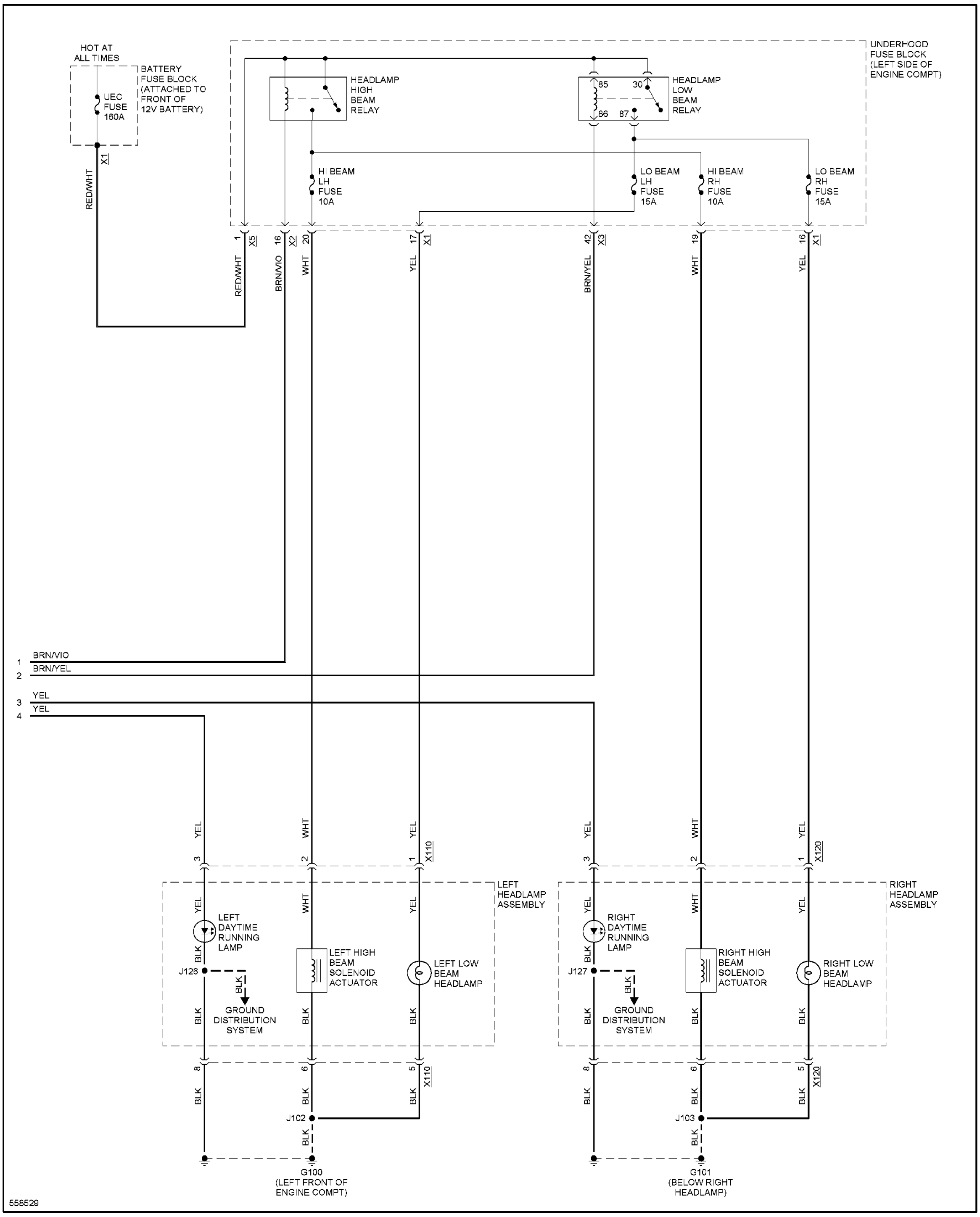

HOT AT ALL TIMES
BATTERY FUSE BLOCK (ATTACHED TO FRONT OF 12V BATTERY)
UEC FUSE 150A
X1
RED/WHT
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
HEADLAMP HIGH BEAM RELAY
HEADLAMP LOW BEAM RELAY
85
30
86
87
HI BEAM LH FUSE 10A
LO BEAM LH FUSE 15A
HI BEAM RH FUSE 10A
LO BEAM RH FUSE 15A
1
X5
16
X2
20
17
X1
42
X3
19
16
X1
RED/WHT
BRN/VIO
WHT
YEL
BRN/YEL
WHT
YEL
1
BRN/VIO
2
BRN/YEL
3
YEL
4
YEL
YEL
WHT
YEL
3
2
1
X110
YEL
WHT
YEL
3
2
1
X120
LEFT HEADLAMP ASSEMBLY
LEFT DAYTIME RUNNING LAMP
LEFT HIGH BEAM SOLENOID ACTUATOR
LEFT LOW BEAM HEADLAMP
J126
BLK
GROUND DISTRIBUTION SYSTEM
RIGHT HEADLAMP ASSEMBLY
RIGHT DAYTIME RUNNING LAMP
RIGHT HIGH BEAM SOLENOID ACTUATOR
RIGHT LOW BEAM HEADLAMP
J127
BLK
GROUND DISTRIBUTION SYSTEM
8
6
5
X110
8
6
5
X120
BLK
J102
J103
G100 (LEFT FRONT OF ENGINE COMPT)
G101 (BELOW RIGHT HEADLAMP)
558529

Fig. 55: Headlights Circuit (2 of 2)

HORN

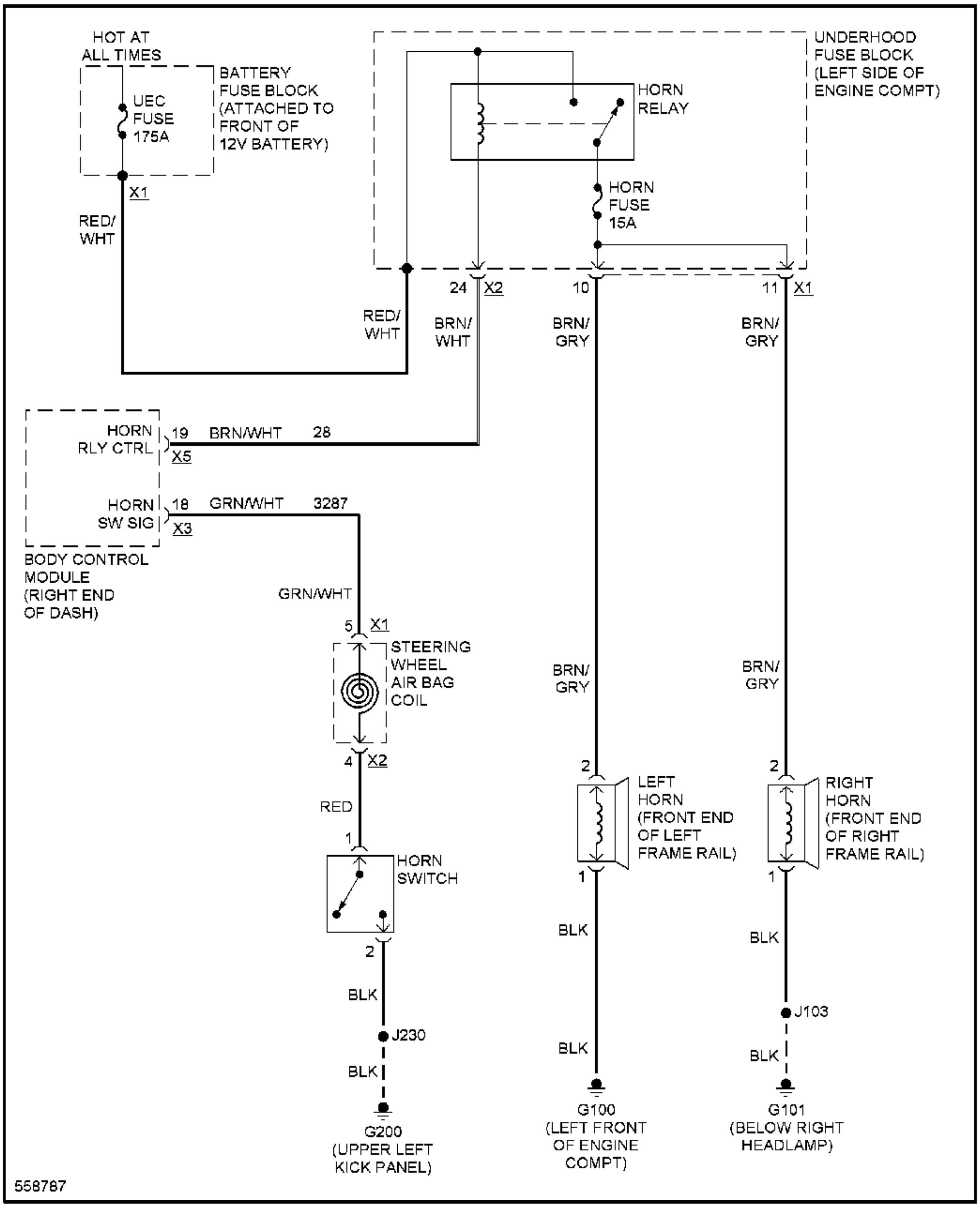

HOT AT ALL TIMES
BATTERY FUSE BLOCK (ATTACHED TO FRONT OF 12V BATTERY)
UEC FUSE 175A
X1
RED/ WHT
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
HORN RELAY
HORN FUSE 15A
24
X2
10
11
X1
RED/ WHT
BRN/ WHT
BRN/ GRY
BRN/ GRY
HORN RLY CTRL
19
BRN/WHT
28
X5
HORN SW SIG
18
GRN/WHT
3287
X3
BODY CONTROL MODULE (RIGHT END OF DASH)
GRN/WHT
5
X1
STEERING WHEEL AIR BAG COIL
4
X2
RED
1
HORN SWITCH
2
BLK
J230
BLK
G200 (UPPER LEFT KICK PANEL)
BRN/ GRY
BRN/ GRY
2
LEFT HORN (FRONT END OF LEFT FRAME RAIL)
1
BLK
BLK
G100 (LEFT FRONT OF ENGINE COMPT)
2
RIGHT HORN (FRONT END OF RIGHT FRAME RAIL)
1
BLK
J103
BLK
G101 (BELOW RIGHT HEADLAMP)
558787

Fig. 56: Horn Circuit

INSTRUMENT CLUSTER

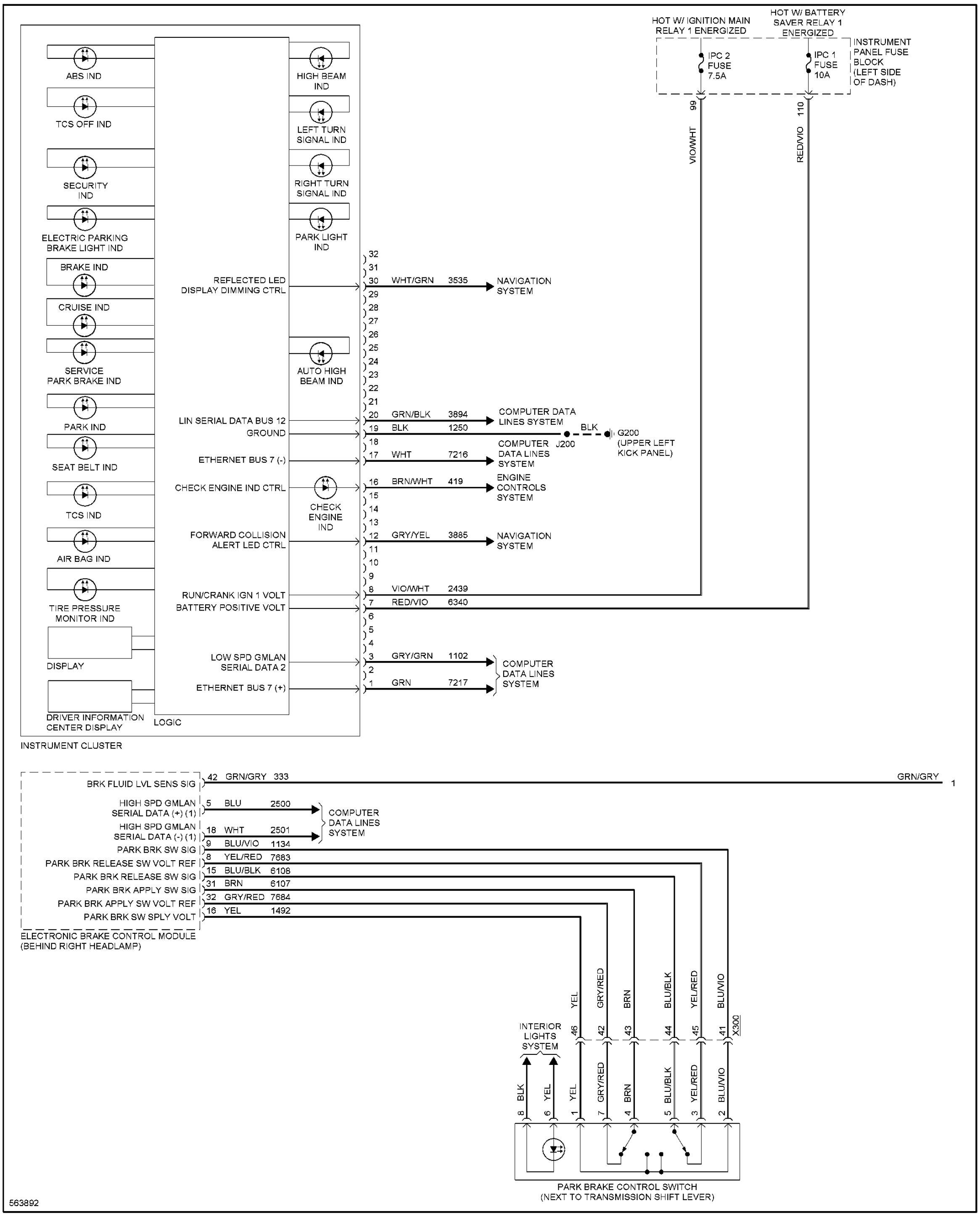

HOT W/ IGNITION MAIN RELAY 1 ENERGIZED
HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
IPC 2 FUSE 7.5A
IPC 1 FUSE 10A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
99
110
VIO/WHT
RED/VIO
ABS IND
TCS OFF IND
SECURITY IND
ELECTRIC PARKING BRAKE LIGHT IND
BRAKE IND
CRUISE IND
SERVICE PARK BRAKE IND
PARK IND
SEAT BELT IND
TCS IND
AIR BAG IND
TIRE PRESSURE MONITOR IND
DISPLAY
DRIVER INFORMATION CENTER DISPLAY
LOGIC
INSTRUMENT CLUSTER
HIGH BEAM IND
LEFT TURN SIGNAL IND
RIGHT TURN SIGNAL IND
PARK LIGHT IND
AUTO HIGH BEAM IND
CHECK ENGINE IND
REFLECTED LED DISPLAY DIMMING CTRL
LIN SERIAL DATA BUS 12
GROUND
ETHERNET BUS 7 (-)
CHECK ENGINE IND CTRL
FORWARD COLLISION ALERT LED CTRL
RUN/CRANK IGN 1 VOLT
BATTERY POSITIVE VOLT
LOW SPD GMLAN SERIAL DATA 2
ETHERNET BUS 7 (+)
32
31
30 WHT/GRN 3535 NAVIGATION SYSTEM
29
28
27
26
25
24
23
22
21
20 GRN/BLK 3894 COMPUTER DATA LINES SYSTEM
19 BLK 1250
18
17 WHT 7216 COMPUTER DATA LINES SYSTEM
J200
BLK
G200 (UPPER LEFT KICK PANEL)
16 BRN/WHT 419 ENGINE CONTROLS SYSTEM
15
14
13
12 GRY/YEL 3885 NAVIGATION SYSTEM
11
10
9
8 VIO/WHT 2439
7 RED/VIO 6340
6
5
4
3 GRY/GRN 1102
2
1 GRN 7217
COMPUTER DATA LINES SYSTEM
BRK FLUID LVL SENS SIG
42 GRN/GRY 333
GRN/GRY
1
HIGH SPD GMLAN SERIAL DATA (+) (1)
5 BLU 2500
HIGH SPD GMLAN SERIAL DATA (-) (1)
18 WHT 2501
COMPUTER DATA LINES SYSTEM
PARK BRK SW SIG
9 BLU/VIO 1134
PARK BRK RELEASE SW VOLT REF
8 YEL/RED 7683
PARK BRK RELEASE SW SIG
15 BLU/BLK 6108
PARK BRK APPLY SW SIG
31 BRN 6107
PARK BRK APPLY SW VOLT REF
32 GRY/RED 7684
PARK BRK SW SPLY VOLT
16 YEL 1492
ELECTRONIC BRAKE CONTROL MODULE (BEHIND RIGHT HEADLAMP)
YEL
GRY/RED
BRN
BLU/BLK
YEL/RED
BLU/VIO
46
42
43
44
45
41
X300
INTERIOR LIGHTS SYSTEM
BLK
YEL
8
6
1 YEL
7 GRY/RED
4 BRN
5 BLU/BLK
3 YEL/RED
2 BLU/VIO
PARK BRAKE CONTROL SWITCH (NEXT TO TRANSMISSION SHIFT LEVER)
563892

Fig. 57: Instrument Cluster Circuit (1 of 2)

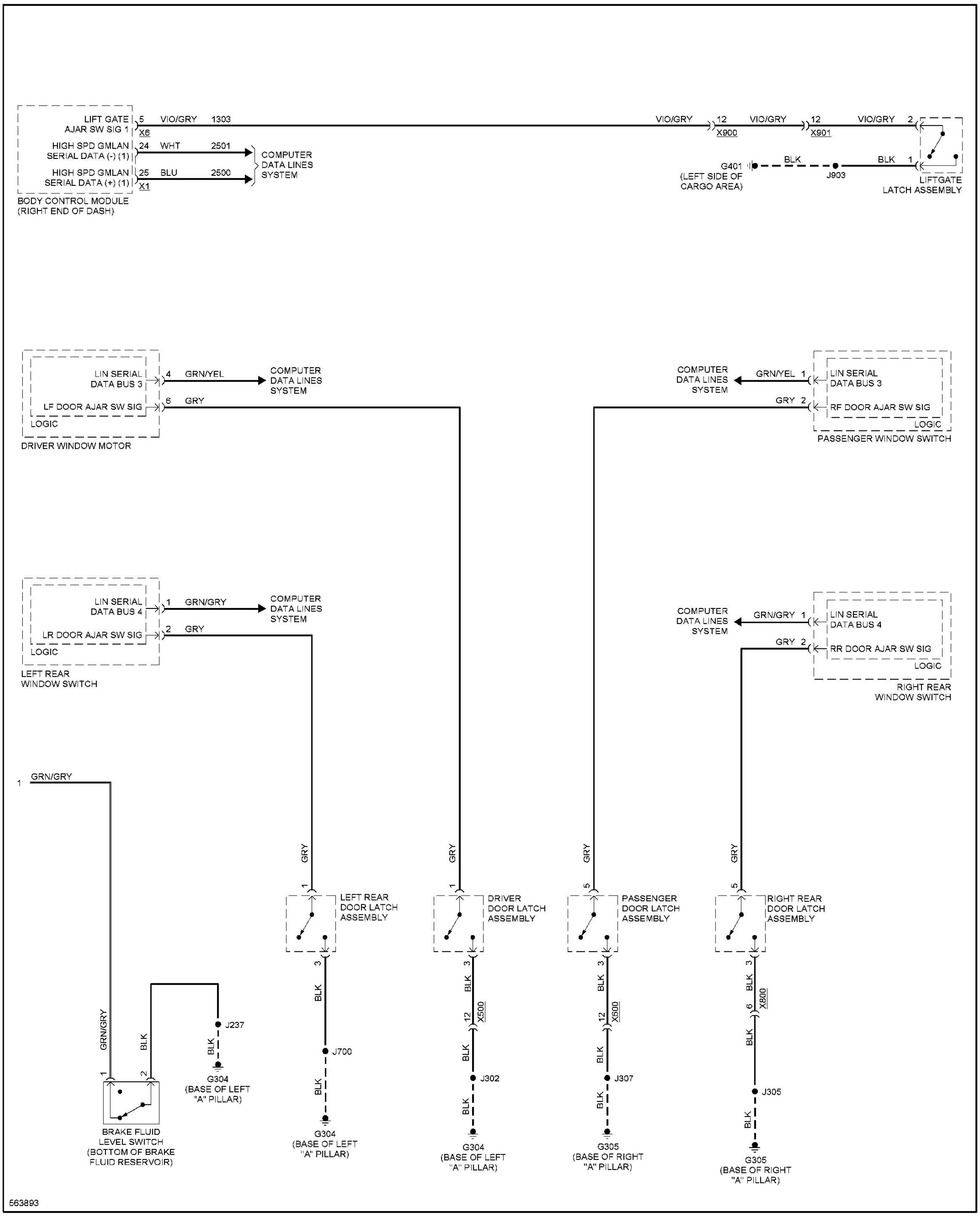

LIFT GATE AJAR SW SIG 1
5
X6
VIO/GRY
1303
HIGH SPD GMLAN SERIAL DATA (-) (1)
24
WHT
2501
HIGH SPD GMLAN SERIAL DATA (+) (1)
25
BLU
2500
X1
COMPUTER DATA LINES SYSTEM
BODY CONTROL MODULE (RIGHT END OF DASH)
VIO/GRY
12
X900
VIO/GRY
12
X901
VIO/GRY
2
G401
(LEFT SIDE OF CARGO AREA)
BLK
J903
BLK
1
LIFTGATE LATCH ASSEMBLY
LIN SERIAL DATA BUS 3
4
GRN/YEL
COMPUTER DATA LINES SYSTEM
LF DOOR AJAR SW SIG
6
GRY
LOGIC
DRIVER WINDOW MOTOR
COMPUTER DATA LINES SYSTEM
GRN/YEL
1
LIN SERIAL DATA BUS 3
GRY
2
RF DOOR AJAR SW SIG
LOGIC
PASSENGER WINDOW SWITCH
LIN SERIAL DATA BUS 4
1
GRN/GRY
COMPUTER DATA LINES SYSTEM
LR DOOR AJAR SW SIG
2
GRY
LOGIC
LEFT REAR WINDOW SWITCH
COMPUTER DATA LINES SYSTEM
GRN/GRY
1
LIN SERIAL DATA BUS 4
GRY
2
RR DOOR AJAR SW SIG
LOGIC
RIGHT REAR WINDOW SWITCH
1
GRN/GRY
GRY
1
LEFT REAR DOOR LATCH ASSEMBLY
GRY
1
DRIVER DOOR LATCH ASSEMBLY
GRY
5
PASSENGER DOOR LATCH ASSEMBLY
GRY
5
RIGHT REAR DOOR LATCH ASSEMBLY
GRN/GRY
BLK
J237
BLK
G304
(BASE OF LEFT "A" PILLAR)
1
2
BRAKE FLUID LEVEL SWITCH (BOTTOM OF BRAKE FLUID RESERVOIR)
3
BLK
J700
BLK
G304
(BASE OF LEFT "A" PILLAR)
3
BLK
12
X500
BLK
J302
BLK
G304
(BASE OF LEFT "A" PILLAR)
3
BLK
12
X600
BLK
J307
BLK
G305
(BASE OF RIGHT "A" PILLAR)
3
BLK
6
X800
BLK
J305
BLK
G305
(BASE OF RIGHT "A" PILLAR)
563893

Fig. 58: Instrument Cluster Circuit (2 of 2)

INTERIOR LIGHTS

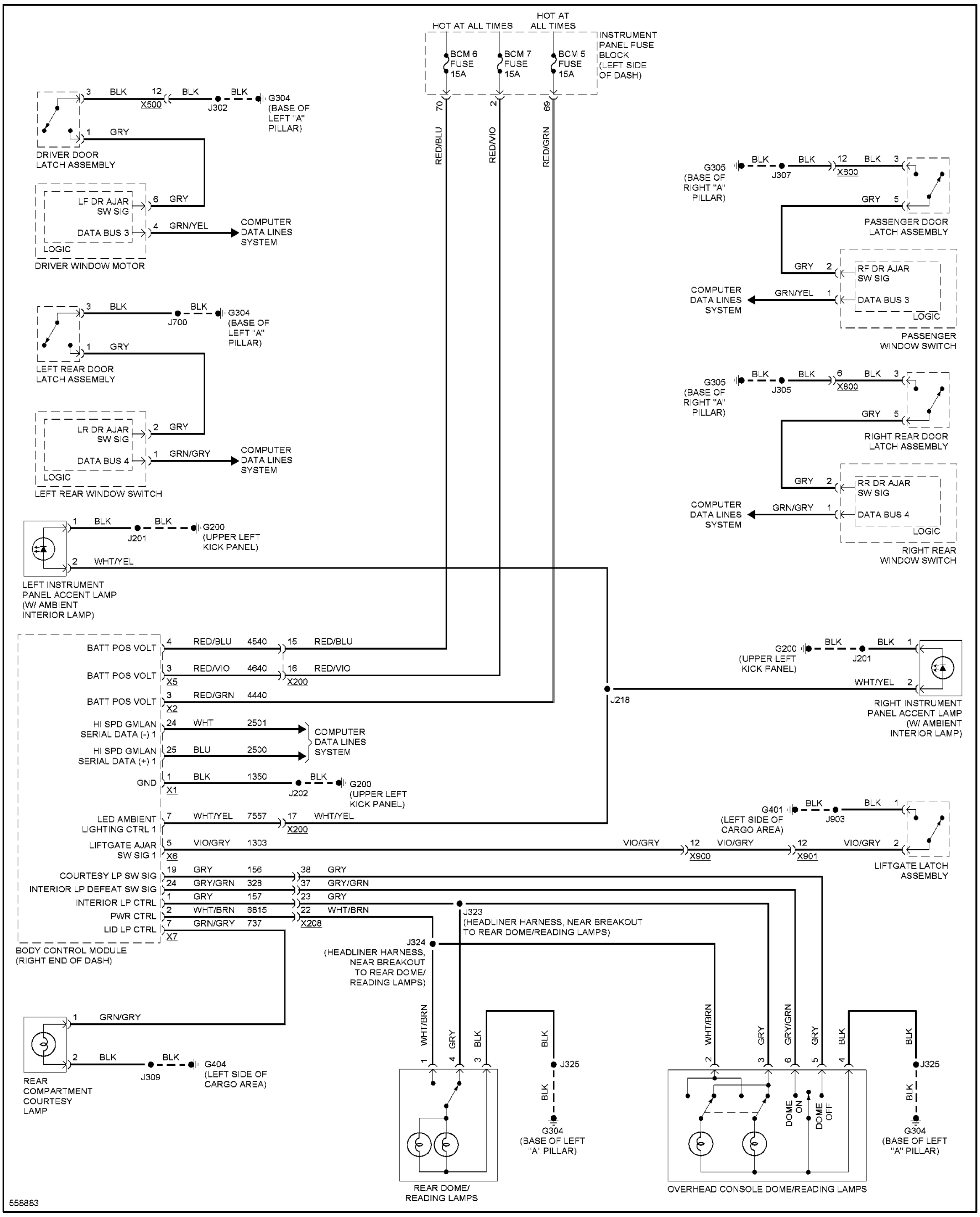
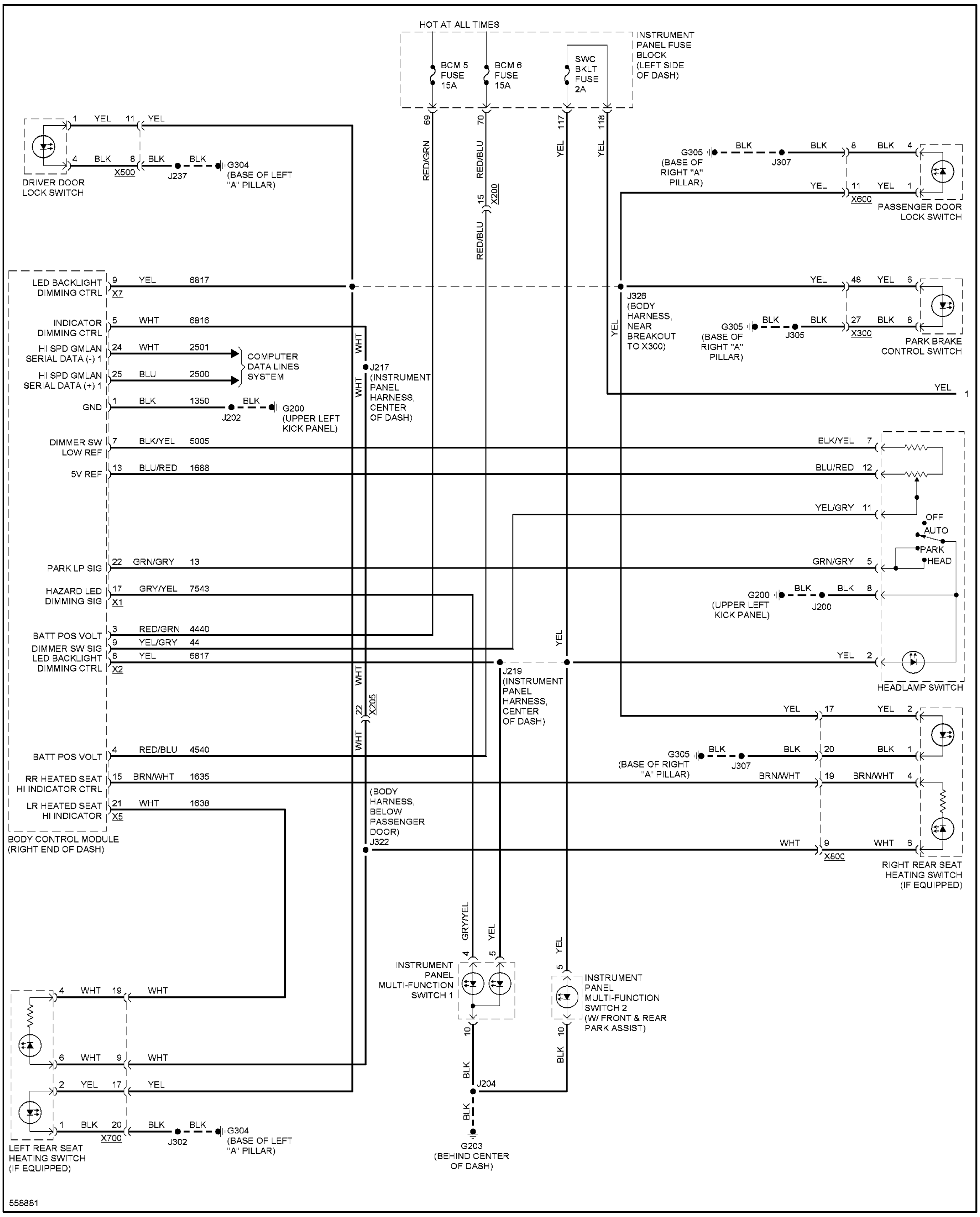

HOT AT ALL TIMES
HOT AT ALL TIMES
BCM 6 FUSE 15A
BCM 7 FUSE 15A
BCM 5 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
70
2
69
RED/BLU
RED/VIO
RED/GRN
3 BLK 12 BLK BLK
X500
J302
G304 (BASE OF LEFT "A" PILLAR)
1 GRY
DRIVER DOOR LATCH ASSEMBLY
LF DR AJAR SW SIG
6 GRY
DATA BUS 3
4 GRN/YEL
COMPUTER DATA LINES SYSTEM
LOGIC
DRIVER WINDOW MOTOR
3 BLK BLK
J700
G304 (BASE OF LEFT "A" PILLAR)
1 GRY
LEFT REAR DOOR LATCH ASSEMBLY
LR DR AJAR SW SIG
2 GRY
DATA BUS 4
1 GRN/GRY
COMPUTER DATA LINES SYSTEM
LOGIC
LEFT REAR WINDOW SWITCH
1 BLK BLK
J201
G200 (UPPER LEFT KICK PANEL)
2 WHT/YEL
LEFT INSTRUMENT PANEL ACCENT LAMP (W/ AMBIENT INTERIOR LAMP)
G305 (BASE OF RIGHT "A" PILLAR)
BLK BLK 12 BLK 3
J307
X800
GRY 5
PASSENGER DOOR LATCH ASSEMBLY
GRY 2
RF DR AJAR SW SIG
COMPUTER DATA LINES SYSTEM
GRN/YEL 1
DATA BUS 3
LOGIC
PASSENGER WINDOW SWITCH
G305 (BASE OF RIGHT "A" PILLAR)
BLK BLK 6 BLK 3
J305
X800
GRY 5
RIGHT REAR DOOR LATCH ASSEMBLY
GRY 2
RR DR AJAR SW SIG
COMPUTER DATA LINES SYSTEM
GRN/GRY 1
DATA BUS 4
LOGIC
RIGHT REAR WINDOW SWITCH
BATT POS VOLT 4 RED/BLU 4540 15 RED/BLU
BATT POS VOLT 3 RED/VIO 4640 16 RED/VIO
X5
X200
BATT POS VOLT 3 RED/GRN 4440
X2
J218
G200 (UPPER LEFT KICK PANEL)
BLK BLK 1
J201
WHT/YEL 2
RIGHT INSTRUMENT PANEL ACCENT LAMP (W/ AMBIENT INTERIOR LAMP)
HI SPD GMLAN SERIAL DATA (-) 1 24 WHT 2501
HI SPD GMLAN SERIAL DATA (+) 1 25 BLU 2500
COMPUTER DATA LINES SYSTEM
GND 1 BLK 1350 BLK
X1
J202
G200 (UPPER LEFT KICK PANEL)
LED AMBIENT LIGHTING CTRL 1 7 WHT/YEL 7557 17 WHT/YEL
X200
G401 (LEFT SIDE OF CARGO AREA)
BLK BLK 1
J903
LIFTGATE AJAR SW SIG 1 5 VIO/GRY 1303
X6
VIO/GRY 12 VIO/GRY 12 VIO/GRY 2
X900
X901
LIFTGATE LATCH ASSEMBLY
COURTESY LP SW SIG 19 GRY 156 38 GRY
INTERIOR LP DEFEAT SW SIG 24 GRY/GRN 328 37 GRY/GRN
INTERIOR LP CTRL 1 GRY 157 23 GRY
PWR CTRL 2 WHT/BRN 6815 22 WHT/BRN
LID LP CTRL 7 GRN/GRY 737
X208
X7
BODY CONTROL MODULE (RIGHT END OF DASH)
J323 (HEADLINER HARNESS, NEAR BREAKOUT TO REAR DOME/READING LAMPS)
J324 (HEADLINER HARNESS, NEAR BREAKOUT TO REAR DOME/ READING LAMPS)
1 GRN/GRY
2 BLK BLK
J309
G404 (LEFT SIDE OF CARGO AREA)
REAR COMPARTMENT COURTESY LAMP
WHT/BRN
GRY
BLK
BLK
1 4 3
J325
BLK
G304 (BASE OF LEFT "A" PILLAR)
REAR DOME/ READING LAMPS
WHT/BRN GRY GRY/GRN GRY BLK BLK
2 3 6 5 4
J325
BLK
G304 (BASE OF LEFT "A" PILLAR)
DOME ON
DOME OFF
OVERHEAD CONSOLE DOME/READING LAMPS
558883

Fig. 59: Courtesy Lamps Circuit



HOT AT ALL TIMES
BCM 5 FUSE 15A
BCM 6 FUSE 15A
SWC BKLT FUSE 2A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
69 RED/GRN
70 RED/BLU
117 YEL
118 YEL
15 X200 RED/BLU
DRIVER DOOR LOCK SWITCH
1 YEL 11 YEL
4 BLK 8 BLK X500 BLK
J237
G304 (BASE OF LEFT "A" PILLAR)
G305 (BASE OF RIGHT "A" PILLAR)
J307
BLK 8 BLK 4
YEL 11 YEL 1 X600
PASSENGER DOOR LOCK SWITCH
LED BACKLIGHT DIMMING CTRL 9 YEL 6817 X7
INDICATOR DIMMING CTRL 5 WHT 6816
HI SPD GMLAN SERIAL DATA (-) 1 24 WHT 2501
HI SPD GMLAN SERIAL DATA (+) 1 25 BLU 2500
COMPUTER DATA LINES SYSTEM
GND 1 BLK 1350 J202 BLK
G200 (UPPER LEFT KICK PANEL)
J217 (INSTRUMENT PANEL HARNESS, CENTER OF DASH)
WHT
J326 (BODY HARNESS, NEAR BREAKOUT TO X300)
YEL 48 YEL 6
G305 (BASE OF RIGHT "A" PILLAR)
BLK J305 BLK 27 BLK 8 X300
PARK BRAKE CONTROL SWITCH
YEL 1
DIMMER SW LOW REF 7 BLK/YEL 5005
5V REF 13 BLU/RED 1688
BLK/YEL 7
BLU/RED 12
YEL/GRY 11
OFF
AUTO
PARK
HEAD
PARK LP SIG 22 GRN/GRY 13
GRN/GRY 5
HAZARD LED DIMMING SIG 17 GRY/YEL 7543 X1
G200 (UPPER LEFT KICK PANEL) BLK J200 BLK 8
BATT POS VOLT 3 RED/GRN 4440
DIMMER SW SIG 9 YEL/GRY 44
LED BACKLIGHT DIMMING CTRL 8 YEL 6817 X2
YEL 2
HEADLAMP SWITCH
J219 (INSTRUMENT PANEL HARNESS, CENTER OF DASH)
22 X205
YEL 17 YEL 2
BATT POS VOLT 4 RED/BLU 4540
G305 (BASE OF RIGHT "A" PILLAR) BLK J307 BLK 20 BLK 1
RR HEATED SEAT HI INDICATOR CTRL 15 BRN/WHT 1635
BRN/WHT 19 BRN/WHT 4
LR HEATED SEAT HI INDICATOR 21 WHT 1638 X5
(BODY HARNESS, BELOW PASSENGER DOOR) J322
WHT 9 WHT 6 X800
BODY CONTROL MODULE (RIGHT END OF DASH)
RIGHT REAR SEAT HEATING SWITCH (IF EQUIPPED)
GRY/YEL 4
YEL 5
INSTRUMENT PANEL MULTI-FUNCTION SWITCH 1
10 BLK
YEL 5
INSTRUMENT PANEL MULTI-FUNCTION SWITCH 2 (W/ FRONT & REAR PARK ASSIST)
10 BLK
J204
BLK
G203 (BEHIND CENTER OF DASH)
4 WHT 19 WHT
6 WHT 9 WHT
2 YEL 17 YEL
1 BLK 20 BLK X700 BLK
J302
G304 (BASE OF LEFT "A" PILLAR)
LEFT REAR SEAT HEATING SWITCH (IF EQUIPPED)
558881

Fig. 60: Instrument Illumination Circuit (1 of 2)

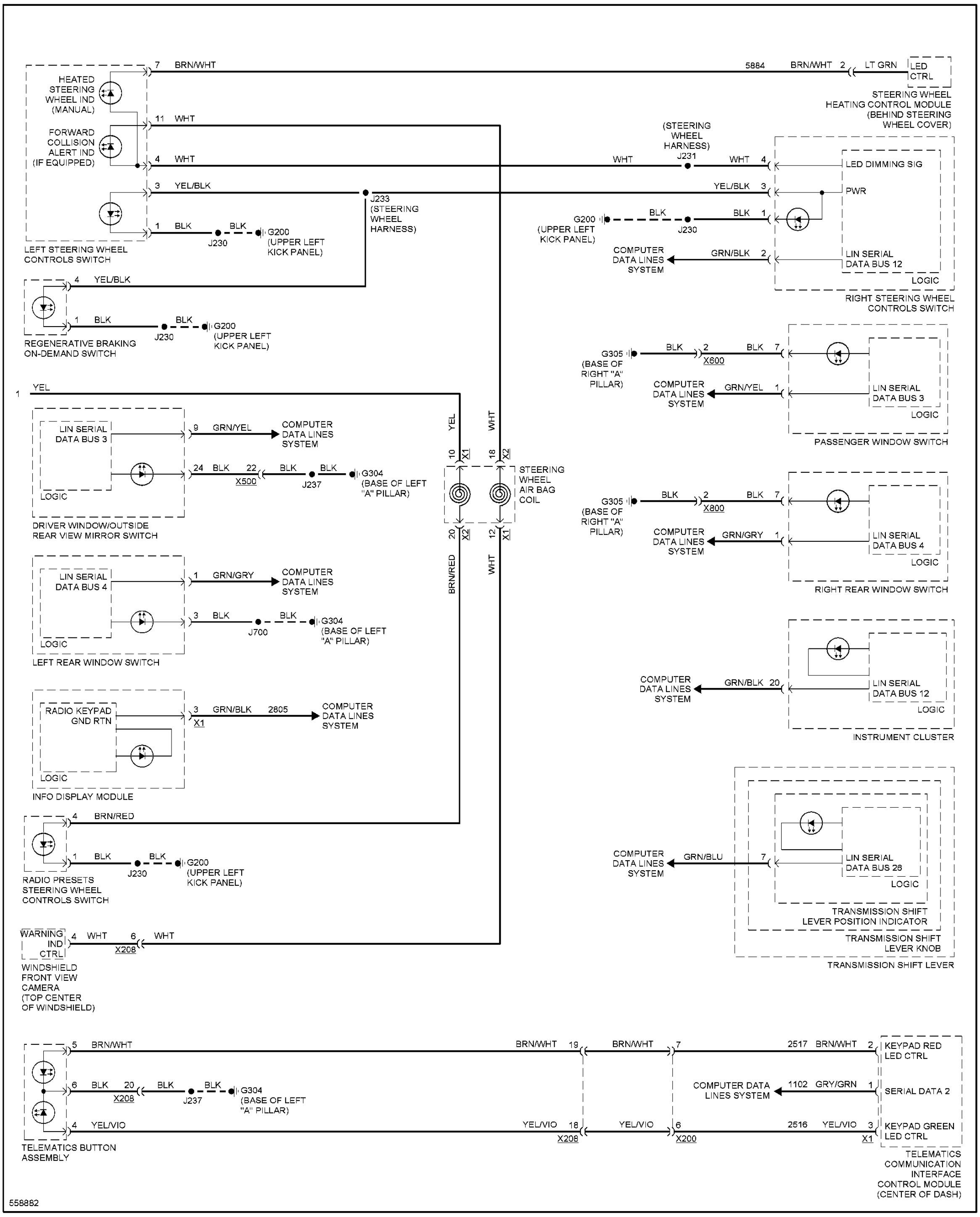

HEATED STEERING WHEEL IND (MANUAL)
FORWARD COLLISION ALERT IND (IF EQUIPPED)
LEFT STEERING WHEEL CONTROLS SWITCH
7 BRN/WHT
5884 BRN/WHT 2 LT GRN
LED CTRL
STEERING WHEEL HEATING CONTROL MODULE (BEHIND STEERING WHEEL COVER)
11 WHT
4 WHT
(STEERING WHEEL HARNESS) J231
WHT
WHT 4
LED DIMMING SIG
3 YEL/BLK
YEL/BLK 3
PWR
J233 (STEERING WHEEL HARNESS)
1 BLK
BLK
J230
G200 (UPPER LEFT KICK PANEL)
G200 (UPPER LEFT KICK PANEL)
BLK
BLK 1
J230
COMPUTER DATA LINES SYSTEM
GRN/BLK 2
LIN SERIAL DATA BUS 12
LOGIC
RIGHT STEERING WHEEL CONTROLS SWITCH
4 YEL/BLK
1 BLK
BLK
J230
G200 (UPPER LEFT KICK PANEL)
REGENERATIVE BRAKING ON-DEMAND SWITCH
G305 (BASE OF RIGHT "A" PILLAR)
BLK
2 X600
BLK 7
COMPUTER DATA LINES SYSTEM
GRN/YEL 1
LIN SERIAL DATA BUS 3
LOGIC
PASSENGER WINDOW SWITCH
1 YEL
YEL
WHT
LIN SERIAL DATA BUS 3
LOGIC
9 GRN/YEL
COMPUTER DATA LINES SYSTEM
24 BLK 22 X500
BLK
BLK
J237
G304 (BASE OF LEFT "A" PILLAR)
DRIVER WINDOW/OUTSIDE REAR VIEW MIRROR SWITCH
10 X1
18 X2
STEERING WHEEL AIR BAG COIL
20 X2
12 X1
G305 (BASE OF RIGHT "A" PILLAR)
BLK
2 X800
BLK 7
COMPUTER DATA LINES SYSTEM
GRN/GRY 1
LIN SERIAL DATA BUS 4
LOGIC
RIGHT REAR WINDOW SWITCH
BRN/RED
WHT
LIN SERIAL DATA BUS 4
LOGIC
1 GRN/GRY
COMPUTER DATA LINES SYSTEM
3 BLK
BLK
J700
G304 (BASE OF LEFT "A" PILLAR)
LEFT REAR WINDOW SWITCH
COMPUTER DATA LINES SYSTEM
GRN/BLK 20
LIN SERIAL DATA BUS 12
LOGIC
INSTRUMENT CLUSTER
RADIO KEYPAD GND RTN
LOGIC
3 X1
GRN/BLK 2805
COMPUTER DATA LINES SYSTEM
INFO DISPLAY MODULE
4 BRN/RED
1 BLK
BLK
J230
G200 (UPPER LEFT KICK PANEL)
RADIO PRESETS STEERING WHEEL CONTROLS SWITCH
COMPUTER DATA LINES SYSTEM
GRN/BLU
7
LIN SERIAL DATA BUS 28
LOGIC
TRANSMISSION SHIFT LEVER POSITION INDICATOR
TRANSMISSION SHIFT LEVER KNOB
TRANSMISSION SHIFT LEVER
WARNING IND CTRL
4 WHT
6 X208
WHT
WINDSHIELD FRONT VIEW CAMERA (TOP CENTER OF WINDSHIELD)
5 BRN/WHT
BRN/WHT 19
BRN/WHT 7
2517 BRN/WHT 2
KEYPAD RED LED CTRL
6 BLK 20 X208
BLK
BLK
J237
G304 (BASE OF LEFT "A" PILLAR)
COMPUTER DATA LINES SYSTEM
1102 GRY/GRN 1
SERIAL DATA 2
4 YEL/VIO
YEL/VIO 18 X208
YEL/VIO 6 X200
2516 YEL/VIO 3 X1
KEYPAD GREEN LED CTRL
TELEMATICS BUTTON ASSEMBLY
TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE (CENTER OF DASH)
558882

Fig. 61: Instrument Illumination Circuit (2 of 2)

NAVIGATION

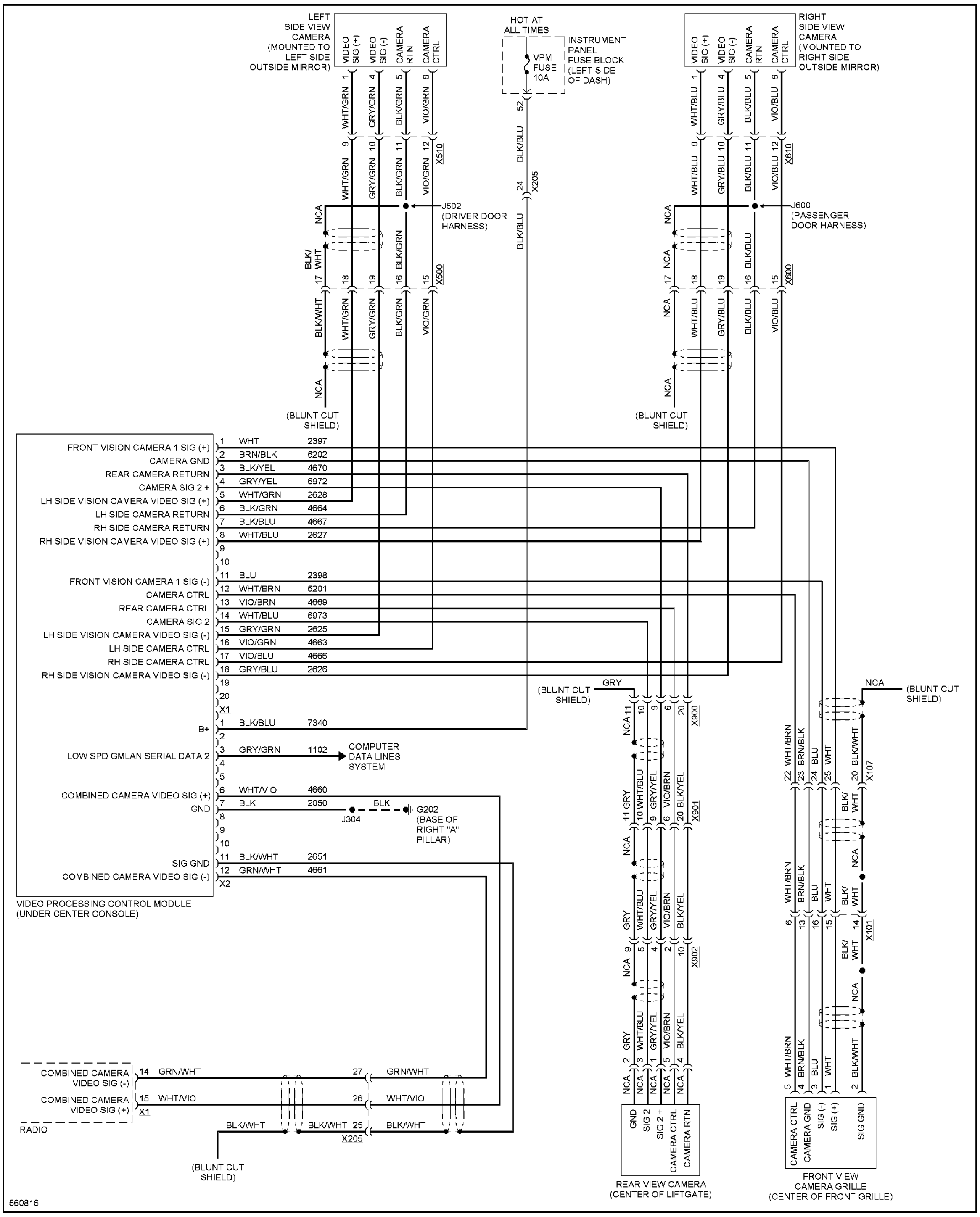
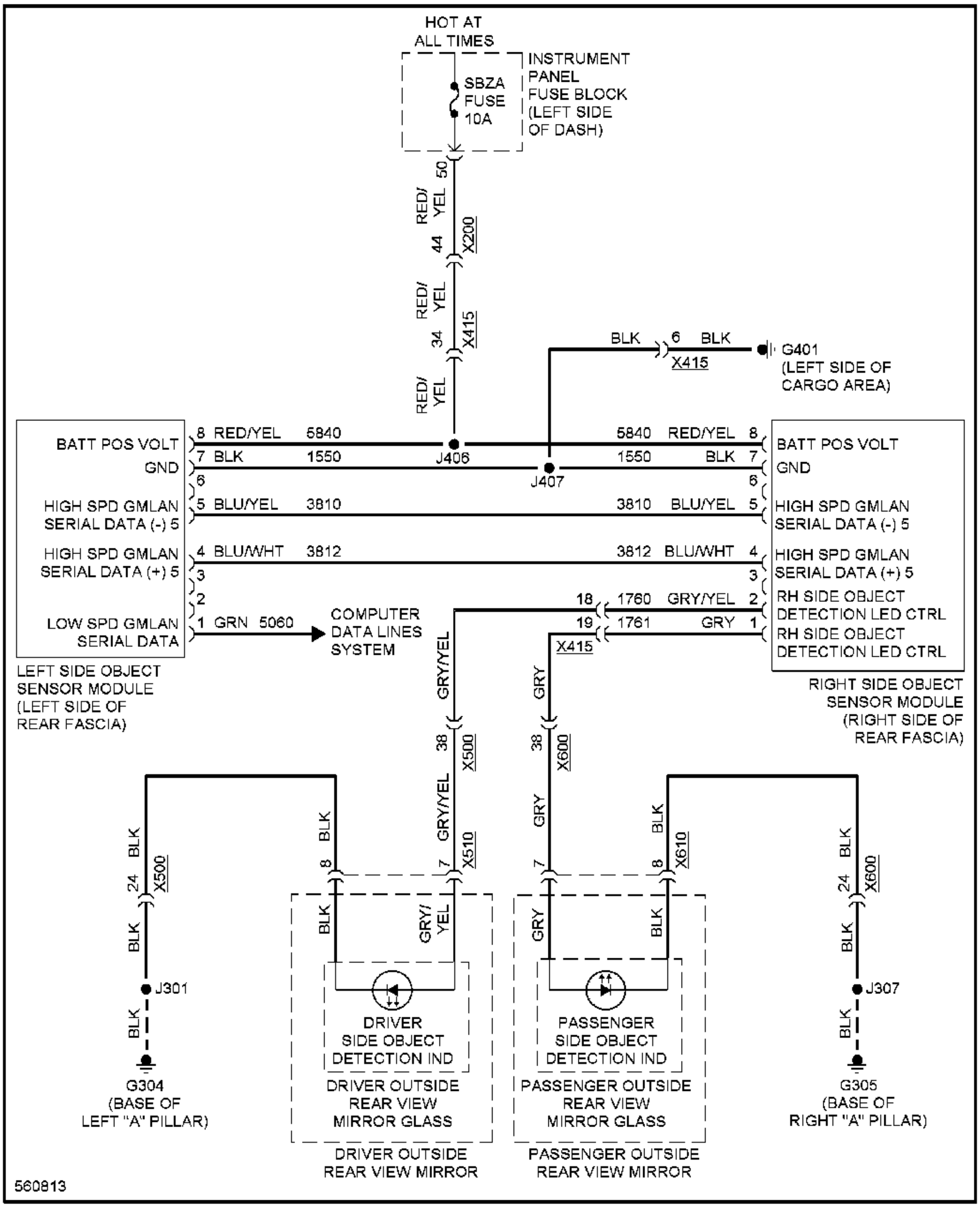

LEFT SIDE VIEW CAMERA (MOUNTED TO LEFT SIDE OUTSIDE MIRROR)
VIDEO SIG (+)
VIDEO SIG (-)
CAMERA RTN
CAMERA CTRL
WHT/GRN
GRY/GRN
BLK/GRN
VIO/GRN
X510
HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
VPM FUSE 10A
BLK/BLU
X205
J502 (DRIVER DOOR HARNESS)
NCA
BLK/WHT
X500
(BLUNT CUT SHIELD)
RIGHT SIDE VIEW CAMERA (MOUNTED TO RIGHT SIDE OUTSIDE MIRROR)
WHT/BLU
GRY/BLU
BLK/BLU
VIO/BLU
X610
J600 (PASSENGER DOOR HARNESS)
X600
FRONT VISION CAMERA 1 SIG (+)
CAMERA GND
REAR CAMERA RETURN
CAMERA SIG 2 +
LH SIDE VISION CAMERA VIDEO SIG (+)
LH SIDE CAMERA RETURN
RH SIDE CAMERA RETURN
RH SIDE VISION CAMERA VIDEO SIG (+)
FRONT VISION CAMERA 1 SIG (-)
CAMERA CTRL
REAR CAMERA CTRL
CAMERA SIG 2
LH SIDE VISION CAMERA VIDEO SIG (-)
LH SIDE CAMERA CTRL
RH SIDE CAMERA CTRL
RH SIDE VISION CAMERA VIDEO SIG (-)
1 WHT 2397
2 BRN/BLK 6202
3 BLK/YEL 4670
4 GRY/YEL 6972
5 WHT/GRN 2628
6 BLK/GRN 4664
7 BLK/BLU 4667
8 WHT/BLU 2627
11 BLU 2398
12 WHT/BRN 6201
13 VIO/BRN 4669
14 WHT/BLU 6973
15 GRY/GRN 2625
16 VIO/GRN 4663
17 VIO/BLU 4666
18 GRY/BLU 2626
X1
B+
1 BLK/BLU 7340
LOW SPD GMLAN SERIAL DATA 2
3 GRY/GRN 1102
COMPUTER DATA LINES SYSTEM
COMBINED CAMERA VIDEO SIG (+)
6 WHT/VIO 4660
GND
7 BLK 2050
J304
BLK
G202 (BASE OF RIGHT "A" PILLAR)
SIG GND
11 BLK/WHT 2651
COMBINED CAMERA VIDEO SIG (-)
12 GRN/WHT 4661
X2
VIDEO PROCESSING CONTROL MODULE (UNDER CENTER CONSOLE)
GRY
X900
X901
X902
WHT/BLU
GRY/YEL
VIO/BRN
BLK/YEL
NCA
(BLUNT CUT SHIELD)
WHT/BRN
BRN/BLK
BLU
WHT
BLK/WHT
X107
X101
COMBINED CAMERA VIDEO SIG (-)
14 GRN/WHT
COMBINED CAMERA VIDEO SIG (+)
15 WHT/VIO
X1
RADIO
27 GRN/WHT
26 WHT/VIO
BLK/WHT 25
X205
(BLUNT CUT SHIELD)
GND
SIG 2
SIG 2 +
CAMERA CTRL
CAMERA RTN
REAR VIEW CAMERA (CENTER OF LIFTGATE)
CAMERA CTRL
CAMERA GND
SIG (-)
SIG (+)
SIG GND
FRONT VIEW CAMERA GRILLE (CENTER OF FRONT GRILLE)
560816

Fig. 62: All Around Vision Camera Circuit



HOT AT ALL TIMES
SBZA FUSE 10A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
50
RED/YEL
44
X200
RED/YEL
34
X415
RED/YEL
BLK
6
BLK
X415
G401 (LEFT SIDE OF CARGO AREA)
BATT POS VOLT
GND
HIGH SPD GMLAN SERIAL DATA (-) 5
HIGH SPD GMLAN SERIAL DATA (+) 5
LOW SPD GMLAN SERIAL DATA
8 RED/YEL 5840
7 BLK 1550
6
5 BLU/YEL 3810
4 BLU/WHT 3812
3
2
1 GRN 5060
COMPUTER DATA LINES SYSTEM
J406
J407
5840 RED/YEL 8
1550 BLK 7
6
3810 BLU/YEL 5
3812 BLU/WHT 4
3
18 1760 GRY/YEL 2
19 1761 GRY 1
X415
BATT POS VOLT
GND
HIGH SPD GMLAN SERIAL DATA (-) 5
HIGH SPD GMLAN SERIAL DATA (+) 5
RH SIDE OBJECT DETECTION LED CTRL
RH SIDE OBJECT DETECTION LED CTRL
LEFT SIDE OBJECT SENSOR MODULE (LEFT SIDE OF REAR FASCIA)
RIGHT SIDE OBJECT SENSOR MODULE (RIGHT SIDE OF REAR FASCIA)
GRY/YEL
38
X500
GRY/YEL
7
X510
GRY
38
X600
GRY
7
BLK
8
BLK
8
X610
BLK
24
X500
BLK
J301
BLK
G304 (BASE OF LEFT "A" PILLAR)
BLK
24
X600
BLK
J307
BLK
G305 (BASE OF RIGHT "A" PILLAR)
BLK
GRY/YEL
GRY
BLK
DRIVER SIDE OBJECT DETECTION IND
PASSENGER SIDE OBJECT DETECTION IND
DRIVER OUTSIDE REAR VIEW MIRROR GLASS
PASSENGER OUTSIDE REAR VIEW MIRROR GLASS
DRIVER OUTSIDE REAR VIEW MIRROR
PASSENGER OUTSIDE REAR VIEW MIRROR
560813

Fig. 63: Blind Spot Monitoring Circuit

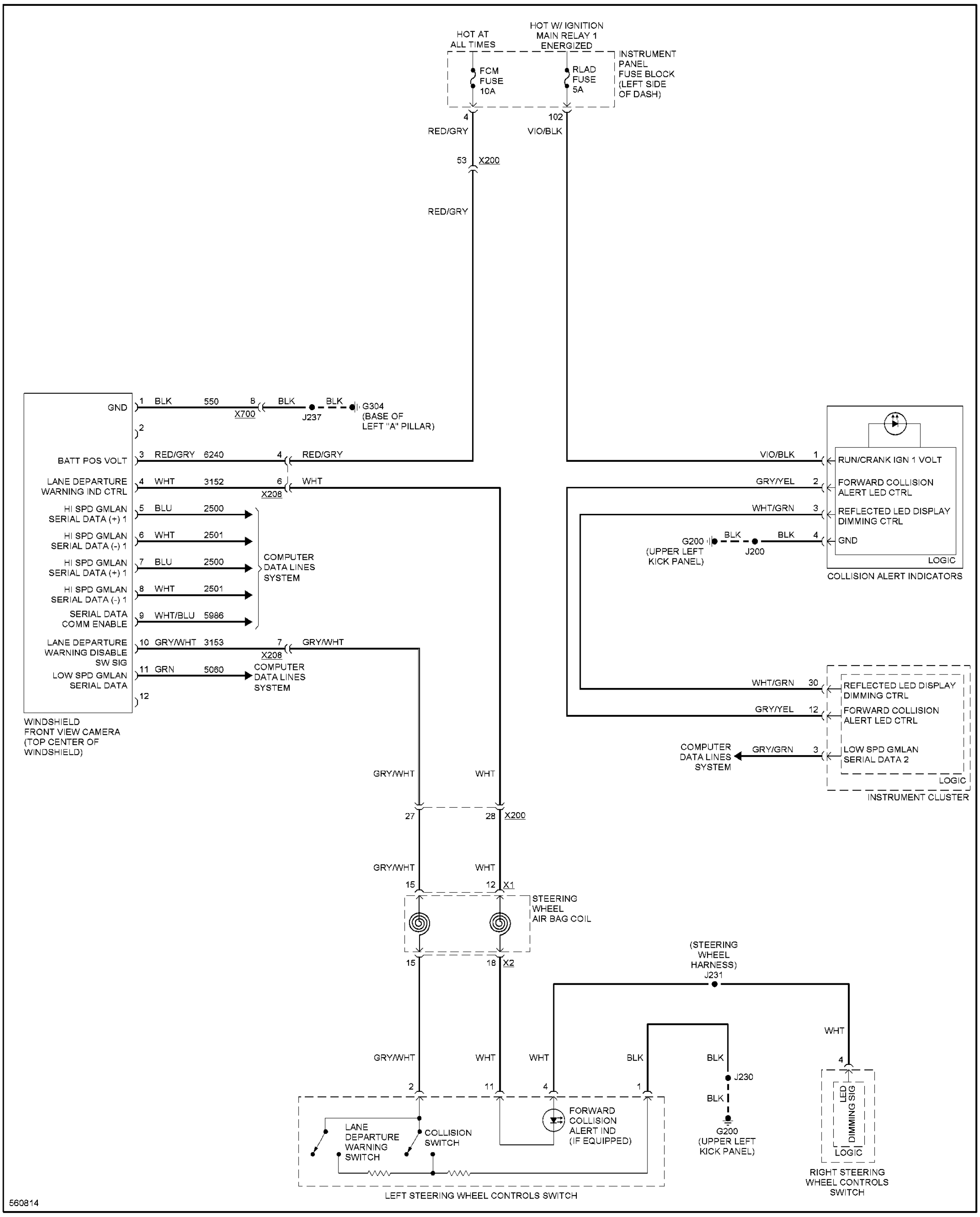
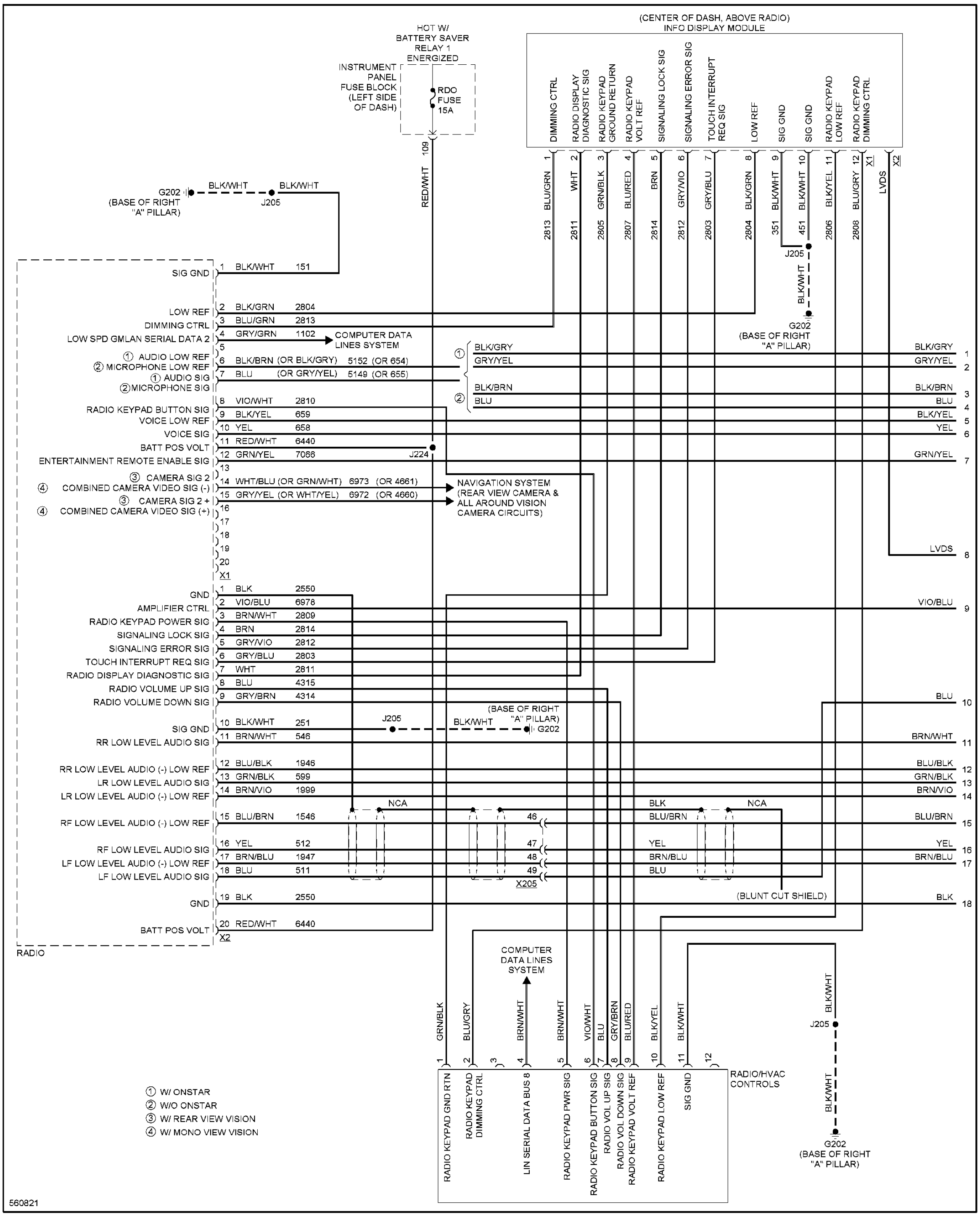

HOT AT ALL TIMES
HOT W/ IGNITION MAIN RELAY 1 ENERGIZED
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
FCM FUSE 10A
RLAD FUSE 5A
4
102
RED/GRY
VIO/BLK
53
X200
RED/GRY
GND
1 BLK 550
8
X700
BLK
J237
BLK
G304 (BASE OF LEFT "A" PILLAR)
2
BATT POS VOLT
3 RED/GRY 6240
4
RED/GRY
LANE DEPARTURE WARNING IND CTRL
4 WHT 3152
6
X208
WHT
HI SPD GMLAN SERIAL DATA (+) 1
5 BLU 2500
HI SPD GMLAN SERIAL DATA (-) 1
6 WHT 2501
HI SPD GMLAN SERIAL DATA (+) 1
7 BLU 2500
HI SPD GMLAN SERIAL DATA (-) 1
8 WHT 2501
SERIAL DATA COMM ENABLE
9 WHT/BLU 5986
COMPUTER DATA LINES SYSTEM
LANE DEPARTURE WARNING DISABLE SW SIG
10 GRY/WHT 3153
7
X208
GRY/WHT
LOW SPD GMLAN SERIAL DATA
11 GRN 5060
COMPUTER DATA LINES SYSTEM
12
WINDSHIELD FRONT VIEW CAMERA (TOP CENTER OF WINDSHIELD)
VIO/BLK
1
RUN/CRANK IGN 1 VOLT
GRY/YEL
2
FORWARD COLLISION ALERT LED CTRL
WHT/GRN
3
REFLECTED LED DISPLAY DIMMING CTRL
G200 (UPPER LEFT KICK PANEL)
BLK
J200
BLK
4
GND
LOGIC
COLLISION ALERT INDICATORS
WHT/GRN
30
REFLECTED LED DISPLAY DIMMING CTRL
GRY/YEL
12
FORWARD COLLISION ALERT LED CTRL
COMPUTER DATA LINES SYSTEM
GRY/GRN
3
LOW SPD GMLAN SERIAL DATA 2
LOGIC
INSTRUMENT CLUSTER
GRY/WHT
WHT
27
28
X200
GRY/WHT
WHT
15
12
X1
STEERING WHEEL AIR BAG COIL
15
18
X2
(STEERING WHEEL HARNESS) J231
WHT
GRY/WHT
WHT
WHT
BLK
BLK
J230
BLK
G200 (UPPER LEFT KICK PANEL)
4
2
11
4
1
LANE DEPARTURE WARNING SWITCH
COLLISION SWITCH
FORWARD COLLISION ALERT IND (IF EQUIPPED)
LEFT STEERING WHEEL CONTROLS SWITCH
LED DIMMING SIG
LOGIC
RIGHT STEERING WHEEL CONTROLS SWITCH
560814

Fig. 64: Lane Departure Warning Circuit



(CENTER OF DASH, ABOVE RADIO)
INFO DISPLAY MODULE
HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
RDO FUSE 15A
109
RED/WHT
DIMMING CTRL
RADIO DISPLAY DIAGNOSTIC SIG
RADIO KEYPAD GROUND RETURN
RADIO KEYPAD VOLT REF
SIGNALING LOCK SIG
SIGNALING ERROR SIG
TOUCH INTERRUPT REQ SIG
LOW REF
SIG GND
SIG GND
RADIO KEYPAD LOW REF
RADIO KEYPAD DIMMING CTRL
X1
X2
2813 BLU/GRN 1
2811 WHT 2
2805 GRN/BLK 3
2807 BLU/RED 4
2814 BRN 5
2812 GRY/VIO 6
2803 GRY/BLU 7
2804 BLK/GRN 8
351 BLK/WHT 9
451 BLK/WHT 10
2806 BLK/YEL 11
2808 BLU/GRY 12
LVDS
G202
(BASE OF RIGHT "A" PILLAR)
BLK/WHT
J205
SIG GND 1 BLK/WHT 151
LOW REF 2 BLK/GRN 2804
DIMMING CTRL 3 BLU/GRN 2813
LOW SPD GMLAN SERIAL DATA 2 4 GRY/GRN 1102
COMPUTER DATA LINES SYSTEM
5
① AUDIO LOW REF
② MICROPHONE LOW REF 6 BLK/BRN (OR BLK/GRY) 5152 (OR 654)
① AUDIO SIG
② MICROPHONE SIG 7 BLU (OR GRY/YEL) 5149 (OR 655)
RADIO KEYPAD BUTTON SIG 8 VIO/WHT 2810
VOICE LOW REF 9 BLK/YEL 659
VOICE SIG 10 YEL 658
BATT POS VOLT 11 RED/WHT 6440
ENTERTAINMENT REMOTE ENABLE SIG 12 GRN/YEL 7066
J224
13
③ CAMERA SIG 2 -
④ COMBINED CAMERA VIDEO SIG (-) 14 WHT/BLU (OR GRN/WHT) 6973 (OR 4661)
③ CAMERA SIG 2 +
④ COMBINED CAMERA VIDEO SIG (+) 15 GRY/YEL (OR WHT/YEL) 6972 (OR 4660)
NAVIGATION SYSTEM (REAR VIEW CAMERA & ALL AROUND VISION CAMERA CIRCUITS)
16
17
18
19
20
X1
① BLK/GRY
GRY/YEL
② BLK/BRN
BLU
BLK/GRY 1
GRY/YEL 2
BLK/BRN 3
BLU 4
BLK/YEL 5
YEL 6
GRN/YEL 7
LVDS 8
GND 1 BLK 2550
AMPLIFIER CTRL 2 VIO/BLU 6978
RADIO KEYPAD POWER SIG 3 BRN/WHT 2809
SIGNALING LOCK SIG 4 BRN 2814
SIGNALING ERROR SIG 5 GRY/VIO 2812
TOUCH INTERRUPT REQ SIG 6 GRY/BLU 2803
RADIO DISPLAY DIAGNOSTIC SIG 7 WHT 2811
RADIO VOLUME UP SIG 8 BLU 4315
RADIO VOLUME DOWN SIG 9 GRY/BRN 4314
SIG GND 10 BLK/WHT 251
RR LOW LEVEL AUDIO SIG 11 BRN/WHT 546
RR LOW LEVEL AUDIO (-) LOW REF 12 BLU/BLK 1946
LR LOW LEVEL AUDIO SIG 13 GRN/BLK 599
LR LOW LEVEL AUDIO (-) LOW REF 14 BRN/VIO 1999
RF LOW LEVEL AUDIO (-) LOW REF 15 BLU/BRN 1546
RF LOW LEVEL AUDIO SIG 16 YEL 512
LF LOW LEVEL AUDIO (-) LOW REF 17 BRN/BLU 1947
LF LOW LEVEL AUDIO SIG 18 BLU 511
GND 19 BLK 2550
BATT POS VOLT 20 RED/WHT 6440
X2
RADIO
J205
BLK/WHT
(BASE OF RIGHT "A" PILLAR)
G202
NCA
46
47
48
49
X205
BLK
BLU/BRN
YEL
BRN/BLU
BLU
NCA
(BLUNT CUT SHIELD)
VIO/BLU 9
BLU 10
BRN/WHT 11
BLU/BLK 12
GRN/BLK 13
BRN/VIO 14
BLU/BRN 15
YEL 16
BRN/BLU 17
BLK 18
COMPUTER DATA LINES SYSTEM
GRN/BLK 1
BLU/GRY 2
3
BRN/WHT 4
BRN/WHT 5
VIO/WHT 6
BLU 7
GRY/BRN 8
BLU/RED 9
BLK/YEL 10
BLK/WHT 11
12
RADIO/HVAC CONTROLS
RADIO KEYPAD GND RTN
RADIO KEYPAD DIMMING CTRL
LIN SERIAL DATA BUS 8
RADIO KEYPAD PWR SIG
RADIO KEYPAD BUTTON SIG
RADIO VOL UP SIG
RADIO VOL DOWN SIG
RADIO KEYPAD VOLT REF
RADIO KEYPAD LOW REF
SIG GND
BLK/WHT
J205
BLK/WHT
G202
(BASE OF RIGHT "A" PILLAR)
① W/ ONSTAR
② W/O ONSTAR
③ W/ REAR VIEW VISION
④ W/ MONO VIEW VISION
560821

Fig. 65: Navigation Circuit, W/ Amplifier (1 of 4)

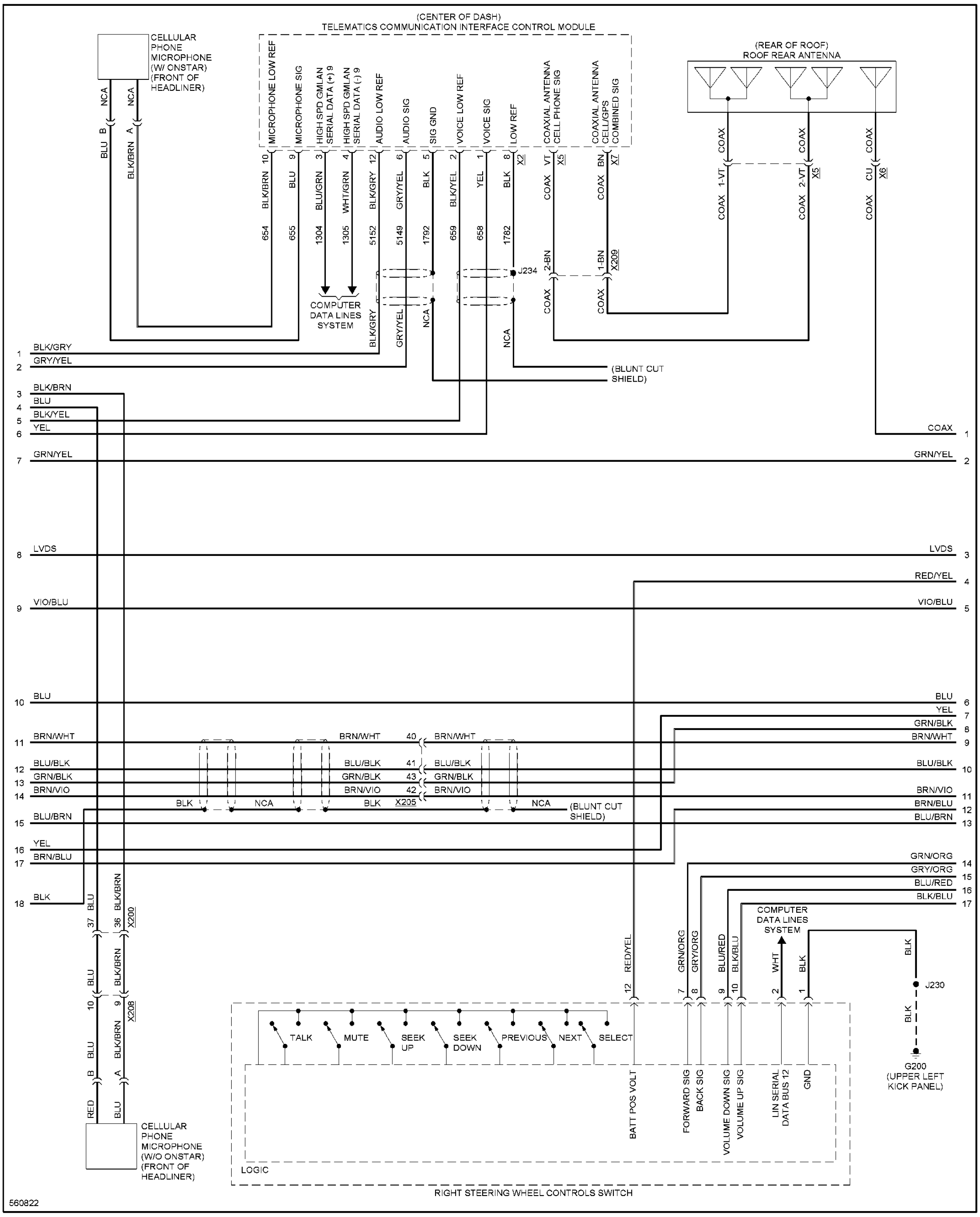

(CENTER OF DASH)
TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE
CELLULAR PHONE MICROPHONE (W/ ONSTAR) (FRONT OF HEADLINER)
NCA
BLU
BLK/BRN
MICROPHONE LOW REF
MICROPHONE SIG
HIGH SPD GMLAN SERIAL DATA (+) 9
HIGH SPD GMLAN SERIAL DATA (-) 9
AUDIO LOW REF
AUDIO SIG
SIG GND
VOICE LOW REF
VOICE SIG
LOW REF
COAXIAL ANTENNA CELL PHONE SIG
COAXIAL ANTENNA CELL/GPS COMBINED SIG
X2
X5
X7
(REAR OF ROOF)
ROOF REAR ANTENNA
COAX
1-VT
2-VT
CU
X6
654
655
1304
1305
5152
5149
1792
659
658
1782
J234
2-BN
1-BN
X209
COMPUTER DATA LINES SYSTEM
(BLUNT CUT SHIELD)
BLK/GRY
GRY/YEL
BLU/GRN
WHT/GRN
BLK/YEL
YEL
BLK
GRN/YEL
LVDS
RED/YEL
VIO/BLU
BRN/WHT
BLU/BLK
GRN/BLK
BRN/VIO
BLU/BRN
BRN/BLU
GRN/ORG
GRY/ORG
BLU/RED
BLK/BLU
X205
X200
X208
J230
G200 (UPPER LEFT KICK PANEL)
TALK
MUTE
SEEK UP
SEEK DOWN
PREVIOUS
NEXT
SELECT
BATT POS VOLT
FORWARD SIG
BACK SIG
VOLUME DOWN SIG
VOLUME UP SIG
LIN SERIAL DATA BUS 12
GND
WHT
LOGIC
RIGHT STEERING WHEEL CONTROLS SWITCH
RED
CELLULAR PHONE MICROPHONE (W/O ONSTAR) (FRONT OF HEADLINER)
560822

Fig. 66: Navigation Circuit, W/ Amplifier (2 of 4)

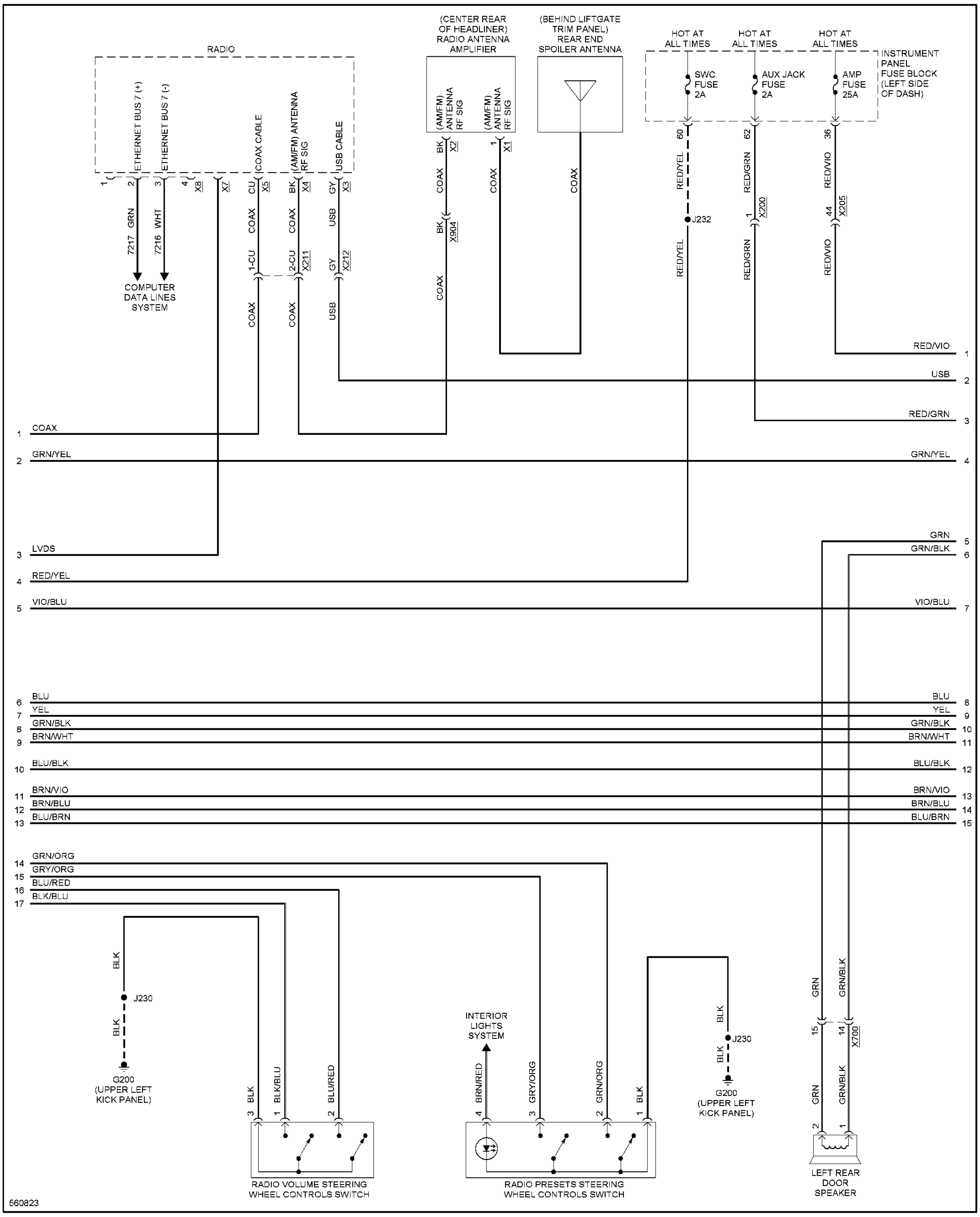

RADIO
ETHERNET BUS 7 (+)
ETHERNET BUS 7 (-)
COAX CABLE
(AM/FM) ANTENNA RF SIG
USB CABLE
1
2
3
4
X8
X7
CU
X5
BK
X4
GY
X3
7217 GRN
7216 WHT
COMPUTER DATA LINES SYSTEM
COAX
1-CU
2-CU
X211
USB
GY
X212
(CENTER REAR OF HEADLINER) RADIO ANTENNA AMPLIFIER
(AM/FM) ANTENNA RF SIG
BK
X2
1
X1
X904
(BEHIND LIFTGATE TRIM PANEL) REAR END SPOILER ANTENNA
HOT AT ALL TIMES
SWC FUSE 2A
AUX JACK FUSE 2A
AMP FUSE 25A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
60
RED/YEL
J232
62
RED/GRN
X200
36
RED/VIO
44
X205
RED/VIO 1
USB 2
RED/GRN 3
GRN/YEL 4
GRN 5
GRN/BLK 6
VIO/BLU 7
BLU 8
YEL 9
GRN/BLK 10
BRN/WHT 11
BLU/BLK 12
BRN/VIO 13
BRN/BLU 14
BLU/BRN 15
1 COAX
2 GRN/YEL
3 LVDS
4 RED/YEL
5 VIO/BLU
6 BLU
7 YEL
8 GRN/BLK
9 BRN/WHT
10 BLU/BLK
11 BRN/VIO
12 BRN/BLU
13 BLU/BRN
14 GRN/ORG
15 GRY/ORG
16 BLU/RED
17 BLK/BLU
BLK
J230
G200 (UPPER LEFT KICK PANEL)
3 BLK
1 BLK/BLU
2 BLU/RED
RADIO VOLUME STEERING WHEEL CONTROLS SWITCH
INTERIOR LIGHTS SYSTEM
4 BRN/RED
3 GRY/ORG
2 GRN/ORG
1 BLK
RADIO PRESETS STEERING WHEEL CONTROLS SWITCH
GRN
GRN/BLK
15
14
X700
2
1
LEFT REAR DOOR SPEAKER
560823

Fig. 67: Navigation Circuit, W/ Amplifier (3 of 4)

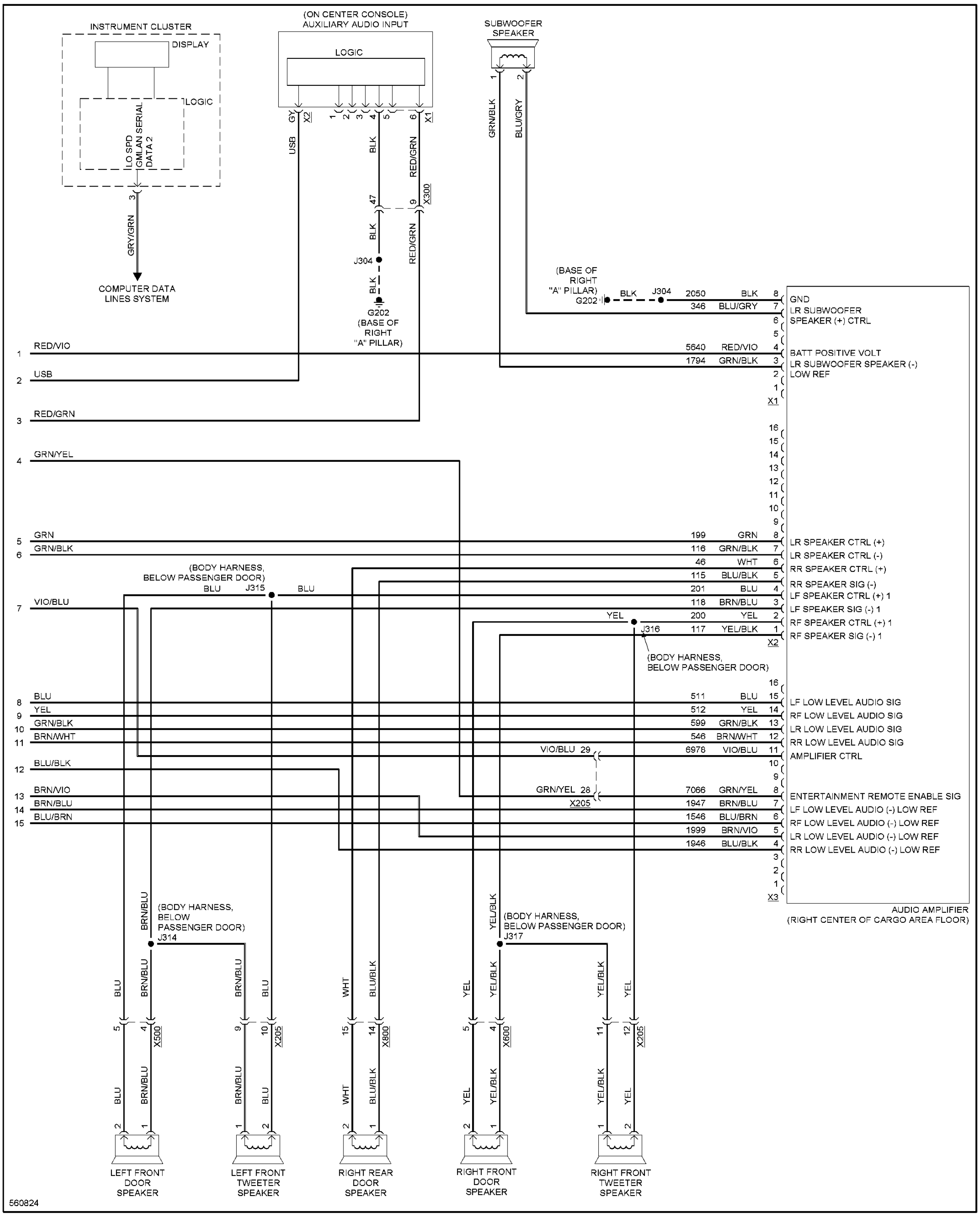

INSTRUMENT CLUSTER
DISPLAY
LOGIC
LO SPD GMLAN SERIAL DATA 2
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
(ON CENTER CONSOLE) AUXILIARY AUDIO INPUT
LOGIC
GY X2
1 2 3 4 5 6 X1
USB
BLK
RED/GRN
47
9 X300
J304
G202 (BASE OF RIGHT "A" PILLAR)
SUBWOOFER SPEAKER
GRN/BLK
BLU/GRY
(BASE OF RIGHT "A" PILLAR) G202
BLK J304
2050 BLK 8 GND
346 BLU/GRY 7 LR SUBWOOFER SPEAKER (+) CTRL
6
5
5640 RED/VIO 4 BATT POSITIVE VOLT
1794 GRN/BLK 3 LR SUBWOOFER SPEAKER (-)
2 LOW REF
1
X1
1 RED/VIO
2 USB
3 RED/GRN
4 GRN/YEL
5 GRN
6 GRN/BLK
7 VIO/BLU
8 BLU
9 YEL
10 GRN/BLK
11 BRN/WHT
12 BLU/BLK
13 BRN/VIO
14 BRN/BLU
15 BLU/BRN
16 15 14 13 12 11 10 9
199 GRN 8 LR SPEAKER CTRL (+)
116 GRN/BLK 7 LR SPEAKER CTRL (-)
46 WHT 6 RR SPEAKER CTRL (+)
115 BLU/BLK 5 RR SPEAKER SIG (-)
201 BLU 4 LF SPEAKER CTRL (+) 1
118 BRN/BLU 3 LF SPEAKER SIG (-) 1
200 YEL 2 RF SPEAKER CTRL (+) 1
117 YEL/BLK 1 RF SPEAKER SIG (-) 1
X2
(BODY HARNESS, BELOW PASSENGER DOOR) BLU J315 BLU
YEL J316
(BODY HARNESS, BELOW PASSENGER DOOR)
16
511 BLU 15 LF LOW LEVEL AUDIO SIG
512 YEL 14 RF LOW LEVEL AUDIO SIG
599 GRN/BLK 13 LR LOW LEVEL AUDIO SIG
546 BRN/WHT 12 RR LOW LEVEL AUDIO SIG
VIO/BLU 29 6976 VIO/BLU 11 AMPLIFIER CTRL
10
9
GRN/YEL 28 X205 7066 GRN/YEL 8 ENTERTAINMENT REMOTE ENABLE SIG
1947 BRN/BLU 7 LF LOW LEVEL AUDIO (-) LOW REF
1546 BLU/BRN 6 RF LOW LEVEL AUDIO (-) LOW REF
1999 BRN/VIO 5 LR LOW LEVEL AUDIO (-) LOW REF
1946 BLU/BLK 4 RR LOW LEVEL AUDIO (-) LOW REF
3 2 1
X3
AUDIO AMPLIFIER (RIGHT CENTER OF CARGO AREA FLOOR)
BRN/BLU
(BODY HARNESS, BELOW PASSENGER DOOR) J314
YEL/BLK
(BODY HARNESS, BELOW PASSENGER DOOR) J317
BLU BRN/BLU BRN/BLU BLU WHT BLU/BLK YEL YEL/BLK YEL/BLK YEL
5 4 X500
9 10 X205
15 14 X800
5 4 X600
11 12 X205
BLU BRN/BLU BRN/BLU BLU WHT BLU/BLK YEL YEL/BLK YEL/BLK YEL
2 1 1 2 2 1 2 1 1 2
LEFT FRONT DOOR SPEAKER
LEFT FRONT TWEETER SPEAKER
RIGHT REAR DOOR SPEAKER
RIGHT FRONT DOOR SPEAKER
RIGHT FRONT TWEETER SPEAKER
560824

Fig. 68: Navigation Circuit, W/ Amplifier (4 of 4)

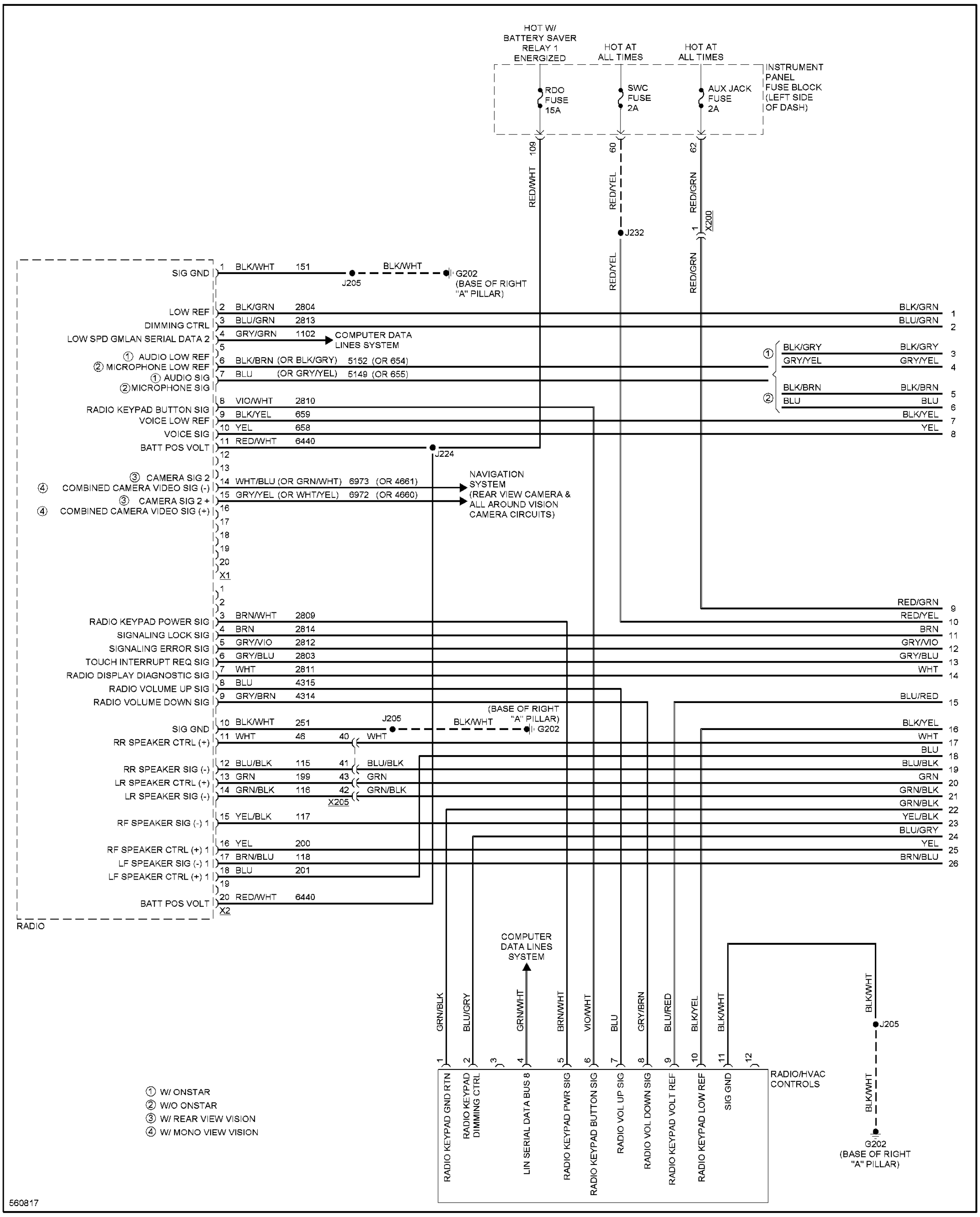

HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
HOT AT ALL TIMES
HOT AT ALL TIMES
RDO FUSE 15A
SWC FUSE 2A
AUX JACK FUSE 2A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
109 RED/WHT
60 RED/YEL
62 RED/GRN
J232
X200
RED/YEL
RED/GRN
SIG GND
LOW REF
DIMMING CTRL
LOW SPD GMLAN SERIAL DATA 2
① AUDIO LOW REF
② MICROPHONE LOW REF
① AUDIO SIG
② MICROPHONE SIG
RADIO KEYPAD BUTTON SIG
VOICE LOW REF
VOICE SIG
BATT POS VOLT
③ CAMERA SIG 2 -
④ COMBINED CAMERA VIDEO SIG (-)
③ CAMERA SIG 2 +
④ COMBINED CAMERA VIDEO SIG (+)
1 BLK/WHT 151
BLK/WHT
J205
G202 (BASE OF RIGHT "A" PILLAR)
2 BLK/GRN 2804
3 BLU/GRN 2813
4 GRY/GRN 1102
COMPUTER DATA LINES SYSTEM
5
6 BLK/BRN (OR BLK/GRY) 5152 (OR 654)
7 BLU (OR GRY/YEL) 5149 (OR 655)
8 VIO/WHT 2810
9 BLK/YEL 659
10 YEL 658
11 RED/WHT 6440
J224
12
13
14 WHT/BLU (OR GRN/WHT) 6973 (OR 4661)
15 GRY/YEL (OR WHT/YEL) 6972 (OR 4660)
NAVIGATION SYSTEM (REAR VIEW CAMERA & ALL AROUND VISION CAMERA CIRCUITS)
16
17
18
19
20
X1
BLK/GRN 1
BLU/GRN 2
① BLK/GRY BLK/GRY 3
GRY/YEL GRY/YEL 4
② BLK/BRN BLK/BRN 5
BLU BLU 6
BLK/YEL 7
YEL 8
1
2
RADIO KEYPAD POWER SIG
SIGNALING LOCK SIG
SIGNALING ERROR SIG
TOUCH INTERRUPT REQ SIG
RADIO DISPLAY DIAGNOSTIC SIG
RADIO VOLUME UP SIG
RADIO VOLUME DOWN SIG
SIG GND
RR SPEAKER CTRL (+)
RR SPEAKER SIG (-)
LR SPEAKER CTRL (+)
LR SPEAKER SIG (-)
RF SPEAKER SIG (-) 1
RF SPEAKER CTRL (+) 1
LF SPEAKER SIG (-) 1
LF SPEAKER CTRL (+) 1
BATT POS VOLT
RADIO
3 BRN/WHT 2809
4 BRN 2814
5 GRY/VIO 2812
6 GRY/BLU 2803
7 WHT 2811
8 BLU 4315
9 GRY/BRN 4314
10 BLK/WHT 251
J205
BLK/WHT
(BASE OF RIGHT "A" PILLAR) G202
11 WHT 46 40 WHT
12 BLU/BLK 115 41 BLU/BLK
13 GRN 199 43 GRN
14 GRN/BLK 116 42 GRN/BLK
X205
15 YEL/BLK 117
16 YEL 200
17 BRN/BLU 118
18 BLU 201
19
20 RED/WHT 6440
X2
RED/GRN 9
RED/YEL 10
BRN 11
GRY/VIO 12
GRY/BLU 13
WHT 14
BLU/RED 15
BLK/YEL 16
WHT 17
BLU 18
BLU/BLK 19
GRN 20
GRN/BLK 21
GRN/BLK 22
YEL/BLK 23
BLU/GRY 24
YEL 25
BRN/BLU 26
COMPUTER DATA LINES SYSTEM
GRN/BLK
BLU/GRY
GRN/WHT
BRN/WHT
VIO/WHT
BLU
GRY/BRN
BLU/RED
BLK/YEL
BLK/WHT
BLK/WHT
J205
BLK/WHT
G202 (BASE OF RIGHT "A" PILLAR)
1 2 3 4 5 6 7 8 9 10 11 12
RADIO KEYPAD GND RTN
RADIO KEYPAD DIMMING CTRL
LIN SERIAL DATA BUS 8
RADIO KEYPAD PWR SIG
RADIO KEYPAD BUTTON SIG
RADIO VOL UP SIG
RADIO VOL DOWN SIG
RADIO KEYPAD VOLT REF
RADIO KEYPAD LOW REF
SIG GND
RADIO/HVAC CONTROLS
① W/ ONSTAR
② W/O ONSTAR
③ W/ REAR VIEW VISION
④ W/ MONO VIEW VISION
560817

Fig. 69: Navigation Circuit, W/O Amplifier (1 of 4)

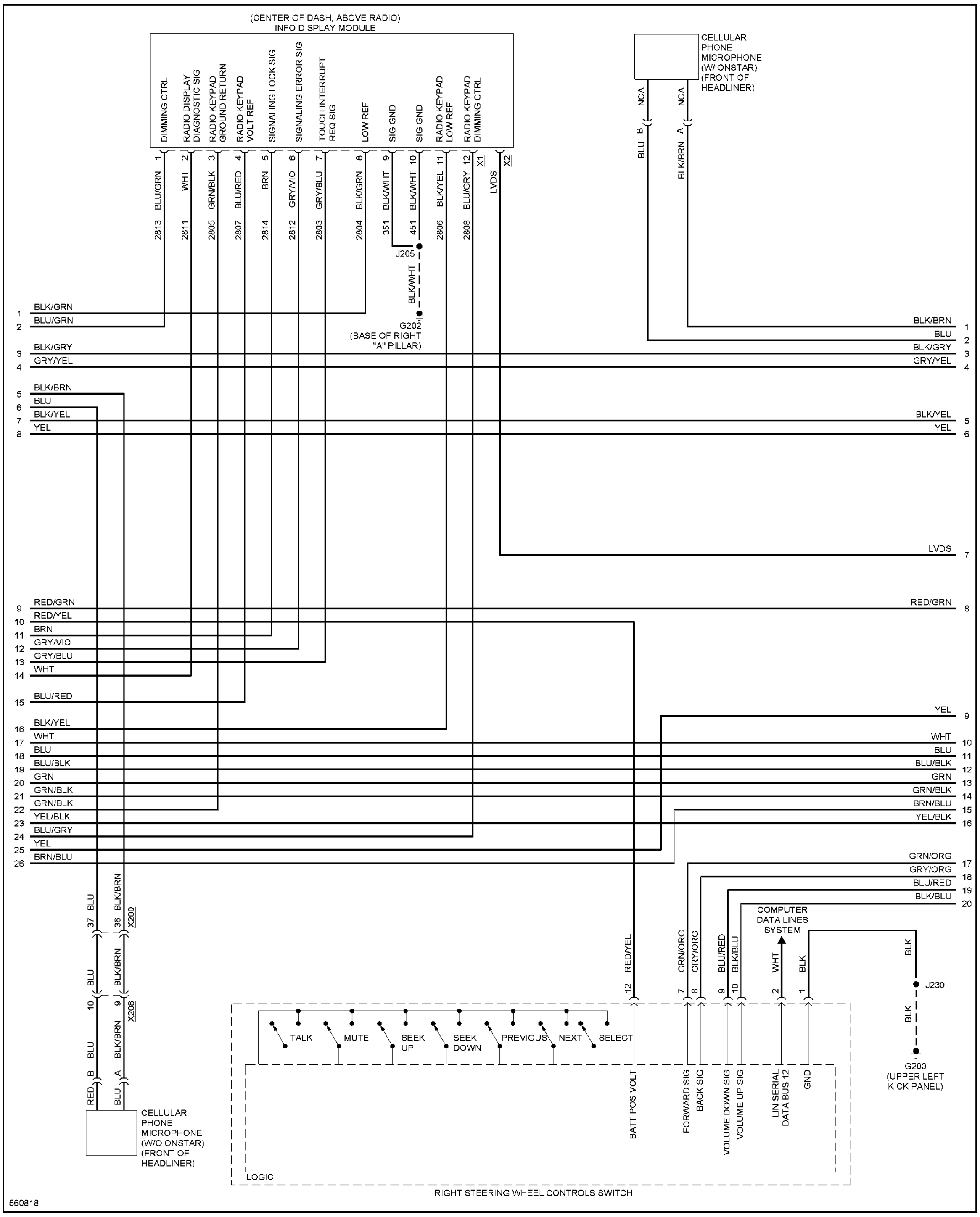

(CENTER OF DASH, ABOVE RADIO)
INFO DISPLAY MODULE
DIMMING CTRL
RADIO DISPLAY DIAGNOSTIC SIG
RADIO KEYPAD GROUND RETURN
RADIO KEYPAD VOLT REF
SIGNALING LOCK SIG
SIGNALING ERROR SIG
TOUCH INTERRUPT REQ SIG
LOW REF
SIG GND
SIG GND
RADIO KEYPAD LOW REF
RADIO KEYPAD DIMMING CTRL
1 BLU/GRN 2813
2 WHT 2811
3 GRN/BLK 2805
4 BLU/RED 2807
5 BRN 2814
6 GRY/VIO 2812
7 GRY/BLU 2803
8 BLK/GRN 2804
9 BLK/WHT 351
10 BLK/WHT 451
11 BLK/YEL 2806
12 BLU/GRY 2808
X1
LVDS
X2
J205
BLK/WHT
G202
(BASE OF RIGHT "A" PILLAR)
CELLULAR PHONE MICROPHONE (W/ ONSTAR) (FRONT OF HEADLINER)
NCA
NCA
B
A
BLU
BLK/BRN
1 BLK/GRN
2 BLU/GRN
3 BLK/GRY
4 GRY/YEL
5 BLK/BRN
6 BLU
7 BLK/YEL
8 YEL
9 RED/GRN
10 RED/YEL
11 BRN
12 GRY/VIO
13 GRY/BLU
14 WHT
15 BLU/RED
16 BLK/YEL
17 WHT
18 BLU
19 BLU/BLK
20 GRN
21 GRN/BLK
22 GRN/BLK
23 YEL/BLK
24 BLU/GRY
25 YEL
26 BRN/BLU
BLK/BRN 1
BLU 2
BLK/GRY 3
GRY/YEL 4
BLK/YEL 5
YEL 6
LVDS 7
RED/GRN 8
YEL 9
WHT 10
BLU 11
BLU/BLK 12
GRN 13
GRN/BLK 14
BRN/BLU 15
YEL/BLK 16
GRN/ORG 17
GRY/ORG 18
BLU/RED 19
BLK/BLU 20
37 BLU
36 BLK/BRN
X200
10 BLU
9 BLK/BRN
X208
B BLU
A BLK/BRN
RED
BLU
CELLULAR PHONE MICROPHONE (W/O ONSTAR) (FRONT OF HEADLINER)
12 RED/YEL
7 GRN/ORG
8 GRY/ORG
9 BLU/RED
10 BLK/BLU
2 WHT
1 BLK
COMPUTER DATA LINES SYSTEM
BLK
J230
BLK
G200
(UPPER LEFT KICK PANEL)
TALK
MUTE
SEEK UP
SEEK DOWN
PREVIOUS
NEXT
SELECT
BATT POS VOLT
FORWARD SIG
BACK SIG
VOLUME DOWN SIG
VOLUME UP SIG
LIN SERIAL DATA BUS 12
GND
LOGIC
RIGHT STEERING WHEEL CONTROLS SWITCH
560818

Fig. 70: Navigation Circuit, W/O Amplifier (2 of 4)

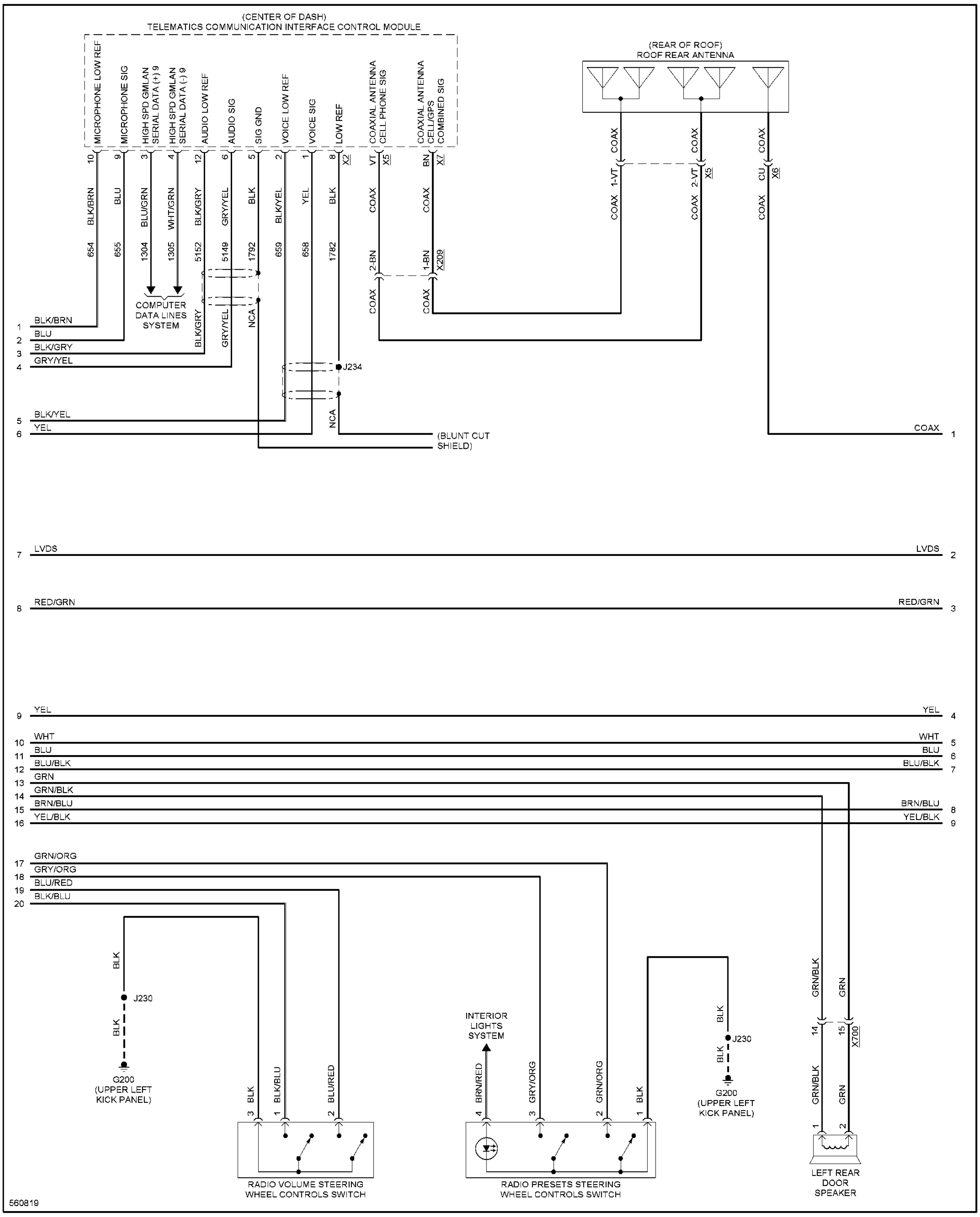

(CENTER OF DASH)
TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE
MICROPHONE LOW REF
MICROPHONE SIG
HIGH SPD GMLAN SERIAL DATA (+) 9
HIGH SPD GMLAN SERIAL DATA (-) 9
AUDIO LOW REF
AUDIO SIG
SIG GND
VOICE LOW REF
VOICE SIG
LOW REF
COAXIAL ANTENNA CELL PHONE SIG
COAXIAL ANTENNA CELL/GPS COMBINED SIG
10 9 3 4 12 6 5 2 1 8 X2
VT X5
BN X7
BLK/BRN 654
BLU 655
BLU/GRN 1304
WHT/GRN 1305
BLK/GRY 5152
GRY/YEL 5149
BLK 1792
BLK/YEL 659
YEL 658
BLK 1782
COAX
2-BN
1-BN X209
COMPUTER DATA LINES SYSTEM
NCA
J234
(REAR OF ROOF)
ROOF REAR ANTENNA
COAX
1-VT
2-VT X5
CU X6
1 BLK/BRN
2 BLU
3 BLK/GRY
4 GRY/YEL
5 BLK/YEL
6 YEL
(BLUNT CUT SHIELD)
COAX 1
7 LVDS
LVDS 2
8 RED/GRN
RED/GRN 3
9 YEL
YEL 4
10 WHT
WHT 5
11 BLU
BLU 6
12 BLU/BLK
BLU/BLK 7
13 GRN
14 GRN/BLK
15 BRN/BLU
BRN/BLU 8
16 YEL/BLK
YEL/BLK 9
17 GRN/ORG
18 GRY/ORG
19 BLU/RED
20 BLK/BLU
BLK
J230
G200 (UPPER LEFT KICK PANEL)
3 BLK
1 BLK/BLU
2 BLU/RED
RADIO VOLUME STEERING WHEEL CONTROLS SWITCH
INTERIOR LIGHTS SYSTEM
4 BRN/RED
3 GRY/ORG
2 GRN/ORG
1 BLK
RADIO PRESETS STEERING WHEEL CONTROLS SWITCH
GRN/BLK 14
GRN 15
X700
1 GRN/BLK
2 GRN
LEFT REAR DOOR SPEAKER
560819

Fig. 71: Navigation Circuit, W/O Amplifier (3 of 4)

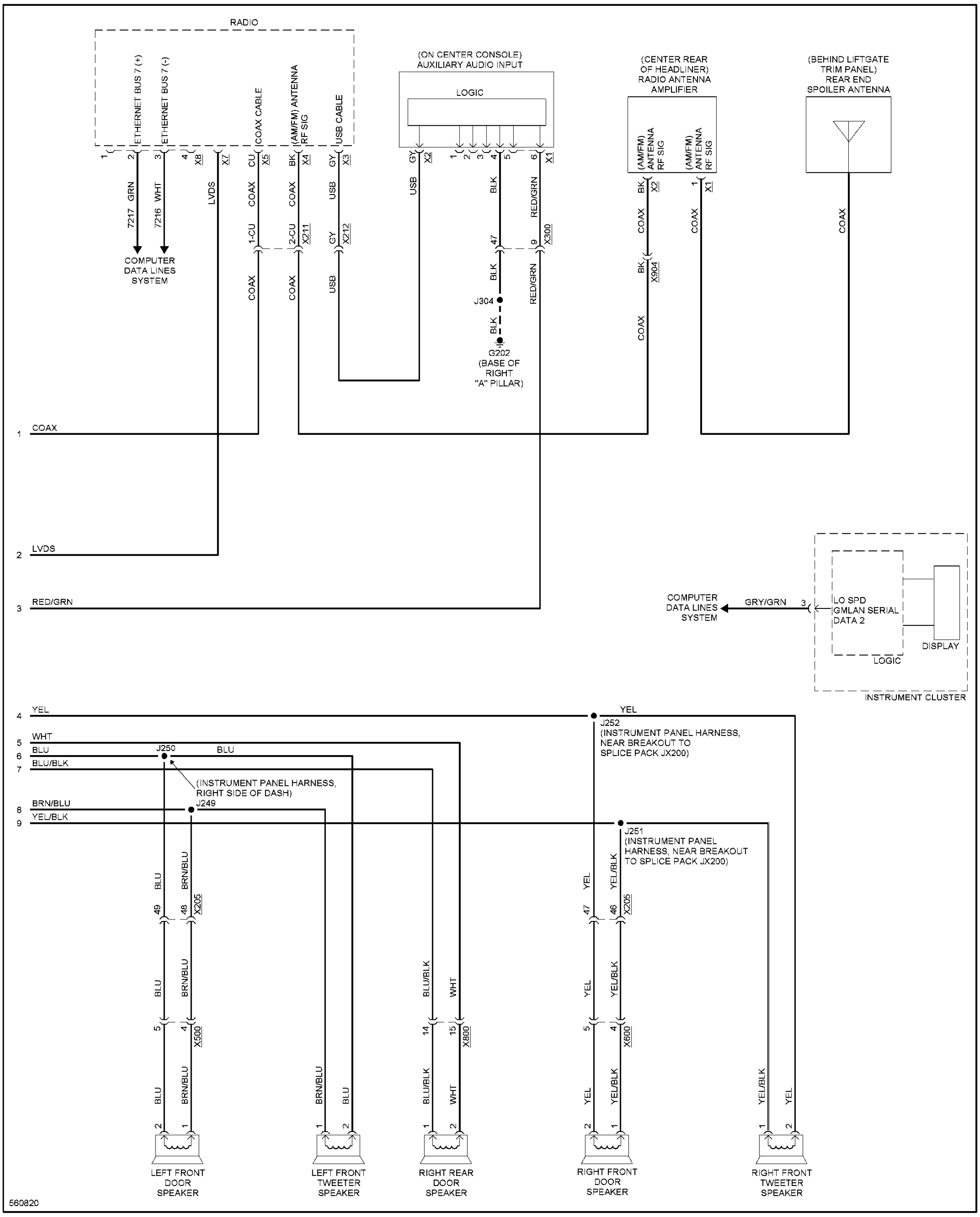

RADIO
ETHERNET BUS 7 (+)
ETHERNET BUS 7 (-)
COAX CABLE
(AM/FM) ANTENNA RF SIG
USB CABLE
1
2
3
4
X8
X7
CU
X5
BK
X4
GY
X3
7217 GRN
7216 WHT
LVDS
COAX
COAX
USB
COMPUTER DATA LINES SYSTEM
1-CU
2-CU
X211
GY
X212
COAX
COAX
USB
(ON CENTER CONSOLE) AUXILIARY AUDIO INPUT
LOGIC
GY
X2
1
2
3
4
5
6
X1
USB
BLK
RED/GRN
47
9
X300
BLK
RED/GRN
J304
BLK
G202 (BASE OF RIGHT "A" PILLAR)
(CENTER REAR OF HEADLINER) RADIO ANTENNA AMPLIFIER
(AM/FM) ANTENNA RF SIG
(AM/FM) ANTENNA RF SIG
BK
X2
1
X1
COAX
COAX
BK
X904
COAX
(BEHIND LIFTGATE TRIM PANEL) REAR END SPOILER ANTENNA
COAX
1
COAX
2
LVDS
3
RED/GRN
COMPUTER DATA LINES SYSTEM
GRY/GRN
3
LO SPD GMLAN SERIAL DATA 2
LOGIC
DISPLAY
INSTRUMENT CLUSTER
4
YEL
YEL
J252 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO SPLICE PACK JX200)
5
WHT
6
BLU
J250
BLU
7
BLU/BLK
(INSTRUMENT PANEL HARNESS, RIGHT SIDE OF DASH)
J249
8
BRN/BLU
9
YEL/BLK
J251 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO SPLICE PACK JX200)
BLU
BRN/BLU
49
48
X205
BLU
BRN/BLU
5
4
X500
BLU
BRN/BLU
2
1
LEFT FRONT DOOR SPEAKER
BRN/BLU
BLU
1
2
LEFT FRONT TWEETER SPEAKER
BLU/BLK
WHT
14
15
X800
BLU/BLK
WHT
1
2
RIGHT REAR DOOR SPEAKER
YEL
YEL/BLK
47
46
X205
YEL
YEL/BLK
5
4
X600
YEL
YEL/BLK
2
1
RIGHT FRONT DOOR SPEAKER
YEL/BLK
YEL
1
2
RIGHT FRONT TWEETER SPEAKER
560820

Fig. 72: Navigation Circuit, W/O Amplifier (4 of 4)

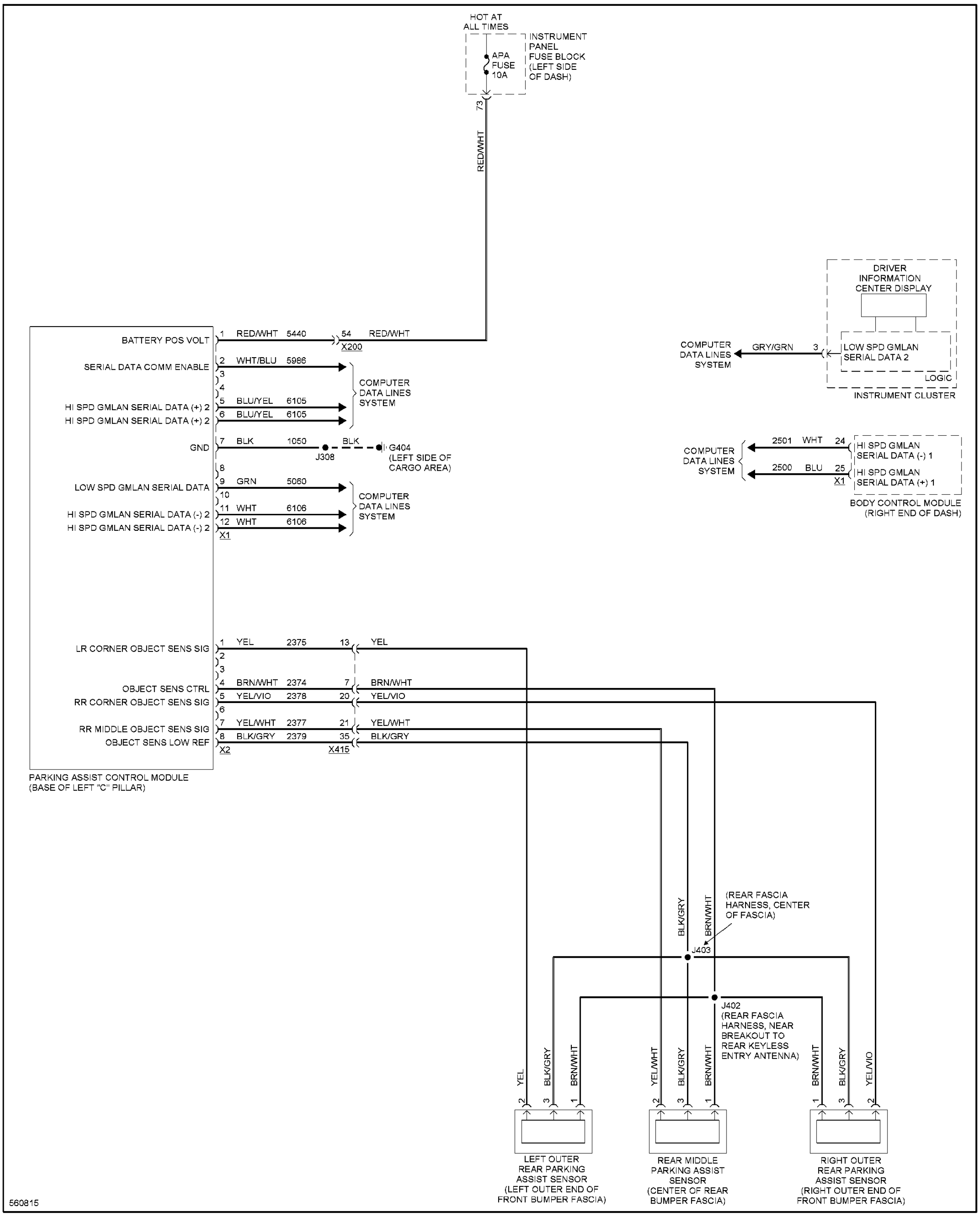

HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
APA FUSE 10A
73
RED/WHT
DRIVER INFORMATION CENTER DISPLAY
LOW SPD GMLAN SERIAL DATA 2
LOGIC
INSTRUMENT CLUSTER
COMPUTER DATA LINES SYSTEM
GRY/GRN
3
BATTERY POS VOLT
1 RED/WHT 5440
54 RED/WHT
X200
SERIAL DATA COMM ENABLE
2 WHT/BLU 5986
3
4
HI SPD GMLAN SERIAL DATA (+) 2
5 BLU/YEL 6105
HI SPD GMLAN SERIAL DATA (+) 2
6 BLU/YEL 6105
COMPUTER DATA LINES SYSTEM
GND
7 BLK 1050
BLK
J308
G404 (LEFT SIDE OF CARGO AREA)
8
LOW SPD GMLAN SERIAL DATA
9 GRN 5060
10
HI SPD GMLAN SERIAL DATA (-) 2
11 WHT 6106
HI SPD GMLAN SERIAL DATA (-) 2
12 WHT 6106
X1
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
2501 WHT 24
HI SPD GMLAN SERIAL DATA (-) 1
2500 BLU 25
HI SPD GMLAN SERIAL DATA (+) 1
X1
BODY CONTROL MODULE (RIGHT END OF DASH)
LR CORNER OBJECT SENS SIG
1 YEL 2375
13 YEL
2
3
OBJECT SENS CTRL
4 BRN/WHT 2374
7 BRN/WHT
RR CORNER OBJECT SENS SIG
5 YEL/VIO 2378
20 YEL/VIO
6
RR MIDDLE OBJECT SENS SIG
7 YEL/WHT 2377
21 YEL/WHT
OBJECT SENS LOW REF
8 BLK/GRY 2379
35 BLK/GRY
X2
X415
PARKING ASSIST CONTROL MODULE (BASE OF LEFT "C" PILLAR)
BLK/GRY
BRN/WHT
(REAR FASCIA HARNESS, CENTER OF FASCIA)
J403
J402 (REAR FASCIA HARNESS, NEAR BREAKOUT TO REAR KEYLESS ENTRY ANTENNA)
YEL
BLK/GRY
BRN/WHT
YEL/WHT
BLK/GRY
BRN/WHT
BRN/WHT
BLK/GRY
YEL/VIO
2
3
1
2
3
1
1
3
2
LEFT OUTER REAR PARKING ASSIST SENSOR (LEFT OUTER END OF FRONT BUMPER FASCIA)
REAR MIDDLE PARKING ASSIST SENSOR (CENTER OF REAR BUMPER FASCIA)
RIGHT OUTER REAR PARKING ASSIST SENSOR (RIGHT OUTER END OF FRONT BUMPER FASCIA)
560815

Fig. 73: Parking Assistant Circuit

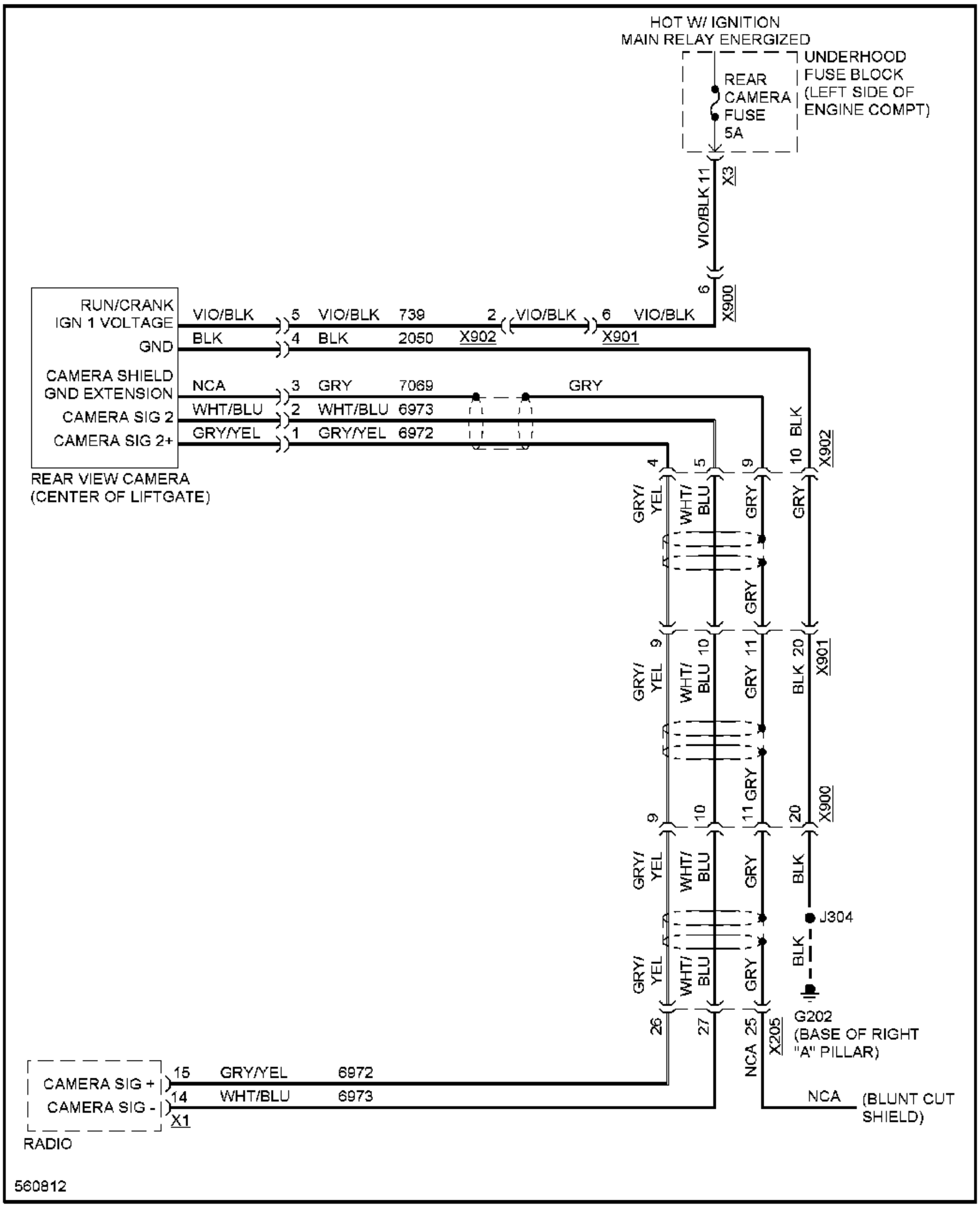

HOT W/ IGNITION
MAIN RELAY ENERGIZED
REAR CAMERA FUSE 5A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
X3
VIO/BLK 11
6
X900
RUN/CRANK IGN 1 VOLTAGE
GND
CAMERA SHIELD GND EXTENSION
CAMERA SIG 2
CAMERA SIG 2+
REAR VIEW CAMERA (CENTER OF LIFTGATE)
VIO/BLK
BLK
NCA
WHT/BLU
GRY/YEL
5 VIO/BLK 739
4 BLK 2050
3 GRY 7069
2 WHT/BLU 6973
1 GRY/YEL 6972
X902
2 VIO/BLK
6 VIO/BLK
X901
GRY
10 BLK
X902
4 5 9
GRY/YEL
WHT/BLU
GRY
GRY
GRY
9 10 11 20
X901
GRY/YEL
WHT/BLU
GRY
BLK
9 10 11 GRY 20
X900
GRY/YEL
WHT/BLU
GRY
BLK
J304
BLK
G202 (BASE OF RIGHT "A" PILLAR)
26 27 25
NCA
X205
CAMERA SIG +
CAMERA SIG -
RADIO
15 GRY/YEL 6972
14 WHT/BLU 6973
X1
NCA
(BLUNT CUT SHIELD)
560812

Fig. 74: Rear View Camera Circuit

POWER DISTRIBUTION

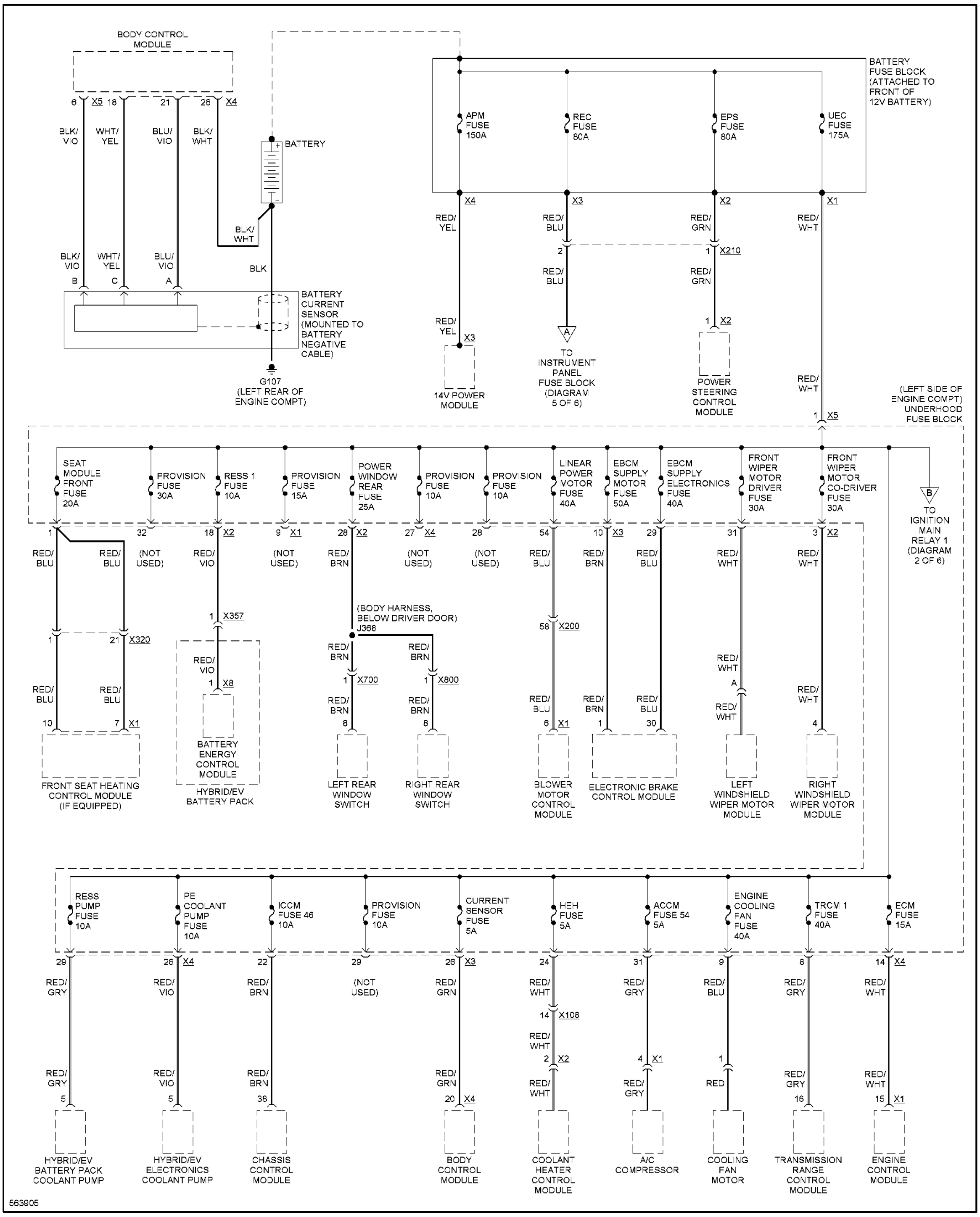

BODY CONTROL MODULE
6 X5 18
21 26 X4
BLK/ VIO
WHT/ YEL
BLU/ VIO
BLK/ WHT
BATTERY
BLK/ WHT
BLK
BATTERY CURRENT SENSOR (MOUNTED TO BATTERY NEGATIVE CABLE)
B C A
G107 (LEFT REAR OF ENGINE COMPT)
BATTERY FUSE BLOCK (ATTACHED TO FRONT OF 12V BATTERY)
APM FUSE 150A
REC FUSE 80A
EPS FUSE 80A
UEC FUSE 175A
X4 X3 X2 X1
RED/ YEL
RED/ BLU
RED/ GRN
RED/ WHT
X210
X3
14V POWER MODULE
TO INSTRUMENT PANEL FUSE BLOCK (DIAGRAM 5 OF 6)
X2
POWER STEERING CONTROL MODULE
X5
(LEFT SIDE OF ENGINE COMPT) UNDERHOOD FUSE BLOCK
SEAT MODULE FRONT FUSE 20A
PROVISION FUSE 30A
RESS 1 FUSE 10A
PROVISION FUSE 15A
POWER WINDOW REAR FUSE 25A
PROVISION FUSE 10A
PROVISION FUSE 10A
LINEAR POWER MOTOR FUSE 40A
EBCM SUPPLY MOTOR FUSE 50A
EBCM SUPPLY ELECTRONICS FUSE 40A
FRONT WIPER MOTOR DRIVER FUSE 30A
FRONT WIPER MOTOR CO-DRIVER FUSE 30A
TO IGNITION MAIN RELAY 1 (DIAGRAM 2 OF 6)
(NOT USED)
RED/ BLU
RED/ VIO
RED/ BRN
RED/ WHT
X357
X8
(BODY HARNESS, BELOW DRIVER DOOR) J368
X700
X800
X200
X320
X1
FRONT SEAT HEATING CONTROL MODULE (IF EQUIPPED)
BATTERY ENERGY CONTROL MODULE
HYBRID/EV BATTERY PACK
LEFT REAR WINDOW SWITCH
RIGHT REAR WINDOW SWITCH
BLOWER MOTOR CONTROL MODULE
ELECTRONIC BRAKE CONTROL MODULE
LEFT WINDSHIELD WIPER MOTOR MODULE
RIGHT WINDSHIELD WIPER MOTOR MODULE
RESS PUMP FUSE 10A
PE COOLANT PUMP FUSE 10A
ICCM FUSE 46 10A
PROVISION FUSE 10A
CURRENT SENSOR FUSE 5A
HEH FUSE 5A
ACCM FUSE 54 5A
ENGINE COOLING FAN FUSE 40A
TRCM 1 FUSE 40A
ECM FUSE 15A
RED/ GRY
RED/ VIO
RED/ BRN
RED/ GRN
RED/ WHT
RED/ BLU
RED
X4 X3 X108 X2 X1
HYBRID/EV BATTERY PACK COOLANT PUMP
HYBRID/EV ELECTRONICS COOLANT PUMP
CHASSIS CONTROL MODULE
BODY CONTROL MODULE
COOLANT HEATER CONTROL MODULE
A/C COMPRESSOR
COOLING FAN MOTOR
TRANSMISSION RANGE CONTROL MODULE
ENGINE CONTROL MODULE
563905

Fig. 75: Power Distribution Circuit (1 of 6)

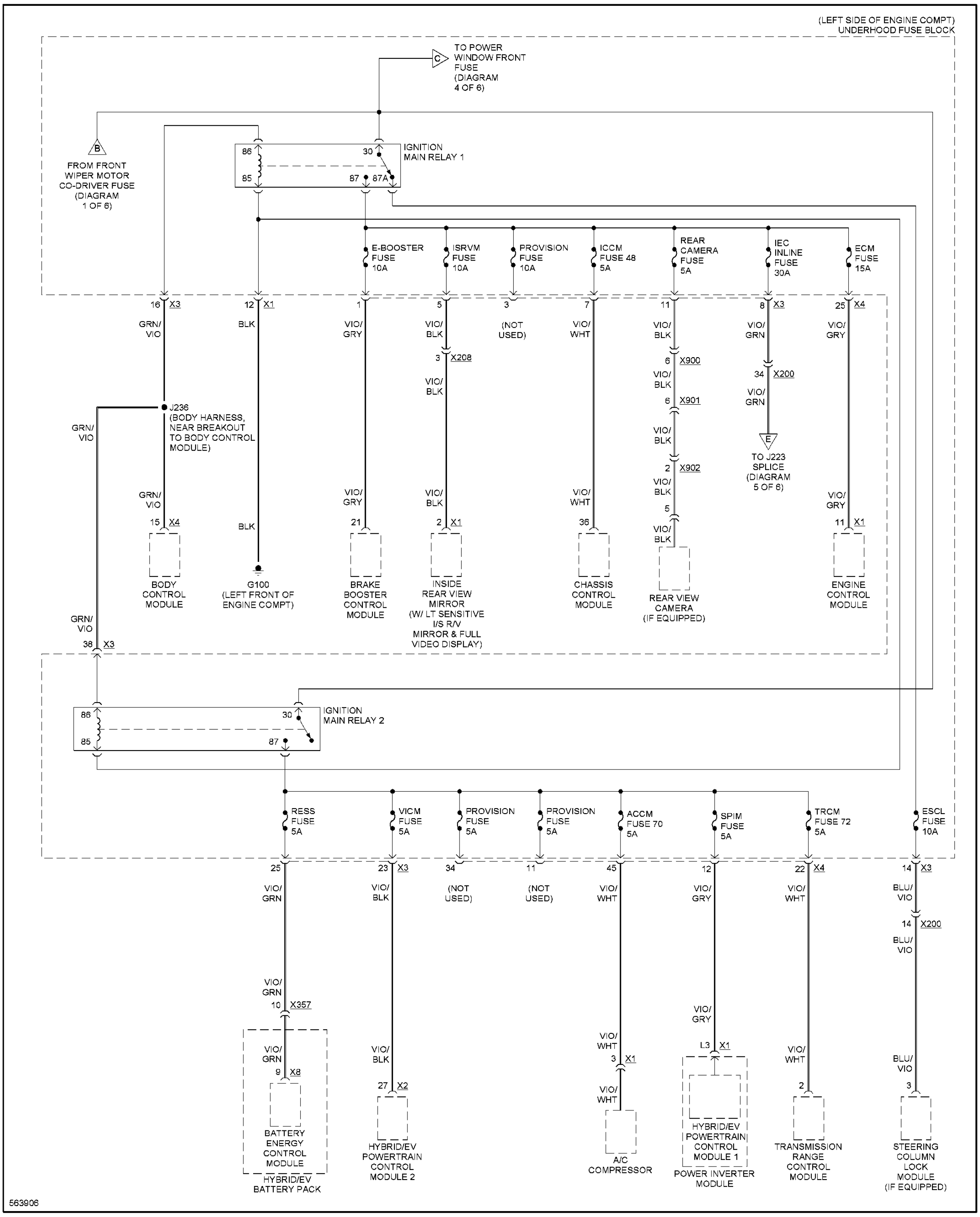

(LEFT SIDE OF ENGINE COMPT)
UNDERHOOD FUSE BLOCK
C
TO POWER WINDOW FRONT FUSE (DIAGRAM 4 OF 6)
B
FROM FRONT WIPER MOTOR CO-DRIVER FUSE (DIAGRAM 1 OF 6)
86
85
30
87
87A
IGNITION MAIN RELAY 1
E-BOOSTER FUSE 10A
ISRVM FUSE 10A
PROVISION FUSE 10A
ICCM FUSE 48 5A
REAR CAMERA FUSE 5A
IEC INLINE FUSE 30A
ECM FUSE 15A
16 X3
12 X1
1
5
3
7
11
8 X3
25 X4
GRN/ VIO
BLK
VIO/ GRY
VIO/ BLK
(NOT USED)
VIO/ WHT
VIO/ BLK
VIO/ GRN
VIO/ GRY
3 X208
VIO/ BLK
6 X900
VIO/ BLK
6 X901
VIO/ BLK
2 X902
VIO/ BLK
5
VIO/ BLK
34 X200
VIO/ GRN
E
TO J223 SPLICE (DIAGRAM 5 OF 6)
GRN/ VIO
J236 (BODY HARNESS, NEAR BREAKOUT TO BODY CONTROL MODULE)
GRN/ VIO
15 X4
BLK
VIO/ GRY
21
VIO/ BLK
2 X1
VIO/ WHT
36
VIO/ GRY
11 X1
BODY CONTROL MODULE
G100 (LEFT FRONT OF ENGINE COMPT)
BRAKE BOOSTER CONTROL MODULE
INSIDE REAR VIEW MIRROR (W/ LT SENSITIVE I/S R/V MIRROR & FULL VIDEO DISPLAY)
CHASSIS CONTROL MODULE
REAR VIEW CAMERA (IF EQUIPPED)
ENGINE CONTROL MODULE
GRN/ VIO
38 X3
86
85
30
87
IGNITION MAIN RELAY 2
RESS FUSE 5A
VICM FUSE 5A
PROVISION FUSE 5A
PROVISION FUSE 5A
ACCM FUSE 70 5A
SPIM FUSE 5A
TRCM FUSE 72 5A
ESCL FUSE 10A
25
23 X3
34
11
45
12
22 X4
14 X3
VIO/ GRN
VIO/ BLK
(NOT USED)
(NOT USED)
VIO/ WHT
VIO/ GRY
VIO/ WHT
BLU/ VIO
14 X200
BLU/ VIO
VIO/ GRN
10 X357
VIO/ GRN
9 X8
BATTERY ENERGY CONTROL MODULE
HYBRID/EV BATTERY PACK
VIO/ BLK
27 X2
HYBRID/EV POWERTRAIN CONTROL MODULE 2
VIO/ WHT
3 X1
VIO/ WHT
A/C COMPRESSOR
VIO/ GRY
L3 X1
HYBRID/EV POWERTRAIN CONTROL MODULE 1
POWER INVERTER MODULE
VIO/ WHT
2
TRANSMISSION RANGE CONTROL MODULE
BLU/ VIO
3
STEERING COLUMN LOCK MODULE (IF EQUIPPED)
563906

Fig. 76: Power Distribution Circuit (2 of 6)

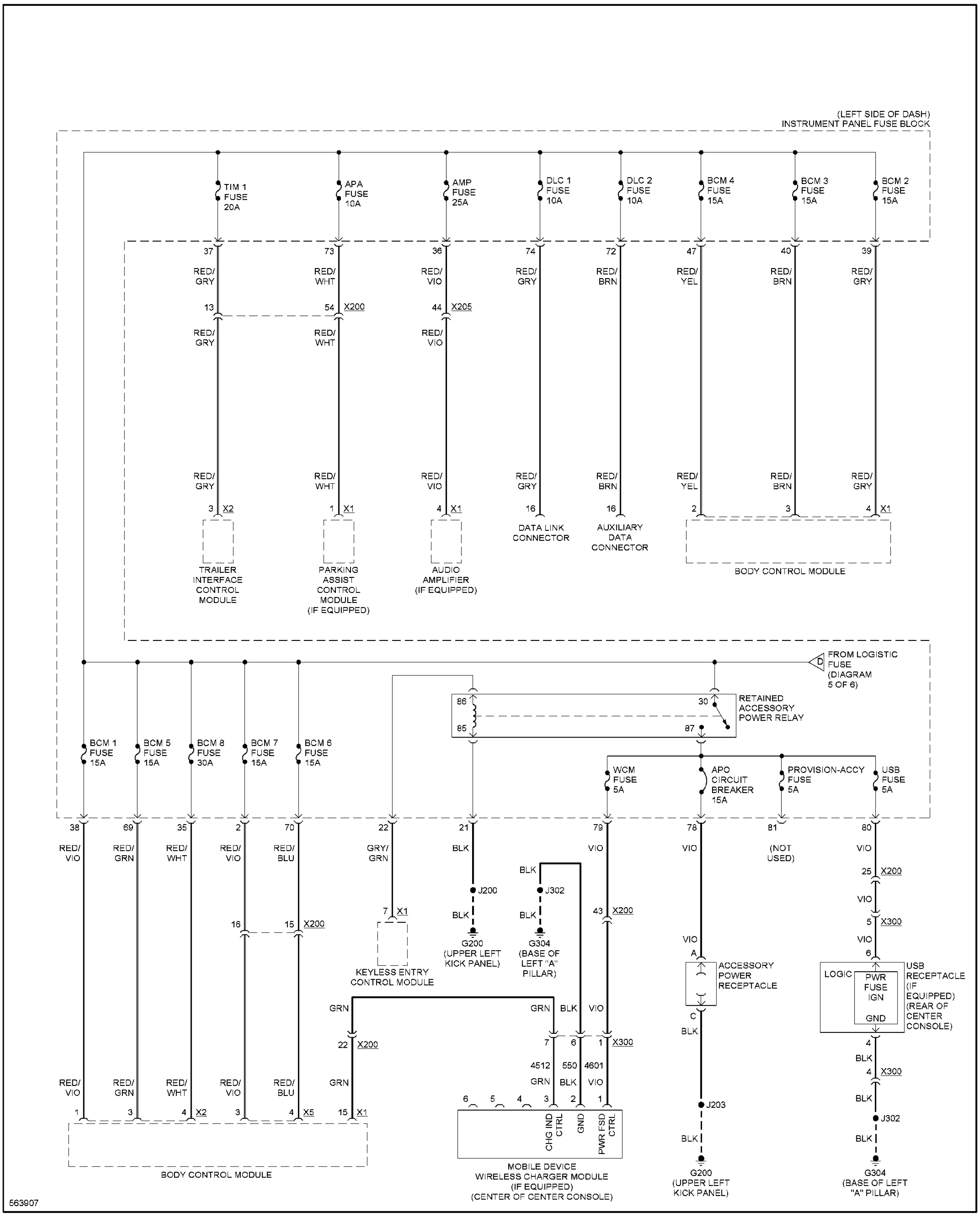

(LEFT SIDE OF DASH)
INSTRUMENT PANEL FUSE BLOCK
TIM 1 FUSE 20A
APA FUSE 10A
AMP FUSE 25A
DLC 1 FUSE 10A
DLC 2 FUSE 10A
BCM 4 FUSE 15A
BCM 3 FUSE 15A
BCM 2 FUSE 15A
37
73
36
74
72
47
40
39
RED/GRY
RED/WHT
RED/VIO
RED/GRY
RED/BRN
RED/YEL
RED/BRN
RED/GRY
13
54
X200
44
X205
3 X2
1 X1
4 X1
16
16
2
3
4 X1
TRAILER INTERFACE CONTROL MODULE
PARKING ASSIST CONTROL MODULE (IF EQUIPPED)
AUDIO AMPLIFIER (IF EQUIPPED)
DATA LINK CONNECTOR
AUXILIARY DATA CONNECTOR
BODY CONTROL MODULE
FROM LOGISTIC FUSE (DIAGRAM 5 OF 6)
D
86
85
30
87
RETAINED ACCESSORY POWER RELAY
BCM 1 FUSE 15A
BCM 5 FUSE 15A
BCM 8 FUSE 30A
BCM 7 FUSE 15A
BCM 6 FUSE 15A
WCM FUSE 5A
APO CIRCUIT BREAKER 15A
PROVISION-ACCY FUSE 5A
USB FUSE 5A
38
69
35
2
70
22
21
79
78
81
80
RED/VIO
RED/GRN
RED/WHT
RED/VIO
RED/BLU
GRY/GRN
BLK
VIO
VIO
(NOT USED)
VIO
16
15 X200
7 X1
KEYLESS ENTRY CONTROL MODULE
J200
BLK
G200 (UPPER LEFT KICK PANEL)
BLK
J302
BLK
G304 (BASE OF LEFT "A" PILLAR)
43 X200
25 X200
VIO
5 X300
VIO
6
LOGIC
PWR FUSE IGN
GND
USB RECEPTACLE (IF EQUIPPED) (REAR OF CENTER CONSOLE)
4
BLK
4 X300
BLK
J302
BLK
G304 (BASE OF LEFT "A" PILLAR)
VIO
A
ACCESSORY POWER RECEPTACLE
C
BLK
J203
BLK
G200 (UPPER LEFT KICK PANEL)
GRN
GRN
BLK
VIO
7
6
1 X300
22 X200
4512
550
4601
GRN
BLK
VIO
6
5
4
3
2
1
CHG IND CTRL
GND
PWR FSD CTRL
MOBILE DEVICE WIRELESS CHARGER MODULE (IF EQUIPPED) (CENTER OF CENTER CONSOLE)
RED/VIO
RED/GRN
RED/WHT
RED/VIO
RED/BLU
GRN
1
3
4 X2
3
4 X5
15 X1
BODY CONTROL MODULE
563907

Fig. 77: Power Distribution Circuit (3 of 6)

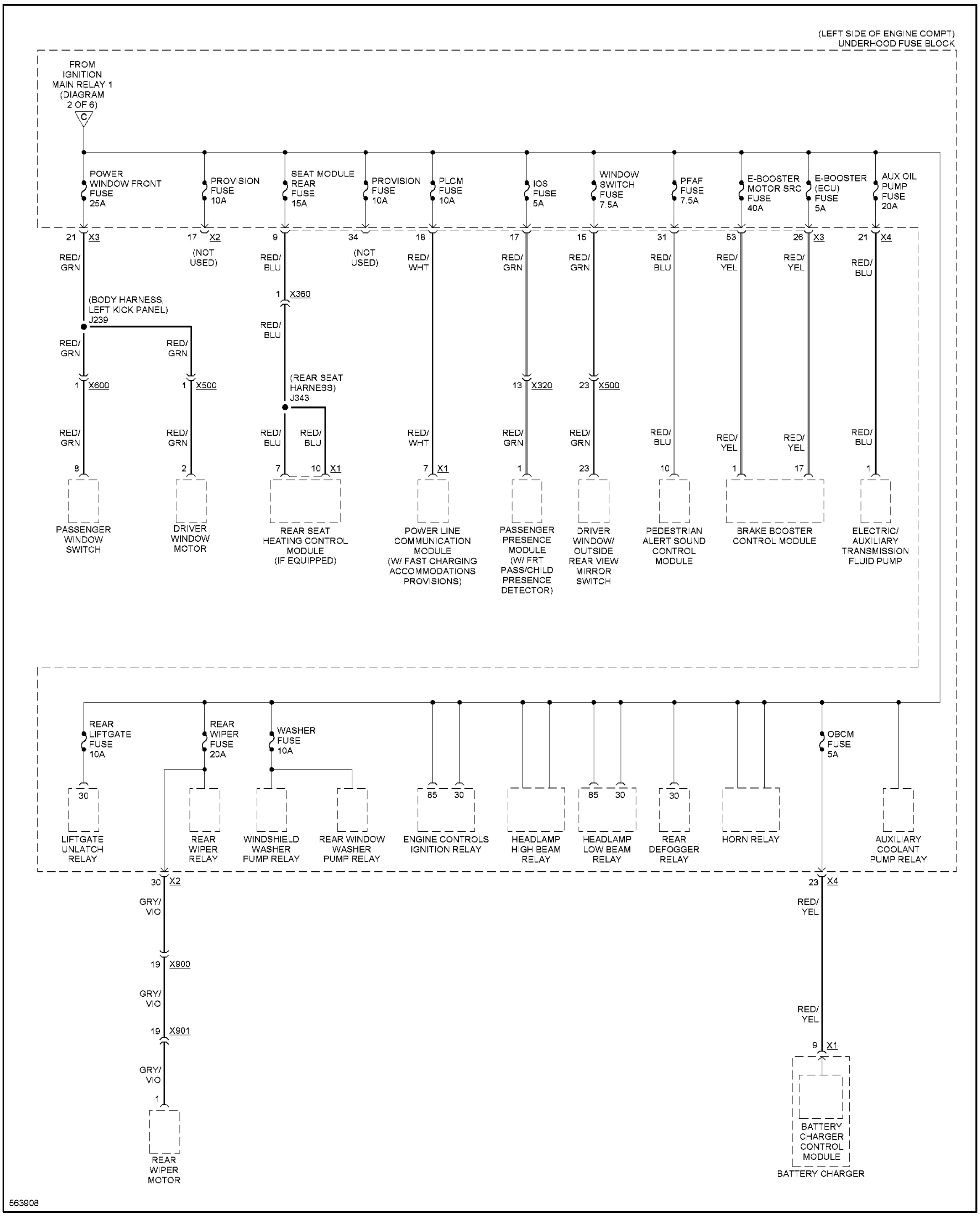

(LEFT SIDE OF ENGINE COMPT)
UNDERHOOD FUSE BLOCK
FROM IGNITION MAIN RELAY 1 (DIAGRAM 2 OF 6)
C
POWER WINDOW FRONT FUSE 25A
PROVISION FUSE 10A
SEAT MODULE REAR FUSE 15A
PROVISION FUSE 10A
PLCM FUSE 10A
IOS FUSE 5A
WINDOW SWITCH FUSE 7.5A
PFAF FUSE 7.5A
E-BOOSTER MOTOR SRC FUSE 40A
E-BOOSTER (ECU) FUSE 5A
AUX OIL PUMP FUSE 20A
21 X3
17 X2
9
34
18
17
15
31
53
26 X3
21 X4
RED/ GRN
(NOT USED)
RED/ BLU
(NOT USED)
RED/ WHT
RED/ GRN
RED/ GRN
RED/ BLU
RED/ YEL
RED/ YEL
RED/ BLU
(BODY HARNESS, LEFT KICK PANEL) J239
1 X360
RED/ BLU
RED/ GRN
RED/ GRN
(REAR SEAT HARNESS) J343
1 X600
1 X500
13 X320
23 X500
RED/ GRN
RED/ GRN
RED/ BLU
RED/ BLU
RED/ WHT
RED/ GRN
RED/ GRN
RED/ BLU
RED/ YEL
RED/ YEL
RED/ BLU
8
2
7
10 X1
7 X1
1
23
10
1
17
1
PASSENGER WINDOW SWITCH
DRIVER WINDOW MOTOR
REAR SEAT HEATING CONTROL MODULE (IF EQUIPPED)
POWER LINE COMMUNICATION MODULE (W/ FAST CHARGING ACCOMMODATIONS PROVISIONS)
PASSENGER PRESENCE MODULE (W/ FRT PASS/CHILD PRESENCE DETECTOR)
DRIVER WINDOW/ OUTSIDE REAR VIEW MIRROR SWITCH
PEDESTRIAN ALERT SOUND CONTROL MODULE
BRAKE BOOSTER CONTROL MODULE
ELECTRIC/ AUXILIARY TRANSMISSION FLUID PUMP
REAR LIFTGATE FUSE 10A
REAR WIPER FUSE 20A
WASHER FUSE 10A
OBCM FUSE 5A
30
85
30
85
30
30
LIFTGATE UNLATCH RELAY
REAR WIPER RELAY
WINDSHIELD WASHER PUMP RELAY
REAR WINDOW WASHER PUMP RELAY
ENGINE CONTROLS IGNITION RELAY
HEADLAMP HIGH BEAM RELAY
HEADLAMP LOW BEAM RELAY
REAR DEFOGGER RELAY
HORN RELAY
AUXILIARY COOLANT PUMP RELAY
30 X2
23 X4
GRY/ VIO
RED/ YEL
19 X900
GRY/ VIO
RED/ YEL
19 X901
9 X1
GRY/ VIO
1
REAR WIPER MOTOR
BATTERY CHARGER CONTROL MODULE
BATTERY CHARGER
563908

Fig. 78: Power Distribution Circuit (4 of 6)

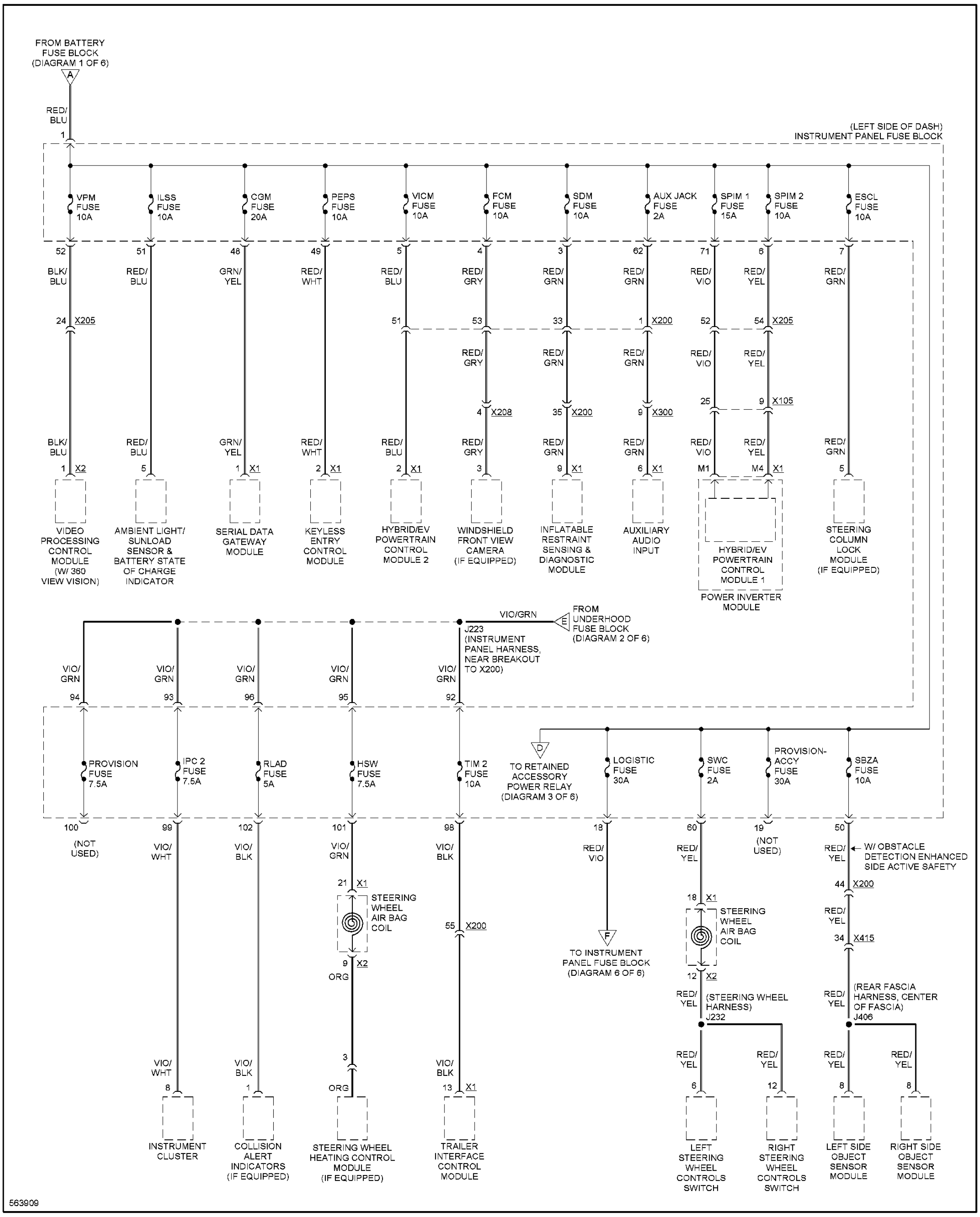

FROM BATTERY FUSE BLOCK (DIAGRAM 1 OF 6)
A
RED/ BLU
1
(LEFT SIDE OF DASH) INSTRUMENT PANEL FUSE BLOCK
VPM FUSE 10A
ILSS FUSE 10A
CGM FUSE 20A
PEPS FUSE 10A
VICM FUSE 10A
FCM FUSE 10A
SDM FUSE 10A
AUX JACK FUSE 2A
SPIM 1 FUSE 15A
SPIM 2 FUSE 10A
ESCL FUSE 10A
52 BLK/ BLU
51 RED/ BLU
48 GRN/ YEL
49 RED/ WHT
5 RED/ BLU
4 RED/ GRY
3 RED/ GRN
62 RED/ GRN
71 RED/ VIO
6 RED/ YEL
7 RED/ GRN
24 X205
51
53
33
1 X200
52
54 X205
RED/ GRY
RED/ GRN
RED/ GRN
RED/ VIO
RED/ YEL
4 X208
35 X200
9 X300
25
9 X105
BLK/ BLU 1 X2
RED/ BLU 5
GRN/ YEL 1 X1
RED/ WHT 2 X1
RED/ BLU 2 X1
RED/ GRY 3
RED/ GRN 9 X1
RED/ GRN 6 X1
RED/ VIO M1
RED/ YEL M4 X1
RED/ GRN 5
VIDEO PROCESSING CONTROL MODULE (W/ 360 VIEW VISION)
AMBIENT LIGHT/ SUNLOAD SENSOR & BATTERY STATE OF CHARGE INDICATOR
SERIAL DATA GATEWAY MODULE
KEYLESS ENTRY CONTROL MODULE
HYBRID/EV POWERTRAIN CONTROL MODULE 2
WINDSHIELD FRONT VIEW CAMERA (IF EQUIPPED)
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE
AUXILIARY AUDIO INPUT
HYBRID/EV POWERTRAIN CONTROL MODULE 1
POWER INVERTER MODULE
STEERING COLUMN LOCK MODULE (IF EQUIPPED)
VIO/GRN
E
FROM UNDERHOOD FUSE BLOCK (DIAGRAM 2 OF 6)
J223 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO X200)
VIO/ GRN 94
VIO/ GRN 93
VIO/ GRN 96
VIO/ GRN 95
VIO/ GRN 92
PROVISION FUSE 7.5A
IPC 2 FUSE 7.5A
RLAD FUSE 5A
HSW FUSE 7.5A
TIM 2 FUSE 10A
D
TO RETAINED ACCESSORY POWER RELAY (DIAGRAM 3 OF 6)
LOGISTIC FUSE 30A
SWC FUSE 2A
PROVISION-ACCY FUSE 30A
SBZA FUSE 10A
100 (NOT USED)
99 VIO/ WHT
102 VIO/ BLK
101 VIO/ GRN
98 VIO/ BLK
18 RED/ VIO
60 RED/ YEL
19 (NOT USED)
50 RED/ YEL
W/ OBSTACLE DETECTION ENHANCED SIDE ACTIVE SAFETY
21 X1
STEERING WHEEL AIR BAG COIL
9 X2
ORG
55 X200
F
TO INSTRUMENT PANEL FUSE BLOCK (DIAGRAM 6 OF 6)
18 X1
STEERING WHEEL AIR BAG COIL
12 X2
RED/ YEL
(STEERING WHEEL HARNESS) J232
44 X200
RED/ YEL
34 X415
RED/ YEL
(REAR FASCIA HARNESS, CENTER OF FASCIA) J406
VIO/ WHT 8
VIO/ BLK 1
3 ORG
VIO/ BLK 13 X1
RED/ YEL 6
RED/ YEL 12
RED/ YEL 8
RED/ YEL 8
INSTRUMENT CLUSTER
COLLISION ALERT INDICATORS (IF EQUIPPED)
STEERING WHEEL HEATING CONTROL MODULE (IF EQUIPPED)
TRAILER INTERFACE CONTROL MODULE
LEFT STEERING WHEEL CONTROLS SWITCH
RIGHT STEERING WHEEL CONTROLS SWITCH
LEFT SIDE OBJECT SENSOR MODULE
RIGHT SIDE OBJECT SENSOR MODULE
563909

Fig. 79: Power Distribution Circuit (5 of 6)

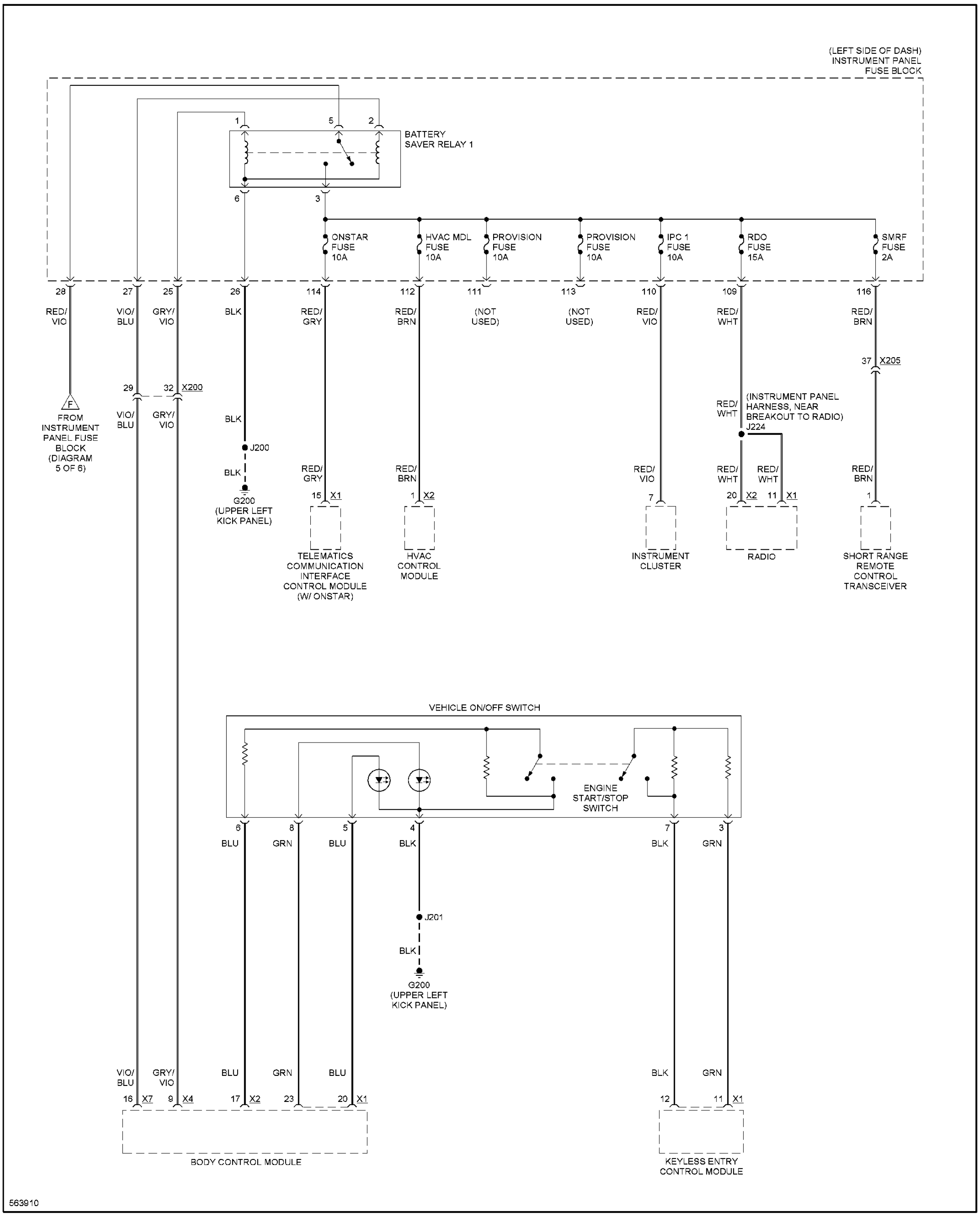

(LEFT SIDE OF DASH)
INSTRUMENT PANEL
FUSE BLOCK
1
5
2
BATTERY
SAVER RELAY 1
6
3
ONSTAR
FUSE
10A
HVAC MDL
FUSE
10A
PROVISION
FUSE
10A
PROVISION
FUSE
10A
IPC 1
FUSE
10A
RDO
FUSE
15A
SMRF
FUSE
2A
28
27
25
26
114
112
111
113
110
109
116
RED/
VIO
VIO/
BLU
GRY/
VIO
BLK
RED/
GRY
RED/
BRN
(NOT
USED)
(NOT
USED)
RED/
VIO
RED/
WHT
RED/
BRN
37 X205
29
32 X200
F
FROM
INSTRUMENT
PANEL FUSE
BLOCK
(DIAGRAM
5 OF 6)
VIO/
BLU
GRY/
VIO
BLK
J200
BLK
G200
(UPPER LEFT
KICK PANEL)
RED/
WHT
(INSTRUMENT PANEL
HARNESS, NEAR
BREAKOUT TO RADIO)
J224
RED/
GRY
RED/
BRN
RED/
VIO
RED/
WHT
RED/
WHT
RED/
BRN
15 X1
1 X2
7
20 X2
11 X1
1
TELEMATICS
COMMUNICATION
INTERFACE
CONTROL MODULE
(W/ ONSTAR)
HVAC
CONTROL
MODULE
INSTRUMENT
CLUSTER
RADIO
SHORT RANGE
REMOTE
CONTROL
TRANSCEIVER
VEHICLE ON/OFF SWITCH
ENGINE
START/STOP
SWITCH
6
8
5
4
7
3
BLU
GRN
BLU
BLK
BLK
GRN
J201
BLK
G200
(UPPER LEFT
KICK PANEL)
VIO/
BLU
GRY/
VIO
BLU
GRN
BLU
BLK
GRN
16 X7
9 X4
17 X2
23
20 X1
12
11 X1
BODY CONTROL MODULE
KEYLESS ENTRY
CONTROL MODULE
563910

Fig. 80: Power Distribution Circuit (6 of 6)

POWER DOOR LOCKS

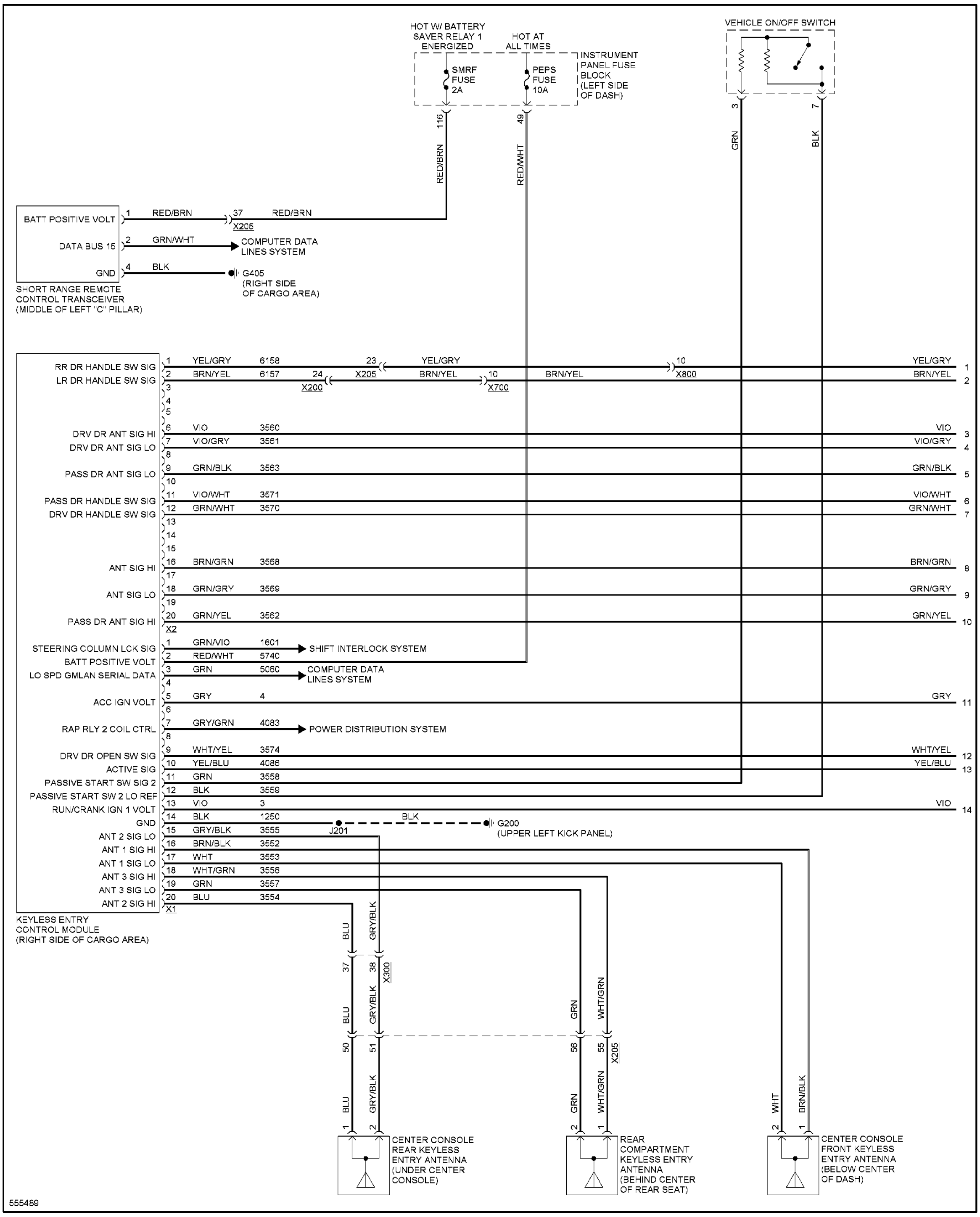

HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
HOT AT ALL TIMES
SMRF FUSE 2A
PEPS FUSE 10A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
VEHICLE ON/OFF SWITCH
116
49
3
7
RED/BRN
RED/WHT
GRN
BLK
BATT POSITIVE VOLT
DATA BUS 15
GND
1
RED/BRN
37
X205
RED/BRN
2
GRN/WHT
COMPUTER DATA LINES SYSTEM
4
BLK
G405 (RIGHT SIDE OF CARGO AREA)
SHORT RANGE REMOTE CONTROL TRANSCEIVER (MIDDLE OF LEFT "C" PILLAR)
RR DR HANDLE SW SIG
LR DR HANDLE SW SIG
DRV DR ANT SIG HI
DRV DR ANT SIG LO
PASS DR ANT SIG LO
PASS DR HANDLE SW SIG
DRV DR HANDLE SW SIG
ANT SIG HI
ANT SIG LO
PASS DR ANT SIG HI
X2
1 YEL/GRY 6158
23 X205 YEL/GRY
10 X800 YEL/GRY 1
2 BRN/YEL 6157
24 X200 BRN/YEL
10 X700 BRN/YEL
BRN/YEL 2
3
4
5
6 VIO 3560 VIO 3
7 VIO/GRY 3561 VIO/GRY 4
8
9 GRN/BLK 3563 GRN/BLK 5
10
11 VIO/WHT 3571 VIO/WHT 6
12 GRN/WHT 3570 GRN/WHT 7
13
14
15
16 BRN/GRN 3568 BRN/GRN 8
17
18 GRN/GRY 3569 GRN/GRY 9
19
20 GRN/YEL 3562 GRN/YEL 10
STEERING COLUMN LCK SIG
BATT POSITIVE VOLT
LO SPD GMLAN SERIAL DATA
ACC IGN VOLT
RAP RLY 2 COIL CTRL
DRV DR OPEN SW SIG
ACTIVE SIG
PASSIVE START SW SIG 2
PASSIVE START SW 2 LO REF
RUN/CRANK IGN 1 VOLT
GND
ANT 2 SIG LO
ANT 1 SIG HI
ANT 1 SIG LO
ANT 3 SIG HI
ANT 3 SIG LO
ANT 2 SIG HI
X1
1 GRN/VIO 1601 SHIFT INTERLOCK SYSTEM
2 RED/WHT 5740
3 GRN 5060 COMPUTER DATA LINES SYSTEM
4
5 GRY 4 GRY 11
6
7 GRY/GRN 4083 POWER DISTRIBUTION SYSTEM
8
9 WHT/YEL 3574 WHT/YEL 12
10 YEL/BLU 4086 YEL/BLU 13
11 GRN 3558
12 BLK 3559
13 VIO 3 VIO 14
14 BLK 1250
J201
BLK
G200 (UPPER LEFT KICK PANEL)
15 GRY/BLK 3555
16 BRN/BLK 3552
17 WHT 3553
18 WHT/GRN 3556
19 GRN 3557
20 BLU 3554
KEYLESS ENTRY CONTROL MODULE (RIGHT SIDE OF CARGO AREA)
BLU
GRY/BLK
37
38
X300
BLU
GRY/BLK
GRN
WHT/GRN
50
51
56
55
X205
BLU
GRY/BLK
GRN
WHT/GRN
WHT
BRN/BLK
1
2
2
1
2
1
CENTER CONSOLE REAR KEYLESS ENTRY ANTENNA (UNDER CENTER CONSOLE)
REAR COMPARTMENT KEYLESS ENTRY ANTENNA (BEHIND CENTER OF REAR SEAT)
CENTER CONSOLE FRONT KEYLESS ENTRY ANTENNA (BELOW CENTER OF DASH)
555489

Fig. 81: Power Door Locks Circuit (1 of 4)

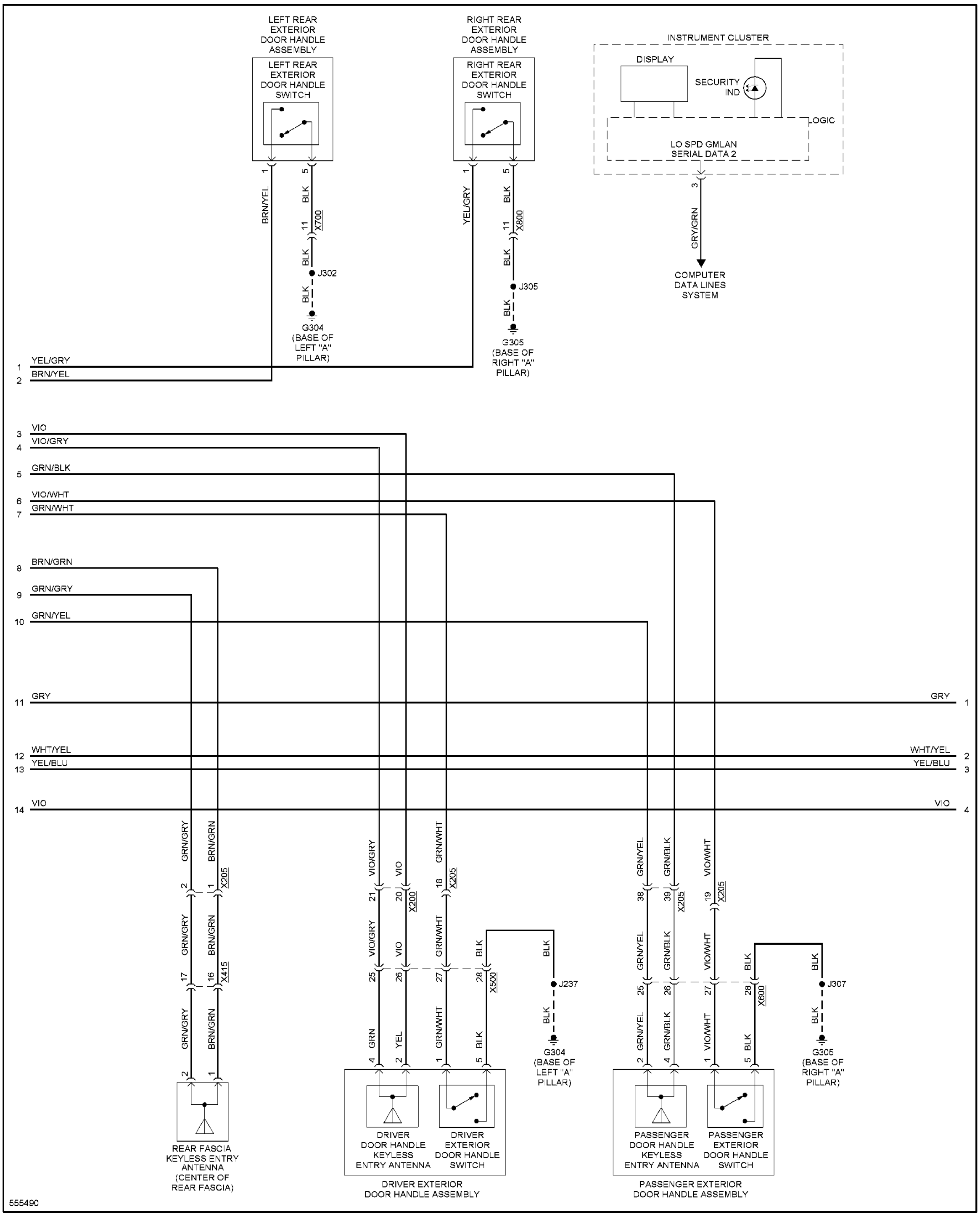

LEFT REAR EXTERIOR DOOR HANDLE ASSEMBLY
LEFT REAR EXTERIOR DOOR HANDLE SWITCH
RIGHT REAR EXTERIOR DOOR HANDLE ASSEMBLY
RIGHT REAR EXTERIOR DOOR HANDLE SWITCH
INSTRUMENT CLUSTER
DISPLAY
SECURITY IND
LOGIC
LO SPD GMLAN SERIAL DATA 2
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
1
BRN/YEL
5
BLK
11
X700
BLK
J302
BLK
G304 (BASE OF LEFT "A" PILLAR)
1
YEL/GRY
5
BLK
11
X800
BLK
J305
BLK
G305 (BASE OF RIGHT "A" PILLAR)
1 YEL/GRY
2 BRN/YEL
3 VIO
4 VIO/GRY
5 GRN/BLK
6 VIO/WHT
7 GRN/WHT
8 BRN/GRN
9 GRN/GRY
10 GRN/YEL
11 GRY
12 WHT/YEL
13 YEL/BLU
14 VIO
GRY 1
WHT/YEL 2
YEL/BLU 3
VIO 4
GRN/GRY
BRN/GRN
2
1
X205
GRN/GRY
BRN/GRN
17
16
X415
GRN/GRY
BRN/GRN
2
1
REAR FASCIA KEYLESS ENTRY ANTENNA (CENTER OF REAR FASCIA)
VIO/GRY
VIO
GRN/WHT
21
20
X200
18
X205
VIO/GRY
VIO
GRN/WHT
BLK
BLK
25
26
27
28
X500
J237
BLK
G304 (BASE OF LEFT "A" PILLAR)
GRN
YEL
GRN/WHT
BLK
4
2
1
5
DRIVER DOOR HANDLE KEYLESS ENTRY ANTENNA
DRIVER EXTERIOR DOOR HANDLE SWITCH
DRIVER EXTERIOR DOOR HANDLE ASSEMBLY
GRN/YEL
GRN/BLK
VIO/WHT
38
39
X205
19
X205
GRN/YEL
GRN/BLK
VIO/WHT
BLK
BLK
25
26
27
28
X600
J307
BLK
G305 (BASE OF RIGHT "A" PILLAR)
GRN/YEL
GRN/BLK
VIO/WHT
BLK
2
4
1
5
PASSENGER DOOR HANDLE KEYLESS ENTRY ANTENNA
PASSENGER EXTERIOR DOOR HANDLE SWITCH
PASSENGER EXTERIOR DOOR HANDLE ASSEMBLY
555490

Fig. 82: Power Door Locks Circuit (2 of 4)

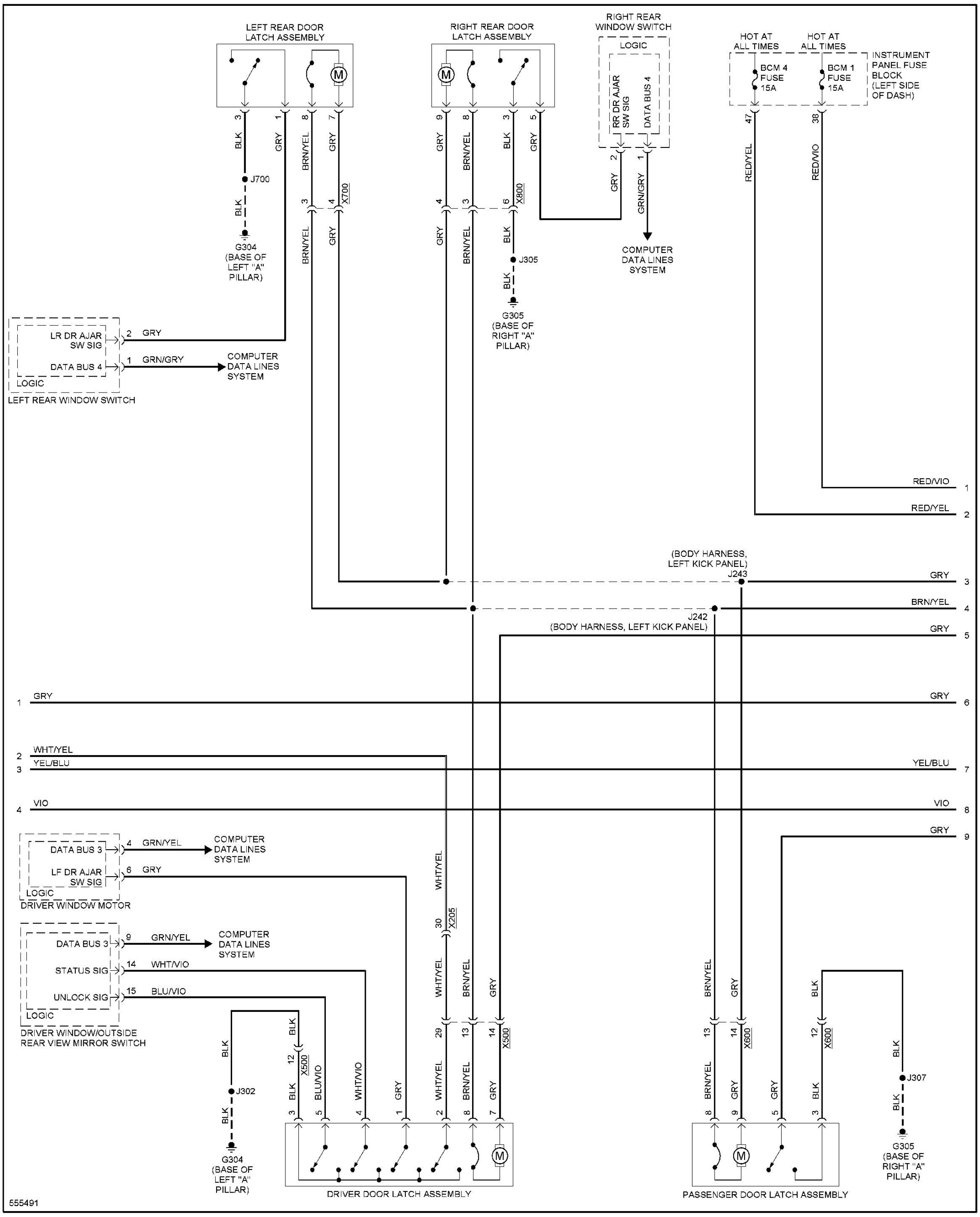

LEFT REAR DOOR LATCH ASSEMBLY
RIGHT REAR DOOR LATCH ASSEMBLY
RIGHT REAR WINDOW SWITCH
LOGIC
RR DR AJAR SW SIG
DATA BUS 4
HOT AT ALL TIMES
HOT AT ALL TIMES
BCM 4 FUSE 15A
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
M
BLK
GRY
BRN/YEL
J700
X700
X800
G304 (BASE OF LEFT "A" PILLAR)
J305
G305 (BASE OF RIGHT "A" PILLAR)
COMPUTER DATA LINES SYSTEM
GRN/GRY
RED/YEL
RED/VIO
LR DR AJAR SW SIG
DATA BUS 4
LOGIC
LEFT REAR WINDOW SWITCH
(BODY HARNESS, LEFT KICK PANEL)
J243
J242
(BODY HARNESS, LEFT KICK PANEL)
WHT/YEL
YEL/BLU
VIO
DATA BUS 3
GRN/YEL
LF DR AJAR SW SIG
DRIVER WINDOW MOTOR
STATUS SIG
WHT/VIO
UNLOCK SIG
BLU/VIO
DRIVER WINDOW/OUTSIDE REAR VIEW MIRROR SWITCH
X205
X500
X600
J302
J307
DRIVER DOOR LATCH ASSEMBLY
PASSENGER DOOR LATCH ASSEMBLY
555491

Fig. 83: Power Door Locks Circuit (3 of 4)

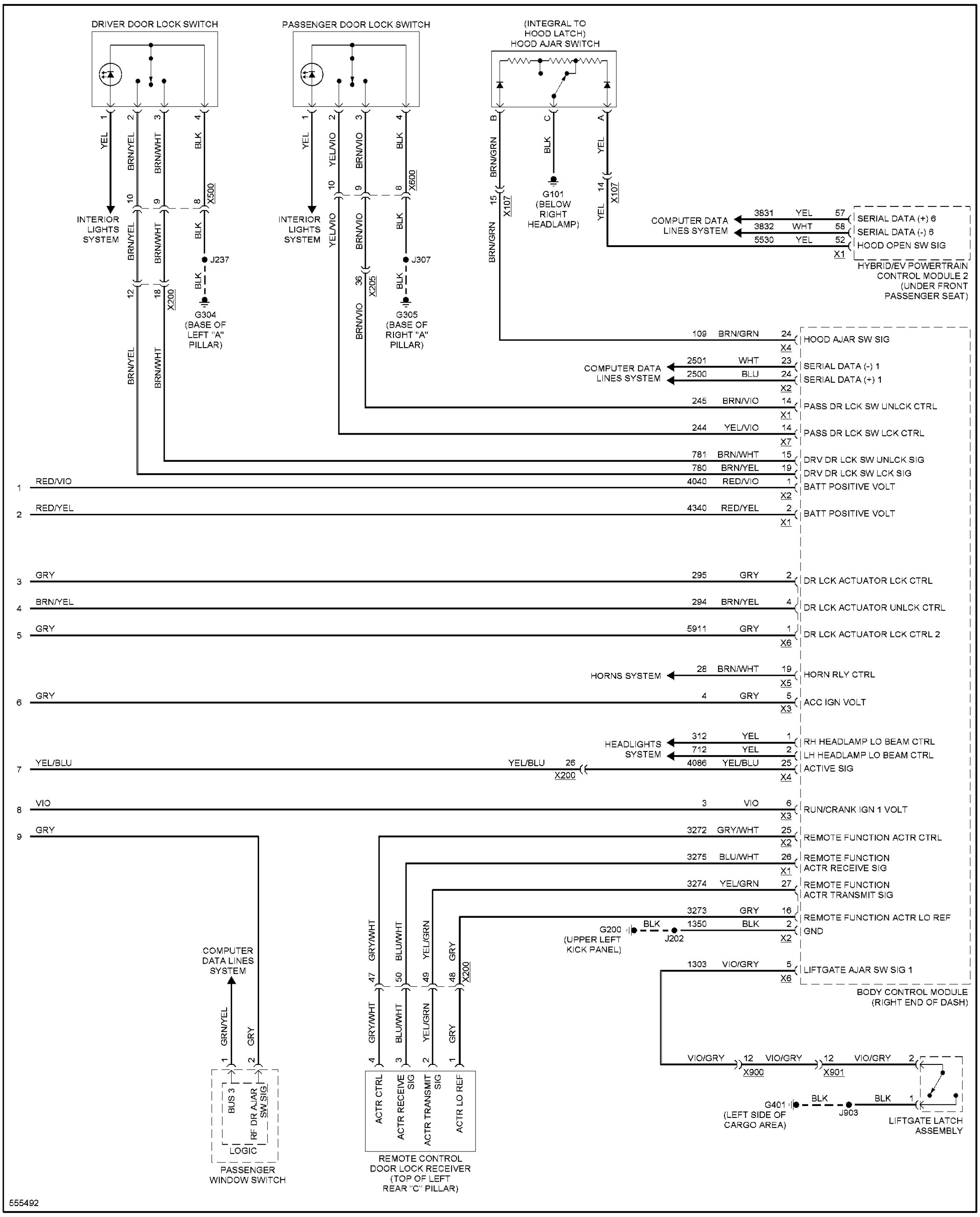

DRIVER DOOR LOCK SWITCH
PASSENGER DOOR LOCK SWITCH
(INTEGRAL TO HOOD LATCH) HOOD AJAR SWITCH
YEL
BRN/YEL
BRN/WHT
BLK
YEL/VIO
BRN/VIO
BRN/GRN
X500
X600
X107
X200
X205
INTERIOR LIGHTS SYSTEM
J237
J307
G304 (BASE OF LEFT "A" PILLAR)
G305 (BASE OF RIGHT "A" PILLAR)
G101 (BELOW RIGHT HEADLAMP)
COMPUTER DATA LINES SYSTEM
3831 YEL 57 SERIAL DATA (+) 6
3832 WHT 58 SERIAL DATA (-) 6
5530 YEL 52 HOOD OPEN SW SIG
X1
HYBRID/EV POWERTRAIN CONTROL MODULE 2 (UNDER FRONT PASSENGER SEAT)
109 BRN/GRN 24 HOOD AJAR SW SIG
X4
2501 WHT 23 SERIAL DATA (-) 1
2500 BLU 24 SERIAL DATA (+) 1
X2
245 BRN/VIO 14 PASS DR LCK SW UNLCK CTRL
X1
244 YEL/VIO 14 PASS DR LCK SW LCK CTRL
X7
781 BRN/WHT 15 DRV DR LCK SW UNLCK SIG
780 BRN/YEL 19 DRV DR LCK SW LCK SIG
1 RED/VIO 4040 RED/VIO 1 BATT POSITIVE VOLT
X2
2 RED/YEL 4340 RED/YEL 2 BATT POSITIVE VOLT
X1
3 GRY 295 GRY 2 DR LCK ACTUATOR LCK CTRL
4 BRN/YEL 294 BRN/YEL 4 DR LCK ACTUATOR UNLCK CTRL
5 GRY 5911 GRY 1 DR LCK ACTUATOR LCK CTRL 2
X6
HORNS SYSTEM 28 BRN/WHT 19 HORN RLY CTRL
X5
6 GRY 4 GRY 5 ACC IGN VOLT
X3
HEADLIGHTS SYSTEM
312 YEL 1 RH HEADLAMP LO BEAM CTRL
712 YEL 2 LH HEADLAMP LO BEAM CTRL
7 YEL/BLU YEL/BLU 26 X200 4086 YEL/BLU 25 ACTIVE SIG
X4
8 VIO 3 VIO 6 RUN/CRANK IGN 1 VOLT
X3
9 GRY 3272 GRY/WHT 25 REMOTE FUNCTION ACTR CTRL
X2
3275 BLU/WHT 26 REMOTE FUNCTION ACTR RECEIVE SIG
X1
3274 YEL/GRN 27 REMOTE FUNCTION ACTR TRANSMIT SIG
3273 GRY 16 REMOTE FUNCTION ACTR LO REF
G200 BLK 1350 BLK 2 GND
J202
(UPPER LEFT KICK PANEL)
X2
1303 VIO/GRY 5 LIFTGATE AJAR SW SIG 1
X6
BODY CONTROL MODULE (RIGHT END OF DASH)
COMPUTER DATA LINES SYSTEM
GRN/YEL
GRY
BUS 3
RF DR AJAR SW SIG
LOGIC
PASSENGER WINDOW SWITCH
GRY/WHT
BLU/WHT
YEL/GRN
47 50 49 48
ACTR CTRL
ACTR RECEIVE SIG
ACTR TRANSMIT SIG
ACTR LO REF
REMOTE CONTROL DOOR LOCK RECEIVER (TOP OF LEFT REAR "C" PILLAR)
VIO/GRY 12 VIO/GRY 12 VIO/GRY 2
X900
X901
G401 BLK BLK 1
J903
(LEFT SIDE OF CARGO AREA)
LIFTGATE LATCH ASSEMBLY
555492

Fig. 84: Power Door Locks Circuit (4 of 4)

POWER MIRRORS

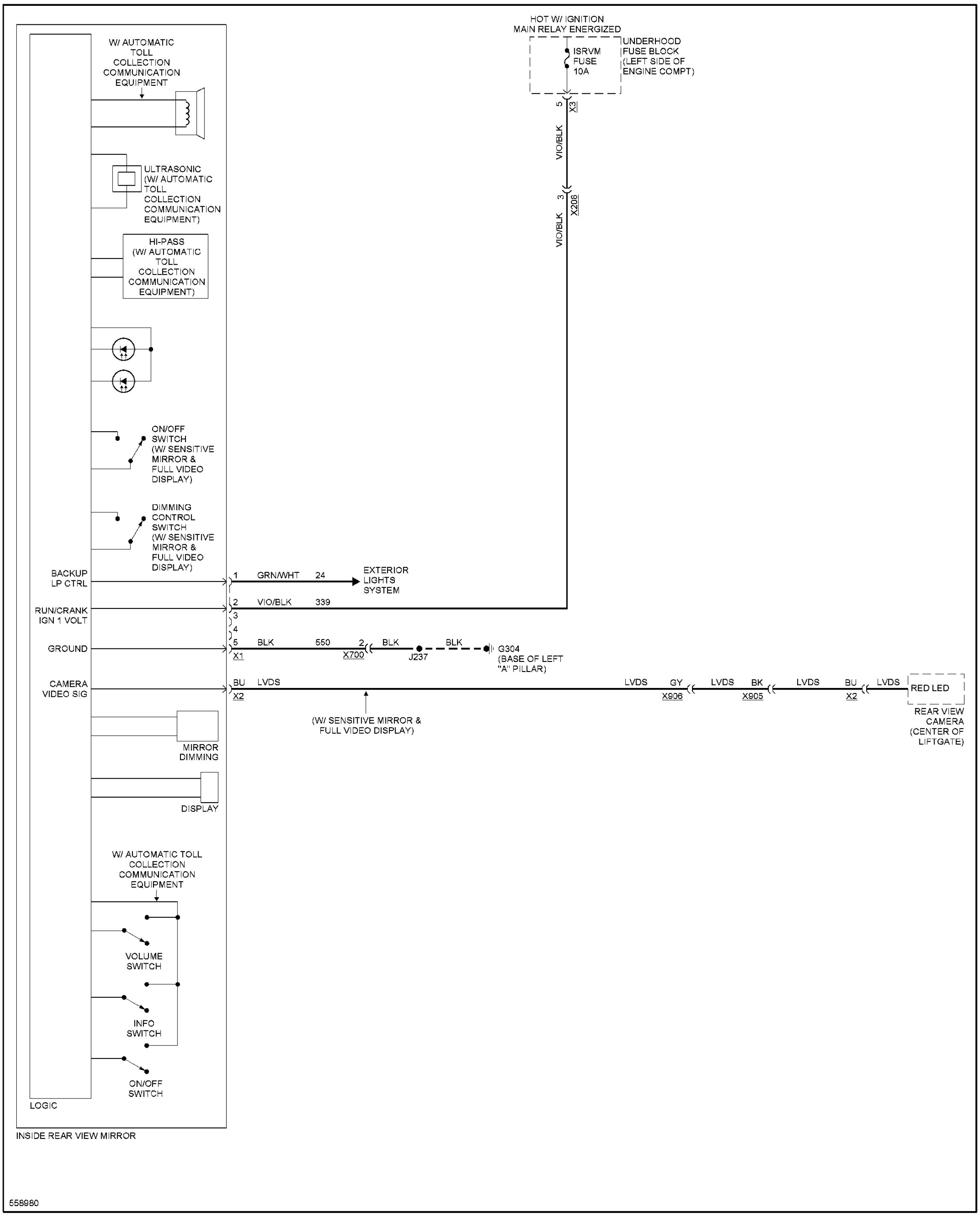

HOT W/ IGNITION
MAIN RELAY ENERGIZED
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
ISRVM FUSE 10A
5
X3
VIO/BLK
3
X208
VIO/BLK
W/ AUTOMATIC TOLL COLLECTION COMMUNICATION EQUIPMENT
ULTRASONIC (W/ AUTOMATIC TOLL COLLECTION COMMUNICATION EQUIPMENT)
HI-PASS (W/ AUTOMATIC TOLL COLLECTION COMMUNICATION EQUIPMENT)
ON/OFF SWITCH (W/ SENSITIVE MIRROR & FULL VIDEO DISPLAY)
DIMMING CONTROL SWITCH (W/ SENSITIVE MIRROR & FULL VIDEO DISPLAY)
BACKUP LP CTRL
1
GRN/WHT
24
EXTERIOR LIGHTS SYSTEM
RUN/CRANK IGN 1 VOLT
2
VIO/BLK
339
3
4
GROUND
5
BLK
550
X1
2
X700
BLK
J237
BLK
G304 (BASE OF LEFT "A" PILLAR)
CAMERA VIDEO SIG
BU
X2
LVDS
(W/ SENSITIVE MIRROR & FULL VIDEO DISPLAY)
LVDS
GY
X906
LVDS
BK
X905
LVDS
BU
X2
LVDS
RED LED
REAR VIEW CAMERA (CENTER OF LIFTGATE)
MIRROR DIMMING
DISPLAY
W/ AUTOMATIC TOLL COLLECTION COMMUNICATION EQUIPMENT
VOLUME SWITCH
INFO SWITCH
ON/OFF SWITCH
LOGIC
INSIDE REAR VIEW MIRROR
558980

Fig. 85: Electrochromic Mirror Circuit

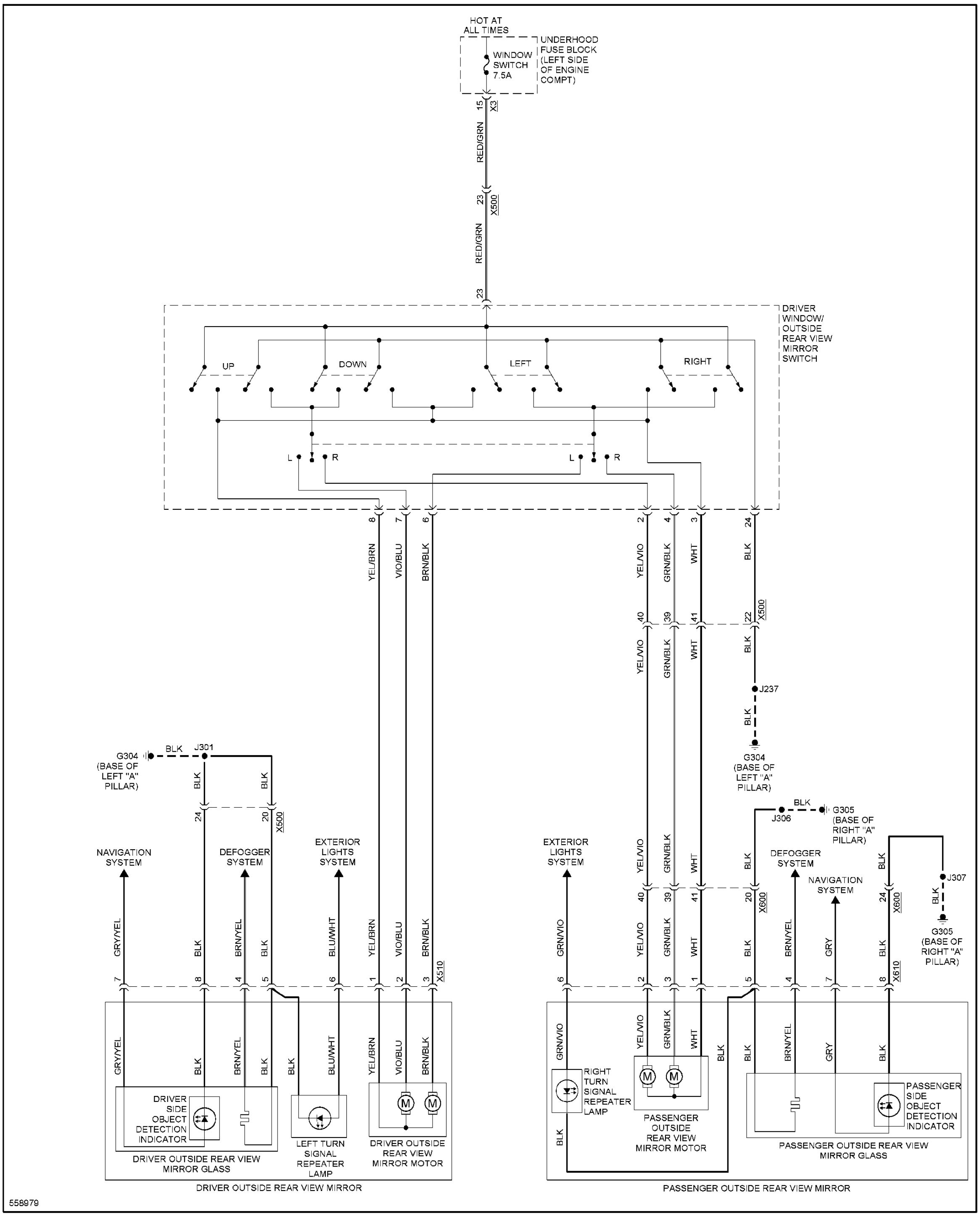

HOT AT ALL TIMES
WINDOW SWITCH 7.5A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
15
X3
RED/GRN
23
X500
RED/GRN
23
DRIVER WINDOW/ OUTSIDE REAR VIEW MIRROR SWITCH
UP
DOWN
LEFT
RIGHT
L
R
L
R
8
7
6
2
4
3
24
YEL/BRN
VIO/BLU
BRN/BLK
YEL/VIO
GRN/BLK
WHT
BLK
40
39
41
22
X500
YEL/VIO
GRN/BLK
WHT
BLK
J237
BLK
G304 (BASE OF LEFT "A" PILLAR)
G304 (BASE OF LEFT "A" PILLAR)
BLK
J301
BLK
BLK
24
20
X500
NAVIGATION SYSTEM
DEFOGGER SYSTEM
EXTERIOR LIGHTS SYSTEM
GRY/YEL
BLK
BRN/YEL
BLK
BLU/WHT
YEL/BRN
VIO/BLU
BRN/BLK
7
8
4
5
6
1
2
3
X510
GRY/YEL
BLK
BRN/YEL
BLK
BLK
BLU/WHT
YEL/BRN
VIO/BLU
BRN/BLK
DRIVER SIDE OBJECT DETECTION INDICATOR
DRIVER OUTSIDE REAR VIEW MIRROR GLASS
LEFT TURN SIGNAL REPEATER LAMP
M
M
DRIVER OUTSIDE REAR VIEW MIRROR MOTOR
DRIVER OUTSIDE REAR VIEW MIRROR
BLK
J306
G305 (BASE OF RIGHT "A" PILLAR)
EXTERIOR LIGHTS SYSTEM
YEL/VIO
GRN/BLK
WHT
BLK
DEFOGGER SYSTEM
NAVIGATION SYSTEM
BLK
J307
BLK
G305 (BASE OF RIGHT "A" PILLAR)
40
39
41
20
X600
24
X600
GRN/VIO
YEL/VIO
GRN/BLK
WHT
BLK
BRN/YEL
GRY
BLK
6
2
3
1
5
4
7
8
X610
GRN/VIO
YEL/VIO
GRN/BLK
WHT
BLK
BLK
BRN/YEL
GRY
BLK
RIGHT TURN SIGNAL REPEATER LAMP
M
M
PASSENGER OUTSIDE REAR VIEW MIRROR MOTOR
BLK
PASSENGER SIDE OBJECT DETECTION INDICATOR
PASSENGER OUTSIDE REAR VIEW MIRROR GLASS
PASSENGER OUTSIDE REAR VIEW MIRROR
558979

Fig. 86: Power Mirrors Circuit

POWER SEATS

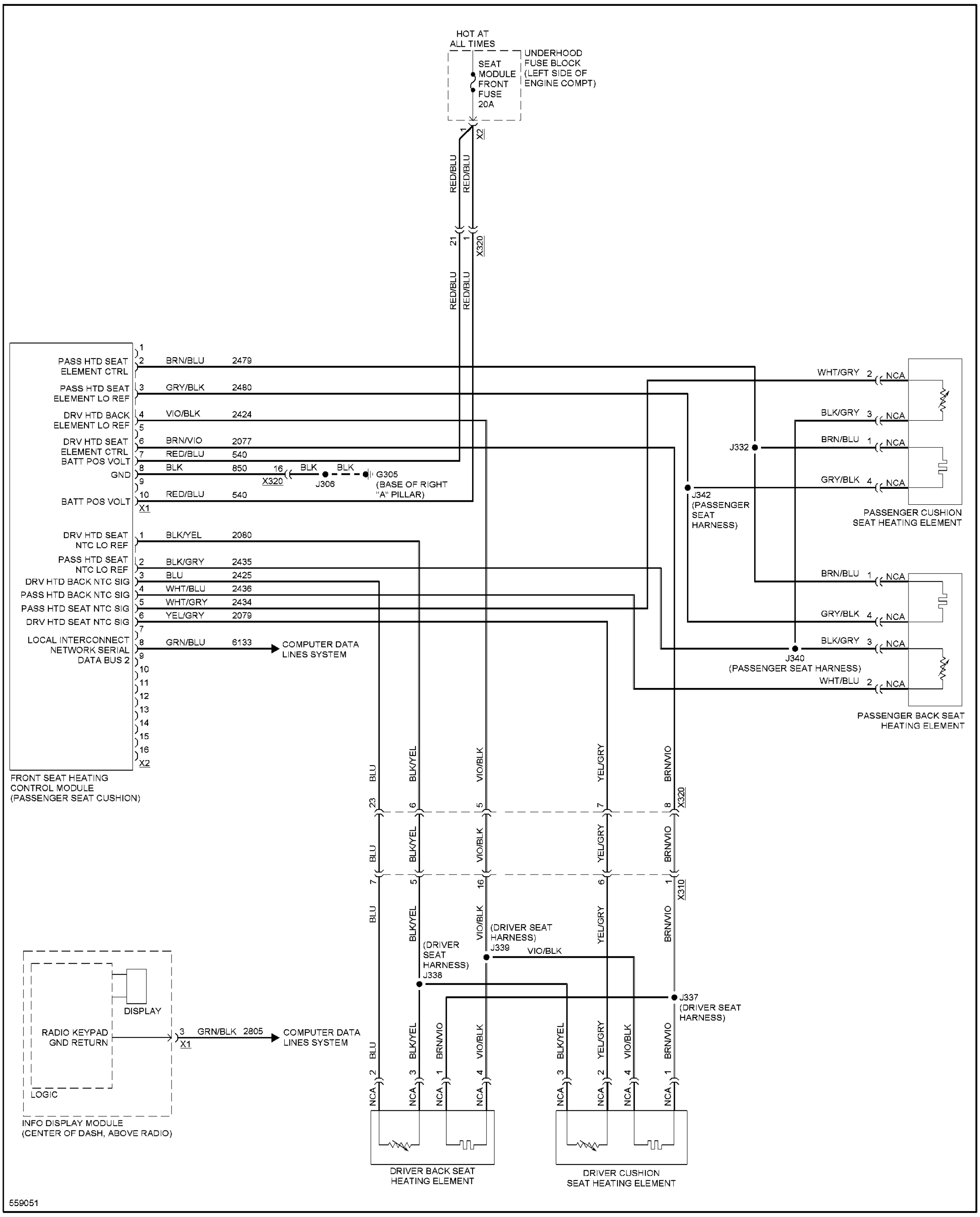

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
SEAT MODULE FRONT FUSE 20A
1
X2
RED/BLU
RED/BLU
21
1
X320
RED/BLU
RED/BLU
PASS HTD SEAT ELEMENT CTRL
PASS HTD SEAT ELEMENT LO REF
DRV HTD BACK ELEMENT LO REF
DRV HTD SEAT ELEMENT CTRL
BATT POS VOLT
GND
BATT POS VOLT
1
2 BRN/BLU 2479
3 GRY/BLK 2480
4 VIO/BLK 2424
5
6 BRN/VIO 2077
7 RED/BLU 540
8 BLK 850
16 X320
BLK
J306
BLK
G305 (BASE OF RIGHT "A" PILLAR)
9
10 RED/BLU 540
X1
DRV HTD SEAT NTC LO REF
PASS HTD SEAT NTC LO REF
DRV HTD BACK NTC SIG
PASS HTD BACK NTC SIG
PASS HTD SEAT NTC SIG
DRV HTD SEAT NTC SIG
LOCAL INTERCONNECT NETWORK SERIAL DATA BUS 2
1 BLK/YEL 2060
2 BLK/GRY 2435
3 BLU 2425
4 WHT/BLU 2436
5 WHT/GRY 2434
6 YEL/GRY 2079
7
8 GRN/BLU 6133
COMPUTER DATA LINES SYSTEM
9
10
11
12
13
14
15
16
X2
FRONT SEAT HEATING CONTROL MODULE (PASSENGER SEAT CUSHION)
WHT/GRY 2 NCA
BLK/GRY 3 NCA
J332
BRN/BLU 1 NCA
GRY/BLK 4 NCA
J342 (PASSENGER SEAT HARNESS)
PASSENGER CUSHION SEAT HEATING ELEMENT
BRN/BLU 1 NCA
GRY/BLK 4 NCA
BLK/GRY 3 NCA
J340 (PASSENGER SEAT HARNESS)
WHT/BLU 2 NCA
PASSENGER BACK SEAT HEATING ELEMENT
BLU
BLK/YEL
VIO/BLK
YEL/GRY
BRN/VIO
23
6
5
7
8
X320
BLU
BLK/YEL
VIO/BLK
YEL/GRY
BRN/VIO
7
5
16
6
1
X310
BLU
BLK/YEL
VIO/BLK
YEL/GRY
BRN/VIO
(DRIVER SEAT HARNESS) J338
(DRIVER SEAT HARNESS) J339
VIO/BLK
J337 (DRIVER SEAT HARNESS)
DISPLAY
RADIO KEYPAD GND RETURN
LOGIC
3 GRN/BLK 2805
X1
COMPUTER DATA LINES SYSTEM
INFO DISPLAY MODULE (CENTER OF DASH, ABOVE RADIO)
BLU 2 NCA
BLK/YEL 3 NCA
BRN/VIO 1 NCA
VIO/BLK 4 NCA
BLK/YEL 3 NCA
YEL/GRY 2 NCA
VIO/BLK 4 NCA
BRN/VIO 1 NCA
DRIVER BACK SEAT HEATING ELEMENT
DRIVER CUSHION SEAT HEATING ELEMENT
559051

Fig. 87: Front Heated Seats Circuit

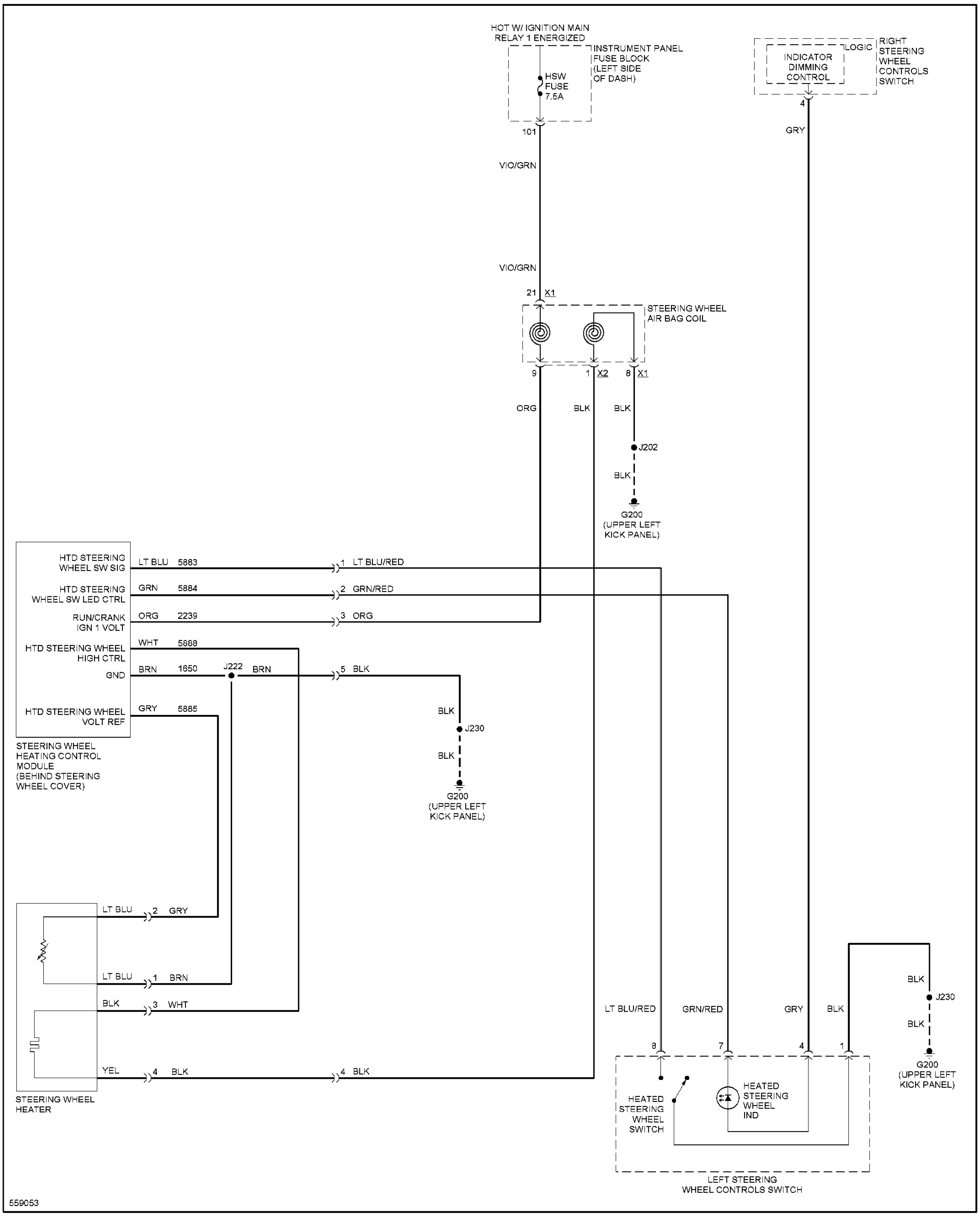
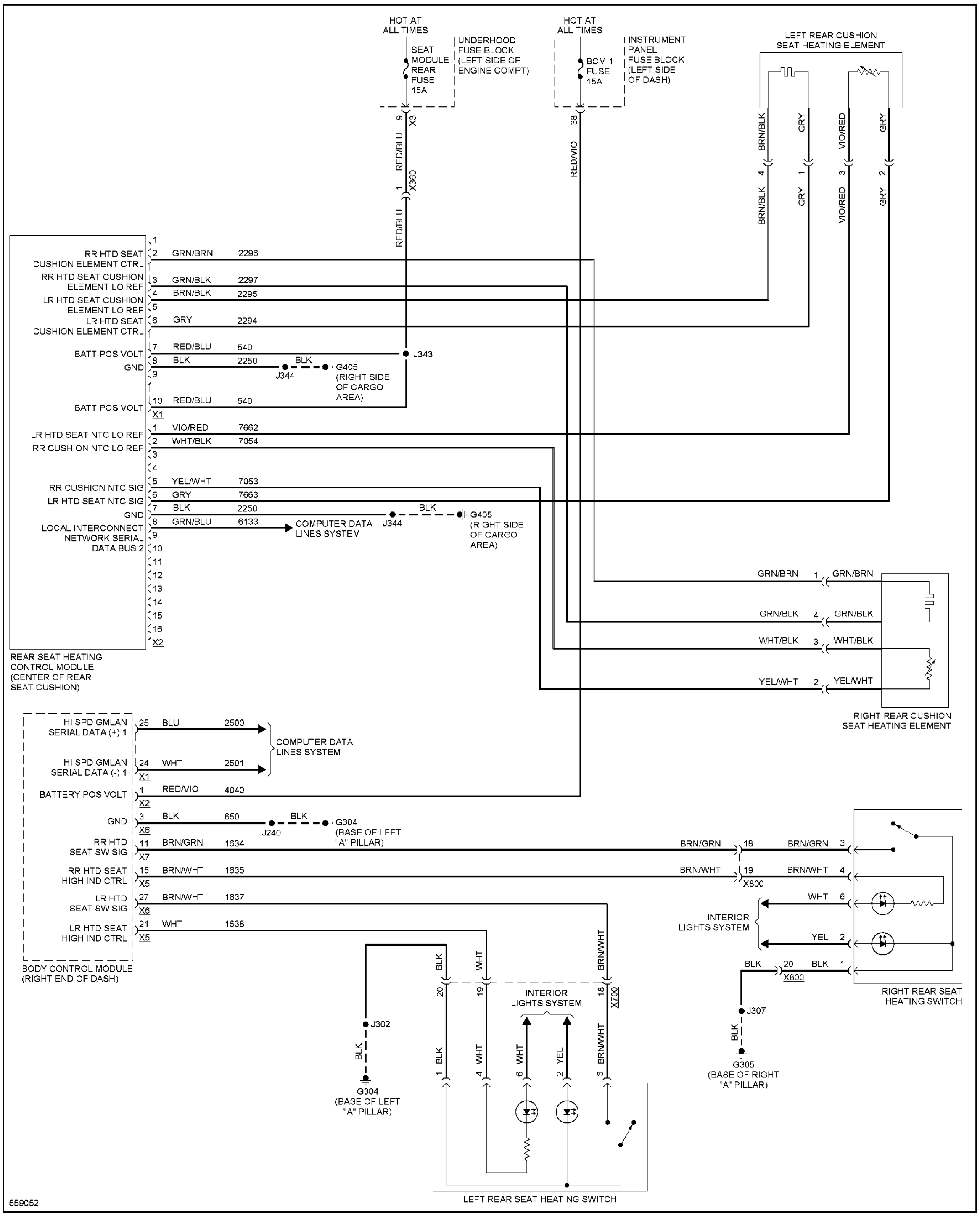

HOT W/ IGNITION MAIN RELAY 1 ENERGIZED
HSW FUSE 7.5A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
101
VIO/GRN
VIO/GRN
INDICATOR DIMMING CONTROL
LOGIC
RIGHT STEERING WHEEL CONTROLS SWITCH
4
GRY
21 X1
STEERING WHEEL AIR BAG COIL
9
1 X2
8 X1
ORG
BLK
BLK
J202
BLK
G200 (UPPER LEFT KICK PANEL)
HTD STEERING WHEEL SW SIG
LT BLU 5883
1 LT BLU/RED
HTD STEERING WHEEL SW LED CTRL
GRN 5884
2 GRN/RED
RUN/CRANK IGN 1 VOLT
ORG 2239
3 ORG
HTD STEERING WHEEL HIGH CTRL
WHT 5888
GND
BRN 1650
J222
BRN
5 BLK
HTD STEERING WHEEL VOLT REF
GRY 5885
BLK
J230
BLK
G200 (UPPER LEFT KICK PANEL)
STEERING WHEEL HEATING CONTROL MODULE (BEHIND STEERING WHEEL COVER)
LT BLU
2 GRY
LT BLU
1 BRN
BLK
3 WHT
YEL
4 BLK
4 BLK
STEERING WHEEL HEATER
BLK
J230
BLK
G200 (UPPER LEFT KICK PANEL)
LT BLU/RED
GRN/RED
GRY
BLK
8
7
4
1
HEATED STEERING WHEEL SWITCH
HEATED STEERING WHEEL IND
LEFT STEERING WHEEL CONTROLS SWITCH
559053

Fig. 88: Heated Steering Wheel Circuit


HOT AT ALL TIMES
SEAT MODULE REAR FUSE 15A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
HOT AT ALL TIMES
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
LEFT REAR CUSHION SEAT HEATING ELEMENT
9 X3 RED/BLU
1 X360 RED/BLU
38 RED/VIO
BRN/BLK 4 BRN/BLK
GRY 1 GRY
VIO/RED 3 VIO/RED
GRY 2 GRY
RR HTD SEAT CUSHION ELEMENT CTRL
RR HTD SEAT CUSHION ELEMENT LO REF
LR HTD SEAT CUSHION ELEMENT LO REF
LR HTD SEAT CUSHION ELEMENT CTRL
BATT POS VOLT
GND
BATT POS VOLT
1
2 GRN/BRN 2296
3 GRN/BLK 2297
4 BRN/BLK 2295
5
6 GRY 2294
7 RED/BLU 540
8 BLK 2250
9
10 RED/BLU 540
X1
J343
BLK
J344
G405 (RIGHT SIDE OF CARGO AREA)
LR HTD SEAT NTC LO REF
RR CUSHION NTC LO REF
RR CUSHION NTC SIG
LR HTD SEAT NTC SIG
GND
LOCAL INTERCONNECT NETWORK SERIAL DATA BUS 2
1 VIO/RED 7662
2 WHT/BLK 7054
3
4
5 YEL/WHT 7053
6 GRY 7663
7 BLK 2250
8 GRN/BLU 6133
9
10
11
12
13
14
15
16
X2
COMPUTER DATA LINES SYSTEM
J344
BLK
G405 (RIGHT SIDE OF CARGO AREA)
REAR SEAT HEATING CONTROL MODULE (CENTER OF REAR SEAT CUSHION)
GRN/BRN 1 GRN/BRN
GRN/BLK 4 GRN/BLK
WHT/BLK 3 WHT/BLK
YEL/WHT 2 YEL/WHT
RIGHT REAR CUSHION SEAT HEATING ELEMENT
HI SPD GMLAN SERIAL DATA (+) 1
25 BLU 2500
HI SPD GMLAN SERIAL DATA (-) 1
24 WHT 2501
X1
COMPUTER DATA LINES SYSTEM
BATTERY POS VOLT
1 RED/VIO 4040
X2
GND
3 BLK 650
X6
J240
BLK
G304 (BASE OF LEFT "A" PILLAR)
RR HTD SEAT SW SIG
11 BRN/GRN 1634
X7
RR HTD SEAT HIGH IND CTRL
15 BRN/WHT 1635
X5
LR HTD SEAT SW SIG
27 BRN/WHT 1637
X6
LR HTD SEAT HIGH IND CTRL
21 WHT 1638
X5
BODY CONTROL MODULE (RIGHT END OF DASH)
BRN/GRN 18 BRN/GRN 3
BRN/WHT 19 BRN/WHT 4
X800
WHT 6
INTERIOR LIGHTS SYSTEM
YEL 2
BLK 20 BLK 1
X800
RIGHT REAR SEAT HEATING SWITCH
J307
BLK
G305 (BASE OF RIGHT "A" PILLAR)
BLK 20
WHT 19
BRN/WHT 18 X700
INTERIOR LIGHTS SYSTEM
J302
BLK
G304 (BASE OF LEFT "A" PILLAR)
BLK 1
WHT 4
WHT 6
YEL 2
BRN/WHT 3
LEFT REAR SEAT HEATING SWITCH
559052

[Fig. 89: Rear Heated Seats Circuit](#)

POWER WINDOWS

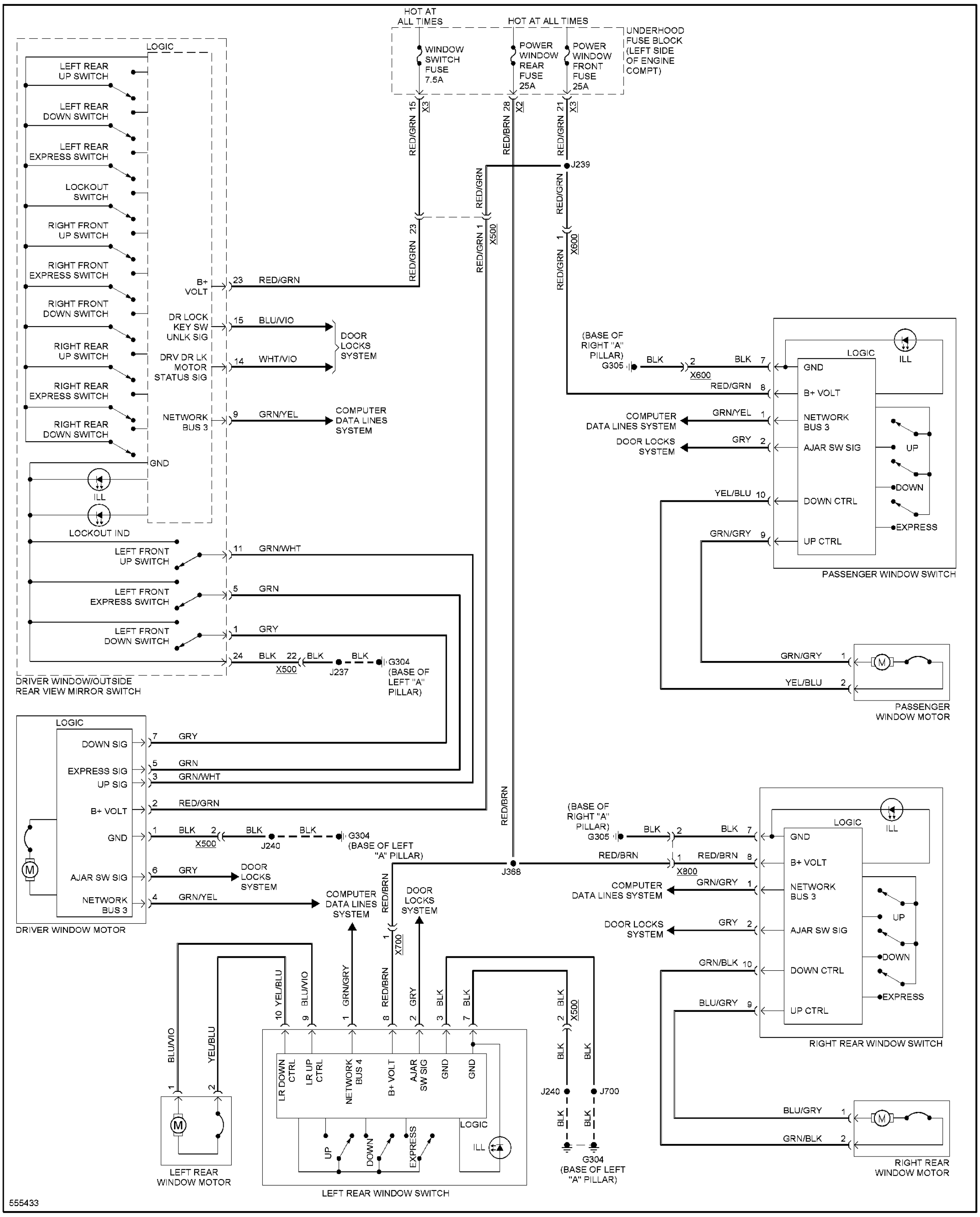

HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
WINDOW SWITCH FUSE 7.5A
POWER WINDOW REAR FUSE 25A
POWER WINDOW FRONT FUSE 25A
LOGIC
LEFT REAR UP SWITCH
LEFT REAR DOWN SWITCH
LEFT REAR EXPRESS SWITCH
LOCKOUT SWITCH
RIGHT FRONT UP SWITCH
RIGHT FRONT EXPRESS SWITCH
RIGHT FRONT DOWN SWITCH
RIGHT REAR UP SWITCH
RIGHT REAR EXPRESS SWITCH
RIGHT REAR DOWN SWITCH
B+ VOLT
DR LOCK KEY SW UNLK SIG
DRV DR LK MOTOR STATUS SIG
NETWORK BUS 3
DOOR LOCKS SYSTEM
COMPUTER DATA LINES SYSTEM
GND
ILL
LOCKOUT IND
LEFT FRONT UP SWITCH
LEFT FRONT EXPRESS SWITCH
LEFT FRONT DOWN SWITCH
DRIVER WINDOW/OUTSIDE REAR VIEW MIRROR SWITCH
G304 (BASE OF LEFT "A" PILLAR)
J237
J239
X500
X600
X700
X800
G305 (BASE OF RIGHT "A" PILLAR)
PASSENGER WINDOW SWITCH
AJAR SW SIG
DOWN CTRL
UP CTRL
UP
DOWN
EXPRESS
PASSENGER WINDOW MOTOR
DRIVER WINDOW MOTOR
DOWN SIG
EXPRESS SIG
UP SIG
J240
J368
J700
RIGHT REAR WINDOW SWITCH
RIGHT REAR WINDOW MOTOR
LEFT REAR WINDOW MOTOR
LEFT REAR WINDOW SWITCH
LR DOWN CTRL
LR UP CTRL
NETWORK BUS 4
RED/GRN
RED/BRN
BLU/VIO
WHT/VIO
GRN/YEL
GRN/WHT
GRN
GRY
BLK
YEL/BLU
GRN/GRY
GRN/BLK
BLU/GRY
555433

Fig. 90: Power Windows Circuit

RADIO

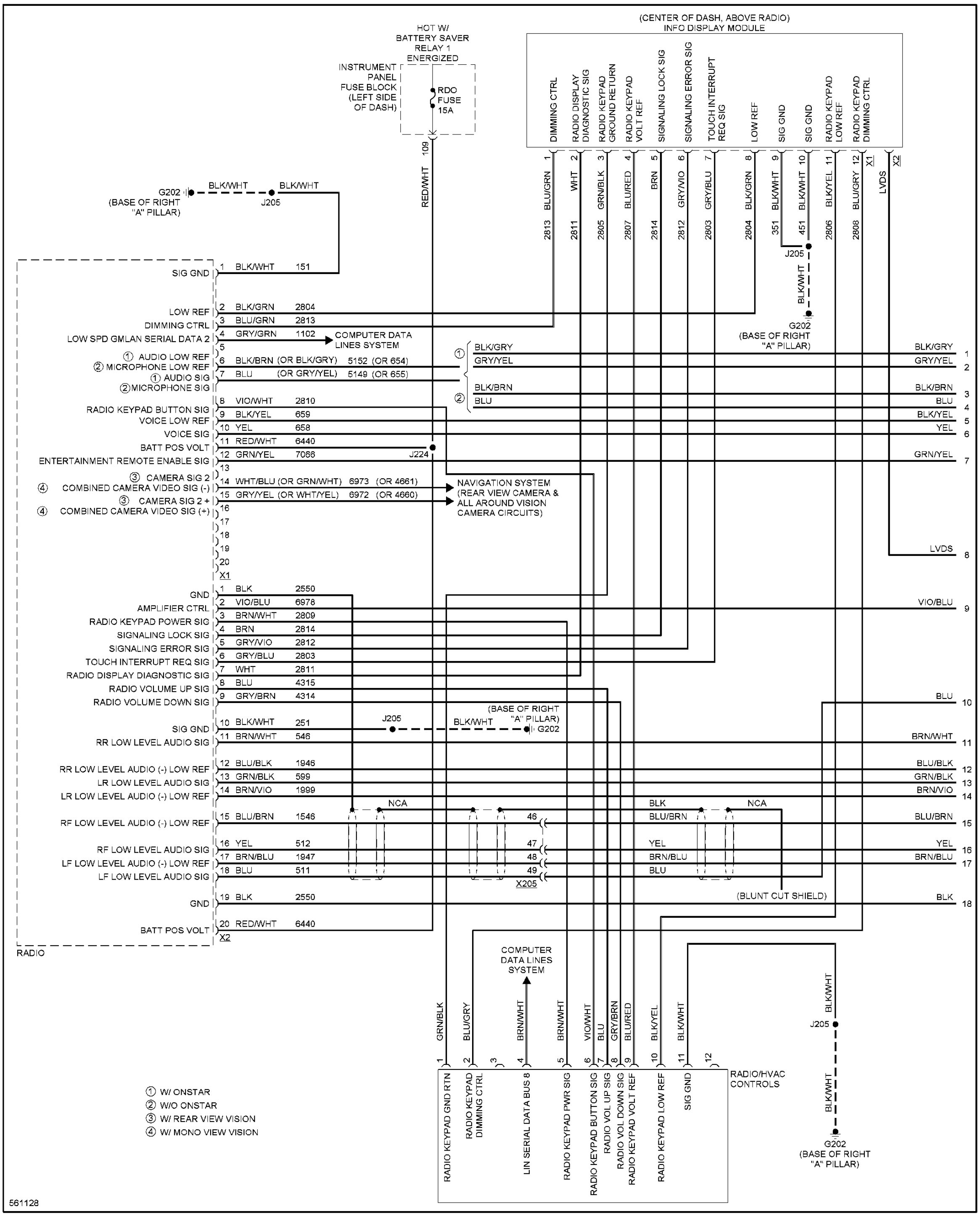

(CENTER OF DASH, ABOVE RADIO)
INFO DISPLAY MODULE
HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
RDO FUSE 15A
109 RED/WHT
DIMMING CTRL
RADIO DISPLAY DIAGNOSTIC SIG
RADIO KEYPAD GROUND RETURN
RADIO KEYPAD VOLT REF
SIGNALING LOCK SIG
SIGNALING ERROR SIG
TOUCH INTERRUPT REQ SIG
LOW REF
SIG GND
SIG GND
RADIO KEYPAD LOW REF
RADIO KEYPAD DIMMING CTRL
1 BLU/GRN 2813
2 WHT 2811
3 GRN/BLK 2805
4 BLU/RED 2807
5 BRN 2814
6 GRY/VIO 2812
7 GRY/BLU 2803
8 BLK/GRN 2804
9 BLK/WHT 351
10 BLK/WHT 451
11 BLK/YEL 2806
12 BLU/GRY 2808
X1
X2
LVDS
J205
BLK/WHT
G202 (BASE OF RIGHT "A" PILLAR)
G202 (BASE OF RIGHT "A" PILLAR)
BLK/WHT
J205
BLK/WHT
SIG GND 1 BLK/WHT 151
LOW REF 2 BLK/GRN 2804
DIMMING CTRL 3 BLU/GRN 2813
LOW SPD GMLAN SERIAL DATA 2 4 GRY/GRN 1102
COMPUTER DATA LINES SYSTEM
5
① AUDIO LOW REF 6 BLK/BRN (OR BLK/GRY) 5152 (OR 654)
② MICROPHONE LOW REF
① AUDIO SIG 7 BLU (OR GRY/YEL) 5149 (OR 655)
② MICROPHONE SIG
① BLK/GRY
GRY/YEL
② BLK/BRN
BLU
RADIO KEYPAD BUTTON SIG 8 VIO/WHT 2810
VOICE LOW REF 9 BLK/YEL 659
VOICE SIG 10 YEL 658
BATT POS VOLT 11 RED/WHT 6440
ENTERTAINMENT REMOTE ENABLE SIG 12 GRN/YEL 7066
J224
13
③ CAMERA SIG 2 - 14 WHT/BLU (OR GRN/WHT) 6973 (OR 4661)
④ COMBINED CAMERA VIDEO SIG (-)
③ CAMERA SIG 2 + 15 GRY/YEL (OR WHT/YEL) 6972 (OR 4660)
④ COMBINED CAMERA VIDEO SIG (+)
NAVIGATION SYSTEM (REAR VIEW CAMERA & ALL AROUND VISION CAMERA CIRCUITS)
16
17
18
19
20
X1
GND 1 BLK 2550
AMPLIFIER CTRL 2 VIO/BLU 6978
RADIO KEYPAD POWER SIG 3 BRN/WHT 2809
SIGNALING LOCK SIG 4 BRN 2814
SIGNALING ERROR SIG 5 GRY/VIO 2812
TOUCH INTERRUPT REQ SIG 6 GRY/BLU 2803
RADIO DISPLAY DIAGNOSTIC SIG 7 WHT 2811
RADIO VOLUME UP SIG 8 BLU 4315
RADIO VOLUME DOWN SIG 9 GRY/BRN 4314
SIG GND 10 BLK/WHT 251
J205
BLK/WHT
(BASE OF RIGHT "A" PILLAR) G202
RR LOW LEVEL AUDIO SIG 11 BRN/WHT 546
RR LOW LEVEL AUDIO (-) LOW REF 12 BLU/BLK 1946
LR LOW LEVEL AUDIO SIG 13 GRN/BLK 599
LR LOW LEVEL AUDIO (-) LOW REF 14 BRN/VIO 1999
NCA
BLK
NCA
RF LOW LEVEL AUDIO (-) LOW REF 15 BLU/BRN 1546
46
BLU/BRN
RF LOW LEVEL AUDIO SIG 16 YEL 512
47
YEL
LF LOW LEVEL AUDIO (-) LOW REF 17 BRN/BLU 1947
48
BRN/BLU
LF LOW LEVEL AUDIO SIG 18 BLU 511
49
BLU
X205
(BLUNT CUT SHIELD)
GND 19 BLK 2550
BATT POS VOLT 20 RED/WHT 6440
X2
RADIO
BLK/GRY 1
GRY/YEL 2
BLK/BRN 3
BLU 4
BLK/YEL 5
YEL 6
GRN/YEL 7
LVDS 8
VIO/BLU 9
BLU 10
BRN/WHT 11
BLU/BLK 12
GRN/BLK 13
BRN/VIO 14
BLU/BRN 15
YEL 16
BRN/BLU 17
BLK 18
COMPUTER DATA LINES SYSTEM
1 GRN/BLK RADIO KEYPAD GND RTN
2 BLU/GRY RADIO KEYPAD DIMMING CTRL
3
4 BRN/WHT LIN SERIAL DATA BUS 8
5 BRN/WHT RADIO KEYPAD PWR SIG
6 VIO/WHT RADIO KEYPAD BUTTON SIG
7 BLU RADIO VOL UP SIG
8 GRY/BRN RADIO VOL DOWN SIG
9 BLU/RED RADIO KEYPAD VOLT REF
10 BLK/YEL RADIO KEYPAD LOW REF
11 BLK/WHT SIG GND
12
RADIO/HVAC CONTROLS
BLK/WHT
J205
BLK/WHT
G202 (BASE OF RIGHT "A" PILLAR)
① W/ ONSTAR
② W/O ONSTAR
③ W/ REAR VIEW VISION
④ W/ MONO VIEW VISION
561128

Fig. 91: Radio Circuit, W/ Amplifier (1 of 4)

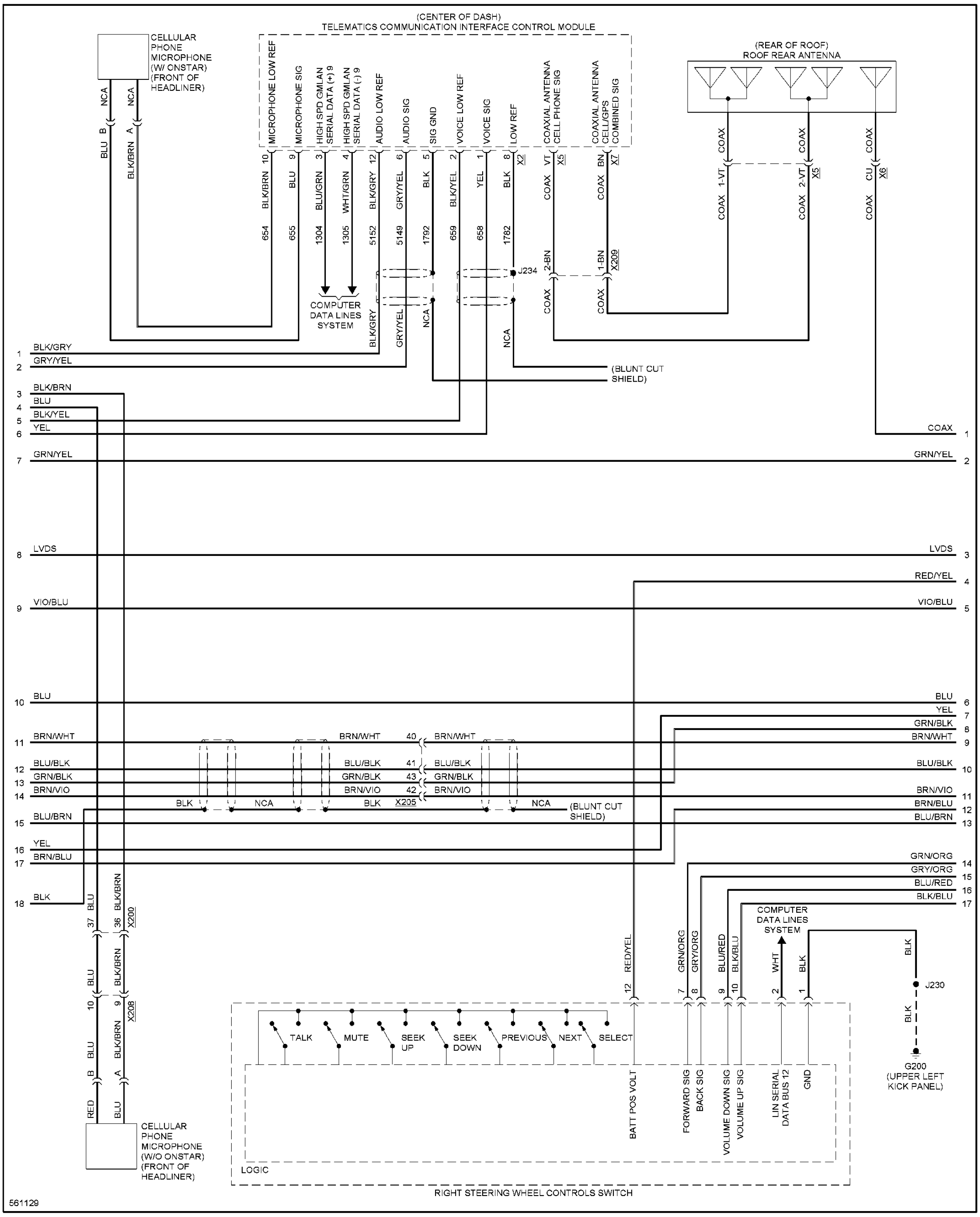

(CENTER OF DASH)
TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE
CELLULAR PHONE MICROPHONE (W/ ONSTAR) (FRONT OF HEADLINER)
NCA
NCA
BLU B
BLK/BRN A
MICROPHONE LOW REF 10
MICROPHONE SIG 9
HIGH SPD GMLAN SERIAL DATA (+) 9 3
HIGH SPD GMLAN SERIAL DATA (-) 9 4
AUDIO LOW REF 12
AUDIO SIG 6
SIG GND 5
VOICE LOW REF 2
VOICE SIG 1
LOW REF 8
X2
COAXIAL ANTENNA CELL PHONE SIG VT X5
COAXIAL ANTENNA CELL/GPS COMBINED SIG BN X7
(REAR OF ROOF)
ROOF REAR ANTENNA
COAX
COAX
COAX
COAX 1-VT
COAX 2-VT X5
COAX CU X6
654 BLK/BRN
655 BLU
1304 BLU/GRN
1305 WHT/GRN
5152 BLK/GRY
5149 GRY/YEL
1792 BLK
659 BLK/YEL
658 YEL
1782 BLK
COAX 2-BN
COAX 1-BN X209
J234
COMPUTER DATA LINES SYSTEM
BLK/GRY
GRY/YEL
NCA
NCA
(BLUNT CUT SHIELD)
1 BLK/GRY
2 GRY/YEL
3 BLK/BRN
4 BLU
5 BLK/YEL
6 YEL
7 GRN/YEL
8 LVDS
9 VIO/BLU
10 BLU
11 BRN/WHT
12 BLU/BLK
13 GRN/BLK
14 BRN/VIO
15 BLU/BRN
16 YEL
17 BRN/BLU
18 BLK
COAX 1
GRN/YEL 2
LVDS 3
RED/YEL 4
VIO/BLU 5
BLU 6
YEL 7
GRN/BLK 8
BRN/WHT 9
BLU/BLK 10
BRN/VIO 11
BRN/BLU 12
BLU/BRN 13
GRN/ORG 14
GRY/ORG 15
BLU/RED 16
BLK/BLU 17
BRN/WHT 40 BRN/WHT
BLU/BLK 41 BLU/BLK
GRN/BLK 43 GRN/BLK
BRN/VIO 42 BRN/VIO
BLK
NCA
BLK X205
NCA
(BLUNT CUT SHIELD)
37 BLU
36 BLK/BRN X200
BLU 10
BLK/BRN 9 X208
BLU B
BLK/BRN A
RED
BLU
CELLULAR PHONE MICROPHONE (W/O ONSTAR) (FRONT OF HEADLINER)
RED/YEL 12
GRN/ORG 7
GRY/ORG 8
BLU/RED 9
BLK/BLU 10
COMPUTER DATA LINES SYSTEM
WHT 2
BLK 1
BLK
J230
BLK
G200 (UPPER LEFT KICK PANEL)
TALK
MUTE
SEEK UP
SEEK DOWN
PREVIOUS
NEXT
SELECT
BATT POS VOLT
FORWARD SIG
BACK SIG
VOLUME DOWN SIG
VOLUME UP SIG
LIN SERIAL DATA BUS 12
GND
LOGIC
RIGHT STEERING WHEEL CONTROLS SWITCH
561129

Fig. 92: Radio Circuit, W/ Amplifier (2 of 4)

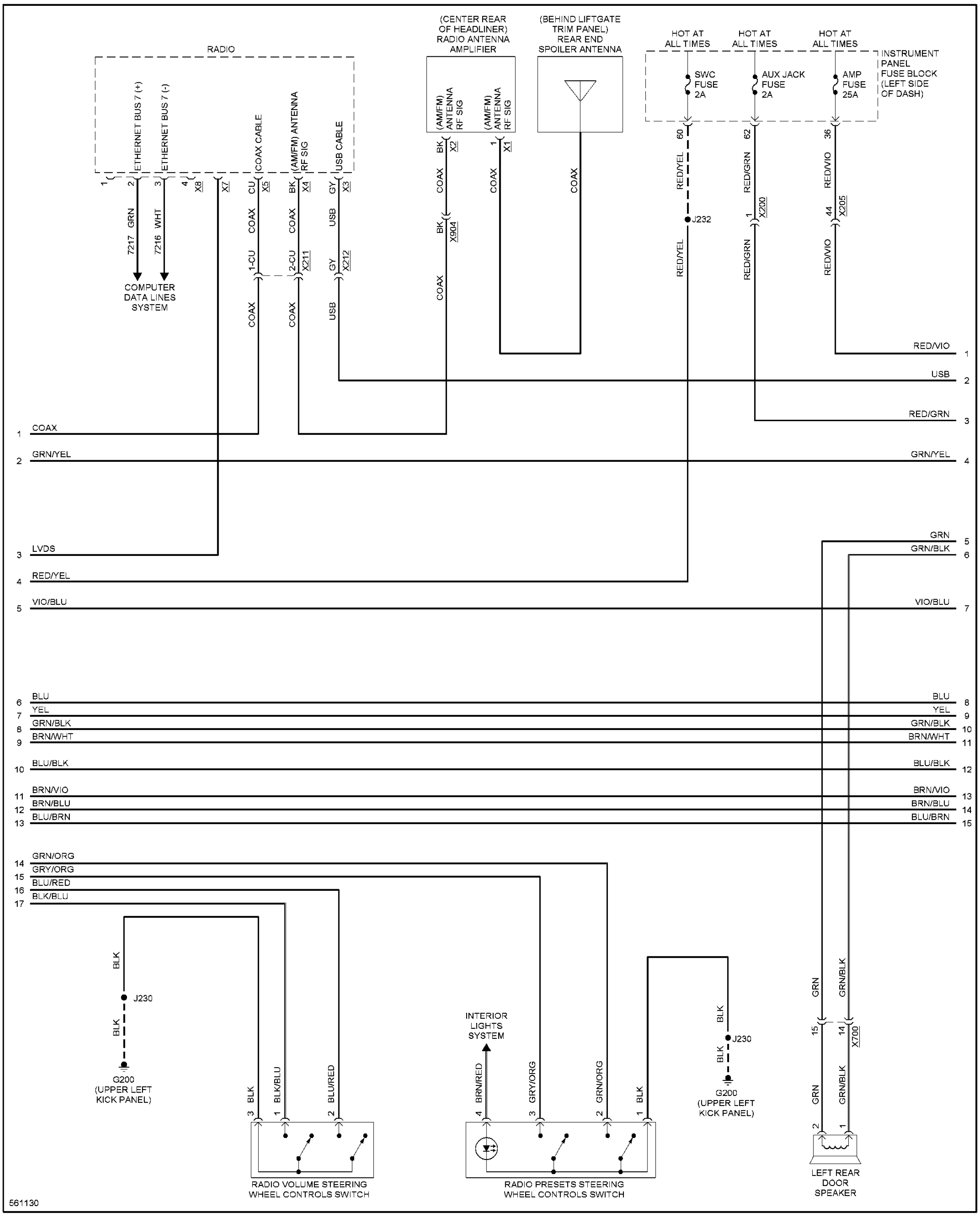

RADIO
ETHERNET BUS 7 (+)
ETHERNET BUS 7 (-)
COAX CABLE
(AM/FM) ANTENNA RF SIG
USB CABLE
X8
X7
X5
X4
X3
7217 GRN
7216 WHT
COMPUTER DATA LINES SYSTEM
1-CU
2-CU
X211
X212
COAX
USB
GY
BK
CU
(CENTER REAR OF HEADLINER) RADIO ANTENNA AMPLIFIER
(AM/FM) ANTENNA RF SIG
X2
X1
X904
(BEHIND LIFTGATE TRIM PANEL) REAR END SPOILER ANTENNA
HOT AT ALL TIMES
SWC FUSE 2A
AUX JACK FUSE 2A
AMP FUSE 25A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
60
62
36
RED/YEL
RED/GRN
RED/VIO
J232
X200
44
X205
RED/VIO 1
USB 2
RED/GRN 3
GRN/YEL 4
GRN 5
GRN/BLK 6
VIO/BLU 7
BLU 8
YEL 9
GRN/BLK 10
BRN/WHT 11
BLU/BLK 12
BRN/VIO 13
BRN/BLU 14
BLU/BRN 15
1 COAX
2 GRN/YEL
3 LVDS
4 RED/YEL
5 VIO/BLU
6 BLU
7 YEL
8 GRN/BLK
9 BRN/WHT
10 BLU/BLK
11 BRN/VIO
12 BRN/BLU
13 BLU/BRN
14 GRN/ORG
15 GRY/ORG
16 BLU/RED
17 BLK/BLU
BLK
J230
G200 (UPPER LEFT KICK PANEL)
3 BLK
1 BLK/BLU
2 BLU/RED
RADIO VOLUME STEERING WHEEL CONTROLS SWITCH
INTERIOR LIGHTS SYSTEM
4 BRN/RED
3 GRY/ORG
2 GRN/ORG
1 BLK
RADIO PRESETS STEERING WHEEL CONTROLS SWITCH
J230
G200 (UPPER LEFT KICK PANEL)
GRN
GRN/BLK
15
14
X700
LEFT REAR DOOR SPEAKER
561130

Fig. 93: Radio Circuit, W/ Amplifier (3 of 4)

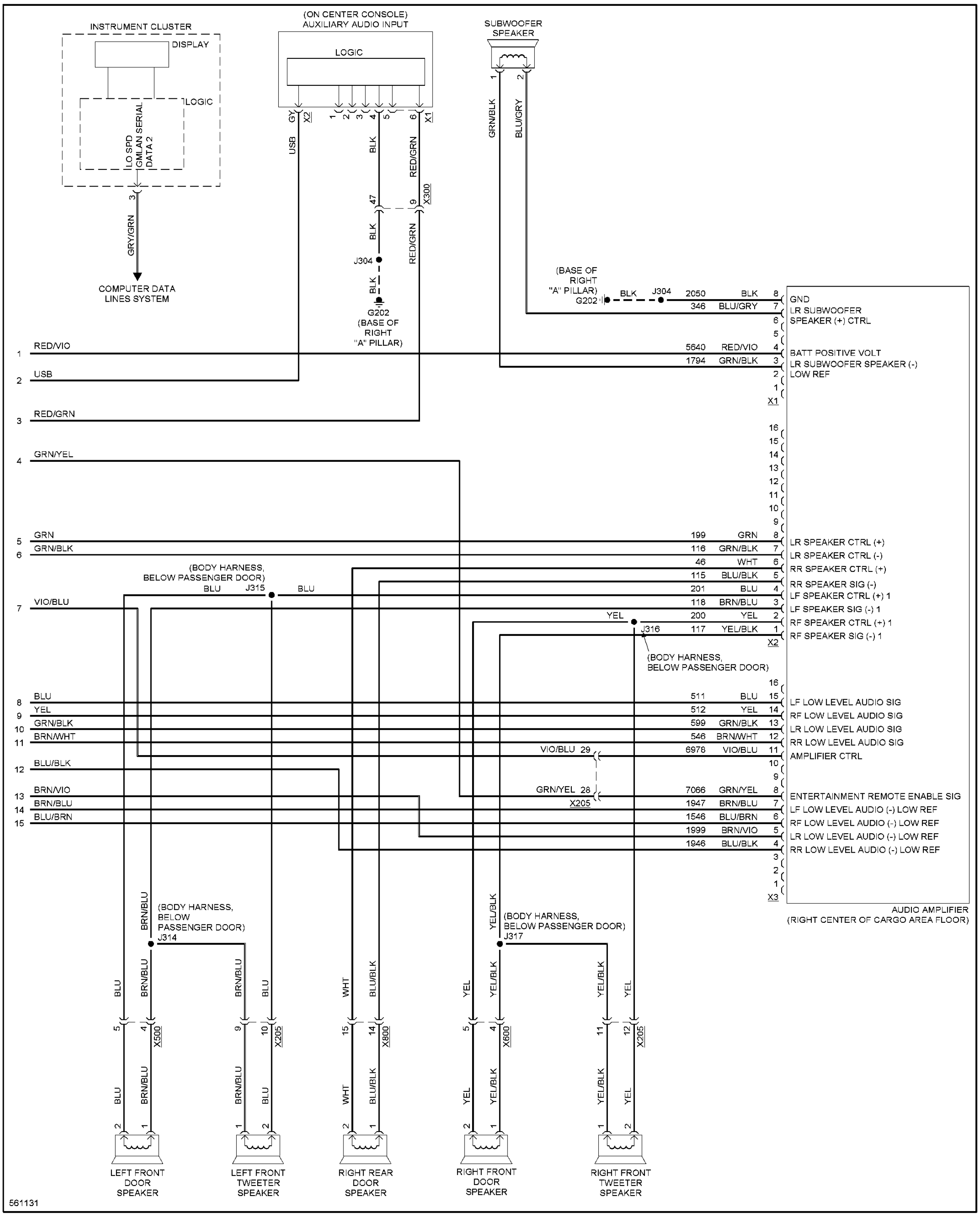

INSTRUMENT CLUSTER
DISPLAY
LOGIC
LO SPD GMLAN SERIAL DATA 2
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
(ON CENTER CONSOLE) AUXILIARY AUDIO INPUT
LOGIC
GY
X2
1
2
3
4
5
6
X1
USB
BLK
RED/GRN
47
9
X300
J304
G202 (BASE OF RIGHT "A" PILLAR)
SUBWOOFER SPEAKER
1
2
GRN/BLK
BLU/GRY
(BASE OF RIGHT "A" PILLAR) G202
BLK
J304
2050 BLK 8 GND
346 BLU/GRY 7 LR SUBWOOFER SPEAKER (+) CTRL
6
5
5640 RED/VIO 4 BATT POSITIVE VOLT
1794 GRN/BLK 3 LR SUBWOOFER SPEAKER (-)
2 LOW REF
1
X1
1 RED/VIO
2 USB
3 RED/GRN
4 GRN/YEL
16
15
14
13
12
11
10
9
5 GRN
6 GRN/BLK
199 GRN 8 LR SPEAKER CTRL (+)
116 GRN/BLK 7 LR SPEAKER CTRL (-)
46 WHT 6 RR SPEAKER CTRL (+)
115 BLU/BLK 5 RR SPEAKER SIG (-)
(BODY HARNESS, BELOW PASSENGER DOOR)
BLU J315 BLU
201 BLU 4 LF SPEAKER CTRL (+) 1
7 VIO/BLU
118 BRN/BLU 3 LF SPEAKER SIG (-) 1
YEL
200 YEL 2 RF SPEAKER CTRL (+) 1
J316
117 YEL/BLK 1 RF SPEAKER SIG (-) 1
X2
(BODY HARNESS, BELOW PASSENGER DOOR)
16
8 BLU
9 YEL
10 GRN/BLK
11 BRN/WHT
511 BLU 15 LF LOW LEVEL AUDIO SIG
512 YEL 14 RF LOW LEVEL AUDIO SIG
599 GRN/BLK 13 LR LOW LEVEL AUDIO SIG
546 BRN/WHT 12 RR LOW LEVEL AUDIO SIG
VIO/BLU 29
6978 VIO/BLU 11 AMPLIFIER CTRL
12 BLU/BLK
10
9
GRN/YEL 28
X205
13 BRN/VIO
14 BRN/BLU
15 BLU/BRN
7066 GRN/YEL 8 ENTERTAINMENT REMOTE ENABLE SIG
1947 BRN/BLU 7 LF LOW LEVEL AUDIO (-) LOW REF
1546 BLU/BRN 6 RF LOW LEVEL AUDIO (-) LOW REF
1999 BRN/VIO 5 LR LOW LEVEL AUDIO (-) LOW REF
1946 BLU/BLK 4 RR LOW LEVEL AUDIO (-) LOW REF
3
2
1
X3
AUDIO AMPLIFIER (RIGHT CENTER OF CARGO AREA FLOOR)
BRN/BLU
(BODY HARNESS, BELOW PASSENGER DOOR) J314
YEL/BLK
(BODY HARNESS, BELOW PASSENGER DOOR) J317
BLU
BRN/BLU
BRN/BLU
BLU
WHT
BLU/BLK
YEL
YEL/BLK
YEL/BLK
YEL
5
4
X500
9
10
X205
15
14
X800
5
4
X600
11
12
X205
BLU
BRN/BLU
BRN/BLU
BLU
WHT
BLU/BLK
YEL
YEL/BLK
YEL/BLK
YEL
2
1
1
2
2
1
2
1
1
2
LEFT FRONT DOOR SPEAKER
LEFT FRONT TWEETER SPEAKER
RIGHT REAR DOOR SPEAKER
RIGHT FRONT DOOR SPEAKER
RIGHT FRONT TWEETER SPEAKER
561131

Fig. 94: Radio Circuit, W/ Amplifier (4 of 4)

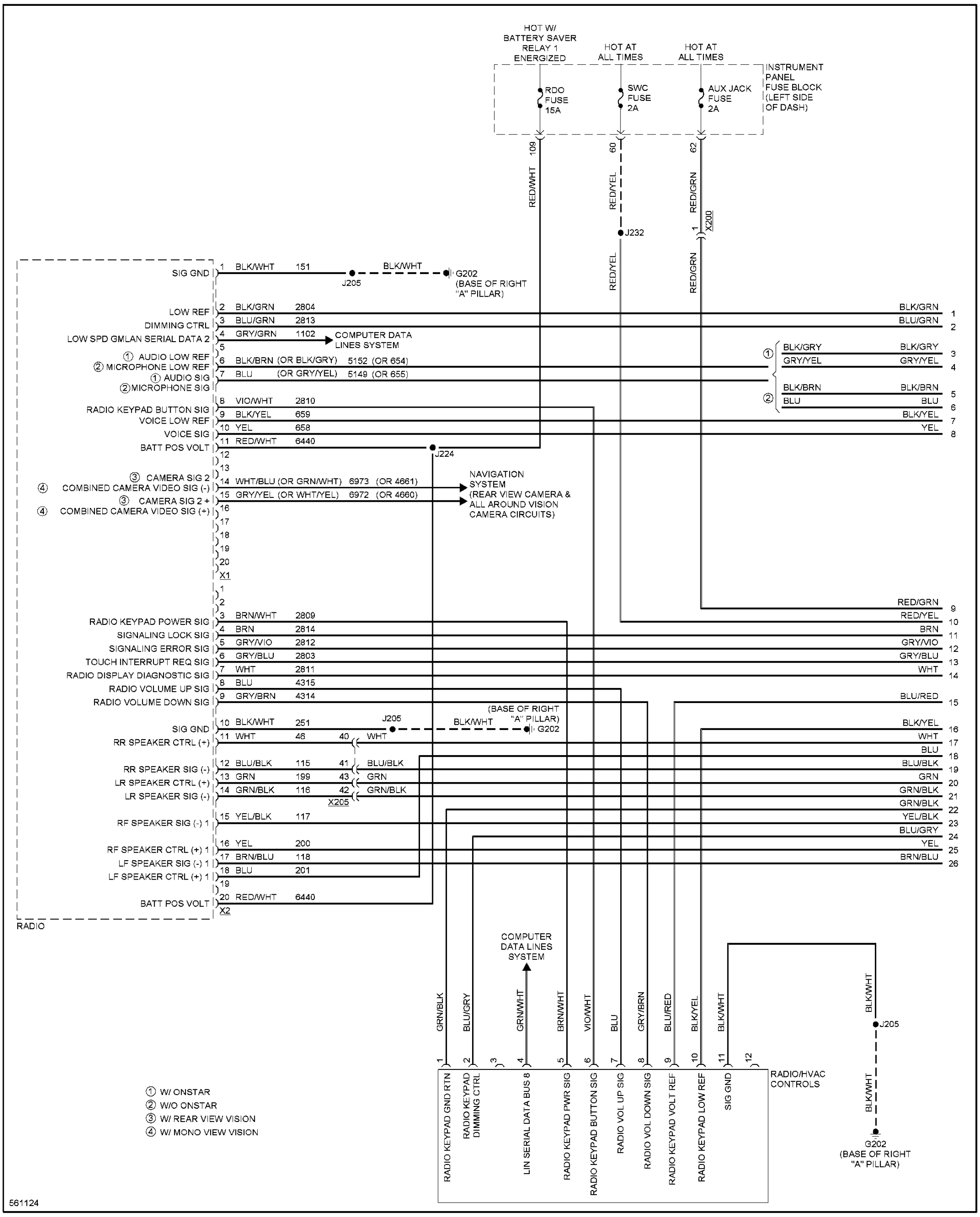

HOT W/ BATTERY SAVER RELAY 1 ENERGIZED
HOT AT ALL TIMES
HOT AT ALL TIMES
RDO FUSE 15A
SWC FUSE 2A
AUX JACK FUSE 2A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
109 RED/WHT
60 RED/YEL
62 RED/GRN
J232
1 X200
RED/YEL
RED/GRN
SIG GND
1 BLK/WHT 151
J205
BLK/WHT
G202 (BASE OF RIGHT "A" PILLAR)
LOW REF
2 BLK/GRN 2804
DIMMING CTRL
3 BLU/GRN 2813
LOW SPD GMLAN SERIAL DATA 2
4 GRY/GRN 1102
COMPUTER DATA LINES SYSTEM
5
① AUDIO LOW REF
② MICROPHONE LOW REF
6 BLK/BRN (OR BLK/GRY) 5152 (OR 654)
① AUDIO SIG
② MICROPHONE SIG
7 BLU (OR GRY/YEL) 5149 (OR 655)
RADIO KEYPAD BUTTON SIG
8 VIO/WHT 2810
VOICE LOW REF
9 BLK/YEL 659
VOICE SIG
10 YEL 658
BATT POS VOLT
11 RED/WHT 6440
J224
12
13
③ CAMERA SIG 2
④ COMBINED CAMERA VIDEO SIG (-)
14 WHT/BLU (OR GRN/WHT) 6973 (OR 4661)
③ CAMERA SIG 2 +
④ COMBINED CAMERA VIDEO SIG (+)
15 GRY/YEL (OR WHT/YEL) 6972 (OR 4660)
NAVIGATION SYSTEM (REAR VIEW CAMERA & ALL AROUND VISION CAMERA CIRCUITS)
16
17
18
19
20
X1
BLK/GRN 1
BLU/GRN 2
① BLK/GRY BLK/GRY 3
GRY/YEL GRY/YEL 4
② BLK/BRN BLK/BRN 5
BLU BLU 6
BLK/YEL 7
YEL 8
1
2
RADIO KEYPAD POWER SIG
3 BRN/WHT 2809
SIGNALING LOCK SIG
4 BRN 2814
SIGNALING ERROR SIG
5 GRY/VIO 2812
TOUCH INTERRUPT REQ SIG
6 GRY/BLU 2803
RADIO DISPLAY DIAGNOSTIC SIG
7 WHT 2811
RADIO VOLUME UP SIG
8 BLU 4315
RADIO VOLUME DOWN SIG
9 GRY/BRN 4314
SIG GND
10 BLK/WHT 251
J205
BLK/WHT
(BASE OF RIGHT "A" PILLAR) G202
RR SPEAKER CTRL (+)
11 WHT 46 40 WHT
RR SPEAKER SIG (-)
12 BLU/BLK 115 41 BLU/BLK
LR SPEAKER CTRL (+)
13 GRN 199 43 GRN
LR SPEAKER SIG (-)
14 GRN/BLK 116 42 GRN/BLK
X205
RF SPEAKER SIG (-) 1
15 YEL/BLK 117
RF SPEAKER CTRL (+) 1
16 YEL 200
LF SPEAKER SIG (-) 1
17 BRN/BLU 118
LF SPEAKER CTRL (+) 1
18 BLU 201
19
BATT POS VOLT
20 RED/WHT 6440
X2
RADIO
RED/GRN 9
RED/YEL 10
BRN 11
GRY/VIO 12
GRY/BLU 13
WHT 14
BLU/RED 15
BLK/YEL 16
WHT 17
BLU 18
BLU/BLK 19
GRN 20
GRN/BLK 21
GRN/BLK 22
YEL/BLK 23
BLU/GRY 24
YEL 25
BRN/BLU 26
COMPUTER DATA LINES SYSTEM
GRN/BLK
BLU/GRY
GRN/WHT
BRN/WHT
VIO/WHT
BLU
GRY/BRN
BLU/RED
BLK/YEL
BLK/WHT
BLK/WHT
J205
BLK/WHT
G202 (BASE OF RIGHT "A" PILLAR)
1 RADIO KEYPAD GND RTN
2 RADIO KEYPAD DIMMING CTRL
3
4 LIN SERIAL DATA BUS 8
5 RADIO KEYPAD PWR SIG
6 RADIO KEYPAD BUTTON SIG
7 RADIO VOL UP SIG
8 RADIO VOL DOWN SIG
9 RADIO KEYPAD VOLT REF
10 RADIO KEYPAD LOW REF
11 SIG GND
12
RADIO/HVAC CONTROLS
① W/ ONSTAR
② W/O ONSTAR
③ W/ REAR VIEW VISION
④ W/ MONO VIEW VISION
561124

Fig. 95: Radio Circuit, W/O Amplifier (1 of 4)

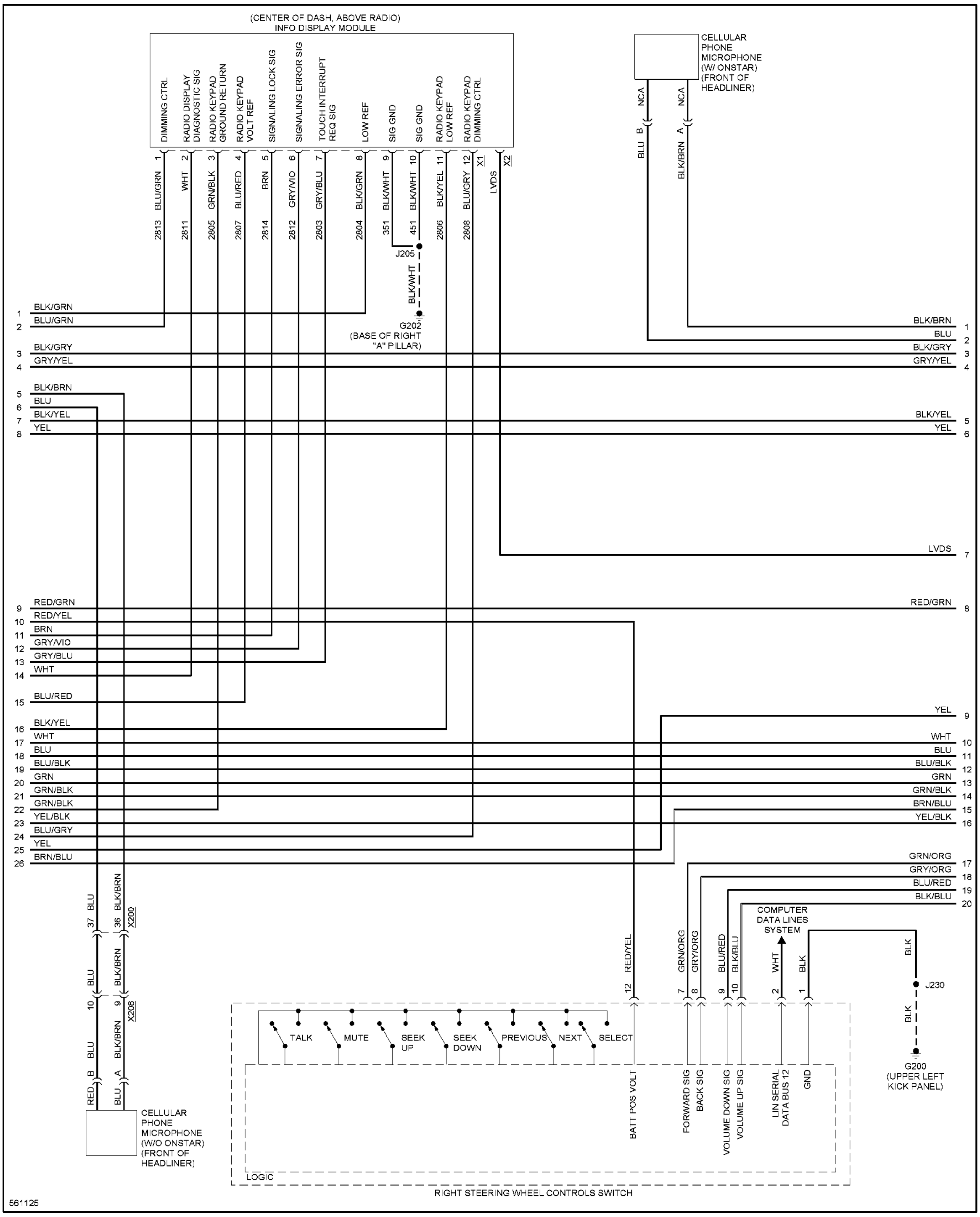

(CENTER OF DASH, ABOVE RADIO)
INFO DISPLAY MODULE
DIMMING CTRL
RADIO DISPLAY DIAGNOSTIC SIG
RADIO KEYPAD GROUND RETURN
RADIO KEYPAD VOLT REF
SIGNALING LOCK SIG
SIGNALING ERROR SIG
TOUCH INTERRUPT REQ SIG
LOW REF
SIG GND
SIG GND
RADIO KEYPAD LOW REF
RADIO KEYPAD DIMMING CTRL
1 2 3 4 5 6 7 8 9 10 11 12 X1 X2
2813 BLU/GRN
2811 WHT
2805 GRN/BLK
2807 BLU/RED
2814 BRN
2812 GRY/VIO
2803 GRY/BLU
2804 BLK/GRN
351 BLK/WHT
451 BLK/WHT
2806 BLK/YEL
2808 BLU/GRY
LVDS
J205
BLK/WHT
G202
(BASE OF RIGHT "A" PILLAR)
CELLULAR PHONE MICROPHONE (W/ ONSTAR) (FRONT OF HEADLINER)
NCA
NCA
BLU B
BLK/BRN A
1 BLK/GRN
2 BLU/GRN
3 BLK/GRY
4 GRY/YEL
5 BLK/BRN
6 BLU
7 BLK/YEL
8 YEL
9 RED/GRN
10 RED/YEL
11 BRN
12 GRY/VIO
13 GRY/BLU
14 WHT
15 BLU/RED
16 BLK/YEL
17 WHT
18 BLU
19 BLU/BLK
20 GRN
21 GRN/BLK
22 GRN/BLK
23 YEL/BLK
24 BLU/GRY
25 YEL
26 BRN/BLU
BLK/BRN 1
BLU 2
BLK/GRY 3
GRY/YEL 4
BLK/YEL 5
YEL 6
LVDS 7
RED/GRN 8
YEL 9
WHT 10
BLU 11
BLU/BLK 12
GRN 13
GRN/BLK 14
BRN/BLU 15
YEL/BLK 16
GRN/ORG 17
GRY/ORG 18
BLU/RED 19
BLK/BLU 20
37 BLU
36 BLK/BRN
X200
10 BLU
9 BLK/BRN
X208
BLU B
BLK/BRN A
RED
BLU
CELLULAR PHONE MICROPHONE (W/O ONSTAR) (FRONT OF HEADLINER)
COMPUTER DATA LINES SYSTEM
12 RED/YEL
7 GRN/ORG
8 GRY/ORG
9 BLU/RED
10 BLK/BLU
2 WHT
1 BLK
BLK
J230
BLK
G200
(UPPER LEFT KICK PANEL)
TALK
MUTE
SEEK UP
SEEK DOWN
PREVIOUS
NEXT
SELECT
BATT POS VOLT
FORWARD SIG
BACK SIG
VOLUME DOWN SIG
VOLUME UP SIG
LIN SERIAL DATA BUS 12
GND
LOGIC
RIGHT STEERING WHEEL CONTROLS SWITCH
561125

Fig. 96: Radio Circuit, W/O Amplifier (2 of 4)

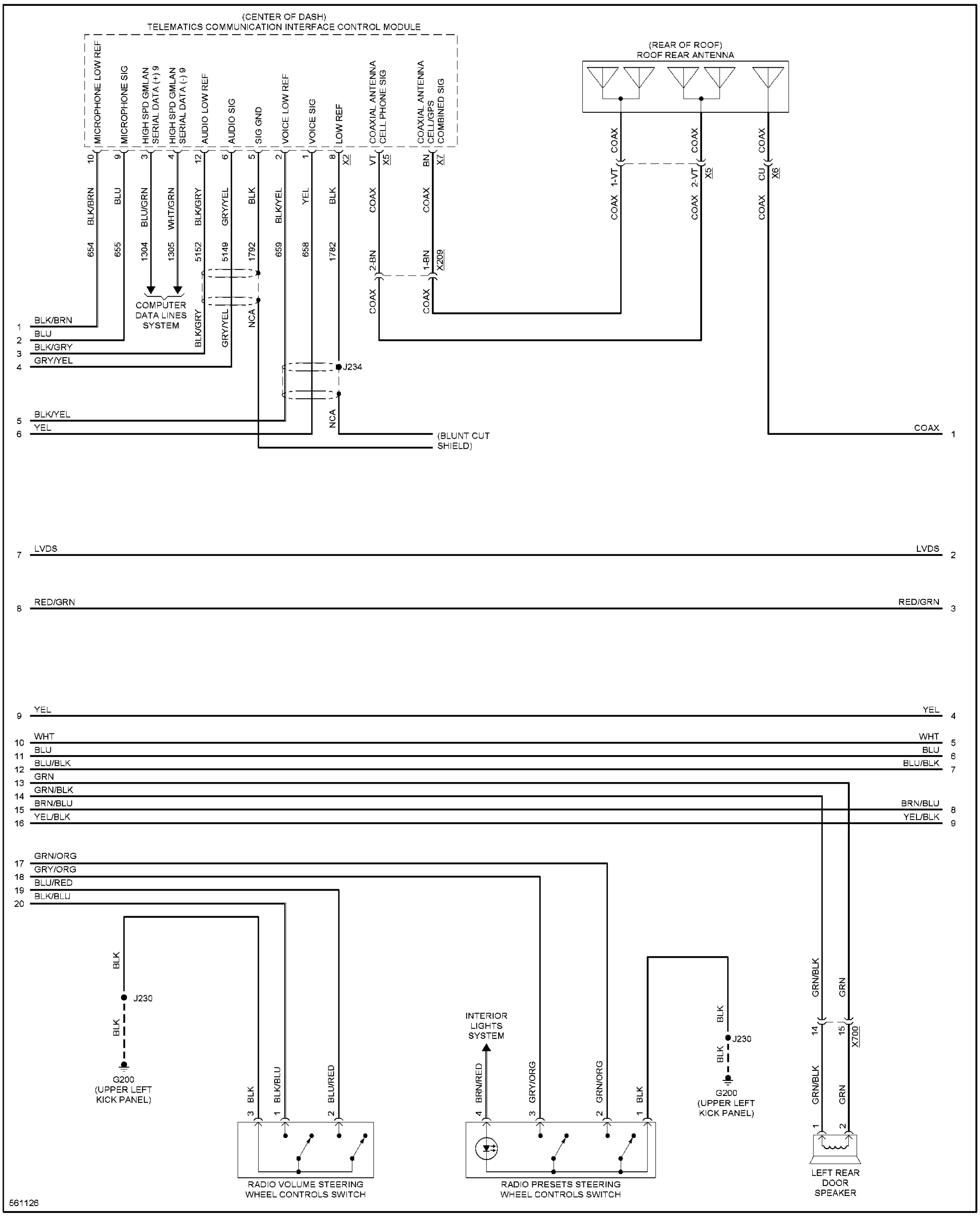

(CENTER OF DASH)
TELEMATICS COMMUNICATION INTERFACE CONTROL MODULE
MICROPHONE LOW REF
MICROPHONE SIG
HIGH SPD GMLAN SERIAL DATA (+) 9
HIGH SPD GMLAN SERIAL DATA (-) 9
AUDIO LOW REF
AUDIO SIG
SIG GND
VOICE LOW REF
VOICE SIG
LOW REF
COAXIAL ANTENNA CELL PHONE SIG
COAXIAL ANTENNA CELL/GPS COMBINED SIG
10
9
3
4
12
6
5
2
1
8
X2
VT
X5
BN
X7
BLK/BRN
BLU
BLU/GRN
WHT/GRN
BLK/GRY
GRY/YEL
BLK
BLK/YEL
YEL
BLK
COAX
COAX
654
655
1304
1305
5152
5149
1792
659
658
1782
2-BN
1-BN
X209
COAX
COAX
COMPUTER DATA LINES SYSTEM
BLK/GRY
GRY/YEL
NCA
J234
NCA
(BLUNT CUT SHIELD)
(REAR OF ROOF)
ROOF REAR ANTENNA
COAX
COAX
COAX
1-VT
2-VT
X5
CU
X6
COAX
COAX
COAX
1 BLK/BRN
2 BLU
3 BLK/GRY
4 GRY/YEL
5 BLK/YEL
6 YEL
COAX 1
7 LVDS
LVDS 2
8 RED/GRN
RED/GRN 3
9 YEL
YEL 4
10 WHT
WHT 5
11 BLU
BLU 6
12 BLU/BLK
BLU/BLK 7
13 GRN
14 GRN/BLK
15 BRN/BLU
BRN/BLU 8
16 YEL/BLK
YEL/BLK 9
17 GRN/ORG
18 GRY/ORG
19 BLU/RED
20 BLK/BLU
BLK
J230
BLK
G200 (UPPER LEFT KICK PANEL)
3 BLK
1 BLK/BLU
2 BLU/RED
RADIO VOLUME STEERING WHEEL CONTROLS SWITCH
INTERIOR LIGHTS SYSTEM
4 BRN/RED
3 GRY/ORG
2 GRN/ORG
1 BLK
RADIO PRESETS STEERING WHEEL CONTROLS SWITCH
BLK
J230
BLK
G200 (UPPER LEFT KICK PANEL)
GRN/BLK
GRN
14
15
X700
GRN/BLK
GRN
1
2
LEFT REAR DOOR SPEAKER
561126

Fig. 97: Radio Circuit, W/O Amplifier (3 of 4)

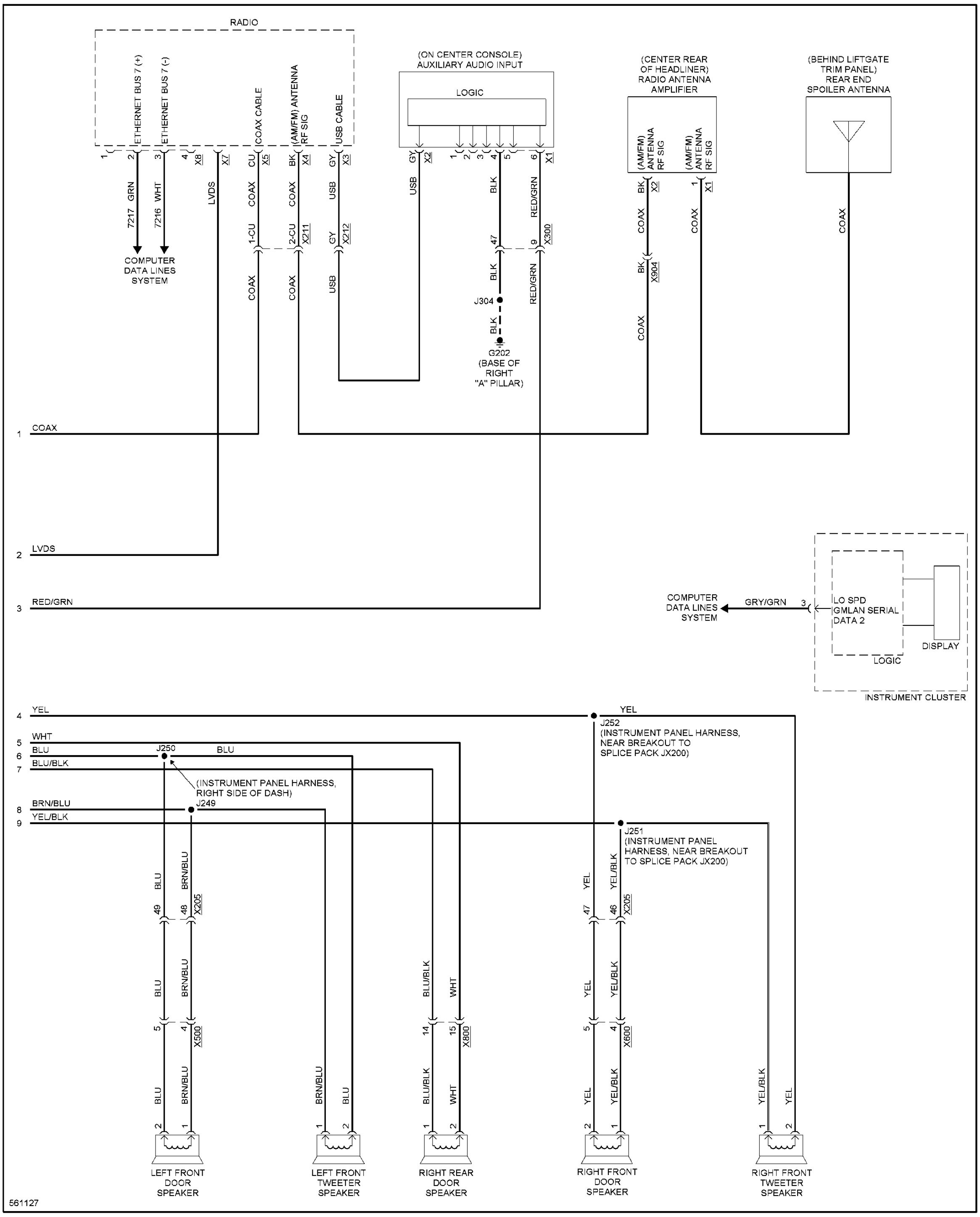

RADIO
ETHERNET BUS 7 (+)
ETHERNET BUS 7 (-)
COAX CABLE
(AM/FM) ANTENNA RF SIG
USB CABLE
X8
X7
X5
X4
X3
7217 GRN
7216 WHT
COMPUTER DATA LINES SYSTEM
LVDS
COAX
1-CU
2-CU
X211
GY
X212
USB
(ON CENTER CONSOLE) AUXILIARY AUDIO INPUT
LOGIC
X2
X1
BLK
RED/GRN
X300
J304
G202 (BASE OF RIGHT "A" PILLAR)
(CENTER REAR OF HEADLINER) RADIO ANTENNA AMPLIFIER
(AM/FM) ANTENNA RF SIG
X904
(BEHIND LIFTGATE TRIM PANEL) REAR END SPOILER ANTENNA
1 COAX
2 LVDS
3 RED/GRN
COMPUTER DATA LINES SYSTEM
GRY/GRN
LO SPD GMLAN SERIAL DATA 2
LOGIC
DISPLAY
INSTRUMENT CLUSTER
4 YEL
5 WHT
6 BLU
7 BLU/BLK
8 BRN/BLU
9 YEL/BLK
J250
J249
(INSTRUMENT PANEL HARNESS, RIGHT SIDE OF DASH)
J252 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO SPLICE PACK JX200)
J251 (INSTRUMENT PANEL HARNESS, NEAR BREAKOUT TO SPLICE PACK JX200)
X205
X500
X800
X600
LEFT FRONT DOOR SPEAKER
LEFT FRONT TWEETER SPEAKER
RIGHT REAR DOOR SPEAKER
RIGHT FRONT DOOR SPEAKER
RIGHT FRONT TWEETER SPEAKER
561127

Fig. 98: Radio Circuit, W/O Amplifier (4 of 4)

SHIFT INTERLOCK

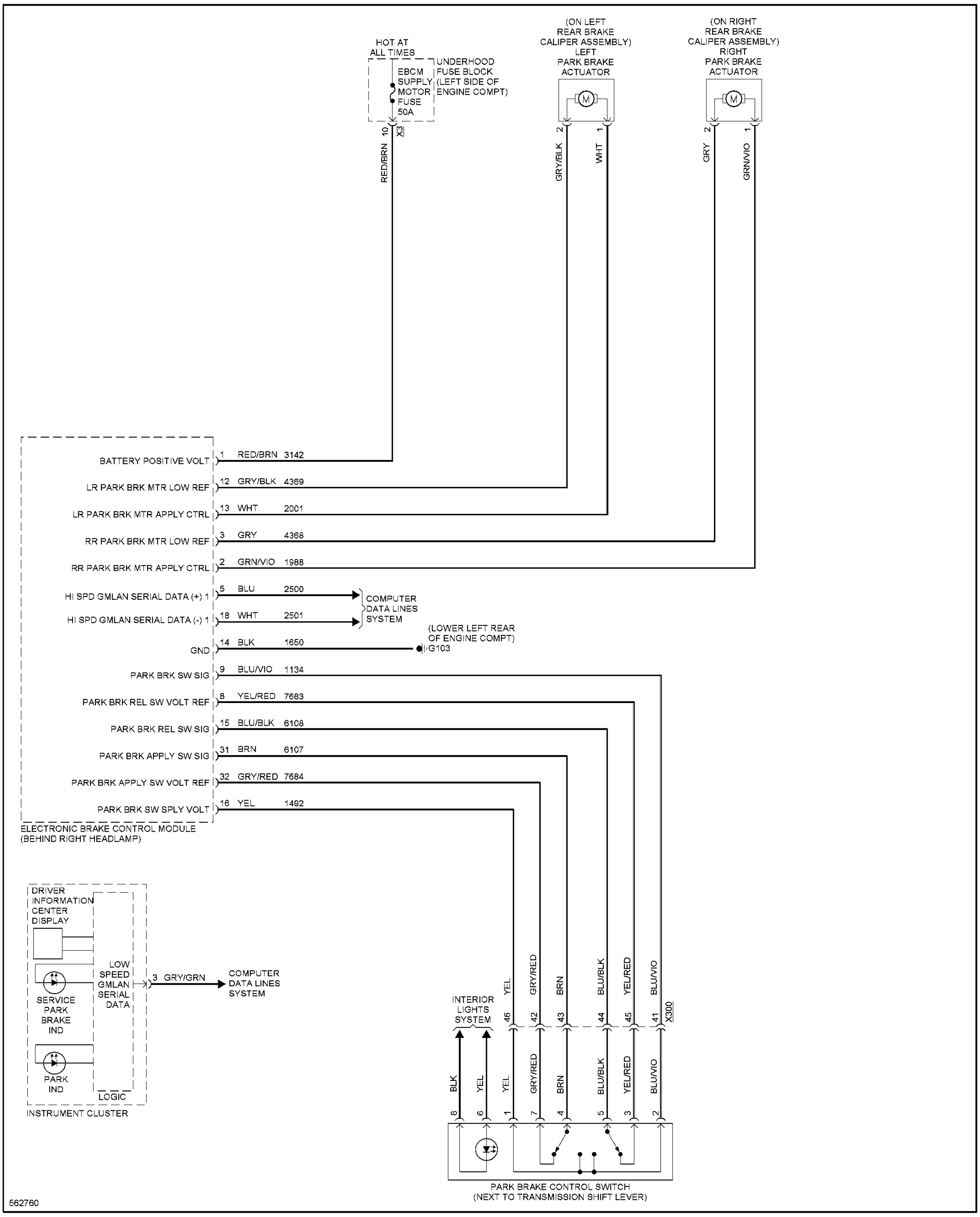

HOT AT
ALL TIMES
EBCM
SUPPLY
MOTOR
FUSE
50A
UNDERHOOD
FUSE BLOCK
(LEFT SIDE OF
ENGINE COMPT)
10
X3
RED/BRN
(ON LEFT
REAR BRAKE
CALIPER ASSEMBLY)
LEFT
PARK BRAKE
ACTUATOR
M
2
1
GRY/BLK
WHT
(ON RIGHT
REAR BRAKE
CALIPER ASSEMBLY)
RIGHT
PARK BRAKE
ACTUATOR
M
2
1
GRY
GRN/VIO
BATTERY POSITIVE VOLT
1 RED/BRN 3142
LR PARK BRK MTR LOW REF
12 GRY/BLK 4369
LR PARK BRK MTR APPLY CTRL
13 WHT 2001
RR PARK BRK MTR LOW REF
3 GRY 4368
RR PARK BRK MTR APPLY CTRL
2 GRN/VIO 1988
HI SPD GMLAN SERIAL DATA (+) 1
5 BLU 2500
HI SPD GMLAN SERIAL DATA (-) 1
18 WHT 2501
COMPUTER
DATA LINES
SYSTEM
GND
14 BLK 1650
(LOWER LEFT REAR
OF ENGINE COMPT)
G103
PARK BRK SW SIG
9 BLU/VIO 1134
PARK BRK REL SW VOLT REF
8 YEL/RED 7683
PARK BRK REL SW SIG
15 BLU/BLK 6108
PARK BRK APPLY SW SIG
31 BRN 6107
PARK BRK APPLY SW VOLT REF
32 GRY/RED 7684
PARK BRK SW SPLY VOLT
16 YEL 1492
ELECTRONIC BRAKE CONTROL MODULE
(BEHIND RIGHT HEADLAMP)
DRIVER
INFORMATION
CENTER
DISPLAY
SERVICE
PARK
BRAKE
IND
PARK
IND
LOW
SPEED
GMLAN
SERIAL
DATA
LOGIC
INSTRUMENT CLUSTER
3 GRY/GRN
COMPUTER
DATA LINES
SYSTEM
INTERIOR
LIGHTS
SYSTEM
YEL
GRY/RED
BRN
BLU/BLK
YEL/RED
BLU/VIO
46
42
43
44
45
41
X300
BLK
YEL
YEL
GRY/RED
BRN
BLU/BLK
YEL/RED
BLU/VIO
8
6
1
7
4
5
3
2
PARK BRAKE CONTROL SWITCH
(NEXT TO TRANSMISSION SHIFT LEVER)
562760

Fig. 99: Park Brake System Circuit

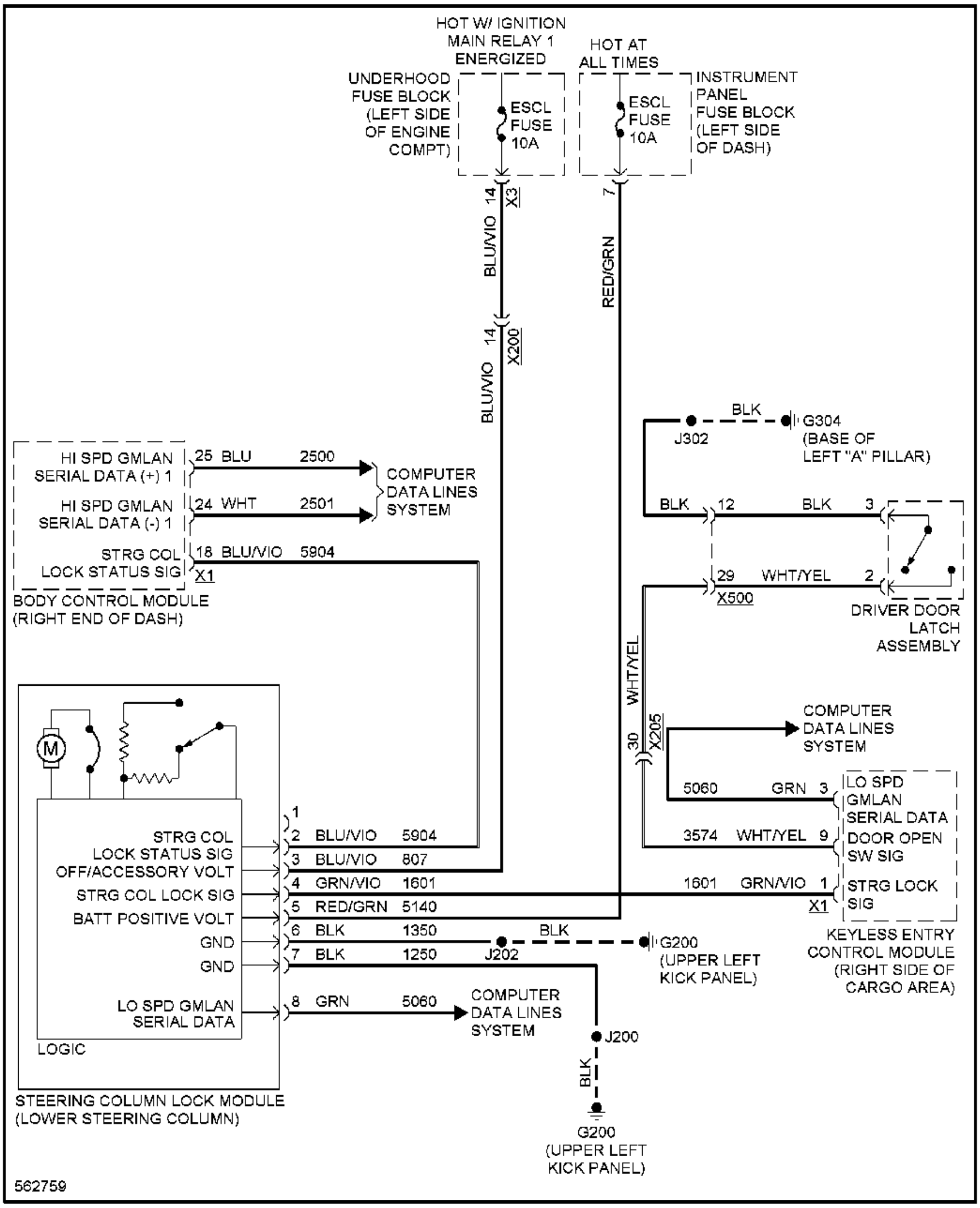

HOT W/ IGNITION
MAIN RELAY 1
ENERGIZED
HOT AT
ALL TIMES
UNDERHOOD
FUSE BLOCK
(LEFT SIDE
OF ENGINE
COMPT)
ESCL
FUSE
10A
ESCL
FUSE
10A
INSTRUMENT
PANEL
FUSE BLOCK
(LEFT SIDE
OF DASH)
14
X3
7
BLU/VIO
RED/GRN
14
X200
BLU/VIO
BLK
J302
G304
(BASE OF
LEFT "A" PILLAR)
HI SPD GMLAN
SERIAL DATA (+) 1
25 BLU
2500
HI SPD GMLAN
SERIAL DATA (-) 1
24 WHT
2501
COMPUTER
DATA LINES
SYSTEM
STRG COL
LOCK STATUS SIG
18 BLU/VIO
5904
X1
BODY CONTROL MODULE
(RIGHT END OF DASH)
BLK
12
BLK
3
29
WHT/YEL
2
X500
DRIVER DOOR
LATCH
ASSEMBLY
WHT/YEL
30
X205
COMPUTER
DATA LINES
SYSTEM
M
5060
GRN
3
LO SPD
GMLAN
SERIAL DATA
3574
WHT/YEL
9
DOOR OPEN
SW SIG
1601
GRN/VIO
1
X1
STRG LOCK
SIG
KEYLESS ENTRY
CONTROL MODULE
(RIGHT SIDE OF
CARGO AREA)
1
STRG COL
LOCK STATUS SIG
2 BLU/VIO 5904
OFF/ACCESSORY VOLT
3 BLU/VIO 807
STRG COL LOCK SIG
4 GRN/VIO 1601
BATT POSITIVE VOLT
5 RED/GRN 5140
GND
6 BLK 1350
BLK
G200
(UPPER LEFT
KICK PANEL)
GND
7 BLK 1250
J202
LO SPD GMLAN
SERIAL DATA
8 GRN 5060
COMPUTER
DATA LINES
SYSTEM
J200
BLK
LOGIC
STEERING COLUMN LOCK MODULE
(LOWER STEERING COLUMN)
G200
(UPPER LEFT
KICK PANEL)
562759

Fig. 100: Steering Lock Circuit

SUPPLEMENTAL RESTRAINTS

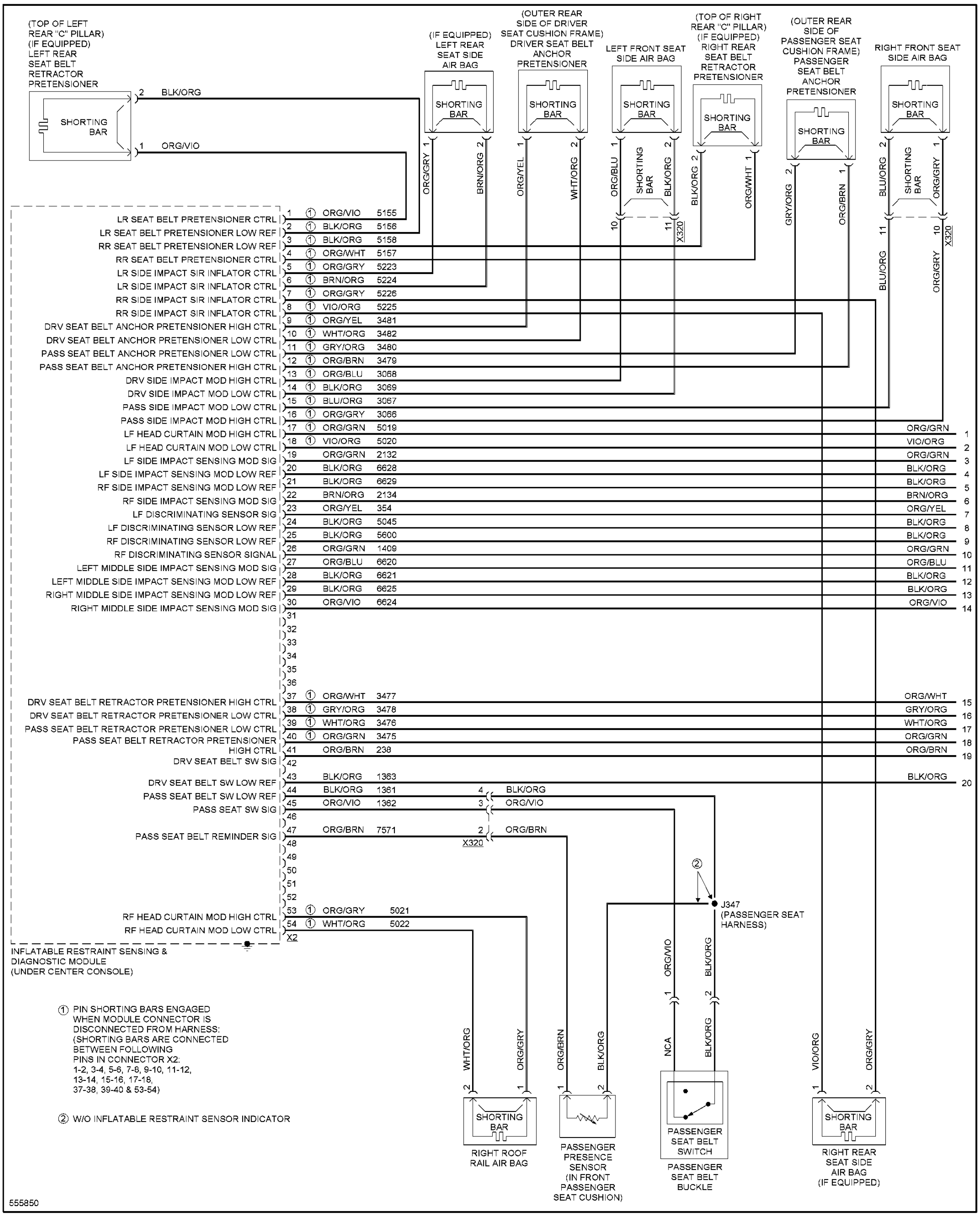

(TOP OF LEFT REAR "C" PILLAR) (IF EQUIPPED) LEFT REAR SEAT BELT RETRACTOR PRETENSIONER
SHORTING BAR
2 BLK/ORG
1 ORG/VIO
(IF EQUIPPED) LEFT REAR SEAT SIDE AIR BAG
(OUTER REAR SIDE OF DRIVER SEAT CUSHION FRAME) DRIVER SEAT BELT ANCHOR PRETENSIONER
LEFT FRONT SEAT SIDE AIR BAG
(TOP OF RIGHT REAR "C" PILLAR) (IF EQUIPPED) RIGHT REAR SEAT BELT RETRACTOR PRETENSIONER
(OUTER REAR SIDE OF PASSENGER SEAT CUSHION FRAME) PASSENGER SEAT BELT ANCHOR PRETENSIONER
RIGHT FRONT SEAT SIDE AIR BAG
ORG/GRY
BRN/ORG
ORG/YEL
WHT/ORG
ORG/BLU
BLK/ORG
ORG/WHT
GRY/ORG
ORG/BRN
BLU/ORG
X320
LR SEAT BELT PRETENSIONER CTRL 1 ① ORG/VIO 5155
LR SEAT BELT PRETENSIONER LOW REF 2 ① BLK/ORG 5156
RR SEAT BELT PRETENSIONER LOW REF 3 ① BLK/ORG 5158
RR SEAT BELT PRETENSIONER CTRL 4 ① ORG/WHT 5157
LR SIDE IMPACT SIR INFLATOR CTRL 5 ① ORG/GRY 5223
LR SIDE IMPACT SIR INFLATOR CTRL 6 ① BRN/ORG 5224
RR SIDE IMPACT SIR INFLATOR CTRL 7 ① ORG/GRY 5226
RR SIDE IMPACT SIR INFLATOR CTRL 8 ① VIO/ORG 5225
DRV SEAT BELT ANCHOR PRETENSIONER HIGH CTRL 9 ① ORG/YEL 3481
DRV SEAT BELT ANCHOR PRETENSIONER LOW CTRL 10 ① WHT/ORG 3482
PASS SEAT BELT ANCHOR PRETENSIONER LOW CTRL 11 ① GRY/ORG 3480
PASS SEAT BELT ANCHOR PRETENSIONER HIGH CTRL 12 ① ORG/BRN 3479
DRV SIDE IMPACT MOD HIGH CTRL 13 ① ORG/BLU 3068
DRV SIDE IMPACT MOD LOW CTRL 14 ① BLK/ORG 3069
PASS SIDE IMPACT MOD LOW CTRL 15 ① BLU/ORG 3067
PASS SIDE IMPACT MOD HIGH CTRL 16 ① ORG/GRY 3066
LF HEAD CURTAIN MOD HIGH CTRL 17 ① ORG/GRN 5019 ORG/GRN 1
LF HEAD CURTAIN MOD LOW CTRL 18 ① VIO/ORG 5020 VIO/ORG 2
LF SIDE IMPACT SENSING MOD SIG 19 ORG/GRN 2132 ORG/GRN 3
LF SIDE IMPACT SENSING MOD LOW REF 20 BLK/ORG 6628 BLK/ORG 4
RF SIDE IMPACT SENSING MOD LOW REF 21 BLK/ORG 6629 BLK/ORG 5
RF SIDE IMPACT SENSING MOD SIG 22 BRN/ORG 2134 BRN/ORG 6
LF DISCRIMINATING SENSOR SIG 23 ORG/YEL 354 ORG/YEL 7
LF DISCRIMINATING SENSOR LOW REF 24 BLK/ORG 5045 BLK/ORG 8
RF DISCRIMINATING SENSOR LOW REF 25 BLK/ORG 5600 BLK/ORG 9
RF DISCRIMINATING SENSOR SIGNAL 26 ORG/GRN 1409 ORG/GRN 10
LEFT MIDDLE SIDE IMPACT SENSING MOD SIG 27 ORG/BLU 6620 ORG/BLU 11
LEFT MIDDLE SIDE IMPACT SENSING MOD LOW REF 28 BLK/ORG 6621 BLK/ORG 12
RIGHT MIDDLE SIDE IMPACT SENSING MOD LOW REF 29 BLK/ORG 6625 BLK/ORG 13
RIGHT MIDDLE SIDE IMPACT SENSING MOD SIG 30 ORG/VIO 6624 ORG/VIO 14
31
32
33
34
35
36
DRV SEAT BELT RETRACTOR PRETENSIONER HIGH CTRL 37 ① ORG/WHT 3477 ORG/WHT 15
DRV SEAT BELT RETRACTOR PRETENSIONER LOW CTRL 38 ① GRY/ORG 3478 GRY/ORG 16
PASS SEAT BELT RETRACTOR PRETENSIONER LOW CTRL 39 ① WHT/ORG 3476 WHT/ORG 17
PASS SEAT BELT RETRACTOR PRETENSIONER HIGH CTRL 40 ① ORG/GRN 3475 ORG/GRN 18
41 ORG/BRN 238 ORG/BRN 19
DRV SEAT BELT SW SIG 42
43 BLK/ORG 1363 BLK/ORG 20
DRV SEAT BELT SW LOW REF 44 BLK/ORG 1361 4 BLK/ORG
PASS SEAT BELT SW LOW REF 45 ORG/VIO 1362 3 ORG/VIO
PASS SEAT SW SIG 46
PASS SEAT BELT REMINDER SIG 47 ORG/BRN 7571 2 ORG/BRN
48
49
50
51
52
RF HEAD CURTAIN MOD HIGH CTRL 53 ① ORG/GRY 5021
RF HEAD CURTAIN MOD LOW CTRL 54 ① WHT/ORG 5022
X2
X320
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (UNDER CENTER CONSOLE)
②
J347 (PASSENGER SEAT HARNESS)
ORG/VIO
BLK/ORG
NCA
VIO/ORG
ORG/GRY
WHT/ORG
ORG/BRN
RIGHT ROOF RAIL AIR BAG
PASSENGER PRESENCE SENSOR (IN FRONT PASSENGER SEAT CUSHION)
PASSENGER SEAT BELT SWITCH
PASSENGER SEAT BELT BUCKLE
RIGHT REAR SEAT SIDE AIR BAG (IF EQUIPPED)
① PIN SHORTING BARS ENGAGED WHEN MODULE CONNECTOR IS DISCONNECTED FROM HARNESS: (SHORTING BARS ARE CONNECTED BETWEEN FOLLOWING PINS IN CONNECTOR X2: 1-2, 3-4, 5-6, 7-8, 9-10, 11-12, 13-14, 15-16, 17-18, 37-38, 39-40 & 53-54)
② W/O INFLATABLE RESTRAINT SENSOR INDICATOR
555850

Fig. 101: Supplemental Restraints Circuit (1 of 3)

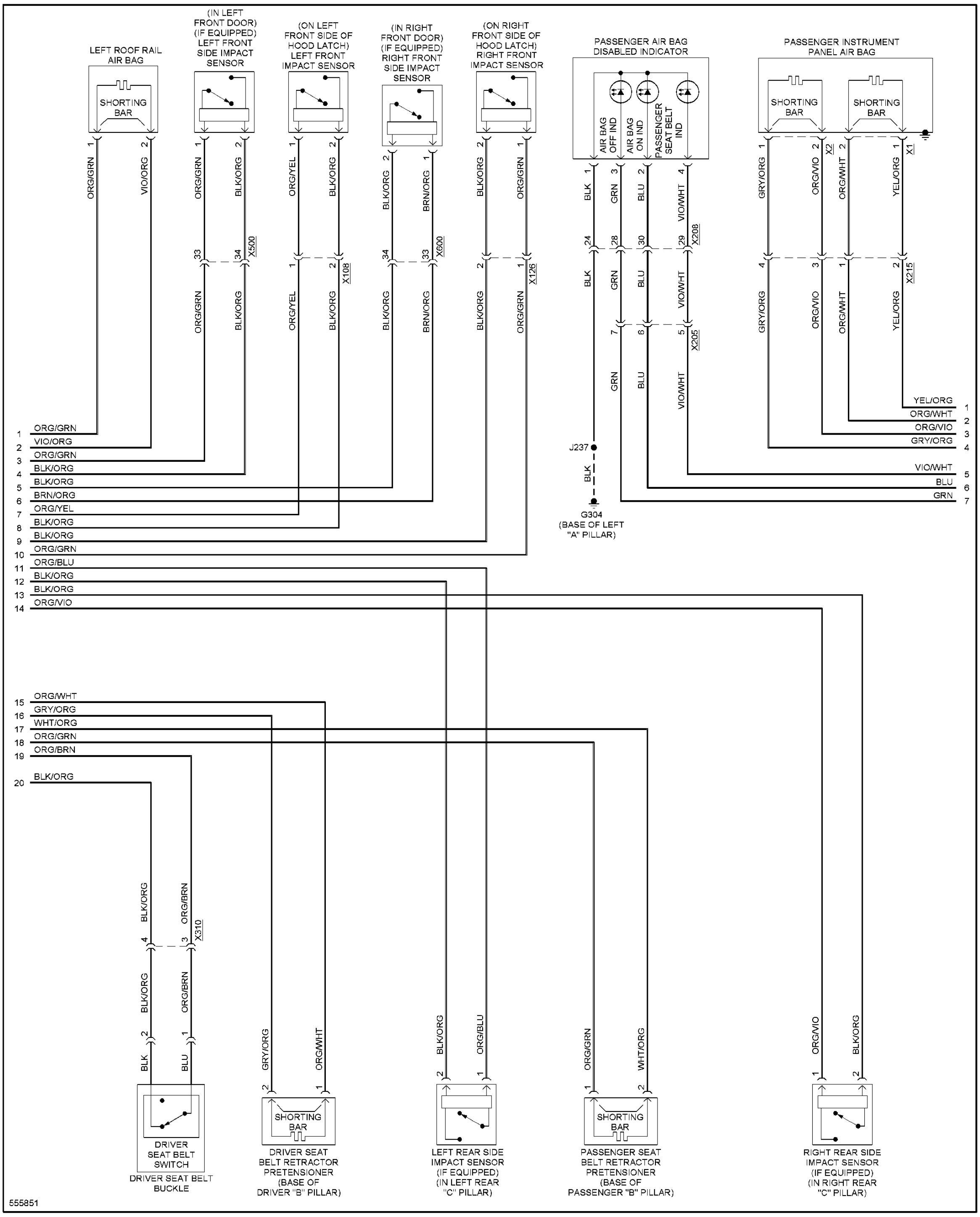

LEFT ROOF RAIL AIR BAG
SHORTING BAR
(IN LEFT FRONT DOOR) (IF EQUIPPED) LEFT FRONT SIDE IMPACT SENSOR
(ON LEFT FRONT SIDE OF HOOD LATCH) LEFT FRONT IMPACT SENSOR
(IN RIGHT FRONT DOOR) (IF EQUIPPED) RIGHT FRONT SIDE IMPACT SENSOR
(ON RIGHT FRONT SIDE OF HOOD LATCH) RIGHT FRONT IMPACT SENSOR
PASSENGER AIR BAG DISABLED INDICATOR
AIR BAG OFF IND
AIR BAG ON IND
PASSENGER SEAT BELT IND
PASSENGER INSTRUMENT PANEL AIR BAG
SHORTING BAR
SHORTING BAR
ORG/GRN
VIO/ORG
ORG/GRN
BLK/ORG
ORG/YEL
BLK/ORG
BLK/ORG
BRN/ORG
BLK/ORG
ORG/GRN
BLK
GRN
BLU
VIO/WHT
GRY/ORG
ORG/VIO
ORG/WHT
YEL/ORG
X500
X108
X600
X126
X208
X205
X2
X1
X215
J237
G304 (BASE OF LEFT "A" PILLAR)
1 ORG/GRN
2 VIO/ORG
3 ORG/GRN
4 BLK/ORG
5 BLK/ORG
6 BRN/ORG
7 ORG/YEL
8 BLK/ORG
9 BLK/ORG
10 ORG/GRN
11 ORG/BLU
12 BLK/ORG
13 BLK/ORG
14 ORG/VIO
15 ORG/WHT
16 GRY/ORG
17 WHT/ORG
18 ORG/GRN
19 ORG/BRN
20 BLK/ORG
YEL/ORG 1
ORG/WHT 2
ORG/VIO 3
GRY/ORG 4
VIO/WHT 5
BLU 6
GRN 7
X310
BLK
BLU
DRIVER SEAT BELT SWITCH
DRIVER SEAT BELT BUCKLE
DRIVER SEAT BELT RETRACTOR PRETENSIONER (BASE OF DRIVER "B" PILLAR)
LEFT REAR SIDE IMPACT SENSOR (IF EQUIPPED) (IN LEFT REAR "C" PILLAR)
PASSENGER SEAT BELT RETRACTOR PRETENSIONER (BASE OF PASSENGER "B" PILLAR)
RIGHT REAR SIDE IMPACT SENSOR (IF EQUIPPED) (IN RIGHT REAR "C" PILLAR)
555851

Fig. 102: Supplemental Restraints Circuit (2 of 3)

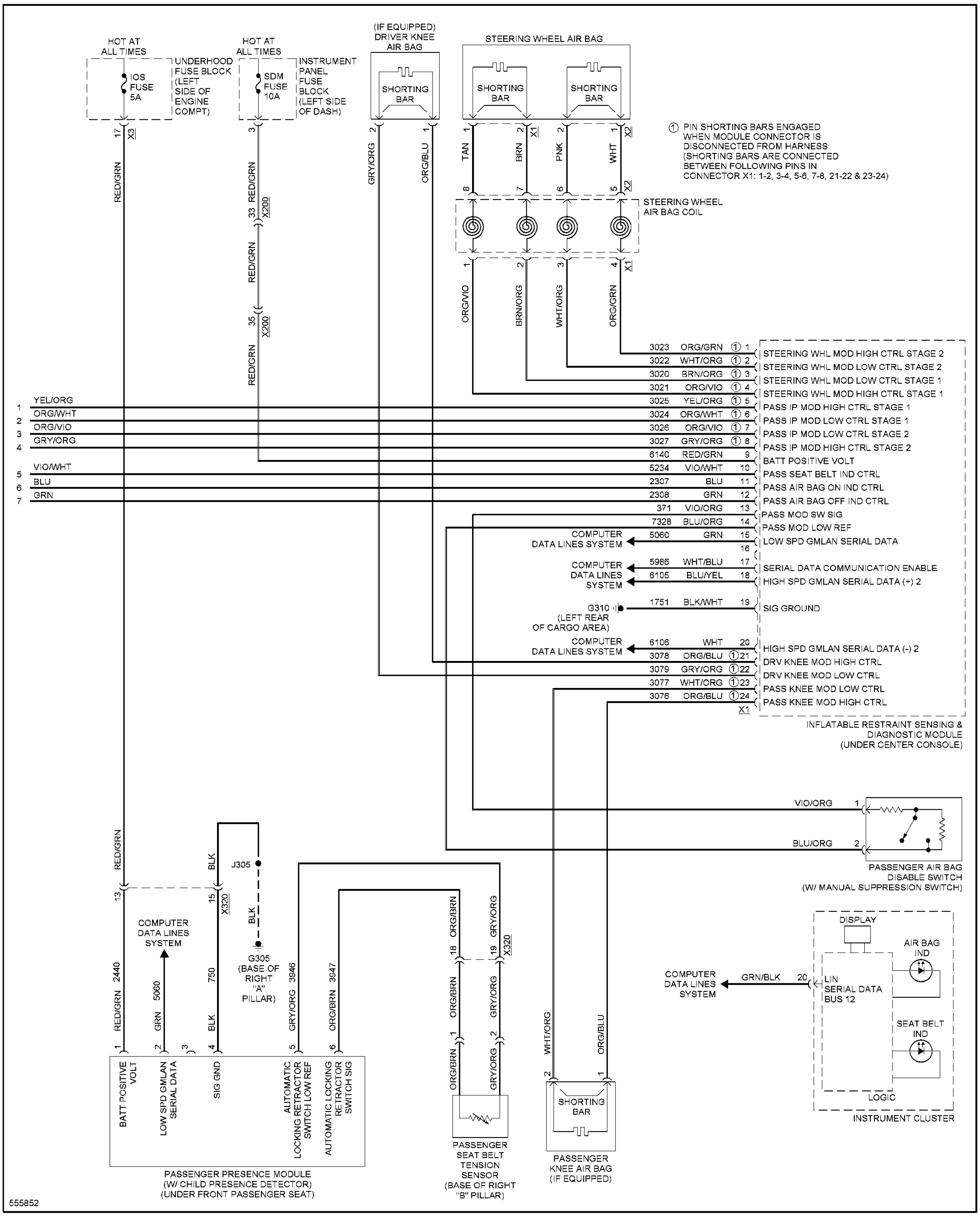

HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
IOS FUSE 5A
HOT AT ALL TIMES
SDM FUSE 10A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
(IF EQUIPPED) DRIVER KNEE AIR BAG
SHORTING BAR
STEERING WHEEL AIR BAG
SHORTING BAR
SHORTING BAR
① PIN SHORTING BARS ENGAGED WHEN MODULE CONNECTOR IS DISCONNECTED FROM HARNESS: (SHORTING BARS ARE CONNECTED BETWEEN FOLLOWING PINS IN CONNECTOR X1: 1-2, 3-4, 5-6, 7-8, 21-22 & 23-24)
STEERING WHEEL AIR BAG COIL
RED/GRN
RED/GRN
X3
X200
X1
X2
TAN
BRN
PNK
WHT
GRY/ORG
ORG/BLU
ORG/VIO
BRN/ORG
WHT/ORG
ORG/GRN
3023 ORG/GRN ① 1 STEERING WHL MOD HIGH CTRL STAGE 2
3022 WHT/ORG ① 2 STEERING WHL MOD LOW CTRL STAGE 2
3020 BRN/ORG ① 3 STEERING WHL MOD LOW CTRL STAGE 1
3021 ORG/VIO ① 4 STEERING WHL MOD HIGH CTRL STAGE 1
1 YEL/ORG 3025 YEL/ORG ① 5 PASS IP MOD HIGH CTRL STAGE 1
2 ORG/WHT 3024 ORG/WHT ① 6 PASS IP MOD LOW CTRL STAGE 1
3 ORG/VIO 3026 ORG/VIO ① 7 PASS IP MOD LOW CTRL STAGE 2
4 GRY/ORG 3027 GRY/ORG ① 8 PASS IP MOD HIGH CTRL STAGE 2
6140 RED/GRN 9 BATT POSITIVE VOLT
5 VIO/WHT 5234 VIO/WHT 10 PASS SEAT BELT IND CTRL
6 BLU 2307 BLU 11 PASS AIR BAG ON IND CTRL
7 GRN 2308 GRN 12 PASS AIR BAG OFF IND CTRL
371 VIO/ORG 13 PASS MOD SW SIG
7328 BLU/ORG 14 PASS MOD LOW REF
COMPUTER DATA LINES SYSTEM 5060 GRN 15 LOW SPD GMLAN SERIAL DATA
16
COMPUTER DATA LINES SYSTEM 5986 WHT/BLU 17 SERIAL DATA COMMUNICATION ENABLE
6105 BLU/YEL 18 HIGH SPD GMLAN SERIAL DATA (+) 2
G310 (LEFT REAR OF CARGO AREA) 1751 BLK/WHT 19 SIG GROUND
COMPUTER DATA LINES SYSTEM 6106 WHT 20 HIGH SPD GMLAN SERIAL DATA (-) 2
3078 ORG/BLU ① 21 DRV KNEE MOD HIGH CTRL
3079 GRY/ORG ① 22 DRV KNEE MOD LOW CTRL
3077 WHT/ORG ① 23 PASS KNEE MOD LOW CTRL
3076 ORG/BLU ① 24 PASS KNEE MOD HIGH CTRL
X1
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (UNDER CENTER CONSOLE)
VIO/ORG 1
BLU/ORG 2
PASSENGER AIR BAG DISABLE SWITCH (W/ MANUAL SUPPRESSION SWITCH)
DISPLAY
AIR BAG IND
COMPUTER DATA LINES SYSTEM GRN/BLK 20
LIN SERIAL DATA BUS 12
SEAT BELT IND
LOGIC
INSTRUMENT CLUSTER
RED/GRN
BLK
J305
BLK
G305 (BASE OF RIGHT "A" PILLAR)
X320
COMPUTER DATA LINES SYSTEM
RED/GRN 2440
GRN 5060
BLK 750
GRY/ORG 3946
ORG/BRN 3947
ORG/BRN
GRY/ORG
BATT POSITIVE VOLT
LOW SPD GMLAN SERIAL DATA
SIG GND
AUTOMATIC LOCKING RETRACTOR SWITCH LOW REF
AUTOMATIC LOCKING RETRACTOR SWITCH SIG
PASSENGER PRESENCE MODULE (W/ CHILD PRESENCE DETECTOR) (UNDER FRONT PASSENGER SEAT)
PASSENGER SEAT BELT TENSION SENSOR (BASE OF RIGHT "B" PILLAR)
WHT/ORG
ORG/BLU
SHORTING BAR
PASSENGER KNEE AIR BAG (IF EQUIPPED)
555852

Fig. 103: Supplemental Restraints Circuit (3 of 3)

TRANSMISSION

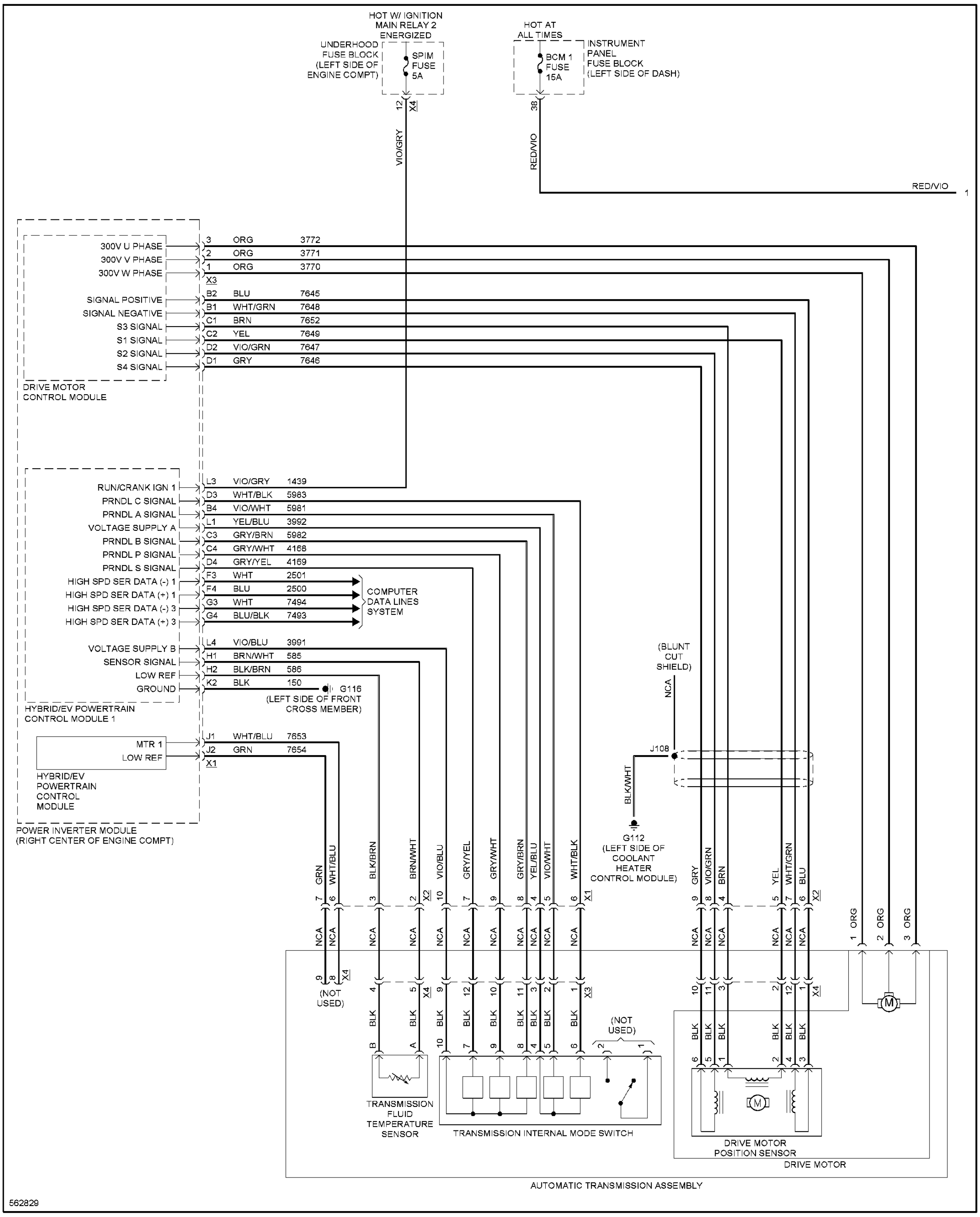

HOT W/ IGNITION MAIN RELAY 2 ENERGIZED
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
SPIM FUSE 5A
12 X4
VIO/GRY
HOT AT ALL TIMES
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
38
RED/VIO
RED/VIO 1
300V U PHASE
300V V PHASE
300V W PHASE
SIGNAL POSITIVE
SIGNAL NEGATIVE
S3 SIGNAL
S1 SIGNAL
S2 SIGNAL
S4 SIGNAL
DRIVE MOTOR CONTROL MODULE
3 ORG 3772
2 ORG 3771
1 ORG 3770
X3
B2 BLU 7645
B1 WHT/GRN 7648
C1 BRN 7652
C2 YEL 7649
D2 VIO/GRN 7647
D1 GRY 7646
RUN/CRANK IGN 1
PRNDL C SIGNAL
PRNDL A SIGNAL
VOLTAGE SUPPLY A
PRNDL B SIGNAL
PRNDL P SIGNAL
PRNDL S SIGNAL
HIGH SPD SER DATA (-) 1
HIGH SPD SER DATA (+) 1
HIGH SPD SER DATA (-) 3
HIGH SPD SER DATA (+) 3
VOLTAGE SUPPLY B
SENSOR SIGNAL
LOW REF
GROUND
HYBRID/EV POWERTRAIN CONTROL MODULE 1
L3 VIO/GRY 1439
D3 WHT/BLK 5983
B4 VIO/WHT 5981
L1 YEL/BLU 3992
C3 GRY/BRN 5982
C4 GRY/WHT 4168
D4 GRY/YEL 4169
F3 WHT 2501
F4 BLU 2500
G3 WHT 7494
G4 BLU/BLK 7493
COMPUTER DATA LINES SYSTEM
L4 VIO/BLU 3991
H1 BRN/WHT 585
H2 BLK/BRN 586
K2 BLK 150
G116 (LEFT SIDE OF FRONT CROSS MEMBER)
MTR 1
LOW REF
HYBRID/EV POWERTRAIN CONTROL MODULE
J1 WHT/BLU 7653
J2 GRN 7654
X1
POWER INVERTER MODULE (RIGHT CENTER OF ENGINE COMPT)
(BLUNT CUT SHIELD)
NCA
J108
BLK/WHT
G112 (LEFT SIDE OF COOLANT HEATER CONTROL MODULE)
GRN 7
WHT/BLU 6
BLK/BRN 3
BRN/WHT 2
X2
VIO/BLU 10
GRY/YEL 7
GRY/WHT 9
GRY/BRN 8
YEL/BLU 4
VIO/WHT 5
WHT/BLK 6
X1
GRY 9
VIO/GRN 8
BRN 4
YEL 5
WHT/GRN 7
BLU 6
X2
1 ORG
2 ORG
3 ORG
NCA
9 8 X4
(NOT USED)
4 5 X4
9 12 10 11 3 2 1 X3
10 11 3 2 12 1 X4
BLK
B A
10 7 9 8 4 5 6
(NOT USED)
2 1
6 5 1 2 4 3
TRANSMISSION FLUID TEMPERATURE SENSOR
TRANSMISSION INTERNAL MODE SWITCH
DRIVE MOTOR POSITION SENSOR
DRIVE MOTOR
M
AUTOMATIC TRANSMISSION ASSEMBLY
562829

Fig. 104: Transmission Circuit (1 of 3)

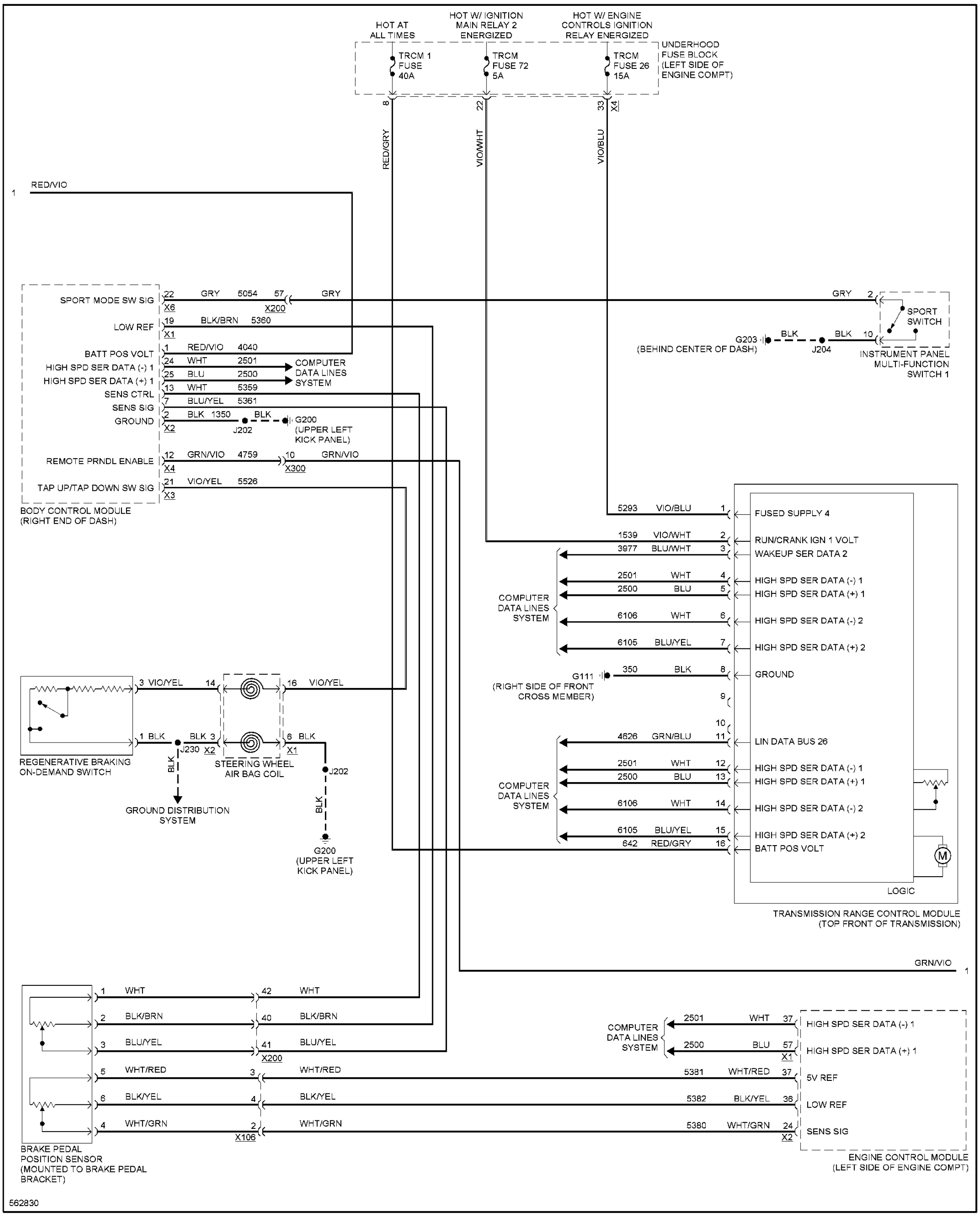

HOT AT ALL TIMES
HOT W/ IGNITION MAIN RELAY 2 ENERGIZED
HOT W/ ENGINE CONTROLS IGNITION RELAY ENERGIZED
TRCM 1 FUSE 40A
TRCM FUSE 72 5A
TRCM FUSE 26 15A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
8
22
33
X4
RED/GRY
VIO/WHT
VIO/BLU
1
RED/VIO
SPORT MODE SW SIG
LOW REF
BATT POS VOLT
HIGH SPD SER DATA (-) 1
HIGH SPD SER DATA (+) 1
SENS CTRL
SENS SIG
GROUND
REMOTE PRNDL ENABLE
TAP UP/TAP DOWN SW SIG
BODY CONTROL MODULE (RIGHT END OF DASH)
22 X6 GRY 5054 57 X200 GRY
19 X1 BLK/BRN 5360
1 RED/VIO 4040
24 WHT 2501
25 BLU 2500
13 WHT 5359
7 BLU/YEL 5361
2 X2 BLK 1350 J202 BLK
G200 (UPPER LEFT KICK PANEL)
COMPUTER DATA LINES SYSTEM
12 X4 GRN/VIO 4759 10 X300 GRN/VIO
21 X3 VIO/YEL 5526
GRY 2
SPORT SWITCH
G203 (BEHIND CENTER OF DASH)
BLK J204 BLK 10
INSTRUMENT PANEL MULTI-FUNCTION SWITCH 1
5293 VIO/BLU 1 FUSED SUPPLY 4
1539 VIO/WHT 2 RUN/CRANK IGN 1 VOLT
3977 BLU/WHT 3 WAKEUP SER DATA 2
2501 WHT 4 HIGH SPD SER DATA (-) 1
2500 BLU 5 HIGH SPD SER DATA (+) 1
6106 WHT 6 HIGH SPD SER DATA (-) 2
6105 BLU/YEL 7 HIGH SPD SER DATA (+) 2
COMPUTER DATA LINES SYSTEM
G111 (RIGHT SIDE OF FRONT CROSS MEMBER)
350 BLK 8 GROUND
9
10
4626 GRN/BLU 11 LIN DATA BUS 26
2501 WHT 12 HIGH SPD SER DATA (-) 1
2500 BLU 13 HIGH SPD SER DATA (+) 1
6106 WHT 14 HIGH SPD SER DATA (-) 2
6105 BLU/YEL 15 HIGH SPD SER DATA (+) 2
642 RED/GRY 16 BATT POS VOLT
COMPUTER DATA LINES SYSTEM
M
LOGIC
TRANSMISSION RANGE CONTROL MODULE (TOP FRONT OF TRANSMISSION)
3 VIO/YEL 14 16 VIO/YEL
1 BLK BLK 3 X2 6 BLK X1
J230
REGENERATIVE BRAKING ON-DEMAND SWITCH
STEERING WHEEL AIR BAG COIL
BLK
GROUND DISTRIBUTION SYSTEM
J202
BLK
G200 (UPPER LEFT KICK PANEL)
GRN/VIO 1
1 WHT 42 WHT
2 BLK/BRN 40 BLK/BRN
3 BLU/YEL 41 X200 BLU/YEL
5 WHT/RED 3 WHT/RED
6 BLK/YEL 4 BLK/YEL
4 WHT/GRN 2 X106 WHT/GRN
BRAKE PEDAL POSITION SENSOR (MOUNTED TO BRAKE PEDAL BRACKET)
COMPUTER DATA LINES SYSTEM
2501 WHT 37 HIGH SPD SER DATA (-) 1
2500 BLU 57 X1 HIGH SPD SER DATA (+) 1
5381 WHT/RED 37 5V REF
5382 BLK/YEL 36 LOW REF
5380 WHT/GRN 24 X2 SENS SIG
ENGINE CONTROL MODULE (LEFT SIDE OF ENGINE COMPT)
562830

Fig. 105: Transmission Circuit (2 of 3)

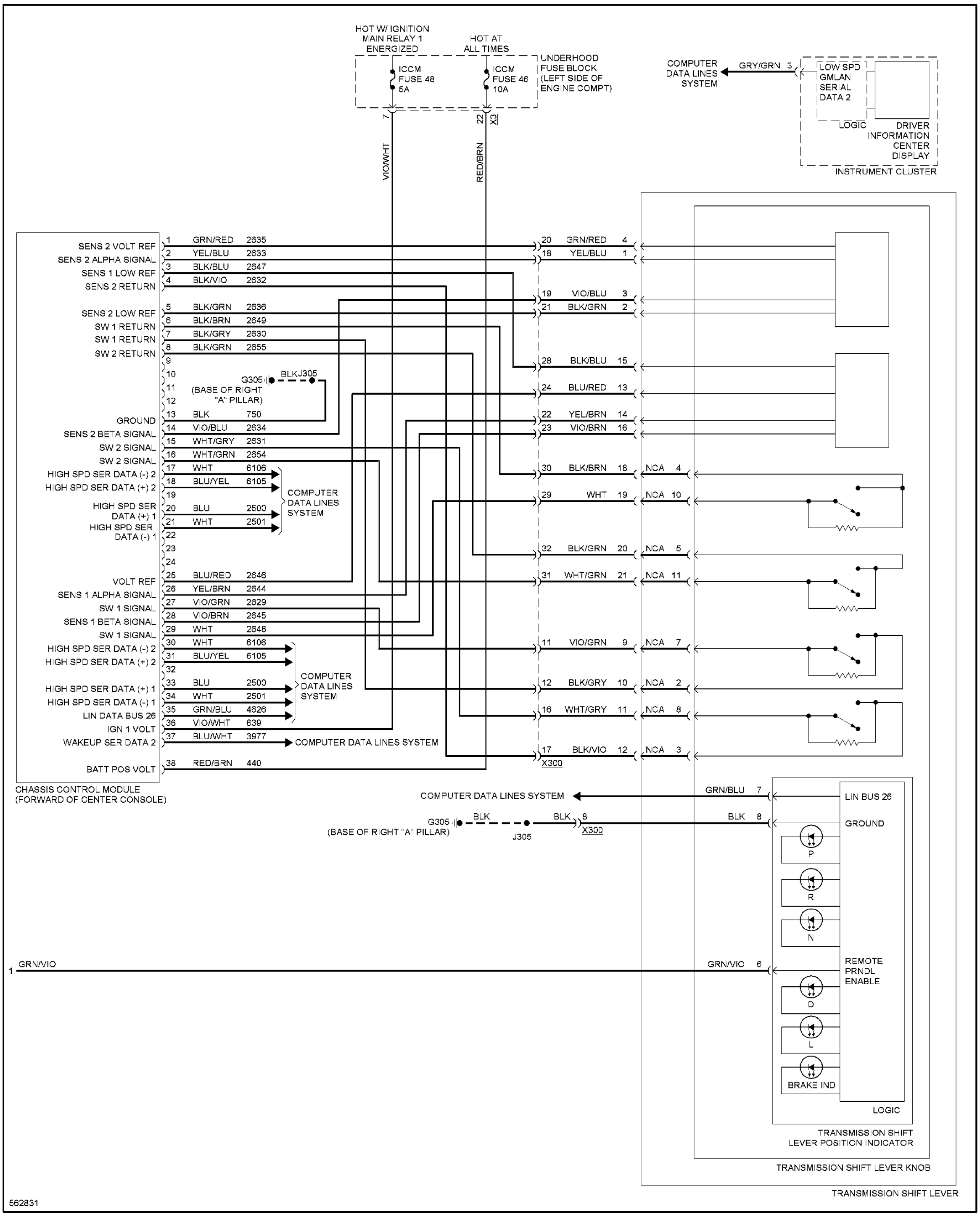

HOT W/ IGNITION MAIN RELAY 1 ENERGIZED
HOT AT ALL TIMES
ICCM FUSE 48 5A
ICCM FUSE 46 10A
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
7
22
X3
VIO/WHT
RED/BRN
COMPUTER DATA LINES SYSTEM
GRY/GRN 3
LOW SPD GMLAN SERIAL DATA 2
LOGIC
DRIVER INFORMATION CENTER DISPLAY
INSTRUMENT CLUSTER
SENS 2 VOLT REF
SENS 2 ALPHA SIGNAL
SENS 1 LOW REF
SENS 2 RETURN
SENS 2 LOW REF
SW 1 RETURN
SW 1 RETURN
SW 2 RETURN
GROUND
SENS 2 BETA SIGNAL
SW 2 SIGNAL
SW 2 SIGNAL
HIGH SPD SER DATA (-) 2
HIGH SPD SER DATA (+) 2
HIGH SPD SER DATA (+) 1
HIGH SPD SER DATA (-) 1
VOLT REF
SENS 1 ALPHA SIGNAL
SW 1 SIGNAL
SENS 1 BETA SIGNAL
SW 1 SIGNAL
HIGH SPD SER DATA (-) 2
HIGH SPD SER DATA (+) 2
HIGH SPD SER DATA (+) 1
HIGH SPD SER DATA (-) 1
LIN DATA BUS 26
IGN 1 VOLT
WAKEUP SER DATA 2
BATT POS VOLT
1 GRN/RED 2635
2 YEL/BLU 2633
3 BLK/BLU 2647
4 BLK/VIO 2632
5 BLK/GRN 2636
6 BLK/BRN 2649
7 BLK/GRY 2630
8 BLK/GRN 2655
9
10
11
12
13 BLK 750
14 VIO/BLU 2634
15 WHT/GRY 2631
16 WHT/GRN 2654
17 WHT 6106
18 BLU/YEL 6105
19
20 BLU 2500
21 WHT 2501
22
23
24
25 BLU/RED 2646
26 YEL/BRN 2644
27 VIO/GRN 2629
28 VIO/BRN 2645
29 WHT 2648
30 WHT 6106
31 BLU/YEL 6105
32
33 BLU 2500
34 WHT 2501
35 GRN/BLU 4626
36 VIO/WHT 639
37 BLU/WHT 3977
38 RED/BRN 440
G305
BLK J305
(BASE OF RIGHT "A" PILLAR)
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
COMPUTER DATA LINES SYSTEM
CHASSIS CONTROL MODULE (FORWARD OF CENTER CONSOLE)
20 GRN/RED 4
18 YEL/BLU 1
19 VIO/BLU 3
21 BLK/GRN 2
26 BLK/BLU 15
24 BLU/RED 13
22 YEL/BRN 14
23 VIO/BRN 16
30 BLK/BRN 18 NCA 4
29 WHT 19 NCA 10
32 BLK/GRN 20 NCA 5
31 WHT/GRN 21 NCA 11
11 VIO/GRN 9 NCA 7
12 BLK/GRY 10 NCA 2
16 WHT/GRY 11 NCA 8
17 BLK/VIO 12 NCA 3
X300
COMPUTER DATA LINES SYSTEM
GRN/BLU 7
LIN BUS 26
G305
BLK
BLK
8
X300
BLK 8
GROUND
(BASE OF RIGHT "A" PILLAR)
J305
P
R
N
1
GRN/VIO
GRN/VIO 6
REMOTE PRNDL ENABLE
D
L
BRAKE IND
LOGIC
TRANSMISSION SHIFT LEVER POSITION INDICATOR
TRANSMISSION SHIFT LEVER KNOB
TRANSMISSION SHIFT LEVER
562831

Fig. 106: Transmission Circuit (3 of 3)

TRUNK, TAILGATE, FUEL DOOR

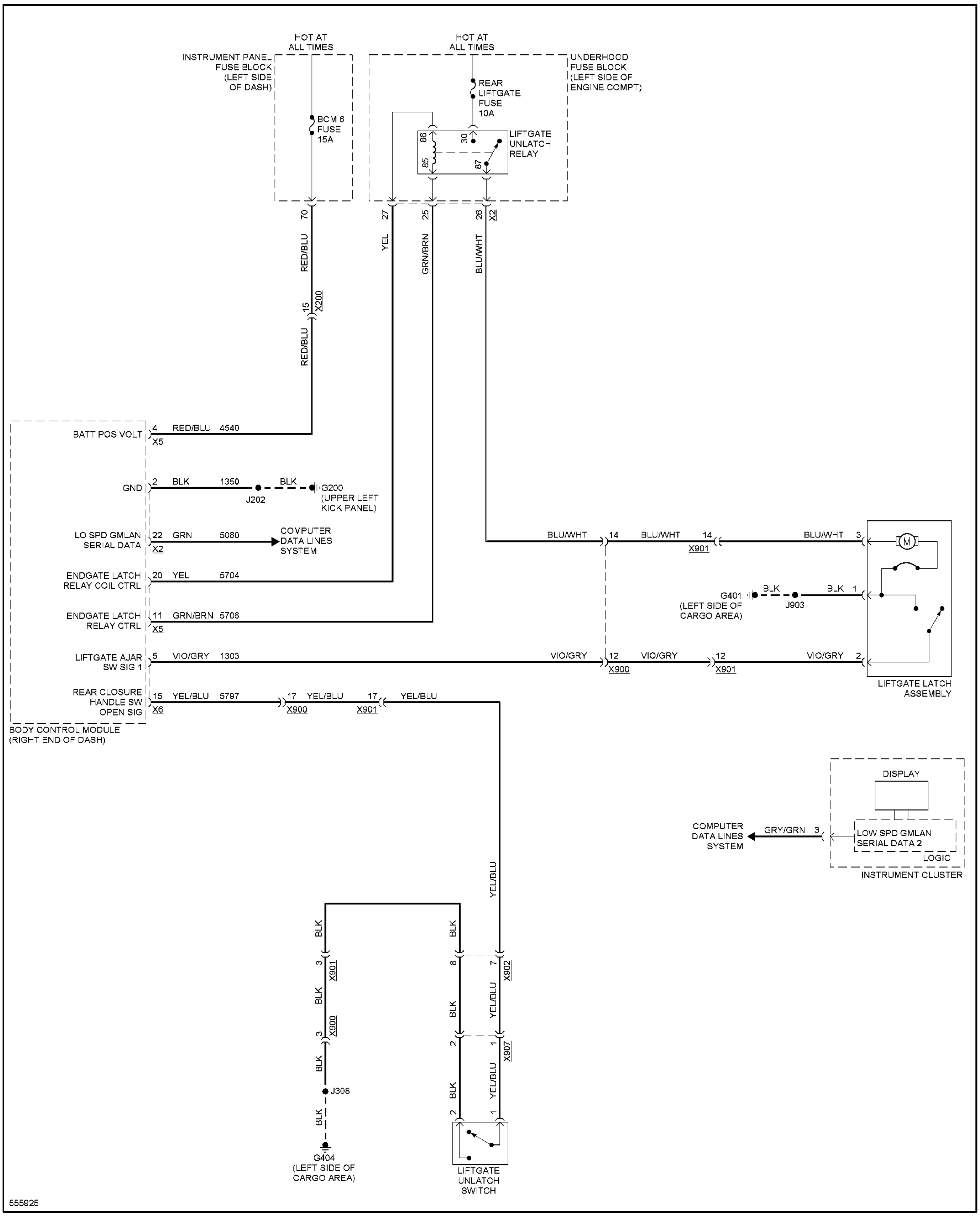

HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
BCM 6 FUSE 15A
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
REAR LIFTGATE FUSE 10A
86
30
85
87
LIFTGATE UNLATCH RELAY
70
27
25
26
X2
RED/BLU
YEL
GRN/BRN
BLU/WHT
15
X200
RED/BLU
BATT POS VOLT
4
RED/BLU
4540
X5
GND
2
BLK
1350
J202
BLK
G200 (UPPER LEFT KICK PANEL)
LO SPD GMLAN SERIAL DATA
22
GRN
5060
X2
COMPUTER DATA LINES SYSTEM
ENDGATE LATCH RELAY COIL CTRL
20
YEL
5704
ENDGATE LATCH RELAY CTRL
11
GRN/BRN
5706
X5
LIFTGATE AJAR SW SIG 1
5
VIO/GRY
1303
REAR CLOSURE HANDLE SW OPEN SIG
15
YEL/BLU
5797
X6
BODY CONTROL MODULE (RIGHT END OF DASH)
17
YEL/BLU
X900
17
X901
YEL/BLU
BLU/WHT
14
BLU/WHT
14
X901
BLU/WHT
3
M
G401 (LEFT SIDE OF CARGO AREA)
BLK
J903
BLK
1
VIO/GRY
12
X900
VIO/GRY
12
X901
VIO/GRY
2
LIFTGATE LATCH ASSEMBLY
DISPLAY
COMPUTER DATA LINES SYSTEM
GRY/GRN
3
LOW SPD GMLAN SERIAL DATA 2
LOGIC
INSTRUMENT CLUSTER
YEL/BLU
BLK
BLK
3
X901
BLK
3
X900
BLK
J308
BLK
G404 (LEFT SIDE OF CARGO AREA)
8
7
X902
BLK
YEL/BLU
2
1
X907
BLK
YEL/BLU
2
1
LIFTGATE UNLATCH SWITCH
555925

Fig. 107: Liftgate Release Circuit

WARNING SYSTEMS

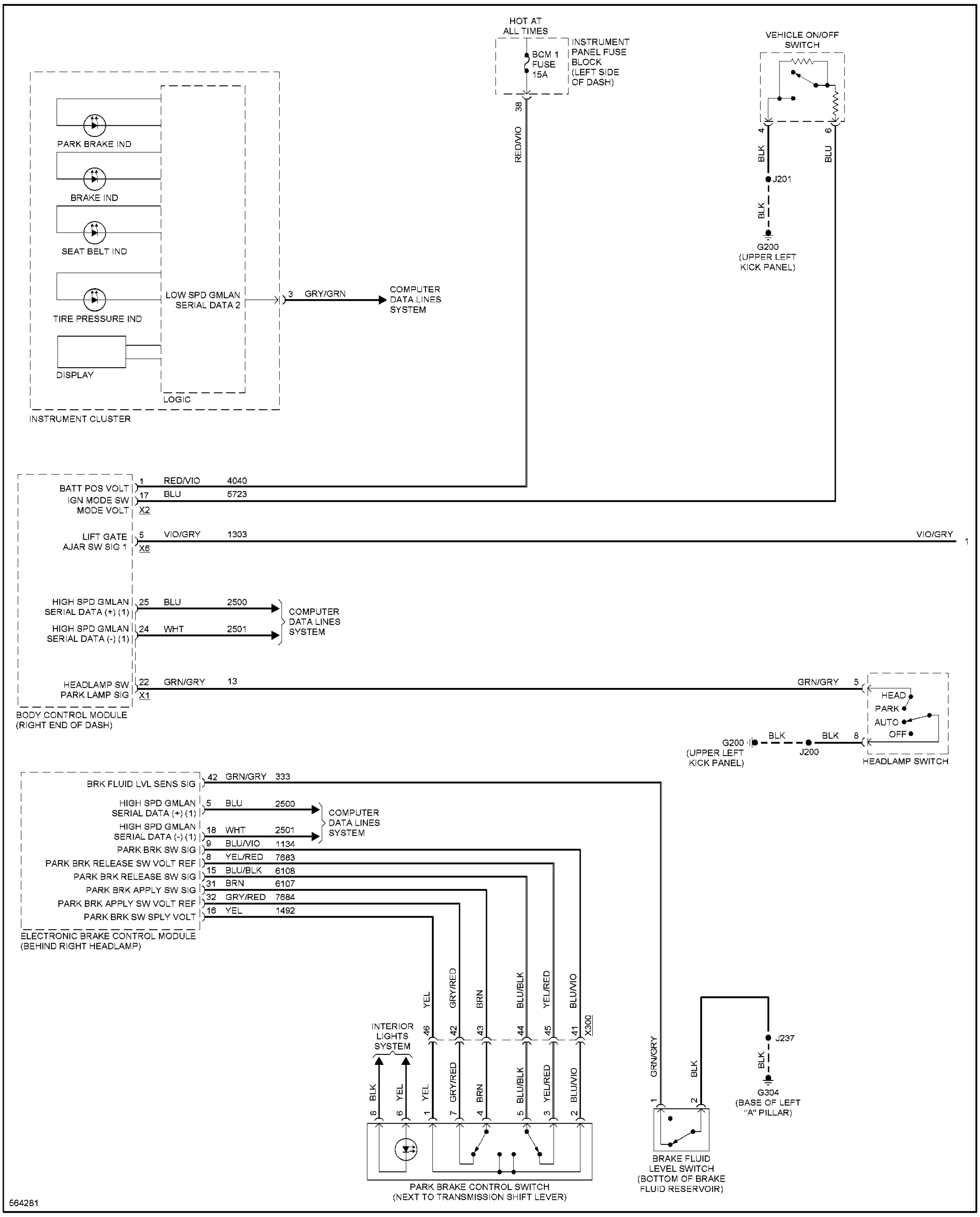

HOT AT ALL TIMES
BCM 1 FUSE 15A
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
38
RED/VIO
VEHICLE ON/OFF SWITCH
4
6
BLK
BLU
J201
BLK
G200 (UPPER LEFT KICK PANEL)
PARK BRAKE IND
BRAKE IND
SEAT BELT IND
TIRE PRESSURE IND
DISPLAY
LOW SPD GMLAN SERIAL DATA 2
LOGIC
INSTRUMENT CLUSTER
3
GRY/GRN
COMPUTER DATA LINES SYSTEM
BATT POS VOLT
IGN MODE SW
MODE VOLT
1
RED/VIO
4040
17
BLU
5723
X2
LIFT GATE AJAR SW SIG 1
5
VIO/GRY
1303
X6
VIO/GRY
1
HIGH SPD GMLAN SERIAL DATA (+) (1)
25
BLU
2500
HIGH SPD GMLAN SERIAL DATA (-) (1)
24
WHT
2501
COMPUTER DATA LINES SYSTEM
HEADLAMP SW PARK LAMP SIG
22
GRN/GRY
13
X1
GRN/GRY
5
BODY CONTROL MODULE (RIGHT END OF DASH)
HEAD
PARK
AUTO
OFF
G200
BLK
J200
BLK
8
(UPPER LEFT KICK PANEL)
HEADLAMP SWITCH
BRK FLUID LVL SENS SIG
42
GRN/GRY
333
HIGH SPD GMLAN SERIAL DATA (+) (1)
5
BLU
2500
HIGH SPD GMLAN SERIAL DATA (-) (1)
18
WHT
2501
COMPUTER DATA LINES SYSTEM
PARK BRK SW SIG
9
BLU/VIO
1134
PARK BRK RELEASE SW VOLT REF
8
YEL/RED
7683
PARK BRK RELEASE SW SIG
15
BLU/BLK
6108
PARK BRK APPLY SW SIG
31
BRN
6107
PARK BRK APPLY SW VOLT REF
32
GRY/RED
7684
PARK BRK SW SPLY VOLT
16
YEL
1492
ELECTRONIC BRAKE CONTROL MODULE (BEHIND RIGHT HEADLAMP)
YEL
GRY/RED
BRN
BLU/BLK
YEL/RED
BLU/VIO
46
42
43
44
45
41
X300
INTERIOR LIGHTS SYSTEM
BLK
YEL
YEL
GRY/RED
BRN
BLU/BLK
YEL/RED
BLU/VIO
8
6
1
7
4
5
3
2
PARK BRAKE CONTROL SWITCH (NEXT TO TRANSMISSION SHIFT LEVER)
GRN/GRY
BLK
1
2
BRAKE FLUID LEVEL SWITCH (BOTTOM OF BRAKE FLUID RESERVOIR)
J237
BLK
G304 (BASE OF LEFT "A" PILLAR)
564281

Fig. 108: Warning Systems Circuit (1 of 2)

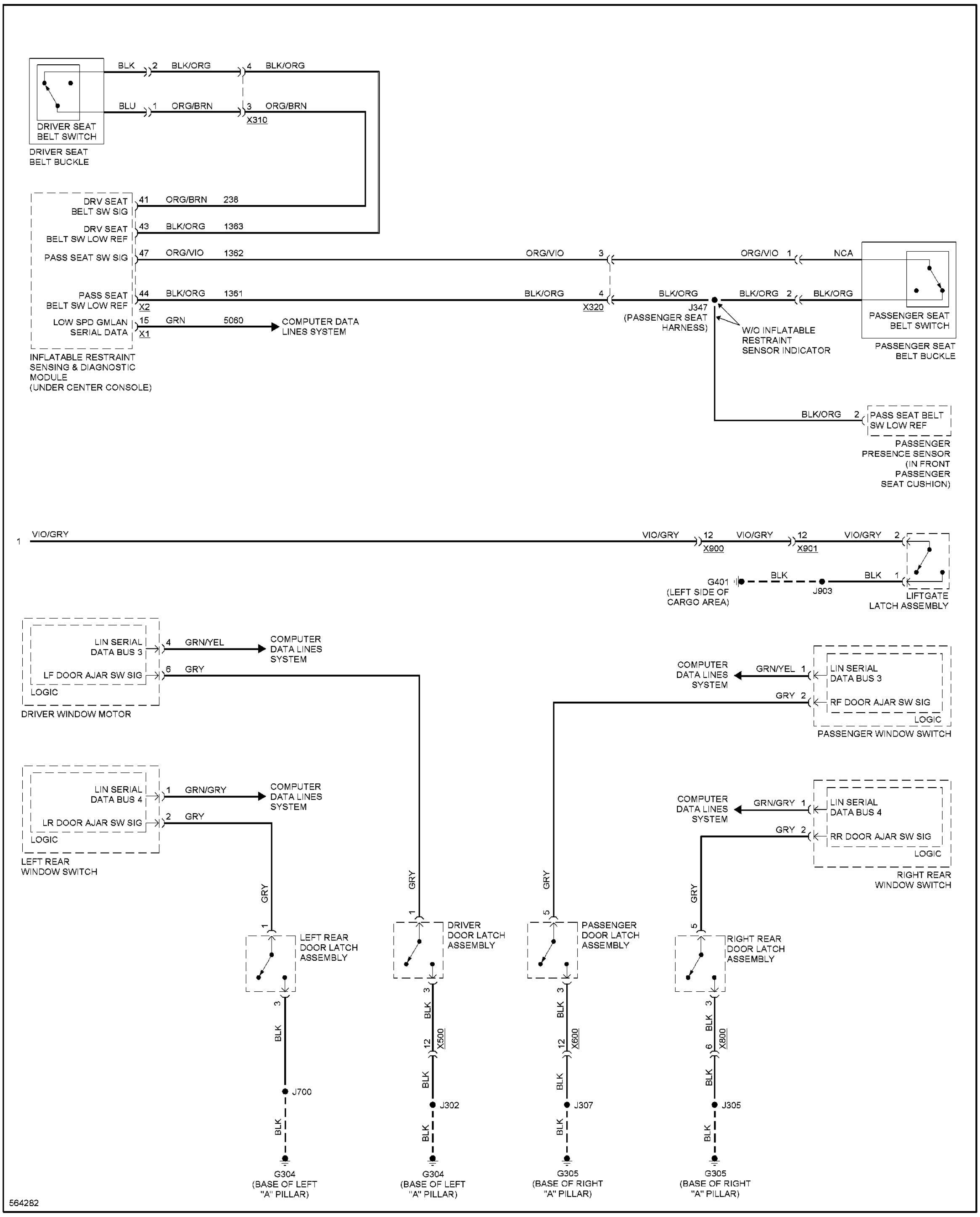

BLK
2
BLK/ORG
4
BLK/ORG
BLU
1
ORG/BRN
3
ORG/BRN
X310
DRIVER SEAT BELT SWITCH
DRIVER SEAT BELT BUCKLE
DRV SEAT BELT SW SIG
41
ORG/BRN
238
DRV SEAT BELT SW LOW REF
43
BLK/ORG
1363
PASS SEAT SW SIG
47
ORG/VIO
1362
ORG/VIO
3
ORG/VIO
1
NCA
PASS SEAT BELT SW LOW REF
44
BLK/ORG
1361
X2
BLK/ORG
4
X320
BLK/ORG
J347 (PASSENGER SEAT HARNESS)
BLK/ORG
2
BLK/ORG
PASSENGER SEAT BELT SWITCH
PASSENGER SEAT BELT BUCKLE
W/O INFLATABLE RESTRAINT SENSOR INDICATOR
LOW SPD GMLAN SERIAL DATA
15
GRN
5060
X1
COMPUTER DATA LINES SYSTEM
INFLATABLE RESTRAINT SENSING & DIAGNOSTIC MODULE (UNDER CENTER CONSOLE)
BLK/ORG
2
PASS SEAT BELT SW LOW REF
PASSENGER PRESENCE SENSOR (IN FRONT PASSENGER SEAT CUSHION)
1
VIO/GRY
VIO/GRY
12
X900
VIO/GRY
12
X901
VIO/GRY
2
G401 (LEFT SIDE OF CARGO AREA)
BLK
J903
BLK
1
LIFTGATE LATCH ASSEMBLY
LIN SERIAL DATA BUS 3
4
GRN/YEL
COMPUTER DATA LINES SYSTEM
LF DOOR AJAR SW SIG
6
GRY
LOGIC
DRIVER WINDOW MOTOR
COMPUTER DATA LINES SYSTEM
GRN/YEL
1
LIN SERIAL DATA BUS 3
GRY
2
RF DOOR AJAR SW SIG
LOGIC
PASSENGER WINDOW SWITCH
LIN SERIAL DATA BUS 4
1
GRN/GRY
COMPUTER DATA LINES SYSTEM
LR DOOR AJAR SW SIG
2
GRY
LOGIC
LEFT REAR WINDOW SWITCH
COMPUTER DATA LINES SYSTEM
GRN/GRY
1
LIN SERIAL DATA BUS 4
GRY
2
RR DOOR AJAR SW SIG
LOGIC
RIGHT REAR WINDOW SWITCH
GRY
1
LEFT REAR DOOR LATCH ASSEMBLY
3
BLK
J700
BLK
G304 (BASE OF LEFT "A" PILLAR)
GRY
1
DRIVER DOOR LATCH ASSEMBLY
3
BLK
12
X500
BLK
J302
BLK
G304 (BASE OF LEFT "A" PILLAR)
GRY
5
PASSENGER DOOR LATCH ASSEMBLY
3
BLK
12
X600
BLK
J307
BLK
G305 (BASE OF RIGHT "A" PILLAR)
GRY
5
RIGHT REAR DOOR LATCH ASSEMBLY
3
BLK
6
X800
BLK
J305
BLK
G305 (BASE OF RIGHT "A" PILLAR)
564282

Fig. 109: Warning Systems Circuit (2 of 2)

WIPER/WASHER

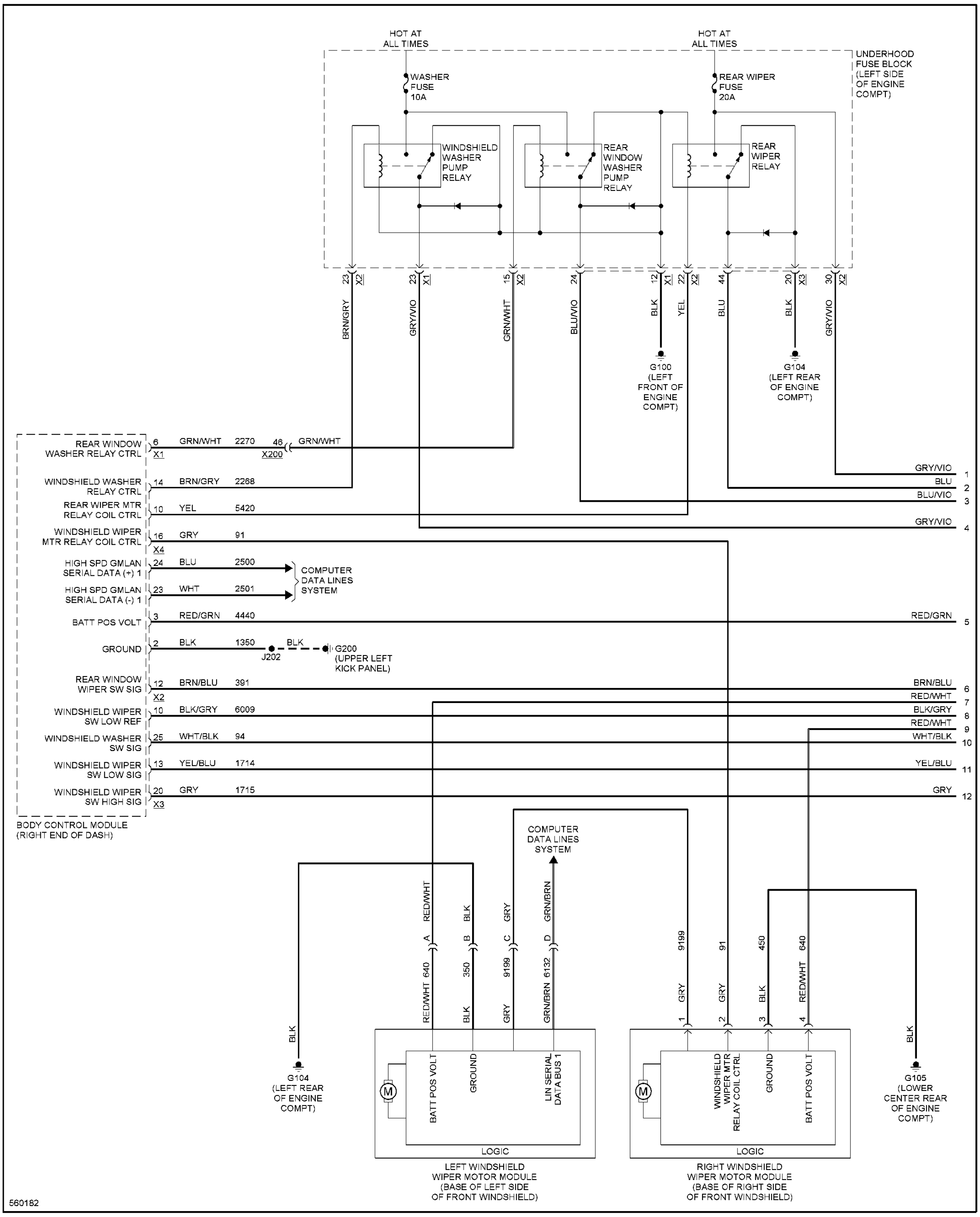

HOT AT ALL TIMES
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
WASHER FUSE 10A
REAR WIPER FUSE 20A
WINDSHIELD WASHER PUMP RELAY
REAR WINDOW WASHER PUMP RELAY
REAR WIPER RELAY
23 X2 BRN/GRY
23 X1 GRY/VIO
15 X2 GRN/WHT
24 BLU/VIO
12 X1 BLK
22 X2 YEL
44 BLU
20 X3 BLK
30 X2 GRY/VIO
G100 (LEFT FRONT OF ENGINE COMPT)
G104 (LEFT REAR OF ENGINE COMPT)
REAR WINDOW WASHER RELAY CTRL 6 X1 GRN/WHT 2270 46 X200 GRN/WHT
WINDSHIELD WASHER RELAY CTRL 14 BRN/GRY 2268
REAR WIPER MTR RELAY COIL CTRL 10 YEL 5420
WINDSHIELD WIPER MTR RELAY COIL CTRL 16 GRY 91 X4
HIGH SPD GMLAN SERIAL DATA (+) 1 24 BLU 2500
HIGH SPD GMLAN SERIAL DATA (-) 1 23 WHT 2501
COMPUTER DATA LINES SYSTEM
BATT POS VOLT 3 RED/GRN 4440
GROUND 2 BLK 1350 J202 BLK G200 (UPPER LEFT KICK PANEL)
REAR WINDOW WIPER SW SIG 12 BRN/BLU 391 X2
WINDSHIELD WIPER SW LOW REF 10 BLK/GRY 6009
WINDSHIELD WASHER SW SIG 25 WHT/BLK 94
WINDSHIELD WIPER SW LOW SIG 13 YEL/BLU 1714
WINDSHIELD WIPER SW HIGH SIG 20 GRY 1715 X3
BODY CONTROL MODULE (RIGHT END OF DASH)
GRY/VIO 1
BLU 2
BLU/VIO 3
GRY/VIO 4
RED/GRN 5
BRN/BLU 6
RED/WHT 7
BLK/GRY 8
RED/WHT 9
WHT/BLK 10
YEL/BLU 11
GRY 12
COMPUTER DATA LINES SYSTEM
RED/WHT A RED/WHT 640
BLK B 350 BLK
GRY C 9199 GRY
GRN/BRN D GRN/BRN 6132
BLK G104 (LEFT REAR OF ENGINE COMPT)
M
BATT POS VOLT
GROUND
LIN SERIAL DATA BUS 1
LOGIC
LEFT WINDSHIELD WIPER MOTOR MODULE (BASE OF LEFT SIDE OF FRONT WINDSHIELD)
9199 GRY 1
91 GRY 2
450 BLK 3
640 RED/WHT 4
M
WINDSHIELD WIPER MTR RELAY COIL CTRL
GROUND
BATT POS VOLT
LOGIC
RIGHT WINDSHIELD WIPER MOTOR MODULE (BASE OF RIGHT SIDE OF FRONT WINDSHIELD)
BLK G105 (LOWER CENTER REAR OF ENGINE COMPT)
560182

Fig. 110: Wiper/Washer Circuit (1 of 2)

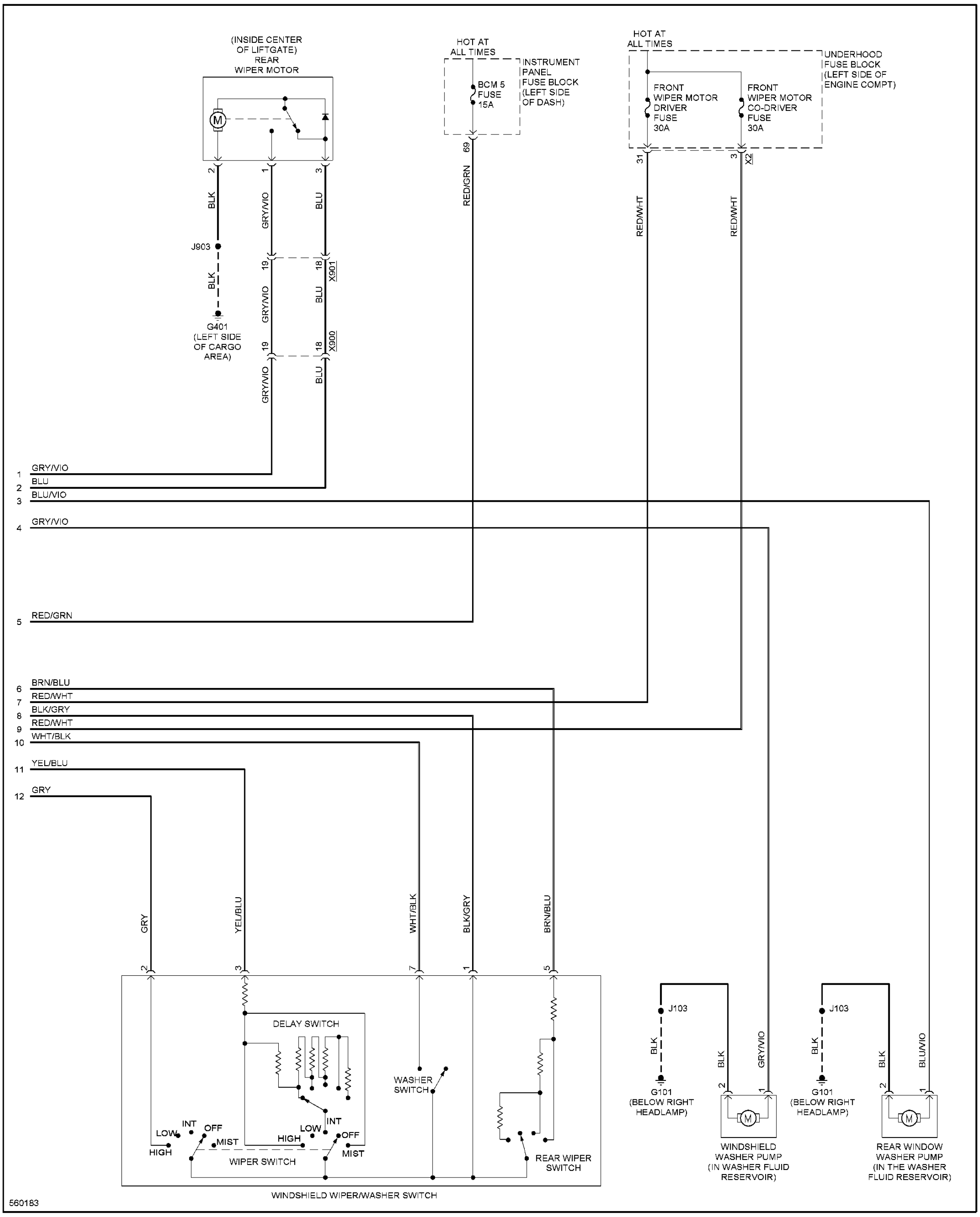

(INSIDE CENTER OF LIFTGATE) REAR WIPER MOTOR
M
2
1
3
BLK
GRY/VIO
BLU
J903
BLK
G401 (LEFT SIDE OF CARGO AREA)
19
18
X901
19
18
X900
HOT AT ALL TIMES
INSTRUMENT PANEL FUSE BLOCK (LEFT SIDE OF DASH)
BCM 5 FUSE 15A
69
RED/GRN
HOT AT ALL TIMES
UNDERHOOD FUSE BLOCK (LEFT SIDE OF ENGINE COMPT)
FRONT WIPER MOTOR DRIVER FUSE 30A
FRONT WIPER MOTOR CO-DRIVER FUSE 30A
31
3
X2
RED/WHT
RED/WHT
1 GRY/VIO
2 BLU
3 BLU/VIO
4 GRY/VIO
5 RED/GRN
6 BRN/BLU
7 RED/WHT
8 BLK/GRY
9 RED/WHT
10 WHT/BLK
11 YEL/BLU
12 GRY
GRY
YEL/BLU
WHT/BLK
BLK/GRY
BRN/BLU
2
3
7
1
5
DELAY SWITCH
WASHER SWITCH
LOW
INT
OFF
MIST
HIGH
WIPER SWITCH
HIGH
LOW
INT
OFF
MIST
REAR WIPER SWITCH
WINDSHIELD WIPER/WASHER SWITCH
J103
BLK
BLK
GRY/VIO
2
1
G101 (BELOW RIGHT HEADLAMP)
M
WINDSHIELD WASHER PUMP (IN WASHER FLUID RESERVOIR)
J103
BLK
BLK
BLU/VIO
2
1
G101 (BELOW RIGHT HEADLAMP)
M
REAR WINDOW WASHER PUMP (IN THE WASHER FLUID RESERVOIR)
560183

Fig. 111: Wiper/Washer Circuit (2 of 2)

Back To Article

TRACTION CONTROL, 4WD, & AWD

Chevrolet - 1980-19

TRACTION CONTROL DISABLE

WARNING: **Placing a non-compatible vehicle on a single-axle dynamometer could result in a safety hazard to technicians and damage to vehicle. Vehicles which use All-Wheel Drive (AWD) or traction control may not be clearly marked. Use common sense and take all necessary precautions when placing any vehicle on the dynamometer. Determine between full-time 4WD and All-Wheel Drive (AWD) for testing purposes. The following tables include information related to full-time 4WD and AWD vehicles, and how to disable the traction control system (if disengageable).**

WARNING: **DO NOT operate vehicle on a 2-wheel dynamometer if the DO NOT TEST column is marked.**

CHEVROLET - CARS

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
Camaro							
1994-02	...	X	...	...	...	X (1)	...
2010-19	...	X	...	...	...	X (9)	...
Caprice							
2011-15	...	X	...	...	...	X (7)	...
2016-17	...	X	...	...	...	X (14)	...
Cavalier							
1995-00	X	...	...	...	...	X (2)	...
2001-05	X	...	...	...	...	X (3)	...
Cobalt							
2007-10	X	...	...	...	...	X (4)	...
Corvette							
1992-97	...	X	...	...	...	X (5)	...
1998-04	...	X	...	...	...	X (10)	...
2005-13	...	X	...	...	...	X (10) (11)	...
2014-19	...	X	...	...	...	X (11) (15)	...
Cruze							
2011-19	...	X	...	...	...	X (9)	...
Impala							
2000-10	X	...	...	...	...	X (6)	...
2011-13	X	...	...	...	...	X (12)	...
2014-19	...	X	...	...	...	X (9)	...
Impala Limited							
2014-16	X	...	...	...	...	X (12)	...
Malibu							

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
2004-07 (& 2008 Classic)	X	...	...	...	...	X (7)	...
2008-12	X	...	...	...	...	X (12)	...
2013-19	X	...	...	...	...	X (9)	...
Monte Carlo							
2000-07	X	...	...	...	...	X (8)	...
Sonic							
2012-19	X	...	...	...	...	X (9)	...
Spark							
2013-15	X	...	...	...	...	X (9)	...
2016-19	X	...	...	...	...	X (14)	...
SS							
2014-15	...	X	...	...	...	X (9)	...
2016-17	...	X	...	...	...	X (15)	...
Volt							
2011	X	...	...	...	...	X (13)	X
2012-15	X	...	...	...	...	X (14)	...
2016-19	X	...	...	...	...	X (9)	...

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test

(1) Press ASR button, located on console. ASR OFF indicator light will illuminate when system is disabled.

(2) ETS system will not operate when A/T selector is in 1 or 2 position. ETS indicator light will stay on when system is disabled.

(3) Traction control is disabled when transaxle is in 1st or 2nd gear only. TRAC OFF indicator light will illuminate when system is disabled.

(4) To turn the ETS off, shift to L (Low) or R (Reverse). The ETS indicator/warning light will come on and stay on and the TRACTION OFF message will be displayed when the gear shift is in L (Low).

(5) Press sliding car icon on the console. The TCS indicator will illuminate when system is disabled.

(6) Press TRAC OFF button on left side of dash. Chime will sound. SERVICE TRACTION SYSTEM indicator light will illuminate when system is disabled.

(7) Press TC button near A/C-heater controls or in front of the shift lever. Indicator light will illuminate when system is disabled.

(8) Press TRAC ON/OFF button on instrument panel or center console. TRACTION CONTROL indicator light will illuminate when system is disabled.

(9) Press and hold the TCS/StabiliTrak button until the Traction Control Off light and the StabiliTrak Off light come on in the instrument panel cluster. The TCS/StabiliTrak button is located near the shift lever.

(10) The TCS Switch allows the driver to shut off the TCS and Active Handling (RPO JL4 - if equipped), by pressing and releasing the switch. If the vehicle is equipped with Active Handling, the TCS switch can be pressed and held for 5 seconds; this places the system in Competitive driving mode. Competitive driving mode turns the TCS off but still allows Active Handling to be active. The switch is located in the center console.

(11) If the Tire Pressure Monitor (TPM) system detects a flat tire and the Driver Information Center (DIC) displays TIRE FLAT, or if the TPM system is malfunctioning and the DIC displays SERVICE TIRE MONITOR, the Active Handling System cannot be turned off by the driver. If the Active Handling System is off, it will be turned back on automatically.

(12) The ESC/TCS button is located on the instrument panel or on console. Press and hold the ESC/TCS button briefly to disable both traction control and ESC. TRACTION OFF and ESC OFF messages will appear, and the ESC/TCS light will be on solid.

(13) Traction Control system turns on automatically whenever the vehicle is on and cannot be turned off.

(14) Press and hold the TCS/StabiliTrak button until the Traction Control Off light and the StabiliTrak Off light come on in the instrument panel cluster. The TCS/StabiliTrak button is located on the overhead console or to the left of the steering wheel.

(15) Press and hold the TCS/StabiliTrak button until the Traction Control Off light and the StabiliTrak Off light come on in the instrument panel cluster. The TCS/StabiliTrak button is located on the center console.

CHEVROLET - TRUCKS

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
Astro							
1990-05 (AWD)	...	...	...	...	(1)	...	...
Avalanche							
2002-13	...	X	...	...	...	X (2)	...
2003-13	...	...	X (4)	...	...	X (3)	...

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
Blazer (2002-05 Jimmy Canadian)							
1980-94	...	X	X (4)	...	...	...	...
1995-05 (4WD)	...	X	X (4)	...	...	...	...
1995-98 (AWD)	...	...	...	...	X (1)	...	...
Captiva Sport							
2012-15 (AWD)	...	...	...	...	X	...	X
2012-15 (FWD)	X	...	...	...	...	X (10)	...
City Express							
2015-19	X	...	...	...	...	X (14)	...
Colorado							
2004-12	...	X	X (4)	...	...	X (3)	...
2015-19	...	X	X (4)	...	...	X (12)	...
Equinox							
2005-19 (AWD)	...	...	...	...	X	...	X
2005-17 (FWD)	X	...	...	...	...	X (9)	...
2019 (FWD)	X	...	...	...	...	X (13)	...
Express (Chevy Express/ Cutaway/ RV)							
2004-11 (RWD)	...	X	...	...	...	X (9)	...
2003-14 (AWD)	...	...	...	...	X	...	X
2012-19 (RWD)	...	X	...	...	...	X (10)	...
HHR							
2008-10	X	...	...	...	...	X (7)	...
K10-30 & K1500-3500 Series							
1980-00	...	X	X (4)	...	...	...	...
LUV							
1980-82	...	X	X (4)	...	...	...	...
Silverado (All Configurations)							
2003-05 (AWD)	...	...	...	...	X	...	X
1999-18	...	X	X (4)	...	...	X (7)	...
SSR							
2003-06	...	X	...	...	...	X (5)	...
Suburban							
1980-99	...	X	X (4)	...	...	...	...
2000-19	...	X	X (4)	...	...	X (7)	...
Tahoe							

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test
1995-99	...	X	X (4)	...	...	...	...
2000-19	...	X	X (4)	...	...	X (7)	...
Tracker							
1998-04	...	X	X (4)	...	...	...	...
TrailBlazer							
2002-09	...	X	X (4)	...	...	X (8)	...
2006-09 (AWD)	...	...	...	...	X	...	X
Traverse							
2009-19 (AWD)	...	...	...	...	X	...	X
2009-19 (FWD)	X	...	...	...	...	X (8)	...
Trax							
2015-19 (AWD)	...	...	...	...	X	...	X
2015-19 (FWD)	X	...	...	...	...	X (12)	...
T10 & T15 Pickup							
1982-01	...	X	X (4)	...	...	...	...
Uplander & Montana SV6							
2006-08 (AWD)	...	...	...	...	X	...	X
Venture							
1997-05	X	...	...	...	...	X (8)	...
2002-05 (AWD)	...	...	...	...	X	...	X

Application	FWD	RWD	Part Time 4WD	Full Time 4WD	AWD	TCS	Do Not Test

(1) All wheel drive is optional.

(2) Press switch with sliding car icon, located left of steering wheel on instrument panel. TRACTION OFF will illuminate when system is disabled.

(3) Traction Assist (TAS) or Traction Control (TCS) can be turned off by pressing TAS or TCS button on instrument panel. TCS light on instrument panel will illuminate.

(4) 4WD With Shift Lever Selector: Shift transfer case to 2WD or 2H mode. 4WD With A/T or M/T Push Button Shift Selector: Press button on instrument panel to select 2HI position. Switch indicator light will flash until new position is active. Indicator light will stay on.

(5) Information from manufacturer is not available.

(6) Press TRACTION ASSIST switch located on dashboard, left of steering wheel. TRACTION OFF indicator light will illuminate when system is disabled.

(7) To turn off both TCS and StabiliTrak, press and hold the TRACTION OFF button until the traction off light and the StabiliTrak OFF light come on and stay on in the instrument cluster.

(8) Press and hold the traction control switch located on instrument panel or center console. When the TCS is turned off, the StabiliTrak light goes on, and an appropriate traction control off message will be displayed on the DIC.

(9) Press the TRACTION OFF button (located on the instrument panel or center console) for more than five seconds to turn off StabiliTrak and TCS. The StabiliTrak light comes on the instrument panel cluster when the system is turned off.

(10) Press the TRACTION OFF button (located on the instrument panel) once to turn off the Traction Control System (TCS). Press and hold the StabiliTrak button for more than five seconds to turn off StabiliTrak and TCS. The StabiliTrak light comes on the instrument panel cluster when the system is turned off.

(11) Press TRACTION OFF button located on instrument panel. The appropriate message displays on Driver Information Center (DCI).

(12) The button for TCS and StabiliTrak is on the center stack. To turn off both TCS and StabiliTrak, press and hold the TRACTION OFF button until the Traction Off Light and StabiliTrak Off Light come on and stay on in the instrument cluster.

(13) TCS and StabiliTrak can be turned OFF or ON using the DIC controls on the steering wheel. On the DIC list of applications, go to Options > Traction & Stability. TCS and StabiliTrack are turned off separately.

(14) To turn off TCS and Electronic Stability Control, press and release the TRACTION OFF button. The Electronic Stability Control (ESC) Off Light comes on and stays on in the instrument cluster. The TRACTION OFF button is on the instrument panel, to the left of the steering wheel.

Back To Article

SPECIFICATIONS

TEMPERATURE VERSUS RESISTANCE (TRANSMISSION FLUID TEMPERATURE SENSOR)

Temperature	Temperature	Minimum Resistance	Nominal Resistance	Maximum Resistance
Â°C	Â°F	Ω	Ω	Ω
-40	-40	95,953	100,865	105,777
-35	-31	69,076	72,437	75,798
-30	-22	50,264	52,594	54,923
-25	-13	36,959	38,583	40,207
-20	-4	27,439	28,582	29,725
-15	5	20,559	21,371	22,183
-10	14	15,540	16,120	16,700
-5	23	11,844	12,261	12,678
0	32	9,097	9,399	9,701
5	41	7,041	7,263	7,485
10	50	5,493	5,658	5,823
15	59	4,318	4,441	4,564
20	68	3,418	3,511	3,604
25	77	2,725	2,795	2,865
30	86	2,185	2,240	2,295
35	95	1,763	1,806	1,849
40	104	1,430	1,465	1,500
45	113	1,167	1,195	1,223
50	122	958	980	1,002
55	131	791	809	827
60	140	656	671	686
65	149	547	559	571
70	158	459	469	479
75	167	387	395	403
80	176	327	334	341
85	185	277	283	289
90	194	236.7	241.8	246.8
95	203	202.5	207.1	211.6
100	212	173.8	178.0	182.1
105	221	149.9	153.6	157.3
110	230	129.7	133.1	136.5
115	239	112.7	115.7	118.7
120	248	98.2	100.9	103.6
125	257	85.9	88.3	90.7
130	266	75.3	77.5	79.6
135	275	66.4	68.3	70.2
140	284	58.6	60.3	62.0
145	293	51.9	53.4	56.2
150	302	46.1	47.5	48.9

FASTENER SPECIFICATIONS (OFF VEHICLE)

Single Use Non-Threaded Fasteners/Components

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application
Automatic Transmission Case Cover Gasket
Automatic Transmission Case Gasket
Automatic Transmission Fluid Filter
Automatic Transmission Fluid Pump Seal
Drive Motor Rotor Bearing Shim
Front Differential Bearing Shim
Front Wheel Drive Shaft Oil Seal Assembly (LHS)
Front Wheel Drive Shaft Oil Seal Assembly (RHS)
Main Shaft Bearing Shim
Manual Shift Shaft Pin
Manual Shift Shaft Seal
Output Shaft Retaining Ring
Shift Shaft Cover Gasket (Coolant Sump)
Shift Shaft Cover Gasket (Oil Sump)
Transmission Vent Pipe
Wiring Harness Connector Assembly

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Quantity	Size	Specification
			Metric (English)
Center Support			
• First Pass	6	M10 X 1.5 X 40.65	58 N.m (43 lb ft)
• Final Pass	6	M10 X 1.5 X 40.65	Plus 30 Degrees
Drive Motor Position Sensor Stator Bolt	3	M6 X 1.0 X 16.4	9 N.m (80 lb in)
Drive Motor Stator Bolt	3	M10 X 1.5 X 148	58 N.m (43 lb ft)
Manual Shift Detent Lever Spring Bolt	1	M6 X 1.0 X 20.2	9 N.m (80 lb in)
Transmission Fill Plug	1	M14 X 1.5	13 N.m (10 lb ft)
Transmission Oil Level Check Plug	1	1/8"-27 NPTF	12 N.m (106 lb in)

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Quantity	Size	Specification Metric (English)
Application	**Quantity**	**Size**	**Specification Metric (English)**
Automatic Transmission Range Selector Lever Nut	1	M10 X 1.5	30 N.m (22 lb ft)
Automatic Transmission Case Bolt	18	M8 X 1.25 X 35.7	22 N.m (16 lb ft)
Automatic Transmission Case Cover Bolt	13	M8 X 1.25 X 35.7	22 N.m (16 lb ft)
Automatic Transmission Fluid Filter Bolt	1	M6 X 1.0 X 20.2	9 N.m (80 lb in)
Automatic Transmission Fluid Pump Bolt	3	M8 X 1.25 X 40.7	22 N.m (16 lb ft)
Drive Motor Power Inverter Module Cable Terminal Insulator Block Bolt	2	M6 X 1.0 X 20	9 N.m (80 lb in)
Oil Pan Baffle Bolt	2	M6 X 1.0 X 20	9 N.m (80 lb in)
Park Pawl Actuator Bracket Bolt	1	M6 X 1.0 X 25	9 N.m (80 lb in)
Park Pawl Actuator Bracket Bolt	2	M6 X 1.0 X 20.2	9 N.m (80 lb in)
Shift Shaft Cover Bolt (Coolant Sump)	14	M6 X 1.0 X 20	9 N.m (80 lb in)
Shift Shaft Cover Bolt (Oil Sump)	8	M6 X 1.0 X 20	9 N.m (80 lb in)

FASTENER SPECIFICATIONS (ON VEHICLE)

Single Use Non-Threaded Fasteners/Components

Application
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***
Automatic Transmission Fluid Pump Seal
Drive Motor Power Inverter Module 3 Phase Cable Connector Seal
Front Wheel Drive Shaft Oil Seal Assembly
Output Shaft Retaining Ring
Shift Shaft Cover Gasket (Coolant Sump)
Shift Shaft Cover Gasket (Oil Sump)

Single Use Threaded Fastener/Component Tightening Specifications

Application	Specification Metric (English)
NOTE: ***All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.***	
Drive Motor Mount Body Side Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	Plus 60 - 75 degrees
Drive Motor Mount Motor Side Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	Plus 60 - 75 degrees
Drive Motor Rear Mount Bracket Drive Motor Side Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	Plus 60 - 75 degrees
Drive Motor Rear Mount Drive Motor Side Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	Plus 60 - 75 degrees
Drive Motor Rear Mount Frame Side Bolt	
• First Pass:	58 N.m (43 lb ft)
• Final Pass:	Plus 60 - 75 degrees
Transmission Fluid Drain Plug	12 N.m (106 lb in)
Transmission Fill Plug	13 N.m (10 lb ft)
Transmission Level Check Plug	12 N.m (106 lb in)

Reusable Threaded Fastener Tightening Specifications

Application	Specification Metric (English)
NOTE: ***All fasteners listed in this table can be reused after removal.***	
Automatic Transmission Electronic Control Bolt	9 N.m (80 lb in)
Automatic Transmission Fluid Pump Bolt	22 N.m (16 lb ft)
Automatic Transmission Range Selector Lever Nut	30 N.m (22 lb ft)
Drive Motor Mount Drive Motor Side Bolt	22 N.m (16 lb ft)
Drive Motor Power Inverter Module 3 Phase Cable Cover Bolt	9 N.m (80 lb in)

Application	Specification
	Metric (English)
Drive Motor Power Inverter Module 3 Phase Cable Connector Bolt	9 N.m (80 lb in)
Range Selector Actuator Hardware Module Assembly Bolt	22 N.m (16 lb ft)
Range Selector Lever Link Adjustment Bolt	5 N.m (44 lb in)
Shift Shaft Cover Bolt (Coolant Sump)	9 N.m (80 lb in)
Shift Shaft Cover Bolt (Oil Sump)	9 N.m (80 lb in)

TRANSMISSION GENERAL SPECIFICATIONS

Name	1ET25
RPO Codes	MMF
Production Location	Incheon, Korea
Transmission Drive	Front Wheel Drive Transaxle
Reverse	Electrically Variable
EVT Mode	Electrically Variable
Pressure Taps	Line Pressure (Fluid Pump)
Transmission Fluid Type	Dexron HP
Transmission Type: Electric	Electrically Variable
Transmission Type: EV	150 kW Drive Motor
Transmission Type: T	Transaxle Mount
Transmission Type: 25	Product Series
Position Quadrant	P, R, N, D, L
Case Material	Die Cast Aluminum
Transmission Net Weight (Wet)	77.4 kg (170.6 lbs)
Maximum Trailer Towing Capacity	N/A

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
1ET25		
Dry Transmission (Empty) - Approximate Capacity	2.9 liters	3.1 quarts
Fluid Change - Approximate Capacity	2.6 liters	2.7 quarts

SHIM SIZE SPECIFICATIONS

Measured Clearance	Shim Thickness
0.98 - 1.03 mm (0.0386~0.0406 in)	0.77 - 0.80 mm (0.0303 - 0.0315 in)
1.03 - 1.08 mm (0.0406 - 0.0425 in)	0.82 - 0.85 mm (0.0323 - 0.0335 in)
1.08 - 1.13 mm (0.0425 - 0.0445 in)	0.87 - 0.90 mm (0.0343 - 0.0354 in)
1.13 - 1.18 mm (0.0445 - 0.0465 in)	0.92 - 0.95 mm (0.0362 - 0.0374 in)
1.18 - 1.23 mm (0.0465 - 0.0484 in)	0.97 - 1.00 mm (0.0382 - 0.0394 in)
1.23 - 1.28 mm (0.0484 - 0.0504 in)	1.02 - 1.05 mm (0.0402 - 0.0413 in)
1.28 - 1.33 mm (0.0504 - 0.0524 in)	1.07 - 1.10 mm (0.0421 - 0.0433 in)
1.33 - 1.38 mm (0.0524 - 0.0543 in)	1.12 - 1.15 mm (0.0441 - 0.0453 in)

Measured Clearance	Shim Thickness
1.38 - 1.43 mm (0.0543 - 0.0563 in)	1.17 - 1.20 mm (0.0461 - 0.0472 in)
1.43 - 1.48 mm (0.0563 - 0.0583 in)	1.22 - 1.25 mm (0.0480 - 0.0492 in)
1.48 - 1.53 mm (0.0583 - 0.0602 in)	1.27 - 1.30 mm (0.0500 - 0.0512 in)
1.53 - 1.58 mm (0.0602 - 0.0622 in)	1.32 - 1.35 mm (0.0520 - 0.0532 in)
1.58 - 1.63 mm (0.0622 - 0.0642 in)	1.37 - 1.40 mm (0.0539 - 0.0551 in)

ADHESIVES, FLUIDS, LUBRICANTS, AND SEALERS

Application	Type of Material	GM Part Number	
		United States	Canada
Automatic Transmission Fluid	Dexron HP	19331925	19300537

TRANSMISSION INTERNAL MODE SWITCH LOGIC

Transmission Internal Mode Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C	Signal P	Signal S
Park (P)	High	Low	High	Low	High
Reverse (R)	Low	High	Low	Low	High
Neutral (N)	High	High	Low	High	Low
Drive (D)	High	Low	High	High	Low
Low (L)	Low	Low	High	High	Low
Always High status: Open/short to voltage condition Always Low status: Short to ground condition					

Typical Scan Tool Data

Internal Mode Switch A/B/C/P

Circuit	Normal Range	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle ON, range selector in Park				
Internal Mode Switch A	1.62 V - 2.49 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch B	0.66 V - 1.02 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch C	0.66 V - 1.02 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch P	1.62 V - 2.49 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch S	1.62 V - 2.49 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Valid High = Switch open = 1.62 V - 2.49 V Valid Low = Switch Closed = 0.66 V - 1.02 V				

SCHEMATIC WIRING DIAGRAMS

AUTOMATIC TRANSMISSION CONTROLS WIRING SCHEMATICS

Temperature and Internal Mode Switch

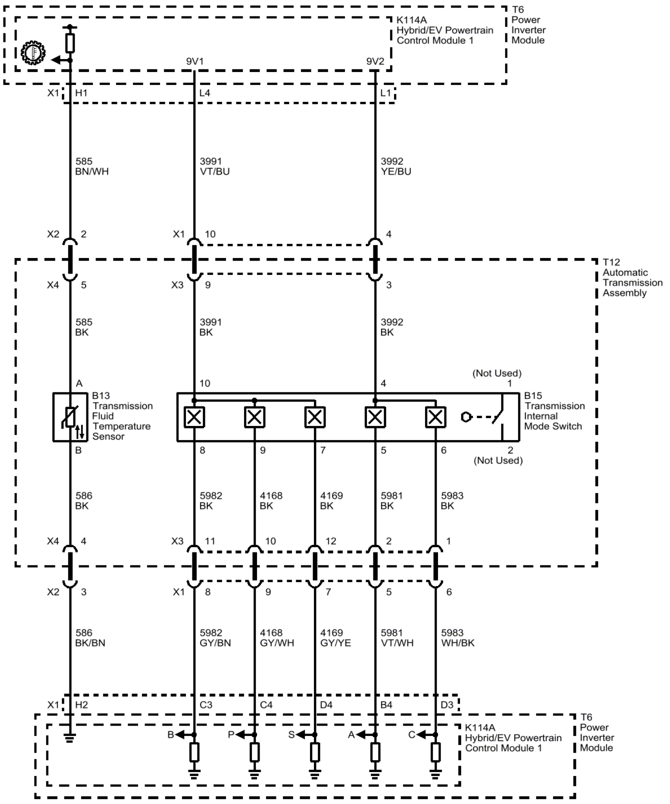

T6
Power
Inverter
Module
K114A
Hybrid/EV Powertrain
Control Module 1
9V1
9V2
X1
H1
L4
L1
585
BN/WH
3991
VT/BU
3992
YE/BU
X2
2
X1
10
4
T12
Automatic
Transmission
Assembly
X4
5
X3
9
3
585
BK
3991
BK
3992
BK
A
B13
Transmission
Fluid
Temperature
Sensor
B
10
4
(Not Used)
1
B15
Transmission
Internal
Mode Switch
8
9
7
5
6
2
(Not Used)
586
BK
5982
BK
4168
BK
4169
BK
5981
BK
5983
BK
X4
4
X3
11
10
12
2
1
X2
3
X1
8
9
7
5
6
586
BK/BN
5982
GY/BN
4168
GY/WH
4169
GY/YE
5981
VT/WH
5983
WH/BK
X1
H2
C3
C4
D4
B4
D3
B
P
S
A
C
K114A
Hybrid/EV Powertrain
Control Module 1
T6
Power
Inverter
Module

Fig. 1: Temperature and Internal Mode Switch
Courtesy of GENERAL MOTORS COMPANY

Regenerative Braking On-Demand Switch

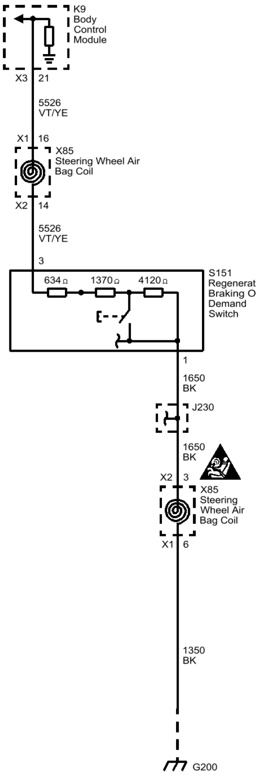

K9
Body
Control
Module
X3
21
5526
VT/YE
X1
16
X85
Steering Wheel Air
Bag Coil
X2
14
5526
VT/YE
3
634Ω
1370Ω
4120Ω
S151
Regenerative
Braking On-
Demand
Switch
1
1650
BK
J230
1650
BK
X2
3
X85
Steering
Wheel Air
Bag Coil
X1
6
1350
BK
G200

Fig. 2: Regenerative Braking On-Demand Switch
Courtesy of GENERAL MOTORS COMPANY

COMPONENT LOCATOR

DISASSEMBLED VIEWS

Case and Associated Parts

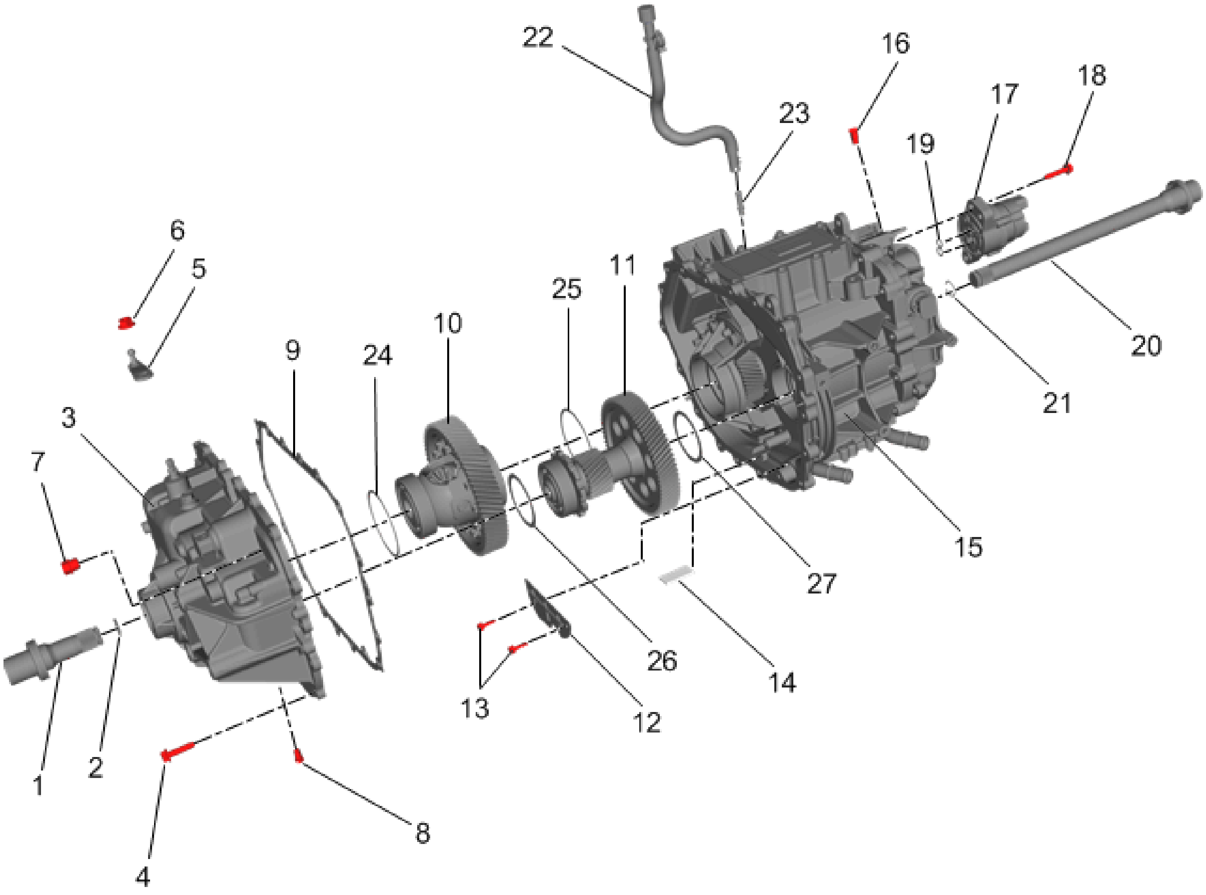


Fig. 3: Case and Associated Parts
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Shaft (RHS)
2	Output Shaft Retaining Ring
3	Automatic Transmission Case
4	Automatic Transmission Case Bolt (Qty: 18)
5	Automatic Transmission Range Selector Lever
6	Automatic Transmission Range Selector Lever Nut
7	Transmission Fill Plug
8	Transmission Fluid Drain Plug
9	Automatic Transmission Case Gasket
10	Front Differential
11	Main Shaft
12	Oil Pan Baffle
13	Oil Pan Baffle Bolt (Qty: 2)
14	Automatic Transmission Fluid Pan Magnet
15	Drive Motor Housing
16	Plug
17	Automatic Transmission Fluid Pump
18	Automatic Transmission Fluid Pump Bolt (Qty: 3)
19	Automatic Transmission Fluid Pump Seal

Callout	Component Name
20	Output Shaft (LHS)
21	Output Shaft Retaining Ring
22	Transmission Vent Hose
23	Transmission Vent Pipe
24	Front Differential Bearing Shim (RHS)
25	Front Differential Bearing Shim (LHS)
26	Main Shaft Bearing Shim (RHS)
27	Main Shaft Bearing Shim (LHS)

Drive Motor Housing Assembly (1 of 2)

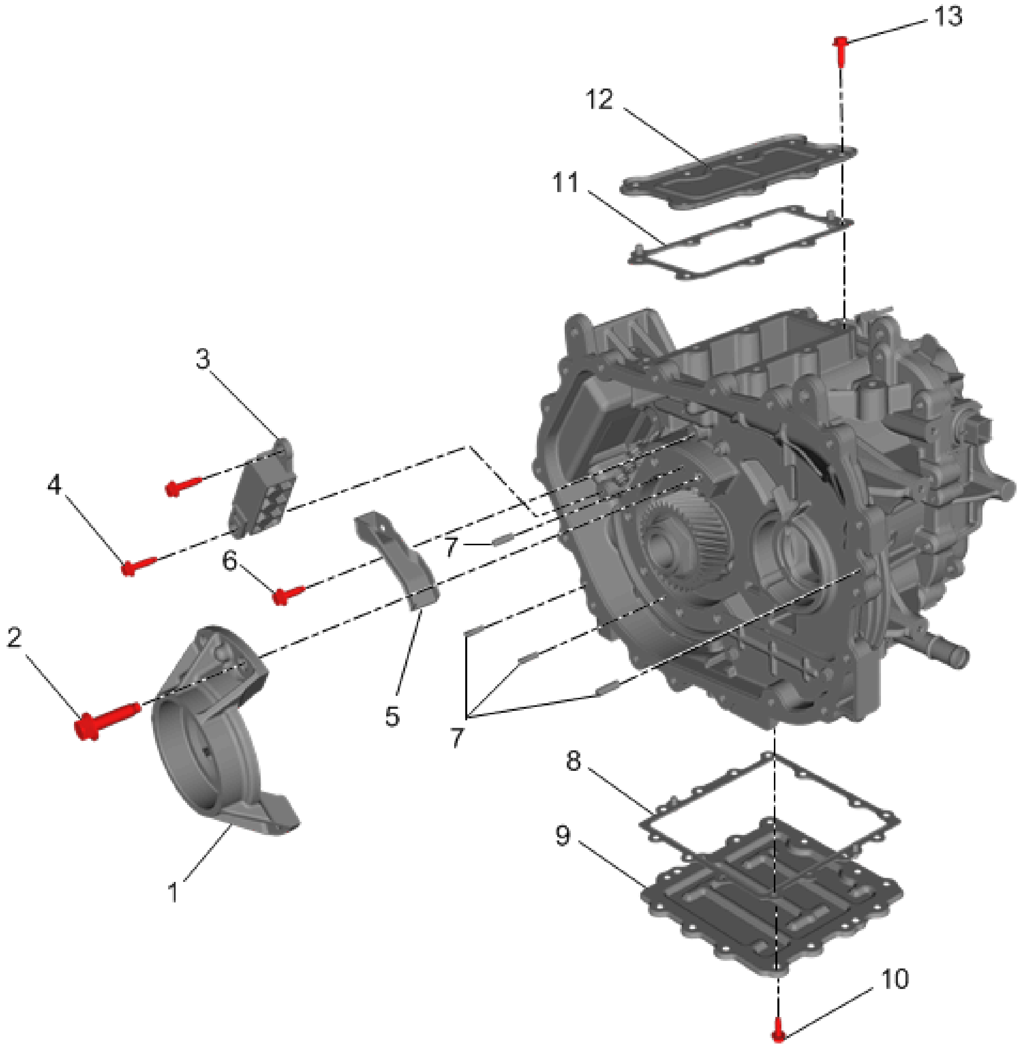


Fig. 4: Drive Motor Housing Assembly (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Center Support
2	Center Support Bolt (Qty: 2)
3	Drive Motor Power Inverter Module Cable Terminal Insulator Block
4	Drive Motor Power Inverter Module Cable Terminal Insulator Block Bolt (Qty: 2)
5	Manual Transmission Oil Trough
6	Manual Transmission Oil Trough Bolt
7	Pin (Qty: 4)
8	Shift Shaft Cover Gasket
9	Shift Shaft Cover (Coolant Sump)
10	Shift Shaft Cover Bolt (Qty: 14)

Callout	Component Name
11	Shift Shaft Cover Gasket
12	Shift Shaft Cover (Oil Sump)
13	Shift Shaft Cover Bolt (Qty: 8)

Drive Motor Housing Assembly (2 of 2)

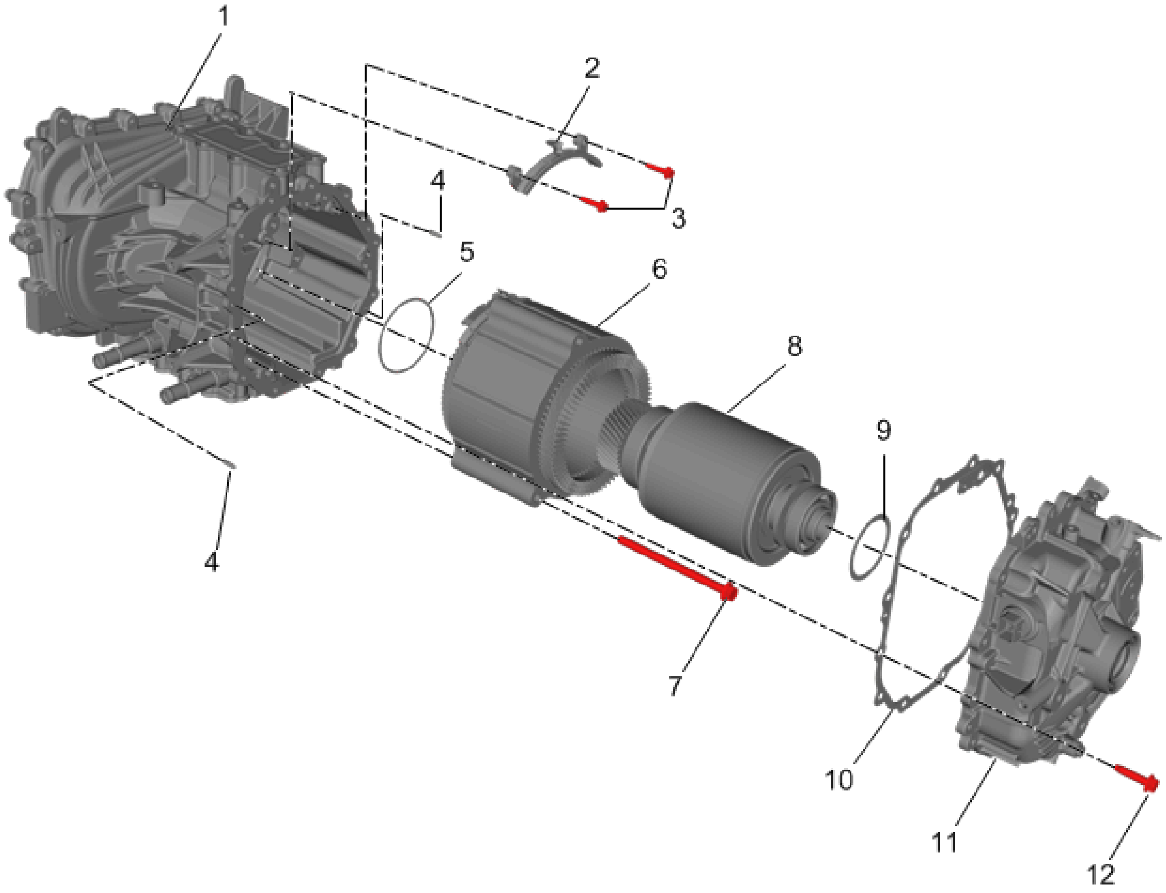


Fig. 5: Drive Motor Housing Assembly (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Housing
2	Drive Motor Stator Coolant Distributor Channel
3	Drive Motor Stator Coolant Distributor Channel Bolt (Qty: 2)
4	Pin (Qty: 2)
5	Drive Motor Rotor Bearing Shim (Right Side)
6	Drive Motor Stator
7	Drive Motor Stator Bolt (Qty: 3)
8	Drive Motor Rotor
9	Drive Motor Rotor Bearing Shim (Left Side)
10	Automatic Transmission Case Cover Gasket
11	Automatic Transmission Case Cover
12	Automatic Transmission Case Cover Bolt (Qty: 13)

Transmission Case Cover Assembly

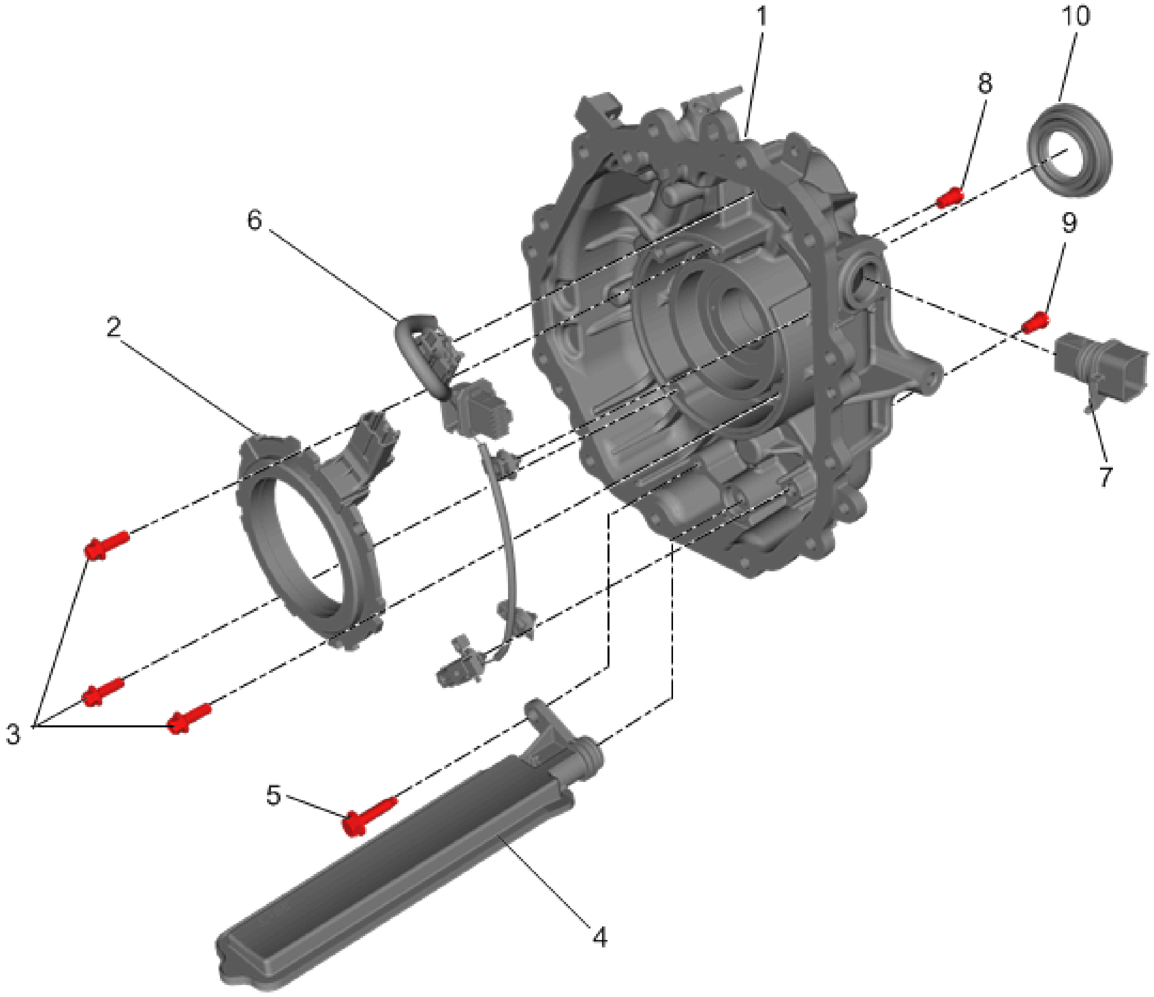
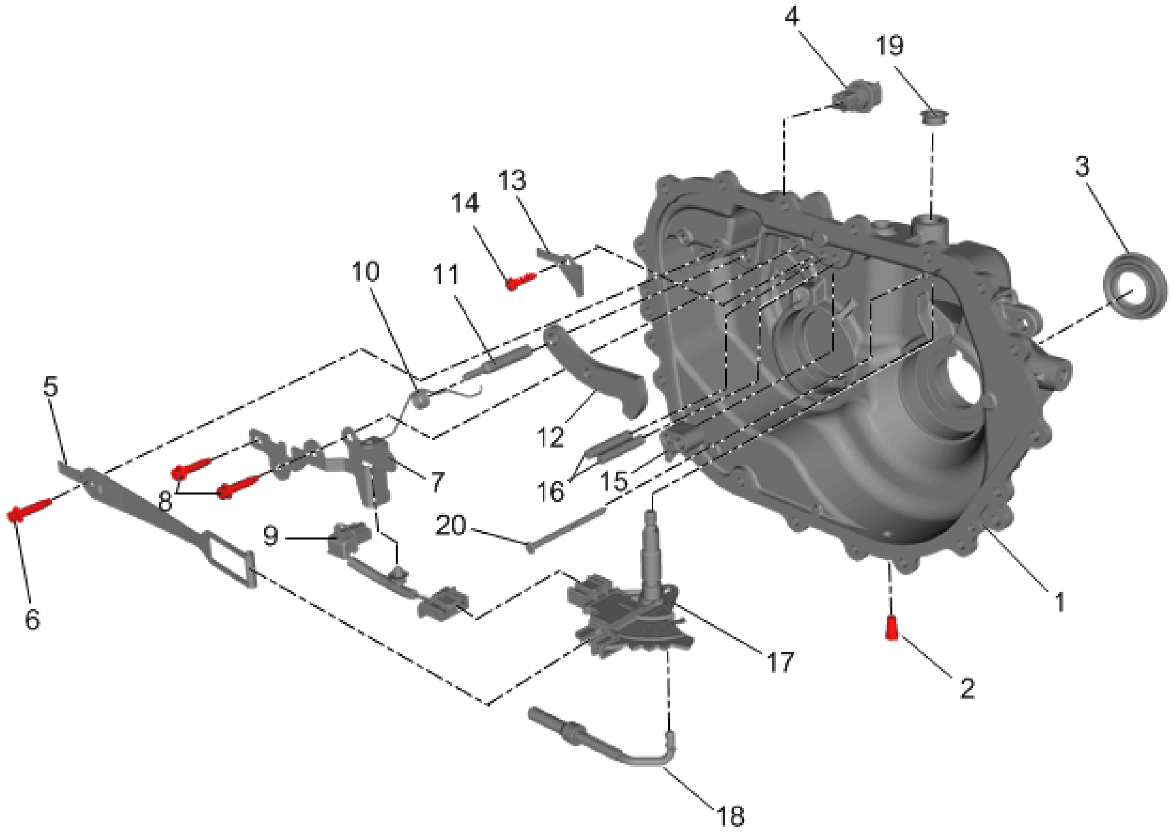


Fig. 6: Transmission Case Cover Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Cover
2	Drive Motor Position Sensor Stator
3	Drive Motor Position Sensor Stator Bolt (Qty: 3)
4	Automatic Transmission Fluid Filter
5	Automatic Transmission Fluid Filter Bolt
6	Automatic Transmission Control Wiring Harness
7	Wiring Harness Electrical Connector
8	Transmission Fluid Drain Plug
9	Transmission Oil Level Check Plug
10	Front Wheel Drive Shaft Oil Seal (LHS)

Parking System Components



[Fig. 7: Parking System Components](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case
2	Transmission Fluid Drain Plug
3	Front Wheel Drive Shaft Oil Seal (RHS)
4	Wiring Harness Electrical Connector
5	Manual Shift Detent Lever Spring
6	Manual Shift Detent Lever Spring Bolt
7	Park Pawl Actuator Bracket
8	Park Pawl Actuator Bracket Bolt (Qty: 2)
9	Automatic Transmission Control Wiring Harness
10	Park Pawl Spring
11	Park Pawl Shaft
12	Park Pawl Shaft
13	Park Pawl Actuator Bracket
14	Park Pawl Actuator Bracket Bolt
15	Park Pawl Actuator Guide
16	Park Pawl Actuator Guide Pin (Qty: 2)
17	Manual Shift Shaft Position Switch
18	Park Pawl Actuator
19	Manual Shift Shaft Seal
20	Manual Shift Shaft Pin

COMPONENT LOCATION

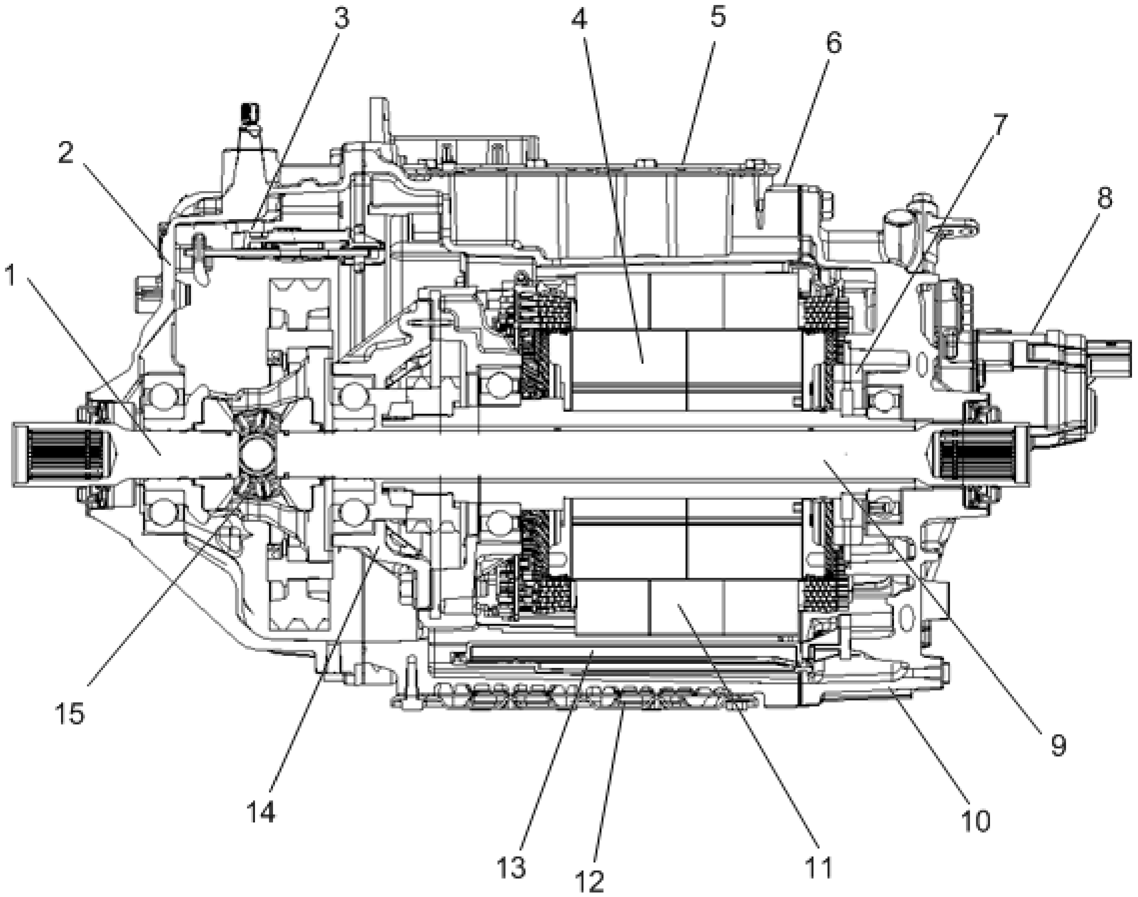


Fig. 8: Transmission Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Shaft Assembly (RHS)
2	Automatic Transmission Case
3	Manual Shift Shaft Position Switch Assembly
4	Drive Motor Rotor Assembly
5	Shift Shaft Cover (Oil Sump)
6	Drive Motor Housing
7	Drive Motor Position Sensor Stator Assembly
8	Automatic Transmission Fluid Pump Assembly
9	Output Shaft Assembly (LHS)
10	Automatic Transmission Case Cover
11	Drive Motor Stator Assembly
12	Shift Shaft Cover (Coolant Sump)
13	Automatic Transmission Fluid Filter Assembly
14	Center Support
15	Front Differential Assembly

SEAL LOCATIONS

Seal Locations (1 of 2)

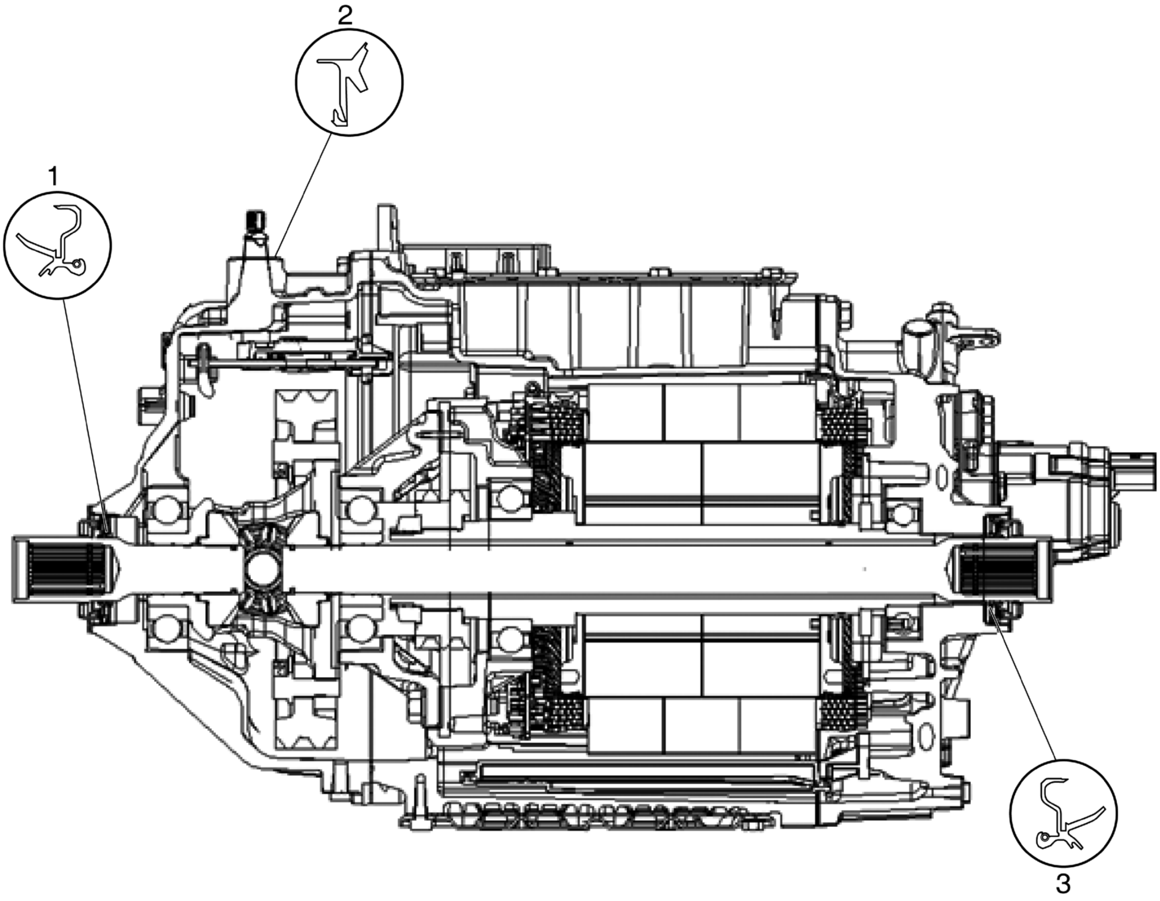


Fig. 9: Seal Locations (1 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal Assembly (RHS)
2	Manual Shift Shaft Seal
3	Front Wheel Drive Shaft Oil Seal Assembly (LHS)

Seal Locations (2 of 2)

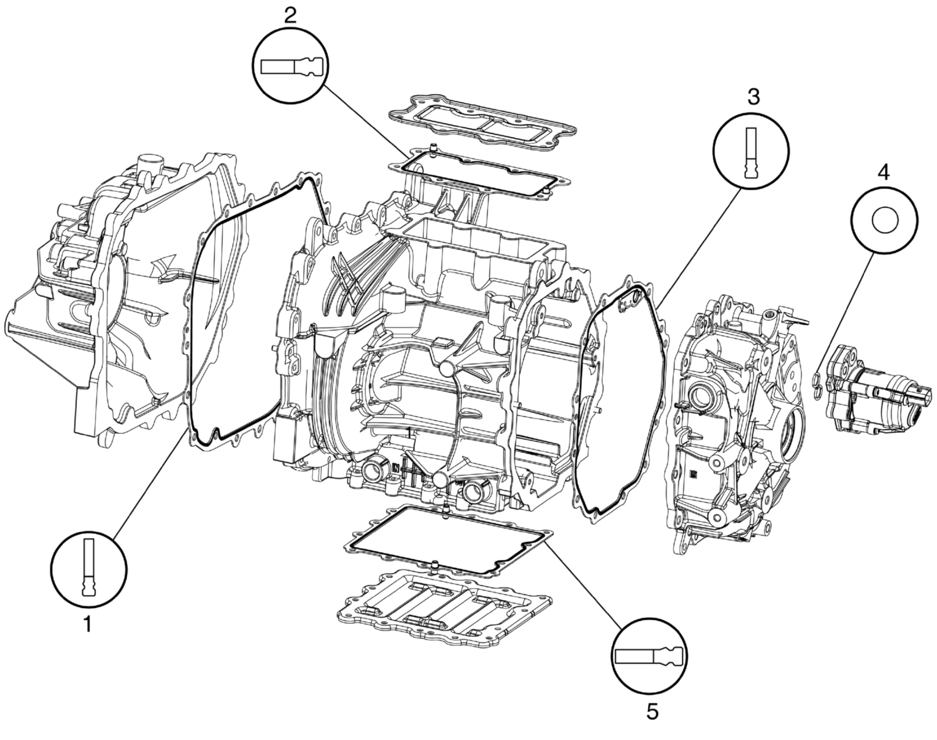


Fig. 10: Seal Locations (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Gasket
2	Shift Shaft Cover Gasket (Oil Sump)
3	Automatic Transmission Case Cover Gasket
4	Automatic Transmission Fluid Pump Seal
5	Shift Shaft Cover Gasket (Coolant Sump)

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC C1217, C1301, OR C1302: TRANSMISSION RANGE STATUS/ONE PEDAL DRIVING PARK BRAKE AUTONOMOUS APPLY REQUEST/ONE PEDAL DRIVING SHIFT TO PARK REQUEST - MESSAGE COUNTER(S) INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C1217

Transmission Range Status Message Counter Incorrect

DTC C1301

One Pedal Driving Park Brake Autonomous Apply Request Message Counter Incorrect

DTC C1302

One Pedal Driving Shift To Park Request Message Counter Incorrect

Circuit/System Description

The Multi-Axis Acceleration sensor sends the amount or rate of acceleration to the Electronic Brake Control Module (EBCM). To improve vehicle performance, the EBCM is constantly sending the K114B Hybrid/EV Powertrain Control Module 2 serial data messages with information regarding the rate of vehicle acceleration. The K114B Hybrid/EV Powertrain Control Module sets this DTC when it detects a discrepancy in the structure of the message, causing the signal message integrity to be questioned.

Conditions for Running the DTC

The system voltage is greater than 10.2 V.

Conditions for Setting the DTC

C1217

The K114B Hybrid/EV Powertrain Control Module detects 74 errors out of 101 samples in the rolling count value sent by the EBCM for 2.5 s.

OR

The K114B Hybrid/EV Powertrain Control Module detects calculated protection value signal does not match the calculated protection value signal sent by the EBCM for 2.5 s.

C1301

The K114B Hybrid/EV Powertrain Control Module detects 60 errors out of 80 samples in the calculated one pedal driving park brake autonomous apply request signal active rolling count value sent by the EBCM for 2 s.

OR

The K114B Hybrid/EV Powertrain Control Module detects calculated one pedal driving park brake protection value signal that does not match the calculated one pedal driving park brake protection value signal sent by the EBCM for 2 s.

C1302

The K114B Hybrid/EV Powertrain Control Module detects 60 errors out of 80 samples in the calculated one pedal driving shift to park requested signal active rolling count value sent by the EBCM for 2 s.

OR

The K114B Hybrid/EV Powertrain Control Module detects calculated one pedal driving shift to park requested protection value signal does not match the one pedal driving shift to park requested protection value signal sent by the EBCM for 2 s.

Action Taken When the DTC Sets

C1217, C1301, and C1302 are Type A DTCs.

C1217

DC fast charging is disabled.

C1301 and C1302

One Pedal Driving function is disabled.

Conditions for Clearing the DTC

C1217, C1301, and C1302 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

- **Circuit Testing**
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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **C1217, C1301, and C1302 are informational DTCs.**
- **Diagnose all other T6 Power Inverter Module and K17 Electronic Brake Control Module DTCs prior to DTC P175F.**

1. Verify there are no other T6 Power Inverter Module or K17 Electronic Brake Control Module DTCs set.
   - **If a DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If a DTC is not set**
2. Complete the diagnosis by looking for a serial data fault. Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device** .
   - **If a serial data circuit fault is found**

     Repair as necessary.

   - **If a serial data circuit fault is not found**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P0711-P0713: TRANSMISSION FLUID TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC P0711

Transmission Fluid Temperature Sensor Performance

DTC P0712

Transmission Fluid Temperature Sensor Circuit Low Voltage

DTC P0713

Transmission Fluid Temperature Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Fluid Temperature Sensor Signal	P0712	P0713	P0713	P0711
Low Reference	-	P0713	-	P0711

Typical Scan Tool Data

Transmission Fluid Temperature

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature **Parameter Normal Range:** -39 to +160Â°C (-38 to +320Â°F)			
Transmission Fluid Temperature Sensor Signal	Greater than 160Â°C (320Â°F)	Less than -39Â°C (-38Â°F)	Less than -39Â°C (-38Â°F)*
Low Reference	-	Less than -39Â°C (-38Â°F)	Less than -39Â°C (-38Â°F)*
* Internal Transmission Fluid Temperature Sensor damage may result if shorted to B+			

Circuit/System Description

The primary source of heat in the transmission is the drive motor generator. The drive motor generator is cooled by the transmission fluid. Hot fluid exits the drive motor generator and flows to the transmission cooler supply line. The supply line connects to the transmission cooler, which is internal to the radiator. The transmission fluid cooler pipe assembly is equipped with an internal thermostat that opens at 80Â°C (176Â°F) for optimum transmission operation and efficiency. The transmission cooler pipe thermostat is part of the transmission fluid cooler pipe assembly, located near the transmission and is not serviced separately. From the cooler, the fluid returns through the transmission fluid cooler pipe assembly and enters the lubrication circuits. The transmission fluid temperature sensor is part of the transmission control wire harness.

Conditions for Running the DTC

The system voltage is greater than or equal to 9 V.

P0711

- Cold soak average temperature is greater than or equal to -40Â°C (-40Â°F).
- DTC P0712 or P0713 is not set.
- Vehicle Off time is greater than 43,200 s.
- HV battery charging off time is greater than 25,200 s.
- HV battery thermal conditioning off time is greater than 25,200 s.
- Transmission Fluid Temperature is -40 to +80Â°C (-40 to +176Â°F).
- Vehicle is On for greater than or equal to 4.5 s.

P0712 and P0713

Vehicle is On.

Conditions for Setting the DTC

P0711

The difference between the Transmission Fluid Temperature and the cold soak average temperature is greater than 20Â°C (68Â°F) for 0.1 s:

- Drive Motor Inverter Temperature
- Auxiliary Transmission Fluid Pump Inverter Temperature
- Hybrid/EV electronics coolant temperature

P0712

The Transmission Fluid Temperature parameter is greater than 149Â°C (300.2Â°F) for greater than 2 s.

P0713

The Transmission Fluid Temperature parameter is less than or equal to -40Â°C (-40Â°F) for greater than 2 s.

Action Taken When the DTC Sets

- DTCs P0711, P0712 and P0713 are Type A DTCs.
- The auxiliary transmission fluid pump is commanded to maximum speed.
- Reduced propulsion is commanded.

Conditions for Clearing the DTC

DTCs P0711, P0712 and P0713 are Type A DTCs.

Diagnostic Aids

While driving, the Transmission Fluid Temperature parameter on the scan tool should rise steadily to a normal operating temperature, and then stabilize.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

DT-44152 Jumper Harness

For equivalent regional tools, refer to **Special Tools**.

Circuit/System Verification

1. Vehicle ON.
2. Verify the scan tool Transmission Fluid Temperature Sensor parameter is between -39 to +120Â°C (-38 to +248Â°F) and changes with vehicle drive time.
   - **If not between -39 to +120Â°C (-38 to +248Â°F) or does not change**

     Refer to Circuit/System Testing.

   - **If between -39 to +120Â°C (-38 to +248Â°F) and changes**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.

- **If the DTC sets**

  Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the X2 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 minutes for all vehicle systems to power down.
2. Connect **DT-44152** jumper harness to the vehicle harness.
3. Test for less than 5 Ω between the Transmission Fluid Temperature Sensor low reference circuit terminal 3 and ground.
    - **If 5 Ω or greater**
    1. Vehicle OFF, disconnect the harness connector at the T6 Power Inverter Module.
    2. Test for less than 2 Ω in the Transmission Fluid Temperature Sensor low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the T6 Power Inverter Module.
    - **If less than 5 Ω**
4. Vehicle ON.
5. Verify the scan tool Transmission Fluid Temperature Sensor parameter is colder than -39Â°C (-38Â°F).
    - **If warmer than -39Â°C (-38Â°F)**
    1. Vehicle OFF, disconnect the harness connector at the T6 Power Inverter Module.
    2. Test for infinite resistance between the Transmission Fluid Temperature Sensor signal circuit terminal 2 and ground.
        - If less than infinite resistance, repair the short to ground on the Transmission Fluid Temperature Sensor signal circuit.
        - If infinite resistance, replace the T6 Power Inverter Module.
    - **If colder than -39Â°C (-38Â°F)**
6. Install a 3 A fused jumper wire between the Transmission Fluid Temperature Sensor signal circuit terminal 2 and the Transmission Fluid Temperature Sensor low reference circuit terminal 3.
7. Verify the scan tool Transmission Fluid Temperature sensor parameter is warmer than 149Â°C (300Â°F).
    - **If colder than the 149Â°C (300Â°F)**
    1. Vehicle OFF, disconnect the harness connector at the T6 Power Inverter Module, vehicle ON.
    2. Test for less than 1 V between the Transmission Fluid Temperature Sensor signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Vehicle OFF.
    4. Test for less than 2 Ω in the Transmission Fluid Temperature Sensor signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the T6 Power Inverter Module.
    - **If warmer than 149Â°C (300Â°F)**
8. Test the Transmission Control Wiring Harness circuits 585 and 586 for a short to voltage, short to ground, an open/high resistance, or short together.
    - If not OK, replace the Transmission Control Wiring Harness.
    - If OK, test or replace the B13 Transmission Fluid Temperature Sensor.

Component Testing

Static Test

1. Vehicle OFF, disconnect the X2 transmission connector.

   NOTE: A thermometer can be used to test the sensor off vehicle.

2. Test the B13 Transmission Fluid Temperature Sensor by comparing the sensor temperature to a known temperature while monitoring the sensor resistance. Compare the readings with the Temperature Versus Resistance (Transmission Fluid Temperature Sensor) table and verify that the resistance is within the specification.
   - **If the transmission fluid temperature resistance does not match the specified value**
   1. Test the Transmission Control Wiring Harness circuits 585 and 586 for a short to voltage, short to ground, an open/high resistance, or short together.
      - If not OK, replace the Transmission Control Wiring Harness.
      - If OK, test or replace the B13 Transmission Fluid Temperature Sensor.
   - **If transmission fluid temperature resistance tests OK**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Refer to Automatic Transmission Control Wiring Harness Removal - Transmission Case for transmission control wiring harness or transmission fluid temperature sensor replacement.
- Refer to Control Module References for T6 Power Inverter Module replacement, programming, and setup.

DTC P152A OR P152D: REGENERATIVE BRAKING CONTROL SWITCH 1-2 CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P152A

Regenerative Braking Control Switch 1 Circuit

DTC P152D

Regenerative Braking Control Switch 1 and 2 Circuit

Diagnostic Fault Information

Regenerative Braking On Demand

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Normal Range = Inactive/Active				
Tap Up/Tap Down Switch Signal 2 Circuit	P152D	Regenerative Braking On Demand Malfunction	Regenerative Braking On Demand Malfunction	P152A, P152C

Circuit/System Description

Regenerative Braking On Demand enables drivers to actively re-capture energy when slowing down, such as when approaching slower traffic or setting up for a tight turn. To engage Regenerative Braking On Demand, the driver releases the accelerator pedal and pulls back on the left steering-wheel paddle to begin regenerating electricity. When engaged, Regenerative Braking On Demand provides vehicle deceleration that is more than what a typical vehicle experiences while coasting or when the transmission shifter is in the L position, providing control and dynamic performance characteristics similar to downshifting in a manual-transmission vehicle. The feature does not bring the vehicle to a complete stop. Releasing the paddle cancels the Regeneration on Demand request, allowing the vehicle to coast normally. The driver can engage and disengage Regeneration on Demand as desired and as traffic conditions allow. When Regenerative Braking On Demand is requested, a signal is sent to the Body Control Module and then to the hybrid/EV powertrain control module 1 via serial data. The Regenerative Braking On Demand parameter is displayed as Inactive and Active on the scan tool. The Regenerative Braking On Demand parameter states are listed below:

- Inactive - when the S151 automatic transmission manual shift switch-left switch is not pressed
- Active - when the S151 automatic transmission manual shift switch-left is pressed

Conditions for Running the DTC

Propulsion system is active.

DTC P152A

DTC P152D is not set.

Conditions for Setting the DTC

P152A

The hybrid/EV powertrain control module 1 detects the Regenerative Braking On Demand is active for greater than 600 s.

P152D

The hybrid/EV powertrain control module 1 detects an invalid voltage regenerative braking on demand switch - left circuit for 60 s.

Action Taken When the DTC Sets

- DTC P152A and P152D are Type C DTCs.
- The hybrid/EV powertrain control module 1 disables regenerative braking on demand.

Conditions for Clearing the DTC

DTC P152A and P152D are Type C DTCs.

Diagnostic Aids

DTC P152A can be customer induced by holding regenerative braking control switch in the regeneration on demand position while driving for greater than 600 s. Verify the customer is not pressing the switch for greater than 600 s.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON, verify with a scan tool the following hybrid/EV powertrain control module 1 parameter displays the correct values the S151 automatic transmission manual shift switch-left state:
    - Regenerative Braking On Demand displays Inactive when not pressed.
    - Regenerative Braking On Demand displays Active when pressed.
    - **If the hybrid/EV powertrain control module 1 parameter is incorrect**

      Refer to Circuit/System Testing.

    - **If the hybrid/EV powertrain control module 1 Regenerative Braking On Demand parameter is correct**
2. After performing the above step, verify that the DTC does not reset by operating the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. If the vehicle passes the Circuit/System Verification procedure, then STOP. Do not perform the Circuit/System Testing or Component Testing as this may result in an unnecessary part replacement. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S151 automatic transmission manual shift switch-left. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the scan tool Regenerative Braking On Demand parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K9 BCM X3 connector.
    2. Test for infinite resistance between the signal circuit terminal X3 21 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 BCM.
    - **If Active**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
6. Verify the scan tool Regenerative Braking On Demand parameter is Active.

  - **If not Inactive**
    1. Vehicle OFF, remove the jumper wire, disconnect the X3 harness connector at the K9 BCM, vehicle ON.
    2. Test for less than 1 V between the signal circuit terminal 21 and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 BCM.
  - **If Active**

7. Test or replace the S151 automatic transmission manual shift switch-left.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- Refer to **Steering Wheel Replacement** for S151 automatic transmission manual shift switch-left replacement.
- Refer to **Control Module References** for K9 BCM replacement, programming, and setup.

DTC P152C: REGENERATIVE BRAKING CONTROL SWITCH SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P152C

Regenerative Braking Control Switch Signal Message Counter Incorrect

Circuit/System Description

Hybrid Low Mode enables drivers to actively re-capture energy when slowing down, such as when approaching slower traffic or setting up for a tight turn. To engage hybrid low mode the shift lever is placed in low (L), the driver shift request, also known as the tap shift function, is activated. The driver shift request allows the vehicle operator to switch from L2 to L1 pressing the minus (-) button and back to L2 by pressing the plus (+) button. The body control module (BCM) supplies a signal circuit to the automatic transmission manual shift switch. The automatic transmission manual shift switch has switches connected to a resistor array. When the lever is in the L position, a voltage drop occurs across the resistor network. When the plus or minus button is pressed, a corresponding voltage drop occurs across the resistor network. This voltage drop is monitored by the BCM. The BCM will send the request to the hybrid/EV powertrain control module 1 to perform the transition from L2 to L1 or if already in L1 then back to L2. When the shifter is moved to the L position, the instrument cluster will display L2, the hybrid/EV powertrain control module 1 will command a higher level of regenerative braking than what is commanded in the D position. When the minus (-) button is pressed, the L1 mode is commanded by the hybrid/EV powertrain control module 1. When the plus (+) button is pressed when in L1 mode, the system will transition back to L2.

Conditions for Running the DTC

The propulsion system is active.

Conditions for Setting the DTC

The hybrid/EV powertrain control module 1 has detected a drive mode signal rolling count error for 10.0 s.

Action Taken When the DTC Sets

- DTC P152C is a Type C DTC.
- The hybrid/EV powertrain control module 1 disables regenerative braking on demand.

Conditions for Clearing the DTC

DTC P152C is a Type C DTC.

Diagnostic Aids

When attempting to set hybrid/EV powertrain control module serial data DTCs, run the vehicle in propulsion system active mode for at least 1 minute, and then shut the vehicle off for 30 seconds. Following this procedure will allow for a complete hybrid/EV powertrain control module shutdown.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Run the vehicle in propulsion system active mode for 1 minute, then vehicle OFF for 30 seconds.
2. Verify DTC P152C is not set.
   - **If the DTC is set**
   1. Program the K114A Hybrid Powertrain Control Module.
   2. Verify the DTC does not set.
      - If the DTC is set, replace the T6 Power Inverter Module.
      - If the DTC does not set
   3. All OK.
   - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for T6 Power Inverter Module replacement, programming and setup.

DTC P152E: UNEXPECTED VEHICLE MOVEMENT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P152E

Unexpected Vehicle Movement

Circuit/System Description

The vehicle provides One-Pedal Driving modes that are selectable using the drive unit shifter or Regen on Demand. One-Pedal Driving modes allow for increased deceleration without use of the brake and will bring the vehicle to a complete stop in many cases. The brake pedal should still be used to hold the vehicle at a stop, even when it may not seem necessary. The brake pedal may be required to bring the vehicle to a stop on sloped surfaces.

Regen on Demand enables One-Pedal Driving by pressing and holding the steering wheel paddle in either D (Drive) or L (Low). The accelerator pedal must be less than halfway engaged for Regen on Demand to work. In addition to this, the Low gear also enables One-Pedal Driving, and used together with Regen on Demand will provide an even higher level of deceleration. When any of these One-Pedal Driving modes are enabled, the brake lights may illuminate during increased deceleration.

The deceleration provided by the One-Pedal Driving modes in Low and in Regen on Demand provide 100% regenerative braking and help to increase energy efficiency.

In One-Pedal Driving modes, the accelerator pedal can be used to control the deceleration rate of the car all the way to a stop. Completely lifting off of the accelerator pedal will result in an aggressive deceleration. However, by slowly lifting off of the accelerator pedal and making adjustments lightly on the accelerator pedal, the deceleration of the vehicle can be adjusted as desired.

If the vehicle begins to move after coming to a complete stop, the Electric Parking Brake may apply to prevent undesired movement. Applying the accelerator pedal will automatically release the Electric Parking Brake as the car moves forward.

Conditions for Running the DTC

- One-Pedal Driving feature is active.
- Holding torque is greater than 90 for 3 s.
- Drive Motor torque is greater than 5.
- Holding torque and vehicle speed are in the same direction and output torque difference is greater than 40.

Conditions for Setting the DTC

The Hybrid/EV Powertrain Control Module 1 detects a 0.08 g torque acceleration greater than the requested torque for 0.1875 s.

Action Taken When the DTC Sets

- P152E is a Type A DTC.
- The Hybrid/EV Powertrain Control Module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

P152E is a Type A DTC.

Diagnostic Aids

This DTC may set if the vehicle is in One-Pedal Driving mode and is bumped or pushed while at a stop.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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Electrical Information Reference

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- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **P152E is an informational DTC.**
- **Diagnose all other T6 Power Inverter Module and K17 Electronic Brake Control Module DTCs prior to DTC P152E.**

1. Verify there are no other T6 Power Inverter Module or K17 Electronic Brake Control Module DTCs set.
   - **If a DTC is set**

     Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

   - **If a DTC is not set**
2. Complete the diagnosis by looking for a serial data fault. Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device** .
   - **If a serial data circuit fault is found**

     Repair as necessary.

   - **If a serial data circuit fault is not found**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

DTC P175F: ACCELERATION SENSOR SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P175F

Acceleration Sensor Signal Message Counter Incorrect

Circuit/System Description

The Multi-Axis Acceleration sensor sends the amount or rate of acceleration to the Electronic Brake Control Module (EBCM). To improve vehicle performance and transmission shift feel, the EBCM is constantly sending the Hybrid/EV Powertrain Control Module 1 serial data messages with information regarding the rate of vehicle acceleration. The Hybrid/EV Powertrain Control Module 1 sets this DTC when it detects a discrepancy in the structure of the message, causing the signal message integrity to be questioned.

Conditions for Running the DTC

- Battery voltage is between 10-11 V.
- Run/Crank voltage is greater than or equal to 11 V.
- No other serial data errors are present.

Conditions for Setting the DTC

The Hybrid/EV Powertrain Control Module 1 detects an error in the rolling count value that does not match with the rolling count value sent by the EBCM.

Action Taken When the DTC Sets

- P175F is a Type C DTC.
- The estimated drive motor temperature will rise and possible de-rate drive motor torque.

Conditions for Clearing the DTC

P175F is a Type C DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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Description and Operation

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Electrical Information Reference

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- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **P175F is an informational DTC.**
- **Diagnose all other T6 Power Inverter Module and K17 Electronic Brake Control Module DTCs prior to DTC P175F.**

1. Verify there are no other T6 Power Inverter Module or K17 Electronic Brake Control Module DTCs set.
    - **If a DTC is set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .

    - **If a DTC is not set**
2. Complete the diagnosis by looking for a serial data fault. Refer to Scan Tool Does Not Communicate with Low Speed GMLAN Device .
    - **If a serial data circuit fault is found**

      Repair as necessary.

    - **If a serial data circuit fault is not found**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

DTC P1762: TRANSMISSION MODE SWITCH SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1762

Transmission Mode Switch Signal Message Counter Incorrect

Circuit/System Description

The ECM monitors the state of the drive mode switch signal message from the body control module (BCM), over the serial data circuits. The ECM uses this message to determine the following driver selected mode of operation:

- Normal
- Sport

Conditions for Running the DTC

The propulsion system is active.

Conditions for Setting the DTC

The ECM has detected a drive mode signal rolling count error for 10 s.

Action Taken When the DTC Sets

- DTC P1762 is a Type C DTC.
- Driver cannot transition to Sport mode.

Conditions for Clearing the DTC

DTC P1762 is a Type C DTC.

Diagnostic Aids

When attempting to set ECM serial data DTCs, run the vehicle in propulsion system active mode for at least 1 minute, and then shut the vehicle off for 30 seconds. Following this procedure will allow for a complete ECM shutdown.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Run the vehicle in propulsion system active mode for 1 minute, then vehicle OFF for 30 seconds.
2. Verify DTC P1762 is not set.
    - **If the DTC is set**
    1. Program the K20 ECM.
    2. Verify the DTC does not set.
        - If the DTC is set, replace the K20 ECM.
        - If the DTC does not set
    3. All OK.
    - **If the DTC is not set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Control Module References** for ECM replacement, programming and setup.

DTC P1775: TRANSMISSION RANGE REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1775

Transmission Range Request Signal Message Counter Incorrect

Circuit/System Description

The Hybrid/EV Powertrain Control Module 1 monitors the serial data messages from the K173 Transmission Range Control Module with information regarding the transmission range state. The Hybrid/EV Powertrain Control Module 1 sets this DTC when it detects a count error of the message.

Conditions for Running the DTC

- Vehicle is On for greater than 3 s.
- Run/Crank voltage is greater than 11 V.

Conditions for Setting the DTC

The Hybrid/EV Powertrain Control Module 1 detects an error in the alive rolling count value that does not match with the alive rolling count value sent by the K173 Transmission Range Control Module.

Action Taken When the DTC Sets

- P1775 is a Type B DTC.
- The Hybrid/EV Powertrain Control Module 1 inhibits the K173 Transmission Range Control Module from shifting to Low (L).

Conditions for Clearing the DTC

P1775 is a Type B DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**

- Wiring Repairs

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE:

- **P1775 is an informational DTC.**
- **Diagnose all other T6 Power Inverter Module and K173 Transmission Range Control Module DTCs prior to DTC P1775.**

1. Verify there are no other T6 Power Inverter Module or K173 Transmission Range Control Module DTCs set.
    - **If a DTC is set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
    - **If a DTC is not set**
2. Complete the diagnosis by looking for a serial data fault. Refer to Scan Tool Does Not Communicate with Low Speed GMLAN Device .
    - **If a serial data circuit fault is found**

      Repair as necessary.
    - **If a serial data circuit fault is not found**
3. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, OR P18C3: INTERNAL MODE SWITCH CIRCUIT(S)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptors

DTC P1824

Internal Mode Switch P Circuit High Voltage

DTC P182A

Internal Mode Switch A Circuit Low Voltage

DTC P182B

Internal Mode Switch B Circuit Low Voltage

DTC P182C

Internal Mode Switch B Circuit High Voltage

DTC P182D

Internal Mode Switch P Circuit Low Voltage

DTC P182E

Internal Mode Switch Indicates Invalid Range

DTC P182F

Internal Mode Switch C Circuit High Voltage

DTC P1838

Internal Mode Switch A Circuit High Voltage

DTC P1839

Internal Mode Switch C Circuit Low Voltage

DTC P1840

Internal Mode Switch S Circuit Low Voltage

DTC P1841

Internal Mode Switch S Circuit High Voltage

DTC P18B5

Internal Mode Switch A Circuit Shorted

DTC P18B6

Internal Mode Switch B Circuit Shorted

DTC P18B7

Internal Mode Switch C Circuit Shorted

DTC P18B8

Internal Mode Switch P Circuit Shorted

DTC P18B9

Internal Mode Switch S Circuit Shorted

DTC P18BA

Internal Mode Switch A Stuck Off

DTC P18BC

Internal Mode Switch C Stuck Off

DTC P18BF

Internal Mode Switch A Stuck On

DTC P18C0

Internal Mode Switch B Stuck On

DTC P18C2

Internal Mode Switch P Stuck On

DTC P18C3

Internal Mode Switch S Stuck On

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Range Signal A	P182A	P1838	P1838	P182E, P18B5
Transmission Range Signal B	P182B	P182C	P182C, P18B6	P182E, P18C0
Transmission Range Signal C	P1839	P182F	P182F, P18BC	P182E
Transmission Range Signal P	P182D	P1824	P1824	P182E, P18C2
Transmission Range Signal S	P1840	P1841	P182E, P1841, P18B9	P18C3

Typical Scan Tool Data

Internal Mode Switch A/B/C/P/S

Circuit	Normal Range	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle ON, range selector in Park				
Internal Mode Switch A	1.62 V - 2.49 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch B	0.66 V - 1.02 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch C	0.66 V - 1.02 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch P	1.62 V - 2.49 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Internal Mode Switch S	1.62 V - 2.49 V	Less than 0.66 V	Greater than 2.49 V	Greater than 2.49 V
Valid High = Switch open = 1.62 V - 2.49 V Valid Low = Switch Closed = 0.66 V - 1.02 V				

Transmission Internal Mode Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C	Signal P	Signal S
Park (P)	High	Low	High	Low	High
Reverse (R)	Low	High	Low	Low	High
Neutral (N)	High	High	Low	High	Low
Drive (D)	High	Low	High	High	Low
Low (L)	Low	Low	High	High	Low

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, is a hall-effect switch attached to the transmission case within the transmission. The 5 outputs from the switch indicate which position is selected by the transmission manual shaft. Five outputs (A, B, C, P, S) are range selection inputs to the hybrid/EV powertrain control module 1. The input voltage at the modules is high when the switch is open and low when the switch is closed to ground. The state of each input is displayed on the scan tool as Internal Mode Switch A/B/C/P/S. The Internal Mode Switch Range input parameters represented are transmission range signal A, signal B, signal C, and signal P signal S. The hybrid/EV powertrain control module 1 is internal to the power inverter module, often referred to as the drive motor generator power inverter module, and is not serviced separately.

Conditions for Running the DTC

P1824, P182A-P182F, P1838-P1841, P18B5-P18BA, P18BC, P18C0, P18C2, or P18C3

- Ignition voltage is greater than or equal to 9 V.
- Run/Crank voltage is greater than 5 V.

P18BF

- Ignition voltage is greater than or equal to 9 V.
- Run/Crank voltage is greater than 5 V.
- Shift lever is in Park.

  And

- Internal Mode Switch signal A is not High for 1.5 s.

P18C0

- Ignition voltage is greater than or equal to 9 V.
- Run/Crank voltage is greater than 5 V.
- Shift lever is in Drive.

  And

- Internal Mode Switch signal B is not High for 1.5 s.

P18C3

- Ignition voltage is greater than or equal to 9 V.
- Run/Crank voltage is greater than 5 V.
- Shift lever is in Park.

  And

- Internal Mode Switch signal S is not High for 1.5 s.

Conditions for Setting the DTC

P1824

Internal Mode Switch P circuit voltage is greater than 2.49 V for 1.75 s in a 2 s window.

P182A

Internal Mode Switch A circuit voltage is less than or equal to 0.66 V for 1.75 s in a 2 s window.

P182B

Internal Mode Switch B circuit voltage is less than or equal to 0.66 V for 1.75 s in a 2 s window.

P182C

Internal Mode Switch B circuit voltage is greater than 2.49 V for 1.75 s in a 2 s window.

P182D

Internal Mode Switch P circuit voltage is less than or equal to 0.66 V for 1.75 s in a 2 s window.

P182E

The Hybrid/EV Powertrain Control Module 1 has detected an invalid Internal Mode Switch range for 2.7 s in a 3.13 s window.

P182F

Internal Mode Switch C circuit voltage is greater than 2.49 V for 1.75 s in a 2 s window.

P1838

Internal Mode Switch A circuit voltage is greater than 2.49 V for 1.75 s in a 2 s window.

P1839

Internal Mode Switch C circuit voltage is less than or equal to 0.66 V for 1.75 s in a 2 s window.

P1840

Internal Mode Switch S circuit voltage is less than or equal to 0.66 V for 1.75 s in a 2 s window.

P1841

Internal Mode Switch S circuit voltage is greater than 2.49 V for 1.75 s in a 2 s window.

P18B5

Internal Mode Switch A circuit voltage is 1.01 - 1.62 V for 1.75 s in a 2 s window.

P18B6

Internal Mode Switch B circuit voltage is 1.01 - 1.62 V for 1.75 s in a 2 s window.

P18B7

Internal Mode Switch C circuit voltage is 1.01 - 1.62 V for 1.75 s in a 2 s window.

P18B8

Internal Mode Switch P circuit voltage is 1.01 - 1.62 V for 1.75 s in a 2 s window.

P18B9

Internal Mode Switch S circuit voltage is 1.01 - 1.62 V for 1.75 s in a 2 s window.

P18BA

Internal Mode Switch A circuit is Low when it is expected to be High for 2.7 s in a 3.13 s window.

P18BC

Internal Mode Switch C circuit is Low when it is expected to be High for 2.7 s in a 3.13 s window.

P18BF

Internal Mode Switch A circuit is High when it is expected to be Low for 2.7 s in a 3.13 s window.

P18C0

Internal Mode Switch B circuit is High when it is expected to be Low for 2.7 s in a 3.13 s window.

P18C2

Internal Mode Switch P circuit is High when it is expected to be Low for 2.7 s in a 3.13 s window.

P18C3

Internal Mode Switch S circuit is High when it is expected to be Low for 2.7 s in a 3.13 s window.

Action Taken When the DTC Sets

DTCs P1824, P182A-P182D, P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3

- DTCs P1824, P182A-P182D, P182F, P1838-P1841, P18B5-P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3 are Type B DTCs.
- No creep or coast torque from the drive motor. The BCM will keep the vehicle awake due to an invalid transmission range signal.

DTC P182E

- DTC P182E is a Type A DTC
- No creep or coast torque from the drive motor but pedal torque is still available.

Conditions for Clearing the DTC

- DTC P182E is a Type A DTC.
- DTCs P1824, P182A-P182D, P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, and P18C3 are Type B DTCs.

Diagnostic Aids

The transmission Internal Mode Switch connects electrically to the hybrid/EV powertrain control 1. Inspect the transmission internal mode switch, harness, connector, and hybrid/EV powertrain control module 1 pins for metallic debris. Use a terminal test kit for any test that requires probing the control solenoid assembly harness connector or a component harness connector. The transmission internal mode switch can be damaged by currents exceeding 2 mA. Test the transmission internal mode switch for an open condition whenever a short to voltage condition is observed.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Vehicle ON, observe the scan tool Internal Mode Switch A/B/C/P/S parameter while moving the gear shift lever from Park, through all gear selector positions, and back to Park. The parameter should match each gear range that is selected. Refer to **Transmission Internal Mode Switch Logic**.

2. Verify all the Internal Mode Switch Status parameters display Valid while moving the gear shift lever from Park, through all gear selector positions, and back to Park.
    - **If any of the parameters display Invalid**

      Refer to Circuit/System Testing.

    - **If all the parameters display valid**
3. Verify all the Internal Mode Switch parameters display 1.62 V - 2.49 V when High and 0.66 V - 1.02 V when Low.
    - **If any of the parameters display outside of the specified range**

      Refer to Circuit/System Testing.

    - **If all the parameters display within the specified range**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
5. Verify **DTC P1824, P182A-P182F, P1838-P1841, P18B5-P18B9, P18BA, P18BC, P18BF, P18C0, P18C2, or P18C3** is not set.
    - **If any of the DTCs are set**

      Refer to Circuit/System Testing.

    - **If none of the DTCs are set**
6. All OK

Circuit/System Testing

NOTE: **You must perform the Circuit/System Verification before proceeding with Circuit/System Testing.**

1. Vehicle OFF.
2. Disconnect the transmission X1 connector.
3. Vehicle in Service Mode.
4. Test for 8.3 V to 9.4 V between both 9 V reference circuits X1 terminal 4, X1 terminal 10 and ground.
    - **If not within the specified range**

      Test the reference circuits for an open/high resistance or short to ground end to end.

    - If 2 Ω or greater, replace the A/Trans Wiring Extension Harness Assembly.
    - If 2 Ω or less, replace the T6 Power Inverter Module.
    - **If within the specified range**
5. Vehicle ON.
6. Install a 3 A fused jumper wire between each signal circuit listed below and the 9 V reference circuit:
    - Switch Signal A: X1 terminal 5 and X1 terminal 4
    - Switch Signal B: X1 terminal 8 and X1 terminal 10
    - Switch Signal C: X1 terminal 6 and X1 terminal 4
    - Switch Signal P: X1 terminal 9 and X1 terminal 10
    - Switch Signal S: X1 terminal 7 and X1 terminal 10
7. Verify each scan tool Internal Mode Switch A/B/C/P/S voltage parameter displays 4.88 - 5.12 V when jumped.
    - **If any parameter does not display 4.88 - 5.12 V when jumped**

      Test the signal circuit for an open/short to voltage or short together.

    - If an open/short to voltage or short together is not found, replace the T6 Power Inverter Module.
    - **If each signal circuit parameter displays 4.88 - 5.12 V when jumped**
8. Test the transmission control wiring harness for open/short to voltage, short to ground or short together.
    - If a circuit concern is found, replace the transmission control wiring harness, do not repair.
    - If the transmission control wiring harness tests OK, replace the B15 Transmission Internal Mode Switch.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Automatic Transmission Control Wiring Harness Removal - Transmission Case** for Transmission Control Wiring Harness replacement.
- Refer to **Manual Shift Shaft Position Switch Removal** for B15 Transmission Internal Mode Switch, often referred to as the Automatic Transmission Manual Shift Detent Lever with Shaft Position Switch Assembly, replacement.
- Refer to **Control Module References** for T6 Power Inverter Module, often referred to as the Drive Motor Generator Power Inverter Module, replacement, programming and setup.

DTC P215B: VEHICLE SPEED - OUTPUT SHAFT SPEED NOT PLAUSIBLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P215B

Vehicle Speed - Output Shaft Speed Not Plausible

Circuit/System Description

The ECM determines vehicle speed based on drive motor speed. This signal is interpreted by the hybrid/EV powertrain control module 1, for speed and direction and is transmitted through the serial data circuits to the ECM module. The ECM and hybrid/EV powertrain control module 1 compare the output speed signal with the anti-lock brake system (ABS) wheel speed sensor signal from the electronic brake control module.

Conditions for Running the DTC

- Serial data communication is active for greater than 1 s.
- The vehicle is not in Park or neutral.

Conditions for Setting the DTC

The ECM OSS signal and the ABS wheel speed sensor signals differ by greater than 20 km/h (12 mph) for 0.125 s in a 0.2 s window.

Action Taken When the DTC Sets

PROPULSION POWER REDUCED message is displayed on the driver information center.

Conditions for Clearing the DTC

P215B is a Type A DTC.

Diagnostic Aids

The propulsion system is very sensitive to the vehicle speed signal for overall operation. The following conditions listed below may cause this DTC to set:

- Transmission mechanical concern such as a broken differential or axle.
- Certain slippery road conditions resulting in erratic wheel spin.
- Certain vehicle spin out or loss of control conditions.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information.

Circuit/System Verification

1. Verify DTC C1207-C1210, C1221-C1228, C1232-C1235, U0073, U0074, or U0129 is not set.
    - **If any of the DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

    - **If the DTCs are not set**
2. Verify there are no transmission mechanical concerns such as a broke axle or differential.
    - **If a transmission mechanical concern exists**

      Refer to **Symptoms - Automatic Transmission**.

    - **If no mechanical concerns**

      Refer to Circuit/System Testing.

Circuit/System Testing

1. Program the control module which set the DTC with the latest software version and retest for DTCs.
    - **If the DTC resets**

      Replace the control module which set the DTC.

    - **If the DTC does not reset**
2. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for K20 ECM or Drive Motor Generator Power Inverter Module, also called the T6 Power Inverter Module replacement, programming, and setup.

SYMPTOMS - AUTOMATIC TRANSMISSION

NOTE: **Use the symptom tables only if the following conditions are met:**

- **Refer to Diagnostic Starting Point - Vehicle .**
- **There are no DTCs set.**
- **The control modules can communicate via the serial data link.**
- **Review the system operation in order to familiarize yourself with the system functions. Refer to Transmission General Description, and Transmission Component and System Description.**

Visual/Physical Inspection

Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections** .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Fluid Diagnosis
  - **Transmission Fluid Level and Condition Check**
  - **Fluid Leak Diagnosis**
  - **Automatic Transmission Fluid Leaks**
- Noise and Vibration Diagnosis
  - **Whine/Growl Noise That Changes with Vehicle Speed**
  - **Noise in Drive or Reverse Gear**
  - **Vibration**
  - **Noise and Vibration Analysis**
- Range Performance Diagnosis
  - **No Park or Drive**
  - **No Drive in All Ranges**
  - **No Reverse**
- **No Drive in All Ranges**
- Symptom Not Found or No Symptom Detected
  - **Transmission Fluid Level and Condition Check**
  - **Drive Motor Power Inverter Module 3 Phase Cable Inspection**
  - **Road Test**
  - **Case Porosity Repair**

REGENERATIVE BRAKING ON DEMAND MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

Diagnostic Fault Information

Regenerative Braking On Demand

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Normal Range = Inactive/Active				
Tap Up/Tap Down Switch Signal 2 Circuit	P152D	Regenerative Braking On Demand Malfunction	Regenerative Braking On Demand Malfunction	P152A, P152C

Circuit/System Description

Regenerative Braking On Demand enables drivers to actively re-capture energy when slowing down, such as when approaching slower traffic or setting up for a tight turn. To engage Regenerative Braking On Demand, the driver releases the accelerator pedal and pulls back on the left steering-wheel paddle to begin regenerating electricity. When engaged, Regenerative Braking On Demand provides vehicle deceleration that is more than what a typical vehicle experiences while coasting or when the transmission shifter is in the L position, providing control and dynamic performance characteristics similar to downshifting in a manual-transmission vehicle. The feature does not bring the vehicle to a complete stop. Releasing the paddle cancels the Regeneration on Demand request, allowing the vehicle to coast normally. The driver can engage and disengage Regeneration on Demand as desired and as traffic conditions allow. When Regenerative Braking On Demand is requested, a signal is sent to the Body Control Module and then to the hybrid/EV powertrain control module 1 via serial data. The Regenerative Braking On Demand parameter is displayed as Inactive and Active on the scan tool. The Regenerative Braking On Demand parameter states are listed below:

- Inactive - when the S151 automatic transmission manual shift switch-left is not pressed
- Active - when the S151 automatic transmission manual shift switch-left is pressed

Diagnostic Aids

The Regenerative Braking On Demand feature has a maximum of 60 kW charging power. Performance may be reduced when the high voltage battery is cold and/or the high voltage battery is fully charged. The following conditions listed below will reduce or inhibit Regenerative Braking On Demand performance:

- The high voltage battery is warmer than 20Â°C (68Â°F), and battery state of charge is greater than 80%.
- The high voltage battery is warmer than 10Â°C (50Â°F), and battery state of charge is greater than 75%.
- The high voltage battery is warmer than 0Â°C (32Â°F), and battery state of charge is greater than 60%.
- The high voltage battery is colder than -10Â°C (+14Â°F).
- If the battery state of charge is greater than 90%, Regenerative Braking On Demand is inhibited.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle ON, verify with a scan tool the following hybrid/EV powertrain control module 1 parameter displays the correct values the S151 automatic transmission manual shift switch-left state:
    - Regenerative Braking On Demand displays Inactive when not pressed.
    - Regenerative Braking On Demand displays Active when pressed.
    - **If the hybrid/EV powertrain control module 1 parameter is incorrect**

      Refer to Circuit/System Testing.

    - **If the hybrid/EV powertrain control module 1 Regenerative Braking On Demand parameter is correct**
2. After performing the above step, verify that the DTC does not reset by operating the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data. If the vehicle passes the Circuit/System Verification procedure then STOP. Do not perform the Circuit/System Testing or Component Testing as this may result in an unnecessary part replacement. Refer to Testing for Intermittent Conditions and Poor Connections .

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the S151 automatic transmission manual shift switch-left. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
    - **If 10 Ω or greater**
    1. Vehicle OFF.
    2. Test for less than 2 Ω in the ground circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, repair the open/high resistance in the ground connection.
    - **If less than 10 Ω**
3. Vehicle ON.
4. Verify the scan tool Regenerative Braking On Demand parameter is Inactive.
    - **If not Inactive**
    1. Vehicle OFF, disconnect the harness connector at the K9 BCM X3 connector.
    2. Test for infinite resistance between the signal circuit terminal X3 21 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K9 BCM.
    - **If Active**
5. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the ground circuit terminal 1.
6. Verify the scan tool Regenerative Braking On Demand parameter is Active.
    - **If not Inactive**
    1. Vehicle OFF, remove the jumper wire, disconnect the X3 harness connector at the K9 BCM, vehicle ON.
    2. Test for less than 1 V between the signal circuit terminal 21 and ground.

        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K9 BCM.
  - **If Active**

7. Test or replace the S151 automatic transmission manual shift switch-left.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- Refer to **Steering Wheel Replacement** for S151 automatic transmission manual shift switch-left replacement.
- Refer to **Control Module References** for K9 BCM replacement, programming, and setup.

TRANSMISSION FLUID LEVEL AND CONDITION CHECK

This procedure checks both the transmission fluid level, as well as the condition of the fluid itself. Since the transmission on this vehicle is not equipped with a fill tube and dipstick, a fill plug in the top of the transmission and level set plug is used to set the fluid level.

CAUTION: **The transmission fluid level must be checked when the transmission fluid temperature is at 15 - 35Â°C (59 - 95Â°F). If the transmission fluid temperature is not at this range, operate the vehicle or allow the fluid to cool as required. Setting the transmission fluid level with fluid temperature outside this range will result in either an under or over-filled transmission. Fluid temperature higher than 35Â°C will result in an under-filled condition. Fluid temperature lower than 15Â°C will result in an over-filled condition. An under-filled transmission will cause premature component damage. An over-filled transmission will cause fluid to discharge out the vent tube, fluid foaming, or pump cavitation.**

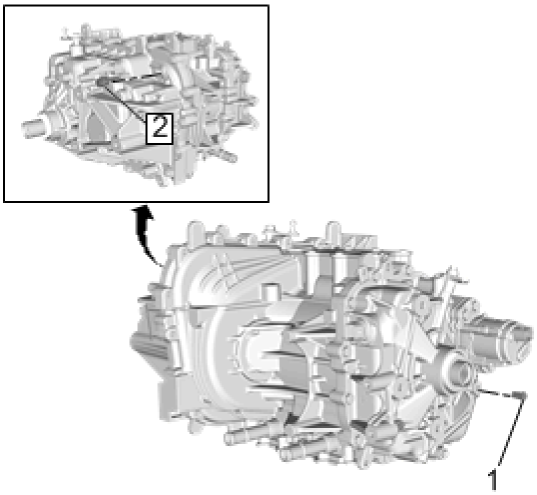


Fig. 11: Transmission Fluid Level Plug And Fill Plug
Courtesy of GENERAL MOTORS COMPANY

NOTE: **The transmission fluid pump must not be running when the transmission fluid level plug is removed or excessive fluid loss will occur, resulting in an under-filled condition.**

NOTE: **Continue to monitor the Transmission Fluid Temperature. If the Transmission Fluid Temperature is not within the specified values,**

reinstall the transmission fluid level plug and repeat the previous steps.

1. Drive vehicle until transmission fluid temperature is 15 - 35Â°C (59 - 95Â°F).
2. Vehicle Off with the transmission in Park (P).
3. Raise the vehicle.
4. Remove Front Wheelhouse Liner. Refer to **Front Wheelhouse Liner Replacement**
5. Remove Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
6. Remove the transmission fluid level plug (1).
7. Verify fluid slowly drips from the transmission fluid level check hole.
   - If the fluid is flowing as a steady stream, wait until the fluid begins to drip. Go to step 9 procedure.
   - If no fluid comes out, remove the transmission fill plug (2) and add 0.5 L (0.52 qts) of fluid using a commercially available hand pump through the case fill hole until fluid drips out. Go to step 8 procedure.

CAUTION: **Refer to Fastener Caution .**

8. Install the NEW transmission fill plug (2) and tighten to 13 N.m (115 lb in).
9. Install the NEW transmission fluid level plug (1) and tighten to 12 N.m (106 lb in).
10. Vehicle in service mode with the transmission in Park (P).
11. Using the scan tool, command the transmission fluid pump speed to on for 1 minute for lubrication.
12. Vehicle Off.
13. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
14. Install Front Wheelhouse Liner. Refer to **Front Wheelhouse Liner Replacement**

Fluid Condition Inspection

- If the fluid has a burnt odor, inspect the fluid for excessive metal particles or other debris which may indicate transmission wear or damage. Refer to **Road Test** to verify transmission operation. Change the transmission fluid if a burnt odor is the only condition found.
- Fluid that is cloudy or milky or appears to be contaminated with water indicates engine coolant or water contamination. Change the transmission fluid.

ROAD TEST

NOTE: **The Road Test Procedure should be performed only as part of the Symptom Diagnosis. Refer to Symptoms - Automatic Transmission.**

The following test provides a method of evaluating the condition of the automatic transmission. The test is structured so that most driving conditions would be achieved. The test is divided into the following parts:

- Electrical Function Check
- Torque Control
- Part Throttle Torque Control
- Coasting

NOTE: **Complete the test in the sequence given. Incomplete testing cannot guarantee an accurate evaluation.**

Before the road test, ensure the following:

- Transmission fluid level is correct. Refer to **Transmission Fluid Level and Condition Check**.

- Tire pressure is correct.

During the road test:

- Perform the test only when traffic conditions permit.
- Operate the vehicle in a controlled, safe manner.
- Observe all traffic regulations.
- View the scan tool data while conducting this test.

  Take along qualified help in order to operate the vehicle safely.

- Observe any unusual sounds or smells.

After the road test, check the following:

- Inspect for proper transmission fluid level. Refer to **Transmission Fluid Level and Condition Check**.
- Inspect for any diagnostic trouble codes (DTCs) that may have set during the testing. Refer to the applicable DTC.
- Monitor the scan tool data for any abnormal readings or data.
- Inspect for fluid leaks. Refer to **Fluid Leak Diagnosis**.

Electrical Function Check

Perform this procedure first in order to ensure the electronic transmission components are functioning properly. If these components are not checked, a simple electrical condition could be misdiagnosed.

1. Connect the scan tool.
2. Ensure the gear selector is in PARK and set the parking brake.
3. Verify that the following scan tool data can be obtained and is functioning properly.

   Refer to **K20 Engine Control Module: Scan Tool Information** for typical data values. Data that is questionable may indicate a concern.

   - Driver Requested Axle Torque
   - Vehicle Speed
   - Output Shaft Direction
   - Brake Switch
   - IMS A/B/C/P
   - IMS
   - Trans. Fluid Temp.
4. Check the garage shifts.
   1. Apply the brake pedal and ensure the parking brake is set.
   2. Move the gear selector through the following ranges:
      1. PARK to REVERSE
      2. REVERSE to NEUTRAL
      3. NEUTRAL to DRIVE
   3. Pause 2 to 3 seconds in each gear position.

      NOTE: **These shifts can-not be felt when trans is functioning properly.**

   4. Verify the gear engagements are immediate and not harsh.
5. Monitor transmission range on the scan tool, trans data list.
   1. Apply the brake pedal and ensure the parking brake is set.
   2. Move the gear selector through all ranges.
   3. Pause 2 to 3 seconds in each range.

    4. Return gear selector to PARK.
    5. Verify that all selector positions match the scan tool display.
6. Check throttle position input.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Ensure the gear selector is in PARK.

If any of the above checks do not perform properly, record the result for reference after completion of the road test.

Manual Gear Range Selection

This range is used to slow the vehicle more when the driver's foot is lifted from the throttle.

Reverse

Perform the following test using a 10 - 15 percent throttle position.

1. With the vehicle stopped, move the gear selector to REVERSE.
2. Slowly accelerate the vehicle.
3. Verify that there is no noticeable slip, noise or vibration.

CASE POROSITY REPAIR

Some external leaks are caused by case porosity in non-pressurized areas. You can usually repair these leaks with the transmission in the vehicle.

1. Thoroughly clean the area to be repaired with a cleaning solvent. Air dry the area.

WARNING: **Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.**

2. Using instructions from the manufacturer, mix a sufficient amount of an epoxy to make the repair.
3. While the transmission case is still hot, apply the epoxy. You can use a clean, dry soldering acid brush to clean the area and also to apply the epoxy cement. Make certain that the area to be repaired is fully covered.
4. Allow the epoxy cement to cure for three hours before operating the vehicle.
5. Repeat the fluid leak diagnosis procedures.

AUTOMATIC TRANSMISSION FLUID LEAKS

Checks	Causes
Case Assembly	• Inspect for porosity or damage on the sealing surfaces • Inspect for damaged manual shift shaft seal • Inspect for damaged or worn axle seal or axle seal Slinger on the axle shafts • Inspect for loose fluid level plug
Case Cover assembly	• Inspect for porosity or damage on the sealing surface • Inspect for damaged case cover gasket • Inspect for loose case cover assembly bolts • Inspect for loose, damaged or leaking case cover assembly bore plugs

FLUID LEAK DIAGNOSIS

General Method

1. Verify that the leak is transmission fluid.

CAUTION: Do not clean using brake cleaner or other reactive solvents as these solvents can damage rubber gaskets, seals and bushings.

2. Thoroughly clean the suspected leak area using a rag.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut OFF the vehicle.
6. Look for fluid spots on the paper.
7. Make the necessary repairs.

Powder Method

CAUTION: Do not clean using brake cleaner or other reactive solvents as these solvents can damage rubber gaskets, seals and bushings.

1. Thoroughly clean the suspected leak area using a rag.
2. Apply an aerosol type leak tracing powder to the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Shut OFF the vehicle.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source of the leak.
7. Make the necessary repairs.

Dye and Black Light Method

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow the manufacturer's instructions in order to determine the amount of dye to use.
2. Operate the vehicle for 24 km (15 mi) or until normal operating temperatures are reached.
3. Detect the leak with the black light.
4. Make the necessary repairs.

Find the Cause of the Leak

Pinpoint the leak and trace the leak back to the source. You must determine the cause of the leak in order to repair the leak properly. For example, if you replace a gasket, but the sealing flange is bent, the new gasket will not repair the leak. You must also repair the bent flange. Before you attempt to repair a leak, check for the following conditions, and make repairs as necessary:

Gaskets

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Improperly tightened fasteners
- Dirty or damaged threads
- Warped flanges or sealing surface
- Scratches, burrs, or other damage to the sealing surface
- Damaged or worn gasket
- Cracking or porosity of the component
- Improper sealant used, where applicable
- Incorrect gasket

Seals

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Damaged seal bore
- Damaged or worn seal
- Improper installation
- Cracks in component
- Manual shaft or output shaft surface is scratched, nicked, or damaged
- Loose or worn bearing causing excess seal wear

Possible Points of Fluid Leaks

Transmission Case Side Cover

- Incorrectly tightened bolts
- Improperly installed or damaged gasket/seal
- Damaged mounting face
- Incorrect gasket seal

Case Leak

- Damaged manual shaft seal
- Worn or damaged axle shaft oil seal
- Loose line pressure pipe plug or fluid level pipe plug
- Porous casting

Leak at the Vent

- Overfilled system
- Water or coolant in the fluid; The fluid will appear milky
- Transmission case porous
- Plugged vent

DRIVE MOTOR POWER INVERTER MODULE 3 PHASE CABLE INSPECTION

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure will perform the following tasks:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Failure to follow the procedures exactly as written may result in serious injury or death.

NOTE: **This procedure is for inspection and repair of the 3 phase high voltage cable outer sheathing only.**

Visual/Physical Inspection

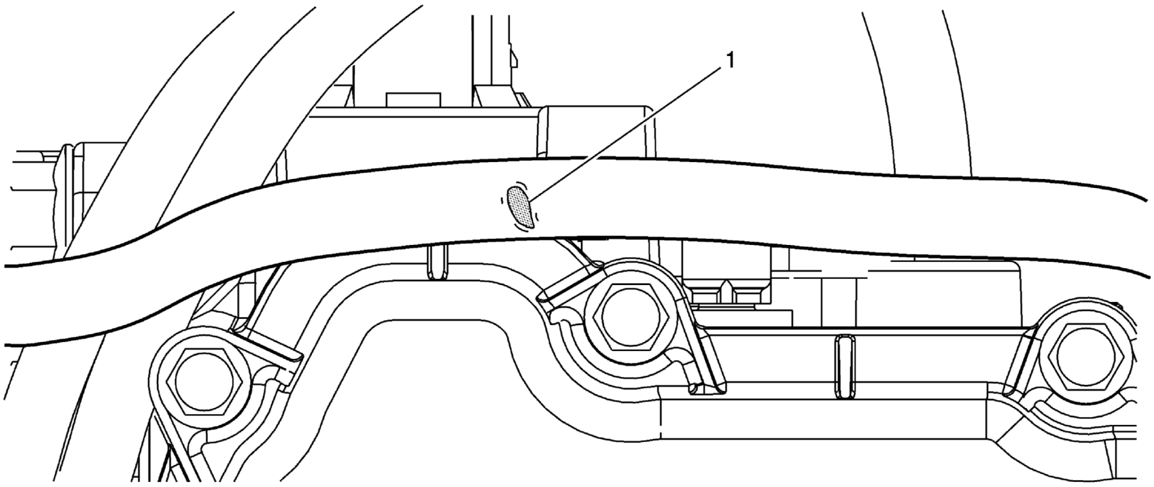


Fig. 12: Inspecting Outer Cable Jacket Or Sheathing
Courtesy of GENERAL MOTORS COMPANY

Cable Construction

- Outer Abrasion Sleeve
- Outer Jacket or Sheathing
- Braided Shield
- Insulated Conductor
- 3 Individual Cables per Cable Assembly, all of the same construction

1. Disconnect or remove the drive motor generator power inverter module cover to gain better visibility of 3 phase cables.
2. Disconnect the 3 phase cable P-clip from the APM shield bracket.
3. Disconnect and drop the cradle assembly with drive unit. If the cable needs to be replaced then this is required anyway, since you cannot remove the 3 phase cable from the Drive unit without first removing the rear drive unit mount.
4. Inspect all three lengths of cable.
5. Determine if the exposure is limited to the braided shield or has penetrated to the insulated conductor.
6. If the conductor wire is exposed, the cable assembly must be replaced.

NOTE: **If the 3 phase cable drive motor generator power inverter module connector is removed two new seals must be used.**

7. Examine the cables for abrasion or damage.
8. If any damage is present then the cable must be replaced.
9. If connector/s to SPIM were removed, install with new seal and torque nuts to 9 N.m +/ - 1.5 N.m (80 lb in +/ - 1 1/2 lb in). The two nuts clamp both the connector and cover, trapping both seals.

VIBRATION

Checks	Causes
Counter Shaft Assembly	Inspect for wear or damage.
Front Differential Assembly	Inspect for damaged gears and bearings.

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion MAY NOT be the result of the transmission.

- Inspect the tires for the following conditions:
  - Uneven wear

  - Imbalance
  - Mixed sizes
  - Mixed radial and bias ply
- Inspect the suspension components for the following conditions:
  - Alignment wear or damage
  - Loose fasteners
  - Driveline damage or wear
- Inspect the transmission mounts for damage and loose bolts.
- Inspect the transmission case mounting holes for the following conditions:
  - Missing bolts, nuts, and studs
  - Stripped threads
  - Cracks

WHINE/GROWL NOISE THAT CHANGES WITH VEHICLE SPEED

Checks	Causes
Front Differential Assembly	Inspect for damaged gears and bearings.

NOISE IN DRIVE OR REVERSE GEAR

Checks	Causes
Front Differential Assembly	Inspect for damaged gears and bearings.
Drive Motor Assembly	Inspect for damaged bearings.

NO PARK OR DRIVE

Checks	Causes
Counter Shaft Assembly	Inspect for wear or damage.
Front Differential Assembly	Inspect for damaged gears and bearings.

NO DRIVE IN ALL RANGES

Checks	Causes
Front Differential Assembly	• Inspect for damaged front differential assembly. • Inspect for damaged front differential bearings.
Drive Motor with Generator	**Motor Failure** • Inspect 3 phase cables • Inspect connections at motor • Inspect 1st gear • Inspect motor end bearings
Counter Shaft Assembly	• Inspect for damaged counter shaft assembly. • Inspect for damaged counter shaft bearings.
Fluid Filter Assembly	• Inspect for damaged or restricted fluid filter assembly. • Inspect for damaged fluid filter seal assembly or improper sealing interface, leaks, and fluid aeration.

Checks	Causes
Fluid Pump Assembly	• Inspect for worn or damaged seal. • Inspect the fluid pump motor.

NO REVERSE

Checks	Causes
Drive Motor with Generator	**Motor Failure** • Inspect 3 phase cables. • Inspect connections at motor. • Inspect motor end bearings.
Output Shaft Assembly	Inspect for damaged internal gears.
Front Differential Assembly	Inspect for damaged gears and bearings.
Counter Shaft Assembly	Inspect for spline wear or damage.
Fluid Filter Assembly	• Inspect for damaged or restricted fluid filter assembly. • Inspect for damaged fluid filter seal assembly or improper sealing interface, leaks, and fluid aeration.
Fluid Pump Seal	Inspect for worn or damaged seal.

REPAIR INSTRUCTIONS - ON VEHICLE

TRANSMISSION ELECTRONIC CONTROL REPLACEMENT

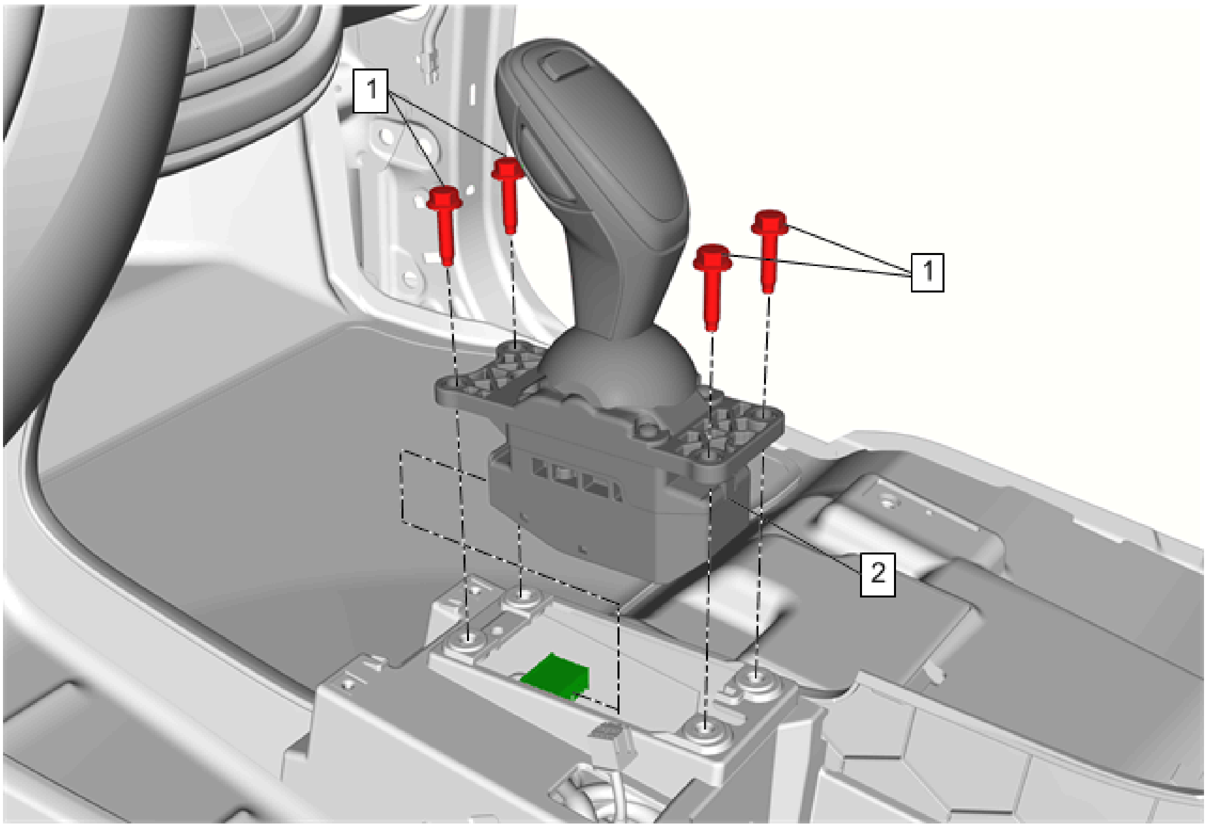


Fig. 13: Transmission Electronic Control
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedures 1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection 2. Remove Front Floor Console Cup Holder. Refer to Front Floor Console Cup Holder Replacement	
1	Automatic Transmission Electronic Control Bolt (Qty: 4) **CAUTION:** **Refer to Fastener Caution** **Tighten** 9 N.m (80 lb in)
2	Automatic Transmission Electronic Control **Procedure** 1. Disconnect the electrical connector. 2. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection

TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

Removal Procedure

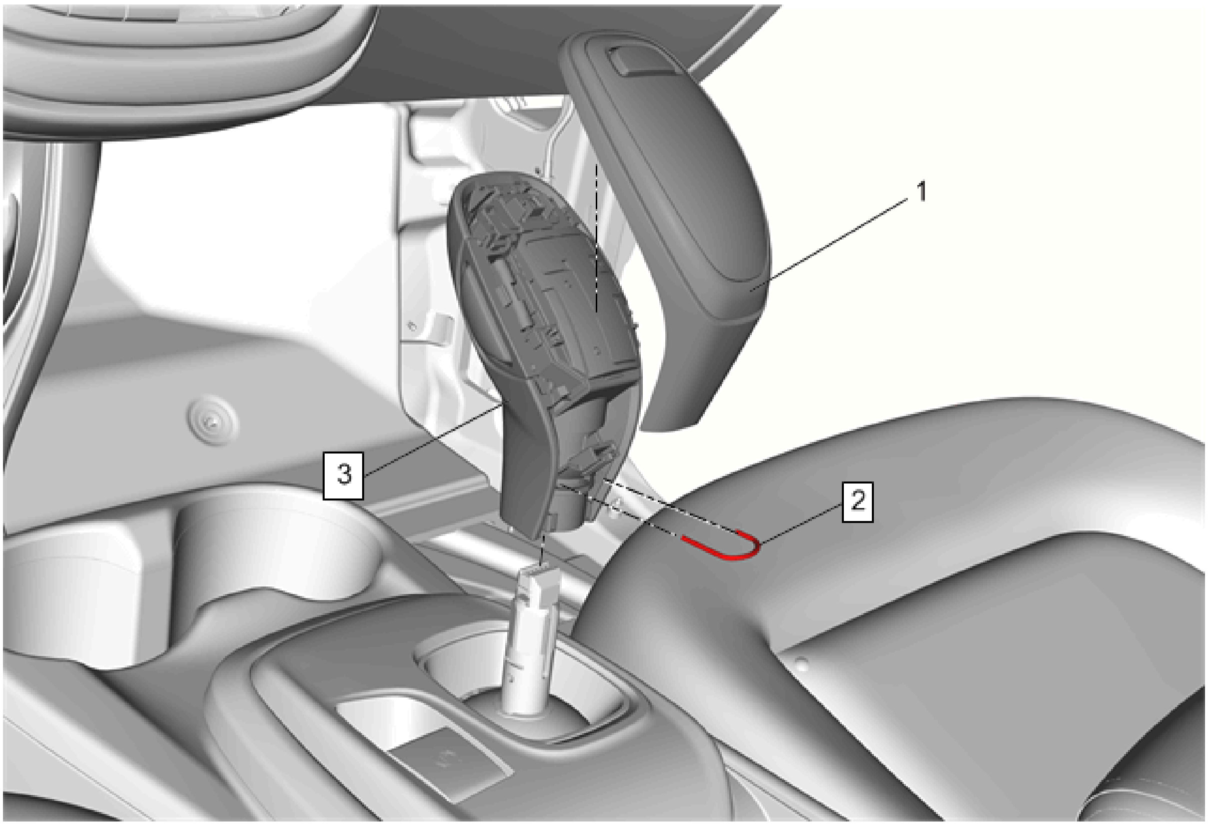


Fig. 14: Transmission Control Lever Knob, Cover And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

1. Using a flat-bladed trim tool, remove the knob cover (1) from transmission control lever knob.
2. Remove Retaining Clip (2)
3. Remove Transmission Control Lever Knob (3) @ Transmission Control Assembly

Installation Procedure

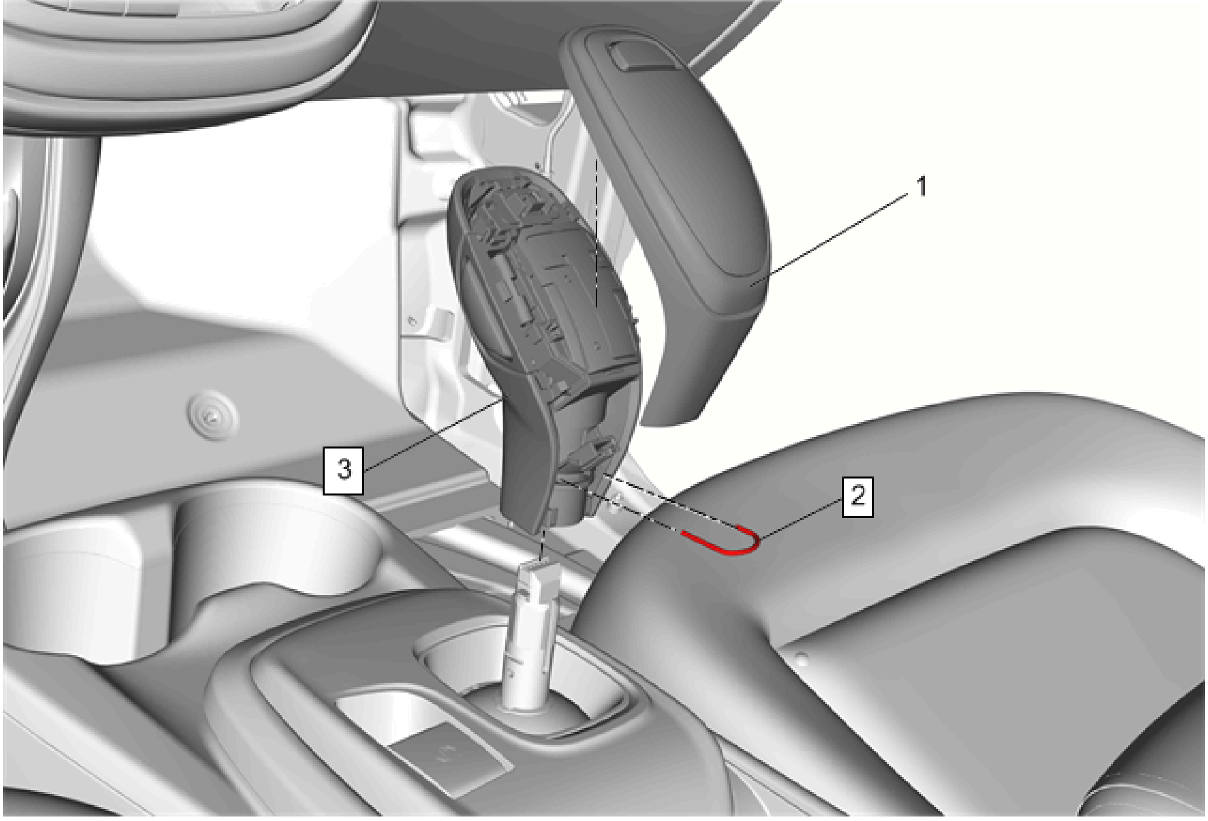


Fig. 15: Transmission Control Lever Knob, Cover And Retaining Clip
Courtesy of GENERAL MOTORS COMPANY

NOTE: **One side is longer. Install the retaining clip correctly.**

1. Insert the retaining clip (2) into the transmission control lever knob (3).
2. Ensure the manual shift button is properly assembled.
3. Install Knob Cover (1) @ Transmission Control Lever Knob (3)
4. Install the transmission control lever knob (3) to the transmission control assembly. Ensure the knob is locked in place.

AUTOMATIC TRANSMISSION RANGE SELECTOR ACTUATOR HARDWARE MODULE REPLACEMENT

Removal Procedure

1. Set the parking brake and chock the wheels.

NOTE: **If re-installing the original automatic transmission range selector actuator hardware module back into the vehicle, the Backup Park Lock Actuator must be activated prior to removal.**

NOTE: **If the automatic transmission range selector actuator hardware module is being replaced due to a malfunction, the original module does not need to be activated prior to removal. Proceed to Step 3.**

NOTE: **Perform this procedure before disconnecting the battery and removal of the actuator.**

2. Perform the Backup Park Lock Actuator Disarming procedure. Refer to **Backup Park Lock Actuator Disarming**
3. Before performing this procedure, review the high voltage safety information. Refer to **High Voltage Safety**
4. Disable the high voltage system. Refer to **High Voltage Disabling**
5. Remove Drive Motor Battery Charger. Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**

6. Remove the left front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement**

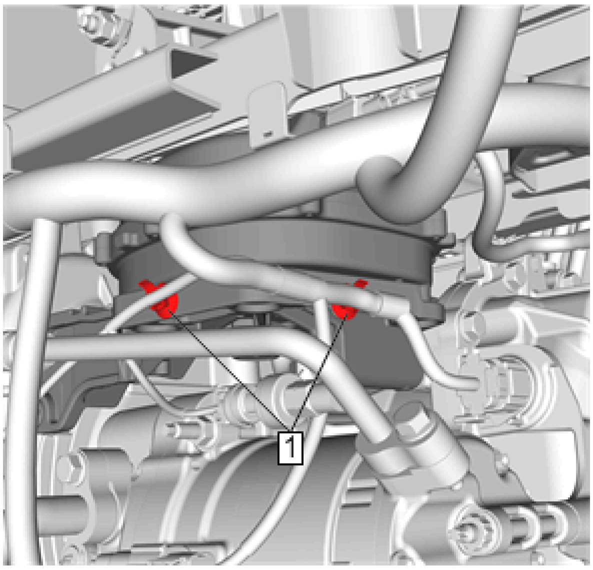


Fig. 16: Retainers
Courtesy of GENERAL MOTORS COMPANY

7. Remove Retainers (1) (Qty: 2)

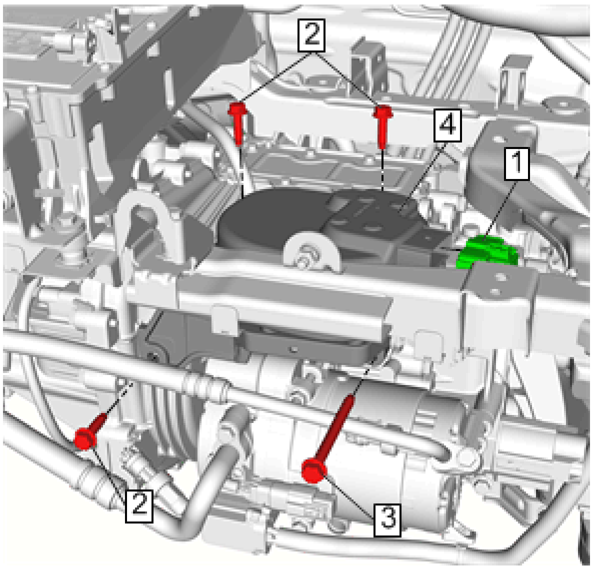


Fig. 17: Range Selector Actuator Hardware Module, Bolts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Electrical Connector (1) @ Range Selector Actuator Hardware Module (4)
9. Remove Range Selector Actuator Hardware Module Bolts (2, 3) (Qty: 4)

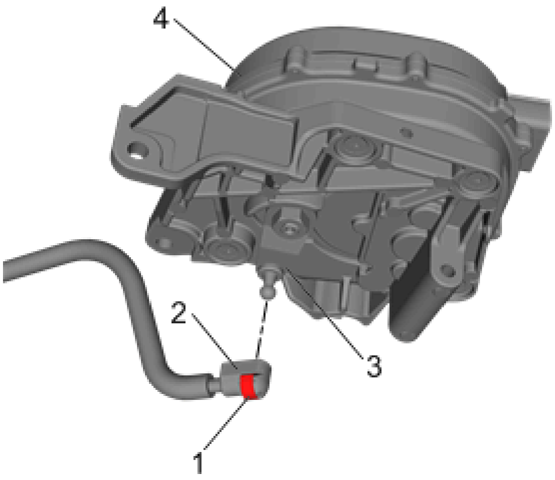


Fig. 18: Transmission Range Selector Lever Link, Retainer And Range Selector Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

10. Using a suitable tool, remove the transmission range selector lever link (2) while pulling the range selector lever link retainer (1).
11. Remove Range Selector Actuator Hardware Module (4)

Installation Procedure

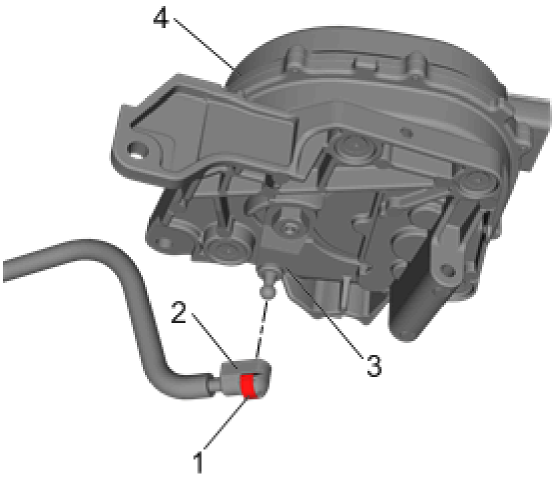


Fig. 19: Transmission Range Selector Lever Link, Retainer And Range Selector Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

1. Verify the transmission range selector actuator hardware module lever is in the park position.
2. Install the transmission range selector lever link (2) to the range selector actuator hardware module lever (3).

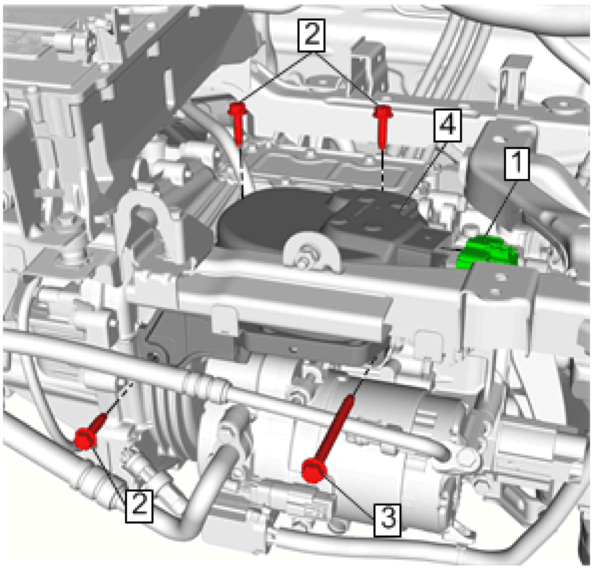


Fig. 20: Range Selector Actuator Hardware Module, Bolts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Install Range Selector Actuator Hardware Module (4) @ Transmission

CAUTION: **Refer to Fastener Caution .**

4. Install and tighten Range Selector Actuator Hardware Module Bolts (2, 3) (Qty: 4) to 22 N.m (16 lb ft)
5. Connect Electrical Connector (1) @ Range Selector Actuator Hardware Module (4)

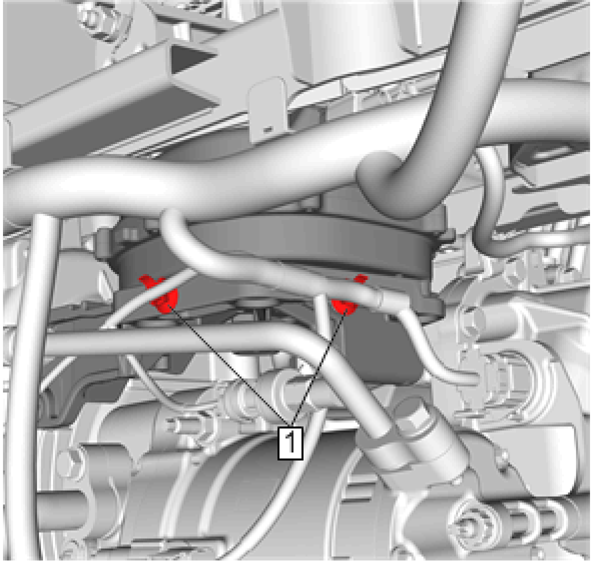


Fig. 21: Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Install Retainers (1) (Qty: 2)
7. Check the range selector lever link adjustment. Refer to **Range Selector Lever Link Adjustment**
8. Install the left front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement**
9. Install Drive Motor Battery Charger. Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**
10. Enable the high voltage system. Refer to **High Voltage Disabling**
11. Program the transmission range control module. Refer to **Control Module References**

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER REPLACEMENT

Removal Procedure

1. Set the parking brake and chock the wheels.
2. Before performing this procedure, review the high voltage safety information. Refer to **High Voltage Safety**
3. Disable the high voltage system. Refer to **High Voltage Disabling**
4. Remove Drive Motor Power Inverter Module. Refer to **Drive Motor Power Inverter Module Replacement**
5. Ensure that the transmission range selector lever is in the park (P) position.

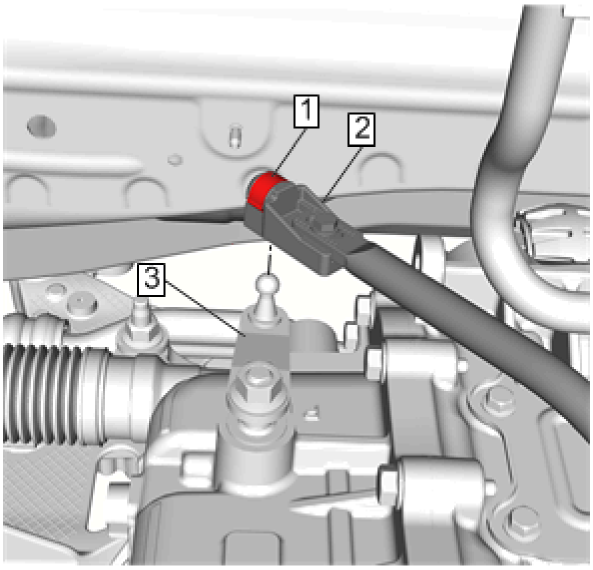


Fig. 22: Transmission Range Selector Lever Link And Retainer
Courtesy of GENERAL MOTORS COMPANY

6. Using a suitable tool, remove the transmission range selector lever link (2) while pulling the range selector lever link retainer (1).

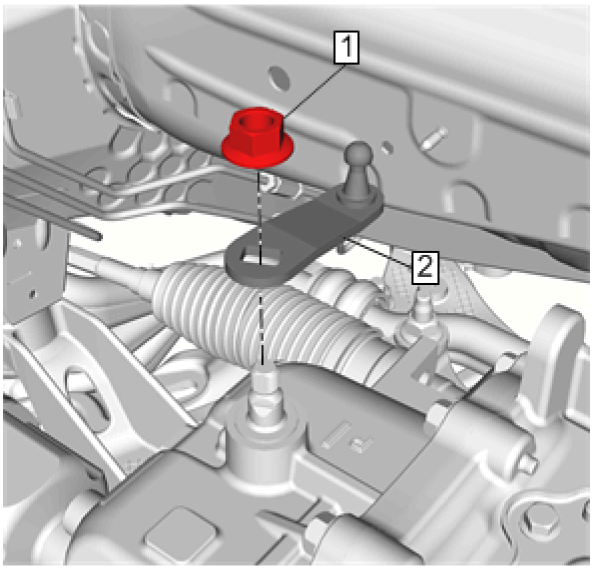


Fig. 23: Transmission Range Selector Lever And Nut
Courtesy of GENERAL MOTORS COMPANY

WARNING: **Hold the transmission range selector lever while removing or installing the lever retaining nut. Failure to hold the lever can cause damage to the transmission internal park system components which could allow the vehicle to roll when placed in the park position.**

7. Remove Transmission Range Selector Lever Nut (1)
8. Remove Transmission Range Selector Lever (2)

Installation Procedure

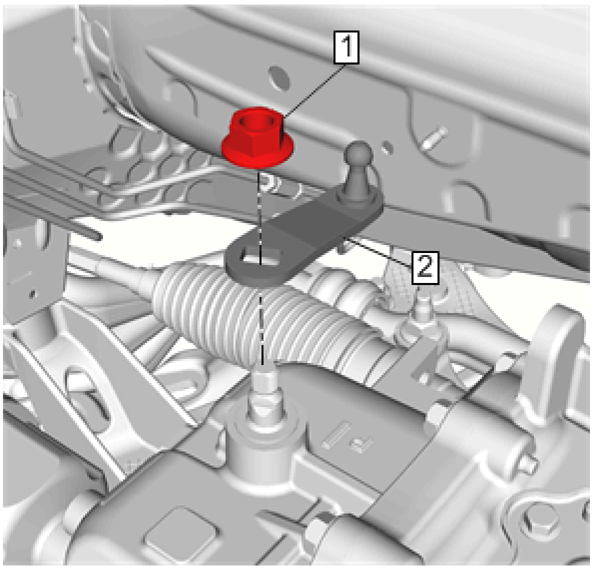


Fig. 24: Transmission Range Selector Lever And Nut
Courtesy of GENERAL MOTORS COMPANY

1. Install Transmission Range Selector Lever (2)

WARNING: **Hold the transmission range selector lever while removing or installing the lever retaining nut. Failure to hold the lever can cause damage to the transmission internal park system components which could allow the vehicle to roll when placed in the park position.**

CAUTION: **Refer to Fastener Caution .**

2. Install and tighten Transmission Range Selector Lever Nut (1) to 30 N.m (22 lb ft)

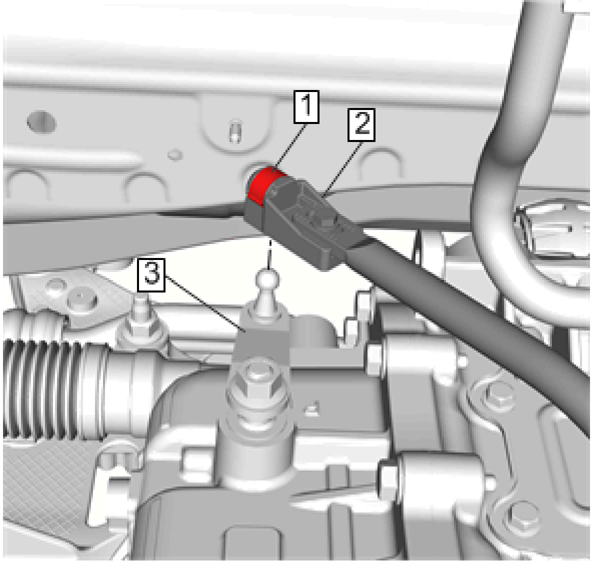


Fig. 25: Transmission Range Selector Lever Link And Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Install Automatic Transmission Range Selector Lever Link (2) @ Transmission Range Selector Lever (3)
4. Check the range selector lever link adjustment. Refer to **Range Selector Lever Link Adjustment**
5. Install Drive Motor Power Inverter Module. Refer to **Drive Motor Power Inverter Module Replacement**
6. Enable the high voltage system. Refer to **High Voltage Enabling**
7. Perform the transmission range control module range motor position learn. Refer to **Transmission Range Control Module Range Motor Position Learn**

RANGE SELECTOR LEVER LINK REPLACEMENT

Removal Procedure

1. Set the parking brake and chock the wheels.
2. Before performing this procedure, review the high voltage safety information. Refer to **High Voltage Safety**
3. Disable the high voltage systems. Refer to **High Voltage Disabling**
4. Remove Drive Motor Battery Charger. Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**
5. Remove Drive Motor Power Inverter Module. Refer to **Drive Motor Power Inverter Module Replacement**
6. Remove the left front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement**

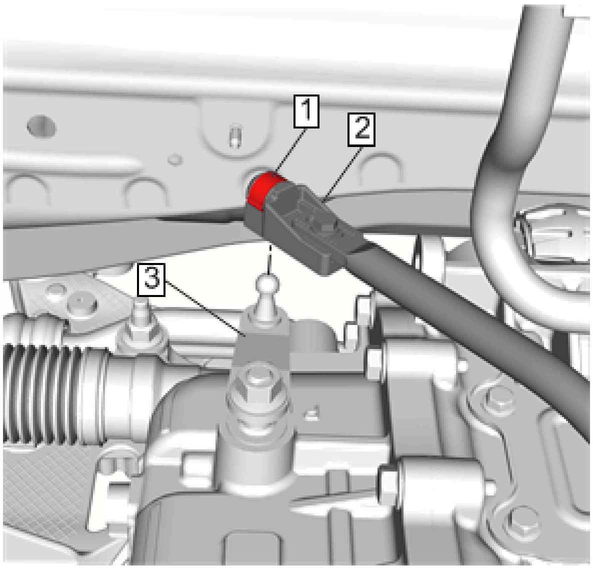


Fig. 26: Transmission Range Selector Lever Link And Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Using a suitable tool, remove the transmission range selector lever link (2) while pulling the range selector lever link retainer (1).

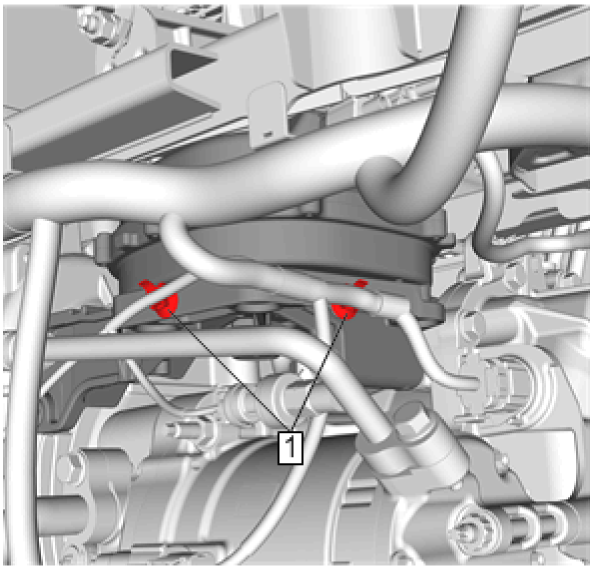


Fig. 27: Retainers

Courtesy of GENERAL MOTORS COMPANY

8. Remove Retainers (1) (Qty: 2)

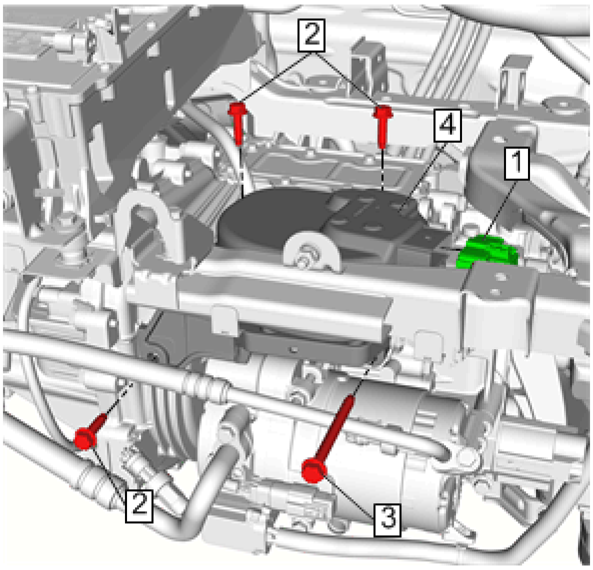


Fig. 28: Range Selector Actuator Hardware Module, Bolts And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Electrical Connector (1) @ Range Selector Actuator Hardware Module (4)
10. Remove Range Selector Actuator Hardware Module Bolts (2, 3) (Qty: 4)

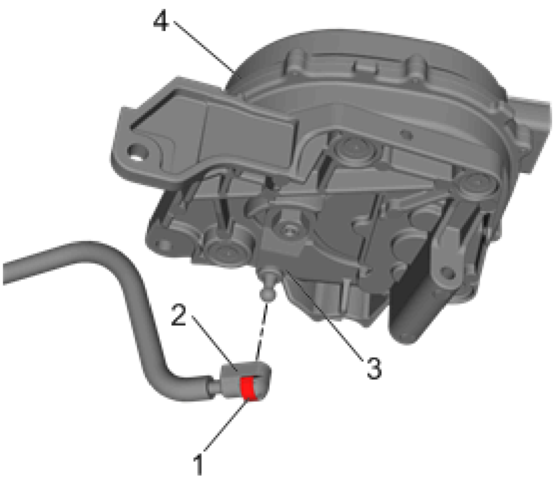


Fig. 29: Transmission Range Selector Lever Link, Retainer And Range Selector Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

11. Remove the transmission range selector lever link (2) and range selector actuator hardware module (4) from the vehicle.
12. Using a suitable tool, remove the transmission range selector lever link (2) while pulling the range selector lever link retainer (1).

Installation Procedure

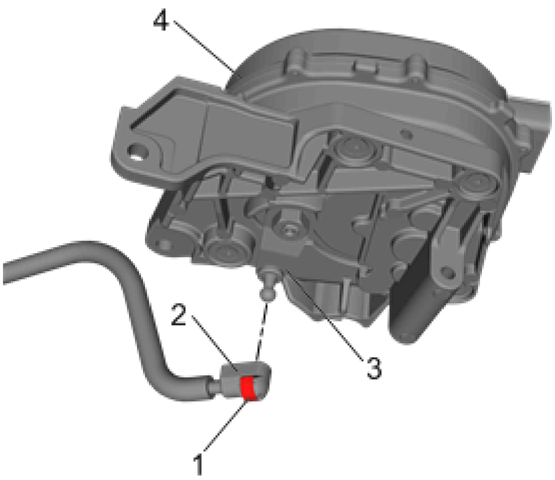


Fig. 30: Transmission Range Selector Lever Link, Retainer And Range Selector Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

1. Verify the transmission range selector actuator hardware module lever is in the park position.
2. Install the range selector lever link (2) to the range selector actuator hardware module lever (3).

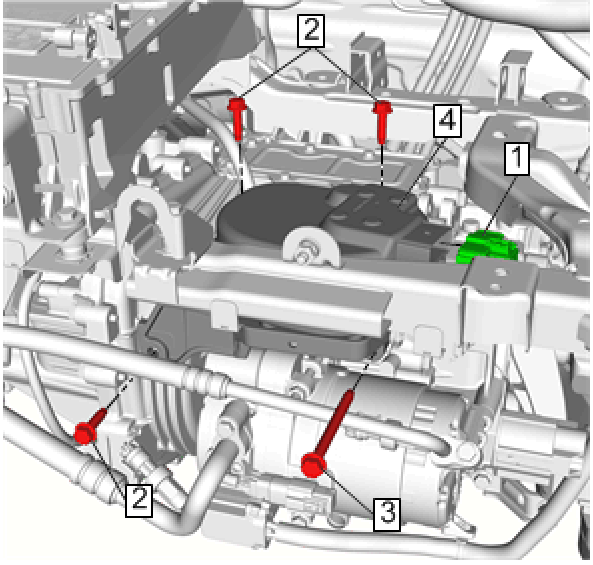


Fig. 31: Range Selector Actuator Hardware Module, Bolts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Install Range Selector Actuator Hardware Module (4) @ Transmission

CAUTION: **Refer to Fastener Caution .**

4. Install and tighten Range Selector Actuator Hardware Module Bolts (2, 3) (Qty: 2) to 22 N.m (16 lb ft)
5. Connect Electrical Connector (1) @ Range Selector Actuator Hardware Module (4)

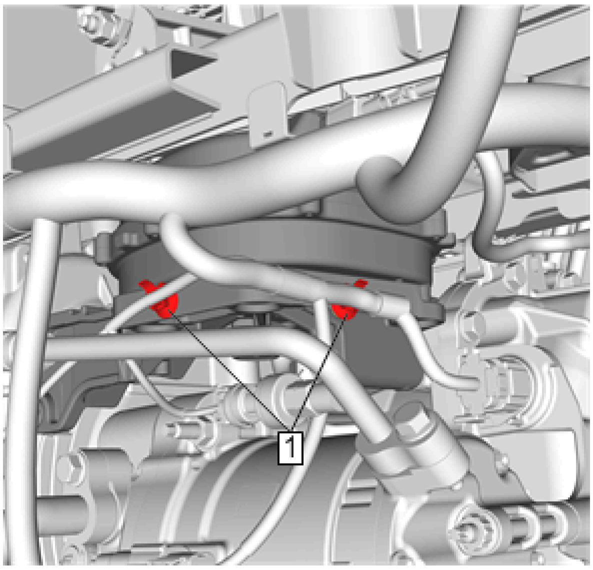


Fig. 32: Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Install Retainers (1) (Qty: 2)

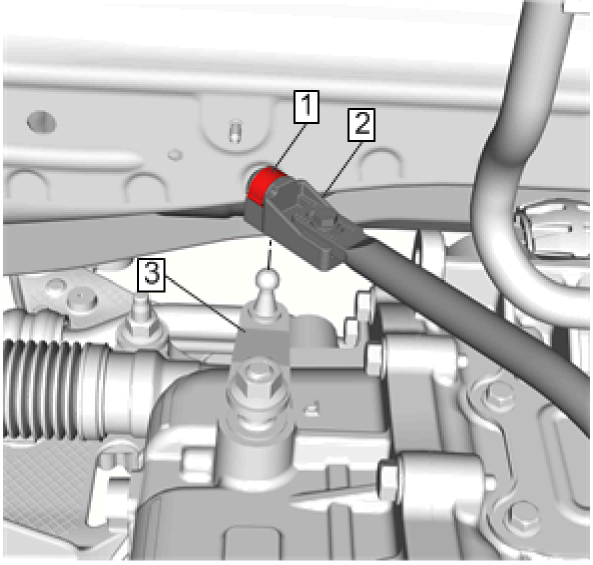


Fig. 33: Transmission Range Selector Lever Link And Retainer
Courtesy of GENERAL MOTORS COMPANY

7. Verify the transmission range selector lever is in the park position.
8. Install Automatic Transmission Range Selector Lever Link (2) @ Transmission Range Selector Lever (3)
9. Check the range selector lever link adjustment. Refer to **Range Selector Lever Link Adjustment**
10. Install the left front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement**
11. Install Drive Motor Power Inverter Module. Refer to **Drive Motor Power Inverter Module Replacement**
12. Install Drive Motor Battery Charger. Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**
13. Enable the high voltage system. Refer to **High Voltage Enabling**
14. Perform the transmission range control module range motor position learn. Refer to **Transmission Range Control Module Range Motor Position Learn**

RANGE SELECTOR LEVER LINK ADJUSTMENT

1. Set the parking brake and chock the wheels.
2. Remove Range Selector Lever Link. Refer to **Range Selector Lever Link Replacement**

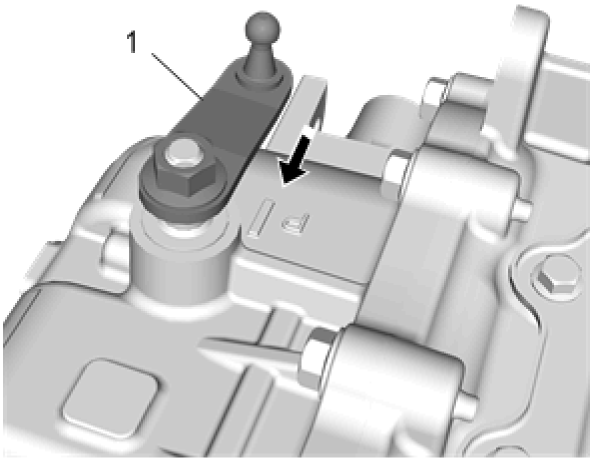


Fig. 34: Transmission Range Selector Lever
Courtesy of GENERAL MOTORS COMPANY

3. Verify the transmission range selector lever (1) is in the park position (arrow).

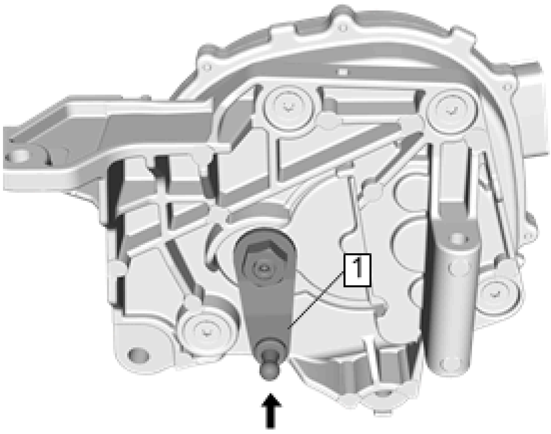


Fig. 35: Transmission Range Selector Actuator Hardware Module Lever
Courtesy of GENERAL MOTORS COMPANY

NOTE: **If the transmission range selector actuator hardware module lever is not in the park position, Set the park position by maximum turning the lever (1) clockwise.**

4. Verify the transmission range selector actuator hardware module lever (1) is in the park position (arrow).
5. Loosen the adjustment bolt on the range selector lever link.
6. Install the range selector lever link with the adjustment bolt loose.
7. Install Range Selector Lever Link. Refer to Range Selector Lever Link Replacement

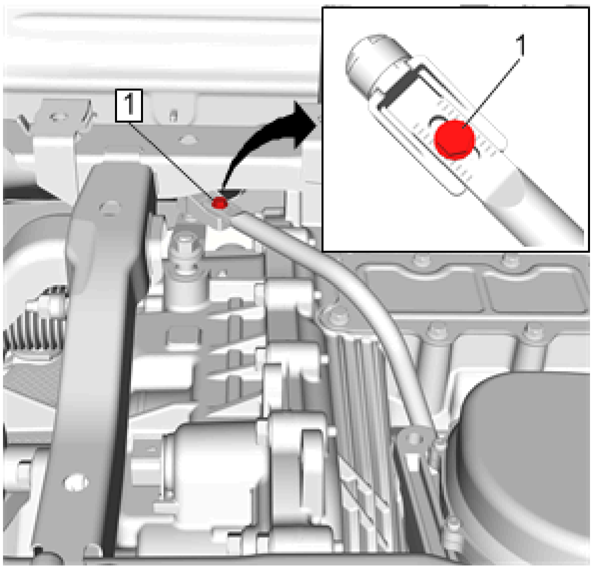


Fig. 36: Range Selector Lever Link Adjustment Bolt
Courtesy of GENERAL MOTORS COMPANY

8. With the link completely installed, and the park location verified on the actuator and transmission.
9. Install and tighten Range Selector Lever Link Adjustment Bolt (1) to 5 N.m (44 lb in)
10. Check the transmission range selector lever in all gear selections for proper operation.

VENT HOSE REPLACEMENT

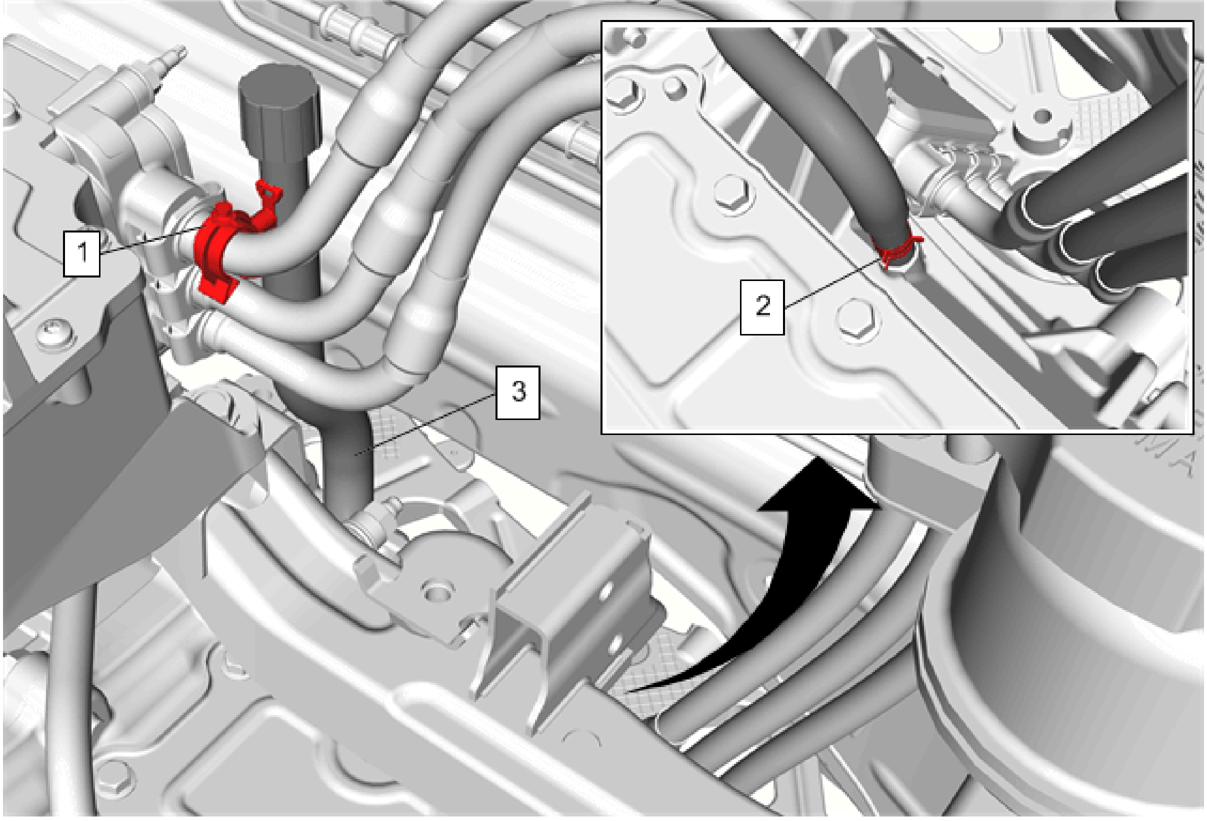


Fig. 37: Vent Hose
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Before performing this procedure, review the high voltage safety information. Refer to **High Voltage Safety** 2. Disable the high voltage systems. Refer to **High Voltage Disabling** 3. Remove Drive Motor Battery Charger. Refer to **Drive Motor Battery Charger Replacement (Except Dubai)** **Drive Motor Battery Charger Replacement (Dubai)**	
1	Transmission Vent Pipe Clip **Procedure** Unclip the transmission vent pipe clip from the 3 Phase Cable.
2	Transmission Vent Hose Clamp **Procedure** Loosen the transmission vent hose clamp using hose clamp pliers.
3	Transmission Vent Hose Assembly **Procedure** Enable the high voltage systems. Refer to **High Voltage Enabling**

TRANSMISSION FLUID PUMP REPLACEMENT

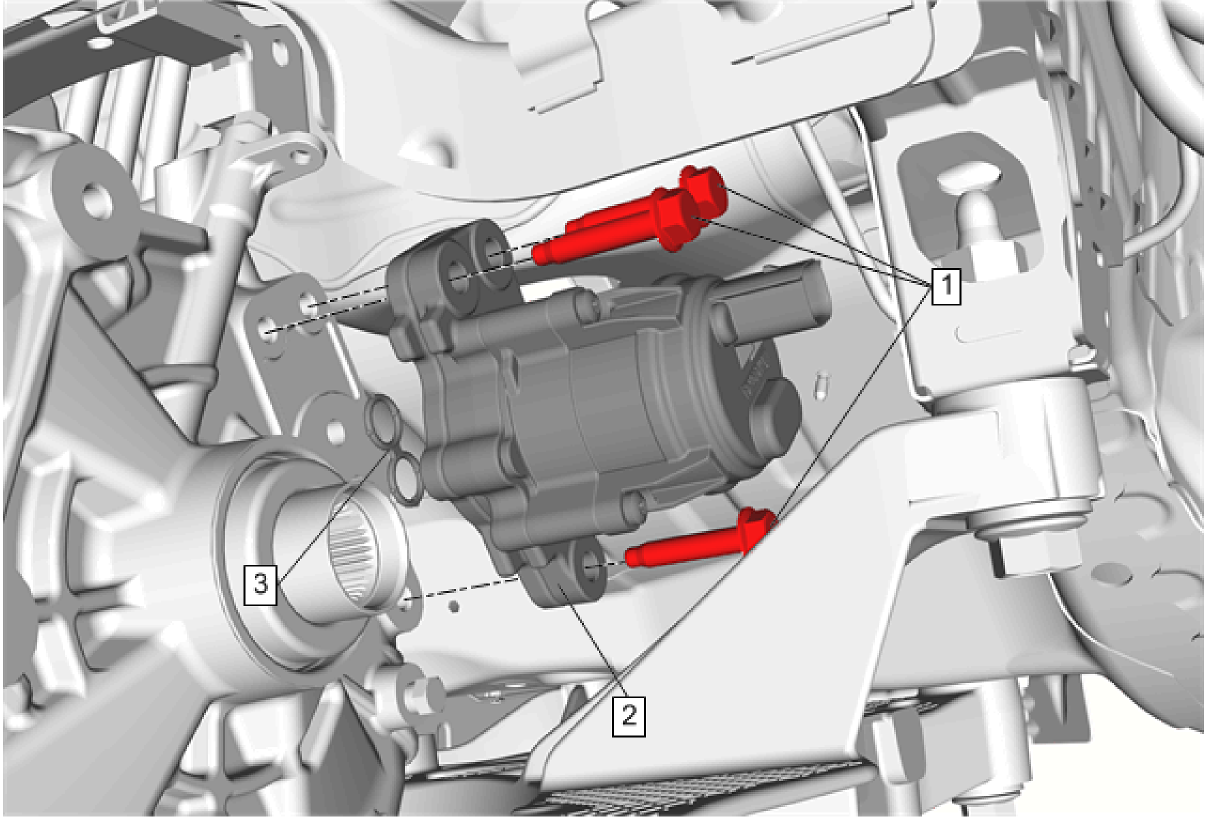


Fig. 38: Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** 2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 3. Remove the left front wheelhouse liner. Refer to **Front Wheelhouse Liner Replacement** 4. Turn the steering wheel to full left.	
1	Automatic Transmission Fluid Pump Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution** **Tighten** 22 N.m (16 lb ft)
2	Automatic Transmission Fluid Pump Assembly **Procedure** 1. Disconnect the transmission fluid pump electrical connector. 2. Connect the battery negative cable. Refer to **Battery Negative Cable Disconnection and Connection** 3. Check the transmission fluid level. Refer to **Transmission Fluid Level and Condition Check**
3	Automatic Transmission Fluid Pump Seal **NOTE:** **Install a NEW fluid pump seal.**

DRIVE MOTOR MOUNT REPLACEMENT (LEFT SIDE)

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
3. Remove Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
4. Remove Front Wheelhouse Liner. Refer to **Front Wheelhouse Liner Replacement**
5. Support the drive motor unit with a suitable jack stand.

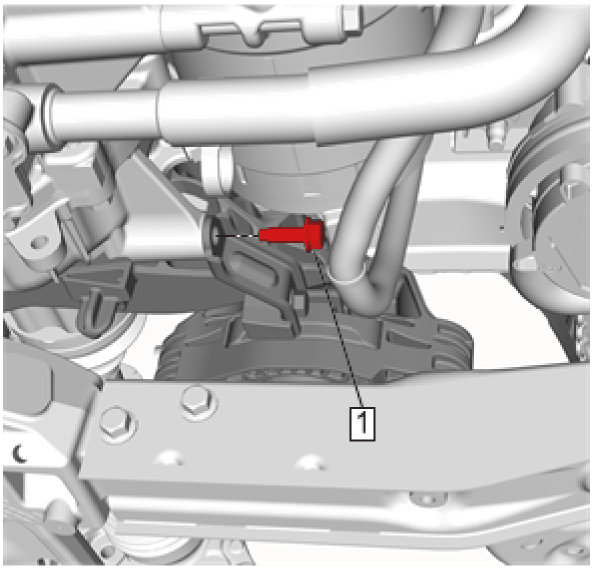


Fig. 39: Drive Motor Mount Drive Motor Side Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Remove Drive Motor Mount Drive Motor Side Bolt (1)

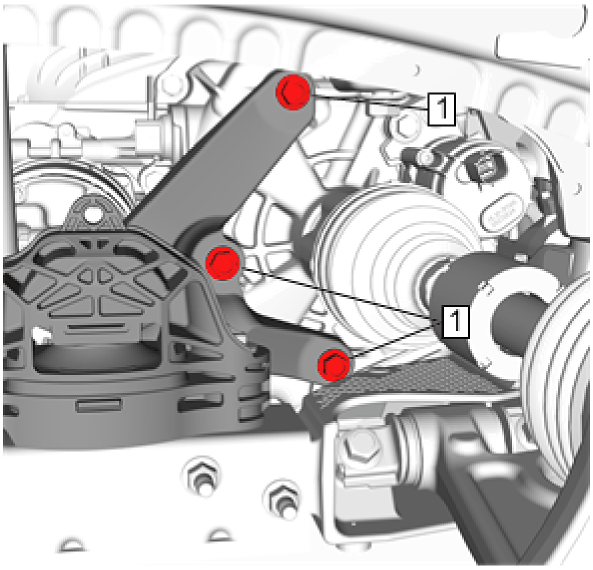


Fig. 40: Drive Motor Mount Motor Side Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Remove and DISCARD Drive Motor Mount Motor Side Bolts (1) (Qty: 3)

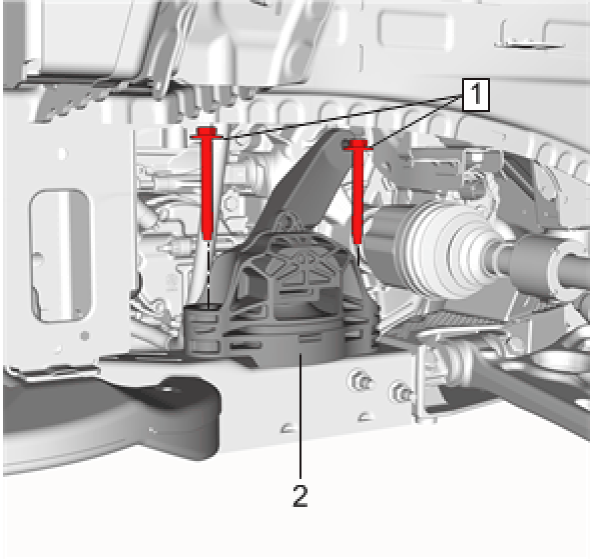


Fig. 41: Drive Motor Mount-Left Side And Bolts
Courtesy of GENERAL MOTORS COMPANY

8. Prior to removing the mount, mark the mount location on the frame using a paint pen or marker for correct positioning during installation.
9. Remove and DISCARD Drive Motor Mount Body Side Bolts (1) (Qty: 2)
10. Remove Drive Motor Mount-Left Side (2)

Installation Procedure

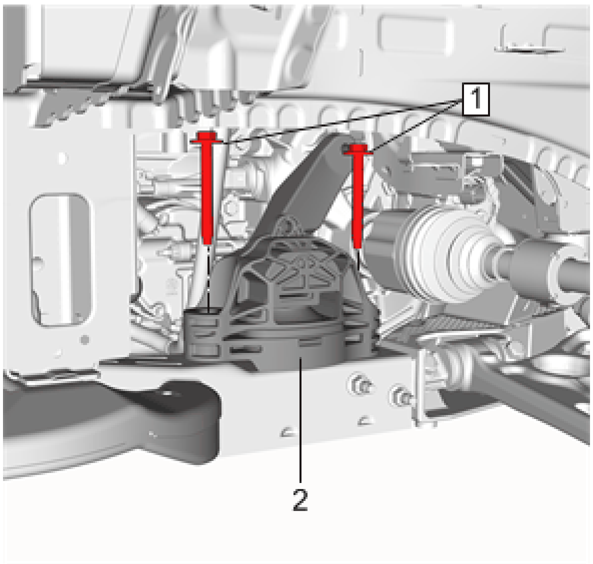


Fig. 42: Drive Motor Mount-Left Side And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Mount-Left Side (2)

CAUTION: **Refer to Fastener Caution**

CAUTION: **Refer to Torque-to-Yield Fastener Caution .**

2. Install NEW Drive Motor Mount Body Side Bolts (1) (Qty: 2)
3. Align the drive motor mount to the previously made marks on the frame.
4. Tighten Drive Motor Mount Body Side Bolt (1) (Qty: 2)
    1. First Pass: 58 N.m (43 lb ft)
    2. Final Pass: 60 - 75 Degrees

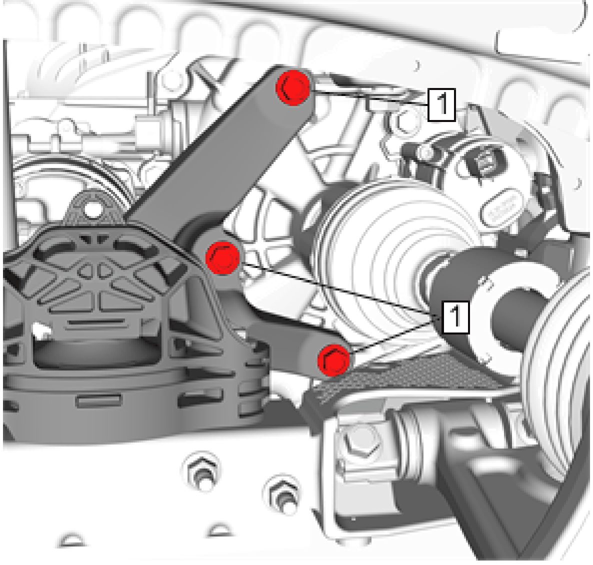


Fig. 43: Drive Motor Mount Motor Side Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install NEW Drive Motor Mount Motor Side Bolts (1) (Qty: 3)
    1. First Pass: 58 N.m (43 lb ft)
    2. Final Pass: 60 - 75 Degrees

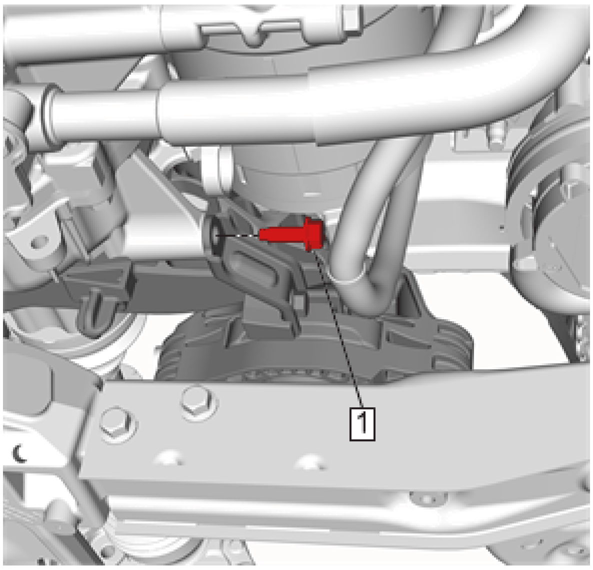


Fig. 44: Drive Motor Mount Drive Motor Side Bolt
Courtesy of GENERAL MOTORS COMPANY

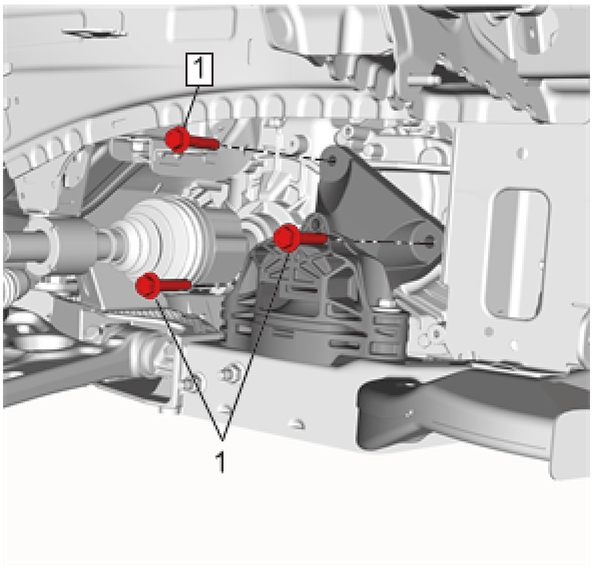
6. Install and tighten Drive Motor Mount Drive Motor Side Bolt (1) to 22 N.m (16 lb ft)
7. Remove the jack stand.
8. Install Front Wheelhouse Liner. Refer to **Front Wheelhouse Liner Replacement**
9. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
10. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
11. Lower the vehicle.

DRIVE MOTOR MOUNT REPLACEMENT (RIGHT SIDE)

Removal Procedure

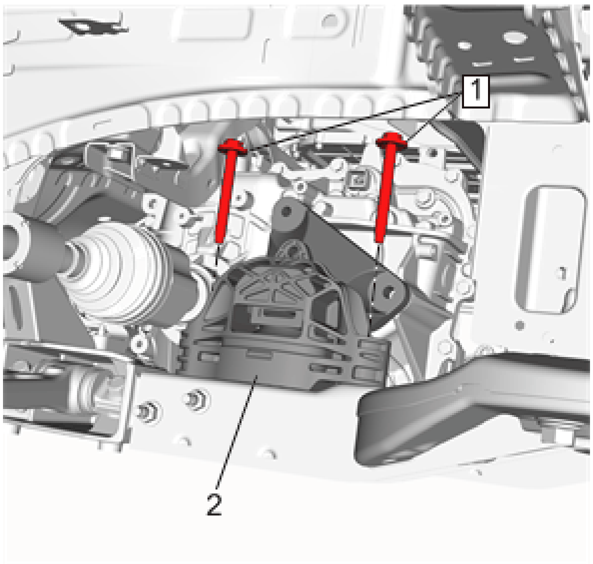
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**
2. Remove the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**
3. Remove Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
4. Remove Front Wheelhouse Liner. Refer to **Front Wheelhouse Liner Replacement**

5. Support the drive motor unit with a suitable jack stand.



[Fig. 45: Drive Motor Mount Motor Side Bolts]
Courtesy of GENERAL MOTORS COMPANY

6. Remove and DISCARD Drive Motor Mount Motor Side Bolts (1) (Qty: 3)



[Fig. 46: Drive Motor Mount-Right Side And Bolts]
Courtesy of GENERAL MOTORS COMPANY

7. Prior to removing the mount, mark the mount location on the frame using a paint pen or marker for correct positioning during installation.
8. Remove and DISCARD Drive Motor Mount Body Side Bolts (1) (Qty: 2)
9. Remove Drive Motor Mount-Right Side (2)

Installation Procedure

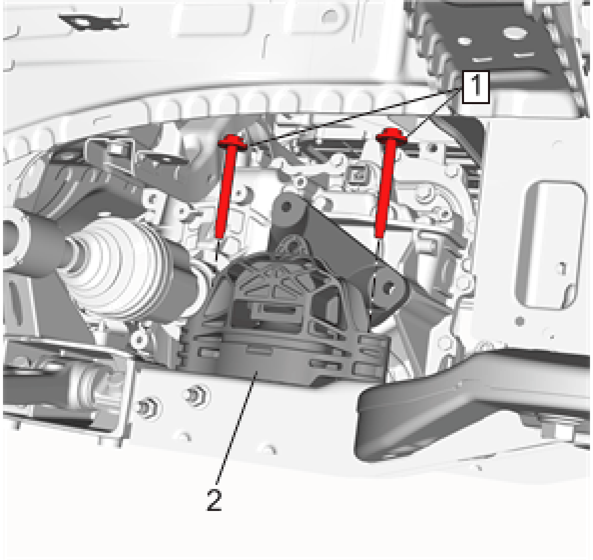


Fig. 47: Drive Motor Mount-Right Side And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Mount-Right Side (2)

CAUTION: **Refer to Fastener Caution**

CAUTION: **Refer to Torque-to-Yield Fastener Caution .**

2. Install NEW Drive Motor Mount Body Side Bolts (1) (Qty: 3)
3. Align the drive motor mount to the previously made marks on the frame.
4. Tighten Drive Motor Mount Body Side Bolts (1) (Qty: 2)
    1. First Pass: 58 N.m (43 lb ft)
    2. Final Pass: 60 - 75 Degrees

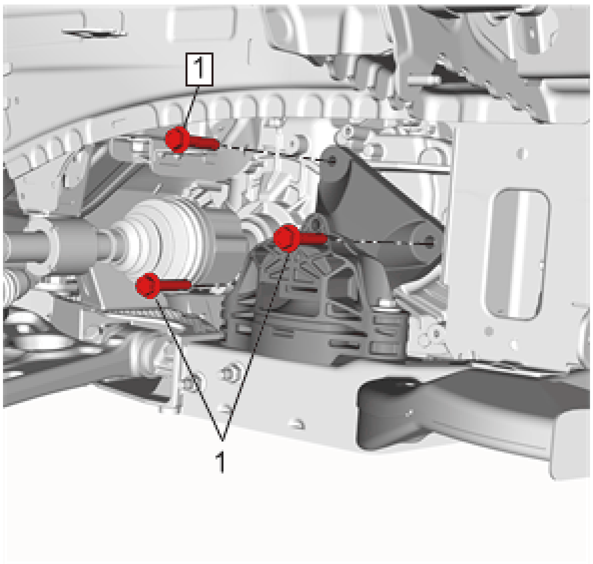


Fig. 48: Drive Motor Mount Motor Side Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install NEW Drive Motor Mount Motor Side Bolts (1) (Qty: 3)
    1. First Pass: 58 N.m (43 lb ft)
    2. Final Pass: 60 - 75 Degrees
6. Remove the jack stand.
7. Install Front Wheelhouse Liner. Refer to **Front Wheelhouse Liner Replacement**
8. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
9. Install the front tire and wheel assembly. Refer to **Tire and Wheel Removal and Installation**

10. Lower the vehicle.

DRIVE MOTOR REAR MOUNT REPLACEMENT

Removal Procedure

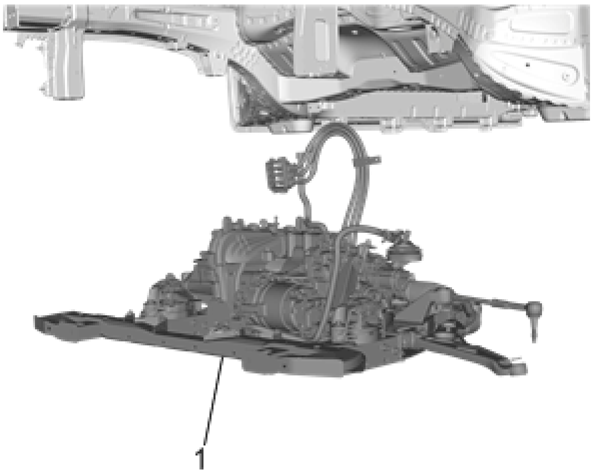


Fig. 49: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to **Drivetrain and Front Suspension Frame Removal and Installation**
2. Using an appropriate lift hook and engine hoist, raise the transmission slightly to remove weight from the rear mount.

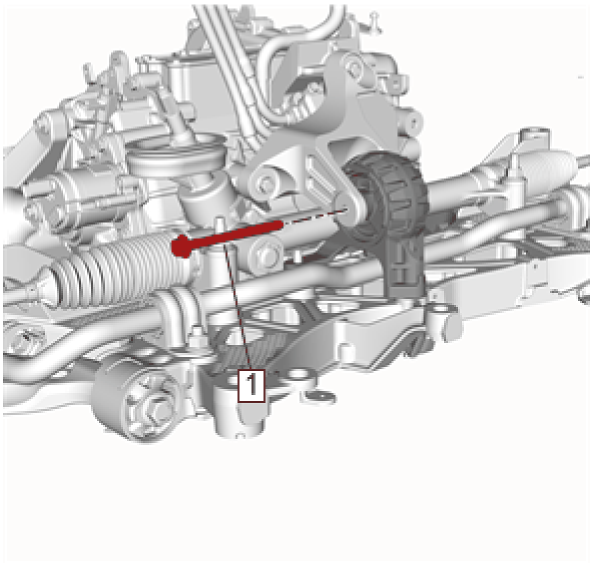


Fig. 50: Drive Motor Rear Mount Drive Motor Side Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Remove and DISCARD Drive Motor Rear Mount Drive Motor Side Bolt (1)

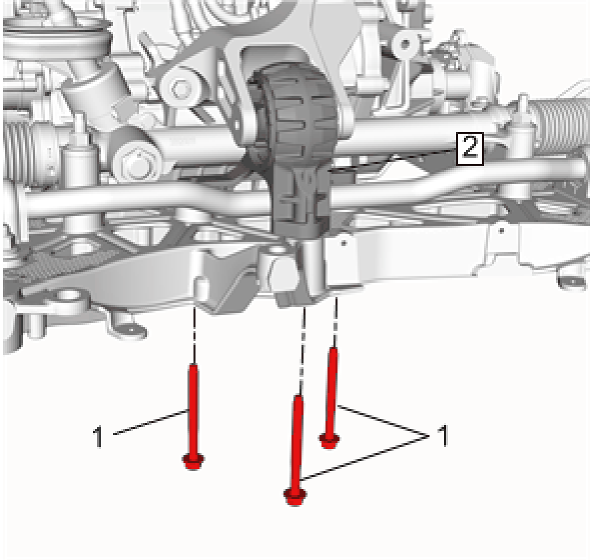


Fig. 51: Drive Motor Rear Mount And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD Drive Motor Rear Mount Drive Motor Side Bolts (1) (Qty: 3)
5. Remove Drive Motor Rear Mount (2)

Installation Procedure

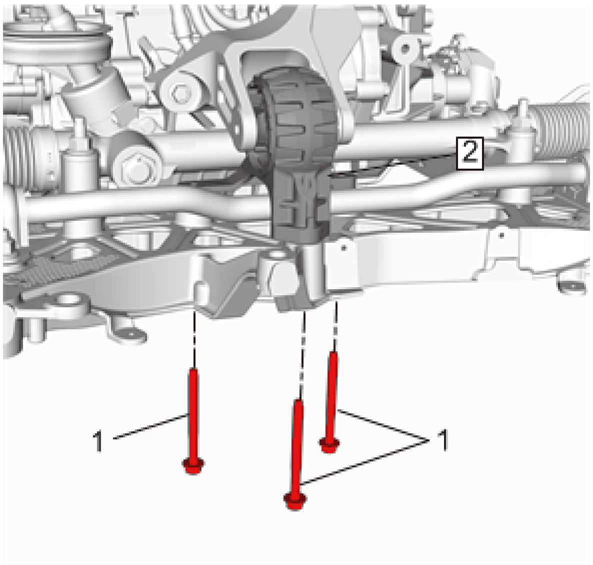


Fig. 52: Drive Motor Rear Mount And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Rear Mount (2)

CAUTION: **Refer to Fastener Caution**

CAUTION: **Refer to Torque-to-Yield Fastener Caution .**

2. Install NEW Drive Motor Rear Mount Frame Side Bolts (1) (Qty: 3)
    1. First Pass: 58 N.m (43 lb ft)
    2. Final Pass: 60 - 75 Degrees
3. Lower the transmission down until the mount and bracket holes are aligned.

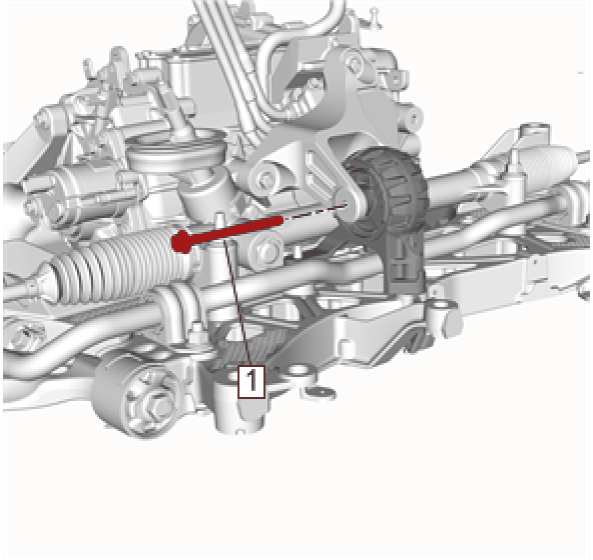


Fig. 53: Drive Motor Rear Mount Drive Motor Side Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Install NEW Drive Motor Rear Mount Drive Motor Side Bolt (1)
    1. First Pass: 58 N.m (43 lb ft)
    2. Final Pass: 60 - 75 Degrees
5. Remove the engine hoist and lift hook.

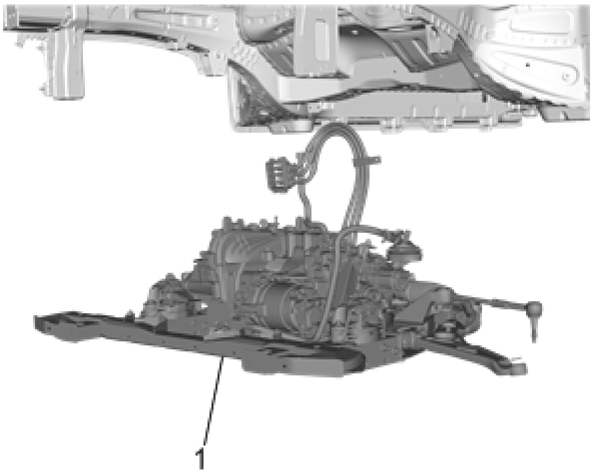


Fig. 54: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

6. Install Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to **Drivetrain and Front Suspension Frame Removal and Installation**

DRIVE MOTOR REAR MOUNT BRACKET REPLACEMENT

Removal Procedure

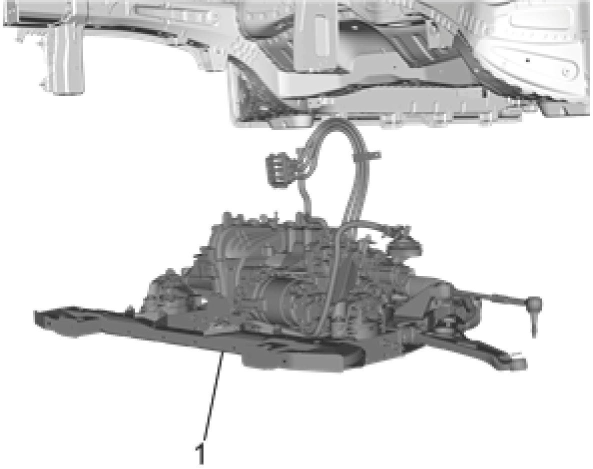


Fig. 55: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

1. Remove Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to **Drivetrain and Front Suspension Frame Removal and Installation**

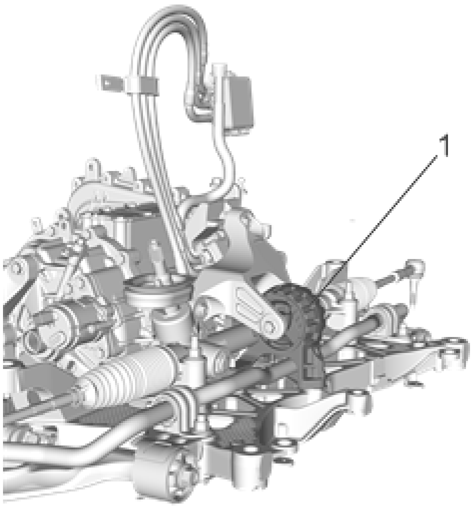


Fig. 56: Drive Motor Rear Mount
Courtesy of GENERAL MOTORS COMPANY

2. Remove Drive Motor Rear Mount (1). Refer to **Drive Motor Rear Mount Replacement**

NOTE: **The lift and hook is already attached as part of the rear mount markup.**

3. Raise the transmission with the engine lift, lift it high enough to gain access to the fasteners.

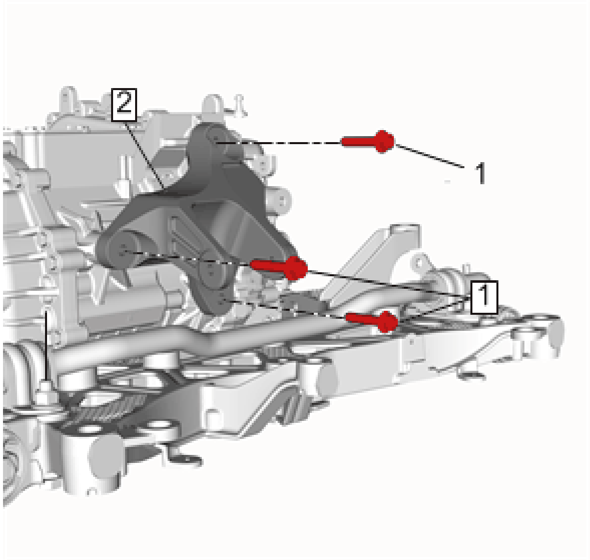


Fig. 57: Drive Motor Rear Mount Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD Drive Motor Rear Mount Bracket Drive Motor Side Bolts (1) (Qty: 3)
5. Remove Drive Motor Rear Mount Bracket (2)

Installation Procedure

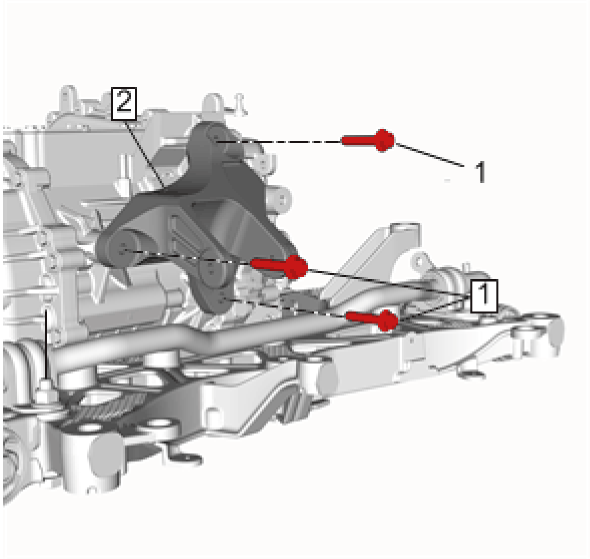


Fig. 58: Drive Motor Rear Mount Bracket And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Rear Mount Bracket (2)

CAUTION: **Refer to Fastener Caution**

CAUTION: **Refer to Torque-to-Yield Fastener Caution .**

2. Install NEW Drive Motor Rear Mount Bracket Drive Motor Side Bolts (1) (Qty: 3)
    1. First Pass: 58 N.m (43 lb ft)
    2. Final Pass: 60 - 75 Degrees

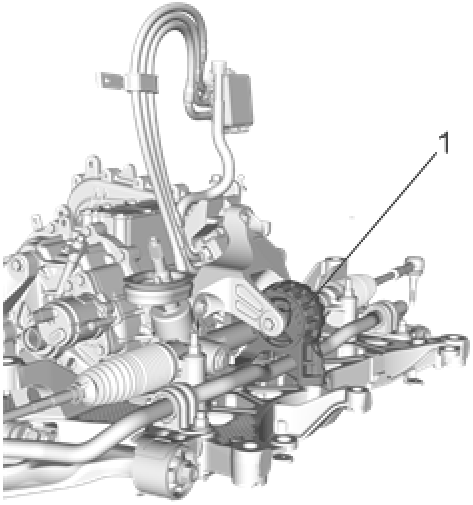


Fig. 59: Drive Motor Rear Mount
Courtesy of GENERAL MOTORS COMPANY

3. Install Drive Motor Rear Mount (1). Refer to **Drive Motor Rear Mount Replacement**

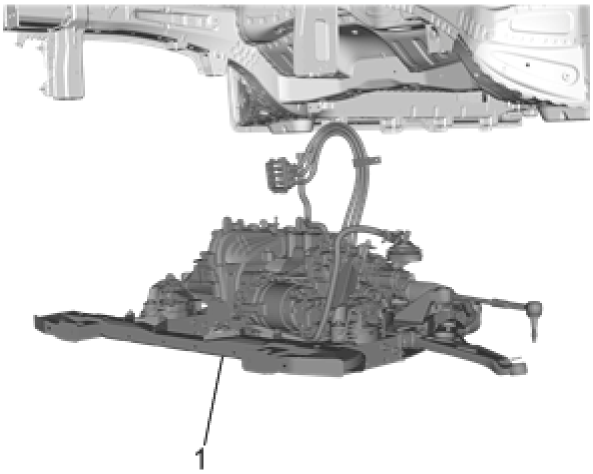


Fig. 60: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

4. Install Automatic Transmission and Drivetrain and Front Suspension Frame Assembly (1). Refer to **Drivetrain and Front Suspension Frame Removal and Installation**

SHIFT SHAFT COVER REPLACEMENT (COOLANT SUMP)

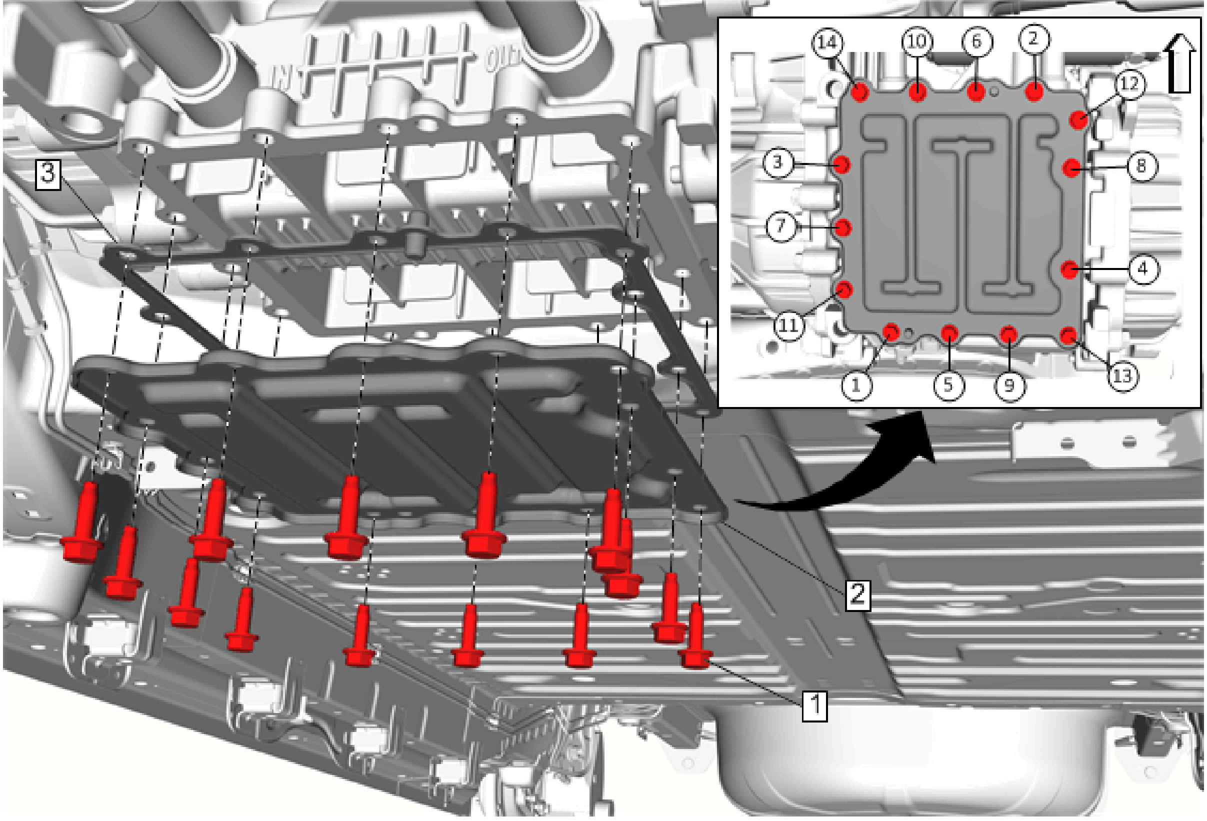


Fig. 61: Shift Shaft Cover With Bolt Tightening Sequence (Coolant Sump)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Remove Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement** 3. Drain the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling** 4. Place a drain pan beneath the transmission.	
1	Shift Shaft Cover Bolt (Qty: 14) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Install all shift shaft cover bolts by hand then tighten all bolts in specified sequence** **Tighten** 9 N.m (80 lb in)
2	Shift Shaft Cover **Procedure** Fill the drive motor generator power inverter module cooling system. Refer to **Drive Motor Generator Power Inverter Module Cooling System Draining and Filling**
3	Shift Shaft Cover Gasket **NOTE:** **Install a NEW gasket.**

SHIFT SHAFT COVER REPLACEMENT (OIL SUMP)

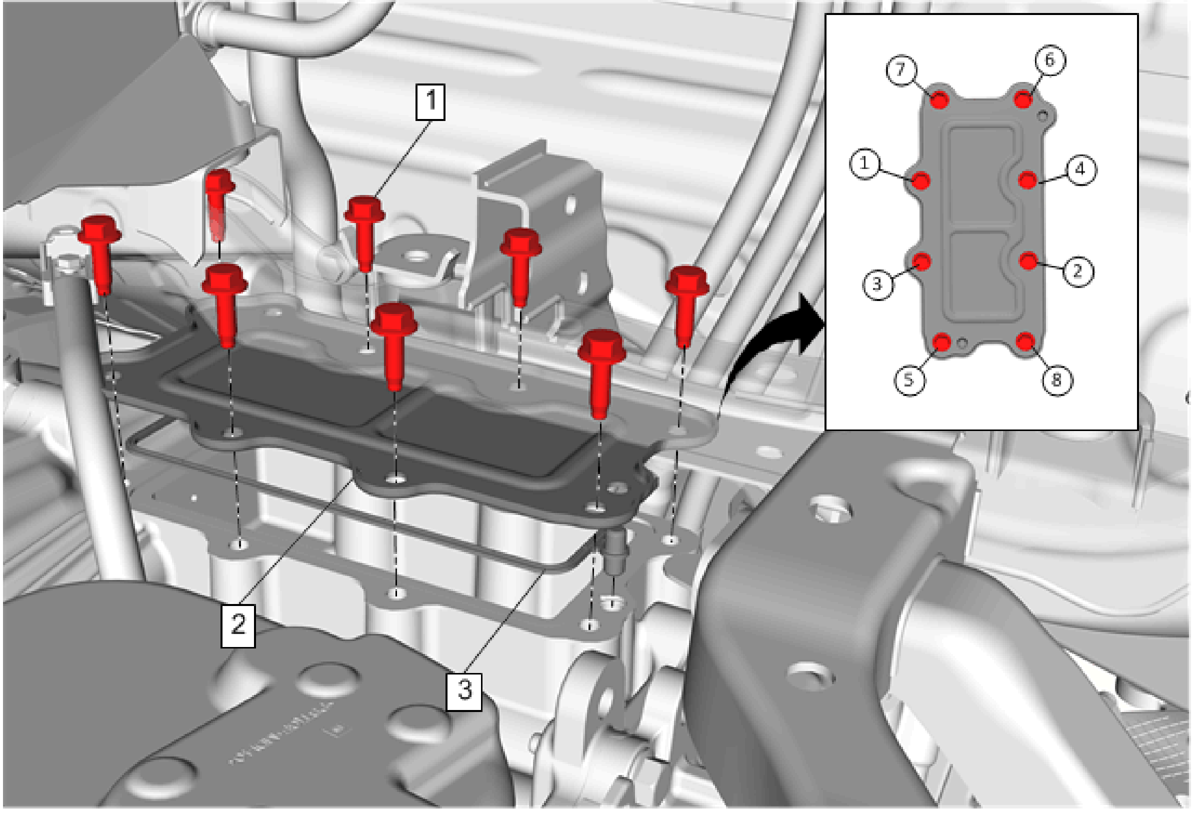


Fig. 62: Shift Shaft Cover With Bolt Tightening Sequence (Oil Sump)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Before performing this procedure, review the high voltage safety information. Refer to High Voltage Safety 2. Disable the high voltage system. Refer to High Voltage Disabling 3. Remove Drive Motor Battery Charger. Refer to Drive Motor Battery Charger Replacement (Except Dubai) Drive Motor Battery Charger Replacement (Dubai)	
1	Shift Shaft Cover Bolt (Qty: 8) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Install all shift shaft cover bolts by hand then tighten all bolts in specified sequence** **Tighten** 9 N.m (80 lb in)
2	Shift Shaft Cover **Procedure** Enable the high voltage system. Refer to High Voltage Enabling
3	Shift Shaft Cover Gasket **NOTE:** **Install a NEW gasket.**

TRANSMISSION FLUID DRAIN AND FILL

1. Drive the vehicle until the normal fluid temperature 15 - 35Â°C (59 - 95Â°F) are reached.

2. Remove Front Wheelhouse Liner. Refer to Front Wheelhouse Liner Replacement
3. Remove Front Compartment Air Deflector. Refer to Front Compartment Air Deflector Replacement

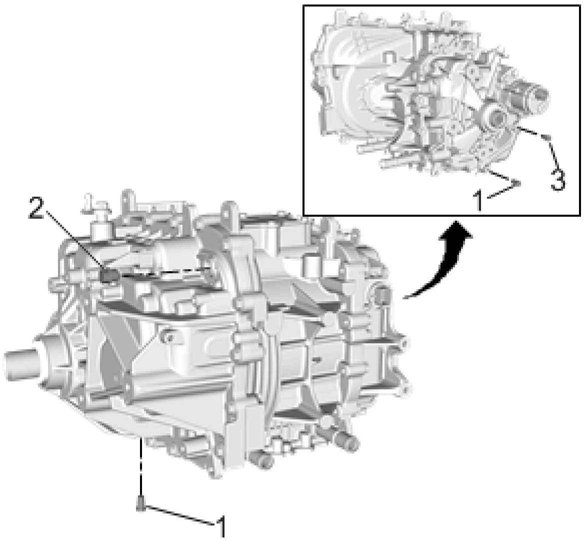


Fig. 63: Transmission Fluid Drain Plugs, Fill Plug And Fluid Level Check Plug
Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD Transmission Fluid Drain Plugs (1, 3) (Qty: 2)
5. Drain the transmission fluid into a suitable container.

CAUTION: **Refer to Fastener Caution .**

6. Install the 2 NEW transmission fluid drain plugs (1) and tighten to 12 N.m (106 lb in).
7. Remove the transmission fill plug (2).
8. Using a commercially available hand pump, add transmission fluid through the fill hole. Refer to Adhesives, Fluids, Lubricants, and Sealers, and Approximate Fluid Capacities for fluid specifications and fluid capacity.
9. Install the NEW transmission fill plug (2) and tighten to 13 N.m (115 lb in).
10. Wait for 5 minutes until oil reaches to the bottom of transmission.
11. Vehicle in service mode with the transmission in Park (P).
12. Using the scan tool, command the transmission fluid pump speed to ON for 1 minute for circulation.
13. Install Front Compartment Air Deflector. Refer to Front Compartment Air Deflector Replacement
14. Install Front Wheelhouse Liner. Refer to Front Wheelhouse Liner Replacement

NOTE: **Continue to monitor the transmission fluid temperature, if the fluid temperature falls below the specified range. Operate the vehicle again, until the transmission fluid temperature is reached.**

15. Drive the vehicle until the normal fluid temperature 35Â°C (95Â°F) are reached.
16. Wait for 5 minutes until oil reaches to the bottom of transmission.
17. Remove Front Wheelhouse Liner. Refer to Front Wheelhouse Liner Replacement
18. Remove Front Compartment Air Deflector. Refer to Front Compartment Air Deflector Replacement
19. Remove the transmission oil level check plug (3) and verify a light drip of fluid comes out.

NOTE: **Do not overfill the transmission. An overfilled transmission may result in foaming or fluid to be expelled out the vent tube when the vehicle is operated.**

20. Check the transmission fluid level. Refer to **Transmission Fluid Level and Condition Check**
21. Install the NEW transmission oil level check plug (3) and tighten to 12 N.m (106 lb in).
22. Install Front Compartment Air Deflector. Refer to **Front Compartment Air Deflector Replacement**
23. Install Front Wheelhouse Liner. Refer to **Front Wheelhouse Liner Replacement**
24. Perform the **Diagnostic Repair Verification** after completing the repair.

OUTPUT SHAFT REPLACEMENT - LEFT SIDE

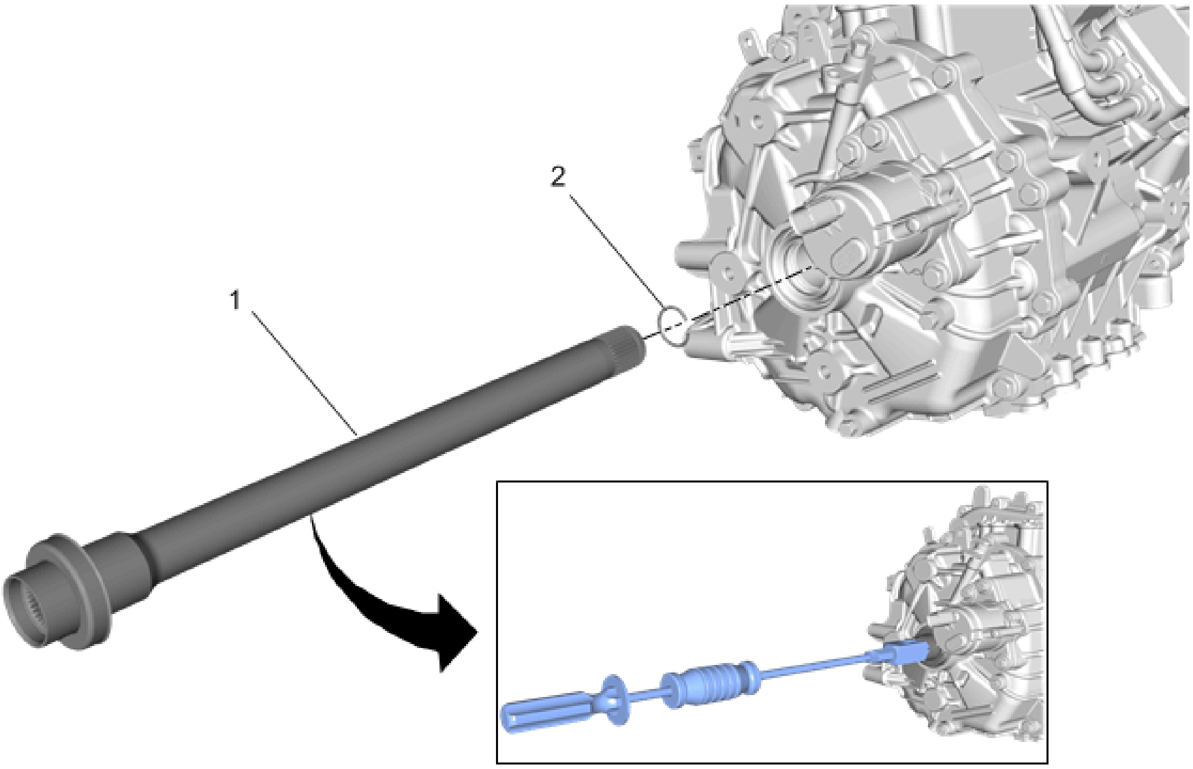


Fig. 64: Output Shaft - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Remove Left Front Wheel Drive Shaft @ Transmission. Refer to **Front Wheel Drive Shaft Replacement**	
1	Output Shaft **Special Tools** - **DT-6125-1B** Slide Hammer - **DT-23907** Bearing Adapter Equivalent regional tools: **Special Tools**
2	Output Shaft Retaining Ring **NOTE:** **Install NEW output shaft retaining ring.**

OUTPUT SHAFT REPLACEMENT - RIGHT SIDE

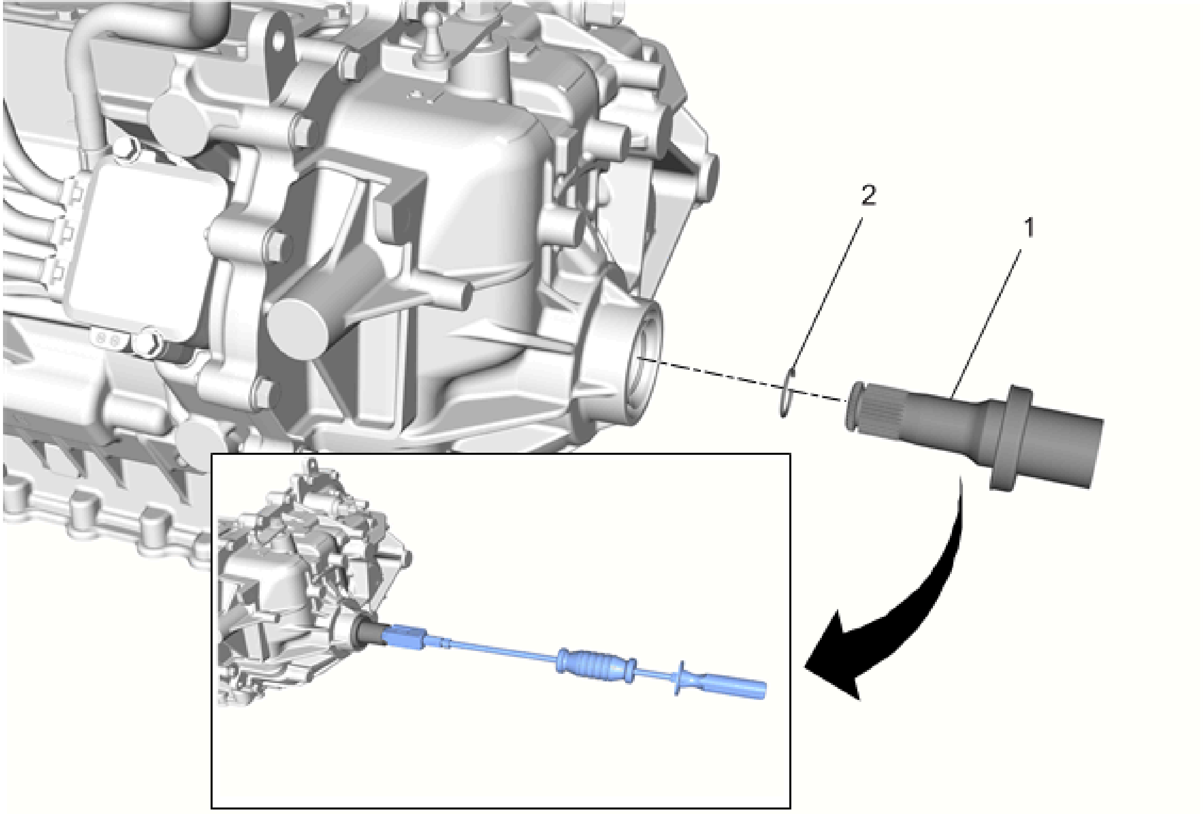


Fig. 65: Output Shaft - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle 2. Remove Right Front Wheel Drive Shaft @ Transmission. Refer to Front Wheel Drive Shaft Replacement	
1	Output Shaft **Special Tools** - **DT-6125-1B** Slide Hammer - **DT-23907** Bearing Adapter Equivalent regional tools: Special Tools
2	Output Shaft Retaining Ring **NOTE:** **Install NEW output shaft retaining ring.**

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - LEFT SIDE

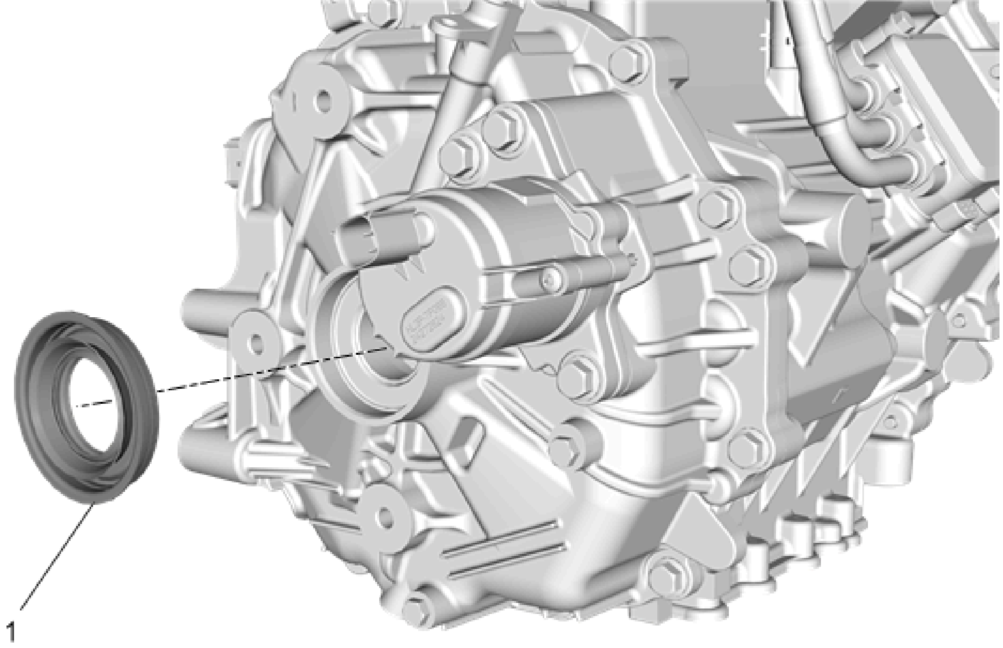


Fig. 66: Front Wheel Drive Shaft Seal - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Remove Left Front Wheel Drive Shaft @ Transmission. Refer to **Front Wheel Drive Shaft Replacement** 3. Remove Output Shaft - Left Side. Refer to **Output Shaft Replacement - Left Side**	
1	Left Front Wheel Drive Shaft Oil Seal **Procedure** 1. For seal removal use **DT-6125-1B** slide hammer with **DT-23129** Universal Seal Remover. 2. For seal installation use **DT-44809** seal installer. **NOTE:** **Use NEW oil seal.** **Special Tools** - **DT-23129** Universal Seal Remover - **DT-6125-1B** Slide Hammer - **DT-44809** Seal Installer Equivalent regional tools: **Special Tools**

FRONT WHEEL DRIVE SHAFT SEAL REPLACEMENT - RIGHT SIDE

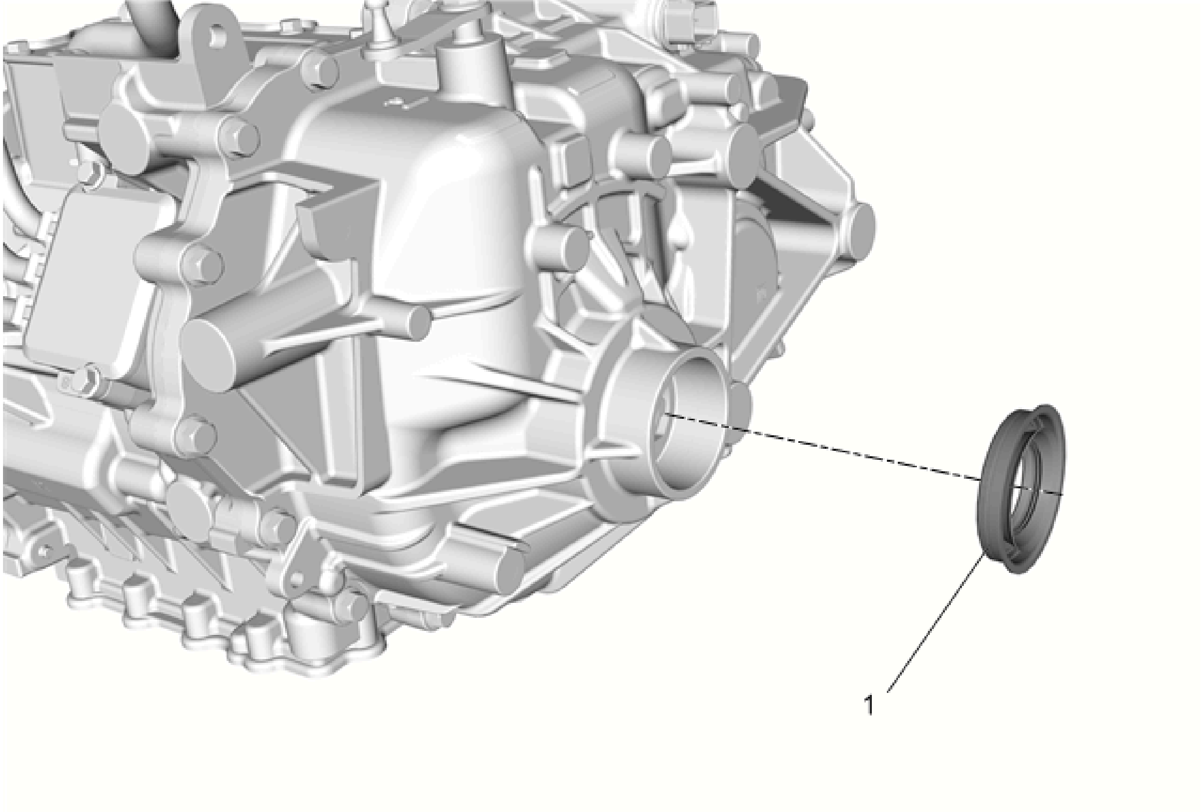


Fig. 67: Front Wheel Drive Shaft Seal - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** 2. Remove Right Front Wheel Drive Shaft @ Transmission. Refer to **Front Wheel Drive Shaft Replacement** 3. Remove Output Shaft - Right Side. Refer to **Output Shaft Replacement - Right Side**	
1	Right Front Wheel Drive Shaft Oil Seal **Procedure** 1. For seal removal use **DT-6125-1B** slide hammer with **DT-23129** Universal Seal Remover. 2. For seal installation use **DT-44809** seal installer. **NOTE:** **Use NEW oil seal.** **Special Tools** - **DT-23129** Universal Seal Remover - **DT-6125-1B** Slide Hammer - **DT-44809** Seal Installer Equivalent regional tools: **Special Tools**

TRANSMISSION REPLACEMENT

Special Tools

EN-36857 Engine Lift Bracket

Equivalent regional tools: Special Tools

Removal Procedure

WARNING: **Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.**

The High Voltage Disabling procedure includes the following steps:

- **Identify how to disable high voltage.**
- **Identify how to test for the presence of high voltage.**
- **Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.**

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- **Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.**
- **Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.**
  - **Visually and functionally inspect the gloves before use.**
  - **Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.**

Failure to follow the procedures may result in serious injury or death.

1. Disable the high voltage system. Refer to High Voltage Disabling
2. Drain the transmission fluid. Refer to Transmission Fluid Drain and Fill

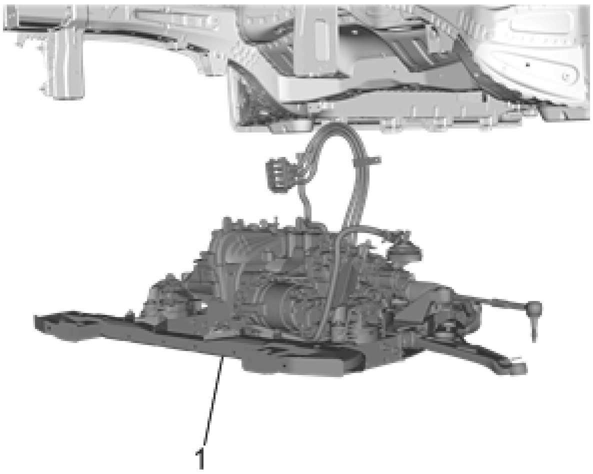


Fig. 68: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

3. Remove the drivetrain and front suspension frame with the automatic transmission from the vehicle. Refer to Drivetrain and Front Suspension Frame Removal and Installation
4. Remove Air Conditioning and Drive Motor Battery Cooling Compressor @ Transmission. Refer to Air Conditioning and Drive Motor Battery Cooling Compressor Replacement

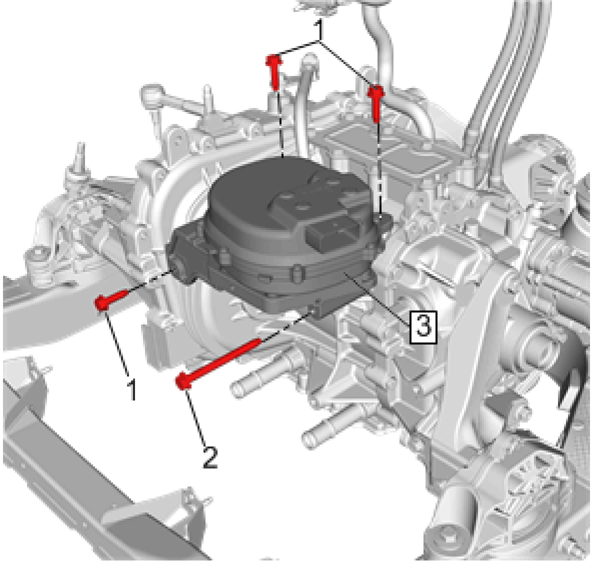


Fig. 69: Range Selector Actuator Hardware Module Assembly Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove Range Selector Actuator Hardware Module Assembly Bolts (1, 2) (Qty: 4)

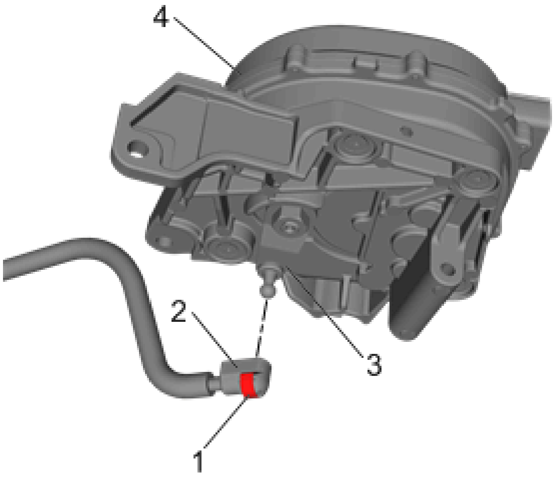


Fig. 70: Transmission Range Selector Lever Link, Retainer And Range Selector Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

6. Using a suitable tool, remove the transmission range selector lever link (2) while pulling the range selector lever link retainer (1).
7. Remove Range Selector Actuator Hardware Module Assembly (4)

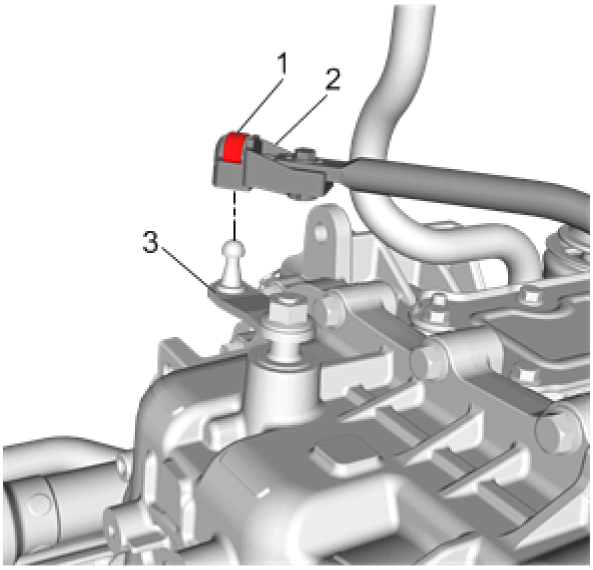


Fig. 71: Transmission Range Selector Lever Link And Lever Link Retainer
Courtesy of GENERAL MOTORS COMPANY

8. Using a suitable tool, remove the transmission range selector lever link (2) while pulling the range selector lever link retainer (1).
9. Position wood blocks under the transmission in order to support the transmission.
10. Remove the left and right drive motor mount. Refer to **Drive Motor Mount Replacement (Left Side)Drive Motor Mount Replacement (Right Side)**
11. Remove the drive motor rear mount bracket. Refer to **Drive Motor Rear Mount Bracket Replacement**

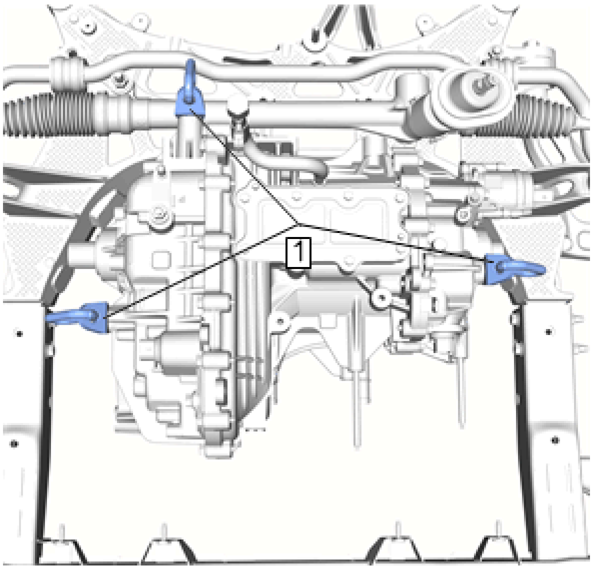


Fig. 72: Engine Lift Brackets And Lift Hooks
Courtesy of GENERAL MOTORS COMPANY

12. Separate the transmission from the drivetrain and front suspension frame.
    1. Install the *EN-36857* engine lift brackets (1) and lift hooks to the bosses on the transmission and use the engine hoist to remove the transmission from the frame.

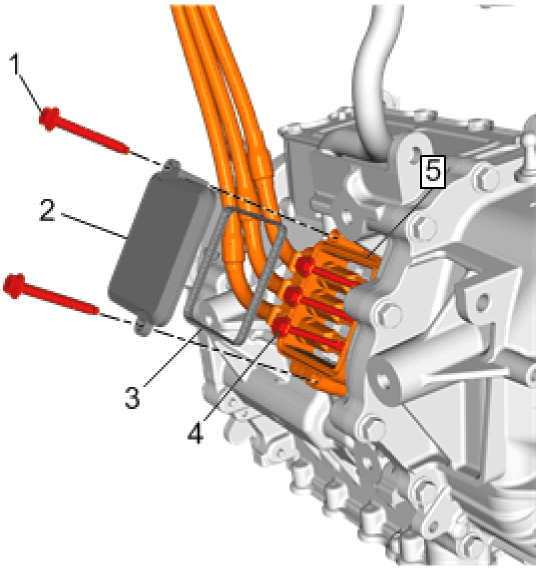


Fig. 73: Drive Motor Power Inverter Module 3 Phase Cable Connector, Cover, Bolts And Seal
Courtesy of GENERAL MOTORS COMPANY

13. Remove Drive Motor Power Inverter Module 3 Phase Cable Cover Bolts (1) (Qty: 2)
14. Remove Drive Motor Power Inverter Module 3 Phase Cable Cover (2)
15. Remove and DISCARD Drive Motor Power Inverter Module 3 Phase Cable Connector Seal (3)
16. Remove Drive Motor Power Inverter Module 3 Phase Cable Connector Bolts (4) (Qty: 3)
17. Remove Drive Motor Power Inverter Module 3 Phase Cable Connector (5) @ Transmission

Installation Procedure

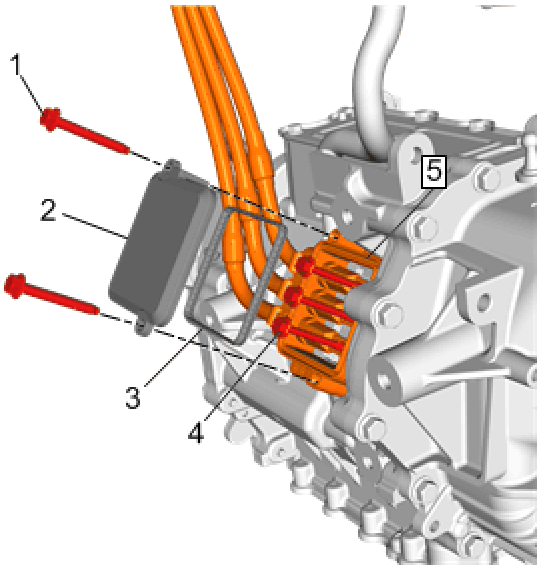


Fig. 74: Drive Motor Power Inverter Module 3 Phase Cable Connector, Cover, Bolts And Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install Drive Motor Power Inverter Module 3 Phase Cable Connector (5) @ Transmission

CAUTION: **Refer to Fastener Caution .**

2. Install and tighten Drive Motor Power Inverter Module 3 Phase Cable Connector Bolts (4) (Qty: 3) to 9 N.m (80 lb in)
3. Install a NEW Drive Motor Power Inverter Module 3 Phase Cable Connector Seal (3).
4. Install Drive Motor Power Inverter Module 3 Phase Cable Cover (2)
5. Install and tighten Drive Motor Power Inverter Module 3 Phase Cable Cover Bolts (1) (Qty: 2) to 9 N.m (80 lb in)

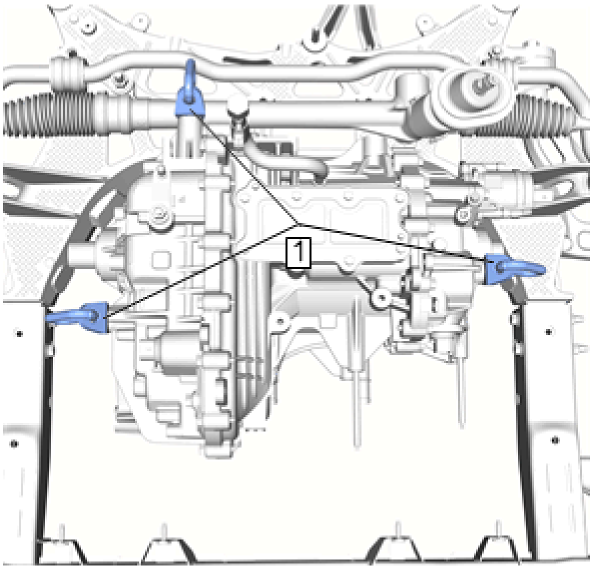


Fig. 75: Engine Lift Brackets And Lift Hooks
Courtesy of GENERAL MOTORS COMPANY

6. Position the transmission to the drivetrain and front suspension frame.
    1. Use the engine hoist to install the transmission to the frame.
    2. Position wood blocks under the transmission in order to support the transmission.
    3. Remove the *EN-36857* engine lift brackets (1) and lift hooks from the transmission.
7. Install the drive motor rear mount bracket. Refer to Drive Motor Rear Mount Bracket Replacement

8. Install the left and right drive motor mount. Refer to **Drive Motor Mount Replacement (Left Side)Drive Motor Mount Replacement (Right Side)**

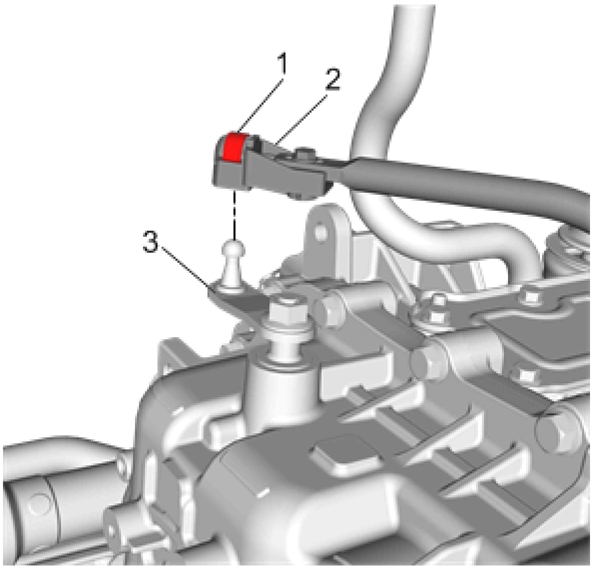


Fig. 76: Transmission Range Selector Lever Link And Lever Link Retainer
Courtesy of GENERAL MOTORS COMPANY

9. Verify the transmission range selector lever is in the park position.
10. Install Automatic Transmission Range Selector Lever Link (2) @ Transmission Range Selector Lever (3)

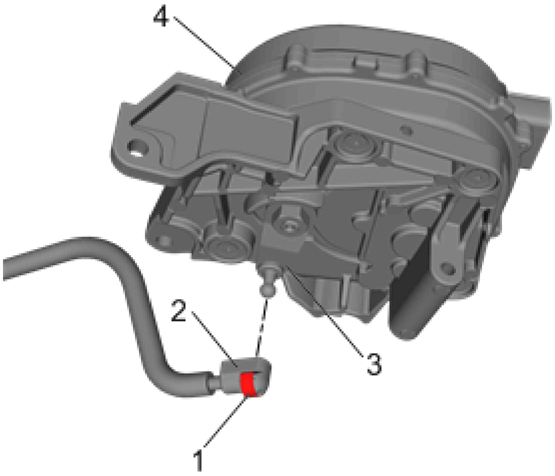


Fig. 77: Transmission Range Selector Lever Link, Retainer And Range Selector Actuator Hardware Module
Courtesy of GENERAL MOTORS COMPANY

11. Verify the transmission range selector actuator hardware module lever is in the park position.
12. Install the transmission range selector lever link (2) to the range selector actuator hardware module lever (3).

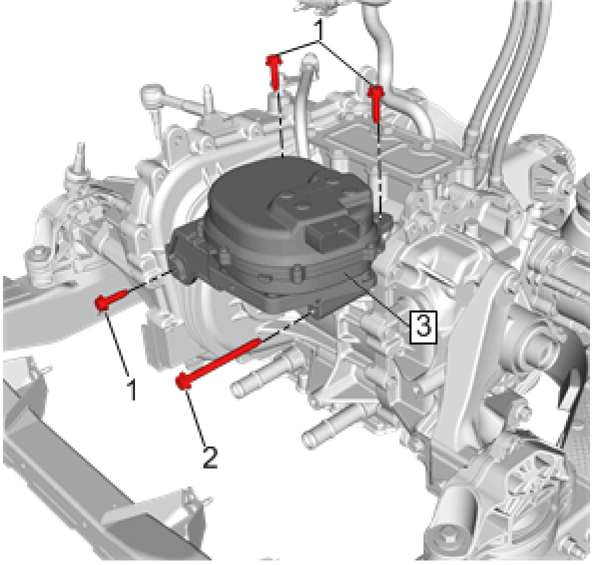


Fig. 78: Range Selector Actuator Hardware Module Assembly Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Install Range Selector Actuator Hardware Module Assembly (3) @ Transmission
14. Install and tighten Range Selector Actuator Hardware Module Assembly Bolts (1, 2) (Qty: 4) to 22 N.m (16 lb ft)
15. Check the range selector lever link adjustment. Refer to **Range Selector Lever Link Adjustment**
16. Install Air Conditioning and Drive Motor Battery Cooling Compressor @ Transmission. Refer to **Air Conditioning and Drive Motor Battery Cooling Compressor Replacement**

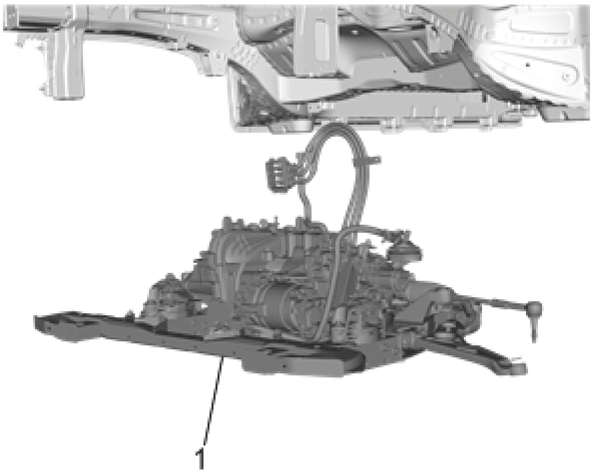


Fig. 79: Automatic Transmission and Drivetrain and Front Suspension Frame Assembly
Courtesy of GENERAL MOTORS COMPANY

17. Install the drivetrain and front suspension frame with the automatic transmission to the vehicle. Refer to **Drivetrain and Front Suspension Frame Removal and Installation**
18. Enable the high voltage system. Refer to **High Voltage Enabling**
19. Fill the transmission with transmission fluid. Refer to **Transmission Fluid Drain and Fill**
20. Perform the transmission range control module range motor position learn. Refer to **Transmission Range Control Module Range Motor Position Learn**
21. Verify proper operation of the transmission.

REPAIR INSTRUCTIONS - OFF VEHICLE

HOLDING FIXTURE INSTALLATION

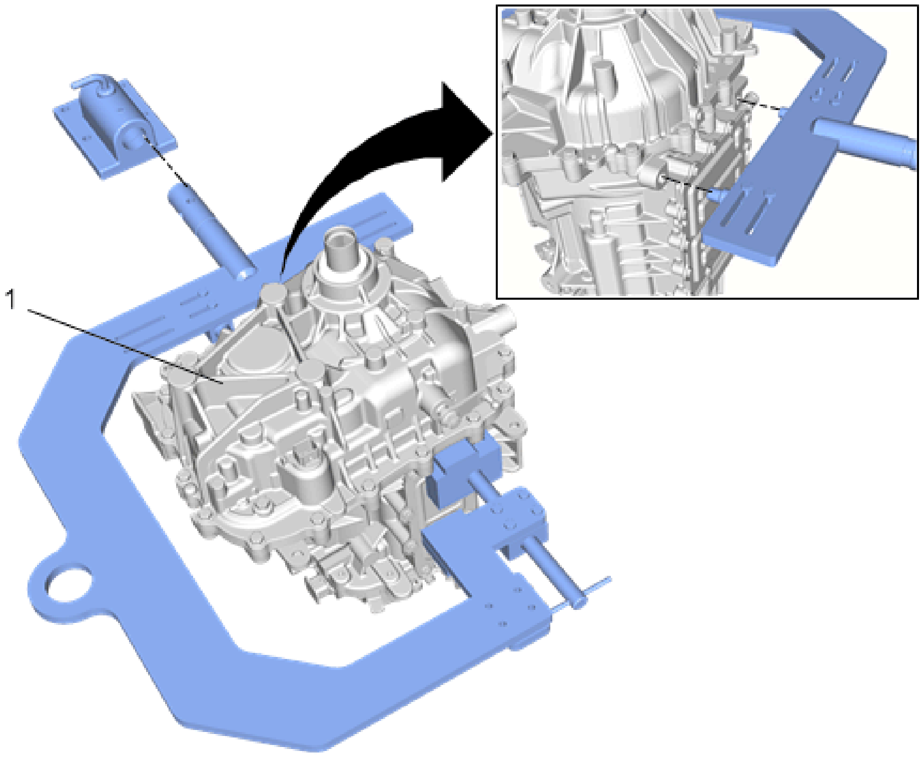


Fig. 80: Holding Fixture
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission **WARNING:** **Handle with care, the transmission assembly weighs over 83 Kg (183 lbs). Bodily injury could occur if not handled properly.** **CAUTION:** **Refer to Fastener Caution .** **Procedure** 1. Use the supplied template to relocate holes on the fixture for mounting blocks. 2. Adjust mounting blocks on holding fixture to match bosses on case and tighten. **Tighten** 13 N.m (115 lb in) **Special Tools** - **DT-3289-20** Holding Fixture Base Assembly - **DT-46625** Holding Fixture - **DT-52009** Holding Fixture Adapter - **DT-46625-10** Holding Fixture Adapter Equivalent regional tools: Special Tools.

TRANSMISSION VENT PIPE REMOVAL

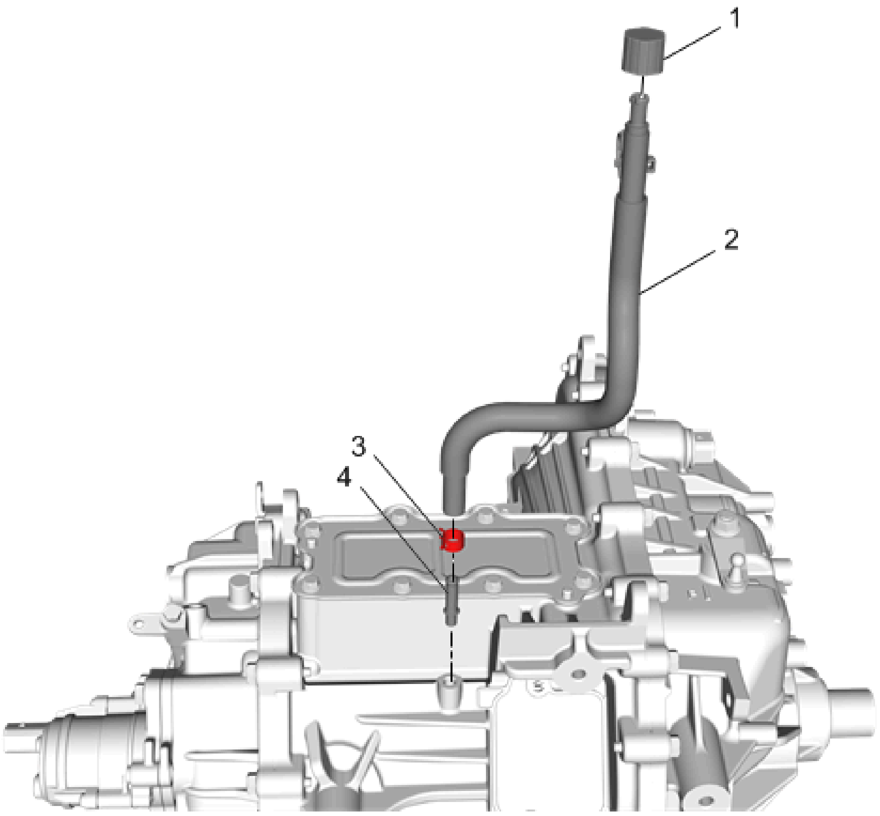


Fig. 81: Transmission Vent Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Vent Cap
2	Transmission Vent Hose
3	Transmission Vent Hose Clamp
4	Transmission Vent Pipe **NOTE:** **DISCARD the vent pipe.**

TRANSMISSION FLUID PUMP REMOVAL

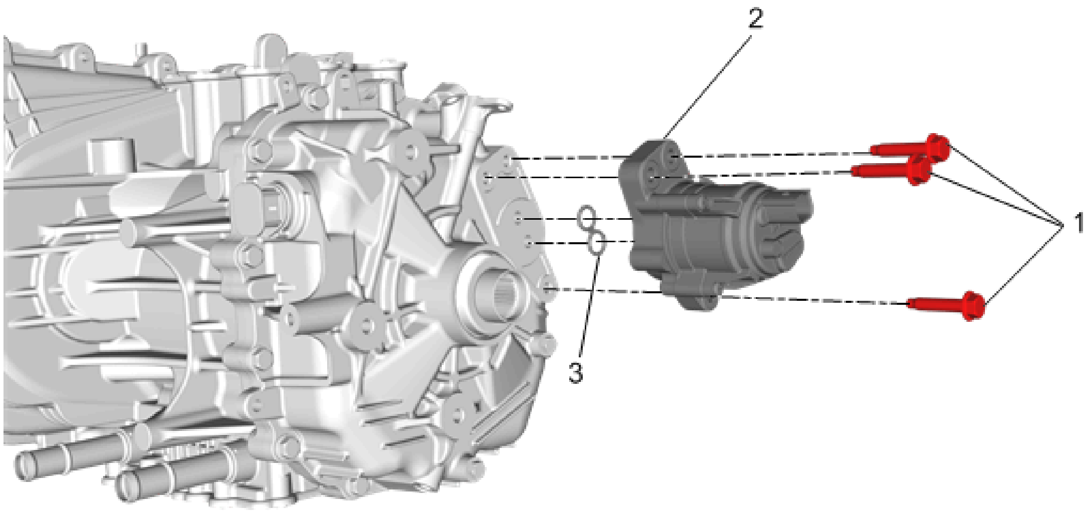


Fig. 82: Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Pump Bolt (Qty: 3)
2	Automatic Transmission Fluid Pump
3	Automatic Transmission Fluid Pump Seal **NOTE:** **DISCARD the automatic transmission fluid pump seal.**

OUTPUT SHAFT REMOVAL

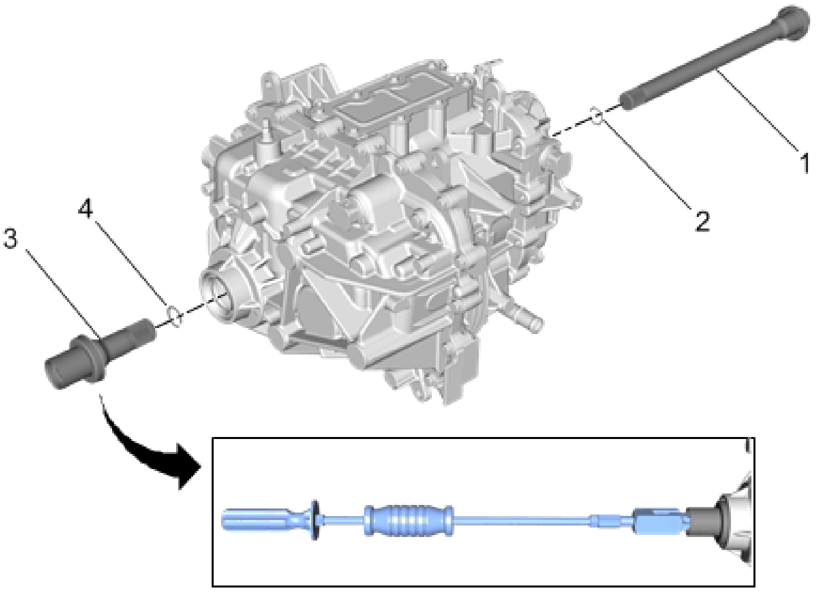


Fig. 83: Output Shaft
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Shaft (LHS) **NOTE:** **The output shaft is retained by an internal retaining ring.** **Special Tools** • **DT-6125-1B** Slide Hammer • **DT-23907** Bearing Adapter Equivalent regional tools: Special Tools.

Callout	Component Name
2	Output Shaft Retaining Ring **NOTE:** **DISCARD the output shaft retaining ring.**
3	Output Shaft (RHS) **NOTE:** **The output shaft is retained by an internal retaining ring.** **Special Tools** - **DT-6125-1B** Slide Hammer - **DT-23907** Bearing Adapter Equivalent regional tools: Special Tools.
4	Output Shaft Retaining Ring **NOTE:** **DISCARD the output shaft retaining ring.**

AUTOMATIC TRANSMISSION CASE REMOVAL

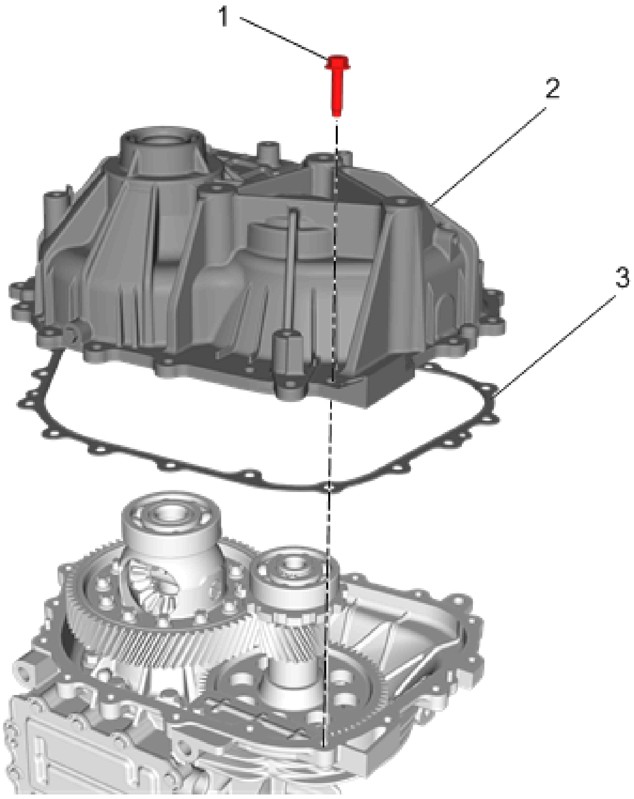


Fig. 84: Automatic Transmission Case
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Bolt (Qty: 18)
2	Automatic Transmission Case

Callout	Component Name
3	Automatic Transmission Case Gasket **NOTE:** **DISCARD the automatic transmission case gasket.**

AUTOMATIC TRANSMISSION CONTROL WIRING HARNESS REMOVAL - TRANSMISSION CASE

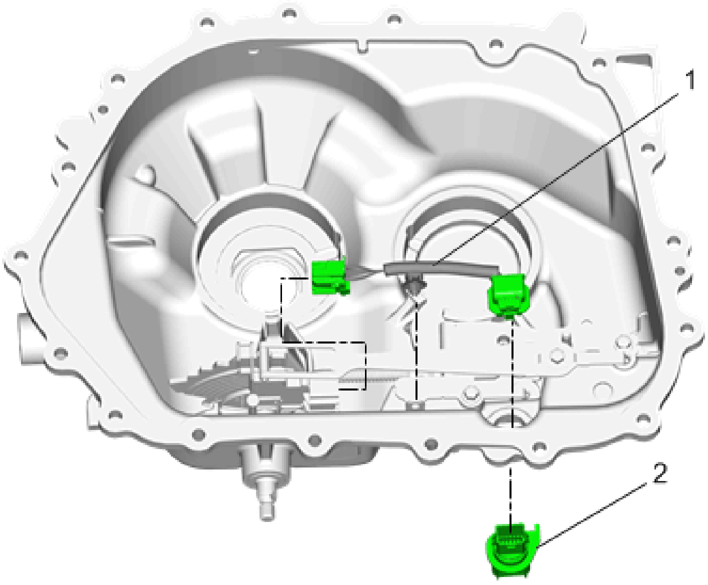


Fig. 85: Automatic Transmission Control Wiring Harness - Transmission Case
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Control Wiring Harness
2	Wiring Harness Electrical Connector **NOTE:** **DISCARD the wiring harness electrical connector.**

PARK PAWL AND MANUAL SHIFT SHAFT REMOVAL

Manual Shift Detent Lever Spring and Bracket Removal

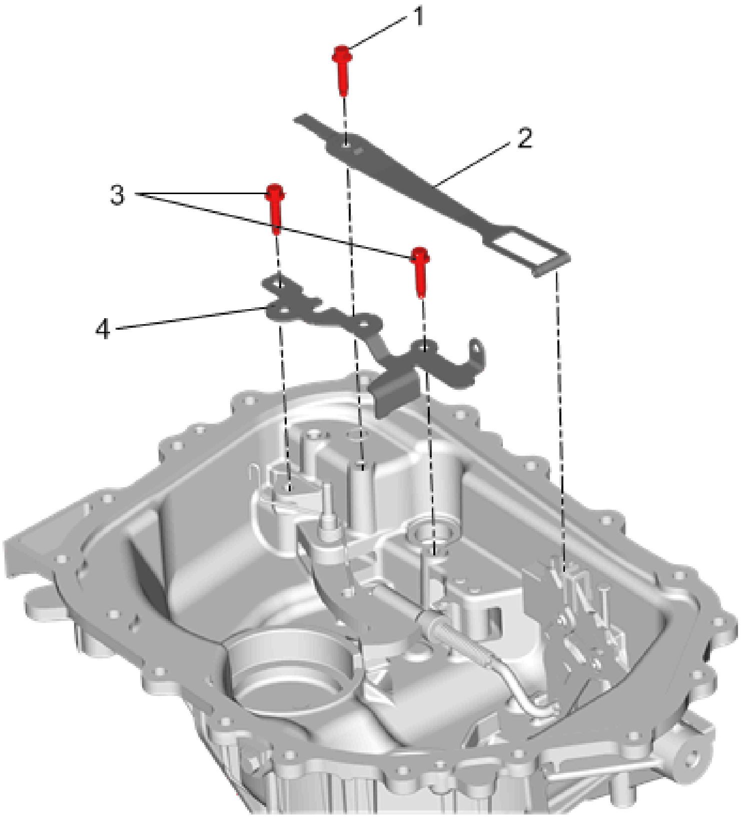


Fig. 86: Manual Shift Detent Lever Spring and Bracket
Courtesy of GENERAL MOTORS COMPANY

Manual Shift Detent Lever Spring and Bracket Removal

Callout	Component Name
1	Manual Shift Detent Lever Spring Bolt **NOTE:** **DISCARD the manual shift detent lever spring bolt**
2	Manual Shift Detent Lever Spring
3	Park Pawl Actuator Bracket Bolt (Qty: 2)
4	Park Pawl Actuator Bracket

Park Pawl, Shaft and Bracket Removal

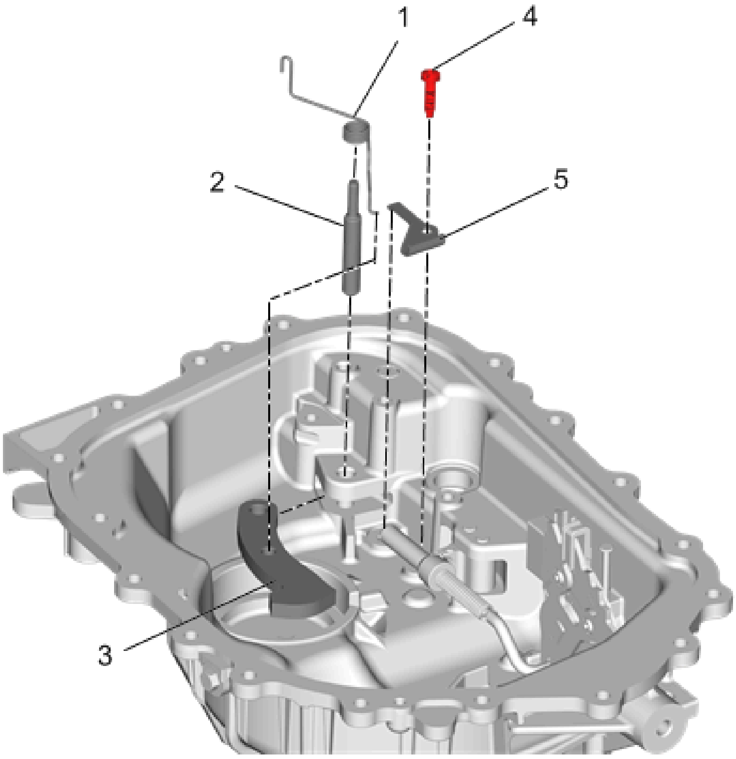


Fig. 87: Park Pawl, Shaft and Bracket
Courtesy of GENERAL MOTORS COMPANY

Park Pawl, Shaft and Bracket Removal

Callout	Component Name
1	Park Pawl Spring
2	Park Pawl Shaft
3	Park Pawl
4	Park Pawl Actuator Bracket Bolt
5	Park Pawl Actuator Bracket

Park Pawl Actuator Guide Removal

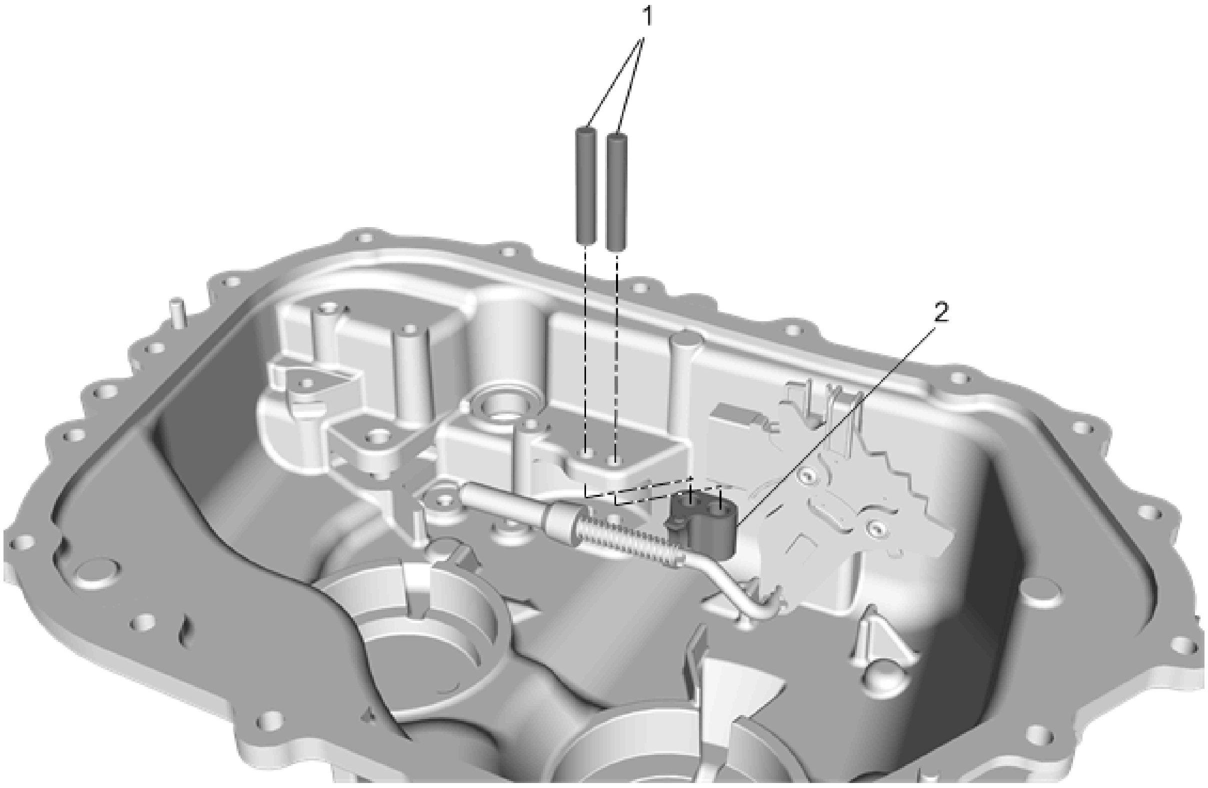


Fig. 88: Park Pawl Actuator Guide
Courtesy of GENERAL MOTORS COMPANY

Park Pawl Actuator Guide Removal

Callout	Component Name
1	Park Pawl Actuator Guide Pin (Qty: 2)
2	Park Pawl Actuator Guide

MANUAL SHIFT SHAFT POSITION SWITCH REMOVAL

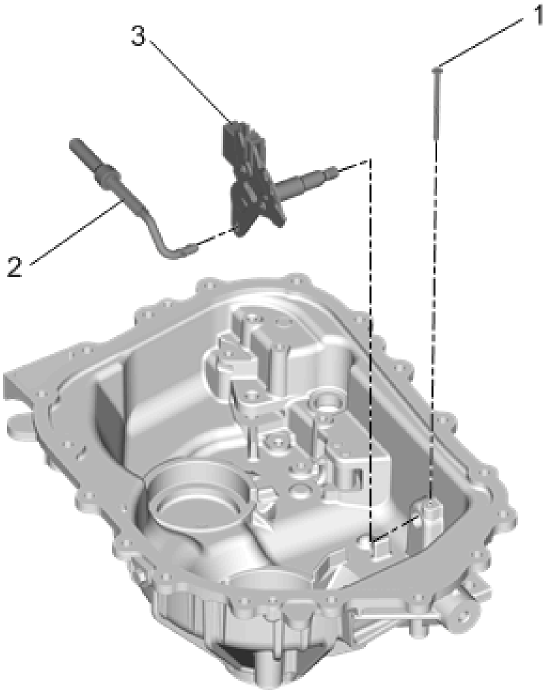


Fig. 89: Manual Shift Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Pin **NOTE:** **DISCARD the manual shift shaft pin.**
2	Park Pawl Actuator
3	Manual Shift Shaft Position Switch

MANUAL SHIFT SHAFT SEAL REMOVAL

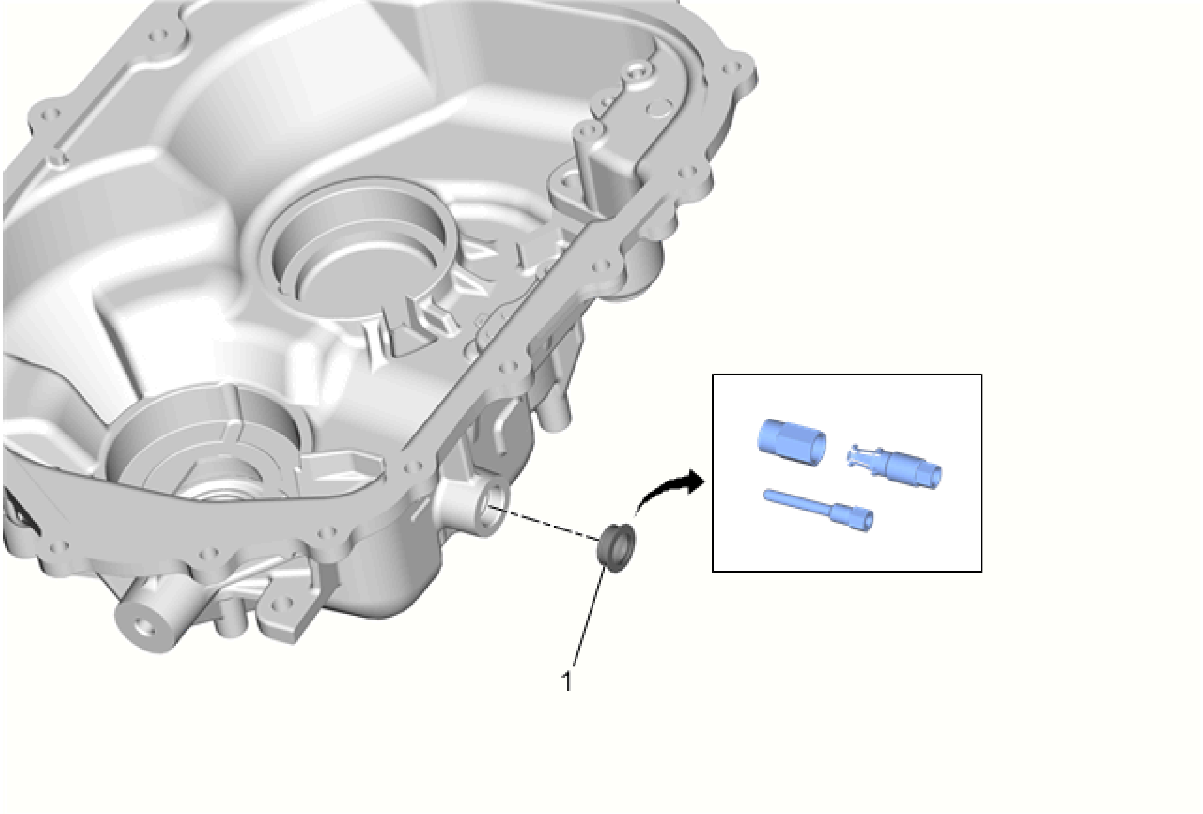


Fig. 90: Manual Shift Shaft Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Seal **NOTE:** **DISCARD the manual shift shaft seal.** **Special Tools** • **DT-45201** Shift Shaft Seal Remover Equivalent regional tools: Special Tools

FRONT WHEEL DRIVE SHAFT OIL SEAL REMOVAL - RIGHT SIDE

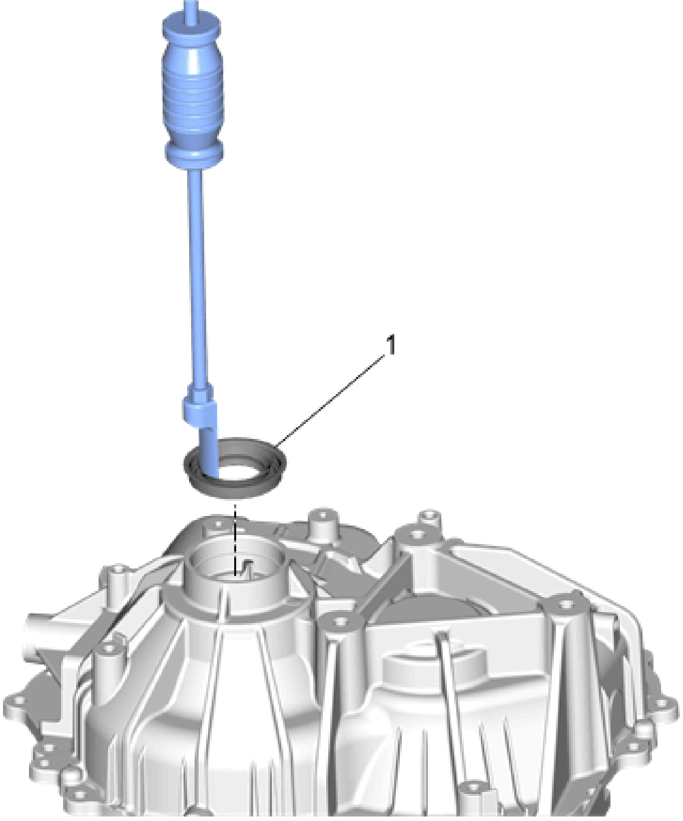
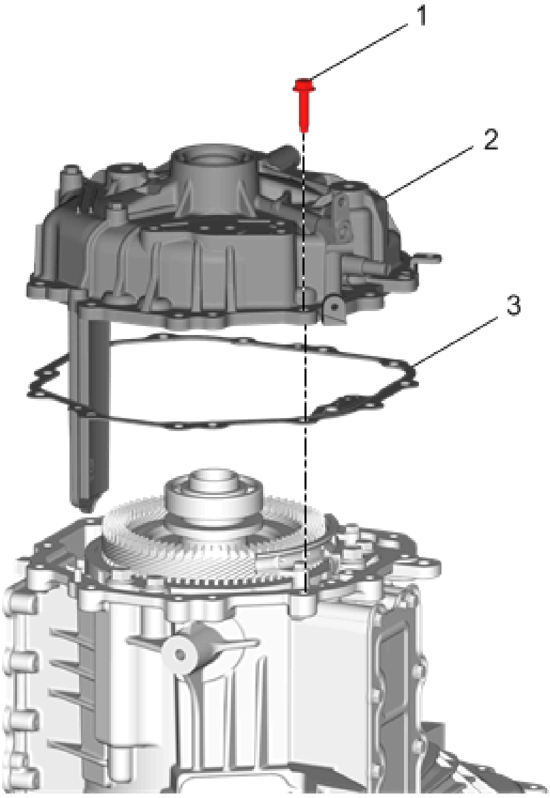


Fig. 91: Front Wheel Drive Shaft Oil Seal - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal (RHS) **NOTE:** **DISCARD the front wheel drive shaft oil seal.** **Special Tools** • **DT-23129** Universal Seal Remover • **DT-6125-1B** Slide Hammer Equivalent regional tools: Special Tools

AUTOMATIC TRANSMISSION CASE COVER REMOVAL



[Fig. 92: Automatic Transmission Case Cover](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Cover Bolt (Qty: 13)
2	Automatic Transmission Case Cover
3	Automatic Transmission Case Cover Gasket **NOTE:** **DISCARD the automatic transmission case cover gasket.**

AUTOMATIC TRANSMISSION CONTROL WIRING HARNESS REMOVAL - TRANSMISSION CASE COVER

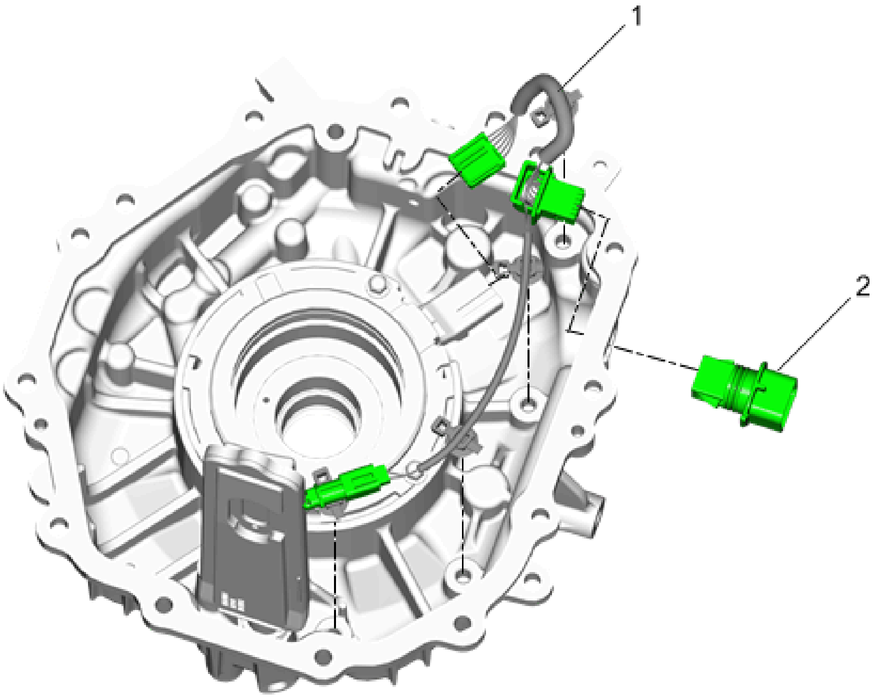


Fig. 93: Automatic Transmission Control Wiring Harness - Transmission Case Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Control Wiring Harness
2	Wiring Harness Electrical Connector **NOTE:** **DISCARD the wiring harness electrical connector.**

AUTOMATIC TRANSMISSION FLUID FILTER REMOVAL

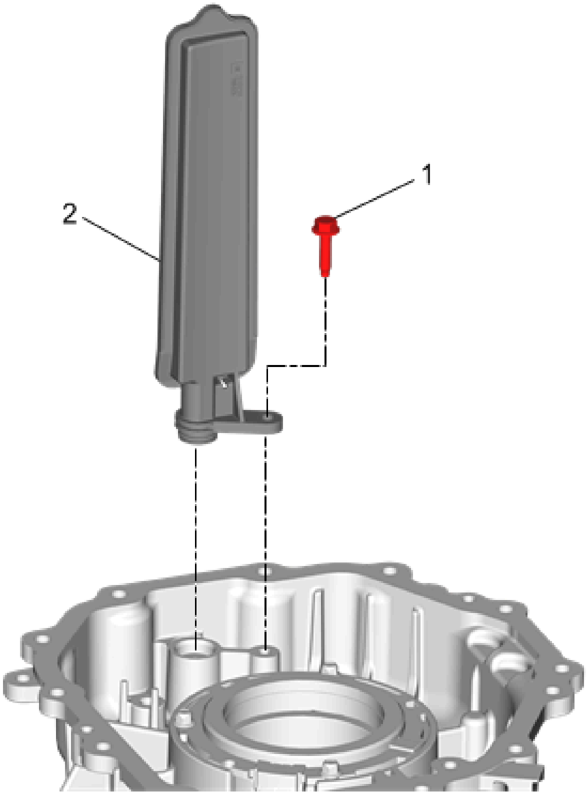


Fig. 94: Automatic Transmission Fluid Filter
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Filter Bolt
2	Automatic Transmission Fluid Filter **NOTE:** **Discard the fluid filter. The fluid filter O-ring is not serviceable separately.**

DRIVE MOTOR POSITION SENSOR STATOR REMOVAL

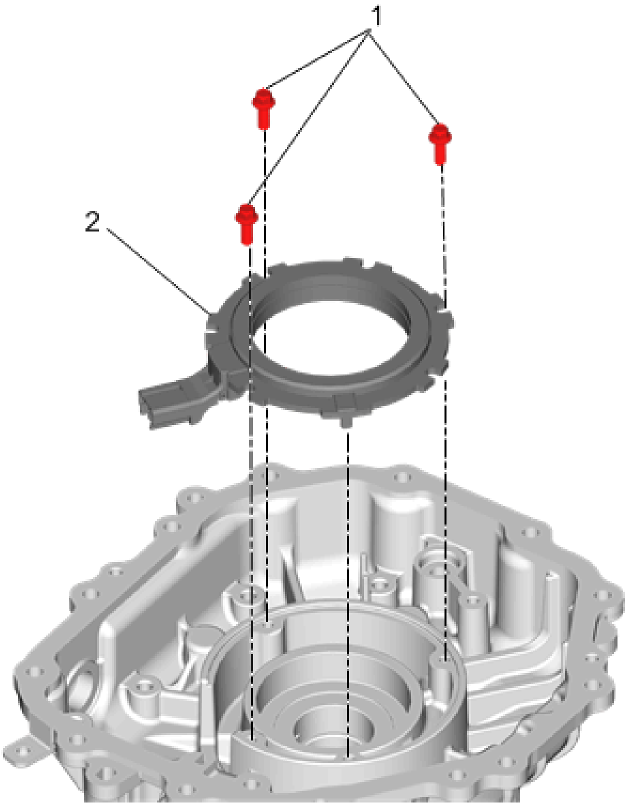


Fig. 95: Drive Motor Position Sensor Stator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Position Sensor Stator Bolt (Qty: 3) **NOTE:** **DISCARD the drive motor position sensor stator bolts.**
2	Drive Motor Position Sensor Stator

FRONT WHEEL DRIVE SHAFT OIL SEAL REMOVAL - LEFT SIDE

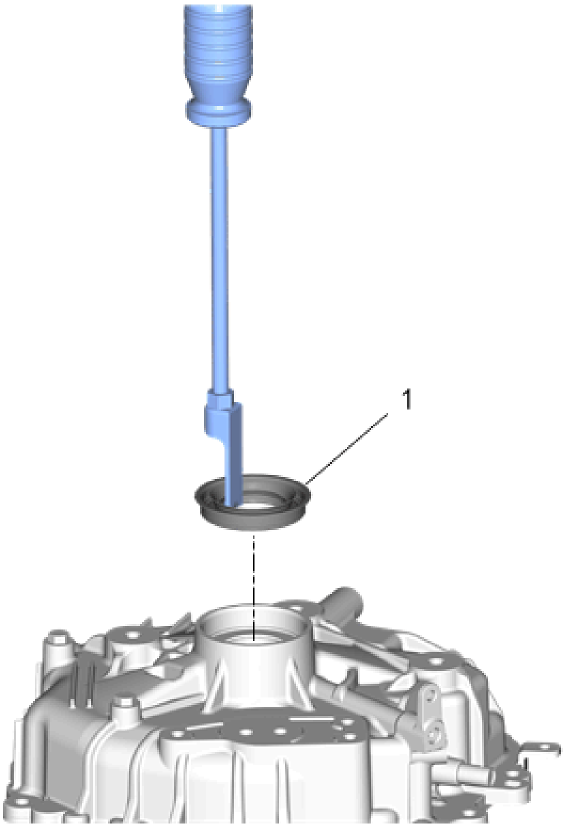


Fig. 96: Front Wheel Drive Shaft Oil Seal - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal (LHS) **NOTE:** **DISCARD the front wheel drive shaft oil seal.** **Special Tools** • **DT-23129** Universal Seal Remover • **DT-6125-1B** Slide Hammer Equivalent regional tools: Special Tools

AUTOMATIC TRANSMISSION FLUID PAN MAGNET REMOVAL

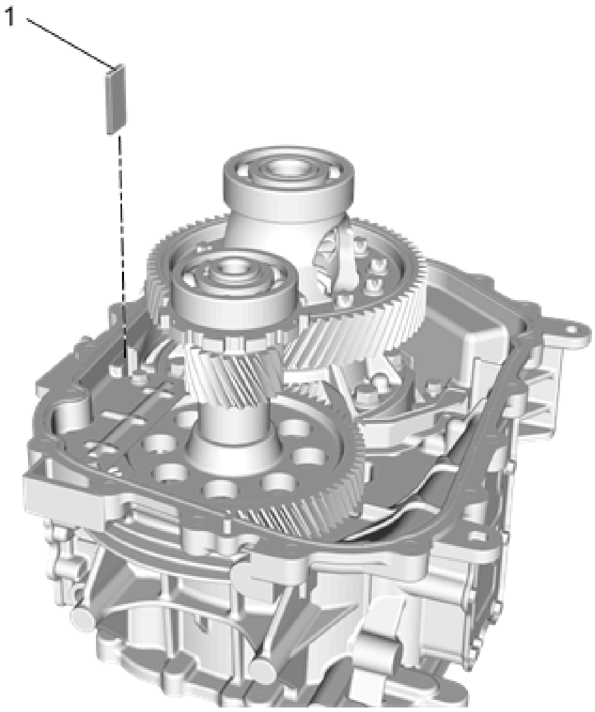


Fig. 97: Automatic Transmission Fluid Pan Magnet
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Pan Magnet

OIL PAN BAFFLE REMOVAL

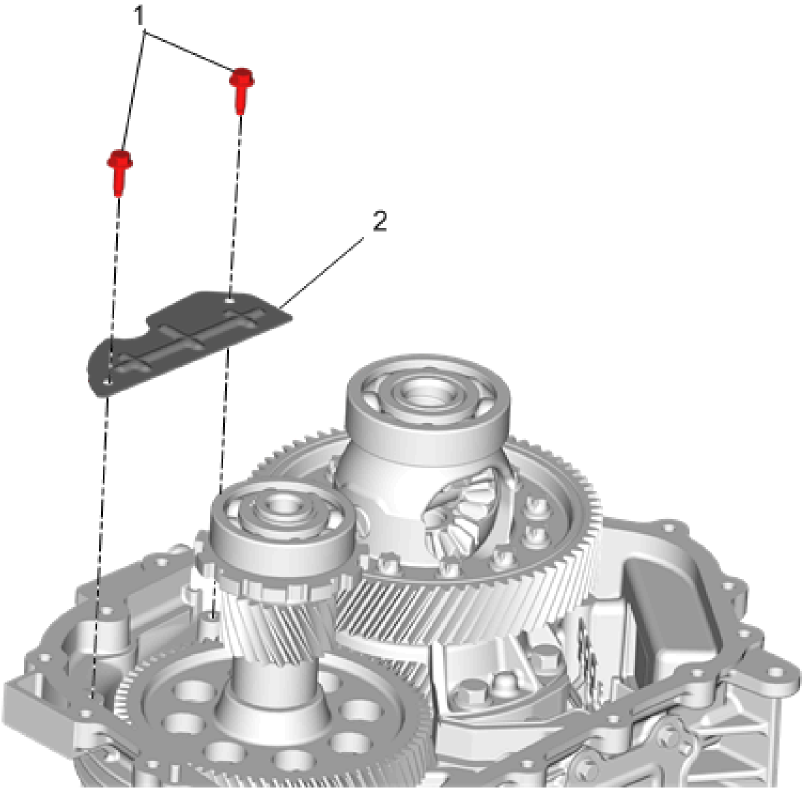


Fig. 98: Oil Pan Baffle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Oil Pan Baffle Bolt (Qty: 2)
2	Oil Pan Baffle

MANUAL TRANSMISSION OIL TROUGH REMOVAL

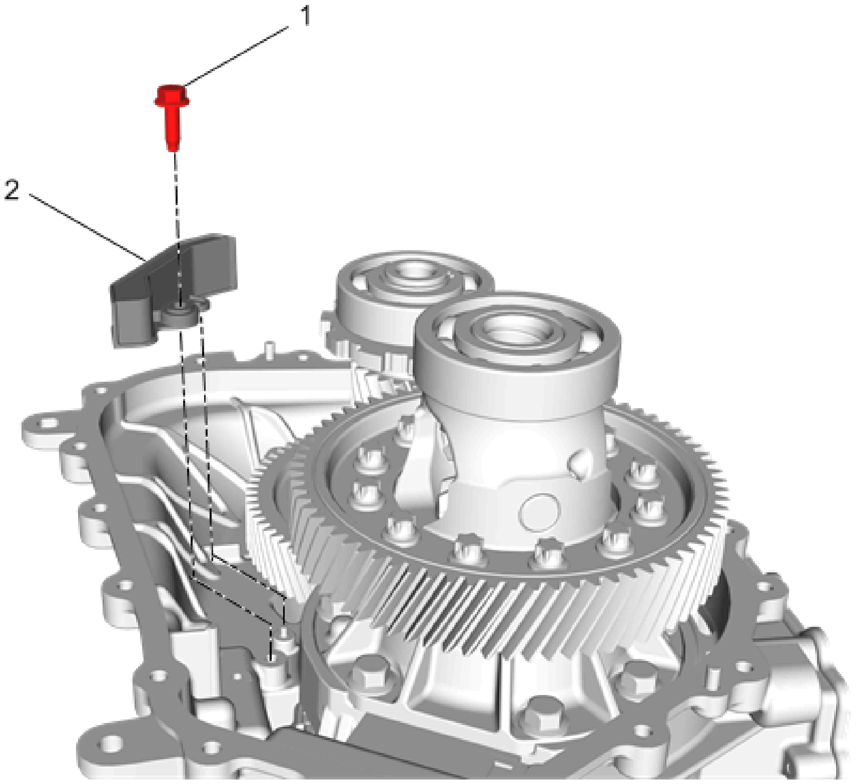


Fig. 99: Manual Transmission Oil Trough
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Transmission Oil Trough Bolt

Callout	Component Name
2	Manual Transmission Oil Trough

DRIVE MOTOR POWER INVERTER MODULE CABLE TERMINAL INSULATOR BLOCK REMOVAL

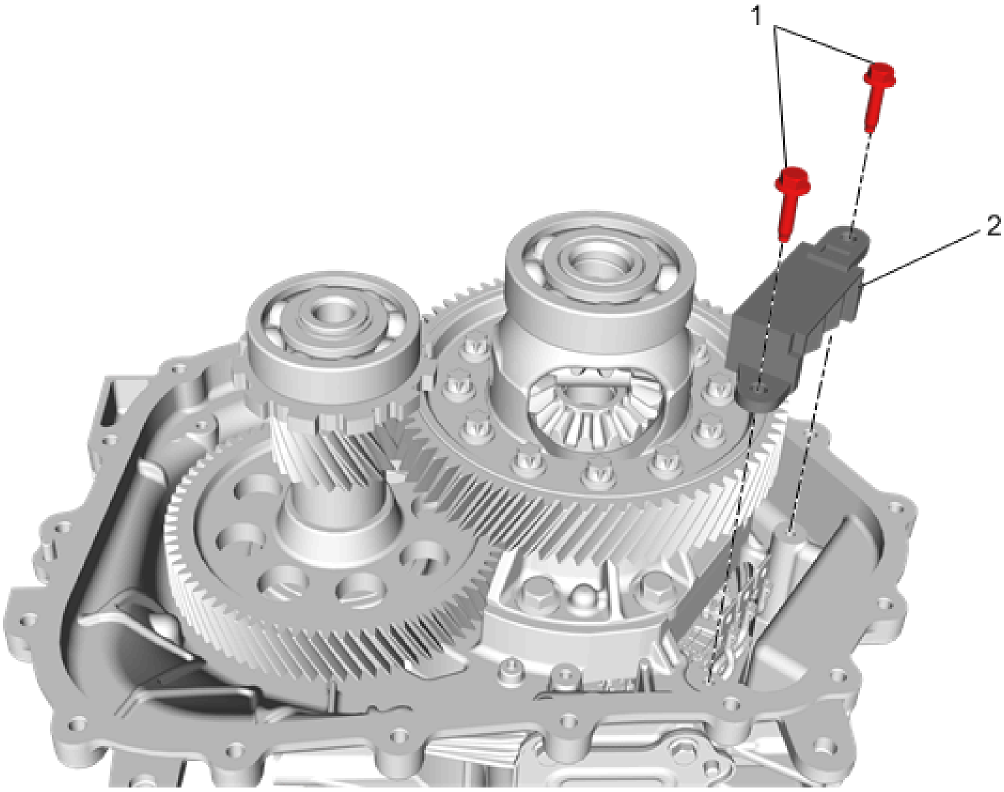


Fig. 100: Drive Motor Power Inverter Module Cable Terminal Insulator Block
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Power Inverter Module Cable Terminal Insulator Block Bolt (Qty: 2)
2	Drive Motor Power Inverter Module Cable Terminal Insulator Block

FRONT DIFFERENTIAL ASSEMBLY REMOVAL

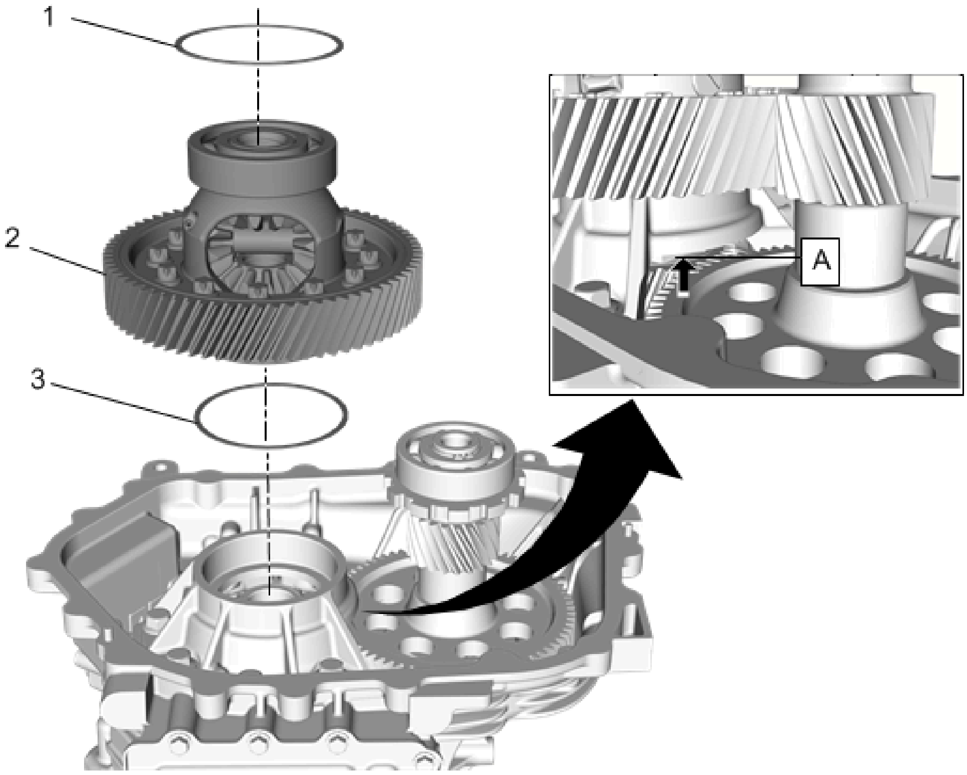


Fig. 101: Front Differential Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Differential Bearing Shim (RHS) **NOTE:** **DISCARD the shim.**
2	Front Differential **NOTE:** **Raise the main shaft assembly until the A position in order to remove the front differential assembly.**
3	Front Differential Bearing Shim (LHS) **NOTE:** **DISCARD the shim.**

CENTER SUPPORT REMOVAL

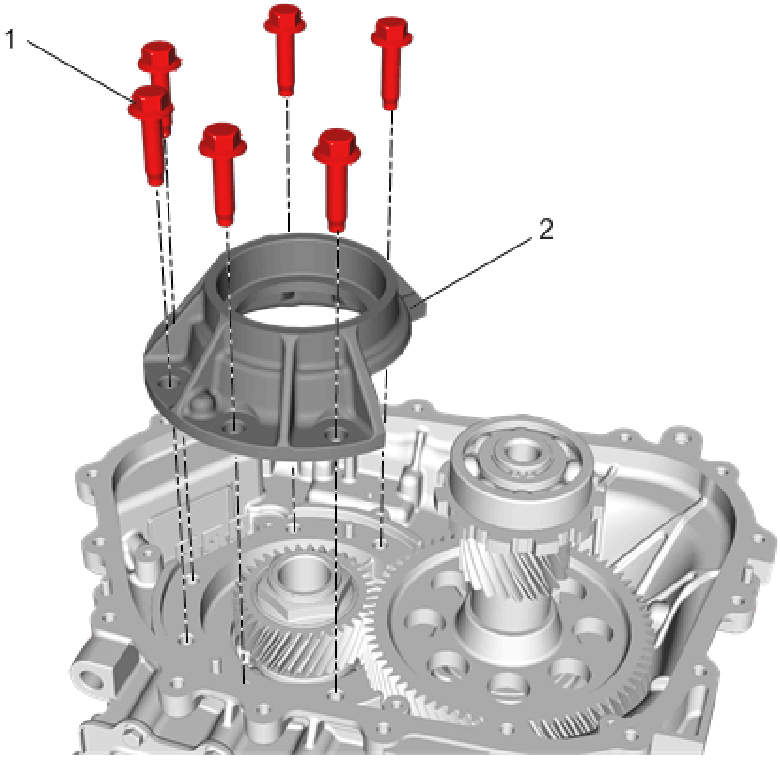


Fig. 102: Center Support
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Center Support Bolt (Qty: 6) **NOTE:** **DISCARD the center support bolts.**
2	Center Support

MAIN SHAFT ASSEMBLY REMOVAL

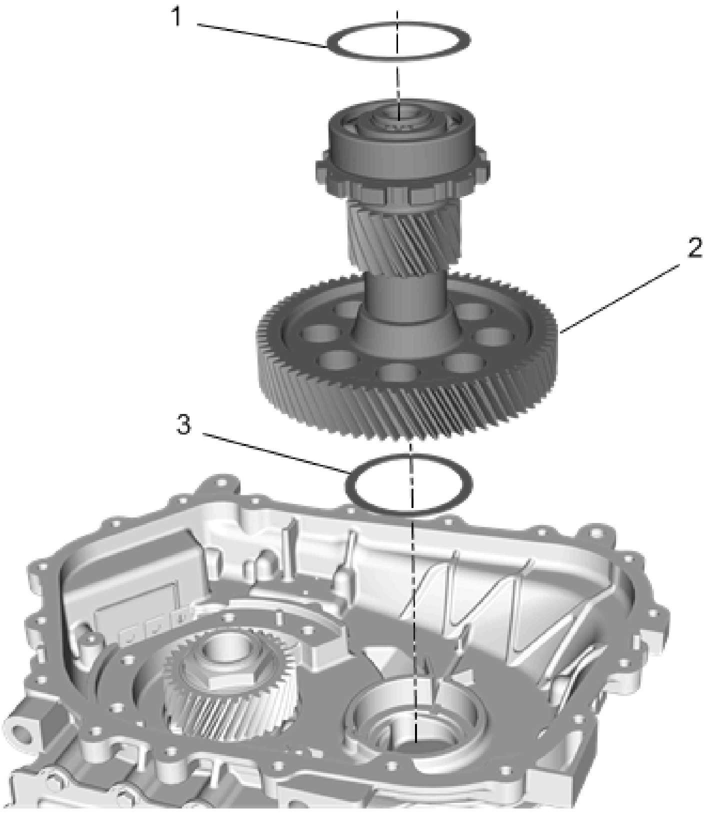


Fig. 103: Main Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Main Shaft Bearing Shim (RHS) **NOTE:** **DISCARD the shim.**
2	Main Shaft
3	Main Shaft Bearing Shim (LHS) **NOTE:** **DISCARD the shim.**

DRIVE MOTOR STATOR COOLANT DISTRIBUTOR CHANNEL REMOVAL

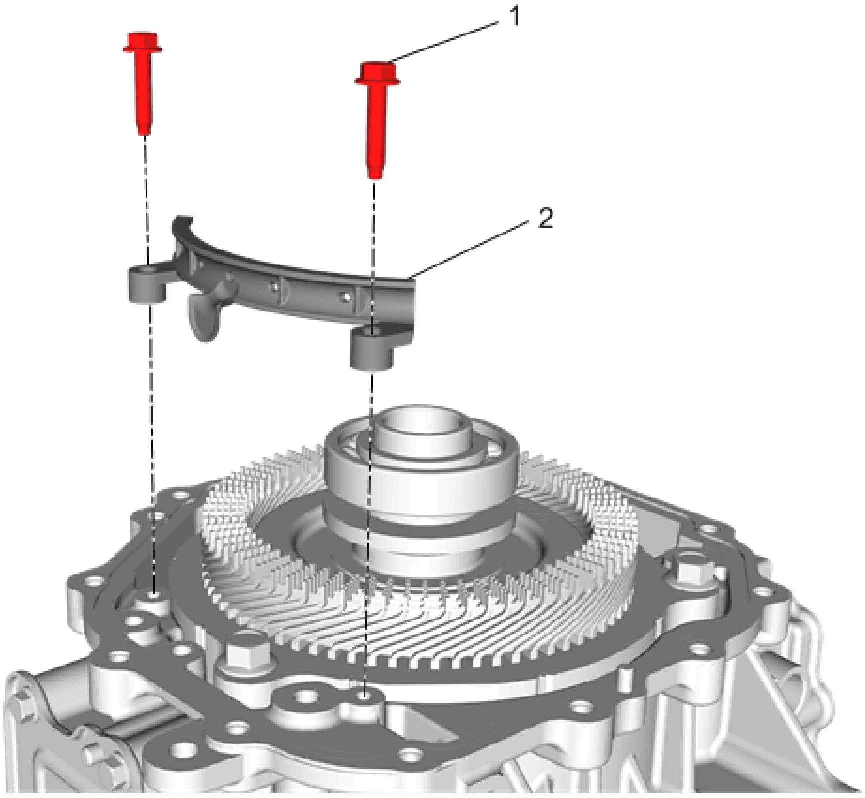


Fig. 104: Drive Motor Stator Coolant Distributor Channel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Stator Cooling Distributor Channel Bolt (Qty: 2)
2	Drive Motor Stator Cooling Distributor Channel

DRIVE MOTOR ROTOR REMOVAL

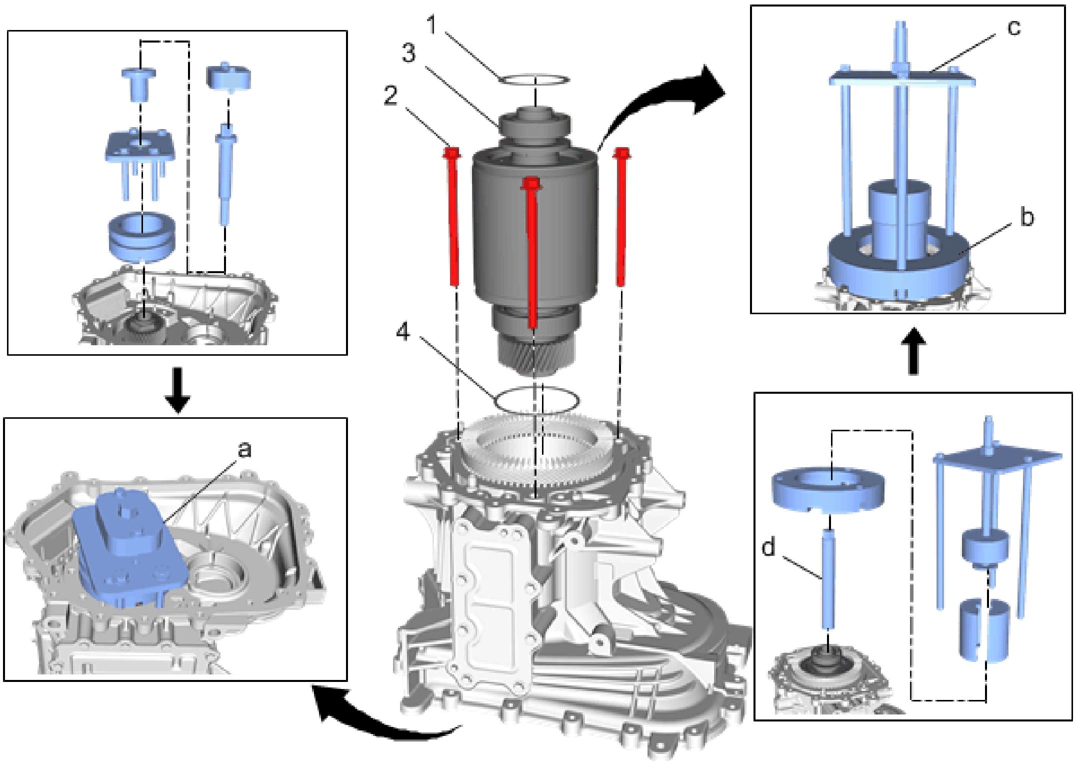


Fig. 105: Drive Motor Rotor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Drive Motor Rotor Bearing Shim (LHS) **NOTE:** **Remove the shim to transmission case cover if there is no shim on drive motor rotor bearing.** **NOTE:** **DISCARD the shim.**
2	Drive Motor Stator Bolt (Qty: 3) **NOTE:** **DISCARD the drive motor stator bolts.**
3	Drive Motor Rotor **Procedure** 1. Install the *DT-52011 - 1* rotor fixing (a), *DT-52011 - 3* hair pin cover (b) and *DT-52011 - 2* rotor remover/installer (c). 2. Remove the drive motor rotor by turning the nut on the *DT-52011 - 2* rotor remover/installer (c) clockwise. **NOTE:** **The drive motor rotor is strongly magnetic. DO NOT place within 6 inches of ferrous metallic components.** **NOTE:** **Place the drive motor rotor on a lint free cloth to prevent metallic debris from adhering to the outer diameter. Metallic debris can be removed from the motor outer diameter by blotting with adhesive tape.** **Special Tools** **DT-52011** Rotor Remover/Installer Kit Equivalent regional tools: Special Tools
4	Drive Motor Rotor Bearing Shim (RHS) **NOTE:** **DISCARD the shim.**

DRIVE MOTOR STATOR REMOVAL

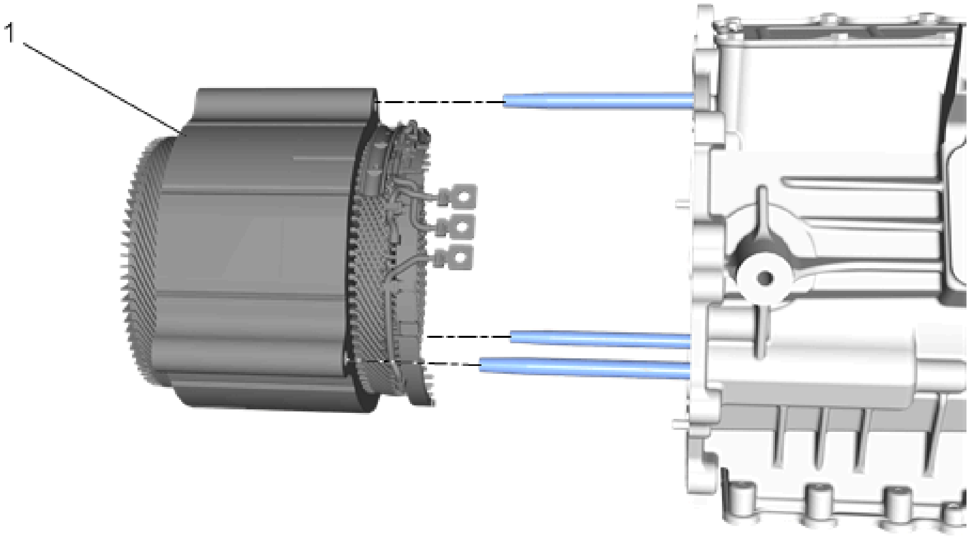
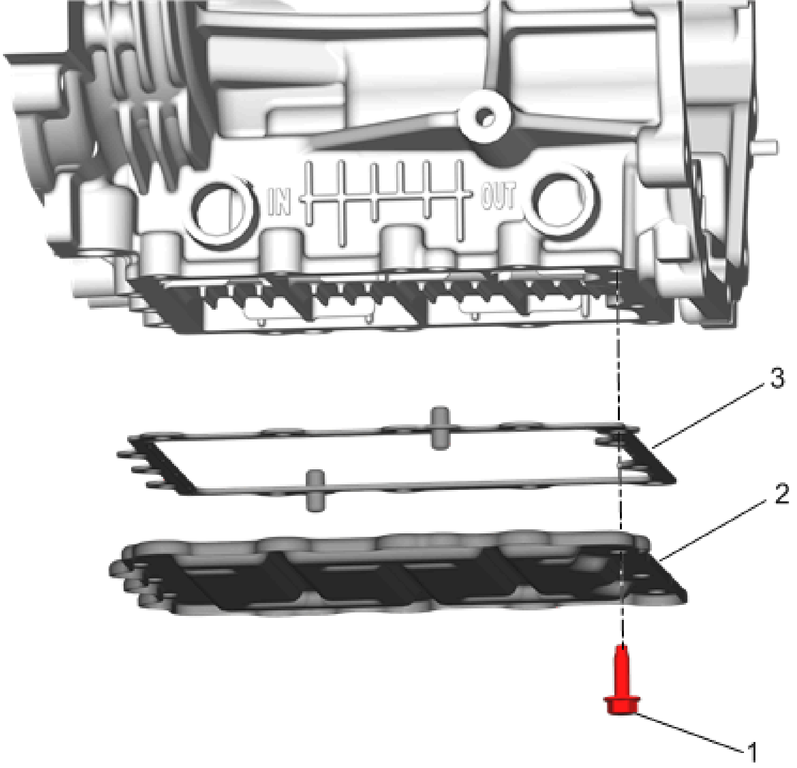


Fig. 106: Drive Motor Stator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Stator **CAUTION:** **DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage.** **NOTE:** **Place the drive motor stator on a lint free cloth over a piece of cardboard.** **Special Tools** **DT-52012** Stator Remover/Installer Equivalent regional tools: **Special Tools**

SHIFT SHAFT COVER REMOVAL - COOLANT SUMP



[Fig. 107: Shift Shaft Cover - Coolant Sump](#)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Shift Shaft Cover Bolt (Qty: 14)
2	Shift Shaft Cover
3	Shift Shaft Cover Gasket **NOTE:** **DISCARD the gasket.**

SHIFT SHAFT COVER REMOVAL - OIL SUMP

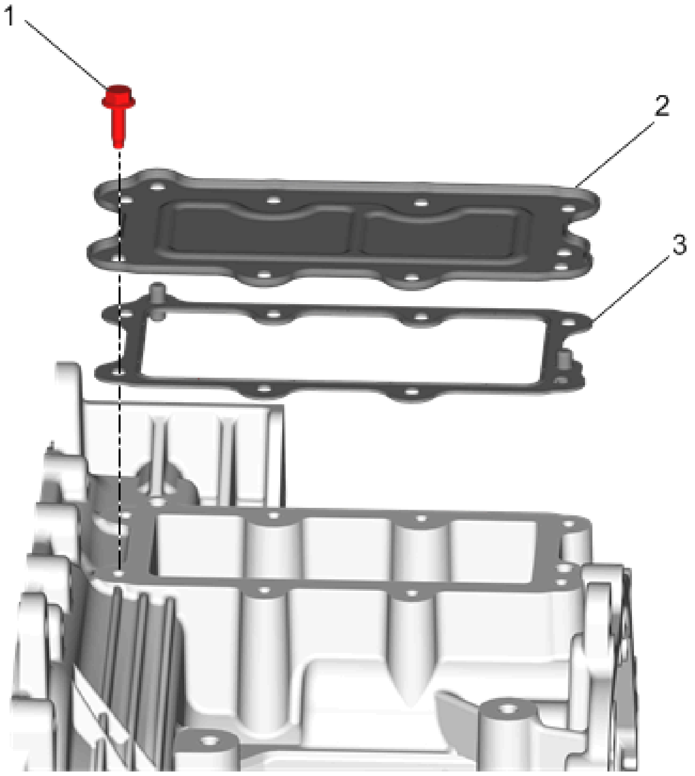


Fig. 108: Shift Shaft Cover - Oil Sump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Shift Shaft Cover Bolt (Qty: 8)
2	Shift Shaft Cover
3	Shift Shaft Cover Gasket **NOTE:** **DISCARD the gasket.**

SHIMMING PROCEDURES

Special Tools

DT-48008 Pinion Bearing Installer

Equivalent regional tools: Special Tools

Shimming Procedures

NOTE: **The correct shim has to be selected using the following procedure.**

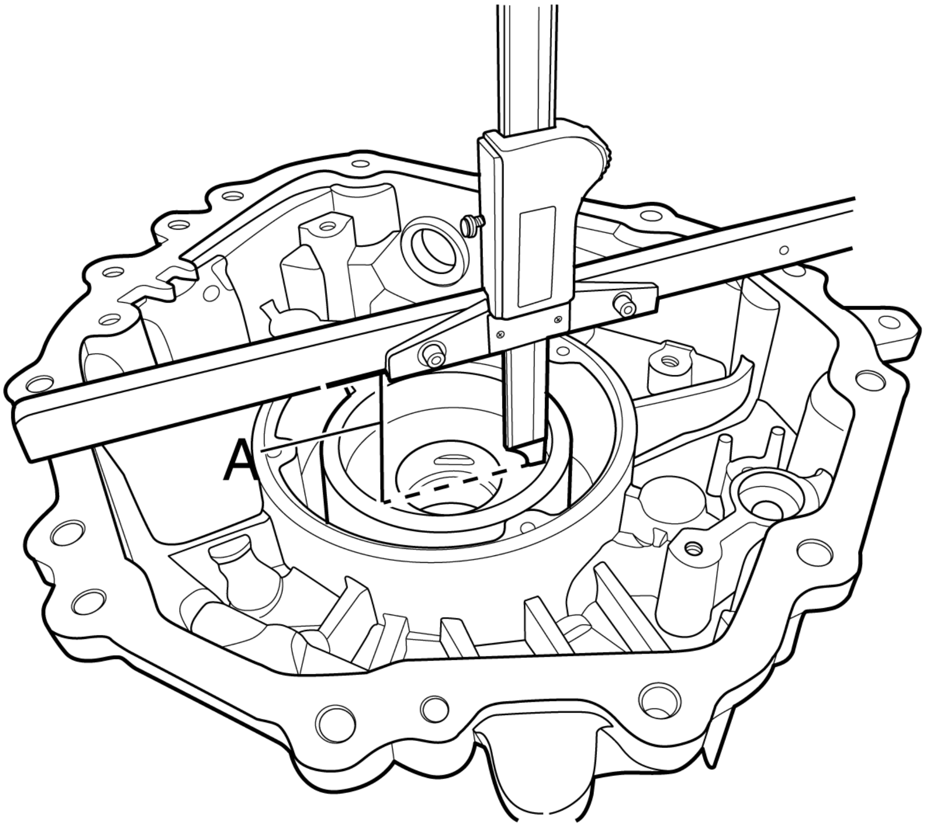


Fig. 109: Measuring Distance Between Transmission Case Cover Gasket Face And Drive Motor Rotor Bearing Pocket
Courtesy of GENERAL MOTORS COMPANY

1. Clean the transmission case cover from debris, oil and grease.
2. Measure the distance between the transmission case cover gasket face and the drive motor rotor bearing pocket using the depth gauge (A).
    1. Measure on 3 points and use the average value.

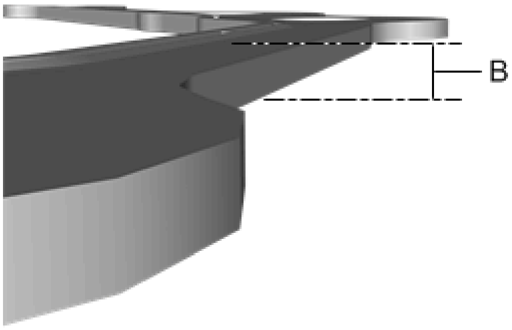


Fig. 110: Measure Transmission Case Cover Gasket Thickness
Courtesy of GENERAL MOTORS COMPANY

3. Measure the transmission case cover gasket thickness (B).
    1. Measure on 3 points and use the average value.

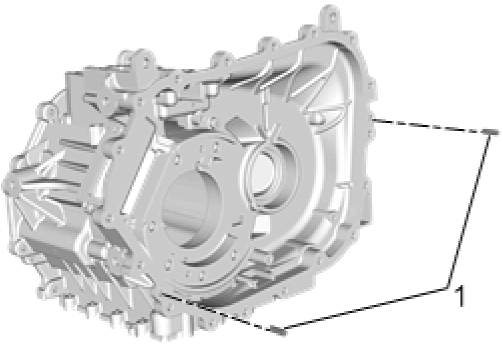


Fig. 111: Dowel Pins
Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD the dowel pins (1) (Qty: 2) from the motor housing using pin punch and hammer.

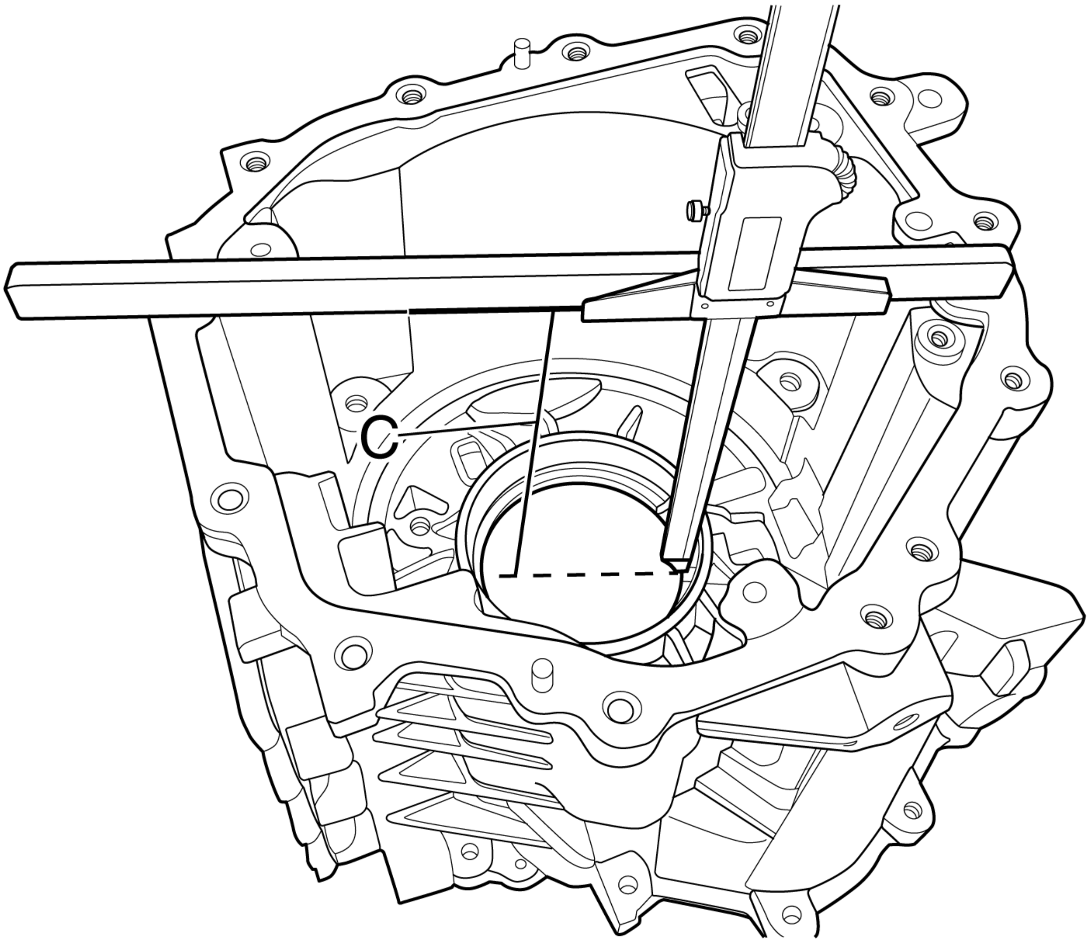


Fig. 112: Measuring Distance Between Drive Motor Housing Gasket Face And Drive Motor Rotor Bearing Pocket
Courtesy of GENERAL MOTORS COMPANY

5. Clean the motor housing from debris, oil and grease.
6. Measure the distance between the drive motor housing gasket face and the drive motor rotor bearing pocket using the depth gauge (C).
    1. Measure on 3 points and use the average value.

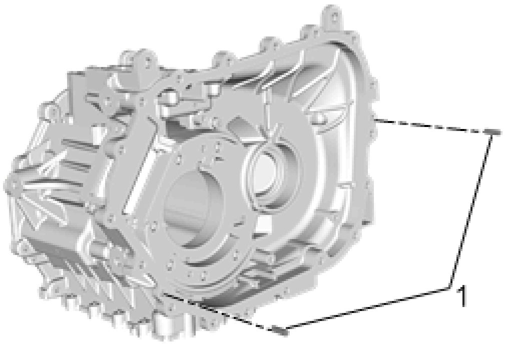


Fig. 113: Dowel Pins
Courtesy of GENERAL MOTORS COMPANY

7. Install 2 NEW dowel pins (1) (Qty: 2) to the motor housing.

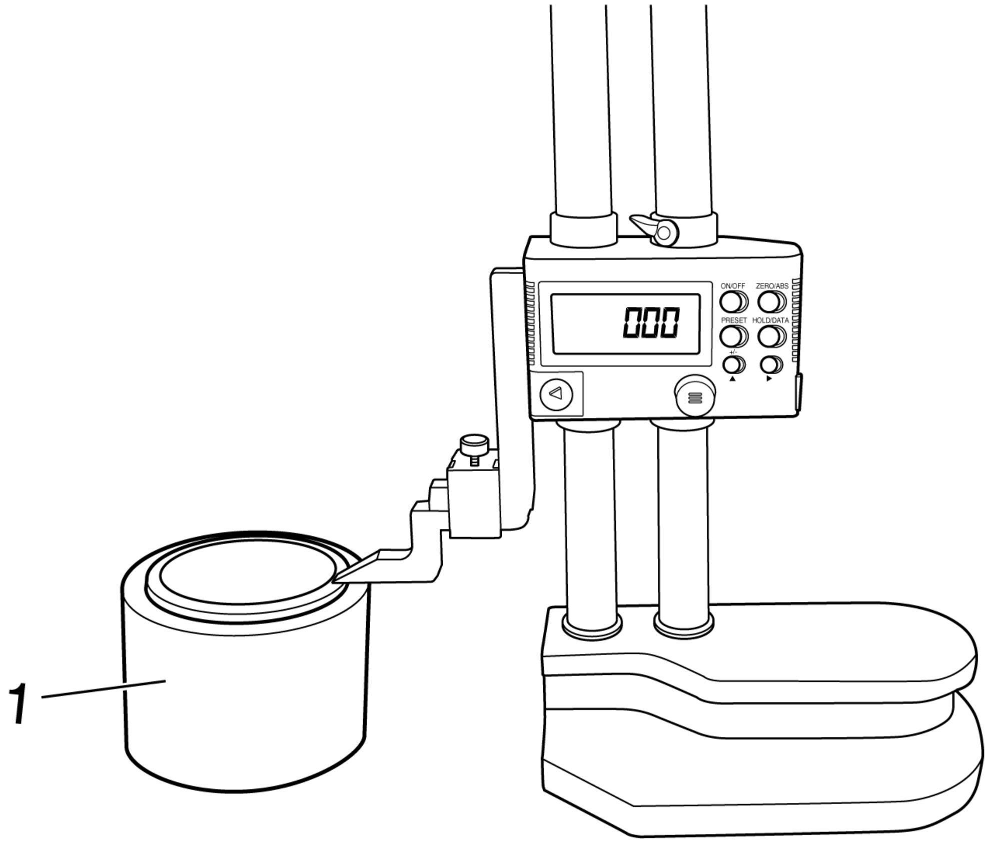

000
ON/OFF
ZERO/ABS
PRESET
HOLD/DATA
+/-
1

Fig. 114: Adjust Zero Point Setting On Pinion Bearing Installer Using Height Gauge
Courtesy of GENERAL MOTORS COMPANY

8. Adjust the zero point setting on the *DT-48008* pinion bearing installer (1) using the height gauge.

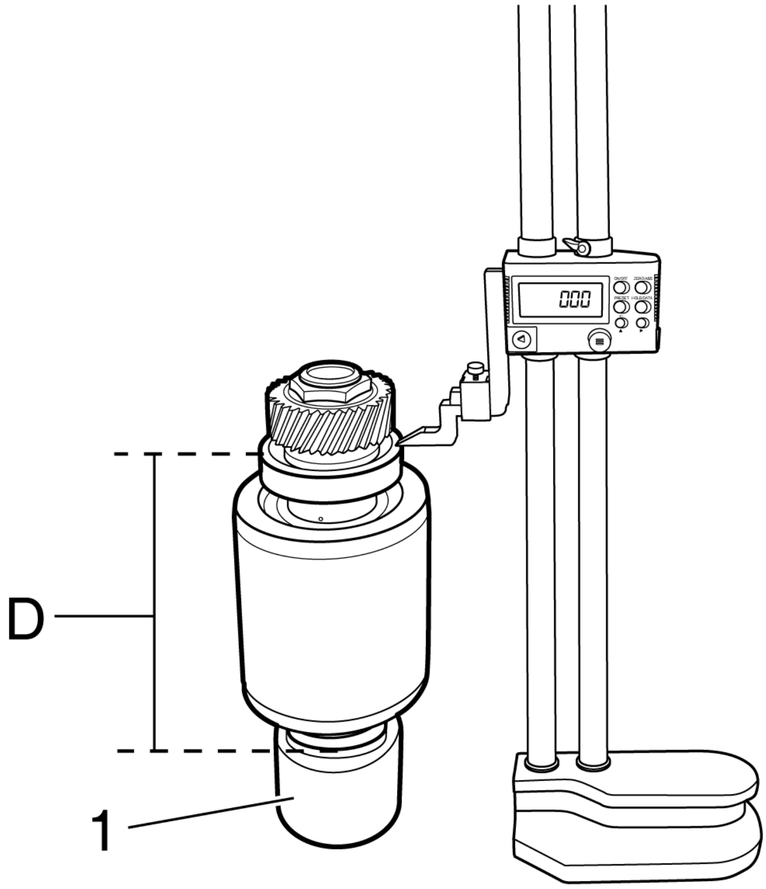


Fig. 115: Measure Distance Between Left Rotor Bearing And Right Rotor Bearing With Drive Motor Rotor Assembly On Pinion Bearing Installer
Courtesy of GENERAL MOTORS COMPANY

9. Place the drive motor rotor assembly on the *DT-48008* pinion bearing installer (1).
10. Measure the distance between the left rotor bearing and the right rotor bearing using the height gauge (D).
    1. Measure on 3 points and use the average value.

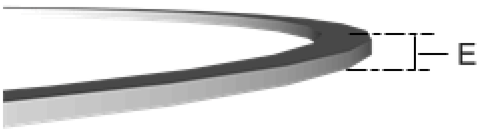


Fig. 116: Measure Shim Thickness Of Left Rotor Bearing Side
Courtesy of GENERAL MOTORS COMPANY

11. Measure the shim thickness of left rotor bearing side (E).
    1. Measure on 3 points and use the average value.
12. Measured clearance F ; F = A + B + C - D - E

13. Select the 1st gear rotor bearing side shim to meet the measured clearance. Refer to Shim Size Specifications

SHIFT SHAFT COVER INSTALLATION - OIL SUMP

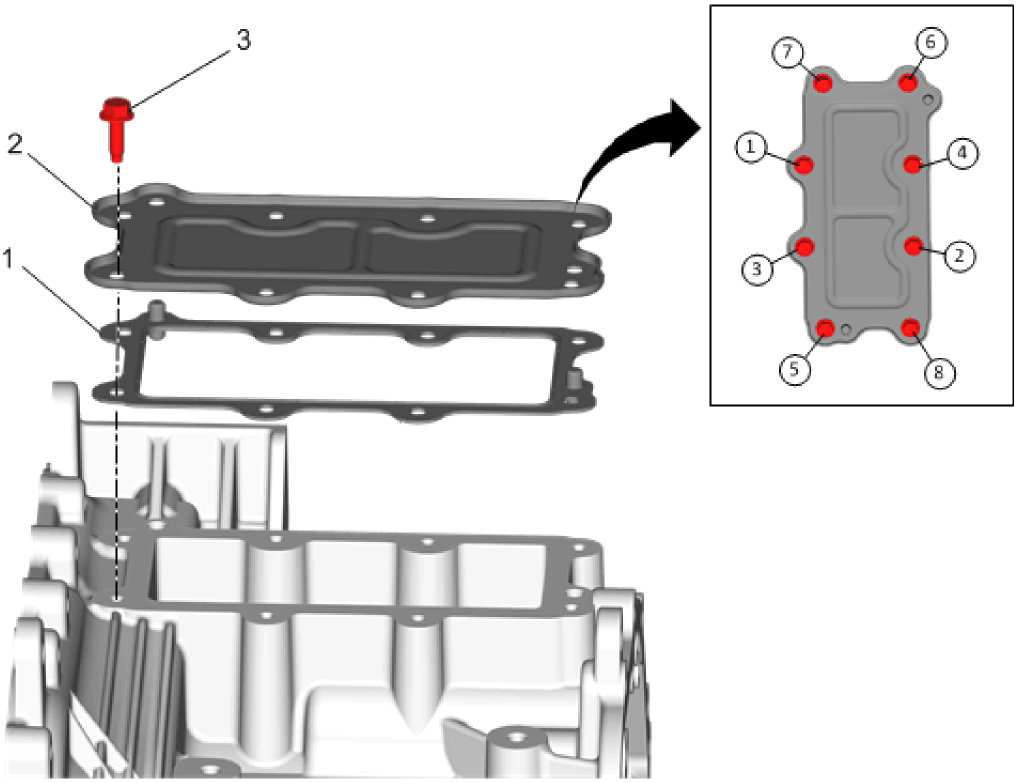


Fig. 117: Shift Shaft Cover With Bolt Tightening Sequence - Oil Sump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Shift Shaft Cover Gasket **NOTE:** **Install NEW gasket. It is not reusable.**
2	Shift Shaft Cover
3	Shift Shaft Cover Bolt (Qty: 8) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

SHIFT SHAFT COVER INSTALLATION - COOLANT SUMP

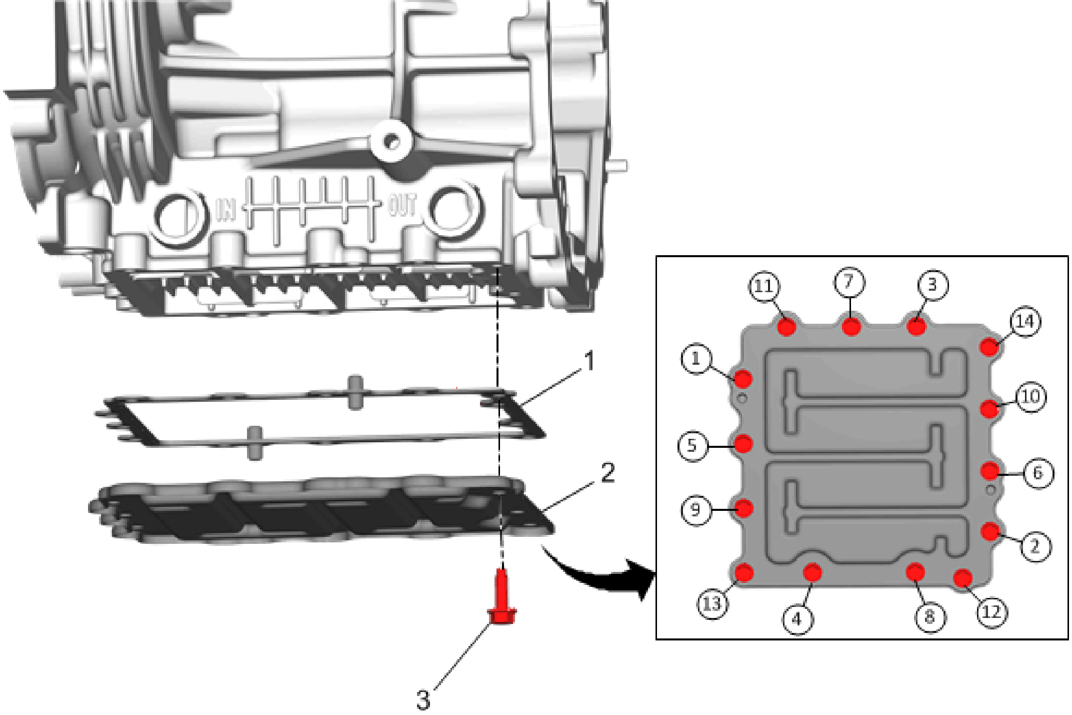


Fig. 118: Shift Shaft Cover With Bolt Tightening Sequence - Coolant Sump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Shift Shaft Cover Gasket **NOTE:** **Install NEW gasket. It is not reusable.**
2	Shift Shaft Cover
3	Shift Shaft Cover Bolt (Qty: 14) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

DRIVE MOTOR STATOR INSTALLATION

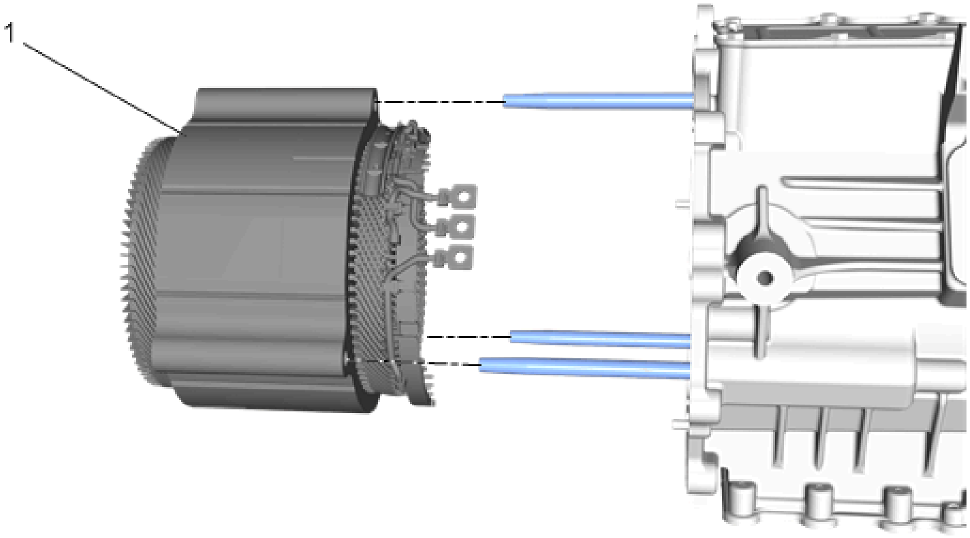


Fig. 119: Drive Motor Stator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Stator **CAUTION:** **DO NOT contact or rest the drive motor stator on the copper end coils. Damage to the copper end coils may cause a high voltage short during vehicle operation, resulting in component damage.** **Special Tools** **DT-52012** Stator Remover/Installer Equivalent regional tools: Special Tools

DRIVE MOTOR ROTOR INSTALLATION

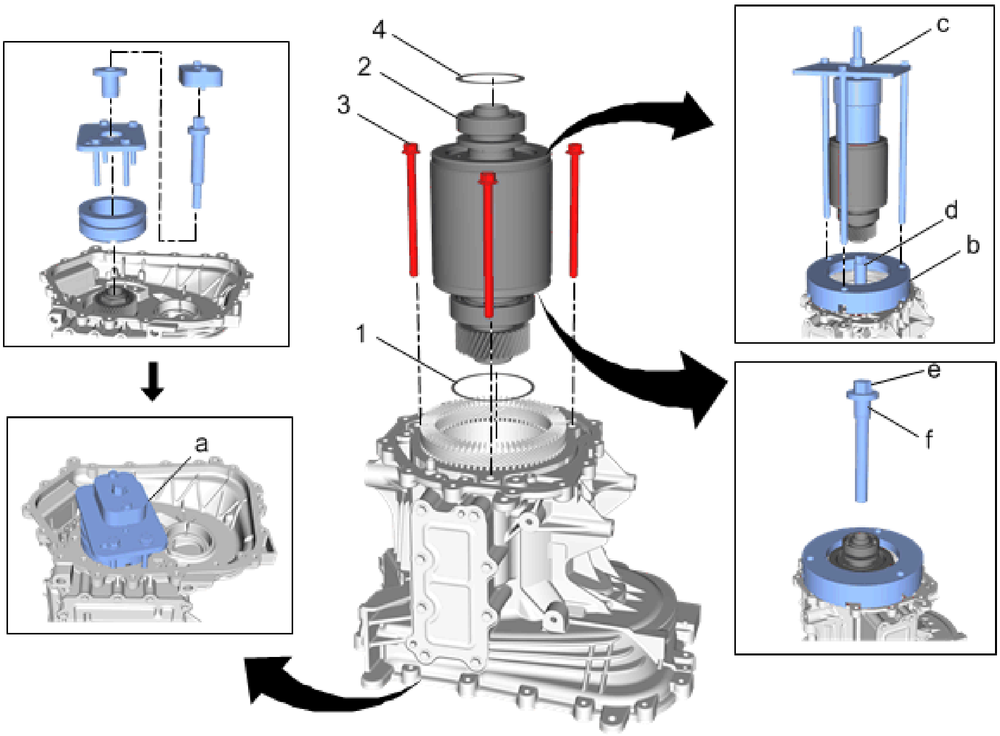


Fig. 120: Drive Motor Rotor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Rotor Bearing Shim (RHS) **Procedure** Measure the drive motor rotor bearing shim before the drive motor stator installation. Refer to **Shimming Procedures** **NOTE:** **Install NEW shim. It is not reusable.**
2	Drive Motor Rotor **Procedure** 1. Install the *DT-52011 - 1* rotor fixing (a) and *DT-52011 - 3* hair pin cover (b). 2. Apply transmission fluid to the drive motor rotor. 3. Install the drive motor rotor by turning the nut on the *DT-52011 - 2* rotor remover/installer (c) counterclockwise. 4. Remove the *DT-52011 - 2* rotor remover/installer (c) and *DT-52011 - 1 - 7* remover guide (d) when the drive motor rotor assembly stops moving. 5. Install the *DT-52011 - 1 - 1* installer guide (e) and *DT-52011 - 1 - 3* adapter (f). 6. Install the drive motor rotor by turning the shaft on the *DT-52011 - 1 - 1* installer guide (e) completely. **NOTE:** **The drive motor rotor is strongly magnetic. DO NOT place within 6 inches of ferrous metallic components. Metallic debris can be removed from the motor outer diameter by blotting with adhesive tape.** **Special Tools** **DT-52011** Rotor Remover/Installer Kit Equivalent regional tools: **Special Tools**

Callout	Component Name
3	Drive Motor Stator Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Install NEW drive motor stator bolts** **Tighten** 58 N.m (43 lb ft)
4	Drive Motor Rotor Bearing Shim (LHS) **NOTE:** **Install NEW shim. It is not reusable.**

DRIVE MOTOR STATOR COOLANT DISTRIBUTOR CHANNEL INSTALLATION

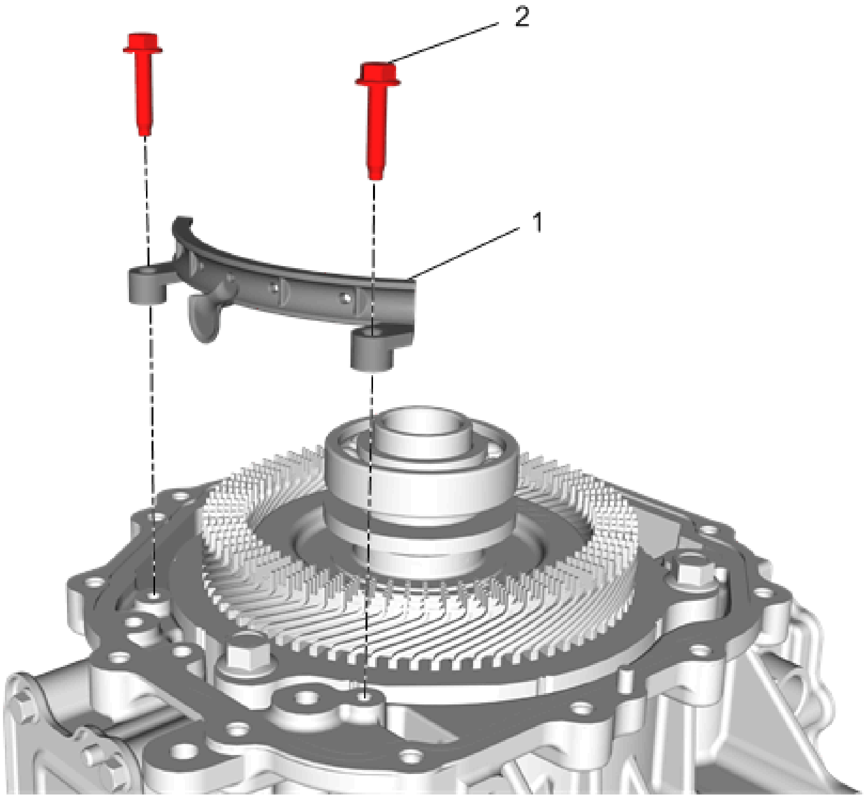


Fig. 121: Drive Motor Stator Coolant Distributor Channel
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Stator Cooling Distributor Channel
2	Drive Motor Stator Cooling Distributor Channel Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

MAIN SHAFT ASSEMBLY INSTALLATION

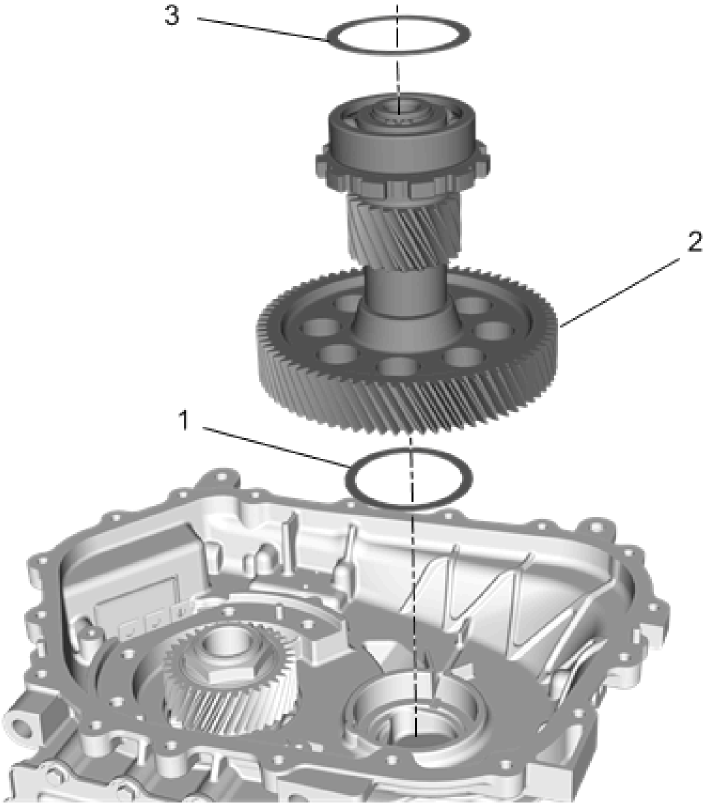


Fig. 122: Main Shaft Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Main Shaft Bearing Shim (LHS) **NOTE:** **Install NEW shim. It is not reusable.**
2	Main Shaft **NOTE:** **Apply transmission fluid to the main shaft bearing.**
3	Main Shaft Bearing Shim (RHS) **NOTE:** **Install NEW shim. It is not reusable.**

CENTER SUPPORT INSTALLATION

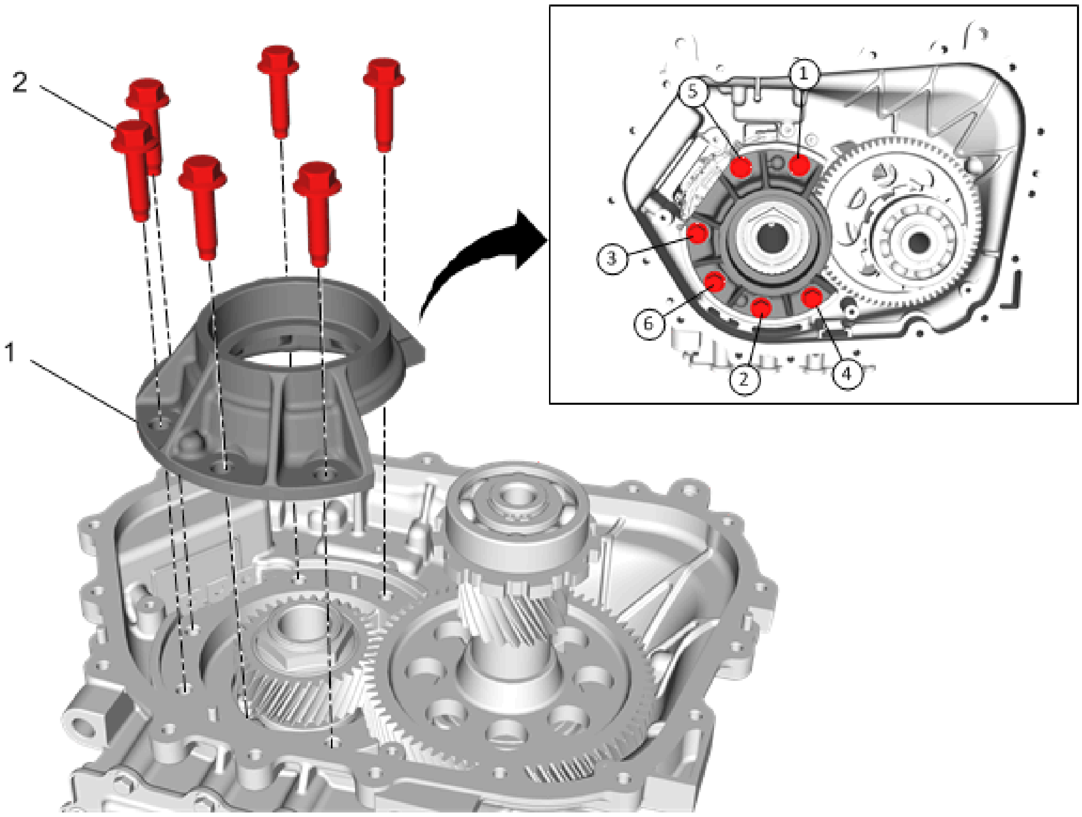


Fig. 123: Center Support
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Center Support
2	Center Support Bolt (Qty: 6) **CAUTION:** **Refer to Fastener Caution .** **CAUTION:** **Refer to Torque-to-Yield Fastener Caution .** **NOTE:** **Install NEW center support bolts.** **Tighten** 1. First pass: 58 N.m (43 lb ft) 2. Final pass: 30 degrees

FRONT DIFFERENTIAL ASSEMBLY INSTALLATION

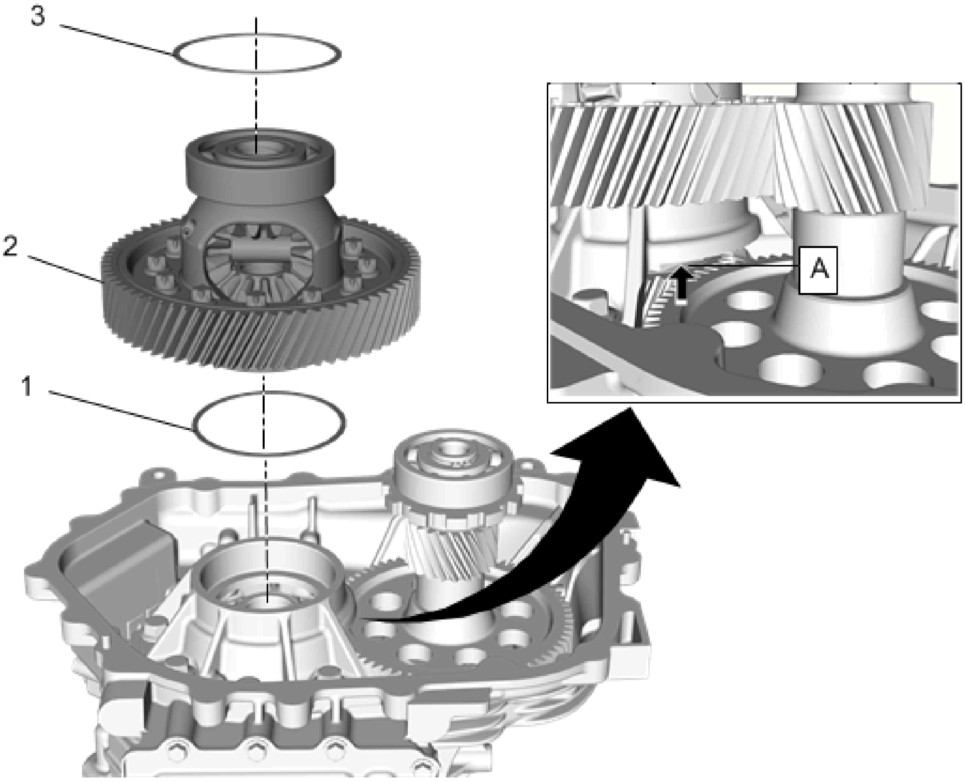


Fig. 124: Front Differential Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Differential Bearing Shim (LHS) **NOTE:** **Install NEW shim. It is not reusable.**
2	Front Differential **NOTE:** **Apply transmission fluid to the front differential bearing.** **NOTE:** **Raise the main shaft assembly until the A position in order to install the front differential assembly.**
3	Front Differential Bearing Shim (RHS) **NOTE:** **Install NEW shim. It is not reusable.**

DRIVE MOTOR POWER INVERTER MODULE CABLE TERMINAL INSULATOR BLOCK INSTALLATION

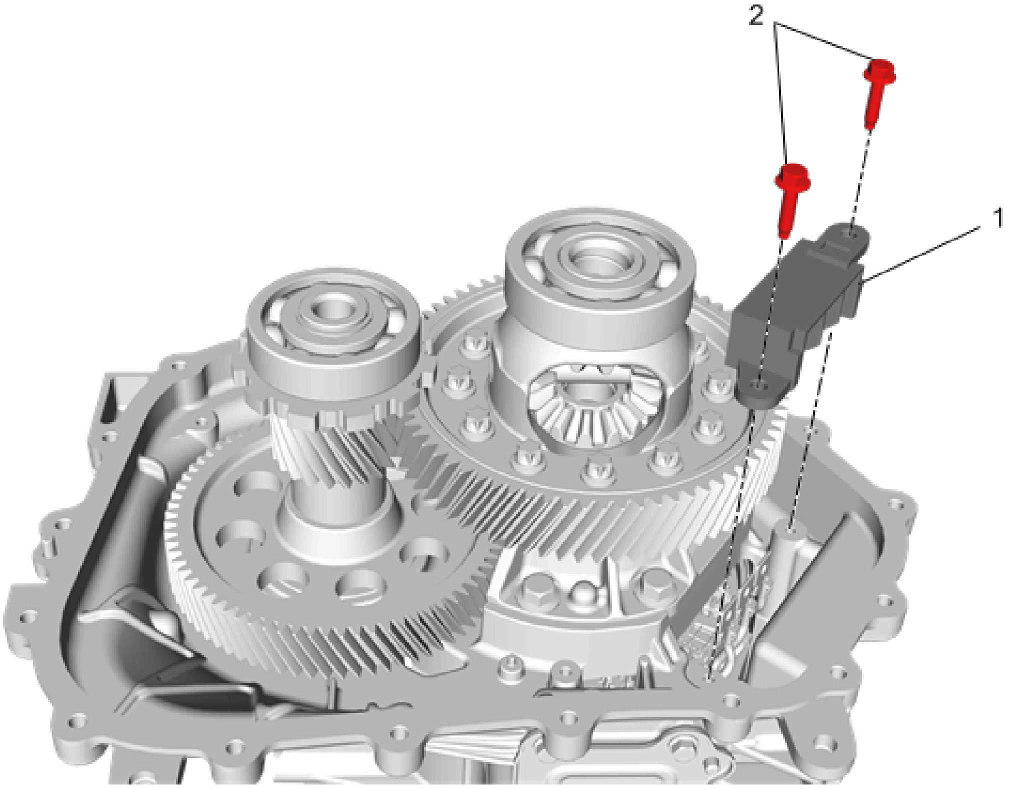


Fig. 125: Drive Motor Power Inverter Module Cable Terminal Insulator Block
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Power Inverter Module Cable Terminal Insulator Block
2	Drive Motor Power Inverter Module Cable Terminal Insulator Block Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

MANUAL TRANSMISSION OIL TROUGH INSTALLATION

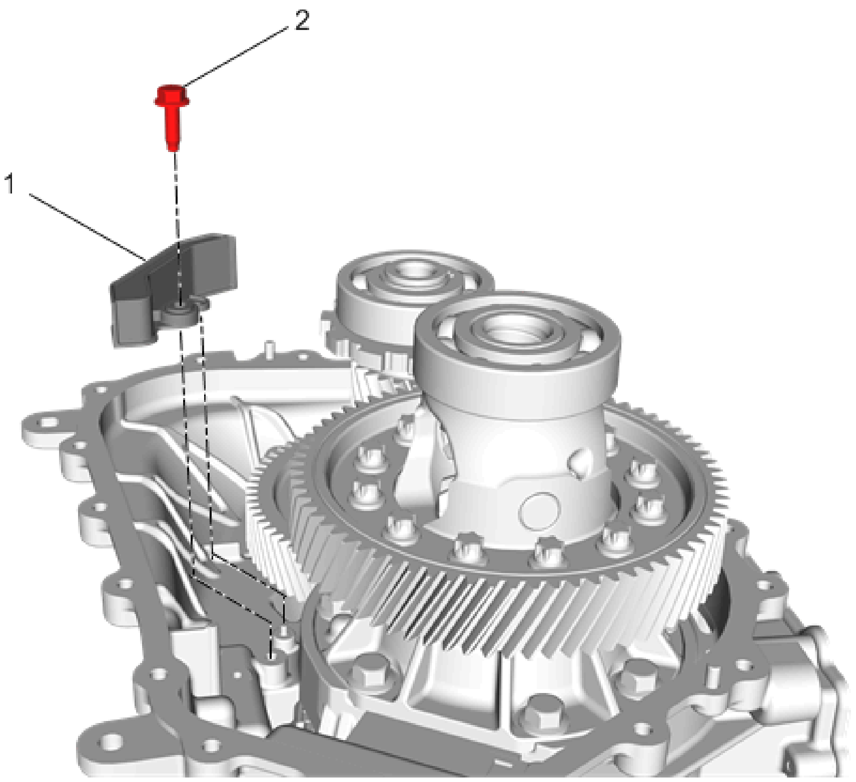


Fig. 126: Manual Transmission Oil Trough
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Transmission Oil Trough
2	Manual Transmission Oil Trough Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

OIL PAN BAFFLE INSTALLATION

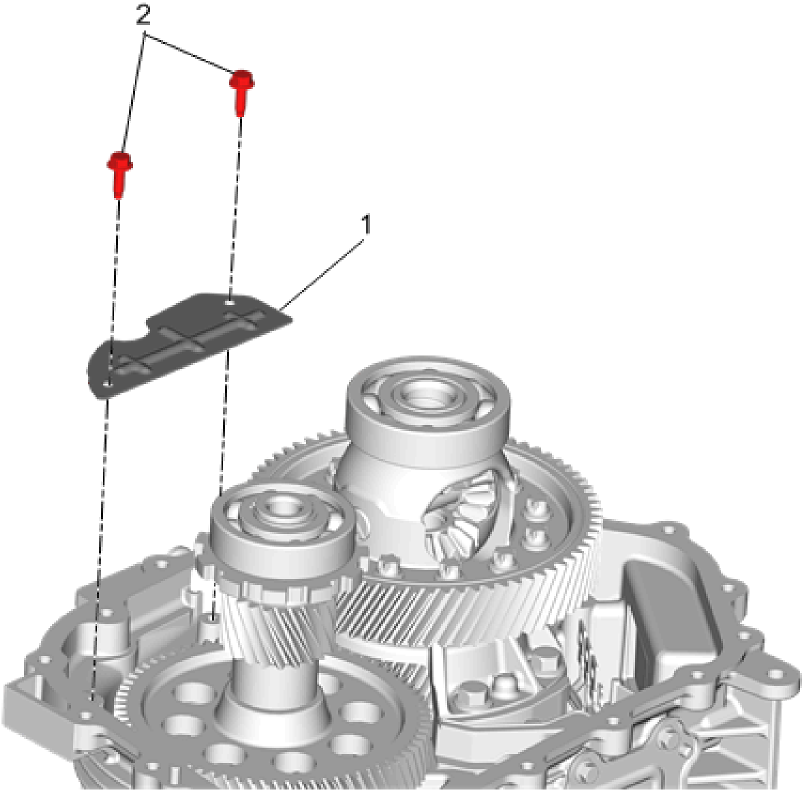


Fig. 127: Oil Pan Baffle
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Oil Pan Baffle
2	Oil Pan Baffle Bolt (Qty: 2) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

AUTOMATIC TRANSMISSION FLUID PAN MAGNET INSTALLATION

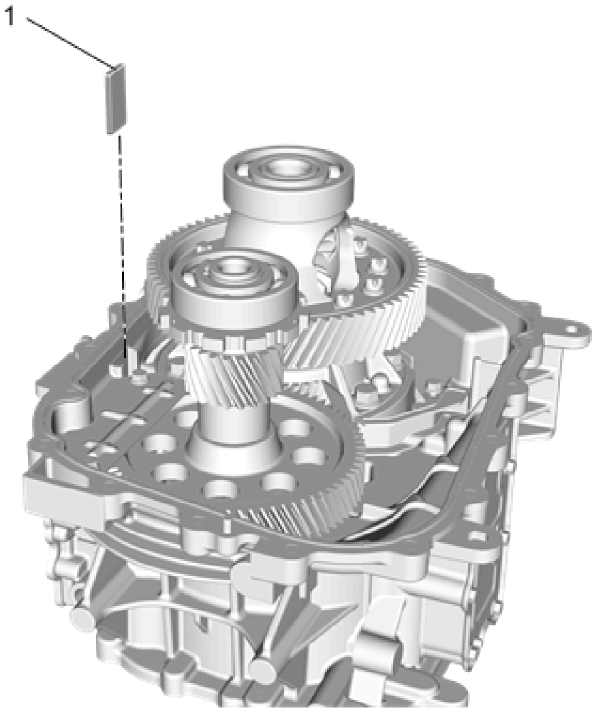


Fig. 128: Automatic Transmission Fluid Pan Magnet
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Pan Magnet

FRONT WHEEL DRIVE SHAFT OIL SEAL INSTALLATION - LEFT SIDE

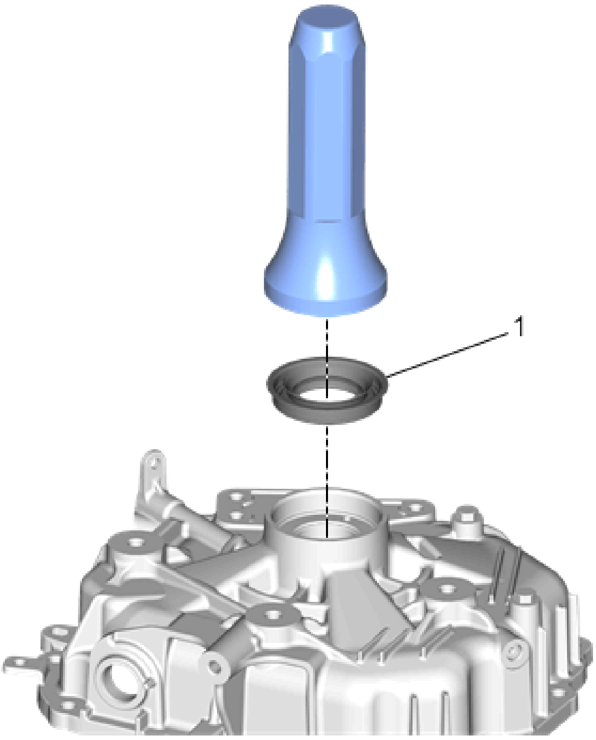


Fig. 129: Front Wheel Drive Shaft Oil Seal - Left Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal (LHS) **NOTE:** **Install NEW seal. It is not reusable.** **Special Tools** **DT-44809** Seal Installer Equivalent regional tools: Special Tools

DRIVE MOTOR POSITION SENSOR STATOR INSTALLATION

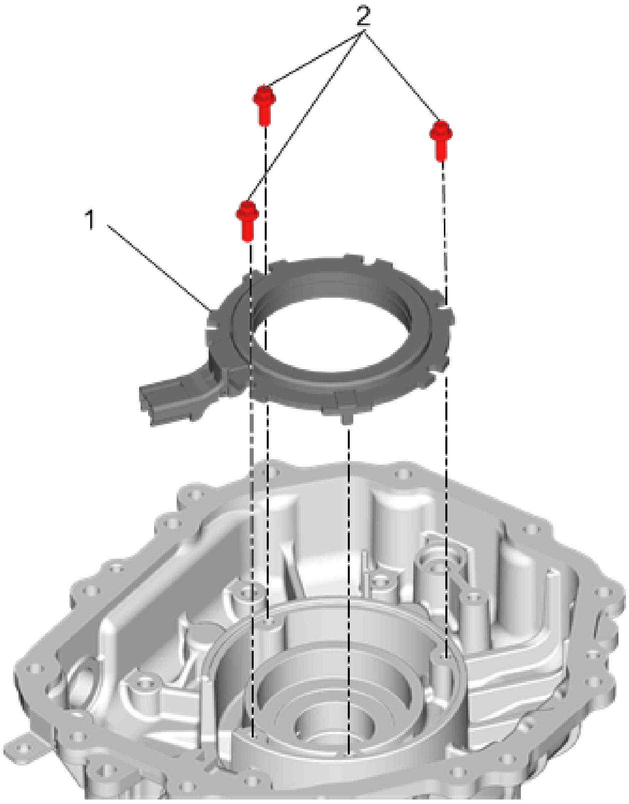


Fig. 130: Drive Motor Position Sensor Stator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Position Sensor Stator
2	Drive Motor Position Sensor Stator Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **NOTE:** **Install NEW drive motor position sensor stator bolts.** **Tighten** 9 N.m (80 lb in)

AUTOMATIC TRANSMISSION FLUID FILTER INSTALLATION

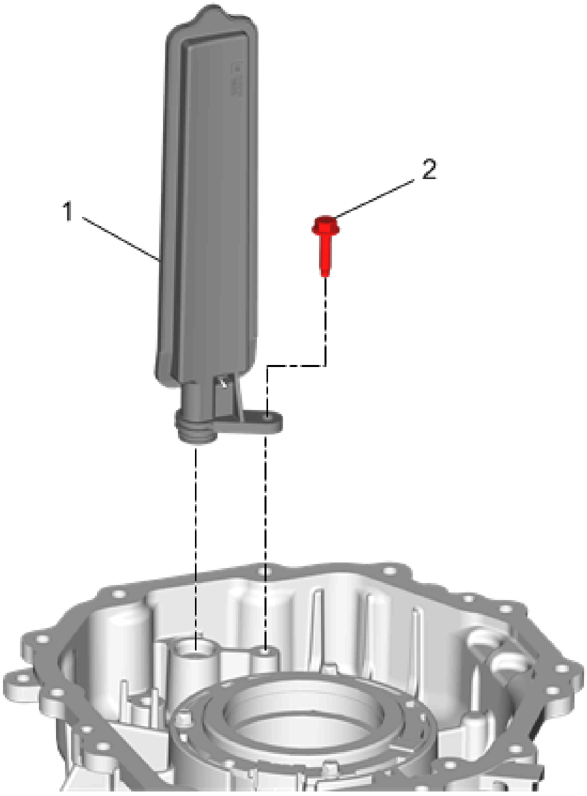


Fig. 131: Automatic Transmission Fluid Filter
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Filter **NOTE:** **Install NEW fluid filter. The fluid filter O-ring is not serviceable separately.**
2	Automatic Transmission Fluid Filter Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)

AUTOMATIC TRANSMISSION CONTROL WIRING HARNESS INSTALLATION - TRANSMISSION CASE COVER

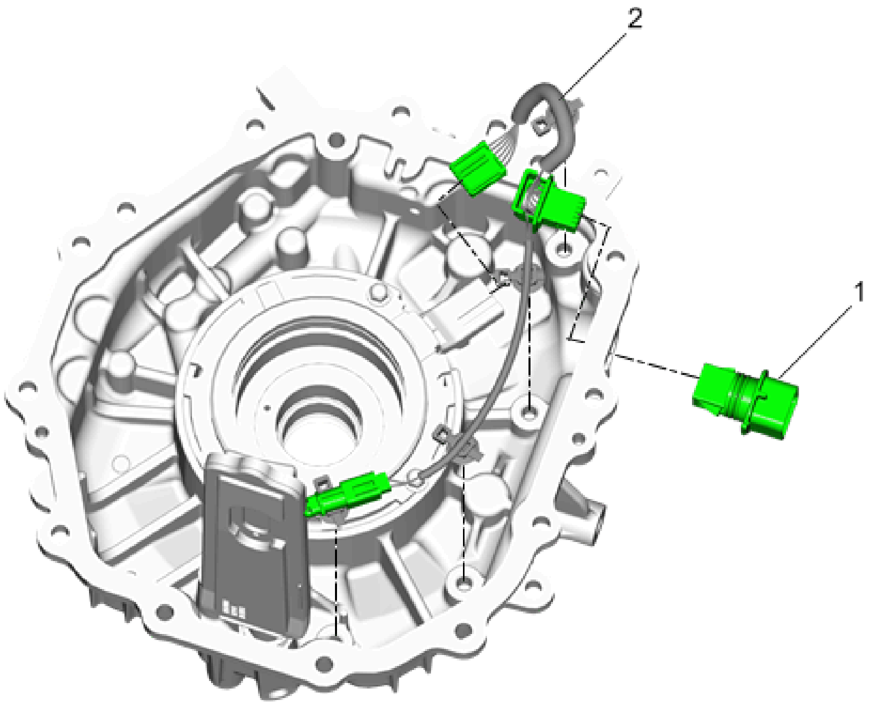


Fig. 132: Automatic Transmission Control Wiring Harness - Transmission Case Cover
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Wiring Harness Electrical Connector **NOTE:** **Install NEW wiring harness electrical connector. It is not reusable.**
2	Automatic Transmission Control Wiring Harness

AUTOMATIC TRANSMISSION CASE COVER INSTALLATION

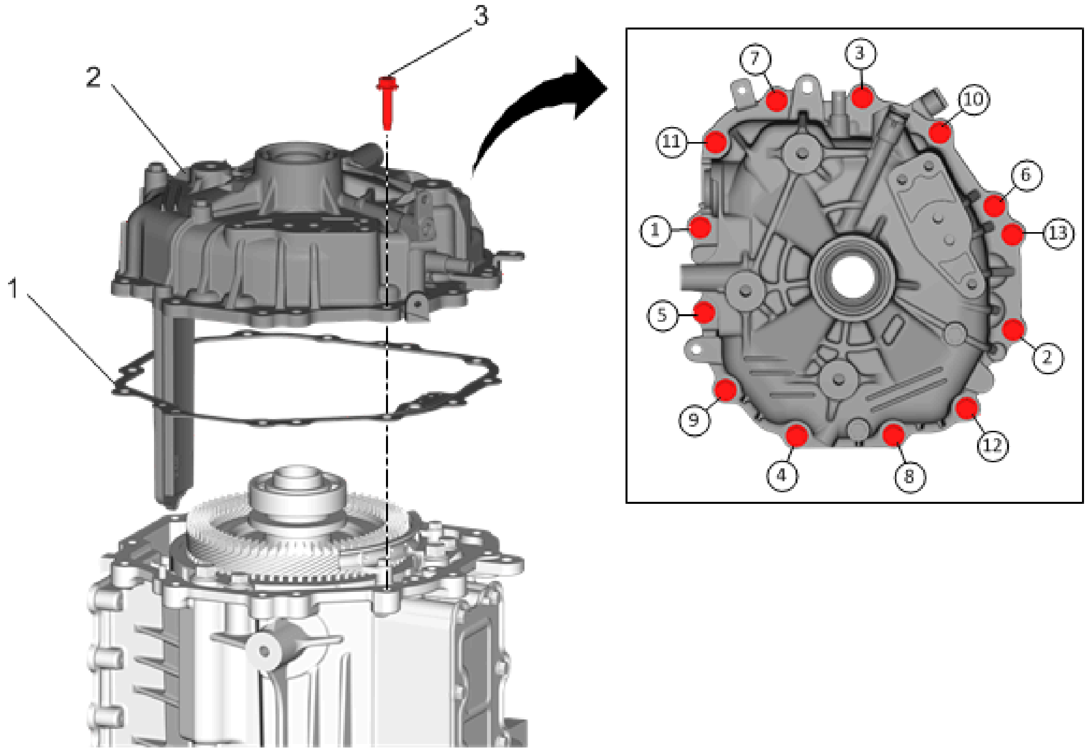


Fig. 133: Automatic Transmission Case Cover With Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Cover Gasket **NOTE:** **Install NEW gasket. It is not reusable.**
2	Automatic Transmission Case Cover
3	Automatic Transmission Case Cover Bolt (Qty: 13) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 22 N.m (16 lb ft)

FRONT WHEEL DRIVE SHAFT OIL SEAL INSTALLATION - RIGHT SIDE

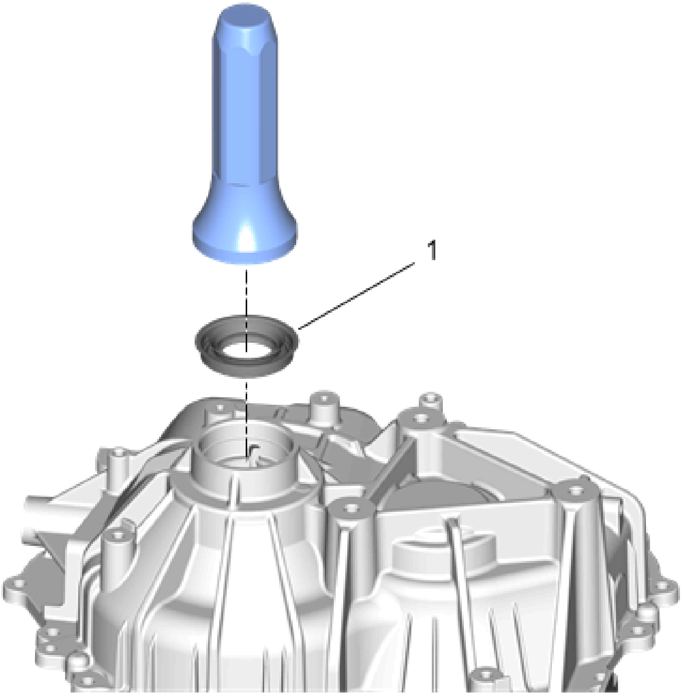


Fig. 134: Front Wheel Drive Shaft Oil Seal - Right Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Wheel Drive Shaft Oil Seal (RHS) **NOTE:** **Install NEW seal. It is not reusable.** **Special Tools** **DT-44809** Seal Installer Equivalent regional tools: Special Tools

MANUAL SHIFT SHAFT SEAL INSTALLATION

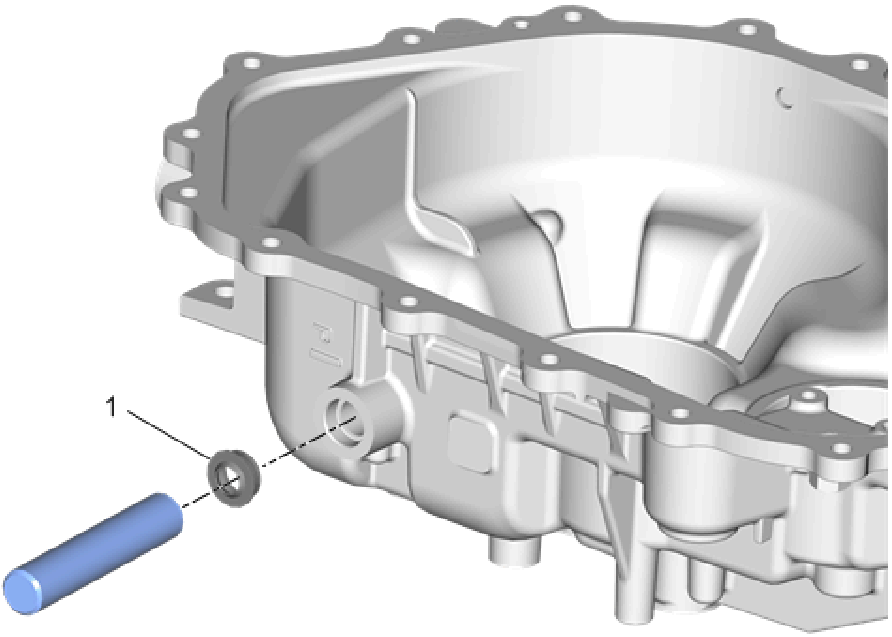


Fig. 135: Manual Shift Shaft Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Seal **NOTE:** **Install NEW seal. It is not reusable.** **Special Tools** **DT-49101** Shift Shaft Seal Installer Equivalent regional tools: **Special Tools**

MANUAL SHIFT SHAFT POSITION SWITCH INSTALLATION

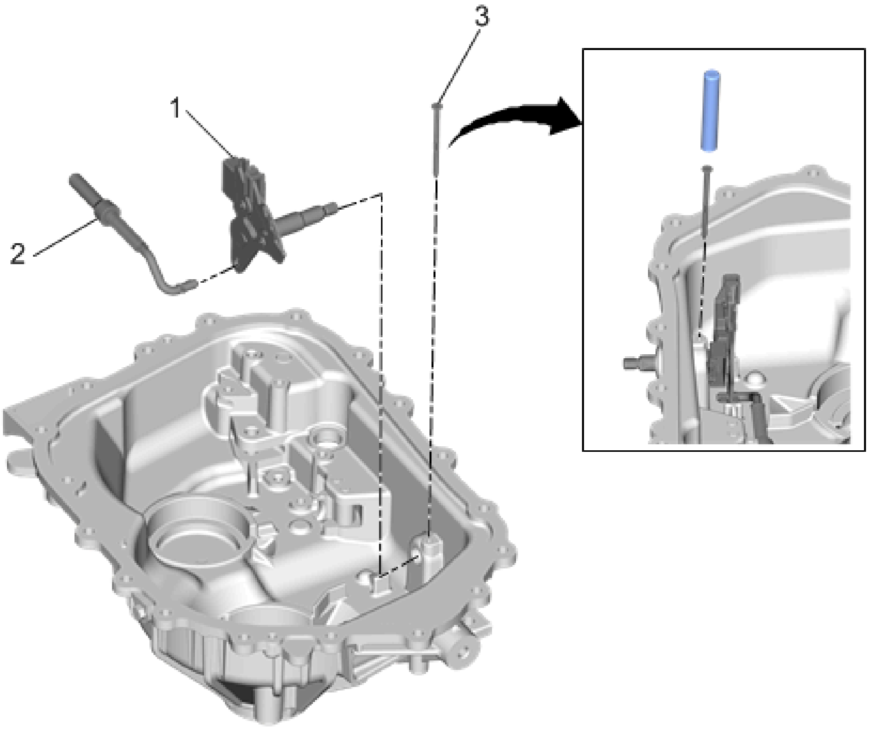


Fig. 136: Manual Shift Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Position Switch
2	Park Pawl Actuator
3	Manual Shift Shaft Pin **NOTE:** **Install NEW pin. It is not reusable.** **Special Tools** **DT-51436** Manual Shaft Pin Installer Equivalent regional tools: Special Tools

PARK PAWL AND MANUAL SHIFT SHAFT INSTALLATION

Park Pawl Actuator Guide Installation

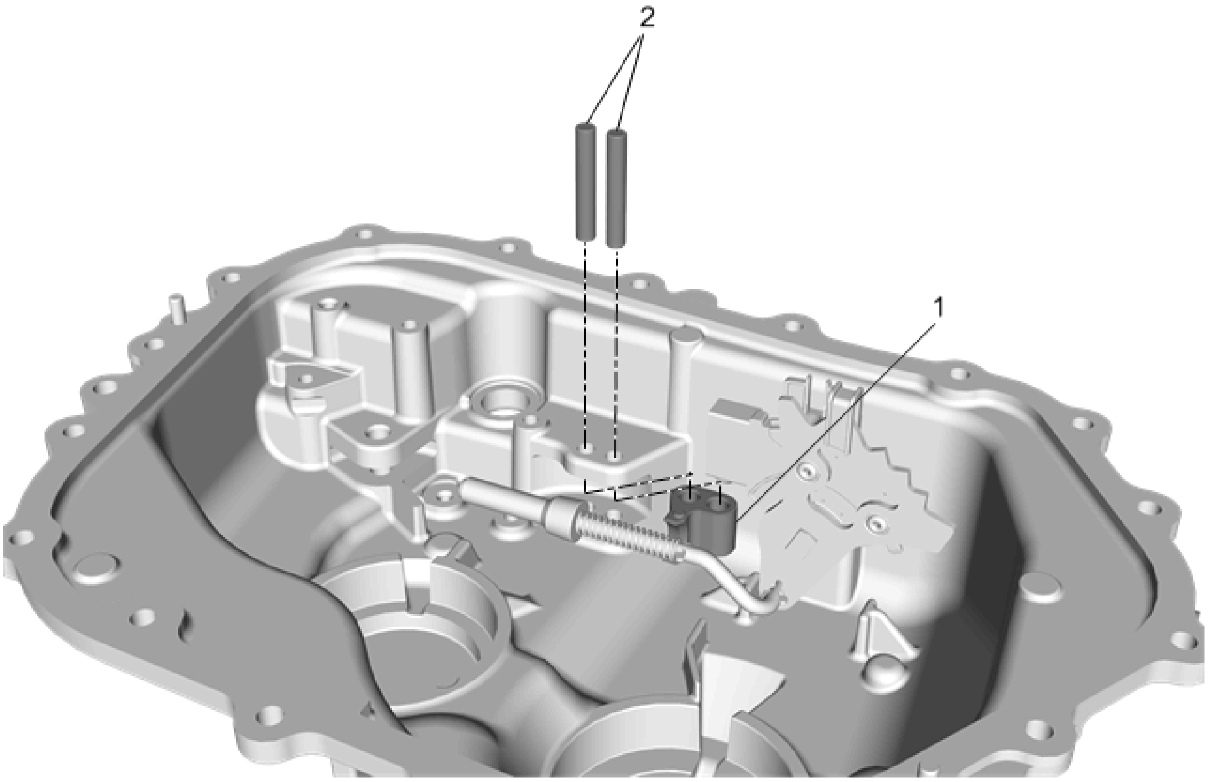


Fig. 137: Park Pawl Actuator Guide
Courtesy of GENERAL MOTORS COMPANY

Park Pawl Actuator Guide Installation

Callout	Component Name
1	Park Pawl Actuator Guide
2	Park Pawl Actuator Guide Pin (Qty: 2)

Park Pawl, Shaft and Bracket Installation

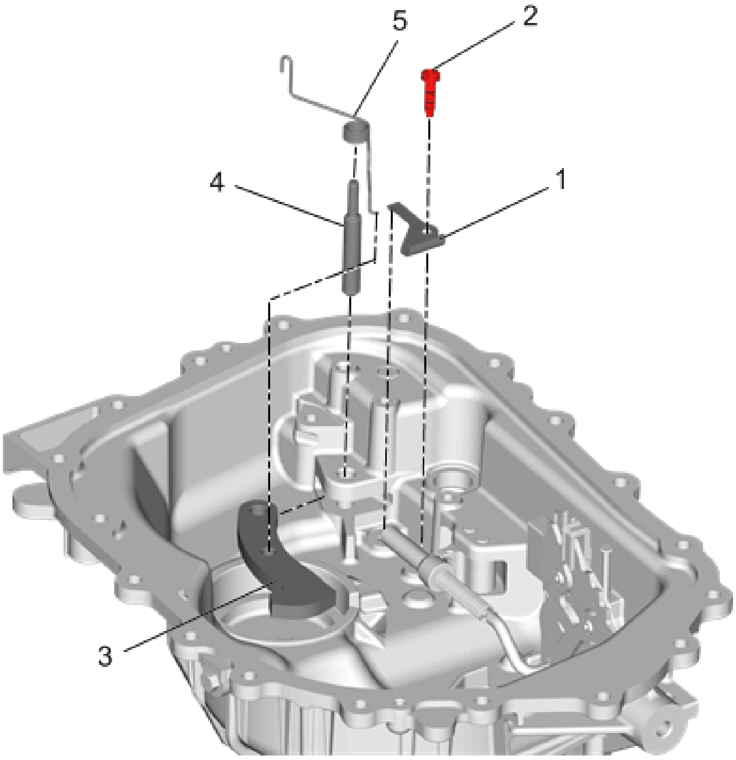


Fig. 138: Park Pawl, Shaft and Bracket
Courtesy of GENERAL MOTORS COMPANY

Park Pawl, Shaft and Bracket Installation

Callout	Component Name
1	Park Pawl Actuator Bracket
2	Park Pawl Actuator Bracket Bolt **CAUTION:** **Refer to Fastener Caution .** **Tighten** 9 N.m (80 lb in)
3	Park Pawl
4	Park Pawl Shaft
5	Park Pawl Spring

Manual Shift Detent Lever Spring and Bracket Installation

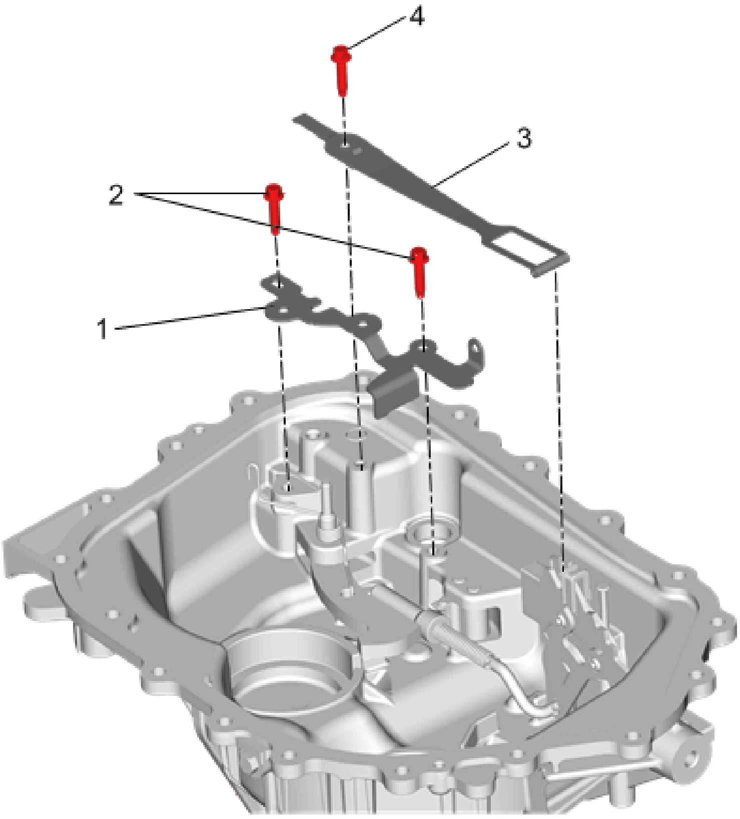


Fig. 139: Manual Shift Detent Lever Spring and Bracket
Courtesy of GENERAL MOTORS COMPANY

Manual Shift Detent Lever Spring and Bracket Installation

Callout	Component Name
1	Park Pawl Actuator Bracket
2	Park Pawl Actuator Bracket Bolt (Qty: 2) **Tighten** 9 N.m (80 lb in)
3	Manual Shift Detent Lever Spring
4	Manual Shift Detent Lever Spring Bolt **NOTE:** **Install NEW manual shift detent lever spring bolt** **Tighten** 9 N.m (80 lb in)

AUTOMATIC TRANSMISSION CONTROL WIRING HARNESS INSTALLATION - TRANSMISSION CASE

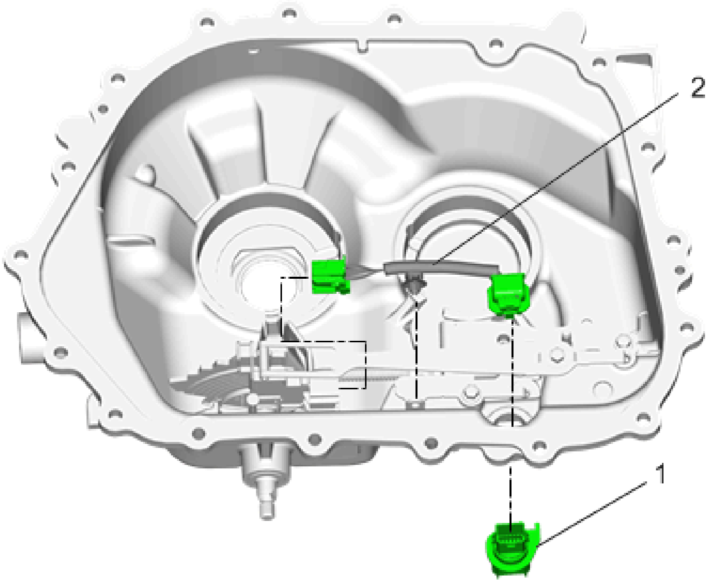


Fig. 140: Automatic Transmission Control Wiring Harness - Transmission Case
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Wiring Harness Electrical Connector **NOTE:** **Install NEW wiring harness electrical connector. It is not reusable.**
2	Automatic Transmission Control Wiring Harness

AUTOMATIC TRANSMISSION CASE INSTALLATION

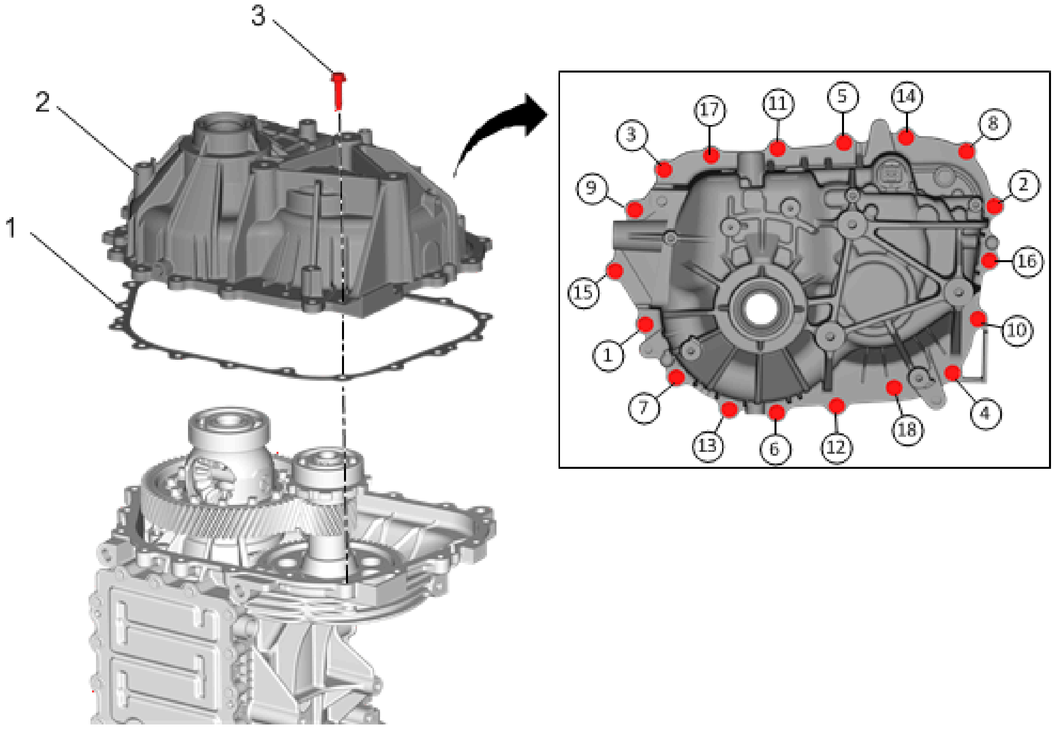


Fig. 141: Automatic Transmission Case With Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Gasket **NOTE:** **Install NEW gasket. It is not reusable.**
2	Automatic Transmission Case
3	Automatic Transmission Case Bolt (Qty: 18) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 22 N.m (16 lb ft)

OUTPUT SHAFT INSTALLATION

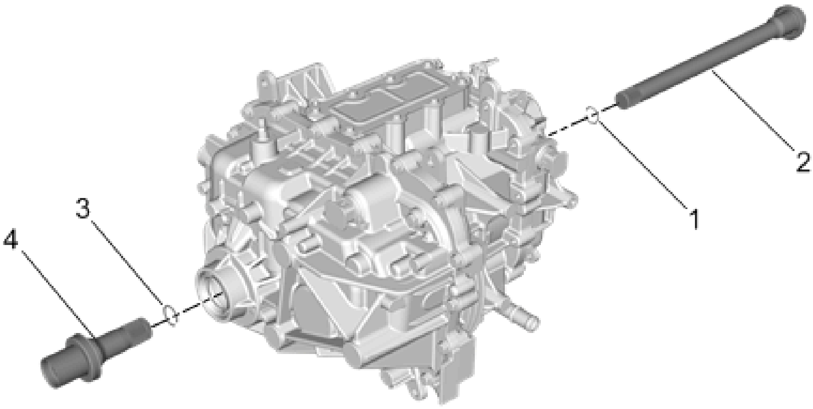


Fig. 142: Output Shaft
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Shaft Retaining Ring **NOTE:** **Install a NEW output shaft retaining ring.**
2	Output Shaft (LHS)
3	Output Shaft Retaining Ring **NOTE:** **Install a NEW output shaft retaining ring.**
4	Output Shaft (RHS)

AUTOMATIC TRANSMISSION FLUID PUMP INSTALLATION

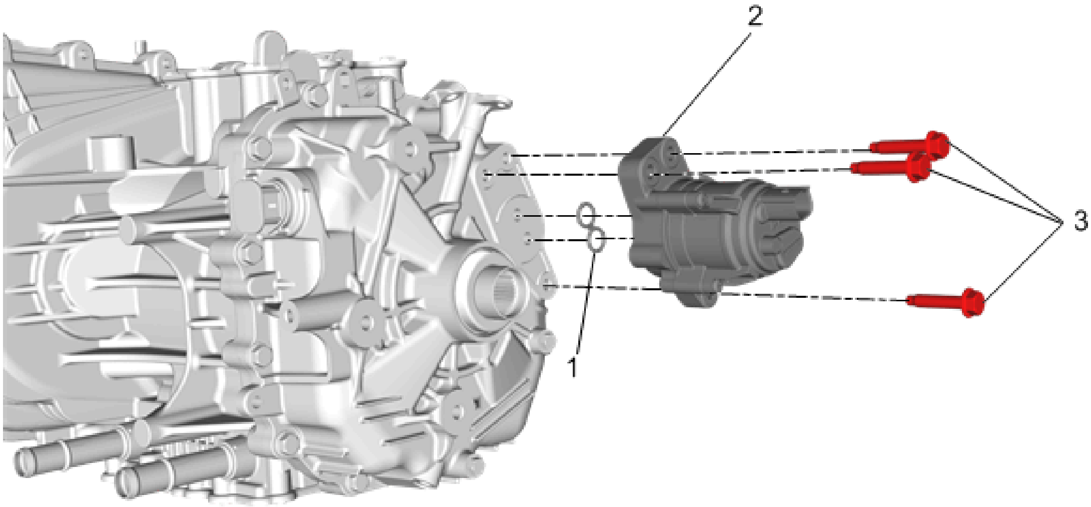


Fig. 143: Automatic Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Pump Seal **NOTE:** **Install NEW seal. It is not reusable.**
2	Automatic Transmission Fluid Pump
3	Automatic Transmission Fluid Pump Bolt (Qty: 3) **CAUTION:** **Refer to Fastener Caution .** **Tighten** 22 N.m (16 lb ft)

TRANSMISSION VENT PIPE INSTALLATION

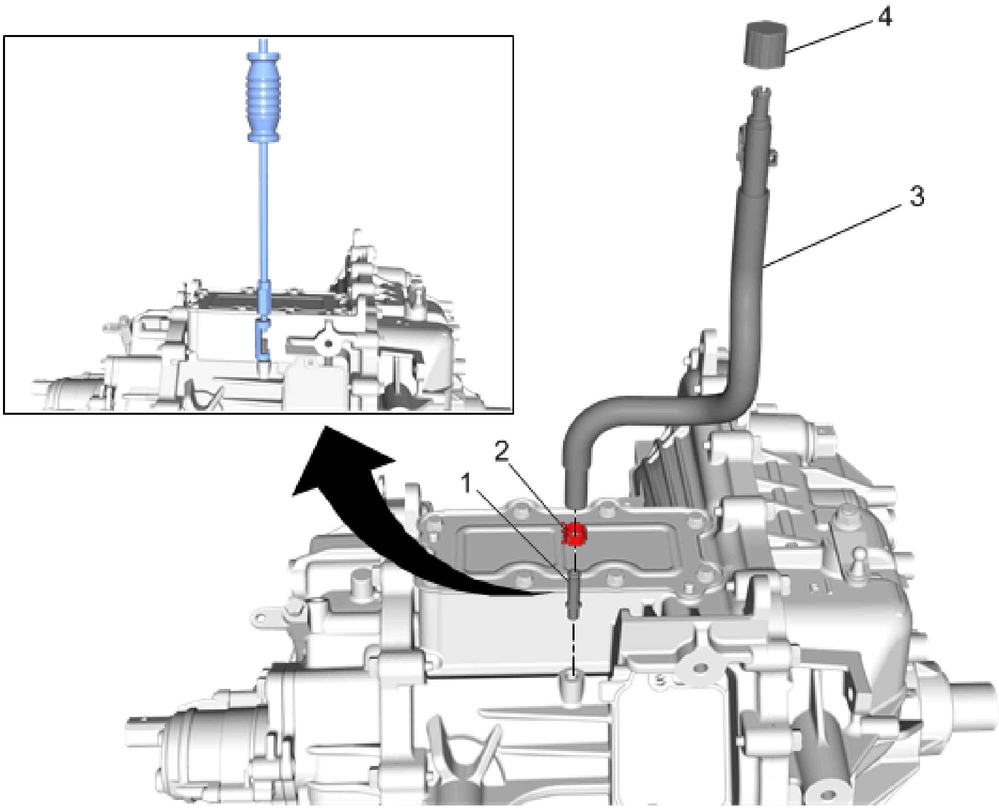


Fig. 144: Transmission Vent Pipe
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Vent Pipe **NOTE:** **Install NEW vent pipe. It is not reusable.** **Special Tools** - **DT-6125-1B** Slide Hammer - **DT-52017** Vent Hose Pipe Installer Equivalent regional tools: Special Tools.
2	Transmission Vent Hose Clamp
3	Transmission Vent Hose
4	Transmission Vent Cap

HOLDING FIXTURE REMOVAL

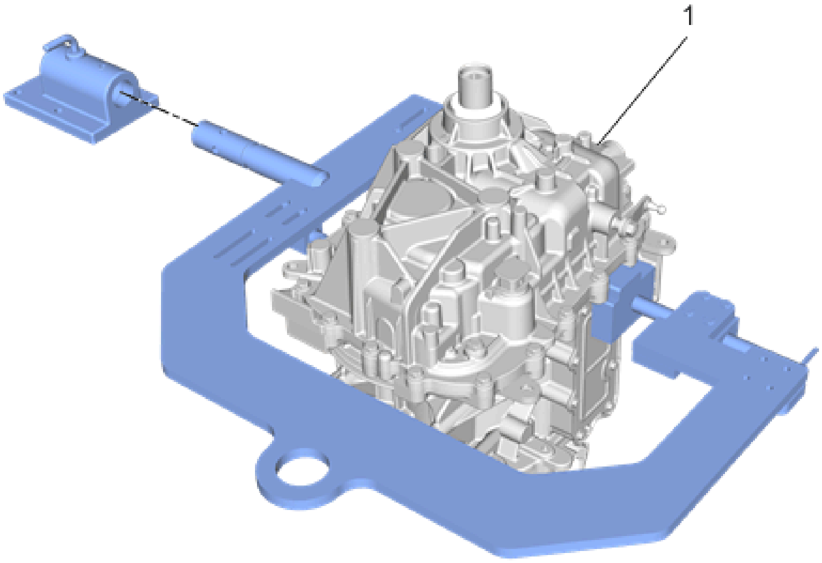


Fig. 145: Holding Fixture
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission **WARNING:** **Handle with care, the transmission assembly weighs over 83 Kg (183 lbs). Bodily injury could occur if not handled properly.** **Special Tools** - **DT-3289-20** Holding Fixture Base Assembly - **DT-46625** Holding Fixture - **DT-52009** Holding Fixture Adapter - **DT-46625-10** Holding Fixture Adapter Equivalent regional tools: Special Tools.

DESCRIPTION AND OPERATION

DEFINITIONS AND ABBREVIATIONS

Propulsion Condition Definitions

Chuggle/Cogging

A bucking or jerking condition.

Shudder

A repeating jerking condition similar to Chuggle/Cogging but more severe and rapid. This condition may be most noticeable during certain ranges of vehicle speed.

Surge

A repeating condition of acceleration and deceleration that is less intense than Chuggle/Cogging.

Noise Conditions

Propulsion System Noise

A whine or growl that increases or fades with vehicle speed, and is most noticeable under a light acceleration. It may also be noticeable in PARK or NEUTRAL operating ranges with the vehicle stationary.

Final Drive Noise

A hum related to vehicle speed which is most noticeable under a light acceleration.

Pump Noise

A high pitched whine or growl that is noticeable only when the auxiliary transmission fluid pump is ON. This condition may also be noticeable in all operating ranges with the vehicle moving.

Transmission Abbreviations

AC

Alternating Current

DC

Direct Current

DLC

Diagnostic Link Connector

DMM

Digital Multimeter

DTC

Diagnostic Trouble Code

EBCM

Electronic Brake Control Module

EMI

Electromagnetic Interference

MIL

Malfunction Indicator Lamp

OBD

On Board Diagnostic

VSS

Vehicle Speed Sensor

TRANSMISSION IDENTIFICATION INFORMATION

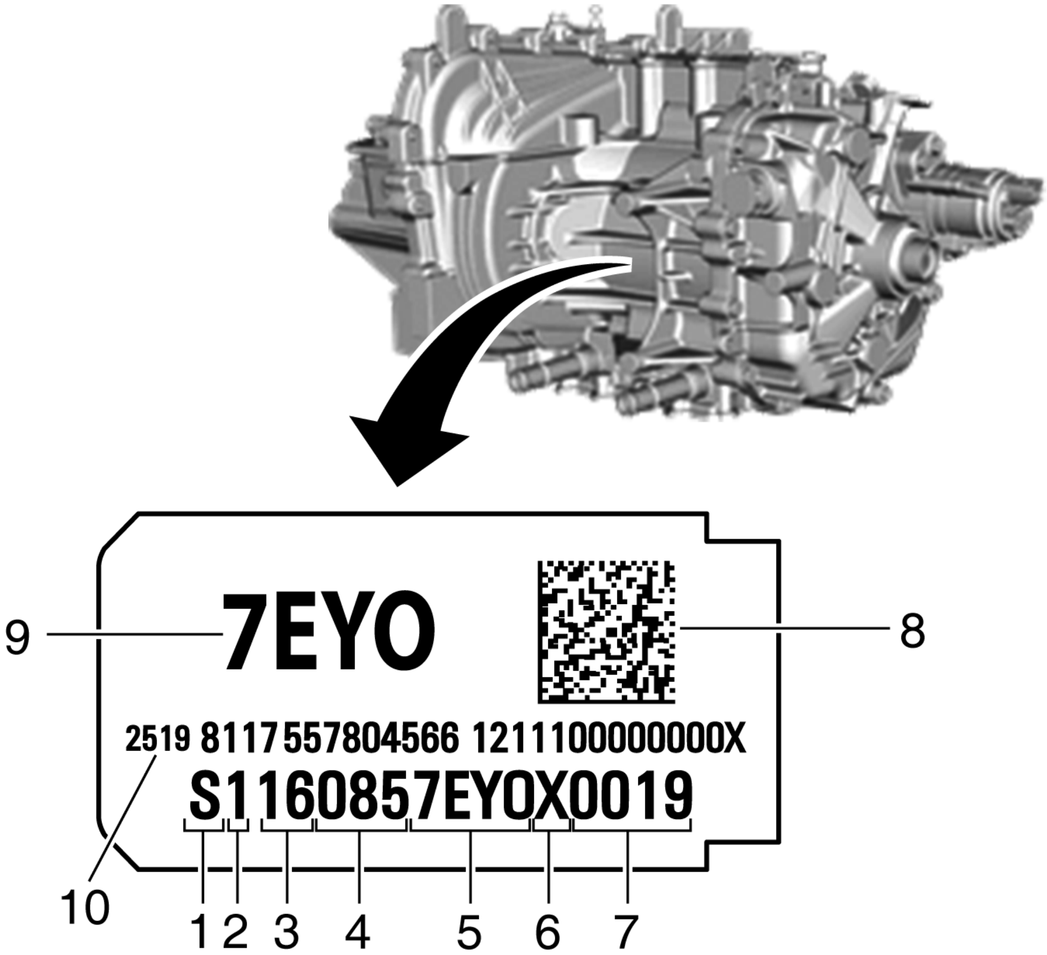


Fig. 146: Identifying Transmission Identification Label
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Line ID
2	Shift ID
3	Build Year
4	Julian Date
5	Broadcast Code
6	Reserved Use
7	Sequence Number
8	Machine Readable Matrix
9	Broadcast Code
10	GM Part Number

TRANSMISSION GENERAL DESCRIPTION

The Chevrolet Bolt EV is a fully electric vehicle. The propulsion of the vehicle is achieved by an electric drive Transmission. The Transmission is a fully automatic, front wheel drive transaxle, variable-speed, electronic-controlled transmission. It consists primarily of an 150kW drive motor, 1 differential/Offset gear set, high voltage electric auxiliary transmission fluid pump and housing, and 2 axles.

The Differential/Offset gear set provides the fixed forward and reverse ratio. Changing speed and torque is fully automatic and is accomplished through the use of a drive motor generator power inverter control module located under hood. The drive motor generator power inverter control module receives and monitors various electronic sensor inputs and uses this information to vary the torque output to the drive axles based on throttle position.

The Lubrication system uses an electric auxiliary fluid pump motor assembly located outside of the transmission for lubrication of rotating components. This is a gerotor-type pump, electric 12V DC

Voltage motor, electric harness, and control module. The control module is located inside of the drive motor generator power inverter module under the hood. The transmission fluid pump operates under low pressure and will only run when out of park or neutral and vehicle speed is detected.

The transmission fluid temperature sensor is internal to the transmission and is located near the transmission fluid oil filter. The transmission fluid temperature sensor is connected to the ECM. The ECM sends the fluid temperature data to the drive motor power inverter module for drive motor torque.

Power delivery is controlled by first Electronic Precision Shift system. This shift and Park-by-wire system sends electronic signals to the Bolt EV's drive unit to manage precise feel and delivery of power and torque, based on drive mode selection and accelerator inputs. A by-wire shifter requires less packaging space than a traditional mechanical shifter, resulting in more interior space and improved interior layout.

The transmission may be operated in any of the following gear ranges:

PARK (P)

This position locks the wheels and prevents the vehicle from rolling either forward or backward. PARK is the best position to use when starting the propulsion system for the vehicle. Because the transmission utilizes a shift lock control system, it is necessary to fully depress the brake pedal before shifting out of PARK. For safety reasons, use the parking brake in addition to the PARK position.

REVERSE (R)

This position allows the vehicle to be operated in a rearward direction by reversing the rotation of the electric drive motor.

NEUTRAL (N)

This position allows the vehicle to be moved without the park pawl engaged.

DRIVE (D)

Drive range should be used for all normal driving conditions for maximum efficiency and range economy. Drive range allows the drive unit to operate in a forward direction by electrically varying the output torque and speed of the electric drive motor.

Low (L)

This position is used for the "feel" of engine braking and can be used for the slowing of the vehicle once the throttle is lifted. While in the position the vehicle will slow quicker and use the motor to more aggressively collect energy during a regenerative braking event.

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

The mechanical components of the Bolt EV MMF 1ET25 are as follows:

- Gerotor type fluid pump
- Drive motor housing
- Drive motor 150 kW
- Transmission case
- Front differential carrier
- Counter shaft
- Center support
- Output shaft (LHS)
- Output shaft (RHS)
- Park pawl

The electrical components of the Bolt EV MMF 1ET25 are as follows:

- Drive Motor, 150 kW
- Manual Shift Shaft Position Sensor is also referred to as the Transmission Internal Mode Switch.
- Electric Auxiliary Fluid Pump Motor
- Transmission Fluid Temperature Sensor
- Drive Motor Position Sensor
- Transmission Control Wiring Harness

TRANSMISSION INDICATORS AND MESSAGES

No transmission-related indicators or messages are displayed on the instrument panel cluster (IPC). For a complete listing and description of all vehicle indicators and messages, refer to **Indicator/Warning Message Description and Operation** .

ELECTRONIC COMPONENT DESCRIPTION

Drive Motor

Drive Motor Housing Assembly (2 of 2)

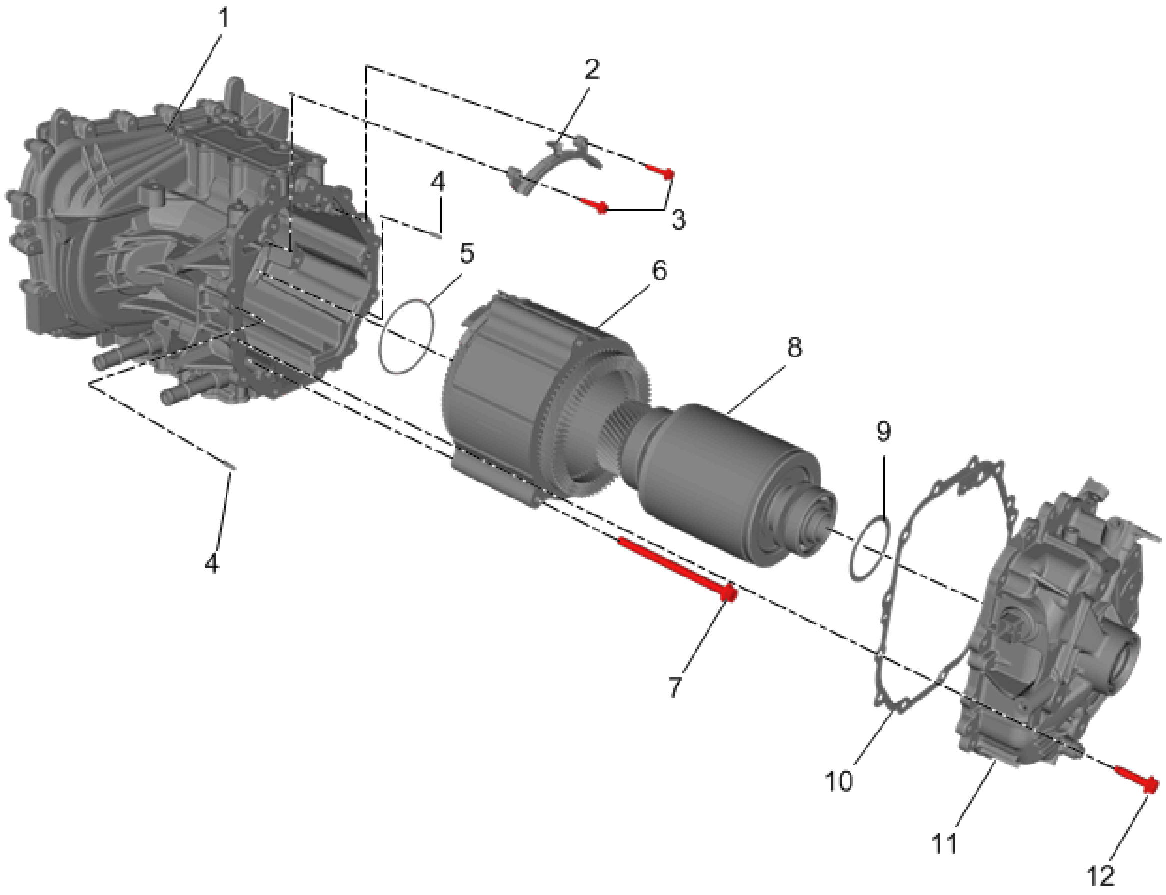


Fig. 147: Drive Motor Housing Assembly (2 of 2)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Housing
2	Drive Motor Stator Coolant Distributor Channel
3	Drive Motor Stator Coolant Distributor Channel Bolt (Qty: 2)
4	Pin (Qty: 2)
5	Drive Motor Rotor Bearing Shim (Right Side)
6	Drive Motor Stator

Callout	Component Name
7	Drive Motor Stator Bolt (Qty: 3)
8	Drive Motor Rotor
9	Drive Motor Rotor Bearing Shim (Left Side)
10	Automatic Transmission Case Cover Gasket
11	Automatic Transmission Case Cover
12	Automatic Transmission Case Cover Bolt (Qty: 13)

The drive motor (1) is a permanent magnet 150 Kw peak power electric machine and is controlled by the power inverter module, often referred to as the drive motor generator power inverter module, in order to provide torque for vehicle propulsion and regenerative braking. Drive motor speed is controlled and monitored by a resolver-type position sensor. The drive motor position sensor is monitored by the drive motor generator power inverter module. The drive motor generator power inverter module monitors the angular position, speed and direction of the drive motor based upon the signals the position sensor outputs to the drive motor generator power inverter module. The drive motor position sensor, or resolver, contains a drive coil, 2 driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. When the vehicle is ON, the drive motor generator power inverter module outputs an AC excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the 2 driven coils and the irregular shaped rotor. The drive motor generator power inverter module then monitors the 2 driven coil circuits for a return signal. The position of the irregular shaped metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the 2 driven coils signals allows the motor control module to determine the exact angle, speed and direction of the drive motor. For more information, refer to **Drive Motor Power Inverter Module Description and Operation** .

Electric Auxiliary Transmission Fluid Pump Motor

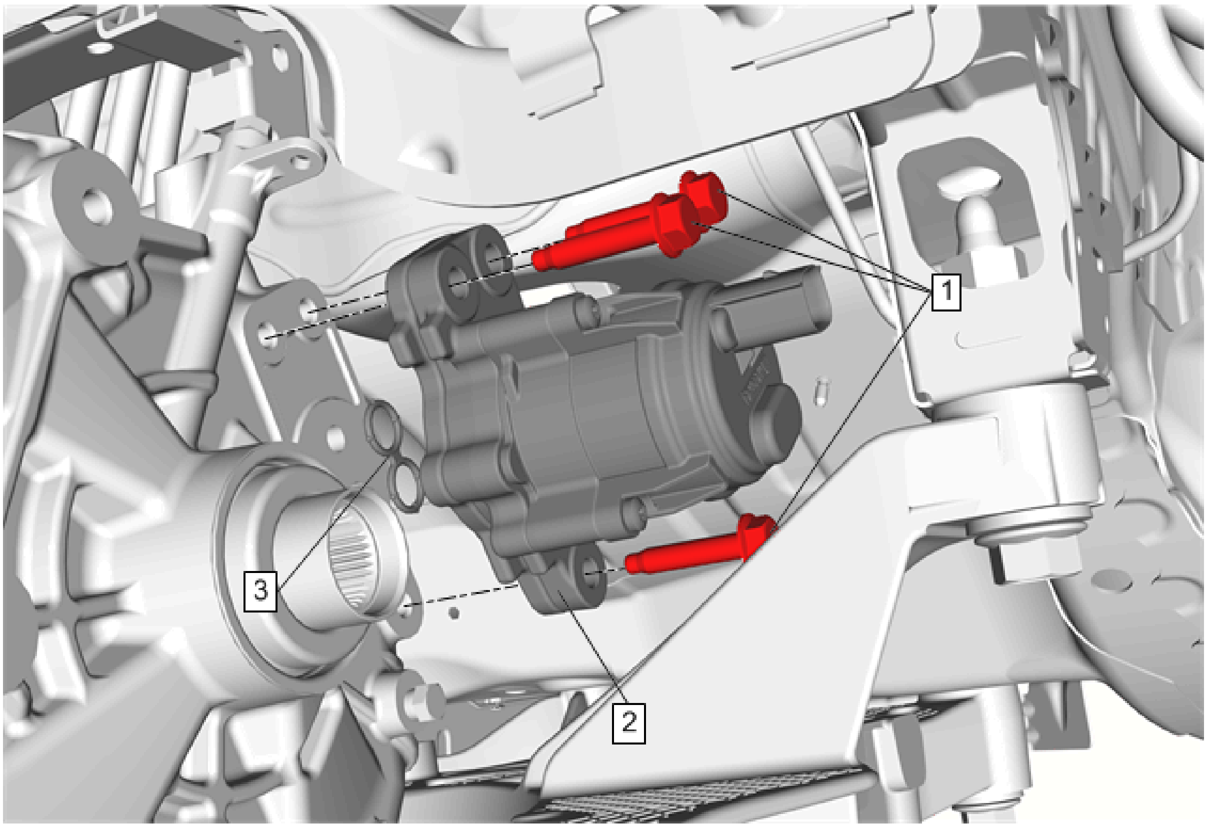


Fig. 148: Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Pump Bolt (Qty: 3)
2	Automatic Transmission Fluid Pump Assembly
3	Automatic Transmission Fluid Pump Seal

The electric auxiliary transmission fluid pump motor assembly is driven by 12V pulse width modulated (PWM) direct current which is controlled by the power inverter module. The purpose of the electric auxiliary transmission fluid pump motor assembly is to supply oil to the transmission for lubrication and cooling during vehicle operation.

Transmission Internal Mode Switch

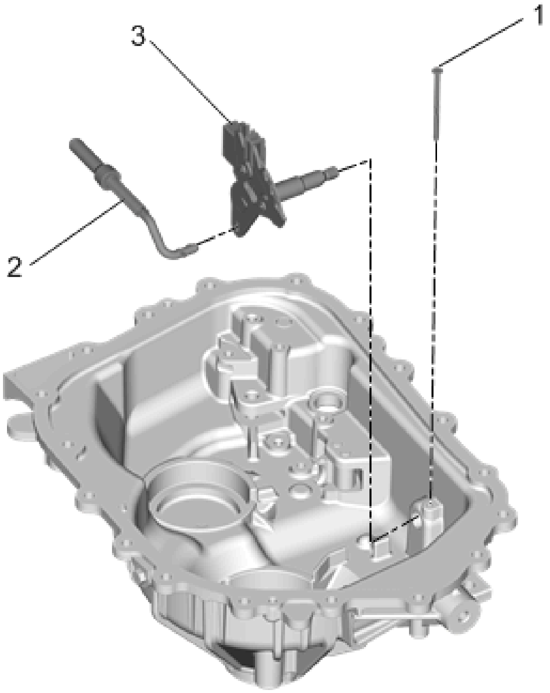


Fig. 149: Transmission Internal Mode
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Pin
2	Park Pawl Actuator
3	Manual Shift Shaft Position Switch Assembly

The 5 electronic switches are called the transmission range switches and are used to indicate the gear position the vehicle operator has selected. The 5 outputs (A, B, C, P, S) are range selection inputs to the hybrid/EV powertrain control module 1, through the Automatic Transmission Wiring Harness - Shift Shaft Position Switch. The manual shift detent lever assembly is mounted on the interior front of the transmission case above the control valve body assembly. The internal mode switch indicates to the hybrid/EV powertrain control module 1 which gear position the vehicle operator has selected. The Internal Mode Switch consists of 5 separate hall effect switches. Each hall effect switch is supplied a 9 V reference circuit, and a signal circuit from the hybrid/EV powertrain control module 1. Each signal circuit for each gear selector position will have either a voltage reading of 0.70 - 0.96 V indicating ON or 1.68 - 2.38 V indicating OFF. The voltage values on each Internal Mode Switch circuit will change and are dependent on the position of the gear selector. The state of each Internal Mode Switch A/B/C/P/S circuit is displayed on the scan tool.

Transmission Fluid Temperature Sensor

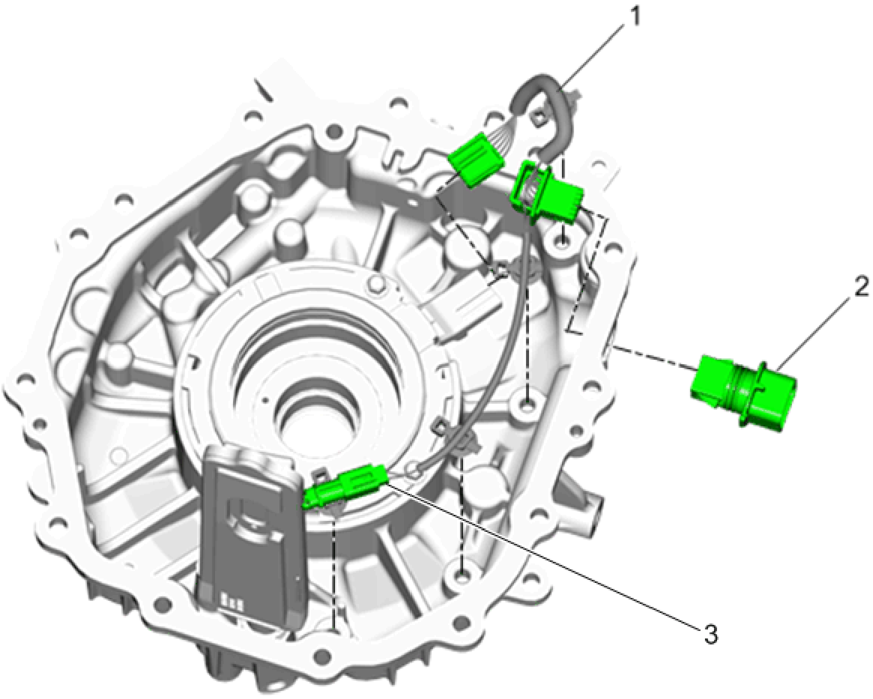


Fig. 150: Transmission Fluid Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Control Wiring Harness
2	Wiring Harness Electrical Connector
3	Transmission Fluid Temperature Sensor

The transmission fluid temperature sensor is part of the A/Trans Control Wiring Harness Assembly and can be serviced separately. The transmission fluid temperature sensor is connected to the ECM. The ECM sends the fluid temperature data to the power inverter module for drive motor torque.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

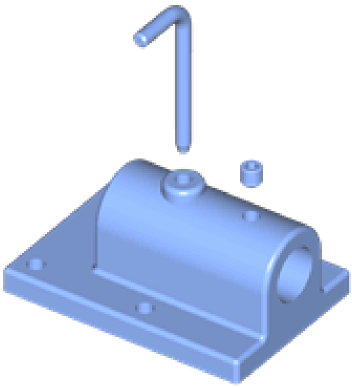
Illustration	Tool Number/Description
	DT-3289-20 J-3289-20 KM 113-2-A Holding Fixture Base Assembly

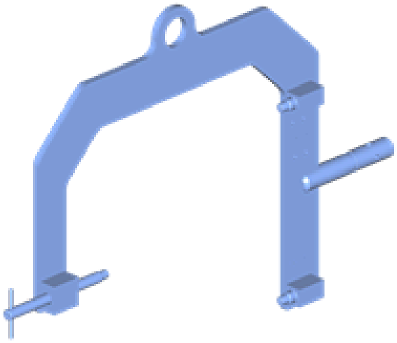
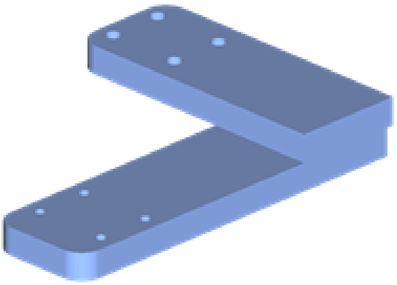
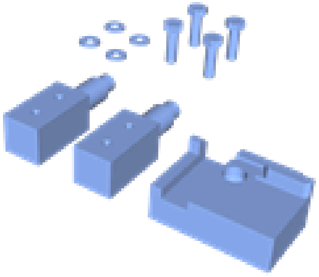
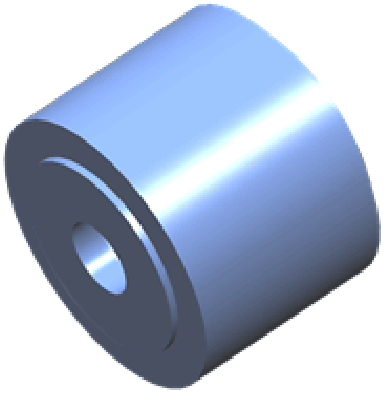
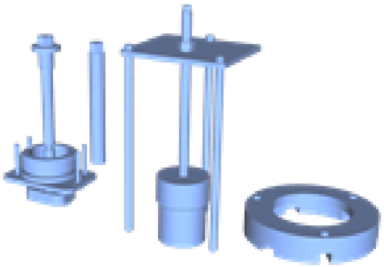
Illustration	Tool Number/Description
	DT-46625 J-46625 Holding Fixture
	DT-46625-10 J-46625-10 Holding Fixture Adapter
	DT-52009 Holding Fixture Adapter
	DT-48008 Pinion Bearing Installer
	DT-52011 Rotor Remover/Installer Kit

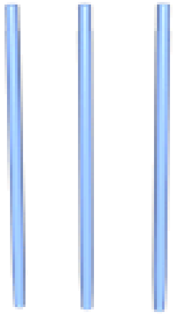
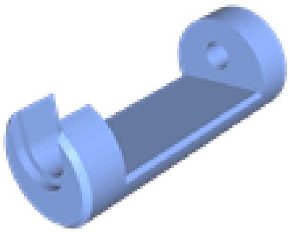
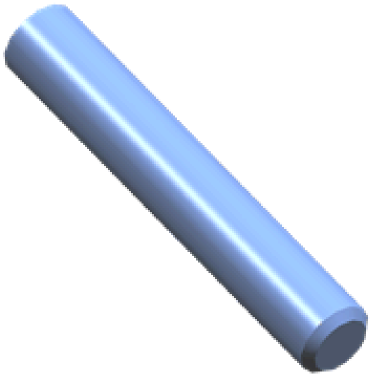
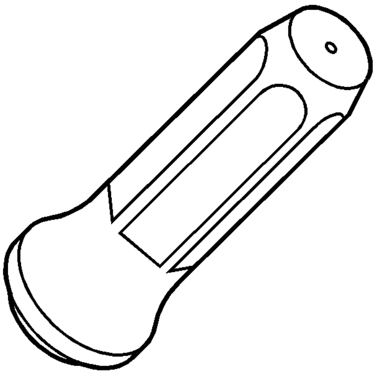
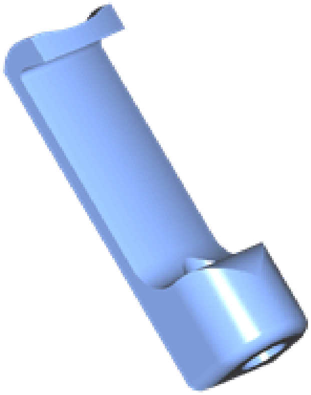
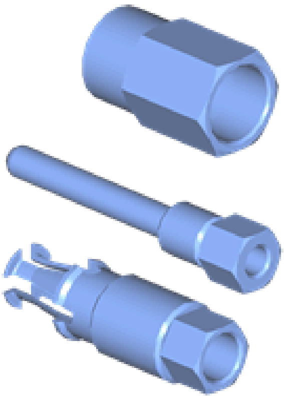
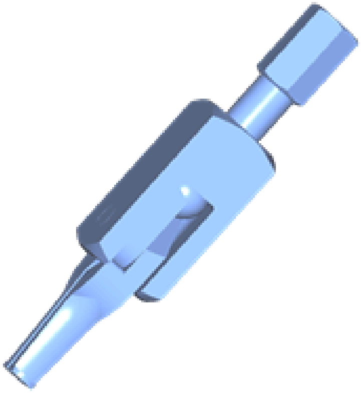
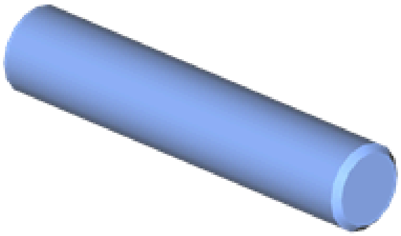
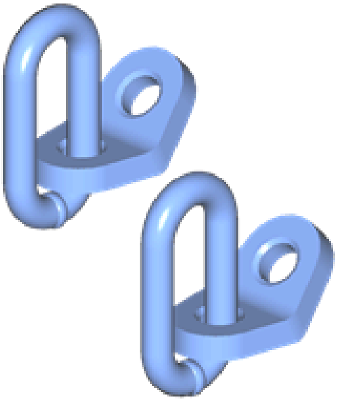
Illustration	Tool Number/Description
	DT-52012 Stator Remover/Installer
	DT-52017 Vent Hose Pipe Installer
	DT-51436 Manual Shaft Pin Installer
	DT-44809 J-44809 Seal Installer
	DT-6125-1B GE-6125-1B J-6125-1B Slide Hammer with Adapter

Illustration	Tool Number/Description
	DT-23129 J-23129 Universal Seal Remover
	DT-45201 J-45201 Seal Remover
	DT-23907 J-23907 Bearing Adapter
	DT-49101 Seal Installer
	EN-36857 J-36857 Engine Lift Bracket

Back To Article

SCHEMATIC WIRING DIAGRAMS

ELECTRONIC TRANSMISSION RANGE SELECTOR WIRING SCHEMATICS

Power, Ground and Serial Data

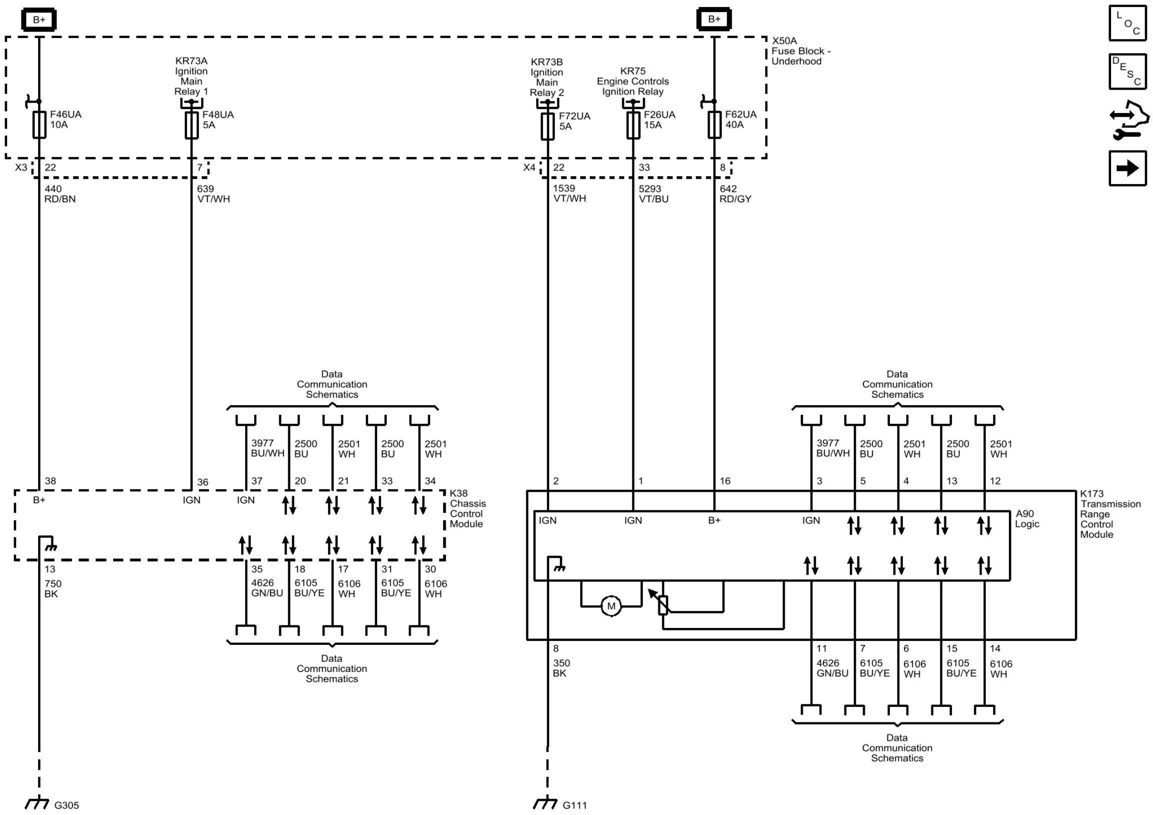

B+
B+
X50A Fuse Block - Underhood
KR73A Ignition Main Relay 1
KR73B Ignition Main Relay 2
KR75 Engine Controls Ignition Relay
F46UA 10A
F48UA 5A
F72UA 5A
F26UA 15A
F62UA 40A
X3
22
7
X4
22
33
8
440 RD/BN
639 VT/WH
1539 VT/WH
5293 VT/BU
642 RD/GY
Data Communication Schematics
3977 BU/WH
2500 BU
2501 WH
2500 BU
2501 WH
38
36
37
20
21
33
34
B+
IGN
IGN
K38 Chassis Control Module
13
750 BK
35
4626 GN/BU
18
6105 BU/YE
17
6106 WH
31
6105 BU/YE
30
6106 WH
Data Communication Schematics
G305
Data Communication Schematics
3977 BU/WH
2500 BU
2501 WH
2500 BU
2501 WH
2
1
16
3
5
4
13
12
IGN
IGN
B+
IGN
A90 Logic
K173 Transmission Range Control Module
M
8
350 BK
11
4626 GN/BU
7
6105 BU/YE
6
6106 WH
15
6105 BU/YE
14
6106 WH
Data Communication Schematics
G111

Fig. 1: Power, Ground and Serial Data

Courtesy of GENERAL MOTORS COMPANY

Electronic Shift Lever

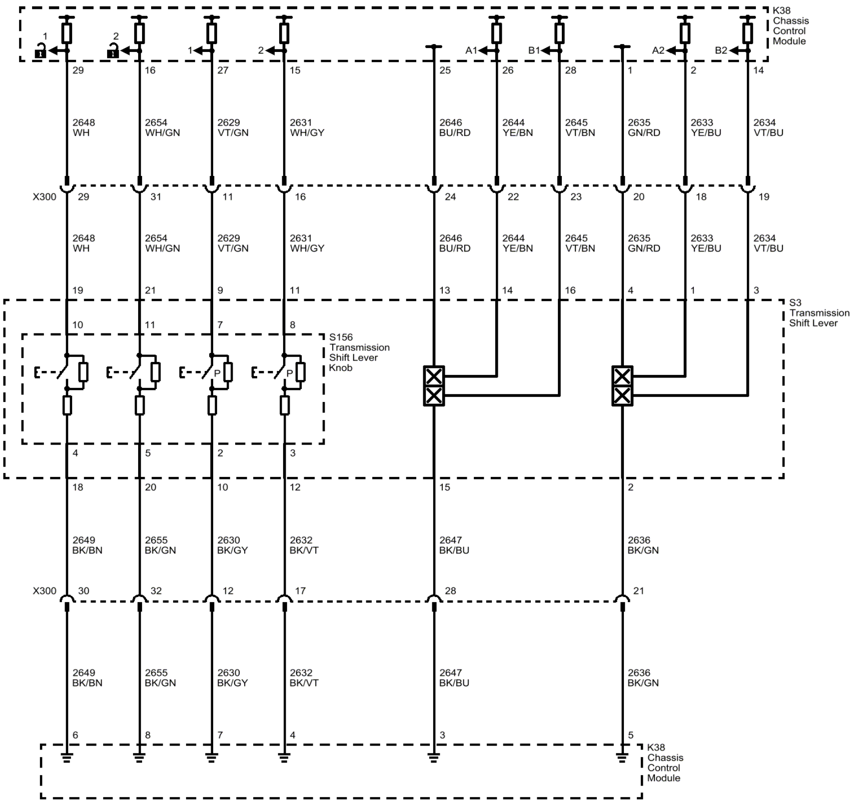

K38 Chassis Control Module
1
2
1
2
A1
B1
A2
B2
29
16
27
15
25
26
28
1
2
14
2648 WH
2654 WH/GN
2629 VT/GN
2631 WH/GY
2646 BU/RD
2644 YE/BN
2645 VT/BN
2635 GN/RD
2633 YE/BU
2634 VT/BU
X300
29
31
11
16
24
22
23
20
18
19
2648 WH
2654 WH/GN
2629 VT/GN
2631 WH/GY
2646 BU/RD
2644 YE/BN
2645 VT/BN
2635 GN/RD
2633 YE/BU
2634 VT/BU
19
21
9
11
13
14
16
4
1
3
S3 Transmission Shift Lever
10
11
7
8
S156 Transmission Shift Lever Knob
P
P
4
5
2
3
18
20
10
12
15
2
2649 BK/BN
2655 BK/GN
2630 BK/GY
2632 BK/VT
2647 BK/BU
2636 BK/GN
X300
30
32
12
17
28
21
2649 BK/BN
2655 BK/GN
2630 BK/GY
2632 BK/VT
2647 BK/BU
2636 BK/GN
6
8
7
4
3
5
K38 Chassis Control Module

Fig. 2: Electronic Shift Lever
Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC B2A00: DOOR OPEN SWITCH SIGNAL - DOOR AJAR SWITCH SIGNAL NOT PLAUSIBLE/DRIVER DOOR OPEN SWITCH CIRCUIT NOT PLAUSIBLE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptors

DTC B2A00 00

Door Open Switch Signal - Door Ajar Switch Signal Not Plausible

DTC B297B 5A

Driver Door Open Switch Circuit Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	B2A00 00, B297B 5A	B2A00 00, B297B 5A	B2A00 00, B297B 5A	-
Ground	-	1	-	-
1. Ajar Indicator Inoperative				

Circuit/System Description

The keyless entry control module provides a 12 V signal to the driver door open switch signal circuit. The driver window motor or the driver window switch provides a 12 V signal to the driver door ajar switch signal circuit. The door open switch and the door ajar switch are integral to the driver door latch assembly.

The door open switch and the door ajar switch contacts will be open with the door is fully closed, the door switches within the door latch are designed so that the when the door is ajar, the contact in the door ajar switch closes, the voltage is pulled low and the driver window motor or the driver window switch will then send a serial data message to the body control module indicating that the door is ajar. When the driver door is opened further, the contact in the door open switch will then close providing a ground for the door open signal circuit, the keyless entry control module will then detect that the door is open.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V.

Conditions for Setting the DTC

B2A00 00

- The chassis control module detects the driver door open switch is Active while receiving a serial data message from the body control module that the driver door ajar switch is Inactive.
- The condition must be present for greater than 30 seconds

B297B 5A

- The keyless entry control module detects the driver door open switch is Active while receiving a serial data message from the body control module that the driver door ajar switch is Inactive.
- The condition must be present for greater than 30 seconds

Action Taken When the DTC Sets

B2A00 00, B297B 5A

The driver information center will display the Service Driver Door Switch message

Conditions for Clearing the DTC

- The DTC will be current for as long as the fault is present.
- When the keyless entry control module receives a serial data message from the BCM that the door is ajar before the keyless entry control module detects the door open switch is active, then the DTC will be a history DTC.
- A history DTC will clear after 50 ignition cycles.

Reference Information

Schematic Reference

- **Door Lock/Indicator Schematics**
- **Remote Function Schematics**

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Keyless Entry System Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**

- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify the scan tool Body Control Module Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.
   - **If the parameter does not change**

     Refer to **Door Ajar Indicator Malfunction**

   - **If the parameter changes**
3. Verify the scan tool Keyless Entry Control Module Driver Door Ajar Switch parameter changes between Inactive and Active when opening and closing the driver door.
   - **If the parameter does not change**

     Refer to Circuit/System Testing

   - **If the parameter changes**
4. All OK.

Circuit/System Testing

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 3 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF.
   2. Test for less than 2 Ω in the ground circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, repair the open/high resistance in the ground connection.
   - **If less than 10 Ω**
3. Ignition ON.
4. Test for greater than 10 V between the signal circuit terminal listed below and ground:
   - Signal circuit terminal 2 (LHD)
   - Signal circuit terminal 4 (RHD)
   - **If 10 V or less**
   1. Ignition OFF, disconnect the harness connector at the K84 Keyless Entry Control Module
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the control circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance on the circuit.
      - If less than 2 Ω, replace the K84 Keyless Entry Control Module
   - **If greater than 10 V**
5. Test or replace the A23D Door Latch Assembly-Driver.

Component Testing

1. Ignition OFF, disconnect the harness connector at the A23D Door Latch Assembly-Driver.

2. Test for infinite resistance between the signal terminal and ground terminal listed below with the switch in the open position.
   - Signal terminal 2 and ground terminal 3 (LHD)
   - Signal terminal 4 and ground terminal 3 (RHD)
   - **If less than infinite resistance**

     Replace the A23D Door Latch Assembly-Driver.

   - **If infinite resistance**
3. Test for less than 5 Ω between the signal terminal and ground terminal listed below with the switch in the closed position.
   - Signal terminal 2 and ground terminal 3 (LHD)
   - Signal terminal 4 and ground terminal 3 (RHD)
   - **If 5 Ω or greater**

     Replace the A23D Door Latch Assembly-Driver.

   - **If less than 5 Ω**
4. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- Refer to **Front Side Door Latch Replacement**
- Refer to **Control Module References** for keyless entry control module replacement, programming and setup

DTC C1280: ELECTRIC PARK BRAKE AVAILABILITY STATUS MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C1280

Electric Park Brake Availability Status Message Counter Incorrect

Circuit/System Description

The internal fault detection is handled inside the device. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to replacement of components or programming/setup of module. Faults in any component or module that work together in this system may cause the programming/setup failure.
- Replacement or inspection of K173 Transmission Range Control Module requires rod linkage (if equipped) to be adjusted. If rod linkage is not properly adjusted, programming and setup procedure may fail and DTCs may set. Check K173 Transmission Range Control Module rod linkage adjustment prior to replacing the K173 Transmission Range Control Module. Something as simple as loosening the K173 Transmission Range Control Module mounting bolts can cause the module to be out of adjustment.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Check for updated software in K17 Electronic Brake Control Module.
    - **If software is not current**

      Perform the **programming** procedure for the K17 Electronic Brake Control Module.

    - **If software is up to date**
3. Replace the K17 Electronic Brake Control Module.
4. Verify DTC C1280 is not set.
    - **If DTC C1280 is set**

      Replace the K38 Chassis Control Module

    - **If DTC C1280 is not set**

5. All OK.

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Control Module References** for module replacement, programming and setup

DTC P073D, P073E, P07E4, P07E5, P1769, OR P1789: UNABLE TO ENGAGE R-D-N-P/TRANSMISSION RANGE SENSOR TRCM CORRELATION/CURRENT TRANSMISSION RANGE UNKNOWN

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P073E

Unable to Engage Reverse

DTC P07E5

Unable to Engage Drive

DTC P073D

Unable to Engage Neutral

DTC P07E4

Unable to Engage Park

DTC P1769

Transmission Range Sensor TRCM Correlation

DTC P1789

Current Transmission Range Unknown

Circuit/System Description

The Transmission Shift Lever will provide electrical signals based on customer input to the Chassis Control Module, where the customer shift request will be determined. When the Chassis Control Module receives the gear request signal from the Transmission Shift Lever it sends the message for the Transmission Range Control Module to engage the selected gear.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

P073E

The actual transmission range does not equal Reverse within 1 s of commanding Reverse.

P07E5

The actual transmission range does not equal Drive within 1 s of commanding Drive.

P073D

The actual transmission range does not equal Neutral within 1 s of commanding Neutral.

P07E4

The actual transmission range does not equal Park within 1 s of commanding Park.

NOTE: **DTC P07E4 could set on conditions when battery voltage is low or battery voltage is high. This may not indicate an issue in the Electronic Transmission Range Selector system but may be a result of a low battery condition. Battery voltage DTCs should be resolved prior to resolving DTC P07E4.**

P1769

The actual transmission range from the internal mode switch does not match the actual transmission range from the rotary shaft position sensor in the TRCM.

P1789

The actual transmission range is not valid for 1 s. This DTC will put the vehicle in Latent Fault Mode. Refer to **Latent Fault Mode Description**.

Action Taken When the DTC Sets

DTC P073E, P07E5, P073D, P07E4, P1769, or P1789 is a Type B DTC. The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify no other DTCs are set.
   - **If other DTCs are set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle and resolve all other DTCs

- **If no other DTCs are set**

3. Verify K173 Transmission Range Control Module is mounted securely and if it has a linkage ensure the linkage from K173 Transmission Range Control Module to Transmission is adjusted properly with no excessive play.
   - **If play is found in the mounting of the K173 Transmission Range Control Module or linkage**

     Resolve issue and perform K173 Transmission Range Control Module learn procedure. Refer to Transmission Range Control Module Range Motor Position Learn.

   - **If no play is found in the mounting of the K173 Transmission Range Control Module or linkage**
4. Check for updated software in K173 Transmission Range Control Module.
   - **If software is not current**

     Perform the **programming** procedure for the K173 Transmission Range Control Module.

   - **If software is up to date**
5. Replace the K173 Transmission Range Control Module
6. Verify DTC P073E, P07E5, P073D, P07E4, P1769, or P1789 did not set.
   - **If any of the DTCs are set**

     Replace the K38 Chassis Control Module

   - **If none of the DTCs are set**
7. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for module replacement, programming and setup.

DTC P07B3-P07B5: TRANSMISSION PARK POSITION SWITCH 1 CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P07B3

Transmission Park Position Switch 1 Circuit Low

DTC P07B4

Transmission Park Position Switch 1 Circuit High

DTC P07B5

Transmission Park Position Switch 1 Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P07B3	P07B4	P07B4	P07B5

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	P07B4	-	-

Circuit/System Description

The Park Button Switch is located in the S156 Transmission Shift Lever Knob which is mounted on the S3 Transmission Shift Lever. The Park Button Switch has two internal sensors which are monitored by the K38 Chassis Control Module. When the Park switch is pressed the K38 Chassis Control Module will process the Park request and send a command signal to the K173 Transmission Range Control Module via serial data. These DTCs will put the vehicle in Latent Fault Mode. Refer to **Latent Fault Mode Description**.

Conditions for Running the DTC

P07B3 or P07B4

The K38 Chassis Control Module monitors this DTC at all times.

P07B5

P07B3 or P07B4 is not set.

Conditions for Setting the DTC

P07B3

The K38 Chassis Control Module detects a low voltage condition, in the Park Button Switch 1 circuit for 1 s. Low voltage is considered 0.2 - 0 V. Fault must be present for 7 out of 9 samples.

P07B4

The K38 Chassis Control Module detects a high voltage condition, in the Park Button Switch 1 circuit for 1 s. High voltage is considered anything greater than 4.8 V. Fault must be present for 7 out of 9 samples.

P07B5

The K38 Chassis Control Module detects a circuit performance condition, in the Park Button Switch 1 circuit for 1 s. Voltage performance fault is considered 3.1 - 3.5 V. Fault must be present for 7 out of 9 samples.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present. Type B DTC.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Transmission Park Position Switch 1 parameter is 35% - 45% when the Park Button Switch is pressed on the Transmission Shift Lever assembly.
    - **If parameter is not 35% - 45%**

      Refer to Circuit/System Testing.

    - **If parameter is 35% - 45%**
3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 10 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Transmission Park Position Switch 1 parameter is greater than 95%.
    - **If less than 95%**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the signal circuit terminal 9 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K38 Chassis Control Module.
    - **If greater than 95%**
5. Install a 3 A fused jumper wire between the signal circuit terminal 9 and the low reference circuit terminal 10.
6. Verify the scan tool Transmission Park Position Switch 1 is less than 5%.
    - **If greater than 5%**
    1. Ignition OFF/Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.

        - If less than 1 V
    3. Ignition OFF/Vehicle OFF
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If less than 5%**
7. Replace the S3 Transmission Shift Lever.
8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC sets**

      Replace the S156 Transmission Shift Lever Knob.

    - **If the DTC does not set**
9. All OK.

Component Testing

NOTE: **When performing Component Testing on the S3 Transmission Shift Lever, the S156 Transmission Shift Lever Knob should remain attached.**

1. Ignition OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever.
2. Verify circuit is 3 - 3.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch not pressed.
    - **If circuit is not between 3 - 3.5K Ω**

      Replace the S3 Transmission Shift Lever and repeat step 2. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

    - **If circuit is between 3 - 3.5 K Ω**
3. Verify circuit is 1 - 1.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch pressed.
    - **If circuit is not between 1 - 1.5K Ω**

      Replace the S3 Transmission Shift Lever and repeat step 3. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

    - **If circuit is between 1 - 1.5K Ω**
4. All OK

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair.
- Refer to Electronic Transmission Range Selector Component Replacement Reference
- Refer to Control Module References for module replacement, programming, and setup.

DTC P07B9-P07BB: TRANSMISSION PARK POSITION SWITCH 2 CIRCUIT

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P07B9

Transmission Park Position Switch 2 Circuit Low

DTC P07BA

Transmission Park Position Switch 2 Circuit High

DTC P07BB

Transmission Park Position Switch 2 Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P07B9	P07BA	P07BA	P07BB
Low Reference	-	P07BA	-	-

Circuit/System Description

The Park Button Switch is located in the S156 Transmission Shift Lever Knob which is mounted on the S3 Transmission Shift Lever. The Park Button Switch has two internal sensors which are monitored by the K38 Chassis Control Module. When the Park switch is pressed the K38 Chassis Control Module will process the Park request and send a command signal to the K173 Transmission Range Control Module via serial data. These DTCs will put the vehicle in Latent Fault Mode. Refer to **Latent Fault Mode Description**.

Conditions for Running the DTC

P07B9 or P07BA

The K38 Chassis Control Module monitors this DTC at all times.

P07BB

P07B9 or P07BA is not set.

Conditions for Setting the DTC

P07B9

The K38 Chassis Control Module detects a low voltage condition, in the Park Button Switch 2 circuit for 1 s. Low voltage is considered 0.2 - 0 volts. Fault must be present for 7 out of 9 samples.

P07BA

The K38 Chassis Control Module detects a high voltage condition, in the Park Button Switch 2 circuit for 1 s. High voltage is considered anything greater than 4.8 volts. Fault must be present for 7 out of 9 samples.

P07BB

The K38 Chassis Control Module detects a circuit performance condition, in the Park Button Switch 2 circuit for 1 s. Voltage performance fault is considered 3.1 - 3.5 volts. Fault must be present for 7 out of 9 samples.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present. Type B DTC.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Transmission Park Position Switch 2 parameter is 35% - 45% when the Park Button Switch is pressed on the Transmission Shift Lever assembly.
    - **If parameter is not 35% - 45%**

      Refer to Circuit/System Testing.

    - **If parameter is 35% - 45%**
3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 12 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Transmission Park Position Switch 2 parameter is greater than 95%.
    - **If less than 95%**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the signal circuit terminal 11 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance, replace the K38 Chassis Control Module.
    - **If greater than 95%**

5. Install a 3 A fused jumper wire between the signal circuit terminal 12 and the low reference circuit terminal 11.
6. Verify the scan tool Transmission Park Position Switch 2 is less than 5%.
    - **If greater than 5%**
    1. Ignition OFF/Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF/Vehicle OFF
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If less than 5%**
7. Replace the S3 Transmission Shift Lever.
8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC sets**

      Replace the S156 Transmission Shift Lever Knob.

    - **If the DTC does not set**
9. All OK.

Component Testing

NOTE: **When performing Component Testing on the S3 Transmission Shift Lever, the S156 Transmission Shift Lever Knob should remain attached.**

1. Ignition OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever.
2. Verify circuit is 3 - 3.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch not pressed.
    - **If circuit is not between 3 - 3.5K Ω**

      Replace the S3 Transmission Shift Lever and repeat step 2. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

    - **If circuit is between 3 - 3.5K Ω**
3. Verify circuit is 1 - 1.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch pressed.
    - **If circuit is not between 1 - 1.5K Ω**

      Replace the S3 Transmission Shift Lever and repeat step 3. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

    - **If circuit is between 1 - 1.5K Ω**
4. All OK

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair.
- Refer to Electronic Transmission Range Selector Component Replacement Reference
- Refer to Control Module References for module replacement, programming, and setup.

DTC P07BE OR P17F3: TRANSMISSION PARK POSITION SWITCH 1-2 NOT PLAUSIBLE/TRANSMISSION PARK POSITION SWITCH CIRCUIT 1 OR 2 STUCK ON

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P07BE

Transmission Park Position Switch 1-2 Not Plausible

DTC P17F3

Transmission Park Position Switch Circuit 1 or 2 Stuck On

Circuit/System Description

The Park Button Switch is located in the S156 Transmission Shift Lever Knob which is mounted on the S3 Transmission Shift Lever. The Park Button Switch has two internal sensors which are monitored by the K38 Chassis Control Module. When the Park switch is pressed the K38 Chassis Control Module will process the Park request and send a command signal to the K173 Transmission Range Control Module via serial data. These DTCs will put the vehicle in Latent Fault Mode. Refer to **Latent Fault Mode Description**.

Conditions for Running the DTC

The K38 Chassis Control Module monitors this DTC at all times.

Conditions for Setting the DTC

P07BE

Park Button Switch 1 and Park Button Switch 2 are both in valid positions (Pressed or Released) but positions to do not match. Fault must be present for 7 out of 9 samples.

P17F3

Park Button Switch 1 and Park Button Switch 2 are both in valid positions (Pressed or Released) but positions to do not match. Fault must be present for 7 out of 9 samples.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present. Type B DTC.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Diagnostic Aids

If the Park Button is not firmly pressed in the center, there is a chance that 1 of the 2 contacts within the button will not make contact. This could cause DTC P07BE or DTC P17F3 to set without any fault present. If this is the case, the customer should be educated to press the Park Button firmly and in the center.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Transmission Park Position Switch 1 and Transmission Park Position Switch 2 is between 55% - 70% when the Park Button Switch is not being pressed on the Transmission Shift Lever assembly.
    - **If parameter is not between 55% - 70%**
    1. Replace the S156 Transmission Shift Lever Knob.
    2. Verify the DTC does not set while operating the vehicle with the Conditions for Running the DTC.
        - If the DTC sets, replace the S3 Transmission Shift Lever.
        - If the DTC does not set
    3. All OK.
    - **If parameter is between 55% - 70%**
3. Verify the scan tool Transmission Park Position Switch 1 and Transmission Park Position Switch 2 is between 35% - 45% when the Park Button Switch is pressed on the Transmission Shift Lever assembly.
    - **If parameter is not between 35% - 45%**
    1. Replace the S156 Transmission Shift Lever Knob.
    2. Verify the DTC does not set while operating the vehicle with the Conditions for Running the DTC.
        - If the DTC sets, replace the S3 Transmission Shift Lever.
        - If the DTC does not set
    3. All OK.
    - **If parameter is between 35% - 45%**
4. All OK.

Component Testing

NOTE: **When performing Component Testing on the S3 Transmission Shift Lever, the S156 Transmission Shift Lever Knob should remain attached.**

1. Ignition OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever.
2. Verify circuit is 3 - 3.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch not pressed.
    - **If circuit is not between 3 - 3.5K Ω**

    Replace the S3 Transmission Shift Lever and repeat step 2. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

  - **If circuit is between 3 - 3.5K Ω**

3. Verify circuit is 1 - 1.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch pressed.
   - **If circuit is not between 1 - 1.5K Ω**

     Replace the S3 Transmission Shift Lever and repeat step 3. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

   - **If circuit is between 1 - 1.5K Ω**
4. All OK

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Electronic Transmission Range Selector Component Replacement Reference**
- Refer to **Control Module References** for module replacement, programming, and setup.

DTC P082A-P082F: TRANSMISSION RANGE SELECTOR X/Y POSITION SENSOR 1 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P082A

Transmission Range Selector X Position Sensor 1 Circuit Performance

DTC P082B

Transmission Range Selector X Position Sensor 1 Circuit Low Duty Cycle

DTC P082C

Transmission Range Selector X Position Sensor 1 Circuit High Duty Cycle

DTC P082D

Transmission Range Selector Y Position Sensor 1 Circuit Performance

DTC P082E

Transmission Range Selector Y Position Sensor 1 Circuit Low Duty Cycle

DTC P082F

Transmission Range Selector Y Position Sensor 1 Circuit High Duty Cycle

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P082B, P082E	P082B, P082E	P082C, P082F	-
Signal 1	P082B	P082B	P082C	P082A
Signal 2	P082E	P082E	P082F	P082D

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Low Reference	-	P082B, P082E	-	-

Circuit/System Description

The S3 Transmission Shift Lever will provide electrical signals based on customer input to the K38 Chassis Control Module, where the customer shift request will be determined. The shift lever position is determined by 2 internal sensors that each transmit an X and Y coordinate signal. All 4 signal circuits are inputs to the K38 Chassis Control Module and are diagnosable for a high duty cycle condition, low duty cycle condition, and a signal performance condition. These DTCs will put the vehicle in Latent Fault Mode. Refer to **Latent Fault Mode Description**.

Conditions for Running the DTC

The K38 Chassis Control Module monitors this DTC at all times.

Conditions for Setting the DTC

P082B

The chassis control module detects a low duty cycle percentage, in the Transmission Range Selector X Position Sensor 1 Circuit for 1 s. Low duty cycle is considered less than 5%. Fault must be present for 7 out of 9 samples.

P082C

The chassis control module detects a high duty cycle percentage, in the Transmission Range Selector X Position Sensor 1 Circuit for 1 s. High duty cycle is considered greater than 95%. Fault must be present for 7 out of 9 samples.

P082A

The chassis control module detects a circuit performance condition, in the Transmission Range Selector X Position Sensor 1 Circuit for 1 s. Fault must be present for 7 out of 9 samples. DTC P082B or P082C is not set.

P082E

The chassis control module detects a low duty cycle percentage, in the Transmission Range Selector Y Position Sensor 1 Circuit for 1 s. Low duty cycle is considered less than 5%. Fault must be present for 7 out of 9 samples.

P082F

The chassis control module detects a high duty cycle percentage, in the Transmission Range Selector Y Position Sensor 1 Circuit for 1 s. High duty cycle is considered greater than 95%. Fault must be present for 7 out of 9 samples.

P082D

The chassis control module detects a circuit performance condition, in the Transmission Range Selector Y Position Sensor 1 Circuit for 1 s. Fault must be present for 7 out of 9 samples. DTC P082E or P082F is not set.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present. Type B DTC.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.

- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Transmission Gear Lever X Position 1 Duty Cycle and Transmission Gear Lever Y Position 1 Duty Cycle parameters are between 5% and 95% and duty cycle changes when gear lever is moved to different positions.
   - **If Transmission Gear Lever X Position 1 Duty Cycle is less than 5% or greater than 95% or does not change**

     Refer to Circuit/System Testing for Transmission Range Selector X Position Sensor 1.

   - **If Transmission Gear Lever Y Position 1 Duty Cycle is less than 5% or greater than 95% or does not change**

     Refer to Circuit/System Testing for Transmission Range Selector Y Position Sensor 1.

   - **If both parameters are between 5% and 95% and change but the DTC is still present**

     Refer to Circuit/System Testing for the appropriate sensor.

   - **If both parameters are between 5% and 95% and change with no DTC present**
3. All OK.

Circuit/System Testing

Transmission Range Selector X Position Sensor 1

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 15 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.

        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 13 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K38 Chassis Control Module.
    - **If between 4.8 - 5.2 V**
5. Test for 4.8 - 5.2 V between the signal circuit terminal 14 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K38 Chassis Control Module.
    - **If between 4.8 - 5.2 V**
6. Replace the S3 Transmission Shift Lever.

Transmission Range Selector Y Position Sensor 1

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 15 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.

- **If less than 10 Ω**

3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 13 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the 5 V reference circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the 5 V reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the 5 V reference circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K38 Chassis Control Module.
    - **If between 4.8 - 5.2 V**
5. Test for 4.8 - 5.2 V between the signal circuit terminal 16 and ground.
    - **If less than 4.8 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the signal circuit and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.
        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K38 Chassis Control Module.
    - **If between 4.8 - 5.2 V**
6. Replace the S3 Transmission Shift Lever.

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Electronic Transmission Range Selector Component Replacement Reference**
- Refer to **Control Module References** for module replacement, programming, and setup.

DTC P089B-P089D OR P08A0-P08A2: TRANSMISSION RANGE SELECTOR X/Y POSITION SENSOR 2 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P089B

Transmission Range Selector X Position Sensor 2 Circuit Performance

DTC P089C

Transmission Range Selector X Position Sensor 2 Circuit Low Duty Cycle

DTC P089D

Transmission Range Selector X Position Sensor 2 Circuit High Duty Cycle

DTC P08A0

Transmission Range Selector Y Position Sensor 2 Circuit Performance

DTC P08A1

Transmission Range Selector Y Position Sensor 2 Circuit Low Duty Cycle

DTC P08A2

Transmission Range Selector Y Position Sensor 2 Circuit High Duty Cycle

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P089C, P08A1	P089C, P08A1	P089D, P08A2	-
Signal 1	P089C	P089C	P089D	P089B
Signal 2	P08A1	P08A1	P08A2	P08A0
Low Reference	-	P089C, P08A1	-	-

Circuit/System Description

The S3 Transmission Shift Lever will provide electrical signals based on customer input to the K38 Chassis Control Module, where the customer shift request will be determined. The shift lever position is determined by 2 internal sensors that each transmit an X and Y coordinate signal. All 4 signal circuits are inputs to the K38 Chassis Control Module and are diagnosable for a high duty cycle condition, low duty cycle condition, and a signal performance condition. These DTCs will put the vehicle in Latent Fault Mode. Refer to **Latent Fault Mode Description**.

Conditions for Running the DTC

The K38 Chassis Control Module monitors this DTC at all times.

Conditions for Setting the DTC

P089C

The chassis control module detects a low duty cycle percentage, in the Transmission Range Selector X Position Sensor 2 Circuit for 1 s. Low duty cycle is considered less than 5%. Fault must be present for 7 out of 9 samples.

P089D

The chassis control module detects a high duty cycle percentage, in the Transmission Range Selector X Position Sensor 2 Circuit for 1 s. High duty cycle is considered greater than 95%. Fault must be present for 7 out of 9 samples.

P089B

The chassis control module detects a circuit performance condition, in the Transmission Range Selector X Position Sensor 2 Circuit for 1 s. Fault must be present for 7 out of 9 samples.

P08A1

The chassis control module detects a low duty cycle percentage, in the Transmission Range Selector Y Position Sensor 2 Circuit for 1 s. Low duty cycle is considered less than 5%. Fault must be present for 7 out of 9 samples.

P08A2

The chassis control module detects a high duty cycle percentage, in the Transmission Range Selector Y Position Sensor 2 Circuit for 1 s. High duty cycle is considered greater than 95%. Fault must be present for 7 out of 9 samples.

P08A0

The chassis control module detects a circuit performance condition, in the Transmission Range Selector Y Position Sensor 2 Circuit for 1 s. Fault must be present for 7 out of 9 samples.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present. Type B DTC.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Transmission Gear Lever X Position 2 Duty Cycle and Transmission Gear Lever Y Position 2 Duty Cycle parameters are between 5% and 95% and duty cycle changes when gear lever is moved to different positions.

- **If Transmission Gear Lever X Position 2 Duty Cycle is less than 5% or greater than 95% or does not change**

  Refer to Circuit/System Testing for Transmission Range Selector X Position Sensor 2.

- **If Transmission Gear Lever Y Position 2 Duty Cycle is less than 5% or greater than 95% or does not change**

  Refer to Circuit/System Testing for Transmission Range Selector Y Position Sensor 2.

- **If both parameters are between 5% and 95% and change but the DTC is still present**

  Refer to Circuit/System Testing for the appropriate sensor.

- **If both parameters are between 5% and 95% and change with no DTC present**

3. All OK.

Circuit/System Testing

Transmission Range Selector X Position Sensor 2

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K38 Chassis Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 4 and ground.
   - **If less than 4.8 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 5 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K38 Chassis Control Module.
   - **If greater than 5.2 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
   2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K38 Chassis Control Module.
   - **If between 4.8 - 5.2 V**
5. With the X1 harness connector at the S3 Transmission Shift Lever still disconnected, test for 4.8 - 5.2 V between the signal circuit terminal 1 and ground.
   - **If less than 4.8 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for infinite resistance between the signal circuit and ground.

      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K38 Chassis Control Module.
   - **If greater than 5.2 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K38 Chassis Control Module.
   - **If between 4.8 - 5.2 V**
6. Replace the S3 Transmission Shift Lever.

Transmission Range Selector Y Position Sensor 2

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 2 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K38 Chassis Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 4 and ground.
   - **If less than 4.8 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for infinite resistance between the 5 V reference circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance
   3. Test for less than 2 Ω in the 5 V reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K38 Chassis Control Module.
   - **If greater than 5.2 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
   2. Test for less than 1 V between the 5 V reference circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V, replace the K38 Chassis Control Module.
   - **If between 4.8 - 5.2 V**
5. With the X1 harness connector at the S3 Transmission Shift Lever still disconnected, test for 4.8 - 5.2 V between the signal circuit terminal 3 and ground.
   - **If less than 4.8 V**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for infinite resistance between the signal circuit and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance
    3. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If greater than 5.2 V**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V, replace the K38 Chassis Control Module.
    - **If between 4.8 - 5.2 V**

6. Replace the S3 Transmission Shift Lever.

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Electronic Transmission Range Selector Component Replacement Reference**
- Refer to **Control Module References** for module replacement, programming, and setup.

DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, OR P17D5: TRANSMISSION RANGE CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC C1201

Transmission Range Redundant Command Message Counter Incorrect

DTC P16F4

Control Module Transmission Range Switch Input Circuitry Performance

DTC P173A

Transmission Range Control Module 5V Reference 1 Circuit Low Voltage

DTC P173B

Transmission Range Control Module 5V Reference 1 Circuit High Voltage

DTC P173C

Transmission Range Control Module 5V Reference 1 Circuit Intermittent

DTC P173D

Transmission Range Control Module 5V Reference 2 Circuit Low Voltage

DTC P173E

Transmission Range Control Module 5V Reference 2 Circuit High Voltage

DTC P173F

Transmission Range Control Module 5V Reference 2 Circuit Intermittent

DTC P174B

Transmission Range Control Module Range Command Signal Message Counter Incorrect

DTC P1771

Transmission Range Control Module Actuation Command Signal Message Counter Incorrect

DTC P178B

Backup Park Lock Actuator Backup Power Supply Performance

DTC P178C

Backup Park Lock Actuator Performance During Park Test

DTC P178D

Backup Park Lock Actuator Performance

DTC P178E

Backup Park Lock Actuator Arming Performance

DTC P17AA

Transmission Range Control Module Read Only Memory Performance

DTC P17AC

Transmission Range Control Module Long Term Memory Reset

DTC P17AD

Transmission Range Control Module Random Access Memory Performance

DTC P17AE

Transmission Range Control Module Performance

DTC P17B1

Transmission Range Control Module System Voltage Performance

DTC P17B6

Transmission Range Selector Shaft Position Sensor Loss of Signal

DTC P17B7

Transmission Range Selector Shaft Position Sensor Signal Low Voltage

DTC P17B8

Transmission Range Selector Shaft Position Sensor Signal High Voltage

DTC P17B9

Transmission Range Selector Shaft Position Sensor Performance

DTC P17BA

Transmission Range Control Module Range Motor Enable Circuit Low Voltage

DTC P17BB

Transmission Range Control Module Range Motor Enable Circuit High Voltage

DTC P17BC

Transmission Range Control Module Range Motor Low Voltage

DTC P17BD

Transmission Range Control Module Range Motor High Voltage

DTC P17BF

Transmission Range Control Module Range Motor Control Circuit High Current

DTC P17CF

Backup Park Lock Actuator Supply Voltage Circuit Low Voltage

DTC P17D5

Transmission Range Control Slow Response

Circuit/System Description

The internal fault detection is handled inside the device. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to replacement of components or programming/setup of module. Faults in any component or module that work together in this system may cause the programming/setup failure.
- Replacement or inspection of K173 Transmission Range Control Module requires rod linkage (if equipped) to be adjusted. If rod linkage is not properly adjusted, programming and setup procedure may fail and DTCs may set. Check K173 Transmission Range Control Module rod linkage adjustment prior to replacing the K173 Transmission Range Control Module. Something as simple as loosening the K173 Transmission Range Control Module mounting bolts can cause the module to be out of adjustment.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify DTC C1201, P16F4, P173A-P173F, P174B, P1771, P178B-P178E, P17AA, P17AC-P17AE, P17B1-P17B9, P17BA-P17BF, P17CF, or P17D5 is not set.
    - **If any of the DTCs are set**
    1. Perform the **programming** procedure for the K173 Transmission Range Control Module.
    2. Verify the DTC does not set.
        - If the DTC is set, replace the K173 Transmission Range Control Module.
        - If the DTC does not set
    3. All OK
    - **If none of the DTCs are set**
3. All OK

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Electronic Transmission Range Selector Component Replacement Reference**
- Refer to **Control Module References** for module replacement, programming and setup

DTC P174C: TRANSMISSION RANGE CONTROL MODULE WHEEL SPEED SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P174C

Transmission Range Control Module Wheel Speed Signal Message Counter Incorrect

Circuit/System Description

The wheel speeds are detected by active wheel speed sensors. Each wheel speed sensor receives a 12 V reference voltage from the electronic brake control module (EBCM) and provides an alternating current square wave signal to the EBCM. As the wheel spins, the EBCM uses the frequency of the square wave signal to calculate the wheel speed. The EBCM sends the wheel speed information as a high speed controller area network (CAN) serial data message.

Conditions for Running the DTC

Ignition ON/Vehicle in Service Mode.

Conditions for Setting the DTC

A supervised periodic message that includes the wheel speed serial data has not been received.

Action Taken When the DTC Sets

Specific subsystems will not function or operate in degraded mode.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

ABS Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Diagnostic Aids

- This DTC can be set due to an incorrect part wheel speed sensor installed.
- Inspect the wheel encoder ring for rust or corrosion.
- If the customer comments that the ABS indicator is ON only during moist environmental conditions (rain, snow, vehicle wash, etc.), inspect the wheel speed sensor wiring for signs of water intrusion.

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC C0035, C0040, C0045, or C0050 is not set in the K17 Electronic Brake Control Module.
    - **If any listed DTC is set**

Refer to Diagnostic Trouble Code (DTC) List - Vehicle to diagnose DTC prior to this diagnostic.

- **If any listed DTC is not set**

3. Replace the K17 Electronic Brake Control Module.
4. Verify the DTC does not set while operating the vehicle under the Conditions for Running the DTC.
   - **If the DTC sets**

     Replace the module that set the DTC.

   - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Refer to Control Module References for control module replacement, programming and setup

DTC P174D OR P17AB: TRANSMISSION RANGE CONTROL MODULE RANGE NOT LEARNED/NOT PROGRAMMED

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P174D

Transmission Range Control Module Range Not Learned

DTC P17AB

Transmission Range Control Module Not Programmed

Circuit/System Description

Some devices must be configured with specific software, serial numbers, vehicle options, or other information. If a device was not properly configured after installation that module may set DTC P174D or DTC P17AB. No external circuit diagnosis is involved.

Conditions for Running the DTC

Battery voltage is between 9 - 16 V and data link communications operate normally.

Conditions for Setting the DTC

The device is not configured properly.

Conditions for Clearing the DTC

- MIL will be illuminated on first trip with fault present. Type A DTC.
- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold, without a repeat of the malfunction.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify that DTC P174D or P17AB is not set.
    - **If DTC P174D is set**

      Perform the **programming and learn** procedure for the K173 Transmission Range Control Module.

    1. Verify DTC P174D is not set.
        - If DTC P174D is set

          Replace the K173 Transmission Range Control Module.

        - If DTC P174D is not set

          All OK.

    - **If DTC P17AB is set**

      Perform the **programming** procedure for the K173 Transmission Range Control Module.

    1. Verify DTC P17AB is not set.
        - If DTC P17AB is set

          Replace the K173 Transmission Range Control Module.

        - If DTC P17AB is not set

          All OK.

    - **If none of the DTCs are set**
3. All OK

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for module replacement, programming and setup.

DTC P1772, P1773, P1775, OR P1778: POWERFLOW ENGAGED/INTERNAL MODE SWITCH STATE/TRANSMISSION RANGE REQUEST/TRANSMISSION RANGE

AVAILABILITY SIGNAL MESSAGE COUNTER(S) INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1772

Powerflow Engaged Signal Message Counter Incorrect

DTC P1773

Internal Mode Switch State Signal Message Counter Incorrect

DTC P1775

Transmission Range Request Signal Message Counter Incorrect

DTC P1778

Transmission Range Availability Signal Message Counter Incorrect

Circuit/System Description

The internal fault detection is handled inside the device. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to replacement of components or programming/setup of module. Faults in any component or module that work together in this system may cause the programming/setup failure.
- Replacement or inspection of K173 Transmission Range Control Module requires rod linkage (if equipped) to be adjusted. If rod linkage is not properly adjusted, programming and setup procedure may fail and DTCs may set. Check K173 Transmission Range Control Module rod linkage adjustment prior to replacing the K173 Transmission Range Control Module. Something

as simple as loosening the K173 Transmission Range Control Module mounting bolts can cause the module to be out of adjustment.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Check for updated software in K71 Transmission Control Module.
    - **If software is not current**

      Perform the **programming** procedure for the K71 Transmission Control Module.

    - **If software is up to date**
3. Replace the K71 Transmission Control Module.
4. Verify DTC P1772, P1773, P1775, or P1778 did not set.
    - **If any of the DTCs are set**

      Replace the K38 Chassis Control Module

    - **If none of the DTCs are set**
5. All OK.

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Control Module References** for module replacement, programming and setup

DTC P1774 OR P177A: RANGE MOTOR POSITION/BACKUP PARK LOCK ACTUATOR STATUS MESSAGE COUNTER(S) INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1774

Range Motor Position Status Message Counter Incorrect

DTC P177A

Backup Park Lock Actuator Status Message Counter Incorrect

Circuit/System Description

The internal fault detection is handled inside the device. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to replacement of components or programming/setup of module. Faults in any component or module that work together in this system may cause the programming/setup failure.
- Replacement or inspection of K173 Transmission Range Control Module requires rod linkage (if equipped) to be adjusted. If rod linkage is not properly adjusted, programming and setup procedure may fail and DTCs may set. Check K173 Transmission Range Control Module rod linkage adjustment prior to replacing the K173 Transmission Range Control Module. Something as simple as loosening the K173 Transmission Range Control Module mounting bolts can cause the module to be out of adjustment.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**

- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify no other DTCs are set.
    - **If other DTCs are set**

      Refer to Diagnostic Trouble Code (DTC) List - Vehicle and resolve all other DTCs

    - **If no other DTCs are set**
3. Verify K173 Transmission Range Control Module is mounted securely and if it has a linkage ensure the linkage from K173 Transmission Range Control Module to Transmission is adjusted properly with no excessive play.
    - **If play is found in the mounting of the K173 Transmission Range Control Module or linkage**

      Resolve issue and perform K173 Transmission Range Control Module learn procedure. Refer to Transmission Range Control Module Range Motor Position Learn.

    - **If no play is found in the mounting of the K173 Transmission Range Control Module or linkage**
4. Check for updated software in K173 Transmission Range Control Module.
    - **If software is not current**

      Perform the **programming** procedure for the K173 Transmission Range Control Module.

    - **If software is up to date**
5. Replace the K173 Transmission Range Control Module
6. Verify DTC P1774 or P177A did not set.
    - **If any of the DTCs are set**

      Replace the K38 Chassis Control Module

    - **If none of the DTCs are set**
7. All OK.

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair.
- Refer to Control Module References for module replacement, programming and setup

DTC P1787 OR P17C8: UNEXPECTED RANGE CHANGE DETECTED/TRANSMISSION RANGE CONTROL MODULE RANGE MOTOR COMMAND PERFORMANCE - PROTECTION MODE ACTIVE

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Refer to Diagnostic Procedure Instructions to provide an overview of each diagnostic category.

DTC Descriptor

DTC P1787

Unexpected Range Change Detected

DTC P17C8

Transmission Range Control Module Range Motor Command Performance - Protection Mode Active

Circuit/System Description

The S3 Transmission Shift Lever will provide electrical signals based on customer input to the K38 Chassis Control Module, where the customer shift request will be determined. When the K38 Chassis Control Module receives the gear request signal from the S3 Transmission Shift Lever it sends the message for the K173 Transmission Range Control Module to engage the selected gear.

Conditions for Running the DTC

The Ignition is ON.

Conditions for Setting the DTC

P1787

The actual transmission range does not equal the requested transmission range, without the driver requesting a range change.

P17C8

The device has detected an internal malfunction.

Action Taken When the DTC Sets

DTC P1787 or P17C8 is a Type B DTC. The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify no other DTCs are set.
    - **If other DTCs are set**

      Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** and resolve all other DTCs

    - **If no other DTCs are set**
3. Verify K173 Transmission Range Control Module is mounted securely and if it has a linkage ensure the linkage from K173 Transmission Range Control Module to Transmission is adjusted properly with no excessive play.
    - **If play is found in the mounting of the K173 Transmission Range Control Module or linkage**

      Resolve issue and perform K173 Transmission Range Control Module learn procedure. Refer to **Transmission Range Control Module Range Motor Position Learn**.

    - **If no play is found in the mounting of the K173 Transmission Range Control Module or linkage**
4. Verify K173 Transmission Range Control Module has the most up to date software.
    - **If software is not current**

      Perform the **programming** procedure for the K173 Transmission Range Control Module.

    - **If software is up to date**
5. Perform the Backup Park Lock Actuator Arming procedure. Refer to **Backup Park Lock Actuator Arming**.
6. Verify DTC P1787 or P17C8 is not set.
    - **If DTC P1787 or P17C8 is set**

      Replace the K173 Transmission Range Control Module

      1. Verify DTC P1787 or P17C8 is not set.
          - If DTC P1787 or P17C8 is set

            Replace the K38 Chassis Control Module.

          - If DTC P1787 or P17C8 is not set

            All OK.

    - **If DTC P1787 or P17C8 is not set**
7. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

Refer to **Control Module References** for module replacement, programming and setup.

DTC P17A3-P17A5: TRANSMISSION SHIFT INTERLOCK 1 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P17A3

Transmission Shift Interlock 1 Circuit Low

DTC P17A4

Transmission Shift Interlock 1 Circuit High

DTC P17A5

Transmission Shift Interlock 1 Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P17A3	P17A4	P17A4	P17A5
Low Reference	-	P17A4	-	-

Circuit/System Description

The Shift Interlock Button Switch is located in the S156 Transmission Shift Lever Knob which is mounted on the S3 Transmission Shift Lever. The Shift Interlock Button Switch has two internal sensors which are monitored by the K38 Chassis Control Module. When the Shift Interlock switch is pressed the K38 Chassis Control Module will process the request and send a command signal to the K173 Transmission Range Control Module via serial data.

Conditions for Running the DTC

P17A3 or P17A4

The K38 Chassis Control Module monitors this DTC at all times.

P17A5

P17A3 or P17A4 is not set.

Conditions for Setting the DTC

P17A3

The chassis control module detects a low voltage condition, in the Shift Interlock 1 circuit for 1 s. Low voltage is considered 0.2 - 0 volts. Fault must be present for 7 out of 9 samples.

P17A4

The chassis control module detects a high voltage condition, in the Shift Interlock 1 circuit for 1 s. High voltage is considered anything greater than 4.8 volts. Fault must be present for 7 out of 9 samples.

P17A5

The chassis control module detects a circuit performance condition, in the Shift Interlock 1 circuit for 1 s. Voltage performance fault is considered 3.1 - 3.5 volts. Fault must be present for 7 out of 9 samples.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.

- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Transmission Shift Interlock Switch 1 parameter is 50% - 60% when the Shift Interlock Button is pressed on the Transmission Shift Lever assembly.
    - **If parameter is not 50% - 60%**

      Refer to Circuit/System Testing.

    - **If parameter is 50% - 60%**
3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 18 and ground.
    - **If 10 Ω or greater**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for less than 2 Ω in the low reference circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Transmission Shift Interlock Switch 1 parameter is greater than 95%.
    - **If less than 95%**
    1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
    2. Test for infinite resistance between the signal circuit terminal 19 and ground.
        - If less than infinite resistance, repair the short to ground on the circuit.

        - If infinite resistance, replace the K38 Chassis Control Module.
    - **If greater than 95%**
5. Install a 3 A fused jumper wire between the signal circuit terminal 19 and the low reference circuit terminal 18.
6. Verify the scan tool Transmission Shift Interlock Switch 1 is less than 5%.
    - **If greater than 5%**
    1. Ignition OFF/Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
    2. Test for less than 1 V between the signal circuit and ground.
        - If 1 V or greater, repair the short to voltage on the circuit.
        - If less than 1 V
    3. Ignition OFF/Vehicle OFF
    4. Test for less than 2 Ω in the signal circuit end to end.
        - If 2 Ω or greater, repair the open/high resistance in the circuit.
        - If less than 2 Ω, replace the K38 Chassis Control Module.
    - **If less than 5%**
7. Replace the S3 Transmission Shift Lever.
8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
    - **If the DTC sets**

      Replace the S156 Transmission Shift Lever Knob.

    - **If the DTC does not set**
9. All OK.

Component Testing

NOTE: **When performing Component Testing on the S3 Transmission Shift Lever, the S156 Transmission Shift Lever Knob should remain attached.**

1. Ignition OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever.
2. Verify circuit is 3 - 3.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch not pressed.
    - **If circuit is not between 3 - 3.5K Ω**

      Replace the S3 Transmission Shift Lever and repeat step 2. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

    - **If circuit is between 3 - 3.5K Ω**
3. Verify circuit is 1 - 1.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch pressed.
    - **If circuit is not between 1 - 1.5K Ω**

      Replace the S3 Transmission Shift Lever and repeat step 3. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

    - **If circuit is between 1 - 1.5K Ω**
4. All OK

Repair Instructions

- Perform the Diagnostic Repair Verification after completing the repair.
- Refer to Electronic Transmission Range Selector Component Replacement Reference
- Refer to Control Module References for module replacement, programming, and setup.

DTC P17A6 OR P17F4: TRANSMISSION SHIFT INTERLOCK SWITCH 1-2 NOT PLAUSIBLE/TRANSMISSION SHIFT INTERLOCK SWITCH CIRCUIT 1 OR 2 STUCK ON

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P17A6

Transmission Shift Interlock Switch 1-2 Not Plausible

DTC P17F4

Transmission Shift Interlock Switch Circuit 1 or 2 Stuck On

Circuit/System Description

The Shift Interlock Button Switch is located in the S156 Transmission Shift Lever Knob which is mounted on the S3 Transmission Shift Lever. The Shift Interlock Button Switch has two internal sensors which are monitored by the K38 Chassis Control Module. When the Shift Interlock switch is pressed the K38 Chassis Control Module will process the request and send a command signal to the K173 Transmission Range Control Module via serial data.

Conditions for Running the DTC

The K38 Chassis Control Module monitors this DTC at all times.

Conditions for Setting the DTC

P17A6

Shift Interlock Switch 1 and Shift Interlock Switch 2 are both in valid positions (Pressed or Released) but positions to do not match. Fault must be present for 7 out of 9 samples.

P17F4

Shift Interlock Switch 1 and Shift Interlock Switch 2 are both in valid positions (Pressed or Released) but positions to do not match. Fault must be present for 7 out of 9 samples.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Diagnostic Aids

If the Shift Interlock Button is not firmly pressed in the center, there is a chance that 1 of the 2 contacts within the button will not make contact. This could cause DTC P17A6 or DTC P17F4 to set without any fault present. If this is the case, the customer should be educated to press the Shift Interlock Button firmly and in the center.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Shift Interlock Switch 1 and Shift Interlock Switch 2 is between 67% - 85% when the Park Button Switch is not being pressed on the Transmission Shift Lever assembly.
    - **If parameter is not between 67% - 85%**
    1. Replace the S156 Transmission Shift Lever Knob.
    2. Verify the DTC does not set while operating the vehicle with the Conditions for Running the DTC.
        - If the DTC sets, replace the S3 Transmission Shift Lever.
        - If the DTC does not set
    3. All OK.
    - **If parameter is between 67% - 85%**
3. Verify the scan tool Shift Interlock Switch 1 and Shift Interlock Switch 2 is between 50% - 60% when the Shift Interlock Button is pressed on the Transmission Shift Lever assembly.
    - **If parameter is not between 50% - 60%**
    1. Replace the S156 Transmission Shift Lever Knob.
    2. Verify the DTC does not set while operating the vehicle with the Conditions for Running the DTC.
        - If the DTC sets, replace the S3 Transmission Shift Lever.
        - If the DTC does not set
    3. All OK.
    - **If parameter is between 50% - 60%**
4. All OK.

Component Testing

NOTE: **When performing Component Testing on the S3 Transmission Shift Lever, the S156 Transmission Shift Lever Knob should remain attached.**

1. Ignition OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever.
2. Verify circuit is 3 - 3.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch not pressed.
    - **If circuit is not between 3 - 3.5K Ω**

Replace the S3 Transmission Shift Lever and repeat step 2. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

  - **If circuit is between 3 - 3.5K Ω**

3. Verify circuit is 1 - 1.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch pressed.
   - **If circuit is not between 1 - 1.5K Ω**

     Replace the S3 Transmission Shift Lever and repeat step 3. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

   - **If circuit is between 1 - 1.5K Ω**
4. All OK

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Electronic Transmission Range Selector Component Replacement Reference**
- Refer to **Control Module References** for module replacement, programming, and setup.

DTC P17A7-P17A9: TRANSMISSION SHIFT INTERLOCK 2 CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P17A7

Transmission Shift Interlock 2 Circuit Low

DTC P17A8

Transmission Shift Interlock 2 Circuit High

DTC P17A9

Transmission Shift Interlock 2 Circuit Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P17A7	P17A8	P17A8	P17A9
Low Reference	-	P17A8	-	-

Circuit/System Description

The Shift Interlock Button Switch is located in the S156 Transmission Shift Lever Knob which is mounted on the S3 Transmission Shift Lever. The Shift Interlock Button Switch has two internal sensors which are monitored by the K38 Chassis Control Module. When the Shift Interlock switch is pressed the K38 Chassis Control Module will process the request and send a command signal to the K173 Transmission Range Control Module via serial data.

Conditions for Running the DTC

P17A7 or P17A8

The K38 Chassis Control Module monitors this DTC at all times.

P17A9

P17A7 or P17A8 is not set.

Conditions for Setting the DTC

P17A7

The chassis control module detects a low voltage condition, in the Shift Interlock 2 circuit for 1 s. Low voltage is considered 0.2 - 0 volts. Fault must be present for 7 out of 9 samples.

P17A8

The chassis control module detects a high voltage condition, in the Shift Interlock 2 circuit for 1 s. High voltage is considered anything greater than 4.8 volts. Fault must be present for 7 out of 9 samples.

P17A9

The chassis control module detects a circuit performance condition, in the Shift Interlock 2 circuit for 1 s. Voltage performance fault is considered 3.1 - 3.5 volts. Fault must be present for 7 out of 9 samples.

Action Taken When the DTC Sets

- MIL will be illuminated on second trip with fault present.
- Vehicle will not be allowed to shift out of park after 35 to 50 trips with fault present.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present and the ignition switch is cycled.
- A history DTC will clear after 40 ignition cycles with no current DTC active during the 40 ignition cycles.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Verify the scan tool Transmission Shift Interlock Switch 2 parameter is 50% - 60% when the Shift Interlock Button is pressed on the Transmission Shift Lever assembly.

- **If parameter is not 50% - 60%**

  Refer to Circuit/System Testing.

- **If parameter is 50% - 60%**

3. All OK.

Circuit/System Testing

1. Ignition OFF/Vehicle OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 20 and ground.
   - **If 10 Ω or greater**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for less than 2 Ω in the low reference circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K38 Chassis Control Module.
   - **If less than 10 Ω**
3. Ignition ON/Vehicle in Service Mode.
4. Verify the scan tool Transmission Shift Interlock Switch 2 parameter is greater than 95%.
   - **If not greater than 95%**
   1. Ignition OFF/Vehicle OFF, disconnect the harness connector at the K38 Chassis Control Module.
   2. Test for infinite resistance between the signal circuit terminal 21 and ground.
      - If less than infinite resistance, repair the short to ground on the circuit.
      - If infinite resistance, replace the K38 Chassis Control Module.
   - **If greater than 95%**
5. Install a 3 A fused jumper wire between the signal circuit terminal 21 and the low reference circuit terminal 20.
6. Verify the scan tool Transmission Shift Interlock Switch 2 is less than 5%.
   - **If greater than 5%**
   1. Ignition OFF/Vehicle OFF, remove the jumper wire, disconnect the harness connector at the K38 Chassis Control Module, Ignition ON/Vehicle in Service Mode.
   2. Test for less than 1 V between the signal circuit and ground.
      - If 1 V or greater, repair the short to voltage on the circuit.
      - If less than 1 V
   3. Ignition OFF/Vehicle OFF
   4. Test for less than 2 Ω in the signal circuit end to end.
      - If 2 Ω or greater, repair the open/high resistance in the circuit.
      - If less than 2 Ω, replace the K38 Chassis Control Module.
   - **If less than 5%**
7. Replace the S3 Transmission Shift Lever.
8. Verify the DTC does not set while operating the vehicle within the Conditions for Running the DTC.
   - **If the DTC sets**

     Replace the S156 Transmission Shift Lever Knob.

   - **If the DTC does not set**
9. All OK.

Component Testing

NOTE: **When performing Component Testing on the S3 Transmission Shift Lever, the S156 Transmission Shift Lever Knob should remain attached.**

1. Ignition OFF, disconnect the X1 harness connector at the S3 Transmission Shift Lever.
2. Verify circuit is 3 - 3.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch not pressed.
   - **If circuit is not between 3 - 3.5K Ω**

     Replace the S3 Transmission Shift Lever and repeat step 2. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

   - **If circuit is between 3 - 3.5K Ω**
3. Verify circuit is 1 - 1.5K Ω between signal circuit terminal 9 and the low reference circuit terminal 10, with the Park Button Switch pressed.
   - **If circuit is not between 1 - 1.5K Ω**

     Replace the S3 Transmission Shift Lever and repeat step 3. If issue still occurs, replace the S156 Transmission Shift Lever Knob.

   - **If circuit is between 1 - 1.5K Ω**
4. All OK

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Electronic Transmission Range Selector Component Replacement Reference**
- Refer to **Control Module References** for module replacement, programming, and setup.

DTC P17CB: HYBRID CHARGING SYSTEM PARK REQUEST SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- Refer to **Diagnostic Procedure Instructions** to provide an overview of each diagnostic category.

DTC Descriptor

DTC P17CB

Hybrid Charging System Park Request Signal Message Counter Incorrect

Circuit/System Description

The internal fault detection is handled inside the device. No external circuit diagnosis is involved.

Conditions for Running the DTC

The device runs the program to detect an internal fault when power up is commanded. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The device has detected an internal malfunction.

Action Taken When the DTC Sets

The device refuses all additional inputs.

Conditions for Clearing the DTC

- A current DTC clears when the malfunction is no longer present.
- A history DTC clears when the device ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

- This DTC may be stored as a history DTC without affecting the operation of the device.
- If stored only as a history DTC and not retrieved as a current DTC, do not replace the device.
- If this DTC is retrieved as both a current and history DTC, replace the device that set the DTC.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to replacement of components or programming/setup of module. Faults in any component or module that work together in this system may cause the programming/setup failure.
- Replacement or inspection of K173 Transmission Range Control Module requires rod linkage (if equipped) to be adjusted. If rod linkage is not properly adjusted, programming and setup procedure may fail and DTCs may set. Check K173 Transmission Range Control Module rod linkage adjustment prior to replacing the K173 Transmission Range Control Module. Something as simple as loosening the K173 Transmission Range Control Module mounting bolts can cause the module to be out of adjustment.

Reference Information

Schematic Reference

Electronic Transmission Range Selector Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Transmission Range Selector Description

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON/Vehicle in Service Mode.
2. Check for updated software in T6 Hybrid Powertrain Control Module.
    - **If software is not current**

      Perform the **programming** procedure for the T6 Hybrid Powertrain Control Module.

    - **If software is up to date**
3. Replace the T6 Hybrid Powertrain Control Module.
4. Verify DTC P17CB is not set.
    - **If DTC P17CB is set**

      Replace the K38 Chassis Control Module

    - **If DTC P17CB is not set**

5. All OK.

Repair Instructions

- Perform the **Diagnostic Repair Verification** after completing the repair.
- Refer to **Control Module References** for module replacement, programming and setup

ELECTRONIC TRANSMISSION RANGE SELECTOR COMPONENT REPLACEMENT REFERENCE

Component	Transmission RPO	Repair Instruction
S3 Transmission Shift Lever	MKE	**Transmission Electronic Control Replacement**
K173 Transmission Range Control Module	MKE	**Automatic Transmission Range Selector Actuator Hardware Module Replacement**

BACKUP PARK LOCK ACTUATOR ARMING

Introduction

The Backup Park Lock function is electrically isolated from the Transmission Range Control Module, and forces the transmission manual shaft to the Park position under specified conditions. Under these conditions the vehicle is put in Latent Fault Mode, refer to **Latent Fault Mode Description**. The procedures below are designed to assist in the arming of the Backup Park Lock Actuator when the position of the actuator becomes unknown. Before you start, read these procedures carefully and completely. For further information regarding the Transmission Range Selector system refer to **Electronic Transmission Range Selector Description**.

Before Running the Arming Procedure

- Ensure Transmission Range Control Module and Chassis Control Module software packages are the most current software available.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to running learn procedure. Refer to **Electronic Transmission Range Selector Description**. Faults in any component or module that work together in this system may cause a learn procedure failure.
- Ensure the MDI tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during learn, learn failure or ECU damage may occur.
- Stable battery voltage is critical during learn procedure. Any fluctuation, spiking, over voltage or loss of voltage will interrupt learn procedure. Install the **EL-49642** SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack unplugged/disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.

Starting the Arming Procedure

1. With your foot off the brake, press and hold the Start/Run Button for 10 seconds to set the ignition correctly.
2. Install a scan tool.
3. Verify that the transmission fluid temperature is 50Ã‚Â°F (10Ã‚Â°C) or greater before running the arming procedure.
4. In the scan tool under Transmission Range Control Module, Configuration/Reset Functions perform the Backup Park Lock Actuator Arming procedure. Follow all on-screen instructions.
5. If arming procedure failure occurs, refer to wiring diagnostics to resolve any electrical faults.
6. Attempt rerunning the arming procedure 2 additional times before replacing Transmission Range Control Module. If the test successfully completed, cycle the ignition OFF.
7. After the Backup Park Lock Actuator Arming procedure has completed successfully, perform the **Diagnostic Repair Verification** .

8. Clear DTCs after arming is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

BACKUP PARK LOCK ACTUATOR DISARMING

Introduction

The Backup Park Lock function is an electrically isolated smart actuator inside the Transmission Range Control Module that is activated when the transmission does not achieve Park. When the Backup Park Lock function is activated, the gear is "disarmed" which rotates the torsional spring forcing the transmission manual shaft to the Park position. The procedure below is designed to disarm the Backup Park Lock Actuator when the rod linkage is adjusted (if equipped) or if the Transmission Range Control Module is being removed then reinstalled. Before you start, read these procedures carefully and completely. For further information regarding the Transmission Range Selector system refer to **Electronic Transmission Range Selector Description**.

Before Running the Disarming Procedure

- Ensure Transmission Range Control Module and Chassis Control Module software packages are the most current software available.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to running the disarming procedure. Refer to **Electronic Transmission Range Selector Description**. Faults in any component or module that work together in this system may cause a disarming procedure failure.
- Ensure the MDI tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during disarming, disarming failure or ECU damage may occur.
- Stable battery voltage is critical during disarming procedure. Any fluctuation, spiking, over voltage or loss of voltage will interrupt disarming procedure. Install the **EL-49642** SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack unplugged/disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.

Starting the Disarming Procedure

1. With your foot off the brake, press and hold the Start/Run Button for 10 seconds to set the ignition correctly.
2. Install a scan tool.
3. Verify that the transmission fluid temperature is 50Ã‚Â°F (10Ã‚Â°C) or greater before running the disarming procedure.
4. In the scan tool under Transmission Range Control Module, Configuration/Reset Functions perform the Backup Park Lock Actuator Disarming procedure. Follow all on-screen instructions.
5. If disarming procedure failure occurs, refer to wiring diagnostics to resolve any electrical faults.
6. Attempt rerunning the disarming procedure 2 additional times before replacing Transmission Range Control Module. If the test successfully completed, cycle the ignition OFF.

TRANSMISSION RANGE CONTROL MODULE RANGE MOTOR POSITION LEARN

Introduction

The Electronic Transmission Range Selector system needs to know exact position of the Transmission Range Control Module Range Motor and the Backup Park Lock Actuator on the Transmission manual shaft. The procedures below are designed to assist in the learning of the Transmission Range Control Module Range Motor and Backup Park Lock Actuator position. Before you start, read these procedures carefully and completely. For further information regarding the Transmission Range Selector system refer to **Electronic Transmission Range Selector Description**.

Before Running the Learn Procedure

- Ensure Transmission Range Control Module and Chassis Control Module software packages are the most current software available.
- Resolve any current DTC's that are present relating to the Electronic Transmission Range Selector system prior to running learn procedure. Refer to **Electronic Transmission Range Selector Description**. Faults in any component or module that work together in this system may cause a learn procedure failure.
- Ensure the MDI tool is equipped with the latest software and is securely connected to the data link connector. If there is an interruption during learn, learn failure or ECU damage may occur.
- Stable battery voltage is critical during learn procedure. Any fluctuation, spiking, over voltage or loss of voltage will interrupt learn procedure. Install the **EL-49642** SPS Programming Support Tool to maintain system voltage. If not available, connect a fully charged 12 V jumper or booster pack unplugged/disconnected from the AC voltage supply.
- Turn OFF or disable systems that may put a load on the vehicles battery such as; interior lights, exterior lights (including daytime running lights), HVAC, radio, etc.

NOTE: **Loosening of the fasteners or replacement of the Transmission Range Control Module will cause module to become out of adjustment. If module is not properly adjusted, learn procedure may fail. If learn procedure fails, check Transmission Range Control Module mounting bolts and rod linkage if applicable prior to replacing the Transmission Range Control Module and running the learn procedure.**

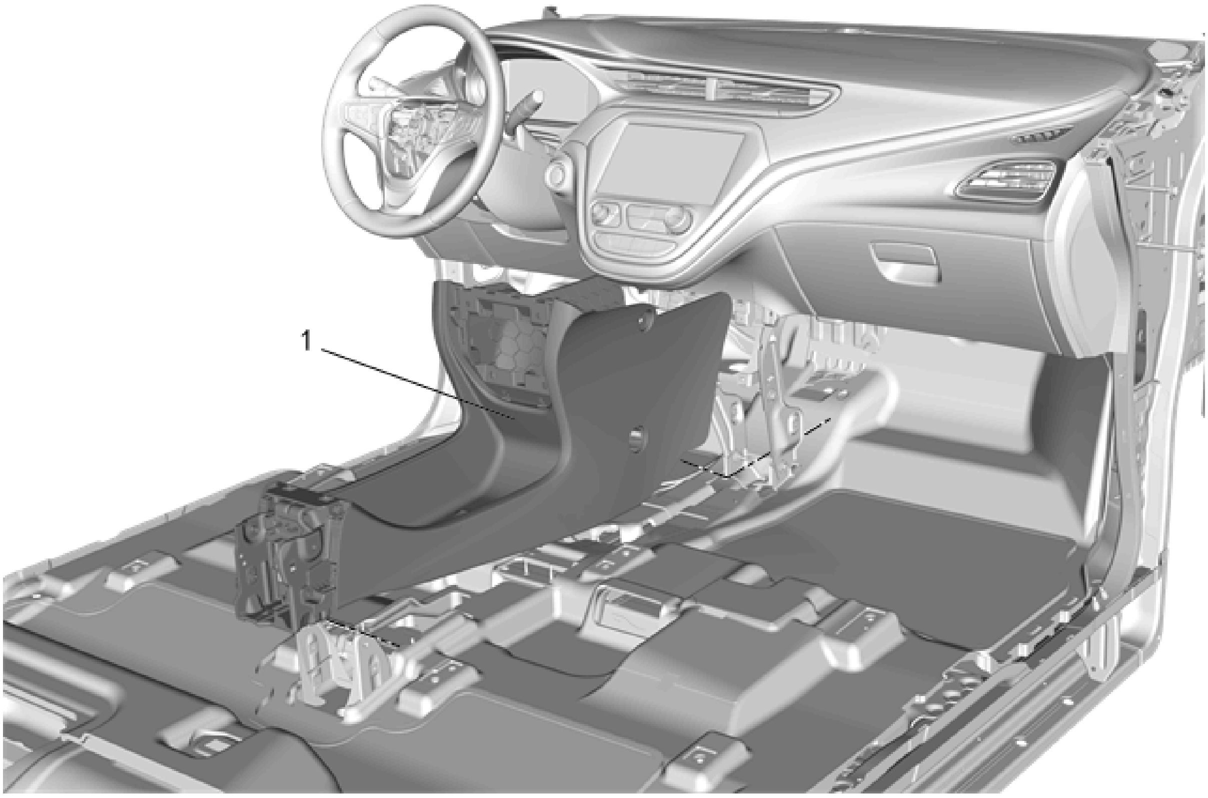
Starting the Learn Procedure

1. With your foot off the brake, press and hold the Start/Run Button for 10 seconds to set the ignition correctly.
2. Install a scan tool.
3. Verify that the transmission fluid temperature is between 50Ã‚Â°F (10Ã‚Â°C) to 104Ã‚Â°F (40Ã‚Â°C) before running a learn procedure.
4. In the scan tool under Transmission Range Control Module, Configuration/Reset Functions perform the Transmission Range Control Module Range Motor Position Learn procedure. Follow all on-screen instructions.
5. If learn procedure failure occurs, refer to wiring diagnostics to resolve any electrical faults and check Transmission Range Control Module mounting bolts, and rod linkage adjustment if applicable. Any looseness or movement in the Transmission Range Control Module will cause learn failure.
6. Attempt rerunning the learn procedure 2 additional times (adjusting rod linkage, if equipped, before each attempt) before replacing Transmission Range Control Module. If the test successfully completed, cycle the ignition OFF.
7. After the Transmission Range Control Module Range Motor Position Learn procedure has completed successfully, perform the **Diagnostic Repair Verification** .
8. Clear DTCs after learn is complete. Clearing powertrain DTCs will set the Inspection/Maintenance (I/M) system status indicators to NO.

REPAIR INSTRUCTIONS

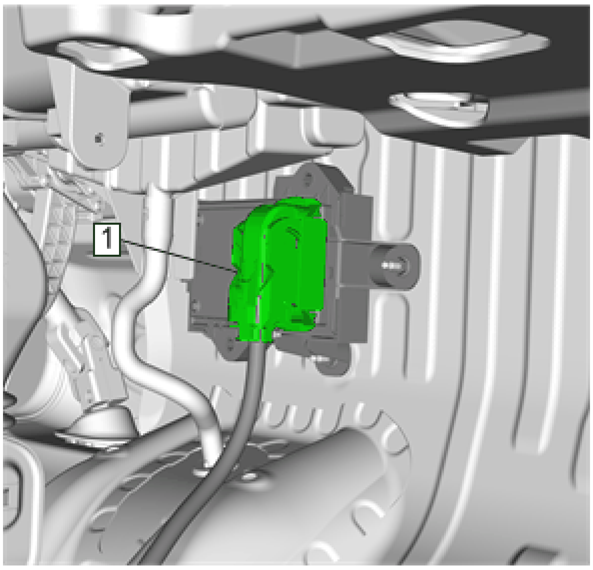
CHASSIS CONTROL MODULE REPLACEMENT

Removal Procedure



[Fig. 3: Front Floor Console](#)
Courtesy of GENERAL MOTORS COMPANY

1. Remove Front Floor Console (1) @ Vehicle. Refer to **Front Floor Console Replacement**



[Fig. 4: Electrical Connector](#)
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1) @ Chassis Control Module

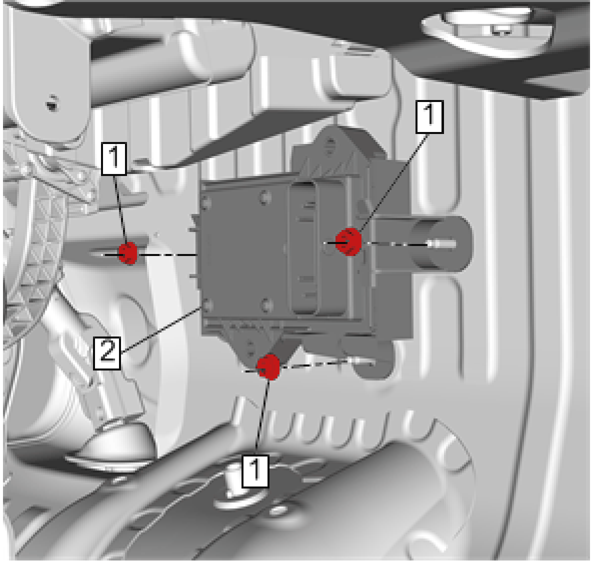


Fig. 5: Chassis Control Module/Bracket Assembly And Nuts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Chassis Control Module Bracket Nuts (1) (Qty: 3)
4. Remove the chassis control module and bracket assembly (2) from the vehicle.

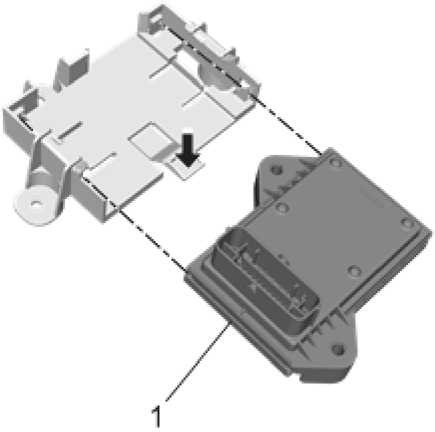


Fig. 6: Chassis Control Module And Chassis Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

5. Remove Chassis Control Module (1) @ Chassis Control Module Bracket

Installation Procedure

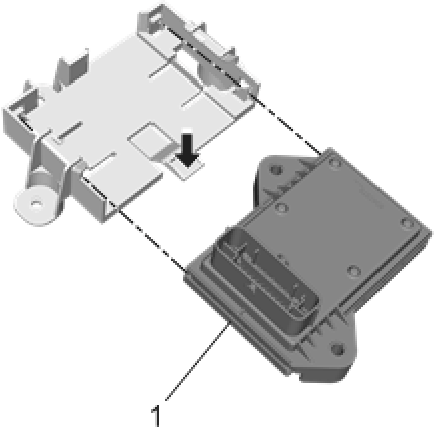


Fig. 7: Chassis Control Module And Chassis Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

1. Install Chassis Control Module (1) @ Chassis Control Module Bracket

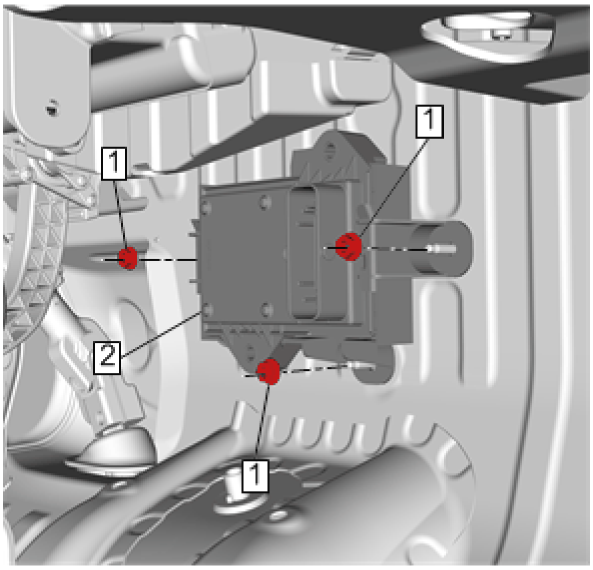


Fig. 8: Chassis Control Module/Bracket Assembly And Nuts
Courtesy of GENERAL MOTORS COMPANY

2. Install the chassis control module and bracket assembly (2) to the vehicle.

CAUTION: **Refer to Fastener Caution**

3. Install and tighten Chassis Control Module Bracket Nuts (1) (Qty: 3) to 9 N.m (80 lb in)

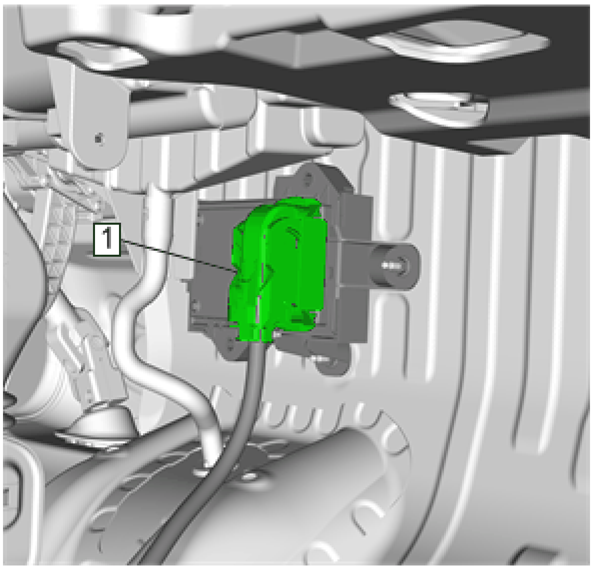


Fig. 9: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connector (1) @ Chassis Control Module

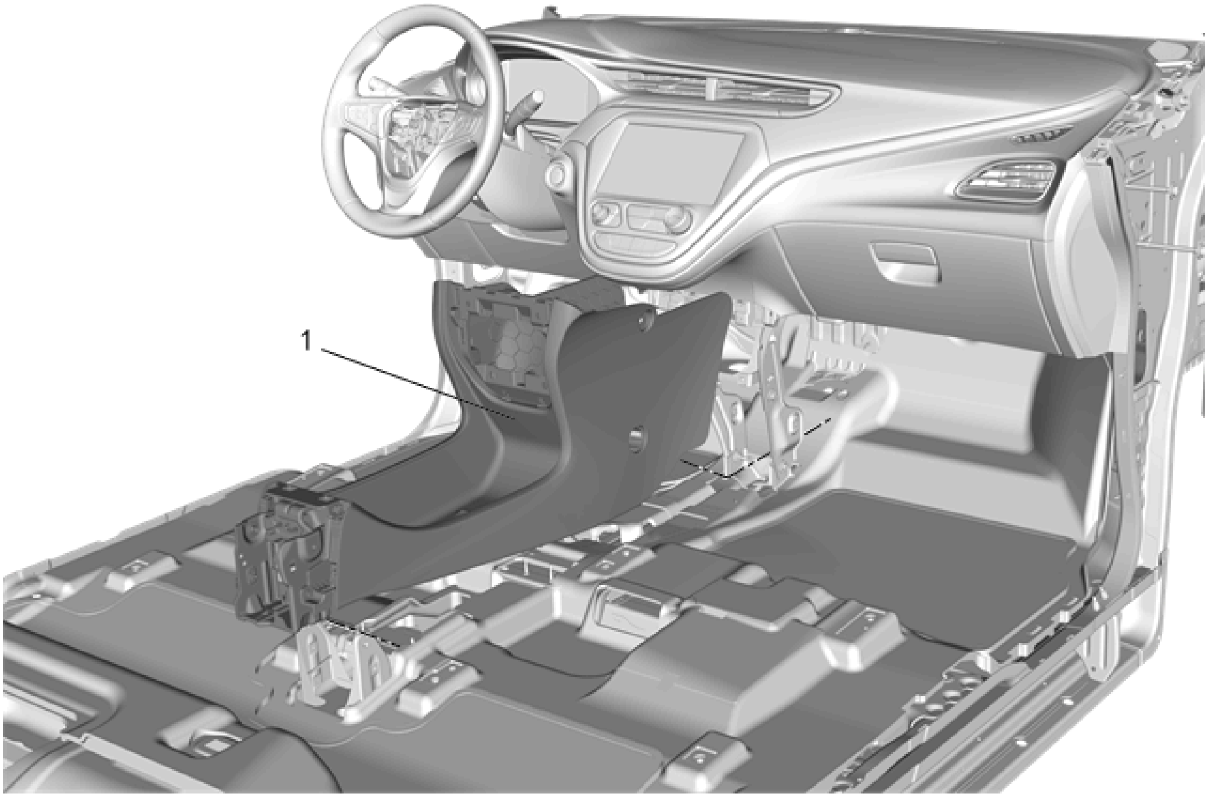


Fig. 10: Front Floor Console
Courtesy of GENERAL MOTORS COMPANY

5. Install Front Floor Console (1) @ Vehicle. Refer to **Front Floor Console Replacement**
6. Program the chassis control module. Refer to **Control Module References**

CRITICAL FAULT MODE MANEUVERING

Critical Fault Mode Maneuvering

The following procedure should be followed if vehicle is in Critical Fault Mode and needs to be moved:

- Verify charge of battery. If necessary, charge or jump start battery.
- Set the parking brake in service mode: **Rear Parking Brake Service Mode Selection**
- If accessible, remove linkage at the transmission: **Range Selector Lever Link Adjustment** . Manually shift the vehicle using transmission shift lever.
- If linkage is not accessible, wheel dollies should be used.

DESCRIPTION AND OPERATION

CRITICAL FAULT MODE DESCRIPTION

Critical Fault Mode

When a fault is detected in the Electronic Transmission Range Selector system and the Requested Gear Position or Actual Gear Position cannot be determined

- Vehicle will remain in current commanded gear position until the vehicle speed is below 3 kph
- In order to lower vehicle speed, the electronic brake control module will engage braking
- When vehicle speed is below 3 kph, the vehicle will engage electronic park brake and backup park lock (also know as Default to Park)
- Electronic park brake will not disengage until the issue is corrected and all related DTC's are History

ELECTRONIC TRANSMISSION RANGE SELECTOR DESCRIPTION

The Electronic Transmission Range Select (ETRS) subsystem selects the transmission range (Park, Reverse, Neutral, Drive, or Manual) by means of electronic control rather than by mechanical means.

The ETRS feature is controlled in the Chassis Control Module. All Electronic Transmission Range Selector and Transmission Range Control Module DTC's will set in the Chassis Control Module. The Chassis Control Module communicates via HS GMLAN, the Chassis Expansion Bus, and LIN.

When a gear is selected, the Transmission Range Control Module (TRCM) will move the transmission manual shaft into the range commanded by the ETRS. The TRCM will communicate on HS GMLAN and the Chassis Expansion Bus.

The Backup Park Lock function is electrically isolated from the TRCM, and forces the transmission manual shaft to the Park position under specified conditions. Under these conditions the vehicle is put in Latent Fault Mode, refer to Latent Fault Mode Description. The Backup Park Lock communicates with the Chassis Control Module via LIN.

The Shifter Assembly in the ETRS system has no mechanical linkage to the transmission. Instead, the shifter will provide electrical signals based on customer input to the Chassis Control Module, where the customer shift request will be determined.

ETRS Shift Lever Assembly includes:

- Shift Interlock Button - The Shift Interlock Button has two sensors which are both inputs to the Chassis Control Module.
- Park Button - The Park Button has two sensors which are both inputs to the Chassis Control Module.
- Two Dimensional Shift Lever - The shift lever is designed so any single fault at the shifter can be isolated and error corrected by the Chassis Control Module. The shift lever position is determined by 2 internal sensors that each transmit an X and Y coordinate signal. All 4 signal circuits are inputs to the Chassis Control Module.
- Transmission Shift Lever Position Indicator - LED display located on the face of the shifter. Indicates transmission actual gear position. Displays "R N P D M", which refer to Reverse, Neutral, Park, Drive, or Manual.

Transmission Range Control Module includes:

- Coupler to coupler, or lever to rod linkage interface with the transmission manual shaft.
- Backup Park Lock function (also know as Default to Park)

The vehicle is equipped with the following Electronic Transmission Range Selector Components:

- S3 Transmission Shift Lever
- K38 Chassis Control Module
- K173 Transmission Range Control Module
- Backup Park Lock is located within the K173 Transmission Range Control Module
- P2 Transmission Shift Lever Position Indicator is located within the S3 Transmission Shift Lever
- K71 Transmission Control Module

LATENT FAULT MODE DESCRIPTION

Latent Fault Mode

When a fault is detected in the Electronic Transmission Range Selector system, the data information center will display the message "Service Transmission Now, Unable to Shift Soon" along with a 10 second chime. The driver must acknowledge the message to show other data on the data information center. The frequency that the message and chime occur will increase until 50 trips are reached with the fault present. At that point, the transmission will not be allowed to shift out of park.

When "Service Shifter See Owner's Manual" message is shown on the data information center, the shift lever is requiring service. If the vehicle is automatically shifting into P (Park), check to see if the park button is stuck by running through the shifter electrical diagnostics. To operate the vehicle, hold the shift lever in the desired gear, R (Reverse) or D (Drive), until vehicle speed exceeds 15 km/h (10 mph), then release the shift lever.

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Brake Systems

BRAKE SYSTEMS

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MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

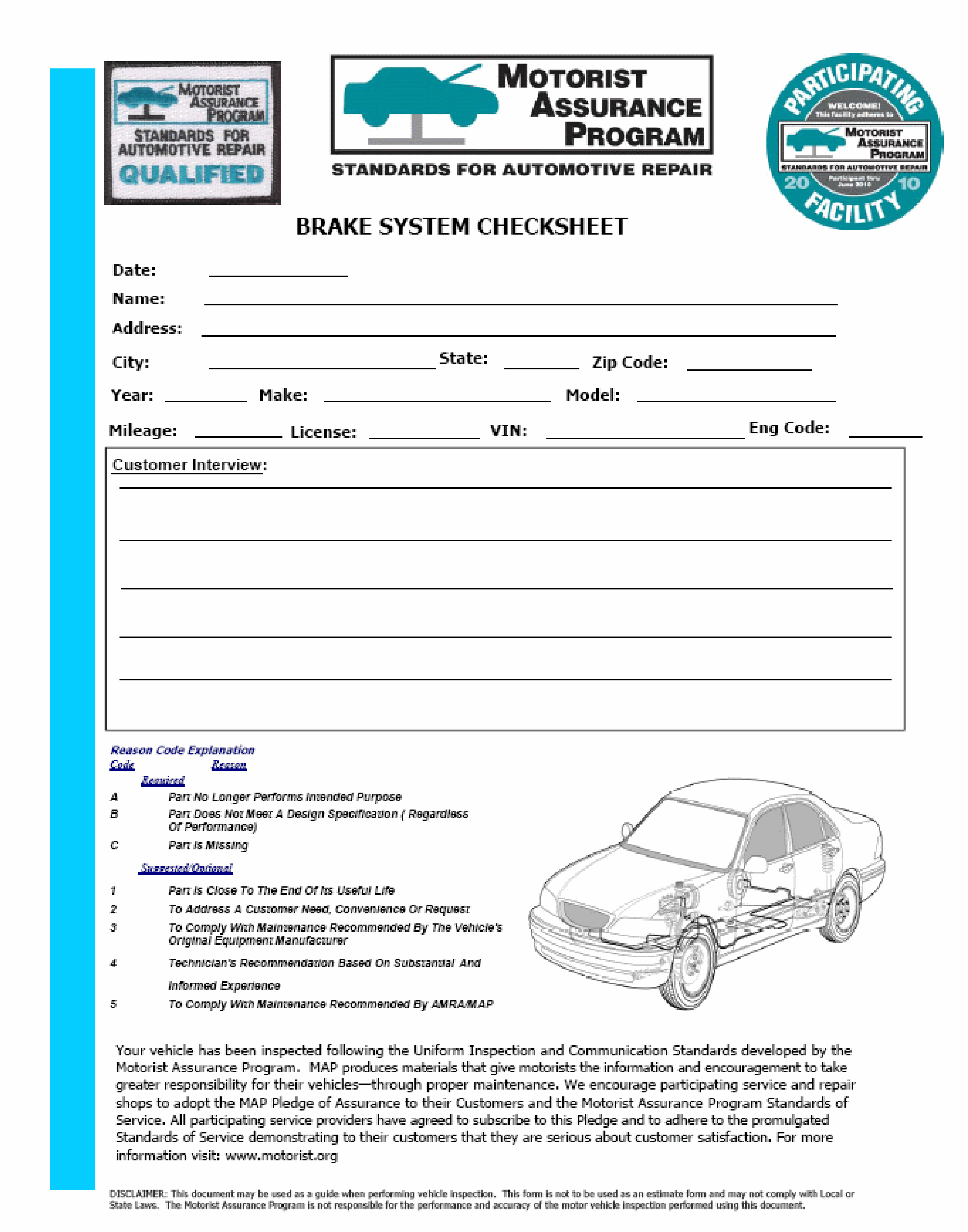
A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	**Reasons to Suggest Repair or Replacement**
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

BRAKE SYSTEM CHECKSHEET



MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
QUALIFIED

MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR

PARTICIPATING FACILITY
WELCOME! This facility adheres to
MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
20 Participant thru June 2010 10

BRAKE SYSTEM CHECKSHEET

Date: ____________

Name: ____________

Address: ____________

City: ____________ State: ____________ Zip Code: ____________

Year: ____________ Make: ____________ Model: ____________

Mileage: ____________ License: ____________ VIN: ____________ Eng Code: ____________

Customer Interview: ____________

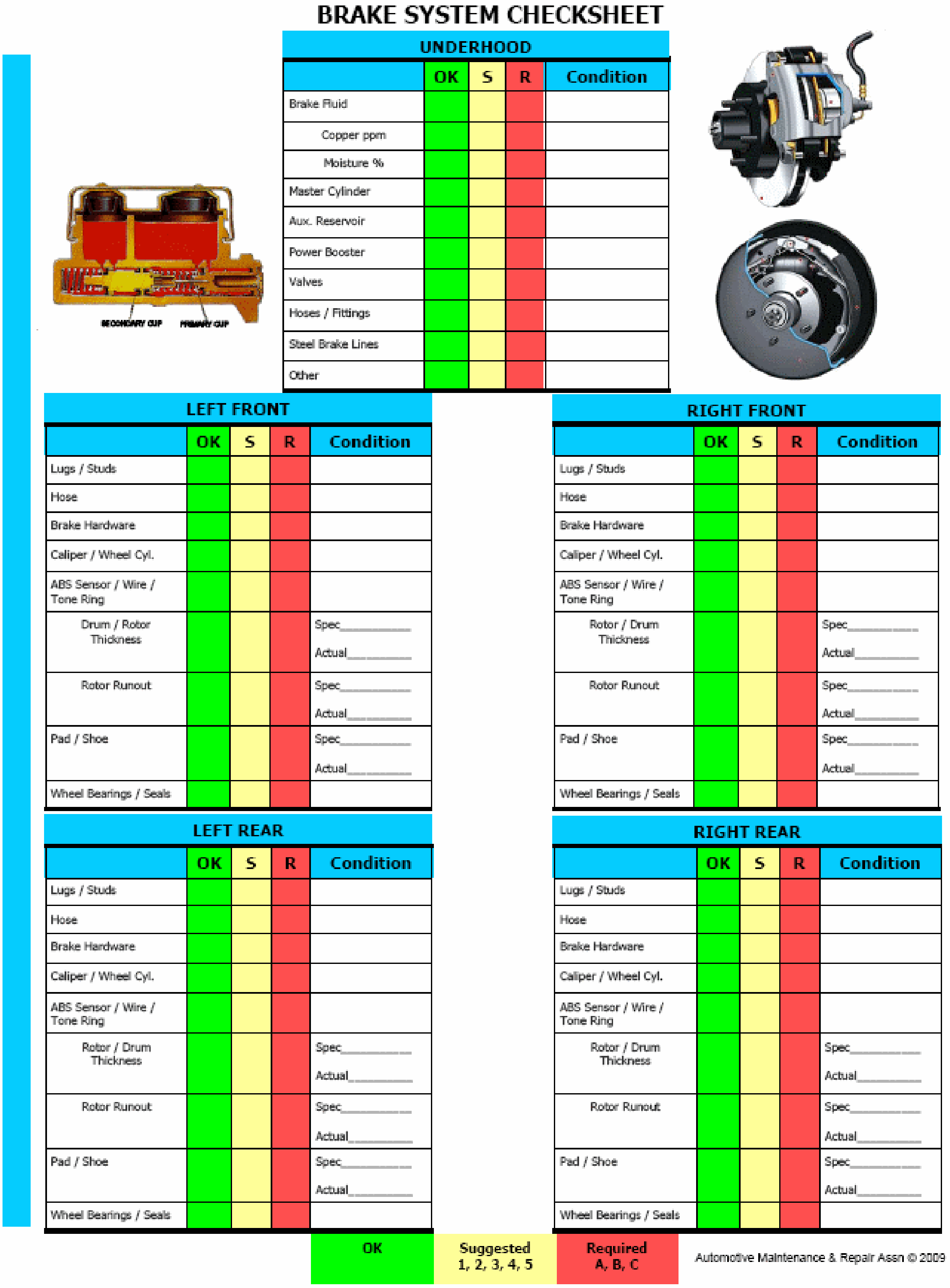
Reason Code Explanation

Code	*Reason*
	Required
A	*Part No Longer Performs Intended Purpose*
B	*Part Does Not Meet A Design Specification (Regardless Of Performance)*
C	*Part Is Missing*
	Suggested/Optional
1	*Part Is Close To The End Of Its Useful Life*
2	*To Address A Customer Need, Convenience Or Request*
3	*To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer*
4	*Technician's Recommendation Based On Substantial And Informed Experience*
5	*To Comply With Maintenance Recommended By AMRA/MAP*

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 1: Brake System Checksheet (1 Of 2)


SECONDARY CUP
PRIMARY CUP

BRAKE SYSTEM CHECKSHEET

UNDERHOOD

	OK	S	R	Condition
Brake Fluid				
Copper ppm				
Moisture %				
Master Cylinder				
Aux. Reservoir				
Power Booster				
Valves				
Hoses / Fittings				
Steel Brake Lines				
Other				

LEFT FRONT

	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Drum / Rotor Thickness				Spec__________ Actual__________
Rotor Runout				Spec__________ Actual__________
Pad / Shoe				Spec__________ Actual__________
Wheel Bearings / Seals				

RIGHT FRONT

	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Rotor / Drum Thickness				Spec__________ Actual__________
Rotor Runout				Spec__________ Actual__________
Pad / Shoe				Spec__________ Actual__________
Wheel Bearings / Seals				

LEFT REAR

	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Rotor / Drum Thickness				Spec__________ Actual__________
Rotor Runout				Spec__________ Actual__________
Pad / Shoe				Spec__________ Actual__________
Wheel Bearings / Seals				

RIGHT REAR

	OK	S	R	Condition
Lugs / Studs				
Hose				
Brake Hardware				
Caliper / Wheel Cyl.				
ABS Sensor / Wire / Tone Ring				
Rotor / Drum Thickness				Spec__________ Actual__________
Rotor Runout				Spec__________ Actual__________
Pad / Shoe				Spec__________ Actual__________
Wheel Bearings / Seals				

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

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Fig. 2: Brake System Checksheet (2 Of 2)

BRAKE SYSTEMS

NOTE: **Some states may have specifications that differ from OEM. Check your local/state regulations. Where state or local laws are stricter, they take precedence over these guidelines.**

ACCELEROMETERS

Condition	Code	Procedure
Condition	**Code**	**Procedure**
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal incorrect	B	Require replacement

ACCUMULATORS

Condition	Code	Procedure
Leaking	A	Require replacement
Missing	C	Require replacement
Pre-charge incorrect	B	Require replacement

ANCHOR PINS

Condition	Code	Procedure
Anchor pin bent	B	Require repair or replacement
Anchor pin broken	A	Require replacement
Anchor pin worn, affecting structural integrity	B	Require replacement

ANTI-LOCK BRAKE CONTROL ASSEMBLY(MODULE)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.**		
Missing	C	Require replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ANTI-LOCK BRAKE CONTROLLER

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
NOTE: **Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).**		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ANTI-LOCK BRAKE SYSTEMS

NOTE: **Anti-lock brakes are an integral part of the brake system. It is essential that the Anti-lock brakes function properly when brake service is performed. Anti-lock brake systems are commonly referred to as "" ABS"" and will be referred to as ABS throughout these guidelines. Some ABS components also function as part of a traction control system (TCS). When diagnosing and servicing high pressure components, observe safety procedures and equipment requirements established by the vehicle manufacturer to reduce the possibility of serious personal injury.**

NOTE: **Intermittent electrical conditions are often caused by a loss of ground, poor connection, or water intrusion into the wiring harness. Electro-magnetic interference (EMI) may be caused by incorrect installation of accessories or components. EMI can result in improper system operation.**

AXLE SEAL

Condition	Code	Procedure
Leaking	A	Require repair or replacement

BACKING PLATES

Condition	Code	Procedure
Anchor pin bent	B	Require repair or replacement
Anchor pin broken	A	Require replacement
Anchor pin worn, affecting structural integrity	B	Require replacement
Backing plate bent	B	Require repair or replacement
Backing plate broken	A	Require replacement
Backing plate cracked	B	Require repair or replacement
Corroded, affecting structural integrity	A	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Shoe lands worn	A	Require repair or replacement

BLEEDER SCREW

Condition	Code	Procedure
Bent	A	Require replacement

Condition	Code	Procedure
Broken	A	Require replacement
Incorrect	B	Require replacement of stud
Loose	A	Require repair or replacement of affected component
Nut flats rounded	A	Require replacement of nut
seized	A	Require replacement of nut and/or stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

BRAKE ABS ACTIVE LIGHT (BLUE)

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Light does not come on during bulb check	Â	Further inspection required to determine cause
Light flashes	Â	Further inspection required to determine cause
Light stays on after initial bulb check	Â	Further inspection required to determine cause

BRAKE FLUID

NOTE: **Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS. DOT 3, DOT 4, and DOT 5.1 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid type is normally stamped on the master cylinder cover.**

NOTE: **Fluid Flush - a process using a sufficient volume of fluid to help remove contaminants and replacing the contaminated fluid with new fluid of the same type and specification. At times a chemical may be used to enhance removal.**

NOTE: **Fluid Exchange/Replace - draining (evacuating) old fluid and replacing it with new fluid of the correct type and specification.**

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
At or beyond OEM service interval	3	Suggest fluid exchange/replacement
Brake fluid type incorrect	B	Require flushing and refilling
NOTE: **For example, DOT fluid lower than specified for the vehicle or silicone brake fluid (DOT 5) in an ABS system**		
Contaminated, for example, fluid other than brake fluid present	A	Require service
NOTE: **If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		
Contaminated, for example, fluid other than brake fluid present	B	Require service

Condition	Code	Procedure
NOTE: **If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid.**		
Corrosion inhibitors depleted	B	Require fluid exchange/replacement
NOTE: **A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid.**		
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
Hydraulic component overhaul or replacement	3	Suggest flushing and refilling
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of gasket
NOTE: **This condition may indicate contaminated brake fluid. Further inspection required.**		

BRAKE FRICTION MATERIAL

NOTE: **Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.**

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
NOTE: **Identify and repair cause of contamination prior to replacing friction material.**		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
NOTE: **When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.**		
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement

Condition	Code	Procedure
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	Â	Further inspection required
NOTE: **Some vehicles use friction materials that are tapered by design. Refer to specific vehicle application. If not normal, require replacement of friction materials and correction of cause.**		
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	Â	Replacement of friction material not suggested or required Further inspection required. See Calipers and Caliper Hardware.
NOTE: **Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.**		
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
NOTE: **The pad-wear indicator light may come on due to other electrical problems.**		
Wear indicator device (mechanical) broken	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.**		
Wear indicator device (mechanical) bent	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material, must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.**		
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required
NOTE: **The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested.**		
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured.**		
Worn close to minimum specifications	1	Suggest replacement
NOTE: **When the part appears to be close to the end of its useful life, replacement may be suggested.**		
Worn to, or below minimum specifications	B	Require replacement

BRAKE ON - OFF SWITCH

Condition	Code	Procedure
Bent, affecting performance	B	Require replacement
Broken	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Missing	C	Require replacement
Out of adjustment	B	Require adjustment or replacement
Output signal incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

BRAKE PADS

NOTE: **Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.**

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
NOTE: **Identify and repair cause of contamination prior to replacing friction material.**		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
NOTE: **When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.**		
Out of Adjustment	B	Require Adjustment or Repair
NOTE: **Determine cause and correct prior to adjustment or repair**		

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Out of Adjustment</td><td>B</td><td>Require Adjustment or Repair</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to adjustment or repair</td></tr>
<tr><td>Out of Adjustment</td><td>B</td><td>Require Adjustment or Repair</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to adjustment or repair</td></tr>
<tr><td>Out of Adjustment</td><td>B</td><td>Require Adjustment or Repair</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to adjustment or repair</td></tr>
<tr><td>Out of Adjustment</td><td>B</td><td>Require Adjustment or Repair</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to adjustment or repair</td></tr>
<tr><td>Permanently attached hardware bent</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware broken</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware loose</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware seized</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Rivets loose</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Separating from backing</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Shoe table or web bent</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Shoe table or web cracked</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Shoe table or web worn, affecting performance</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Tapered wear</td><td>B</td><td>Suggest replacement</td></tr>
<tr><td colspan="3">NOTE:
Some vehicles use pads that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of pads.</td></tr>
<tr><td>Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)</td><td>Â</td><td>Replacement of friction material not suggested or required Further inspection required See Calipers and Caliper Hardware</td></tr>
<tr><td colspan="3">NOTE:
Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.</td></tr>
<tr><td>Wear indicator device (electronic) contacts rotor</td><td>B</td><td>Require replacement of appropriate parts</td></tr>
<tr><td colspan="3">NOTE:
The pad-wear indicator light may come on due to other electrical problems.</td></tr>
<tr><td>Wear indicator device (mechanical) broken</td><td>Â</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested</td></tr>
<tr><td>Wear indicator device (mechanical) bent</td><td>Â</td><td>Further inspection required</td></tr>
</table>

Condition	Code	Procedure
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested**		
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested**		
Worn close to minimum specifications	1	Suggest replacement
NOTE: **When the part appears to be close to the end of its useful life, replacement may be suggested.**		
Worn to, or below minimum specifications	B	Require replacement

BRAKE PEDALS

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement
Broken	A	Require repair or replacement
Pedal pad missing	C	Require replacement of pedal pad
Pedal pad worn	1	Suggest replacement
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings

BRAKE SHOE HARDWARE

NOTE: **See also Self-Adjusting Systems.**

Condition	Code	Procedure
Broken	A	Require replacement
Distorted	A	Require replacement
Missing	C	Require replacement
Surfaces rust-pitted	1	Suggest replacement
Worn, affecting performance	A	Require replacement

BRAKE SHOES

NOTE: **Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.**

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
NOTE: **Identify and repair cause of contamination prior to replacing friction material.**		

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Cracked (Cracked through)</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Cracked (Surface cracking)</td><td>Â</td><td>No service suggested or required. Further inspection may be necessary to determine cause</td></tr>
<tr><td>Flaking or chunking</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Glazed (shiny)</td><td>Â</td><td>No service suggested or required</td></tr>
<tr><td>Grooves or ridges</td><td>Â</td><td>No service suggested or required</td></tr>
<tr><td colspan="3">NOTE:
When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.</td></tr>
<tr><td>Out of Adjustment</td><td>B</td><td>Require adjustment or repair</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to adjustment or repair</td></tr>
<tr><td>Permanently attached hardware bent</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware broken</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware loose</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Permanently attached hardware seized</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Rivets loose</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Separating from backing</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Shoe table or web bent</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Shoe table or web cracked</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Shoe table or web worn, affecting performance</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Tapered wear</td><td>Â</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Some vehicles use shoes that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of shoes.</td></tr>
<tr><td>Thickness of one shoe is greater than opposite shoe in the same drum (uneven wear)</td><td>Â</td><td>Replacement of friction material not suggested or required. Further inspection required.</td></tr>
<tr><td>Worn close to minimum specifications</td><td>1</td><td>Suggest replacement</td></tr>
<tr><td colspan="3">NOTE:
When the part appears to be close to the end of its useful life, replacement may be suggested.</td></tr>
<tr><td>Worn to, or below minimum specifications</td><td>B</td><td>Require replacement</td></tr>
</table>

BRAKE STOPLIGHT SWITCHES

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Bent, affecting performance</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Broken</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Connector (Weatherpack type) leaking</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector melted</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to replacement of part.</td></tr>
<tr><td>Connector missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Leaking</td><td>B</td><td>Require Repair or Replacement</td></tr>
</table>

Condition	Code	Procedure
Missing	C	Require replacement
Out of adjustment	B	Require adjustment or replacement
Output signal incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

BRAKE WARNING LIGHT (AMBER)

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Warning light does not come on during bulb check	Â	Further inspection required to determine cause
Warning light flashes	Â	Further inspection required to determine cause
Warning light stays on after initial bulb check	Â	Further inspection required to determine cause

BRAKE WARNING LIGHT (RED)

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Warning light does not come on during bulb check	Â	Further inspection required to determine cause
Warning light flashes	Â	Further inspection required to determine cause
Warning light stays on after initial bulb check	Â	Further inspection required to determine cause

BULB SOCKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Bulb seized in socket	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of socket.**		
Burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of socket**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

BULBS AND LEDS

NOTE: **Does not include soldered-in components.**

Condition	Code	Procedure
Application incorrect	B	Require replacement
NOTE: **Application incorrect includes wrong bulb coating or color.**		
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Burned out	A	Require replacement
Intermittent	A	Require replacement

Condition	Code	Procedure
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

CALIPER HARDWARE

Condition	Code	Procedure
Bent	A	Require repair or replacement
Broken	A	Require repair or replacement
Corroded, affecting performance	A	Require repair or replacement
Dust boots on slider pin (bolt) missing	C	Require replacement of boots
Dust boots on slider pin (bolt) torn	A	Require replacement of boots
Missing	C	Require replacement
Shim (OE standard) missing	C	Require replacement
NOTE: **Aftermarket shims may be suggested to reduce noise.**		
Shim bent	A	Require removal or replacement
NOTE: **Removal is acceptable if shim is not OEM.**		
Shim out of position	B	Require removal or replacement
NOTE: **Removal is acceptable if shim is not OEM.**		
Shim worn	A	Require removal or replacement
NOTE: **Removal is acceptable if shim is not OEM.**		
Slider pin (bolt) bent	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) rust-pitted	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) worn	A	Require replacement of slider pin or bolt and lubricants
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

CALIPER MOUNTING PIN

Condition	Code	Procedure
Slider pin (bolt) bent	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) rust-pitted	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) worn	A	Require replacement of slider pin or bolt and lubricants

CALIPER PISTON

Condition	Code	Procedure
Broken	A	Require repair or replacement
Corroded, affecting performance	A	Require repair or replacement
Worn, affecting performance	A	Require replacement

CALIPER SHIM

Condition	Code	Procedure
Shim (OEM standard) missing	C	Require replacement
Shim bent	A	Require removal or replacement
Shim out of position	B	Require removal or replacement
Shim worn	A	Require removal or replacement

CALIPER SLIDER PIN (BOLT) DUST BOOT

Condition	Code	Procedure
Dust boots on slider pin (bolt) missing	C	Require replacement of boots
Dust boots on slider pin (bolt) torn	A	Require replacement of boots
Missing	C	Require replacement

CALIPER SLIDER PIN (BOLT)

Condition	Code	Procedure
Broken	A	Require repair or replacement
Missing	C	Require replacement
Slider pin (bolt) bent	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) rust-pitted	A	Require replacement of slider pin or bolt and lubricants
Slider pin (bolt) worn	A	Require replacement of slider pin or bolt and lubricants
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

CALIPERS

NOTE: **You are not required to replace or rebuild calipers in axle sets. However, when replacing or rebuilding a caliper due to the conditions that follow, you may suggest servicing, rebuilding, or replacement of the other caliper (on the same axle) for improved performance and preventive maintenance (for example, the part is close to the end of its useful life, replacing the caliper may extend pad life, or contribute to more balanced braking). When installing loaded calipers, it is required that friction material be matched in axle sets for consistent braking characteristics.**

Condition	Code	Procedure

Condition	Code	Procedure
Bleeder port damaged	A	Require repair or replacement of caliper
Bleeder screw broken off in caliper	A	Require repair or replacement of caliper
NOTE: **Only required if hydraulic system must be opened.**		
Bleeder screw plugged	A	Require repair or replacement of bleeder screw
NOTE: **Only required if hydraulic system must be opened.**		
Bleeder screw seized	A	Require replacement of caliper
NOTE: **Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.**		
Casting corroded, affecting structural integrity	A	Require replacement
Casting damaged, affecting structural integrity	A	Require replacement
Dust boot around caliper piston torn	A	Require replacement of dust boot
Leaking	A	Require repair or replacement
Mounting pin threads damaged	A	Require repair or replacement of component with damaged threads
Mounting pin threads stripped (threads missing)	A	Require repair or replacement of component with stripped threads
Mounting pin threads stripped in caliper bracket (threads missing)	A	Require repair or replacement of caliper bracket
Mounting pin threads stripped in steering knuckle (threads missing)	A	Require repair or replacement of steering knuckle
Parking brake cable support, lever, or return spring bent	A	Require replacement of parts
Parking brake cable support, lever, or return spring broken	A	Require replacement of parts
Parking brake mechanism in caliper inoperative	A	Require repair or replacement
Piston corroded (pitted or peeling chrome plating)	B	Require replacement of piston and rebuilding or replacement of caliper
Piston damaged, affecting performance	B	Require replacement of piston and rebuilding or replacement of caliper
Piston damaged, not affecting performance	Â	No service suggested or required
Piston finish worn off	B	Require replacement of piston and rebuilding or replacement of caliper
Piston sticking	A	Require rebuilding or replacement of caliper
Slide mechanism sticking	A	Require repair or replacement of slide mechanism

COMBINATION VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CONTROLLERS

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
NOTE: **Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).**		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

DIGITAL RATIO AXLE CONTROLLERS AND BUFFERS (DRAB AND DRAM)

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

DISABLE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

DRUMS

NOTE: **Determine the need to recondition based upon individual drum conditions that follow. Friction material replacement does not require drum reconditioning unless other justifications exist. Do not recondition new drums unless they are being pressed or bolted onto an existing hub. It is not necessary to replace drums in axle sets. However, when replacing or reconditioning a drum due to the conditions that follow, you may suggest reconditioning of the other drum on the same axle to eliminate uneven braking behavior. Always wash drums after servicing or before installing.**

Condition	Code	Procedure
Balance weight missing Affecting performance	A	Require repair or replacement
Balance weight missing Not affecting performance	Â	No service suggested or required

Condition	Code	Procedure
Bell-mouthed, affecting performance	A	Require reconditioning or replacement
Cooling fin broken	Â	No service suggested or required
Cracked	B	Require replacement
Drum diameter is greater than OEM ""machine to"" specifications but less than ""discard at""	1	Suggest replacement
specifications, and the drum does not require reconditioning	Â	Â
NOTE: **Only applies to vehicles for which OEM ""machine to"" specifications exist. If OEM does not supply ""machine to"" specifications, the drum may be worn to discard specifications**		
Drum diameter will exceed OEM ""machine to"" specifications after required reconditioning	B	Require replacement
NOTE: **If OEM does not supply ""machine to"" specifications, you may machine to discard specifications.**		
Hard -spotted	2	Suggest reconditioning or replacement
Measured diameter is greater than OEM discard specifications	B	Require replacement
Out-of-round (runout), affecting performance	A	Require reconditioning or replacement
Out-of-round (runout), exceeding manufacturer's specifications	B	Require reconditioning or replacement
Scored	B	Require reconditioning or replacement
Surface threaded due to improper machining	B	Require reconditioning or replacement
Tapered, affecting performance	A	Require reconditioning or replacement

ELECTRICAL BRAKE PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRICAL PARK MOTOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRICAL PUMPS AND MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRO-MAGNETIC INTERFERENCE

NOTE: **An engineering term used to designate interference in a piece of electronic equipment caused by another piece of electronic or other equipment.**

ELECTRONIC BRAKE CONTROL MODULATOR

NOTE: **Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible, then replace the modulator assembly.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRONIC BRAKE DISTRIBUTION

NOTE: **EBD adjusts braking pressure front-to-rear, based on the weight distribution of passengers and/or cargo. Weight distribution is typically determined via the relative difference in rotational speed of the front and rear wheels. Greater braking pressure, (and subsequently stopping power), is directed to the rear wheels when loads in the rear are heavier. This contributes to a more controlled stop, and minimizes ""brake dive"" during hard braking.**

ELECTRONIC BRAKE TRACTION CONTROL MODULE

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRONIC CONTROLLERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
NOTE: **Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).**		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
Electro Magnetic Brake Inoperative	A	Require repair or replacement
Expansion Spring Brake Inoperative	A	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Pulse Width Modulation Valve Inoperative	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRONIC TRACTION CONTROL

NOTE: **The further development of the electronic locking differential. It electronically reduces engine torque, preventing engine and wheel braking from working against each other. (Example: a driver continues to apply the accelerator while the electronic traction control is attempting to redistribute excess engine torque through braking). This system works in unison with some OEM's stability control systems.**

EXTERNAL BRAKE CABLE

Condition	Code	Procedure
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly

FLOW CONTROL VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FLUID LEVEL SENSOR SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Float saturated	A	Require replacement
Leaking	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement

Condition	Code	Procedure
Worn	1	Suggest replacement

FLUID

NOTE: **Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS. DOT 3, DOT 4, and DOT 5.1 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid type is normally stamped on the master cylinder cover.**

NOTE: **Fluid Flush - a process using a sufficient volume of fluid to help remove contaminants and replacing the contaminated fluid with new fluid of the same type and specification. At times a chemical may be used to enhance removal.**

NOTE: **Fluid Exchange/Replace - draining (evacuating) old fluid and replacing it with new fluid of the correct type and specification.**

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
At or beyond OEM service interval	3	Suggest fluid exchange/replacement
Brake fluid type incorrect	B	Require flushing and refilling
NOTE: **For example, DOT fluid lower than specified for the vehicle or silicone brake fluid (DOT 5) in an ABS system.**		
Contaminated, for example, fluid other than brake fluid present	B	Require service
NOTE: **If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid.**		
Contaminated, for example, fluid other than brake fluid present	A	Require service
NOTE: **If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		
Corrosion inhibitors depleted	B	Require fluid exchange/replacement
NOTE: **A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid.**		
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
Hydraulic component overhaul or replacement	3	Suggest flushing and refilling with correct fluid
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of gasket

Condition	Code	Procedure
NOTE: **This condition may indicate contaminated brake fluid.**		

FOUR WHEEL DRIVE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

FRICTION MATERIAL

NOTE: **Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.**

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
NOTE: **Identity and repair cause of contamination prior to replacing friction material.**		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
NOTE: **When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.**		
Out of Adjustment	B	Require Adjustment or Repair
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	B	Suggest replacement
NOTE: **Some vehicles use pads that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of pads.**		
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	Â	Replacement of friction material not suggested or required. Further inspection required.
NOTE: **Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.**		
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
NOTE: **The pad-wear indicator light may come on due to other electrical problems.**		
Wear indicator device (mechanical) bent	Â	Further inspection required

Condition	Code	Procedure
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.**		
Wear indicator device (mechanical) broken	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured.**		
Wear indicator device (mechanical) broken	Â	Further inspection required
NOTE: **The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested.**		
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is Suggested.**		
Worn close to minimum specifications	1	Suggest replacement
NOTE: **When the part appears to be close to the end of its useful life, replacement may be suggested.**		
Worn to, or below minimum specifications	B	Require replacement

G SENSORS

Condition	Code	Procedure
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal incorrect	B	Require replacement

GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

GRAVITATIONAL SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

GREASE SEAL

Condition	Code	Procedure
Leaking	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

HEIGHT SENSING PROPORTIONING VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

HIGH PRESSURE ACCUMULATOR

Condition	Code	Procedure
Leaking	A	Require replacement
Missing	C	Require replacement
Pre-charge incorrect	B	Require replacement

HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement

Condition	Code	Procedure
Expansion affecting performance	A	Require Replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

HUB

Condition	Code	Procedure
Worn or damaged affecting performance	A	Require repair or replacement

HYDRAULIC CONTROL UNIT

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

HYDRAULIC MODULATORS

NOTE: **Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not possible, then replace the modulator assembly.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

HYDRO-BOOSTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Does not apply assist, or inadequate assist	A	Require repair or replacement
Leaking	B	Require repair or replacement
Leaks fluid at fitting	B	Require tightening or replacement
Leaks fluid at unit	B	Require repair or replacement
Leaks fluid from pressure hose(s)	B	Require replacement of hose(s)
Leaks fluid into passenger compartment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

HYDRO-ELECTRIC BOOSTERS (POWERMASTER)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Does not apply assist, or inadequate assist	A	Require repair or replacement
Leaking	B	Require repair or replacement
Leaks fluid at fitting	B	Require tightening or replacement
Leaks fluid at unit	B	Require repair or replacement
Leaks fluid from pressure hose(s)	B	Require replacement of hose(s)
Leaks fluid into passenger compartment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

IGNITION DISABLE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

LAMP DRIVER RELAY

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

LATERAL ACCELERATION SWITCHES

Condition	Code	Procedure
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal Incorrect	B	Require replacement

LEDS

NOTE: **Does not include soldered-in components.**

Condition	Code	Procedure

Condition	Code	Procedure
Application incorrect	B	Require replacement
NOTE: **Application incorrect includes wrong bulb coating or color.**		
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Burned out	A	Require replacement
Intermittent	A	Require replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

LENSES

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

LOW PRESSURE ACCUMULATOR

Condition	**Code**	**Procedure**
Leaking	A	Require replacement
Missing	C	Require replacement
Pre-charge incorrect	B	Require replacement

LUG NUT

Condition	**Code**	**Procedure**
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

MASTER CYLINDER COVER GASKET

Condition	**Code**	**Procedure**
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of the gasket
NOTE: **This condition may indicate contaminated brake fluid. See Brake Fluid.**		

MASTER CYLINDERS

Condition	**Code**	**Procedure**
Brake fluid leaking from rear of master cylinder bore	B	Require repair or replacement
Brake pedal drops intermittently	A	Require repair or replacement
NOTE: **This condition may be normal on some vehicles equipped with anti-lock brakes.**		
Fluid level low	Â	Further inspection required
NOTE: **Refer to OEM procedures for adjusting low fluid level. Inspect for brake hydraulic leaks and friction material wear.**		
Internal valve failure	A	Require repair or replacement
Master cylinder leaking brake fluid internally	A	Require repair or replacement
Piston does not return	A	Require repair or replacement
Ports plugged	A	Require repair or replacement
Pushrod out of adjustment	B	Require Repair or Replacement
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of the gasket
NOTE: **This condition may indicate contaminated brake fluid. See Brake Fluid.**		

MODULATORS

NOTE: **Many modulators can only be replaced as complete assemblies. Whenever possible, replace the failed component part. If replacement of the failed part is not**

Condition	Code	Procedure
possible, then replace the modulator assembly.	Â	Â
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Disabled	A	Require repair or replacement
Electrical failure	A	Require repair or replacement
External leak	A	Require repair or replacement
Housing cracked	A	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Internal leak	A	Require repair or replacement
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve stuck	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

MOTOR PACK

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	2	Require repair or replacement
Terminal loose not affecting performance	1	Suggest repair or replacement
Terminal Loose, Affecting Performance	B	Require repair or replacement

MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
NOTE: **Determine source of contamination. Require repair or replacement.**		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

PADS

NOTE: **Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.**

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
NOTE: **Identify and repair cause of contamination prior to replacing friction material.**		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
NOTE: **When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.**		
Out of Adjustment	A	Require Repair or Replacement
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement

Condition	Code	Procedure
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	Â	Further inspection required
NOTE: **Some vehicles use pads that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of pads.**		
Thickness of one pad is greater than opposite pad in the same caliper (uneven wear)	Â	Replacement of friction material not suggested or required Further inspection required. See Calipers and Caliper Hardware.
NOTE: **Uneven pad thickness is normal on some vehicles. Refer to specific vehicle applications.**		
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
NOTE: **The pad-wear indicator light may come on due to other electrical problems.**		
Wear indicator device (mechanical) broken	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested**		
Wear indicator device (mechanical) bent	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested**		
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required
NOTE: **Explain to the customer that the purpose of the wear indicator is to alert him or her to check for friction wear. Wear indicators may be bent or broken. Therefore, the friction material must be measured. The need for friction material replacement is determined based upon the conditions stated in this section. Periodic inspection is suggested**		
Worn close to minimum specifications	1	Suggest replacement
NOTE: **When the part appears to be close to the end of its useful life, replacement may be suggested.**		
Worn to, or below minimum specifications	B	Require replacement

PARKING BRAKE CABLE

Condition	Code	Procedure
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly

PARKING BRAKE MECHANISM

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement of inoperative parts
Parking brake parts bent	B	Require repair or replacement of bent parts
Parking brake parts broken	A	Require replacement of broken parts
Parking brake parts missing	C	Require replacement of missing parts
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

PARKING BRAKE SHOES

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
NOTE: **Identify and repair cause of contamination prior to replacing friction material.**		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
NOTE: **When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.**		
Out of Adjustment	B	Require adjustment or repair
NOTE: **Determine cause and correct prior to adjustment or repair**		
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement

Condition	Code	Procedure
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	Â	Further inspection required
NOTE: **Some vehicles use shoes that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of shoes.**		
Thickness of one shoe is greater than opposite shoe in the same drum (uneven wear)	Â	Replacement of friction material not suggested or required Further inspection required
Worn close to minimum specifications	1	Suggest replacement
NOTE: **When the part appears to be close to the end of its useful life, replacement may be suggested.**		
Worn to, or below minimum specifications	B	Require replacement

PARKING BRAKE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement

Condition	Code	Procedure
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

PARKING BRAKE SYSTEMS

NOTE: **The parking brake is an integral part of the brake system. It is important that the parking brake function properly when brake service is performed.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly
Inoperative	A	Require replacement of inoperative parts
NOTE: **Inoperative Includes intermittent operation.**		
Parking brake parts bent	B	Require repair or replacement of bent parts
Parking brake parts broken	A	Require replacement of broken parts
Parking brake parts missing	C	Require replacement of missing parts
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

PEDAL TRAVEL SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement

Condition	Code	Procedure
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

PEDALS

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement
Broken	A	Require repair or replacement
Pedal pad missing	C	Require replacement of pedal pad
Pedal pad worn	1	Suggest replacement
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings

POWER DISTRIBUTION CENTER

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Melted, not affecting performance	2	Suggest replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

POWERMASTER

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Does not apply assist, or inadequate assist	A	Require repair or replacement
Leaking	B	Require repair or replacement
Leaks fluid at fitting	B	Require tightening or replacement
Leaks fluid at unit	B	Require repair or replacement
Leaks fluid from pressure hose(s)	B	Require replacement of hose(s)
Leaks fluid into passenger compartment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

PRESSURE DIFFERENTIAL SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

PRESSURE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

PRESSURE TRANSDUCERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Drive mechanism damaged, affecting performance	A	Require repair or replacement
NOTE: **Further inspection required to determine cause.**		
Drive mechanism damaged, not affecting performance	2	Suggest repair or replacement
NOTE: **Further inspection required to determine cause.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation or out of specification.**		
Leaking (vacuum/fluid/air)	A	Require replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	Â	No service suggested or required
Linkage binding, affecting performance	A	Require repair or replacement of linkage

Condition	Code	Procedure
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Further inspection required
NOTE: **Follow OEM recommended adjustment procedures. Repair or replace if out of specification.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

PROPORTIONING VALVE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
NOTE: **Determine source of contamination. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

RELUCTOR (SPEED) RING

NOTE: **If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

ROTORS

NOTE: **Determine the need to recondition based upon individual rotor conditions that follow. Friction material replacement does not require rotor reconditioning unless other justifications exist. Do not recondition new rotors unless it does not meet installed OEM specifications. It is not necessary to replace rotors in axle sets unless required by the vehicle manufacturer. However, when replacing or reconditioning a rotor due to the conditions that follow, you may suggest reconditioning of the other rotor on the same axle to eliminate uneven braking behavior. Determine the need to replace based upon the individual rotor conditions that follow. Reconditioning is defined as machining and block sanding, or block sanding only. Block sanding is defined as using 120-150 grit sandpaper with moderate to heavy force for 60 seconds per side. Always wash rotors after servicing or before installing.**

Condition	Code	Procedure

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Corrosion affecting structural integrity</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Examples of severe corrosion are: composite plate separated from friction surfaces and cooling fins cracked or missing.</td></tr>
<tr><td>Cracked</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Hard spots</td><td>2</td><td>Suggest reconditioning or replacement of rotor according to OEM specifications</td></tr>
<tr><td>Lateral runout (wobble) exceeds OEM specifications</td><td>B</td><td>Require re-indexing, reconditioning, or replacement according to specifications</td></tr>
<tr><td>Measured thickness is less than OEM discard specifications</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Rotor thickness is less than OEM ""machine to"" specifications but thicker than ""discard at""</td><td>1</td><td>Suggest replacement</td></tr>
<tr><td>specifications, and rotor does not require reconditioning</td><td>Â</td><td>Â</td></tr>
<tr><td colspan="3">NOTE:
Only applies to vehicles for which OEM ""machine to"" specifications exist. If OEM does not supply ""machine to"" specifications, the rotor may be worn to discard specifications.</td></tr>
<tr><td>Rotor thickness will be less than OEM ""machine to"" specifications after required reconditioning</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
If OEM does not supply ""machine to"" specifications, you may machine to discard specifications.</td></tr>
<tr><td>Surface finish incorrect</td><td>B</td><td>Require recondition or replacement</td></tr>
<tr><td>Surface is rust-pitted</td><td>B</td><td>Require reconditioning or replacement of rotor according to OEM specifications</td></tr>
<tr><td>Surface is scored</td><td>B</td><td>Require reconditioning or replacement of rotor according to OEM specifications</td></tr>
<tr><td colspan="3">NOTE:
Scoring is defined as grooves or ridges in the friction contact surface. Some vehicle manufacturers require machining when scoring exceeds their allowable specifications.</td></tr>
<tr><td>Tapered affecting performance</td><td>A</td><td>Require reconditioning or replacement</td></tr>
<tr><td>Thickness variation (parallelism) exceeds OEM specifications</td><td>B</td><td>Require reconditioning or replacement of rotor according to OEM specifications</td></tr>
</table>

SELF-ADJUSTING SYSTEMS

Condition	Code	Procedure
Bent	A	Require repair or replacement of bent part
Broken	A	Require repair or replacement of broken part

Condition	Code	Procedure
Inoperative	A	Require repair or replacement of inoperative parts
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement of missing part
Star wheel does not turn freely	A	Require repair or replacement

SHOE HARDWARE

NOTE: **See also Self-Adjusting Systems.**

Condition	Code	Procedure
Broken	A	Require replacement
Distorted	A	Require replacement
Missing	C	Require replacement
Surfaces rust-pitted	1	Suggest replacement
Worn, affecting performance	A	Require replacement

SHOES

NOTE: **Original Equipment Manufacturer (OEM) specifications designate replacement at different thicknesses. It is required that friction material be matched in axle sets for consistent braking characteristics.**

Condition	Code	Procedure
Contaminated, for example, fluid that leaked from caliper, wheel cylinder, or axle seal	A	Require replacement
NOTE: **Identify and repair cause of contamination prior to replacing friction material.**		
Cracked (Cracked through)	B	Require replacement
Cracked (Surface cracking)	Â	No service suggested or required. Further inspection may be necessary to determine cause
Flaking or chunking	B	Require replacement
Glazed (shiny)	Â	No service suggested or required
Grooves or ridges	Â	No service suggested or required
NOTE: **When reconditioning or replacing drums or rotors, replacement of friction material may be suggested depending on the severity of the grooves or ridges.**		
Out of Adjustment	B	Require Adjustment or Repair
Permanently attached hardware bent	A	Require replacement
Permanently attached hardware broken	A	Require replacement
Permanently attached hardware loose	A	Require replacement
Permanently attached hardware missing	C	Require replacement
Permanently attached hardware seized	A	Require repair or replacement
Rivets loose	B	Require replacement
Separating from backing	B	Require replacement
Shoe table or web bent	B	Require replacement
Shoe table or web cracked	A	Require replacement
Shoe table or web worn, affecting performance	A	Require replacement
Tapered wear	B	Suggest replacement

Condition	Code	Procedure
NOTE: **Some vehicles use shoes that are tapered by design. Refer to specific vehicle application. If not normal, require correction of cause and replacement of shoes.**		
Thickness of one shoe is greater than opposite shoe in the same drum (uneven wear)	Â	Replacement of friction material not suggested or required. Further inspection required.
NOTE: **Uneven shoe thickness is normal on some vehicles. Refer to specific vehicle applications.**		
Worn close to minimum specifications	1	Suggest replacement
NOTE: **When the part appears to be close to the end of its useful life, replacement may be suggested.**		
Worn to, or below minimum specifications	B	Require replacement

SOCKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Bulb seized in socket	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Melted	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SPEED SENSOR (RELUCTOR) RING

NOTE: **If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement
NOTE: **If a sensor is not adjustable, further inspection is required to identify and correct cause.**		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as metal particles or water. Require repair or replacement**		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Leaking	B	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

STAR WHEEL

Condition	Code	Procedure
Bent	A	Require repair or replacement of bent part
Broken	A	Require repair or replacement of broken part
Inoperative	A	Require repair or replacement of inoperative parts
Missing	C	Require replacement of missing part
Star wheel does not turn freely	A	Require repair or replacement

STEEL BRAKE LINES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting structural integrity	A	Require replacement
Fitting incorrect (for example, compression fitting)	B	Require replacement
Flare type incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement

Condition	Code	Procedure
Line material incorrect (copper, etc.)	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require routing correction
Rust-pitted	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

STOPLIGHT SWITCHES

Condition	Code	Procedure
Bent, affecting performance	B	Require replacement
Broken	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require Repair or Replacement
Missing	C	Require replacement
Out of adjustment	B	Require adjustment or replacement
Output signal incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

STROKE SENSOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

TIRES

NOTE: **Consult the vehicle owner's manual or vehicle placard for correct size, speed ratings, and inflation pressure of the original tires.**

Condition	Code	Procedure
Tire diameter incorrect, affecting ABS or TCS	A	Require replacement
Tire pressure incorrect, affecting ABS or TCS	A	Require repair or replacement
Tire size incorrect, affecting ABS or TCS	A	Require replacement

TONE RING

NOTE: **If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

TOOTHED RINGS (TONE WHEEL)

NOTE: **If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

TRACTION CONTROL SYSTEM (TCS)

NOTE: **The further development of the electronic locking differential. It electronically reduces engine torque, preventing engine and wheel braking from working against each other. (Example: a driver continues to apply the accelerator while the electronic traction control is attempting to redistribute excess engine torque through braking). This system works in unison with some OEM's stability control systems.**

TRANSFER TUBES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting structural integrity	A	Require replacement
Fitting incorrect (for example, compression fitting)	B	Require replacement
Flare type incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Line material incorrect (copper, etc.)	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require routing correction
Rust-pitted	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

VACUUM BOOSTERS

Condition	Code	Procedure
Applies too much assist (oversensitive)	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Auxiliary vacuum pump inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Check valve grommet deteriorated, affecting performance	A	Require replacement of grommet
Check valve grommet deteriorated, not affecting performance	1	Suggest replacement of grommet
Check valve inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Check valve leaking	A	Require replacement of check valve
Check valve missing	C	Require replacement of check valve
Check valve noisy	2	Suggest replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Leaking	A	Require replacement
Pushrod out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Vacuum hose filter leaking	A	Require replacement of filter
Vacuum hose filter restricted	A	Require replacement of filter
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

VACUUM HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair

Condition	Code	Procedure
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Linkage bent (rear load valves)	A	Require repair or replacement of linkage
Linkage broken (rear load valves)	A	Require repair or replacement of linkage
Pressure out of specification	B	Require adjustment If not possible, require replacement
Seized	A	Require replacement
Sticking	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WEAR INDICATOR

Condition	Code	Procedure
Wear indicator device (electronic) contacts rotor	B	Require replacement of appropriate parts
Wear indicator device (mechanical) broken	Â	Further inspection required
Wear indicator device (mechanical) bent	Â	Further inspection required
Wear indicator device (mechanical) contacts rotor	Â	Further inspection required

WHEEL ATTACHMENT HARDWARE

NOTE: **For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow manufacturer's torque**

specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement
NOTE: **Some manufacturers require replacement of all studs on any wheel if two or more studs or nuts on the same wheel are broken or missing.**		
Loose	A	Require repair or replacement of affected component
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

WHEEL BEARINGS, RACES AND SEALS

NOTE: **When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions.**

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing and race assembly.
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or	B	Require replacement of bearing and race assembly
other damage affecting performance.	Â	Â
Seal leaking	A	Require replacement of seal and inspection of bearings
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.**		
Seal missing	C	Require replacement

WHEEL CYLINDERS

NOTE: **You are not required to replace or rebuild wheel cylinders in axle sets. However, when rebuilding or replacing a wheel cylinder due to the conditions that follow, you may suggest rebuilding or replacement of the other wheel cylinder (on the same axle) for preventive maintenance, for**

example, the part is close to the end of its useful life. Determine the need to rebuild or replace based upon the individual wheel cylinder conditions.

Condition	Code	Procedure
Attaching hardware bent	B	Require replacement of bent parts
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of corroded parts
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bleeder port damaged (if non-repairable)	A	Require replacement
Bleeder screw broken off in wheel cylinder (if non-repairable)	A	Require replacement
NOTE: **Only required if the hydraulic system must be opened.**		
Bleeder screw plugged	A	Require repair or replacement
NOTE: **Only required if the hydraulic system must be opened.**		
Bleeder screw seized	A	Require replacement
NOTE: **Seized is defined as bleeder screw that cannot be removed after a practical attempt at removing. Only required if the hydraulic system must be opened.**		
Bore corroded (pitted)	B	Require replacement
Bore grooved	A	Require replacement
Bore oversized	B	Require replacement
Dust boot missing	C	Require replacement of dust boot
Dust boot torn	A	Require replacement of dust boot
Leaking	A	Require rebuilding or replacement
NOTE: **Leaking is defined as a drop or more. Dampness is normal.**		
Loose	B	Require repair or replacement
Piston corroded, affecting performance	B	Require replacement of piston and rebuilding or replacement of wheel cylinder
Piston finish worn off	B	Require replacement of piston and rebuilding or replacement of wheel cylinder
Piston stuck in bore	A	Require replacement of wheel cylinder
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

WIRING HARNESSES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

YAW RATE SENSOR

Condition	Code	Procedure
Broken	A	Require replacement
Connector loose	A	Require repair or replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require re-positioning to vehicle manufacturer's specifications
Output signal incorrect	B	Require replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	

Code	Reason
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

AUTOMOTIVE TERMINOLOGY & DEFINITIONS

ABS

see 'anti-lock brake system "

ANCHOR PIN

a component located on the brake backing plate, on which the brake shoes rotate and to which the return springs are secured.

ANTI-LOCK BRAKE SYSTEM (ABS)

a computer controlled system that allows the vehicle to be controlled under heavy braking by releasing hydraulic pressure to wheels that are about to lock up and skid. Sensors located at the wheels, monitor rotating wheel speed in relation to other wheels and send the information to a control module that in turn controls a hydraulic modulator, which regulates hydraulic fluid pressure to each brake assembly.

ANTI-LOCK BRAKING SYSTEM (ABS)

ABS keeps the wheels from fully locking up while braking to allow the driver to maintain steering control. Without ABS, too much force applied to the brake pedal can cause one or more wheels to stop turning (lockup) and begin skidding, greatly reducing the capability of the driver to steer. With ABS, maximum force on the brake pedal slows each wheel to the point of maximum braking - without skidding.
Since all wheels are still rolling, the driver maintains steering control within the limits of traction. Many light trucks use rear-wheel ABS to prevent rear wheel lockup.

BACKING PLATE

the component to which the brake shoes, wheel cy/inder and related components are attached.

BLEEDER VALVE

a valve located on disc brake calipers, wheel cylinders and some master cylinders that allows air and fluid to be removed from the brake system.

BRAKE DRAG

a condition that occurs when brake pads or shoes are in continuous contact with the disc brake rotors or brake drums.

BRAKE DRUM

a round cast iron housing attached to an axle shaft or spindle, on which the brake shoes press to stop its rotation.

BRAKE FADE

phenomenon that takes place when the temperature of the friction surfaces increases to a point where the application of heavy pedal pressure results in little braking action.

BRAKE FLUID

the hydraulic fluid used to transmit hydraulic pressure through the brake lines in a brake system.

BRAKE FLUSHING

a procedure to clean the brake hydraulic system with fresh, clean fluid that should be performed whenever new parts are installed, if there is any doubt as to the grade of fluid in the system, if a glycol fluid has been mixed with a silicone-based fluid, or if the fluid has been contaminated with petroleum or mineral based fluids.

BRAKE HOSE

flexible hoses that connect the brake lines on the chassis with the calipers or wheel cylinders, or the junction block on a solid axle.

BRAKE LINE

metal tubing that carries the brake fluid from the master cylinder to other brake system components.

BRAKE PAD

see 'disc brake pad'.

BRAKE ROTOR

see 'disc brake rotor'.

BRAKE SHOE

friction material that is bonded or riveted to curved metal structures and attached to the backing plate. The brake shoes press on the brake drum to stop its rotation.

BURNISH

the process of polishing a part using the pressure of a sliding tool.

BURR

a ragged metal edge left on a part during machining.

CALIPER

see 'disc brake caliper'.

CHAFING

damage or wearing away caused by friction and rubbing.

CHAMFER

a bevel or taper at the edge of a hole or corner, usually cut at 45 degrees.

CLEARANCE

the specified distance between two components.

COMBINATION VALVE

a single unit in the hydraulic brake system that incorporates the metering and proportioning valves in conjunction with the pressure differential switch. Combination valves are categorized as being either two-function or three-function devices, depending on the number of functions they perform. A threefunction valve provides all of the aforementioned capabilities of metering, proportioning and warning. However, the two-function unit combines either the proportioning and warning light functions or the metering and warning light operations into a single component.

COMPENSATING PORT

an opening between the master cylinder bore and reservoir that allows brake fluid to return to the reservoir.

CONTRACTION

a reduction in size, drawing together, narrowing, shrinking or shortening; the opposite of expansion.

DATA LINK CONNECTOR

a means through which information about the state of the vehicle control system can be extracted with a scan tool. This information includes actual readouts on each sensor's input circuit and some actuator signals. It also includes any trouble codes stored. The data link connector is also used to disable the computer's ignition timing adjustments on some engines so base or reference timing can be measured with a timing light. Before OBD II, each OEM had a unique Data link Connector (DLC) and :alled it by a different name. With the advent of OBO-II, the DLC became standardized as a 16-pin connector to which the scan tool could be connected to read data and sometimes control outputs of the PCM.

DISC BRAKE CALIPER

a hydraulically actuated device in a disc brake system that is mounted straddling the brake disc. The caliper contains at least one piston and is used to provide clamping force of the brake pads on the disc.

DISC BRAKE PAD

friction material that is bonded or riveted to metal plates and mounted in the disc brake caliper. The brake pads are clamped against the disc brake rotor to stop its rotation.

DISC BRAKE ROTOR

a cast iron disc mounted on the wheel hub, which is clamped by the caliper and disc brake pads to slow and stop its rotation.

DISC BRAKE

a braking system that uses cast iron discs mounted on the wheel hubs, over which brake calipers are mounted. Hydraulic pressure from the brake system forces the caliper piston(s) against friction pads mounted in the calipers, which in turn clamp the brake discs, stopping their rotation.

DISTORTION

warp, twist or other deformation in a part.

DOT

department of transportation.

DRUM BRAKE

a braking system that uses cast iron drums mounted to the wheel hubs. Hydraulic pressure from the brake system forces pistons in the wheel cylinder to press friction lined brake shoes against the inside of the drum, stopping its rotation.

DUAL MASTER CYLINDER

a master cylinder that has one cylinder bore, but two pistons and two fluid reservoirs. Each piston applies hydraulic pressure to two wheels only. In the event one of the hydraulic circuits fails, the other provides enough braking power to stop the vehicle.

DUO-SERVO DRUM BRAKES

a drum brake design that provides increased stopping power due to the servo or self-energizing action of the brake shoes.

ELECTRONIC BRAKE-FORCE DISTRIBUTION

operates in conjunction with ABS to balance the force applied to brakes at front and rear wheels. Can prevent over-braking, improve brake-pad life, reduce "brake fade" caused by excessive heat, and ensure peak braking efficiency in all conditions.

ELECTRONIC CONTROL MODULE (ECM)

the computer in an electronic control system, also known as an electronic control unit (EGU).

ELECTRONIC CONTROL UNIT (ECU)

see 'electronic control module (ECM)'.

ELECTRONIC STABILITY CONTROL

the next logical evolution of ABS and traction control. It has ABS's hardware and two additional sensors: steering-wheel angle sensor, which measures the position and rate the steering-wheel is turning, and a yaw sensor, which measures the rate the vehicle is actually turning. By comparing them, the on-board computer will know if the vehicle is oversteering or understeering.

FEELER GAUGE

thin metal strip manufactured in precise thickness and used to measure clearance between parts; usually part of a set.

FIXED CALIPER

a brake caliper design that contains one or two pistons positioned on either side of the rotor. The caliper is rigidly attached to the spindle and the pads are applied with equal hydraulic pressure from both sides..

FIXED SEAL

a type of brake caliper seal that is installed in a groove in the caliper bore.

FLOATING CALIPER

a brake caliper design that uses an adapter, or anchor plate, which is bolted to the spindle. The caliper floats laterally across a pair of special bolts that are screwed into the adapter. As hydraulic pressure is applied to the piston, the inboard pad is forced against the rotor. This pressure causes the caliper to move inboard until an equal pressure is applied by the outside pad to the outer disc surface.

FRICTION

the resistance to the motion of two moving objects in contact with each other.

GO/NO-GO GAUGE

a measuring tool that tells if a tolerance is met or not.

HARD SPOT

in area in a casting which has become harder (more dense) than the surrounding material; areas in the friction surface of a brake drum or rotor that have become harder than the surrounding metal.

HOLD-DOWN SPRINGS

springs that are used to keep the brake shoes secured to the backing plate.

HYDRAULIC PRESSURE

pressure exerted through a liquid.

HYDRO-BOOST

a power brake system that uses power steering pump fluid pressure rather than intake manifold vacuum.

HYGROSCOPIC

the ability of a material or substance to attract water.

ID

inside diameter.

INNER BEARING RACE

inner part of a ball or roller bearing that provides a surface for the balls or rollers to rotate.

INTEGRAL ABS

an anti-lock braking system that substitutes the traditional master cylinder and power booster with a self-contained hydraulic modulator and high-pressure accumulator.

LEADING-TRAILING DRUM BRAKES

a non-servo drum brake system where both brake shoes are held in place against a solidly attached anchor mounted to the bottom of the backing plate.

MASTER CYLINDER

the primary fluid pressurizing device in some hydraulic systems. In automotive use, it is found in the brake and hydraulic clutch systems and is pedal-activated, either directly or through a vacuum assist unit.

METERING VALVE

a valve used on front disc/rear drum brake systems for the purpose of providing a simultaneous application of the front and rear friction materials. Located in the front brake hydraulic circuit, the metering valve delays front disc brake operation until the rear brakes shoes overcome the return spring tension.

MILLIMETER

the base of metric size measurement. One millimeter equals 0.039370-in. One inch is equal to 25.4 m m.

MODULATOR

a component in the ABS system that contains the solenoid valves that regulate hydraulic fluid pressure to the calipers or wheel cylinders.

NORMAL WEAR

the average expected wear when operating under normal conditions.

OEM

original equipment manufacturer.

OXIDATION

the process of combining with oxygen, resulting in rusting or burning. Rust is slow oxidation; fire is rapid oxidation.

PARKING BRAKE

a system that applies the brakes mechanically through a series of linkages and cables. Depending on the vehicle, the parking brake system will either be actuated using a foot pedal or a hand-operated lever.

PASCAL'S LAW

the law of physics stating that liquids are noncompressible, and that a force applied to the top of a liquid in a closed container is exerted equally in all directions.

PERMEABILITY

ability of a membrane or other material to permit a substance to pass through it.

PITTING

surface irregularities caused by corrosion or excess wear.

PLAY

the relative movement between or among parts.

POWER BOOSTER

a device that uses a diaphragm, engine vacuum and atmospheric pressure to assist the driver with brake application. Also known as a vacuum booster.

POWER BRAKES

a system that uses vacuum or hydraulic pressure to assist the driver with brake application.

PRELOAD

tightening a bearing a specified amount past zero lash to eliminate axial play.

PRESSURE DIFFERENTIAL SWITCH

a valve and switch assembly installed in dual circuit brake systems to alert the driver in the event of a pressure loss in one of the hydraulic circuits.

PRIMARY SHOE

the brake shoe in a duo-servo drum brake system that transfers part of its force to the secondary shoe. The brake shoe facing the front of the vehicle when the vehicle is moving forward.

PROPORTIONING VALVE

the proportioning valve is used to control hydraulic pressure to the rear brakes. When the pressure to the rear brakes reaches a predetermined level, the proportioning valve overcomes the force of its spring-loaded piston and stops the flow of fluid to the rear brakes. This action maintains rear brake system pressure at a lower level than the front brakes, keeping the rear brakes from locking during hard stops.

QUICK TAKE-UP MASTER CYLINDER

a master cylinder design that is used to prevent excessive brake pedal travel. The quick take-up master cylinder uses a larger rear cylinder bore and quick take-up valve. This arrangement provides a large volume of fluid at low pressure (light pedal application) during the initial part of the pedal stroke. Also called a step-bore master cylinder.

RACE

a channel in the inner or outer ring of an anti-friction bearing in which the balls or rollers operate.

REGENERATIVE BRAKING

process of recovering some of a hybrid or electric vehicle's kinetic energy by allowing the wheels to drive a traction motor as a generator, thereby producing electric power that is stored for later use. When the driver brakes, the motor becomes a generator, using the kinetic energy of the vehicle to generate electricity that can be stored in the battery for later use. Traditional friction brakes are also necessary, as well as a strategy for smoothly blending the two braking mechanisms. Regenerative and friction brakes need to be controlled electronically so that stopping ability is maximized to make the dual brake operation transparent to the driver.

RESIDUAL PRESSURE

remaining or leftover pressure.

RETURN SPRINGS

springs that secure the tops of the brake shoes to an anchor pin on the backing plate. These springs allow the shoes to move in and out laterally.

SECONDARY SHOE

the brake shoe in a duo-servo drum brake system that receives force from the primary shoe when the brakes are applied. The secondary shoe does most of the braking when the vehicle is traveling forward, so its lining is larger than that of the primary shoe.

SENDING UNIT

a mechanical, electrical, hydraulic or electromechanical device which transmits information to a gauge or other receiving unit.

SERVO

a device, such as an electric motor or hydraulic piston, that is controlled by an amplified signal from a low power command device.

SLIDING CALIPER

a brake caliper design that operates similarly to the floating design, however, it attaches to the anchor plate using only one attachment point.

SPONGINESS

the feel of a soft or mushy brake pedal usually caused by trapped air in the hydraulic system.

STAR WHEEL

the star shaped wheel that is attached to the screw of a drum brake shoe adjuster. If brake shoe-to-drum clearance is excessive, the wheel is turned by the self-adjuster lever when the brakes are applied with the vehicle in reverse, moving the brake shoes closer to the drum.

TAPER

a gradual decrease in width or thickness; the difference in diameter between the cylinder bore at the bottom of the hole and the bore at the top of the hole, just below the ridge.

TECHNICAL SERVICE BULLETIN (TSB)

information published by vehicle manufacturers that describe updated service procedures and service procedures that should be used to handle vehicle defects.

TENSION

stress exerted on an object by pulling that tends to extend the material.

TOLERANCE

the difference between the allowable maximum and minimum dimensions of a mechanical part; the basis for determining the accuracy of a fitting.

TORQUE SEQUENCE

a specified order in which a component's mounting bolts should be tightened

TORQUE WRENCH

a breaker bar or ratchet wrench with an indicator that measure the twisting effort applied to a fastener during tightening.

TORQUE

twisting effort on a shaft or bolt.

UNDERSIZE

when an inside or outside diameter has been machined to a dimension smaller than standard. Undersized bearings are used to compensate.

VACUUM BOOSTER

see 'power booster'.

VALVE

a device that controls the pressure, direction or rate of flow of a liquid or gas.

WARPAGE

a condition that exists when a part is bent or twisted; the degree to which a part deviates from flatness.

WHEEL CYLINDER

a cylinder connected to a drum brake hydraulic system. Hydraulic pressure in the system applies piston(s) in the wheel cylinder against the brake shoes, forcing the shoes against the inside of the brake drum and stopping its rotation.

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Drive Train & Transmission Systems

DRIVE TRAIN & TRANSMISSION SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

DRIVETRAIN AND TRANSMISSION

NOTE: **When a procedure states that a required or suggested repair or replacement is recommended, the basis for the recommendation MUST be explained to the customer. If the customer asks whether there are alternatives to the recommendation, generally acceptable repair/replacement options must be explained, whether performed or not by the shop.**

NOTE: **Whenever transmission or drive-train service is performed that affects the suspension alignment, for example, removing the engine cradle, it is required that the alignment be checked and corrected if necessary.**

NOTE: **The conditions listed for the components included in this section assume that the problem has been isolated to the specific component through proper testing.**

ACTUATORS (ELECTRICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	2	Require repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

ACTUATORS (VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware.
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement

Condition	Code	Procedure
Out of adjustment	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

AUTOMATIC TRANSMISSION / TRANSAXLE ASSEMBLIES/CVTS

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the automatic transmission / transaxle assembly.
NOTE: **It is required that the torque converter and all other failure-related components be inspected for cause and condition. For components not requiring removal of the assembly, refer to the component listing**		

AUTOMATIC TRANSMISSION FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
Burned	Â	Further inspection required
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service

Condition	Code	Procedure
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Varnish deposits present on system components affecting performance	Â	Further inspection required

AXLES

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement
Bent, beyond specification	B	Require repair or replacement
Broken	A	Require replacement
End play exceeds specifications	B	Require repair or replacement
Flange bent	A	Require replacement
Flange threads stripped	A	Require repair or replacement
Twisted	A	Require replacement
Worn, affecting performance	A	Require repair or replacement

BEARINGS AND RACES

NOTE: **When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.**

Condition	Code	Procedure
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible
NOTE: **If proper adjustment can't be obtained, require replacement of bearing assembly.**		
Bearing rollers, balls or races are worn, pitted, noisy, or feel rough when rotated as an assembly	B	Require replacement of bearing assembly

BELL CRANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require repair or replacement
Broken	A	Require repair or replacement
Cracked	A	Require repair or replacement
Missing	C	Require replacement
Worn, affecting performance	A	Require repair or replacement

BELL HOUSINGS

Condition	Code	Procedure
Bearing race loose in bore	A	Require repair or replacement
Broken, affecting performance	A	Require repair or replacement
Cracked	A	Require repair or replacement
Dowel pin holes worn, affecting performance	Â	See Dowel Pins, Guides, and Pilot Holes
Leaking Coolant	B	Require Repair or Replacement
NOTE: **This condition is found mostly on Hybrid vehicles with a liquid cooled inverter.**		
Machined surfaces damaged, affecting performance	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require repair or replacement

BUSHINGS (EXTERNAL)

Condition	Code	Procedure
Attaching hardware bent	B	Require repair or replacement of bent part if available, otherwise, replace bushing
Attaching hardware broken	A	Require repair or replacement of broken part if available, otherwise, replace bushing
Attaching hardware corroded, affecting structural Integrity	A	Require repair or replacement of corroded part if available, otherwise, replace bushing
Attaching hardware incorrect	B	Require repair or replacement of incorrect part if available, otherwise, replace bushing
Attaching hardware loose	A	Require repair or replacement of loose part if available, otherwise, replace bushing
Attaching hardware missing	C	Require repair or replacement of missing part if available, otherwise, replace bushing
Attaching hardware threads damaged	A	Require repair or replacement of part with damaged threads if available, otherwise, replace bushing
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of part with damaged threads if available, otherwise, replace bushing
Binding	A	Require repair or replacement
Contaminated	1	Suggest replacement
Deteriorated, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Distorted, affecting performance	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.**		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted out of position	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required
Worn affecting performance	A	Require repair or replacement
Worn, close to the end of Its useful life	1	Suggest replacement

CABLES (SPEEDOMETER)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	2	Suggest repair or replacement of bracket
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	2	Suggest repair or replacement of bracket
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly, affecting performance	B	Require repair
Seized	A	Require repair or replacement

CABLES (TV, DETENT AND SHIFT)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement

CARRIER BEARINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing rollers, balls or races are worn, pitted, noisy, or feel rough when rotated as an assembly	A	Require replacement of bearing assembly
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	2	Suggest repair or replacement of bracket
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Cracked	B	Require replacement
Rough (brinelling, spalling)	A	Require replacement
Rubber deteriorated, affecting performance	A	Require replacement
Seized	A	Require replacement

CLUTCH CABLES AND CABLE HOUSINGS

Condition	Code	Procedure
Broken	A	Require replacement
Cable bent	A	Require replacement
Cable binding	A	Require repair or replacement
Cable mounting loose	B	Require repair or replacement
Cable out of adjustment	B	Require repair or replacement
Frayed	B	Require replacement
Housing heat -damaged	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

CLUTCH DISCS (MANUAL TRANSMISSIONS)

Condition	Code	Procedure
Backing plate cracked	B	Require replacement
Broken	A	Require replacement
Contaminated with oil	A	Require replacement
NOTE: **Determine source of oil and correct prior to repair or replacement of clutch disc.**		
Damper cushion broken	A	Require replacement
Damper cushion collapsed	A	Require replacement
Damper spring collapsed	A	Require replacement
Damper spring missing	C	Require replacement
NOTE: **Not all clutch discs have springs in all spring chambers on the disc.**		
Friction material cracked through	B	Require replacement
Friction material flaking or chunking	B	Require replacement
Friction material surface cracking	Â	No service suggested or required
Grooved	B	No service suggested or required unless the pressure plate or flywheel is being resurfaced or replaced. In this case, replacement of clutch disc is required
Ridged	B	No service suggested or required unless the pressure plate or flywheel is being resurfaced or replaced. In this case, replacement of clutch disc is required
Splines worn, affecting performance	A	Require replacement
Warped, affecting performance.	A	Require replacement
Wear exceeds specifications (where applicable)	B	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance yet close to the end of its useful life	1	Suggest replacement

CLUTCH FORKS

Condition	Code	Procedure
Bent, affecting performance	B	Require replacement
Broken	A	Require repair or replacement
Cracked	B	Require repair or replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance yet close to the end of its useful life	1	Suggest replacement

CLUTCH LINKAGES (MECHANICAL)

Condition	Code	Procedure
Components missing	C	Require replacement of missing components
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage

Condition	Code	Procedure
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

CLUTCH MASTER CYLINDERS

Condition	Code	Procedure
Cover gasket distorted	A	Require replacement of cover gasket
Cover gasket gummy	A	Require replacement of cover gasket
NOTE: **This condition may indicate contaminated fluid. Further inspection required.**		
Cylinder leaking fluid from rear of bore	A	Require repair or replacement
Cylinder leaking fluid internally	A	Require replacement
Dust boot missing	C	Require replacement of dust boot
Dust boot punctured	A	Require replacement of dust boot
Dust boot torn	A	Require replacement of dust boot
Fluid level incorrect	B	Require fluid level adjustment
Housing damaged, affecting performance	A	Require repair or replacement
Master cylinder has residue in reservoir	2	Further inspection required
NOTE: **Do not replace master cylinder unless it exhibits conditions listed for replacement.**		
Pushrod out of adjustment	B	Require Repair or Replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

CLUTCH PEDALS

Condition	Code	Procedure
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Pedal pad missing	C	Require replacement of pedal pad
Pivot bushings worn, affecting performance	A	Require replacement of pivot bushings

CLUTCH PIVOTS

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement

Condition	Code	Procedure
Broken	A	Require repair or replacement
Cracked	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance, but close to the end of its useful life	2	Suggest replacement

CLUTCH PRESSURE PLATES

Condition	Code	Procedure
Balance weight missing	C	Require replacement
Broken	A	Require replacement
Contact surface distorted	B	Require replacement
Cracks	B	Require replacement
Fingers bent	A	Require replacement
Hard spots	B	Require replacement
Scored	B	Require replacement
Spring rate less than specifications	B	Require replacement
Worn beyond specifications	B	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

CLUTCH RELEASE BEARINGS

Condition	Code	Procedure
Collar broken	A	Require replacement
Cracked	B	Require replacement
Rough when rotated as an assembly	B	Require replacement
Seized	A	Require replacement
Wear exceeds specifications	B	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

CLUTCH SLAVE CYLINDERS (CONCENTRIC)

Condition	Code	Procedure
Bearing rough when rotated as an assembly	B	Require replacement
Bearing seized	A	Require replacement
Bleeder pipe leaks	A	Require repair or replacement
Carrier assembly worn, affecting performance	A	Require replacement
Collar broken	A	Require replacement
Cracked	B	Require replacement
Housing leaks	A	Require replacement
Inoperative	A	Require replacement
Release binding	A	Require replacement
Spring broken	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

CLUTCH SLAVE CYLINDERS (CONVENTIONAL OR EXTERNAL)

Condition	Code	Procedure

Condition	Code	Procedure
Binding	A	Require repair or replacement
Bleeder port damaged (not repairable)	A	Require replacement
NOTE: **Only required if the hydraulic system must be opened.**		
Bleeder port damaged (repairable)	A	Require repair
NOTE: **Only required if the hydraulic system must be opened.**		
Bleeder screw broken off in slave cylinder	A	Require replacement
NOTE: **Only required if the hydraulic system must be opened.**		
Bleeder screw seized	A	Require replacement
NOTE: **Seized is defined as a bleeder screw that cannot be removed after a practical attempt at removing it has been made. Only required if the hydraulic system must be opened.**		
Bore corroded (pitted)	B	Require replacement
Bore grooved	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

COMPANION FLANGES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent, affecting performance	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Transmission connector leaking	See Transmission Assembly	Â
Voltage drop out of specification	A	Require repair or replacement

COOLER BYPASS VALVES

Condition	Code	Procedure
Inoperative	A	Require replacement
Installed incorrectly	A	Require repair
Leaking	A	Require repair or replacement
Restricted	A	Require repair or replacement

COOLER LINES

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
NOTE: **If clamp removed, require replacement.**		
Connected incorrectly	A	Require repair
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	B	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

COOLERS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal restrictions	B	Require repair or replacement
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

CV JOINTS

Condition	Code	Procedure

Condition	Code	Procedure
Bearing, bushing or seal surface worn, affecting performance	A	Require repair or replacement
Boot clamp broken	A	Require repair or replacement of clamp
Boot clamp loose	A	Require repair or replacement of clamp
Boot clamp missing	C	Require repair or replacement of clamp
Boot leaking	A	Require replacement of CV boot
NOTE: **Further inspection of joint required before replacing boot.**		
Boot surface cracked, not leaking	2	Suggest replacement of CV boot
Cage broken	A	Require repair or replacement of CV joint
Housing damaged to the extent that it no longer performs its intended function	A	Require repair or replacement of CV joint
NOTE: **Housing assembly may appear blue in color from normal manufacturing process of heat treating the housing.**		
Housing worn to the extent that it no longer performs its intended function	A	Require repair or replacement
NOTE: **Housing assembly may appear blue in color from normal manufacturing process of heat treating the housing.**		
Internal parts binding	A	Require repair or replacement
Internal parts worn	A	Require repair or replacement
Lubricant missing	C	Require cleaning, inspection, and repacking of CV joint
Mounting holes elongated	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

DIFFERENTIAL AND FINAL DRIVE ASSEMBLIES

NOTE: **Does not include half shafts.**

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the differential assembly
NOTE: **For components not requiring removal of the assembly, refer to the component listing.**		

DIFFERENTIAL FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement

Condition	Code	Procedure
NOTE: **Determine and correct cause.**		
Burned	Â	Further inspection required
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Â	Further inspection required

DIP STICK TUBES

Condition	Code	Procedure
Broken	A	Require repair or replacement
Check ball missing	C	Require repair or replacement
Cracked	B	Require repair or replacement
Hold down bracket broken	A	Require repair or replacement
Hold down bracket missing	C	Require replacement
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

DIP STICKS (FLUID LEVEL INDICATORS)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Broken	A	Require replacement
Compressed	A	Require repair or replacement
Missing	C	Require replacement
Modified	A	Require replacement
Stretched	A	Require repair or replacement

DOWEL PINS, GUIDES AND PILOT HOLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Cracked	A	Require repair or replacement
Distorted	A	Require repair or replacement
Missing	C	Require replacement
Positioned incorrectly	B	Require repair or replacement
Stepped	A	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		
Missing	C	Require replacement
Threads Damaged	A	Require repair or replacement

DRIVE SHAFT FLANGES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent, affecting performance	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts

Condition	Code	Procedure
Yoke damaged, affecting performance	A	Require repair or replacement

DRIVE SHAFTS AND HALF SHAFTS

Condition	Code	Procedure
Balance weight missing	C	Require repair or replacement
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke
Out of balance	A	Require repair or replacement
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn, affecting performance	A	Require repair or replacement
Splines worn, not affecting performance, but close to the end of their useful life	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement of Yoke

DUST BOOTS

Condition	Code	Procedure
Cracked, not leaking	1	Suggest replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Torn	A	Require replacement
Weather checked, surface cracked	Â	No service suggested or required

ENGINE MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

EXCITER RINGS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement

Condition	Code	Procedure
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	B	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

FILLER TUBES

Condition	Code	Procedure
Broken	A	Require repair or replacement
Check ball missing	C	Require repair or replacement
Cracked	B	Require repair or replacement
Hold down bracket broken	A	Require repair or replacement
Hold down bracket missing	C	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

FILTERS AND SCREENS

Condition	Code	Procedure
At service interval	3	Suggest replacement
Bent, affecting performance	A	Require repair or replacement
Exceeding service interval	3	Suggest replacement
Missing	C	Require replacement
Near service interval	3	Suggest replacement
Restricted	A	Require repair or replacement
NOTE: **Further inspection may be required to determine the source of restriction or contamination.**		
Torn	A	Require replacement
Worn, affecting performance (metal or nylon screen type)	A	Require repair or replacement

FLANGES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent, affecting performance	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

FLEX PLATES

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement
Bent, not affecting performance	Â	No service suggested or required
Bolt or stud holes elongated	B	Require replacement
Broken	A	Require replacement
Cracked	B	Require replacement
Ring gear worn close to the end of its useful life	1	Suggest replacement
Ring gear worn to the extent that it no longer performs its intended function	A	Require replacement
Weights missing	A	Require repair or replacement

FLUID LEVEL INDICATORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Broken	A	Require replacement
Compressed	A	Require repair or replacement
Missing	C	Require replacement
Modified	A	Require replacement
Stretched	A	Require repair or replacement

FLUIDS AND LUBRICANTS

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
Burned	Â	Further inspection required
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		

Condition	Code	Procedure
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Â	Further inspection required

FLYWHEELS

NOTE: **Clutch disc replacement does not necessitate flywheel reconditioning, unless other conditions justify the reason to do so.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked (other than mounting area)	A	Require repair or replacement of hardware
NOTE: **Some manufacturers allow slight surface cracking in the friction surface.**		
Cracks in mounting area	B	Require replacement
Hard spots	B	Require repair or replacement
Ring gear teeth worn, affecting performance	A	Require replacement of ring gear
Runout exceeds specifications	B	Require repair or replacement
Scored	B	Require repair or replacement
Surface cracks after resurfacing to manufacturer's minimum specifications	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wear exceeds specifications	B	Require replacement
Worn, affecting performance	A	Require repair or replacement
Worn, not affecting performance, but close to the end of its useful life	1	Suggest repair or replacement

FORCE MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	1	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

GUIDES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Cracked	A	Require repair or replacement
Distorted	A	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Positioned incorrectly	B	Require repair or replacement
Stepped	A	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

HALF SHAFTS

Condition	Code	Procedure
Balance weight missing	C	Require repair or replacement
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Out of balance	A	Require repair or replacement
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn, affecting performance	A	Require repair or replacement
Splines worn, not affecting performance, but close to the end of their useful life	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement of yoke

HOSES, LINES, AND TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	2	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	2	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	1	Suggest repair or replacement

HOUSINGS (BELL, CASE, TAIL(EXTENSION) AND AUXILIARY)

Condition	Code	Procedure
Bearing race loose in bore	A	Require repair or replacement
Broken, affecting performance	A	Require repair or replacement
Cracked	B	Require repair or replacement
Dowel pin holes worn, affecting performance	A	Require repair or replacement
Machined surfaces damaged, affecting performance	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require repair or replacement

HYDRAULIC FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
Burned	Â	Further inspection required
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service

Condition	Code	Procedure
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Â	Further inspection required

INTERMEDIATE SHAFT SUPPORT BEARINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing rollers, balls or races are worn, pitted, noisy, or feel rough when rotated as an assembly	A	Require replacement of bearing assembly
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	2	Suggest repair or replacement of bracket
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Cracked	B	Require replacement
Rough (brinelling, spalling)	A	Require replacement
Rubber deteriorated, affecting performance	A	Require replacement
Seized	A	Require replacement

KEY INTERLOCK SYSTEMS

NOTE: **See: Actuators (Electrical), Cables, Linkages (External), Switches**

LIMITED SLIPS

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the differential assembly.
NOTE: **For components not requiring removal of the assembly, refer to the component listing.**		

LINES

Condition	**Code**	**Procedure**
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	I	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

LINKAGES (EXTERNAL)

Condition	**Code**	**Procedure**
Components missing	C	Require replacement of missing components
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

LOCKING HUB ASSEMBLIES

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Loose	B	Require repair or replacement
Seized in any position	A	Require repair or replacement

LOCKING HUB CONTROL KNOBS

Condition	Code	Procedure
Damaged, affecting performance	A	Require replacement
Missing	C	Require replacement
Worn, affecting performance	A	Require replacement

LUBRICANTS

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
At service interval	3	Suggest replacement
Beyond service interval	3	Suggest replacement
Burned	Â	Further inspection required
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correctly specified hydraulic fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Near service interval	3	Suggest replacement
Oxidized	A	Require replacement of fluid
Rubber master cylinder cover gasket distorted and gummy	A	Require service
NOTE: **If a fluid other than brake fluid is present in the system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		

MANUAL TRANSMISSION FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
Burned	Â	Further inspection required
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Â	Further inspection required

MANUAL TRANSMISSION/TRANSAXLE ASSEMBLIES

Condition	Code	Procedure

Condition	Code	Procedure
Any internal component failure that requires removal of the assembly from the vehicle for service.	A	Require repair or replacement of the manual transmission / transaxle assembly.

NOTE:

For components not requiring removal of the assembly, refer to the component listing.

METAL CLAD SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement

NOTE:

Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.

METALASTIC JOINTS

NOTE: **These joints may be found on half and/or drive shafts. They are usually found on European vehicles featuring a three-lug drive flange. They may be equipped with a centering ball or pin.**

Condition	Code	Procedure
Drive flange bent	A	Require replacement
Drive flange damaged, affecting performance	A	Require replacement
Rubber drive joint cracked	2	Suggest replacement
Rubber drive joint damaged, affecting performance	A	Require replacement
Rubber drive joint split between mounting holes	A	Require replacement
Rubber drive joint torn at mounting holes	A	Require replacement
Rubber drive joint weather-cracked	Â	No service suggested or required

MODULATOR PINS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Missing	C	Require replacement

MODULATORS

Condition	Code	Procedure
Bent, affecting performance	A	Require replacement
Contaminated (water, fuel, etc.)	A	Require replacement

NOTE:

Further inspection is required to determine the cause of the contamination.

Condition	Code	Procedure
Housing cracked	A	Require replacement
Inoperative	A	Require replacement

NOTE:

Inoperative includes intermittent operation.

Condition	Code	Procedure
Leaking fluid externally	A	Require repair or replacement
Leaking fluid internally	A	Require replacement
Leaking vacuum	A	Require replacement

Condition	Code	Procedure
Nipple broken	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

ODOMETER DRIVES (MECHANICAL)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Teeth broken	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

ODOMETER HEADS (MECHANICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		

Condition	Code	Procedure
Lens cloudy	2	Suggest repair or replacement
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Noisy	2	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

OIL PANS

Condition	Code	Procedure
Bent, interfering with filter or other internal components	A	Require repair or replacement
Leaking	A	Require repair or replacement

PANS

Condition	Code	Procedure
Bent, interfering with filter or other internal components	A	Require repair or replacement
Leaking	A	Require repair or replacement

PILOT HOLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Cracked	A	Require repair or replacement
Distorted	A	Require repair or replacement
Missing	C	Require replacement
Positioned incorrectly	B	Require repair or replacement
Stepped	A	Require repair or replacement
Worn to the extent that it no longer performs its intended function	A	Require repair or replacement

PRESSURE PLATES

Condition	Code	Procedure
Balance weight missing	C	Require replacement
Broken	A	Require replacement
Contact surface distorted	B	Require replacement
Cracks	B	Require replacement
Fingers bent	A	Require replacement
Hard spots	B	Require replacement
Scored	B	Require replacement
Spring rate less than specifications	B	Require replacement

Condition	Code	Procedure
Worn beyond specifications	B	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

PRESSURE SWITCHES

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Attaching hardware broken</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware not functioning</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Binding, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Binding, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Burned, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Burned, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Cracked, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Cracked, not affecting performance</td><td>1</td><td>Suggest repair or replacement</td></tr>
<tr><td>Leaking</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Malfunctioning</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Includes inoperative, intermittent operation, or failure to perform all functions.</td></tr>
<tr><td>Melted, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Melted, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Out of adjustment</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal burned, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Terminal burned, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Terminal corroded, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal corroded, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Terminal loose, affecting performance</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal loose, not affecting performance</td><td>1</td><td>Suggest repair or replacement</td></tr>
<tr><td>Won't return</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Worn</td><td>1</td><td>Suggest replacement</td></tr>
</table>

RACES

NOTE: **When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.**

Condition	Code	Procedure
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing assembly
NOTE: **When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions**		
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly	B	Require replacement of bearing assembly
NOTE: **When replacing or re-packing bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions**		

RUBBER JOINTS (METALASTIC)

NOTE: **These joints may be found on half and/or drive shafts. They are usually found on European vehicles featuring a three-Jug drive flange. They may be equipped with a centering ball or pin.**

Condition	Code	Procedure
Drive flange bent	A	Require repair or replacement
Drive flange damaged, affecting performance	A	Require replacement
Rubber drive joint cracked	2	Suggest replacement
Rubber drive joint damaged, affecting performance	A	Require replacement
Rubber drive joint split between mounting holes	A	Require replacement
Rubber drive joint torn at mounting holes	A	Require replacement
Rubber drive joint weather-cracked	Â	No service suggested or required

SCREENS

Condition	Code	Procedure
At service interval	3	Suggest replacement
Bent, affecting performance	A	Require repair or replacement
Exceeding service interval	3	Suggest replacement
Missing	C	Require replacement
Near service interval	3	Suggest replacement
Restricted	A	Require repair or replacement
NOTE: **Further inspection may be required to determine the source of restriction or contamination.**		
Torn	A	Require replacement
Worn, affecting performance (metal or nylon screen type)	A	Require repair or replacement

SEALS (METAL CLAD)

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Leaking</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.</td></tr>
</table>

SEALS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Leaking</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.</td></tr>
</table>

SELECTOR INTERLOCK SYSTEMS

NOTE: **See: Actuators (Electrical), Cables, Linkages (External), Switches**

Condition	Code	Procedure
Binding	A	Require repair or replacement
Broken	A	Require repair or replacement
Components missing	C	Require replacement of missing components
Loose, affecting performance	A	Require repair or replacement
Out of adjustment	B	Require repair
Worn, affecting performance	A	Require repair or replacement

SENSORS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Attaching hardware broken</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware not functioning</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Connector (Weatherpack type) leaking</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector melted</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Connector missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Inoperative</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Inoperative includes intermittent operation or out of specification.</td></tr>
<tr><td>Leaking (vacuum/fluid/air)</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Out of adjustment</td><td>B</td><td>Further inspection required</td></tr>
</table>

Condition	Code	Procedure
NOTE: **Follow OEM recommended adjustment procedures. Repair or replace if out of specification.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SERVOS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage

Condition	Code	Procedure
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SHIFT INTERLOCK SYSTEMS (SELECTOR AND KEY INTERLOCK SYSTEMS)

NOTE: **See: Actuators (Electrical), Cables, Linkages (External), Switches**

Condition	Code	Procedure
Binding	A	Require repair or replacement
Broken	A	Require repair or replacement
Components missing	C	Require replacement of missing components
Loose, affecting performance	A	Require repair or replacement
Out of adjustment	B	Require repair
Worn, affecting performance	A	Require repair or replacement

SIDE COVERS

Condition	Code	Procedure
Bent, interfering with filter or other internal components	A	Require repair or replacement
Leaking	A	Require repair or replacement

SLIP YOKES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap

Condition	Code	Procedure
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

SOLENOIDS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware.
Attaching hardware not functioning	A	Require repair or replacement of hardware.
Connector (Weatherpack type) leaking	A	Require repair or replacement.
Connector broken	A	Require repair or replacement.
Connector melted, affecting performance	A	Require repair or replacement.
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement.
Inoperative	A	Require replacement.
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement.
Noisy	2	Suggest repair or replacement.
Out of adjustment	B	Require repair or replacement.
Terminal broken	A	Require repair or replacement.
Terminal burned, affecting performance	A	Require repair or replacement.
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement.
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement.
Terminal corroded, not affecting performance	1	Suggest repair or replacement.
Terminal loose, affecting performance	B	Require repair or replacement.
Terminal loose, not affecting performance	1	Suggest repair or replacement.

SPEED SENSORS (ELECTRONIC WHEEL AND VEHICLE)

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement

Condition	Code	Procedure
NOTE: **If a sensor is not adjustable, further inspection is required to identify and correct cause.**		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as metal particles or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

SPEEDOMETER- DRIVEN GEAR HOUSING

Condition	Code	Procedure

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Teeth broken	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

SPEEDOMETER/ODOMETER DRIVES (MECHANICAL)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Teeth broken	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn close to the end of its useful life	1	Suggest replacement
Worn, affecting performance	A	Require replacement

SPEEDOMETER/ODOMETER HEADS (MECHANICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Lens cloudy	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Noisy	2	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SPEEDOMETERS/ODOMETERS (ELECTRONIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Lens cloudy	2	Suggest repair or replacement
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only .**		
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

TONE WHEELS

NOTE: **If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

TOOTHED RINGS (TONE WHEEL)

NOTE: **If the toothed ring requires replacement and cannot be replaced as a separate component, replace the assembly of which the ring is a part.**

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Bent	B	Require replacement
Contaminated, affecting performance	A	Require repair. Identify and correct cause
Cracked	A	Require replacement
Loose	A	Require replacement of worn parts
Missing	C	Require replacement
Number of teeth incorrect	B	Require replacement
Teeth broken	A	Require replacement
Teeth damaged, affecting performance	A	Require replacement

TORQUE CONVERTERS

Condition	Code	Procedure
Converter clutch lock-up operation is faulty	A	Require replacement
Cover shell damaged, affecting performance	A	Require replacement
Does not meet stall speed specification	B	Require replacement
End play exceeds specifications	B	Require replacement
Hub broken	A	Require replacement
Hub cracked	A	Require replacement
Internal component failure	A	Require replacement
Leaking	B	Require repair or replacement
Pilot broken	A	Require replacement
Pilot worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Weights missing	C	Require replacement

TRANSAXLE MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

TRANSDUCERS (TRANSMISSION)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation or out of specification.**		
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
NOTE: **Follow OEM recommended adjustment procedures. Repair or replace if out of specification.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

TRANSFER CASE ASSEMBLIES

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Any internal component failure that requires removal of the assembly from the vehicle for service.</td><td>A</td><td>Require repair or replacement of the transfer case differential assembly</td></tr>
<tr><td colspan="3">NOTE:
For components not requiring removal of the assembly, refer to the component listing.</td></tr>
</table>

TRANSFER CASE FLUID

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Additive depletion</td><td>A</td><td>Require replacement of fluid</td></tr>
<tr><td>Application incorrect</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine and correct cause.</td></tr>
<tr><td>Burned</td><td>Â</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Fluid that is burned indicates a serious problem. Determine and correct the cause.</td></tr>
<tr><td>Contaminated, for example, fluid other than the specified fluid present</td><td>B</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</td></tr>
<tr><td>Contaminated, for example, fluid other than the specified fluid present</td><td>A</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</td></tr>
<tr><td>Fluid at or beyond service interval</td><td>3</td><td>Suggest replacement</td></tr>
<tr><td>Fluid discolored</td><td>Â</td><td>No service suggested or required</td></tr>
<tr><td colspan="3">NOTE:
Further testing necessary to determine condition of fluid.</td></tr>
<tr><td>Fluid incorrect</td><td>B</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.</td></tr>
<tr><td>Level incorrect</td><td>B</td><td>Require correction of fluid level</td></tr>
</table>

Condition	Code	Procedure
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Â	Further inspection required

TRANSMISSION COOLERS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal restrictions	B	Require repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

TRANSMISSION MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

TRANSMISSION PANS

Condition	Code	Procedure
Bent, interfering with filter or other Internal components	A	Require repair or replacement

Condition	Code	Procedure
Leaking	A	Require repair or replacement

TRANSMISSION RANGE INDICATORS (PRNDL)

Condition	Code	Procedure
Binding	A	Require repair or replacement
Broken	A	Require repair or replacement
Components missing	C	Require replacement of missing components
Loose, affecting performance	A	Require repair or replacement
Out of adjustment	B	Require repair
Worn, affecting performance	A	Require repair or replacement

TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

UNIVERSAL JOINTS (CARDAN OR CROSS TYPE)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing cap distorted	B	Require replacement
Binding	A	Require replacement

Condition	**Code**	**Procedure**
Cross (trunion) worn, affecting performance	A	Require replacement
Double cardan centering ball damaged	A	Require replacement
Double cardan centering ball worn, affecting performance	A	Require replacement
Double cardan centering spring broken	A	Require replacement
Double cardan centering spring missing	C	Require replacement
Double cardan centering spring weak	A	Require replacement
End cap seal cracked	2	Suggest replacement
End cap seal missing	C	Require replacement of seal
Grease fitting broken	A	Require replacement of grease fitting
NOTE: **A broken grease fitting does not require replacement of the U-Joint.**		
Grease fitting missing	C	Require replacement of grease fitting
NOTE: **A missing grease fitting does not require replacement of the U-Joint.**		
Rust-colored powder around end cap seals	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Worn, affecting performance	A	Require replacement

VACUUM CONTROLS

Condition	**Code**	**Procedure**
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage

Condition	Code	Procedure
Linkage binding, not affecting performance	1	Require repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

VACUUM HOSES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted, affecting performance	B	Require repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

VACUUM MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

VACUUM-OPERATED SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn affecting performance	B	Require replacement

VEHICLE SPEED SENSORS

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement
NOTE: **If a sensor is not adjustable, further inspection is required to identify and correct cause.**		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as metal particles or water. Require repair or replacement.**		
Inoperative	B	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

VENTS

Condition	Code	Procedure
Broken	A	Require replacement
Missing	C	Require replacement
Plugged	A	Require repair or replacement

NOTE:

A plugged vent may force fluid past the seal.

VIBRATION DAMPERS

Condition	Code	Procedure
Broken	A	Require replacement
Missing	C	Require replacement
Out of position	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

WHEEL ATTACHMENT HARDWARE

NOTE: **For conditions noted below, also check conditions of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.**

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement

NOTE:

Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.

Condition	Code	Procedure
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut rounded	A	Require replacement of nut

NOTE:

Only required if removing wheel.

Condition	Code	Procedure
Lug nut seized	A	Require replacement of nut

Condition	Code	Procedure
NOTE: **Only required if removing wheel.**		
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

WHEEL SPEED SENSORS

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment or replacement
NOTE: **If a sensor is not adjustable, further inspection is required to identify and correct cause.**		
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as metal particles or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Sensor housing cracked	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement

Condition	Code	Procedure
Wire lead corroded	A	Require repair or replacement
Wire lead misrouted	B	Require re-routing according to vehicle manufacturer's specifications
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WIRING HARNESSES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, not affecting performance	1	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Transmission connector leaking	See Transmission Assembly	Â
Voltage drop out of specification	A	Require repair or replacement

YOKES AND SLIP YOKES

Condition	Code	Procedure
Bearing cap bore distorted	A	Require repair or replacement
Bent	A	Require replacement
Bolt holes elongated	A	Require repair or replacement
Bushing or seal surface worn, affecting performance	A	Require repair or replacement
Leaking through soft yoke plug	A	Require repair or replacement of soft yoke plug
Retainer strap bent	A	Require replacement of retainer strap
Slip yoke broken	A	Require replacement
Splines worn close to the end of their useful life	1	Suggest replacement
Splines worn, affecting performance	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
U-bolt damaged, affecting performance	A	Require replacement of U-bolts
Yoke damaged, affecting performance	A	Require repair or replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

AUTOMOTIVE TERMINOLOGY & DEFINITIONS

ACTUATOR

a control device that delivers mechanical action in response to a vacuum or electrical signal; anything that the engine control computer uses to do something, such as trigger fuel injection or fire a spark plug. Most actuators on a computercontrolled engine system are activated by grounding their circuits rather than by actively powering them, since that protects the computer from short circuits.

ADDITIVE

in automotive terminology, a substance added to a liquid, such as engine oil, transmission fluid, gear oil or coolant to enhance its properties.

AUTO SHIFT MANUAL TRANSMISSION AND SELECT SHIFT MANUAL TRANSMISSION

select shift manual (SSM) and auto shift manual (ASM) use a combination of auto-clutch and shift-by-wire electronic control system technology to provide the customer a fun-to-shift experience along with significant fuel economy improvements over a base manual transmission. The Select Shift Manual mode allows a customer to command gear changes according to his/her personal preference like a conventional manual transmission. The Auto Shift Manual mode provides the customer automatic gear shifting much like an automatic transmission.

AUTOMATIC TRANSMISSION FLUID (ATF)

the oil that is used in an automatic transmission.

AUTOMATIC TRANSMISSION

a transmission that changes forward gears automatically.

AXLE HOUSING

an enclosure for the differential and drive axles.

AXLE

a rotating shaft that rotates another part, such as a wheel.

BALL BEARING

a friction-reducing bearing that uses a series of steel balls held between inner and outer bearing races such as in a roller clutch.

BAND

in an automatic transmission, a device used to prevent members of a planetary gearset from rotating.

BEARING RACE

the machined surface of a bearing assembly against which the needles, balls or rollers ride. The outer race is also called a cup.

BEARING

part that supports and reduces friction between a stationary and moving part or two moving parts.

BELL HOUSING

connects the engine to the transmission and encloses the clutch assembly. It also provides mounting points for part of the clutch release mechanism.

CARDAN UNIVERSAL JOINT

the most common type of universal joint used. Consists of a center cross, four bearing cups, each containing a set of needle roller bearings, grease seals and snap rings.

C-CLIP

part used to retain the axle shaft in a drive axle assembly

CLUTCH DISC

the part of a clutch that receives the driving motion from the flywheel and pressure plate assembly and transmits that motion to the transmission input shaft.

CLUTCH FACING

the friction material on a clutch disc.

CLUTCH FORK

also known as the release fork. The device which moves the throwout (release) bearing, activating the pressure plate.

CLUTCH PACK

in an automatic transmission, an assembled series of clutch friction discs and clutch plates that are alternately layered.

CLUTCH PRESSURE PLATE

the part of a clutch assembly that is used to hold the driven disc against the flywheel. The pressure plate is composed of a cover and coil springs, driving disc and release levers, or a diaphragm spring.

CLUTCH RELEASE BEARING

a sealed ball or roller bearing unit that rides on a sleeve over the transmission input shaft, and acts on the pressure plate to disengage the clutch disc when the clutch release mechanism is applied. Also called a throwout bearing.

CLUTCH THROWOUT BEARING

see 'clutch release bearing'.

CLUTCH

in a manual transmission, a device that allows the driver to engage and disengage the engine from the drivetrain; in an automatic transmission, a device capable of both holding and turning members of a planetary gearset; a device used to engage and disengage and A/C compressor.

CONSTANT MESH

in a transmission, where all gears are constantly in contact and turning with one another.

CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

a continuously variable transmission is an automatic that can select any desired drive ratio within its operating range. Unlike a traditional three-, four-, or fivespeed automatic transmission the CVT is an "infinite speed" transmission, the CVT continually selects an optimum overall drive ratio between engine and drive wheels for all operating conditions, whether accelerating or cruising. Unlike conventional automatics, there are no perceptible shifts. During maximum acceleration, the drive ratio Is adjusted to maintain peak engine horsepower. At a constant vehicle speed, the ratio is set to maintain an engine rpm which will support the required power. A CVT provides smooth, fast acceleration and high cruising efficiency with the convenience of an automatic transmission.

COUNTERGEAR

a set of different size gears incorporated in one casting, used in a manual transmission.

DIFFERENTIAL CARRIER

enclosure for the differential and ring and pinion gears. Can be removable or integral part of axle housing. Also called differential housing.

DIFFERENTIAL CASE

housing for the differential pinion gears and side gears. Mounting point for ring gear.

DIFFERENTIAL PINION GEARS

gears that are meshed with the differential side gears and rotate on the differential pinion shaft inside the differential case.

DIFFERENTIAL PINION SHAFT

a shaft mounted inside the differential case, provides support and pivot for the differential pinion gears.

DIFFERENTIAL SIDE GEARS

gears that are meshed with the pinion gears inside the differential case and splined to the axle shafts.

DIFFERENTIAL

gear assembly that transmits power from the driveshaft to the wheels; allows the outside wheel to turn faster than the inside when cornering.

DIRECT DRIVE

downward gear engagement in which the input shaft and output shaft are locked together; the gearing in a drivetrain in which one turn of the crankshaft equals one turn of the wheels.

DOUBLE CARDAN UNIVERSAL JOINT

two cardan universal joints connected by a yoke; also called a constant velocity (CV) joint.

DOUBLE OFFSET JOINT

a Rzeppa type plunger CV-joint used on the inboard side of the interconnecting shaft.

DOWEL

a peg or pin which fits into corresponding holes used for holding two parts together or to locate two parts in a set position.

DRIVE MEMBER

a gear that drives or provides power for other gears in a planetary gearset.

DRIVELINE ANGLE

see 'driveshaft angle'.

DRIVELINE

all of the parts connecting the engine to the drive axle.

DRIVESHAFT ANGLE.

the installation angle of the driveshaft off the true horizontal; also called driveline angle.

DRIVESHAFT

transfers power from the transmission to the differential on a rear-wheel drive vehicle. Consists of a hollow metal tube with universal joints at each end, each of which is attached to yokes at the transmission and differential.

DRIVETRAIN

all of the components that generate power and transfer it to the vehicle's wheels.

ELECTRONIC AUTOMATIC TRANSMISSION

an electronic automatic transmission utilizes an electronic control module to signal when to shift. The module also determines when to lock and unlock the torque converter. By controlling these functions electronically rather than mechanically, the transmission can be tuned for better driveability.

ENDPLAY

the amount of axial or end-to-end movement in a shaft due to clearance in the bearings; the regulated movement of a component, usually a shaft, during operation.

EXCESSIVE WEAR

in mechanical terms, wear of a component that exceeds designed limits; wear caused by overloading a part that is in an out-of-balance condition, resulting in lower-than-normal life expectancy of the part being subjected to the adverse operating condition.

EXTENSION HOUSING

aluminum or cast iron enclosure for the transmission output shaft and bearings, speedometer drive and driven gears. Provides support for driveshaft slip yoke.

FLANGE

a projecting rim or collar on a component used for holding it in place, giving it strength or guiding it into place or attaching it; a part mounted on the pinion gear that provides the mounting point for the rear universal joint of the driveshaft.

FLYWHEEL

a cast iron or steel wheel mounted to the end of the crankshaft; helps to smooth the engine's power delivery, the teeth around its circumference provide an engagement for the starter, and it provides the mounting points for the pressure plate and friction surface for the clutch disc.

FOUR WHEEL DRIVE (4WD)

system that supplies power to both the front and rear wheels of the vehicle when activated.

FREE PLAY

the measurable travel in a mechanical device between the time force is applied and work is accomplished; looseness in a linkage between the start of application and the actual movement of the device, such as the movement in the steering wheel before the wheels start to turn.

FREE TRAVEL

distance a clutch pedal moves before it begins to take up slack in the clutch linkage; essentially the same as free play, usually applied to shaft movement.

FREEWHEEL

a mechanical device that engages the driving member to impart motion to a driven member in one direction but not the other; in automotive terms, a device that permits the driveshaft to continue turning when its speed exceeds that of the crankshaft, thus allowing free coasting with the gear train engaged.

FRONT WHEEL DRIVE

the entire drivetrain is located at the front of and drives the front wheels of the vehicle.

FULL FLOATING AXLE

system where the weight of the vehicle is supported by the axle housing and the axle bearing is located outside of the axle housing; most often used on trucks.

FULLY SYNCHRONIZED

in a manual transmission, where gears are changed using synchronizers.

GEAR PITCH

number of teeth per given unit of pitch diameter. Gear pitch is determined by dividing the number of teeth by the pitch diameter of the gear.

GEAR RATIO

the number of revolutions a driving gear must turn to rotate the driven gear through one revolution. Numerical value determined by dividing the number of teeth on the driven gear by the number of teeth on the driving gear; the ratio between the number of teeth on meshing gears.

GEAR REDUCTION

when a smaller gear drives a larger gear, there is a speed reduction but an increase in torque.

GEAR

a toothed wheel, disc, etc. designed to mesh with another or with the thread of a worm; used to transfer or change motion.

GOVERNOR PRESSURE

the change in line pressure that takes place as a result of an increase in vehicle speed.

GOVERNOR

a device used on non-electronic automatic transmissions, which regulates the operation of the shift valves inside the valve body according to vehicle speed.

HELICAL GEAR

a gear in which the teeth are cut so as to form a spiral; gear with teeth that are cut at an angle or are spiral to the gear's axis of rotation.

HUNTING GEARSET

differential gearset where any one pinion gear tooth contacts all ring gear teeth.

HYPOID GEAR

bevel-cut gear in a system in which the driven gear is not in the same plane as the drive gear. A type of spiral, beveled ring and pinion gearset in a differential. Hypoid gears mesh below the ring gear centerline.

INPUT SHAFT

the shaft that is splined to the clutch disc and transfers power from the engine into the transmission; the shaft to which torque is applied, usually carrying the drive gear or gears.

INSERT SPRING.

exerts pressure on the inserts in a synchronizer assembly.

INSERT

a part of the synchronizer assembly that fits between the hub and sleeve, also called key or plate. The insert spring pushes the inserts into the sleeve, helping to center the sleeve on the hub.

LIMITED SLIP DIFFERENTIAL

a type of differential that uses clutches to supply a major portion of the drive torque to the wheel that has better traction when one wheel is slipping,

LINE PRESSURE

in an automatic transmission, the hydraulic pressure of the fluid after it leaves the pump and is regulated by the pressure regulator.

LIVE AXLE

an axle on which the wheels are firmly affixed, with the axle driving the wheels.

MAINLINE PRESSURE

in an automatic transmission, pressure that is regulated in the hydraulic system.

MESH

to fit closely together or interlock, as the fit of gear teeth.

NEEDLE BEARING

an anti-friction device that consists of a number (usually a large number) of thin rollers riding within races.

NEUTRAL START SWITCH

a switch that prevents starter engagement if the transmission is in another gear besides Park or Neutral.

NONHUNTING GEARSET

differential gearset in which one drive pinion gear tooth contacts only three ring gear teeth after several rotations.

OIL COOLER

device used to remove heat from the engine or transmission oil. There are oil-to-air coolers and oil coolers that are incorporated into the vehicle's cooling system.

ORIGINAL EQUIPMENT MANUFACTURER (OEM)

the original manufacturer of a vehicle or engine.

OUTER BEARING RACE

outer part of a bailor roller bearing that provides a surface for the balls or rollers to rotate. Can be integral with the bearing or a separate part.

OUT-OF-ROUND

when a previously round hole or bore has different diameters when measured at different points due to wear or distortion.

OUTPUT SHAFT

the shaft that delivers the power that has come through the transmission or transaxle.

OVERDRIVE

a gear assembly that outputs more shaft revolutions than were input.

OVERRUNNING CLUTCH

a clutch that locks in one direction and overruns or freewheels in the other.

PINION GEAR

the smaller, drive gear of the ring and pinion gearset; one of the gears inside the differential that rotates on the differential pinion shaft; rotates around the sun gear in a planetary gearset.

PINION

the smaller of two meshing gears.

PLANETARY CARRIER

houses the pinion gears in a planetary gearset.

PLANETARY GEARSET

a gear system consisting of three primary components: a sun gear, a planetary pinion carrier and a ring or internal gear.

POWERTRAIN CONTROL MODULE (PCM)

on vehicles with computer control systems, the main computer that determines engine operation based on sensor inputs and by using its actuator outputs. The PCM may also control transmission operation.

PRESSURE PLATE

the driving member of the clutch assembly. Coil springs or a diaphragm spring in the pressure plate exert pressure on the clutch disc, holding it against the flywheel.

REAR WHEEL DRIVE

system where the driveline drives the rear wheels of the vehicle. Most often the engine is located in the front of the vehicle and a transmission and drive shaft connect to a drive axle, however there are also systems where the entire drive line is located toward the rear of the vehicle.

RELEASE BEARING

see 'clutch release bearing'.

REVERSE IDLER GEAR

a gear used to reverse the direction of power in a transmission.

RING GEAR

the larger, driven gear of the ring and pinion gearset; the largest member in a planetary gearset, also known as the internal gear or annulus. The internal teeth of the gear mesh with and rotate on the planetary pinions.

ROTARY FLOW

torque converter oil flow associated with the coupling stage of operation.

SEAL

a part, usually made of rubber or plastic, installed around a moving part or shaft to prevent leaks.

SEMI-FLOATING AXLE

system where the axle bearing is located inside the axle housing and the weight of the vehicle is supported by the axle.

SHIFT FORK

a device in a manual transmission that moves the synchronizer assembly sleeve, in response to movement from the shift linkage.

SHIFT RAILS

the parts of transmission shift linkage that transfer motion from the driver-controlled gear shift lever to the shift forks.

SHIFTER

the lever operated by the driver to shift the transmission. The shifter is attached directly to internal linkage in the transmission or it is mounted on the outside of the transmission or on the frame or vehicle floor, and connected to the transmission or trans axle by external linkage rods or cables.

SLAVE CYLINDER

a device that is connected to the release bearing in a hydraulic clutch system. When the clutch pedal is depressed, hydraulic fluid flows from the master cylinder through the hydraulic fluid line to the slave cylinder. Pressure in the system causes the slave cylinder to act on the release bearing, disengaging the clutch

SLIP YOKE

a driveline component that is splined to the transmission output shaft and connected to the driveshaft front U-joint. Allows in and out movement on the transmission extension housing in response to rear suspension movement.

SLIP

condition caused when a driving part rotates faster than a driven part.

SPLINES

grooves cut into the outside or inside surface of a component to enable it to fit with another component having corresponding grooves. Commonly used to keep a component secured on a rotating shaft.

SPRAG CLUTCH

a type of overrunning clutch.

SUMP

the reservoir that holds the oil for the pump.

SYNCHRONIZER

a type of clutch assembly used in a manual transmission to shift gears. Consists of a hub splined to the main shaft, inserts (keys) and insert springs, outer sleeve and blocking rings. There are grooves machined into the sleeves to capture the shift forks, which transfer the motion from the gearshift linkage. The sleeve moves along the splined inner hub in response to the shift fork, forcing the blocking ring against the gear cone and then, when the gear is at the same speed, slides over the blocking ring and gear engagement teeth, locking the gear to the synchronizer hub and shaft.

THROWOUT BEARING

see 'clutch release bearing'.

THRUST BEARING

a bearing that separates rotating parts from each other and non-rotating parts, and absorb thrust loads; a bearing with side surfaces that controls the fore and aft movement of a shaft.

TORQUE CONVERTER CLUTCH

a device located inside the torque converter that mechanically links the engine and transmission together.

TORQUE CONVERTER

a fluid coupling device used to transfer engine torque from the crankshaft to the transmission.

TORQUE STEER

the tendency of many front -wheel-drive vehicles with half-shafts of unequal length, to turn somewhat from the desired direction when accelerating, especially in a curve, or when decelerating in a curve.

TRANSFER CASE

attached to or connected to the transmission in a four-wheel drive vehicle. Transfers power to both front and rear axles.

TRANSMISSION CONTROL MODULE (TCM)

the computer that controls the transmission.

TRANSMISSION

transfers the engine's power to the driveshaft and the rear wheels. Contains a series of gears that provide torque multiplication, so the vehicle can be moved from a standstill and also cruise at highway speeds at lower engine rpms.

TRANSVERSE

perpendicular or at a right angle to a front-to-back centerline.

TRIPOD JOINT

a type of CV-joint consisting of a spider, which is splined to the interconnecting shaft of the halfshaft, three rollers that turn on needle roller bearings located between the spider and rollers, a housing, or yoke, that is part of the stub shaft, and a boot. Used on the inboard side of the halfshaft.

UNIVERSAL JOINT (U-JOINT)

a joint that allows the drives haft to transmit torque at different angles as the suspension moves up and down.

VACUUM MODULATOR

a device used to vary line pressure according to engine load in an automatic transmission.

VALVE BODY

in an automatic transmission, the housing that contains most of the valves used for transmission operation.

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Electrical Systems

ELECTRICAL SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

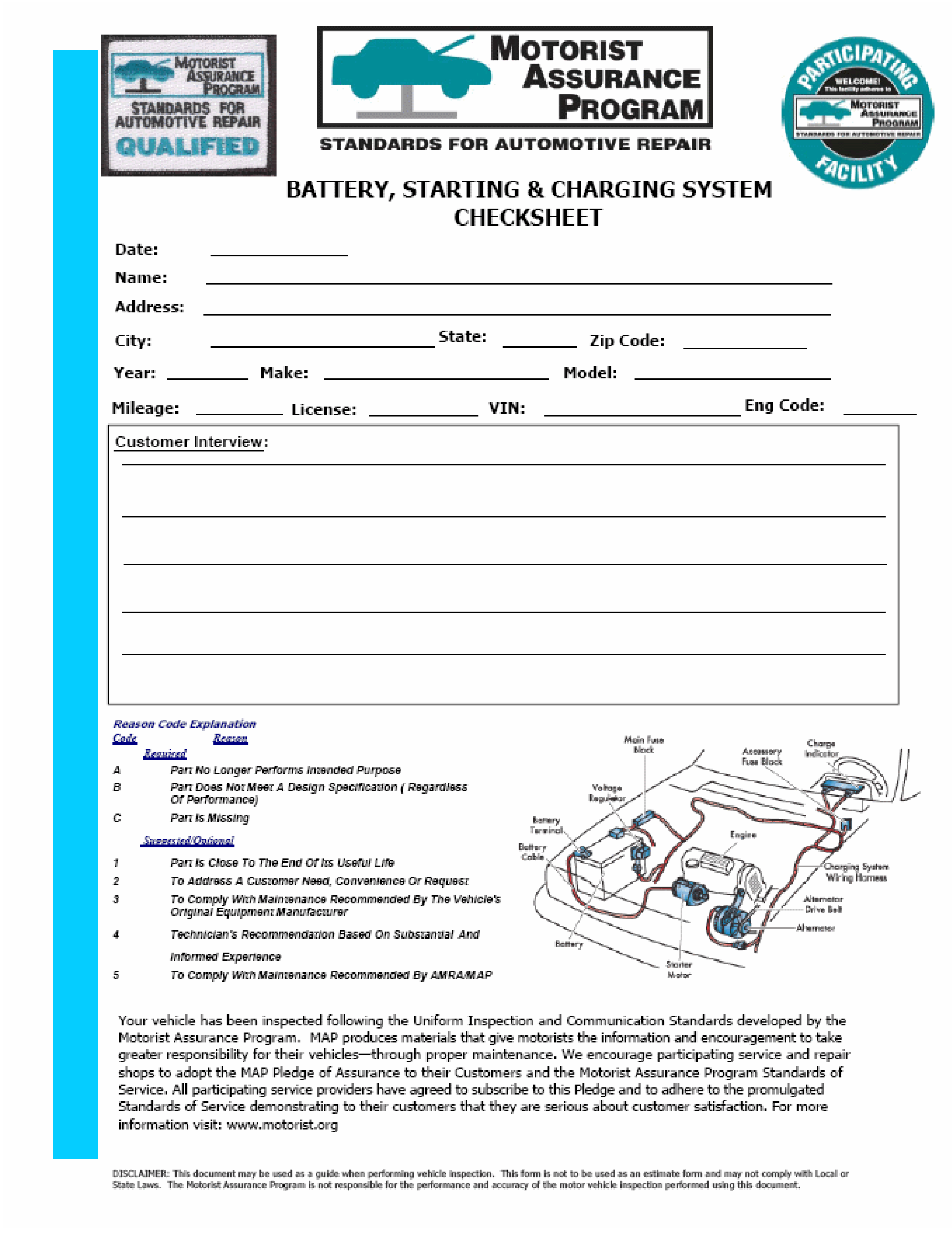
A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	**Reasons to Suggest Repair or Replacement**
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

BATTERY, STARTING & CHARGING SYSTEM CHECKSHEET



MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
QUALIFIED

MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR

PARTICIPATING FACILITY
WELCOME! This facility adheres to
MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR

BATTERY, STARTING & CHARGING SYSTEM
CHECKSHEET

Date: ______________

Name: ____________________________________

Address: ____________________________________

City: ______________________ State: ________ Zip Code: ____________

Year: ________ Make: ______________________ Model: ____________________

Mileage: ________ License: ___________ VIN: ____________________ Eng Code: _______

Customer Interview:

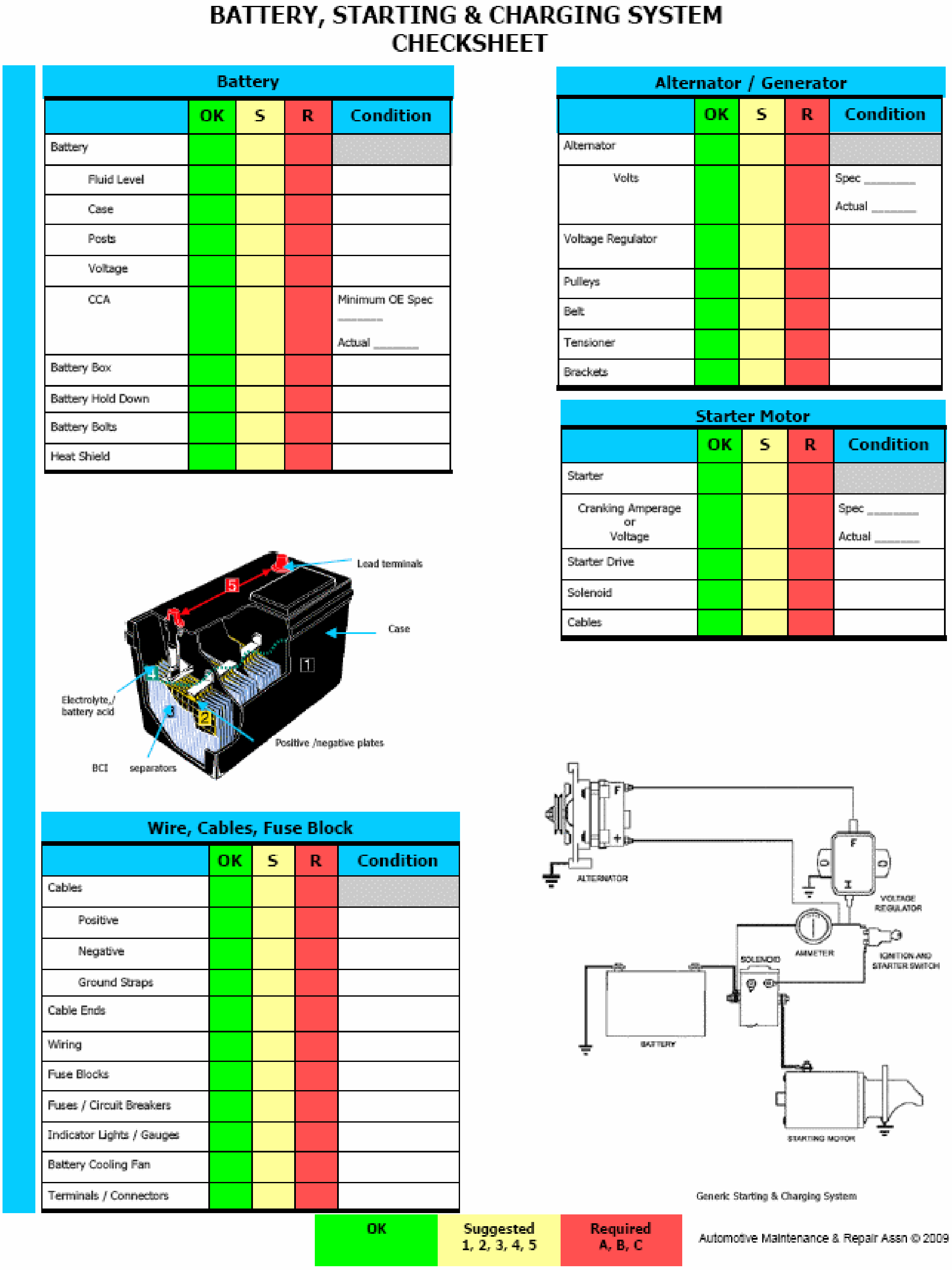
Reason Code Explanation

Code	*Reason*
	Required
A	*Part No Longer Performs Intended Purpose*
B	*Part Does Not Meet A Design Specification (Regardless Of Performance)*
C	*Part Is Missing*
	Suggested/Optional
1	*Part Is Close To The End Of Its Useful Life*
2	*To Address A Customer Need, Convenience Or Request*
3	*To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer*
4	*Technician's Recommendation Based On Substantial And Informed Experience*
5	*To Comply With Maintenance Recommended By AMRA/MAP*

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 1: Battery, Starting & Charging System Checksheet (1 Of 2)



BATTERY, STARTING & CHARGING SYSTEM CHECKSHEET

Battery

	OK	S	R	Condition
Battery				
Fluid Level				
Case				
Posts				
Voltage				
CCA				Minimum OE Spec ______ Actual ______
Battery Box				
Battery Hold Down				
Battery Bolts				
Heat Shield				

Alternator / Generator

	OK	S	R	Condition
Alternator				
Volts				Spec ______ Actual ______
Voltage Regulator				
Pulleys				
Belt				
Tensioner				
Brackets				

Starter Motor

	OK	S	R	Condition
Starter				
Cranking Amperage or Voltage				Spec ______ Actual ______
Starter Drive				
Solenoid				
Cables				

Lead terminals
Case
Electrolyte / battery acid
BCI
separators
Positive /negative plates
1
2
3
4
5

Wire, Cables, Fuse Block

	OK	S	R	Condition
Cables				
Positive				
Negative				
Ground Straps				
Cable Ends				
Wiring				
Fuse Blocks				
Fuses / Circuit Breakers				
Indicator Lights / Gauges				
Battery Cooling Fan				
Terminals / Connectors				

ALTERNATOR
F
VOLTAGE REGULATOR
AMMETER
IGNITION AND STARTER SWITCH
SOLENOID
BATTERY
STARTING MOTOR

Generic Starting & Charging System

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

Automotive Maintenance & Repair Assn © 2009

Fig. 2: Battery, Starting & Charging System Checksheet (2 Of 2)

ELECTRICAL SYSTEMS

ACTUATOR MOTORS (ELECTRIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

ACTUATOR MOTORS (VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement

Condition	Code	Procedure
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement

AIR BAGS

NOTE: **For all air bag components and conditions, refer to vehicle manufacturer's specifications for diagnosis and parts replacement.**

ALTERNATORS AND GENERATORS

NOTE: **If components have been added that increase vehicle electrical load requirement (for example, sound systems, air conditioning, alarm systems, etc.), charging system output must meet the increased demand.**

Condition	Code	Procedure
Alternator output meets OEM specification but is insufficient for add on electrical load	2	Suggest upgrade of alternator or removal of excess electrical load
Alternator's rated output is below OEM specification	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware non-functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Diode inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Noisy	2	Suggest repair or replacement
Pulley incorrect	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Terminal resistance (voltage drop) out of specification	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Voltage drop out of specification	A	Require repair or replacement

AMPLIFIERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ANTENNAS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	2	Suggest repair or replacement
Binding	2	Suggest repair or replacement
Broken	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation or out of specification.**		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Motor runs continuously	A	Require or replacement
Power antenna noisy	2	Suggest repair or replacement
Sticking	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

BATTERIES

NOTE: **Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.**

Definition of Terms

Battery Performance Testing - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.

Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0Â° F (-17.8Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

Cranking Amps (CA) - The number of amperes a new, fully charged battery, typically at 32Â° F (0Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12volt battery).

OEM Cranking Amps - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.

Condition	Code	Procedure
Battery frozen	Â	Further inspection required
NOTE: **Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.**		
Battery tests near the ""end of its useful life"" utilizing a tester or on-board monitor able to accurately determine this condition	1	Suggest Replacement
Case leaking	A	Require replacement
Casing swollen	A	Further inspection required
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Circuit open internally	A	Require replacement
Electrolyte contamination	A	Further inspection required
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Electrolyte discoloration	A	Further inspection required

Condition	Code	Procedure
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Fails to accept and hold charge	A	Require replacement
NOTE: **This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer' s specifications.**		
Fluid level low	B	Further inspection required
NOTE: **Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test.**		
NOTE: **If battery does not meet specifications, require replacement.**		
NOTE: **If battery is sealed type (non-removable filler caps), require replacement.**		
Out of performance specification for battery	B	Require replacement
NOTE: **The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.**		
Out of specification for application	B	Require replacement
NOTE: **The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.**		
Post (top or side) burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Post (top or side) burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Post (top or side) corroded, affecting performance	A	Require repair
Post (top or side) corroded, not affecting performance	2	Suggest repair
Post (top or side) loose	A	Require replacement
Post (top or side) melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Post (top or side) melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Specific gravity low</td><td>B</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.</td></tr>
<tr><td>State of charge low</td><td>A</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.</td></tr>
<tr><td>Top dirty</td><td>2</td><td>Suggest cleaning battery</td></tr>
<tr><td>Top wet</td><td>A</td><td>Require cleaning battery Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.</td></tr>
<tr><td>Vent cap loose</td><td>A</td><td>Require repair or replacement of vent cap</td></tr>
<tr><td>Vent cap missing</td><td>C</td><td>Require replacement of vent cap</td></tr>
</table>

BATTERY CABLES, WIRES AND CONNECTORS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Application incorrect</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Attaching hardware broken</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware not functioning</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Connector broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector melted</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Connector missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Insulation damaged, conductors exposed</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.</td></tr>
<tr><td>Insulation damaged, conductors not exposed</td><td>1</td><td>Suggest replacement</td></tr>
<tr><td>Open</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Protective shield (conduit) melted</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Protective shield (conduit) missing</td><td>C</td><td>Suggest repair or replacement</td></tr>
<tr><td>Resistance (voltage drop) out of specification</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Routed incorrectly</td><td>B</td><td>Require repair</td></tr>
<tr><td>Secured incorrectly</td><td>B</td><td>Require repair</td></tr>
<tr><td>Shorted</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal broken</td><td>A</td><td>Require repair or replacement</td></tr>
</table>

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

BATTERY CABLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
NOTE: **Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.**		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Voltage drop out of specification	A	Require repair or replacement

BATTERY TRAYS AND HOLD DOWN HARDWARE

Condition	Code	Procedure
Battery improperly secured	2	Suggest repair
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Â	No service suggested or required
Broken, affecting performance	A	Require repair or replacement
Broken, not affecting performance	Â	No service suggested or required
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Water drain clogged	A	Require repair

BATTERY WIRES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
NOTE: **Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.**		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

BULB SOCKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Bulb seized in socket	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of socket.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of socket.**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	**Code**	**Procedure**
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

BULBS, SEALED BEAMS AND LEDS

NOTE: **Does not include soldered-in components.**

Condition	**Code**	**Procedure**
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
NOTE: **Application incorrect includes wrong bulb coating or color.**		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		

Condition	Code	Procedure
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

CD PLAYERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Skips	A	Require repair or replacement
Sound quality poor	A	Require repair or replacement
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Speed incorrect	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CIGARETTE LIGHTER ASSEMBLIES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Loose	B	Require repair or replacement
Missing	2	Suggest replacement
Sticking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

CLUTCH SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
NOTE: **Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).**		
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair

Condition	Code	Procedure
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CRUISE CONTROL BRAKE SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

CRUISE CONTROL CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
NOTE: **Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.**		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

CRUISE CONTROL CLUTCH SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

CRUISE CONTROL LINKAGES AND CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
NOTE: **Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.**		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

CRUISE CONTROL RESERVOIRS

Condition	Code	Procedure

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

CRUISE CONTROL TUBES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

CRUISE CONTROL VACUUM DUMP RELEASE VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Suggest replacement
Out of adjustment	B	Further inspection required
NOTE: **Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.**		

CRUISE CONTROL VACUUM HOSES, TUBES AND

Condition	Code	Procedure
Reservoirs	Â	Â
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

CRUISE CONTROL VEHICLE SPEED SENSORS

Condition	Code	Procedure
Air gap incorrect	B	Require adjustment to vehicle manufacturer's specifications

Condition	Code	Procedure
NOTE: **If a sensor is not adjustable, further inspection is required to identify and correct cause.**		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Housing cracked	B	Require replacement
Internal resistance does not meet specifications	B	Require replacement
NOTE: **Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
NOTE: **Some integral bearing assemblies with sensors may require replacement.**		
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
NOTE: **Component failure may be caused by water intrusion into the wiring harness. Always check insulation for damage and wiring for excessive resistance.**		
Surface contaminated	2	Suggest cleaning; identify and correct source
Tip bent	B	Require replacement
Tip broken	B	Require replacement
Tip missing	B	Require replacement
Wire lead burned	A	Require replacement
Wire lead conductors exposed	B	Require replacement
Wire lead corroded	A	Require replacement
Wire lead open	A	Require replacement
Wire lead shorted	A	Require replacement

DEFOGGERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

DEFROSTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

DELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

DIMMERS

Condition	Code	Procedure

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

ELECTRIC HEATERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

EQUALIZERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FUSE BLOCKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Melted, not affecting performance	2	Suggest replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

FUSE BOXES AND BLOCKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Melted, not affecting performance	2	Suggest replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

FUSIBLE LINKS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement

Condition	Code	Procedure
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

GAUGES

NOTE: **Includes odometers, speedometers, and tachometers (except cable-driven).**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Lens cloudy	2	Suggest repair or replacement
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

GENERATORS

NOTE: **If components have been added that increase vehicle electrical load requirement (for example, sound systems, air conditioning, alarm systems, etc.), charging system output must meet the increased demand.**

Condition	Code	Procedure
Alternator output meets OEM specification but is insufficient for add on electrical load	2	Suggest upgrade of alternator or removal of excess electrical load
Alternator's rated output is below OEM specification	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware non-functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Diode inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Noisy	2	Suggest repair or replacement
Pulley incorrect	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Terminal resistance (voltage drop) out of specification	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Voltage drop out of specification	A	Require repair or replacement

GROUND CABLES AND STRAPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

GROUND STRAPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

HEADLIGHT ADJUSTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, preventing adjustment	A	Require repair or replacement
Broken	A	Require repair or replacement
Indicator broken	A	Require replacement
Indicator missing	C	Require replacement
Missing	C	Require replacement of adjusters
Seized	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

HEATING ELEMENTS (DEFROSTERS, DEFOGGERS, ELECTRIC HEATERS AND SEATS)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

HORNS AND SIRENS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Out of adjustment	B	Require adjustment
Sound quality poor	A	Require repair or replacement. Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

IGNITION SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

INDICATOR LIGHTS

Condition	Code	Procedure
Does not come on during bulb check	Â	Further inspection required
NOTE: **See service manual for further information.**		
Fails to function properly during test mode	Â	Further inspection required
NOTE: **See service manual for further information.**		
On constantly	Â	Further inspection required
NOTE: **See service manual for further information.**		
On intermittently	Â	Further inspection required
NOTE: **See service manual for further information.**		

KEYLESS ENTRY KEYPADS AND TRANSMITTERS

Condition	Code	Procedure

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

KEYLESS ENTRY TRANSMITTERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

LEDS

NOTE: **Does not include soldered-in components.**

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
NOTE: **Application incorrect includes wrong bulb coating or color.**		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

LENSES

Condition	Code	Procedure
Adjustment out of specification	B	Require repair
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required

Condition	Code	Procedure
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

MICROPHONES

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Membrane torn	A	Require replacement
Missing	C	Require replacement
Polarity reversed	A	Require repair
Sound quality poor	A	Require repair or replacement. Further inspection required
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

MIRRORS (ELECTROCHROMATIC AND HEATED)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Cracked	B	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

MOTORS

Condition	Code	Procedure
Amperage draw out of specification	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent	A	Require repair or replacement
Bracket broken	A	Require repair or replacement
Bracket cracked	A	Require repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket missing	C	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Drive mechanism damaged, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Further inspection required to determine cause.**		
Drive mechanism damaged, not affecting performance	2	Suggest repair or replacement
NOTE: **Further inspection required to determine cause.**		
Fails to disengage	A	Require repair or replacement
Housing broken, affecting performance	A	Suggest repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	Â	No service suggested or required
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Further inspection required
NOTE: **Follow OEM recommended adjustment procedures. Repair or replace if out of specification.**		
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement

Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

NEUTRAL SAFETY SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

ODOMETERS, SPEEDOMETERS AND TACHOMETERS (CABLE DRIVEN)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Drive cable broken	A	Require replacement
Drive cable noisy	2	Suggest repair or replacement
Inoperative	A	Further inspection required
NOTE: **Inoperative includes intermittent operation, out of OEM specification, or out of range.**		
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Lens cloudy	2	Suggest repair or replacement
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

ODOMETERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Lens cloudy	2	Suggest repair or replacement
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

POWER DISTRIBUTION CENTER

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of fuse box.**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Melted, not affecting performance	2	Suggest replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

PULLEYS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require replacement
Cracked	B	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Pulley damaged, affecting belt life	A	Require replacement

RECEIVERS, AMPLIFIERS, EQUALIZERS AND SUB-WOOFER VOLUME CONTROLS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

RELAY BOXES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	Â	No service suggested or required
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of relay box.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of relay box.**		
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Cover missing	C	Require replacement of cover
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Melted, affecting performance	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Melted, not affecting performance	2	Suggest replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

Condition	Code	Procedure
Terminal loose, not affecting performance	1	Suggest repair or replacement

SEALED BEAMS

NOTE: **Does not include soldered-in components.**

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SEAT HEATERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

SECURITY ALARM SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

SIRENS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Out of adjustment	B	Require adjustment
Sound quality poor	A	Require repair or replacement. Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

SOLENOIDS

NOTE: **For starter solenoids that are integral to the starter assembly, see Starters. For starter relays, see Relays.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage

Condition	Code	Procedure
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SPEAKERS AND MICROPHONES

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Membrane torn	A	Require replacement
Missing	C	Require replacement
Polarity reversed	A	Require repair
Sound quality poor	A	Require repair or replacement. Further inspection required
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SPEEDOMETER AND TACHOMETER LINKAGES AND CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

SPEEDOMETER CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement

Condition	Code	Procedure
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

SPEEDOMETERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Lens cloudy	2	Suggest repair or replacement
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Malfunctioning</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.</td></tr>
<tr><td>Mechanical head noisy</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Terminal broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal burned, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Terminal burned, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Terminal corroded, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal corroded, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Terminal loose, affecting performance</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal loose, not affecting performance</td><td>1</td><td>Suggest repair or replacement</td></tr>
</table>

STARTERS

NOTE: **To prevent misdiagnosis, care should be taken to eliminate the possibilities of mechanical problems or high resistance in power and/or ground circuits.**

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Amperage draw does not meet OEM specifications</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Attaching hardware broken</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware not functioning</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td colspan="3">NOTE:
Inspect block or bell housing mounting surface.</td></tr>
<tr><td>Bracket bent, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Bracket bent, not affecting performance</td><td>Â</td><td>No service suggested or required</td></tr>
<tr><td>Bracket broken, affecting performance</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Bracket broken, not affecting performance</td><td>Â</td><td>No service suggested or required</td></tr>
<tr><td>Bracket corroded, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Bracket corroded, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Bracket cracked, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Bracket cracked, not affecting performance</td><td>1</td><td>Suggest repair or replacement</td></tr>
<tr><td>Bracket holes elongated, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Bracket holes elongated, not affecting performance</td><td>Â</td><td>No service suggested or required</td></tr>
<tr><td>Bracket loose, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Bracket loose, not affecting performance</td><td>1</td><td>Suggest repair or replacement</td></tr>
<tr><td>Bracket missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Drive gear damaged, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Further inspection required to determine cause. Require inspection of ring gear.</td></tr>
<tr><td>Drive gear damaged, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
</table>

Condition	Code	Procedure
NOTE: **Further inspection required to determine cause. Require inspection of ring gear and service as needed.**		
Fails to disengage	A	Require repair or replacement
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Noisy	2	Suggest repair or replacement
Shimmed incorrectly	B	Require repair
Starter shaft bushing missing	C	Require replacement
NOTE: **Bushing may be in bell housing.**		
Starter shaft bushing worn, affecting performance	A	Require replacement
Starter shaft bushing worn, not affecting performance	1	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SUB-WOOFER VOLUME CONTROL

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement

Condition	Code	Procedure
Sound quality poor	A	Require repair or replacement
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement

SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

TACHOMETER CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

TACHOMETERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require replacement
Lens broken	A	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Lens cloudy	2	Suggest repair or replacement
NOTE: **If lens is available as a separate part, suggest replacement of lens only.**		
Lens missing	C	Require repair or replacement
NOTE: **If lens is available as a separate part, require replacement of lens only.**		
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Mechanical head noisy	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

TAPE PLAYERS AND CD PLAYERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement

Condition	Code	Procedure
Malfunctioning	A	Require repair or replacement
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Skips	A	Require repair or replacement
Sound quality poor	A	Require repair or replacement
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Speed incorrect	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

TENSIONERS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Cracked	B	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

TIMERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

TRANSCEIVERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Malfunctioning	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Malfunctioning includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Sound quality poor	A	Require repair or replacement
NOTE: **Make sure poor sound quality is not caused by ignition/charging system or other forms of electrical interference.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

TRANSDUCERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Drive mechanism damaged, affecting performance	A	Require repair or replacement
NOTE: **Further inspection required to determine cause.**		
Drive mechanism damaged, not affecting performance	2	Suggest repair or replacement
NOTE: **Further inspection required to determine cause.**		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation or out of specification.**		
Leaking (vacuum/fluid/air)	A	Require replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	Â	No service suggested or required
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Out of adjustment	B	Further inspection required
NOTE: **Follow OEM recommended adjustment procedures. Repair or replace if out of specification.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

VACUUM ACCUMULATORS (RESERVOIRS)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement

VOLTAGE REGULATORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

WASHER FLUID LEVEL SENDERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WASHER PUMPS

Condition	Code	Procedure

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WIPER ARMS AND BLADES

NOTE: **Windshield coatings or waxes can cause blades to not function as intended. Clean surface before making final judgment about blade replacement.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching socket stripped	A	Require replacement
Bent	A	Require repair or replacement
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement

Condition	Code	Procedure
Size incorrect	2	Suggest replacement
Tension insufficient	B	Require repair or replacement
Torn	A	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance	1	Suggest replacement

WIPER BLADES

NOTE: **Windshield coatings or waxes can cause blades to not function as intended. Clean surface before making final judgment about blade replacement.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching socket stripped	A	Require replacement
Bent	A	Require repair or replacement
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Size incorrect	2	Suggest replacement
Tension insufficient	B	Require repair or replacement
Torn	A	Require replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance	1	Suggest replacement

WIPER HOSES AND NOZZLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blocked	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Spray pattern incorrect	2	Suggest repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

WIPER LINKAGES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching stud stripped	A	Require replacement
Bent	A	Require repair or replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Tension insufficient	B	Require repair or replacement
Worn, affecting performance	A	Require replacement
Worn, not affecting performance	1	Suggest replacement

WIPER NOZZLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blocked	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Spray pattern incorrect	2	Suggest repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

WIPER PUMP RESERVOIRS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cap missing	C	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement

WIRING HARNESSES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement

Condition	Code	Procedure
Insulation damaged, conductors not exposed	1	Suggest repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

AUTOMOTIVE TERMINOLOGY & DEFINITIONS

ACTUATOR

a control device that delivers mechanical action in response to a vacuum or electrical signal; anything that the engine control computer uses to do something, such as trigger fuel injection or fire a spark plug. Most actuators on a computercontrolled engine system are activated by grounding their circuits rather than by actively powering them, since that protects the computer from short circuits.

AEMD (AUTOMOTIVE ELECTRIC DRIVE MOTOR)

a U.S. Department of Energy program to develop low-cost traction drive motors for automotive applications.

AIR BAGS

air bags are fabric bags that are filled quickly with a gas to provide supplemental protection for vehicle passengers during some collisions. Side-impact air bags are becoming increasingly available. Air bags are most effective in protecting vehicle occupants who are properly belted.

ALTERNATING CURRENT (A C)

electrical current that flows in one direction, from positive to negative, and then reverses direction, from negative to positive.

ALTERNATOR

a belt driven device that provides electrical current for the vehicle's charging system.

AMMETER

an instrument for measuring the strength of electrical current flow in a circuit in terms of amperes.

AMPERAGE

the amount of electrical current flowing in a circuit.

AMPERE (AMP)

a unit for measuring the strength (rate of flow) of an electrical current.

AMPLIFIER

a device with electron tubes or semiconductors used to increase the voltage or current of a signal.

AMPLIFY

to enlarge or strengthen original characteristics. Usually used in reference to electronics.

ANION

negative ion. Alkali, molten carbonate, and solid oxide fuel cells are "anion-mobile" cells - anions migrate through the electrolyte toward the anode.

ANODE

one of two electrodes in a fuel cell or battery. The anode, the negative post of the fuel cell, conducts the electrons that are freed from the hydrogen molecules so that they can be used in an external circuit. It has channels etched into it that disperse the hydrogen gas equally over the surface of the catalyst.

ARCING

the ability of electrical energy to jump across an air gap.

ARMATURE

a laminated, soft iron core wrapped by wire that converts 11ectrical energy to mechanical energy.

BATTERY ACID

the sulfuric acid solution used as the electrolyte in a battery.

BATTERY CELL

the part of a battery made from two dissimilar metals and an acid solution. A cell stores chemical energy to be used later as electrical energy.

BATTERY SAVER

the battery saver system is an effective way to prevent complete battery discharge when the engine is shut down. Based on the preset time-limit, the system automatically disconnects the battery load when the battery is not being charged. Depressing the reset push button will enable the battery to be reconnected for additional periods of time. Critical systems can be set up to have battery power maintained.

BATTERY

a device that produces electricity through, electrochemical action.

BENDIX DRIVE

the starter drive gear that is attached to the starter motor armature and engages the gear teeth on the flywheel.

BRUSH

a bar of conductive material that rides on the commutator of a generator or motor.

CAPACITOR

a device, made up of two or more conducting plates, separated by an insulator, used to store an electric surge or charge of current.

CATHODE

one of two electrodes in a fuel cell or battery. The cathode, the positive post of the fuel cell, has channels etched into it that distribute the oxygen to the surface of the catalyst. It also conducts the electrons back from the external circuit to the catalyst, where they can recombine with the hydrogen ions and oxygen to form water.

CATION

positive ion. Phosphoric acid and proton exchange membrane (PEM) fuel cells are "cation-mobile" cells - the cation migrates through the electrolyte toward the cathode.

CHARGING SYSTEM

the system that supplies electrical power for vehicle operation and recharges the battery.

CIRCUIT BREAKER

a device used in an electrical circuit to interrupt current flow in the event of an overload or short.

CIRCUIT

a path through which electricity flows before returning to its source.

COLD CRANKING AMPS

the amount of cranking amperes that a battery can deliver in 30 seconds at OÂ°F (- 18Â°C).

COMMUTATOR

a slotted ring located at the end of the armature of a generator or motor. The commutator provides the electrical connection between the armature and brushes.

CONDUCTIVITY

transmission of electricity by metallic substances. Metals have high electrical conductivity, and with few exceptions, their conductivity decreases with increasing temperature.

CONDUCTOR

a material that provides a path for the flow of electrical current or heat.

CONTINUITY

the condition that exists in a working electrical circuit. A circuit that is unbroken, not open.

CORRODE

gradual loss from a metal surface from chemical action.

CORROSION

deteriorative loss of a metal as a result of environmental reactions.

CORROSIVITY

the characteristic of a material that enables it to dissolve metals and other materials or burn the skin.

DELAYED ACCESSORY POWER

delayed accessory power continues electric power temporarily to certain convenience features after vehicle power has been turned off. For example, the feature allows the customer to close a window without reinserting the key. Delayed accessories include radio and power windows, power moon roof and message center.

DIGITAL SIGNAL PROCESSING AUDIO SYSTEM

a Digital Signal Processing (DSP) system modifies audio signals digitally to achieve better control of sound quality. DSP can be used for standard functions such as volume, balance, fade and tone control, as well as AM and FM stereo decoding. It also allows advanced audio processing such as concert hall emulation, sound shaping and adaptive noise reduction filtering.

DIGITAL VOLT/OHMMETER (DVOM)

an instrument that measures volts, ohms and amps and displays the results numerically.

DIGITAL

a voltage signal that uses on and off pulses.

DISCHARGE

the flow of current from a battery; to remove the refrigerant from an air conditioning system.

DIVERSITY ANTENNA

a diversity antenna system uses two antennas mounted at different locations on the vehicle and automatically chooses one that provides the better FM radio signal.

DUTY CYCLE

a signal that varies the ratio of on time to off time, resulting in a square wave that can range between zero and 100 percent or may be high or low, and off may be high or low; in a process, the ratio of on time to total cycle time; in fuel injectors, the percentage of on-time to total cycle time; in solenoids, the percentage of on-time to total cycle time.

ELECTRICITY

electric current used as a power source. Electricity can be generated from a variety of feedstocks, including oil, coal, nuclear, hydro, natural gas, wind, and solar. In electric vehicles, onboard rechargeable batteries power electric motors.

ELECTROCHEMISTRY

science that deals with the relation of electricity to chemical changes and with the interconversion of chemical and electrical energy.

ELECTRODE

electrical terminal that conducts an electric current into or out of a fuel cell.

ELECTRODE

a terminal that conducts an electric current into or away from the conducting part of a circuit, such as the terminal of a battery; firing terminals found in a spark plug.

ELECTROLYSIS

chemical and electrical decomposition process that can damage metals such as brass, copper and aluminum in the cooling system; the decomposition of an electrolyte by the action of an electric current passing through it.

ELECTROLYTE

chemical compound that conducts electricity from one electrode to the other inside a fuel cell.

ELECTROLYTE

a material whose atoms become ionized (electrically charged) in solution. In automobiles, the battery electrolyte is a mixture of sulfuric acid and water.

ELECTROMAGNET

an iron core surrounded by a coil of wire that temporarily becomes a magnet when an electric current flows through the wire.

ELECTROMAGNETIC INDUCTION

moving a wire through a magnetic field to create current flow in the wire.

ELECTROMECHANICAL

refers to a device that incorporates both electrical and mechanical principles together in its operation.

ELECTRONIC

pertaining to the control of systems or devices by the use of small electrical signals and various semiconductor devices and circuits.

EMITTER

in a transistor, the region or layer of semiconductor material from which electrons are injected into the base region.

ENERGY

the capacity for doing work and overcoming resistance.

FIELD COIL

a wire coil on an alternator rotor or starter motor frame; a field coil produces a magnetic field when energized.

FLUX DENSITY

the degree of concentration of the magnetic lines of force that emanate from a magnetic sensor; when the tooth of a reluctor aligns with the sensor tip, the magnetic lines of force are squeezed together, which increases flux density.

FLYWHEEL

a mechanical battery that stores kinetic energy. A flywheel is essentially a spinning wheel with a motor. Flywheels can be more responsive than chemical batteries, and they are less susceptible to the effects of weather.

FREQUENCY

the number of cycles of a periodic waveform typically measured in one second intervals or hertz (cycles per second).

FUSE

a metal circuit protection device that melts when there is a circuit overload or short.

FUSIBLE LINK

a smaller gauge wire that is included in an electrical circuit to provide circuit protection. The smaller gauge wire will melt when the circuit is overloaded.

GENERATOR

a device that converts mechanical energy into electrical energy; SAE J1930 nomenclature for an alternator; a generating device that uses diode rectifiers to convert ac to dc.

GROUND CIRCUIT

that part of the circuit that is connected electrically to the negative terminal of the battery. Every electric circuit has a power and ground side. Most computer actuations consist of completing the ground side of an actuator's circuit; this protects the computer from short circuits. Resistance in a ground circuit will reduce the current through it and cause deterioration in the function of the circuit.

GROUND

a connecting body whose electrical potential is zero to which an electrical circuit can be connected.

HALL EFFECT

when current flows through a thin wafer of semiconductor material, and a magnetic field crosses it at a right angle, a voltage known as a Hall effect voltage will be generated at the edge of the material. Interrupting the magnetic field turns off the voltage. This is the principle used by Hall effect sensors.

HEAT SINK

part of a system designed to be at a lower temperature than its surroundings, used to dissipate heat from that system; device to dissipate heat and protect parts.

HIGH INTENSITY DISCHARGE HEADLAMPS

high intensity discharge (HID) headlamps provide a brighter, whiter light for increased forward visibility. They produce about 2 times as much light as conventional halogen bulbs and have a distinct appearance. Also, they are more durable than filament bulbs and require 37 percent less power to operate.

HIGH TENSION

that part of a system that operates under or carries high voltage; in an ignition system, voltages in the secondary circuit of the system as opposed to the low, primary circuit voltage.

HYDROMETER

an instrument used to measure the specific gravity of a solution.

IMPEDANCE

the total resistance of an electrical device measured in ohms.

INDUCTION

the process by which an electric or magnetic effect is produced in an electrical conductor or magnetic body, when it is exposed to variation of a field of force. Induction is the principle used in an ignition coil to increase voltage.

INSULATED CIRCUIT.

a circuit that includes all of the high-current cables and connections from the battery to the starter motor.

INSULATOR

a non-conductive material used to insulate wires in an electrical circuit.

INTEGRATED CIRCUIT

an electrical circuit containing many interconnected amplifying devices and circuit elements formed on a single body or chip of semiconductor material; diodes, transistors and other electronic components mounted on semiconductor material and able to perform numerous functions.

ION CHROMATOGRAPHY

a form of liquid chromatography that uses ion-exchange resins to separate atomic or molecular ions based on their interaction with the resin.

ION

atom that carries a positive or negative charge because of the loss or gain of an electron.

KEEP-ALIVE MEMORY

a series of vehicle battery-powered memory locations in the microcomputer that store information on input failure, identified in normal operations for use in diagnostic routines; adapts some calibration parameters to compensate for changes in the vehicle system.

LIGHT EMITTING DIODE (LED)

a digital electronic display device which can be used as a simple signal light or arranged to show letters and/or numbers.

LIQUID CRYSTAL DIODE (LCD)

a digital electronic display device made of a special glass and liquid, which requires a separate light source.

MAGNET

any substance that attracts iron or an iron, steel or any ferrous metal alloy.

MAGNETIC FIELD

the areas surrounding the poles of a magnet which are affected by its forces of attraction or repulsion; the region of space in which there is a measurable magnetic force.

MAGNETIC GAUGES

electrical analog gauges that use magnetic forces to move the needle left or right.

MAGNETIC PULSE GENERATOR

a sensor used to monitor the position of any point on a rotating part such as a crankshaft or input shaft.

MEMORY PROFILE SYSTEM

the Memory Profile System offers different drivers the ability to set into memory their preferred positions for several comfort and convenience features. A driver is identified by a unique key fob or entry code, and the vehicle systems automatically adjust to his or her settings. Depending on the vehicle, some of the following features can be included in the memory profile: Seat position Steering wheel position (tilt/telescope) Mirror positions Safety belt "D" ring height Pedal positions Radio stations Power steering assist level Ride firmness

MEMORY

part of a computer that stores or holds programs and other data.

MERCURY SWITCH

a type of switch that uses the flow of liquid metal, Mercury, to complete the electrical circuit. Mercury switches are frequently used to control trunk and underhood lights.

MICROPROCESSOR

the portion of a microcomputer that receives sensor input and handles calculations.

MODULE

an electronic control unit.

MOTOR

a machine that converts electrical energy into mechanical energy.

MOTOR

in an HEV, an electric traction motor converts electrical energy from the energy storage unit to mechanical energy that drives the wheels of the vehicle. Unlike a traditional vehicle, where the engine must "ramp up" before full torque can be provided, an electric motor provides full torque at low speeds. This characteristic gives the vehicle excellent "off the line" acceleration.

OHM

a unit of electrical resistance of a circuit in which an electromotive force of one volt maintains a current of one ampere, named after German physicist Georg Ohm.

OHMMETER

an instrument that measures electrical resistance in ohms.

OHM'S LAW

a basic law of electricity expressing the relationship between current, resistance and voltage in any electrical circuit. Ohm's law states that the voltage in a circuit is equal to the current multiplied by the resistance.

PARALLEL CIRCUIT

a circuit with more than one path for the current to follow.

PARALLEL CONFIGURATION

a hybrid electric vehicle (HEV) with a parallel configuration has a direct mechanical connection between the power unit and the wheels, as in a conventional vehicle, but also has an electric motor that drives the wheels. For example, a parallel vehicle could use the power created from an internal combustion engine for highway driving and the power from the electric motor for accelerating.

PERIOD

in an electrical signal the period is the amount of time it takes for one cycle of an electrical signal to repeat itself; the number of periods that occur in one second is the frequency of the signal.

PHASE

any point or points of parallel movements or oscillations, in or out of synchronization; the rotational positions of the U-joints and yokes in a driveline.

PHOTOVOLTAIC PANEL

photovoltaic panels contain cells that convert sunlight into electricity. While solar-powered vehicles are not currently feasible for production, solar panels could be used to power vehicle components, such as a fan to exhaust hot interior air when the vehicle is parked in the sun or to recharge the vehicle battery. Photovoltaic panels can be integrated into the hood, roof, sunroof, deck lid or spoiler.

PICKUP COIL

a weak, permanent magnet-and-wire assembly which forms a position sensor.

PIEZOELECTRIC SENSOR

a sensor that generates voltage from physical shock or motion, a knock sensor.

POLARITY

the condition of being positive or negative relative to a reference point or object; the particular state (positive or negative) with reference to the two magnetic poles.

POTENTIOMETER

a device that changes voltage by varying its internal resistance.

PROGRAM

a set of instructions or procedures that a computer must follow when controlling a system.

PULSE WIDTH MODULATED

electronic control of a solenoid that rapidly cycles it on and off many times per second in order to achieve a specific output.

PULSE WIDTH

the length of time during which a circuit is energized.

RANDOM ACCESS MEMORY (RAM)

a type of memory used in a computer to store information temporarily.

READ-ONLY MEMORY (ROM)

a type of memory used in a computer to store information permanently, as opposed to the temporary storage provided by random-access memory (RAM).

RECTIFIER

a device that changes alternating current (AC) into direct current (DC).

RECTIFY

to change one type of voltage to another.

REFERENCE PULSE

a voltage signal generated by the crankshaft position sensor (or distributor, or camshaft position sensor - all equivalent components for this purpose). The voltage signal is sent to the computer as a fixed number of degrees BTDC for each cylinder, with the signal for cylinder No.1 distinguishable from the signal for the others.

REFERENCE VOLTAGE

the voltage supplied by the system computer to certain sensors. The sensors reduce the voltage by a specific amount, according to their function, and send the signal back to the computer. The computer then uses the reduced voltage signal to interpret the information sent.

RELAY

an electromagnetic switch that uses low amperage current to control a circuit with high amperage.

RELUCTOR

in an electronic ignition, the trigger wheel mounted on the distributor shaft that triggers the pickup coil, which in turn signals the control module to fire the coil.

REMOTE LIGHTING SYSTEM

the Remote Lighting System removes the sources of light from the lamp fixture. Instead, light for all fixtures is generated from a single "light battery". Light is transmitted to the various fixtures and accessories via fiber optics or light pipes. The advantages of remote lighting include reduced power consumption, greater durability and more flexibility in packaging and styling lamp fixtures.

RESISTANCE

the opposition offered by a substance or body to the passage of electric current through it.

RESISTOR

an electrical device installed in a circuit to lower voltage and current flow.

RHEOSTAT

a variable resistor used to control current flow in a circuit.

SATURATION

point at which current flowing through a coil or wire has built up the maximum magnetic field.

SEMICONDUCTOR

a material that is neither a good conductor of electricity nor a good insulator.

SENSOR

any mechanism by which the engine control computer can measure some variable on the engine, such as coolant temperature or engine speed. Each sensor works by sending the computer a signal of some sort, a coded electronic message that corresponds to some point on the range of the variable measured by that sensor.

SERIES CIRCUIT

a circuit that has only one path for current to follow.

SERIES CONFIGURATION

some hybrid electric vehicles (HEVs) use a series configuration, in which the heat engine or fuel cell together with a generator produce electricity for the battery pack and electric motor. Series HEVs have no mechanical connection between the hybrid power unit and the wheels; this means that all motive power is transferred from chemical energy to mechanical energy, to electrical energy, and back to mechanical energy to drive the wheels.

SERIES-PARALLEL CIRCUIT

a circuit that combines series and parallel circuits.

SHORT CIRCUIT

a condition that occurs in an electrical circuit when the current bypasses the intended load and takes a path with little or no resistance, such as another circuit or ground.

SHUNT

an alternate path through which electrical current or fluids may flow.

SOLENOID

a coil of wire that becomes an electromagnet when current flows through it. It then loses its magnetism when the current flow is turned off. The solenoid contains an iron plunger inside the wire coil that is spring loaded to one position. When the solenoid is energized, the plunger moves to the other position.

SOLID STATE

an electrical device with no moving parts.

SPECIFIC GRAVITY

the ratio of the weight or mass of the given volume of a substance to that of an equal volume of another substance, e.g. - water for liquids and solids; air or hydrogen for gases, are used as standards.

SPLICE

to join or unite by weaving, binding, soldering, cementing, etc., usually at the ends of two objects.

SQUARE WAVE/SINE WAVE

voltage fluctuations of different shapes in an electric circuit. The square wave goes immediately from one voltage to the other; the sine wave gradually changes, going through the intervening values. An electromagnetic pulse generator like a wheel speed sensor or a reluctor-type distributor pickup produces a sine wave. Hall Effect sensors, photoelectric switches, and other on-off signal generators produce square waves. For many purposes, square waves are easier for computers to work with, so on many vehicles there are electronic devices to modify sine waves into square waves.

STARTER

the electric motor that is used to start an engine.

STATOR

a device located between the impeller and turbine in a torque converter. It contains specifically angled blades around both sides of its circumference to redirect the flow of fluid coming off the turbine, which increases the force of the fluid driving the turbine, resulting in torque multiplication.

STEPPER MOTOR

an electric motor that can move to a specific position on its range of travel.

SWITCH

a device used to open, close or direct the current in an electrical circuit.

THERMISTOR

a temperature sensitive variable resistor in which the resistance decreases as its ternperature increases.

TRANSDUCER

a device that changes a force into an electrical signal.

TRANSDUCER

device that converts variations in one energy form into corresponding variations in another, usually electrical.

TRANSISTOR

an electronic device produced by joining three sections of semiconductor materials. Used as a switching or amplifying device.

ULTRACAPACITOR

ultracapacitors are higher specific energy and power versions of electrolytic capacitors-devices that store energy as an electrostatic charge. They are electrochemical systems that store energy in a polarized liquid layer at the interface between an ionically conducting electrolyte and a conducting electrode. Energy storage capacity increases by increasing the surface area of the interface. Ultracapacitors are being developed as primary energy devices for power assist during acceleration and hill climbing, as well as recovery of braking energy.

VARIABLE RELUCTANCE SENSOR

a magnetic sensor that generates its own alternating current voltage based on the interference of a moving object across its tip.

VARIABLE RESISTOR

a resistor that can be adjusted so the amount of resistance produced in the circuit changes.

VOLT

unit of electromotive force. One volt of electromotive force applied steadily to a conductor of one-ohm resistance produces a current of one ampere.

VOLTAGE DROP

voltage lost by the passage of electrical current through resistance.

VOLTAGE REGULATOR

a device used to control the output of an alternator or generator.

VOLTMETER

an instrument used to measure voltage in a circuit.

WATT

a unit of measurement of electrical power. One volt multiplied by one amp equals one watt.

ZENER DIODE

a silicone diode that allows current to flow in the opposite direction, once an applied voltage reaches a certain level.

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Engine Performance And Maintenance

ENGINE PERFORMANCE AND MAINTENANCE (INCLUDING EXHAUST SYSTEMS)

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

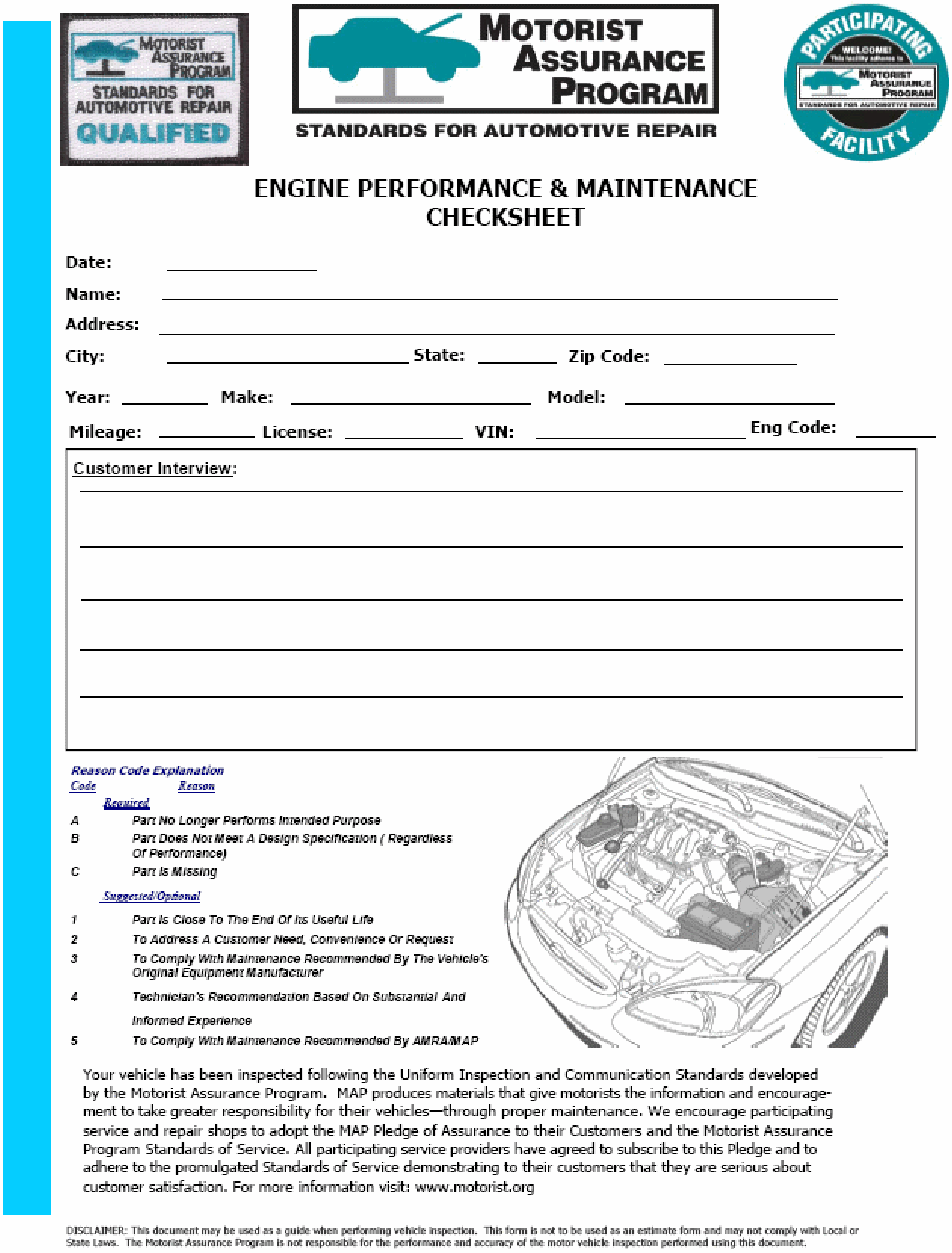
A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

ENGINE PERFORMANCE & MAINTENANCE CHECKSHEET


MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
QUALIFIED
MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
PARTICIPATING
WELCOME! This facility adheres to
MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
FACILITY

ENGINE PERFORMANCE & MAINTENANCE CHECKSHEET

Date: ____________

Name: ____________

Address: ____________

City: ____________ State: ________ Zip Code: ____________

Year: ________ Make: ____________ Model: ____________

Mileage: ________ License: ________ VIN: ____________ Eng Code: ________

Customer Interview:

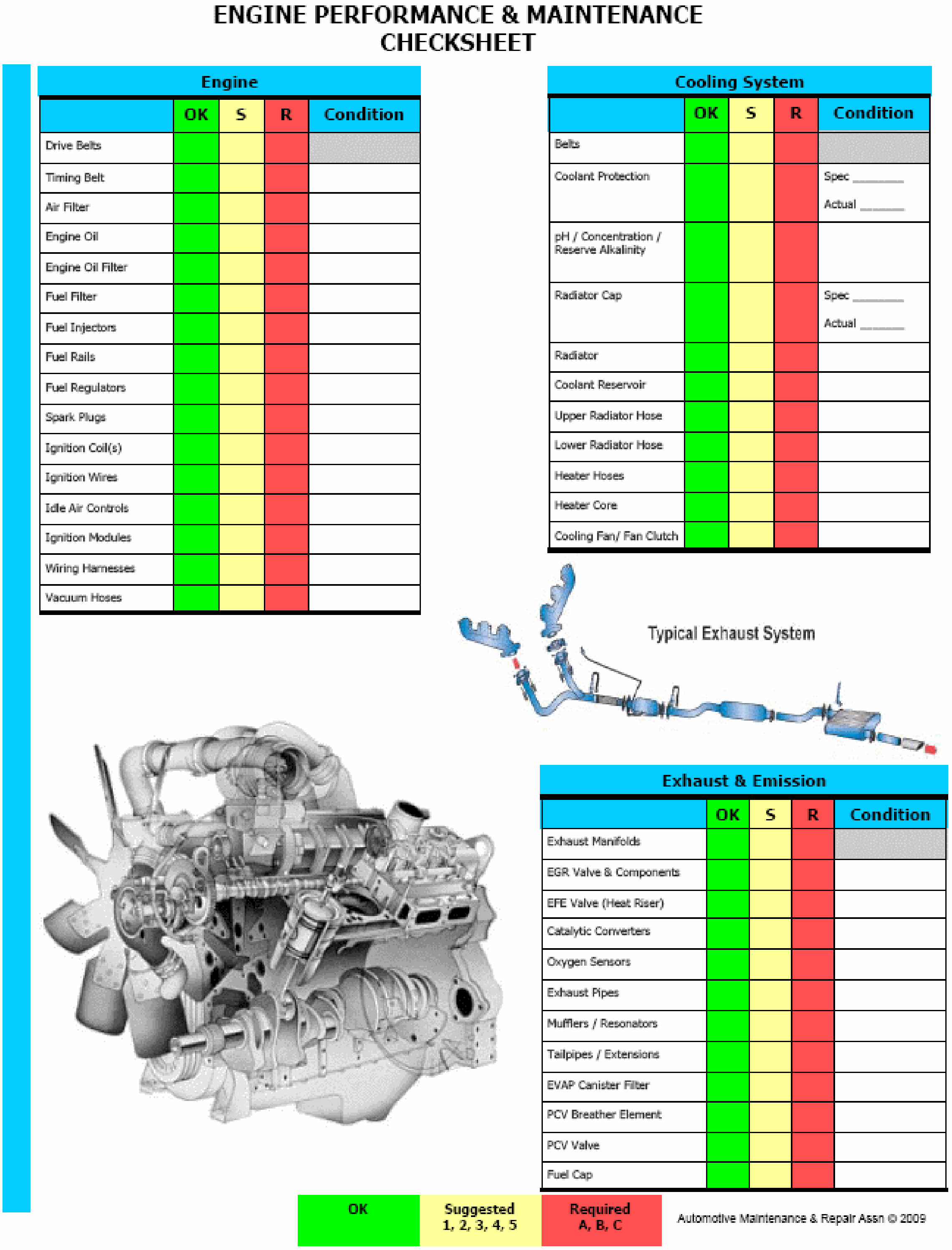
Reason Code Explanation

Code	*Reason*
	Required
A	*Part No Longer Performs Intended Purpose*
B	*Part Does Not Meet A Design Specification (Regardless Of Performance)*
C	*Part Is Missing*
	Suggested/Optional
1	*Part Is Close To The End Of Its Useful Life*
2	*To Address A Customer Need, Convenience Or Request*
3	*To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer*
4	*Technician's Recommendation Based On Substantial And Informed Experience*
5	*To Comply With Maintenance Recommended By AMRA/MAP*

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 1: Engine Performance & Maintenance Checksheet (1 Of 2)



ENGINE PERFORMANCE & MAINTENANCE CHECKSHEET

Engine	OK	S	R	Condition
Drive Belts				
Timing Belt				
Air Filter				
Engine Oil				
Engine Oil Filter				
Fuel Filter				
Fuel Injectors				
Fuel Rails				
Fuel Regulators				
Spark Plugs				
Ignition Coil(s)				
Ignition Wires				
Idle Air Controls				
Ignition Modules				
Wiring Harnesses				
Vacuum Hoses				

Cooling System	OK	S	R	Condition
Belts				
Coolant Protection				Spec ______ Actual ______
pH / Concentration / Reserve Alkalinity				
Radiator Cap				Spec ______ Actual ______
Radiator				
Coolant Reservoir				
Upper Radiator Hose				
Lower Radiator Hose				
Heater Hoses				
Heater Core				
Cooling Fan/ Fan Clutch				

Typical Exhaust System

Exhaust & Emission	OK	S	R	Condition
Exhaust Manifolds				
EGR Valve & Components				
EFE Valve (Heat Riser)				
Catalytic Converters				
Oxygen Sensors				
Exhaust Pipes				
Mufflers / Resonators				
Tailpipes / Extensions				
EVAP Canister Filter				
PCV Breather Element				
PCV Valve				
Fuel Cap				

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

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Fig. 2: Engine Performance & Maintenance Checksheet (2 Of 2)

ENGINE PERFORMANCE AND MAINTENANCE

NOTE: **CHEMICAL ENGINE DECARBONIZATION is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.**

NOTE: **SUGGEST Chemical Engine Decarbonization service every 15,000 miles or 12 months.**

NOTE: **CONTAMINATED OIL SYSTEM SERVICE is an event based process**

(beyond that of a normal oil and filter change) performed to remove coolant, water or fuel contamination. Contamination increases oil's oxidation rate and has been shown to result in increased engine wear and reduced oil flow.

CAUTION: **Some OEM's (including GM and Honda) have issued Technical Service Bulletins dvising that Chemical Crankcase Flushing may damage some engine components and that such damage will not be covered by the manufacturer's new car warranty.**

ACCELERATOR PEDAL POSITION SENSOR

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	B	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ACCESSORY BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		

Condition	Code	Procedure
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

ACCESSORY PULLEYS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require replacement
Cracked	A	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Pulley damaged, affecting belt life	A	Require replacement

AIR CONDITIONING CYCLING SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

AIR CONDITIONING PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

AIR DUCTS AND TUBES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

AIR FILTER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Paper filter element oil-soaked	A	Require replacement
NOTE: **Further inspection required to determine cause.**		
Restricted, affecting performance	A	Require replacement
Water-contaminated	A	Require replacement
NOTE: **Further inspection required to determine cause.**		

AIR FILTER GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement

AIR FILTER HOUSINGS AND GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement

AIR FUEL RATIO SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

Condition	Code	Procedure
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

AIR INJECTION CONTROL SOLENOIDS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

AIR PLENUMS

Condition	Code	Procedure

Condition	Code	Procedure
Integrated air or fuel control components inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Internal air or fuel components damaged, affecting performance	A	Require repair or replacement of component
Internal air or fuel components damaged, not affecting performance	Ã,Â	No service suggested or required
Internal air or fuel components missing	C	Require replacement of component
Leaking	A	Require repair or replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

AIR PUMP BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

AIR PUMPS (ELECTRIC DRIVEN)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

AIR TUBES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

ASPIRATOR, CHECK AND DECEL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	Ã,Â	No service suggested or required
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

BAFFLES

Condition	Code	Procedure

Condition	Code	Procedure
Application incorrect, affecting cooling system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting cooling system performance	A	Require repair or replacement
Blocked, affecting cooling system performance	A	Require repair or replacement
Broken, affecting cooling system performance	A	Require repair or replacement
Cracked, affecting cooling system performance	A	Require repair or replacement
Loose, affecting cooling system performance	A	Require repair
Loose, not affecting cooling system performance	2	Suggest repair
Missing, affecting cooling system performance	C	Require replacement

BALLAST PRIMARY SUPPLY RESISTOR WIRES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Conductor exposed	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Insulation overheated	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

BALLAST RESISTORS AND PRIMARY SUPPLY RESISTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Conductor exposed	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Insulation overheated	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

BAROMETRIC PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

NOTE:

Determine cause and correct prior to repair or replacement of part.

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

BATTERIES

NOTE: **Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.**

Definition of Terms

Battery Performance Testing - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.

Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0Ã,Â° F (-17.8Ã,Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

Cranking Amps (CA) - The number of amperes a new, fully charged battery, typically at 32Ã,Â° F (0Ã,Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12volt battery).

OEM Cranking Amps - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.

Condition	Code	Procedure
Battery frozen	Ã,Â	Further inspection required

NOTE:

Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.

Battery tests near the ""end of its useful life"" utilizing a tester or on-board monitor able to accurately determine this condition	1	Suggest Replacement
Case leaking	A	Require replacement
Casing swollen	A	Further inspection required

Condition	Code	Procedure
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Circuit open internally	A	Require replacement
Electrolyte contamination	A	Further inspection required
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Electrolyte discoloration	A	Further inspection required
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Fails to accept and hold charge	A	Require replacement
NOTE: **This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.**		
Fluid level low	B	Further inspection required
NOTE: **Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps), require replacement.**		
Out of performance specification for battery	B	Require replacement
NOTE: **The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.**		
Out of specification for application	B	Require replacement
NOTE: **The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.**		
Post (top or side) burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Post (top or side) burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Post (top or side) corroded, affecting performance	A	Require repair
Post (top or side) corroded, not affecting performance	2	Suggest repair
Post (top or side) loose	A	Require replacement
Post (top or side) melted, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Post (top or side) melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Specific gravity low	B	Further inspection required
NOTE: **Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.**		
State of charge low	A	Further inspection required
NOTE: **Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.**		
Top dirty	2	Suggest cleaning battery
Top wet	A	Require cleaning battery Further inspection required
NOTE: **Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.**		
Vent cap loose	A	Require repair or replacement of vent cap
Vent cap missing	C	Require replacement of vent cap

BATTERY CABLES, WIRES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
NOTE: **Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.**		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

BATTERY CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
NOTE: **Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.**		
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

BATTERY TRAYS AND HOLD DOWN HARDWARE

Condition	Code	Procedure
Battery improperly secured	2	Suggest repair
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã,Â	No service suggested or required
Broken, affecting performance	A	Require repair or replacement
Broken, not affecting performance	Ã,Â	No service suggested or required
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Water drain clogged	A	Require repair

BATTERY WIRES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
NOTE: **Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.**		
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

BELT IDLER ASSEMBLIES (ACCESSORY AND CAM BELTS)

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Cracked	2	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Seized	A	Require repair or replacement

BELT TENSIONERS (ACCESSORY AND CAM BELT)

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Cracked	B	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

BELT-DRIVEN AIR PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley alignment incorrect	B	Require repair or replacement
Pulley bent	A	Require replacement
Pulley cracked	A	Require replacement
Pulley loose	A	Require repair or replacement
Pulley missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

BOOST CONTROL MECHANISM

Condition	Code	Procedure
Boost pressure incorrect	A	Require repair or replacement. Further inspection required
NOTE: **Incorrect boost pressure includes intermittent operation.**		
Leaking	A	Require repair or replacement

CAMSHAFT POSITION SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CARBURETORS AND CHOKES

NOTE: **Proper operation of a carburetor includes the ability to control air/fuel mixtures during all phases or driving operation to comply with all federal and local emissions standards. Adjustments are to be considered repairs.**

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Air/fuel control incorrect	B	Require repair or replacement
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Components binding	A	Require repair or replacement
Components damaged, affecting operation or performance	A	Require repair or replacement
Components missing	C	Require replacement of components
Contaminated	A	Require repair or replacement. Further inspection required
NOTE: **Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Controlling linkages binding	A	Require repair or replacement of linkage
Leaking	B	Require repair or replacement
Mechanical operation incorrect	B	Require repair or replacement
Operating incorrectly	B	Require repair or replacement

CASTING CORE PLUGS AND EXPANSION PLUGS

Condition	Code	Procedure
Leaking	A	Require replacement
Material type incorrect	2	Suggest replacement

CHARGE AIR COOLERS ""INTERCOOLERS"" (CAC)

Condition	Code	Procedure
Air-to-air intercooler leaking, affecting boost performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking coolant	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

CHECK VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	Ã,Â	No service suggested or required
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

CHEMICAL ENGINE DECARBONIZATION

NOTE: **CHEMICAL ENGINE DECARBONIZATION is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.**

NOTE: **SUGGEST Chemical Engine Decarbonization service every 15,000 miles or 12 months.**

CHOKES

Condition	Code	Procedure
Air/fuel control incorrect	B	Require repair or replacement

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Components binding	A	Require repair or replacement
Components damaged, affecting operation or performance	A	Require repair or replacement
Components missing	C	Require replacement of components
Contaminated	A	Require repair or replacement. Further inspection required
NOTE: **Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Controlling linkages binding	A	Require repair or replacement of linkage
Leaking	B	Require repair or replacement
Mechanical operation incorrect	B	Require repair or replacement
Operating incorrectly	B	Require repair or replacement

CLUTCH PEDAL POSITION SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

Condition	Code	Procedure
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

COLD START INJECTORS

NOTE: **You are not required to replace injectors in sets. However, you may suggest replacement of all injectors for preventive maintenance.**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Flow restricted	B	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation, out of OEM specification. Some components may be serviceable.**		
Leaking	A	Require repair or replacement
Resistance out of specification	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

COMBUSTION CHAMBER CLEANING

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

COOLANT RECOVERY TANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing (if original equipment)	C	Require replacement

COOLANT

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement

Condition	Code	Procedure
NOTE: **The system should be drained and/ or flushed and refilled with correct coolant according to OEM recommended service interval and procedures.**		
Contaminated	B	Require replacement or recycling Further inspection required
NOTE: **Determine source of contamination and require correction prior to coolant replacement.**		
Fluid discolored	Ã,Â	No service Suggested or Required
NOTE: **Further testing necessary to determine condition of fluid.**		
Level incorrect	B	Require correction of fluid level
NOTE: **Determine source of incorrect level and suggest repair.**		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

COOLING FAN MOTOR MODULES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Housing cracked	2	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation or failure to perform all functions.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

COOLING FAN MOTOR RELAYS AND MODULES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Housing cracked	2	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation or failure to perform all functions.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

COOLING FAN MOTOR RESISTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Missing	C	Require replacement
Open	A	Require replacement
Resistance out of specification	B	Require repair or replacement
Shorted	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

COOLING FAN MOTOR SENSORS AND SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

COOLING FAN MOTOR SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement

Condition	Code	Procedure
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

COOLING FAN MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Hydraulic fan motor leaking	A	Require repair or replacement
Inoperative	A	Require replacement
NOTE: **Check fan motor/controls. Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CRANKSHAFT POSITION SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CYLINDER DEACTIVATION SOLENOID

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

CYLINDER HEAD ASSEMBLIES

NOTE: **A Cylinder Head Assembly is a cylinder head fitted with valves, associated springs, retainers, and on overhead camshaft cylinder heads (ORC), camshaft, camshaft bearings, lash adjusters, tappets and rockers.**

Condition	Code	Procedure
Adjustable valve lash is out of specification	B	Require repair
Combustion efficiency is reduced due to carbon deposits in the combustion chamber	2	Suggest repair
Combustion efficiency is reduced due to carbon deposits on the intake valve	2	Suggest repair
Internal component failure (any component)	A	Require repair or replacement of cylinder head assembly
NOTE: **It is Required that all other failure-related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement, such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience). For example: If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be suggested that additional inspections be performed, such as the other head gasket on a V - type engine.**		

DECEL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	Ã,Â	No service suggested or required
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

DEFLECTORS

Condition	Code	Procedure
Application incorrect, affecting cooling system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting cooling system performance	A	Require repair or replacement
Blocked, affecting cooling system performance	A	Require repair or replacement
Broken, affecting cooling system performance	A	Require repair or replacement
Cracked, affecting cooling system performance	A	Require repair or replacement
Loose, affecting cooling system performance	A	Require repair
Loose, not affecting cooling system performance	2	Suggest repair
Missing, affecting cooling system performance	C	Require replacement

DIP STICK TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Bent	2	Suggest repair or replacement
Broken, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Broken, not affecting performance	2	Suggest repair or replacement
Leaking, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Leaking, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement

DIP STICKS AND TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Bent	2	Suggest repair or replacement

Condition	Code	Procedure
Broken, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Broken, not affecting performance	2	Suggest repair or replacement
Leaking, affecting performance (for example, fuel mixture)	A	Require repair or replacement
Leaking, not affecting performance	2	Suggest repair or replacement
Missing	C	Require replacement

DISTRIBUTOR ADVANCES AND RETARDERS (MECHANICAL AND VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Out of specification	B	Require repair or replacement

DISTRIBUTOR BOOTS AND SHIELDS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Deteriorated	A	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Torn	A	Require replacement

DISTRIBUTOR CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Arcing	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Burned	A	Require replacement
Carbon button missing	A	Require replacement
Carbon button worn, affecting performance	A	Require replacement
Carbon button worn, not affecting performance	1	Suggest replacement
Carbon-tracked	A	Require replacement
Cracked	B	Require replacement
Loose	B	Suggest repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

NOTE:

Determine cause and correct prior to repair or replacement of part.

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal eroded, affecting performance	A	Require repair or replacement
Terminal eroded, not affecting performance	Ã,Â	No service suggested or required
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

DISTRIBUTOR RETARDERS (MECHANICAL AND VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Inoperative	A	Require repair or replacement

NOTE:

Inoperative includes intermittent operation.

Leaking	A	Require replacement
Out of specification	B	Require repair or replacement

DISTRIBUTOR ROTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Carbon-tracked	A	Require replacement
Contact burned	A	Require replacement
Corroded	1	Suggest replacement
Eroded	1	Suggest replacement
Loose	B	Require repair or replacement
Out of specification	B	Require replacement

DISTRIBUTOR SHIELDS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Out of specification	B	Require repair or replacement

DISTRIBUTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bushings worn, affecting performance	A	Require repair or replacement
Bushings worn, not affecting performance	1	Suggest repair or replacement
Cam lobes worn, affecting performance	A	Require repair or replacement
Cam lobes worn, not affecting performance	1	Suggest repair or replacement
Gear broken	A	Require repair or replacement
Gear worn, affecting performance	A	Require replacement
Gear worn, not affecting performance	Ã,Â	No service suggested or required
Integrated pickup triggering device loose	A	Require repair or replacement
Integrated pickup triggering device magnetism incorrect	A	Require repair or replacement
Leaking oil internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pickup triggering device (reluctor) broken	A	Require repair or replacement
Pickup triggering device (reluctor) loose	A	Require repair or replacement
Pickup triggering device (reluctor) weak	A	Require repair or replacement
Reluctor (pickup triggering device) broken	A	Require repair or replacement
Reluctor (pickup triggering device) loose	A	Require repair or replacement
Reluctor (pickup triggering device) weak	A	Require repair or replacement
Shaft bent	A	Require replacement
Thrust washer broken	A	Require repair or replacement
Thrust washer missing	C	Require repair or replacement
Thrust washer worn, affecting performance	A	Require repair or replacement
Thrust washer worn, not affecting performance	1	Suggest repair or replacement

EARLY FUEL EVAPORATION VALVES (HEAT RISER ASSEMBLIES)

Condition	Code	Procedure
Broken	A	Require replacement of affected parts
Diaphragm inoperative	A	Further inspection required
NOTE: **Inoperative includes intermittent operation. If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heat riser.**		
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Seized	A	Require replacement of affected parts
Spring broken	B	Require replacement of spring(s)
Spring inoperative	A	Require replacement of spring(s)

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		

EGR COOLERS

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

EGR EXHAUST MANIFOLD PASSAGES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

EGR INTAKE AND EXHAUST MANIFOLD PASSAGES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

EGR PLATES AND COOLERS

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

ELECTRONIC SPARK CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	A	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement of source.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Includes inoperative, intermittent operation or failure to perform all functions.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRONIC TRANSMISSION CONTROL DEVICES

Condition	Code	Procedure
Application Incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation or failure to perform all functions.**		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ELECTRONIC TRANSMISSION FEEDBACK DEVICES

Condition	Code	Procedure
Application Incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ENGINE COOLANT TEMPERATURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement

Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

ENGINE COOLING SYSTEMS

NOTE: **Overheating, poor engine performance, and insufficient cabin heat can be affected by, but are not limited to, all of the components in the engine cooling system**

ENGINE COVERS (OIL PAN, VALVE COVER, TIMING COVER)

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã,Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement

ENGINE DECARBONIZATION

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

ENGINE OIL CANISTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Bulged	A	Require replacement. Further inspection required
NOTE: **Inspect pressure relief valve.**		
Canister attaching hardware broken	A	Require repair or replacement of hardware
Canister attaching hardware loose	A	Require repair
Canister attaching hardware missing	C	Require replacement
Canister attaching hardware not functioning	A	Require repair or replacement of hardware
Center tube collapsed	A	Require replacement. Further inspection required
NOTE: **Inspect bypass.**		
Dented	2	Suggest replacement. Further inspection required

Condition	Code	Procedure
NOTE: **Determine cause, such as broken motor mount.**		
Leaking	B	Require repair or replacement

ENGINE OIL COOLERS (EXTERNAL)

Condition	Code	Procedure
Air flow restriction	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypassed	A	Require repair or replacement
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	2	Suggest repair or replacement
Fluid flow restrictions	A	Require repair or replacement
Internal restrictions, affecting performance	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

ENGINE OIL DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
NOTE: **Some OEMs require replacement of drain plug gasket when removing drain plug. Inspect threads in oil pan for damage.**		

ENGINE OIL FILTERS AND CANISTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Bulged	A	Require replacement. Further inspection required
NOTE: **Inspect pressure relief valve.**		
Canister attaching hardware broken	A	Require repair or replacement of hardware
Canister attaching hardware loose	A	Require repair
Canister attaching hardware missing	C	Require replacement
Canister attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Center tube collapsed	A	Require replacement. Further inspection required
NOTE: **Inspect bypass.**		
Dented	2	Suggest replacement. Further inspection required
NOTE: **Determine cause, such as broken motor mount.**		
Leaking	B	Require repair or replacement

ENGINE OIL GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
NOTE: **Some OEMs require replacement of drain plug gasket when removing drain plug. Inspect threads in oil pan for damage.**		

ENGINE OIL PRESSURE GAUGES (MECHANICAL)

Condition	Code	Procedure
Indicates out of range	B	Further inspection required
NOTE: **Gauge may indicate problem with contaminated oil, level, pressure, or temperature, or problem with gauge.**		
Inoperative	A	Further inspection required
NOTE: **Gauge may indicate problem with contaminated oil, level, pressure, or temperature, or problem with gauge. Inoperative includes intermittent operation, out of OEM specification, or out of range. Further inspection required to determine cause.**		
Leaking	B	Require repair or replacement
Reads inaccurately	2	Suggest repair or replacement

ENGINE OIL

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Contaminated	A	Require replacement of oil and filter; Further Inspection Required
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water when changing oil.**		

Condition	Code	Procedure
Fluid discolored	Ã,Â	No Service Suggested or Required
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
Level Incorrect	B	Adjust to correct level. Further Inspection Required.
NOTE: **Determine cause of incorrect level such as leaking gaskets or contamination by engine coolant, fuel or water.**		
Oxidized	A	Require replacement of fluid

EVAPORATIVE EMISSIONS (EVAP) CANISTER FILTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with OEM recommended service interval
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	A	Require replacement

EVAPORATIVE EMISSIONS (EVAP) CANISTER PURGE DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

EVAPORATIVE EMISSIONS (EVAP) CANISTERS

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Missing	C	Require replacement
Saturated	A	Require replacement

EVAPORATIVE EMISSIONS (EVAP) FEEDBACK DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

EXHAUST GAS RECIRCULATION DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	1	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

EXHAUST GAS RECIRCULATION FEEDBACK DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	1	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

EXPANSION PLUGS

Condition	Code	Procedure
Leaking	A	Require replacement
Material type incorrect	2	Suggest replacement

FAN CONTROL SENSOR

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FUEL ACCUMULATORS AND DAMPERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connections leaking	A	Require repair or replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement

FUEL AND COLD START INJECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Flow restricted	B	Require repair or replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation, out of OEM specification. Some components may be serviceable.**		

Condition	**Code**	**Procedure**
Leaking	A	Require repair or replacement
Resistance out of specification	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

FUEL CAPS

Condition	**Code**	**Procedure**
Application incorrect	B	Require replacement
Fails to maintain proper pressure	A	Require replacement
Gaskets missing	C	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Plugged (vacuum and pressure relief)	A	Require replacement
Seals missing	C	Require replacement

FUEL DAMPERS

Condition	**Code**	**Procedure**
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connections leaking	A	Require repair or replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement

FUEL DELIVERY CHECK VALVES

Condition	**Code**	**Procedure**
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Missing	C	Require replacement
Pressure leaking (bleeds down)	A	Require repair or replacement

FUEL DISTRIBUTORS (BOSCH CIS)

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require repair or replacement
Out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement. Further inspection required
NOTE: **Some components may be serviceable; check for accepted cleaning procedure.**		

FUEL FILLER NECKS AND RESTRICTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted	2	Suggest repair or replacement

FUEL FILTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with OEM recommended service interval
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	2	Suggest replacement

FUEL INJECTOR CLEANING

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

FUEL INJECTORS

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FUEL LEVEL SENDERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FUEL PRESSURE REGULATORS

Condition	Code	Procedure
Contaminated	2	Suggest repair or replacement. Further inspection required
NOTE: **Some components may be serviceable; check for accepted cleaning procedure. Determine source of contamination. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking (internally or externally)	A	Require repair or replacement
Pressure out of specification	B	Require repair or replacement
Vapor bypass restricted	A	Require repair or replacement

FUEL PUMPS (IN-TANK, EXTERNAL, ELECTRICAL OR MECHANICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
NOTE: **Determine source of contamination. Require repair or replacement.**		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally (includes pulsator)	A	Require repair or replacement
Leaking internally (includes pulsator)	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FUEL RAILS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Contaminated	A	Require replacement
NOTE: **Determine source of contamination. Require repair or replacement.**		
Leaking	A	Require repair or replacement
Restricted	A	Require repair or replacement
Rust-pitted	1	Suggest replacement

FUEL RESTRICTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted	2	Suggest repair or replacement

FUEL SYSTEM CLEANING SERVICE

NOTE: See CHEMICAL ENGINE DECARBONIZATION.

FUEL TANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Baffles loose	A	Require repair or replacement
Contaminated	A	Require repair
NOTE: **Determine source of contamination. Require repair or replacement.**		
Corroded internally	A	Require repair or replacement
Distorted, affecting performance	B	Require replacement
Distorted, not affecting performance	Ã,Â	No service suggested or required
Leaking	A	Require repair or replacement

FUEL

Condition	Code	Procedure
Contaminated	B	Require repair or replacement
NOTE: **Determine of source of contamination. Require repair or replacement.**		
Fuel incorrect	B	Require flushing of system
NOTE: **If a fuel other than specification fuel is present in the system, the required service is to flush and fill with the correct fuel.**		

GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

GROMMETS (VALVE COVER)

Condition	Code	Procedure
Leaking	A	Suggest repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

HARMONIC DAMPERS

Condition	Code	Procedure
Application incorrect	B	Require replacement

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	B	Require replacement
Dented (fluid type only)	A	Require replacement
Keyway distorted	A	Require repair or replacement
Leaking (fluid damper only)	A	Require replacement
Loose	A	Require replacement
Noisy	A	Require replacement
Outer ring slipped out of position	A	Require replacement
Positioned incorrectly	A	Require repair or replacement
Rubber damping material deteriorated	1	Suggest replacement
Seal surface worn, causing a leak	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

HEATER CONTROL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypassed	A	Require replacement
Coolant leak	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Vacuum leak	A	Require repair or replacement

HEATER CORES

Condition	Code	Procedure
Air flow restriction	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypassed	A	Require repair or replacement
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	2	Suggest repair or replacement
Internal restrictions, affecting performance	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement

HOSE CLAMPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

HOSE CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

HOSE COUPLERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

HOSES AND TUBE COUPLERS, CONNECTORS AND CLAMPS

NOTE: **When replacing fuel lines and hoses, replace with product that meets or exceeds OEM design specifications.**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

HOSES AND TUBES (FUEL LINES, RADIATOR, VACUUM, BY-PASS, HEATER, RECOVERY TANK AND OIL COOLERS)

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Dry-rotted	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

IDLE AIR CONTROLS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

IDLE SPEED CONTROL ACTUATORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

IGNITION BOOTS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair

Condition	Code	Procedure
NOTE: **If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

IGNITION COIL TOWERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

IGNITION COILS

Condition	Code	Procedure
Arcing	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement

Condition	Code	Procedure
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require replacement
Corroded, not affecting performance	2	Suggest replacement
Distorted	Ã,Â	No service suggested or required
NOTE: **Distortion may be the result of overheating; coil should be tested.**		
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Oil leaking	A	Require replacement
Out of specification	B	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

IGNITION CONTROL MODULES (ICM)

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
NOTE: **Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	A	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

IGNITION SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

IGNITION TERMINALS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair
NOTE: **If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

IGNITION WIRES (SECONDARY)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair
NOTE: **If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

INERTIA FUEL SHUT-OFF SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

INTAKE AIR TEMPERATURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

INTAKE CLEANING

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

INTAKE MANIFOLDS

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Corroded, affecting sealability	A	Require repair or replacement
Integrated air or fuel control components inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Internal air or fuel components damaged, affecting performance	A	Require repair or replacement of component
Internal air or fuel components damaged, not affecting performance	Ã,Â	No service suggested or required
Internal air or fuel components missing	C	Require replacement of component
Leaking	A	Require repair or replacement
Out of specification	B	Require replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Warped	B	Require repair or replacement

IN-TANK FUEL STRAINERS

Condition	Code	Procedure
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Torn	A	Require replacement

INTERCOOLERS

Condition	Code	Procedure
Air-to-air intercooler leaking, affecting boost performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking coolant	A	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require repair or replacement

KNOCK SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

LIQUID VAPOR SEPARATORS

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement

LONG BLOCK ASSEMBLIES

NOTE: **A Long Block Assembly is a short block assembly together with a cylinder head assembly and all those components fitted within the rocker or cam cover, and timing cover (the whole presented as an assembly). A rebuilt or new oil pump, or kit shall be supplied or fitted as appropriate.**

Condition	Code	Procedure
Combustion efficiency is reduced due to carbon deposits in the combustion chamber	2	Suggest repair
Internal component failure (any component)	A	Require repair or replacement of the long block assembly
NOTE: **It is Required that all other failure-related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience). For example: If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be Suggested that additional inspections be performed, such as the other head gasket on a V -type engine.**		

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement

Condition	**Code**	**Procedure**
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

MASS AIR FLOW (MAF) SENSORS

Condition	**Code**	**Procedure**
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

METAL AIR MANIFOLDS AND PIPES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair of injection tube or replacement of manifold
Corroded, affecting structural integrity	1	Suggest replacement of injection tube or manifold
Leaking	A	Require repair of injection tube or replacement of manifold
Loose	A	Require repair
Missing	C	Require replacement
Restricted	A	Require replacement of injection tube or manifold
Threads damaged	A	Require repair
Threads stripped (threads missing)	A	Require replacement

METAL AIR PIPES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Broken	A	Require repair of injection tube or replacement of manifold
Corroded, affecting structural integrity	1	Suggest replacement of injection tube or manifold
Leaking	A	Require repair of injection tube or replacement of manifold
Loose	A	Require repair
Missing	C	Require replacement
Restricted	A	Require replacement of injection tube or manifold
Threads damaged	A	Require repair
Threads stripped (threads missing)	A	Require replacement

MIX CONTROL SOLENOIDS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

MOTOR MOUNTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	Ã,Â	No service suggested or required
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	Ã,Â	No service suggested or required
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

O2 SENSORS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>At or beyond service interval</td><td>3</td><td>Suggest replacement to comply with vehicle's OEM recommended service intervals</td></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware threads damaged</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads stripped (threads missing)</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Connector (Weatherpack type) leaking</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector melted</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Connector missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Contaminated</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</td></tr>
<tr><td>Inoperative</td><td>A</td><td>Require repair or replacement. Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</td></tr>
<tr><td>Leaking</td><td>A</td><td>Require repair or replacement</td></tr>
</table>

Condition	Code	Procedure
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

OIL PANS

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã,Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement

OIL PRESSURE SENDING UNITS

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require replacement
Output signal incorrect	B	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

OIL PUMP PICK-UP SCREENS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bypass stuck	A	Require repair or replacement
Cracked	A	Require repair or replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Positioned incorrectly	A	Require repair or replacement
Restricted	A	Require repair or replacement
Screen torn	A	Require replacement

OIL PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Leaking	B	Require repair or replacement
Pressure relief valve stuck	A	Require repair or replacement
Seized	A	Require repair or replacement
Worn beyond specifications	B	Require repair or replacement

O-RINGS, GASKETS, SEALS AND SPRING LOCKS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

PARK NEUTRAL POSITION SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

PCV BREATHER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	A	Require replacement

PCV ORIFICES

Condition	Code	Procedure
At or beyond service interval	3	Suggest repair or replacement to comply with OEM recommended service intervals
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement

PCV VALVES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Grommet broken	A	Require repair or replacement of grommet
Grommet missing	C	Require replacement of grommet
Grommet not functioning	A	Require repair or replacement of grommet
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require replacement

PICK-UP ASSEMBLIES (INCLUDES MAGNETIC, HALL EFFECT AND OPTICAL)

Condition	Code	Procedure
Adjustment incorrect	B	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement

Condition	Code	Procedure
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation. Refer to OEM recommended service procedures.**		
Oil-soaked	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

POWER STEERING PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

POWERTRAIN CONTROL MODULES (PCM) AND PROM

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
NOTE: **Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).**		
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation or failure to perform all functions.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement

Condition	**Code**	**Procedure**
Terminal burned, affecting performance	A	Require repair or replacement

NOTE:

Determine cause and correct prior to repair or replacement of part.

Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

POWERTRAIN CONTROL PROM

Condition	**Code**	**Procedure**
Application incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required

NOTE:

Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).

Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

NOTE:

Determine cause and correct prior to repair or replacement of part.

Connector missing	C	Require repair
Contaminated	A	Require repair or replacement

NOTE:

Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.

Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement

NOTE:

Includes inoperative, intermittent operation or failure to perform all functions.

Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: Determine cause and correct prior to repair or replacement of part.		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

PRESSURIZED EXPANSION TANK CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Coolant recovery check valve inoperative	A	Require replacement
NOTE: Inoperative includes intermittent operation.		
Fails to maintain proper pressure	B	Require replacement
Gasket missing	C	Require replacement of gasket
Missing	C	Require replacement
Seal missing	C	Require replacement of seal

RADIATOR / COOLING FAN BLADES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require replacement
Broken	A	Require replacement
Cracked	B	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement

RADIATOR / COOLING FAN CLUTCHES

NOTE: **Some lateral movement, measured at the fan blade tip, may be normal.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing noisy	A	Require replacement

Condition	Code	Procedure
Bearing worn	A	Require replacement
Fastener loose	A	Require repair or replacement of fastener
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Suggest replacement
Seized	A	Require replacement
Slips (insufficient fan speed)	A	Require replacement
Thermal control incorrect	B	Require repair or replacement

RADIATOR CAPS AND PRESSURIZED EXPANSION TANK CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Coolant recovery check valve inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Fails to maintain proper pressure	B	Require replacement
Gasket missing	C	Require replacement of gasket
Missing	C	Require replacement
Seal missing	C	Require replacement of seal

RADIATORS

Condition	Code	Procedure
Air flow restriction	A	Require repair
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	2	Suggest repair or replacement
Internal oil cooler leaking	A	Require repair or replacement
Internal restrictions, affecting performance	A	Require repair or replacement
Internal restrictions, not affecting performance	2	Suggest repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Ã,Â	No service suggested or required

ROLL OVER VALVES

Condition	Code	Procedure
Inoperative	A	Require replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require replacement
Missing	C	Require replacement

SEALING COMPOUNDS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

SECONDARY AIR INJECTION SYSTEM MANAGEMENT DEVICES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SHORT BLOCK ASSEMBLIES

NOTE: **A Short Block Assembly is a cylinder block and all those components contained within the limits of the block deck or decks, the pan rail, the block rear face and the timing cover (where fitted), including the crankshaft.**

Condition	Code	Procedure
Combustion efficiency is reduced due to carbon deposits in the combustion chamber	2	Suggest repair
Internal component failure (any component)	A	Require repair or replacement of the short block assembly

Condition	Code	Procedure
NOTE: **It is Required that all other failure-related components be inspected for cause and condition. Additional components or assemblies may be Suggested for repair or replacement, such as a water pump on a short block (reason code 4, technician's recommendation based on substantial and informed experience). For example: If there is a failed head gasket with an external coolant leak, in addition to Requiring replacement of the head gasket, inspection of the following for cause and condition is Required: Block, Cooling System, Cylinder Head. It may be Suggested that additional inspections be performed, such as the other head gasket on a V -type engine.**		

SHROUDS, BAFFLES AND DEFLECTORS

Condition	Code	Procedure
Application incorrect, affecting cooling system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting cooling system performance	A	Require repair or replacement
Blocked, affecting cooling system performance	A	Require repair or replacement
Broken, affecting cooling system performance	A	Require repair or replacement
Cracked, affecting cooling system performance	A	Require repair or replacement
Loose, affecting cooling system performance	A	Require repair
Loose, not affecting cooling system performance	2	Suggest repair
Missing, affecting cooling system performance	C	Require replacement

SPARK PLUGS

NOTE: **You are not required to replace spark plugs in sets. However, you may suggest replacement of the other plugs for preventive maintenance.**

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Electrode eroded	1	Suggest replacement
Fouled	A	Require repair or replacement
NOTE: **Determine cause of fouling and suggest repair.**		
Gap incorrect	B	Require repair or replacement
Improperly Indexed	Ã,Â	Remove and Reinstall following manufacturers installation requirements
Insulation broken	A	Require replacement
Insulator cracked	A	Require replacement
Leaking compression	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SPRING LOCKS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

SUPER CHARGERS

Condition	Code	Procedure
Attaching hardware damaged, affecting operation or performance	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Bearing noisy	A	Require replacement
Bearing worn	A	Require replacement
Boost pressure incorrect	A	Require repair or replacement
NOTE: **Boost pressure problems may be caused by other systems or components.**		
Clearance out of specification	B	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

THERMAL VACUUM VALVES

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

THERMOSTATIC AIR DOOR ASSEMBLIES

Condition	Code	Procedure
Attaching hardware damaged, affecting operation or performance	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Binding	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized	A	Require repair or replacement

THERMOSTATS AND HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

THROTTLE BODIES

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Deposits on throttle body components	A	Require repair
NOTE: **Some throttles are coated by manufacturer; follow OEM-recommended procedures.**		
Leaking	A	Require repair or replacement
Restricted, affecting performance	A	Require repair
NOTE: **Some components may be serviceable; check for accepted cleaning procedure.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Throttle shaft binding, affecting performance	A	Require repair or replacement
Throttle shaft worn, affecting performance	A	Require repair or replacement
Throttle shaft worn, not affecting performance	1	Suggest repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

THROTTLE BODY CLEANING

NOTE: See CHEMICAL ENGINE DECARBONIZATION.

THROTTLE CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement

Condition	Code	Procedure
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Ã,Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Ã,Â	No service suggested or required
Bracket Corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
NOTE: **Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.**		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

THROTTLE LINKAGES AND CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Ã,Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Ã,Â	No service suggested or required
Bracket Corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Kinked	A	Require repair or replacement
Melted	A	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
NOTE: **Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.**		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

THROTTLE POSITION SENSORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

THROTTLE POSITION SWITCHES

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

TIMING BELT SPROCKETS

Condition	Code	Procedure
Alignment incorrect	B	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require replacement
Cracked	B	Require replacement
Key damaged	A	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Pulley damaged, affecting belt life	A	Require replacement
Sprocket damaged, affecting belt life	A	Require repair or replacement
Sprocket loose	B	Require repair or replacement
Sprocket-to-shaft alignment incorrect	B	Require repair or replacement

TIMING BELTS

Condition	Code	Procedure
Adjustment incorrect	B	Suggest adjustment
NOTE: **Inspect belt tensioners, pulleys, and cover.**		
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Broken	A	Require replacement
Cam timing out of specification	B	Require repair
Cracked	1	Suggest replacement
Fluid-soaked	1	Suggest replacement. Further inspection required
Frayed	1	Suggest replacement
Missing	C	Require replacement
NOTE: **Internal engine damage may result from timing belt damage/failure.**		
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Teeth missing	A	Require replacement
Tension out of specification	B	Require adjustment or replacement

TIMING COVERS

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã,Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement

TORQUE STRUTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require replacement
Body dented	A	Further inspection required
NOTE: **Require replacement of units where dents restrict strut piston rod movement. If dents don't restrict movement, no service is suggested or required.**		
Body punctured	A	Require replacement
Bushing deteriorated, affecting performance	A	Require replacement
Bushing deteriorated, not affecting performance	Ã,Â	No service suggested or required
Bushings missing	C	Require replacement
Bushings separated from mounting eye	1	Suggest replacement
Damping (none)	A	Require replacement
Leaking oil, enough for fluid to be running down the body	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **If noise is isolated to shock or strut, suggest replacement.**		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

TRANSMISSION RANGE SWITCHES

Condition	Code	Procedure
Application Incorrect	B	Require repair or replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		

Condition	Code	Procedure
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance .	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

TUBE CLAMPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

TUBE CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

TUBE COUPLERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Cracked	B	Require replacement
Dry-rotted	1	Suggest repair or replacement
Dry-rotted	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement

Condition	Code	Procedure
Safety clip missing	C	Require replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Stripped	A	Require replacement
Swollen	B	Require replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement
Type incorrect	2	Suggest repair or replacement

TURBO CHARGERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Boost pressure incorrect	A	Require repair or replacement
NOTE: **Boost pressure problems may be caused by other systems or components.**		
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Oil seal (internal) leaking	A	Require repair or replacement
Vibrates	A	Require repair or replacement

VACUUM CONNECTIONS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC)

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

VACUUM REGULATOR SOLENOIDS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

VACUUM TUBES

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

VALVE COVERS

Condition	Code	Procedure
Attaching hardware incorrect	B	Require replacement
Attaching hardware loose	A	Require repair or replacement
Attaching hardware missing	C	Require replacement
Baffle loose	2	Suggest repair or replacement
Baffle missing	C	Require replacement
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Ã,Â	No service suggested or required
Cracked (not leaking)	2	Suggest repair or replacement
Leaking externally	A	Require repair or replacement
Leaking internally, causing fluid contamination	A	Require repair or replacement
Missing	C	Require replacement
Restricted passage	A	Require repair or replacement
Threads damaged	A	Require repair or replacement

VEHICLE SPEED SENORS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

VOLUME AIR FLOW SENSORS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware threads damaged</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads stripped (threads missing)</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Connector (Weatherpack type) leaking</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Connector melted</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Connector missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Contaminated</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.</td></tr>
<tr><td>Inoperative</td><td>A</td><td>Require repair or replacement. Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.</td></tr>
<tr><td>Leaking</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Resistance out of specification</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal broken</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal burned, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Terminal burned, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Terminal corroded, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal corroded, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td>Terminal loose, affecting performance</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Terminal loose, not affecting performance</td><td>1</td><td>Suggest repair or replacement</td></tr>
<tr><td>Threads damaged</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Threads stripped (threads missing)</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Wire lead conductors exposed</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Wire lead corroded</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Wire lead open</td><td>A</td><td>Require repair or replacement</td></tr>
</table>

Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

WASTE GATE AND BOOST CONTROL MECHANISMS

Condition	Code	Procedure
Boost pressure incorrect	A	Require repair or replacement. Further inspection required
NOTE: **Incorrect boost pressure includes intermittent operation.**		
Leaking	A	Require repair or replacement

WASTE GATE CONTROL SOLENOIDS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WATER PUMPS (ELECTRIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Check fan motor/controls. Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WATER PUMPS (NON-ELECTRIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corrosion (internal) is excessive, affecting performance	A	Require replacement
Corrosion (internal) is excessive, not affecting performance	2	Suggest cooling system service
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Noisy	A	Require replacement
Rotation incorrect for application	B	Require repair or replacement
Shaft bent	A	Require replacement

WIRING HARNESSES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Voltage drop out of specification	A	Require repair or replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

AUTOMOTIVE TERMINOLOGY & DEFINITIONS

ACCELERATION

an increase in velocity or speed.

ADDITIVE

in automotive terminology, a substance added to a liquid, such as engine oil, transmission fluid, gear oil or coolant to enhance its properties.

ADVANCED TECHNOLOGY VEHICLE (ATV)

a vehicle that combines new engine/power/drivetrain systems to significantly improve fuel economy. This includes hybrid power systems and fuel cells, as well as some specialized electric vehicles.

AIR GAP

a specified space between two components. Space or gap between spark plug electrodes, motor and generator armatures Ind field shoes. The space or gap between the compressor drive hub and pulley assembly.

AIR INJECTION REACTION (AIR) SYSTEM

a system that provides fresh air to the exhaust system under controlled conditions to reduce emissions. The air source can be a pulse-air pump or an electrically or belt driven pump. Upstream air injection goes into the exhaust manifold to assist in after-burning HC laden exhaust gases. Downstream air injection goes into the oxidation bed of the catalytic converter to help oxidize HC and CO emissions.

AIR PUMP

device to produce a flow of air at higher-thanatmospheric pressure. Normally referred to as a thermactor air supply pump.

AIR/FUEL RATIO

the proportion of air to fuel by weight in the fuel mixture drawn into the engine.

ALLOY

mixture containing mostly metals. For example, brass is an alloy of copper and zinc. Steel contains iron and other metals, but also carbon

ALTERNATIVE FUEL VEHICLE (AFV)

as defined by the Energy Policy Act, any dedicated, flexible-fuel, or dual-fuel vehicle designed to operate on at least one alternative fuel.

ALTERNATIVE FUEL

alternative fuel, also known as non-conventional fuels, is any material or substance that can be used as a fuel, other than fossil fuels, or conventional fuels of petroleum (oil), coal, propane, and natural gas. The term "alternative fuels" usually refers to a source of which energy is renewable. Methanol, denatured ethanol, and other alcohols; mixtures containing 85% or more by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; non-alcohol fuels (such as biodiesel) derived from biological material; and electricity. 'P-Series' fuels were added to this list since the original definition in EPAct.

AMBIENT TEMPERATURE

the temperature of the medium surrounding an object

ANTIFREEZE

a material such as ethylene glycol which is added to water to lower its freezing point; used in an automobile's cooling system.

B100

100% (neat) biodiesel.

B20

a blend of biodiesel fuel with petroleum-based diesel where 20% of the volume is biodiesel.

BABBITT

a soft bearing alloy used in engine bearings.

BACK PRESSURE

pressure created by a blockage or restriction in an exhaust system.

BACKFIRE

the sudden combustion of gasses in the intake or exhaust manifold, resulting in a loud explosion.

BALANCE SHAFT

a weighted shaft used on some engines to dampen or reduce vibration.

BALLAST RESISTOR

resistor in the primary side of the ignition system hat is used to reduce voltage by approximately 4-5 volts.

BATTERY

batteries are the principal energy storage devices for hybrid electric vehicles (HEVs). Desirable attributes of high-power batteries for HEV applications are high-peak and pulse-specific power, high specific energy at pulse power, a high charge acceptance to maximize regenerative braking utilization, and long calendar and cycle life. Developing methods/designs to balance the packs electrically and thermally, developing accurate techniques to determine a battery's state of charge, and developing abuse-tolerant batteries, and recyclability are additional technical challenges.

BDC

bottom dead center, when the piston is at its lower limit in the cylinder bore.

BEARING CAP

the lower half of the bearing saddle. It is removable, as in main cap or rod cap.

BEARING CLEARANCE

the space between a bearing and its corresponding component's loaded surface. Bearing clearances are commonly provided to allow lubrication between the parts.

BEARING CRUSH

the bearing is slightly larger at its parting lines so that when the two halves of the bearing are tightened together, the bearing seats firmly in its bore. This keeps the bearing from rotating.

BEARING LINING

the bearing surface area of a bearing, it is usually made up of an alloy of several metals, including lead.

BEARING SPREAD

the condition in which the distance across the outer edges of the bearing insert is slightly greater than the diameter of the housing bore. A bearing is spread slightly apart at its paning halves so that it snaps into place in its bore and remains there during assembly.

BEFORE TOP DEAD CENTER (BTDC)

the degrees of crankshaft rotation just before the piston in a specific cylinder reaches TDC, the highest point in its vertical travel on the compression stroke. On most vehicles, spark occurs a certain number of degrees of crankshaft rotation BTDC.

BI-FUEL VEHICLE

a vehicle with two separate fuel systems designed to run on either an alternative fuel, or gasoline or diesel, using only one fuel at a time. Bi-fuel vehicles are referred to as "dual-fuel" vehicles in the Clean Air Act Amendments and Energy Policy Act.

BIOCK

the casting made up of cylinders and the crankcase.

BLOWBY

the unburned fuel and products of combustion that are forced past the piston rings and into the crankcase during the combustion stroke.

BOOST PRESSURE.

term used when a turbocharger increases the air pressure entering an engine above atmospheric pressure.

BORE GAUGE

a precision measuring instrument used to measure the diameter of a bore.

BORE

a cylindrical hole.

BOSS

the part of a piston that fits around its pin.

BOTTOM DEAD CENTER (BDC)

when the piston is at its lower limit in the cylinder bore.

BRAKE HORSEPOWER

power developed by an engine as measured at the flywheel or crankshaft.

BRAKE-SPECIFIC FUEL CONSUMPTION

the ratio of engine fuel consumption to power output. It is a measure of engine efficiency.

BTDC

see 'before top dead center'.

CAMSHAFT BEARING

a bearing that supports the camshaft journal. On some engines it is full round and pressed in place. On some OHC engines the camshaft bearing is made up of two shells like a connecting rod bearing.

CAMSHAFT FOLLOWER

on OHC engines the equivalent of a rocker arm.

CAMSHAFT JOURNAL

the bearing area of a camshaft.

CAMSHAFT LOBE

the eccentric on a camshaft that acts on lifters or followers and in turn, other valvetrain components as the camshaft is rotated, to open the intake and exhaust valves.

CAMSHAFT POSITION SENSOR (CMP)

a magnetic, hall effect, optical or magneto resistive sensor usually mounted internally in the engine to inform the ECM or PCM of piston position on the intake stroke for timing and synchronization of sequential fuel injection.

CAMSHAFT SPROCKET

the sprocket on a camshaft that is turned by a chain or belt from the crankshaft. The camshaft sprocket has twice as many teeth as the crankshaft sprocket.

CARBON DIOXIDE (CO_2)

A product of combustion that has become an environmental concern in recent years. CO_2 does not directly impair human health, but is a greenhouse gas that traps the Earth's heat and contributes to the potential for global warming.

CARBON MONOXIDE (CO)

a colorless, odorless gas, which is highly poisonous. CO is produced by incomplete combustion. It is absorbed by the bloodstream 400 times faster than oxygen.

CARBON

a hard or soft nonmetallic element that forms in an engine's combustion chamber when oil is burned.

CARBURETOR

a device that atomizes air and fuel in a proportion that is burnable in the engine.

CASTING

metal that is manufactured by pouring it into a mold. It is more porous than forged metal and does not conduct heat as well. It is less expensive to manufacture, however.

CATALYTIC CONVERTER

an emission control device located in the exhaust system that contains catalysts, which reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gases.

CATALYTIC OXIDATION

process of oxidizing unburned hydrocarbons and carbon monoxide by means of a catalytic reaction to reduce pollution.

CHOKE

a device used on carbureted vehicles to reduce the amount of air entering the intake manifold while leaving the amount of fuel unchanged. The purpose of a choke is to richen the mixture enough that a cold engine can still get enough vaporized fuel to start.

CLOSED LOOP

electronic feedback system in which sensors provide constant information on what is taking place in the engine; the state of the engine control computer system when it is working normally, at full operating temperature and normal speeds with the oxygen sensor switching. The fuel injection quantity is determined by the set of inputs from the engine control computer's sensors, most specifically the oxygen sensor in the exhaust stream. A closed loop system samples its output and uses that sampling to modify the next inputs.

CLOSED-LOOP CARBURETION

system in which the fuel/air ratio in the engine is carefully controlled to optimize emissions performance. A closed-loop system uses a fuel metering correction signal to optimize fuel metering.

COIL-ON-PLUG IGNITION

a Coil-on-Plug ignition system uses one ignition coil for each cylinder attached to the spark plug. The system replaces remote ignition coils and high-voltage ignition wires in a distributorless ignition system.

COLD START

difficulty of starting an internal combustion engine in cold weather because of gasoline, which evaporates more slowly when it is cold; oil, which gets thicker in cold weather; and the chemical reactions inside the battery, which progress more slowly in cold weather.

COMBUSTION CHAMBER

enclosure formed by a pocket in the cylinder head and the top of the piston, where the spark plug ignites the compressed air/fuel mixture. The volume of the cylinder above the piston when the piston is at TDC.

COMBUSTION

the burning of the air/fuel mixture.

COMMON RAIL DIRECT INJECTION (CDI)

a fuel-injection system that uses a single "rail" (fuel line) that maintains constant fuel pressure regardless of injection sequence (also called common rail injection). The engine's electronic timing regulates fuel-injection timing and quantity according to data from sensors on the camshafts and crankshafts so that compression and injection occur independently. Fuel is injected only as needed, which reduces fuel consumption and emissions.

COMPRESSION IGNITION

the form of ignition that initiates combustion in a diesel engine. The rapid compression of air within the cylinders generates the heat required to ignite the fuel as it is injected.

COMPRESSION RATIO

ratio of the volume in the cylinder above the piston when the piston is at bottom dead center to the volume in the cylinder above the piston when the piston is at top dead center.

COMPRESSION RINGS

usually the top two rings on a piston, they form a seal between the piston and cylinder wall to compress the air fuel mixture in the cylinder.

COMPRESSION STROKE

the second stroke of the 4-stroke engine cycle, in which the piston moves from bottom dead center and the intake valve is closed, trapping and compressing the air/fuel mixture in the cylinder.

COMPRESSION

in a solid material, compression is the opposite of tension. In a gas, compression causes the gas to be confined in a smaller area, raising its temperature and pressure.

COMPRESSION-IGNITION DIRECT-INJECTION (CIDI) ENGINE

commonly called the diesel engine, has the highest thermal efficiency of any internal combustion engine. Challenges to improvements include a lower specific power than the gasoline engine; significant particulate matter and nitrogen oxides in the exhaust; and the noise, vibration, and smell of the engine.

CONNECTING ROD BEARINGS

the plain bearing shells located in the big end of the connecting rod that support the connecting rod and piston on the crankshaft.

CONNECTING ROD CAP

the removable part of the big end of the connecting rod.

CONNECTING ROD

a rod that connects the crankshaft to the piston and enables the reciprocating motion of the piston to turn the crankshaft.

CONTINUOUS INJECTION

a system that uses fuel under pressure to maintain or change the fuel injection area.

COOLANT

the mixture of water and antifreeze used in an engine's cooling system to maintain the engine's temperature throughout Its operating range.

COOLING FAN

a mechanically or electrically driven propeller that draws air through the radiator.

COOLING SYSTEM

the system used to remove excess heat from an engine and transfer it to the atmosphere. Includes the radiator, cooling fan, hoses, water pump, thermostat and engine coolant passages.

CORROSION INHIBITORS

additives used to inhibit corrosion (e.g., rust) in the fuel system.

CRANK THROW

distance from the crankshaft main bearing centerline to the connecting rod journal centerline. The stroke of any engine is the crank throw.

CRANK WEB

unmachined portion of a crankshaft that lies between two crank pins or between a crankpin and main bearing journal.

CRANKCASE

the lower part of an engine block that houses the crankshaft.

CRANKPIN

the part of the crankshaft to which the connecting rod is attached.

CRANKSHAFT JOURNALS

the bearing areas of a crankshaft are the main and rod journals.

CRANKSHAFT POSITION SENSOR (CKP)

a magnetic, hall effect, optical or magneto resistive sensor usually mounted internally in the engine, externally to the engine or in the distributor to inform the ECM or PCM of crankshaft position, location of No.1 piston, and crankshaft speed for ignition timing and other calculations needed by the system where rpm is an input.

CRANKSHAFT PULLEY

the belt drive pulley mounted on the front of the vibration damper.

CRANKSHAFT THRUST COLLAR

a flat machined area that is 90 degrees to the crankshaft main journals. The flange of the thrust main bearing rides against it to control cranksnan end tnrust.

CRANKSHAFT

a lower engine part with main and rod bearing journals. It converts reciprocating motion to rotary motion.

CROSSFLOW RADIATOR

a radiator in which coolant enters on one side, travels through tubes, and collects on the opposite side (see downflow radiator).

CRUSH

the bearing is slightly larger at its parting lines so that when the two halves of the bearing are tightened together, the bearing seats firmly in its bore. This keeps the bearing from rotating.

CYLINDER HEAD

the casting that contains the valves and valve springs, and covers the top of the cylinders.

CYLINDER LEAKAGE TEST

in engine diagnostic test where the piston in the cylinder to be tested is brought to top dead center (TDC) on the compression stroke and compressed air is pumped into the cylinder through the spark plug hole. Where the air leaks out shows the location of the compression leak. A leakage tester will compare the air leaking out of the cylinder to the amount of air being put into it, expressed as a percentage.

CYLINDER SLEEVE

a replacement iron liner that fits into a cylinder bore. It can be either wet or dry. The outside diameter of wet sleeves contacts the coolant.

CYLINDER WALLS

the walls of the cylinder bore.

CYLINDER

round hole in the engine block for the piston.

DAMPER

a device mounted on the front of the crankshaft. It reduces the torsional or twisting vibration that occurs along the length of the crankshaft in multiple cylinder engines. It is also called a harmonic balancer.

DEAD CENTER

the extreme upper or lower position of the crankshaft throw at which the piston is not moving in either direction.

DECK

the top of the engine block where the cylinder head is attached.

DETONATION

abnormal combustion of an air fuel mixture. When pressure in the cylinder becomes excessive and the mixture explodes violently, instead of burning in a controlled manner. The sound of detonation can be heard as the cylinder walls vibrate. Detonation is sometimes confused with preignition or ping.

DIAGNOSTIC TROUBLE CODE (DTC)

a code that represents and can be used to identify a malfunction in a computer control system.

DIE CASTING

an accurate casting made by pouring pressurized molten material into a mold or die.

DIESEL ENGINE

any internal-combustion engine in which air is compressed to a sufficiently high temperature to ignite fuel injected into a cylinder. A diesel engine differs from other internal-combustion engines, such as gasoline engines, in that it employs no ignition devices, such as an electric spark. For this reason, it is often called a compression-ignition engine.

DIESEL FUEL

petroleum products normally used as fuel for diesel engines are components of crude oil having heavy hydrocarbons containing at least 12 to 16 carbon atoms per molecule. These heavier fractions are taken from crude oil after the more volatile portions used in gasoline are removed.

DIESELING

a condition by which hot spots in the combustion chamber(s) cause the engine to run on after the key is turned off.

DIRECT IGNITION

distributorless ignition system in which spark distribution is controlled by the computer.

DIRECT INJECTION (DI)

in DI, fuel is injected directly into the cylinder, as is typical in a diesel engine (also called direct fuel injection). Most other internal combustion engines use either carburetion (in which the air and fuel are mixed long before the air enters the cylinder) or port fuel injection (in which the fuel is injected just in front of the cylinder intake valve).

DIRECT INJECTION ENGINE

direct injection (DI) refers to fuel injected directly into the combustion chamber above the piston. Direct Injection has long been used on large diesel engines. Smaller diesels are increasingly adopting direct injection (vs. indirect injection into a pre-chamber). Direct Injection also can be used in spark ignition (generally gasoline) engines instead of port fuel injection - for cleaner emissions, increased full throttle power and potentially for lean-burn operation.

DIRECT INJECTION SPARK IGNITION (DISI)

with direct injection spark ignition (DISI) engines, fuel is injected in one of two ways depending on operating conditions. Lean burn operation (at part throttle), injects fuel after the air has entered, causing higher fuel concentration near the injector and spark plug for easy ignition. This is known as stratified charge. The overall air/fuel ratio is lean for better fuel consumption. At full power, fuel is injected at the same time as air (same as for conventional) to promote good mixing. Fuel evaporating in the combustion chamber cools the air slightly for higher volumetric efficiency and power. Since all fuel being injected goes directly into the cylinder, it can be metered more precisely, promoting cleaner emissions.

DIRECT INJECTION

a fuel injection system wherein fuel is sprayed directly into the combustion chamber, that is, no precombustion chambers or manifold injection.

DISPLACEMENT

the volume of a cylinder displaced by the piston as it moves from TDC to BDC (a complete stroke).

DISTILLATION CURVE

the percentages of gasoline that evaporate at various temperatures. The distillation curve is an important indicator for fuel standards such as volatility (vaporization).

DRIVEABILITY

the degree to which a vehicle operates properly, including starting, running smoothly, accelerating and delivering reasonable fuel mileage.

DRY SLEEVE

a sleeve, that when installed in a cylinder block, does come into contact with coolant.

DTC

see 'diagnostic trouble code',

DUAL-FUEL VEHICLE

vehicle designed to operate on a combination of an alternative fuel and a conventional fuel. This includes (a) vehicles that use a mixture of gasoline or diesel and an alternative fuel in one fuel tank, commonly called flexible-fuel vehicles; and (b) vehicles capable of operating either on an alternative fuel, a conventional fuel, or both, simultaneously using two fuel systems. They are commonly called bi-fuel vehicles.

DURATION

the length of time that a valve remains open, measured in crankshaft degrees.

DWELL TIME

degree of crankshaft rotation during which the primary circuit is on.

DYKEM BLUE

a dye which is painted on a valve seat in order to determine seat concentricity. The valve is inserted into the guide, lightly seated, and rotated about 1/8 in. A continuous blue line should appear all the way around the valve face if the valve and seat are mating properly. Open patches or breaks in the line indicate that the seat is not concentric and the low spots are not making contact.

E85

a mixture of 85% denatured ethanol and 15% gasoline, by volume; an alternative engine fuel.

E93

ethanol mixture that contains 93% ethanol, 5% methanol and 2% kerosene, by volume.

E95

ethanol/gasoline mixture that contains 95% denatured ethanol and 5% gasoline, by volume.

EGR VALVE POSITION SENSOR

a sensor mounted on the EGR valve that signals the engine control computer regarding EGR valve pintle position and EGR flow.

EGR VALVE

see 'exhaust gas recirculation (EGR) valve',

EMBEDABILITY

the ability of the bearing lining material to absorb contaminants.

ENGINE BLOCK

the casting made up of cylinders and the crankcase.

ENGINE CONTROL MODULE (ECM)

the electronic computer that controls engine operation. ECM is synonymous with ECA, ECU, SBEC or SMEC. It is less powerful than the PCM or VCM in that it controls only engine operation.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

a sensor which works by a negative coefficient thermistor that loses resistance as its temperature goes up (just like the intake air temperature sensor). When the computer applies its 5-volt reference signal to the sensor, this voltage is reduced through a ground circuit by an amount corresponding to the temperature of the engine coolant.

ENGINE DISPLACEMENT

the volume displaced by all of the pistons in all of an engine's cylinders.

ENGINE

a device that converts heat energy into mechanical energy.

EQUIVALENCE RATIO

actual air/fuel ratio divided by the stoichiometric air/fuel ratio. An air/fuel mixture is said to be stoichiometric when fuel combustion consumes all of the initial reacting species in going to completion.

ETHANOL

a liquid alcohol made by fermenting sugars derived from starches in plants, such as corn or sugar cane (CH3CH2OH, ethyl or grain alcohol). When denatured (made unfit for human consumption), it can be used as an engine fuel. Can be produced chemically from ethylene or biologically from the fermentation of various sugars from carbohydrates found in agricultural crops and cellulosic residues from crops or wood. Used in the United States as a gasoline octane enhancer and oxygenate, it increases octane 2.5 to 3.0 numbers at 10% concentration. Ethanol also can be used in higher concentration in alternative fuel vehicles optimized for its use.

ETHYL TERTIARY BUTYL ETHER (ETBE)

a fuel oxygenate used as a gasoline additive to increase octane and reduce engine knock.

EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID

"EVAP" canister purging is controlled by the engine control computer, which determines when the canister should be purged based on various sensor inputs. When purging is needed the computer operates the purge solenoid, which controls the vacuum to purge the canister. Generally, the purge solenoid is activated when the engine is running above idle speed and at normal operating temperature.

EVAPORATIVE EMISSION (EVAP) CANISTER PURGE VALVE

a valve on the line between the EVAP canister and the intake manifold. When the engine is running, under certain operating conditions, the valve opens, fresh air is drawn in through the canister air filter and the air and fuel vapors are drawn into the engine and burned, purging the canister.

EVAPORATIVE EMISSION (EVAP) CANISTER

a charcoal-filled container with lines to the top of the fuel tank, to the intake manifold and to the air cleaner. The charcoal element adsorbs fuel vapors from the gas tank and stores them until the engine is running at normal operating temperatures and speeds. Then, a valve between the canister and engine opens, fresh air is drawn in through the canister air filter and the air and fuel vapors are drawn into the engine and burned, purging the canister.

EVAPORATIVE EMISSION (EVAP) SYSTEM

an emission control system that prevents HC emissions from escaping the fuel system to atmosphere.

EVAPORATIVE EMISSIONS

hydrocarbon vapors that escape from a fuel storage tank or a vehicle fuel tank or vehicle fuel system.

EXHAUST AFTERTREATMENT

a method of controlling emissions from internal combustion engines - primarily Nox - by applying air pollution control technologies to engine exhaust (as opposed to treatments applied to the engine's intake air or during in-cylinder combustion stages).

EXHAUST GAS RECIRCULATION (EGR) SYSTEM.

helps prevent the formation of oxides of nitrogen (Nox) by recirculating a certain amount of exhaust as an inert gas through the intake manifold to keep the peak combustion temperatures below what would form those chemical compounds. The computer determines when and how much exhaust to recirculate based on information from all its other sensors. It then actuates the EGR solenoid, which opens a vacuum circuit or operates an electronic circuit or operates an electronic circuit to actually work the EGR valve. The computer uses a duty-cycle (percentage of on-time) signal to activate the solenoid.

EXHAUST GAS RECIRCULATION (EGR) VALVE

component in the EGR system, used to meter a controlled amount of exhaust gas into the intake air stream.

EXHAUST GAS RECIRCULATION (EGR)

an emissions control technique that reuses engine exhaust gases as part of the intake air supply to help reduce harmful emissions (especially Nox).

EXHAUST MANIFOLD

the part of the exhaust system that is fastened to the cylinder head.

EXHAUST PIPE

the pipe between the exhaust manifold and muffler.

EXHAUST PORT

the passage or opening in a four stroke cylinder head for the exhaust valve.

EXHAUST STROKE.

the final stroke in a 4-stroke cycle engine during which the exhaust valve is open and the intake valve is closed, exhausting the combusted gases.

EXHAUST VALVE

poppet valves in the cylinder head that control the flow of exhaust from the engine.

FEEDBACK

a basic concept in the way the engine control system works. 'Feedback' refers to the mechanism whereby the computer is able to measure the Oxygen in the exhaust stream and then modify the amount of fuel injected into the intake manifold to optimize exhaust emissions by keeping the air/fuel ratio at stoichiometry.

FLEXIBLE-FUEL VEHICLE (FFV)

a Vehicle with a common fuel tank designed to run on varying blends of unleaded gasoline with either ethanol or methanol.

FLOATING PIN

a piston pin that moves in the piston and the small end of a connecting rod. It is held in place by retaining clips in the pin bosses.

FLOODING

a condition in which unvaporized fuel in the intake manifold and/or combustion area, prevents the engine from starting.

FLUTTER

as applied to engine valves, refers to a condition wherein the valve is not held tightly on its seat due to a weak valve spring, during the time the cam is not lifting it.

FOOT POUND

a unit of measurement for torque. One foot pound is the torque obtained by a force of one pound applied to a wrench handle that is 12-in. long; a unit of energy required to raise a weight of one pound, a distance of one foot.

FOUR STROKE CYCLE ENGINE

an engine, either gasoline or diesel that uses four strokes: intake, compression, power and exhaust. A firing impulse occurs every two turns of the crankshaft. When this engine is a gasoline engine it is also called an Otto cycle engine after its inventor. A diesel engine is called a Diesel cycle engine for the same reason.

FREEZE PLUG

another name for core plug.

FUEL FLEXIBLE

ability of a vehicle to operate on either (a) a wide range of fuels blends (e.g., blends of gasoline and alcohol) or (b) two different fuels carried aboard the vehicle (e.g., gasoline and compressed natural gas).

FUEL INJECTION

a system that sprays fuel directly into the intake air stream.

FUEL INJECTOR

an electrically-opened nozzle that sprays finely atomized fuel through its aperture into the intake manifold during a cylinder's intake stroke. On some vehicles, these injections are sequential, on others, the injectors are fired all at once or in banks.

FUEL PRESSURE REGULATOR

uses intake manifold vacuum, or more properly intake manifold absolute pressure (MAP), to modify the pressure in the fuel rail. The fuel pump can pump more fuel than the engine can use, so the system routes the extra fuel back to the tank through the fuel pressure regulator.

FUEL PUMP (FP) RELAY

the computer controls the electric fuel pump by energizing the fuel pump relay. It does so by grounding the fuel pump relay coil circuit. The relay then directly supplies power to the fuel pump.

FUEL PUMP

a mechanical or electronic device that draws fuel from the fuel tank and sends it to the carburetor or fuel injection system.

FUEL RAIL

a manifold used to connect fuel injectors to the fuel pump

FUEL SHUTOFF

works by de-energizing the fuel pump relay. This occurs if the engine speed sensor indicates excessive engine speed or if the vehicle speed sensor indicates a certain mph.

FUEL TRIM (STFT / LTFT)

fuel delivery (volume) adjustments based on closed loop feedback. values above the nominal value (0%) indicate increased injector pulse width (IPW); values below 0% indicate decreased injector pulse width. Positive percentages indicate richening air/fuel ratio; negative percentages indicate a leaning air/fuel ratio. Short Term Fuel Trim (STFT) is based on current oxygen sensor switching values. Long Term Fuel Trim (LTFT) is a learned value used to compensate for continual deviation of STFT from the nominal value. For example, if STFT continually signals richening the air/fuel ratio, it will reach a value sufficient to increment the LTFT to a richer value.

FUEL, IGNITION OR SPARK MAP

a multi-dimensional 'map' that correlates engine speed, temperature, load and other factors into a specific spark advance and fuel injection pulse width for that set of conditions. There are several such 'maps' in the computer's hardwired memory. The fine-tuning of the fuel mixture is completed by the signal from the oxygen sensor. On some vehicles, a knock sensor is included to fine-tune the ignition advance to accommodate differences in fuel octane rating and engine wear.

GAS TURBINE

a rotary engine that draws energy from a fuel-air mixture. A compressor raises the pressure and temperature of the inlet air. The air is then moved into a burner, where fuel is injected and combusted to raise the temperature of the air. Power is produced when the heated, high-pressure mixture is expanded and cooled through the turbine.

GASKET

a material such as artificial rubber, cork, or steel used to seal between parts that would otherwise leak fuel, coolant, lubricants or combustion gases.

GLOW PLUG

an electrically heated wire that helps ignite diesel fuel when a compression ignition engine is cold and the compression process may not raise the air to a high enough temperature for ignition.

HARMONIC BALANCER

a device that reduces the torsional or twisting vibration that occurs along the length of the crankshaft in multiple cylinder engines. It is also called a vibration damper.

HEATED OXYGEN SENSOR(HO2S)

an oxygen sensor with a resistance element built into it to shorten the time needed to bring the sensor to operating temperature. Heated oxygen sensors will keep the sensor at operating temperature during idle, low speeds, and in very cold weather. The HO2's heater is on whenever the ignition switch is on.

HEMISPHERICAL COMBUSTION CHAMBER

a combustion chamber shape that resembles a half a globe. The valves are on the sides of the spark plug, which is in the center.

HG

the chemical symbol for the element mercury. Engine vacuum is measured in inches of mercury or in/Hg

HONE

abrasive tool for correcting small irregularities or differences in diameter in a cylinder, such as an engine cylinder or brake caliper; to enlarge or smooth a bore with a rotating tool containing an abrasive material.

HORSEPOWER (HP)

measurement of an engine's ability to perform work. One horsepower is the energy required to lift 550 pounds 1 foot in 1 second.

HOUSING BORE

the machined bore in a block or head where a bearing will be installed.

IDLE AIR CONTROL (IAC) VALVE

controls the amount of air allowed to bypass the closed throttle to keep the engine at the proper idle speed. The computer also controls the idle speed of the engine, depending on engine coolant temperature and the number of accessories such as headlights, air conditioning, etc. that are engaged. The idle air control (lAC) valve controls air flow through a throttle bypass passage by means of a stepper motor, an electric motor that can move to a specific location in its travel. Based on the information from its sensors and the parameters in its memory, the computer sends a duty-cycle (percentage of on-time) signal to the lAC valve motor to open or close the bypass to increase or slow the idle speed. This signal can range from zero to 100 percent, and corresponds to the amount of airflow the computer determines is needed. Displayed on the scan tool as counts or percentage.

IGNITABILITY

characteristic of a solid that enables it to spontaneously ignite. Any liquid with a flash point below 140Ã‚Â°F is said to possess ignitability.

IGNITION COIL

transforms the low 12-volt battery ignition primary current into the high voltage secondary current that fires the spark in the plugs. The current through the primary coil windings builds up an electromagnetic field around the ferrous core of the coil. When the current is suddenly shut off, the electromagnetic field collapses and generates the high voltage in the secondary windings.

IGNITION CONTROL MODULE (ICM)

the computer does not directly operate the ignition coil, because of the comparatively high voltages and currents involved. Instead, it signals the ignition control module when to fire the spark. The (ICM) has a power transistor which turns on the ignition primary circuit to charge the coil by building an electromagnetic field around the ferrous core, and fires the spark by shutting off the current to the primary circuit, al/owing the field to collapse and generate a high voltage spark current in the coil secondary circuit. The ignition control module typically includes additional internal circuits to perform other functions such as calculating dwell. Some modern systems have dwell and timing control in the PCM regulating the ICM to the duties of an on-off switch for the coil.

IGNITION SWITCH

a key operated switch located on the steering column, that connects and disconnects power to the ignition and electrical systems.

IGNITION SYSTEM

the components that produce the spark to ignite the air/fuel mixture in the combustion chamber.

IGNITION TIMING

refers in crankshaft degrees to the position of the piston in the cylinder when the spark occurs.

I-HEAD

a valve arrangement in most modern engines where the valve is positioned above the piston (in the cylinder head). The engine can be either an OHC (overhead cam) or pushrod type.

IMPELLER

commonly referred to as a pump, the impeller is the rear halt ot the torque converter shell that drives the turbine; a driving nember in a turbine or pump.

INCH POUND

one twelfth of a foot pound.

INJECTOR

a device which receives metered fuel under relatively low pressure and is activated either electrically or mechanically to spray the fuel under relatively high pressure into the engine.

INSERT GUIDES

valve guides that are pressed fit in the cylinder head

INSTALLED SPRING HEIGHT

distance from the valve spring seat to the underside of the valve spring retainer.

INSTALLED STEM HEIGHT

distance from the valve spring seat to the stem tip.

INTAKE AIR TEMPERATURE (IAT) SENSOR

works by a negative coefficient thermistor that loses resistance as its temperature goes up (like the engine coolant temperature sensor). When the computer applies its 5-volt reference signal to the sensor, this voltage is reduced through a ground circuit by an amount corresponding to the temperature of the intake air.

INTAKE MANIFOLD

a part with runners that connect the fuel system to the intake valve ports.

INTAKE PORT

the passage or opening in a cylinder head that is closed by the intake valve.

INTAKE STROKE

the first stroke of a 4-stroke cycle engine in which the intake valve is open and the exhaust valve is closed, during which the downward motion of the piston draws the fuel/air mixture into the cylinder.

INTAKE VALVE

also called inlet valve, it closes off the intake port and opens it at the correct time in response to movement from the cam lobe.

INTEGRAL GUIDES

valve guides that are part of the cylinder head.

INTEGRAL SEATS

valve seats that are part of the head.

INTERCOOLER

a component on some turbocharged engines used to cool the compressed intake air.

INTERNAL COMBUSTION ENGINE (ICE)

engine that converts the energy contained in the fuel inside the engine into motion. Combustion engines use the pressure created by the expansion of the gases to do mechanical work.

JET

precisely-sized, calibrated hole in a hollow passage through which fuel or air can pass.

JOURNAL

the bearing surface on a shaft.

KEEPERS

small locks that hold the valve retainer onto the valve stem. Also called split locks.

KNOCK SENSOR(KS)

a sensor used in the engine control system that detects preignition, detonation and knocking. It contains a piezoelectric crystal that produces an AC voltage under vibration.

LAPPING

the process of fitltng one surface to another by rubbing them together with an abrasive material between the two surfaces.

LASH ADJUSTER

a device for adjusting valve lash or maintaining zero lash in certain types of OHC engines. The lash adjuster is stationary in the cylinder head, with one end of a cam follower mounted on top of it. The other end of the follower acts on the valve stem when the camshaft lobe, which is positioned over the center of the follower, pushes the follower down.

LASH

the amount of clearance between components in a geartrain or valvetrain.

LEAN BURN ENGINE

a lean burn engine is designed to operate with a very lean air-fuel ratio during light load conditions. Most modern gasoline engines are controlled to run at a chemically correct (stoichiometric) air fuel ratio (about 14.7:1) to make the three-way catalyst operate at high efficiency, reducing tailpipe emissions. Lean burn engines mix more air with the fuel when full power is not needed, resulting in better fuel economy. Air/fuel ratio in lean burn engines can be as high as 20:1. When full power is needed, such as during acceleration or hill climbing, a lean burn engine reverts to a stoichiometric (14.7:1) ratio or richer.

LIFTER BORES

the holes in an engine block that the litters fit into.

LIFTER

the valvetrain part that rides on the camshaft lobe.

LITER (L)

a metric measurement used to calculate the volume displacement of an engine. One liter is equal to 1,000 cubic centimeters or 61 cubic inches.

LOBE

the eccentric part of the camshaft that moves the lifter.

LOCATING LUG

the tab on a bearing back that fits into the slot in the main or rod bearing bore to locate it properly.

M85

85% methanol and 15% unleaded gasoline by volume, used as a motor fuel in FFVs.

MAF SENSOR

see 'mass airflow sensor'.

MAIN BEARING CAPS

the lower removable lower halves of the main bearing bores.

MAIN BEARING CLEARANCE

the clearance between the main bearing journal and its bearings.

MAIN BEARING JOURNAL

the central, load-bearing points along the axis of a crankshaft, where the main bearings support the shaft in the block.

MAIN BEARING SADDLE BORES

the housings that are machined for main bearings.

MAIN BEARINGS

the plain bearings that support the crankshaft in the engine block.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

a sensor that measures changes in intake manifold pressure resulting from changes in engine load and speed. The pressure in the intake manifold as referenced to a perfect vacuum. Manifold vacuum is the difference between MAP and atmosphere pressure. For example, in a standard atmosphere (sea level) the pressure is 29.92 inches of mercury, 101 kilopascals, or 0 inches of vacuum.

MANIFOLD ABSOLUTE PRESSURE

measure of the degree of vacuum or pressure within an intake manifold.

MANIFOLD VACUUM

relatively low pressure in an engine's intake manifold just below the throttle plate(s). Manifold vacuum is highest at idle and drops during acceleration.

MAP SENSOR

see 'manifold absolute pressure sensor'.

MASS AIRFLOW (MAF) SENSOR

a sensor in a fuel injection system that measures the mass (weight/density) of the incoming air flowing through a meter. The measurement transmitted to the PCM is usually either a frequency or a voltage.

MISFIRE

failure of an explosion to occur in one or more cylinders whiIe the engine is running; can be continuous or intermittent failure.

MISS

a lack of power observed in one or more cylinders, either regularly or intermittently.

MULTI-PORT FUEL INJECTION (MFI)

a fuel injection system in which there is one fuel injector for each cylinder.

MULTIVISCOSITY OIL

chemically-modified oil that has been tested for viscosity at cold and hot temperatures.

MUSHROOM LIFTERS

lifters with contact faces that are wider than the lifter bore. They must be installed through the bottom of the lifter bores, before the cam is installed.

MUSHROOMED VALVE STEM TIP

a folding over of the metal at the tip of the valve stem in response to pounding from too loose a valve adjustment or a defective hydraulic lifter.

NITROGEN OXIDES (NOX)

a by-product of the combustion process when using petroleum-based fuels; one of the primary causes of acid rain and a contributor to global warming.

OHC ENGINE

overhead cam engine. An engine with the camshaft located in the cylinder head.

OIL CLEARANCE

the difference between the inside bearing diameter and the journal's diameter.

OIL GALLERY

a line that supplies oil to areas of the engine block or cylinder head.

OIL GROOVE

a groove machined in the bearing surface that provides a channel for oil flow.

OIL PAN

the part that encloses the crankcase at the lower end of the block.

OIL PRESSURE

the pressure that results from resistance to flow from the oil pump. As the pump turns faster, it produces more flow. A relief valve limits the amount of pressure it can produce.

OIL PUMP PICKUP

the screen that filters and keeps debris out of the oil pump.

OIL PUMP

the pump that circulates lubricating oil throughout the engine, usually driven by the camshaft (by way of the distributor).

OIL RINGS

the bottom ring on the pistons, scrapes excess oil from the cylinder walls to keep it from entering and burning in the combustion chamber.

ON-BOARD DIAGNOSTICS (OBD)

a diagnostic software system in the ECM or PCM that monitors computer inputs, outputs, and resultant engine/transmission operations for failure. OBD-l is thought of as any of the systems in use before OBD-ll , typically 1979 to 1995 systems, although some OEMs started transitioning to OBD-ll in 1994 and 1995. OBD-ll has been a federally mandated system since 1996, it monitors emission control systems for degradation as well as for failures.

OPEN-LOOP FUEL CONTROL

system in which the air/fuel mixture is preset by design with no feedback correction signal to optimize fuel metering.

OSCILLOSCOPE

an instrument that displays electrical activity in the form of line patterns on a screen.

OVERBORE

the dimension by which a machined hole is larger than the standard size.

OVERHEAD CAM (OHC) ENGINE

an engine with the camshaft located in the cylinder head.

OVERHEAD VALVE ENGINE

an I-head engine. The intake and exhaust valves are located in the cylinder head.

OXIDES OF NITROGEN (NOX)

regulated air pollutants, primarily NO and NO2 but including other substances in minute concentrations. Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various Nox. Like hydrocarbons, Nox are precursors to the formation of smog. They also contribute to the formation of acid rain.

OXYGEN SENSOR (O2S)

a sensor that consists of a ceramic zirconium thimble, coated on each side with a very thin film of platinum. Once it reaches operating temperature of 600Ã‚Â°F, the oxygen sensor begins to function as a very low current battery, producing between 0 and 1.0 volt with the output corresponding to the difference in oxygen between the exhaust and the ambient air. The signal from the oxygen sensor enables the computer to keep the air/fuel mixture as close as possible to the stoichiometric mixture. Under normal conditions, the oxygen sensor signal should fluctuate above and below 450 millivolts several times a second while the system is in closed loop.

PARTICULATE TRAP

diesel vehicle emission control device that traps and incinerates diesel particulate emissions after they are exhausted from the engine but before they are expelled into the atmosphere.

PCV SYSTEM

see 'positive crankcase ventilation system'.

PCV VALVE

a part of the positive crankcase ventilation system. Meters crankcase vapors into the intake manifold.

PISTON HEAD

the part of the piston that is above the rings.

PISTON PIN

see 'wrist pin',

PISTON RING

an open-ended ring which fits into a groove on the outer diameter of the piston. Its chief function is to form a seal between the piston and cylinder wall. Most automotive pistons have three rings: two for compression sealing, one for oil sealing.

PISTON SLAP

a noise that result from excessive piston to cylinder wall clearance.

PISTON

the cylindrical component that is attached to the connecting rod and moves up and down in the cylinder bore. The top of the piston forms the bottom of the combustion chamber. When combustion occurs, the piston is forced downward in the cylinder, moving the connecting rod which in turn rotates the crankshaft.

PLASMA-ASSISTED CATALYSIS

a diesel exhaust treatment system that uses a small amount of electricity from the engine to generate a nonthermal plasma (NTP) on a ceramic surface. The resulting reaction can reduce Nox and particulates by up to 90% without onboard chemicals or heating.

PLASTIGAGE

a plastic material that is compressed between a bearing and journal, and the resulting compressed material measured to determine the clearance.

PORT FUEL INJECTION (PFI)

port fuel injection (used spark-ignition engines) have injectors in the intake port near the valve. During the intake stroke, fuel sprayed into the port enters the combustion chamber along with the air charge.

PORT FUEL INJECTION

a fuel injection system that uses one injector at each cylinder, making fuel distribution exactly equal among all the cylinders.

PORTS

valve openings in a cylinder head.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

a system that controls crankcase emissions by using a valve to meter crankcase vapors nto the intake manifold.

POWER STROKE

the third stroke of a four-stroke cycle engine which begins with the combustion of the fuel/air mixture, driving the piston away from top dead center, which then exerts turning force on the crankshaft.

PRECOMBUSTION CHAMBER

a diesel engine design with a small combustion chamber in the cylinder head that contains the fuel injector. The fuel is ignited in this chamber. This design is often used with automotive diesels because of lower combustion pressures and because fuel quality is not as critical.

PREIGNITION

also called ping, it is abnormal combustion of the air/fuel mixture before it is time to do so. A hot surface or carbon deposit in the combustion chamber ignites the air/fuel mixture before the spark plug is fired. The sound of preignition can be heard as the cylinder walls vibrate. Detonation is sometimes confused with preignition.

PRIMARY CIRCUIT

the low-voltage circuit of an ignition system.

PRUSSIAN BLUE

a paste used to determine the contact area between two parts, such as the height of the valve seat on the valve face.

PUMP OCTANE

the octane as posted on retail gasoline dispensers as (R+M)/2; same as Antiknock Index.

PUSH ROD

a rod between the lifter and rocker arm. They are sometimes hollow to allow oil distribution to the valves.

RADIATOR CAP

a device that seals the radiator and maintains a set pressure in the cooling system.

RADIATOR

the part of the cooling system that acts as a heat exchanger, transferring heat to atmosphere. It consists of a core and holding tanks connected to the cooling system by hoses.

REAR MAIN OIL SEAL

a seal that fits around the rear of the crankshaft to prevent oil leaks.

RECIPROCATING

an up and down or back and forth motion.

RIDGE REAMER

a tool used to remove the ridge from the top of a cylinder bore.

RIDGE

a raised area at the top of a cylinder bore created by ring lear. The ridge occurs because the piston ring does not travel all the way to the top of the bore, thereby leaving an unused portion of cylinder bore above the limit of ring travel. This ridge will usually be more pronounced on high mileage engines.

RIDGED HONE

a hone that removes metal and imparts a precise finish and crosshatch to the bore.

RING END GAP

the clearance between the ends of a piston ring when installed in the cylinder bore.

RING FILE

a tool used to trim the ends of a piston ring to bring the ring end gap within specification.

RING LANDS

the raised parts between the piston ring grooves.

ROCKER ARM

a pivot lever mounted on a round shaft or a stud. One end of the rocker arm is applied by the push rod and the other end acts upon the valve stem.

ROCKER SHAFT

a round pipe that is mounted parallel on top of the cylinder head. All of the rocker arms on the head are mounted on it.

ROCKER STUD

a stud that is pressed or threaded into a cylinder head on which the rocker arm is mounted.

SCAN TOOL DATA

Information from the ECM, PCM ,or VCM that is displayed on the scan tool. This data includes component and system values on the data stream, DTCs, and on some systems, freeze frame data, system monitors and readiness monitors.

SEAT

a surface (Usually machined) upon which another part rests or seats (e.g., valve seat).

SEQUENTIAL FUEL INJECTION (SFI)

a fuel injection system that uses one electronically pulsed fuel injector for each cylinder. The injectors are pulsed in firing-order sequence, ordinarily during the engine's intake stroke for that cylinder.

SERPENTINE BELT

a flat, ribbed drive belt that makes multiple angles, driving several components.

SLUDGE

when oil is not changed often enough, moisture and by products of combustion combine in the engine oil to form sludge.

SPARK KNOCK

engine noise caused by abnormal, uncontrolled combustion due to preignition or detonation.

SPARK PLUG

an electrical device that is connected to a high voltage source. The high voltage travels down an electrode inside the spark plug and arcs across an air gap, thereby creating the spark that starts the combustion process in the combustion chamber.

SPARK-IGNITION (SI) ENGINE

an internal combustion engine in which the fuel mixture is ignited electrically. A spark-ignition engine runs on an Otto cycle - most gasoline engines run on a modified Otto cycle. This cycle uses a homogeneous air-fuel mixture that is combined before it enters the combustion chamber. Once in the combustion chamber, the mixture is compressed, then ignited by a spark plug (spark ignition). The engine is controlled by limiting the amount of air allowed inside through the use of a throttling valve placed on the air intake (carburetor or throttle body).

STOICHIOMETRIC.

chemically correct. An air/fuel mixture is considered stoichiometric when it is neither too rich nor too lean; an ideal mixture is composed of 14.7 parts air to one part fuel.

STROKE

the distance the piston moves from TDC to BDC.

SUPERCHARGER

a compressor, mechanically driven by the engine's crankshaft, that pumps air into the intake manifold.

SWIRL COMBUSTION

a swirling of the air/fuel mixture in a corkscrew pattern that improves combustion.

TAILPIPE EMISSIONS

EPA-regulated vehicle exhaust emissions released through the vehicle tailpipe. Tailpipe emissions do not include evaporative and refueling emissions, which are also regulated by EPA. EPA publishes allowable emission levels and vehicle certification standards in the Code of Federal Regulations.

TDC

see 'top dead center'.

TETRAETHYL LEAD OR LEAD

an octane enhancer. One gram of lead increases the octane of one gallon of gasoline about 6 numbers. The EPA has phased down the use of lead in gasoline as it has been determined to be a health hazard. Lead has been prohibited in highway vehicle gasoline since January 1, 1996.

THREE-WAY CATALYTIC CONVERTER (TWC)

a catalytic converter system that reduces exhaust gas emission levels. Usually consists of two beds of catalyst, the upstream bed (reduction bed) reducing Nox emissions to nitrogen and oxygen and the downstream bed (oxidation bed) reducing HC and CO emissions to CO2, 02, and H2O.

THROTTLE BODY INJECTION (TBI)

also called central fuel injection, it has an intake manifold like that used with a carburetor. One or more fuel injectors are mounted in the throttle body, which resembles a carburetor in physical appearance.

THROTTLE POSITION (TP) SENSOR

a potentiometer that is mechanically connected to the throttle shaft of the throttle body assembly. It provides an input to the vehicle computer control system regarding throttle position. The TP sensor reduces the 5-volt reference voltage supplied by the computer to an amount corresponding to the degree to which the driver is holding the throttle open by foot.

THROTTLE VALVE (TV) PRESSURE.

in an automatic transmission, line pressure that passes through the valley of the throttle pressure spool valve.

TIMING BELT

a toothed reinforced belt used to drive the camshaft from a sprocket on the crankshaft.

TIMING CHAIN

a chain that drives the camshaft from a sprocket on thecrankshatt.

TIMING GEARS

gears that drive the camshaft from the crankshaft.

TIMING

refers in crankshaft degrees to the position of the piston in the cylinder. When referring to camshaft timing, it is when the valves open. When referring to ignition timing, it is when the spark occurs.

TOP DEAD CENTER (TDC)

the position of the crankshaft for a specific cylinder when the piston is at the highest point in its vertical travel on the compression stroke.

TORQUE

the turning force produced by an engine.

TORQUE-TO-YIELD HEAD BOLTS

head bolts that are often not reusable. They are torqued into yield, which means that they have purposely stretched beyond the point where they will return to their original length. This provides more uniform clamping force.

TP SENSOR

see 'throttle position sensor'.

TURBINE

machine for generating rotary mechanical power from the energy in a stream of fluid. The energy, originally in the form of head or pressure energy, is converted to velocity energy by passing through a system of stationary andmoving blades in the turbine.

TURBOCHARGER

an exhaust driven pump which compresses intake air and forces it into the combustion chambers at higher than atmospheric pressure. The increased air pressure allows more fuel to be burned and results in increased horsepower being produced.

UMBRELLA TYPE VALVE SEALS

valve guide seals that fit tightly on the valve stem. They move up and down with the valve stem acting like an umbrella to shield oil away.

VACUUM ADVANCE

a distributor mounted mechanism that controls spark advance in response to engine vacuum.

VALVE COVER

an enclosure fastened to the top of a cylinder head, over the valvetrain.

VALVE DURATION

the length of time, in degrees of crankshaft rotation, that a valve is open.

VALVE FACE

the area of the valve that contacts the valve seat.

VALVE FLOAT

when valves remain open, usually at high rpm, due to weak or broken valve springs.

VALVE GUIDE KNURLING

a method of refinishing the inside of a valve guide by restoring its original size. This method can be used on guides worn less than 0.007-in.

VALVE GUIDE LINER

a thin bronze bushing installed in a valve guide to restore it to original size.

VALVE GUIDE

a bore in the cylinder head that the valve stem fits into.

VALVE KEEPERS

small locks that hold the valve retainer onto the valve stem. Also called split locks.

VALVE LASH

the amount of clearance in the valvetrain when the lifter is on the base circle of the camshaft lobe.

VALVE LIFT

the distance from the valve seat when the valve is fully open.

VALVE LIFTER

a small cylinder that fits into a bore above the cam lobe. It acts on a push rod and rocker arm to open the valve.

VALVE ROTATOR

a part found at the end of some valve springs that rotates the valve each time it opens. This aids in providing even cooling to the valve.

VALVE SEAL

a seal located over the valve stem, used to prevent oil from leaking down the valve guide and into the combustion chamber.

VALVE SEAT

the machined surface that the valve face seats against.

VALVE SPRING COMPRESSOR

a tool used to compress the valve spring on a cylinder head. When the valve spring is compressed, the valve keepers can be removed, then the spring is released and the spring, valve spring retainer and valve can be removed from the cylinder head.

VALVE SPRING INSTALLED HEIGHT

the specified distance between the machined spring seat on the cylinder head to the underside of the valve spring retainer. Both grinding the valve and grinding the valve seat result in an increase in this dimension. A shim can be installed under the spring to restore the original installed height for proper spring tension.

VALVE SPRING RETAINER

the part that connects the valve spring to the valve and holds the valve against the cylinder head. It is held to the valve by keepers.

VALVE SPRING SEATS

metal shims used, usually on aluminum cylinder heads, to protect the head from the bottom of the valve spring.

VALVE SPRING

a small coil spring used to keep the valve closed against the valve seat.

VALVE STEM

the part of the valve that is inside the valve guide.

VALVE TIMING

set rotations of the camshaft and crankshaft to open/close valves at proper intervals during the piston strokes for optimal operation of an engine.

VALVE TRAIN GEOMETRY

the dynamic relationship between the rocker arm and valve stem during the time when the valve is opening and closing.

VALVETRAIN

parts that convert camshaft movement to valve movement. These include the camshaft, cam timing parts, lifters or cam followers, push rods, rocker arms, valve and spring.

VARIABLE FUEL VEHICLE (VFV)

a vehicle that has the capacity of burning any combination of gasoline and an alternative fuel. Also known as a flexible-fuel vehicle.

VARIABLE VALVE TIMING

variable valve timing allows the point at which an engine's valves open and close to change with operating conditions - such as engine speed and throttle position. In addition to changing the valve timing with respect to the crankshaft, some systems also change the duration the valve is open and the extent to which it opens. Varying these parameters allows the engine to operate more efficiently at all engine speeds while maintaining driveability.

VIBRATION DAMPER

see 'harmonic balancer'.

WASTEGATE

a valve used to limit the boost developed in a turbocharger. A wastegate allows some of an engine's exhaust flow to bypass the turbocharger's turbine under certain conditions.

WATER JACKET

also called a cooling jacket, it is the hollow area of a casting designed for coolant flow.

WET SLEEVE

a sleeve, which when installed in a cylinder block, is exposed to coolant.

WRIST PIN

a hollow metal tube that secures the piston to the connecting rod and allows the piston to swivel on the rod. Also called a piston pin.

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Exhaust Systems

EXHAUST SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

EXHAUST SYSTEMS

WARNING: **Federal EPA rules prohibit altering an exhaust system in any way that defeats the emission reduction components of a vehicle. Be sure to review and adhere to EPA policy on removing and replacing catalytic converters. Where state or local laws are stricter, they take precedence over these guidelines.**

NOTE: **Some exhaust systems are of a welded design. It is not required that the entire system be replaced. Determine the need to replace individual components based on conditions of component.**

CATALYTIC CONVERTERS

Condition	Code	Procedure
Air injection tube broken	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube burnt	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube leaking	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube loose	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube restricted	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube threads damaged	A	Require repair or replacement of injection tube or replacement of catalytic converter
Air injection tube threads stripped (threads missing)	A	Require repair or replacement of injection tube or replacement of catalytic converter
Body Cracked	B	Require repair or replacement
Converter empty	A	Require repair or replacement
Converter fill plug missing	C	Require repair or replacement
Converter missing	C	Require repair or replacement
Exhaust gases leaking	A	Require repair or replacement
Flanges leaking	A	Require repair or replacement of flanges
Inlet pipes cracked	B	Require repair or replacement
Internal rattle (except pellet-type)	2	Further Inspection required
NOTE: **If the converter is breaking up, suggest converter replacement. If an object has fallen into the converter, remove object**		
Mounting brackets that are part of converter broken	A	Require repair or replacement
Obvious overheating	Require testing of converter	

Condition	Code	Procedure
NOTE: **Overheating is caused by something other than the converter. Further diagnosis is required to determine the cause of the overheating.**		
Outlet pipes cracked	B	Require repair or replacement
Pieces of catalyst material found downstream	1	Suggest replacement
Plugged	A	Require replacement
NOTE: **Determine cause and correct to ensure that new converter will not become plugged.**		
Testing has determined that existing converter has been lead-poisoned, contaminated or failed testing	A	Require repair or replacement

EXHAUST AND TAIL PIPES

Condition	Code	Procedure
Broken bracket	A	Require repair or replacement
Pipe Bent Out Of Position	B	Require repair or replacement
Pipe Broken	A	Require repair or replacement
Pipe Cracked	B	Require repair or replacement
Pipe Leaking	A	Require replacement
Pipe Missing	C	Require replacement
Pipe Plugged	A	Require replacement
Pipe Weak Due To Corrosion, But No Leaks Present	1	Suggest replacement
Weld Broken	A	Require repair or replacement

EXHAUST CONNECTIONS

Condition	Code	Procedure
Attaching hardware Incorrect	B	Require replacement of hardware
Clamp broken	A	Require replacement
Clamp Loose	A	Require repair or replacement
Clamp missing	C	Require replacement
Corroded, affecting structural integrity	1	Suggest replacement
Incorrect type (i.e. Flange, Ball & Socket, etc.)	B	Require replacement
Leaking	A	Require repair
Loose	A	Require repair

HANGERS

Condition	Code	Procedure
Broken	A	Require replacement
Corroded, affecting structural integrity	1	Suggest replacement
Incorrect type	B	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Out of position	B	Require repair or replacement

Condition	Code	Procedure
Rubber deteriorated	1	Suggest replacement

HEAT RISERS (MECHANICAL EFE DEVICES)

Condition	Code	Procedure
Broken	A	Require replacement of affected parts
Diaphragm Inoperative	A	Require replacement
NOTE: **If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heatriser**		
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement of affected parts
Seized	A	Require repair or replacement of affected parts
Spring broken	B	Require replacement of spring(s)
Spring Inoperative	A	Require replacement of spring(s)

HEAT SHIELDS

Condition	Code	Procedure
Bent, affecting performance	B	Require repair or replacement
Broken	A	Require replacement
Corroded affecting structural integrity	1	Suggest replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement

MANIFOLDS (CAST AND TUBE TYPE)

Condition	Code	Procedure
Air injection tube in manifold broken	A	Require repair or replacement of injection tube or replacement of manifold
Air injection tube in manifold corroded, affecting structural integrity	1	Suggest replacement of Injection tube or manifold
Air injection tube in manifold leaking	A	Require repair or replacement of injection tube or replacement of manifold
Air injection tube in manifold loose	A	Require repair
Air injection tube in manifold restricted	A	Require replacement of injection tube or manifold
Air injection tube in manifold threads damaged	A	Require repair of injection tube or manifold
Air injection tube in manifold threads stripped (threads missing)	A	Require replacement of injection tube or manifold
Bolt Broken	A	Require replacement of bolt(s)

Condition	Code	Procedure
Bolt Loose	A	Require tightening or replacement of bolt(s)
Bolt Missing	C	Require replacement of bolt(s)
Corroded, affecting sealability	A	Require repair or replacement
Cylinder head threads stripped	A	Require repair or replacement of cylinder head
Gasket leaking	A	Require tightening or replacement of gasket
Heat Stove Bent	B	Require Repair Or Replacement of Stove
NOTE: **Stove may not be available separately. This may require replacement of manifold.**		
Heat Stove Broken	A	Require replacement of stove
NOTE: **Stove may not be available separately. This may require replacement of manifold.**		
Heat Stove Corroded, Affecting Structural Integrity	1	Suggest replacement of stove
NOTE: **Stove may not be available separately. This may require replacement of manifold.**		
Heat Stove Missing	C	Require replacement of stove
NOTE: **Stove may not be available separately. This may require replacement of manifold.**		
Manifold Broken	A	Require repair or replacement
Manifold Cracked	B	Require repair or replacement
Manifold Warped	A	Require repair or replacement
Out of specification	B	Require repair or replacement
Stud broken	A	Require replacement of stud
Stud missing	C	Require replacement of stud
Stud threads damaged	A	Require Repair Or Replacement of Stud
Stud threads stripped (threads missing)	A	Require replacement of stud

MECHANICAL EFE DEVICES

Condition	Code	Procedure
Broken	A	Require replacement of affected parts
Diaphragm Inoperative	A	Require replacement
NOTE: **If the inoperative diaphragm is separate from the heat riser, then require replacement of the inoperative diaphragm. If the inoperative diaphragm is part of the heat riser, then replace the heatriser**		
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement of affected parts
Seized	A	Require repair or replacement of affected arts

Condition	Code	Procedure
Spring broken	B	Require replacement of spring(s)
Spring Inoperative	A	Require replacement of spring(s)

MUFFLER VALVE

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
NOTE: **It may be necessary to replace the muffler assembly to correct this condition.**		

MUFFLERS AND RESONATORS

Condition	Code	Procedure
Body shell distorted, affecting performance or structural integrity	A	Require replacement
Corrosion Hole	A	Require replacement
Missing	C	Require replacement
Mounting bracket broken	A	Require repair or replacement
Mounting bracket cracked	B	Require repair or replacement
Nipple Cracked	A	Require repair or replacement
Nipple Loose	B	Require replacement
Outer wrap peeling (Exhaust Not Leaking)	1	Suggest replacement
Plugged	A	Require replacement
Puncture (other than drain hole)	A	Require replacement
Rattling or knocking noise from inside muffler	B	Require replacement
Seam open (exhaust leaking)	A	Require replacement
Sound quality unsatisfactory	2	Suggest replacement to address customer need and/or request
Split (exhaust leaking)	A	Require replacement
NOTE: **Further diagnosis required to determine cause of the split seam (i.e. Backfiring).**		
Weak due to corrosion, but no leaks present	1	Suggest replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer

Code	Reason
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Heating, Ventilation And Air Conditioning Systems

HEATING, VENTILATION & AIR CONDITIONING SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

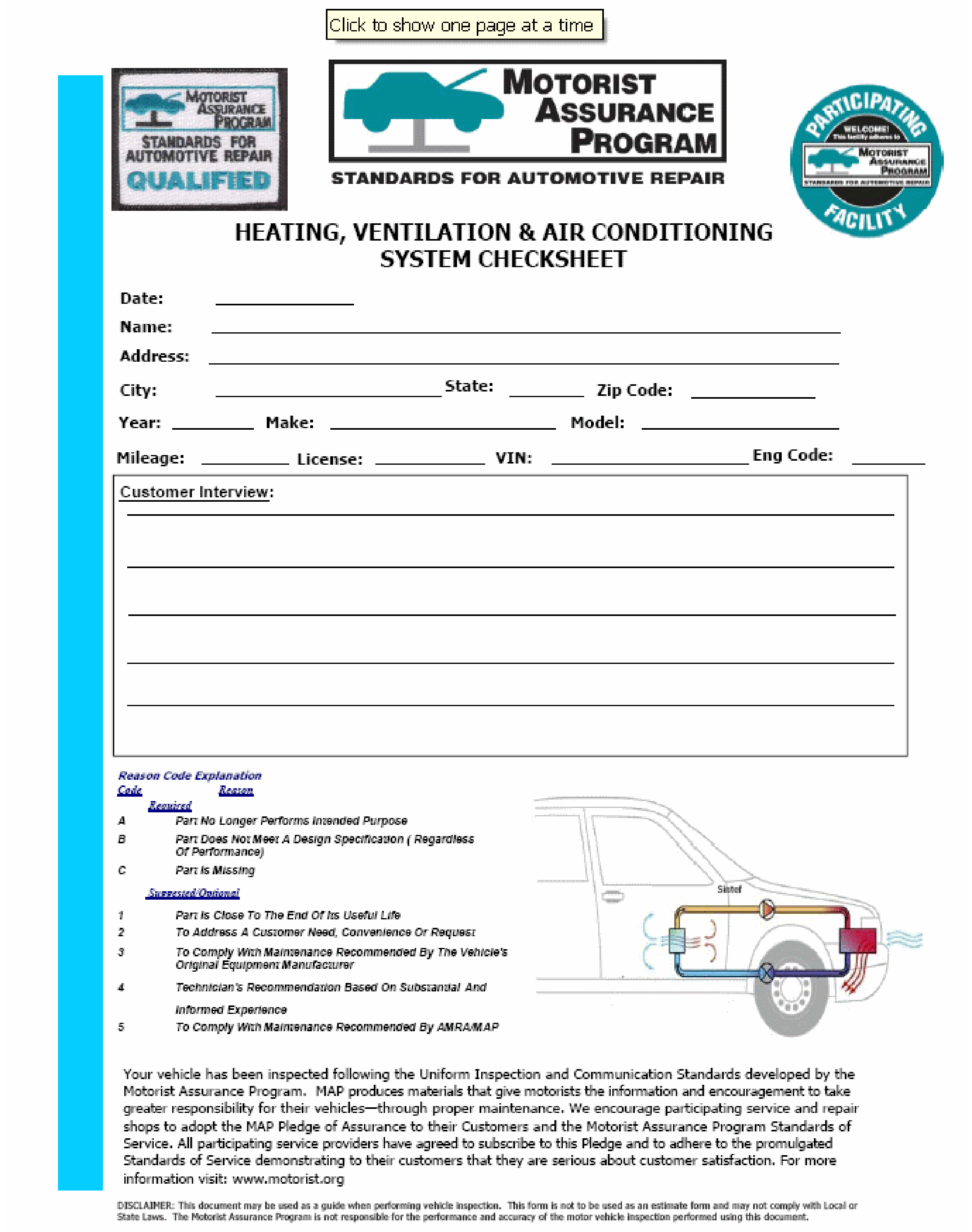
A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	**Reasons to Suggest Repair or Replacement**
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

HEATING, VENTILATION & AIR CONDITIONING SYSTEM CHECKSHEET



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MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
QUALIFIED
MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
PARTICIPATING
WELCOME! This facility adheres to
MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
FACILITY
Sistef

HEATING, VENTILATION & AIR CONDITIONING
SYSTEM CHECKSHEET

Date: ____________

Name: ____________

Address: ____________

City: ____________ State: ________ Zip Code: ____________

Year: ________ Make: ____________ Model: ____________

Mileage: ________ License: ________ VIN: ____________ Eng Code: ________

Customer Interview:

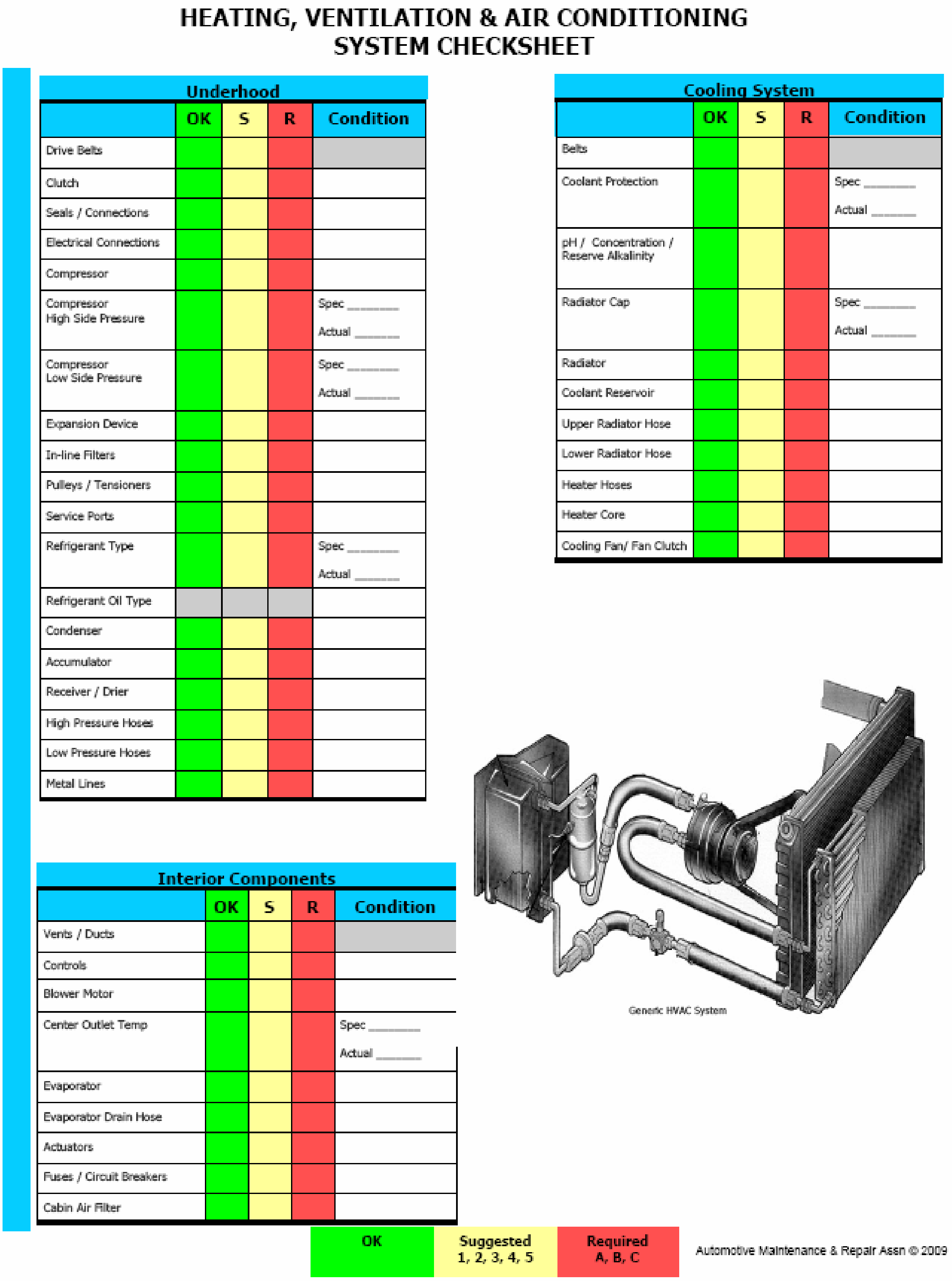
Reason Code Explanation

Code	*Reason*
Required	
A	*Part No Longer Performs Intended Purpose*
B	*Part Does Not Meet A Design Specification (Regardless Of Performance)*
C	*Part Is Missing*
Suggested/Optional	
1	*Part Is Close To The End Of Its Useful Life*
2	*To Address A Customer Need, Convenience Or Request*
3	*To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer*
4	*Technician's Recommendation Based On Substantial And Informed Experience*
5	*To Comply With Maintenance Recommended By AMRA/MAP*

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 1: Heating, Ventilation & Air Conditioning System Checksheet (1 Of 2)



HEATING, VENTILATION & AIR CONDITIONING
SYSTEM CHECKSHEET

Underhood

	OK	S	R	Condition
Drive Belts				▨
Clutch				
Seals / Connections				
Electrical Connections				
Compressor				
Compressor High Side Pressure				Spec _______ Actual _______
Compressor Low Side Pressure				Spec _______ Actual _______
Expansion Device				
In-line Filters				
Pulleys / Tensioners				
Service Ports				
Refrigerant Type				Spec _______ Actual _______
Refrigerant Oil Type	▨	▨	▨	
Condenser				
Accumulator				
Receiver / Drier				
High Pressure Hoses				
Low Pressure Hoses				
Metal Lines				

Cooling System

	OK	S	R	Condition
Belts				▨
Coolant Protection				Spec _______ Actual _______
pH / Concentration / Reserve Alkalinity				
Radiator Cap				Spec _______ Actual _______
Radiator				
Coolant Reservoir				
Upper Radiator Hose				
Lower Radiator Hose				
Heater Hoses				
Heater Core				
Cooling Fan/ Fan Clutch				

Generic HVAC System

Interior Components

	OK	S	R	Condition
Vents / Ducts				▨
Controls				
Blower Motor				
Center Outlet Temp				Spec _______ Actual _______
Evaporator				
Evaporator Drain Hose				
Actuators				
Fuses / Circuit Breakers				
Cabin Air Filter				

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

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Fig. 2: Heating, Ventilation & Air Conditioning System Checksheet (2 Of 2)

HEATING, VENTILATION & AIR CONDITIONING SYSTEMS

NOTE: AIR CONDITIONING SYSTEM FLUSHING utilizes chemicals or refrigerant to remove oil, debris and contaminants from the evaporator, condenser, hoses or metal lines.

NOTE: An INLINE FILTER, both high and low side, protects a/c components from residual debris in the system. An inline filter or suction screen is suggested when a condenser, evaporator, compressor, expansion valve, accumulator/drier, hoses or metal lines is replaced, or if debris is found in the system during an a/c repair. An inline filter is suggested to help prevent future component damage and increase system longevity.

ACCUMULATORS

Condition	Code	Procedure
NOTE: **When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).**		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Beyond vehicle manufacturer's service interval	3	Suggest replacement
Desiccant at the end of its useful life (saturated with moisture)	1	Suggest repair or replacement
Desiccant bag deteriorated	A	Require replacement. Further inspection required
NOTE: **Inspect system to determine effects of desiccant bag deterioration.**		
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement

ACTUATORS (ELECTRICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

ACTUATORS (VACUUM)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking (vacuum)	A	Require repair or replacement
Linkage bent, affecting performance	A	Require repair or replacement of linkage
Linkage bent, not affecting performance	2	Suggest repair or replacement of linkage
Linkage binding, affecting performance	A	Require repair or replacement of linkage
Linkage binding, not affecting performance	1	Suggest repair or replacement of linkage
Linkage broken	A	Require repair or replacement of linkage
Linkage loose, affecting performance	A	Require repair or replacement of linkage
Linkage loose, not affecting performance	1	Suggest repair or replacement of linkage
Linkage missing	C	Require replacement
Linkage noisy	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement

AIR CONDITIONING FITTINGS

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	A	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

AIR CONDITIONING HOSES

NOTE: **When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).**

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	A	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

AIR CONDITIONING METAL LINES

NOTE: **When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).**

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	A	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

AIR CONTROL DOORS

Condition	Code	Procedure

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

AIR DAMS (EXTERNAL)

Condition	Code	Procedure
Application incorrect, affecting air conditioning system performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting air conditioning system performance	A	Require repair or replacement
Blocked, affecting air conditioning system performance	A	Require repair or replacement
Broken, affecting air conditioning system performance	A	Require repair or replacement
Cracked, affecting air conditioning system performance	A	Require repair or replacement
Loose, affecting air conditioning system performance	A	Require repair
Loose, not affecting air conditioning system performance	2	Suggest repair
Missing, affecting air conditioning system performance	C	Require replacement

AIR DISTRIBUTION SYSTEM

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

BLEND DOORS

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement

Condition	Code	Procedure
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

BLOWER FANS (BLOWER WHEEL OR SQUIRREL CAGE)

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Cracked	B	Require replacement
Distorted	A	Require replacement
Fins missing	C	Require replacement
Hub separated	A	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Mounting loose	A	Require repair or replacement
Noisy	2	Suggest replacement
Out of balance	A	Require repair or replacement

BLOWER MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Current draw out of specification	B	Require repair or replacement
Inoperative	A	Require replacement

Condition	Code	Procedure
NOTE: **Check fan motor/controls. Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Motor speed insufficient	2	Suggest repair or replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

BLOWER RESISTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware,
Attaching hardware not functioning	A	Require repair or replacement of hardware
Conductor exposed	A	Require replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	1	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Insulation overheated	A	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

BLOWER SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
NOTE: **Missing includes high pressure cut-off switches not installed during a retrofit from R12 to 134a.**		
Out of adjustment	B	Require repair or replacement
Pressure switch leaking	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

CABIN AIR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Insulation damaged, conductors exposed	A	Suggest repair or replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

COMPRESSOR CLUTCH ASSEMBLIES

Condition	Code	Procedure
Air gap incorrect	B	Require repair or replacement

Condition	Code	Procedure
Bearing seized	A	Require replacement of bearing or assembly
Bearing worn, affecting performance	A	Require replacement of bearing or assembly
Coil shows signs of overheating	1	Suggest replacement of coil
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Hub broken	A	Require replacement
Hub cracked	B	Require replacement
Hub loose on shaft	A	Require replacement
Hub scored, affecting performance	A	Require replacement
Hub warped, affecting performance	A	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Noisy	2	Suggest repair or replacement
Slips	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Will not disengage	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

COMPRESSORS

NOTE: **When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Housing broken, affecting performance	A	Require repair or replacement
Housing broken, not affecting performance	Â	No service suggested or required
Housing cracked, affecting performance	A	Require repair or replacement
Housing cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
NOTE: **Compressor noise can also be caused by low oil level, state of charge, air contamination, or type of refrigerant.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CONDENSER AIR SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement

CONDENSER FAN MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Hydraulic fan motor leaking	A	Require repair or replacement
Inoperative	A	Require replacement
NOTE: **Check fan motor/controls. Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement

Condition	Code	Procedure
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CONDENSERS

NOTE: **When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).**

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Air flow obstruction, affecting performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	Â	No service suggested or required
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Restricted internally	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Circuit open	A	Require repair or replacement
Circuit resistance (voltage drop) out of specification	A	Require repair or replacement

Condition	Code	Procedure
Circuit shorted	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Diode open	A	Require repair or replacement
Diode shorted	A	Require repair or replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Protective shield (conduit) melted	2	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

CONTROL CABLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket Corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require repair or replacement
Cracked	2	Suggest repair or replacement
Disconnected	A	Require repair or replacement
Kinked	2	Suggest repair or replacement
Melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Out of adjustment	B	Require repair or replacement
NOTE: **Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.**		
Routed incorrectly	B	Suggest repair
Seized	A	Require repair or replacement

CONTROL HEADS (FUNCTION SELECTORS)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	2	Suggest require replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
Melted, not affecting performance	Â	No service suggested or required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement

CONTROL LINKAGES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent, affecting performance	A	Require repair or replacement
Binding	A	Require repair or replacement
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Broken	A	Require replacement
Cracked	B	Require repair or replacement
Disconnected	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Out of adjustment	B	Require repair or replacement
NOTE: **Follow OEM recommended adjustment procedures. Require repair or replacement if out of specification.**		
Seized	A	Require repair or replacement

CONTROL MODULES

NOTE: **Includes, but not limited to: IRCM, Coolant Fan Control Module (CFCM), AC Controller, Amplifier, Programmers, Control Heads, Power Modules, etc.**

Condition	Code	Procedure

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Code set (if applicable)	A	Further inspection required
NOTE: **Refer to manufacturer's diagnostic trouble code procedure and require repair or replacement of affected component(s).**		
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement. Check for accepted cleaning procedure.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

COOLANT

Condition	Code	Procedure

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement
Contaminated	B	Require replacement or recycling. Further inspection required
NOTE: **Determine source of contamination and require correction prior to coolant replacement.**		
Fluid discolored	Â	No service suggested or required
NOTE: **Further testing necessary to determine condition of fluid.**		
Level incorrect	B	Require filling to proper level
NOTE: **Determine source of incorrect level and suggest repair.**		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

COOLING FAN BLADES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bent	A	Require replacement
Broken	A	Require replacement
Cracked	B	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement

COOLING FAN CLUTCHES

NOTE: **Some lateral movement, measured at the fan blade tip, may be normal.**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing noisy	A	Require replacement
Bearing worn	A	Require replacement
Fastener loose	A	Require repair or replacement of fastener
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Suggest replacement

Condition	Code	Procedure
Seized	A	Require replacement
Slips (insufficient fan speed)	A	Require replacement
Thermal control incorrect	B	Require repair or replacement

COOLING FAN MOTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Hydraulic fan motor leaking	A	Require repair or replacement
Inoperative	A	Require replacement
NOTE: **Check fan motor/controls. Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Noisy	2	Suggest replacement
Rotation incorrect for application	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

EVAPORATOR DRAIN TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require replacement
Missing	C	Require replacement

Condition	Code	Procedure
Restricted	A	Require repair or replacement
Routed incorrectly	B	Require repair

EVAPORATOR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

EVAPORATOR PRESSURE REGULATORS (EPRS)

Condition	Code	Procedure
Inoperative	A	Require repair or replacement

NOTE:

Inoperative includes intermittent operation.

EVAPORATORS

NOTE: **When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component damage (see Code 5).**

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Air flow obstruction, affecting performance	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Evaporator foam seal leaking	A	Require replacement
Evaporator foam seal missing	C	Require replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Leaking	B	Require repair or replacement

Condition	Code	Procedure
Microbial growth causing odor	2	Suggest microbial odor removal
NOTE: **If the evaporator case is contaminated with debris, it may be necessary to remove the debris before applying microbial odor treatment.**		
Restricted internally	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

EXPANSION VALVES

NOTE: **Expansion valves indicated for use on R134a systems are acceptable for R12 systems.**

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded internally	1	Suggest replacement
Filter screen torn	A	Require replacement of screen
Inoperative	A	Require repair or replacement
NOTE: **Expansion valve operation may be affected by capillary tube location, corrosion, and insulation tape. Inoperative includes intermittent operation.**		
Leaking	B	Require replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

FUNCTION SELECTORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	2	Suggest require replacement
Leaking	B	Require repair or replacement

Condition	**Code**	**Procedure**
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	Â	No service suggested or required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

Condition	**Code**	**Procedure**
Application incorrect	B	Require replacement
Blown	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Insulation damaged, conductors exposed	A	Suggest repair or replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

FUSIBLE LINKS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Insulation damaged, conductors exposed	A	Suggest repair or replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

HEATER CASES

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Microbial growth causing odor	2	Suggest microbial odor removal
NOTE: **If the heater case is contaminated with debris, it may be necessary to remove the debris before applying microbial odor treatment.**		
Noisy	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

HEATER CONTROL VALVES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding	2	Suggest repair or replacement
Coolant leak	A	Require repair or replacement
Disconnected	A	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Seized	A	Require repair or replacement
Vacuum leak	A	Require repair or replacement

HEATER CORES

Condition	Code	Procedure
Air flow obstruction	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Disconnected	A	Require repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required

Condition	Code	Procedure
Internal restrictions, affecting performance	A	Require repair or replacement
Leaking	B	Require repair or replacement
Missing	C	Require replacement

HEATER HOSES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require repair or replacement
Hard (brittle)	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest repair
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracks (dry-rotted)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

HIGH PRESSURE RELIEF VALVES (HPRV)

Condition	Code	Procedure
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

IDLERS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Bracket cracked	A	Require repair or replacement
Housing cracked	A	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

IN-LINE FILTERS

Condition	Code	Procedure
Connection leaking	A	Require repair or replacement
Leaking	B	Require repair or replacement
Restricted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

METAL FITTINGS

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	B	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	B	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

METAL LINES

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	Â	No service suggested or required
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
Connected incorrectly	A	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	Â	No service suggested or required
Cracked	B	Require repair or replacement
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

MIX AND AIR CONTROL DOORS (BLEND DOORS)

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair

Condition	Code	Procedure
Restricted	A	Require cleaning, repair, or replacement

ORIFACE TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Bypassing internally	A	Require repair or replacement
Filter screen torn	A	Require replacement
Installation incorrect	B	Require repair
Restricted	A	Require repair or replacement

O-RINGS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

PILOT-OPERATED ABSOLUTES (POAS)

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement
Fitting damaged	B	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Threads stripped (threads missing)	A	Require replacement

PLENUMS

Condition	Code	Procedure
Air control door binding	A	Require repair or replacement
Air control door broken	A	Require repair or replacement
Air control door leaking	A	Require repair or replacement
Air control door seized	A	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	2	Suggest repair or replacement
Drain hole restricted	A	Require repair
Drain plugged	A	Require repair
Duct disconnected	A	Require repair or replacement
Duct leaking	A	Require repair or replacement
Duct missing	C	Require replacement
Duct restricted	A	Require repair or replacement

Condition	Code	Procedure
Leaking	B	Require repair or replacement
Noisy	2	Suggest cleaning or repair
Odor	2	Suggest cleaning or repair
Restricted	A	Require cleaning, repair, or replacement

PRESSURE CONTROL VALVES

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement
Fitting damaged	B	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

PRESSURE SENSORS

NOTE: **Includes, but not limited to, In-Car Temperature, Ambient Air Temperature, Sun Load Sensor, etc.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Calibration incorrect	B	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

PULLEYS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing noisy	2	Suggest replacement
Bearing seized	A	Require repair or replacement
Bearing worn	1	Suggest replacement
Cracked	B	Require replacement
Loose	B	Require repair or replacement
Missing	C	Require replacement
Pulley damaged, affecting belt life	A	Require replacement

RADIATORS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Drain inoperative	A	Require repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal oil cooler leaking	A	Require repair or replacement
Internal restrictions	B	Require repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

RECEIVER-DRIERS

NOTE: **For VIRs, see Valves in Receiver (VIRs). When replacing this component it is suggested to install or replace high and low side inline filters to prevent future component**

Condition	Code	Procedure
damage (see Code 5).	Â	Â
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Contaminated, affecting performance	A	Require replacement
Desiccant at the end of its useful life (saturated with moisture)	1	Suggest repair or replacement
Desiccant bag deteriorated	A	Require replacement. Further inspection required
NOTE: **Inspect system to determine effects of desiccant bag deterioration.**		
Fusible plug leaking	A	Require replacement of plug
Leaking	B	Require replacement
Pressure relief device leaking	A	Require replacement of pressure relief device
Restricted	A	Require repair or replacement
Sight glass no longer transparent	2	Suggest replacement of drier
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement

REFRIGERANT OIL

Condition	Code	Procedure
Contaminated	A	Require repair or replacement
Overfilled	B	Require repair
Underfilled	B	Require repair

REFRIGERANT

NOTE: **Refrigerants include any SNAP (Significant New Alternative Policy)-approved blends.**

Condition	Code	Procedure
Contaminated (other than refrigerant blends)	B	Require service to remove contamination
Different types of refrigerants in the same system (other than refrigerant blends)	B	Require repair
Overcharged	B	Require repair
Refrigerant type does not match fittings and label	B	Require repair
Undercharged	B	Require repair

RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement

Condition	Code	Procedure
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SEALS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

SERVICE PORTS

Condition	Code	Procedure
Application does not match refrigerant type	B	Require replacement
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Valve cap leaking	A	Require repair or replacement of cap
Valve cap missing	C	Require replacement of valve cap
Valve core sticking	B	Require repair or replacement

SPRING LOCK COUPLINGS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

SUCTION THROTTLING VALVES (STVS)

Condition	Code	Procedure
Connection damaged	B	Require repair or replacement
Fitting damaged	B	Require repair or replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SWITCHES (ELECTRICAL)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Missing	C	Require replacement
NOTE: **Missing includes high pressure cut-off switches not installed during a retrofit from R12 to 134a.**		
Out of adjustment	B	Require repair or replacement
Pressure switch leaking	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

TENSIONERS

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearing worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Bracket cracked	A	Require repair or replacement
Housing cracked	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

THERMISTORS AND PRESSURE SENSORS

NOTE: **Includes, but not limited to, In-Car Temperature, Ambient Air Temperature, Sun Load Sensor, etc.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Calibration incorrect	B	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

THERMOSTATS AND HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cracked	B	Require replacement
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

VACUUM HOSES AND TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	A	Require repair or replacement

Condition	Code	Procedure
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Routing incorrect	B	Require repair
Surface cracks (dry-rotted)	1	Suggest replacement

VACUUM RESERVOIRS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Check valve leaking internally	A	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement

VACUUM TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Melted	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Routing incorrect	B	Require repair
Surface cracks (dry-rotted)	1	Suggest replacement

VALVES IN RECEIVER (VIRS)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	Â	No service suggested or required
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	Â	No service suggested or required
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket holes elongated, affecting performance	A	Require repair or replacement
Bracket holes elongated, not affecting performance	Â	No service suggested or required
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Connection damaged	B	Require repair or replacement
Contaminated, affecting performance	A	Require replacement

Condition	Code	Procedure
Corroded internally	1	Suggest replacement
Desiccant at the end of its useful life (saturated with moisture)	1	Suggest repair or replacement
Desiccant bag deteriorated	A	Require replacement. Further inspection required
NOTE: **Inspect system to determine effects of desiccant bag deterioration.**		
Filter screen torn	A	Require replacement of screen
Fitting damaged	B	Require repair or replacement
Fusible plug leaking	A	Require replacement of plug
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Pressure relief device leaking	A	Require replacement of pressure relief device
Restricted	A	Require repair or replacement
Sight glass no longer transparent	2	Suggest replacement of drier
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Tubing connection leaking	A	Require repair or replacement

WATER PUMPS (ELECTRIC AUXILIARY)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Vibration	1	Suggest replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WIRING HARNESSES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Circuit open	A	Require repair or replacement
Circuit resistance (voltage drop) out of specification	A	Require repair or replacement
Circuit shorted	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector melted, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Diode open	A	Require repair or replacement
Diode shorted	A	Require repair or replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Protective shield (conduit) melted	2	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

AUTOMOTIVE TERMINOLOGY & DEFINITIONS

ACCUMULATOR

a servo action device in an automatic transmission that cushions the motion of a clutch; in an air conditioning system, a device that combines the suction throttling valve and POA valves as well as the receiver/dryer; a component used to store or hold liquid refrigerant in an air conditioning system that also contains a jesiccant; in a non-integral ABS system, a chamber that temporarily stores fluid during the pressure decrease phase of ABS operation; in an integral ABS system , a sealed vessel containing a thick flexible diaphragm that separates brake fluid from high-pressure nitrogen gas.

ACTUATOR

a control device that delivers mechanical action in response to a vacuum or electrical signal; anything that the engine control computer uses to do something, such as trigger fuel injection or fire a spark plug. Most actuators on a computercontrolled engine system are activated by grounding their circuits rather than by actively powering them, since that protects the computer from short circuits.

AERATION

to expose to the air or mix with air, as with a liquid; to charge a liquid with gas.

AIR CONDITIONING (A/C)

a system that cools and dehumidifies the air entering the passenger compartment of a vehicle.

AIR DUCT

a tube, channel or other tubular structure used to carry air to a specific location.

AMBIENT TEMPERATURE SWITCH

a switch that prevents air conditioner operation below a certain ambient temperature.

AMBIENT TEMPERATURE

the temperature of the air surrounding an object.

ATMOSPHERIC PRESSURE

the pressure exerted on an object by the weight of the earth's atmosphere. At sea level, 14.7 psi, less at higher altitudes.

ATOMIZATION

the breaking down of a fluid into a fine mist that can be suspended in air.

AUTOMATIC TEMPERATURE CONTROL SYSTEM

a climate control system that uses the heating and air conditioning systems to maintain the interior temperature selected by the vehicle's passengers.

AUXILIARY CLIMATE CONTROL DEVICES

specialized add-on heating units, or combination heating/cooling units, that operate with the truck engine turned off. They eliminate the need to leave engines idling solely to heat or cool the cab and sleeper compartment.

BIMETALLIC

two kinds of metal, with different thermal expansion rates, that when attached to one another, the resulting assembly will bend in the direction of the metal that expands the least.

BLEND DOOR

a door in the heating and air conditioning system that controls the temperature of the air going into the passenger compartment.

BLOWER MOTOR.

the electric motor which drives the fan that circulates air inside the vehicle passenger compartment.

BOILING POINT

the temperature at which a liquid turns to vapor.

CAPILLARY TUBE

a thin, gas-filled tube that senses the temperature of the evaporator and relays this information to the thermostat and/or expansion valve.

CARBON DIOXIDE (CO2)

a colorless, odorless, noncombustible gas, heavier than air; can be compressed into a super-cold solid known as dry ice; changes from solid to vapor at - 78.5Â°C.

CELSIUS

the basis of the metric system of temperature measurement in which water's boiling point is 100Â°C and its freezing point is 0 C.

CHARGE

the electrical current that passes through the battery to restore it to full power; to fill, or bring up to the specific level, an A/C system with refrigerant; the required amount of refrigerant for an A/C system.

CHECK VALVE

a gate or valve that allows passage of a gas or liquid in one direction only.

CHLOROFLUOROCARBON (CFC)

any organic chemical compounds made up of carbon, chlorine and fluorine atoms, usually used in refrigeration. R12 is a CFC.

CLUTCH CYCLING SWITCH

a device that opens and closes the circuit that engages the air conditioning compressor clutch based on pressure or temperature.

COMPRESSOR

an engine driven device that compresses refrigerant gas and pumps it through the air conditioning system.

CONDENSATION

the process of a vapor becoming a liquid; the opposite of evaporation.

CONDENSE

to cool a vapor to below its boiling point, where it then condenses into a liquid.

CONDENSER

a device, similar to a radiator, in which the refrigerant loses heat and changes state from a high-pressure gas to a high pressure liquid as it dissipates heat to the surrounding air.

CORE PLUGS.

plugs that fill holes in a block or head left from the casting process. Also called freeze, welsh or expansion plugs.

CYCLING CLUTCH SYSTEM

an A/C system that controls temperature by switching the compressor clutch on and off.

DEGREE

used to designate temperature readings or 1 degree as a 1/360 part of a circle.

DEHUMIDIFY

to remove moisture (humidity) from the air.

DESICCANT

any hygroscopic material that removes and traps moisture, usually found in a bag in the accumulator or receiver/drier in air conditioning systems.

DIAPHRAGM

flexible, impermeable membrane on which pressure acts to produce mechanical movement; in automotive terminology, any disc-shaped device; can be as diverse as thin membranes that separate two chambers in a component, and large metal discs that activate clutch pressure plates.

DOWNFLOW RADIATOR

a radiator in which coolant enters the top of the radiator and is drawn downward by gravity (see crossflow radiator).

DUAL-ZONE CLIMATE CONTROL

allows individualized control of heating and air conditioning. Most systems are adjustable for the driver and front passenger; others feature a third adjustment for rear passengers.

EVACUATE

the process of applying vacuum to a closed refrigeration system to remove air and moisture.

EVAPORATION

the process through which a liquid is turned into vapor.

EVAPORATOR

a heat exchanger, in which low-pressure refrigerant flows and changes state, absorbing heat from the surrounding air.

EXPANSION TUBE

used in some air conditioning systems, a component with a fixed opening through which refrigerant passes as it is metered into the evaporator core. Also called an orifice tube.

EXPANSION VALVE

used on some air conditioning systems, a temperature sensitive device that meters the flow of refrigerant into the evaporator core. Also called a thermostatic expansion valve (TXV).

FAHRENHEIT

a scale of temperature measurement with the boiling point of water at 212Â°F. In the metric system, water's boiling point is 100Â°Celsius.

FAIL-SAFE COOLING SYSTEM

a fail-safe cooling system allows a vehicle to be driven under limited power in the event that engine coolant is lost. In case of a ruptured hose, the engine operates in an emergency mode with limited power for driving a short distance (10-50 miles depending on the system). This eliminates the cost and inconvenience of having the vehicle towed to a service station and does not leave the customer stranded.

FAN CLUTCH

a device attached to a mechanically driven cooling fan that allows the fan to freewheel when the engine is cold or the vehicle is driven at speed.

FAN SHROUD

an enclosure that routes air through the radiator cooling fins.

FAN

a mechanically or electrically driven propeller that draws or pushes air through the radiator, condenser, heater core or evaporator core.

FIXED ORIFICE TUBE

a method of controlling refrigerant flow in an air conditioning system whereby the rate of flow is determined by the pressure difference across an orifice.

FREON

DuPont registered trade name for R-12 (dichlorodifluoromethane).

GREENHOUSE GASES

gases, such as carbon dioxide, Nox, methane, and water vapor, that help capture heat from the sun in the lower atmosphere of the earth. As the amount of greenhouse gases in the atmosphere increases, more heat is captured, which can lead to global warming (the greenhouse effect).

HEAD PRESSURE

the pressure of the refrigerant at the compressor outlet.

HEAT EXCHANGER

device (e.g., a radiator) that is designed to transfer heat from the hot coolant that flows through it to the air blown through it by the fan.

HEATER CORE

a radiator-like device used to heat the inside of a vehicle. Hot coolant is pumped through it by the water pump, and heat from the coolant moves from the heater core to the passenger compartment as the blower fan forces air through it.

HIGH SIDE

the high-pressure half of an A/C system, usually refers to all components between the compressor outlet and the expansion valve or expansion tube. In this part of the A/C system, the refrigerant is in a liquid form.

HUMIDITY

moisture in air, usually referred to as relative humidity since the amount of moisture air can hold increases as temperature increases.

HVAC

acronym for Heating, Ventilation and Air Conditioning.

LATENT HEAT OF CONDENSATION

the amount of heat given off as a vapor changes state from a gas to a liquid without the temperature changing.

LATENT HEAT OF EVAPORATION

the amount of heat needed for a liquid to change state to a vapor without the temperature changing.

LEAK DETECTOR

a tool used to locate refrigerant leaks.

LOW SIDE

the suction side of an A/C system between the evaporator core inlet (after the expansion valve or expansion tube) and the compressor. In this part of the A/C system, the refrigerant is in a gas form.

MANIFOLD GAUGE SET

the set of gauges that attaches to the high and low side of the A/C system and used for diagnosis.

ORIFICE TUBE

used in some air conditioning systems, a component with a fixed opening through which refrigerant passes as it is metered into the evaporator core. Also called an expansion tube.

ORIFICE

a precisely sized hole that controls the flow of fluid.

O-RING SEAL

a sealing ring, usually made of rubber and installed in a groove; a type of valve seal that fits into a valve stem groove under the valve keepers.

PAG

polyalkyline glycol oil (lubricant) used with A/C systems containing R- 134a refrigerant.

PHOSGENE GAS

a poisonous gas produced when R- 12 refrigerant is burned.

POROSITY

the condition of having pores through which fluids, gases or light can pass; tiny holes in casting caused by air bubbles.

POUNDS PER SQUARE INCH (PSI)

a unit of measure for pressure.

PRESSURE

the exertion of force upon a body, measured in pounds per square inch on a gauge.

PSI

measurement of pressure in pounds per square inch.

R12

the generic term for CFC refrigerant used in older A/C systems. Also called Freon.

R134A

generic term for a modern refrigerant that does not contain CFCs and does not harm the ozone layer.

RECEIVER/DRIER

an A/C system component into which high-pressure liquid refrigerant flows and is temporarily stored and dehydrated, usually located between the condenser outlet and expansion valve.

RECLAIM

to send refrigerant to an off-site facility where it is restored to its original purity so that it may be reused.

RECOVER

to remove refrigerant from a system and store it temporarily.

RECYCLE

to remove contaminants such as moisture, particulates, etc, from refrigerant and re-introduce it into the A/C system.

REFRIGERANT CYCLE

the complete loop or circuit that refrigerant passes through as it changes state from a vapor, to a liquid, then back to a vapor.

REFRIGERANT OIL

either a mineral or synthetic oil designed specifically for A/C systems.

REFRIGERANT

a chemical compound used in an A/C system to remove heat from the evaporator and transfer it to the condenser.

SCHRADER VALVE

a spring operated valve used to open and close the service outlets in an A/C system. They are the service valves used to attach manifold gauges and to charge or evacuate the system.

SERVICE PORT

any of the various designs of fittings that allow service tools such as manifold gauges to be attached to an A/C system. See also Schrader valve.

SUCTION LINE

the low side tube and/or hose leading from the evaporator core outlet to the compressor inlet.

SUCTION

exists in a vessel when the pressure is lower than the atmospheric pressure.

SUPERHEAT SWITCH

a switch, usually mounted on the compressor on certain A/C systems that completes the circuit to the thermal limiter switch.

SUPERHEAT

the addition of more heat to a gas after it has already vaporized; the heat added to vaporized refrigerant after it has changed state from a liquid to a gas controlled by the expansion valve.

TENSIONER

a device used with a timing chain or belt to maintain its tension.

THERMOSTAT

a device installed in the cooling system that allows the engine to come to operating temperature quickly and then maintain a minimum operating temperature.

THERMOSTATIC EXPANSION VALVE (TXV)

used on some air conditioning systems, a temperature sensitive device that meters the flow of refrigerant into the evaporator core. Also called an expansion valve.

VACUUM

a pressure lower than atmospheric.

VAPOR

a substance in a gaseous state. Liquid becomes vapor when brought above the boiling point.

WATER PUMP

a device used to circulate coolant through the engine.

WATER VALVE

a device used to control the flow of hot coolant to the heater core, usually operated by cable or vacuum.

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Routine Inspection Reference Guide

ROUTINE INSPECTION REFERENCE GUIDE

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

MAINTENANCE OVERVIEW

ANTIFREEZE/COOLANT

The main function of the Engine Cooling System is to carry heat away from the engine and maintain the desired operating temperature. This is accomplished by circulating antifreeze/coolant through the engine, where heat is generated, and carrying it to the radiator to be cooled.

Over the past decade internal combustion engines have become more fuel efficient; however, most of the energy in the gasoline (perhaps 70%) is converted into heat, and the cooling system keeps the engine from overheating by transferring this heat to the air. But the cooling system also has several other functions.

An automobile engine runs best at a fairly high temperature. When the engine is cold, components wear out faster, and the engine is less efficient and releases more pollutants into the atmosphere. The cooling system is designed to allow the engine to heat up as quickly as possible, and then to keep the engine at a constant temperature.

Modern automobiles operate in a wide variety of ambient temperatures, from well below freezing to well over 100 F. The fluid used to cool the engine must have a very low freezing point, a high boiling point, and it must have the ability to transfer a lot of heat.

An adequate amount of an antifreeze/coolant and water mixture is necessary to reduce the possibility of engine overheating and freezing, and to prevent rust and corrosion in the cooling system.

Water is one of the most effective fluids for holding heat, but water freezes at too high a temperature to be used in car engines. The fluid that most cars use is a mixture of water and ethylene glycol, also known as antifreeze. By adding ethylene glycol to water, the boiling and freezing points are improved significantly.

The temperature of the coolant can sometimes reach 250 to 275 F (121 to 135 C). Even with ethylene glycol added, these temperatures would boil the coolant. The cooling system is pressurized, which further raises the boiling point of the coolant. Most automobiles have around 14 to 15 pounds per square inch (psi), which raises the boiling point approximately 45 F so the coolant can endure the high temperatures produced in the engine.

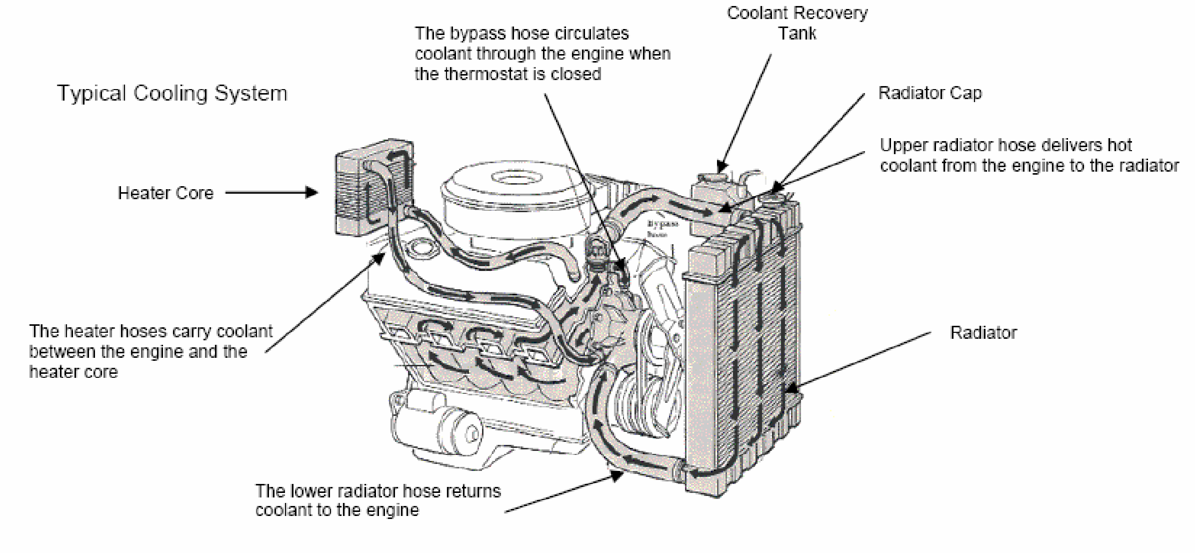

Typical Cooling System
The bypass hose circulates coolant through the engine when the thermostat is closed
Coolant Recovery Tank
Radiator Cap
Upper radiator hose delivers hot coolant from the engine to the radiator
Heater Core
Bypass hose
The heater hoses carry coolant between the engine and the heater core
Radiator
The lower radiator hose returns coolant to the engine

Fig. 1: Typical Cooling System

Hoses showing obvious signs of wear such as cracks, cuts, stiffness, bulges, excessive softness or abrasions should be replaced.

The National Automotive Radiator Service Association (NARSA) recommends a seven (7)-point preventative cooling system maintenance check at least once every two years. The program is designed to identify any areas that need attention, and consists of:

- a visual inspection of all cooling system components, including belts and hoses
- a radiator cap test to check for the recommended system pressure level
- a thermostat check for proper opening and closing
- a pressure test to identify any external leaks to the cooling system parts; including the radiator, water pump, engine coolant passages, radiator and heater hoses and heater core
- an internal leak test to check for combustion gas leakage into the cooling system
- an engine fan test for proper operation h a system power flush and refill with car manufacturer's recommended concentration of coolant

VISUAL INSPECTION

What you are looking for is the condition of the belts and hoses. The radiator hoses and heater hoses are easily inspected just by opening the hood and looking. You want to be sure that the hoses have no cracking or splitting and that there is no bulging or swelling at the ends. If there is any sign of problems, the hose should be replaced with the correct part number for the year, make and model of the vehicle. Never use a universal hose unless it is an emergency and a proper molded hose is not available.

Heater hoses are usually straight runs and are not molded, so a universal hose is fine to use and often is all that is available. Make sure that you use the proper inside diameter for the hose being replaced. For either the radiator hoses or the heater hoses, make sure that you route the replacement hose in the same way that the original hose was running. Position the hose away from any obstruction that can possibly damage it and always use new hose clamps. After you refill the cooling system with coolant, do a pressure test to make sure that there are no leaks.

RADIATOR CAP TEST

A radiator cap is designed to maintain pressure in the cooling system at a certain maximum pressure. If the cooling system exceeds that pressure, a valve in the cap opens to bleed the excessive pressure into the reserve tank. Once the engine has cooled off, a negative pressure begins to develop in the cooling system. When this happens, a second valve in the cap allows the coolant to be siphoned back into the radiator from the coolant reservoir. If the cap should fail, the engine can easily overheat. A pressure test of the radiator cap is a quick way to tell if the cap is doing its job. It should be able to hold its rated pressure for two minutes.

ENGINE FAN

The radiator cooling fan is an important part of the cooling system operation. While a fan is not really needed while a vehicle is traveling down the highway, it is extremely important when driving slowly or stopped with the engine running. In the past, the fan was attached to the engine and was driven by the fan belt. The speed of the fan was directly proportional to the speed of the engine; a viscous fan drive was developed in order to disengage the fan when it was not needed.

With computer controls, the engine-driven fans gave way to electric fans mounted directly on the radiator. A temperature sensor determined when the engine was beginning to run too hot and turned on the fan to draw air through the radiator to cool the engine. On many cars, there were two fans mounted side by side to make sure that the radiator had a uniform air flow for the width of the unit.

When the car is in motion, the speed of the air entering the grill is usually sufficient to keep the coolant at the proper temperature and the fans shut off. When the vehicle is stopped, there is no air flow and the fan is turned on when the engine reaches a designated temperature.

When the A/C is turned on the fan circuit would power the fans regardless of engine temperature. The air conditioning system always requires a good air flow through the condenser mounted in front of the radiator. If the air flow stopped, the air-conditioned air coming through the dash outlets would immediately start warming up.

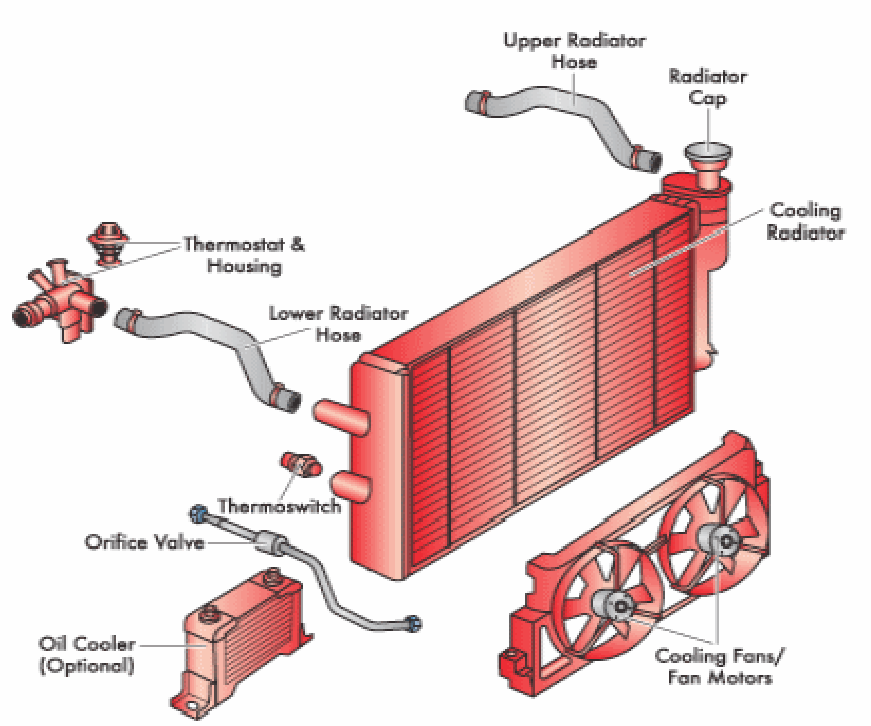


Fig. 2: Typical Cooling Fan

COOLING SYSTEM POWER FLUSH AND REFILL

Old coolant can be replaced by draining it out and replacing it with fresh coolant; however, power flushing will remove all the old coolant and pull out any sediment and scale along with it. Power flushing requires special equipment and generally requires the thermostat to be removed, the lower radiator hose disconnected, and the flush machine connected in line. Water and, sometimes, a cleaning agent are pumped through the cooling system in a reverse path from the normal coolant flow. When completed, the hose is reconnected and a new thermostat is installed. The cooling system is refilled with the appropriate amount of antifreeze to bring the coolant to the proper mixture of antifreeze and water. For most vehicles and most climates, the mixture is 50 / 50. In colder climates, more antifreeze is used, but must never exceed 75 percent antifreeze. Follow the vehicle manufacturers' procedures and recommendations.

BELTS (EXCEPT TIMING BELTS)

On most older vehicles, the water pump is driven by a V belt or serpentine belt on the front of the engine that is also responsible for driving the alternator, power steering pump and air conditioner compressor. These types of belts are easy to inspect and replace if they are worn. You are looking for dry cracking on the inside surface of the belt.

On later vehicles, the water pump is often driven by the timing belt. This belt usually has a specific life expectancy at which time it must be replaced to insure that it does not fail. Since the timing belt is inside the engine and will require partial engine disassembly to inspect, it is very important to replace it at the correct interval.

Low belt tension, contamination and belt vibration are common sources of belt noise. A screeching or squealing noise that occurs when pulling away from a stop normally indicates a lack of tension; check belt tension and automatic tensioners.

A grinding noise can result from damaged bearings, which must be replaced, aligned and lubricated to eliminate the noise and further damage. Vibration and noise can develop over time as drive components such as pulleys and spring tensioners wear, bearings and brackets loosen, or belts wear and stretch.

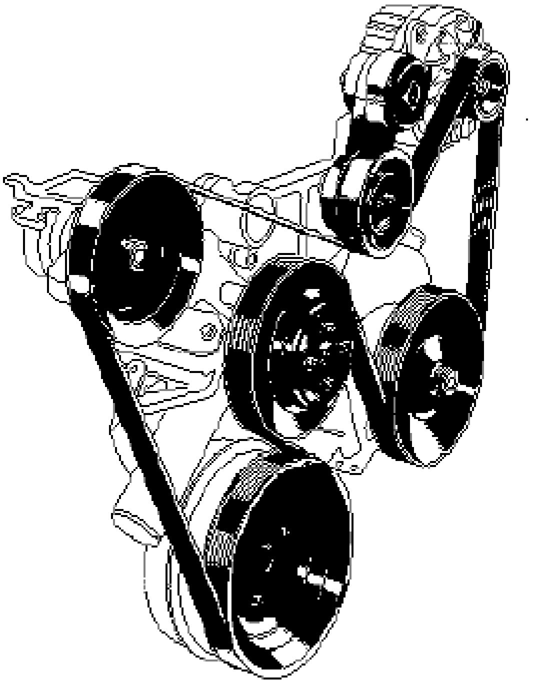


Fig. 3: Typical Accessory Drive Belt

The angle between belt span and pulley is the critical factor responsible for causing the "chirp" associated with misalignment noise. The presence of high humidity (or a damp belt) often increases the likelihood for misalignment noise to occur. Misalignment angle can result from many different combinations of pulley positions - parallel and angular are two typical examples.

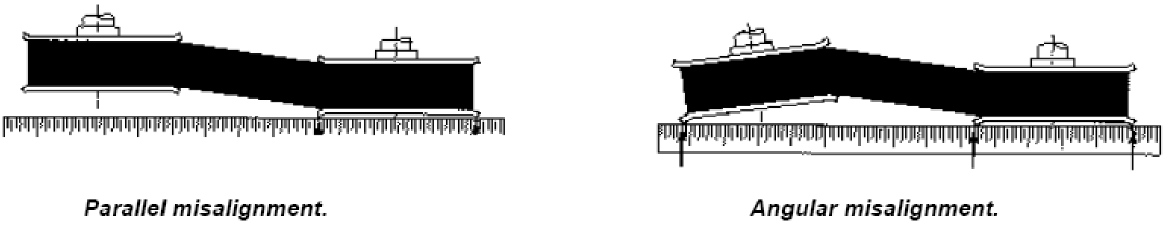


Fig. 4: Accessory Drive Belt Misalignment

Whenever a vehicle owner complains of belt noise, determine the type of noise and under what circumstances it occurs. The correction for a noise problem caused by belt misalignment is not likely to resolve a slip noise problem that may be caused by insufficient tension or other problem. The highest occurrence of belt noise due to misalignment comes from short belt spans entering large diameter pulleys. In the case of severe misalignment, repositioning of drive components may be required. Pulley alignment and tension must be correct for the drive to operate properly.

BELT TENSIONER

Belt tensioners are used to maintain constant tension on the belt, extending both belt and accessory drive bearing life.

NOTE: **A tensioner cannot be rebuilt since internal parts are not available. Never try to disassemble a tensioner unit. Injury may result.**

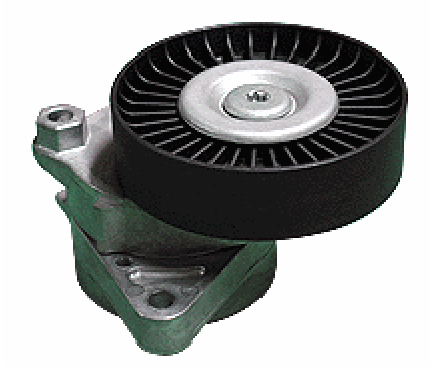


Fig. 5: Typical Accessory Dive Belt Tensioner

AUTOMATIC TRANSMISSION FLUID

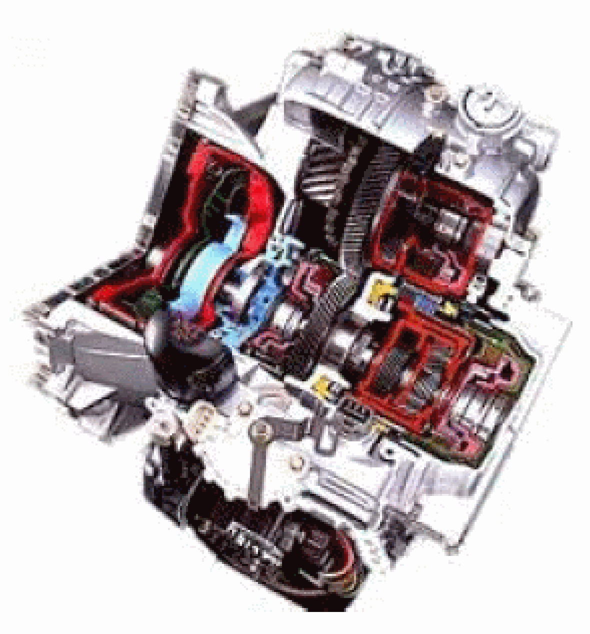


Fig. 6: Crosssection Of Automatic Transmission - Typical

Automatic transmission fluid (ATF) is the fluid used in vehicles with a self-shifting or automatic transmission. It is typically colored red or green to distinguish it from motor oil and other fluids in the vehicle. The fluid is a highly refined mineral oil optimized for the special requirements of an automatic transmission, such as valve operation, clutch and band operation, torque converter and gear lubrication. ATF is also used as a hydraulic medium in some power-assisted steering systems and as a lubricant in some 4WD transfer cases.

ATF usually contains an additive package with anti-foam additives, detergents and dispersants, anti-oxidation compounds, surfactants and petroleum dye. There are many specifications for ATF, such as the DEXRON and MERCON series, and the vehicle manufacturer will identify the ATF specification appropriate for each vehicle. The vehicle's owner's manual will typically list the ATF specification(s) that are recommended by the manufacturer. Some manufacturers will recommend different ATF products for different kinds of vehicle use, such as frequent trailer towing or vehicles that are used for longer periods between routine maintenance.

Overused ATF often has reduced lubrication properties and abrasive friction materials (from clutches and bands) suspended in it; failure to replace such fluid will accelerate transmission wear and could eventually ruin a transmission. Color is not an indication of the service life of an ATF as most ATF products will darken with use. The manufacturer's recommended service interval is a more reliable measure of ATF life.

AUTOMATIC TRANSMISSION FLUID EXCHANGE & FILTER REPLACEMENT

Automatic transmission fluid lubricates, cools and cleans internal components of the transmission. It also helps to maintain the hydraulic pressure necessary for the transmission to function. The additives in the transmission fluid can be depleted over time and should be replaced following the manufacturer's recommended service interval.

ENGINE OIL

The temperature range the oil is exposed to in most vehicles can be wide, ranging from cold ambient temperatures in the winter before the vehicle is started up to hot operating temperatures when the vehicle is fully warmed up in hot summer weather. A "specific" oil will have high viscosity when cold and a low viscosity at the engine's operating temperature. The difference in viscosities for any single-grade oil is too large between the extremes of temperature. To bring the difference in viscosities closer together, additives called viscosity index improvers are added to the oil. This creates "multi-grade" oil which has the viscosity of the first number when cold and the viscosity of the second number when hot. This allows one type of oil to be generally used all year.

In engines, there is inevitably some exposure of the oil to products of internal combustion, and microscopic particles from black soot accumulate in the oil during operation. Also the rubbing of metal engine parts inevitably produces some microscopic metallic particles from the wearing of the surfaces. Such particles could circulate in the oil and grind against the part surfaces causing wear. The oil filter removes many of the particles and sludge, but eventually the oil filter can become clogged, if used for extremely long periods. The motor oil and especially the additives also undergo thermal and mechanical degradation. For these reasons, the oil and the oil filter need to be periodically replaced.

Most vehicle manufacturers utilize a time/mileage-based schedule. Time-based intervals account for both the short trip driver who does fewer miles, but builds up more contaminates, as well as the long highway trips that are much easier on the oil. Many vehicle manufacturers list somewhat higher intervals for changing of oil and filter, with "severe" service requiring more frequent changes. This generally applies to vehicles that are mostly used in "Stopand- Go" driving conditions; experience extended periods of idling; or used for short trips of under 10 miles, where the oil does not get to full operating temperature and other adverse conditions.

Some vehicle manufacturers have installed engine Oil Life Monitors using computer calculations to estimate the oil's condition based on the factors which degrade it. Conditions such as RPMs, temperatures, and trip length are factored in to the equation; and one system adds an optical sensor for determining the clarity of the oil in the engine.

OIL LIFE
100%

Fig. 7: Engine Oil Life Monitor Display Example

AIR FILTERS

The engine air filter prevents dirt from entering the engine's cylinders, where it would cause mechanical wear and oil contamination. Most fuel injected vehicles use a pleated paper filter element in the form of a flat panel. This filter is usually placed inside a plastic box connected to the throttle body with an intake tube. Older vehicles that use carburetors or throttle body fuel injection typically use a cylindrical air filter, usually a few inches high and between 6 and 16 inches in diameter, positioned above the carburetor or throttle body and may incorporate ducting to provide cool and/or warm inlet air, and secured with a metal or plastic lid.

A Pleated paper filter element is used for most automobile engine air cleaners, because they are efficient, easy to service, and cost-effective. The pleated-paper filter is sized appropriately for the airflow volumes encountered in a particular application and present only minor restriction to air flow until the filter has become clogged with dirt.

CABIN AIR FILTER

The cabin air filter is typically a pleated-paper filter that is placed in the outside-air intake for the vehicle's passenger compartment. Some of these filters are rectangular and similar in shape to the combustion air filter. Others are uniquely shaped to fit the available space of particular vehicles' outside-air intakes. Clogged or dirty cabin air filters can significantly reduce airflow from the cabin vents, as well as introduce allergens into the cabin air stream.

BRAKE FLUID

The purpose of brake fluid is to:

1. Utilize hydraulic pressure to apply force on brake components that use a friction material to slow the vehicle
2. Protect the brake system from corrosion

Motor vehicle brake fluids are hygroscopic and absorb moisture when exposed to the atmosphere and in service. Water contamination from any source, including mechanical or accidental additions of free water, will appreciably lower the original boiling point of the brake fluid and increase its viscosity at low ambient temperatures. Water contamination may cause corrosion of brake cylinder bores and pistons, and may seriously affect the braking efficiency and safety of the brake actuating system. While moisture is definitely an issue with brake fluids, no consistent and accurate measurement identifying the percentage of moisture that is detrimental to brake fluid performance has been found in the literature. In addition, no specification exists for an in-use brake fluid boiling point that can be identified by a testing procedure and therefore no recommendation for replacement based on moisture content can be made with confidence.

It has been demonstrated that corrosion inhibitors in brake fluid deplete over time and can be severely depleted by 36 months. The depletion of corrosion inhibitors results in corrosion. Copper is not found in new brake fluid and is used as a brazing alloy in the brake lines, which represent a high surface area for brake fluid contact. Copper is the first metal to corrode in a brake system, and is a principle contaminate in brake fluid. Copper levels increase slowly and stably over time. The slow and steady increase in copper levels provides a means to predict the age of brake fluid under normal conditions. The age of the brake fluid can help determine when brake fluid should be serviced according to OEM recommendations when applicable. Copper can also directly affect ABS components as it can plate to the valve and valve seats.

Iron levels begin to sharply increase when the copper levels reach 150-250 ppm indicating corrosion of iron components. This also allows copper levels to be used to predict when iron levels will increase or the start of component corrosion and the depletion of corrosion inhibitors. Once iron corrosion begins copper acts as a catalyst to speed corrosion. At this point (iron corrosion) it is evident that the brake fluid no longer performs the intended purpose of protecting the system from corrosion.

A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid and Brake Fluid Replacement is Required.

BATTERY

The automotive battery is an electrochemical device that produces voltage and delivers current. In an automotive battery the electrochemical action can be reversed, recharging the battery, providing many years of service. Batteries emit hydrogen gas while charging and the battery case cannot be completely sealed. Batteries (maintenance free) have small vents on the side forcing the gases to go through baffles to escape. This process allows the liquid to condense and flow back to the bottom of the battery.

The purpose of the battery is to supply current to the starter motor, provide current to the ignition system while cranking, to supply additional current when the demand is higher than the alternator can supply and to act as an electrical reservoir. Batteries are rated in cold cranking amps. This represents the current the battery can produce for 30 seconds at 0 degrees before the battery voltage drops below 7.2 volts.

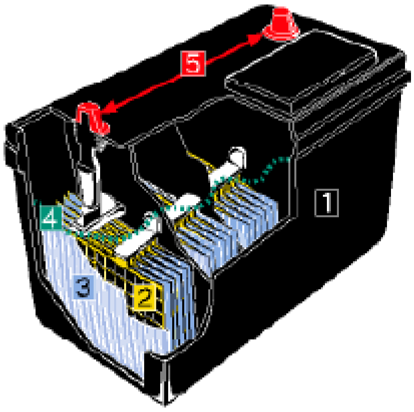


Fig. 8: Typical Battery Components

BATTERY CABLES

Battery cables are large diameter, multi-stranded wire which conveys the high current (250+ amps) necessary to operate the starter motor. Some battery cables will have a smaller wire, soldered to the terminal, which is used to either operate a smaller device or to provide an additional ground. When the smaller cable burns it indicates a high resistance in the heavy cable.

Even maintenance free batteries need periodic inspection and cleaning to insure they stay in good working order. Inspect the battery to see that it is clean and that it is held securely in its carrier. Some corrosion naturally collects around the battery. Electrolyte condensation contains corrosive sulfuric acid, which eats away the metal of battery terminals, cable ends and battery hold-down parts.

POWER STEERING

Power steering is a system for reducing the steering effort on cars by using an external power source to assist in turning the wheels. Most vehicles have power steering and the trend to front wheel drive, greater vehicle mass and wider tires means that modern vehicles would be extremely difficult to maneuver at low speeds (e.g. when parking) without assistance.

POWER STEERING FLUID

Power Steering Fluid is the hydraulic component in power steering systems and is charged with pressure transfer and component protection. It fails when it stops performing one of its tasks. When a fluid becomes oxidized, its resistance to flow is greater and it decreases its ability to protect components and transfer pressure. The more common failure mode of PSF is internal and external contamination, and excess particles in fluid promote component wear and can lead to component failures, including seals, shafts and gears.

Most power steering systems work by using a belt driven pump to provide hydraulic pressure to the system. This hydraulic pressure is generated by a rotary-vane pump which is driven by the vehicle's engine. As the speed of the engine increases, the pressure in the hydraulic fluid also increases, hence a relief valve is incorporated into the system to allow excess pressure to be bled away. Some of the hydraulic systems also include an electronic pressure valve which can reduce the hydraulic pressure of the power steering lines as the vehicle's speed increases (Variable assist power steering).

Electric Power Steering uses sensors to detect the motion and torque of the steering column and a computer module applies electric motor to provide power assist. This allows variable assist power steering to be applied depending on driving conditions. In the event of component failure, a mechanical linkage such as a rack and pinion serves as a back-up in a manner similar to that of hydraulic systems. Electric power steering is usually limited to smaller vehicles rather than trucks and SUVs. Electric systems have a significant advantage in fuel efficiency because there is no hydraulic pump constantly running, whether assistance is required or not.

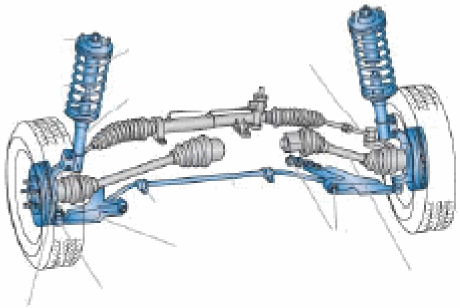


Fig. 9: Typical Front Suspension & Steering Components

WIPER BLADES

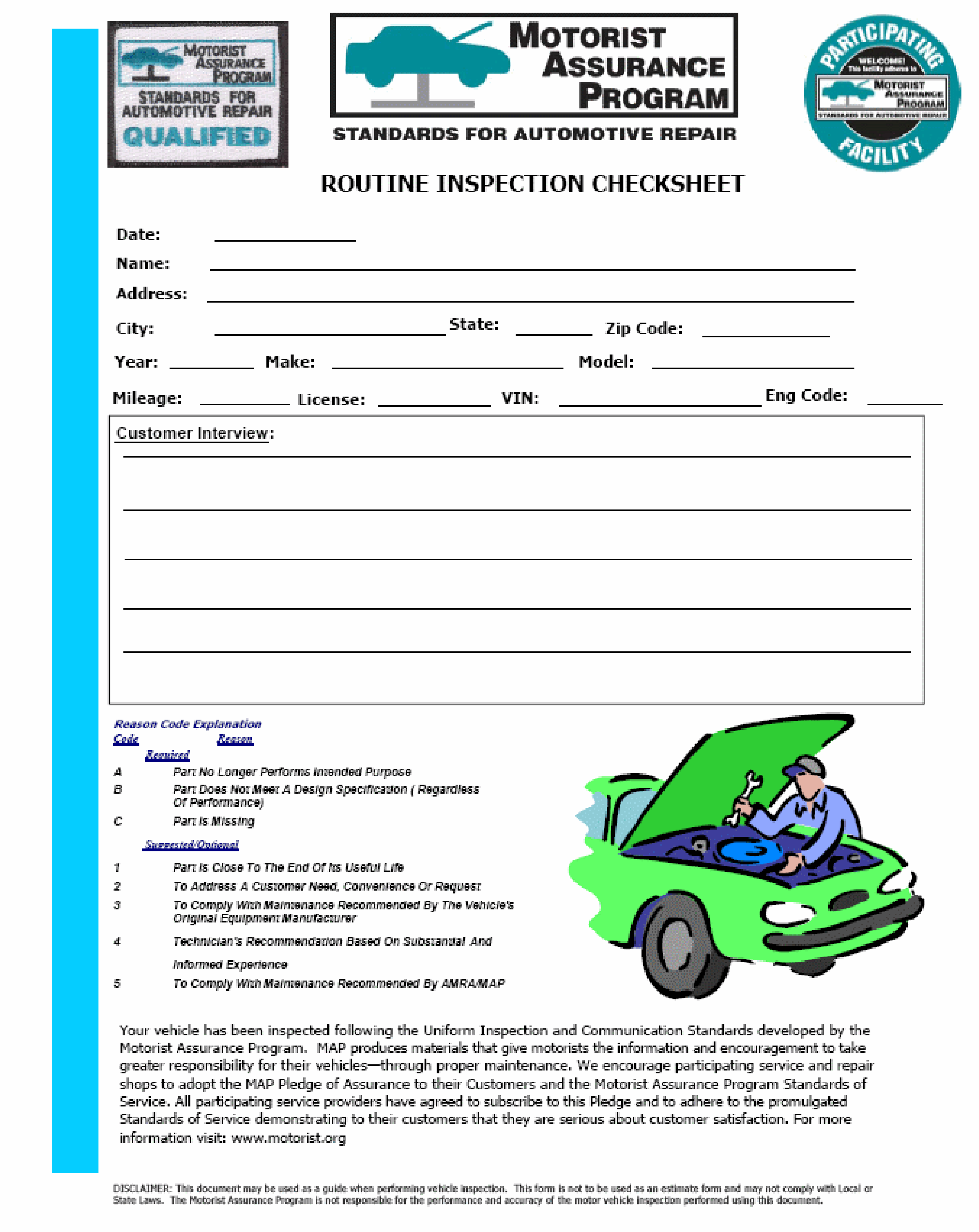
Worn wiper blades are dangerous. Ozone, airborne contaminants, oil, sunlight and dirt all act to weaken and reduce your wiper blades' ability to keep your view unobstructed. And exposure to sunlight and ozone cause the wiper blades to age, even if they're not used much. Weather also plays a critical role in your windshield wiper blades' deterioration. Freezing temperatures make the rubber in your wiper blades hard and brittle, which increases their tendency to crack or tear. Hot weather warps the rubber and prevents the blade from wiping your windshield cleanly.

Heavy use is hard on the wipers because dust, abrasives, road grime and bug juice wear away the cutting edge the blade needs to wipe cleanly. Even road dirt acts like an abrasive to wear away the flat surface necessary for a good squeegee effect. Rubber also deteriorates over time. As blades age, they lose their flexibility and are less able to wipe cleanly. They may develop a permanent set or curvature, which prevents full contact with your windshield.

A wiper blades ability to clean the glass depends on:

- The slope and area of the windshield: Windshields are sloped for improved aerodynamics and a "cab-forward" windshield with a lot of surface area directs more wind against the wipers, and can force the blades away from the windshield at high speeds unless the wiper system is designed to resist lift.
- The amount of spring tension on the wiper arm: This is important to keep the wiper blade in tight contact with the windshield and provide a squeegee effect.
- The number of pressure points or claws holding the blade: The more claws a blade has, the broader the area over which the pressure of the wiper arm is spread. More claws also provide increased flexibility so the blade can more easily follow the curvature of a large, sloping windshield for full side-to-side contact.

ROUTINE INSPECTION CHECKSHEET



MOTORIST ASSURANCE PROGRAM

STANDARDS FOR AUTOMOTIVE REPAIR

ROUTINE INSPECTION CHECKSHEET

Date: ____________

Name: ____

Address: ____

City: ____________________ State: ________ Zip Code: ____________

Year: ________ Make: ____________________ Model: ____________________

Mileage: ________ License: ____________ VIN: ____________________ Eng Code: ________

Customer Interview:

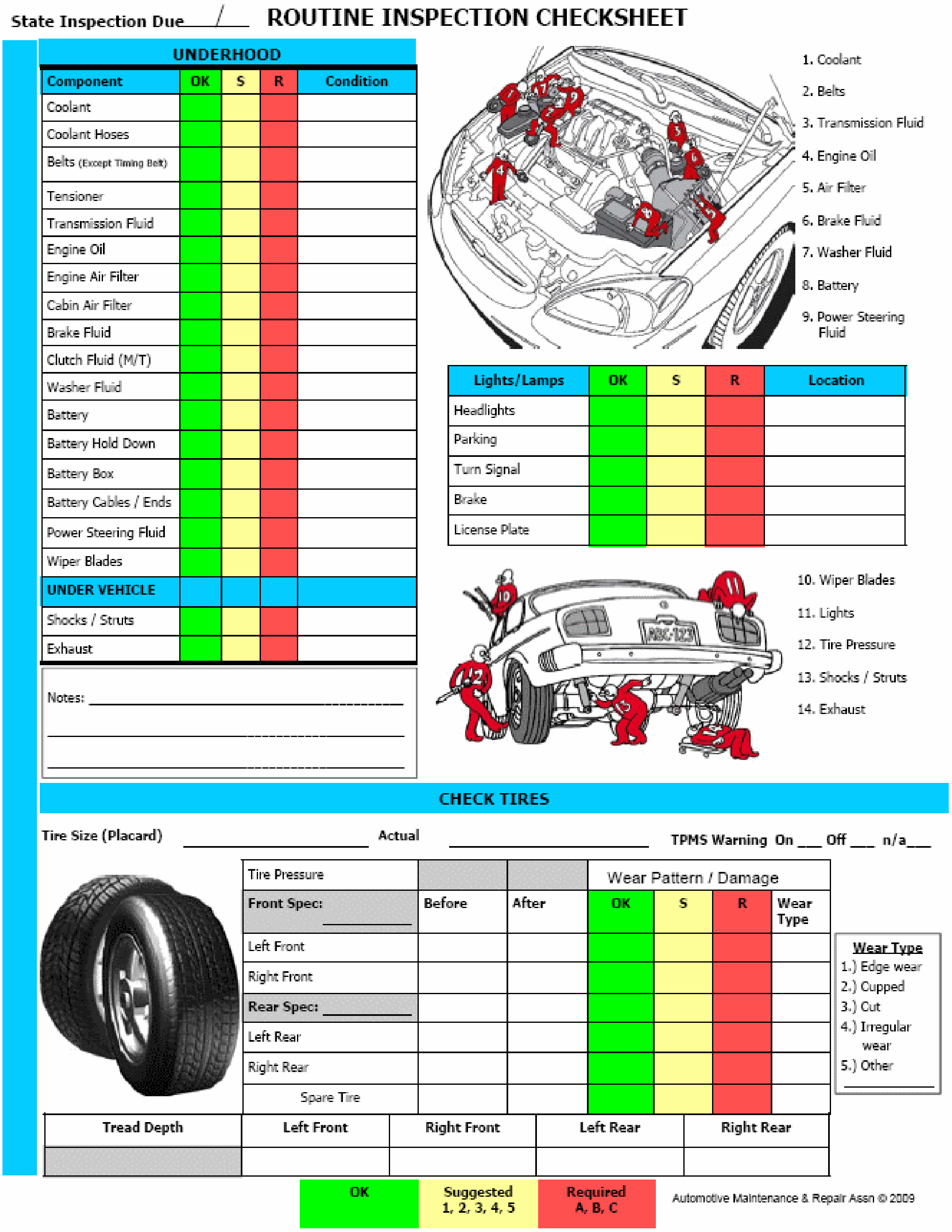
Reason Code Explanation

Code	Reason
	Required
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
	Suggested/Optional
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 10: Routine Inspection Checksheet (1 Of 2)



State Inspection Due ___/___ **ROUTINE INSPECTION CHECKSHEET**

UNDERHOOD

Component	OK	S	R	Condition
Coolant				
Coolant Hoses				
Belts (Except Timing Belt)				
Tensioner				
Transmission Fluid				
Engine Oil				
Engine Air Filter				
Cabin Air Filter				
Brake Fluid				
Clutch Fluid (M/T)				
Washer Fluid				
Battery				
Battery Hold Down				
Battery Box				
Battery Cables / Ends				
Power Steering Fluid				
Wiper Blades				
UNDER VEHICLE				
Shocks / Struts				
Exhaust				

Notes: ____________________

1. Coolant
2. Belts
3. Transmission Fluid
4. Engine Oil
5. Air Filter
6. Brake Fluid
7. Washer Fluid
8. Battery
9. Power Steering Fluid

Lights/Lamps	OK	S	R	Location
Headlights				
Parking				
Turn Signal				
Brake				
License Plate				

10. Wiper Blades
11. Lights
12. Tire Pressure
13. Shocks / Struts
14. Exhaust

CHECK TIRES

Tire Size (Placard) ____________ Actual ____________ TPMS Warning On ___ Off ___ n/a___

Tire Pressure			Wear Pattern / Damage			
Front Spec: ______	Before	After	OK	S	R	Wear Type
Left Front						
Right Front						
Rear Spec: ______						
Left Rear						
Right Rear						
Spare Tire						

Wear Type
1.) Edge wear
2.) Cupped
3.) Cut
4.) Irregular wear
5.) Other
______

Tread Depth	Left Front	Right Front	Left Rear	Right Rear

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

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Fig. 11: Routine Inspection Checksheet (2 Of 2)

ROUTINE INSPECTION - UICS

BRAKE SYSTEMS

NOTE: Some states may have specifications that differ from OEM. Check your local/state regulations. Where state or local laws are stricter, they take precedence over these guidelines.

BRAKE FLUID

NOTE: Most manufacturers prohibit the use of DOT 5 brake fluid in a system equipped with ABS. DOT 3, DOT 4, and DOT 5.1 brake fluids are clear or light amber in color. DOT 5 brake fluid is violet in color. Correct fluid type is normally stamped on the master cylinder cover.

NOTE: Fluid Flush - a process using a sufficient volume of fluid to help remove

contaminants and replacing the contaminated fluid with new fluid of the same type and specification. At times a chemical may be used to enhance removal.

NOTE: **Fluid Exchange/Replace - draining (evacuating) old fluid and replacing it with new fluid of the correct type and specification.**

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>At or beyond OEM service interval</td><td>3</td><td>Suggest fluid exchange/replacement</td></tr>
<tr><td>Brake fluid type incorrect</td><td>B</td><td>Require flushing and refilling</td></tr>
<tr><td colspan="3">NOTE:
For example, DOT fluid lower than specified for the vehicle or silicone brake fluid (DOT 5) in an ABS system</td></tr>
<tr><td>Contaminated, for example, fluid other than brake fluid present</td><td>A</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If a fluid other than brake fluid is present in the brake system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</td></tr>
<tr><td>Contaminated, for example, fluid other than brake fluid present</td><td>B</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If a fluid other than brake fluid is present in the brake system which DOES NOT affect the rubber parts, the required service is to flush and fill with the correct brake fluid.</td></tr>
<tr><td>Corrosion inhibitors depleted</td><td>B</td><td>Require fluid exchange/replacement</td></tr>
<tr><td colspan="3">NOTE:
A copper content of 200 ppm or greater indicates a depletion of corrosion inhibitors in the brake fluid.</td></tr>
<tr><td>Fluid discolored</td><td colspan="2">No Service Suggested or Required</td></tr>
<tr><td colspan="3">NOTE:
Further testing necessary to determine condition of fluid.</td></tr>
<tr><td>Hydraulic component overhaul or replacement</td><td>3</td><td>Suggest flushing and refilling</td></tr>
<tr><td>Rubber master cylinder cover gasket distorted and gummy</td><td>A</td><td>Require replacement of gasket</td></tr>
<tr><td colspan="3">NOTE:
This condition may indicate contaminated brake fluid. Further inspection required.</td></tr>
</table>

BULBS AND LEDS

NOTE: **Does not include soldered-in components.**

Condition	Code	Procedure

Condition	Code	Procedure
Application incorrect	B	Require replacement
NOTE: **Application incorrect includes wrong bulb coating or color.**		
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Burned out	A	Require replacement
Intermittent	A	Require replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement
Expansion affecting performance	A	Require Replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

LENSES

Condition	Code	Procedure
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	No Service Suggested or Required	
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

LUG NUT

Condition	Code	Procedure
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

MASTER CYLINDER COVER GASKET

Condition	Code	Procedure
Rubber master cylinder cover gasket distorted and gummy	A	Require replacement of the gasket

NOTE:

This condition may indicate contaminated brake fluid. See Brake Fluid.

PARKING BRAKE CABLE

Condition	Code	Procedure
Cable improperly adjusted	B	Require cable adjustment
Cable or individual wires in the cable are broken	A	Require replacement of cable assembly
Cable sticking	A	Require cable lubrication
Cable stuck inside conduit and cannot be lubricated so that parking brake functions properly	A	Require replacement of cable assembly

VACUUM HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Incorrectly secured	B	Require repair
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly	B	Require repair

WHEEL ATTACHMENT HARDWARE

NOTE: **For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow manufacturer's torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.**

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement

Condition	Code	Procedure
NOTE: **Some manufacturers require replacement of all studs on any wheel if two or more studs or nuts on the same wheel are broken or missing.**		
Loose	A	Require repair or replacement of affected component
Lug nut flats rounded	A	Require replacement of nut
Lug nut installed backward	B	Require repair
Lug nut mating surface dished	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut seized	A	Require replacement of nut and/or stud
Stud incorrect	B	Require replacement of stud
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped (threads missing)	A	Require replacement of component with stripped threads

WHEEL BEARINGS, RACES AND SEALS

NOTE: **When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions.**

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing and race assembly
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or other damage affecting performance.	B	Require replacement of bearing and race assembly
Seal leaking	A	Require replacement of seal and inspection of bearings
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.**		
Seal missing	C	Require replacement

DRIVETRAIN AND TRANSMISSION

NOTE: **When a procedure states that a required or suggested repair or replacement is recommended, the basis for the recommendation MUST be explained to the customer. If the customer asks whether there are alternatives to the recommendation, generally acceptable repair/replacement options must be explained, whether performed or not by the shop.**

NOTE: **Whenever transmission or drive-train service is performed that affects the suspension alignment, for example, removing the engine cradle, it is required that the alignment be checked and corrected if necessary.**

NOTE: **The conditions listed for the components included in this section assume that the problem has been isolated to the specific component through proper testing.**

AUTOMATIC TRANSMISSION FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
Burned	Further inspection required	
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Varnish deposits present on system components affecting performance	Further inspection required	

CLUTCH MASTER CYLINDERS

Condition	Code	Procedure
Cover gasket distorted	A	Require replacement of cover gasket
Cover gasket gummy	A	Require replacement of cover gasket
NOTE: **This condition may indicate contaminated fluid. Further inspection required.**		
Cylinder leaking fluid from rear of bore	A	Require repair or replacement
Cylinder leaking fluid internally	A	Require replacement
Dust boot missing	C	Require replacement of dust boot
Dust boot punctured	A	Require replacement of dust boot
Dust boot torn	A	Require replacement of dust boot
Fluid level incorrect	B	Require fluid level adjustment
Housing damaged, affecting performance	A	Require repair or replacement
Master cylinder has residue in reservoir	2	Further inspection required
NOTE: **Do not replace master cylinder unless it exhibits conditions listed for replacement.**		
Pushrod out of adjustment	B	Require Repair or Replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

COOLER LINES

Condition	Code	Procedure
Abrasion damage, affecting structural integrity	A	Require repair or replacement
Abrasion damage, not affecting structural integrity	No Service Suggested or Required	
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Clamp corroded, not reusable	1	Suggest replacement
NOTE: **If clamp removed, require replacement.**		
Connected incorrectly	A	Require repair
Corroded, affecting structural integrity	A	Require replacement
Corroded, not affecting structural integrity	No Service Suggested or Required	
Cracked	B	Require repair or replacement

Condition	Code	Procedure
Fitting type incorrect (such as compression fitting)	B	Require replacement
Flange leaking	A	Require repair or replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Routed incorrectly	B	Require repair
Swollen	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

COOLERS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	No Service Suggested or Required	
Internal restrictions	B	Require repair or replacement
Leaking	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	No Service Suggested or Required	

DIFFERENTIAL FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement

Condition	Code	Procedure
NOTE: **Determine and correct cause.**		
Burned	Further inspection required	
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
NOTE: **Further testing necessary to determine condition of fluid.**		
fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Further inspection required	

DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td colspan="3">NOTE:
Require inspection of mating and sealing surface and repair or replace as necessary.</td></tr>
<tr><td>Missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Threads Damaged</td><td>A</td><td>Require repair or replacement</td></tr>
</table>

FILTERS AND SCREENS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>At service interval</td><td>3</td><td>Suggest replacement</td></tr>
<tr><td>Bent, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Exceeding service interval</td><td>3</td><td>Suggest replacement</td></tr>
<tr><td>Missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Near service interval</td><td>3</td><td>Suggest replacement</td></tr>
<tr><td>Restricted</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Further inspection may be required to determine the source of restriction or contamination.</td></tr>
<tr><td>Torn</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Worn, affecting performance (metal or nylon screen type)</td><td>A</td><td>Require repair or replacement</td></tr>
</table>

FLUIDS AND LUBRICANTS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Additive depletion</td><td>A</td><td>Require replacement of fluid</td></tr>
<tr><td>Application incorrect</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine and correct cause.</td></tr>
<tr><td>Burned</td><td colspan="2">Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Fluid that is burned indicates a serious problem. Determine and correct the cause.</td></tr>
<tr><td>Contaminated, for example, fluid other than the specified fluid present</td><td>A</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</td></tr>
<tr><td>Contaminated, for example, fluid other than the specified fluid present</td><td>B</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</td></tr>
</table>

Condition	Code	Procedure
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Further inspection required	

HOSES, LINES, AND TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	2	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	2	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement

Condition	Code	Procedure
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	1	Suggest repair or replacement

HYDRAULIC FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
Burned	Further inspection required	
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service

Condition	Code	Procedure
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Further inspection required	

LUBRICANTS

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
At service interval	3	Suggest replacement
Beyond service interval	3	Suggest replacement
Burned	Further inspection required	
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correctly specified hydraulic fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Near service interval	3	Suggest replacement
Oxidized	A	Require replacement of fluid
Rubber master cylinder cover gasket distorted and gummy	A	Require service
NOTE: **If a fluid other than brake fluid is present in the system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		

MANUAL TRANSMISSION FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td colspan="3">NOTE:
Determine and correct cause.</td></tr>
<tr><td>Burned</td><td colspan="2">Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Fluid that is burned indicates a serious problem. Determine and correct the cause.</td></tr>
<tr><td>Contaminated, for example, fluid other than the specified fluid present</td><td>A</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.</td></tr>
<tr><td>Contaminated, for example, fluid other than the specified fluid present</td><td>B</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.</td></tr>
<tr><td>Fluid at or beyond service interval</td><td>3</td><td>Suggest replacement</td></tr>
<tr><td>Fluid discolored</td><td colspan="2">No Service Suggested or Required</td></tr>
<tr><td colspan="3">NOTE:
Further testing necessary to determine condition of fluid.</td></tr>
<tr><td>Fluid discolored</td><td colspan="2">No Service Suggested or Required</td></tr>
<tr><td colspan="3">NOTE:
Further testing necessary to determine condition of fluid.</td></tr>
<tr><td>Fluid incorrect</td><td>B</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.</td></tr>
<tr><td>Level incorrect</td><td>B</td><td>Require correction of fluid level</td></tr>
<tr><td>Oxidized</td><td>A</td><td>Require replacement of fluid</td></tr>
<tr><td>Rubber master/ clutch cylinder cover gasket distorted or gummy</td><td>A</td><td>Require service</td></tr>
<tr><td colspan="3">NOTE:
If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.</td></tr>
<tr><td>Varnish deposits present on system components affecting performance</td><td colspan="2">Further inspection required</td></tr>
</table>

MOUNTS (ENGINE, TRANSAXLE AND TRANSMISSION)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken	A	Require replacement
Leaking (hydraulic mount)	A	Require replacement
Mounting hole worn, affecting performance	A	Require replacement
Mounting hole worn, not affecting performance	No Service Suggested or Required	
Rubber deteriorated, affecting performance	A	Require replacement
Rubber deteriorated, not affecting performance	No Service Suggested or Required	
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

TRANSFER CASE FLUID

Condition	Code	Procedure
Additive depletion	A	Require replacement of fluid
Application incorrect	B	Require replacement
NOTE: **Determine and correct cause.**		
Burned	Further inspection required	
NOTE: **Fluid that is burned indicates a serious problem. Determine and correct the cause.**		
Contaminated, for example, fluid other than the specified fluid present	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct brake fluid.**		
Contaminated, for example, fluid other than the specified fluid present	B	Require service
NOTE: **If a fluid other than the specified fluid is present in the hydraulic system which DOES NOT affect the rubber parts, the required service is to flush and fill following OEM specified procedure with the correct hydraulic fluid.**		
Fluid at or beyond service interval	3	Suggest replacement
Fluid discolored	No Service Suggested or Required	

Condition	Code	Procedure
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
NOTE: **If a fluid other than the correctly specified fluid is present in the hydraulic system, the required service is to flush and fill with the correct hydraulic fluid.**		
Level incorrect	B	Require correction of fluid level
Oxidized	A	Require replacement of fluid
Rubber master/ clutch cylinder cover gasket distorted or gummy	A	Require service
NOTE: **If an incorrect fluid is present in the hydraulic system which DOES affect the rubber parts, the required service is to: 1) remove all components having rubber parts from the system, 2) flush lines, 3) repair or replace all components having rubber parts, and 4) fill with correct fluid.**		
Varnish deposits present on system components affecting performance	Further inspection required	

VACUUM HOSES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked line or tube	A	Require replacement
Hard hose	1	Suggest replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted, affecting performance	B	Require repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Suggest replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly	B	Suggest replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement
Surface cracked (weather-checked)	1	Suggest repair or replacement

Condition	Code	Procedure
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

ELECTRICAL SYSTEMS

BATTERIES

NOTE: **Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.**

Definition of Terms

Battery Performance Testing - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.

Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0Ã,Â° F (-17.8Ã,Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

Cranking Amps (CA) - The number of amperes a new, fully charged battery, typically at 32Ã,Â° F (0Ã,Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12volt battery).

OEM Cranking Amps - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.

Condition	Code	Procedure
Battery frozen	Further inspection required	
NOTE: **Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.**		
Battery tests near the ""end of its useful life"" utilizing a tester or on-board monitor able to accurately determine this condition	1	Suggest Replacement
Case leaking	A	Require replacement
Casing swollen	A	Further inspection required
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Circuit open internally	A	Require replacement
Electrolyte contamination	A	Further inspection required
NOTE: **No service suggested or required unless the battery fails performance test, in which case, require replacement.**		
Electrolyte discoloration	A	Further inspection required

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td colspan="3">NOTE:
No service suggested or required unless the battery fails performance test, in which case, require replacement.</td></tr>
<tr><td>Fails to accept and hold charge</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.</td></tr>
<tr><td>Fluid level low</td><td>B</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps), require replacement.</td></tr>
<tr><td>Out of performance specification for battery</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.</td></tr>
<tr><td>Out of specification for application</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.</td></tr>
<tr><td>Post (top or side) burned, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Post (top or side) burned, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Post (top or side) corroded, affecting performance</td><td>A</td><td>Require repair</td></tr>
<tr><td>Post (top or side) corroded, not affecting performance</td><td>2</td><td>Suggest repair</td></tr>
<tr><td>Post (top or side) loose</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Post (top or side) melted, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Post (top or side) melted, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
</table>

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Specific gravity low	B	Further inspection required
NOTE: **Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.**		
State of charge low	A	Further inspection required
NOTE: **Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.**		
Top dirty	2	Suggest cleaning battery
Top wet	A	Require cleaning battery Further inspection required
NOTE: **Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.**		
Vent cap loose	A	Require repair or replacement of vent cap
Vent cap missing	C	Require replacement of vent cap

BATTERY CABLES

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
NOTE: **Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.**		
Insulation damaged, conductors not exposed	1	Suggest replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

BATTERY TRAYS AND HOLD DOWN HARDWARE

Condition	Code	Procedure
Battery improperly secured	2	Suggest repair
Bent, affecting performance	A	Require repair or replacement
Bent, not affecting performance	No Service Suggested or Required	
Broken, affecting performance	A	Require repair or replacement
Broken, not affecting performance	No Service Suggested or Required	
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Water drain clogged	A	Require repair

BULBS, SEALED BEAMS AND LEDS

NOTE: **Does not include soldered-in components.**

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement

Condition	Code	Procedure
NOTE: **Application incorrect includes wrong bulb coating or color.**		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	No Service Suggested or Required	
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	No Service Suggested or Required	
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement

Condition	Code	Procedure
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

FUSES, FUSIBLE LINKS AND CIRCUIT BREAKERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Blown	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Corroded, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Inoperative	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
Missing	C	Require replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement

GROUND CABLES AND STRAPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

GROUND STRAPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Insulation damaged, exposing conductors	2	Suggest replacement
Loose	A	Require repair
Missing	C	Require replacement
Open	A	Require repair or replacement
Resistance high	A	Require repair or replacement
Terminal resistance (voltage drop) is out of specification	B	Require repair or replacement
Voltage drop out of specification	B	Require repair or replacement

LENSES

Condition	Code	Procedure
Adjustment out of specification	B	Require repair
Application incorrect	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Broken, affecting performance	A	Require replacement
Broken, not affecting performance	No Service Suggested or Required	
Cracked	B	Require replacement
Discolored	A	Require replacement
Leaking	B	Require repair or replacement
Melted, affecting performance	A	Require replacement
Melted, not affecting performance	2	Suggest replacement
Missing	C	Require replacement

SEALED BEAMS

NOTE: **Does not include soldered-in components.**

Condition	Code	Procedure
Adjustment out of specification	B	Require repair or replacement
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Base burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Base corroded, affecting performance	A	Require repair or replacement
Base corroded, not affecting performance	2	Suggest repair or replacement
Base leaking	A	Require repair or replacement
Base loose, affecting performance	B	Require repair or replacement
Base loose, not affecting performance	1	Suggest repair or replacement
Base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Bracket bent, affecting performance	A	Require repair or replacement
Bracket bent, not affecting performance	No Service Suggested or Required	
Bracket broken, affecting performance	A	Require replacement
Bracket broken, not affecting performance	No Service Suggested or Required	
Bracket corroded, affecting performance	A	Require repair or replacement
Bracket corroded, not affecting performance	2	Suggest repair or replacement
Bracket cracked, affecting performance	A	Require repair or replacement
Bracket cracked, not affecting performance	1	Suggest repair or replacement
Bracket loose, affecting performance	A	Require repair or replacement
Bracket loose, not affecting performance	1	Suggest repair or replacement
Bracket missing	C	Require replacement
Burned out	A	Require replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		

Condition	Code	Procedure
Connector missing	C	Require replacement
Corroded, affecting performance	A	Require repair or replacement
Corroded, not affecting performance	2	Suggest repair or replacement
Cracked	B	Require replacement
Intermittent	A	Require replacement
Lamp base melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Seized in socket	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

WASHER PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation.**		
Leaking externally	A	Require repair or replacement
Leaking internally	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Resistance out of specification	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

WIPER ARMS AND BLADES

NOTE: **Windshield coatings or waxes can cause blades to not function as intended. Clean surface before making final judgment about blade replacement.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching socket stripped	A	Require replacement
Bent	A	Require repair or replacement
Loose	2	Suggest repair or replacement
Missing	C	Require replacement
Noisy	2	Suggest repair or replacement
Size incorrect	2	Suggest replacement
Tension insufficient	B	Require repair or replacement
Torn	A	Require replacement
Worn, affecting performance	A	Require replacement

Condition	Code	Procedure
Worn, not affecting performance	1	Suggest replacement

WIPER HOSES AND NOZZLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Blocked	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Spray pattern incorrect	2	Suggest repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

WIPER PUMP RESERVOIRS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Cap missing	C	Require replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement

ENGINE PERFORMANCE AND MAINTENANCE

NOTE: **CHEMICAL ENGINE DECARBONIZATION is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.**

NOTE: **SUGGEST Chemical Engine Decarbonization service every 15,000 miles or 12 months.**

NOTE: **CONTAMINATED OIL SYSTEM SERVICE is an event based process (beyond that of a normal oil and filter change) performed to remove coolant, water or fuel contamination. Contamination increases oil's oxidation rate and has been shown to result in increased engine wear and reduced oil flow. CAUTION: Some OEM's (including GM and Honda) have issued Technical Service Bulletins advising that Chemical Crankcase Flushing may damage some engine components and that such damage will not be covered by the manufacturer's new car warranty.**

ACCESSORY BELTS

Condition	Code	Procedure

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

AIR FILTER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Paper filter element oil-soaked	A	Require replacement
NOTE: **Further inspection required to determine cause.**		
Restricted, affecting performance	A	Require replacement
Water-contaminated	A	Require replacement
NOTE: **Further inspection required to determine cause.**		

AIR FILTER GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement

AIR FILTER HOUSINGS AND GASKETS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement
Missing	C	Require replacement

AIR PUMP BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

BATTERIES

NOTE: **Proper operation of any electrical system or component can be affected by battery condition. The battery(ies) must meet or exceed minimum specification for vehicle as equipped and test to that specific battery's CCA.**

Definition of Terms

Battery Performance Testing - Testing that determines whether or not a battery meets both vehicle OEM and battery manufacturer's specifications.

Cold Cranking Amp (CCA) Rating - The number of amperes a new, fully charged battery at 0Ã‚Â° F (-17.8Ã‚Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12-volt battery).

Cranking Amps (CA) - The number of amperes a new, fully charged battery, typically at 32Ã‚Â° F (0Ã‚Â° C) can deliver for 30 seconds and maintain at least a voltage of 1.2 volts per cell (7.2 volts for a 12volt battery).

OEM Cranking Amps - The minimum CCA required by the original vehicle manufacturer for a specific vehicle.

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Battery frozen</td><td colspan="2">Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Do not attempt to charge a frozen battery. Allow battery to warm thoroughly and then performance-test. If battery fails performance test, require replacement.</td></tr>
<tr><td>Battery tests near the ""end of its useful life"" utilizing a tester or on-board monitor able to accurately determine this condition</td><td>1</td><td>Suggest Replacement</td></tr>
<tr><td>Case leaking</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Casing swollen</td><td>A</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
No service suggested or required unless the battery fails performance test, in which case, require replacement.</td></tr>
<tr><td>Circuit open internally</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Electrolyte contamination</td><td>A</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
No service suggested or required unless the battery fails performance test, in which case, require replacement.</td></tr>
<tr><td>Electrolyte discoloration</td><td>A</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
No service suggested or required unless the battery fails performance test, in which case, require replacement.</td></tr>
<tr><td>Fails to accept and hold charge</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
This phrase refers to a battery that fails to either accept and/or retain a charge using appropriate times listed in the Battery Charging Guide of the BCI Service Manual, battery charger operating manual, or battery manufacturer's specifications.</td></tr>
<tr><td>Fluid level low</td><td>B</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Determine cause of low fluid level. Refill to proper level(s) with water (distilled water preferred). Recharge battery and performance-test. If battery does not meet specifications, require replacement. If battery is sealed type (non-removable filler caps), require replacement.</td></tr>
<tr><td>Out of performance specification for battery</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
The battery may meet vehicle's OEM specifications for that vehicle but test below the minimum specifications defined by the battery manufacturer.</td></tr>
<tr><td>Out of specification for application</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
The battery may meet battery manufacturer's specifications but test below the minimum specification defined by the vehicle's OEM for that vehicle.</td></tr>
</table>

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Post (top or side) burned, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Post (top or side) burned, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Post (top or side) corroded, affecting performance</td><td>A</td><td>Require repair</td></tr>
<tr><td>Post (top or side) corroded, not affecting performance</td><td>2</td><td>Suggest repair</td></tr>
<tr><td>Post (top or side) loose</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Post (top or side) melted, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Post (top or side) melted, not affecting performance</td><td>2</td><td>Suggest repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
Determine cause and correct prior to repair or replacement of part.</td></tr>
<tr><td>Specific gravity low</td><td>B</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.</td></tr>
<tr><td>State of charge low</td><td>A</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Recharge and test to manufacturer's specifications. If battery fails performance test, require replacement.</td></tr>
<tr><td>Top dirty</td><td>2</td><td>Suggest cleaning battery</td></tr>
<tr><td>Top wet</td><td>A</td><td>Require cleaning battery Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Check fluid level and adjust to manufacturer's specification. Suggest checking charging system for proper operation.</td></tr>
<tr><td>Vent cap loose</td><td>A</td><td>Require repair or replacement of vent cap</td></tr>
<tr><td>Vent cap missing</td><td>C</td><td>Require replacement of vent cap</td></tr>
</table>

BATTERY CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest replacement
NOTE: **Exposed conductor at replacement (aftermarket) terminal end does not require repair or replacement.**		
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Suggest repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

BELT IDLER ASSEMBLIES (ACCESSORY AND CAM BELTS)

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Cracked	2	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Seized	A	Require repair or replacement

BELT TENSIONERS (ACCESSORY AND CAM BELT)

Condition	Code	Procedure
Alignment incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Bearings worn	1	Suggest replacement
Belt tension incorrect	B	Require adjustment or repair
Cracked	B	Suggest replacement
Missing	C	Require replacement
Noisy	2	Suggest replacement
Pulley damaged, affecting belt life	A	Require replacement
Seized	A	Require repair or replacement

CHEMICAL ENGINE DECARBONIZATION

NOTE: **Chemical engine decarbonization is a process utilizing chemicals to remove soft and semi-hardened gum, varnish, resin and carbon deposits from the air/fuel delivery systems and combustion chambers of gasoline internal combustion engines, providing benefits that include improved fuel economy, performance and driveability and reduced emissions. This process is performed to remove deposits preferably prior to deposit accumulation and hardening which may require costly mechanical deposit removal or component replacement.**

NOTE: **SUGGEST Chemical Engine Decarbonization service every 15,000 miles or 12 months.**

COMBUSTION CHAMBER CLEANING

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

COOLANT RECOVERY TANKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require repair or replacement

Condition	**Code**	**Procedure**
Missing (if original equipment)	C	Require replacement

COOLANT

Condition	**Code**	**Procedure**
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement
NOTE: **The system should be drained and/ or flushed and refilled with correct coolant according to OEM recommended service interval and procedures.**		
Contaminated	B	Require replacement or recycling Further inspection required
NOTE: **Determine source of contamination and require correction prior to coolant replacement.**		
Fluid discolored	No Service Suggested or Required	
NOTE: **Further testing necessary to determine condition of fluid.**		
Level incorrect	B	Require correction of fluid level
NOTE: **Determine source of incorrect level and suggest repair.**		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

DISTRIBUTOR CAPS

Condition	**Code**	**Procedure**
Application incorrect	B	Require replacement
Arcing	A	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Burned	A	Require replacement
Carbon button missing	A	Require replacement
Carbon button worn, affecting performance	A	Require replacement
Carbon button worn, not affecting performance	1	Suggest replacement
Carbon-tracked	A	Require replacement
Cracked	B	Require replacement
Loose	B	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal eroded, affecting performance	A	Require repair or replacement
Terminal eroded, not affecting performance	No Service Suggested or Required	
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

DISTRIBUTOR ROTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Carbon-tracked	A	Require replacement
Contact burned	A	Require replacement
Corroded	1	Suggest replacement
Eroded	1	Suggest replacement
Loose	B	Require repair or replacement
Out of specification	B	Require replacement

ENGINE COOLING SYSTEMS

NOTE: **Overheating, poor engine performance, and insufficient cabin heat can be affected by, but are not limited to, all of the components in the engine cooling system.**

ENGINE DECARBONIZATION

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

ENGINE OIL DRAIN PLUGS AND GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
NOTE: **Some OEMs require replacement of drain plug gasket when removing drain plug. Inspect threads in oil pan for damage.**		

ENGINE OIL FILTERS AND CANISTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Bulged	A	Require replacement. Further inspection required
NOTE: **Inspect pressure relief valve.**		
Canister attaching hardware broken	A	Require repair or replacement of hardware
Canister attaching hardware loose	A	Require repair
Canister attaching hardware missing	C	Require replacement
Canister attaching hardware not functioning	A	Require repair or replacement of hardware
Center tube collapsed	A	Require replacement. Further inspection required
NOTE: **Inspect bypass.**		
Dented	2	Suggest replacement. Further inspection required
NOTE: **Determine cause, such as broken motor mount.**		
Leaking	B	Require repair or replacement

ENGINE OIL

Condition	Code	Procedure
Additive Depletion	A	Require replacement of fluid
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Contaminated	A	Require replacement of oil and filter; Further Inspection Required
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water when changing oil.**		
Fluid discolored	No Service Suggested or Required	
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid incorrect	B	Require service
Level Incorrect	B	Adjust to correct level. Further Inspection Required.
NOTE: **Determine cause of incorrect level such as leaking gaskets or contamination by engine coolant, fuel or water.**		
Oxidized	A	Require replacement of fluid

FUEL FILTERS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with OEM recommended service interval
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	2	Suggest replacement

FUEL INJECTOR CLEANING

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

FUEL INJECTORS

Condition	Code	Procedure
15,000 miles or 12 months beyond most recent Chemical Engine Decarbonization	5	Suggest chemical engine decarbonization
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement

Condition	Code	Procedure
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

FUEL SYSTEM CLEANING SERVICE

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

HOSE CLAMPS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

HOSE CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	A	Require replacement

Condition	Code	Procedure
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

HOSE COUPLERS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Safety clip missing (not leaking)	C	Require replacement of safety clip
Stripped	A	Require replacement

HOSES AND TUBES (FUEL LINES, RADIATOR, VACUUM, BY-PASS, HEATER, RECOVERY TANK AND OIL COOLERS)

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Connected incorrectly	A	Require repair
Corroded, not reusable	1	Suggest replacement
Cracked	B	Require replacement
Dry-rotted	1	Suggest repair or replacement
Hard	1	Suggest repair or replacement
Inner fabric (webbing) damaged	A	Require replacement
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Outer covering damaged	1	Suggest replacement
Outer covering damaged to the extent that the inner fabric is visible	A	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Safety clip missing	C	Require replacement
Spongy	1	Suggest repair or replacement
Stripped	A	Require replacement

Condition	Code	Procedure
Swollen	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

IGNITION WIRES (SECONDARY)

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Carbon-tracked	A	Require replacement
Corroded	1	Suggest repair or replacement
Insulation leaking (shorted)	A	Require repair or replacement
Metal heat shield bent	2	Suggest repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Resistance incorrect	B	Require replacement
Routed incorrectly	B	Suggest repair

NOTE:

If improper routing affects the performance of other systems, require repair. Proper routing, hardware, heatshields, etc., are intended to prevent premature failure of secondary ignition components.

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

NOTE:

Determine cause and correct prior to repair or replacement of part.

Condition	Code	Procedure
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

INTAKE CLEANING

NOTE: **See CHEMICAL ENGINE DECARBONIZATION.**

O2 SENSORS

Condition	Code	Procedure

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require repair or replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement. Further inspection required
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	A	Require repair or replacement
Missing	C	Require replacement
Resistance out of specification	B	Require repair or replacement
Restricted, affecting performance	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement

Condition	Code	Procedure
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

PCV BREATHER ELEMENTS

Condition	Code	Procedure
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Leaking	A	Require replacement
Melted	A	Required replacement
Missing	C	Require replacement
Restricted, affecting performance	A	Require replacement
Restricted, not affecting performance	1	Suggest replacement
Water-contaminated	A	Require replacement

PCV VALVES

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement to comply with vehicle's OEM recommended service intervals
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Grommet broken	A	Require repair or replacement of grommet
Grommet missing	C	Require replacement of grommet
Grommet not functioning	A	Require repair or replacement of grommet
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require replacement

RADIATOR CAPS AND PRESSURIZED EXPANSION TANK CAPS

Condition	Code	Procedure
Application incorrect	B	Require replacement

Condition	Code	Procedure
Coolant recovery check valve inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Fails to maintain proper pressure	B	Require replacement
Gasket missing	C	Require replacement of gasket
Missing	C	Require replacement
Seal missing	C	Require replacement of seal

SPARK PLUGS

NOTE: **You are not required to replace spark plugs in sets. However, you may suggest replacement of the other plugs for preventive maintenance.**

Condition	Code	Procedure
Application incorrect	B	Require replacement
At or beyond service interval	3	Suggest replacement
Electrode eroded	1	Suggest replacement
Fouled	A	Require repair or replacement
NOTE: **Determine cause of fouling and suggest repair.**		
Gap incorrect	B	Require repair or replacement
Improperly Indexed	Remove and Reinstall following manufacturers installation requirements	
Insulation broken	A	Require replacement
Insulator cracked	A	Require replacement
Leaking compression	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

THERMOSTATS AND HOUSINGS

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Housing corroded	1	Suggest replacement of housing
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Installation incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement

Condition	Code	Procedure
Thermostat missing	C	Require replacement of thermostat
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement

THROTTLE BODY CLEANING

NOTE: See CHEMICAL ENGINE DECARBONIZATION.

TIMING BELTS

Condition	Code	Procedure
Adjustment incorrect	B	Suggest adjustment
NOTE: **Inspect belt tensioners, pulleys, and cover.**		
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
At or beyond service interval	3	Suggest replacement to comply with vehicle OEM recommended service intervals
Broken	A	Require replacement
Cam timing out of specification	B	Require repair
Cracked	1	Suggest replacement
Fluid-soaked	1	Suggest replacement. Further inspection required
Frayed	1	Suggest replacement
Missing	C	Require replacement
NOTE: **Internal engine damage may result from timing belt damage/failure.**		
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Teeth missing	A	Require replacement
Tension out of specification	B	Require adjustment or replacement

VACUUM HOSES, TUBES AND CONNECTIONS (NON-METALLIC)

Condition	Code	Procedure
Leaking	A	Require repair or replacement
Melted	A	Require replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Surface cracks (dry-rotted)	1	Suggest replacement

EXHAUST SYSTEMS

WARNING: **Federal EPA rules prohibit altering an exhaust system in any way that defeats the emission reduction components of a vehicle. Be sure to review and adhere to EPA policy on removing and replacing catalytic converters. Where state or local laws are stricter, they take precedence over these guidelines.**

NOTE: **Some exhaust systems are of a welded design. It is not required that the entire system be replaced. Determine the need to replace individual components based on conditions of component.**

EXHAUST AND TAIL PIPES

Condition	Code	Procedure
Broken bracket	A	Require repair or replacement
Pipe Bent Out Of Position	B	Require repair or replacement
Pipe Broken	A	Require repair or replacement
Pipe Cracked	B	Require repair or replacement
Pipe Leaking	A	Require replacement
Pipe Missing	C	Require replacement
Pipe Plugged	A	Require replacement
Pipe Weak Due To Corrosion, But No Leaks Present	1	Suggest replacement
Weld Broken	A	Require repair or replacement

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

NOTE: **AIR CONDITIONING SYSTEM FLUSHING utilizes chemicals or refrigerant to remove oil, debris and contaminants from the evaporator, condenser, hoses or metal lines.**

NOTE: **An INLINE FILTER, both high and low side, protects a/c components from residual debris in the system. An inline filter or suction screen is suggested when a condenser, evaporator, compressor, expansion valve, accumulator/drier, hoses or metal lines is replaced, or if debris is found in the system during an a/c repair. An inline filter is suggested to help prevent future component damage and increase system longevity.**

BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement

Condition	Code	Procedure
Worn so it contacts bottom of pulley	A	Require replacement

CABIN AIR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

COOLANT

Condition	Code	Procedure
Acidity (pH) incorrect	1	Suggest correction or replacement
At or beyond service interval	3	Suggest replacement
Contaminated	B	Require replacement or recycling. Further inspection required
NOTE: **Determine source of contamination and require correction prior to coolant replacement.**		
Fluid discolored	No Service Suggested or Required	
NOTE: **Further testing necessary to determine condition of fluid.**		
Level incorrect	B	Require filling to proper level
NOTE: **Determine source of incorrect level and suggest repair.**		
Mixture incorrect	B	Require correction or replacement
Type incorrect	B	Require replacement

EVAPORATOR DRAIN TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require replacement
Missing	C	Require replacement
Restricted	A	Require repair or replacement
Routed incorrectly	B	Require repair

EVAPORATOR FILTERS

Condition	Code	Procedure
Air flow obstruction	A	Require cleaning or replacement
At or beyond service interval	3	Suggest replacement
Microbial growth causing odor	A	Require replacement of filter
Missing	C	Require replacement

IN-LINE FILTERS

Condition	Code	Procedure
Connection leaking	A	Require repair or replacement
Leaking	B	Require repair or replacement
Restricted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

VACUUM HOSES AND TUBES

Condition	Code	Procedure
Disconnected	A	Require repair
Leaking	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	A	Require repair or replacement
Missing	C	Require replacement
Oil-soaked (spongy)	1	Suggest replacement
Restricted	A	Require repair or replacement
Routing incorrect	B	Require repair
Surface cracks (dry-rotted)	1	Suggest replacement

STEERING AND SUSPENSION, WHEEL ALIGNMENT, WHEELS AND TIRES

NOTE: **Steering and Suspension are complex systems made up of a variety of interdependent components and controls. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.**

NOTE: **Listed repair conditions assume that the problem has been isolated to the specific component by proper testing procedures. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications for both ride height and alignment angle tolerances.**

NOTE: **Improper alignment geometry, and/or improper tire/wheel fitment may affect other systems such as Adaptive Cruise Control, Electronic Stability Control, Electronic Traction Control and Variable Ratio Steering. These systems may require attention after an alignment or suspension service is performed. Care must be taken to identify these vehicles/systems before any repair procedures are performed. Failure to follow OEM guidelines when servicing interrelated systems could result in an unsafe condition.**

CAUTION: **Do not use ride height altering or load compensating components, such as variable rate springs or coil over shocks on vehicles with height sensing or load sensing proportioning- valve equipped braking systems, unless these components are supplied as original equipment.**

HYDRAULIC HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

POWER STEERING BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

POWER STEERING FLUID

Condition	Code	Procedure
50,000 miles or greater on OE fluid (in absence of published manufacturer interval)	5	Suggest Replacement
NOTE: **One time only fluid exchange**		
Additive Depletion	A	Require replacement of fluid
Fluid at or beyond service interval	3	Suggest fluid replacement

Condition	Code	Procedure
Fluid contaminated (i.e. fluid other than power steering fluid present)	B	Require flushing and refilling of the system
NOTE: **Determine and correct source of contamination. OEM specifications must be followed for fluid type.**		
Fluid discolored	No Service Suggested or Required	
NOTE: **Further testing necessary to determine condition of fluid.**		
Fluid level incorrect	B	Require adjustment of fluid level
Fluid type incorrect	B	Require flushing and refilling with correct fluid
Oxidized	A	Require replacement of fluid

POWER STEERING HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES

NOTE: **You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for one or more of the following: improved performance or preventive maintenance; part is close to the end of its useful life; to extend tire life; to balance ride and handling; or to improve stopping distance. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications. Under no circumstances should**

a technician bend struts or strut housings. A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details. If vehicle is equipped with OEM coil over shocks, apply the conditions for coil springs from the Springs: Coil, Leaf, and Torsion Bar section of the Steering and Suspension guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacement with standard shocks for a spring-related condition.

Condition	Code	Procedure
50,000 miles or greater on OEM Shocks or Struts	1	Suggest Replacement
NOTE: **Applies only to OEM hydraulic fluid and/or gas charged shocks and struts, NOT electronically controlled units.**		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require replacement
Body dented	A	Further inspection required
NOTE: **Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.**		
Body punctured	A	Require replacement
Brake hose bracket bent	B	Require repair or replacement
Brake hose bracket missing	C	Require replacement
Brake hose bracket threads damaged	A	Require repair or replacement
Brake hose bracket threads stripped (threads missing)	C	Require replacement
Compression bumper missing	C	Require replacement of compression bumper
Compression bumper split	1	Suggest replacement of compression bumper
Damping (none)	A	Require replacement
Dust boot (bellows) missing	C	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which causes piston rod seal wear.**		
Dust boot (bellows) split	A	Require replacement of boot

Condition	Code	Procedure
NOTE: **If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Dust boot (bellows) torn	A	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Dust shield broken	2	Suggest replacement
NOTE: **This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Dust shield missing	2	Suggest replacement
NOTE: **This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Gland nut (strut housing cap) is not removable using appropriate tool	A	Require replacement of nut and/or housing
NOTE: **Only required if replacing cartridge.**		
Gland nut (strut housing cap) threads damaged	A	Require repair or replacement of nut
Housing dented	A	Further inspection required
NOTE: **Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.**		
Housing punctured	A	Require replacement
Jounce bumper missing	C	Require replacement of jounce bumper
Jounce bumper split	1	Suggest replacement of jounce bumper
Leaking oil, enough for fluid to be running down the body	A	Require replacement
NOTE: **If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.**		
Noisy	2	Further inspection required
NOTE: **If noise is isolated to shock or strut, suggest replacement.**		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Piston rod has surface defect	2	Suggest replacement

Condition	Code	Procedure
Piston rod threads damaged	A	Require repair or replacement
Piston rod threads stripped (threads missing)	A	Require replacement
Seized	A	Require replacement
Shock missing	C	Require replacement
Strut housing bent	A	Require replacement
Strut housing cap (gland nut) is not removable using appropriate tool	A	Require replacement of nut and/or housing
NOTE: **Only required if replacing cartridge.**		
Strut housing cap (gland nut) threads damaged	A	Require repair or replacement of nut
Strut housing cap (gland nut) threads stripped (threads missing)	A	Require replacement of nut
Strut housing severely corroded, affecting structural integrity	A	Require replacement
Strut housing threads damaged	A	Require repair or replacement
Strut housing threads stripped (threads missing)	A	Require replacement
Tire cupping	A	Further inspection required
NOTE: **Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension system. If the shock or strut is found to be contributing to the tire cupping, require replacement.**		

STRUT RODS

Condition	Code	Procedure
Adjusting nut seized	A	Require repair or replacement of hardware
NOTE: **Only required if an alignment is being performed and adjustment of the strut in question is required.**		
Attaching (mating) hole oversized	A	Require repair or replacement of bracket or frame
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Attaching point on bracket or frame corroded, affecting structural integrity	A	Require repair of bracket or frame
Bent, affecting performance	A	Require replacement

Condition	Code	Procedure
Mating (attaching) hole oversized	A	Require repair or replacement of bracket or frame
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

TIRE PRESSURE MONITORING SYSTEM

NOTE: **A Tire Pressure Monitoring System (TPMS) is designed to detect and alert the driver should the air pressure level in one or more of the vehicle's tires, up to all four tires, fall below the manufacturer's recommended inflation pressure or another pre-set level.**

NOTE: **NHTSA does not consider installation of an aftermarket or replacement tire or rim that is not compatible with the TPMS to be a "make inoperative" situation under 49 U.S.C. 30122, provided that the entity does not disable the TPMS malfunction indicator.**

TIRE PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent failure.**		
Loose	B	Require repair or replacement
Missing (Non-OE Wheel and/or Tire Applications)	2	Suggest replacement if appropriate sensor is available
Missing (OE Wheel and Tire Applications)	C	Replacement Reqiuired
Not Responding	Further inspection required	
NOTE: **If sensor does not Wake Up, follow manufacturers recommended diagnostic procedure to determine cause**		

TIRES

NOTE: **These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association When replacing tires, it is suggested that the replacement tires match or**

exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle. Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule. Do not mix size or type (Run Flat, all season, performance, mud and snow) of tires on the same axle. If any flammable emergency tire inflation product has been used on a tire, consult inflation product, manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death. In some vehicles, changing the tire diameter from factory-equipped size can affect drive ability, as well as the performance of ABS and other vehicle systems. Consult the vehicle manufacturer's specifications.

Condition	**Code**	**Procedure**
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement
Bead leaking, caused by tire	A	Require repair or replacement
Bead wire/cord exposed	A	Require replacement
Cord or belt material exposed	A	Require replacement
Cord ply separations	A	Require replacement
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning
Irregular tread wear, affecting performance	2	Suggest replacement
NOTE: **Determine and correct cause of irregular tire wear.**		
Load ratings less than OEM specifications	B	Require replacement
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require replacement
Number of punctures exceeds manufacturer's limit	B	Require replacement
Out of balance	B	Require rebalance of tire/wheel assembly
Ply separation	A	Require replacement
Pull or lead, caused by tire	A	Require repair or replacement
Radial and bias or bias-belted ply tires on same axle	B	Require repair or replacement
Radials are on the front and not on the rear	B	Require repair or replacement
NOTE: **If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.**		
Run flat damage	A	Require replacement
Shoulder cut	A	Require replacement
Shoulder puncture	A	Require replacement
Shoulder with plug	A	Require replacement
Sidewall bulge	A	Require replacement
Sidewall cut	A	Require replacement
Sidewall indentation	No service required or suggested	

Condition	Code	Procedure
Sidewall puncture	A	Require replacement
Sidewall with plug	A	Require replacement
Speed rating designations different on same axle	2	Suggest rotation or replacement
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part
NOTE: **Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.**		
Tires with excessive diameter difference on an all-wheel drive vehicle or four-wheel drive vehicle	B	Require replacement
NOTE: **Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4"" diameter difference.**		
Tires with excessive diameter difference on the same side of a dual-wheel application	B	Require replacement
NOTE: **Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4"" diameter difference.**		
Tread area puncture larger in diameter than manufacturer's specifications	B	Require replacement
Tread missing pieces (chunking), exposing cord	A	Require replacement
Tread missing pieces (chunking), not exposing cord	1	Suggest replacement
Tread separations	A	Require replacement
Tube in tubeless tire	3	Suggest removal of tube
NOTE: **Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel . Assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and! Or wheel listed in these guidelines.**		
Weather-checking	No service required or suggested	
Worn to tread wear indicators	B	Require replacement

VALVE STEMS

NOTE: **Most tire manufacturers suggest replacement of non-TPMS valve stems any time a new tire is installed. For TPMS valve stems, the manufacturer may require replacement of the valve stem, o-ring seals, washers, gaskets, valve cores, compression washers and/or locking nut.**

Condition	Code	Procedure
Bent	2	Suggest replacement
Broken	A	Require replacement

Condition	**Code**	**Procedure**
Cap seized	A	Require repair or replacement
Cut, but not leaking	1	Suggest replacement
Deteriorated (cracking, dry rot)	1	Suggest replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
O-Ring leaking	A	Require replacement of O-Ring
Threads damaged	A	Require repair or replacement
Threads stripped	A	Require replacement
Valve cap missing	C	Require replacement of cap

WHEEL ATTACHMENT HARDWARE

NOTE: **For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.**

Condition	**Code**	**Procedure**
Bent	A	Require replacement
Broken	A	Require replacement
NOTE: **Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.**		
Locking lug nut locking groove damaged	A	Require replacement
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface distorted	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut missing	C	Require replacement
Lug nut rounded	A	Require replacement of nut
NOTE: **Only required if removing wheel.**		
Lug nut seized	A	Require replacement of nut
NOTE: **Only required if removing wheel.**		
Stud incorrect	B	Require replacement of stud
Stud missing	C	Require replacement
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped	A	Require replacement of component with stripped threads

WHEEL BEARINGS, RACES AND SEALS

NOTE: **When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets.**

Determine the need to replace based upon the individual component conditions that follow.

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing and race assembly
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or other damage affecting performance.	B	Require replacement of bearing and race assembly
Seal leaking	A	Require replacement of seal and inspection of bearings
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.**		
Seal missing	C	Require replacement

WHEEL & TIRE SUPPLEMENT

Steering and suspension are complex systems made up of a variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed. Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

NOTE: **When replacing steering and/or suspension components that may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.**

CAUTION: **Do not use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.**

NOTE: **Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.**

WARNING: **These guidelines do not apply to split rims.**

TIRES

When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle.

Consult the vehicle owner's manual or vehicle placard for correct tire size, service description, load index, speed rating and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association (www.us-tra.org)

When replacing fewer than ALL tires on a vehicle, follow the vehicle manufacturer's recommendations as to the placement of the new tires. If it is not possible to follow the vehicle manufacturer's tire replacement recommendations, remember to replace tires on the same axle with the same size, construction, speed rating, and, if possible, similar tread pattern.

Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and non-radial tires are mixed on the same vehicle, the radials must be on the rear. If radial and non-radial tires are used on a vehicle equipped with dual rear tires, radial tires may be used on either axle. High-pressure temporary compact spare tires are exempt from this rule.

Do not mix size or type (all season, performance, mud and snow) of tires on the same axle. When replacing only two tires on front or rear drive vehicles, follow the vehicle manufacturer's recommendations concerning placement. If it is not possible to follow OE recommendations, it is preferable to place the two new tires on the rear for greater stability, greater adhesion affecting steering -- on other than dry pavement -- and overall safety, regardless of whether the vehicle is front or rear wheel drive.

It is particularly important to match all tire sizes and constructions on 4-wheel (4x4) and all-wheel (AWD) drive vehicles unless otherwise specified by vehicle manufacturer. Ideally, all four tires should be replaced at the same time. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

MOUNTING TIRES

Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels.

Mount tires only on same or approved rim widths.

Attempting to mount a tire of one diameter on a wheel of a different diameter , bead taper or flange type may result in serious injury or death.

If any flammable emergency tire inflation product has been used in a tire, consult inflation product manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death.

VEHICLE TIRE PLACARD

Since 1968, cars and light trucks sold in the United States have been required to have a tire information sticker, called a vehicle tire placard. The vehicle tire placard indicates the size of the original equipment tires (including the spare), cold inflation pressure for the tires on both axles as well as the spare, and load index or range. Depending on the vehicle, the vehicle tire placard will either be located on the edge of any door, the doorpost, glove box, fuel door or inside trunk lid. If the tire placard is missing, consult the owner's manual, vehicle manufacturer, or tire manufacturer regarding applicable tire information.

Always refer to the vehicle manufacturer's recommendations before replacing tires. Tires should always be replaced with the same size designation, or approved options, as recommended. Never choose a smaller size with less load carrying capacity than the size on the tire placard. (Some vehicle manufacturers require different-sized tires for either the front or rear axles.)

NOTE: **It is not always possible to select a replacement tire with exactly the same size as shown on the placard. Consult with a vehicle or tire manufacturer for replacement recommendations.**

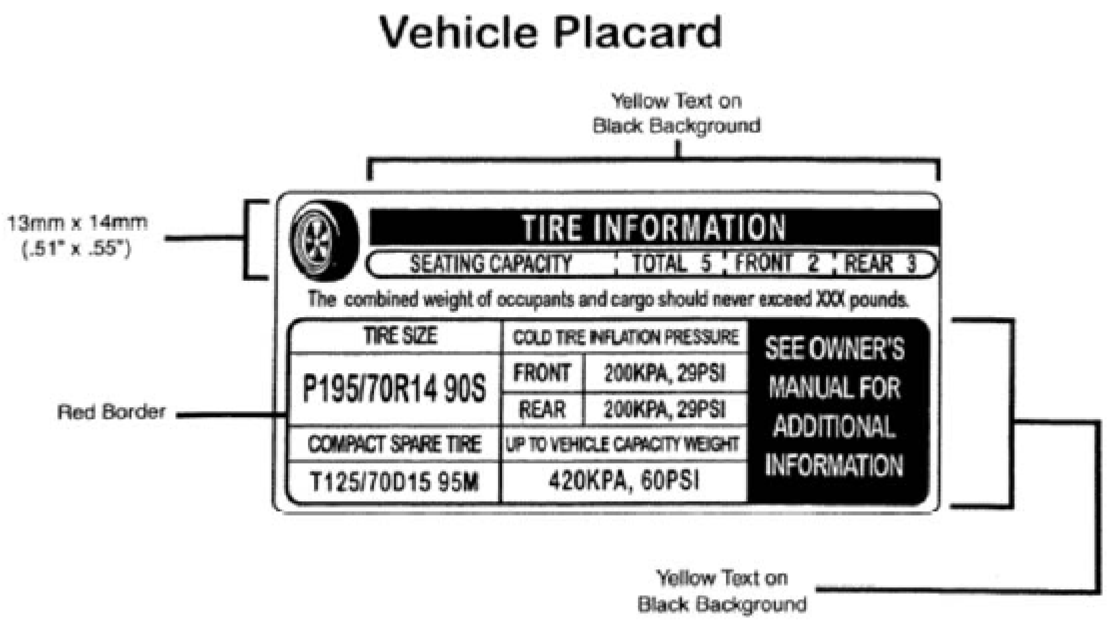

Vehicle Placard
Yellow Text on Black Background
13mm x 14mm (.51" x .55")
TIRE INFORMATION
SEATING CAPACITY
TOTAL 5
FRONT 2
REAR 3
The combined weight of occupants and cargo should never exceed XXX pounds.
TIRE SIZE
COLD TIRE INFLATION PRESSURE
P195/70R14 90S
FRONT
200KPA, 29PSI
REAR
200KPA, 29PSI
COMPACT SPARE TIRE
UP TO VEHICLE CAPACITY WEIGHT
T125/70D15 95M
420KPA, 60PSI
SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION
Red Border
Yellow Text on Black Background

Fig. 12: Vehicle Tire Placard - Typical

TIRE ROTATION

The front tires on most vehicles tend to wear out faster than the rear tires. This is due to the effects of steering the vehicle and the weight transfer that occurs during braking. To ensure that all four tires wear evenly, it is important to rotate them on a regular basis. Tire rotation helps maintain balanced handling because it allows all four tires to wear at the same rate. Keep in mind, as tire wear reduces tread depth, it increases the tires' response to driver inputs. Consequently, by equalizing tire wear at all four corners, dry road performance is actually enhanced. Another advantage of regular rotation is that it allows the tires to be replaced in complete sets rather than in pairs. This maintains handling continuity. It also enables drivers to take advantage of the latest in tire technology, instead of trying to match a pair of older tires.

Most manufacturers list rotation intervals in the scheduled maintenance section of the vehicle service manual and/or the owner's manual. Tire rotation patterns can also be found in these books. If this information is unavailable for a particular vehicle, rotate the tires every 5-7,000 miles following the appropriate rotation sequence shown in the illustrations. After completing a tire rotation, be sure to reset inflation pressures to the manufacturer's recommended specifications indicated on the vehicle tire placard.

To ensure that the proper amount of clamping force is applied to each fastener, follow these guidelines:

- Make sure the area around the lug holes, as well as the wheel and hub mating surfaces are clean and dry. A wire brush can be used to remove corrosion and other debris. Wipe the areas clean using a shop rag.
- Inspect the bolt holes for damage. Do not use a wheel if the bolt holes are deformed.
- Inspect the wheel studs and lug nuts or lug bolts and bolt holes (depending on the vehicle) for damage. Replace or repair any damaged or worn components.
- Always follow a star pattern when tightening lugs.

WHEEL LUG NUT TORQUE & CLAMPING FORCE

Although proper wheel lug nut torque is important, it does not guarantee that the required clamping force will be achieved. For example, excessive corrosion on the wheel and hub mating surfaces will result in improper clamping force, even when the lugs are tightened with a calibrated torque wrench. Low clamping force can also occur if the threads are dirty. This is because dirt causes interference between the mating threads. As a result, the torque wrench will register the correct reading but the clamping force will be inadequate. To improve the chances of achieving the precise clamping force between the wheel and hub, proper torque must be applied to clean components in good condition. Specifications for wheel lug nut torque can be found in the `Tire and Wheel' section of most vehicle service manuals. When specifications are indicated as a range, adjust the torque wrench to the middle of the range to compensate for normal variations in tool calibration.

POPULAR TIRE ROTATION PATTERNS

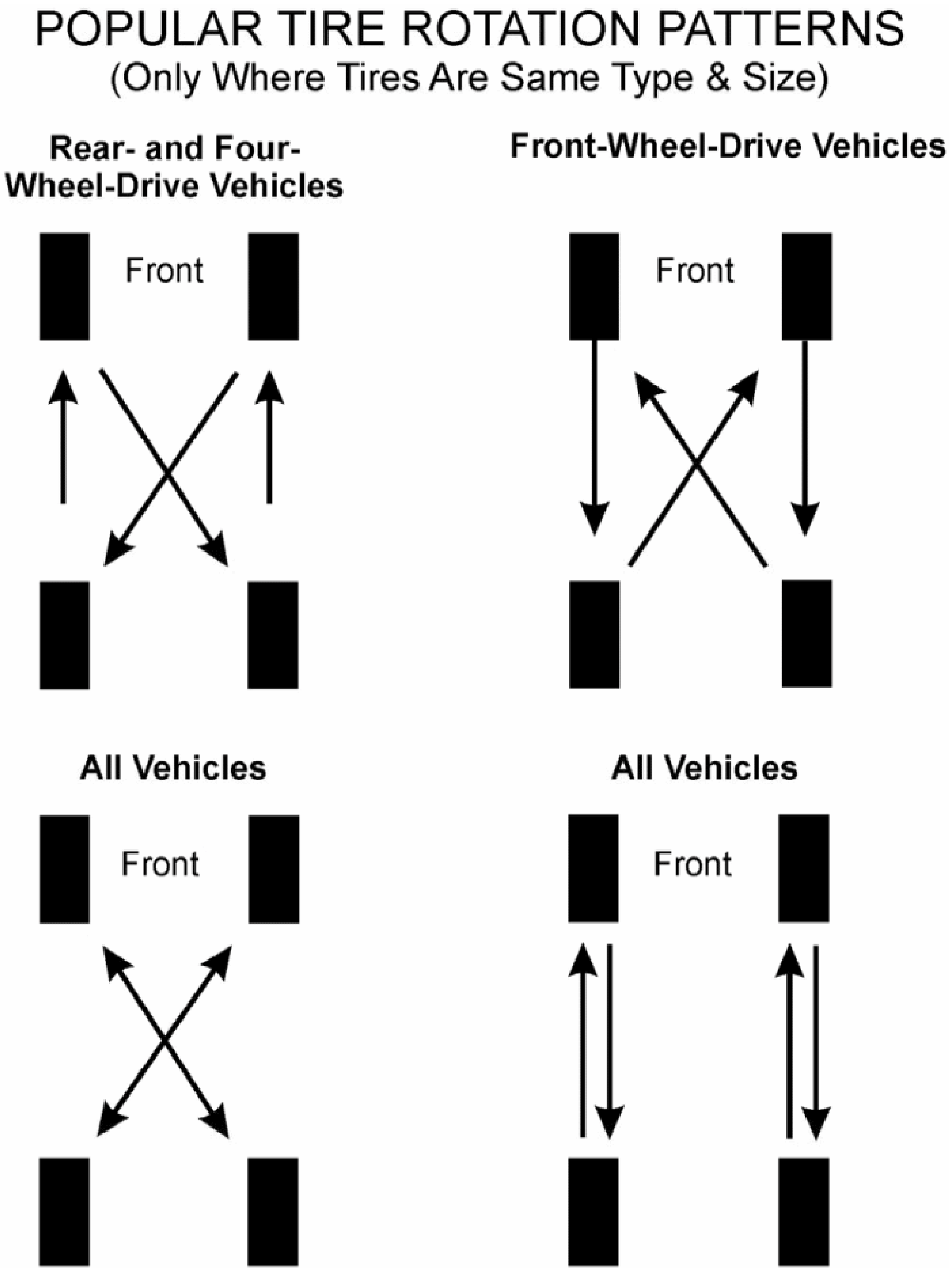

POPULAR TIRE ROTATION PATTERNS
(Only Where Tires Are Same Type & Size)
Rear- and Four-Wheel-Drive Vehicles
Front
Front-Wheel-Drive Vehicles
Front
All Vehicles
Front
All Vehicles
Front

Fig. 13: Popular Tire Rotation Patterns - Without Dual Rear Wheels

Never rotate directional tires from side-to-side since this will reverse their direction of rotation. Directional tires can only be rotated from front to rear or vice versa. Directional tires are typically used on high-performance cars and can be identified by the arrows imprinted on the sidewall.

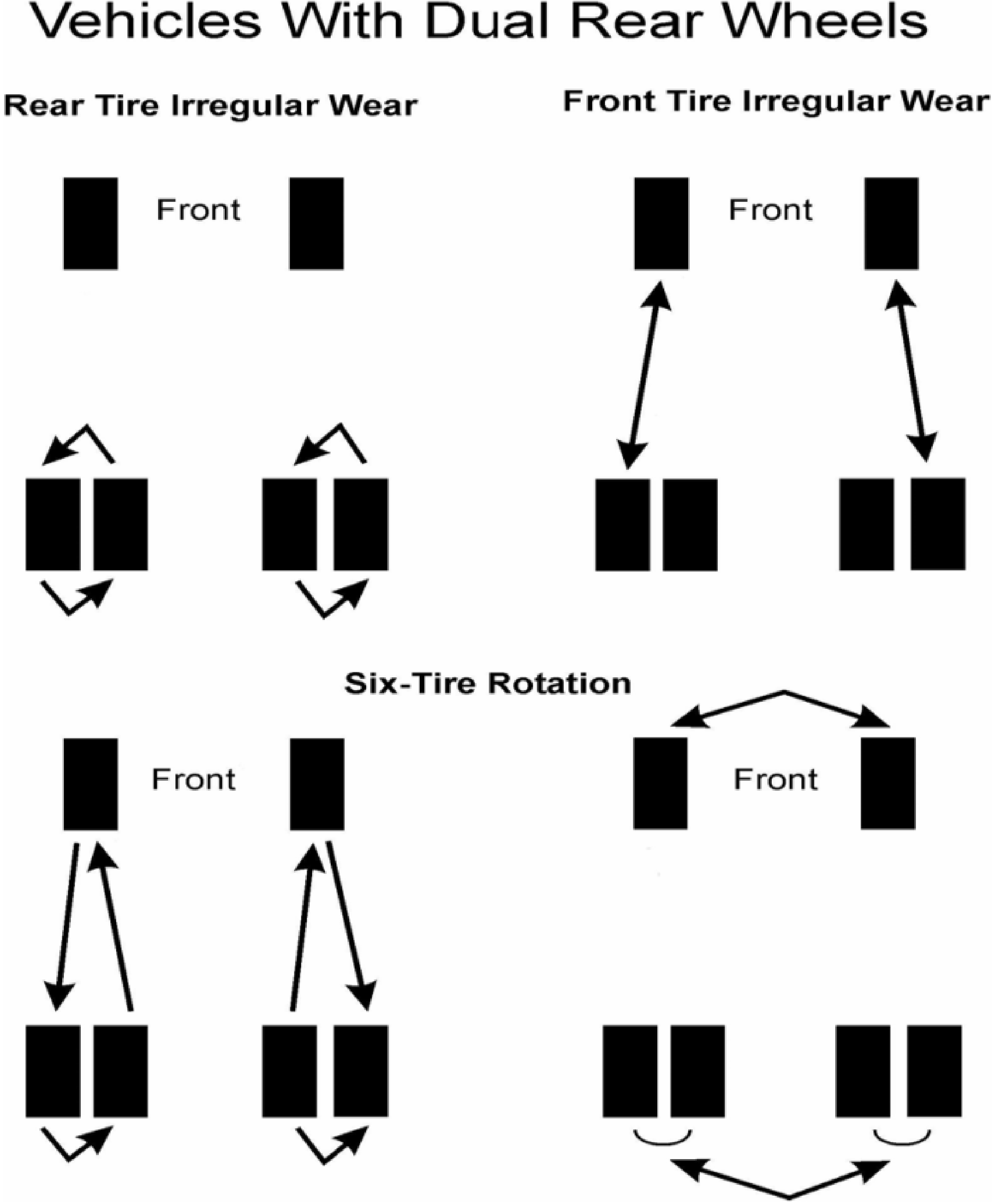


Fig. 14: Popular Tire Rotation Patterns - With Dual Rear Wheels

Some tires cannot be rotated in the manners described. Such tires include uni-directional tires and tires with asymmetric tread designs. Also, some vehicles may have different-sized tires mounted on the front and rear axles, and these different-sized tires also have rotation restrictions. Check your owner's manual or with a tire manufacturer or a tire dealer for proper recommendations for these specific cases.

WHEELS AND RIMS

The wheels on today's vehicles are made of steel, aluminum, or aluminum alloy (a combination of two or more metals). Steel wheels are the least expensive to produce, which is why they come as original equipment on many passenger cars and light trucks. The center section includes the bolt circle, or mounting holes, and is used to attach the wheel to the vehicle. The flange is the outermost lip of the rim, and is the area typically used for attaching wheel (balancing) weights. The rim is formed by rolling a strip of metal and then welding the two ends together. The interior section of the rim has a smaller diameter section called a drop center. This area provides the means for removing and installing a tire, since the bead is not designed to stretch. During removal or installation, most of the tire bead is pushed into the drop center so that the exposed portion can be pulled over the rim. The edges of the rim are flared to form the bead seats, which hold the tire and provide the airtight seal. Many rims include safety humps. These are small elevations on the inside of the bead seats. Safety humps help prevent the tire from falling into the drop center during a blowout. This allows the driver to maintain better directional control of a vehicle running on one or more deflated tires.

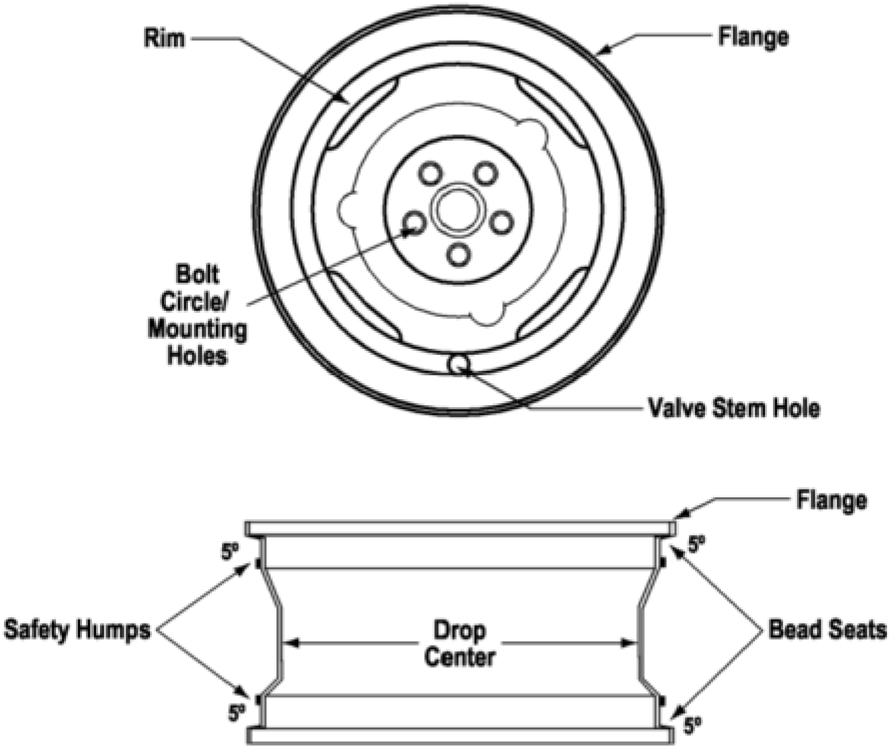


Fig. 15: Steel Wheel

WARNING: **Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Mount tires only on approved rim widths. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Load, cold inflation pressure, and tire construction forces imposed on the rim/wheel must not exceed the rim/wheel manufacturer's recommendations, even if the tire is approved for a higher load or inflation. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.**

TIRE PRESSURE MONITORING SYSTEMS

To avoid damaging sensors when mounting and demounting tires, it is beneficial to know where the sensors are located. Sensor assemblies are commonly attached to the valve stem, with the valve stem acting as an antenna to assist with transmitting RF signals. They may also be strapped to the drop center of the wheel. If this is the case, the sensor assembly should be located in-line with the valve stem.

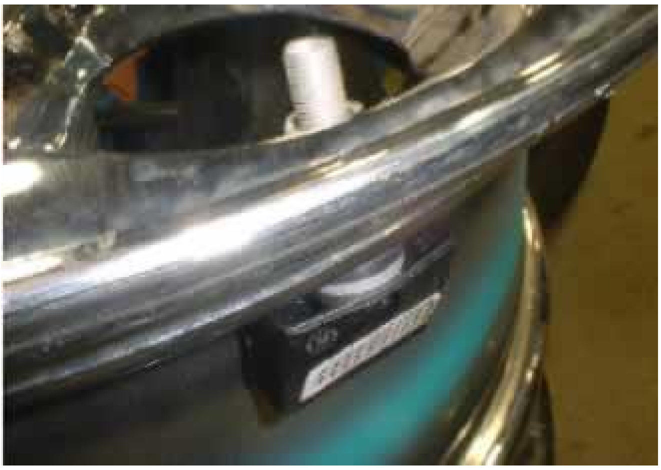


Fig. 16: Valve Stem Mounted Sensor

To avoid damaging sensors when demounting tires, do not break the bead within 45 of either side of sensor assembly locations. Be careful not to damage sensors when mounting tires as well. Sensors are not repairable and require replacement if damaged or when their battery is completely drained. It is recommended that the sensor be carefully "dropped into the tire" prior to demounting to avoid damage.

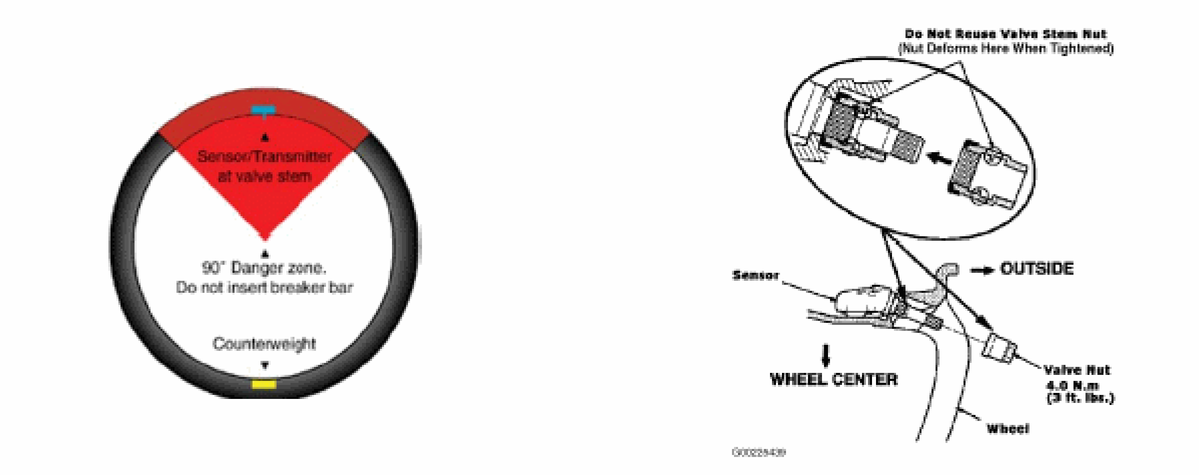
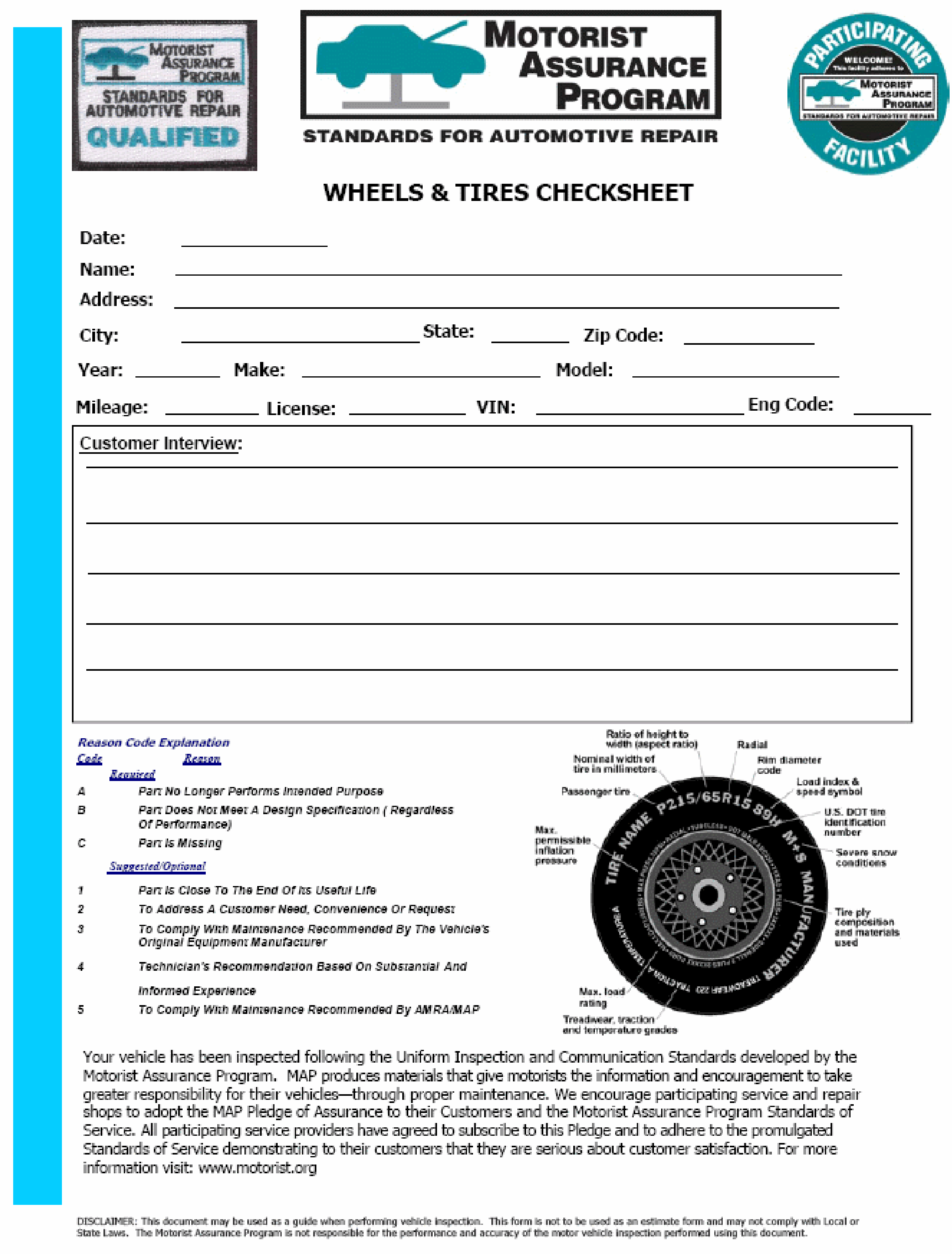

Sensor/Transmitter at valve stem
90° Danger zone.
Do not insert breaker bar
Counterweight
Do Not Reuse Valve Stem Nut
(Nut Deforms Here When Tightened)
Sensor
OUTSIDE
WHEEL CENTER
Valve Nut
4.0 N.m
(3 ft. lbs.)
Wheel
G00225439

Fig. 17: Mounting Sensor

When reinstalling the sensor, it is suggested that the locknut, gasket and valve stem be replaced and torgued to the proper specification. It is also necessary to use the proper valve cap as it is also an integral part of the system.

It may be necessary to reprogram the TPMS when the tires are rotated, when a new sensor is installed, or after the vehicle loses power. This usually requires a scan tool and may involve the use of a special magnet. Refer to the vehicle service manual to properly reprogram the TPMS.

WHEELS & TIRES CHECKSHEET



MOTORIST ASSURANCE PROGRAM

STANDARDS FOR AUTOMOTIVE REPAIR

QUALIFIED

PARTICIPATING FACILITY

WELCOME! This facility adheres to

WHEELS & TIRES CHECKSHEET

Date: ____________

Name: ____________

Address: ____________

City: ____________ State: ________ Zip Code: ____________

Year: ________ Make: ____________ Model: ____________

Mileage: ________ License: ________ VIN: ____________ Eng Code: ________

Customer Interview:

Reason Code Explanation

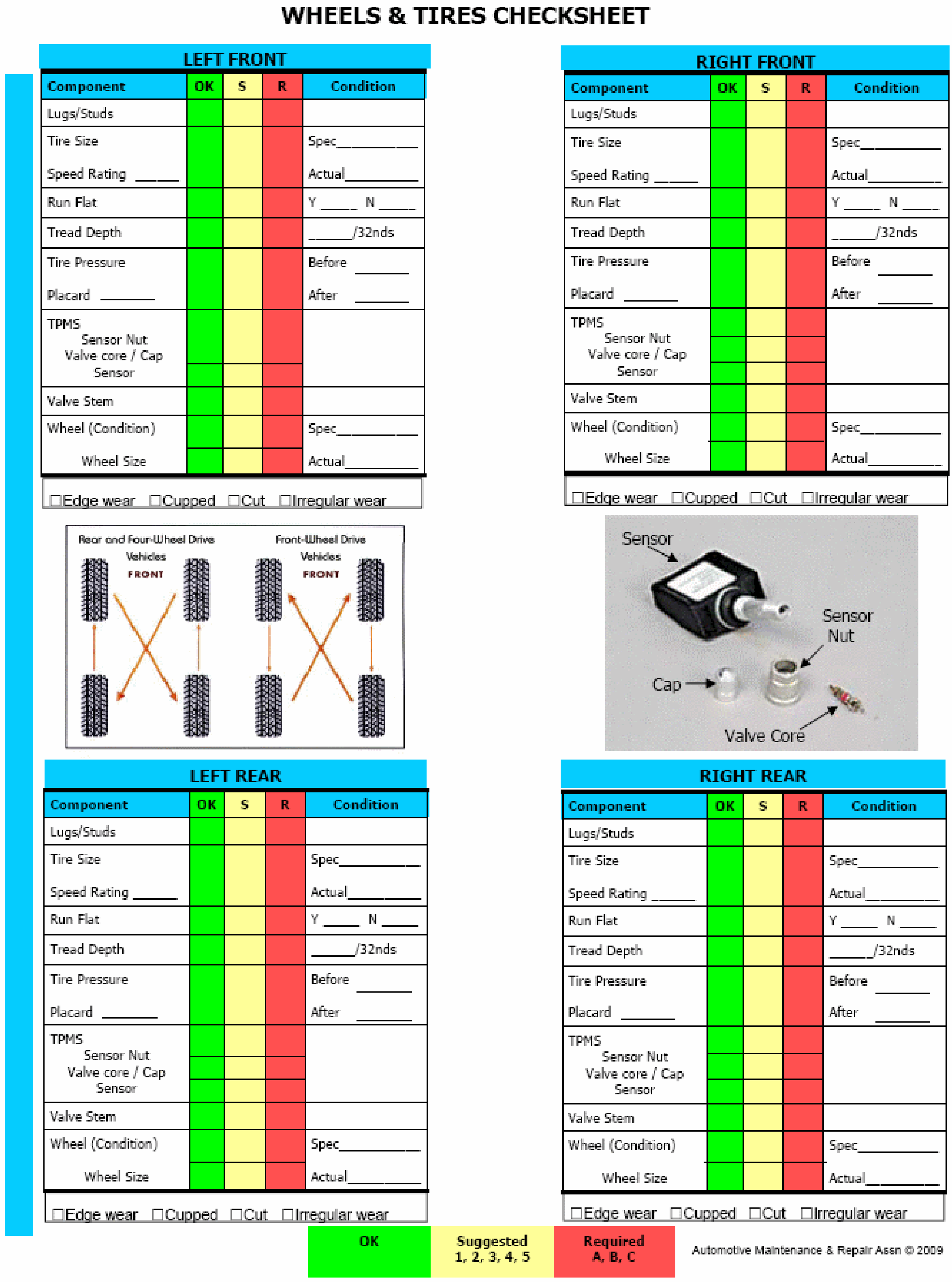
Code	*Reason*
	Required
A	*Part No Longer Performs Intended Purpose*
B	*Part Does Not Meet A Design Specification (Regardless Of Performance)*
C	*Part Is Missing*
	Suggested/Optional
1	*Part Is Close To The End Of Its Useful Life*
2	*To Address A Customer Need, Convenience Or Request*
3	*To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer*
4	*Technician's Recommendation Based On Substantial And Informed Experience*
5	*To Comply With Maintenance Recommended By AMRA/MAP*

Ratio of height to width (aspect ratio)
Radial
Nominal width of tire in millimeters
Rim diameter code
Load index & speed symbol
Passenger tire
U.S. DOT tire identification number
Max. permissible inflation pressure
Severe snow conditions
Tire ply composition and materials used
Max. load rating
Treadwear, traction and temperature grades
P215/65R15 89H
TIRE NAME
M+S
MANUFACTURER
TREADWEAR 220 TRACTION A

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 18: Wheels & Tires Checksheet (1 Of 2)



WHEELS & TIRES CHECKSHEET

LEFT FRONT

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

RIGHT FRONT

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

Rear and Four-Wheel Drive Vehicles
FRONT
Front-Wheel Drive Vehicles
FRONT
Sensor
Sensor Nut
Cap
Valve Core

LEFT REAR

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

RIGHT REAR

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

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Fig. 19: Wheels & Tires Checksheet (2 Of 2)

WHEEL & TIRE - UICS

TIRE PRESSURE MONITORING SYSTEM

NOTE: **A Tire Pressure Monitoring System (TPMS) is designed to detect and alert the driver should the air pressure level in one or more of the vehicle's tires, up to all four tires, fall below the manufacturer's recommended inflation pressure or another pre-set level.**

NOTE: **NHTSA does not consider installation of an aftermarket or replacement tire or rim that is not compatible with the TPMS to be a "make inoperative" situation under 49 U.S.C. 30122, provided that the entity does not disable the TPMS malfunction indicator.**

TIRE PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent failure.**		
Loose	B	Require repair or replacement
Missing (Non-OE Wheel and/or Tire Applications)	2	Suggest replacement if appropriate sensor is available
Missing (OE Wheel and Tire Applications)	C	Replacement Reqiuired
Not Responding	Ã,Â	Further inspection required
NOTE: **If sensor does not Wake Up, follow manufacturers recommended diagnostic procedure to determine cause**		

TIRES

NOTE: **These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle. Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule. Do not mix size or type (Run Flat, all season, performance, mud and snow) of tires on the same axle. If any flammable emergency tire inflation product has been used on a tire, consult inflation product, manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death. In some vehicles, changing the tire diameter from factory-equipped size can affect drive ability, as well as the performance of ABS and other vehicle systems. Consult the vehicle manufacturer's specifications.**

Condition	Code	Procedure
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement
Bead leaking, caused by tire	A	Require repair or replacement
Bead wire/cord exposed	A	Require replacement
Cord or belt material exposed	A	Require replacement

Condition	Code	Procedure
Cord ply separations	A	Require replacement
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning
Irregular tread wear, affecting performance	2	Suggest replacement
NOTE: **Determine and correct cause of irregular tire wear.**		
Load ratings less than OEM specifications	B	Require replacement
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require replacement
Number of punctures exceeds manufacturer's limit	B	Require replacement
Out of balance	B	Require rebalance of tire/wheel assembly
Ply separation	A	Require replacement
Pull or lead, caused by tire	A	Require repair or replacement
Radial and bias or bias-belted ply tires on same axle	B	Require repair or replacement
Radials are on the front and not on the rear	B	Require repair or replacement
NOTE: **If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.**		
Run flat damage	A	Require replacement
Shoulder cut	A	Require replacement
Shoulder puncture	A	Require replacement
Shoulder with plug	A	Require replacement
Sidewall bulge	A	Require replacement
Sidewall cut	A	Require replacement
Sidewall indentation	Ã,Â	No service required or suggested
Sidewall puncture	A	Require replacement
Sidewall with plug	A	Require replacement
Speed rating designations different on same axle	2	Suggest rotation or replacement
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part
NOTE: **Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.**		
Tires with excessive diameter difference on an all-wheel drive vehicle or four-wheel drive vehicle	B	Require replacement
NOTE: **Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4"" diameter difference.**		
Tires with excessive diameter difference on the same side of a dual-wheel application	B	Require replacement
NOTE: **Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4"" diameter difference.**		

Condition	Code	Procedure
Tread area puncture larger in diameter than manufacturer's specifications	B	Require replacement
Tread missing pieces (chunking), exposing cord	A	Require replacement
Tread missing pieces (chunking), not exposing cord	1	Suggest replacement
Tread separations	A	Require replacement
Tube in tubeless tire	3	Suggest removal of tube
NOTE: **Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel . Assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and! Or wheel listed in these guidelines.**		
Weather-checking	Ã,Â	No service required or suggested
Worn to tread wear indicators	B	Require replacement

WHEEL ALIGNMENT

NOTE: **Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to manufacturer specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment. Failure to replace or correct suggested parts or service may prevent a proper alignment. Before performing an alignment check, inspect and verify the following: Tire pressure and size . Vehicle loading . Ride height . Steering and suspension parts only if the inspection reveals that all the above are within published specifications, a wheel alignment check and a proper wheel alignment, if needed, may be performed. Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer. All measurements and specifications must be noted on the inspection report.**

Condition	Code	Procedure
Beyond manufacturer's service interval	3	Suggest alignment check
Dog tracking, shown to be caused by faulty alignment	2	Suggest repair
Drift, shown to be caused by faulty alignment	A	Require alignment
Lead, shown to be caused by faulty alignment	A	Require alignment
Outside manufacturer's specifications	B	Require repair
Part has been changed, affecting alignment	A	Require alignment check
Pull, shown to be caused by faulty alignment	A	Require alignment
Steering wheel off-center	2	Suggest alignment
Tire wear, shown to be caused by faulty alignment	A	Require alignment
Wander, shown to be caused by faulty alignment	A	Require alignment

WHEEL ATTACHMENT HARDWARE

NOTE: **For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.**

Condition	Code	Procedure
Bent	A	Require replacement

Condition	Code	Procedure
Broken	A	Require replacement
NOTE: **Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.**		
Locking lug nut locking groove damaged	A	Require replacement
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface distorted	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut missing	C	Require replacement
Lug nut rounded	A	Require replacement of nut
NOTE: **Only required if removing wheel.**		
Lug nut seized	A	Require replacement of nut
NOTE: **Only required if removing wheel.**		
Stud incorrect	B	Require replacement of stud
Stud missing	C	Require replacement
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped	A	Require replacement of component with stripped threads

WHEELS (RIMS)

NOTE: **Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.**

Condition	Code	Procedure
Bead leaking, caused by wheel	A	Require repair or replacement
NOTE: **Do not attempt to correct a bent rim.**		
Bent hub mounting surface	A	Require replacement
Bent rim, causing vibration	2	Suggest replacement
NOTE: **Do not attempt to correct a bent rim.**		
Broken	A	Require replacement
Cast wheel porous, causing a leak	A	Require repair or replacement
Clip-on balance weight is incorrect type for rim flange	2	Suggest replacement of weight
Corrosion affecting structural integrity	A	Require replacement
Corrosion build-up on wheel mounting surface	A	Require repair
Cracked	B	Require replacement

Condition	Code	Procedure
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning
Load capacity less than OEM specifications	B	Require replacement
Mating surface distorted	A	Require replacement
Offset mismatched on same axle	B	Require replacement
Rivets leaking	A	Require replacement
Run-out beyond OEM specs	B	Require replacement
NOTE: **Some wire-spoke wheels may be repaired.**		
Stud holes elongated	A	Require replacement
NOTE: **Inspect wheel attaching hardware for damage.**		
Welded or brazed repair	2	Suggest replacement
Welds leaking	A	Require replacement
Wheel centering (pilot) hole incorrect	B	Require replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

AUTOMOTIVE TERMINOLOGY & DEFINITIONS

ABRASIVE CLEANING

removing contaminants using a cleaning agent containing abrasive material. Cleaning that requires physical abrasion (e.g., glass bead blasting, wire brushing).

ADDITIVE

in automotive terminology, a substance added to a liquid, such as engine oil, transmission fluid, gear oil or coolant to enhance its properties.

AEROSOL

a cloud consisting of particles dispersed in a gas or gases

AFTERMARKET

broad term that applies to any change after the original purchase, such as adding equipment. When applied to AFVs, it refers to conversion devices or kits for conventional fuel vehicles.

ALIGNMENT

an adjustment to bring parts or components into a line or proper coordination.

ALTERNATOR

a belt driven device that provides electrical current for the vehicle's charging system.

ANTIFREEZE

a material such as ethylene glycol which is added to water to lower its freezing point; used in an automobile's cooling system.

AQUAPLANING

the loss of traction that results when a tire loses sufficient grip on a wet roadway, the tire actually loses contact with the road surface and rides on a thin film of water.

AUTOMATIC TRANSMISSION FLUID (ATF)

the oil that is used in an automatic transmission.

BATTERY ACID

the sulfuric acid solution used as the electrolyte in a battery.

BATTERY CELL

the part of a battery made from two dissimilar metals and an acid solution. A cell stores chemical energy to be used later as electrical energy.

BATTERY SAVER

the battery saver system is an effective way to prevent complete battery discharge when the engine is shut down. Based on the preset time-limit, the system automatically disconnects the battery load when the battery is not being charged. Depressing the reset push button will enable the battery to be reconnected for additional periods of time. Critical systems can be set up to have battery power maintained.

BATTERY

batteries are the principal energy storage devices for hybrid electric vehicles (HEVs). Desirable attributes of high-power batteries for HEV applications are high-peak and pulse- specific power, high specific energy at pulse power, a high charge acceptance to maximize regenerative braking utilization, and long calendar and cycle life. Developing methods/designs to balance the packs electrically and thermally, developing accurate techniques to determine a battery's state of charge, and developing abuse-tolerant batteries, and recyclability are additional technical challenges.

BEARING RACE

the machined surface of a bearing assembly against which the needles, balls or rollers ride. The outer race is also called a cup.

BEARING

part that supports and reduces friction between a stationary and moving part or two moving parts.

BLEEDER VALVE

a valve located on disc brake calipers, wheel cylinders and some master cylinders that allows air and fluid to be removed from the brake system.

BOILING POINT

the temperature at which a liquid turns to vapor.

BRAKE DRAG

a condition that occurs when brake pads or shoes are in continuous contact with the disc brake rotors or brake drums.

BRAKE FLUSHING

a procedure to clean the brake hydraulic system with fresh, clean fluid that should be performed whenever new parts are installed, if there is any doubt as to the grade of fluid in the system, if a glycol fluid has been mixed with a silicone-based fluid, or if the fluid has been contaminated with petroleum or mineral based fluids.

BRAKE HOSE

flexible hoses that connect the brake lines on the chassis with the calipers or wheel cylinders, or the junction block on a solid axle.

BRAKE LINE

metal tubing that carries the brake fluid from the master cylinder to other brake system components.

CHARGE

the electrical current that passes through the battery to restore it to full power; to fill, or bring up to the specific level, an A/C system with refrigerant; the required amount of refrigerant for an A/C system.

CHARGING SYSTEM

the system that supplies electrical power for vehicle operation and recharges the battery.

CHEMICAL CLEANING

relies primarily on chemical action to remove dirt, grease, scale, paint or rust.

COLD CRANKING AMPS

the amount of cranking amperes that a battery can deliver in 30 seconds at OÃ,Â°F (- 18Ã,Â°C).

COLD START

difficulty of starting an internal combustion engine in cold weather because of gasoline, which evaporates more slowly when it is cold; oil, which gets thicker in cold weather; and the chemical reactions inside the battery, which progress more slowly in cold weather.

CONDENSER

a device, similar to a radiator, in which the refrigerant loses heat and changes state from a high-pressure gas to a high pressure liquid as it dissipates heat to the surrounding air.

COOLANT

the mixture of water and antifreeze used in an engine's cooling system to maintain the engine's temperature throughout Its operating range.

COOLING FAN

a mechanically or electrically driven propeller that draws air through the radiator.

COOLING SYSTEM

the system used to remove excess heat from an engine and transfer it to the atmosphere. Includes the radiator, cooling fan, hoses, water pump, thermostat and engine coolant passages.

CORE PLUGS

plugs that fill holes in a block or head left from the casting process. Also called freeze, welsh or expansion plugs.

CORE

in automotive terminology, the main part of a heat exchanger, such as a radiator, evaporator or heater. Usually made of tubes, surrounded by cooling fins, used to transfer heat from the coolant to the air.

CORROSION INHIBITORS

additives used to inhibit corrosion (e.g., rust) in the fuel system.

CROSSFLOW RADIATOR

a radiator in which coolant enters on one side, travels through tubes, and collects on the opposite side (see downflow radiator).

DIFFERENTIAL

gear assembly that transmits power from the driveshaft to the wheels; allows the outside wheel to turn faster than the inside when cornering.

DIGITAL VOLT/OHMMETER (DVOM)

an instrument that measures volts, ohms and amps and displays the results numerically.

DIRECTIONAL TIRE

tire with a tread pattern that is designed to give maximum traction by removing water from under the tread in such a way as to minimize the risk of aquaplaning. Directional tires must be installed to turn in a specific direction.

DOWNFLOW RADIATOR

a radiator in which coolant enters the top of the radiator and is drawn downward by gravity (see crossflow radiator).

DRIVETRAIN

all of the components that generate power and transfer it to the vehicle's wheels.

DUAL MASTER CYLINDER

a master cylinder that has one cylinder bore, but two pistons and two fluid reservoirs. Each piston applies hydraulic pressure to two wheels only. In the event one of the hydraulic circuits fails, the other provides enough braking power to stop the vehicle.

DUO-SERVO DRUM BRAKES

a drum brake design that provides increased stopping power due to the servo or self- energizing action of the brake shoes.

EGR VALVE

see 'exhaust gas recirculation (EGR) valve',

ELECTROLYTE

a material whose atoms become ionized (electrically charged) in solution. In automobiles, the battery electrolyte is a mixture of sulfuric acid and water.

ELECTRONIC AIR SUSPENSION

electronic air suspension provides the comfort of riding on air with adjustable spring rates and capability to change ride height and load-carrying ability. Under normal driving conditions, an electronic air suspension vehicle rides at the same height as a traditionally sprung vehicle. With a heavy load, ride height is increased automatically. On current vehicles, the suspension lowers the ride height by 20 mm at highway speeds for improved aerodynamics, with about 2 percent better fuel economy. Lower ride height also can improve on-center feel of steering due to the change in suspension geometry and increased caster angle.

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

a sensor which works by a negative coefficient thermistor that loses resistance as its temperature goes up (just like the intake air temperature sensor). When the computer applies its 5-volt reference signal to the sensor, this voltage is reduced through a ground circuit by an amount corresponding to the temperature of the engine coolant.

EVAPORATOR

a heat exchanger, in which low-pressure refrigerant flows and changes state, absorbing heat from the surrounding air.

EXHAUST GAS RECIRCULATION (EGR)

component in the EGR system, used to meter a controlled amount of exhaust gas into the intake air stream.

EXHAUST GAS RECIRCULATION (EGR) VALVE

an emissions control technique that reuses engine exhaust gases as part of the intake air supply to help reduce harmful emissions (especially Nox).

FAHRENHEIT

a scale of temperature measurement with the boiling point of water at 212Ã‚Â°F. In the metric system, water's boiling point is 100Ã‚Â°Celsius.

FAN CLUTCH

a device attached to a mechanically driven cooling fan that allows the fan to freewheel when the engine is cold or the vehicle is driven at speed.

FAN SHROUD

an enclosure that routes air through the radiator cooling fins.

FAN

a mechanically or electrically driven propeller that draws or pushes air through the radiator, condenser, heater core or evaporator core.

FILTER

a screen or filter element that can be made to filter specified sizes of particles from air or liquid.

FLOODING

a condition in which unvaporized fuel in the intake manifold and/or combustion area, prevents the engine from starting.

FOOT POUND

a unit of measurement for torque. One foot pound is the torque obtained by a force of one pound applied to a wrench handle that is 12-in. long; a unit of energy required to raise a weight of one pound, a distance of one foot.

FOUR STROKE CYCLE ENGINE

an engine, either gasoline or diesel that uses four strokes: intake, compression, power and exhaust. A firing impulse occurs every two turns of the crankshaft. When this engine is a gasoline engine it is also called an Otto cycle engine after its inventor. A diesel engine is called a Diesel cycle engine for the same reason.

FREEZE PLUG

another name for core plug.

FRONT WHEEL DRIVE

the entire drivetrain is located at the front of and drives the front wheels of the vehicle.

FUSE

a metal circuit protection device that melts when there is a circuit overload or short.

FUSIBLE LINK

a smaller gauge wire that is included in an electrical circuit to provide circuit protection. The smaller gauge wire will melt when the circuit is overloaded.

GASKET

a material such as artificial rubber, cork, or steel used to seal between parts that would otherwise leak fuel, coolant, lubricants or combustion gases.

GENERATOR

a device that converts mechanical energy into electrical energy; SAE J1930 nomenclature for an alternator; a generating device that uses diode rectifiers to convert ac to dc.

HALFSHAFT

transfers power from the transaxle to the front wheels on a front-wheel drive vehicle. Also used on some vehicles with rear-wheel drive and independent rear suspension to transfer power from the differential to the rear wheels. Consists of a stub shaft that is splined into the differential side gear, another stub shaft that is splined into the wheel hub, an interconnecting shaft, and two CV-joints, which connect the interconnecting shaft to the stub shafts.

HEATER CORE

a radiator-like device used to heat the inside of a vehicle. Hot coolant is pumped through it by the water pump, and heat from the coolant moves from the heater core to the passenger compartment as the blower fan forces air through it.

HUB

mounting point for the wheelan an axle or spindle; the part of the synchronizer assembly that is splined to the transmission shaft; the center part of a wheel, gear, etc., that rides on a shaft.

HYDRAULIC PRESSURE

pressure exerted through a liquid.

HYDROMETER

an instrument used to measure the specific gravity of a solution.

IMPEDANCE

the total resistance of an electrical device measured in ohms.

INCH POUND

one twelfth of a foot pound.

INDEPENDENT SUSPENSION

a suspension in which each wheel can travel up and down without directly affecting the position of the opposite wheel.

INNER BEARING RACE

inner part of a ball or roller bearing that provides a surface for the balls or rollers to rotate.

INTEGRATED CIRCUIT

an electrical circuit containing many interconnected amplifying devices and circuit elements formed on a single body or chip of semiconductor material; diodes, transistors and other electronic components mounted on semiconductor material and able to perform numerous functions.

INTERCOOLER

a component on some turbocharged engines used to cool the compressed intake air.

INTERNAL COMBUSTION ENGINE (ICE)

engine that converts the energy contained in the fuel inside the engine into motion. Combustion engines use the pressure created by the expansion of the gases to do mechanical work.

JAM NUT

a locknut.

KEEP-ALIVE MEMORY

a series of vehicle battery-powered memory locations in the microcomputer that store information on input failure, identified in normal operations for use in diagnostic routines; adapts some calibration parameters to compensate for changes in the vehicle system.

LEAF SPRING

a suspension spring consisting of a single flat plate made of steel or composite material or several steel plates bundled together.

LIGHT-DUTY VEHICLE

passenger cars and trucks with a gross vehicle weight rating of 8,500 or less.

LIMITED SLIP DIFFERENTIAL

a type of differential that uses clutches to supply a major portion of the drive torque to the wheel that has better traction when one wheel is slipping,

LITER (L)

a metric measurement used to calculate the volume displacement of an engine. One liter is equal to 1,000 cubic centimeters or 61 cubic inches.

LUBRICATION

the process of introducing a friction reducing substance between moving parts to reduce wear.

MACPHERSON STRUT

the principal device in the suspension of the same name, in which the spring, shock absorber and sometimes the steering knuckle are combined in a single unit.

MALFUNCTION INDICATOR LIGHT (MIL)

also known as the CHECK ENGINE or SERVICE ENGINE SOON light on many vehicles. The MIL comes on when the ignition is first turned on (to check the bulb) and then goes out once the engine is started, unless a trouble code is stored in the computer. If the MIL is on when the vehicle is running, there has been a malfunction on one of the sensor or actuator circuits monitored by the computer, and a diagnosis will have to be made by retrieving the code.

MASTER CYLINDER

the primary fluid pressurizing device in some hydraulic systems. In automotive use, it is found in the brake and hydraulic clutch systems and is pedal-activated, either directly or through a vacuum assist unit.

MILLIMETER

the base of metric size measurement. One millimeter equals 0.039370-in. One inch is equal to 25.4 m m.

MULTIVISCOSITY OIL

chemically-modified oil that has been tested for viscosity at cold and hot temperatures.

OFF-ROAD

any non-stationary device, powered by an internal combustion engine or motor, used primarily off the highways to propel, move, or draw persons or property, and used in any of the following applications: marine vessels, construction/farm equipment, locomotives, utility and lawn and garden equipment, off-road motorcycles, and off-highway vehicles.

OHM

a unit of electrical resistance of a circuit in which an electromotive force of one volt maintains a current of one ampere, named after German physicist Georg Ohm.

OHMMETER

an instrument that measures electrical resistance in ohms.

OHM'S LAW

a basic law of electricity expressing the relationship between current, resistance and voltage in any electrical circuit. Ohm's law states that the voltage in a circuit is equal to the current multiplied by the resistance.

OIL COOLER

device used to remove heat from the engine or transmission oil. There are oil-to-air coolers and oil coolers that are incorporated into the vehicle's cooling system.

OIL PAN

the part that encloses the crankcase at the lower end of the block.

OIL PRESSURE

the pressure that results from resistance to flow from the oil pump. As the pump turns faster, it produces more flow. A relief valve limits the amount of pressure it can produce.

ON-CAR BALANCING

the practice of spinning a wheel on the car to balance the wheel and all other rotational components together.

ORIGINAL EQUIPMENT MANUFACTURER (OEM)

the original manufacturer of a vehicle or engine.

OSCILLOSCOPE

an instrument that displays electrical activity in the form of line patterns on a screen.

OUTER BEARING RACE

outer part of a bailor roller bearing that provides a surface for the balls or rollers to rotate. Can be integral with the bearing or a separate part.

OXIDATION

the process of combining with oxygen, resulting in rusting or burning. Rust is slow oxidation; fire is rapid oxidation.

PAG

polyalkyline glycol oil (lubricant) used with A/C systems containing R- 134a refrigerant.

PARALLEL CIRCUIT

a circuit with more than one path for the current to follow.

PARKING BRAKE

a system that applies the brakes mechanically through a series of linkages and cables. Depending on the vehicle, the parking brake system will either be actuated using a foot pedal or a hand-operated lever.

PASCAL'S LAW

the law of physics stating that liquids are noncompressible, and that a force applied to the top of a liquid in a closed container is exerted equally in all directions.

PCV SYSTEM

see 'positive crankcase ventilation system'.

PCV VALVE

a part of the positive crankcase ventilation system. Meters crankcase vapors into the intake manifold.

PLAY

the relative movement between or among parts.

POLARITY

the condition of being positive or negative relative to a reference point or object; the particular state (positive or negative) with reference to the two magnetic poles.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

a system that controls crankcase emissions by using a valve to meter crankcase vapors nto the intake manifold.

POWER BRAKES

a system that uses vacuum or hydraulic pressure to assist the driver with brake application.

PSI

measurement of pressure in pounds per square inch.

RADIAL RUNOUT

the out-of-roundness ot a wheel or tire.

RADIATOR CAP

a device that seals the radiator and maintains a set pressure in the cooling system.

RADIATOR

the part of the cooling system that acts as a heat exchanger, transferring heat to atmosphere. It consists of a core and holding tanks connected to the cooling system by hoses.

REAR WHEEL DRIVE

system where the driveline drives the rear wheels of the vehicle. Most often the engine is located in the front of the vehicle and a transmission and drive shaff connect to a drive axle, however there are also systems where the entire drive line is located toward the rear of the vehicle.

REAR WHEEL STEERING

a system used on a some vehicles to change the toe of the rear wheels to either steepen a sharp turn or enhance cornering on a shallower, faster one.

RESISTOR

an electrical device installed in a circuit to lower voltage and current flow.

RIDE HEIGHT

the dimension between a fixed point on the vehicle and the pavement. The fixed point varies according to vehicle and manufacturer. Also called vehicle height.

RUNOUT

wobble or deflection beyond a rotating part's normal plane of movement.

SCAN TOOL

microprocessor designed to communicate with a vehicle's on-board computer system to perform diagnostic and troubleshooting functions.

SEMICONDUCTOR

a material that is neither a good conductor of electricity nor a good insulator.

SENDING UNIT

a mechanical, electrical, hydraulic or electromechanical device which transmits information to a gauge or other receiving unit.

SERIES CIRCUIT

a circuit that has only one path for current to follow.

SERIES-PARALLEL CIRCUIT

a circuit that combines series and parallel circuits.

SERVO

a device, such as an electric motor or hydraulic piston, that is controlled by an amplified signal from a low power command device.

SHOCK ABSORBER

a device used to dampen the oscillation of the suspension caused by irregularities in the road surface.

SHORT CIRCUIT

a condition that occurs in an electrical circuit when the current bypasses the intended load and takes a path with little or no resistance, such as another circuit or ground.

SPECIFIC GRAVITY

the ratio of the weight or mass of the given volume of a substance to that of an equal volume of another substance, e.g. - water for liquids and solids; air or hydrogen for gases, are used as standards.

SPONGINESS

the feel of a soft or mushy brake pedal usually caused by trapped air in the hydraulic system.

SPRUNG WEIGHT

the weight of all the vehicle components that are supported by the springs; see 'unsprung weight'.

STABILIZER BAR

a torsion-bar spring connecting the suspension on either side of the vehicle. When a vehicle rolls to the side in a turn, the suspension at the outside wheel compresses and the suspension at the inside wheel extends. The stabilizer bar that connects them twists to apply a counteracting force to hold the vehicle closer to level. Also called an anti-roll bar or sway bar.

STARTER

the electric motor that is used to start an engine.

STUD

a fastener that has screw threads at both ends.

TECHNICAL SERVICE BULLETIN (TSB)

information published by vehicle manufacturers that describe updated service procedures and service procedures that should be used to handle vehicle defects.

TENSIONER

a device used with a timing chain or belt to maintain its tension.

THERMOSTAT

a device installed in the cooling system that allows the engine to come to operating temperature quickly and then maintain a minimum operating temperature.

TIMING BELT

a toothed reinforced belt used to drive the camshaft from a sprocket on the crankshaft.

TOLERANCE

the difference between the allowable maximum and minimum dimensions of a mechanical part; the basis for determining the accuracy of a fitting.

TORQUE SEQUENCE

a specified order in which a component's mounting bolts should be tightened

TORQUE WRENCH

a breaker bar or ratchet wrench with an indicator that measure the twisting effort applied to a fastener during tightening.

TORQUE

twisting effort on a shaft or bolt.

TWIN I-BEAM SUSPENSION

a type of independent front suspension and used on light trucks and vans. It consists of two I-beams supported by coil springs, and the steering knuckles/spindles, which are connected by king pins or ball joints. The inner end of the axle connects to the vehicle frame through a rubber bushing. A radius arm also connects to the frame through rubber bushings to control wheelbase and caster.

UNIVERSAL JOINT (U-JOINT)

a joint that allows the drives haft to transmit torque at different angles as the suspension moves up and down.

UNSPRUNG WEIGHT

the components of a vehicle that rest directly on the road surface without being supported by the suspension springs.

VACUUM

a pressure lower than atmospheric.

VOLT

unit of electromotive force. One volt of electromotive force applied steadily to a conductor of one-ohm resistance produces a current of one ampere.

VOLTAGE DROP

voltage lost by the passage of electrical current through resistance.

VOLTMETER

an instrument used to measure voltage in a circuit.

WATER PUMP

a device used to circulate coolant through the engine.

WHEEL ALIGNMENT

the adjustment of suspension and steering components to optimize steering control and minimize tire wear.

WHEEL BALANCE

the condition in which a wheel/tire assembly has equal weight around its center, preventing vibration at high speeds. Wheel balance can be static, such as on a bubble balancer, or dynamic, such as with a spin balancer.

WHEEL WEIGHTS

small weights, usually made of lead, attached either mechanically or by adhesive to a wheel/tire assembly to correct its balance.

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UNIFORM INSPECTION & COMMUNICATION STANDARDS 2010 - 2011

Steering & Suspension Systems

STEERING & SUSPENSION SYSTEMS

These materials are confidential and are not to be disclosed to, or utilized by, any individual or entity other than participants of the Motorist Assurance Program (MAP).

The Automotive Maintenance and Repair Association (AMRA) and MAP do not warrant these materials or guarantee their accuracy, and AMRA and MAP assume no liability for errors.

MAP STANDARDS OF SERVICE

MAP developed standards of service for shops to follow in working with customers. Written from the point of view of customers, and for the use of maintenance and repair shops, the standards expand on the ideas and promises established in MAP's Pledge to Customer

I. Our recommendations are based upon the following definitions.

System Failure - Parts/system indicated are out of manufacturers' specifications, have failed or are unable to perform their normal function as intended or designed by the manufacturers. Service/replacement is required.

Preventive/Scheduled Maintenance - Parts/system are scheduled for service/ replacement per industry standards or are near the end of their useful life and repair/ replacement is recommended in advance of parts/system failure. Service/replacement is suggested.

Improved System Performance - Parts/ system indicated are recommended for repair/ replacement to enhance/improve the vehicle's ability to perform as intended or designed by the manufacturer, or as requested by the customer. Service/replacement is suggested.

II. Training/Criteria Our personnel have acquired auto repair expertise through formal education or work experience. Where appropriate, personnel are moving toward certification (e.g. vehicle manufacturer, ASE, etc.) for the services performed. Continuing education will be supported by all MAP participants.

III. Appropriate Company Approved Inspection

We will perform an appropriate inspection based on MAP Uniform Inspection & Communication Standards.

IV. Written Estimates

Written estimates based on our inspection, in compliance with state and local regulations, will include parts (dollar amount), labor (dollar amount), and the total estimate.

V. Work Authorization

No work will be performed without the customer's prior approval.

VI. Limited Warranty

A minimum limited warranty will be offered of 90 days or 4,000 miles, whichever comes first, covering parts and labor.

VII. Returned Parts

All customers will be entitled to the return of old parts, or if they choose, they may examine the parts prior to leaving the store. Where failed parts are required to be returned to the manufacturer in order to

honor the warranty, the customer will be allowed to examine the parts.

VIII. Classification of Parts

Replaced parts will be identified as new, remanufactured, rebuilt or used. MAP participants will inform the customer and indicate on the estimate and invoice whether a part is new, remanufactured, rebuilt or used.

THE MAP PROCESS - OVERVIEW

Repair Association, Inc. (AMRA). Participation in the Motorist Assurance Program comes from retailers, suppliers, independent repair facilities, vehicle manufacturers and industry associations.

Our organization's mission is to strengthen the relationship between the consumer and the auto repair industry. We produce materials that give motorists the information and encouragement to take greater responsibility for their vehicles-through proper, manufacturer / recommended maintenance. We encourage participating service and repair shops (including franchisees and dealers) to adopt (1) a Pledge of Assurance to their Customers and (2) the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction.

These Standards of Service require that an inspection of the vehicle's (problem) system be made and the results communicated to the customer according to industry standards. Given that the industry did not have such standards, the Motorist Assurance Program successfully promulgated industry inspection communication standards in 1994-95 for the following systems: Exhaust, Brakes, ABS, Steering and Suspension, Engine Maintenance and Performance, HVAC, Electrical Systems, and Drive Train and Transmissions. Further, revisions to all of these inspection communication standards are continually re-published. Participating shops utilize these Uniform Inspection & Communication Standards as part of the inspection process and for communicating their findings to their customers.

The Motorist Assurance Program continues to work cooperatively and proactively with government agencies and consumer groups toward solutions that both benefit the customer and are mutually acceptable to both regulators and industry. We maintain the belief that industry must retain control over how we conduct our business, and we must be viewed as part of the solution and not part of the problem. Meetings with state and other government officials (and their representatives), concerned with auto repair and/or consumer protection, are conducted. Feedback from these sessions is brought back to the association, and the program adjusted as needed.

We welcome you to join us as we continue our outreach... with your support, both the automotive repair industry and your customers will reap the benefits. Please visit MAP at our Internet site www.motorist.org or contact us at:

201 Park Washington Court

Falls Church, Virginia 22046

Tel: (703) 532-2027 * Fax: (202) 318-0378

THE MAP PROCESS - OVERVIEW OF SERVICE REQUIREMENTS AND SUGGESTIONS

It is MAP policy that all exhaust, brake, steering, suspension, wheel alignment, drive-train, engine performance and maintenance, and heating, ventilation and air conditioning, and electrical services be offered and performed under the standards and procedures specified in these sections.

Before any service is performed on a vehicle, an inspection of the appropriate system must be performed. The results of this inspection must be explained to the customer and documented on an inspection form. The condition of the vehicle and its components will indicate what services/part replacements may be "Required" or "Suggested". In addition, suggestions may be made to satisfy the requests expressed by the customer.

When a component is suggested or required to be repaired or replaced, the decision to repair or replace must be made in the customer's best interest, and at his or her choice given the options available.

This section lists the various parts and conditions that indicate a required or suggested service or part replacement. Although this list is extensive, it is not fully inclusive. In addition to this list, a technician may make a suggestion. However, any suggestions must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval and must be documented. However, any suggestions must be documented and must be based on substantial and informed experience or the vehicle manufacturer's recommended service interval. NOTE: Vehicle manufacturer service intervals are often categorized as either Normal or Severe. Frequently, motorists are unaware that their driving patterns and habits meet the criteria for following Severe Service schedules. Severe Service is generally defined as, but not limited to one or more of the following conditions: Driving in stop-and-go traffic; frequent short trips; high-speed driving; extreme temperatures; towing or hauling.

Some conditions indicate that service or part replacement is required because the part in question is no longer providing the function for which it is intended, does not meet a vehicle manufacturer's design specification or is missing.

- **Example:** An exhaust pipe has corroded severely and has a hole in it through which exhaust gases are leaking. Replacement of the exhaust pipe in this case is required due to functional failure.
- **Example:** A brake rotor has been worn to the point where it measures less than the vehicle manufacturer's discard specifications. Replacement of the rotor is required because it does not meet design specifications.

Some conditions indicate that a service or part replacement is suggested because the part is close to the end of its useful life or addresses a customer's need, convenience or request. If a customer's vehicle has one of these conditions, the procedure may be only to suggest service.

- **Example:** An exhaust pipe is rusted, corroded or weak, but no leaks are present. In this case, the exhaust pipe has not failed. However, there is evidence that the pipe may need replacement in the near future. Replacement of the pipe may be suggested for the customer's convenience in avoiding a future problem.
- **Example:** The customer desires improved ride and/or handling, but the vehicle's shocks or struts have not failed. In this case, replacement may be suggested to satisfy the customer's wishes. In this case, replacement of the shocks or struts may not be sold as a requirement.

A customer, of course, has the choice of whether or not a shop will service his or her vehicle. He or she may decide not to follow some of your suggestions. When a repair is required, a MAP shop must refuse partial service on that system if, in the judgment of the service provider, proceeding with the work could create or continue an unsafe condition. When a procedure states that required or suggested repair or replacement is recommended, the customer must be informed of the generally acceptable repair/replacement options whether or not performed by the shop.

The following reasons may be used for required and suggested services. These codes are shown in the "Code" column of the MAP Uniform Inspection & Communications Standards that follow:

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
A. Part no longer performs intended purpose B. Part does not meet a design specification (regardless of performance) C. Part is missing	1. Part is close to the end of its useful life B - Part does not meet a design specification (regardless of performance) (just above discard specifications, or weak; failure likely to occur soon, etc.) 2. To address a customer need, convenience, or request (to stiffen ride, enhance performance, eliminate noise, etc.) 3. To comply with maintenance recommended by the vehicle's Original Equipment Manufacturer (OEM) 4. Technician's recommendation based on substantial and informed experience 5. To comply with maintenance recommended by AMRA / MAP

Reasons to Require Repair or Replacement	Reasons to Suggest Repair or Replacement
NOTE: **When a repair is required, the shop must refuse partial service to the system in question, if the repair creates or continues an unsafe condition.**	**NOTE:** **Suggested services are *always* optional. When presenting suggested repairs to the customer, you must present the facts, allowing the customer to draw their own conclusions and make an informed decision about how to proceed.**

WHEEL AND TIRE

Steering and suspension are complex systems made up of a variety of interdependent components. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed. Conditions listed assume that the problem has been isolated to the specific component by proper testing procedures.

NOTE: **When replacing steering and/or suspension components that may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications.**

CAUTION: **Do not use ride height altering or load compensating components, such as variable rate springs and coil over shocks, on vehicles with height or load sensing proportioning valve-equipped braking systems, unless these components are original equipment.**

NOTE: **Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.**

WARNING: **These guidelines do not apply to split rims.**

TIRES

When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle.

Consult the vehicle owner's manual or vehicle placard for correct tire size, service description, load index, speed rating and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association (www.us-tra.org)

When replacing fewer than ALL tires on a vehicle, follow the vehicle manufacturer's recommendations as to the placement of the new tires. If it is not possible to follow the vehicle manufacturer's tire replacement recommendations, remember to replace tires on the same axle with the same size, construction, speed rating, and, if possible, similar tread pattern.

Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and non-radial tires are mixed on the same vehicle, the radials must be on the rear. If radial and non-radial tires are used on a vehicle equipped with dual rear tires, radial tires may be used on either axle. High-pressure temporary compact spare tires are exempt from this rule.

Do not mix size or type (all season, performance, mud and snow) of tires on the same axle. When replacing only two tires on front or rear drive vehicles, follow the vehicle manufacturer's recommendations concerning placement. If it is not possible to follow OE recommendations, it is preferable to place the two new tires on the rear for greater stability, greater adhesion affecting steering -- on other than dry pavement -- and overall safety, regardless of whether the vehicle is front or rear wheel drive.

It is particularly important to match all tire sizes and constructions on 4-wheel (4x4) and all-wheel (AWD) drive vehicles unless otherwise specified by vehicle manufacturer. Ideally, all four tires should be replaced at the same time. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes.

MOUNTING TIRES

Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels.

Mount tires only on same or approved rim widths.

Attempting to mount a tire of one diameter on a wheel of a different diameter , bead taper or flange type may result in serious injury or death.

If any flammable emergency tire inflation product has been used in a tire, consult inflation product manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death.

VEHICLE TIRE PLACARD

Since 1968, cars and light trucks sold in the United States have been required to have a tire information sticker, called a vehicle tire placard. The vehicle tire placard indicates the size of the original equipment tires (including the spare), cold inflation pressure for the tires on both axles as well as the spare, and load index or range. Depending on the vehicle, the vehicle tire placard will either be located on the edge of any door, the doorpost, glove box, fuel door or inside trunk lid. If the tire placard is missing, consult the owner's manual, vehicle manufacturer, or tire manufacturer regarding applicable tire information.

Always refer to the vehicle manufacturer's recommendations before replacing tires. Tires should always be replaced with the same size designation, or approved options, as recommended. Never choose a smaller size with less load carrying capacity than the size on the tire placard. (Some vehicle manufacturers require different-sized tires for either the front or rear axles.)

NOTE: **It is not always possible to select a replacement tire with exactly the same size as shown on the placard. Consult with a vehicle or tire manufacturer for replacement recommendations.**

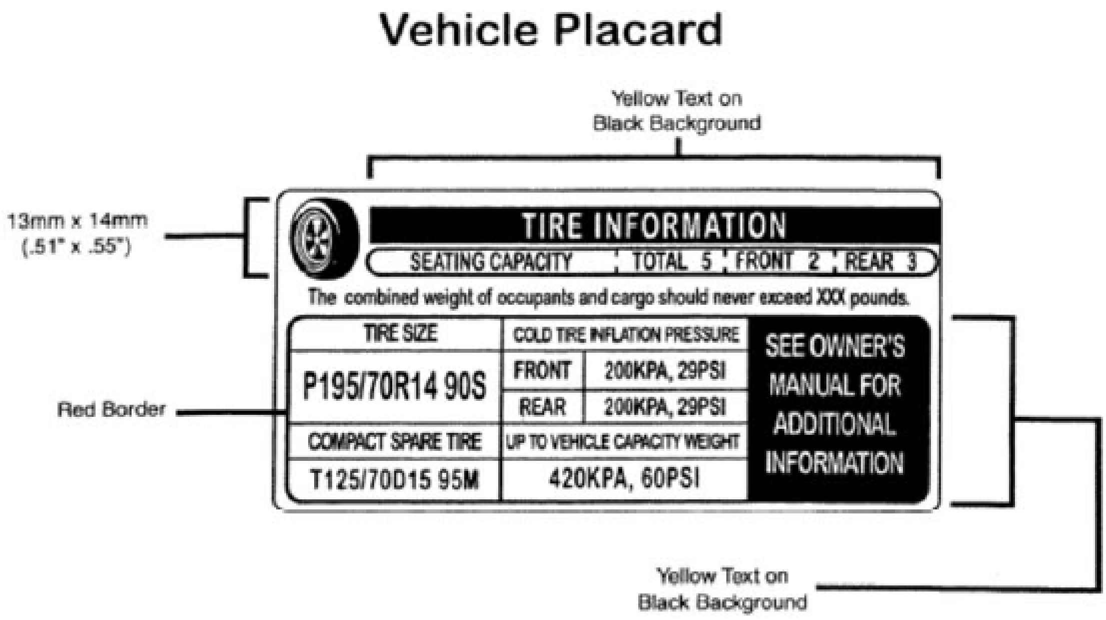

Vehicle Placard
Yellow Text on Black Background
13mm x 14mm (.51" x .55")
TIRE INFORMATION
SEATING CAPACITY TOTAL 5 FRONT 2 REAR 3
The combined weight of occupants and cargo should never exceed XXX pounds.
TIRE SIZE
COLD TIRE INFLATION PRESSURE
P195/70R14 90S
FRONT 200KPA, 29PSI
REAR 200KPA, 29PSI
COMPACT SPARE TIRE
UP TO VEHICLE CAPACITY WEIGHT
T125/70D15 95M
420KPA, 60PSI
SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION
Red Border
Yellow Text on Black Background

Fig. 1: Vehicle Tire Placard - Typical

TIRE ROTATION

The front tires on most vehicles tend to wear out faster than the rear tires. This is due to the effects of steering the vehicle and the weight transfer that occurs during braking. To ensure that all four tires wear evenly, it is important to rotate them on a regular basis. Tire rotation helps maintain balanced handling because it allows all four tires to wear at the same rate. Keep in mind, as tire wear reduces tread depth, it increases the tires' response to driver inputs. Consequently, by equalizing tire wear at all four corners, dry road performance is actually enhanced. Another advantage of regular rotation is that it allows the tires to be replaced in complete sets rather than in pairs. This maintains handling continuity. It also enables drivers to take advantage of the latest in tire technology, instead of trying to match a pair of older tires.

Most manufacturers list rotation intervals in the scheduled maintenance section of the vehicle service manual and/or the owner's manual. Tire rotation patterns can also be found in these books. If this information is unavailable for a particular vehicle, rotate the tires every 5-7,000 miles following the appropriate rotation sequence shown in the illustrations. After completing a tire rotation, be sure to reset inflation pressures to the manufacturer's recommended specifications indicated on the vehicle tire placard.

To ensure that the proper amount of clamping force is applied to each fastener, follow these guidelines:

- Make sure the area around the lug holes, as well as the wheel and hub mating surfaces are clean and dry. A wire brush can be used to remove corrosion and other debris. Wipe the areas clean using a shop rag.
- Inspect the bolt holes for damage. Do not use a wheel if the bolt holes are deformed.
- Inspect the wheel studs and lug nuts or lug bolts and bolt holes (depending on the vehicle) for damage. Replace or repair any damaged or worn components.
- Always follow a star pattern when tightening lugs.

WHEEL LUG NUT TORQUE & CLAMPING FORCE

Although proper wheel lug nut torque is important, it does not guarantee that the required clamping force will be achieved. For example, excessive corrosion on the wheel and hub mating surfaces will result in improper clamping force, even when the lugs are tightened with a calibrated torque wrench. Low clamping force can also occur if the threads are dirty. This is because dirt causes interference between the mating threads. As a result, the torque wrench will register the correct reading but the clamping force will be inadequate. To improve the chances of achieving the precise clamping force between the wheel and hub, proper torque must be applied to clean components in good condition. Specifications for wheel lug nut torque can be found in the `Tire and Wheel' section of most vehicle service manuals. When specifications are indicated as a range, adjust the torque wrench to the middle of the range to compensate for normal variations in tool calibration.

POPULAR TIRE ROTATION PATTERNS

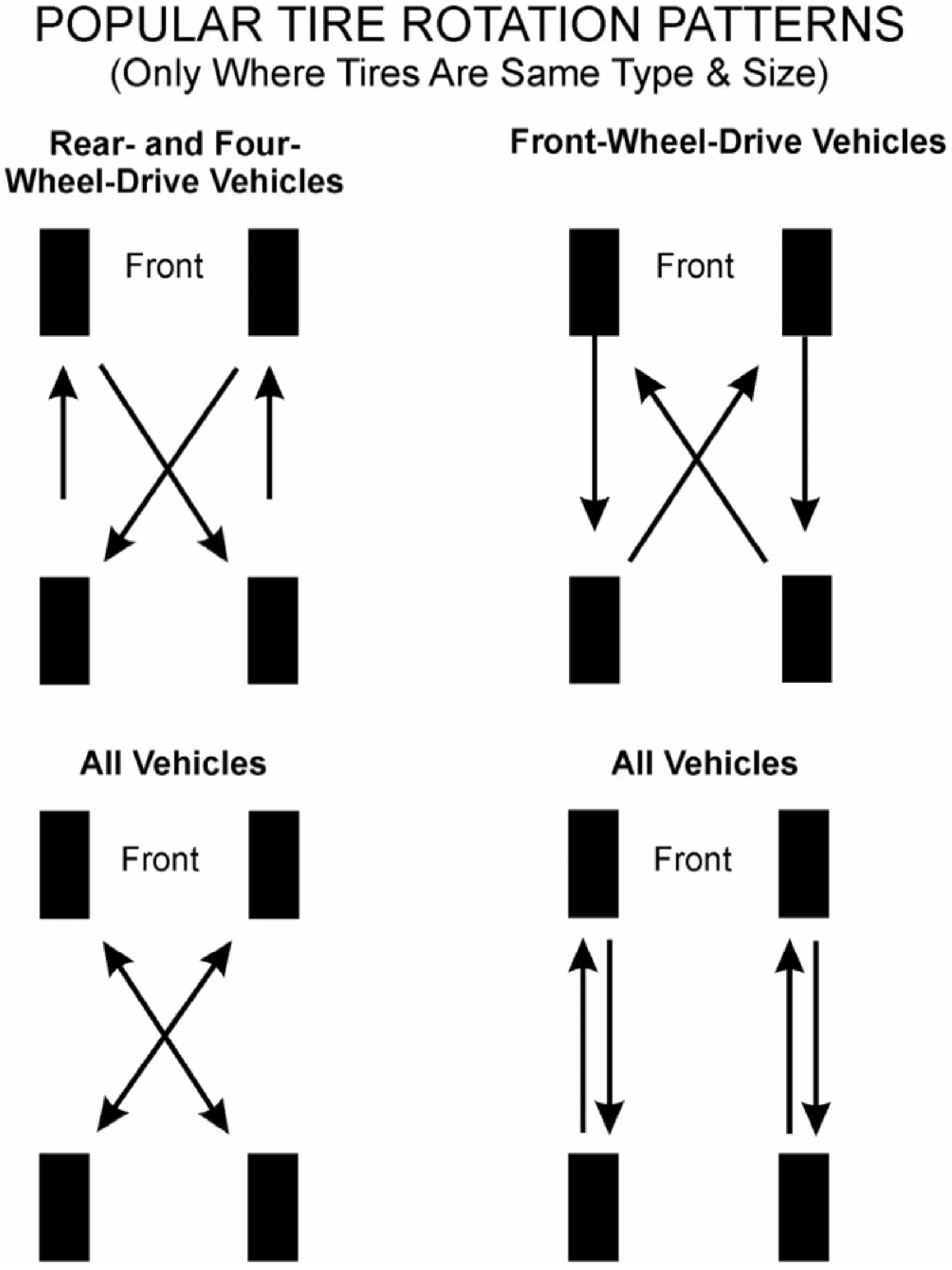

POPULAR TIRE ROTATION PATTERNS
(Only Where Tires Are Same Type & Size)
Rear- and Four-Wheel-Drive Vehicles
Front
Front-Wheel-Drive Vehicles
Front
All Vehicles
Front
All Vehicles
Front

Fig. 2: Popular Tire Rotation Patterns - Without Dual Rear Wheels

Never rotate directional tires from side-to-side since this will reverse their direction of rotation. Directional tires can only be rotated from front to rear or vice versa. Directional tires are typically used on high-performance cars and can be identified by the arrows imprinted on the sidewall.

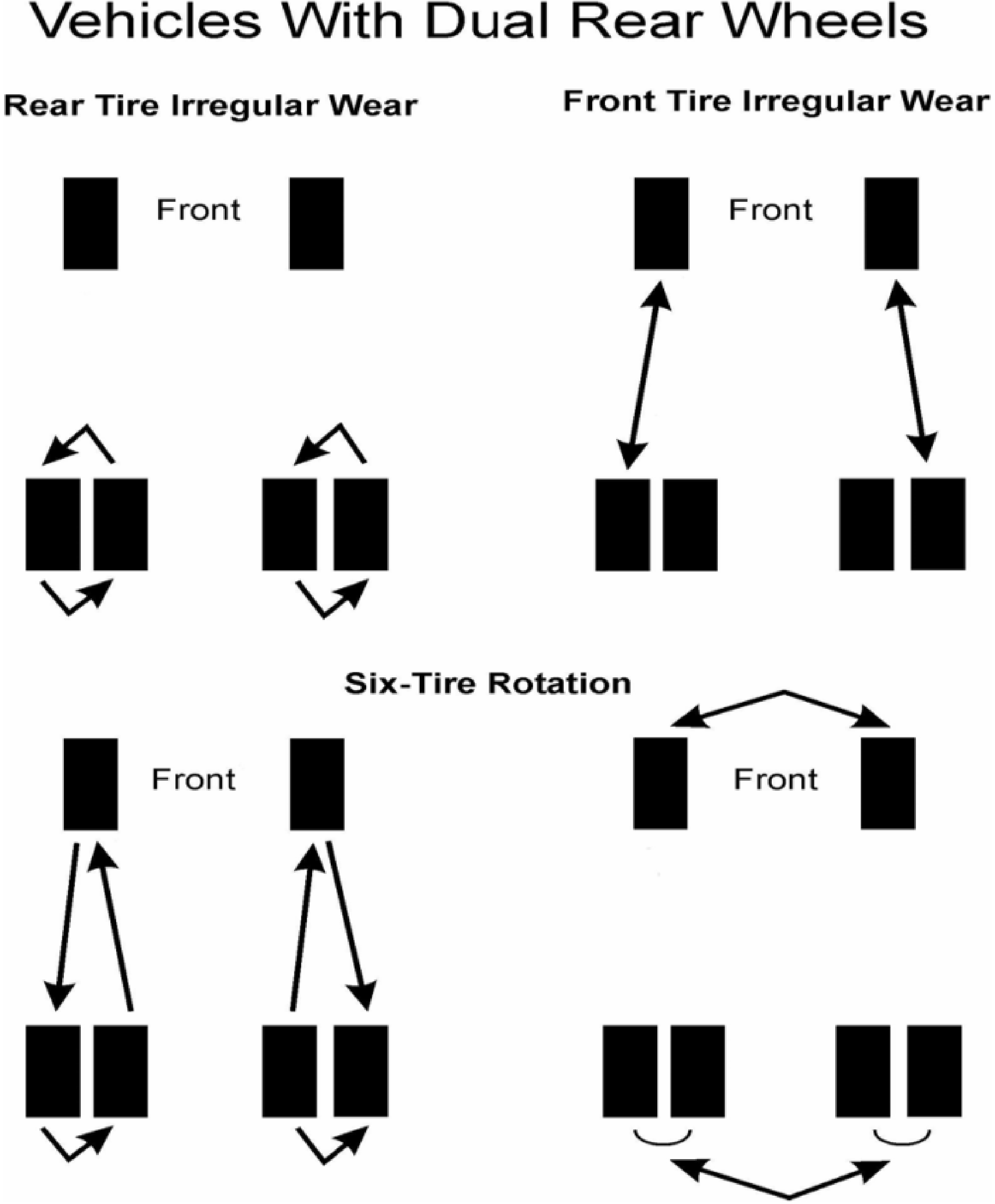


Fig. 3: Popular Tire Rotation Patterns - With Dual Rear Wheels

Some tires cannot be rotated in the manners described. Such tires include uni-directional tires and tires with asymmetric tread designs. Also, some vehicles may have different-sized tires mounted on the front and rear axles, and these different-sized tires also have rotation restrictions. Check your owner's manual or with a tire manufacturer or a tire dealer for proper recommendations for these specific cases.

WHEELS AND RIMS

The wheels on today's vehicles are made of steel, aluminum, or aluminum alloy (a combination of two or more metals). Steel wheels are the least expensive to produce, which is why they come as original equipment on many passenger cars and light trucks. The center section includes the bolt circle, or mounting holes, and is used to attach the wheel to the vehicle. The flange is the outermost lip of the rim, and is the area typically used for attaching wheel (balancing) weights. The rim is formed by rolling a strip of metal and then welding the two ends together. The interior section of the rim has a smaller diameter section called a drop center. This area provides the means for removing and installing a tire, since the bead is not designed to stretch. During removal or installation, most of the tire bead is pushed into the drop center so that the exposed portion can be pulled over the rim. The edges of the rim are flared to form the bead seats, which hold the tire and provide the airtight seal. Many rims include safety humps. These are small elevations on the inside of the bead seats. Safety humps help prevent the tire from falling into the drop center during a blowout. This allows the driver to maintain better directional control of a vehicle running on one or more deflated tires.

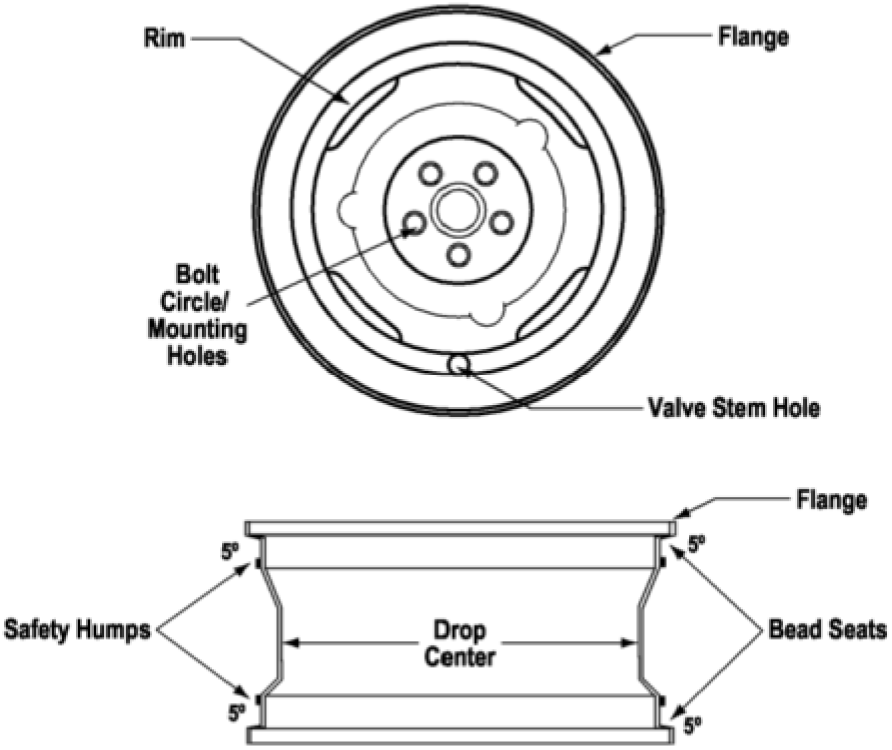


Fig. 4: Steel Wheel

WARNING: **Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Mount tires only on approved rim widths. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Load, cold inflation pressure, and tire construction forces imposed on the rim/wheel must not exceed the rim/wheel manufacturer's recommendations, even if the tire is approved for a higher load or inflation. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.**

TIRE PRESSURE MONITORING SYSTEMS

To avoid damaging sensors when mounting and demounting tires, it is beneficial to know where the sensors are located. Sensor assemblies are commonly attached to the valve stem, with the valve stem acting as an antenna to assist with transmitting RF signals. They may also be strapped to the drop center of the wheel. If this is the case, the sensor assembly should be located in-line with the valve stem.

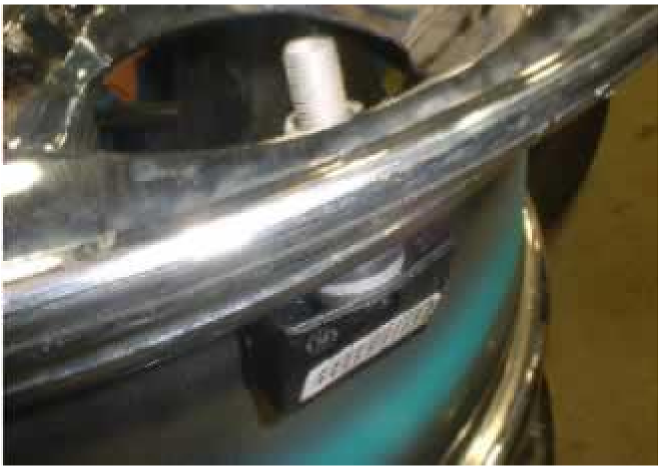


Fig. 5: Valve Stem Mounted Sensor

To avoid damaging sensors when demounting tires, do not break the bead within 45 of either side of sensor assembly locations. Be careful not to damage sensors when mounting tires as well. Sensors are not repairable and require replacement if damaged or when their battery is completely drained. It is recommended that the sensor be carefully "dropped into the tire" prior to demounting to avoid damage.

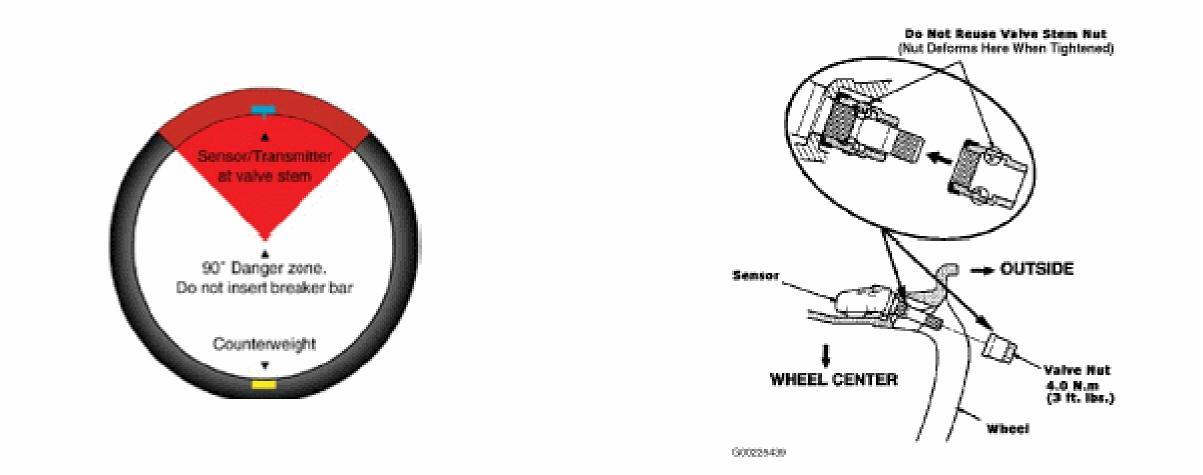
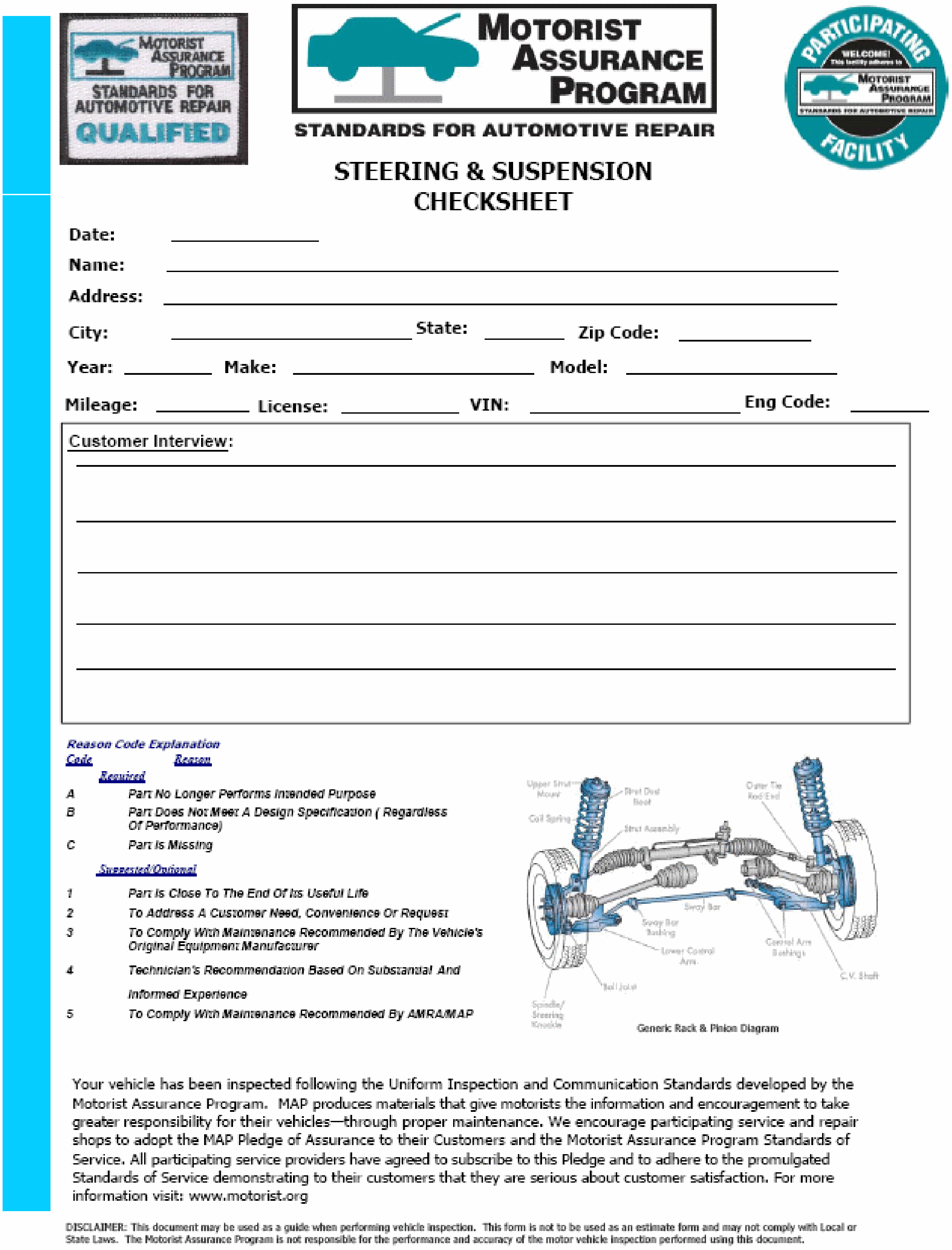

Sensor/Transmitter
at valve stem
90° Danger zone.
Do not insert breaker bar
Counterweight
Do Not Reuse Valve Stem Nut
(Nut Deforms Here When Tightened)
Sensor
OUTSIDE
WHEEL CENTER
Valve Nut
4.0 N.m
(3 ft. lbs.)
Wheel
G00225439

Fig. 6: Mounting Sensor

When reinstalling the sensor, it is suggested that the locknut, gasket and valve stem be replaced and torgued to the proper specification. It is also necessary to use the proper valve cap as it is also an integral part of the system.

It may be necessary to reprogram the TPMS when the tires are rotated, when a new sensor is installed, or after the vehicle loses power. This usually requires a scan tool and may involve the use of a special magnet. Refer to the vehicle service manual to properly reprogram the TPMS.

STEERING & SUSPENSION CHECKSHEET



MOTORIST ASSURANCE PROGRAM

STANDARDS FOR AUTOMOTIVE REPAIR

STEERING & SUSPENSION CHECKSHEET

Date: ____________

Name: ____________

Address: ____________

City: ____________ State: ________ Zip Code: ____________

Year: ________ Make: ____________ Model: ____________

Mileage: ________ License: ________ VIN: ____________ Eng Code: ________

Customer Interview:

Reason Code Explanation

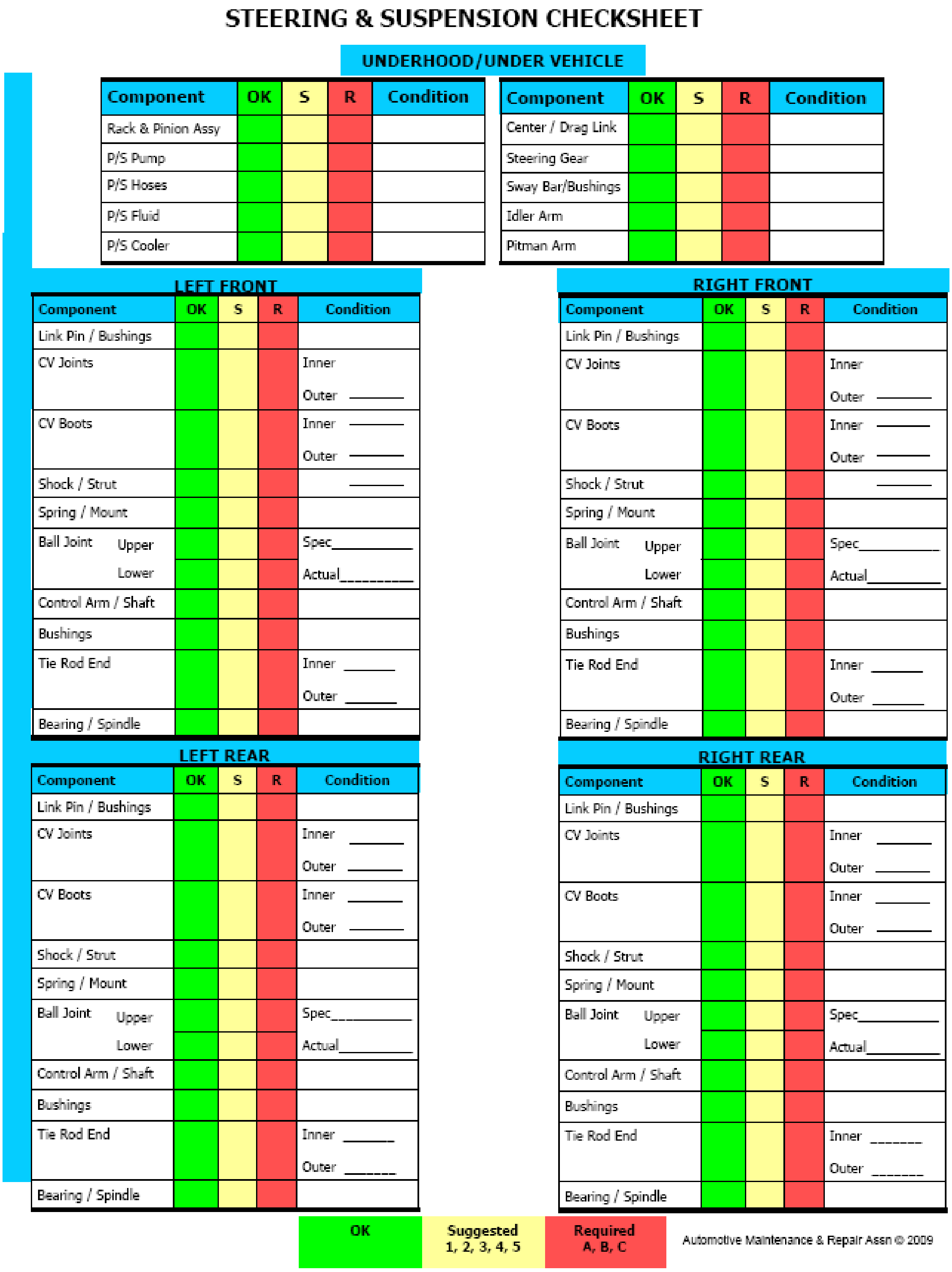
Code	Reason
	Required
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
	Suggested/Optional
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

Generic Rack & Pinion Diagram

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 7: Steering & Suspension Checksheet (1 Of 2)



STEERING & SUSPENSION CHECKSHEET

UNDERHOOD/UNDER VEHICLE

Component	OK	S	R	Condition	Component	OK	S	R	Condition
Rack & Pinion Assy					Center / Drag Link				
P/S Pump					Steering Gear				
P/S Hoses					Sway Bar/Bushings				
P/S Fluid					Idler Arm				
P/S Cooler					Pitman Arm				

LEFT FRONT

Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner Outer ______
CV Boots				Inner ______ Outer ______
Shock / Strut				______
Spring / Mount				
Ball Joint Upper				Spec__________
Lower				Actual__________
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner ______ Outer ______
Bearing / Spindle				

RIGHT FRONT

Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner Outer ______
CV Boots				Inner ______ Outer ______
Shock / Strut				______
Spring / Mount				
Ball Joint Upper				Spec__________
Lower				Actual__________
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner ______ Outer ______
Bearing / Spindle				

LEFT REAR

Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner ______ Outer ______
CV Boots				Inner ______ Outer ______
Shock / Strut				
Spring / Mount				
Ball Joint Upper				Spec__________
Lower				Actual__________
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner ______ Outer ______
Bearing / Spindle				

RIGHT REAR

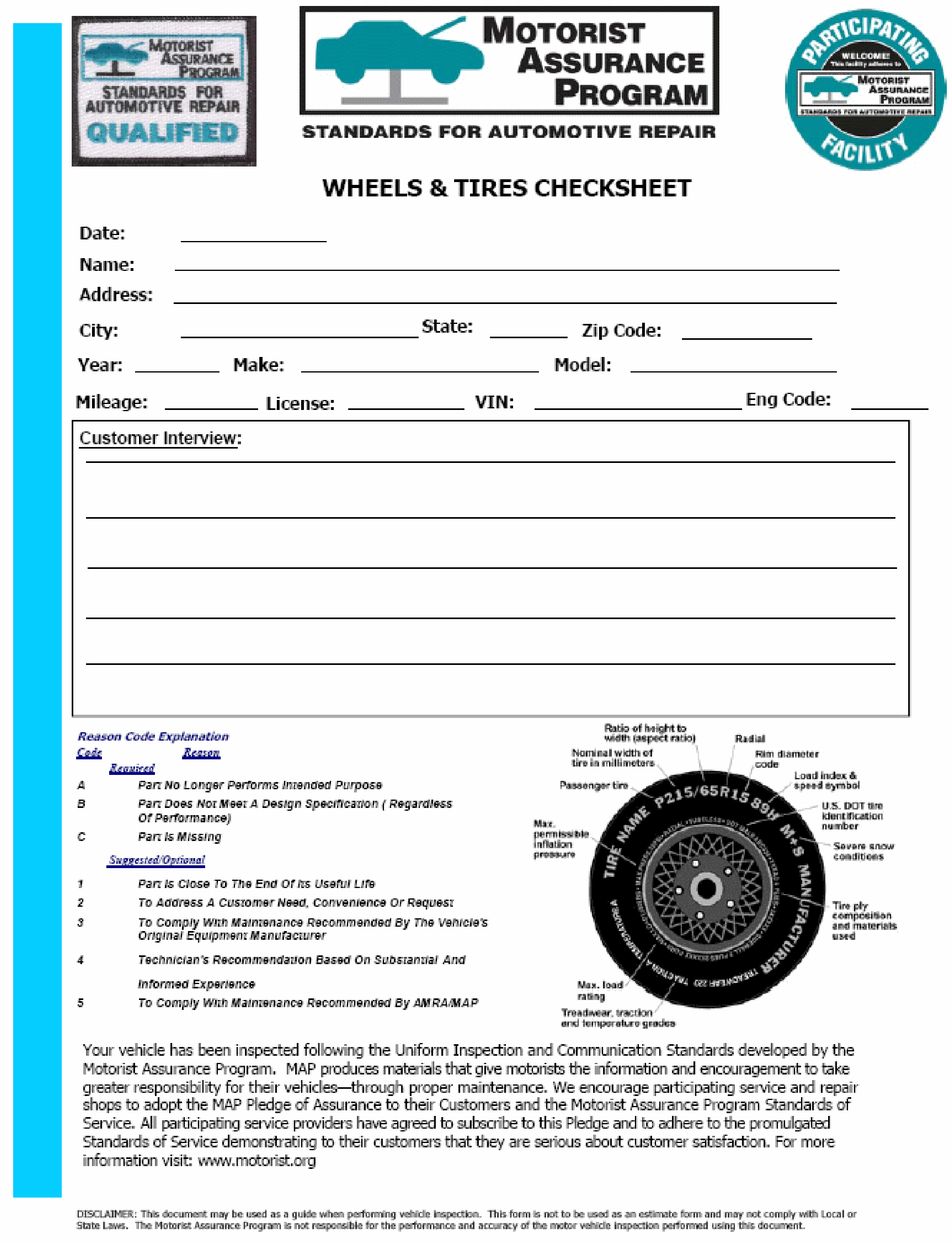
Component	OK	S	R	Condition
Link Pin / Bushings				
CV Joints				Inner ______ Outer ______
CV Boots				Inner ______ Outer ______
Shock / Strut				
Spring / Mount				
Ball Joint Upper				Spec__________
Lower				Actual__________
Control Arm / Shaft				
Bushings				
Tie Rod End				Inner _______ Outer _______
Bearing / Spindle				

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

Automotive Maintenance & Repair Assn © 2009

Fig. 8: Steering & Suspension Checksheet (2 Of 2)

WHEELS & TIRES CHECKSHEET



MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
QUALIFIED

MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR

PARTICIPATING
WELCOME!
This facility adheres to
MOTORIST ASSURANCE PROGRAM
STANDARDS FOR AUTOMOTIVE REPAIR
FACILITY

WHEELS & TIRES CHECKSHEET

Date: ______________

Name: ____

Address: ____

City: ______________________ State: ________ Zip Code: ____________

Year: ________ Make: ______________________ Model: ____________________

Mileage: ________ License: __________ VIN: ____________________ Eng Code: ________

Customer Interview:

____

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Reason Code Explanation

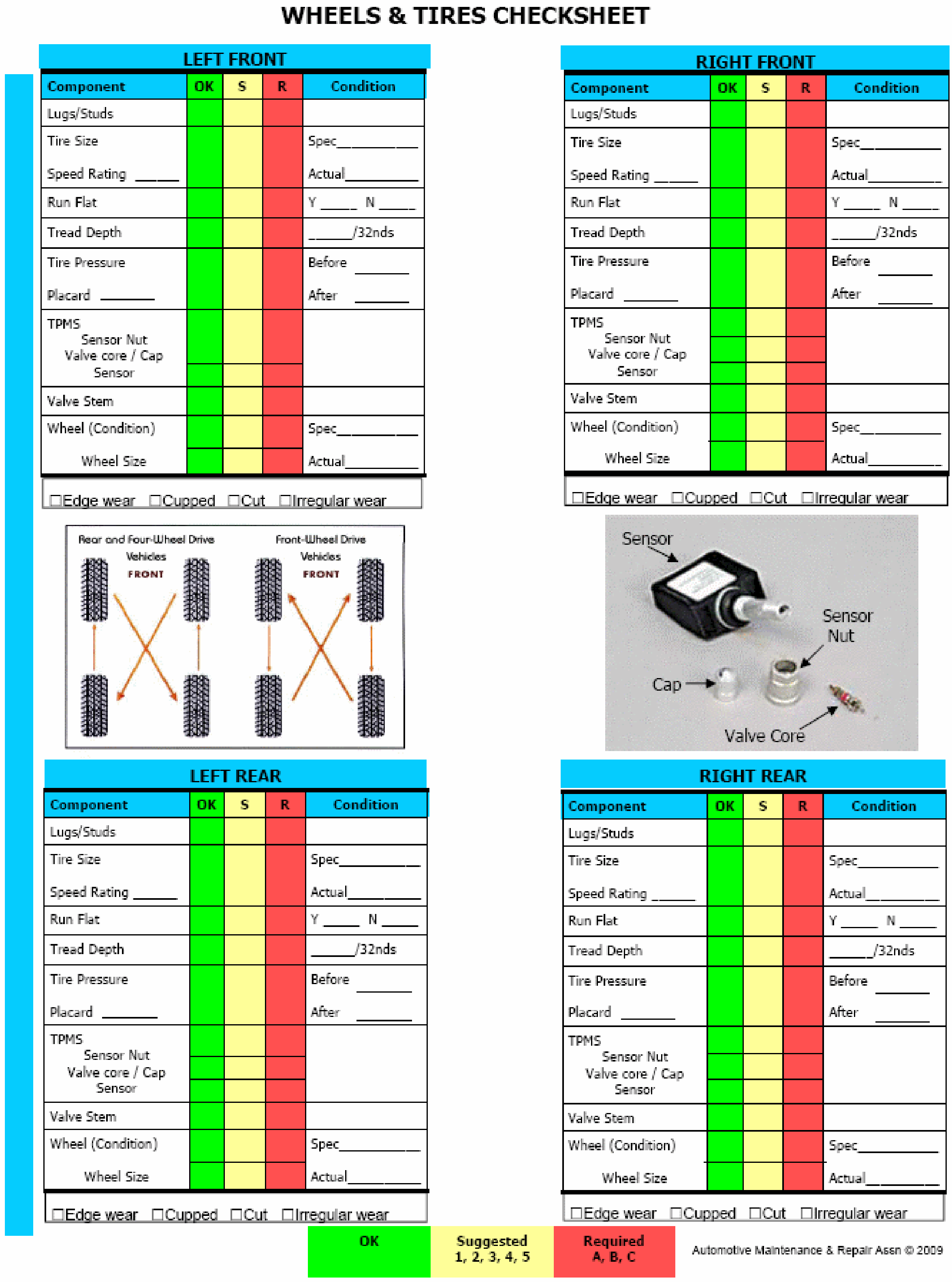
Code	*Reason*
	Required
A	*Part No Longer Performs Intended Purpose*
B	*Part Does Not Meet A Design Specification (Regardless Of Performance)*
C	*Part Is Missing*
	Suggested/Optional
1	*Part Is Close To The End Of Its Useful Life*
2	*To Address A Customer Need, Convenience Or Request*
3	*To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer*
4	*Technician's Recommendation Based On Substantial And Informed Experience*
5	*To Comply With Maintenance Recommended By AMRA/MAP*

Ratio of height to width (aspect ratio)
Radial
Nominal width of tire in millimeters
Rim diameter code
Load index & speed symbol
Passenger tire
U.S. DOT tire identification number
Max. permissible inflation pressure
Severe snow conditions
Tire ply composition and materials used
Max. load rating
Treadwear, traction and temperature grades
P215/65R15 89H
TIRE NAME
M+S
MANUFACTURER
TREADWEAR 220 TRACTION A
TEMPERATURE A

Your vehicle has been inspected following the Uniform Inspection and Communication Standards developed by the Motorist Assurance Program. MAP produces materials that give motorists the information and encouragement to take greater responsibility for their vehicles—through proper maintenance. We encourage participating service and repair shops to adopt the MAP Pledge of Assurance to their Customers and the Motorist Assurance Program Standards of Service. All participating service providers have agreed to subscribe to this Pledge and to adhere to the promulgated Standards of Service demonstrating to their customers that they are serious about customer satisfaction. For more information visit: www.motorist.org

DISCLAIMER: This document may be used as a guide when performing vehicle inspection. This form is not to be used as an estimate form and may not comply with Local or State Laws. The Motorist Assurance Program is not responsible for the performance and accuracy of the motor vehicle inspection performed using this document.

Fig. 9: Wheels & Tires Checksheet (1 Of 2)



WHEELS & TIRES CHECKSHEET

LEFT FRONT

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

RIGHT FRONT

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

Rear and Four-Wheel Drive Vehicles
FRONT
Front-Wheel Drive Vehicles
FRONT
Sensor
Sensor Nut
Cap
Valve Core

LEFT REAR

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

RIGHT REAR

Component	OK	S	R	Condition
Lugs/Studs				
Tire Size Speed Rating _____				Spec__________ Actual__________
Run Flat				Y _____ N _____
Tread Depth				______/32nds
Tire Pressure Placard ________				Before ________ After ________
TPMS Sensor Nut Valve core / Cap Sensor				
Valve Stem				
Wheel (Condition) Wheel Size				Spec__________ Actual__________

☐Edge wear ☐Cupped ☐Cut ☐Irregular wear

OK	Suggested 1, 2, 3, 4, 5	Required A, B, C

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Fig. 10: Wheels & Tires Checksheet (2 Of 2)

STEERING AND SUSPENSION, WHEEL ALIGNMENT, WHEELS AND TIRES

NOTE: **Steering and Suspension are complex systems made up of a variety of interdependent components and controls. For proper vehicle handling, ride, and tire wear, a thorough inspection is required whenever suspension work is being performed.**

NOTE: **Listed repair conditions assume that the problem has been isolated to the specific component by proper testing procedures. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications for both ride height and alignment angle tolerances.**

NOTE: Improper alignment geometry, and/or improper tire/wheel fitment may affect other systems such as Adaptive Cruise Control, Electronic Stability Control, Electronic Traction Control and Variable Ratio Steering. These systems may require attention after an alignment or suspension service is performed. Care must be taken to identify these vehicles/systems before any repair procedures are performed. Failure to follow OEM guidelines when servicing interrelated systems could result in an unsafe condition.

CAUTION: Do not use ride height altering or load compensating components, such as variable rate springs or coil over shocks on vehicles with height sensing or load sensing proportioning- valve equipped braking systems, unless these components are supplied as original equipment.

ACTIVE HANDLING

NOTE: An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.

NOTE: On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

NOTE: When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.

ACTIVE SUSPENSION CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	B	Require repair or replacement

Condition	Code	Procedure
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

ACTIVE VARIABLE RATIO STEERING

NOTE: **Besides electronically providing variable steering ratios, the computer is linked with the Vehicle Stability Control system to aid in directional stability. As the vehicle travels down the highway, road surfaces and wind gusts can affect the vehicle's directional stability. The vehicle may wander or dart to one side, (as many who have met a tractor-trailer unit on a windy day have experienced). Sensors on the vehicle detect this sudden, unintentional movement and the computer will stabilize the vehicle by moving the Active Steering electric motor and steering gear, all without the driver turning the steering wheel.**

NOTE: **Additionally, if the driver experiences a skid or slide because of poor road conditions, the Active Steering will react to information from the yaw rate and steering angle sensors to modify the steering angle of the front wheels and stabilize the vehicle. This occurs much faster than the driver can react. If the Active Steering correction is not adequate to control the skid or slide, then the Stability Control system is also activated.**

Condition	Code	Procedure
Improper Operation	Â	Â
NOTE: **Refer to manufacturers' service information.**		

ACTIVE YAW CONTROL

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

ADAPTIVE CRUISE CONTROL

NOTE: **Similar to conventional cruise control. It maintains the vehicle's pre-set speed. However, beyond conventional cruise control, this system automatically adjusts speed to maintain proper distance between vehicles in the same lane. This is achieved through use of a radar or laser headway sensor, a digital signal processor and a longitudinal controller. If the lead vehicle slows down, or another object is detected, the system sends a signal to the engine and/or braking system to decelerate. Then, when the lane is clear, the system will re-accelerate the vehicle back to the set speed. Some OEM's require that the radar or laser headway sensor be calibrated to the thrustline of the vehicle.**

ADVANCE TRAC

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

AIR BAGS

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Collar cracked	A	Require replacement
End cap cracked	A	Require replacement

Condition	Code	Procedure
Inner fabric of bag damaged	A	Require replacement
Leaking	A	Require repair or replacement
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement
Piston cracked	A	Require replacement

AIR RIDE CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

AIR RIDE SUSPENSION TORSION SPRINGS (COUNTER BALANCING)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Broken	A	Require replacement
Missing	C	Require replacement

AIR RIDE SUSPENSION

NOTE: **Depending on the air suspension design, there are some aftermarket products available to eliminate the air ride suspension on certain vehicles. If the system has been eliminated with one of these products, then no service is suggested or required.**

AIR RIDE TUBES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connected incorrectly	A	Require repair
Insufficient clamping force, allowing hose to leak	A	Require repair or replacement
Leaking	A	Require repair or replacement
Melted	1	Suggest repair or replacement
Missing	C	Require replacement
Protective sleeves damaged	2	Suggest replacement of sleeves
Protective sleeves missing	C	Require replacement of sleeves
Restricted, affecting performance	A	Require repair or replacement
Restricted, not affecting performance	2	Suggest repair or replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Safety clip missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Type incorrect	2	Suggest repair or replacement

AIR SHOCKS AND AIR STRUTS

NOTE: **This section covers the air spring portion of the air shock or strut. For damping portion of shock or strut conditions and procedures, refer to the Shock Absorbers, Strut Cartridges, and Strut Assemblies section.**

Condition	Code	Procedure
Inner fabric of air bag damaged	A	Require replacement
Leaking	A	Require repair or replacement
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement

AIR SPRING VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blocked	A	Require repair or replacement
Connector bent	A	Require repair or replacement
Connector broken	A	Require replacement
Connector loose	A	Require repair or replacement
Inoperative	A	Require repair or replacement
Leaking	B	Require repair or replacement
Restricted	A	Require repair or replacement

AIR SPRINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Collar cracked	A	Require replacement
End cap cracked	A	Require replacement
Inner fabric of bag damaged	A	Require replacement
Leaking	A	Require repair or replacement
Outer covering of air bag is cracked to the extent that inner fabric of air bag is visible	1	Suggest replacement
Piston cracked	A	Require replacement

AIR SUSPENSION CONTROL VALVES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require repair or replacement
Output incorrect	B	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

AIR SUSPENSION DRIERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Contaminated, affecting performance	A	Require replacement
Desiccant bag deteriorated	A	Require replacement
NOTE: **Inspect system to determine effects of desiccant bag deterioration.**		
Leaking	B	Require replacement
Restricted	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Tubing connection leaking	A	Require repair or replacement

AXLE ACCELERATION SENSOR

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Housing cracked	B	Require replacement
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

BALL JOINTS

NOTE: **Before requiring or suggesting ball joint replacement, the approved OEM procedure must be used to measure ball joint wear. The measurement(s) obtained, along with the vehicle manufacturer's specifications, must be noted on the inspection report. Some states require that these measurements also appear on the invoice. The term ""perceptible movement,"" defined as any visible movement in any direction, has been the industry standard for determining the need for replacement of follower (non-load carrying) ball joints. Some vehicle manufacturers are now publishing specifications for follower ball joints that were previously diagnosed by the ""perceptible movement"" standard. Before requiring or suggesting any parts be replaced based on ""perceptible movement,"" consult your repair manual to determine if OEM specifications exist. You are not required to replace ball joints in axle sets. However, when replacing a ball joint due to wear exceeding manufacturer's specification, you may suggest replacement of the other ball joint if its measurement shows it is close to the end of its useful life, for preventive maintenance.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Further inspection required
NOTE: **If greaseable, grease ball joint. If problem persists or joint is non-greaseable, require replacement.**		
Grease boot cracked	2	Suggest replacement
NOTE: **Cracked grease boot will allow contaminants to enter the ball joint and will accelerate wear.**		
Grease boot missing	C	Require replacement

Condition	Code	Procedure
NOTE: **Lack of grease boot will allow contaminants to enter the ball joint and will accelerate wear.**		
Grease boot torn	A	Require replacement
NOTE: **Torn grease boot will allow contaminants to enter the ball joint and will accelerate wear.**		
Grease fitting broken	A	Require replacement of grease fitting
NOTE: **Some vehicles come from the factory with broken fittings. No service is suggested or required on these vehicles.**		
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Greaseable ball joint will not take grease	2	Suggest replacement of grease fitting
NOTE: **If the greaseable ball joint still will not take grease after replacing the grease fitting, suggest replacement of ball joint.**		
Nut on ball joint loose	A	Require repair or replacement
NOTE: **Check for bent stud or damaged taper hole.**		
Pre-load adjustment incorrect	B	Require repair or replacement
Seized	A	Require replacement
Stud bent	B	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud broken	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Wear exceeds manufacturer's specifications	B	Require replacement

BODY ACCELERATION SENSOR

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware

Condition	Code	Procedure
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Housing cracked	B	Require replacement
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

BUSHINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Deteriorated, affecting performance	A	Require repair or replacement
NOTE: **If condition is caused by oil-soaking, further inspection is required to determine source of oil.**		
Distorted, affecting performance	A	Require repair or replacement
Leaking (fluid-filled type)	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.**		
Oil-soaked, affecting performance	A	Require replacement
NOTE: **Further inspection required to determine source of oil.**		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

CENTER LINKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Binding	A	Further inspection required
NOTE: **If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.**		
Grease boot cracked	2	Require replacement of boot

Condition	Code	Procedure
NOTE: **If boot is not available as a separate component, suggest replacement of center link (reason code 2). Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.**		
Grease boot missing	C	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of center link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear**		
Grease boot torn	A	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of center link (reason code 2). Torn grease boot will allow contaminants to enter the joint and will accelerate wear .**		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement
NOTE: **If seal is not available as a separate component, suggest replacement of center link (reason code 2). Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.**		
Grease seal torn	A	Require replacement
NOTE: **If seal is not available as a separate component, suggest replacement of center link (reason code 2). Torn grease seal will allow contaminants to enter the joint and will accelerate wear.**		
Greaseable center link will not take grease	2	Suggest replacement of grease fitting
NOTE: **If greaseable center link still will not take grease after replacing the grease fitting, suggest replacement of center link.**		
Looseness (perceptible horizontal movement)	1	Suggest replacement
NOTE: **If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Looseness that is excessive	B	Require replacement
NOTE: **Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.**		

Condition	Code	Procedure
CAUTION: **Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Seized	A	Require replacement
Stud bent	B	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud broken	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud loose in taper hole	A	Require repair or replacement
NOTE: **Check for damaged taper hole.**		
Taper hole elongated	A	Require replacement
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Wear exceeds manufacturer's specifications	B	Require replacement

COMPRESSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector bent	A	Require repair or replacement
Connector broken	A	Require replacement
Connector loose	A	Require repair or replacement
Does not build pressure	A	Require replacement
Excessive run time	B	Require replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Leaking	B	Require repair or replacement
Missing	C	Require replacement
Noisy (abnormal)	2	Suggest replacement

Condition	Code	Procedure
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

CONTINUOUS DAMPING CONTROL

NOTE: **A semi-active suspension system which continuously adjusts damping levels according to road conditions and vehicle dynamics, (such as speed, turning and cornering, as well as driver inputs). An ECU processes driver inputs and data from sensors. The sensors include accelerometers mounted on the vehicle body and suspension position sensors, which feed steering wheel angle, vehicle speed, brake pressure and other chassis control data to the ECU. The ECU processes sensor data and sends signals which adjust the damping level of each shock.**

CONTROL ARM SHAFTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Shaft bushing surface undersized (worn)	B	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

CONTROL ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware

Condition	Code	Procedure
Ball joint hole oversized (loose interference or press fit)	B	Further inspection required
NOTE: **If oversized ball joint is available, require replacement orb all joint. If oversized ball joint is not available, require replacement of control arm.**		
Bent, affecting performance	B	Require replacement
Bushing hole oversized	B	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Holes distorted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

CONTROL MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

DISTANCE REGULATION CONTROL MODULE

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Dust boot missing	C	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot split	A	Require replacement of boot

Condition	Code	Procedure
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Dust boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Housing cracked	B	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Malfunctioning	A	Require replacement
NOTE: **includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.**		
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

DISTANCE REGULATION SENSOR

NOTE: **OEM may require this sensor be calibrated to the vehicle thrustline.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Housing cracked	B	Require replacement
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement

Condition	Code	Procedure
Wire lead shorted	A	Require repair or replacement

DRAG LINKS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Binding	A	Further inspection required
NOTE: **If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.**		
Grease boot cracked	2	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of drag link (reason code 2). Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.**		
Grease boot missing	C	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of drag link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.**		
Grease boot torn	A	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of drag link (reason code 2). Torn grease boot will allow contaminants to enter the joint and will accelerate wear.**		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement
NOTE: **If seal is not available as a separate component, suggest replacement of drag link (reason code 2). Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.**		
Grease seal torn	A	Require replacement
NOTE: **If seal is not available as a separate component, suggest replacement of drag link (reason code 2). Torn grease seal will allow contaminants to enter the joint and will accelerate wear.**		
Greaseable drag link will not take grease	2	Suggest replacement of grease fitting

Condition	Code	Procedure
NOTE: **If greaseable center link still will not take grease after replacing the grease fitting, suggest replacement of drag link.**		
Looseness (perceptible horizontal movement)	1	Suggest replacement
NOTE: **If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Looseness that is excessive	B	Require replacement
NOTE: **Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.**		
CAUTION: **Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Seized	A	Require replacement
Stud bent	B	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud broken	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud loose in taper hole	A	Require repair or replacement
NOTE: **Check for damaged taper hole.**		
Taper hole elongated	A	Require replacement
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Wear exceeds manufacturer's specifications	B	Require replacement

DYNAMIC STABILITY CONTROL

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

Condition	Code	Procedure
NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**		
NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**		

DYNAMIC STABILITY TRACTION CONTROL

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

ELECTRONIC RIDE CONTROL SHOCKS AND STRUTS

NOTE: **This section covers the electronic damping control portion of the electronic shock or strut. For damping portion of shock or strut conditions and procedures, refer to the Shock Absorbers, Strut Cartridges, and Strut Assemblies section.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector bent	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector loose	A	Require repair or replacement
Electronic valve control inoperative	A	Require replacement
NOTE: **It is acceptable to replace with a non-electronically controlled unit, where available.**		
Terminal bent	A	Require repair or replacement

Condition	Code	Procedure
Terminal broken	A	Require repair or replacement
Terminal corroded	A	Require repair or replacement
Terminal loose	A	Require repair or replacement

ELECTRONIC STABILITY CONTROL

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

ELECTRONIC SUSPENSION SYSTEM

NOTE: **(Typical) A semi-active suspension system which continuously adjusts damping levels according to road conditions and vehicle dynamics, (such as speed, turning and cornering, as well as driver inputs). An ECU processes driver inputs and data from sensors. The sensors include accelerometers mounted on the vehicle body and suspension position sensors, which feed steering wheel angle, vehicle speed, brake pressure and other chassis control data to the ECU. The ECU processes sensor data and sends signals which adjust the damping level of each shock.**

FLEX COUPLERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Flex coupler binding	A	Require repair or replacement of coupler
Flex coupler loose	A	Require repair or replacement of coupler
Flex coupler missing parts	A	Require repair or replacement of coupler
Flex coupler soft/ spongy	A	Require replacement of coupler
Flex coupler tom	A	Require replacement of coupler
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Steering coupler shield torn	2	Suggest replacement
U-joint binding	A	Require repair or replacement of joint
U-joint loose	A	Require repair or replacement of joint

GASKETS

Condition	Code	Procedure
Leaking	A	Require repair or replacement
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary.**		

HEIGHT SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Dust boot missing	C	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Dust boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Housing cracked	B	Require replacement
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

HYDRAULIC HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

HYDRAULIC POWER STEERING PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement

Condition	Code	Procedure
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

HYDRAULIC SUSPENSION HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

HYDRAULIC SUSPENSION PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Fluid at or beyond service interval	3	Suggest fluid change
Fluid contaminated	B	Require flushing and refilling of the system
NOTE: **Determine and correct source of contamination. OEM specifications must be followed for fluid type.**		
Fluid contaminated	B	Require flushing and refilling of the system
NOTE: **Determine and correct source of contamination. OEM specifications must be followed for fluid type.**		
Fluid level incorrect	B	Require adjustment of fluid level
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

IDLER ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Further inspection required

Condition	Code	Procedure
NOTE: **If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.**		
Grease boot cracked	B	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of idler arm (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease boot missing	C	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of idler arm (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease boot torn	A	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of idler arm (reason code 2). Torn grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement of seal
NOTE: **If seal is not available as a separate component, suggest replacement of idler arm (reason code 2). Missing grease seal will allow contaminants to enter joint and will accelerate wear.**		
Grease seal torn	A	Require replacement of seal
NOTE: **If seal is not available as a separate component, suggest replacement of idler arm (reason code 2). Torn grease seal will allow contaminants to enter joint and will accelerate wear.**		
Greaseable joint will not take grease	2	Suggest replacement of grease fitting
NOTE: **If greaseable joint will not take grease after replacing the grease fitting, suggest replacement of idler arm.**		
Looseness at frame bracket end	B	Require repair or replacement
NOTE: **If manufacturer's procedures and specifications exist, use those procedures and specifications; otherwise, use an approved inspection method such as the dry park check.**		
NOTE: **Looseness is defined as movement that creates excessive toe change.**		
Looseness at link end (perceptible horizontal movement)	1	Suggest replacement

Condition	Code	Procedure
NOTE: **If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Looseness at link end that is excessive	B	Require replacement
NOTE: **Excessive looseness is defined as significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.**		
CAUTION: **Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Mounted out of position (center link not parallel)	B	Require repositioning
Nut on stud loose	A	Require repair or replacement
NOTE: **Check for bent stud or damaged taper hole.**		
Seized	A	Require replacement
Stud bent	B	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud broken	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Taper hole elongated	A	Require replacement
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Wear exceeds manufacturer's specifications	B	Require replacement

INTERMEDIATE SHAFT U-JOINTS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Flex coupler binding	A	Require repair or replacement of coupler
Flex coupler loose	A	Require repair or replacement of coupler
Flex coupler missing parts	A	Require repair or replacement of coupler
Flex coupler soft/ spongy	A	Require replacement of coupler
Flex coupler tom	A	Require replacement of coupler
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Steering coupler shield torn	2	Suggest replacement
U-joint binding	A	Require repair or replacement of joint
U-joint loose	A	Require repair or replacement of joint

KING PINS

NOTE: **You are not required to replace king pins in axle sets. However, when replacing a king pin due to wear exceeding manufacturer's specifications, you may suggest replacement of the other king pin on the axle if its measurement shows it is close to the end of its useful life.**

Condition	Code	Procedure
Bearing balls pitted	A	Require replacement
Bearing balls worn	A	Require replacement
Bearing races pitted	A	Require replacement
Bearing races worn	A	Require replacement
Bearing rollers pitted	A	Require replacement
Bearing rollers worn	A	Require replacement
Bearing seal bent	2	Suggest replacement of seal or bearing
Bearing seal missing	C	Require replacement of seal if available separately or bearing and seal together
Bearing seal torn	A	Require replacement of seal if available separately or bearing and seal together
Binding	A	Require repair or replacement of affected parts
End caps missing	C	Require replacement of missing part, if available; otherwise, replace king pin
End play exceeds specifications	B	Require repair
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting will not seal	A	Require replacement of grease fitting
Locating pins missing	C	Require replacement of missing part, if available; otherwise, replace king pin
Looseness exceeds manufacturer's specifications	B	Require replacement of worn parts
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Will not take grease	2	Suggest replacement of grease fitting

Condition	Code	Procedure
NOTE: **If king pin will not take grease after replacement of grease fitting, suggest replacement of king pin.**		

MODULES

Condition	Code	Procedure
Application incorrect	B	Require replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require repair
Contaminated	A	Require repair or replacement
NOTE: **Determine source of contamination, such as engine coolant, fuel, metal particles, or water. Require repair or replacement.**		
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation. Some components may be serviceable; check for accepted cleaning procedure.**		
Leaking	B	Require repair or replacement
Malfunctioning	A	Require replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specifications, or out of range.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

Condition	Code	Procedure
Wire lead conductors exposed	B	Require repair or replacement
Wire lead corroded	A	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

PITMAN ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Binding	A	Further inspection required
NOTE: **If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.**		
Grease boot cracked	2	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of pitman arm (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease boot missing	C	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of pitman arm (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease boot torn	A	Require replacement of boot
NOTE: **If boot is not available as a separate component, suggest replacement of pitman arm (reason code 2). Tom grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease fitting broken	A	Require replacement grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement of seal
NOTE: **If seal is not available as a separate component, suggest replacement of pitman arm (reason code 2). Lack of grease seal will allow contaminants to enter joint and will accelerate wear.**		
Grease seal torn	A	Require replacement of seal

Condition	Code	Procedure
NOTE: **If seal is not available as a separate component, suggest replacement of pitman arm (reason code 2). Tom grease seal will allow contaminants to enter joint and will accelerate wear.**		
Looseness (perceptible horizontal movement)	1	Suggest replacement
NOTE: **If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Looseness that is excessive	B	Require replacement
NOTE: **Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.**		
CAUTION: **Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Nut on stud loose	A	Require repair or replacement
NOTE: **Check for bent stud or damaged taper hole.**		
Seized	A	Require replacement
Splines damaged	A	Require repair or replacement
Splines stripped (splines missing)	A	Require replacement
Stud bent	B	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud broken	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud loose in taper hole	A	Require repair or replacement
NOTE: **Check for damaged taper hole.**		
Taper hole elongated	A	Require replacement
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
NOTE: **Check for damaged taper hole.**		

POWER STEERING BELTS

Condition	Code	Procedure
Alignment incorrect	B	Further inspection required
NOTE: **Determine cause of incorrect alignment and require repair.**		
Cracked	1	Suggest replacement
Frayed	1	Suggest replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **Determine cause of noise and suggest repair.**		
Plies separated	A	Require replacement
Serpentine belt routed incorrectly	B	Require repair
Tension out of specification	B	Require adjustment or replacement
Worn beyond adjustment range	B	Require replacement
Worn so it contacts bottom of pulley	A	Require replacement

POWER STEERING COOLERS

Condition	Code	Procedure
Air flow obstruction	A	Require repair
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connection leaking	A	Require repair or replacement
Contaminated	A	Require repair or replacement
Corroded	1	Suggest repair or replacement
Fins damaged, affecting performance	A	Require repair or replacement
Fins damaged, not affecting performance	Â	No service suggested or required
Internal restrictions	B	Require repair or replacement
Leaking	B	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require repair or replacement
Tubes damaged, affecting performance	A	Require repair or replacement
Tubes damaged, not affecting performance	Â	No service suggested or required

POWER STEERING FLUID

Condition	Code	Procedure
50,000 miles or greater on OE fluid (in absence of published manufacturer interval)	5	Suggest Replacement
NOTE: **One time only fluid exchange**		
Additive Depletion	A	Require replacement of fluid
Fluid at or beyond service interval	3	Suggest fluid replacement

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Fluid contaminated (i.e. fluid other than power steering fluid present)</td><td>B</td><td>Require flushing and refilling of the system</td></tr>
<tr><td colspan="3">NOTE:
Determine and correct source of contamination. OEM specifications must be followed for fluid type.</td></tr>
<tr><td>Fluid discolored</td><td>Â</td><td>No Service Suggested or Required</td></tr>
<tr><td colspan="3">NOTE:
Further testing necessary to determine condition of fluid.</td></tr>
<tr><td>Fluid level incorrect</td><td>B</td><td>Require adjustment of fluid level</td></tr>
<tr><td>Fluid type incorrect</td><td>B</td><td>Require flushing and refilling with correct fluid</td></tr>
<tr><td>Oxidized</td><td>A</td><td>Require replacement of fluid</td></tr>
</table>

POWER STEERING HOSES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Blistered	B	Require replacement
Fitting threads damaged	A	Require repair or replacement
Fitting threads stripped (threads missing)	A	Require replacement
Inner fabric (webbing) cut	B	Require replacement
Leaking	A	Require replacement
Missing	C	Require replacement
Outer covering is cracked to the extent that inner fabric of hose is visible	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Secured incorrectly	B	Require repair

POWER STEERING LINES (STEEL)

NOTE: **When replacing steel power steering lines, be sure to use a replacement product that meets or exceeds OEM specifications.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Corroded, affecting structural integrity	A	Require replacement

Condition	Code	Procedure
Fitting incorrect (for example, compression fitting)	B	Require replacement
Flare type incorrect	B	Require repair or replacement
Leaking	A	Require repair or replacement
Line material incorrect (copper, etc.)	B	Require replacement
Restricted	A	Require replacement
Routed incorrectly (where failure is likely to occur)	B	Require repair or replacement
Rust-pitted, not affecting structural integrity	1	Suggest replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

POWER STEERING PUMPS - ELECTRIC

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement

Condition	Code	Procedure
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

POWER STEERING PUMPS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Fluid at or beyond service interval	3	Suggest fluid change
Fluid contaminated	B	Require flushing and refilling of the system
Fluid level incorrect	B	Require adjustment of fluid level
Leaking	B	Require repair or replacement
Leaking	A	Require repair or replacement
Noisy	2	Suggest repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap

Condition	Code	Procedure
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Seized	A	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

RADAR SENSOR

NOTE: **OEM may require this sensor be calibrated to the vehicle thrustline.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot torn	A	Require replacement of boot

Condition	Code	Procedure
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Housing cracked	B	Require replacement
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

RADIUS ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent, affecting performance	B	Require replacement
Corroded, affecting structural integrity	a	Require replacement
Holes distorted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

RELAY RODS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware not functioning</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads damaged</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads stripped (threads missing)</td><td>A</td><td>Require replacement of hardware</td></tr>
<tr><td>Bent, affecting performance</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Binding</td><td>A</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.</td></tr>
<tr><td>Grease boot cracked</td><td>B</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available as a separate component, suggest replacement of relay rod (reason code 2). Cracked grease boot will allow contaminants to enter the joint and will accelerate wear.</td></tr>
<tr><td>Grease boot missing</td><td>C</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available as a separate component, suggest replacement of relay rod (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.</td></tr>
<tr><td>Grease boot torn</td><td>A</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available as a separate component, suggest replacement of center link (reason code 2). Torn grease boot will allow contaminants to enter the joint and will accelerate wear.</td></tr>
<tr><td>Grease fitting broken</td><td>A</td><td>Require replacement of grease fitting</td></tr>
<tr><td>Grease fitting missing</td><td>C</td><td>Require replacement of grease fitting</td></tr>
<tr><td>Grease fitting won't seal</td><td>A</td><td>Require replacement of grease fitting</td></tr>
<tr><td>Grease seal missing</td><td>C</td><td>Require replacement of seal</td></tr>
<tr><td colspan="3">NOTE:
If seal is not available as a separate component, suggest replacement of relay rod (reason code 2). Lack of grease seal will allow contaminants to enter the joint and will accelerate wear.</td></tr>
<tr><td>Grease seal torn</td><td>A</td><td>Require replacement of seal</td></tr>
<tr><td colspan="3">NOTE:
If seal is not available as a separate component, suggest replacement of relay rod (reason code 2). Torn grease seal will allow contaminants to enter the joint and will accelerate wear.</td></tr>
<tr><td>Greaseable relay rod will not take grease</td><td>2</td><td>Suggest replacement of grease fitting</td></tr>
<tr><td colspan="3">NOTE:
If greaseable relay rod still will not take grease after replacing the grease fitting, suggest replacement of relay rod.</td></tr>
<tr><td>Looseness (perceptible horizontal movement)</td><td>1</td><td>Suggest replacement</td></tr>
</table>

Condition	Code	Procedure
NOTE: **If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Looseness that is excessive	B	Require replacement
NOTE: **Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.**		
CAUTION: **Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Seized	A	Require replacement
Stud bent	B	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud broken	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud loose in taper hole	A	Require repair or replacement
NOTE: **Check for damaged taper hole.**		
Taper hole elongated	A	Require replacement
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Wear exceeds manufacturer's specifications	B	Require replacement

RELAYS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware

Condition	Code	Procedure
Housing broken	A	Require replacement
Housing cracked	2	Suggest replacement
Inoperative	A	Require replacement
NOTE: **Inoperative includes intermittent operation.**		
Missing	C	Require replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent operation or out of specification.**		
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
NOTE: **Follow OEM recommended adjustment procedures. Repair or replace if out of specification.**		
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement

Condition	Code	Procedure
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

SHOCK ABSORBERS, STRUT CARTRIDGES AND STRUT ASSEMBLIES

NOTE: **You are not required to replace shocks or struts in axle sets. However, when replacing a shock or strut due to the conditions that follow, you may suggest replacement of the other shock or strut on the same axle for one or more of the following: improved performance or preventive maintenance; part is close to the end of its useful life; to extend tire life; to balance ride and handling; or to improve stopping distance. When replacing steering and/or suspension components which may affect an alignment angle, you are required to check and adjust alignment as needed. Refer to the OEM specifications. Under no circumstances should a technician bend struts or strut housings. A vehicle's load-carrying and handling abilities are limited by its suspension, tires, brakes, and driveline. Installing coil over shocks or any other load assist device does not increase the vehicle's load capacity. See the vehicle owner's manual for more details. If vehicle is equipped with OEM coil over shocks, apply the conditions for coil springs from the Springs: Coil, Leaf, and Torsion Bar section of the Steering and Suspension guidelines. If the vehicle is equipped with add-on coil over shocks, you may suggest replacement with standard shocks for a spring-related condition.**

Condition	Code	Procedure
50,000 miles or greater on OEM Shocks or Struts	1	Suggest Replacement
NOTE: **Applies only to OEM hydraulic fluid and/or gas charged shocks and struts, NOT electronically controlled units.**		
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require replacement
Body dented	A	Further inspection required
NOTE: **Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.**		

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Body punctured</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Brake hose bracket bent</td><td>B</td><td>Require repair or replacement</td></tr>
<tr><td>Brake hose bracket missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Brake hose bracket threads damaged</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Brake hose bracket threads stripped (threads missing)</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Compression bumper missing</td><td>C</td><td>Require replacement of compression bumper</td></tr>
<tr><td>Compression bumper split</td><td>1</td><td>Suggest replacement of compression bumper</td></tr>
<tr><td>Damping (none)</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Dust boot (bellows) missing</td><td>C</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which causes piston rod seal wear.</td></tr>
<tr><td>Dust boot (bellows) split</td><td>A</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</td></tr>
<tr><td>Dust boot (bellows) torn</td><td>A</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available as a separate component, suggest replacement of shock or strut (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</td></tr>
<tr><td>Dust shield broken</td><td>2</td><td>Suggest replacement</td></tr>
<tr><td colspan="3">NOTE:
This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</td></tr>
<tr><td>Dust shield missing</td><td>2</td><td>Suggest replacement</td></tr>
<tr><td colspan="3">NOTE:
This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.</td></tr>
<tr><td>Gland nut (strut housing cap) is not removable using appropriate tool</td><td>A</td><td>Require replacement of nut and/or housing</td></tr>
<tr><td colspan="3">NOTE:
Only required if replacing cartridge.</td></tr>
<tr><td>Gland nut (strut housing cap) threads damaged</td><td>A</td><td>Require repair or replacement of nut</td></tr>
<tr><td>Housing dented</td><td>A</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
Require replacement of units where dents restrict shock or strut piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube shocks.</td></tr>
<tr><td>Housing punctured</td><td>A</td><td>Require replacement</td></tr>
</table>

Condition	Code	Procedure
Jounce bumper missing	C	Require replacement of jounce bumper
Jounce bumper split	1	Suggest replacement of jounce bumper
Leaking oil, enough for fluid to be running down the body	A	Require replacement
NOTE: **If the strut cartridge has been replaced previously, the oil on the strut housing may be filler oil. The technician must identify the source of the oil.**		
Noisy	2	Further inspection required
NOTE: **If noise is isolated to shock or strut, suggest replacement.**		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Piston rod has surface defect	2	Suggest replacement
Piston rod threads damaged	A	Require repair or replacement
Piston rod threads stripped (threads missing)	A	Require replacement
Seized	A	Require replacement
Shock missing	C	Require replacement
Strut housing bent	A	Require replacement
Strut housing cap (gland nut) is not removable using appropriate tool	A	Require replacement of nut and/or housing
NOTE: **Only required if replacing cartridge.**		
Strut housing cap (gland nut) threads damaged	A	Require repair or replacement of nut
Strut housing cap (gland nut) threads stripped (threads missing)	A	Require replacement of nut
Strut housing severely corroded, affecting structural integrity	A	Require replacement
Strut housing threads damaged	A	Require repair or replacement
Strut housing threads stripped (threads missing)	A	Require replacement
Tire cupping	A	Further inspection required
NOTE: **Although shocks or struts may have contributed to tire cupping, an inspection is needed of the entire suspension system. If the shock or strut is found to be contributing to the tire cupping, require replacement.**		

SPINDLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement

Condition	Code	Procedure
Broken	A	Require replacement
Pinch bolt bent	B	Require replacement
Pinch bolt incorrect	B	Require replacement with bolt that meets OEM design
Pinch bolt loose	B	Require repair
Pinch bolt missing	C	Require replacement
Pinch bolt tabs deformed (gap closer together than allowed by OEM specification, typically minimum .032"" gap before clamping)	B	Require replacement
NOTE: **Steering knuckle deformation can cause pinch bolt breakage.**		
Race seat area undersized	B	Require replacement
Scored	A	Require repair or replacement
Taper hole elongated	A	Require replacement
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SPRINGS, COIL, LEAF AND TORSION BARS

NOTE: **When springs are replaced, it is suggested, but not required, that both springs on an axle be replaced to maintain equal height from side to side and to provide a balanced ride and proper handling. When variable rate springs are installed in place of conventional coil springs, they must be installed in axle sets to ensure proper handling, uniform ride, and proper chassis height. Erroneous height measurements may result from: improper tire inflation, non-standard tire or wheel size, and heavy load in vehicle or trunk.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Broken (all springs except secondary leave(s) on multi-leaf springs)	A	Require replacement
Coil clash	Â	Further inspection required
NOTE: **Require ride height check and inspection of strike out Jounce) bumper. If vehicle is within manufacturer's height specifications, no service is suggested or required.**		
Coil spring insulator deteriorated	2	Suggest replacement of insulator
Coil spring insulator missing	C	Require replacement of insulator
Coil spring insulator split	2	Suggest replacement of insulator

Condition	Code	Procedure
Coil spring plastic coating deteriorated - rust present	A	Refer to manufacturer's service requirements
NOTE: **Some manufacturers require replacement under these conditions.**		
Composite spring damaged	Â	Further inspection required
NOTE: **Check vehicle ride height. If ride height is OK, no service is suggested or required.**		
Cracked (all springs except composite leaf and secondary leave(s) on multileaf springs)	A	Require replacement
Installed incorrectly	B	Require repair
Leaf spring insulators missing	C	Require replacement of insulators
Secondary leaf on multi-leaf spring broken	1	Suggest repair or replacement
Secondary leaf on multi-leaf spring cracked	1	Suggest repair or replacement
Torsion bar adjuster bent	A	Require repair or replacement of adjuster
NOTE: **Only required if ride height needs to be adjusted.**		
Torsion bar adjuster seized	A	Require repair or replacement of adjuster
NOTE: **Only required if ride height needs to be adjusted.**		
Torsion bar adjuster threads damaged	A	Require repair or replacement of part with damaged threads
NOTE: **Only required if ride height needs to be adjusted.**		
Torsion bar adjuster threads stripped (threads missing)	A	Require replacement of part with stripped threads
Vehicle suspension height not within OEM specifications	A	Require adjustment or replacement

STABILITRAC

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

STABILITY MANAGEMENT SYSTEM

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

STEERING ANGLE SENSOR

NOTE: **OEM may require this sensor be calibrated to the vehicle thrustline. Sensor must be reset when replacing / servicing steering rack assembly.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Housing cracked	B	Require replacement

Condition	Code	Procedure
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

STEERING ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement
Broken	A	Require replacement
Pinch bolt bent	B	Require replacement
Pinch bolt incorrect	B	Require replacement with bolt that meets OEM design
Pinch bolt loose	B	Require repair
Pinch bolt missing	C	Require replacement
Pinch bolt tabs deformed (gap closer together than allowed by OEM specification, typically minimum .032"" gap before clamping)	B	Require replacement
NOTE: **Steering knuckle deformation can cause pinch bolt breakage.**		
Race seat area undersized	B	Require replacement
Scored	A	Require repair or replacement
Taper hole elongated	A	Require replacement

Condition	Code	Procedure
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

STEERING COUPLERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Flex coupler binding	A	Require repair or replacement of coupler
Flex coupler loose	A	Require repair or replacement of coupler
Flex coupler missing parts	A	Require repair or replacement of coupler
Flex coupler soft/ spongy	A	Require replacement of coupler
Flex coupler tom	A	Require replacement of coupler
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Steering coupler shield torn	2	Suggest replacement
U-joint binding	A	Require repair or replacement of joint
U-joint loose	A	Require repair or replacement of joint

STEERING DAMPERS

NOTE: **The following procedures are only required if the vehicle was originally equipped from the factory with a steering damper. If the steering damper is an add-on unit, then the unit may be removed (and not replaced), based on customer's informed decision.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require replacement
Damper body dented	A	Further inspection required

Condition	Code	Procedure
NOTE: **Require replacement of units where dents restrict damper piston rod movement. If dents don't restrict movement, no service is suggested or required. Especially critical on mono-tube dampers.**		
Damper body punctured	A	Require replacement
Damping (none)	A	Require replacement
Dust boot (bellows) missing	C	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of steering damper (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Dust boot (bellows) split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of steering damper (reason code 2). This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Dust shield broken	2	Suggest replacement
NOTE: **This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Dust shield missing	2	Suggest replacement
NOTE: **This condition can lead to damage of the piston rod, which, in turn, causes premature piston rod seal wear.**		
Leaking oil, enough for fluid to be running down the body	A	Require replacement
Loose	A	Require repair or replacement
Missing	C	Require replacement
Noise	2	Further inspection required
NOTE: **If noise is isolated to damper, suggest replacement.**		
Piston rod bent	A	Require replacement
Piston rod broken	A	Require replacement
Piston rod has surface defect	2	Suggest replacement
Piston rod threads damaged	A	Require repair or replacement
Piston rod threads stripped (threads missing), affecting performance	A	Require replacement
NOTE: **Only required if condition affects structural integrity or if unit needs to be serviced.**		
Seized	A	Require replacement

STEERING GEARS (EXCEPT RACK AND PINION)

Condition	Code	Procedure

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Fluid contaminated	B	Require flushing and refilling of the system
NOTE: **Determine and correct source of contamination. OEM specifications must be followed for fluid type.**		
Gasket leaking	A	Require repair or replacement of gasket
Housing leaking	A	Require replacement
Hydraulic fittings leaking	A	Require repair or replacement of fittings
Inadequate power assist	A	Further inspection required
NOTE: **If steering gear is source of inadequate assist, require repair or replacement.**		
Lash exceeds manufacturer's specifications	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Seal leaking	A	Require repair or replacement of seal and / or mating part
Splines damaged	A	Require repair or replacement of splines
Splines stripped	A	Require replacement of splines
Steering coupler shield cracked	2	Suggest replacement
Steering coupler shield missing	C	Require replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement of part with damaged threads
Threads stripped (threads missing)	A	Require replacement of part with stripped threads
Unequal power assist	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

STEERING GEARS, RACK AND PINION

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Balance tube blocked	A	Require repair or replacement of balance tube
Balance tube missing	C	Require replacement of balance tube
Balance tube restricted	A	Require repair or replacement of balance tube
Bellows boot clamp missing	C	Require replacement of clamp
Bellows boot cracked (not through)	2	Suggest replacement of bellows boot
Bellows boot missing	C	Require replacement of bellows boot
Bellows boot not sealing	A	Require repair or replacement of bellows boot
Bellows boot torn	A	Require replacement of bellows boot
Bellows boot twisted (from toe adjustment)	B	Require repair
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Connector missing	C	Require replacement
Fitting leaking	A	Require repair or replacement
Fitting missing	A	Require replacement of fitting
Fitting threads damaged	A	Require repair or replacement of part with damaged threads
Fitting threads stripped (threads missing)	A	Require replacement of part with stripped threads
Fluid contaminated	B	Require flushing and refilling of the system
NOTE: **Determine and correct source of contamination. OEM specifications must be followed for fluid type.**		
Gasket leaking	A	Require repair or replacement

Condition	Code	Procedure
Housing cracked, affecting structural integrity	B	Require replacement
Housing leaking	A	Require replacement
Inadequate power assist	A	Further inspection required
NOTE: **If steering gear is source of inadequate assist, require repair or replacement.**		
Lash exceeds manufacturer's specifications	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, failure to perform all functions, out of OEM specification, or out of range.**		
Seal leaking	A	Require repair or replacement
Splines damaged	A	Require repair or replacement
Splines stripped (splines missing)	A	Require replacement
Steel line blocked	A	Require repair or replacement of line
Steel line leaking	A	Require repair or replacement of line
Steel line missing	C	Require replacement of line
Steel line restricted	A	Require repair or replacement of line
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement of part with damaged threads
Threads stripped (threads missing)	A	Require replacement of part with stripped threads
Unequal power assist	A	Require repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

STEERING KNUCKLES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement
Broken	A	Require replacement
Pinch bolt bent	B	Require replacement

Condition	Code	Procedure
Pinch bolt incorrect	B	Require replacement with bolt that meets OEM design
Pinch bolt loose	B	Require repair
Pinch bolt missing	C	Require replacement
Pinch bolt tabs deformed (gap closer together than allowed by OEM specification, typically minimum .032"" gap before clamping)	B	Require replacement
NOTE: **Steering knuckle deformation can cause pinch bolt breakage.**		
Race seat area undersized	B	Require replacement
Scored	A	Require repair or replacement
Taper hole elongated	A	Require replacement
NOTE: **Check for damaged stud.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

STRIKE OUT BUMPERS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Missing	C	Require replacement
Split	A	Suggest replacement

STRUT BEARING PLATE ASSEMBLIES

NOTE: **When the following guidelines indicate replacement of bearing, only the bearing should be replaced if it is available separately; otherwise, replace the bearing plate assembly.**

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Axial or radial movement exceeds vehicle manufacturer's specifications	B	Require replacement
Bearing binding	A	Require replacement of bearing

Condition	Code	Procedure
Bearing missing	C	Require replacement of bearing
Bearing seized	A	Require replacement of bearing
Bent, affecting performance	B	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Holes distorted	A	Require replacement
Missing	C	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

STRUT RODS

Condition	Code	Procedure
Adjusting nut seized	A	Require repair or replacement of hardware
NOTE: **Only required if an alignment is being performed and adjustment of the strut in question is required.**		
Attaching (mating) hole oversized	A	Require repair or replacement of bracket or frame
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Attaching point on bracket or frame corroded, affecting structural integrity	A	Require repair of bracket or frame
Bent, affecting performance	A	Require replacement
Mating (attaching) hole oversized	A	Require repair or replacement of bracket or frame
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SUSPENSION PUMPS (HYDRAULIC)

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Fluid at or beyond service interval	3	Suggest fluid change
Fluid contaminated	B	Require flushing and refilling of the system

Condition	Code	Procedure
NOTE: **Determine and correct source of contamination. OEM specifications must be followed for fluid type.**		
Fluid level incorrect	B	Require adjustment of fluid level
Leaking	B	Require repair or replacement
Noisy	2	Suggest repair or replacement
Pulley bent	A	Require repair or replacement of pulley
Pulley missing	C	Require replacement of pulley
Pump output out of manufacturer's specifications	A	Require repair or replacement
Remote reservoir leaking	A	Require replacement of reservoir
Reservoir cap broken	A	Require replacement of cap
Reservoir cap missing	C	Require replacement of cap
Seized	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SWAY BAR LINKS

Condition	Code	Procedure
Attaching (mating) hole distorted	A	Require repair or replacement of bracket or control arm
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Ball and socket has looseness (perceptible vertical movement)	1	Suggest replacement
NOTE: **If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Ball and socket has looseness that is excessive	B	Require replacement
NOTE: **Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method.**		
CAUTION: **Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.** Â	Â	Â
Bent	B	Require replacement
Broken	A	Require replacement
Bushing cracked	A	Require replacement

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Bushing deteriorated, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
If condition is caused by oil-soaking, further inspection is required to determine source of oil.</td></tr>
<tr><td>Bushing distorted, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Bushing missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Bushing oil-soaked, affecting performance</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Further inspection required to determine source of oil.</td></tr>
<tr><td>Bushing shows surface cracking (weather-checked)</td><td>Â</td><td>No service suggested or required</td></tr>
<tr><td>Bushing split</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Corroded, affecting structural integrity</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Grease boot cracked</td><td>2</td><td>Suggest replacement</td></tr>
<tr><td colspan="3">NOTE:
Cracked grease boot will allow contaminants to enter the joint and will accelerate wear .</td></tr>
<tr><td>Grease boot missing</td><td>C</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available separately, suggest replacement of sway bar link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.</td></tr>
<tr><td>Grease boot torn</td><td>A</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available separately, suggest replacement of sway bar link (reason code 2). Lack of grease boot will allow contaminants to enter the joint and will accelerate wear.</td></tr>
<tr><td>Mating (attaching) hole distorted</td><td>A</td><td>Require repair or replacement of bracket or control arm</td></tr>
<tr><td>Missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Nut on stud loose</td><td>A</td><td>Require repair</td></tr>
<tr><td colspan="3">NOTE:
Check for bent stud or damaged mating hole.</td></tr>
<tr><td>Stud bent</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Check for damaged mating hole.</td></tr>
<tr><td>Stud broken</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Check for damaged mating hole.</td></tr>
<tr><td>Threads damaged</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Threads stripped (threads missing)</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Check for damaged mating hole.</td></tr>
</table>

SWAY BAR MOUNTING BUSHINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Deteriorated, affecting performance	A	Require repair or replacement
NOTE: **If condition is caused by oil-soaking, further inspection is required to determine source of oil.**		
Distorted, affecting performance	A	Require repair or replacement
Leaking (fluid-filled type)	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.**		
Oil-soaked, affecting performance	A	Require replacement
NOTE: **Further inspection required to determine source of oil.**		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

SWAY BARS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	B	Require replacement
Broken	A	Require replacement

Condition	Code	Procedure
Sway bar corroded at point of attachment to frame bushing	A	Require repair or replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

SWITCHES

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Binding, affecting performance	A	Require repair or replacement
Binding, not affecting performance	2	Suggest repair or replacement
Broken	A	Require repair or replacement
Burned, affecting performance	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Burned, not affecting performance	1	Determine cause and correct prior to repair or replacement of part
Cracked, affecting performance	A	Require repair or replacement
Cracked, not affecting performance	1	Suggest repair or replacement
Leaking	B	Require repair or replacement
Malfunctioning	A	Require repair or replacement
NOTE: **Includes inoperative, intermittent operation, or failure to perform all functions.**		
Melted, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Melted, not affecting performance	2	Determine cause and correct prior to repair or replacement of part
Missing	C	Require replacement
Out of adjustment	B	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Won't return	A	Require repair or replacement
Worn	1	Suggest replacement

TIE ROD ENDS (INNER AND OUTER)

Condition	Code	Procedure
Adjusting sleeve bent	B	Require replacement of sleeve
Adjusting sleeve clamps out of position	B	Require repair

Condition	Code	Procedure
Adjusting sleeve corroded, affecting structural integrity	A	Require replacement of sleeve
Adjusting sleeve missing	C	Require replacement of sleeve
Adjusting sleeve seized	A	Require repair or replacement
NOTE: **Only required if toe needs to be adjusted.**		
Adjusting sleeve threads damaged	A	Require repair or replacement of sleeve
Adjusting sleeve threads stripped (threads missing)	A	Require replacement of sleeve
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Bent	A	Require replacement
Binding	A	Further inspection required
NOTE: **If greaseable, grease joint. If problem persists or joint is non-greaseable, require replacement.**		
Grease boot cracked	2	Suggest replacement of boot
NOTE: **If boot is not available separately, suggest replacement of tie rod end (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease boot missing	C	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of tie rod end (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of tie rod end (reason code 2). Torn grease boot will allow contaminants to enter joint and will accelerate wear.**		
Grease fitting broken	A	Require replacement of grease fitting
Grease fitting missing	C	Require replacement of grease fitting
Grease fitting won't seal	A	Require replacement of grease fitting
Grease seal missing	C	Require replacement of seal
NOTE: **If seal is not available separately, suggest replacement of tie rod end (reason code 2). Lack of grease seal will allow contaminants to enter joint and will accelerate wear.**		
Grease seal torn	A	Require replacement of seal

Condition	Code	Procedure
NOTE: **If seal is not available separately, suggest replacement of tie rod end (reason code 2), wear. Torn grease seal will allow contaminants to enter joint and will accelerate wear.**		
Greaseable tie rod end won't take grease	2	Suggest replacement of grease fitting
NOTE: **If greaseable tie rod end will not take grease after replacing the grease fitting, suggest replacement of tie rod end.**		
Looseness (perceptible horizontal movement)	1	Suggest replacement
NOTE: **If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Looseness exceeds manufacturer's specifications	B	Require replacement
Looseness that is excessive	B	Require replacement
NOTE: **Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.**		
CAUTION: **Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.**		
Noisy	2	Further inspection required
NOTE: **If greaseable, grease joint. If problem persists or joint is non-greaseable, suggest replacement.**		
Nut on stud loose	A	Require repair or replacement
NOTE: **Check for bent stud or damaged taper hole.**		
Seized	A	Require replacement
Stud bent	B	Require replacement
NOTE: **Check for damaged taper hole.**		
Stud broken	A	Require replacement
NOTE: **Check for damaged taper hole.**		
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement
NOTE: **Check for damaged taper hole.**		

TIRE PRESSURE MONITORING SYSTEM

NOTE: **A Tire Pressure Monitoring System (TPMS) is designed to detect and alert the driver should the air pressure level in one or more of the vehicle's tires, up to all four tires, fall below the manufacturer's recommended inflation pressure or another pre-set level.**

NOTE: **NHTSA does not consider installation of an aftermarket or replacement tire or rim that is not compatible with the TPMS to be a "make inoperative" situation under 49 U.S.C. 30122, provided that the entity does not disable the TPMS malfunction indicator.**

TIRE PRESSURE SENSORS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Inoperative	A	Require repair or replacement
NOTE: **Inoperative includes intermittent failure.**		
Loose	B	Require repair or replacement
Missing (Non-OE Wheel and/or Tire Applications)	2	Suggest replacement if appropriate sensor is available
Missing (OE Wheel and Tire Applications)	C	Replacement Reqiuired
Not Responding	Â	Further inspection required
NOTE: **If sensor does not Wake Up, follow manufacturers recommended diagnostic procedure to determine cause**		

TIRES

NOTE: **These guidelines do not apply to split rims. Some vehicle manufacturers restrict replacement of tires to specific brands, types, or sizes. High pressure temporary compact spare tires should not be used with any other rims or wheels, nor should standard tires, snow tires, wheel covers, or trim rings be used with high pressure compact spare rims or wheels. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. Only specially trained persons should de-mount or mount tires. Explosions of tire and wheel assembly can result from improper mounting, possibly causing serious injury or death. Consult the vehicle owner's manual or vehicle placard for correct size, speed rating, designation, and cold inflation pressure of the original tires. Do not exceed the maximum load or inflation capacity of the tire specified by the Tire and Rim Association When replacing tires, it is suggested that the replacement tires match or exceed the OEM speed rating designation. If tires of different speed rating designations are mixed on the same vehicle, the tires may vary in handling characteristics. Do not mix different speed rating designations on the same axle. Do not mix radials with non-radial tires on the same axle, as this may affect vehicle handling and stability. If radial tires and bias or bias-belted ply tires are mixed on the same vehicle, the radials must be on the rear. High-pressure temporary compact spare tires are exempt from this rule. Do not mix size or type (Run Flat, all season, performance, mud and snow) of tires on the same axle. If any flammable**

emergency tire inflation product has been used on a tire, consult inflation product, manufacturer's product information label for tire deflation procedures to avoid possible serious injury or death. In some vehicles, changing the tire diameter from factory-equipped size can affect drive ability, as well as the performance of ABS and other vehicle systems. Consult the vehicle manufacturer's specifications.

Condition	Code	Procedure
Air pressure incorrect	B	Require repair
Bead broken	A	Require replacement
Bead leaking, caused by tire	A	Require repair or replacement
Bead wire/cord exposed	A	Require replacement
Cord or belt material exposed	A	Require replacement
Cord ply separations	A	Require replacement
Directional/asymmetrical tires mounted incorrectly	B	Require remounting and/or repositioning
Irregular tread wear, affecting performance	2	Suggest replacement
NOTE: **Determine and correct cause of irregular tire wear.**		
Load ratings less than OEM specifications	B	Require replacement
Mixed tread types (all season, performance, mud and snow) on same axle	A	Require replacement
Number of punctures exceeds manufacturer's limit	B	Require replacement
Out of balance	B	Require rebalance of tire/wheel assembly
Ply separation	A	Require replacement
Pull or lead, caused by tire	A	Require repair or replacement
Radial and bias or bias-belted ply tires on same axle	B	Require repair or replacement
Radials are on the front and not on the rear	B	Require repair or replacement
NOTE: **If radials and bias or bias-belted ply tires are on the same vehicle, the radials must be on the rear axle, except for high-pressure temporary spares.**		
Run flat damage	A	Require replacement
Shoulder cut	A	Require replacement
Shoulder puncture	A	Require replacement
Shoulder with plug	A	Require replacement
Sidewall bulge	A	Require replacement
Sidewall cut	A	Require replacement
Sidewall indentation	Â	No service required or suggested
Sidewall puncture	A	Require replacement
Sidewall with plug	A	Require replacement
Speed rating designations different on same axle	2	Suggest rotation or replacement
Tire and wheel assembly has excessive run-out	B	Require repair or replacement of appropriate part
NOTE: **Excessive is defined as enough to contribute to performance problems. Match mounting may correct run-out. If not, require replacement of appropriate part. Refer to manufacturer's specifications.**		
Tires with excessive diameter difference on an all-wheel drive vehicle or four-wheel drive vehicle	B	Require replacement

Condition	Code	Procedure
NOTE: **Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4"" diameter difference.**		
Tires with excessive diameter difference on the same side of a dual-wheel application	B	Require replacement
NOTE: **Excessive diameter difference is defined as exceeding manufacturer's specifications or, if no manufacturer's specifications exist, with more than 1/4"" diameter difference.**		
Tread area puncture larger in diameter than manufacturer's specifications	B	Require replacement
Tread missing pieces (chunking), exposing cord	A	Require replacement
Tread missing pieces (chunking), not exposing cord	1	Suggest replacement
Tread separations	A	Require replacement
Tube in tubeless tire	3	Suggest removal of tube
NOTE: **Most manufacturers do not recommend tubes in tubeless tires. Inspect tire and wheel . Assembly to determine the reason for a tube in tubeless tire. Recommendation for repair or replacement should be based upon condition of tires and! Or wheel listed in these guidelines.**		
Weather-checking	Â	No service required or suggested
Worn to tread wear indicators	B	Require replacement

TORQUE SENSOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
Connector missing	C	Require replacement
Inoperative	A	Require repair or replacement
Leaking (vacuum/fluid/air)	A	Require replacement
Out of adjustment	B	Further inspection required
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Threads damaged	A	Require repair or replacement

Condition	Code	Procedure
Threads stripped (threads missing)	A	Require replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

TORSION SPRINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Broken	A	Require replacement
Missing	C	Require replacement

TRACK BAR BUSHINGS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Binding	A	Require repair or replacement
Deteriorated, affecting performance	A	Require repair or replacement
NOTE: **If condition is caused by oil-soaking, further inspection is required to determine source of oil.**		
Distorted, affecting performance	A	Require repair or replacement
Leaking (fluid-filled type)	A	Require replacement
Missing	C	Require replacement
Noisy	2	Further inspection required
NOTE: **If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.**		
Oil-soaked, affecting performance	A	Require replacement
NOTE: **Further inspection required to determine source of oil.**		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement

Condition	Code	Procedure
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

TRACK BARS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Attaching (mating) hole distorted</td><td>A</td><td>Require repair or replacement of bracket or frame</td></tr>
<tr><td>Attaching hardware broken</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware not functioning</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads damaged</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads stripped (threads missing)</td><td>A</td><td>Require replacement of hardware</td></tr>
<tr><td>Bent, affecting performance</td><td>B</td><td>Require replacement</td></tr>
<tr><td>Corroded, affecting structural integrity</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Grease boot cracked</td><td>2</td><td>Suggest replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available separately, suggest replacement of tie rod end (reason code 2). Cracked grease boot will allow contaminants to enter joint and will accelerate wear .</td></tr>
<tr><td>Grease boot missing</td><td>C</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available separately, suggest replacement of track bar (reason code 2). Lack of grease boot will allow contaminants to enter joint and will accelerate wear.</td></tr>
<tr><td>Grease boot torn</td><td>A</td><td>Require replacement of boot</td></tr>
<tr><td colspan="3">NOTE:
If boot is not available separately, suggest replacement of track bar (reason code 2). Torn grease boot will allow contaminants to enter joint and will accelerate wear.</td></tr>
<tr><td>Holes distorted</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Looseness (perceptible horizontal movement)</td><td>1</td><td>Suggest replacement</td></tr>
<tr><td colspan="3">NOTE:
If manufacturer's procedures for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check. Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</td></tr>
<tr><td>Looseness that is excessive</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Excessive looseness is defined as being significant enough to affect vehicle handling or structural integrity. If manufacturer's procedures 'for inspection exist, use those procedures; otherwise, use an approved inspection method such as the dry park check.</td></tr>
</table>

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td colspan="3">CAUTION:
Do not use pliers or pry bar to check ball and socket movement. Use only moderate hand pressure.</td></tr>
<tr><td>Mating (attaching) hole distorted</td><td>A</td><td>Require repair or replacement of bracket or frame</td></tr>
<tr><td>Nut on stud loose</td><td>A</td><td>Require repair or replacement of nut</td></tr>
<tr><td colspan="3">NOTE:
Check for bent stud or damaged mating hole.</td></tr>
<tr><td>Seized</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Stud bent</td><td>B</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Check for damaged mating hole.</td></tr>
<tr><td>Stud broken</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Check for damaged mating hole.</td></tr>
<tr><td>Threads damaged</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Threads stripped (threads missing)</td><td>A</td><td>Require replacement</td></tr>
<tr><td colspan="3">NOTE:
Check for damaged mating hole.</td></tr>
<tr><td>Wear exceeds manufacturer's specifications</td><td>B</td><td>Require replacement</td></tr>
</table>

TRAILING ARM BUSHINGS

<table>
<tr><th>Condition</th><th>Code</th><th>Procedure</th></tr>
<tr><td>Attaching hardware broken</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware missing</td><td>C</td><td>Require replacement of hardware</td></tr>
<tr><td>Attaching hardware not functioning</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads damaged</td><td>A</td><td>Require repair or replacement of hardware</td></tr>
<tr><td>Attaching hardware threads stripped (threads missing)</td><td>A</td><td>Require replacement of hardware</td></tr>
<tr><td>Binding</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Deteriorated, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td colspan="3">NOTE:
If condition is caused by oil-soaking, further inspection is required to determine source of oil.</td></tr>
<tr><td>Distorted, affecting performance</td><td>A</td><td>Require repair or replacement</td></tr>
<tr><td>Leaking (fluid-filled type)</td><td>A</td><td>Require replacement</td></tr>
<tr><td>Missing</td><td>C</td><td>Require replacement</td></tr>
<tr><td>Noisy</td><td>2</td><td>Further inspection required</td></tr>
<tr><td colspan="3">NOTE:
If noise isolated to bushing, suggest repair or replacement. Use only approved lubricant on rubber bushings. Petroleum-based lubricants may damage rubber bushings.</td></tr>
</table>

Condition	Code	Procedure
Oil-soaked, affecting performance	A	Require replacement
NOTE: **Further inspection required to determine source of oil.**		
Rubber separating from internal metal sleeve on bonded bushing	A	Require replacement
Seized	A	Require replacement
Shifted (out of position)	B	Require repair or replacement
Split	A	Require replacement
Surface cracking (weather-checked)	Â	No service suggested or required

TRAILING ARMS

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Ball joint hole oversized (loose interference or press fit)	B	Further inspection required
NOTE: **If oversized ball joint is available, require replacement of ball joint. If oversized ball joint is not available, require replacement of control arm.**		
Bent, affecting performance	B	Require replacement
Bushing hole oversized	B	Require replacement
Corroded, affecting structural integrity	A	Require replacement
Holes distorted	A	Require replacement
Threads damaged	A	Require repair or replacement
Threads stripped (threads missing)	A	Require replacement

VALVE STEMS

NOTE: **Most tire manufacturers suggest replacement of non-TPMS valve stems any time a new tire is installed. For TPMS valve stems, the manufacturer may require replacement of the valve stem, o-ring seals, washers, gaskets, valve cores, compression washers and/or locking nut.**

Condition	Code	Procedure
Bent	2	Suggest replacement
Broken	A	Require replacement
Cap seized	A	Require repair or replacement
Cut, but not leaking	1	Suggest replacement
Deteriorated (cracking, dry rot)	1	Suggest replacement
Leaking	A	Require repair or replacement
Missing	C	Require replacement
O-Ring leaking	A	Require replacement of O-Ring

Condition	Code	Procedure
Threads damaged	A	Require repair or replacement
Threads stripped	A	Require replacement
Valve cap missing	C	Require replacement of cap

VEHICLE DYNAMICS CONTROL

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

VEHICLE SPEED SENSOR

Condition	Code	Procedure
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware corroded, affecting structural integrity	A	Require replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require replacement
Connector missing	C	Require replacement
NOTE: **Determine cause and correct prior to replacement of part.**		
Dust boot missing	C	Require replacement of boot
Dust boot split	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure**		
Dust boot torn	A	Require replacement of boot
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		

Condition	Code	Procedure
Housing cracked	B	Require replacement
NOTE: **If boot is not available separately, suggest replacement of sensor (reason code 2). This condition can lead to damage of the sliding magnet, which, in turn, causes premature sensor failure.**		
Lead routing incorrect	B	Require rerouting according to vehicle manufacturer's specifications
Loose	B	Require adjustment to vehicle manufacturer's specifications
Missing	C	Require replacement
Output signal incorrect	B	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Wire lead burned	A	Require repair or replacement
Wire lead conductors exposed	B	Require repair or replacement
Wire lead open	A	Require repair or replacement
Wire lead shorted	A	Require repair or replacement

VEHICLE STABILITY ASSIST

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.**

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

VEHICLE STABILITY/SKID CONTROL

NOTE: **An evolution of ABS and Traction Control. It uses the ABS hardware and two additional sensors: a steering-wheel angle sensor, which measures the position and rate of steering wheel input, and a yaw sensor, which measures the rate at which the vehicle is actually turning. By comparing rates, computer determines if the vehicle is oversteering or understeering.**

NOTE: **On slippery surfaces or during aggressive maneuvers, if the vehicle understeers severely, the computer will actuate the brakes on the inside rear wheel, just hard enough and just long enough to correct the steering**

behavior. When the vehicle oversteers severely, the system will brake the outside front wheel instead.

NOTE: **When servicing this system, OEM may require steering angle sensor be calibrated to the vehicle thrustline.**

WARNING LAMPS

Condition	Code	Procedure
Bulb burned out	A	Require replacement
Warning light does not come on during bulb check	Â	Further inspection required to determine cause
Warning light flashes	Â	Further inspection required to determine cause
Warning light is intermittent	Â	Further inspection required to determine cause
Warning light stays on after initial bulb check	Â	Further inspection required to determine cause

WHEEL ALIGNMENT

NOTE: **Wheel alignment is defined as the measurement, analysis, and adjustment of steering and suspension angles to conform to manufacturer specifications. These angles usually include, but are not limited to: caster, camber, toe, and thrust angle. Where these angles are not adjustable and not in specification, component replacement or correction kits may be required. Errors in set-back and steering axis inclination (SAI) are often attributable to failed or damaged components and must be corrected prior to performing an alignment. Failure to replace or correct suggested parts or service may prevent a proper alignment. Before performing an alignment check, inspect and verify the following: Tire pressure and size . Vehicle loading . Ride height . Steering and suspension parts only if the inspection reveals that all the above are within published specifications, a wheel alignment check and a proper wheel alignment, if needed, may be performed. Under no circumstances should a technician bend or heat any steering or suspension component, unless specified by the vehicle manufacturer. All measurements and specifications must be noted on the inspection report.**

Condition	Code	Procedure
Beyond manufacturer's service interval	3	Suggest alignment check
Dog tracking, shown to be caused by faulty alignment	2	Suggest repair
Drift, shown to be caused by faulty alignment	A	Require alignment
Lead, shown to be caused by faulty alignment	A	Require alignment
Outside manufacturer's specifications	B	Require repair
Part has been changed, affecting alignment	A	Require alignment check
Pull, shown to be caused by faulty alignment	A	Require alignment
Steering wheel off-center	2	Suggest alignment
Tire wear, shown to be caused by faulty alignment	A	Require alignment
Wander, shown to be caused by faulty alignment	A	Require alignment

WHEEL ATTACHMENT HARDWARE

NOTE: **For conditions noted below, also check condition of wheel stud holes. Proper lug nut torque is essential. Follow recommended torque specifications and tightening sequence. DO NOT lubricate threads unless specified by the vehicle manufacturer.**

Condition	Code	Procedure
Bent	A	Require replacement
Broken	A	Require replacement
NOTE: **Some manufacturers require replacement of all studs on that wheel if two or more studs or nuts on the same wheel are broken or missing.**		
Locking lug nut locking groove damaged	A	Require replacement
Loose	A	Require repair or replacement of affected component
Lug nut installed backward	B	Require repair or replacement
Lug nut mating surface distorted	A	Require replacement of nut
Lug nut mating type incorrect	B	Require replacement of nut
Lug nut missing	C	Require replacement
Lug nut rounded	A	Require replacement of nut
NOTE: **Only required if removing wheel.**		
Lug nut seized	A	Require replacement of nut
NOTE: **Only required if removing wheel.**		
Stud incorrect	B	Require replacement of stud
Stud missing	C	Require replacement
Threads damaged	A	Require repair or replacement of component with damaged threads
Threads stripped	A	Require replacement of component with stripped threads

WHEEL BEARINGS, RACES AND SEALS

NOTE: **When replacing or repacking wheel bearings, grease seal replacement is required. You are not required to replace these components in axle sets. Determine the need to replace based upon the individual component conditions that follow.**

Condition	Code	Procedure
Axle seal on drive axle leaking	A	Require replacement of seal and inspection of axle, bearing, housing, and vent tube
Bearing end-play exceeds specifications	B	Require adjustment of bearing, if possible If proper adjustment cannot be obtained, require replacement of bearing and race assembly
Bearing rollers, balls or races are worn, pitted, or feel rough when rotated as an assembly or other damage affecting performance.	B	Require replacement of bearing and race assembly
Seal leaking	A	Require replacement of seal and inspection of bearings
NOTE: **Require inspection of mating and sealing surface and repair or replace as necessary. Check vent. A plugged vent may force fluid past the seal.**		
Seal missing	C	Require replacement

WHEELS (RIMS)

NOTE: **Mounting a regular tire on a high-pressure compact spare wheel is not permitted. Attempting to mount a tire of one diameter on a wheel of a different diameter or flange type may result in serious injury or death. If the wheel identification stamp is not legible, or cannot be found, do not use the wheel until the size and type have been properly identified. Wheels of different diameter, offset, or width cannot be mixed on the same axle. Bead seat tapers cannot be interchanged.**

Condition	Code	Procedure
Bead leaking, caused by wheel	A	Require repair or replacement
NOTE: **Do not attempt to correct a bent rim.**		
Bent hub mounting surface	A	Require replacement
Bent rim, causing vibration	2	Suggest replacement
NOTE: **Do not attempt to correct a bent rim.**		
Broken	A	Require replacement
Cast wheel porous, causing a leak	A	Require repair or replacement
Clip-on balance weight is incorrect type for rim flange	2	Suggest replacement of weight
Corrosion affecting structural integrity	A	Require replacement
Corrosion build-up on wheel mounting surface	A	Require repair
Cracked	B	Require replacement
Directional/asymmetrical wheels mounted incorrectly	B	Require remounting and/or repositioning
Load capacity less than OEM specifications	B	Require replacement
Mating surface distorted	A	Require replacement
Offset mismatched on same axle	B	Require replacement
Rivets leaking	A	Require replacement
Run-out beyond OEM specs	B	Require replacement
NOTE: **Some wire-spoke wheels may be repaired.**		
Stud holes elongated	A	Require replacement
NOTE: **Inspect wheel attaching hardware for damage.**		
Welded or brazed repair	2	Suggest replacement
Welds leaking	A	Require replacement
Wheel centering (pilot) hole incorrect	B	Require replacement

WIRING HARNESSES AND CONNECTORS

Condition	Code	Procedure
Application incorrect	B	Require repair or replacement
Attaching hardware broken	A	Require repair or replacement of hardware
Attaching hardware missing	C	Require replacement of hardware
Attaching hardware not functioning	A	Require repair or replacement of hardware
Attaching hardware threads damaged	A	Require repair or replacement of hardware

Condition	Code	Procedure
Attaching hardware threads stripped (threads missing)	A	Require replacement of hardware
Connector (Weatherpack type) leaking	A	Require repair or replacement
Connector broken	A	Require repair or replacement
Connector melted	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Connector missing	C	Require replacement
Insulation damaged, conductors exposed	A	Require repair or replacement
Insulation damaged, conductors not exposed	1	Suggest repair or replacement
Open	A	Require repair or replacement
Protective shield (conduit) melted	2	Suggest repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Protective shield (conduit) missing	C	Require repair or replacement
Resistance (voltage drop) out of specification	A	Require repair or replacement
Routed incorrectly	B	Require repair
Secured incorrectly	B	Require repair
Shorted	A	Require repair or replacement
Terminal broken	A	Require repair or replacement
Terminal burned, affecting performance	A	Require repair or replacement
NOTE: **Determine cause and correct prior to repair or replacement of part.**		
Terminal burned, not affecting performance	2	Suggest repair or replacement
Terminal corroded, affecting performance	A	Require repair or replacement
Terminal corroded, not affecting performance	2	Suggest repair or replacement
Terminal loose, affecting performance	B	Require repair or replacement
Terminal loose, not affecting performance	1	Suggest repair or replacement
Voltage drop out of specification	A	Require repair or replacement

REASON CODE EXPLANATION

Code	Reason
Required	
A	Part No Longer Performs Intended Purpose
B	Part Does Not Meet A Design Specification (Regardless Of Performance)
C	Part Is Missing
Suggested/Optional	
1	Part Is Close To The End Of Its Useful Life
2	To Address A Customer Need, Convenience Or Request
3	To Comply With Maintenance Recommended By The Vehicle's Original Equipment Manufacturer
4	Technician's Recommendation Based On Substantial And Informed Experience
5	To Comply With Maintenance Recommended By AMRA/MAP

AUTOMOTIVE TERMINOLOGY & DEFINITIONS

ACTIVE SUSPENSION SYSTEM

active suspension systems move each wheel up and down to control body motion in response to road abnormalities. The system responds to inputs from the road and the driver. With an active suspension, a vehicle can simultaneously provide the smooth ride of a soft suspension along with the superior handling associated with a firm suspension.

ACTIVE TILT CONTROL

active tilt control winds up the stabilizer bars in the front and rear suspension to resist body lean while cornering. Because active control is used only as needed, vehicle spring rates and stabilizer bar stiffness can be reduced, improving normal ride characteristics. In addition, this system has potential to increase low-speed, off-road traction on 4WD vehicles.

ACTIVE VARIABLE RATIO STEERING

electronically provides variable steering ratios. A computer is linked with the vehicle stability control system to aid in directional stability of the vehicle. As the vehicle travels down the highway, road surfaces and wind gusts can affect the vehicle directional stability. The car may wander a little or dart to one side, as many who have met a tractor-trailer unit on a windy day have experienced. Sensors on the car detect this sudden unintentional movement and the computer will stabilize the car by moving the Active Steering electric motor and steering gear. The driver doesn't turn the steering wheel at all.

AIR SPRING

a suspension device made up of a flexible bladder containing compressed air. The air spring takes the place of a :onvent;onal coil or leaf spring. Air is supplied by an on-board ;ompressor, usually with auxiliary equipment to sense vehicle leight and modify the pressure in the air spring as needed.

AIR SUSPENSION

instead of steel coil or leaf springs, some vehicles have a bellows-like unit at each corner that contains pressurized air. As a rule, air suspensions can produce a softer ride.

ALIGNMENT

an adjustment to bring parts or components into a line or proper coordination.

ALL-WHEEL DRIVE

the method of providing traction to any of the wheels of a vehicle, as conditions require. Depending on the system, it may be full-time or part-time.

ANTI-ROLL BAR

see 'stabilizer bar'.

ASPECT RATIO

the relationship between the height of a tire from bead to tread, and the tread width, usually expressed as a percentage of the tread width.

AUTOMATIC RIDE CONTROL

automatic ride control adjusts vehicle shock absorber resistance (damping) in response to driver inputs such as steering and braking and for changes in road surface. During maneuvers such as hard braking or quick lane changes, the system increases suspension damping to improve dynamic stability. Damping is automatically decreased during steady driving, so that bumps and potholes are absorbed rather than being transmitted to the occupants. Some systems also allow the driver to select suspension settings: soft, normal or firm (sport).

AXIAL LOAD

a type of load placed on a bearing that is parallel to the axis of the rotating shaft.

AXIAL PLAY

movement of a component parallel to the axis of rotation.

AXIAL

round, on or along an axis; having the same direction or being parallel to the axis of rotation.

AXIS

a real or imaginary straight line on which or around which an object rotates.

BALANCE

a condition of equal weight distribution within a component or among components; the act of equalizing the weight distribution, such as balancing a tire or an engine's reciprocating assembly.

BALL JOINT

a suspension component that provides a pivot point, allowing the steering knuckle to move up and down as well as turn. In response to steering input. The ball fits into a socket housing that is attached to the control arm and the stud on the other end of the ball is attached to the steering knuckle. A dust cover is installed over the ball and socket assembly to keep dirt out and lubricant in.

BEAD

the steel reinforced inner edge of a tire, which fits inside and seals against the wheel rim.

BOOT

protective rubber cover with accordion pleats used to contain lubricants and exclude contaminating dirt, water and grime, located at each end of the rack-and- pinion assembly and FWD CV-joints.

BUMP STEER

a steering problem in which a vehicle tends to the left or the right after a bump, without steering wheel input from the driver. This is usually caused by some steering misalignment or damage that permits change of toe when the suspension works up and down.

BUSHING

a liner, usually removable, for a bearing; an anti-friction liner used in place of a bearing; a type of bearing that is used to support rotating shafts.

CAMBER

the attitude of a wheel/tire assembly in which, when viewed from the front, the distance between the tops and bottoms of the tires are different. If the distance between the tops is greater than between the bottoms, positive camber is present. If the distance between the tops is less than between the bottoms, negative camber is present.

CASTER

angle formed between the kingpin axis and a vertical axis as viewed from the side of the vehicle. Caster is considered positive when the top of the kingpin axis is behind the vertical axis, that is, tilted toward the rear of the vehicle.

CENTER LINK

a steering linkage component which attaches the Pitman arm to the idler arm, tie-rod or crosslink.

COIL SPRING

spring steel rod wound into a coil that supports the vehicle's weight while allowing suspension movement.

COLLAPSIBLE STEERING COLUMN

a steering column that is designed to collapse, to prevent the column from heavily impacting the driver during an accident.

CONSTANT VELOCITY (CV) JOINT

a flexible coupling between two shafts that allows each shaft to maintain the same speed regardless of operating angle.

CONTROL ARM

a suspension component that connects the vehicle frame to the steering knuckle or axle housing and allows the up and down movement of the wheels.

COTTER PIN.

a safety component made from soft steel, used to keep a nut from loosening on a bolt or stud. The cotter pin is inserted through a hole in the bolt or stud and through slots in the nut (see 'castellated nut'), then the ends of the cotter pin are spread to lock it in position.

CROSSMEMBER

part of the vehicle frame structure, arranged transversely and attached to the frame rails at each side of the vehicle. Can be removable or welded in place.

DAMPEN

to slow or reduce oscillations or movement.

DEAD AXLE

a load-supporting axle that does not transmit power; an axle that does not rotate, but merely forms a base on which to attach the wheels.

DIRECTIONAL STABILITY

the ability of a car to travel in a straight line on a flat surface with a minimum of driver control.

DIRECTIONAL TIRE

tire with a tread pattern that is designed to give maximum traction by removing water from under the tread in such a way as to minimize the risk of aquaplaning. Directional tires must be installed to turn in a specific direction.

DOWNFORCE

negative aerodynamic lift.

DRAG COEFFICIENT

drag divided by the product of dynamic pressure and projected area. A factor representing the drag acting on a body (as an automobile or airfoil).

DRAG LINK

a steering linkage component that connects the pitman arm and the steering arm.

DRAG

horizontal aerodynamic retarding force on a vehicle parallel to the relative wind direction.

DYNAMIC BALANCING

balancing a part while it is in motion.

ELECTRICALLY POWERED STEERING

electrically powered steering uses an electric motor to drive either the power steering hydraulic pump or the steering linkage directly. The power steering function is therefore independent of engine speed, resulting in significant energy savings.

ELECTRONIC AIR SUSPENSION

electronic air suspension provides the comfort of riding on air with adjustable spring rates and capability to change ride height and load-carrying ability. Under normal driving conditions, an electronic air suspension vehicle rides at the same height as a traditionally sprung vehicle. With a heavy load, ride height is increased automatically. On current vehicles, the suspension lowers the ride height by 20 mm at highway speeds for improved aerodynamics, with about 2 percent better fuel economy. Lower ride height also can improve on-center feel of steering due to the change in suspension geometry and increased caster angle.

ELECTRONIC LEVEL CONTROL.

a suspension system that uses air springs to maintain vehicle ride height. Height sensors are used to signal a control unit when the vehicle is riding low or high. In response to this signal, compressed air is either sent to or vented from the air springs.

HALFSHAFT

transfers power from the transaxle to the front wheels on a front-wheel drive vehicle. Also used on some vehicles with rear-wheel drive and independent rear suspension to transfer power from the differential to the rear wheels. Consists of a stub shaft that is splined into the differential side gear, another stub shaft that is splined into the wheel hub, an interconnecting shaft, and two CV-joints, which connect the interconnecting shaft to the stub shafts.

HARMONIC VIBRATION

periodic motion or vibration along a straight line. The severity depends on the frequency or amplitude.

HEIGHT SENSOR

a component used in an air suspension system to signal a control unit when the vehicle is riding low or high. In response to this signal, compressed air is either sent to or vented from the air springs.

HUB

mounting point for the wheelan an axle or spindle; the part of the synchronizer assembly that is splined to the transmission shaft; the center part of a wheel, gear, etc., that rides on a shaft.

IDLER ARM

a conventional steering system component consisting of an arm that swivels in a bushing on a shaft, which is attached to the frame. The idler arm is mounted on the right side of the vehicle and is the same length and set at the same angle as the Pitman arm. Its function is to hold the right end of the center link level with the left end, which is moved by the pitman arm, and transfer the steering motion to the right side tie-rod.

INCLUDED ANGLE

the sum of the angle of camber and steering axis inclination; the sum of two intersecting angles.

INDEPENDENT SUSPENSION

a suspension in which each wheel can travel up and down without directly affecting the position of the opposite wheel.

INTEGRAL POWER STEERING

a power steering system in which the power cylinder and control valve are contained in one housing.

INTELLIGENT VEHICLE HIGHWAY SYSTEM (IVHS)

the Intelligent Vehicle Highway System (IVHS) provides a variety of information to the vehicle and driver through cooperation of automotive electronics, communications, controls and systems engineering technologies. IVHS has two areas of interest to car and truck makers: (1)telematics and (2)active safety warning and control systems. Several features are: Telematics: Navigation systems Traffic messaging Emergency messaging and security tracking (e.g. RESCU - Remote Emergency Satellite Cellular Unit) Short range communications/ automatic toll collection Active Safety Warning and Control Systems Collision warning/avoidance - Backup and parking aids - Side vision aid - Vision enhancement - (all weather/night vision) - Adaptive cruise control - Lane departure control

INTERACTIVE VEHICLE DYNAMICS (IVD)

interactive Vehicle Dynamics is designed to minimize loss of vehicle control due to loss of traction. The IVD system could be activated when a vehicle is taking a turn too quickly or when encountering an icy patch.

JAM NUT

a locknut.

KINGPIN

the pivot shaft for the steering knuckle on most early axles and some modern heavy-duty axles.

KNUCKLE

the suspension component that connects the upper and lower control arms or the strut and lower control arm. On rear wheel drive vehicles, it usually incorporates the front wheel spindle and on front wheel drive vehicles it has an opening where the halfshaft passes through. A steering arm is attached to the knuckle, where the tie-rod end is connected. Also called a steering knuckle.

LANE-DEPARTURE WARNING SYSTEM

Issues a warning when the vehicle edges off course and reaches the highway lane markers. Introduced on the 2005 Infiniti FX and available on the 2006 Infiniti M45, the system developed by Iteris can detect lane dividers even in rainy weather. It delivers a noticeable sound when the vehicle starts to move into an adjacent lane, whether due to inattention, drowsiness or distraction.

LATERAL RUNOUT

side-to-side movement or wobble in a wheel or tire.

LEAF SPRING

a suspension spring consisting of a single flat plate made of steel or composite material or several steel plates bundled together.

LOW TIRE PRESSURE WARNING

a low tire pressure warning system alerts the driver if the air pressure in a tire becomes too low. Typically, a light on the instrument panel will be illuminated to warn of the low-pressure condition.

MACPHERSON STRUT

the principal device in the suspension of the same name, in which the spring, shock absorber and sometimes the steering knuckle are combined in a single unit.

MEMORY STEER

a steering condition where the steering wheel and wheels want to return to a position other than center. This can be caused by tightening rubber bonded socket tie-rod ends when the steering wheel is not centered, binding in the upper strut mounts, or binding in a steering component or ball joint.

ON-CAR BALANCING

the practice of spinning a wheel on the car to balance the wheel and all other rotational components together.

PARALLELOGRAM STEERING LINKAGE

a type of conventional steering linkage consisting of a pitman arm, center link, idler arm and tierod assemblies to connect to the steering knuckles. The pitman arm, center link and idler arm form three sides of a parallelogram.

PITMAN ARM

a steering system component mounted on the steering box shaft and transfers the gearbox motion to the steering linkage.

PLUNGER JOINT

the inboard CV-joint on a halfshaft, so called because the joint moves in and out in response to the suspension's up and down movement, which causes the distance between the transaxle and the wheel to change. The movement takes place within the joint, with the tripod rollers or double offset ball bearings moving in and out on elongated grooves in the yoke or outer race.

PRESS FIT

when a part is slightly larger than a hole it must be forced together with a press.

PULL

a steering condition where the vehicle driver has to maintain constant pressure on the steering wheel to keep the vehicle moving straight.

RACK-AND-PINION STEERING

a type of steering mechanism that replaces the pitman arm, center link and idler arm on gearbox steering. The steering column ends in a pinion gear that moves the driven rack to the left and right. The rack ends contain ball studs connected to the outer tie-rod ends and steering knuckles.

RADIAL LOAD

load applied at 90 degrees to an axis of rotation.

RADIAL RUNOUT

the out-of-roundness ot a wheel or tire.

RADIAL

branching out in all directions from a common center; perpendicular to the shaft or bearing bore.

RADIUS ARM

a suspension component that is connected to a twin I-beam or solid axle at one end and to the vehicle frame through bushings at the other. The radius arm braces the I-beam or axle and keeps it at a right angle to the vehicle frame.

REAR WHEEL STEERING

a system used on a some vehicles to change the toe of the rear wheels to either steepen a sharp turn or enhance cornering on a shallower, faster one.

RIDE HEIGHT

the dimension between a fixed point on the vehicle and the pavement. The fixed point varies according to vehicle and manufacturer. Also called vehicle height.

ROLLING RESISTANCE

retarding force, parallel to the direction of travel, caused by tire resistance along the ground.

RUNOUT

wobble or deflection beyond a rotating part's normal plane of movement.

SAI

see 'steering axis inclination',

SCRUB RADIUS

the distance between the point at which the tire's vertical centerpoint intersects the road, and the steering axis inclination (SAI) intersects the road.

SHACKLE

the attachment to the frame for one end of a leaf spring. The shackle allows the spring to change in length as the vehicle encounters uneven road surfaces.

SHIM

thin sheets of material, usually metal, used as spacers to control the distance between parts.

SHOCK ABSORBER

a device used to dampen the oscillation of the suspension caused by irregularities in the road surface.

SHORT AND LONG ARM SUSPENSION

a suspension system in which the upper control arm is shorter than the lower control arm, allowing the wheel to deflect in a vertical direction with minimal change in camber.

SPINDLE

a shaft used to attach the wheel assembly on non-drive axles.

SPRING

a suspension system component that supports the vehicle and absorbs shock caused by uneven road surfaces; a device that returns to its original form after being forced out of shape.

SPROCKET

a toothed wheel used to engage a chain or ribbed belt.

SPRUNG WEIGHT

the weight of all the vehicle components that are supported by the springs; see 'unsprung weight'.

STABILIZER BAR

a torsion-bar spring connecting the suspension on either side of the vehicle. When a vehicle rolls to the side in a turn, the suspension at the outside wheel compresses and the suspension at the inside wheel extends. The stabilizer bar that connects them twists to apply a counteracting force to hold the vehicle closer to level. Also called an anti-roll bar or sway bar.

STATIC BALANCE

balance at rest; still balance; the equal distribution of weight of the wheel and tire around the axis of rotation such that the wheel assembly has no tendency to rotate by itself regardless of its position.

STEERING ARM

the steering system component that links the steering knuckle to the tie-rod assembly.

STEERING AXIS INCLINATION

the angle between true vertical and an imaginary line running through the rotational center of the ball joint(s).

STEERING COLUMN

the housing, steering shaft, bearings and related components between the steering wheel and the steering gear.

STEERING GEAR

the assembly located at the end of the steering column, which contains the gears and other components that multiply the driver turning force.

STEERING KNUCKLE

the suspension component that connects the upper and lower control arms or the strut and lower control arm. On rear wheel drive vehicles, it usually incorporates the front wheel spindle and on front wheel drive vehicles it has an opening where the halfshaft passes through. A steering arm is attached to the steering knuckle, where the tie-rod end is connected.

STEERING LINKAGE

all of the components that connect the steering gear to the front wheels.

STRUT ROD

on vehicles where the lower control arm is attached to the frame at one pivot point, a strut rod is used to brace the control arm against the vehicle frame.

STUD

a fastener that has screw threads at both ends.

SWAY BAR

see 'stabilizer bar',

THRUST ANGLE

the difference between the thrust line and the geometric centerline of the vehicle.

THRUST LINE ALIGNMENT

aligning the front wheels to the thrust line during a wheel alignment, when rear wheel toe cannot be adjusted to specification.

THRUST LINE

an imaginary line that divides the total toe angle of the rear wheels.

THRUST LOAD

load placed on a part that is parallel to the center of the axis.

TIE-ROD END

a ball and socket joint that connects the tie-rod to the steering knuckle arm and to the center link or steering rack.

TIE-ROD

steering linkage member which connects the steering knuckle arm with the centerlink or the steering rack.

TIRE ROTATION

the practice of moving a set of tires to different positions on the vehicle to equalize wear and extend the life of the tires.

TIRE SLIP

see 'wheel slip'.

TOE

the direction in which a wheel tends to roll, a major factor in tire wear.

TOE-IN

a condition that exists if the tire's line of forward direction intersects the extended centerline of the vehicle.

TOE-OUT ON TURNS

the designed angle of the steering arm on the steering knuckle, which causes the inside front wheel to turn at a sharper angle than the outside front wheel during a turn. The specification is checked using the turntables on wheel alignment machine. Toe-out on turns is not an adjustable angle, and if it is incorrect it is most likely due to a bent steering arm.

TOE-OUT

a condition that exists if the tire's line of forward direction and the vehicle centerline are angled apart.

TRACK

the distance between the centers of the treads of parallel wheels.

TRACKING

travel of the rear wheels in a parallel path with the front wheels.

TWIN I-BEAM SUSPENSION

a type of independent front suspension and used on light trucks and vans. It consists of two I-beams supported by coil springs, and the steering knuckles/spindles, which are connected by king pins or ball joints. The inner end of the axle connects to the vehicle frame through a rubber bushing. A radius arm also connects to the frame through rubber bushings to control wheelbase and caster.

UNSPRUNG WEIGHT

the components of a vehicle that rest directly on the road surface without being supported by the suspension springs.

VARIABLE ASSIST POWER STEERING

a power steering system that uses valves and speed sensors to vary the amount of steering assist according to engine or road speed. At slow speeds more steering assist is delivered and steering the wheels is easier; necessary for parking, etc.. At higher speeds, steering assist is reduced and more steering effort is required to steer the car, giving the driver greater feel of the road. Also known as Speed-sensitive power steering.

VEHICLE HEIGHT

see 'ride height'.

WHEEL ALIGNMENT

the adjustment of suspension and steering components to optimize steering control and minimize tire wear.

WHEEL BALANCE

the condition in which a wheel/tire assembly has equal weight around its center, preventing vibration at high speeds. Wheel balance can be static, such as on a bubble balancer, or dynamic, such as with a spin balancer.

WHEEL OFFSET

the dimensional difference between a wheel's centerline and the plane of the axle flange mounting surface.

WHEEL SLIP

a measurement (in percentage) of the friction between the tire and road surface; at zero slip the tire rotates freely, while at 100% slip the tire is locked up and is pushed along the road surface by the moving vehicle. Also called tire slip.

WHEEL SPEED SENSOR

a permanent magnetic sensor that sends information to the computer in an ABS system regarding wheel speed.

WHEEL WEIGHTS

small weights, usually made of lead, attached either mechanically or by adhesive to a wheel/tire assembly to correct its balance.

WORM GEAR

a gear into which teeth are cut, resembling the threads of a screw.